

OPERATOR'S MANUAL

MODEL: WEATHER RADAR

TYPE: **WR110**



FURUNO

www.furuno.com

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.

Importer in Europe

The following concern acts as our importer in Europe, as defined in DECISION No.768/2008/EC.

- Name: FURUNO EUROPE B.V.

- Address: Ridderhaven 19B, 2984 BT Ridderkerk, The Netherlands.

Software version: 8450002-05.**

**denotes minor modifications.

CE declarations

With regards to CE declarations, please refer to our website (www.furuno.com), for further information about RoHS conformity declarations.

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 12.7m (Safety standard is 10 W/m^2).

NOTE: The value is applied for being installed in the public space. And it is defined on human body surface over any 6-minutes period with the flux density averaged from the measurement.

Distance from Antenna	-m	-m	12.7m
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 surge 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

WR110 restrictions

There are restrictions frequency band as follows to use at Lithuania and Slovakia.

WR110 is operated with a channel from the following four channels:

CH1: 9422.5MHz, CH2: 9427.5MHz, CH3: 9432.5MHz, CH4: 9437.5MHz

WEATHER RADAR

WR110 Operation manual

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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. While installing antenna on a rooftop of building in urban area, it must be installed in the safety area covered by lightning rod based on JIS A4201 and IEC61024-1.
2. Nothing should be surrounded around the antenna area.



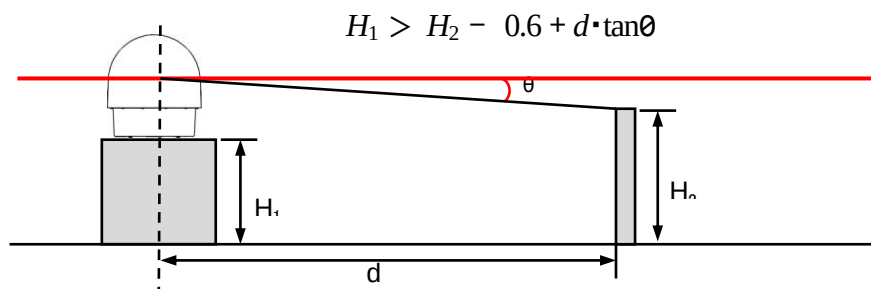
Notice:

Do not go around the antenna area.

Safe distance:

- If H1 is taller than 1.6 meters, it is safe unless touch the antenna directory.
- If H1 is shorter than 1.6 meters, do not enter within a radius of 6 meters from the antenna.

Notice: It based on the standard of 2 meters tall person.



Safety zone around radar

e.g.: H2 (Height) = 2m,

d (Distance between center of the antenna and human) = 6m, $\theta = 2^\circ$ (Minimum azimuth is -2°)

$$H_2 - 0.6 + d \cdot \tan \theta = 2 - 0.6 + 6 \cdot \tan 2^\circ = 1.6095 < H_1$$

Therefore, H1 (Height of base) = 1.6m,

System Configuration

The observation system consists of Antenna Unit (radome), Junction Unit (connection box), and Data Processing 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 in the ATU.

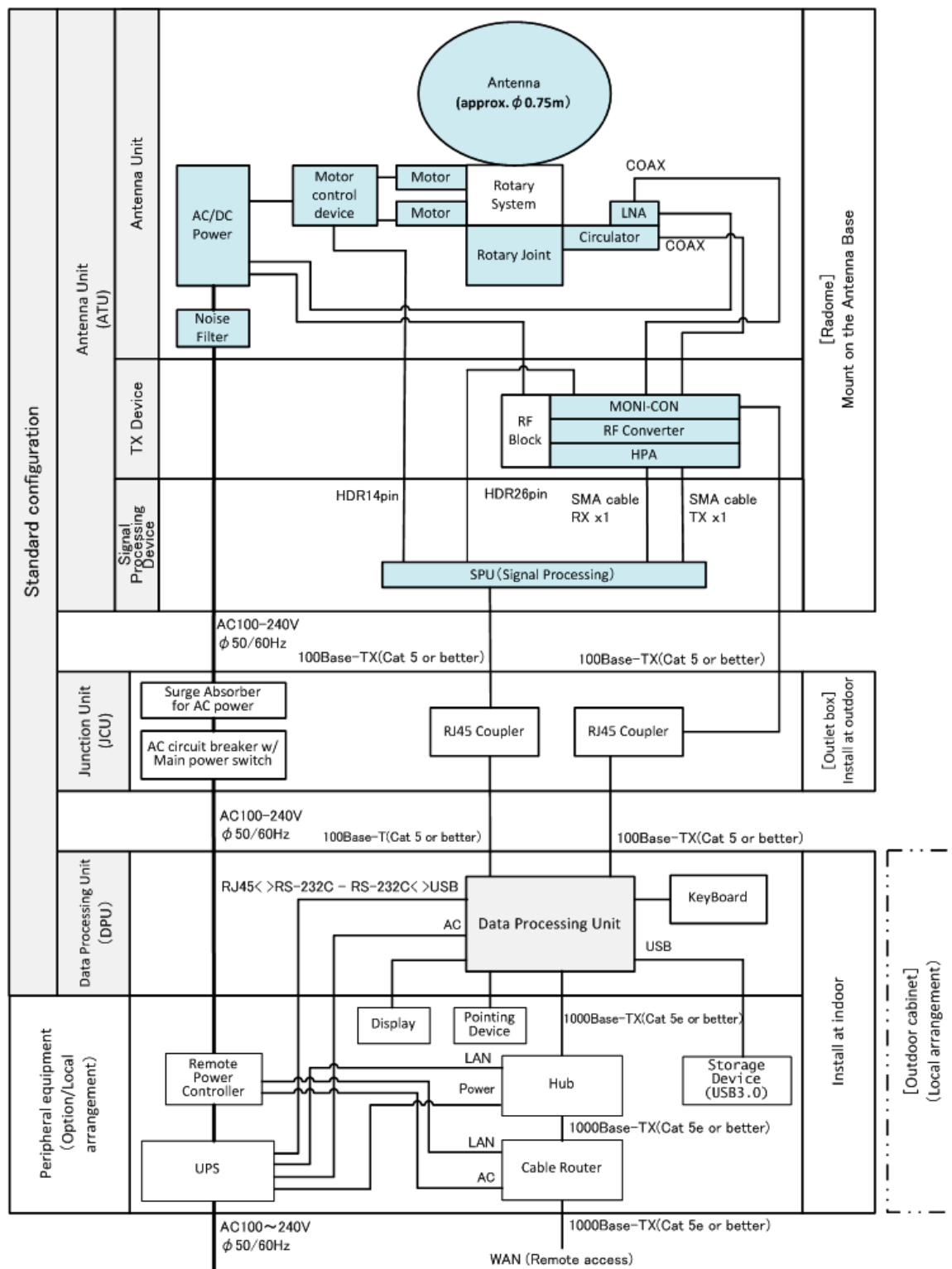
2) Junction Unit (connection box)

This unit is a relay point of LAN cable (100Base-T or better) and switches the power of the ATU.

3) Data Processing Unit (indoor unit)

To display and record the data of weather observation.

WR110 Configuration



1. Operating Procedure of System

1.1. Startup the Radar System

(1) Turn on the circuit breaker of the Junction Unit (connection box)



(2) Turn on the power of the Data Processing Unit to start the observation from the RainMap



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



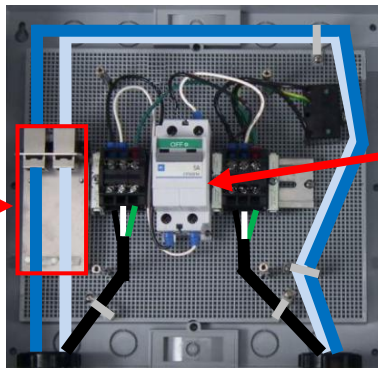
In process.

1. The circuit breaker is in the Junction Unit (connection box).



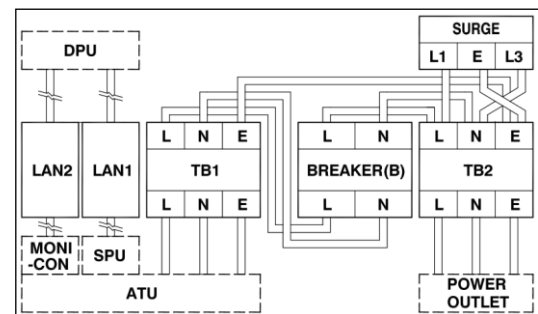
2. Turn on the circuit breaker.

RJ45 coupler



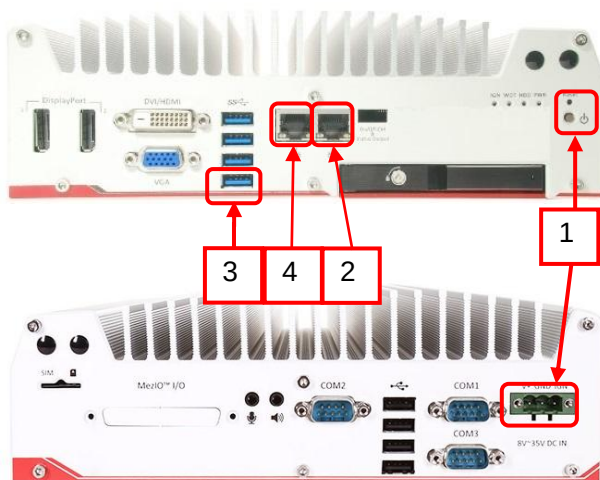
From ATU

From DPU



1.2. Startup the Data Processing Unit

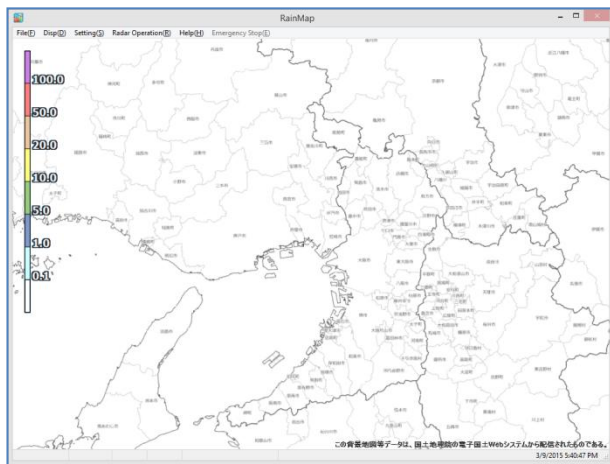
Sample image of DPU



1. Setup Data Processing Unit

- (1) Connect AC power supply cord from electrical outlet to DPU, and turn ON the power. (Turn ON the power of ATU before turn ON the power of DPU)
- (2) Connect LAN cable from DPU to ATU (SPU), and setup IP address of DPU. (192.168.31.110)
- (3) Use USB / LAN adapter if only 2 LAN connectors are mounted. Connect (MONI-CON), and setup IP address of DPU. (192.168.1.80)
- (4) Connect LAN cable from router to DPU for using Internet. (e.g.: 192.168.0.5)

Notice: Do not use the same IP address as ATU.



2. Turn on the power of the Data Processing Unit.

Username: radar

Password: radar

- (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.

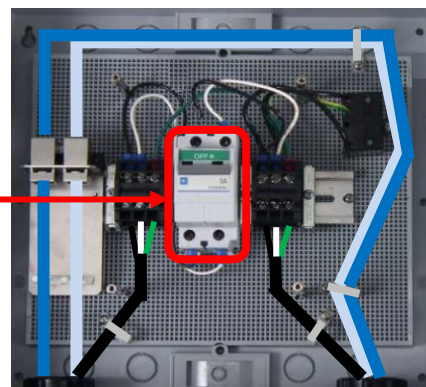
1.3. Shut down / Reboot the Radar System

If turned off the circuit breaker in the Junction Unit (JCU), the radar system will also be off.

Process of the Data Processing Unit operation is necessary when shut down the Antenna Unit. Moreover, restart ATU in case of having problem for example the radar is hanged up.

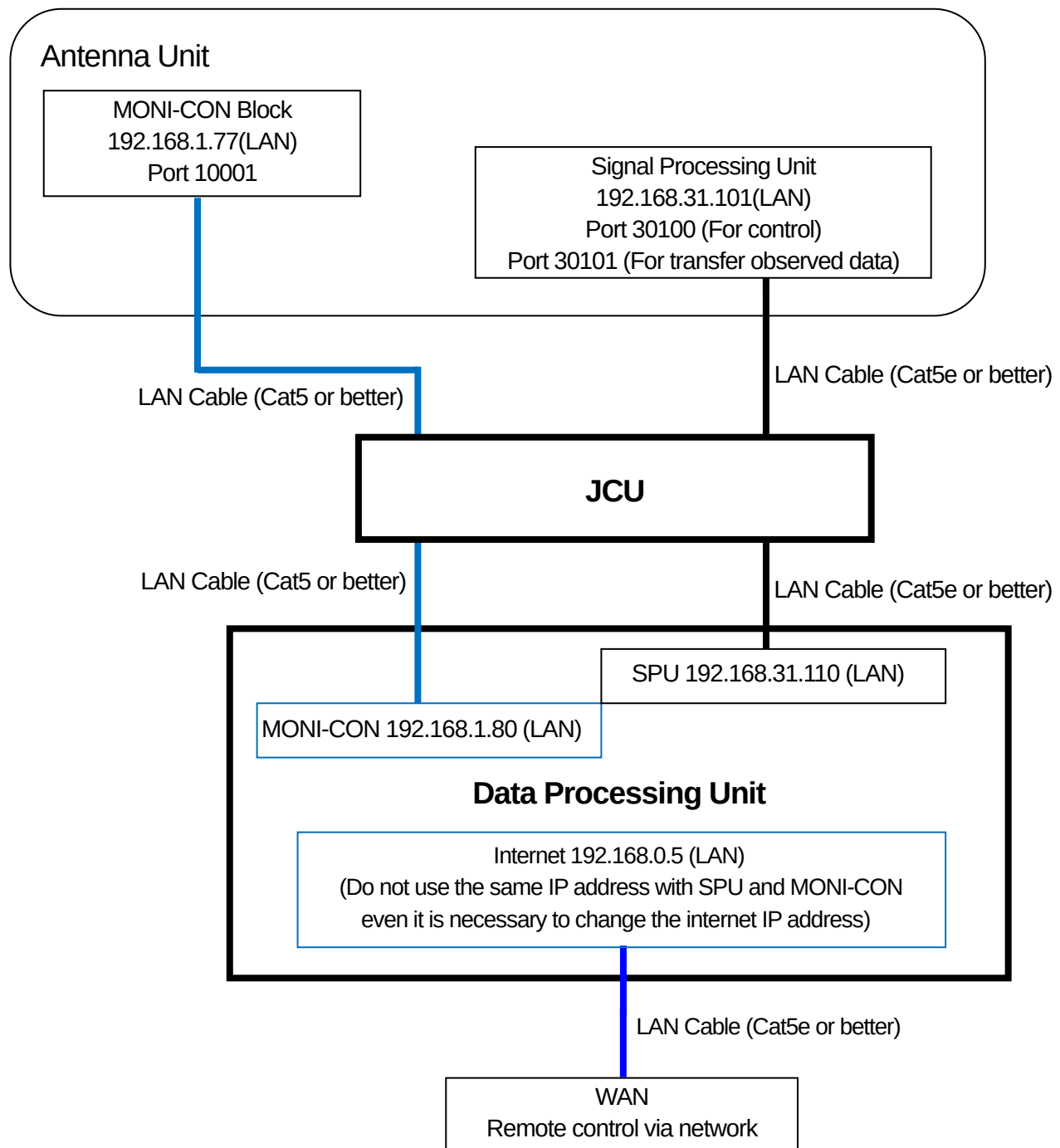
Caution: It may break down if remove a plug or turn off a breaker without following this process.

Shut down the circuit breaker in the Junction Unit.



2. Data Processing Unit Configuration

2.1. Configuration



2.2. Data Processing Unit

The Data Processing Unit receives output data from the Antenna Unit and displays the rainfall data in real time.

Software name	Display software	RainMap.exe
Specification	Function	
OS: Windows® 10 IoT Enterprise 64bit Language displayed: English and Japanese (default: English)	Change from English to Japanese corresponding to the language setting of Windows®	
Data display: - Observational date and time: - Maximum distance displayed - Display scale - Unit displayed (inside: [m]) - Polar coordinate display (rθ) - Coloration	Local time display corresponding to the time zone of Windows® 70 km 0.5-70 km km Maximum 15 colors in table (maximum 16 values including no color)	
Map display: Local map display:	Display BMP map	
Display of status: - Data types - ATU	Display the setting button and current setting values. Rain (mm/h), Zh (dBz), Zh_corr (dBz), V (m/s), W(m/s) Display of current activation and setting values of azimuth & observed elevation	
Setting of radar operation: - Scan mode - Removal of interference - Display ON or OFF of topographical echo removal - Transmission mask function - Elevation angle (-2 to 90 degrees) - Setting of radar constant (Transmission pulse width, rainfall strength conversion constant B, and β)	Conduct the setting to ATU section from the menu and the confirmation. PPI, Volume Scan, Sector PPI/RHI, Obtain an interference removed echo data Obtain a topographical removed echo data Obtain a masked echo data that setting to ATU. Obtain a specified elevation angle echo data that setting to ATU. Obtain a setting echo data that setting to ATU.	
Data manipulation: - Saving of displayed data - Play of displayed data	Save as a chronological order unit (Time based file name) Play from the specification file name.	
Data output: Output of data file	Output per 1 to 5minutes	

3. Operating Procedure of DPU

3.1. Power up

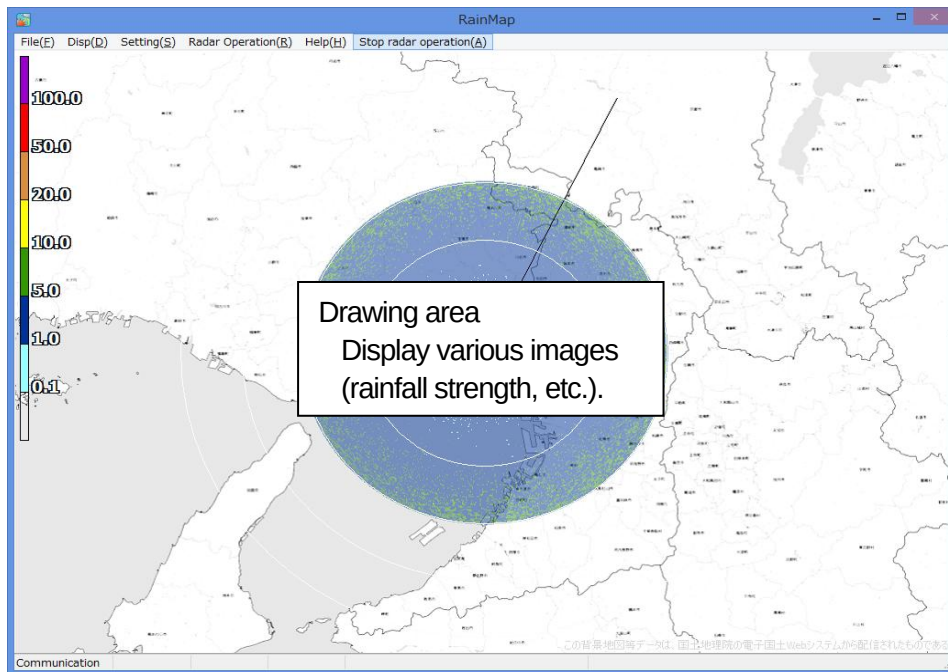
Turn on the power of DPU to start Windows®.

User name: radar

Password: radar

3.2. Startup screen

The following screen will display during startup.



3.3. Power down

- 1) Shut down the Windows®.

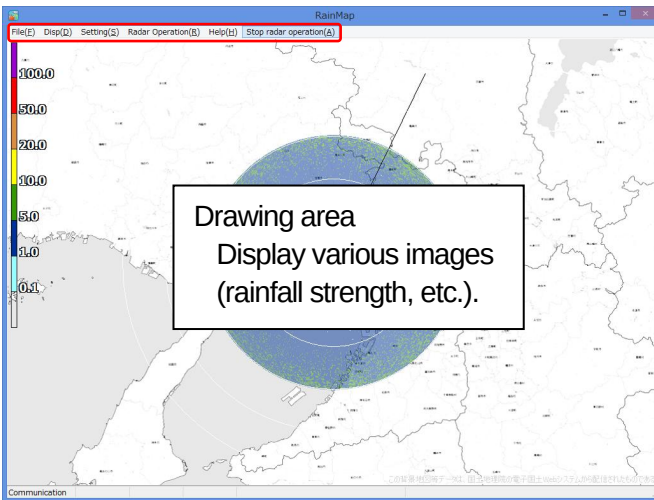
There are 3 ways to shutdown the windows:

- Method 1. Right click [Start button] -> Choose [Shutdown or Sign out] -> [Shutdown]
- Method 2. Press [Windows] + [X] key -> choose [Shutdown or Sign out] -> [Shutdown]
- Method 3. Press [ALT] + [F4] key -> [Shutdown]

- 2) Turn off the power of DPU.

4. Software operation

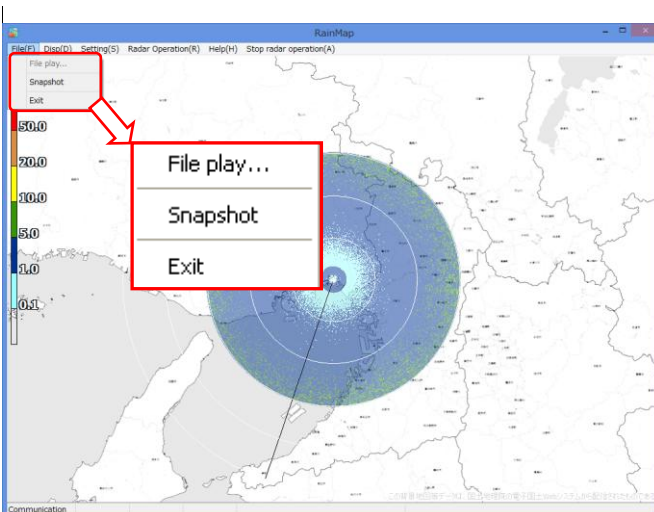
4.1. Name & Function of RainMap



File Menu bar

Click the menu name to display each selected menu item.

- File
- Disp
- Setting
- Radar Operation
- Help
- Stop radar operation



File menu

File play:

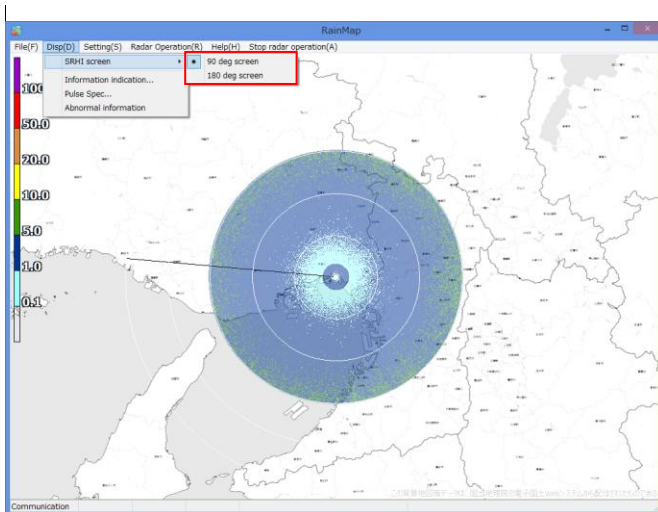
Display the play screen of log data.
RainPlay software will popup. See the instruction of 4.4.

Snapshot:

Capture the screen

Exit:

Close the software



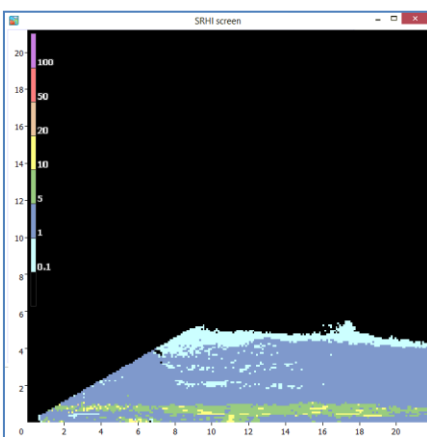
Disp

SRHI screen:

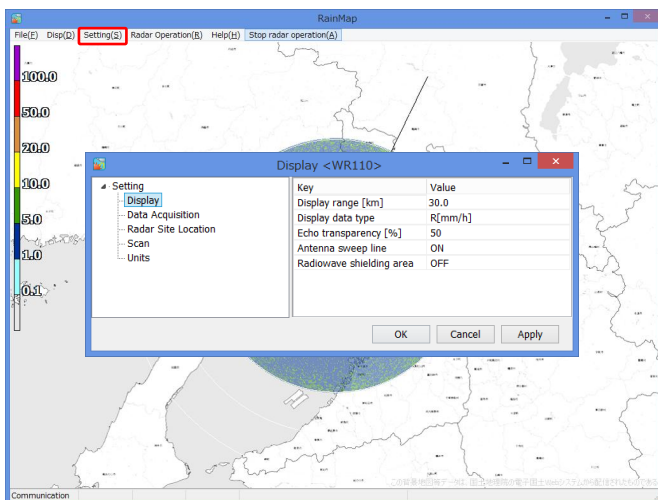
- 90 degrees screen (Indicate the echo of SRHI with 90 degrees on sub screen)
- 180 degrees screen (Indicate the echo of SRHI with 180 degrees on sub screen)

Information Indication:

Indicate condition of specific hardware.



(Image screen of SRHI 90 deg.)



Setting

Display

Display the setting menu according to the indication.

Data Acquisition

Display the setting menu according to the Log.

Radar Site Location

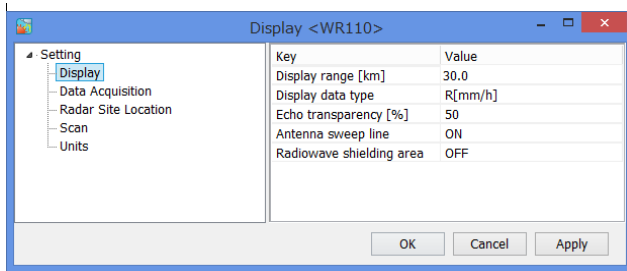
Display a setting menu according to an installation place of antenna.

Scan

Setup a pattern of scan mode and details.

Units

Setup a type of indication on rotation speed.

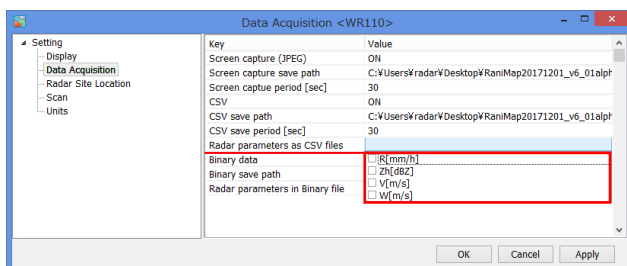
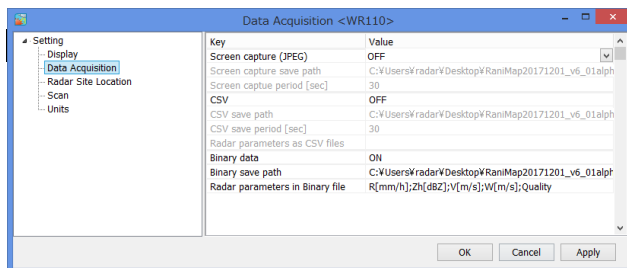


Key	Value
Display range [km]	30.0
Display data type	R[mm/h]
Echo transparency [%]	50
Antenna sweep line	ON
Radiowave shielding area	OFF

Radiowave shielding area:

Display (OFF, 1, 2) radiowave shielding area on screen. * Setting file is necessary.

- 1: Gray images
- 2: Gray scale images



Display

Display range [km]:

Setup an indication range.

Display data type:

Setup an indication of the radar parameter.

Notice: WR110 could only use the following types.

- **Rain [mm/h]:** Intensity of rainfall
- **Zh [dBZ]:** Reflection factor of the horizontal polarimetric radar
- **Zhh_corr [dBZ]:** Attenuation corrected Zh of the horizontal polarimetric radar
- **V [m/s]:** Reflection factor of the vertical polarimetric radar
- **W [m/s]:** Doppler velocity spectrum width

Echo transparency [%]:

Setup transmittance of the indication echo.

Antenna sweep line:

Turn ON or OFF a sweep line of screen.

Data Acquisition

Screen capture (JPEG):

Turn ON or OFF to capture data on the screen (jpeg).

- **Screen capture save path:**
Setup a folder to save a capture screen.
- **Screen capture period:**
Setup a time interval to save a capture screen.

CSV:

Turn ON or OFF to save data by CSV.

- **CSV save path:**
Setup a folder to save the CSV data.
- **CSV save period [sec]:**
Setup an interval time to save the CSV data.

Radar parameters as CSV files:

Choose a type of parameter.

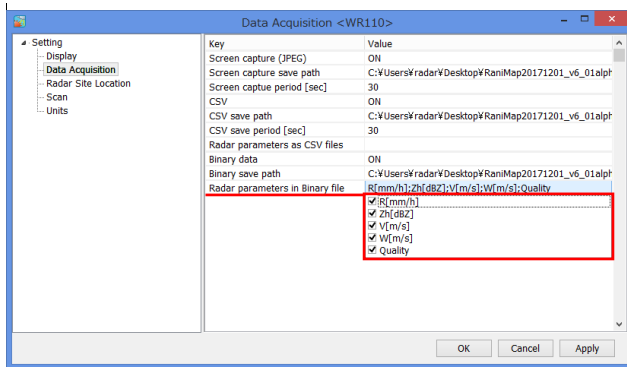
(Rain [mm/h], Zh [dBZ], V [m/s], W [m/s])

Binary data:

Turn ON or OFF to record by binary data.

Binary save path:

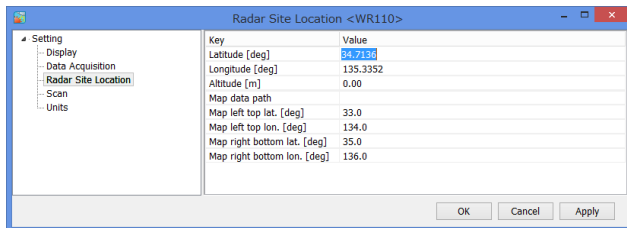
Setup a folder to save the binary data.



Radar parameters in Binary file:

Select a type of parameter.

(Rain [mm/h], Zh [dBz], V [m/s], W [m/s], Quality)



Radar Site Location

Latitude [deg]:

Setup the latitude of the installed point.

Longitude [deg]:

Setup the longitude of the installed point.

Altitude [m]:

Setup the altitude of the installed point.

Map data path:

Setup an indication map for RainMap.
This program treats as the equidistant cylindrical projection.

Map left top lat [deg]:

Setup the latitude of left top corner of Map Image.

Map left top lon [deg]:

Setup the longitude of left top corner of Map Image.

Map right bottom lat [deg]:

Setup the latitude of bottom right corner of "Map Image".

Map right bottom lon [deg]:

Setup the longitude of bottom right corner of "Map Image".

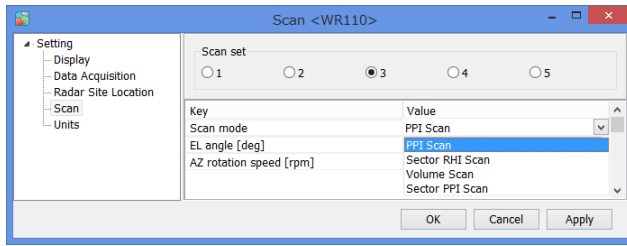


Table 1.

Scan mode	Extension
PPI scan mode	Scn
Sector RHI scan mode	Rhi
Volume Scan scan mode	Scn
Sector PPI scan mode	Spqi

- **Sector PPI scan:** (ref. Fig.3)
[Sector Plan Position Indicator scan]
It scans horizontally within a preset azimuth area while changing elevation based on up to 32 possible values generating a 3 dimensional rectangular solid angle.

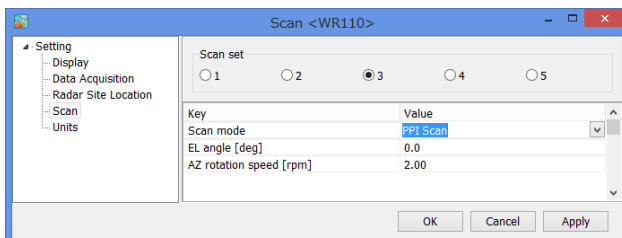
Scan set

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

Scan mode:

Select the scan mode of antenna.

- **PPI scan (2D data):**
[Plan Position Indicator scan]
It continues equiangular 360 degrees on horizontal rotation mode at a single selectable elevation.
- **Sector RHI scan (3D data):** (ref. Fig.1)
[Sector Range Height Indicator scan]
It scans vertically (RHI) and slightly to move horizontally continuous within a preset azimuth and elevation range generating a 3 dimensional rectangular solid angle. Horizontal data would not be saved. It continues move to the azimuth direction with clockwise and counter clockwise as 1 set.
- **Volume scan (3D data):** (ref. Fig.2)
This is the mode to activate PPI scan to change the elevation angle up to 32 steps. It starts with the basic time (It comes with Volume Scan Period and RainMap time indication).



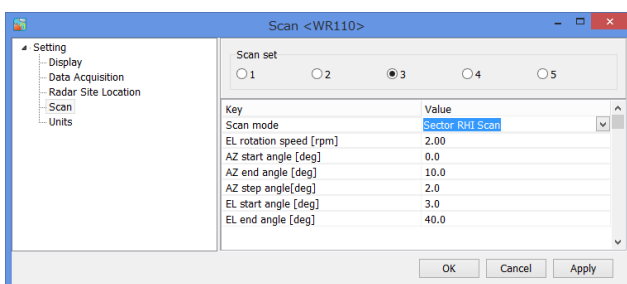
PPI scan:

EL angle [deg]:

Setup an angle of antenna's elevation during PPI mode.

AZ rotation speed [rpm]

Setup an azimuth rotation speed at fixed azimuth angel.



Sector RHI scan:

EL rotation speed [rpm]

Setup an elevation speed of SRHI.

AZ start angle [deg]

Setup an angle of start azimuth range.

AZ end angle [deg]

Setup an angle of end azimuth range.

AZ step angle [deg]

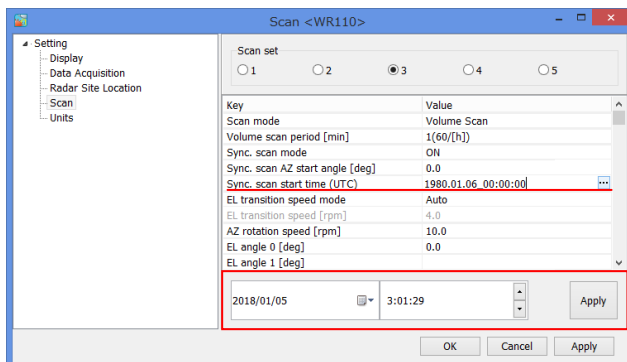
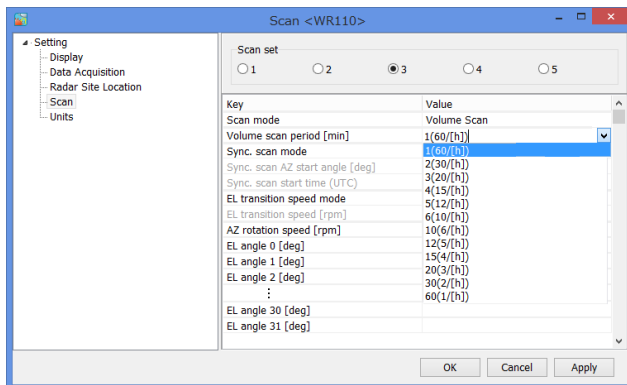
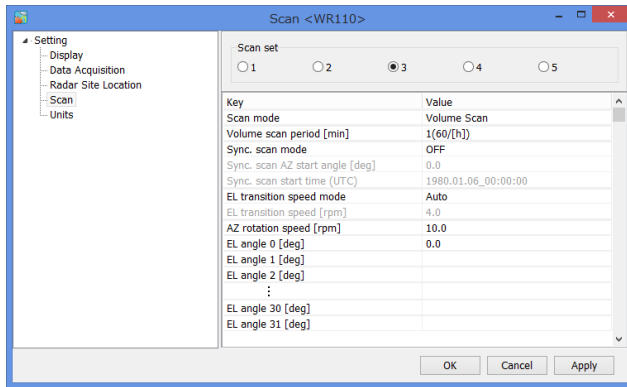
Setup a quantity of antenna rotation while changing an angle of azimuth.

EL start angle [deg]

Setup an angle of elevation start to observe volume.

EL end angle [deg]

Setup an angle of elevation end to observe volume.



Volume scan:

Volume scan period [min]:

Select a periodic volume scan movement from 1(60/h) / 2(30/h) / 3(20/h) / 4(15/h) / 5(12/h) / 6(10/h) / 10(6/h) / 12(5/h) / 15(4/h) / 20(3/h) / 30(2/h) / 60(1/h)

e.g. Volume scan will activate every 2 minutes if select 2/30(H). (It turns 30 times per hour) and measurement start time will be; 00, 02, 04, ..., 58 seconds on Data Processing Unit.

Sync. scan mode:

Turn ON or OFF to operate antenna synchronize scan when using 2 or more radars.

Notice: It can use only when the optional device has been installed.

- **Sync. scan AZ start angle:**
Setup the azimuth start angle of synchronize scan.
e.g.: Stagger azimuth angle to 90 degrees against the opponent radar when using 2 radars.
- **Sync. scan start date/time (UTC):**
Setup the time of starting synchronize scan.
Note: This is GPS time therefore it might be different as the time shows on RainMap screen.

EL transition speed mode:

Select speed mode of elevation "Auto" or "Manual".

- **Auto:** RainMap will adjust a speed of radar elevation automatically.
- **Manual:** Input speed value by hand.

EL transition speed [rpm] (Manual setting)

Setup a rotation speed of elevation direction during elevation change in volume scan (Horizontal Sequence) observation.

Rotation speed of elevation direction = [Volume Scan elevation moving direction of rotation speed] + [Volume Scan elevation movement difference of rotation speed]

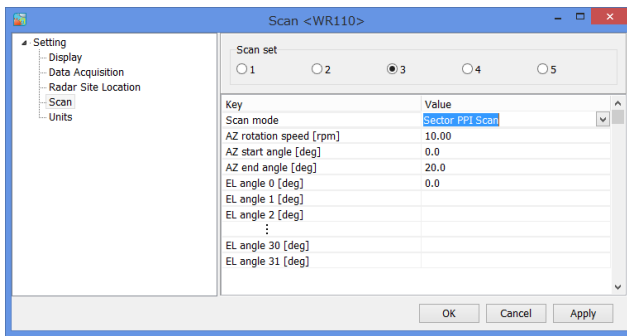
Notice: [Volume Scan elevation moving direction of rotation speed] $\geq$ [Volume Scan elevation movement difference of rotation speed].

AZ rotation speed [rpm]

Setup the volume azimuth rotation speed for each elevation.

EL angle 0 – 31 [deg]

Setup each elevation variation, up to 32 different values. It automatically sorts in ascending order of elevation setting value.



Sector PPI scan:

AZ rotation speed [rpm]

Setup an azimuth rotation speed at fixed azimuth angel.

AZ start angle [deg]

Setup the preset start azimuth range.

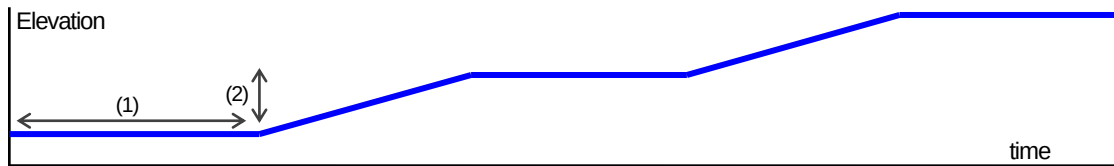
AZ end angle [deg]

Setup the preset end azimuth range.

EL angle 0 – 31 [deg]

Setup each elevation variation, up to 32 different values. It automatically sorts in ascending order of elevation setting value.

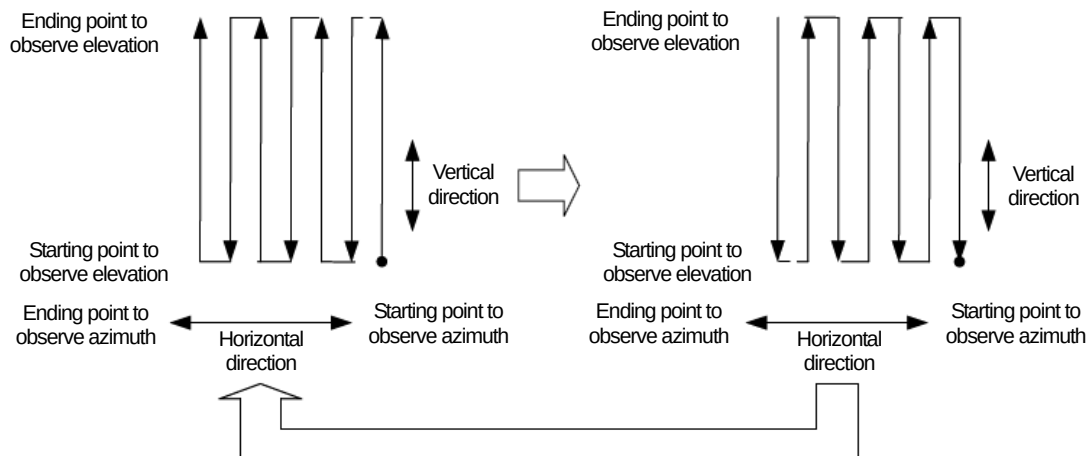
Table 2.



- (1) AZ rotation speed [rpm]
(2) EL transition speed [rpm]

Table 3. Rotation speed range

Menu	Range
EL rotation speed	0.5 to 6.0 rpm
EL transition speed	0.5 to 6.0 rpm
AZ rotation speed	0.5 to 16.0 rpm



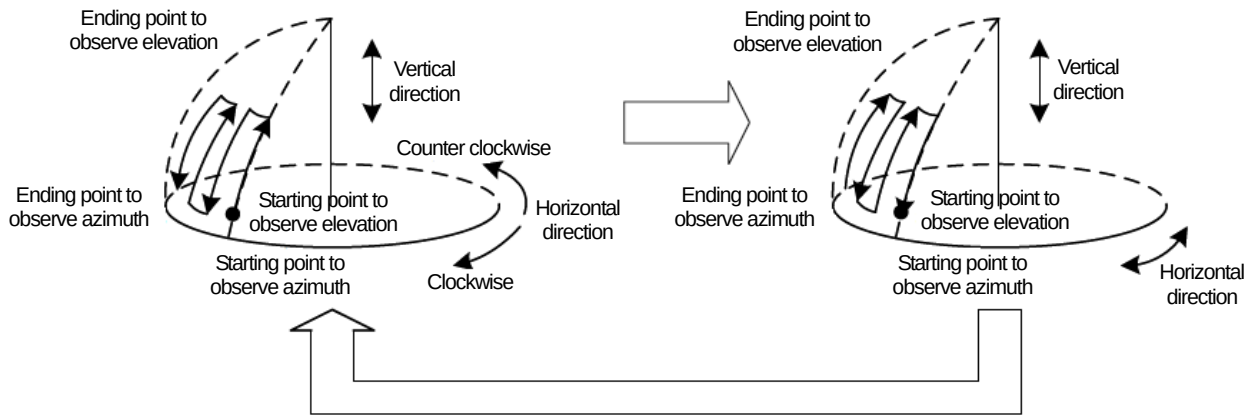


Figure 1. SRHI scan mode

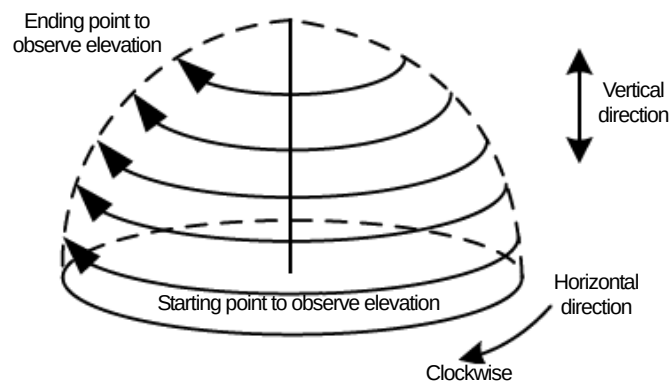


Figure 2. Volume scan mode

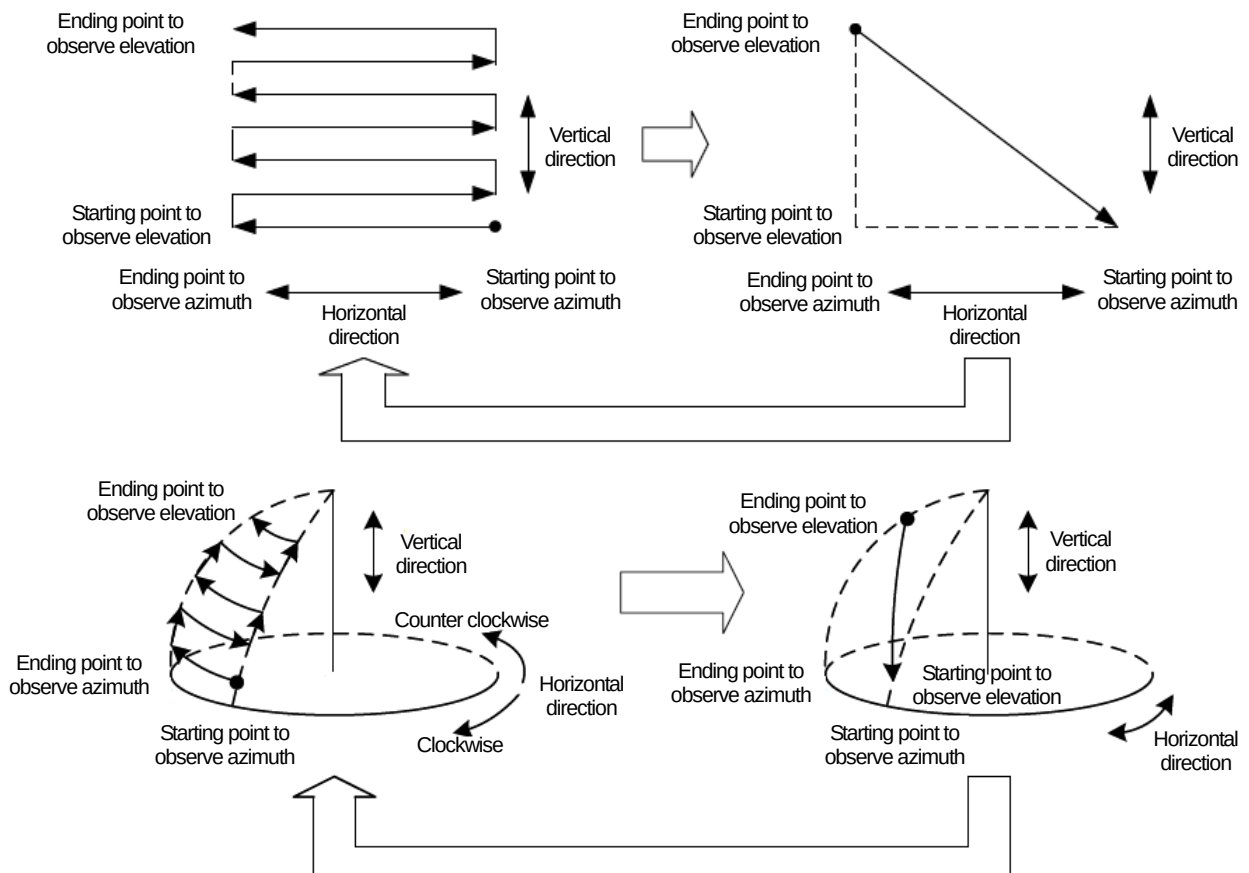
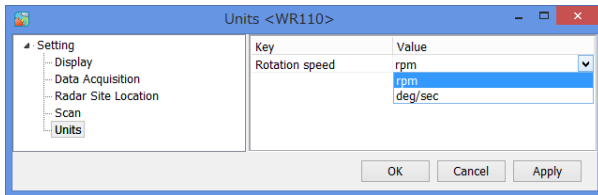
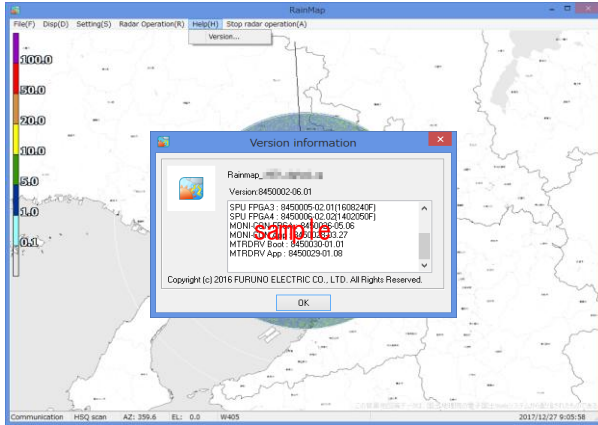


Figure 3. SPPI Scan mode

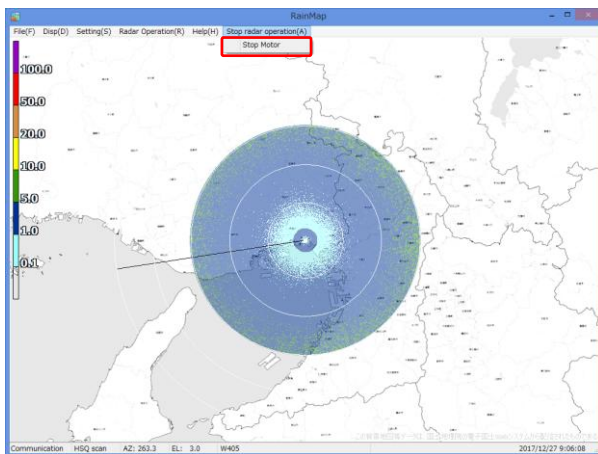
**Units:**Rotation speed

Select a type of indication on rotation speed.

**Help:**Version

Indicate version of software and connect- ing devices.

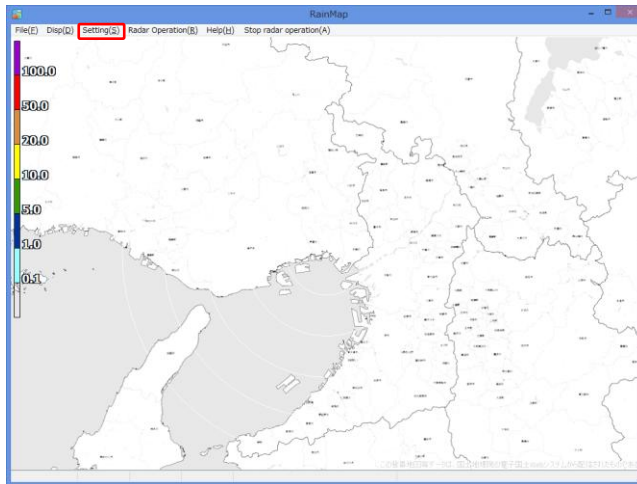
(RainMap, SPU FPGA1-4, MONI-CON FPGA, MONI-CON boot, MONI-CON App, MTRDRV Boot, MTRDRV App)

**Stop radar operation**Stop Motor

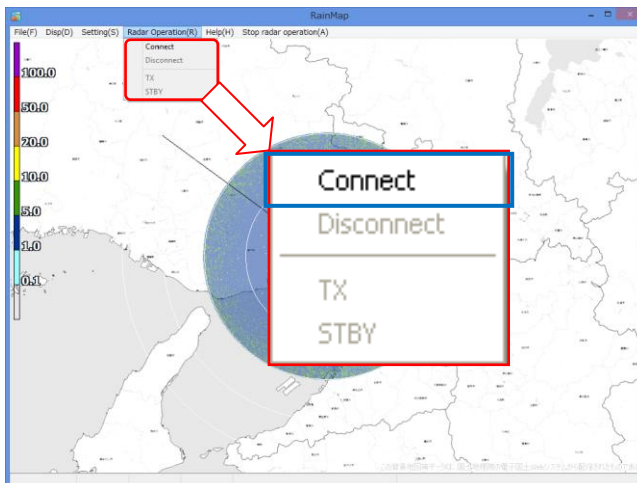
Stop motor of radar and TX at once.

4.2. Rainfall observation operation

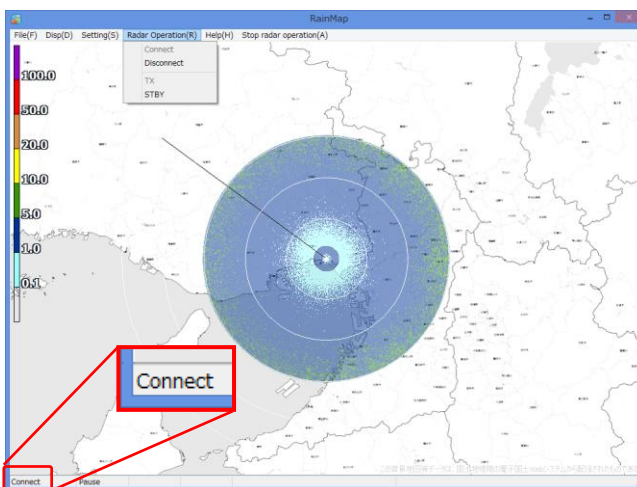
1) Start rainfall observation



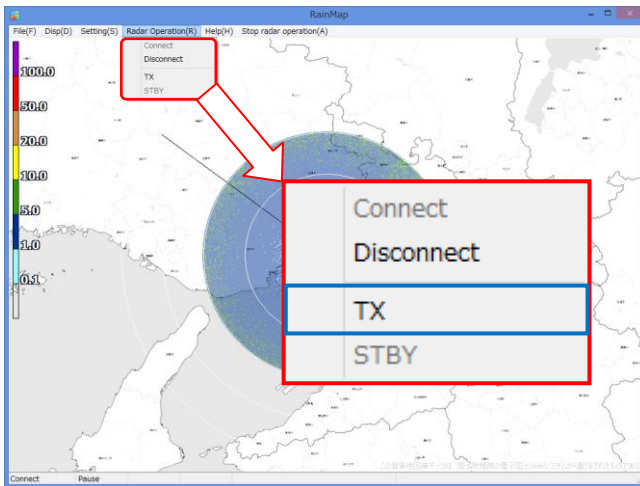
Conduct the setting of elevation angle of antenna, recording of data, and display data.



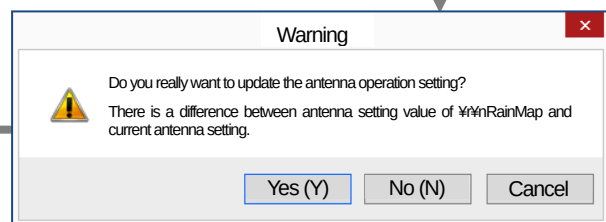
Click [Connect] from pull-down menu of [Radar Control].



It will indicate [Connect] on the bottom-left of screen when the Antenna Unit (ATU) and communication has been connected.



Click [TX] from pull-down menu of [Radar operation] .



If clicked [Yes], it will initialize the antenna and will indicate a message as below. Radar will start TX operation after initialization.

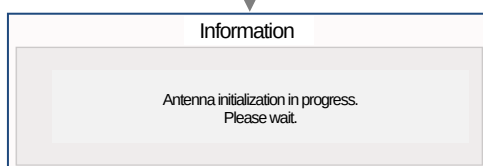
Yes

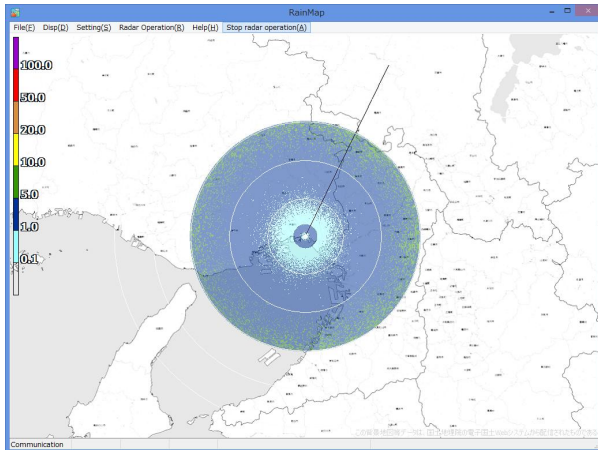
No

Cancel

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

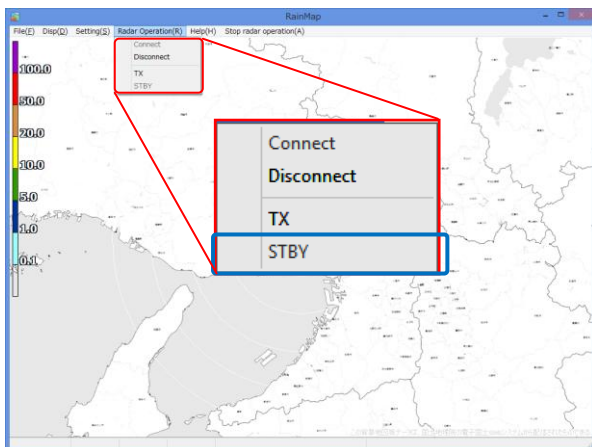
If clicked [No], it will start TX operation without making change.



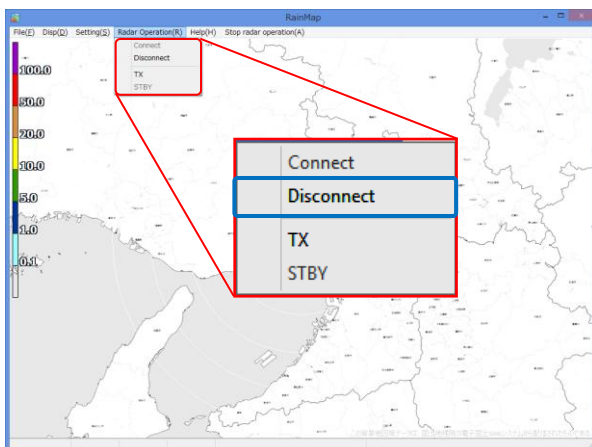


Start the operation of radar, and display the observed information on the screen.
The recorded data is saving on a data storage device.

2) Stop rainfall observation



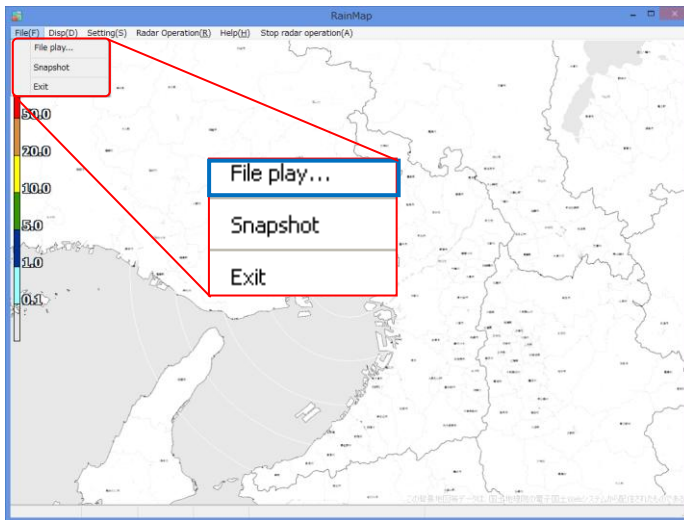
Click [STBY] to stop the radar operation.



Click [Disconnect] to close ATU.

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 Antenna Unit (ATU).

Go to [4.4. Name and Function of RainPlay]

2) Scale label

It indicates the signal level of image by color. The upper color means the strong signal and lower color means the weak signal that indicates with the value according with the data type of observation. The size of indication depends on the screen size that indicates on the left side of screen.

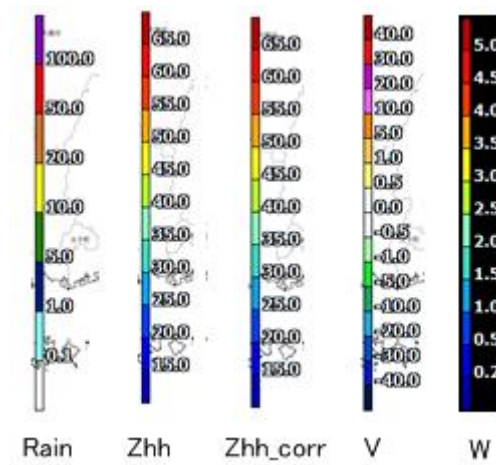
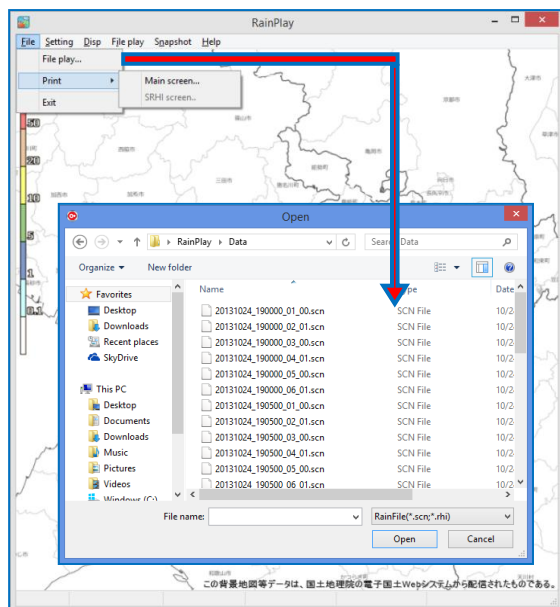
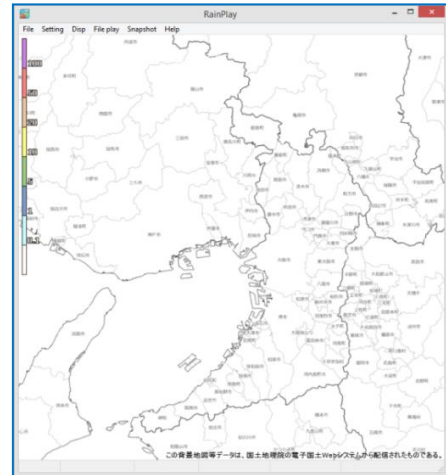
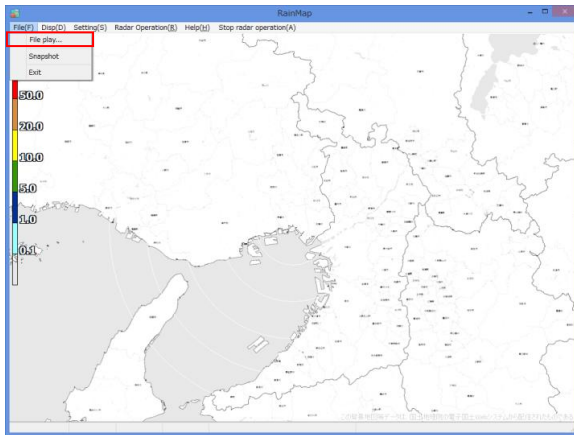


Figure 4. SRHI scale label indication

4.4. Name & Function of RainPlay

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

It could also possible to use RainPlay.exe from "RainMap_RainPlay" folder on desktop even during RainMap is activating.



File

File play:

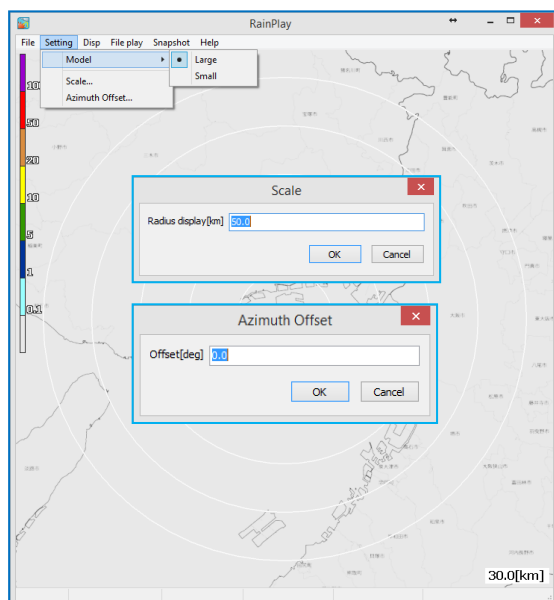
Select files of log data (*.scn; *rhi) to play (Slide show) on screen

Print:

- Main screen: Printout the main screen
- SRHI screen: Printout the SRHI screen

Exit:

Close the software



Setting

Model:

Select a type of radar model from below:

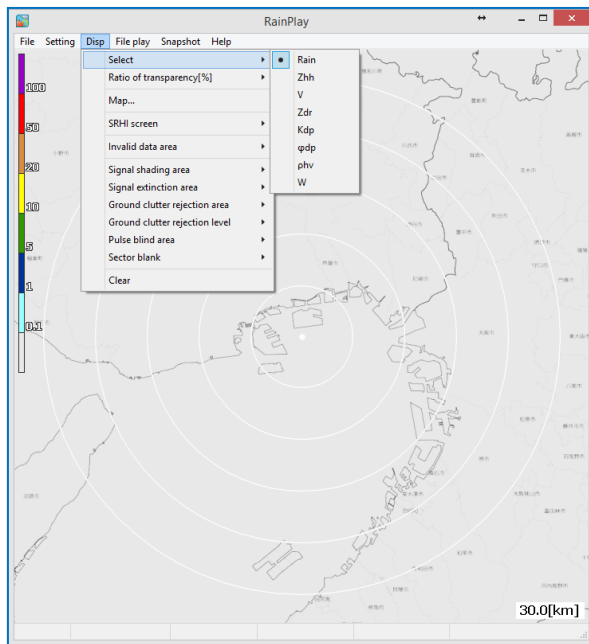
- Large: Dual Doppler (WR2120)
- Small: Single Doppler (WR110)

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]

**Ground clutter rejection area:**

Select the indication of ground clutter rejection area.

OFF: Hidden, 1: Grayed out, 2: Gray scale

Ground clutter rejection level:

Select the level of ground clutter rejection from 0 to 7

Pulse blind area:

Select the indication of pulse blind area.

OFF: Hidden, 1: Grayed out, 2: Gray scale

Sector blank:

Select the indication of sector blank.

OFF: Hidden, 1: Grayed out, 2: Gray scale

Clear:

Data of Rain file will be cleared from screen

Disp**Select:**

Select an indication of data type:

- **Rain:** Intensity of rainfall
- **Zhh:** Reflection factor of the horizontal polarimetric radar
- **V:** Doppler velocity
- **Zdr:** Radar reflection factor difference
- **Kdp:** Propagation phase difference rate of change
- **Φdp:** Differential Phase Shift
- **phv:** Polarimetric Correlation Coefficient
- **W:** Doppler velocity spectral width

Notice, the following data types are disused: Zdr, Kdp, Φdp, phv

Ratio of transparency [%]:

Setup a Transmittance of the indication echo.

Map:

Output a map from input file (*.bmp)

SRHI screen:

- 90 degrees screen (Indicate the echo of SRHI with 90 degrees)
- 180 degrees screen (Indicate the echo SRHI with 180 degrees)

Invalid data area:

Turn ON/OFF the indication of invalid data area.

Signal shading area:

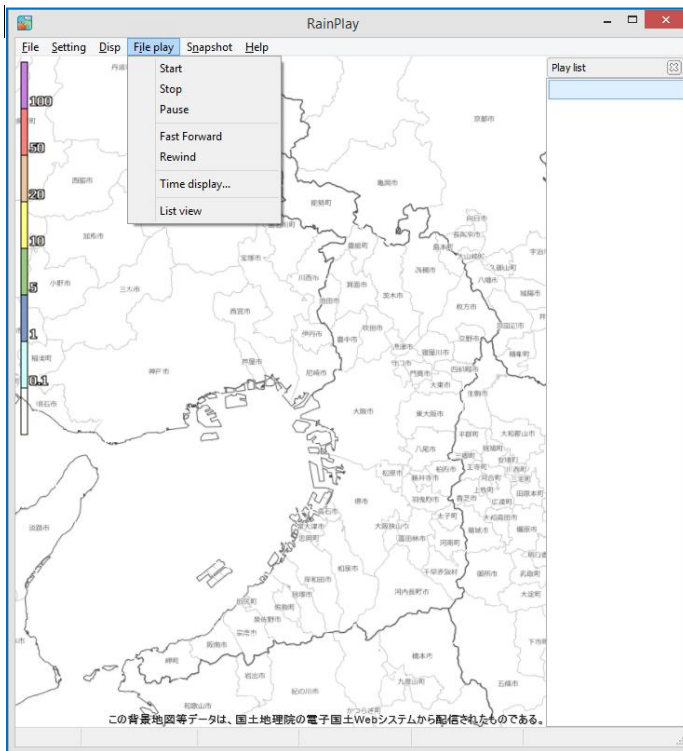
Select the indication of signal shading area

OFF: Hidden, 1: Grayed out, 2: Gray scale

Signal extinction area:

Select the indication of signal extinction area beyond strong rain area

OFF: Hidden, 1: Grayed out, 2: Gray scale



File play

Start:

To start playing a log data

Stop:

To stop playing

Pause:

To pause playing

Fast Forward:

To fast forward playing

Rewind:

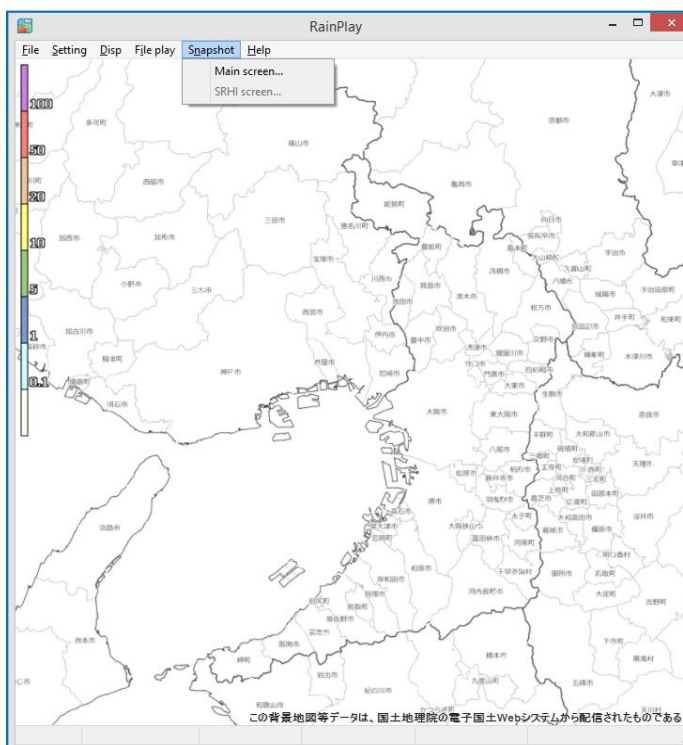
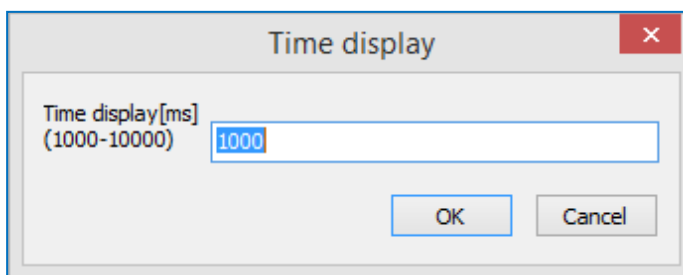
To rewind playing

Time display:

Pop up a setup windows to setup a time display [between 1000 - 10,000 ms]

List view:

To show a play list on the right screen



Snapshot

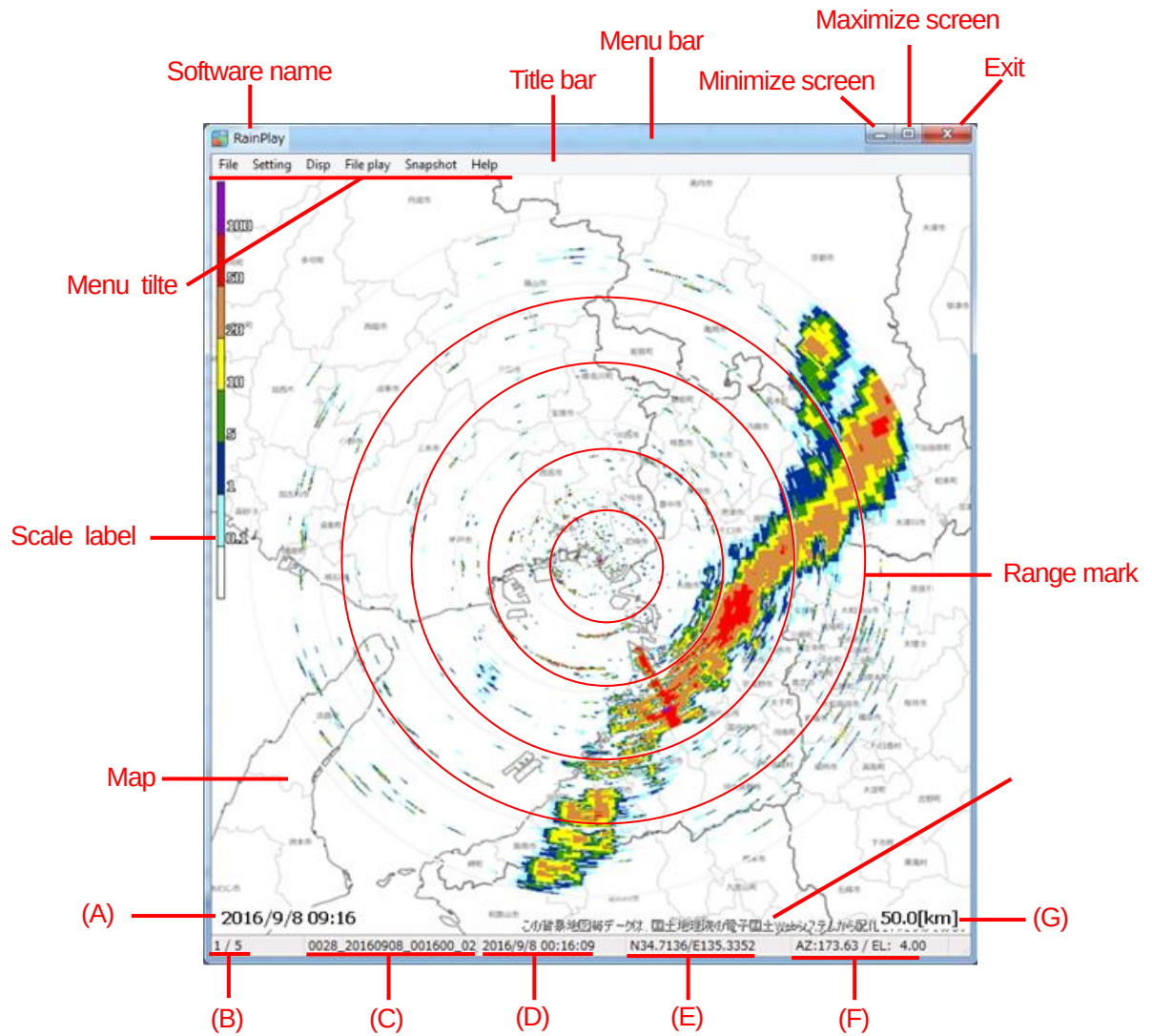
Main screen

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]

2) RainPlay screen



- (A) Acquired date/time (Local time)
- (B) Play file number / Read out number
- (C) Play file name
- (D) Acquired date/time (UTC)
- (E) Radar location
- (F) Start acquired Azimuth/Elevation
- (G) Maximum image distance

4.5. Log file function

1) Log record:

Log record folder will be created automatically in to RainMap folder and to save log data.

[log]

- RainMap.log (Log file)

- YYYYMMDDhhmmss.dat (The configuration file which compressed (ZIP) the transmission start date and time is up to 1,000 files)

2) Limit of Log file (RainMap.log):

When a file of transmission start date and time is over 1,000 files, it will overwrite from the oldest file.

3) Log file (RainMap.log) format:

It saves with Text format.

e.g.)

[2014/06/17 10:35:06] SendParam,20140617_103506.dat

[2014/06/18 20:08:45] TRxStart,20140618_200845.dat

Configuration file (YYYYMMDDhhmmss.ini)

This file is saved by section and key setting with RainMap software.

(This file is using for saving a current set value)

Detail of Log record contents: (It records a normal and error situation)

Message	Detail	Situation	Remarks
AppStart	—	Start of Application	
AppEnd	—	End of Application	
Connect	—	Start Connection	
Connected	Command	Connect Command Port	
	Data	Connect Data Port	
Disconnect	—	Shutdown Connection	
	Command	Shutdown Command Port	
	Data	Shutdown Data Port	
SendParam	(Saved configuration file)	Send Parameter	ZIP configuration file
TRxStart	(Saved configuration file)	Start TRX	ZIP configuration file
EmrStop	—	Emergency stop	
ErrStat	(PXI status))	Failure status	

RainMap_ErrorDisp.log: It saves the display detail of failure information that refers from GUI of RainMap.

RainMap_ErrHist.log: It saves all failure that occurred before.

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.

This manual is belonging to the following software version:

- RainMap v06.01
- RainPlay v1.10

6. Maintenance

6.1. 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 air conditioner stopped	Please contact us.
No radar echo indication.	Restart the radar system. (see 1.3)

6.2. 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.

7. Specifications

7.1. Antenna Unit

Parameter	Descriptions	Remarks
Operating Frequency	9.4 GHz band	Carrier Frequency
Maximum range	70km	Displayable observation level : 50km
Doppler measurement	Max. ± 64 m/sec	
Power supply	100 to 240VAC, Single Phase, 50/60 Hz	
Power consumption	Max. 250W	
Rated Ampere	1.5 to 3.5A	
Size	$\Phi 980$ mm $\times$ H1068mm	radome size
Weight	65kg (143.3b)	
Operating Temperature range	-10 to +50 °C	
Storage Temperature range	-40 to +70°C	
Water & Dust proof	IP55	
Maximum wind survival speed	60.0m/sec	
Occupied Band Width	60 MHz or less	
Type of Emission	P0N, Q0N, V0N	
Amplifier	Solid state module	
Peak Power	100 W	Horizontal
Duty Ratio	Up to 12 %	
Pulse Width	1 to 50 μ s	
Pulse Repetition Frequency	1600 – 2500 Hz	
Frequency Shift	2 – 20 MHz	except P0N
Antenna Type	Cassegrain	
Aperture Size	$\Phi 750$ mm	
Antenna Gain	33.0 dBi	
Antenna Polarity	Single polarimetric	Horizontal
Beam Width	2.7 degree	Horizontal
AZ Rotation Speed	0.5 to 16 rpm	Adjustable
Horizontal Scan Angle	360 degrees	Continuously-rotating
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.

7.2. Data Processing Unit

Receive data from Antenna Unit (ATU) to indicate a picture of rainfall in real time.

Hardware	
Parameter	Descriptions
Power supply	100 to 240VAC, 50/60Hz
Power consumption	Max. 150W
Rated Ampere	0.8 to 2.0A
CPU	Core-i7 (3GHz) or better
RAM	8GB or more
Data storage device	500GB or more
OS	Windows 10 IoT Enterprise 64bit
Internal LAN	2 port, 100base-T Cat5e or better (Connect to ATU)
LAN Adapter	1000base-T Cat5e adapter x3 (Access with outside PC)
I/O	USB2.0×2 port, and USB3.0×1 port minimum
Temp. range	0 to +50 °C
Display Software	
For weather observation system	
Name	RainMap, RainPlay
Data indication	Rainfall intensity R (mm/h), Reflectivity factor Zh (dBZ), Doppler velocity V (m/s), Doppler velocity spectrum width W (m/s),
Status display	Indicate ATU and DPU status
File output	Save and output one scan period of data
For remote maintenance	
Name	TeamViewer GmbH
Version	TeamViewer Host (For remote server) 12
Function	Remotely operate the software, view and download the observation data.
Requirement	It must be connecting to internet

Notice of the data communication:

Condition of the data communication (Transfer efficiency: 50%)

Baud rate	Cycle (Data transmission possibilities)
1Mbps/min or more	4 elevations/ 5min.
4Mbps/min or more	2 elevations/ 1min.
8Mbps/min or more	4 elevations / 1min.

7.3. Output Data Format

7.3.1. Data file type 1(csv)

1) Record 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) Record 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]

V: Doppler velocity [m/s]

W: Doppler velocity width [m/s]

3) Data format

CSV format:

Row	Data	e.g.
1	Record date (date of DPU)	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) Ex.) The case of output rain-fall intensity occurred on 2012/10/01 9:37:26 would become																
Direction of azimuth (θ) "Variable length" →																
<- Azimuth of every each sweep [degree] -> 3.65 4.04 4.48 4.92 5.41 5.84 6.28 6.72 7.21 <- 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"	0.04	0.44	0.92	1.32	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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	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	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
	0.1	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
	0.2	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	0.1
	0.2	0.3								0.2	0.5	0.5	0.1	0.2	0.0	0.1
	0.2	0.3								0.2	0.5	0.5	0.1	0.2	0.0	0.1
	0.3	0.3								0.3	0.6	0.6	0.2	0.2	0.0	0.1
	0.3	0.4								0.3	0.6	0.7	0.2	0.2	0.0	0.1
	0.3	0.4								0.3	0.7	0.7	0.2	0.3	0.0	0.1
	0.3	0.4								0.3	0.8	0.8	0.2	0.3	0.0	0.2
	0.4	0.5								0.4	0.8	0.9	0.2	0.3	0.1	0.2
	0.4	0.5								0.4	0.9	0.9	0.2	0.3	0.1	0.2
	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	0.2
	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	0.2
	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	0.2
	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	0.2
	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	0.3
	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	0.3
	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	0.3
	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	0.3
	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	0.3
	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	0.2
	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	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	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	0.2
	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	0.2
	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	0.2
	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	0.1
	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	0.1
	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	0.1
	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

Sample of Output Data:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	2014/10/9 13:26	1													
2	34.7266														
3	135.238														
4	445														
5	502														
6	100														
7	0.18	0.66	1.19	1.85	2.37	2.86	3.3	3.87	4.39	5.05	5.58	6.02	6.5	7.08	7.6
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9															
10															
11															
12															
13															
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0.1	0.2	0.2	0.2	0.1	0	0	0	0	0	0	0	1.7	2
16	0	0.1	0.2	0.2	0.2	0.1	0	0	0	0	0	0	0	1.5	1.9
17	0.2	0	0.7	0.9	0.9	0.6	1.4	1.6	1.7	1.7	0.4	0.2	1.6	3.9	4.5
18	0.2	0	0.4	0.5	0.6	0.4	1.4	1.5	1.6	1.6	0.3	0.1	1.4	2.3	2.5
19	0	0.1	0.1	0	0	0	0	0.8	1	1.1	1.1	0.6	0.1	2.1	2.8
20	0	0.3	0.4	0.2	0.2	0.1	0.1	2.4	3.1	3.3	3.3	1.4	2.7	5.9	6.6
21	0	0.3	0.2	0.2	0.2	0	0	0.9	1.1	1.2	1.2	0.4	1.9	4.8	5.4
22	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0	0	0.7	0.8
23	0.1	0.3	0.3	0.3	0.2	0	0	0	0.1	0	0	0	1.1	1.6	1.8
24	0	0.3	0.4	0.5	0.3	0.1	0	0.1	0.1	0.1	0.1	0	1.3	2.8	3.2
25	0	0.3	0.4	0.4	0.3	0.1	0	0.3	0.4	0.4	0.2	0	0.5	1.6	1.9
26	0	0	0	0	0	0	0	0.1	0.1	0.1	0	0	0.5	0.9	1.1
27	0	0	0	0	0	0	0	0.3	0.3	0.3	0.1	0	0.1	1	1.1
28	0	0.2	0.3	0.4	0.3	0.1	0	0.3	0.3	0.3	0.1	0	0.4	1.2	1.4
29	0	0.3	0.4	0.4	0.4	0.1	0	0.2	0.2	0.1	0	0	0.4	1.3	1.5
30	0	0	0	0	0	0	0	0.5	0.6	0.4	0.2	0	0.3	0.7	0.7
31	0	0	0	0	0	0	0.2	0.3	0.3	0.3	0.2	0	0.1	0.5	0.6
32	0	0.1	0.1	0.1	0	0	0.5	0.7	0.8	0.8	0.4	0.1	0.1	0.8	1
33	0	0.1	0.1	0.1	0	0	0.1	0.6	0.7	0.7	0.5	0.1	0.1	0.5	0.6
34	0	0.3	0.4	0.4	0.1	0	0.2	0.6	0.7	0.7	0.5	0.1	0.2	1.1	1.3
35	0	0.5	0.6	0.6	0.1	0	0	0.5	0.7	0.7	0.6	0.1	0	0.7	0.8
36	0	0.4	0.3	0.4	0.1	0	0	0.4	0.6	0.6	0.1	0	0.2	0.4	0.5
37	0	0	0	0	0	0	0	0.1	0.3	0.2	0	0	0.2	0.8	1
38	0	0	0	0	0	0	0	0.2	0.4	0.3	0.1	0	0.2	0.8	0.9
39	0	0.2	0.2	0.4	0.1	0	0	0	0.1	0.1	0	0	0	0.5	0.7
40	0	0.2	0.2	0.4	0.1	0	0	0.1	0.2	0.2	0.1	0	0.2	0.5	0.6

7.3.2. Data file type 2(scn, and others)

1) Record unit

Each scn file includes one scan data (e.g. one round in azimuth) which is stored in a capture folder specified in RainMap acquisition setting.

2) Record file name

Note 1: (*1) is applied only for scn version 3.

Note 2: scn version 3 is recorded under RainMap version 4.0 and later version. And the earlier RainMap version records scn format version 2.

File name: Product number (xxxx) (*1) _ Scenario start time (YrMoDa _ HrMinSec) _ Elevation angle number (##) [deg] _ Tx pulse type (**) .scn

File name extension: .scn, .rhi, .spci, .scnd

xxxx_YYYYMMDD_hhmmss_##_** .scn

e.g.: 0001_20130514_123400_01_00

Product number: alphanumeric

Scenario start time: UTC

Elevation angle number is numbered from the lowest angle as 01, 02, 03 . . .

Tx pulse type

00: pulse modulation, 01: frequency modulation (pulse compression), 02: 00 + 01 (alternative)

*File format of "rhi", "spci", and "scnd" are also same.

The case of SRHI, File name: Product number + Scenario start time (YrMoDaHrMinSec) + Serial order (rhi)

Product number + Scenario start (YrMoDaHrMinSec) + Serial order

e.g.: 0001_20170714_140100_001.rhi

SRHI azimuth start to end point or end to start point will be scenario start YrMoDaHrMinSec. Serial order will be changed by every azimuth (It will add serial order by moving upper and lower direction of elevation).

3) Data format

Note 1: (*1) is applied only for scn version 3.

Note 2: scn version 3 is recorded with RainMap version 4.0 and later version. And the earlier RainMap version records scn format version 2.

Binary format (Byte order: Little-endian)

Block	Item	Detail	Size [byte]	Offset	Data type
Header	Size of header	e.g. 62 [Byte] e.g. 80 [Byte] (*1)	2	2	unsigned short
	Production type information (*1) and Version of data format	e.g. 003 (*1) (Range:0-99)	2	4	unsigned short
	DPU Log time: year	e.g. 2013	2	6	unsigned short
	DPU Log time: month	e.g. 05	2	8	unsigned short
	DPU Log time: day	e.g. 15	2	10	unsigned short
	DPU Log time: hour	e.g. 18	2	12	unsigned short
	DPU Log time: minute	e.g. 30	2	14	unsigned short
	DPU 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. Lon: +, W. Lon:-)	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

Header	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 (10 times level of [rpm])	2	34	unsigned short
	PRF1	e.g. 1600.0 (10 times level of [Hz])	2	36	unsigned short
	PRF2	e.g. 2000.0 ([Hz] 10 times level)	2	38	unsigned short
	Noise level (Pulse Modulation) - Horizontal polarization	e.g. -62.00 (100 times level of [dBm])	2	40	signed short
	Noise level (Frequency Modulation) - Horizontal polarization	e.g. -62.00 (100 times level of [dBm])	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 (100 times level of [m])	2	48	unsigned short
	Constant radar: Mantissa (Horizontal polarization)	Range: -999999999 - 999999999	4	52	signed long
	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
	Azimuth Offset	e.g. 200.00 ([deg] x 100) Offset value of North and radar direction of origin	2	62	unsigned short
	Record UTC time: year (*1)	e.g. 2013	2	64	unsigned short
	Record UTC time: month (*1)	e.g. 05	2	66	unsigned short
	Record UTC time: day (*1)	e.g. 15	2	68	unsigned short
	Record UTC time: hour (*1)	e.g. 09	2	70	unsigned short
	Record UTC time: minute (*1)	e.g. 30	2	72	unsigned short
	Record UTC time: second (*1)	e.g. 00	2	74	unsigned short
Observation angularity information	Record item (*1)	e.g. 511 bit0: Rain, bit1: Zhh, bit2: V, bit3: Zdr, bit4: Kdp, bit5: phi-dp, bit6: rho-hv, bit7: W, bit8: quality information, bit9-15: reserved	2	76	unsigned short
	Tx pulse blind area (*1)	e.g. 7500 [m]	2	78	unsigned short
	Tx pulse specification (*1)	e.g. 8	2	80	unsigned short
Observation angularity information	Information ID	e.g. 6 [byte]	2	82	unsigned short
	Azimuth *Angle from initial position of ATU	Range: 0 - 359.99 100 times level of [deg] Initial position: 0 deg	2	84	unsigned short

Observation angularity information	Elevation	Range: -3.00 - 180.00 100 times level of [deg] Horizontal: 0deg, Elevation: +, Dip: -	2	86	signed short
Observed data	Observed data size	e.g. 5402 [byte]	2	88	unsigned short
	Rain (Rainfall intensity)	Range: 0 - 65535 Calculation formula N is a recording level. $\text{Rain}[\text{mm/h}] = (\text{N} - 32768) / 100$ 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. $\text{Zhh}[\text{dBZ}] = (\text{N} - 32768) / 100$ Zhh Range: -327.67 - 327.67dBz Resolution: 0.01dBz N=0 is invalid	2 x Range direction data mark	-	unsigned short
	V (Doppler velocity)	Range: 0 - 65535 Calculation formula N is a recording level. $\text{V}[\text{m/s}] = (\text{N} - 32768) / 100$ V Range: -327.67 - 327.67m/s Resolution: 0.01m/s N=0 is invalid	2 x Range direction data mark	-	unsigned short
	W (Doppler velocity spectrum width)	Range: 0 - 65535 Calculation formula N is a recording level. $\text{W}[\text{m/s}] = (\text{N} - 1) / 100$ W Range: 0.00 - 655.34m/s Resolution: 0.01m/s N=0 is invalid	2 x Range direction data mark		unsigned short
	Quality information (*1)	e.g. 2 bit0: signal shading, bit1: signal extinction, bit2: clutter reference, bit3-15: reserved	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			

7.3.3. Data size

1) Standard setting of every scan quantity (one round to azimuth direction)

Header		Observation angularity information		Observation data				Range direction data		Total sweep		Quantity of every scan
80	+	((6	+	2)	+	(18	x	e.g. 1000))	x	e.g. 720	=	12,960,088 byte

2) Quantity in every hour

$$12,960,088 \text{ byte} \times 3600 \text{ sec.} / 6 \text{ sec.} = \text{approx. } 7.8\text{GB (7,776,052,800)}$$

3) Quantity in 30 days

$$7,776,052,800 \text{ byte} \times 30 \text{ days} \times 24 \text{ hrs.} = \text{approx. } 5.6\text{TB}$$

Notice:

Basically data capacity can compress around 50 to 70%. However the compression ratio will be changed by weather condition (Fine weather data will get smaller after compressed).

If the user would like to reduce the data size on actual condition, it has to decimate the data and reduce the generated file size. It can decimate the data from the RainMap setting where to reduce the range of data point and the time of sweeps per rotation.

csv file will generate each checked item of each scan for output csv.

All factors regardless of the checking will save each scan under the circumstances of csv output.

Sample 1: Maximum setting

Azimuth scan speed: 16 rpm

Vertical scan speed: 36 deg./sec.

Elevation angles: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 25, 30, 40 and 50 degrees (14 angles)

Volume scan interval: 1 min.

$$\text{Required speed} = 14 \times 15.55784 \times 8 / 60 = 29.04 \text{ [Mbps]}$$

Sample 2: Reduced setting

Azimuth scan speed: 3 rpm

Vertical scan speed: 6 deg./sec.

Elevation angles: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 25, 30 and 40 degrees (13 angles)

Volume scan interval: 5 min.

$$\text{Required speed} = 13 \times 15.55784 \times 8 / (5 \times 60) = 5.39 \text{ [Mbps]}$$

Additional explanation:

The weather radar has narrow beam called “pencil beam”. Both horizontal and vertical planes on beam width of pencil beam are the same.

In order to take accurate data, it is necessary to scan hemi-sphere over the radar for changing its elevation angle as shown in the Figure 1.

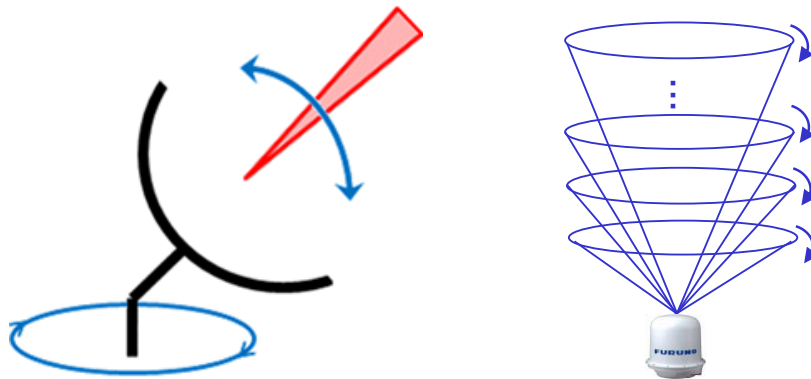


Figure 1. Basic volume scan

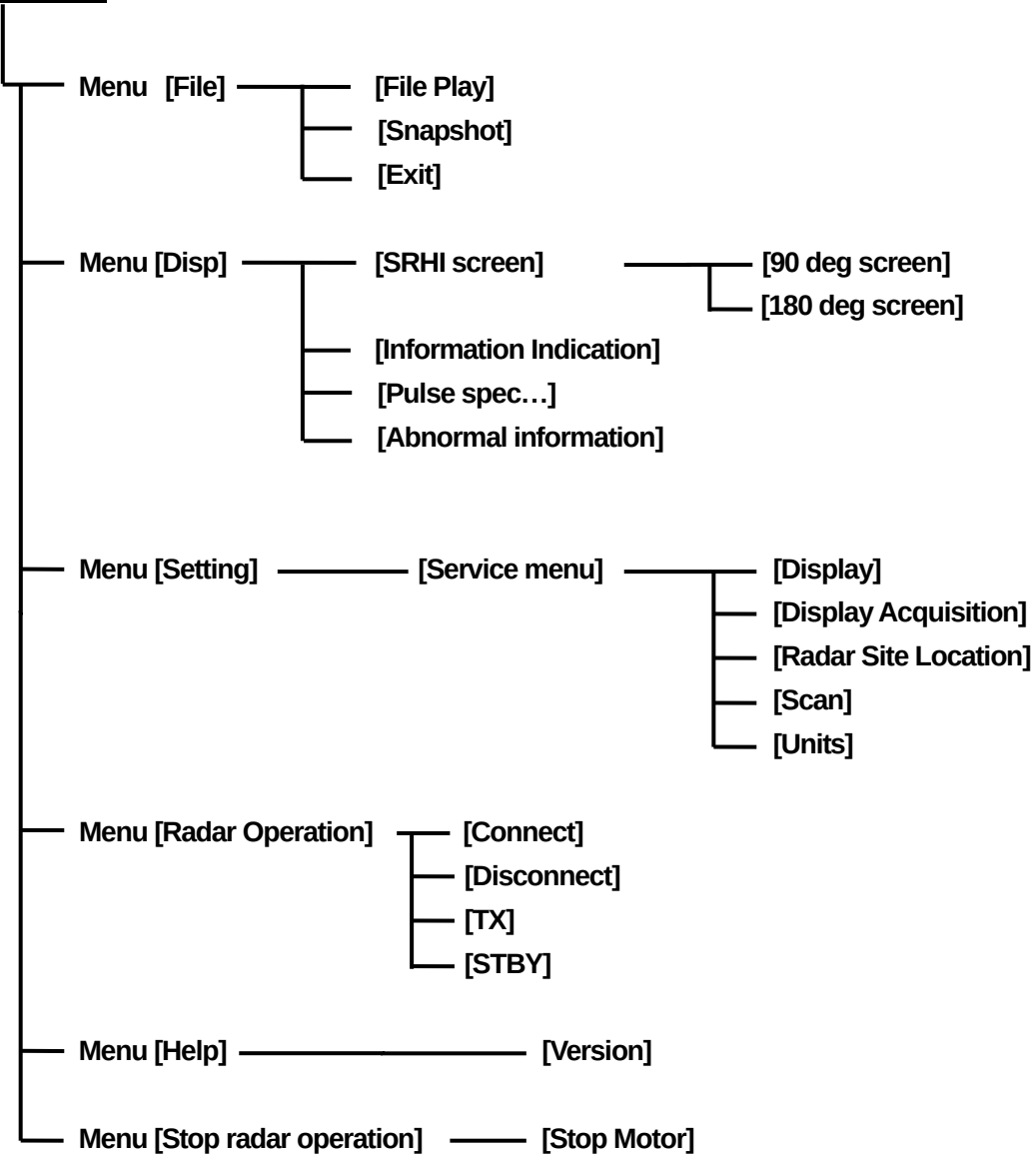
The radar, WR110 will output the data files for each elevation angle. When use eight elevation angles, eight data files will be generated that will go up to 15.55784 MB, however it depends on settings.

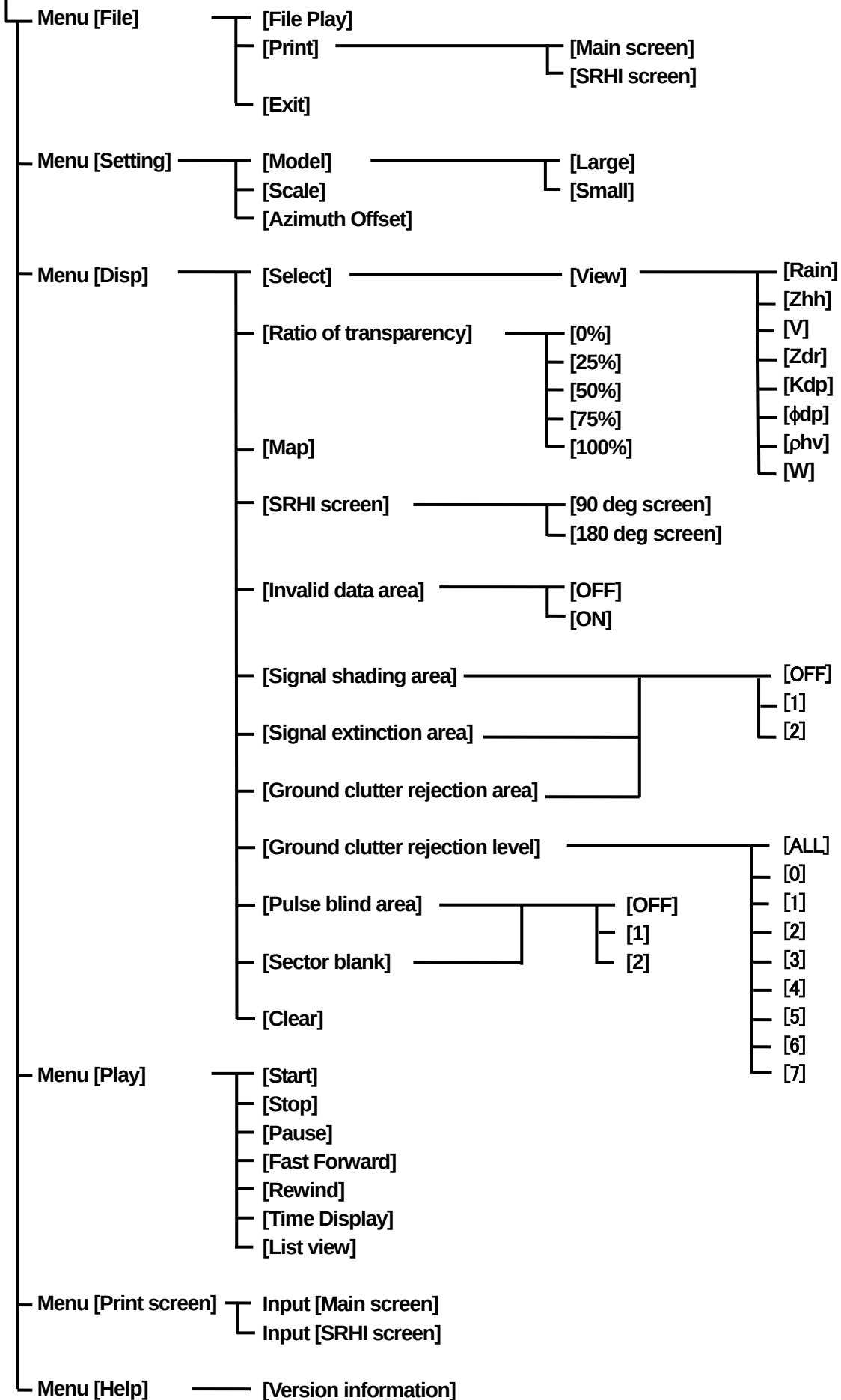
Requirement of the data transfer speed will be decided by time span that will need to make one set of volume scan data. Therefore this time span will depend on the scanning speed of antenna.

Hereinafter, this document will be presented from some examples of the scanning strategy and generating data size by calculation. The minimum transfer speed requirement will be calculated using these total file size and the time span per one volume scan.

8. Menu Tree

RainMap



RainPlay

9. Other

9.1. Trademarks

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

9.2. 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.

10. Peripheral equipment

10.1. Optional equipment

It is good to prepare wired router, SW HUB, Uninterruptive Power Supply (above 1KVA), and Remote Power Controller as a peripheral equipment (indoor facilities) for remote control.

1. Wired router

Function	Connect with an external network
WAN port	10/100/1000BASE-T, 1 port, MDI/MDI-X auto switch
LAN port	10/100/1000BASE-T, 4 port or more, MDI/MDI-X auto switch
Input voltage	AC100V-240V, Single phase, 50/60 Hz
Remarks	YAMAHA RTX810 or equivalent

2. SW HUB

Function	Connect with LAN
LAN port	10/100/1000BASE-T, 5 port or more, MDI/MDI-X auto switch
Input voltage	AC100-240V, Single phase, 50/60 Hz
Remarks	ELECOM EHC-G05MN-HJ or equivalent

3. Uninterruptive Power Supply

Function	Automatically shut down after 10 minutes operation during a power failure
Output voltage	More than 1,000VA
Input voltage	AC100-240V, Single phase, 50/60 Hz
Remarks	APC Smart-UPS series w/ network or equivalent

4. External data storage device

Function	Save scan data
Capacity	3TB or more
Interface	USB3.0 (Note: Plug in USB3.0 cable in to the USB3.0 port of DPU)
Input voltage	AC100-240V, Single phase, 50/60 Hz
Remarks	WD 3TB or equivalent

5. Remote Power Controller

Function	Reboot the power of equipments by remote
Capacity	1-4 individual outlet power control (ON/OFF/Reboot/Schedule)
Interface	10BASE-T/100BASE-TX RJ-45X1, RS232
Input voltage	AC100-240V, Single phase, 50/60 Hz
Remarks	AVIOSYS IP POWER series or equivalent

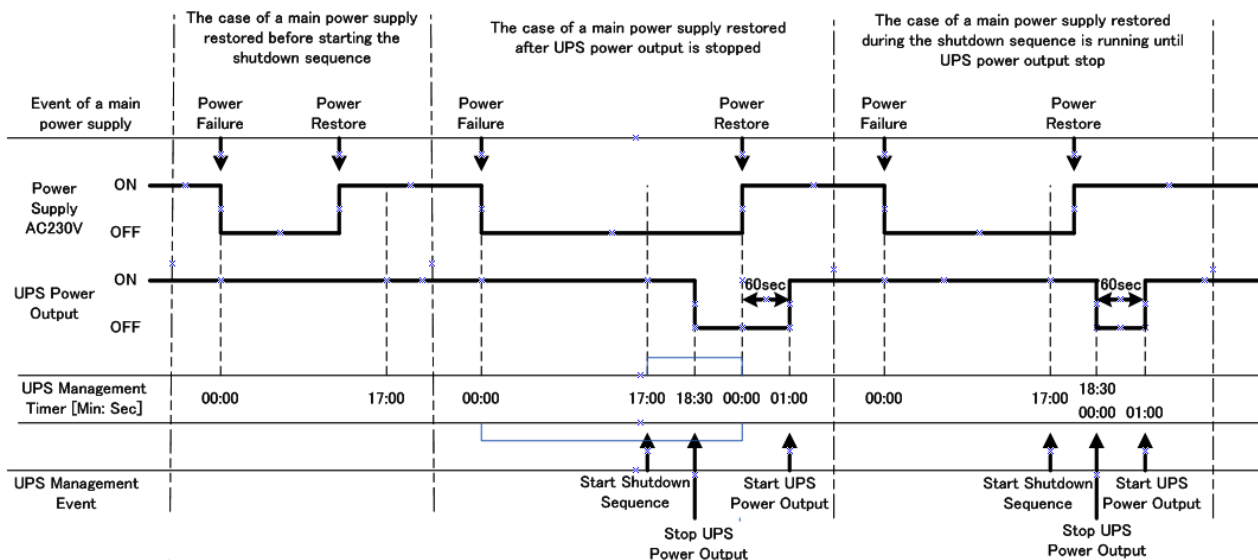
Note: Get and read instruction of equipment from manufacturer

10.2. UPS setting

This procedure is only for Smart-UPS 1500RM model, it picked up only for some main points to setup on software of "Power Chute".

General	Power Parameters	High Transfer [V]	265	
		Low Transfer [V]	196	
		Sensitivity	High	
		Nominal Output [V]	220	
		Audible Warning	On Battery	
Server Shutdown	Shutdown Sequence	Command File	Not Enabled	
		Operating System	Delay [mins]	00:00
			Duration [mins]	01:30
	Power Failure	When power fails, begin a shutdown procedure	At runtime limit	
		When power returns, reboot UPS	After the following occurs	Battery charges to 0% And the elapsed time is: 60sec
		Shutdown Type	Shutdown	

Note: For the rest of the above setting would be default setting.



※ UPS runtime limit (e.g. 17minutes)

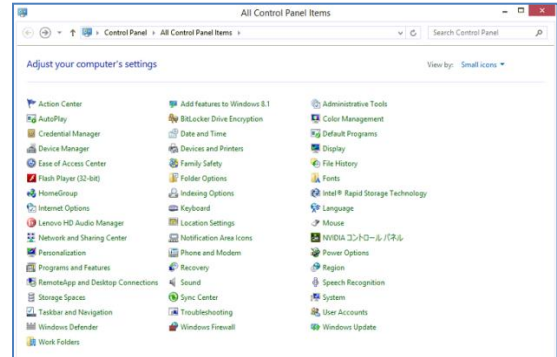
10.3. Windows Language setting

DPU can change an indication to Japanese or English language.

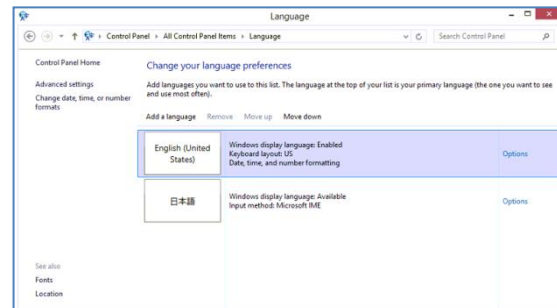
RainMap and Power Chute (UPS software) are also automatically switching a language.

Instruction of changing a language of DPU:

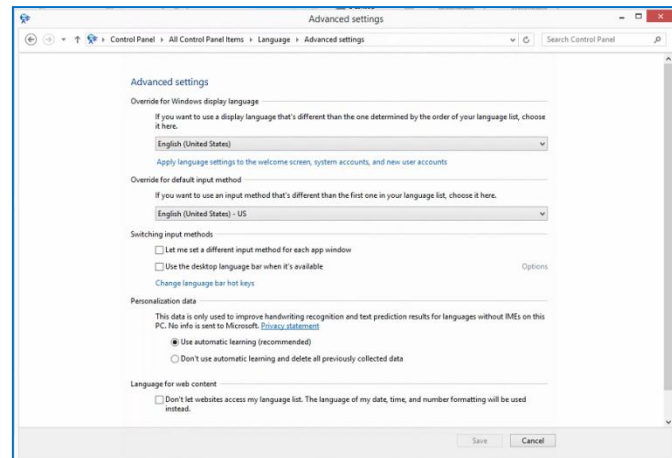
1. Click [Control Panel] from [Startup] button (Left bottom of Windows screen).
2. Click [Language].



3. Choose a language and double click. Add a language if your language is not in the list.

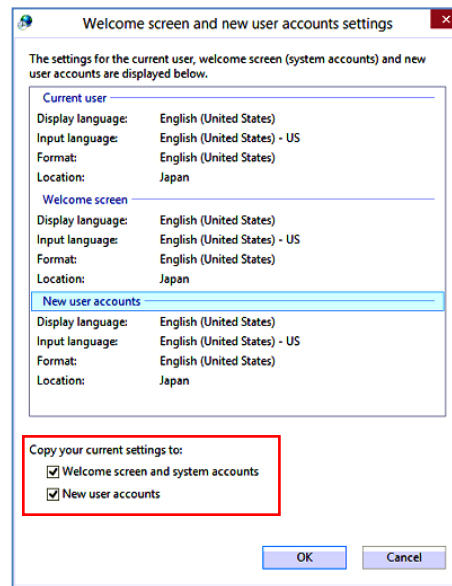
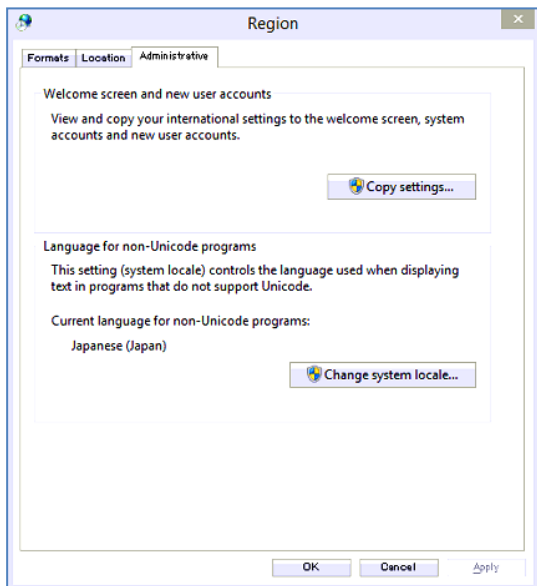


4. Open [Advanced settings] to select language at [Override for windows display language] and [Override for default input method].

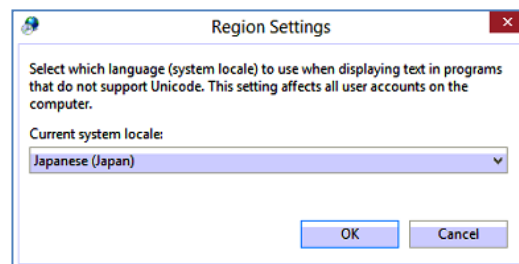
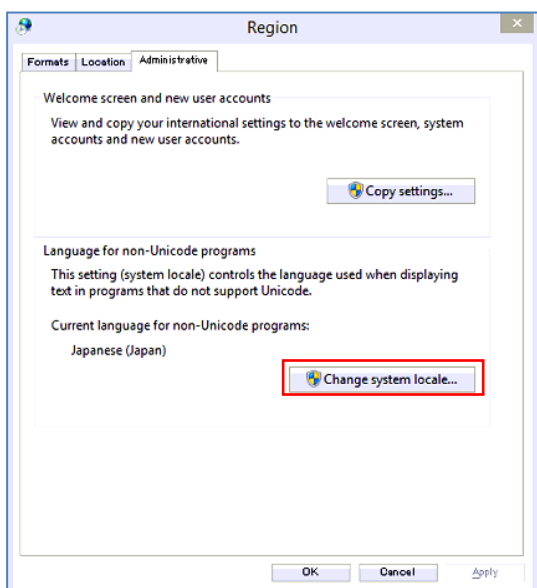


5. Setup [Region]

- Click [Administrative] tab.
- Click [Copy settings...] button in [Administrative] tab to popup [Welcome screen and new user accounts settings].
- Put a check on “Welcome screen and system accounts”, and “New user accounts” at “Copy your current settings to:”.
- Click [OK] to exit [Welcome screen and new user accounts settings].



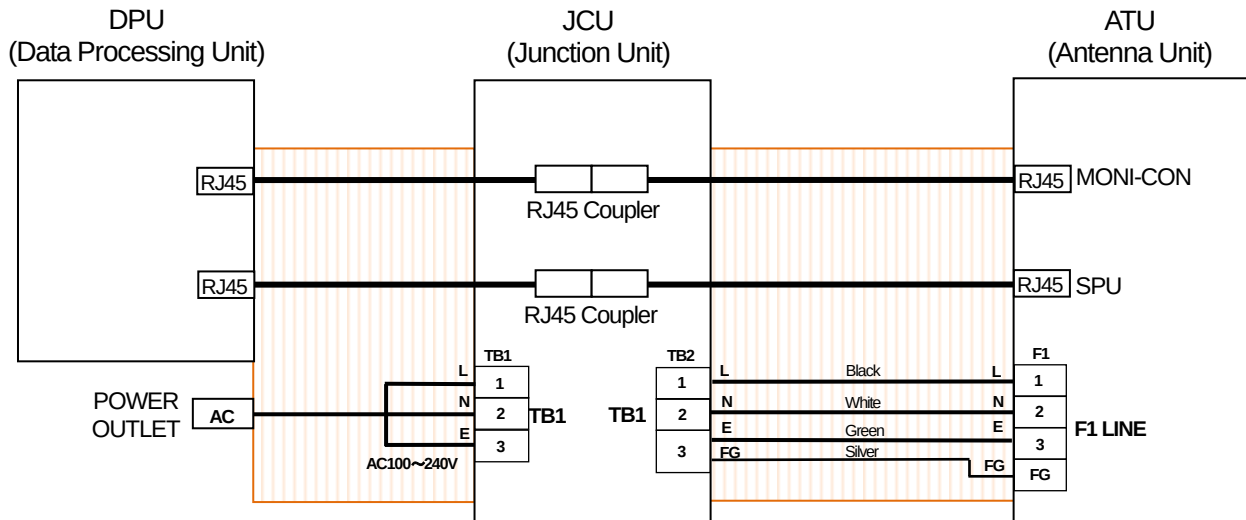
- Click [Change system locale...] button in [Administrative] tab to popup [Region Settings].
- Choose a language of “Current system locale”.
- Click [OK] to exit [Region Settings].



- Click [OK] to exit [Region].
- Reboot DPU to reflect your language settings.

APPENDIX

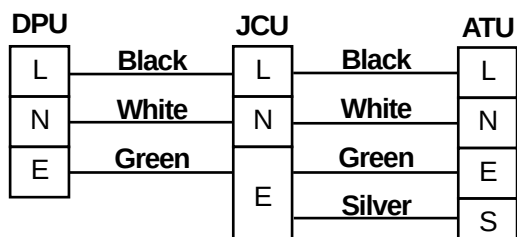
1. SYSTEM DIAGRAM



Notice: All cables and protective tube between DPU side and JCU should be prepared at local.

 : Protective tube

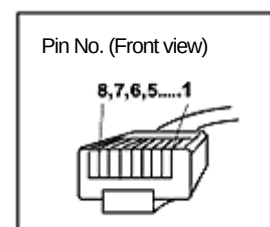
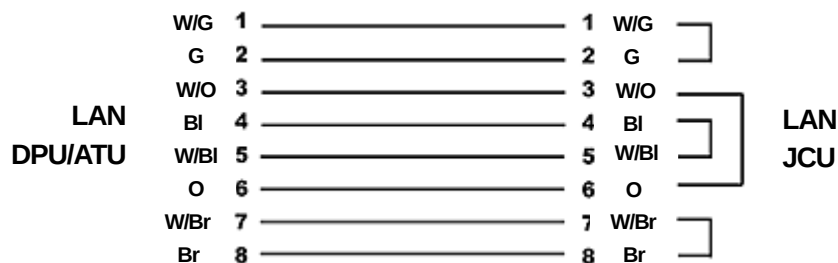
AC100~240V



Notice: Cable colors vary by country.

Cable shield use for GND cable

RJ45



2. RADIO REGULATORY INFORMATION

USA-Federal Communications Commission (FCC)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Caution: Exposure to Radio Frequency Radiation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65.

This equipment should be installed and operated keeping the radiator at least 12.7m or more away from person's body.

This device must not be co-located or operating in conjunction with any other antenna or transmitter.

3. DECLARATION OF CONFORMITY

Bulgarian (BG)	С настоящото Furuno Electric Co., Ltd. декларира, че гореспоменат тип радиосъоръжение е в съответствие с Директива 2014/53/ЕС. Цялостният текст на ЕС декларацията за съответствие може да се намери на следния интернет адрес:
Spanish (ES)	Por la presente, Furuno Electric Co., Ltd. declara que el tipo de equipo radioeléctrico arriba mencionado es conforme con la Directiva 2014/53/UE. El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente:
Czech (CS)	Tímto Furuno Electric Co., Ltd. prohlašuje, že výše zmíněné typ rádiového zařízení je v souladu se směrnicí 2014/53/EU. Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese:
Danish (DA)	Hermed erklærer Furuno Electric Co., Ltd., at ovennævnte radioudstyr er i overensstemmelse med direktiv 2014/53/EU. EU-overensstemmelseserklæringens fulde tekst kan findes på følgende internetadresse:
German (DE)	Hiermit erklärt die Furuno Electric Co., Ltd., dass der oben genannte Funkanlagentyp der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar:
Estonian (ET)	Käesolevaga deklareerib Furuno Electric Co., Ltd., et ülalmainitud raadioseadme tüüp vastab direktiivi 2014/53/EL nõuetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil:
Greek (EL)	Με την παρούσα η Furuno Electric Co., Ltd., δηλώνει ότι ο προαναφερθέντας ραδιοεξοπλισμός πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο:
English (EN)	Hereby, Furuno Electric Co., Ltd. declares that the above-mentioned radio equipment type is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address:
French (FR)	Le soussigné, Furuno Electric Co., Ltd., déclare que l'équipement radioélectrique du type mentionné ci-dessus est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante:
Croatian (HR)	Furuno Electric Co., Ltd. ovime izjavljuje da je gore rečeno radijska oprema tipa u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi:
Italian (IT)	Il fabbricante, Furuno Electric Co., Ltd., dichiara che il tipo di apparecchiatura radio menzionato sopra è conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE è disponibile al seguente indirizzo Internet:
Latvian (LV)	Ar šo Furuno Electric Co., Ltd. deklarē, ka augstāk minēts radioiekārta atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē:

Lithuanian (LT)	Aš, Furuno Electric Co., Ltd., patvirtinu, kad pirmiau minėta radijo įrenginių tipas atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu:
Hungarian (HU)	Furuno Electric Co., Ltd. igazolja, hogy fent említett típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen:
Maltese (MT)	B'dan, Furuno Electric Co., Ltd., niddikjara li msemmija hawn fuq-tip ta' tagħmir tar-radju huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan l-indirizz tal-Internet li ġej:
Dutch (NL)	Hierbij verklaar ik, Furuno Electric Co., Ltd., dat het hierboven genoemde type radioapparatuur conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres:
Polish (PL)	Furuno Electric Co., Ltd. niniejszym oświadcza, że wyżej wymieniony typ urządzenia radiowego jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym:
Portuguese (PT)	O(a) abaixo assinado(a) Furuno Electric Co., Ltd. declara que o mencionado acima tipo de equipamento de rádio está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet:
Romanian (RO)	Prin prezenta, Furuno Electric Co., Ltd. declară că menționat mai sus tipul de echipamente radio este în conformitate cu Directiva 2014/53/UE. Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet:
Slovak (SK)	Furuno Electric Co., Ltd. týmto vyhlasuje, že vyššie spomínané rádiové zariadenie typu je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese:
Slovenian (SL)	Furuno Electric Co., Ltd. potrjuje, da je zgoraj omenjeno tip radijske opreme skladen z Direktivo 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu:
Finnish (FI)	Furuno Electric Co., Ltd. vakuuttaa, että yllä mainittu radiolaitetyyppi on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa:
Swedish (SV)	Härmed försäkrar Furuno Electric Co., Ltd. att ovan nämnda typ av radioutrustning överensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress:

Online Resource

http://www.furuno.com/en/support/red_doc

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