OPERATOR'S MANUAL

Compact Dual Polarimetric X-band
Doppler Weather Radar

MODEL WR-2100

FURUNO

IMPORTANT NOTICES

General

- This manual has been authored with simplified grammar, to meet the needs of international users.
- The operator of this equipment must read and follow the descriptions in this manual. Wrong operation or maintenance can cancel the warranty or cause injury.
- Do not copy any part of this manual without written permission from FURUNO.
- If this manual is lost or worn, contact your dealer about replacement.
- The contents of this manual and equipment specifications can change without notice.
- The example screens (or illustrations) shown in this manual can be different from the screens you see on your display. The screens you see depend on your system configuration and equipment settings.
- Save this manual for future reference.
- Any modification of the equipment (including software) by persons not authorized by FURUNO will cancel the warranty.
- All brand and product names are trademarks, registered trademarks or service marks of their respective holders.

How to discard this product

Discard this product according to local regulations for the disposal of industrial waste. For disposal in the USA, see the homepage of the Electronics Industries Alliance (http://www.eiae.org/) for the correct method of disposal.

⚠ SAFETY INSTRUCTIONS

The user and installer must read the appropriate safety instructions before attempting to install or operate the equipment.

⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.

⚠ WARNING

☢ Radio Frequency Radiation Hazard

The radar antenna sends the electromagnetic radio frequency (RF) energy. This energy can be dangerous to you, especially on your eyes. Do not look at the radiator or near the antenna when the antenna is rotating.

The distances at which RF radiation levels of 100 W/m^2, 50 W/m^2 and 10 W/m^2 exist are shown in the table.

DO NOT go near more than 5.9m (Safety standard is 10 W/m^2).

Distance from Antenna	1.1m	2.8m	5.9m
Power flux density	100 W/m^2	50 W/m^2	10 W/m^2

⚠ WARNING

⚡	**Do not open the radome.** Electrical shock can occur. Only qualified personnel should work inside the equipment.
	Wear a hard hat and safety belt when mounting the antenna unit. Serious injury or death can result if someone falls from the radar antenna.
🚫	**Do not use any other power except 100 to 240 VAC.** Connection of an incorrect power supply can cause fire or damage the equipment.
❗	**Turn off the power immediately if water leaks into the equipment or smoke or fire is coming from the equipment.** Failure to turn off the equipment can cause fire or electrical shock.
	Do not operate the equipment with wet hands. Electrical shock can occur.
	Do not disassemble or modify the equipment. Fire or electrical shock can occur.

!	**Use only the specified power cable.** Fire or damage to the equipment can result if a different cable is used.
!	**Use the power supply grounded certainly.** Electrical shock or defect of operation can occur.
⃠	**When a thunderbolt is expected, do not approach a system or do not touch a hand.** There is a possibility of receiving an electric shock. A worker's safety is guaranteed although the measures which protect apparatus from indirect lightning stroke serge are taken against this machine. It is not a thing. Moreover, if a direct stroke is impressed, it may break down.
⏚	**Attach securely protective earth to the unit.** The protective earth (grounding) is required to the AC power supply to prevent electrical shock.

⚠ CAUTION

!	**Do not put liquid-filled containers on the top of the equipment.** Fire or electrical shock can occur if a liquid spills into the equipment.
!	**Establish space in the surroundings of apparatus as much as possible.** It becomes a cause of performance degradation and failure.
⃠	**Do not put any strong impact to LCD because of glass.** **Serious injury may cause by broken glass.**

WARNING LABEL
Warning labels are attached to the equipment. Do not remove any label.
If a label is missing or damaged, contact us for the replacement.

Antenna Unit (radome)
Name:　　Radiation Warning Label
Type :　　03-142-3201-0
number :　100-266-890-10

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Compact Dual Polarimetric X-band Doppler Weather Radar
## WR-2100
Operation manual

CONTENTS

Outline of System

This system observes the development of rain clouds, outputs the strength of precipitation, the speed of rain clouds (Doppler speed), and observes phenomena of rainfall.

Features:
1. Installation to building roof in Urban area.
2. High Resolution Rain Observation, Rain Cloud, Density, and Speed Observation.
3. Predominantly-longer-life transmitter with solid-state devices instead of magnetron.
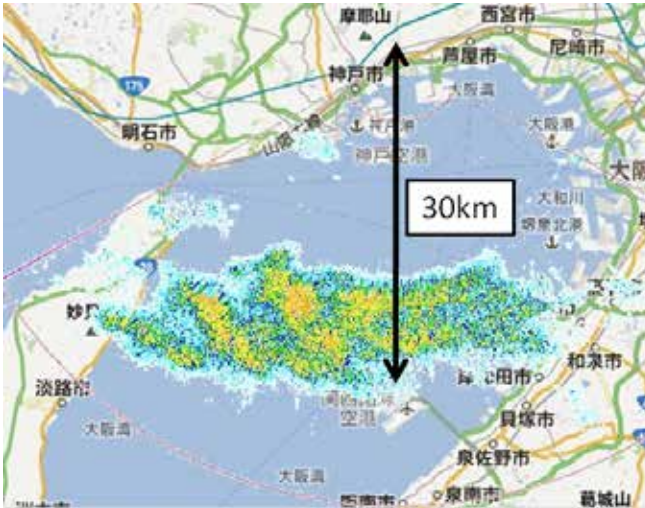
Notice:
Do not go around the antenna area.

$$H_2\,[m] < (H_1 + 0.6) - d \cdot \tan(\theta/2)$$

θ : Beam Width
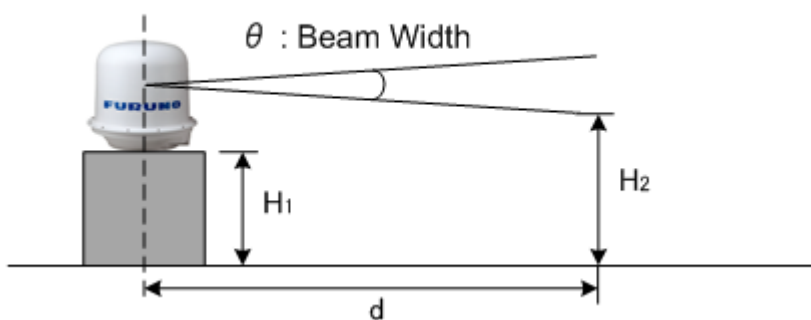
Safety zone around radar

e.g.: H1 (Height of base) = 1.8m,
H2 (Height of human) = 1.8m,

d (Distance from center of base to human): $\dfrac{(H1 + 0.6) - H2}{0.06}$ = $\dfrac{H1 - H2}{0.06}$ +10   6.0m

System Configuration

The observation system consists of Antenna Unit (radome), Signal Processing Unit (storage box), and Display Unit (indoor unit) as shown below.

1) Antenna Unit (radome)

 The Antenna is stored in the radome turning and radiating the radio waves.

 The radiated waves are backscattered by precipitation particles on the propagation path, return to the antenna, and are processed by RF converter to transfer the signals to Signal Processing Unit

2) Signal Processing Unit (storage box)

 Signal Processing Unit is stored in the storage box, and processes received signals digitally.

 The digital processed signals are transferred to the display unit via 1000Base-T (LAN).

3) Display Unit (indoor unit)

 The data is displayed graphically and stored with a general-purpose to personal computer (PC).

Block diagram
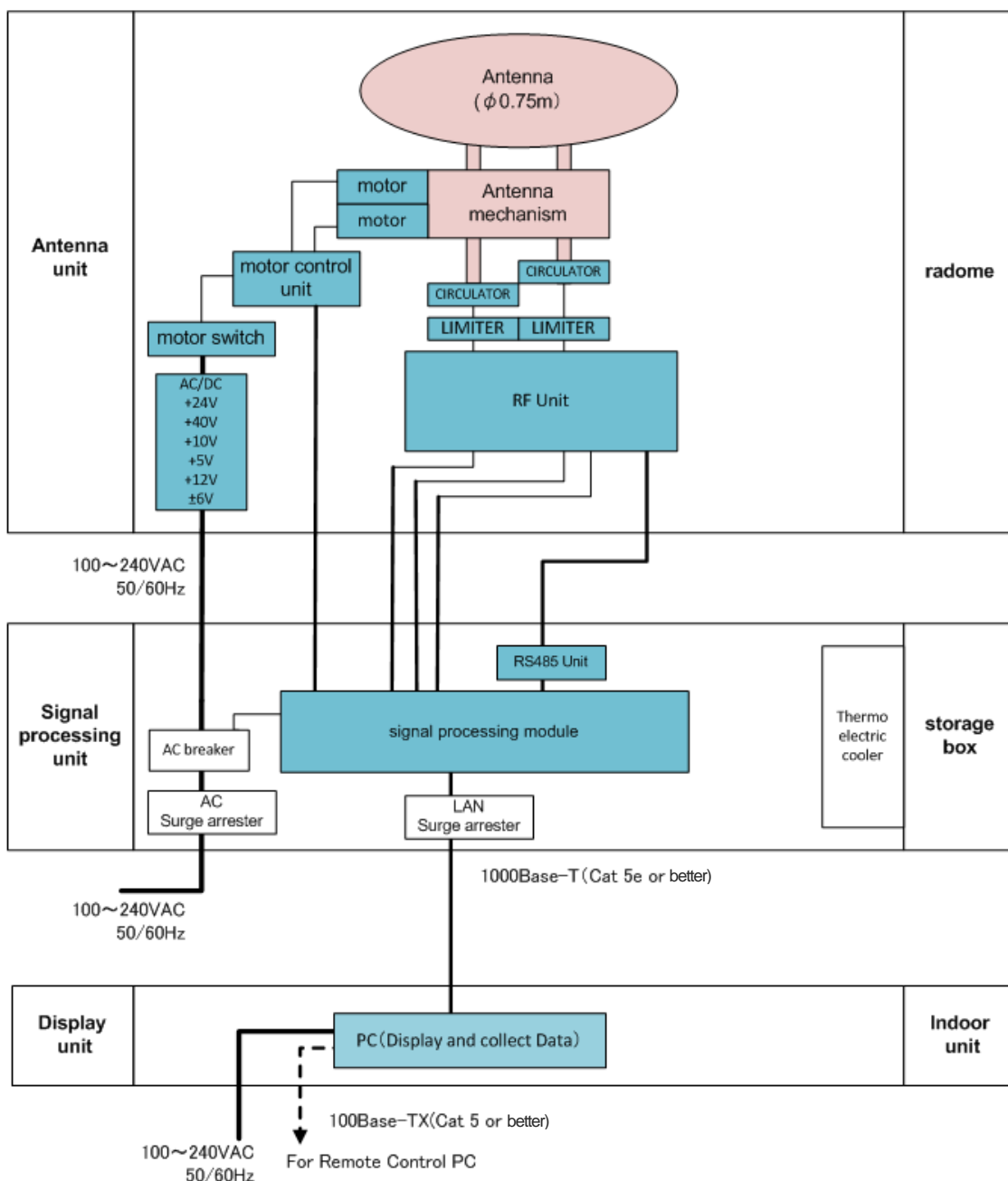
1. Operating Procedure of System

1.1. Startup the Radar System

(1) Turn on the circuit breaker of the Antenna Unit and the Signal Processing Unit (storage box)

⬇

The Antenna Unit and the Signal Processing Unit are in the waiting status.

⬇

(2) Turn on the power of the Display Unit (PC), and place the main outlet to supply a power for the Antenna unit and the Signal Processing Unit

⬇

(3) Start the observation from the menu of the Display Unit

⬇

Output the data periodically with displaying images, and display the data image.

⬇

In process.

1. The circuit breaker is in the Signal Processing Unit (storage box).

Signal processing unit (storage box).

2. To turn on the circuit breaker.

1.2. Startup the Display Unit (General PC)
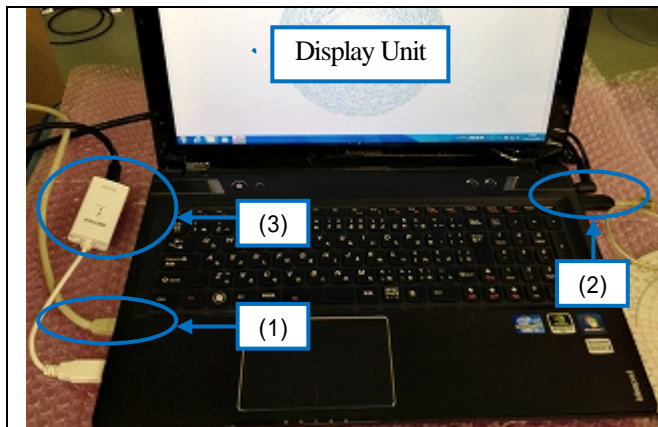
1. Install the Display Unit.
   (1) Connect the LAN cable which connects to external the Signal Processing Unit into the LAN port equipped in the PC.
   (2) Connect the AC power cable.
   (3) Connect the LAN cable which connects to external network/PC into a USB-LAN adapter.

2. Turn on the power of the Display Unit (PC).
   (1) The display software starts automatically.
   (2) Click [Connect] to start radar operation.
   (3) Click the [Start emission] to start observation and to display radar images.

1.3. Shut down the Radar System

Turn off the circuit breaker in the Signal Processing Unit.
The radar system will turn off immediately.

1. The circuit breaker is in the Signal Processing Unit (storage box).

Signal Processing Unit (storage box).

2. Turn off the circuit breaker.

* The radar system will turn off immediately.

2. Display Unit Configuration

2.1. Configuration

Signal Processing Unit
(storage box)

192.168.3.200(LAN1)

Signal Processing Unit

192.168.1.100(LAN2)

LAN Cable (Cat5e or better)

192.168.1.1 (LAN)

Display unit (indoor unit)
Note PC

(USB3.0)

DHCP
USB-LAN adapter

LAN Cable (Cat5e or better)

for remote controll PC
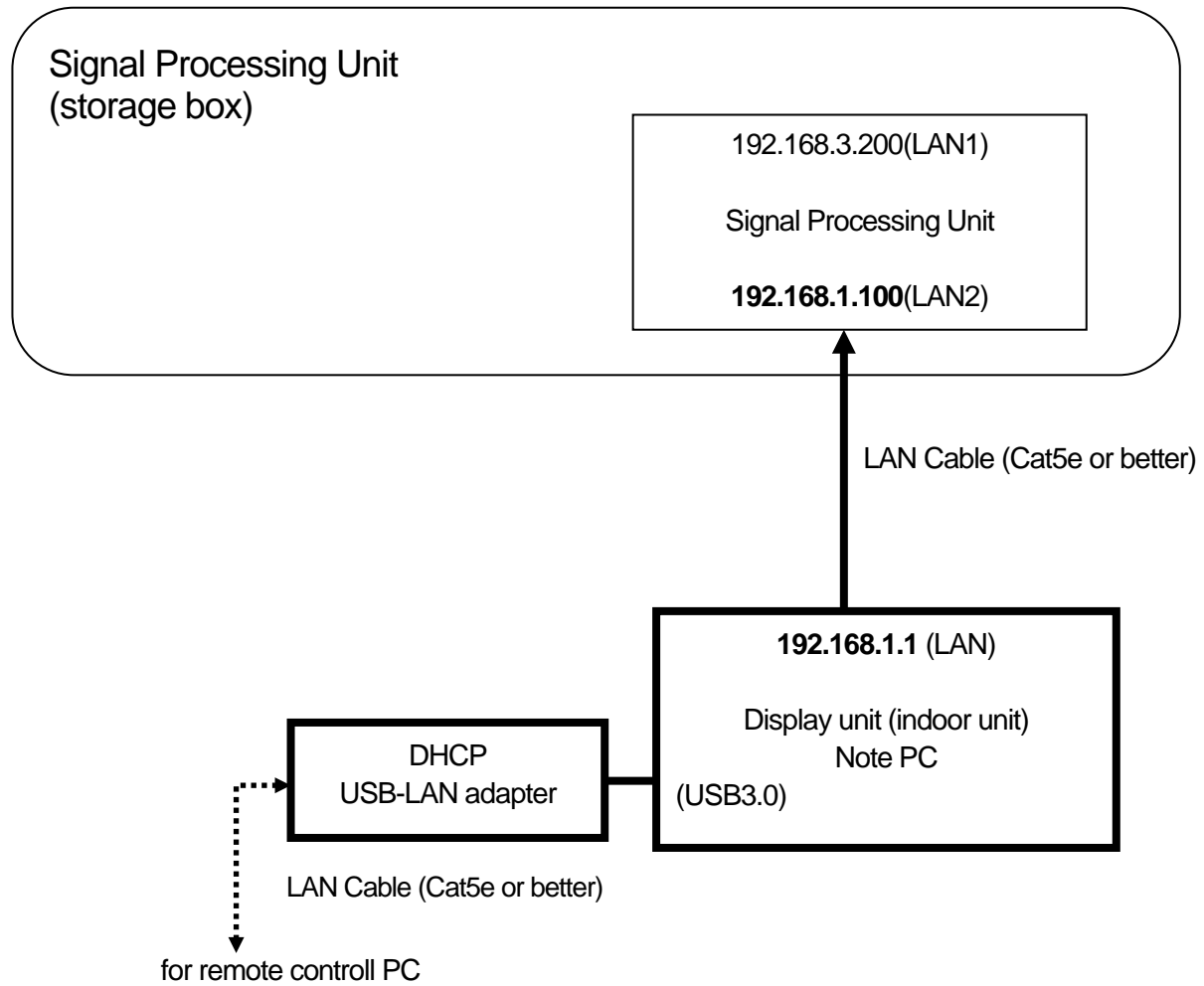
2.2. Display Unit

The display unit receives output data from the Signal Processing Unit (hereinafter called as SPU) and displays the rainfall data in real time.

Software name	Display software		RainMap.exe
Specification	**Function**		
OS: Windows® 8 64bit Professional			
• Language displayed: English and Japanese (default: English)	Change from English to Japanese corresponding to the language setting of Windows®		
Echo data display:			
• Observational date and time:	Local time display corresponding to the time zone of Windows®		
• Maximum distance displayed	50 km		
Display scale	10, 30, 50 [km]		
Unit displayed (inside: [m])	km		
• Polar coordinate display (rθ)			
• Rainfall echo display	Display change of rainfall strength (mm/h) or reflection strength (dBZ)		
• Coloration	Maximum 15 colors in table (maximum 16 values including no color)		
Display of data processed by SPU:			
• Display of Doppler speed	Display Doppler speed data (m/s)		
Map display:			
• Local map display:	Display BMP map		
Display of status:	Display the setting button and current setting values.		
• Display the rainfall strength or reflection strength	Setting button		
• Doppler speed display change	Change from rainfall echo display to Doppler speed display		
• Display of radar setting values (Transmission pulse width, PRF)	Display of current setting values		
Setting of radar operation:	Conduct the setting to SPU section from the menu and the confirmation.		
• Removal of interference	Obtain a removed echo data that setting to SPU.		
• Display ON or OFF of topographical echo removal	Obtain a removed echo data that setting to SPU.		
• Transmission mask function	Obtain a masked echo data that setting to SPU.		
• Elevation angle (-2 to 90 degrees)	Obtain a specified elevation angle echo data that setting to SPU.		
• Setting of radar constant (Transmission pulse width, rainfall strength conversion constant B, and β)	Obtain a setting echo data that setting to SPU.		
Data manipulation:			
• Saving of displayed data	Save as a chronological order unit (Time based file name)		
• Play of displayed data	Play from the specification file name.		
Data output:			
• Output of data file	Output per 1 to 5minutes		

2.3. How to install Software

Use "Setup.exe" (in CD-ROM) to install the software.

If reinstallation is required, first uninstall the software, then install it again because there is no function to correct the specific programs, etc. individually.

For reinstallation, conduct the setting from the beginning because the current setting values are deleted.

3. Operating Procedure of Display Unit

3.1. Power up

Turn on the power of PC to start Windows® and to display the startup screen.

3.2. Startup screen

The following screen will display during startup.

Drawing area
  Display various images
  (rainfall strength, etc.).
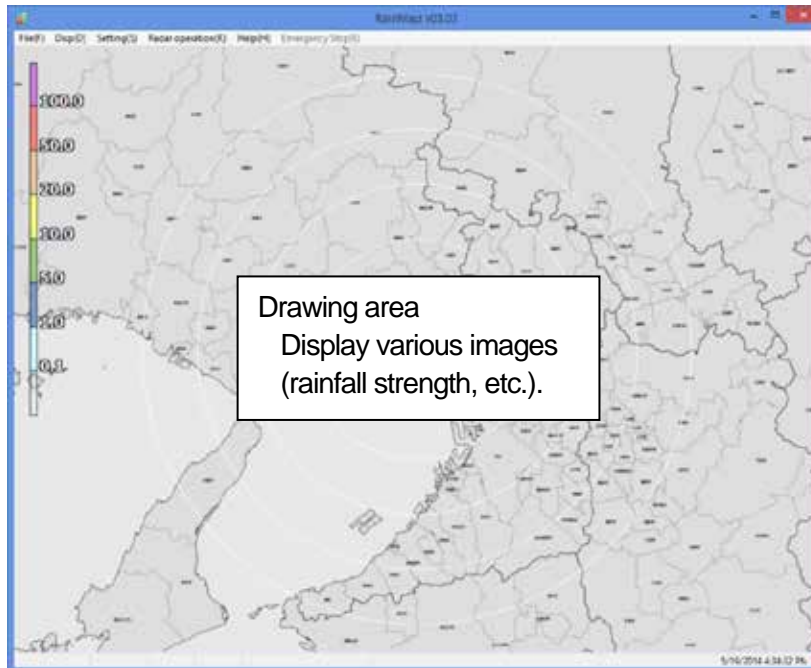
3.3. Power down

1) Shut down the Windows®.
   Click   [Start] -> [Shutdown(U)] -> [OK]

2) Turn off the power of PC.

4. Software operation

4.1. Name & Function of RainMap
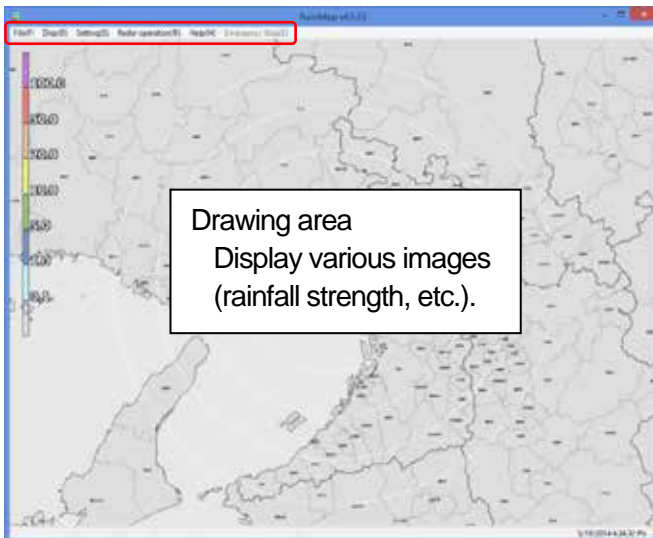
File Menu bar
Click the menu name to display each selected menu item.

- File
- View
- Setting
- Radar operation
- Help
- Emergency Stop

File menu
File play:
To display the play screen of log data

Snapshot:
To capture the screen

Exit:
To close a software
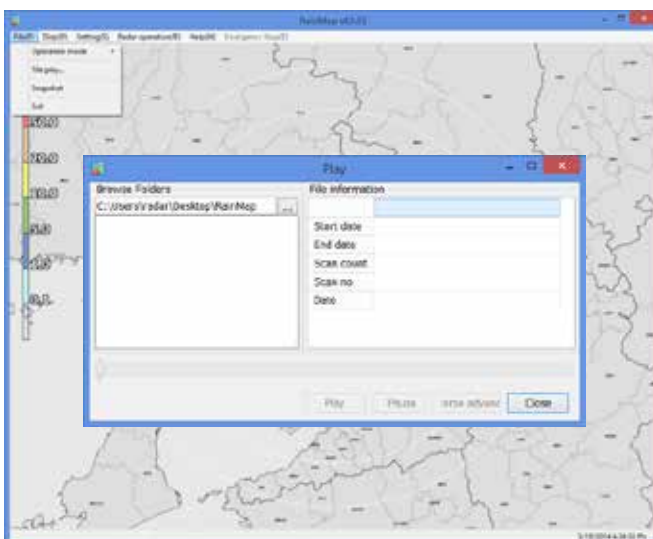
File play
Find log data from folder selection
Check the file information
- Record start date/time
- Record end date/time
- Scan counter
- Scan number
- Date/time
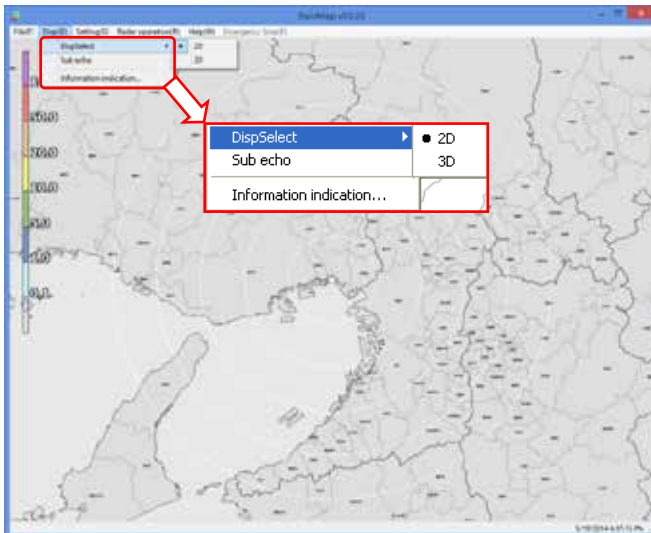
View menu
View selection:

- 2D (Indicate the echo by 2 Dimension)
- 3D (Indicate the echo by 3 Dimension)

Sub-screen:
To show sub screen to indicate the echo

Information Indication:
*Under construction.
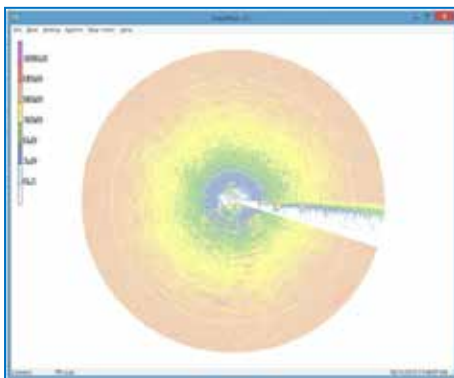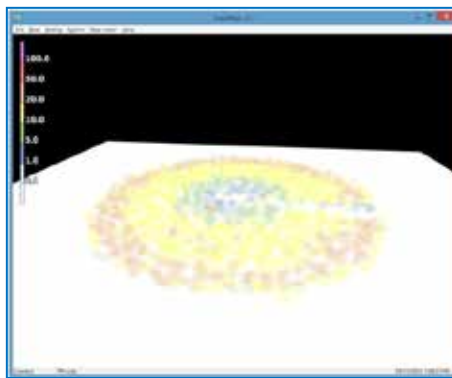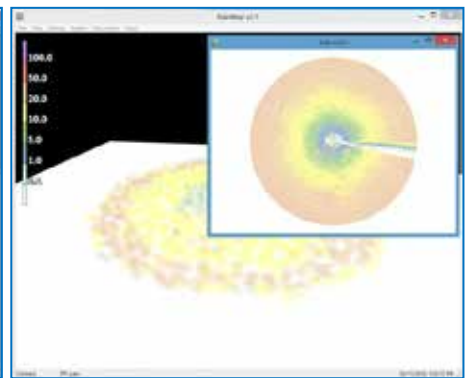
| 2D | 3D | Sub echo |
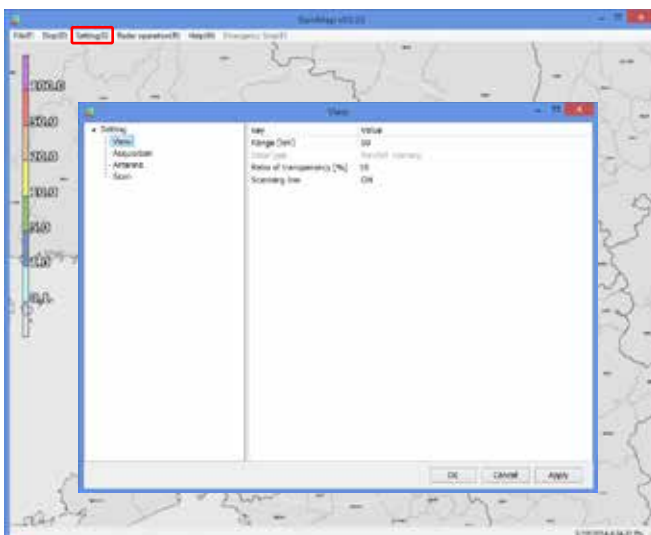
Setting
View
To display the setting menu according to the indication.

Acquisition
To display the setting menu according to the Log.

Antenna
To display a setting menu according to an installation place of antenna.

Network
To display a menu according to a network connection.
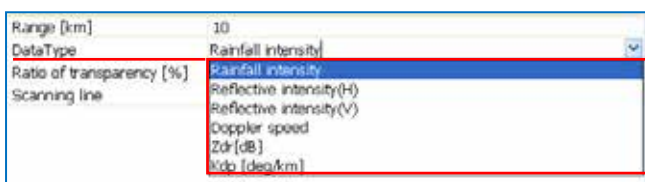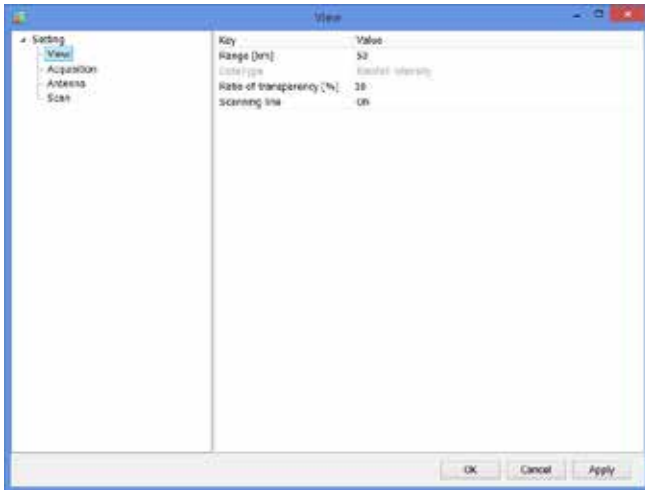
Scanning line:
Turn ON or OFF a scan line of screen.
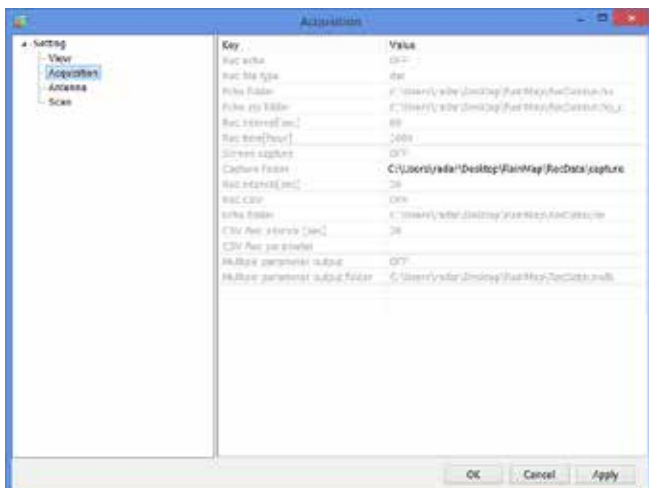
View
Range [km]:
To setup an indication range.

DataType:
To setup an indication of the radar parameter.

- **Rainfall intensity:**
  Intensity of rainfall [mm/h]
- **Reflective intensity (H):**
  Reflection factor of the horizontal polarimetric radar [dBz]
- **Reflective intensity (V):**
  Reflection factor of the vertical polarimetric radar [dBz]
- **Doppler speed:**
  Doppler speed [m/s]
- **Zdr[dB]:**
  Radar reflection factor difference
- **Kdp [deg/km]:**
  Propagation phase difference rate of change

Ratio of transparency [%]:
To setup a Transmittance of the indication echo.

Acquisition
Rec echo:
Turn ON or OFF a Log of echo data.

Rec file type:
To setup a log form of echo data.
(dat (idx) / ZIP / dat (idx) + ZIP)

Echo folder:
To setup a log folder of echo data.

Echo zip folder:
To setup a log folder of echo zip data file.

Rec interval [sec]:
To setup a recording interval of echo data.

Rec time [hour]:
To setup a time of recording echo data.

Screen capture:
Turn ON or OFF a screen capture.

Key	Value
Rec echo	ON
Rec file type	dat
Echo folder	C:\Users\radar\Desktop\RainMap\RecData\echo
Echo zip folder	C:\Users\radar\Desktop\RainMap\RecData\echo_c
Rec interval[sec]	60
Rec time[hour]	1000
Screen capture	ON
Capture folder	C:\Users\radar\Desktop\RainMap\RecData\capture
Rec interval[sec]	30
Rec CSV	ON
Echo folder	C:\Users\radar\Desktop\RainMap\RecData\csv
CSV Rec interval [sec]	30
CSV Rec parameter	
Multiple parameter output	☐ Rain[mm/h] ☐ Zhh[dBz] ☐ Zvv[dBz] ☐ DS[m/s] ☐ Zdr[dB] ☐ Kdp[deg/km]
Multiple parameter output folder	

Capture folder:
To setup a folder of capture.

Rec interval [sec]:
To setup an interval time of capture

Rec CSV:
To setup a recording of CSV data.

Echo folder (CSV):
To setup a folder of CSV data.

CSV Rec interval [sec]:
To setup an interval time of CSV data.

CSV Rec Parameter:
To select a weather parameter of recording CSV.

· **Rain [mm/h]:** Intensity of rainfall [mm/h]

· **Zhh [dBz]:** Reflection factor of the horizontal polarimetric radar [dB]

· **Zvv [dBz]:** Reflection factor of the vertical polarimetric radar [dB]

· **DS [m/s]:** Doppler speed [m/s]

· **Zdr [dB]:** Radar reflection factor difference [dB]

· **Kdp [deg/km]:** Propagation phase difference rate of change [deg/km]

Multiple parameter output
Turn ON or OFF an output record of multi-parameter.
(*It can setup only when Echo data mode of TRX is selected)

Multiple parameter output folder
To setup a folder of recording multi-parameter.
(*It can setup only when Echo data mode of TRX is selected)

Antenna
Latitude [deg]:
To setup a latitude of the installed point.

Longitude [deg]:
To setup a longitude of the installed point.

Altitude [m]:
To setup an altitude of the installed point.

Image:
To setup a filename of map.
This program treats as the equidistant cylindrical projection.

Left Top Latitude [deg]:
To setup a latitude of left top corner of Map Image.

Left Top Longitude [deg]:
To setup a longitude of left top corner of Map Image.

Right Bottom Latitude [deg]:
To setup a latitude of bottom right corner of "Map Image".

Right Bottom Longitude [deg]:
To setup a longitude of bottom right corner of "Map Image".
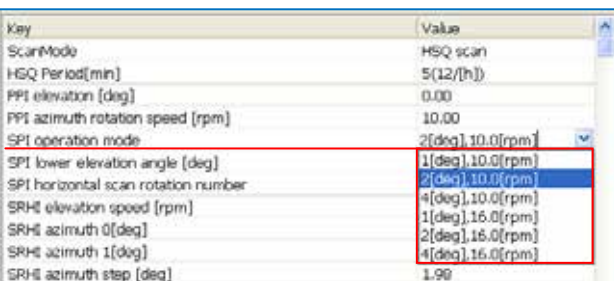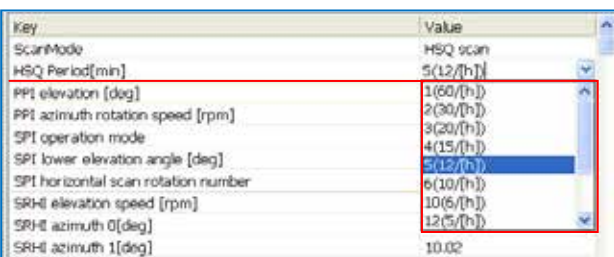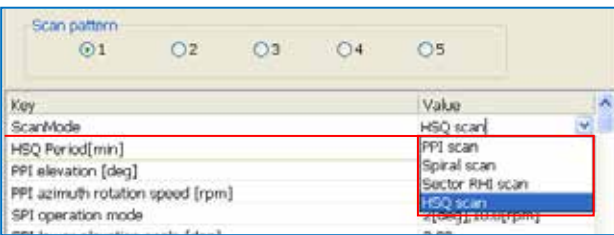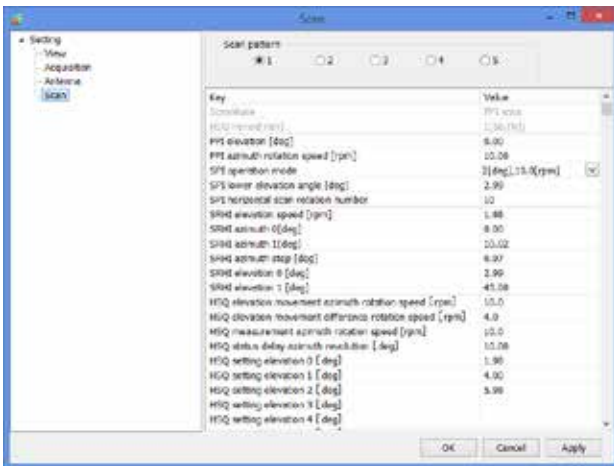
SPI lower elevation angel [deg]:
>To setup an angle of SPI lowest elevation. SPI mode will start from this angle to upper angle.

SPI horizontal scan rotation number:
>To setup a number of rotation in horizontal direction of SPI scan..
>It will move upward/downward as setup number while rotating on azimuth direction.

SRHI elevation speed [rpm]:
>To setup elevation speed of SRHI (Sector RHI).

Scan

There are 5 scan patterns that could customize and save a setting.

ScanMode:
>To setup a scan mode of antenna.
>
>· **PPI scan:** Equiangular elevation with horizontal rotation mode. It generates 2 dimension data.
>
>· **Spiral scan:** The mode to rotate horizontal while shifting elevation continuously, and scans in a spiral. It generates 3 dimension data.
>
>· **Sector RHI scan:** The mode to scan elevation direction on special direction area, and generate 3 dimension of rectangular solid angle.
>
>· **HSQ scan:** The mode to activate PPI scan while shifting an elevation. It generates 3 dimension data.

HSQ Period [min]:
>To setup an periodic movement of HSQ during HSQ mode.
>(1(60/(H)) / 2(30/(H)) / 3(20/(H)) / 4(15/(H)) / 5(12/(H)) / 6(10/(H)) / 10(6/(H)) / 12(5/(H)))
>e.g. HSQ will activate every 2 minutes if select 2/30/(H). (It turns 30 times per hour)

PPI elevation [deg]:
>To setup an angle of antenna's elevation during PPI mode.

PPI azimuth rotation speed [rpm]:
>To setup the rotation speed of azimuth in rotation per minutes (rpm)
>Parameters affect only to PPI mode.

SPI operation mode:
>To setup the elevation angle step and azimuth rotation speed.
>For example, when the setting is shown as below table 1, antenna will rotate at 2.99, 3.99 and 6.99 degrees.

Table 1 (Example of SPI (Spiral) operation)

Parameter	Settings
SPI operation mode	2 [deg], 10 [rpm]
SPI lower elevation angle	2.99 [deg]
SPI horizontal scan rotation	3

HSQ elevation movement difference rotation speed [rpm]

To setup a rotation speed of elevation direction during elevation change in HSQ (Horizontal Sequence) observation.

Rotation speed of elevation direction = [HSQ elevation moving direction of rotation speed] + [HSQ elevation movement difference of rotation speed].

Notice: [HSQ elevation moving direction of rotation speed] [HSQ elevation movement difference of rotation speed]

HSQ measurement azimuth rotation speed [rpm]

To setup the azimuth rotation speed at fixed elevation angle.

HSQ status delay azimuth revolution [deg]

To setup the angle of shifting elevation.

HSQ setting elevation 0-31 [deg]

To setup the elevation variation.
It is possible to setup 32 elevation.

SRHI azimuth 0 [deg]

To setup the range of azimuth.
It will observe RHI in between azimuth 0 to 1 continuously.

SRHI azimuth 1 [deg]

To setup an angle of azimuth during SRHI observation.

SRHI azimuth step [deg]

To setup a quantity of antenna rotation while changing an angle of azimuth

SRHI elevation 0 [deg]

To setup the range of elevation.
SRHI will start from elevation 0 to 2.

SRHI elevation 1 [deg]

To setup an angle of elevation in HSQ (Horizontal Sequence) observation.

HSQ elevation movement azimuth rotation speed [rpm]

To setup an azimuth rotation speed until the elevation movement in HSQ (Horizontal Sequence) observation
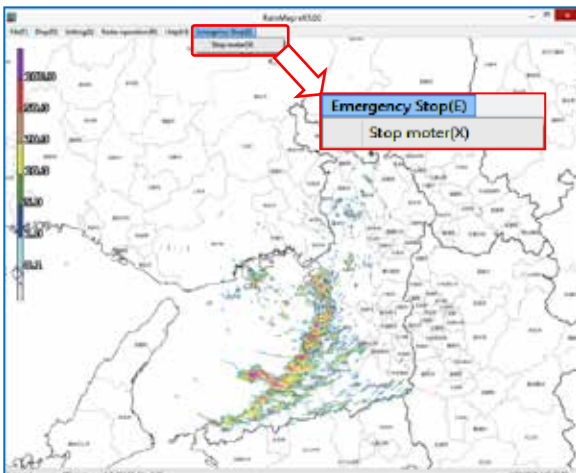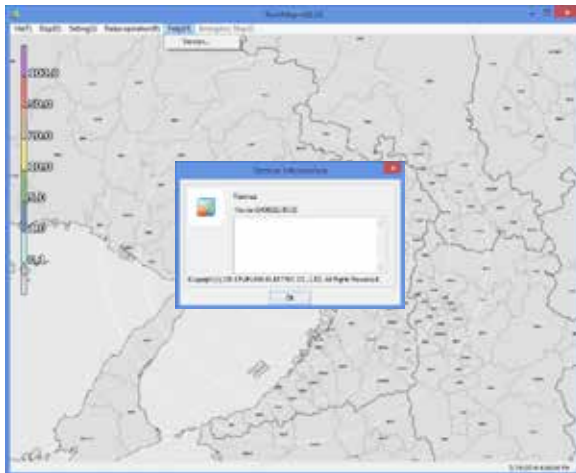
Help

Version

To indicate the version information of software .

Emergency Stop

Stop motor

To stop motor of radar and TX at once.

4.2. Rainfall observation operation

1) Start rainfall observation
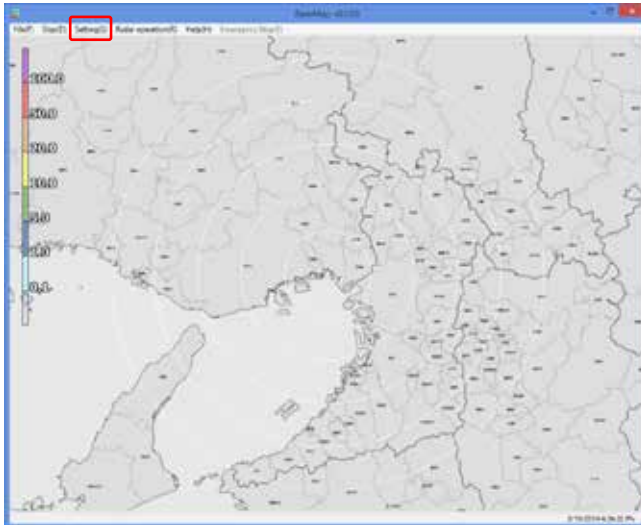
Conduct the setting of elevation angle of antenna, recording of data, and display data.
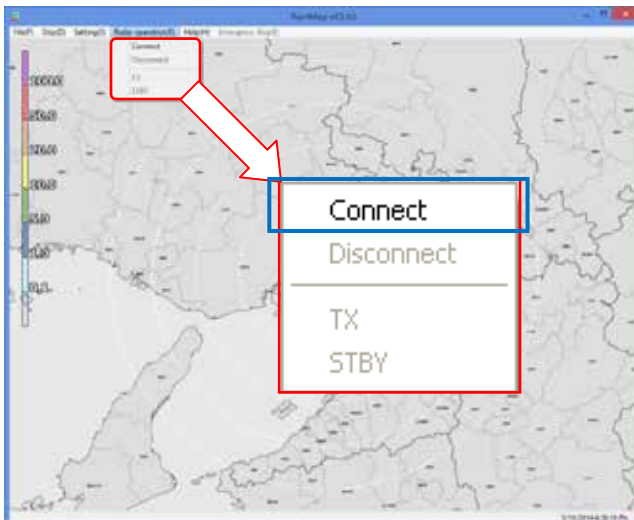
Click [Connect] from pull-down menu of [Radar Control].
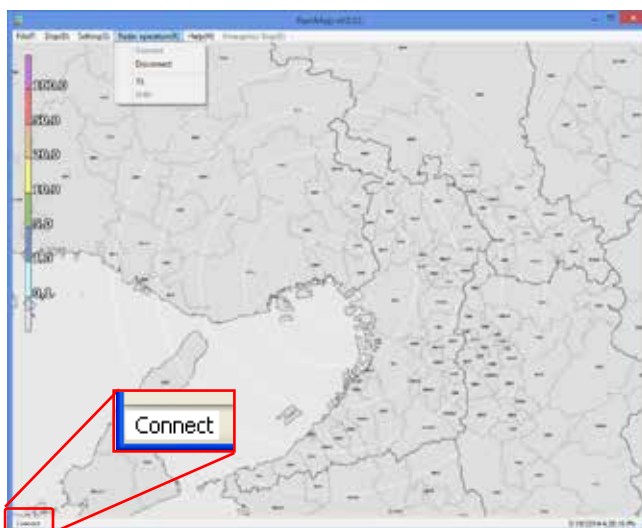
It will indicate [Connect] on the bottom-left of screen when the Signal Processing Unit (SPU) and communication has been connected .
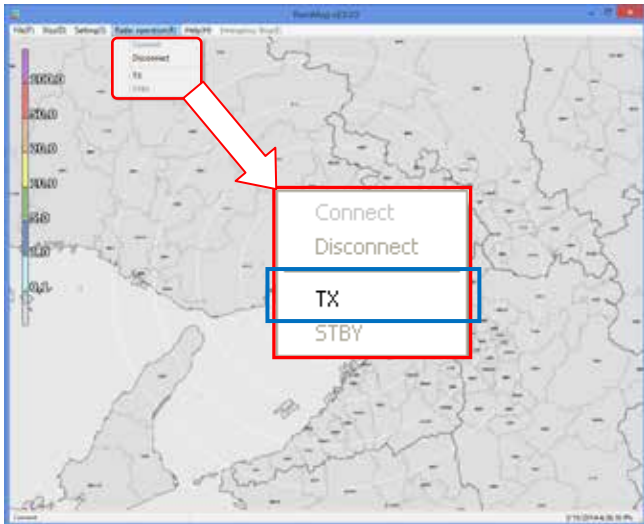
Click [TX] from pull-down menu of [Radar operation] .

Warning

Do you really want to update the antenna operation setting?
There is a difference between antenna setting value of ¥¥nRainMap and current antenna setting.

Yes (Y)　　No (N)　　Cancel
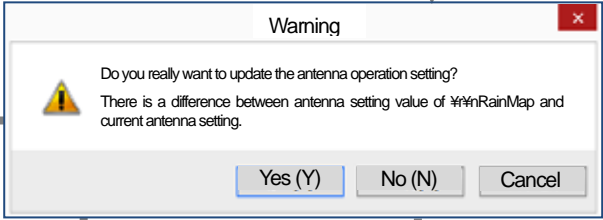
If clicked [Yes], it will initialize the antenna and will indicate a message as below. Radar will start TX operation after initialization.

Yes

No

Cancel

If clicked [Cancel], an operation will be cancelled.

If clicked [No], it will start TX operation without making change.

Information

Antenna initialization in progress.
Please wait.
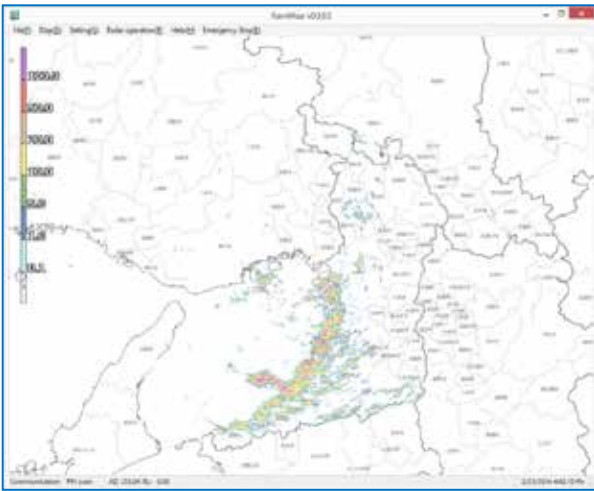
Start the operation of radar, and display the observed information on the screen. The recorded data is saving on a HDD.

2) Stop rainfall observation
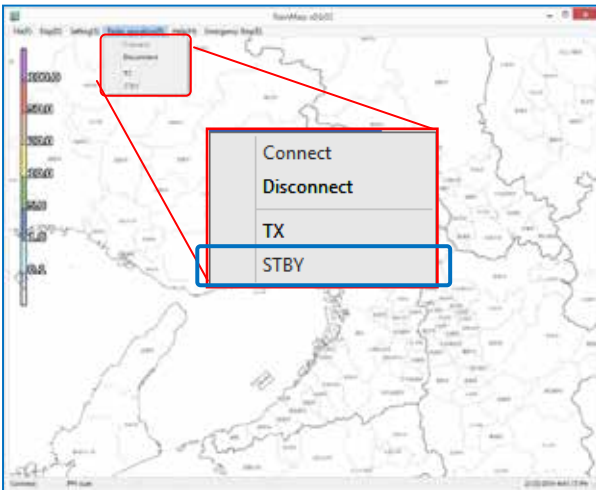
Click [STBY] to stop the radar operation.
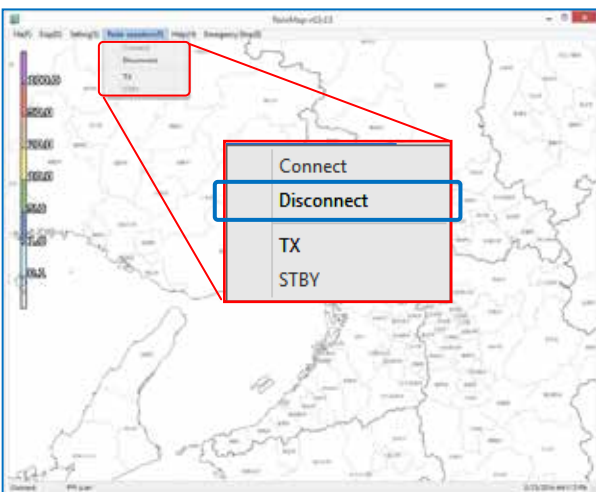
Click [Disconnect] to close SPU.

4.3. Observation Data operation

1) Start playing the Observation Data
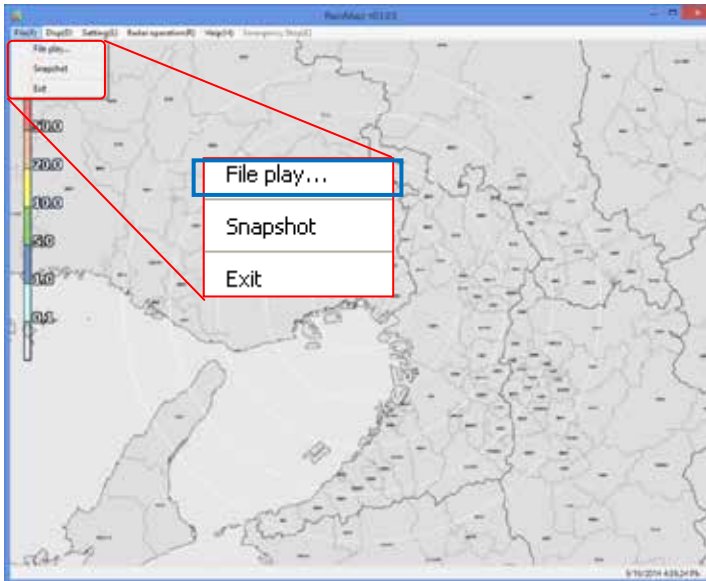
Click [File] on File menu bar, and select [File play..]
* [File play..] cannot control while accessing with the Signal Processing Unit (SPU).

Click [Disconnect] to stop the access.
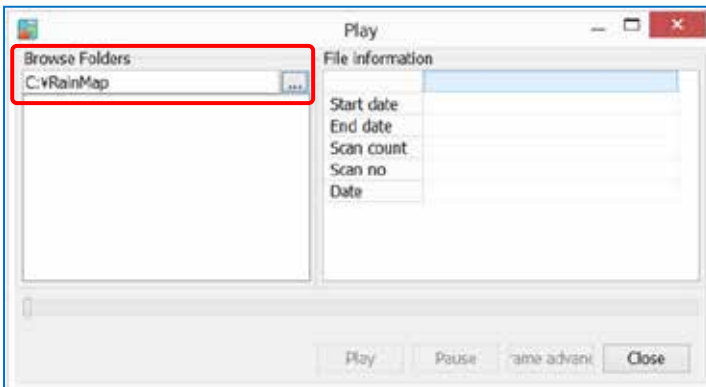
To indicate the play screen.
To select a folder which have been saved in [Browse Folders] to play data.
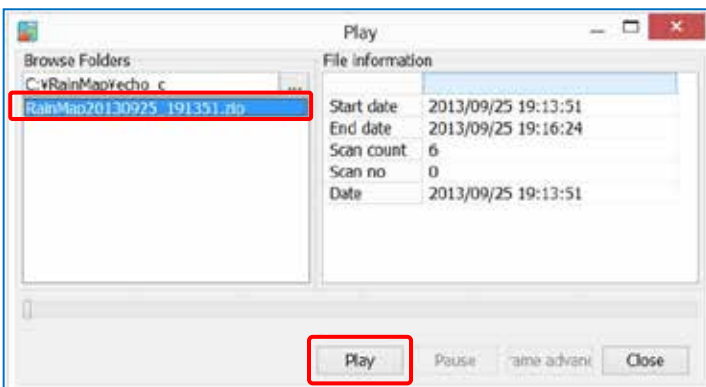
To indicate a list of log data.
At first, to select a data to play, and then click [Play] to start playing.

2) Stop playing the Observation Data
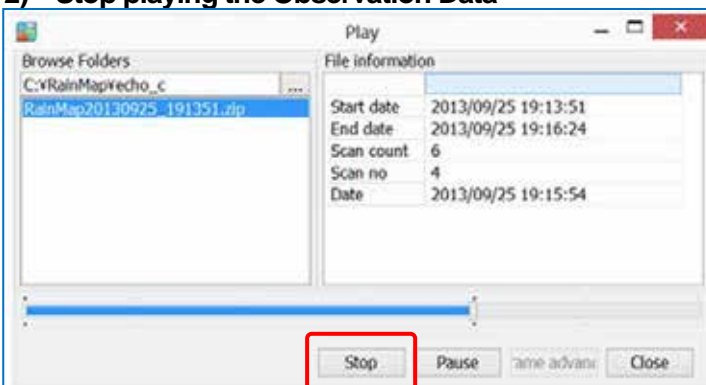
Click [Stop] to stop playing.

4.4. Name & Function of RainPlay

RainPlay will indicate after selecting [File play] on RainMap.
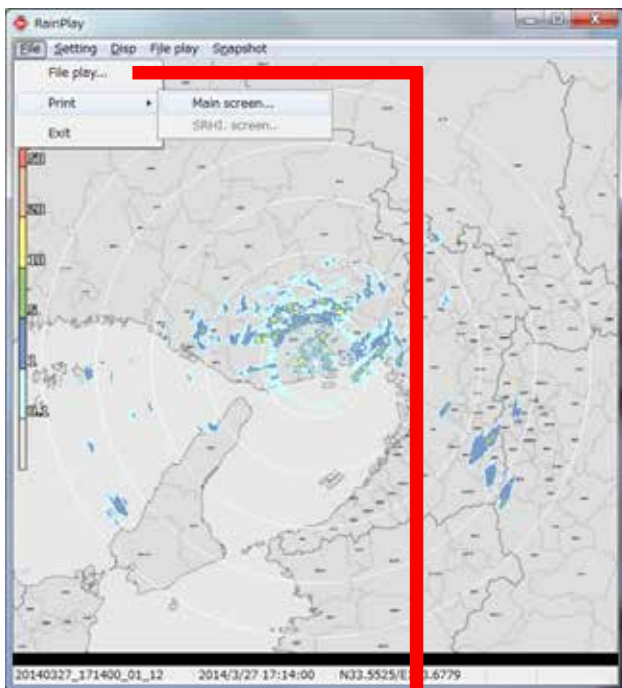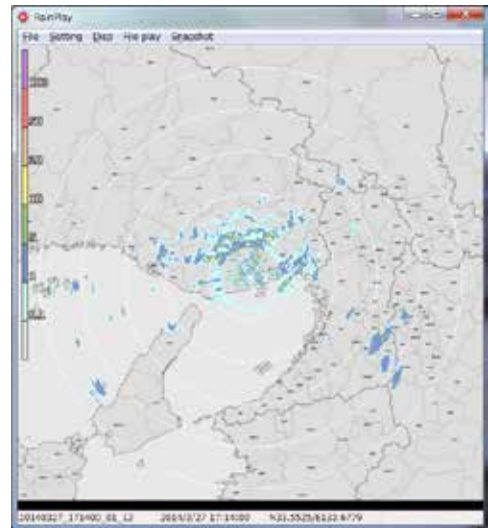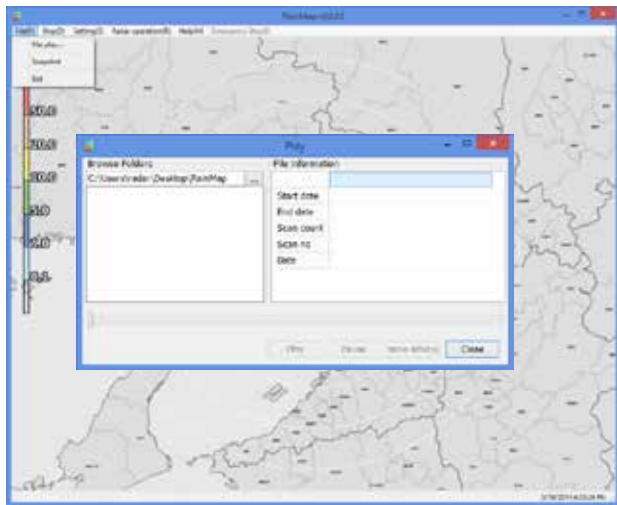
File

○ **File play:**
Select files of log data (*.scn; *rhi) to play
(Slide show) on screen

○ **Print**
Main screen: Printout the main screen
SRHI screen: Printout the SRHI screen

○ **Exit**
To close a software
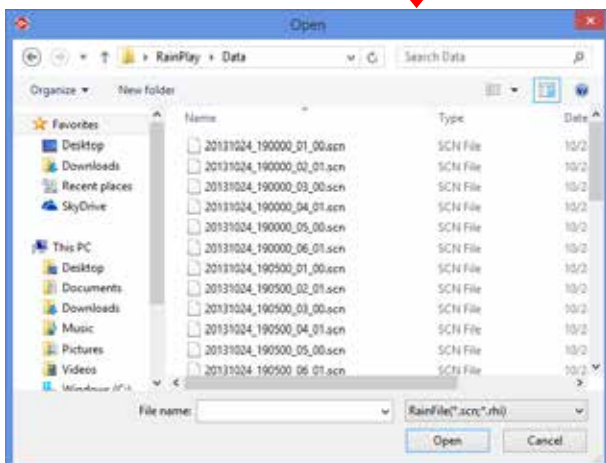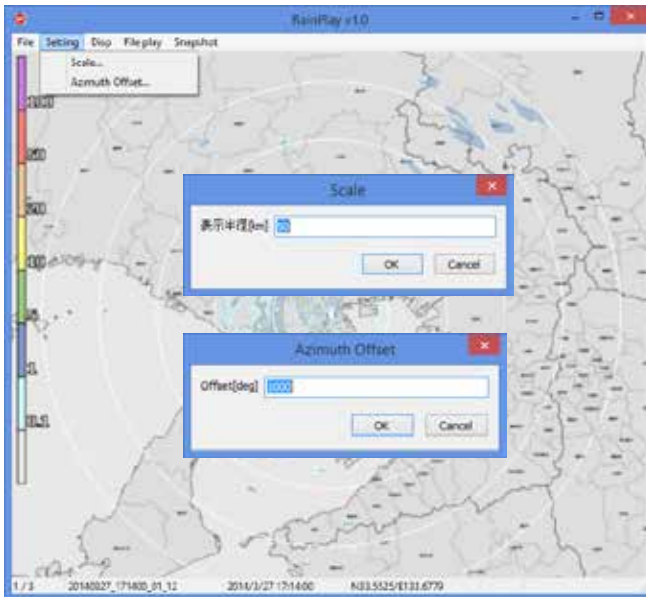
Setting
- **Scale:**
  Setup a distance of scale into a pop-up window of [Scale]

- **Azimuth offset**
  Setup a degree of offset into a pop-up window of [Azimuth Offset]
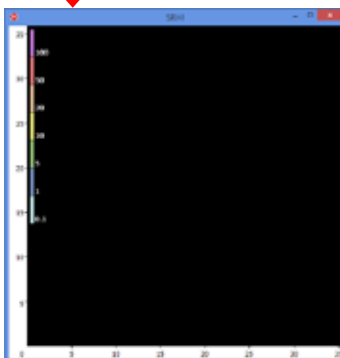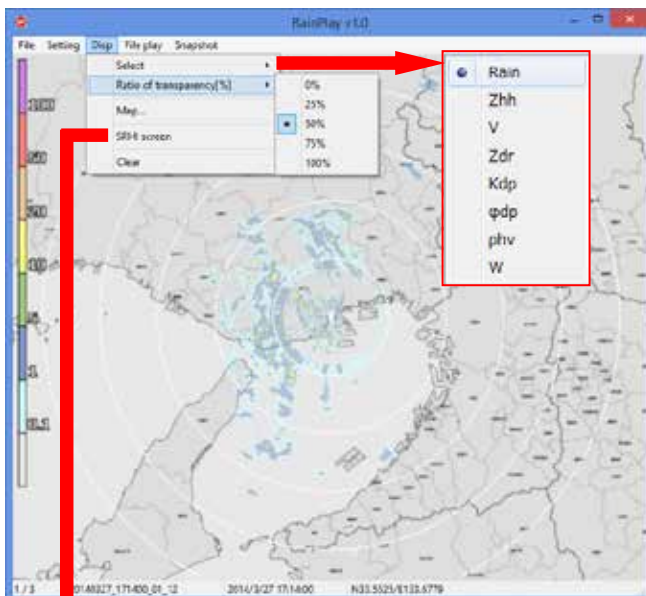
Disp
- **Select**
  Select an indication of data type
  Rain   Intensity of rainfall
  Zhh   Reflection factor of the horizontal polarimetric radar
  Zvv Reflection factor of the vertical polarimetric radar
  DS   Doppler speed
  Zdr   Radar reflection factor difference
  Kdp   Propagation phase difference rate of change
  Φdp: Differential Phase Shift
  ρ   : Polarimetric Correlation Coefficient
  W: Spectral Width

- **Ratio of transparency [%]:**
  To setup a Transmittance of the indication echo.

- **Map**
  Output a map from input file (*.bmp)

- **SRHI screen**
  SRHI screen will popup on window

- **Clear**
  Data of RainFile will be cleared on a screen
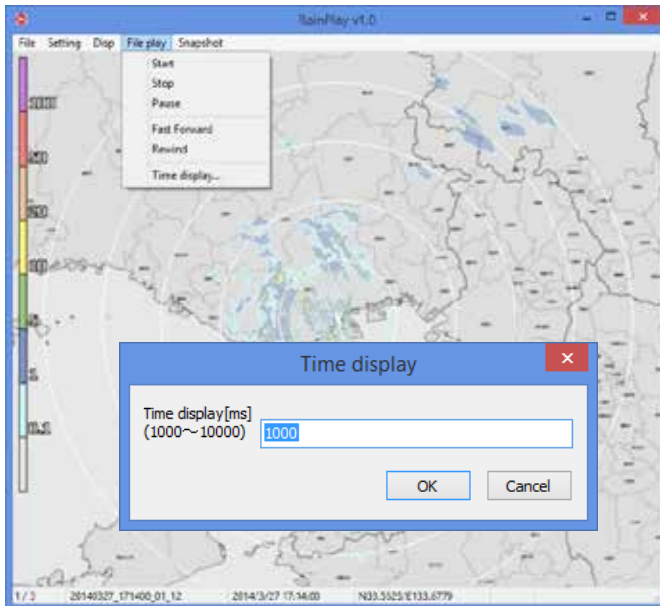
Play
- **Start**
  To start playing a log data

- **Stop**
  To stop playing

- **Pause**
  To pause playing

- **Fast Forward**
  To fast forward playing

- **Rewind**
  To rewind playing

- **Time display**
  Popup a setup windows to setup a time display [between 1000 - 10,000 ms]
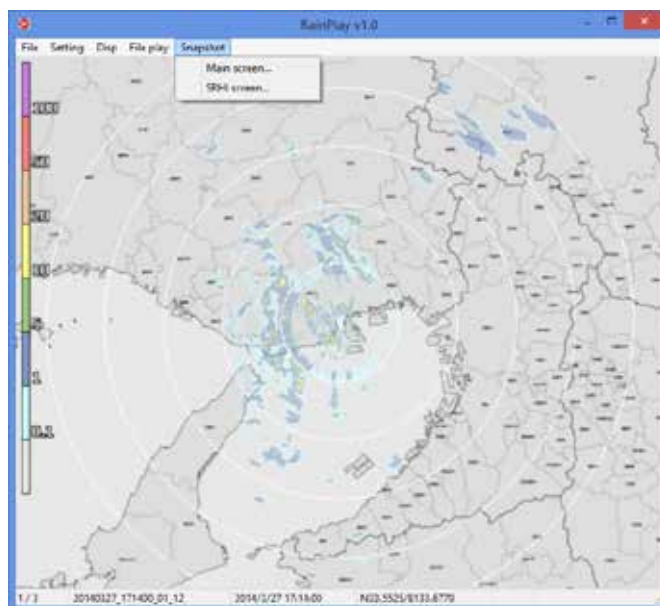
Snapshot
- **Main screen**
  To copy a main screen and select a place to save a screen file(*.jpg)
- **SRHI screen**
  To copy a SRHI screen and select a place to save a screen file(*.jpg) while Indicating SRHI screen from [Disp]

5. Precautions on operation

5.1. Data backup

Because of no guarantee to the data integrity such as observation data, output file, etc., make sure to backup data to an external hard disk drives.

We shall have no responsibility for damages, data integrity, repair, and any other damages resulting from the data loss.

5.2. Software version

Information of the software version is displayed on the software screen panel.

6. When having trouble

6.1. How to reset the radar system

Restart the radar system when the radar system is hanged up.

Signal Processing Unit (storage box).	1. The circuit breaker is in the Signal Processing Unit (storage box).
	2. Turn off the circuit breaker. 3. Take a minute interval. 4. Turn on the circuit breaker again to restart the radar system.

7. Maintenance

7.1. Troubleshooting

STATE	CONTENT/PROCEDURE
Cannot turn the power on	Make sure that the power cable has not loosened.
	Make sure that the contact of the power cable plug has not stained.
	Make sure that the power cable has not damaged.
	Make sure that the circuit breaker in the Signal Processing Unit is "ON".
Thermo electric cooler box is stopped	Please contact us.
No radar echo indication.	Restart the radar system. (see 6.1)

7.2. Preventative Maintenance

PERIOD	ITEM	CHECK POINT	CONTENT/PROCEDURE
When needed	Visual check of the Radar radome surface.	Sea salt, oil, etc. adhered to the surface?	Wipe an adhering substances with a wet soft cloth. However, since radome is made with FRP, don't use gasoline, benzine, and a solvent like ketone.
After six months, a strong wind or a thunderbolt	Visual check of the Radar radome damage	Any crack?	Please contact to our trouble support after finished the waterproofing disposal.
After six months	Fix a protective tube	Any slack?	Please strengthen fixation of a protective tube.

*Before to start the maintenance, please make sure the power of radar system is off.

8. Specifications

8.1. Antenna Unit

Parameter	Descriptions	Remarks
Operating Frequency	9470 MHz	Carrier Frequency
Maximum range	Approx. 30km	
Doppler measurement	Max. 79m/sec	
Power supply	100-240VAC, Single Phase, 50/60 Hz	
Power consumption	Max. 350W	
Rated Ampere	1.5-3.5A	
Size	Φ1086mm×H1024mm	radome size
Weight	65kg (144lb)	
Operating Temperature range	-10 to +50 °C	
Storage Temperature range	-20 to +60 °C	
Water & Dust proof	IPX5	
Maximum wind survival speed	60.0m/sec	
Occupied Band Width	60 MHz or less	
Type of Emission	P0N, Q0N, V0N	
Peak Power	100 W	Horizontal and Vertical each
Duty Ratio	Up to 12 %	
Pulse Width	0.1 – 50μs	
Pulse Repetition Frequency	600 – 2500 Hz	
Frequency Shift	2 – 20 MHz	except P0N
Antenna Type	Cassegrain	
Aperture Size	Φ750 mm	
Antenna Gain	33.0 dBi	
Antenna Polarity	Dual polarimetric	Vertical and Horizontal
Beam Width	2.7 degree	Both Horizontal and Vertical
Antenna Rotation Speed	2 to 16 rpm	Adjustable
Horizontal Scan Angle	360 degrees	Continuously-rotating
Vertical Scan Angle	-2 to 90 degrees	
Resolution of Angle	0.1 degrees	
Precision of Angle	0.2 degrees	

*1 P0N : Sequence of pulses without modulation.

*2 Q0N : Sequence of pulses, frequency modulation within each pulse.

*3 V0N : Combination of P0N and Q0N.

8.2. Signal Processing Unit

Parameter	Descriptions
Data Output	Reflectivity factor Zh (dBZ), Doppler velocity V (m/s), Doppler velocity width W(m/s), Cross polarization difference phase φdp(deg), Specific differential phase KDP(deg/km), Correlation coefficient between two polarizations ρHV, Differential reflectivity factor ZDR, Rainfall intensity R (mm/h)
Scan modes	PPI,CAPPI,RHI (Sector Scacn availiable)
Ground clutter Rejection	Enable
Data Correction	Distance attenuation, Rain attenuation, Excessive Doppler velocity, Suppression of signal returns from lan, Clutter suppression
Interface	LAN 1 port, Ethernet 1000 Base-T (Cat5e or better)
Power supply	100-240VAC, Single Phase, 50/60 Hz
Power consumption	Max. 650W include Antenna unit
Rated Ampere	2.7-6.5A
Size	W725mm×D300mm×H750mm
Weight	50kg (111lb)
Operating Temperature range	-10 to +50 °C
Storage Temperature range	-20 to +60 °C
Water & Dust proof	IPX5

8.3. Display Unit

Receive data from Signal Processing Unit (SPU) to indicate a picture of rainfall in real time.

Hardware	
Parameter	**Descriptions**
Main	General Laptop PC
Power supply	100-240VAC, 50/60Hz
Power consumption	Max. 200W
Rated Ampere	0.8-2.0A
CPU	Core-i7 (2.3GHz) minimum
RAM	4GB minimum
HDD	500GB minimum
OS	Windows8 64bit professional
Internal LAN	x1 port, 1000base-T (Connect to SPU)
LAN Adapter	USB3.0 1000base-T adapter x1 (Access with outside PC)
I/O	USB2.0×1 port, and USB3.0×1 port minimum
Video Tip	GeForce GTX 650M minimum
Display	17inch minimum
Resolution	1920×1080
Storage	DVD±R/RW
Display Data	Rainfall echo Doppler velocity (m/s)
Data Output	Rainfall strength (mm/h) data file, Output 1 to 5 per minutes.
Operating Temperature	+10 to +35 **°C**
Display Software	
Name	Furuno RainMap.exe
Function	Receive data from Signal Processing Unit (SPU) to indicate a picture of rainfall in real time. And also to use cycle setting to make an observation data file.
Software of remote maintenance function	
Name	TeamViewer GmbH
Version	TeamViewer Host (For remote server) 8.0 minimum
Function	Download the observation data and/or to set up an indicated software connecting by remote.
Requirement	It must be connecting to internet

8.4. Exterior

1) Antenna Unit (radome)

Ø1086

1024

204

Unit: mm

2) Signal Processing Unit (storage box).

125   600   300

600

150

Unit: mm
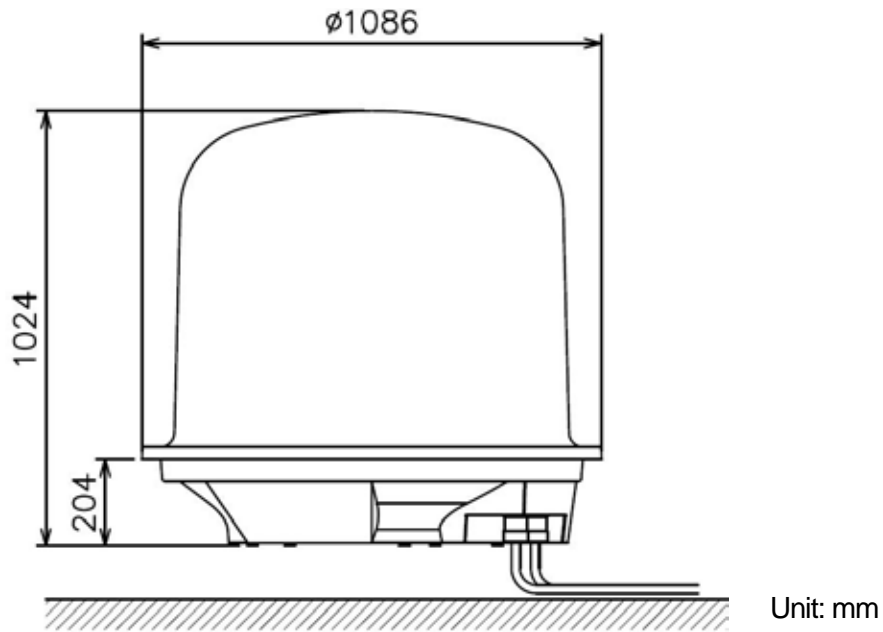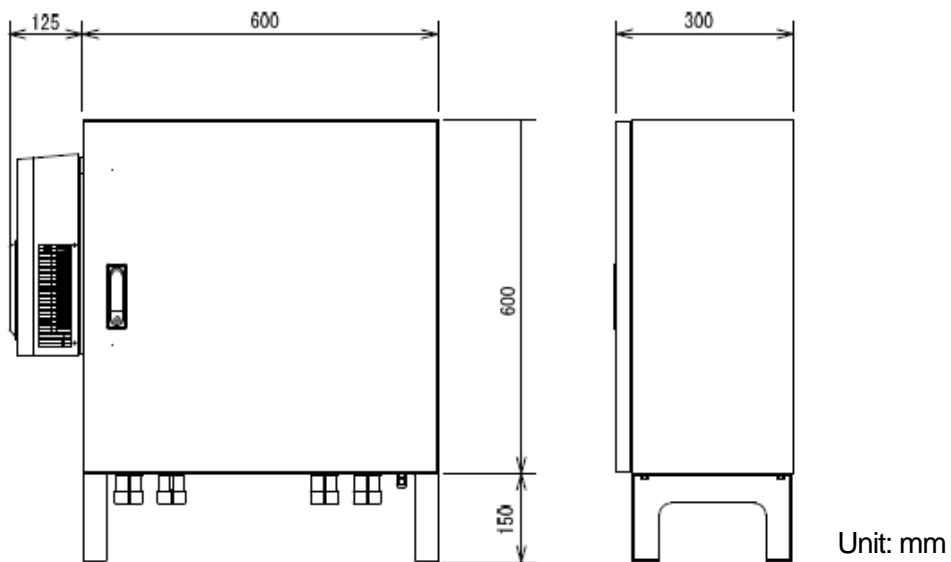
8.5. Output Data Format

8.5.1. Data file type 1

1) Log unit

   Write down a file to any folder in a computer in each setting cycle (e.g. 60 sec.)

   It is possible to set up a log folder.

2) Log file name

   Output file extension: csv
   Form: DATE_TIME_DATAKIND.csv (YYYYMMDD_HHMMSS_xx.csv).
   e.g.) Output the Rainfall strength "01/10/2012 9:37:26" → "20121001_093726_Rain.csv".

   Output data types are shown below:
   Rain: Rainfall intensity [mm/h]
   Zhh: Reflective intensity (Horizontal) [dBZ]
   Zvv: Reflective intensity (Vertical) [dBZ]
   DS: Doppler speed [m/s]
   Zdr: Radar reflection factor difference [dB]
   Kdp: Propagation phase difference rate of change [deg/km]

3) Data format

   CSV format:

Row	Data	e.g.
1	Log date (date of PC)	01/10/2012 9:37:26
2	Latitude [deg] (+:N, -:S)	34.713607 deg
3	Longitude [deg] (+:E, -:W)	135.335231 deg
4	The total number of sweeps (MAX 8192)	797 number
5	Data mark of the direction of distance (MAX 1028)	525 point
6	Resolution of the direction of distance [m]	96 m
7	Azimuth direction (θ) [deg] (The angle of azimuth for every sweep)	0.44 deg
8	Elevation direction (θ) [deg] (The angle of elevation for every sweep)	0.00deg
9 to MAX	Range direction (r) [BIN] Data mark of the distance direction +7 (Variable length is depends on a number of antenna rotations)	row 532 (=525 point + 7row)

2012/10/1 9:37 <- Log Date/Time (PC Time)
34.713607 <- Latitude [Degree] (+:N, -:S)
135.335231 <- Longitude [Degree] (+:E, -:W)
797 <- Total Sweep value (Max: 8192)
525 <- Data point of range direction (Max: 1028)
96 <- Resolution of range distance [m]

Model of file name is Date_Time_data type.csv(YYYYMMDD_HHMMSS_xx.csv)
E.g.) The case of output rain-fall intensity occurred on 2012/10/01 9 37 26 would become

Direction of azimuth (θ) "Variable length"

| 0.04 | 0.44 | 0.92 | 1.32 | <- Azimuth of every each sweep [degree] -> | | 3.65 | 4.04 | 4.48 | 4.92 | 5.41 | 5.84 | 6.28 | 6.72 | 7.21 |
| 0.00 | 0.00 | 0.00 | 0.00 | <- Elevation of every each sweep [degree] -> | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Range (r) "Variable length"

[Data type](xx)
Rain   Raill-fall intensity [mm/h]
Zhh   Reflectivity factor of Horizontal to Horizontal [dBZ]
Zvv   Reflectivity factor of Vertical to Vertical [dBZ]
DS   Doppler speed [m/s]
Zdr   Difference reflectivity[dB]
Kdp   Specific differential phase [deg/km]

Sample of Output Data:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	2012/10/1 9:37																
2	34.713607																
3	135.335231																
4	797																
5	525																
6	96																
7	0.04	0.44	0.92	1.32	1.85	2.24	2.72	3.12	3.65	4.04	4.48	4.92	5.41	5.84	6.28	6.72	7.21
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.0	0.0
13	0.2	0.2	0.2	0.3	0.4	0.5	0.0	0.1	0.1	0.2	0.4	0.4	0.1	0.2	0.0	0.0	0.1
14	0.2	0.3	0.2	0.3	0.4	0.6	0.0	0.1	0.1	0.2	0.5	0.5	0.1	0.2	0.0	0.0	0.1
15	0.2	0.3	0.3	0.4	0.5	0.6	0.1	0.2	0.1	0.2	0.5	0.5	0.1	0.2	0.0	0.0	0.1
16	0.3	0.3	0.3	0.4	0.5	0.7	0.1	0.2	0.1	0.3	0.6	0.6	0.2	0.2	0.0	0.0	0.1
17	0.3	0.4	0.3	0.5	0.6	0.8	0.1	0.2	0.1	0.3	0.6	0.7	0.2	0.2	0.0	0.0	0.1
18	0.3	0.4	0.3	0.5	0.7	0.9	0.1	0.2	0.1	0.3	0.7	0.7	0.2	0.3	0.0	0.0	0.1
19	0.3	0.4	0.4	0.6	0.7	1.0	0.1	0.2	0.1	0.3	0.8	0.8	0.2	0.3	0.0	0.0	0.2
20	0.4	0.5	0.4	0.6	0.8	1.0	0.1	0.2	0.1	0.4	0.8	0.9	0.2	0.3	0.1	0.0	0.2
21	0.4	0.5	0.4	0.7	0.8	1.1	0.1	0.3	0.2	0.4	0.9	0.9	0.2	0.3	0.1	0.0	0.2
22	0.4	0.5	0.5	0.7	0.9	1.2	0.1	0.3	0.2	0.4	1.0	1.0	0.3	0.4	0.1	0.0	0.2
23	0.5	0.6	0.5	0.8	1.0	1.3	0.1	0.3	0.2	0.5	1.0	1.1	0.3	0.4	0.1	0.0	0.2
24	0.5	0.6	0.5	0.8	1.0	1.4	0.1	0.3	0.2	0.5	1.1	1.2	0.3	0.4	0.1	0.0	0.2
25	0.5	0.6	0.6	0.9	1.1	1.5	0.1	0.4	0.2	0.5	1.2	1.2	0.3	0.4	0.1	0.0	0.2
26	0.6	0.7	0.6	0.9	1.2	1.6	0.1	0.4	0.2	0.1	1.2	1.3	0.3	0.5	0.1	0.0	0.3
27	0.6	0.7	0.5	1.0	0.3	1.7	0.1	0.2	0.2	0.1	1.3	1.4	0.4	0.5	0.1	0.0	0.3
28	0.6	0.1	0.1	1.0	0.1	0.7	0.1	0.1	0.2	0.1	1.4	1.5	0.2	0.5	0.1	0.0	0.3
29	0.3	0.1	0.1	1.1	0.1	0.1	0.1	0.1	0.2	0.0	1.5	1.5	0.0	0.6	0.1	0.0	0.3
30	0.0	0.1	0.0	1.1	0.2	0.1	0.2	0.0	0.2	0.1	1.5	1.3	0.0	0.6	0.0	0.0	0.3
31	0.0	0.0	0.0	1.2	0.1	0.1	0.2	0.0	0.2	0.2	1.6	0.3	0.0	0.6	0.0	0.0	0.2
32	0.0	0.0	0.0	1.3	0.0	0.1	0.2	0.0	0.2	0.2	1.7	0.3	0.0	0.4	0.0	0.1	0.1
33	0.1	0.0	0.0	1.3	0.0	0.1	0.2	0.0	0.2	0.2	1.8	0.3	0.1	0.0	0.0	0.1	0.1
34	0.1	0.0	0.0	1.1	0.0	0.1	0.2	0.0	0.3	0.2	1.8	0.2	0.1	0.0	0.0	0.0	0.2
35	0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.3	0.2	1.9	0.2	0.1	0.0	0.1	0.0	0.2
36	0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.1	0.3	0.2	0.2	0.1	0.1	0.0	0.1	0.0	0.2
37	0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.3	0.3	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.1
38	0.1	0.0	0.1	0.1	0.0	0.5	0.2	0.3	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
39	0.0	0.1	0.1	0.1	0.0	0.6	0.2	0.1	0.3	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1
40	0.0	0.1	0.0	0.0	0.0	0.6	0.2	0.0	0.1	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0

8.5.2. Data file type 2

1) Log unit
   Write down a file to any folder in a computer in each scan (one round to azimuth)
   It is possible to set up a log folder.

2) Log file name
   File name: Start scenario (year/date/min/sec) + elevation number + modulation system
   File name extension: scn
   YYYYMMDD_hhmmss_##_** scn
   e.g.) 20130514_123400_01_00.scn
   Elevation number: If the lowest elevation is 01, it would be 01, 02, 03 ….
   Modulation system: 00:Pulse modulation, 01:Frequency modulation (pulse compression)

3) Data format
   Binary format (Byte array: Little endian)

Block	Item	Detail	Size [byte]	Offset	Data type
Header	Size of header	e.g. 56 [Byte]	2	2	unsigned short
	Version of data format	e.g. 001	2	4	unsigned short
	PC Log time: year	e.g. 2013	2	6	unsigned short
	PC Log time: month	e.g. 05	2	8	unsigned short
	PC Log time: date	e.g. 15	2	10	unsigned short
	PC Log time: hour	e.g. 18	2	12	unsigned short
	PC Log time: minute	e.g. 30	2	14	unsigned short
	PC Log time: second	e.g. 00	2	16	unsigned short
	Latitude: degree	e.g. 34 (N. Lat: +, S. Lat:-)	2	18	signed short
	Latitude: minute	e.g. 44	2	20	unsigned short
	Latitude: second	e.g. 59.999 (1000 times level)	2	22	unsigned short
	Longitude: degree	e.g. 135 (E. Lat: +, W. Lat.+)	2	24	signed short
	Longitude: minute	e.g. 21	2	26	unsigned short
	Longitude: second	e.g. 59.999 (1000 times level	2	28	unsigned short
	Antenna Altitude (Upper)	Range Upper: 0 - 65535	2	30	unsigned short
	Antenna Altitude (Lower)	Range Lower: 0 - 9999 Altitude[cm] Upper x 10000 Lower e.g. 123456[cm] 12 x 10000 3456	2	32	unsigned short
	Antenna rotation speed (azimuth	e.g. 10.0 [rpm] 10 times level	2	34	unsigned short
	PRF1	e.g. 1600.0 [Hz] 10 times level	2	36	unsigned short
	PRF2	e.g. 2000.0 [Hz] 10 times level	2	38	unsigned short
	Noise level (Horizontal polarization)	e.g. -62.00 ([dBm] 100 times level)	2	40	signed short
	Noise level (Horizontal polarization)	e.g. -62.00 ([dBm] 100 times level)	2	42	signed short
	Total number of sweep: L	e.g. 720 [qty]	2	44	unsigned short
	Number of range direction data: M	e.g. 300 [qty]	2	46	unsigned short
	Resolution of range direction	e.g. 100.00 ([m] 100 times level)	2	48	unsigned short
	Constant radar: Mantissa (Horizontal polarization)	Range: -999999999 - 999999999	4	52	signed long

Header	Constant radar: Characteristic (Horizontal polarization)	Range: Characteristic:-32768 - 32767 Constant Mantissa x 10^ Characteristic e.g. 9.876E-9 9876 x 10^-12	2	54	signed short
	Constant radar: Mantissa (Vertical polarization)	Same as above (Same as horizontal polarization)	4	58	signed long
	Constant radar: Characteristic (Vertical polarization)		2	60	signed short
Observation angularity information	Information ID	e.g. 6	2	62	unsigned short
	Azimuth	Range: 0 - 359.99 [deg] 100 times level North: 0 deg	2	64	unsigned short
	Elevation	Range: -3.00 - 180.00 [deg] 100 times level Horizontal: 0deg, Elevation: +, Dip: -	2	66	signed short
Observed data	Information ID	e.g. 4802	2	68	unsigned short
	Rain Rainfall intensity	Range: 0 - 65535 Calculation formula N is a recording level. Rain mm/h]= N-32768)/100 Rain Range: -327.67 - 327.67mm/h Resolution: 0.01mm/h N=0 is invalid	2 x Range direction data mark		unsigned short
	Zhh Reflective intensity Horizontal polarization	Range: 0 - 65535 Calculation formula N is a recording level. Zhh dBZ]= N-32768)/100 Zhh Range: -327.67 - 327.67dBz Resolution: 0.01dBz N=0 is invalid	2 x Range direction data mark		unsigned short
	V Doppler speed	Range: 0 - 65535 Calculation formula N is a recording level. V m/s]= N-32768)/100 V Range: -327.67 - 327.67m/s Resolution: 0.01m/s N=0 is invalid	2 x Range direction data mark		unsigned short
	Zdr Radar reflection factor difference	Range:0 - 65535 Calculation formula N is a recording level. Z dB]= N-32768)/100 Zdr Range: -327.67 - 327.67dB Resolution: 0.01dB N=0 is invalid	2 x Range direction data mark		unsigned short
	Kdp Propagation phase difference rate of change	Range: 0 - 65535 Calculation formula N is a recording level. Kdp deg/km]= N-32768)/100 Zdp Range: -327.67 - 327.67deg/km Resolution: 0.01deg/km N=0 is invalid	2 x Range direction data mark		unsigned short

Observed data	φdp Differential phase shift	Range: 0 - 65535 Calculation formula N is a recording level. φdp [deg]=360 N-1)/65535 φdp Range: 0.0 - 359.9945deg Resolution: 0.0055deg N=0 is invalid	2 x Range direction data mark		unsigned short
	ρhv Correlation coefficient between horizontally and vertically polarized echoes	Range: 0 - 65535 Calculation formula N is a recording level. ρhv[no unit]=2 x N-1)/65534 ρhv Range:0.0 - 2.0 Resolution: 0.0000030 N=0 is invalid	2 x Range direction data mark		unsigned short
	W Doppler speed width	Range: 0 - 65535 Calculation formula N is a recording level. W[m/s]= N-1)/100 W Range: 0.00 - 655.34m/s Resolution: 0.01m/s N=0 is invalid	2 x Range direction data mark		unsigned short

Observation angularity information	sweep 1	Range direction data 1
Observation data	sweep 1	Range direction data 1
│	│	│
│	sweep 1	Range direction data M
│	sweep 1	Range direction data M
│	sweep 2	Range direction data 1
│	sweep 2	Range direction data 1
│	│	│
│	sweep 2	Range direction data M
│	sweep 2	Range direction data M
│	Sweep L	Range direction data 1
│	Sweep L	Range direction data 1
│	│	│
│	Sweep L	Range direction data M
│	Sweep L	Range direction data M

8.5.3. Data size

1) Every scan quantity (one round to azimuth direction)

Header		Observation angularity information		Observation data		Range direction data		Total sweep		Quantity of every scan
60	+	((6	+	2)	+	(16 x	e.g. 300))	x	e.g. 720 =	3,461,820 byte

2) Quantity in every hour

  3,461,820 byte x 3600 sec. / 6 sec. = approx. 2.1GB 2,077,092,000)

3) Quantity in 30 days

  2,077,092,000 byte x 31 days x 24 hrs. = approx. 1.55TB

9. Menu Tree

RainMap
- **Menu [File]**
  - **Menu [File Play.]**
  - **Menu [Snapshot]**
  - **Menu [Exit]**
- **Menu [Disp]**
  - **Menu [Disp select]**
    - **Menu [2D]**
    - **Menu [3D]**
  - **Menu [Sub echo]**
  - **Menu [Information Indication]**
- **Menu [Setting]**
  - **Input [View]**
  - **Input [Acquisition]**
  - **Input [Antenna]**
  - **Input [Scan]**
- **Menu [Radar Operation]**
  - **Menu [Connect]**
  - **Menu [Disconnect]**
  - **Menu [TX]**
  - **Menu [STBY]**
- **Menu [Help]**
  - **Menu [Version]**
- **Menu [Emergency Stop]**
  - **Menu [Stop motor]**

RainPlay

- Menu [File]
  - Menu [File Play]
  - Menu [Print]
    - Menu [Main screen]
    - Menu [SRHI screen]
  - Menu [Exit]

- Menu [Setting]
  - Input [Scale]
  - Input [Azimuth Offset]

- Menu [Disp]
  - Menu [Select] — Menu [View]
    - Input [Rain]
    - Input [Zhh]
    - Input [V]
    - Input [Zdr]
    - Input [Kdp]
    - Input [φdp]
    - Input [phv]
    - Input [W]
  - Menu [Transparency]
    - Input [0%]
    - Input [25%]
    - Input [50%]
    - Input [75%]
    - Input [100%]
  - Menu [Map]
  - Menu [SRHI screen]
  - Menu [Clear]

- Menu [Play]
  - Menu [Start]
  - Menu [Stop]
  - Menu [Pause]
  - Menu [Fast Forward]
  - Menu [Rewind]
  - Menu [Time Display]

- Menu [Print screen]
  - Menu [Main screen]
  - Menu [SRHI screen]

10. Other

10.1. Trademarks

Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.

10.2. Security export control

1) This device will be applicable to export controlled goods of Japan.

2) Principle, export, sale, and transfer of foreign user list subjects established by the Japanese government, is prohibited.

3) Based on the catch-all controls, if the end-user, end use is involved in the development, manufacture and use of weapons of mass destruction, or the like, or, if the involvement is suspected, export is prohibited.

4) If you want to export this product, please contact us in advance.

11. Packing List

11.1. Parts List

PRODUCT NAME	MODEL
Compact Dual Polarimetric X-band Doppler Weather Radar	WR-2100

Items	Units	Descriptions	Qty
Antenna Unit	WR-2100-ATU	Size: Φ1086mm x H1024mm (include radome) Weight: 70Kg	1
Signal Processing Unit	WR-2100-SPU	Sze: W725 x D300 x H750mm (include storage box) Weight: 60kg	1
Display Unit	WR-2100-DPU	General PC (ex. HP envy dv7)	1
Mount Plate for radome	52-037-2301-1	Size: 900mm x 800mm x t 10mm, Weight: 15kg	1
	52-037-2302-0	Size: 950mm x 920mm x t 10mm, Weight: 18kg	

11.2. Cable list

Antenna Unit (radome) --- Signal Processing Unit (storage box) cable			
Items	Descriptions	Length	Qty
Signal cable	25pin cable (Both Dsub-25Pin)	5m	1
Com cable	9pin cable (Both Dsub-9Pin)	5m	1
RF cable	3D-2W (Both SMA-P Connector)	5m	3
AC Power cable	Power cable 3core 1.25sq	5m	1
Signal Processing Unit (storage box) --- Display Unit (storage box) cable			
LAN cable	Outdoor 1000Base-T (Cat5e or better), length depends on measure value	by measure	1
AC power cable	Power cable 3core	by measure	1
Protective tube for cable			
Protective tube	Flexible conduit Inner diameter : 28 mm radome --- storage box	by measure	2
Protective tube	Flexible conduit Inner diameter : 28 mm storage box --- indoor	by measure	2

11.3. Equipment list

Items	Descriptions	Qty
Key of storage box	No.200	2
M10x35 Hexagon Bolt	Material : SUS304 (Fixed for antenna)	12
M10 Spring Washer	Material : SUS304 (Fixed for antenna)	12
M10 Flat Washer	Material : SUS304 (Fixed for antenna)	12
M12x40 Hexagon Bolt	Material : SUS304 (Fixed for antenna & mount plate)	5
M12 Spring Washer	Material : SUS304 (Fixed for antenna & mount plate)	5
M12 Flat Washer	Material : SUS304 (Fixed for antenna & mount plate)	5
M16x40mm Hexagon Bolt (*1)	Material : SUS304 (Fixed for mount plate and a base)	12
M16 Nut	Material : SUS304 (Fixed for mount plate and a base)	12
M16 Spring Washer	Material : SUS304 (Fixed for mount plate and a base)	12
M16 Flat Washer	Material : SUS304 (Fixed for mount plate)	24

*1: Length of Hexagon Bolt will depend on a thickness of a base.

12. **Option**

12.1. Construction equipments (Option)

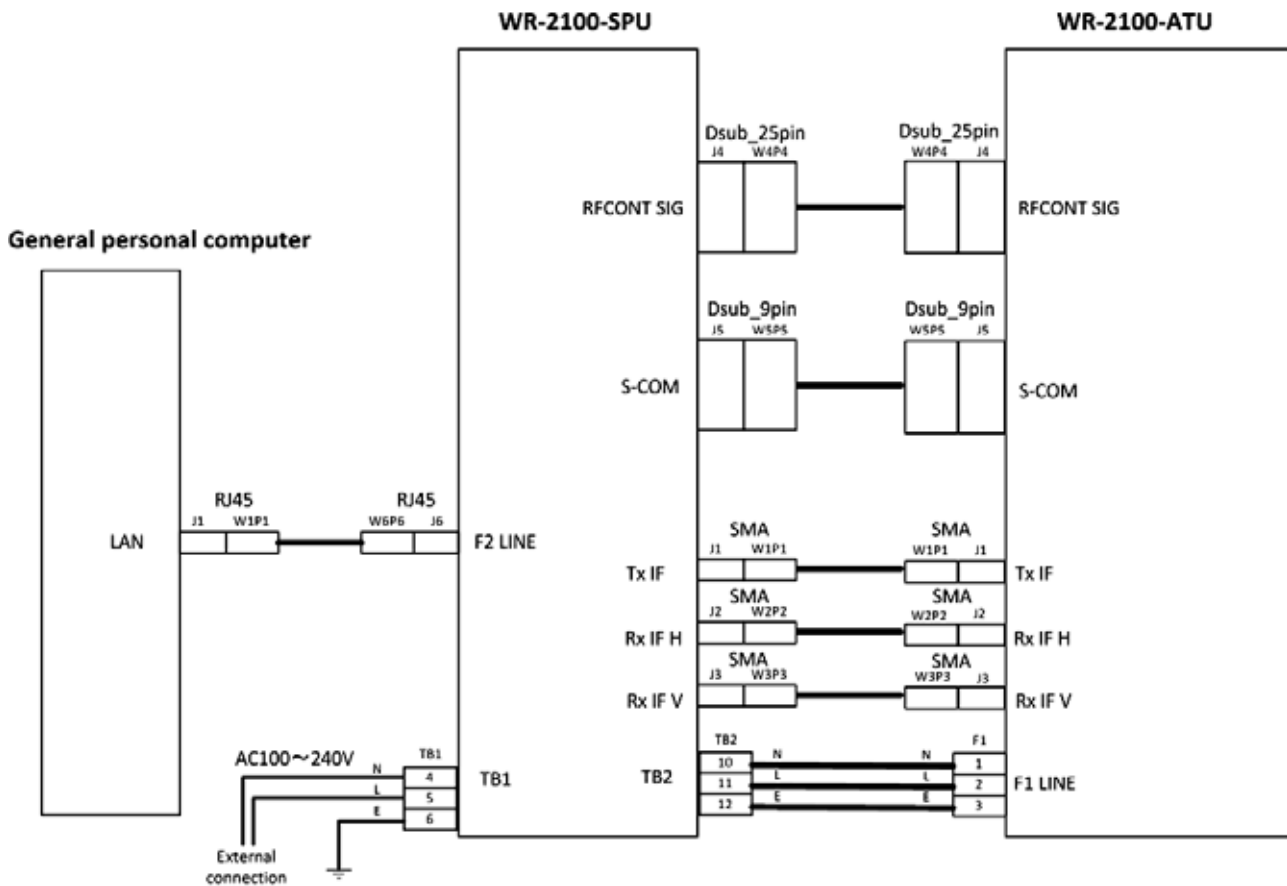| Items	Descriptions	Qty
M10x35 Hexagon Bolt	Material : SUS304 (Fix for up/down parts of radome)	12
M10 Spring Washers	Material : SUS304 (Fix for up/down parts of radome)	12
M10 Flat Washers	Material : SUS304 (Fix for up/down parts of radome)	12
M12x40 Hexagon Bolt	Material : SUS304 (Fix for radome and mount plate)	5
M12 Spring Washers	Material : SUS304 (Fix for radome and mount plate)	5
M12 Flat washers	Material : SUS304 (Fix for radome and mount plate)	5
FV2-M4 Round Crimping Terminal	For electric cables	6
Putty for pipe	Non-hardening, Electric insulation	qs
Multi Plug Outlet Power strip	(3-core) 4-Outlets minimum w/ surge protector	1
Heavy Duty Cable Tie (2 types)	Nylon 6/6 w/ weather resistance 140mm, 300mm	100
M10 Anchor Bolt	Fixed for storage box	4
Earth wire 2sq green	To protection against electric shock	1

Notice: Please refer to attached documents of UPS, Router, and other equipments separately.

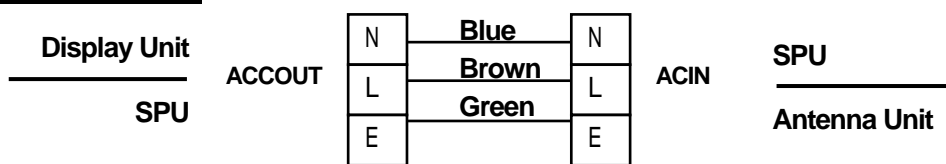## 12.2. Construction tools (Reference parts)

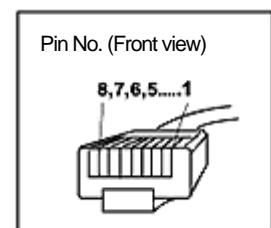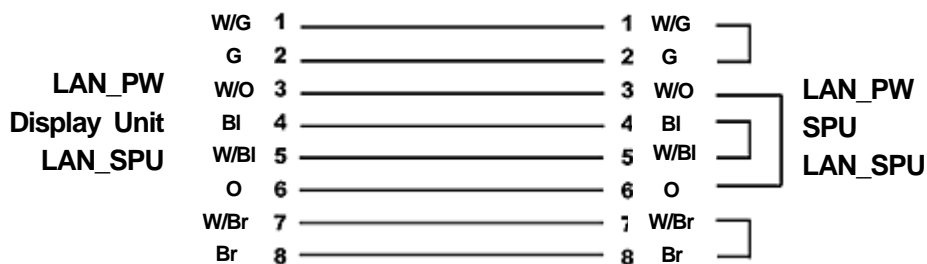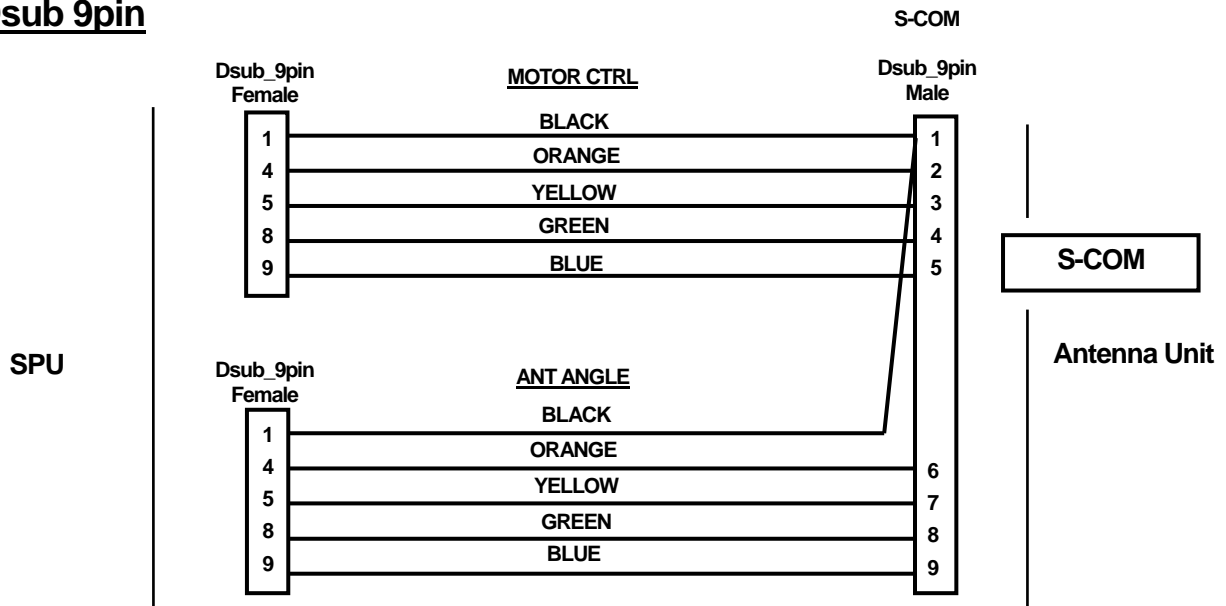| Items	Descriptions
SMA Torque wrench 74Z-0-0-21	SMA connector conclusion Substitute: Caliber 5/16 inch or 8mm wrench
Socket Wrench (4 types)	M8 (13mm), M10 (17mm), M12 (19 mm) M16 (24mm) hexagon bolt (Substitute: Monkey wrench)
Hexagon Wrench (3 types of Ball-point)	M3 (2.5mm), M4 (3mm), M5 (4mm) Bolt with Hexagon hole
[+] Driver No.1	Dsub-9pin
[+] Driver No.2	M3, M4, M5, Dsub-25pin, for Electric Filter
[+] Driver No.2 (Long type)	Length 30cm minimum fixed for PXI
[-] Driver M8	Multiuse
Box Driver (2 types)	5mm, 5.5mm fixed for Dsub connector
Flat Ratchet (3 types)	M10 (17mm), M12 (19mm), M16 (24mm)
Nipper	For wiring work
Wire Strippers	For wiring work
Electrical workers knives	For wiring work
Crimped Terminal tool 1.25sq	Power cable (M4), GND wire (M8) for wiring work
Tape Measures (5m minimum)	Measure length of outdoor power cable and LAN cable
Self-fusing Tape (Black)	Fit Tape insulation / protect (Length 10m)
Electrical Tape (Black)	Heat & Fire proof (L19m x W20mm x D0.18mm)
Curing Tape	Multiuse
Chemiseal	S-8400W Aluminum Tube 50G
Silicone grease	Temperature range -30 to +200°C
Safety belt	For high place work

13. APPENDIX

13.1. System diagram

AC100　240V

Notice: Cable colors vary by country.

RJ45

Dsub 9pin

Dsub_9pin Female

MOTOR CTRL

Pin	Wire
1	BLACK
4	ORANGE
5	YELLOW
8	GREEN
9	BLUE

Dsub_9pin Male — S-COM

Wire	Pin
BLACK	1
ORANGE	2
YELLOW	3
GREEN	4
BLUE	5

S-COM

Antenna Unit

Dsub_9pin Female

ANT ANGLE

Pin	Wire	Pin
1	BLACK	
4	ORANGE	6
5	YELLOW	7
8	GREEN	8
9	BLUE	9

SPU

Dsub 25pin

Dsub_9pin Female

RF CTRL

Pin	Wire
1	BLACK
4	ORANGE
5	YELLOW
8	GREEN
9	BLUE

RFCONT SIG

Dsub_25pin Male

Pin	Signal
1	SPU-TX-P
14	SPU-TX-N
2	GND
15	GND
3	SPU-RX-P
16	SPU-RX-N

RFCON SIG

Antenna Unit

Dsub_25pin Male

Pin	Wire	Pin	Signal
10	BROWN	4	RF_TRIG-P
22	RED	17	RF_TRIG-N
9	ORANGE	5	GND
21	YELLOW	18	GND
8	GREEN	6	TRIG-ACK-P
20	BLUE	19	TRIG-ACK-N
7	BROWN	7	Pulse_No(1)-P
19	RED	20	Pulse_No(1)-N
6	ORANGE	8	GND
18	YELLOW	21	GND
5	GREEN	9	Pulse_No(0)-P
17	BLUE	22	Pulse_No(0)-N
4	BROWN	10	TRX_ON-P
16	RED	23	TRX_ON-N
3	ORANGE	11	GND
15	YELLOW	24	GND
2	GREEN	12	Sector_Blank_N
14	BLUE	25	Sector_Blank_N
1	BLACK	13	GND

Level Convert

HDMI

SPU