

[www.goodtech.kr](http://www.goodtech.kr)

2020, 2021

# Good Tech, Korea

## *‘Educational Training System-01’*

Global business company  
Leading laboratory equipment manufacturer  
Practical teaching materials linked to commercial products

**ISO 9001**

(Certificate no Q155314)



**good•Tech**



Certificate of Small & Middle Business Firm issued by The Ministry of SMEs and Startups(MSS)  
[www.smba.go.kr](http://www.smba.go.kr)  
<http://sminfo.mss.go.kr/>



Certificate of Woman's Corporate issued by The Ministry of SMEs and Startups(MSS)  
[www.smba.go.kr](http://www.smba.go.kr)  
[www.smpp.go.kr](http://www.smpp.go.kr)



ISO 9001-2015 Certificate issued by International Certification Registrar Ltd  
[www.icrqa.com](http://www.icrqa.com)



Certificate of Research & Development Institute issued by Korea Industrial Technology Association(KOITA)  
[www.koita.or.kr](http://www.koita.or.kr)  
[www.rnd.or.kr](http://www.rnd.or.kr)



Certificate of Business License issued by National Tax Service  
[www.nts.go.kr](http://www.nts.go.kr)



Certificate of a factory registration issued by Gimcheon City Hall  
[www.gimcheon.go.kr](http://www.gimcheon.go.kr)



Certificate of Promising Export Firm issued by The Ministry of SMEs and Startups(MSS)  
[www.smba.go.kr](http://www.smba.go.kr)



model : Satellite-7000 patented by [www.patent.go.kr](http://www.patent.go.kr)

# Contents

<b>01. a group of Cellular mobile training system .....</b>	<b>02</b>
1. GSM-5000 .....	03
2. WCDMA-5000 .....	06
3. CMTS-G7000M .....	09 <b>(updated)</b>
4. CMTS-G8000M .....	14 <b>(New)</b>
5. LTE-9000 .....	21 <b>(New)</b>
6. Mobile phone repair-GT4 .....	26
<b>02. a group of GPS training system .....</b>	<b>32</b>
7. GPS-5000 .....	33
<b>03. a group of Satellite Communication training system .....</b>	<b>37</b>
8. Satellite-TVRO & Internet .....	38
9. Satellite-7000 .....	42
10. Satellite-8000 .....	48
<b>04. a group of Radar Taining system .....</b>	<b>53</b>
11. Radar-1000 .....	54
<b>05. a group of Microwave communication training system .....</b>	<b>56</b>
12. RFKIT-3000 .....	57
<b>06. a group of ANTENNA training system .....</b>	<b>61</b>
13. Antenna-3000 .....	62 <b>(under renewal)</b>
<b>07. a group of Analog &amp; Digital Communication system .....</b>	<b>65</b>
14. Digital-5000 .....	66
15. Analog & Digital-5000 .....	69
<b>08. a group of Wi-Fi training system .....</b>	<b>73</b>
16. WiFi-GT7000 .....	74
17. TETRA-5000.....	80
<b>09. a group of AI (Artificial Intelligence) Training System (NEW) .....</b>	<b>83</b>
18. Artificial Intelligence-GT19 .....	84
<b>10. a group of AR/VR Training System (NEW) .....</b>	<b>88</b>
19. AR Virtual Aquarium-GT3000).....	89
20. VR Drone-GT700 .....	92
<b>11. a group of LED Training System .....</b>	<b>100</b>
21. LED-GT4.0 .....	101
<b>12. a group of Nuclear Power Plant Training System .....</b>	<b>105</b>
22. Nuclear Power Plant-GT4.0 .....	106
<b>13. a group of Drone training system .....</b>	<b>111</b>
23. Drone-GT100 .....	112
24. Anti Drone-GT800 .....	116
<b>14. a group of GIS(Geographic Information System) training system .....</b>	<b>120</b>
25. JOYMAP EDU .....	121
<b>15. a group of Bluetooth training system .....</b>	<b>128</b>
26. BT-4000 .....	129
<b>16. a group of Fiber optic training system .....</b>	<b>131</b>
27. Fiber optic connectorization & splice kit .....	132
28. Fiber optic-3000 .....	134
29. Fiber optic line field service trainer-5000 .....	137
<b>17. a group of RFID Trainer .....</b>	<b>143</b>
30. RFID-1356 .....	144 <b>(New)</b>
<b>18. a group of Digital Multimedia Broadcasting trainer .....</b>	<b>149</b>
31. DMB-7000 .....	150
<b>19. a group of TV trainer .....</b>	<b>155</b>
32. GT-HDTV15 .....	156
<b>20. a group of Cyber Security Training system .....</b>	<b>160</b>
33. Cyber Security-GT4.0 .....	161 <b>(New)</b>

<b>21. a group of Forensic Training system .....</b>	<b>165</b>
34. Mobile Forensic-3000 .....	166
35. Mobile Forensic-5000 .....	170
36. Desktop forensic qator-EDU .....	174
<b>22. a group of Big Data Management Training system .....</b>	<b>177</b>
37. IoT & BigData700 .....	178
38. BigData-EDU4.0 .....	186 <b>(New)</b>
39. GT-BDAP7000 .....	190
<b>23. a group of IoT (Internet of Things) Training system .....</b>	<b>196</b>
40. GT-IoT300 .....	197
41. GT-IoT900 .....	203
42. IoT Home Network Testbed-GT16 .....	209
<b>24. a group of IoT Home Network Training Sytem .....</b>	<b>214</b>
43. GT-IoT Home Network .....	215
<b>25. a group of Programming kit .....</b>	<b>218</b>
44. GT- C learning & Android App programming .....	219
45. GT-Arduino77 .....	224
46. GT-Arduino700 .....	228
47. GT-ISDK700(JAVA programming) .....	232
48. GT-Raspberrypi3 .....	234
49. Coding Analyzer-GT700 .....	238
50. Test Automation-700 & QMC .....	246
51. Performance Load Testing-700 .....	256
<b>26. a group of SMART Phone training system .....</b>	<b>260</b>
52. Android4.3JB .....	261
<b>27. a group of SMART Building control system .....</b>	<b>265</b>
53. Smart building-GT7000 .....	266
<b>28. a group of MOBILE GAME training system .....</b>	<b>275</b>
54. MGT-1000 .....	276
55. MGT-3000 .....	278
<b>29. a group of FPGA &amp; SoC training equipment .....</b>	<b>280</b>
56. CPLD-1000 .....	281
57. FPGA-1000 .....	284
58. FPGA-GTC2500 .....	286
59. FPGA Design-4000 .....	289
60. FPGA/SoC -5000 .....	294
61. SoC Design-7000 .....	298
<b>30. a group of DSP training system .....</b>	<b>302</b>
62. DSP-TMS320F28335 .....	303
<b>31. a group of Miconcontroller &amp; Microprocessor training system .....</b>	<b>306</b>
63. Breadboard-1000 .....	307
64. PIC-16F874 .....	308
65. Microcontroller - PIC, 8051, AVR .....	310
66. Micriprocessor-8051 .....	312
67. Micriprocessor-AVR .....	314
68. Micriprocessor-Cortex M3 .....	316
69. Micriprocessor-8054, AVR, Cortex M3 .....	318
<b>32. a group of ROBOT training system .....</b>	<b>321</b>
70. DC motor robot-1000 .....	322
71. STEP motor robot-1000 .....	325
72. RF control robot-1000 .....	328
73. Humanoid-5000 .....	331 <b>(updated)</b>
74. Intelligent Mobile Robot Trainer-7000 .....	334
75. ibrain Mobile robot trainer-8000 .....	343
76. Omi-directional & 7-DOF Manipulator robot -8000 .....	348
77. Industrial 6 axis robot-GT290 .....	352
<b>33. a group of Biomedical training system .....</b>	<b>355</b>
78. GT-Biomedical 3 .....	356
<b>34. a group of Electric &amp; electronic circuit training system .....</b>	<b>364</b>
79. GT-Electric & electronic circuit 11 .....	365
<b>35. a group of LOGIC LAB training system .....</b>	<b>368</b>
80. Logic circuit design-GTC4100 .....	369
81. Digital Logic Circuit-GT510 .....	373
82. Digital logic-3000 .....	376
83. Logic Simulator, GT-LSP .....	377
<b>36. a group of Mechatronics training system .....</b>	<b>378</b>
84. PLC-GLOFA-1000 .....	379
85. PLC-MASTER-K-2000 .....	380
86. PLC-XGK-3000 .....	381
87. PLC MELSEC-Q .....	382
88. GT-PLC700 .....	384
<b>37. a group of Mechanical training system .....</b>	<b>386</b>
89. Hydraulic-GT280 .....	387
90. Pneumatic-GT270 .....	397
91. Pneumatic control-7000 .....	405
<b>38. a group of Mechatronics training system .....</b>	<b>413</b>
92. Analog sensor-GT230 .....	414
93. Digital sensor-GT240 .....	418
94. Vision sensor-GT250 .....	422
95. Safety sensor-GT260 .....	427
96. Mechatronics-GT222 .....	431

<b>39. a group of Electricity training system .....</b>	<b>436</b>
97. 3-phase induction motor-500 .....	437
98. 3-phase induction motor-1000 .....	439
99. 1-phase condenser induction motor-500 .....	441
100. 1-phase condenser induction motor-1000 .....	443
101. Sensor Drive-500 .....	445
102. Sensor Drive-1000 .....	447
103. Limit Drive-500 .....	449
104. Limit Drive-1000 .....	451
105. Temperature control-500 .....	453
106. Temperature control-1000 .....	455
107. DC motor-500 .....	457
108. DC motor-1000 .....	459
109. DC motor-1500 .....	461
110. Stepping motor-1000 .....	463
111. Stepping motor-1500 .....	465
112. AC Servo motor -1500 .....	467
113. DC Servo motor -1500 .....	469
114. Servo motor trainer (GT-SMCT100) .....	471
115. Inverter control-1500 .....	473
116. Relay Drive-1000 .....	475
117. Basic sequence-700 .....	476
118. Sequence-1000 .....	478
119. Swquence-5000 .....	479
120. 7-Segment experiment kit .....	482
121. Lamp load experiment kit .....	484
122. Heater load experiment kit .....	486
123. Car parking-1000 .....	488
124. Traffic signal control-1000 .....	489
125. Electric power conversion experiment -1000 .....	490
126. High-voltage Electricity-GT11M .....	492
127. HighVoltage-GT700 .....	498
128. Elevator Training system .....	503
129. Automatic Door Training system .....	505
<b>40. a group of FMS (flexible manufacturing system) training system .....</b>	<b>507</b>
130. FMS-5000 .....	508
131. Production Automation-5000 .....	510
<b>41. a group of Power Line Communication system .....</b>	<b>514</b>
132. Power Line Communication trainer .....	515
<b>42. a group of Aircraft training system .....</b>	<b>518</b>
133. Aircraft & aviation-AT1000 .....	519
<b>43. a group of Solar &amp; Wind Energy Training Sytem .....</b>	<b>522</b>
134. GT-Solargen16 .....	523
135. Energy Conversion-1000 .....	526
136. GT-Wind Energy16 .....	531
137. GT-Windgen17 .....	533
138. GT-Solar & Wind trainer .....	536
139. GT-Fuel Cell16 .....	539
140. Renewable energy-1500 .....	542
141. Smart Grid-GTP990 .....	547
<b>44. a group of Thermal, Steam &amp; Boiler Training Sytem .....</b>	<b>552</b>
142. GT-Steam & Boiler 16 .....	553
143. Steam Plant-GT19 .....	555 (New)
144. GT-Thermal55 .....	557
145. GT-Geothermal heat energy700 .....	560
146. Ice Stores-5000 .....	563
147. Heat Exchanger-5000 .....	565
148. Water Heating-5000 .....	568
149. Cooling system with Ice Storages-GT900 .....	571
<b>45. a group of Refrigeration, Air Conditioner, Ice making system .....</b>	<b>573</b>
150. Refrigeration-GT100 .....	574
151. Refrigeration & Freezing-GT200 .....	576
152. Air Conditioning-GT300 .....	578
153. Ice making system-GT400 .....	580
154. Multi Compressor rack refrigeration -GT500 .....	582
155. Air ventilation(heating & cooling) -GT600 .....	584
156. Splat cooling regrigeration-GT700 .....	586
<b>46. a group of Live &amp; long-distance interactive learning Studio system .....</b>	<b>588</b>
157. GT-Interactive learning Studio16 .....	589
158. CCTV-5000 .....	596
159. GT-Solar & Wind vane16 .....	602

# 01

## a group of Cellular mobile training system

1. GSM-5000
2. WCDMA-5000
3. CMTS-G7000M
4. CMTS-G8000M
5. LTE-9000
6. Mobile phone repair-GT4



model: **GSM-5000**

## Cellular Mobile Trainer (GSM/GPRS Trainer)

### Feature

GSM-5000 is the training system enabling users to study GSM/GPRS communication protocol and to experience the overall knowledges about mobile communication through GSM module control. To control the GSM module, there is advanced set of AT Commands according to GSM ETSI (European Telecommunications Standard Institutes). GSM-5000 has full training contents of Command Level Study on AT Commands.

GSM-5000 is based upon GSM cellular phone and allows for connection to PC for operation and programming.

This trainer is designed to instruct the students System operation, Theory, Programming, Servicing, Problem diagnosis of GSM cellular mobile systems.

GSM-5000 is mainly used for students to learn fundamentals in mobile communication systems such as mobile station network entry, calling process, network signals, AT Commands, Audio communication, Short message services,,etc. The training covers the command level study with AT Commands, GPRS Internet Connection, Multiplexer Protocol training and Hardware test experiments, Introduce of Embedded OS system and GUI programming on GSM-5000 through the provided source codes.

### Functions

- Understanding of GSM technology & network, GSM capability & data services.
- Real Time Study of GSM 07.05 & 07.07 and ITU-T recommendation V.25ter with AT command
- Study of SIM card interface and SIM data control
- Study of GSM 07.10 Multiplexer Protocol
- GSM network by actually connecting to the GSM environment
- Development Windows CE based user application
- Debugging experience with serial port

### Components

GSM Hardware platform with GSM module and Embedded system board (GSM Modem and Antenna was installed to Hardware board)	1 ea
AC Adapter	1 ea
RS232C Cable for debugging	1 ea
Ear Set (Ear Phone + Mic)	1 ea
GSM Mobile phone (user's mobile phone can be used)	0
Software installation CD	1 ea
User's Manual	1 ea
USIM Card	1 ea



## System configuration

- 1) GSM Hardware platform with GSM module and Embedded system board



- 2) System operating configuration



## Training contents

### Chapter 1. Understanding of GSM

- 1.1 History
- 1.2 Technical Specification
- 1.3 Definition of Terms

### Chapter 2. Command for modem & sim card hardware

- 2.1 What are AT Commands?
- 2.2 AT Command Standards
- 2.3 AT Command Syntax
- 2.4 AT commands in SIM900
- 2.5 SIM Card
- 2.6 AT Commands Related to Modem and SIM Card
- 2.7 Using the GSM Trainer
- 2.8 Practice
- 2.9 Practice Report

### Chapter 3. Network Registration and Command

- 3.1 AT Commands Related to Network Registration
- 3.2 Practice
- 3.3 Practice Report

### Chapter 4. Call Processing Control and Command

- 4.1 AT Commands Related to Call Processing
- 4.2 Practice
- 4.3 Practice Report

### Chapter 5. Call Setting and Command

- 5.1 AT Commands Related to Call Setting
- 5.2 Practice

- 5.3 Practice Report

### Chapter 6. Call Information and Command

- 6.1 Mobile Subscriber Identify in the GSM Network
- 6.2 AT commands related to Call Information
- 6.3 Practice
- 6.4 Practice Report

### Chapter 7. Short Message Service (SMS) and Command

- 7.1 What 's SMS service?
- 7.2 AT Commands Related to SMS
- 7.3 Practice
- 7.4 Practice Report

### Chapter 8. Message Setting and Command

- 8.1 AT Commands Related to Message Setting
- 8.2 Practice
- 8.3 Practice Report

### Chapter 9. Cell ID Check for handover

- 9.1 Handover
- 9.2 AT Commands Related to Cell ID check for handover
- 9.3 Practice
- 9.4 Practice Report

### Chapter 10. Make PPP Connection

- 10.1 Basic Understanding of PPP
- 10.2 Configure PPP in the GSM Trainer
- 10.3 Change PPP in the GSM Trainer
- 10.4 Disconnect PPP in the GSM Trainer



**Chapter 11. Internet Connection with Browser**

## 11.1 Internet Connection

**Chapter 12. MUX Driver Load / Unload**

## 12.1 MUX driver load / unload

## 12.2 AT commands related to MUX driver load / unload

## 12.3 Practice

## 12.4 Practice Report

**Chapter 13. Test Multiple Serial Port**

## 13.1 Open COM6 through the practice program GsmTest

## 13.2 Open COM5 via PPP Connection for Internet

**Chapter 14. Windows CE Configuration**

## 14.1 Windows CE 6.0

## 14.2 ActiveSync

**Chapter 15. Build & Debugging CE Application**

## 15.1 Environment Setup for Application

## 15.2 SDK(Software Development Kit) Installation

## 15.3 Create Application

**Chapter 16. SIM900B module**

## 16.1 SIM900B Description

## 16.2 Application Interface

**Chapter 17. Phonebook**

## 17.1 AT Commands related to Phonebook

## 17.2 Practice

## 17.3 Practice Report

**Appendix**

## 1. Introduction Global System for Mobile Communications

## 2. Introduction to WCDMA

## 3. LTE introduction

## Specification

**1. Hardware Spec**

- 1) OS : Microsoft Windows CE.NET 6.0
- 2) CPU : ARM11 500MHz Processor (ATLAS-IV)
- 3) Memory : 128MB SDRAM, 2G NAND Flash
- 4) Display interface : 7 inch TFT LCD / 800\*480 Pixels  
/ Touch screen
- 5) Audio : Stereo Audio CODEC, Built-in Speaker, MIC for GSM
- 6) Output : Data indication LED, Debug serial port / USB 2.0 Port
- 7) Power : 5V, 1.5A AC
- 8) SIM : Built-in SIM card slot / 1.8V, 3V SIM card support
- 9) GSM/GPRS features
  - (1) GSM Module : SIM900B
  - (2) Quad-band GSM/GPRS
    - GSM 850MHz
    - EGSM 900MHz
    - DCS 1800MHz
    - PCS 1900MHz
  - (3) GSM Class : Small MS
  - (4) Transmitting power:
    - Class 4 (2W) at GSM 850 and EGSM 900
    - Class 1 (1W) at DCS 1800 and PCS 1900
  - (5) GPRS connectivity
    - GPRS multi-slot class 10 (Default)
    - GPRS multi-slot class 8 (Optional)

- GPRS mobile station class B
- (6) DATA GPRS
    - GPRS data downlink transfer: max. 85.6kbps
    - GPRS data uplink transfer: max. 42.8kbps
    - GPRS coding schemes: CS-1, CS-2, CS-3, CS-4
    - Supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections
    - Integrates the TCP/IP protocol
    - Support Packet Switched Broadcast Control Channel (PBCCH)
  - (7) SMS
    - MT, MO, CB, Text and PDU mode
    - SMS storage: SIM card
  - (8) Serial Port
    - 1200bps to 115200bps
    - Serial Port can be used for AT command or data stream
    - Supports RTS/CTS hardware handshake and software ON/OFF flow control
    - Multiplex ability according to GSM 07.10 Multiplexer Protocol.
    - Autobauding supports baud rate from 1200 bps to 57600 bps

**2. Software Spec & practice**

- 1) Software spec
  - C/C++ language
  - User Interface on LCD
  - GSM Driver
- 2) Training for Software
  - (1) ENVIRONMENT SETUP FOR APPLICATION
  - (2) SDK(SOFTWARE DEVELOPMENT KIT) INSTALLATION
  - (3) CREATE APPLICATION
  - (4) Project creation, coding, compiling
  - (5) Exporting execution file of the created application to GSM Trainer
  - (6) Running the created application in the GSM Trainer
  - (7) MODIFICATION IN AT COMMAND APPLICATION

# model: **WCDMA-5000**

## **Cellular Mobile Trainer (WCDMA Trainer)**

### **Feature**

**W-CDMA (Wideband Code Division Multiple Access)** is an air interface standard found in 3G mobile telecommunications networks.

**3G** is a generation of standards for mobile phones and mobile telecommunications services. Application services include wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment.

**WCDMA-5000** gives the understanding for the air interface standard of 3GPP, and the training for the logic design of signal modulation and de-modulation as well as encoding.

Also, **WCDMA-5000** gives an actual practice for Voice Call Processing, Video Telephony Processing, Hand-off Practice, Power Control Practice,,, etc.

Also, it teaches the design method of physical layer software which enables the result of logic design to operate normally.

### **Functions**

- 1) WCDMA-5000 is the Training system having 3G Mobile Communication Standards.
- 2) WCDMA-5000 is the upgraded Mobile Communication system having Data, Voice and Video Call processing than the existing CDMA, GSM system.
- 3) As WCDMA-5000 equipped with MSM6245 WCDMA/EDGE/GPRS/GSM (WEDGE) Chipset which manufactured by Qualcomm for 3G Mobile Phone, Video Call and Voice Call is possible.
- 4) Mobile development training is available through Qualcomm BREW platform.
- 5) Through QVGA 2.4 "(320x240) TFT color LCD, Video and Camera VOD can be received.
- 6) Through the USB/Serial interface, various communication module and Multi-media module can be mounted.
- 7) By providing Bluetooth headset, Speaker, Micro-phone, Earphone, user can easily do various & practical practices.
- 8) Without a separate Base Station device, user can use their Mobile phone by changing USIM Chip from USIM Card.
- 9) Supports WCDMA (UMTS), EDGE and GSM/GPRS networks.
- 10) ARM926EJ-S™ microprocessor core with memory management unit (MMU)
- 11) QDSP4000™ high-performance digital signal processors.
- 12) ARM Jazelle™ Java hardware acceleration
- 13) Support for BREW and Java applications
- 14) Q camera™: Up to 2 megapixel digital images
- 15) Mobile video solutions: video streaming, playback, recording, and video telephony module can be mounted.
- 16) Digital audio support for MP3/AAC/aacPlus™/Enhanced aac Plus
- 17) CMX : Customized ringtone, screensaver and greeting card solution
- 18) Integrated Universal Serial Bus (USB) support
- 19) Bluetooth 1.1 connectivity
- 20) 2D/3D graphics

### **System Configuration**



## Training Contents

### Chapter 1, WCDMA development environment

- 1.1 Introduction to Wireless Mobile Communication
- 1.2 Introduction to WCDMA development environment
  - 1.2.1 - Build environment
- 1.3 Practice
  - 1.3.1 - Making Build environment
  - 1.3.2 - Make build
  - 1.3.3 - Download
  - 1.3.4 - Debugging practice

### Chapter 2, Firmware Programming

- 2.1 WCDMA -3G Platform introduction
  - 2.1.1 - WCDMA ? 3G Platform Hardware
  - 2.1.2 - WCDMA ? 3G Platform Software
- 2.2 Board Support Package
  - 2.2.1 - Boot method
  - 2.2.2 - Memory Interface
  - 2.2.3 - Booting process
- 2.3 LCD Drive implementation
  - 2.3.1 - General
  - 2.3.2 - Interface spec
  - 2.3.3 - Principles of Operation
  - 2.3.4 - Driver design
- 2.4 LCD Driver design practice
  - 2.4.1 - Booting image exchange practice
  - 2.4.2 - Image update practice
  - 2.4.3 - Font display practice

### Chapter 3, WCDMA Physical Layer

- 3.1 WCDMA Technology introduction
- 3.2 WCDMA Channel structure
  - 3.2.1 - Downlink channel structure
  - 3.2.2 - Uplink channel structure
- 3.3 Practice
  - 3.3.1 - WCDMA Active Set PSC strength practice
  - 3.3.2 - Pilot Channel Scanner practice
  - 3.3.3 - Layer 1 status monitoring practice
  - 3.3.4 - Channel operation checking practice

### Chapter 4, UMTS Network

- 4.1 UMTS Introduction
  - 4.1.1 - Non-Access Stratum
  - 4.1.2 - Access Stratum
- 4.2 Core Network
  - 4.2.1 - Core Service Domain
  - 4.2.2 - Packet service Domain
  - 4.2.3 - Registers Domain
- 4.3 UMTS Terrestrial Radio Access Network
- 4.4 UE (User Equipment)
  - 4.4.1 - ME (Mobile equipment)
  - 4.4.2 - UMTS Subscriber Identity Module

### Chapter 5, MAC (Medium Access Control) Layer

- 5.1 MAC introduction
- 5.2 MAC-b entity
- 5.3 UE MAC Structure
  - 5.3.1 MAC - c/sh entities
  - 5.3.2 MAC - d entities
  - 5.3.3 MAC - hs entities
- 5.4 UTRAN Network MAC Structure
  - 5.4.1 - MAC - c/sh entities for UTRAN Network
  - 5.4.2 - MAC - d entities for UTRAN Network
  - 5.4.3 - MAC- hs entities for UTRAN Network
- 5.5 MAC PDU (Protocol Data Units)
  - 5.5.1 - MAC Header to Dedicated channel
- 5.6 Data Flow & Memory control between layers
- 5.7 Real Practice
  - 5.7.1 - Practice contents
  - 5.7.2 - BCH Header processing design
  - 5.7.3 - BCH Header processing implementation

- 5.7.4 - Transport Block processing
- 5.7.5 - Transport Block processing design

### Chapter 6, RLC (Radio Link Control) Layer

- 6.1 RLC Introduction
- 6.2 RLC Entities
- 6.3 RLC Functionality
- 6.4 The Service which provided to higher Layer
- 6.5 RLC Layer design
- 6.6 Real RLC Practice

### Chapter 7, RRC (Radio Resource Control) Layer

- 7.1 RRC Layer introduction
- 7.2 RRC Layer structure
- 7.3 RRC State
- 7.4 RRC Function
- 7.5 RRC Task
- 7.6 Real RRC Practice

### Chapter 8, Call Processing Service for Voice

- 8.1 Call Processing Introduction
- 8.2 Call Processing for UE Voice sending
- 8.3 Call processing for UE Voice receiving
- 8.4 Call Release Procedures
  - 8.4.1 Call Release procedures by UE
  - 8.4.2 Call Release procedures by Network
- 8.5 Physical process for Voice information
- 8.6 Real Practice

### Chapter 9, Call Processing Service for Video Telephony

- 9.1 Video Telephony Processing
- 9.2 UE Video Telephony Processing
- 9.3 Physical Transmitting Procedures for Video Information
- 9.4 Real Practice

### Chapter 10, Hand Over

- 10.1 Hand Over Technology
- 10.2 CDMA Hand Over
  - 10.2.1 - Idle Hand Over
  - 10.2.2 - Hand Over in Traffic State
- 10.3 WCDMA Hand Over
- 10.4 Real Practice

### Chapter 11, Power Control

- 11.1 Introduction of Power Control
- 11.2 CDMA Power Control Technology
  - 11.2.1 - Reverse Power Control
  - 11.2.2 - Forward Power Control
- 11.3 WCDMA Power Control
  - 11.3.1 - Open Loop Power Control
  - 11.3.2 - Inner Loop Power Control
- 11.4 Real Practice

### Chapter 12, Download Implementation of 3G-WCDMA

- 12.1 Algorithm Overview of Downloading
  - 12.1.1 - J-TAG Downloading method
  - 12.1.2 - Downloading Program method
- 12.2 Asynchronous HDLC Protocol
- 12.3 AMSS Diagnosis Packet Service
- 12.4 Downloading Protocol
- 12.5 Real Practice

### Chapter 13, Brew Programming

- 13.1 BREW (Binary, Runtime, Environment, Wireless)
- 13.2 BREW Structure
- 13.3 BREW Installation
- 13.4 BREW SDK
- 13.5 Real Practice

## Components

1) Main Hardware Platform	1 ea
2) Manual book	1 ea
3) USIM CARD	not provided
(1) User's mobile phone USIM Card can be used to this system.	
(2) User's mobile phone is connected to WCDMA-5000 Hardware.	
(3) WCDMA-5000 Hardware is connected to User's mobile phone.	
4) JTAG Emulator CodeViser	1 ea
5) S/W CD	1 ea
6) Serial Cable	1 ea
7) USB Cable	1 ea
8) Power Adaptor	1 ea

## Hardware Spec

Processor	Qualcomm MSM6245 Chipset (ARM926EJ-S 225MHZ) QDSP -100MHz
Memory	SDRAM 512MB, NAND 512Mb
Modem	WCDMA, GSM, GPRS, EDGE, DTM
RF	RTR6275, PAM, TCXO(19.2MHz)
PMU	PMIC6650-2
Frequency band	2100MHz (WCDMA Frequency)
Wireless Protocol	3GPP WCDMA R99, Release 5 compliance, Jun 2005 for WCDMA
LCD	260K colors QVGA 2.4 "TFT LCD
Camera processor	Qualcomm Q camera TM
Video telephony	Qvideo phone, 15fps QCIF
Audio	1 loud Speaker, 1 Microphone, 1 stereo Ear Phone Jack
Vo-coder	AMR
Audio/video decoders	MP3, AAC, AAC+, ADPCM, MPEG-4, H263, H264
Bluetooth	Qualcomm Blue QTM?
USB	USB 1.1 slave and host (OTG)
UART1	RS-232 9-pin connector
UART2	USIM interface
Keypad	22 keys
LED Indicator	5 LEDs( Reset, PS hold, PA on, NAND CE, Camera power on)
RF connector	SMA external type connector
Antenna	Chip Antenna
USB connector	General USB Interface
JTAG connector	JTAG Compatible(ANSI/IEEE1149.1A-1993) 20pin
Input Power	9V DC Power Supply
Extension slot	GPIO[1-5], I2C, UART

## Software Spec

Wireless Protocol	1) 3GPP Release 99 and 5 compliance
	2) SMS : 3GPP TS 23.040 Technical realization of the Short Message Service (SMS)
	3) 3GPP TS 24.011 Point-to-Point (PP) Short Message Service (SMS) Support on Mobile Radio Interface.
	4) USIM : 3GPP TS 23.048 Security Mechanisms for the (U)SIM application toolkit
	5) Video Service : 3GPP Release 99 TS 26.110 Codec (s) for CS Multimedia Telephony Service: General Description
	6) 3GPP Release 99 TS 26.111 Codec (s) for CS Multimedia Telephony Service: Modifications to H.324
	7) ITU-T Recommendation H.324, Terminal for low bit-rate multimedia communication
	8) ITU-T Recommendation H.263, Video coding for low bit rate communication
	9) Voice Service 3GPP Release 99 TS 24.008 Technical Specification Group Core Network : Mobile Radio Interface Layer 3 Specification
	10) 3GPP Release 99 TS 26.071 Technical Specification Group Services and System Aspects
	11) AMR Speech Codec; General Description
Platform	Brew3.1
BT	BT 1.2 stack/ L2CAP profile, RFCOMM profile
GUI	GUI support
USB	USB 1.2 full speed
OS	Window XP (recommended)

# model: **CMTS-G7000M**

**GSM / GPRS, WCDMA(UMTS), LTE Cellular Mobile Network  
performance measurement and processing &  
analyzing the logging data training system**

## **Feature**

**CMTS-G7000M supports various Specs like below which is covering 2G & 2.5G and 3G and 4G of mobile technologies in real time operation by connecting with real Base Station.**

**This system has below features.**

- 1) Supports Asynchronous & Synchronous ;  
- Asynchronous [transmission] : GSM/GPRS, WCDMA (UMTS). LTE.
- 2) Provides real time logging and display of Layer 1,2,3 messages, Packet messages (PPP, TCP/IP, UDP), and RF KPIs
- 3) Up to 2 mobile terminals and 2 scanners can be put on test simultaneously (2Voice, or 2 Data + 2 Voice/MOS)
- 4) Provides quality measurement function for Data Service (FTP, HTTP, Ping/TraceRT, E-Mail, UDP, SMS, WAP,...)
- 5) Voice Service (Voice MOS)
- 6) Easy Port setting and sophisticated Auto-call scenario setting.
- 7) Provides Bench marking test for business customers, mobile terminals and systems.
- 8) Provides Real Time Mapping (MapX or MIF) function by interfacing with GPS (NMEA format)
- 9) Saves and edits user-defined values
- 10) Provides the information about the condition of equipments
- 11) Provides convenience for users with GUI
- 12) Provides voice alarm function
- 13) In-building Mapping as default (BMP file)
- 14) Replay Function for simple analysis (easy to use)



## Functions

### < General Function >

- 1) Auto-Call Script
- 2) Create Script
- 3) Call Statistics Window
- 4) Message Decoding
- 5) KPIs Graph Display
- 6) Mapping
- 7) BTS Information and Serving Line
- 8) Draw Test Drive Route
- 9) Trace Function
- 10) Distance Measurement
- 11) Draw User defined mark
- 12) Various setting for the real time mapping window
- 13) User defined graph
- 14) User defined table
- 15) User defined summary info
- 16) Handoff status using Cell measurement info (for GSM)
- 17) 3G Handoff Events & 3G to 2G Handoff Events for GSM

- 18) Trace Back Function
- 19) GPS Status and GPS Satellite Status
- 20) Logging Info and Communication Statistics
- 21) Audible Alarms
- 22) Hot Key / User Event / Log file path setting
- 23) BTS Manager
- 24) Relay

### < Applications >

- 1) Voice MOS (1/4, MOS call statistics and MOS value graph)
- 2) Voice MOS (2/4, PESQ MOS information)
- 3) Voice MOS (3/4, PESQ parameters description)
- 4) Voice MOS (4/4, MOS signal graph and wave format graph)
- 5) Ping and TraceRT status
- 6) UDP
- 7) Voice MOS
- 8) UDP

## Programs which can be performed by CMTS-G7000M through Software CD.

### 1. Extensive Advanced Logger

- 1) mobile/modem interface control
- 2) GPS interface control
- 3) Digital Scanner interface control
- 4) Real Time Mapping management
- 5) RF KPI display and logging control
- 6) Layer 2 & 3 message display and logging control
- 7) Packet message display and logging control
- 8) Autocall script management
- 9) Alarm & Event management
- 10) Statistics management
- 11) Import/Export management

### 2. Extensive Advanced Post processing

- 1) Data logging file converting
- 2) Graph Analysis
- 3) Spread sheet Analysis
- 4) Map Analysis
- 5) Layer 2 & 3 message analysis
- 6) Packet message analysis
- 7) Binning control
- 8) Map display option control
- 9) Analysis report management
- 10) Import/Export file management
- 11) Event analysis
- 12) CDF/PDF & Statistics management

## Components and System configuration



S/W CD	1 ea
Phone Interface Cable (for interface between a mobile terminal and multi DM H/W)	4 ea (1Slot -4 ea)
Multi DM H/W	1 ea
LAN Cable (Connection between H/W and a lap top)	1 ea
AC to DC Inverter	1 ea
GPS Receiver	1 ea
Mobile Phone	3 ea (4G type)
Manual	1 book

## Textbook contents

### (Part-1, real time software-based solution for wireless mobile network performance measurement )

#### Chapter 1. Introduction

- 1.1 CMTS-G7000ML Introduction
- 1.2 Key Features
- 1.3 Requirements
  - 1.3.1 Minimum
  - 1.3.2 Recommended

#### Chapter 2. Getting Started with CMTS-G7000M

- 2.1 Software Installation Procedure
- 2.2 Hardware Installation Procedure
  - 2.2.1 Installation of Key Lock Driver
  - 2.2.2 Installation of USB GPS Driver
  - 2.2.3 Installation of Modem Driver for Dial-Up Network Connection

#### Chapter 3. User Interface

- 3.1 Icon Bar
- 3.2 Status Bar

#### Chapter 4. Port Setting

- 4.1 Mobile Setting - Interface
  - 4.1.1 Interface
  - 4.1.2 Phone
  - 4.1.3 Data Port
  - 4.1.4 DUN
  - 4.1.5 Logmask
  - 4.1.6 AT Port
- 4.2 Mobile Setting - DM Port
- 4.3 Mobile Setting - Modem
- 4.4 Mobile Setting - AT Port
- 4.5 GPS Port Setting
- 4.6 Scanner Port Setting
- 4.7 Network RegEdit
- 4.8 Enable DHCP

#### Chapter 5. AutoCall Setting

- 5.1 AutoCall Scenario Management Window
  - 5.1.1 Add a Scenario
  - 5.1.2 Edit a Scenario
  - 5.1.3 Remove a Scenario
  - 5.1.4 Import a Scenario
  - 5.1.5 Export a Scenario
  - 5.1.6 Run a Scenario(s)
- 5.2 AutoCall Time
- 5.3 AutoCall Type
  - 5.3.1 Voice Call
  - 5.3.2 FTP Call
  - 5.3.3 PPP Call
  - 5.3.4 Ping / TraceRT
  - 5.3.5 HTTP
  - 5.3.6 E-mail (POP3, SMTP)
  - 5.3.7 CS
  - 5.3.8 Key Emul
  - 5.3.9 PS
- 5.4 Multi-RAB

#### Chapter 6. Real Time Mapping

- 6.1 Real Time Mapping
- 6.2 Map Control Icon
  - 6.2.1 Map Properties
    - Map-Smart Map
    - MAP Import - MIF
    - MAP - MapX
    - BTS Class
    - BTS/Repeater
    - Serving Line
    - Custom Draw
    - ETC
    - Coverage
    - Legend
- 6.3 Trace
- 6.4 Note

- 6.4.1 Draw Line
- 6.4.2 Draw Text
- 6.5 Display Symbol/Line/Circle
  - 6.5.1 Map Mark Alias Setting
  - 6.5.2 Symbol
  - 6.5.3 Line
  - 6.5.4 Circle
  - 6.5.5 Mark List
  - 6.5.6 Adjust Data Offset
  - 6.5.7 Reset Data Offset

#### Chapter 7. File

- 7.1 Logging On / Off
- 7.2 Autocall Start / Stop/ Control
- 7.3 User Event
- 7.4 Manual Capture
- 7.5 Replay
- 7.6 NV Read / Write
- 7.7 Real Time Mapping
- 7.8 Capture Active Window
- 7.9 Capture Main Window
- 7.10 Convert PPP Frames
- 7.11 Export to File

#### Chapter 8. Setting

- 8.1 Port Setting
- 8.2 Mobile Alias Setting
- 8.3 Color Setting
- 8.4 Cell site Color Setting
- 8.5 Key Setting
- 8.6 Alarm Setting
  - 8.6.1 Event
  - 8.6.2 Signalling
  - 8.6.3 RF Parameter
  - 8.6.4 System Transition
- 8.7 User Event Setting
- 8.8 Log File Setting
- 8.9 BTS Manager
- 8.10 Save All Setting
- 8.11 Load All Setting

#### Chapter 9. Message

- 9.1 Signaling Message
  - 9.1.1 Message Filter
  - 9.1.2 Pause
  - 9.1.3 Export
  - 9.1.4 Packet Message
- 9.2 Packet Message
- 9.3 Alarm Event Manager
- 9.4 L2 RLC Message
- 9.5 Mobile Message
- 9.6 PPP Frame Message
- 9.7 Packet Capture Viewer

#### Chapter 10. Call Statistics

- 10.1 Call Statistics for Current Scenario
  - 10.1.1 All Info
  - 10.1.2 Detailed Info
    - Call Statistics View
    - Call Result View
    - Call Event History View
- 10.2 Call Statistics for All Scenario

#### Chapter 11. Statistics / Status

- 11.1 EVDO Session Assignment Test
- 11.2 WCDMA Statistics
- 11.3 Ping Test
- 11.4 Ping Status
- 11.5 TraceRT Status
- 11.6 Throughput Info
- 11.7 GPS Status
- 11.8 GPS Satellite Status
- 11.9 Logging Status

- 11.10 Communication Statistics
- 11.11 QPCH Statistics

#### Chapter 12. Window

#### Chapter 13. Help

- 13.1 About
- 13.2 Help

#### Chapter 14. User Defined

- 14.1 Graph
- 14.2 Table
- 14.3 Summary Info
- 14.4 Cell Measurement
- 14.5 Trace
- 14.6 Sync

#### Chapter 15. Scanner Setting

- 15.1 DTI (PCTEL) Scanner Setting (Seagull Tri-band Scanner-WCDMA/GSM)
  - UMTS Measurement
  - Spectrum Measurement
  - Time Slot Measurement
  - GSM Measurement - Control
  - Channel Color Code
  - GSM Measurement - RSSI Scan
  - WCDMA Measurement - RSSI Scan
- 15.2 DTI (PCTEL) Scanner Setting (Seagull Dual-band Scanner-CDMA2000/EVDO)
  - CDMA Measurement
  - EVDO Measurement
- 15.3 Anritsu Scanner Setting (ML8720B)
- 15.4 Anritsu Scanner Setting (ML8740/8741)
  - Version Information
  - Basic Conditions
  - User defined Antenna Gain
  - Setting Measurement Conditions
  - Measurement Start
  - Measurement Stop
- 15.5 Panasonic Scanner Setting
  - General Interface Setting
  - General Measurement Setting
  - BCH Measurement
  - CH Power Measurement
- 15.6 Anritsu PDC Scanner Setting (ML8753A)
- 15.7 CMTS-G7000M (CDMA/EVDO)
- 15.8 CMTS-G7000M (Extensive CDMA Advanced Logger - WCDMA Scanner)

#### Chapter 16. Worksheet

#### Chapter 17. Report

- 16.1 Worksheet
- 17.1 Report



( Part-2, processing & analyzing the logging data for IS-95A/B, CDMA-2000, EV-DO, GSM/GPRS, WCDMA (UMTS). LTE. )

**Chapter 1. Introduction**

- 1.1 About this document
- 1.2 Revision history

**Chap 2, Description**

- 2.1 Overview
- 2.2 Key functions and features
  - Functions
  - Features
- 2.3 System requirements

**Chap 3, Installation**

- 3.1 CMTS-G7000M
- 3.2 Key lock driver

**Chap 4, Graphic User Interface**

- 4.1 Menu bar
  - File
  - View
  - Tools
  - Window
  - Help
- 4.2 Tool bar
  - Main tool bar
  - Graph bar
  - Map bar
  - Viewer bar
- 4.3 Work bar
- 4.4 Workspace
  - Workspace list manager

**Chap 5, Basic Operation**

- 5.1 New model creation
  - New model window
- 5.2 Model open
  - Model open in File menu
  - Model open from Work bar
- 5.3 Parameter selection
- 5.4 Display Manager
- 5.5 Map Manager
  - MapX engine
  - MIF engine
- 5.6 BTS Manager
  - BTS Manager selection
  - BTS Manager window
- 5.7 Sync function
- 5.8 Auto reporting
- 5.9 Filtering
- 5.10 Coverage info
- 5.11 Import data
  - Procedure
  - Import Tektronix
  - Import Ethereal
  - Legend setting
  - Longitude/Latitude setting
- 5.12 Options setting
  - General
  - Path
  - Map Property
  - Map Items
  - Site
  - Inbuilding
  - Graph
  - CDF/PDF
  - MOS

**Chap 6, Graph Analysis**

- 6.1 Open parameter graph
  - Open single parameter graph
  - Open multiple parameter graph
  - Open Overlay parameter graph
- 6.2 Graph mouse menu
  - Panning
  - Zoom
  - CDF/PDF

- ARG
- PIE/Bar
- Copy to Clipboard
- Export
- Print
- Remove Graph
- Range To Sync
- Create Template
- Create Favorite
- Create PN Graph
- Create Model
- Show Legend
- Show Average
- Show Min-Max
- FTP Event
- Auto Range
- Setting

**Chap 7, Map Analysis**

- 7.1 Open parameter
  - Open single parameter map
  - Open Multiple Parameter Map
- 7.2 Map Mouse Menu
  - Undo
  - Panning
  - Zoom
  - Add BTS Data
  - Add Repeater Data
  - Copy to Clipboard
  - Export
  - Print
  - PIE/BAR
  - Range To Sync
  - Selection Manager
  - Selection Mode
  - Site Selection
  - Site Color Change
  - Highlight Co-PN (PSC/BCCH/PI)
  - Create Model
  - Run Binning
  - Create Delta Map
  - Create Template
  - Create Favorite
  - Distance Circle
  - Selection Circle Range
  - Distance Line
  - Replay
  - Best Server Cell Name
  - Set Site Line
  - Find Position
  - Set Area
  - Remove Lines
  - Multi Print
  - Scanned Map
  - Configure
  - Legend Mouse Menu
- 7.3 Call Result Legend Setting
  - Legend Setting
  - Statistics Setting

**Chap 8, Table Analysis**

- 8.1 Open Parameter
  - Open Single Parameter Table
  - Open Multiple Parameter Table
- 8.2 Table Sorting
  - Table Mouse Menu
  - Column Delete
  - Create Correlation
  - Create Favorite
  - Create Template
  - Range to Sync
  - Create Model

- File Exporting
- Select All
- Column Info
- Show Row Header
- Hide Statistics

**8.3 Table Tree Analysis**

- PSYNC Pollution-Qualcomm Tree
- PSC Pollution
- Neighbor List Analysis-Scanner Tree

**Chap 9, Message Analysis**

- 9.1 Open Message Window
  - Logging Message Window
  - Packet Message Window
- 9.2 Message Mouse Menu
  - File Exporting
  - Synchronized Row Exporting
  - Range to Sync
  - Column Setting
  - Create Log File
  - Column Condition
  - Event Filtering
  - Create Model
  - Hide Statistics
  - Hide Detail
  - Message Duration Time
  - Setup Range Setting
  - Bookmark
  - Find
  - Export
  - Filter Tree
  - Show/Hide
  - New Filter
  - Divide Msg
  - Add to Map
  - Add User Column
  - Reset Protocol Rev
  - Show Vertical Frame

**Chap 10, CDF/PDF Graph Analysis**

- 10.1 Open CDF/PDF Graph
  - Open Single CDF/PDF Parameter Graph
  - Open Multiple CDF/PDF Parameter Graph
  - Open Overlay CDF/PDF Parameter Graph
- 10.2 CDF/PDF Mouse Menu
  - 2D/3D Line Graph
  - 2D/3D Bar Graph
  - CDF/PDF Line -> Bar
  - Remove Graph
  - Create Template
  - Create Favorite
  - Copy to Clipboard
  - Export
  - Print
  - Setting
  - Show Legend

**Appendix - 1 Optional Functions**

- MOS/LCG Function (Optional)
- Play audio MOS/LCG file
- MOS/LCG Sampling

**Appendix - 2 QC Parameter Description**

- Qualcomm
- Qualcomm HSDPA
- Qualcomm HSUPA
- Qualcomm GSM
- Qualcomm GPRS

## Specification

### 1) Spec for Multi-DM

CPU	Intel Core i7-2715QE 2.1GHz
Memory	RAM : 8GByte, HDD : 32GByte(1ea)
Operating System	Windows 7 Professional. Windows 10
Interface	1Gbps Ethernet
Phone	Max 6-port
Interface Port	(USB3.0, UART, Audio Interface)
Input Voltage	DC 48V
Current Ratings	Typically, 290W (6A) Max, 450W (9.4A)
Number of PIU Slot	PIU(Phone interface CPU Unit) 5-slot loadable(max.)
Cooling FAN	2-FAN
Safety Fuse	DC current fuse(10A break)
External Interface	Gigabit Ethernet 2-port
GPS connection	Serial interface GPS
Operating Temperature	Temperature : -5 ~ 55℃ (Recommend)
Environment	Humidity : 0 ~ 90%RH Vibration : 3G (X-Y-Z each axis)

### 2) Spec for USB type GPS

- SiRFStarIIe GPS Chipset
  - L1 1575.42MHz, C/A CODE
  - 12 Channel Satellite Receiver
  - COLD START < 60s (Typical)
  - WARM START < 38s (Typical)
  - RTC/SRAM Back up Battery (Embedded)
- Protocol
  - 4800, NONE, 8, 1
  - NO FLOW CONTROL
  - NMEA-0183 (GGA,GSA,GSV,RMC)
- Accuracy (Position)
  - < 10 meter 2DRMS
- Interface
  - USB 1.1 compliant
- Operation Environment
  - Temperature: -20 to +70
  - Altitude: 18,000m below
  - Speed: 515m/s below
- Power
  - 5V USB Power (from PC)
  - 160mA
- Dimension
  - 55.7 x 45.4 x 16.00mm (W x D x H)



# model: **CMTS-G8000M**

**GSM / GPRS, WCDMA(UMTS), LTE, IMT-2020(5G), Cellular Mobile  
Trainer for network performance measurement  
and processing & analyzing the logging data**

## **Feature**

**CMTS-G8000M supports various Specs like below which is covering 2G & 2.5G and 3G, 4G and 5G (IMT-2020) of mobile technologies in real time operation by connecting with real Base Station.**

**This system has below features.**

- 1) Supports Asynchronous & Synchronous ;
  - Asynchronous [transmission] : GSM/GPRS, WCDMA (UMTS). LTE. 5G (IMT-2020).
- 2) Provides real time logging and display of Layer 1,2,3 messages, Packet messages (PPP, TCP/IP, UDP), and RF KPIs
- 3) Up to 2 mobile terminals and 2 scanners can be put on test simultaneously (2Voice, or 2 Data + 2 Voice/MOS)
- 4) Provides quality measurement function for Data Service (FTP, HTTP, Ping/TraceRT, E-Mail, UDP, SMS, WAP,...)
- 5) Voice Service (Voice MOS)
- 6) Easy Port setting and sophisticated Auto-call scenario setting.
- 7) Provides Bench marking test for business customers, mobile terminals and systems.
- 8) Provides Real Time Mapping (MapX or MIF) function by interfacing with GPS (NMEA format)
- 9) Saves and edits user-defined values
- 10) Provides the information about the condition of equipments
- 11) Provides convenience for users with GUI
- 12) Provides voice alarm function
- 13) In-building Mapping as default (BMP file)
- 14) Replay Function for simple analysis (easy to use)

#### 15) 5G (IMT-2020) - NR & Legacy Key benefits

- (1) Supports the wide range of major wireless technologies and chipsets first to the market
- (2) 5G (IMT-2020) NR Analysis has below features ;
  - \* Best Server PCI & Beam Switch
  - \* NR-PCI Pollution Analysis
  - \* Dominant Beam Holding Information
  - \* NSA Coverage Delta Analysis, Interference Factor Analysis
  - \* L3 Analysis etc.
- (3) 5G-NR Report : 5G-NR Coverage Analysis Report, 5G-NR RF Comparison Report, etc.
- (4) Root Cause Analysis(RCA) : provides the cause type for the dropped/ failed/ incomplete call
- (5) Scalable, stable platform - either stand-alone or client-server configuration
- (6) Support Pre-defined Customized Report and User Defined Report

#### 16) 5G (IMT-2020) - NR Key features

- (1) Supported Chipset and Scanner
  - \* 5G-NR Chipset: Qualcomm, Samsung, Hisilicon(Limited), MTK(TBD), Intel(TBD)
  - \* 5G-NR Scanner: PCTEL, R&S(Rohde-Schwarz)
- (2) 5G-NR Qualcomm Log Analysis (L1/L2)
  - \* ML1 Serving Cell Beam Mgmt. / MAC BRS Report(SSB / CSI-RS Beam)
  - \* ML1 Searcher Init Acquisition / ML1 Searcher Measurement
  - \* Tx Power Control Info / MAC LL1 CSF Info / MAC RACH MSG1 ~ MSG4
  - \* MAC PD(U)SCH Info / PDCCH DCI Format Info / PD(U)SCH BLER Info
  - \* L1 & L2 Throughput / RLC & PDCP Statistics Summary
- (3) 5G-NR Samsung Log Analysis (L1/L2)
  - \* NR-EUTRA Cell Info / NR-PHY Debug Statistics / NR-PHY PRACH Status
  - \* L1 & L2 Throughput / NR-PHY PRB / NR-PHY TBS / NR-PHY MCS
  - \* NR-PHY BLER / RLC & PDCP Statistics Summary, NSA Coverage Delta Analysis
- (4) 5G-NR Log Analysis : L3 (RRC/NAS)
  - \* Signaling Call Flow and Logging Message Viewer provide the supported parsers from the latest RRC / NAS specification. [3GPP TS 38.331 / 24.301 / 24.501(developing)]
- (5) 5G-NR Log Analysis (Slot Level)
  - Qualcomm
    - \* MAC DCI Info[Per Slot], MAC PDSCH Statistics[Per Slot], MAC PDSCH Status[Per Slot]
    - \* MAC LL1 CSF Info[Per Slot]
  - Samsung>
    - \* NR-PHY PDSCH Status, NR-PHY PUSCH Status, NR-PHY DCI UL/DL Grant Info
- (6) 5G-NR PCTEL / R&S Log Analysis
  - \* PCI & Beam Management Info / Top Nth PCI Info
  - \* NR-PCI Pollution & Interference Analysis / Dominant Cell Holding Info
- (7) 5G-NR Main Tree : Two approaches
  - \* 5G KPI Main Tree (set of commonly used parameters/ KPIs/ IEs) & Chipset-Specific Main
  - \* Tree (full set of chipset specific used parameters/ KPIs/ IEs/KPIs)

#### 17) Legacy features

- (1) Coverage Analysis
  - \* Able to check real coverage of optimization sector or cell planning by RF data
- (2) Data Filtering Analysis
  - \* Filtering data by Bad Coverage, Good Coverage, Idle, Traffic stats or user defined condition and display result in table/graph/map/window
- (3) In-building Analysis
  - \* Support In-building condition analysis by inputting map
- (4) Packet Analysis
  - \* Analyze only packet information for packet data
- (5) Application Analysis
  - \* Provide APP analysis function and statistical items including Ping/VOD/HTTP in Auto call
- (6) Statistics Analysis
  - \* Support statistical information for each call and able to analysis with particular parameter by synchronize with specific call
- (7) VoLTE Analysis
  - \* Able to analyze SIP/ RTP packets
- (8) Voice QoS Analysis
  - \* PESQ/ POLQA based MOS result analysis, Voice mute detection & analysis
- (9) Shell Command based Interface Compatibility
  - \* Support shell (DOS Prompt) command to link task to 3rd party tool
- (10) Scheduling Processing
  - \* Automated Task Processing in scheduling in unattended mode
- (11) Root Cause Analysis
  - \* Provide Root Cause Analysis for log analysis of drop and fail call to voice and data call
- (12) 3GPP/ETSI KPI and Statistics
  - \* Provide FTP, HTTP, Email, Voice(VoLTE) Statistics and LTE/NB-IoT/UMTS/GSM KPI

## Functions

### < General Function >

- 1) Auto-Call Script
- 2) Create Script
- 3) Call Statistics Window
- 4) Message Decoding
- 5) KPIs Graph Display
- 6) Mapping
- 7) BTS Information and Serving Line
- 8) Draw Test Drive Route
- 9) Trace Function
- 10) Distance Measurement
- 11) Draw User defined mark
- 12) Various setting for the real time mapping window
- 13) User defined graph
- 14) User defined table
- 15) User defined summary info
- 16) Handoff status using Cell measurement info (for GSM)
- 17) 3G Handoff Events & 3G to 2G Handoff Events for GSM

- 18) Trace Back Function
- 19) GPS Status and GPS Satellite Status
- 20) Logging Info and Communication Statistics
- 21) Audible Alarms
- 22) Hot Key / User Event / Log file path setting
- 23) BTS Manager
- 24) Relay

### < Applications >

- 1) Voice MOS (1/4, MOS call statistics and MOS value graph)
- 2) Voice MOS (2/4, PESQ MOS information)
- 3) Voice MOS (3/4, PESQ parameters description)
- 4) Voice MOS (4/4, MOS signal graph and wave format graph)
- 5) Ping and TraceRT status
- 6) UDP
- 7) Voice MOS
- 8) UDP

## Programs which can be performed by CMTS-G8000M through Software CD.

### 1. Extensive Advanced Logger

- 1) mobile/modem interface control
- 2) GPS interface control
- 3) Digital Scanner interface control
- 4) Real Time Mapping management
- 5) RF KPI display and logging control
- 6) Layer 2 & 3 message display and logging control
- 7) Packet message display and logging control
- 8) Autocall script management
- 9) Alarm & Event management
- 10) Statistics management
- 11) Import/Export management

### 2. Extensive Advanced Post processing

- 1) Data logging file converting
- 2) Graph Analysis
- 3) Spread sheet Analysis
- 4) Map Analysis
- 5) Layer 2 & 3 message analysis
- 6) Packet message analysis
- 7) Binning control
- 8) Map display option control
- 9) Analysis report management
- 10) Import/Export file management
- 11) Event analysis
- 12) CDF/PDF & Statistics management

## Components and System configuration



S/W CD	1 ea
Phone Interface Cable (for interface between a mobile terminal and multi DM H/W)	4 ea (1Slot -4 ea)
Multi DM H/W	1 ea
LAN Cable (Connection between H/W and a lap top)	1 ea
AC to DC Inverter	1 ea
GPS Receiver	1 ea
Mobile Phone (4G SIM Card type, or 5G SIM Card type)	3 ea
Manual	1 book

## Textbook contents

### (Part-1, real time software-based solution for wireless mobile network performance measurement )

#### Chapter 1. Introduction

- 1.1 CMTS-G8000ML Introduction
- 1.2 Key Features
- 1.3 Requirements
  - 1.3.1 Minimum
  - 1.3.2 Recommended

#### Chapter 2. Getting Started with CMTS-G8000M

- 2.1 Software Installation Procedure
- 2.2 Hardware Installation Procedure
  - 2.2.1 Installation of Key Lock Driver
  - 2.2.2 Installation of USB GPS Driver
  - 2.2.3 Installation of Modem Driver for Dial-Up Network Connection

#### Chapter 3. User Interface

- 3.1 Icon Bar
- 3.2 Status Bar

#### Chapter 4. Port Setting

- 4.1 Mobile Setting - Interface
  - 4.1.1 Interface
  - 4.1.2 Phone
  - 4.1.3 Data Port
  - 4.1.4 DUN
  - 4.1.5 Logmask
  - 4.1.6 AT Port
- 4.2 Mobile Setting - DM Port
- 4.3 Mobile Setting - Modem
- 4.4 Mobile Setting - AT Port
- 4.5 GPS Port Setting
- 4.6 Scanner Port Setting
- 4.7 Network RegEdit
- 4.8 Enable DHCP

#### Chapter 5. AutoCall Setting

- 5.1 AutoCall Scenario Management Window
  - 5.1.1 Add a Scenario
  - 5.1.2 Edit a Scenario
  - 5.1.3 Remove a Scenario
  - 5.1.4 Import a Scenario
  - 5.1.5 Export a Scenario
  - 5.1.6 Run a Scenario(s)
- 5.2 AutoCall Time
- 5.3 AutoCall Type
  - 5.3.1 Voice Call
  - 5.3.2 FTP Call
  - 5.3.3 PPP Call
  - 5.3.4 Ping / TraceRT
  - 5.3.5 HTTP
  - 5.3.6 E-mail (POP3, SMTP)
  - 5.3.7 CS
  - 5.3.8 Key Emul
  - 5.3.9 PS
- 5.4 Multi-RAB

#### Chapter 6. Real Time Mapping

- 6.1 Real Time Mapping
- 6.2 Map Control Icon
  - 6.2.1 Map Properties
    - Map-Smart Map
    - MAP Import - MIF
    - MAP - MapX
    - BTS Class
    - BTS/Repeater
    - Serving Line
    - Custom Draw
    - ETC
    - Coverage
    - Legend
- 6.3 Trace
- 6.4 Note

- 6.4.1 Draw Line
- 6.4.2 Draw Text
- 6.5 Display Symbol/Line/Circle
  - 6.5.1 Map Mark Alias Setting
  - 6.5.2 Symbol
  - 6.5.3 Line
  - 6.5.4 Circle
  - 6.5.5 Mark List
  - 6.5.6 Adjust Data Offset
  - 6.5.7 Reset Data Offset

#### Chapter 7. File

- 7.1 Logging On / Off
- 7.2 Autocall Start / Stop/ Control
- 7.3 User Event
- 7.4 Manual Capture
- 7.5 Replay
- 7.6 NV Read / Write
- 7.7 Real Time Mapping
- 7.8 Capture Active Window
- 7.9 Capture Main Window
- 7.10 Convert PPP Frames
- 7.11 Export to File

#### Chapter 8. Setting

- 8.1 Port Setting
- 8.2 Mobile Alias Setting
- 8.3 Color Setting
- 8.4 Cell site Color Setting
- 8.5 Key Setting
- 8.6 Alarm Setting
  - 8.6.1 Event
  - 8.6.2 Signalling
  - 8.6.3 RF Parameter
  - 8.6.4 System Transition
- 8.7 User Event Setting
- 8.8 Log File Setting
- 8.9 BTS Manager
- 8.10 Save All Setting
- 8.11 Load All Setting

#### Chapter 9. Message

- 9.1 Signaling Message
  - 9.1.1 Message Filter
  - 9.1.2 Pause
  - 9.1.3 Export
  - 9.1.4 Packet Message
- 9.2 Packet Message
- 9.3 Alarm Event Manager
- 9.4 L2 RLC Message
- 9.5 Mobile Message
- 9.6 PPP Frame Message
- 9.7 Packet Capture Viewer

#### Chapter 10. Call Statistics

- 10.1 Call Statistics for Current Scenario
  - 10.1.1 All Info
  - 10.1.2 Detailed Info
    - Call Statistics View
    - Call Result View
    - Call Event History View
- 10.2 Call Statistics for All Scenario

#### Chapter 11. Statistics / Status

- 11.1 EVDO Session Assignment Test
- 11.2 WCDMA Statistics
- 11.3 Ping Test
- 11.4 Ping Status
- 11.5 TraceRT Status
- 11.6 Throughput Info
- 11.7 GPS Status
- 11.8 GPS Satellite Status
- 11.9 Logging Status

- 11.10 Communication Statistics
- 11.11 QPCH Statistics

#### Chapter 12. Window

#### Chapter 13. Help

- 13.1 About
- 13.2 Help

#### Chapter 14. User Defined

- 14.1 Graph
- 14.2 Table
- 14.3 Summary Info
- 14.4 Cell Measurement
- 14.5 Trace
- 14.6 Sync

#### Chapter 15. Scanner Setting

- 15.1 DTI (PCTEL) Scanner Setting (Seagull Tri-band Scanner-WCDMA/GSM)
  - UMTS Measurement
  - Spectrum Measurement
  - Time Slot Measurement
  - GSM Measurement - Control
  - Channel Color Code
  - GSM Measurement - RSSI Scan
  - WCDMA Measurement - RSSI Scan
- 15.2 DTI (PCTEL) Scanner Setting (Seagull Dual-band Scanner-CDMA2000/EVDO)
  - CDMA Measurement
  - EVDO Measurement
- 15.3 Anritsu Scanner Setting (ML8720B)
- 15.4 Anritsu Scanner Setting (ML8740/8741)
  - Version Information
  - Basic Conditions
  - User defined Antenna Gain
  - Setting Measurement Conditions
  - Measurement Start
  - Measurement Stop
- 15.5 Panasonic Scanner Setting
  - General Interface Setting
  - General Measurement Setting
  - BCH Measurement
  - CH Power Measurement
- 15.6 Anritsu PDC Scanner Setting (ML8753A)
- 15.7 CMTS-G8000M (CDMA/EVDO)
- 15.8 CMTS-G8000M (Extensive CDMA Advanced Logger - WCDMA Scanner)

#### Chapter 16. Worksheet

- 16.1 Worksheet

#### Chapter 17. Report

- 17.1 Report



( Part-2, processing & analyzing the logging data for IS-95A/B, CDMA-2000, EV-DO, GSM/GPRS, WCDMA (UMTS). LTE. )

**Chapter 1. Introduction**

- 1.1 About this document
- 1.2 Revision history

**Chap 2, Description**

- 2.1 Overview
- 2.2 Key functions and features
  - Functions
  - Features
- 2.3 System requirements

**Chap 3, Installation**

- 3.1 CMTS-G8000M
- 3.2 Key lock driver

**Chap 4, Graphic User Interface**

- 4.1 Menu bar
  - File
  - View
  - Tools
  - Window
  - Help
- 4.2 Tool bar
  - Main tool bar
  - Graph bar
  - Map bar
  - Viewer bar
- 4.3 Work bar
- 4.4 Workspace
  - Workspace list manager

**Chap 5, Basic Operation**

- 5.1 New model creation
  - New model window
- 5.2 Model open
  - Model open in File menu
  - Model open from Work bar
- 5.3 Parameter selection
- 5.4 Display Manager
- 5.5 Map Manager
  - MapX engine
  - MIF engine
- 5.6 BTS Manager
  - BTS Manager selection
  - BTS Manager window
- 5.7 Sync function
- 5.8 Auto reporting
- 5.9 Filtering
- 5.10 Coverage info
- 5.11 Import data
  - Procedure
  - Import Tektronix
  - Import Ethereal
  - Legend setting
  - Longitude/Latitude setting
- 5.12 Options setting
  - General
  - Path
  - Map Property
  - Map Items
  - Site
  - Inbuilding
  - Graph
  - CDF/PDF
  - MOS

**Chap 6, Graph Analysis**

- 6.1 Open parameter graph
  - Open single parameter graph
  - Open multiple parameter graph
  - Open Overlay parameter graph
- 6.2 Graph mouse menu
  - Panning
  - Zoom
  - CDF/PDF

- ARG
- PIE/Bar
- Copy to Clipboard
- Export
- Print
- Remove Graph
- Range To Sync
- Create Template
- Create Favorite
- Create PN Graph
- Create Model
- Show Legend
- Show Average
- Show Min-Max
- FTP Event
- Auto Range
- Setting

**Chap 7, Map Analysis**

- 7.1 Open parameter
  - Open single parameter map
  - Open Multiple Parameter Map
- 7.2 Map Mouse Menu
  - Undo
  - Panning
  - Zoom
  - Add BTS Data
  - Add Repeater Data
  - Copy to Clipboard
  - Export
  - Print
  - PIE/BAR
  - Range To Sync
  - Selection Manager
  - Selection Mode
  - Site Selection
  - Site Color Change
  - Highlight Co-PN (PSC/BCCH/PI)
  - Create Model
  - Run Binning
  - Create Delta Map
  - Create Template
  - Create Favorite
  - Distance Circle
  - Selection Circle Range
  - Distance Line
  - Replay
  - Best Server Cell Name
  - Set Site Line
  - Find Position
  - Set Area
  - Remove Lines
  - Multi Print
  - Scanned Map
  - Configure
  - Legend Mouse Menu
- 7.3 Call Result Legend Setting
  - Legend Setting
  - Statistics Setting

**Chap 8, Table Analysis**

- 8.1 Open Parameter
  - Open Single Parameter Table
  - Open Multiple Parameter Table
- 8.2 Table Sorting
  - Table Mouse Menu
  - Column Delete
  - Create Correlation
  - Create Favorite
  - Create Template
  - Range to Sync
  - Create Model

- File Exporting
- Select All
- Column Info
- Show Row Header
- Hide Statistics

**8.3 Table Tree Analysis**

- PSYNC Pollution-Qualcomm Tree
- PSC Pollution
- Neighbor List Analysis-Scanner Tree

**Chap 9, Message Analysis**

- 9.1 Open Message Window
  - Logging Message Window
  - Packet Message Window
- 9.2 Message Mouse Menu
  - File Exporting
  - Synchronized Row Exporting
  - Range to Sync
  - Column Setting
  - Create Log File
  - Column Condition
  - Event Filtering
  - Create Model
  - Hide Statistics
  - Hide Detail
  - Message Duration Time
  - Setup Range Setting
  - Bookmark
  - Find
  - Export
  - Filter Tree
  - Show/Hide
  - New Filter
  - Divide Msg
  - Add to Map
  - Add User Column
  - Reset Protocol Rev
  - Show Vertical Frame

**Chap 10, CDF/PDF Graph Analysis**

- 10.1 Open CDF/PDF Graph
  - Open Single CDF/PDF Parameter Graph
  - Open Multiple CDF/PDF Parameter Graph
  - Open Overlay CDF/PDF Parameter Graph
- 10.2 CDF/PDF Mouse Menu
  - 2D/3D Line Graph
  - 2D/3D Bar Graph
  - CDF/PDF Line -> Bar
  - Remove Graph
  - Create Template
  - Create Favorite
  - Copy to Clipboard
  - Export
  - Print
  - Setting
  - Show Legend

**Appendix - 1 Optional Functions**

- MOS/LCG Function (Optional)
- Play audio MOS/LCG file
- MOS/LCG Sampling

**Appendix - 2 QC Parameter Description**

- Qualcomm
- Qualcomm HSDPA
- Qualcomm HSUPA
- Qualcomm GSM
- Qualcomm GPRS



**( Part-3, IMT-2020, 5G-NR & Legacy practice )**

**Chap 1, Practice of 5G (IMT-2020) - NR**

- (1) Supported Chipset and Scanner
  - \* 5G-NR Chipset: Qualcomm, Samsung, Hisilicon(Limited), MTK(TBD), Intel(TBD)
  - \* 5G-NR Scanner: PCTEL, R&S(Rohde-Schwarz)
- (2) 5G-NR Qualcomm Log Analysis (L1/L2)
  - \* ML1 Serving Cell Beam Mgmt. / MAC BRS Report(SSB / CSI-RS Beam)
  - \* ML1 Searcher Init Acquisition / ML1 Searcher Measurement
  - \* Tx Power Control Info / MAC LL1 CSF Info / MAC RACH MSG1 ~ MSG4
  - \* MAC PD(U)SCH Info / PDCCH DCI Format Info / PD(U)SCH BLER Info
  - \* L1 & L2 Throughput / RLC & PDCP Statistics Summary
- (3) 5G-NR Samsung Log Analysis (L1/L2)
  - \* NR-EUTRA Cell Info / NR-PHY Debug Statistics / NR-PHY PRACH Status
  - \* L1 & L2 Throughput / NR-PHY PRB / NR-PHY TBS / NR-PHY MCS
  - \* NR-PHY BLER / RLC & PDCP Statistics Summary, NSA Coverage Delta Analysis
- (4) 5G-NR Log Analysis : L3 (RRC/NAS)
  - \* Signaling Call Flow and Logging Message Viewer provide the supported parsers from the latest RRC / NAS specification. [3GPP TS 38.331 / 24.301 / 24.501(developing)]
- (5) 5G-NR Log Analysis (Slot Level)
  - Qualcomm
    - \* MAC DCI Info[Per Slot], MAC PDSCH Statistics[Per Slot], MAC PDSCH Status[Per Slot]
    - \* MAC LL1 CSF Info[Per Slot]
  - Samsung>
    - \* NR-PHY PDSCH Status, NR-PHY PUSCH Status, NR-PHY DCI UL/DL Grant Info
- (6) 5G-NR PCTEL / R&S Log Analysis
  - \* PCI & Beam Management Info / Top Nth PCI Info
  - \* NR-PCI Pollution & Interference Analysis / Dominant Cell Holding Info
- (7) 5G-NR Main Tree : Two approaches
  - \* 5G KPI Main Tree (set of commonly used parameters/ KPIs/ IEs) & Chipset-Specific Main
  - \* Tree (full set of chipset specific used parameters/ KPIs/ IEs/KPIs)

**Chap 2, Practice on Legacy**

- (1) Coverage Analysis
  - \* Able to check real coverage of optimization sector or cell planning by RF data
- (2) Data Filtering Analysis
  - \* Filtering data by Bad Coverage, Good Coverage, Idle, Traffic stats or user defined condition and display result in table/graph/map/window
- (3) In-building Analysis
  - \* Support In-building condition analysis by inputting map
- (4) Packet Analysis
  - \* Analyze only packet information for packet data
- (5) Application Analysis
  - \* Provide APP analysis function and statistical items including Ping/VOD/HTTP in Auto call
- (6) Statistics Analysis
  - \* Support statistical information for each call and able to analysis with particular parameter by synchronize with specific call
- (7) VoLTE Analysis
  - \* Able to analyze SIP/ RTP packets
- (8) Voice QoS Analysis
  - \* PESQ/ POLQA based MOS result analysis, Voice mute detection & analysis
- (9) Shell Command based Interface Compatibility
  - \* Support shell (DOS Prompt) command to link task to 3rd party tool
- (10) Scheduling Processing
  - \* Automated Task Processing in scheduling in unattended mode
- (11) Root Cause Analysis
  - \* Provide Root Cause Analysis for log analysis of drop and fail call to voice and data call
- (12) 3GPP/ETSI KPI and Statistics
  - \* Provide FTP, HTTP, Email, Voice(VoLTE) Statistics and LTE/NB-IoT/UMTS/GSM KPI

## Specification

### 1) Spec for Multi-DM

Power input	48VDC (require external power supply, AC-DC))
Power consumption	Typically, 290W. Max 500W
Size	236 x 133 x 256 (mm, W x H x D)
Weight	< 6.5kg
CPU	Intel Core i7-2715QE 2.1GHz
Memory	RAM : 8GByte, HDD : 32GByte(1ea)
Operating System	Windows 7 Professional. Windows 10
Interface	1Gbps Ethernet
Phone	Max 6-port
Interface Port	(USB3.0, UART, Audio Interface)
Input Voltage	DC 48V
Current Ratings	Typically, 290W (6A) Max, 450W (9.4A)
Number of PIU Slot	PIU(Phone interface CPU Unit) 5-slot loadable(max.)
Cooling FAN	2-FAN
Safety Fuse	DC current fuse(10A break)
External Interface	Gigabit Ethernet 2-port
GPS connection	Serial interface GPS
Operating Temperature	Temperature : -5 ~ 55℃ (Recommend)
Environment	Humidity : 0 ~ 90%RH Vibration : 3G (X-Y-Z each axis)

### 2) Spec for USB type GPS

- SiRFStarIIe GPS Chipset
  - L1 1575.42MHz, C/A CODE
  - 12 Channel Satellite Receiver
  - COLD START < 60s (Typical)
  - WARM START < 38s (Typical)
  - RTC/SRAM Back up Battery (Embedded)
- Protocol
  - 4800, NONE, 8, 1
  - NO FLOW CONTROL
  - NMEA-0183 (GGA,GSA,GSV,RMC)
- Accuracy (Position)
  - < 10 meter 2DRMS
- Interface
  - USB 1.1 compliant
- Operation Environment
  - Temperature: -20 to +70
  - Altitude: 18,000m below
  - Speed: 515m/s below
- Power
  - 5V USB Power (from PC)
  - 160mA
- Dimension
  - 55.7 x 45.4 x 16.00mm (W x D x H)



model: **LTE-9000**

## LTE Training system

LTE-9000 provides real-time network performance measurement & analyzing the logging data for LTE, WCDMA.

### Key features

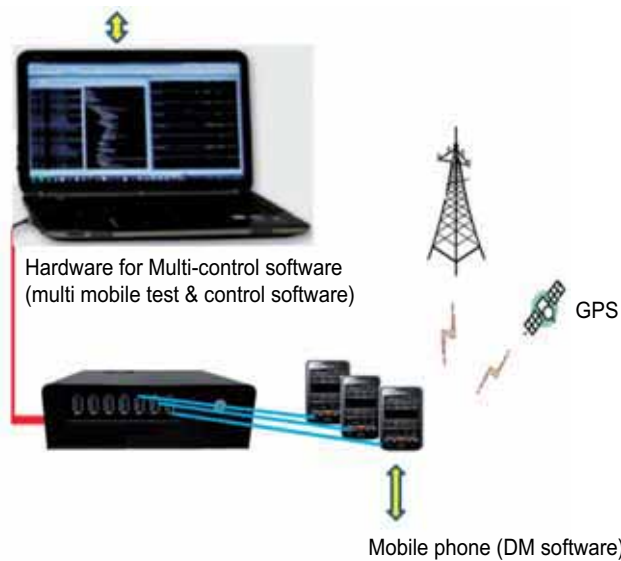
- 1) Provides automated test function of full-length modem to automatically measure the quality of wireless environment with various call test types. (Voice, FTP, Ping, Idle)
- 2) Various network tests (LTE, WCDMA)
- 3) Provides the same test environment as QxDM and provides the ability to collect logs in Qualcomm format. (LTE, WCDMA)
- 4) Provides various analysis types of Call Data (Table, Graph, Map)
- 5) The measurement data file is transmitted to the server and provides the function of analysis through the Web

### Functions

- 1) It provides an environment to test multiple equipment modems at the same time, and collects data separately. (Up to 2)
- 2) Collects various modem data using minimal UI
- 3) Network protocol support (LTE, WCDMA)
- 4) Provides the same test environment as QxDM and provides the ability to collect logs in Qualcomm format. (LTE, WCDMA)
- 5) Real time RF and system parameter monitoring function (Table, Graph, Map trace..)
- 6) Support for various test scenarios (Sequential, Multi-rab)
- 7) Supports various Auto Call tests to automatically measure the quality of the automotive field wireless modem (Voice, FTP, Ping, Idle)
- 8) Provides remote measurement capability that can be automatically tested according to measurement conditions and test plans
- 9) The measurement data file is transmitted to the server and provides the function of analysis through the Web
- 10) Gather current location data using GPS

## System configuration

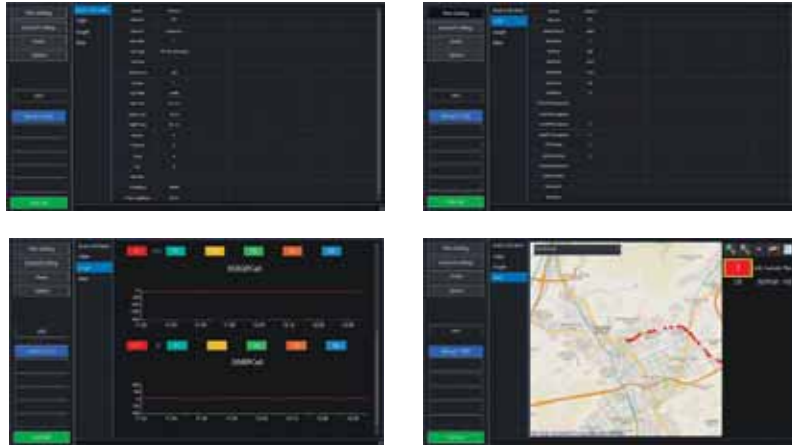
- 1) Mobile Connection Setup
- 2) Test Call Practice  
(Voice Call, FTP Up/Down Call, HTTP Call, VOD Call, Ping Call)
- 3) Applying Test Call to Mobile Phone
- 4) RF Status View & Call test statistics
- 5) Map View
  - \* Test Route map
  - \* RF Parameter along the Route map
  - \* Network Status
  - \* RF Parameter
  - \* BTS indicator
- 6) Replay Monitoring,,, etc



- 1) Simultaneous multiple mobile network test (max, 3 types)  
for Voice, VOD, FTP,,, etc
- 2) Monitor real-time Test progress & Network environment
- 3) RF Parameter capturing for selected network of mobile phones
- 4) Quick test reproduction,,, etc
  - Replay file creation during test
  - Fast reproduction for any event occurred
  - Data synchronization

### Auto Call Plan Setting





## Components

1) Hardware	Hardware for Multi-control Mobile phone (max, 3 mobile phone) Laptop PC, or desktop PC	1 unit 3 mobile phone Customer purchase
2) Software	Multi-control software (install to Laptop PC) DM software (install to mobile phone)	1 copy 1 copy
3) Manual book	1 book	

## Training Contents

PART 1. LTE - 9000, introduction  
 LTE-9000 introduction  
 LTE-9000 installing the software

PART 2. LTE - 9000, Operation & Performance Test

### 1.1 Main Menu

#### 1.1.1 Bottom Menu

- \* Main
- \* Sub View
- \* Auto Call
- \* Map
- \* Config

#### 1.1.2 Option Menu

### 1.2 Main View

### 1.3 Sub View

#### 1.3.1 Graph View

#### 1.3.2 PSC Search / ReCell List

#### 1.3.3 Serving Cell / Cell Info / UL/DL Link

#### 1.3.4 AP List / CH Graph / RSSI Graph

#### 1.3.5 Log Msg

### 1.4 Auto Call Test

#### 1.4.1 Plan setup

- \* Voice Call
- \* FTP Call
- \* HTTP Call
- \* VOD Call
- \* Ping Call
- \* Scenario Call

#### 1.4.2 Call main

#### 1.4.3 History

#### 1.4.4 Test Info

- \* HTTP View
- \* VOD View
- \* Ping View

#### 1.4.5 Log File Control

- \* Result Report
- \* Log File Upload (DM Server)
- \* Log File Upload (FTP Server)
- \* Send e-Mail

### 1.5 Map View

#### 1.5.1 Outdoor

- \* Offline Map
- \* Offline Map add
- \* Offline Map loading

#### 1.5.2 In-Building test

- \* Floor plan (Map Draw)
- \* Route Edit
- \* Inbuilding test

### 1.6 Config

#### 1.6.1 Upload Server Set

#### 1.6.2 Legend Set

#### 1.6.3 System Information

#### 1.6.4 Mobile Information

#### 1.6.5 Band Setup

#### 1.6.6 RF Threshold Setup

#### 1.6.7 Event Mask

#### 1.6.8 Network Test

- 1.7 Power Control
- 1.8 High speed Downlink Packet access
- 1.9 Hand Off
- 1.10 Idle mode
- 1.11 Block Error rate
- 1.12 File transfer protocol

#### PART 3. LTE - 9000, Case Study

- 1.7 Practice for multi mobile phone test & control software.
  - 1.7.1 Enhanced mobility with smart phone Application practice using DM software solution.
    - : Outdoor, in-building, subway, mountain,,, etc. where is difficult to
  - 1.7.2 LTE, WCDMA measurement
  - 1.7.3 Handy in-building (lab) measurement.
    - : Real time route drawing supported during measurement for in-building test.
  - 1.7.4 Remote Call Test Control and auto log file uploading practice to the server.
    - : Set the call test plan in WAS [Web Analysis Server] and auto call testing.
  - 1.7.5 Easy analysis and reporting practice
    - : Immediately analysis and reporting after measurement
- 1.8 Practice for DM software to control mobile phone
  - 1.8.1 Automation test - Voice, FTP, HTTP, PING, VOD
  - 1.8.2 Log file record for post process
  - 1.8.3 Layer-3 message monitoring
  - 1.8.4 Result report on the phone after test
  - 1.8.5 Indoor/outdoor map
  - 1.8.6 Network info, RF info monitoring
  - 1.8.7 Packet message monitoring

#### PART 4. LTE - 9000, Report

- 1.9 Report
  - 1.9.1 Call Information of Report
  - 1.9.2 Call Plan of Report
  - 1.9.3 Map of Report
  - 1.9.4 Call Event of Report
  - 1.9.5 Table of Report
  - 1.9.6 Graph of Report
  - 1.9.7 L3 Msg of Report

## Spec

- 1) Multi mobile phones, test & control software (max, 3 mobile phone).
  - (1) Monitoring all connected mobiles ' test status, RF/network
  - (2) BTS information loading on the outdoor map
  - (3) Automation test control – Voice, FTP, HTTP, PING, VOD
- 2) DM software to control mobile phones.
  - (1) Automation test – Voice, FTP, HTTP, PING, VOD
  - (2) Log file record for post process
  - (3) Layer-3 message monitoring
  - (4) Result report on the phone after test
  - (5) Network info, RF info monitoring
  - (6) Packet message monitoring
- 3) Hardware
  - (1) CPU : Intel i5, or over
  - (2) Memory : 4GB
  - (3) SSD : 64G
  - (4) USB : USB 3.0 (7 Port), USB 2.0 (2Port)
  - (5) LAN Port : 2 Port
  - (6) HDMI : 1 Port
  - (7) Mic/Audio : 1 Port

(8) OS : Windows 10

(9) DML Software is installed to Hardware.



4) Below parameters are supported.

(1) LTE

- RSRP, RSSI, RSRQ, SINR, Tx Power (P Cell, S Cell )
- EARFCN, PCI, Frequency, eNB ID, ECI, Local Cell ID, TAC. (P Cell, S Cell )
- MNC, MCC, EMM State, EMM Sub State
- AGC Mode, Duplex Mode, RACH Type, RACH Mode
- LTE-TDD Parameter – Frame Assignment, Frame Structure Pattern
- CQI, BLER, RB, RI, Modulation. (P Cell, S Cell )
- Throughput, Neighbor Cell Information

(2) WCDMA

- RSCP, RSSI, Ec/Io, Tx Power
- UARFCN, PSC, RRC State, Cell ID, LAC
- MCC, MNC
- DRX, BLER



# model: Mobile phone repair-GT4

## Mobile phone repair training equipment

Mobile phone repair-GT4 is mainly consisted of 4 parts as below ;

- 1) Disassembly Jig for Mobile phone
- 2) Mobile Phone Dryer equipment
- 3) Rework Station equipment for Mobile phone
- 4) Assembly equipment for Mobile phone

This equipment can be used for the students who is in Telecom, Electronic, Electrical department in university, Polytechnic, Technical high school.

### Equipment Lists

#### 1) Disassembly Jig for Mobile phone

##### (1) Function

: Disassembling LCD, back cover of the cellular phone

##### (2) System configuration



A bar used to precisely break down the cellular phone



Use a bracket to hold your cellphone



After adjusting the position, tighten the screw so that upper part of the adsorber not to be shaken.



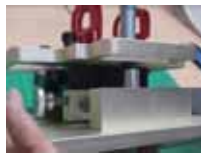
When the position is fixed, raise the end of the precision bar as much as possible.  
(To disassemble using the precision bar when disassembling)



Make sure that the top and bottom mobile phones are as close as possible.  
From the adsorber turned down, raise the handle so that it can be adsorbed.



It does the same way up and down.



Using bar, disassemble the cell phone while spreading it little by little.



At the time of disassembly, spray a little methyl alcohol on the corner of the cell phone and disassemble little by little.



### (3) Size

size : 220 X 210 X 140(mm), weight : 3.32kg



## 2) Mobile Phone Dryer

### (1) Function

- : easy and quick disassembly for smartphone
- Maintain stable temperature of dryer inside by Convection drying.
- by door sensor, not work when the door is open.
- Adopted safety circuit to protect the equipment from over current and overheating of heater

## (2) System configuration



## (3) Spec

Contents	Specifications
Heating Method	Air Convection by fan motor
Temperature Sensor	NTC Type
Max current	1.6A
Rated Voltage / frequency	AC220V/ 50~60Hz
Max Power consumption	About 350W
Weight	Approximately 10Kgs
Production location	MADE IN KOREA
Size of outside	(W)200mm x (L)430mm x (H)380mm
Size of inside	(W)160mm x (L)310mm x (H)250mm
Application	Heating of mobile devices for repair
Options (Not included)	Upper jig with handle with 2 Suction cups (TABATA) and lower jig to hold mobile phone (Disassembly jig set), Alcohol and dropper(brush), protective glove

## 3) Rework Station for Mobile Phone

### (1) Function

Removing and attaching parts such as defective chip or metal cover, heat sink, SIM card slot, charging terminal, AP(CPU), memory chip, image sensing chip etc.  
Used to connect the circuit by reheating when the lead ball is cracked.  
Check PCB chip pattern defect and reconnect the defect pattern

### (2) System configuration



#### Main controller

- : Equipped with high-performance 7-inch touch panel
- : Equipped with Cortex-A8 600Mhz CPU
- : 65535 Color 800 X 480



#### Heater for Upper / lower part

- : 1200W high efficiency heater
- : 1 to 10 step temperature rise control
- : hot air volume control function



#### PCB Holder

- : Possible to mount different type PCB
- : Easy to move, possible to soldering without separation of PCB



#### Temperature setting screen

- Provide default temperature program
- Easy setting change
- Temperature program backup and save



#### Operation screen

- Real-time check of work progress graph
- Real-time temperature display
- Function to see specific position temperature graph by an external temperature sensor
- USB storage function



#### Parts Pickup Fan

- 64 kPa, 7 L/min High performance suction pump



#### Upper and lower part nozzles

- : Applicable with permanent magnet to easily attach and detach
- : 10 nozzles by free of charge as per size



#### Light

- Easy to observe the work site by applying high-brightness LED lamp
- Apply laser pointer to identify the center point of the work target position



#### USB PORT

- Temperature program backup and temperature graph saving by USB storage
- USB cable, wireless mouse, keyboard available



### (3) Spec (PCB board for mobile phone)

Item	Spec
PCB mountable size	210mm * 260mm
PCB workable thickness	0.5mm ~ 2mm
PCB workable parts	1mm ~ 35mm
Suction capacity	64 kpa, 7L/min
temperature Sensor	K Type
Motion control device	Cortex-A8 600Mhz 7inch
Temperature control method	PID Control
External interface	USB, Mouse
Program storage capacity	999 ea
Power Consumption	220V 60Hz 2700W
Size	L440 X W470 X H630
Weight	19 Kg

## 4) Assembly equipment for Mobile phone

### (1) Function

: It is a device to assemble the rear cover and smartphone body with constant pressure by attaching the temporarily assembled smartphone with rear cover to the compression system.

### (2) System configuration



Pull the heating element toward you before assembling the smartphone



assemble the mobile phone to the compression jig.  
(Make sure that the rear cover is in close contact with the surface of the compression jig)



Press the Start01 (left) button and the Start02 (right) button to squeeze the phone.  
(After 20 seconds, squeezing is completed and the device is lifted up.)



### (3) Spec

Power	AC 100~140V / AC 220~240V
Max Watts	500W
Max Current	2.3A
Size	(W)350mm x (D)490mm x (H)410mm
Weight	22kg

- 5) Driver (+ - \* y special +)
- 6) Iron
- 7) Heat wind machine (small type)
- 8) Hot plate
- 9) Copper wire
- 10) LCD wiping liquid
- 11) Clean room machine (small type)
- 12) OCA optical film (bond)
- 13) OCA equipment
- 14) Plastic spatula
- 15) Hera (steel, plastic)
- 16) Flux (About 2 types) - Subsidiary materials used for lead removal and reassembly
- 17) Solder Wick (about 3 kinds of thickness) - Subsidiary material to remove lead residue from board or memory
- 18) Precision tweezers
- 19) microscope
- 20) FLU spray (PCB board cleaner)
- 21) 530 Spray (Multi-Purpose Cleaner)
- 22) Repair board support
- 23) Power supply
- 24) Connecting cable for power supply of mobile phone
- 25) Latex gloves
- 26) Silicone mat (used in all tasks when repairing a cell phone)

## Training Contents

### Part-1, Overview of Smartphone

1. Overview
2. Smartphone generation, type, feature
3. Smartphone basic structure
4. Role of each part
5. Related terms

### Part-2, Hardware Repair

1. Cell phone disassembly and assembly
2. Initialize Cell phone
3. Broken screen exchange (Apple, Samsung, LG)
4. Mainboard replacement (Apple, Samsung, LG)
5. Broken camera exchange (Apple, Samsung, LG)
6. Housing replacement work
7. Charging Port Replacement (Apple, Samsung, LG)
8. Receiver speaker, induction cable exchange (Apple, Samsung, LG)
9. Front sensor exchange (Apple, Samsung, LG)
10. Home button exchange (Apple, Samsung, LG)
11. Menu button exchange (Samsung, LG)
12. Power Button (Apple, Samsung, LG)
13. Volume button (Apple, Samsung, LG)
14. Battery replacement (Apple, Samsung, LG)
15. Make usable for the damaged screen (Apple, Samsung)
16. SIM card slot removing
17. charging terminal removing
18. memory chip removing
19. Vibration motor replacement repair
20. Cleaning and testing of mobile phones that was dropped to water

### Part-3, Data recovery & analysis (Forensic) - option

# 02

## a group of GPS training system

### 7. GPS-5000



# model: **GPS-5000**

## **GPS Trainer**

### Feature

GPS technology is widely being used for PDA, Smart phone, Navigation system., etc.

GPS-5000 is the GPS training system enabling the user to acquire the skills of GPS technology through the practice of Satellite Position, GMT Time, Latitude, Longitude, Speed, PDOP, HDOP, VDOP, TTFF Time,,etc using GPS Platform and Protocol.

User can also have a Software training on GPS protocol, Analysis of GPS on Window CE Embedded OS.

### Functions

- Understanding concept of GPS
- Measurement of Latitude & Longitude
- Analysis of NMEA-0183 protocol
- Study of DOP (PDOP, HDOP, VDOP)
- Development Windows CE based user application
- Debugging experience with serial port

### Components

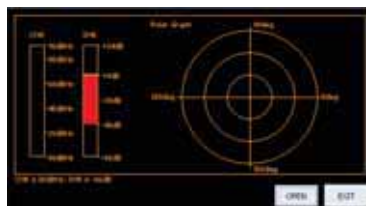
• Embedded system board with GPS module)	1 ea
• Carriage Bag	1 ea
• AC Adapter	1 ea
• Data Cable for debugging	1 ea
• External GPS Antenna	1 ea
• Software CD	1 ea
• User's Manual	1 ea

## System configuration

1) Platform board



2) Software Screen shot



## Specification

• CPU	ARM920T 400MHz Processor	
• Memory	64MB SDRAM, 64MB NAND Flash	
• Audio	Stereo Audio CODEC, Built-in Speaker	
• Video	4.3 TFT LCD/480*272 Pixels/ 16.7M Colors	
• Input device	Touch Screen, 4-Button	
• Output	Data indication LED, Debug serial port	
• Power	Input Voltage	DC +5V

• GPS features		
- General	Channel	20
	Frequency	L1, 1575.42MHz
	CA Code	1.023MHz Chip Rate
- Accuracy	Position	10meters CEP without SA
	Velocity	0.1meters/second without SA
	Time	1microsecond synchronized to GPS time
- Sensitivity	Tracking	-157dBm
	Acquisition	-154dBm
- TTFF(Time to Fix)	Hot Start	1sec.
	Warm Start	38sec.
	Cold Start	42sec.
- Dynamic Condition	Altitude	1,800meters
	Velocity	<515meters/sec.
	Acceleration	4g
	Jerk	20meters/sec <sup>3</sup>
- Serial Communication	Interface	USB to Serial full duplex
	Baud rate	38400bps
	Protocol Message	NMEA-0183(default) or SiRF Binary

• Operating System	Microsoft Windows CE 5.0
• Application compiler	Microsoft Embedded Visual C++ 4.0
• Development Language	C / C++

• PDOP : Percent Dilution of Position.
• TTFF : Time to First Fix.
• HDOP : Horizontal Dilution of Precision
• VDOP : Vertical Dilution of Precision
• NMEA : The National Marine Electronics Association
• GPFGA : Global Positioning System Fix Data
• GPGSV : GPS Satellites in View
• GPRMC : Recommended Minimum data
• GPGSA : GNSS DOP and Active Satellite
• GNSS : Global Navigation Satellite Systems

## Training contents

### Chapter 1, GPS5000 Introduction GPS5000 Introduction

- 1 Focus
- 2 Theory
  - 2.1. GPS SYSTEM OVERVIEW
  - 2.2. GPS Program History
  - 2.3. GPS5000

### Chapter 2, Basic Concept of GPS Positioning Basic Concept of GPS Positioning

- 1 Focus
- 2 Theory
  - 2.1 Basic Concept of GPS
  - 2.2. GPS Service
  - 2.3. GPS Theory of Operation

### Chapter 3, GPS5000 Hardware Operation GPS5000

- 1 Focus
- 2 Theory
  - 2.1 GPS5000 Development Environment
  - 2.2 GPS5000 System
- 3 Experiment
  - 3.1 GPS5000 Install
  - 3.2 GPS5000 Setting
  - 3.3 GPS5000 operate

### Chapter 4, Establishing Link between GPS Satellite and GPS-5000 Establishing link between GPS Satellite and GPS Trainer

- 1 Focus
- 2 Theory
  - 2.1 GPS Receiver
  - 2.2 GPS Time
  - 2.3 Data Structure
- 3 Experiment
  - 3.1 Date
  - 3.2 Time

### Chapter 5, DOP

- 1 Focus
- 2 Theory
  - 2.1. Position
  - 2.2. DOP
  - 2.3. Data Structure
- 3. Experiment
  - 3.1. Position
  - 3.2. DOP

### Chapter 6, GPS Signal

- 1 Focus
- 2 Theory
  - 2.1. Error
  - 2.2. Satellite
  - 2.3. Error on Satellite
  - 2.4. DataStructure
- 3. Experiment
  - 3.1. SNR
  - 3.2. Elevation and Azimuth

### Chapter 7, GPS Protocol: NMEA-0183

- 1 Focus
- 2 Theory
  - 2.1. Accuracy and Precision
  - 2.2. 2D/3D Position
  - 2.3. NMEA0183
- 3. Experiment
  - 3.1. Accuracy and Precision in 2D
  - 3.2. Accuracy and Precision in 2D/3D

### **Chapter 8, GPS Protocol: SiRF**

- 1 Focus
- 2 Theory
  - 2.1. SiRF Binary Protocol
  - 2.2. General Message
  - 2.3. Additional Information

### **Chapter 9, Validating GPS Protocol**

- 1 Focus
- 2 Theory
  - 2.1. Check Sum
  - 2.2. NMEA0183 Sentence
  - 2.3. Data Structure
- 3. Experiment
  - 3.1. Check Sum
  - 3.2. Handling

### **Chapter 10, Parsing GPS Protocol**

- 1 Focus
- 2 Theory
  - 2.1. Parsing
  - 2.2. NMEA Talker Sentences
  - 2.3. Velocity
- 3. Experiment
  - 3.1. Parsing GPGLL
  - 3.2. Velocity

### **Chapter 11, GPS GUI Introduction**

- 1 Focus
- 2 Theory
  - 2.1. Window CE
  - 2.2. GDI
  - 2.3. UI

### **Chapter 12, GPS GUI Base Programming**

- 1 Focus
- 2 Theory
  - 2.1. Mapping
  - 2.2. MFC Configuration
  - 2.3. GDI Configuration
  - 2.4. UI Area of Time
- 3. Experiment
  - 3.1. GUI Base
  - 3.2. GUI Time

### **Chapter 13, GPS GUI Programming**

- 1 Focus
- 2 Theory
  - 2.1. GPS5000
  - 2.2. UI Area of Mapping
  - 2.3. UI Area of Polar
- 3. Experiment
  - 3.1. GUI Mapping
  - 3.2. GUI Polar
  - 3.3. GUI SNR

### **Chapter 14, GPS GUI Debug**

- 1 Focus
- 2 Theory
  - 2.1. GPS5000 Debug Mode
  - 2.2. UI Area of SNR
  - 2.3. UI Area of Velocity
- 3. Experiment
  - 3.1. GUI SNR
  - 3.2. GUI Velocity

### **Appendix 1, GPS 5000 Hardware**

- 1 Focus
- 2 Theory
  - 2.1. GPS5000 Embedded System
  - 2.2. Specification of GPS5000
  - 2.3. Core and External Interface
  - 2.4. Specification of GPS5000 Connector

### **Appendix 2, GPS Position Mapping**

- 1 Focus
- 2 Theory
  - 2.1. Mapping
  - 2.2. Map
  - 2.3. Mapping GPS Position
  - 2.4. Draw Image
- 3. Experiment
  - 3.1. Map
  - 3.2. Mapping

### **Appendix 3, Measure Distance**

- 1 Focus
- 2 Theory
  - 2.1. Measure Distance Application
  - 2.2. Space and Coordinate
  - 2.3. Measure Distance
- 3 Experiments
  - 3.1. Measure Distance

### **Appendix 4, Location Based Service**

- 1 Focus
- 2 Theory
  - 2.1. Location Based Service
  - 2.2. Location Application Program
- 3 Experiments
  - 3.1. Measure Distance

# 03

## a group of Satellite Communication training system

- 8. Satellite-TVRO & Internet
- 8. Satellite-7000
- 10. Satellite-8000

# model: **Satellite-TVRO & Internet**

## **Satellite Communication System - TVRO & Internet**

### **Overview**

Satellite TVRO & Internet system is designed for real TV Broadcasting & Internet use with a real satellite. This system can utilize worldwide popular 1.2m motorized satellite antenna and receiver(or VSAT Modem) so that operator(customers) can experience its feature-rich function for satellite receiver(or VSAT Modem) and pointing the satellite antenna. The system is also designed to Ku-band, the most common and reliable receive frequency and provide L-band interface to accommodate satellite signal for customers.

### **Feature**

- 1) Simple design & appearance using standard 19" rack
- 2) Low power consumption
- 3) Easy installation and transportation
- 4) Selection among two different polarization receive frequency(Vertical, Horizontal)
- 5) Monitoring of IF carrier characteristic from front monitoring panel with Spectrum Analyzer
- 6) Various TV Broadcasting & Data for internet signal testing
- 7) IF signal is standard L-band interface(950MHz ~1450MHz)
- 8) Motorization antenna kit with antenna controller
  - Azimuth(CW, CCW)
  - Elevation(Up, Down)
- 9) Various satellite pointing from Antenna controller's front panel including
- 10) Monitoring of various satellite signal parameters with the spectrum analyzer and satellite receiver.(or VSAT Modem)
  - Satellite name
  - Receive Frequency
  - Signal quality
  - C/N of Receive carrier
  - Broadcasting signal type
  - TV & Internet

### **Function**

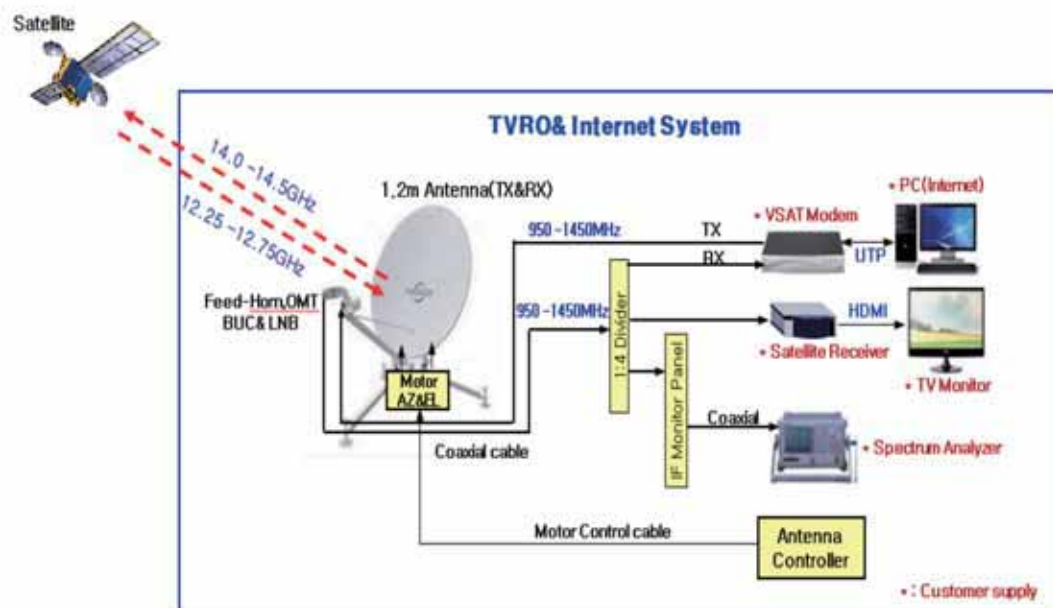
- 1) Satellite polarization set-up
- 2) Antenna azimuth adjustment with azimuth motor
- 3) Antenna elevation adjustment with elevation motor
- 4) Antenna angle control through the antenna controller in remote
- 5) Satellite receiver parameter configuration (Satellite, frequency, Symbol rate, FEC, etc.)
- 6) Receiving and monitoring of L-band frequency
- 7) C/N measurement from spectrum analyzer
- 8) Various TV Broadcasting signal testing with satellite receiver
- 9) TV & Internet

## Components

1) Equipment Rack	1 ea
2) 1.2m Ku-band Antenna with AZ&EL motors	1 ea
3) Antenna Feed (OMT)	1 ea
4) BUC(Block Up-Converter)	1 ea
5) LNB(Low Noise Block Down-Converter)	1 ea
6) Antenna controller	1 ea
7) IF Monitoring Panel	1 ea
8) L-Band Divider	1 ea
9) Motor Control cable Assy(30m max.) for AZ&EL	1 ea
10) IF Cable Assy(30m max.) for transmit and receive	1 ea
11) User's Manual	1 book
< Customer Supply >	
• HD TV Monitor - Customer supply	1 ea
• VSAT Modem - Customer supply	1 ea
• Satellite receiver(Set-top Box) - Customer supply	1 ea

## System configuration

### 1) System Block Diagram



## 2) Outline





## Specification

### 1) Antenna

Antenna Diameter	1.2m
Antenna Type	Offset, Motor driven
Mount Type	Elevation Over Azimuth
Azimuth adjustment range	0° to 360° (Continuous)
Elevaation adjustment range	5° to 90° (Continuous)
Frequency Range	RX 10.95 to 12.75 GHz. TX 13.75 to 14.50GHz
Gain, Mid-band	RX 41.5dBi, TX 43.0dBi
Polization	Linear pol(H-Pol, V-Pol)
Antenna Noise Temp.	46 °K at 20° Elevation
-3dB Beam Width	1.51°
VSWR	2.5
G/T	18.96dB / °K (0.8dB LNB)
Cross Polization Isolation	RX 35dB, TX 35dB
Side Lobe	ITU RS 580
Max Power	100W
Feed Interface	WR-75
OperationalTemp	-20 °C to +50° C
Operational Wind	72 Km/H

### 2) Antenna controller

LCD Display	AZ 3digit, EL 3digit
Botton	Power Button, AZ-CW/CCW EL-UP/DN
Connector type(rear)	MS-type, AZ&EL
Size	W482(19") x H88.8(2U) x D400[mm]
Input Power	220VAC, 60Hz
Power consumption	20Watt
Operating Temperature	0 °C to + 50 °C

### 3) BUC(Block Up-converet)

Output Frequency	14.0 to 14.5GHz
LO Frequency	13.05 GHz
Input Frequency	950 to 1450 MHz
Output Power(P1dB)	34dBm(3W Linear)
Linear Gain	58dB typ. 51dB min.
External Reference	10MHz(Sine wave), -5 to +5 dBm@Input port
Input connector	F-Type, Female(75 )
Output connector	Waveguide, WR-75
Power	DC Power, +24V(+12 to +30V)
Power consumption	15Watt
Operating Temperature	-40 °C to + 55 °C

### 4) LNB(Low Noise Block Down-converter)

Input Frequency	12.25 to 12.75GHz
LO Frequency	11.30 GHz
Output Frequency	950 to 1450 MHz
Output Power(P1dB)	8dBm
Conversion gain	60dB typ. 55dB min.
Noise Figure	0.8dB typ.
Input connector	Waveguide, WR-75
Output connector	F-Type, Female(75 )
Power	+12 to +24VDC (over IF Coaxial cable)
Power consumption	5Watt

### 5) IF Monitor Panel

Frequency	950 to 2000MHz
Port Interface	BNC Type female , 1Port(RX)
Panel size	1 U

### 6) L-band Divider

Frequency	950 to 2150MHz
In/Out Port	Input 1, Output 4
Port Interface	F-Type, female All port
Insertion Loss(In-out)	7.9dB typical
Isolation(Out-Out)	20dB typical

## 7) Rack

Size	600(W) x 750(H)x 600(D) mm
Prime Power socket	90 - 250VAC, 4 hole

## 8) Cable Assy

Antenna Control cable	MS-Type connector, AZ&EL, 30m Max.
IF Signal Cable	RG-6, F-type Connector, 30m Max.

## Manual contents

### Chapter 1, Satellite TVRO&Internet System Operation guide

1. Introduction
  - Overview, System function and feature
  - Components
  - System block diagrams
  - Specification
  - System Front and Rear view
  - Antenna controller operating
2. Satellite Antenna assemble Procedure
  - Components
  - Antenna assemble Procedure
3. Satellite Antenna pointing Procedure
  - Overview
  - Antenna pointing Procedure
4. Satellite receiver set-up Procedure
  - Overview & Description
  - Basic operating
  - Main menu
  - Satellite Broadcasting Receive Procedure
5. VSAT Modem set-up Procedure
  - Overview & Description
  - Modem configuration
  - Troubleshooting
6. Satellite Carrier monitoring Procedure
  - Overview
  - Satellite Carrier monitoring Procedure

### Chapter 2. Introduction to Satellite communication

1. Fundamentals of Satellite System
  - Basic Characteristics of Satellite
  - System Elements
  - Satellite Orbit Configurations
  - Frequency Spectrum Allocations
2. Evolution of Satellite Communication
  - Source of the Original Idea
  - Evolving Satellite Coverage
  - Specialized Systems: DTH and Mobile
  - Expansion at Higher Frequency Bands: Ka-Band
3. Satellite Network Architectures
  - General Features of Satellite Networks
  - Point-to-Multipoint (Broadcast) Networks
  - Point-to-Point Networks
  - VSAT Networks
4. Microwave Link Engineering
  - The Decibel
  - Propagation on the Earth-Space Link
  - Microwave Transmitters and Receivers
  - Overall Link Quality
5. Modulation, Multiple Access and Impairments
  - Digital Baseband Signals and Hierarchies
  - Digital Modulation
  - Multiple Access Methods
  - Distortion and Impairments

# model: **Satellite-7000**

## **Satellite Communication System trainer**

### **Overview**

Satellite-7000 is a integrated system to simulate satellite telecommunication without a real satellite. This system utilizes worldwide popular top-level satellite modems so that operators(customers) can experience its feature-rich function and performance. The system is also designed to adopt Ku-band, the most common and reliable bandwidth, among available satellite frequency bandwidth and provide IP-based interface to accommodate various applications from customers

### **Feature**

- 1) Simple design & appearance using standard 19" rack
- 2) Low power consumption
- 3) Easy installation and transportation
- 4) Selection among three different bands in receive frequency bandwidth
- 5) Monitoring of uplink & downlink IF carrier characteristic from front monitoring panel
- 6) IP-based various application testing (Video, Data, VoIP)
- 7) Satellite telecommunication standard L-band interface(950~1,450MHz)
- 8) Monitoring and configuring of various satellite parameters from modem's front panel including
  - Tx Level
  - Tx Frequency
  - Eb/No
  - Data Rate
  - FEC
  - Modulation&Demodulation Type

### **Function**

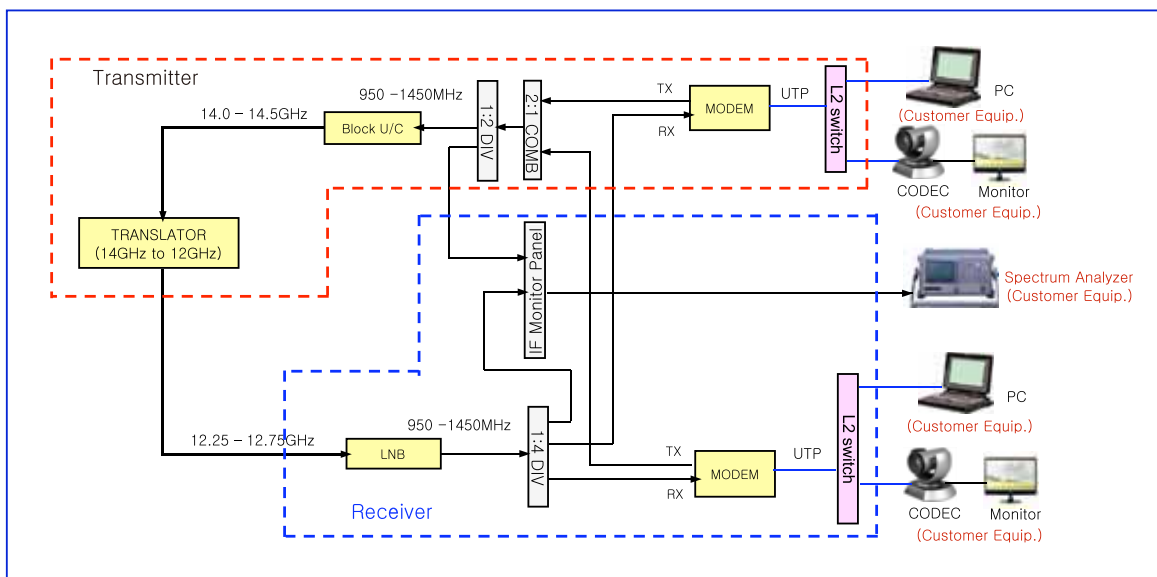
- 1) Satellite modem Tx parameter configuration (Data Rate, Modulation, FEC, IP etc.)
- 2) Satellite modem Rx frequency and level configuration
- 3) Transmitting and monitoring of L-band frequency
- 4) Frequency conversion and amplifying of L-band(950~1450 MHz) to Ku band(14.0~14.5 GHz)
- 5) RF frequency conversion (14.0~14.5 to 12.25~12.75 GHz)
- 6) RF signal level control in Ku-band (20 dB/min)
- 7) Satellite modem Rx parameter configuration (Data Rate, Modulation, FEC, etc.)
- 8) Receiving and monitoring of L-band frequency
- 9) C/N measurement from spectrum analyzer
- 10) Test data transmit and receive

## System configuration

Transmitter



Receiver



## Components

### 4.1 Transmitter

Equipment Rack	1 ea
L2 switch	1 ea
Satellite Modem with IP Interface	1 ea
BUC(Block Up-Converter)	1 ea
L-Bnad Combiner	1 ea
L-Band Divider	1 ea
Translator(TLT)	1 ea
RF cable Assy	1 ea
User's Manual	1 ea

### 4.2 Receiver

Equipment Rack	1 ea
L2 switch	1 ea
Satellite Modem with IP Interface	1 ea
LNB(Low Noise Block Down-Converter)	1 ea
IF Monitoring Panel	1 ea
L-Band Divider	1 ea
RF cable Assy	1 ea
User's Manual	1 ea

## Specification

### 1) Transmitter

#### 1.1) Satellite Modem

Frequency Range	950 to 2000MHz, 100Hz resolution
Data Interface	10/100base-T Ethernet
Data Rate Range	2.4 kbps to 5Mbps
Modulation&FEC Type	1/2BPSK, 1/2QPSK/OQPSK, 3/4QPSK/OQPSK 7/8QPSK/OQPSK, 2/3QPSK/OQPSK
M&C Interface	EIA-232, EIA-485(2- or 4-wire)
Input/Output Impedance	50 $\Omega$ , female Type N Connector
Modulator Output power	0 to -40dBm, 0.1dB steps
Power supply	100 to 240 VAC, 50/60Hz, 37W
Display Size	20/L x 93/H mm

#### 1.2) Block Up Converter

Output Frequency	14.0 to 14.5 GHz
LO Frequency	13.05 GHz
Input Frequency	950 to 1450 MHz
Output Power(P1dB)	34dBm min, 3Watt Linear
Linear gain	51dB min.
Input connector	F-type, Female
Output connector	SMA, Female
Power	DC Power, +24V (over IF coaxial cable)
Power consumption	18W Typ., 23W Max. @ Pout = +34 dBm

#### 1.3) Translator

Frequency Input range	14.0 to 14.5 GHz
Frequency Output range	12.25 to 12.75 GHz at LO 1 Frequency 1750 MHz 11.70 to 12.00 GHz at LO 2 Frequency 2300 MHz 10.95 to 11.45 GHz at LO 3 Frequency 3050 MHz
Maximum Input Power	10Watt, continuous
Insertion Loss	40dB min, 75dB max.
Level Control	25dB min. 1dB steps
LO Selection	3 Bands, Front Panel Selectable Band 1: 1750MHz, Band 2: 2300 MHz, Band 3: 3050MHz
Input/Output connector	SMA, Female
Power	90 to 250VAC, 47-63Hz
Display Size	Frequency : 12/L x 43/H mm Attenuation : 12/L x 20/H mm

#### 1.4) Rack

Size	600(W) x 500(H)x 600(D) mm
Prime Power Socket	90 - 250VAC, 8hole

### 2) Receiver

#### 2.1) Satellite Modem

Frequency Range	950 to 2000MHz, 100Hz resolution
Input power range	-130 +10 log symbol rate dBm (minimum) -90 +10 log symbol rate dBm (maximum)
Data Interface	10/100base-T Ethernet,
Data Rate Range	2.4 kbps to 5Mbps
Demodulation&FEC Type	1/2BPSK, 1/2QPSK/OQPSK, 3/4QPSK/OQPSK 7/8QPSK/OQPSK, 2/3QPSK/OQPSK
Monitor Fuction	Eb/No, Frequency offset, BER, Rx Signal level
M&C Interface	EIA-232, EIA-485(2- or 4-wire)
Input/Output Impedance	50 $\Omega$ , female Type N Connector
Power supply	100 to 240 VAC, 50/60Hz, 37W
Display Size	20/L x 93/H mm

## 2.2) Block Down Converter

Input Frequency	12.25 to 12.75GHz
LO Frequency	11.30 GHz
Output Frequency	950 to 1450 MHz
Conversion gain	55dB min
Noise Figure	0.8 Typ., 1.0 dB max
Input connector	SMA, Female
Output connector	F-Type, Female
Power	18VDC (+12 to +24VDC, over IF Coaxial cable)

## 2.3) Monitoring Panel

Frequency	RX IF : 950 to 1450MHz TX RF : 14.0 - 14.5 GHz
Port Interface	RX IF : F-type/Female, TX RF : SMA/Female
Panel size	1 U

## 2.4) Rack

Size	600(W) x 500(H)x 600(D) mm
Prime Power socket	90 - 250VAC, 8 hole

## Training contents

## &lt;Book-1&gt;

## Part-1, Satellite Emulation Training System

## Operation Guide

## Chap 1, Satellite Training System Introduction

- 1.1 Overview
- 1.2 Function
- 1.3 Feature
- 1.4 Components
- 1.5 System Block diagram
- 1.6 Specification
- 1.7 System Rack

## Chap 2, Equipment Function and Characteristics

- 2.1 Satellite Modem
- 2.2 Block Up Converter
- 2.3 Test Loop Translator
- 2.4 Block Down Converter
- 2.5 L2 Switch
- 2.6 IF/RF Monitoring Panel

## Chap 3, Satellite Modem Operation

- 3.1 Front Panel Operation
- 3.2 Web Based Operation

## Chap 4, System Performance Test (1)

- 4.1 Carrier Bandwidth & C/N Test
- 4.2 Frequency Stability Measurement
- 4.3 Frequency Level Measurement
- 4.4 Data Throughput Test
- 4.5 Data File Transfer Test
- 4.6 Web Test(Internet)
- 4.7 Video Transfer Test
- 4.8 Uplink & Down link level adjustment

## Chap 5, System Performance Test (2)

- 5.1 Transmitting Gain
- 5.2 Transmitting Gain Stability
- 5.3 Receiving Gain
- 5.4 Receiving Frequency Stability
- 5.5 Frequency Conversion Accuracy

## Part-2, Introduction to Satellite Communication (Theory)

## Chap 1, Fundamentals of Satellite System

## 1.1 Basic Characteristics of Satellite

- 1.1.1 Advantages of Satellite Communication
- 1.1.2 Use of Microwave Frequencies
- 1.1.3 Digital Transmission, Compression, and Routing
- 1.1.4 Improved Space Platforms and Launching Systems
- 1.1.5 Integration with Terrestrial Wired and Wireless Networks

## 1.2 System Elements

- 1.2.1 Space Segment
- 1.2.2 Ground Segment
- 1.2.3 Overall System

## 1.3 Satellite Orbit Configurations

## 1.4 Frequency Spectrum Allocations

- 1.4.1 ITU Spectrum Allocations and Regions
- 1.4.2 VHF and UHF Frequency Ranges
- 1.4.3 Microwave Bands: L and S
- 1.4.4 Microwave Bands: C, X, and Ku
- 1.4.5 Millimeter Wave and Higher: Ka-, Q-, and V-Bands
- 1.4.6 Guided and Unguided Optical Properties

## Chap 2, Evolution of Satellite Communication

## 2.1 Source of the Original Idea

- 2.1.1 SYNCOM
- 2.1.2 COMSAT

## 2.2 Evolving Satellite Coverage

- 2.2.1 Global Service: INTELSAT, PanAmSat, and Orion
- 2.2.2 Regional Coverage: EUTELSAT and SES
- 2.2.3 Domestic Systems: Telesat, Westar, and Palapa

## 2.3 Specialized Systems: DTH and Mobile

- 2.3.1 DTH Development
- 2.3.2 MSS Development
- 2.3.3 Digital Information Broadcasting

## 2.4 Expansion at Higher Frequency Bands: Ka-Band

- Chap 3, Satellite Network Architectures
  - 3.1 General Features of Satellite Networks
    - 3.1.1 Dedicated Bandwidth Services
    - 3.1.2 Circuit-Switched Services
    - 3.1.3 Packet-Switched Services
    - 3.1.4 Flexibility Features
    - 3.1.5 Reliability of Satellites and Links
    - 3.1.6 Quality Features and Issues
  - 3.2 Point-to-Multipoint (Broadcast) Networks
    - 3.2.1 Video Distribution
    - 3.2.2 Direct-to-Home Television
    - 3.2.3 Content Distribution Networks
    - 3.2.4 Mobile Satellite Communications
  - 3.3 Point-to-Point Networks
  - 3.4 VSAT Networks
- Chap 4, Microwave Link Engineering
  - 4.1 The Decibel
  - 4.2 Propagation on the Earth-Space Link
    - 4.2.1 Basic Microwave Propagation
    - 4.2.2 Isotropic Radiator
    - 4.2.3 Directional Properties of Antennas
    - 4.2.4 Polarization (Linear and Circular)
    - 4.2.5 Propagation Losses
  - 4.3 Microwave Transmitters and Receivers
    - 4.3.1 Transmitting Station
    - 4.3.2 Receiving Station
    - 4.3.3 Definition of a Transponder
  - 4.4 Overall Link Quality
    - 4.4.1 How Noise and Interference Affect a Microwave Link
    - 4.4.2 Carrier-to-Noise Ratio
    - 4.4.3 Link Budget Analysis
    - 4.4.4 Link Margin
- Chap 5, Modulation, Multiple Access, and Impairments
  - 5.1 Digital Baseband Signals and Hierarchies
    - 5.1.1 Digital Information Sources and Bandwidth Requirements
    - 5.1.2 Analog-to-Digital Conversion
    - 5.1.3 Compression
    - 5.1.4 Error Detection and Correction
    - 5.1.5 Scrambling and Encryption
  - 5.2 Digital Modulation
    - 5.2.1 Frequency Shift Keying
    - 5.2.2 Phase Shift Keying
    - 5.2.3 Amplitude and Phase Shift Keying
  - 5.3 Multiple Access Methods
    - 5.3.1 Frequency Division Multiple Access
    - 5.3.2 Time Division Multiple Access
    - 5.3.3 ALOHA Packet Multiple Access
    - 5.3.4 Code Division Multiple Access
    - 5.3.5 RF Bandwidth Utilization in Multiple Access
  - 5.4 Distortion and Impairments
    - 5.4.1 Digital Signal Impairments
    - 5.4.2 Transponder Intermodulation Impairment
    - 5.4.3 Uplink and Downlink RF Interference
- Chap 6, Earth Stations and Network Technology
  - 6.1 Basic Earth Station Configuration
  - 6.2 Performance Requirements
    - 6.2.1 Transmit EIRP
    - 6.2.2 Receive G/T
    - 6.2.3 Location and Platform Requirements
  - 6.3 Radio Frequency Equipment
    - 6.3.1 Antennas for Earth Stations
    - 6.3.2 Antenna Beam Pointing
    - 6.3.3 High-Power Amplifiers
    - 6.3.4 Upconverters and Downconverters
    - 6.3.5 RF Combining
    - 6.3.6 Uplink Power Control
  - 6.4 Intermediate Frequency and Baseband Equipment
    - 6.4.1 Modulators, Demodulators, and Modems
    - 6.4.2 Multiplexing and Packet Processing
  - 6.5 Tail Links and Terrestrial Interface
    - 6.5.1 Terrestrial Tail Options
    - 6.5.2 Terrestrial Network Interfaces
  - 6.6 Earth Station Facility Design
  - 6.7 Major Classes of Earth Stations
    - 6.7.1 TT&C Ground Facilities
    - 6.7.2 TV Uplinks and Broadcast Centers
    - 6.7.3 FDMA Digital Communications Service
    - 6.7.4 Full-Mesh TDMA Earth Station
    - 6.7.5 VSAT Star Network Terminal
    - 6.7.6 TV Receive-Only Design
    - 6.7.7 MSS User Terminals

## <Book-2>

### Part-3, Satellite Modem with Optional High Performance, Packet Processor and Installation and Operation Manual

#### Chap 1, INTRODUCTION

- 1.1 Overview
  - 1.1.1 Modem Features Overview
  - 1.1.2 Functional Description
- 1.2 Features
  - 1.2.1 Physical Description
  - 1.2.2 Dimensional Envelope
  - 1.2.3 Physical Features
  - 1.2.4 Standard Data Interfaces
  - 1.2.5 Verification
  - 1.2.6 AUPC
  - 1.2.7 EDMAC
  - 1.2.8 Updating Modem Firmware
  - 1.2.9 Fully Accessible System Topology (FAST)

- 1.2.10 Supporting Hardware and Software
- 1.3 Summary of Specifications
  - 1.3.1 Modulator
  - 1.3.2 Demodulator
  - 1.3.3 Standard AUPC (Automatic Uplink Power Control)
  - 1.3.4 DoubleTalk<sup>®</sup> Carrier-in-Carrier<sup>®</sup> (CnC)
  - 1.3.5 Data and Miscellaneous Interfaces
  - 1.3.6 Data Rate Ranges
  - 1.3.7 VersaFEC Adaptive Coding and Modulation (ACM)
  - 1.3.8 Power
  - 1.3.9 Physical Properties
  - 1.3.10 Miscellaneous
  - 1.3.11 Approvals



Chap 2, INSTALLATION AND STARTUP (Satellite Modem with Optional Packet Processor)	7.4.1 Operational Features
2.1 Unpack and Inspect the Shipment	7.4.2 CDM-570A HTTP Interface ; ' Menu Tree
2.2 Install the Modem into a Rack Enclosure	7.4.3 CDM-570A HTTP Interface Page
2.2.1 Install the Optional Rear Support Brackets Kit	Descriptions
2.3 Configure the Modem	Chap 8, SERIAL-BASED REMOTE PRODUCT MANAGEMENT
2.4 Verify Operation (IF Loopback Test)	8.1 Overview
2.5 Connect the External Cables	8.2 EIA-485
Chap 3, REAR PANEL CONNECTORS AND PINOUTS	8.3 EIA-232
3.1 Overview-Cabling Connection Types	8.4 Basic Protocol
3.1.1 Coaxial Cable Connections	8.4.1 Packet Structure
3.1.2 D-Subminiature Cable Connections	8.5 Remote Commands and Queries
3.1.3 RJ-XX Cable Connections	8.5.1 Table Indexes
3.2 Modem Cabling Connections	8.5.2 Transmit (Tx) Parameter Commands and Queries
3.2.1 IF Connections Group	8.5.3 Receive (Rx) Parameter Commands and Queries
3.2.2 Terrestrial Data Connections Group	8.5.4 Unit Parameter Commands and Queries
3.2.3 Utility Connections Group	8.5.5 Bulk Configuration Commands and Queries
3.3 Modem Ground, Power, and Fuse Connections	8.5.6 Modem Information Commands and Queries
3.3.1 Chassis Ground Interface	8.5.7 Modem Performance Information
3.3.2 Standard Alternating Current (AC) Power and Fusing Interfaces	8.5.8 BUC (L-Band Block Up Converter) Commands and Queries
3.3.3 Modem Optional -24V or -48V DC Power Interfaces	8.5.9 LNB (L-Band Low-noise Block Down Converter) Commands and Queries
Chap 4, UPDATING FIRMWARE	Chap 9, OPTIONAL PACKET PROCESSOR ; ' SERIAL/TELNET CLI OPERATION
4.1 Overview	9.1 Overview
4.1.1 About Firmware Files, Naming, Versions, and Archive Formats	9.1.1 Access to the CLI
4.2 Ethernet FTP Upload Procedure	9.2 Command Line Interface (CLI)
4.2.1 Getting Started: Prepare for the Firmware Download	9.2.1 CLI Menus ; ' Common Navigation and Operation Features
4.2.2 Download and Extract the Firmware Update	9.3 CLI Operations
4.2.3 Perform the Ethernet FTP Upload Procedure	9.3.1 CLI Main Menu
Chap 5, FAST ACTIVATION PROCEDURE	9.3.2 Administration
5.1 Overview	9.3.3 Interface Configuration
5.2 FAST Activation Procedure	9.3.4 QoS (Quality of Service) Configuration
5.2.1 FAST Activation via the Modem Front Panel	9.3.5 Route Table Configuration
5.2.2 FAST Activation via the CDM-570A HTTP Interface	9.3.6 Protocol Configuration
Chap 6, FRONT PANEL OPERATION	9.3.7 Vipersat Configuration
6.1 Overview	9.3.8 Satellite Modem
6.1.1 LED Indicators	9.3.9 Operations and Maintenance > Statistics Menu>
6.1.2 Keypad	IP Statistics>Diagnostics
6.1.3 Vacuum Fluorescent Display (VFD)	Chap 10, ODU (TRANSCEIVER, BUC, LNB) M&C OPERATIONS
6.2 Compatible Mode Operation (CDM-570A/570AL vs. CDM-570/570L)	10.1 Overview
6.3 Front Panel Operation	10.1.1 CDM-570A/570AL Front Panel Operation-Overview
6.3.1 SELECT: (Main) Menu	10.1.2 CDM-570A HTTP Interface-Overview
6.3.2 (SELECT:) Config (Configuration) Menus	10.1.3 CDM-570A/570AL Serial Remote Control-Overview
6.3.3 SELECT: Monitor	10.2 Transceiver M&C via the CDM-570A (70/140 MHz) Satellite Modem
6.3.4 SELECT: TEST	10.2.1 Transceiver M&C via the CDM-570A Front Panel
6.3.5 SELECT: Info	10.2.2 Transceiver M&C via the CDM-570A 's HTTP Interface
6.3.6 SELECT: Save/Load	10.2.3 Transceiver M&C via CDM-570A Serial Remote Control
6.3.7 SELECT: Util (Utility)	10.3 BUC and LNB M&C via the CDM/R-570AL (L-Band) Satellite Modem
6.3.8 SELECT: ODU	10.3.1 BUC and LNB M&C via the CDM/R-570AL Front Panel
Chap 7, ETHERNET-BASED REMOTE PRODUCT MANAGEMENT	10.3.2 BUC and LNB M&C via the CDM-570A HTTP Interface
7.1 Overview	
7.1.1 Ethernet Management Interface Protocols	
7.2 SNMP Interface	
7.2.1 Management Information Base (MIB) Files	
7.2.2 SNMP Community Strings	
7.2.3 SNMP Traps	
7.2.4 MIB-II	
7.2.5 Private MIB	
7.3 Telnet Operation via HyperTerminal	
7.4 CDM-570A HTTP (Web Server) Interface	

# model: **Satellite-8000**

## Satellite Trainer - Transmitter & Receiver with TVRO

### Overview

Satellite Trainer is a integrated system to simulate satellite telecommunication without a real satellite. This system utilizes worldwide popular top-level satellite modems so that operators(customers) can experience its feature-rich function and performance. The system is also designed to adopt Ku-band, the most common and reliable bandwidth, among available satellite frequency bandwidth and provide IP-based interface to accommodate various applications from customers. This system also provide TVRO system so that it can receive and monitor TV Broadcasting signal. And the supplied 1.2m antenna can be controlled by antenna controller remotely

### Feature

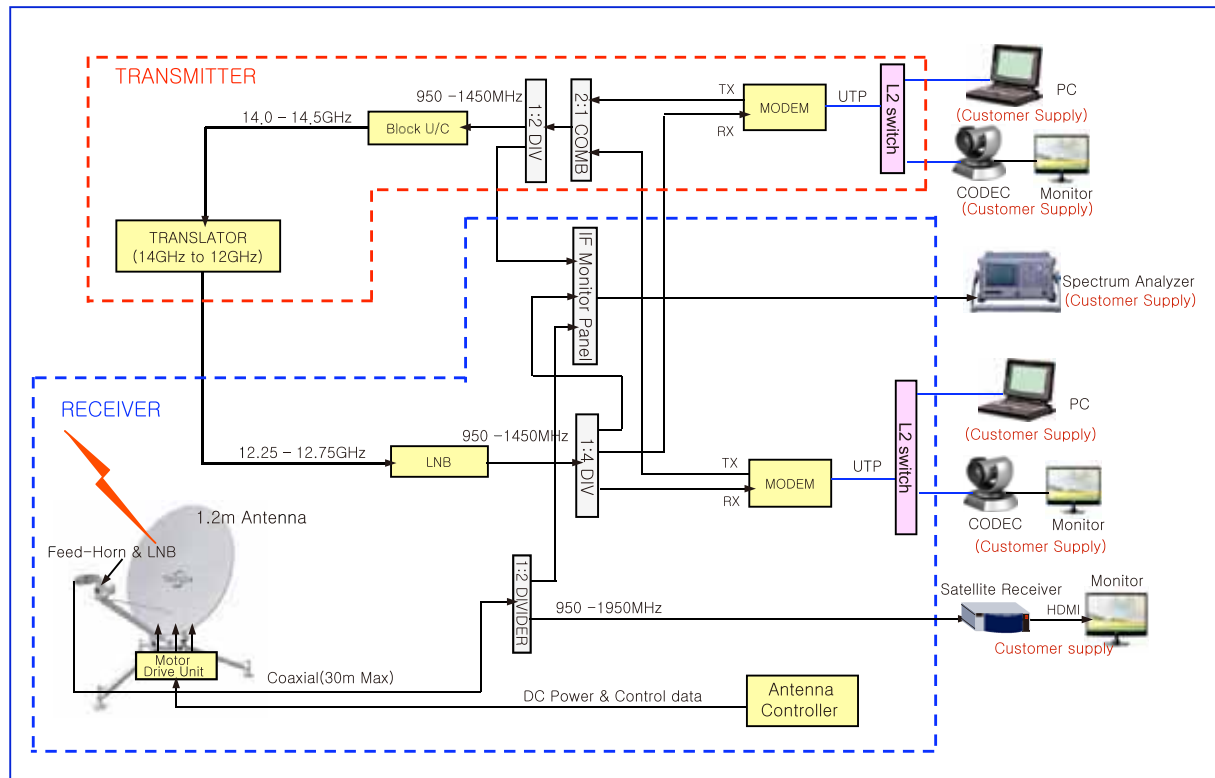
- 1) Simple design & appearance using standard 19" rack
- 2) Low power consumption
- 3) Easy installation and transportation
- 4) Selection among three different bands in receive frequency bandwidth
- 5) Monitoring of uplink & downlink IF carrier characteristic from front monitoring panel
- 6) IP-based various application testing (Video, Data, VoIP)
- 7) Satellite telecommunication standard L-band interface(950~1,450MHz)
- 8) Monitoring and configuring of various satellite parameters from modem's front panel including
  - Tx Level, Tx Frequency, Eb/No, Data rate, FEC, Modulation&Demodulation Type
- 9) Motorization antenna kit with antenna controller
  - Polarization(Vertical, Horizontal)
  - Azimuth(CW, CCW)
  - Elevation(Up, Down)
- 10) Various satellite pointing from Antenna controller's front panel

### Function

- 1) Satellite modem Tx parameter configuration (Data Rate, Modulation, FEC, IP etc.)
- 2) Satellite modem Rx frequency and level configuration
- 3) Transmitting and monitoring of L-band frequency
- 4) Frequency conversion and amplifying of L-band(950~1450 MHz) to Ku band(14.0~14.5 GHz)
- 5) RF frequency conversion (14.0~14.5 to 12.25~12.75 GHz)
- 6) RF signal level control in Ku-band (20 dB/min)
- 7) Satellite modem Rx parameter configuration (Data Rate, Modulation, FEC, etc.)
- 8) Receiving and monitoring of L-band frequency
- 9) C/N measurement from spectrum analyzer
- 10) Test data transmit and receive
- 11) Antenna Azimuth&Elevation adjustment with antenna controller
- 12) Antenna Polarization adjustment with antenna controller
- 13) Satellite receiver parameter configuration (Satellite, frequency, Symbol rate, FEC, etc.)

## System configuration

### 1) System Block Diagram



### 2) Outline

Transmitter



Receiver



1.2m Antenna



## Components

### 4.1 Transmitter

Equipment Rack	1 ea
L2 switch	1 ea
Satellite Modem with IP Interface	1 ea
BUC(Block Up-Converter)	1 ea
L-Bnad Combiner	1 ea
L-Band Divider	1 ea
Translator(TLT)	1 ea
RF cable Assy	1 ea
User's Manual	1 ea

#### 4.2 Receiver

Equipment Rack	1 ea
* L2 switch	1 ea
* Satellite Modem with IP Interface	1 ea
* LNB(Low Noise Block Down-Converter)	2 ea
* 1.2m Antenna(TVRO)	1 ea
* Antenna Controller	1 ea
* IF Monitoring Panel	1 ea
* L-Band Divider	2 ea
* Motor Control & IF cable Assy(30m max.)	1 ea
* RF cable Assy	1 ea
* User's Manual	1 ea

## Training contents

### Part 1, Introduce - Satellite Communication Overview

- 1) What is satellite communication ?
- 2) Satellite communication characteristics
- 3) Satellite TV Broadcasting characteristics
- 4) Satellite communication system configuration

### Part 2, Satellite Modem Configuration

- 1) Satellite modem feature & function
- 2) Satellite modem configuration method and procedure

### Part 3, Test Translator Configuration

- 1) Test translator feature & function
- 2) Test translator configuration method and procedure

### Part 4, Satellite Receiver Configuration

- 1) Satellite receiver feature & function
- 2) Satellite receiver configuration method and procedure

### Part 5, 1.2m Antenna installation and set-up

- 1) 1.2m antenna feature & function
- 2) Antenna installation procedure
- 3) Antenna pointing procedure with antenna controller

### Part 6, Satellite Signal Measurement

- 1) Tx frequency & level measure and adjust
- 2) Rx frequency & level measure and adjust
- 3) Rx Eb/No & C/N measure
- 4) Application connection test(PC data, Codec Video.. Etc)
- 5) BER test with Satellite Modem
- 6) Uplink & Downlink level adjust
- 7) Receive level and C/N adjustment with antenna
- 8) TV Broadcasting signal monitoring

## Specification

### 1) Transmitter

#### 1.1) IF Part

Frequency Range	950 to 2000MHz, 100Hz resolution
Data Interface	EIA-422/-530DCE, V.35 DCE, Sync EIA-232 10/100base-T Ethernet,
Data Rate Range	2.4 kbps to 2Mbps
Modulation&FEC Type	1/2BPSK, 1/2QPSK/OQPSK, 3/4QPSK/OQPSK 7/8QPSK/OQPSK, 2/3QPSK/OQPSK
M&C Interface	EIA-232, EIA-485(2- or 4-wire)
Input/Output Impedance	50 $\Omega$ , female Type N Connector
Modulator Output power	0 to -40dBm, 0.1dB steps
Power supply	100 to 240 VAC, 50/60Hz, 37W

## 1.2) RF Part

Output Frequency	14.0 to 14.5 GHz
* LO Frequency	13.05 GHz
* Input Frequency	950 to 1450 MHz
* Output Power(P1dB)	37.8dBm min, 6Watt
* Linear gain	60dB
* Max Input power	13dBm
* Input connector	N(50 ) or F(50 )
* Output connector	WR-75
* Power	+15 to +24VDC (over Coaxial cable)
* Power consumption	48W max.

## 1.3) Translator

Frequency Input range	14.0 to 14.5 GHz
Frequency Output range	12.25 to 12.75 GHz at LO 1 Frequency 1750 MHz 11.70 to 12.00 GHz at LO 2 Frequency 2300 MHz 10.95 to 11.45 GHz at LO 3 Frequency 3050 MHz
Maximum Input Power	10Watt, continuous
Insertion Loss	50dB min, 70dB max.
Level Control	20dB min. 1dB steps
LO Selection	3 Bands, Front Panel Selectable Band 1: 1750MHz, Band 2: 2300 MHz, Band 3: 3050MHz
Input/Output connector	SMA, Female
Output connector	WR-75
Power	90 to 250VAC, 47-63Hz

## 1.4) Rack

Size	600(W) x 500(H)x 600(D) mm
Prime Power socket	90 - 250VAC, 8 hole

## 2) Receiver

## 2.1) IF Part

Frequency Range	950 to 2000MHz, 100Hz resolution
Input power range	-30 to -60dBm
Data Interface	EIA-422/-530DCE, V.35 DCE, Sync EIA-232 10/100base-T Ethernet,
Data Rate Range	2.4 kbps to 2Mbps
Demodulation&FEC Type	1/2BPSK, 1/2QPSK/OQPSK, 3/4QPSK/OQPSK 7/8QPSK/OQPSK, 2/3QPSK/OQPSK
Monitor Fuction	Eb/No, Frequency offset, BER, Rx Signal level
M&C Interface	EIA-232, EIA-485(2- or 4-wire)
Input/Output Impedance	50 , female Type N Connector
Power supply	100 to 240 VAC, 50/60Hz, 37W

## 2.2) RF Part

Input Frequency	12.25 to 12.75GHz
LO Frequency	11.30 GHz
Output Frequency	950 to 1450 MHz
Output Power(P1dB)	8dBm
Conversion gain	60dB
Noise Figure	0.7 to 0.9dB
Input connector	WR-75
Output connector	F-Type(75 )
Power	+15 to +24VDC (over IF Coaxial cable)

### 2.3) Antenna including antenna controller

Antenna Diameter	1.2m
Antenna Type	Offset
Mount Type	Elevation Over Azimuth
Azimuth adjustment range	0 °to 360 °(Continuous)
Elevaation adjustment range	5 °to 90 °(Continuous)
Frequency Range	10.95 to 12.75 GHz
Gain, Mid-band	41.5dB
Polization	Linear pol(H-Pol, V-Pol)
Antenna Noise Temp.	46 °K at 20 °Elevation
-3dB Beam Width	1.51 °
VSWR	2.5
G/T	18.96dB / °K (0.8dB LNB)
Cross Polization Isolation	35dB
Side Lobe	ITU RS 580
Max Power	46 °K at 20 °Elevation
Feed Interface	WR-75
OperationalTemp	20 °C to +50 °C
Operational Wind	72 Km/H
Antenna Drive Type	Motorized - AZ, EL, POL

### 2.4) Monitoring Part

Frequency	950 to 2000MHz
Port Interface	BNC Type female , 2Port(TX & RX)
Panel size	1 U

### 2.5) Rack

Size	600(W) x 500(H)x 600(D) mm
Prime Power socket	90 - 250VAC, 8 hole

# 04

## a group of Radar Taining system

11. Radar-1000



# model: **Radar -1000**

## PC based Radar training system

### Overview

Radar -1000 can generate a modern Radar Signal and give user a variety of capabilities to test X-band receivers covering 8~12 GHz such as the receivers of RWR, MWR and other EW Receivers. It generates lots of Radar signals according to user's intention.

With compact and rugged design, user can make their own scenario to generate the Radar signals through their test procedures or test purpose.

Radar-1000 can generate CW or Pulsed signals up to 4 signals simultaneously and is very useful to test EW system and train EW operator.

### Features

- Radar Simulator function
- Radar Detector function
- Simulate Various Radar Signals
- Generate Multiple Radar Signals Simultaneously (Up to 4 radars)
- Programmable Emitter Parameters : Freq. PRI, PW, SCAN etc
- EW Operators Training
- ECM Technique Development

### System configuration



### System configuration

Hardware platform	1 set
Horn Antenna & Triangular Stand	1 set
RF Cable	1 ea
Ethernet cable	1 ea
BNC cable	1 ea
Program CD	1 ea
Manual book	1 book

## Experiments (Study objectives)

Chap 1, Overview of Radar technology  
 Chap 2, Introduction of Radar training system  
 Chap 3, Hardware configuration & function  
 Chap 4, Operating Procedures & Software install  
 Chap 5, Radar Fundamentals - I (Pulse Radar)  
 Chap 6, Radar Fundamentals - II (FMCW Radar)  
 Chap 7, Frequency Modulation Test (Fixed, Agile, Hopping)

Chap 8, Pulse Modulation Test - I (CW, Stable, Jitter)  
 Chap 9, Pulse Modulation Test -II (Dwell & Switch, Random)  
 Chap 10, Scan Modulation Test - I  
 (Conical, Steady, Sector, Lobe-Switching, Circular)  
 Chap 11, Scan Modulation Test - II  
 (Orthogonal, Helical, Spiral, Raster)  
 Chap 12, Multi Threat Signal Test

## Spec

### 1) Radar Simulator Function

- (1) Frequency Characteristics
  - RF output from 8.0GHz to 12.0GHz
  - Frequency type : Fixed, Agile, Hopping
  - Agile Pattern : Sine, Triangle, Rectangle, Saw
  - Hopping Frequency Number : 8
- (2) Pulse Characteristics
  - Pulse Range : 10us ~ 100ms
  - PW Range : 0.1~225us
  - Pulse type : CW, Stable, Jitter, Stagger, Dwell & Switch, Random
  - Stagger : 16 steps
  - Jitter Pattern : Sine, Triangle, Rectangle, Saw
  - Dwell & Switch : programmable up to 16 steps
- (3) Scan Characteristics
  - Scan type : Conical, Steady, Sector, Lobe-Switching, Circular, Orthogonal Helical, Spiral, Raster
  - Scan Rate : 50mS ~ 10Sec
  - Scan Depth : 0~ 30dB
- (4) Number of RF Signal
  - 8.0GHz ~ 12.0 GHz
  - 4 pulse Signals or 1 CW

### 2) Radar Detector Function

- (1) Pulse Radar Characteristics
  - PW : 5nsec, Fixed Signal
  - Detection Range : 10meters (Max.)
  - Display : Range
- (2) FMCW Radar Characteristics
  - Detection Range : 10meters (Max.)
  - Display : Range, Velocity

### 3) Other Features

- 110-240 VAC operation
- Accessories
  - \* (2)RF cable (3 meters, N(M) to N(M))
  - \* AC power cable
  - \* (2)BNC cable (1 meters)
  - \* Ethernet Cable (Option : -U)
  - \* (2)Horn Antenna
  - \* Triangular Stand
  - \* Laptop
  - \* Accessories ABS Case

### 4) Environmental

- Operating Temperature 10°C to +40°C
- Storage Temperature -10°C to +70°C
- Relative humidity 5% to 85% (non condensing)
- Mechanical shock rating 20G

### 5) Inputs/Outputs

- Ethernet Interface Port
- USB x 3 Interface Port
- Video Out
  - Scan Monitor : BNC(f)
  - Pulse Monitor : BNC(f)
- RF Output
  - N-type (f)
- RF Monitor Output
  - SMA(f)

# 05

## **a group of Microwave communication Training system**

12. RFKIT-3000

# model: RFKIT-3000

## Microwave communication trainer

### Feature

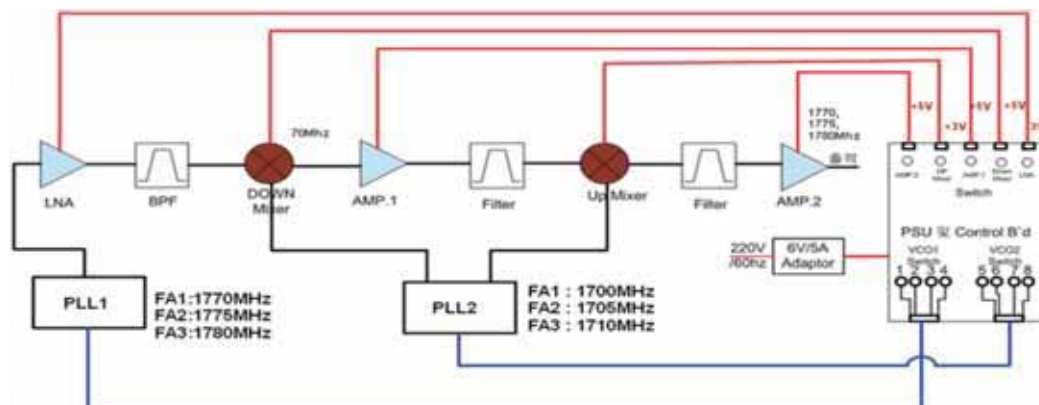
- 1) Learn basic experiment for signal analyzer.
- 2) Independent basic RF modules enabling to design and test RF circuit for various educational purposes (Amplifier, Mixer, Filters and etc,,)
- 3) Through actual experiment, understand the characteristics of RF modules and system.
- 4) Learn basic theory on RF components and PCB design.
- 5) Learn Super-heterodyne receiver system.
- 6) Learn Super-heterodyne transmitter system.
- 7) Design Super-Heterodyne module system
- 8) Learn basic theory on RF components and PCB design.

### System cinfigation

(System configuration)



(Block Diagram)



## Components

Items	specification	q'ty
Three Filter Modules	BPF1	1EA
	BPF2	1EA
	LC Filter	1EA
Three AMP Modules	LNA	1EA
	IF AMP	1EA
	RF AMP	1EA
Two Mixer Modules	Up Mixer	1EA
	Down Mixer	1EA
Two VCO Modules	PLL1	1EA
	PLL2	1EA
Power Supply Modules	PSU2	1EA
RF Cable	SMA to SMA, RF 316, 0.5M	2EA
	SMA to SMA, RF 316, 1M	3EA
Cable Harness	PSU-RF Module, 2-pin, 400mm	4EA
	PSU-PLL Module, 6-pin, 400mm	2EA
RF Accessory	Adaptor, N(M)-SMA(F)	2EA
	Adaptor, SMA(M)-SMA(M)	8EA
	Attenuator, 10dB	2EA
	Termination, SMA(M), 50ohm, 1W	2EA
Wrench	Torque wrench, 5/16"	1EA
AC/DC Adaptor	6V/2A	1EA
Manual book		1 book

## Training contents

### part 1. Basic experiment for signal analyzer

- Chapter 1 . Basic for signal analyzer
  - 1.1 Definition of the signal
  - 1.2 Structure of signal analyzer
  - 1.3 Front and back side structure for signal analyzer
- Chapter 2 . Basic experiment for signal analyzer
  - 2.1 Comparison of the Signal
  - 2.2 Signal distribution of the same amplitude
  - 2.3 Decomposition of small signal obscured by large signal
  - 2.4 Improving frequency measurement
  - 2.5 Reducing the span from signal around
  - 2.6 Tracing of drifting signal
  - 2.7 Measurement of small signal
  - 2.8 Gain measurement
  - 2.9 Noise measurement
  - 2.10 1 dB gain compression point
  - 2.11 Third intermodulation distortion
  - 2.12 Tracking Generator
  - 2.13 AM signal modulation
  - 2.14 FM signal modulation

### part 2. RFKIT-3000 experiments using signal analyzer

- Chap 3, Description on RF Terms
- Chap 4, RF Transmitter / Receiver Configuration
  - 4.1 Tuned RF Receiver Configuration
  - 4.2 Configuring the Superheterodyne Receiver
- Chap 5, Components & System configuration of RFKIT-3000
  - 5.1 RFKIT-3000 components
  - 5.2 CID (Cable Interconnection Diagram)
  - 5.3 CID List
  - 5.4 the assembled modules
  - 5.5 Photo of carrying bag
- Chap 6, psu module
  - 6.1 psu connection diagram
  - 6.2 Explanation on Power operation
  - 6.3 Explanation on Freq. Sel (PLL) button operation

## Chap 7, Experiment as per modules

- 7.1 LNA (Low Noise Amplifier) module experiment
- 7.2 Filter1 (Band Pass Filter) module experiment
- 7.3 Mixer1 (Down-conversion) module experiment
- 7.4 IF AMP ( Intermediate Frequency Amplifier) module experiment
- 7.5 Filter1 (LC Filter) module experiment
- 7.6 Up Mixer (Up-conversion) module experiment
- 7.7 Filter2 (Band Pass Filter) module experiment
- 7.8 RF AMP(Amplifier) module experiment
- 7.9 PLL1 (Phase Lock Loop) module experiment
- 7.10 PLL2(Phase Lock Loop) module experiment
- 7.11 psu(Power Supply Unit) module experiment

**part 3. About super-heterodyne trainer**

Chap 8. Configuration of Super-heterodyne transceiver

Chap 9. Component of Super-heterodyne trainer

Chap 10. Characteristics of Super-heterodyne trainer

Chap 11, Superheterodyne experiments

- 11.1 Configuration and Test Point
- 11.2 The assembled modules
- 11.3(1) TP1(Test Point1) : M10
- 11.3(2) TP1(Test Point1) : M10 (Practice example)
- 11.4(1) TP2(Test Point2) : M10+M1
- 11.4(2) TP2(Test Point2) : M10+M1 (Practice example)
- 11.5(1) TP3(Test Point3) : M10+M1+M2
- 11.5(2) TP3(Test Point3) : M10+M1+M2 (Practice example)
- 11.6(1) TP4(Test Point4) : M10+M1+M2+M3
- 11.6(2) TP4(Test Point4) : M10+M1+M2+M3 (Practice example)
- 11.7(1) TP5(Test Point5) : M10+M1+M2+M3+M4
- 11.7(2) TP5(Test Point5) : M10+M1+M2+M3+M4 (Practice example)
- 11.8(1) TP6(Test Point6) : M10+M1+M2+M3+M4+M5
- 11.8(2) TP6(Test Point6) : M10+M1+M2+M3+M4+M5 (Practice example)
- 11.9(1) TP7(Test Point7) : M10+M1+M2+M3+M4+M5+M6
- 11.9(2) TP7(Test Point7) : M10+M1+M2+M3+M4+M5+M6 (Practice example)
- 11.10(1) TP8(Test Point8) : M10+M1+M2+M3+M4+M5+M6+M7
- 11.10(2) TP8(Test Point8) : M10+M1+M2+M3+M4+M5+M6+M7 (Practice example)
- 11.11(1) TP9(Test Point9) : M10+M1+M2+M3+M4+M5+M6+M7+M8
- 11.11(2) TP9(Test Point9) : M10+M1+M2+M3+M4+M5+M6+M7+M8 (Practice example)

## Specifications

**1) Moduel & Q'ty**

Items	specification	q'ty
Three Filter Modules	BPF1	1EA
	BPF2	1EA
	LC Filter	1EA
Three AMP Modules	LNA	1EA
	IF AMP	1EA
	RF AMP	1EA
Two Mixer Modules	Up Mixer	1EA
	Down Mixer	1EA
Two VCO Modules	PLL1	1EA
	PLL2	1EA
Power Supply Modules	PSU	1EA

**2) Module Spec & accessories**

PLL1 Module	Frequency : 1770~1780MHz (step : 5MHz)	
LNA Module	Frequency : 100~6000MHz, Gain : 15.3 dB(1770MHz)	
BPF1/BPF2 Module	Frequency : 1770~1780MHz, Insertion Loss : -2dB	
Down Mixer Module	Frequency : 1700~2400MHz, Conversion Loss : -8dB	
PLL2 Module	Frequency 1700~1710MHz (step : 5MHz), Output : - 1.5dBm (2 Port)	
IF AMP Module	Frequency : 5~4000MHz, Gain : 17.5dB (70MHz)	
LC Filter Module	Frequency : 70MHz (BW=10MHz), Insertion Loss : -3dB (70MHz)	
Up Mixer Module	Frequency : 1200~2500MHz, Conversion Loss : -9dB	
RF AMP	Frequency : 5~4000MHz, Gain : 16.2dB (1775MHz)	
Power Supply Module (PSU)	Power Supply (+5v)	
RF Cable	SMA to SMA, RF 316, 0.5M	2EA
	SMA to SMA, RF 316, 1M	3EA
Cable Harness	PSU-RF Module, 2-pin, 400mm	4EA
	PSU-PLL Module, 6-pin, 400mm	2EA
RF Accessory	Adaptor, N(M)-SMA(F)	2EA
	Adaptor, SMA(M)-SMA(M)	8EA
	Attenuator, 10dB	2EA
	Termination, SMA(M), 50ohm, 1W	2EA
AC/DC Adaptor	6V/2A	1EA



# 06

## a group of ANTENNA training system

13. Antenna-3000

# model: **Antenna-3000**

## Antenna Trainer

### Feature

This equipment is suitable for practicing features of antennas, radio characteristics of RF signals and standing wave characteristics.

This Antenna trainer is a device to make a Mobile radio signal which changes according to the radio propagation environment of a mobile and wireless system, and to practice impedance matching by using a Smith Chart, as well as an Antenna radiation pattern, Polarization character, Diversity reception characteristics.

As a results, this Antenna trainer is so structured as to conduct education on measurement of radiation characteristics and strength of electric field with frequency of various antennas, characteristics of standing wave with frequency, media and distance and the SMITH CHART Tool that facilitates calculation of transmission lines for RF engineers.

### Functions

- 1) Measurement of radio characteristics and strength of electric field
- 2) Practice of radiation patterns of antenna
- 3) Test on characteristics of 12 kinds of antennas including dipole and monopole antennas
- 4) Test on diversity characteristics
- 5) Analysis of standing wave characteristics
- 6) Understanding of Smith Chart and test on inductance and impedance coupling

### Components

Main Hardware system	1ea
Antenna Mast (Mobile)	1ea
Antenna Mast (Fixed)	1ea
800MHz dipole antenna	2ea
1.8GHz monopole antenna	2ea
1.8GHz microstrip antenna	2ea
1.8GHz dipole antenna	2ea
2.1GHz rectangular patch antenna	2ea
2.1GHz circular patch antenna	2ea
Slot antenna	2ea
Rectangular CPW Patch Antenna	2ea
Yagi-Uda antenna	2ea
Coupled Type Omni Antenna	2ea
Directional type Omni antenna	2ea
Dipole type Patch antenna	2ea
Software Program CD	1ea
manual	1ea
USB cable	1ea
RF Cable (SMAP-SMAP)	2ea
Ant Mast Cable	1ea
AC Power cord	1ea

## System configuration



## Training contents

### Part 1. Introduction of Antenna-3000 and Software Installation

- Chap 1, Introduction of Antenna-3000
- Chap 2, Software installation

### Part 2. Experiments to analyze the properties of various antennas and radio signals

- Chap 3, Radio properties and electric field intensity
- Chap 4, Antenna properties and parameters
- Chap 5, Characteristics of dipole antenna and monopole antenna
- Chap 6, Characteristics of patch antenna
- Chap 7, Characteristics of slot antenna
- Chap 8, Characteristics of rectangular CPW patch antenna
- Chap 9, Characteristics of Yagi-Uda antenna
- Chap 10, Space diversity experiment
- Chap 11, Analysis of characteristics of standing wave

### Part 3. SMITH CHART

- Chap 12, Analysis of transmission lines
- Chap 13, Short-circuit line and open line
- Chap 14, Understanding of Smith Chart
- Chap 15, Smith Chart
- Chap 16, Smith Chart impedance match with reactance
- Chap 17, Smith Chart impedance match with stub

### Part 4. Antenna measuring experiments using Network analyzer, and comparing with SMITH CHART Simulator.

- Chap 18, Introduction and how to use network analyzer
- Chap 19, Dipole antenna measurement experiment
- Chap 20, Monopole antenna measurement experiment
- Chap 21, Patch antenna measurement experiment
- Chap 22, Slot antenna measurement experiment
- Chap 23, Yagi-Uda antenna measurement experiment

## Specifications

RF Frequency	800MHz bandwidth : 868 MHz 1.8GHz bandwidth : 1840, 1845, 1850, 1855, 1860, 1865, 1870 MHz 2.1 GHz bandwidth : 2110, 2115, 2120, 2125, 2130, 2135, 2140 2145, 2150, 2155, 2160, 2165 MHz
IF Frequency	100 MHz
Frequency Oscillation	PLL
Output power	5 dBm max
Connector	SMA type
Impedance	50
LCD Display	4 x 40 Character / built-in LED Back Light
Standard location Setting	Automatic Zero-point adjustment function
Local Oscillator (LO) Frequency	Each RF Frequency + 100 MHz
Communication port	USB 2 Ports
Front Panel	System On, System OFF, System Reset Switch 2 Channels RF Input Port - Input A, Input B 800MHz, 1.8GHz, 2.1GHz Output Port Display LED : USB1, USB2, ANT MAST
Rear Panel	USB Connection port (2PORT) System Cooling Fan Antenna Mast Connection Port Power Connector
Antenna Mast (Mobile)	Antenna Angle Control Range : 0~360 degree Antenna Angle Resolution : 1.8 degree per step Input Voltage : 5V, 18V
Antenna types	800MHz dipole antenna 1.8GHz monopole antenna 1.8GHz microstrip antenna 1.8GHz dipole antenna 2.1GHz rectangular patch antenna 2.1GHz circular patch antenna Slot antenna Rectangular CPW Patch Antenna Yagi-Uda antenna Coupled Type Omni Antenna Directional type Omni antenna Dipole type Patch antenna
Textbook contents	Introduction of Antenna-3000 Software installation Radio properties and electric field intensity Antenna properties and parameters Characteristics of dipole antenna and monopole antenna Characteristics of patch antenna Characteristics of slot antenna Characteristics of rectangular CPW patch antenna Characteristics of Yagi-Uda antenna Space diversity experiment Analysis of characteristics of standing wave Analysis of transmission lines Short-circuit line and open line Understanding of Smith Chart Smith Chart Smith Chart impedance match with reactance Smith Chart impedance match with stub Introduction and how to use network analyzer Dipole antenna measurement experiment Monopole antenna measurement experiment Patch antenna measurement experiment Slot antenna measurement experiment Yagi-Uda antenna measurement experiment

# 07

## a group of Analog & Digital Communication system

14. Digital-5000

15. Analog & Digital-5000

# model: **Digital-5000**

## **Digital Communication Trainer**

### **Feature**

- It is possible to practice ASK, FSK, PCM, TDM, PSTN, BPSK, QPSK, optical communication and wired / wireless communication experiments without any equipment
- High precision digital signal generators and measurement circuits are equipped.
- It consists of 8 independent experimental modules, so user can practice easily and conveniently.
- Each module can be operated independently or inter-module.
- Each lab module can be used for experimenting with other equipment..
- Two electronic circuit modules can be mounted / tested simultaneously on the main body of the equipment allowing interlocking experiments between different circuits.
- It provides various experiment exercises related to wired and wireless communication.
- It is possible to transmit and receive digital data by connecting with a PC.
- PC-based 2-channel analog oscilloscope S / W is basically provided.

### **System cinfuration**



### **Components**

Hardware platform	1 set
AC Power Cable	1 ea
Earset	1 ea
Handset (for Phone)	2 ea
USB cable	1 ea
Jumper calbe	1 ea
Oscilloscope Probes	2 sets
S/W Program CD	1 ea
Manual book	1 book

## Training contents

- Chapter 1. ASK wired Modulation / Memodulation and data communication experiment  
ASK Radio(wireless) Modulation / Demodulation and Data Communication Experiment
- Chapter 2. FSK wired Modulation / Memodulation and data communication experiment  
FSK Radio(wireless) Modulation / Demodulation and Data Communication Experiment
- Chapter 3. Experiment of digital data conversion using PCM encoding  
Digital data restoration experiment using PCM decoding
- Chapter 4. Experiment of Digital Data Transmission using TDM  
Experiment of Digital Data Reception using TDM
- Chapter 5. Experiment of digital data transmission using optical communication  
Experiment of digital data reception using optical communication
- Chapter 6. PSTN Network Configuration Experiment
- Chapter 7. Experiment of Digital Data Transmission using BPSK  
Experiment of Digital Data Reception using BPSK
- Chapter 8. Experiment of Digital Data Transmission using QPSK  
Experiment of Digital Data Reception using QPSK

## Specification

### 1) Hardware spec for Baseboard

- Digital output device : 8bit (8 port) Digital output port
- Digital input device : 8bit (8 port) Digital input port
- PC connection : USB connection
- Oscilloscope: 2 channels (250KHz)
- Digital voltmeter: +/- 20V measurable, 6 digits
- Frequency counter: 10MHz, 6 digit, analog / digital input available
- Fixed power output : +5V/0.5A, -5V/0.5A, +15V/0.5A, -15V/0.5A
- Variable power output : +0V ~ +10V / 0.5A, -0V ~ -10V / 0.5A, 4 digit digital voltmeter
- Variable signal voltage output: -5V to + 5V / 10mA, 4 digit digital voltmeter
- Speaker 1: 0.5W speaker, 20Hz ~ 20000Hz, Adjustable input volume
- Speaker 2: 0.5W speaker, 20Hz ~ 20000Hz, Adjustable input volume
- Frequency to Voltage Converter : Max. 100KHz
- Voltage to Frequency Converter : Max. 100KHz
- Low Pass Filter : Max. 15KHz
- Band Pass Filter : Max. 40KHz
- Analog signal generator 1 : 1Hz ~ 1MHz, 3Vp-p
- Analog signal generator 2 : 1Hz ~ 1MHz, 3Vp-p
- Analog low-frequency amplifier : Max. 1MHz, 3Vp-p
- Analog high-frequency amplifier : Max. 100MHz, 2Vp-p
- Analog signal adder : 1ea
- Analog signal subtractor : 1ea
- Digital program signal generator 1 : 8 BIT with Start Switch
- Digital program signal generator 2 : 8 BIT with Start Switch
- Digital Switch 1 : High -> Low
- Digital Switch 2 : Low -> High
- TTL fixed frequency output Port : 1Hz, 0.5Hz
- Digital frequency output Port : 2.048MHz, 256KHz, 128KHz, 64KHz, 32KHz, 16KHz, 8KHz, 4KHz, 2KHz, 1KHz, 500Hz
- Extend Port : 1ea
- 8Bit RISC CPU for control
- Up to 2A Input Power Overcurrent Protection
- 2A Active Current limit and output On/Off
- Low voltage drop input current high side measurement using INA139
- Input overcurrent control within 100ms by control RISC CPU
- Maximum 4.7V input current measurement stage protection
- Automatic recovery within 3 seconds when removing the cause of overcurrent or short circuit
- Control RISC Output power by CPU 500ms Sequential output On
- In-rush current control for over 2A and over-heat protection over 50°C
- Separate Output Power Over-Current Protection and Short-Circuit Protection
- + 5V / 1A, -5V / 500mA, + 15V / 300mA, -15V / 300mA Output Current Limit

### 2) Application Module

- Voice signal amplification circuit
- ASK communication practice
  - ASK Low Frequency Modulation Circuit

- ASK low frequency demodulation circuit
- ASK high-frequency wireless modulation transmission circuit (built-in antenna)
- ASK high frequency radio modulation receiving circuit (with built-in antenna)
- Using the ISM BAND frequency band
- FSK communication practice
  - FSK low frequency modulation and demodulation circuit
  - FSK High Frequency Radio Modulation Transmitting / Receiving Circuit (Built-in Antenna)
  - Using the ISM BAND frequency band
- PCM communication practice
  - PCM Codec encoding circuit (with built-in microphone)
  - PCM Codec Decoding circuit
  - Voice signal amplifier circuit 1 for transmission
  - Voice signal amplifier circuit 2 for transmission
  - Digital clock input
- TDM communication practice
  - TDM Transmitter (2 channel)
  - TDM Receiver (2 channel)
  - Voice signal amplifier circuit 1 for transmission
  - Voice signal amplifier circuit 2 for transmission
  - Digital clock input
  - TDM transmit and receive circuit (using codec)
  - TDM Time slot change, display and Loop Back
  - Microphone built-in voice call experiment circuit
- BPSK, QPSK communication practice
  - Serial Data rate select: 100Hz, 50Hz, 10bit independent setting, applied by start button
  - Carrier frequency selection: 100Hz, 200Hz, sine, cosine waveform (internal 180 degree delay waveform)
  - I, Q Data independent BPSK modulation and De-modulation(sine, cosine)
  - QPSK waveform generation and QPSK data demodulation by I-BPSK and Q-BPSK synthesis
  - BPSK Modulated Waveform and QPSK Modulated Waveform
  - Comparing BPSK demodulation step-by-step waveform and the demodulated data and source data
  - Generate QPSK waveform by synthesizing BPSK waveform
  - Change the data rate and carrier frequency to check each side / demodulated waveform
  - Experiment by changing the data in units of 10 bits (measurement of waveform change)
- Optical communication experiment
  - Optic Transmitter (2 channel)
  - Optic Receiver (2 channel)
  - PCM Codec for Encoding/Decoding
  - Transmission voice signal amplifier circuit
  - Digital clock input
  - SC optic connector
  - MM optical module configuration circuit
  - TTL I / O and analog I / O
- Wired / wireless communication experiment
  - Ringing SLIC Module (2 channel)
  - DTMF analysis circuit (2 channels)
  - DTMF number display device
  - RJ-11 connector (2 channels)
  - Experiment with 1: 1 call (DTMF type phone)
  - TDM module and interlocking circuit

### 3) Software spec

- Simulator : 1 Copy (required), built-in type without separate module
  - Supports 8 channel data input function
  - Supports 8 channel data output function
  - Data Acquisition function using USB
  - One measurement and continuous measurement function
  - Supports save, print and clipboard function of measured data
  - Supports the measured data Group / UnGroup function
  - Set arbitrary data (0 or 1) in the input channel
  - Channel Name Change Function
- Oscilloscope : 1 Copy (required), built-in type without separate module
  - Channel : 2ch
  - Display Minimum, Maximum, and Mean voltage values for each channel
  - Timebase : display time value per field on two channels
  - 0V voltage display per channel
  - Trigger method: Always, Rising, Falling, Level
  - Trigger level voltage display function
  - Oscilloscope connection status display function
  - Seven-level voltage step adjustment from 100mV to 10V per channel
  - 14-step time value display function per timebase one block



# model: **Analog & Digital-5000**

## **Analog & Digital Communication trainer**

### **Feature**

- It is possible to practice AM, FM, ASK, FSK, PCM, TDM, PSTN, BPSK, QPSK, optical communication and wired / wireless communication experiments without any equipment
- High precision digital signal generators and measurement circuits are equipped.
- It consists of 10 independent experimental modules, so user can practice easily and conveniently.
- Each module can be operated independently or inter-module.
- Each lab module can be used for experimenting with other equipment..
- Two electronic circuit modules can be mounted / tested simultaneously on the main body of the equipment allowing interlocking experiments between different circuits.
- It provides various experiment exercises related to wired and wireless communication.
- It is possible to transmit and receive digital data by connecting with a PC.
- PC-based 2-channel analog oscilloscope S / W is basically provided.
- PC-based 2-channel analog oscilloscope S / W is basically provided.
- PC-based Digital Logic Emulator S/W is provided.

### **System cinfigation**

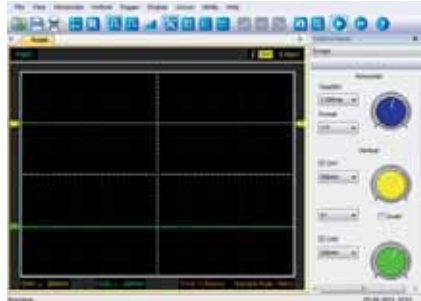
1) photo for hardware platform



## 2) Software program

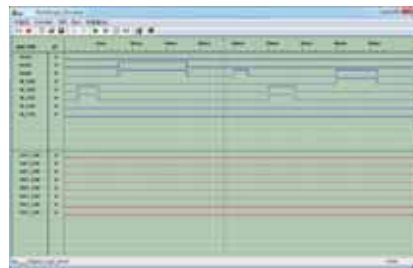
### (1) Oscilloscope Simulator program (PC based)

: Signal Input Voltage and Frequency Measurement Oscilloscope Screen  
Carrier Input Voltage and Frequency Measurement Oscilloscope Screen,,, etc



### (2) Digital Logic Emulator (PC based)

: Digital Logic Emulator is a program designed to transfer the data of set logic circuits to COMPUTER or to check the logic circuit value executed on the board from the COMPUTER.



## Components

Hardware platform	1 set
AC Power Cable	1 ea
Earset	1 ea
Handset (for Phone)	2 ea
USB cable	1 ea
Jumper cable	1 ea
Oscilloscope Probes	2 sets
S/W Program CD	1 ea
(1) PC-based 2-channel analog oscilloscope S / W is basically provided.	
(2) PC-based Digital Logic Emulator S/W is provided.	
Manual book	1 book

## Training contents

- Chapter 1. Wired and Wireless AM Modulation and Demodulation Signal Transmission Experiment
- Chapter 2. FM Wired and Wireless Modulation and Demodulation and Signal Transmission Experiment
- Chapter 3. ASK wired Modulation / Memodulation and data communication experiment
  - ASK Radio(wireless) Modulation / Demodulation and Data Communication Experiment
- Chapter 4. FSK wired Modulation / Memodulation and data communication experiment
  - FSK Radio(wireless) Modulation / Demodulation and Data Communication Experiment
- Chapter 5. Experiment of digital data conversion using PCM encoding
  - Digital data restoration experiment using PCM decoding
- Chapter 6. Experiment of Digital Data Transmission using TDM
  - Experiment of Digital Data Reception using TDM
- Chapter 7. Experiment of digital data transmission using optical communication
  - Experiment of digital data reception using optical communication
- Chapter 8. PSTN Network Configuration Experiment
- Chapter 9. Experiment of Digital Data Transmission using BPSK
  - Experiment of Digital Data Reception using BPSK
- Chapter 10. Experiment of Digital Data Transmission using QPSK
  - Experiment of Digital Data Reception using QPSK

## Specification

### 1) Hardware spec for Baseboard

- Digital output device : 8bit (8 port) Digital output port
- Digital input device : 8bit (8 port) Digital input port
- PC connection : USB connection
- Oscilloscope: 2 channels (250KHz)
- Digital voltmeter: +/- 20V measurable, 6 digits
- Frequency counter: 10MHz, 6 digit, analog / digital input available
- Fixed power output : +5V/0.5A, -5V/0.5A, +15V/0.5A, -15V/0.5A
- Variable power output : +0V ~ +10V / 0.5A, -0V ~ -10V / 0.5A, 4 digit digital voltmeter
- Variable signal voltage output: -5V to + 5V / 10mA, 4 digit digital voltmeter
- Speaker 1: 0.5W speaker, 20Hz ~ 20000Hz, Adjustable input volume
- Speaker 2: 0.5W speaker, 20Hz ~ 20000Hz, Adjustable input volume
- Frequency to Voltage Converter : Max. 100KHz
- Voltage to Frequency Converter : Max. 100KHz
- Low Pass Filter : Max. 15KHz
- Band Pass Filter : Max. 40KHz
- Analog signal generator 1 : 1Hz ~ 1MHz, 3Vp-p
- Analog signal generator 2 : 1Hz ~ 1MHz, 3Vp-p
- Analog low-frequency amplifier : Max. 1MHz, 3Vp-p
- Analog high-frequency amplifier : Max. 100MHz, 2Vp-p
- Analog signal adder : 1ea
- Analog signal subtractor : 1ea
- Digital program signal generator 1 : 8 BIT with Start Switch
- Digital program signal generator 2 : 8 BIT with Start Switch
- Digital Switch 1 : High -> Low
- Digital Switch 2 : Low -> High
- TTL fixed frequency output Port : 1Hz, 0.5Hz
- Digital frequency output Port : 2.048MHz, 256KHz, 128KHz, 64KHz, 32KHz, 16KHz, 8KHz, 4KHz, 2KHz, 1KHz, 500Hz
- Extend Port : 1ea
- 8Bit RISC CPU for control
- Up to 2A Input Power Overcurrent Protection
- 2A Active Current limit and output On/Off
- Low voltage drop input current high side measurement using INA139
- Input overcurrent control within 100ms by control RISC CPU
- Maximum 4.7V input current measurement stage protection
- Automatic recovery within 3 seconds when removing the cause of overcurrent or short circuit
- Control RISC Output power by CPU 500ms Sequential output On
- In-rush current control for over 2A and over-heat protection over 50°C
- Separate Output Power Over-Current Protection and Short-Circuit Protection
- + 5V / 1A, -5V / 500mA, + 15V / 300mA, -15V / 300mA Output Current Limit

### 2) Application Module

- Voice signal amplification circuit
- AM communication practice
  - : Wired and Wireless AM Modulation & Demodulation and Signal Transmission circuit
- FM communication practice
  - : FM Wired and Wireless Modulation & Demodulation, and Signal Transmission circuit
- ASK communication practice
  - ASK Low Frequency Modulation Circuit
  - ASK low frequency demodulation circuit
  - ASK high-frequency wireless modulation transmission circuit (built-in antenna)
  - ASK high frequency radio modulation receiving circuit (with built-in antenna)
  - Using the ISM BAND frequency band
- FSK communication practice
  - FSK low frequency modulation and demodulation circuit
  - FSK High Frequency Radio Modulation Transmitting / Receiving Circuit (Built-in Antenna)
  - Using the ISM BAND frequency band
- PCM communication practice
  - PCM Codec encoding circuit (with built-in microphone)
  - PCM Codec Decoding circuit
  - Voice signal amplifier circuit 1 for transmission
  - Voice signal amplifier circuit 2 for transmission
  - Digital clock input

- TDM communication practice
  - TDM Transmitter (2 channel)
  - TDM Receiver (2 channel)
  - Voice signal amplifier circuit 1 for transmission
  - Voice signal amplifier circuit 2 for transmission
  - Digital clock input
  - TDM transmit and receive circuit (using codec)
  - TDM Time slot change, display and Loop Back
  - Microphone built-in voice call experiment circuit
- BPSK, QPSK communication practice
  - Serial Data rate select: 100Hz, 50Hz, 10bit independent setting, applied by start button
  - Carrier frequency selection: 100Hz, 200Hz, sine, cosine waveform (internal 180 degree delay waveform)
  - I, Q Data independent BPSK modulation and De-modulation(sine, cosine)
  - QPSK waveform generation and QPSK data demodulation by I-BPSK and Q-BPSK synthesis
  - BPSK Modulated Waveform and QPSK Modulated Waveform
  - Comparing BPSK demodulation step-by-step waveform and the demodulated data and source data
  - Generate QPSK waveform by synthesizing BPSK waveform
  - Change the data rate and carrier frequency to check each side / demodulated waveform
  - Experiment by changing the data in units of 10 bits (measurement of waveform change)
- Optical communication experiment
  - Optic Transmitter (2 channel)
  - Optic Receiver (2 channel)
  - PCM Codec for Encoding/Decoding
  - Transmission voice signal amplifier circuit
  - Digital clock input
  - SC optic connector
  - MM optical module configuration circuit
  - TTL I / O and analog I / O
- Wired / wireless communication experiment
  - Ringing SLIC Module (2 channel)
  - DTMF analysis circuit (2 channels)
  - DTMF number display device
  - RJ-11 connector (2 channels)
  - Experiment with 1: 1 call (DTMF type phone)
  - TDM module and interlocking circuit

### 3) Software spec

- Simulator : 1 Copy (required), built-in type without separate module
  - Supports 8 channel data input function
  - Supports 8 channel data output function
  - Data Acquisition function using USB
  - One measurement and continuous measurement function
  - Supports save, print and clipboard function of measured data
  - Supports the measured data Group / UnGroup function
  - Set arbitrary data (0 or 1) in the input channel
  - Channel Name Change Function
- Oscilloscope : 1 Copy (required), built-in type without separate module
  - Channel : 2ch
  - Display Minimum, Maximum, and Mean voltage values for each channel
  - Timebase : display time value per field on two channels
  - 0V voltage display per channel
  - Trigger method: Always, Rising, Falling, Level
  - Trigger level voltage display function
  - Oscilloscope connection status display function
  - Seven-level voltage step adjustment from 100mV to 10V per channel
  - 14-step time value display function per timebase one block

# 08

## a group of Wi-Fi training system

- 16. WiFi-GT7000
- 17. TETRA-5000

# model: **WiFi-GT7000**

## WiFi network construction & optimization training system

### Features

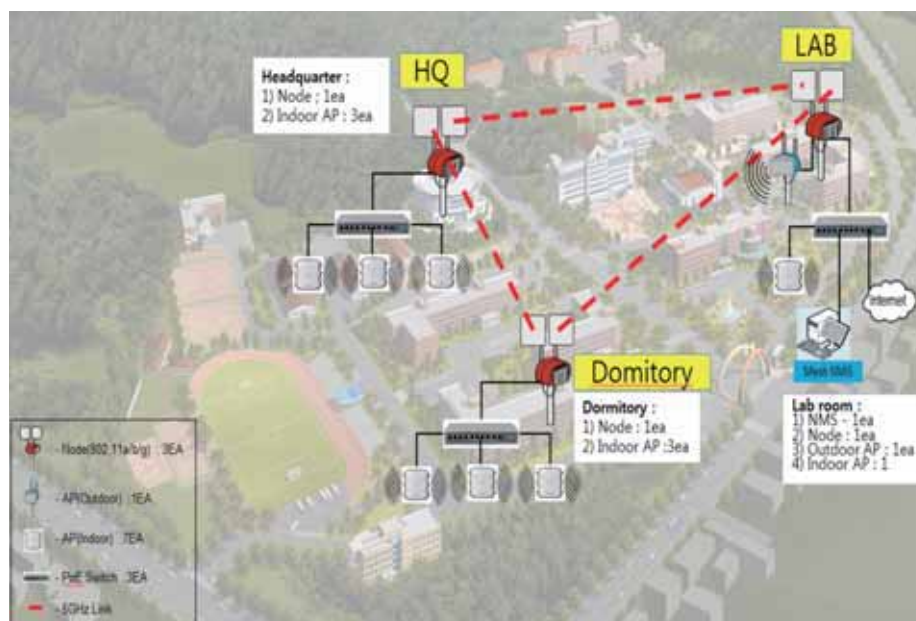
- 1) Set the training room as an integrated control center for installation and training.
- 2) Install the Mesh Node on the roof of a serviced building for WiFi service and training.
- 3) Install Indoor AP & Outdoor AP along with the Mesh Node on the roof of the building for WiFi service and training.
- 4) Install NMS program in server to monitor, optimize and control WiFi Network system
- 5) Install wireless Antennas to test and optimize wireless link performance

### Functions

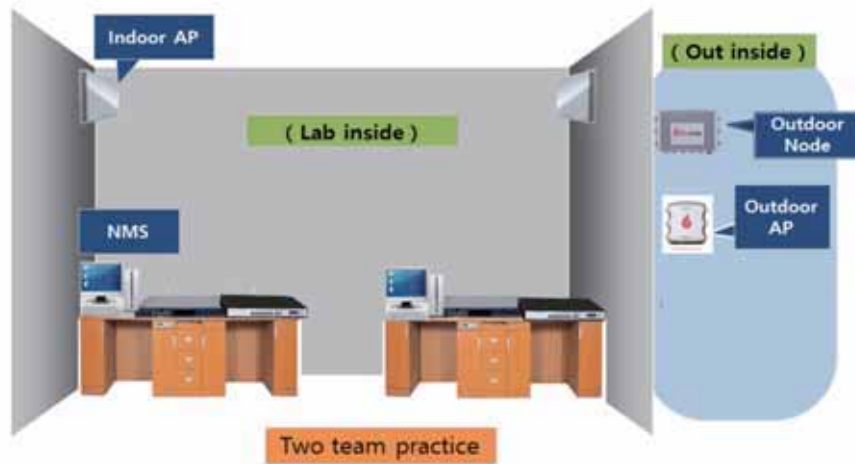
- 1) Train versatile technicians and top engineers who can use knowledge and experience obtained through installation and operation of mobile communication, wireless LAN and high-speed communication networks, network optimization, repair and development practice in their job without re-training.
- 2) Teach students for installation of WiFi communication networks, network optimization and repair & development required by the industry, R&D centers, developers and small and specialized human resources.
- 3) Train key task force required in the high-income field.
  - (1) Train engineers for installing, maintaining and repairing relays and base stations.
  - (2) Train engineers for analyzing the radio environment.
  - (3) Train A/S, operation and development engineers, mobile communication and maintenance service providers.
- 4) Students who receive systematic training with the system can have job chance on following areas
  - (1) wireless network, WiFi Network and System, Radio communication, Wireless Equipment and antenna Manufacturer
  - (2) Research and Development Center for wireless network, WiFi network and radio communication
  - (3) Specialized engineers for radio facility, frequency and electronics, wireless and WiFi network

### System configuration

#### 1) Installing outdoor equipment

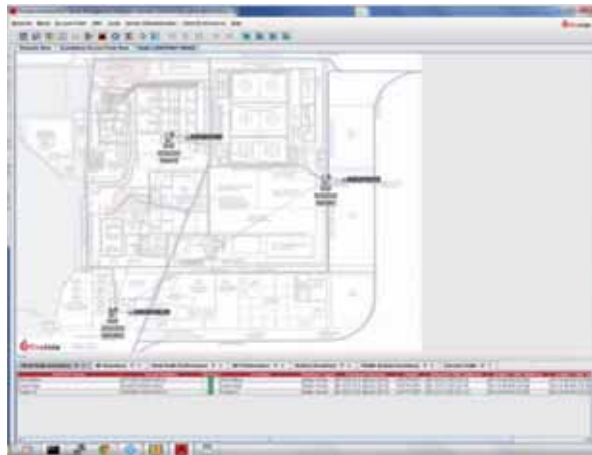


## 2) Installing indoor equipment



## 3) Software screen shot

### (1) Wi-Fi system speed measurement



- understand RSSI
- Speed measurement using Smart phone
- Speed measurement using Program
- Ping Test
- How to Determine the frequency and its intensity
- AP Test for the new standard
- Performance Comparison with existing equipment

### (2) Testing simultaneous access to Wi-Fi system

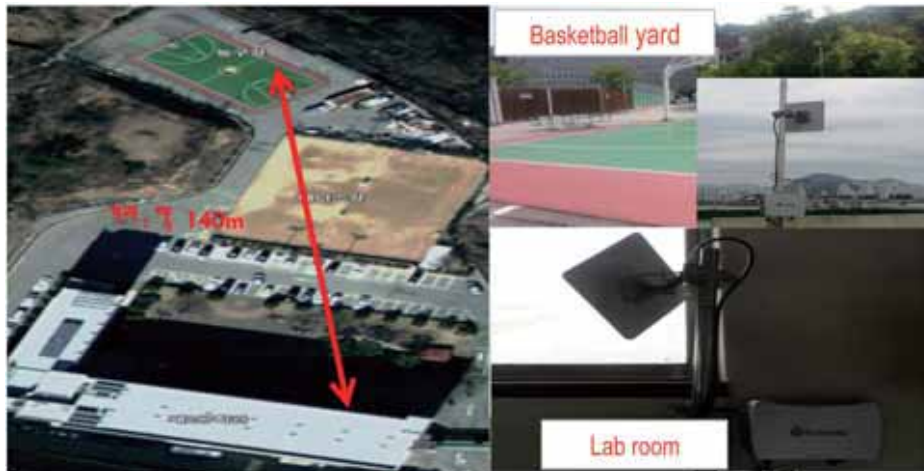


- Measure single terminal communication speed.
- Measure multiple-terminal communication speed.
- Compare performance of simultaneous access by multiple terminals.



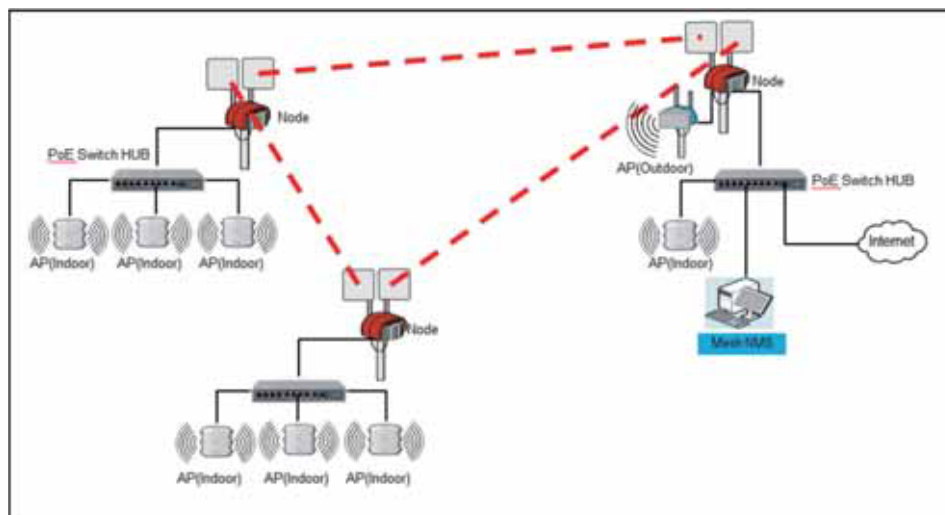
#### 4) Practice Cases

(1) Use the Wi-Fi Bridge to construct a wireless backhole.



- Understand the wireless backbone system.
- Specify an LOS point.
- Method of setting channels/bandwidth.
- Test communication sensitivity and speed.
- Caution in constructing a wireless network.
- Diagnose service shadow areas.
- Improve the capacity of maintenance, repair and assessment.

(2) Constructing mobile communication network



- Construct an integrated mobile communication system.
- Use Mesh Node and WiFi AP
- Use NMS
- Understand the scheme of application, use and configuration.

## Training contents

- Chap 1 : Student check and introduction to training course
- Chap 2 : Wireless Mesh and Wi-Fi Theory
- Chap 3 : Use Wireless Mesh Network and Wi-Fi to construct exemplary service network
- Chap 4 : Practice of measuring Mesh Node & AP service and speed by means of smart phone
- Chap 5 : Test simultaneous access of Wi-Fi AP by means of smart phone
- Chap 6 : Wi-Fi mode theory and practice
- Chap 7 : Interference by barriers (theory and practice)
- Chap 8 : Mutual interference of Wi-Fi AP (theory and practice)
- Chap 9 : Use Mesh Node to test wireless backhole
- Chap 10 : Measure Wireless Mesh and Wi-Fi data
- Chap 11 : NMS(theory and settings, reading data, management)
- Chap 12 : Construct Wireless Mesh Node, Wi-Fi AP and NMS service network (theory and practice)



## Components

Equipment	Description	Q,ty
Mesh Node	Outdoor, 802.11bg	3ea
Antenna	23dBi Patch Antenna	6ea
AP	Indoor AP, 802.11abgn	7ea
	Outdoor AP, 802.11abgn	1ea
NMS	Management Program	1ea
Switch HUB	PoE Switch, 8Port	3ea
Manual	Operation Manual	1

## Specification

### 1) PoE Switch Hub

Network Protocol and Standards Compatibility	IEEE 802.3ab 1000BASE-T
	IEEE 802.3z 1000BASE-X
	IEEE 802.3x full-duplex flow control
	IEEE 802.3af (DTE Power Via MDI)
Power Supply	59.3W maximum
Network Ports	Eight (8) 10/100/1000Mbps autosensing + 2 Gigabit SFP uplinks
Dimension	236 x 101.6 x 27mm (9.3 x 4 x 1.07in)
Weight	0.7kg (1.55lb)
Performance Specifications	Forwarding modes: Store-and-forward
	Bandwidth: 20Gbps full duplex
	Buffer memory: 512KB embedded memory per unit
	Mean time between failures (MTBF): 157,004 hours (~18 years)
Operating temperature	0°Δ to 104°Δ F (0°Δ to 40°Δ C)
Storage temperature:	-4°Δ to 158°Δ F (-20°Δ to 70°Δ C)
Status LEDs	Per RJ45 port: Link/activity, speed,PoE status
	Per SFP port: Link/speed
	Per device: Power, PoE Max
Power Adapter	48V, 1.25A external power adapter, localized to country of sale
Administrative Switch Management	IEEE 802.1Q static VLAN (64 groups, static)
	Protected ports
	IEEE 802.1p Class of Service (CoS)
	Port-based QoS
	DSCP-based QoS
	IEEE 802.3ad Link Aggregation (manual or LACP)
	IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)
	IEEE 802.1s Multiple Spanning Trees Protocol (MSTP)
	IEEE 802.1ab Link Layer Discovery Protocol (LLDP)
	LLDP-MED
	SNMP v1, v2c, v3
	Auto voice VLAN
	DHCP Filtering
	Auto denial-of-service (DoS) protection
	HTTP and HTTPS
	RFC 2131 DHCP client
	DHCP filtering
	Port-based security by locked MAC addresses
	MAC and IP-based ACL
	IGMP snooping v1/v2
	Port-based egress rate limiting
	SNTP
	Web-based configuration
	Password access control
	Syslog
	Firmware upgradeable

## 2) Indoor AP

IEEE	802.11 b/g/n(Radio 1), 802.11 a/n(Radio 2) 3 x 3 MIMO ( 2 Antennas and 2 streams)
Tx Power	Up to 100mW Auto Transmit Power Control
Networking	Up to 16 SSIDs per AP Up to 16 independent VLANs
Network Port	1 Ports, 10/100/1000Mbps PoE supported
Ethernet Connector	RJ-45
Power	Input power: 48VDC via external power supply or via 802.3af PoE External power supply: 100~240 VAC Power consumption:11.925W Typical
Operating Temperature	0 to + 50
Weight	0.4kg
Dimension	7.3" W x 6.8" L x 1.4" H

## 3) Outdoor AP

IEEE	802.11 b/g/n(Radio 1), 802.11 a/n(Radio 2) 3 x 3 MIMO ( 2 Antennas and 2 streams)
Tx Power	Up to 100mW Auto Transmit Power Control
Networking	Up to 16 SSIDs per AP Up to 16 independent VLANs
Network Port	1 Ports, 10/100/1000Mbps PoE supported
Ethernet Connector	RJ-45
Power	Input power: 48VDC via PoE External DC Input: 15V, 1.3A External power supply: 100~240 VAC Power consumption:18.925W Max
Operating Temperature	-40 to +60
Weight	1.7Kg
Dimension	-40 to +60 5.4Kg

## 4) Mesh Node

Throughput	Bonded Mode Multi-Hop	400Mbps Max. 200Mbps max. over unlimited number of hops
Radio		Dual-radio
IEEE		Basic: 802.11a/b/g, Option:802.11n MIMO
Tx Power		Up to 400mW
Network Port		3 Ports, 10/100/1000Mbps
Ethernet Connector		RJ-45
PoE capability		48VDC, Port 2 and 3
Power		AC: 100-240VAC, 0.9A DC: 12VDC $\pm$ 10%, 2.8A Power Consumption (without PoE): 34W (Max) Ports 2 and 3: IEEE 802.3af compliant PoE(PSE) (Max 17W per port)
Operating Temperature		-40 to +60
Weight		5.4Kg
Dimension		11.6" L X 8.1" W X 4.1" H

## 5) Network Management Software

Division	specification
MANAGEMENT & CONTROL	Architecture
	Mesh/Node Configuration Settings
	MultiMesh Management
	Concurrent Administrators One Multiple
	Web-based Client
	Node Statistics & Fault Log
	Database / Export
OPTIMAL PERFORMANCE	Inventory Management
	Class of Service Traffic Prioritization
	Link Elimination
	Transmit Data Rate Control
	Transmit Power / Multi-Hop / RSSI Threshold
	EthernetDirect
	Static Route Assignments
	Bandwidth Metrics
	Broadcast Containment
	Load Balancing
FLEXIBLE DEPLOYMENT	Extended Range
	MeshBridge Integration
	NGI(s) & Gateway Server Internetworking
	Gateway Server Redundancy
MAXIMUM SECURITY	Virtual LANs
	AES/WPA2/WEP Encryption & Access Control
	ESSID Encryption
	Signed Certificates
	Load Balancing
ACCESS FEATURES	Virtual Access Point Grouping
	Zero Configuration
	Client Based Policy Management
	Service Level Agreement
	Captive Portal Management
	Walled Garden

## 6) Patch Antenna

Frequency range	5.125 ~ 5.875GHz
Gain	23dBi
Radiation Pattern	Directional
Front to Back Ratio(Min.)	40dB
Nominal Impedance	50 Ohm
Vertical Beam Width	10.5
Horizontal Beam width	10.5
Polarization	Linear Vertical
Connector	N-Type
	External power supply: 100~240 VAC
	Power consumption:11.925W Typical
Operating Temp. Range	-40 ~ +65
Wind Survival	200Km/H
Dimension	305(H)x305(W)x 15(D) mm
Weight	0.9Kg

# model: **TETRA-5000**

## **TETRA training solution**

### **Introduction**

- 1) Essential solution for TRS (Trunked Radio Service) network quality monitoring and optimization.
- 2) Digital TETRA TRS RF Data display on the Map by various Table, Graph
- 3) Best Solution for TRS coverage extension and quality optimization

### **Features**

TETRA quality measurement tool for optimization and coverage control to minimize RF Gap area.  
Hand-Held type for your convenience at in-building test and mountainous area test.  
Real-time mapping on the various digital map (Google Map, etc) and report the result automatically on the Tablet PC.  
RF Filter can be connected to the application of TETRA optimization solution.  
User can measure RF network data and spurious at the same time.

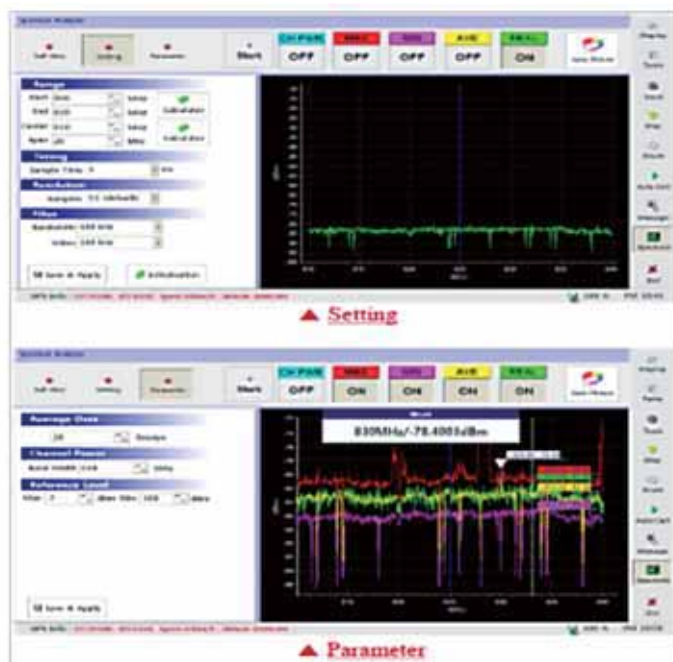
### **Functions**

- 1) Real-Time Parameter Mapping
  - (1) Active info(Carrier, Band, RSSI, MER, BER)
  - (2) Neighbor Info
  - (3) RF indicator chart
  - (4) Mapping the testing route of RF Info per second
  - (5) Real-time layer 3 message parsing and display
  - (6) Result reporting for measured data
- 2) Various TRS device support (Airbus, Teltronic.).
  - : Commercial TRS terminal can be used for network performance monitoring
- 3) Smart PC support for user convenience and time saving for subway or tunnel test.
  - : Multi window supported to monitor various type of network quality monitoring indicator
- 4) Analyze and Check quality via Graph & Table view
  - : Auto recording, Excel export and log replay
- 5) Flexible map can be applied for user convenience
  - : Google Hybrid, Google Satellite, Google or Open Street
- 6) All Major required functions are supported for competitive cost

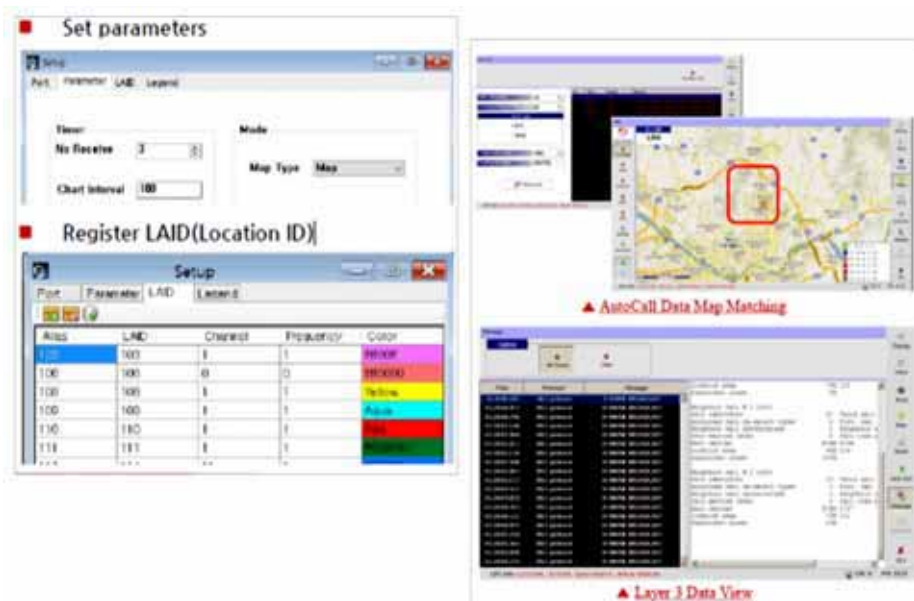
## System configuration



< Screen shot for Customized spectrum analyzer >



< Screen shot for TETRA optimization S/W solution >



## Components & price

TETRA terminal (Phone)	1 ea
Spectrum analyzer	1 ea
GPS receiver	1 ea
Software program CD	1 ea
1) TETRA DM(Diagnostic Monitor) software	
2) Spectrum Analyzer Interface Module Software	
Manual book	1 book

## Training topics & Spec

### Chap 1, Introduction of TETRA

### Chap 2, TETRA-5000 installing the software

### Chap 3, Spectrum Analyzer

- 1) Setting/ Parameter : Spectrum configuration
- 2) Mark : Peak Value
- 3) CH PWR : average Channel power
- 4) ETC : MAX, MIN, AVE, REAL

### Chap 4, Setting

- 1) Range : measured bandwidth
- 2) Timing : Sample Time
- 3) Resolution : Sampling resolution
- 4) Filter : RBW & VBW Filter
- 5) Save & Apply : save current configuration

### Chap 5, Parameter

- 1) Average Over : average
- 2) Channel Power : CH PWR Span
- 3) Reference Level : vertical Level

### Chap 6, User customized parameter and BTS information configuration

- 1) Set parameters
- 2) Register LAID(Location ID)

### Chap 7, Automation Call Test

- 1) Repeatedly testing as preconfigured test scenario

### Chap 8, Setting / Configuration

- 1) Idle Time: Set idle time between each call
- 2) Connect Timer: Set connect time during each
- 3) PTT / SEND: Set Group(PTT) ro Private(SEND)
- 4) Call Count: Set total call count

### Chap 9, Map display

### Chap 10, Table /Message

- 1) Radio Status : display parameters( Location Area, Main Carrier, Frequency Band, C1&C2, RSSI, TxPower, MER, BER)
- 2) Message Analysis: realtime message analyzer based on TETRA Standard

### Chap 11, Graph

- 1) Serving Cell : Active signal detail view
- 2) Display Parameter : TxPower, RSSI, C1&C2, BER, MER
- 3) C1 & C2 Graph
- 4) RSSI Graph
- 5) RSSI information : Active & Neighbor signal view

### Chap 12, Inbuilding / Subway

- 1) Subway and Tunnel Map loading supported, easy test and data accuracy increased
- 2) makes the route where to go
- 3) complete to setup the route by "Complete button"
- 4) click the start/stop button and change the first marker color
- 5) continuous click start/stop button

### Chap 13, Replay & Analyze

- 1) Multi functional log replay for analysis and data export for report( Excel, Word and photo capture)
- 2) Display detail parameters by mouse on marker(RSSI, RSSI(A), Latitude, Longitude, Date)
- 3) Timely synchronized information upon any marker selection on the map(Graph, table and map)

### Chap 14, Customized spectrum analyzer

- 1) Portable S.A and Filter for Spurious measurement and analysis Mounted into a Car for drive test to recognize wide area Measurement Data recording and real time map display
- 2) Data Recording and Reply
- 3) Cost effective and high portability  
USB interworking with UMPC  
Mobility(210\*140\*25mm, 700g)  
Portable OmniLOG antenna
- 4) BTS and Repeater Test & Maintenance  
Acceptance and Performance Test  
Additional Amplifier & Attenuator for other equipment test
- 5) Application Software  
Display configured frequency & level  
GIS Correlation

# 09

**a group of AI (Artificial Intelligence)  
training system**

18. Artificial Intelligence-GT19

# model: **Artificial Intelligence-GT19**

## **AI (Artificial Intelligence) Training System**

### **Features**

- 1) Artificial Intelligence (AI) is a field that focuses on solving cognitive problems, primarily related to human intelligence, as learning, problem solving, and pattern recognition.
- 2) Artificial Intelligence-GT19 use RaspberryPi and Python to learn the use of Google Assistant voice recognition and image processing (visual recognition) by using camera.
- 3) Through voice recognition, user can do the practice of application system using various devices from sensor and actuator control.
- 4) Through visual recognition, the user realizes object detection and recognition from various images and learns how to control the device.
- 5) The user also learn how to detect and recognize images using OpenCV, which is widely used for visual recognition.
- 6) In addition, the Jupiter Lab in Windows environment will be used to learn the basics of AI machine learning such as Linear Regression, Logistic Regression, Softmax classification, and CNN,,, etc using TensorFlow and Python.
- 7) User also learn how to improve the recognition rate by applying various algorithms of machine learning to MINIST number recognition.
- 8) From our products to our open-source platforms, we ensure that the benefits of AI are accessible to everyone.
- 9) Artificial Intelligence-GT19 is the training system that can meet the needs for a myriad of national & regional initiatives underway seeking to establish organizational structures of AI.

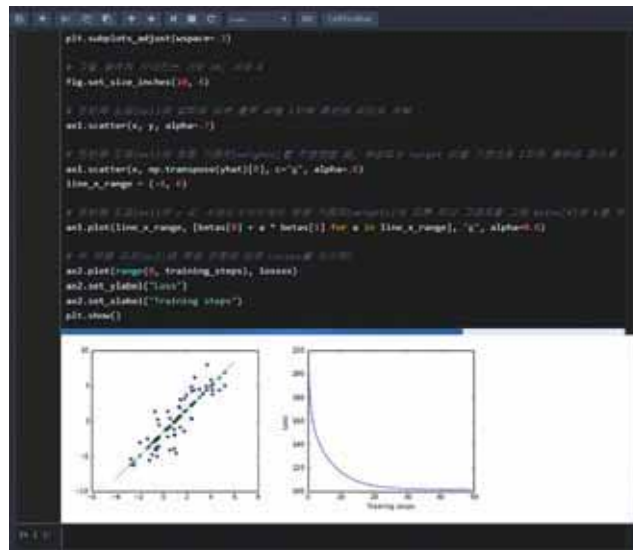
### **System configuration**

- 1) Hardware photo





## 2) Software screen-shop



## Components

Hardware platform	1 set
Program CD	1 ea
USB Camera	1 ea
Speaker & USB Microphone	1 ea
Micro USB Cable	1 ea
Jupmer cable	1 ea
DC 12V/3A Adaptor	1 ea
Micri SD Card & Reader	1 ea
HDMI Cable	1 ea
USB Keyboard & Mouse	each 1 ea
7 Inch LCD	1 ea
Textbook	2 book

## Training contents

< book-1, AI Voice recognition and Machine learning >

- Chap 1, Overview of Artificial Intelligence (Theory)
  - 1.1 Introduction of AI (Artificial Intelligence)
  - 1.2 History and types of AI
- Chap 2, Artificial Intelligence Classification / Product Configuration and Features (Theory)
  - 2.1 Learning and reasoning
  - 2.2 Understanding languages
  - 2.3 Visual recognition
  - 2.4 Situation awareness
  - 2.5 AI Product Configuration and Features
- Chap 3, RaspberryPi development environment (Practice)
  - 3.1 About RaspberryPi
  - 3.2 Hardware Assemble
  - 3.3 Operating system installation
  - 3.4 Network settings
  - 3.5 SAMBA setting
  - 3.6 GPIO introduction

- 3.7 GPIO library installation
- 3.8 System development method
- Chap 4, Voice recognition and Google assistant (Practice)
  - Introduction of Google Assistant
  - Build Google assistant development environment
- Chap 5, Voice recognition device (Practice)
  - Device control method through speech recognition
  - LED control practice
  - Switch (KEYPAD) control practice
- Chap 6, Voice recognition device (Practice)
  - FAN control practice
  - TEXTLCD control practice
  - Buzzer control practice
- Chap 7, Interlock with voice recognition sensor -1 (Practice)
  - Interlock with illuminance sensor
  - Interlock with GAS sensor

- Chap 8, Interlock with voice recognition sensor -2 (Practice)
  - Interlock with Temperature and Humidity Sensor (DHT11)
  - Interlock with Motion sensor (PIR)
- Chap 9, Design of voice recognition system (Theory)
  - Fire monitoring system
  - Cooling control system
  - Lighting control system
  - Intrusion detection system
- Chap 10, Overview of Machine learning (Practice)
  - Introduction of Machine learning
  - Basics of Machine learning
- Chap 11, Machine learning development environment (Theory & Practice)
  - Introduction of TensorFlow
  - Construction of TensorFlow development environment
  - TensorFlow API
- Chap 12, Linear regression (Theory & Practice)
  - Theory of Linear regression
  - Minimize the losses
  - Multivariable Linear Regression
- Chap 13, Machine Learning Practice (Theory & Practice)
  - Generalization, Over Integration, and Learning Rate Theory
  - Verification exercise
- Chap 14, Machine learning and characteristics (Theory & Practice)
  - Character extraction and data refining theory
  - Cross-Cultural Practice
- Chap, 15 Logistic regression (Theory & Practice)
  - Theory of Logistic regression
  - Minimize the losses
- Chap 16, Overview of Internet of Things (IoT)
- Chap 17, Design of Internet of Things (IoT)

< book-2, AI Vision and Machine learning >

- Chap 1, Overview of Artificial Intelligence (Theory)
  - 1.1 Introduction of AI (Artificial Intelligence)
  - 1.2 History and types of AI
- Chap 2, Artificial Intelligence Classification / Product Configuration and Features (Theory)
  - 2.1 Learning and reasoning
  - 2.2 Understanding languages
  - 2.3 Visual recognition
  - 2.4 Situation awareness
  - 2.5 AI Product Configuration and Features
- Chap 3, RaspberryPi development environment (Practice)
  - 3.1 About RaspberryPi
  - 3.2 Accessories of RaspberryPi
  - 3.3 Hardware Assemble
  - 3.4 Operating system installation
  - 3.5 Network settings
  - 3.6 SAMBA setting
  - 3.7 GPIO introduction
  - 3.8 GPIO library installation
  - 3.9 AI development environment setup
- Chap 4, Visual recognition and Google assistant (Practice)
  - Introduction of Google Assistant
  - Build Google assistant development environment
  - Visual recognition devices
- Chap 5, Visual Recognition-1 using Google Vision API
  - Label recognition
  - Text recognition
- Chap 6, Visual Recognition-2 using Google Vision API
  - Human face recognition
  - Facial expression recognition
  - Landmark recognition
- Chap 7, Visual Recognition-3 using Google Vision API
  - Image properties
  - Safe search properties
- Chap 8, Visual Recognition-4 using Google Vision API
  - Hints for cut
  - Web recognition
- Chap 9, Visual Recognition-5 using Google Vision API
  - Document text recognition
  - Logo recognition
- Chap 10, TensorFlow development environment
  - Introduction of TensorFlow
  - Development environment setting for TensorFlow
  - use of TensorFlow library
  - Implement TensorFlow algorithm / programming
- Chap 11, Image Recognition-1 using Machine Learning
  - Softmax classification
  - MNIST number recognition
- Chap 12, Image Recognition-2 using Machine Learning
  - CNN (Convolution Neural Network)
  - MNIST number recognition using CNN
- Chap 13, Image Recognition-3 using Machine Learning
  - Introduction of objects recognition
  - Image recognition
- Chap 14, OpenCV development environment
  - Introduction of OpenCV
  - OpenCV development environment setting
- Chap 15, Visual recognition-1 using OpenCV
  - use the camera
  - Human face recognition

## Specification

### 1) Hardware spec

- (1) Raspberrypi3 Board
  - Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz
  - 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN
  - Bluetooth 4.2, BLE
  - Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps)
  - 1GB LPDDR2 SDRAM
  - Extended 40-pin GPIO header
  - Full-size HDMI

4 USB 2.0 ports  
 CSI camera port for connecting a Raspberry Pi camera  
 DSI display port for connecting a Raspberry Pi touchscreen display  
 4-pole stereo output and composite video port  
 Micro SD port for loading your operating system and storing data  
 5V/2.5A DC power input  
 Power-over-Ethernet (PoE) support (requires separate PoE HAT)

## (2) Base Interface

Raspberry Pi 3 Adapter Board : LEVEL Buffer I/O Connector  
 Raspberry Pi 3 40-pin GPIO header  
 Raspberry Pi 3 8-pin Analog Input Port  
 Base board power supply switch  
 MUX Switch (SW1, SW2)  
 Sensor and Actuator Control Connector(9)  
 LED BAR display, Microphone input, Speaker output  
 DC 12V Power Supply Connector

## (3) Base devices

PIR Motion Sensor	Block time : 2.5S (default)
	Delay time : 5 S (default)
	Sentry Angle : < 110 degree
	Sentry Distance : 3m (default) - max 7m
	Lens Size : Diameter : 23mm (Default)
ILUM Sensor	CDS 10mm Light Sensor
TEMP/HUMI Sensor (DHT11)	Temperature : -40~80°... Range, Digital input I/F
	Humidity : 0~100% Range, Digital input I/F
Smoke Sensor (Gas)	Interface type : Analog, Wide detecting scope
	Wide detecting scope
DC BLOWER FAN	51 X 52mm DC BLOWER FAN
LED	10mm Round type LED(4EA)
KEYPAD	3-COLUMN, 4-ROW push Button Switch
BUZZER	Interface type : Analog
	wide detecting scope
TEXT LCD	16 X 2 Text lcd

## (4) External Device

Display	7 inch IPS Screen LCD
	1024 x 600 hardware resolution
	Capacitive Touch Control
WebCam	HD Web Cam C310
	Max resolution : 720p / 30fps
	Angle : 60 degree
Microphone	CMP-G7 USB Microphone
	Direction : Omnidirectional
	Sensitivity : 20 ± 4dB

**2) Software spec**

## (1) Artificial intelligence voice recognition

- Raspbian GNU/Linux 9.4 (stretch)
  - + Linux OS: Embedded Linux(Kernel 4.14) , Debian Stretch base
  - + Display : HDMI Device Driver
    - MIPI Display Device Driver
    - MIPI camera Device Driver
  - + Audio: ALSA
  - + WIFI: 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac AP mode support, USB Interface
  - + Bluetooth: bluetooth 4.2, BLE support
  - + Multimedia: H.264.MPEG-4
  - + Decode(1080p30); h.264
  - + Encode(1080p30); OpenGL ES 1.1,2.0 graphics
  - + LAN: 1G Hz Support
- Python 2.7.13, Python 3.5.3

## (2) Artificial Intelligence Machine Learning

- Operating OS : Windows 10
- IDE : jupyter lab 0.33.7 (Crome)
- Jupyter notebook 5.5.0
- Language : Python 3.6.2

# 10

## a group of AR/VR Training System

- 19. AR (Augmented Reality) Interactive Virtual Aquarium System  
(AR Virtual Aquarium-GT3000)
- 20. VR (Visual Reality) Drone flight control training simulator  
(VR Drone-GT700)

# model: **AR Virtual Aquarium-GT3000**

## **AR (Augmented Reality) Interactive Virtual Aquarium System**

The virtual aquarium can interact with virtual fishes and user's hand in response to user hand movements. Also, it is a virtual aquarium system in which the L-shaped dual displays (front and bottom) are interlocked to increase the immersion feeling of spectators.

To implement Interactive Virtual Aquarium System, below 5 technologies are used.

### **Technologies for Interactive Virtual Aquarium System**

#### 1) Virtual multitouch technology



#### 2) Motion recognition technology



#### 3) AR(Augmented Reality) technology



#### 4) Spatial cognition technology



### 5) Multi Display Interlocking Technology



## Function and operation of virtual aquarium

### 1) One hand fishing

- (1) Wait for 1 to 2 seconds with the right hand in front.
- (2) A green circle is generated on the front display.
- (3) Green fish steaming is generated at the position of the hands on the bottom display.
- (4) When steam is moved along the hand and processed with fish, hands are included on the head and catch the fish.



### 2) Hand fishing

- (1) Utilize both hands to drive the fish into the fishing nets on the display and place the fish in the aquarium.
- (2) Fish taken at this time enter the fishing port on the front display.



### 3) Force feedback using smartphone

- (1) After successful fishing in conjunction with the smartphone, images of the fish are transferred by the smartphone.



## System configuration



( Display Appearance Change )



## Lists of Experiment

### < Book-1, AR Hardware Practice >

- Part 1, Installation
  - 1.1 Hardware connection
  - 1.2 System SDK Install
    - \* Decklink SD K install
    - \* Kinect SDK install
    - \* Install Visual Studio2012 & update
  - 1.3 PC environment setting
  - 1.4 Camera setting
- Part 2, How to set up system Calibraiton
- Part 3, How to run and operate a virtual aquarium
  - 3.1 Connect the PC and TV power.
  - 3.2 Connect power to camcorder
  - 3.3 Run IVA.exe
    - \* IvaFishConfig.ini
    - \* IVA Key Mapping
    - \* IVA Execute
- Part 4, Operation of virtual aquarium
  - 4.1 One hand fishing
  - 4.1 Hand fishing
  - 4.3 Force feedback using smartphone

### < Book-2, AR/VR Software Learning >

- Chap 1, VR/AR Contents planning
  - : Deriving ideas
- Chap 2, C Programming for Unity
  - : C Programming
- Chap 3, Unity basic programming
  - : Practice - 1, Learning Unity Capabilities (PC based games)
- Chap 4, Unity VR Programming
  - : Practice - 2, VR Content Development Technique (Gear VR / Daydream)
- Chap 5, Unity AR Programming
  - : Practice - 3, AR content development technique (Galaxy S10 / HoloLens 2)
- Chap 6, Network Programming
  - : Practice - 4, Networking technique (PC based network game)
- Chap 7, High - end HMD based VR Programming
  - : VIVE Pro, Oculus Quest based development technique
- Chap 8, Application deepening learning
  - : Machine learning by ML - Agent
- Chap 9, Application Contents Development - 1
  - : Contents development of Network VR Shooting Game by using Gear VR
- Chap 10, Application Contents Development - 2
  - : Contents development of Bomb training by using VIVE, or Oculus
- Chap 11, Application Contents Development - 3
  - : Contents development of Human anatomy practice by using HoloLens 2

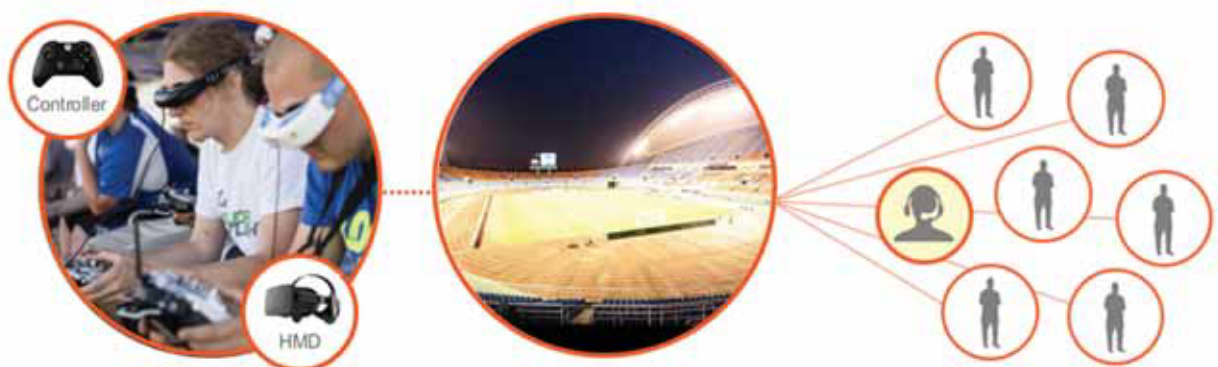


# model: VR Drone-GT700

## VR (Virtual Reality) Drone flight control training simulator

### Overview

VR Drone-GT700 is the simulation software for Drone flight control. Curriculum is consisted of theory Education and Simulator exercise.



#### Hardware

- Various integrated military drone hardware
- Various integrated drone controller
- Supports various integrated 2D and 3D HMD equipment

#### Content

- Real drones flight course
- Realistic 3D objects  
a feel similar to a real drone flight
- Apply physical values

#### Network

- Personal, multi-person simulated flight experience through network
- Real-time strategy instruction and teaching function through Observing Mode
- Flight pattern analysis function through replay function



(2) GM-55EL01 TV, 2 unit

GM-55EL01 - Power consumption 130W, Rated voltage AC 100 ~ 240V, 50 ~ 60Hz

4) Camcorder Spec

- (1) Live streaming support: Full HD resolution support
- (2) Video standard: Uses NTSC format as default
- (3) Sony HDR-CX240 is recommended.
- (4) HDR-CX240 - Rated voltage 100V ~ 240V, 47 / 63Hz

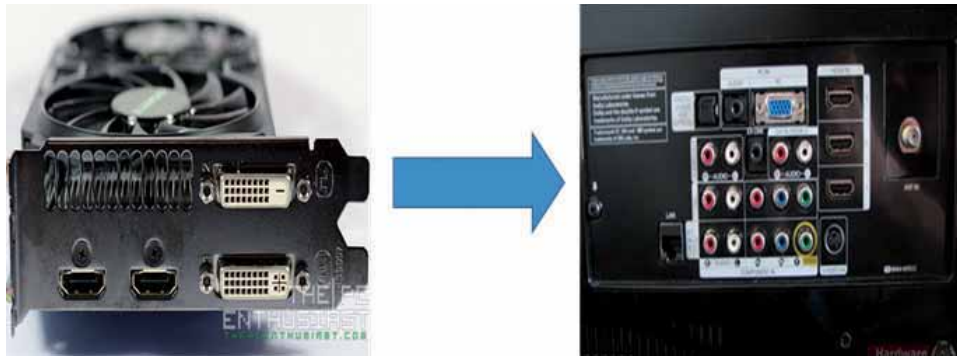
5) Kinect

Recommended use of Kinect model

XBOX360 - Rated voltage 100V ~ 240V, 50 / 60Hz

6) TV connection cable

HDMI - DVI cable, 3ea



7) PC Power Cable, 1 ea

8) Camcorder connection cable

Decklink Intensity pro -> camcorder connection cable

9) Wireless keyboard / mouse

Any device configured wirelessly as an input device for controlling the system is possible.

10) Software spec

- (1) C Programming for Unity
- (2) Unity basic programming - Learning Unity Capabilities (PC based games)
- (3) Unity VR Programming - VR Content Development Technique (Gear VR / Daydream)
- (4) Unity AR Programming - AR content development technique (Galaxy S10 / HoloLens 2)
- (5) Network Programming - Networking technique (PC based network game)
- (6) High-end HMD based VR Programming - VIVE Pro, Oculus Quest based development technique
- (7) Application deepening learning - Machine learning by ML-Agent
- (8) Application Contents Development - Contents development of Network VR Shooting Game by using Gear VR
- (9) Application Contents Development - Contents development of Bomb training by using VIVE, or Oculus
- (10) Application Contents Development - Contents development of Human anatomy practice by using HoloLens 2

## Spec

### 1) Aquarium Hardware spec

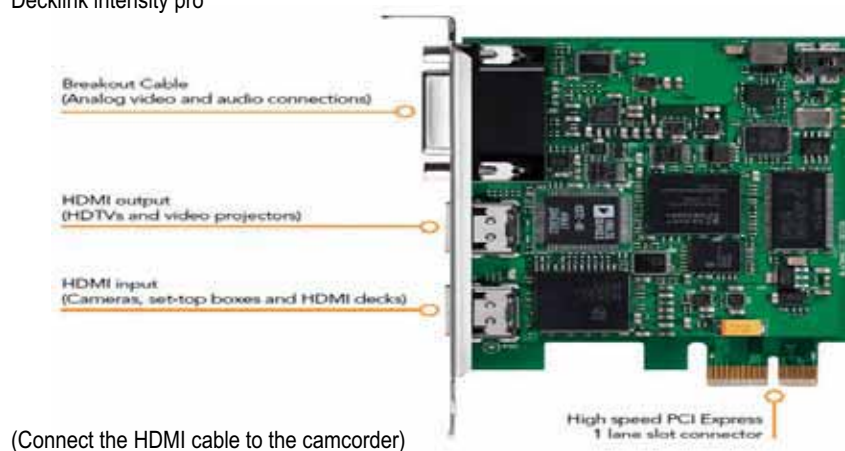
Hardware size : 1380mm(W) x 960mm(L) x 960mm(H)  
 Front side panel : Acrylic cover, thick 8mm, size 1380mm(W) x 960mm(L)  
 Upper side panel : Acrylic cover, thick 8mm, size 1380mm(W) x 960mm(L)

### 2) PC Spec

CPU	Intel Core i5-4 Generation 4440 (Original)
Mainboard	ASUS H87-PLUS STCOM (Intel H87/ATX)
Memory	Samsung DDR3 16G PC3-12800 8G (Original)
HDD	WD 500GB BLUE WD5000AAKX (SATA3/7200/16M)
ODD	LG Super-Multi GH24NS96 (Black Genuine Bulk)
VGA	GeForce GTX750 Ti UD2 OC D5 2GB Black Edition : Products with more than 3 monitor output terminals



CASE	[Zalman] Z3 PLUS (middle tower)
Power	Zalman ZM600-GLX (ATX/600W), Maximum power 600W, AC 115 ~ 230V, 50 ~ 60Hz
Streaming Card	Decklink intensity pro



### 3) TV Spec

(1) TS - 50CLFHDTV, 1 unit  
 50 inch (125.731cm) / 16:9  
 1920 x 1080 @ 60Hz  
 16,700,000 color  
 300cd/m  
 DCR 10,000,000 : 1  
 6ms  
 178 / 178 (Up Down/Left Right)  
 16W (8W + 8W)  
 AVI, MPEG, MP4, TS, MKV, FLV, VC-A/WMV9, RMCB  
 HDMI(x3), USB, D-USB, Component(RCA), Video(RCA), Audio(L,R/RCA)  
 200 x 100mm  
 30,000 Hrs  
 83W(max) / 05W(off)  
 TS-50CLFHDTV - Power consumption 83W, Rated voltage AC 220V / 60Hz

## System configuration



VR Drone-GT700 provides Hardware and Simulator engine.

### 1) Hardware

- (1) Various integrated drone controller
- (2) Supports various integrated 2D and 3D HMD equipment

### 2) Simulator engine

#### (1) Drone control

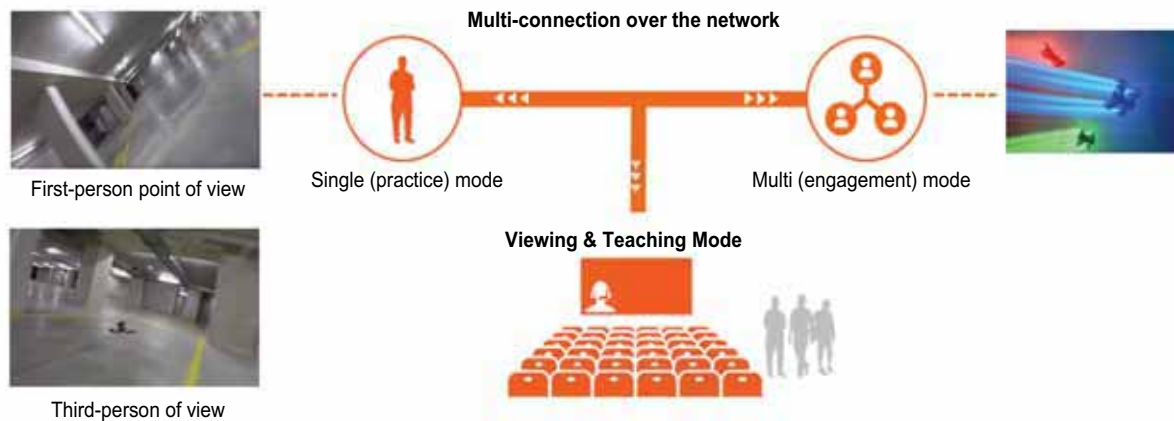
- \* Drone movement, speed control function
- \* Rolling & Pitch control

#### (2) Training environment control

- \* Select a flight
- \* Select flight posture mode
- \* Select map
- \* Select weather environment
- \* Select training courses

## NETWORK SERVICE

Provides various targets, viewpoints, and contextual training services



Also, VR Drone-GT700 provides Network Services (various targets, viewpoints, and contextual training services).

- 1) Various viewpoints
  - (1) FPV mode (First-person point of view)
  - (2) TPV mode (Third-person point of view)
  - (3) Provides Flight observation views from First-person and Third-person perspective
- 2) Various services
  - (1) Individual flight training service
  - (2) Multi Network, Multiplayer service
  - (3) Replay of flights function
  - (4) Play / Analyze your own flight records
  - (5) Expansion of drone pilot guidance for military and drone management education service
- 3) Various targets
  - (1) Single Trainer mode
  - (2) Multi engagement mode
  - (3) Observer Mode (Monitoring & Teaching Function)

## Components (10 users)

1) Server System	1
2) Simulator Hardware (Drone Controller+USB Dongle+Auth.Key)	
- Drone Controller	1
- USB Simulation dongle	1
- USB Dongle key (Auth. Key)	1
3) VR HMD set (VR Oculus Rift)	1
4) Client Education Program (VR Drone Flight Training System)	1
- VR Flight Training Simulator	
- Learning Management System	
5) System PC	1
6) Training VIDEO (for teachers) - CD	1
7) Manual book	2

\* System PC can be prepared by user (below is recommended).

Cpu : Intel i5, or over / Graphic card : GTX 1070, or over  
Memory : 16GB, or over / OS : Window 10

## Training contents

### < Book-1, VR Hardware practice >

OT	Lesson-1	Overview of the entire course
Basic theory lesson	Lesson-2	Drone Trend / History / Classification / Term Definitions / Market Status
	Lesson-3	1) Function of each part of the flight simulator 2) checking points for before and after flight
	Lesson-4	1) Theory & characteristics of aviation (propulsive force,, etc) 2) Forces that is affected to flight device
	Lesson-5	1) Transceiver operation 2) Battery control
	Lesson-6	1) Procedures for abnormal situations such as malfunctions 2) Manipulators and Human Factors / Safety Management
Evaluation-1	Lesson-7	Mid-term Assessment
Preparation for simulating (Simulation setting)	Lesson-8	Slogan / Action Procedure
VR Drone training (Simulator exercise)	Lesson-9	Takeoff flight
	Lesson-10	Hovering flight / Stop hovering
	Lesson-11	Hovering flight / Left side hovering
	Lesson-12	Hovering flight / Right side hovering
	Lesson-13	Straight and backward horizontal flight (50m)
	Lesson-14	Triangular flight
	Lesson-15	Rudder Turn flight
	Lesson-16	Emergency operation (emergency landing)
	Lesson-17	Approach and landing (posture mode)
	Lesson-18	Crosswind approach and landing (GPS mode)
	Lesson-19	Practical full course driving practice
Evaluation-2	Lesson-20	Full Course Driving Assessment

### < Book-2, AR/VR Software Learning >

Chap 1, VR/AR Contents planning  
     : Deriving ideas  
 Chap 2, C Programming for Unity  
     : C Programming  
 Chap 3, Unity basic programming  
     : Practice-1, Learning Unity Capabilities (PC based games)  
 Chap 4, Unity VR Programming  
     : Practice-2, VR Content Development Technique (Gear VR / Daydream)  
 Chap 5, Unity AR Programming  
     : Practice-3, AR content development technique (Galaxy 510 / HoloLens 2)  
 Chap 6, Network Programming  
     : Practice-4, Networking technique (PC based network game)  
 Chap 7, High-end HMD based VR Programming  
     : VIVE Pro, Oculus Quest based development technique  
 Chap 8, Application deepening learning  
     : Machine learning by ML-Agent  
 Chap 9, Application Contents Development-1  
     : Contents development of Network VR Shooting Game by using Gear VR  
 Chap 10, Application Contents Development-2  
     : Contents development of Bomb training by using VIVE, or Oculus  
 Chap 11, Application Contents Development-3  
     : Contents development of Human anatomy practice by using HoloLens 2

## Spec

### 1) Server system

- E3-1220v3 (3.0GHz) / Ram 16GB / DDR4 / 1TB(HDD) / 290WW
- SmartFoxServer / IIS / MariaDB

System specifications may vary depending on service conditions.

### 2) Drone Controller (MZ-12 Drone Controller / 22 in 1 Simulator with standard USB interface)



- Operating voltage : 3.3~6V
- Channel : 6CH
- Operating current : about 250.0mA
- Controller : 32bit micro controller
- Screen : 128x64 Mono LCD
- Toggle switch : 5ea
- Charging the battery : DC Jack
- Connection : Wired/Wireless
- Battery : BATTERY HOLDER(including ALKALINE 4cell)
- Battery charging : yes
- Size : 183.6 x 258.7 x 95.9mm(7.22 x 10.18 x 3.76)
- Weight : 570.4g (20.12 oz)
- 22 in 1 Simulator with standard USB interface

### 3) VR HMD set (Oculus Rift + Touch Virtual Reality System)

- Component : Oculus VR Headset + Oculus Touch Controller + Oculus Sensor 1+1)



- Rated Voltage: Headset - USB 5V / Power Consumption: Headset - USB 5V
- Graphic : OLED 2160 \* 1200 @ 90Hz / Viewing angle : 110°
- Sound: Built-in 3D audio headphones (removable)
- Weight : 470g
- Position tracking technology: 360 degree infrared LED tracking
- Input : 6 degrees of freedom through 'Constellation' technology of Oculus infrared ultra-precision sensor (3 side abduction tracking + 3 side position tracking)
- Sensor : Gyro sensor, Acceleration sensor, Magnetic sensor
- Controller : Oculus touch motion controller with finger recognition technology
- Connection : hdmi 1.3, usb 2.0, usb 3.

4) Client System

- Cpu : Intel i5 / Graphics card : GeForce 1050 / Memory : 8GB / OS : Windows 10
- VR Flight Training Simulator
- Learning Management System

5) Software spec

- (1) C Programming for Unity
- (2) Unity basic programming - Learning Unity Capabilities (PC based games)
- (3) Unity VR Programming - VR Content Development Technique (Gear VR / Daydream)
- (4) Unity AR Programming - AR content development technique (Galaxy S10 / HoloLens 2)
- (5) Network Programming - Networking technique (PC based network game)
- (6) High-end HMD based VR Programming - VIVE Pro, Oculus Quest based development technique
- (7) Application deepening learning - Machine learning by ML-Agent
- (8) Application Contents Development - Contents development of Network VR Shooting Game by using Gear VR
- (9) Application Contents Development - Contents development of Bomb training by using VIVE, or Oculus
- (10) Application Contents Development - Contents development of Human anatomy practice by using HoloLens 2

# 11

## a group of LED Training System

21. LED-GT4.0



# model: **LED-GT4.0**

## **LED Trainer**

### **Features**

1. It is designed so that it can be practiced directly by wiring for field oriented type practice.
2. Basic driving method Practice (basic driving, constant voltage driving, constant current driving) is possible
3. Various LED devices can be applied to form a circuit and an application device for testing can be provided.
4. PLC and MPU can work together.
5. The entire modules is removable type from the aluminum profile
6. Compact size for easy storage
7. It is a module type that is free of circuit wiring practice and can be extended application
8. The base panel of each training module is designed to have a structure suitable for easy mounting each modules.
9. Each training module can be detached and attached to aluminum profile by applying one-touch clamping method

### **System configuration**



### **Components**

1. Hardware platform
2. Power cable : 1ea
3. PLC communication cable : 1ea
4. Manual book

### **Training contents**

- Chap 1, About LED
- Chap 2, FND control practice
- Chap 3, LED control practice for Voltage
- Chap 4, LED control practice for Current
- Chap 5, LED control practice for Constant Current
- Chap 6, 3-color LED control practice
- Chap 7, Dot Matrix Control Practice
- Chap 8, Square type, 2 color LED control experiment

## Specifications

1. PLC module
  - 1) Input contact point : 16 points
  - 2) Output contacts point : 16 points
  - 3) Output Device : Relay
  - 4) Manufactured to attach and detach with PLC
  - 5) One-touch clamping method
  - 6) Aluminum profile detachable
2. Aluminum profile
  - 1) Size : 800\*600
  - 2) With handles for easy movement
  - 3) Making module removable
3. MPU Base Board module
  - 1) CLCD
    - \* Number of Characters : 16 characters x 2 Lines
    - \* Module dimension : 80.0 x 36.0 x 13.5(MAX)
    - \* View area : 66.0 x 16.0
    - \* Character size : 2.95 x 5.55
  - 2) UART 1( RS232 )
  - 3) Tact S/W : 4ea
    - \* Contact Resistance : 100m ohm Max
    - \* Rating : DC12V 50mA
    - \* operating Life : 100,000 Cycled Min
  - 4) ATmega8
    - \* 8Kbytes of In-System Self-programmable Flash program memory
    - \* 512Bytes EEPROM
    - \* 1Kbyte Internal SRAM
    - \* Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
    - \* Two 8-bit Timer/Counters with Separate Prescaler, one Compare Mode
    - \* One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
    - \* Real Time Counter with Separate Oscillator
    - \* Three PWM Channels
    - \* 8-channel ADC in TQFP and QFN/MLF package
    - \* 6-channel ADC in PDIP package
    - \* Six Channels 10-bit Accuracy
    - \* Byte-oriented Two-wire Serial Interface
    - \* Programmable Serial USART
    - \* Master/Slave SPI Serial Interface
    - \* Detachable to CPU Base Board
  - 5) ATmega16
    - \* 16K Bytes of In-System Self-Programmable Flash( Endurance: 10,000 Write/Erase Cycles)
    - \* 512 Bytes EEPROM
    - \* 1K Byte Internal SRAM
    - \* Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
    - \* One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
    - \* Real Time Counter with Separate Oscillator
    - \* Four PWM Channels
    - \* 8-channel, 10-bit ADC
    - \* 8 Single-ended Channels
    - \* Byte-oriented Two-wire Serial Interface
    - \* Programmable Serial USART
    - \* Master/Slave SPI Serial Interface
    - \* Detachable to CPU Base Board
  - 6) I/O Port(YMW025)
    - \* Voltage Rating : AC/DC 250V
    - \* Current Rating : AC/DC 3A
    - \* Contact Resistance : 30mΩ MAX
    - Insulation Resistance : 1000MΩ MIN
  - 7) LED : 4ea
  - 8) Aluminum profile detachable
  - 9) One-touch clamping method

4. Step Motor module
  - 1) Stop Angle : 1.8 degree
  - 2) Rated Voltage : 12V/Phase
  - 3) Application of bolt type terminal block
  - 4) Apply the rotating plate
  - 5) Photo interrupter for rotation detection: 1ea
  - 6) There is a common use function to operate PLC & MPU
  - 7) Aluminum profile detachable
  - 8) One-touch clamping method
5. DC Motor module
  - 1) Control System : Voltage phase control
  - 2) Bearing type : Plastic Resin type
  - 3) Torque 4.8/6.0V : 4.2 / 5.2 [kg cm]
  - 4) Apply the bolt type terminal block
  - 5) Speed (rpm) :100rpm at 4.8V / 126rpm at 6.0V
  - 6) Photo interrupter for rotation detection : 4ea
  - 7) There is a common use function to operate PLC & MPU
  - 8) Apply the rotating plate
  - 9) Aluminum profile detachable
  - 10) One-touch clamping method
6. Signal input module
  - 1) Push S/W : 8ea
    - \* Operation voltage : 5V , 24V
    - \* Electrical life-cycle : 50,000 operations
    - \* Mechanical life-cycle : 100,000 operations
  - 2) Selector S/W : 1ea
    - \* Operation classification : On/Off
    - \* Operation Voltage : 5V , 24V
  - 3) There is a common use function to operate PLC & MPU
  - 4) Built-in insulation BOX
  - 5) Apply the bolt type terminal block
  - 7) Aluminum profile detachable
  - 8) One-touch clamping method
7. FND module
  - 1) 6 dot
  - 2) color : red
  - 3) Operation voltage : 5V
  - 4) Aluminum profile detachable
8. Voltage LED module
  - 1) Operation voltage : 5V
  - 2) color : High Brightness LED
  - 3) Variable resistance design
  - 4) Aluminum profile detachable
9. Current LED module
  - 1) Operation voltage : 5V
  - 2) color : High Brightness LED
  - 3) size : 3 pie
  - 4) Variable resistance design
  - 5) Aluminum profile detachable
10. Constant current LED module
  - 1) Operation voltage : 5V
  - 2) color : High Brightness LED
  - 3) size : 3 pie
  - 4) Variable resistance design
  - 5) Aluminum profile detachable
11. 3-color LED module
  - 1) Operation voltage : 5V
  - 2) color : red, green, blue
  - 3) size : 3 pie
  - 4) Aluminum profile detachable

12. Dot matrix module
  - 1) Operation voltage : 12V
  - 2) Dot : 8 x 8
  - 3) color : red, green
  - 4) Aluminum profile detachable
13. Square-type, 2-color LED
  - 1) Operation voltage : 12V, 24V
  - 2) color : red, blue
  - 3) Square type LED : over 4\*4
  - 4) Aluminum profile detachable
  - 5) There is a common use function to operate PLC & MPU
14. Relay module
  - 1) Contact point type : 2A2B, 4A4B
  - 2) Operation voltage : 24V
  - 3) Aluminum profile detachable
15. Power Supply module
  - 1) Operation voltage : DC24V, DC12V, DC5V
  - 2) Power protection fuse
  - 3) Over current indication and blocking function
  - 4) Aluminum profile detachable
  - 5) Applicable of bolt type terminal block: 12ea (+, -)
  - 6) Output current : over DC24V - 2A, over DC12V - 2A, over DC5V - 2A

# 12

## a group of Nuclear Power Plant Training System

22. Nuclear Power Plant-GT4.0

# model:**Nuclear Power-GT4.0**

## **Nuclear power generation & simulation equipment**

### **Features**

- 1) This training system was designed and manufactured as a system that can reproduce the principles of nuclear power generation and electric power transmission and distribution in the same process as the real one, and to understand and experience the principle.
- 2) The power generation part can visually display nuclear reactor steam supply, generator system, ancillary equipment and MCR system, and can monitor the pressure value, output value and various measured values according to the pressurization.
- 3) The MCR of the power plant is constructed to control various control parts as in actual power generation and to display important data related to power generation.
- 4) It simulates the control process of nuclear reactor control rods and is designed to intuitively check water temperature change and flow as well as numerical values
- 5) It consists of a power transmission substation and a power distribution substation and it visually shows the process of transmission and distribution to factories and customers.
- 6) Toll tower related to transmission and distribution, Transformer, substation, and customer house are made up of a miniature shape with a reduced size.
- 7) The power line is designed to understand the flow of electricity and it is designed to show different colors on the transmission line
- 8) The power transferred from the substation can change the power main value to enable the event to occur and the display is provided to confirm the changed power waveform.
- 9) Two factory stations and two houses for load operation is configured and events can be configured and confirmed to the incoming power state and power consumption
- 10) Control and generation data related to power generation, transmission, and power use can be controlled and monitored in parallel in both local and remote form.
- 11) It provides the dedicated apps for control and monitoring using smart devices.
- 12) Provides a description of various components related to power generation and transmission and distribution in content form
- 13) The training equipment is composed of a solid console desk in the form of a frame, and the related devices are mounted on the table in a panel structure and a three-dimensional structure

### **System cinfigation**



## Components

Hardware platform	1 set
AC Power Cable	1 set
Monitoring control program	1 copy
Communication cable	1 set
Manual book	1 book

## Training contents

### Part-1, Overview of Nuclear Power Generation

- Chap 1, What is nuclear power ?
- Chap 2, What is an atom ?
- Chap 3, Nuclear Power, more than we imagined
  - \* What is a nuclear fission reaction?
  - \* What is a nuclear fusion ?
- Chap 4, Why nuclear energy is needed ?
- Chap 5, Development of nuclear reactor
  - \* Graphite Light Water Reactor
  - \* Gas-cooled reactor
  - \* Light Water Reactor
  - \* Pressurized heavy water reactor
- Chap 6, Nuclear reactor for generation IV
  - \* Transition of nuclear reactor
  - \* generation IV, Nuclear Power System
- Chap 7, Principle of nuclear power generation
- Chap 8, Moderator
- Chap 9, Coolant
- Chap 10, Control rod
- Chap 11, The water in nuclear reactor does not boil at 100 degrees.
- Chap 12, Light water reactor & Heavy water reactor

### Part-2, Overview of Electric Power System

- Chap 13, Electric Power System
  - \* Configuration of electric power system
  - \* AC electric power transmission system
  - \* DC electric power transmission system
- Chap 14, Overhead Electric power transmission line
  - \* Overhead electric power transmission line
  - \* Pylon
  - \* Insulator for overhead electric power transmission line
- Chap 15, Underground electric power transmission line
- Chap 16, Grounded neutral system
- Chap 17, Transposition of Transmission line
- Chap 18, Transforming station (Substation)
- Chap 19, GIS Substation

### Part-3, Overview of Control panel simulator

- Chap 20, Nuclear Power Plant Control
  - \* Practice-1, Control of Nuclear fuel rod
  - \* Practice-2, Nuclear reactor output control
  - \* Practice-3, Power Supply Pump Control
  - \* Practice-4, Circulation pump control
  - \* Practice-5, Reactor Coolant Pump Start/Stop
- Chap 21, Primary Substation control
  - \* Practice-1, R-Phase control
  - \* Practice-2, S-Phase control
  - \* Practice-3, T-Phase control
- Chap 22, Secondary Substation control
  - \* Practice-1, R-Phase control
  - \* Practice-2, S-Phase control
  - \* Practice-3, T-Phase control

## Spec

### 1. Main Frame

- 1) Material : Steel & AL Frame
- 2) Type : Console Desk + Consol Panel + Display mt brc , Front and rear retractable door mounted.
- 3) Size : around 2400\*2000\*2200(W\*D\*H)

### 2. Nuclear Power Plant Panel

- 1) Nucleay Reactor containment vessel
  - (1) Operating type : Animated on LCD Color Display (more than 32 ), interlocked with subsidiary equipment
  - (2) Type : Panel insert type
  - (3) Components : Nuclear reactor containment vessel, Nuclear reactor, Pressurizer, Steam generator, Coolant pump, etc.
  - (4) Operation function
    - Control of the Control rod
    - Control of Nuclear reactor output
    - Control of water supply
    - Control of steam output
  - (5) Graphic function
    - Activate fuel rod
    - Flow and color display according to the amount of steam change
    - Pressure change color
    - Water flow
  - (6) Controller
    - CPU : Intel i7-4790(3.6GHz)
    - RAM : DDR3 PC3 16G
    - SSD : 240GB
    - Graphic : Geforce GTX1050 Ti D5 4GB
    - Interface : USB, RS-232C, LAN
- 2) Turbine & Generator
  - (1) Configuration method : semi-landfill & Transparent cover
  - (2) Turbine
    - Steam turbine model : DC MOTOR
    - RPM : max 60
    - Steam input Indication : LED net control
- 3) Auxiliary equipment
  - (1) Composition : Water tank, condenser, water pump, circulating water pump, Sea
  - (2) Water flow indication : LED net & matrix control
- 4) Measuring instrument
  - (1) Composition : Compressor pressure gauge, steam pressure gauge, water supply thermometer, turbine RPM, 1st boost of the generator output voltmeter
  - (2) Display type : TFT-LCD Display 7
- 5) MCR Data Monitoring
  - (1) Monitor : TFT-LCD Display 27
  - (2) Display data
    - Nuclear Reactor state, Nuclear reactor output control value, water supply pump control value, steam control valve status, current values of various measuring instruments, power generation, etc.

### 3. Transmission and distribution substation

- 1) Transmission and distribution tower : 4ea
  - (1) Material : Steel & PLA type
  - (2) Type : Miniature form of a real transmission tower
  - (3) Installation Configuration : Power Plant <=> Primary Substation <=> Secondary Substation <=> installation between factories
  - (4) Powerline configuration : LED Cable
- 2) Substation-1
  - (1) Configuration : Actual power distribution tower in substation, transformer in miniature form
  - (2) Power line configuration : The power line transmitted from the power plant is connected to the transformer through the power distribution tower
  - (3) Operation function
    - Distribution power Second boost: 765KV
    - Transmission and distribution power monitoring and adjustment: phase difference, phase voltage, frequency, input voltage, output voltage, insulation resistance, etc.
    - Circuit breaker drive according to the occurred trouble
    - Automatic double line configuration due to trouble occurrence



(4) Display Monitor

TFT-LCD Display 27

Display data : Measured values and waveforms such as Phase difference, phase voltage, frequency, input voltage, output voltage, insulation resistance, etc., t

(5) Controller

CPU : Intel i7-4790(3.6GHz)

RAM : DDR3 PC3 16G

SSD : 240GB

Graphic : Geforce GTX1050 Ti D5 4GB

Interface : USB, RS-232C, LAN

3) Substation-2

(1) Configuration : Actual power distribution tower in substation, transformer in miniature form

(2) Power line configuration : The power line transmitted from the Substation-1 is connected to the transformer through the power distribution tower.

(3) Operation function

Distribution power decompression: 22.9KV

Transmission and distribution power monitoring and adjustment: phase difference, phase voltage, frequency, input voltage, output voltage, insulation resistance, etc.

Circuit breaker drive according to the occurred trouble

Automatic double line configuration due to trouble occurrence

(4) Display Monitor

TFT-LCD Display 40

Display data : Measured values and waveforms such as phase difference, phase voltage, frequency, input voltage, output voltage, insulation resistance

(5) Controller

CPU : Intel i7-4790(3.6GHz)

RAM : DDR3 PC3 16G

SSD : 240GB

Graphic : Geforce GTX1050 Ti D5 4GB

Interface : USB, RS-232C, LAN

#### 4. Load Part

1) Factory 1

(1) Type : miniature factory

(2) Configuration load : LAMP

(3) measuring instruments : the used power

2) Factory 2

(1) Type : miniature factory

(2) Configuration load : DC MOTOR

(3) measuring instruments : the used power

3) Apartment : 2ea

(1) Type : miniature apartments

(2) Configuration load : LAMP

(3) measuring instruments : the used power

4) Operation function

(1) Quality change for distribution power

(2) Load operation according to power event

#### 5. Operating Panel

1) Power Switch : 2ea

2) MCR Part

(1) PB S/W : 1ea

(2) Dial nob : 3ea

3) 1st Transmission substation part

(1) Dial nob : 6ea

4) 2nd Transmission substation part

(1) Dial nob : 6ea

5) Load Part

(1) Load on/off switch : 4ea

6) Local & Remote S/S : 1ea

7) Material: AL / silk printing

## 6. Software

- 1) Nuclear Power generation system monitoring program
  - (1) Operating OS : windows7, windows10
  - (2) Display of important measurement data such as generation value, steam pressure
  - (3) Alarm display for each trouble
  - (4) Data transmission method : TCP / IP or USB
- 2) Substation system monitoring program
  - (1) Operating OS : windows7, windows10
  - (2) Display of important measurement data such as input voltage, output voltage, power supply
  - (3) Graph display for each phase: Error rate : 0.5%
  - (4) Alarm display for each trouble
  - (5) Data transmission method : TCP / IP or USB
- 3) Control panel program
  - (1) Operating OS : windows7, windows10
  - (2) Interworking with each panel software
  - (3) Same operation and specification as control panel
  - (4) Data transmission method : TCP / IP or USB

# 13

## a group of Drone training system

23. Drone-GT100

24. Anti drone-GT800

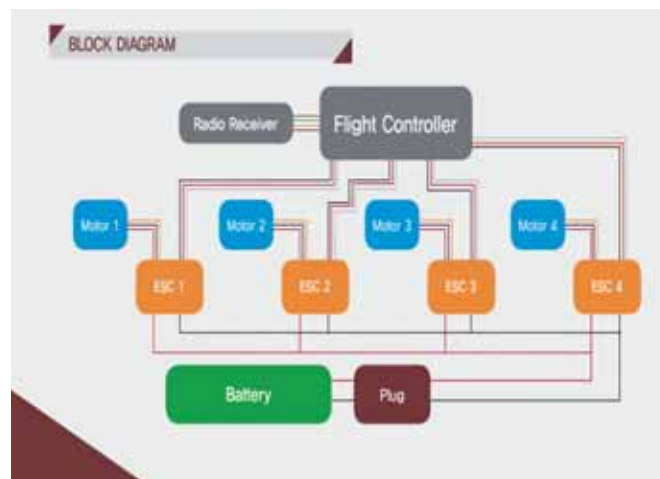
# model: **Drone Quadcopter-GT4.0**

## **Programmable DIY Drone Training Equipment**

### **Features**

- 1) Provides a creative drone platform to create the desired drone platform
- 2) Drone production practice using Libre Pilot flight control module
- 3) Provide Flight Control Firmware Source
- 4) Practice of 3D printing production & production changing by the provided 3D design drawing of drone platform
- 5) Drone can be flown by attaching the specific objects
- 6) Change of drone size according to size of the objects that is going to be transported.
- 7) Easy to assemble and disassemble drones for easy storage and transportation.
- 8) It is possible to add sensor devices such as camera, LIDAR and the practice using the added devices.
- 9) It is possible of autonomous driving platform using GPS, LIDAR, Vision camera, etc.
- 10) It is possible for the user to make Drone by 3D printing with the provided 3D drawings, rather than existing stereotyped Drone platforms.
- 11) User can easily learn the drone (quad-copter), which is recently getting more and more popular.
- 12) By using Libre Pilot flight control module, user can utilize various open source, so user can do practical drone experiments.
- 13) It is easy to assemble and disassemble, so user can go outdoors and fly experiment easily.
- 14) By having a flexible platform type, user can easily implement creative additional functions.
- 15) It is possible to make various drones over 380 ~ 600mm class.
- 16) In addition to cameras, LIDAR, shipping BOX, etc., user can implement various functions in the flight body
- 17) User can easily and safely carry out basic experiments such as flight control module, motor, and motor control within a classroom inside.

### **System configuration**



## Components

Hardware platform	1 set
Program CD	1 ea
Manual book	1 book

## Training contents

Chapter	Title of Contents	Sub-Titles	Others
1	Overview of Drone	Introduction of Drone Types of Drone Introduction of Quad-copter Drones Trends and Industries Used	Theory
2	About drone control	Drone controller configuration and operation How to operate Drone	Theory / Practice
3	Drone development environment	Hardware preparation Software installation Drone development methods	Theory / Practice
4	Overview of Drone assemble	Drone configuration H/W configuration	Theory
5	Drone assembly : H/W	Frame assemble Motor connection Power connection Assembly finish	Practice
6	Drone assembly : S/W	Overview of GCS Hardware configuration of drone	Theory / Practice
7	Initial Flight Test	Flying preparations Flight test and review	Theory / Practice
8	Roll/Pitch/Yaw/Throttle setting	Mix Level Throttle Curve	Theory / Practice
9	Steering (operation) signal input	Input Channel Stabilization Mode Arming Settings	Theory / Practice
10	Motor output & Attitude	Output Channel Output test Attitude setting	Theory / Practice
11	Drone control & Stabilization	Drone control basic PID control Stabilization	Theory / Practice
12	Sensor configuration	Sensor Overview Sensor Drive	Theory / Practice
13	Flight Test-1 : Throttle/Roll/Pitch/Yaw	Throttle Test & Feedback Roll/Pitch/Yaw Test & Feedback	Theory / Practice
14	Flight Test-2 : Flying mode	Flying mode setting Flight test and feedback for each mode	Theory / Practice
15	Flight Test-3 : Frame Change	Consider frame changes and Actions Flight Test & Feedback	Theory / Practice

## Spec

### 1) Hardware spec



Frame  
 Control Box top / bottom  
 Base Board  
 Bolt Handle  
 Clamp / Clamp Holder  
 Motor Mounter



**Motor**  
Brushless Outrunner Motor  
Voltage: 6.4~12.6V (2~3S LiPoly)  
RPM / V: 1130kv  
Max current: 17A



**Flight Controller**  
Flight Controller  
32bit ARM Cortex M4  
10DOF  
433MHz Telemetry Link  
Micro USB Interface



**Propeller**  
10x4.5 SF Props  
2pc Standard Rotation / 2 pc RH Rotation



**ESC**  
Plush 30amp Speed Controller  
Cont Current: 30A  
Burst Current: 40A  
Lipo Cells: 2-4



**Transmitter / Receiver**  
9Ch Transmitter Module  
8ch Receiver (Mode 2)



**LIPO Battery**  
Capacity: 6000mAh  
Voltage: 3S1P / 3 Cell / 11.1V  
Discharge: 25C Constant / 50C Burst



**Battery Charger**  
Balancer Charger 60W 6A Battery  
LiPo LiFe NiMh LiHV



**Oplink**  
Mini Ground Station  
433MHZ RF link  
100mW RF Output  
Micro-B USB



**Alram**  
Low Voltage Buzzer Alarm  
Lipo / LiFe / Li-ion  
Alarm Set Values: OFF or 2.7 - 3.8V

## 2) Software spec

1. Firmware Upload : LibrePilot GCS
2. Drone Ground Control Station
  - (1) Welcome Tab
    - : Project information, Airplane setup wizard
  - (2) Flight Data Tab
    - : Displays the real-time data of the flight controller
    - : Displays useful information about the flight controller status
  - (3) Configuration Tab
    - : Use the graphical interface to configure the main elements of the flight controller
    - : TabConfiguration
      - \* Hardware Tab : An image of the flight controller connected to the GCS is displayed, and the FC port can be set.
      - \* Vehicle Tab : Set the Mix Level, Throttle Curve and Motor output channels according to the type of drone
      - \* Input Tab : Set the operation according to the control of the controller in Input Channel Configuration for radio control input
      - \* Output Tab : Set the output channel and set the operating point of each motor
      - \* Attitude Tab : Sensor calibration and GPS setting, magnetometer setting
      - \* Stabilization Tab : Set the bank according to the number of flight modes. In each bank, the sensitivity and stabilization are set.
      - \* Gimbal Tab : Set the Camera
      - \* TxPID Tab : Set up position during flight test
      - \* OPLink : Set up drones remotely through OPLink settings
  - (4) System Tab : Provides a configurable interface to view and modify status, such as advanced settings, real-time data, and GPS data
  - (5) Scopes Tab : Displays real-time graph of flight controller data
  - (6) HITL Tab : Provides a GCS interface that acts as a bridge between flight simulators of real hardware running over telemetry links or flight simulators of virtual hardware running on a computer.
  - (7) Firmware Tab : Check the current firmware version and upgrade the flight controller's boot loader/firmware
3. Host S/W : LibrePilot GCS 15.09
4. Drone production 3D Drawing : 1copy
  - (1) Control Box top / bottom
  - (2) Base Board
  - (3) Bolt Handle
  - (4) Clamp / Clamp Holder
  - (5) Motor Mounter

# model: **Anti drone-GT800**

## Anti-Drone System

### Feature

Anti drone-GT800 is a total ready system to protect critical infrastructures and humans against such threats, it can detect, track, recognize and counter such drones.

It consists of Radar, Jammer, EO/IR camera, ADS-B receiver(option), Interface Control Equipment, Field Terminal and Command & Control GUI Software.

The operators can use GUI software to find and recognize drone approaching and counter any threats from drones, the operators can differentiate the cooperative drones equipped with ADS-B transmitter from the non-cooperative and/or threat drones by comparing radar data and ADS-B identification data, and he can use built-in Jammer to counter the drone approaching flight and control system parameters for radar, jammer and camera and their operation.

### Functions

- Drone Detection and Tracking
- Real Time Video Display from EO/IR Camera
- Countering Drones by Jammer Operation
- ADS-B Identification Processing
- System Control & Configuration : Radar, Jammer, EO/IR, ADS-B
- Integrated Monitoring & Control of Target Detection and Countering

### Components

Command & Control Software	1 ea
Interface Control Equipment	1 ea
Integrated 3D Radar & Jammer	1 ea
EO/IR Camera	1 ea
ADS-B Receiver	1 ea
Field Terminal	1 ea
Drone for Test	1 ea
Drone Control Software (GCS, Option)	1 ea
Ground Wireless Transceiver (Option)	1 ea



## Application Program

\* Windows on PC & Server

\* Command & Control GUI Software

- Display: Radar Scope, Video, Map, Configuration
- Radar Trajectories on the map with radar scope as 3D Coordinates
- Real Time Video Display from EO/IR Camera
- ADS-B Identification Information
- Configuration & Control
  - . Radar Detection Area Settings
  - . Radar Detection Parameter Settings
  - . Radar/Jammer Mode Control
  - . Camera PTZ Control & Etc.
  - . Camera PTZ Auto Tracking from Radar
- Recording Target Information Data
  - . Target Trajectories, Videos and Reaction Histories
  - . Replay of recorded target data

## Training contents

### Chapter 1, Anti-Drone System Introduction Anti-Drone System Introduction

- 1 Focus
- 2 Background and Cases
- 3 Theory
  - 3.1. UAS OVERVIEW
  - 3.2. Anti-Drone Technologies
  - 3.3. The concept of Anti-Drone System Operation
  - 3.4. Anti drone-GT800

### Chapter 2, Basic Concept of UAS Basic Concept of UAS

- 1 Focus
- 2 Theory
  - 2.1 Basic Concept of UAS
  - 2.2. The structure of UAS
  - 2.3. The operation of UAS & Drones
  - 2.4. The countering of Drones

### Chapter 3, Basic Concept of Radar Basic Concept of Radar

- 1 Focus
- 2 Theory
  - 2.1 Basic Concept of Radar System
  - 2.2 the overview of Radar Technologies
  - 2.3 The operation of Radar System
- 3 Radar and Drones
  - 3.1 The issue of Detection of Drones

### Chapter 4, Basic Concept of Jammer Basic Concept of Jammer

- 1 Focus
- 2 Theory
  - 2.1 Basic Concept of Radio Propagation
  - 2.2 Basic Theory of Satellite Navigation
  - 2.3 Basic Theory of Radio Communication
  - 2.4 The concept of Jamming Technologies
  - 2.5 Countering Drones by Jammer

### Chapter 5, Basic Concept of Optical System

- 1 Focus
- 2 Theory
  - 2.1. The system of EO/IR System
  - 2.2. The operation of Optical Surveillance System
  - 2.3. The issue of Drone Detection and Tracking

### Chapter 6, Basic Concept of ADS-B

- 1 Focus
- 2 Theory
  - 2.1. The concept of Air Traffic Monitoring and Control
  - 2.2. ADS-B Technologies
  - 2.3. Data Information and Structure of ADS-B

### Chapter 7, Anti drone-GT800 Operation

- 1 Focus
- 2 Theory
  - 2.1. System Specification
  - 2.2 Preparing System Operation
  - 2.3. The operation of Anti drone-GT800
  - 2.4. Command & Control Software
3. Simulation & Experiment
  - 3.1. Target Simulation
  - 3.2. Simulated Operation of Anti drone-GT800

### Chapter 8, Practices

- 1 Focus
- 2 Experiment
  - 2.1. System Preparation
  - 2.2 Detection & Tracking of Drones
  - 2.3. The classification of Drone Threats
  - 2.4. Countering Drones

### Appendix 1, Anti drone-GT800

- 1 Focus
- 2 Theory
  - 2.1. Hardware Specifications
  - 2.2. Software Specification
  - 2.3. Core and External Interface
  - 2.4. UI Menu and Manual
- 3 Experiment
  - 3.1. System Preparation Manual
  - 3.2. System Operation

### Appendix 2, Radar and Jammer

- 1 Focus
- 2 Theory
  - 2.1. Hardware Specifications
  - 2.2. External Interfaces
3. Experiment
  - 3.1. Radar System Preparation
  - 3.2. Basic Maintenance

### Appendix 3, Optical System

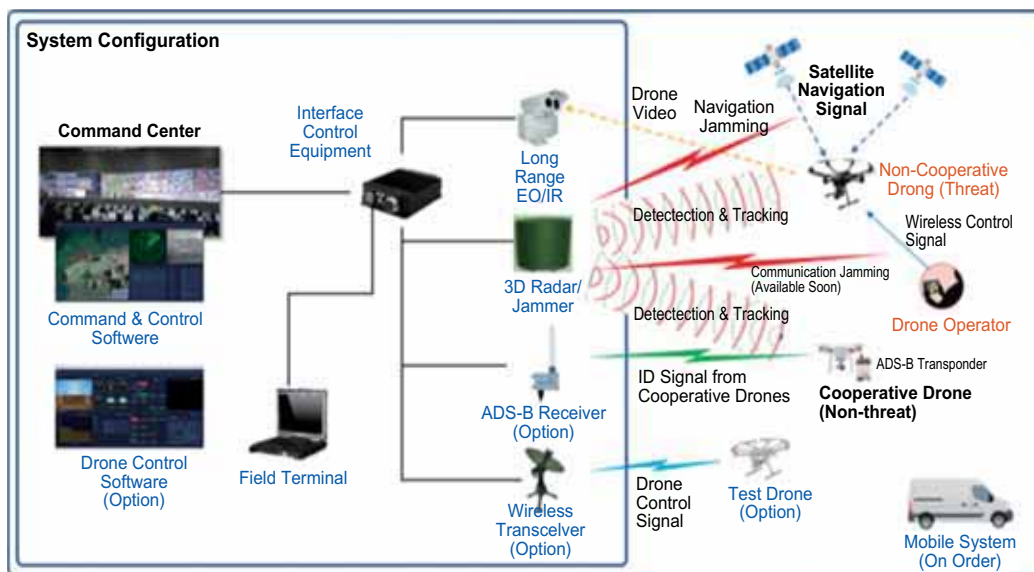
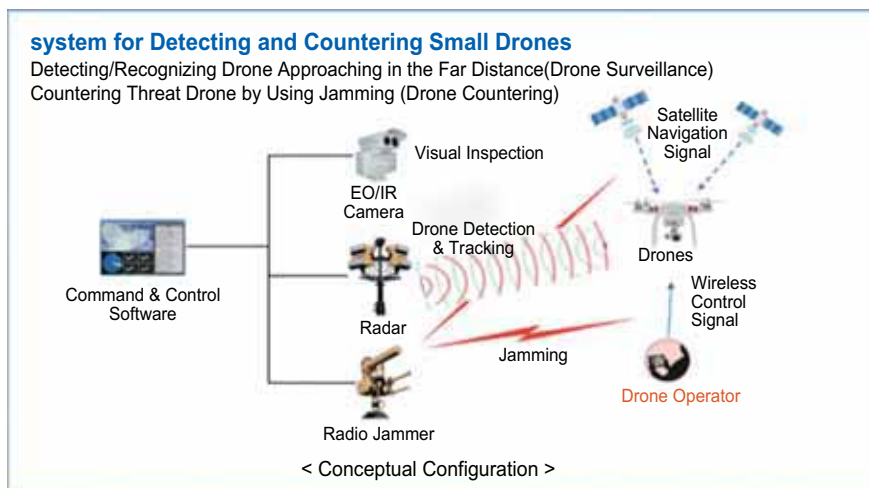
- 1 Focus
- 2 Theory
  - 2.1. Hardware Specifications
  - 2.2. External Interfaces
3. Experiment
  - 3.1. Optical System Preparation
  - 3.2. Basic Maintenance

### Appendix 4, ADS-B Receiver

- 1 Focus
- 2 Theory
  - 2.1. Hardware Specifications
  - 2.2. External Interfaces
3. Experiment
  - 3.1. ADS-B Receiver Preparation
  - 3.2. Basic Maintenance

## System configuration

### 1) Integrated System



### 2) Software Screen shot



## Specification

- 1) Operation PC for Command & Control Software
  - OS : Window 10 64bit recommended
  - CPU : i7 or above recommended
  - Memory : 8GB above recommended
  - HDD : 200GB above recommended
- 2) Radar
  - Operation Type : AESA 3D Radar with Electronic Beam Scan
  - Detection Distance : ~6km for Micro UAV(RCS 0.01m<sup>2</sup>)
  - Detection Area : Azimuth 360° / Elevation -5°~50°
  - Range Accuracy : 25m (target speed 1~60m/s)
  - Angle Accuracy : Azimuth 2°, Elevation 3.6°
  - Update Period : within 4 sec
  - Dimension : size 70(H)\*56( ) cm, weight 82kg (including Jammer)
  - Power : 1,000W / 48VDC (including Jammer)
- 3) Jammer
  - Satellite Navigation : GPS/GLONASS
  - Communication Jammer : 900MHz, L band, 2.4GHz, 5GHz
  - Jamming Distance : Navigation ~10km, Communication ~2km
  - Jamming Distance : Navigation ~10km, Communication ~2km
  - Jamming Mode : Directional Beamforming Jamming - Spot/Sector
- 4) Long Range EO/IR PTZ system
  - Resolution : EO - 1920\*1080(Full HD), Thermal - 640\*480
  - Focal Length/Zoom : EO - 12.7~1,000mm (Continuous 78x Optical Zoom)  
Thermal - 58~735mm (Continuous 12.7x Optical Zoom, 16x Digital Zoom)
  - Video Interface : IP/Ethernet/RTP
  - Positiner : Tilt - -90°~90°, Pan - 360° continuous / Control Resolution 0.001°
  - Power : 1,000W less / 24VDC
- 5) ADS-B Receiver
  - Receiving Frequency : 1,090MHz / 978MHz
  - Sensitivity : -88dBm(1,090MHz), -93dBm(978MHz), DO-282B/DO-260B
  - Interface : Ethernet
  - Dimension : 12.2\*5.85\*8.2cm, 23cm (Antenna Length)
  - Power : 48VDC / 500mW

## Software Specification

* Operating System	Microsoft Windows 10
* Application compiler	N.A
* Development Language	N.A

* UAS : Unmanned Aerial System/Unmanned Aircraft System
* UAV : Unmanned Aerial Vehicle
* AESA : Active Electronic Scan Array
* GPS : Global Positioning System
* GLONASS : Global Navigation Satellite System
* RCS : Radar Cross Section
* EO : Electronic Optics
* IR : Infrared
* PTZ : Pan/Tilt/Zoom
* ADS-B : Automatic Dependent Surveillance-Broadcast
* RTP : Real Time Protocol

# 14

a group of GIS(Geographic Information System) training system

25. Artificial Intelligence-GT19

# model:JOYMAP EDU

## GIS Training System

### Features

GIS is a Geographic Information System designed to capture, store, manipulate, analyze, manage, and present all types of geographically referenced data.

GIS technology is widely being used in various industrial areas especially for government agencies and enterprises to plan and manage their various assets, facilities and to use the analyzed data in marketing etc.

By using the GIS system, people can minimize the time for planning, managing and operating, and also it will assure you of information quality by intelligent analysis process.

JOYMAP EDU provides basic functions and API(Application Programming Interface) so that students can develop small pilot systems with the basic functions.

By this curriculum, students can improve their ability to build many kinds of GIS applications, and it help get an application development-related job in various fields.

### Function

- 1) Read/Write functions of various GIS formats such as DXF, SHP, TAB, DGN, KML, GML, etc.
- 2) GIS format conversion and batch migration
- 3) Using various coordinate systems such as TM, GRS80, UTM, etc.
- 4) Using various layers of Open API maps such as Google, Bing, Yahoo... image map / satellite map
- 5) Editing topographic maps and attributes
- 6) Editing object styles and using thematic maps
- 7) Various spatial operations and CAD editing functions
- 8) Interworking with GPS data
- 9) Interworking with other GIS systems
- 10) Interworking with other modules such as ERP, EA, etc.
- 11) Standard interface for GIS application development
- 12) All the same functions above on Desktop, Web, and Mobile. (Perfect cross capability)

### System configuration

#### 1) Hardware



## 2) Software screen



(Installing outdoor equipment)

## Components

1) Hardware platform	1 ea
2) Software installation CD (JOYMAP EDU for Education ver)	1 ea
- sample code for desktop application development	
- sample code for Android mobile application development	
3) Manual	5 book
4) Power cable	1 ea
5) 4-Digit LED device	1 ea

## Application Program

- 1) JOYMAP EDU Mapper for Education - "JOYMAP EDU Object" based Desktop GIS GUI management tool.
  - (1) View/Read/Write/Edit/Save the GIS data
  - (2) Data searching by each condition(attribute data/spatial data)
  - (3) Various coordinate conversion
    - Can be converted to 2,400 coordinate systems, and learn about the existing coordinate systems
  - (4) Various spatial analysis
    - Thematic map (Unique / Range / Chart), theme styling, example creation
  - (5) Batch transformation of spatial data
    - various GIS DBMSs, files can be transformed all at once by this GUI tool
  - (6) Editing spatial data
    - CAD Editing : Rotate, Trim, Extend, Scale, Break etc.
    - Batch edit & vertex edit, snap, etc.
  - (7) Spatial data processing
    - spatial operations : Union, Intersection, Buffer, etc.
    - OGC standard spatial types : Point, LineString, Polygon, etc.
    - space searching : Contains, Intersects, Touches, Overlaps, Within, Crosses, Disjoin, etc.

- (8) Various format conversion
  - various GIS data formats : SHP, DXF, MIF, DGN, GML(OGC), KML(Google), etc / OGC WKB, WKT, etc.
  - Spatial DBMS Geometry types
  - support ArcSDE(using ESRI driver) format to interwork with other GIS system
- (9) Etc. Functions
  - many character labeling, annotation lines, various character and object styling
  - GPS linkage, GPS coordinate input
- 2) JOYMAP EDU Migration for Education - Data migration tool
  - (1) Easier data migration functions.
  - (2) Batch migration
- 3) JOYMAP EDU Desktop Object - GIS Application programming library.
  - (Actually, it is not the application program but it is the core library to learn the programming of the desktop GIS application)
  - (1) Standard programming interfaces for GIS application development - help learn OGC GIS standard
  - (2) Object library for desktop application development
- 4) JOYMAP EDU Android Object - GIS Application programming library.
  - (Actually, it is not the application program but it is the core library to learn the programming of the Android mobile GIS application)
  - (1) Standard programming interfaces for GIS application development - help learn OGC GIS standard
  - (2) Object library for Android mobile application development
- 5) Other applications to learn how to develop the GIS applications
  - (1) Eclipse IDE to run and develop the Java-based applications (Java-based desktop sample, Android Java-based mobile sample)
  - (2) Microsoft Visual Studio 2010 or higher ver. To run and develop the c++ based applications
  - (3) Free Tomcat (WAS server, when need to run the web sample application)

## Training contents

### Book-1, JOYMAP EDU Manual for Beginners

#### 1. Introduce and GIS Overview (Getting Started)

- 1.1. This Manual Is
- 1.2. Before You Start
- 1.3. What Is GIS?
  - 1.3.1. What Is GIS
  - 1.3.2. The Characteristics of Geographic Information
  - 1.3.3. Composition of GIS
  - 1.3.4. Main Functions of GIS
  - 1.3.5. Main fields of GIS
- 1.4. How To Service GIS
  - 1.4.1. Data Build
  - 1.4.2. Data Management
  - 1.4.3. Service Development
  - 1.4.4. Service Development Using JOYMAP EDU
- 1.5. How to make the GIS Data Composition for the GIS Service
  - 1.5.1. Choosing Service type
  - 1.5.2. Choosing Service Data
  - 1.5.3. Set the Basic Topographic Data
  - 1.5.4. Set the Real-time Service Data
  - 1.5.5. DB Server Composition
  - 1.5.6. GIS Server(MiddleWare) Composition
  - 1.5.7. How To Develop the Client Applications
- 1.6. Introduction of JOYMAP EDU Solution
  - 1.6.1. JOYMAP EDU Software Composition
  - 1.6.2. Feature of JOYMAP EDU
  - 1.6.3. Comparison between Android mobile GIS engines
  - 1.6.4. Comparison between Desktop/Web engines
  - 1.6.5. Comparison between functions (2D/3D/UX)
  - 1.6.6. JOYMAP EDU Multi-cross Technology
  - 1.6.7. Using Open Source Library
- 1.7. Installation
  - 1.7.1. Installation procedure

- 1.7.2. Run
- 1.8. Customized Software Packaging and Deploying

## 2. Component Model Overview

- 2.1. Understanding Geometry
- 2.2. Understanding Feature
- 2.3. Understanding Layer
- 2.4. Understanding Canvas
- 2.5. Understanding Transaction
- 2.6. GUI Tool Kit
  - 2.6.1. What is the GUI Tool Kit ?
  - 2.6.2. Application interface
  - 2.6.3. DockWidget/SplitterWidget interface
- 3 Knowledge Base
  - 3.1. Geometry
    - 3.1.1. Geometry
    - 3.1.2. Relational Operators
    - 3.1.3. The Dimensionally Extended Nine – Intersection Model
    - 3.1.4. Named Spatial Relationship predicates based on the DE-91M
  - 3.2. WKT, WKB (Well-Known Text, Well-Known Binary)
    - 3.2.1. WKT (Well-Known Text)
    - 3.2.2. WKB (Well Known Binary)
  - 3.3. Symbolizer
  - 3.4. Annotation XML
  - 3.5. Coordinate System
    - 3.5.1. PROJ.4

## Book-2, JOYMAP EDU Manual for Client Developers

### 1. Introduction of JOYMAP EDU

- 1.1. This manual is
- 1.2. Before you start
- 1.3. Introduction of JOYMAP EDU solution
  - 1.3.1. JOYMAP EDU Software Composition
  - 1.3.2. Feature of JOYMAP EDU
  - 1.3.3. Comparison between Android mobile GIS engines
  - 1.3.4. Comparison between Desktop/Web engines
  - 1.3.5. Comparison between functions (2D/3D/UX)
  - 1.3.6. JOYMAP EDU Multi-cross Technology

### 2. Installation and Usage

- 2.1. Installation
- 2.2. How to use the JOYMAP EDU Mapper (GUI ToolKit)
- 2.3. How to use the JOYMAP EDU Mobile (Android)

### 3. Practical Training

- 3.1. Running the given sample sources on each system  
[Development settings to use the JOYMAP EDU Object for each language and environment]
  - 3.1.1. Application development using C#(ActiveX/COM)
  - 3.1.2. Application development using Visual Basic.net
  - 3.1.3. Application development using Java (SWT/Swing,etc.)
  - 3.1.4. Mobile application development using Android Java (forAndroid)
- 3.2. Configuration Study (Basic interface and functions of the JOYMAP EDU)
  - 3.2.1. Application-related interface
    - 3.2.1.1. Application
  - 3.2.2. Widget-related interface
    - 3.2.2.1. IndexMapWidget
    - 3.2.2.2. LayerTreeWidget
    - 3.2.2.3. FeatureAttributeTreeWidget
    - 3.2.2.4. MapToolBarWidget
    - 3.2.2.5. DockWidget
    - 3.2.2.6. TabWidget
  - 3.2.3. Canvas-related interface
    - 3.2.3.1. Map2D
    - 3.2.3.2. Map3D



- 3.2.3.3. MapAR
- 3.2.3.4. MapEarth
- 3.2.4. Factory-related interface
  - 3.2.4.1. CommonFactory
  - 3.2.4.2. FeatureCanvas
  - 3.2.4.3. DisplayFactory
  - 3.2.4.4. GeometryFactory.
  - 3.2.4.5. LayerSourceFactory
- 3.2.5. Layer-related interface
  - 3.2.5.1. FeatureLayer
  - 3.2.5.2. Layer
  - 3.2.5.3. LayerSource
- 3.2.6. Feature-related interface
  - 3.2.6.1. Feature
  - 3.2.6.2. FeatureCollection
- 3.2.7. Geometry-related interface
  - 3.2.7.1. GeometryCollection
  - 3.2.7.2. Point
  - 3.2.7.3. LineString
  - 3.2.7.4. Curve
  - 3.2.7.5. LinearRing
  - 3.2.7.6. Polygon
  - 3.2.7.7. SpatialReference
- 3.2.8. Annotation-related interface
  - 3.2.8.1. Annotation
  - 3.2.8.2. Label
- 3.2.9. Attribute-related interface
  - 3.2.9.1. FeatureAttributeDescriptor
  - 3.2.9.2. FeatureType
- 3.2.10. Style-related interface
  - 3.2.10.1. FeatureStyle
  - 3.2.10.2. FeatureStyleCollection
- 3.3. Implementation of Sample (utilizing the interface along with the sample)
  - 3.3.1. Implimentation of sample sources by using the basic interfaces  
(Utilizing the interface for Desktop application development)
    - 3.3.1.1. C#
      - 3.1.2.1. Visual Basic .net
      - 3.1.2.2. Java
  - 3.2.1. Implementation of a simple mobile application using JOYMAP EDU  
(Utilizing the interface for Mobile application development)
    - 3.2.1.1. Android
  - 3.2.2. Debugging and test

## Appendix

- A. Layer Source Driver
- B. Style options to express a Feature object on the screen

## Book-3, JOYMAP EDU GUI ToolKit Manual

### 1. Introduction of JOYMAP EDU Mapper (GUI ToolKit)

### 2. Conventions

- 2.1. GUI Conventions
- 2.2. Guide for Each Platform

### 3. How to run the JOYMAP EDU Mapper

- 3.1. How to run the JOYMAP EDU Mapper tool
- 3.2. Screen Composition

### 4. Composition of the JOYMAP EDU Mapper

- 4.1. Menu Bar
  - 4.1.1. Composition
- 4.2. Docking Window
- 4.3. Toolbar

- 4.3.1. Composition
- 4.4. Layer Control Window
  - 4.4.1. Composition
- 4.5. Attribute Control Window
  - 4.5.1. Composition
- 4.6. Index Map Window
  - 4.6.1. Composition
- 4.7. Canvas Control Window
  - 4.7.1. Composition
- 4.8. Status bar
  - 4.8.1. Composition

### 5. GIS Data Composition & Usage

- 5.1. GIS Data
- 5.2. Data Build
- 5.3. Data Management

## 6. Data Management by using JOYMAP EDU Mapper (Settings for the detail options & Description for Functions)

- 6.1. File
  - 6.1.1. New Project
  - 6.1.2. Open Project
  - 6.1.3. Save Project
  - 6.1.4. Save As Project
  - 6.1.5. Save As Image
  - 6.1.6. Print Layout
- 6.2. Edit
  - 6.2.1. Undo
  - 6.2.2. Cut
  - 6.2.3. Copy
  - 6.2.4. Paste
  - 6.2.5. Add Feature
  - 6.2.6. Modify Feature
  - 6.2.7. Modify Vertex
  - 6.2.8. Snap Properties
- 6.3. View
  - 6.3.1. 2D Map
  - 6.3.2. Earth Map (3D Map)
  - 6.3.3. Pan
  - 6.3.4. Zoom
  - 6.3.5. Select
  - 6.3.6. Distance
  - 6.3.7. Area
  - 6.3.8. Map Control
  - 6.3.9. Windows

## 7. Data Management by using JOYMAP EDU Mapper (How to edit the GIS data & application)

- 7.1. Layer Management
  - 7.1.1. New Layer
  - 7.1.2. Add Vector Layer
  - 7.1.3. Add Grid Layer
  - 7.1.4. Add DBMS Layer

- 7.1.5. Add Web Layer
- 7.1.6. Remove Layer
- 7.1.7. Show/Hide/Close Layers
- 7.1.8. Save As Layers
- 7.1.9. Layer Processing
- 7.1.10. Open Attribute Table
- 7.1.11. Style Settings for Data Analysis
- 7.1.12. Layer CRS
- 7.1.13. Attribute
- 7.1.14. Search
- 7.1.15. Labeling
- 7.2. Vector Data Management
  - 7.2.1. Geometry Process
  - 7.2.2. Vector Process
  - 7.2.3. Route Finder
  - 7.2.4. Spatial Query Builder
  - 7.2.5. Coordinate Conversion
- 7.3. Raster Data Management
  - 7.3.1. Raster calculator
  - 7.3.2. Georeference
  - 7.3.3. Interpolation
  - 7.3.4. Terrain analysis
  - 7.3.5. Coordinate Conversion
  - 7.3.6. Extraction
  - 7.3.7. Raster Analysis

## 8. Data Management by using JOYMAP EDU Mapper (How to interwork with other data)

- 8.1.1. Add DBMS Layer
- 8.1.2. Add Web Layer
- 8.1.3. Set CRS of Layer
- 8.1.4. Layer Properties
- 8.1.5. Query
- 8.1.6. Coordinate Conversion

## Book-4, JOYMAP EDU Application project-1, Aerial Image System

### 1. Introduction of Application Program

- 1.1 The Outline of Application Program
- 1.2 The Objective of Application Program

### 2. Data Construction

- 2.1 Process the aerial image for web GIS service

### 3. Practical Training

- 3.1 Project Overview

- 3.2 Interface

- 3.3 Project Implementation

### 5. GIS Data Composition & Usage

- 5.1. GIS Data
- 5.2. Data Build
- 5.3. Data Management

## Book-5, JOYMAP EDU Application project-2, Gas Mapper 2D

### 1. Introduction of Application Program

- 1.1 The Outline of Application Program
- 1.2 The Objective of Application Program

### 2. Introduction of Application Program

- 2.1 JDK Installation & Environment Construction
- 2.2 Eclipse Installation
- 2.3 Android Plug-in ADT Installation
- 2.4 Android SDK Installation
- 2.5 JOYMAP EDU Android SDK File Setting

### 3. Practical Training

- 3.1 Project Overview
- 3.2 Interface
- 3.3 Project Implementation

## Specification

### 1) Software

OS	1) Windows, Linux, Unix, Mac for desktop (1) available only on Windows for this education ver. 2) iOS, Android and WinRT for mobile (1) available only to Android for this education ver. (2) For this Android mobile training, Android device is needed for each student, and it is not provided by this training system. 3) the default Android emulator can be used for the application development training. (1) The emulator is free of charge and is used on desktop.
Language (for application development)	1) Java, JavaScript, COM+(C, C++) (1) available on Free license Eclipse IDE for Java for this education ver. (2) Microsoft Visual Studio 2010 or higher version is available to learn how to develop the c++ based applications for this education ver. ( Microsoft Visual Studio is commercial S/W, and it is not provided by this GIS trainer )
DB	1) Any Spatial DB (1) Any commercial spatial DBMS that your student wants to use can be used. (2) The free license postGIS is recommended for this education ver. (This PostGIS DBMS is free of charge)
WAS Server	1) Available on Free license Tomcat (1) Web Application Server. It is not compulsory but can be used when need to run the web sample application (Tomcat is free of charge).
Application Project S/W Program	Application Project-1, Aerial Image System Application Project-2, Gas Mapper 2D
Others	1) Desktop GIS application (JOYMAP EDU Mapper for Education) (1) View/Read/Write/Edit/Save the GIS data (2) Data searching by each condition(attribute data/spatial data) (3) Various coordinate conversion (4) Various spatial analysis 2) Data migration tool (JOYMAP EDU Migration for Education) (1) Easier data migration functions. (2) Batch migration

### 2) Hardware

Mobile phone	not provided (user s mobile can be used)
CPU	INTEL 590 (Quardcore/3.3GHz/LGA1150/HD4600)
M/B	LVDS support (17*17Cm) Industrial board INTEL H81/ DDR3 / HDMI/ RGB
RAM	SO-DIMM DDR3 4G / 1600 240Pin
HDD	over 500GB (Notebook PC/SATA2/5400/16M)
Power	19V 4.5A Adaptor (over 85W)
VGA	Integrated on the system board
Display	15" LCD Screen Panel
Cooler	1U Cooler for Server
Chassis	rear part : 100 * 100 VESA hole aluminum chassis
Wifi	Mini PCI-eAW-NB041H(Wifi & Bluetooth) & Antenna
Output	4 Digit LED Display
Port	1 USB port for Mouse + 1 USB port for general use

# 15

**a group of Bluetooth training system**

26. BT-4000

model: **BT-4000**

## Bluetooth S/W Program Development Kit

### Features

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength radio transmissions in the ISM band from 2400 – 2480 MHz) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security.

In BT-4000, user can learn about Bluetooth S/W Architecture and can learn about Host Control, Logical Link Control, Generic Access Profile.

After learning this kit, user can develop Bluetooth HCI S/W, Bluetooth Profile S/W.

And Also can check link quality, quality of service,,, etc.

- BT-4000 is the Bluetooth Protocol Stack Training System
- BT-4000 educate how to control the Bluetooth host.
- User can do the programming of Bluetooth software.
- BT-4000 display Bluetooth status on the GUI.
- BT-4000 is independent H/W, only S/W.

BT-4000 Hardware provides Bluetooth Interface programming practice that below application areas can be implemented.

- 1) RS232 cable replacement
- 2) Truck/Bus monitoring system
- 3) Car Diagnostics
- 4) Wireless POS system
- 5) Wireless machine(healthcare/industrial) monitoring
- 6) Wireless Factory monitoring
- 7) PLC programming
- 8) Wireless Printing
- 9) Wireless logistics

### System configuration



### Training contents

#### Part1. Bluetooth Overview

Chapter1. Bluetooth Overview

#### Part2. Host Control

Chapter2. Device Setup

Chapter3. Discovery

Chapter4. Connection

Chapter5. Disconnection

Chapter6. Device Information

Chapter7. Data Transmission

Chapter8. Link Information

#### Part3. Logical Link Control

Chapter9. L2CAP Connection

Chapter10. L2CAP Data

Chapter11. Connectionless Data

Chapter12. Echo and Ping

Chapter13. Quality of Service

#### Part4. Generic Access

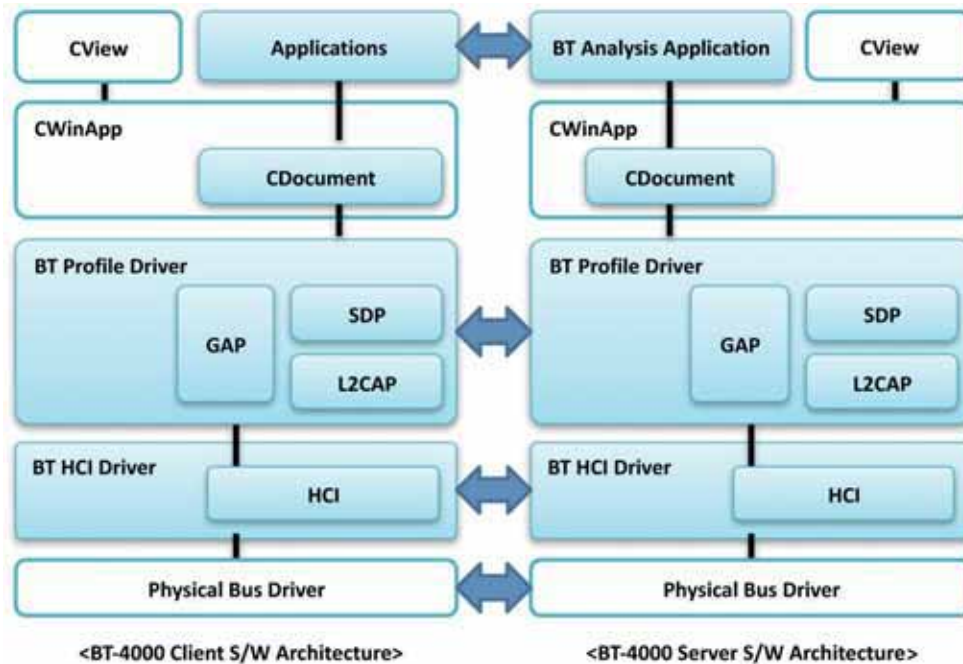
Chapter14. Bluetooth Service

Chapter15. Generic Access Profile

## Components

1) BT-4000 Hardware board	1 ea	5) Manual book	1 book
2) DC Power Adapter	1 ea	6) Dongle	1 ea
3) Serial data cable	1 ea	7) USB Cable	1 ea
4) Program CD	1 ea	8) Carrying bag	1 bag

## Software Architecture



## Specification

- 1) Bluetooth S/W
  - (1) Bluetooth Core v3.0 supported Core v2.1
  - (2) Bluetooth Core v3.0 Host Control Interface
  - (3) Bluetooth Core v3.0 Logical link control and adaptation protocol
  - (4) Bluetooth Core v3.0 Service Discovery Profile
  - (5) Bluetooth Core v3.0 General Access Profile
- 2) Software programming practice using BT-4000 Client & Server S/W.
  - (1) Bluetooth S/W programming practice of Device Setup
  - (2) Bluetooth S/W programming practice of Discovery
  - (3) Bluetooth S/W programming practice of Connection
  - (4) Bluetooth S/W programming practice of Disconnection
  - (5) Bluetooth S/W programming practice of Device Information
  - (6) Bluetooth S/W programming practice of Data Transmission
  - (7) Bluetooth S/W programming practice of Link Information
  - (8) Bluetooth S/W programming practice of L2CAP Connection
  - (9) Bluetooth S/W programming practice of L2CAP Data
  - (10) Bluetooth S/W programming practice of Connectionless Data
  - (11) Bluetooth S/W programming practice of Echo and Ping
  - (12) Bluetooth S/W programming practice of Quality of Service
  - (13) Bluetooth S/W programming practice of Bluetooth Service
  - (14) Bluetooth S/W programming practice of Generic Access Profile
- 3) PC SW UI
  - (1) Bluetooth Client S/W
    - Display Bluetooth Local Device Information and Status
    - Display Bluetooth Host Control Command
    - Display Bluetooth Raw Data
  - (2) Bluetooth Server S/W
    - Display Bluetooth Local Device Information and Status
    - Display Bluetooth Remote Device Information and Status
    - Display Bluetooth Host Control Command
    - Display Bluetooth Event Code and Event Message
- 4) Hardware spec
  - (1) Output Interface UART
    - : Compliant Bluetooth Specification v1.2- improved AFH (Adaptive Frequency Hopping)
  - (2) Transmit Power : Max. +4dBm
  - (3) Receiving Sensitivity : -80dBm(0.1%BER)
  - (4) Provides transparent RS232 serial cable replacement.
  - (5) Supports Bluetooth Serial Port Profile.
  - (6) Interoperability with PDA, laptops etc.
  - (7) Built-in chip antenna included
  - (8) Supports firmware upgrade via windows-based software
  - (9) Working distance ( In an open field ): Class 2, Nom. 30meters, up to 300m using patch antenna

# 16

## a group of Fiber optic training system

- 27. Fiber optic connectorization & splice kit
- 28. Fiber optic-3000
- 29. Fiber optic line field service trainer-5000

## Fiber optic connectorization & splice Kit

## Features

These Kits are very necessary for termination and splicing the optical fiber. With metal cables you simply twist both the cables together and join them electrically. In Optical Fiber you are required to match exactly the glass surfaces of both the fibers to make an optically perfect joint. Any mismatch or gap between the surfaces will increase, the optical losses during transmission.

These Kits contains all necessary tools, consumables, connectors and cable to demonstrate and practice the process.

The focus is on the specialization and quality rather than just collecting material and supplying it.

A neatly written step by step procedure with pictures is provided in the Instruction booklets.

These kits form an important part of the Fiber Optic Laboratory.  
One can understand clearly how optical fibers are joined and terminated.

## System configuration



## Components

Fiber stripper	1 EA
Semi-automatic fiber cutter	1 EA
Wire stripper	1 EA
Scissor	1 EA
SC/PC Connectors for field connection (for FTTH)	1 EA
(Another types can be provided)	
Alcohol injector	1 EA
Fiber Power-meter	1 EA
A Failure detector	1 EA
IPA Alcohol	1 Bottle
Gauze	1 Pack
Steel ruler	1 EA
Aluminium carrying bag	1 BAG



## Spec

### 1) Semi-automatic fiber cutter

Optical fiber diameter	125 $\mu$ m
Coating diameter	250 ~ 900 $\mu$ m
Cutting angle	90 ° $\pm$ 0.5 °
Cutting length	Single 5mm ~ 20mm
Blade life-cycle	50,000
size	58 x 55 x 48mm
weight	340g

### 2) A Failure detector

- (1) The 650nm visible red light is transmitted, where the bent & crack & break point of fiber optic cable can be detected.
- (2) Enhanced durability with aluminum body.
- (3) It is useful to check the fiber optic cable number from the long distance area.
- (4) With universal connector type, user can check all of 2.5mm (SC, ST, FC connectors) ferrule.
- (5) For the LC measurements, user can purchase the additional hybrid adapter

### 3) Fiber Power-meter

Measuring range	FHP1A02	-60 to +3
(dBm)	FHP1B02	-40 to +23
Resolution(dB)	0.01	
Wavelength	850, 1300, 1310, 1490, 1550nm	
Connector	FC/PC, SC/PC, ST/PC, Universal	
Accuracy	$\pm 0.35\text{dB} \pm 10\text{nW}$	
Detector	InGaAs	
Uncertainty	+/- 5%	
Power	1pcs Li-ion battery : 5V AC/DC Adapter	
Operating temperature	-10 ~ + 50	
Storage temperature	-20 ~ + 70	

## Training contents

### . Overview

#### . Optical fiber cable

1. Considerations on manufacturing optical fibers
2. Single optical cable
  - 1) Structure of buffer jacket for optical fiber cable
  - 2) Data sheet for single-mode optical fiber
  - 3) Data sheet for Stepped type, refractive index of optical

fiber

3. Multi-layer optical cable
  - 1) Data sheet for multi-layer optical cable
  - 2) Cable structure
  - 3) Cable photo

#### . Splicing

1. Fusion splicing
2. Mechanical splicing
  - 1) photo of mechanical connection
  - 2-1) Mechanical type, Splice-1
  - 2-2) Mechanical type, Splice-2
  - 3-1) Optical fiber elastic polymers, Splice-1
  - 3-2) Optical fiber elastic polymers, Splice-2
3. Real practice for splicing

#### . Optical Connector

1. Optical Connector
2. Basic structure
3. Connection loss

4. main cause of reflection noise
5. Type of Connectors for optical fiber
6. Adapter
7. single & multi-layer optical fiber connector
8. Principle of magnified beam
9. Single-mode magnified beam connector

#### . Connection Loss

1. Mismatch of fiber characteristics (intrinsic loss)
2. Misalignment loss (extrinsic loss)
3. Fiber properties mismatch

#### . Optical fiber coupler

1. Coupler distribution system
- 2-1. Forming coupler
- 2-2. Formula of Forming coupler
3. T Coupler
4. Bi-directional coupler specification
5. Other coupler

#### . Optical fiber switch

1. Simple Optical switch
2. Direct Optical switch

# model: **Fiber optic-3000**

## Fiber optic trainer

### Features

- This system is designed for users who practice Analog and Digital signal transmission experiment using the basic signal amplifier and the optic fiber.
- Hardware architecture was modularized as per each functions for easy understanding on below ;
  - characteristics of optical devices
  - characteristics on fibers
  - configuration on peripheral circuits
- All light sources used for the system are designed using the visible light spectrum so that users can visually check the light emitted from the system and can also observe the total reflection phenomenon of the optic fiber.
- Users can check digital signal transmission and processing without a PC using the keypad and FND module provided with the system and can also perform experiments using the provided PC communication program.
- Any users who are interested in optical communication can easily access this system to perform experiments. The system can also be used as a textbook at universities or for field engineers in the optical communication industries to learn about optical communication knowledge.

### Functions

- 1) understanding on Fiber optic equipment
- 2) practice of Analog/Digital communication via fiber optic devices
- 3) Voice communication practice via optic cable
- 4) Interface to external circuitry
  - Digital communication (Serial Communication by USB to RS-232 cable)
  - Optical conversion circuit (Electricity-Optical, Optical-Electricity)
  - Voice (Mike, Speaker)
- 5) PC connection to demonstrate data link.

So, Fiber optic-3000 is suitable for many levels of education like below ;

- Technical training centers
- Scientific / Technical Professionals
- Research and development personnel in industry
- Students in Universities, Polytechnics and Science Colleges.

### System configuration



## Components

Hardware platform	1
USB to RS232 cable	2
Mike	1
Double Convex lens	1
Optical jumper cable (10 meter)	1
Optical jumper cable (connector)	2
Single mode optical jumper cable	1
Optical guide	1
Laser point	1
Half Mirror Box	1
Half Mirror	1
Optical jumper cable	1
AC/DC ADAPTER	2
Optical jumper cable (50Cm)	1
Program CD for RX, TX	1
Manual book	1

## Training Contents

- Chap 1, Introduction to optical communication technology  
 Chap 2, Measuring the characteristics of S1 and Ge diodes with a waveform generator  
 Chap 3, Measuring the characteristics of electrical-optical conversion device, LED, with an oscilloscope and a waveform generator  
 Chap 4, Measuring the characteristics of electrical-optical conversion device, LD, with a oscilloscope and a waveform generator  
 Chap 5, Measuring the characteristics of optical-electrical conversion device, PD, with an oscilloscope and a waveform generator  
 Chap 6, Measuring the threshold angle of total reflection using a Laser pointer  
 Chap 7, Practice of optical characteristics using lens  
 Chap 8, Measuring loss with bending radius of optic fiber  
 Chap 9, Observing noise of multi-mode optic fiber  
 Chap 10, Measuring loss with connection of optical connector  
 Chap 11, Understanding the principle of optical coupler and measuring the branching ratio  
 Chap 12, Practice of voice transmission with mike and optic fiber  
 Chap 13, Measuring loss with length of optic fiber  
 Chap 14, Comparison of multi-mode optic fiber and single mode optic fiber with different diameters of optic core  
 Chap 15, Practice of digital signal transmission using the keypad and the FND module  
 Chap 16, Digital signal transmission using PC

## Spec

### 1) Main board

Main board size	350*400 mm
Output connector	BNC, oscilloscope port, 3 ea
	Tx, RS-232, D-sub 9p, 2 ea
	Power output for Laser diode
	Speaker output
Input connector	RS, RS-232, D-sub 9p, 2 ea
	Mike input port
Optical connector	PD input connector
	LED output connector, 2 ea, Red/White
	Laser diode output connector
External power input	100~240 V, 50~60 Hz
Internal power	DC 12 V, 2 ch
Power consumption	Below 15 V (subject to change)

2) Laser Diode

Peak wavelength	650nm
Operating voltage	4.5V
Operating current	< 40mA
Optical power	135mW( $\pm$ 5mW)
Spot diameter	10 < 15
Operating temperature	-36 ~+65
Storage temperature	-36 ~+65

3) Function Generator

Frequency Range	10Hz 10KHz
Wave Form	Sinusoidal, Triangle, Square
Amplitude	0V 1.5V

4) Display

Output	7-segment, 4 ea
Input	USB to RS-232C communication

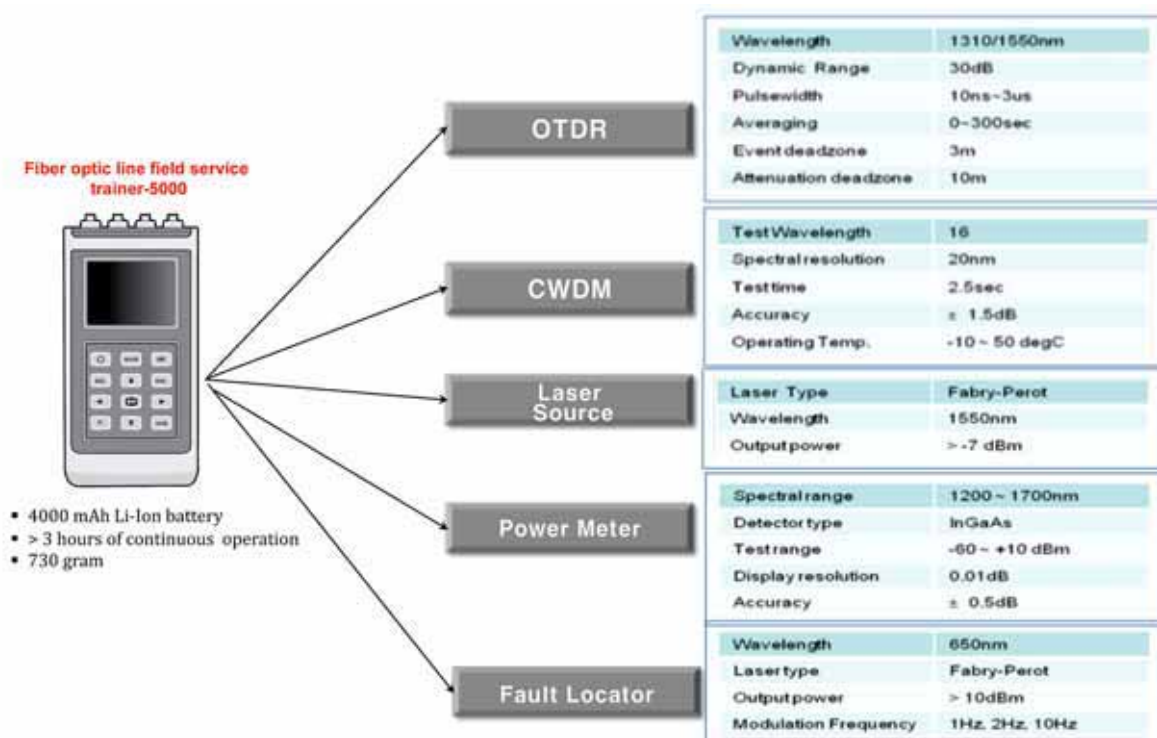
# model: Fiber optic line field service-5000

## Fiber optic line field service training system

- 1) Fiber optic line field service-5000 is the equipment for optical line field service.
- 2) In optical line field service, OTDR, CWDM, Laser Source, Power Meter, Fault Locator is mainly used.
- 3) Fiber optic line field service-5000 was developed to implement 5 functions such as OTDR, CWDM, Laser Source, Power Meter, Fault Locator in a single device.
- 4) Fiber optic line field service-5000 was developed for easy-to-carry size hardware. In particular, it was developed for fast speed in initial working stage through the short boot & run time.
- 5) By easy operation, untrained user can easily operate the system.
- 6) Fiber optic-5000 application software program, which is installed to all of Android terminals, is provided.  
If user install Fiber optic-5000 application software program to Android terminals (Samsung Galaxy phone, or Samsung Galaxy Tab,, etc), Fiber optic-5000 hardware and Samsung Galaxy Tab is connected by Bluetooth pairing. Then, the measured data from Fiber optic-5000 for OTDR, CWDM, Laser Source, Power meter, Fault Locator is automatically and simultaneously displayed to Samsung Galaxy Tab.  
Data can be saved and controlled by Samsung Galaxy Tab.
- 7) Fiber optic-5000 manual book is faithful to learn about the theory on OTDR, CWDM, Laser Source, Power Meter, Fault Locator. There are the detailed explanation of theory, formula,, etc for OTDR, CWDM, Laser Source, Power Meter, Fault Locator.

### Features

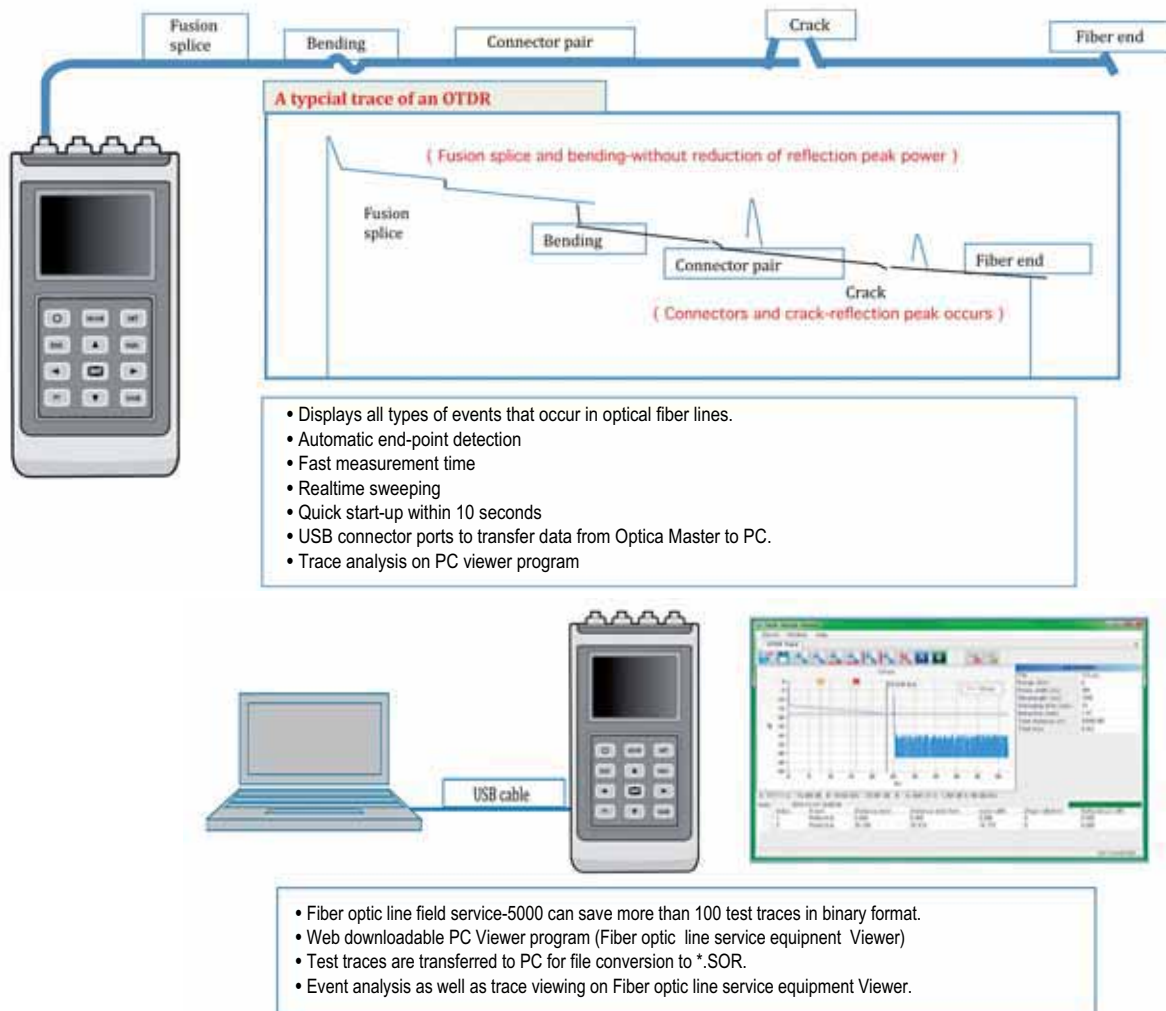
Fiber optic line field service-5000 was developed to implement 5 functions such as OTDR, CWDM, Laser Source, Power Meter, Fault Locator in a single device



## Functions

### 1) OTDR

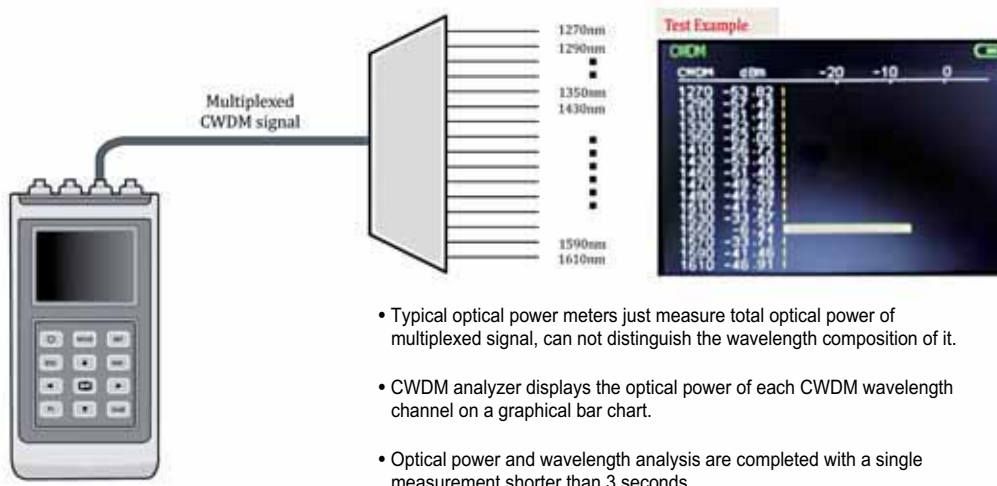
It is a device that measures a loss distribution of optical fiber by measuring a distance from the intensity of backscattered light, which is formed when the optical pulse is reflected after being projected to the optical fiber.



### 2) CWDM Analyzer (2 sets of hardware is needed)

CWDM stands for Coarse Wavelength Division Multiplexing.

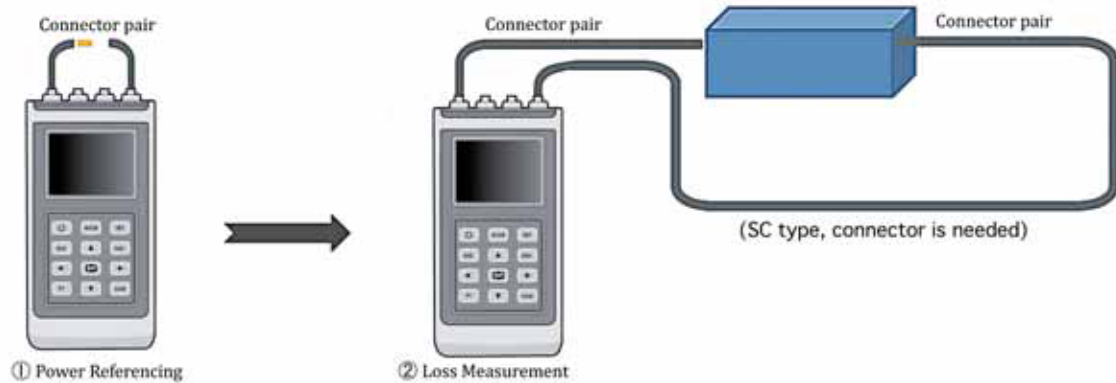
Base station network of mobile communication generally uses an optical carrier wavelength that applies correspondingly to CWDM standard of ITU-T.



### 3) Loss Measurement ( Laser Source & Optical Power Meter )

Laser Source is a laser light source which is used with Optical Power Meter to measure a loss of optical fiber. Optical Power Meter is a measuring equipment used for inspecting flaws including a disconnection of optical fiber cable and poor signal, and it is used to examine the connection status of optical fiber cable between the base station and repeater.

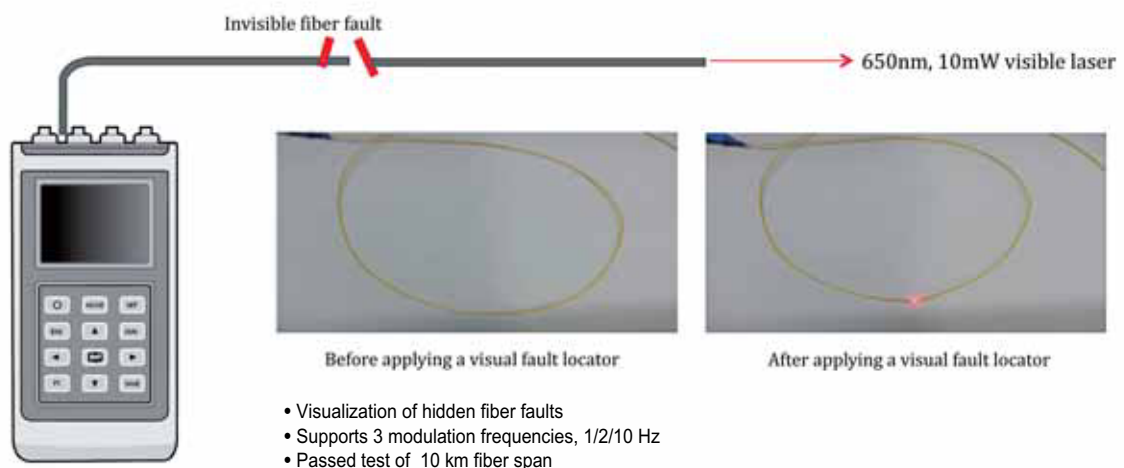
- Optical loss measurement with a single test set
- Laser On/Off control in Optical Power Meter mode



### 4) Visual Fault Locator

Visual Fault Locator is used for verifying cut-off point of optical fiber with the naked eye by using 650nm of red visible light source.

In case of communication problem due to an uncertain cause, connect Fault Locator to the broken cable.





### [ Currently used system ]

: Below 5 devices are mostly & frequently used in optical line field service.



- Too expensive
- Too heavy
- Too many
- Too complicated to operate
- Too long to start up



### All in one system

(5 functions is implemented by Fiber optic line field service-5000)

### [ Fiber optic line field service -5000 ]



- Cost effective
- Light weight
- All in a single enclosure
- Easy & intuitive
- Quick to start up



## Specification (Components included)

### 1) Components

Hardware of Fiber optic line field service trainer	1 set
test cable dummy	1 km
USB Cable	1 ea
FC Adapter Head for replacement	3 ea
Charging adapter	1 ea
Software Program CD (Android Terminals Application S/W)	1 ea
Car Charging Jack	1 ea

### 2) Specification on Hardware of Fiber optic-5000

OTDR	Laser wavelength	1310nm / 1550nm
	Laser type	Fabry-Perot type
	Output power	over 60mW
	The minimum pulse width	10nsec
	The maximum pulse width	3usec
	Dynamic Range	More than 33dB
	Event dead zone	3m or less
	Attenuation dead zone	10m or less
	Distance Accuracy	within 3m @10km
	Number of sampling points	12800ea
	Averaging time	real time ~ 300sec
	Optical adapter	SC/PC, FC/PC adapter head 2 type provided
LD Source	Laser wavelength	1550nm
	Laser type	Fabry-Perot type
	Output power	more than -7dBm
	Power Stability	0.1dB
	Optical adapter	SC/PC, FC/PC adapter head 2 type provided
CWDM Analyzer	number of scan wavelength	CWDM 16 wavelength (1370nm, 1390nm excluded)
	Scan speed	under 3sec /scan
	Power accuracy	1dB or less
	Scan type	Stepper motor driven type
	Optical adapter	SC/PC, FC/PC adapter head 2 type provided
Optic power meter	Wavelength area	1200nm ~ 1700nm
	Detector type	InGaAs
	Power measuring range	-60 ~ +10dBm
	Power accuracy	within 0.5dB
	Display resolution of optical power	0.02dB
	Optical adapter	2.5mm, univesal type
Fault Locator	Laser wavelength	650nm
	Laser type	Fabry-Perot type
	Output power	more than 10mW
	Modulation frequency	0Hz / 1Hz / 2Hz / 10Hz
	Optical adapter	SC/PC, FC/PC adapter head 2 type provided
General spec	Display	3.5inch color TFT LCD
	Date port	5pin mini USB
	Power	Li-Ion Polymer rechargeable battery (built-in)
	External devices can be interlocked	Android-based smartphones and tablets
	Charge capacity	4000mAh
	Hardware system Size	210(L) * 105(W) * 50(T) [mm]
	Weight	730g
	operating temperature	-10 ~ 60 °C
	Storage Temperature	-40 ~ 80 °C

## Training contents

### Part-1) Introduction of Fiber optic-5000

1. Notice before operating
2. Breakdown of product components
3. Specification for Exterior and basic operation keys
4. Getting started.
5. Setting Current time
6. Mode (Functions and Words)
7. Mode : OTDR
  - 1) Enter to SET Mode
  - 2) Start Measurement
  - 3) Save
  - 4) Recall stored files
  - 5) Delete stored files
8. Mode : CWDM Analyzer
9. Mode : LD Sources
10. Mode : Optical Power Meter
11. Mode : Visible Laser

### Part-2) Connection status of Fiber optic-5000 using dummy cable, Distribution frame and jump cable

1. OTDR measurement
2. CWDM measurement
3. Power Meter measurement
4. Visible Laser measurement

### Part-3) Quick operating guide of Fiber optic-5000

1. Develop Environment
2. Product Components
3. Basic manipulation
4. Principal Details
5. Major function - OTDR
  - 1) Understanding of OTDR
    - (1) OTDR
    - (2) Rayleigh scattering
    - (3) Distance calculation
    - (4) Ghost Echoes
    - (5) Pulse Width
    - (6) Dead zone
    - (7) Pulse width & distinguish limit

- (8) Equalization
  - (9) Setting
  - (10) Measure
  - (11) Save and Recall
  - (12) Android Terminals handset interlock
  - (13) Getting SOR file by Android handset
  - (14) Android handset chart window
6. Major function - CWDM Analyzer
  - (1) Coarse Wavelength Division Multiplexing
7. Major function - Visual fault locator
9. Major function - Loss Measurement
  - ( Laser source and optical power meter)
    - 1) LD Source
    - 2) Optical Power meter

### Part-4) Theory of Fiber optic-5000

1. OTDR
  - 1) The principles of OTDR
  - 2) Rayleigh backscattering and Fresnel reflection
  - 3) Attenuation dead zone(ADZ) and dynamic range(DR)
2. CWDM
  - 1) The principle of CWDM
  - 2) CWDM and DWDM
3. Power Meter
  - 1) The principle of optical power meter
  - 2) Power measuring range
4. LD Source
5. Visible Laser

# 17

## a group of RFID Trainer

30. RFID-1356

# model: **RFID-1356**

## **RFID Development Kit**

### **General**

RFID-1356 Kit is the best developer kit to characterize and understand the equipment of RFID 13.56MHz band. The kit is designed for use of university students, research institutions. It is configured to be compatible with Arduino. User can control RFID reader, LCD, LED, and Buzzer under Arduino board environment or by connecting directly to PC.

RFID-1356 kit is high performance learning and training system for understanding basics, working and application of RFID (Radio Frequency Identification) in the school or laboratories.

It comprises of Contactless RFID Reader, 5 Contactless RFID Cards, Host program, Firmware source and Textbook for lectures.

Using this trainer, a professor can teach students the RFID technologies including Anti-collision algorithm.

RFID\_main\_demo, BUSCARD\_demo, Gate-control\_demo, Step motor-control\_demo is exercised.

Also belows are provided to help the development of RFID-13.56MHz applications ;

ISO15693 Air Interface Protocol Function Library

RFID13.56MHz API Development Guide for RFID Reader

RFID13.56MHz Demo Source Code (PC) (c#/c++/Delphi/Java/vb6)

### **Feature**

Contactless RFID Reader operating at 13.56 MHz(ISO15693) over 16cm range (CARD Type).

Supports for ISO15693 passive Transponders(Tags).

Supports for ISO15693 Standard and Optional commands.

Supports for Anti-collision operations (detects multiple Tags simultaneously).

Provided with Host GUI DEMO Program for protocol training.

Provided with Arduino Source Code Support

Provided with Demo Source Code Support For PC user(c#/c++/Delphi/Java/vb6)

USB port used for serial communication with PC (It also supports 9pin serial ports).

Use an Arduino Mega 2560 compatible board.

It can be changed by user's programming for on-board Buzzer, LCD, LED(red, green) display of system operations.

Easy to manufacture RFID applications through Arduino with a lot of versatility and peripheral devices.

#### **< operation through Arduino, RFID Reader & PC >**

UID display or other status values can be displayed on the LCD

Practice building an embedded system by programming with Arduino

Practice data communication between Arduino board and PC

Read and write data block of tag

Write and read by designating tag block

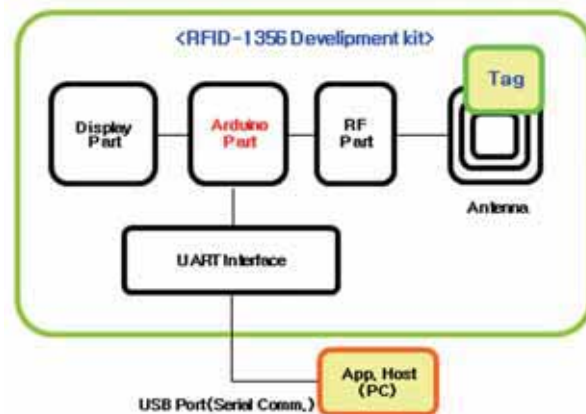
Try the use of the anti-collision function

Using RFID Reader Self-Option function

Arduino buzzer, LED, Step-motor control by RFID Reader & Tag

## System configuration

### 1) Conceptual Diagram



### 2) Hardware system



## Advantages

- 1) Over 3ea of Tags can be simultaneously detected depending on Tag size, which is the same performance with the commercial system.
- 2) The recognition speed is 100 m / s based on UID and recognition distance is 16cm.
- 3) Variety of contents including basic theory, operation experiments, protocols such as anticollision, application programming, etc. in manual book.
- 4) Easy learning of RFID commands and protocol through Host GUI program.
- 5) Learning basic RFID control makes it easier to implement a commercial RFID management system such as Libraries, gate control, public transportation card system, membership management, access control, etc.

## Components

item	Spec	Q ty
RFID Reader	13.56MHz(ISO15693)	1EA
Tag (VICC)	CARD Type	20 EA
Tag (VICC)	Inlay Type	10 EA
USB2.0 Cable (With Converter)	PC Interface	1EA
Power Adaptor	"DC 12V output, AC 220V 60Hz input"	1EA
Arduino Board	Arduino Mega 2560	1 EA
Power Adaptor	DC 9V output, AC 220V 60Hz input	1EA
Base Board	"BASE BOARD(LCD + LED(R/G))"	1EA
	+ Step-motor + Buzzer	
	+ Dead volt (DC12V, GATE Access control)	1EA
Program CD		1EA
Manual book		2 book

## Training Contents

### \* Training Books No 1 (RFID-1356 Guide)

#### Part-1, Operational manual for RFID-13.56MHz kit

- 1) Notes
- 2) Components
- 3) Assemble and connect the parts.
- 4) Install Demo program and start the operation
  - 4.1) install and operate for RFID\_main\_demo
    - 4.1.1) execute TagAccess\_CS.exe
    - 4.1.2) Main\_demo GUI menu is below ;
  - 4.2) Install and operate for RFID\_BUSCARD\_demo
    - 4.2.1) execute "RFID\_SAMPLE.exe"
    - 4.2.2) GUI menu for BUSCARD DEMO
  - 4.3) Install and operate for RFID\_Gate\_Control demo
    - 4.3.1) execute RFID\_SAMPLE.exe
    - 4.3.2) GUI menu for GATE Control DEMO
  - 4.4) LED/BUZZ/LCD/LOCK On/Off Protocol
- 5) explanation on ARDUINO
- 6) Step-motor control
  - 6.1) Hardware & how to operate Step motor
  - 6.2) MOTOR PinMAP
  - 6.3) Mortor example source code

#### Part-2, ISO15693 Air Interface Protocol Function Library

- 1) Introduction
- 2) Application Integration
- 3) Programming Interface
  - 3.1) Brief Introduce
  - 3.2) ISO15693\_GetLibVersion [Get Library Version]
  - 3.3) ISO15693\_CreateInvenParam [Create Inventory Parameter]
  - 3.4) ISO15693\_ParseTagDataReport [Parse Tag Data Report]
  - 3.5) ISO15693\_Connect [Connect Tag]
  - 3.6) ISO15693 Standard Command
    - 3.6.1. ISO15693\_ReadMultiBlocks [Read Multi Blocks]
    - 3.6.2. ISO15693\_WriteMultipleBlocks [Write Multiple Blocks]
    - 3.6.3. ISO15693\_LockMultipleBlocks [Lock Multiple Blocks]
    - 3.6.4. ISO15693\_WriteAFI [Write AFI]
    - 3.6.5. ISO15693\_LockAFI [Lock AFI]
    - 3.6.6. ISO15693\_WriteDSFID [Write DSFID]
    - 3.6.7. ISO15693\_LockDSFID [Lock DSFID]
    - 3.6.8. ISO15693\_GetSystemInfo [Get System Info]
    - 3.6.9. ISO15693\_GetBlockSecStatus [Get Data Block Security Status]
  - 3.7) NXP ICODE-SLI Custom Command
    - 3.7.1. NXPICODESLI\_EableEAS [Open EAS Function]
    - 3.7.2. NXPICODESLI\_DisableEAS [Close EAS Function]
    - 3.7.3. NXPICODESLI\_LockEAS [Lock EAS]
    - 3.7.4. NXPICODESLI\_EASCheck [Check EAS]
    - 3.7.5. NXPICODESLI\_GetRandomAndSetPassword [Get Random Password]
    - 3.7.6. NXPICODESLI\_WritePassword [Write Password]
    - 3.7.7. NXPICODESLI\_LockPassword [Lock Password]
    - 3.7.8. NXPICODESLI\_PasswordProtect [Set Password Protect]

#### Part-3, RFID13.56MHz API Development Guide for RFID Reader

- 1) Summarize
- 2) Layer
  - 2.1) General Structure
  - 2.2) Layer#1 :Device Drivers
  - 2.3) Layer#2: Device Common Programming Interface
  - 2.4) Layer#3: Air protocol interface
    - 2.4.1) Description
    - 2.4.2) Supported air protocol interface
- 3) Directory navigation
  - 3.1) doc
  - 3.2) samples
- 4) API calling step
  - 4.1) Open reader driver
  - 4.2) RFID Reader Operation
    - 4.2.1) Tag Inventory
    - 4.2.2) RFID Tag Access
  - 4.3) ISO15693 tag access C++ example
- 5) Connection String
  - 5.1) Description
  - 5.2) Build connection string of serial port
    - 5.2.1) Format example
    - 5.2.2) Parameter description
  - 5.3) Build connection string of USB
    - 5.3.1) Format example
    - 5.3.2) Parameter description
  - 5.4) Build connection string of network
    - 5.4.1) Format example
    - 5.4.2) Parameter description
  - 5.5) Build connection string of Bluetooth
    - 5.5.1) Format example
    - 5.5.2) Parameter description
- 6) Description of common API calls for the rfidlib\_reader.dll
  - 6.1) Enumerate serial ports
    - 6.1.1) API Introduction
    - 6.1.2) C# programming example
  - 6.2) Enumerate the inserted USBHID Readers
    - 6.2.1) API introduction
    - 6.2.2) C# programming example
  - 6.3) Enumerate the matched Bluetooth readers
    - 6.3.1) API introduction
    - 6.3.2) C# programming example
  - 6.4) Enumerates the loaded RFID reader driver
    - 6.4.1) API introduction
    - 6.4.2) C# Programming example
  - 6.5) RS485 Bus programming
    - 6.5.1) Description
    - 6.5.2) C++ programming example
  - 6.6) GPIO output control
    - 6.6.1) API introduction
    - 6.6.2) API calling process
    - 6.6.3) C++ programming example

- 6.7) Get Input GPIO status
- 6.8) Get device information
- 6.9) Read/write configuration block
- 6.10) To fetch buffer record in Buffer mode

- 1.3. Variable type defined in C#
- 1.4. Variable type defined in delphi
- 1.5. Variable type defined in VB
- 1.6. Variable type defined in VB.net

#### Appendix 1. RFIDLIB variable type

- 1.1. Variable Type Description
- 1.2. Variable type defined in C++

#### Appendix 2. RFIDLIB API error table

- 1.1. H/W Question & Answer
- 1.2. S/W Question & Answer

### \* Training Books No 2 (Source Code Collection)

#### Part-4, RFID13.56MHz Demo Source Code (PC) (c#/c++/Delphi/Java/vb6)

Practice-1, RFID port set / UID read / Block read & write etc.

#### Part-5, RFID-13.56MHz Demo Source Code for Arduino

Practice-1, RFID port set / UID read / Block read & write etc.

Practice-2, LCD Control / buzzer Control / LED control

Practice-3, Data communication control

#### Part-6, RFID-13.56MHz Application Practice Source Code

Practice-1, Gate Control System

Practice-2, Public Transport Card System

Practice-3, Step-motor Control System

## Specification

### (1) General

- Operating Voltage	: 12.0VDC $\pm$ 5%
- Reader Status Monitor	: 16*2 character LCD
- Transponder Type	: ISO 15693 type RFID Card(13.56MHz)
- Interface	: RS232, RS485, USB(converter)
- Reading Distance	: 16 cm
- Anticollision Performance	: over 3 Transponders
- RF power	: Max 0.6w
- Host Interface Type	: USB-Virtual serial comm.
- Host Interface Baud Rate	: 38400 bps
- Operating Current(RF carrier ON)	: 400mA(MAX)
- Operating Temperature	: -25 to +70 °C

### 2) Hardware Devices

#### (1) Reader & Control Board

RFID Air Interface Section	- Operating frequency	: 13.56MHz
	- Proximity operating distance (~16 cm)	
	- Supported ISO15693	
	- Automatic detection of parallel u-processor interface type	
	- Comfortable 64 byte send and receive FIFO-buffer	
	- Unique serial number	
Control Section	- User programmable start-up configuration	
	- Microcontroller ATmega2560 (R3)	
	- Operating Voltage 5V	
	- Input Voltage (recommended) 7-12V	
	- Input Voltage (limits) 6-20V	
	- Digital I/O Pins 54 (of which 14 provide PWM output)	
	- Analog Input Pins 16	
	- DC Current per I/O Pin 40 mA	
	- DC Current for 3.3V Pin 50 mA	
	- Flash Memory 256 KB of which 8 KB used by bootloader	
	- SRAM 8 KB	
	- EEPROM 4 KB	
	- Clock Speed 16 MHz	
	- ATmega2560 Support 4 H/W UART for 5V TTL Serial Communication	
	- ATmega2560 Support TW, SPI Communication	

Display & keypad Section	- Format : 16x2 characters
	- LCD mode : STN / Negative/Transmissive /Blue
	- Viewing direction : 6 o'clock
	- Driving scheme : 1/16 Duty, 1/5 Bias
	- Power supply voltage (VDD) : 5.0V
	- LCD driving voltage : 5V (reference voltage)
	- 5 simulation keystrokes
	- Backlight color : Side White
	- Module size : 85.0mm(L)*58.0mm(W)*19.6 mm(H)max
	- Viewing area : 65.00mm(L)*17.20mm(W)
	- Character pitch : 3.65mm(L)*5.05mm(W)
	- Character size : 2.95mm(L) *4.35mm(W)
	- Dot pitch : 0.60mm(L)*0.55mm(W)
	- Dot size : 0.55mm(L)*0.50mm(W)
Buzzer & LED Section	- 10mm Buzzer
	- 2 LED ( Red/ Green)

**(2) Tag**

- Supported Standard	: ISO15693
- Operating Frequency	: 13.56MHz
- Typ. Required Activation Field Strength Read (at _25°C)	: 94 dBuA/m
- Typ. Required Activation Field Strength Write (at _25°C)	: 97 dBuA/m
- Factory Programmed Read Only	: 64bit
- Memory (user programmable)	: over 1K bits

**3) Software Programs****(1) GUI Program**

- Support for PORT/OPEN/CLOSE menu
- Support for UID SCAN Information
- Support for Scan Option configuration
- Support for DataBlock Read & Write
- Support for Multitag read test mode
- Support for DSFID/AFI Write Command
- ISO15693 commands selectable using 'Select Command
- Serial port selectable from COM PORT menu

**(2) Application Programs**

- Buzzer beep embedded programming application
- Support for APIs as object file for RFID embedded programming
- Program source for Gate Control System application (use gate DeadBolt)
- Program source for Public Transport Card System application
- Program source for Step-motor Control System application



# 18

a group of  
**Digital Multimedia Broadcasting trainer**

31. DMB-7000

# model: **DMB-7000**

## Digital multimedia broadcasting system trainer

### System configuration & Features

#### ( System configuration )



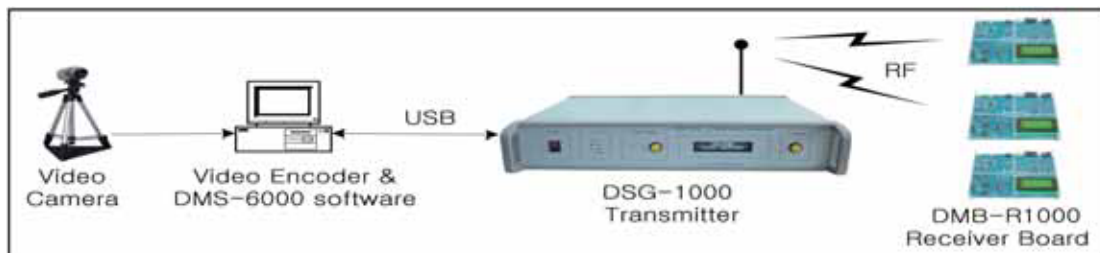
(Transmitter : DSG-1000 )



(Receiver : DMB-R1000 )



(Program CD : DMS-6000)



- a) Through USB connection to personal computer, the DMS-6000 Manager Software on a PC can perform various functions such as; control and monitoring of the DSG-1000 transmitter, ETI stream transfer, etc.
- b) User can receive DAB / DMB signals with their test receiver and can perform various tests.

#### ( Features )

We announce the developments of DAB / DMB Trainer System, DSG-1000 and DMB-R1000. Which comply Eureka-147 and T-DMB standard completely, and can be used in training of DAB / DMB receiver development. The System consisted of DMB-R1000, receiver board, DSG-1000, the T-DMB transmitter, and DMS-6000, the Manager Software for DSG-1000. DSG-1000, the DMB signal generator, generate Band 3 (174~250MHz) RF signal. With USB interface adopted, this equipment can be connected to a PC and can transfer contents and control data. The DMS-6000, Manager Software for DSG-1000, runs on a PC and performs controls over DSG-1000 and can transfer contents data from a PC to the transmitter.

DMB-R1000, the T-DMB receiver board, can receive the T-DMB signal and can produce sound for audio services, or can capture the stream of TV channels. Using this board, students can examine various functionality such as; control of tuner, baseband chip, switches, and display devices of the DMB-R1000 receiver board.

The development environment for the trainer system is a Linux system running on a PC. Using Linux system, students can edit, compile, download to DSG-1000 board, and execute their test program of DMB receiver.

The contents for generation of DMB signal can be stored in Flash Memory of the transmitter or a hard disc of a PC. Using these contents, the software of DSG-1000 or DMS-6000 Manager Software can generate ETI stream, which can be used for DMB signal generation in real time.

For training of DMB receiver development using DSG-1000 and DMB-R1000, students only require experience of basic C programming.

With DMB-R1000 receiver boards, DSG-1000 transmitter, and a DMS-6000 Manager Software, and a 15 chapter textbook students can learn and test T-DMB system architecture, T-DMB services, T-DMB receiver hardware and software.

With its convenient and flexible functionality, the DMB-7000 Trainer System provides the complete environment for training of DAB/DMB receiver development.

DSG-1000, the T-DMB signal generator, features can be summerized as follows ;

- 1) Eureka - 147 standard comply.
- 2) T-DMB standard comply
- 3) OFDM signal generation
- 4) Transmission mode 1,2,3, 4
- 5) RF signal : Band 3 (174 ~ 250 MHz)
- 6) RF output level : 0 ~ - 20 dBm
- 7) USB interface for control / data transfer
- 8) ROM ETI mode, File ETI mode, ETI sythesis mode, DMB system download.

DMB-R1000, the T-DMB receiver board, features can be summerized as follows ;

- 1) Eureka - 147 standard comply.
- 2) T-DMB standard comply.
- 3) ARM9 processor based control of LED/LCD/Tuner/Baseband chips.
- 4) Audio and video contents receiving.

DMS-6000, the DMS-6000 Manager Software, features can be summerized as follows ;

- 1) Eureka - 147 standard comply.
- 2) T-DMB standard comply
- 3) ETI 300 799, Ensemble Transport Interface (ETI) comply.
- 4) Multiplexing.
- 5) Control of DSG-1000 transmitter.
- 6) Downloading of contents streams to a DSG-1000 transmitter.
- 7) USB interface to/from DSG-1000 transmitter.
- 8) Monitoring of DSG-1000 transmitter.

Through above features, DMB-7000 Trainer System can support the following Applications;

- 1) Training of DAB / DMB receiver development.
- 2) Test system for DAB / DMB contents.
- 3) Training for RF signals of DAB / DMB system.
- 4) Test Transmit equipment of DAB / DMB.
- 5) Demonstration system for DAB / DMB.

## Specifications

### DSG-1000

- 1) System standard
  - (1) Eureka 147 DAB system : ETSI EN 300 401
  - (2) ETI : ETS 300 799 Ensemble transfer protocol
  - (3) Terrestrial DMB : TTAS.KO-07.0024, TTAS.KO-07.0026
- 2) RF
  - (1) Frequency : Band 3 (174 ~ 250MHz)
  - (2) Output level : 0 dBm ~ - 20 dBm
  - (3) Impedance : 50 Ohm
- 3) Modulation
  - (1) OFDM (Orthogonal Frequency Division Multiplex)
  - (2) DQPSK (Differential QuadraTURE Phase Shift Keying)
- 4) Frequency Reference
  - (1) Internal Reference & Stability : 10MHz, + -10exp(-7)
- 5) Remote Control
  - (1) USB
- 6) Miscellaneous
  - (1) Operation Temperature : 0 ~ 55
  - (2) Power Supply : 100 to 240VAC, 50 / 60Hz
  - (3) Dimensions : 434(W) x 370(L) x 88(H)
  - (4) Weight : 5.0kg

### DMB-R1000

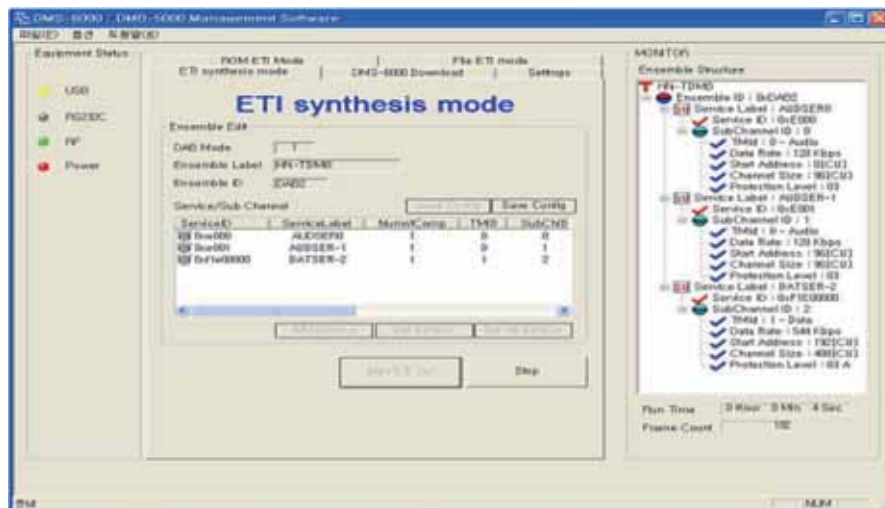
- 1) System standard
  - (1) Eureka 147 DAB system : ETSI EN 300 401
  - (2) Terrestrial DMB : TTAS.KO-07.0024, TTAS.KO-07.0026
- 2) RF
  - (1) Frequency : Band 3 (174 ~ 250MHz)
  - (2) sensitivity : -96dBm
  - (3) Antenna Impedance : 50 ohm

- 3) DMB Processor
  - (1) Tuner : ITD3010 (Integrant)
  - (2) Baseband : PN3030(PNP Network)
  - (3) Controller : S3C2440(ARM9, Samsung)
- 4) PC Interface
  - (1) USB
- 5) Peripheral
  - (1) Monochrome LCD : 16 x 4 characters
  - (2) LED 4 ea.
  - (3) DIP switch : 4 ea.
  - (4) Audio Jack : 1 ea.
- 6) Miscellaneous
  - (1) Operation Temperature : 0 ~ 55 Degrees Celsius.
  - (2) Power Supply : DC 5V, 3A
  - (3) Dimension : 185(W) x 155(L) x 35(H) mm
  - (4) Weight : 300g

## Components

DSG-1000 Transmitter	1 EA
DMB-R1000 Receiver Board	1 EA
DMS-6000 Manager Software CD	1 EA
Textbook	1 EA
User manual	1 EA
Adaptor	1 EA
USB Cable	1 EA
Antenna	2 EA
Power cable	1 EA

## DMS-6000 Manager Software



- 1) ROM ETI mode.
  - (1) Using ETI stream stored in flash memory, DSG-1000 can generate DAB/DMB signals.
  - (2) Via DMS-6000 software, users can transfer ETI stream file from PC hard disc to flash memory of DSG-1000.
- 2) File ETI mode.
  - (1) Using any ETI stream file stored in a PC, DMS-6000 and DSG-1000 can generate DAB/DMB signals in real time.
  - (2) DMS-6000 software display the Ensemble configuration of current ETI stream.
- 3) ETI synthesis mode.
  - (1) Using audio, video and data streams stored in a PC, DMS-6000 can synthesize ETI stream, transfer ETI streams to DSG-1000, and DMS-6000 and DSG-1000 can generate the DAB / DMB RF signals in real time.
  - (2) DMS-6000 software display the Ensemble configuration of the synthesized ETI stream.

- 4) DSG-1000 download.
  - (1) Users can download ETI stream data from PC hard disc to DSG-1000 flash memory for DAB / DMB signal generation.
  - (2) ETI stream data sizes : 120MB (8min, 20 sec), 2x60MB (4min, 10sec).
- 5) Settings.
  - (1) RF on/off : users can switch on or off RF output signals.
  - (2) RF frequency : Frequencies can be selected by up/down control in the range of Band 3 ; 174~250MHz.
  - (3) RF level : Output level of RF signals can be selected by up / down control in the range, from 0 dBm to - 20dBm.

## Training Contents

### Part 1. Theory Of Radio Broadcasting And T-DMB System

#### Chapter 1. History and Theory Of Radio Broadcasting

- 1-1. Purpose Of Study
- 1-2. Introduction
- 1-3. History Of Radio Broadcasting
  - 1-3-1. Development Of Wire Communication
  - 1-3-2. Development Of Wireless Communication
- 1-4. Radio Characteristics Of Radio Broadcasting System
  - 1-4-1. Frequency Resources
  - 1-4-2. Medium Wave Broadcasting (Amplitude Modulation; AM)
  - 1-4-3. Short Wave Broadcasting
  - 1-4-4. Ultrashort Wave Broadcasting (Frequency Modulation; FM)
- 1-5. Broadcasting Equipment
  - 1-5-1. Microphone
  - 1-5-2. Radio Studio
  - 1-5-3. Control Room
  - 1-5-4. Main Control Room
    - 1-5-5. Access Program
    - 1-5-6. Transmit Station
- 1-6. AM(Amplitude Modulation) Broadcasting
- 1-7. FM(Frequency Modulation) Broadcasting
- 1-8. Other Radio Broadcasting Services
  - 1-8-1. Short Wave Radio Broadcasting
  - 1-8-2. Low Power Radio Broadcasting
  - 1-8-3. Satellite Radio Broadcasting

#### Chapter 2. DAB And DMB Services

- 2-1. Purpose of Study
- 2-2. Demand of Radio Services and Frequency Resources
- 2-3. Merit of Digital Transmission
- 2-4. Digital Radio Broadcasting
- 2-5. Terrestrial Digital Radio Broadcasting
  - 2-5-1. In-Band DAB
  - 2-5-2. Out-Of-Band DAB
  - 2-5-3. Comparison of Eureka-147 and IBOC System
- 2-6. Satellite Digital Radio Broadcasting
  - 2-6-1. ISDB-S (Integrated Services Digital Broadcasting-Satellite)
  - 2-6-2. World Space
  - 2-6-3. XM Satellite Radio
  - 2-6-4. Sirius Satellite Radio
- 2-7. DAB Data Services and DMB Service
- 2-8. Status of Digital Radio Broadcasting
  - 2-8-1. United States of America (USA)
  - 2-8-2. England
  - 2-8-3. Germany
  - 2-8-4. Japan
  - 2-8-5. Korea

#### Chapter 3. DAB/DMB System Structure

- 3-1. Purpose Of Study
- 3-2. Features of Eureka-147 DAB System
- 3-3. Eureka-147 Transmission Frame Structure
- 3-4. Eureka-147 DAB Service Structure
- 3-5. CIF (Common Interleaved Frame) Data Structure
- 3-6. FIC (Fast Information Channel) Data Structure
- 3-7. FIG (Fast Information Group) Data Structure

- 3-8. Ensemble Information
- 3-9. Sub-channel Information
- 3-10. Service and Service Component
  - 3-10-1. Basic Service and Service Component
  - 3-10-2. Stream Data Services
  - 3-10-3. Packet Data Services
  - 3-10-4. Service Label

### Part 2. T-DMB receiver Operation and Control

#### Chapter 4. Basic Operation Of T-DMB Receiver

- 4-1. Experiment purpose
- 4-2. DMB Receiver Board And PC Connection
  - 4-2-1. Part List Of DMB Receiver Board
  - 4-2-2. Connection Of DMB Receiver Board and PC
  - 4-2-3. Structure Of DMB Receiver Board
- 4-3. Install Of Firmware Developing Environment
  - 4-3-1. Linux Environment
  - 4-3-2. Cygwin System Installation
  - 4-3-3. Editing of Program Code
  - 4-3-4. Compiling
  - 4-3-5. Download and Run
- 4-4. T-DMB Audio and Video Receiving

#### Chapter 5. Control of General Purpose I/O Port

- 5-1. Experiment Purpose
- 5-2. General Purpose I/O Port Control Experiment of ARM Processor
  - 5-2-1. General Purpose I/O Port Structure of ARM Processor
  - 5-2-2. General Purpose I/O Port Setting of ARM Processor
  - 5-2-3. General Purpose I/O Port Utilizing of ARM Processor
- 5-3. LED Control Experiment
  - 5-3-1. LED Control Experiment Circuit
  - 5-3-2. LED Experiment Preparation
  - 5-3-3. LED On/Off Experiment -1
  - 5-3-4. LED On/Off Experiment -2
  - 5-3-5. LED On/Off Experiment -3
- 5-4. LCD Control Experiment
  - 5-4-1. Preparation Before Experiment
  - 5-4-2. LED Display Experiment

#### Chapter 6. BaseBand Chip Control Using IIC

- 6-1. Experiment purpose
- 6-2. IIC(Inter-IC) Interface
  - 6-2-1. Operating Principles IIC
  - 6-2-2. BaseBand Chip Control Using IIC

#### Chapter 7. DMB Receiver Chip Control Using IIC

- 7-1. Experiment Purpose
- 7-2. IIC Interface Data Transfer Of Tuner Chip (ITD3010)
  - 7-2-1. On-chip Register Of Tuner Chip
  - 7-2-2. Read/Write Of Tuner Chip Register
- 7-3. IIC Interface Data Transfer Of Baseband Chip (PN3030)
  - 7-3-1. On-chip Register Of BaseBand Chip
  - 7-3-2. IIC Related Register Of BaseBand Chip

#### Chapter 8. SPI Port And Communication With BaseBand Chip

- 8-1. Experiment Purpose
- 8-2. SPI(Serial Peripheral Interface) Interface
  - 8-2-1. SPI Interface Connection Structure
  - 8-2-2. SPI Interface Operating Principles

**Chapter 9. Chipset Control For T-DMB Receiving.**

- 9-1. Experiment Purpose
- 9-2. Structure And Operating Principles Of BaseBand Chip (PN3030)
  - 9-2-1. Analog-to-Digital Converter(ADC)
  - 9-2-2. OEDM(Orthogonal Frequency Division Multiplexing) Modulation and Demodulation
  - 9-2-3. FEC(Forward Error Correction) Decoder
- 9-3. Structure And Operating Principles Of Turner Chip (IDT3010)
- 9-4. DMB Signal Receiving Using DMB Receiver Board

**Part 3. T-DMB Channel Information Analysis Experiment**

**Chapter 10. FIC Data Structure and Analysis Experiment**

- 10-1. Experiment Purpose
- 10-2. DAB/DMB System Structure
  - 10-2-1. FIC(Fast Information Channel) Data Structure
  - 10-2-2. FIB(Fast Information Block) Data Structure
  - 10-2-3. FIG TYPE 0 Data Field Structure
  - 10-2-4. FIG TYPE 1 Data Field Structure
  - 10-2-5. FIG TYPE 5 Data Field Structure
  - 10-2-6. FIG TYPE 6 Data Field Structure
- 10-3. FIG Data Analysis
  - 10-3-1. Preparation for Experiment
  - 10-3-2. Storing Of FIG Data
  - 10-3-3. Programming of FIG Analysis

**Chapter 11. FIG TYPE 0 Data Structure and Analysis**

- 11-1. Experiment Purpose
- 11-2. FIG(Fast Information Group) TYPR 0 Data Structure
  - 11-2-1. FIG TYPE 0 Extension 0 Data Structure
  - 11-2-2. FIG TYPE 0 Extension 1 Data Structure
  - 11-2-3. FIG TYPE 0 Extension 2 Data Structure

**Chapter 12. FIG Type 1 Data Structure and Analysis**

- 12-1. Experiment Purpose
- 12-2. FIG(Fast Information Group) Type 1 Data Structure
  - 12-2-1. FIG Type 1 Extension 0 Data Structure
  - 12-2-2. FIG Type 1 Extension 1 Data Structure
  - 12-2-3. FIG Type 1 Extension 2 Data Structure
  - 12-2-4. FIG Type 1 Extension 3 Data Structure
  - 12-2-5. FIG Type 1 Extension 4 Data Structure
  - 12-2-6. FIG Type 1 Extension 5 Data Structure

**Chapter 13. T-DMB Audio Channel Receiving and Data analysis**

- 13-1. Experiment Purpose
- 13-2. Procedure For T-DMB Audio Receiving
  - 13-2-1. Preparation For Experiment
  - 13-2-2. Procedure For T-DMB Audio Receiving
- 13-3. Audio Data Structure of T-DMB System
  - 13-3-1. Audio Frame Header
  - 13-3-2. Programming For Audio Frame Header Analysis
- 13-4. Audio Control By BaseBand Chip (PN3030)
  - 13-4-1. Audio Related Register of BaseBand Chip

**Chapter 14. T-DMB Video Channel Receiving**

- 14-1. Experiment Purpose
- 14-2. Procedure For T-DMB Video Receiving
  - 14-2-1. Preparation For Experiment
  - 14-2-2. Procedure For T-DMB Video Receiving

**Chapter 15. Data Transfer Using USB Interface Between T-DMB Receiver Board and PC**

- 15-1. Experiment Purpose
- 15-2. Data Transfer Using USB Interface
- 15-3. LED control Using USB Interface
- 15-4. Video Channel Real Time Display Using USB Interface

# 19

**a group of TV trainer**

32. GT-HDTV15

# model:GT-HDTV15

## HDTV Trainer

### Description

**HDTV Trainer is an ideal training equipment to teach the operation of LCD/LED TV receivers.**

**The complete circuit of LCD/LED TV Receiver is printed on single PCB.**

**It safe to operate because all the test points are protected against accidental shortcircuits.**

**By using the fault simulation method, it is possible to introduce the most common breakdown and their rectification.**

**Technical manual book includes circuit diagram with component lists of each section.**

**Test point details with typical voltage and wave forms are provided in the manual.**

**It can also be used as a normal desktop LCD/LED TV Receiver.**

**The training device has a circuit board LCD/LED TV simple, powerful and good performance characteristics.**

**Has the following characteristics:**

- 1) using open-type training board, the board has complete installation wiring diagram, test points, adjusrational layout, easy plug ;
- 2) with leakage, short circuit, overload protection devices, LCD/LED TV power supply using the cold floor and prepare double protection isolation transformer, built-in line output transformer to avoid high voltage electric shock hazard,
- 3) to adjust meter, clarity, sensitivity and stability than conventional appliances bench ;
- 4) The tuning part of the increase in the manual adjustment function, so the experiment is very convenient.
- 5) To meet the needs of all schools, training boards in the TV added intelligence assessment device.  
Point of failure by the computer according to the assessment requirements set teachers, sent to the students through the examination system, the open-style TV training unit, students use a computer or microcontroller devices to answer the answer.
- 6) The MSD237HFG is a highly integrated controller IC for LCD/LED DTV applications with resolutions up to full-HD(1920 x 1080).
- 7) For digital TV application, the board comprises an MPEG-2 transport processor with advanced section filtering capability, an MPEG-2 (MP@HL profile) video decoder, an MPEG layer I and II digital audio decoder with analog audio outputs that are designed to support existing and future DVB-T programs while handling conditional access. Furthermore, it is also possible to decode MPEG-4, JPEG, MP3 formats from external sources such as USB interfaces.
- 8) For analog TV, the board includes NTSC/PAL/SECAM multi-standard video decoder comprising a 3-D motion adaptive comb filter and time-based correction, and a NICAM/A2 audio decoder to support worldwide television standards. The board is also configured with a VBI processor to decode digital information such as Close Caption/V-chip/teletext/WSS/CGMS-A/VPS. In addition, the MStar advanced LCD/LED TV processor enhances video quality, motion adaptive de-interlacer, picture quality adjustment units, and MStarACE-3 color engine.



## System configuration



## Components

Hardware platform of HDTV Trainer	1 set
Power cable	1 ea
Remote control	1 ea
Manual book	1 book
Aluminum carrying bag	1 ea
USB Cable	1 ea

## Training contents

### Part-1, Theory of Broadcasting & TV

- Chap 1, Understanding Broadcast Technology
- Chap 2, Broadcasting and frequency Allocation
- Chap 3, Broadcasting methods
- Chap 4, Basic of the TV signal
- Chap 5, Basis of the analog TV
- Chap 6, Analog Chassis Description
- Chap 7, Power / deflection section design
- Chap 8, V-CHIP, CLOSED CAPTION, KBPS
- Chap 9, Overview of Teletext
- Chap 10, Plasma Display Panel
- Chap 11, Overview of LCD TV
- Chap 12, DMB & DVB-H Technology
- Chap 13, related terms of Digital

### Part-2, Practical exercise of HDTV Trainer

- Chap 1, LCD TV in the basic structure of the major components and the basic working principle
- Chap 2, Recognize the major cell circuit LCD TV composition, understand the basic working principle
- Chap 3, Electronic Measurement and Analysis tuner
- Chap 4, Remote control and keyboard control the measurement and analysis unit
- Chap 5, The video signal processing flow measurement and analysis
- Chap 6, The measurement of audio signal processing and analysis
- Chap 7, RGB Input(PC) Measurement and Analysis
- Chap 8, Measurement and analysis of switching regulator circuit
- Chap 9, backlight inverter drive circuit measurement and analys
- Chap 10, Study of RF-Section through test points, fault simulation&rectification
- Chap 11, Study of Video/Chroma section through test points, fault simulation&rectification
- Chap 12, Study of System Control Section through test points, faults simulation&rectification
- Chap 13, study of Audio Sound section and many more.

## Technical Spec (Parameters)

### 1) the LCD/LED TV technology parameters:

- (1) **Display size:** 15
- (2) **Contrast ratio:** 400:1
- (3) **Resolution:** 1024 x 768
- (4) **Response time:** <16ms
- (5) **screen brightness:** 300cd/m<sup>2</sup>
- (6) **Perspective :** > 120 degrees
- (7) **Screen Aspect Ratio:** 4:3
- (8) **standard:** NTSC / PAL / SECAM
- (9) **Input:** VIDEO,PC, HDMI, AUDIO L/R
- (10) **Audio:** STEREO 5W OUTPUT
- (11) **Power Supply:** ADAPTER (AC 100- 240V 50/60Hz; 12V,3A OUTPUT)
- (12) **Number of colors:** 16.77 million;
- (13) **pixels:** 16.77 million.

### 2) the training sets the power configuration:

- (1) **a fixed AC power supply:** Rated voltage 220V
- (2) **DC power Output:** 12V/3A
- (3) **AC power:** two isolated power outlet plug-type group, two conventional electrical outlet plug-type group
- (4) **I / O communication board:** Set point of failure
- (5) **Set the point of failure:** Set equipment failure
- (6) **Insulation resistance:** 10M
- (7) **Dielectric strength:** 1500V/60s
- (8) **Current leakage protection action:** 30mA, 0.1 s.

### 3) training global parameter tables:

- (1) **Input Power:** AC 220V  $\pm$  10% 50Hz
- (2) **Training sets material:** melamine board for the main sheet
- (3) **Operating temperature:** 0 ~ 35
- (4) **Humidity:** 20% to 80%
- (5) **Safety protection:**
  - action current leakage protection: 30mA, 0.1S
  - over-voltage, over current, overload, leakage protection measures, in line with national standards
- (6) **Environmental requirements:** material selected in line with relevant national environmental standards.
- (7) **Input Signal:**
  - All VESA standard RGB input with clear image
  - Refresh rate from 56Hz up to 75Hz
  - Video-System: Automatic Video standard detection
  - High display quality of expanded image from the lower resolution input
  - TV-System: NTSC-M [Analog] : (Korea, Japan, USA)
  - TV-System: PAL(B,D,G,H,I) [Analog] and DVB-T [Digital] : Asia, Africa, Middle East, Europe countries.
  - TV-System: PAL(M,N) [Analog] - South America countries.
  - HDMI(v1.2)
- (8) **Easy to use On-screen Display menu to control all supported function:**
  - Automatic adjustment for screen image control
  - Bright and Contrast control
  - Manual Geometry control for H/V position, H size, and Phase adjustment
  - Color balance and Color temperature control
  - Positioning of OSD Menu and 2 language (Korean/English) selection
  - input source selection
  - Channel Auto Search
  - Channel Edit
  - 7 key OSD control button
  - Remote control Support
- (9) **This controller is designed for Multi Function with HDTV monitor using different size of TFT LCD/LED panels.**
- (10) **This section provides some guidelines for assembly and preparation of a finished display solution.**
- (11) **LCD/LED Panel:** This controller has 12V or 5V, 3.3V LVDS interface logic on the board for different kind of TFT LCD/LED panel. Due to the differential signal timing and electrical characteristics from each LCD/LED panel manufacturer, we need to use different Firmware, different LCD/LED interface cable and select DC power level for LCD/LED panel even on the same board.  
For selecting DC power level, you can select in BC504, BC503, BC501.
- (12) **LCD/LED signal cables:** In order to provide a good signal, it is recommended that LCD/LED signal cables should be no longer than 20cm. But it depends on signal frequency and LCD/LED interface type.

- (13) **Inverter** : Each LCD panels have their own inverter to obtain optimum performance and long lifetime. Because, Each LCD panel makers use different type of back light tubes for their all different models and Inverter drives the tubes directly.  
The controller board just supplies the power for inverter logic and controls a light On/Off signal and a brightness control signal. So, it is important to use the inverter that has proper driving capacity and control input signal.
- (14) **Inverter cable**: This cable supplies Inverter 's power, an on/off control signal and a brightness control signal to the inverter.  
**OSD Button**: See Operational Function section.
- (15) **Color LED**: This LED shows the state of controller.
- Green – Normal state
  - Red Off – Power Off mode
  - Green Blinking a per 1 second – No-Signal & No-cable
  - Red – DPMS Power Off
- (16) **Power switch** : This switch is located on OSD button board.
- (17) **Power input** : +12Vdc is required to supply enough power for the controller, Inverter and LCD/LED panel.
- (18) **VGA Input Cable** : As this may affect regulatory emission test result, a suitably shielded cable should be utilized.
- (19) **Consideration should be given to:**
- Electrical insulation.
  - Grounding.
  - Cable management.
  - Heat & ventilation
- (20) **Applicable Graphic and Video Mode (RGB Input Format).**  
: The microprocessor measures the H-sync, V-sync and V-sync/H-sync polarity for RGB inputs, and uses this timing information to control all of the display operation to get the proper image on a screen.
- (21) **30 Test Points and 3 Fault Switch is mounted.**

# 20

## a group of Cyber Security Training system

33. Cyber Security-GT4.0

# model: **Cyber security-GT4.0**

## **Cyber Security Training System**

### Feature

This is a educational equipment which enables user to have training on Embedded Programming Practice on Internet Environment.

- 1) learn the concept of network using all sorts of TCP/IP & applying protocols and managing systems
- 2) learn Embedded programming practice of TCP/IP protocol suite
- 3) TCP / IP protocol analysis
- 4) affordable to gain skills about how to use a network system
- 5) gain practical experience about the concept required for understanding and managing network basics including embedded Linux porting
- 6) understand basics of the Internet, TCP/IP architecture and protocols
- 7) ideal for learning the concept of networks, firewall system configuration, router (RIP, OSPF) configuration, web server configuration, VPN practice by using IPSec, or Intrusion Detection System (IDS).
- 8) Embedded program porting practice
- 9) Practice for Embedded Programming Application
- 10) Cyber security-GT4.0 is to learn about OpenWRT based routers development that is rated as one of the most excellent embedded OS platform for network equipment.
- 11) User can learn about the target firmware programming to develop a router device as well as the routing protocols RIP, OSPF implementation.
- 12) Cyber security-GT4.0 is the training equipment enabling the development a variety of high-end network equipment such as IDS, VPN, IoT(Internet of Things) Smart gateway which is recently & rapidly being emerged.

### System configuration



( 1 unit of Cyber security-GT4.0 hardware)

### Components

Cyber security-GT4.0 hardware	2 unit
Ethernet cable	4 ea
USB3.0 AM/AF 1.0M Cable	2 ea
Textbook	2 book
Program CD	1 ea
Power Adapter (12.0V, 2.0A)	2 ea

## Contents

### Chapter 1. Concept of Network

- 1.1 OSI reference model
  - 1.1.1 Encapsulating OSI 7 layer
- 1.2 Ethernet(Ethernet)
  - 1.2.1 CSMA/CD (Carrier Sense Multiple Access/Collision Detect)
  - 1.2.2 Encapsulating Ethernet
- 1.3 TCP/IP
  - 1.3.1 Understanding IP (Internet Protocol)
  - 1.3.2 Understanding TCP (Transmission Control Protocol)
- 1.4 Network System
  - 1.4.1 Hub
  - 1.4.2 Repeater
  - 1.4.3 Bridge
  - 1.4.4 Multiplexing
  - 1.4.5 Router
  - 1.4.6 Gateway

### Chapter 2. Understanding Practice Environment

- 2.1 Architecture of Cyber security-GT4.0
  - 2.1.1 Specification
  - 2.1.2 Cyber security-GT4.0 kit
- 2.2 Hardware interface
  - 2.2.1 JTAG (Joint Test Access Group)
  - 2.2.2 Serial cable
  - 2.2.3 Ethernet cable
  - 2.2.4. Hardware information
- 2.3 Software interface

### Chapter 3. Practicing Embedded Linux Porting

- 3.1 Embedded system
  - 3.1.1 What is embedded system?
  - 3.1.2 Embedded system operating system
- 3.2 Linux
  - 3.2.1 What is Linux?
  - 3.2.2 Features of Linux
  - 3.2.3 Linux architecture
- 3.3 Preparations for practice
- 3.4 Porting environment
- 3.5 Sequence of practice
  - 3.5.1 Operating Linux kernel
  - 3.5.2 Changing Linux kernel
  - 3.5.3 Boot loader (PPCBOOT)
- 3.6 Review/Report

### Chapter 4. Building Firewall

- 4.1 Objective of Practice and Concept
  - 4.1.1 Firewall
  - 4.1.2 Types of firewall
- 4.2 Preparations for practice
- 4.3 Practice environment
- 4.4 Sequence of practice
  - 4.4.1 Compiling kernel
  - 4.4.2 Placing in iptables RAMdisk
  - 4.4.3 Practicing firewall
- 4.5 Review/Report

### Chapter 5. Making Router

- 5.1 Objective of practice and concept
  - 5.1.1 Router
  - 5.1.2 RIP
  - 5.1.3 OSPF (Open Shortest Path First Protocol)
  - 5.1.4 Zebra
- 5.2 Preparations for practice
- 5.3 Practice environment
- 5.4 Sequence of practice

- 5.4.1 Cross-compiling
- 5.4.2 Sending Zebra to Cyber security-GT4.0
- 5.4.3 Setting up Zebra
- 5.4.4 Setting up ripd.conf file
- 5.4.5 Setting up ospfd.conf file
- 5.4.6 Setting up PC-2 and PC-3
- 5.4.7 Practicing ripd
- 5.4.8 Practicing ospfd
- 5.5 Review/Report

## **Chapter 6. Practice for Network Programming**

- 6.1, Practice for ping Programming
- 6.2, Practice for arping Programming
- 6.3, Practice for tftpd Programming

## **Chapter 7. Building Web Server**

- 7.1 Objective of practice and concept
  - 7.1.1 What is web server?
  - 7.1.2 What is HTML?
  - 7.1.3 HTTP
  - 7.1.4 Process of operating HTTP
  - 7.1.5 HTTP message format
- 7.2 Preparations for practice
- 7.3 Practice environment
- 7.4 Sequence of practice
  - 7.4.1 Cross-compiling
  - 7.4.2 Sending web server to Cyber security-GT4.0
  - 7.4.3 Setting up web server
  - 7.4.4 Testing web server
- 7.5 Review/Report

## **Chapter 8. Building VPN by Using SSL**

- 8.1 Objective of practice and concept
  - 8.1.1 AH protocol
  - 8.1.2 ESP protocol
  - 8.1.3 Key management
  - 8.1.4 IPSec VPN and SSL VPN
- 8.2 Preparations for practice
- 8.3 Practice environment
- 8.4 Steps of practice
  - 8.4.1 OpenVPN kernel configuration and cross-compilation
  - 8.4.2 Compiling OpenVPN and passing to Cyber security-GT4.0
  - 8.4.3 OpenVPN Setup and Exercise
- 8.5 Review/Report

## **Chapter 9. Building Intrusion Detection System (IDS)**

- 9.1 Objective of practice and concept
  - 9.1.1 Misuse IDS
  - 9.1.2 Anomaly IDS
  - 9.1.3 Intrusion type
  - 9.1.4 Network attack technique
- 9.2 Preparations for practice
- 9.3 Practice environment
- 9.4 Sequence of practice
  - 9.4.1 Installing A.P.M.
  - 9.4.2 Installing libpcap library
  - 9.4.3 Installing IDS
  - 9.4.4 Setting up IDS
  - 9.4.5 Setting up MySQL
  - 9.4.6 Installing log analysis tool
- 9.5 Review/Report

## **APPENDIX A - Ethereal**

- 1. Installing Ethereal
  - 1.1 Installing Ethereal
  - 1.2 Packet filtering

## **APPENDIX B - vi editor**

1. vi Introduction
  - 1.1 Execution, end and saving file
  - 1.2 Text entry
  - 1.3 Cursor movement
  - 1.4 Text change
  - 1.5 Text deletion
  - 1.6 Text copy
  - 1.7 Others
2. vi Intermediate level user
  - 2.1 Screen movement
  - 2.2 Marking
  - 2.3 Using multi-buffer
  - 2.4 Pattern search and replacement
  - 2.5 Executing Unix/Linux in vi
  - 2.6 Ex mode
3. vi High-level user
  - 3.1 Using idiom

#### APPENDIX C - JTAG

1. JTAG (Joint Test Access Group)
2. Architecture of boundary scan

#### APPENDIX D - Port No.

#### APPENDIX E - Acronyms

#### APPENDIX F - RFC (Request for Comments)

1. HTTP (Hyper Text Transfer Protocol)
2. IPsec (Internet Protocol Security)
3. RIP (Route Information Protocol)
4. OSPF (Open Shortest Path First)
5. NAT (Network Address Translation)

## Specifications

1) Cyber security-GT4.0 hardware	2 unit
2) Ethernet cable	4 ea
3) USB3.0 AM/AF 1.0M Cable	2 ea
4) Textbook	2 book
5) Program CD	1 ea
6) Power Adapter (12.0V, 2.0A)	2 ea
7) Hardware spec	
(1) CPU	MIPS74Kc@720 MHz
(2) RAM	128MBytes
(3) Boot Flash	512KBytes
(4) User Flash	16MBytes
(5) Ethernet	10/100/1000Base-T, WAN - 1 port
	10/100/1000Base-T, LAN - 1 port (Switch - 4 port)
(6) WIFI	802.11ac
(7) USB	USB2.0 x 2 ea
(8) Reset Switch	1 ea
(9) LEDs	Power, RUN, Ethernet status
(10) Power port	1 ea
(11) On/Off Switch	1 ea
(12) USB Port	1 ea
(13) USN LED	1 ea
(14) Console port	1 ea



# 21

## a group of Forensic Training system

- 34. Mobile Forensic-3000
- 35. Mobile Forensic-5000
- 36. Desktop forensic qator-EDU

# model: **Mobile Forensic-3000**

## Mobile Forensic Education Training Kit

### Feature

Forensic-3000 is the training system enabling users to study and experience the overall knowledges about mobile forensics process for below category.

- 1) Smartphone Forensic.
  - (1) This is for Smartphone forensic.
  - (2) the data for Flash Memory Chip, USIM, SD Memory Card is extracted and analyzed.
  - (3) Hardware platform, data cable, extraction software(GT-EXTR), analysis software(GT-ANA) included.
- 2) USIM forensic.
  - (1) This is the case that USIM Chip can be only provided.
  - (2) USIM data is extracted and analyzed.
  - (3) Hardware platform, USIM-Reader, Connecting USB Cable, extraction software(GT-EXTR), analysis software(GT-ANA) included.
- 3) SD Memory Card forensic.
  - (1) This is the case that SD Memory Card can be only provided.
  - (2) SD Memory Card data is extracted and analyzed.
  - (3) Hardware platform, SD Memory Card Reader, Connecting USB Cable, extraction software(GT-EXTR), analysis software(GT-ANA) included.

In brief, Forensic-3000 is consisted of below Hardware & Software.

- 1) Hardware platform
- 2) Forensic Hardware devices
  - (1) USIM Reader for USIM Card
  - (2) SD Memory Card Reader for SD Memory Card
- 3) Forensic Software
  - (1) GT-EXTR : this is for the extraction software
    - Mobile device data extraction tool
    - Included all data extraction functions of extraction tools
      - : Smartphone logical / physical, USIM, SD memory
    - USB cable connection to the mobile phone
    - Graphical user guide for each model
    - Data preview support
    - Partition auto recognition and extraction of selected partition
    - User defined data extraction by selection of files and category
    - 10 types of Hash support
    - Android/iOS data extraction
    - Reports generation
    - License - 1 PC or Server
    - Support system - Windows 7/8/10 64Bit, CPU i5 or above ,  
Memory Min.8GB , Disk Min.1TB, Display 1280X1024 or above
  - (2) GT-ANA : this is for the analysis software
    - Global smartphone vendor's 5 Model support : Samsung, LG, Apple, Xiaomi, Huawei
    - Data extraction method support : SD Memory, USIM, Smartphone
    - Data extraction tools support : GT-EXTR
    - File system parsing and recovery : FAT/FAT32/NTFS/EXT1,2,3/HFS
    - Script programming and debugging tools support
      - : Code generation, Code completion, Syntax highlight, Breakpoint stop/resume, Variable, Call stack, Line by line execution.
    - Python script editor support
    - Smartphone Data Analysis
      - : Call log, Address book, SMS/MMS, Memo, Internet history, Email
    - Data viewers – DB, HEX, Plist, Text, Photo gallery
    - 5 popular App Analysis modules
    - Analysis Data Filtering, Sorting, Advanced Search

- Data source visualization - GPS, Timeline, Map, Chatview
- Reports generation - PDF, Excel, HTML
- License - 1 PC or Server
- Support system - Windows 7/8/10 64Bit, CPU i5 or above ,  
Memory Min.8GB , Disk Min.1TB, Display 1280X1024 or above

The softwares GT-EXTR and GT-ANA work only with USB authentication key.

This trainer is designed to instruct the students mobile forensics theory, mobile phone data processing and application analysis script programming.

Again, Mobile Forensic-3000 is mainly used for students to learn fundamentals in mobile forensics solutions such as smartphones, USIM Card, SD Memory Card data acquisition analysis.

The training covers the graphical user interface study with GT-EXTR and GT-ANA.

## Functions

- Understanding of mobile forensics technology & process, mobile data acquisition, recovery and analysis.
- Smartphone data acquisition, recovery and analysis.
- USIM Card, SD Memory Card data acquisition, recovery and analysis.
- Sample application data analysis and script programming practice.
- Mobile forensics reports generation.
- Debugging experience with log.

## System configuration

### 1) Hardware platform & the equipped Forensic devices



### 2) Carrying bag for Forensic Hardware devices



## Components

1) Hardware platform (hardware is provided)	1 set
2) Forensic hardware devices	
(1) USIM Reader for USIM Card	1 ea
(2) USIM Card	2 ea
(3) USB Connector Cable for USIM Card	1 ea
(4) SD Memory Reader for SD Memory Card	1 ea
(5) SD Memory Card	2 ea
(6) USB Connector Cable for SD Memory Card.	1 ea
(7) USB Connector Cable for Android Smartphones	1 ea
(8) USB Connector Cable for iPhone Smartphones	1 ea
(9) USB Dongle key (Auth. Key)	1 ea
3) Forensic software	
(1) GT-EXTR Software Installation CD	1 ea
(2) GT-ANA Software Installation CD	1 ea
4) Textbook	1 book
5) Aluminum carrying bag	1 ea

## Specification

### 1) Hardware platform

CPU	i5-3317 or over
CLOCK	1.70 GHz / max 2.60 GHz
M/B	Mini-ITX(17*17Cm)
RAM	8GB or over
HDD	1TB or over
Power	12V 5A (60W)
VGA	Integrated on the system board
Display	17" LCD Touch Screen Panel
Wifi	Mini PCI-eAW-NB041H(Wifi & Bluetooth) & Antenna or over
Port	6 USB port

### 2) Hardware Spec of SD Memory Reader for SD Memory Card

Full speed USB (12Mbps)  
 USB A-Type connector(1.X/2.0/3.0)  
 USB bus powered device  
 Read-Only Write Protection  
 CCID compliant

### 3) Hardware Spec of USIM Reader for USIM Card

Full speed USB (12Mbps)  
 USB A-Type connector(1.X/2.0/3.0)  
 USB bus powered device  
 CCID compliant

### 4) Software spec.

#### (1) GT-EXTR : this is for the extraction software

- \* Mobile device data extraction tool
- \* Included all data extraction functions of extraction tools  
 : Smartphone logical / physical, USIM, SD memory
- \* USB cable connection to the mobile phone
- \* Graphical user guide for each model
- \* Data preview support
- \* Partition auto recognition and extraction of selected partition
- \* User defined data extraction by selection of files and category
- \* 10 types of Hash support
- \* Android/iOS data extraction
- \* Reports generation
- \* License - 1 PC or Server
- \* Support system : Windows7/8/10 64Bit, CPU i5 or above ,  
 Memory Min.8GB , Disk Min.1TB, Display 1280 X1024 or above

(2) GT-ANA : this is for the analysis software

- \* Global smartphone vendor's 5 Model support  
: Samsung, LG, Apple, Xiaomi, Huawei
- \* Data extraction method support - SD Memory, USIM, Smartphone
- \* Data extraction tools support : GT-EXTR
- \* File system parsing and recovery  
: FAT/FAT32/NTFS/EXT1,2,3/HFS
- \* Script programming and debugging tools support  
: Code generation, Code completion, Syntax highlight,  
Breakpoint stop/resume, Variable, Call stack, Line by line execution.
- \* Python script editor support
- \* Smartphone Data Analysis  
: Call log, Address book, SMS/MMS, Memo, Internet history, Email.  
Multimedia, Deleted data recovery, System log
- \* Data viewers - DB, HEX, Plist, Text, Photo gallery
- \* 5 popular App Analysis modules
- \* Analysis Data Filtering, Sorting, Advanced Search
- \* Data source visualization - GPS, Timeline, Map, Chatview
- \* Reports generation - PDF, Excel, HTML
- \* License - 1 PC or Server
- \* Support system - Windows7/8/10 64Bit, CPU i5 or above ,  
Memory Min.8GB , Disk Min.1TB, Display 1280 X1024 or above

## Training contents

### Chapter 1. Understanding of Mobile forensics

- 1.1 Definition
- 1.2 Basic principles
- 1.3 Case studies

### Chapter 2. Mobile forensics procedures

- 2.1 Evidence collections
- 2.2 Logical extraction technology
- 2.3 Physical extraction technology
- 2.4 File systems basics
- 2.5 SQLite
- 2.6 Plist, XML
- 2.7 Application analysis basics
- 2.8 Application Encryption/Decryption

### Chapter 3. Smartphone forensics - iPhones

- 3.1 Basics
- 3.2 H/W Structure, Jailbreak, Filesystem
- 3.3 Extraction method(Logical, Physical)
- 3.4 Data Analysis

### Chapter 4. Smartphone forensics - Android phones

- 4.1 Basics
- 4.2 H/W Structure, Rooting, Filesystem
- 4.3 Extraction method
- 4.4 Data Analysis

### Chapter 5. Script programming on new app analysis

- 5.1 Python Basics
- 5.2 Sample Script Source Review
- 5.3 Practice - App. Analysis Script

### Chapter 6. GT-EXTR Overview

- 6.1 GT-EXTR Extraction Basics
- 6.2 GT-EXTR Feature review
- 6.3 Extraction How-tos
- 6.4 Extraction Reports

### Chapter 7. GT-ANA Overview

- 7.1 GT-ANA Analysis Basics
- 7.2 GT-ANA Feature review
- 7.3 Analysis How-To
- 7.4 Analysis Report

### Chapter 8. Practice - USIM Card

- 8.1 USIM Card basics
- 8.2 USIM Card memory Data extraction
- 8.3 USIM Card memory File image analysis

### Chapter 9. Practice - SD Memory Card

- 10.1 SD memory card basics
- 10.2 SD memory card Data extraction
- 10.3 SD memory card File image analysis

### Chapter 10. Practice - Smartphones

- 11.1 iPhone Extraction Practice
- 11.2 Android Phones Extraction Practice
- 11.3 iPhone Analysis Practice
- 11.4 Android Phones Analysis Practice

### Chapter 11. Trouble shooting

- 12.1 Software Installation problem
- 12.2 Phone models support
- 12.3 Application support
- 12.4 Extraction problems
- 12.5 Recovery problems
- 12.6 Firmware recovery
- 12.7 Image File handling
- 12.8 Data source tracking
- 12.9 Advanced filtering and search

### Appendix

- 1. Glossary
- 2. FAQ

# model: **Mobile/Digital Forensic-5000**

**Mobile/Digital Forensic Training system for Smartphone, Chip-off memory, USIM Card, SD Memory Card**

## Feature

Forensic-5000 is the training system enabling users to study and experience the overall knowledges about mobile forensics process for below four category.

1) Smartphone Forensic.

- (1) This is the case that Smartphone is not broken.
- (2) the data for Flash Memory Chip, USIM, SD Memory Card is extracted and analyzed.
- (3) Hardware platform, data cable, extraction software(GT-EXTR), analysis software(GT-ANA) included.

2) Chip-off memory forensic.

- (1) This is the case that Smartphone broken, so Memory Chip is detached from the broken Smartphone.
- (2) the detached Memory Chip data is extracted and analyzed.
- (3) Hardware platform, GT-Reader, Connecting USB Cable, extraction software(GT-EXTR), analysis software(GT-ANA) included.

3) USIM forensic.

- (1) This is for USIM Chip forensic.
- (2) USIM data is extracted and analyzed.
- (3) Hardware platform, USIM-Reader, Connecting USB Cable, extraction software(GT-EXTR), analysis software(GT-ANA) included.

4) SD Memory Card forensic.

- (1) This is for SD Memory Card forensic.
- (2) SD Memory Card data is extracted and analyzed.
- (3) Hardware platform, SD Memory Card Reader, Connecting USB Cable, extraction software(GT-EXTR), analysis software(GT-ANA) included.

This trainer is designed to instruct the students mobile forensics theory, mobile phone data processing and application analysis script programming.

Forensic-5000 is mainly used for students to learn fundamentals in mobile forensics solutions such as smartphones, USIM Card, SD Memory Card and the detached Chip-off memory data acquisition and analysis.

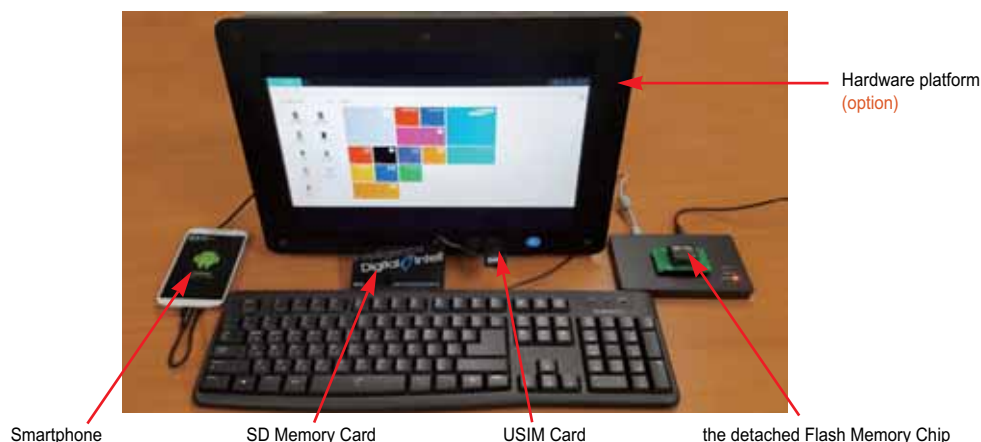
The training covers the graphical user interface study with GT-EXTR and GT-ANA.

## Functions

- Understanding of mobile forensics technology & process, mobile data acquisition, recovery and analysis.
- Smartphone data acquisition, recovery and analysis.
- USIM Card, SD Memory Card and the detached Chip-off memory, Smartphone data acquisition, recovery and analysis.
- Sample application data analysis and script programming practice.
- Mobile forensics reports generation.
- Debugging experience with log.

## System configuration

### 1) Hardware platform & the equipped Forensic devices



### 2) Carrying bag for Forensic Hardware devices



## Components

1) Hardware platform (option)	1 set
(This hardware is similar with normal laptop PC, but optimized for forensic)	
2) Forensic hardware devices	
(1) Smart phone forensic	
data cable (USB Connector Cable for Android Smartphone)	1 ea
data cable (USB Connector Cable for iPhone)	1 ea
( user's Smartphone can be used )	
(2) for Chip-off memory forensic	
GT-Reader for data extraction from chip-off memory	1 ea
the detached Memory Chip Mounting Sockets	5 ea
the detached Memory Chip	2 ea
DC 5V/2A Adapter for GT-Reader	1 ea
USB Cable	1 ea
(3) USIM Card forensic	
USIM Reader for USIM Card	1 ea
USIM Card	2 ea
USB cable	1 ea
(4) SD Memory card forensic	
SD memory card reader for SD memory card	1 ea
SD memory Card	2 ea
USB cable	1 ea
(5) USB Dongle key (Auth. Key)	1 ea
3) Forensic software	
(1) GT-EXTR Software Installation CD	1 ea
(2) GT-ANA Software Installation CD	1 ea
4) User's Manual book	1 book

## Training contents

### Chapter 1. Understanding of Mobile forensics

- 1.1 Definition
- 1.2 Basic principles
- 1.3 Case studies

### Chapter 2. Mobile forensics procedures

- 2.1 Evidence collections
- 2.2 Logical extraction technology
- 2.3 Physical extraction technology
- 2.4 File systems basics
- 2.5 SQLite
- 2.6 Plist, XML
- 2.7 Application analysis basics
- 2.8 Application Encryption/Decryption

### Chapter 3. Smartphone forensics - iPhones

- 3.1 Basics
- 3.2 H/W Structure, Jailbreak, Filesystem
- 3.3 Extraction method(Logical, Physical)
- 3.4 Data Analysis

### Chapter 4. Smartphone forensics - Android phones

- 4.1 Basics
- 4.2 H/W Structure, Rooting, Filesystem
- 4.3 Extraction method
- 4.4 Data Analysis

### Chapter 5. Script programming on new app analysis

- 5.1 Python Basics
- 5.2 Sample Script Source Review
- 5.3 Practice - App. Analysis Script

### Chapter 6. GT-EXTR Overview

- 6.1 GT-EXTR Extraction Basics
- 6.2 GT-EXTR Feature review
- 6.3 Extraction How-tos
- 6.4 Extraction Reports

### Chapter 7. GT-ANA Overview

- 7.1 GT-ANA Aanalysis Basics
- 7.2 GT-ANA Feature review
- 7.3 Analysis How-To
- 7.4 Analsys Report

### Chapter 8. Practice - USIM Card

- 8.1 USIM Card basics
- 8.2 USIM Card memory Data extraction
- 8.3 USIM Card memory File image analysis

### Chapter 9. Practice - the detaced Chip-off memory

- 9.1 Chip-off memory basics

- 9.2 Chip-off memory Data extraction

- 9.3 Chip-off memory File image analysis

### Chapter 10. Practice - SD Memory Card

- 10.1 SD memory card basics
- 10.2 SD memory card Data extraction
- 10.3 SD memory card File image analysis

### Chapter 11. Practice - Smartphones

- 11.1 iPhone Extraction Practice
- 11.2 Android Phones Extraction Practice
- 11.3 iPhone Analysis Practice
- 11.4 Android Phones Analysis Practice

### Chapter 12. Trouble shooting

- 12.1 Software Installation problem
- 12.2 Phone models support
- 12.3 Application support
- 12.4 Extraction problems
- 12.5 Recovery problems
- 12.6 Firmware recovery
- 12.7 Image File handling
- 12.8 Data source tracking
- 12.9 Advanced filtering and search

### Appendix

- 1. Glossary
- 2. FAQ

## Specification

### 1) Hardware platform

CPU	i5 or over
M/B	LVDS support (17*17Cm) Industrial board INTEL H81/ DDR3 / HDMI/ RGB
RAM	8GB or over
HDD	1TB or over
Power	19V 4.5A Adaptor (over 85W)
VGA	Integrated on the system board
Display	15" LCD Screen Panel
Cooler	1U Cooler for Server
Chassis	rear part : 100 * 100 VESA hole aluminum chassis
Wifi	Mini PCI-eAW-NB041H(Wifi & Bluetooth) & Antenna
Port	6 USB port



## 2) Spec of GT-Reader for the detached Chip-off memory

CPU	Samsung S5PV210
RAM	DDR256M
Memory	NAND 512M
Input Voltage	DC 5V
Size	110 x 140 x 35mm
function	supports Emmc/eMCP chip type
	provides 5 kinds of sockets
	supports extraction of selected partition
	supports resume of extraction
	Max.12MBytes/sec extraction performance

## 3) Hardware Spec of SD Memory Reader for SD Memory Card

Full speed USB (12Mbps)
USB A-Type connector(1.X/2.0/3.0)
USB bus powered device
Read-Only Write Protection
CCID compliant

## 4) Hardware Spec of USIM Reader for USIM Card

Full speed USB (12Mbps)
USB A-Type connector(1.X/2.0/3.0)
USB bus powered device
CCID compliant

## 5) GT-EXTR software : this is for the extraction software

(1) Mobile device data extraction tool
(2) Included all data extraction functions of extraction tools : Smartphone logical / physical, USIM, SD memory
(3) USB cable connection to the mobile phone
(4) Data preview support
(5) Partition auto recognition and extraction of selected partition
(6) User defined data extraction by selection of files and category
(7) 10 types of Hash support
(8) Android/iOS data extraction
(9) Reports generation
(10) License key - 1 PC or Server

## 6) GT-ANA software : this is for the analysis software

(1) Global smartphone vendor's 5 Model support : Samsung, LG, Apple, Xiaomi, Huawei
(2) Data extraction method support - SD Memory, USIM, Smartphone
(3) Data extraction tools support : GT-EXTR
(4) File system parsing and recovery : FAT/FAT32/NTFS/EXT1,2,3/HFS
(5) Script programming and debugging tools support : Code generation, Code completion, Syntax highlight, Breakpoint stop/resume, Variable, Call stack, Line by line execution.
(6) Python script editor support
(7) Smartphone Data Analysis : Call log, Address book, SMS/MMS, Memo, Internet history, Multimedia, Deleted data recovery, System log
(8) Data viewers – DB, HEX, Plist, Text, Photo gallery
(9) 5 popular App Analysis modules
(10) Analysis Data Filtering, Sorting, Advanced Search
(11) Data source visualization – GPS, Timeline, Map
(12) Reports generation - PDF, Excel, ODS
(13) License key - 1 PC or Server

# model: Desktop forensic qator-EDU

## On-line desktop(PC) Forensic training system

### Features

- Desktop forensic qator-EDU is for on-line desktop(PC) forensic training system.
- Desktop forensic qator-EDU can always prevent the data leakage through the security inspection in advance!!
- User can trace the path of the leakage by using Qator Enterprise to inspect the data which are collected periodically when leakage incident occurs!!
- User can inspect/analyze the PC of the target personnel that are being monitored through the remote inspection easily!!
- User can inspect/submit the evidential data and the correspondence data easily through the collected data during the lawsuit about the particular incident.  
(Compliance and eDiscovery Response)!!

#### 1) Incident Prevention

- User can utilize Desktop forensic qator-EDU to minimize companies' loss of the important confidential data leakage within the enterprise.

#### 2) Incident Response

- User can utilize Desktop forensic qator-EDU to inspect the incidents efficiently through data collection analysis/forensic analysis / remote analysis in case of the important confidential data leakage within the enterprise.

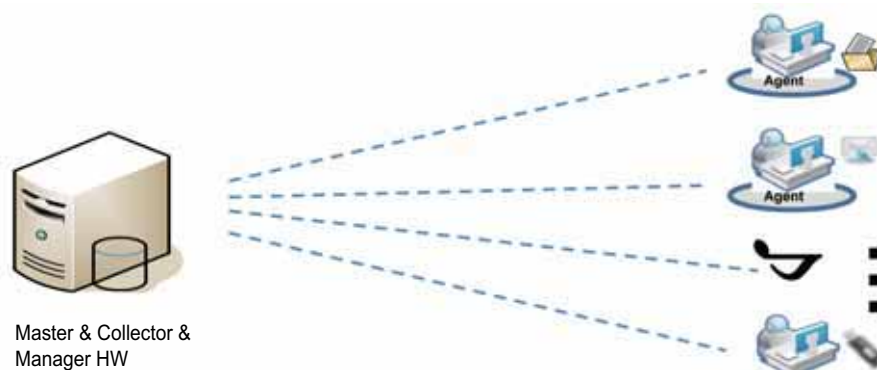
#### 3) e-Discovery

- User can utilize Desktop forensic qator-EDU to minimize the risk of the enterprise by obtaining favorable evidence to respond to the potential lawsuits.

### Functions

Case Management	Remote case management and the inspectors share the case; allows for report management
Regular Data Collection	Collect necessary data regularly according to the policy while the inspector does not have to inspect
Remote System Inspection	Inspect clients by applying agents remotely
File System Analysis	File system analysis through disk direct access
Deleted File Inspection	Inspect after restoring the files of the clients
File Distribution	Check distribution of the individual clients of the specific files
File Timeline Analysis	Distribution chart according to the file creation date, date of change, approach work
Search	Search file contents according to the specific keywords or patterns
Remote disk imaging	Forensic analysis about the client disk is possible in the form of imaging to inspect in-depth data
User's Activity Collection	Collect the user's current system's status and volatile data in the way of a continuous inspection
USB Storage Medium Automatic collection	Automatic imaging of the USB storage device and real-time monitoring the usage contents about the USB medium
Snapshot File System	Save and analyze file system status of the specific time point
Bookmark	Save work if necessary while working
Report and Other Data Export	Provide export and report generation function about possible data analysis
Preview	File original type, simple text extraction, Hex view support
Simultaneous Inspection	It is possible to inspect about the multiple clients simultaneously

## System configuration



## Components

### 1) Hardware : Collector server H/W Platform : 1 unit

(1) Hardware function
• Distributes agents
• Policy control
• Collects the agents job results according to the job instructions
(2) Hardware spec
• Dell Precision T1700, or similar level
• Intel Xeon E3-1225v3 CPU
• 8GB DDR3-1600 Memory
• 2TB HDD
• OS : Windows7 Professional

### 2) Software : 1 copy

(1) Master S/W Program
• Manages the Qator Manager and the Collector server
• Checks the inspector 's registration/certification and the activity contents
(2) Manager S/W Program
• A tool to investigate the target PC on the part of inspector
(3) Agent S/W Program
• Executes tasks installed on the individual PC.

### 3) Operating manual book : 1 book

## Training contents

### Part-1, Disk Forensic Basic

#### Chap 1, Disk Layout Information

- 1-1, Partition Scheme, Partition Spec, Disk Sector Analysis

#### Chap 2, Windows File system Information

- 2-1, NTFS, FAT, exFAT, CDFS
- 2-2, MFT, NTFS Metadata, FileAllocationTable, DirectoryEntry
- 2-3, Date & Time

#### Chap 3, File Recovery

- 3-1, Deleted File Recovery
- 3-2, File Entry Analysis
- 3-3, File Slack Analysis

#### Chap 4, OS Artifact

- 4-1, Registry Analysis
- 4-2, System Log
- 4-3, File Classification

#### Chap 5, Internet Artifact

- 5-1, Visited URL
- 5-2, Cache Data

## Part-2, Forensic Investigation Steps

### Chap 6, Remote Disk Imaging

- 6-1, Agent Based Disk Imaging Strategy
- 6-2, Disk Scheme
- 6-3, Support Image Format

### Chap 7, Disk Image File Analysis with Image Server

- 7-1, Multi Disk Image Analysis simultaneously
- 7-2, Same Image File Analysis with different investigator at the same time

### Chap 8, Filename, Keyword, Cluster Search

- 8-1, Search with filename, file contents and unallocated space
- 8-2, Search with Regular Expression
- 8-3, Regular Expression Test before keyword search

### Chap 9, File Timeline

- 9-1, Specific Date & Time Analysis

### Chap 10, Evidence Bookmark

- 10-1, Important Evidence Bookmarking during Analysis

### Chap 11, Data Recovery

- 11-1, Deleted File Recovery

### Chap 12, Data Viewing

- 12-1, Original Format, Overview, Hex and Text View for Analysis

### Chap 13, E-Mail Analysis

- 13-1, MS Outlook File Analysis
- 13-2, Deleted Message Recovery

### Chap 14, Co-operation with other analysis tools

- 14-1, Export Bookmark and File Classification Data to Forensic Image File
- 14-2, Physical Disk Emulation from remote system 's logical drive

### Chap 15, Analysis Report

- 15-1, Generate Forensic Analysis Report including Search Result, Bookmark and Others

## Spec

- 1) Disk imaging of the target system's drive
- 2) Perform a file system analysis of the target system from a remote
- 3) Perform analysis of the disk image files stored on a server repository
- 4) Fast keyword search using index on the disk image file
- 5) Recover deleted files and folders on the file system
- 6) Category classification support to fast analysis
- 7) File Timeline
- 8) Search with filename, file contents and unallocated space
- 9) Search with Regular Expression
- 10) Search filename, keyword and patterns on network drives
- 11) Windows Registry Analysis
- 12) Analysis of Outlook e-mail file and deleted message recovery
- 13) Original view, Hex view, text view and file information view
- 14) Hash values of Files
- 15) Bookmark the important evidence items
- 16) Scheduled or event based screenshot of target system
- 17) the file system information of the target system (deletion and file time like modification, creation and access)
- 18) Gathering information about using USB storage device
- 19) Bluetooth connection history and document history using by BT
- 20) Memory dump of the process
- 21) OS artifact like versions and installation date and H/W Information
- 22) Generate Forensic Analysis Report including Search Result, Bookmark and Other

# 22

## a group of Big Data Management Training system

37. IoT & BigData700

28. BigData-EDU4.0

39. Big Data-bean7000

# model:GT-IoT&bigdata700

## Embedded IoT & Bigdata Training system

### Smart Gateway & BigData of GT-IoT700

- 1) GT-IoT300 supports the network communication through LoRa protocol and IP Camera equipped for security and surveillance to be used of video analyzing and algorithm technology platform.
- 2) Recently, information and communication-based various service technologies, such as cloud, smart devices and IoT (Internet of Things) have been rapidly developed.
- 3) In addition, platform technologies of network equipment like routers, smart gateways, switches, firewalls which are required for this various technologies are being developed as well.
- 4) Development of information & communication technology enables users not only to overcome time and space constraints for the use of smart devices, but also to continue what they are doing in any other places including the office, home, school and to provide the same network environment as that of physically remote location.
- 5) Technology that is making the multiple remote network to one local network can be implemented through well-known inter-network VPN (Virtual Private Network) equipment. Commercial VPN equipment has been evolved to provide the application of many advanced functions including not only basic router and tunneling functions, but also intelligent firewall including IDS (Intrusion Detection System) and IPS (Intrusion Protection System), QoS (Quality of Service) technology, multi-line support, and load balancing, etc.  
These commercial VPN equipment are being used as high-performance products in a dedicated line environment with the support of experts.
- 6) Moreover, these are expensive and dedicated equipment due to their technical nature so that it is not easy to ensure for them to provide the compatibility between equipment.
- 7) Also as mentioned earlier, under the situation that small and medium-sized businesses and even the public increasingly require the need for the same network environment such as cloud, IoT (Internet of Things) and multi-screen, the need for the wired/wireless router to support inter-network VPN under general internet environment has been increased because application of dedicated VPN equipment to the expensive leased line environment is not economical.
- 8) Accordingly, a technology providing reliable VPN environment in a vulnerable network environment which shows relatively less CPU and memory performances than dedicated VPN equipment is required.
- 9) Although several existing wired/wireless routers to support VPN exist, their simple VPN server functions only provide direct linkage to a PC or a smartphone not a inter-network VPN linkage.
- 10) Therefore, their utilization is decreased, the machine to support is limited and the speed rate is around 5Mbps level.  
In addition, not only that it is not economical to popularize commercial VPN dedicated equipment, but that its operation is not possible without dedicated line.
- 11) Due to this reason, we come to propose below solutions to resolve the above problems;  
First, we propose a platform (Smart Gateway) to support VPN tunneling to the affordable cost hardware.  
Second, we propose an implementation plan to support at least 20Mbps for VPN tunneling rate for each tunneling algorithm through new platform (Smart Gateway).  
Third, we propose a method for applying different-features, multi-queueing techniques via Smart Gateway beyond the simple QoS, ToS (Type of Service) methods by identifying real-time internet line situation even if the change of internet line quality is large.
- 12) The hardware, operating system and software platform used in Smart Gateway of IoT&BigData700 are based on OpenWRT which many developers in the various network equipment fields have used for a long time.  
The techniques of VPN tunneling-related solutions applied to Smart Gateway of IoT&BigData700 can be used in various network equipment such as smart gateway application for IoT.
- 13) GT-IoT300 supports the network communication through LoRa protocol and IP Camera equipped for security and surveillance to be used of video analyzing and algorithm technology platform.
- 14) IoT & BigData Server provides sensor control technology and smart gateway technology.  
The implemented sensor control contents & the smart gateway technology is saved BigData server in real time and provides skills that can be controlled and analyzed. Also, provides the practice what is implemented.  
Based on this, it can be used to implement BigData Artificial Intelligence.

## Features

IoT & BigData700 has BigData Server and it provides below :

- 1) It collects the IoT sensor data.
- 2) Sends a control command according to the sensor data to enable operation.
- 3) Control and adjust IoT & bigData server function through the web or app program.
- 4) It enables intelligent analysis and processing based on data collected from numerous sensors.

Also, Smart Gateway was developed & provided and it can be used for commercial purposes to control home appliances.

The Internet of Things (IoT) is the network of physical objects, devices, vehicles, buildings and other items which are embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.

The "Internet of Things" connects devices and vehicles using electronic sensors and the Internet.

The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more-direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

Many of IoT training systems are so configured as to allow practice of on-board sensor control using a Raspberry Pi Module.

To control the on-board sensors through the Raspberry Pi Module, virtual IP is used, not through a commercial Cloud Server.

Therefore, it is not easy to practice remote control of various home appliances through Raspberry-pi based IoT training system.

Moreover, the Raspberry-Pi module does not provide the gateway function.

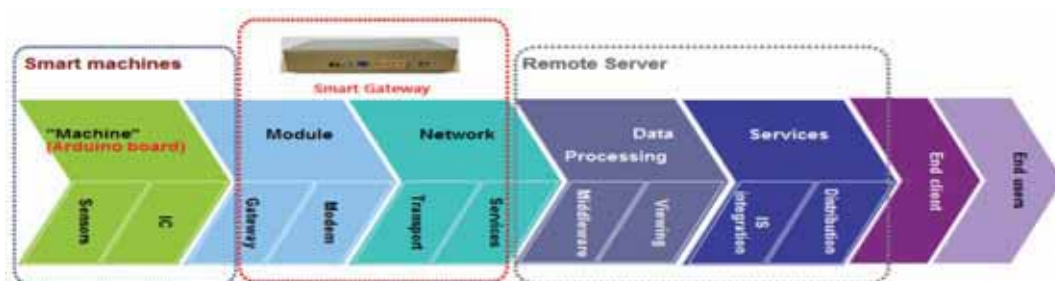
Also, as for Cloud Server, as several virtual machines operate on a single Real Machine, there may occur some problems associated with the Virtual Server (e.g. the server might be inaccessible in case of DB shutdown, Max-Connect count over, etc.).

Since several VMs operate on a single Cloud server and a large part of the memory is used by other VMs, connection fail can be occurred.

The Cloud server provides many advantages such as cost saving, customer support, convenience, etc.

However, it is better to use an independent Real-Machine such as VPN Smart Gateway.

### ( IoT concept using VPN based Smart Gateway )



Practice of sensor control using an Arduino module and Smart Gateway.

Various sensors (home appliances) can be controlled at a low cost since the sensor control is carried out independent of the network, and the sensor control can be done safely and conveniently as the security and connection settings are centralized through Smart Gateway.

IoT&BigData700 is IoT training system using OpenWRT based VPN Smart Gateway and Arduino board that various sensors mounted. OpenWrt is an operating system (in particular, an embedded operating system) based on the Linux kernel, primarily used on embedded devices to route network traffic.

IoT&BigData700 is so configured as to allow practice of sensor control on the Arduino board through the VPN Smart Gateway as well as remote audio TV, Video control using Raspberry Module.

IoT&BigData700 provides benefits as follows:

- 1) Things (sensors) are separated from the Internet (VPN Smart Gateway), allowing various interfaces such as USB Serial, Bluetooth, Zigbee, etc.
- 2) It is possible to practice control of various sensors on the Arduino platform through the VPN Smart Gateway and possible to remotely control the real (commercial) home appliances of Audio.
- 3) From the OpenWRT platform, the Internet is useful for expansion of various functions and security such as WWW, IPCAM, firewall, VPN, etc.

## Functions

### 1) Sensors Control Practice on Arduino Board via OpenWRT based VPN Smart Gateway

- (1) Sea of LED Control
- (2) Button Control
- (3) Color LED Control
- (4) DC motor Control
- (5) Step motor Control
- (6) Buzzer Control
- (7) 7-segment Control
- (8) Crystal LCD Control
- (9) Light sensor Control
- (10) IR Sensor Control
- (11) PSD sensor Control

### 2) Project modules control practice by Java programming & C programming.

- (12) OLED sensor Control
  - (13) Relay sensor Control
  - (14) PIR sensor Control
  - (15) GAS sensor Control
- \* for module control - C programming  
\* for web Interface - Java programming

### ) Home Appliances (Audio, TV, Video) Control & IoT network construction using Raspberry Module.

- (1) How to implement IoT (Internet of Things)
  - Introduction IoT using YUN Shield
  - Introduction IoT using Raspberry Pi
  - Introduction IoT using Beaglebone black
- (2) Smart Gateway
  - Introduction
  - OpenWRT
  - IDE
  - Interworking with Arduino
  - Interworking with Sensor Network
  - Interworking with Internet
- (3) Application practice
  - IoT Sensor Control Interworking
  - IoT Sensor Cam Interworking
  - Programming practice for the Kernel supporting serial communication.
  - Programming practice for the Kernel supporting UVC-Camera
  - Programming practice for the kernel supporting Bluetooth communication
  - node.js installation and programming practice which supports bi-directional Web UI
  - smtp programming practice for mail communication
- (4) Home Appliance Control ( real Audio, TV, Video Control )

### 4) Security control by IP Camera

- CCTV (video) surveillance solution which is based on cutting-edge video analyzing and algorithm technology platform.
- (1) For real Time surveillance via intelligent video analysis.
  - (2) Transmit alarms by various ways to administrator & related association.
  - (3) Retrieve the required video in the event storage server.

### 5) IoT training courses in programming practice.

- (1) Serial Communication Program
- (2) Bluetooth Communication Program
- (3) Java script Program

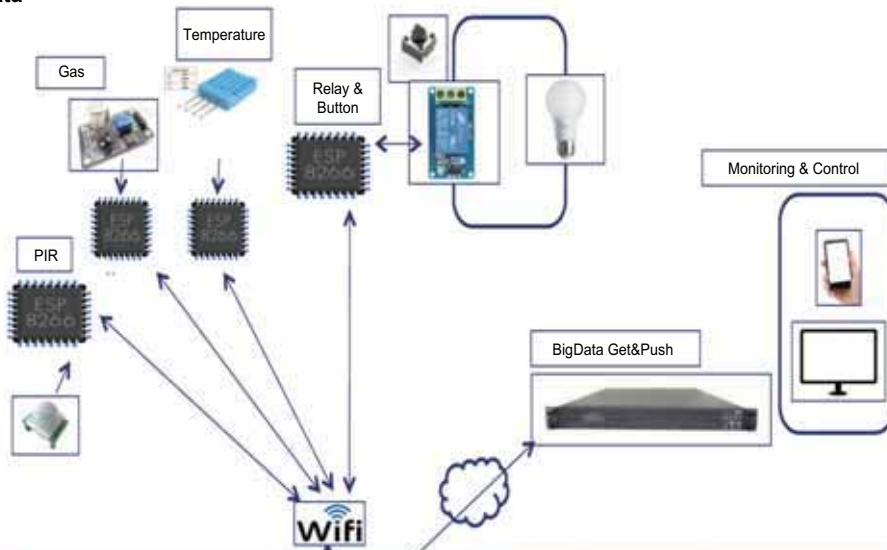
### 6) IoT & BigData server training courses in programming practice.

- (1) ESP8266 TCP/IP Communication Program
- (2) Gas, Temperature, Relay Sensor Control Program
- (3) Ubuntu Server DB & TCP/IP System Program
- (4) IoT Sensors & Server Communication Control Program
- (5) Web(or APP) Communication Control Program

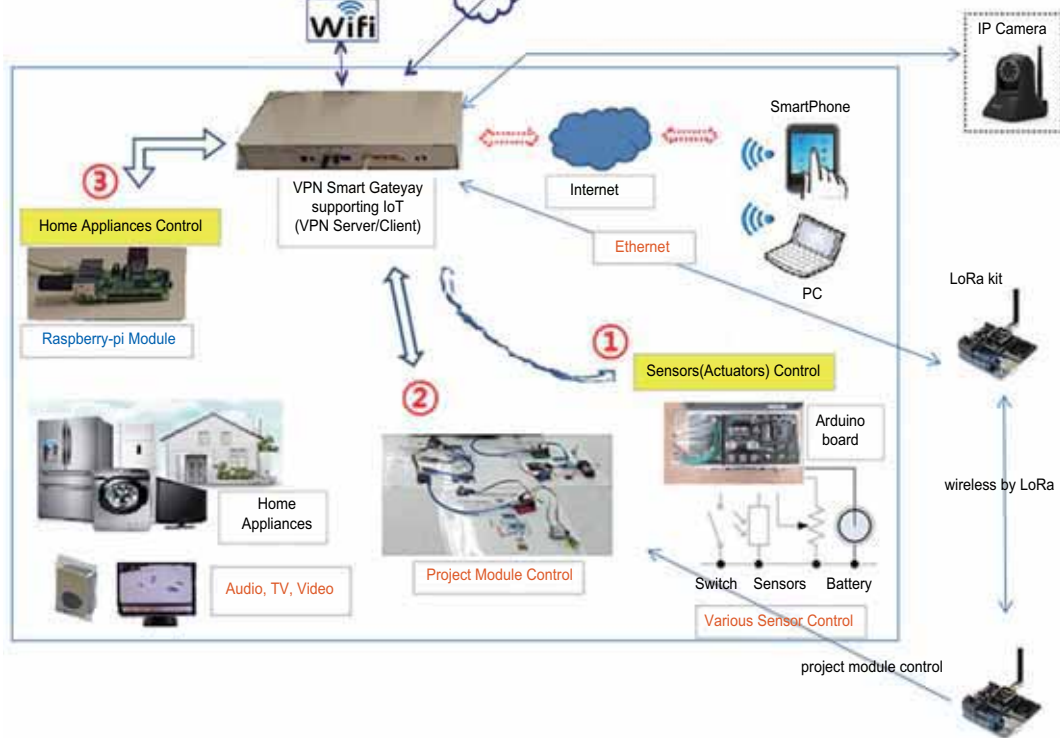


## System configuration

### 1) BigData



### 2) IoT



## Hardware photo



## Components

1) VPN Smart Gateway	1 set
2) Web camera	1 ea
3) Arduino board	1 set
4) Raspberry-pi Module	1 ea
5) Audio	1 ea
6) Project module	
(1) OLED sensor module	1 ea
(2) Relay sensor module	1 ea
(3) PIR sensor module	1 ea
(4) GAS sensor module	1 ea
(5) LoRa kit	2 set
(6) ESP8266 Gas sensor module	1 ea
(7) ESP8266 Temperature sensor module	1 ea
(8) ESP8266 Relay+Button sensor module	1 ea
(9) ESP8266 PIR sensor module	1 ea
7) BigData server	1 unit
8) Program CD	1 ea
9) Textbook	1 book

## Training contents

Chap 1. The final result demonstrated.

Chap 2. About lessons.

Chap 3. Embedded systems overview.

Chap 4. About IoT (Internet of Things)

- 1) Outline
- 2) Introduction IoT using YUN Shield
- 3) Introduction IoT using Raspberry Pi
- 4) Introduction IoT using Smart Gateway

Chap 5. Arduino - Things

Part-1)

- 1) Arduino start
- 2) Digital inputs and outputs (GPIO) and PWM
- 3) Analog signals and Sensor values
- 4) USB and serial communication
- 5) Serial inter-working
- 6) Bluetooth inter-working
- 7) Serial.parseInt()

Part-2)

- 1) What is Arduino ?
- 2) 8ea of LED control to be connected to digital pin
- 3) Controlling the button connected to digital pin
- 4) Color LED control to be connected to digital pin
- 5) Buzzer Control connected to digital pin
- 6) 7-Segment Control to be connected to digital pin
- 7) Crystal LCD Control to be connected to I2C
- 8) Light sensor Control to be connected to analog pin
- 9) IR Sensor Control to be connected to analog pin
- 10) How to utilize PSD Sensor to be connected to analog pin
- 11) How to utilize DC Motor
- 12) SPL-Duino Control by Smart Phone

Chap 6. Smart Gateway - Internet

- 1) OpenWRT overview

2) OpenWRT - IDE

3) OpenWRT - Kernel Program Supporting Serial, Bluetooth, UVC-Cam

4) OpenWRT - Arduino inter-working, Programming USB-Serial

- LED Control
- Buzzer Control
- TMP35 Control
- Servo motor Control
- DC motor Control
- SPL-Duino Control

5) OpenWRT - Arduino inter-working, Programming USB-Bluetooth

6) OpenWRT - Arduino inter-working, Programming WWW-node.js and Webcam

7) OpenWRT - Arduino inter-working, Programming ALERT

Chap 7. IoT Projects Programming

- 1) Arduino nano + bluetooth + relay
- 2) Arduino nano + bluetooth + pir + gas
- 3) Arduino nano + bluetooth + oled

Chap 8. Programming using the Raspberry Pi

- 1) About Raspberry Pi
- 2) Basic setting of Raspberry Pi
- 3) GPIO Control
- 4) Remote audio / video play, TV Control
- 5) OpenWRT - Raspberry Pi inter-working TCP/IP
- 6) OpenWRT - Raspberry Pi inter-working WWW-node.js

Chap 9. Network communication & programming practice using LoRa module.

- 1) About LoRa
- 2) LoRa implementation using Raspiberry-pi / Arduino module

3) Remote control using LoRa module.

- (1) LoRa + relay
- (2) LoRa + pir + gas
- (3) LoRa + oled

Chap 11, Surveillance IP Camera

- 1) Motion Detection Alert
- 2) Remote controlling IP Camera

Chap 10, Network communication & programming practice using ESP8266 and BigData Server.

- 1) About ESP8266
- 2) Client TCP/IP & IoT Sensors Program implementation using ESP8266
  - (1) Gas sensor Program
  - (2) Temperature sensor Program
  - (3) Relay & Button sensor Program
  - (4) PIR sensor Program
- 3) BigData Server implementation
  - (1) Ubuntu Server System Preparation
  - (2) Maria DB(or MongoDB) Preparation
  - (3) Server TCP/IP & DB Program implementation
  - (4) IoT sensors & Server Operation Test
  - (5) WEB(or APP) implementation

## Spec

[ Arduino Board ]

1) Arduino Board	
(1) Atmega328 Processor	
(2) Arduino compatible boards	
(3) Built-in Bluetooth	
(4) Built-in IO expansion pin (12ea of digital pin, 6es of analog pin)	
(5) Built-in Motor connection pin (2ea of DC motors connection pin)	
(6) Built-in illumination sensor	
(7) Built-in 3ea of button switch	
(8) USB connection cable provided	
(9) Battery connecting case provided	
2) Infrared sensor module-----	3EA
(1) 3AW4C02	
(2) Reverse Current	10uA
3) PSD sensor module-----	1EA
(1) High Sensitivity PSD Sensor	GP2YOA21YK
(2) Detecting output type	Analog voltage
(3) Detection distance	10 ~ 80Cm
4) LCD Display module-----	1EA
(1) STN, Negative, Transmissive Mode	
(2) Display Data Color	Light Gray or Deep Blue
(3) Viewing Angle	6H
(4) Driving Method	1/16 duty, 1/5 bias
(5) Back Light	White LED backlight
(6) input voltage	6V Max.
(7) LCD Panel	16x2 Char (5x8dots)
5) LED Display module -----	1EA
(1) 2012 Type LED	
(2) Straight Type 8EA LED	
6) Cable -----	20EA
(1) SIZE	30cm
(2) AWG 24	
(3) color	black
(4) Molex 3 pins	
7) 7-segment -----	1EA
(1) ForwardVoltage, Per Segment	2.2V Max.
(2) Continuous Forward Current, Per Segment	30mA
(3) Solder Temperature 1/16 inch Below Seating Plane 3 Secongs at 250	2 Channel
8) Push Button-----	4EA

9) DC Gear motor-----	2EA
(1) Input Voltage(DC.V)	3.5V
(2) Motor	HRF-300CA
(3) Reduction Ratio	1:20
(4) MOTOR RPM	5,100 +- 10%
(5) Output	RPM 250
(6) TORQUE(Kg.cm)	0.149
(7) P(Kg)	0.3
(8) Gear	3-step Gear
10) 3-color LED-----	1EA
(1) Standard PLCC-6 package (Plastic Leaded Chip Carrier) with individual addressable pin-out for higher flexibility of driving configuration.	
(2) LED package with diff used silicone encapsulation	
(3) Using AlInGaP and InGaN dice technologies	
(4) Wide viewing angle at 120 °	
(5) Compatible with reflow soldering process	
(6) JEDEC MSL 3	
(7) Luminous Intensity Red	Min 560, Max 1124
(8) Luminous Intensity Green	Min 1400, Max 2850
(9) Luminous Intensity Blue	Min 285, Max 560
11) Buzzer-----	1EA
(1) Min. Sound Output at 10cm	85dB
(2) Max. Current Consumption	80mA

[ Smart gateway ]

(1) Power port	1 ea
(2) On/Off Switch	1 ea
(3) USB Port	1 ea
(4) USB LED	1 ea
(5) Ethernet 1 port	1 ea
(6) Ethernet 2 port	4 ea
(7) Reset Switch	1 ea
(8) Console port	1 ea
(9) CPU MIPS74Kc@720 MHz	
(10) RAM 128MBytes	
(11) Boot Flash 512KBytes	
(12) User Flash 16MBytes	
(13) Ethernet 10/100/1000Base-T, WAN - 1 port	
10/100/1000Base-T, LAN - 1 port (Switch - 4 port)	
(14) USB USB2.0 x 2 ea	
(15) LEDs Power, RUN, Ethernet status	
(16) AC Adaptor Power +12VDC/3A	

[ Raspberry Module ]

(1) Core architecture Quad-core ARM Cortex-A7	
(2) CPU	900MHz
(3) Memory	1GB LPDDR2
(4) Operating system	Boots from Micro SD Card, running a version of the Linux Operating system
(5) Ethernet	10/100 BaseT Ethernet scket
(6) Video Output	HDMI (rev 1.3 & 1.4)
(7) Audio Output	3.5mm jack, HDMI
(8) USB	4 x USB 2.0 Connector
(9) GPIO Connector	40-pin 2.54mm, providing 27 GPIO pins
(10) Camera Connector	15-pin MIPI
(11) Display Connector	Display Serial Interface (DSI) 15 way flat flex cable connector

[ ESP8266 & Sensors Module ]

(1) ESP8266 : ESP8266 mini	4 ea
(2) Gas Sensors	1 ea
(3) Temperature Sensors	1 ea
(4) PIR Sensor	1 ea
(5) Button and cables	1set

## [ BigData Server ]

Hardware	1 unit
Mini servers	Connect concurrently less than 100 users
CPU	i3, RAM : 4G, SSD : 320G

## [ Software programming ]

(1) Virtual Box
(2) Putty
(3) Ubuntu
(4) OpenWRT IDE
(5) vi, Makefile, gcc
(6) DB, PHP

# model: **BigData-EDU4.0**

## **Big Data Management Platform**

### **Feature**

Big data management tools and technologies are rising in demand all over the world due to the use of big data in business. BigData-EDU4.0 is the integrated big data management platform helping the users to acquire the skills of finding business insights from their data through the practice of big data ingestion, processing, cleansing, storage, delivery, and monitoring. Users can also have a Software training on metadata standardization and management. CE Embedded OS.

### **Functions**

- Understanding concept of big data integration and processing
- Big data extraction, transformation, and load
- Study of data processing in the Hadoop environment
- Interface with open sources applications
- Gaining experiences through real-world case studies

### **Application Program**

- 1) Big data integration
  - DataStream for batch data processing
  - DataStream for Hadoop of processing data in the Hadoop environment
- 2) Interface with R Studio for analysis

## System configuration

### 1) Hardware

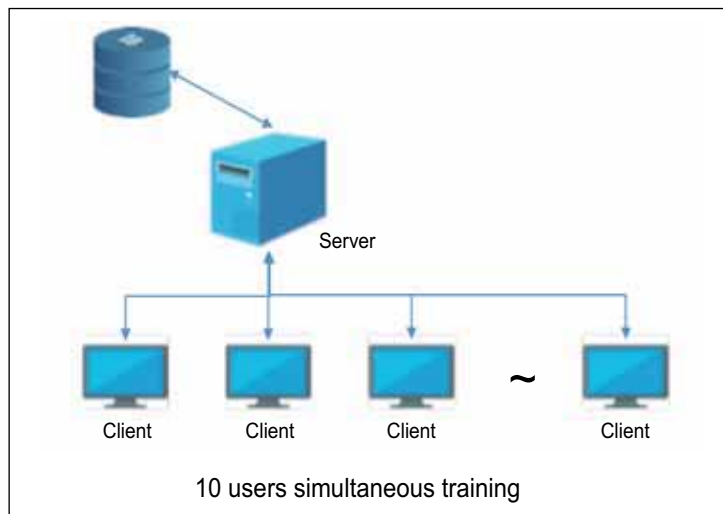


(Server)

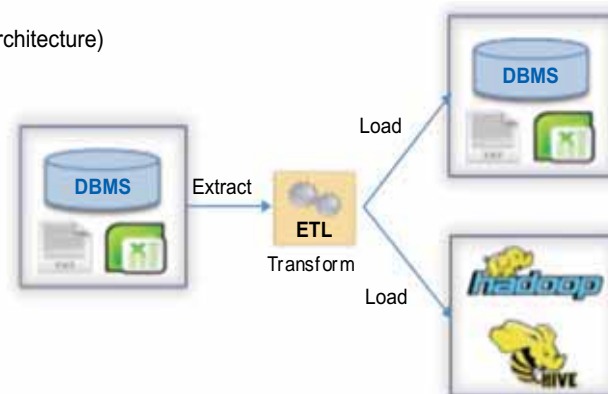


(Client PC)

(Physical architecture)



(Product architecture)



### 2) Software Screen shot



## Components

Appliance Product Hardware Platform Server	1 ea (8Core, 128GB Memory, 1TB Usable)
Appliance Product Platform Software (Program CD)	10 ea
Client PC	10 unit (not provided)
Installation Manual	10 book
User's Manual	10 book

## Training contents

### Chapter 1, Introduction to Big Data Integration and Processing

1. Big Data: Why and When
2. Getting Value out of Big Data
3. What is Big Data Platform?
4. Introducing BigData-EDU4.0
  - 4.1 Overviews
  - 4.2 Architecture
  - 4.3 Why Choose BigData-EDU4.0 ?

### Chapter 2, Getting Started with BigData-EDU4.0

1. Environment Configuration of BigData-EDU4.0
2. Operating BigData-EDU4.0
  - 2.1 Module Introduction
  - 2.2 Access Control and User Management
  - 2.3 Connecting with Open Sources
  - 2.4 Dashboards and Monitoring

### Chapter 3, Modules of BigData-EDU4.0

1. Introduction to DataStream
  - 1.1 Overviews
  - 1.2 Architecture
  - 1.3 Features
2. Introduction to DataStream for Hadoop
  - 2.1 Overviews
  - 2.2 Architecture
  - 2.3 Features

### Chapter 4, Foundations of BigData-EDU4.0, Data Integration and Storage

1. Data Integration Concepts and Architecture
2. Ingesting, Transforming and Loading Data Using DataStream
  - 2.1 Connecting to a Relational Database
  - 2.2 Extracting Data from Relational Database
  - 2.3 Summarizing Data/Data Cleansing
  - 2.4 Loading Data
3. A Real-World Case Study

### Chapter 5, Big Data Integration with BigData-EDU4.0

- 1 Large Scale Data Extraction and Storage
2. Big Data Retrieval and Processing Using DataStream for Hadoop
  - 2.1. Connecting to Hadoop Ecosystem
  - 2.2. Data Storage in Hadoop Environment
  - 2.3. Interfacing with Open Sources
- 3 A Real-World Case Study

## Spec

### 1) Hardware spec

#### (1) Server Version Specification

Operating System	Linux Kernel 2.6 or above
CPU	X86 64-bit, 8Core or above
Compiler	3.4.x version or above
RAM	128GB or above
DISK	Usable 1TB or above



## 2) Software spec

### (1) DataONE (DataStream for Hadoop, DataONE Manager)

- . Supports various types of structured and unstructured data collection
  - Connectors : Oracle, Altibase, DB2, GreenPlum, MySQL, JSON, XML, MS SQL, Netezza, Sybase IQ, Sybase ASE, TeraData, Tibero, SAP, PostgreSQL, Hive, DBF, CSV
- . GUI designer for ETL processing both to DBMS and Hadoop
- . Flexible data integraton with Hadoop HDFS, Hive, Hbase
- . Distributed parallel processing of both DBMS and SAMFile for bulk loading
- . Supports high performance extraction
- . GUI based Hadoop ecosystem
- . 1:1 data mapping automation
- . Job scheduler for batch processing
- . Supports SQL on Hadoop
- . Multi SQL processing in GUI
- . Easy accessibility to R thru DataONE GUI Manager
- . Remote call and execute R analysis model from DataStream for Hadoop
- . Supports multi-thread processing
- . Web monitoring for operating environments
- . Scale-out capability for securing storage space
- . 150 embedded internal functions for ease of use

# model: **GT-BDAP7000**

## **BigData Training System**

GT-BDAP7000 is BigData Analytics Platform.

BDAP is a data acquisition required for the big data technology / processing / storage / analysis that provides both such as the software platform traditional high-end DW system compared to low TCO and the expected linear performance gain.

BDAP is the main key feature of Big Data Hadoop emerging as the global standard technology to standardize & provide the performance, reliability, ease of use and optimized for the enterprise environment.

In addition to big data, ranging from installation, user training, technical support, user can minimize the trial and error at the time of big data adoption by provided all services.

### Features

- (1) BigData - for Structured data, Unstructured data
- (2) Next generation - for the advanced DW system
- (3) Hadoop Based Platform
- (4) All-in-one-platform

### Functions

- (1) R+Hive Component - Integration of R and Hive
- (2) Unified SQL Engine - ANSI SQL, Distribute data processing
- (3) Engine Data Store - HDFS, Map-Reduce
- (4) Enterprise Collector - Source data collector, Check-Pointing for agentless method
- (5) Admin Center - Distributed coordinator, BDAP management, Dashboard

### System configuration

- (1) Hardware (Server), 6 unit
- (2) Software, 6 Nodes



( Server Platform )



( Online Client Service )

## Component

Hardware (Server)	6 unit (HP DL360e Gen8, or similar)
Software program	6 Nodes Management & Collecting node : 2 ea Data node : 3 ea Analysis node : 1 ea
Manual book	7 books

## Training Contents ( Syllabus)

### Book - 1 : BDAP, User Guide ( 7 Lesson )

1. Overview
  - 1.1. Introduction of user guide on BDAP  
(BigData Analytics Platform)
  - 1.2. BDAP Architecture
  - 1.3. Components
2. Getting started with BDAP
  - 2.1. BDAP Web introduction
3. Dashboard
  - 3.1. Getting started with Dashboard
  - 3.2. Description
  - 3.3. BDAP Cluster Service Daemon Status
  - 3.4. BDAP cluster resource usage
  - 3.5. BDAP statistics information
4. Data Transfer 29
  - 4.1. Getting Started with Data Transfer
  - 4.2. Connections
  - 4.3. Import Jobs
  - 4.4. Export Jobs
5. HDFS Browser
  - 5.1. HDFS storage
  - 5.2. HDFS Directory Explorer
  - 5.3. HDFS File Explorer
  - 5.4. Create directory
  - 5.5. Move directory / file
  - 5.6. Copy directory / file
  - 5.7. Rename directory / file
  - 5.8. Delete directory / file
  - 5.9. File Upload
  - 5.10. File Download
  - 5.11. Permission on file
  - 5.12. Preview file contents
6. Workbench
  - 6.1. Getting Started with BDAP Workbench
  - 6.2. Worksheets
  - 6.3. Snippets
  - 6.4. History
  - 6.5. Schemas
7. Workflow
  - 7.1. Getting Started with Workflow
  - 7.2. Project
  - 7.3. Workflow
  - 7.4. Node
  - 7.5. Schedules
  - 7.6. History
  - 7.7. How to use EL
8. Document
  - Appendix-1, How to use EL  
[ EL to use when querying (Expression Language) ]
  - Appendix-2, Changes in history

### Book - 2 : BDAP Installation Guide ( 6 Lesson )

1. Overview
  - 1.1. Introduction of installation guide
  - 1.2. BDAP Component Version Information
2. Preparation for the installation
  - 2.1. About installation
  - 2.2. System Requirements
  - 2.3. Planning the Cluster
  - 2.4. Preparation in advance
3. Installation
  - 3.1. BDAP install
  - 3.2. How to Set Up a Service High Availability
- Configuration
  - 3.3. Start and stop services
  - 3.4. BDAP setting
  - 3.5. RHive install
  - 3.6. Ganglia install
  - 3.7. NiFi install
4. Delete
  - 4.1. BDAP delete
5. BDAP Upgrade
  - 5.1. BDAP upgrade
- Appendix-1, Add JDBC driver
- Appendix-2, Changes in history

### Book - 3 : BDAP 4.6.1 Administration Guide ( 6 Lesson )

1. Overview
  - 1.1. Introduction of administration guide
  - 1.2. Component
  - 1.3. BDAP Component Version Information
2. BDAP operation
  - 2.1. BDAP Service Management
  - 2.2. Manage logs
  - 2.3. Manage settings
  - 2.4. Encryption / decryption management
  - 2.5. Event Notification management
  - 2.6. Fair Scheduler management
  - 2.7. Security File management (backup)
3. BDAP Web interface
  - 3.1. Introduction of BDAP Web interface
  - 3.2. Login / Logout
  - 3.3. BDAP Version information
  - 3.4. Audit
  - 3.5. Queries
  - 3.6. Decryption Logs
  - 3.7. MapReduce Jobs
  - 3.8. Users
  - 3.9. Roles

- 3.10. ACL Management
- 3.11. Configuration
- 3.12. BDAP Configurations
- 3.13. Decryption
- 4. Interworking BDAP and R/RHive
  - 4.1. R/RHive installation and environment setting
- 5. HDFS management
  - 5.1. Rack Awareness setting
  - 5.2. Updating Data Nodes
  - 5.3. How to recover from a failure
  - 5.4. How to use the administration tool
  - 5.5. Add / Remove Host
  - 5.6. Log files and log messages depending on the situation
  - 5.7. Data that needs to be backed up
- 6. HBase management
  - 6.1. How to recover from a failure
  - 6.2. How to use the administration tool
  - 6.3. Log files and log messages depending on the situation
  - 6.4. Data that needs to be backed up
- 7. ZooKeeper management
  - 7.1. How to recover from a failure
  - 7.2. How to use the administration tool
  - 7.3. Log files and log messages depending on the situation
  - 7.4. Data that needs to be backed up
- 8. BDAP Configuration setting
  - 8.1. Dashboard
    - A. Service Account
    - B. Port setting
    - C. Apache Ranger
      - C.1. Introducing Ranger Web Interface
      - C.2. Login/Logout
      - C.3. Access Manager
      - C.4. Audit
      - C.5. Users
      - C.6. Groups
      - C.7. Permissions
    - D. Ranger HDFS Audit Log View
      - D.1. Audit Log location
      - D.2. Create hive table
      - D.3. Query using built in udf
    - E. Apache NiFi
      - E.1. Introducing the NiFi web interface
      - E.2. Login/Logout
      - E.3. How to register User rights
      - E.4. NiFi management page
      - E.5. NiFi Configuration File
    - F. BDAP SSO Authenticator
      - F.1. Interworking method
    - G. Changes in history

#### Book - 4 : BDAP 4.6.1 Monitoring Guide ( 3 Lesson )

- 1. Overview
  - 1.1. Introduction of monitoring guide
  - 1.2. Component
  - 1.3. BDAP Component Version Information
- 2. Node general metrics
  - 2.1. CPU
  - 2.2. Disk
  - 2.3. Load
  - 2.4. Memory
  - 2.5. Network
- 3. Hadoop metrics
  - 3.1. HDFS
  - 3.2. YARN
- 4. HBase metrics
  - 4.1. HBase Master

- 4.2. HBase RegionServer
- 5. ZooKeeper metrics
  - 5.1. ZooKeeper
- 6. Oozie metrics
  - 6.1. JVM metrics
- 7. BDAP metrics
  - 7.1. BDAP Management Server
  - 7.2. HAProxy
- 8. BDAP Monitoring View
  - 8.1. How to use the BDAP monitoring view
  - 8.2. Summary
  - 8.3. HDFS
  - 8.4. YARN
  - 8.5. Hbase
  - 8.6. ZooKeeper
  - 8.7. Oozie
  - 8.8. BDAP
  - 8.9. HAProxy
    - A. Ganglia Troubleshooting Guide
      - A.1. in case that Metrics are not displayed in the graph
    - B. How to change your Ganglia settings
      - B.1. Node delete
    - C. Changes in history

#### Book - 5 : BDAP, API Guide ( 10 Lesson )

- 1. Overview
  - 1.1. BDAP API introduction
- 2. Preparations and common in API
  - 2.1. Preparation
  - 2.2. common in API
- 3. Data Transfer
  - 3.1. Connection
  - 3.2. Import
  - 3.3. Export
- 4. HDFS Browser
  - 4.1. File/Directory move
  - 4.2. Change permissions of File / directory access
  - 4.3. Change permissions of File / directory access and ownership
  - 4.4. Copy files / directories
  - 4.5. Permission of File / Directory Ownership
  - 4.6. Verify HDFS Quota
  - 4.7. Read the file
  - 4.8. File / Directory Check
  - 4.9. Create directory
  - 4.10. File upload
  - 4.11. File download
  - 4.12. Delete 1 file / directory
  - 4.13. Delete multiple files / directories
  - 4.14. Name change
  - 4.15. File system shutdown
  - 4.16. Identify access routes
- 5. Workbench
  - 5.1. Workcheets
  - 5.2. Snippets
  - 5.3. Database
  - 5.4. Table
  - 5.5. View
  - 5.6. History
- 6. Workflow
  - 6.1. Project
  - 6.2. Workflows
  - 6.3. Schedules
  - 6.4. History
  - 6.5. Global Variables

## 7. Administration

- 7.1. Audit
- 7.2. Queries
- 7.3. Decryption Logs
- 7.4. MapReduce Jobs
- 7.5. USER
- 7.6. ROLE
- 7.7. Application
- 7.8. Decryption
- 7.9. BDAP Configurations
- 7.10. Regular Expressions
  - A. SWAGGER
    - A.1. what is SWAGGER ?
    - A.2. How to use SWAGGER
  - B. Changes in history

**Book - 6 : BDAP, Tutorial Guide ( 3 Lesson )**

## 1. Overview

- 1.1. Introduction of tutorial
- 1.2. BDAP Architecture
- 1.3. Component of tutorial
- 1.4. BDAP Component Version Information

## 2. BDAP Practice Preparation

- 2.1. install BDAP
- 2.2. Permissions and user settings
- 2.3. Practice Scenario
- 2.4. Preparation of Practice Equipment
- 2.5. Preparation of Practice Data

## 3. Data collection (File to Hive)

- 3.1. Objectives of Training
- 3.2. Creating Connection for Source
- 3.3. create Target Hive Table
- 3.4. create Import Job
- 3.5. Run Import Job and check the results

## 4. Data collection (Database to Hive)

## 4.1. Objectives of training

- 4.2. Deploying JDBC drivers to BDAP
- 4.3. create DB Connection
- 4.4. Prepare source data
- 4.5. create Target Hive Table
- 4.6. create Import Job
- 4.7. Run Import Job and check the results

## 5. Data analysis

- 5.1. Objectives of Training
- 5.2. create Target table
- 5.3. Create analytic query
- 5.4. Saving results to an aggregate table

## 6. Exporting Data to an External RDB

- 6.1. Objectives of Training
- 6.2. create target table of external DB
- 6.3. Create a Connection to the Target Table
- 6.4. create Export Job
- 6.5. execute Export Job

## 7. make Workflow

- 7.1. Objectives of Training
- 7.2. create Workflow
- 7.3. Workflow execution and validation
- 7.4. Create Remote Shell Node for RHive

## 8. create Schedule

- 8.1. Objectives of Training
- 8.2. create Schedule

## 9. Action plan when Import/Export, Workflow is failure

- 9.1. Objectives of Training
- 9.2. Import / Export Job Execution Status and Log Check
- 9.3. Check Query run status and log checking
- 9.4. Workflow status and log checking
  - A. Hive UDF Function
    - A.1. str\_to\_date
    - A.2. sysdate
  - B. rhive-basic-func.R
  - C. Changes in history

**Book - 7 : BDAP, Advanced Course ( 20 Lesson )**

This is the advanced course for bigdata learning.

Through the Hadoop-based Big Data Platform, users are able to experience the process of processing and analyzing various large-scale data through hands-on experience.

By applying various analytical methods and techniques, we share know-how and learn practical examples that is applied to commercial business area.

Big data analysis	Introduction of Big Data system
Hadoop, Big data processing	Hadoop-based Big Data Processing and Techniques -1 Hadoop-based Big Data Processing and Techniques -2
DW, Hive	Data Warehouse System - Hive
Hbase	Non-relational distributed database -Hbase
BAP (Big data analytic platform)	Big Data Platform, Introduction and Practice -1 Big Data Platform, Data Processing (Work-Bench) - Practice -2 Big Data Platform, Data Processing (Workflow) - Practice -3 Big Data Platform, Data Processing (Managenent) - Practice -4 Big Data Platform, Open Source R - Practice -5
Analytical methodology,	Big data analysis methodology and Deployment case study -1 : actual implementation examples
Analytical methodology,	Big data analysis methodology and Deployment case study -2 : actual implementation examples
RCA analytical methodology	Big data based RCA (Root Cause Analysis) analysis methodology -1 Big data based RCA (Root Cause Analysis) analysis methodology -2
Unstructured Data Analysis	Unstructured data-based Big data analysis methodology -1 Unstructured data-based Big data analysis methodology -2
FDS	Bank Depository Institution Big Data-based FDS Methodology -1 Bank Depository Institution Big Data-based FDS Methodology -2

## Spec

### 1) System

- A system that the Distributed Parallel Processing-based data collection, storage, processing, management
- A system that the Distributed Parallel Processing-based the advanced analysis of R function
- A system that supports the distributed parallel processing for data acquisition, storage, processing, analysis and supports Hadoop for data storage
- Systems that support all Linux-based x86 servers without hardware dependencies

### 2) Data collection

- Remote log file collection function
- Formal data collection (sqoop, etc.)
- Unstructured data streaming collection function (Flume etc.)
- Supports various types of unstructured data
- Irregular multi-line data collection function
- Parallel processing collection function for bulk loading
- File data collection function with SSL / TCP
- Import to HDFS, Import to Hive, Import to Hbase
- User pre-confirmation with collection data preview function
- GUI-based import / export of structured data
- Agent and agentless data collection function
- Data collection function through data transmission interval encryption (SSL)

### 3) Data storage and processing

- Parallel distributed processing function of big data store
- Storage features that integrate NoSQL and HDFS
- Ability to process NoSQL and HDFS based on Hive (using SQL processing)
- DB data processing function of repository data
- Storage directory navigation
- Supports data encryption / decryption of Storage Level (storage and inquiry)
- GUI-based access control (ACL) processing and storage
- Process design features for ETL processing
- R linkage processing function for ETL processing
- Data consistency check function in ETL processing
- support Collection target data mapping function (ETL)
- Collection data processing / filtering function (ETL)
- RDBMS interworking function of Oracle, MS-SQL, MySQL etc
- Provides separate GUI (Workbench) Tool for SQL based processing
- Unified SQL Engine that can process data in SQL-based  
: provide Hive Storage Handler (HDFS, Hbase, and JDBC Connect can be easily handled based on Hive API)
- Multi-SQL processing in GUI
- Provides extended UDF for various SQL processing
- SQL-based DB, table access control processing function (grant processing function)
- Provides GUI environment for SQL-based DB / Table / View creation
- Ability to store big data processing results in HDFS, NoSQL, File, RDBMS, etc.
- Scheduling function for distributed parallel processing jobs
- GUI-based workflow for data management and batch processing
- Branch, dependency add-on function in workflow
- provide Extension interface with external application / server on workflow  
: Rest API interworking, ssh, java interworking

### 4) Advanced data analysis

- Formal analysis and atypical analysis
- Provides the distributed parallel processing for analysis of hundreds of millions of big data
- Parallel distributed processing function based on SQL by linking R to Hive
- Provides separate advanced analysis functions when execute Parallel distributed processing by linking with R to Hive
- Provide a separate working area for analysts to use  
: Hive-based analysis repository for each user and integrated management between data stores
- Provides compatibility with various analysis / BI tools Including R for securing upgrading and expandability of analysis results.

## 6) Big Data Platform H / W Specification

## (1) Managed node &amp; Collection node (2 EA)

- CPU : 8core \* 2EA (1U)
- Memory : 128GB, or over
- Disk : SAS, 600GB \* 4, RAID 1+0
- Network : 10Gb port \* 2 ea
- Operation system : Linux 64bit OS(CentOS 3.x)

## (2) Data node (3 EA)

- CPU : 6core \* 2EA (1U or 2U)
- Memory : 48GB, or over
- Disk : SATA 2TB \* xEA (JBOD), SATA 500GB \* 1EA
- Network : 10Gb port \* 2 ea
- Operation system : Linux 64bit OS(CentOS 3.x)

## (3) Analysis node (1EA)

- CPU : 6core \* 2EA (1U)
- Memory : 512GB, or over
- Disk : SAS, 600GB \* 4, RAID 1+0
- Network : 10Gb port \* 2 ea
- Operation system : Linux 64bit OS(CentOS 3.x)

## (5) Switch (2EA)

- Port : 48port 10Gb SFP Switch 2 node
- Cable : 44 x 3m DAC cable
- others : 4 x 10 SFP+ equipped

## (6) Rack (1EA)

- Standard Rack : 42U, 19 ~ Full Rack

## (7) System installation and optimization support

# 23

## a group of IoT (Internet of Things) Training system

- 40. GT-IoT300
- 41. GT-IoT900
- 42. IoT Home Network Testbed-GT16



# model:GT-IoT300

## Embedded IoT & Security Training system

### Developing Smart Gateway of GT-IoT300

- 1) Recently, information and communication-based various service technologies, such as cloud, smart devices and IoT (Internet of Things) have been rapidly developed.
- 2) In addition, platform technologies of network equipment like routers, smart gateways, switches, firewalls which are required for this various technologies are being developed as well.
- 3) Development of information & communication technology enables users not only to overcome time and space constraints for the use of smart devices, but also to continue what they are doing in any other places including the office, home, school and to provide the same network environment as that of physically remote location.
- 4) Technology that is making the multiple remote network to one local network can be implemented through well-known inter-network VPN (Virtual Private Network) equipment. Commercial VPN equipment has been evolved to provide the application of many advanced functions including not only basic router and tunneling functions, but also intelligent firewall including IDS (Intrusion Detection System) and IPS (Intrusion Protection System), QoS (Quality of Service) technology, multi-line support, and load balancing, etc.  
These commercial VPN equipment are being used as high-performance products in a dedicated line environment with the support of experts.
- 5) Moreover, these are expensive and dedicated equipment due to their technical nature so that it is not easy to ensure for them to provide the compatibility between equipment.
- 6) Also as mentioned earlier, under the situation that small and medium-sized businesses and even the public increasingly require the need for the same network environment such as cloud, IoT (Internet of Things) and multi-screen, the need for the wired/wireless router to support inter-network VPN under general internet environment has been increased because application of dedicated VPN equipment to the expensive leased line environment is not economical.
- 7) Accordingly, a technology providing reliable VPN environment in a vulnerable network environment which shows relatively less CPU and memory performances than dedicated VPN equipment is required.
- 8) Although several existing wired/wireless routers to support VPN exist, their simple VPN server functions only provide direct linkage to a PC or a smartphone not a inter-network VPN linkage.
- 9) Therefore, their utilization is decreased, the machine to support is limited and the speed rate is around 5Mbps level.  
In addition, not only that it is not economical to popularize commercial VPN dedicated equipment, but that its operation is not possible without dedicated line.
- 10) Due to this reason, we come to propose below solutions to resolve the above problems;  
First, we propose a platform (Smart Gateway) to support VPN tunneling to the affordable cost hardware.  
Second, we propose an implementation plan to support at least 20Mbps for VPN tunneling rate for each tunneling algorithm through new platform (Smart Gateway).  
Third, we propose a method for applying different-features, multi-queuing techniques via Smart Gateway beyond the simple QoS, ToS (Type of Service) methods by identifying real-time internet line situation even if the change of internet line quality is large.
- 11) Historic network-based equipment including routers, firewalls, and VPN equipment have been developed continuously even today. Development of hardware performance itself is required, but development of software technology is further required in recent days not only for the proper responses to a variety of services and environment changes, but also for the need of popularization of associated network equipment to respond against explosive expansion of various services such as cloud, big data, and IoT.
- 12) The hardware, operating system and software platform used in Smart Gateway of GT-IoT300 are based on OpenWRT which many developers in the various network equipment fields have used for a long time.  
The techniques of VPN tunneling-related solutions applied to Smart Gateway of GT-IoT300 can be used in various network equipment such as smart gateway application for IoT.

## Features

Smart Gateway was developed for GT-IoT300 and it is used for commercial purposes to control home appliances.

The Internet of Things (IoT) is the network of physical objects, devices, vehicles, buildings and other items which are embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.

The "Internet of Things" connects devices and vehicles using electronic sensors and the Internet.

The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more-direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

Many of IoT training systems are so configured as to allow practice of on-board sensor control using a Raspberry Pi Module.

To control the on-board sensors through the Raspberry Pi Module, virtual IP is used, not through a commercial Cloud Server.

Therefore, it is not easy to practice remote control of various home appliances through Raspberry-pi based IoT training system.

Moreover, the Raspberry-Pi module does not provide the gateway function.

Also, as for Cloud Server, as several virtual machines operate on a single Real Machine, there may occur some problems

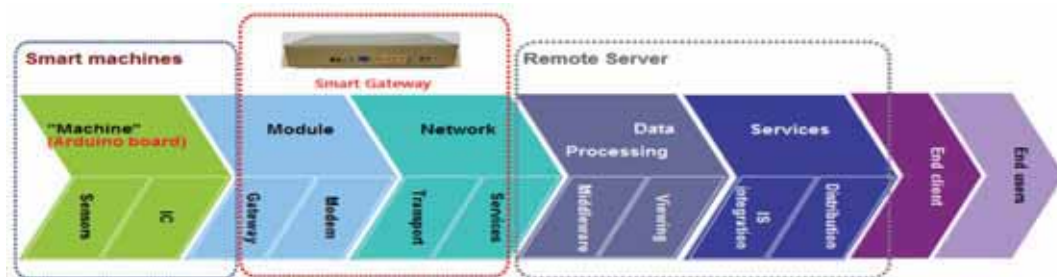
associated with the Virtual Server (e.g. the server might be inaccessible in case of DB shutdown, Max-Connect count over, etc.).

Since several VMs operate on a single Cloud server and a large part of the memory is used by other VMs, connection fail can be occurred.

The Cloud server provides many advantages such as cost saving, customer support, convenience, etc.

However, it is better to use an independent Real-Machine such as VPN Smart Gateway.

### ( IoT concept using VPN based Smart Gateway )



Practice of sensor control using an Arduino module, Raspberry-pi module and VPN Smart Gateway. Various sensors (home appliances) can be controlled at a low cost since the sensor control is carried out independent of the network, and the sensor control can be done safely and conveniently as the security and connection settings are centralized through Smart Gateway.

GT-IoT300 is IoT training system using OpenWRT based VPN Smart Gateway and Arduino board that various sensors mounted.

OpenWrt is an operating system (in particular, an embedded operating system) based on the Linux kernel, primarily used on embedded devices to route network traffic.

GT-IoT300 is so configured as to allow practice of sensor control on the Arduino board through the VPN Smart Gateway as well as remote audio TV, Video control using Raspberry Module.

GT-IoT300 provides benefits as follows:

- 1) Things (sensors) are separated from the Internet (VPN Smart Gateway), allowing various interfaces such as USB Serial, Bluetooth, Zigbee, etc.
- 2) It is possible to practice control of various sensors on the Arduino platform through the VPN Smart Gateway and possible to remotely control the real (commercial) home appliances of Audio.
- 3) From the OpenWRT platform, the Internet is useful for expansion of various functions and security such as WWW, IPCAM, firewall, VPN, etc.

## Functions

### 1) Sensors Control Practice on Arduino Board via OpenWRT based VPN Smart Gateway

- (1) 8ea of LED Control
- (2) Button Control
- (3) Color LED Control
- (4) DC motor Control
- (5) Step motor Control
- (6) Buzzer Control
- (7) 7-segment Control
- (8) Crystal LCD Control
- (9) Light sensor Control
- (10) IR Sensor Control
- (11) PSD sensor Control

## 2) Project modules control practice by Java programming & C programming.

- (12) OLED sensor Control
- (13) Relay sensor Control
- (14) PIR sensor Control
- (15) GAS sensor Control

\* for module control - C programming

\* for web Interface - Java programming

## 3) Home Appliances (Audio, TV, Video) Control & IoT network construction using Raspberry Module.

- (1) How to implement IoT (Internet of Things)
  - Introduction IoT using YUN Shield
  - Introduction IoT using Raspberry Pi
  - Introduction IoT using Beaglebone black
- (2) Smart Gateway
  - Introduction
  - OpenWRT
  - IDE
  - Interworking with Arduino
  - Interworking with Sensor Network
  - Interworking with Internet
- (3) Application practice
  - IoT Sensor Control Interworking
  - IoT Sensor Cam Interworking
  - Programming practice for the Kernel supporting serial communication.
  - Programming practice for the Kernel supporting UVC-Camera
  - Programming practice for the kernel supporting Bluetooth communication
  - node.js installation and programming practice which supports bi-directional Web UI
  - smtp programming practice for mail communication
- (4) Home Appliance Control ( real Audio, TV, Video Control )

## 4) Security control by IP Camera.

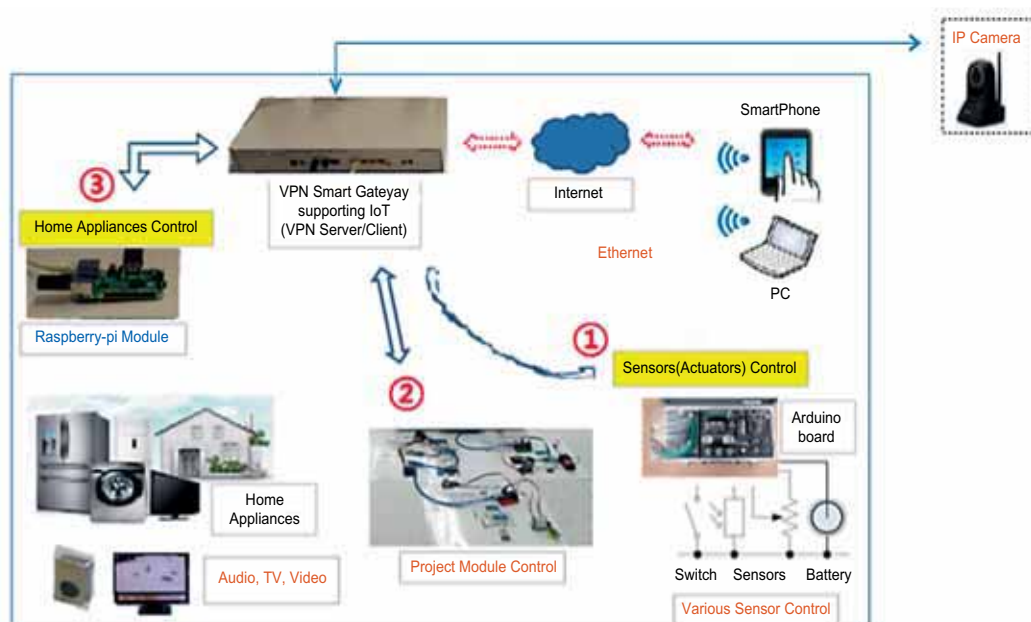
CCTV (video) surveillance solution which is based on cutting-edge video analyzing and algorithm technology platform.

- (1) For real Time surveillance via intelligent video analysis.
- (2) Transmit alarms by various ways to administrator & related association.
- (3) Retrieve the required video in the event storage server.

## 5) IoT training courses in programming practice.

- (1) Serial Communication Program
- (2) Bluetooth Communication Program
- (3) Java script Program

## System configuration



## Hardware photo



## Components

1) VPN Smart Gateway	1 set
2) Web camera	1 ea
3) Arduino board	1 set
4) Raspberry-pi Module	1 ea
5) Audio 1 ea	
6) Project module	
(1) OLED sensor module	1 ea
(2) Relay sensor module	1 ea
(3) PIR sensor module	1 ea
(4) GAS sensor module	1 ea
7) IP Camera	1 ea
8) Program CD	1 ea
9) Textbook	2 book

## Training contents

Chap 1. The final result demonstrated.

Chap 2. About lessons.

Chap 3. Embedded systems overview.

Chap 4. About IoT (Internet of Things)

- 1) Outline
- 2) Introduction IoT using YUN Shield
- 3) Introduction IoT using Raspberry Pi
- 4) Introduction IoT using Smart Gateway

Chap 5. Arduino - Things

Part-1)

- 1) Arduino start
- 2) Digital inputs and outputs (GPIO) and PWM
- 3) Analog signals and Sensor values
- 4) USB and serial communication
- 5) Serial inter-working
- 6) Bluetooth inter-working
- 7) Serial.parseInt()

Part-2)

- 1) What is Arduino ?
- 2) 8ea of LED control to be connected to digital pin
- 3) Controlling the button connected to digital pin
- 4) Color LED control to be connected to digital pin
- 5) Buzzer Control connected to digital pin
- 6) 7-Segment Control to be connected to digital pin

- 7) Crystal LCD Control to be connected to I2C
- 8) Light sensor Control to be connected to analog pin
- 9) IR Sensor Control to be connected to analog pin
- 10) How to utilize PSD Sensor to be connected to analog pin
- 11) How to utilize DC Motor
- 12) SPL-Duino Control by Smart Phone

Chap 6. Smart Gateway - Internet

- 1) OpenWRT overview
- 2) OpenWRT - IDE
- 3) OpenWRT - Kernel Program Supporting Serial, Bluetooth, UVC-Cam
- 4) OpenWRT - Arduino inter-working, Programming USB-Serial
  - LED Control
  - Buzzer Control
  - TMP35 Control
  - Servo motor Control
  - DC motor Control
  - SPL-Duino Control
- 5) OpenWRT - Arduino inter-working, Programming USB-Bluetooth
- 6) OpenWRT - Arduino inter-working, Programming WWW-node.js and Webcam
- 7) OpenWRT - Arduino inter-working, Programming ALERT

Chap 7. IoT Projects Programming

- 1) Arduino nano + bluetooth + relay
- 2) Arduino nano + bluetooth + pir + gas
- 3) Arduino nano + bluetooth + oled

Chap 8. Programming using the Raspberry Pi

- 1) About Raspberry Pi
- 2) Basic setting of Raspberry Pi
- 3) GPIO Control
- 4) Remote audio / video play, TV Control
- 5) OpenWRT - Raspberry Pi inter-working TCP/IP
- 6) OpenWRT - Raspberry Pi inter-working WWW-node.js

Chap 9. Surveillance IP Camera

- 1) Motion Detection Alert
- 2) Remote controlling IP Camera

## Spec

[ Arduino Board ]

1) Arduino Board	
(1) Atmega328 Processor	
(2) Arduino compatible boards	
(3) Built-in Bluetooth	
(4) Built-in IO expansion pin (12ea of digital pin, 6es of analog pin)	
(5) Built-in Motor connection pin (2ea of DC motors connection pin)	
(6) Built-in illumination sensor	
(7) Built-in 3ea of button switch	
(8) USB connection cable provided	
(9) Battery connecting case provided	
2) Infrared sensor module-----	3EA
(1) 3AW4C02	
(2) Reverse Current	10uA
3) PSD sensor module-----	1EA
(1) High Sensitivity PSD Sensor	GP2Y0A21YK
(2) Detecting output type	Analog voltage
(3) Detection distance	10 ~ 80Cm
4) LCD Display module-----	1EA
(1) STN, Negative, Transmissive Mode	
(2) Display Data Color	Light Gray or Deep Blue
(3) Viewing Angle	6H
(4) Driving Method	1/16 duty, 1/5 bias
(5) Back Light	White LED backlight
(6) input voltage	6V Max.
(7) LCD Panel	16x2 Char (5x8dots)
5) LED Display module -----	1EA
(1) 2012 Type LED	
(2) Straight Type 8EA LED	
6) Cable -----	20EA
(1) SIZE	30cm
(2) AWG 24	
(3) color	black
(4) Molex 3 pins	
7) 7-segment -----	1EA
(1) ForwardVoltage, Per Segment	2.2V Max.
(2) Continuous Forward Current, Per Segment	30mA
(3) Solder Temperature 1/16 inch Below Seating Plane 3 Secongs at 250	2 Channel
8) Push Button-----	4EA
9) DC Gear motor-----	2EA
(1) Input Voltage(DC.V) :3.5V	
(2) Motor : HRF-300CA	
(3) Reduction Ratio : 1:20	
(4) MOTOR RPM : 5,100 +- 10%	

(5) Output : RPM 250	
(6) TORQUE(Kg.cm): 0.149	
(7) P(Kg) : 0.3	
(8) Gear : 3-step Gear	
10) 3-color LED-----1EA	
(1) Standard PLCC-6 package (Plastic Leaded Chip Carrier) with individual addressable pin-out for higher flexibility of driving configuration.	
(2) LED package with diff used silicone encapsulation	
(3) Using AlInGaP and InGaN dice technologies	
(4) Wide viewing angle at 120°Δ	
(5) Compatible with reflow soldering process	
(6) JEDEC MSL 3	
(7) Luminous Intensity Red : Min 560, Max 1124	
(8) Luminous Intensity Green : Min 1400, Max 2850	
(9) Luminous Intensity Blue : Min 285, Max 560	
11) Buzzer-----1EA	
(1) Min. Sound Output at 10cm	85dB
(2) Max. Current Consumption	80mA

[ VPN based Smart Gateway ]

(1) Power port	1 ea
(2) On/Off Switch	1 ea
(3) USB Port	1 ea
(4) USB LED	1 ea
(5) Ethernet 1 port	1 ea
(6) Ethernet 2 port	4 ea
(7) Reset Switch	1 ea
(8) Console port	1 ea
(9) CPU MIPS74Kc@720 MHz	
(10) RAM 128MBytes	
(11) Boot Flash 512KBytes	
(12) User Flash 16MBytes	
(13) Ethernet 10/100/1000Base-T, WAN - 1 port	
10/100/1000Base-T, LAN - 1 port (Switch - 4 port)	
(14) USB USB2.0 x 2 ea	
(15) LEDs Power, RUN, Ethernet status	
(16) AC Adaptor Power +12VDC/3A	

[ Raspberry Module ]

(1) Core architecture	Quad-core ARM Cortex-A7
(2) CPU	900MHz
(3) Memory	1GB LPDDR2
(4) Operating system	Boots from Micro SD Card, running a version of the Linux Operating system
(5) Ethernet	10/100 BaseT Ethernet scket
(6) Video Output	HDMI (rev 1.3 & 1.4)
(7) Audio Output	3.5mm jack, HDMI
(8) USB	4 x USB 2.0 Connector
(9) GPIO Connector	40-pin 2.54mm, providing 27 GPIO pins
(10) Camera Connector	15-pin MIPI
(11) Display Connector	Display Serial Interface (DSI) 15 way flat flex cable connector

[ Software programming ]

(1) Virtual Box
(2) Putty
(3) Ubuntu
(4) OpenWRT IDE
(5) vi, Makefile, gcc

model: **GT-IoT900**

## Embedded IoT Training System

### Introduction

GT-IoT900 is mainly consisted of CPU Board, Gateway (Raspberry Pi) and eight kinds of sensors, seven kinds of actuators.

It is provided with User-designed environment in which the user can design and practice for IoT Farm Management. Also the results can be checked and controlled via Internet or Android App.

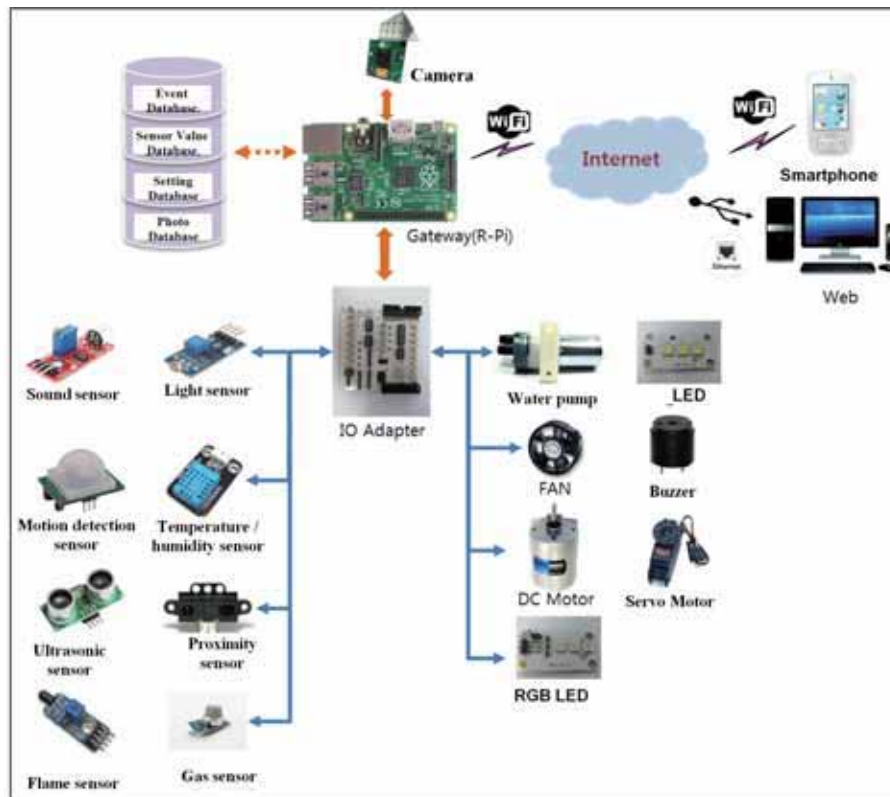
### Features

- 1) GT-IoT900 is the training System that can learn about IoT, IoT design principle, and learn about how to implement IoT Application.
- 2) transfer the collected & gathered data from farm, factory / school / office / building, houses & apartment to smartphone in real-time.
- 3) provides a fun and easy developing environment in which to make your ideas in a reality.
- 4) Each application examples are consisted of Gateway (Raspberry Pi) S/W, Sensor S/W, Actuator S/W, Smartphone Application S/W.
- 5) Gateway works with variety of sensors (temperature, humidity, light intensity, movement, sound, flame, smoke, gas, soil Temperature / Humidity, cameras, etc.)  
And it controls the various actuators (Relay, LED, Buzzer, Sound, flashing lights, Piezo Siren, Pump, Motor, etc.)
- 6) Through a smartphone app, you can implement a variety of scenarios in response to the video and sensor data.
- 7) GT-IoT900 offers Firmware, Web program, smart phone (for Android) software examples necessary to various application design / practice.

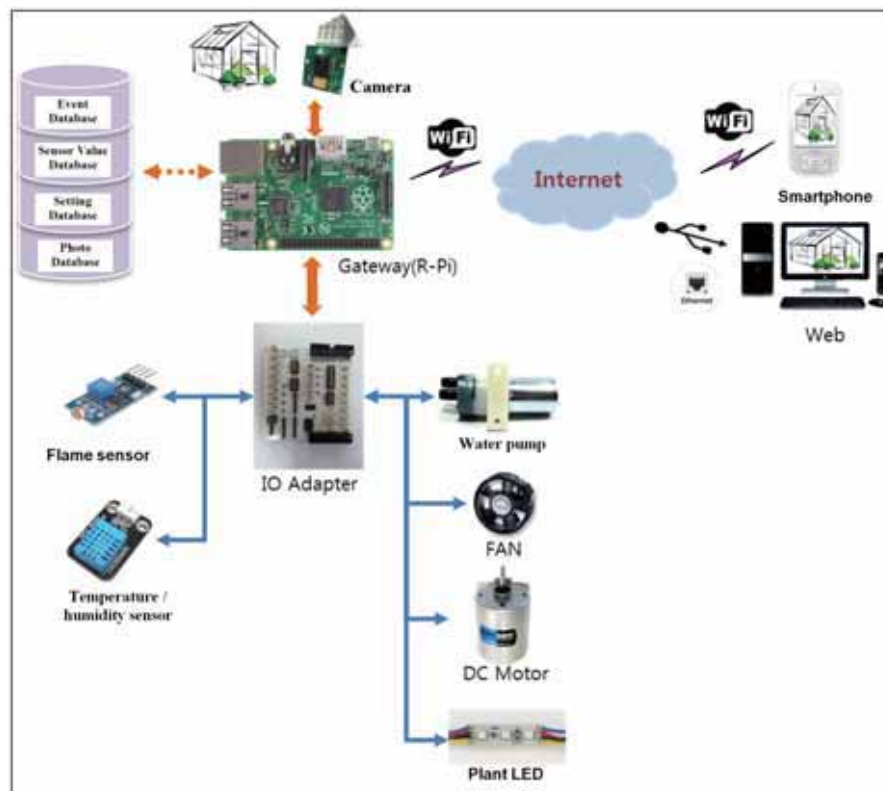


## System configuration

[ Smart IoT Design System Configuration ]



[ Smart IoT Farm Management System ]







## Components

### 1) Hardware spec

(1) IoT Hardware platform		1 set
(2) 40pin GPIO extension cable		1 ea
(3) SD Memory Reader		1 ea
(4) DC 5V power adapter		1 ea
(5) DC 12V power adapter		1 ea
(6) WiFi Dongle		1 ea
(7) Bluetooth dongle		1 ea
(8) HDMI to DVI cable		1 ea
(9) Sensor cables		1 set

## 2) Software (Providing Example Source)

- Sensor Driver
- Actuator Driver
- SmartHome Scenario
- SmartHome Actuator control
- SmartHome Database
- SmartHome Server program
- Android App Source Code
- Firmware Source Code

## Training Contents

### Chapter 01. Overview of IoT

- 1.1 What is IoT?
- 1.2 Development Process of IoT
- 1.3 IoT Technology Trends
  - 1.3.1 IoT(Internet of Things) Communication

#### Protocol

- 1.3.2 Major Domestic Service Cases
- 1.3.3 Examples of Connection between Smartphones and Hardware

#### 1.4 Reference

### Chapter 02. IoT Base Technology

- 2.1 Overview of IoT Base Technology
- 2.2 Sensor
  - 2.2.1 The Age of Trillion Sensors
  - 2.2.2 Human Senses and Sensors
  - 2.2.3 Classification of Sensors
- 2.3 Image Processing (Camera)
- 2.4 Network Infrastructure
  - 2.4.1 Network Infrastructure in the Age of IoT
  - 2.4.2 Background of Network Infrastructure

#### Competition

- 2.4.3 Key Network Infrastructure Technologies

- 2.5 Communication Technology
- 2.6 Service Interface Technology
- 2.7 OS and Software
- 2.8 IoT Security

- 2.8.1 Overview of IoT Security
- 2.8.2 Why is IoT Vulnerable to Security?
- 2.8.3 Examples of Internet Security Vulnerabilities
- 2.8.4 How to Attack IoT Security
- 2.8.5 IoT Security Measures

#### 2.9 Reference

### Chapter 03. IoT Sensors and Actuators

- 3.1 IoT Smart Sensor Concept
- 3.2 Basics of Sensors
- 3.3 Basic Characteristics and Terminology of Sensors
- 3.4 Development of Convergence Sensors
  - 3.4.1 Overview of Convergence Sensors
  - 3.4.2 Direction of Multiple Sensor Development
- 3.5 Actuator

### Chapter 04. Raspberry Pi

- 4.1 What is Raspberry Pi?
- 4.2 Raspberry Pi Quick Start
  - 4.2.1 Writing Operating System Image to an SD Card
  - 4.2.2 Backing up the SD Card Image
  - 4.2.3 Connecting Peripherals
  - 4.2.4 Booting and Setting Raspberry Pi
- 4.3 Raspberry Pi GPIO
  - 4.3.1 GPIO Utilization
- 4.4 Raspberry Pi Wired/Wireless Setup
- 4.5 SSH Connection (Remote Connection)

### 4.6 Samba Connection

### Chapter 05 IoT Camera Link

- 5.1 Raspberry Pi Camera Module
  - 5.1.1 Description of Raspberry Pi Cameras
  - 5.1.2 Camera Module Software
- 5.2 Camera Image Control (C, Java)
- 5.3 Playing Video Streaming

### Chapter 06 Smartphone Programs

- 6.1 Smartphone Communication Technology
- 6.2 Installing Development Tools
- 6.3 Android "Hello World" Exercise

### Chapter 07 Apache, PHP and MySQL Server Build

### Chapter 08 Database Exercise

- 8.1 Creating Database
- 8.2 Database Exercise

### Chapter 09. Introduction to IoT Training System (GT-IoT900)

- 9.1 Configuration of IoT Training System
  - 9.1.1. Overview of IoT Training System
  - 9.1.2 Features of IoT Training System
  - 9.1.3 Element Technology
  - 9.1.4 Components of Five Types of Smart IoT

#### 9.2 IoT Training System Software

#### 9.3 IoT Hardware

- 9.2.1 Raspberry Pi (model B+)
- 9.2.2 IO Adapter Board
- 9.2.3 Sensor
- 9.2.4 Actuator

### Chapter 10 IoT Smart Farm Exercise

- 10.1 Overview of IoT Smart Farm Management System
  - 10.1.1 Smart Farm Management System Hardware
  - 10.1.2 Smart Farm Management System Software
- 10.2 Configuration of Smart Farm Management System
- 10.3 Smart Farm Management System Sensor Training
  - 10.3.1 Temperature/Humidity Sensor Test
  - 10.3.2 Light Sensor Test
- 10.4 Smart Farm Management System Actuator Exercise
  - 10.4.1 A Water Pump
  - 10.4.2 Fan
  - 10.4.3 DC Motor
  - 10.4.4 RGB Led
  - 10.4.5 Smart Farm Integrated Actuators Exercise
- 10.5 Smart Farm Management System Scenario Practice
- 10.6 Controlling the Farm Actuator with a Smartphone
  - 10.6.1 Hardware Connection Diagram
  - 10.6.2 TCP/IP Programming Using an Android Terminal
  - 10.6.3 Raspberry Pi TCP/IP Server Programming
- 10.7 Smart Farm System Server Program
  - 10.7.1 Database Design
  - 10.7.2 Server Run and Camera Video
- 10.8 Smart Farm Android Apps Program

## Spec

### 1) Hardware spec

- (1) CPU Board (webserver gateway)
  - Core architecture : ARM11
  - Memory : 512MB SDRAM
  - Operating System : Linux operating system
  - Power : Micro USB socket 5V, 2A,
  - Ethernet : 10/100 BaseT Ethernet socket
  - Video Output : HDMI (rev 1.3 & 1.4) Composite RCA (PAL and NTSC)
  - Audio Output : 3.5mm jack, HDMI, USB : 4 x USB 2.0 Connector
  - GPIO Connector : 40-pine expansion,
  - Camera : 15-pin MIPI Interface
  - Display Connector : Display Serial Interface (DSI)
  - Memory Card Slot : SDIO
- (2) Camera Module
  - 5M Pixel
  - Omnivision 5647 Camera Module
  - Video : Supports 1080p @ 30fps, 720p @ 60fps
- (3) Micro SD Card
  - this is the storage device for Gateway booting and Linux-based operating system.
  - Executable application software (Class 10) for Gateway is installed.
- (4) IO Board (Actuator + Seonsor Interface)

item	spec	output/input
Interface	40pin GPIO(Raspberry Pi)	GPIO connector
Power Supply	DC 3.3V, DC 5V, DC12V	GPIO connector
8-channel, AD converter	MCP3208, SPI interface	input
DC 3.3V Analog sensor connector	8 port	input
DC 3.3V digital sensor connector	4 port	input
DC 3.3V UART connector	1 port	output
UART connector	1 port	output

### (5) 8 kinds of sensor module - inter-working with Raspberry Standard GPIO Headers(40pin)

Gas sensor



- 1) by the mounted heater & sensor , can detect ammonia, contaminated gas.
- 2) Burn in time is required to obtain stable results when the heater contained inside is raised to the proper temperature.

Motion detection sensor



- 1) IR coming from the human or animal body has a wavelength of about 10μm.
- 2) Respond when detect the wavelength.

Sound sensor



- 1) by detecting the ambient sound, emit it to analog signal or digital signal.

Temperature / humidity sensor



- 1) Combined one for Temperature sensor & Humidity sensor .
- 2) It has a temperature calculation formula and a humidity calculation formula.

Proximity Sensor



- 1) May be measured about 10 ~80cm away , the output voltage changes according to the distance to the sensor module

Ultrasonic Sensor



- 1) The ultrasonic sensor emits a short sound through high frequency pulses at regular intervals.
- 2) These are spread in the air through the speed of sound and sensing the reflected echo signal that is made by colliding with an object.

Flame Sensor



- 1) detect flame wavelength (frequency, 760nm~1100nm) at a distance of about 1m around.

Light sensor



- 1) Detect by converting light itself or information of light into electric signals.
- 2) Characteristics is non contact, non destructive, high speed, without influence of the ambient noise.

(6) 7 kinds of Actuator module - independently works with Raspberry Pi (40pin)

DC motor



- 1) Rated voltage : 12V
- 2) Rated current : 70mA
- 3) No load speed : 8700rpm

Servo motor



- 1) Dual ball bearing, brushless digital servo
- 2) working voltage : 4.8V, 4.8V/6.0V, 6V
- 3) Torque (Kg.cm): 10Kg, speed: Medium
- 4) Size (g): 50g, gear Material: Plastic
- 5) Rotation angle: 180 degrees

Fan



- 1) Brushless DC FAN
- 2) Rated voltage: DC 5V, Speed : 2.4m/s
- 3) 30 x 30 x 10mm, fan speed: 7000-14000 RPM

water pump



- 1) Rated voltage : 12V
- 2) Maximum pressure : >40PSI
- 3) Flux : >500mL/min

RGB LED



- 1) RGB 3 chip luminosity Chip LED
- 2) 5.7 x 5.0 x 1.8 mm (L x W x H)
- 3) Wide Viewing angle
- 4) Long operating life (70,000 hours)

LED



- 1) LED 3EA
- 2) DC 12V with 4pcs 1W Xeon emitter
- 3) Superior ESD protection

Buzzer



- 1) 102dB Piezo Siren
- 2) Operates on 6-14V DC, 150mA Current at 12V
- 3) Buzzer Tone rated at 2,000-4,500Hz

## 2) Software spec

OS	Debian GNU/Linux, Fedora, Arch Linux ARM, RISC OS
Compiler	gcc version 4.6.3
Python	Python 2.7.3(Python 3.0 support)
Device Driver	USB,, MIFI Camera Device Driver, HDMI Device Driver Audio In/Out Device Driver, Micro SD Device Driver 10/100 Mbit/s Ethernet Device Driver 17Pin GPIO, UART, I <sup>2</sup> C bus, SPI, I <sup>2</sup> S Device Driver Wifi Device Driver, Bluetooth Device Driver
API	GPIO control - 8 kinds of sensors driver & 7 kinds of actuator driver program - 1 kind of example programs & web server program ( IoT Farm Management ) APM(Apache PHP MySQL) Web server program, database program
Android platform App	1 kind of App program source is provided

# model:IoT Home Network Testbed-GT16

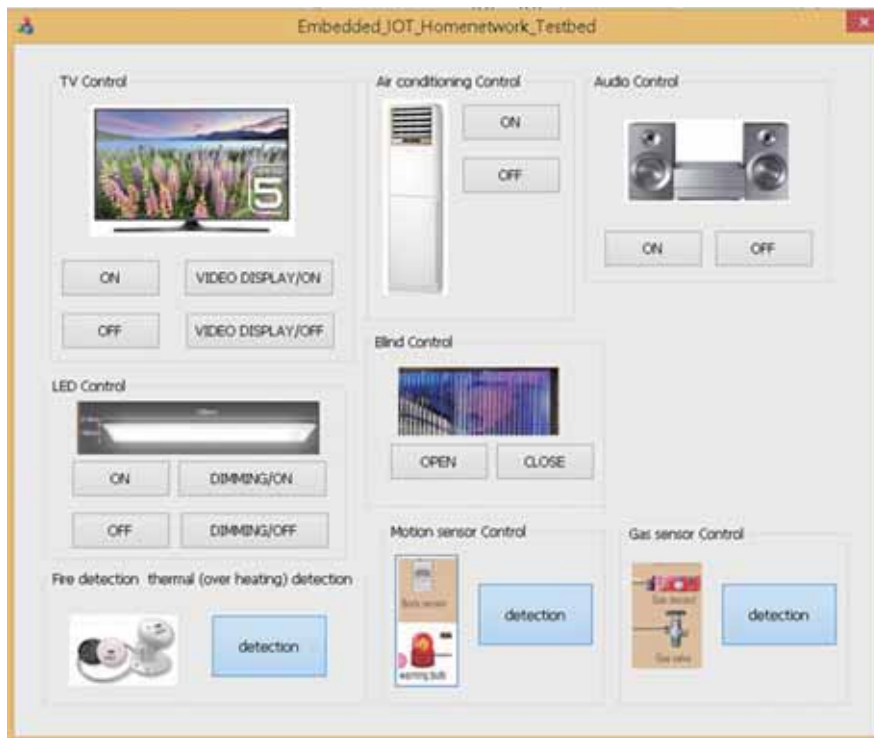
## Embedded IoT Home Network Test-bed (OpenWrt based)

### Photo



#### < 8 kinds of Home Appliances Control >

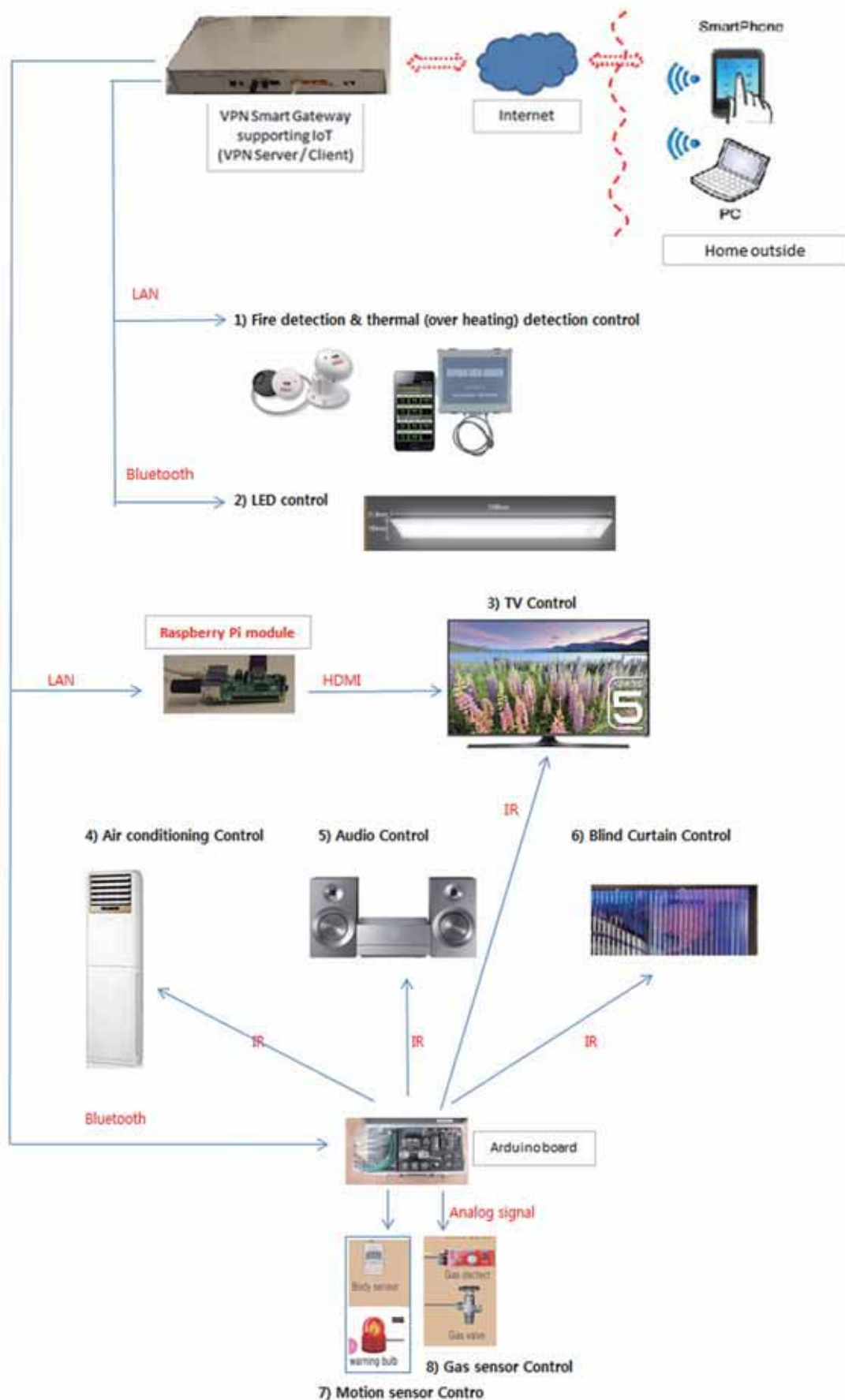
Fire & thermal (over heating) detection Control  
TV Control  
Air Conditioning Control  
Audio Control  
LED Light Control (on/off, dimming)  
Blind Control (open/close/angle control)  
Motion Sensor Control  
Gas Sensor Control



### Components

1) Desktop PC ( for Test-bed outside)	1 ea	
2) Smart Gateway	2 unit	1 unit for building VPN
3) Raspbery-pi module	1 ea	
4) Arduino board	1 set	
5) Fire & thermal (over heating) detection Control system	1 set	
6) TV	1 set	Buyer local purchase
7) Air Conditioning	1 set	Buyer local purchase
8) Audio	1 set	
9) LED Light (on/off, dimming)	1 set	
10) Electric Blind (open/close/angle control)	1 set	
11) Motion Sensor	1 set	
12) Gas Sensor	1 set	
13) Webcam	1 set	

## System configuration ( real home appliances & sensors control - 8 kinds )



## Specification

### 1. Hardware spec

#### 1) Smart gateway (OpenWrt based)

- (1) VPN tunneling & multi-queueing techniques function
  - : VPN tunneling capabilities that can be accessed securely from the outside is provided.
  - : Multiple queueing capabilities that avoid internet lines congestion is provided.
- (2) Wired and wireless router function
  - : Router (AP, Repeater, Bridge, RIP) control programming by OpenWrt based.
- (3) IP Camera Control function.
  - : IP camera programming by OpenWrt based.
  - : Operation status of eight kinds of control objects can be monitored with webcam
- (4) Sensor network (BLE) + Internet router function
  - : 7 kinds of Home Appliances Connection (Bluetooth) Control programming by OpenWrt based.
  - : Connection status between Smart gateway and Arduino board
  - : Connection status between Smart gateway and Raspiberry-pi module.
- (5) Firewall, IDS, IPS function
  - : Firewall Control Programming by OpenWrt based.
- (6) VPN function
  - : VPN Control programming by OpenWrt based.

Power port	1 ea
On/Off Switch	1 ea
USB Port	1 ea
USB LED	1 ea
Ethernet 1 port	1 ea
Ethernet 2 port	4 ea
Reset Switch	1 ea
Console port	1 ea
CPU MIPS74Kc@720 MHz	
RAM 128MBytes	
Boot Flash 512KBytes	
User Flash 16MBytes	
Ethernet 10/100/1000Base-T, WAN - 1 port	
10/100/1000Base-T, LAN - 1 port (Switch - 4 port)	
USB USB2.0 x 2 ea	
LEDs Power, RUN, Ethernet status	
AC Adaptor Power +12VDC/3A	

#### 2) Raspberry Module

Core architecture :	Quad-core ARM Cortex-A7
CPU :	900MHz
Memory :	1GB LPDDR2
Operating system :	Boots from Micro SD Card, running a version of the Linux Operating system
Ethernet :	10/100 BaseT Ethernet scket
Video Output :	HDMI (rev 1.3 & 1.4)
Audio Output :	3.5mm jack, HDMI
USB :	4 x USB 2.0 Connector
GPIO Connector :	40-pin 2.54mm, providing 27 GPIO pins
Camera Connector :	15-pin MIPI
Display Connector :	Display Serial Interface (DSI) 15 way flat flex cable connector

#### 3) Arduino Board

Atmega328 Processor
Arduino compatible boards
Built-in Bluetooth
Built-in IO expansion pin (12ea of digital pin, 6es of analog pin)



## 2. Software Spec

Virtual Box
Putty
Ubuntu
OpenWRT IDE
vi, Makefile, gcc

## 3. specs for 8 kinds of Home appliances

### 1) Fire & thermal (over heating) detection Control

- (1) Main board :
  - Android App support
  - Two Relay port : Siren control
  - Two Relay port : Fire & Thermal sensor control
- (2) Fire sensor : UV flame, 185~260nm, 5-74m, IP64
- (3) Thermal sensor : NTC type, 2m, -25°...~65°...
- (4) LED Lamp Siren
- (5) web-mail Control programming

### 2) LED Light Control (on/off, dimming)

- (1) Bluetooth 2.0
- (2) Rated voltage : AC220/60Hz
- (3) Power Consumption : 35W
- (4) Optical efficiency : more than 100mW
- (5) Rated durability : 40,000 hours
- (6) LED Control programming
- (7) Bluetooth connection Control programming from Smart gateway

### 3) TV Control

- (1) TV On/off control by IR Remocon Sensor
  - Supply Voltage Range : 2.7V to 6V
  - TTL and CMOS compatibility
  - Photo detector and preamplifier in one package
  - Internal filter for PCM frequency
  - Open collector output (built-in Pull-up resistor(40KΩ))
  - Output active low
  - Enhanced Immunity against all kinds of disturbance light
  - No occurrence of disturbance pulses at output pin within nominal conditions
  - Short setting time after power On(below 1msec)
- (2) IR Remocon Control programming (TV) from Arduino
- (3) Bluetooth connection programming (TV) from Smart gateway
- (4) TV Channel & Video control programming from Raspberry-pi module

### 4) Air Conditioning Control

- (1) Air Conditioner On/off control by IR Remocon Sensor
  - Supply Voltage Range : 2.7V to 6V
  - TTL and CMOS compatibility
  - Photo detector and preamplifier in one package
  - Internal filter for PCM frequency
  - Open collector output (built-in Pull-up resistor(40KΩ))
  - Output active low
  - Enhanced Immunity against all kinds of disturbance light
  - No occurrence of disturbance pulses at output pin within nominal conditions.
  - Short setting time after power On(below 1msec)
- (2) IR Remocon Control programming (Air Conditioner) by Arduino
- (3) Bluetooth connection programming (Air Conditioner) from Smart gateway

### 5) Audio Control

- (1) Audio On/off control by IR Remocon Sensor
  - Supply Voltage Range : 2.7V to 6V

TTL and CMOS compatibility  
 Photo detector and preamplifier in one package  
 Internal filter for PCM frequency  
 Open collector output (built-in Pull-up resistor(40KΩ))  
 Output active low  
 Enhanced Immunity against all kinds of disturbance light  
 No occurrence of disturbance pulses at output pin within nominal conditions.

Short setting time after power On(below 1msec)

- (2) IR Remocon Control programming (Audio) by Arduino
- (3) Bluetooth connection programming (Audio) from Smart gateway

### 6) Blind Curtain Control (open/close/angle control)

- (1) Remote control
- (2) Blind curtain size : 1400 x 700mm
- (3) Electric motors (SOMFY 518A6 18/20)
  - Power Consumption : 170W
  - Power supply : 220V / 60Hz
  - Torque : 18Nm
  - Rotating speed : 20RPM
- (4) RTS radio transmitter(Remocon)
  - Material : ABS (120Β/Ε X 45Β/Ε X 17Β/Ε)
  - Power : Battery 3V DC
  - Frequency : 447Mhz
  - Channel : 4CH
- (5) RTS wireless switch
  - Material : ABS (120Β/Ε X 45Β/Ε X 17Β/Ε)
  - Power : Battery 3V DC
  - Frequency : 447Mhz
- (6) IR Remocon Control programming (Blind Curtain) by Arduino
- (7) Bluetooth connection programming (Blind Curtain) from Smart gateway

### 7) Motion Sensor Control

- (1) Motion detection sensor (DYP-ME003)
  - Input Voltage : DC 4.5-20V
  - Static current : 50uA
  - Trigger : H-Yes, L -No
  - Block time : 2.5 S (default)
  - Delay time : 5 S (default)
  - Sentry Angle : < 110 degree
  - Sentry Distance : 3 m (default) - max 7 m
  - Lens Size : Diameter : 23mm (default)
  - Dimensions : 32mm x 24mm
- (2) Motion sensor Control programming for bluetooth connection by Arduino
- (3) Bluetooth connection programming (Motion sensor) from Smart gateway

### 8) Gas Sensor Control

- (1) MQ-2 analog gas sensor module [SEN0127]
  - Power supply needs : 5V
  - Interface type : Analog



- Fast response and High sensitivity
- Simple drive circuit
- Stable and long life
- Size : 36.4 x 26.6mm
- (2) Gas sensor Control programming for bluetooth connection by Arduino

- (3) Bluetooth connection programming (Gas sensor) from Smart gateway

## Training Contents

**Chap 1. The final result demonstrated.**

**Chap 2. About lessons.**

**Chap 3. Embedded systems overview.**

**Chap 4. About IoT (Internet of Things)**

- 1) Outline
- 2) Introduction IoT using YUN Shield
- 3) Introduction IoT using Raspberry Pi
- 4) Introduction IoT using Smart Gateway

**Chap 5. Arduino - Things**

- 1) Arduino start
- 2) Digital inputs and outputs (GPIO) and PWM
- 3) Analog signals and Sensor values
- 4) USB and serial communication
- 5) Serial inter-working
- 6) Bluetooth inter-working
- 7) Serial.parseInt()

**Chap 6. Smart Gateway - Internet**

- 1) OpenWRT overview
- 2) OpenWRT - IDE
- 3) OpenWRT - Kernel Program Supporting Serial, Bluetooth, UVC-Cam
- 4) OpenWRT - Arduino inter-working, Programming USB-Serial
  - LED Control
  - Buzzer Control
  - TMP35 Control
  - Servo motor Control
  - DC motor Control
  - SPL-Duino Control
- 5) OpenWRT - Arduino inter-working, Programming USB-Bluetooth
- 6) OpenWRT - Arduino inter-working, Programming WWW-node.js and Webcam
- 7) OpenWRT - Arduino inter-working, Programming ALERT

**Chap 7. IoT Projects Programming**

- 1) Arduino nano + bluetooth + relay
- 2) Arduino nano + bluetooth + pir + gas
- 3) Arduino nano + bluetooth + oled
- 4) Bluetooth Control programming (TV, Air Conditioner, Audio, LED, BLIND Curtain, MOTION SENSOR, GAS SENSOR)

**Chap 8. Programming using the Raspberry Pi**

- 1) About Raspberry Pi
- 2) Basic setting of Raspberry Pi
- 3) GPIO Control
- 4) Remote audio / video play, TV Control
- 5) OpenWRT - Raspberry Pi inter-working TCP/IP
- 6) OpenWRT - Raspberry Pi inter-working WWW-node.js

**Chap 9. Home appliances Control Programming using Arduino**

- 1) TV Control programming using IR Remocon from Arduino
- 2) Air Conditioner Control programming using IR Remocon from Arduino
- 3) Audio Control programming using IR Remocon from Arduino
- 4) Blind Curtain Control programming using IR Remocon from Arduino
- 5) Motion sensor Control programming for Bluetooth connection from Arduino
- 6) Gas sensor Control programming for Bluetooth connection from Arduino

# 24

## a group of IoT Home Network Training Sytem

43. GT-IoT Home Network

# model: GT-IoT Home Network

## Embedded IoT (Internet of Things) Home Network Training System

### Introduction

- 1) GT-IoT Home Network is configured so that the user can monitor home status and control various home appliances by expanding sensors & actuators as their wishes.
- 2) Using the smart phone app, user can monitor the access status of home and home inside status, even can control gas valve, hot water valve from a remote location.
- 3) the collected data from flame sensor, gas sensor, sound sensor, light sensor, temperature / humidity, motion detection sensor is saved and transmit home inside status to user.

### Features

- 1) remote control of Home network system actuator using Smartphone
- 2) door open when RFID access card is authenticated
- 3) after detecting room brightness through light sensor, and LED lights ON / OFF
- 4) Real-time monitoring via remote control video

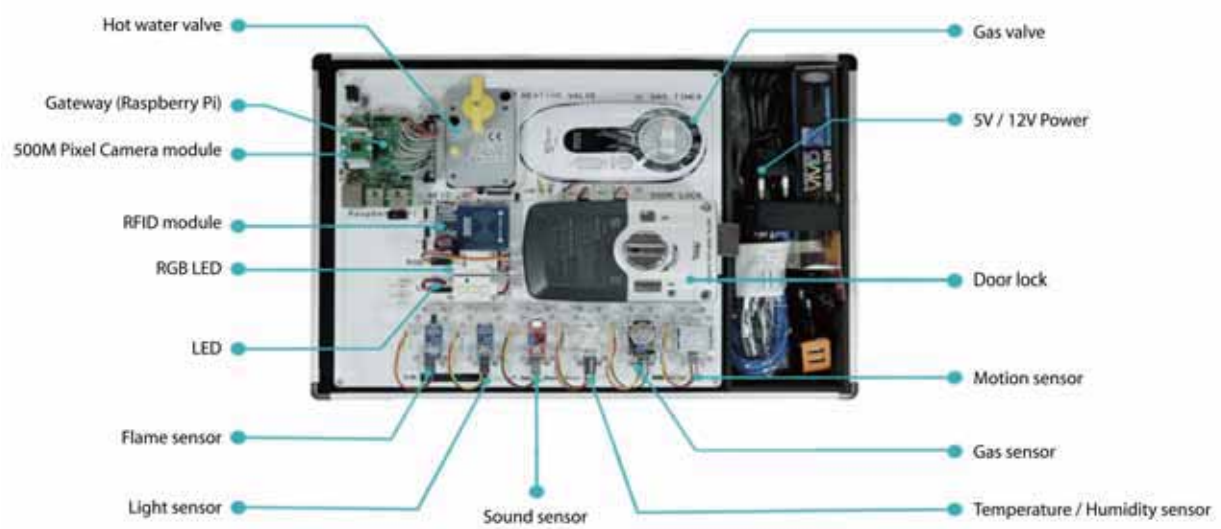
### Components

Hardware platform	1 set
40pin GPIO Extension cable	1 ea
SD Memory Reader	1 ea
DC 5V Power adapter	1 ea
DC 12V Power adapter	1 ea
WiFi Dongle	1 ea
Bluetooth dongle	1 ea
HDMI to DVI cable	1 ea
RFID Module	1 ea
Program CD	1 ea
Textbook	1 book

### Training Contents

- Chap 1, IoT Introduction
- Chap 2, IoT-based technologies
- Chap 3, IoT sensors and actuators
- Chap 4, Gateway configuration and developing environment
- Chap 5, IoT Camera interworking
- Chap 6, Smartphone program
- Chap 7, Apache, PHP, MySQL Server construction
- Chap 8, Practice Database
- Chap 9, Overview of Home Network Design System
- Chap 10, Practice of Home Network Design System
- Chap 11, Appendix

## System configuration



[ IoT Android Application UI ]



Main menu



Home network connection



Camera connection



Actuator Control

## Specifications

### 1) Hardware spec

#### (1) CPU Board (webserver gateway)

Core architecture : ARM11

Memory : 512MB SDRAM

Operating System : Linux operating system

Power : Micro USB socket 5V, 2A,

Ethernet : 10/100 BaseT Ethernet socket

Video Output : HDMI (rev 1.3 & 1.4) Composite RCA (PAL and NTSC)

Audio Output : 3.5mm jack, HDMI, USB : 4 x USB 2.0 Connector

GPIO Connector : 40-pine expansion,

Camera : 15-pin MIPI Interface

Display Connector : Display Serial Interface (DSI)

Memory Card Slot : SDIO

(2) Camera Module

5M Pixel  
Omnivision 5647 Camera Module  
Video : Supports 1080p @ 30fps, 720p @ 60fps

(3) Micro SD Card

this is the storage device for Gateway booting and Linux-based operating system.  
Executable application software (Class 10) for Gateway is installed.

(4) Actuator Module

Door Lock	Door opening : 1WAY method (password) Operating power : 6V -1.5V AA-size alkaline batteries, 4 ea
Gas valve	DC 6V (battery 1.5V, 4EA / AA size) Motor-driven : how to apply cock valve Valve-off time: less than 4 seconds Setting time : 20 minutes for default setting, up to 9 hours
RFID	Working current : 13—26mA/ DC 3.3V Standby current : 10-13mA/DC 3.3V Working frequency : 13.56MHz Card reading distance : 0 ~ 60mm(mifare1 card) Protocol : SPI data communication speed : Maximum 10Mbit/s Card types supported : mifare1 S50, mifare1 S70, mifare UltraLight, mifare Pro, mifare Desfire
Hot water valve	DC 12V / 850mA Counter-clockwise for opening, clockwise for closing Operation time, 4 seconds. 15A ~ 25A all models (brass, stainless steel)
RGB LED	RGB 3-chip luminosity Chip LED 5.7 x 5.0 x 1.8 mm (L x W x H) Wide Viewing angle, Long operating life
LED	LED 3EA, DC 12V with 4pcs 1W Xeon emitter Superior ESD protection

(5) Sensor module - interworking with Raspberry Standard GPIO Headers(40pin)

Gas sensor	by the mounted heater & sensor, can detect ammonia, contaminated gas.
Motion selection sensor	IR coming from the human or animal body has a wavelength of about 10 $\mu$ m. Respond when detect the wavelength.
Temperature / Humidity Sensor	Combined one for Temperature sensor & Humidity sensor.
Acoustic sensors	by detecting the ambient sound, emit it to analog signal or digital signal.
Flame Sensor	detect flame wavelength (frequency, 760nm~1100nm) at a distance of about 1m around.
Light sensor	Detect by converting light itself or information of light into electric signals. Characteristics is non-contact, non-destructive, high-speed, without influence of the ambient noise.

2) Software spec

OS	Debian GNU/Linux, Fedora, Arch Linux ARM, RISC OS
Compiler	gcc version 4.6.3
Python	Python 2.7.3(Python 3.0 support)
Device Driver	USB Device Driver, MIFI Camera Device Driver, HDMI Device Driver Audio In/Out Device Driver, Micro SD Device Driver 10/100 Mbit/s Ethernet Device Driver 17Pin GPIO, UART, I <sup>2</sup> C BUS, SPI, I <sup>2</sup> S Device Driver Wifi Device Driver, Bluetooth Device Driver
API	GPIO Control 6 kinds of sensor Driver, 6 kinds of actuator Driver program Home network practice program, Home network server program APM(Apache PHP MySQL) Web server program, database program
Android platform App	Android S/W, IoT Home network android App

# 25

## a group of Programming kit

- 44. GT- C learning & Android App programming
- 45. GT-Arduino77
- 46. GT-Arduino700
- 47. GT-ISDK700(JAVA programming)
- 48. GT-Raspberrypi3
- 49. Coding Analyzer-700
- 50. Test Automation-700 & QMC
- 51. Performance Load Testing-700

# model: GT- C learning & Android App programming

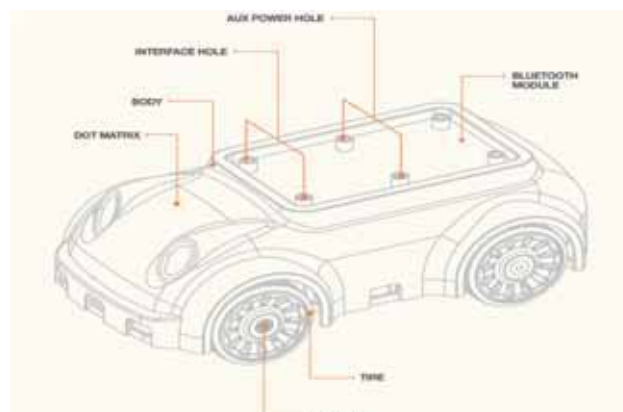
## C language learning & Android App programming robot kit

### Feature

- 1) C programming practice.
  - (1) Various PC-based C Programming & Android App programming practice using a robot kit
  - (2) Enable user to develop various algorithms and applications.
- 2) Source programs provided.
  - [ C language ]
    - (1) C Programming Source on Motor Control using robot kit
    - (2) C Programming Source on Buzzer & 8 ea of LED Control using robot kit
    - (3) C Programming Source on Dot Matrix Control using robot kit
    - (4) C Programming Source on Sensors Control using robot kit
    - (5) C Programming Source on Data & Variables using robot kit
    - (6) C Programming Source on the Operator using robot kit
    - (7) C Programming Source on If-Statement using robot kit
    - (8) C Programming Source on the Loop using robot kit
    - (9) C Programming Source on the Function using robot kit
    - (10) C Programming Source on the Array using robot kit
    - (11) C Programming Source on the Structure using robot kit
    - (12) C Programming Source on File Input/Output using robot kit
    - (13) C Programming Source on Auto Drive using robot kit
  - [ Android App programming ]
    - (1) Android App programming source on EditTextTest
    - (2) Android App programming source on TextViewTest
    - (3) Android App programming source on ListViewTest
    - (4) Android App programming source on DialogTest
    - (5) Android App programming source on InOutViewTest
    - (6) Android App programming source on MenuVlew
    - (7) Android App programming source on SampleImageView
    - (8) Android App programming source on BitmapView
    - (9) Android App programming source on SurfaceView
    - (10) Android App programming source on OtherWidgetView
    - (11) Android App programming source on SensorSample
    - (12) Android App programming source on TouchSample
    - (13) Android App programming source on Buzzer
    - (14) Android App programming source on Buzzer2
    - (15) Android App programming source on Dotmatrix1
    - (16) Android App programming source on LED8
    - (17) Android App programming source on Motor1
    - (18) Android App programming source on Motor2
    - (19) Android App programming source on Motor3
    - (20) Android App programming source on IR1
    - (21) Android App programming source on Sensor1
    - (22) Android App programming source on Smart1
- 3) Robot kit control by Smart phone
  - Using "Play Store Application Program which is provided by Google, user can download Web Program to their Smart Phone and can control C Learning robot Kit using their Smart Phone.
- 4) Robot hardware has the following characteristics ;
  - (1) Robot kit is a four wheel drive system and has a front wheel steering system.
  - (2) High endurance, Ultralight body

- (3) Steering System
  - \* Install the bearing at all Rotation Axis
  - \* Low-power, High-performance steering motor
  - \* High Resolution Steering angle
- (4) Low-power Circuit design
- (5) Installed Battery Management System
- (6) Installed Various Sensors
  - \* Infrared Sensor 6 pair
  - \* Compass Sensor
  - \* 3 Axis Acceleration Sensor
  - \* Temperature Sensor
  - \* Illumination Sensor
- (7) LED Indicator
  - \* Front light high brightness white LED - 2 ea,
  - \* Forward direction amber color LED - 2 ea,
  - \* Rear direction orange color LED - 2 ea,
  - \* Rear direction red color LED - 2ea.
- (8) LED 8x8Dot Matrix
  - \* Equipped with a 8x8 dot matrix, Letters, Numbers, special characters can be displayed
  - \* Full ASCII code, Software matrix Served
- (9) RISC Dual MCU Install
- (10) Clock
  - \* ATMEGA 128 Main 14.7456 MHz
  - \* ATMEGA 88 Sub 18.4320 MHz
- (11) Interface
  - \* Bluetooth 2.4 GHz With CE
  - \* UART TTL and, RS-232 signal level
- (12) Extension
  - \* AUX Power Output (7.4w 7.4v 1000mA) from battery controlled BCS
  - \* AUX UART out side
- (13) Obstacle detection systems
- (14) Torque PID, PWM Duty motor controller Install

## System configuration





## Components

Robot Hardware platform	1 SET
Program CD	1 EA
USB to ISP cable	1 EA
Bluetooth dongle	1 EA (for Desktop PC)
Power Adaptor	1 EA
Manual book	1st BOOK for C language learning 2nd BOOK for Android App programming

## Training contents

### [ manual book for C language ]

#### Chap 1, Hardware introduction of robotic systems

- 1) Robot Features
- 2) Robot Specifications
- 3) Robot communication system
- 4) Drawing for Robot Assemble

#### Chap 2, Visual C

- 1) understand how to use Visual C
- 2) Robot Kit Control through Bluetooth Communication

#### Chap 3, Robot Motor Control

- 1) learn Robot DC Motor
- 2) Robot DC Motor operating and C Programming practice
- 3) Robot steering structure operating and C programming practice

#### Chap 4, Robot Kit Buzzer and 8 LED control

- 1) learn Robot Buzzer
- 2) learn Robot LED
- 3) Robot Buzzer Sound control and C Programming practice
- 4) 8 ea of LED On/Off control and C Programming practice

#### Chap 5, Robot Dot Matrix Control

- 1) learn Robot Dot Matrix
- 2) Letters Display practice on Dot Matrix and C Programming practice
- 3) Numbers Display practice on Dot Matrix and C Programming practice

#### Chap 6, Robot control using the sensor

- 1) Distance Detection practice by IR Sensor, and C Programming practice
- 2) Brightness measurement practice by light sensor, and C Programming practice
- 3) Temperature measuring practice by temperature sensor, and C Programming practice
- 4) X,Y,Z direction gradient value measuring practice using 3-axis accerometer, and C Programming practice
- 5) X, Y, Z direction geomagnetic value output practice by geomagnetic sensor, and C Programming practice

#### Chap 7, learn Data and Variables using robot kit

- 1) learn Data and C Programming practice
- 2) learn Variables and C Programming practice

#### Chap 8, learn Operator using robot kit

- 1) learn Operator and C Programming practice

#### Chap 9, learn if-Statement using robot kit

- 1) understand if-Statement and C Programming practice
- 2) understand if-else and C Programming practice
- 3) understand if-switch and C Programming practice

**Chap 10, learn Loop using robot kit**

- 1) learn for-Loop and C Programming practice
- 2) learn while-Loop and C Programming practice
- 3) learn do while-Loop and C Programming practice

**Chap 11, learn Function using robot kit**

- 1) learn Function and C Programming practice

**Chap 12, learn Array using robot kit**

- 1) learn Array and C Programming practice
- 2) learn Pointer and C Programming practice

**[ manual book for Android App programming ]**

**Chap 1, Install Android**

- 1.1 prepare Android development environment and Installation
- 1.2 JAVA JDK installation
- 1.3 Android Studio installation
- 1.4 Android Studio installation

**Chap 2, Create Android Project**

- 2.1 create Project
- 2.2 Learn the generated project
- 2.3 create Project and try to use layout
- 2.4 use various layout

**Chap 3, understand Input and Output**

- 3.1 EditText
- 3.2 TextView
- 3.3 ListView
- 3.4 understand Dialog
- 3.5 use Input and Output

**Chap 4, understand Menu**

**Chap 5, understand View**

- 5.1 ImageView
- 5.2 Bitmap
- 5.3 SurfaceView

**Chap 6, understand other Widgets**

**Chap 7, understand Smart phone sensor**

- 7.1 understand Smart phone sensor
- 7.2 understand Smart phone touch

**Chap 8, understand Bluetooth function**

- 8.1 Bluetooth setup
- 8.2 Bluetooth activation
- 8.3 Device discovery
- 8.4 Server
- 8.5 Client
- 8.6 Connection control
- 8.7 Bluetooth service of Smart phone

**Chap 9, Buzzer control**

- 9.1 buzzer control using button
- 9.2 make 8 stage octave sound by buzzer

**Chap 10, DotMatrix control**

- 10.1 DotMatrix control using button

**Chap 11, 8ea of LED control**

11.1 8ea of LED control using button

**Chap 12, Motor control**

- 12.1 Motor control using 2ea of button
- 12.2 Motor speed control by transmission button
- 12.3 Motor control using speech recognition
- 12.4 Application examples

**Chap 13, Distance sensor control**

13.1 Autonomous driving control of robot kit

**Chap 14, Other sensors control of robot kit**

14.1 Other sensors control of robot kit

**Chap 15, Robot kit control using a smartphone accelerometer sensor**

## Specifications

- |  |
|--|
| 1) size : 97mm x 180mm x 64mm (LxWxH)  |
| 2) material : ABS  |
| 3) Processor : Atmega 128, Atmega 88 Dual Processor  |
| 4) Comm between Dual Processor : Serial comm & Error detection algorithm   |
| 5) Motor : DC Geared motor / 30:1 / 250RPM / 3.5~8VDC, [Servo motor] / 2.5~6V / 220:1  |
| 6) Steering control motor : DC Geared motor / 220:1 / 2.5~6VDC   |
| 7) Wheel : 4wheel driving  |
| 8) Speed : MAX. 50cm/s   |
| 9) Sensor : Infrared sensors for obstacle detection<br>(front - 3ea, rear - 1ea, side - each 1ea)  |
| 11) Measuring distance : [min] 2cm ~ [max] 15cm  |
| 12) Steering control sensor : 1 ea   |
| 13) Geomagnetic sensor [3-axis] : 1ea  |
| 14) Battery voltage sense : ADC output   |
| 15) Accelerometer sensor [3-axis] : 1ea  |
| 16) Temperature sensor : 1ea   |
| 17) Light sensor : 1ea   |
| 18) IR Receiver : 1ea  |
| 19) Display : Dot Matrix 8x8,  |
| 20) Buzzer : 1ea   |
| 21) Power Switch : 1ea   |
| 22) PC comm : RS232 - 1ea  |
| 23) Wireless comm : Bluetooth  |
| 24) Program download : ISP (In System Program)   |
| 25) Battery :<br>(1) Battery : Li-ion cell<br>(2) Nominal Voltage : 7.2V 2600mAh<br>(3) Charging Voltage : 8.4V 1200mAh<br>(4) Runtime : 3Hour ~   |
| 26) Charger :<br>(1) Input : 100-240VAC / 47-63Hz<br>(2) Output : 8.4V 1200mAh<br>(3) LED indicators - Red : charging, - Green : Fully charge<br>(4) Charge time : around 2 hour<br>(5) Certified : RoHS, CE |

# model: **GT-Arduino77**

## **Arduino Training Kit**

GT-Arduino77 consists of seven sensor input parts and a control communication unit that processes the input parts. GT-Arduino77 is a physical Arduino software training tool that is made by assembling robustly on the printed circuit board (PCB) of 5 kinds of drive output parts that can analyze and control the data inputted through the sensor. GT-Arduino77 is the most basic "Arduino physical software training tool" and is the educational tool for students to learn software programming. After completing the basic course from Chap 1~15, user will be able to carry out 13 kinds of projects which is in Chap 16. We provide a variety of source code for running these projects and the content that is required for the user's activities.

### **Features**

- Robustly manufactured, trouble-free and repeatable
- Time-intensive software training by removing jumper lines and modularization
- Software training in the Sketch environment that is an integrated Arduino developing environment.
- Entries that support block coding, all I / O control in mblock environment
- Uses mega2560, the same environment as arduino UNO board and easy to expand
- Sensor input part (7 kinds), drive output part (5 kinds), control communication part (2 kinds)
- Simple software training environment configuration with USB cable
- Programmable using tablet or smartphone (otg usb cable)
- Support various project-based software training programs
- Provide Developing programs for the creative activities and provide the necessary components
- Instantly test other creative ideas
- Cultivate the ability to implement projects

### **System configuration**



## Components

Hardware platform	1 set
USB cable	1 ea
OTG connection cable	1 ea
Program CD	1 ea
Manual book	1 book

## Training Contents

Chap-1	What is software?	What is software training? Software and daily living Software that deals with information
Chap-2	Computer and Software	Computer Programming Types of software and fields
Chap-3	Flowchart and Raptor	Draw a flowchart Installing and Using Raptor Programs Practice programming with Raptor
Chap-4	Learning Variables	The meaning of variables, arrays Various data structures Practice programming with Raptor
Chap-5	Learn Operators	Arithmetic, comparison, and logical operators Bit, increment / decrement operator
Chap-6	Learning Control Structures	Condition, judgment, jump structure Sequential, selective, repeat control statements
Chap-7	Learning the function	Functions Function Usage - Library, API
Chap-8	Sensor Input Software practice-1	Temperature and humidity sensor, Illuminance sensor, Collision sensor
Chap-9	Sensor Input Software practice-2	Sound sensor, vibration sensor, ultrasonic sensor, joystick
Chap-10	Drive output software practice-1	Speaker, RGB LED, Step Motor Character LCD, OLED output
Chap-11	Drive output software practice-2	Smartphone sensors and apps Controlling with Bluetooth
Chap-12	User project : Smart greenhouse construction-1	Learn about the Smart Greenhouse Configuring Smart Greenhouse Scenario Input section, output section program
Chap-13	User project : Smart greenhouse construction-2	Construction
Chap-14	User project : Responding Doll-1	Learn about the responding doll Doll function. Exterior design Input section, output section program
Chap-15	User project : Responding Doll-2	Manufacturing
Chap-16	Project (13 projects) project-1, LED lighting DIY creative experience Project-2, Piano keyboard playing DIY creative experience Project-3, Controlling the colors of light by applause Project-4, Doorbell Melody Play DIY Creative Experience Project-5, A simple auto-mobile DIY creation experience with a motor Project-6, Vibration and earthquake detector DIY creation experience Project-7, Night Intrusion Alarm DIY creation experience Project-8, DIY creative experience of speed-controlled fan depending on temperature Project-9, DIY creative experience to control brightness of lighting depending on the distance from the object Project-10, IoT Tank DIY creation experience by the sound-driven Project-11, IoT Auto-mobile creation experience that is run away when the things is approached to them Project-12, Detecting temperature and humidity of soil using smart phone Project-13, Check the temperature and humidity of the house and control the fan using the smart phone	

## Spec

### 1. H/W Specification

- 1) Main board : Arduino Mega (ATmega2560)
  - Microcontroller: ATmega2560
  - Operating Voltage: 5V
  - Input Voltage (recommended): 7-12V
  - Input Voltage (limits): 6-20V
  - Digital I/O Pins: 54 (of which 14 provide PWM output)
  - Analog Input Pins: 16
  - DC Current per I/O Pin: 40 mA
  - DC Current for 3.3V Pin: 50 mA
  - Flash Memory: 256 KB of which 8 KB used by bootloader
  - SRAM: 8 KB
  - EEPROM: 4 KB
  - Clock Speed: 16 MHz
- 2) Bluetooth : HC-06
  - Input voltage : 3.6~6V
  - Power Consumption : unpaired 30mA, paired 10mA
  - Communication distance : 10m
  - Communication type : 8 data bits, 1 stop bit, no parity setting : Using AT Command (baud rate, path, variable)
- 3) Power : 5V, 50mA
- 4) Input & Output
  - (1) USART communication, 4 port
    - Serial: 0 (RX) and 1 (TX);
    - Serial 1: 19 (RX) and 18 (TX);
    - Serial 2: 17 (RX) and 16 (TX);
    - Serial 3: 15 (RX) and 14 (TX). Used to receive (RX) and transmit (TX) TTL serial data.
    - Serials Pins 0 (RX) and 1 (TX) are connected to ATmega8U2 USB-to-TTL Serial chip to communicate with PC
  - (2) External interrupt 6 port
    - : 2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 (interrupt 2).
  - (3) PWM output : Provides 8-bit PWM output from 0 to 13.
  - (4) SPI communication : 50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS).
  - (5) LED No. 13 : Provides fixed LED on board.
  - (6) I2C communication: 20 (SDA), 21 (SCL). Providing I2C (TWI) communication
- 5) Sensor and actuator specifications
  - (1) Temperature & humidity sensor
    - Operating voltage : 3.3V ~ 5V
    - Measuring temperature : 0~50°
    - Temperature Accuracy :  $\pm 2^\circ$
    - Measuring Humidity : 20~90% RH
    - Humidity precision :  $\pm 5\%$
  - (2) Light Sensor
    - CDS light intensity sensor
    - Digital / analog available
    - Operating voltage : 3.3~5V
    - Current used : 15mA
  - (3) Collision (proximity) sensor
    - Infrared proximity sensor
    - Operating voltage : 3.3~5V
    - Detection distance : less than 30mm
  - (4) Sound sensor
    - LM393
    - Operating voltage : 3.3V ~ 5V
    - Microphone sound input
    - Digital / analog input
    - Sensitivity can be adjusted by using potentiometer
  - (5) Vibration (shock) sensor
    - Vibration and shock sensor
    - Built-in status LED
    - Operating voltage : 3.3V ~ 5V
  - (6) Ultrasonic (distance) sensor
    - Input voltage : 3~5.5V
    - Measuring range : 2~450cm (5V), 2~400cm (3.3V)

(7) Joystick	Digital, analog interface Measure X and Y coordinates and push buttons 5-pin joystick Prefabricated 3mm holes Operating Voltage: 3.3V to 5V
6) The driving unit	
(1) Speaker	Buzzer speaker module Digital interface Operating Voltage: 3.3V to 5V
(2) RGB LED	Module with 10mm RGB LED 16.5 million colors Operating Voltage: 3.3V to 5V Operating current: 10 ~ 60mA
(3) Step motor	Integrated Step Motor / Motor Driver Rotation angle, direction, speed control Operating Voltage : 5V Reduction ratio : 1/64 Rotation speed : 0 to 18 revolutions per minute Step motor : 28BYJ-48 Driver : ULN2003
(4) Character LCD	16x2 character LCD 1602 LCD Green backlight Brightness adjustment : Using 10K ohm variable resistor
OLED	OLED Driver IC : SSD1306 Resolution: 128x64 Angle of view : 160 degrees Communication method: I2C 4-pin OLED display module

## 2. S/W Specification

- 1) support Arduino MEGA, Integrated Development Environment (IDE)
  - Digital I / O Library
  - Analog I/O Library
  - Advanced I/O Library
  - Math Library
  - Characters Library
  - interrupts() Library
  - noInterrupts() Library
  - Communication Library
- 2) Scratch, entry, mBlock block coding environment
- 3) Serial, SPI, I2C communication library
- 4) 7 kinds of sensor drive software library
- 5) 5 kind actuator drive software library
- 6) Character LCD, O-LED graphics library software
- 7) Poject software
- 8) Android App program

# model: **GT-Arduino700**

## **Arduino Training kit**

### Features

GT-Arduino700 is the most beloved kit providing below training environment.

- 1) Arduino UNO 100% compatible
- 2) Arduino sketch Download via wireless through Bluetooth connection
- 3) Provide 2ea of motor ports for DC motor control
- 4) Provide 2ea of analog ports for sensor input
- 5) Built-in 3ea of TACT Switch and CDS Sensor
- 6) Smart device interworking function via Bluetooth Serial Communication
- 7) Input power : 7~12V

### System configuration



### Components

Arduino kit	1 unit
I2C Cable	1ea
Digital cable for Arduino kit	10ea
Analog cable	5ea
DC Motor cable for Arduino kit	2ea
USB Cable (Power cable, data cable)	1ea
USB Dongle (Program CD)	1ea
Manual book	1 book



## Training contents

### [Part-1]

1. What is Arduino?
  - 1.1 Installing program
  - 1.2 Arduino integrated development environment
  - 1.3 Program Download
2. Sea of LED control to be connected to digital pin
  - 2.1 Types of digital sensors
  - 2.2 Digital Write
  - 2.3 Blinking LED using Digital Write
  - 2.4 Make Morse code using LED
  - 2.5 Flickering 8Bit LED
  - 2.6 Flicker 8Bit LED in order every second
3. Controlling the button connected to digital pin
  - 3.1 Reading value of digital Push button
  - 3.2 Comparing values using if command
  - 3.3 Controlling the LED using Digital Push button value
  - 3.4 Utilizing digital Push button as toggle switch
  - 3.5 application practice
4. Color LED control to be connected to digital pin
  - 4.1 Types of Digital Sensor
  - 4.2 analogWrite (=PWM)
  - 4.3 Displaying red LED
  - 4.4 Displaying green LED
  - 4.5 Displaying blue LED
  - 4.6 Displaying white LED
  - 4.7 Turning off LED
5. Buzzer Control connected to digital pin
  - 5.1 Playing basic melody using tone command
  - 5.2 Creating un-continuous sound
  - 5.3 Playing simple melody
  - 5.4 Making program simply using arrangement
  - 5.5 Application practice
6. 7-Segment Control to be connected to digital pin
  - 6.1 Display 3 in DIG.1 of seven segments
  - 6.2 Light L1, L2, DP and print 8 on DIG.1, DIG.2, DIG.3, DIG.4 of seven segments
  - 6.3 Make 1 increases in 4 of seven segments
  - 6.4 Application practice
7. Crystal LCD Control to be connected to I2C
  - 7.1 Displaying Hello World text
  - 7.2 Flickering backlight
  - 7.3 Building illuminometer
  - 7.4 Display in two lines
  - 7.5 Display the text I made
  - 7.6 Display multiple custom texts
  - 7.7 Display built-in special text
  - 7.8 Application practice
8. Light sensor Control to be connected to analog pin
  - 8.1 Read the value from intensity sensor using analog command
  - 8.2 Change flickering frequency of LED depending on value from intensity sensor
  - 8.3 Application practice
9. IR Sensor Control to be connected to analog pin
  - 9.1 Displaying the IR sensor value on screen
  - 9.2 Sound play based on IR sensor value
  - 9.3 Application practice
10. How to utilize PSD Sensor to be connected to analog pin
  - 10.1 Displaying the PSD sensor value on screen
  - 10.2 Sound play depending on PSD sensor value
  - 10.3 Application practice
11. How to utilize DC Motor
  - 11.1 Operating DC motor
  - 11.2 Controlling the speed of DC motor
12. Controlling the speed of DC motor
  - 12.1 Controlling speed of DC motor through intensity sensor
  - 12.2 Controlling the speed of DC motor thorough button sensor
  - 12.3 LED that automatically turns on when dark
  - 12.4 Application practice

[Part-2]

- 13. Understanding Arduino and SPL-Duino
  - 13.1 Learning Objectives
  - 13.2 Required equipment
  - 13.3 Theory
  - 13.4 Practice courses
  - 13.5 Practice examples
  - 13.6 Application examples
- 14. Using digital commands and digital sensors
  - 14.1 Learning Objectives
  - 14.2 Required equipment
  - 14.3 Theory
  - 14.4 Practice courses
  - 14.5 Practice examples
  - 14.6 Application examples
- 15. Creating a melody using the speaker connected to the digital pin
  - 15.1 Learning Objectives
  - 15.2 Required equipment
  - 15.3 Theory
  - 15.4 Practice courses
  - 15.5 Practice examples
  - 15.6 Application examples
- 16. Controlling SPL-Duino with a smartphone
  - 16.1 Learning Objectives
  - 16.2 Required equipment
  - 16.3 Theory
  - 16.4 Practice courses
  - 16.5 Practice examples

## Spec

- 1) Arduino Board
  - (1) Atmega328 Processor
  - (2) Arduino compatible boards
  - (3) Built-in Bluetooth
  - (4) Built-in IO expansion pin (12ea of digital pin, 6ea of analog pin)
  - (5) Built-in Motor connection pin (2ea of DC motors connection pin)
  - (6) Built-in illumination sensor
  - (7) Built-in 3ea of button switch
  - (8) USB connection cable provided
  - (9) Battery connecting case provided
- 2) Infrared sensor module -----3EA
  - (1) 3AW4C02
  - (2) Reverse Current : 10uA
- 3) PSD sensor module -----1EA
  - (1) High Sensitivity PSD Sensor : GP2YOA21YK
  - (2) Detecting output type : Analog voltage
  - (3) Detection distance : 10 ~ 80Cm
- 4) LCD Display module -----1EA
  - (1) STN, Negative, Transmissive Mode
  - (2) Display Data Color : Light Gray or Deep Blue
  - (3) Viewing Angle : 6H
  - (4) Driving Method : 1/16 duty, 1/5 bias
  - (5) Back Light : White LED backlight
  - (6) input voltage : 6V Max.
  - (7) LCD Panel : 16x2 Char (5x8dots)
- 5) LED Display module -----1EA
  - (1) 2012 Type LED
  - (2) Straight Type 8EA LED
- 6) Cable -----20EA
  - (1) SIZE : 30cm
  - (2) AWG 24
  - (3) color : black
  - (4) Molex 3 pins

- 7) 7-segment -----1EA
  - (1) Forward Voltage, Per Segment : 2.2V Max.
  - (2) Continuous Forward Current, Per Segment : 30mA
  - (3) Solder Temperature 1/16 inch Below Seating Plane 3 Seconds at 250 °C 2 Channel
- 8) Push Button-----4EA
- 9) DC Gear motor-----2EA
  - (1) Input Voltage(DC.V) :3.5V
  - (2) Motor : HRF-300CA
  - (3) Reduction Ratio : 1:20
  - (4) MOTOR RPM : 5,100 +- 10%
  - (5) Output : RPM250
  - (6) TORQUE(Kg.cm): 0.149
  - (7) P(Kg) : 0.3
  - (8) Gear : 3-step Gear
- 9) 3-color LED-----1EA
  - (1) Standard PLCC-6 package (Plastic Leaded Chip Carrier) with individual addressable pin-out for higher flexibility of driving configuration.
  - (2) LED package with diff used silicone encapsulation
  - (3) Using AlInGaP and InGaN dice technologies
  - (4) Wide viewing angle at 120 °
  - (5) Compatible with reflow soldering process
  - (6) JEDEC MSL 3
  - (7) Luminous Intensity Red : Min 560, Max 1124
  - (8) Luminous Intensity Green : Min 1400, Max 2850
  - (9) Luminous Intensity Blue : Min 285, Max 560
- 10) Buzzer-----1EA
  - (1) Min. Sound Output at 10cm : 85dB
  - (2) Max. Current Consumption : 80mA

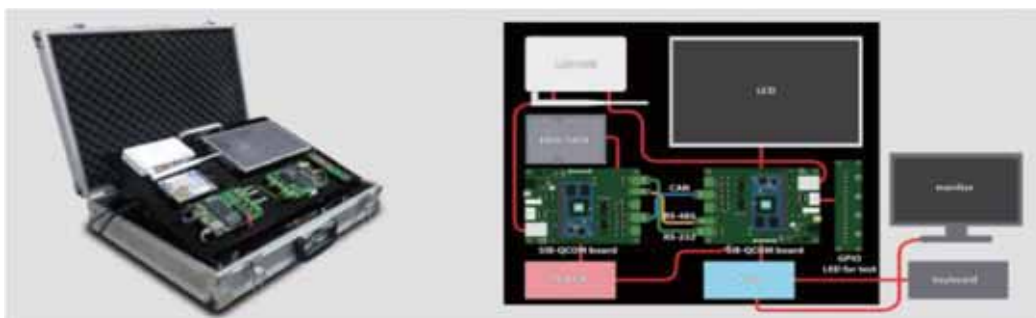
# model:GT-ISDK700

## Embedded ISDK Java training platform

### Features

- 1) Without the use of the C language, user can do the serial communications, GPIO control, CAN communication only using JAVA.
- 2) Without using Thread, TCP/IP, UDP/IP Socket communication can be implemented by Event-driven.
- 3) Also, USD Socket communication, which is provided by UNIX, can be implemented by Event-driven.
- 4) the applied area
  - (1) Home-net
    - \* Support IoT Module which can be used in Home-net area.
    - \* User can easily implement Device Driver using Java which is needed by Home Automation.
    - \* User can configure the best home gateway by variety of protocols supported by the Java library
    - \* User can learn the Internet of Things (IoT) technology via Java.
  - (2) Factory automation
    - \* User can get high reliability by mounting the system logic programs using Java on the Linux OS.
    - \* User can implement the exact alarm service in a variety of platforms.
    - \* The factory operating status can be monitored via Web browser.
  - (3) Industrial automation
    - \* The provided Solutions was optimized for implementation of the comprehensive monitoring system.
    - \* It supports the world's leading SDK to access a variety of data.
    - \* It supports the UI using Java to make a variety of reports.
    - \* Perfect training for a comprehensive monitoring system such as Electric power, industrial complex monitoring, disaster prevention systems.
  - (4) Building automation
    - \* It supports various protocols using Java.
    - \* It supports the best library for the training of Elevator, electric power, parking management, air-conditioning equipment, integrated broadcasting, lighting control, access control, etc.
    - \* Building Management System development.
    - \* Various Database SDK based on Java is supported.

### System configuration



## Components

SDK Module	2	Freescall I.MX6Quad@1GHz
SDK Module	2	RS-232/485, HDMI, SATA, Ethernet
Display	1	LCD display 10.2"
HUB	1	4 port
HDD	1	2.5" 1.0TB

## Training contents

Chap 1, Training on CAN communication JAVA Library and the used Examples of Practice.  
 Chap 2, Training on Serial communication JAVA Library and the used Examples of Practice.  
 Chap 3, Training on LCD JAVA Library and the used Examples of Practice  
 Chap 4, Training on GPIO control module and the used sample code.  
 Chap 5, Training on WIFI JAVA Library and the used sample code.  
 Chap 6, Training on USB device JAVA Library and the used sample code.  
 Chap 7, Training on Web application JAVA Library and the used sample code.  
 Chap 8, Training on TCP/IP JAVA Library and the used sample code.  
 Chap 9, System update JAVA Library and the used sample code.  
 Chap 10, Training on System information JAVA Library and the used sample code.  
 Chap 11, Training on Local Database JAVA Library and the used sample code.  
 Chap 12, Training on Remote Database JAVA Library and the used sample code.  
 Chap 13, Learn about Real Time Monitoring in Elevator  
 Chap 14, Learn about Efficiency Energy Management System -  
 Chap 15, Learn about Monitoring System

## Specifications

### 1) Smart gateway

- (1) 32 bit, ARM-Processor, Freescale IMX6DQ
- (2) Hardware design data to support the capacitive touch, UART, CAN, GPIO, USB HOST, SATA, HDMI, LCD
- (3) Hardware lists ;

SDK Module	2	Freescall I.MX6Quad@1GHz
SDK Module	2	RS-232/485, HDMI, SATA, Ethernet
Display	1	LCD display 10.2"
HUB	1	4 port
HDD	1	2.5" 1.0TB

### 2) Software

- (1) u-Boot & Image file
- (2) Kernel & Image file
- (3) File system and the related operating system & Sources which JAVA is supported.
  - \* CAN communication JAVA Library and the used Examples
  - \* Serial communication JAVA Library and the used Examples
  - \* LCD JAVA Library and the used Examples
  - \* GPIO control module and the used sample code.
  - \* WIFI JAVA Library and the used sample code.
  - \* USB device JAVA Library and the used sample code.
  - \* Web application JAVA Library and the used sample code.
  - \* TCP/IP JAVA Library and the used sample code.
  - \* JAVA Library and the used sample code.
  - \* System information JAVA Library and the used sample code.
  - \* Local Database JAVA Library and the used sample code.
  - \* Remote Database JAVA Library and the used sample code.

# model:GT-Raspberrypi3

## Raspberry-pi model B training kit

### Overview

Learn about Raspberry Pi3 model B and available for wearable IoT experiment exercises.

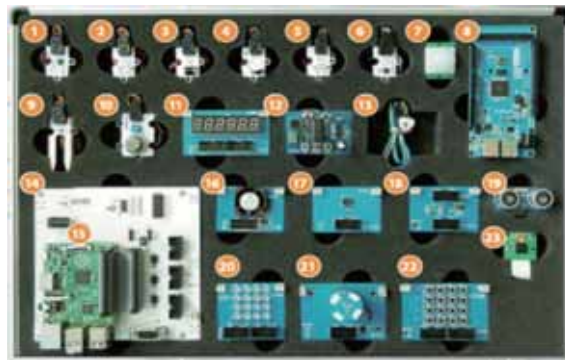
Learn basic Wi-Fi and Bluetooth communication techniques.

22 types of module control practice and the project practice by interlocking each sensors.

Compatible with various smart devices through Android application program.

Available for student's self-study using the provided application examples and based on detailed textbooks

### System Configuration



### Components

1. Photo Interrupter Sensor	1 ea
2. Red LED	1 ea
3. Vibration Detection Sensor	1 ea
4. Active Buzzer	1 ea
5. Green LED	1 ea
6. 3-Axis Compass Sensor	1 ea
7. PIR Motion Sensor	1 ea
8. Arduino mega ADK	1 ea
9. Soil Moistur Sensor module	1 ea
10. Smoke Sensor	1 ea
11. 7-Segment	1 ea
12. Voice Record	1 ea
13. Pulse Sensor	1 ea
14. Raspberry Pi3 + Adapter module	1 ea
15. Micro SD Card (16G)	1 ea
16. FAN	1 ea
17. Buzzer	1 ea
18. Temperature/Humidity/Light sensor	1 ea
19. Ultrasonic Sensor	1 ea
20. LED	1 ea
21. DC Motor	1 ea
22. Keypad	1 ea
23. Camera	1 ea

## Training Contents

### **Chap 1, Overview of Raspberry-pi**

- 1.1 Raspberry-pi Introduction
- 1.2 Raspberry-pi Accessories
- 1.3 Raspberry-pi Product Configuration and Features

### **Chap 2, Raspberry-pi Development environment**

- 2.1 Hardware Installation
- 2.2 Operating system installation
- 2.3 Network settings

### **Chap 3, Raspberry-pi and IoT programming**

- 3.1 GPIO Introduction
- 3.2 Installing the Library
- 3.3 System development method

### **Chap 4, Module Control**

- 4.1 LED Control & programming
- 4.2 Switch Control & programming
- 4.3 FND Control & programming
- 4.4 Motor Control & programming
- 4.5 FAN Control & programming
- 4.6 Buzzer Control & programming
- 4.7 Voice recording Control & programming
- 4.8 Camera Control & programming

### **Chap 5, Sensor Control**

- 5.1 Temperature / humidity Control & programming
- 5.2 Light Sensor Control & programming
- 5.3 Soil moisture sensor Control & programming
- 5.4 Ultrasonic sensor Control & programming
- 5.5 Motion sensor Control & programming
- 5.6 Heart rate sensor Control & programming
- 5.7 Gas sensor Control & programming

### **Chap 6, Wi-fi communication and Android App development**

- 6.1 Wi-Fi communication
- 6.2 Android App development & programming

### **Chap 7, Smart fan using Wi-fi**

- 7.1 Smart fan design & programming
- 7.2 Smart fan control

### **Chap 8, Design & programming of bridge safety management using Wi-fi**

- 8.1 Design & programming of bridge safety management system
- 8.2 Control of bridge safety management system

### **Chap 9, Digital door lock using Wi-fi**

- 9.1 Digital door lock design & programming
- 9.2 Digital door lock control

### **Chap 10, Intrusion detection system using Wi-fi**

- 10.1 Intrusion detection system design & programming
- 10.2 Intrusion detection system control

### **Chap 11, Flowerpot water management system using Wi-fi**

- 11.1 Flowerpot water management system design & programming
- 11.2 Flowerpot water management system control

### **Chap 12, Fire and gas leakage detection using Wi-fi**

- 12.1 Fire and gas leakage detection system design & programming
- 12.2 Fire and gas leakage detection system control

### **Chap 13, Healthcare using Wi-Fi and heart rate sensors**

- 13.1 Health care design & programming using heart rate sensor
- 13.2 Health care control using heart rate sensor

### **Chap 14, Car-parking system using Wi-fi and ultrasonic**

- 14.1 Car-parking system design & programming using ultrasonic
- 14.2 Car-parking system control using ultrasonic

## Spec

### 1. Hardware platform

#### 1-1) Raspberry Pi3

- Processor : Broadcom BCM2387 chipset, 1.2GHz Quad-Core, ARM Cortex-A53
- GPU : Dual Core Video Core IVÆ
- RAM : 1GB LPDDR2 SDRAM
- 802.11 b/g/n Wireless LAN
- Composite Video / 1080p HDMI
- Bluetooth 4.1
- 10/100 Ethernet

#### 1-2. Arduino ADK : ATmega2560

- Up to 20MIPS Throughput at 20MHz
- Boot Loader (USB-to-Serial program),
- ISP Program
- 256KBytes FLASH, 8KBytes bootloader
- 8KBytes Internal SRAM, 4KBytes EEPROM
- 15-Channel PWM, 16-channel 10-bits ADC
- I2C, 4-UART, 54-Digital I/O

### 2. Raspberry Pi3 Adapter board

- UART
- GPIO 40pin connector : for connection with Raspberry Pi3
- Power : +3.3V, 5V
- RS232C support
- I2C support
- UART support
- J5 ~ J8 GPIO support

### 3. LED module

- 8 Green LEDs / 8 Red LEDs

### 4. Buzzer module

- DC SMD Piezzo

### 5. 7-Segment module

- 6 Digits 7-Segment

### 6. Key PAD module

- 16 Push Button Switch

### 7. Sensor module

- CDS Sensor
- Photo TR
- Temperature and humidity sensor

### 8. DC FAN module

- 25mm small size, DC FAN

### 9. DC Motor module

- Forward / reverse rotation DC Motor

### 10. Photo Interrupter Sensor module

- Operating voltage~DC 5.0V
- Power supply needs: 5V
- Interface type: Digital

### 11. Vibration Detection Sensor module

- Fast response and High sensitivity
- Pin Definition: S-Sigal V-VCC G-GND
- Material: Gold plated
- Super wide vibration detect range
- No direction limit

### 12. 3-Axis Compass Sensor module

- built-in drive circuit
- I2C digital interface
- 12-bit ADC and low interference AMR sensor

### 13. PIR Motion Sensor module

- Block time: 2.5 S(default)
- Delay time: 5 S(default)
- Sentry Angle:< 110 degree
- Sentry Distance:3 m(default) - max 7 m



**14. Pulse Sensor module**

- 24-inch Color-Coded Cable
- 4 Transparent Stickers
- 3 holes around the outside edge
- An Ear Clip, perfectly sized to the sensor

**15. Ultrasonic Sensor module**

- power supply : 5V DC
- quiescent current : <2mA
- effectual angle: <15°
- ranging distance : 2cm - 500 cm

**16. Smoke Sensor module**

- Power supply needs: 5V
- Interface type: Analog
- Pin Definition: S-Sigal V-VCC G-GND
- Wide detecting scope

**17. Soil Moistur Sensor module**

- Power supply: 3.3v or 5v
- Output voltage signal: 0~4.2v
- Current: 35mA
- Pin definition: Analog output(Yellow wire)

**18. Red LED module**

- Voltage : +3.3~5V
- Pin Definition : 1 Signal(Yellow) 2 Vcc(Red) 3 GND(black)

**19. Green LED module**

- Voltage : +3.3~5V
- Pin Definition : 1 Signal(Yellow) 2 Vcc(Red) 3 GND(black)

**20. Active Buzzer module**

- Power supply needs : 5V
- Interface type : Analog
- Pin Definition: S-Sigal V-VCC G-GND

**21. Voice Record module**

- Push-button interface
- Automatic power-dwon mode
- On-chip 8 speaker driver
- Signal 3V Power Supply

**22. Camera module**

- Interface : CSI(Camera Serial Interface), FPC 15P Cable
- Sensor : 5M Pixel

**23. Micro SD Card**

- Frequency : 2.4GHz
- 16G Micro SDHC
- size : 15mm x 11mm
- Transmission grade : Class 4

**24. Raspberrypi & IoT Application Example Program (17 types)****25. Commercial IoT Cloud Program Operation S/W**

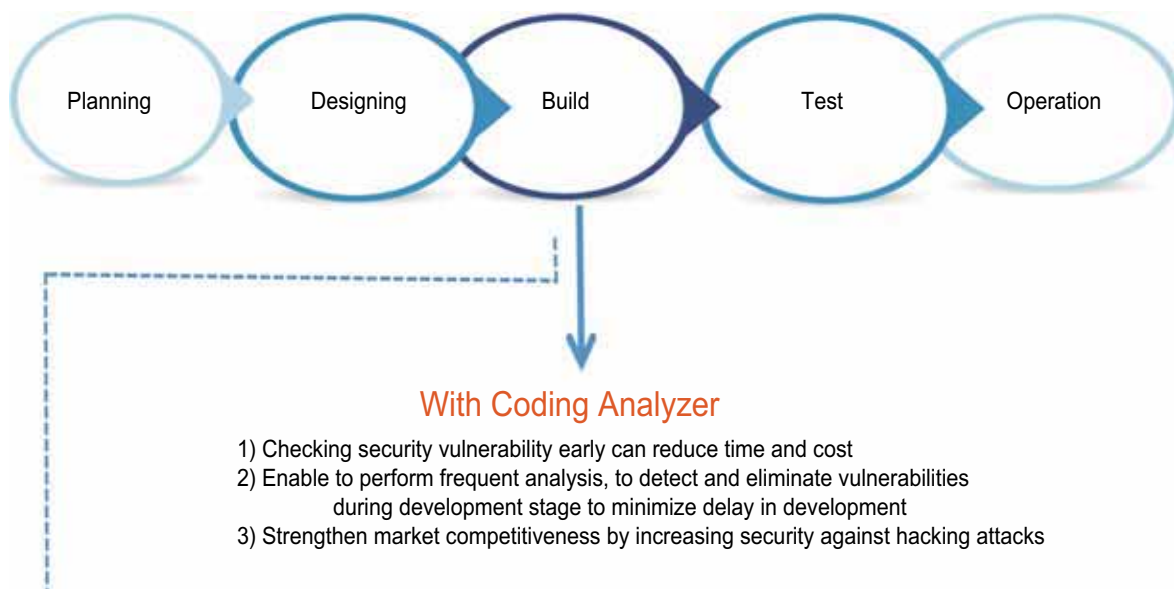
- Web user interface : Provides easy administrator screen through web interface
- Support modem / wireless LAN connection management and setting, offline DB interlocking support
- Device management : gateway registration, software distribution management
- Sensor managemen t: Provides the ability to manage (register / modify / delete) and test the sensor
- Security : Secure transmission over SSL, providing user authentication

# model: **Coding Analyzer-GT700**

## Coding Analyzer solution

### 1. What is Coding Analyzer-GT700 ?

Coding Analyzer-GT700 is a series of process to eliminate inherent security vulnerabilities and to check coding quality in the SW by developers' mistakes or logical errors.



#### Without Coding Analyzer

- 1) Study shows that the cost significantly increase when vulnerabilities are fixed later in SDLC
- 2) If try to fix during test stage, there could be too many issues to solve problems in time
- 3) Weaken market competitiveness due to delay in development

## 2. Features of Coding Analyzer-GT700

### 1) Coding security

: SAST-Build Security into the Software

- (1) Semantic based static program analysis engine to detect security weakness in your source code
- (2) Detect and remediate vulnerabilities including XSS and SQL injection
- (3) Follow a strict set of compliance requirements and standards such as CWE, CERT, SANS Top 25, OWASP Top 10, PCI DSS and more.

### 2) Coding quality

: SAQT-Accurate & efficient Quality Control for SW Development

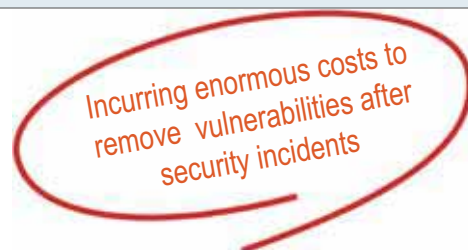
- (1) Semantic based static program analysis tool to detect quality flaws in your software's source code
- (2) Source Code quality analysis tool that can detect issues that can influence performance.  
(ex. Memory leak, null pointer...etc)
- (3) Support MISRA C++, MISRA C, BSSC, HIS, HIC ++, JPL, JSF C++, MSDN C# and more

## 3. Why do we need Coding Analyzer-GT700 ?

Below table shows the result of cost analysis for each time eliminating defects such as coding quality & security vulnerabilities from the SW design phase to the product release, which represents the cost for security vulnerability elimination can be maximum 30 times different on each phases of design, coding, integration, beta release and product release. That is, the cost can be minimized when defects are modified at the design phase.

< Analysis on modifying cost of SW development phased faults >

Phase	Design	Coding	Integration	Beta Ver	Release
Design fault	X1	X5	X10	X15	X30
Coding fault		X1	X10	X20	X30
Integration			X1	X10	X20



## 4. Overview of Coding Analyzer-GT700

: Coding Analyzer-700 is the most convenient solution for developers, which detects coding quality and security weaknesses through code analysis and eliminates the detected weaknesses automatically.

### 1) Navigation

- : A navigator to track source code execution flow
- : Enable to view variables, functions, names in the source code with a click (Highlighter function)

### 2) Active Suggestion(AS)

- : Provide fix guide of detected vulnerability using the actual source code

### 3) Advanced Issue Filtering(AIF)

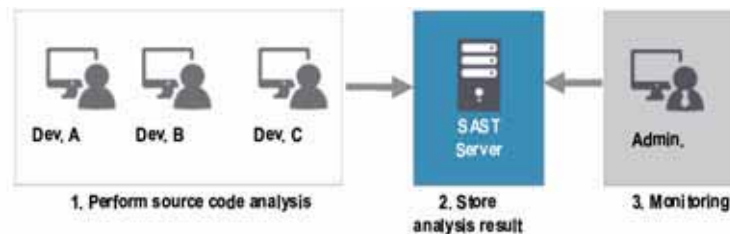
- : Filter by vulnerability path and cause
- : Enable to batch process of the same vulnerabilities

### 4) Intelligent Issue Clustering(IIC)

- : Via machine learning, automated classification of similar vulnerabilities
- Provide grouping of vulnerabilities with similar source code structure

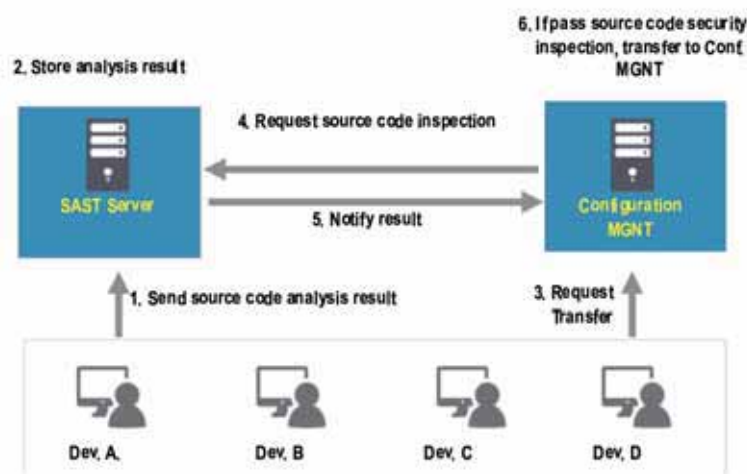
## 5. Need for Active Coding Analyzer

: Coding Analyzer can be used in various operational situations. The followings are the most common operation scenarios.



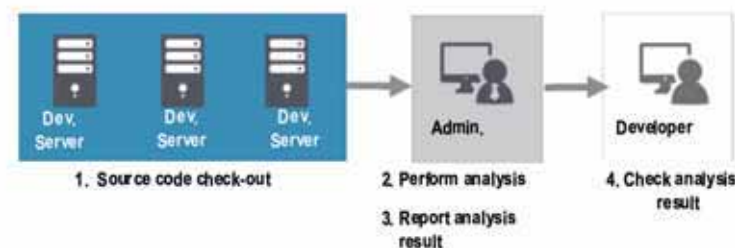
### (Frequent Inspection)

1. Multiple developers use IDEs to perform source code analysis
2. Store the analysis results in the SAST server
3. Developer can check the analysis results using IDE and administrator can also monitor the process



### (Transfer Control)

1. Developer submit source code analysis result to SAST server
2. Store the analysis results to SAST server
3. Developer request transfer to configuration management system
4. Configuration system request SAST server to check the security of the source code
5. After SAST server inspect the source code, the inspection result will be sent to configuration system
6. If source code pass the inspection, transfer the code to configuration system



### (Batch Analysis)

1. Administrator check the source codes from the development serves
2. Perform the batch analysis from administrator PC
3. Notify results to developers
4. Developers fix source code based on analysis results

## 6. Solution Composition

: Coding Analyzer is consisted of 3 products as below ;

### 1) Management Server

Item	Description
Dashboard	Able to view analysis results of entire projects
Statistics	View statistical information of analysis by projects
Report	Generate an analysis result report
Result Management	Manage history and analysis results
WAS	WAS for web based result management sharing
Analysis result DB	Database for stroing analysis result

## 2) Code Analyzing Engine

Item	Description
Java parser	Process Java source to be understood by the engine
C/C++ parser	Process C/C++ source to be understood by the engine
Semantic Engine	Semantic analysis engine
Syntactic Engine	Syntactic parsing engine

## 3) Analyzing Client [ Client(GUI, CLI) / Plugin ]

### (1) Client (GUI, CLI)

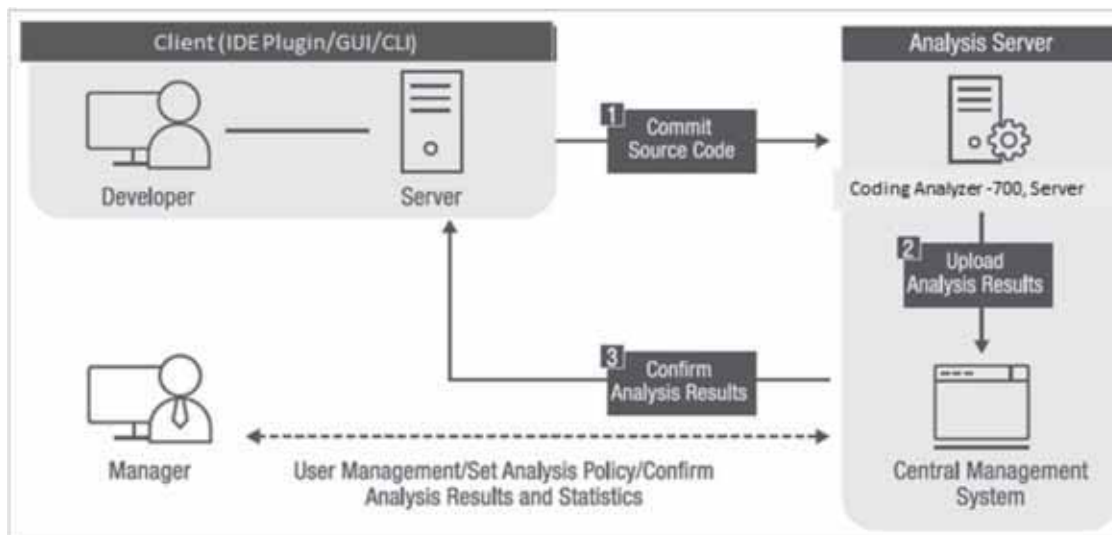
Item	Description
Perform analysis	"Build and run engine Save analysis results to NEST Server"
Build System Tracking	Track the build environment to generate the files that is needed for analysis
Client Agent	Perform remote analysis commands

### (2) Plugin

Item	Description
Perform analysis	Analyze the source code by running the engine directly in the plugin IDE
Result upload	Upload analysis results to the integrated management system
Review of results	Analyze results in the IDE

## 7. Solution Structure

: Coding Analyzer-GT700 performs source code analysis with server and client structure without changing existing environment.



## 8. Key Functionalities

- 1) Dashboard & Statistic
  - (1) Identify the number of analysis, detection issues, risks and projects
  - (2) Analysis history logs by time frame
  - (3) Provide daily and accumulated status and statistic of entire projects and by user
- 2) Analysis History Management
  - (1) Differentiate new issues from old ones by comparing the result with prior analysis results
  - (2) Automatically track prior detection results even if source code lines change
  - (3) Prevention of unauthorized use or tempering through provision of execution request/approval process
- 3) Provide a detailed correction suggestion
  - (1) Provide a detailed description of detection results, examples and solutions
  - (2) Built-in editor for central editing
  - (3) Offer real code suggestion via Active Suggestion
- 4) Customized Report
  - (1) Ability to edit project summary, analysis file information, results by risks, Top 10, violation reference, etc.
  - (2) Reports (PDF, Excel, Word)
- 5) Various Analysis Methods
  - (1) Easy to use GUI
  - (2) CLI for batch and scheduling analysis
  - (3) Plugins installed in development IDE enable analysis and result checking
  - (4) Simple drag and drop analysis via web management system without separate client program
- 6) Integration with other solutions
  - (1) Transfer control via integration with source code version controls
  - (2) Automation control via integration with Build Management Tool (CI) and Issue Tracking System (ITS)
  - (3) Hybrid analysis via interaction with DAST and RASP

## 9. Strong Points

- 1) Web Management
  - (1) Enable users to view, manage, and use various analysis results with its dashboard
  - (2) Centralized rule management based on risk levels, options and more.
- 2) Fast & Powerful Analysis
  - (1) MVC structure analysis, association file analysis, multiple step function/file call relationship analysis
  - (2) Incremental analysis to minimize analysis time by analyzing only changed and related files
- 3) Convenient Tools
  - (1) Issue navigator that follows process from cause of vulnerability to problem occurring point
  - (2) Automated real source code suggestion for detected vulnerabilities
- 4) Compliance
  - (1) Detect based on domestic/international compliance and standard guidance
  - (2) Support over 800 checkers related to security
  - (3) Support over 1700 checkers related to quality and coding convention

## 10. System Requirements

Supported languages	Java, JSP, JavaScript, C/C++, PHP, C#, ASP(.NET), VB(.NET), VBS, SQL, XML, ABAP, SWIFT, HTML, Android Java, Objective' C, Python and more
Report formats	PDF, Word, Excel
Compliance/Standards	CWE, OWASP, CERT, MISRA C, BSSC C/C++, HIC C++ and more
Framework	Spring, Struts2, IBATIS/MYBATIS, Tmax ProFrame, MiPlatform, Xplatform, Nexacro, eGovernment Standard Framework
OS	Server: Windows, Linux (Redhat, Debian) Client: Windows, Linux (Redhat, Debian), AIX, HP · UX, Solaris, MacOS
CPU	Server: Quad Core 2.5GHz or faster Client: Dual Core 2GHz or faster
RAM	Server: 16GB or higher Client: 2GB or higher
HDD	Server: 300GB or larger Client: 500MB + size of source file*2

## 11. Components

Server (1~5 users)	1 unit
Program CD for Server	5 ea
User License	5 ea
Manual book	5 book

## 12. Manual contents

### Chap 1, Getting Started

- 1-1) Type of Guides
- 1-2) Glossary

### Chap 2, Product Overview

- 2-1) Product Introduction
- 2-2) Benefits
- 2-3) Components

### Chap 3, Installation & operation

#### <Server>

- 3-1) Server installation
- 3-2) Start Server
- 3-3) How to use server
- 3-4) How to login
- 3-5) How to view dashboard
- 3-6) How to check statistics
- 3-7) How to exclude issues
- 3-8) How to view bulletin board
- 3-9) Management
  - 3-9-1) User management
  - 3-9-2) Integration setting
  - 3-9-3) How to set up remote engine
  - 3-9-4) How to check license status
  - 3-9-5) How to check log files
  - 3-9-6) How to check system information
  - 3-10) How to use Alert Center

#### <Client>

- 3-11) How to install client
- 3-12) Connecting using client program
- 3-13) How to use client
  - 3-13-1) Analysis
  - 3-13-2) How to view results
  - 3-13-3) How to request exclusion
  - 3-13-4) How to print reports
  - 3-13-5) How to use Alert Center
  - 3-13-6) How to access my account
- 3-14) How to perform analysis
  - 3-14-1) How to perform analysis based on compliance guides (both security & quality checks)
  - 3-14-2) How to perform analysis using GUI (Graphic User Interface)
  - 3-14-3) How to perform analysis using CLI (Command Line User Interface)
  - 3-14-4) How to perform analysis using IDEs
  - 3-14-5) How to perform batch processing

### Chap 4, Convenient tools

- 4-1) How to use Active Suggestion
- 4-2) How to use navigation tools
- 4-3) How to use advanced issue filtering
- 4-4) How to use intelligent issue clustering

### Chap 5, Options

- 5-1) List of commonly used options
- 5-2) How to change option settings

## 13. Specification

- 1) Semantic based static program analysis engine with machine learning capability that can detect & remediate security vulnerabilities in the source code.
- 2) perform source code analysis on server and client structures without changing existing environment
- 3) detect security weaknesses through code analysis and eliminates the detected weaknesses automatically.
  - (1) Navigation
    - A navigator to track source code execution flow
    - Enable to view variables, functions, names in the source code with a click (Highlighter function)
  - (2) Active Suggestion(AS)
    - Provide fix guide of detected vulnerability using the actual source code
  - (3) Advanced Issue Filtering(AIF)
    - Filter by vulnerability path and cause
    - Enable to batch process of the same vulnerabilities
  - (4) Intelligent Issue Clustering(IIC)
    - Via machine learning, automated classification of similar vulnerabilities
    - Provide grouping of vulnerabilities with similar source code structure
- 4) Active Coding Analyzer-700
  - (1) A new concept of active Coding Analyzer-700 allowing analysis and elimination of security vulnerabilities automatically.
- 5) Dashboard & Statistic
  - (1) Identify the number of analysis, detection issues, risks and projects
  - (2) Analysis history logs by time frame
  - (3) Provide daily and accumulated status and statistic of entire projects and by user
- 6) Analysis History Management
  - (1) Differentiate new issues from old ones by comparing the result with prior analysis results
  - (2) Automatically track prior detection results even if source code lines change
  - (3) Prevention of unauthorized use or tempering through provision of execution request/approval process
- 7) Provide a detailed correction suggestion
  - (1) Provide a detailed description of detection results, examples and solutions
  - (2) Built-in editor for central editing
  - (3) Offer real code suggestion via Active Suggestion
- 8) Customizable Report
  - (1) Ability to edit project summary, analysis file information, results by risks, Top 10, violation reference, etc.
  - (2) Reports (PDF, Excel, Word)
- 9) Various Analysis Methods
  - (1) Easy to use GUI
  - (2) CLI for batch and scheduling analysis
  - (3) Plugins installed in development IDE enable analysis and result checking
  - (4) Simple drag and drop analysis via web management system without separate client program
- 10) Integration with other solutions
  - (1) Transfer control via integration with source code version controls
  - (2) Automation control via integration with Build Management Tool (CI) and Issue Tracking System (ITS)
  - (3) Hybrid analysis via interaction with DAST and RASP
- 11) Web Management
  - (1) Enable users to view, manage, and use various analysis results with its dashboard
  - (2) Centralized rule management based on risk levels, options and more.
- 12) Fast & Powerful Analysis
  - (1) MVC structure analysis, association file analysis, multiple step function/file call relationship analysis
  - (2) Incremental analysis to minimize analysis time by analyzing only changed and related files



## 13) Convenient Tools

- (1) Issue navigator that follows process from cause of vulnerability to problem occurring point
- (2) Automated real source code suggestion for detected vulnerabilities

## 14) Compliance

- (1) Detect based on domestic/international compliance and standard guidance
- (2) Support over 800 checkers related to security
- (3) Support over 1700 checkers related to quality and coding convention

## 15) System Requirements

Supported languages	Java, JSP, JavaScript, C/C++, PHP, C#, ASP(.NET), VB(.NET), VBS, SQL, XML, ABAP, SWIFT, HTML, Android Java, Objective' C, Python and more
Report formats	PDF, Word, Excel
Compliance/Standards	CWE, OWASP, CERT, MISRA C, BSSC C/C++, HIC C++ and more
Framework	Spring, Struts2, IBATIS/MYBATIS, Tmax ProFrame, MiPlatform, Xplatform, Nexacro, eGovernment Standard Framework
OS	Server: Windows, Linux (Redhat, Debian) Client: Windows, Linux (Redhat, Debian), AIX, HP - UX, Solaris, MacOS
CPU	Server: Quad Core 2.5GHz or faster Client: Dual Core 2GHz or faster
RAM	Server: 16GB or higher Client: 2GB or higher
HDD	Server: 300GB or larger Client: 500MB + size of source file*2

# model: Test Automation-700, Test Automation-QMC

## Test Automation Solutions

There are many menus on WEB or APP, and Test Automation-700 is a solution to test whether each menu works well. Test Automation-QMC is the solution that reports and monitors the test results of many menus on WEB or APP.

### Concept of Test Automation-700, Test Automation-QMC and System configuration

Test Automation-700 is an automated solution to improve the service quality improvement through Automatic Function Tests on the Service S/W running on various terminals.

Test Automation-700 supports test automation and Test Automation-QMC supports test quality management.

Two solution supports Test Automation and standardized Test Quality Management Processes for various mobile terminals, OS and applications.

Test Automation-700 solution enables customers to achieve the desired level of test productivity and service quality improvement with fast and accurate testing, regardless of test device specifications and service GUI environment.

Also, helps reduce testing costs through efficient use of limited test personnel.

- 1) Test Automation-700
  - (1) Script Recorder: Writing and editing scripts
  - (2) Controller: Run Script
  - (3) Gateway: Test mobile terminal management
- 2) Test Automation-QMC
  - (1) Test case management
  - (2) Manage Test Execution
  - (3) Manage test results and report generation

### Concept of Test Automation-700, Test Automation-QMC and System configuration

Test Automation-QMC solution is a web-based standardized test quality management solution.

It supports various types of test execution methods through interworking with test automation solution (Test Automation-700) and provides stable service development and quality control.

- 1) function
  - (1) Pre-test (total) process control
  - (2) Test execution management and real-time monitoring
  - (3) Manage the test results and track defect tracking
  - (4) Analyze the test results and generate reports
  - (5) Pre-test (full) process dashboard capability
  - (6) User Rights Management
- 2) Benefits
  - (1) Provides web-based standardized test management interface
  - (2) Supports various test execution methods
  - (3) Real-time monitoring support for test devices
  - (4) Support various kinds of defect tracker interlocking
  - (5) Provide real-time results analysis and report of various results.
  - (6) Improved test productivity with standardized test management system
  - (7) Improving service quality by extending test coverage and analyzing real-time test results
  - (8) Reduce test management costs with convenient test management and efficient use of limited resources

## Features of Test Automation-700, Test Automation-QMC

- 1) One-Script Multi-Test : Various terminal tests with different OS and resolution by a single script.
- 2) Test without software modifying : Can be tested without S / W modifying such as jailbreaking, rooting,,, etc
- 3) Apply image recognition technology : : Create sophisticated test scripts in a non-standard GUI environment
- 4) Automatic test result : Automatic determination of test results by applying OCR technology
- 5) Perform the same test as the actual load situation
- 6) Accurate performance diagnosis and validation of service quality

## Overview of Test Automation-700

Test Automation-700 is a test automation solution that supports customer's test productivity & service quality improvement by providing an automated test execution environment for service applications running on various types of devices based on various recognition technologies.

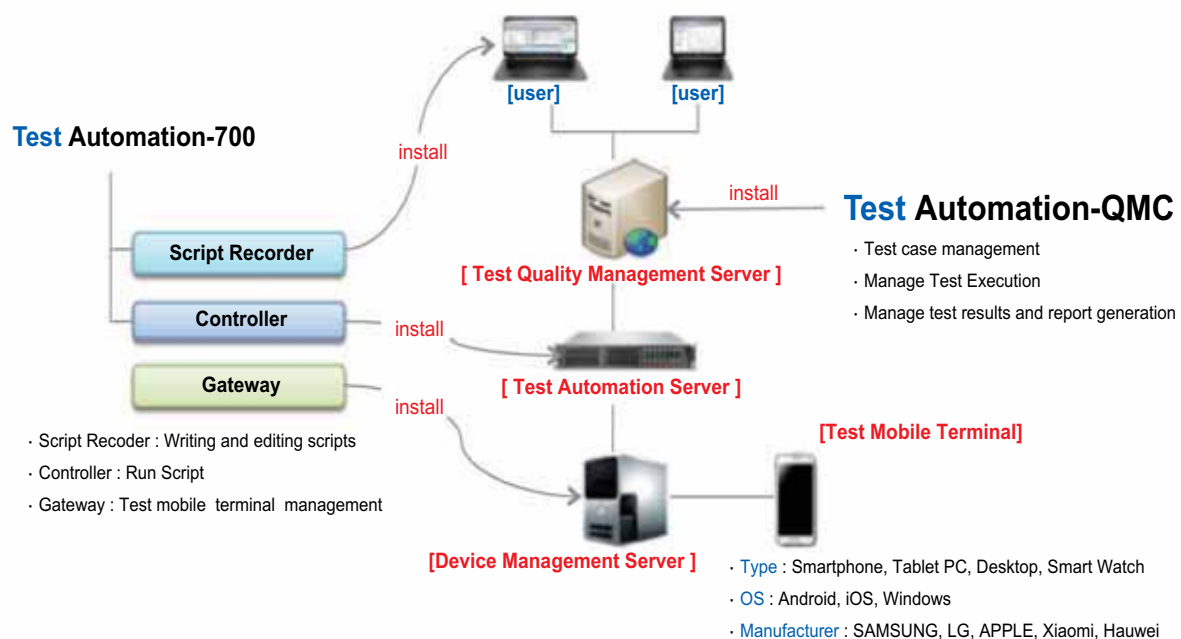
### 1) function

- (1) Automatic Test Script production and editing, verification, execution function
- (2) Automatic test device recognition and connection management
- (3) Ability to test multiple devices simultaneously
- (4) multiple device synchronization test
- (5) 2 channel interlock test function

### 2) Benefits

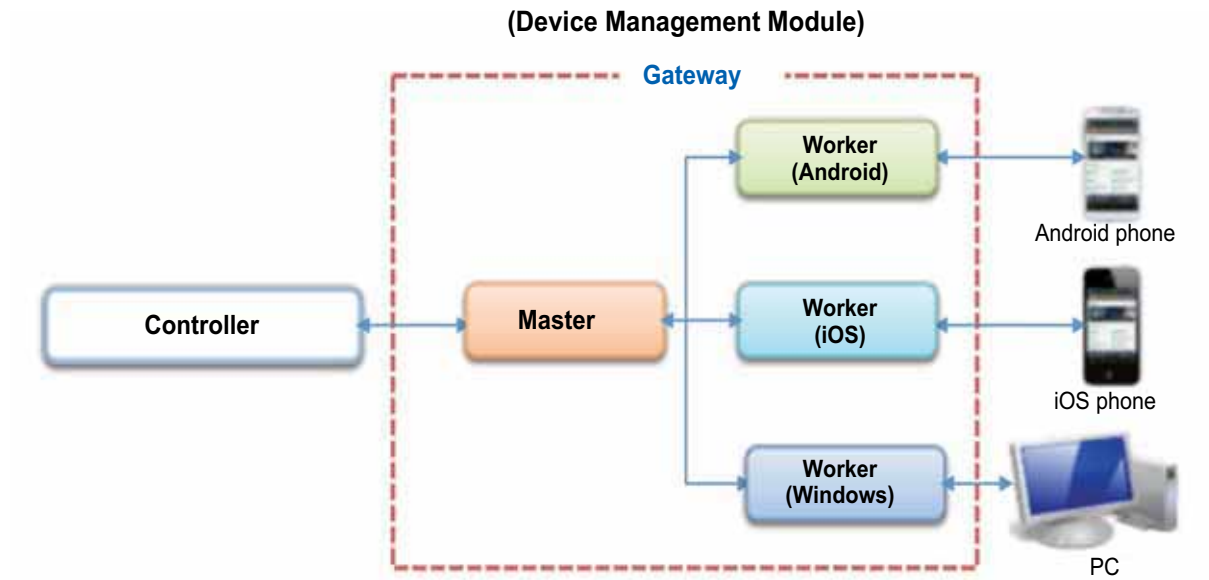
- (1) Non-standard GUI environment and various applications test by applying various recognition technologies.  
(One-Script Multi-Test, One-Script Multi-Browser)
- (2) Automatically generate and run scripts based on user behavior
- (3) Simultaneous testing of multiple devices without test scripts
- (4) Automatic device recognition and rapid test without device operation
- (5) Support data integration and sharing test between different devices or apps
- (6) Increase test productivity by automating the simple & repetitive testing tasks
- (7) Improve service quality with fast and accurate repeat testing on various test devices
- (8) Reduce testing costs by efficiently using limited test personnel

## System Configuration



## Test Automation-700, Test Device Management Function

Provides test device management function that manages connection of test device and relays data/reception between script execution module and test device to support various mobile terminals and various OS without special operation.



- **Master** : Data collection, transformation, and controller transfer
- **Worker** : Manage test devices and device lists, and Relay data between master and device

## Components ( for 10 users)

1) Hardware	(1) Test Quality Management Server : 1 unit (2) Test Automation Server : 2 unit (3) Device Controller Server : 1 unit (4) Mobile phone : 10 unit
2) Software	(1) S/W Program CD : 1 ea (for 10 users) (2) Test App is needed.
3) Desktop PC (or, Laptop PC) & APP	: 10 unit of Desktop PC is needed in the Lab.

## Test Automation-700 operating procedures

- 1) 1st step : write the Script
  - (1) Connect Test Device
  - (2) Write the Script and verify
- 2) 2nd step : distribute the Script
- 3) 3rd step : execute the Test
  - (3) Execute the Script
  - (4) Automatic execute the Test
  - (5) One-Script Multi-Test

## Test Automation-QMC, Operating procedures

- 1) Create Test Data
  - (1) Requirements
  - (2) Test Case
  - (3) Test Script
  - (4) Test Scenario
- 2) Test Execution
- 3) Result Registration (automatic)
- 4) Register Result (by manual)
- 5) Result Analysis & generate report
- 6) Test

## Test Automation-700, Test Device Management Function

Provides test device management function that manages connection of test device and relays data transmission / reception between script execution module and test device to support various mobile terminals and various OS without special operation.

- 1) Device Management Module
  - (1) Controller : Script Execution Module
  - (2) Gateway
    - \* Master : Data collection, transformation, and controller transfer
    - \* Worker : Manage test devices (Android phone, iOS phone, PC) and device lists & Relay data between master

## Test Automation-700, Script generation function

Automatically generate test scripts as with the order of manipulating the screen just like the test personnel do the Application test. Provides automatic script generation function that can directly verify the generated test script.

- 1) Script creation by simple click
  - (1) Create a test script as soon as you click on what you want to test
  - (2) Suitable for generating test scripts for simple screen manipulation such as screen touch
  - (3) Apply the object recognition technology
- 2) Script generation function by area designation
  - (1) After specifying the area to be tested, select the script command to test, then generate a test script
  - (2) Suitable for generating the test scripts for screen control and suitable for Screen verification, text input, etc as well as Complex functional testing.
  - (3) Apply the image recognition technology

## Test Automation-QMC, Scope that provides test management function

Test Automation-700QMC solution provides standardized pre-test process management functions such as test case management, test execution and defect management, and report management through a web-based interface, enabling effective test output management and easy test execution management.

- 1) Test design
  - (1) manage the test plans
  - (2) manage the requirements
  - (3) manage the Risk
  - (4) manage the Test case
  - (5) manage the Script
- 2) Test Execution
- 3) Defect generation
  - (1) Self Defect Tracker (internal module)
  - (2) External defect tracker (external interlock, mantisBT, JIRA)
- 4) Report generation

## Test Automation-QMC, real-time monitoring

Provides the real-time monitoring function that can monitor the screen of the currently running test terminal and the status of the terminal resource used by the app under test in real time.

- 1) Main functions
  - (1) Selection of monitoring information
  - (2) monitoring test execution information (monitor the terminal resource information)
  - (3) monitoring sharing setting function
    - \* Share monitoring screens with other users
    - \* register, view and delete shared users
  - (4) Refresh function
- 2) Real-time monitoring information
  - (1) test progress indication (normal, failure, shutdown)
  - (2) APP test Screen
  - (3) test step information and results
  - (4) test summary information
    - \* Device information
    - \* Test Case Information
    - \* Test Script Information
  - (5) test Mobile Resource information
    - \* CPU usage
    - \* Memory usage
    - \* Network usage

## Test Automation-QMC, detailed view of test results

Automatically collects and analyzes test execution results, and provides the function to view test execution history such as test execution summary information, execution statistical information, terminal resource usage status, and detailed execution details by script.

- 1) Provide test summary information
  - (1) test APP, date and time of execution, execution method, execution result, number of execution steps
  - (2) time spent, average response time, average CPU utilization, average memory usage
- 2) Provide test statistical information
  - (1) execution steps (success, failure, sum)
  - (2) response time (average, maximum, minimum)
  - (3) CPU utilization (average, maximum, minimum)
  - (4) memory usage (average, maximum, minimum)
- 3) Provide a graph of test terminal resource usage
- 4) Provide detailed execution details by script
  - (1) execution command, execution result, execution time, elapsed time
  - (2) Details executed
  - (3) CPU utilization, memory utilization
    - \* Processing result
    - \* Input contents (coordinates, search image, parameters, OCR search string)
    - \* Limited time to wait
    - \* test device Screen image
    - \* test run video

## Test Automation-QMC, Manage the report generation

By automatically collecting and analyzing test data and test results, provides the report generation management function that can generate test execution reports including test summary information, statistical information, and detailed information, and display generated the reports via web screen or save them as files.

- 1) Type of Reports
  - (1) Comprehensive Test Report
  - (2) Report for the requirement
  - (3) Report for Risk Analysis
  - (4) Test Case Report
  - (5) Test Plan Report
  - (6) Test Execution Report
  - (7) Test Results Report
  - (8) Defect management Report
- 2) Report menu for Statistical Information
- 3) Report menu for Summarized information
- 4) Report menu for Detailed information

## Test Automation-700, Benefits

Test Automation-700 enables customers to achieve the desired level of test productivity and service quality improvement with fast and accurate testing, regardless of test device specifications and service GUI environment.

Also, helps reduce testing costs through efficient use of limited test personnel.

- 1) Automatically generate the scripts based user behavior
- 2) Sophisticated testing even in a non-standard GUI environment
- 3) Rapid test without any manipulation of the device
- 4) Multiple Device Synchronization Test

Through above, user can have below benefits.

- 1) Reduced scripting time
- 2) Increased script reusability
- 3) Extend test coverage
- 4) Shortening the test period
- 5) Improved test processing power per hour

## Test Automation-QMC, Benefit

Test Automation-QMC solutions help improve test productivity through Web-based & standardized test management capabilities, improve service quality through extended test coverage and analysis of real-time test results, and reduce testing costs through efficient use of limited resources.

- 1) Web-based & standardized Test management interface
- 2) Various Test Execution method and support real-time monitoring
- 3) Support Interlocking of various external defect trackers
- 4) Real-time results analysis and Provide a variety of results reports

Through above, user can have below benefits.

- 1) Reduced test process time
- 2) Easy to share test data and results
- 3) Extend test coverage
- 4) Prompt fault identification and fault management
- 5) Reduced time to analyze test results

## Table of Manual Contents

### 1) Test Automation-700

#### Chap 1, Test Automation-700 Overview

- 1.1 Test Automation-700 Mobile Introduction
- 1.2 Need for functional testing
- 1.3 Functional testing procedure
- 1.4 Test Automation-700 Mobile components and features

#### Chap 2, Installation and Setup

- 2.1 Pre-installation checks and requirements
  - 2.1.1 Test Automation-700 Mobile user registration / license issue
  - 2.1.2 Reinstalling / upgrading Test Automation-700 Mobile
  - 2.1.3 Confirmed joint use with other software
  - 2.1.4 Check the environment setting
- 2.2 Test Automation-700 Mobile Integrated installation
  - 2.2.1 Operating environment
  - 2.2.2 Installing the Test Automation-700 Mobile controller
  - 2.2.3 Test Automation-700 Mobile Gateway/Driver Install
  - 2.2.4 Mobile device new environment procedure
  - 2.2.5 How to allow USB debugging of mobile devices (Android)
  - 2.2.6 USB Driver Install (Android)
  - 2.2.7 Installing and configuring the Mobile Gateway
    - 2.2.7.1 JDK Install
    - 2.2.7.2 Setting Java environment variables (JAVA\_HOME)
    - 2.2.7.3 Device Management Server Configuration
- 2.3 Test Automation-700 Mobile License Install
- 2.4 Folder configuration and settings
- 2.5 Test Automation-700 Mobile Remove

#### Chap 3, Program operation and environment setting

- 3.1 Configuring the Mobile Environment Test
  - 3.1.1 Android terminal test environment
  - 3.1.2 iOS terminal test environment
- 3.2 operate Test Automation-700 Gateway for Android
  - 3.2.1 Java version Gateway
  - 3.2.2 (.Net) version Gateway
- 3.3 operate Test Automation-700 Gateway for iOS
- 3.4 Driving the Test Automation-700 Mobile controller
  - 3.4.1 Configure settings
  - 3.4.2 Gateway address management
  - 3.4.3 Select gateway / Service
- 3.5 operate Test Automation-QMC agent
- 3.6 Test Automation-700 Mobile Screen Configuration and Description
- 3.7 use the Object Recognition (Instrument Option)

#### **Chap 4, Basics of writing automation scripters**

- 4.1 Device Usage and Screen Control
- 4.2 Device Usage and Agent Installation
- 4.3 Screen control
  - 4.3.1 Wake up device (WakeUp)
  - 4.3.2 Controlling device display
  - 4.3.3 Device operation
- 4.4 Writing and editing scripts
  - 4.4.1 Considerations when writing scripts
  - 4.4.2 Image (object) based commands
  - 4.4.3 Coordinate-based command
  - 4.4.4 Using Exceptions
  - 4.4.5 save the Results File Image Option
- 4.5 use the horizontal mode screen
- 4.6 Script edit function
- 4.7 Run Script

#### **Chap 5, Write automation script details**

- 5.1 guide for basic building
  - 5.1.1 Touch
  - 5.1.2 Text input
  - 5.1.3 Check selection
- 5.2 Writing Guide by the Function
  - 5.2.1 Set Variable
  - 5.2.2 Sequence (Do)
  - 5.2.3 Branch
  - 5.2.4 Loop
  - 5.2.5 Break
  - 5.2.6 Continue
  - 5.2.7 Sleep
- 5.3 Case-by-case creation guide
  - 5.3.1 In the case of a scroll area
  - 5.3.2 In case of communication processing

#### **Chap 6, How to use APP accessibility**

- 6.1 Overview of app accessibility
    - 6.1.1 App Accessibility Criteria
    - 6.1.2 App Accessibility Purpose
    - 6.1.3 App Accessibility Structure (Compliance)
    - 6.1.4 App accessibility Environment
    - 6.1.5 Instrument Procedure in Android App
  - 6.2 How to use app accessibility
    - 6.2.1 Check alternate text
    - 6.2.2 Focus Assist Inspection
    - 6.2.3 Color contrast check
    - 6.2.4 Subtitle area inspection
- Appendix1, How to install USB driver for Android terminal
- Appendix 2, Android KEYEVENT
- Appendix 3, Useful ADB Commands

## **2) Test Automation-QMC , manual contents**

#### **Chap 1, Introduction**

- 1.1 System overview
- 1.2 System structure
- 1.3 Service Screen Configuration
- 1.4 Service procedure
- 1.5 License

#### **Chap 2, Installation and System Connections**

- 2.1 Establishment of execution environment
- 2.2 Test Automation-QMC ,Install
- 2.3 Test Automation-QMC, System Connection



### **Chap 3, Set up the environment**

- 3.1 Screen Layout
- 3.2 Set up a test automation environment
- 3.3 Agent
- 3.4 Set up the system
- 3.5 Device
- 3.6 Data
- 3.7 Create Defect Tracker
- 3.8 View and Generate Defect Tracker
- 3.9 Edit and delete defect trackers

### **Chap 4, Service connection**

- 4.1 Screen layout
- 4.2 Service connection
- 4.3 User registration
- 4.4 Password

### **Chap 5, Test Project Management**

- 5.1 Screen layout
- 5.2 Project composition
- 5.3 Project inquiry
- 5.4 Project progress changes
- 5.5 Project Change
- 5.6 Project approval
- 5.6 Project start
- 5.7 Project finish
- 5.8 Project delete
- 5.9 Project edit
- 5.10 Project retrieve
- 5.11 Test work-force management

### **Chap 6, Test planning management**

- 6.1 Screen layout
- 6.2 make Test plan
- 6.3 inquire Test plan
- 6.4 edit Test plan
- 6.5 delete Test plan
- 6.6 retrieve Test plan
- 6.7 Test person registration management
- 6.8 Test case registration management
- 6.9 Test scenario registration management
- 6.10 make Test build
- 6.11 inquire Test build
- 6.12 edit Test build
- 6.13 delete Test build
- 6.14 manage Test device registration
- 6.15 register to Test case build
- 6.16 How to register to Test build
- 6.17 Release Test case that was registered to the build

### **Chap 7, manage the requirements**

- 7.1 Screen layout
- 7.2 Requirements
- 7.3 Requirements Specification
- 7.4 inquire the required specification
- 7.5 generate the required specification
- 7.6 edit the required specification
- 7.7 delete the required specification
- 7.8 manage the registration of the attached file  
for the required specification.
- 7.9 Requirements
- 7.10 inquire the requirements
- 7.11 generate the requirements

- 7.12 edit the requirements
- 7.13 delete the requirements
- 7.14 manage Test case connections
- 7.15 manage the associated requirements
- 7.16 manage the risk
- 7.17 manage the attached file for requirements
- 7.18 generate the required version and manage the other version
- 7.19 retrieve the tree for requirements

#### **Chap 8. manage the risk analysis**

- 8.1 Screen layout
- 8.2 Risk management
- 8.3 Risk folder management
- 8.4 inquire Risk folder
- 8.5 generate Risk folder
- 8.6 edit Risk folder

## **Specification**

### **A. Test Automation-700**

#### **1) Script generation function**

- (1) generate scripts by automatically recording user test scenarios
- (2) Use the test data sets and data replacement
- (3) Automatic support for variables (OS, version, resolution, etc.) for devices
- (4) Automatic substitution the changed script's data (eg login, password, etc.)
- (5) Step-by-step verification of generated scripts
- (6) Real-time automatic display of test device screen
- (7) Save all or part of the test device screen (save file)
- (8) Use the object recognition methods by image pattern matching method
- (9) Script generation and execution through object recognition method
- (10) Object Recognition Compatibility even if the device screen resolution is different
- (11) Quickly modify for the image changes
- (12) Common parts can be saved as libraries and reused
- (13) Exception handling part can be saved / used as common library
- (14) create and manage scenarios and scripts hierarchically, including scenarios, cases, and sequences
- (15) save and use common libraries of various standard and secure keypad input screens
- (16) operate device's hardware key (Home / Menu / Back / Search etc.)
- (17) detailed terminal test possible (logcat etc.) using the Android API (ADB)
- (18) create and validate scripts by connecting multiple mobile devices simultaneously
- (19) Test data set can be automatically replaced with test management system

#### **2) Test execution function**

- (1) One script can be used to test multiple terminals at the same time with different OS / version
- (2) Manually run (test) multiple terminal synchronization without scripts
- (3) Character object recognition by OCR method
- (4) 2 channel interlock test support
  - Data interworking and sharing tests between different types of devices or apps (e.g. ARS authentication test in conjunction with phone app, SMS authentication test in conjunction with SMS app)
  - Interworking test between smartphone and PC (eg Smartphone-PC certificate copy test)
- (5) Compatibility verification function for non-functional screen contents
- (6) Supports horizontal / vertical mode operation
- (7) Executable by variable setting, branching and condition
- (8) Automatically install or run apps using automated tools
- (9) Provide verification points and corresponding functions
  - Attributes and Data (Display Output) Values
  - Capture images, compare values, and respond with regular expressions
- (10) reuse existing scripts despite changes in device, OS, and resolution
- (11) Provides condition and repeat functionality
- (12) Providing various information by test execution monitor
  - CPU, memory, resource usage status, log information, etc.
  - Provides response speed for each step
- (13) Provides execution time, result screen capture for execution result
- (14) run test scenarios by assigning test data to datasets

**3) Support various test environments**

- (1) support iOS/Android mobile terminal
- (2) support iOS mobile test without source code
- (3) support for the latest OS version
- (4) Test support for non-standard GUI APP (X-Internet, Win32 control, ActiveX, Flash, etc.)
- (5) Test support for hybrid APP

**4) Extended function**

- (1) Provide API for implementing script add-in
- (2) Simultaneous testing of multiple devices without a script
- (3) Provide the latest new terminal addition function

**5) Device management function**

- (1) Test device reservation management
- (2) Testing device connected via USB / WiFi
- (3) Wake-up when device is in sleep mode
- (4) Can be used by connecting multiple devices (10 or more) from one computer

**B. TestAutomation-QMC**

- (1) Pre-test process management functions (requirements management, test case management, execution management, defect management, report generation management, etc.)
- (2) Tracking between test processes (requirements, test cases, execution results, fault linkage management)
- (3) Support various kinds of test execution method by linking with test automation tool (automatic, reservation, scenario execution, etc.)
- (4) Defect management to manage defect traps such as log, capture, and video
- (5) Real-time monitoring capability for the device under test
- (6) Manual test support and convenient functions (Capture, edit, etc.)
- (7) Manage various types of analysis graphs and report generation for test results
- (8) provide detailed execution information for each test step
- (9) User Roles and Rights Management
- (10) Install and manage apps

# model: Performance Load Testing-700

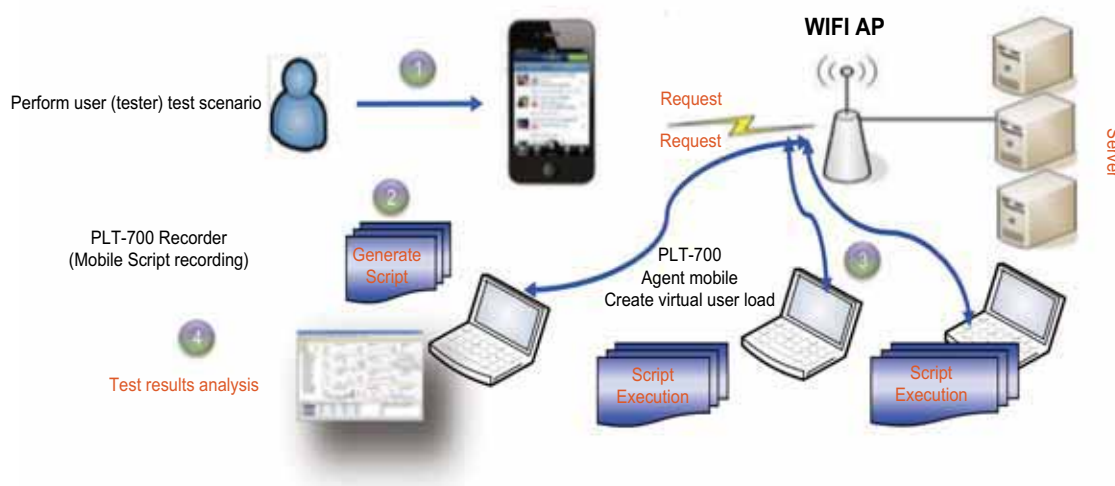
## Performance Load Testing Solutions

### Overview

Performance Load Testing-700 performs accurate performance diagnosis and verification of service quality by measuring performance data, after generating a large amount of load on the test server.

- 1) Improve the development productivity
- 2) Quantitative Quality Process
- 3) The quantified Service Quality Measurements
- 4) Improve the service quality
- 5) Cost reduction (development, operation, introduction)

### System configuration



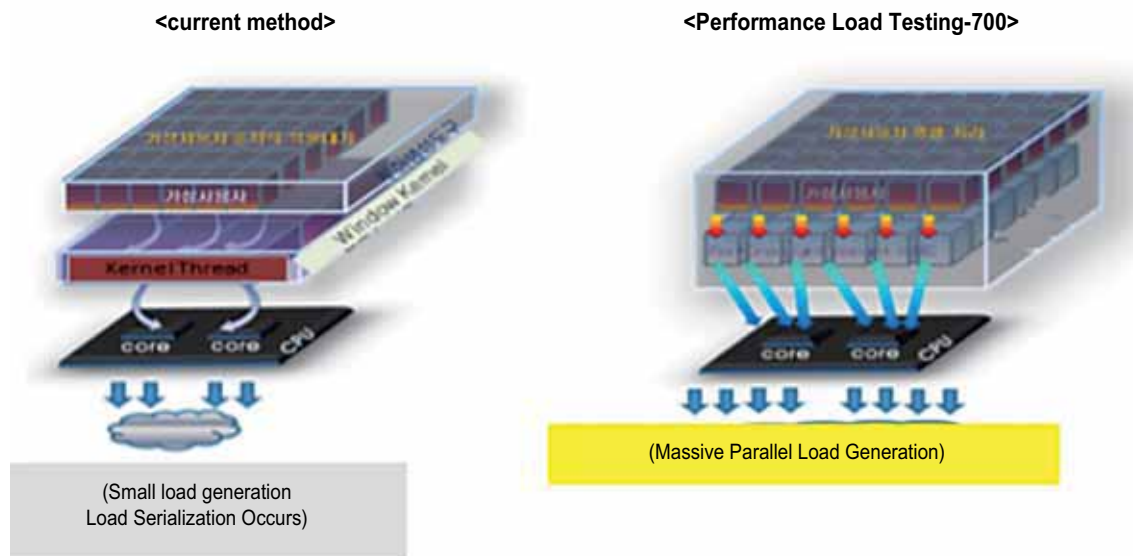
### Features

Performance Load Testing-700 performs accurate performance diagnosis and verification with various data analysis by the excellent load generation technology. It performs almost the same test as the actual load situation.

- 1) Lightweight thread creation control
  - : Accurate and precise mass load generation without system load.
- 2) Using its own scheduler
  - : Minimizing the scheduling overhead of the load generation system.
- 3) Efficient distributed parallel processing
  - : Can generate a large amount of load with few resources.
- 4) Horizontal analysis and vertical analysis
  - : Easily identify bottlenecks and identify sources
  - : Horizontal analysis: service, function, URI analysis
  - : Vertical analysis: server section, network section analysis

## Function

- 1) Precise load generation and control yield accurate test results
  - : Tests execution close to real user environment (multi-core, multi-processor strong)
  - by the way of virtual user load generation which is lightweight and precise.



- 2) Fast load generation, performance measurement, performance analysis
  - (1) Maximum parallelization, processing with maximum utilization of distributed nodes by the distributed parallel processing method and in less resources (CPU, memory).
  - (2) Optimize processing time with distributed parallel processing in performance data analysis
  - (3) Manage thousands of nodes in a controller
- 3) Easy testing (Easy Recording, Editing method)
  - : Automatically generate test scripts
- 4) Script editing support
  - : Supports the function to edit additional functions such as Loop, Think Time, Rendezvous, etc in automatically generated scripts.
- 5) Automatic generation of replacement data
  - (1) In the composed Script, automatically generate necessary replacement data when each virtual user needs to generate a load with different data
  - (2) Automatic generation of GET, POST, and Value replacement data of web page script.
- 6) GET / POST string replacement function
  - : In script, substitute POST and GET strings in URL by replacing specific string.
- 7) Easy to test (Quick Play, Monitoring method)
  - : Easily perform and monitor test scenarios.
- 8) Easy to test (fast and accurate analysis)
  - : After the test is completed, the analysis result is calculated quickly and accurately.
- 9) Test results are easy to analyze and use
  - (1) Quickly analyze test results and provide accurate and versatile analysis results.
  - (2) It is easy to access through the web, enabling developers, testers, and administrators to collaborate.



10) Mobile (smartphone) app testing is easy

- (1) User directly execute the scenario on smartphone App, Automatically burn scripts from PerfOne.
- (2) generate a load by creating mobile virtual user from the Test Agent, on the recorded script.
- (3) Monitor test results and analyze results.
- (4) Applies to both iphone and android phones.

## Spec

1) **Generate performance test scripts**

- (1) Generate script by automatically record your scenarios
- (2) Generate scripts for performance load testing using mobile apps
- (3) Generate script using captured packet file (PCAP)
- (4) Automatically substitute the change data (ID, password, etc.) of script
- (5) Insert user Think time
- (6) verify after script replay
- (7) Compare Script
- (8) Correlation
- (9) remotely save the script
- (10) Direct testing with database queries
- (11) Error code processing
- (12) Define TCP professional format and process result (error)
- (13) support Web(HTTP, HTTPS), TCP/IP, .NET, SOAP, WSDL, ODBC protocol

2) **Performance test load generation**

- (1) Virtual user generation able to simulate the use of concurrent users on Internet services (Web, TCP / IP based)
- (2) Create virtual user from created script
- (3) More than 500 virtual users per PC
- (4) Regardless of the number of virtual users, install the limitedly created load agents to PC, Server and create the load.
- (5) Drives multiple load generation agents to one PC or server
- (6) Support various OS (Windows, Linux, Unix ,,, etc)
- (7) Support (SMP:symmetric Multi Processing)

3) **Performance test control function, multi-core**

- (1) Rendezvous generating a load after waiting for a certain number of users in a specific process stage
- (2) Ramp-Up, Ramp-Down function
- (3) Customizing for a specific protocol or environment

- (4) SLA setting (Goal-Oriented test) function
- (5) Accurate server response time, TPS measurement capability
- (6) Test progress monitoring function
- (7) Server monitoring function
- (8) Performance monitoring function for section  
(Performance response time monitoring for section as to web server, AP server, DB server, etc.)
- (9) Network delay monitoring function
- (10) Selection function of monitoring graph

#### **4) Analysis of Performance test result**

- (1) Provide Excel data for Performance result graph
- (2) Provide MS Word Report
- (3) Change report format modification by user-defined  
(customized report generation function)
- (4) Provides summary information of test result
- (5) Provides virtual users, transactions, errors, Web server resources, Web page decomposition, server monitoring, interval monitoring, and combined graphs
- (6) Analysis function by agent / region

# 26

## a group of SMART Phone training system

52. Android4.3JB



# model: **Android4.3JB**

## Android training system & courseware

### Overview

Android-4.3JB is Android/ Embedded training platform with i.MX 6 Quadcore Processor manufactured by Freescale. Freescale i.MX6Q as the Cortex-A9 architecture-based quad-core processors up to 1.2GHz clock, is the high-performance Application Processor which optimized for Industrial applications as well as Embedded systems and automotive plant.

### Features

- 1) 4x ARMv7 Cortex-A9 up to 1.2 GHz per core
- 2) Vivante GC2000 GPU / OpenVG 1.1
- 3) OpenGL ES 2.0 & Hapti, CL EP
- 4) Displays : 2 x 4XGA (2048x1536) or 2 x [1080p + WXGA (1280x720)]
- 5) Memory Support: 2x32 LP-DDR2, 1x64 DDR3 / LV-DDR3
- 6) Video Codec: 1080p 60 h.264(Decode), 1080p 30 h.264 BP/ Dual 720p(Encode) USB 2.0, SATA2, MIPI support, Gigabit Ethernet, PCIe 2.0(1 lane), FlexCAN, HDMI1.4
- 7) Mounted Android operating system 4.3 (Jelly Bean)
- 8) Provide USB2.0 HOST and SATA2 interface.
- 9) By connecting various USB Devices to 3ea of USB2.0 port, its function can be extended and through SATA2 interface and connection of SSD & HDD, this system can be used for mass storage device.
- 10) MIPI / Parallel Camera@ Interface support.
- 11) eMMC 4.4 / SPI-NOR / T-Flash mounted.
- 12) Wi-Fi/ Bluetooth / GPS Ethernet support.
- 13) PCI-Express 2.0 support.
- 14) FlexCAN port support.
- 15) Provides LTE Modem, sensor Module(Accelerator, Compass, Ambient Light, GPS function).
- 16) by FPGA module, I / O expansion and digital design available.

### Components

1) Hardware platform	1 ea	
2) FPGA module	1 ea	mounted
3) sensor Module	1 ea	separate module (detachable)
4) Textbook Book-1, Android Design and Application Book-2, Linux Design and Application (there is a textbook for Application practice, this book is option and separately provided)	2 book	
5) Program CD	1 ea	

## Training contents

### Book-1, Android Design and Application

1. Embedded System overview
  - 1.1. Embedded Sytem
  - 1.2. History of Embedded system
  - 1.3. The development trend of embedded systems
  - 1.4. Embedded software standardization
  - 1.5. Hardware of the embedded system
  - 1.6. Embedded Software
2. Build a development environment
  - 2.1. Virtual Machine software installation
  - 2.2. Linux Installation
3. Linux host utilization
  - 3.1. Linux command
  - 3.2. Learning the vi editor
4. Build host system development environment
  - 4.1. Download of system development environment package
  - 4.2. Network-based development tools
  - 4.3. Installation of development tool using USB
  - 4.4. Build the Kernel and build options related tools
  - 4.5. Tools for communication between embedded devices and hosts
5. Android Overview
  - 5.1. Overview of mobile operating systems
  - 5.2. What is Android ?
6. Build Android development environment
  - 6.1. Install the Android development environment
  - 6.2. Installation of Development Tools
  - 6.3. Android Application Development Method
7. bootloader
  - 7.1. Bootloader
  - 7.2. bootloader compile
  - 7.3. bootloader record
  - 7.4. u-boot command
8. kernel
  - 8.1. The role of general Linux kernel and Android Linux kernel
  - 8.2. Kernel compile
9. Android file system
  - 9.2. Android Kernel Features
  - 9.3. Zygote
  - 9.4. After completing, the boot status of each process
  - 9.5. Android application(Apps)
  - 9.6. Making Android file system
10. Java Native Interface
  - 10.1. JNI structure
  - 10.2. NDK installation
  - 10.3. Device drive overview
11. External I/O Device JNI
  - 11.1. FPGA LED
  - 11.2. FPGA FND
  - 11.3. Dot Matrix
  - 11.4. Text LCD control
  - 11.5. DIP Switch
  - 11.6. Push Switch
  - 11.7. Buzzer
  - 11.8. Step motor

### Book-2, Linux Design and Application (Option)

- 1.1. Embedded Sytem
- 1.2. History of Embedded system
- 1.3. The development trend of embedded systems
- 1.4. Embedded software standardization
- 1.5. Hardware of the embedded system
- 1.6. Embedded Software
2. Android4.3JB OverView
  - 2.1. IMX6 Quad Processor
  - 2.2. MX6Q
3. Linux installation
  - 3.1. Virtual Machine software installation
  - 3.2. Linux installation
4. Linux host utilization
  - 4.1. Linux command
  - 4.2. Learning the vi editor
5. Build Embedded system development environment
  - 5.1. Download development environment system package
  - 5.2. Network-based development tools
  - 5.3. Installation of development tool using USB
  - 5.4. Build the Kernel and build options related tools
  - 5.5. Tools for communication between embedded devices and hosts
6. Bootloader
  - 6.1. Bootloader
  - 6.2. bootloader compile
  - 6.3. bootloader record
  - 6.4. u-boot command
7. Kernel
  - 7.1. The role of general kernel
  - 7.2. Kernel compile
8. Root File System
  - 8.1. Root File system
  - 8.2. Configuring the Root File System
- 8.3. Minimum File System
- 8.4. File System Fusing
9. Module Programming
  - 9.1. Kernel Module
10. Device driver
  - 10.1. Linux device driver
  - 10.2. Classification of Device Driver
11. Bluetooth device
  - 11.1. Bluetooth overview
    - 11.1.1. Bluetooth communication method
    - 11.1.2. Bluetooth spec
    - 11.1.3. Bluetooth Profile
  - 11.2. Bluetooth On Linux
    - 11.2.1. BlueZ
    - 11.2.2. Bluez-util
12. WiFi device
  - 12.1. WiFi overview
    - 12.1.1. MAC Address / IP Address / Port
  - 12.2. WiFi on Linux
  - 12.3. WiFi utils
13. FPGA device
  - 13.1. External FPGA Device Driver
  - 13.2. External LED
  - 13.3. FND
  - 13.4. Dot Matri
  - 13.5. Text LCD control
  - 13.6. DIP Switch
  - 13.7. Push Switch
  - 13.8. Buzzer
  - 13.9. Step motor
14. Device Application
  - 14.1. Frame Buffer
  - 14.2. Serial Communication Programming

## System configuration



## Specification

### 1) Hardware spec

#### (1) Base board

Board to board connector	0.5mm Pitch, 314 Contacts MXM3.0 Standard
LCD	7" WSVGA LCD 1024*600 (TFT LCD)
Touch Screen	10-Point Capacitive Multi-Touch Screen Panel
USB	Microchip USB 2514, hi-Speed USB Hub Controller 3*USB HOST Connector USB ITG Connector
Speaker / MIC	1W Speaker/Microphone With Amplifier
HDMI	1080p, HDMI v1.4 CEC Interface
SATA	SATA2, SATA 1.5 Gb/s SATA 3.0 Gb/s Speed With Power Port
Ethernet	Gigabit Ethernet (10/100/1000Mbps Support)
Mini PCI Express	PCI Express 2.0 Support with USB2.0 Host USIM Connector
Sensor/GPS Module	Accelerator Compass Ambient Light Sensor GPS Module
Parallel Camera	2MPixel Parallel Camera with Strobe LED
MLB Port	MLB (Media Lab Bus) Support The Standardized on-PCB, Inter-Chip Communication Bus for MOST/Æ Based Devices
CAN	2*FlexCAN v2.0B
2 UART	9pin d-SUB(Debug) EXT UART
Keys	Power/Reset, Android Key (Home, Back, PROG, Volume)
Power	AC Adapter 12V/3A

#### (2) CPU board

CPU	Freescale I.MX6Q Quadcore Cortex-A9 1.2GHz
Memory	DDR3 64bit 2GB 533MHz
PMIC	Freescale MMPF0100( 6 Buck, 6 LDO)
Storage	4GB eMMC, 4MB SPI-NOR Flash, T-FLASH
ETC	3.3V Power IN, UART Connector, RESET S/W

(3) FPGA module ( Xilinx Spartan6 FPGA )

TEXT-LCD (16X2 Character)	LED 8EA
DOT-MATRIX 7 * 5 : 2EA	FND 4 DIGIT
PIEZO BUZZER	DIP 8EA,
PUSH Button S/W 4EA	STEPPING MOTOR
PUSH Button S/W 9EA	Oscillator 2EA (33MHz, 12MHz)
Reset Push Button	FPGA JTAG(Xilinx Platform Cable)

2) Software spec

OS	Linux Kernel 3.0.35 Android Jelly Bean 4.3 Embedded Linux by Buildroot
Compiler	GNU Compiler Collection for ARM
Boot loader	U-boot 1.1.5
Device Driver	7" WSVGA LCD 1024 * 600 (TFT LCD) Device Driver 10-POINT Multi Touch Screen Panel Device Driver eMMC 16Gbyte eMMC (eMMC4.4 support) Device Driver 2 million pixel, ĄCSI Interface, Auto Focus Camera Device Driver Power, Reset, Volume Up/Dn Device Driver Audio Cirrus Logic CS42888 Codec chipset Device Driver T-Flash Connector Device Driver USB Host2.0, USB OTG 2.0 Device Driver SATA 3.0(SATA 6.0 Gb/s) Device Driver Wi-Fi : IEEE802.11a/b/g/n 54Mbps data rate SDIO2.0 Device Driver

# 27

## a group of SMART Building control system

53. Smart building-GT7000

# model: **Smart Building-GT7000**

## **Smart Building Control Training system**

### **Overview**

Smart Building-GT7000 is a practical & very excellent system to learn BAS, IBS, BMS, BEMS which is building control and management system.

- 1) Measures indoor environment and energy use status
- 2) The collected data are used to identify the inefficient operating facilities through analysis of facility operation and analysis of energy consumption.
- 3) Provides a pleasant environment through optimal facility control,
- 4) This is a smart building control system that maximizes energy saving.

### **Features**

- 1) Each control system is composed by module.  
And, it is configured to be capable of individual Module control and interlocking control between modules.
  - (1) Air conditioning control system  
: Understand, program & design the air conditioning control system by controlling equipment such as fan, damper, and heating / heating valve.
  - (2) Geothermal Control System  
: understand, program development & design the New & Renewable Energy System of Heating & Cooling by controlling equipment such as geothermal circulation pump and heat pump
  - (3) Heating / cooling control system  
: understand, program development & design the cooling and heating control system through control of equipment such as water heater, cooling tower, and pump
  - (4) Lighting control system  
: program development / design on efficient lighting control to check & control the ON / OFF status of each lighting
  - (5) Fire control system  
: by detector & transmitting device, Check whether there is fire or not. After then, program & design according to the fire status.
  - (6) Power control system  
: program & design for efficient energy use and control of electric power using digital power meter
  - (7) Security system  
: Program development / design for understanding and efficient control of security system using access detection and surveillance equipment
  - (8) Solar power system  
: Program development / design for efficient use of renewable energy such as solar cell module, power control device

- 2) System configuration applied to real intelligent building system (IBS)
- 3) Remote monitoring and control function using Ethernet TCP / IP, BACnet, MODBUS on JAVA Platform based PC
- 4) Real time equipment operation status display function
- 5) Program design, development, implementation by device control scenario for each modules.
- 6) Design and Implementation of Control System Applying Energy Saving Control Algorithm
- 7) It is composed of the same equipment and control sequence as the integrated control system used for the real intelligent building automatic control, and it is effective to understand and learn the building automatic control
- 8) It is possible to produce a program suitable for the situation by setting different control environment, and it is effective to raise the ability for the program.

## System configuration



Size : width x height (1010 x 1560 mm)

## Components

1) Hardware platform	1 set
2) Software program CD	1 ea
3) Manual book	1 book

## Training contents

- Chap 1, Understand Building Energy Management Systems
- 1) overview of Building Energy Management Systems
  - 2) Technology & Market Trends
  - 3) Purpose of Building Energy Management System
  - 4) Needs of Building Energy Management System
  - 5) Configuration of Building Energy Management System
  - 6) Construction example of Building energy management system
  - 7) Construction process of Building energy management system
- Chap 2, Building Energy Management System Structure
- 1) Building energy management system communication method and characteristic
  - 2) Building energy management system control equipment
  - 3) System structure and principle

Chap 3, Digital control circuit structure

- 1) Organizing and understanding of the design drawings
- 2) I/O List (Point List)
- 3) Configuration and understanding of the control circuit

Chap 4, Basic utilization of NiagaraAX

- 1) NiagaraAX install
- 2) Configuration of NiagaraAX
- 3) Creation of Station
- 4) HMI
- 5) Logic Programming
- 6) Examples

Chap 5, Establish basic system environment

- 1) JACE initialization
- 2) JACE Station creation
- 3) Platform time synchronization
- 4) System communication connection

Chap 6, HMI for air conditioning control system

- 1) Creation of Host PC Station
- 2) Basic usage for HMI
- 3) HMI configuration of air conditioning control system

Chap 7, Programming of Air conditioning control system

- 1) Prepare for the practice
- 2) Programming of Air conditioning control system

Chap 8, Construction of Air conditioning control system

- 1) Prepare for the practice
- 2) DDC Point connection
- 3) Niagara Network Point registration
- 4) Control button creation of Host Station HMI
- 5) Connection of Host Station HMI status Point
- 6) Operation of Air conditioning control system

Chap 9, Hardware operation practice

- 1) System start
- 2) Station setting
- 3) Operation practice of Air conditioning control system
- 4) Operation practice of Geothermal Control System
- 5) Operation practice of Heating / cooling control system
- 6) Operation practice of Security system
- 7) Operation practice of Lighting control
- 8) Operation practice of Fire control
- 9) Operation practice of Solar energy generation system
- 10) Operation practice of Electric Power control system

## Spec

### 1) Configuration of Air conditioning control system

It is aimed to control the temperature and airflow distribution suitable for humans to operate in a certain space, and at the same time to remove foreign substances in the air to maintain a comfortable space.

Heat exchange cycle and Cooling & heating system  
(Air Handling Unit: AHU, air conditioner).

- (1) Communication : Ethernet, Modbus
- (2) I/O Port : AI-6, AO-4, BI-2, BO-3
- (3) Display SIZE : 710(W) X 350(H)
- (4) Control Device : EasyIO-30p





**Equipment control**

- Feed / ventilation fan
- External / ventilation, mixing damper
- Heater to prevent frostbite
- Air / heating valve
- Humidification valve

**Input the control parameters**

- External temperature / humidity
- ventilation temperature / humidity
- Air supply temperature
- mixed temperature
- Smoke detector alarm
- Filter differential pressure alarm

**checking the Equipment status**

- Feed / ventilation fan
- External / ventilation, mixing damper
- Heater to prevent frostbite
- Air / heating valve
- Humidification valve
- Smoke detector alarm
- Filter differential pressure alarm
- External temperature / humidity
- ventilation temperature / humidity
- Air supply temperature
- mixed temperature

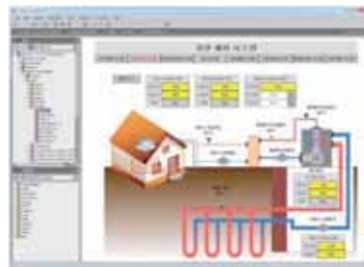
**2) Configuration of Geothermal control system**

Geothermal energy is a technology used for cooling and heating by using temperature difference between water, ground water and underground heat.

Approximately 47% of the solar heat is stored in the ground through the surface, and the temperature of the earth's surface that absorbs this heat is different depending on the terrain.

However, the temperature near the surface of the ground is maintained at about 10 °... ~ 20 °..., and it is used for heating and cooling system using heat pump.

- (1) Communication : Ethernet, Modbus
- (2) I/O Port : AI-3, AO-1, BO-4
- (3) Display SIZE : 350(W) X 300(H)
- (4) Control Device : EasyIO-30p #3

**(5) Monitoring point for Geothermal control system****Equipment control**

- Geothermal circulation pump
- Heat pump
- Heat exchange circulation pump
- Hot and cold water circulation pump
- Heat exchange valve

**Input the control parameters**

- Geothermal water temperature
- Heat exchange supply temperature
- Hot and cold water supply temperature

**checking the Equipment status**

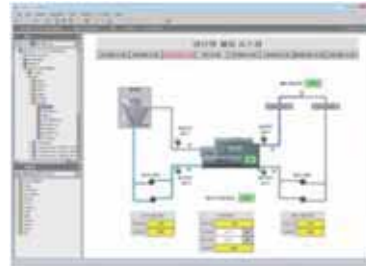
- Geothermal water circulation pump
- Geothermal water temperature
- Heat pump
- Heat exchange supply temperature
- Heat exchange circulation pump
- Hot and cold water circulation pump
- Hot and cold water supply temperature

### 3) Configuration of Heating / cooling control system

The heating and cooling control system is a system for supplying & controlling thermal energy to the heating & cooling apparatus.

And this system uses thermal energy in heating and cooling valves and other buildings.

- (1) Communication : Ethernet, Modbus
- (2) I/O Port : AI-4, BI-3, BO-3
- (3) Display SIZE : 350(W) X 300(H)
- (4) Control Device : EasyIO-30p #1 & #2



- (5) Monitoring point for Heating / cooling control system

#### Equipment control

- Cold water and hot water making machine
- Cooling tower
- Coolant pump
- Hot and cold water pump

#### checking the Equipment status

- Cold water and hot water making machine
- Alarm for cold / hot water heater
- Cooling tower
- Coolant pump
- Hot and cold water pump
- Alarm for Head Differential pressure
- Hot and cold water supply temperature
- Hot and cold water return temperature
- Cooling water supply temperature
- Cooling water return temperature

#### Input the control parameters

- Hot and cold water supply temperature
- Hot and cold water return temperature
- Cooling water supply temperature
- Cooling water return temperature
- Condition of the water heater
- Alarm for cold / hot water heater
- Hot and cold water pump status
- Cooling water pump status
- Alarm for Head Differential pressure

### 4) Configuration of Lighting control system

The illumination control system is intended to turn on / off the lights with a system for controlling the various lights that is equipped to the building.

Because there are a lot of lights in the building, it supports to monitor and control ON / OFF state of lighting in Host PC's HMI.

In addition to direct control by the user, the lighting is automatically turned on when a person is detected by the sensor.

If it is not detected, it can be programmed to be OFF.

It is also possible to control the emotional lighting to change the lighting atmosphere of the room according to the irradiation amount.

- 1) Communication : Ethernet, Modbus
- (2) I/O Port : BI-8, BO-7
- (3) Display SIZE : 350(W) X 300(H)
- (4) Control Device : EasyIO-30p #2



(5) Monitoring point of Lighting control system

Equipment control

- Room 1 lighting
- Room 2 lighting
- Living room lighting
- Toilet lighting
- Emotional lighting

Input the control parameters

- Room 1 light switch
- Room 2 light switch
- Living room light switch
- Toilet light switch
- Room 1 switch
- Room 2 switch

checking the Equipment status

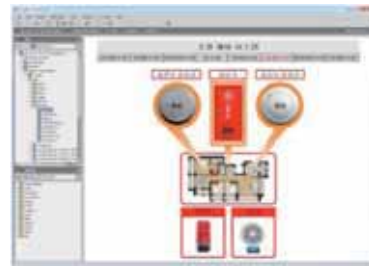
- Room 1 lighting
- Room 2 lighting
- Living room lighting
- Toilet lighting
- Emotional lighting
- Room 1 Human Detection
- Room 2 Human Detection
- Detect human in living room
- Detect human in toilet

**5) Configuration of Fire control system**

It aims to protect the lives, bodies and property of residents in buildings in the event of fire (prevention, boundary, suppression) and disaster and other emergency situations.

Therefore, it is necessary to notify the user of the fire detection status, and to prevent the second fire through the interlocking with other systems.

- (1) Communication : Ethernet, Modbus
- (2) I/O Port : BI-3, BO-2
- (3) Display SIZE : 200(W) X 300(H)
- (4) Control Device : EasyIO-30p #3



(5) Monitoring point of fire control system

Equipment control

- Warning light
- Siren
- Interlocking control with air conditioner
- Interlocking control with Lighting
- Interlocking control with Cooling, heating

Input the control parameters

- Photoelectric detector
- Differential temperature fire detector
- Transmitter

checking the Equipment status

- Photoelectric detector
- Differential temperature fire detector
- Transmitter
- Warning light
- Siren

## 6) Configuration of Electric Power control system

For power supplied from the outside, the power factor, the reactive power, the current, and the line voltage are identified through the power equipment, and the HMI of the host PC monitors it by connecting it through communication.

Based on the monitored values, the power management report is produced, the monthly power consumption is determined, and the role of the power supply line is checked to see if there is any abnormality in the specific power line.

- (1) Communication : Modbus
- (2) Baud Rate : 9600bps
- (3) Display SIZE : 200(W) X 300(H)
- (4) Control Device : ODT-203



### (5) Monitoring point of Electric Power control system

- Equipment control
- Air conditioning control system
  - Geothermal Control System
  - Heating / cooling control system
  - Lighting control system

- checking the Equipment status
- Voltage
  - Current
  - Line voltage
  - Instant power
  - Frequency
  - Power factor
  - Active power
  - Reactive power

## 7) Configuration of Security system

It is a system that protects and prevents property of building from danger such as thieves, robber, destroyer, intruder and accidental disaster inevitably in building.

The purpose of this system is to establish a crime prevention system and to reduce labor costs for administrative work.

- (1) Communication : Ethernet, Modbus
- (2) I/O Port : AI-1, BI-1
- (3) Display SIZE : 200(W) X 300(H)
- (4) CCTV IP : 192.168.0.50
- (5) Control Device : EasyIO-30p #3



### (6) Monitoring point of Security control system

- Equipment control
- CCTV
  - Siren
  - Interlocking control with Lighting

- checking the Equipment status
- CCTV
  - Magnetic sensor
  - Infrared sensor

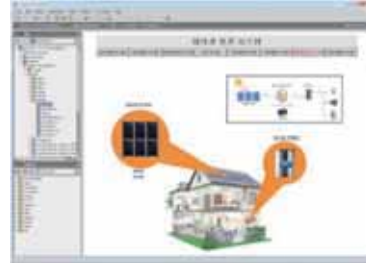
- Input the control parameters
- Magnetic sensor
  - Infrared sensor

### 8) Configuration of Solar energy generation system

Photovoltaic power generation is a power generation technology that generates electricity by converting light energy. It uses photovoltaic power to generate photovoltaic power when light is irradiated on a contact surface of a metal and a semiconductor or a PN junction of a semiconductor.

Solar power generation system consists of module composed of solar cell, battery, power control device and inverter.

- (1) Communication : Ethernet, Modbus
- (2) I/O Port : AI-1, BI-1
- (3) Display SIZE : 350(W) X 300(H)
- (4) Control Device : EasyIO-30p #3



- (5) Monitoring point of Solar energy generation system

#### Equipment control

- Air conditioning control system
- Geothermal Control System
- Heating / cooling control system
- Light control system

#### checking the Equipment status & Input the control parameters

- generation of electricity
- Inverter status

### 9) Other specs

#### NiagaraAX Web-Supervisor

- Windows XP and 7, 8, 10
- JVM Engine
- at least 1Gb RAM
- at least 300MB HDD
- Fox Protocol via LAN with JACE



#### JACE-200

- owerPC 405EP 250 MHz processor
- 64MB SDRAM & 64 MB Serial Flash
- IBM J9 JVM Java Virtual Machine
- 2 Ethernet Ports - 10/100 Mbps (RJ-45 Connectors)
- 1 RS 232 Port (9 pin D-shell connector)
- 1 RS 485 non isolated port (3 Screw Connector on base board)
- NPB-PWR - Optional: 24 Volt AC/DC power supply module



#### EasyIO-30P

- 24VAC, 3.6VA max, 20~34VDC
- EIA-485 (BUS A,B) Two-wire
- Baud Rate Speed: (9.6K, 19.2k, 38.4K, 76.8K bit/s)
- Data Bit: (8 bits)
- Application Support: BACnet IP, BACnet Ethernet
- Universal Input : 8 Channels
- Digital Input : 8 Channels
- Digital Output : 8 Channels
- Analog Output : 4 Channels(12 bits resolution)



Smart Building Control Training system (model : Smart Building-GT7000)

Software	NiagaraAX 3.8
Main controller	JACE-200
System module	Air conditioning control system / Geothermal control system / Heating / cooling control system / Lighting control system / Fire control system / Power control system / Security system / Solar power energy generation system
DDC	EasyIO-30P
Indicator	WES-IDC10
Power monitoring unit	Digital Power Meter ( ODT-203)
CCTV	QCAM-3000
Supported protocol	BACnet MS/TP, Modbus, Fox, Sox
option	SQL Driver & reporting S/W (Report Automaker)

# 28

## a group of MOBILE GAME training system

54. MGT-1000

55. MGT-3000

# model: **MGT-1000**

## Mobile Game Trainer

### Feature

This trainer enables user to learn about J2ME Programming, how to develop J2ME Mobile Games and J2ME Network Server/Client. Also the user can learn the porting and testing to J2ME Mobile games by connecting to real Cellular Mobile (GSM type).

### Functions

- 1) A student can learn how to develop mobile games based on J2ME(Java2 Mobile Edition) Platform. since this toolkit provide j2me tutorial, example code and Mobile Phone Emulator software .
- 2) A student can get advanced skill for developing mobile games with example code and Mobile Game Toolkit Server.
- 3) A student can get advanced skill for porting and testing mobile games to real cellular phone with example code and Mobile Game Toolkit Server.
- 4) Mobile Game Toolkit Server can be used Network Game Server when student develop mobile network game with using mobile phone Emulator

### Components

MGT Toolkit Server H/W	1 EA	Data cable	1 EA
Galaxy Note	1 EA	Textbook	1book
Power cable	1 EA	Example programming CD	1 EA

### System configuration

(Hardware can be changed to another type)



1) Mobile Game Toolkit Server H/W



2) Software screen shoot



3) Manual Book

### Specification

#### 1) Hardware spec

(1) Phone	Galaxy Note
(2) CPU	INTEL Core Processor, or over
(3) Memory	1GB, or over
(4) HDD	SATA II 80GB, or over
(5) VGA	Integrated on the system board
(6) Display	12.1" LCD Screen Panel



**2) Software Specification (CD-ROM)**

(1) J2ME SDK
(2) J2ME API sample source code
(3) WAP Server Source code
(4) Mobile Game sample source code

## Training contents

**Chap 1. J2ME Introduction**

1. J2ME Platform
2. Hardware Setup
3. Software Setup

**Part2. J2ME API****Chap 2. J2ME MIDP Programming : SCREEN**

1. Text Box
  - 1.1 Text Box Theory
  - 1.2 Text Box Practice
2. List
  - 2.1 List Theory
  - 2.2 List Practice
3. Alert
  - 3.1 Alert Theory
  - 3.2 Alert Practice
4. Form
  - 4.1 From Theory
  - 4.1 From Practice

**Chap 3. J2ME MIDP Programming : ITEM**

1. Choice Group
  - 1.1 Choice Group Theory
  - 1.2 Choice Group Practice
2. DateField
  - 2.1 DateField Theory
  - 2.2 DateField Practice
3. Gauge
  - 3.1 Gauge Theory
  - 3.2 Gauge Practice
4. TextField
  - 4.1 TextField Theory
  - 4.2 TextField Practice

**Chap 4. J2ME MIDP Programming : EVENT**

1. Item State Event
  - 1.1 Item State Event Theory
  - 1.2 Item State Event Practice
2. Canvas Event
  - 2.1. Canvas Event Theory
  - 2.2. Canvas Event Practice

**Chap 5. J2ME MIDP Programming : GRAPHICS**

1. Graphics Class
  - 1.1 Graphics Theory
  - 1.2 Graphics Practice
2. Image Class
  - 2.1 Image Theory
  - 2.2 Image Practice
3. Font Class
  - 3.1 Font Theory
  - 3.2 Font Practice

**Chap 6. J2ME MIDP Programming : Thread / Timer**

1. Thread
  - 1.1 Thread Theory
  - 1.2 Thread Practice
2. Timer
  - 2.1. Timer Theory
  - 2.2. Timer Practice

**Chap 7. J2ME MIDP Programming : RMS**

1. RMS
  - 1.1 RMS Theory
  - 1.2 RMS Practice
2. RMS Deepening: Array and Filtering
  - 2.1 Array and Filtering
  - 2.2 RMS Practice (2)
  - 2.3 RMS Practice (3)
3. Filtering of E-mail Directory
  - 3.1 Design of Directory
  - 3.2 Drawing up of Directory

**Chap 8. J2ME MIDP Programming : NETWORK**

1. HttpURLConnection
  - 1.1 HttpURLConnection Theory
  - 1.2 HttpURLConnection Practice
2. Socket
  - 2.1 Socket Theory
  - 2.2 Socket Practice

**Chap 9. J2ME MIDP Game Programming**

1. PushPuzzle
  - 1.1 Outline of PushPuzzle
  - 1.2 Implementation of PushPuzzle
  - 1.3 Addition of function of PushPuzzle
  - 1.4 Implementation of PushPuzzle

**Chap 10. J2ME MIDP Programming : Graphic API**

1. GameCanvas and Graphic API
  - 1.1 Theory of GameCanvas
  - 1.2 Implementation of GameCanvas
2. PushPuzzle that uses Graphic API
  - 2.1 Design of PushPuzzle that uses Graphic API
  - 2.2 Implementation of PushPuzzle that uses Graphic API

**Chap 11. J2ME MIDP Programming : Audio API**

1. Audio API
  - 1.1 Audio API Theory
  - 1.2 Audio API Practice
2. PushPuzzle that uses Audio API
  - 2.1 Design of PushPuzzle that uses Audio API
  - 2.2 Implementation of PushPuzzle that uses Audio API

**Chap 12. J2ME MIDP Programming : Porting**

1. Porting
  - 1.1 Installation of Download Program
  - 1.2 Setting of Environment and Creation of File
  - 1.3 Download and Execution
  - 1.4 How to Operate Game

**Appendix. Game practice - HoneyBee**

1. HoneyBee
  - 1.1 Programming Tip
  - 1.2 Game Structure and Explanation for the methods
  - 1.3 Program run

model: **MGT-3000**

## Mobile Game Trainer

### Feature

This trainer enables user to learn about J2ME Programming, how to develop J2ME Mobile Games and J2ME Network Server/Client. Also the user can learn the porting and testing to J2ME Mobile games by connecting to real Cellular Mobile (GSM type).

### Functions

- 1) A student can learn how to develop mobile games based on J2ME(Java2 Mobile Edition) Platform. since this toolkit provide j2me tutorial, example code and Mobile Phone Emulator software .
- 2) A student can get advanced skill for developing mobile games with example code and Mobile Game Toolkit Server.
- 3) A student can get advanced skill for porting and testing mobile games to real cellular phone with example code and Mobile Game Toolkit Server.
- 4) Mobile Game Toolkit Server can be used Network Game Server when student develop mobile network game with using mobile phone Emulator

### Components

MGT Toolkit Server H/W	1 EA	Data cable	1 EA
Galaxy Note	1 EA	Textbook	1book
Power cable	1 EA	Example programming CD	1 EA

### System configuration

(Hardware can be changed to another type)



1) Mobile Game Toolkit Server H/W



2) Software screen shoot



3) Manual Book

### Specification

#### 1) Hardware spec

(1) Platform	SUN Java 2 Micro Edition
(2) Phone	Galaxy Note
(3) Network Interface	TCP/IP, USB cable, Data cable
(4) CPU	INTEL Dual-Core Processor or over
(5) L2 Cache	1MB, or over
(6) Memory	1GB, or over
(7) HDD	SATA II 80GB, or over
(8) Network	LAN Embedded 100M Gigabit
(9) VGA	Integrated on the system board
(10) Port	USB 4port, Mouse 1port, Keyboard 1port.
(11) Display	15" LCD Touch Screen Panel

**2) Software spec**

(1) J2ME SDK with Mobile phone
(2) J2ME API sample source code
(3) WAP Server source code
(4) Mobile Game sample source code
(5) Mobile Game Server Application & source code

## Training contents

**Chap 1. Java Introduction****Chap 2. Java Programming ( )****Chap 3. Java Programming ( )****Chap 4. J2ME Introduction**

1. J2ME Platform
2. Hardware Setup
3. Software Setup

**Chap 5. J2ME MIDP Programming : SCREEN**

1. Text Box
  - 1.1 Text Box Theory
  - 1.2 Text Box Practice
2. List
  - 2.1 List Theory
  - 2.2 List Practice
3. Alert
  - 3.1 Alert Theory
  - 3.2 Alert Practice
4. Form
  - 4.1 Form Theory
  - 4.1 Form Practice

**Chap 6. J2ME MIDP Programming : ITEM**

1. Choice Group
  - 1.1 Choice Group Theory
  - 1.2 Choice Group Practice
2. DateField
  - 2.1 DateField Theory
  - 2.2 DateField Practice
3. Gauge
  - 3.1 Gauge Theory
  - 3.2 Gauge Practice
4. TextField
  - 4.1 TextField Theory
  - 4.2 TextField Practice

**Chap 7. J2ME MIDP Programming : EVENT**

1. Item State Event
  - 1.1 Item State Event Theory
  - 1.2 Item State Event Practice
2. Canvas Event
  - 2.1. Canvas Event Theory
  - 2.2. Canvas Event Practice

**Chap 8. J2ME MIDP Programming : GRAPHICS**

1. Graphics Class
  - 1.1 Graphics Theory
  - 1.2 Graphics Practice
2. Image Class
  - 2.1 Image Theory
  - 2.2 Image Practice
3. Font Class
  - 3.1 Font Theory
  - 3.2 Font Practice

**Chap 9. J2ME MIDP Programming : Thread / Timer**

1. Thread
  - 1.1 Thread Theory
  - 1.2 Thread Practice

## 2. Timer

- 2.1. Timer Theory
- 2.2. Timer Practice

**Chap 10. J2ME MIDP Programming : RMS**

1. RMS
  - 1.1 RMS Theory
  - 1.2 RMS Practice
2. RMS Deepening: Array and Filtering
  - 2.1 Array and Filtering
  - 2.2 RMS Practice (2)
  - 2.3 RMS Practice (3)
3. Filtering of E-mail Directory
  - 3.1 Design of Directory
  - 3.2 Drawing up of Directory

**Chap 11. J2ME MIDP Programming : NETWORK**

1. HttpURLConnection
  - 1.1 HttpURLConnection Theory
  - 1.2 HttpURLConnection Practice
2. Socket
  - 2.1 Socket Theory
  - 2.2 Socket Practice

**Chap 12. J2ME MIDP Game Programming**

1. PushPuzzle
  - 1.1 Outline of PushPuzzle
  - 1.2 Implementation of PushPuzzle
  - 1.3 Addition of function of PushPuzzle
  - 1.4 Implementation of PushPuzzle

**Chap 13. J2ME MIDP Programming : Graphic API**

1. GameCanvas and Graphic API
  - 1.1 Theory of GameCanvas
  - 1.2 Implementation of GameCanvas
2. PushPuzzle that uses Graphic API
  - 2.1 Design of PushPuzzle that uses Graphic API
  - 2.2 Implementation of PushPuzzle that uses Graphic API

**Chap 14. J2ME MIDP Programming : Audio API**

1. Audio API
  - 1.1 Audio API Theory
  - 1.2 Audio API Practice
2. PushPuzzle that uses Audio API
  - 2.1 Design of PushPuzzle that uses Audio API
  - 2.2 Implementation of PushPuzzle that uses Audio API

**Chap 15. J2ME MIDP Programming : Porting**

1. Porting
  - 1.1 Installation of Download Program
  - 1.2 Setting of Environment and Creation of File
  - 1.3 Download and Execution
  - 1.4 How to Operate Game

**Appendix. Game practice - HoneyBee**

1. HoneyBee
  - 1.1 Programming Tip
  - 1.2 Game Structure and Explanation for the methods
  - 1.3 Program run

# 29

## a group of FPGA & SoC training equipment

- 56. CPLD-1000
- 57. FPGA-1000
- 58. FPGA-GTC2500
- 59. FPGA Design-4000
- 60. FPGA/SoC -5000
- 61. SoC Design-7000

# model: **CPLD-1000**

## **CPLD Training Kit**

### Feature

CPLD-1000 which uses CPLD of EPM7128SLC84 has one clock source at 20MHz and one extension clock slot. CPLD-1000 divides the 20MHz clock into 20MHz, 10MHz, 2MHz, 200KHz, 10KHz and 2KHz with DIP\_sw to selectively use them.

User can insert any clock oscillator which they want in the extension clock slot.

One set of LEDs (8) to represent 8 bits, one set of DIP switches and 4ea of 7-segments are used to display the state and CPLD output.

One text LCD of 16 columns × 2 lines can be used as a display device.

A circuit is provided to drive the STEP motor for practicing motor control, to generate STEP pulse to operate the STEP motor in CPLD.

Also, it is designed to enable feedback control by constituting a circuit for driving the DC motor and a block for receiving and processing input from the encoder of the DC motor in CPLD.

User can download programs in Jtag by connecting ByteblaterMV in the Kit to the parallel port of user PC.

### Functions

- (1) understand to Altera MAX 7000s EPM7128LC84 device
- (2) understand to 20MHz Main Clock Oscillator
- (3) the user intended Clock Oscillator Plug-in practice to 1ea of expansion Clock slot
- (4) practice of 16X2 character LCD
- (5) practice of 4-digit FND
- (6) practice of 8 LEDs
- (7) practice of 8 pole-DIP Switch
- (8) practice of STEP Motor
- (9) practice of DC Motor
- (10) practice of SERVO Motor
- (11) practice of 3 set IR Sensor
- (12) practice of 1 dedicated reset key

### Components

Items	q'ty
MAX7000S EPM7128SLC84 Board	1 EA
Parallel cable	1 EA
DC Power adaptor (12V 1.5A)	1 EA
Manual book	1 EA
Software Program CD	1 EA

## System configuration



## Specifications

Div	Spec
CPLD Device	Altera MAX 7000s EPM7128LC84 device
Main clock	20MHz Main Clock Oscillator mounted
Deviding clock	available Oscillator expansion socket to meet user needs
Display Device	16X2 character LCD
	4-digit FND
	8 LEDs
Input Device	8 pole-DIP Switch
	3 set IR Sensor
Output Device	STEP Motor
	DC Motor
	SERVO Motor
Reset	1 dedicated reset key
Operating voltage	5V DC pwer
STEP Motor Driver	SLA7024
DC Motor Driver	L898N
STEP Motor	TM-Motor
SERVO Motor	KR-410
LCD	16X2 line
Power Driver	LM2575

## Training contents

### Chapter 1, PLD introduction

- 1.1 what is PLD ?
- 1.2 PLD types
- 1.3 CPLD and FPGA
- 1.4 CPLD IN Training KIT

### Chapter 2, VHDL

- 2.1 VHDL basic grammar
- 2.2 VHDL basic structure
- 2.3 example file which designed by VHDL

### Chapter 3, Setting up the development environment

- 3.1 Login Design Flow
- 3.2 Design Software
- 3.3 composition of Training KIT
- 3.4 Quartus II download and install
- 3.5 program download using Quartus II

**Chapter 4, LED and Dip Switch**

- 4.1 LED explanation
- 4.2 Hardware of LED & Dip Switch
- 4.3 Experiment 1 - LED Switch on which corresponding to DIP\_Switch
- 4.4 Display to LED by operating the DIP\_Switch input (Addition and Subtraction)

**Chapter 5, Clock**

- 5.1 CLOCK of Training KIT
- 5.2 Explanation on Hardware
- 5.3 Experiment 1, on Clock divider
- 5.4 Experiment 2, LED Flashing using clock

**Chapter 6, 7- Segment**

- 6.1 Explanation of 7-segment
- 6.2 Explanation of Hardware
- 6.3 Experiment 1, Numeric Display on 7-segment (0~15)
- 6.4 Experiment 2, 4-digit Numeric Display

**Chapter 7, TXT\_LCD**

- 7.1 What is TEXT LCD ?
- 7.2 TEXT LCD types
- 7.3 LCD Structure and Principle
- 7.4 TEXT LCD (16X2) Module's configuration
- 7.5 Explanation on Hardware
- 7.6 Experiment 1, display ASCII characters
- 7.7 Experiment 2, write the desired sentence to TEXT LCD

**Chapter 8, STEP\_MOTOR**

- 8.1 STEP Motor outline
- 8.2 STEP Motor classification
- 8.3 simple model of 2-phase STEP Motor.
- 8.4 STEP Motor Drive types
- 8.5 STEP Motor control
- 8.6 Explanation on Hardware
- 8.7 Experiment 1, STEP\_Motor forward rotation
- 8.8 Experiment 2, STEP\_Motor forward & backward rotation

**Chapter 9, DC\_MOTOR**

- 9.1 DC Motor outline
- 9.2 DC Motor Drive types
- 9.3 Motor rotation sensing devices
- 9.4 Encoder counter design
- 9.5 Explanation on Hardware
- 9.6 Experiment 1, forward and backward rotation
- 9.7 Experiment 2, speed control using DIP\_Switch

**Chapter 10, SERVO\_Motor**

- 10.1 RC SERVO\_Motor outline
- 10.2 RC SERVO\_Motor inside configuration
- 10.3 RC SERVO\_Motor control
- 10.4 Explanation on Hardware
- 10.5 Experiment 1, forward and backward rotation
- 10.6 Experiment 2, angle change using Dip\_switch

**Chapter 11, IR Sensor**

- 11.1 IR Sensor outline
- 11.2 Explanation of Hardware
- 11.3 Experiment 1, IR Sensor operation
- 11.4 Experiment 2, STEP\_Motor forward & backward rotation using IR Sensor

# model: **FPGA-1000**

## **Basic FPGA Trainer**

### **Feature**

FPGAs are the electronic designers friend, as they are programmable hardware, as opposed to microcontrollers which are programmable software.

In other words, they can be placed in a circuit and programmed & re-programmed to do different functions, either signal routing, logic or features such as counters.

This is the new generation of FPGAs from Altera, called the Cyclone range.

As well as being low cost, the Cyclone FPGAs incorporate lots of features to make the designer's life simpler, including embedded memory, external memory interfaces and clock management circuitry.

This is a sophisticated package that includes Schematic Entry, VHDL editor and compiler plus fitters and programmer interface.

### **Functions**

FPGA-1000 has the basic structure like LookUp Table & Flip-Flop typed LE (Logic Element), also LAB (Logic Array Block) is constituted by making multiple LE (in case of FLEX10K, 8ea).

This LAB is arrayed as Grid from FPGA inside and Row and Column connection block exists between this.

FPGA-1000 is suitable for sequential circuit using many Flip-Flop, or where large capacity is needed.

- 1) Training on PLD inside structure & I/O Pin control can be conducted using EP1C6Q240C which is made by ALTERA Inc and FPGA CYCLONE series.
- 2) Electronic devices such as LED, 7-Segment, LCD and DC, STEP, SERVO Motor control practice can be conducted.
- 3) PLD Control using Cyclone board (EP1C6Q240C) and VHDL & Schematic.
- 4) User can use any desired Clock by distributing the 20MHz basic Clock to Dip\_switch.
- 5) Program download practice can be conducted using Quartus and using the built-in Byteblaster MV function.
- 6) Without Oscilloscope, user can identify Signal Waveform using SignalTap Analyzer function of Quartus.

### **System configuration**





## Components

Item	q'ty
FPGA main hardware system	1 ea
Parallel cable	1 ea
DC power adaptor (12V 1.5A)	1ea
Program CD	1ea
Manual book	1 book

## Specification

Div	Spec
Device	EP1C6Q240C(PQFP type)
Logic Elements	5,980LEs
Total RAM bits	92,160bits (11,520 bytes)
Available I/O	185 Programmable I/O
System Clock	20MHz usage by distribution, 25MHz fixed clock.
S/W operating system	over Quartus II ver5.0
Program download	built-in ByteBlasterMV function
usage of PC parallel port	JTAG Download
Input device	8ea of Dip_Switch, 4ea of Tact_switch, 4 x 4 Function
Switch	16ea of Switch
Sensor	3ea of On/Off proximity sensor 3ea of Distance detection & Infrared sensor
Output device	12ea of LED, 1ea of 4Digit_7segment, 8X8 Dot MATRIX
Motor	1ea of STEP motor, 1ea of DC Motor, 1ea of SERVO Motor
Motor Drive IC	SLA7024, L298N
Input & board power	Input power : AC 85~264V,
Board power	DC 5V
1ea of TEXT LCD	16X2, Back Light built-in
Sound	by Speaker

## Training contents

1. Configuration
2. Brief explanation on Training Kit
3. Product specification
4. Explanation on each parts of Training Kit
5. Developing environment
6. How to use the developing tool, Quartus II.
7. System Clock of FPGA Training kit
8. Experiment 1, led01 (how to use Block Diagram/Schematic Quartus II)
9. Practice for LED
10. Experiment 2, LED01vhdl (how to use VHDL Quartus II)
11. Experiment 3, clk
12. Practice for 7-Segment
13. Experiment 4, segment
14. Experiment 5, segment01
15. Experiment 6, Sensor
16. Experiment 7, key\_matrix
17. Practice for Step motor
18. Experiment 8, step
19. Practice for DC Motor
20. Experiment 9, DC\_motor
21. Practice for RC Servo motor
22. Experiment 10, servo\_motor
23. Experiment 11, dot\_matrix
24. Practice for Text LCD
25. Experiment 12, text\_lcd
26. Experiment 13, sound



# model: **FPGA-GTC2500**

## Application bench type, FPGA Training Kit

### Overview

- 1) ALTERA Cyclone IV Module is installed as standard, and AVR and Arduino modules can be replaced
- 2) Built-in USB Blaster Downloader
- 3) Target-oriented experimental equipment from basic to various applications
- 4) Provides design flexibility and expansionability characteristic of FPGA
- 5) Various application examples using device module
- 6) Separate application bench space allows for selective practice by subject
- 7) Use a standard IDC cable for connecting the FPGA to the module

### Expected Effect from the training

- 1) Understand the characteristics of Altera FPGAs and learn how to use QUARTUS II software.
- 2) Using VHDL, user can acquire the ability to control various devices through various types of application control experiment exercises from simple logic design stage to complex control circuit design
- 3) Practice using LED, Button, Counter, etc.
- 4) Through traffic signal controller practice, learn how to generate and use various counters and sequential control technique
- 5) Students acquire application technology for temperature and humidity sensor
- 6) Students will learn how to use ADC and PSD and how to apply them through distance measurement.
- 7) Lighting control and FAN control experiment using illumination sensor and ADC
- 8) Understanding PWM and acquiring its application skills through PWM control circuit design practice
- 9) Learn remote control technology using IR transceiver
- 10) To understand how to amplify Audio MIC signal through OP-AMP and to digitize the signal level through ADC

### Product Features

- 1) It is equipped with ALTERA Cyclone IV Module, and it is compatible with AVR and Arduino modules.
- 2) By using USB Blaster and Configuration device, there is no need for separate downloading equipment.
- 3) By using internal oscillator and regulator, The module can be used alone.
- 4) The FPGA connection port is divided into 8pin units using 2x5 standard IDC cable, making cable connection easy.
- 5) Various device combinations are possible by designing the device units on a module basis, also each module can be used separately.
- 6) Easy to design various application modules by utilizing application bench space

### System configuration



## Components

1) Hardware platform	1 set
2) USB-B cable	1 ea
3) DC 5V/3A Adaptor	1 ea
4) 2 × 5 IDC cable	1 ea
5) Program CD	1 ea
6) Manual book	1 book

## Training Contents

- Chap 1, about VHDL
- Chap 2, QUARTUS II Installation and Configuration
- Chap 3, How to use SCHEMATIC & VHDL and how to use QUARTUS II Simulation
- Chap 4, SCHEMATIC & VHDL Basic Design Practice
  - LED, Keypad, 7-Segment, Dot Matrix, LCD, FAN, Motor control practice
- Chap 5, Traffic Signal Controller Design
  - Counter generator design
  - Traffic Signal Control using Counter
- Chap 6, Audio Level meter design
  - Digital conversion of OP-AMP output to ADC
  - Level meter design using OP-AMP and ADC
- Chap 7, Lighting control using illuminance sensor
  - Lighting control using PHOTO TR and ADC
  - Lighting control using CdS and ADC
- Chap 8, FAN automatic control (1)
  - FAN control / temperature and humidity sensor control
  - FAN automatic control using temperature and humidity sensor
- Chap 9, FAN automatic control (2)
  - IR Receiver Control - Displayed by Received Value LED
  - FAN control using IR remote control
- Chap 10, Digital Door Locks (1)
  - Switch control exercises
  - Switch analysis and storage
- Chap 11, Digital Door Locks (2)
  - 7-Segment display control
  - Buzzer drive and motor drive
  - Digital door locks with switches and 7-segment
- Chap 12, Rear detector (1)
  - Distance Digital conversion using PSD sensor and ADC
- Chap 13, Rear detector (2)
  - 7-Segment display control, LED display control, Buzzer control
  - Rear detector using PSD sensor
- Chap 14, Vending machine design (1)
  - Operation classification by button input and LED driving
- Chap 15, Vending machine design (2)
  - 7-Segment Drive and Matrix LED Control
- Chap 16, Vending machine design (3)
  - Text LCD control and vending machine implementation

## Spec

### 1. Main MCU

- \* Built-in download function (circuit) to Main MCU Module itself.
- \* Built-in Power circuit for Main MCU Module that directly can be received Power input
- \* 5V/3A Adapter is provided
- \* Standardized 2x5 standard IDC cables and connectors should be applied for smooth practice.
- \* Built-in Cyclone IV E : EP4CE22F17C7
- \* Configuration : EPCS64
- \* Built-in USB Blaster (JTAG mode)
- \* 12-bits A/D Converter
- \* 2KB I2C EEPROM
- \* Digital Accelerometer

- \* 8 Green LEDs / 2 Push Button / 4 Dip-switch
- \* 32MB SDRAM
- \* 50MHz Clock Oscillator
- \* 40-pin(2X20) GPIO Header X 2 EA
- \* 26-pin(2X13) Header 1EA, (include 8 ADC port)

[AVR : ATmega128A] - option

- \* Up to 16MIPS Throughput at 16MHz
- \* JTAG Interface, ISP Program included
- \* 128KBytes FLASH, 4KBytes Internal SRAM
- \* 4KBytes EEPROM
- \* 8-Channel PWM, 8-Channel 10-bits ADC
- \* I2C, Dual UART

[Arduino : ATmega2560] - option

- \* Up to 20MIPS Throughput at 20MHz
- \* Built-in Boot Loader (USB to Serial Program), ISP Program
- \* 256KBytes FLASH, 8KBytes bootloader
- \* 8KBytes Internal SRAM, 4KBytes EEPROM
- \* 15-Channel PWM, 16-Channel 10bits ADC
- \* I2C, 4-UART, 544-Digital I/O

## 2. Application module

- \* To increase the efficiency of the practice, all application modules are not built into the main board (PCB) but are provided as individual modules.
- \* For Each application modules, Power supply circuit (3.3V, 2 port) should be built-in for individual operation apart from main board.
- \* Standardized 2x5 standard IDC cables and connectors should be applied for smooth practice
- 1) LED module : 8 Green LEDs / 8 Red LEDs
- 2) DC Motor module : Forward / Reverse Rotatable DC Motor
- 3) Buzzer module : DC SMD Piezzo
- 4) 7-Segment module : 6 Digits 7-Segment
- 5) Key PAD module : 16 Push Button Switch
- 6) Text LCD module : 16 x 2 Text LCD, 3.3V Backlight
- 7) IR module : Free Voltage(2.5V~5.5V) IR receiver
- 8) Dot Matrix LED module : 8 x 8 Dot Matrix LED
- 9) Sensor module : CDS sensor, Photo TR, Temperature/humidity sensor
- 10) OP-AMP module : High Sensitivity Condenser Micro Phone, JRC OP-AMP
- 11) DC FAN module : 25mm small DC FAN
- 12) PSD sensor module : 10 ~ 80 cm PSD sensor
- 13) Traffic control module : 16 Green LEDs / 12 Red LEDs / 4 Yellow LEDs

## 3. Main Board

- 1) FPGA Bench : 1 FPGA slot
- 2) Storage function : 11 EA fixed slot
- 3) Application Bench : 9 EA Application Bench
- 4) Size : 450mm x 285mm x 130mm Aluminium Frame

## 4. Simulator

- \* Includes theory, operation status, schematic, and source examples for each practice
- \* Displays the motion waveforms linked to the functions that are running on the exercise equipment
  - available of Scope Status Run/Stop
- \* Output settings for waveform display are available.
  - Signal Pin Config Display(Index/Port/Pin No./Pin Description)
  - Span Hourly Waveform Display
  - 3 types of Trigger Mode (Normal/None/Single)
  - Trigger Edge setting selectable (Rising/Falling)
  - Trigger Edge Position setting available

## 5. Application circuit & FW

- \* Provides C language-based programming source & manual for applications that is for designing more than 30 capstone designs related to Main Processor Module and 100 types of I / O, Communication, Sensor, Display Module.
- \* Using Atmega128A, High-precision Wide Variable Multiple Output Voltage Setting Circuit and FW
- \* Using Atmega128A, OP-AMP, High precision multi-channel wide current measurement circuit and FW
- \* Using Atmega128A & For OLED panel lighting, insulated high-speed high-voltage / high-current switching circuit and FW
- \* Using Atmega128A, Multi-channel voltage variable LED back light PWM & constant current control circuit and FW
- \* High Power LED PWM Brightness USB & Remote Control Circuit and FW interlocking with Atmega128A and AC / DC power circuit

# model: **FPGA Design-4000**

## **FPGA Design Training system**

### Features

By available of alternating use between Altera & Xilinx FPGA that is most commonly used in FPGA-Combo practice, FPGA Design-4000 can mitigate the refusal mind of FPGA use and support a variety of peripheral devices Also by providing various application modules, enable to proceed team-based project that is comparable to level of industrial use.

### Functions

- 1) Digital logic circuits training equipment for basic practices
  - (1) As available of circuit control design to Bread Board using individual circuits, FPGA Design-4000 helps user can do hands-on practice as well as understanding of digital logic concept
  - (2) From the basic control targets such as Switch, LED, 7-Segment, TEXT-LCD, DOT-MATRIZ that is for the undergraduate students who facing digital circuits for the first time, FPGA Design-4000 provides more such as ADC, DAC, Step Motor, SRAM, ROM so that the students can do high level control
  - (3) Circuit design by individual use of Bread Board or FPGA Board is possible, also mixed circuit design with FPGA and Bread Board is available In addition this, Advanced applications design for high grade students is also available
- 2) FPGA Design Training System for various applications and advanced control practices
  - (1) The most commonly used in practice, Altera, Xilinx FPGA can be manufactured by module types and substitution is possible to use
  - (2) For sufficient logic design capacity support, FPGA Design-4000 was designed to selectively use the 100 million gates level FPGA of ALTERA Cyclone-II / Xilinx Spartan3
  - (3) FPGA Design-4000 was designed to adjust the I/O level (3.3V, 2.5V, 1.8V) of expansion ports by developing tools
  - (4) Improved Multimedia peripherals : Audio in/out, 1W mono Speaker, USB interface, UART, PS/2, TV in/out
  - (5) Provide the enough examples for VHDL/Verilog HDL programming language enabling the advanced design
  - (6) No costs for the purchase of FPGA development software (Quartus-II Web Edition/ ISE Webpack)

### Components

Hardware Platform	1 ea
Xilinx FPGA Module and Altera module	1 ea
Program CD	1 ea
USB Altera and Xilinx USB Cable	1 ea
USB to Serial Cable	1 ea

## Training contents

### Chapter 01 Overview of FPGA and how to design FPGA

- 1.1 Digital System Design Process
- 1.2 Digital System Design Process using FPGA
- 1.3 FPGA Design Advantages
- 1.4 FPGA Design Process
- 1.5 FPGA Concept
- 1.6 FPGA Programming Structures

### Chapter 02 Development environment and project practice of Altera Quartus-II/ModelSim

- 2.1 Install of Altera Quartus-II 7.1 / ModelSim
- 2.2 ALTERA FPGA Project Design Examples using HDL
- 2.3 Compile the project
- 2.4 To verify using the Modelsim-Altera Simulator
- 2.5 To verify in FPGA-Combo

### Chapter 03 Xilinx ISE development environment and project practice

- 3.1 Install Xilinx ISE 7.1
- 3.2 Xilinx FPGA Project Design Examples using HDL

### Chapter 04 FPGA-Combo Device Configuration and Use

- 4.1 Overview
- 4.2 Name of each parts
- 4.3 Block Diagram
- 4.4 Product Spec
- 4.5 Setting
- 4.6 I/O Configuration
- 4.7 Bread Board
- 4.8 To mount components on a breadboard
- 4.9 Test Procedures

### Chapter 05 LED, 7-Segment Control Practice (Verilog-HDL) using FPGA

- 5.1 Overview
- 5.2 About LED and 7-Segment
- 5.3 Description on LED and 7-Segment Controller
- 5.4 Creating the Source Code
- 5.5 Checking the operation in FPGA-Combo

### Chapter 06 TEXT-LCD Control Practice (Verilog-HDL) using FPGA

- 6.1 Overview
- 6.2 About TEXT-LCD
- 6.3 Description on TEXT-LCD Controller
- 6.4 Creating the Source Code
- 6.5 Checking the operation in FPGA-Combo

### Chapter 07 Dot Matrix Control Practice (Verilog-HDL) using FPGA

- 7.1 Overview
- 7.2 About Dot Matrix
- 7.3 Description on Dot Matrix Controller
- 7.4 Creating the Source Code
- 7.5 Checking the operation in FPGA-Combo

### Chapter 08 UART Control Practice (Verilog-HDL) using FPGA

- 8.1 Overview
- 8.2 About UART
- 8.3 Description on UART Controller
- 8.4 Creating the Source Code
- 8.5 Checking the operation in FPGA-Combo

### Chapter 09 PS/2 Control Practice (Verilog-HDL) using FPGA

- 9.1 Overview
- 9.2 About UART
- 9.3 Description on UART Controller
- 9.4 Creating the Source Code
- 9.5 Checking the operation in FPGA-Combo

**Chapter 10 TFT-LCD Control Practice (Verilog-HDL) using FPGA**

- 10.1 Overview
- 10.2 About TFT-LCD
- 10.3 Description on TFT-LCD Controller
- 10.4 Creating the Source Code
- 10.5 Checking the operation in FPGA-Combo

**Chapter 11 VGA Control Practice (Verilog-HDL) using FPGA**

- 11.1 Overview
- 11.2 About VGA
- 11.3 Description on VGA Controller
- 11.4 Creating the Source Code
- 11.5 Checking the operation in FPGA-Combo

**Chapter 12 Step Motor Control Practice (Verilog-HDL) using FPGA**

- 12.1 Overview
- 12.2 About Step-Motor
- 12.3 Description on Step-Motor Controller
- 12.4 Creating the Source Code
- 12.5 Checking the operation in FPGA-Combo

**Chapter 13 LED, 7-Segment Control Practice (VHDL) using FPGA**

- 13.1 Overview
- 13.2 About LED and 7-Segment
- 13.3 Description on LED and 7-Segment Controller
- 13.4 Creating the Source Code
- 13.5 Checking the operation in FPGA-Combo

**Chapter 14 TEXT-LCD Control Practice (VHDL) using FPGA**

- 14.1 Overview
- 14.2 About TEXT-LCD
- 14.3 Description on TEXT-LCD Controller
- 14.4 Creating the Source Code
- 14.5 Checking the operation in FPGA-Combo

**Chapter 15 Dot Matrix Control Practice (VHDL) using FPGA**

- 15.1 Overview
- 15.2 About Dot Matrix
- 15.3 Description on Dot Matrix Controller
- 15.4 Creating the Source Code
- 15.5 Checking the operation in FPGA-Combo

**Chapter 16 UART Control Practice (VHDL) using FPGA**

- 16.1 Overview
- 16.2 About UART
- 16.3 Description on UART Controller
- 16.4 Creating the Source Code
- 16.5 Checking the operation in FPGA-Combo

**Chapter 17 PS/2 Control Practice (VHDL) using FPGA**

- 17.1 Overview
- 17.2 About UART
- 17.3 Description on UART Controller
- 17.4 Creating the Source Code
- 17.5 Checking the operation in FPGA-Combo

**Chapter 18 TFT-LCD Control Practice (VHDL) using FPGA**

- 18.1 Overview
- 18.2 About TFT-LCD
- 18.3 Description on TFT-LCD Controller
- 18.4 Creating the Source Code
- 18.5 Checking the operation in FPGA-Combo

**Chapter 19 VGA Control Practice (VHDL) using FPGA**

- 19.1 Overview
- 19.2 About VGA
- 19.3 Description on VGA Controller



#### 19.4 Creating the Source Code

#### 19.5 Checking the operation in FPGA-Combo

### Chapter 20 Step Motor Control Practice (VHDL) using FPGA

#### 20.1 Overview

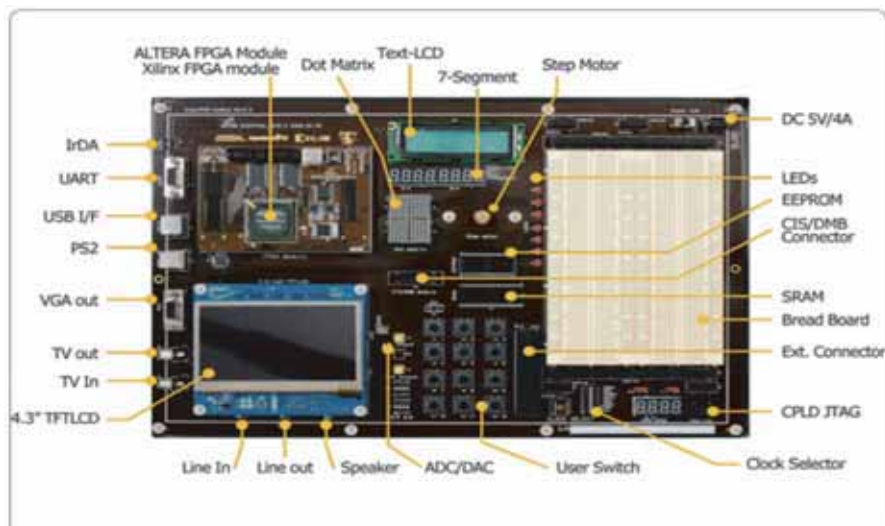
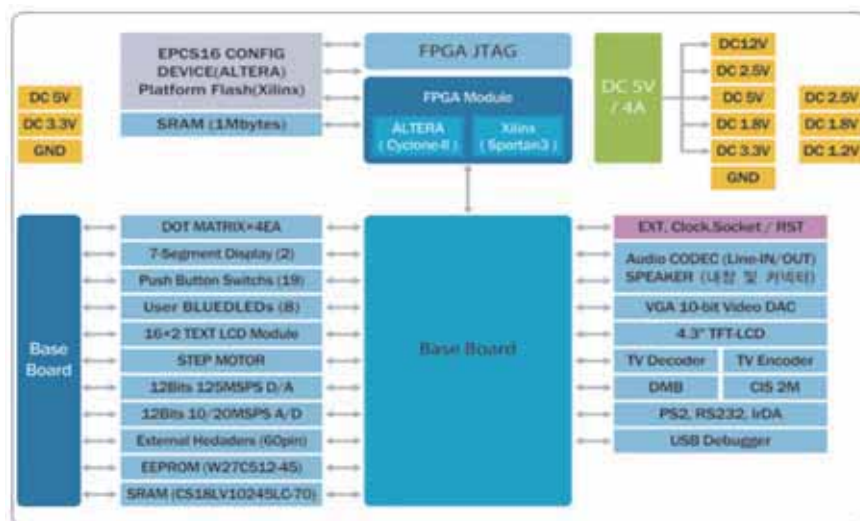
#### 20.2 About Step-Motor

#### 20.3 Description on Step-Motor Controller

#### 20.4 Creating the Source Code

#### 20.5 Checking the operation in FPGA-Combo

## System configuration



( Xilinx USB Cable )



## Specification

### 1) Altera FPGA Module

Item	Spec
FPGA	Cyclone II EP2C50 (1 million gate) FG672C8
JTAG	ByteBlaster-II (Active Serial Mode) / FPGA JTAG (Debug Mode)
SRAM	1MB (512KB x 2EA)

### 2) Xilinx FPGA Module

Item	Spec
FPGA	XC3S2000FG676 (2 million gate)
JTAG	FPGA JTAG
SRAM	1MB (512KB x 2EA)

### 3) Base Board

Item	Spec
CLOCK	Two external clock input socket, reset switch
VGA	1 Port 16Million Colors
TV Input/Output	NTSC/PAL TV Signal input / Output (ITU-656 format)
DMB/CIS	1 Slot Terrestrial DMB (ITU-656 Format) Module Connector, 2M Pixels CIS Camera Module Connector
Audio Codec	Stereo Codec(WM8711), LINE In/Out, Head-phone, 1W Speaker built-in
Display	4.3" Color TFT LCD (480x272)
ADC/DAC	12-Bit, 20MHZ Sampling A/D Converter 12-Bit, 125 MSPS D/A Converter
Motor	STEP Motor
UART	FPGA UART
Debugging Port	USB(PC) to GPIO(FPGA) Interface
Input / Output device	Push Switch : 12ea, 7-Segment : 8 number, LED : 8ea, 6x12 TEXT-LCD, PS/2
Extension port	FPGA I/O 96Pin (Side) (3.3V, 2.5V, 1.8V I/O Selectable)
Development Environment	XilinX ISE Webpack (Windows-based software) Altera Quartus-II Web Edition (Windows-based software)
Accessories	XilinX FPGA JTAG(Print port dongle) / Altera Byte Blaster-II(Print port dongle)
Power	AC220V(Input), DC5V/4A(Output) AC Adapter

# model: **FPGA / SoC-5000**

## FPGA / SoC Trainer

### Feature

This SoC training system use FPGA and ARM926 for SoC design.

In addition to the experience of digital design from FPGA using VHDL/Verilog, this SoC trainer provides the implementation method as well as the practice metrials how to apply to SoC using ARM

- 1) Understanding the ARM926 Processor usage and H/W & S/W Co-Design education
- 2) Implementation education using FPGA and ARM926 core for SoC design
- 3) Hardware Verification : ARM Debugger and ICE equipment
- 4) Software Verification : ARM Debugger/Firmware/Compiler
- 5) FPGA and ARM design theme, embedded systems (Linux)
- 6) Very Easy SoC education using EasyIP v1.0

### Functions

- 1) A design theme consists of FPGA and ARM926 core based example.
- 2) Verilog HDL/VHDL implement for FPGA operation, and then able to control of ARM using the same design
- 3) SoC development environment is designed to provide an easy to use and allows users to quickly implement FPGA logics.
  - (1) Altera Quartus II software design environment
  - (2) 1M gates Altera Cyclone II FPGA and rapid processing speed (XilinX Gate count = 2M Gates)
  - (3) Verilog HDL/ VHDL Easy IP v1.0 make graphic library and then easy to make user design.
  - (4) Able to understand the IP reuse and AMBA bus interconnect.
  - (5) ARM926EJ Core.
  - (6) ARM926(Max speed 226MHz) SoC Processor, AHB2.0 Bus, Available the RTOS porting.
  - (7) Provides an wrapper and register for development.
  - (8) Hardware verification with ARM Debugger
  - (9) Able to implement new firmware or application code with ARM IDE environments
- 4) We provide EasyIP v1.0 for AMBA bus design and support many peripheral for a number of design theme.

Multimedia in	Multimedia out	Memory	Comm. and interfaces	Control
TV Decoder	TV Encoder	DPRAM(48KB)	ADC / DAC	Step Motor
CIS / DMB	VGA / TFT	SRAM(1MB)	UART, USB	Dot Matrix, FND
Line In	Line Out / Speaker		PS2,IrDA	S/W, Text-LCD

### Components

Items	Num
Main Hardware Platform (including carrying bag)	1 ea
Serial 9P extension cable	1 ea
H-JTAG	1 ea
Ethernet Cross cable	1 ea
Adaptor (5V/4A)	1 ea
Download Dongle (Byte Blaster II – Parallel type)	1 ea
Program CD (USB Dongle)	1 ea
Manual book	1 book

## Specification

### 1) Hardware spec

Item	Specifications
CPU	ARM926EJ-S Core / AMBA 2.0 Compliant
CPU Clock	Core MAX. 266MHz
Bus	AMBA 2.0 AHB, APB, ASB
DDRAM	64MB DDRAM (16BIT, 133) MAX 128MB
FLASH	16MB (Serial Flash) MAX 64MB
USB Host	Two USB 2.0 Host
USB CLIENT	One USB 2.0 Client Interface
Ethernet	One 10M/100Mbps Controller
UART	Three CPU UART / One FPGA UART
Audio Codec	WM8711 Stereo Codec, Mic Port, Headphone Port, Speaker Connector
I <sup>2</sup> C	I <sup>2</sup> C Port Connector
Debugging Port	20-Pin Header for Multi-ICE(ARM Debugger)
FPGA	Cyclone II 100M Gates FBGA672-8
Debugging Port	FPGA JTAG : 10-Pin JTAG(AS Mode / JTAG Mode) USB(PC) to GPIO(FPGA) Interface
SRAM	1MB (512KB x 2EA)
User I/O	CPU : 6 GPIO FPGA : 9 Push Switch, 8LEDs, 1 DIP Switch, PS2 I/F Dot-Matrix, 7-Segment, TEXT-LCD, IrDA External Clock 2EA. Switch able 60PIN
Motor	STEP Motor
VGA	16Million Colors
CIS2M Connector	2M Color CIS Sensor Module(Optional)
AD/DA(FPGA)	12-BIT, 20MHz MSPS A/D Converter 12-BIT, 125 MSPS D/A Converter
TV Input/Output	CVBS Encoder/Decoder (ITU-601, 656 Format)
Display	4.3" Color TFT LCD (480x272)
Audio	1W Speaker / Line In / Out
Power Supply	AC220V(Input) DC5V 4A(Output) Adaptor

### 2) Software spec

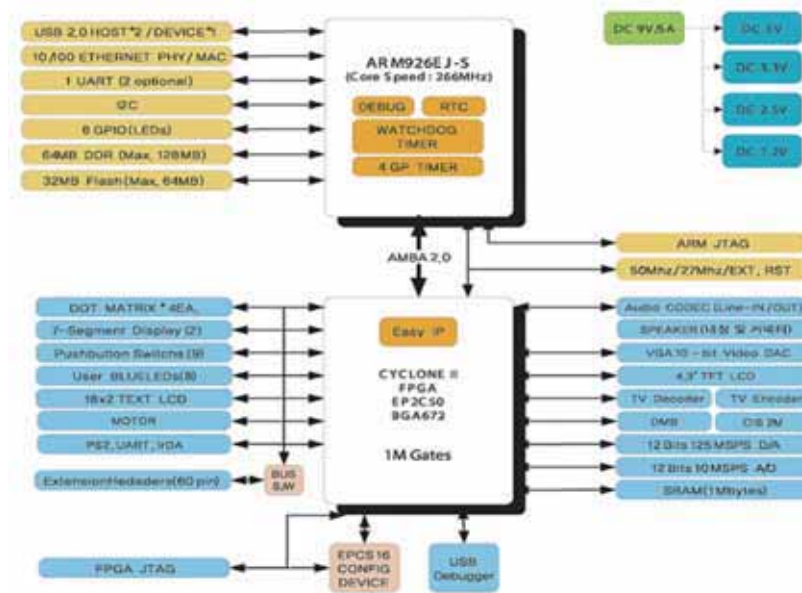
Item	Specifications
Compiler	ARM ADS/RVDS C Compiler, Debugger, Assembler Multi ICE/RV-ICE ARM Emulator (Option)
Easy IP - AMBA	EIP-Matrix EIP-AHB2AHB Bridge EIP-AHB2APB Bridge
Easy IP - APB	EIP-User I/O Controller ( LED, 7-Segment, TEXT-LCD Dot-Matrix ) EIP- Step Motor Controller EIP- PS2 Controller EIP-UART Controller EIP-IrDA Controller EIP-Interrupt Controller EIP-Timer Controller
Easy IP - AHB	EIP-Audio Controller EIP-A/D Controller EIP-CIS Controller EIP-CVBS Decoder Controller EIP-CVBS Encoder Controller EIP-D/A Controller EIP-DMA Controller EIP-DMB Controller EIP-SRAM Controller EIP-TFT-LCD Controller EIP-VGA Controller

## System configuration

### 1) Hardware Platform



### 2) Block Diagram



## Training contents

### Chapter 1 Introduce to SoC and design methodology

- 1.1 - Introduction
- 1.2 - SoC concept and
- 1.3 - SoC design method
- 1.4 - SoC design process
- 1.5 - SoC training system for SoC design
- 1.6 - Software for SoC design

### Chapter 2 Understanding the SoC architecture using ARM processor

- 2.1 - Processor design theory
- 2.2 - Processor Block Diagram
- 2.3 - Memory Map

### Chapter 3 AMBA 2.0 Specification (Advanced MicroController Bus Architecture)

- 3.1 - Key to timing diagram conventions
- 3.2 - Introduction to AMBA
- 3.3 - amba Signals
- 3.4 - AMBA AHB
- 3.5 - AMBA APB

### Chapter 4 Introduce to development tools : ALTERA and ARM tools

- 4.1 - Altera Quartus- / ModelSim, ADS / Multi-ICE installation and run
- 4.2 - ARM Developer Suit (ADS) / Multi - ICE installation and run

### Chapter 5 EasySoC Specification

- 5.1 - Introduction
- 5.2 - Part Names of Hardware platform
- 5.3 - Block diagram
- 5.4 - Features of the training system
- 5.5 - Components of training system
- 5.6 - Specification of training system
- 5.7 - Switch and mode
- 5.8 - FPGA Pin number

### Chapter 6 Implement of LED,7-Segment Controller using FPGA

- 6.1 - Introduction
- 6.2 - Explanation of LED and 7-Segment configuration and operating.
- 6.3 - Operating of LED and 7-Segment
- 6.4 - Creating project to design the Watch using LED and 7-Segment
- 6.5 - Watch design using LED and 7-Segment
- 6.6 - Source code making
- 6.7 - Project Compling
- 6.8 - Verification using ModelSim-Altera Simulator
- 6.9 - Verification using SoC

### Chapter 7 Implement of LED,7-Segment Controller using ARM [926EJ-S(APB)]

- 7.1 - Introduction
- 7.2 - Understanding of EasySoC system structure using LED and 7-Segment EasyIP
- 7.3 - Creating LED and 7-Segment Control IP AMBA connection project.
- 7.4 - Control of LED, 7-Segment using Multi-ICE and AXD

**Chapter 8 Implement of Text-LCD Controller using FPGA**

- 8.1 - Introduction
- 8.2 - Explanation of Text-LCD configuration and operating.
- 8.3 - Operation of Text-LCD
- 8.4 - Creating the Text-LCD Controller design project.
- 8.5 - Text-LCD Controller design.
- 8.6 - Source code making
- 8.7 - Verification using ModelSim-Altera Simulator
- 8.8 - Verification using SoC

**Chapter 9 Implement of Text-LCD Controller using ARM (926EJ-S)**

- 9.1 - Introduction
- 9.2 - Understanding of SoC system structure using Text-LCD EasyIP.
- 9.3 - Creating the Text-LCD Control IP AMBA connection project.
- 9.4 - Text-LCD control using Multi-ICE and AXD.
- 9.5 - Analysis of Text-LCD EasyIP design file.

**Chapter 10 Implement of Dot Matrix Controller using FPGA**

- 10.1 - Introduction
- 10.2 - Explanation of Dot Matrix configuration and operating
- 10.3 - Operation of Dot Matrix
- 10.4 - Creating the Dot Matrix Controller design project
- 10.5 - Dot Matrix Controller design
- 10.6 - Source code making
- 10.7 - Project compiling
- 10.8 - Verification using ModelSim-Altera Simulator
- 10.9 - Verification using SoC

**Chapter 11 Implement of Dot Matrix Controller using ARM926EJ-S**

- 11.1 - Introduction
- 11.2 - Understanding of SoC system structure using Dot Matrix EasyIP.
- 11.3 - Creating the Dot Matrix IP AMBA connection project.
- 11.4 - Control of Dot Matrix using Multi-ICE and AXD.
- 11.5 - Analysis of Dot Matrix EasyIP design source file.

**Chapter 12 Implement of UART Controller using FPGA**

- 12.1 - Introduction
- 12.2 - Explanation of UART Configuration and operating
- 12.3 - Operation of UART
- 12.4 - Creating the UART Controller design project.
- 12.5 - Design of UART Controller
- 12.6 - Source code making
- 12.7 - Project compiling
- 12.8 - Verification using ModelSim-Altera Simulator
- 12.9 - Verification using SoC

**Chapter 13 Implement of UART Controller using ARM926EJ-S**

- 13.1 - Introduction
- 13.2 - Understanding of SoC system structure using UART EasyIP.
- 13.3 - Creating the UART IP AMBA connection project.
- 13.4 - Control of UART using Multi-ICE and AXD.
- 13.5 - UART Address Decoder.

**Chapter 14 Implement of PS/2 Controller using FPGA**

- 14.1 - Introduction
- 14.2 - Explanation of PS/2 configuration and operating
- 14.3 - Operation of PS/2.
- 14.4 - Creating the PS/2 controller design project.
- 14.5 - Design of PS/2 Controller.
- 14.6 - Source code making
- 14.7 - Project compiling
- 14.8 - Verification using ModelSim-Altera Simulator
- 14.9 - Verification using SoC

**Chapter 15 Implement of PS/2 Controller using ARM926EJ-S**

- 15.1 - Introduction
- 15.2 - Understanding of SoC system structure using PS/2 EasyIP.
- 15.3 - Creating the PS/2 IP AMBA connection project.
- 15.4 - Control of PS/2 using Multi-ICE and AXD.

- 15.5 - Analysis of PS/2 EasyIP design source file.

**Chapter 16 Implement of DPRAM Controller using ARM926EJ-S**

- 16.1 - Introduction
- 16.2 - Understanding of SoC system structure using DPRAM EasyIP.
- 16.3 - Creating the DPRAM IP AMBA connection project.
- 16.4 - Control of LED, 7-Segment using Multi-ICE and AXD.
- 16.5 - DPRAM creating method from FPGA inside.
- 16.6 - AHB Slave Wrapper design method.
- 16.7 - Analysis of DPRAM EasyIP design source file.

**Chapter 17 Implement of LED,7-Segment Controller using ARM926EJ-S(AHB)**

- 17.1 - Introduction
- 17.2 - Understanding of SoC system structure using AHB 7-Segment/LED Easy IP.
- 17.3 - Creating the AHB 7-Segment/LED IP AMBA connection project.
- 17.4 - Control of 7-Segment/LED using Multi-ICE and AXD.
- 17.5 - Analysis of EasyIP design source file : AHB Control Register.

**Chapter 18 Implement of Asynchronous SRAM Controller using ARM (926EJ-S)**

- 18.1 - Introduction
- 18.2 - Understanding of SoC system structure using Async. SRAM EasyIP.
- 18.3 - Creating the Async. SRAM IP AMBA connection project.
- 18.4 - Control of Async. SRAM, LED using Multi-ICE and AXD.
- 18.5 - Analysis of EasyIP design source file : Async. SRAM IP.

**Chapter 19 Implement of TFT-LCD, DMA Controller using ARM (926EJ-S)**

- 19.1 - Introduction
- 19.2 - Understanding of SoC system structure using TFT-LCD EasyIP.
- 19.3 - Creating the TFT-LCD IP AMBA connection project.
- 19.4 - Control of TFT-LCD using Multi-ICE and AXD.

**Chapter 20 Implement of TFT-LCD, CIS Controller using ARM (926EJ-S)**

- 20.1 - Introduction
- 20.2 - Understanding of SoC system structure using CIS / TFT-LCD EasyIP.
- 20.3 - Creating the CIS / TFT-LCD IP AMBA connection project.
- 20.4 - Control of CIS / TFT-LCD using Multi-ICE and AXD.
- 20.5 - Analysis of EasyIP design source file : CIS / TFT-LCD IP.

**Chapter 21 Implement of VGA Controller using ARM (926EJ-S)**

- 21.1 - Introduction.
- 21.2 - Understanding of SoC system structure using VGA EasyIP.
- 21.3 - Creating the VGA IP AMBA connection project.
- 21.4 - Control of VGA using Multi-ICE and AXD.
- 21.5 - Analysis of VGA EasyIP design source file

**Chapter 22 Implement of Step-motor Controller using ARM (926EJ-S)**

- 22.1 - Introduction.
- 22.2 - Understanding of SoC system structure using Step Motor EasyIP.
- 22.3 - Creating the Step Motor IP AMBA connection project.
- 22.4 - Control of Step Motor using Multi-ICE and AXD.
- 21.5 - Analysis of Step Motor EasyIP design source file

# model: **SoC Design-7000**

## **SoC Design Training system**

### **Introduction**

- 1) SoC Design-7000 is consisted of Processing System (PS) part and Programmable Logic (PL) part.**
  - (1) Processing System part includes ARM Cortex A9 Dual processor, DDR3 Controller, NAND/NOR Controller, Gigabit Ethernet Controller, SPI EEPROM Controller, USB OTG, UART, DMA, GPIO, AXI Bus IP. Cortex A9, which is in Processing System part, is able to control User Logic of FPGA inside through AXI Bus Matrix, and basically support DDR3 Controller, SPI EEPROM Controller, USB OTG etc. User can implement the desired circuit by adding IP to FPGA inside.
  - (2) Programmable Logic part includes FPGA of 1,300,000 ASIC Gates and includes ADC, Block, Memory in FPGA inside.
- 2) SoC Design-7000 Board is including TFTLCD, Audio, USB, Ethernet.**
- 3) As SoC Design-7000 includes Giga bytes Ethernet PHY, USB PHY, WIFI module, an UART connector, Communication is possible with other devices like PC**
- 4) SoC Design-7000 includes Multi-media devices such as TFTLCD, HDMI transceiver, AC97 Codec**
- 5) As SoC Design-7000 includes 7-Segment, Push Button (8ea), LED (8ea), DIP (8ea), It can use various GPIO devices**

### **Features**

- 1) Xilinx Z7020 chip and DDR3 Memory, SPI EEPROM, Gigabit Ethernet, USB OTG, UART, SDIO supporting which support Processing System Part and Programmable Logic Part are equipped to SoC Design-7000.**
- 2) Also, Programmable Logic I / O pins (200 pins) can be connected to another boards through 240pin connector (Tile Interface).**
- 3) SoC Design-7000 is connected with Base Board, and there is 5 "TFT LCD, Camera, AC97, HDMI, Wifi, 7-Segment, Text-LCD, GPIO (LED, Push Button, DIP Switch), User Expansion pin to Base Board**
- 4) SoC Design-7000 equipped with Cortex-A9 Core and built-in AXI Bus System in FPGA Part, user can design for industrial, medical, system control, automotive purposes**
- 5) SoC Design-7000 has Tile Interface, 120-pin Samtec Connector which can be easily mounted to Base Board and can transmit the signal in a high-speed**
- 6) The Base Board of SoC Design-7000 can connect the modular that Xilinx ZYNQ (XC7Z020) chip is mounted**
  - (1) Dual Cortex-A9 processor built-in
  - (2) AMBA AXI support, and peripheral device support
  - (3) High-performance FPGA design environment
- 7) It is possible to use 5 "WVGA (800x480) HD TFT LCD, Gigabit Ethernet, WIFI, USB2.0 OTG**
- 8) Various application program can be implemented with a SD mass memory card, and support Embedded Linux Kernel and Device Driver**
  - (1) Embedded Linux Kernel and Device Driver regarding a Dual Cortex-A9 processor
  - (2) support AC '97, UART, USB2.0, Gigabits Ethernet, HDMI Device Driver assistance
  - (3) DDR3 SDRAM, TFTLCD, CMOS Camera
- 9) ADC / DAC module is sampled by connected to the RPS-Z7020M module**
  - (1) ADC 1CH 12bit 40MSPS
  - (2) DAC 1CH 12bit 125MSPS
  - (3) SMA Connector

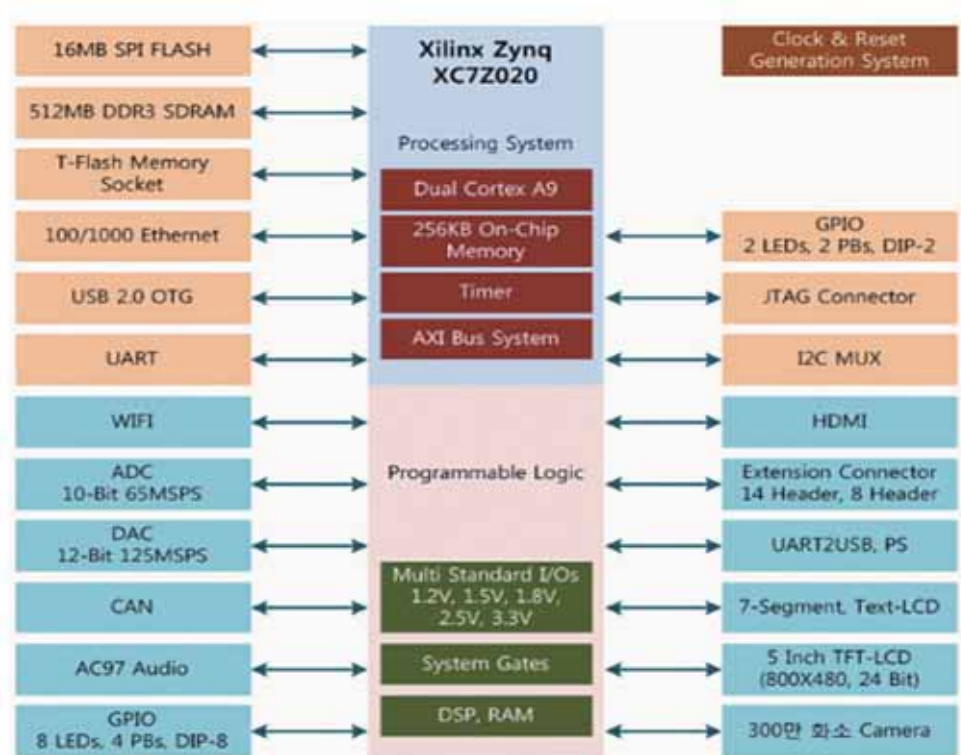


## Components

Hardware Platform	1 ea
Program CD	1 ea
Xilinx USB Platform Cable	1 ea
Ethernet Cross Cable	1 ea
USB to Serial Cable	1 ea
5V4A 2.5pi Adaptor	1 ea

## System configuration

### 1) Block diagram



### 2) Hardware photo



## Training contents

### Chap 1, SoC outlines and how to design

- 1.1 An outline
- 1.2 SoC concept and design element
- 1.3 How to SoC design
- 1.4 A SoC design process
- 1.5 SoC-7000 for a SoC design
- 1.6 Software for a SoC design

### Chap 2, Understand SoC design structure using Xilinx Zyng-7000

- 2.1 A processor design outline
- 2.2 Processor block diagram 4
- 2.3 Memory map

### Chap 3, Understand ARM AMBA protocol

- 3.1 Rules regarding a timing diagram
- 3.2 Introduction of AMBA
- 3.3 AMBA AXI
- 3.4 AMBA AXI4 Lite
- 3.5 AMBA AHB
- 3.6 AMBA APB

### Chap 4, Xilinx ISE Tool using method

- 4.1 Xilinx ISE install and Execute
- 4.2 Project making and operation including Process system 7

### Chap 5, SoC Design-7000 equipment configuration and spec

- 5.1 An outline
- 5.2 A name of each parts
- 5.3 A block diagram
- 5.4 A product name
- 5.5 Product configuration
- 5.6 Product spec
- 5.7 Setting
- 5.8 I/O pin configuration

### Chap 6, LED, 7-Segment control practice using FPGA

- 6.1 An outline
- 6.2 LED and 7-Segment configuration and explanation on operating
- 6.3 LED and 7-Segment operation methods
- 6.4 Making the simple watch design project using LED and 7-Segment
- 6.5 Watch design using LED and 7-Segment
- 6.6 Writing a source code
- 6.7 Project Compile
- 6.8 Verification using Xilinx Isim
- 6.9 Verification in SoC Design-7000

### Chap 7, LED, 7-Segment control practice (APB) using ARM

- 7.1 An outline
- 7.2 Understand SoC Design-7000 system structure using LED and 7-Segment control IP
- 7.3 LED and 7-Segment control IP AMBA connection project generation
- 7.4 LED, 7-Segment control using Xilinx Software Development kit
- 7.5 LED and 7-Segment IP design source file analysis

### Chap 8, Text-LCD control practice using FPGA

- 8.1 An outline
- 8.2 Text-LCD configuration and explanation on the operation
- 8.3 A Text-LCD operation method
- 8.4 Text-LCD controller design project making
- 8.5 Design Text-LCD controller
- 8.6 Writing a source code
- 8.7 Project Compile
- 8.8 Verification using Xilinx Isim
- 8.9 Verification in SoC Design-7000

### Chap 9, Text-LCD Control practice (APB) using ARM

- 9.1 An outline
- 9.2 Understand SoC Design-7000 system structure using Text-LCD Control IP
- 9.3 Text-LCD Control IP AMBA connection project making
- 9.4 Text-LCD control using Xilinx Software Development Kit
- 9.5 Text-LCD Control IP design source file analysis.

### Chap 10, Interrupt practice using Push Button

- 10.1 An outline
- 10.2 Interrupt configuration and explanation on the operation
- 10.3 Interrupt operating method
- 10.4 Interrupt Generator design project making by Push Button
- 10.5 Firmware operation using Xilinx USB Platform and SDK
- 10.6 Interrupt Generator design source file analysis

### Chap 11, TFT-LCD control practice using FPGA

- 11.1 An outline
- 11.2 TFT-LCD configuration and explanation on the operation
- 11.3 TFT-LCD operation method
- 11.4 Design Block Diagram
- 11.5 Adding TFT-LCD demonstration logic
- 11.6 Verification on SoC-7000 platform
- 11.7 HDL code analysis
- 11.8 Simulation using Xilinx Isim

### Chap 12, TFT-LCD control practice (AHB) using ARM

- 12.1 An outline
- 12.2 Understand SoC Design-7000 system structure using Text-LCD Control IP
- 12.3 Text-LCD Control IP AMBA connection project making
- 12.4 Text-LCD control using Xilinx Software Development Kit
- 12.5 Text-LCD Control IP design source file analysis

### Chap 13, Camera control practice using FPGA

- 13.1 An outline
- 13.2 Camera configuration and explanation on the operation
- 13.3 Camera Control IP AMBA connection project making
- 13.4 Design Block Diagram
- 13.5 Add Camera demonstration logic
- 13.6 Verification from SoC Design-7000 platform
- 13.7 HDL code analysis

### Chap 14, LED, 7-Segment control practice (AXI) using ARM

- 14.1 An outline
- 14.2 understand SoC Design-7000 system structure using AXI Interface IP
- 14.3 AXI Slave IP connection project making
- 14.4 AXI IP control using Xilinx Software Development Kit



## Specification

### 1) Module Spec

tem.	Spec
FPGA.	XC7Z020-CLG484 (Process: Dual core ARM Cortex-A9, FPGA: Artix7~1.3 M ASIC Gates))
I/O.	Tile Connector: 120-pin connector 2ea (total 240 pins)
Configuration.	Pin Header (14 pins. 2mm pitch) SPI Flash Memory (128M bits)
Clock.	Processor Clock Oscillator: 33MHz
Memory.	DDR3 Memory: 512M Bytes SPI EEPROM: 128M bits
UART.	High-speed UART (up to 1Mb/s)
SD/MMC.	SD/MMC Slot
Communication.	Gigabit Ethernet (Marvell 88E1116R) USB2.0 OTG (SMSC USB3320)
GPIO.	Processor: two LED, two Push Button, DIP Switch-2 FPGA: four LED, one Push Button, DIP Switch-2
Power.	5V Power connector or 5V Power from base board Regulator 3.3V Regulator-1ea, 2.5V Regulator-1ea 1.5V Regulator-1ea, 1.0V Regulator-1ea

### 2) Base Board spec

Item.	Spec
Tile Connector.	120-pin Connector, 2ea (a SoC-7000M mounting dragon)
Display.	HDMI Transceiver 5.0 Inch/380 [c d], 800x480 24bit (Data enable mode use)
Camera.	CMOS image sensor camera module (3000000 pixels)
Audio.	AC97 Audio Codec (CS4202)
Clock.	24MHz Crystal/PLL (10-200MHz) Oscillator Socket
Communication.	WIFI: high speed IEEE802.11b/g, 54 magabps data rate USB2UART (CP2103) Controller area network (CAN) interface I2C interface-6ea
ADC.	ADC 10-bit 65MSPS
DAC.	DAC 12-bit 125MSPA
GPIO.	LED-8ea, Push Switch-8ea, DIP-8 Switch Extension connector 1) 20 pins 2.54mm pin header: 3.3V Power out, Ground, FPGA I/O 14pins 2) Ten pins 2.54mm pin header 3.3V Power out, Ground, FPGA I/O eight pins
ETC.	7-Segemt, Text-LCD
Power.	ATX Power connector Regulator 3.3V Regulator-1ea, 1.8V Regulator-1ea

### 3) Software Spec

OS.	Kernel 2.6.35
Compiler.	GNU Tool for ARM
Bootloader.	U-boot 2010.03
Device Driver.	T-Flash, USB2.0 Host USB2.0 OTG GPS, Ethernet 100/1000, Serial (RS232), HDMI, Key Button/Tact Switch /LED/Dip Switch

# 30

## a group of DSP training system

62. DSP-TMS320F28335

# model: **DSP-TMS320F28335**

## Digital Signal Processor Trainer

DSP-TMS320F28335 is a universal training kit designed to practice functions of processors using Delfino product family TMS320F283xx processors of TI (Texas Instruments) (e.g. TMS320F28335, TMS320C28346, etc...)

DSP-TMS320F28335 is the first trainer that has introduced a Dual MCU and the concept of interaction, allowing to users evaluate and practice all functions and of a Delfino processor on a single board.

Moreover, DSP-TMS320F28335 is equipped with a firmware for evaluation and training, allowing users to practice a high-performance processor more dynamically.

DSP-TMS320F28335 is basically equipped with various application circuits including analog, digital and communication circuits so that user can directly implement systems in various applications.

DSP-TMS320F28335 is provided with high-precision HiFi stereo codec/mike to process analog/digital audio and video signals and supports various communication protocols such as CAN/SPI/SCI/I2C, etc.

DSP-TMS320F28335 also provides interfaces for external memory bus expansion, main expansion and auxiliary expansion, and various application boards such as LCD, TCP/IP, USB, DC motor, Boost/Buck, etc. will be released.

### Feature

- 1) Industry 's first training kit equipped with a Dual MCU
  - Delfino processor + TMS320F2808 processor
  - Delfino processor: TMS320F28335 or TMS320C28346 selectable
  - TMS320F2808 processor: Equipped with a firmware for evaluation and training
- 2) Interactive EVM
  - Communication between MCUs on a single board (support CAN, SPI, SCI, I2C and McBSP tests)
  - Provide multi-MCU system design technology
  - Provide more dynamic self-training
  - Various test signals delivered from TMS320F2808
- 3) External memory bus output
  - Memory expandable
  - Simple to add devices such as TCP/IP, USB, LCD, etc., which are controlled over the memory bus
- 4) External communication ports
  - Optional CAN/RS232C common 2 channels
  - Syncworks standard 8-pin communication connector (CAN A/B, SCI, I2C)
- 5) External interface
  - Main expansion: 2 x 32, 2.54 mm ADC/PWM/CAP/QEP/GPIO port output
  - Auxiliary expansion: Auxiliary ADC, auxiliary PWM port output

## Components

Hardware Platform (Development Board)	Hardware platform (Delfino development board) – Accommodated in an aluminum case	1EA
Processor module	TMS320F28335 micro bus module x 1EA, TMS320F2808 micro module x 1EA	2EA
Accessory module	Communication module 1EA Motor module 1EA	2EA
JTAG Emulator	Insulated JTAG emulator 1EA	1EA
Development Software CD	Code Composer Studio 5 (free version)	1EA
Other Software CD	Motor control Android APP & PC program	1EA
Textbook		3 BOOKS
Power cable		1EA

## System configuration



## Software and Functions

Code Composer Studio 5	Editor, compiler and debugger functions for DSP development
Android App	Commands for motor control and data monitoring
PC Program	Commands for motor control and data monitoring

## Textbook

### [ Book - 1 ] - Introduction to DSP Trainer and Firmware Design

#### Part 1. Operation Manual for DSP Trainer

Chapter 1, Introduction to DSP Processor

Chapter 2, DSP Hardware Operation Manual

#### Part 2. Firmware Design

Chapter 1, Introduction to TMS320F28x and Understanding of Development Environment

Chapter 2, CPU Structure and Linker

Chapter 3, Chip Initialization

Chapter 4, Interrupt & Boot

Chapter 5, Project Creation

Chapter 6, Flash Boot and Optimization of Flash Memory Speed

### [ Book - 2 ] - System Design

Chapter 1, ePWM/HRPWM

Chapter 2, Communication

Chapter 3, eCAP/eQEP

Chapter 4, ADC and QMATH

Chapter 5, H/W Design

Chapter 6, DMA

Chapter 7, FLASH API

### [ Book - 3 ] - Practice of Sample Examples

Experiment 1, GPIO Practice

Experiment 2, CPU Timer Practice

Experiment 3, ADC Practice

Experiment 4, ADC / DMA Practice

Experiment 5, PWM Practice

Experiment 6, EPWM Practice

Experiment 7, EQEP Practice

Experiment 8, eCAP/Eqep Practice

Experiment 9, FLASH Programming Practice

## Specification (Hardware & Software)

### 1) General spec

1. Dimension	39cm x 28cm x 17cm (W x H x D) Aluminum Case
2. Power	220V
3. Key Functions	
3.1 Main Processor Module 1EA	TMS320F28335 micro bus module: Main control
3.2 Sub Processor Module 1EA	TMS320F2808 micro bus module: Auxiliary functions for the main processor.
3.2 Communication Module 1EA	Bluetooth, USB communication
3.3 Stepping Motor Circuit 1EA	Experiment of Micro stepping motor control
3.4 DC Motor Circuit 1EA - included high precision encoder.	Experiment of speed and position control using an encoder.
3.5 Variable Resistor Circuits 2EA	AD Converter Function Test Circuits
3.6 HiFi Stereo Audio Codec Circuit 1EA	SPI Communication test and voice signal analysis test
3.7 Capacitor Mike Circuits 2EA	Voice signal collection circuit for voice processing
3.8 LED Circuits 24EA - including circuits for main processor and auxiliary processor	High brightness LEDs for control display
3.9 Rotary Encoder 1EA on a motor.	Encoder test circuit simulating an encoder mounted on a motor.
3.10 RRS232 Interface 1EA, CAN Interface 1EA I2C Interface 1EA	Circuits to test communication between boards and between chips.
3.11 PWM to Analog Circuit 1EA	Analog output test circuit using high precision PWM

### 2) Main processor spec

Processor	TI, TMS320F28335ZJZA
CPU	32bit integer C28x Core
Computational power	150MHz, 150MMAC, 300MFLOPS
Memory	RAM: 68KByte, OTP: 2KByte, Flash 512KByte
DMA	6CH
Timer	"32bit CPU Timer 3ea, 8bit Watchdog Timer 1ea, 32bit CAP Timer 6ea 16bit PWM Timer 6ea, 32bit QEP Timer 2ea"
PWM	"PWM 12CH(ePWM 6ea, 6.67ns), HRPWM 6CH(allot to each ePWMxA 150ps) APWM 6CH(when eCAP module is used to APWM mode)."
CAP/QEP	6ea / 2ea
ADC	12bit, 16CH, Max 12.5MSPS
GPIO	88ea
Communication	SCI 3ea, SPI 1ea, eCAN 2ea, McBSP 2ea, I2C 1ea
Boot mode	Flash, SPI, SCI, eCAN, internal RAM, OTP, Parallel ,,,etc.
Voltage	Core: 1.9V, I/O: 3.3V
Operation temperature	-40 ° ~ +85 °

# 31

## **a group of Microcontroller & Microprocessor training system**

- 63. Breadboard-1000
- 64. PIC-16F874
- 65. Microprocessor & Controller - PIC, 8051, AVR
- 66. Microprocessor-8051
- 67. Microprocessor-AVR
- 68. Microprocessor-Cortex M3
- 69. Microprocessor-8051, AVR, Cortex M3

# model: Breadboard -1000

## Breadboard kit

### Feature

1. use five types of Power (fixed five channel) that is actually needed in circuit experiment
2. Output Indicator by each voltage
3. Input power FREE VOLT
4. Various circuit experiment

### System configuration



### Specifications

1) INPUT POWER	FREE VOLT (110/220V)
2) OUTPUT VOLTAGE (fixed five CH)	+5V, +12V, +15V, -12V, -15V
3) OUTPUT TERMINAL	5 EA
4) TIE POINT	1920
5) BUS TIE POINT	300
6) Use temperature 0-45 degrees, below 85% R.H	
7) Input power	FREE VOLT
8) Size	213mm(W) × 80mm(H) × 270mm(D)

### Components

1) Hardware Bread Board	1 ea
2) JUMPER WIRE	1 set
3) Power supply cable	1 ea

# model: **PIC-16F874**

## PIC Microcontroller kit

### Feature

PIC Microcontroller kit, PIC- 16F874 is a training system for students to easily understand and access PIC microcontroller applications in the industry.

PIC-16F874 enables students to learn about the hardware theory and software programming methodology for each application as well as the basic theory of PIC and to understand the PIC theory and technology through examples and practices that can be implemented by students themselves.

The purpose of PIC-16F874 is to present various practices of clock, thermo/humidity meter, velocity-controlled motor, lock-key, etc. for students to understand technologies applicable to the industry and to provide a motive for development of enhanced embedded systems.

PIC-16F874 is designed to make it easy to learn software programming methodology as well as hardware theory of applications and to allow students to practice the whole training course of the embedded system.

It is expected that PIC-16F874 will help students understand the embedded system and will encourage interest in practices and increase utilization of applications.

### Functions

- Applicable to on-site Embedded exercise per module
- Module by hardware and software, Training.
- Easy Embedded software Training.
- Hardware exercise is possible.
- Using a computer can be monitoring and control all function.
- Provides CD for exercise programming.

### Application Program

- UART Communication control practice
- FND Display control practice
- RTC control practice
- Sensor control practice
- Motor control practice
- Encoder control practice
- LCD control practice
- Key Matrix control practice
- EEPROM control practice

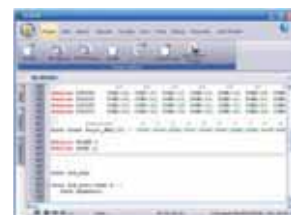
### System configuration



<PC Application>



<Hardware board of PIC 16F874>



<PIC Compiler>



## Training Contents

- Part1. Introduction of PIC Microcontroller Trainer (PIC-16F874)
  - Chapter1. Introduction of PIC Microcontroller Trainer (PIC-16F874)
  - Chapter2. Understanding to PIC Microcontroller.
- Par2. PIC Hardware practice
  - Chapter3. Clock practice
  - Chapter4. Communication control practice
  - Chapter5. Temperature and Humidity practice
  - Chapter6. Motor control practice
  - Chapter7. Lock-Key practice
- Part3. Clock Software practice
  - Chapter8. UART Control practice
  - Chapter9. FND control practice
  - Chapter10. Interrupt control practice
  - Chapter11. Timer control practice
  - Chapter12. RTC control practice
- Part4. Temperature and Humidity Software practice
  - Chapter13. SMD type, temperature control practice
  - Chapter14. Semi-conductor type, Temperature control practice
  - Chapter15. Semi-conductor type, Humidity control practice
- Part5. Software practice for Motor which Speed-control can be controlled
  - Chapter16. Motor control practice using IO
  - Chapter17. Motor control practice using Timer
  - Chapter18. Motor control practice using PWM
  - Chapter19. Motor feedback practice
- Part6. Lock-Key Software practice
  - Chapter20. Character LCD control practice
  - Chapter21. EEPROM control practice

## Hardware Specification

Controller Specification	
Chipset	PIC16F874
Operating speed	20MHz
Flash program memory	4K x 14bit words
Data memory	192 byte
EEPROM data memory	128 byte
Interface	USB to UART
Function	GPIO, External Interrupt, Timer, RTC, ADC, I2C, PWM
Device Specification	
FND	4 Array Digit 7-segment x 2ea
RTC	Leap year compensation valid up to 2100
SMD type Temp. Sensor	-55 °C to +125 °C
IC type Temp. Sensor	-55 °C to +125 °C, I2C
IC type Humidity Sensor	0-100% RH, I2C
DC Motor	mini DC motor

## Component

Hardware Board	1EA	Clock sub-board	1EA	Temperature and Humidity sub-board	1EA
Motor control sub-board for	1EA	Lock-Key sub-board	1EA	Demo MCU Board	1EA
Practice MCU Board	1EA	Power cable	1EA	Data cable	1EA
Communication cable	1EA	Textbook	1 Book	Example programming CD	1EA
Installation guide manual	1 EA				

# model: **Microcontroller - PIC, 8051, AVR**

## **Microcontroller Trainer**

### **Feature**

1. High Speed MICOM Writing function using USB Port.
2. 89S51, AVR, PIC Writing using USB Port of PC.  
(Equipped the Writer for Read, Write, Erase, Verify, Edit, Save function, and can experiment for various I/O devices)
3. Various I/O Port experiment and Interrupt experiment is available using LED, PUSH Switch & Toggle Switch.
4. DOT Matrix(8 × 8Dots), 2-Color(Red, Green) experiment.
5. Various display test (text) using LCD(16 × 2Line).
6. Stop Watch & Clock experiment is available using 4ea of 7-segment.
7. CDS, Thermistor, IrDA Sensor experiment.
8. Step Motor control experiment using Step Motor Driver Circuit.
9. DC Motor control experiment using PWM.
10. Sound experiment using Buzzer.
11. Numeric and event processing experiment using a 4 × 4 Keypad.
12. Relay Control experiment.
13. Equipped Bread board for User extended experiment.

### **System configuration**



### **Components**

Hardware platform.	1 ea
PIC module ( PIC16F874/877 )	1 ea
8051 Processor module ( AT89S51 )	1 ea
AVR module ( ATmega128 )	1 ea
USB cable	1 ea
RS232C cable	1 ea
Power adaptor	1 ea
Program CD	1 ea
Manual book	1 book

## Spec

### 1) Software

mDigital STUDIO
mDigital PROGRAMMER

### 2) MCU

8051	AT89S51
AVR	ATmega128
PIC	PIC16F84/877

### 3) Hardware

DC Motor	Motor- DC +12V (Motor Driver : L293),
Sensor	Photo Interrupt
STEP Motor	DC12V, 0.35A, 1.8°(Motor Driver ULN2064)
I/O Experiment	Toggle switch x 4, Push switch x 4, LED(3Ø) x 8
Display	Text LCD(16 x 2)
7 -Segment	4 Digits
Sensor Experiment	CDS, Thermistor, IrDA Sensor
Dot Matrix LED	8 x 8Dots(2 Color : Red, Green)
A/D Converter	MCP3202(Include AT89S51 Top Board)
SOUND	Buzzer
Keypad	4 x 4 Tact Switches
Relay	DC +5V, x 2
Serial Port	RS- 232C(MAX232)
Data comm	USB port

## Training contents

### 1. Overview

- 1-1. Package
- 1-2. Spec. of the MULTI MICOM DDS Kit

### 2. mDIGITAL Studio

- 2-1. Install mDIGITAL Studio
- 2-2. Overview mDIGITAL Studio
- 2-3. Executing C-Language Program
- 2-4. mDIGITAL PROGRAMMER

### 3. Experiment

- 3-1. LED on/off
- 3-2. Blink LED
- 3-3. Display a 7-segment
- 3-4. Flash "HELP"
- 3-5. Scan a 4x4 Key-matrix
- 3-6. External Interrupt
- 3-7. Clock
- 3-8. Display a character in LCD
- 3-9. Shift a character in LCD
- 3-10. Beep
- 3-11. Timer-counter
- 3-12. Step motor control
- 3-13. Step motor control
- 3-14. DC motor control
- 3-15. CdS
- 3-16. INFRARED
- 3-17. THERMISTOR
- 3-18. DOT
- 3-19. Data Communication

### Appendix

# model: **Microprocessor - 8051**

## **Microprocessor Trainer**

### **Feature**

This is Microprocessor Trainer which is very useful for the students who want to learn about 16-bit micro-processor. The detailed features can be described as below ;

- 1) Training system of 16-bit Microprocessor.
- 2) One module of 8051 Processor mounted.
- 3) 8051's Architecture, Assembler and Firmware practice.
- 4) Provide the manual book for Assembler and C language based 8051 module practice.
- 5) Provide various peripheral devices such as I/O Port, Dot Matrix, LCD, FND, Audio, Keypad, ADC/DAC, etc)

### **Functions**

- 1) This trainer is designed one module of 8051.
- 2) Users can do the following practices ;
  - (1) Peripheral device control by using assembler language to one module.
  - (2) Software and Hardware debugging practice.
- 3) The manual book is provided to manage Instruction and Program Status to be used as STEP Function.
- 4) The source program is provided for remote control and mutual communication & control through RS-232 cable by equipping 8051 module to Hardware platform.
- 5) C source code is provided which used for KEIL uVision 8051 Compiler by connecting 8051 (AT89C52) processor module.
- 6) Various peripheral devices like I/O Port, Dot Matrix is provided, and thus various experimental practice is available such as Step Motor speed, angle, LCD, FND, Audio, KEY, A / D, sensors, D / A test lab.
- 7) Lab test assembler, C source code and schematics are provided.

### **System configuration**

1) Hardware Platform



2) Configuration



## Components

Items	Num
Hardware platform	1 ea
8051 Processor module	1 ea
Parallel cable (for ISP)	1 ea
Serial cable	1 ea
USB cable	1 ea
Power cable	1 ea
Program CD	1 ea
Manual book for 8051 using Assembler and C language	1 book

## Spec

### 1) H/W : Processor Module

Items	Specification
	8051
Processor	AT89S52
Flash memory	8KB
SRAM	256Byte
A/D Converter	8 CH ADC
Debug port	ISP port
Extension port	50Pin Connector

### 2) H/W : Base Board

Item	Specification
RS-232C Port	2EA
RS-422 Port	1EA
Digital I/O	DIP Switch - 8EA, Tack Switch - 1EA, LED - 8EA
7 Segment	2EA
Key Matrix	16EA(4 x 4)
Stepping Motor	1EA
A/D Converter	ADC0809 (16bit,8CH) - 1EA
RTC,EEPROM	RTC - 1EA, EEPROM - 1EA
D/A Converter	AD 9708 (16bit) - 1EA
DOT Matrix	3 Colors(8 x8) - 1EA
Character	16 x 2 Line - 1EA
Graphic LCD	128 X 64 Graphic - 1EA
Sensor	Temp. Sensor -1 EA, Light Sensor - 1EA
Extension I/O Port	1EA (82C55-IO extension)
BUZZER	1EA
Speaker	1EA

### 3) S/W

Item	Specification
8051	KEIL uVision 8051 related Assembler practice example

## Training contents

### \* 8051 design and application using C language.

#### 8051 overview and tools

- Basic understanding of 8051
- Description to Circuit
- Compiler, ISP DOWNLOADER
- Address decoder (CPLD) configuration
- Basic practice using KEIL UVISION
- Usage of KEIL UVISION DEBUG tool
- Chapter 1 Assembly language, data transfer command
- Chapter 2 Assembly language, data transfer command
- Chapter 3 Assembly language, arithmetic command
- Chapter 4 Assembly language, logic operation, bit command
- Chapter 5 Assembly language jump command,

- subroutine call command
- Chapter 6 IO port control (LED)
- Chapter 7 Interrupt control practice
- Chapter 8 Timer / Counter practice
- Chapter 9 Serial port control
- Chapter 10 7-SEGMENT control
- Chapter 11 DOT MATRIX control
- Chapter 12 TEXT LCD control
- Chapter 13 Graphic LCD control
- Chapter 14 External expansion IO control
- Chapter 15 STEP MOTOR control
- Chapter 16 DAC/ADC control

# model: **Microprocessor-AVR**

## **Microprocessor Trainer**

### **Feature**

This is Microprocessor Trainer which is very useful for the students who want to learn about 16-bit micro-processor. This trainer has processor-module like AVR (Atmega 128).

The detailed features can be described as below ;

- 1) Training system of 16-bit Microprocessor.
- 2) One module like AVR (Atmega 128) Processor mounted.
- 3) AVR Architecture, Assembler and Firmware practice.
- 4) Practice of the initialized code analysis using Keil MDK-ARM, WinAVR compiler.
- 5) Provide the manual book for Assembler and C language based AVR module practice.
- 6) Provide various peripheral devices such as I/O Port, Dot Matrix, LCD, FND, Audio, Keypad, ADC/DAC, etc)

### **Functions**

- 1) This trainer is designed one module of AVR to be easily replaced from Hardware platform.
- 2) Users can do the following practices ;
  - (1) Peripheral device control by using assembler language to three modules.
  - (2) Booting the board through Keil MDK-ARM, WinAVR compiler.
  - (3) Software and Hardware debugging practice.
- 3) The manual book is provided to manage Instruction and Program Status to be used as STEP Function.
- 4) The source program is provided for remote control and mutal communication & control through RS-232 cable by equipping AVR module to Hardware platform.
- 5) C source code is provided which used for Keil MDK-arm Compiler by connecting AVR (ATmega128) processor module.
- 6) Various peripheral devices like I/O Port, Dot Matrizz is provided, and thus various experimental practice is available such as Step Motor speed, angle, LCD, FND, Audio, KEY, A / D, sensors, D / A test lab.
- 7) Lab test assembler, C source code and schematics are provided.

### **System configuration**

1) Hardware Platform



2) Configuration



## Components

Items	Num
Hardware platform	1 ea
AVR Processor module	1 ea
Parallel cable (for ISP)	1 ea
Serial cable	1 ea
USB cable	1 ea
Power cable	1 ea
Program CD	1 ea
Manual book for AVR using Assembler and C language	1 book

## Spec

### 1) H/W : Processor Module

Items	Specification
	AVR
Processor	ATmega128
Flash memory	128KB
SRAM	4KB
A/D Converter	8 CH ADC
Debug port	ISP port
Extension port	50Pin Connector

### 2) H/W : Base Board

Item	Specification
RS-232C Port	2EA
RS-422 Port	1EA
Digital I/O	DIP Switch - 8EA, Tack Switch - 1EA, LED - 8EA
7 Segment	2EA
Key Matrix	16EA(4 x 4)
Stepping Motor	1EA
A/D Converter	ADC0809 (16bit,8CH) - 1EA
RTC,EEPROM	RTC - 1EA, EEPROM - 1EA
D/A Converter	AD 9708 (16bit) - 1EA
DOT Matrix	3 Colors(8 x8) -1EA
Character	16 x 2 Line - 1EA
Graphic LCD	128 X 64 Graphic - 1EA
Sensor	Temp. Sensor -1 EA, Light Sensor - 1EA
Extension I/O Port	1EA (82C55-IO extension)
BUZZER	1EA
Speaker	1EA
Case Dimension	530(W) x 350(D) x 215(H)mm

### 3) S/W

Item	Specification
AVR	WinAVR related C language practice example

## Training contents

### \* 8051 AVR design and application using C language

#### AVR overview and tools

Basic understanding of AVR  
 CPU Core, Single Level Pipelining  
 General Purpose Register File  
 X-register, Y-register, and Z-register  
 Stack Pointer, RAM Page Z Select Register-RAMPZ  
 Command execution timing. Reset and Interrupt handling  
 Interrupt response time, Memory  
 Compiler (WinAVR) install and tool usage

Chapter 1 Debugger example practice I  
 Chapter 2 Debugger example practice II  
 Chapter 3 Debugger example practice III

Chapter 4 GPIO LED control  
 Chapter 5 Interrupt  
 Chapter 6 types of Interrupt  
 Chapter 7 External LED control  
 Chapter 8 FND control  
 Chapter 9 Character LCD control  
 Chapter 10 Dot Matrix control  
 Chapter 11 Graphic LCD control  
 Chapter 12 Dip Switch control  
 Chapter 13 Key Pad control  
 Chapter 14 Step Moter control  
 Chapter 15 Buzzer control  
 Chapter 16 USART control



# model: Microprocessor-Cortex-M3

## Microprocessor Trainer

### Feature

This is Microprocessor Trainer which is very useful for the students who want to learn about 32-bit micro-processor. This trainer has one processor-module like Cortex-M3.

The detailed features can be described as below ;

- 1) Training system of 32-bit Microprocessor.
- 2) One module like Cortex-M3 Processor mounted.
- 3) Cortex-M3 Architecture, Assembler and Firmware practice.
- 4) Practice of the initialized code analysis using Keil MDK-ARM, WinAVR compiler.
- 5) Provide the manual book for Assembler and C language based Cortex-M3 module practice.
- 6) Provide various peripheral devices such as I/O Port, Dot Matrix, LCD, FND, Audio, Keypad, ADC/DAC, etc)

### Functions

- 1) This trainer is designed one module of Cortex-M3 to be easily replaced from Hardware platform.
- 2) Users can do the following practices ;
  - (1) Peripheral device control by using assembler language to three modules.
  - (2) Booting the board through Keil MDK-ARM, WinAVR compiler.
  - (3) Software and Hardware debugging practice.
- 3) The manual book is provided to manage Instruction and Program Status to be used as STEP Function.
- 4) The source program is provided for remote control and mutual communication & control through RS-232 cable by equipping Cortex-M3 module to Hardware platform.
- 5) C source code is provided which used for Keil MDK-arm Compiler by connecting Cortex-M3 (STM32) processor module.
- 6) Various peripheral devices like I/O Port, Dot Matrix is provided, and thus various experimental practice is available such as Step Motor speed, angle, LCD, FND, Audio, KEY, A / D, sensors, D / A test lab.
- 7) Lab test assembler, C source code and schematics are provided.

### System configuration

1) Hardware Platform



2) Configuration





## Components

Items	Num
Hardware platform	1 ea
Cortex-M3 Processor module	1 ea
Parallel cable (for ISP)	1 ea
Serial cable	1 ea
USB cable	1 ea
Power cable	1 ea
Program CD	1 ea
Manual book for Cortex-M3 using Assembler and C language	1 book

## Spec

### 1) H/W : Processor Module

Items	Specification
	Cortex-M3
Processor	STM32F103
Flash memory	32KB
SRAM	6KB
DMA	7CH DMA
A/D Converter	16CHADC
USB	USB2.0 Client
Debug port	JTAG port
SD Card	SD Card *1 port
Ethernet	SPI Ethernet controller
Extension port	50Pin Connector

### 2) H/W : Base Board

Item	Specification
RS-232C Port	2EA
RS-422 Port	1EA
Digital I/O	DIP Switch - 8EA, Tack Switch - 1EA, LED - 8EA
7 Segment	2EA
Key Matrix	16EA(4 x 4)
Stepping Motor	1EA
A/D Converter	ADC0809 (8bit,8CH) - 1EA
RTC,EEPROM	RTC - 1EA, EEPROM - 1EA
D/A Converter	AD 9708 (8bit) - 1EA
DOT Matrix	3 Colors(8 x8) -1EA
Character	16 x 2 Line - 1EA
Graphic LCD	128 X 64 Graphic - 1EA
Sensor	Temp. Sensor -1 EA, Light Sensor - 1EA
Extension I/O Port	1EA (82C55-IO extension)
BUZZER	1EA
Speaker	1EA
Case Dimension	530(W) x 350(D) x 215(H)mm

### 3) S/W

Item	Specification
Cortex-M3	KEIL MDK- ARM related C language practice example

## Training contents

### \* Cortex-M3 design and application using C language

#### Cortex-M3 overview and tools

Introduction of Cortex-M3  
 Structure of Cortex-M3  
 CortexM3 Pin configuration  
 Programming tool  
 Compiler (KEIL MDK ARM) installation  
 How to use the development tool.

Chapter 1 GPIO LED control  
 Chapter 2 LED control  
 Chapter 3 Interrupt

Chapter 4 External LED control  
 Chapter 5 FND control  
 Chapter 6 Character LCD control  
 Chapter 7 Dot Matrix control  
 Chapter 8 Graphic LCD control  
 Chapter 9 Dip Switch control  
 Chapter 10 Key Pad control  
 Chapter 11 Step Moter control  
 Chapter 12 Buzzer control  
 Chapter 13 USART control

# model: Microprocessor - 8051.AVR.Cortex-M3

## Microprocessor Trainer

### Feature

This is Microprocessor Trainer which is very useful for the students who want to learn about 32-bit / 8-bit micro-processor. This trainer has three processor-modules like 8051, AVR, Cortex-M3.

The detailed features can be described as below ;

- 1) Training system of 32-bit, 8-bit Microprocessor.
- 2) Three modules like Cortex-M3, AVR, 8051 Processor mounted.
- 3) Cortex-M3, AVR, 8051's Architecture, Assembler and Firmware practice.
- 4) Practice of the initialized code analysis using Keil MDK-ARM, WinAVR compiler.
- 5) Provide the manual book for Assembler and C language based Cortex-M3, AVR, 8051 module practice.
- 6) Provide various peripheral devices such as I/O Port, Dot Matrix, LCD, FND, Audio, Keypad, ADC/DAC, etc)

### Functions

- 1) This trainer is designed three modules of Cortex-M3, AVR, 8051 to be easily replaced from Hardware platform.
- 2) Users can do the following practices ;
  - (1) Peripheral device control by using assembler language to three modules.
  - (2) Booting the board through Keil MDK-ARM, WinAVR compiler.
  - (3) Software and Hardware debugging practice.
- 3) The manual book is provided to manage Instruction and Program Status to be used as STEP Function.
- 4) The source program is provided for remote control and mutual communication & control through RS-232 cable by equipping Cortex-M3, AVR, 8051 modules to Hardware platform.
- 5) C source code is provided which used for Keil MDK-arm Compiler by connecting Cortex-M3 (STM32) processor module.
- 6) C source code is provided which used for Keil MDK-arm Compiler by connecting AVR (ATmega128) processor module.
- 7) C source code is provided which used for Keil MDK-arm Compiler by connecting 8051 (AT89C52) processor module.
- 8) Various peripheral devices like I/O Port, Dot Matrix is provided, and thus various experimental practice is available such as Step Motor speed, angle, LCD, FND, Audio, KEY, A / D, sensors, D / A test lab.
- 9) Lab test assembler, C source code and schematics are provided.

### System configuration

1) Hardware Platform



2) Configuration



Cortex-M3



AVR



8051

## Components

Items	Num
Hardware platform	1 ea
8051 Processor module	1 ea
AVR Processor module	1 ea
Cortex-M3 Processor module	1 ea
Parallel cable (for ISP)	1 ea
Serial cable	1 ea
USB cable	1 ea
Power cable	1 ea
Program CD	1 ea
Manual book for 8051 using Assembler and C language	1 book
Manual book for AVR using Assembler and C language	1 book
Manual book for Cortex-M3 using Assembler and C language	1 book

## Spec

### 1) H/W : Processor Module

Items	Specification		
	Cortex-M3	AVR	8051
Processor	STM32F103	ATmega128	AT89S52
Flash memory	32KB	128KB	8KB
SRAM	6KB	4KB	256Byte
DMA	7CH DMA		
A/D Converter	16CHADC	8 CH ADC	
USB	USB2.0 Client		
Debug port	JTAG port	ISP port	ISP port
SD Card	SD Card *1 port		
Ethernet	SPI Ethernet controller		
Extension port	50Pin Connector	50Pin Connector	50Pin Connector

### 2) H/W : Base Board

Item	Specification
RS-232C Port	2EA
RS-422 Port	1EA
Digital I/O	DIP Switch - 8EA, Tack Switch - 1EA, LED - 8EA
7 Segment	2EA
Key Matrix	16EA(4 x 4)
Stepping Motor	1EA
A/D Converter	ADC0809 (8bit,8CH) - 1EA
RTC,EEPROM	RTC - 1EA, EEPROM - 1EA
D/A Converter	AD 9708 (8bit) - 1EA
DOT Matrix	3 Colors(8 x8) -1EA
Character	16 x 2 Line - 1EA
Graphic LCD	128 X 64 Graphic - 1EA
Sensor	Temp. Sensor -1 EA, Light Sensor - 1EA
Extension I/O Port	1EA (82C55-IO extension)
BUZZER	1EA
Speaker	1EA
Case Dimension	530(W) x 350(D) x 215(H)mm

### 3) S/W

Item	Specification
Cortex-M3	KEIL MDK- ARM related C language practice example
AVR	WinAVR related C language practice example
8051	KEIL uVision 8051 related Assembler practice example

## Training contents

### 1) 8051 design and application using C language.

#### 8051 overview and tools

- Basic understanding of 8051
- Description to Circuit
- Compiler, ISP DOWNLOADER
- Address decoder (CPLD) configuration
- Basic practice using KEIL UVISION
- Usage of KEIL UVISION DEBUG tool

Chapter 1 Assembly language, data transfer command (1)  
Chapter 2 Assembly language, data transfer command (2)  
Chapter 3 Assembly language, arithmetic command  
Chapter 4 Assembly language, logic operation, bit command  
Chapter 5 Assembly language jump command, subroutine call command  
Chapter 6 IO port control (LED)  
Chapter 7 Interrupt control practice  
Chapter 8 Timer / Counter practice  
Chapter 9 Serial port control  
Chapter 10 7-SEGMENT control  
Chapter 11 DOT MATRIX control  
Chapter 12 TEXT LCD control  
Chapter 13 Graphic LCD control  
Chapter 14 External expansion IO control  
Chapter 15 STEP MOTOR control  
Chapter 16 DAC/ADC control

### 2) AVR design and application using C language

#### AVR overview and tools

- Basic understanding of AVR
- CPU Core, Single Level Pipelining
- General Purpose Register File
- X-register, Y-register, and Z-register
- Stack Pointer, RAM Page Z Select Register-RAMPZ
- Command execution timing. Reset and Interrupt handling
- Interrupt response time, Memory
- Compiler (WinAVR) install and tool usage

Chapter 1 Debugger example practice I  
Chapter 2 Debugger example practice II  
Chapter 3 Debugger example practice III  
Chapter 4 GPIO LED control  
Chapter 5 Interrupt  
Chapter 6 types of Interrupt  
Chapter 7 External LED control  
Chapter 8 FND control  
Chapter 9 Character LCD control  
Chapter 10 Dot Matrix control  
Chapter 11 Graphic LCD control  
Chapter 12 Dip Switch control  
Chapter 13 Key Pad control  
Chapter 14 Step Moter control  
Chapter 15 Buzzer control  
Chapter 16 USART control

### 3) Cortex-M3 design and application using C language

#### Cortex-M3 overview and tools

- Introduction of Cortex-M3
- Structure of Cortex-M3
- CortexM3 Pin configuration
- Programming tool
- Compiler (KEIL MDK ARM) installation
- How to use the development tool.

Chapter 1 GPIO LED control  
Chapter 2 LED control  
Chapter 3 Interrupt  
Chapter 4 External LED control  
Chapter 5 FND control  
Chapter 6 Character LCD control  
Chapter 7 Dot Matrix control  
Chapter 8 Graphic LCD control  
Chapter 9 Dip Switch control  
Chapter 10 Key Pad control  
Chapter 11 Step Moter control  
Chapter 12 Buzzer control  
Chapter 13 USART control

# 32

## a group of ROBOT training system

- 70. DC motor robot-1000
- 71. STEP motor robot-1000
- 72. RF control robot-1000
- 73. Humanoid-5000
- 74. Intelligent Mobile Robot Trainer-7000
- 75. ibrain Mobile robot trainer-8000
- 76. Omi-directional & 7-DOF Manipulator robot -8000
- 77. Industrial 6 axis robot-GT290

# model: **DC motor robot-1000**

## **DC Motor Robot Trainer**

### **Feature**

DC robot-1000 is an educational robot assembly kit in which modules are connected through flat cables, and user can assemble the provided components to make the DC motor robot kit.

User can learn about microprocessors with the assembled robot kit, and the robot is extensible so that user can do practice with the extension modules.

Also, user can download programs with AVR Studio 4, and user can practice programming for various parts of the microcontroller with the source programs provided in DC robot-1000.

### **Functions**

1) by using AVR-Family series, Microcontroller ATmega128 which AVR Core is built-in,

- (1) Infrared sensor experiment
- (2) Motor experiment
- (3) DC motor experiment using PWM
- (4) Forward, backward, Acceleration, Deceleration experiment on Motor
- (5) Motor operation experiment by sensor
- (6) Line tracer experiment

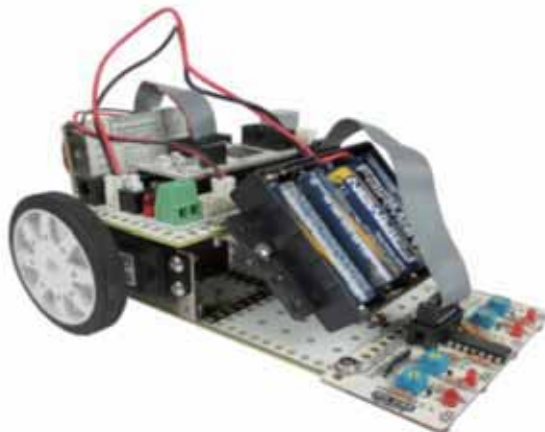
2) by using the expansion module,

- (1) Dot Matrix experiment
- (2) LED experiment
- (3) KEY experiment
- (4) TEXT LCD experiment
- (5) Graphic LCD experiment
- (6) STEP motor experiment
- (7) SERVO motor experiment
- (8) Ultrasonic sensor experiment
- (9) PSD sensor experiment
- (10) FND experiment

3) For Line-tracer robot practice,

- (1) Assembling DC Motor robot,
- (2) Operating practice of DC motor robot
- (3) Programming practice for DC motor robot

### **System configuration**



## Components

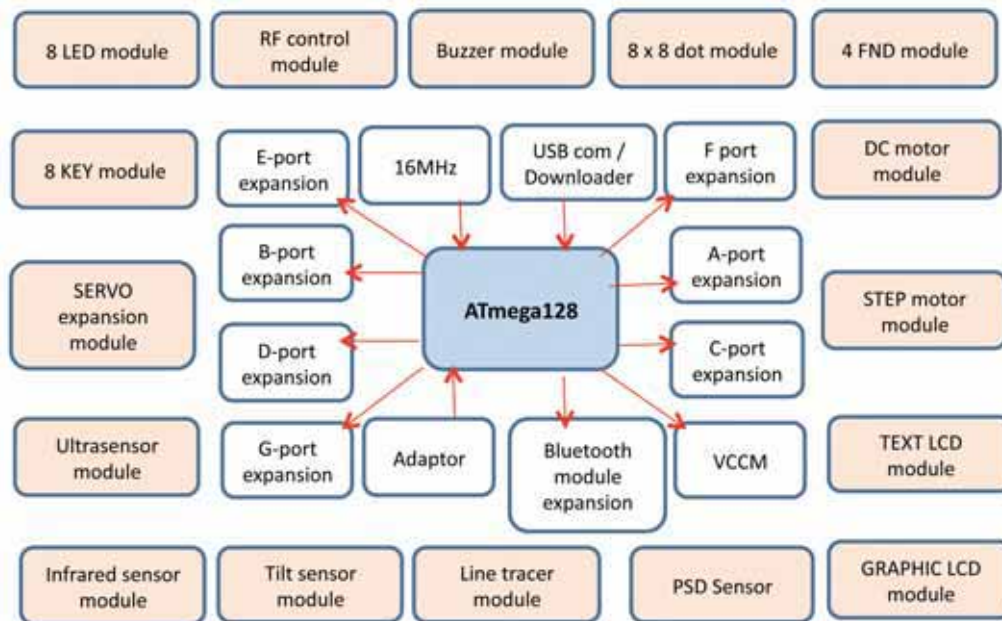
Component	q'ty	
	equipped	separate
Hardware of DC motor control robot		1
USB Downloader(6pin modular cable+TM-USB100)		1
power cable	2	
10pin flat cable (20cm)	2	2
charging battery	1	
FND Module		1
LED Module		1
Switch(Key) Module		1
Infrarde Module	1	
Interface Module	1	
DC Motor Module	1	
ATmega128 Module	1	
DC motor	2	
wheel	2	
Adaptor		1
Program CD		1
Manual book		1

## Training contents

1. about DC motor robot
2. Block Diagram
3. Contents of Experiment
4. Types of external expansion module
5. Description of Robot components
6. Circuit diagram
7. Program Download
8. about AVR
9. AVR Microcontroller types
10. Features of ATmega128
11. Explanation of ATmega128 port
12. Internal structure of ATmega128
13. ATmega128 Memory
14. System Clock
15. Timer/Counter Oscillator
16. System Control and Reset
17. Watchdog Timer
18. ATmega128 I/O Register
19. Experiment 1. LED
20. Experiment 2. Switch
21. Experiment 3. Timer
22. Experiment 4. Interrupt
23. Experiment 5. Counter
24. about DC Motor
25. Experiment 6. Forward & Backward rotation experiment on DC Motor
26. Experiment 7. Motor experiment using PWM
27. Experiment 8. Acceleration & Deceleration experiment on DC Motor
28. about Infrared Sensor
29. Experiment 9. LED experiment using infrared sensor
30. Experiment 10. Motor experiment using infrared sensor
31. Line-tracer Assembly Diagram
32. Experiment 11. Experiment 1 for Line-tracer Robot
33. Experiment 12. Experiment 2 for Line-tracer Robot
34. Programming practice for DC Motor robot



## Block Diagram



## Specification

Item	Spec
MCU Module	TM128-100(ATmega128)
DC driver Module	TM-MOT100(L298)
Power	AA size (1.5V X 4 )
Line sensor	TM-SEN-300(4ch sensor)
downloader	TM-USB100
Software	AVR Studio4
Body frame	120X80
DC Motor	250 RPM Motor
Battery casing	TM-BAT100
Main frame	118mmX78mm
Fixed frame for motor	"L" tab 2X3
Wheel	Wheel 60 pies
Cable	10PIN flat cable
DC motor module power cable	2 PIN cable



# model: **STEP robot-1000**

## **STEP Motor Robot Trainer**

### Feature

STEP robot-1000 is an educational robot assembly kit in which modules are connected through flat cables, and user can assemble the provided components to make the DC motor robot kit.

User can learn about microprocessors with the assembled robot kit, and the robot is extensible so that user can do practice with the extension modules.

Also, user can download programs with AVR Studio 4, and user can practice programming for various parts of the microcontroller with the source programs provided in STEP robot-1000.

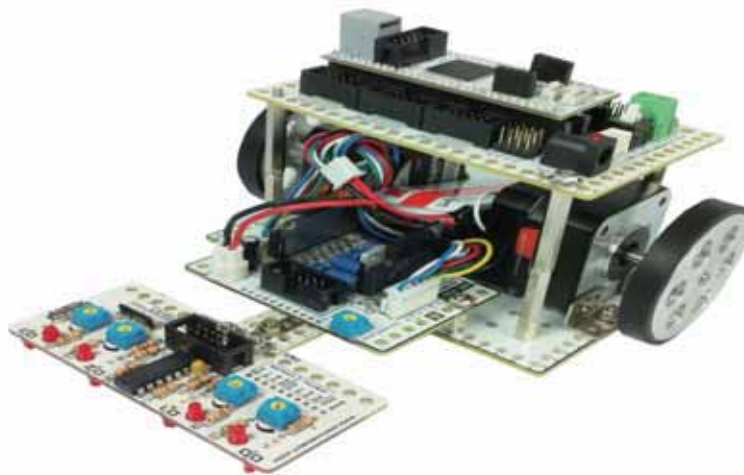
### Functions

- 1) by using AVR-Family series, Microcontroller ATmega128 which AVR Core is built-in,
  - (1) Infrared sensor experiment
  - (2) Motor experiment
  - (3) DC motor experiment using PWM
  - (4) Forward, backward, Acceleration, Deceleration experiment on Motor
  - (5) Motor operation experiment by sensor
  - (6) Line tracer experiment
- 2) by using the expansion module,
  - (1) Dot Matrix experiment
  - (2) LED experiment
  - (3) KEY experiment
  - (4) TEXT LCD experiment
  - (5) Graphic LCD experiment
  - (6) STEP motor experiment
  - (7) SERVO motor experiment
  - (8) Ultrasonic sensor experiment
  - (9) PSD sensor experiment
  - (10) FND experiment
- 3) For STEP motor robot practice,
  - (1) Assembling STEP Motor robot
  - (2) Operating practice of STEP motor robot
  - (3) Programming practice of STEP Motor robot

## Components

Components	q'ty (ea)	Components	q'ty (ea)
USB Downloader	1	Supporting pole 10mm	8
Interface module	1	Supporting pole 50mm	4
TM128-100	1	Driver	1
TM-MOT200	1	Nut Driver	1
Motor	2	12Cm Flat cable	2
Wheel	2	Bolt	50
Sensor board	1	Nut Driver	50
Main frame	1	5mm Bolt	10
"L" Width 1X1 frame	4	Power Cable	1

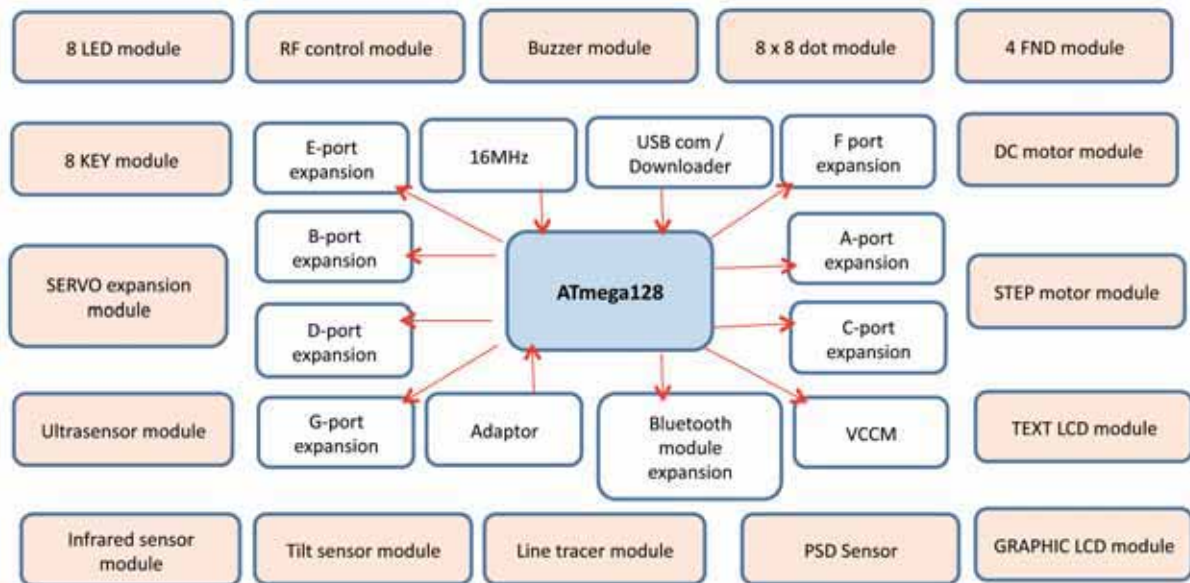
## System configuration



## Training Contents

1. about STEP motor robot
2. Block Diagram
3. Contents of Experiment
4. Types of external expansion module
5. Description of Robot components
6. Circuit diagram
7. Program Download
8. about AVR
9. AVR Microcontroller types
10. Features of ATmega128
11. Explanation of ATmega128 port
12. Internal structure of ATmega128
13. ATmega128 Memory
14. System Clock
15. Timer/Counter Oscillator
16. System Control and Reset
17. Watchdog Timer
18. Experiment 1. LED
19. Explanation on STEP motor
20. Experiment 2. STEP motor experiment - 1
21. Experiment 3. STEP motor experiment - 2
22. Experiment 4. STEP motor experiment - 3
23. Explanation on Sensor
24. Experiment 5. LED experiment using Sensor
25. Experiment 6. Motor experiment - 1 using Sensor
26. Experiment 7. Motor experiment - 2 using Sensor
27. Experiment 8. Explanation on Infrared Sensor
28. Experiment 9. LED experiment using Sensor
29. Experiment 10. Motor experiment using Sensor
30. Experiment 11. Robot assembling experiment for STEP motor Line-tracer robot - 1
31. Experiment 12. Robot assembling experiment for STEP motor Line-tracer robot - 2
32. Programming practice for STEP Motor robot

## Block Diagram



## Specifications

Item	Spec
MCU Module	TM128-100(ATmega128)
DC driver Module	TM-MOT200(SLA7026)
Power	Lithium-Polymer battery
Line sensor	TM-SEN-300(4ch sensor)
downloader	TM-USB100
Software	AVR Studio4
Body frame	120X80
Motor	STEP motor
Main frame	118mmX78mm
Middle frame	78mmX28mm
Connecting cable	10PIN flat cable
Wheel	Aluminum Wheel 50.2 pies
STEP motor Drive	SLA7026
Power cable	2 PIN cable
Fixed frame for STEP motor	L1X1X3 frame

# model: **RF Control Robot-1000**

## **RF Control robot trainer**

### **Feature**

RF robot-1000 is an educational robot assembly kit in which modules are connected through flat cables, and user can assemble the provided components to make the DC motor robot kit. User can learn about microprocessors with the assembled robot kit, and the robot is extensible so that user can do practice with the extension modules and can learn about UART communication. Also, user can download programs with AVR Studio 4, and user can practice programming for various parts of the microcontroller with the source programs provided in RF robot-1000.

### **Functions**

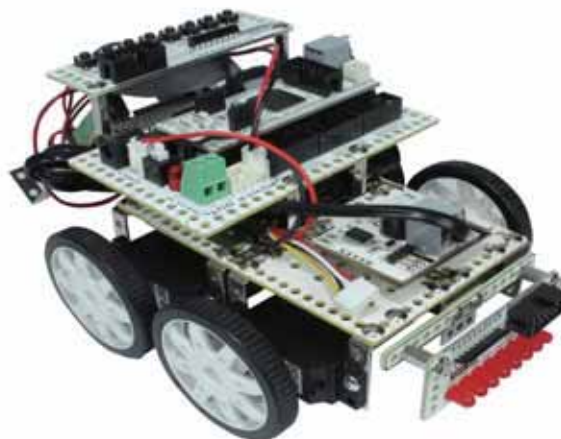
- 1) by using AVR-Family series, Microcontroller ATmega128 which AVR Core is built-in,
  - (1) Infrared sensor experiment
  - (2) Motor experiment
  - (3) DC motor experiment using PWM
  - (4) Forward, backward, Acceleration, Deceleration experiment on Motor
  - (5) Motor operation experiment by sensor
  - (6) Line tracer experiment
- 2) by using the expansion module,
  - (1) Dot Matrix experiment
  - (2) LED experiment
  - (3) KEY experiment
  - (4) TEXT LCD experiment
  - (5) Graphic LCD experiment
  - (6) STEP motor experiment
  - (7) SERVO motor experiment
  - (8) Ultrasonic sensor experiment
  - (9) PSD sensor experiment
  - (10) FND experiment
- 3) For RF Control robot practice,
  - (1) Assembling RF Control robot,
  - (2) Operating practice of RF Control robot
  - (3) Programming practice of RF Control robot

Component	q'ty	
	equipped	separate
Hardware of RF Control robot-1000		1
USB Downloader(6pin modular cable+TM-USB100)		1
Power cable	2	
10pin flat cable (20cm)	1	2
Charging battery	1	
FND Module		1
LED Module		1
Switch(Key) Module		1
Bluetooth Module	1	
Interface Module	1	
DC Motor Module	1	
ATmega128 Module	1	
DC motor	4	
wheet	4	
Bluetooth Remote Control		1
Program CD		1
Manual book		1

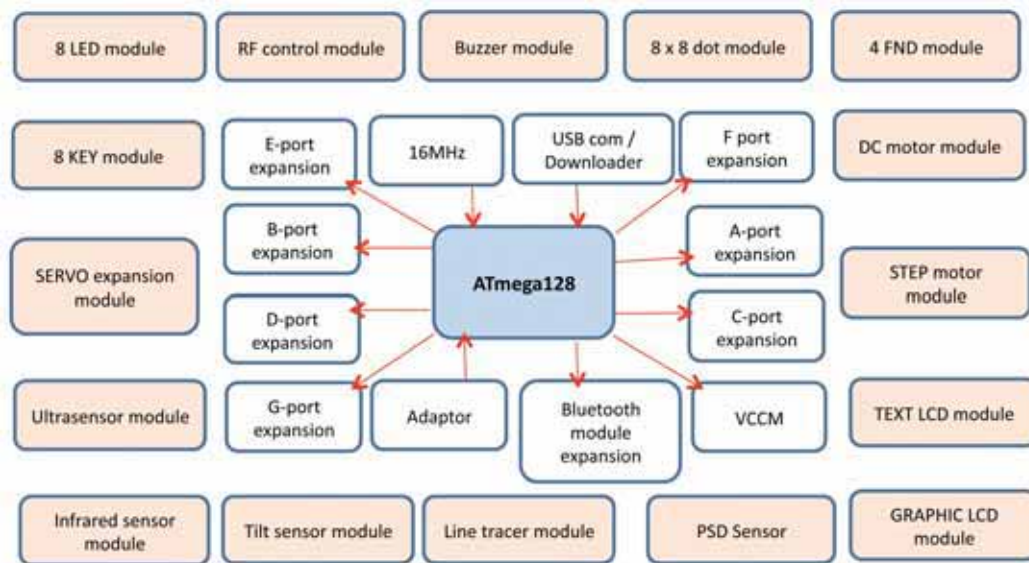
## Training contents

1. about RF Control Robot
2. Block Diagram
3. Contents of Experiment
4. Types of external expansion module
5. Description of Robot components
6. Circuit diagram
7. Program Download
8. about AVR
9. AVR Microcontroller types
10. Features of ATmega128
11. Explanation of ATmega128 port
12. Internal structure of ATmega128
13. ATmega128 Memory
14. System Clock
15. Timer/Counter Oscillator
16. System Control and Reset
17. Watchdog Timer
18. ATmega128 I/O Register
19. Experiment 1. LED-1
19. Experiment 2. LED-2
20. Experiment 3. Switch-1
20. Experiment 4. Switch-2
21. about Interrupt
22. Experiment 5. Interrupt
23. Experiment 6. Timer
24. Experiment 7. Counter
25. about DC Motor
26. Experiment 8. Forward & Backward rotation experiment on DC Motor
27. Experiment 9. Motor experiment using PWM
28. Experiment 10. Acceleration & Deceleration experiment on DC Motor
29. Experiment 11. UART Communication
30. RF robot Assembly Diagram
31. Experiment 12. RF Robot Control Test-1
32. Experiment 13. RF Robot Control Test-2
33. Programming practice for RF Control Robot

## System configuration



## Block Diagram



## Specifications

Item	Spec
MCU Module(TM128-100)	ATmega128 (Bluetooth can be installed )
DC driver Module	TM-MOT100(L298)
Power	Lithium Polymer
Line sensor	TM-SEN-300(4ch sensor)
downloader	TM-USB100 (Bluetooth can be installed)
Software	AVR Studio4
Body frame	120X80
DC motor	250 RPM Motor
LED board	8 channel red LED(TM-LED8)
KEY board	8 channel SW(TM-KEY8)
RF Receiver module (TM-RF100)	4P4C connector
RF controller	Function key - 16KEY
Main frame	118mmX78mm
Small frame	78mmX8mm
Connection cable	10PIN flat cable
Wheel	Wheel 60 pies
Cable	10 PIN flat cable
DC motor module power cable	2 PIN cable

# model: **Humanoid-5000**

## **Humanoid Robot Trainer**

### **Feature**

Humanoid-5000 is a bipedal (2-legged) humanoid programmable walking robot designed for educational needs. It contains MR-C30224 FX controller and 17 MRS-D2009SP servomotors,,, etc  
User can learn basic programming concepts and enabling themselves to perform more sophisticated actions. Humanoid-5000 can be controlled with a remote controller, and can detect the objects and speak.

A humanoid robot is a robot with its body shape built to resemble the human body. The design of Humanoid-5000 is for functional purposes, such as various programming to learn the basic of interacting with human tools and environments, for experimental purposes, such as the study of bipedal locomotion, or for other purposes. Humanoid-5000 robot has a torso, a head, two arms, and two legs,,, etc

There are many C-language programming courses for webcam service using Raspberry-pi module,,, etc

- \* Humanoid-5000 Robot Pan/Tilt Service Programming
- \* Humanoid-5000 ROBOT BUILT-IN MOTION PROGRAMMING
- \* Humanoid-5000 ROBOT DRIVE PROGRAMMING
- \* Humanoid-5000 ROBOT SENSOR PROGRAMMING
- \* Humanoid-5000 ROBOT CAMERA PROGRAMMING ,,, etc

The course will help you get started and ignite user's knowledge in robotics field while building your basic programming skills.

### **Functions**

- 1) Various robot functions are built in.  
User can precisely adjust joints and enable various robot's actions:
  - (1) Walking
  - (2) Image recognition
  - (3) Obstacle detection
  - (4) Distance measurement
  - (5) Voice generation
- 2) Simple robot control using remote controller.
- 3) Computer based control using C-language programming ;
  - (1) Programming MF Bumper application
  - (2) Making robot move
  - (3) Making robot speak
  - (4) Programming MF PlayMotionSoundLed Service Application
  - (5) Calculating the distance value of obstacles
  - (6) Programming DRIVE Service Application,,, etc.
  - (7) Programming practice for webcam service using Raspberry-pi module.
- 4) Total system including frame, controller, UI software, Power, Sensor is provided.
- 5) User can create new motions & functions using MSRDS VPL.
- 6) Strong holding torque as all parts are manufactured in aluminum.



## Components

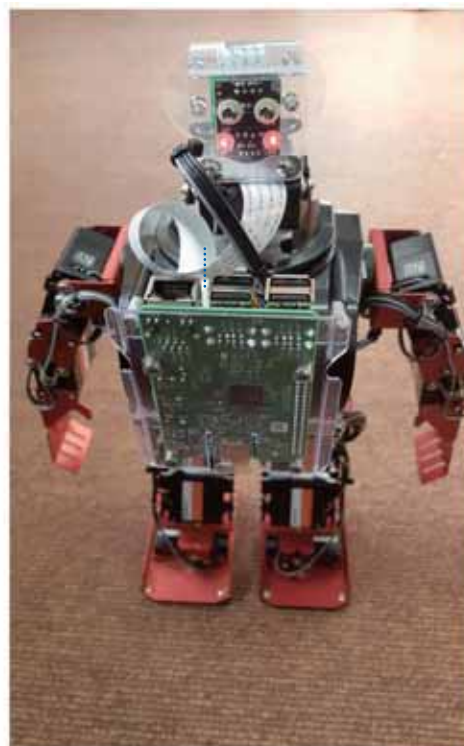
Humanoid-5000, robot kit	1 unit
Adaptor	1 ea
Remocon	1 ea
Manual book	1 book
LAN Cable	1 ea
Data cable	1 ea

## System configuration

( front side)



(back side)



Programmable & walking robot

## Specifications

Dimensions	310 x 180 x 90 (L x H x W)
weight	1.5kg
controllers	MR-C3024 FX, Servomotors
driver module	LCD
A/D converter	8 Channel
Ports	32 I/O digital, 3 PWM, 8 analog-digital converters
USB Hub	Port:4; power: 3.3V~5V
Communication	IR interface, 3V
Bluetooth	38 x 45 x 35mm, Output:3.3V~5V, USB,
Antenna	7.3pi
Charger	Input: AC 100V~220V 50~60Hz, Output: DC6V 1000mA
Motor	MRS-D2009SP
UART	high speed serial connection
DRC camera	1.3 pixel
Raspberry-pi module	for webcam service & programming



## Training contents

### Chap 1 Humanoid-5000 Robot Pan/Tilt Service Programming

- 1.1 Humanoid-5000PanTilt function
  - 1.1.1 Humanoid-5000 robot Raspberry pi setting
- 1.2 Examples of Humanoid-5000 robot PanTilt service programming applications
  - 1.2.1 Move the Humanoid-5000 robot head left and right
  - 1.2.2 Move the Humanoid-5000 robot head up and down
  - 1.2.3 Move the Humanoid-5000 robot
  - 1.2.4 Move the Humanoid-5000 robot 4 times up and down
  - 1.2.5 Move the Humanoid-5000 robot 2 times left and right

### Chap 2 Humanoid-5000 robot built-in motion programming

- 2.1 Humanoid-5000Motion function
- 2.2 Examples of Humanoid-5000 robot Motions programming applications
  - 2.2.1 Play Humanoid-5000 robot Dance(33~64) motions
  - 2.2.2 Play Humanoid-5000 robot Fight(65~96) motions
  - 2.2.3 Play Humanoid-5000 robot Game(97~ 128) motions
  - 2.2.4 Play Humanoid-5000 robot Soccer(129~160) motions
  - 2.2.5 Play Humanoid-5000 robot Hurdle race(161~192) motions
  - 2.2.6 Play Humanoid-5000 robot built-in sounds
  - 2.2.7 Play Humanoid-5000 robot built-in Leds

### Chap 3 Humanoid-5000 robot drive programming

- 3.1 Humanoid-5000 Drive
- 3.2 Examples of Humanoid-5000 robot Drive programming applications
  - 3.2.1 Play Humanoid-5000 robot forwards
  - 3.2.2 Play Humanoid-5000 robot left
  - 3.2.3 Play Humanoid-5000 robot right
  - 3.2.4 Play Humanoid-5000 robot backwards

### Chap 4 Humanoid-5000 robot Sensor programming

- 4.1 Humanoid-5000 Sensor service
- 4.2 Examples of Humanoid5000 robot sensor programming applications
  - 4.2.1 Play Humanoid-5000 robot Sensor Leds Control

### Chap 5 Humanoid-5000 robot camera programming

- 5.1 Examples of Humanoid-5000 robot camera programming applications
  - 5.1.1 Output camera video
  - 5.1.2 Upside down camera output
  - 5.1.3 Reduce and print camera images
  - 5.1.4 Gray image output
  - 5.1.5 Control Humanoid with the keyboard
  - 5.1.6 Draw a line on the camera image.
  - 5.1.7 Humanoid5000 Head Left and Right Face Tracking .



# model: **Mobile robot-7000**

## Intelligent Mobile robot trainer

### Features & functions

Mobile robot-7000 is an autonomous mobile robot platform for education in technical high school, polytechnics and university as well as training and research center.

Mobile robot-7000 is high functionality, advanced sensor system and maneuverability make learning a fun and creative experience.

Mobile robot platform is a powerful research and learning tool that aims to address the needs of robot-related, engineering and IT labs or advanced users in robust, ease to customize, upgrade and (un)mount various devices platform.

Mobile robot-7000 can be customized for any level of research and easy robotic application development for researchers, developers and users.

- 1) Clean and modern design
- 2) Voice recognition, joystick and other various services can be easily represented graphically via VPL
- 3) Line Tracking System
  - The 7 IR sensors on the bottom of the robot offer a precise, error-free ability to track a line.
  - Line tracking system is the best way to learn about sensors and sensor programming.
- 4) 3 rubber ring-shaped coverings fit around a wheel rim to protect it and enable a close contact with the ground. For easy coverings maintenance there are special "U" type notches on rims.
- 5) Autonomous Drive
  - With 3 PSD sensors Mobile robot-7000 self-drives and avoids obstacles.
  - With highly precise PSD sensor system we deliver advanced obstacle avoidance and self-drive technology.
  - Its highly flexible and reliable sensor system designed to determine robot's position effortlessly and allow user employ high level algorithms (Map building and so on). Use sensor system to ease your robotic application development and enhance your robot experience.
- 6) Payload
  - Strong enough to lift 20 kg
  - Detachable payload tray
- 7) Maneuverability
  - Mobile robot-7000 offers high maneuverability and mobility on rough terrain.
  - Can climb over a 30-degree slope.
- 8) Front-wheel drive/Four-wheel drive
  - Advanced algorithms allow power all four wheels or drive the front wheels only.
- 9) Long-distance communication
  - with Bluetooth technology you can be connected with Mobile robot-7000 up to 1 km away.
- 10) Supports Microsoft VPL (Visual Programming Language)
  - Mobile robot-7000 is an ideal platform to learn Visual Programming Language (VPL) without all the wires.
- 11) SPL / a high-functional robot platform
  - SPL / a high-functional robot platform Mobile robot-7000 provide a quick way to learn Simple Programming Language (SPL).
- 12) AVR / Dual Processor (ATMEGA128, 88)
  - AVR / Dual Processor (ATMEGA128, 88) creates an effective space for learning and programming microcontrollers.

- 13) Android
  - Fast and effective way to learn how to develop Android apps for robots.
- 14) Sound localization
  - Sound localization with 4 microphones robot can be interactive and fun.
- Mobile robot-7000 hears and reacts to sounds.
  - Audio source tracking, autonomous obstacle avoidance, line tracing.
  - With 4 sound sensors Mobile robot-7000 robot platform delivers efficient and improved sound localization experience.
  - Mobile robot-7000 identify the direction of sound in real-time while moving.
- 15) Dot Matrix
  - With 8x8 dot matrix on the top of the Mobile robot-7000 body you can display different graphics, emoticons and alphanumeric characters.
- 16) Speed up to 1 m/s
- 17) 64 LED-based display
- 18) 4 user programmable function buttons
- 19) Rechargeable lithium-ion battery
- 20) PID control algorithm
  - Enhance accuracy and improve performance.
  - Mobile robot-7000 PID algorithm maintains motor motion control and offers an automatic tuning method for the calibration of PID controllers.
- 21) 4 wheel drive to 2 wheel drive conversion system
  - Robust and immensely powerful Mobile robot-7000 robot platform offers a unique 4 wheel drive to 2 wheel drive transformable structure.
  - It features excellent maneuverability and can carry up to 20 kg.
- 22) Motor torque control algorithm
  - Increase robot motion effectiveness.
  - It calculates motor torques and determines load torques to produce superior motor performance.
- 23) Encoder algorithm
  - Encoder algorithms incorporated in robot is ideally suited to calculate robot motion.
  - Mobile robot-7000 easily measure displacement, velocity and acceleration

## System configuration



## Components

Mobile robot-7000 Hardware platform	1 ea
Battery (mounted on the robot)	1 ea
Battery Charger	1 ea
Program CD	1 ea
USB to ISP cable	1 ea
Textbook Book	4 books
1) VPL textbook (Visual Programming language) - 1 book	
2) SPL textbook (Simple Programming language) - 1 book	
3) AVR textbook - 1 book	
4) Android textbook - 1 book	
Quick guide Manual	1 ea

## Educational Programs Step by Step

- 1 step : VPL (Visual Programming Language) education and training for building basic programming skills
- 2 step : SPL (Simple Programming Language) education and training for building practical programming skills
- 3 step : AVR (ALF BOGEN, VERGARD WOLLEN, RISC) education and training using C Language and Assembly
- 4 step : ANDROID education and training for enhancing the application and programming development skills

## Training Contents

### 1. VPL (Visual Programming Language) Textbook

#### 1. Mobile robot-7000 Education System

- 1.1. Getting Started
- 1.2. Features
- 1.3. Specifications
- 1.4. In the box
- 1.5. Get to know Mobile robot-7000
- 1.6. Mobile robot-7000 Communication
- 1.7. LED indicators and function buttons
- 1.8. Mobile robot-7000 charging scheme

#### 2. Microsoft Robotics Developer Studio Introduction

- 2.1. Visual Programming Language
- 2.2. VPL Environment
- 2.3. VPL Menus
- 2.4. Toolboxes
- 2.5. Using Services

#### 3. Using basic Activities 1

- 3.1. Data Activity
- 3.2. Calculate Activity
- 3.3. Variable Activity
- 3.4. Join Activity
- 3.5. Merge Activity

#### 4. Using basic Activities 2

- 4.1. Switch Activity
- 4.2. If Activity
- 4.3. List and List Functions Activity
- 4.4. Activity block
- 4.5. Comment Activity

#### 5. Often used Services

- 5.1. Simple Dialog Service
- 5.2. Log Service
- 5.3. TTS Service
- 5.4. Timer Service
- 5.5. Direction Dialog Service
- 5.6. Use often used Services
- 5.7. Programming Assignments: Often used Services

#### 6. Mobile robot-7000 DotMatrixBuzzer Service

- 6.1. Mobile robot-7000 LED Matrix
- 6.2. Mobile robot-7000 DotMatrixBuzzer Service
- 6.3. Practice Problems
- 6.4. Use Mobile robot-7000 DotMatrixBuzzer Service
- 6.5. Programming Assignments: Mobile robot-7000 DotMatrixBuzzer Service

#### 7. Mobile robot-7000 Drive Service

- 7.1. DC Geared Motor
- 7.2. Mobile robot-7000 Drive Service
- 7.3. Practice Problems
- 7.4. Use Mobile robot-7000 Drive Service
- 7.5. Programming Assignments: Mobile robot-7000 Drive Service

#### 8. Mobile robot-7000 PSD Sensor Service

- 8.1. An Overview
- 8.2. Mobile robot-7000 PSD Sensor
- 8.3. Practice Problems
- 8.4. Use Mobile robot-7000 PSD Sensor Service
- 8.5. Programming Assignments: Mobile robot-7000 PSD Sensor Service

#### 9. Mobile robot-7000 IR Sensor Service

- 9.1. An Overview
- 9.2. Mobile robot-7000 IR Sensor Service
- 9.3. Practice Problems
- 9.4. Use Mobile robot-7000 IR Sensor Service
- 9.5. Programming Assignments: Mobile robot-7000 IR Sensor Service

#### 10. Mobile robot-7000 Button Service

- 10.1. Mobile robot-7000 Button Service
- 10.2. Practice Problems
- 10.3. Use Mobile robot-7000 Button Service
- 10.4. Programming Assignments: Mobile robot-7000 Button Service

## 11. MIC Service

- 11.1. An Overview
- 11.2. Mobile robot-7000 MIC Service
- 11.3. Practice Problems
- 11.4. Use Mobile robot-7000 MIC Service
- 11.5. Programming Assignments:  
Mobile robot-7000 MIC Service

## 12. Mobile robot-7000 Encoder Service

- 12.1. Mobile robot-7000 Encoder Service
- 12.2. Practice Problems

## 13. Mobile robot-7000 Torque Service

- 13.1. Mobile robot-7000 Torque Service
- 13.2. Practice Problems

## 2. SPL (Simple Programming Language) Textbook

### 1. Mobile robot-7000 Education System

- 1.1. Getting Started
- 1.2. Features
- 1.3. Specifications
- 1.4. In the box
- 1.5. Get to know Mobile robot-7000
- 1.6. Mobile robot-7000 Communication
- 1.7. LED Indicators and Function buttons
- 1.8. Mobile robot-7000 Charging scheme

### 2. Installing SPL (Simple Programming Language)

- 2.1. An Overview
- 2.2. Installing MSRDS R4
- 2.3. SPLX Setup Installation
- 2.4. SPLX Service and Sample Pack Installation

### 3. Using SPL (Simple Programming Language)

- 3.1. Running SPL
- 3.2. Commands to control Mobile robot-7000

### 4. Mobile robot-7000 DotMatrixBuzzer Service

- 4.1. Mobile robot-7000 DotMatrixBuzzer
- 4.2. An Overview
- 4.3. Mobile robot-7000 DotMatrixBuzzer  
Service Basic Examples
- 4.4. Exercising Mobile robot-7000  
DotMatrixBuzzer Service

### 5. Mobile robot-7000 Drive Service

- 5.1. An Overview
- 5.2. Mobile robot-7000 Drive Service Basic Examples
- 5.3. Exercising Mobile robot-7000 Drive Service

### 6. Mobile robot-7000 PSD Sensor Service

- 6.1. An Overview
- 6.2. Mobile robot-7000 PSD Sensor Service Basic  
Examples
- 6.3. Exercising Mobile robot-7000 PSD Sensor  
Service DotMatrixBuzzer Service

### 7. Mobile robot-7000 IR Sensor Service

- 7.1. An Overview
- 7.2. Mobile robot-7000 IR Sensor Service Basic  
Examples
- 7.3. Exercising Mobile robot-7000 IR Sensor Service

### 8. Mobile robot-7000 Button Service

- 8.1. An Overview
- 8.2. Mobile robot-7000 Button Service Basic Examples
- 8.3. Exercising Mobile robot-7000 Button Service

### 9. Mobile robot-7000 MIC Service

- 9.1. An Overview
- 9.2. Mobile robot-7000 MIC Service Basic Examples
- 9.3. Exercising Mobile robot-7000 MIC Service

### 10. Mobile robot-7000 Encoder Service

- 10.1. An Overview
- 10.2. Mobile robot-7000 Encoder Service Basic  
Examples

### 11. Mobile robot-7000 Torque Service

- 11.1. An Overview
- 11.2. Mobile robot-7000 Torque Sensor Service  
Basic Examples

## 3. AVR Textbook

### 1. Mobile robot-7000 Education System

- 1.1. Getting Started
- 1.2. Features
- 1.3. Specifications
- 1.4. In the box
- 1.5. Get to know Mobile robot-7000
- 1.6. Mobile robot-7000 Communication
- 1.7. LED indicators and function buttons
- 1.8. Mobile robot-7000 charging scheme

### 2. Using SPL (Simple Programming Language)

- 2.1. ATmega128 Features
- 2.2. Mobile robot-7000 Architecture

### 3. Installing Microcontroller Development Tools

- 3.1. Microcontroller Development Environment  
and Setting Preparation
- 3.2. Installing WinAVR
- 3.3. Installing AVR Studio
- 3.4. How to use AVR Studio

### 4. I/O Ports

- 4.1. An Overview
- 4.2. Controlling Single LED
- 4.3. Controlling Dot Matrix
- 4.4. Controlling Button Input

### 5. Interrupts

- 5.1. An Overview
- 5.2. Controlling Encoder

### 6. Timer/Counter0

- 6.1. An Overview
- 6.2. Controlling Basic Timer/Counter
- 6.3. 16-bit Timer/Counter1 and Timer/Counter3
- 6.4. Controlling Basic Timer
- 6.5. Controlling Buzzer
- 6.6. Controlling Motor

## **7. Analog to Digital Converter (ADC)**

- 7.1. An Overview
- 7.2. Using PSD Sensor Data
- 7.3. Using IR Sensor Data

## **8. Serial Communication (USART)**

- 8.1. An Overview
- 8.2. Controlling robot using HyperTerminal

## **9. Intelligent Robot Platform**

- 9.1. Autonomous Driving
- 9.2. Line tracking

## **10. Appendix**

## **4. Andorid Textbook**

### **1. Mobile robot-7000 Education System**

- 1.1. Getting Started
- 1.2. Features
- 1.3. Specifications
- 1.4. In the box
- 1.5. Get to know Mobile robot-7000
- 1.6. Mobile robot-7000 Communication
- 1.7. LED indicators and function buttons
- 1.8. Mobile robot-7000 charging scheme

### **2. Installing Andorid Development Tool**

- 2.1. Andorid Development Environment and Setting Preparation
- 2.2. JAVA JDK Installation
- 2.3. Eclipse Installation
- 2.4. ADT Eclipse Plug-in Installation
- 2.5. Android SDK Installation
- 2.6. Using AVD
- 2.7. Using DDMS

### **3. Andorid Interface Programming**

- 3.1. Creating the Android Project
- 3.2. Layout
- 3.3. Input and Output
- 3.4. Menu
- 3.5. View
- 3.6. Other widgets
- 3.7. Smartphone Sensor

### **4. Understanding the Bluetooth function in Smartphone**

- 4.1. Bluetooth Setup
- 4.2. Bluetooth Activation
- 4.3. Device Discovery
- 4.3. Operation using Server
- 4.4. Operation using Clnet
- 4.5. Connectivity management
- 4.6. Using the bluetooth service in smartphone

### **5. Mobile robot-7000 DotMatrixBuzzer Service**

- 5.1. Controlling Dotmatrix with ASCII Code using buttons
- 5.2. Controlling DotMatrix by lines using buttons
- 5.3. Plain Text
- 5.4. Programming Assignments: Mobile robot-7000 DotMatrixBuzzer Service

### **6. Mobile robot-7000 DotMatrixBuzzer Service**

- 6.1. Using buttons to control buzzer
- 6.2. Generating sound using music scale
- 6.3. Programming Assignments: Mobile robot-7000 DotMatrixBuzzer Service

### **7. Mobile robot-7000 Motor Service**

- 7.1. Controlling motor using 2 buttons
- 7.2. Controlling button as Transmission
- 7.3. Voive Recognition
- 7.4. Programming Assignments: Mobile robot-7000 Motor Service

### **8. Mobile robot-7000 PSD Sensor Service**

- 8.1. Autonomous Driving
- 8.2. Programming Assignments: Mobile robot-7000 PSD Sensor Service

### **9. Mobile robot-7000 IR Sensor Service**

- 9.1. Line Detection
- 9.2. Programming Assignments: Mobile robot-7000 IR Sensor Service

### **10. Mobile robot-7000 Encoder Service**

- 10.1. An Overview
- 10.2. Mobile robot-7000 Encoder Service Basic Examples

### **10. Mobile robot-7000 Application Development Ttraining**

- 10.1. Smartphone Acceleration Sensor
- 10.2. IP Camera
- 10.3. Programming Assignments: Mobile robot-7000 Application Service

## Specification

Item	Spec
Dimensions	200x193x94.8 (LxWxH)
Dual Processor	Atmega 128, Atmega 88 dual processor
Communication	- Cable: UART (RS232) - Wireless: Bluetooth 2.4GHz, Max: 1Km)
Motor	DC Geared motor [with integrated encoder] / 30:1 / 12VDC
Wheels	4 wheel drive to 2 wheel drive conversion type Wheel diameter : 60.1 mm
Rim	size 60.1 (with tire: 64)
Speed	up to 1m/s
Payload	around 20 kg
Detachable payload tray	Holes 32 Distance between holes 30mm “ L ” type slots for tray attaching
Sensors	7 IR floor sensors 3 obstacle detection PSD sensors 4 Audio source detection sensors
Battery Charger	Input 100-240 VAC Output 12.6 Vdc, 1.2Ah Charge time 1 hour 45 minutes
Program downloader	USB to ISP cable
Display	Dot Matrix 8x8 State display lights: 8 4 function buttons
Connectivity	PC connectivity cable UART(RS232) WiFi connectivity Bluetooth(2.4GHz, up to : 1Km)
Battery	Input : 100-240VAC +/-10% 47-63Hz , Output : 12.6Vdc, 2.0Ah LED indicators - Red : charging, - Green : Fully charge Charge time : 2.5 hours Certificate : RoHs, CE
Speaker output	manually setting type, Voice setting available
Multifunction button input	4ea
Power switch input	1 ea
PC communication connector pin	RS232, 1ea
Power connection terminal	3 Pie, 1ea
Wireless communication	Bluetooth short-range wireless networks, 2.0+EDR Class1 100m connection speed, 38400bps



# [ Option 1 ]

## Vision system

### Features

The 3D vision system can see the front object within 40cm via "near mode", through the improved skeletal tracking it can sense which user is tracked.

Addition, high-performance of speech configuration elements mounted speech and audio function is provided.

The upgraded API can realize a smooth connectivity between windows based computer and robot by using usb interface.

### Configuration



### Configuration

3D Vision Sensor	1EA
USB / Power Cable	1EA
3D vision sensor mount	1EA
Manual / Battery	1EA
Installation CD	1EA
SDK Software	1Copy

### Specification

- dimension :
  - a. 3D Vision Sensor (280mm x 600mm x 800mm)
  - b. 3D vision sensor mount (220mm x 300mm x 310mm)
- 3D Vision Sensor
  - a. RGB camera
  - b. Length measurement sensors
  - c. Multi-array microphone basic type
  - d. Robot control library
  - e. Able to detect the object within 40cm via "near mode"
  - f. Improved skeleton tracking
  - g. Viewing angle (FOV) : Horizontal 60 ° vertical 70 °
  - h. Offshore distance: 0.8m ~ 4m
  - i. Color stream : 1920 x 1080 x 16 bpp 16:9 YUY2 @ 30fps
  - j. Depth stream : 512 x 424 x 16 bpp, 13-bit depth
  - k. Infrared stream : 512 x 424, 11-bit dynamic range
  - l. Recognition : color/depth, flow IR
  - m. Audio capture : 4-mic array returning 48KHz audio
  - n. Data connectivity : USB 3.0
- 3D vision sensor mount :
  - a. Detachable payload tray with height adjustment function enables to fix any size of notebook
  - b. Much easier assemble is designed to minimize the size of packing in foreign exports
  - c. Height adjustment possible to place the 3D camera sensor
  - d. A round bar is not used to maintain the greatest degree of smooth motion
  - e. The 3D camera sensor line organizer and battery case using rear bracket are required
- Recommended Specifications for PC controller
  - a. 32bit (x86) or (x64) Processor
  - b. Dual-core 2.68-GHz or faster Processor
  - c. Dedicated USB 2.0 bus
  - d. 2GB RAM



# [ Option 2 ]

## Micro processor Sensor Network system

### Features

Micro processor sensor network system different from the standard fixed experiment unit can realize the activated experiment/test/education.

Various kinds of experiments are also accessible since it is mounted with 15 types of sensors and display units.

Micro processor sensor network system can not only be used for individual experiment separately but also be used together with robot as a whole unit through the serial communication,

### System configuration



### Components (Microprocessor Assembly)

Items	Qty.
Main Board	1
LCD Module	1
FND Module	1
LED Module	1
Dot Matrix Module	1
GPS Module	1
Ultra Sonic Module	3
PSD Module	1
CDS Module	1
Tilt Module	1
3Axis Module	1
Gyro Module	1
Compass Module	1
Temperature and Humidity Module	1
Bluetooth Module	1
Total	17

### Detailed specification( Microcontroller processor Assembly)

1) CPU : VR ATmega 128

- Input voltage : 6V Max.

2) Power : Basic using power : 5v / 1A, 11.1v / 2.6A

- LCD Panel : 16x2 Char (5x8dots)

- Recommended Specifications for jon controller

3) LCD Module

- STN, Negative, Transmissive Mode
- Display Data Color : Light Gray or Deep Blue
- Viewing Angle : 6H
- Driving Method : 1/16 duty, 1/5 bias
- Back Light : White LED backlight

4) FND Module

- Forward Voltage, Per Segment : 2.2V Max.
- Continuous Forward Current, Per Segment : 30mA
- Solder Temperature 1/16 inch Below Seating Plane 3 Seconds at 250 °...

#### 5) LED Module

- 2012 Type LED
- Straight Type 8EA LED

#### 6) Dot Matrix Module

- 2012 Type LED
- 8x8 Dot Matrix Type

#### 7) Ultra Sonic Module

- Voltage - 5v only required
- Current - 30mA Typ. 50mA Max.
- Frequency - 40KHz
- Range - 2cm ~ 3.3 m
- Trigger signal :5u sec

#### 8) PSD Module

- High sensitivity of PSD Sensor : GP2YOA21YK
- Detecting output type : Analog voltage
- Detection distance : 10 ~ 80Cm

#### 9) CDS Module

- Minimum illuminance : 50Lux
- Material: cadmium sulfide
- OP Amp : LM324

#### 10) Tilt Module

- SA-1 ( Amp indoor type ) : DAS
- Electronic-component approach Sensor
- Measuring range : +60 \_ , -60 \_
- Power supply : 5V
- Resolution : 0.1 degrees

#### 11) 3Axis Module

- Selectable Sensitivity (1.5g/2g/4g/6g)
- Low Current Consumption: 500μA
- Sleep Mode: 3 μA
- Low Voltage Operation: 2.2 V 3.6 V
- 6mm x 6mm x 1.45mm QFN
- High Sensitivity (800 mV/g @1.5 g)
- Fast Turn On Time
- High Sensitivity (1.5 g)
- Integral Signal Conditioning with Low Pass Filter
- Robust Design, High Shocks Survivability
- Pb-Free Terminations
- Environmentally Preferred Package
- Low Cost

#### 12) Gyro Module

- Ultra-small and ultra-lightweight
- Quick response
- Low driving voltage, low current consumption
- Lead type: SMD
- Reflow soldering (standard peek temp. 245 deg. C)

#### 13) Compass Module

- Voltage : 5V
- Current : 25mA
- Resolution : 0.1 Degree (0.0 ~ 359.99 degrees)
- Accuracy : 3-4 degrees approx. after calibration
- Output 1 : Timing Pulse 1ms to 37ms in 0.1ms increments
- Output 2 : I2C Interface, SMBUS compatible, 0-255 and 0-3599 SCL speed up to 1MHz
- Small Size : 32mm x 35mm
- Low Cost : Best Price Compass Module Available
- Communication : I2C

#### 14) Temperature and Humidity Module

- IC Type Sensor : LM35D
- Wide Temperature Range : -55 °C ~ 150 °C
- Supply Voltage : +4V ~ +30V (+5V)
- input voltage : DC 5V
- output voltage : 0.8V ~ 3.9V
- response velocity : 15ms
- Operating Range : 0 ~ 100 %RH

#### 15) Bluetooth Module

- UARTInterface, Bluetooth specification v2.0+EDR
- Transmit Power - Max. 18dBm
- Receiving Sensitivity: 90dBm(0.1%BER)
- Compact size - 27.5 x 30.0 x 14.0 (mm)
- RS232 serial cable replacement
- 4 multiple simultaneous connections supported
- Serial Port Profile supported
- Interactive operation with PDA, notebook
- on-board built-in chip antenna
- Simple windows based firmware upgrade using software (ParaniUpdater)
- Communication range (open space)
- Basically 100M, up to 1000m is also posible when use patch antenna
- Simple windows based setting software supported
- No need any other separate drivers and software

#### 16) Battery :

- Battery : Li-ion cell
- Nominal Voltage : Average 11.1 volts 2.6Ah
- Charging Voltage : 12.6 volts,
- Runtime : more than 5 hours

#### 17) Charger :

- Input : 100-240VAC +/-10% 47-63Hz , 1.0Amax at 110VAC input / IEC320 C14, with ground
- Output : 12.6Vdc, 2.0Ah
- LED indicators - Red : charging, - Green : Fully charge
- Charge time :more than 5 hours
- Certificate : RoHs, CE

# model: **ibrain Mobile robot-8000**

## **ibrain Mobile robot trainer**

### **Features**

- 1) Uses STM32 F4 CPU of the Cortex-M4 series available which is a latest microprocessor of ARM.
- 2) STM32 F4 is a Cortex-M4 core, and strong in performance including fast operating speed of 168 MHz and a large program memory of 168 MHz.  
This contributes to implementing application of even better performance than existing MCU cores (8051, AVR, ARM7).
- 3) The environment for development enables even beginners who does not have basic knowledge of C program to develop programs, and users can use C to control the robot.
- 4) You can select and use temperature and humidity sensors and various types of modules, and add functions you want to practice them.
- 5) Textbook ideal for the curriculum for window design and embedded systems is provided.
- 6) This is optimized to learn essential knowledge and practice of applications of a mobile robot.
- 7) Interworking with Android applications contributes to implementing expanded functions through smartphones or tablet PCs.
- 8) The environment for development is available even for specialized use by enterprises, and the industry.

### **Functions**

- 1) General functions
  - (1) Developing and learning microprocessor  
: Develop and practice hardware and software for the essential microprocessor architecture on the basis of the STCortex-M4 processor architecture and essential functions.
  - (2) Unmanned driving  
: The ultrasound sensor and the infrared sensor detect obstacles to control the motor so that the robot can travel along a given path.



- (3) Pattern drive  
: Driving according to a specified pattern on the basis of unmanned driving.



- (4) Line tracer  
: Recognizes specific color to move along a given line.



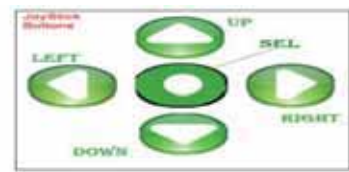
(5) Touch GUI Provided



Environment Setting



sensor data display



joystick button

(6) Smartphone/Tablet interworking

: enables data communication/control with the robot through Wi-Fi or Bluetooth by android smartphones/tablets.



(7) Wireless processing of camera video (optional)

: The robot uses the wireless camera module to take video. The video taken and wanted remotely (smartphone/tablet) or by the robot is processed.



2) CMSIS software

: The file for controlling Cortex M4 or Cortex M3 is provided in the CMSIS specification available from ARM.

It is easy to use the Cortex-M core so that you can easily develop programs to significantly reduce development time.



3) Cortex-M4 Software

(1) The function library is provided for beginners.

: Beginners can easily control the robot by implementing applications with API for the main function.

Application F/W	C-based firmware for controlling hardware
CMSIS	CMSIS
Device Driver F/W	Device Driver F/W
Hardware	Hardware

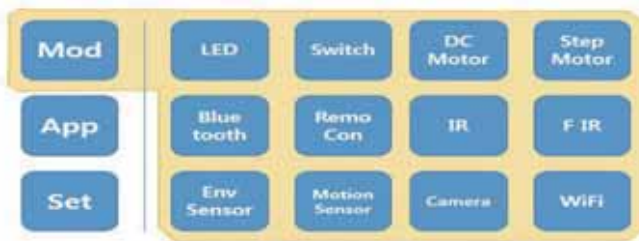
(2) C based programming for Professional developers

Application F/W	C-based firmware to use API
Function Library	C-based library for controlling hardware
CMSIS	CMSIS
Device Driver F/W	Device Driver F/W
Hardware	Hardware

#### 4) Essential module software

: A basic control module for each device. Each module is made to control various control for a given device.

- (1) LED: GPIO is composed of controlling indicator LED.
- (2) Switch: input device, composed of GPIO and interrupts.
- (3) DC Motor: controls the DC motor driver.
- (4) Step Motor: Step motor control which uses PWM.
- (5) Bluetooth: used for communication with external devices.
- (6) RemoCon: used to display input on the screen.
- (7) IR: indicates detected objects in the measurement direction.
- (8) FIR: displays cliffs on the screen if detected.
- (9) Env: displays numerical intensity of illumination, humidity and temperature on the screen.
- (10) Motion: displays gradients and acceleration on the screen.
- (11) Camera: press the button Capture to display video.
- (12) Wi-Fi: remote communication with the host.



#### 5) Application module software

: You can use a plurality of modules to implement application projects.

- (1) Line Tracer: drives the robot along the line.
- (2) Free Run: unmanned driving while avoiding obstacles.
- (3) Remote Control: use Bluetooth or the remote controller to control the robot.
- (4) Camera: captures and output video during unmanned driving.



## System configuration



( Emotional Robot )

- 1) The robot is implemented to have sensitivities to make a database of human sensitivities. The values of the environment sensor are used to determine mobile robot motion.  
This operation is implemented to use the voice interface with users in order to continue to build databases for easy learning depending on learning targets.
- 2) The process of infusing the robot with sensitivities through the sensitivity result with a variety of sensors interworks with the Exynos module.  
The Exynos module receives human voice and provides music or poems compatible with the sensitivities.

## Components

ibrain Mobile robot Hardware platform		1 ea
Program CD		1 ea
Power adapter		1 ea
Textbook Book		1 book
Extension Modules	1) MEMS (Acceleration / Angular / Geomagnetic)	1 ea
	2) PIR (human detection)	1 ea
	3) Temperature / humidity sensor	1 ea

## Training Contents

1) Basic theory course		
Micro controller unit	1) Features of micro controller unit	
	2) Cortex-M4 architecture	
Building the developing environment	1) Outline of developing environment	
	2) How to install Keil compiler	
2) Basic training course		
I/O port control	1) GPIO outline	
	2) LED configuration circuit analysis	
interrupt	1) Interrupt outline & Structure	
	2) Internal interrupt and external interrupt	
timer counter	1) Timer outline	
	2) Clock and counter	
servo motor	1) Servo motor structure and principle	
	2) Servo motor driving practice	
DC motor	1) DC motor structure and principle	
	2) Encoder structure and principle	
graphic LCD	1) LCD structure and principle	
	2) Character output Practice using LCD	
Environment sensor	1) Temperature, Humidity, Lighting sensor structure	
	2) Sensor value output using LCD	
Motion sensor	1) Geomagnetic, acceleration, gyro sensor structure	
	2) Sensor value output using LCD	
Detection sensor	1) Distance measuring practice using Ultrasonic sensor	
	2) Distance measuring practice using PSD sensor	
3) Application practice		
Line tracer	1) The principle and structure of Line tracer	
	2) Practice to obstacle avoidance, movement and return	
Auto driving	1) The principle and structure of Auto driving	
	2) Driving practice using omni wheel	
Bluetooth	1) Bluetooth outline	
	2) Bluetooth communication structure / principles	
Camera	1) Camera module structure	
	2) Image processing using camera module	
Creative Design I, II	1) Application implementation examples	
	2) Programming methods	

## Specification

Div	ibrain Mobile
CPU	Cortex-M4(MAX. 180MHz)
RAM	256KB + 2048KB(Ext)
Flash	2048KB
Audio	H/W Audio Codec
UART	RS232(1EA)
USB	USB 2.0 OTG
Bluetooth	Bluetooth 3.0
Wi-Fi	default
micro-SD	default
camera	2MP
LED	Status, Programmable (7ea)
button	Push Switch (3ea)
motor	4x DC Motor(Encoder x4)
wheel	Indoor(Omni)+Offroad
gyro	default
magnetic	default
accelerometer	default
illuminate	default
humidity	default
temperature default	
sound detect	default
PIR	default
warning	default
Wireless Image Sensor(WiFi)	default
cliff	Left, Front, Right, Rear (4ea)
IR Remocondefault	
USS	Left, Right, Front, Rear (4ea)
PSD	Left, Right, Front, Rear (4ea)

# model: Omni-directional & 7-DOF Manipulator robot-8000

## Omni-directional & 7-DOF Manipulator robot trainer (PC based type)

### Feature

Omni-directional mobile robot has an advantage that the robot can change the direction from arbitrary angle of direction to any direction by revolving each wheel arbitrarily.

Omni-directional & 7-DOF Manipulator robot-8000 is Wheel based and PC based type and equipped with 7-DOF (degree of freedom) Manipulator.

Omni-directional & 7-DOF Manipulator robot-8000 is designed in a structure that allows motions in all directions on an omni-type hardware structure and implements precise motion control by combining high-performance components.

The manipulator mounted on the robot maximizes motor efficiency by combining 7-DOF (degrees of freedom) with a perpendicular articulated structure.

The manipulator is equipped with an adaptive controller which is intelligently operated based on the weight of moving object by applying dynamic control of advanced control technique.

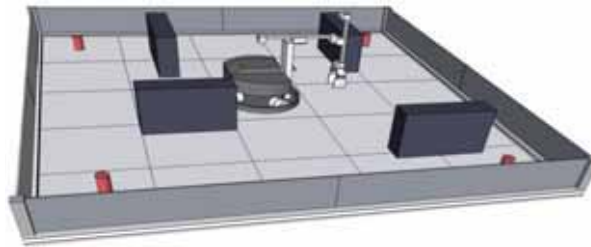
This robot provides educational effects such as algorithm and mechanism of mobile robot, robot-sensor networking structure and technique, analysis of advanced control technology, etc. and is helpful for various training programs and studies.

### Features

- 1) The main controller of the manipulator is so designed as to provide intelligent motion control.  
The primary part of the motion controller can measure the motor torque to determine the weight of external target with the external input signal.
- 2) The measured data is transferred to the acceleration/deceleration controller to determine the motor speed.  
To improve increment of the determined speed and mechanical stability, the dynamic controller of advanced technology stabilizes the motor signal and finally transfers the signal to the external system.
- 3) The driving system with three degrees of freedom can be immediately driven with the joystick after power on and can implement vector control and individual motor control.
- 4) The mobile robot platform is so designed as to ensure safe experiments and is equipped with a lateral support, allowing the platform to be laid down laterally so that peripheral devices and sensors can be mounted and adjusted conveniently on the platform bottom.
- 5) The robot provides a test jig for no load test.
- 6) The mobile robot platform has a robust structure firmly fixed with several objects in order to avoid deformation that might be caused by excessive load and frequent disassembly/assembly while conducting various tasks.
- 7) The front part is completely open, allowing installation of various hardware application devices.
- 8) The control panel of the platform is equipped with multi-purpose input/output devices, text display and battery level indicator.  
The battery level indicator is equipped with a power switch to turn on the power as needed.
- 9) The battery can be replaced by simply loosening and tightening the bolts without removing the platform cover.
- 10) For the floor-detecting photo sensor, the height from the floor to the emitter/receiver is adjustable using the optical fiber and the sensitivity is simply adjustable from the outside of the platform.
- 11) For the metal-detecting inductive sensor, the height from the sensing surface is adjustable from the outside of the platform.
- 12) The platform is equipped with connection ports for Gyro sensor and color tracking camera.
- 13) The manipulator has total seven degrees of freedom including gripper and camera tilt.
- 14) Data can be exchanged between the mobile robot platform and the manipulator, and manipulator feedback is provided for status monitoring.
- 15) Working range : X-263mm, Y-302mm, Z- 180 degrees (rotation angle)
- 16) Payload : 300g or more
- 17) 2.4GHz remote controller is available.
- 18) The remote controller of the manipulator provides 9 channels or less.
- 19) The camera mounted in the manipulator provides Pan/Tilt. The camera and the moving actuator are embedded type.
- 20) The battery is featured by 13.2V, 2300mAh, Continuous 30C, 60C Pulses or more.
- 21) Robot driver : Omni-direction wheel based
- 22) Articulated part : 6-axis based manipulator
- 23) Software : C coding based AVR



## System configuration



Mechanical part	6-axis perpendicular articulated type with a gripper mounted at the end point of action
Motors part connection to the axis.	The motors drive individual axes using a belt and pulley at the end of an axis or through direct  Two motors are mounted on the robot hand, providing thumb and forefinger motions.
Power Supply part	12V/DC battery with maximum output of 10A is used
Electrical part	A microcontroller is mounted on the motor control unit to implement an adaptive controller and to monitor output of each axis. It is connected to the mobile robot platform to provide interface between the mobile robot controller and other devices.
Communication part	Bluetooth and Wi-Fi are configured in a wireless communication network for interworking between different devices.

## Specification

<b>1) Omni-Directional Wheel Based robot platform</b>	
(1) Dimension	365 (Exterior diameter) x 300 (height) mm
(2) Drive type	Omni-Direction (3DOF vector-driven control and individual motor control)
(3) Effective load	Max 10 Kg
(4) Wheel unit	80mm (exterior diameter) Omni-wheel and fixation shaft unit 3 EA, allowed load 40kg/unit
(5) Travel speed	XY: Below 1,000mm/s, Rotation: Below 250 °/s
(6) Battery	Chargeable, 12V, 5AH lead-acid battery 2 EA, removable, running 60 minutes or longer under 5kg
(7) Charger	Input: 220VAC, 60Hz - Output: 29.4~27.4VDC, 5Amax
(8) Drive unit	24VDC geared motor 3 EA, 3600RPM, encoder 500 pulses/rev, rated output current (I <sub>n</sub> )=0.9A, start-up current (I <sub>s</sub> )=4A, rated torque (T)=3.8Ncm, start-up torque (T <sub>s</sub> )=20Ncm
(9) Motor drive	3 EA, Power: 24VDC, speed command: 0~10V PID speed control, Max driving current (I <sub>p</sub> )=90A, Max output:120W
(10) CPU	ATmega128(A)-Main controller, ATmega16-PSD sensor processor, ST8S207-platform drive controller
(11) Programming environment	C, Compile-WinAVR, AVR Studio, MSRDS VPL
(12) Program downloader	STK500 USB ISP cable; Bluetooth interface
(13) Digital input	User input 8 EA (24V NPN type), universal push button input 3 EA digital sensor (inductive sensor 2 EA, photo sensor 3 EA), dedicated input 5 EA

(14) Digital output	User output 8 EA (24V NPN type, 1Amax), universal LED output 3 EA, buzzer output 1 EA
(15) Analog input	User analog voltage input (0~10V) 4 EA, ADC-10 Bits
(16) Text display	20-character 2-line LCD display
(17) Operating panel	Push button 3EA, LED lamp 1 EA, buzzer 1 EA, mode selection switch (TASK/JOYSTICK), emergency stop button, power lamp, digital voltage indicator, system reset button
(18) Inductive sensor	M12, 24VDC NPN type metal-detecting sensor 2 EA
(19) Photo sensor	24VDC NPN type optical fiber sensor 3 EA, emitter/receiver height and sensitivity adjustable
(20) Distance detecting sensor	Analog output IR PSD sensor, sensing distance 60~800mm, height 25mm 9EA
(21) Tool bracket	Master bracket for racing tool installation (Puck collector, lancer, etc.)
(22) Communication (UART)	Bluetooth V2.0 port, camera port for color tracking, Gyro sensor port
(23) Manual joystick	60 x130 x34mm, analog output (0~10V) 3 channels and button output 1 EA (Open collector)
(24) Platform plate	260*260*260mm (triangular), height 35mm
(25) Operation mode	TASK (task execution) mode, JOY (manual 3DOF joystick operation) mode
(26) Platform control output	Platform vector control output: DirX, DirY, Dirw, Vx, Vy, Vw. Motor selection output: M1, M2, M3 Travel distance output data selection: SEL1, SEL0 (X, Y, angular travel selection) Platform forced stop command output
(27) Platform control input	Platform travel distance (rotation angle) pulse input: 1 pulse per 1mm (1 °rotation) Platform ready (READY), run mode (TASK/JOY), platform status (error, normal) input
(28) Optional device input/output	Work lift up/down command output, lift location analog input (0~5V) Gripper (self holding) open command output, gripper open signal input Camera up, down, rotation, low speed, camera angle input (0~5V)
(29) Platform accessories	User Manual, User program set Battery (DC 24V) charger set Joystick (wired) module

## 2) 7-DOF robot Manipulator

(1) size	440(mm) x 110(mm) x 695(mm)
(2) Processor	Atmega 128 [x1]
(3) Motor	Servo Motor [x7]
(4) Payload	over 300g
(5) Weight	Less than 3Kg
(6) Runtime	More than 45 minutes
(7) Display	Status display LCD : 1.5 inch
(8) Input & Output devices	Interrupt : 9 Channel ADC : 8 Channel PWM : 3Channel I/O : 5Channel S/W : 5Channel BackLight : 1Channel B/T Status : 1Channel Buzzer : 1Channel RS232 : 1Channel P/WLED : 1Channel User Output LED : 3Channel
(9) Manipulator	AFHSS 2.4GHz / PPM / PCM Compatible Easy to Read 5.1 Inch Wide Backlit Touch Screen Customizable Menus One-Stop Model Type Setting 3 Multi-Tasking Digital Trims Fully Assignable Control Switch, Knob, Stick and Digital Trims Highly Sensitive 8 Ball-Bearing Gimbals with Adjustable Tension Full-Sized Comfortable Hand Grips Featuring Top Quality Elastomer Selectable Control Stick Mode / Change Hardware without Opening Case Power Management System (Adjustable Backlight & Auto Shut-off Time) Digital Trim Nano-Adjuster (Approx. 0.025deg per step up to 5deg)
(10) Battery	13.2V, 2300mAh, 4 Cell Size : 135(mm) x 54(mm) x 26.5(mm) Weight : 305g Continuous : 30C Pulse : 60C
(11) Charger	Input : 11~18V, DC Charging Power : Max, 50W Charging Current : 0.1~4.0A Weight : 120g Size : 100(mm) x 60(mm) x 20(mm)

## Training Contents

### Part 1, Introduction of Mobile service robot

#### Part 2, Operating principle of Mobile service robot

- 2.1 Platform Drive DOF (DOF, Degree of freedom)
- 2.2 Omni Directional & The driving coordinate system, X, Y,
- 2.3 Driving principle of Omni Directional Mobile Robot Platform
- 2.4 Driving analysis of Omni Directional 3DOF Mobile Robot Platform
- 2.5 Global Coordinate System and Mobile Robot Platform
- 2.6 General mobile robot platform movement control method
- 2.7 Platform drive control system
- 2.8 Encoder signal and movement (rotation) distance
- 2.9 Safe drive speed area of platform

#### Part 3, Understand platform hardware structure and specifications

- 3.1 Base frame configuration
- 3.2 Assemble basic sensor and side bracket
- 3.3 Some sensor assembly of platform
- 3.4 Battery removal and attachment
- 3.5 The driving unit
- 3.6 Middle part fixing plate, main control board, joystick control board installation
- 3.7 User I / O terminal, optical sensor amplifier, operating
- 3.8 Platform transport
- 3.9 Platform power switch

#### Part 4, Understand the electrical and mechanical properties of platform components

- 4.1 Drive unit
- 4.2 Infrared distance sensor (IR PSD Distance sensor)
- 4.3 Inductive metal sensing sensor (Inductive sensor)
- 4.4 Diffused reflection fiber photo sensor
- 4.5 Platform control board configuration diagram (TOP View)
- 4.6 User wiring terminal board (MRP33MUCON)
- 4.7 Operating panel
- 4.8 20 x 4Line LCD Display
- 4.9 PSD sensor data processing board
- 4.10 Operating test for Operational panel

#### Part 5, C-language operator and control statement summary in programming

- 5.1 Type & explanation of the Operator
- 5.2 Type & explanation of the Control Statement

#### Part 6, How to install and use AVR program related software (MCU Program S/W)

- 6.1 WinAVR Install
- 6.2 AVR-Studio Install
- 6.3 AVR Toolchain installation
- 6.4 ISP Driver Install
- 6.5 AVR Studio
- 6.6 Using AVR Studio
- 6.6.1 Program coding
- 6.6.2 Enter Program
- 6.6.3 Program compile
- 6.7 Deleting the ATmega 128 program memory

#### Part 7, Summary of ATmega128 registers required for programming

- 7.1 Microcontroller ATmega128
- 7.2 ATmega128 External Pin Description
- 7.3 ATmega128 internal structure
- 7.4 SREG-Status Register
- 7.5 General purpose register
- 7.6 X,Y,Z register
- 7.7 SP, Stack pointer
- 7.8 Flash memory (program memory)
- 7.9 SRAM data memory
- 7.10 EEPROM data memory
- 7.11 I / O port & I / O port related registers
- 7.12 Interrupt control
- 7.13 External interrupt control
- 7.14 Timer / Counter 0 & Timer / Counter 0 Related Registers
- 7.15 Timer / Counter 2 & Timer / Counter 2 Related Registers
- 7.16 Timer / Counter 1, 3
- 7.17 A / D conversion (Analog-Digital conversion) & A / D conversion related registers
- 7.18 USART & USART related registers
- 7.19 SPI & SPI related registers
- 7.20 TWI & TWI related registers
- 7.21 EEPROM & EEPROM related registers

#### Part 8, Explains the library for the drive program provided by MRP33MV3

- 8.1 Practice using lamps and buzzer
- 8.2 Practice using switches
- 8.3 Practice using basic sensor (optical sensor, inductive sensor)
- 8.4 Practice using character LCD display
- 8.5 Practice of reading IR-PSD sensor data
- 8.6 User's digital input
- 8.7 User digital output, using analog input
- 8.8 Using Motor Encoder Input

#### Part 9, Create a platform test program and check the status

- 9.1 Type & explanation of libraries

#### Part 10, Practice 13 kinds of example programs to understand the platform

- 10.1 Platform Test Program

#### Part 11, Demo & Task programs

- 11.1 Platform Test Program

#### APPENDIX A1 - Circuits

# model: 6 axis robot-GT290

## Industrial 6-axis multi-joint robot training equipment

### Features

- 6-axis multi-joint robot
- Real-world assembly process training
- Teaching pendant and operating modules
- Various exercise with robot I/O interface
- Maximum working radius : 505mm
- Maximum load capacity : 4Kg
- Maximum resultant velocity : 9000mm/sec
- Repeatability :  $\pm 0.02\text{mm}$
- A dedicated controller included
- A teaching pendant included
- Transparent cover and door
- Sequence programming software

### System configuration



### Component Lists

(1) Hardware platform	1 set
(2) Power cord	1 ea
(3) Operating manual	1 book
(4) Teach pendant and cable	1 ea
(5) Workpiece set	1 set
(6) Program CD	1 ea

## Training Contents

- Chap 1. Configuration of 6-axis robot training equipment
  - 1.1 Overview
  - 1.2 Configuration of 6-axis equipment robot training equipment
  - 1.3 Operating procedures
  - 1.4 Coordinate system
- Chap 2. Robot teaching pendant
  - 2.1 How to Hold a Ching Pendant and Deadman Switch
  - 2.2 Name of Teaching Pendant
  - 2.3 Types of operation modes
  - 2.4 Manual mode
  - 2.6 Teaching
- Chap 3. Basic knowledge of programming
  - 3.1 PAC language features
  - 3.2 Overview of Program Configuration
  - 3.3 Overview and properties of variables
  - 3.4 Programming the teaching pendant
  - 3.5 The main commands of the program
  - 3.6 Program start by teaching check mode
  - 3.7 Stop operation of robot
- Chap 4. WINCAPS program
  - 4.1 Start of WINCAP3
  - 4.2 WINCAP3 program and controller connection
  - 4.3 Start the program
  - 4.4 Manipulation of arm 3D views
- Chap 5. I/O allotment
  - 5.1 I/O allotment Table
  - 5.2 I/O monitoring
- Chap 6. Program language
  - 6.1 Robot control statement

## Spec

- 1) Training table frame
  - Dimension: 1200 x 900 x 1800 (W x D x H)
  - Door material: poly carbonate
  - Aluminum profile plate with T-slot
- 2) Air service unit
  - Pressure range: 0.5~10 kg/cm<sup>2</sup>
  - Shut off valve
  - Filter degree: 40μm
  - Size of connector: G1/4
  - Nominal flow rate: 550 /min
- 3) Robot body
  - weight: appr.30Kg
  - joint: 6-axis
  - max. load weight: 4Kg
  - operating range: 620 mm
  - repeat precision: ± 0.04mm
  - type: AC servo motor
  - Gripper unit(air chuck)
- 4) Robot control unit
  - specific controller for the robot
- 5) Supply unit
  - Stack magazine: 1EA
  - Magazine material: acrylic
  - Double acting cylinder with 2 magnetic proximity sensors : 1EA
- 6) Conveyor unit
  - Conveyor belt with DC geared motor : 1EA
  - Power: DC 24V
  - Black urethane belt (1.4t)
  - Proximity sensor on end position
- 7) Storing slide for source material
- 8) Assembly tray

- 9) Solenoid valve
  - 5/2-way single solenoid valve: 1ea
  - 5/2-way double solenoid valve: 1ea
- 10) I/O terminal
  - electric terminal for wiring
- 11) Control panel
  - 3 push-button switches with emergency switch
- 12) Tower lamp
  - 3 colors
- 13) DC Power supply
  - input power: AC 180~260V, 50/60Hz
  - output power: DC 24V, 3A
  - overload & short circuit proof
- 14) Noiseless air compressor, 1 set
- 15) Automation simulation software
  - (1) PLC programming, machine simulator, machine editor, HMI drawing, machine vision, hardware interlocking function can be done simultaneously by installing one software package.
  - (2) The PLC program tool can be programmed using the PLC standard language ladder (LD), sequential function chart (SFC), function block diagram (FBD), and structured text (ST).
  - (3) The PLC program tool has functions such as editing, compiling, downloading, CPU execution / stop, monitoring and so on the same as using actual PLC.
  - (4) Machine simulator realizes realistic reality with 3D graphic image and effect sound.
  - (5) The machine simulator is controlled not only by the PLC program tool installed but also by the actual PLC using interface module.
  - (6) The machine simulator needs to be able to identify input and output elements and can also be manipulated manually.
  - (7) Interactive augmented reality, such as pushing a switch on the operation panel with a mouse or moving a work piece, is implemented in the simulated screen.
  - (8) Be able to monitor and manipulate the system at various angles and distances using a mouse and keyboard.
  - (9) The machine editor must provide a variety of libraries, and it should be able to create or add new ones to the user.
  - (10) When adding a Siemens simulation driver, it must be compatible with the Siemens STEP7 program.
  - (11) Can work with other control software such as Mitsubishi, Beckhoff TwinCAT, Rockwell RSLogix using standard OPC communication protocol.
  - (12) The connection of the interface module should provide USB, serial, parallel, Ethernet connectable driver, and can control not only digital input / output but also analog signal.
  - (13) The HMI editor includes various symbols such as buttons, switches, lamps, combo boxes, check boxes, progress bars, status graphs, gauges, tanks and valves.  
So, the HMI system is easy to control.
  - (14) Using visual control function, can implement the machine vision function through normal webcam.
  - (15) In case of adding I / O interface module ;  
The I / O module must be able to connect to DC24V which is the voltage level used in PLC.  
Input 16 points, output 16 points, electrical connection is through 4mm safety socket.  
Switches that PNP & NPN can be selected, so it can be applied to various types of PLC.

# 33

## a group of Biomedical training system

78. GT-Biomedical 3

# model: **GT-Biomedical 3**

## Biomdeical signal measurement and signal algorithm analysis equipment

### Overview

Specialized medical engineering system for biomedical signal measurement and signal algorithm analysis.

#### 1) Open source and library offerings

Provide developers with the ability to implement matching algorithms as well as a generalized implementation of algorithms by providing variuos sample codes, and through Implementation of bio-signal processing algorithm for precise signal measurement

##### Analysis and Implementation of Signal Processing Algorithm

Medical bio-signal processing	Analog signal Signal and system Signal input / output Amplifier and signal processing
Algorithm analysis	AD Converter Software Flow analysis Algorithm Flow analysis
Algorithm implementation	Algorithm modification Biolmedical signal filtering Biolmedical signal amplification
Reliability check	Data detection Data Sampling Data Transmission

#### 2) Platform-based biomedical signal monitoring and measurement system

Provides LabView library for analyzing biomedical signal data and user program development, and provides advanced application program based on PC and embedded system

- PC Appliaion
- Embedded Appliaion
- LabView

#### 3) Various wired / wireless communication interface

For analyzing and delivering measured biomedical signal data, GT-Biomedical3 is consisted of various wired / wireless communication interfaces and various peripherals needed for application system development.

- Circuit Design and Implementable Project Development System
- High-performance smart embedded platform interworking
- Provides biomedical signal measurement program in various environments



## Product Structure

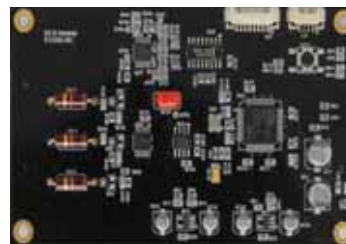
GT-Biomedical3 is consisted of a module system for measuring biological signals and an embedded board for displaying and using measured signals.

And it is consisted of various peripheral devices that is required for development.

### (1) Electrocardiogram measuring system (ECG)

Electrocardiogram (ECG) is the recording of the heart's electrical signal through an electrode attached to the skin. ECG is one of the electrophysiological tests that detect the change of electrical activity related to the heartbeat at using an electrode attached to the body surface and the results of a physiological test is recorded and displayed as a chart. In this system, the bipolar standard LEAD II is measured by LEAD electrocardiography, which is the most standard test method.

Channel : 3 lead Patient cable
Band width : 0.05~150Hz
Filter : High Pass Filter(0.05Hz) Low Pass Filter(150Hz) Notch Filter(digital 60Hz)
Power Isolation : Isolation DC/DC Mold Type
Data Isolation : Opto Coupler
HR measuring range : 30 to 300BPM

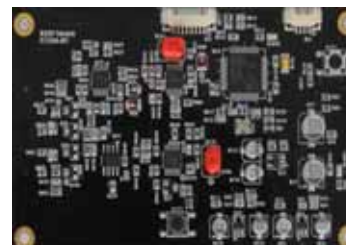


### (2) Respiration measuring system

Impedance Plethysmography is used to measure respiration rate.

Impedance plethysmography is a method of measuring changes in the volume of air entering to the lung tissue. The respiration rate is measured indirectly by measuring the voltage change across the breath between two thoracic surface electrodes.

Measuring method : Impedance Plethysmography
Measuring range : 0, 10 to 120 breaths/min
Leads : LA
Power Isolation Isolation : DC/DC Mold type
Data Isolation : opto Coupler



### (3) Bio-Impedance measurement system

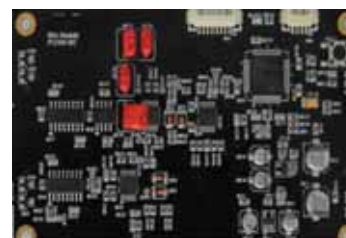
For Bioelectric Impedance Analysis (BIA), sends a fine alternating current signal to the human body and Impedance is differently generated from body water, fat, muscle, and so on.

Also, the impedance and the body composition generated at this time have a certain relation with each other, according to this relation

the body composition is evaluated and measured.

It is a method that takes advantage of the fact that the ratio of the two organizations, the human body consists of a high conductive and a low conductive, is reflected in the electrical characteristics and the impedance measurement value.

Measuring method : Tetra-Polar Method
Measuring range : 100 ~ 800[Ohms]
Segmentation : Single Segment
Segmentation : Single Frequency (110Khz)
Frequency : Single Current(800·IA)
Current : Isolation DC/DC



(4) Blood pressure measurement system (NIBP)

Blood pressure is caused by the contractile force of the heart and refers to the pressure exerted on the walls of blood vessels as blood flows through them.

In this system, Non Invasive Blood Pressure (NIBP), is used.

A pressure sensor detects and records the magnitude of the pressure oscillation generated in the cuff on the blood vessel to measure the blood pressure.

Measuring method : Sphygmo-oscillometricmethod
Pulse measuring range : 40 to 200BPM
Cuff Pressure Range : 0 to 250mmHg
Systolic blood pressure : 60 to 230mmHg
Mean blood pressure : 55 to 210mmHg
Diastolic blood pressure : 50 to 200mmHg



(5) Oxygen saturation measurement system (SpO2)

Measurement of oxygen saturation (SpO2) is a technique to monitor the oxygen supply of the human body through oxygen hemoglobin and reduced hemoglobin, which play a major role in oxygen supply in the blood vessels.

It is a technique to measure PPG (Photo Plethysmo Graphy) signal through oxygen hemoglobin and hemoglobin absorption coefficient using two different light sources with different wavelengths.

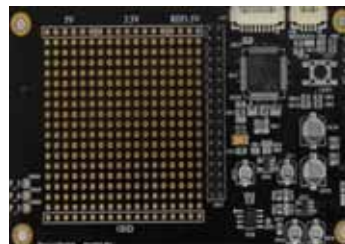
Measuring method : Photo Plethysmography
Pulse measuring range : 30 to 300BPM
SpO2 measuring range : 1 to 100%
Power Isolation : Isolation DC/DC Mold Type
Data Isolation : Optocoupler



(6) System for circuit design (Project)

The system for circuit design has MCU, power circuit and I / O port,, etc and It is configured so that the user can make and program the desired circuit.

MCU : ARM Cortex-M3 STM32F103
Boot : selection
Resistor : H/W Setting
UART : TTL 3.3V
JTAG : S/W Debug&Download
Reset : S/W CPU H/W Reset
ADC : 1ch



(7) Biomedical signal measurement and application program

<Hardware spec>

AP : SamSung Cortex-A8 S5PV210 Processor
Display : 7inch 800x480 Wide TFT LCD Capacitive Touch
Memory : DDR2 SDRAM 512Mbyte, Nand Flash 256Mbyte
Communication : Wi-Fi / Bluetooth / Ethernet / RS232
Audio : WM8960(I2S) - Mic/Stereo 1W Speaker x2 (Class-D)
Sensor : 3Axis acceleration, Digital Compass, Vibration Sensor
Storage : SD-CARD 1 Port, T-Flash 1Port
I/O Interface : USB 2.0Host 4 port, USB 2.0 OTG 1port
Digital : Video HDMI(1080p)
Power : 5V/3A, Battery(4000mA Lithium-ion battery)
Printer : Thermal Printer Connector





<Software spec >

OS : support Embedded Linux, Android System
Bootloader : u-boot
FileSystem : Yaffs2
DeviceDriver : CMOS Camera, TFT LCD, WiFi, Bluetooth, GPS, Ethernet, Serial, 3Axis Acceleration, Digital Compass,Audio, Haptic, SD, USB 2.0 Host/OTG, HDMI
Application : 5 kinds of biological signal monitoring program QT Application (4.7.5) Graph Waveform, Size, Position, Speed Control, Data Storage and Output

System configuration & Components

1) Hardware Platform (Biomedical signal module system)



2) Embedded system



3) Cables for measuring biomedical signals



4) USB Serial cable



5) SpO2 measuring sensor & cable



6) NIBP Measuring Cuffs and Hoses



7) Power adaptor



## Components

Hardware platform	1 set
Cables for measuring biomedical signals	1 set
Power cable	1 ea
USB cable	1 ea
SpO2 measuring sensor & cable	1 set
NIBP Measuring Cuffs and Hoses	1 set
Manual book	1 book
Program CD (S/W)	1 ea

## Training topics

### Chap 1, Introduction

- 1.1 Features
- 1.2 System configuration
  - 1.2.1 Hardware platform
  - 1.2.2 Analog based board
  - 1.2.3 Biomedical signal measurement module
  - 1.2.4 Embedded system
  - 1.2.5 Other components

### Chap 2, Principle of measuring biomedical signals

- 2.1 Techniques for acquiring biomedical signals
  - 2.1.1 Who should measure
  - 2.1.2 Sensor
  - 2.1.3 Biomedical signals
  - 2.1.4 Signal processing
  - 2.1.5 Output display
- 2.2 Biomedical signal filtering
  - 2.2.1 Low-pass filter (LPF)
  - 2.2.2 High-pass filter (HPF)
  - 2.2.3 Band-pass filter (BPF)
  - 2.2.4 Band-Resistance filter (BRF)
- 2.3 Biomedical signal amplification
  - 2.3.1 Operational amplifier
  - 2.3.2 Differential amplifier

### Chap 3, Biomedical Signal Measurement System

- 3.1 ECG measurement
  - 3.1.1 Overview
  - 3.1.2 Standard 12-lead electrocardiogram
  - 3.1.3 Electrocardiography
  - 3.1.4 ECG module introduction
  - 3.1.5 ECG module main circuit
  - 3.1.6 ECG module Block Diagram
  - 3.1.7 ECG Software Flow
  - 3.1.8 Algorithm Flow
- 3.2 Respiration module introduction
  - 3.2.1 Overview
  - 3.2.2 Respiration module introduction
  - 3.2.3 Respiration module main circuit
  - 3.2.4 Respiration module Block Diagram
  - 3.2.5 Respiration Software Flow
  - 3.2.6 Algorithm Flow

### 3.3 Bio-Impedance Module

- 3.3.1 Overview
- 3.3.2 Principle of bioelectrical impedance analysis
- 3.3.3 Impedance
- 3.3.4 Bio-Impedance module introduction
- 3.3.5 Bio-Impedance module main circuit
- 3.3.6 Bio-Impedance Module Block Diagram
- 3.3.7 Bio-Impedance Software Flow
- 3.3.8 Algorithm Flow

### 3.4 NIBP Module

- 3.4.1 Overview
- 3.4.2 Blood pressure measurement principle
- 3.4.3 Implementation of blood pressure measurement system
- 3.4.4 NIBP module introduction
- 3.4.5 NIBP module main circuit
- 3.4.6 NIBP module Block Diagram
- 3.4.7 NIBP Software Flow
- 3.4.8 Algorithm Flow

### 3.5 SpO2 Module

- 3.5.1 Overview
- 3.5.2 Principle of measurement
- 3.5.3 SpO2 module introduction
- 3.5.4 SpO2 module main circuit
- 3.5.5 SpO2 module Block Diagram
- 3.5.6 SpO2 Software Description
- 3.5.7 Algorithm Flow

### Appendix

- 4.1 Biomedical Signal Module Communication Protocol
- 4.2 MCU (Cortex M3) development environment and project creation
- 4.3 How to use measurement program for PC

## Spec

### 1) Base Board

Module	ECG, Respiration, Bio-Impedance, NIBP, SpO2, Project module
MCU	Atmega256A3U
USB	USB Connector B Type, USB Hub GL850A
UART	USB to Serial 8ch : CP2108(4ch) * 2
Switch	tact switch 3*3 9ea, rotary switch 1ea, power switch 1ea, MCU reset switch 1ea
GPIO	8channel
PDI	Debug&Download
Power	DC 12V / 3.5A

## 2) Analog Board

### (1) Hardware platform

MCU : ARM Cortex-M3 CPU(STM32F103)  
Boot selection Resistor(H/W setting)  
UART : TTL 3.3V  
JTAG : S/W Debug&Download  
UART : TTL 3.3V, ADC 1ch, CPU H/W Reset

### (2) ECG Module

Channel : 3lead Patient cable  
Band width : 0.05~150Hz  
Filter : High Pass Filter(0.05Hz), Low Pass Filter(150Hz), Notch Filter(digital60Hz)  
Power Isolation : Isolation DC/DC Mold type  
Data Isolation : OptoCoupler  
HR measuring range : 30 to 300BPM  
HR measuring accuracy :  $\pm 3$ BPM

### (3) NIBP Module

Measuring method : Sphygmo-oscillometric method  
Pulse measuring range : 40 to 200BPM  
Cuff Pressure Range : 0 to 250mmHg (0kpa to 33.3kpa)  
Systolic blood pressure : 60 to 230mmHg (8.0kpa to 30.0kpa)  
Mean blood pressure : 55 to 210mmHg (7.5kpa to 27.9kpa)  
Diastolic blood pressure : 50 to 200mmHg (6.7kpa to 26.5kpa)

### (4) Respiration module

Measuring method : Impedance Pneumography  
Measuring range : 0, 10 to 120 breaths/min (Baseline 1000 )  
Leads : LA  
Power Isolation : Isolation DC/DC Mold type  
Data Isolation : OptoCoupler

### (5) SpO2 Module

Measuring method : Photo Plethysmography  
Pulse measuring range : 30 to 300BPM  
SpO2 measuring range : 1 to 100% (Pulse Amplitude 10%)  
Power Isolation : Isolation DC/DC Mold type  
Data Isolation : OptoCoupler

### (6) Bio Impedance module

Measuring method : Tetra-Polar Method  
Measuring range : 100 ~ 800[Ohms] , measuring accuracy :  $\pm 5\%$   
Segmentation : Single Segment  
Frequency : Single Frequency(110KHz)  
Current : Single Current(800uA)  
Impedance calculation : Multiple Interpolation  
Power Isolation : Isolation DC/DC Mold type  
Data Isolation : optoCoupler

## 3) Evaluation Board

### (1) Bio Sensor

ECG	3lead Patient cable
Respiration	3lead Patient cable
SpO2	SpO2 Sensor reusable model, Measure range(SpO2 35~100%, Pulse rate 20~250bpm)
NIBP	Adult use, Single tube adult NIBP cuff with TPU bladder Size: 25~35cm, Single tube/dual tube available

(2) Embedded Tablet Board

AP	SamSung Cortex-A8 S5PV210 Processor
Display	7inch 800x480 Wide TFT LCD Capacitive Touch
Memory	DDR2 SDRAM 512Mbyte, Nand Flash 256Mbyte, SD-CARD 1 Port, T-Flash 1Port
USB	USB 2.0Host 1 port, USB 2.0 OTG 1port
Sensor	3Axis acceleration, Digital Compass
HDMI	HDMI Output 1port(1080p)
key	Tact Switch 4EA, Power On/Off 1EA, Reset 1EA
Debug	USB to Serial Port 1EA, Serial Port 1EA
Wi-fi	802.11b/g/n
Bluetooth	V2.1+EDR
Camera	MOS 5M Pixels Auto Focus, Removable bidirectional slot

(3) Embedded base board

USB	USB Host 3EA, USB Client 1EA
Ethernet	10/100 Ethernet 1 port(RJ45)
Printer	Thermal Printer
Switch	Reset switch 1ea

4) S/W Specification

(1) Analog Firmware S/W

ECG Module Analog filter firmware source  
 SpO2 Module Analog filter firmware source  
 NIBP Module Analog filter firmware source  
 Respiration Module Analog filter firmware source  
 Impedance Module Analog filter firmware source

(2) LabView : ECG, NIBP, Respiration, SpO2 LabViewr Test Source

(3) Measurement monitoring : PC based biomedical signal measurement program (QT Application)

(4) Embedded Board

OS	Embedded Linux Kernel 2.6.35
Bootloader	u-boot
File System	Yaffs2
Application	5 kinds of biomedical signals QT Application (version 4.8.5), basic menu composition such as waveform, size, position, speed

# 34

## a group of Electric & electronic circuit training system

79. GT-Electric & electronic circuit 11



# model: **GT-Electric & electronic circuit 11**

## **PC based Electric & Electronic circuit training kit**

### **Overview**

Understand the fundamental characteristics of resistors, capacitors, and inductors based on electrical and electronic circuit construction through practical exercises and improve their skills through comprehensive exercises.

It is composed of practical modules for each learning field, and it is easy to do laboratory exercises.

Basic signal generator, power supply, voltage, current and resistance measuring devices are equipped to this training system. So, experiment is possible without separate measuring devices.

- Easy and convenient practice on various basic theories of electricity and electronics
- Convenient signal input and output confirmation through various signal input / output devices
- Provide various experimental methods faithful to the basics
- Make additional circuit construction and experiment through breadboard
- USB Oscilloscope function provides accurate result measurement
- Complex experiments available through simultaneous installation of two modules •
- Automatic power off and alarm notification when a circuit is short-circuited

### **Features**

- Oscilloscope function provides measurement and real-time monitoring of analog signals, thus enhancing learning effect
- Efficient laboratory practice through simultaneous output of wide range of frequency generators, variable duty and various types of waveforms
- Generate various AC output voltage and use AC voltage for power circuit experiment
- Easy to practice variable experiment of various circuits with various kinds of variable resistors and capacitors
- Two electronic modules can be tested at the same time.
- Validation and monitoring of test results through the equipped audible speakers (by eye & ear)
- Various application circuits can be configured with the provided breadboard
- Breadboard type connector for each electronic circuit module connection makes easy & convenient wiring
- For the safety of the training equipment, each individual power protection circuit is automatically shut off when the circuit is short-circuited and an alarm together
- Various application exercises are possible through selection switch operat
- Learn how to use basic instruments operating such as power supplies, oscilloscopes, and function generators
- User can practice how to identify and use the capacity of components such as resistors, capacitors, and inductors.
- Any logic data can be generated and used as input to the circuit using USB DAQ.

### **Benefits**

- Students learn the skills how to use instruments such as power supply, oscilloscope, function generator, voltage meter and resistance meter.
- Learn how to choose the right device by verifying values and data sheets for passive devices such as resistors, capacitors, and inductor
- Improve the students comprehension through application circuit configuration using basic passive element.
- Can compare theory and practice results through practicing the basic circuit theory using resistors, capacitors, and inductors
- Learn how to make the DC power that we use through the power rectifier circuit configuration
- Learn the electrical characteristics and usage of diodes through the characteristic study of diode.

## System configuration



## Components

Hardware platform	1 set
AC Power cable	1 ea
USB Cable	1 ea
Jumper cable	1 ea
Oscilloscope probe	1 set
manual book	1 book
Program CD	1 ea

## Training topics

Chap 1, Ohm's Law and Resistive Parallel Circuits  
 Chap 2, Kirchhoff's current law, voltage law  
 Chap 3, Capacitor characteristics and capacitor serial & parallel circuit, RC serial circuit  
 Chap 4, Inductor characteristics and serial & parallel circuit, RL serial circuit  
 Chap 5, Differential and integral of waveform, R-C, R-L Parallel circuit  
 Chap 6, wheatstone bridge  
 Chap 7, Voltage multiplier and current Shunt  
 Chap 8, Maximum power delivery conditions and impedance matching  
 Chap 9, RLC serial & parallel resonance circuits  
 Chap 10, The Thevenin and Norton theorem  
 Chap 11, The principle of superposition  
 Chap 12, Switching Diodes, Zener Diodes, LED Characteristics  
 Chap 13, Half wave, full wave rectification circuit

## Training topics

### < Baseboard hardware spec >

[Input section : All below functions are built-in type]

- 1) Resistance measurement
  - (1) Digital resistance measurement through resistance measuring terminal
  - (2) Measuring range : 10 $\cdot\ddot{y}$ , 100 $\cdot\ddot{y}$ , 1k $\cdot\ddot{y}$ , 10k $\cdot\ddot{y}$ , 100k $\cdot\ddot{y}$ , 1M $\cdot\ddot{y}$
- 2) AC Power : 0V, 6V, 9V, 12V
- 3) AC Voltmeter : 12V
- 4) Slide Switch : +5V 2EA, -5V 2EA, +15V 2EA, -15V 2EA
- 5) Tact Switch : +5V 1EA, -5V 1EA, +15V 1EA, -15V 1EA
- 6) Waveform Generators & Output Level Regulators
  - (1) Sine wave, triangle wave, square wave through built-in waveform generator
  - (2) 0.1Hz ~ 100kHz

- 7) Duty generator : 10% ~ 90%
- 8) Variable resistance generator : 1k $\cdot\ddot{y}$ , 10k $\cdot\ddot{y}$ , 50k $\cdot\ddot{y}$ , 100k $\cdot\ddot{y}$  4 range variable resistance regulators
- 9) Capacitor Selector : 100F, 1nF, 10nF, 47nF, 100nF, 1000nF Range Measurement
- 10) Variable Power Generator : + 1.5V to + 18V, -1.5V to -18V
- 11) Fixed voltage output : + 5V, -5V, + 15V, -15V
- 12) Fixed frequency output : 0.5Hz, 1Hz, 50Hz, 100Hz
- 13) Variable signal voltage generator : +5V ~ -5V

[Output section : All below functions are built in type]

- 1) Frequency counter: 0Hz ~ 10kHz measurement
- 2) Analog & Digital voltmeter: 0V ~ 30V, AC and DC voltage measurement
- 3) Analog & Digital ammeter: 0A to 1A, AC and DC current measurement
- 4) Display function
  - (1) 7-Segment : 2ea
  - (2) LED : 8ea (For output display)
  - (3) LED : 3ea (Mode status display)
  - (4) Speaker : 1ea
  - (5) Speaker Volume Control : 1ea
  - (6) USB DAQ Input & Output : each 1ea
  - (7) Program waveform output : 1ea
  - (8) Scope : 2 channels, 250KHz
- 5) Oscilloscope Output : USB (Cortex-M3)
- 6) DAQ Output : USB To Serial (FTDI - FT232BL)

[Module Implementation Section]

- 1) RF SMB Type Connector : 25 - Includes Digital Logic Module Compatibility
- 2) At least, 2 practice modules is simultaneously installed / practiced on the main body (excluding breadboard)

< Practice Theme Module Specifications >

- 1) Module-1, Ohm's law and resistor serial / parallel circuit (1 ea)
- 2) Module-2, The current-voltage law of Kirchhoff (1 ea)
- 3) Module-3, The serial / parallel circuit of the capacitor, the R-C serial circuit (1 ea)
- 4) Module-4, Inductor serial / parallel circuit, R-L serial circuit (1 ea)
- 5) Module-5, Differential and integral of the waveform, R-C, R-L Parallel circuit (1 ea)
- 6) Module-6, Wheatstone bridge (resistor / capacitor measurement circuit) (1 ea)
- 7) Module-7, voltage multiplier and current multiplier, maximum power delivery condition and impedance matching circuit (1 ea)
- 8) Module-8, R-L-C serial & parallel resonant circuit (1 ea)
- 9) Module-9, The Thevenin and Norton Theorem (1 ea)
- 10) Module 10, Principle of superposition, diode characteristics (junction / zener / LED) (1 ea)
- 11) Module 11, Half-wave rectification and full-wave rectification circuit (center tap / bridge rectification circuit) (1 ea)

< Software Specifications >

- 1) Simulator : Main hardware built-in type without separate module (1 Copy)
  - (1) 8 channel data input function
  - (2) Supports 8 channel data output function
  - (3) Data Acquisition function via USB
  - (4) One-time measurement and continuous measurement function
  - (5) Supports save, print and clipboard function of measured data
  - (6) Supports the measured data Supports Group / UnGroup function
  - (7) Set arbitrary data (0 or 1) in the input channel
  - (8) Channel Name Change Function
- 2) Oscilloscope : Main Hardware built-in type without separate module (1 copy)
  - (1) Channel : 2ch
  - (2) Display minimum, maximum, and mean voltage values on each channel
  - (3) Timebase: display time value per field on two channels
  - (4) 0V voltage display per channel
  - (5) Trigger method : support Always, Rising, Falling, Level method
  - (6) Trigger level voltage display function
  - (7) Oscilloscope connection status display function
  - (8) Seven-level voltage step adjustment from 100mV to 10V per channel
  - (9) 14 step time value display function per Timebase one scale

# 35

## a group of LOGIC LAB training system

- 80. Logic circuit design-GTC4100
- 81. Digital Logic Circuit-GT510
- 82. Digital logic-3000
- 83. Logic Simulator, GT-LSP

# model: **Logic circuit design-GTC4100**

## **Logic Circuit Design Practice Kit**

### **Features**

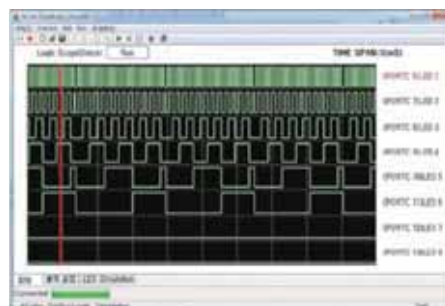
- 1) provide simulation function via USB DAQ
- 2) Practice without separate measuring equipment  
: equipped with Signal Generator / Frequency Counter / Variable Resistor / Slid Switch / Pull Up & Pull Down Resistor
- 3) Automatic power off and alarm when a circuit is short-circuited
- 4) Convenient maintenance due to removable type of breadboard
- 5) Easy wiring in circuit design by using connector for breadboard
- 6) by equipping audible speaker, verification and monitoring of experimental results using visual and auditory

### **System configuration**

- 1) Hardware



- 2) Digital Logic\_Simulation Software



## Components

1) Hardware platform	1 set
2) AC Power cable	1 ea
3) USB Cable	1 ea
4) Jumper cable	1 ea
5) Program CD	1 ea
6) Manual book	1 book

## Training Contents

Part 1, Logic Circuit Design Practice kit  
Part 2, How to use Logic Simulation Software

## Specifications

### 1) Input part

#### (1) Waveform Generator



- \* variable frequency : 0.1Hz ~ 1KHz
- \* 0.1Hz ~ 10Hz, 10Hz ~ 1KHz : 2 Range Select switch
- \* Duty Control : 10% ~ 90%
- \* Waveform : Square
- \* Output level : TTL (0 ~ +5V)
- \* fixed frequency : 0.5Hz, 1Hz, 50Hz, 100Hz, 125Hz, 250Hz, 500Hz, 1000Hz
- \* OUT terminal : Setting frequency output

#### (2) Button Switch



- \* output voltage : +5V, switch is 4 ea
- \* Switch #1: Normal status "1". if press, become "0"
- \* Switch #2: Normal status "0". if press, become "1"
- \* Switch# 3: Normal status "1". If press, become "0"  
: Automatic return to "1" after 1 pulse (20ms)  
No change in state even after pressing and holding.  
Unlock and press again, then become activate.
- \* Switch # 4: Normal status "0". if Press, become "1"  
: Automatic return to "0" after 1 pulse (20ms)  
No change in state even after pressing and holding.  
Unlock and press again, then become activate.
- \* Since it is not chattering when using as a clock input of logic IC,  
it can be input by 1 clock

#### (3) Slid Switch



- \* Output voltage : +5V
- \* Switch, 8 ea
- \* In case of ON, Output comes through 1K
- \* In case of OFF, connect to Ground.

#### (4) Variable resistor



- \* 10K ohm 3-terminal variable resistor
- \* 100K ohm 3-terminal variable resistor

(5) Frequency counter / Digital voltmeter display



- \* Frequency Counter Input Voltage Range : +/- 0.5V to +/- 15V,
- \* Frequency counter input waveform : square wave, sine wave, triangle wave
- \* Input response time : 1 second
- \* DC voltage display digit : 3 digit
- \* DC voltage meter Input range : -15V to + 15V

(6) Frequency counter / Digital voltmeter selection switch



- \* Left side when selecting frequency counter
- \* Right side when measuring DC voltage

(7) Pull Up Resistor



- \* connected to +5V via 1K
- \* Consists of 8ea of independent pull-up terminals

(8) Pull Down Resistor



- \* connected to Ground via 1K
- \* Consists of 8ea of independent pull-down terminals

(9) Variable Positive Power / Variable Negative Power



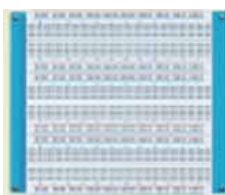
- \* Variable Positive Power
- \* Output voltage : 0V ~ +13.5V
- \* Output Current : Max 0.2A
- \* Variable Negative Power
- \* Output voltage : 0V ~ -13.5V
- \* Output Current : Max 0.2A

(10) DAQ input(8Bit)



- \* 8-bit TTL data input port from logic circuit training equipment to PC
- \* Pull-up via 10K

(11) Breadboard



- \* Bread board size : 165 x 164
- \* 6 ea of Power Bus Strips
- \* 3 ea of common terminal strips
- \* Structure capable of attachment and detachment

## 2) Output part

### (1) Speaker



- \* Input Frequency : 20Hz ~ 20,000Hz
- \* Max output : 0.5W
- \* Adjust speaker output with volume control bar

### (2) 7-segment(Anode Common)



- \* connected via Anode common type 470
- \* Color : RED, Green

### (3) 7-segment(Cathode Common)



- \* connected via Cathode common type 470
- \* Color : RED, Green

### (4) LED



- \* 8-Bit TTL Data Output from PC to Practice Equipment
- \* output via 100

### (5) USB DAQ / Reset switch / status LED



- \* Main Power LED : Main power indicator LED
- \* Status LED : Status indication of LAB UNIT equipment  
: Alarm when + 5V of main power supply is short-circuited.
- \* Reset switch : reset of LAB UNIT device status
- \* USB DAQ : Input signal programming or output signal monitoring

### (6) Status LED



- \* 8-Bit TTL Data Output from PC to Practice Equipment
- \* output via

### (7) DAQ output(8Bit)



- \* connect to ground via 1K
- \* Consists of 8ea of independent pull-down terminals

### (8) Fixed voltage output section



- \* -10V voltage : max 0.2A
- \* +10V voltage : max 0.2A
- \* Ground terminal
- \* -5V voltage : max 0.2A
- \* +5V voltage : max 0.4A
- \* Independent power output



# model: **Digital Logic Circuit-GT510**

## Digital Logic Circuit Training Equipment

### Overview

- complex experiment of digital logic circuit and electronic circuit
- provide Simulation software via USB DAQ
- Practice without separate measuring equipment
- provide of USB Oscilloscope function
- Automatic power off and alarm notification when a circuit is short-circuited

### the expected effects

- Digital logic circuit operation and application learning can be done through experiments on digital logic circuits, and various logic circuits can be experimented through various logic circuit combinations. Also, user can learn the characteristics of the TTL IC through each individual module experiment.
- Latch circuits and flip-flop circuits can be used to test sequential logic circuits and increase their operating principles and applications.
- User can understand the operation of logic circuits and learn design skills through configuration and experiments of adders, subtractors, encoders, decoders, multiplexers, and demultiplexers.
- Understand the basic principles of CMOS IC and verify the operation of CMOS IC through experiment.
- Through ADC and DAC, understand to the conversion of analog signals & digital signals.
- And, through interlocking with digital logic, understand & improve the ability to actually design complex circuits of digital and analog circuits.

### Features

- It is composed of each module block so that the digital logic IC can be configured according to each learning stage experiment.
- Built-in digital logic ICs required for basic experiment allows simple experiment without additional module.
- Logic data input/output is available through USB, also input/output can be checked on computer.
- Real-time output data monitoring & storage via USB
- Power cut-off and alarm when output power is short-circuited for safety of training equipment
- Signal input to digital logic circuit using basic input device switch, frequency signal generator, USB DAQ, variable voltage, duty changer
- Check & monitor the experiment result data through frequency counter, 7-segment, LED, speaker and USB DAQ
- Ability to configure additional logic circuits using the breadboard
- Interlocking experiment with digital circuit is possible as It consists of a connector that can be linked with the electronic circuit module of the electronic circuit training equipment
- By application experiment using ADC, DAC, CMOS IC, through interworking with electronic circuit module, various experiments is available
- Visual verification of output waveform using oscilloscope function



## Spec

### Hardware spec

#### 1) Built-in Input terminal

- \* Frequency generator
  - Fixed frequency generator : 0.5Hz, 1Hz, 50Hz, 100Hz, 125Hz, 250Hz, 500Hz, 1kHz
  - Variable frequency generator : 0.1Hz ~ 1KHz
- \* Duty cycle : 10% ~ 90%, voltage ratio change method
- \* C-MOS Input voltage regulator : 0V ~ +5V
- \* DIP Switch : 2EA(8bit)

- \* Slide Switch : 16EA
- \* Button Switch : 4EA
- \* Pull-up Register : 16EA
- \* Pull-down Register : 16EA
- \* DAQ Input : 8bit Data Input, USB communication
- \* RF SMB connector (gold plated): 36 - Interlocking with electronic circuit experiment module

#### 2) Built-in output terminal

- \* Frequency counter : 0Hz ~ 1KHz
- \* Frequency speaker : 1W, 20Hz ~ 20KHz
- \* LED : 16EA (BLUE 8EA, RED 8EA)
- \* FND : 4EA (Anode Common 2EA, Cathode Common 2EA)
- \* DAQ output : 8bit Data Output, USB communication

- \* DAQ USB 1EA
- \* Oscilloscope USB : 250KHz, 1ch
- \* Power : Input AC 220V / Output DC +5V/4A
- \* Reset switch

#### 3) Logic circuit design blocks and modules

- \* BASE Board, Basic Mounting Block  
(There is a risk of losing the modules, so the following 21 kinds of basic gates is mounted to the base board)
  - AND Gate 2-in 4EA,
  - OR Gate 2-in 4EA,
  - NOT Gate 2-in 4EA,
  - NOR Gate 2-in 4EA,
  - NAND Gate 2-in 4EA,
  - XOR Gate 2-in 4EA,
  - NAND Gate 3-in 2EA,
  - NAND Gate 4-in 4EA,
  - Decimal decoder 1EA,
  - 7-segment decoder 2EA,
  - 4-bit latch 1EA,
  - 4-bit pre-adder 1EA,
  - 4-bit comparator 1EA,
  - Decimal counter 1EA,
  - 4-bit binary counter 1EA,

- Dual JK F/F 1EA,
- Timer 1EA,
- Multivibrator-1 1EA,
- Multivibrator-2 1EA,
- Multivibrator-3 1EA,

- \* Provided experimental module (module type)
  - NOT Gate 2-in 4EA, 7404 1EA
  - NAND Gate 2-in 4EA, 7400 2EA
  - XOR Gate 2-in 4EA, 7486 2EA
  - NAND Gate 3-in 2EA, 7410 1EA
  - Dual JK F/F 1EA, 7473 1EA
  - Dual JK F/F 1EA, 7474 2EA
  - C-MOS 1, 4066, Quad Analog Switch, 1EA
  - C-MOS 2, 4051, 8-1 Analog Switch, 1EA
  - C-MOS 3, 4052, Dual 4-1 Analog Switch, 1EA
  - C-MOS 4, 4053, Triple 2-1 Analog Switch, 1EA

#### 4) Application design module

- \* BreadBoard Module : 1EA
  - 200mm x 110mm, Terminal Strip 3EA, Bus Strip 4EA
- \* Universal board module

- Size 130mm x 110mm : 1EA
- Size 60mm x 50mm : 2EA

### Software spec

#### \* Simulator

- support 8 channel data input function
- support 8 channel Data Output function
- provide DATA Acquisition function via USB
- support one-time / continuous measuring function
- supports save, print and clipboard function of

- measured data
- support the measured data Supports Group / UnGroup function
- Set arbitrary data (0 or 1) in the input channel
- Channel Name Change Function

#### \* Oscilloscope

- Channel number. 1 channel
- Display Minimum, Maximum, and Mean voltage values for each channel
- Timebase: display time value per field on two channels
- 0V voltage display per channel
- Trigger type : support Always, Rising, Falling,

- Level method
- Trigger level voltage display function
- Oscilloscope connection status display function
- Seven-level voltage step adjustment from 100mV to 10V per channel
- Timebase 14-step time value display function

#### \* Simulation function

- 13 kinds of electronic circuit modules

- 11 kinds of basic electrical and electronic circuits

# model: Digital logic-3000

## Digital logic trainer

### Feature

- 1) Digital logic-3000 is a training system to perform various logic experiments by applying varieties of elementary logic gates. This system is equipped with a power supply and a pulse generator, enabling to perform experiments without separate peripheral devices.
- 2) Digital logic-3000 enables to practice experiments by combining various digital components. Since numerous telecommunication devices today including electronic calculators are digitalized, it is essential to understand operation, configuration and use of digital circuits.
- 3) This training system enables to test and experiment various digital gates such as digital IC, flip-flop, etc. from the fundamentals to their applications.
- 4) Applies various logic gates
- 5) Applies TTL ICs.
- 6) An elegant bag-style case convenient for storage and handling
- 7) Apply a wide range of basic logic gates.
- 8) Apply TTL IC.
- 9) Input voltage: Free volt
- 10) Easy to conduct various logic experiments
- 11) A bag-style case convenient for storage and handling

### Manual Contents

Chap 1. Digital signals and computer  
Chap 2. Number system and digital codes  
Chap 3. Binary logic and logic gates  
Chap 4. Simplification of logic functions

Chap 5. Combinational logic circuit  
Chap 6. Sequential logic circuit  
Chap 7. Counter  
Chap 8. Counter design and register

### System configuration



### Components

1) Hardware system	1 set
2) LEAD WIRE	1 set
3) Power supply cable	1 ea
4) Manual book	1 book

### Specifications

1) INPUT POWER	FREE VOLT(110/220[V])
2) LOGIC SW	8EA
3) 2 WIDE 2 INPUT AND OR INVERTER	4EA
4) 2 INPUT NAND	8EA
5) 4 INPUT NAND	4EA
6) LED DISPLAY	8BIT
7) CLOCK	SLOW(1-10HZ)/FAST(10-100KHZ)
8) J-K FLIP-FLOP	4EA
9) PULSE GENERATOR	1EA
10) HEX INVERTER	6EA
11) 2 INPUT NOR	4EA
12) 2 INPUT AND	4EA
13) 2 INPUT OR	4EA
14) BREAD BOARD	1EA
15) General spec	
(1) Operating temperature	0 - 45 , 85% R.H. below
(2) Input power	AC 220V, 50/60Hz
(3) Size	370mm(W) x 120mm(H) x 262mm(D)

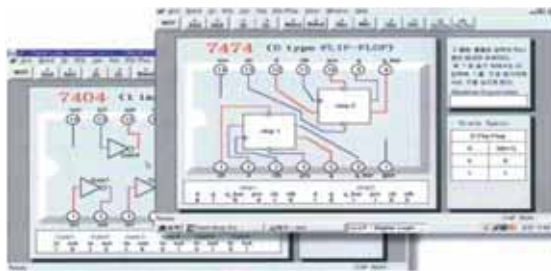
# model: **Logic Simulator, GT-LSP**

## **Logic simulation SW program**

### **Feature**

1. Various GATE practice is available such as basic digital IC, Flip-Flop,, etc.
2. Logic results can be directly checked by simulation.
3. Easy understandings due to IC graphic on simulation program (screen)
4. BonPouRoGeuRaem draws formal system of registration of a copyright association, and you shall join.
4. Each gate that was implemented to the parts (components) should be freely controlled the main power input and signal sources in real time.

### **System configuration**



### **Manual Contents**

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| 1) NOT GATE experiment              | 8) Two INPUT NOR GATE experiment    |
| 2) Two INPUT AND GATE experiment    | 9) Three INPUT NOR GATE experiment  |
| 3) Three INPUT AND GATE experiment  | 10) Two INPUT XOR GATE experiment   |
| 4) Two INPUT OR GATE experiment     | 11) Three INPUT XOR GATE experiment |
| 5) Three INPUT OR GATE experiment   | 12) D FLIP FLOP experiment          |
| 6) Two INPUT NAND GATE experiment   | 13) JK FLIP FLOP experiment         |
| 7) Three INPUT NAND GATE experiment |                                     |

### **Specifications**

- |                                      |                                       |
|--------------------------------------|---------------------------------------|
| 1) Programmed by Visual C            | (5) Three INPUT OR GATE experiment.   |
| 2) Gate - 4ea                        | (6) Two INPUT NAND GATE experiment.   |
| 3) TestPin - 14ea                    | (7) Three INPUT NAND GATE experiment. |
| 4) IC : Logic 7408 IC                | (8) Two INPUT NOR GATE experiment.    |
| 5) Logic simulation experiments      | (9) Three INPUT NOR GATE experiment.  |
| (1) NOT GATE experiment.             | (10) Two INPUT XOR GATE experiment.   |
| (2) Two INPUT AND GATE experiment.   | (11) Three INPUT XOR GATE experiment. |
| (3) Three INPUT AND GATE experiment. | (12) D FLIP FLOP experiment.          |
| (4) Two INPUT OR GATE experiment.    | (13) JK FLIP FLOP experiment.         |

### **Components**

1) Logic Simulation Program CD	1 ea
2) Manual book	1 book

# 36

## a group of Mechatronics training system

- 84. PLC-GLOFA-1000
- 85. PLC-MASTER-K-2000
- 86. PLC-XGK-3000
- 87. PLC MELSEC-Q
- 88. GT-PLC700

# model: **PLC GLOFA-1000**

## PLC GLOFA trainer

### Feature

- 1) PLC GLOFA-1000 is a training system designed to help understanding of the fundamentals of PLC and automatic control for engineering students and technicians who study PLC.
- 2) PLC GLOFA-1000 is designed to practice the automation process in the industry from analysis and utilization of elementary components to their applications. The training system adopts only the components used in the industry.
- 3) Automatic control is the basis of sequence control and design itself would be impossible without analysis of components and their functions. It would be also impossible to implement creative control and to design program using PLC without such analysis of components and their functions.
- 4) Applies GLOFA series PLC, allowing students to practice the language of global standard.
- 5) 32 inputs, 32 outputs
- 6) Practice various programs by connecting an IBM PC
- 7) A bag-style case convenient for storage and handling
- 8) Empty slots of PLC mounted in a dummy module facilitates further performance enhancement.

### Manual Contents

Chap 1. Overview of GLOFA PLC  
 Chap 2. GLOFA hardware configuration and features  
 Chap 3. Software operation and commands  
 Chap 4. Experiment using input switches  
 Chap 5. Experiment on PLC-based circuit configuration  
 Chap 6. Experiment on input and output

Chap 7. Experiment on motor control with output  
 Chap 8. Experiment on motor drive control  
 Chap 9. Experiment on flicker control with a timer

### System configuration



### Components

1) Hardware system	1 set
2) RS-232C CABLE	1 ea
3) PROGRAM CD	1 ea
4) Power cable	1 ea
5) Lead wire	1 set
6) Manual book	1 book

### Specifications

1) CPU (GLOFA)	Control mode	Program cyclic operation method
	Input / output control mode	Scan synchronized batch processing method
	Program language	LD,IL,SFC
	Processing speed	0.2μs/Command,STEP
	Program memory capacity	128Kbyte
2) Power module	Input AC220V, Output DC5V,24V.	
3) Input module	Input score	32 score (16*2)
	Rated input voltage	DC12/24V
	Rated input current	5/11mA
	Operation display	LED display
	Method of insulation	Photo-coupler insulation
4) Output module	Output score	32 points (16*2)
	Rated load voltage	DC24V,AC220V
	Operation display	LED display
	INPUT POINTS	32EA
5) DEMONSTRATION PANEL	INPUT S/W(TOGGLE), S/W(PUSH)	8EA
	DIGITAL S/W(4DIGIT)	1EA
	OUTPUT POINTS	32EA
	DIGITAL DISPLAY(4DIGIT)	1EA
	DC MOTOR UNIT	1EA
	SIMULATION LAMPS	8EA
	BUZZER SIMULATOR	1EA
	OUTPUT POWER	DC24V
	POWER S/W(MAIN,PLC)	1EA
	AD/DA experiment unit, (-10V ~ +10V) control unit	1SET
	AD/DA experimental display	1EA
6) General spec	Operation temperature	0 ~ 45 , 85% R.H. below
	Input power	AC 220V, 50/60Hz
	Size	610mm(W)X170mm(H)X390mm(D)

# model: PLC MASTER-K-2000

## PLC MASTER-K trainer

### Feature

- 1) PLC MASTER-K-2000 is a training system designed to help understanding of the fundamentals of PLC and automatic control for engineering students and technicians who study PLC.
- 2) PLC MASTER-K-2000 is designed to practice the automation process in the industry from analysis and tilization of elementary components to their applications. The training system adopts only the components used in the industry.
- 3) Automatic control is the basis of sequence control and design itself would be impossible without analysis of components and their functions. It would be also impossible to implement creative control and to design program using PLC without such analysis of components and their functions.
- 4) Applies MASTER-K series PLC, enable to construct and learn about small production line network.
- 5) 32 INPUT, 32 OUTPUT
- 6) Practice various programs by connecting an IBM PC.
- 7) In case of equipped with dedicated lab, useful ergonomic desktop-type lay-out and design.
- 8) Empty slots of PLC mounted in a dummy module facilitates further performance enhancement.

### Manual Contents

- |   |  |
|---|--|
| Chap 1. Overview of MASTER-K PLC                      | Chap 6. Experiment on input and output             |
| Chap 2. MASTER-K hardware configuration and features  | Chap 7. Experiment on motor control with output    |
| Chap 3. Software operation and commands               | Chap 8. Experiment on motor drive control          |
| Chap 4. Experiment using input switches               | Chap 9. Experiment on flicker control with a timer |
| Chap 5. Experiment on PLC-based circuit configuration |  |

### System configuration



### Components

1) Hardware system	1 set
2) RS-232C CABLE	1EA
3) PROGRAM CD	1 EA
4) Power cable	1 EA
5) Lead wire	1 SET
6) Manual book	1 BOOK

### Specifications

1) CPU (MASTER-K)	Operation mode & Processing speed	0.2 $\mu$ s/STEP, cyclic operation method
	Input / Output	Up to 512~1024 points
	Program language	LD, Mnemonic
	Program capacity	15K steps
2) Power module	Input AC220V, Output DC5V,24V	
3) Input module	Input	32 points (16*2)
	Rated input voltage	DC12/24V
	Rated input current	5/11mA
	Operation display	LED display
4) Output module	Insulation method	Photo-coupler insulation
	Output	32points (16*2)
	Rated load voltage	DC24V,AC220V
	Operation display	LED display
5) DEMONSTRATION PANEL AND UNI	INPUT POINTS	32EA
	INPUT S/W(TOGGLE)	16EA
	INPUT S/W(PUSH)	8EA
	OUTPUT POINTS	32EA
	FND SIMULATOR	1EA
	DC MOTOR UNIT	1EA
	SIMULATION LAMPS	8EA
	BUZZER SIMULATOR	1EA
	OUTPUT POWER	DC24V
	AC, DC Volt Meter	each1EA.
	Operation temperature	0~45 , 85% R.H. below
	Input power	AC 220V, 50/60Hz
6) General spec	Size	610mm(W)X170mm(H)X390mm(D)



# model: **PLC XGK-3000**

## PLC XGK trainer

### Feature

- 1) PLC XGK-3000 is a training system designed to help understanding of the fundamentals of PLC and automatic control for engineering students and technicians who study PLC.
- 2) PLC XGK-3000 is designed to practice the automation process in the industry from analysis and utilization of elementary components to their applications. The training system adopts only the components used in the industry.
- 3) Automatic control is the basis of sequence control and design itself would be impossible without analysis of components and their functions. It would be also impossible to implement creative control and to design program using PLC without such analysis of components and their functions.
- 4) Applies XGK series PLC, allowing students to learn about next generation PLC in automated era.
- 5) 32 INPUT, 32 OUTPUT
- 6) Practice various programs by connecting an IBM PC
- 7) In case of equipped with dedicated lab, useful ergonomic desktop-type lay-out and design
- 8) Empty slots of PLC mounted in a dummy module facilitates further performance enhancement.

### Manual Contents

- |   |  |
|---|--|
| Chap 1. Overview of XGK PLC                           | Chap 6. Experiment on input and output             |
| Chap 2. XGK hardware configuration and features       | Chap 7. Experiment on motor control with output    |
| Chap 3. Software operation and commands               | Chap 8. Experiment on motor drive control          |
| Chap 4. Experiment using input switches               | Chap 9. Experiment on flicker control with a timer |
| Chap 5. Experiment on PLC-based circuit configuration |  |

### System cinfigation



### Components

1) Hardware system	1 set
2) RS-232C CABLE	1 ea
3) PROGRAM CD	1 EA
4) Power cable	1 EA
5) Lead wire	1SET
6) Manual book	1 BOOK

### Specifications

1) CPU (XGK)	Control mode and processing rate	84ns loop operation.
	Input / Output	1,536 points
	Program language	Ladder Diagram
	I/O control	Scan synchronous batch processing
	Program capacity	16 K steps
2) Power module	Input AC220 V, output DC5 V, 24 V	
3) Input module	Input	32 points (16 * 2)
	Rated Input Voltage	DC24 V
	Rated Input current	4 mA
	Operation display	LED display
	Insulation	Photo coupler
4) Output module	Output	32 points (16 * 2)
	Rated Voltage	DC24 V, AC220 V
	Operation display	LED display
5) DEMONSTRATION PANEL AND UNIT	INPUT, OUTPUT POINTS	Each 32EA
	INPUT S/W(TOGGLE), S/W(PUSH)	16EA
	DIGITAL S/W(4DIGIT)	1EA
	DIGITAL DISPLAY(4DIGIT)	1EA
	FND SIMULATOR	1EA
	DC MOTOR, STEP MOTOR UNIT	Each 1EA
	SIMULATION LAMPS	8EA
	BUZZER SIMULATOR	2EA
	PHOTO S/W	1EA
	DUAL CONTROL SYSTEM	1EA
6) General spec	Operating temperature	0~45 , 85% R.H. below
	Input power	AC 220V, 50/60Hz
	size	610mm(W)X170mm(H)X390mm(D)

# model: **PLC MELSEC-Q**

## **PLC MELSEC-Q trainer**

### **Feature**

- 1) PLC MELSEC-Q is a training system designed to help understanding of the fundamentals of PLC and automatic control for engineering students and technicians who study PLC.
- 2) PLC MELSEC-Q is designed to practice the automation process in the industry from analysis and utilization of elementary components to their applications.  
The training system adopts only the components used in the industry.
- 3) Automatic control is the basis of sequence control and design itself would be impossible without analysis of components and their functions. It would be also impossible to implement creative control and to design program using PLC without such analysis of components and their functions.
- 4) Applies PLC MELSEC-Q, enable to construct and learn about small and medium production line network.
- 5) 32 INPUT, 32 OUTPUT
- 6) Practice various programs by connecting PC.
- 7) In case of equipped with dedicated lab, useful ergonomic desktop-type lay-out and design.
- 8) Empty slots of PLC mounted in a dummy module facilitates further performance enhancement.

### **System configuration**



### **Manual Contents**

- Chap 1. Overview of PLC MELSEC-Q
- Chap 2. PLC MELSEC-Q hardware configuration and features
- Chap 3. Software operation and commands on PLC MELSEC-Q
- Chap 4. Experiment using input switches on PLC MELSEC-Q
- Chap 5. Experiment on PLC-based circuit configuration on PLC MELSEC-Q
- Chap 6. Experiment on input and output on PLC MELSEC-Q
- Chap 7. Experiment on motor control with output PLC-MELSEC-Q
- Chap 8. Experiment on motor drive control on PLC MELSEC-Q
- Chap 9. Experiment on flicker control with a timer on PLC MELSEC-Q

## Specifications

1) CPU ( Q02HCPU )		
Operation mode & Processing speed	0.079μs/STEP, Refresh operation method	
Input / Output	Up to 4096 points	
Program language	LD, Mnemonic	
Program capacity	28K steps	
2) Power module (Q62P)		
Input AC220V, Output DC24V		
3) The main base (Q38B)		
4) Input module (QX41)		
Input	32 points (16*2)	
Rated input voltage	DC12/24V	
Rated input current	5/7mA	
Operation display	LED display	
Insulation method	Photo-coupler insulation	
5) Output module (QY10)		
Output	32points (16*2)	
Rated load voltage	DC24V, AC220V	
Operation display	LED display	
6) DEMONSTRATION PANEL AND UNI		
INPUT POINTS	32EA	
INPUT S/W(TOGGLE)	8EA	
INPUT S/W(PUSH)	8EA	
OUTPUT POINTS	32EA	
DC MOTOR UNIT	1EA	
SIMULATION LAMPS	8EA	
BUZZER SIMULATOR	1EA	
OUTPUT POWER	DC24V	
POWER S/W(MAIN,PLC)	1EA	
DIGITAL DISPLAY(4DIGIT)	1EA	
AD/DA experiment UNIT, for (-10V ~ +10V) control UNIT	1EA	
AD/DA experiment DISPLAY	1EA	
7) General spec		
Operation temperature	0~45 , 85% R.H. below	
Input power	AC 220V, 50/60Hz	
Size	610mm(W) X 170mm(H) X 390mm(D)	

## Feature

1) Hardware system	1 set
2) RS-232C CABLE	1EA
3) PROGRAM CD	1 EA
4) Power cable	1 EA
5) Lead wire	1 SET
6) Manual book	1 BOOK

model: **GT-PLC700**

## Specification of PLC TRAINER

### Main features

- Basic PLC input and output control
- Motor and sensor control with PLC digital I/O
- Availability in narrow space

### System configuration



### Training contents

- PLC operation - sweep cycle
- Using PLC digital/analog input/output
- Using logic/ algorithm statement
- Program debugging

## Specification

### 1. Detail specifications of common part

#### a) I/O Module

##### 1) Digital Input/Output module

- DI/DO : 16/16
- PnP type
- Input voltage : 24V
- One touch mounting clamp : 2EA

#### b) Digital & Analog module

##### 1) Training contents :

- Usage of BCD switch
- 4digital FND program
- Motor operation CW, CCW program
- Analog input, output control
- IN/OUT cable terminal : 1EA (Input: 32, Output: 32)
- Toggle switch : 16EA
- LED : 16EA (24V, LED)
- Buzzer : 1EA
  - Capacity : 0.04W
  - Frequency : 420Hz
- 4 digit 7 FND
- Current meter : 1EA
  - Size: 48 x 54mm
- Volume switch : 2EA
  - Control switch attached
- Aluminum box : 1EA

#### c) Analog Input/Output module

- Analog input 4CH / Analog output 2CH
- Analog terminal 4mm, 3T
- Aluminum box
- One touch mounting clamp: 2EA

#### d) Frame

##### 1) Frame and terminal

- Size : 500 \* 300 \* 400mm
- Frame : Aluminum profile
- Panel : Aluminum panel 1.5T
- Input 40Pin terminal and cable
- Output 40Pin terminal and cable
- Analog input/output 4mm socket
- Power consent and switch
- Input : 4mm socket 32 points
- Output : 4mm socket 32 points
- Profile size : 500(L) x 300 (D) x 15 (T)
- Profile plate material : Aluminum
- Profile plate groove pitch : 25mm

##### 2) Electrical cable set

- RED: 600mm-30EA, 300mm-10EA
- BLUE: 600mm-20EA, 300mm-5EA
- High elasticity and special coating

#### e) PLC

##### 1) CPU

- Input : 4096 points
- Program capacity : 28K step
- Process speed : 0.034 $\mu$ s
- Program memory capacity : 112KB

##### 2) Input

- 32 points, DC 24V, 4mA
- Response time : 1/5/10/20/70ms
- 32 points 1 common, plus common

##### 3) Output

- 32 points, DC 12~24V
- OFF leakage current : 0.1mA
- Response time : 1ms
- 32 points, 1 common, sink type

##### 4) Base

- Power + CPU + 8 I/O slot additional power module is adaptable
- Q series module

##### 5) Power

- Input voltage : AC 100~240V
- Output voltage : DC 5V / 24V
- Output current : 3A / 0.6A

##### 6) Analog input

- 4CH
- Input: DC-10~10V, DV 0~20mA
- Output (resolution) : 0~4000, -4000~4000, 0~12000, -12000~12000, 0~16000, -16000~16000
- Conversion speed: 80 $\mu$ s / 1CH

##### 7) Analog output

- 2CH
- Input (resolution): 0~4000, -4000~4000, 0~12000, -12000~12000, 0~16000, -16000~16000
- Output : DC -10~10V, DC 0~20mA
- Conversion speed: 80 $\mu$ s / 1CH

# 37

## a group of Mechanical training system

- 89. Hydraulic-GT280
- 90. Pneumatic-GT270
- 91. Pneumatic control-7000

# model: **Hydraulic-GT280**

## Hydraulic training equipment

### Features

- Removing parts by push clamp
- Aluminium profile panel and structure
- u-box electrical panel
- 4mm safety sockets and cables
- Components with circuit symbols
- Hydraulic pipe: use quick coupling
- Robust parts storage cabinet
- Engineering design considering trainee's body shape

### System configuration



### Training contents

- Understanding basic principles of hydraulic pressure
- Functions and applications of hydraulic valves and hydraulic system
- Measuring pressure, flow rate, working time, etc.
- Physical formulas calculation of hydraulics
- Hydraulic schematic design
- Understanding basic hydraulic control and system
- Relationship between cross-sectional area and pressure of a hydraulic cylinder
- Function of flow control valve
- Speed Increasing, differential and memory circuit
- Circuit and control of hydraulic motor
- Configuration of pressure sequence circuit
- Design of synchronization speed control circuit
- Structure and use of hydraulic accumulator
- Pressure loss in pipes

## Spec

### 1) Main Part Lists

- (1) Double acting cylinder, 1 ea
- (2) Single acting cylinder, 1 ea
- (3) Hydraulic motor, 1 ea
- (4) 2/2-way Roller lever valve, 1 ea
- (5) 2/2-way Roller lever valve, 1 ea
- (6) 2/2-way Directional control valve, 1 ea
- (7) 2/2-way Directional control valve, 1 ea
- (8) 3/2-way Directional control valve, 1 ea
- (9) 3/2-way Directional control valve, 1 ea
- (10) 4/3-way Directional control valve (PT connection type), 1 ea
- (11) 4/3-way Directional control valve (PABT blocked), 1 ea
- (12) 4/3-way Directional control valve (PABT connection type), 1 ea
- (13) 4/3-way Directional control valve (ABT connection type), 1 ea
- (14) 4/3-way Directional control valve (PAT connection type), 1 ea
- (15) Pressure relief valve, 1 ea
- (16) Pressure relief valve, piloted, 1 ea
- (17) Direct-acting relief valve, 1 ea
- (18) Check valve (1 bar), 1 ea
- (19) Check valve (5 bar), 1 ea
- (20) Check valve, piloted, 1 ea
- (21) One-way flow control valve, 2 ea
- (22) Two-way flow control valve, 1 ea
- (23) Pressure compensated flow control valve, 1 ea
- (24) Shut-off valve, 1 ea
- (25) Pressure relief valve, 1 ea
- (26) Pressure gauge-mounted distributor, 1 ea
- (27) Counter balance valve, 1 ea
- (28) Distributor, 1 ea
- (29) T-type block connector, 1 ea
- (30) Pressure relief unit, 1 ea

### 2) Proportional servo hydraulic parts

- (1) Setpoint control module, 1 ea
- (2) Proportional amplifier, 1 ea
- (3) PID controller, 1 ea
- (4) Linear potentiometer, 1 ea
- (5) Linear potentiometer guide, 1 ea
- (6) Proportional pressure relief valve, 1 ea
- (7) Proportional control valve, 1 ea
- (8) Input filter, 1 ea
- (9) Input compensation valve, 1 ea
- (10) Servo valve, 1 ea
- (11) Measurement display unit, 1 ea
- (12) Pressure sensor, 1 ea
- (13) Temperature sensor, 1 ea
- (14) Flow meter, 1 ea

### 3) Training table

- (1) Hydraulic training table (stand/single side), 1 cabinet, 1 ea
- (2) Hydraulic training table (stand/double side), 2 cabinets, 1 ea
- (3) Hydraulic power unit (for one-side), 1 ea
- (4) Hydraulic power unit (for both-side), 1 ea
- (5) overload breaker(essential for power unit), 1 ea
- (6) Flexible hose set, 1 ea

### 4) Additional accessories

- (1) Hydraulic hose hanger (stand-alone), 1 ea
- (2) Hydraulic hose hanger (attached), 1 ea
- (3) Hydraulic oil (ISO VG32), 1 ea



## 5) spec for each unit

### (1) Hydraulic power unit (for single-sided)



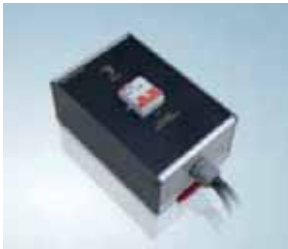
- Motor : AC 220 single-phase, 0.75KW
- External gear pump type
- Discharge flow rate : 3 /min
- Working pressure : 5 ~ 60kgf/cm<sup>2</sup>
- Tank capacity : 20
- Pressure gauge mounted-type
- Equipped with filter-attached oil filler, oil gauge, thermometer

### (2) Hydraulic power unit (for double-sided)



- Motor : AC 220 single-phase, 0.75KW
- External gear pump type
- Discharge flow rate : 3 /min
- Working pressure : 5 ~ 60kgf/cm<sup>2</sup>
- Tank capacity : 30
- Pressure gauge mounted-type
- Equipped with filter-attached oil filler, oil gauge, thermometer

### (3) Overload circuit breaker



- POWER LED Built-in Indicator lamp
- AC220V For single phase
- Maximum allowable current : 15A
- Practice table mounting clamp

### (4) Hose set for piping



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Working temperature : -40C ~ 125C
- Minimum bending radius : 80mm
- 600mm : 12EA
- 1,000mm : 6EA
- 1,500mm : 2EA

### (5) Single-acting cylinder



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Piston diameter : 25mm
- Piston rod diameter : 18mm
- Cylinder stroke : 200mm

### (6) Double-acting cylinder



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Piston diameter : 25mm
- Piston rod diameter : 18mm
- Cylinder stroke : 200mm

(7) Hydraulic motor



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Forward & reverse bidirectional operation
- Motor structure: internal gear Roller lever valve

(8) 2/2-WAY roller lever valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Stem-operation valve
- N.O-type valve

(9) 2/2-WAY hand lever valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manual operating mode

(10) 3/2-WAY hand lever valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manual operating mode

(11) 4/2-WAY hand lever valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manual operating mode

(12) 4/3-WAY hand lever valve (PT-connected)



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manual operating mode
- PT-connected

(13) 4/3-WAY hand lever valve (PABT blocked)



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manual operating mode
- PABT blocked

(14) 4/3-WAY hand lever valve (ABT blocked)



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manual operating mode
- ABT-connected

(15) Pressure relief valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manually controlled manner

(16) Pressure relief valve, piloted



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manually controlled manner

(17) Pressure sequence valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60bar
- Manually controlled manner
- External pilot connection
- External train

(18) Check valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Check opening pressure : 5kgf/cm<sup>2</sup>

(19) Check valve, piloted



- Working pressure range: 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure: 60kgf/cm<sup>2</sup>
- Manually controlled manner
- Pilot-operated

(20) One-way flow control valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Flow rate : 10 /min
- Check valve opening pressure : 1kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manually controlled manner

(21) Two-way flow control valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Flow rate : 10 /min
- Working pressure : 60kgf/cm<sup>2</sup>
- Manually controlled manner

(22) Pressurecompensated flow control valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manually controlled manner
- Built-in pressure compensation mechanism

(23) Shut-off valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- manual operating type

(24) Pressure relief valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Manually controlled manner

(25) Pressure gauge-mounted distributor



- Measuring pressure range : 0 ~ 100kgf/cm<sup>2</sup>
- Precision 1.6%
- Cushioning oil : glycerol
- Working fluid : Hydraulic
- Gauge diameter : 60
- 4 distribution connectors attached

(26) Counterbalance valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60bar
- Manually controlled manner
- External pilot connection
- External train

(27) T-connector



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>

(28) Pressure relief unit



- For pressure relief
- Manual operation type

(29) Pressure gauge



- Measuring pressure range : 0 ~ 100kgf/cm<sup>2</sup>
- Precision 1.6%
- Cushioning oil : glycerol
- Working fluid : Hydraulic
- Gauge diameter : 60

(30) Measuring container



- For flow measurement : 2
- 4 hydraulic couplings attached
- 1 coupling for connecting for accumulator and hand pump
- 1 silencer attached for pressure resistance
- Built-in flow limit device
- Hand valve mounted

(31) 2/2-WAY solenoid valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Power consumption : 12W
- Operational voltage : DC 24V
- LED and protection circuit

(32) 3/2-WAY solenoid valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Power consumption : 12 W
- Operational voltage : DC 24V
- LED and protection circuit

(33) 4/2-WAY single acting solenoid valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Power consumption : 12W
- Operational voltage : DC 24V
- LED and protection circuit

(34) 4/2-WAY double-acting Solenoid valve



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Power consumption : 12W
- Operational voltage : DC 24V
- LED and protection circuit

(35) 4/3-WAY solenoid valve (P.T connection type)



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Power consumption : 12W
- PT-connected (bypass type)
- Operational voltage : DC 24V
- LED and protection circuit

(36) 4/3-WAY solenoid valve (P.A.B.T cut-off type)



- Working pressure range : 0 ~ 120 kgf/cm<sup>2</sup>
- Working pressure : 60 kgf/cm<sup>2</sup>
- Power consumption : 12 W
- P.A.B.T cut-off type (ALL BLOCK TYPE)
- Operational voltage : DC 24V
- LED and protection circuit

(37) 4/3-WAY solenoid valve (A.B.T connection type)



- Working pressure range : 0 ~ 120kgf/cm<sup>2</sup>
- Working pressure : 60kgf/cm<sup>2</sup>
- Power consumption : 12W
- A.B.T connection type
- Operational voltage : DC 24V
- LED and protection circuit

(38) Pressure Switch



- Working pressure : 10 ~ 70kgf/cm<sup>2</sup>
- Hysteresis : app. 15%
- Maximum load factor : 5A
- Contact structure : 1a, 1b
- Manual setting method

(39) Linear potentiometer



- range : 200 mm
- resistor : 10K
- operating voltage : DC 24 V
- output voltage : 0~10V
- include a cylinder bracket

(40) Proportional pressure relief valve



- type : proportional solenoid
- pressure : 0~100 bar
- resolution: 1mA
- hysteresis: 2%
- Min. flowrate : 0.1 /m
- Max. flowrate : 20 /m

(41) 4/3-WAY proportional valve



- type : proportional solenoid
- pressure : 250 bar
- resolution : 1mA
- hysteresis : 2%
- Min. flowrate : 0.02 /m
- Nominal flowrate : 5 /m

(42) Pressure filter



- pressure : 0~120 bar
- pollution indicator

(43) 4/3-WAY servo valve



- valve : single sleeve spool valve
- operating : magnetic linear motor
- flow rate : 5 /min( Pn=35bar,  $\pm 10\%$ )  
2 /min( Pn=5bar,  $\pm 10\%$ )
- max. pressure : P,A,B port-120bar T port -50bar
- power/max.current : DC24V/1.2A
- input range :  $\pm 10V$  DC/2~10V DC
- response time : 12ms

(44) Pressure sensor



- power : 24V DC
- output voltage : 0~10V DC
- measuring range : 0~100bar
- load impedance : Rx(min) 2K

(45) Temperature sensor



- power : 24V DC
- output current : 4~20mA
- measuring range : 0 ~ 100bar
- load impedance : RL 0.65K



# model: **pneumatic-GT270**

## Pneumatic training equipment

### Features

- Removing parts by push clamp
- Aluminium profile panels and structures
- u-box electrical panel
- 4 mm safety sockets and cables
- Circuit symbol-marked components
- Pneumatic piping; using a standard 4 hose
- Robust parts storage cabinet
- Engineered design considering trainee' body

### System configuration



### Training contents

- Construction of automation system
- Generation and distribution of compressed air
- Type and structure of pneumatic actuators
- Logical elements and control diagram
- Basic pneumatic control
- Pneumatic sequence control circuit
- Pneumatic system safety
- Physical basic principles of electro-pneumatic
- Function and usage of electric-pneumatic equipment
- Creating relay control circuit
- Construction of electric self-holding circuit
- Structure and properties of magnetic proximity switch
- Electric sequence control circuit
- Creation of movement step diagram

## Spec

### 1) Part Lists

- (1) Service unit, 1 ea
- (2) Air distributor, 1 ea
- (3) Single acting cylinder, 1 ea
- (4) Double acting cylinder, 1 ea
- (5) Double acting cylinder (flow rate adjustment attachment type), 2 ea
- (6) Pressure regulating valve, 1 ea
- (7) Pneumatic time delay valve (N/O), 1 ea
- (8) Pneumatic time delay valve (N/C), 1 ea
- (9) One-way flow control valve, 4 ea
- (10) Quick exhaust valve, 1 ea
- (11) Input sequence valve, 1 ea
- (12) 3/2-WAY Push button valve (N/O), 1 ea
- (13) 3/2-WAY Push button valve (N/C), 2 ea
- (14) 3/2-WAY Manual switching valve, 1 ea
- (15) 5/2-WAY Manual switching valve, 1 ea
- (16) 3/2-WAY Roller lever valve, 6 ea
- (17) 3/2-WAY Roller lever valve (one-way), 2 ea
- (18) 3/2-WAY Single acting pneumatic valve (N/C), 1 ea
- (19) 3/2-WAY Single acting pneumatic valve (N/O), 1 ea
- (20) 5/2-WAY Single acting pneumatic valve, 2 ea
- (21) 5/2-WAY Double acting pneumatic valve, 8 ea
- (22) OR valve, 2 ea
- (23) AND valve, 2 ea
- (24) Pressure gauge, 1 ea
- (25) 3/2-WAY Solenoid valve (N/C), 1 ea
- (26) 3/2-WAY Solenoid valve (N/O), 1 ea
- (27) 5/2-WAY Single acting Solenoid valve, 3 ea
- (28) 5/2-WAY Double acting Solenoid valve, 3 ea
- (29) 5/3-WAY solenoid valve(Center Closed), 1 ea
- (30) 5/3-WAY solenoid valve(Center Exhaust), 1 ea
- (31) 5/3-WAY solenoid valve(Center Pressure), 1 ea
- (32) Pneumatic-electrical signal converter, 1 ea
- (33) Push button switch module, 2 ea
- (34) Emergency switch module, 1 ea
- (35) 3 pair relay module, 3 ea
- (36) Time relay module, 1 ea
- (37) Digital counter module, 1 ea
- (38) Electrical distributor module, 1 ea
- (39) Photo sensor, 1 ea
- (40) Capacitive sensor, 1 ea
- (41) Inductive sensor, 1 ea
- (42) Electrical limit switch (left), 3 ea
- (43) Electrical limit switch (right), 3 ea
- (44) Power supply module, 1 ea
- (45) Cable set, 2 ea

### 2) Training table

- (1) Pneumatic training table(flat), 1 cabinet 1 ea
- (2) Pneumatic training table(flat), 2 cabinets 1 ea
- (3) Pneumatic training table (stand/single side), 1 cabinet 1 ea
- (4) Pneumatic training table (stand/single side), 2 cabinets 1 ea
- (5) Pneumatic training table (stand/double side), 2 cabinets 1 ea

### 3) Additional accessories

- (1) 4 Pneumatic hose (200m/roll), 1 roll
- (2) 6 Pneumatic hose (100m/roll), 1 roll
- (3) T-type connector (10ea), 1 ea
- (4) Hose cutter, 1 ea
- (5) Electric cable hanger, 1 ea

#### 4) spec for each unit

##### (1) Services unit



- Maximum operating pressure :  $10\text{kgf/cm}^2$
- Air filter, lubricator, Pressure regulator valve
- Blocking valve, mounting type
- Filterability :  $40\mu\text{m}$
- Connector : G1/4
- Normal flow rate :  $750\text{ l/min}$

##### (2) Air distributor



- Maximum operating pressure :  $10\text{kgf/cm}^2$
- Input coupler : 1EA
- Output coupler : 8EA, Check embedded connectors
- One-touch coupler

##### (3) Single acting cylinder



- Working pressure :  $0.5\sim 8.5\text{kgf/cm}^2$
- Cylinder bore : 25
- Stroke : 50mm
- Cylinder output(6bar) : 25kgf
- Cylinder return force : 2.4kg
- Built-in sensor detecting magnet

##### (4) Double acting cylinder



- Working pressure :  $0.5\sim 8.5\text{kgf/cm}^2$
- Cylinder bore : 25
- Stroke : 125mm
- Cylinder output(6bar) : 26.7kgf
- Cylinder return force : 22kgf
- Built-in sensor detecting magnet
- Adjustable built-in cushion type

##### (5) Double acting cylinder



- Working pressure :  $0.5\sim 8.5\text{kgf/cm}^2$
- Cylinder bore : 25
- Stroke : 125mm
- Cylinder output(6bar) : 26.7kgf
- Cylinder return force : 22kgf
- Built-in sensor detecting magnet
- Adjustable built-in cushion type

##### (6) Double acting cylinder



- Working pressure :  $0.5\sim 9.8\text{kgf/cm}^2$
- Electric proximity switch : 2EA
- Cylinder bore : 25
- Stroke : 125mm
- Cylinder output(6bar) : 26.7kgf
- Cylinder return force : 22kgf
- Built-in sensor detecting magnet

(7) Pressure regulating valve



- Working pressure : 0~9.8kgf/cm<sup>2</sup>
- Maximum pressure : 16kgf/cm<sup>2</sup>
- Gauge attached type
- Normal flow rate : 800 /min

(8) Time delay valve(N.O)



- Working pressure : 0~8.5kgf/cm<sup>2</sup>
- N/O type valve
- Delay time : 0.1~30sec
- Signal pressure : 1.5~8kgf/cm<sup>2</sup>

(9) Time delay valve(N.C)



- Working pressure : 0~8.5kgf/cm<sup>2</sup>
- N/C type valve
- Delay time : 0.1~30sec
- Signal pressure : 1.5~8kgf/cm<sup>2</sup>

(10) One-way flow control valve



- Working pressure : 0.3~10kgf/cm<sup>2</sup>
- Regulating direction 1(A) 2(B) : 0~180 /min
- Free direction 2(B) 1(A) : 110 /min

(11) Quick exhaust valve



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Normal flow rate 1(P) 2(A) : 300 /min
- Quick exhaust flow 2(A) 3(R) : 390 /min

(12) Pressure sequence



- Working pressure : 1.5~8kgf/cm<sup>2</sup>
- Control pressure range : 1.5~8kgf/cm<sup>2</sup>
- Slide-time
- Spring return type

(13) 3/2-WAY push button valve (N/O)



- Push button operation type
- Working pressure : 0~9.8kgf/cm<sup>2</sup>
- Spring return type
- Direct-acting type

(14) 3/2-WAY push button valve (N/C)



- Push button operation type
- Working pressure : 0~9.8kgf/cm<sup>2</sup>
- Spring return type
- Direct-acting type

(15) 3/2-WAY manual switching valve



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- N/C-type valve
- Spring return type
- Direct-acting type valve

(16) 5/2-WAY manual switching valve



- Manually transfer switch operated type
- Working pressure : 0~9.8kgf/cm<sup>2</sup>
- Spring return type
- Direct-acting type

(17) 3/2-WAY roller lever valve



- Roller lever-operated type
- Working pressure : 0~8.5kgf/cm<sup>2</sup>
- N/C-type valve
- Spring return type

(18) 3/2-WAY roller lever valve (one-way)



- Roller lever-operated type
- Working pressure : 0~8.5kgf/cm<sup>2</sup>
- N/C-type valve
- Spring return type

(19) 3/2-WAY pneumatic valve (N/C)



- Working pressure :  $1.5 \sim 10 \text{ kgf/cm}^2$
- N/C-type valve
- Return method : spring + internal pilot pressure
- Manually operable
- Spool valve

(20) 3/2-WAY pneumatic valve (N/O)



- Working pressure :  $1.5 \sim 10 \text{ kgf/cm}^2$
- N/O type valve
- Return method : spring + internal pilot pressure
- Manually operable
- Spool valve

(21) 5/2-WAY single acting pneumatic valve



- Working pressure :  $1.5 \sim 10 \text{ kgf/cm}^2$
- Return method : spring + internal pilot pressure
- Manually operable
- Spool valve

(22) 5/2-WAY double acting pneumatic valve



- Return method : Internal pilot pressure
- Manually operable
- Spool valve
- Working pressure :  $1.5 \sim 10 \text{ kgf/cm}^2$
- Self-hold valve

(23) Check valve



- Working pressure :  $0.5 \sim 9.8 \text{ kgf/cm}^2$
- Opening pressure (B A) :  $0.5 \text{ kgf/cm}^2$
- Normal flow rate (B A) : 600 /min

(24) OR valve (Shuttle valve)



- Working pressure :  $1 \sim 10 \text{ kgf/cm}^2$
- Normal flow rate X/Y A : 500 /min

(25) AND valve (2-pressure valve)



- Working pressure : 1~10kgf/cm<sup>2</sup>
- Normal flow rate X/Y A : 500 /min

(26) Pressure gauge



- Working pressure : 0~10kgf/cm<sup>2</sup>
- Bourdon tube method
- Display : 40

(27) Vacuum valve



- Working pressure : 1~10kgf/cm<sup>2</sup>
- Norminal flowrate : 15 /min
- Silencer attached
- Use with Suction gripper(AT1134)

(28) 3/2-WAY single acting solenoid valve (N.C)



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Response time : 20ms or less
- LED and protection circuit
- Return method : spring + internal pilot pressure
- Manually operable

(29) 3/2-WAY single acting solenoid valve (N.O)



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Response time : 20ms or less
- LED and protection circuit
- Return method : spring + internal pilot pressure
- Manually operable

(30) 5/2-WAY single acting solenoid valve



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Response time : 20ms or less
- LED and protection circuit
- Return method : spring + internal pilot pressure
- Manually operable



(31) 5/2-WAY double acting solenoid valve



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Response time : 20ms or less
- LED and protection circuit

(32) 5/3-WAY solenoid valve (Center Closed)



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Response time : 20ms or less
- Operational voltage : DC 24V
- LED and protection circuit

(33) 5/3-WAY solenoid valve (Center Exhaust)



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Response time : 20ms or less
- Operational voltage : DC 24V
- LED and protection circuit

(34) 5/3-WAY solenoid valve (Center Pressure)



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Response time : 20ms or less
- Operational voltage : DC 24V
- LED and protection circuit

(35) Pneumatic-electrical signal converter



- Working pressure : 0.5~9.8kgf/cm<sup>2</sup>
- Setting pressure adjustment function
- Built-in set pressure display window

(36) EtherCAT valve terminal



- Network type : EtherCAT
- Network connector : Socket type M8
- Operating voltage : DC 24V
- Power consumption : 0.85W
- Operating pressure : 1~7.1kgf/cm<sup>2</sup>
- Manual operating : non-locking push
- Performance : Max. 5Hz



# model: **Pneumatic control-7000**

## Pneumatic control laboratory equipment with PLC

### Feature

- **Purposes of education**

- Basic principle and terminology of control engineering
- Pneumatic working elements
- Pneumatic direction control valve
- Logic elements and control diagram
- Structure and function of pneumatic components
- Safety of pneumatic system
- Physical basic principle of electric-pneumatics
- Function and usage of electric-pneumatic equipment
- Pneumatic sequence control circuit
- Creating relay control circuit
- PLC control of electric-pneumatic equipment

- **Features of equipment**

- As it consists of a variety of electric and pneumatic parts, learners can practice application control by using pure pneumatics, electric-pneumatics, relays and PLC.
- As it has a built-in 0.5 HP air compressor that provides more than 10L surge tank capacity, additional compressed air supplying equipment is not required.
- Working table is equipped with not only the wheels for moving and fixing but also horizontal support device and module storage drawers
- Profile-type practice board larger than 1100(W)X700(D) is used.
- As components can be fixed with 2 different fastening methods on the working board which is designed as profile panel, pneumatic modules can be installed as the same as displayed circuit drawing and are removeable easily.
- Electric-pneumatic modules are connected to a circuit by 4  $\phi$  plug cord, and operating voltage of each module is DC 24V.
- All the components used for pneumatic circuit are the most commercially available ones in the actual industrial field.

### System configuration



## Manual Contents

### 1. Overview

- 1-1. Overview of LP8200
- 1-2. Equipment configuration

### 2. Equipment installation and maintenance

- 2-1. Precautions before use
- 2-2. Names of each part
- 2-3. Equipment maintenance
- 2-4. Installation location

### 3. Introduction to pneumatics

- 3-1. Development of pneumatic technology
- 3-2. Features of pneumatic system
- 3-3. Comparison based on driving methods
- 3-4. Use of pneumatics
- 3-5. Nature of air
- 3-6. Basic configuration of pneumatic system

### 4. Pneumatic source and air purification

- 4-1. Configuration of pneumatic system
- 4-2. Air compressor
- 4-3. Foreign matters in compressed air
- 4-4. Rear cooler
- 4-5. Main pipe filter
- 4-6. Air dryer
- 4-7. Mist separator
- 4-8. Other microfiltration filters

### 5. Pneumatic auxiliary device

- 5-1. Pipes
- 5-2. Filters
- 5-3. Lubricators
- 5-4. Silencers
- 5-5. Sprayed oil separator for exhaust

### 6. Pneumatic control device

- 6-1. Introduction
- 6-2. Pressure control valve
- 6-3. Direction control valve
- 6-4. Flow control valve

### 7. Practice

- 7-1. Basic pneumatic practice
  - 7.1.1 Direction control circuit of single-acting cylinder
  - 7.1.2 Speed control circuit of single-acting cylinder
  - 7.1.3 Rapid reverse circuit of single-acting cylinder
  - 7.1.4 Direction control circuit of double-acting cylinder
  - 7.1.5 Speed control circuit of double-acting cylinder
  - 7.1.6 Intermediate stop circuit of cylinder
  - 7.1.7 AND logic circuit practice
  - 7.1.8 OR logic circuit practice
  - 7.1.9 Flipflop logic circuit practice

#### 7-2 Pneumatic application circuit practice

- 7.2.1 Automatic reciprocating circuit
- 7.2.2 Continuous reciprocating circuit
- 7.2.3 Time delay circuit
- 7.2.4 Pressure control circuit
- 7.2.5 Alternate action circuit

#### 7-3 Pneumatic sequence circuit practice

- 7.3.1 A+B+A-B- circuit
- 7.3.2 A+B+B-A- circuit
- 7.3.3 A+B+B-A- circuit
- 7.3.4 A+A-B+B- circuit
- 7.3.5 A+B+B-A- circuit by cascade chain
- 7.3.6 A+A-B+B- circuit by cascade chain
- 7.3.7 Single/double-acting cycle function added sequential operation circuit
- 7.3.8 A+B+C+A-B-C- circuit
- 7.3.9 A+B+B-C+C-A- circuit

#### 7.4 Electric sequence basic circuit

- 7.4.1 AND circuit practice
- 7.4.2 OR circuit practice
- 7.4.3 NOT circuit practice
- 7.4.4 Self-holding circuit practice
- 7.4.5 Interlocking circuit practice
- 7.4.6 Matching circuit practice
- 7.4.7 Chain circuit practice
- 7.4.8 ON delay circuit practice
- 7.4.9 OFF delay circuit practice
- 7.4.10 Period of time operation circuit practice

#### 7-5 Electric-pneumatic basic practice

- 7.5.1 Control circuit practice of single-acting cylinder
- 7.5.2 Control circuit of double-acting cylinder
- 7.5.3 Automatic return circuit practice of double-acting cylinder
- 7.5.4 Continuous reciprocating circuit practice
- 7.5.5 Single-acting/interlocking cycle selection circuit practice





#### 7-6 Sequence circuit practice

- 7.6.1 A+B+B-A- circuit practice
- 7.6.2 A+A-B+B- circuit practice
- 7.6.3 A+A-B+B- circuit practice
- 7.6.4 A+B+A-B- circuit practice
- 7.6.5 A+A-B+B- circuit practice
- 7.6.6 A+B+B-A- circuit practice
- 7.6.7 Single-acting/interlocking function added A+B+A-B- circuit practice
- 7.6.8 3-cylinder sequence operation circuit

## Components

1) Compressed air distributor Max. operating pressure: 10 Kg/cm <sup>2</sup> Input connection: 1 Output connection: more than 6 (built-in check valve) Opening/closing air supply is available	1	
2) Air service unit Air filter + regulator + lubricator Set pressure range: 0.5~8.5 kgf/cm <sup>2</sup> Max. flow: more than 500 L/min. Filtration degree: less than 20 μm	1	
3) single-acting cylinder Min. operating pressure: 1.8 kgf/cm <sup>2</sup> Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Cylinder diameter: more than 20Ø Stroke length : more than 50 mm	2	
4) double-acting cylinder Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Tube diameter: more than 20Ø Stroke: more than 150 mm Built-in air cushion	2	
5) Pressure gauge Indication range: 0~10 kgf/cm <sup>2</sup> Indicator diameter: more than 40 mm Limit indicator is attached	2	
6) Pressure control valve Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Pressure gauge attached Pressure adjustment is available (Relief type)	1	
7) 3/2Way push button valve N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area : 2.5 mm <sup>2</sup>	2	
8) 3/2Way push button valve N/O direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area: 2.5 mm <sup>2</sup>	2	
9) 3/2Way manual switching valve N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> 2 position selector switch	1	
10) 5/2Way manual switching valve N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> 2 position selector switch	1	
11) 3/2Way roller lever valve N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area: 2.5 mm <sup>2</sup>	2	
12) 3/2Way roller lever valve N/C & N/O are available Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area: 2.5 mm <sup>2</sup>	2	
13) OR valve Higher pressure operated first Min. operating pressure :0.5kgf/cm <sup>2</sup> Implementing OR logic by using air flow	3	
14) AND valve Lower pressure operated first Min. operating pressure: 0.5 kgf/cm <sup>2</sup> Implementing AND logic by using air flow	3	
15) Stop plug Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Low crank pressure: 0.2 kgf/cm <sup>2</sup> Flow path is open in one direction only	2	

16) Uni-directional flow control valve Speed control is available Free flow rate: 340 L/min. Control flow rate: 170 L/min.	1	
17) Time delay valve Normal state is closed Pressure signal range: 2.5~8 kgf/cm <sup>2</sup> Delay time range: 0.5 ~ 60s	1	
18) 3/2 Way solenoid valve N,C Coil voltage: DC 24V Response time: less than 30 ms LED is mounted Spring return	2	
19) 5/2 Way uni-directional solenoid valve Coil voltage: DC 24V Response time: less than 30 ms LED is mounted Spring return	2	
20) 5/2 Way bi-directional solenoid valve Internal pilot type Coil voltage: DC 24V Response time: less than 30 ms LED is mounted Spring return	4	
21) Vacuum generator Vacuum forming pressure: -0.7 kgf/cm <sup>2</sup> Operating pressure: 1.5 ~ 10 kgf/cm <sup>2</sup> Vacuum pad is attached	1	
22) Limit switch Roller lever-operated type Spring return Contacts: 1a, 1b, 1c Contacts rating: DC 24V 5A	2	
23) Photo sensor NPN Type Detection distance: max. 200mm Power voltage: DC 12~25V ± 10% Output: NPN open collector output Response time: less than 3ms Object reflecting type	1	
24) Proximity switch Capacitor type Detection distance: max. 15 mm Power voltage: DC 10~30V Current consumption: less than 15 mA Operating indicator lamp: red LED	1	
25) Pressure switch Max. operating pressure: 9.9 Kgf/cm <sup>2</sup> Contact: 1c Switch rating: AC 250V, DC 30V Adjusting differential troubles	1	
26) 4/3 manual lever valve N/C direct-acting type V/V Max. operating pressure: 10.2 Kgf/cm <sup>2</sup> 3 position selector switch	1	
27) Relay set Consisting of MK, PLC Contact composition : In Out, each 16 Contact rating: DC 24V 3A Input voltage: DC 24V	1	
28) PB switch 2 built-in recovery type switches 1 built-in lock type switch DC 24V Lamp mounted (red, green, yellow) Contacts: 2a, 2b Current rating: DC 24V 1.5A	2	

29) Emergency switch 1a1b locking type device Built-in insulation box	1	
30) Time relay Consisting of 2 timers Contacts: 5a, 5b Input voltage: DC 24V Delay Timer: 0.5~10 sec Operating method: Time ON Delay Built-in insulation box 5 +, - contacts respectively	1	
31) Buzzer & Lamp DC 24V Buzzer Built-in 4 lamps for DC 24V Lamp Color: Red, Green, Yellow, White Insulation Box	1	
32) Power supply Free voltage input (85V~250V) Output: DC 24V, 2A Built-in short circuit protection circuit	1	
33) T-type connector Connecting hose: outer diameter: 6 Connector for branching	10	
34) Connecting lead wire Red, black, blue 700 mm	1set	
35) Air hose 30m Inner diameter: 4 mm Outer diameter: 6 mm	1	
36) Air hose cutter For cutting air hoses	1	
37) Repairing component set Components set for repairing pneumatic practice equipment	1	
38) Practice table Larger than 1520(W)x1680(H)x850(D)mm Size of practice board: high-end aluminum profile larger than 1100(W) x 750(H) Moving wheels are mounted (locking is available) Horizontal adjustment device is installed	1	
39) Air compressor Non-vibration, Noiseless 0.5 horsepower (optional)	1	
40) Pneumatic control manual	1	
41) Logic simulation SW program (1) Programmed by visual C. (2) Gate - 4ea (3) TestPin - 14ea (4) IC : Logic 7408 IC (5) Logic simulation experiments · NOT GATE experiment. · Two INPUT AND GATE experiment. · Three INPUT AND GATE experiment. · Two INPUT OR GATE experiment. · Three INPUT OR GATE experiment. · Two INPUT NAND GATE experiment. · Three INPUT NAND GATE experiment. · Two INPUT NOR GATE experiment. · Three INPUT NOR GATE experiment. · Two INPUT XOR GATE experiment. · Three INPUT XOR GATE experiment. · D FLIP FLOP experiment. · JK FLIP FLOP experiment.	1 copy	

## Specifications

1) Compressed air distributor	Max. operating pressure: Kg/cm <sup>2</sup> Input connection: 1 Output connection: more than 6 (built-in check valve) Opening/closing air supply is available	1
2) Air service unit	Air filter + regulator + lubricator Set pressure range: 0.5~8.5 kgf/cm <sup>2</sup> Max. flow: more than 500 L/min. Filtration degree: less than 20 μm	1
3) Single-acting cylinder	Min. operating pressure: 1.8 kgf/cm <sup>2</sup> Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Cylinder diameter: more than 20 Ø Stroke length : more than 50 mm	2
4) Double-acting cylinder	Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Tube diameter: more than 20 Ø Stroke: more than 150 mm Built-in air cushion	2
5) Pressure gauge	Indication range: 0~10 kgf/cm <sup>2</sup> Indicator diameter: more than 40 mm Limit indicator is attached	2
6) Pressure control valve	Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Pressure gauge attached Pressure adjustment is available (Relief type)	1
7) 3/2Way push button valve	N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area : 2.5 mm <sup>2</sup>	2
8) 3/2Way push button valve	N/O direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area: 2.5 mm <sup>2</sup>	2
9) 3/2Way manual switching valve	N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> 2 position selector switch	1
10) 5/2Way manual switching valve	N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> 2 position selector switch	1
11) 3/2Way roller lever valve	N/C direct-acting type V/V Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area: 2.5 mm <sup>2</sup>	2
12) 3/2Way roller lever valve	N/C & N/O are available Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Return: spring return Effective cross-sectional area: 2.5 mm <sup>2</sup>	2
13) OR valve	Higher pressure operated first Min. operating pressure :0.5 kgf/cm <sup>2</sup> Implementing OR logic by using air flow	3
14) AND valve	Lower pressure operated first Min. operating pressure: 0.5 kgf/cm <sup>2</sup> Implementing AND logic by using air flow	3
15) Stop plug	Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Low crank pressure: 0.2 kgf/cm <sup>2</sup> Flow path is open in one direction only	2
16) Uni-directional flow control valve	Speed control is available Free flow rate: 340 L/min. Control flow rate: 170 L/min.	1
17) Time delay valve	Normally closed Pressure signal range: 2.5 ~ 8 kgf/cm <sup>2</sup> Delay time range: 0.5 ~ 60s	1
18) 3/2 Way solenoid valve	N,C Coil voltage: DC 24V Response time: less than 30 ms LED is mounted Spring return	2

19) 5/2 Way uni-directional solenoid valve	Coil voltage: DC 24V Response time: less than 30 ms LED is mounted Spring return	2
20) 5/2 Way bi-directional solenoid valve	Internal pilot type Coil voltage: DC 24V Response time: less than 30ms LED is mounted Spring return	4
21) Vacuum generator	Vacuum forming pressure: -0.7 kgf/cm <sup>2</sup> Operating pressure: 1.5 ~ 10 kgf/cm <sup>2</sup> Vacuum pad is attached	1
22) Limit switch	Roller lever-operated type Spring return Contacts: 1a, 1b, 1c Contacts rating: DC 24V 5A	4
23) Photo sensor	NPN Type Detection distance: max. 200 mm Power voltage: DC 12~25V $\pm$ 10% Output: NPN open collector output Response time: less than 3ms Object reflecting type	1
24) Proximity switch	Capacitor type Detection distance: max. 15 mm Power voltage: DC 10~30V Current consumption: less than 15 mA Operating indicator lamp: red LED	1
25) Pressure switch	Max. operating pressure: 9.9 Kg/cm <sup>2</sup> Contact: 1c Switch rating: AC 250V, DC 30V Adjusting differential troubles	1
26) 4/3 manual lever valve	N/C direct-acting type V/V Max. operating pressure: 10.2 Kg/cm <sup>2</sup> 3 position selector switch	1
27) Relay set	Consisting of MK, PLC Contact composition : In Out, each 16 Contact rating: DC 24V 3A Input voltage: DC 24V	1
28) PB switch	2 built-in recovery type switches 1 built-in lock type switch DC 24V Lamp mounted (red, green, yellow) Contacts: 2a, 2b Current rating: DC 24V 1.5A	2
29) Emergency switch	1a1b locking type device Built-in insulation box	1
30) Time delay	Consisting of 2 timers Contacts: 5a, 5b Input voltage: DC 24V Delay Timer: 0.5~10 sec Operating method: Time ON Delay Built-in insulation box	1
31) Buzzer & Lamp	DC 24V Buzzer Built-in 4 lamps for DC 24V Lamp Color: Red, Green, Yellow, White Insulation Box	1
32) Power supply	Free voltage input (85V~250V) Output: DC 24V, 2A Built-in short circuit protection circuit	1
33) T-type connector	Connecting hose: outer diameter: 6 Connector for branching	10
34) Connecting lead wire	Red, black, blue 700 mm	1set
35) Air hose	30 m Inner diameter: 4 mm Outer diameter: 6 mm	1

36) Air hose cutter	For cutting air hoses	1
37) Repairing component set	Components set for repairing pneumatic practice equipment	1
38) Practice table	Larger than 1520(W) x 1680(H) x 850(D)mm Size of practice board:high-end aluminum profile larger than 1100(W) x 750(H) Moving wheels are mounted (locking is available) Horizontal adjustment device is installed	1
39) Air compressor	Non-vibration, Noiseless 0.5 horsepower (optional)	1
40) Pneumatic control manual		1
41) Logic simulation SW program	(1) Programmed by visual C. (2) Gate - 4ea (3) TestPin - 14ea (4) IC : Logic 7408 IC (5) Logic simulation experiments · NOT GATE experiment. · Two INPUT AND GATE experiment. · Three INPUT AND GATE experiment. · Two INPUT OR GATE experiment. · Three INPUT OR GATE experiment. · Two INPUT NAND GATE experiment. · Three INPUT NAND GATE experiment. · Two INPUT NOR GATE experiment. · Three INPUT NOR GATE experiment. · Two INPUT XOR GATE experiment. · Three INPUT XOR GATE experiment. · D FLIP FLOP experiment. · JK FLIP FLOP experiment.	1copy



# 38

## a group of Mechatronics training system

- 92. Analog sensor-GT230
- 93. Digital sensor-GT240
- 94. Vision sensor-GT250
- 95. Safety sensor-GT260
- 96. Mechatronics-GT222

# model: **Analog sensor-GT230**

## Analog sensor training equipment

### Feature

- Analogue inductive sensors
- Analogue ultrasonic sensors
- Analog pressure sensors
- Temperature sensors and temperature controllers
- Spindle drive unit
- Attachment/detachment of parts by one-touch clamp
- Aluminum profile practice panel
- Modular electrical box
- Use 4 mm safety socket
- Circuit symbol-marked components
- Rugged parts cabinet
- Ergonomic design considering trainee's body type

### System configuration



< type of analog sensor applications >



1) Checking the degree of winding of rubber sheets



2) Detecting liquid level



3) Detecting the pass of glass wafers



4) Detecting the pass of tires



5) Detecting the pass of transparent containers



6) Detecting pellets in a hopper



7) Water supply control of bottles



8) Managing adsorption pressure of O-ring



## Training contents

- Chap 1, Measuring distance with contactless inductive sensor, optical sensor and ultrasonic sensor
- Chap 2, Installing and connecting spindle drive- an electric-powered measuring device
- Chap 3, Control of gear motor-driven spindle driver and displacement sensor
- Chap 4, Operating characteristics of analog ultrasonic sensor
- Chap 5, Machine displacement measurement and material detection using analogue inductive sensors
- Chap 6, Velocity and position measurement using rotary encoders
- Chap 7, Recording and analysis of measurements
- Chap 8, Recording of sensor characteristics
- Chap 9, Practical measurement

## Spec

### 1) Analog sensor parts

- (1) Analog optical sensor, 1 EA
  - \* With integral fiber unit
  - \* Reflective sensor with analog output
  - \* Measuring range : 8~40mm
  - \* Output current : 4~20mA
  - \* Peak reflection time : 1ms
  - \* 4mm Safety socket
  - \* Mounting Clamp Type
- (2) Displacement sensor, 1 EA
  - \* Sensor for linear position detection
  - \* Measuring range : 200mm
  - \* allowable error : < 0.07%
  - \* Control speed : < 10<sup>ms</sup>
- (3) Displacement sensor conversion module, 1 EA
  - \* Convert variable resistance value to voltage
  - \* Power supply voltage : DC24V
  - \* Output voltage : 0~10V
  - \* Output current : 4~20mA
  - \* Module power indicator (LED)
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (4) Analog ultrasonic sensor, 1 EA
  - \* Type : Cylindrical type M18
  - \* Measuring range : 60~250mm
  - \* Minimum measurement target : 30 x 30 mm
  - \* Power supply voltage : 24V DC
  - \* Output voltage : 2.2~10V
  - \* Resolving power : 2mm (80mV)
  - \* Ultrasonic frequency : 360kHz
  - \* Built-in reverse connection protection circuit
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (5) Analog Inductive Sensor, 1 EA
  - \* Type : Cylindrical type M30
  - \* Power supply voltage : 15~30V DC
  - \* Measuring distance : 3~8mm
  - \* Minimum precision : 50um
  - \* Repeat precision : 1 % of measuring range
  - \* Output voltage : 0~10V
  - \* Output current : 0~20mA
  - \* Maximum measuring frequency : 80Hz
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (6) Temperature sensor, 1 EA
  - \* RTD(Pt-100 )
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (7) Temperature controller module
  - \* Sensor type : TC, RTD
  - \* Power supply voltage : AC220V
  - \* Built-in PID control function
  - \* Output current : 4~20mA
  - \* Contact output : 1C contact
  - \* Module power indicator (LED)
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (8) Heating unit, 1 EA
  - \* Built-in fan
  - \* 4mm Safety socket
  - \* Mounting Clamp Type

## 2) Base parts.

- (1) Set of test objects : 1 ea/set
  - aluminum case
  - magnet, mild steels, Stainless steel, Aluminum, plastics, Rubber, Brass, Copper, Bolts, Transparent board, cardboards
- (2) Position slide : 1 ea/set
  - sliding range : 150mm
  - rotary angle :  $\pm 90^\circ$
- (3) Ruler : 1 ea/set
  - stainless steel
  - length : 1000mm
- (4) Lamp & buzzer module : 1 ea/set
  - electrical distributor with lamps & buzzers
  - buzzer : 2 ea
  - lamp : 8 ea
  - power consumption: 1.2W
  - aluminum case and mounting clamp
- (5) Counter module : 1 ea/set
  - power: 24V DC
  - input voltage:  $\pm 30V$  DC
  - power consumption : 1.2W
  - 2 digit FND
  - static pulse output : 100p/s, 1000 p/s
  - aluminum case and mounting clamp
- (6) Conveyor unit : 1 ea/set
  - motor : 24V DC geared
  - Type : belt
  - 2 mounting clamps
- (7) Conveyor control module : 1 ea/set
  - Power : 24V DC
  - Type : PWM output
  - CW/CCW direction control
  - aluminum case and mounting clamp
- (8) Storing box: 1ea/set
  - mounting clamp
- (9) Workpiece set
  - cylindrical workpiece
  - plastics: thickness, material
  - metal: aluminum
- (10) Switch module: 1ea/set
  - Switch : 2 push-button, 1 lockable-button(1c contact)
  - lamp included(24V)
  - aluminum case and mounting clamp
- (11) 3-fold relay module: 1ea/set
  - relay : 3ea with 4-c contact
  - aluminum case and mounting clamp
- (12) Power supply module : 1ea/set
  - input power : AC 220 V
  - output power : DC 24V, 3A
  - type: SMPS
  - short-circuit protection
  - aluminum case and mounting clamp
- (13) 4mm safety Cable set : 1set/set
  - red : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - blue : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - black : 1000mm - 2ea , 500mm - 10ea
- (14) Digital multi meter : 1 ea/set
  - hand held type
- (15) Sensor mounting profile : 1 set/set
  - 1 straight
  - 2 angled
  - material: aluminum
- (16) Profile plate : 1 set/set
  - training panel with 25mm groove
  - 8mm slot
  - size: 750x750x30
  - material: aluminum

# model: **Digital Sensor-GT240**

## Digital sensor training equipment

### Feature

- Capacity proximity sensors
- Inductive proximity sensors
- Photoelectric sensors, optical fiber sensors
- RFID reader / tag
- Sample set
- Attachment/detachment of parts by one-touch clamp
- Aluminum profile practice panel
- Module-type electrical box
- Use 4 mm safety socket
- Circuit symbol-marked components
- Rugged parts cabinet
- Ergonomic design considering trainee's body type

### System configuration



< type of digital sensor applications >

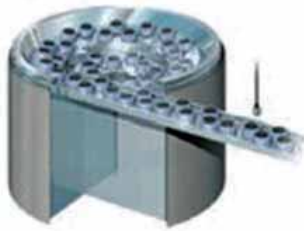
- 1) Detecting the index position of the rotary assembly machine



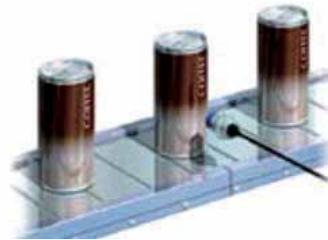
- 2) Detecting aluminum bottle cap



- 3) Detecting the presence of parts supply



- 4) Detecting the presence of aluminum cans



- 5) Detecting the presence of the engine block



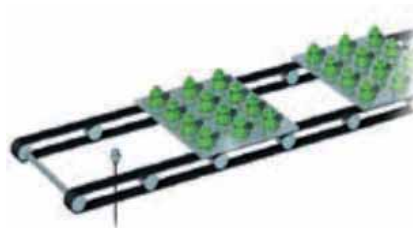
- 6) Detecting car wheel pass



- 7) Sensing objects on conveyor



- 8) Checking palette pass



## Training contents

- Chap 1, Operating characteristics of proximity sensors and reed switches
- Chap 2, Types and response curves of induction-type sensors
- Chap 3, Types and utilization of optical sensors
- Chap 4, Response characteristics of capacitive type sensors
- Chap 5, Utilizing ultrasonic sensors
- Chap 6, Training rotating units and the counter units
- Chap 7, Measuring speed using transmission-type sensors
- Chap 8, Technical Data Analysis
- Chap 9, Electrical wiring
- Chap 10, Circuit configuration
- Chap 11, Sensor adjustment and application limitations
- Chap 12, Applications in industrial setting

## Spec

### 1) Digital sensor training set

- (1) Magnetic inductive proximity sensor : 1 ea/set
  - power : 12~24V DC
  - response range : 7~17mm
  - maximum switching current : 200mA
  - maximum switching frequency : 1000Hz
- (2) Inductive proximity sensor, M12 : 1 ea/set
  - power : 12~24V DC
  - switching distance : 2mm
  - maximum switching frequency : 800Hz
  - current consumption : 10mA
- (3) Inductive proximity sensor, M18 : 1 ea/set
  - power: 12~24V DC
  - switching distance : 5mm
  - maximum switching frequency : 350Hz
- (4) Through-beam sensor, Transmitter : 1 ea/set
  - power: 12~24V DC
  - optical type: Infrared
  - detecting distance : 5m
  - power consumption: Max. 40mA
- (5) Through-beam sensor, Receiver: 1 ea/set
  - power: 12~24V DC
  - optical type: Infrared
  - detecting distance : 5m
  - response time : Max. 1ms
  - maximum switching current : 200mA
- (6) Optical fiber sensor: 1ea/set
  - power: 12~24V DC
  - optical type: Infrared
  - detecting distance : 30~80mm
  - maximum current : 200mA
  - response time : Max. 1ms
  - power consumption : 40mA
- (7) Optic fiber with a bracket: 1 ea/set
  - diameter : 2.2mm
  - length : 2000mm
  - allowed bending diameter : 30mm
  - Min. detection distance : 0.03mm
  - size : M6
- (8) Mirror reflective optical sensor: 1 ea/set
  - power : 12~24V DC
  - optical type : Infrared
  - detecting distance : 1.5m
  - maximum switching current : 200mA
  - response time : Max. 1ms
- (9) Mirror reflective sensor, reflect unit : 1 ea/set
  - material : plastic
  - size : 60 x 40mm
- (10) Optical proximity sensor(M18) : 1 ea/set
  - diffuse reflective sensor
  - power : 12~24V DC
  - optical type : Infrared
  - switching distance : 100mm
  - response time : Max. 1ms
- (11) Capacitive sensor, M18 : 1 ea/set
  - power: 12~24V DC
  - switching distance : 2~8mm
  - maximum current : 200mA
  - maximum switching frequency : 50Hz



## 2) Base parts

- (1) Set of test objects : 1 ea/set
  - aluminum case
  - magnet, mild steels, Stainless steel, Aluminum, plastics, Rubber, Brass, Copper, Bolts, Transparent board, cardboards
- (2) Position slide : 1 ea/set
  - sliding range : 150mm
  - rotary angle :  $\pm 90^\circ$
- (3) Ruler : 1 ea/set
  - stainless steel
  - length : 1000mm
- (4) Lamp & buzzer module : 1 ea/set
  - electrical distributor with lamps & buzzers
  - buzzer : 2 ea
  - lamp : 8 ea
  - power consumption : 1.2W
  - aluminum case and mounting clamp
- (5) Counter module : 1 ea/set
  - power : 24V DC
  - input voltage :  $\pm 30V$  DC
  - power consumption : 1.2W
  - 2 digit FND
  - static pulse output : 100p/s, 1000 p/s
  - aluminum case and mounting clamp
- (6) Conveyor unit : 1 ea/set
  - motor : 24V DC geared
  - Type : belt
  - 2 mounting clamps
- (7) Conveyor control module : 1 ea/set
  - Power : 24V DC
  - Type : PWM output
  - CW/CCW direction control
  - aluminum case and mounting clamp
- (8) Storing box: 1ea/set
  - mounting clamp
- (9) Workpiece set
  - cylindrical workpiece
  - plastics: thickness, material
  - metal: aluminum
- (10) Switch module: 1ea/set
  - Switch : 2 push-button, 1 lockable-button(1c contact)
  - lamp included(24V)
  - aluminum case and mounting clamp
- (11) 3-fold relay module: 1ea/set
  - relay: 3ea with 4-c contact
  - aluminum case and mounting clamp
- (12) Power supply module: 1ea/set
  - input power : AC 220 V
  - output power : DC 24V, 3A
  - type: SMPS
  - short-circuit protection
  - aluminum case and mounting clamp
- (13) 4mm safety Cable set : 1set/set
  - red : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - blue : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - black : 1000mm - 2ea , 500mm - 10ea
- (14) Digital multi meter : 1 ea/set
  - hand held type
- (15) Sensor mounting profile : 1 set/set
  - 1 straight
  - 2 angled
  - material: aluminum
- (16) Profile plate : 1 set/set
  - training panel with 25mm groove
  - 8mm slot
  - size: 750x750x30
  - material: aluminum

# model: **Vision sensor-GT250**

## Vision sensor training equipment

### Feature

- Digital camera stand
- Lighting systems
- Rotary index or conveyor modules
- Determine the presence of components
- Measure position and angle of components
- Quality inspection
- Quantity check
- Change specifications according to consumer requests
- Aluminium profile panels and structures
- Ergonomic design considering trainee's body type

### System configuration



< type of vision sensor applications >



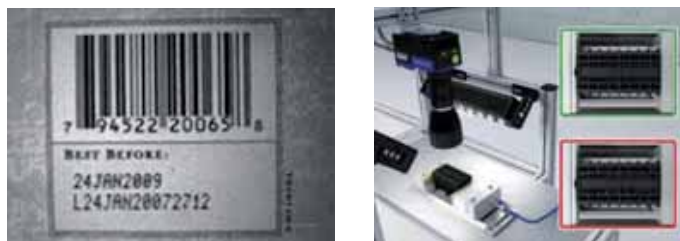
1) surface control



2) Part Orientation



3) Expiring Date Integrity



4) Level Control



5) Product Conformity

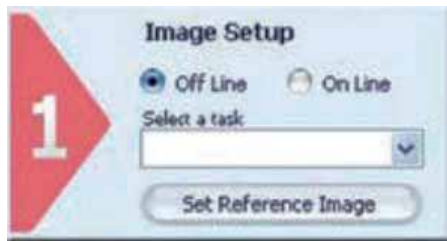


6) Bottling Check



< Program running procedure (using the Wizard function) >

step-1 : image setup



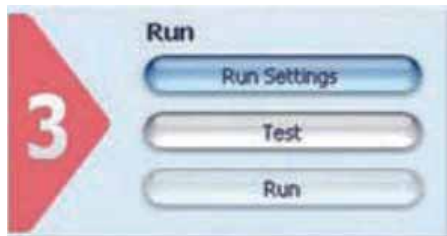
Connect the sensor, shoot sample images and set quality parameters of the image. Stored sample images serve as a template for comparison of vision sensors.

step-2 : teach



Select the inspection items and determine the standard of OK and NG. Several criteria may be combined.

step-3 : run



Determine output form of the sensors, test the running conditions on the PC and store the project in the camera; then, the vision independently executed.

## Training contents

- Chap 1, Vision system overview
- Chap 2, Type and use of vision sensor
- Chap 3, Camera selection according to applications
- Chap 4, Vision cameras and lights
- Chap 5, Control using trigger signals
- Chap 6, Various vision inspection methods
- Chap 7, Creating a project using software
- Chap 8, Pattern matching method and principle
- Chap 9, OCR character recognition
- Chap 10, Barcode detection system
- Chap 11, Configuration of machine vision system
- Chap 12, Interlocking method of automation equipment

## Spec

### 1) Vision camera part

- (1) Vision camera
  - \* Working Voltage : DC24V
  - \* Integrated controller and lighting
  - \* Trigger input available
  - \* Output type : TR
  - \* Blob / pattern matching / counting function
  - \* Ethernet port support
  - \* Use software created exclusively
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (2) Vision camera fixing profile
  - \* Mounting Clamp Type
- (3) Workpiece label set
  - \* For attachment of workpiece
- (4) Ethernet cable
  - \* 5m

### 2) Base part

- (1) Set of test objects : 1 ea/set
  - aluminum case
  - magnet, mild steels, Stainless steel, Aluminum, plastics, Rubber, Brass, Copper, Bolts, Transparent board, cardboards
- (2) Position slide : 1 ea/set
  - sliding range : 150mm
  - rotary angle:  $\pm 90^\circ$
- (3) Ruler : 1 ea/set
  - stainless steel
  - length : 1000mm
- (4) Lamp & buzzer module : 1 ea/set
  - electrical distributor with lamps & buzzers
  - buzzer : 2 ea
  - lamp : 8 ea
  - power consumption : 1.2W
  - aluminum case and mounting clamp
- (5) Counter module : 1 ea/set
  - power : 24V DC
  - input voltage :  $\pm 30V$  DC
  - power consumption : 1.2W
  - 2 digit FND
  - static pulse output : 100p/s, 1000 p/s
  - aluminum case and mounting clamp
- (6) Conveyor unit : 1 ea/set
  - motor : 24V DC geared
  - Type : belt
  - 2 mounting clamps
- (7) Conveyor control module : 1 ea/set
  - Power : 24V DC
  - Type : PWM output
  - CW/CCW direction control
  - aluminum case and mounting clamp
- (8) Storing box : 1ea/set
  - mounting clamp
- (9) Workpiece set
  - cylindrical workpiece
  - plastics : thickness, material
  - metal: aluminum
- (10) Switch module : 1ea/set
  - Switch : 2 push-button, 1 lockable-button(1c contact)
  - lamp included(24V)
  - aluminum case and mounting clamp

- (11) 3-fold relay module : 1ea/set
  - relay : 3ea with 4-c contact
  - aluminum case and mounting clamp
- (12) Power supply module : 1ea/set
  - input power : AC 220 V
  - output power : DC 24V, 3A
  - type : SMPS
  - short-circuit protection
  - aluminum case and mounting clamp
- (13) 4mm safety Cable set : 1set/set
  - red : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - blue : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - black : 1000mm - 2ea , 500mm - 10ea
- (14) Digital multi meter : 1 ea/set
  - hand held type
- (15) Sensor mounting profile : 1 set/set
  - 1 straight
  - 2 angled
  - material : aluminum
- (16) Profile plate : 1 set/set
  - training panel with 25mm groove
  - 8mm slot
  - size: 750x750x30
  - material: aluminum

# model: **safety sensor-GT260**

## Safety sensor training equipment

### Feature

- Light curtain, air line sensor
- Safety door switch, emergency switch
- Safety relay
- Alarm lamps, tower lamp, buzzer
- Stand-alone safety controller
- EtherCAT communication support type safety remote I/O
- Aluminium profile panels and

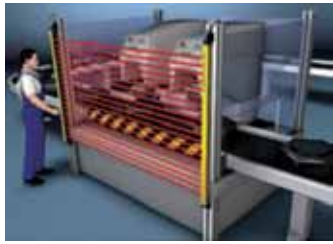
### System configuration



< Type and use of safety sensors >



1) Light curtains



2) Light curtains (for muting)



3) Safety door switches



4) Area sensors



5) Area sensors (access control)



## Training contents

- Chap 1, Safety technology overview
- Chap 2, Type and use of safety sensors
- Chap 3, Safety relay wiring and use
- Chap 4, Light curtain and muting sensor
- Chap 5, Safety door switch usage
- Chap 6, Safety conditions and regulations
- Chap 7, Setting and using a stand-alone safety controller
- Chap 8, Safety PLC programming
- Chap 9, Usage and settings of TwinCAT safety remote I/O
- Chap 10, Applications



## Spec

### 1) Safety sensor part

- (1) Safety curtain, 1 SET
  - \* Type of sensor : Type4 safety light curtain
  - \* Safety Category : Category 4, 3, 2, 1, B for safety measures
  - \* Minimum sensing object : opaque diameter 25mm
  - \* Optical axis pitch (P) : 20 mm
  - \* Number of optical axes (n) : 8 to 102
  - \* Detection width (PH) : 185 ~ 2065mm
  - \* Lens Diameter : 5mm
  - \* Detection distance : 0.2 ~ 7m
  - \* Light source (emission wavelength) : Infrared LED (wavelength 870nm)
  - \* Output operation mode : Control output: ON at light ON
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (2) Safety door switch, 1 SET
  - \* With actuator hinge
  - \* 1a-2b contact
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (3) Safety relay module, 1 SET
  - \* 2-channel input safety relay
  - \* Working Voltage : DC24V
  - \* Output contact : 2a-1b
  - \* Insert a circuit on an aluminum nameplate
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (4) Safety magnet switch, 1 SET
  - \* Can be attached to the door
  - \* 4mm safety socket
  - \* Mounting Clamp Type
- (5) Safety door frame, 1 SET
  - \* Aluminum profile structure
  - \* Sliding door (transparent acrylic)
  - \* Magnet switch, Door switch can be attached
  - \* Mounting Clamp Type

### 2) Base part

- (1) Set of test objects : 1 ea/set
  - aluminum case
  - magnet, mild steels, Stainless steel, Aluminum, plastics, Rubber, Brass, Copper, Bolts, Transparent board, cardboards
- (2) Position slide : 1 ea/set
  - sliding range : 150mm
  - rotary angle :  $\pm 90^\circ$
- (3) Ruler : 1 ea/set
  - stainless steel
  - length: 1000mm
- (4) Lamp & buzzer module : 1 ea/set
  - electrical distributor with lamps & buzzers
  - buzzer : 2 ea
  - lamp : 8 ea
  - power consumption : 1.2W
  - aluminum case and mounting clamp
- (5) Counter module : 1 ea/set
  - power : 24V DC
  - input voltage :  $\pm 30V$  DC
  - power consumption : 1.2W
  - 2 digit FND
  - static pulse output : 100p/s, 1000 p/s
  - aluminum case and mounting clamp

- (6) Conveyor unit : 1 ea/set
  - motor : 24V DC geared
  - Type : belt
  - 2 mounting clamps
- (7) Conveyor control module : 1 ea/set
  - Power : 24V DC
  - Type: PWM output
  - CW/CCW direction control
  - aluminum case and mounting clamp
- (8) Storing box: 1ea/set
  - mounting clamp
- (9) Workpiece set
  - cylindrical workpiece
  - plastics: thickness, material
  - metal: aluminum
- (10) Switch module: 1ea/set
  - Switch : 2 push-button, 1 lockable-button(1c contact)
  - lamp included(24V)
  - aluminum case and mounting clamp
- (11) 3-fold relay module: 1ea/set
  - relay : 3ea with 4-c contact
  - aluminum case and mounting clamp
- (12) Power supply module: 1ea/set
  - input power : AC 220 V
  - output power : DC 24V, 3A
  - type: SMPS
  - short-circuit protection
  - aluminum case and mounting clamp
- (13) 4mm safety Cable set : 1set/set
  - red : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - blue : 1000mm - 5ea , 500mm - 10ea, 250mm - 5ea, 100mm - 5ea
  - black : 1000mm - 2ea , 500mm - 10ea
- (14) Digital multi meter : 1 ea/set
  - hand held type
- (15) Sensor mounting profile : 1 set/set
  - 1 straight
  - 2 angled
  - material : aluminum
- (16) Profile plate : 1 set/set
  - training panel with 25mm groove
  - 8mm slot
  - size : 750x750x30
  - material : aluminum

# model: **Mechatronics-GT222**

## **Total Mechatronics system training equipment**

### **Features**

The air unit, solenoid valve and control cylinder are built in. When the air is supplied, it operates without any additional equipment.

Mitsubishi PLC is used and it is configured to enable the monitoring and PLC communication

#### **1) STATION #1**

Station #1 is a device that identifies the various processes that perform work related to production, which is an essential element of process automation.

And Station #1 is consisted of Feeder, drilling machine, belt conveyor transfer device, sensors, defective product extracting device, and the goods storage warehouse.

The goods storage warehouse system can precisely implement the position control using high performance AC servo motor and the driver.

The equipment including cylinder, conveyor, etc. is installed on the workbench.

Control panels, PLC mounting board and optional modules for additional functions are installed vertically to facilitate operation and identification

The PLC controller panel should be made of steel aluminum box.

In order to understand the system, the nameplate is stickered on equipment surface to show the contents of the process.

And, the LED should be built in so that it can display the work status

#### **2) STATION #2**

X, Y, Z Cartesian coordinate system, which is used in industrial field, enables precise position control using high performance AC servo motor and the driver.

X, Y, Z Cartesian coordinate system is applied, and the structure is made by 3-layer, 3-row type warehouse.

In addition, a light sensor is attached to each warehouse to identify whether the product is loaded or not.

The goods can be transported using a combination of rotating cylinder and gripper cylinder.

All processes must be able to communicate in real time.

The communication of each process must be programmed.

### **System configuration**

#### **1) Station # 1: supply - processing - inspection- feed**



- Supply process (magazine type)
- Index table (Geneva gear)
- Processing / inspection process
- Linear cylinder transfer
- Transfer conveyor

## 2) Station # 2 : handling - storage



- Workpiece handling & feed
- Automatic storage system
- Stacker crane (2-axis servo motor)
- Switch & lamp set
- Solid aluminum profile plate

## 3) combined system for Station # 1 + Station # 2



## Components

1) Hardware platform	1 set
2) Pneumatic hose	4mm( 4)
3) AC Power cord	1 ea
4) USB cable	1 set
5) Manual book	1 book
6) Program CD	1 ea

## Training Contents

### Part 1, STATION #1(MT6410)

- Chap 1, Overview
- Chap 2, TMS Practice Equipment Configuration and Module Description
- Chap 3, Basic of Mitsubishi PLC
- Chap 4, How to use GX-WORKS2 program
- Chap 5, Programming for the supply modules
- Chap 6, Programming for the Index Module
- Chap 7, Classification by adsorption and discharge
- Chap 8, Automatic / manual programming technique
- Chap 9, Intermittent / continuous programming technique
- Chap 10, Programming for Emergency Stop and Pause

### Part 2, STATION #2(MT6420)

- Chap 1, Understanding the Automatic Warehouse System
- Chap 2, Configuration of servo motor and control system
- Chap 3, Positioning module and servo amplifier setting
- Chap 4, Jog operation and position data setting
- Chap 5, Programming for Location
- Chap 6, How to use Special Commands
- Chap 7, Basic programming for Automatic warehouse
- Chap 8, Application programming for Automatic warehouse
- Chap 9, Stop condition and error handling
- Chap 10, Troubleshooting

## Spec

### 1) Commonly applied specs

- (1) Practice table, 1SET
  - size : around 1200 x 750 x 700mm
  - material : AL profile
  - Space between holes : 25mm
  - Vertically mounted AL profile : AL profile, 25mm
- (2) O/P Panel, 1SET
  - Power ON/OFF switch, 1EA
  - selection switch, 1EA
  - start switch : Push Button switch, 1EA
  - stop switch : Push Button switch, 1EA
  - Reset switch : Push Button switch, 1EA
  - Emergency stop switch, 1EA
  - Extra Push Button Switches for Practice, 3EA
  - LAMP, 4EA
- (3) Air service unit module, 1SET
  - Working pressure : 0 ~ 10bar, setting pressure : 0.5 ~ 8.5bar
  - Air filter, pressure regulating valve (with pressure gauge), with automatic drain valve
- (4) Operating Controller, 1SET
  - CPU module
  - Control method : Iterative operation of the stored program
  - Relay symbol language (ladder), logical symbol language (list), Melsap3(SFC), MELSAAP-L Structured Text
  - Connecting port : USB, Ethernet
  - Processing speed : LD command -20ns, MOV command -40ns, PC MIX value -28
  - Total command number : 858
  - Available of PID command
  - Base module : 6Based
  - Power module : AC 100~240V input, DC 5V 3A output, DC 24V 0.6A output
  - Input module : 32 point
  - Output module : 32 point
  - Available of Ethernet communication control
  - POWER SUPPLY 5A

### 2) STATION #1

- (1) Material supply module, 1SET
  - Round magazine, 1EA
    - \* Diameter : 40
    - \* material : Transparent acrylic
    - \* height : stored 8ea of simulation components
  - Double acting cylinder (workpiece transfer and clamping), 1EA
    - \* size : over  $\varnothing$ 16-75mm
    - \* Allowable working pressure : 0.5~9.9kgf/cm<sup>2</sup>
    - \* With flow control valve, 2EA
  - Lead switch : 2EA . a Contact (with LED)
  - \* Power supply voltage : 10~30V DC
  - \* Response time : 2ms
  - Optical sensor (transmission type), 1EA
    - \* Optical cable 1000mm
    - \* Power supply voltage : 10~30V DC
- (2) Processing module, 1SET
  - Double acting cylinder (for electric drill) : 1EA
    - \* size : over 10-50mm
    - \* Allowable working pressure : 0.5~9.9kgf/cm<sup>2</sup>
    - \* Flow control valve, 2 ea
    - \* Sensing distance : over 50mm
  - Lead switch (for Electric drill & for attaching the cylinder), 2EA
    - \* a Contact (with LED)
    - \* Power supply voltage : 10~30V DC
    - \* Response time : 2ms
  - Electric drill for processing, 1EA
    - \* DC 24V, 1600rpm, 3.5Watt
    - \* Cylindrical Slim Structure

- (3) Sensor module, 1SET
  - Inductive sensor for metal and non-metal discrimination, 1EA
  - size : 18
  - height : over 150mm
  - Include fixtures in the profile structure
- (4) Indexing table, 1SET
  - Geneva wheel type, four-split control
  - With DC 24V geared motor sensor
  - Rotating plate \_ transparent acrylic
  - Stainless steel wheel shaft
  - With fixed bearing
  - Sensor bracket
  - Photo sensor for Rotational speed & number
  - Defective material discharge storage box (width \* length 100mm \* 100mm)
- (5) Cylinder (for removing defective products), 1SET
  - size : over 16-75mm
  - Allowable working pressure : 0.5~9.9kgf/cm<sup>2</sup>
  - With flow control valve, 2EA
- (6) Defective goods box, 1SET
  - materials : Stainless steel, 1T
  - size : over 80(L) \* 60(W) \* 60(H)
  - Can be attached and detached from the profile horizontally and vertically using lever and cam
- 7) 1 Spherical Adsorption Cup Module, 1 SET
  - Left and right vertical cylinder stroke distance 50mm, 100mm each 1ea
  - Includes adsorption cup module for adsorption
  - Rugged stainless steel anodizing material
  - Easy to move about 100mm from indexing table to conveyor module
  - Height : over 150mm
- (8) Conveyor module, 1 SET
  - Compact conveyor : DC 24V geared motor
  - size : over 42(W)\*300(L)
  - TYPE : belt type
  - Height discrimination With capacitive sensor
  - Optical fiber sensor for detection of work arrival
- (9) Height fault discriminating cylinder module, 1SET
  - Stroke distance 50mm double acting cylinder
  - 1/8, 6" Pneumatic Hose Fitting
  - Possible to attach conveyor module

### 3) STATION #2

- (1) Rotating Cylinder Module, 1SET
  - Small Rotating Cylinder: Rotation radius and adjustable over 90.
  - Product size : 6 Pneumatic hose connection possible, over 300 (L)
  - Fixed using type bracket
  - Attaching a thin cylinder for rotating cylinder that is for upside movement
  - Attaching a gripper cylinder for Workpiece transfer
- (2) Base module for arrival of material, 1SET
  - Optical fiber sensor for arrival confirmation
  - With a profile of 150mm or more in height
  - Possible to hold workpiece made of black synthetic resin
  - Material gripper standby type
  - Solid aluminum type
  - The type in which the stacker module can grip the material
- (3) Storage warehouse module, 1SET
  - AL Profile : AL Profile 20 x 20 structure (3 layer, 3 row)
  - Photo sensor : DC 24V for storage material detection (9ea)
  - Storage cover (transparent acrylic)

(4) Stacker Crane Module, 1SET

X- axis

- \* Type : Ball Screw Drive Type
- \* Travel distance : 500mm or more
- \* Feeding speed : 1200mm / m
- \* Position detection sensor : 7EA  
(DC24V 30mA, T Type, Detection distance: 5mm, Detection method: Transmission type, Micro, NPN output)
- \* Cable Bear : Size 36.3 \* 25, Max Cable Size: 16
- \* LM Unit : Base size : 63 \* 91mm  
Accuracy grade: H  
Rated load : 24400N (operation), 35200N (stop)  
Moment : 310 Nm (operation), 450 Nm (stop)
- \* Drive motor : DC24V 25W 3000rpm Reduction gear 10 : 1

Y - axis

- \* Type : Ball Screw Drive Type
- \* Travel distance: 250mm
- \* Feed rate : 600mm/m
- \* Position detection Sensor : 6ea  
(DC24V 30mA, T Type, Detection distance: 5mm, Detection method: Transmission type, Micro, NPN output)
- \* Cable Bear: Size 24 \* 20.5, Max Cable Size: 12
- \* LM Unit : Base size: 32 \* 43mm  
Accuracy grade: H  
Rated load: 4200N (operation), 6260N (stop)  
Moment: 31 Nm (operation), 46 Nm (stop)
- \* Drive motor: DC24V 25W 3000rpm Reduction gear 10 : 1

Y - axis

- \* Type : Ball Screw Drive Type
- \* Travel distance: 250mm
- \* Feed rate : 600mm/m
- \* Position detection Sensor : 6ea  
(DC24V 30mA, T Type, Detection distance: 5mm, Detection method: Transmission type, Micro, NPN output)
- \* Cable Bear: Size 24 \* 20.5, Max Cable Size: 12
- \* LM Unit : Base size: 32 \* 43mm  
Accuracy grade: H  
Rated load: 4200N (operation), 6260N (stop)  
Moment: 31 Nm (operation), 46 Nm (stop)
- \* Drive motor: DC24V 25W 3000rpm Reduction gear 10 : 1

Z - axis

- \* Type : Pneumatic drive type
- \* Double rod cylinder : ADRL 10-50  
Speed Control M5 \* 4  
Front and back operation detection sensor attachment type
- \* Air chuck (parallel type closed type, with auto switch -2EA, 4)
- \* Gripper (AL)
- \* Sol valve : DC24V 5 / 2Way Double acting - 2EA

(5) Servo Drive & Servo Motor, 1SET

- \* Position control, speed control, torque control
- \* Connected with PLC,
- \* 3000 RPM
- \* 2-axis control possible

# 39

## a group of Electricity training system

- 97. 3-phase induction motor-500
- 98. 3-phase induction motor-1000
- 99. 1-phase condenser induction motor-500
- 100. 1-phase condenser induction motor-1000
- 101. Sensor Drive-500
- 102. Sensor Drive-1000
- 103. Limit Drive-500
- 104. Limit Drive-1000
- 105. Temperature control-500
- 106. Temperature control-1000
- 107. DC motor-500
- 108. DC motor-1000
- 109. DC motor-1500
- 110. Stepping motor-1000
- 111. Stepping motor-1500
- 112. AC Servo motor -1500
- 113. DC Servo motor -1500
- 114. Servo motor trainer (GT-SMCT100)
- 115. Inverter control-1500
- 116. Relay Drive-1000
- 117. Basic sequence-700
- 118. Sequence-1000
- 119. Sequence-5000
- 120. 7-Segment experiment kit
- 121. Lamp load experiment kit
- 122. Heater load experiment kit
- 123. Car parking-1000
- 124. Traffic signal control-1000
- 125. Electric power conversion experiment -1000
- 126. High-voltage Electricity-GT11M
- 127. HighVoltage-GT700
- 128. Elevator Training system
- 129. Automatic Door Training system



# model: 3-phase induction motor-500

## 3-phase induction motor trainer

### Feature

- 1) 3-phase induction motor-500 is a training system designed to help understanding of the fundamentals and automatic control of 3-phase induction motor that converts electrical energy to mechanical energy.
- 2) 3-phase induction motor is an electrical device whose rotor gains a rotating force from the rotating field induced by 3-phase power supply and is used as an essential component to drive a mechanical system. It is widely used for driving load as its rotating magnetic force is powerful than that of 1-Phase induction motor.
- 3) Direct drive and Y- drive types are widely used to control 3-phase induction motors. It is easy to set reverse rotation by simply exchanging two phases and this feature is also used for reverse-phase braking.
- 4) This training system is configured to perform experiments on the direct drive type used for 3HP and less, the Y- drive type used for 3HP or more, and their applications.
- 5) Compatible with PLC and sequence trainer
- 6) Motor driving status can be checked directly.
- 7) Test can be done just with the trainer body.
- 8) For 3-phase induction motor winding/wiring, the control panel is displayed in graphics in accordance with the JIS standard.

### System configuration



(3-phase induction motor trainer)



(Basic relay board-500)

### Manual Contents

#### [ book-1, 3-Phase induction motor trainer ]

- Chap 1. Overview of three-phase induction motor
- Chap 2. Experiment on Y connected three-phase induction motor
- Chap 3. Experiment on connected three-phase induction motor
- Chap 4. Experiment on forward and reverse control of three-phase induction motor
- Chap 5. Three-phase induction motor drive control
- Chap 6. Y- drive control of three-phase induction motor
- Chap 7. Three-phase induction motor Drive Control with PLC (if PLC equipment provided)
- Chap 8. PLC-based Y- drive control of three-phase induction motor (if PLC equipment provided)

#### [ book-2, Basic relay board-500 ]

- Chap 1. Overview of Relay
- Chap 2. Experiment of Relay contact characteristics
- Chap 3. Display lamp types and how to use the lamps.
- Chap 4. Pushbutton Switch Types and how to use the switches.
- Chap 5. Relay ON, OFF and Jogging circuit experiment
- Chap 6. Experiment on Relay holding circuit

## Specifications

[ 3-phase induction motor trainer ]

A. Motor	1) 380 [V] 60 HZ 25 [W] / 220 [V] 60 HZ	
	2) Rated current and speed	0.4 [A], 1550 [RPM]
	3) Number of poles	2 poles
	4) Y- $\Delta$ switchingB. Driving relay	1) Voltage AC220 [V] / DC 24 [V] selective
B. Driving relay	1) Voltage	AC220 [V] / DC 24 [V] selective
	2) Relay	3 Sets embedded (Separate type)
	3) Contact ratings	220 [V] – 3 [A] (24 [V] – 3 [A])
	4) Voltage toggle switch	1 Set
	5) Micro photo sensor (u-shaped)	1 Set
	6) Power supply 2P jack for photo sensor	1 Set
	7) Sensor output port	1 Set
	8) Sensor driving relay	1 Set
C. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	AC 220 V, 50/60 Hz
	3) Dimension	380mm (W) × 180mm (H) × 280mm (D)

[ Basic relay board - 500 ]

Power module	Input power 1 2 W AC110~220 V	
	Main Power Switch 2A(250V)	1ea
	Protective fuse holder	1 SET
	Input power socket 2P	1ea
	Output power DC24V	1ea
Control module	Input power AC220 V or DC24 V	
	Auxiliary relay 3a 3b 1A	2ea
	PB S/W A,B CONTACT 250V 2A	2ea
	Single lamp 16 DC24V 2W	2ea
	Control module 4 jack plugging	
	Timer (0.001sec ~ 9999 hour)	1ea
	Digital counter (1 ~ 9999)	1ea

## Components

1) Hardware system	3-Phase induction motor trainer	1set
	Basic relay board-500	1set
2) LEAD WIRE		2 set
3) Power supply cable		2 ea
4) Manual book		2 book

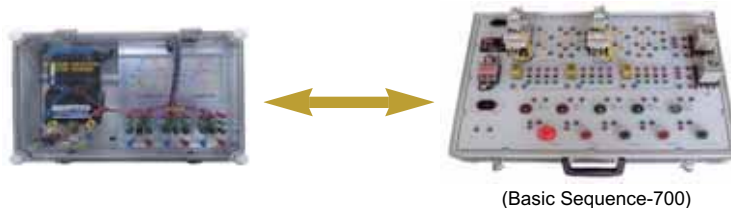
# model: 3-phase induction motor-1000

## 3-phase induction motor trainer

### Feature

- 1) 3-Phase Induction Motor-1000 is a training system designed to help understanding of the fundamentals and automatic control of 3-phase induction motor that converts electrical energy to mechanical energy.
- 2) 3-phase induction motor is an electrical device whose rotor gains a rotating force from the rotating field induced by 3-phase power supply and is used as an essential component to drive a mechanical system. It is widely used for driving load as its rotating magnetic force is powerful than that of 1-Phase induction motor.
- 3) Direct drive and Y- drive types are widely used to control 3-phase induction motors. It is easy to set reverse rotation by simply exchanging two phases and this feature is also used for reverse-phase braking.
- 4) This training system is configured to perform experiments on the direct drive type used for 3HP and less, the Y- drive type used for 3HP or more, and their applications.
- 5) Compatible with PLC and sequence trainer
- 6) Motor driving status can be checked directly.
- 7) Test can be done just with the trainer body.
- 8) For 3-phase induction motor winding/wiring, the control panel is displayed in graphics in accordance with the JIS standard.

### System configuration



### Manual Contents

#### [ book-1, 3-Phase induction motor-1000 ]

- Chap 1. Overview of three-phase induction motor
- Chap 2. Experiment on Y connected three-phase induction motor
- Chap 3. Experiment on connected three-phase induction motor
- Chap 4. Experiment on forward and reverse control of three-phase induction motor
- Chap 5. Three-phase induction motor drive control
- Chap 6. Y- drive control of three-phase induction motor
- Chap 7. Three-phase induction motor Drive Control with PLC (if PLC equipment provided)
- Chap 8. PLC-based Y- drive control of three-phase induction motor (if PLC equipment provided)

#### [ book-2, Basic Sequence-700 ]

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output
- Part 9, BCD Output Control experiment by Counter
- Part 10, Drive Control experiment of DC Motor
- Part 11, Drive Control experiment of Single-phase induction motor
- Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor
- Part 13, Forward and reverse control experiment of 3-phase induction motor
- Part 14, Y- Drive control experiment of 3-phase induction motor
- Part 15, Motor braking experiment by Sensor
- Part 16, Temperature Control experiment by Thermostat

## Specifications

[ 3-phase induction motor ]

A. Motor	1) 380 [V] 60 HZ 25 [W] / 220 [V] 60 HZ	
	2) Rated current and speed	0.4 [A], 1550 [RPM]
	3) Number of poles	2 poles
	4) Y- $\Delta$ switchingB. Driving relay	1) Voltage AC220 [V] / DC 24 [V] selective
B. Driving relay	1) Voltage	AC220 [V] / DC 24 [V] selective
	2) Relay	3 Sets embedded (Separate type)
	3) Contact ratings	220 [V] – 3 [A] (24 [V] – 3 [A])
	4) Voltage toggle switch	1 Set
	5) Micro photo sensor (u-shaped)	1 Set
	6) Power supply 2P jack for photo sensor	1 Set
	7) Sensor output port	1 Set
	8) Sensor driving relay	1 Set
C. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	AC 220 V, 50/60 Hz
	3) Dimension	380mm (W) × 180mm (H) × 280mm (D)

[ Basic Sequence - 700 ]

Power module	Input power 3 3 W 220 V / 1 2 W 220 V	
	Earth leakage breaker 3 15 A	1ea
	Protective phase fail display type fuse holder 3P	1 SET
	Input power socket 3P	1ea
	Output power socket 3P	1ea
	Control power port 2P	1ea
Control module	nput power AC220 V or DC24 V	
	Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	2ea
	Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b	2ea
	Auxiliary relay 4a 4b 1A	3ea
	Timer (0.001sec ~ 9999 hour)	2ea
	E-STOP A,B Contact 250V 3A	1ea
	PB S/W A,B CONTACT 250V 3A	4ea
	Single lamp 25 DC24V 2W	4ea
	Single Buzzer 25 DC24V	4ea
	Control module 4 jack plugging	

## Components

1) Hardware	3-Phase induction motor-1000	1set	
	Basic sequence-700	1set	
2) LEAD WIRE			2 set
3) Power supply cable			2 ea
4) Manual book			2 book

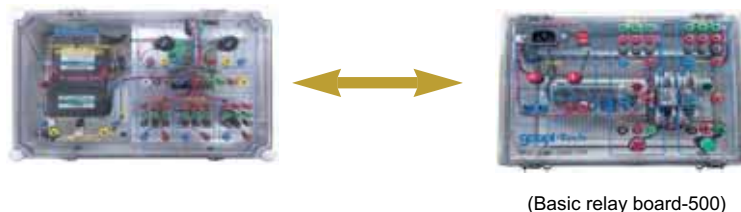
# model: 1-phase induction motor-500

## 1-phase induction motor trainer

### Feature

- 1) 1-phase induction motor-500 is a training system designed to help understanding of the fundamentals and automatic control of 1-phase induction motor that converts electrical energy to mechanical energy.
- 2) 1-phase induction motor is an electrical device whose rotor gains a rotating force from the rotating magnetic field induced by AC 1-phase power supply and is used as an essential component to drive small mechanical tools.  
1-phase induction motors are typically used for small load because 1-phase power can be secured more easily than 3-phase power. However, only low-power 1-phase induction motors (less than 1HP) are produced as starting and driving characteristics are worse and more materials are required than 3-phase induction motors.
- 3) A separate starting unit is required because no starting torque is generated by the stator composed of 1-phase windings
- 4) Induction motors that acquire rotating field with 1-phase power are categorized into repulsion start type repulsion induction type, capacitor start type, bushing type and shading type.
- 5) The capacitor start type is suitable for high-power motors and shows considerably good control characteristics. The capacitor start type continues to activate the capacitor after starting, allowing to select an optimal capacitance during operation.  
This type shows good efficiency and power factor characteristics compared with other types
- 6) 1-phase induction motor has two coils, starting coil and operating coil
- 7) A capacitor is connected to the starting coil in series and the rotor is activated by the phase difference corresponding to the capacitance between the operating coil and the starting coil.
- 8) 1-phase induction motor is typically fixed to rotate in one direction (forward direction).  
However, a condenser induction motor with output leads (3 or 4 wires) can be controlled to rotate in forward or reverse direction or is used for reverse-phase braking by changing wiring
- 9) Low-power motors are typically used for small mechanical tools for which motor speed control is essential. This training system is configured to perform speed control experiments using the T/G output signals as feedback to single-phase induction motor
- 10) Compatible with PLC and sequence trainer
- 11) Built-in controller type
- 12) Motor driving status can be checked directly
- 13) Test can be done just with the trainer body
- 14) Enhance understanding by displaying the condenser induction motor structure in graphics

### System configuration



### System configuration

[ book-1, 1-phase induction motor trainer ]

- Chap 1. Overview of 1-phase condenser induction motor
- Chap 2. Experiment on forward control of 1-phase condenser induction motor
- Chap 3. Experiment on reverse control of 1-phase condenser induction motor
- Chap 4. Experiment on forward & reverse Drive Control of 1-phase condenser induction motor
- Chap 5. Experiment on forward & reverse Speed Control of 1-phase condenser induction motor
- Chap 6. Time offset control of 1-phase condenser induction motor
- Chap 7. Time offset and velocity control of 1-phase condenser induction motor
- Chap 8. 1-phase induction motor Round-trip Time Control with PLC (if PLC equipment provided)
- Chap 9. 1-phase induction motor Time Difference Control with PLC (if PLC equipment provided)

[ book-2, Basic relay board-500 ]

- Chap 1. Overview of Relay
- Chap 2. Experiment of Relay contact characteristics
- Chap 3. Display lamp types and how to use the lamps.
- Chap 4. Pushbutton Switch Types and how to use the switches.
- Chap 5. Relay ON, OFF and Jogging circuit experiment
- Chap 6. Experiment on Relay holding circuit

## Specifications

[ 1-phase induction motor trainer ]

A. Motor	1) 220 [V] 60 HZ 15 [W]	
	2) Rated current and speed	0.2 [A], 1550 [RPM]
	3) Number of poles	4 poles
B. Driving relay	1) Voltage	AC220 [V] / DC 24 [V] selective
	2) Relay	3 Sets embedded (Separate type)
	3) Contact ratings	220 [V] – 3 [A] (24 [V] – 3 [A]) a 3b - 3 Sets x 3 EA (4 jack)
	4) Voltage toggle switch	1 Set
	5) Micro photo sensor (u-shaped)	1 Set
	6) Power supply 2P jack for photo sensor	1 Set
	7) Sensor output port	1 Set
	8) Sensor driving relay	1 Set
C. Single-phase induction motor controller	1) Voltage	220 [V]
	2. Frequency conversion board	1 EA
	3) Multi-step speed control VR	2 EA
	4) AC input port	2 EA (4 jack)
	5) VR input port	3 EA (4 jack)
	6) Motor output port	2 EA (4 jack)
	7) Speed control UR	2 EA
D. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	AC 220 V, 50/60 Hz
	3) Dimension	380mm (W) x 180mm (H) x 280mm (D)

[ Basic relay board-500 ]

Power module	Input power 1 2 W AC110~220 V	
	Main Power Switch 2A(250V)	1ea
	Protective fuse holder	1 SET
	Input power socket 2P	1ea
	Output power DC24V	1ea
Control module	Input power AC220 V or DC24 V	
	Auxiliary relay 3a 3b 1A	2ea
	PB S/W A,B CONTACT 250V 2A	2ea
	Single lamp 16 DC24V 2W	2ea
	Control module 4 jack plugging	
	Timer (0.001sec ~ 9999 hour)	1ea
	Digital counter (1 ~ 9999)	1ea

## Components

1) Hardware system	1-phase induction motor trainer	1set
	Basic relay board-500	1set
2) LEAD WIRE		2 set
3) Power supply cable		2 EA
4) Manual book		2 book

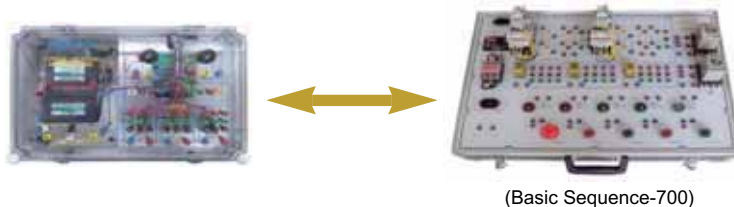
# model: 1-phase induction motor-1000

## 1-phase induction motor trainer

### Feature

- 1) 1-phase Induction Motor-1000 is a training system designed to help understanding of the fundamentals and automatic control of single-phase induction motor that converts electrical energy to mechanical energy.
- 2) Single-phase induction motor is an electrical device whose rotor gains a rotating force from the rotating magnetic field induced by AC 1-phase power supply and is used as an essential component to drive small mechanical tools.  
Single-phase induction motors are typically used for small load because 1-phase power can be secured more easily than 3-phase power. However, only low-power single-phase induction motors (less than 1HP) are produced as starting and driving characteristics are worse and more materials are required than 3-phase induction motors.
- 3) A separate starting unit is required because no starting torque is generated by the stator composed of 1-phase windings
- 4) Induction motors that acquire rotating field with 1-phase power are categorized into repulsion start type repulsion induction type, capacitor start type, bushing type and shading type.
- 5) The capacitor start type is suitable for high-power motors and shows considerably good control characteristics. The capacitor start type continues to activate the capacitor after starting, allowing to select an optimal capacitance during operation.  
This type shows good efficiency and power factor characteristics compared with other types
- 6) Single-phase induction motor has two coils, starting coil and operating coil
- 7) A capacitor is connected to the starting coil in series and the rotor is activated by the phase difference corresponding to the capacitance between the operating coil and the starting coil.
- 8) Single-phase induction motor is typically fixed to rotate in one direction (forward direction).  
However, a condenser induction motor with output leads (3 or 4 wires) can be controlled to rotate in forward or reverse direction or is used for reverse-phase braking by changing wiring
- 9) Low-power motors are typically used for small mechanical tools for which motor speed control is essential. This training system is configured to perform speed control experiments using the T/G output signals as feedback to single-phase induction motor
- 10) Compatible with PLC and sequence trainer
- 11) Built-in controller type
- 12) Motor driving status can be checked directly
- 13) Test can be done just with the trainer body
- 14) Enhance understanding by displaying the condenser induction motor structure in graphics

### System configuration



### System configuration

[ book-1, 1-Phase induction motor-1000 ]

- Chap 1. Overview of single-phase condenser induction motor
- Chap 2. Experiment on forward control of single-phase condenser induction motor
- Chap 3. Experiment on reverse control of single-phase condenser induction motor
- Chap 4. Experiment on forward & reverse Drive Control of single-phase condenser induction motor
- Chap 5. Experiment on forward & reverse Speed Control of single-phase condenser induction motor
- Chap 6. Time offset control of single-phase condenser induction motor
- Chap 7. Time offset and velocity control of single-phase condenser induction motor
- Chap 8. Single-phase induction motor Round-trip Time Control with PLC (if PLC equipment provided)
- Chap 9. Single-phase induction motor Time Difference Control with PLC (if PLC equipment provided)

[ book-2, Basic Sequence-700 ]

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output

## 1-phase condenser induction motor trainer (model : 1-phase induction motor-1000)

Part 9, BCD Output Control experiment by Counter  
 Part 10, Drive Control experiment of DC Motor  
 Part 11, Drive Control experiment of Single-phase induction motor  
 Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor  
 Part 13, Forward and reverse control experiment of 3-phase induction motor  
 Part 14, Y- Drive control experiment of 3-phase induction motor  
 Part 15, Motor braking experiment by Sensor  
 Part 16, Temperature Control experiment by Thermostat

## Specifications

[ 1-phase induction motor-1000 ]

A. Motor	1) 220 [V] 60 HZ 15 [W]	
	2) Rated current and speed	0.2 [A], 1550 [RPM]
	3) Number of poles	4 poles
B. Driving relay	1) Voltage	AC220 [V] / DC 24 [V] selective
	2) Relay	3 Sets embedded (Separate type)
	3) Contact ratings	220 [V] – 3 [A] (24 [V] – 3 [A]) a 3b - 3 Sets x 3 EA (4 jack)
	4) Voltage toggle switch	1 Set
	5) Micro photo sensor (u-shaped)	1 Set
	6) Power supply 2P jack for photo sensor	1 Set
	7) Sensor output port	1 Set
	8) Sensor driving relay	1 Set
C. Single-phase induction motor controller	1) Voltage	220 [V]
	2. Frequency conversion board	1 EA
	3) Multi-step speed control VR	2 EA
	4) AC input port	2 EA (4 jack)
	5) VR input port	3 EA (4 jack)
	6) Motor output port	2 EA (4 jack)
	7) Speed control UR	2 EA
D. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	AC 220 V, 50/60 Hz
	3) Dimension	380mm (W) x 180mm (H) x 280mm (D)

[ Basic Sequence - 700 ]

Power module	Input power 3 3 W 220 V / 1 2 W 220 V	
	Earth leakage breaker 3 15 A	1ea
	Protective phase fail display type fuse holder 3P	1 SET
	Input power socket 3P	1ea
	Output power socket 3P	1ea
	Control power port 2P	1ea
Control module	nput power AC220 V or DC24 V	
	Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	2ea
	Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b	2ea
	Auxiliary relay 4a 4b 1A	3ea
	Timer (0.001sec ~ 9999 hour)	2ea
	E-STOP A,B Contact 250V 3A	1ea
	PB S/W A,B CONTACT 250V 3A	4ea
	Single lamp 25 DC24V 2W	4ea
	Single Buzzer 25 DC24V	4ea
	Control module 4 jack plugging	

## Components

1) Hardware	1-phase induction motor-1000	1set
	Basic sequence-700	1set
2) LEAD WIRE		2 set
3) Power supply cable		2 EA
4) Manual book		2 book



# model: **Sensor Drive-500**

## **Sensor Drive experiment kit**

### **Feature**

- 1) Sensor Drive-500 is a training system designed to help understanding of the operating principle and automatic control of sensors from basic operation to applications.
- 2) Sensor types are largely categorized into photo sensors, proximity sensors and dielectric sensors, depending on the mechanisms to detect the source materials.
- 3) Photo sensor is a typical type of photoelectric sensors. Photo sensor is used for control by emitting light from the light source and detecting the light reflected by an object.
- 4) The emitter radiates light and the receiver receives the reflected light. Infrared is widely used as the light source
- 5) Detection method and nomenclature of photo sensor are different depending on configuration of emitter and receiver
- 6) Compatible with PLC and sequence trainer
- 7) Applies the sensors used in the industry
- 8) Practice sensor driving and control
- 9) Adopts a bracket for sensitivity control

### **System configuration**



(Sensor drive experiment kit)



(Basic relay board-500)

### **System configuration**

[ Book-1, Sensor drive experiment kit ]

- Chap 1. Overview of sensors
- Chap 2. Principle and features of photo sensors, proximity sensors and dielectric sensors
- Chap 3. Experiment on detection of various objects with a photo sensor
- Chap 4. Experiment on detection of various objects with a proximity sensor
- Chap 5. Experiment on detection of various objects with a dielectric sensor
- Chap 6. Forward and reverse control of motor with a sensor
- Chap 7. PLC-based forward and reverse motor control of the Sensor Drive Trainer (if PLC equipment is provided)

[ book-2, Basic relay board-500 ]

- Chap 1. Overview of Relay
- Chap 2. Experiment of Relay contact characteristics
- Chap 3. Display lamp types and how to use the lamps.
- Chap 4. Pushbutton Switch Types and how to use the switches.
- Chap 5. Relay ON, OFF and Jogging circuit experiment
- Chap 6. Experiment on Relay holding circuit

## Specifications

[ Sensor drive experiment kit ]

A. Motor	1) DC 24 [V], 1750 [RPM], 2-pole reducer-connected type	
	2) Reduction ratio	120:1
B. Motor driving RY	1) Forward/reverse relay	2 EA
	2) Speed control Relay	1 EA
	3) Sensor driving relay	3 EA
	4) Sensor output A, B CONTACT	3 Sets (4 jack)
	5) Drive port	2 EA (4 jack)
C. AC 220V Switching power built-in	1) Input 220 [V]	
	2) Output 6 [V], 12 [V], 24 [V]	
D. DC rectifying circuit embedded		
E. Sensor	1) Photo sensor	1 EA (4 jack)
	2) Proximity sensor	1 EA (4 jack)
	3) Dielectric sensor	1 EA (4 jack)
	4) Sensor power DC 24 [V]	
	5) Round driving board	
	6) Sensing material	Metal, reflection plate, dielectric material, 1EA respectively
F. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	DC 24 [V]
	3) Dimension	380mm (W) × 180mm (H) × 280mm(D)

[ Basic relay board-500 ]

Power module	Input power 1 2 W AC110~220 V	
	Main Power Switch 2A(250V)	1ea
	Protective fuse holder	1 SET
	Input power socket 2P	1ea
	Output power DC24V	1ea
Control module	Input power AC220 V or DC24 V	
	Auxiliary relay 3a 3b 1A	2ea
	PB S/W A,B CONTACT 250V 2A	2ea
	Single lamp 16 DC24V 2W	2ea
	Control module 4 jack plugging	
	Timer (0.001sec ~ 9999 hour)	1ea
	Digital counter (1 ~ 9999)	1ea

## Components

1) Hardware system	Sensor drive experiment kit	1set
	Basic relay board-500	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book

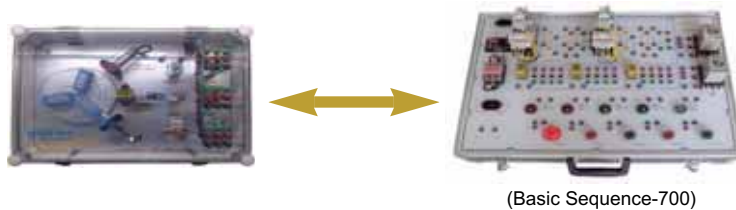
# model: **Sensor Drive-1000**

## **Sensor Drive experiment kit**

### **Feature**

- 1) Sensor drive-1000 is a training system designed to help understanding of the operating principle and automatic control of sensors from basic operation to applications.
- 2) Sensor types are largely categorized into photo sensors, proximity sensors and dielectric sensors, depending on the mechanisms to detect the source materials.
- 3) Photo sensor is a typical type of photoelectric sensors. Photo sensor is used for control by emitting light from the light source and detecting the light reflected by an object.
- 4) The emitter radiates light and the receiver receives the reflected light. Infrared is widely used as the light source
- 5) Detection method and nomenclature of photo sensor are different depending on configuration of emitter and receiver
- 6) Compatible with PLC and sequence trainer
- 7) Applies the sensors used in the industry
- 8) Practice sensor driving and control
- 9) Adopts a bracket for sensitivity control

### **System configuration**



### **System configuration**

[ Book-1, Sensor Drive-1000 ]

- Chap 1. Overview of sensors
- Chap 2. Principle and features of photo sensors, proximity sensors and dielectric sensors
- Chap 3. Experiment on detection of various objects with a photo sensor
- Chap 4. Experiment on detection of various objects with a proximity sensor
- Chap 5. Experiment on detection of various objects with a dielectric sensor
- Chap 6. Forward and reverse control of motor with a sensor
- Chap 7. PLC-based forward and reverse motor control of the Sensor Drive Trainer (if PLC equipment is provided)

[ book-2, Basic Sequence-700 ]

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output
- Part 9, BCD Output Control experiment by Counter
- Part 10, Drive Control experiment of DC Motor
- Part 11, Drive Control experiment of Single-phase induction motor
- Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor
- Part 13, Forward and reverse control experiment of 3-phase induction motor
- Part 14, Y- Drive control experiment of 3-phase induction motor
- Part 15, Motor braking experiment by Sensor
- Part 16, Temperature Control experiment by Thermostat

## Specifications

[ Sensor Drive-1000 ]

A. Motor	1) DC 24 [V], 1750 [RPM], 2-pole reducer-connected type	
	2) Reduction ratio	120:1
B. Motor driving RY	1) Forward/reverse relay	2 EA
	2) Speed control Relay	1 EA
	3) Sensor driving relay	3 EA
	4) Sensor output A, B CONTACT	3 Sets (4 jack)
	5) Drive port	2 EA (4 jack)
C. AC 220V Switching power built-in	1) Input 220 [V]	
	2) Output 6 [V], 12 [V], 24 [V]	
D. DC rectifying circuit embedded		
E. Sensor	1) Photo sensor	1 EA (4 jack)
	2) Proximity sensor	1 EA (4 jack)
	3) Dielectric sensor	1 EA (4 jack)
	4) Sensor power DC 24 [V]	
	5) Round driving board	
	6) Sensing material	Metal, reflection plate, dielectric material, 1EA respectively
F. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	DC 24 [V]
	3) Dimension	380mm (W) × 180mm (H) × 280mm(D)

[ Basic Sequence - 700 ]

Power module	Input power 3 3 W 220 V / 1 2 W 220 V	
	Earth leakage breaker 3 15 A	1ea
	Protective phase fail display type fuse holder 3P	1 SET
	Input power socket 3P	1ea
	Output power socket 3P	1ea
	Control power port 2P	1ea
Control module	Input power AC220 V or DC24 V	
	Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	2ea
	Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b	2ea
	Auxiliary relay 4a 4b 1A	3ea
	Timer (0.001sec ~ 9999 hour)	2ea
	E-STOP A,B Contact 250V 3A	1ea
	PB S/W A,B CONTACT 250V 3A	4ea
	Single lamp 25 DC24V 2W	4ea
	Single Buzzer 25 DC24V	4ea
	Control module 4 jack plugging	

## Components

1) Hardware	Sensor Drive-1000	1set
	Basic sequence-700	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book

# model: Limit Drive-500

## Limit Drive experiment kit

### Feature

- 1) Limit drive-500 is a training system designed in a planar (large milling machine) type to help understanding of the operating principle and automatic control of limit switches from basic operation to applications.
- 2) Limit switches are largely categorized into large type, medium type, small type and micro type.
- 3) Limit switches can also be classified based on size and shape of dog and cam and actuator type.
- 4) Strictly speaking, it is reasonable to classify limit switches based on actuator type.
- 5) Actuator types include fixed roller lever type, adjustable roller lever type, adjustable lot lever type, roller lever lamp type, twin lever lock type, fixed large roller lever type, coil spring type, push roller type, etc.
- 6) The sensing switch is intended to detect the status or change in a control target and is used to detect various control quantities such as location, liquid level, pressure, temperature, voltage, etc.
- 7) Limit switch is widely used to detect contact of an object with the contactor.  
When an object contacts the contactor of a limit switch, the contactor moves to close or open the internal contact. Limit switch is a kind of sensor for detecting location and is widely used for bulky work pieces or work pieces processed at a low speed and for applications with issues of cost efficiency and noise rather than applications requiring precise control.
- 8) The inclined contact is called CAM and the sharp piece is called DOG under the operating condition of a limit switch. CAMs are categorized into the linear type that detects plus or minus offset from the specified position and the rotary type that detects number of revolutions. DOG is installed to determine arrival at a specified position for pallets traveling horizontally or vertically.
- 9) Compatible with PLC and sequence trainer.
- 10) Applies the limit switches used in the industry
- 11) Practice driving and control of limit switches

### System configuration



(Limit drive experiment kit)



(Basic relay board-500)

### Manual Contents

#### [ book-1, Limit drive experiment kit ]

- Chap 1. Overview of limit switch
- Chap 2. Experiment on forward control of plate drive motor
- Chap 3. Experiment on reverse control of plate drive motor
- Chap 4. Experiment on plate drive motor speed control
- Chap 5. Forward and reverse control of motor with a limit switch
- Chap 6. Experiment on PLC-based limit switch detection (if PLC equipment is provided)
- Chap 7. PLC-based forward and reverse control of the Limit Drive Trainer (if PLC equipment is provided)

#### [ book-2, Basic relay board-500 ]

- Chap 1. Overview of Relay
- Chap 2. Experiment of Relay contact characteristics
- Chap 3. Display lamp types and how to use the lamps.
- Chap 4. Pushbutton Switch Types and how to use the switches.
- Chap 5. Relay ON, OFF and Jogging circuit experiment
- Chap 6. Experiment on Relay holding circuit

## Specifications

[ Limit drive experiment kit ]

A. Motor	1) DC 24 [V], 1750 [RPM], 2-pole reducer-connected type	
	2) Reduction ratio	120 : 1
	3) Plate reduction ratio	5 : 1 screw
B. Motor driving RY	1) Forward/reverse relay	2EA
	2) Speed control relay	1EA
	3) Driving port	2EA (4 jack)
C. Motor driving transformer	1) Input 220 [V] external out LET processing	
	2) Output 6 [V], 12 [V], 24 [V]	
D. DC rectifying circuit embedded	1) Embedded interlock circuit for manual operation	
	2) TG S/W for manual operation (N type)	2EA
E. Limit	1) E-stop (Sealed type)	2EA
	2) Stop (Ladder type)	2EA
	3) Low speed	2EA
	4) A, B contact for each L/S	1 Set
	5) Apply a plate processing line body model (300 : 1)	
F. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	
	3) Dimension	380mm(W) × 180mm(H) × 280mm(D)

[ Basic relay board-500 ]

Power module	Input power 1 2 W AC110~220 V	
	Main Power Switch 2A(250V)	1ea
	Protective fuse holder	1 SET
	Input power socket 2P	1ea
	Output power DC24V	1ea
Control module	Input power AC220 V or DC24 V	
	Auxiliary relay 3a 3b 1A	2ea
	PB S/W A,B CONTACT 250V 2A	2ea
	Single lamp 16 DC24V 2W	2ea
	Control module 4 jack plugging	
	Timer (0.001sec ~ 9999 hour)	1ea
	Digital counter (1 ~ 9999)	1ea

## Components

1) Hardware system	Limit drive experiment kit	1set
	Basic relay board - 500	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book

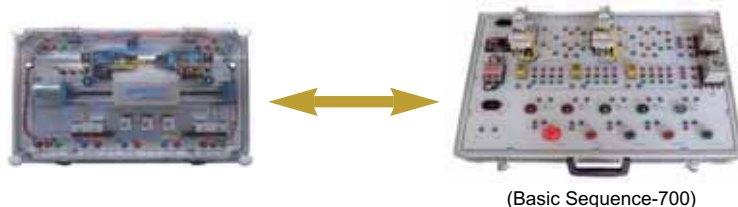
# model: Limit Drive-1000

## Limit Drive experiment kit

### Feature

- 1) Limit drive-1000 is a training system designed in a planar (large milling machine) type to help understanding of the operating principle and automatic control of limit switches from basic operation to applications.
- 2) Limit switches are largely categorized into large type, medium type, small type and micro type.
- 3) Limit switches can also be classified based on size and shape of dog and cam and actuator type.
- 4) Strictly speaking, it is reasonable to classify limit switches based on actuator type.
- 5) Actuator types include fixed roller lever type, adjustable roller lever type, adjustable lot lever type, roller lever lamp type, twin lever lock type, fixed large roller lever type, coil spring type, push roller type, etc.
- 6) The sensing switch is intended to detect the status or change in a control target and is used to detect various control quantities such as location, liquid level, pressure, temperature, voltage, etc.
- 7) Limit switch is widely used to detect contact of an object with the contactor.  
When an object contacts the contactor of a limit switch, the contactor moves to close or open the internal contact.  
Limit switch is a kind of sensor for detecting location and is widely used for bulky work pieces or work pieces processed at a low speed and for applications with issues of cost efficiency and noise rather than applications requiring precise control.
- 8) The inclined contact is called CAM and the sharp piece is called DOG under the operating condition of a limit switch.  
CAMs are categorized into the linear type that detects plus or minus offset from the specified position and the rotary type that detects number of revolutions. DOG is installed to determine arrival at a specified position for pallets traveling horizontally or vertically.
- 9) Compatible with PLC and sequence trainer.
- 10) Applies the limit switches used in the industry
- 11) Practice driving and control of limit switches

### System configuration



### Manual Contents

#### [ book-1, Limit Drive-1000 ]

- Chap 1. Overview of limit switch
- Chap 2. Experiment on forward control of plate drive motor
- Chap 3. Experiment on reverse control of plate drive motor
- Chap 4. Experiment on plate drive motor speed control
- Chap 5. Forward and reverse control of motor with a limit switch
- Chap 6. Experiment on PLC-based limit switch detection (if PLC equipment is provided)
- Chap 7. PLC-based forward and reverse control of the Limit Drive Trainer (if PLC equipment is provided)

#### [ book-2, Basic Sequence-700 ]

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output
- Part 9, BCD Output Control experiment by Counter
- Part 10, Drive Control experiment of DC Motor

PPart 11, Drive Control experiment of Single-phase induction motor  
 Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor  
 Part 13, Forward and reverse control experiment of 3-phase induction motor  
 Part 14, Y- Drive control experiment of 3-phase induction motor  
 Part 15, Motor braking experiment by Sensor  
 Part 16, Temperature Control experiment by Thermostat

## Specifications

[ Limit Drive - 1000 ]

A. Motor	1) DC 24 [V], 1750 [RPM], 2-pole reducer-connected type	
	2) Reduction ratio	120 : 1
	3) Plate reduction ratio	5 : 1 screw
B. Motor driving RY	1) Forward/reverse relay	2EA
	2) Speed control relay	1EA
	3) Driving port	2EA (4 jack)
C. Motor driving transformer	1) Input 220 [V] external out LET processing	
	2) Output 6 [V], 12 [V], 24 [V]	
D. DC rectifying circuit embedded	1) Embedded interlock circuit for manual operation	
	2) TG S/W for manual operation (N type)	2EA
E. Limit	1) E-stop (Sealed type)	2EA
	2) Stop (Ladder type)	2EA
	3) Low speed	2EA
	4) A, B contact for each L/S	1 Set
	5) Apply a plate processing line body model (300 : 1)	
F. General	1) Operating temperature	0 – 45 , below 85% R.H
	2) Input power	
	3) Dimension	380mm(W) × 180mm(H) × 280mm(D)

[ Basic Sequence - 700 ]

Power module	Input power 3 3 W 220 V / 1 2 W 220 V	
	Earth leakage breaker 3 15 A	1ea
	Protective phase fail display type fuse holder 3P	1 SET
	Input power socket 3P	1ea
	Output power socket 3P	1ea
	Control power port 2P	1ea
Control module	Input power AC220 V or DC24 V	
	Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	2ea
	Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b	2ea
	Auxiliary relay 4a 4b 1A	3ea
	Timer (0.001sec ~ 9999 hour)	2ea
	E-STOP A,B Contact 250V 3A	1ea
	PB S/W A,B CONTACT 250V 3A	4ea
	Single lamp 25 DC24V 2W	4ea
	Single Buzzer 25 DC24V	4ea
	Control module 4 jack plugging	

## Components

1) Hardware	Limit Drive - 1000	1set
	Basic sequence-700	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book



# model: **Temperature control-500**

## **Temperature control experiment kit**

### **Feature**

- 1) Temperature Control-500 is a training system designed to help understanding of temperature control from basic operation to applications.
- 2) Temperature control types include Feedback control and sequence control and temperature control typically refers to feedback control.
- 3) The temperature control system is composed of temperature sensor, regulator, electronic temperature controller and control target. Temperature sensor types include Pt100 thermal resistance sensor and thermocouples of J (IC) type and K (CA) type.  
The sensing temperature range depends on characteristics of sensor and temperature controller. In other words, sensor and temperature controller should be selected depending on the temperature range to be controlled.
- 5) Regulator type is determined depending on the fuel used for heating. For example, electric flow on/off is controlled using electronic contactor, SSR, etc. in case electricity is used for heating, while solenoid valve, gate valve, etc. are used when gas or oil is used for heating.
- 6) Compatible with PLC and sequence trainer
- 7) Applies a heater model used in the industry
- 8) A reduced model of an industrial heater
- 9) Adopts industrial temperature controller layout

### **System configuration**



(Temperature control experiment kit)



(Basic relay board-500)

### **Manual Contents**

[ book-1, Temperature control experiment kit ]

- Chap 1. Overview of temperature control
- Chap 2. Types and features of temperature sensors
- Chap 3. Theory & setting methods on universal temperature controller
- Chap 4. Experiment on universal temperature controller
- Chap 5. Temperature changes test by Heater drive
- Chap 6. Continuous Control by temperature controller
- Chap 7. Experiment on Heater Load Drive circuit by PLC (if PLC equipment is provided)

[ book-2, Basic relay board-500 ]

- Chap 1. Overview of Relay
- Chap 2. Experiment of Relay contact characteristics
- Chap 3. Display lamp types and how to use the lamps.
- Chap 4. Pushbutton Switch Types and how to use the switches.
- Chap 5. Relay ON, OFF and Jogging circuit experiment
- Chap 6. Experiment on Relay holding circuit

## Specifications

[ Temperature control experiment kit ]

1) Heater 220 [V] 6 [W]	9 Sets
2) Heater holder 18	18EA
3) PT100!& sensor (Serial / parallel sensing type)	2EA
4) PT100!& DUSRUFDYD 4 jack	3EA x 2
5) Radiating fan 220 [V]	1EA
220 [V] control 4 port	2EA
6) Y- driving relay for each phase	2EA x 2
7) Driving relay control 4 port 4EA x 2	
8) Y- driving layout model	1EA
9) General	
(1) Operating temperature	0 – 45 , below 85% R.H
(2) Input power	AC220 [V], 50/60 Hz
(3) Dimension	380mm (W) x 180mm (H) x 280mm (D)

[ Basic relay board-500 ]

Power module	Input power 1 2 W AC110~220 V	
	Main Power Switch 2A(250V)	1ea
	Protective fuse holder	1 SET
	Input power socket 2P	1ea
	Output power DC24V	1ea
Control module	Input power AC220 V or DC24 V	
	Auxiliary relay 3a 3b 1A	2ea
	PB S/W A,B CONTACT 250V 2A	2ea
	Single lamp 16 DC24V 2W	2ea
	Control module 4 jack plugging	
	Timer (0.001sec ~ 9999 hour)	1ea
	Digital counter (1 ~ 9999)	1ea

## Components

1) Hardware system	Temperature control experiment kit	1set
	Basic relay board - 500	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book

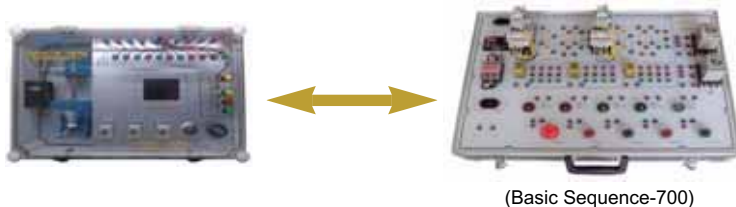
# model: **Temperature control-1000**

## Temperature control experiment kit

### Feature

- 1) Temperature Control-1000 is a training system designed to help understanding of temperature control from basic operation to applications.
- 2) Temperature control types include Feedback control and sequence control and temperature control typically refers to feedback control.
- 3) The temperature control system is composed of temperature sensor, regulator, electronic temperature controller and control target. Temperature sensor types include Pt100 thermal resistance sensor and thermocouples of J (IC) type and K (CA) type.  
The sensing temperature range depends on characteristics of sensor and temperature controller. In other words, sensor and temperature controller should be selected depending on the temperature range to be controlled.
- 5) Regulator type is determined depending on the fuel used for heating. For example, electric flow on/off is controlled using electronic contactor, SSR, etc. in case electricity is used for heating, while solenoid valve, gate valve, etc. are used when gas or oil is used for heating.
- 6) Compatible with PLC and sequence trainer
- 7) Applies a heater model used in the industry
- 8) A reduced model of an industrial heater
- 9) Adopts industrial temperature controller layout

### System configuration



### Manual Contents

[ book-1, Temperature control-1000 ]

- Chap 1. Overview of temperature control
- Chap 2. Types and features of temperature sensors
- Chap 3. Theory & setting methods on universal temperature controller
- Chap 4. Experiment on universal temperature controller
- Chap 5. Temperature changes test by Heater drive
- Chap 6. Continuous Control by temperature controller
- Chap 7. Experiment on Heater Load Drive circuit by PLC (if PLC equipment is provided)

[ book-2, Basic Sequence-700 ]

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output
- Part 9, BCD Output Control experiment by Counter
- Part 10, Drive Control experiment of DC Motor

PPart 11, Drive Control experiment of Single-phase induction motor  
 Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor  
 Part 13, Forward and reverse control experiment of 3-phase induction motor  
 Part 14, Y- Drive control experiment of 3-phase induction motor  
 Part 15, Motor braking experiment by Sensor  
 Part 16, Temperature Control experiment by Thermostat

## Specifications

[ Temperature control - 1000 ]

1) Heater 220 [V] 6 [W]	9 Sets
2) Heater holder 18	18EA
3) PT100!& sensor (Serial / parallel sensing type)	2EA
4) PT100!& DUSRUFDYD 4 jack	3EA x 2
5) Radiating fan 220 [V]	1EA
220 [V] control 4 port	2EA
6) Y- driving relay for each phase	2EA x 2
7) Driving relay control 4 port 4EA x 2	
8) Y- driving layout model	1EA
9) General	
(1) Operating temperature	0 – 45 , below 85% R.H
(2) Input power	AC220 [V], 50/60 Hz
(3) Dimension	380mm (W) x 180mm (H) x 280mm (D)

[ Basic Sequence - 700 ]

Power module	Input power 3 3 W 220 V / 1 2 W 220 V	
	Earth leakage breaker 3 15 A	1ea
	Protective phase fail display type fuse holder 3P	1 SET
	Input power socket 3P	1ea
	Output power socket 3P	1ea
	Control power port 2P	1ea
Control module	nput power AC220 V or DC24 V	
	Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	2ea
	Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b	2ea
	Auxiliary relay 4a 4b 1A	3ea
	Timer (0.001sec ~ 9999 hour)	2ea
	E-STOP A,B Contact 250V 3A	1ea
	PB S/W A,B CONTACT 250V 3A	4ea
	Single lamp 25 DC24V 2W	4ea
	Single Buzzer 25 DC24V	4ea
	Control module 4 jack plugging	

## Components

1) Hardware	Temperature control	1set
	Basic sequence-700	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book

# model: **DC motor-500**

## **DC motor experiment kit**

### **Feature**

- 1) DC motor-500 is featured by creating a magnetic field using permanent magnet instead of using DC voltage and its speed is controlled by applying variable DC voltage to the armature.  
A fixed DC voltage of 90V or 180V is applied when creating a magnetic field with DC voltage.  
Large-scale bridge diodes and A device that simultaneously starts at DC motor ON/OFF is also installed.  
Moreover, a device to remove surge generated at ON/OFF needs to be installed at the contact.
- 2) DC motor can be controlled in multiple steps using several VRs. Motor brake can be controlled by reverse-phase control or by inserting resistor and others to the armature port as soon as the motor stops.  
A device to control the rising time to the rated speed and the falling time to the stationary speed may be attached to a large motor.  
Brake rate is also controlled to avoid excessive force on the machine by adjusting resistance in multiple steps starting from Step 1.
- 3) Although this training system is controlled a little different from high-power industrial motors, the basic control process is all the same. Therefore, practice of motor control in this textbook will be helpful for application of DC motors to the industry. T/G is not used for this training system because volt feedback is applied to motor control.
- 4) Compatible with PLC and sequence trainer.
- 5) Built-in controller type.
- 6) Motor driving status can be checked directly.
- 7) Test can be done just with the trainer body.

### **System configuration**



(DC motor experiment kit)



(Basic relay board-500)

### **Manual Contents**

#### [ book-1, DC motor experiment kit ]

- Chap 1. Overview of DC motor
- Chap 2. Experiment on forward and reverse control of DC motor
- Chap 3. Experiment on DC motor speed control
- Chap 4. Multi-step speed control of DC motor
- Chap 5. DC motor brake control
- Chap 7. DC motor drive control by PLC (if PLC equipment is provided)

#### [ book-2, Basic relay board-500 ]

- Chap 1. Overview of Relay
- Chap 2. Experiment of Relay contact characteristics
- Chap 3. Display lamp types and how to use the lamps.
- Chap 4. Pushbutton Switch Types and how to use the switches.
- Chap 5. Relay ON, OFF and Jogging circuit experiment
- Chap 6. Experiment on Relay holding circuit

## Specifications

[ DC motor experiment kit ]

A. Motor	1. DC 90 [V] 25 [W]	
	2. Rated current and speed	0.4 [A], 1750 [RPM]
	3. Number of poles	2 poles
B. Driving relay	1. Voltage	220 [V] / DC 24 [V]
	2. Relay	3 Sets embedded (Separate type)
	3. Contact ratings	220 [V] – 3 [A] (24 [V] – 3 [A])
	3a 3b - 3 Sets x 3 EA (4 jack)	
	4. Voltage toggle switch	1 Set
	5. Micro photo sensor (u-shaped)	1 Set
	6. Power supply 2Pjack for photo sensor	1 Set
	7. Sensor output port (4 jack)	1 Set
C. Dc motor controller	8. Sensor driving relay	1 Set
	1. Voltage	220 [V]
	2. Output Voltage	Max DC 90 [V]
	3. Multi-step speed control VR	2 EA
	4. AC input port	2EA (4 jack)
	5. VR input port	3EA (4 jack)
D. General	6. Motor output port	2EA (4 jack)
	1. Operating temperature	0 – 45 , below 85% R.H
	2. Input power	AC 220 V, 50/60 Hz
	3. Dimension	380mm(W) x 180mm(H) x 280mm(D)

[ Basic relay board-500 ]

Power module	Input power 1 2 W AC110~220 V	
	Main Power Switch 2A(250V)	1ea
	Protective fuse holder	1 SET
	Input power socket 2P	1ea
	Output power DC24V	1ea
Control module	Input power AC220 V or DC24 V	
	Auxiliary relay 3a 3b 1A	2ea
	PB S/W A,B CONTACT 250V 2A	2ea
	Single lamp 16 DC24V 2W	2ea
	Control module 4 jack plugging	
	Timer (0.001sec ~ 9999 hour)	1ea
	Digital counter (1 ~ 9999)	1ea

## Components

1) Hardware system	DC motor experiment kit	1set
	Basic relay board - 500	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book

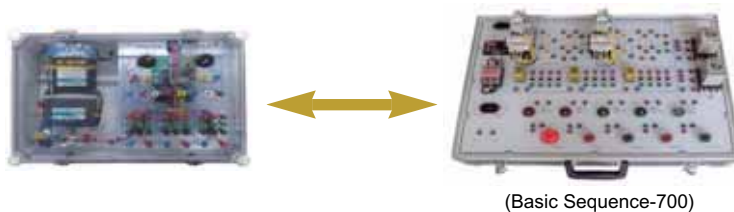
# model: **DC motor-1000**

## **DC motor experiment kit**

### **Feature**

- 1) DC motor-1000 is featured by creating a magnetic field using permanent magnet instead of using DC voltage and its speed is controlled by applying variable DC voltage to the armature.  
A fixed DC voltage of 90V or 180V is applied when creating a magnetic field with DC voltage.  
Large-scale bridge diodes and A device that simultaneously starts at DC motor ON/OFF is also installed.  
Moreover, a device to remove surge generated at ON/OFF needs to be installed at the contact.
- 2) DC motor can be controlled in multiple steps using several VRs. Motor brake can be controlled by reverse-phase control or by inserting resistor and others to the armature port as soon as the motor stops.  
A device to control the rising time to the rated speed and the falling time to the stationary speed may be attached to a large motor.  
Brake rate is also controlled to avoid excessive force on the machine by adjusting resistance in multiple steps starting from Step 1.
- 3) Although this training system is controlled a little different from high-power industrial motors, the basic control process is all the same. Therefore, practice of motor control in this textbook will be helpful for application of DC motors to the industry. T/G is not used for this training system because volt feedback is applied to motor control.
- 4) Compatible with PLC and sequence trainer.
- 5) Built-in controller type.
- 6) Motor driving status can be checked directly.
- 7) Test can be done just with the trainer body.

### **System configuration**



### **Manual Contents**

#### [ book-1, DC Motor-1000 ]

- Chap 1. Overview of DC motor
- Chap 2. Experiment on forward and reverse control of DC motor
- Chap 3. Experiment on DC motor speed control
- Chap 4. Multi-step speed control of DC motor
- Chap 5. DC motor brake control
- Chap 7. DC motor drive control by PLC (if PLC equipment is provided)

#### [ book-2, Basic Sequence-700 ]

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output
- Part 9, BCD Output Control experiment by Counter
- Part 10, Drive Control experiment of DC Motor
- PPart 11, Drive Control experiment of Single-phase induction motor

Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor  
 Part 13, Forward and reverse control experiment of 3-phase induction motor  
 Part 14, Y- Drive control experiment of 3-phase induction motor  
 Part 15, Motor braking experiment by Sensor  
 Part 16, Temperature Control experiment by Thermostat

## Specifications

[ DC Motor-1000 ]

A. Motor	1. DC 90 [V] 25 [W]	
	2. Rated current and speed	0.4 [A], 1750 [RPM]
	3. Number of poles	2 poles
B. Driving relay	1. Voltage	220 [V] / DC 24 [V]
	2. Relay	3 Sets embedded (Separate type)
	3. Contact ratings	220 [V] – 3 [A] (24 [V] – 3 [A])
	3a 3b - 3 Sets x 3 EA (4 jack)	
	4. Voltage toggle switch	1 Set
	5. Micro photo sensor (u-shaped)	1 Set
	6. Power supply 2Pjack for photo sensor	1 Set
	7. Sensor output port (4 jack)	1 Set
C. Dc motor controller	8. Sensor driving relay	1 Set
	1. Voltage	220 [V]
	2. Output Voltage	Max DC 90 [V]
	3. Multi-step speed control VR	2 EA
	4. AC input port	2EA (4 jack)
	5. VR input port	3EA (4 jack)
	6. Motor output port	2EA (4 jack)
D. General	1. Operating temperature	0 – 45 , below 85% R.H
	2. Input power	AC 220 V, 50/60 Hz
	3. Dimension	380mm(W) x 180mm(H) x 280mm(D)

[ Basic Sequence - 700 ]

Power module	Input power 3 3 W 220 V / 1 2 W 220 V	
	Earth leakage breaker 3 15 A	1ea
	Protective phase fail display type fuse holder 3P	1 SET
	Input power socket 3P	1ea
	Output power socket 3P	1ea
	Control power port 2P	1ea
Control module	nput power AC220 V or DC24 V	
	Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	2ea
	Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b	2ea
	Auxiliary relay 4a 4b 1A	3ea
	Timer (0.001sec ~ 9999 hour)	2ea
	E-STOP A,B Contact 250V 3A	1ea
	PB S/W A,B CONTACT 250V 3A	4ea
	Single lamp 25 DC24V 2W	4ea
	Single Buzzer 25 DC24V	4ea
	Control module 4 jack plugging	

## Components

1) Hardware	DC Motor-1000	1set
	Basic sequence-700	1set
2) LEAD WIRE		2 set
3) Power cable		2 EA
4) Manual book		2 book



model:**DC motor-1500**

DC motor (Shunt / Series winding) & DC generator (Compound winding) training equipment

Overview

- 1) Input / output instruction of motor & generator by 7ea of currents, voltmeter, RPM meter
- 2) Safe practice with overload cutout and compatible Motor and Generator
- 3) Transparent protection cover to motor and generator part.
- 4) Start and load characteristics by DC Series-wound & DC Shunt-wound motor

Hardware configuration



Components

DC motor hardware	1 set
Circuit Connection Cord (Ø4 Plug)	1 set
AC Power Cord	1 ea
Manual book	1 book

## Manual book

- Chap 1, Start and load characteristics practice of DC shunt-wound motor
- Chap 2, Start and load characteristics practice of DC series-wound motor
- Chap 3, Loss and efficiency practice of DC motor
- Chap 4, Relationship of motor speed practice with the electromotive force
- Chap 5, Load characteristics practice of DC compound motor
- Chap 6, Cumulative compound and differential compound characteristics practice
- Chap 7, Generator rotating speed and output characteristics practice
- Chap 8, Loss and efficiency practice of DC compound generator

## Specification

### MOTOR SECTION

Winding Type	Shunt/Series
Speed	1250~1800RPM
Input Power	120V, 3.5A
Shunt Field Exc.	0.4A(Sep.), 120V
Number of Pole	2 Pole
Horsepower	1/3 HP
Shunt Field Rheostat	0~300 $\Omega$ , 50W
Armature Rheostat	0~10 $\Omega$ , 80W
Indication Meter	2-Current, 1-Voltage 1-RPM(Digital)
Over Load Trip	4A Approx.

### GENERATOR SECTION

Winding Type	Compound
Speed	1800RPM
Output power	DC 0~120V, 1A
Number of Pole	2 Pole
Field Exc.	Self Exciting
Shunt Field Rheostat	0~300 $\Omega$ , 50W
Series Field Rheostat	0~500 $\Omega$ , 50W
Indication Meter	2-Current, 1-Voltage
Overload Trip	2A Approx.
Load Resistance	48~480 $\Omega$ , 500W

### General spec

Main Input Voltage	AC 220V
Rating	30Minutes
Motor size	145(diameter) x 255(length)mm
Generator size	145(diameter) x 215(length)mm
System size	990(W) x 665(H) x 480(D)mm
weight	75kg

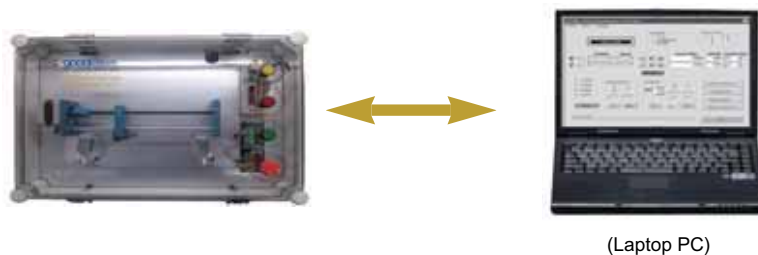
# model: Stepping motor-1000

## Stepping motor experiment kit

### Feature

- 1) Stepping motor-1000 is a training system designed to help understanding of the fundamentals and automatic control of stepping motors used to convert electrical energy to mechanical energy.
- 2) This stepping motor trainer is designed to practice the principle of stepping motor and sequence control using PLC. It is designed to control motor speed by adjusting time offset of pulse with PLC, to control 200 steps or 400 steps per revolution of a stepping motor in the forward or reverse direction and to count the contact signal of PLC to control time offset.
- 3) The training system puts an emphasis on stepping motor control using a reserved slot of PLC rather than the concept that stepping motor can be controlled just with a special controller or a microprocessor.
- 4) Stepping motors are distinguished from other motors in that digital electrical signal is converted to mechanical dynamic energy.
- 5) Speed of a stepping motor is controlled by the rate of pulses sequentially applied to the four ports. By the structural features, stepping motor is apt to stop as soon as no pulse is applied. It is widely used for paper transport in a copy machine and feeding machines as it gives a large torque at a compact size.
- 6) Compatible with PLC and sequence trainer.
- 7) Practice the principle and control of stepping motor.
- 8) Check the driving state of stepping motor
- 9) 1- phase, 2- phase and 1-2 phase control.

### System configuration



(Laptop PC)

### Training contents

- Chap 1. Overview of stepping motor
- Chap 2. Basis of Stepping Motor equipment -1
- Chap 3. Basis of Stepping Motor equipment -2
- Chap 4. PC-based experiment on forward control of stepping motor
- Chap 5. PC-based experiment on reverse control of stepping motor
- Chap 6. PC-based experiment on stepping motor speed control
- Chap 7. PC-based Multi-step speed control experiment on stepping motor
- Chap 8. PC-based Experiment on Application program

## Specifications

1) MOTOR (1.8M degree/STEP, 6V 0.73A/PHASE)	1 EA
2) SIGNAL INPUT	4 EA (4 jack)
3) HOME POSITION SENSOR	1 EA
4) Each phases INDICATOR	4 EA
5) Stepping motor control and Driving circuit built-in	
6) Forward & reverse direction control	
7) General spec	
Operating temperature	0 - 45 , 85% R.H. below
Input power	AC 220V, 50/60Hz
Size	380mm(W) × 180mm(H) × 280mm(D)

## Components

1) Hardware system	1 set
2) LEAD WIRE	1 set
3) Power Cable	1 ea
4) Program CD	1 ea
5) Manual book	1 book

# model: **Stepping motor-1500**

## Stepping motor training equipment

### Overview

- 1) Graphical display of functional block diagram on the system surface
- 2) LM Guide and Rotary Encoder for position control
- 3) Angle control using rotary plate
- 4) Real-time monitoring and control by PC Control Program
- 5) Prevents operation error by recovering 0 point automatically when POWER ON or RESET
- 6) Displays moving distance and angle data using LCD
- 7) Portable type with Aluminum Carrying Case

### Hardware configuration



### Components

Stepping motor hardware	1 set
AC Power Cord	1 ea
S/W for PC	1 ea
Manual book	1 book

## Training contents

Chap 1, Position control practice by step operation  
 Chap 2, Position control practice by continuous operation  
 Chap 3, Angle control practice by step operation  
 Chap 4, Angle control practice by photo sensor  
 Chap 5, Learn the characteristics by phase excitation changes  
 Chap 6, Learn the dynamic torque characteristics of stepping motor using frequency modulation  
 Chap 7, Wave form measurement practice using oscilloscope  
 Chap 8, Speed control practice by control S/W  
 Chap 9, Angle control practice by simulation S/W

## Specification

Computer control	section
	Step operation / continuous operation by control program
	Operation of forward / reverse rotation direction by control program
	Operation of output pulse frequency by control program
	On-line and real time control by RS-232C
Manual control unit	Step operation / continuous operation by manual setting value
	Forward / reverse rotation direction operation by manual setting value
	Operation of output pulse frequency by manual setting value
Stepping motor : 2ea	2-phase HB type, Unipola Drive type: 0 ~ 2000 PPS
	Using PWM Constant Current Drivers
	LM GUIDE drive (position control) and disk drive (angle control)
	LM GUIDE : 1set
	Ball Screw Travel Distance: 200mm or more
	Protection circuit by photosensor when drive range is exceeded
	ROTARY ENCODER
	400 / Rev, built-in signal output terminal
	LCD display device (for rotation angle and for moving displacement display)

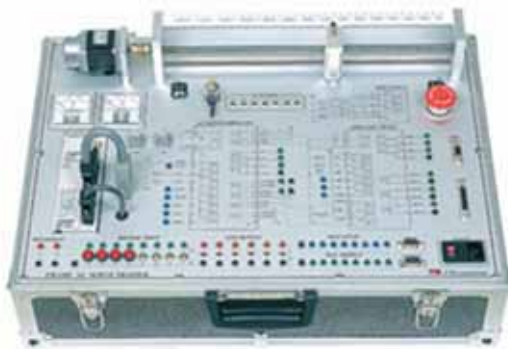
# model: **AC Servo motor -1500**

## AC Servo motor training equipment

### Overview

- 1) Experiments on Servo Motor control techniques using Servo Driver
- 2) Aluminum carrying case for convenient storage and mobility
- 3) JOG operation, PLC control operation, PC control operation
- 4) Various types of control elements easily to be mounted
- 5) Capable of checking normal operating voltage / over current by voltmeter and ammeter
- 6) Basic sequence control practice by connecting with Realy board-500

### Hardware configuration



[Servo (AC) motor hardware]



(Basic relay-500)

### Components

Servo (AC) motor hardware	1 set
AC Power Cord : 1ea	1 ea
S/W for PC	1 ea
Basic relay board-500	1 set
Cable set for signal control	1 set
Manual book	1 book

## Training contents

- 1) Part-1, Servo(AC) motor
  - Chap 1, Practice of uniformity starting point using APM
  - Chap 2, Practice of velocity and position control using APM
  - Chap 3, Practice of operation mode using APM
  - Chap 4, ZONE/POINT operation practice using APM
  - Chap 5, Practice of limit detection and return to starting point using MMC
  - Chap 6, Practice of velocity and position control using MMC
- 2) Part-2, Basic relay-500
  - Chap 1. Overview of Relay
  - Chap 2. Experiment of Relay contact characteristics
  - Chap 3. Display lamp types and how to use the lamps.
  - Chap 4. Pushbutton Switch Types and how to use the switches.
  - Chap 5. Relay ON, OFF and Jogging circuit experiment
  - Chap 6. Experiment on Relay holding circuit

## Specification

### 1) Servo (AC) motor hardware

Samsung CSMT (100W level) Motor	normal output	Single-phase, AC 220V 100W
	Rated / Max Speed	RPM 3000
	Current continuous	1.0A, max 3.0A
	Maximum torque	9.7kgf · cm, 0.95N · m
	Weight	0.4 kg
	Applied Encoder	17bit Serial Encoder (Incremental, Absolute Encoder, etc.)
Samsung CSDJ series Servo Driver Control	Compact, lightweight, all-in-one product with full digital system using 32bit high-speed DSP	
	Main circuit power	Three-phase, 220V (+10%, -15%, 50/60MHz)
	Control power source	Single-phase, 220V (+10%, -15%, 50/60MHz)
	Control method	PWM Control using IPM
	Encoder	2048/2500/10000 Pulse/Rev.
	Dynamic Brake	Servo / controller off, when alarm occurs
Samsung CSDJ series Servo Driver Control	Speed control range	1 : 5,000
	Frequency fluctuation	550Hz
	Set acceleration / deceleration	0~60 sec
	time constant	
	Input signal command	Sign+Pulse, 90°Δ Phase difference
	Pulse type	2-phase pulse (A phase + B phase), CCW Pulse, CW Pulse
	Pulse shape	Line Drive(+5V), Open Collector(+5, +12V, +24V)

### 2) Basic relay board - 500

#### (1) Power module

Input power 1 2 W AC110~220 V  
 Main Power Switch 2A(250V) - 1ea  
 Protective fuse holder - 1 SET  
 Input power socket 2P - 1ea  
 Output power DC24V - 1ea

#### (2) Control module

Input power AC220 V or DC24 V  
 Auxiliary relay 3a 3b 1A - 2ea  
 PB S/W A,B CONTACT 250V 2A - 2ea  
 Single lamp 16 DC24V 2W - 2ea  
 Control module 4 jack plugging  
 Timer (0.001sec ~ 9999 hour) - 1ea  
 Digital counter (1 ~ 9999) - 1ea



model:

DC Servo motor-1500

DC Servo motor training equipment

Overview

- Graphical display of functional block diagram on the surface
- Speed and angle control by step operation and photo sensor
- 100W DC Servo Motor with a built-in encoder
- Motor load test using the brake of the vortex braking method
- Display of the rotational speed and angle data using LCD
- Portable type with Aluminum Carrying Case
- PC control and waveform output functions

Hardware configuration



Components

Servo (DC) motor hardware	1 set
AC Power Cord	1 ea
S/W for PC	1 ea
Manual book	1 book

## Training contents

Chap 1, Learn the principles of Servo Motor's rotation  
 Chap 2, Learn the PWM circuit for current control  
 Chap 3, Learn the control system of Servo Motor  
 Chap 4, Servomotor basic driving practice  
 Chap 5, Servo operation practice by control block input  
 Chap 6, Learn the characteristics of P-control  
 Chap 7, Learn the characteristics of PI-control  
 Chap 8, Learn the characteristics of PID-control  
 Chap 9, Position control practice by potentiometer's feedback  
 Chap 10, Practice of Brake load characteristics  
 Chap 11, Servo Motor Torque Load Practice

## Specification

Control unit	Servo operation by input per control block
	Speed control according to output pulse frequency change
	Encoder output and various output pulse measurement
	Position and speed control by feedback
	Built-in voltmeter and ammeter
	Monitoring and control of operating characteristics by S/W
	Measurement of motor load characteristics using brakes
DC Servo motor : 1ea	Rated output 80W, Built-in encoder, 0 ~ 3000RPM
Operating unit	PWM constant current drive method
	Operation of forward / reverse direction by input of two power sources
	Complementary High Power Amplifier for Bidirectional Control
	Built-in A / D converter 4Ch, D / A converter 1Ch
	Built-in vortex brake system
	ROTARY ENCODER (Built-in motor)
	500/Rev.
	Built-in signal output terminal
	Includes LCD display device (for display of rotation angle and rotation speed)

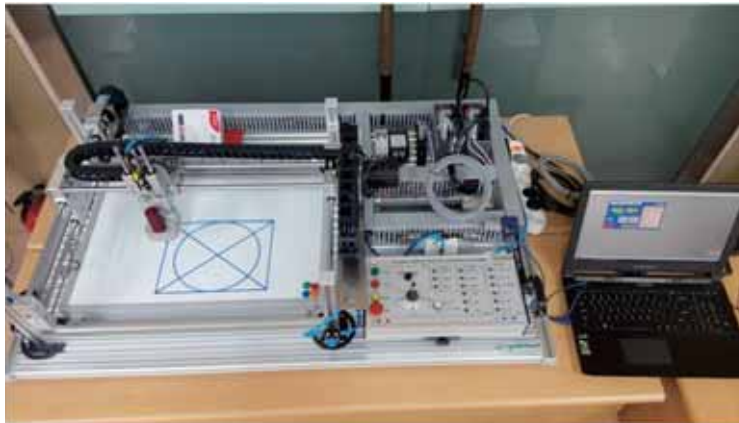
# model: **GT-SMCT100**

## Specification of Servo Motor Trainer

### Features

- 2 axes servo motor system
- Linear spindle drive ball-screw type
- Drawing operation with a white board and marking pen
- Basic and advanced training of servo control technology
- Jog control, program control
- Position control 1 or 2 axes
- Linear interpolation
- Circular interpolation
- Open structure for practical training

### System configuration



### Main components

- |  |  |
|--|--|
| - Linear spindle drive module : 2 axes | - Servo motion controller : 2 axes     |
| - Spindle : ball screw type            | - Operating I/O devices                |
| - Pneumatic cylinder with twin guide   | - I/O terminal connection : 4mm socket |
| - Pen clamping device                  | - DC 24V power supply                  |
| - White board                          |  |
| - Servo motor and driver : 2set        |  |

## Specification

1. Model: GT-SMCT100
2. Size: 1200 x 750 x 540 (W x D x H) mm
3. Weight: 45 Kg
4. Power input : AC 220V
5. Control power : DC 24V
6. Operating pressure : 0.4~0.6 MPa
7. Servo motor:
  - AC servo, 100W
  - Torque : 0.32Nm
  - Speed : 3000 r/min(Max:5000 r/min)
  - Encoder pulse : 2000P/r incremental type
  - Weight : 0.85Kg
8. Controller: Servo motion controller(2 axes)
  - Highly functional, economical, small 2-axis motion controller
  - Feed command system through variables (position, speed, dwell, L variable)
  - Variable-based comparison, macro computation, and indirect variable
  - Fixed cyclic (10ms) sequence control composed of convenient operating commands
  - External encoder pulse coding
  - High-speed I-Mark by input signals
  - Signal output during feed
  - Possible to execute the Single Block feed command
  - Various PLC protocol support for touch panel and PLC communication
  - Program editing and operation at PC and teach-pendant
  - Various operating tools
  - Multi-axis (maximum 63 axes) interworking operation through RS485
9. Servo motor driver : 2 set
  - Input power : AC230V, 50/60Hz,  $\pm 5\%$  and noise filter
  - Output type : Differential line driver output
  - 131,072 pulse/r
  - Control : PWM
  - Speed control
  - Position control
  - Torque control
  - Dynamic break included.
  - Full Digital, 32-bit High-speed DSP and
  - Speed/Position/Torque Combination
  - Position Control Operation
    - Available Input Pulse Type of Various Position
    - Command Input signal type : Open collector or line drive
    - Position input frequency : 500,000 (Pulse/sec)
    - Users selective position control through 4 electronic gear ratio
    - Feed-forward function for reduction of position decision time
    - Backlash compensation function
    - Speed Control Operation
    - Use various speed command type
- High precision speed control (speed control scope 1:5,000)
- Set increase & decrease speed pattern by machine
- Prevent the damage of machine by the limit of torque (current)
- Control the minute speed as overriding function
10. End effector : Marking pen with a pneumatic cylinder
11. Drawing cylinder (reed switch included) - 2ea
  - Up/down for drawing
  - Twin cylinder guide unit
  - Cylinder stroke : 100mm
  - Bracket for Marking pen
12. Solenoid valve - 1ea
  - Control for Drawing cylinder
  - 5/2-way double solenoid valve
13. Limit switch and sensor
  - Limit switch for X axis safety : 2ea
  - Limit switch for Y axis safety : 2ea
  - ORG sensor for X axis : 1ea
  - ORG sensor for Y axis : 1ea
14. Operating box
  - DC 24V power supply
  - Switches: Start / Stop / Reset / EMG / Jog / Down / 4 direction joy-stick function.
  - Signal Input
    - Limit X-, Limit X+, ORG X
    - Limit Y-, Limit Y+, ORG Y
    - Extra input port for program : 3ea
  - Signal Output
    - Servo on, Cylinder up, Cylinder down
    - Extra output port for program : 3ea
15. Spindle drive : 2ea
  - Ball screw type
  - 400mm screw drive and guide unit
16. White board : 1ea
17. Eraser and board marker : 1set
18. Power cable and RS-232 cable : 1set
19. Manual and Software
  - Manual and workbook
  - Software for MCU controller

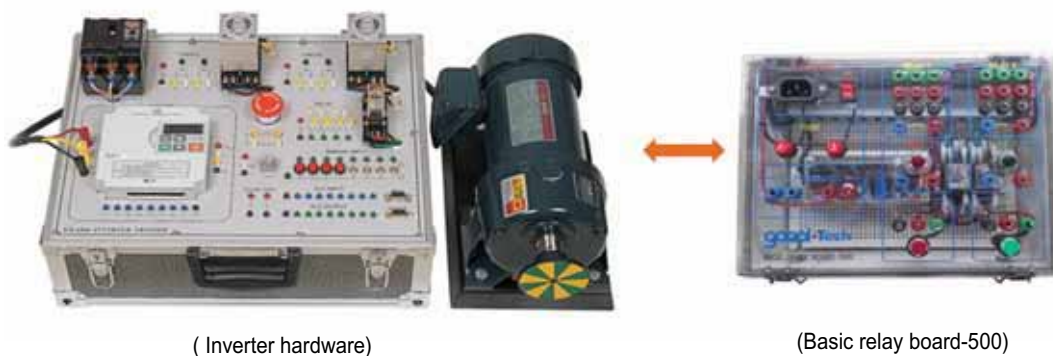
# model: Inverter-1500

## Inverter training equipment

### Overview

- 1) Control experiments using a PLC module (in use of D/A module)
- 2) Feasible contact-type PLC control
- 3) Practical training on inverter and 3-phase induction motor operations
- 4) Basic sequence control practice by connecting with Relay board-500
- 5) Carrying case type structure for convenient storage and mobility

### Hardware configuration



( Inverter hardware)

(Basic relay board-500)

### Components

Inverter Hardware platform	1 set
Program CD	1 ea
AC Power Cord	1 ea
Basic relay board-500	1 set
Cable set for signal control	1 set
Manual book	1 book

## Training contents

### Part-1, Inverter hardware

- Chap 1, Basic operation practice using keypad
- Chap 2, Basic operation practice using control terminal
- Chap 3, Basic Operation Practice Using Variable Resistors
- Chap 4, Control exercises using magnetic holding circuits and timers
- Chap 5, Repetition control exercises using two timers
- Chap 6, Control exercises using PLC contacts
- Chap 7, Multi-step speed control exercise using PLC contact
- Chap 8, Speed control practice using D/A module of PLC
- Chap 9, Inverter control practice by sequence control

### Part-2, Basic relay-500

- Chap 1. Overview of Relay
- Chap 2. Experiment of Relay contact characteristics
- Chap 3. Display lamp types and how to use the lamps.
- Chap 4. Pushbutton Switch Types and how to use the switches.
- Chap 5. Relay ON, OFF and Jogging circuit experiment
- Chap 6. Experiment on Relay holding circuit

## Specification

### 1) Inverter hardware

- (1) 1HP class 3-phase general-purpose inverter
- (2) Digital MMI, Trip-less operation, Shortest / Best Acceleration, Deceleration
- (3) Built-in various functions such as PID control function and stable operation guarantee
- (4) Built-in RS485
- (5) iG5 inverter

motor	[HP]	0.5	1	2
	[KW]	0.4	0.75	1.5
Output rating	Rated capacity [KVA]	0.95	1.9	3
	Rated current [A]	2.5	5	8
Input rating	Output frequency	0~ 400Hz		
	Output voltage	3 220 ~ 230V		
	voltage	1 220~230VAC ( ± 10%)		
	Frequency	50Hz~60Hz ( ± 5%)		
Frequency setting	Digital command	0.01Hz(100Hz ), 0.1Hz(100Hz )		
Resolution	Analog command	0.03Hz/60Hz		
Frequency accuracy	Digital command	0.01% of maximum output frequency		
	Analog command	0.1% of maximum output frequency		
Frequency setting	Analog	0~ 10V/4~20mA		
	Digital	Using the keypad		
Inverter weight (kg)		0.77	1.12	1.84
Control type	VF method			
VF ratio	Linear, 2-pole reduction, User V / F			
Operation method	Keypad / terminal block / communication operation selectable			

### 2) Basic relay board - 500

#### (1) Power module

- Input power 1 2 W AC110~220 V
- Main Power Switch 2A(250V) - 1ea
- Protective fuse holder - 1 SET
- Input power socket 2P - 1ea
- Output power DC24V - 1ea

#### (2) Control module

- Input power AC220 V or DC24 V
- Auxiliary relay 3a 3b 1A - 2ea
- PB S/W A,B CONTACT 250V 2A - 2ea
- Single lamp 16 DC24V 2W - 2ea
- Control module 4 jack plugging
- Timer (0.001sec ~ 9999 hour) - 1ea
- Digital counter (1 ~ 9999) - 1ea

# model: Relay Drive-1000

## Relay Drive experiment kit

### Feature

- 1) Relay drive-1000 is designed to drive relays required for sequence control and PLC driving.  
This training system is intended to help understanding of automatic control using relays and switches, which are basic components of control, and lamps for display.
- 2) The relays mounted on the Relay Drive-1000 are used for sequence control with low-power contacts.  
When used for PLC control, the relays are connected to terminals of PLC OUTPUT to control load with the relay contacts.
- 3) Auxiliary relays mounted on the Relay Drive-1000 are classified into the four types of 1A1B (LY1), 2A2B (LY2), 3A3B (LY3) and 4A4B (LY4) depending on relay contact types. The type given in a parenthesis is the nomenclature typically used in the industry.
- 4) Power supply is classified into AC and DC types. AC types include 110V and 220V, and DC types include 24V, 48V, 100V and 200V.
- 5) Compatible with PLC trainer.
- 6) Compatible with sequence trainer.
- 7) Practice sequence control of relays.

### Manual Contents

- Chap 1. Overview of relay  
 Chap 2. Experiment on characteristics of relay contacts  
 Chap 3. Push button switch types and utilization  
 Chap 4. Experiment on relay ON, OFF inching circuit  
 Chap 5. Experiment on Relay ON, OFF interlock circuit  
 Chap 6. Experiment on relay holding circuit

### System configuration



(Power Supply is needed - Voltage output : 0~30V,  
Current output : 0~3A)

### Components

1) Hardware system	1 set
2) LEAD WIRE	1 set
3) Manual book	1 book

### Specifications

A. Driving relay	1. Voltage	AC220 [V] / DC 24 [V] selective
	2. Relay	6 sets embedded
	3. Contact ratings	220 [V] – 3 [A] (24 [V] – 3 [A]) 3a 3b - 3 Sets x 6 EA (4 jack)
B. Display lamps	1. 16 DC24 [V] / AC220 [V] selective	EA (W, R, Y, G)
	2. LAMP output 4 jack	4 Sets
C. Input switch	1. 16 250 [V] 3 [A] (Contact ratings).	
	2. Contact	1a 1b (4 jack) 6 EA Red 3 EA, Green 3 EA
	3. Graphics in compliance with JIS standard for switches	6 Sets
D. General	1. Operating temperature	0 – 45 , below 85% R.H
	2. Input power	AC 220 V, 50/60 Hz
	3. Dimension	380mm(W) x 180mm(H) x 280mm(D)

# model: **Basic Sequence-700**

## **Basic sequence trainer**

### **Feature**

- 1) Basic sequence-700 is the experimental equipment in which engineering degree technicians can study the basic analysis of electricity and basis of automatic control.
- 2) Basic Sequence-700 was manufactured to implement diverse experiments like from interpreting & utilizing various components, to be used in producing the industrial automation process, to stepping-up stages of application design level on the various components.

### **System configuration**



### **Manual Contents**

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output
- Part 9, BCD Output Control experiment by Counter
- Part 10, Drive Control experiment of DC Motor
- Part 11, Drive Control experiment of Single-phase induction motor
- Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor
- Part 13, Forward and reverse control experiment of 3-phase induction motor
- Part 14, Y- Drive control experiment of 3-phase induction motor
- Part 15, Motor braking experiment by Sensor
- Part 16, Temperature Control experiment by Thermostat

### **Components**

1) Hardware system	1 set
2) Power cable	1 ea
3) Lead wire	1 set
4) Manual book	1 boo



## Specifications

Power module		
Input power 3	3 W 220 V / 1	2 W 220 V
Earth leakage breaker 3	15 A	1ea
Protective phase fail display type fuse holder 3P		1 SET
Input power socket 3P		1ea
Output power socket 3P		1ea
Control power port 2P		1ea
Control module		
Input power AC220 V or DC24 V		
Magnet S/W main circuit 3a Auxiliary circuit 1a 1b		2ea
Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b		2ea
Auxiliary relay 4a 4b 1A		3ea
Timer (0.001sec ~ 9999 hour)		1ea
Digital counter (1 ~ 9999)		1ea
E-STOP A,B Contact 250V 3A		1ea
PB S/W A,B CONTACT 250V 3A		4ea
Single lamp 25 DC24V 2W		4ea
Single Buzzer 25 DC24V		4ea
Control module 4	jack plugging	

# model: Sequence-1000

## Sequence training equipment

### Feature

- 1) Sequence - 1000 is a training system designed to help understanding of the fundamentals and automatic control of sequence for engineering students and technicians who study sequence control.
- 2) The sequence control trainer is designed to practice the automation process in the industry from analysis and utilization of elementary components to their applications. The training system adopts only the components used in the industry.
- 3) Automatic control is the basis of sequence control and design itself would be impossible without analysis of components. It would also be impossible to implement creative control and to design program using PLC without such analysis of components.
- 4) This training system covers basic selection of breakers, utilization of electronic contactors, utilization of auxiliary relays, features of electronic timers, features of electronic counters, utilization and features of temperature controller, etc. Students can automatically access automatic control by conducting experiments using the control devices provided optionally.

### Manual Contents

Chap 1. Experiment on relay ON, OFF inching and interaction circuit  
 Chap 2. Experiment on relay holding circuit  
 Chap 3. Experiment on sequence control with magnetic contactors  
 Chap 4. Experiment on holding circuit with magnetic contactors  
 Chap 5. Experiment on sequence control with timers  
 Chap 6. Experiment on sequence control with counters  
 Chap 7. Experiment on sequence control with sensors  
 Chap 8. Experiment on FND control with input and output  
 Chap 9. Experiment on BCD output control with a timer  
 Chap 10. Experiment on DC motor drive control

Chap 11. Experiment on single-phase induction motor drive control  
 Chap 12. Experiment on forward & reverse/multistep speed control of single-phase induction motor  
 Chap 13. Experiment on forward and reverse control of three-phase induction motor  
 Chap 14. Experiment on Y- drive control of three-phase induction motor  
 Chap 15. Experiment on motor brake with a sensor  
 Chap 16. Experiment on temperature control with a temperature controller  
 Chap 17. Experiment on level controller

### System configuration



### Components

1) Hardware system	1 set
2) Power cable	1 ea
3) Lead wire	1 ea
4) Manual book	1 book

### Specifications

1) Power module	Input power 3 3 W 220 V / 1 2 W 220 V	
	Earth leakage breaker 3 15 A	1ea
	phase fail display type fuse holder 3P	1 SET
	Input power socket 3P	1ea
	Output power socket 3P	1ea
	Control power port 4P	1ea
2) Control module	Input power AC220 V or DC24 V	
	Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	3ea
	EOCR auxiliary circuit 1a 1b	1ea
	Auxiliary relay 4a 4b 1A	4ea
	Digital timer (0.001 SEC ~ 9999 HOUR)	2ea
	E-STOP A, B Contact 250 V 3A	1ea
	PB S/W A, B Contact 250 V 3A	4ea
	Signal lamp 25 220 V (DC24 V) 2 W	3ea
	Signal buzzer 25 220 V (DC24 V)	1ea
	Control module 4 jack plugging	
	Digital counter (1 ~ 9999)	1ea
	Digital Temp (0 ~ 999 !)	1ea
	SEL S/W (2a)	1ea
	DC motor simulator	1ea
	Level controller	1ea

# model: Sequence-5000

## Sequence control laboratory equipment

### Feature

Automatic control is widely used for the purpose of operating cost saving, quality enhancement, efficient utilization of labors, improvement of facility efficiency, etc., and automatic control types include feedback control, program control, numerical control, sequence control, etc.

Sequence control types include time limit control, sequence control, condition control, etc., and the textbook of Sequence-5000 is so structured as to provide theoretical understanding and practices of various circuits (logical circuit, self-holding circuit, timer circuit, priority circuit, detection circuit,,, etc.) and induction motor circuits (reactor circuit, inching circuit, forward/reverse circuit,,, etc.)

Sequence-5000 hardware is featured by:

- 1) One-touch attachment of various motor control modules on the aluminum profile rail
- 2) A convenient structure for wiring practice using the AC single-phase and three-phase power supply mounted on the test plate.
- 3) Wide range of test from inverter controller and elementary circuits of contact sequence to inverter control of motors.
- 4) Each module provides symbols and terminals for the convenience of wiring.

### System configuration



### Components

Sequence-5000 Hardware platform	1 set
Inverter module	1 set
Reactor module	1 set
Three phase induction motor module :	1 set
Single phase induction motor module :	1 set
Push-button Switch module	1 set
Indicator / Buzzer module :	1 set
Relay module	1 set
Electron Contactor module	1 set
Assistance Relay module	1 set
Overload Relay module	1 set
Timer module	2 set
Circuit breaker module for wiring	1 set
Terminal block module :	1 set
Sequence I/O Check module	1 set
Manual book	1 book
Motor / Sequence training Simulation Software	2 CD
4 JACK Cable	1 set

## Specifications

1) Working table : (1200X450X1770mm ± 5%)	- material : Aluminum profile system (A6NO1S) , Wheel locking devices included.
2) Working board (1120X960mmX40t ± 5%)	- material : Aluminum profile system (A6NO1S) , hole interval : 40mm
3) A variety of motor control experiments	<ul style="list-style-type: none"> <li>- Inverter operation of induction motor</li> <li>- Reactor operation of induction motor</li> <li>- Temporary operation of induction motor</li> <li>- Delay-start operation of induction motor</li> <li>- Reverse operation of induction motor</li> <li>- Inching operation of induction motor</li> <li>- Y- operation of induction motor</li> <li>- Dual-input induction motor operation</li> <li>- Priority Control operation of induction motor</li> <li>- Single-input direct operation of induction motor</li> <li>- Timer operation of induction motor</li> <li>- Self-sustaining operation of induction motor</li> <li>- Display and Alarm operation of induction motor</li> </ul>
4) Inverter module : 1 set	
5) Reactor module : 1 set	<ul style="list-style-type: none"> <li>- AC 220V, 3Ph , Output frequency 0.1 - 400 Hz</li> <li>- Control method : V/F Control , Digital keypad setting</li> <li>- Forward &amp; Reverse rotation, Control in several stages, Protection function</li> </ul>
6) Three phase induction motor module : 1 set	<ul style="list-style-type: none"> <li>- AC 220V/380V, 3Ph 60HZ</li> <li>- Speed : 1550 RPM</li> <li>- Decelerator : 8GD36BMN</li> </ul>
7) Single phase induction motor module : 1 set	<ul style="list-style-type: none"> <li>- AC 220VV, 3Ph 60HZ , 30 min</li> <li>- Speed : 1550 RPM , 0.8 μF</li> <li>- Decelerator : S6DA36B</li> </ul>
8) Push-button Switch module : 1 set	<ul style="list-style-type: none"> <li>- Green, Red, Yellow PBS Contact : 1a,1b</li> <li>- Emergency Stop Switch Contact : 1a,1b</li> </ul>
9) Indicator / Buzzer module : 1 set	
10) Relay module : 1 set	<ul style="list-style-type: none"> <li>- Green, Red, Yellow lamp (AC220V) , FUSE</li> <li>- AC220V BUZZER Control method</li> <li>- 14 pin Relay : 3ea, Input Contact : 4a 4b 4c / relay</li> </ul>
11) Electron Contactor module : 1 set	<ul style="list-style-type: none"> <li>- COIL voltage : AC220V, 60Hz</li> <li>- Main Contact : 3a , Auxiliary Contact : 2a , 2b</li> </ul>
12) Assistance Relay module : 1 set	<ul style="list-style-type: none"> <li>- COIL voltage : AC220V, 60Hz</li> <li>- Contact : 2a , 2b</li> </ul>
13) Overload Relay module : 1 set	<ul style="list-style-type: none"> <li>- Reset button, TIME: 0.25-04 SEC</li> <li>- Contact : 1a , 1b</li> </ul>
14) Timer module : 2 set	<ul style="list-style-type: none"> <li>- COIL voltage : AC220V, 60Hz</li> <li>- Contact : 2a , 2b</li> <li>- On-delay, Timer function</li> </ul>
15) Circuit breaker module for wiring : 1 set	<ul style="list-style-type: none"> <li>- 50AF 3-pole, 10A</li> </ul>
16) Terminal block module : 1 set	- TERNIMAL 6P , 10A
17) Sequence I/O Check module : 1 set	<ul style="list-style-type: none"> <li>- Polarity of TR and Quality Check function, Buzzer function.</li> <li>- DC voltage (2.5V, 10V, 50V, 250V, 1000V)</li> <li>- AC voltage (10V, 50V, 250V, 1000V)</li> <li>- Includes measuring function of DC Current, Resistance, TR CHECK(PNP,NPN)</li> </ul>

## Training Contents

### Chap 1, Overview

1. What is the control ?
2. What is the Automatic control ?
3. The need for Automatic control
4. Control method
5. Types of Automatic control
6. Types of Sequence control

### Chap 2, Elements of the Control

1. How to display a Contact
2. Operation unit
3. Sequence Cartography

### Chap 3, Basic circuit

### Chap 4, Logic circuit

### Chap 5, Self-holding circuit

### Chap 6, Timer circuit

### Chap 7, Priority circuit

### Chap 8, Detection circuit

### Chap 9, Indication and Alarm circuit

### Chap 10, Single-input direct start circuit of induction motor

### Chap 11, Dual-input direct start circuit of induction motor

### Chap 12, Reactor Starting circuit of Induction motor

### Chap 13, Inching circuit of Induction motor

### Chap 14, Reverse circuit of Induction motor

### Chap 15. Delay-starting circuit of Induction motor

### Chap 16. Temporary operation of Induction motor

### Chap 17. Y- start of Induction motor

### Chap 18. Inverter start of Induction motor

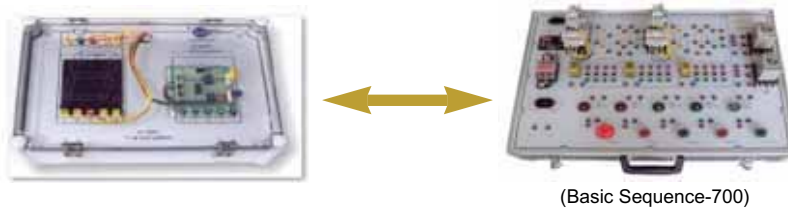
# model: 7-Segment-1000

## 7-Segment experiment kit

### Feature

- 1) compatible with PLC and sequence trainer
- 2) Actual counting control equipment that is being used in ABS production line
- 3) It can be applied to various sequential controls
- 4) It can be applied to a sequential control by BCD

### System configuration



### Manual Contents

#### [ Book-1, 7-Segment experiment kit ]

- 1) Outline of light emitting diode
- 2) 7-SEGMENT LED indicator.
- 3) 7-SEGMENT DECODER/DRIVER.
- 4) Basic experiment of each control unit on 7-SEGMENT LED.
- 5) Number Display experiment by 7-SEGMENT LED.
- 6) Output control experiment by BCD control.
- 7) Direct control experiment of 7-SEGMENT by PLC (if PLC equipment is provided)
- 8) Application control experiment of 7-SEGMENT by PLC (if PLC equipment is provided)

#### [ book-2, Basic Sequence-700 ]

- Part 1, Relay ON, OFF Jog Circuit experiment and inter-locking circuit experiment
- Part 2, Holding Circuit experiment
- Part 3, Control experiment by Magnetic Contactor
- Part 4, Holding Circuit experiment by Magnetic Contactor
- Part 5, Control experiment by Timer
- Part 6, Control experiment by Counter
- Part 7, Control experiment by Sensor
- Part 8, FND Control experiment by Input / Output
- Part 9, BCD Output Control experiment by Counter
- Part 10, Drive Control experiment of DC Motor
- Part 11, Drive Control experiment of Single-phase induction motor
- Part 12, Forward and reverse / multi-step speed control experiment of Single-phase induction motor
- Part 13, Forward and reverse control experiment of 3-phase induction motor
- Part 14, Y- Drive control experiment of 3-phase induction motor
- Part 15, Motor braking experiment by Sensor
- Part 16, Temperature Control experiment by Thermostat

## Specification

[ 7-Segment experiment kit ]

1) 7-Segment (90 x 125mm big size FND)	1 ea
2) Drive terminal port (4 Jack)	10 EA
3) BCD controller board (mounted the stabilized power supply device for FND)	1 ea
4) BCD single operation (4 Jack)	5ea
5) 7- Segment deployment model	1 EA
6) Use temperature	0-45 degrees, below 85% R.H
7) Input power	DC2.4 [V]
8) Size	380mm(W) x 180mm(H) x 280mm(D)

[ Basic sequence-1000 ]

Power module	
• Input power 3 3 W 220 V / 1 2 W 220 V	
• Earth leakage breaker 3 15 A	1ea
• Protective phase fail display type fuse holder 3P	1 SET
• Input power socket 3P	1ea
• Output power socket 3P	1ea
• Control power port 2P	1ea
Control module	
• Input power AC220 V or DC24 V	
• Magnet S/W main circuit 3a Auxiliary circuit 1a 1b	2ea
• Over LOAD 0.8~1.2A Auxiliary circuit 1a 1b	2ea
• Auxiliary relay 4a 4b 1A	3ea
• Timer (0.001sec ~ 9999 hour)	2ea
• E-STOP A,B Contact 250V 3A 1ea	
• PB S/W A,B CONTACT 250V 3A	4ea
• Single lamp 25 DC24V 2W	4ea
• Single Buzzer 25 DC24V	4ea
• Control module 4 jack plugging	

## Components

1) Hardware	7-Segment experiment-1000	1set	
	Basic sequence-700	1set	
2) LEAD WIRE			2 set
3) Power cable			2ea
4) Manual book			2book

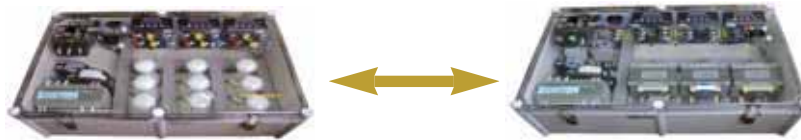
# model: Lamp load experiment-1000

## Lamp load experiment kit

### Feature

- 1) Easy checking the status & Output of load
- 2) Load capacity adjustment by varying ports conjunction
- 3) Y- load and single-phase load can be freely configured and tested

### System configuration



(Power Conversion - 1000)

### Components

1) Hardware	Lamp Load -1000	1set
	Power Conversion -1000	1set
2) LEAD WIRE		2set
3) Manual book		2 book
4) Power cable		2ea

### Manual Contents

[ book-1, Lamp Load-1000 ]

- 1) Lamp load experiment for serial load conjunction.
- 2) Lamp load experiment for parallel load conjunction.
- 3) Lamp load experiment for serial load Y conjunction.
- 4) Lamp load experiment for parallel load Y conjunction.

[ book-2, Power Conversion-1000 ]

- 1) Overview of Auto-transformer
- 2) Transformer Regulation
- 3) No-load & short-circuit characteristics of Single-phase transformer
- 4) 3-phase Y & connection of a single-phase transformer.



## Components

### [ Lamp Load-1000 ]

1) Lamp capacity for load 220[V], 100[W]	12ea
2) Configured R, S, T phase input jack	each 4set
3) Heat-resistant exhaust (ventilation) fan (220V, 4 inches of fan)	1ea.
4) Adopted an anti-crossed duct (insulated type)	
5) Adopted BOX of OPEN button type.	
6) Adopted the insulated type wire.	
7) Watt Meter	1ea
8) Watt confirmation button for output Power meter	3ea
9) Use temperature	0-45 degrees, below 85% R.H
10) input power	AC 220V, 50/60 Hz.
11) Size	500mm (W) × 200mm (H) × 400mm (D).
12) C.T for the deflector	3ea
13) transportation handle	2ea
14) SYSTEM CONTROL UNIT	1set
15) power leak circuit breaker 1ea	
16) POWER FUSE	3EA
17) Lamp load hardware platform	1ea
18) LEAD WIRE	1set
19) Manual book	1book
20) Electric power supply cable	1ea

### [ Power Conversion-1000 ]

1) Insulated case.	
2) The power	3-phase four-wire system 380[V]/220[V]. 3-phase three-wire system 380[V]/220[V].
3) Power input MCCB	1 ea
4) Digital voltmeter for output voltage	1ea
5) Digital ammeter for output current	1 ea
6) Wattmeter for output	1ea
7) Each phase selective Switch for output voltmeter	3ea
8) Each phase selective Switch for output ammeter	3ea
9) Each phase selective Switch for wattmeter	3ea
10) Protection fuse 9P in transformer input	1set
11) Protection fuse 9P in transformer output	1set
12) Terminal block 4P for load connection	1set
13) Double wiring transformer (input : 220/380[V], output : 110/220[V])	3ea
14) Deflector C.T	3ea
15) handle for transportation	2ea
16) SYSTEM CONTROL UNIT	1set
17) Hardware platform for Electric power conversion experiment	1ea.
18) 3-phase four-wire system electric power supply cable	1set
19) Lead line	1set
20) 3-phase four-wire system load output cable	1set

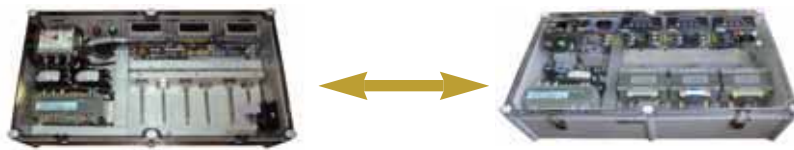
# model: Heater load experiment -1000

## Heater load experiment kit

### Feature

- 1) Easy checking the status & Output of load
- 2) Load capacity adjustment by varying ports conjunction
- 3) Y- $\Delta$  load and single-phase load can be freely configured and tested

### System configuration



(Power Conversion - 1000)

### Components

1) Hardware	Heater Load-1000	1set
	Power Conversion -1000	1set
2) LEAD WIRE		2set
3) Manual book		2 book
4) Power cable		2ea

### Manual Contents

[ book-1, Heater Load-1000 ]

1. Heater load experiment for serial load conjunction.
2. Heater load experiment for parallel load conjunction.
3. Heater load experiment for serial load Y conjunction.
4. Heater load experiment for parallel load Y conjunction.

[ book-2, Power Conversion-1000 ]

- 1) Overview of Auto-transformer
- 2) Transformer Regulation
- 3) No-load & short-circuit characteristics of Single-phase transformer
- 4) 3-phase Y & connection of a single-phase transformer.

## Specifications

### [ Heater Load-1000 ]

1) Heater capacity for load 220[V], 40[W]	6ea
2) Configured R, S, T phase input jack	each 2set
3) Heat-resistant exhaust (ventilation) fan (220V, 4 inches of fan)	1ea.
4) Adopted an anti-crossed duct (insulated type)	
5) Adopted BOX of OPEN button type.	
6) Adopted the insulated type wire.	
7) Watt Meter	1ea
8) Watt confirmation button for output Power meter	3ea
9) Use temperature	0-45 degrees, below 85% R.H
10) input power	AC 220V, 50/60 Hz.
11) Size	500mm (W) × 200mm (H) × 400mm (D).
12) C.T for the deflector	3ea
13) transportation handle	2ea
14) SYSTEM CONTROL UNIT	1set
15) power leak circuit breaker	1ea
16) POWER FUSE	3EA
17) Heater load hardware platform	1ea.
18) LEAD WIRE	1set.
19) Electric power supply cable	1ea.
20) Manual book	1book.

### [ Power Conversion-1000 ]

1) Insulated case.	
2) The power	3-phase four-wire system 380[V]/220[V].
	3-phase three-wire system 380[V]/220[V].
3) Power input MCCB	1 ea
4) Digital voltmeter for output voltage	1ea
5) Digital ammeter for output current	1 ea
6) Wattmeter for output	1ea
7) Each phase selective Switch for output voltmeter	3ea
8) Each phase selective Switch for output ammeter	3ea
9) Each phase selective Switch for wattmeter	3ea
10) Protection fuse 9P in transformer input	1set
11) Protection fuse 9P in transformer output	1set
12) Terminal block 4P for load connection	1set
13) Double wiring transformer (input : 220/380[V], output : 110/220[V])	3ea
14) Deflector C.T	3ea
15) handle for transportation	2ea
16) SYSTEM CONTROL UNIT	1set
17) Hardware platform for Electric power conversion experiment	1ea.
18) 3-phase four-wire system electric power supply cable	1set
19) Lead line	1set
20) 3-phase four-wire system load output cable	1set

# model: Car parking control-1000

## Car parking system trainer

### Feature

- 1) Car Parking control – 1000 is a training system designed to help understanding of the fundamentals and automatic control of car parking for engineering students and technicians who study automatic control.
- 2) The car parking trainer is designed to practice the automation process in the industry from analysis and utilization of elementary components to their applications. The training system adopts only the components used in the industry.
- 3) Automatic control is the basis of sequence control and design itself would be impossible without analysis of components and their functions. It would be also impossible to implement creative control and to design program using PLC without such analysis of components and their functions.
- 4) This training system is intended to help understanding of automatic control using relays and switches, which are basic components of control, and lamps for display.

### Manual Contents

Chap 1. ON, OFF circuit	Chap 6. Counter application circuit	Chap 11. #3 CALL circuit
Chap 2. Holding circuit	Chap 7. Timer circuit	Chap 12. #4 CALL circuit
Chap 3. Interlock circuit	Chap 8. Flicker circuit using a timer	Chap 13. #5 CALL circuit
Chap 4. Forward and reverse circuit	Chap 9. Manual drive circuit	Chap 14. Auto standby circuit
Chap 5. Auto interaction circuit	Chap 10. 8. HI-LOW SPEED circuit	Chap 15. Auto circulation circuit

### System configuration



### Components

1) Hardware system	1 set
2) JUMPER WIRE	1 set
3) Manual book	1 book
4) Power supply cable	1 ea

### Specifications

1) Power module	AC220 V Input (OUTLET processing) 1 Set	
	DC power supply (surge protection) 1 Unit	
	Power control switch (power on display embedded type) 1EA	
	Emergency stop switch (E-STOP) 1EA	
	Auto/Manual switch 1EA	
2) Input signal control module	CALL switch 3EA	
	Pallet manual control switch 2EA * 5 Sets	
	Vehicle sensing Micro photo sensor 5EA	
	Pallet position sensing micro photo sensor 10EA	
	Control input port 20 Sets	
3) Control module	Control relay (with interlock function) 24 Sets	
	Control lamp 10EA	
	Control motor (24 V 1;125 reducer) 5 Units	
	Vehicle sensing lamp 5EA	
	Frame (high intensity profile) 22EA	
4) Mechanical part	Pallet model (Bakelite) 5EA	
	Pulling chain 3 Sets	
	Conveyance chain 2 Sets	
	Pulling saw-tooth 3 Sets	
	Conveyance saw-tooth 2 Sets	
	Desk type case 1 Set	
	Vehicle model 5 Units	
	Balance 3EA	
	(1) Operating temperature	0 – 45 , below 85% R.H.
	(2) Input power	AC 220 V, 50 / 60 HZ.
5) General	(3) Dimension	820mm(W) x 520mm(H) x 460mm(D)

# model: Traffic signal control-1000

## Traffic signal control experiment kit

### Feature

- 1) The Traffic Control-1000 is a training system designed to practice advanced sequence control along with PLC (Programmable Logic Controller).
- 2) Practice of traffic control is carried out with simple operation rules but has an advantage of configuring various control methods, allowing students to understand a lot of combinations of programs in the process of programming sequence control based on block.
- 3) The system is intended for elementary programmers, and is designed to practice design and application of interlock circuit and to help understanding of interworking program at design and application phases.  
This system is featured by providing a step to correct data inadequate for executing a program.
- 4) The system provides a time-based lamp on/off function actually used for traffic control.

### Manual Contents

- Chap 1. Experiment on vehicle traffic signal ON, OFF circuit  
 Chap 2. Experiment on pedestrian traffic signal ON, OFF circuit  
 Chap 3. Experiment on traffic signal control using a holding circuit  
 Chap 4. Experiment on traffic signal control using an interlock circuit  
 Chap 5. Experiment on traffic signal control using an auto interaction circuit  
 Chap 6. Experiment on traffic signal control using a timer circuit  
 Chap 7. Experiment on flicker circuit using a timer  
 Chap 8. Experiment on traffic signal lamp drive  
 Chap 9. Experiment on comprehensive crossway control circuit

### System configuration



### Components

1) Hardware system	1 set
2) LEAD WIRE	1 set
3) Manual book	1 book

### Specifications

1) Power part	DC24V1.5A - 1ea, POWER FUSE - 1ea, POWER SW - 1ea, POWER LAMP - 1ea, POWER OUTLET - 1 set.	
2) Display panel part	Signal Lamp Part 4 sets : (each Green - 1ea, Red - 1ea, Yellow - 1ea, Left turn - 1ea) 8 sets : (each Green - 1ea, Red - 1ea) Signal Input Part : Auto-Manual SW - 1EA, Input SW - 4EA	
3) Control part	INPUT PART : 16ea, COM - 2ea / OUTPUT PART : 16ea, COM - 2ea	
4) Main system	4-direction signaling graphic : 1set	
5) General spec	(1) Operating temperature	0 - 45 , 85% R.H. below
	(2) Input power	AC 220V, 50/60Hz.
	(3) Size	640mm(W) x 180mm(H) x 420mm(D)

# model: **Electric power conversion experiment -1000**

## **Electric power conversion experiment kit**

### **Feature**

- 1) Train on electric power conversion that is actually applied in industrial area
- 2) Transparent & insulated main body panel enabling the check of real operation status
- 3) Little measurement errors using high-precision digital measuring equipment

### **System configuration**



### **Manual Contents**

- 1) Auto-transformer
  - (1) A purpose
  - (2) Background knowledge of auto-transformer
  - (3) Equipment and materials of auto-transformer
  - (4) Experiment procedures of auto-transformer
  - (5) Experiment report
- 2) Transformer Regulation
  - (1) A purpose
  - (2) Background knowledge of transformer Regulation
  - (3) Equipment and materials of transformer Regulation
  - (4) Experiment procedures of transformer Regulation
  - (5) Experiment report
- 3) No-load & short-circuit characteristics of Single-phase transformer
  - (1) A purpose
  - (2) Background knowledge of Single-phase transformer
  - (3) Equipment and materials of Single-phase transformer
  - (4) Connection wiring of Single-phase transformer
  - (5) Experiment procedures of Single-phase transformer
  - (6) Experiment report
- 4) 3-phase connection of a single-phase transformer
  - (1) A purpose
  - (2) Background knowledge of 3-phase connection of Single-phase transformer
  - (3) Equipment and materials of 3-phase connection of Single-phase transformer
  - (4) Connection wiring of 3-phase connection of Single-phase transformer
  - (5) Experiment procedures of 3-phase connection of Single-phase transformer
  - (6) Experiment report

## Components

1) Hardware platform for Electric power conversion experiment	1ea
2. 3-phase four-wire system electric power supply cable	1set
3. Lead line	1set
4. 3-phase four-wire system load output cable	1set
5. Manual book	1book

## Specifications

1) Insulated case.	
2) The power	3-phase four-wire system 380[V]/220[V] 3-phase three-wire system 380[V]/220[V]
3) Power input MCCB	1 ea
4) Digital voltmeter for output voltage	1ea
5) Digital ammeter for output current	1 ea
6) Wattmeter for output	1ea
7) Each phase selective Switch for output voltmeter	3ea
8) Each phase selective Switch for output ammeter	3ea
9) Each phase selective Switch for wattmeter	3ea
10) Protection fuse 9P in transformer input	1set
11) Protection fuse 9P in transformer output	1set
12) Terminal block 4P for load connection	1set
13) Double wiring transformer (input : 220/380[V], output : 110/220[V])	3ea
14) Deflector C.T	3ea
15) handle for transportation	2ea
16) SYSTEM CONTROL UNIT	1set
17) Hardware platform for Electric power conversion experiment	1ea
18) 3-phase four-wire system electric power supply cable	1set
19) Lead line	1set
20) 3-phase four-wire system load output cable	1set
21) Manual book	1book

# model: High voltage electricity-GT11M

## High-voltage Electricity distribution & monitoring system trainer

### Introduction of Smart Incoming Panel

- 1) As the usage rate of electric / electronic / communication facilities increases according to the development of society, the human, material damage which is spread in the case of an electric accident also sharply increases, and stable electric power supply is indispensable.
- 2) In order to prevent electrical disturbance of incoming panel, a smart incoming panel is developed and commercialized so that electrical managers can monitor the status of power facilities in real time regardless of time and place.
- 3) In the case of industrial switchgear, it is necessary to supply electric power to the customer by receiving the electric power of Electrical Power Distribution Company's transmission line (22.9Kv) and converting the voltage (380V). GT11M connects to the laboratory's 380V for safety in the laboratory.  
By using CT and PT Tune-ratio and by adjusting the proportion, it can show as if 22.9 Kv is applied.  
Of course, user can do the experiment using real 22.9 Kv by directly connecting to Electrical Power Distribution Company's transmission line.  
However, considering that the cost of connecting 22.9 Kv power line to the lab is enormous, we designed to use 380V that is connected to the laboratory. But, by using CT and PT Tune-ratio and by adjusting the proportions, user can make as if 22.9Kv is applied.  
So, GT11M can make the same practice environment as High voltage electricity distribution & monitoring system that is used in industrial field.
- 4) High-voltage electricity-GT11M modularizes the core parts of the distribution and relay system elements to miniaturize the size of the power distribution system.  
It is able to grasp the complicated configuration, use the commercial power 380VAC and build the insulation system.
- 5) Real-time monitoring, analysis and control of PC, HMI, and smart phone through the exchange of data between PLC and industrial automation S / W is possible, so that preliminary learning of smart switchboard used in industry is possible.
- 6) In this system, the measurement and management parts are power monitoring, fault detection, and system control. Power monitoring monitors power such as voltage, current, power, power factor, and frequency.



## System configuration



### 1) Power module

- (1) Built-in separate power breaker that is needed for driving each experimental devices.
- (2) Supply single-phase AC 220V and single-phase DC 110V to each devices
- (3) Receives a trip signal such as VCB, ACB, or ELR, supplies the trip signal to each devices.  
In addition, the trip signal transmission experiment to the PLC DI MODULE.

### 2) Auto Control module

- (1) Built-in TOUCH PC PANEL (15 inch)
- (2) Built-in PLC DI (24 points), DO (24 points)
- (3) Practice & operate the system through PLC DI contact and DO contact
- (4) System information collection experiment through 485 communication with each Modules.
- (5) Understand about the whole system through TOUCH PC PANEL
- (6) Each MODULE CONTROL (CB ON, CB OFF, CB TRIP, CB state etc.) Experiment through TOUCH PC PANEL and PLC communication
- (7) Each MODULE VIEW is available with MOBILE (CONTROL function can be added) through interworking between TOUCH PC PANEL and MOBILE

### 3) Schematic Diagram

- (1) Configuration of power distribution system and display of power flow
- (2) understand the power distribution system through power flow
- (3) ON / OFF control of LBS, VCB, ACB and auto transit switch (ATS) practice
- (4) understand PROTECTION RELAY system configuration of each module through CT, PT connection of VCB, ACB
- (5) understand WHM operation through MAIN CT, PT connection

### 4) Load Break Switch module (L.B.S)

- (1) Built-in LBS ON, OFF switch and WHM
- (2) Reinforced field adaptability by using equipment and parts used in industrial field
- (3) LBS ON and OFF experiment through connection with main MODULE
- (4) WHM operation experiment through connection with main MODULE

### 5) Automatic Transfer Switch module (ATS)

- (1) Built-in ATS switching controller
- (2) Built-in power generation MCCB
- (3) ATS manual switching experiment through ATS CONTROLLER
- (4) ATS automatic switching experiment through power generation MCCB

### 6) Electric Leakage Rely module (ELR)

- (1) Built-in short circuit alarm (trip device)
- (2) Leakage signal forced output test (SQUARE LAMP ON, TRIP RELAY output contact) per circuits by setting a short circuit condition

### 7) Control Module (CAM S/W)

- (1) Built-in VCB and ACB ON and OFF CAM S / W
- (2) VCB, ACB operation experiment (LOACL / REMOTE) through the connection with main MODULE

8) Circuit tester module

- (1) Built-in CIRCUIT TESTER
- (2) V, A, W, Var, VA WH confirmation experiment of VCB, ACB PROTECTION RELAY through voltage and current forced output (Assuming a situation similar to actual field situation).
- (3) OCR, OCGR, UVR, OVR TRIP experiments of VCB, ACB PROTECTION RELAY through voltage and current forced output (Assuming a situation similar to actual field situation).
- (4) Recovery experiment of VCB, ACB PROTECTION RELAY in OCR, OCGR, UVR, OVR TRIP through voltage and current forced output (Assuming a situation similar to actual field situation).

9) VCB module

- (1) Built-in VCB PROTECTION RELAY
- (2) Built-in CTT, PTT (include terminal block)
- (3) Understand the PROTECTION RELAY system configuration through the connection with main MODULE
- (4) V, A, W, Var, VA WH confirmation experiment of VCB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
- (5) OCR, OCGR, UVR, OVR TRIP experiments of VCB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
- (6) Recovery experiment of VCB PROTECTION RELAY in OCR, OCGR, UVR, OVR TRIP through Voltage and current forced output (Assuming the situation similar to actual situation)
- (7) setting experiment of PROTECTION RELAY POWER, PT RATING, CT RATING, RELAY,,, etc
- (8) VCB ON and OFF experiment through PROTECTION RELAY

10) ACB module

- (1) Built-in ACB PROTECTION RELAY
- (2) Built-in CTT, PTT (include terminal block)
- (3) Understand the PROTECTION RELAY system configuration through the connection with main MODULE
- (4) V, A, W, Var, VA WH confirmation experiment of ACB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
- (5) OCR, OCGR, UVR, OVR TRIP experiments of ACB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
- (6) Recovery experiment of ACB PROTECTION RELAY in OCR, OCGR, UVR, OVR TRIP through Voltage and current forced output (Assuming the situation similar to actual situation)
- (7) setting experiment of PROTECTION RELAY POWER, PT RATING, CT RATING, RELAY,,, etc
- (8) ACB ON and OFF experiment through PROTECTION RELAY

11) phase changer module

- (1) Built-in PHASE CHANGER
- (2) use when the input power is not 3-phase 380V (voltage and phase converter)

## Components

1) Hardware platform	1 set
2) Software program CD	1 ea
3) Manual book	1 book

## Training contents

Chap 1, Introduction of high-voltage electricity distribution & monitoring system in the industrial field.

Chap 2, Learn about 11 module types (Test Apparatus) of the advanced high-voltage electricity distribution & monitoring system and layout

- 1) Power module
- 2) Auto Control module
  - (1) Practice to write basic program & operate the system through PLC DI contact switch and DO contact
  - (2) System information collection experiment through 485 communication with each Modules.
  - (3) Understand about the whole system through TOUCH PC PANEL
  - (4) Each MODULE CONTROL (CB ON, CB OFF, CB TRIP, CB state etc.) Experiment through TOUCH PC PANEL and PLC communication
- 3) Schematic Diagram
  - (1) understand the power distribution system through power flow
  - (2) ON / OFF of LBS, VCB, ACB, power generation switching experiment through connection with each MODULE
  - (3) understand PROTECTION RELAY system configuration of each module through CT, PT connection of VCB, ACB
  - (4) understand WHM operation through MAIN CT, PT connection
- 4) Load Break Switch module (L.B.S)
  - (1) Reinforced field adaptability by using equipment and parts used in installation of real power distribution system
  - (2) LBS ON and OFF experiment through connection with main MODULE
  - (3) WHM operation experiment through connection with main MODULE

Chap 1, Introduction of high-voltage electricity distribution & monitoring system in the industrial field.

Chap 2, Learn about 11 module types (Test Apparatus) of the advanced high-voltage electricity distribution & monitoring system and layout

- 1) Power module
- 2) Auto Control module
  - (1) Practice to write basic program & operate the system through PLC DI contact switch and DO contact
  - (2) System information collection experiment through 485 communication with each Modules.
  - (3) Understand about the whole system through TOUCH PC PANEL
  - (4) Each MODULE CONTROL (CB ON, CB OFF, CB TRIP, CB state etc.) Experiment through TOUCH PC PANEL and PLC communication
- 3) Schematic Diagram
  - (1) understand the power distribution system through power flow
  - (2) ON / OFF of LBS, VCB, ACB, power generation switching experiment through connection with each MODULE
  - (3) understand PROTECTION RELAY system configuration of each module through CT, PT connection of VCB, ACB
  - (4) understand WHM operation through MAIN CT, PT connection
- 4) Load Break Switch module (L.B.S)
  - (1) Reinforced field adaptability by using equipment and parts used in installation of real power distribution system
  - (2) LBS ON and OFF experiment through connection with main MODULE
  - (3) WHM operation experiment through connection with main MODULE
- 5) Automatic Transfer Switch module (ATS)
  - (1) ATS manual switching experiment through ATS CONTROLLER
  - (2) ATS automatic switching experiment through power generation MCCB
- 6) Electric Leakage Rely module (ELR)
  - (1) Leakage signal forced output test (SQUARE LAMP ON, TRIP RELAY output contact) per circuits by setting a short circuit condition
- 7) Control Module (CAM S/W)
  - (1) VCB, ACB operation experiment (LOACL / REMOTE) through the connection with main MODULE
- 8) Circuit tester module
  - (1) V, A, W, Var, VA WH confirmation experiment of VCB, ACB PROTECTION RELAY through voltage and current forced output (Assuming a situation similar to actual field situation).
  - (2) OCR, OCGR, UVR, OVR TRIP experiments of VCB, ACB PROTECTION RELAY through voltage and current forced output (Assuming a situation similar to actual field situation).
  - (3) Recovery experiment of VCB, ACB PROTECTION RELAY in OCR, OCGR, UVR, OVR TRIP through voltage and current forced output (Assuming a situation similar to actual field situation).
- 9) VCB module
  - (1) Understand the PROTECTION RELAY system configuration through the connection with main MODULE
  - (2) V, A, W, Var, VA WH confirmation experiment of VCB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
  - (3) OCR, OCGR, UVR, OVR TRIP experiments of VCB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
  - (4) Recovery experiment of VCB PROTECTION RELAY in OCR, OCGR, UVR, OVR TRIP through Voltage and current forced output (Assuming the situation similar to actual situation)
  - (5) setting experiment of PROTECTION RELAY POWER, PT RATING, CT RATING, RELAY,,, etc
  - (6) VCB ON and OFF experiment through PROTECTION RELAY
- 10) ACB module
  - (1) Understand the PROTECTION RELAY system configuration through the connection with main MODULE
  - (2) V, A, W, Var, VA WH confirmation experiment of ACB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
  - (3) OCR, OCGR, UVR, OVR TRIP experiments of ACB PROTECTION RELAY through Voltage and current forced output (Assuming the situation similar to actual situation)
  - (4) Recovery experiment of ACB PROTECTION RELAY in OCR, OCGR, UVR, OVR TRIP through Voltage and current forced output (Assuming the situation similar to actual situation)
  - (5) setting experiment of PROTECTION RELAY POWER, PT RATING, CT RATING, RELAY,,, etc
  - (6) ACB ON and OFF experiment through PROTECTION RELAY
- 11) phase changer module

Chap 3, Learn about operating, troubleshooting and disposal.

Chap 4, Learn LBS system (Satisfy filed practice guideline)

Chap 5, Learn the system principle and training on the system operation & the Application system of high-voltage electricity distribution & monitoring system.  
( the Integration structure of Analog & Digital Type )

Chap 6, Different Experiment Set-ups and analysis the artificial event or malfunction circuit, and training of management

Chap 7, Learn the Applied control system that can completely protect the industrial electric field line

Chap 8, Learn Terminal Size Classification as per Power (AC / DC) to secure safety

Chap 9, Learn Cable standard Compliance

Chap 10, Through PLC & industrial automation S/W, real-time monitoring, analysis and control by PC, HMI, and smart phone.

## Components

### 1) Semi-automatic fiber cutter

(1) Power Module	<ul style="list-style-type: none"> <li>• MCCB : 6ea</li> <li>• AC220V Output(B-Jack) : 7ea</li> <li>• DC24V Output(B-Jack) : 7ea</li> <li>• ELD Output(B-Jack) : 9ea</li> <li>• MCCB 1~8: 8ea</li> <li>• MCCB Alarm : 1ea</li> <li>• VCB Output(B-Jack) : 7ea</li> <li>• 50/51 OCR: 1ea</li> <li>• 50/51N OCGR: 1ea</li> <li>• 67G SGR: 1ea</li> <li>• 47 POR: 1ea</li> <li>• 59 OVR: 1ea</li> <li>• 64 OVGR : 1ea</li> <li>• 27 UVR : 1ea</li> <li>• ACB Output(B-Jack) : 3ea</li> <li>• 50/51 OCR : 1ea</li> <li>• 50/51N OCGR: 1ea</li> <li>• 27 UVR : 1ea</li> </ul>
(2) Auto Control module	<ul style="list-style-type: none"> <li>PLC</li> <li>HMI</li> </ul>
(3) Schematic Diagram	<ul style="list-style-type: none"> <li>• Confirm power transfer path via Lamp</li> <li>• Confirm the schematic diagram of incoming / transformation / distribution of electric power</li> <li>• Training installed devices position and function (Measurement device, Relay, Circuit breaker)</li> </ul>
(4) Load Break Switch module (L.B.S)	<ul style="list-style-type: none"> <li>• Operation indicator Lamp, Interworking between CAM S/W &amp; Touch Screen</li> <li>• LAMP : 3ea <ul style="list-style-type: none"> <li>: AC22.9KV Power Lamp</li> <li>LBS On Lamp</li> <li>LBS Off Lamp</li> </ul> </li> <li>• Watt-Hour-Meter(WHM)</li> <li>: MOF PT, CT wiring</li> <li>Check the WHM</li> </ul>
(5) Automatic Transfer Switch module (ATS)	<ul style="list-style-type: none"> <li>• Automatic Transfer Switch or Manual Transfer Switch test of Commercial electricity / Generated electricity</li> <li>• MCCB: 2ea <ul style="list-style-type: none"> <li>: Commercial electricity</li> <li>Generated electricity</li> </ul> </li> <li>• Lamp: 2ea <ul style="list-style-type: none"> <li>: Commercial electricity On Lamp, 1ea</li> <li>: Generated electricity On Lamp, 1ea</li> </ul> </li> </ul>
(6) Electric Leakage Rely module (ELR)	<ul style="list-style-type: none"> <li>• Leakage current detecting &amp; Warning</li> <li>• Square Lamp : 10ea <ul style="list-style-type: none"> <li>: MCCB Lamp, 8ea</li> <li>: MCCB Alarm Lamp, 2ea</li> </ul> </li> </ul>
(7) Control Module (CAM S/W)	<ul style="list-style-type: none"> <li>• CAM S/W: 3ea <ul style="list-style-type: none"> <li>: VCB On/Off, 1ea</li> <li>ACB On/Off, 1ea</li> <li>ACB Local/Remote, 1ea</li> </ul> </li> <li>• Lamp: 2ea <ul style="list-style-type: none"> <li>: ACB Remote On Lamp, 1ea</li> <li>ACB Remote Off Lamp, 1ea</li> </ul> </li> </ul>
(8) Circuit tester module	<ul style="list-style-type: none"> <li>• Make an artificial malfunction via circuit tester</li> <li>• Malfunction analysis , Malfunction processing</li> <li>• Training the operating characteristics of circuit breaker, measurement device, relay</li> </ul>
(9) VCB module	<ul style="list-style-type: none"> <li>• Digital multi-function power protection measurement device(VIDER M20) <ul style="list-style-type: none"> <li>: Protective relay, Measurement, Communication, CB On/Off</li> </ul> </li> <li>• Potential Transformer(PT): 1ea</li> <li>• Potential Test Terminal(PTT): 1ea</li> </ul>

				<ul style="list-style-type: none"> <li>• Current Transformer(CT): 1ea</li> <li>• Current Test Terminal(CTT): 1ea</li> <li>• Buzzer: 1ea</li> <li>• Lamp: 2ea               <ul style="list-style-type: none"> <li>: VCB On Lamp: 1ea</li> <li>VCB Off Lamp: 1ea</li> </ul> </li> <li>• Square Lamp: 7ea               <ul style="list-style-type: none"> <li>: 50/51 OCR Lamp, 1ea</li> <li>50/51N OCGR Lamp, 1ea</li> <li>67G SGR Lamp, 1ea</li> <li>47 POR Lamp, 1ea</li> <li>59 OVR Lamp, 1ea</li> <li>64 OVGR Lamp, 1ea</li> <li>27 UVR Lamp, 1ea</li> </ul> </li> </ul>
(10) ACB module				<ul style="list-style-type: none"> <li>• Digital multi-function power protection measurement device(VIDER M20)               <ul style="list-style-type: none"> <li>: Protective relay, Measurement, Communication, CB On/Off</li> </ul> </li> <li>• Potential Transformer(PT): 1ea</li> <li>• Potential Test Terminal(PTT): 1ea</li> <li>• Current Transformer(CT): 1ea</li> <li>• Current Test Terminal(CTT): 1ea</li> <li>• Lamp: 2ea               <ul style="list-style-type: none"> <li>: ACB On Lamp, 1ea</li> <li>ACB Off Lamp, 1ea</li> </ul> </li> <li>• Square Lamp : 3ea               <ul style="list-style-type: none"> <li>50/51 OCR Lamp, 1ea</li> <li>50/51N OCGR Lamp, 1ea</li> <li>27 UVR Lamp, 1ea</li> </ul> </li> </ul>
(11) Phase changer module	1	220VAC	3	220VAC

## 2) Software spec

PLC, Q03UDV S/W
SCADA S/W for education version
HMI S/W

# model: **High Voltage-GT700**

**Modular High-voltage Test System (AC + DC Impulse Test System for Education, portable type)**

## Overview

Modular High Voltage Test System is based on a system of components made with the highest precision and can be used to build systems both for teaching and research as well as for industrial routine and type tests.

The system gives highly accurate values and can even be used for calibration purposes.

This product is the same as that of commercial products, and students can practice the quality level of the engineers in the commercial market by practicing the most precise products.

Modular design makes it quick and easy to set up different test circuits, allowing maximum time for experimentation.

Specially designed joints facilitate interconnection of components.

Designed to minimize partial discharge.

Certificate of Origin is issued by South Korea (Republic of Korea).

## Operating Conditions:

Altitude :  $\pm 2000\text{m}$

Ambient Temperature:  $-10 \sim +60$

Max. Daily Temp. Difference 25

Relative Humidity: 90% (at 20 )

Anti Earthquake: Class 7

Geoclimatic Horizontal Acceleration:  $3.0\text{m/s}^2$

Geoclimatic Vertical Acceleration:  $1.5\text{m/s}^2$

Waveform of power supply voltage is sine actually, and the waveform distortion rate is  $<3\%$

- Set a reliable earthing section, and its earthing resistance is  $<0.5 \text{ ohm}$

## Applied Standards:

IEC60-1	《 High Voltage Test Technique 》
JB/T9641-1999	《 Testing Transformer 》
GB1094.1-1996	《 Power Transformer 》 - Section 1: General
GB1094.3-2003	《 Power Transformer 》 - Section 3: Insulation and Insulation Test
GB1094.5-1985	《 Power Transformer 》 - Section 5: Ability of Short-circuit Withstand
GB/T.311.1-1997	《 Insulation and Coordinate of High Voltage Power Transmission and Distribution 》
GB/T16927.1-1997	《 Technique of High Voltage Test 》 - Section 1: General Requirements
GB/T16927.2-1997	《 Technique of High Voltage Test 》 - Section 2: Measurement

## System configuration

No.	Mode	Name	Qty
1	HCTT 100-0.1	Power Frequency Test Transformer	1set
2	HID 50/200	Impulse Voltage Divider	1set
3	HDD 70kV	DC Resistance Divider	1set
4	HDR 50-5-0.1	Damping Resistance	1set
5	TEDGC 5 kVA	Voltage Regulator	1set
6	50kV/0.1uF	Impulse Capacitor	1set
7	100kV/0.1uF	Impulse Capacitor	1set
8	Silicon Stack		1set
9	HSG 70kV	Sphere Gap	1set
10	Front resistor, tail resistor,		
11	Manual Control System		1set
12	Accessories	Measurement and Control Cable, HV corona-free tube, earthing bar, Fence	whole set

## Main Equipment configuration & spec



(The photo above may vary depending on production conditions)

### 1) Testing Transformer

Mode: HCTT 50-0.1  
 Cylinder type  
 Single phase  
 Frequency: 50Hz  
 Rated Capacity: 5kVA  
 Rated output voltage: 50kV  
 Rated output current: 0.1A  
 Cooling methods: ONAN  
 No-load current 10%  
 Waveform deviation 5%  
 Impedance voltage 5%  
 Transformer Partial discharge level <5pC @RATED VOLTAGE  
 Continuous working: half hour on at rated power.  
 Temperature rise of transformer windings is less than 65K, temperature rise of oil surface is less than 55K.  
 Transformer Oil: 25#

## 2) Impulse Voltage Divider

Mode: HID 50/200

Rated Voltage: AC: 50kV; DC: 70kV; Impulse (L.I): 70kV

Frequency: 50Hz

Nominal Capacity: 200pF

Nominal Dividing Ratio: 500:1

PD level: less than 5pC @rated voltage

Dielectric Loss <0.5%

Cooling: ONAN

Measuring Accuracy: 1%

Allowed Operating Time: same with the transformer

Structure: Oil-immersed type and with removable design in structure which composed by corona rings, LV arm, HV arm and removable base.

Dimension: 120/ 150 x 600

Weight: <35kg



## 3) Damping Resistor

Mode: HDR 50-5-0.1

Rated Frequency: 50Hz

Rated Voltage: 50kV

Rated Current: 0.1A

Nominal Resistance: 5K

Operating Time: same with the transformer

Dimension: 100 x 280

Weight: <7kg

## 4) Voltage Regulator

Mode: TEDGC 5 kVA

Rated input voltage: 0.38kV

Rated output voltage range: 0~0.42kV

Rated Capacitance: 5 kVA

Equip inside of the Control Cabinet.

We propose oil immersed regulator, which will be more suitable for long duration test.



## 5) HDD 70kV DC Resistance Voltage Divider

Mode: HDD 70/200

Rated Voltage: 70kV

Rated resistance: 100M

Nominal ratio: 1000:1

Measuring error: <=5% (include low voltage arm, measuring cable, digit voltmeter)

Structure: HV resistors, installed inside the oil immersed epoxy tube. Resistor is consist of top electrode, body and low voltage arm.



6)HV Silicon Stack

The counter voltage:  $U = 150\text{kV}$

Rated rectified current:  $100\text{mA}$

The connection structure: plug-in

7)Impulse Capacitor

C1:  $0.1 \mu\text{F} / 50 \text{ kV}$  ( $0.2 \mu\text{F} / 50 \text{ kV}$ )

C2:  $0.1 \mu\text{F} / 100\text{kV}$  ( $0.2 \mu\text{F} / 100\text{kV}$ )

The lower part of the capacitor is provided with an insulating post, and the upper part is equipped with a socket.



8)Manual Control Cabinet (CE CERTIFICATED)



Function Specification: AC/DC/IMPULSE CONTROL

Winding measurement voltmeter

HV divider measurement voltmeter

Voltmeter for test transformer input winding, Amperemeter for test transformer input winding.

Equip voltage regulator upper and lower position limited protection, Return-to-zero automatically.

There are emergency button, alarm bell, and chain lock for the door.

The function of raise and decrease the voltage, timing for the withstanding test, over-current protection.

## List of Experiments

- 1) Generation and Measurement of Alternating Voltage
- 2) Generation and Measurement of Direct Voltages
- 3) Generation and Measurement of Direct Voltages II
- 4) Generation of Impulse Voltages
- 5) Measurement of Impulse Voltages
- 6) Power Frequency and Impulse Voltage Tests on Power Transformer
- 7) Experiment on Solid and Insulating Liquids
- 8) Experiment on PD and Gliding Discharges
- 9) Break down of Gases

## Packing Lists :

Serial	Product name	Unit	QTY	Remark
1	5 kVA Regulator	pcs	1	
2	50kV, 5kVA AC Test Transformer	pcs	1	
3	50kV,200pF Impulse Divider	pcs	1	
4	70kV,100M Resistance Divider	pcs	1	
5	Damping Resistor	pcs	1	
6	Charging Resistor	pcs	3	
7	Front resistor	pcs	3	
8	Tail Resistor	pcs	3	
9	Body support	set	1	
10	Chopping Support	set	1	
11	HV Silicon Stack	pcs	4	
12	Impulse Capacitor	pcs	4	
13	Control System	pcs	1	Include 500W isolation device
14	Sparking Sphere	Pair	1	
15	Trigging Sphere	Pair	1	
16	Isolation Gap	Pair	1	
17	Control cable/measuring cable	set	1	
18	Trigger device	set	1	
19	Movable basement	set	2	
20	Grounding rod	set	1	
21	Static voltmeter	pcs	1	
22	Oscilloscope	pcs	1	USA, TDS2012(Tektronix)
23	Fence	set	1	

# model: Elevator training -1000

## Elevator training system

### Feature

1. this is 3 floor Elevator training equipment and there is Stop buttons as per each floor.
2. this system was made in accordance with all of the features and design for real elevator system.
3. Students can look well for elevator operation status as the kit has transparent window.  
It will make the training to be effective.
4. By applying a high-sensitivity sensor and the location is easy to control, increased to the adaptability in industrial areas
5. by precise equipment structure, maximize the adaptability to real elevator system
6. As PLC is mounted to elevator equipment, increase the convenience of elevator training almost same as real elevator system which is using in industrial areas

### System configuration



### Manual Contents

- 1) ON, OFF circuit experiment
- 2) Holding circuit experiment
- 3) Inter-lock circuit experiment
- 4) Reverse circuit (UP & DOWN) experiment
- 5) Manual drive circuit experiment
- 6) HI-LOW SPEED circuit experiment
- 7) 1 floor CALL circuit experiment
- 8) 2 floor CALL circuit experiment
- 9) 3 floor CALL circuit experiment
- 10) Automatic standby circuit experiment
- 11) Automatic inter-lock circuit experiment on Automatic circulation circuit

### Components

1) Elevator experiment hardware platform	1set
2) JUMPER WIRE & 232C CABLE	1set
3) PLC example Software program CD	1ea
4) Power Supply Cable	1ea
5) Manual book	1book

## Specifications

1. Power Supply Part	1) Input Power	AC220V
	2) Output Power	DC 0V. 5V. 12V. 24V
	3) POWER UNIT	
2. Drive Part	1) DC 24V, POWER Screw-type motor	
	2) Deceleration rate	495:1
3. Drive Control Part	1) POWER CONTROL LY	1ea
	2) SPEED CONTROL LY	1ea
	3) UP CONTROL LY	1ea
	4) DOWN CONTROL LY	1ea
	5) Brake Controller	1set
4. Controller Part	1) SIGNAL LAMP per each floor	3ea, 3set
	2) CONTROL SW	4ea
	3) E-STOP SW	1ea
	4) AUTO, MANU SW	1ea
	5) UP, DOWN CONTROL SW	1ea
	6) PHOTO SENSOR	5ea
5. Hardware Structure	1) Elevator Structure	1set
	2) Graphic	1set
	3) Perspective drawing of Evevator system	1set
	4) Sensor Bracket	1ea
	5) Balance	1ea
	6) Color transparent windows can be seen in all directions	1set
	7) Ergonomic Case	1set
	8) Carrying handle	1set
6. Transparent monitoring unit		1set
7. PLC Controller Part	1) As made of high-strength ABS material with transparent student can check operation of each sensors	
	1) As PLC equipped,experiment is possible without additional PLC	
	2) PLC configuration module (SYSTEM) contact point is produced by putting the unique number using Y-terminal & the numbering (notation) tubes	

# model: Automatic door training-1000

## Automatic Door Training system

### Feature

- 1) Adaptation of control system applicable to real door system
- 2) Simultaneously or individually controlled in accordance with the experiments
- 3) Step by step experiments is available, and thus helpful to improve users' understandings
- 4) Applying a high-sensitivity sensor, easy location control
- 5) By applying timing control, minimize errors in control
- 6) As PLC is mounted to automatic door equipment, increase the convenience of training almost same as real automatic door system which is using in industrial areas

### System configuration



### Manual Contents

1. ON, OFF circuit experiment
2. Holding circuit experiment
3. Inter-lock circuit experiment
4. Reverse circuit experiment
- 5) Manual drive circuit experiment
- 6) HI-LOW SPEED circuit experiment
7. Door Open circuit experiment
8. Door Close circuit experiment
9. Sensor detection circuit experiment
10. Automatic standby circuit experiment
- 11) Automatic inter-lock circuit experiment on Automatic circulation circuit

### Components

1) Automatic door experiment hardware platform	1set
2) JUMPER WIRE & 232C CABLE	1set
3) PLC example Software program CD	1ea
4) Power Supply Cable	1ea
5) Manual bookm	1book

## Specifications

1. Power Supply Part	1) Input Power	AC220V
	2) Output Power	DC0V, 5V, 12V, 24V
	3) POWER UNIT	
2. Drive Part	1) DC 24V, POWER Screw-type motor	1ea
	2) Deceleration rate (495:1)	1ea
	3) Tension bearing structure	1set
	4) Timing belt	1set
3. Drive Control Part	1) POWER CONTROL LY	1ea
	2) FORWARD CONTROL LY	1ea
	3) REVERSE CONTROL LY	1ea
	4) Brake Controller	1set
4. Controller Part	1) AUTO, MANU SW	1ea
	2) DOOR CONTROL SW	1ea
	3) OPEN, CLOSE CONTROL SW	1ea
	4) OPEN PHOTO SENSOR	1ea
	5) PHOTO SENSOR	2ea
5. Hardware Structure	1) Automatic door structure	1set
	2) POWER Graphic	1set
	3) Perspective drawing of automatic door	1set
	4) Sensor Bracket	2ea
	5) Control sensor	2ea
	6) Transparent monitoring unit	1set
	7) Ergonomic Case	1set
	8) Carrying handle	1set
7. PLC Controller Part	1) As PLC equipped, experiment is possible without additional PLC	
	2) PLC configuration module (SYSTEM) contact point is produced by putting the unique number using Y-terminal & the numbering (notation) tubes	

# 40

## a group of FMS (Flexible manufacturing system) Trainer

130. FMS-5000

131. Production Automation-5000

model: **FMS-5000**

## FMS (Flexible Manufacturing System) Trainer

### Feature

The FMS technique controls and operates various instruments to enhance productivity. FMS-5000 enables users to practice individual processes including PLC programming, HMI software technology, sensor control, conveyer control, pneumatic control, practice of electrical control device and process-specific unit process control.

### Functions

- Parts feeding control
- Parts transfer control
- Punching control
- Unloading control
- Return control

### Components

Mechanical part	1 ea
Practice table set	1 ea
Software CD	1 ea
User's Manual	1 ea

### Training contents

#### Part1, Introduce and FMS

1. Concept and Understanding of FMS
2. FMS Hardware Structure and Description

#### Part2, PLC Program

1. Concept and Definition of PLC
2. Understanding PLC Commands
3. Understanding PLC Basic Commands

#### Part3, Mechanic Configuration by Process and Practice of Programming for Control Module

1. Parts feeding control and programming practice
2. Parts transfer control and programming practice
3. Punching control and programming practice
4. Unloading control and programming practice
5. Return control and programming practice

### System configuration

1) FMS Mechanical Part



2) PLC Converter Test Set





## Specification

### 1. Hardware spec

1) Part Feeder		
* Actuator	Double-acting Air Cylinder	D16S80mm
* Control Output Device	pneumatic solenoid valve	DC24V 0.1A
* Control Input Device	Cylinder Auto forward/Reverse	DC24V /AC220V(Contact type)
* Control Method	Time-delayed Round Trip ON/OFF	Speed Control-Use pneumatic speed control
* Parameter	Idle time after moving forward	
2) Tuning Table		
* Actuator	3-phase AC Motor	AC220V 0.1A
* Control Output Device	3-phase Inverter Speed Controller, AC220V	AC220V
* Control Input Device	Zeroing Switch, High Frequency Input Device	DC24V NPN
* Control Method	Equiangular Rotation	
* Parameter	Idle time after moving forward	
3) Process Machine		
* Actuator	Double-acting Air Cylinder	D16S40mm
* Control Output Device	pneumatic solenoid valve	DC24V 0.1A
* Control Input Device	Cylinder Auto forward/Reverse	DC24V /AC220V (Contact type)
* Control Method	Time-delayed Round Trip ON/OFF	Speed Control-Use pneumatic speed control
* Parameter	Idle time after moving forward	
4) XY Unloading Robot		
* X-axis Actuator	Double-acting Air Cylinder	D16S40mm
* Control Output Device	pneumatic solenoid valve	DC24V 0.1A
* Control Input Device	Cylinder Auto forward/Reverse	DC24V /AC220V (Contact type)
* Control Method	Round-trip ON/OFF	Speed Control-Use pneumatic speed control
* Parameter	None	
* Y-axis Actuator	Double-acting Air Cylinder	D16S40mm
* Control Output Device	pneumatic solenoid valve	DC24V 0.1A
* Control Input Device	Cylinder Auto forward/Reverse	DC24V /AC220V (Contact type)
* Control Method	Round-trip ON/OFF	Speed Control-Use pneumatic speed control
* Parameter	None	
* Finger	Double-acting Air Cylinder	
* Control Output Device	pneumatic solenoid valve	DC24V 0.1A
* Control Input Device	None	
* Control Method	Time-delayed Round Trip ON/OFF	
* Parameter	Operation Time Delay	
5) DC motor conveyer		
* Actuator	DC Motor	DC24V 1A
* Control Output Device	DC Motor Speed Controller	DC24V 3A
* Control Input Device	Optic Sensor	DC24V NPN
* Control Method	ON/OFF	
* Parameter	None	
6) PLC		
Master-K 300S		
7) HMI		
MT8070iH		7" TOUCH SCREEN

### 2. Software program

1) PLC SOFTWARE	
* Master - K	
2) HMI SOFTWARE	
* EasyBuilder 8000	EB8000 Touch Screen Edit Software
* EasyConverter	Data conversion tool
* Project Manager	MT8000 Integrated Management software
* ReleaseNote	Software version and new release notification

# model: **Production Automation-5000**

## **Production Automation Control equipment**

### **Feature**

This product was developed for students to practice implementation of production Line automation systems, which are the basis of factory automation and unmanned production line systems.

Since this product is equipped with the GLOFA PLC, users can perform programming using the PLC programming tool, GMWIN, and can practice sequence control by conducting 9 tests (lamp on/off circuit, AND and OR circuit, self-holding circuit, etc.)

Besides, users can conduct 13 pneumatic cylinder control experiments and 10 PLC programming tests after learning about hardware configuration of Production Automation-5000.

### **System configuration**



### **Components**

1) Production Automation-5000 Hardware platform	1 set
2) Power cable	1 ea
3) FUSE	10 ea
4) Software (GM-WIN)	1 ea
5) Communication cable (RS-232)	1 ea
6) Goods for line test (metal and non-metal)	each 5 ea
7) Manual book	1 book

## Training Contents

### Part -1, Basis of the PLC control system

#### Chap 1, PLC control system

1. What is the elements of PLC control
2. What is PLC ?
3. History of PLC Development
4. PLC standardization and Features
5. PLC selection and Application area

#### Chap 2, PLC Structure

1. Hardware structure
2. PLC Input / Output structure
3. Software structure
4. PLC Program (GMWIN FOR GLOFA PLC) Setup
5. Programming Tool (GMWIN)
  - 5-1) GMWIN Start
  - 5-2) Screen menu (configuration)
  - 5-3) Structure of the Project
  - 5-4) LD Edit
  - 5-5) UP-load
  - 5-6) Menu
  - 5-7) Toolbar
  - 5-8) Files that are generated in GMWIN
  - 5-9) File Open
  - 5-10) File Save
6. Composition of the Data
7. Operation Processing
8. Programming basic
9. Sequence basic circuit and LD sample program

### Part -2, Sequence control practice

- Practice task -1, In / Out Point, 1:1 Drive
- Practice task -2, Lamp lighting circuit
- Practice task -3, AND Circuit
- Practice task -4, OR Circuit
- Practice task -5, Self-holding circuit
- Practice task -6, Inter-lock circuit
- Practice task -7, On-Delay circuit
- Practice task -8, Off-Delay circuit
- Practice task -9, Operating circuit for certain period of time

### Part -3, Pneumatic cylinder control practice

- Practice task -1, A+, A-
- Practice task -2, B+, B-
- Practice task -3, A+, 3 sec, A-
- Practice task -4, B+, 3 sec, B-
- Practice task -5, A+, A-, B+, B-
- Practice task -6, A+, B+, B-, A-
- Practice task -7, A+, B+, 3 sec, B-, A-
- Practice task -8, A+, 2 sec, A-, B+, 2 sec, B-
- Practice task -9, A+, B+, B-, B+, B-, A-
- Practice task -10, A+, B+, 2 sec, B-, B+, 2 sec, B-, A-
- Practice task -11, A+, A-, B+, B-, C+, C-
- Practice task -12, A+, B+, D+, D-, B-, A-
- Practice task -13, A+, 2 sec, A-, B+, 2 sec, B-, C+, 2 sec, C-

### Part -4, Explanation of Production Automation-5000 system

1. Configuration
2. Components of Training equipment
3. Process Flow Chart
4. Control Panel
5. Pneumatic and hydraulic schematic
6. Input Allocation Table
7. Output Allocation Table
8. PLC Input and Output Wiring

### Part -5, Ten types of Project practices for Production Line Automation

## Specification

1) Air Service Unit (Profile locking system / One-touch mounting structure)
- Consisted of Air filter, Regulator, Lubricator
- Working / Setting Pressure : 9.9 kgf/cm <sup>2</sup> / 0.5-9.9 kgf/cm <sup>2</sup>
2) PLC Module (Profile locking system / One-touch mounting structure)
- Power Unit : AC 220V 60Hz (1 ea) : AC 220V Input, DC 24V Output
- CPU Unit (1 ea) : LD,SFC,IL, Processing Speed : over 0.5 $\mu$ s / step
- Input Unit : DC 24V 16 point - 1 ea, Isolation method : Photo Coupler, LED Display
- Output Unit : Relay Output 16 point - 1 ea, Isolation method : Realy, Load : DC12/24V, AC110/220V
3) Distribution Module
(1) Diameter : Transparent-Tower type Storage Rack 40mm which can be kept less than 40mm Workpiece : 1 ea
(2) Clamping pieces for workpieces transport (non-rotating type) : 1ea
- Diameter : over 16mm, Cylinder Stroke : over 60mm, Allowable Operating Pressure : 7 bar
Mounting Flow Control Valve : 2ea , Magnetic sensor : 2ea , A Contact LED built-in type
(3) Optical Sensor for verification of the workpiece : 1ea
- Fiber optic cable 500mm, Operating voltage : 10 ~ 30V DC , Sensing distance : 50mm
4)Drilling Module
(1) Cylinder for electric drill feed : 1ea
- With anti-rotation, Diameter over 16mm, Stroke under 40mm, Allowable Operating Pressure : 7 bar
Mounting of Flow Control Valve : 2ea ,
(2) Magnetic sensor (Cylinder mounting for electric drill feed) : 2ea
(3) 24V Electric drill for workpieces processing (SIMULATION) : 1ea
5) Feed Module
(1) Cylinder for workpieces transport (Anti-rotation type) : 1ea
- Diameter : over 16mm, over Cylinder Stroke : 60mm, Allowable Operating Pressure : 7 bar
Mounting of Flow Control Valve : 2ea, Magnetic sensor (a Contact LED built-in type) : 2ea
(2) Cylinder guide frame workpieces transport
6) Sensor Module
(1) Sensor for the detection of workpieces : 3ea
- Sensing distance 2mm (Metals, non-metallic), Power DC24V,15mA, Response frequency 50Hz,
Built-in surge protection circuit
(2) Sensor fixing bracket
7)Ejecting Module
(1) Cylinder for removing defective (Anti-rotation type) : 1ea
- Diameter : over 16mm, Cylinder Stroke : over 60mm, Allowable Operating Pressure : 10bar
Mounting of Flow Control Valve : 2ea, Magnetic sensor (a Contact LED built-in type) : 2ea
8)Conveyor Module
(1) Conveyor belt
- Driven by a gear motor , Size : over 500(L) × 70(W) × 200(H)mm, Power roller : 1ea
Idle roller : 1ea , Tension control roller : 1ea , Gear motor DC 24V
9) Pneumatic solenoid valves
(1) 5/2 Way Single solenoid valve - 4ea
(2) 5/2 Way Double solenoid valve - 1ea
10) Tower Lamp (Profile locking system / One-touch mounting structure)
- Lamp color : Red, Green, Yellow, Power : DC 24V
11) Production Automation Control Module
(1)PLC Digital Input.Output unit (connect with PLC Module)
- Input. Output point : 16 points, Jack terminals : 36 ea ( 8 point, 1 com)
- DC Power Jack : 4 ea ( + : 2 ea, - : 2 ea)
(2) Input and output unit for Production Automation Control
- Input. Output point : 16 points, Jack terminal : 36 ea ( 8 points 1 com)
- DC Power Jack : 4 ea ( + : 2 ea, - : 2 ea)
(3) Conveyor Belt speed controls and indicators : 1ea
- Gear motor and motor output controller
(4) Power Supply : 1ea
- Input : AC 220V , 60Hz , Output : 24V, DC, max, 2A
(5) Relay unit : 2 ea
-14 pin Relay : 3ea, Input Contact : 4c / relay
- Coil voltage : DC 24V, Current in use : DC 0.9W
(6) Signal input switch : 3 ea
-Push Button Switch, separate LED mounting (Red,Yellow,Green) / Contact : 1C
(7) Emergency stop switch : 1 ea
- Lock function in red color P/B switch, Input Contact : 1a, 1b
(8) Digital Counter unit : 1 ea
- 4 line, 4 position, 1k Cps, Contact : Relay( 1c )
- Counter Input : Photo coupler(DC 12 - 24V)

(9) Power switch

- AC Power switch (include Lamp) , DC FUSE (2A) , 24V LED,

(10) Motion Display graphics panel

Graphic panels for System process

- LED(3 ) for Magazine supply cylinder forward & reverse
- LED(3 ) for Drill U/D cylinder forward & reverse
- LED(3 ) for operation of Switch 4 ea
- LED(3 ) for Drill motor operation
- LED(3 ) for Conveyor motor operation
- LED(3 ) for outgoing cylinder forward & reverse
- LED(3 ) for Sensor 1 , 2, 3 ,4 detection
- LED(3 ) for Wrongly working cylinder forward & reverse
- LED(3 ) for Tower Lamp Red, Green, Yellow color

Graphic Panel for Hydraulic schematic

- LED(3 ) for Magazine supply cylinder forward & reverse
- LED(3 ) for Drill U/D cylinder forward & reverse
- LED(3 ) for Drill motor operation
- LED(3 ) for outgoing cylinder forward & reverse
- LED(3 ) for Wrongly working cylinder forward & reverse
- LED(3 ) for SOL Valve ( SV 1, 2, 3, 4, 5 )

# 41

## a group of Power Line Communication system

132. Power Line Communication trainer

# model: Power Line Communication-5000

## Power Line Communication Trainer

### Feature

- 1) High-speed Micom Writer function using USB port.
- 2) Communication Experiment using PLC(Power Line Communication).
- 3) various Micom Compling using MICOM STUDIO.
- 4) providing the Writing Program (Read, Write, Erase, Check, Edit, Save) of Micom 8051 using USB port.
- 5) PLC (Power Line Communication) Programming practice
  - (1) not using default home code. Instead, transmitting to each client by user setting
  - (2) Bulb lighting practice using default home code.
  - (3) LED Display practice by receiving a wall socket status.
  - (4) LED ON/OFF practice by receiving Toggle Switch status.
  - (5) LED display by reading Client Humidity / Temperature seonsor
  - (6) Home code setting by creating Password
  - (7) 3-steps bulb lighting practice by reading ADC value on Fiber Optic sensor (Cds)
- 6) Application Control Experiment
  - (1) LED ON/OFF
  - (2) Brink LED
  - (3) DISPLAY 7-SEGMENT
  - (4) FLASH 'HELP'
  - (5) SCAN 4X4 KEY MATRIX
  - (6) EXTERNAL INTERRUPT
  - (7) CLOCK
  - (8) Display a CHARACTER in LCD
  - (9) Shift a CHARACTER in LCD
  - (10) BEEP
  - (11) TIMER-COUNTER
  - (12) STEP MOTOR CONTROL-1
  - (13) STEP MOTOR CONTROL-2
  - (14) DC MOTOR CONTROL
  - (15) Cds
  - (16) INFRARED
  - (17) THERMISTOR
  - (18) DOT MATRIX
  - (19) DATA COMMUNICATION

### System cinfigation



## Experiments(Study objectives)

### 1. Overview

- 1.1 Package
- 1.2 Spec. of the Modem-5000 Kit

### 2. mDIGITAL Studio

- 2.1 Install mDIGITAL Studio
- 2.2 Overview mDIGITAL Studio
- 2.3 Executing C-Language Program
- 2.4 mDIGITAL PROGRAMMER
- 2.5 The AT89S51/2 architecture

### 3. Experiment

- 3.1 LED on/off
- 3.2 Blink LED
- 3.3 Display 7-segment
- 3.4 Flash "HELP"
- 3.5 Scan 4x4 Key-matrix
- 3.6 External Interrupt
- 3.7 Clock
- 3.8 Display a character in LCD
- 3.9 Shift a character in LCD
- 3.10 Beep
- 3.11 Timer-counter
- 3.12 Step motor control I
- 3.13 Step motor control II
- 3.14 DC motor control
- 3.15 CDS
- 3.16 INFRARED
- 3.17 THERMISTOR
- 3.18 DOT MATRIX

### 4. Modem(PLC) Programming Introduction

- 4.1 Understanding of Home Network
  - 4.1.1 Definition of home network
  - 4.1.2 Factors for Home Network Implementation
  - 4.1.3 Home Networking Applications
  - 4.1.4 Gateway interlocking with power line communication technology
- 4.2 Understanding of Modem(PLC)
  - 4.2.1 Overview of Power Line Communication Technology
    - 4.2.1.1 Definition of power line communication
    - 4.2.1.2 History of power line communication technology
  - 4.2.2 Core technology of Power Line Communication
    - 4.2.2.1 Front End Skill (PLC Coupling technology)
    - 4.2.2.2 Channel Coding
    - 4.2.2.3 Modem
    - 4.2.2.4 MAC
  - 4.2.3 Principle of operation and implementation for power line communication
    - 4.2.3.1 Coupling circuit between power line and communication signal
    - 4.2.3.2 Signal attenuation of power line and measures
    - 4.2.3.3 Modulation to noise environment
    - 4.2.3.4 Transmission gain and reliability enhancement in the limited band
    - 4.2.3.5 Error correction for increasing transmission efficiency
    - 4.2.3.6 Multiple Access (MAC)
      - 4.2.3.6.1 CSMA/CD (Carrier Sense Multiple Access with Collision Detection)
      - 4.2.3.6.2 CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance)
      - 4.2.3.6.3 CSMA/CDCA (Carrier Sense Multiple Access/Collision Detection Collision Avoidance)
  - 4.2.4 Power Line Communication Protocol
    - 4.2.4.1 X10 Protocol (x-10)
    - 4.2.4.2 LonWorks Protocol (Echelon)
    - 4.2.4.3 CEBus Protocol
    - 4.2.4.4 CENELEC (European Norm 50065)

### 5. Modem(PLC) Protocol

- 5.1. PLC Packet Configuration
  - 5.1.1. PLC packet configuration
  - 5.1.2. Description of PLC packet
  - 5.1.3. PLC Command

### 6. Experiment

- 6.1. Data Communication
- 6.2. PLC Communication
- 6.3. PLC Communication(with LED)
- 6.4. PLC Communication(with 7-SEGMENT)
- 6.5. PLC Communication(with STEP MOTOR)
- 6.6. PLC Communication(with DC MOTOR)
- 6.7. PLC Communication(with INFRARED)

### Appendix



## Components

1) Program CD	1 ea
2) RS-232C Cable (9 pin)	1 ea
3) USB cable	1 ea
4) AC Cable (for Power Line Communication)	2 ea
5) AC Multi Concent (for Power Line Communication)	1 ea
6) Power cable	1 ea
7) Manual book	1 book
8) Jumper cable	12 ea

## Spec

Provided	1) MICOM STUDIO
Program	2) MICOM PROGRAMMER
Micom	8051 : AT89S51
Hardware	1) PLC Communication Module : 2ea of APLC-485MA (for Transmitting / Receiving) (PLC = Power Line Communication)
Spec	2) PLC Application Practice (1) LED : LED(3 ) × 8ea (2) I/O experiment : Slide Switch - 4ea, PUSH Switch - 4ea (3) Keypad : 4 × 4, Key Matrix (4) 7-Segment : 4ea (5) Display : LCD (16 × 2 line) (6) Sensor : Thermistor, Cds, Infrared sensor (for Transmitting/Receiving) (7) Relay : 2 ea (8) Buzzer : 1 ea (9) Serial port : RS232C(MAX232 × 1ea) (10) Dot-Matrix : 8 Å × 8 Dots(Red, Green, Yellow) (11) DC Motor Å: Motor - DC +5V, Input sensor - Photo Interrupt, two-way LED(5 ) × 1ea (12) STEP Motor : DC12V, 0.35A, 1.8 °
PC Interface	1) USB × 1ea (for Program writing) 2) RS-232C communication port

# 42

## a group of Aircraft training system

133. Aircraft & aviation-AT1000

# model: **Aircraft & aviation-AT1000**

## **Aircraft (Aviation) education training system**

### **Feature**

Aircraft & aviation-AT1000 is designed for Aircraft operational training (Flight training) and procedures training is certified under FAA regulations.

It consists of Hardware cockpit platform, Wide Field View Display System & Simulation computer complex.

The aircraft model feature accurate aerodynamics, system replication and complex aircraft instruments simulation.

- 1) Full consideration is given to all variable surfaces and their effects.
- 2) Simulation include :
  - Variation of airplane longitudinal, lateral and directional stability with altitude, air speed and gross weight
  - Wind Effects
  - Ground Handling characteristics
  - Approach to Stall Characteristics
- 3) Pilot cockpit system
  - Simulated instrument / panel and LCD graphic instrument
- 4) Visual Display System
  - LCD monitor for 3 channel will be provided.

This training system can generally be upgraded to a more powerful training device qualifying for higher credits in the flight training.

### **Components**

1) Hardware cockpit platform (Instrument Panel)	1 ea
2) Throttle Quadrants	1 ea
3) Graphic Displays for flight Instruments	1 ea
4) Rudder Pedals	1 ea
5) Host Computer	1 ea
6) 3 Channel Image Generator	1 ea
7) Visual Display System ( 3ea of LCD monitor)	1 set
8) Instructor Monitor	1 ea

### **Training contents**

#### Part 1, Simulator Operation

- Strat and Shutdown
- Initial Configuration

#### Part 2, Simulator Basic Control

- IOS Operation Overview
- IOS Main Menu
- IOS Environment Page
- IOS Control Page

**Part 3, Flight Malfunction Training Control**

- Instrument and System Failures
- Engine Failures
- Aircraft Control Failures

**Part 4, Visual Display Operation**

- Image Generator Operation
- Display System Operation

**Part 5, Aircraft General Instruments Familiarization**

- General Instruments

**Part 6, Aircraft Radio Navigation Receivers Familiarization**

- Radio Navigation Receivers
- DME, ADF, GPS

**Part 7, Simulator Assemble and Maintenance**

- Configuration Overview
- Simulator Hardware Connection
- Hardware Configuration
- Instrument Configuration

## System configuration

(Visual Display System & cockpit platform)



## Specification

**1) General spec**

**(1) Hardware cockpit platform**

The system must have equipment (e.g., instruments, panels, systems, circuit breakers, and controls) simulated sufficiently for the authorized training/checking events to be accomplished.

Actuation of equipment must replicate the appropriate function in the airplane.

Fire axes, landing gear pins, and any similar purpose instruments need only be represented in silhouette.

< Trainer Qualification >

- Aircraft-AT1000 comply with FAA Airplane Flight Training Device Qualification.

**(2) Host Computer**

Installed systems must simulate the applicable airplane system operation, both on the ground and in flight.

Installed systems must be operative to the extent that applicable normal, abnormal, and emergency operating procedures.

Training Device must have at least one airplane system installed and functional .

**a. Navigation Database**

- WGS 84 System

**b. Aircraft System Simulation**

- Engine
- Flight Control System
- Landing Gear
- Electrical System
- Hydraulic System

(3) Graphic Cockpit Displays for flight Instruments

Gamin GNS430 based avionics instrument panel must be provided.

a, Navigation Simulation

- ADF System
- Marker Beacon System
- DME System

b. Communication Simulation

- Radio System

(4) Image Generator System

The image generator system consists of a three channel image generators.

Each channel will be provide 1,920x1,024 resolution video source for interfacing the visual display system.

The image generator system must provide following functions.

- Time of Day (TOD)
- Weather Control : Rain, Snow and Fog
- Wind Control
- Cloud Control
- Airport lighting system control
- Aviation training using Airport database
- : 4 airport database( WIII Jakarta, WARR Surabaya, WADD Bali, WARJ Yogyakarta)
- Update Rate : 60 Hz

(5) Visual Display System

The visual system must respond to abrupt input at the pilot's position.

The visual system must provide 3 LCD monitor for visual display.

< Visual System >

- 3 LCD monitor
- FOV : Horizontal 200 Degree, Vertical 35 Degree
- Number of Polygons : 20,000/channel

(6) Instructor System

The training device must have instructor controls that permit activation of normal, abnormal, and emergency conditions as appropriate.

Once activated, proper system operation must result from system management by the crew and not require input from the instructor controls.

- Initial Position Control
- Weather/Atmospheric Conditions control
- Map display
- Visual Control
- Malfunction Injection

## 2) Application program

- (1) Flight Simulation Software for C172
- (2) Graphic Instrument Driven Software
- (3) Image Generation Software
- (4) Instructor Operation Software

## 3) Components

- |   |       |
|---|-------|
| (1) Hardware cockpit platform                       | 1 ea  |
| (2) Throttle Quadrants                              | 1 ea  |
| (3) Graphic Cockpit Displays for flight Instruments | 1 ea  |
| (4) Rudder Pedals                                   | 1 ea  |
| (5) Host Computer                                   | 1 ea  |
| (6) 3-Channel Image Generator                       | 1 ea  |
| (7) Visual Display System ( 3ea of LCD monitor)     | 1 set |
| (8) Instructor Monitor                              | 1 ea  |

# 43

## a group of Solar & Wind Energy Training Sytem

- 134. GT-Solargen16
- 135. Energy Conversion-1000
- 136. GT-Wind Energy16
- 137. GT-Windgen17
- 138. GT-Solar & Wind trainer
- 139. GT-Fuel Cell16
- 140. Renewable energy-1500
- 141. Smart Grid-GTP990

# model:GT-Solargen16

## Solar Energy training system

### Features

- 1) GT-Solargen16 is consisted of Solar modules, batteries, and control devices,,, etc.
- 2) This system is designed to understand the principles of solar energy utilization and to conduct various experiments.
- 3) This system is configured to calculate energy production from sunlight and solar thermal equipment and to obtain various data.
- 4) As a stand-alone photovoltaic system, it is configured to operate through the produced and the stored power.
- 5) In order to help the understanding of grid-tie photovoltaic systems, a grid-tie photovoltaic system is also constructed
- 6) For convenient transportation, each solar and solar thermal system is separated and can be practiced by easily combining each other in the practice place.
- 7) There is a connecting parts for geothermal equipment (geothermal heater pump connector and light distribution connector)

### System configuration



### Components

Hardware platform	1 set
Program CD	1 ea
Textbook	1 book

### Training Contents

- 1) Configuration of equipment
- 2) Description of equipment
- 3) Basic Theory of Solar Energy
- 4) Topics of practice
  - Practice-1 : Measuring the efficiency of solar panel
  - Practice-2 : Experiment of solar modules with light intensity
  - Practice-3 : Experiment of Solar Module with Temperature Variation
  - Practice-4 : Photovoltaic generation according to shadows
  - Practice-5 : Characteristics of solar cell module according to incident angle
  - Practice-6 : Experiments of serial and parallel connection
  - Practice-7 : Charge Controller Experiment
  - Practice-8 : DC-AC inverter experiment
  - Practice-9 : DC-AC inverter load experiment

## Spec

1) Solar module
(1) Peak Power : 40w or more
(2) Cell type : MONO Crystalline Silicon
(3) Number of cells : 36 Cells in series or more
(4) Weight : 4 KG or less
(5) Maximum voltage : 17.82V or more
(6) Maximum current : 2.27A or more
(7) Open voltage : 21.96V or more
(8) Short circuit current : 2.54A
2) Stand-alone artificial power supply
(1) Voltage and current display function using LCD display
(2) Stable voltage, current output function
(3) Stable voltage and current automatic conversion function
(4) Multi-loop high precision voltage regulation
(5) Continuous current control function
(6) Extended output terminal
(7) Voltage : DC 0-30V
(8) Current : DC 0-3A
3) Grid-tie inverter
(1) 250W or less micro inverter
(2) 24-hour trace control function
4) Stand-alone inverter
(1) Capacity : 1KW or more
(2) Soft start function by program
(3) Conversion control function by program
(4) Step wave method similar to PWM
(5) Automatic control of input voltage by program
(6) Screw fixing method of Input power terminal
(7) Automatic control of input / output by overheating / overload
(8) Automatic low voltage / high voltage control by program
(9) Low voltage / high voltage re-operation function by program
(10) Battery protection function by program
(11) Output Short / Over surge protection function
(12) Automatic control of blower (fan)
5) Battery
(1) Voltage : DC 12V
(1) Capacity : 12V 100AH, Gel type
6) Distribution box and connection bar
8) Multi-test
9) Watt Hour Meter Module
10) DC Voltage Meter(3ea), DC Ampere Meter(3ea)
11) AC wiring breaker module : 1EA
12) AC Voltage Meter(1ea), AC Ampere Meter(1ea)
13) AC Load Module



## 14) Software program spec

- (1) DC voltage, DC current, AC voltage, AC current,, etc are displayed for each part of Solar module, charge controller, battery, grid-tie inverter, stand-alone inverter, commercial power, etc.
- (2) DC part and AC part are divided and displayed in table format to provide user's monitoring convenience.
- (3) When user configure stand-alone invert and grid-tie inverter, inverter efficiency is calculated in real time by detecting each input voltage and output voltage.
- (4) Voltage and current data of each point of DC part and AC part is displayed in real time graph with the equipment configuration, and only selected data is displayed as a graph.
- (5) Battery status monitoring is possible.
- (6) ESS System protection function
  - Protection against temperature
    - If any cell of battery temperature < 0°C, stop charging / release at +2°C
    - If any cell of battery temperature > +45°C, stop charging / release at +43°C
    - If any cell of battery temperature < -20 °C, stop discharging / open MC4 / release at -18 °C
    - If any cell of battery temperature >+ 55°C, stop discharging / open MC4 / release at 53°C
    - If any cell of battery temperature < +2°C and cell is being charged, turn on cell heating mat release at +4°C
    - If any cell of battery temperature > +43°C, turn on cooling fan / release at +40°C
  - Protection against voltage
    - If any of cell voltage < 8.1V, stop discharging / Stop PCU / release at 13.4V
    - If any of cell voltage < 7.0V, System off
    - If any cell of battery voltage > 14.25V, open MC and trigger alarm: alarm message: "cell short" / release by power reset
  - Protection against current
    - If battery discharge current > 13.5A, open MC alarm message "over discharge current" / release by power reset
  - Protection against Short circuit (If pack voltage < 9.5V, open MC)
  - Protection fuse (Use slow blow fuse)

# model: **Energy conversion-1000**

## Energy conversion laboratory equipment

### Introduction

- Understanding the principles and concepts of renewable energy generation
- Conversion experiment of the generated energy
- Understanding energy processing principles and concepts for generating energy
- Separation of energy production module and energy processing module
- Free attachment and detachment of working board and module
- Light source control using artificial solar light source
- Power processing circuit production and practice

### System configuration



### Components

1) Enhanced Photovoltaic module	1 ea
2) Data Collect Module	1 ea
3) Charger Module	1 ea
4) Step-Up Converter Module	1 ea
5) Single Phase Inverter module	1 ea
6) Dimmer Module	1 ea
7) DC Power Supply Module	1 ea
8) Battery Module	1 ea
9) Lamp Module	1 ea
10) AC Motor Module	1 ea
11) Charger Assemble Module	1 ea
12) Step-Up Converter Assemble Module	1 ea
13) Single Phase Inverter Assemble Module	1 ea
14) Program CD	1 ea
15) Manual book	1 book

## Training Contents

- Part-1, Photoelectric effect simulation
- Part-2, Ohm's Law, Voltage / Ammeter Experiment
- Part-3, Experiment of solar module characteristics (Isc, Voc, Im, Vm, Fill, Factor)
- Part-4, Incidence angle and intensity experiment using external light source
- Part-5, Battery Charging Experiment
- Part-6, Power conversion experiment using boost module and inverter
- Part-7, AC and DC load experiment
- Part-8, Charging circuit production and characteristics experiment
- Part-9, Boosting circuit production and characteristics experiment
- Part-10, Inverter circuit production and characteristics test

## Spec

### 1) Software spec

#### (1) Monitoring S / W



- Output characteristics according to light quantity
- Output characteristics according to temperature
- Output characteristics according to azimuth angle
- Output characteristics according to incident angle

#### (2) Photovoltaic effect and Simulation method of electric and electronic, low-voltage, ammeter.



### 2) Hardware spec

#### (1) Enhanced Photovoltaic module



- Azimuth angle and inclination angle variable portion
  - Azimuth : Rotate up to 120 ° with manual knob
  - Angle of incidence : Changeable from 0 to 90 ° (in units of 15 °)
- Artificial light source device
  - 500W halogen lamp : 2ea
  - Angle control using joints
- Solar cell module
  - Maximum output : 10W

#### (2) Data Collect Module



- Modules for characterizing solar cell voltage and current
  - Solar cell connection block : output terminals of solar cell 1 and solar cell 2
  - Curve Tracer Block : V-I Characteristic Curves Through an Oscilloscope
  - LCD Display : Displays the voltage, current, and temperature of the solar cell.
  - Load block : 0 ~ 200 Ω, 50W class VR
  - PC interface block : Data analysis through dedicated program after connection with PC

(3) Charger Module



- Module for charging solar battery output to battery
  - Overcharge, overdischarge prevention circuit
  - Solar Cell terminal : Solar cell output input
  - Output terminal : Battery voltage output
  - Battery terminal : Terminal to connect battery
  - Batt Low Set VR : Battery drain setting
  - Batt Low Set VR : Battery drain setting
  - Batt Volt Set VR : Battery charge voltage setting

(4) Step-Up Converter Module



- Module that boosts output of solar cell and battery by commercial AC voltage
  - Input terminal : Charging module output & input
  - Output terminal: boosted voltage output (about 10 times of input)
  - Checkpoint: Oscillation Circuit and FET Gate Waveform

(5) Single Phase Inverter module



- Module that receives DC voltage of boost module and converts it to AC voltage
  - PWM inverter circuit
  - DC Input terminal : Boost module output & input
  - AC Output Terminal : Load Connection for AC Power
  - REF. VR : Output voltage control
  - Checkpoint : Check each part waveform
  - Supplied + 15V, -15V using SMPS module

(6) Dimmer Module



- 500W Halogen lamp Module for adjusting the light quantity of two
  - Built-in fuse 250V 8A

(7) DC Power Supply Module



- Module for supplying + 15V, -15V power to inverter circuit
  - Fuse 250V 8A

(8) Battery Module



- DC 12V, 7AH Battery connected with charging module
  - Fuses 250A, 3A

(9) Lamp Module



- Operating power : 220V, 10W

(10) AC Motor Module



- Operating power : AC 110V, 10W
- Motor drive status display using the rotating plate

(11) Charger Assemble Module



- Modules for students to make charge circuit using breadboard
  - Breadboard for circuit configuration
  - Parts for charging circuit

(12) Step-Up Converter Assemble Module



- Module in which Students use the breadboard to make the logic part of the booster circuit.
  - Breadboard for circuit configuration
  - Main Circuit Power Stack PCB
  - Parts for DC-DC boost circuit

(13) Single Phase Inverter Assemble Module



- Module for the students to make logic part of inverter circuit directly by using breadboard.
  - Breadboard for circuit configuration
  - Main Circuit Power Stack PCB
  - Components for single-phase inverter circuits

(14) Others

- Dimensions : 1218(W) × 1533(H) × 720(D)mm
- Working Board
  - size : 1100(W) × 540(H)mm
- Module storage drawer
  - Size: 350 (W) × 600 (H) × 500 (D) mm or more, can be negotiated

(15) ESS System protection function

- Protection against temperature
  - If any cell of battery temperature  $< 0^{\circ}\text{C}$ , stop charging / release at  $+2^{\circ}\text{C}$
  - If any cell of battery temperature  $> +45^{\circ}\text{C}$ , stop charging / release at  $+43^{\circ}\text{C}$
  - If any cell of battery temperature  $< -20^{\circ}\text{C}$ , stop discharging / open MC4 / release at  $-18^{\circ}\text{C}$
  - If any cell of battery temperature  $> +55^{\circ}\text{C}$ , stop discharging / open MC4 / release at  $53^{\circ}\text{C}$
  - If any cell of battery temperature  $< +2^{\circ}\text{C}$  and cell is being charged, turn on cell heating mat release at  $+4^{\circ}\text{C}$
  - If any cell of battery temperature  $> +43^{\circ}\text{C}$ , turn on cooling fan / release at  $+40^{\circ}\text{C}$
- Protection against voltage
  - If any of cell voltage  $< 8.1\text{V}$ , stop discharging / Stop PCU / release at  $13.4\text{V}$
  - If any of cell voltage  $< 7.0\text{V}$ , System off
  - If any cell of battery voltage  $> 14.25\text{V}$ , open MC and trigger alarm: alarm message: "cell short" / release by power reset
- Protection against current
  - If battery discharge current  $> 13.5\text{A}$ , open MC alarm message "over discharge current" / release by power reset
- Protection against Short circuit (If pack voltage  $< 9.5\text{V}$ , open MC)
- Protection fuse (Use slow blow fuse)

# model: GT-Wind Energy16

## Wind Energy Generation Training equipment

### Feature

- 1) Wind energy power is generated by Blower and blade (wing : 3ea).
- 2) Wind energy power is generated by the generator.
- 3) Learn about the principles of Wind energy generation using the generator
- 4) Wind energy characteristics experiments using the generated Wind energy.
- 5) To understand the driving principles of Wind energy generator, Hardware was manufactured by configuring the circuits of electricity generating process.
- 6) Built-in inverter and charge controller, battery, converter (DC / DC), Battery & Grid Power automatic change-over switch.
- 7) the Load devices can be driven using the generated power.
- 8) Offers a variety of practical solutions from the mechanical structure to the development principles.
- 9) equipped with various digital monitoring instrumentation (meters) which is required for development measurement.
- 10) easy wiring practice using 4mm B-Jack Cable.
- 11) Transparent acrylic protective case equipped for safety to generating parts.
- 12) Wind energy generation simulation S/W (GUI) is provided.
- 13) GUI display the voltage, current, wind power generation status in the form of graph.

### System configuration

#### 1) Wind energy generation by the generator



(Wind energy generation equipment)

#### 2) Wind energy generation using blade & blower



(Wind energy generation equipment)



(Blower)



### Components

Wind energy generation equipment	1 set
Blade	1 set
Blower (3 step, wind power control)	1 ea
AC LOAD	1 set
DC LOAD	1 set
Accessories	1 set
Program CD	1 ea
Wind energy generation simulation S/W (GUI)	1 ea
Manual book	1 book

## Training Contents

Chapter 1, Wind energy generation control & monitoring technology  
 Chapter 2, Components of Wind energy generator  
 Chapter 3, The principle of wind energy generator.  
 Chapter 4, Wind energy characteristics experiment according to the wind speed  
 Chapter 5, Wind energy generator load test & experiment  
 Chapter 6, Charging controller experiment  
 Chapter 7, Battery characteristics experiment  
 Chapter 8, DC-AC inverter experiment  
 Chapter 9, DC-AC inverter load experiment

## Specifications

### 1. Wind energy generation equipment ( 1set )

Synchronous Wind Power Generator	Rated output : 200W Rated speed : 1850RPM POLE : 6 EA Engine type : Three-phase permanent magnet generator
BLDC motor for driving the generator	Rated output : 300W Input voltage : DC 24V Speed 50~2,000 RPM (1,000 RPM limit for safety)
Motor controller for driving the generator	PWM output control, reverse control RPM Display 50~2,000 RPM speed control (Fixed and variable available)

### 2. Blade ( 1set ) : Blade diameter : 600mm Carbon fiber blade and 3 wings equipped.

### 3. Blower ( 1set ) : 3 steps wind speed control.

### 4. Power conversion system ( 1set )

DC/AC inverter	built-in over Current, over temperature, reverse polarity protection function pure sine wave output rated output : 300W Output voltage : AC 220V/60Hz Input voltage : 0.8~30VDC, efficiency 90%
DC/DC converter	built-in over-current protection, short circuit protection function Synchronous Rectification : 200W Input voltage : DC 12V $\pm$ 10% Output voltage, Current : DC 24V, 9A voltage level adjustable (Display available)
Three-phase rectifier	AC / DC conversion, the diode bridge circuit
Automatic change-over switch	Main voltage : 190~240V Sub voltage : 0~240V Voltage switching time : 30sec Converted voltage to sub power : 180V Switch to mains voltage : 188V
Charge and discharge controller	Rectifier built-in, overcharge protection Overdischarge controller functions Overspeed protection function, Automatic battery recognition The maximum charging power : 14.4V/15A UPS function

### 5. GUI Program

1) GT-Wind energy16 is displayed on GUI.
2) Voltage, current, wind power generation status is displayed on GUI in the form of graph.

### 6. Battery ( 1ea )

Voltage	12V
Capacity	12AH

### 7. Load module ( 1set )

AC Load	AC LAMP 6EA, AC MOTOR 1EA
DC Load	DC LAMP 6EA, DC MOTOR 1EA



# model: GT-Windgen17

## Wind energy trainer

### Overview

- 1) GT-Windgen17 is the training system for wind turbine hybrid systems.
- 2) This system is constructed so that it can operate with wind power system in order to understand the principle of use of wind energy and various experiments
- 3) This system is constructed so that various data can be acquired and this system can calculate the energy yields generated from wind power devices

### System configuration



### Components

Hardware platform	1 set
Wind Blade	1 set
Wind Blower	1 set
Program CD	1 ea
Manual book	1 book

### Experiment (Study objectives)

- Chap 1, about Energy classification
- Chap 2, Wind Energy technology
- Chap 3, Battery Overview
- Chap 4, Experiment of connecting wind module
- Chap 5, Experiments of wind module according to wind speed
- Chap 6, Direct / Parallel Connection Characteristics Experiment
- Chap 7, Charger controller experiment
- Chap 8, DC-AC inverter experiment
- Chap 9, DC-AC inverter load experiment
- Chap 10, Grid-connected inverter experiment (No load)

## Specs

- 1) Wind Energy system
  - CapacityRated Power : 400W
  - Rated Voltage : 12V/24VDC
  - Numbers of Blades : 3
  - Rated Rotating Rate : 950r/m
  - Length of Blades : 58CM
  - Rotor Diameter : 1200mm
- 2) Stand-alone artificial power supply
  - CapacityDisplay voltage and current using LCD display
  - Stable voltage, current output function
  - Voltage : DC 0-30V
  - Current : DC 0-3A
- 3) Grid-connected inverter
  - Capacity250W or less Micro Inverter
  - 24-hour trace control function
- 4) Stand-alone inverter
  - CapacityCapacity: 1KW or more
  - Soft start function by program
  - Program conversion control function
  - PWM similar step wave method
  - Automatic control of input voltage by program
  - Input power terminal screw fixing method
  - Automatic control of input / output by overheating / overload
  - Automatic low voltage / high voltage control by program
  - Low voltage / high voltage re-operation function by program
  - Battery protection by program
- 5) Battery
  - CapacityVoltage : DC 12V
  - Capacity : 12V 100AH, Gel type
- 6) Distribution box and connection bar
- 8) Multi-test
  - CapacityC Ampear
  - Hook meter
  - Multimeter
- 9) Watt Hour Meter Module
- 10) DC Voltage Meter(3ea), DC Ampere Meter(3ea)
- 11) AC wiring breaker module: 1EA
- 12) AC Voltage Meter(1ea), AC Ampere Meter(1ea)
- 13) AC LOAD MODULE
- 14) General spec
  - (1) Wind generator : 400W of DC power
  - (2) Stand-alone Inverter : Provides up to 1,000W of capacity when converting DC 12V battery power to AC220V
  - (3) System monitoring
    - Voltages and ammeters for wind power systems can be monitored
    - Protects heating and low battery conditions for auto shutdown, overload, short circuit
    - Computer can monitor the Inputs and outputs of wind turbine for voltage and wattage in the battery inverter
    - Monitor system records for 1 hour to 1 year
    - Real-time monitoring of various graphs and energy saving effects
  - (6) 12V Renewable energy Deep cycle Battery: Renewable energy
  - (7) Deep Cycle battery
  - (8) Load device : provide Variable load device & maximum load

## 15) Software program spec

- (1) DC voltage, DC current, AC voltage, AC current,,, etc are displayed for each part of Solar module, charge controller, battery, grid-tie inverter, stand-alone inverter, commercial power, etc.
- (2) DC part and AC part are divided and displayed in table format to provide user's monitoring convenience.
- (3) When user configure stand-alone invert and grid-tie inverter, inverter efficiency is calculated in real time by detecting each input voltage and output voltage.
- (4) Voltage and current data of each point of DC part and AC part is displayed in real time graph with the equipment configuration, and only selected data is displayed as a graph.
- (5) Battery status monitoring is possible.
- (6) ESS System protection function
  - Protection against temperature
    - If any cell of battery temperature  $< 0^{\circ}\text{C}$ , stop charging / release at  $+2^{\circ}\text{C}$
    - If any cell of battery temperature  $> +45^{\circ}\text{C}$ , stop charging / release at  $+43^{\circ}\text{C}$
    - If any cell of battery temperature  $< -20^{\circ}\text{C}$ , stop discharging / open MC4 / release at  $-18^{\circ}\text{C}$
    - If any cell of battery temperature  $> +55^{\circ}\text{C}$ , stop discharging / open MC4 / release at  $53^{\circ}\text{C}$
    - If any cell of battery temperature  $< +2^{\circ}\text{C}$  and cell is being charged, turn on cell heating mat release at  $+4^{\circ}\text{C}$
    - If any cell of battery temperature  $> +43^{\circ}\text{C}$ , turn on cooling fan / release at  $+40^{\circ}\text{C}$
  - Protection against voltage
    - If any of cell voltage  $< 8.1\text{V}$ , stop discharging / Stop PCU / release at  $13.4\text{V}$
    - If any of cell voltage  $< 7.0\text{V}$ , System off
    - If any cell of battery voltage  $> 14.25\text{V}$ , open MC and trigger alarm: alarm message: "cell short" / release by power reset
  - Protection against current
    - If battery discharge current  $> 13.5\text{A}$ , open MC alarm message "over discharge current" / release by power reset
  - Protection against Short circuit (If pack voltage  $< 9.5\text{V}$ , open MC)
  - Protection fuse (Use slow blow fuse)

# model: **GT-Solar & Wind energy700**

## Solar & Wind energy trainer

### Overview

- 1) GT-Solar & Wind Energy700 is the training system for solar and wind turbine hybrid systems. Solar modules, wind power module batteries, AC volt amps, DC volt amps, etc., are applied to this system.
- 2) This system is constructed so that it can interoperate with solar power system and wind power system in order to understand the principle of utilization of solar energy and use of wind energy and various experiments
- 3) This system is constructed so that various data can be acquired and this system can calculate the energy yields generated from solar and wind power devices
- 4) This hybrid system is constructed & operated through independent solar photovoltaic systems, and thus help user understand for stand-alone photovoltaic systems.
- 5) This hybrid system is able to configure grid-connected photovoltaic system together with grid-assisted photovoltaic system.
- 6) For convenience of transportation, each solar and solar heat system is made to be separated and moved separately, and it is made to be able to practice by combining easily in practice place.
- 7) Renewable Wind and Solar Hybrid Program is provided.

### System configuration



## Components

Hardware platform	1 set
Wind Blade	1 set
Wind Blower	1 set
Photovoltaic module	1 set
Light source (bulb)	1 set
Battery	1 ea
Monitoring Program CD	1 ea
Manual book	1 book

## Experiment (Study objectives)

- Chap 1, about Energy classification
- Chap 2, Solar Energy technology
- Chap 3, Wind Energy technology
- Chap 4, Battery Overview
- Chap 5, Photovoltaic power generation that can be inter-working with outdoor production system
- Chap 6, Measuring brightness (illuminance) of light
- Chap 7, Measure the intensity of light along a distance
- Chap 8, Measuring efficiency of solar panels.
- Chap 9, Experiment of Solar Module Characteristics by Light Intensity
- Chap 10, Solar Module Characteristics Experiment with Temperature Variation
- Chap 11, Experiment of connecting wind module
- Chap 12, Experiments of wind module according to wind speed
- Chap 13, Electrical characteristics of solar cell module according to the angle of incidence
- Chap 14, Hybrid Direct / Parallel Connection Characteristics Experiment
- Chap 15, Hybrid charge controller experiment
- Chap 16, Hybrid DC-AC inverter experiment
- Chap 17, Hybrid DC-AC inverter load experiment
- Chap 18, Grid-connected inverter experiment (No load)

## Specs

- 1) Photovoltaic module : Two modules for serial connection and parallel connection 400W or more,DC12 / DC24V
- 2) Wind Energy system
  - Rated Power : 400W
  - Rated Voltage : 12V/24VDC
  - Numbers of Blades : 3
  - Rated Rotating Rate : 950r/m
  - Length of Blades : 58CM
  - Rotor Diameter : 1200mm
- 2) Stand-alone artificial power supply
  - Display voltage and current using LCD display
  - Stable voltage, current output function
  - Voltage : DC 0-30V
  - Rated Current : DC 0-3A
- 3) Grid-connected inverter
  - 250W or less Micro Inverter
  - 24-hour trace control function
- 4) Stand-alone inverter
  - Capacity: 1KW or more
  - Soft start function by program
  - Program conversion control function
  - Rated PWM similar step wave method
  - Rated Automatic control of input voltage by program
  - Input power terminal screw fixing method
  - Automatic control of input / output by overheating / overload
  - Automatic low voltage / high voltage control by program
  - Low voltage / high voltage re-operation function by program
  - Battery protection by program

5) Battery

Voltage : DC 12V

Capacity : 12V 100AH, Gel type

6) Distribution box and connection bar

8) Multi-test

C Amper

Hook meter

Multimeter 9) Watt Hour Meter Module

10) DC Voltage Meter(3ea), DC Ampere Meter(3ea)

11) AC wiring breaker module: 1EA

12) AC Voltage Meter(1ea), AC Ampere Meter(1ea) 13) AC LOAD MODULE

14) General spec

(1) Wind generator : 400W of DC power

(2) Photovoltaic generator : DC power of 400W

(3) Hybrid System : Interoperable system of wind and solar power enables various power conversion experiments

(4) Stand-alone Inverter : Provides up to 1,000W of capacity when converting DC 12V battery power to AC220V

(5) System monitoring

Voltages and ammeters for wind and solar power systems can be monitored

Protects heating and low battery conditions for auto shutdown, overload, short circuit

Computer can monitor the Inputs and outputs of wind turbine for voltage and wattage, and can monitor the solar in the battery inverter

Monitor system records for 1 hour to 1 year

Real-time monitoring of various graphs and energy saving effects

(6) 12V Renewable energy Deep cycle Battery: Renewable energy

(7) Deep Cycle battery

(8) Load device : provide Variable load device & maximum load

15) Software program spec

(1) DC voltage, DC current, AC voltage, AC current,,, etc are displayed for each part of Solar module, charge controller, battery, grid-tie inverter, stand-alone inverter, commercial power, etc.

(2) DC part and AC part are divided and displayed in table format to provide user's monitoring convenience.

(3) When user configure stand-alone invert and grid-tie inverter, inverter efficiency is calculated in real time by detecting each input voltage and output voltage.

(4) Voltage and current data of each point of DC part and AC part is displayed in real time graph with the equipment configuration, and only selected data is displayed as a graph.

(5) Battery status monitoring is possible.

(6) ESS System protection function

- Protection against temperature

If any cell of battery temperature < 0°C, stop charging / release at +2°C

If any cell of battery temperature > +45°C, stop charging / release at +43°C

If any cell of battery temperature < -20 °C, stop discharging / open MC4 / release at -18 °C

If any cell of battery temperature > + 55°C, stop discharging / open MC4 / release at 53°C

If any cell of battery temperature < +2°C and cell is being charged, turn on cell heating mat release at +4°C

If any cell of battery temperature > +43°C, turn on cooling fan / release at +40°C

- Protection against voltage

If any of cell voltage < 8.1V, stop discharging / Stop PCU / release at 13.4V

If any of cell voltage < 7.0V, System off

If any cell of battery voltage > 14.25V, open MC and trigger alarm: alarm message:

"cell short" / release by power reset

- Protection against current

If battery discharge current > 13.5A, open MC alarm message "over discharge current"/

release by power reset

- Protection against Short circuit (If pack voltage < 9.5V, open MC)

- Protection fuse (Use slow blow fuse)

# model: GT-Fuel Cell16

## Solar-Hydrogen Fuel Cell Experiment Equipment

### Features

- 1) Electricity should be generated at Solar cell (Solar module) from a halogen lamp.
- 2) The generated electricity should be supplied to Electrolyzer.
- 3) H<sub>2</sub>/O<sub>2</sub> that is gotten by Electrolyzer should be supplied PEMFC Fuel cell stack (10unit) as fuel.
- 4) The generated electricity should be data analysis of current and voltage feature.
- 5) The generated electricity should be used by load device on sight operation in this apparatus.
- 6) should be displayed to Voltage and current

### System configuration



### Components

Hardware platform		1 set
Power Cable		1 ea
Connection Cable		2 ea
Banana jack	red	20 ea
	black	20 ea
Manual book		1 book
Program CD		1 ea

## Training contents

### 1) PLC electric circuit control theory & application

- (1) Basic circuit installation training with switches
- (2) C-contact circuit training with Relay switches.
- (3) AND circuit configuration and training
- (4) OR circuit configuration and training
- (5) NOT circuit configuration and training
- (6) NAND circuit configuration and training
- (7) NOR circuit configuration and training
- (8) Self-hold circuit configuration and training

### 2) Solar powered generation system application training & experiment curriculum

- (1) Electrolysis and power consumption measurement experiment
- (2) Fuel cell characteristics experiment
- (3) Fuel cell experiment by using solar panel
- (4) Comparison of efficiency experiment of fuel cells
- (5) Off-grid inverter system installation training
- (6) Load test of solar power module
- (7) Series and parallel control circuit composition and load power input circuit
- (8) Automatic transfer circuit configuration at electric discharge or power failure
- (9) Grid-connected inverter circuit configuration
- (10) Module efficiency test by variation of incidence angle
- (11) Battery power input circuit training
- (12) Experiment of power output by Series & parallel circuit configuration
- (13) Real-time monitoring experiment
- (14) System connect inverter load operation experiment
- (15) System connect inverter system PLC control training
- (16) Termination voltage measurement experiment by discharge of battery
- (17) Charger controller overcharge prevention experiment

### 3) Animation & Flash program

- (1) Simulation program suitable for sequence circuit training
- (2) Contains 10 different circuit animation contents for on-job training
- (3) Voice instructions connected with each animations of circuit system
- (4) Can display circuit circulation process with visualized animations
- (5) Can explain each phase of sequence circuit operating system
- (6) Includes circuit installation instruction video for users.

### 4) Video contents

- (1) Includes circuit installation progress video which helps users operating the equipment
- (2) Provided with operation guide voice comments
- (3) Instructions of hydrogen fuel cell installation & operation
- (4) Hydrogen fuel cell controller instruction
- (5) Hydrogen fuel cell components instruction
- (6) Data acquisition hardware instruction
- (7) Introduction of solar powered hydrogen fuel cell experiment equipment

## Spec

### 1) Solar Module

- (1) Power : 10W
- (2) Weight : 1.5 Kg
- (3) Qty : 3EA

### 2) Halogen Lamp - Power: 220V / 300W : 3EA

### 3) H<sub>2</sub>/O<sub>2</sub> Electrolyzer : 3EA

### 4) PEMFC Fuel Cell Stack : 3EA

- (1) Power : 200mW per Cell / Total 10 Cells 2 Watt
- (2) Fuel : H<sub>2</sub>/Air



**5) Control panel**

- (1) NFB 30A, Single 1A
- (2) SMPS (24V 3.1A)
- (3) Voltage meter : DC voltage 1EA
- (4) Current meter : DC Am meter 1EA
- (5) Toggle Switch : 1EA
- (6) Testers Part : DC Motor, LED Lamp

**6) Size**

- (1) Installation table (with multi caster) : 1,220(W) \* 820(H) \* 700(D)(mm)
- (2) Control panel : 960(W) \* 280(H) \* 170(D)(mm)

**7) PROGRAM HARDWARE & SOFTWARE**

(1) Data acquisition hardware

Can measure change of physical phenomenon depends on the type of sensors and variation of voltage & current  
 Converts and controls analog signals of temperature, pressure, voltage into digital data  
 Can be connected with PC provides manual adjusting features to control each components of solar power generation equipment  
 Uses RS-232 signaling method to interlock with common software including LabVIEW  
 Displays DC/AC voltage and current of each components including solar panel, charger controller, battery, fuel cell, electrolytic bath and power supply

(2) Data acquisition software

Real-time displaying of current & voltage graph and system diagrams  
 Adjustment feature of solar radiation value, panel temperature, electrolytic bath, fuel cell size & characteristics  
 Can measure and calculate the input / output voltage of both off grid & system interconnection inverter  
 Can select data acquisition interval time and display data by one decimal points  
 Offset adjustment to voltage available by displaying varied amount by users  
 Prevents data loss from power shutdown by saving data to xml format  
 Real-time monitoring of battery usage available  
 Shows diagram of experiment process by indicating voltage & current of each components and helps understanding of overall system  
 Includes image capture & save of displayed diagram and graphs  
 Can display selected voltage & current on the graph  
 Compatible with Windows 2000, XP, Vista, 2008 and both 32bit & 64bit OS

**8) Guarantee : For 1 year**

# model: Renewable energy-1500

## Renewable energy training system

### Features

- Principles and components of renewable energy
- Hybrid renewable energy development practice (solar, wind, fuel cell)
- Stand-alone and grid-connected renewable energy generation system practice
- Understand the principles and structure of stand-alone and grid-connected inverters, and system concept
- Serial and Parallel Connected Solar Power Generation Practice
- Built-in wiring protection circuit
- Using charge controller test points, Principles of charge controller exercise
- Analyzing the quality of electric power produced by inverter using power quality analyzer
- Including analog integrated watt hour meter
- Real-time monitoring on lab equipment without PC
- Provided with electronic instrument and electronic part, can measure solar and fuel cell performance without separate measuring equipment.

### System configuration



### Components

(1) MONITORING SYSTEM MODULE	1 ea
(2) PV CELL MODULE-I	1 ea
(3) PV CELL MODULE-II	1 ea
(4) CHARGE CONTROLLER MODULE	1 ea
(5) AC LOAD MODULE	1 ea
(6) DC LOAD MODULE	1 ea
(7) SMART MULTIMETER MODULE	1 ea
(8) DC ELECTRONIC LOADER MODULE	1 ea
(9) DC-DC CONVERTER MODULE	1 ea
(10) LIGHT CONTROL MODULE	1 ea
(11) SINGLE PHASE INVERTER MODULE	1 ea
(12) GRID-CONNECTED INVERTER MODULE	1 ea
(13) WATTHOUR METER MODULE	1 ea
(14) DIGITAL MULTIMETER MODULE	1 ea
(15) POWER SUPPLY MODULE	1 ea
(16) Loader (LED/Resistor)	1 ea
(17) Wind energy MODULE	1 ea
(18) Wind energy MODULE-2	1 ea
(19) Program CD	1 ea
(20) Manual book	1 book

## Training Contents

- Part-1, Photoelectric effect simulation
- Part-2, Ohm's Law and Voltmeter / Ammeter Experiment
- Part-3, Measurement of solar panel efficiency
- Part-4, Solar module characteristics experiment by light quantity
- Part-5, Solar module characteristics experiment with temperature change
- Part-6, Photovoltaic generation by shaded area
- Part-7, Experiment of exposure defects protection and hot spot
- Part-8, Electrical characteristics of solar module according to incident angle
- Part-9, Direct / Parallel Connectivity Experiment
- Part-10, Bypass Diode Experiment
- Part-11, Charging controller experiment
- Part-12, Battery characteristics experiment
- Part-13, DC-AC inverter experiment
- Part-14, DC-AC inverter load experiment
- Part-15, Grid-connected inverter experiment (no load)
- Part-16, Grid-connected inverter experiment (load)

## Spec

### 1) Software spec

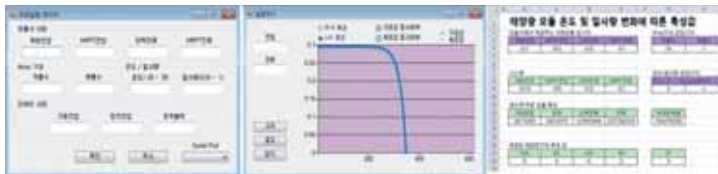
- (1) Power generation monitoring (embedded monitoring system)



- (2) Photovoltaic effect and Simulation method of electric and electronic, low-voltage, ammeter



- (3) Solar characteristics simulation program (PC program)



### 2) Hardware spec

- (1) MONITORING SYSTEM MODULE



- PXA 270 Embedded System
  - 7" TFT LCD Touch Display
  - USB Host/ Client, TCP/IP
- RS485, RS232C, ZigBee & PLC
  - ZigBee Module
  - PLC Module (Option)

(2) PV CELL MODULE-I



Electricity production by PV module  
Practice efficiency by brightness and angle of light  
Output 10W  
Auxiliary lighting: 300W, halogen lamp, adjustable angle

(3) PV CELL MODULE-II



Direct and parallel connection of solar cell possible  
Rated power: 0.5W x 6 EA  
Rated power : 2V  
Rated current : 250mA  
Open voltage : 2.3V  
Maximum current : 275mA  
Input terminal: 6 EA, Output terminal: 2 EA

(4) CHARGE CONTROLLER MODULE



Test Point : 4EA  
(Output, GND, over voltage check, reference voltage)  
LED: Charging status, over discharge check  
Variable resistance: Charge voltage setting, over discharge reference voltage setting  
Input terminal  
BATTERY terminal  
LOAD OUTPUT  
BATTERY : DC 12V, 7A

(5) AC LOAD MODULE



Fluorescent lamp  
· Operating voltage : AC 220V  
· Rated input current / lighting frequency : 0.09A / 42KHz  
AC Motor  
· Operating voltage : AC 110/220V  
· Power Consumption / Speed: 3.5W / 36rpm  
220V Two Outlets: 220V / 15A

(6) DC LOAD MODULE



DC lamp: 3 ~ 12VDC  
DC Motor  
· Operating voltage : 12V  
· Power Consumption / Speed: 0.63W / 6,100rpm  
Input polarity check buzzer  
· Operating voltage : 5~12V

(7) SMART MULTIMETER MODULE



Power quality analysis device  
Rated voltage : AC 85~600V  
Rated current : CT 5A  
Control power source : AC 100~240V  
frequency : 50/60Hz  
Communication method : MODBUS  
Communication speed : 9600bps

(8) DC ELECTRONIC LOADER MODULE



Auto-Increment LOAD Current Function  
(Automatic increase of load current)  
Configurable Delay Timing  
(Delay timing setting function)  
Display LCD  
Load input terminal

(9) DC-DC CONVERTER MODULE



DC/DC Converter  
DC FAN  
Input polarity check buzzer

(10) LIGHT CONTROL MODULE



AC / DC lighting brightness and power supply  
Brightness control of light by dimmer controller  
AC Dimmer Controller : AC 220V / 1KW  
DC Dimmer Controller : DC 12V

(11) SINGLE PHASE INVERTER MODULE



Input voltage: DC 10 ~ 15V  
AC output: 220V / 60Hz, 200W  
Output Waveform: Analogous Inverter  
Test Point  
Frequency variable dial  
Reverse voltage protection circuit

(12) GRID-CONNECTED INVERTER MODULE



Input voltage range : DC 11~30V  
AC output : 220V/60Hz, 300W  
Voltage Meter  
Ampere Meter  
Reverse voltage protection circuit

(13) WATTHOUR METER MODULE



Real-time consumption monitoring based on power generation  
Forward rotation at power consumption, reverse rotation  
at power generation power transmission  
3-wire type: Single-phase 2-wire type  
Wiring method: Up-and-down wiring method /  
Left-right wiring method  
Mounting type: Exposed type  
Rated: 220V 40 (10) A 60Hz  
AC IN / OUTPUT: Double protection terminal 4EA

(14) DIGITAL MULTIMETER MODULE



- DC Voltage Meter
- DC Ampere Meter
- AC Voltage Meter
- AC Ampere Meter
- RS485, ZigBee Connector

(15) POWER SUPPLY MODULE



- DC : 30V / 3A
- Meter: Analog V, A
- VR : 1 EA
- Input power: AC 220V

(16) Loader (LED/Resistor)



- Load (LED & Resistor Setps 11)
- LED Loader x 3 EA
- Resistor : 3.4 ~ 300
- Input terminal: 8 EA

(17) Wind energy MODULE



- 25W Generator & Motor 1 set
- Built-in motor speed control system
- Operation of charge controller and stand-alone inverter due to wind turbine power generation

(18) Wind energy MODULE-2



- 300W generator
- Output voltage: 12V
- Rotation diameter: 90.3cm
- 4 stage blower

# model: Smart Grid-GTP990

## Smart Grid Training Equipment

### Features

The existing Electric Power Grid is concentrated in the center (Electric Power Generation & Distribution Company) and supplies the power in one direction according to the demand.

On the other hand, Smart Grid uses the produced power by the decentralized power sources (Solar & Wind Energy,,, etc) through network connection and the information transfer process is performed automatically in both directions.

So, it is possible to make intelligent demand management such as electric vehicle charging, and new and renewable energy interconnection by exchanging information of power generation and consumption information in real time between the supplier and the consumer.

1) Configuration of the system is as follows ;

- Solar panel
- Wind turbine
- Smart-grid hardware,
- Power system interconnection hardware
- Scaled Power System Hardware (Equipment for 5 bus power system)
- SCADA/EMS software (Monitoring & control GUI)
- HMI Server

2) Service voltage : AC 110V~240V, AC380V

3) Features of Smart Grid-GTP990

(1) Smart-grid hardware.

Commercial (industrial) solar panel and wind turbine can be connected.

Also, this system is consisted of ESS & Inverter, Load,,, etc, so it is possible to practice the power energy generation, storage, use and DC/AC conversion experiment based upon load forecasting.

(2) Power system Interconnection hardware.

Power System Interconnection experiment, Electric power transmission control experiment, and Voltage control experiment can be performed by M-G set-based Power System interconnection equipment to link with Smart Grid equipment and Power distribution company (Utility).

(3) Scaled Power System Hardware (Equipment for 5 bus power system).

To enable Power system simulation of 345kV, 154kV, 22.9kV, 66/22kV, this hardware is consisted of 5 bus Power system of grounding / ungrounding method. Also, this system configuration enable to practice Power flow experiment, fault detection experiment, voltage-reactive power control experiment, protection relay experiment, and Power system interconnection experiment for variable load.

(4) SCADA/EMS software (Monitoring & control GUI).

Smart Grid-GTP990 is HMI based experimental equipment and configured to implement the experiment for Remote control on Smart-grid hardware & Scaled power system hardware.

It is possible to learn the communication technology for Power Control through remote monitoring control by each tag of Digital Meter Contact Point and communication device & Computer communication.

(5) Nowadays. there is big supply of the decentralized power sources based on renewable energy such as solar power and wind power,,, etc.

So, it is needed to educate Smart-grid power technology in university, polytechnics,,, etc.

Smart Grid-GTP990 is the experimental equipment having whole modules such as Smart Grid Hardware, Power System Interconnection hardware, Scaled Power System hardware, SCADA/EMS monitoring & control software.

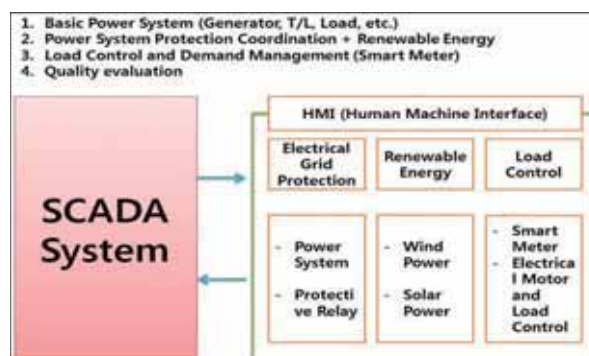
(6) Smart Grid-GTP990 can rear the engineers for design, monitor, control & analysis technique of Smart Grid, Power System Interconnection,

Scaled Power System, SCADA/EMS software that has been widely expanded to industrial market for the decentralized power sources such as Solar & Wind energy.

(7) Smartgrid-GTP990 is the training equipment that enables to rear an engineer capable of adapting to the industrial field through training of Smart Grid Experimental equipment and Simulation Software that works in commercial market.

- (8) Various practical examples (15 chapters on manual book) can be exercised for design & operation technique using Smart Grid Training Equipment.
- (9) Through Smart Grid-GTP990, the student can learn & improve the ability on modeling, Power Flow Calculation, Fault Analysis,,, etc
- (10) Training on Interconnection Control Technique between the decentralized Power Sources and High power system.
- (11) Learning on systematic maintenance by training basic knowledge of monitoring control system.
- (12) provides the new renewable-based decentralized power design data, smartgrid power system equipment, and PSS / E simulation data so that the students can utilize it.

## System configuration





## Components

1) Smart-grid hardware (included Solar panel & Wind turbine)	1 set
• Solar panel (installed to outdoor),	1 set
• Wind turbine (installed to indoor),	1 set
2) Power system interconnection hardware	1 set
3) Scaled power system hardware	1 set
4) SCADA, monitoring & control software	1 copy
5) Manual book	1 book

## Textbook contents

### Part-1, Introduction of Smart Grid-GTP990

#### Chap 1, Smart grid equipment

- 1) Why Smart Grid ?
  - (1) The need for renewable energy
  - (2) Function of Smart Grid
- 2) Configuration of Smart Grid Equipment
  - (1) Configuration of Smart Grid Equipment
  - (2) Solar modules
  - (3) Wind modules
  - (4) Inverter
  - (5) Battery
  - (6) Charge control device
  - (7) Wire
- 3) Design of Smart Grid System
  - (1) Design concept
  - (2) Photovoltaic system design
  - (3) Wind power system design
  - (4) Hybrid System Design

#### Chap 2, Scaled power system equipment

- 1) System overview
  - (1) Object
  - (2) System overview
  - (3) Key Learning Features
- 2) System configuration
  - (1) Rated power equipment
  - (2) configuration & function of protective relay system

#### Chap 3, Power System interconnection equipment

- 1) System overview
- 2) Power System connection method
- 3) Configuration of interconnection equipment
- 4) How to use

#### Chap 4, SCADA system

- 1) System overview
- 2) HMI S/W
- 3) Setting for communication
- 4) Create menu
- 5) Data interface configuration and utilization

### Part-2, Practice of Smart Grid-GTP990

#### Chap 5, Practice of Electric Power System Design based on renewal energy

- 1) Solar power system design (grid-connected, stand-alone)
- 2) Wind power system design and hybrid power configuration

#### Chap 6, Smart Grid Power System Practice

- 1) Smart Grid Power System Experiment on Solar & Wind Energy equipment

#### Chap 7, Simulation analysis technique experiment of high power system

- 1) Modeling of Electric Power System Components, Power flow calculation, Fault calculation & Theory

#### Chap 8, Computer simulation experiment of High power system analysis

- 1) Based -PSS / E and to 5 bus Power System , computer simulation practice of Power flow Calculation, Fault Calculation, Voltage-Inactivity Control

Chap 9, Practice for 5 bus Power system status

- 1) Ferranti effect, Power flow analysis, Failure analysis practice using Smart Grid-GTP990 equipment

Chap 10, Protection Relay Setting Practice for power distribution system

- 1) Computer simulation of 1-line ground, 3-phase short circuit
- 2) Protective Relay Setting
- 3) Experiment of Electric Power System Protection

Chap 11, Power System Interconnection Technique Experiment of the decentralized Power Sources

- 1) Power System Interconnection Principle & Voltage Flow Control Technique Experiment

Chap 12, Power System Interconnection Experiment of the decentralized Power System

- 1) Synchronizing & release of the Power System Interconnection
- 2) Power flow & voltage control experiment

Chap 13, Remote Control Technique experiment by HMI

- 1) SCADA Technology by Human Machine Interface

Chap 14, Characteristics experiment of HMI, Information & Communication devices

- 1) Information & communication system configuration for Smart Grid Remote Control

Chap 15, Realization experiment of EMS/SCADA technology

- 1) EMS/SCADA system operation experiment for Smart Grid-GTP990

## Spec

### 1) Smart Grid hardware part.

(1) Smart-grid hardware part is consisted of below systems.

- Smart-grid hardware (installed to indoor), : 1 set
  - 12V Wind power generation terminal(12V,400W) with Energy Storage System : 1 ea
  - 12V Solar Power generation terminal with Energy Storage System : 1 ea
  - 24V Solar power generation terminal with Energy Storage System : 1 ea
  - Charging units : 2 ea
  - DC-DC Converter(24V /12V) for DC grid interconnection : 1 ea
  - DC-AC converter(DC 24V/ AC 220V) for DC /AC power transferring : 1 ea
  - DC and AC electric loads
  - Digital metering units
  - Programmerable Logic Controller to control and communication : 1 ea
- Solar panel (installed to outdoor) : 1 set
  - 12V 40W PV panel with structure
  - 24V 160W PV panel with structure
  - Connection wire and switch panel
- Wind turbine (installed to outdoor), : 1 set
  - 1 12V 400W wind turbine generator
  - 1 tower and guideline

(2) Smart-grid hardware part has below functions

- 24V / 12V DC-DC loads & interconnected operation
- 24V DC/220V AC inverter & loads & system interconnected operation

(3) User can learn belows from Smart-grid hardware part.

This is to learn about renewable energy based stand-alone photovoltaic & wind power system design evaluation technique.

- Load demand calculation (DC, AC)
- Specify renewable power energy system size depending on the environment
- Maximum battery capacity & supply calculation
- Battery size and standard selection
- Charge controller selection
- Inverter standard selection

### 2) Power System Interconnection hardware part

(1) Micro Grid Output : DC 24V

(2) Single Phase Output : AC 220V

(3) MG Set applied construction

(4) Power interconnection type

DC-DC interconnection

- DC 12V and DC 24V interconnection method experiment using DC/DC inverter and measure the efficiency of the inverter

DC-AC interconnection

- DC 24V and AC 220V interconnection method experiment using DC/AC inverter.
- test the charging effect of DC due to capacitor and charge in AC due to the inverter.

AC-AC interconnection

- 3-phase synchronous generator interconnection method equipment
- Principles of synchronous and interconnection experiment

(5) Power interconnection hardware

- DC 12V to DC 24V 360W step up converter regulator
- DC 24V to AC 220V 360W converter
- AC 1 phase 220V Motor-Generator AC 3phase 220V set with Synchronizing Detector

### **3) Scaled Power System hardware part**

- (1) 2 Power source bus: Renewable energy power, testing power
- (2) Experimental loads: Dynamic & static loads, load control availability
- (3) Transformer: Step-up, Step-down, Y-Y, Y-Delta connected transformer
- (4) Phase modifying equipment: Shunt Reactor, static capacitor 3 sections each
- (5) 3 phase, 2circuit Transmission lines and 3 phase 2 circuit distribution lines
- (6) Synchronizing Detector for microgrid interconnection
- (7) 4 Fault terminals(single phase ground fault, 3 phase short fault)
- (8) 1 Digital protection relay and 3 Over Current Relays and 1 Over Current Ground Relay.
- (9) 2 PTTs and 11 CTTs for CT and PT connection change.
- (10) Controllable Loads for Light Load, Mid Load, Peak Load
- (11) Programmable Logic Controller to control and communication

### **4) Supervisory Control and Data Acquisition (SCADA) system**

- (1) Monitoring and Control Microgrid and Scaled Power System power status
- (2) Display single line diagram of Microgrid and Scaled Power System features
- (3) Monitoring DC and AC Power, Voltage, Current
- (4) Monitoring Circuit Breaker operating status(On-Off)
- (5) Monitoring Circuit Breaker operating status(On-Off)
- (6) Records operating status(CB On-Off, Power, Voltage, Current for each measuring points)
- (7) control transmission and distribution line power flows and voltages with Circuit breakers
- (8) Data preparation for load flow calculation with program

# 44

## a group of Thermal, Steam & Boiler Training Sytem

- 142. GT-Steam & Boiler 16
- 143. Steam Power-GT19
- 144. GT-Thermal55
- 145. GT-Geothermal heat energy700
- 146. Ice Stores-5000
- 147. Heat Exchanger-5000
- 148. Water Heating-5000
- 149. Cooling system with Ice Storages-GT900

# model:GT-Steam & Boiler16

## Steam / Boiler system trainer

### Features

Automatic control and fault diagnosis experiments are available.  
 Through double-tube heat exchangers, learn the temperature changes & its calculation of tube heat exchangers.  
 Understand the principles of Steam & boiler system through the circuit of the piping.  
 Experiments on each system operation.  
 Test on Fan coil units.  
 Data is automatically saved.

### System configuration



### Components

Hardware platform	1 set
Program CD	1 ea
Manual book	1 book

### Training contents

- 1) Overview
- 2) Specification for Hardware platform and basic operations
- 3) How to use Control and measurement devices
- 4) How to use Sensor data program
  - (1) Select the log data from experiments conducted.
  - (2) Save the data
  - (3) Check the data for temperature, pressure, flux in real time
  - (4) Export data for data processing using other software
- 5) Technical descriptions
- 6) Theory

## Spec

### 1) Hardware

Rated evaporation :	50Kg/hr
Maximum operating pressure :	0.7(7Kg/cm <sup>2</sup> )
Heat output :	0.04MW
Heat efficiency :	86%
Heat transfer area :	2.6m <sup>2</sup>
The amount of water :	40L
Burner motor :	0.04kw
Feed pump :	0.25kw
Combustion system :	Forced ventilation indentation
Control method :	on-off control
Fuel :	diesel
Fuel consumption :	3.61kg/h
Gas duct (inside diameter) :	100mm
Gas duct (external diameter) :	120mm
Oil tank :	20L
Water tank :	feed water or over 20L
Fan coil units :	1EA
Water flow meter :	20A

### 2) Software (Heat treatment table program)

(1) Select the log data from experiments conducted.
(2) Save the data
(3) Check the data for temperature, pressure, flux in real time
(4) Export data for data processing using other software

# model: Steam Plant-GT19

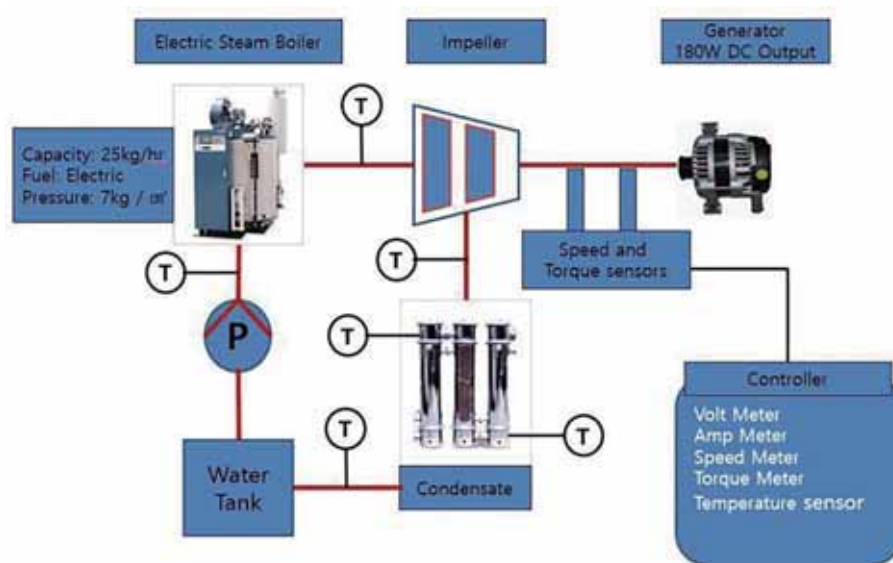
## Steam Turbine Power System

complete miniature vapor power system illustrating the concepts of thermodynamic cycles, mass and energy conservation and electrical power generation

### Product Description

- Portable Educational Vapor Power System
- Simple to Operate with Automatic Safety Features Throughout
- Complete Thermodynamic Teaching Solution
- Modern Real World Steam Turbine Design
- DAQ Data Acquisition System Utilizing USB Technology
- User Configurable Real Time Computer Data Display
- Supplied with a Comprehensive Operator's Manual, Checklists and Safety Instructions.

### System configuration



(Actual production may vary)

## Components

Steam Plant-GT19 is consisted of below components ;

- 1) Steam boiler, 1 unit
- 2) Impeller, 1 unit
- 3) Generator, 1 unit
- 4) Condenser, 1 unit
- 5) Tachometer, 1 unit
- 6) Pressure gauge, 1 unit
- 7) Digital voltmeter, 1 unit
- 8) Digital Amperemeter, 1 unit
- 9) Controller, 1 unit
- 10) Water tank, 1 unit
- 11) Speed & Torque sensors
- 12) Software program (Data logging analysis program), 1 copy
- 13) Piping

## Experimental Opportunities

- Chap 1, Energy relationships and the First Law of Thermodynamics.  
Chap 2, Cycle analysis and the Second Law of Thermodynamics.  
Chap 3, Control volume analysis.  
Chap 4, Entropy analysis.  
Chap 5, Isentropic analysis and the study of turbine / nozzle efficiency.  
Chap 6, Heat transfer analysis and the study of boiler efficiency.  
Chap 7, Combustion processes.  
Chap 8, Vapor power system fundamentals.  
Chap 9, Electric power generation.  
Chap 10, Experimental and data acquisition technique.

## Specifications

1. Consisting of a fossil-fueled boiler, steam turbine and condenser tower mounted on a rigid, mobile frame.
2. Steam rate adjustable through a steam admission valve, regulating turbine speed and power output.
3. Axial flow turbine used to drive an alternating current generator.
4. Generator output to be rectified allowing the output of direct current.
5. Generator output capable of delivering 24 Volts at 1 Amp to infinitely adjustable 24 Watt load.
6. Unit to include analog boiler pressure gauge, generator voltage and generator current meters.
7. To be supplied with a USB based digital data acquisition system complete with computer and user configurable data acquisition software capable of measuring and recording analog, digital and frequency signals.
8. Equipped with calibrated transducers and thermocouples capable of measuring boiler temperature and pressure, turbine inlet and exit temperature and pressure, turbine RPM, fuel flow rate and generator load, voltage and current.
9. All metal surfaces to be stainless steel, anodized or powder coated to promote durability and wear resistance.
10. Provided with a comprehensive Operator's Manual with design, operation and construction information.
11. Provided with summary operating checklists for all operating conditions.
12. Provided with safety instructions to address all operating conditions.
13. Dimensions
  - Steam Turbine Power System : 1400 x 1220 x 770 mm
  - Boiler : 1000 x 800 x 1200 mm
  - Digital : Data Acquisition System
  - Data Acquisition Software with Configurable Data Output
  - Windows Computer for On-Screen Data Display
14. Sensors (Preinstalled and Calibrated)
  - Boiler Temperature and Pressure
  - Turbine Inlet Temperature and Pressure
  - Turbine Exit Temperature and Pressure
  - Turbine RPM
  - System Electrical Load
  - Generator Voltage Output & Current Draw
  - Analog: Boiler Pressure, Generator Voltage Output & Current Draw
15. Operating Requirements
  - Typical Laboratory or Classroom Setting
  - Power: 220V single-phase 50~60Hz
  - Fuel: Liquid Petroleum



# model: **GT-Thermal55**

## Thermal storage training system

### Features

1. The components of the product consist of solar collectors, heat storage tanks, pumps, sequence modules, graphic modules, heat exchangers, data acquisition devices and switch devices. User can also add the required modules according to the needs.
2. In order to perform various experiments on the solar heating system, a heat load device should be provided so that the heat source can be controlled in various ways.
3. By measuring the inlet / outlet temperature of the load device, the amount of heat exchange can be calculated and a proper design can be made.
4. Calories generated from solar heaters can be calculated and various data can be acquired to enable efficient measurement.
5. According to the data collection device configuration, temperature and pressure conditions can be checked on the computer, and automatic control according to temperature variation is possible.
6. It is a structure that can apply and utilize the heat that has accumulated heat by exchanging indoor heat exchanger.
7. The entire flow is checked at a glance, the graphic module for manual control is applied, and the operating part is indicated by pilot lamp.
8. The control panel and graphic panel are attached to the front of the product, so that the equipment can be driven by the sequence circuit and the entire control circuit of the system can be configured.
9. It consists of a system using graphical panel to view system flow.
10. At least 15 sequence control circuits can be satisfied.
11. Data Logger program , Solar Heat Scale Program is provided.

### System Configuration



Sequence Control Unit  
Graphics Module Device  
Mechanical Devices

## Components

Hardware platform	1 set
Bananna Jack (Red)	20 ea
Bananna Jack (Black)	20 ea
Power cable	1 ea
Program CD	1 ea
Manual book	1 book

## Spec

### A) Machine part

- 1) Solar heat collector
  - (1) Type: Heat pipe type
- 2) Data Acquisition and Switching Device
- 3) Solenoid valve
- 4) Feeding pump - for circulating solar equipment
- 5) Solar Thermal Storage Tank - Connected with Solar Thermal Equipment
  - (1) size: more than 552\*1000mm
  - (2) Tank bore size: 440
- 6) Heat Exchanger Module - Load Regulator
  - (1) 4-way ceiling-mounted heat exchanger
  - (2) Floor-mounted heat exchanger - front discharge
- 7) Circulation pump - connected to heat exchanger
- 8) Piping (including insulation)
- 9) Refrigeration equipment for heat exchange - for load regulation
- 10) Entire system configuration
  - (1) Frame: composed by profile frame
  - (2) Dimension : appx. 1800 × 800 × 1750 mm
  - (3) Install sequence module and graphic module on the front

### B) Electrical part

- 1) Automatic control module: 795 \* 600 aluminum printing or engraving
- 2) Electronic switch: 13A, 5a2b: 3EA
- 3) Relay (8Pin): 4EA
- 4) Timer (24hr) : 1EA, Timer (60sec) : 1EA
- 5) Thermal overload relay: 1EA (with MC)
- 6) High and Low Pressure Switch : LPS, HPS
- 7) Power control: toggle, push button, select switch
- 8) Safety devices: overcurrent breaker (N.F.B), buzzer, fuse
- 9) Indicator lamp: red, green, yellow, white
- 10) Digital thermometer: 10EA (temperature controlled type)
- 11) Digital hygrometer: 1EA (humidity control type)
- 12) Indicator lamp: red, green
- 13) Graphics module: 795 \* 600 aluminum

### C) Software Program part

- 1) Data Logger program
- 2) Solar Heat Scale Program

## Training contents

- Chap 1) Experiment / Practice for basic circuit configuration using switch
- Chap 2) Experiment / practice for configuring a and b contact circuit using MC  
(Magnetic Switch, Magnetic Contactor)
- Chap 3) Experiment / Practice for configuring C Contact Circuit using a Relay (auxiliary relay)
- Chap 4) Circuit configuration using MC (magnetic switch, magnetic contactor)
- Chap 5) Operation of Solar System using toggle switch and MC
- Chap 6) Operation of Solar Device using Toggle Switch and Relay
- Chap 7) Automatic operation of heat exchanger using relay and temperature switch -  
(automatic heating operation)
- Chap 8) Automatic operation of heat exchanger using relay and temperature switch -  
(automatic cooling operation)
- Chap 9) Automatic operation circuit configuration of solar heating system using lock-up circuit -  
(Automatic heating operation using switch)
- Chap 10) Automatic operation circuit configuration of solar heating system using lock-up circuit -  
(Automatic heating operation using switch)
- Chap 11) Automatic operation circuit configuration of solar thermal system using sequence circuit -  
(Automatic heating operation using MC)
- Chap 12) Automatic operation circuit configuration of solar thermal system using sequence circuit -  
(Automatic heating operation using MC and temperature switch)
- Chap 13) Automatic operation circuit configuration of solar thermal system using sequence circuit -  
(Automatic heating operation using toggle switch and temperature sensor)
- Chap 14) Automatic operation circuit configuration of solar thermal system using sequence circuit -  
(automatic heating operation)
- Chap 15) Automatic operation circuit configuration of solar thermal system using sequence circuit -  
(automatic cooling operation)
- Chap 16) Automatic operation circuit configuration of solar thermal system using sequence circuit -  
(Sequence control using relay and MC)
- Chap 17) Automatic operation circuit configuration of solar thermal system using sequence circuit -  
(Switching operation of heat exchanger through freezer)

# model: **GT-Geothermal Heat Energy700**

## **Geothermal Heat Energy system trainer**

### **Overview**

1. The system using geothermal energy is constructed to understand the basic theory and the principle of geothermal heat energy.
2. It is a system using geothermal energy and it is organized on the table to make an easy operation principle.
3. The main part of the system is made of a transparent case, and it has a structure that can monitor the actual operation situation and the flow of the pipe.
4. It is possible to perform various tests according to temperature setting from low temperature to high temperature by using the principle of the actual geothermal heat energy.
5. It is necessary to be able to measure geothermal temperature, to measure the temperature of each point of the refrigerator and the heating medium chamber in real time through temperature display panel.
6. The heat source of the refrigeration system is the heat pump type and is composed of a system that can make various choices according to the usage method of cold and heat, heat and heat
7. Control and graphic panel is attached to the front of the equipment so that the equipment can be driven by the sequence circuit using the banana jack and overall control circuit configuration is possible
8. It is easy to understand the system configuration and flow using graphical panel to view the system flow.
9. At least 15 sequence control circuit configurations is implemented.

### **System configuration**



## Components

Hardware platform	1 set
Bananna jack (red)	20 ea
Bananna jack (black)	20 ea
Power cable	1 ea
Geothermal heat energy data logger program	1 ea
Manual book	1 book

## Experiments (Study Objectives)

Chap 1, Geothermal Heat Pump Trainer configuration  
 Chap 2, Geothermal Heat Pump Trainer © Sequence control part  
 Chap 3, Geothermal Heat Pump Trainer © Machinery part  
 Chap 4, Geothermal Heat Pump Trainer Sequence of operations  
 Chap 5, Geothermal Heat Pump Trainer Cycle and P-H Chart  
 Chap 6, Record of Pressure, Temperature and Enthalpy Values  
 Chap 7, Calorie Calculation and P-H diagram  
 Chap 8, How to use manifold  
 Chap 9, Electric Parts use explanation  
 Chap 10, Machine parts use explanation  
 Chap 11, Practice contents.  
 Chap 12, How to operate the program

## Spec

- Underground heat exchange unit ( It is operated by its own temperature control system)
  - The heat flowing through the pipe uses the underground heat as energy.
  - Structure that is made transparent and can check the heat exchange method and status.
  - Transparent & size : over 500mm x 300mm x 400mm
  - Heater unit : U type 2ea
  - Refrigeration device : 1/2hp, fin tube heat exchanger, tube type heat exchanger
  - Safety device using pressure switch
- Overall system configuration
  - Frame: Two-stage profile frame, consisting of controller cover, with one drawer
  - Size : around 1800 x 730 x 1750mm
  - Sequence module and graphic module installed on the front part
  - Heat pump unit installed on the top plate, underground heat exchange unit and temperature control unit installed in the lower part
- Heat pump device
  - Compressor : 1/2hp or more.
  - Heat exchanger-1 : Coil type, smooth heat exchange with underground heat exchange unit
  - Heat exchanger-2 : Heat exchanger in transparent case (Pin-Coil type)
  - Liquid receiver : over 1/2hp
  - Liquid separator(Accumulator) : over 1/2hp
  - Four-way valve : 1/2 " - 3/8 "
  - Filter dryer : 3/8 " welding type
  - Check valve (2ea) : 3/8 "
  - Manual expansion valve (2ea) : As-0.093
- Sequence automatic control module
  - Automatic control module : 795 \* 600 aluminum
  - Electronic switch : 13A, 5a2b : 3EA
  - Relay (8Pin) : 4EA
  - Timer (24hr) : 1EA, Timer (60sec) : 1EA
  - Thermal overload relay : 1EA (MC attachment type)
  - High and low pressure switch : LPS, HPS
  - Power control : toggle, pushbutton, select switch
  - Safety devices : overcurrent breaker (N.F.B), buzzer, fuse
  - Indicators : red, green, yellow, white

5. Simulation module

- 1) Digital thermometer : 8EA (temperature controlled type)
- 2) Indicators : red, green
- 3) Graphics module: 795 \* 600 or higher

6. Heat exchanger : 320 \* 350 \* 500 Transparent structure, 1/3hp heat exchanger, fan, fan motor, fan cover, 4 stage bevel gear damper (inlet and outlet)

7. Circulation pump - connected to heat exchanger

- 1) Lift (m) : 3 or more
- 2) Compression height (m) : 3 or more
- 3) Diameter (mm): 25

8. Data communication via Laptop PC

- 1) The data collecting and transmitting device is free from any problem in receiving and using the data.
- 2) Main menu, temperature and pressure display part, process diagram part, P-I graph part and review part
- 3) A diagram of the refrigeration cycle, a real-time enthalpy and change value view portion of each section during operation, a data storage interval setting portion, and a start portion
- 4) The program is able to drive the machine, and the drive must be capable of manual operation and automatic operation according to the temperature set point.
- 5) Data recording and system monitoring program of the refrigeration system can be used to save the experimented data as an excel file.
- 6) It consists of a review program that can recall the P-I diagram by importing the file saved as Excel or other file
- 7) It consists of a graph that shows each individual temperature and pressure change
- 8) Real-time view of the refrigeration effect on the refrigeration cycle, the heat of compression, the heat released by the condenser, the latent heat of vaporization, and the coefficient of performance.
- 9) The set value and the temperature pressure enthalpy value should be able to be saved automatically in real time
- 10) Condenser : air-cooled, single phase 220V (transparent glass tube)
- 11) Liquid separator, liquid receiver: (transparent glass)
- 12) Geothermal heat energy control data logger software program

# model: Ice Stores-5000

## Ice Stores

### Features

1. Experiment on temperature, pressure, automatic control of the device with Ice Accumulation
2. Learn the refrigeration system with Ice thermal storage and device's principle
3. Experiment on cycle change of refrigeration equipment according to temperature and Mollier diagram drawing in P-I diagram drawing part.
4. Theoretical education and experiment related to efficiency test of device and Ice storage
5. Theoretical education of a fundamental circuit, application circuit and experiment with Ice storage
6. Experiment on temperature, pressure and automatic control and operation via Sequence screen attached to the graphic module control department and power automatic control machine.
7. Visual control department
8. Automatic control with graphic panel and two automatic control modules
9. Data formation by data auto-saving and P-I diagram auto-operation in the system with control program
10. The high-pressure and the low-pressure piping of the freezer should be convertible made of a transparent pipe so that the refrigerant flow of the piping can be seen.
11. The receiver, liquid separator and condenser should be convertible made of a transparent pipe so that the flow of refrigerant can be seen.
12. It should re-read the data stored in the data program so that they can review the diagram.

### System configuration



### Components

- |  |  |
|--|--|
| Part 1, Fitting refrigerant  | Part 8, Temperature control at evaporator        |
| Part 2, Vacuum test  | Part 9, Temperature control at condenser         |
| Part 3, Leak test  | Part 10, Pressure control at low side            |
| Part 4, Troubleshooting at brine system machine                            | Part 11, Pressure control at high side           |
| Part 5, Troubleshooting at electric circuit                                | Part 12, Measuring features kind as brine liquid |
| Part 6, Fitting electric circuits for brine system                         | Part 13, Component understanding of brine system |
| Part 7, Refrigeration effect as ratio of the expansion V/V in brine system | Part 14, COP calculation for brine system        |

## Spec

- 1) Compressor : 1/2HP, single-phase 220V, Control Box
- 2) Condenser : Air-cooled type, single-phase 220V  
(It should use 5-stage transparent material to see the flow of refrigerant)
- 3) Evaporator : Chamber with accumulation of heat, plate Heat Exchange
- 4) Liquid receiver : 1HP, Accumulator : 1/2HP  
(It should use transparent material to see the flow of refrigerant)
- 5) Expansion Valve: manual expansion valve, capillary tube, automatic Expansion
- 6) Electronic Valve : : 3/8" nut clamp type or welding type
- 7) Filter dryer : 3/8" nut clamp type or welding type
- 8) Manometer: High Pressure, Low Pressure
- 9) Filling nipple : Attached to a nipple for Filling
- 10) Sight Glass : welding type or nut clamp type
- 11) circulation pump : circulation for heat medium
- 12) Chamber(ice maker)
- 13) Plat exchanger
- 14) Sequency control screen: 795\*600,
- 15) Magnet Contact : 13A, 5a2b : 3EA
- 16) Relay (8Pin) : 4EA
- 17) Timer (24hr) : 1EA, Timer (60sec) : 1EA
- 18) THR : 1EA (with MC)
- 19) High and Low pressure switch : LPS, HPS
- 20) Power Control : toggle, push button, selected switch
- 21) Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
- 22) Pilot lamp : Red, Green, Yellow, White
- 23) Digital thermometer : 7EA (temperature contol type)
- 24) Action lamp : red, green
- 25) Graphic module : 795 \* 600 AI
- 26) Digital watt meter
- 27) High-pressure piping and low-pressure piping should be convertible with transparent pipe and flare rings should be used, and be manufacured without any connection structures.
- 28) the part where the transparent piping is installed
  - (1) Compressor - Condenser Piping
  - (2) Condenser - Liquid receiver piping
  - (3) Liquid receiver piping - Filter Dryer
  - (4) Filter Dryer - Sight Glass,
  - (5) Sight Glass - Expansion Valve
  - (6) Evaporator - Liquid separator
  - (7) Liquid separator - compressor
- 29) Size(LxWxH): 1600x810x1750mm
- 30) Weight: 200kg
- 31) Software program to control Ice Store-5000, and data logging & automatic P\_I lead program
  - (1) It is necessary to be able to check data information of temperature and pressure of refrigerator experiment device in real time and to be able to check temperature change due to phase change in real time.
  - (2) It should be able to increase the program utilization because it is divided into the areas where the process diagram and P-I chart diagram
  - (3) A review system should be constructed to check the operation of the device and to view the graph again
  - (4) It is possible to control the relay on the program and it should be configured so that automatic control and manual control are possible according to the program configuration.
  - (5) P-I chart should be automatic drawing in real time, and P-I chart automatic drawing function should be included when inserting data in Excel file required for training.
  - (6) LabVIEW-based programs to improve compatibility with other products.



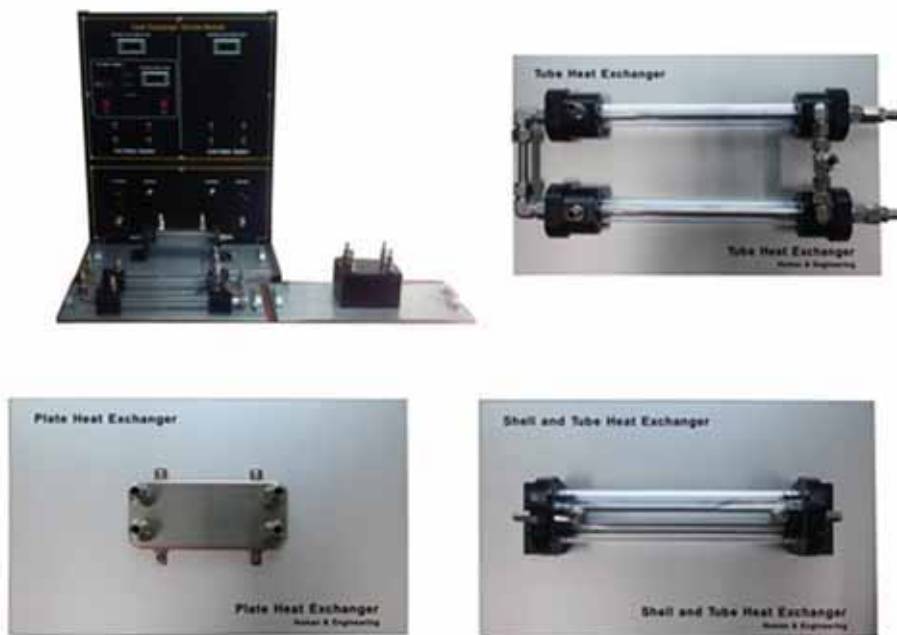
# model: Heat Exchanger-5000

## Trainer for various heat exchanger

### Features

- 1) It should be a bench type consisting of small-sized heat exchanger modules to be used for educational purposes.
- 2) The heat exchanger should consist of tubes, plates, cells and tubes, containers, coils and stirrers, etc. of the most commonly used type in the industry.
- 3) The heat exchanger module should be constructed so that it can be exchanged and connected easily, quickly and safely.
- 4) The heat exchange service module should have a digital display window to facilitate reading data values.
- 5) Each module should be convertible made of a transparent material and be convenient for students to view the structure.
- 6) Each heat exchanger module should have a base with a schematic diagram drawn to help students understand how to connect.
- 7) Real-time data monitoring should be possible by linking the universal data acquisition system.

### System configuration



### Function

Hardware platform	1 set
Program CD data logging & automatic P_I lead program	1 ea
Simulation S/W CD for Electric Sequence & 2D / 3D virtual Building (water supply valve system, underground garage ventilation system, automatic door control, etc)	1 ea
USB S-Lock Dongle	1 ea
Manual book	1 book

## Training contents

- Part 1, Learn the heat exchanger system
- Part 2, Experiment of the tube in tube type heat exchanger
- Part 3, Experiment of the plate type heat exchanger
- Part 4, Experiment of the shell and tube type heat exchanger
- Part 5, Heat exchanger comparison experiment
- Part 6, Operation of the product heat exchange experiment device program

## Spec

- 1) General spec
  - (1) 3 heat exchangers
    - : tube in tube type, plate type, and shell and tube type
  - (2) Hot water boiler .
  - (3) Thermostat . 4ea
  - (4) Hot water circulation pump .
  - (5) Hot water tank .
  - (6) Water Connectter
  - (7) Water Control Valve
  - (8) Water Control temp
  - (9) Control panel with On/Off switch, Volt meter, ampere meter and temperature meter with digital display.
- 2) Heat Exchange Service Module
  - (1) Size: 760 mm x 610 mm x 600 mm
  - (2) Weight: 40 kg
  - (3) Hot water system:
    - About 7.5 liters hot water tank
    - 2.75 kW heater
    - 3 marks: tank full, half or empty
    - Pump flow rate at 1 bar: 3.5 L.min-1
    - Refilling water due to electrical operation
    - Setting the temperature by PID control
    - 5 L.min-1 back pressure: 1 bar (minimum) to 3 bar (maximum)
- 3) Concentric Tube Heat Exchanger
  - (1) Size: 500mm x 260mm x 160mm
  - (2) Weight: 3.5kg
  - (3) Outer Tube (Cell): Clear acrylic, 30mm outer diameter and 20mm inner diameter.
  - (4) Inner tube: Stainless steel, 12mm outer diameter and 10mm inner diameter
  - (5) Average heat exchange area: 0.02m<sup>2</sup>
- 4) Plate Heat Exchanger
  - (1) Size: 500mm x 260mm x 100mm
  - (2) Weight: 2.4kg
  - (3) Four stainless steel plates, each 0.005 m<sup>2</sup>
  - (4) Average heat exchange area: 0.02m<sup>2</sup>
- 5) Cell and Tube Heat Exchanger
  - (1) Size: 500mm X 260mm X 150mm
  - (2) Weight: 2.7kg
  - (3) Outer Tube (Cell): Clear acrylic, 60mm outer diameter and 50mm inner diameter
  - (4) Tube Bundle: 6 stainless steel tubes, each 6mm outer diameter and 4mm inner diameter, and 3 blocking devices
  - (5) Average heat exchange area: 0.02m<sup>2</sup>
- 6). Universal Data Acquisition Device
  - (1) Size: 190 mm x 130 mm x 45 mm
  - (2) Weight: 4.5 kg
  - (3) Type: Frame type
  - (4) PC Connection Type: USB type (with lead)
  - (5) Accessories: Connector and Cable Lines
  - (6) STP lead for equipment connection
- 7) Software program to control of Heat Exchanger-5000 hardware and Data Logging Program

- (1) Monitor the current status of device through communication between control board and sensor board
  - (2) provide PC Interface
    - Windows 10.1, 2
    - Interface : USB communication & USB Driver
  - (3) measure & save data, print the measured (graph) data
  - (4) Control and monitoring from PC
  - (5) The review function is provided in the program for loading the saved data and viewing the graph again.
  - (6) The process is marked and must be able to display data on the current location.
- 8) Simulation S/W for Electric sequence & 2D / 3D virtual Building
- Simultaneous control simulation between virtual building (plant) and electric control circuit composed of 2D / 3D (water supply valve system, underground garage ventilation system, automatic door control)
- Provides more than 100 examples of electrical sequence control circuits that can be simulated immediately, examples of real wiring application circuits, and examples of PLC control programs
- Provides electric sequence symbol and virtual equipment element, so that it is possible to train electric sequence control and PLC control related technology using software even when actual training equipment is not provided
- Run on Windows 10, 8, 7
- Possible to use PLC programming tool (GMWIN, XG5000, MITSUBISHI, GX-Developer, SIEMENS S7, etc.)
- (1) Circuit design and editing module
    - Possible to manage circuit diagram, layout diagram, PLC program file in batch by individual project
    - Provides a sequence circuit symbol element that can be configured as single-phase and three-phase three-wire, three-phase four-wire, and three-phase circuits
    - Ability to simply copy and paste objects with attributes on the virtual plant
    - Undo / redo function during circuit design
    - Easily configure circuit by drag & drop design element
    - Enlarge or reduce the circuit diagram (all views, partial enlargement, etc.)
    - Displays a list of parts on an incompletely-designed circuit diagram and displays the error elements in a different color so that the user can easily find them.
    - Electrical circuit printing conforming to industrial specifications (including support for Plotter printing)
    - User Library function that can save user defined objects or make them easy to load
    - All or part of a drawing can be saved as a file such as bmp, emf, DXF, etc., so it can be easily added to a word or a CAD program.
    - Capture and save the whole drawing, part of drawing, whole screen, part of screen as video
  - (2) Circuit simulation module
    - Simultaneous simulation of circuit diagram, layout diagram and PLC program in project unit
    - Possible to practice troubleshooting of the part that user wants in the circuit diagram or the schematic diagram of the switchgear during the simulation
    - Simulation results are expressed by image change and color change of element
    - Sound effects is supported in simulation (switches, buzzer, motor, etc.)
    - In the simulation, it is able to detect the voltage, current, and resistance of the desired part on the circuit diagram through the measurement element
    - Provides time chart function that can monitor the state of input and output elements in time graph form
  - (3) Virtual PLC and programming tool, simulation
    - The PLC contact address already assigned to the electrical element and the contact address on the ladder circuit are automatically corrected by changing the PLC type and I / O slot number to match the changed contents
    - Supports international standard addressing
    - The created ladder diagram can be downloaded and executed on the actual PLC
    - Virtual PLC provides functions such as run, stop, pause, etc.
    - Mandatory I / O function that can control the value of PLC contact on ladder diagram during virtual PLC operation is provided
    - Monitor the contact points of virtual PLC and display on the ladder diagram in real time
  - (4) On-line control and monitoring module
    - Control the external device on-line by monitoring and simulating external devices by using PLC communication function during simulation.

# model: **Water heating-5000**

## **Domestic water heating with flat collector**

### **Features**

- 1) It should be capable of building a system that can be convertible with the evacuated flat tube type solar collector system and the photovoltaic collector system
- 2) The entire components shall be composed of solar heat collectors, photovoltaic collectors, heat storage tanks, pumps, sequence modules, graphic modules, heat exchangers, data acquisition and switching devices, and additional modules if required.
- 3) A heat load device should be provided so that the heat source can be adjusted in various ways to enable various experiments of solar devices.
- 4) It should be constructed so that it can acquire various data to display the electricity generated from the evacuated flat tube type solar collector and the photovoltaic module, and the usage can be measured.
- 5) It should be structured so that conditions, such as power status and temperature, can be checked on the computer according to the configuration of the data logger device.
- 6) It should be structured such that it can apply and utilize the heat accumulated through the indoor heat exchanger.
- 7) The graphical module should be applied to view the entire flow and for manual control and its operation parts should be indicated by the indicator lamps.
- 8) The control and graphic panel should be attached to the front of the equipment so that the equipment can be driven by the sequence circuit and the entire control circuit configuration of the system should be possible.
- 9) It should be composed of a system using graphical panel to view the system flow.
- 10) It should be configured such that at least 15 sequence control circuits shall be constructed.

### **System configuration**



( product photo can be changed )

## Features

- 1) Algorithm of CCTV (video) analysis
  - (1) Qualified Intelligent video analysis algorithm & its technology
  - (2) Provides the customization for optimizing detection
- 2) Minizes the false alarm
  - (1) Applied for noise removing tech on dynamic BG (tide, leaf, snow, rain & etc.)
  - (2) Applied for noise removing tech on Light (headlight, Lights & etc.)
  - (3) Setting up undetectable time & zone
- 3) High expandable
  - (1) Provides all Analog/IP, Fixed/PTZ Camera (SD, D1, HD & etc.)
  - (2) 16ch Real time analysis for any of camera brands (Workstation)
  - (3) Provides video inputs for DVR, NVR

## Components

1) Main Hardware platform	1 set
2) the evacuated flat tube type solar collector and photovoltaic collector	each 1 set
3) Program CD	1 ea
4) Manual book	1 book

## Training contents

- Part 1, Heat storage system principle and operation test  
 Part 2, Refrigerated thermal storage system principle and operation test  
 Part 3, Heat exchange system principle and operation test  
 Part 4, Basic theory of electric sequence and manual control  
 Part 5, Manual and automatic control of electrical sequence  
 Part 6, Automatic control experiment using the temperature switch  
 Part 7, How to calculate the value of the heat storage system  
 Part 8, Solar cell module principle and application use

## Spec

- 1) Photovoltaic Collector
  - (1) Output: Up to 36V
  - (2) Maximum current: 6.94V
  - (3) Maximum power: 250W
- (4) Photovoltaic controller
- (5) Battery: 50A or more
- (6) Inverter: 36V-220V Inverter
- 2) the evacuated flat tube type solar collector
  - (1) Type: Plate heat exchanger type
  - (2) Generate hot water for energy saving
- 3) Data acquisition and switching device
- 4) Solenoid valve
- 5) Feed pump - for circulating solar heat equipment
- 6) Solar thermal storage tank
  - (1) Size: approximately  $\varnothing 352 * 1000\text{mm}$
  - (2) Tank inside diameter: approximately  $\varnothing 300$
  - (3) Built-in heater type
  - (4) Temperature display
- 7) Heat exchanger module - Load regulator
  - (1) Floor mounted heat exchanger - front discharge
- 8) Circulation pump – connected to the heat exchanger
- 9) Battery charger – the auxiliary battery charging device

- 10) Piping (including heat insulation)
- 11) Refrigeration system for heat exchange - for load control
  - (1) Type: reciprocating type
  - (2) Capacity: 1/2 hp
  - (3) Condenser: Included in the transparent piping system (Check refrigerant phase change)
  - (4) convertible Transparent piping: Make the high pressure and low pressure piping of the freezer transparent.
- 12) The Entire System Configuration
- 13) Sequence Control Device
  - (1) Automatic control module: 795 \* 600 aluminum printing or engraving
  - (2) Electronic switch: 13A, 5a2b: 3EA
  - (3) Relay (8 Pins): 4EA
  - (4) Timer (24 hrs): 1EA, Timer (60 sec): 1EA
  - (5) Thermal overload relay: 1EA (MC attachment type)
  - (6) High and low pressure switch: LPS, HPS
  - (7) Power Control: toggle, push button, select switch
  - (8) Safety Devices: over-current breaker (N.F.B), buzzer, fuse
  - (9) Indicator Light: red, green, yellow and white
  - (10) Digital Thermometer: 10EA (temperature controlled type)
  - (11) Indicator Light: red, green
  - (12) Graphics Module: 795 \* 600 aluminum
- 14) Software program to control Water heating-5000 equipment and calculate, display the heat usage.

# model: Cooling system with Ice Storages-GT900

## Cooling system combined with Ice Storages

### Features

- 1) The possibility of the experiment on temperature, pressure, automatic control of the device with Ice Accumulation and mechanical trouble
- 2) The comprehension of refrigeration system with Ice thermal storage and device's principle
- 3) The experiment on cycle change of refrigeration equipment according to temperature and Mollier diagram drawing in P-I diagram drawing part.
- 4) Theoretical education and experiment related to efficiency test of device and Ice storage
- 5) Theoretical education of a fundamental circuit, application circuit and experiment with Ice storage
- 6) The sequence screen attached to the graphic module control department and power automatic control machine for experiment on temperature, pressure and automatic control and operation
- 7) Unlike separated system from machine department, the control department is visual
- 8) The cooling system using the ice storage system can use the energy saving system utilizing the late night electricity.
- 9) The ice storage system can be used with ice balls or other similar methods, and indirect cooling should be used.
- 10) Data formation by data auto-saving and P-I diagram auto-operation in the system with control program
- 11) The high-pressure piping and the low-pressure piping of the freezer are made of a transparent material so that the refrigerant flow of the piping can be seen.
- 12) Liquid receiver, the liquid separator, and the condenser are made of a transparent material so that the flow of the refrigerant can be seen.
- 13) User can recall the data stored in the data program and review the diagram

### System configuration



### Components

1) Hardware platform	1 set
2) Program CD	1 ea
3) Manual book	1 book

## Training Contents

Chap 1, Fitting refrigerant  
 Chap 2, Vacuum test  
 Chap 3, Leak test  
 Chap 4, Troubleshooting at brine system machine  
 Chap 5, Troubleshooting at electric circuit  
 Chap 6, Fitting electric circuits for brine system  
 Chap 7, Refrigeration effect as ratio of the expansion V/V in brine system  
 Chap 8, Temperature control at evaporator  
 Chap 9, Temperature control at condenser  
 Chap 10, Pressure control at low side  
 Chap 11, Pressure control at high side  
 Chap 12, Measuring features kind as brine liquid  
 Chap 13, Component understanding of brine system  
 Chap 14, COP calculation for brine system

## Spec

1) Compressor : 1/2HP, single-phase 220V, Control Box
2) Condenser : Air-cooled type, single-phase 220V (User should be able to see the refrigerant flow using 5 layers of transparent material)
3) Evaporator : Chamber with accumulation of heat, plate Heat Exchange
4) Liquid receiver : 1HP, Accumulator : 1/2HP (Be able to see the flow of refrigerant by using transparent material)
5) Expansion Valve: manual expansion valve, capillary tube, automatic Expansion
6) Electronic Valve : : 3/8" nut clamp type or welding type
7) Filter dryer : 3/8" nut clamp type or welding type
8) Manometer: High Pressure, Low Pressure
9) Filling nipple : Attached to a nipple for Filling
10) Sight Glass : welding type or nut clamp type
11) circulation pump : circulation for heat medium
12) Chamber
13) Plat exchanger
14) Brine circulation pump
15) Cooling water circulation pump
16) Ceiling Heat Exchanger, Floor Heat Exchanger (for generating cold air)
17) Sequency control screen: 795*600,
18) Magnet Contact : 13A, 5a2b : 3EA
19) Relay (8Pin) : 4EA
20) Timer (24hr) : 1EA, Timer (60sec) : 1EA
21) THR : 1EA (with MC)
22) High and Low pressure switch : LPS, HPS
23) Power Control : toggle, push button, selected switch
24) Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
25) Pilot lamp : Red, Green, Yellow, White
26) Digital thermometer : 7EA (temperature contol type)
27) Action lamp : red, green
28) Graphic module : 795 * 600 Al
29) Digital watt meter
30) Transparent piping parts : Compressor - Condenser piping, Condenser - Hydraulic piping, Liquid Receiver - Filter drier, Filter drier - Sight glass, Sight glass - expansion valve, evaporator-liquid separator, liquid separator-compressor
31) Size(LxWxH): 1600x810x1750mm
32) Weight: 200kg



# 45

## a group of Refrigeration, Air Conditioner, Ice Ice making system

- 150. Refrigeration-GT100
- 151. Refrigeration & Freezing-GT200
- 152. Air Conditioning-GT300
- 153. Ice making system-GT400
- 154. Multi Compressor rack refrigeration -GT500
- 155. Air ventilation(heating & cooling) -GT600
- 156. Splat cooling regrigeration-GT700

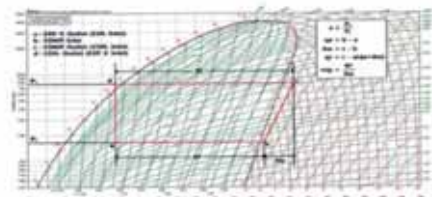
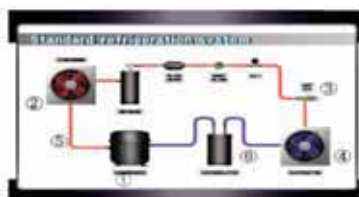
# model: **Refrigeration-GT100**

## Refrigeration system trainer

### Features

- 1) The possibility of the experiment on temperature, pressure, automatic control and mechanical trouble
- 2) The possibility of experiment and theoretical education related to automatic control ,refrigeration system and refrigerator accessories .
- 3) The experiment on cycle change of refrigeration equipment according to temperature and Mollier diagram drawing in P-I diagram drawing part.
- 4) Theoretical education of efficiency test and experiment while operating
- 5) The sequence screen attached to the graphic module control department and power automatic control machine for experiment on temperature, pressure and automatic control and operation
- 6) The control department is made up of visual lamps separated system from machine department
- 7) Automatic control with graphic panel and two automatic control modules
- 8) Data formation by data auto-saving and P-I diagram auto-operation in the system with control program

### System configuration



(PH-diagram drawing program software screenshot)

### Experiments(Study objectives)

- Part 1, Fitting refrigerant
- Part 2, Vacuum test
- Part 3, Leak test
- Part 4, Troubleshooting at refrigeration machine
- Part 5, Troubleshooting at electric circuit
- Part 6, Fitting electric circuits
- Part 7, Refrigeration effect as ratio of the expansion  $V/V$  in standard refrigeration system
- Part 8, Temperature control at evaporator
- Part 9, Temperature control at condenser
- Part 10, Pressure control at low side
- Part 11, Pressure control at high side
- Part 12, Pump-down operation

## Spec

### 1) Machine

- a. Compressor : 1/2HP, single-phase 220V, Control Box
- b. Condenser : Air-cooled type, single-phase 220V
- c. Evaporator: pin, Tube Air-cooled type, chamber, damper
- d. Liquid receiver : 1HP, Accumulator : 1/2HP
- e. Expansion Valve : manual expansion valve (welding type)
- f. Electronic valve : 3/8" nut clamp type or welding type
- g. Filter dryer : 3/8" nut clamp type or welding type
- h. Manometer : High Pressure, Low Pressure
- i. Filling nipple : Attached to a nipple for Filling
- j. Sight Glass : welding type or nut clamp type

### 2) Control

- a. Magnet Contact : 13A, 5a2b : 2EA
- b. Relay (8Pin) : 2EA
- c. Timer (60sec) : 1EA
- d. High and Low pressure switch : LPS, HPS
- e. Power Control : toggle, Push button, selected switch
- f. Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
- g. Pilot lamp : Red, Green, Yellow, White
- h. Graphic module and automatic module : 595 \* 600 Al

### 3) Simulation

- a. Digital thermometer : 6EA (temperature control type)
- b. ACTION LAMP : red, green
- c. Graphic module : 595 \* 595 Al

### 4) Dimensions and weight

Size(LxWxH) : 1200x730x1720mm

Weight : 150kg

### 5) Calorimetry equipment

(1) Equipment default configuration.

Pressure gauges, pressure sensors, thermometers, temperature sensors, flow meters, flow sensors, output devices, and data loading unit, the power measurement device

(2) Features.

- A) Measuring devices are easy to configure and install
- B) The configuration of the basic refrigeration cycle, refrigeration cycle, 2 cycle, the heat pump also can be measured
- C) The measured value for each type of gas used in real time on the leading EI Mori projection
- D) The value of real-time projection can be separately
- E) Record the data in a separate note or clarifications
- F) The pressure of the cycle, the temperature regulation
- G) Use the refrigerant Freon R - 134A
- H) Each part of the start-up flow rate, temperature, Pressure measured in terms of calories and can
- I) Condensation, in accordance with the load fluctuation of the evaporator temperature, the change in pressure can be checked
- J) Input against output (COP)
- K) A separate, dedicated S / W is applied

(3) Benefits.

- A) Basic Refrigeration or an easy measurement using frozen pipe circuit
- B) Filling and replacement or change of state of the refrigerant can be recorded
- C) The load variation of the low pressure in the high pressure region of each other, a pressure, a temperature change be measured and know the change in flow rate
- E) Of the refrigerant control (filling, and purge), and the refrigerating capacity can be seen Modulation
- F) Failure, leading to what's happening on EI memory can be identified
- G) Changes in each part of the gas phase and in the gas phase to familiarize yourself with the basic state can be

## Components

Hardware platform	1 unit
Bananna jack (red)	20 ea
Bananna jack (black)	20 ea
Power cable	1 ea
Program CD (program for Calorimetry equipment)	1 ea
Manual book	1 book

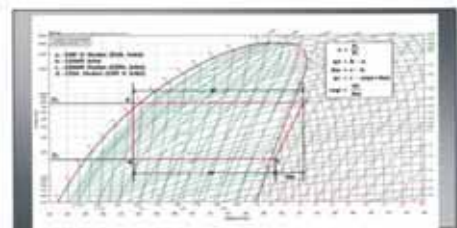
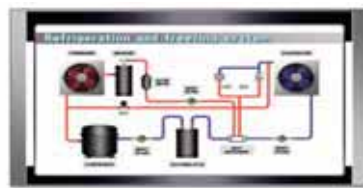
# model: Refrigeration & Freezing-GT200

## Refrigeration & Freezing system trainer

### Features

- 1) The possibility of the experiment on temperature, pressure, defrosting auto control of automatic pressure control device and mechanical trouble
- 2) A check of change of the refrigeration system according to expansion valve 's shape and function with connecting expansion valve of other types
- 3) The experiment on cycle change of refrigeration equipment according to temperature from evaporator and Mollier diagram drawing in P-I diagram drawing part.
- 4) Theoretical education of a fundamental circuit, application circuit and experiment by various circuit composition
- 5) The comprehension of principle of hot gas defrost, passive, capillary tube and temperature sensor type of expansion valve
- 6) Unlike separated system from machine department , the control department is visual
- 7) Automatic control with graphic panel and two automatic control modules
- 8) Data formation by data auto-saving and P-I diagram auto-operation in the system with control program

### System configuration



(PH-diagram drawing program software screenshot)

### Experiments(Study objectives)

- Part 1, Fitting refrigerant in freezing system
- Part 2, Vacuum test in freezing system
- Part 3, Leak test in freezing system
- Part 4, Troubleshooting at refrigeration machine in freezing system
- Part 5, Troubleshooting at electric circuit
- Part 6, Fitting electric circuits in freezing system
- Part 7, Refrigeration effect as ratio of the expansion V/V in freezing system
- Part 8, Temperature control at evaporator in freezing system
- Part 9, Temperature control at condenser in freezing system
- Part 10, Pressure control at low side in freezing system
- Part 11, Pressure control at high side in freezing system
- Part 12, Pump-down operation in freezing system
- Part 13, Defrosting operation

## Spec

### 1) Machine

- a. Compressor : 1/2HP, single-phase 220V, Control Box
- b. Condenser : Air-cooled type, single-phase 220V
- c. Evaporator: pin, Tube Air-cooled type, chamber, damper
- d. Liquid receiver : 1HP, Accumulator : 1/2HP
- e. Expansion Valve: manual expansion valve, capillary tube, temperature Expansion Valve
- f. Electronic Valve for operation : : 3/8" nut clamp type or welding type
- g. Filter dryer : 3/8" nut clamp type or welding type
- h. Manometer: High Pressure, Low Pressure
- i. Filling nipple : Attached to a nipple for Filling
- j. Sight Glass : welding type or nut clamp type
- k. Chamber for Evaporator : 320\*350\*500, damper

### 2) Control

- a. Sequence control screen: 795\*600,
- b. Magnet Contact : 13A, 5a2b : 3EA
- c. Relay (8Pin) : 4EA
- d. Timer (24hr) : 1EA, Timer (60sec) : 1EA
- e. THR : 1EA (with MC)
- f. High and Low pressure switch : LPS, HPS
- g. Power Control : toggle, Push button, selected switch
- h. Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
- i. Pilot lamp : Red, Green, Yellow, White

### 3) Simulation

- a. Digital thermometer : 8EA (temperature control type)
- b. ACTION LAMP : red, green
- c. Graphic module : 795 \* 600 AI

### 4) Dimensions and weight

Size(LxWxH): 1600x730x1720mm  
Weight: 180kg

### 5) Calorimetry equipment

- (1) Equipment default configuration.

Pressure gauges, pressure sensors, thermometers, temperature sensors, flow meters, flow sensors, output devices, and data loading unit, the power measurement device

- (2) Features.

- A) Measuring devices are easy to configure and install
- B) The configuration of the basic refrigeration cycle, refrigeration cycle, 2 cycle, the heat pump also can be measured
- C) The measured value for each type of gas used in real time on the leading El Mori projection
- D) The value of real-time projection can be separately
- E) Record the data in a separate note or clarifications
- F) The pressure of the cycle, the temperature regulation
- G) Use the refrigerant Freon R - 134a
- H) Each part of the start-up flow rate, temperature, Pressure measured in terms of calories and can
- I) Condensation, in accordance with the load fluctuation of the evaporator temperature, the change in pressure can be checked
- J) Input against output (COP)
- K) A separate, dedicated S / W is applied

- (3) Benefits.

- A) Basic Refrigeration or an easy measurement using frozen pipe circuit
- B) Filling and replacement or change of state of the refrigerant can be recorded
- C) The load variation of the low pressure in the high pressure region of each other, a pressure, a temperature change be measured and know the change in flow rate
- E) Of the refrigerant control (filling, and purge), and the refrigerating capacity can be seen Modulation
- F) Failure, leading to what's happening on El memory can be identified
- G) Changes in each part of the gas phase and in the gas phase to familiarize yourself with the basic state can be

## Components

Hardware platform	1 unit
Bananna jack (red)	20 ea
Bananna jack (black)	20 ea
Power cable	1 ea
Program CD (program for Calorimetry equipment)	1 ea
Manual book	1 book

# model: **Air Conditioning-GT300**

## **Air conditioning system trainer**

### **Features**

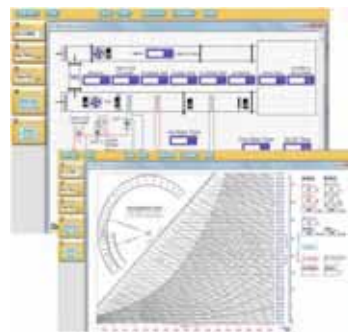
- 1) Simple air conditioning system
- 2) Ventilation duct, cross-section 250x250mm
- 3) Expansion element selectable using solenoid valves: expansion valve and capillary tubes 1m
- 4) Radial fan with regulating flap
- 5) Lamellar evaporator with drip tray
- 6) Determination of airflow rate by velocity measurement with Pilot tube 2 temperature sensors, 1 differential pressure transducer
- 7) Controllable valves and equipment actuated by software

### **System configuration**

(Hardware platform)



(Data logger program)



### **Experiments(Study objectives)**

- Part 1, Fitting refrigerant
- Part 2, Vacuum test
- Part 3, Leak test
- Part 4, Troubleshooting at AHU system machine
- Part 5, Troubleshooting at electric circuit
- Part 6, Fitting electric circuits for AHU
- Part 7, Duct work effect of AHU system
- Part 8, Drawing PSI chart
- Part 9, Component understanding of AHU system
- Part 10, Cycle through the manual operation of manual operation panel

## Spec

### 1) Machine

- a. Compressor : 1/2HP, single-phase 220V, Control Box
- b. Condenser : Air-cooled type, Single-phase 220V
- c. Evaporator : Pin, Tube type
- d. Accumulator : 1HP, Receiver tank : 1/2HP
- e. Expansion Valve : Manual expansion valve (welding type)
- f. Electronic valve for operation : 3/8" nut clamp type or welding type
- g. Filter dryer : 3/8" Nut clamp type or welding type
- h. Manometer: High Pressure, Low Pressure
- i. Filling nipple : Attached to a nipple for Filling
- j. Sight Glass : welding type or nut clamp type
- k. Duct : PC 250X250
- l. Ventilator : 220V, Fan speed controller included
- M. Heater : Pin type, 1Kw
- n. Wind pressure : 220V, Pitot tube

### 2) Control

- a. Temperature, pressure and humidity data acquisition control program
- b. Unit of the device on / off control program

### 3) Dimensions and weight

Size(LxWxH): 1100x720x490mm

Weight: 80kg

### 4) Compressor

### 5) Condenser : Air-cooled type, single-phase 220V(inclusion of transparent glass tube )

### 6) Liquid receiver, Accumulator : Vertical style

### 7) Calorimetry equipment

#### (1) Equipment default configuration.

Pressure gauges, pressure sensors, thermometers, temperature sensors, flow meters, flow sensors, output devices, and data loading unit, the power measurement device

#### (2) Features.

- A) Measuring devices are easy to configure and install
- B) The configuration of the basic refrigeration cycle, refrigeration cycle, 2 cycle, the heat pump also can be measured
- C) The measured value for each type of gas used in real time on the leading EI Mori projection
- D) The value of real-time projection can be separately
- E) Record the data in a separate note or clarifications
- F) The pressure of the cycle, the temperature regulation
- G) Use the refrigerant Freon R - 134A
- H) Each part of the start-up flow rate, temperature, Pressure measured in terms of calories and can
- I) Condensation, in accordance with the load fluctuation of the evaporator temperature, the change in pressure can be checked
- J) Input against output (COP)
- K) A separate, dedicated S / W is applied

#### (3) Benefits.

- A) Basic Refrigeration or an easy measurement using frozen pipe circuit
- B) Filling and replacement or change of state of the refrigerant can be recorded
- C) The load variation of the low pressure in the high pressure region of each other, a pressure, a temperature change be measured and know the change in flow rate
- E) Of the refrigerant control (filling, and purge), and the refrigerating capacity can be seen Modulation
- F) Failure, leading to what's happening on EI memory can be identified
- G) Changes in each part of the gas phase and in the gas phase to familiarize yourself with the basic state can be

## Components

1) Hardware Platform	1 unit
2) Power cable	1 ea
3) USB cable	1 ea
4) program CD for Calorimetry equipment	1 ea
5) Manual book	1 book

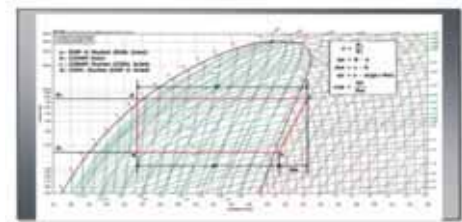
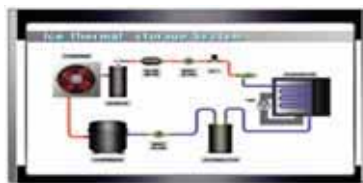
# model:Ice making system-GT400

## Ice Making system trainer

### Feature

- 1) The possibility of the experiment on temperature, pressure, automatic control of the deice with Ice Accumulation and mechanical trouble
- 2) The comprehension of refrigeration system with Ice thermal storage and deice's principle
- 3) The experiment on cycle change of refrigeration equipment according to temperature and Mollier diagram drawing in P-I diagram drawing part.
- 4) Theoretical education and experiment related to efficiency test of deice and Ice storage
- 5) Theoretical education of a fundamental circuit, application circuit and experiment with Ice storage
- 6) The sequence screen attached to the graphic module control department and power automatic control machine for experiment on temperature, pressure and automatic control and operation.
- 7) Unlike separated system from machine department , the control department is visual
- 8) Automatic control with graphic panel and two automatic control modules
- 9) Data formation by data auto-saving and P-I diagram auto-operation in the system with control program

### System configuration



(PH-diagram drawing program screenshot)

### Experiments(Study objectives)

- Part 1, Fitting refrigerant
- Part 2, Vacuum test
- Part 3, Leak test
- Part 4, Troubleshooting at brine system machine
- Part 5, Troubleshooting at electric circuit
- Part 6, Fitting electric circuits for brine system
- Part 7, Refrigeration effect as ratio of the expansion V/V in brine system
- Part 8, Temperature control at evaporator
- Part 9, Temperature control at condenser
- Part 10, Pressure control at low side
- Part 11, Pressure control at high side
- Part 12, Measuring features kind as brine liquid
- Part 13, Component understanding of brine system
- Part 14, COP calculation for brine system



## Spec

### 1) Machine

- a. Compressor : 1/2HP, single-phase 220V, Control Box
- b. Condenser : Air-cooled type, single-phase 220V
- c. Evaporator : Chamber with accumulation of heat, Tube type
- d. Liquid receiver : 1HP, Accumulator : 1/2HP
- e. Expansion Valve: manual expansion valve, capillary tube, automatic Expansion
- f. Electronic Valve : : 3/8" nut clamp type or welding type
- g. Filter dryer : 3/8" nut clamp type or welding type
- h. Manometer: High Pressure, Low Pressure
- i. Filling nipple : Attached to a nipple for Filling
- j. Sight Glass : welding type or nut clamp type
- k. circulation pump : circulation for heat medium
- l. Chamber(ice maker)

### 2) Control

- a. Sequency control screen: 795\*600,
- b. Magnet Contact : 13A, 5a2b : 3EA
- c. Relay (8Pin) : 4EA
- d. Timer (24hr) : 1EA, Timer (60sec) : 1EA
- e. THR : 1EA (with MC)
- f. High and Low pressure switch : LPS, HPS
- g. Power Control : toggle, push button, selected switch
- h. Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
- i. Pilot lamp : Red, Green, Yellow, White

### 3) Simulation

- a. Digital thermometer : 7EA (temperature contol type)
- b. Action lamp : red, green
- c. Graphic module : 795 \* 600 AI

### 4)Dimensions and weight

Size(LxWxH): 1600x730x1720mm

Weight: 200kg

### 5) Calorimetry equipment

- (1) Equipment default configuration.  
Pressure gauges, pressure sensors, thermometers, temperature sensors, flow meters, flow sensors, output devices, and data loading unit, the power measurement device
- (2) Features.
  - A) Measuring devices are easy to configure and install
  - B) The configuration of the basic refrigeration cycle, refrigeration cycle, 2 cycle, the heat pump also can be measured
  - C) The measured value for each type of gas used in real time on the leading EI Mori projection
  - D) The value of real-time projection can be separately
  - E) Record the data in a separate note or clarifications
  - F) The pressure of the cycle, the temperature regulation
  - G) Use the refrigerant Freon R - 134a
  - H) Each part of the start-up flow rate, temperature, Pressure measured in terms of calories and can
  - I) Condensation, in accordance with the load fluctuation of the evaporator temperature, the change in pressure can be checked
  - J) Input against output (COP)
  - K) A separate, dedicated S / W is applied
- (3) Benefits.
  - A) Basic Refrigeration or an easy measurement using frozen pipe circuit
  - B) Filling and replacement or change of state of the refrigerant can be recorded
  - C) The load variation of the low pressure in the high pressure region of each other, a pressure, a temperature change be measured and know the change in flow rate
  - E) Of the refrigerant control (filling, and purge), and the refrigerating capacity can be seen Modulation
  - F) Failure, leading to what's happening on EI memory can be identified
  - G) Changes in each part of the gas phase and in the gas phase to familiarize yourself with the basic state can be

## Components

Haraware platform	1 unit
Bananna kack (red)	20 ea
Bananna kack (black)	20 ea
Power cable	1 ea
Program CD (program for Calorimetry equipment)	1 ea
Manual book	1 book

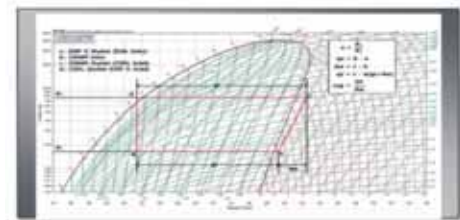
# model: Multi Compressor rack refrigeration -GT500

## Multi compressor rack refrigerating system trainer

### Features

- 1) Available to test checking fault, temp. control, and pressure control in multi condensing unit system.
- 2) Available to compare with effect of one condensing unit and two condensing unit..
- 3) Available to check oil level gauge at system with visual by using oil level regulator at each of compressor.
- 4) Available to draw p-l diagram as changing system cycle in refrigeration apparatus, since the measured section in the system should be selected.
- 5) Available to test performance with theory on operation of device.
- 6) Available to acquisition and save data of p-l diagram with program software.

### System configuration



(PH-diagram drawing program screenshot)

### Experiments(Study objectives)

- Part 1, Fitting refrigerant
- Part 2, Vacuum test
- Part 3, Leak test
- Part 4, Troubleshooting at refrigeration machine
- Part 5, Troubleshooting at electric circuit
- Part 6, Fitting electric circuits in freezing system
- Part 7, Refrigeration effect as ratio of the expansion V/V in standard refrigeration system
- Part 8, Comparing effect one cycle and two
- Part 9, Temperature control at evaporator in freezing system
- Part 10, Temperature control at condenser in freezing system
- Part 11, Pressure control at low side in freezing system
- Part 12, Pressure control at high side in freezing system
- Part 13, Pump-down operation in freezing system
- Part 14, Defrosting operation

## Spec

### 1) Machine

- a. Compressor : 1/2HP, single-phase 220V, Control Box 3ea
- b. Condenser : Air-cooled type, single-phase 220V
- c. Evaporator : Pin, Tube type
- d. Liquid receiver : 1HP, Accumulator : 1HP
- e. Expansion Valve: manual expansion valve(Welding)
- f. Electronic valve for operation : 3/8" nut clamp type or welding type
- g. Electronic Valve : : 3/8" nut clamp type or welding type
- h. Manometer: High Pressure, Low Pressure
- i. Filling nipple : Attached to a nipple for Filling
- j. Sight Glass : welding type or nut clamp type 3ea
- k. Oil separator
- l. C.P.R

### 2) Control

- a. Magnet Contact : 13A, 4EA
- b. Relay : 2EA
- c. Timer (60sec) : 1EA
- d. Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
- e. Digital thermometer : 6EA (temperature control type)
- f. Pilot lamp : Green, White

### 3) Dimensions and weight

Size(LxWxH): 1500x700x700mm  
Weight: 80kg

### 4) Dimensions and weight

Size (LxWxH) : 1800x700x700mm

### 5) Calorimetry equipment

- (1) Equipment default configuration.  
Pressure gauges, pressure sensors, thermometers, temperature sensors, flow meters, flow sensors, output devices, and data loading unit, the power measurement device
- (2) Features.
  - A) Measuring devices are easy to configure and install
  - B) The configuration of the basic refrigeration cycle, refrigeration cycle, 2 cycle, the heat pump also can be measured
  - C) The measured value for each type of gas used in real time on the leading EI Mori projection
  - D) The value of real-time projection can be separately
  - E) Record the data in a separate note or clarifications
  - F) The pressure of the cycle, the temperature regulation
  - G) Use the refrigerant Freon R - 134a
  - H) Each part of the start-up flow rate, temperature, Pressure measured in terms of calories and can
  - I) Condensation, in accordance with the load fluctuation of the evaporator temperature, the change in pressure can be checked
  - J) Input against output (COP)
  - K) A separate, dedicated S / W is applied
- (3) Benefits.
  - A) Basic Refrigeration or an easy measurement using frozen pipe circuit
  - B) Ffilling and replacement or change of state of the refrigerant can be recorded
  - C) The load variation of the low pressure in the high pressure region of each other, a pressure, a temperature change be measured and know the change in flow rate
  - E) Of the refrigerant control (filling, and purge), and the refrigerating capacity can be seen Modulation
  - F) Failure, leading to what's happening on EI memory can be identified
  - G) Changes in each part of the gas phase and in the gas phase to familiarize yourself with the basic state can be

## Components

Hardware platform	1 unit
Power cable	1 ea
Program CD (program for Calorimetry equipment)	1 ea
Manual book	1 book

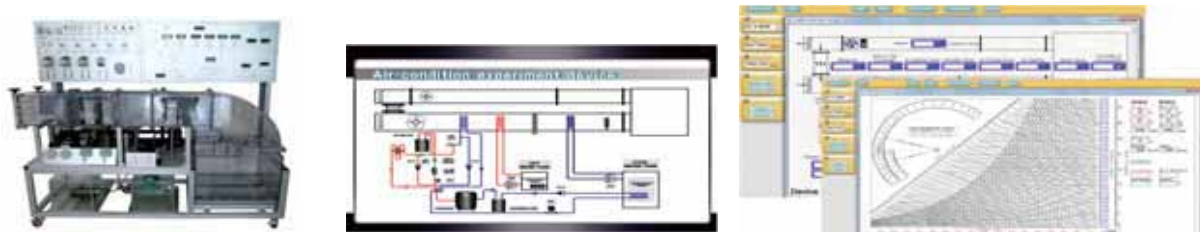
# model: Air ventilation(heating & cooling) -GT600

## Air ventilation (cooling & heating) system trainer

### Feature

1. The possibility of experiment on ventilation system (4-type) and cool - warm condition with heat pump
2. Assistant heat source with heat pump and humidification for both cooling and heating water
3. Humidification device made up of watering or air crossing type, inhalation and emission of conditioning damper and inside made up of inhalation and emission part
4. The structure of humidified cooling or heating water according to user 's temperature control
5. The structure to operating system from outside and the structure to control inside temperature and humidity
6. Automatic control by systematic temperature and humidity
7. The sequence screen attached to the graphic module control department and power automatic control machine for experiment on temperature, pressure and automatic control and operation
8. The possibility of cutting the overload, working the pressure switch, alarm bell and a pilot lamp and safe operation with occuring the problem of a thermo-hygrostat
9. Application to refrigeration system for compressor of variable types

### System configuration



### Components

Hardware platform	1 unit
Bananna jack (red)	20 ea
Bananna jack (black)	20 ea
Power cable	1 ea
Program CD for Calorimetry equipment	1 ea
Manual book	1 book

### Experiments(Study objectives)

- Fitting refrigerant
- Vacuum test
- Leak test
- Troubleshooting at AHU system machine
- Troubleshooting at electric circuit
- Fitting electric circuits for AHU
- Duct work effect of AHU system
- mixture and heating RA and OA
- mixture and cooling RA and OA
- mixture and humidifying & heating RA and OA
- Preheating, cleaning and reheating between RA and OA
- Drawing PSI chart
- Component understanding of AHU system
- Cycle through the manual operation of manual operation panel

## Experiments(Study objectives)

### 1) Machine

- a. Compressor : 1/2HP, single-phase 220V, Control Box
- b. Condenser : Air-cooled type, single-phase 220V
- c. Heat exchanger for cool and warm water (2EA) : nipple clamp type
- d. Evaporator for heat pump : pin, Tube Air-cooled type (welding type)
- e. Liquid receiver1/2HP, Accumulator : 1HP
- f. Expansion Valve(2EA): manual expansion valve
- g. Electronic Valve : 3/8" nut clamp type or welding type
- h. Filter dryer : 3/8" nut clamp type or welding type
- i. Manometer: High Pressure, Low Pressure
- j. Filling nipple : Attached to a nipple for Filling
- k. Sight Glass : welding type or nut clamp type
- l. Transportation pump : 220V, 60/50Hz
- m. Sealing valve : 220V, 60/50Hz
- n. Exhaust valve : 220V, 60/50Hz
- o. Humidifier device: spray type and atmospheric crossing type

### 2) Control

- a. Sequence control screen: 795\*600,
- b. Magnet Contact : 13A, 5a2b : 3EA
- c. Relay (8Pin) : 4EA
- d. Timer (24hr) : 1EA, Timer (60sec) : 1EA
- e. THR : 1EA (with MC)
- f. High and Low pressure switch : LPS, HPS
- g. VOLT, AMPER METER
- h. Power Control : toggle, push button, selected switch
- i. Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
- j. Pilot lamp : Red, Green, Yellow, White

### 3) Simulation

- a. Digital thermometer : 11EA (temperature control type)
- b. Hygrometer : 1ea (Humidity control type)
- c. Action lamp : red, green
- d. Graphic module : 995 \* 600 AI

### 4) Dimensions and weight

Size(LxWxH): 1800x730x1720mm  
Weight: 250kg

### 5) Calorimetry equipment

(1) Equipment default configuration.

Pressure gauges, pressure sensors, thermometers, temperature sensors, flow meters, flow sensors, output devices, and data loading unit, the power measurement device

(2) Features.

- A) Measuring devices are easy to configure and install
- B) The configuration of the basic refrigeration cycle, refrigeration cycle, 2 cycle, the heat pump also can be measured
- C) The measured value for each type of gas used in real time on the leading EI Mori projection
- D) The value of real-time projection can be separately
- E) Record the data in a separate note or clarifications
- F) The pressure of the cycle, the temperature regulation
- G) Use the refrigerant Freon R - 134A
- H) Each part of the start-up flow rate, temperature, Pressure measured in terms of calories and can
- I) Condensation, in accordance with the load fluctuation of the evaporator temperature, the change in pressure can be checked
- J) Input against output (COP)
- K) A separate, dedicated S / W is applied

(3) Benefits.

- A) Basic Refrigeration or an easy measurement using frozen pipe circuit
- B) Filling and replacement or change of state of the refrigerant can be recorded
- C) The load variation of the low pressure in the high pressure region of each other, a pressure, a temperature change be measured and know the change in flow rate
- E) Of the refrigerant control (filling, and purge), and the refrigerating capacity can be seen Modulation
- F) Failure, leading to what's happening on EI memory can be identified
- G) Changes in each part of the gas phase and in the gas phase to familiarize yourself with the basic state can be

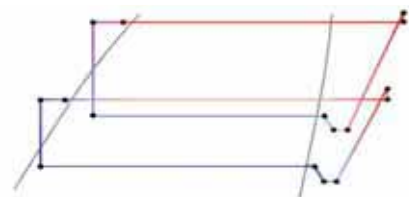
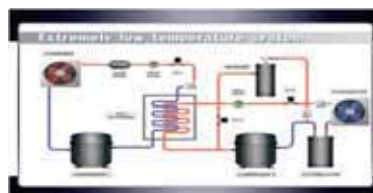
# model: Splat cooling regrigeration-GT700

## Splat cooling refrigeration system trainer

### Features

- 1) The possibility of experiment on temperature, pressure, automatic control and mechanical trouble shooting by splat cooling refrigeration system.
- 2) The comprehension of refrigeration system with an extremely low temperature.
- 3) The experiment on cycle change of refrigeration equipment accodding to temperature and Mollier diagram drawing in P-I diagram drawing part.
- 4) Low temperature side's evaporator is range of between -50 and -70 .
- 5) Theoretical education of a fundamental circuit, Application circuit & experiment by splat cooling refrigeration system.
- 6) The sequence screen attached to the graphic module control department, and power automatic control machine for experiment on temperature, pressure and automatic control and operation.
- 7) Transparent accessories to observe refrigerant state or flow.
- 8) The control department is made up of visual lamps separated system from machine department.
- 9) Automatic control with graphic panel and two automatic control modules.
- 10) Data formation by data auto-saving and P-I diagram auto-operation in the system with control program.

### System configuration



### Experiments(Study objectives)

- Fitting refrigerant
- Vacuum test
- Leak test
- Troubleshooting at Splat cooling refrigeration system trainer.
- Troubleshooting at electric circuit
- Fitting electric circuits for Splat cooling refrigeration system trainer.
- Refrigeration effect as ratio of the expansion  $V/V$  in Splat cooling refrigeration system trainer.
- Temperature control at evaporator.
- Temperature control at condenser.
- Pressure control at low side.
- Pressure control at high side.
- Understanding the principle of Splat cooling refrigeration system trainer.
- Learn the components of Splat cooling refrigeration system trainer.
- COP calculation for Splat cooling refrigeration system trainer.

### Components

Hardware platform	1 unit
Bananna jack (red)	20 ea
Bananna jack (black)	20 ea
Power cable	1 ea
Program CD for Calorimetry equipment	1 ea
Manual book	1 book

## Spec

### 1) Machine

- a. Compressor : High temperature, Low temperature, single-phase 220V, Control Box
- b. Plate heat exchangers (low temperature side), Evaporator: Tube type
- c. Accumulator, Receiver tank : 1HP
- d. Expansion Valve: manual expansion valve, capillary tube
- e. Electronic Valve for operation : nut clamp type or welding type
- f. Filter dryer : nut clamp type or welding type (2EA)
- g. Manometer: High Pressure(2EA), Low Pressure(2EA)
- h. Filling nipple : Attached to a nipple for Filling
- i. Sight Glass : welding type or nut clamp type (2EA)

### 2) Control

- a. Automatic control module : 795 \* 600,
- b. Magnet Contact : 13A, 5a2b : 3EA
- c. Relay (8Pin) : 4EA
- d. Timer (24hr) : 1EA, Timer (60sec) : 1EA
- e. THR : 1EA (with MC)
- f. High and Low pressure switch : LPS, HPS
- g. Power Control : toggle, push button, selected switch
- h. Safety device : Blocking overvoltage (N.F.B), buzzer, fuse
- i. Pilot lamp : Red, Green, Yellow, White

### 3) Simulation

- a. Digital thermometer : 8EA (temperature control type)
- b. Action lamp : red, green
- c. Graphic module : 795 \* 600 AI

### 4) Dimensions and weight

Size(LxWxH): 1800x730x1720mm  
Weight: around 250kg

### 5) Calorimetry equipment

- (1) Equipment default configuration.  
Pressure gauges, pressure sensors, thermometers, temperature sensors, flow meters, flow sensors, output devices, and data loading unit, the power measurement device
- (2) Features.
  - A) Measuring devices are easy to configure and install
  - B) The configuration of the basic refrigeration cycle, refrigeration cycle, 2 cycle, the heat pump also can be measured
  - C) The measured value for each type of gas used in real time on the leading EI Mori projection
  - D) The value of real-time projection can be separately
  - E) Record the data in a separate note or clarifications
  - F) The pressure of the cycle, the temperature regulation
  - G) Use the refrigerant Freon R - 134a
  - H) Each part of the start-up flow rate, temperature, Pressure measured in terms of calories and can
  - I) Condensation, in accordance with the load fluctuation of the evaporator temperature, the change in pressure can be checked
  - J) Input against output (COP)
  - K) A separate, dedicated S / W is applied
- (3) Benefits.
  - A) Basic Refrigeration or an easy measurement using frozen pipe circuit
  - B) Filling and replacement or change of state of the refrigerant can be recorded
  - C) The load variation of the low pressure in the high pressure region of each other, a pressure, a temperature change be measured and know the change in flow rate
  - E) Of the refrigerant control (filling, and purge), and the refrigerating capacity can be seen Modulation
  - F) Failure, leading to what's happening on EI memory can be identified
  - G) Changes in each part of the gas phase and in the gas phase to familiarize yourself with the basic state can be

# 46

## a group of Live & long-distance interactive learning Studio system

157. GT-Interactive learning Studio16

158. CCTV-5000

159. GT-Solar & Wind vane16



# model: GT-Interactive learning Studio16

## Live & Long-distance interactive learning studio system

GT-Studio16 produces a live & long-distance on line interactive learning studio by the provided hardware & software Studio system.

GT-Studio16 is a live online learning system that utilizes video, voice, text and multifunctional multimedia.

GT-Studio16 enhances the learning effectiveness efficiency in real time, and customized one-to-one lectures and lecture review over recording.

GT-Studio16 has live & long-distance education (e-learning) software, developed to serve a large number of concurrent users, GT-Studio16 can be effectively used for all types of schools, educational institutes and enterprises.

### Feature

#### 1) Make a virtual Studio & VR Contents production

- (1) Edit color, size, scale of graphics or videos before or during recording without any third party editing application
- (2) Export and use tasks of 3D Max or Maya, 3D editors, in real time.
- (3) Support the Collada 3D export format to import required 3D objects into the Studio to arrange them and set up animation thereof.
- (4) Combine any set of respective 3D sets for producing the Studio without using 3D Max.
- (5) Provide cloud set components for producing endless sets without using 3D Max or Maya tool for producing the Studio.
- (6) Automatically create and control at least 900 tracks by freely setting camera tracks, 3 video screen monitor animation, actor's location and rotation of Chroma key scenes without using an edition program, for example, 3D Max.
- (7) Set curve screens of the virtual monitors in real time to be controlled without using any program, for example, 3D Max.
- (8) Show animation texture in the virtual monitor frame, and implement HSV and RGB conversion through sliders to change colors.
- (9) Support the 2.5D system which is a 3D virtual Studio of 2D multi layer type.
- (10) Freely receive, insert and change Studio desks, ceiling and decoration (decoration sets) from the outside.
- (11) Freely change loading the Studio from the virtual Studio to change it into a set for broadcasting other programs in real time.
- (12) Arrange and modify texture for inserting logos through input from the outside.
- (13) Freely arrange synthesis of respective multi camera mixing (at most 6 scenes) with the DownStream key to configure it as a synthesized screen, and easily edit it as a different scene through animation.
- (14) Adjust color and transparency of skin texture of each character by adjusting Shader to implement changes.

#### 2) Realistic one-to-one education

- (1) The realistic private education allows one-to-one customized learning.
- (2) Live video from a Camera device HDMI or USB
- (3) Support tracking sensors with the full 3D-virtual studio.
- (4) A real-time render camera interworks with external tracking devices through the sensorless tracking system.
- (5) Automatic tracking occurs by the key frame setting of at least 12 virtual tracking sensors.
- (6) It is possible to control the virtual monitor and animation of 3D animation object at the same time together with each track scene.
- (7) The preview monitor screen is displayed independently of the SDI/HDMI output.
- (8) It is mapped to the scene switching button of the sensorless virtual scene and the sensor tracking scene as preview scene.
- (9) The switching button of the virtual monitor is provided as a menu. At least 30 scenes are displayed on the screen as a menu for the scenes required in real-time broadcasting.
- (10) For easy AR mode support, virtual 3D objects or animation are displayed in various scenes through easy scaling, positioning and angle control.

- 3) Facilitate group discussion
  - (1) Multiple users can participate in video discussions.
  - (2) A plurality of remote computer screens are displayed on the virtual screen through real-time IP access to them.
  - (3) Full 3D virtual Studio concurrently with 4 HD cameras, one VGA/DVI input support and storing data in a USB simultaneously.
- 4) Support of various types of learning methods and Multimedia files.
  - (1) MS Office, GUL documents, PDF and various of image types.
  - (2) Video, music and other multimedia files recording function available.
- 5) Convenient electronic blackboard function
  - (1) An electronic blackboard (drawing board mode) can provide a realistic classroom environment for the students.
  - (2) Support drawing and painting for 3 virtual monitors while moving a cursor of each monitor.
  - (3) In each monitor, painting can be controlled for color, thickness and transparency, and monitor animation does not affect painting positions.
- 6) Online class
  - (1) Real time online education system.
  - (2) Easy to make and use required effects, for example, special effects, mixing and transitions.
  - (3) Easy to configure interaction between motion captured data and characters, and easy to control them.
  - (4) 3 monitors is simultaneously displayed
    - 1st monitor can be for Lecturing materials (Professor's power point materials)
    - 2nd monitor can be for Live-channel for 1:1 live conversation, chatting.
    - 3rd monitor can be for Local monitor (realtime photo shop menu display,,, etc.)
  - (4) Several editions are available for different scenarios and budgets
  - (5) Create up to 12 dynamic animation scenes with very easy Scene Editing functions
  - (6) Three or fewer virtual monitor screen contents switching screens are automatically selected in the monitor with the mouse as a scene-selected screen.
  - (7) Support 3 or fewer control monitors to switch scenes or change monitor scenes by both PD and actors.
  - (8) Support automatic AR automatically in line with contents AR for monitor AR to display it without distortion compatible with any video or graphic AR.
- 7) Live broadcasting
  - (1) Live-broadcasting to U-Tube, Africa TV, Facebook,,, etc and simultaneous recording is possible in a real time.
  - (2) Real time Record & stream simultaneously in .FLV or .MP4 formats
  - (3) Support recording, streaming displayed screens, and Skype in real time.
  - (4) Record and hang out the displayed screens in real time.
  - (5) Display the remote scenes concerned as virtual studio scenes through access to Skype with actors or reporters in the concerned remote location.
  - (6) Display live cameras or laptop computers of reporters in a remote location on the virtual screen in real time, and to control the scenes easily as new animation.
  - (7) Allow system options to be added to support the HDMI and SDI. Cameras if required.
  - (8) Support switching to the hybrid tracking mode by interworking with the tracking sensor.
  - (9) Implement real-time character interworking through interworking for capturing motions. Essential to receive character motion data of captured motions to display character animation in real time. (Chroma key processing is not allowed in the motion builder.)
  - (10) Directly set up independently arranging, scaling, rotating and moving a plurality of characters (at least 6) in the virtual studio.
- 8) Long-distance interactive live classroom
  - (1) Beyond borderline between countries, long-distance interactive live classroom is available.
  - (2) Live Stream or Live meeting compatible with Skype, QQ, Hangouts, YouTube, UStream, LiveStream, Afreeca & other streaming services
  - (3) Display and control character animation interactively in real time.
  - (4) Support the edition capability of adjusting and arranging the frame of 12 or fewer switching scenes as free virtual studio multi-camera mixing scenes by receiving simultaneously multi actors.
  - (5) studio scenes of different Chroma key and background through PIP or multi scene mixing with scenes of different size, scale and rotation.
- 9) HD Video
  - (1) H.264 MP4 format to provide stable and high quality videos
  - (2) Generate high-quality video of presenters using 3D rendering and composition technology
  - (3) Freedom to adjust the video resolution, size and frame rate for recording
  - (4) Independent audio level controls for media files
- 10) Multi media education for university, graduate school
  - (1) The optional presenter tracking technology ensures high-quality output for projector screens
  - (2) Easy AR broadcasting by inserting 3D objects and implementing AR function through Animation to control color and transparency, change and set location, scale and rotation of every 12 scenes.
  - (3) Display at least 3 output ports and control monitors in 3 monitors.
  - (4) Remote training in welfare facilities as well as educational institutes,
  - (5) Employee training in the large corporation.
  - (6) Create virtual eye-contact with the audience even in a large conference hall

## System configuration

### 1) Studio photo & VR Contents production

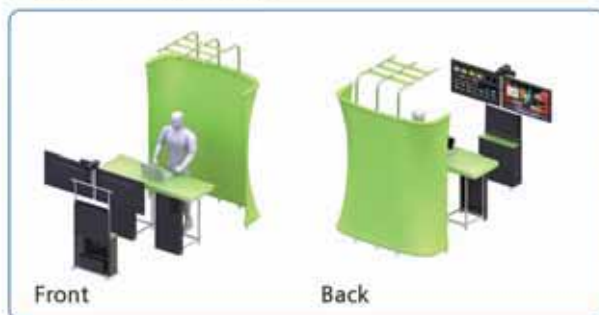


### 2) Smart Classroom



### 3) Video Conferencing

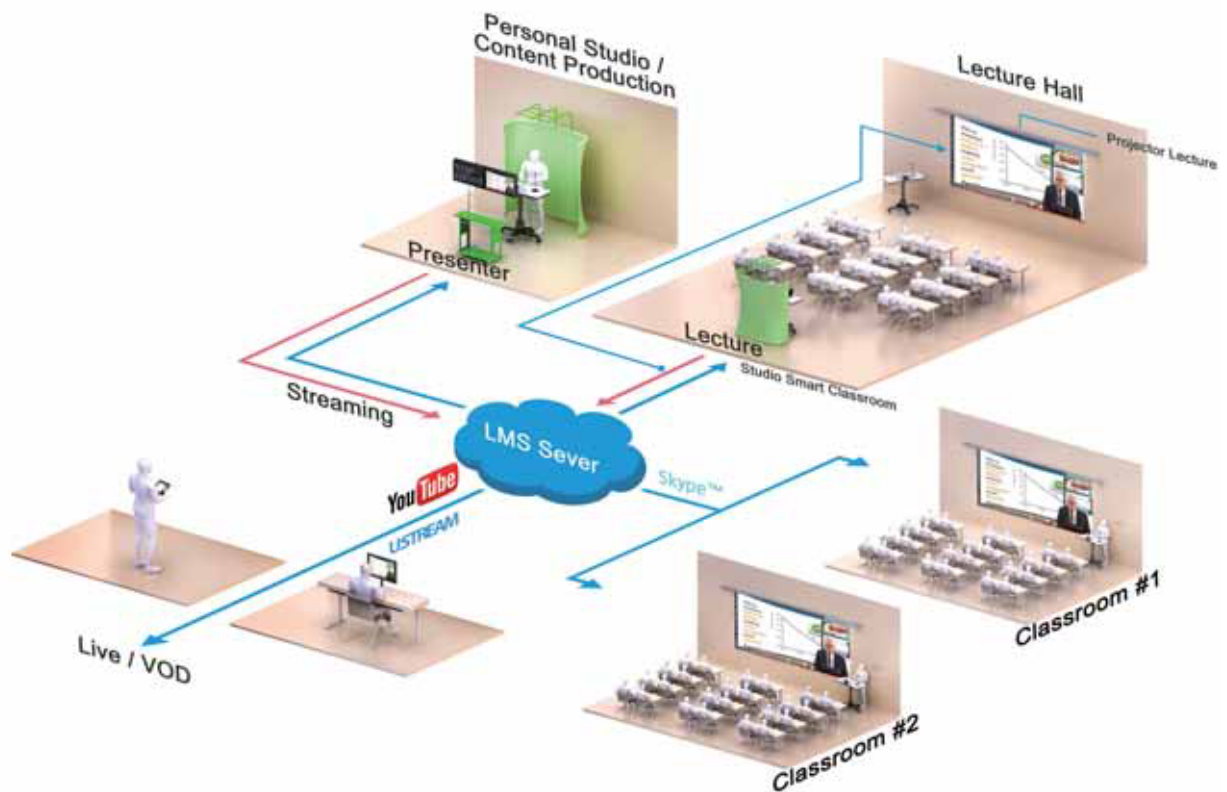
#### Personal Broadcast Studio



#### Video conferencing



#### 4) System architecture



#### 5) Live broadcasting



## Specifications

no	Spec	Unit
<b>1</b>	<b>GT-Studio16 hardware</b>	<b>1 set</b>
	(1) Movable VR lecturing Studio	
	3D trakless(full360)	
	1 Actors, 3 Virtual Monitor	
	12 Scenes	
	Output : 2 VGA, File, Stream	
	Input : 2HDMI, 1DVI	
	(2) Input: 2 HDMI cameras, VGA/DVI/HDMI notebook, USB camera, multimedia files (Video, images)	
	(3) Output: multiple HDMI preview, HDMI program output (optional)	
	(4) 12 Button Preset Switcher	
	Scene, layout editing mode 3D	
	Real-time Remote Switcher control	
	Real-time Content ( AVI, Image, Video),USB camera, VGA/DVI switching	
	(5) Animated Title Support	
	TGA Format	
	After Effect Animated Title Support	
	(6) Video Mixer/Scaler/Switcher Built in	
	Full 3D Mixer : Freely adjustable Z coordinate for multiple virtual set elements	
	Multi-Layer Mixer : Video/Image Layer+Camera+DVI/VGA/HDMI+Outer Frame+Title	
	PIP(Picture in Picture) Mixer : Camera video and VGA/DVI/HDMI input bi-directional PIP	
	Scale : 4:3/16:9 Scale, Custom Ratio Scale.	
	(7) Virtual Electric White board (3 Virtual Monitors)	
	Drawing function overlay on the Virtual monitor	
	Pointer display and recording in Virtual monitor	
	Control option for the pointer on color, thickness, and transparency	
	Eraser function for partial or all parts of drawing	
	(8) Document Camera Function	
	External document camera input (VGA/DVI/HDMI) - PIP screen mixer	
	USB Camera	
	Chroma-key Function	
	Chroma-key for video input from camera	
	Mixing with pre-made 3D virtual set	
	Multiple layers display with presenter from Chroma-key	
	Sophisticated Audio Mixer	
	Multiple line and audio inputs with 3 independent stereo outputs	
<b>2</b>	<b>Camera</b>	<b>2 ea</b>
	1/2.8" 60fps low lux 2m pixel	
	CMOS sensor 12xlossless true optical zoom	
	f = 3.9mm(wide)~46.1mm(tele)	
	D = 82. (wide)~6.3. (tele)	
	F = 1.8(wide) ~ 2.8(tele)	
<b>3</b>	<b>Tripod</b>	<b>2 ea</b>
	4 steps height adjustment,	
	maximum diameter 2.5cm / minimum 1.5cm,	
	height up to 162cm / minimum 134cm.	
<b>4</b>	<b>Chroma-key wall</b>	<b>1 ea</b>
	180*60*220cm Transpotable, Washable Wrinkle-Free	
<b>5</b>	<b>Console</b>	<b>1 set</b>
	180*60*220cm Transpotable, Washable Wrinkle-Free	
<b>6</b>	<b>Mic</b>	<b>1 ea</b>
	40.....20,000 Hz(Frequency response)	
	Sensitivity : 3mV/Pa Min.	
	terminating impedance : 1k	
<b>7</b>	<b>Mic2</b>	<b>1 ea</b>
	-47db ± 3db   Max0.5mA	
	S/N Ratio : 55dB	
	S/N Ratio : 55dB	
<b>8</b>	<b>Monitor</b>	<b>2 ea</b>
	22"   16:9   54.6cm   1000:1(Contrast)	
	Viewing Angle(178/178)   16.7M Colors	

no	Spec	Unit
<b>9 Speaker</b>		<b>2 ea</b>
	2-way powered speaker	
	65Hz-22kHz	
	Line 1: -10dB (RCA-pin),	
	Line 2: +4dB (XLR3-31 type, Phone) 4.4kg; 9.7lbs	
<b>10 Light</b>		<b>2 set</b>
	Stand Lights	
	- 2pcs-including cable	
	- 64cm ~ 200cm	
	- 50LEDs/75LEDs	
	- 1000 LUX(4000k~5500k Color Temperature)	
<b>11 Audio Mixer</b>		<b>1 set</b>
	(1) 8-Input 2-Bus Mixer, 2 mono MC/line input,	
	(2) 2 Stereo input CD/tape inputs assignable to main mix or control room/phones outputs	
	(3) Real-time Video Mixer	
	12 Layer independent Mixing & Independent Scaling, Sizing, Positioning	
	- Background Layer : 3D templates from 3D Studio Max, AVI, Image	
	- Wall layer : AVI, Image, TGA, PNG, AVI + Alpha	
	- DVI/VGA/HDMI-Monitor Frame layer: TGA, (AVI + Alpha)	
	- Animated Title Layer	
	- Independent 3D Desk & 3D Decoration insertion	
	- Custom animated 3DObject insertion in 3DSet	
	- Color theme adjustment for 3D objects	
	Scene combination of mixing presenter and VGA/DVI/HDMI inputs in one screen (Mixer)	
	Control for presenter frame TGA/Animated Video	
	Up/down/right/left position control	
	Up/down/right/left scale control	
	Background image/video scale or movement control	
	Mixing presenter from chromakey or non-chromakey mode with pre-made background and multiple layers	
	(4) Output screen selection switch	
	12 Buttons pre-set screen editing mode - Positioning Background/ Wall/Camera/Monitor	
	Switcher preview icon automated generation	
	Virtual camera output screen, FOV, Position control	
	Input camera, DVI/VGA, Full Screen switching	
	USB, VGA/DVI/HDMI preview function	
	Wireless/wired mouse click switching control function	
	External Wireless/Wire Keypad control function	
	PIP, Video + Video model selection function	
	(5) Virtual monitor screen control and selection switching function	
	Content server function - Image, Video (AVI, WMV, MP4, MPG) file loading and storage	
	Real-time content Preview Thumbnail ( video/image file Preloaded ) selection and play function	
	Paint / Drawing/ Erasing (Thickness and color of pen control function)	
	(6) Recording and streaming function	
	MP4, Flash (FLV) format selection	
	Various Bitrate control - Audio/Video	
	IP Streaming function	
	(7) Pointer (cursor) selection and input for new designed cursor by user	
	User Editable cursor format support	
	Real-time Overlay cursor display	
	Simultaneous cursor and video Recording	
<b>12 Laptop PC</b>	<b>Window 8, MS Office</b>	<b>1 ea</b>
<b>13 LAN Cable</b>	<b>20m, length</b>	<b>1 ea</b>
<b>14 Router</b>	<b>for LAN &amp; WiFi</b>	<b>1 ea</b>
<b>15 HDMI Cable</b>	<b>5m</b>	<b>5 ea</b>
<b>16 HDMI Cable</b>	<b>10m</b>	<b>5 ea</b>
<b>17 VGA Cable</b>		<b>2 ea</b>
<b>18 HDMI to DVI Cable</b>		<b>2 ea</b>
<b>19 HDMI to HDMI Gender</b>		<b>3 ea</b>
<b>20 Monitor bracket</b>		<b>4 ea</b>



## Components

no	Items	Q'ty	Unit
1	GT-Studio16 Hardware	1	ea
2	Camera	2	ea
3	Tripod	2	ea
4	Chroma key wall	1	ea
5	Console	1	set
6	Mic	1	ea
7	Mic2	1	ea
8	Monitor	2	ea
9	Speaker	2	ea
10	Light	2	set
11	Audio Mixer	1	set
12	Laptop PC	1	ea
13	Program CD	1	ea
14	Manual book	1	book

## Training Contents

### Part-1) Starting GT-Studio16

- (1) Connect to the External Monitor and Power
- (2) Start Program
- (3) Startup Screen

### Part-2) Installation and setup

- (1) Video Settings
- (2) Video Input Cabling
- (3) Input Source

### Part-3) Operating GT-Studio16

- (1) Live Control
- (2) Chromakey Interface Tips
- (3) Recording Options
- (4) Studio Selection
- (5) Static Elements
- (6) Keyframe Design

### Part-4) Audio Setting for VT620

### Part-5) Exercise for various functions

- (1) Make a virtual Studio & VR Contents production
- (2) Realistic one-to-one education
- (3) Facilitate group discussion
- (4) Support of various types of learning methods and Multimedia files.
- (5) Convenient electronic blackboard function
- (6) Online class
- (7) Live broadcasting
- (8) Long-distance interactive live classroom
- (9) HD Video
- (10) Multi media education for university, graduate school

### Part-6) How to make real VR contents production by students

model: **CCTV-5000**

## CCTV Surveillance training system

### Introduction

CCTV-5000 is CCTV (video) surveillance solution minimizing false alarm which is based on cutting-edge video analyzing and algorithm technology platform.

- (1) Learn total security system via intelligent CCTV (video) surveillance.
- (2) For real Time surveillance via intelligent video analysis.
- (3) Transmit alarms by various ways to administrator & related association.
- (4) Retrieve the required video in the event storage server.
- (5) Possible to link with existing CCTV system

### Features

- 1) Algorithm of CCTV (video) analysis
  - (1) Qualified Intelligent video analysis algorithm & its technology
  - (2) Provides the customization for optimizing detection
- 2) Minizes the false alarm
  - (1) Applied for noise removing tech on dynamic BG (tide, leaf, snow, rain & etc.)
  - (2) Applied for noise removing tech on Light (headlight, Lights & etc.)
  - (3) Setting up undetectable time & zone
- 3) High expandable
  - (1) Provides all Analog/IP, Fixed/PTZ Camera (SD, D1, HD & etc.)
  - (2) 16ch Real time analysis for any of camera brands (Workstation)
  - (3) Provides video inputs for DVR, NVR

### Functions

#### 1) Standard function

- (1) Security & prevention
  - Fence intrusion detection
  - Zone intrusion detection
  - Violence detection
  - Loitering detection
  - Objects counting
- (2) Facility management
  - Fire detection
  - Smoke detection
  - Theft detection
  - Trash detection
- (3) Traffic management
  - Wrong direction
  - Illegal parking
  - Theft detection



**2) Specialized function**

- (1) Abnormal sound detection
- (2) Object auto tracking
- (3) Electrical failure (Arc / Short)
- (4) Vehicle counting / Avg. velocity
- (5) Multi channel booadcasting
- (6) Video restoration

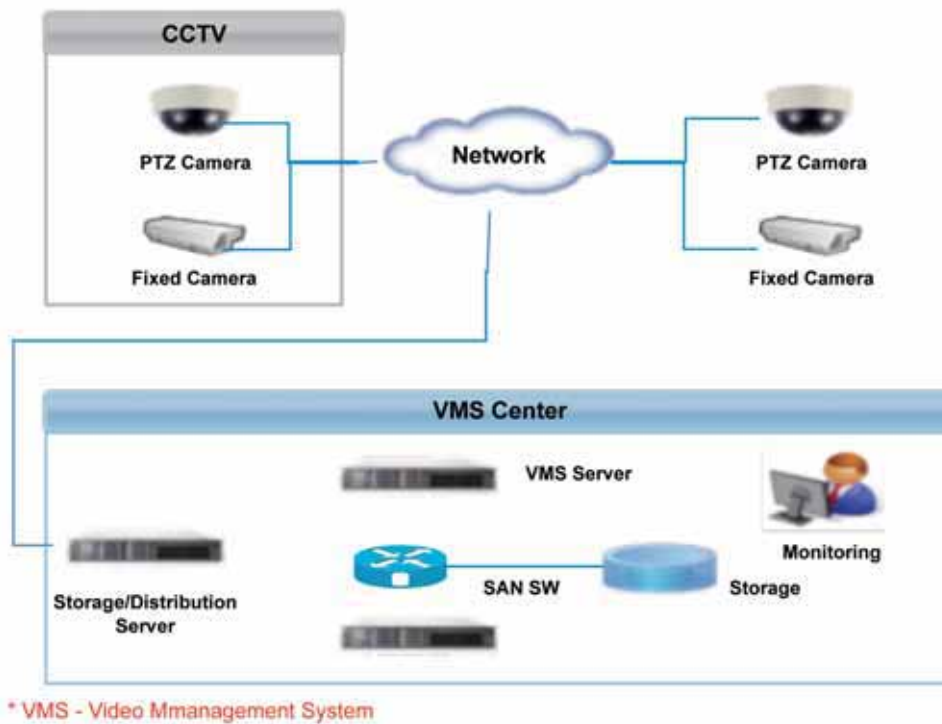
**3) Platform function**

- (1) Camera
  - Real time video analyze for 16 Cameras of 1 server
  - Support camera based on Analog(Video server)/IP (fixed, PTZ)
  - Support ONVIF camera
- (2) Camera control
  - Preset function incl. camera direction & Zoom value
  - Various event detect setting function for each Preset
- (3) Alarm Output
  - Screen Alarm, Lighting, Speaker, SMS, Screen pop-up & etc..
  - Event/Camera/User/Alarm type
- (4) User setting
  - Provides system authorization for each differentiation level of users and set for user accounting
- (5) Object filter
  - Dynamic Background noise remove : Flag waving, tree branches , stream, Wave, Twilight lights and etc..
  - Light noise remove : Shadow, Vehicle Headlight, Garden light, Night Sign light and etc..
- (6) Object classification
  - People, Vehicle, Unclassified
- (7) Event detection
  - Detection Range : Polygon shape for each CCTV, Possible to set multi event detection zone
  - Event detection rule : Assigning for each event detection zone
  - Event classification set: Refers to description of video analyze function
  - Alarm set : Screen Alarm, Lighting, Speaker, SMS & etc.
  - Detection schedule set : time base
  - Undetectable zone set : possible to set polygon shape
- (8) Video output (real time)
  - Equality screen division : provides 1/4/9/16/25/32ch
  - Full screen mode
  - Converting multi channel monitoring by time setting
  - Pop-up & registering CCTV installation drawing functions
  - Show the moving objects & direction function
- (9) Video recording
  - Compression : MPEG4(DIVX), H264
  - Recording : Continuous/Event/Prompt records
  - Set time scope before & after event
  - Storage management : Maximum usage of storage space & automatic video remove via set for max. allowed storage space
- (10) Search storage video
  - Provides searching condition by Time/Event type/CCTV type/Object classification
  - Function for prompt play for searched event video
  - Time line: Video recording condition by time periods & show situation of the event by the graph
- (11) Play storage video
  - Time base playing : select the play position on the time line
  - Event base playing : select specific event from recent raised event lists or searched event lists
  - Forward, Reverse direction play & fast play(Forward/Reverse direction) function
- (12) Export storage video
  - File format : AVI file
  - Provides select time scope function or export by event

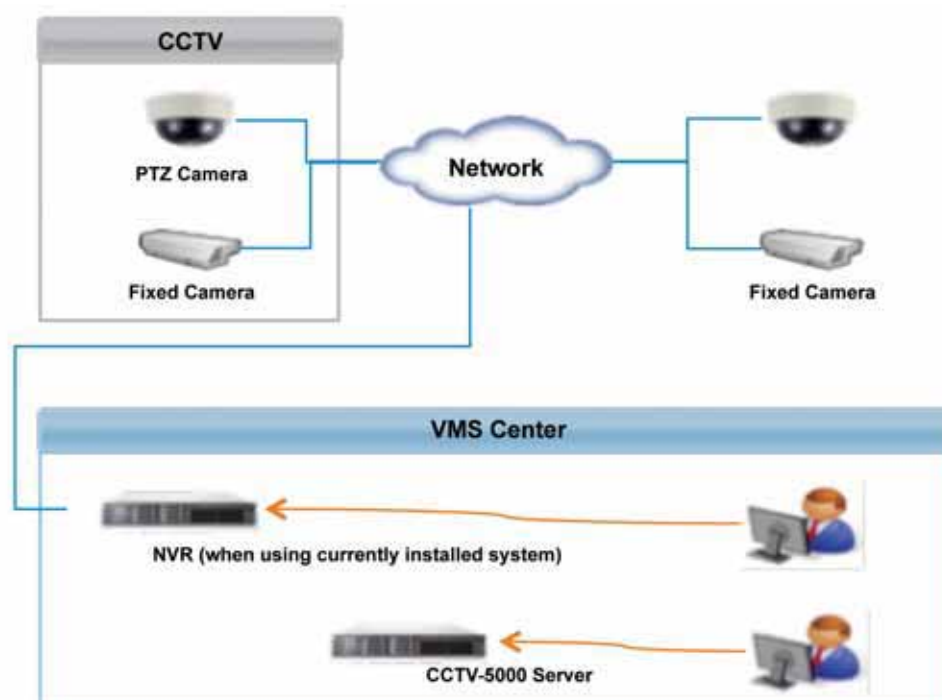
## System configuration

: 3 types of system configuration is available.

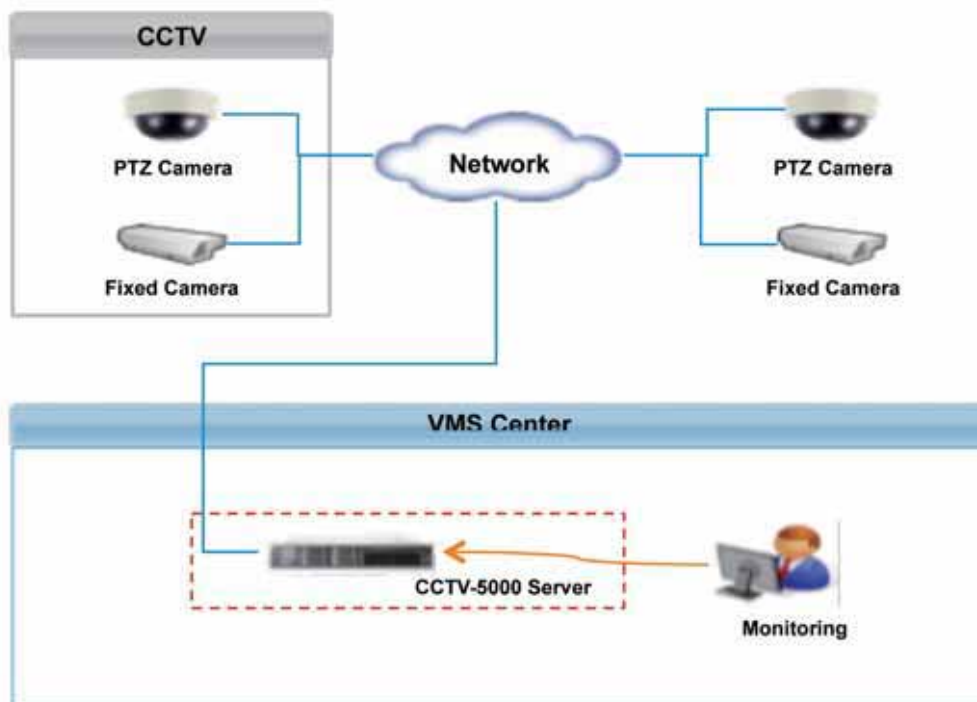
### 1) System construction plan(VMS environment)



### 2) System construction plan (NVR/DVR environment)



### 3) System construction plan (Stand-Alone)



### Components (Stand-Alone system)

1) PTZ Camera	1 unit (available to max 16 unit)
2) Fixed Camera	1 unit (available to max 16 unit)
3) Server	1 unit
(1) CPU	Intel Core i7-4 Generation 4790, or over
(2) RAM	Samsung DDR4 8G PC3-12800, or over
(3) HDD	Seagate 4TB Desktop HDD.15 ST4000DM000 (SATA3/5900/64M), or over
(4) VGA	GeForce GTX750 Ti STORM X Dual OC D5 2GB, or over
(5) OS	Windows 7, 64bit, or over
4) Software program CD	1 ea
( Intelligent Image Analysis SW Installation File )	
5) Manual book	1 book

### Manual contents

#### 6. Manual contents

##### Chapter 1, Overview

##### 1.1 Introduction

##### Chapter 2, System

##### 2.1 Software Install & Start

##### 2.1.1 Software Install

##### 2.1.2 NVR Start

##### 2.1.3 NVR Finish

##### 2.2 Configuration of Main screen

##### 2.2.1 Button configuration

##### 2.3 LiveView - Live video

##### 2.3.1 VideoScreen- Video output screen

##### 2.3.2 StatusView

##### 2.3.3 PTZViewPTZ- operation

##### 2.3.4 EventView

- 2.4 Playback View
  - 2.4.1 Overview of PlaybackView
  - 2.4.2 TimelineSearch
    - 2.4.2.1 Video view of Playback after retrieving recording information
    - 2.4.2.2 control of Playback video
    - 2.4.2.3 Digital zoom
    - 2.4.2.4 Goto-Playback Quick View
    - 2.4.2.5 AVIExport-Playback video save to external
  - 2.4.3 EventSearch-event retrieval
    - 2.4.3.1 Event Search (retrieve) and view the Playback video
- 2.5 EventView - EventView
  - 2.5.1 EventView- Screen configuration
  - 2.5.2 NVR-Event retrieval
- Chapter 3, Setting
  - 3.1 Camera Registration
    - 3.1.1 Camera registration (add)
    - 3.1.2 Modifying Camera registration information (edit)
    - 3.1.3 Delete a registered camera (del)
    - 3.1.4 Find a connected camera (find)
    - 3.1.5 Camera Setting
    - 3.1.6 Assigning cameras to NVR channels (Assign)
  - 3.2 Assign - Channel assign
    - 3.2.1 Assigning a camera to a channel (edit)
    - 3.2.2 Delete a camera assigned to a channel (del)
  - 3.3 Disk - Setting the Recording Storage Disk
    - 3.3.1 Specifying the disk where recorded video will be saved (edit)
    - 3.3.2 Set up capacity notifications (Low Storage Notification)
    - 3.3.3 Cycle setting (Cycle Recording)
    - 3.3.4 Disk Management
  - 3.4 Recording - Setting recording
    - 3.4.1 Specifying recording attributes
    - 3.4.2 Specifying the recording schedule mode
    - 3.4.3 Editing Recording Schedule Mode
  - 3.5 Network - Setting network information
    - 3.5.1 Changing network information
  - 3.6 Time - View and change date / time
    - 3.6.1 Changing the system date / time
  - 3.7 User - Setting user information
    - 3.7.1 Adding a user account (add)
    - 3.7.2 Modifying user accounts (edit)
    - 3.7.3 Deleting a user account (del)
  - 3.8 Alarm Information – E-mail, alarm setting
    - 3.8.1 E-mail, alarm setting
  - 3.9 System Information - Checking system information
    - 3.9.1 Checking system information
    - 3.9.2 Using system-related features
      - 3.9.2.1 Calculating Recording Capacity (Disk space calculator)
      - 3.9.2.2 Change system name
      - 3.9.2.3 System update
      - 3.9.2.4 Factory reset
- Chapter 4, CCTV Surveillance detection practice
  - 4.1 Violence detection
  - 4.2 Boundary line intrusion detection.
  - 4.3 Boundary Zone Intrusion Detection
  - 4.4 Wandering detection
  - 4.5 Fire and smoke detection
  - 4.6 Disappearance (theft) and appearance (dumping) detection
  - 4.7 Object analysis
  - 4.8 Vehicle and person counting
- Chapter 5, Algorithm Setting
  - 5.1 CCTV-5000 algorithm Setting
  - 5.2 How to use the Poly of algorithm setting
  - 5.3 How to use the Line of algorithm Setting
    - 5.3.1 Setting the Boundary Factor
    - 5.3.2 Retrieval (Search) for boundary Factor
  - 5.4 Level Setting
    - 5.4.1 Detail Setting of Level Setting
  - 5.5 3D Calibration Setting
- Chapter 6, Operation after Algorithm setting
  - 6.1 Connecting Camera
  - 6.2 Algorithm operation policy setting for camera
  - 6.3 Algorithm detail settings
  - 6.4 Algorithm operation test on various images
  - 6.5 Log and save the results of algorithm operation

## Specifications

### 1) CCTV (Video) surveillance

#### (1) Violence detection

If two or more people move abnormally fast on a CCTV image, it is possible to detect it by violence.

#### (2) Boundary line intrusion detection.

In the CCTV video, a function is provided to detect persons and vehicles entering the set boundary.

Boundary line intrusion detection is capable of forward, reverse, and bi-directional intrusion detection.

plurality of boundary lines can be set in one CCTV image.

#### (3) Boundary Zone Intrusion Detection

A polygonal boundary zone is set on the CCTV image, and the function of detecting the person and vehicle entering the set boundary zone is provided.

It is possible to prevent false detection due to vehicle lighting and sudden illumination change

Boundary zone intrusion detection function shall be provided with the function of detecting the entry into the boundary zone and the detection of deviation from the boundary zone

#### (4) Wandering detection

It is possible to provide a polygonal wandering detection area on the CCTV image, and to detect a person staying in the setting area for more than a predetermined time.

It should be possible to set multiple wandering detection zones on one CCTV image.

It should be possible to set the staying time to judge wandering detection.

#### (5) Fire and smoke detection

The function of fire detection is provided by analyzing the motion and color of flame in CCTV image.

Through CCTV images, the ability to detect smoke by analyzing the color and movement of the colored gas is provided.

The fire detection sensitivity is set according to the flame size.

#### (6) Disappearance (theft) and appearance (dumping) detection

A function is provided to detect the disappearance (theft) of an existing objects or the sudden appearance in the CCTV image.

For intensive detection of disappearance (stolen) or appearance (dumping) at a specific location, a polygonal detection zone should be set up.

#### (7) Object analysis

It is possible to provide a function to analyze and store color components, speeds, and sizes in objects such as people and vehicles appearing in CCTV images and store them in a DB.

#### (8) Vehicle and person counting

CCTV images is provided with a function to set a multi-angled type boundary and to count vehicles and people passing through them.

The boundary is possible to be simultaneously counted for the forward pass object and the reverse pass object.

### 2) Platform and monitoring capabilities

(1) It is possible to simultaneously analyze and monitor 16 channels of HD video at the same time (main server).

(2) Support both image input and control for stationary and PTZ cameras.

(3) Preset function for Camera direction and Zoom value are set, and Preset there must be more than 10 Preset setting.

(4) Each preset is possible to set detection rules for different boundaries, boundary zones, and so on.

(5) It is possible to retrieve by the time of stored video, detection event type, and search condition by CCTV.

(6) It is possible of forward and backward reproduction of the stored image and fast reproduction in each direction.

(7) Continuous digital video recording is possible.

(8) It is possible to set the schedule for video surveillance time and non-detection time.

(9) It is possible to set the area of interest that performs video surveillance and the area of non-interest that does not perform as a polygonal area.

(10) Alarm detection is provided to the control personnel through speaker, warning light, SMS, etc. when event detection through image analysis.

(11) Alarm display is possible to set speaker, warning light, SMS etc separately for the purpose of detection and as per camera.

(12) SMS sending is possible to be set for each registered user.

(13) support more than 23 kinds of screen layout layout for image display, and to be able to define each layout directly by the user.

(14) A Software Development Kit (SDK) is provided for compatibility with other external systems.

# model: **GT-Solar & Wind vane16**

## Solar radiation and wind speed data recording logger system

### Features

GT-Solar & Wind vane16 offers compact, advanced performance at real time weather measurement in the field and is powered either by AC Power or by an integrated solar panel.

Back-up battery is available is available when main power is not available.

GT-Wind vane16 interfaces with the basic sensor set of wind speed and direction, air temperature, relative humidity and precipitation.

In addition to the basic functions powering and measuring sensors, this system also processes statistical calculations, performs data quality control, logs data into memory, and formats data for output in standard and user applicable formats.

- 1) real time weather monitoring and data display
- 2) Sensor input and expandable
- 3) Quick installation and disassemble
- 4) Communication through wire and wireless
- 5) Solar power and battery backup
- 6) Meteorological measurement research and development

### System configuration



### Experiments

- 1) How to quick install and disassemble
- 2) experiment on real time weather monitoring and data display
- 3) experiment on Sensor input and expandable
- 4) experiment on communication through wire and wireless
- 5) experiment on Solar power and battery backup
- 6) experiment on Meteorological measurement research and development

## Components

3 meter tower	1 ea
Solar Radiation sensor	1 ea
Wind direction	1 ea
Wind speed	1 ea
Atmospheric Temperature sensor	1 ea
Grass Temperature	1 ea
Soil Temperature	4 ea
humidity / temperature measurement probe	1 ea
Aspirator	1 ea
Atmospheric Pressure	1 ea
Bucket Rain Gauge	1 ea
Rain Detector-1	1 ea
Rain Detector-2	1 ea
Data logger	1 ea
Setopbox	1 ea
Cable & others	
Data Acquisition and Display Program (USB dongle)	1 ea
Manual book	1 book

## Spec

### 1) Solar Radiation sensor

Spectral range (50% points)	285 to 2800 nm
Sensitivity	5 to 20 $\mu\text{V}/\text{W}/\text{m}^2$
Response time	18 s
Zero offset A	< 10 $\text{W}/\text{m}^2$
Zero offset B	< 4 $\text{W}/\text{m}^2$
Directional response (up to 80 °with 1000 $\text{W}/\text{m}^2$ beam)	< 20 $\text{W}/\text{m}^2$
Temperature dependence of sensitivity (-10 to +40 )	< 4 %
Operational temperature range	-40 to +80
Maximum solar irradiance	2000 $\text{W}/\text{m}^2$
Field of view	180 °



### 2) Wind Direction

This sensor is designed to operate properly under any weather conditions. The sensor consists of the counter-balanced, light wind vane and highly accurate, low threshold gray code encoder. The wind direction is measured in the built-in Micro-processor and measured value is a digital output.

#### Specifications

Type	Vane
Range	0~360 °
Threshold	0.3 $\text{m/s}$ Below
Resolution	2.8 °
Output	RS-232
Accuracy	2.8 °
Power	7~ 15 VDC, 80mA
Operating Environment	-50~+60
	Wind gust less than 75 $\text{m/s}$
Material	Aluminum, Hard coating
Dimension	Height 423 $\text{mm}$
Weight	Approximately 880g



### 3) Wind Speed

This wind speed sensor is designed to be responsive even to low wind speed with quick responding time.

Followed by the rotation of 3 cups, the 60-hole photo chopper, connected to the lower part of bearing, rotates.

In accordance with the number of this rotation, a photo diode produces the frequency in proportion to wind speed. The light and chemically etched rotor of a sensor rotates along with cup set.

#### Specifications

Type	3 cup
Range	0~75 m/s
Threshold	0.3 m/s Below
Resolution	0.1 m/s
Output	0 ~1407HZ square wave (TTL)
Accuracy	± 0.5 m/s < 10 m/s
Power	7~ 15 VDC,20mA
Operating Environment	Temperature : -50~+60 Wind gust less than 75 m/s
Material	Aluminum, Hard coating(cup =Polycarbonate)
Dimension	Height 330mm
Weight	Approximately 710g



### 4) Atmospheric Temperature

The sensor is designed in compliance with the principle that electric resistance value of a pure metal changes in accordance with fluctuation of temperature.

The sensor is excellent in linearity and stability and in compensating for resistance value by using the 4-line type, in which corrosion-free platinum is used.

The sensor is designed to be easily adaptable for different use of sensor, such as measuring air temperature, ground temperature, soil temperature and grass height temperature respectively.

#### Specifications

Type	PT-100 4Wire, Class A
Range	-50~+60
Resolution	0.1
Response Time	45sec
Accuracy	± 0.3
Power	7~ 15 VDC,80mA
Operating Environment	Temperature : -50~+60 Humidity :0~100%
Material	Stainless
Dimension	Diameter 65mm



### 5) Grass Temperature

The sensor is designed in compliance with the principle that electric resistance value of a pure metal changes in accordance with fluctuation of temperature.

The sensor is excellent in linearity and stability and in compensating for resistance value by using the 4-line type, in which corrosion-free platinum is used.

The sensor is designed to be easily adaptable for grass height temperature by attaching the pole.

#### Specifications

Type	PT-100 4Wire, Class A
Range	-50~+60
Resolution	0.1
Response Time	45sec
Accuracy	± 0.3
Power	7~ 15 VDC,80mA
Operating Environment	Temperature : -50~+60 Humidity :0~100%
Material	Stainless
Dimension	Diameter 65 mm





## 6) Soil Temperature

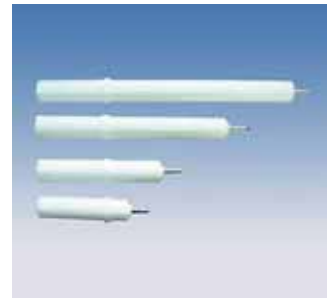
The sensor is designed in compliance with the principle that electric resistance value of a pure metal changes in accordance with fluctuation of temperature.

The sensor is excellent in linearity and stability and in compensating for resistance value by using the 4-line type, in which corrosion-free platinum is used.

The sensor is designed to be easily adaptable for use under the ground at the height of -5, -10, -20, -30cm.

### Specifications

Type	PT-100 4Wire, Class A
Range	-50~+60
Resolution	0.1
Response Time	45sec
Accuracy	± 0.3
Operating Environment	Temperature : -50~+60 Humidity : 0~100%
Material	Stainless
Dimension	Diameter 65 mm
Under ground Installation height(cm)	2,5,10,20,30,50,100



## 7) Relative Humidity

Accurate humidity / temperature measurement over a wide working range, fitted in a small-sized housing and high flexibility. Long term stable sensor technology and an innovative electronic concept will meet these challenging objectives.

- Small humidity probe
- Low power Consumption
- Standard M8 connector and detachable cable
- HUMICAP 180R, Stable and Strong against environment

### Specifications

Type	Capacitive
Range	0~100%
Resolution	0.1
Response Time	45sec
Accuracy	at 0 ~ +40 0 ~ 90% RH ± 1.7 %RH 90 ~ 100% at -40 ~ 0 , +40 ~ +80 0 ~ 90% RH ± 3.0 %RH 90 ~ 100 % RH ± 4.0%
Element	Vaisala HUMICAP 180R
Resolution	±0.1%
Operating Environment	Temperature : -40~+80 Humidity : 0~100%
Output	0 ~ 1 VDC
Power	5 ~ 28 VDC



## 8) Aspirator

Aspirator is a fan aspirated shield ideal for most of situations of Air temperature and Humidity observation.

The Aspirator protects Temperature and Humidity Sensors from both solar radiation and precipitation by allowing free flow of air through the shield.

The Plate is highly UV resistant and it withstands long term exposure and it has thermal conductivity and the high luster white color reflects incident solar radiation.

### Specifications

Type	Fan Aspirated
Structure	Double Aspirator (Water proof Motor Fan)
Material	ASA
Fan Speed	4 ~ 6 m/s
Power	12VDC
Dimension	Diameter 160 mm. Height 260 mm
Resolution	± 0.1%
Operating Environment	Temperature : -40~+80 Humidity : 0~100%
Output	0 ~ 1 VDC
Power	5 ~ 28 VDC
Etc	RPM detect



## 9) Atmospheric Pressure

Pressure measurement by Atmospheric Pressure is based on pressure sensor using internal silicon capacitive. This ensures high precision of pressure measurement and long -tem stability  
Pressure Dats is provided via RS-232 interface and prorocol amd is displayed on LCD window.  
HYB400 is applicable gor the atea required high precision measurement such as aviation meteorological system, meteorological office and industries.

### Specifications

Range	500 ~1200 hpa
Resolution	0.1hpa
Accuracy	± 0.4hpy, 25
Operating Environmeng	-40 ~ +85
Long term Stability	± 0.5 hpa/year
Power	10 ~ 25VDC
Resolution	± 0.1%
Output	RS232 full duplex
Measuring Unit	hpa
Response time	1sec



## 10) Range Gauge

Tipping Bucket Rain Gauge and Precision Weather Instrument for measuring rainfall volume.  
The gauge is designed in the form of tunnel covered with 200 mm-diameter screen, when rainwater enter tge funnel, it flows into the triangular tipping bucket, and when the water reached 0.5mm, it is tipped, which activates the closed lead switch, transmitting the signal to the Data Logger.

### Specifications

Type	Tipping Bucket
Range	Infinite
Resolution	0.5mm
Accuracy	3% at 20~50mm/hr
Collector	Diamenter 200mm. Edge angle:30 °± 5 °
Operating Environmeng	Temperature :-50~+50
Material	Staunless(SUS201)
Heater(Optional)	"220VAC/60Hz, Power Consumption 200W ± 10% 12 vdc 25W ± 10%"
Wind Deflector	Option



## 11) Rain Detector-1

The Rain Detector Sensor detects the presence of surface moisture.  
The secsor is an electrical-resistance type.  
The esnsor measures tne conductivity across grid and and convert voltage level.

### Specifications

Type	Conductivity
Detection type	Rain, Snow
Measuring type	ASA
Fan Speed	conductivity measurement by internal processor
Type	Conductivity
Detection type	Rain, Snow
Measuring type	ASA
Fan Speed	conductivity measurement by internal processor



## 12) Rain Detector-2

The Rain Detector Sensor detects the presence of surface moisture.

The sensor is an electrical-resistance type.

The sensor has PTC heater to dry the surface after stopping rain and during fog and dew to avoid false measurement.

### Specifications

Type	Conductivity
Detection type	Rain, Snow
Measuring type	conductivity measurement by internal processor
Output	Pulse, RS-232, Popen collector
Power	12VDC $\pm$ 10%
Power Consumption	10mA
Operating Environment"	-35 ~+55 ,0~100%RH



## 13) Data logger

Data Logger is designed to be able to select or apply a variety of Metrological sensors provided by Sensor libraries, the user can use the Data logger for metrological observations without any special training.

### Specifications

Processor	32bit ARM7TDMI
Memory	Code Memory: 256Kbyte (External NOR FLASH) Data Memory: 8 Mbytes(External SRAM) RAM:256 kBytes (Internal RAM) Extend Data Memory: CompactFlash/E Memory Card
Interface	RS-232C, RS-422, RS-485, SDI-12
Control	LCD display(2*16 Character LCD), 16Keypad
Analog Channel	Analog channel: Single Input 24 channel or differential 12channel(User Selectable) Resolution: 16bit Uncertainty: Less than $\pm(3 \times 1/2)$ of Input Voltage
Excitation Channel	400uA 2 Channel(Basic ), 8 Channel(Option)
Digital Channel	8 Channel
Power	10~16VDC
Pulse Channel	2Channel or Pulse 4 Channel
Operating Environment	-50 ~ +80



## 14) Setopbox (Weather Display)

Setopbox is communicating with Data logger and get the weather data and it convert the weather data to Graphic display for the user.

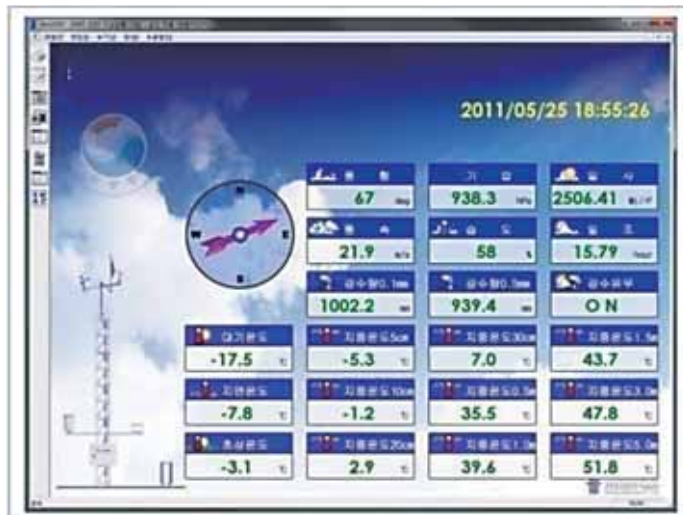
### Specifications

Power	110~240 VAC
CPU	Intel ATOM Dual Core Processor330
Memory	2G
Video	RGB Port
Communication	Serial port(RS-232c,RS-422), LAN Port
Network Interface	10/100 Base-T 1 Port



### 15) Data Acquisition and Display Program

- User friendly and configurable display screen based on Microsoft Windows GUI
- Complied to Standard KMA protocol and adaptavle to User Request.
- Easy to take action in case of fault in systems and sensors by system display.
- Real time monitoring of data acquisition at each sites.
- In case of power out and communication fail, Data is recollected automatically.
- Network interface is available with Serial, TCP/IPv4, UDP/IPv4, TCP/IPv6, UDP/IPv6. and M2M.



# ‘Educational Training System’

Global business company  
Leading laboratory equipment manufacturer  
Practical teaching materials linked to commercial products



Promising Export Firm



ISO 9001:2015  
(Certificate No.: Q155314)





#### Good-Tech Address

904-1, Bugok-dong, Gimcheon-si, Gyeongsangbuk-do, 740-977 South Korea (head office)

E-mail : [khn5@goodtech.kr](mailto:khn5@goodtech.kr)

Website: [www.goodtech.kr](http://www.goodtech.kr)

# 2020, 2021 **Good Tech, Korea** Educational Training System - 01

good Tech