AROTA-VQ100™
USER'S MANUAL

ARTECH

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IMPORTANT NOTE:

FCC RF Radiation Exposure Statement:

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

AROTA-VQ100™

AROTA-VQ100(ARTECH Over The Air - Verizon Wireless Quad-band 100k square feet System)

1 Introduction

1.1 Overview

AROTA-VQ100K is a quad-band OTA repeater for Verizon Wireless to offer in-building coverage up to 100K sq. ft. The system provides the digital filter technology enabling the customer to have a flexible sub-band frequency selection.

The repeater system is designed for modular architecture with rack mountable structure so that the customer can equip the particular radio module(s) based upon the market demand.

The system supports the following frequency bands and OTA technologies:

- 700Mhz for LTE,
- 850MHz for CDMA CELLULAR,
- 1900Mhz for CDMA PCS .

Each band can be supported by simply plugging in individual modules

1.2 Product Summary

Item	Specification	Remarks
Type	Shelf (Standard 19” Rack Mountable)	
Size(mm, W x H x D)	482.8(19″) X 355(8U) X560	
Weight	61kg(Full equipped except for AWS)	
Input Power	AC120V/A	
Power consumption	700W(Full mounted)	
Power Connector	Terminal Block 3P	
RF IN/OUT Port Location	SMA, N-Type/FEU(Front End Unit)	
Circumstance	-5℃ ~ 50℃ (Operating Temperature)	

Table 1 System Summary

1.3 Network Configuration

The in-building repeater system provides coverage to shadow areas in the building. The network configuration is illustrated in Figure 1. In general, the configuration consists of Donor antenna~ Shelf ~ Directional coupler ~ 2 or 3 way splitter ~ Indoor omni-antenna.

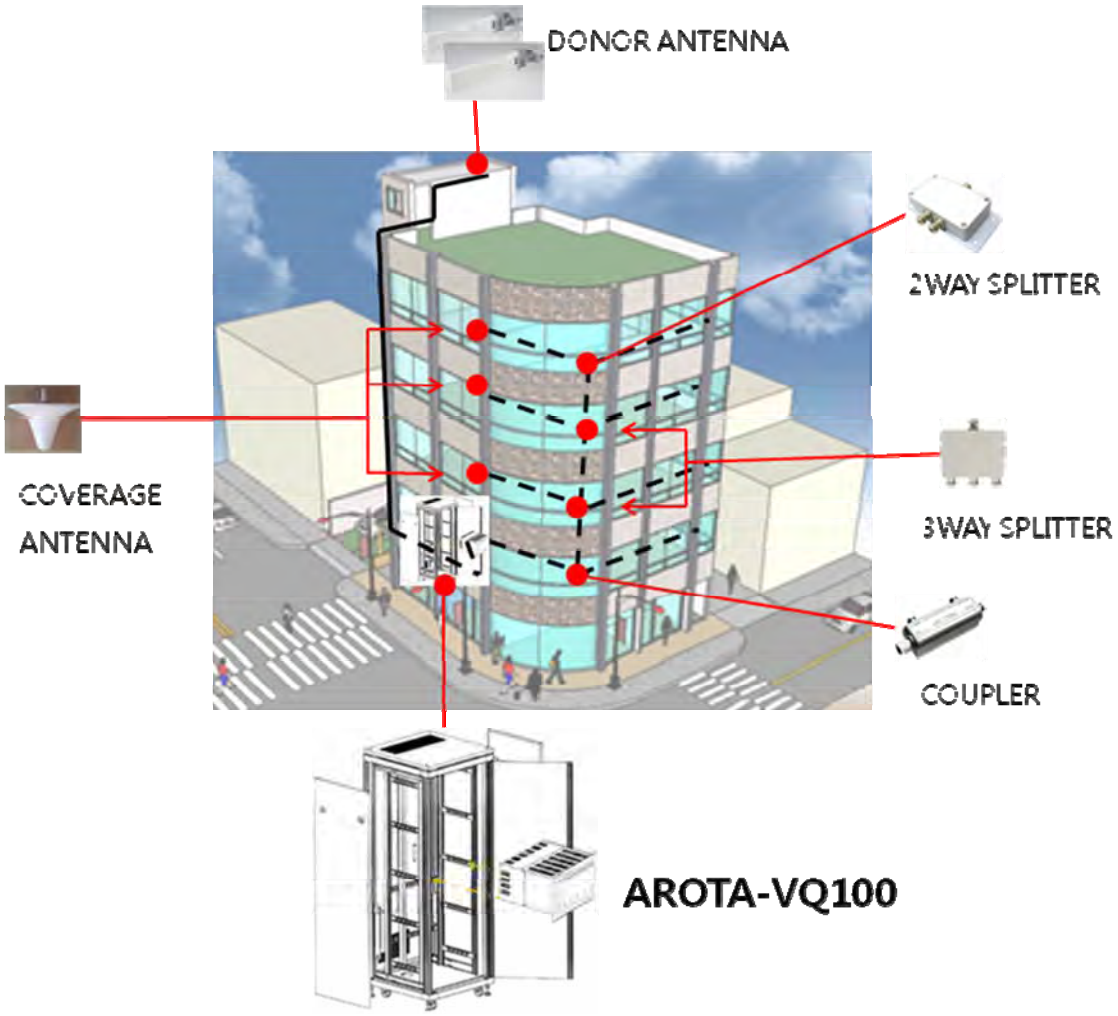

Figure 1 Network Configuration

2 System Installation

1. Ensure the installation site is appropriate in terms of temperature and humidity.
2. Install a standard 19 inch rack if necessary.
3. Mount the repeater shelf on the rack with screws.
4. Connect ground cable to the repeater shelf.
5. Plug a power cable into the AC input connector on the FEU unit .
6. Connect a RJ-45 jack to Ethernet Port on the front of OMU unit for communication with NOC.

2.1 Package Inspection

Visually inspect the repeater unit and other accessories for any damage.

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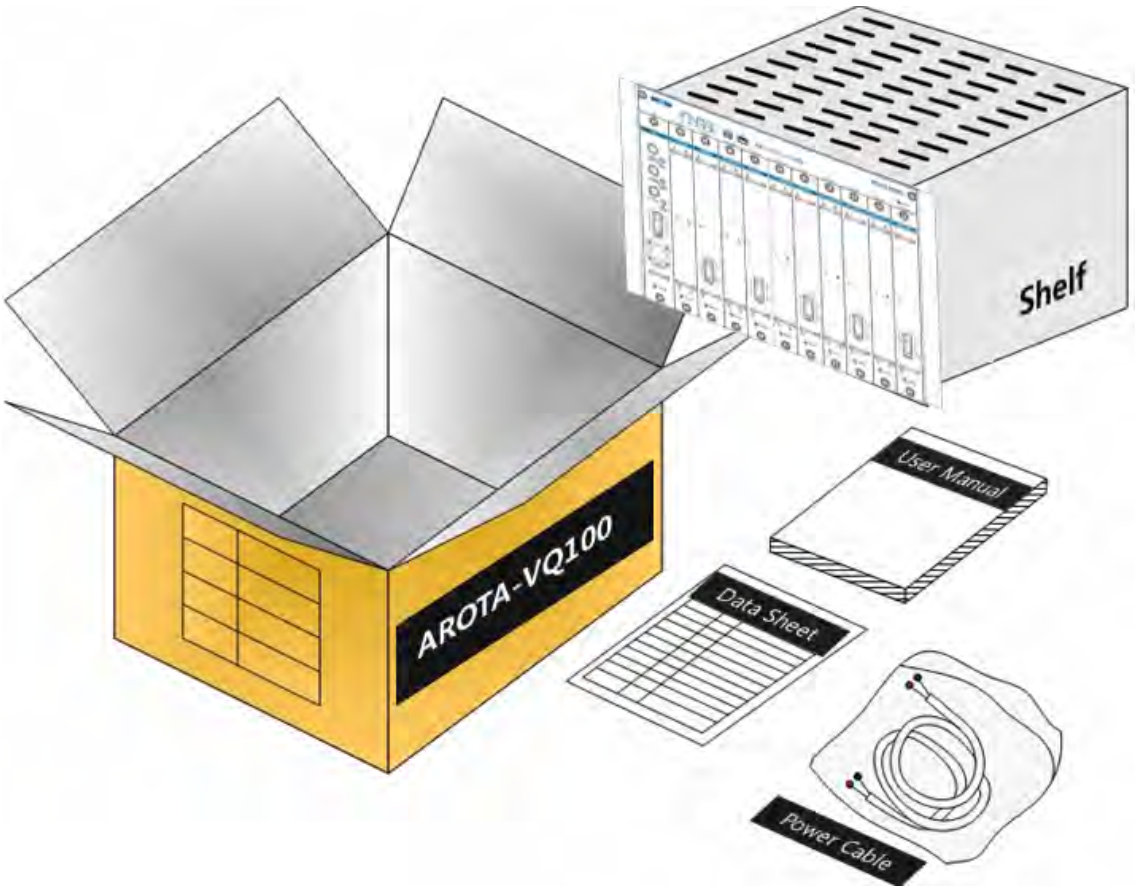
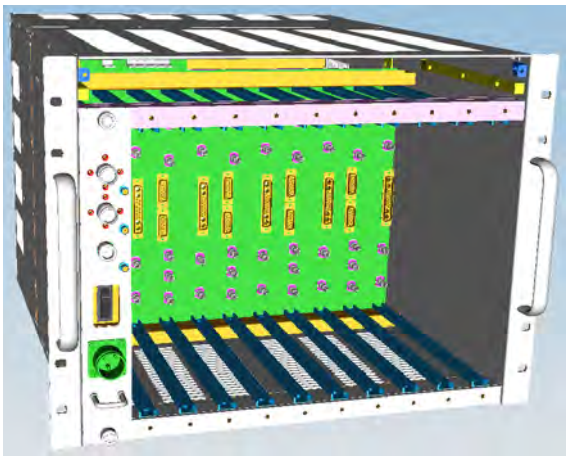


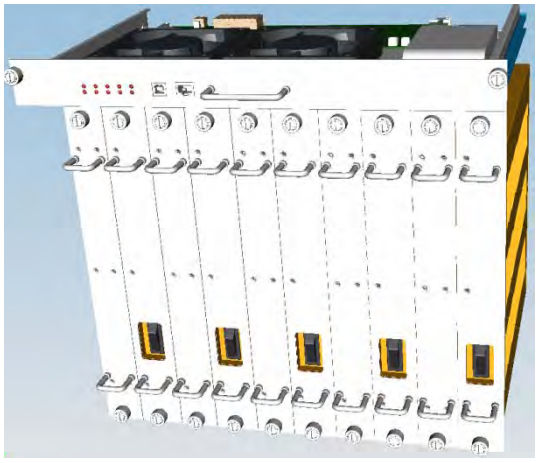
Figure 2 Packaging and Contents

Package	Item	Qty	Unit	Remarks
BOX1	Shelf (FEU Unit Included)	1	Set	
BOX2	Power Cable	1	EA	AC Supply
	User Manual	1	Copy	
	Installation guideline	1	Copy	
	Inspection Sheet	1	Copy	
	OMU, XCVR & HPA UNITs	1	Set	
	MOUNTING BRACKET	1	Set	

Table 2 Packaging and Contents



[BOX1 : SHELF]



[BOX2 : XCVR & HPA UNITs]

Figure 3 Individual Packaging and Contents

2.2 Installation

The installation procedures are described in this section. Please carefully follow the instructions below when installing the repeater unit.

Check the rack and shelf location

1. Prepare a 19 inch standard rack.
2. Choose a location considering air flowing inside the shelf. (An inner Fan is making air blowing downward from top to bottom)
3. Install the shelf securing 1U~2U free space for stability and effective heat dissipation system on the device.

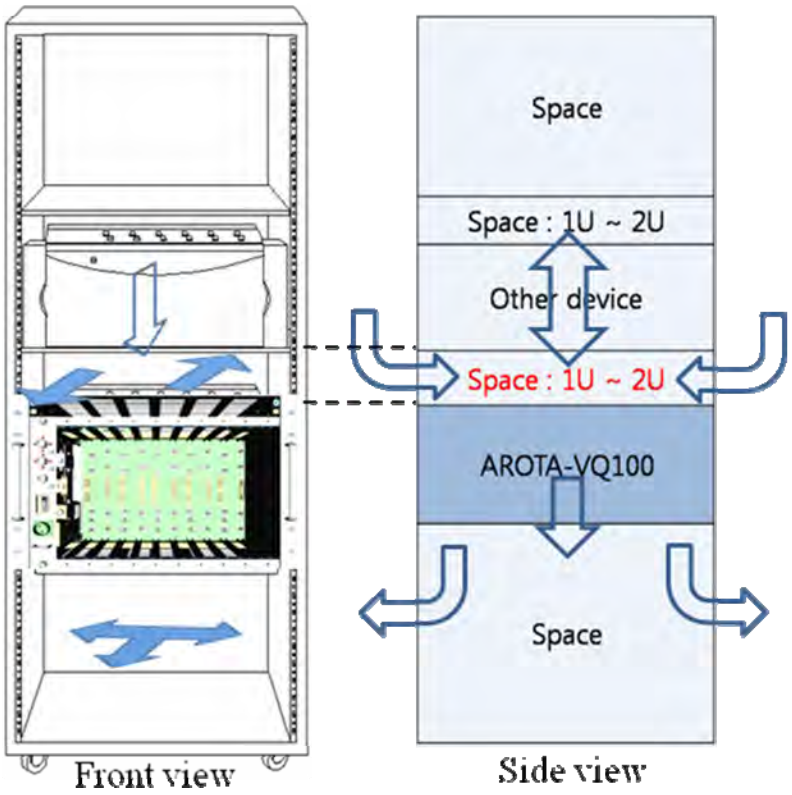


Figure 4 Space Consideration for Shelf Installation

Installing a guide in the rack

1. Check the rack whether a guide bar is already installed to support the weight of the shelf.
2. If there is not, Use guide bar from the package and install it in the rack as shown in Figure 5.

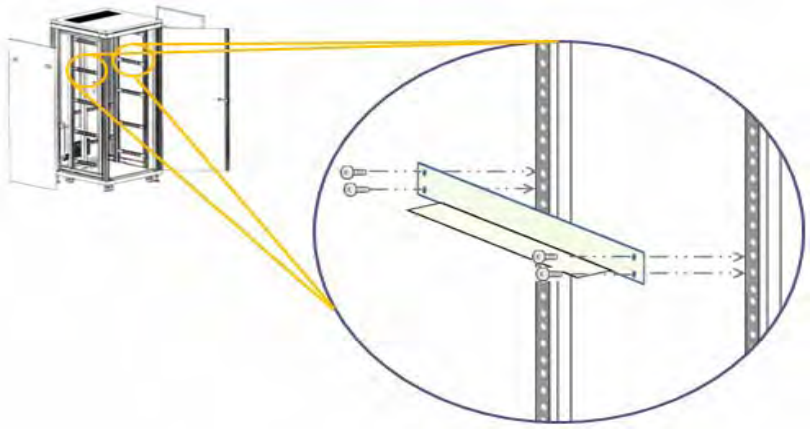


Figure 5 Rack Guide Bar Installation

Moving and installing the Repeater Shelf

1. A two-person team should carry the shelf for safety.
2. Put the shelf on the bracket of 19” rack and push it into the end of the rack to mount.
3. Fasten both sides of the shelf with screws in the rack.

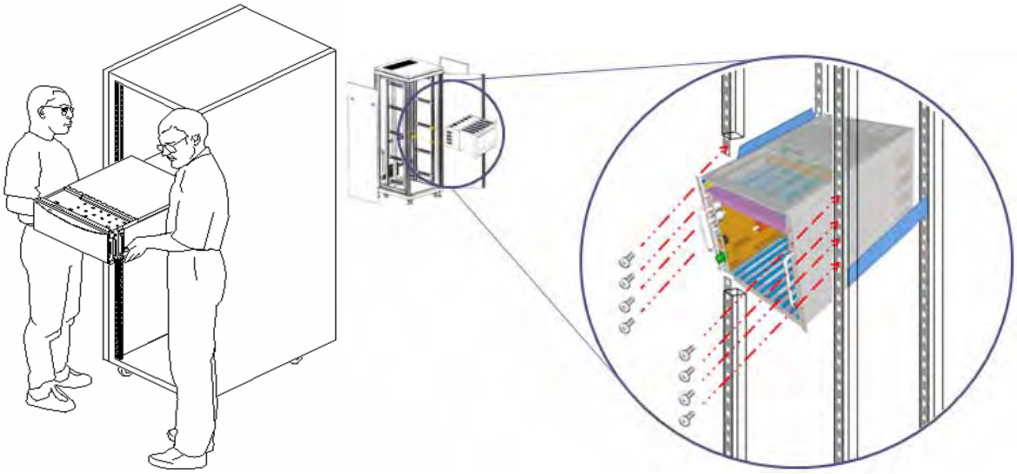


Figure 6 Moving and Installing the Repeater

Module Installation

1. Inspect the shelf to ensure the shelf is securely mounted in the rack.
2. Ensure FEU unit is located at the leftmost slot and mount other modules to the shelf..
3. Insert OMU unit into the top horizontal slot first and then, tighten up 2 captive screw on the both sides.
4. Before inserting modules, compare all names of modules printed on the bottom of OMU unit with each name that is also printed on every front side of unit. Then, secure the modules by fastening the screws..

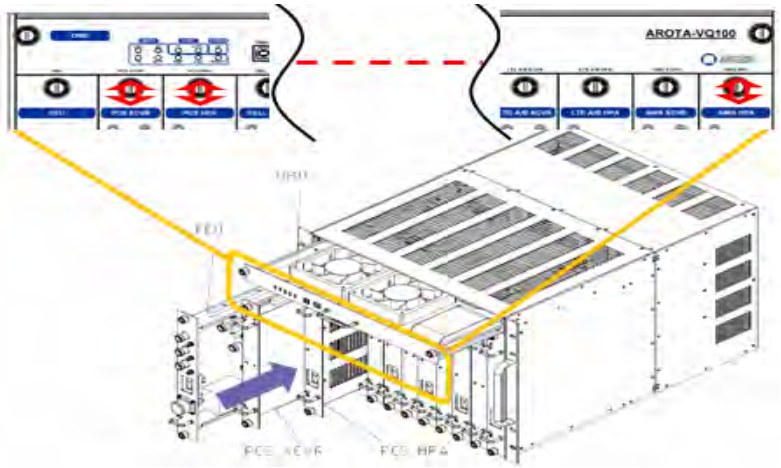


Figure 7 Plugging in Modules

Complete installation of a shelf (Fully Equipped)

1. Insert all modules into the proper slots as shown in Figure 8.
2. Double-check the modules with their each name printed on the front side of OMU unit.

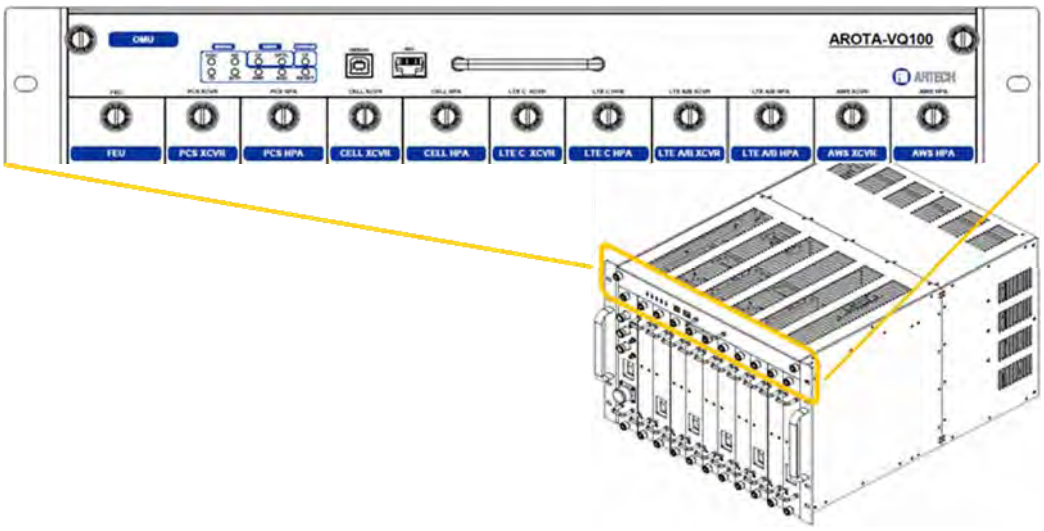
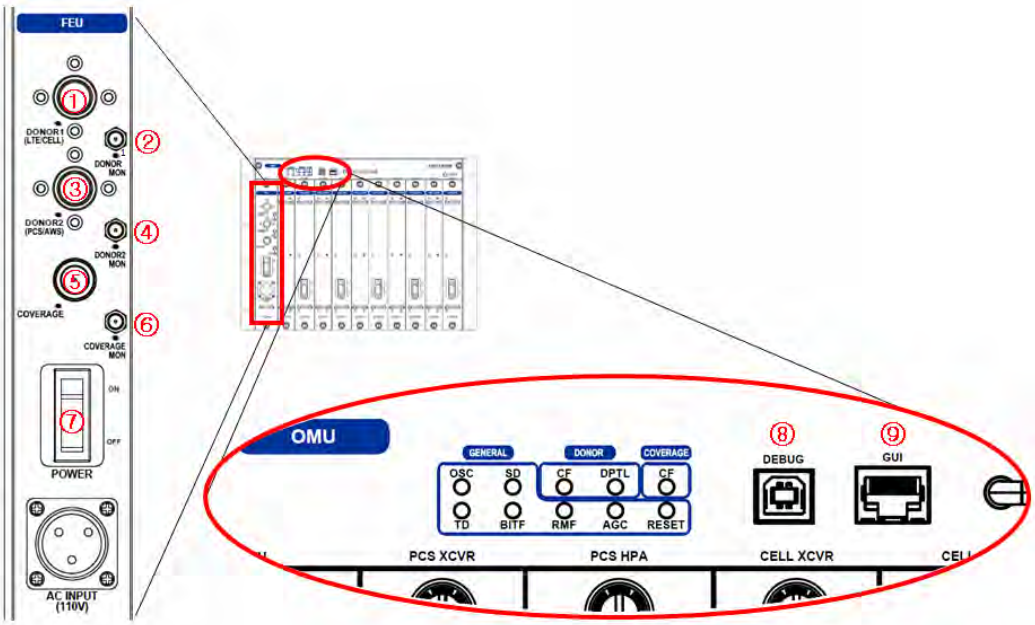


Figure 8 Illustration of Fully Equipped Shelf

2.3 Cable Connection

2.3.1 Cables and Connector Specification

The connectors used for the repeater are described below.



Num	Name	Connection	Connector Type
①	DONOR1(LTE/CELL)	Donor ANT1 for LTE/CELL	UL/DL_N Type Female
②	DONOR1 MON	Donor Monitoring Port	SMA Male
③	DONOR2(PCS/AWS)	Donor ANT2 for PCS/AWS	UL/DL_N Type Female
④	DONOR2 MON	Port of measuring instrument	SMA Male
⑤	COVERAGE	Coverage ANT for ALL	UL/DL_N Type Female
⑥	COVERAGE MON	Monitoring Port for Coverage Ant.	SMA Male
⑦	AC INPUT(110V)	AC (110V) Outlet	
⑧	DEBUG	USB port of PC	USB Type-B Female
⑨	GUI	Network port of PC	RJ-45

Table 3 Front Connector Descriptions

Num	Name	Connection	Connector Type
1	GROUND	Ground Cable	Ground Cable Connector

Table 4 Rear Side Connector Description

2.3.2 Cable Installation

Cable Length

Before installing antenna cables, ensure that the lengths of the antenna cables are proper so that the cable loss will not affect optimal service.

SHELF Cable Connection on the Front Panel

1. Check for types of service required for the installation site. (e.g. LTE C band)
2. Confirm the names of the connectors on the front panel as shown in Figure 9.
3. Connect the cable for DONOR1 (LTE/CELL) to a topmost port on FEU Card.
4. Connect the cable for DONOR2 (PCS/AWS) to port located at the second from the top port on FEU Card.
5. Terminate ports that will not be in service with 50Ohm terminator
6. Connect the cable for Coverage Antenna to port located at the third from the top port on FEU Card.
7. Connect 120V AC power cable to the bottom port.

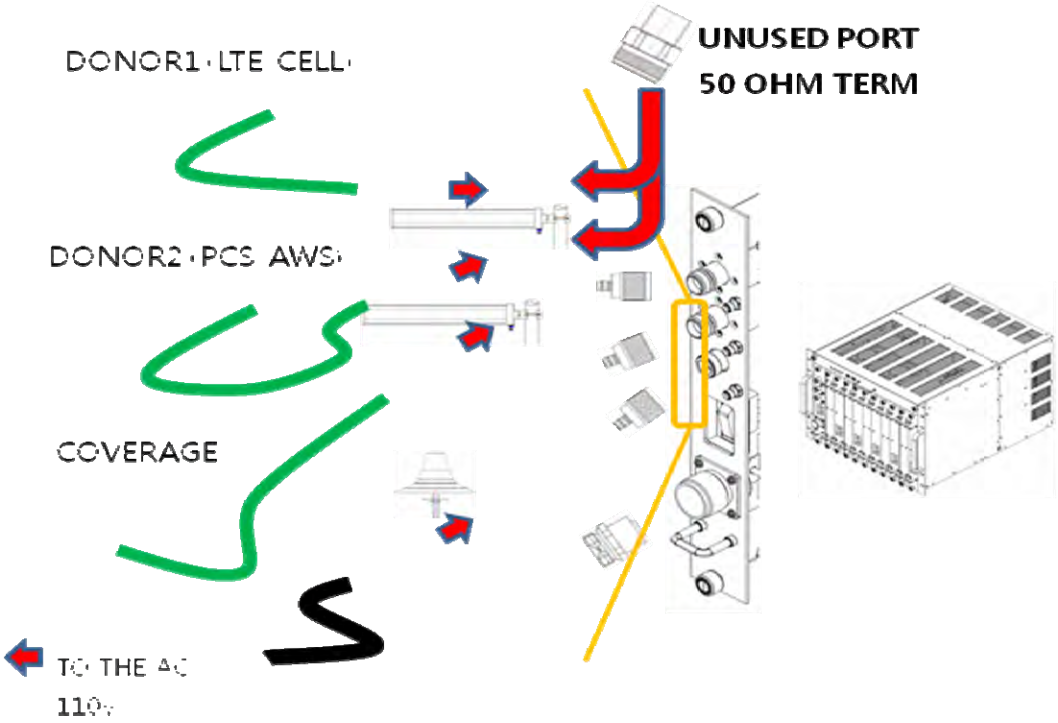


Figure 9 Cable Connection (Front of Shelf)

Cable Connection on the rear panel

Connect a ground cable to the ground connector on the rear panel as shown in Figure 10. The ground connection should be made according to the safety the regulation.

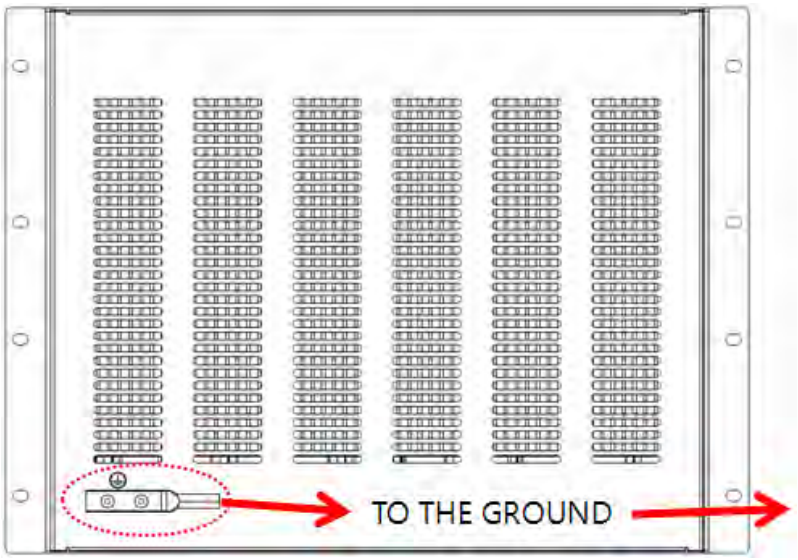


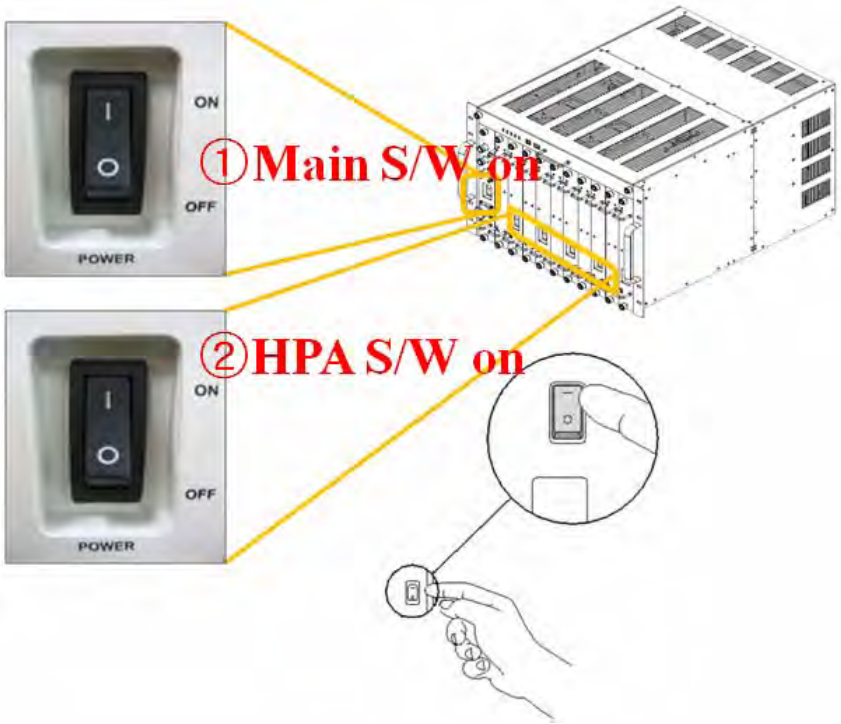
Figure 10 Cable Connection (Back of shelf)

3 Powering Up System

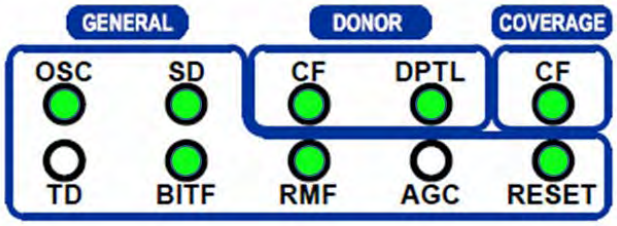
When the normal operation conditions such as cable connections, shelf installation, input power level, communication with NOC are met, power up the system following the procedures below.

SW ON

1. Make sure all switches are on OFF position.
2. Locate switches for each modules as shown below..
   - MAIN S/W : Bottom of Front FEU Card.
   - HPA S/Ws : Bottom of each HPA's.
3. Turn ON MAIN switch as in figure ①.
4. Turn ON HPA switch as in figure ②
5. Make sure to turn OFF the switch when removing HPA card from the shelf..



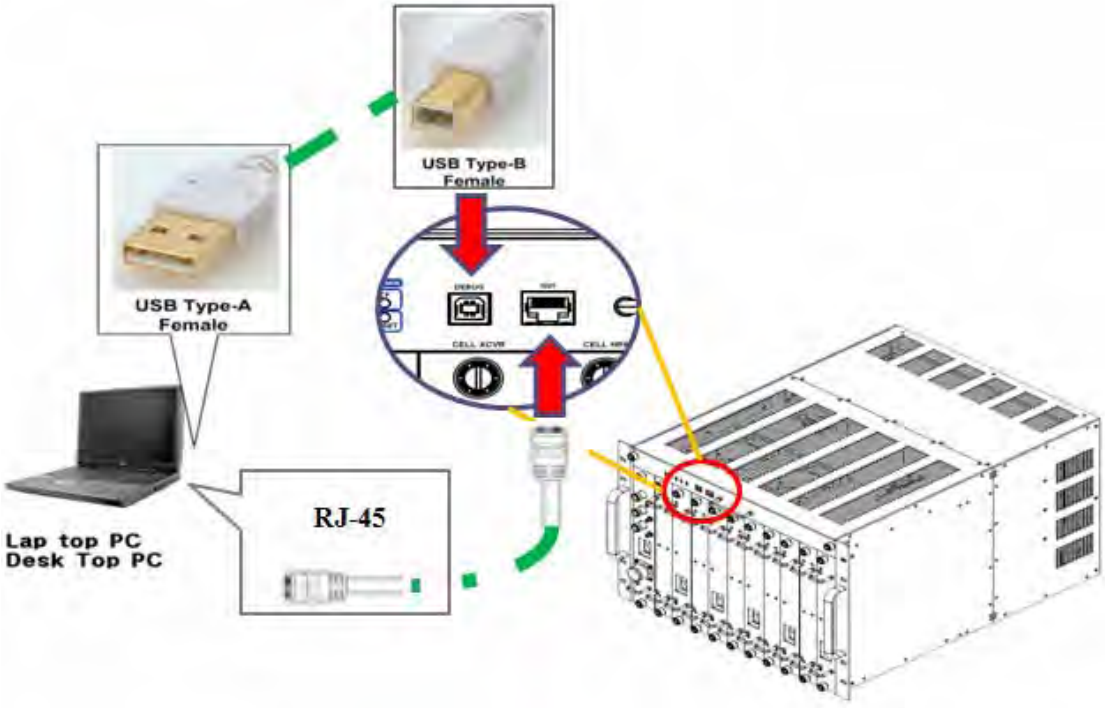
Verifying ALARM LED



When the system is operating normally after power-up, the LED's should be all GREEN. After verifying the LED's are all green, the next steps can be followed. If any of the LED's does display GREEN, please refer to Chapter 7, Troubleshooting and Recovery.

GUI Installation and Operation

Refer to section 4.1 for procedures to download, install and use the GUI..



GUI Default Values

1. AGC OUTPUT LEVEL is set to be the maximum output power possible by default. Please refer to [4.6.1 AGC ON Setup] and adjust AGC OUTPUT LEVEL to a desired level.

2. Default status of XCVR is OFF. Please turn it ON while referring to [4.6.1 XCVR ON/OFF Setting].

3. Default status of HPA is OFF. Please turn it ON while referring to [4.6.5 XCVR ON/OFF Setting].

4 System Operation

4.1 GUI Installation

The GUI program of AROTA_VQ100 contains installation files in Figure 11.

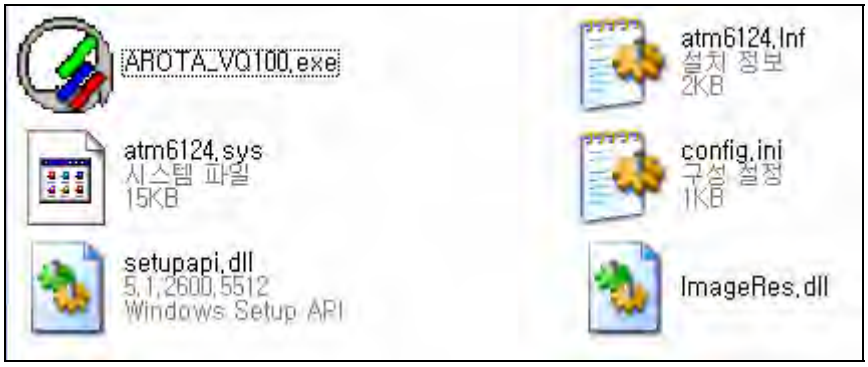
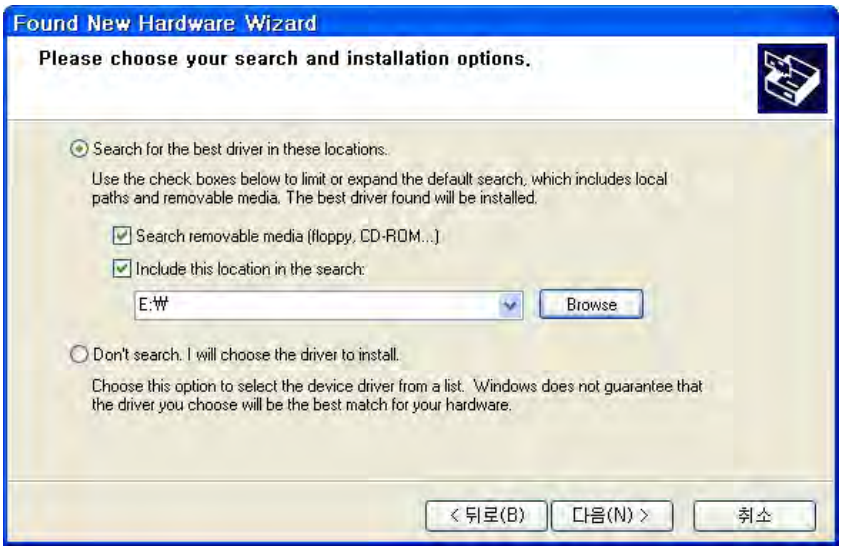


Figure 11 Installation Files

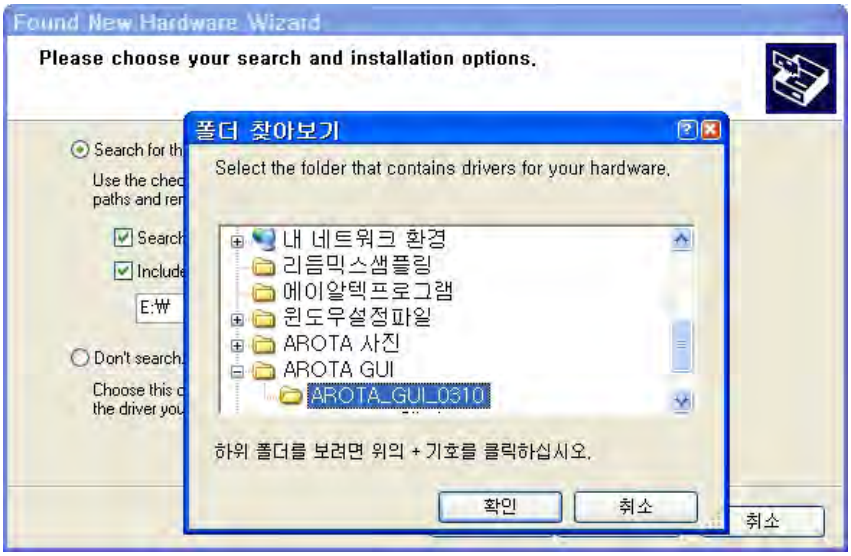
4.1.1 Set up a driver

When a USB port is connected to a PC, the set-up message will pop up as below. Set an installation path as the directory containing GUI first and then start to install a driver.

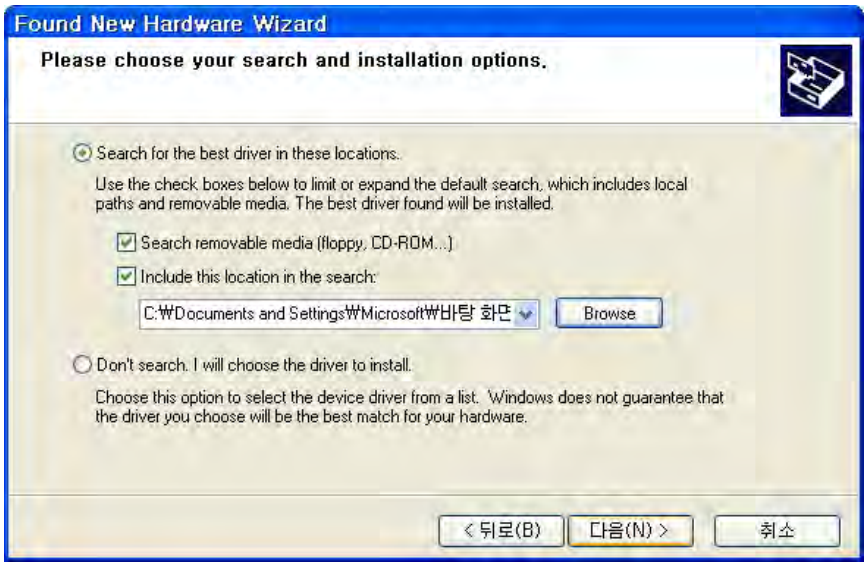
Driver Setup 1



Driver Setup 2



Driver Setup 3



Driver Setup 4

Driver Setup 5

4.1.2 Starting GUI

When you run AROTA_VQ100, a pop-up to select communication method with main board will come on.

- If the port cannot be connected, error message will be shown up as below.

Port Fail

- Check the USB connection and try again if “Port Open Failed” message appears.

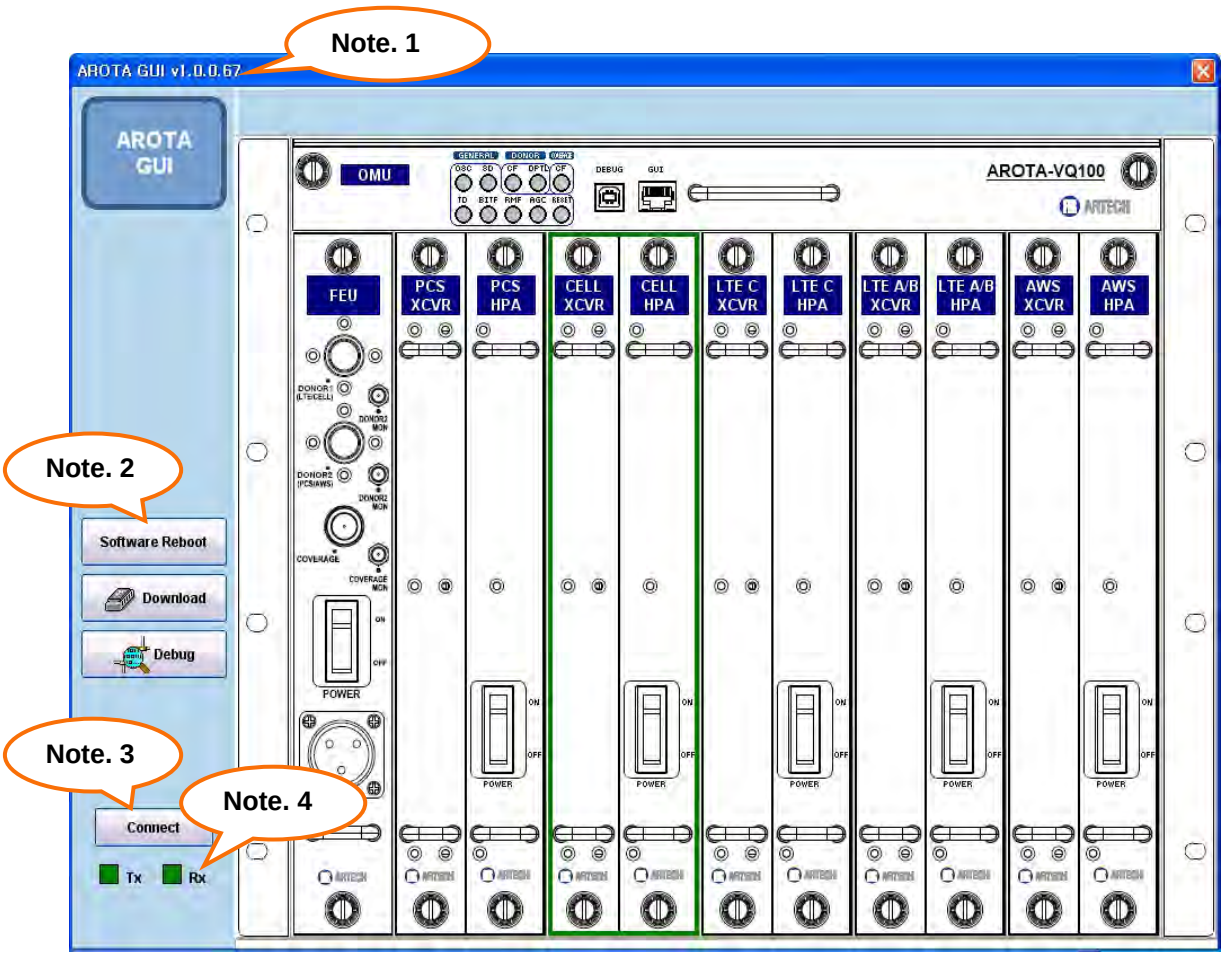


Figure 12 Main Window

Note.	Description
1	Display the version of GUI
2	Reset all modules and systems including main board
3	Displays communication status with main board.
4	Show communication connection with main board -Tx: The red light comes on during data transmission from GUI to the main board. -Rx: The red light comes on during data transmission from GUI to the main board.

4.1.3 Main Functions

If you move your mouse to the location showing each module on front shelf, the green- line border will turn up to the screen around the module in Figure.14.

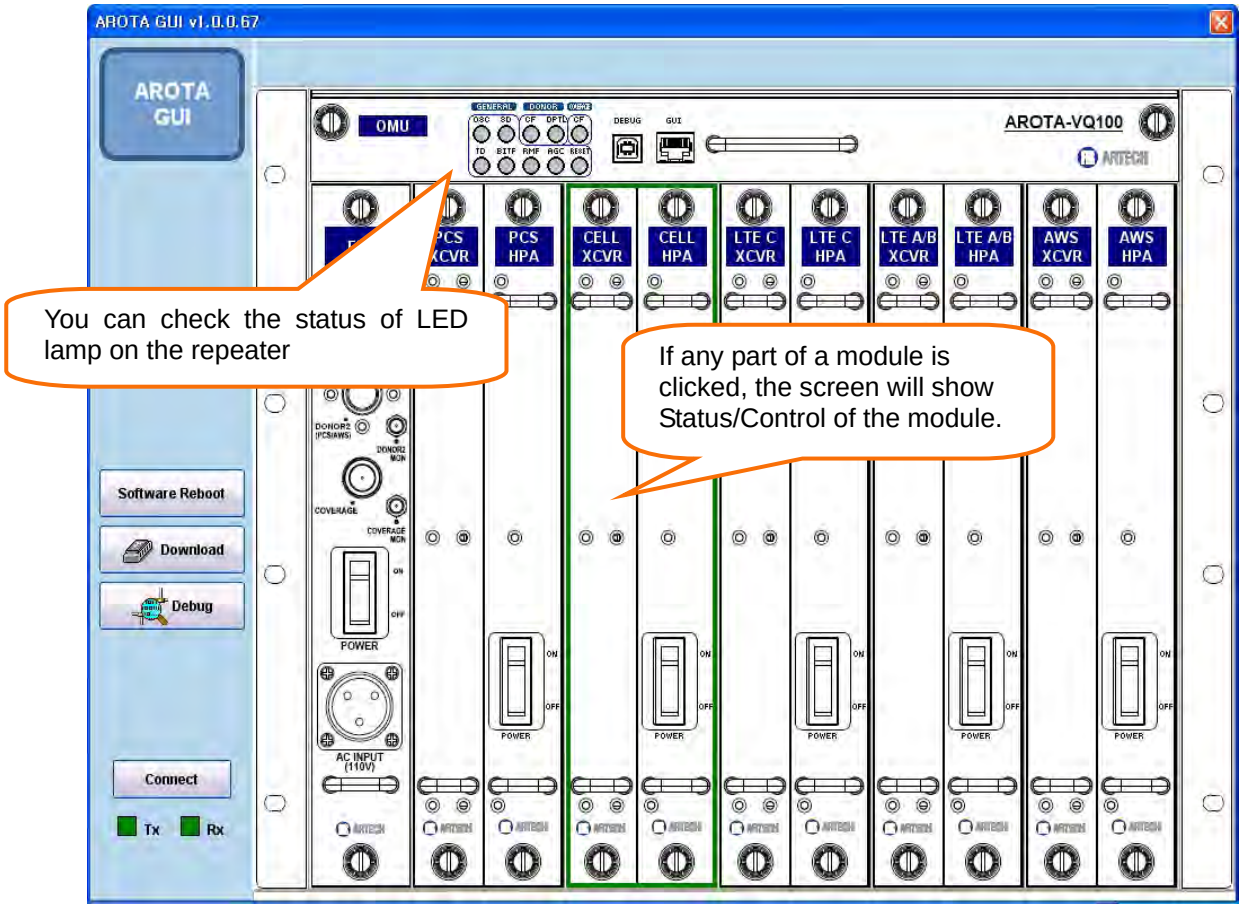


Figure 13 Shelf module Selection Screen

Basic setup of modules

The interface and input method of all modules excluding OMU, FEU and AWS are identical.

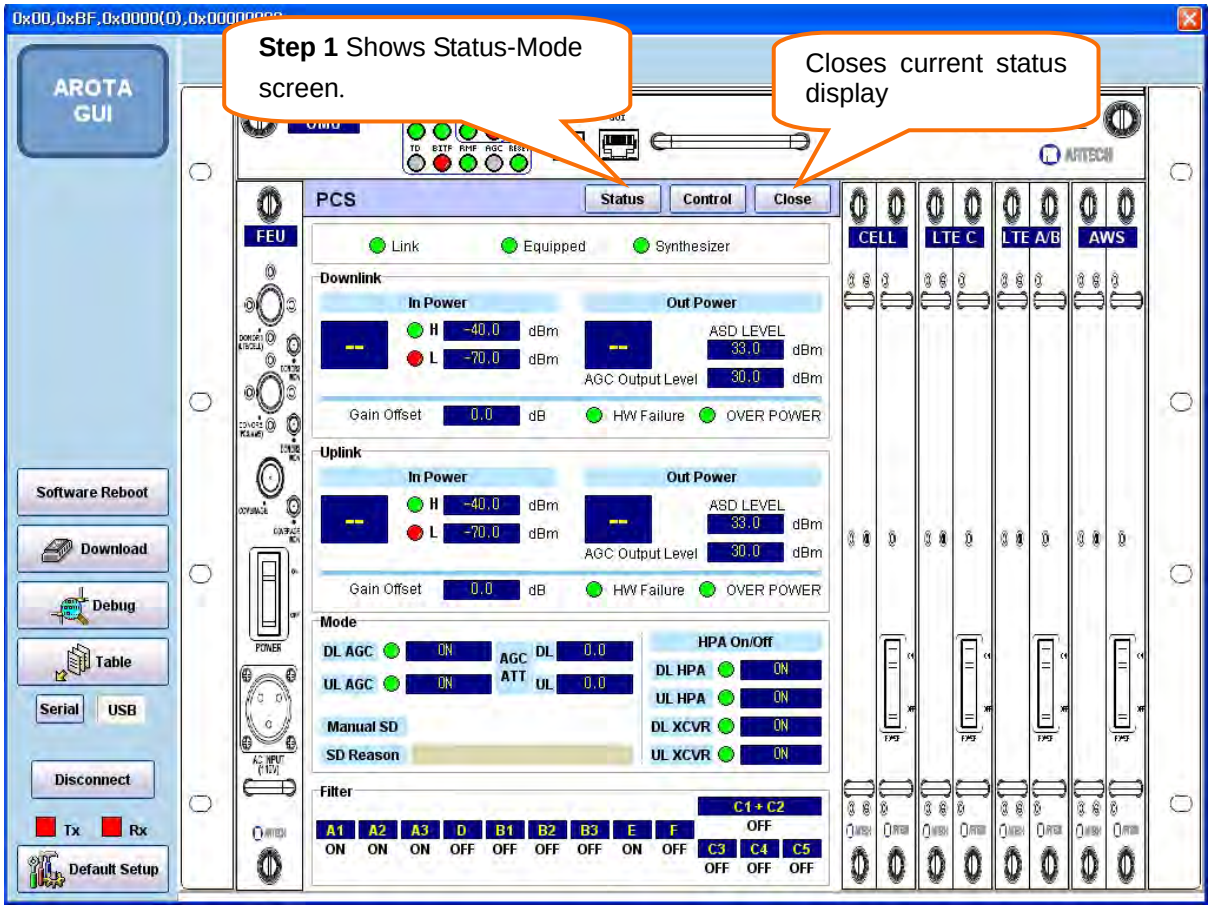


Figure 14 Status Mode Screen

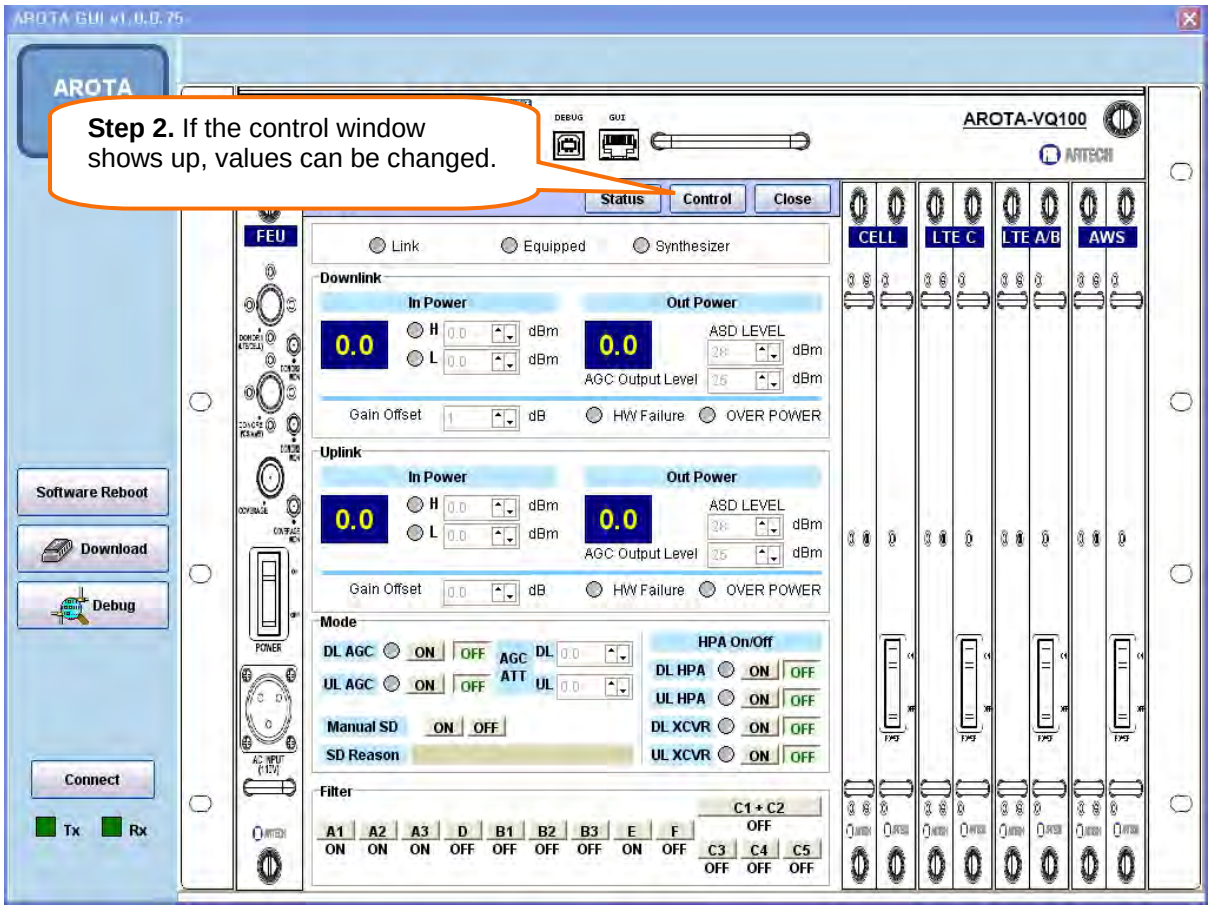


Figure 15 Control Mode

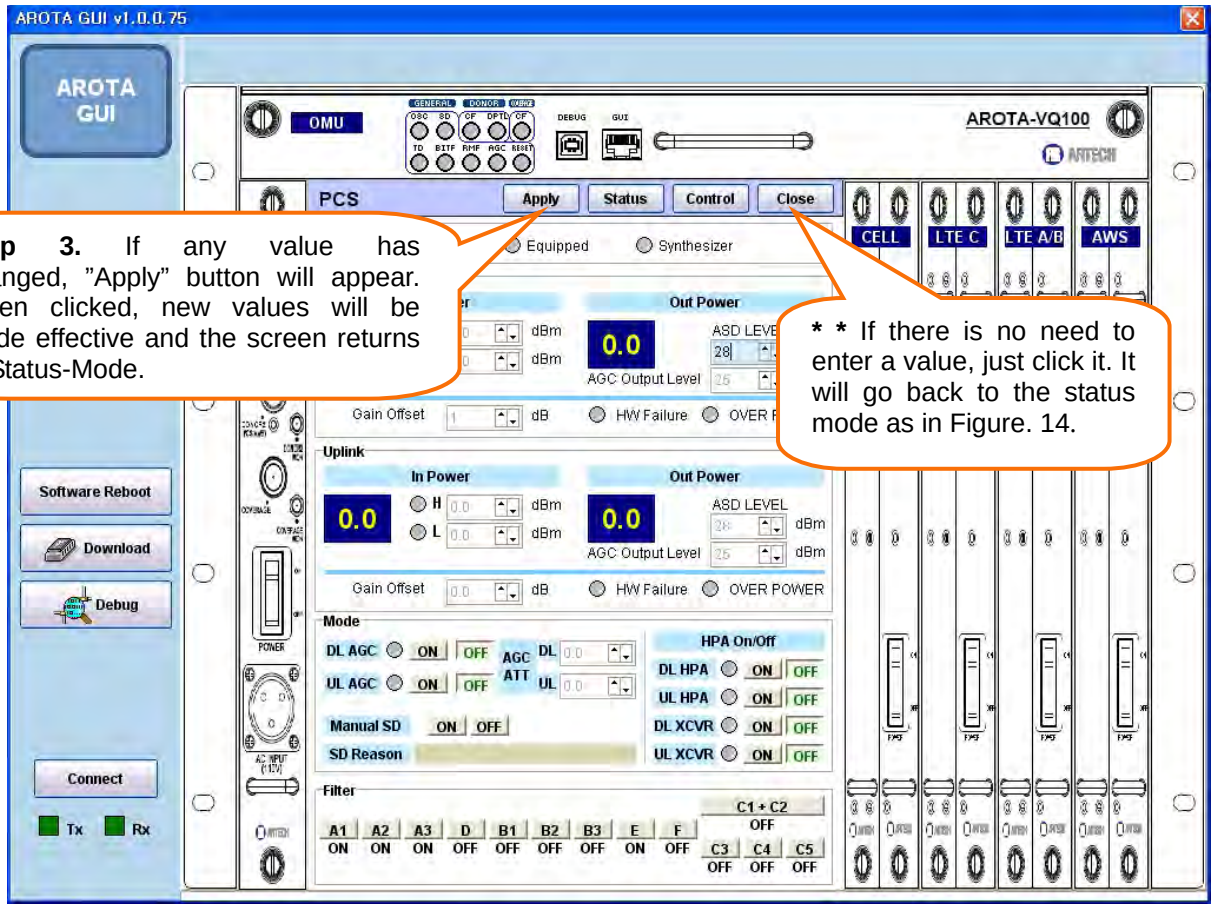
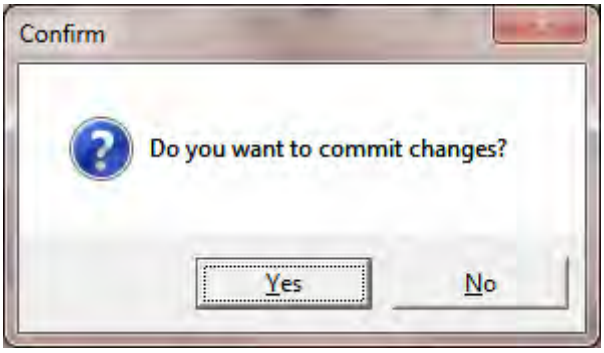
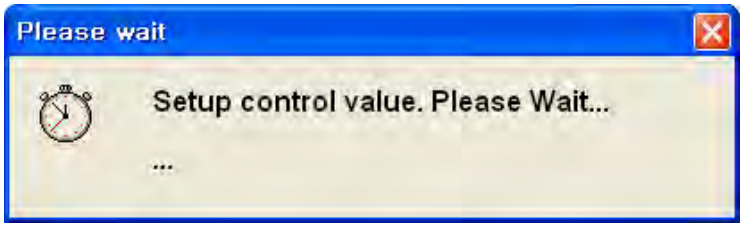


Figure 16 Control Mode Screen with New Values

- When "Apply" button is pressed or "Enter" key is pressed after changing a value, a confirmation window will appear as below.



- If "Yes" is clicked, the window below will appear while change is being made effective from the modules.



Control Command Execution Window

- If there is no response from the modules, the commands will be timed out and no change will be applied..

Timeout Window

4.2 Default Values

Figure 17 PCS Band Default Values Screen

Figure 18 Cellular Band Default Value Screen

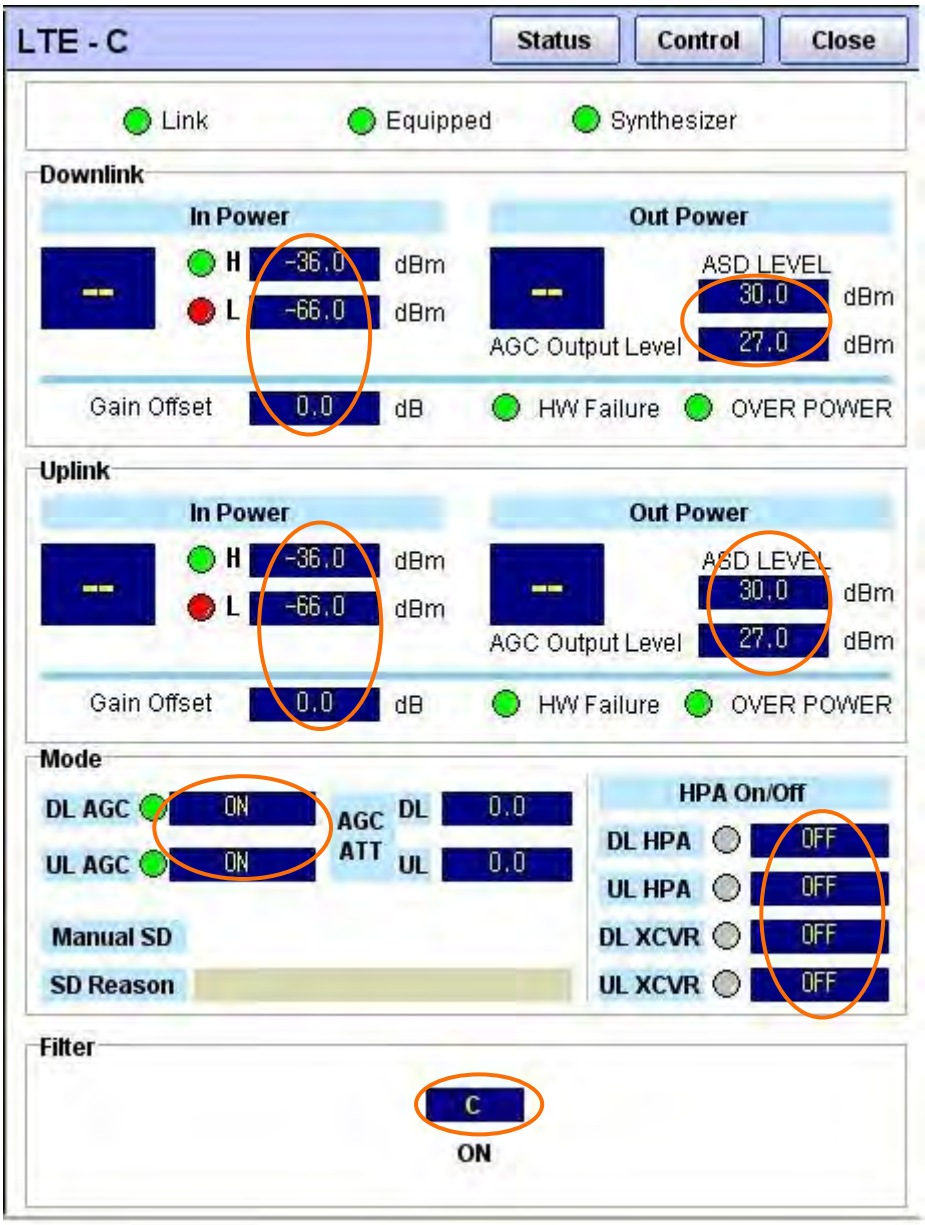


Figure 19 LTE-C Band Default Value Screen

Figure 20 LTE A/B Band Default Value Screen

4.3 Alarm Functions

4.3.1 OMU

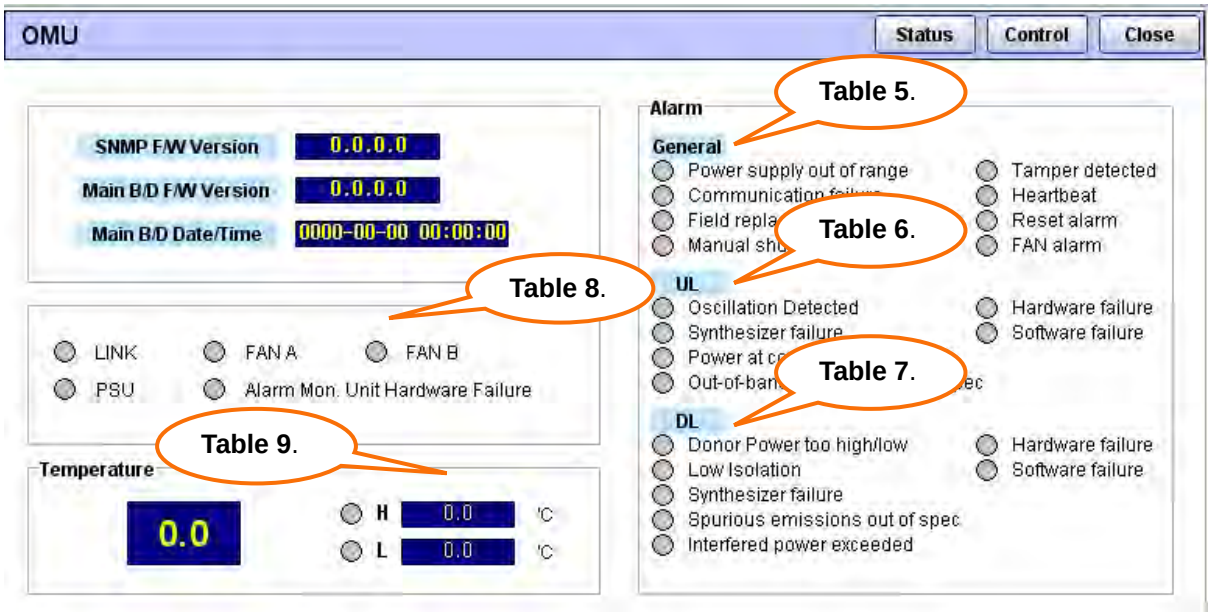


Figure 21 OMU Screen

Power Supply out of range	Problem with power supply
Tamper detected	Not used
Communication failure	Communication problem with high rank center
Heartbeat	Not used
Field replaceable module failure	Replaceable module failure
Reset alarm	Reset is activated
Manual shut down alarm	Manual shutdown is activated
Power Supply out of range	Problem with power supply

Table 5 General Alarm

Oscillation detected	Problem with oscillation detected
Hardware failure	Hardware abnormal
Synthesizer failure	PLL unlock detected
Software failure	Software abnormal
Power at coverage port too high	Input power at coverage port too high
Out of band out of emission spec	Filter rejection abnormal

Table 6 UL Alarm

Donor power too high/low	Input power at donor port too high/low
Hardware failure	Hardware abnormal
Low isolation	Problem with low oscillation detected
Software failure	Software abnormal
Synthesizer failure	PLL unlock detected
Spurious emissions out of spec	Spurious emissions out of FCC limits
Interfered power exceeded	Filter rejection abnormal

Table 7 DL Alarm

LINK	Communication problem with modules
PSU	Power Supply abnormal
FAN A,B	Fan abnormal
Alarm Mon Unit H/W Failure	Alarm monitoring unit hardware abnormal

Table 8 OMU Alarm

HIGH	Temperature is above upper threshold
LOW	Temperature is below lower threshold

Table 9 Temperature

4.3.2 MODULES

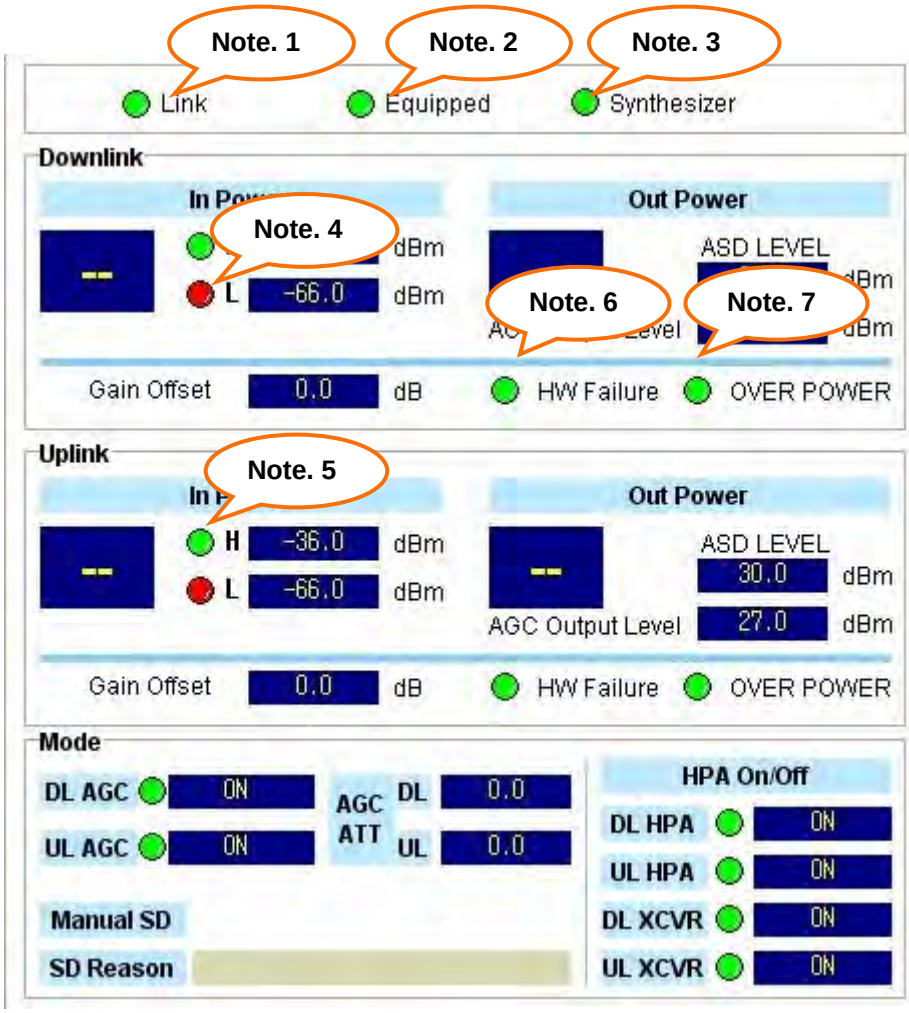
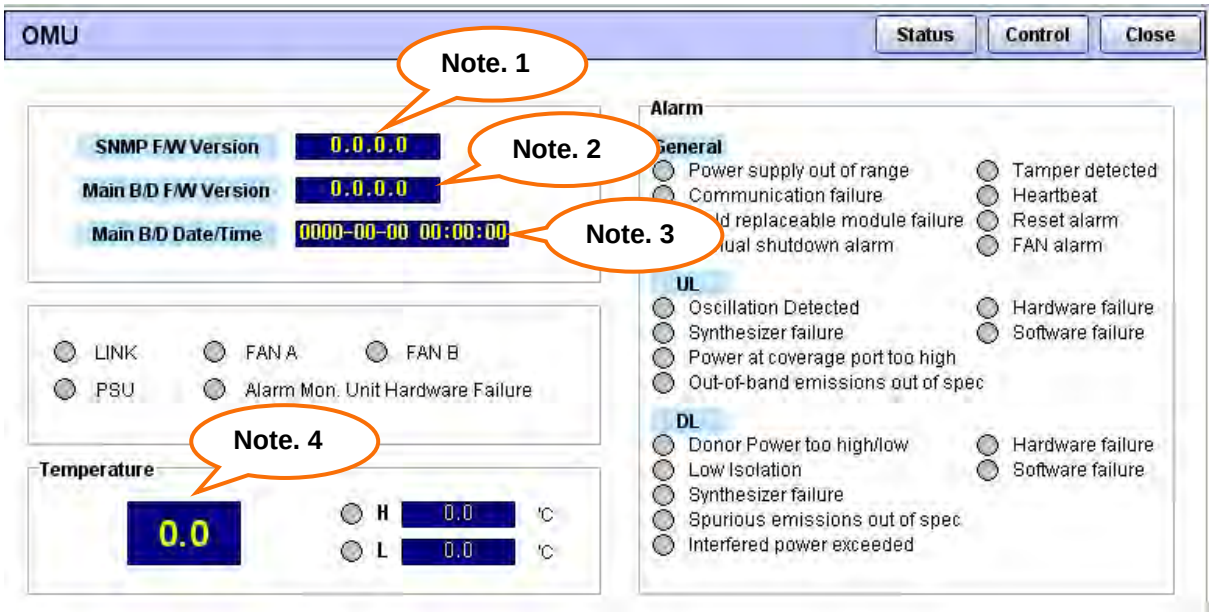


Figure 22 Module Screen

Note.	Description
1	Communication Problem with MAIN CONTROL BOARD
2	Module Equipped
3	PLL LOCK Status
4	Below Lower Threshold
5	Above Upper Threshold
6	XCVR H/W Abnormal
7	OUTPUT OVER POWER

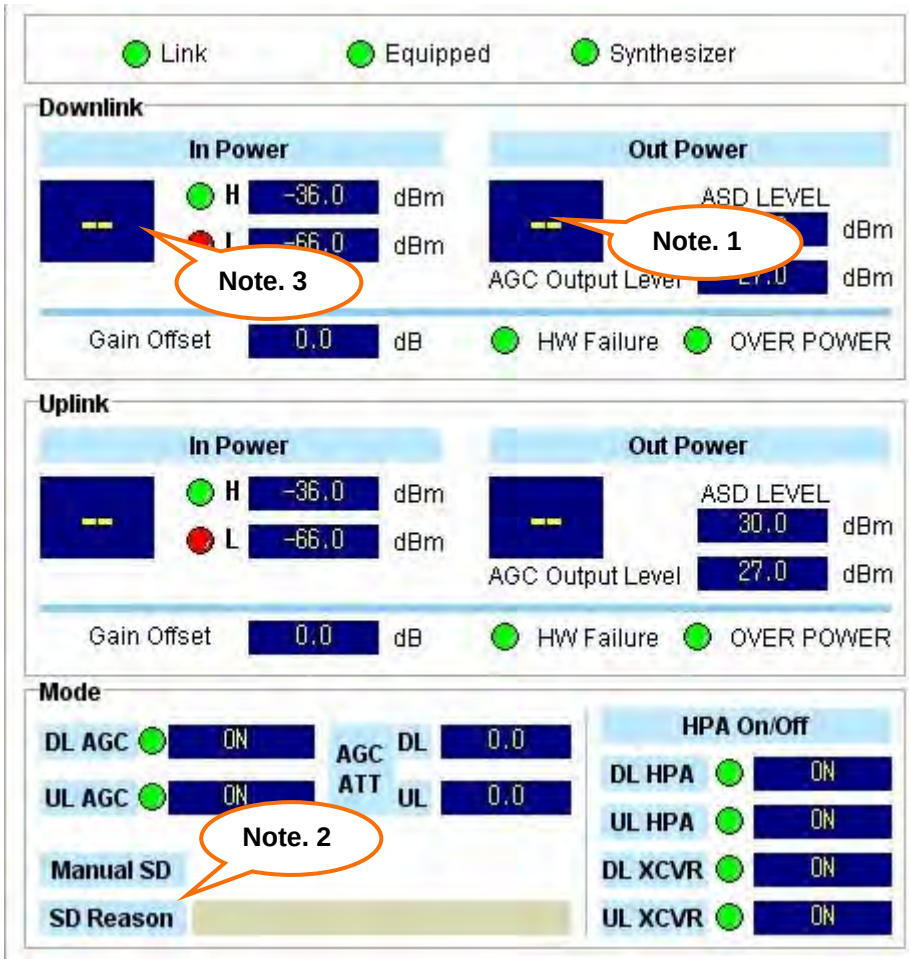
4.4 Description of the value state

4.4.1 OMU



Note.	Description
1	Displays the version of SNMP board
2	Displays the version of main board
3	Displays real time of main board
4	Displays temperature of shelf

4.4.2 MODULES



Note.	Description
1	Output Power
2	Reason for Shutdown
3	Input Power

4.5 CONTROL Functions

4.5.1 AGC ON

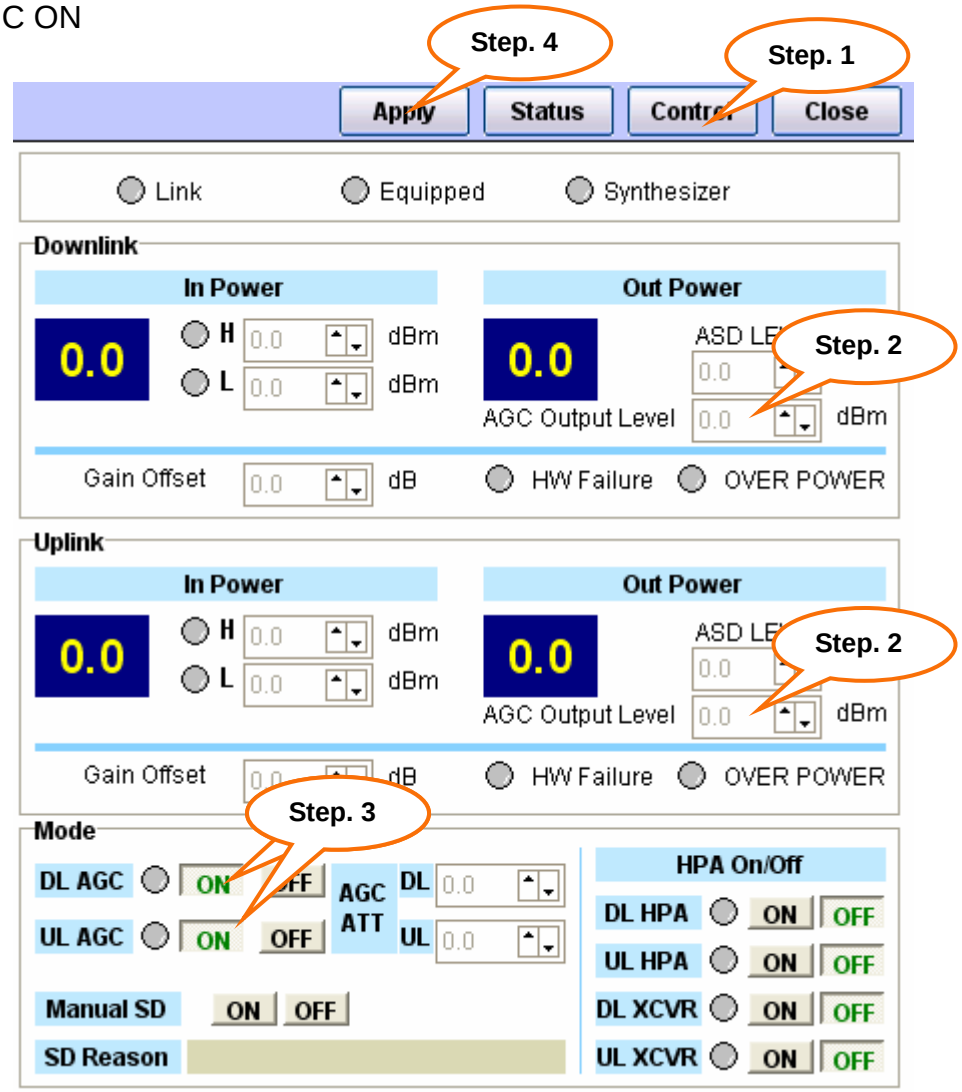


Figure 23 AGC ON

STEP	
1.	Click “Control” to change mode to control-mode
2.	Enter the level that you need.
3.	Set the AGC Mode ON.
4.	Click Apply

4.5.2 AGC OFF

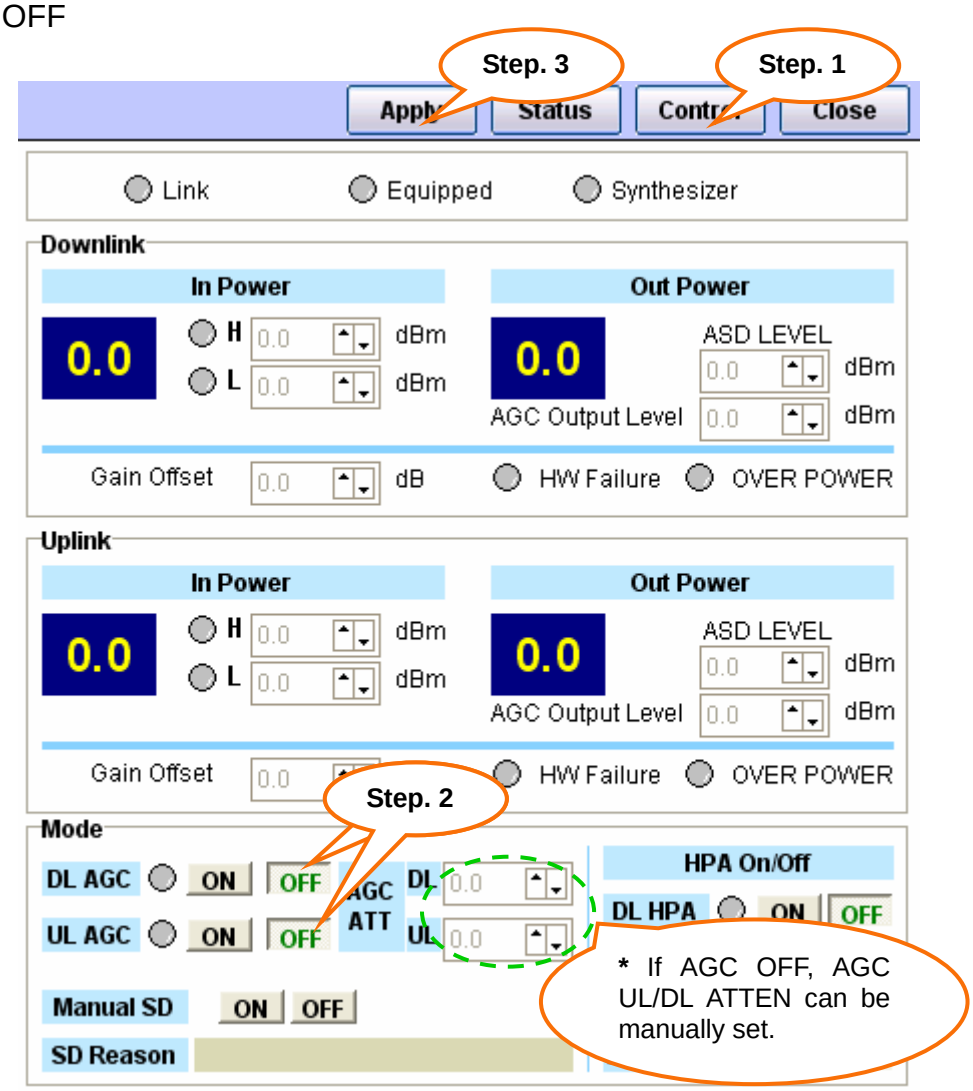


Figure 24 AGC OFF

STEP	
1.	Once you click 'Status' on the first window, it will be changed to 'Control' as in above picture.
2.	Set the AGC mode 'OFF'.
3	Click "Apply"

4.5.3 Upper and lower limits in PD input power

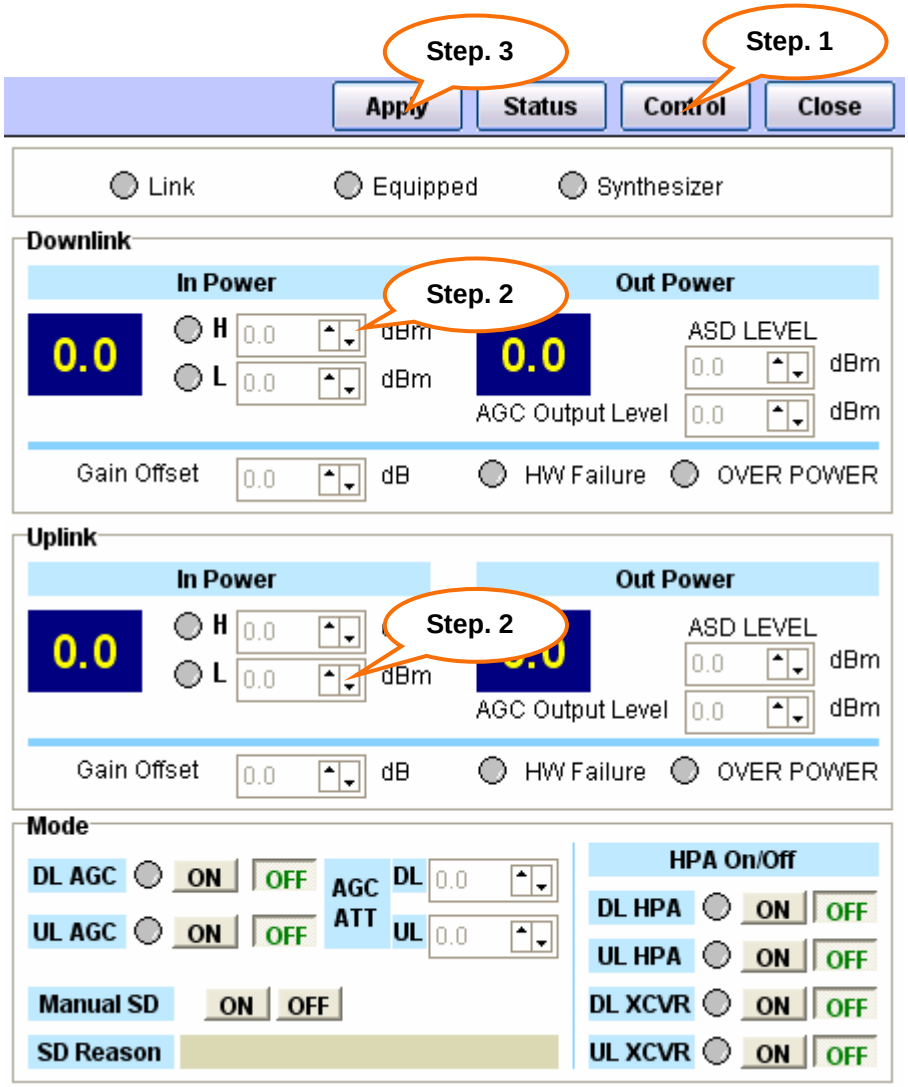


Figure 25 Setting Upper and Lower Limits

	STEP
1.	Click on “Control” to change mode to Control
2.	When changing a high or low limit is needed, enter each value.
3.	Click ‘Apply’.

4.5.4 GAIN OFFSET

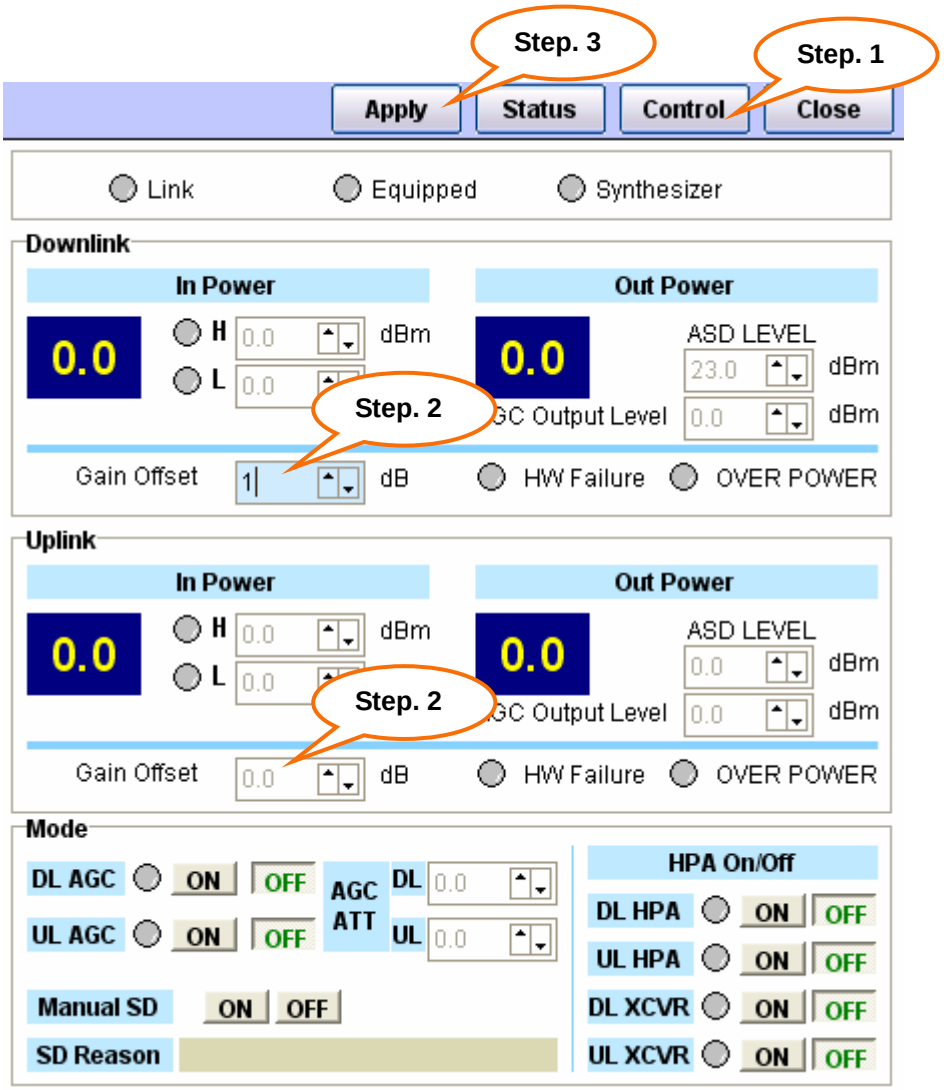


Figure 26 Gain Offset

STEP	
1.	Click on “Control” to change mode to Control.
2.	Enter a value (-3 dB ~ 3dB)
3.	Click ‘Apply’.

4.5.5 HPA ON/OFF

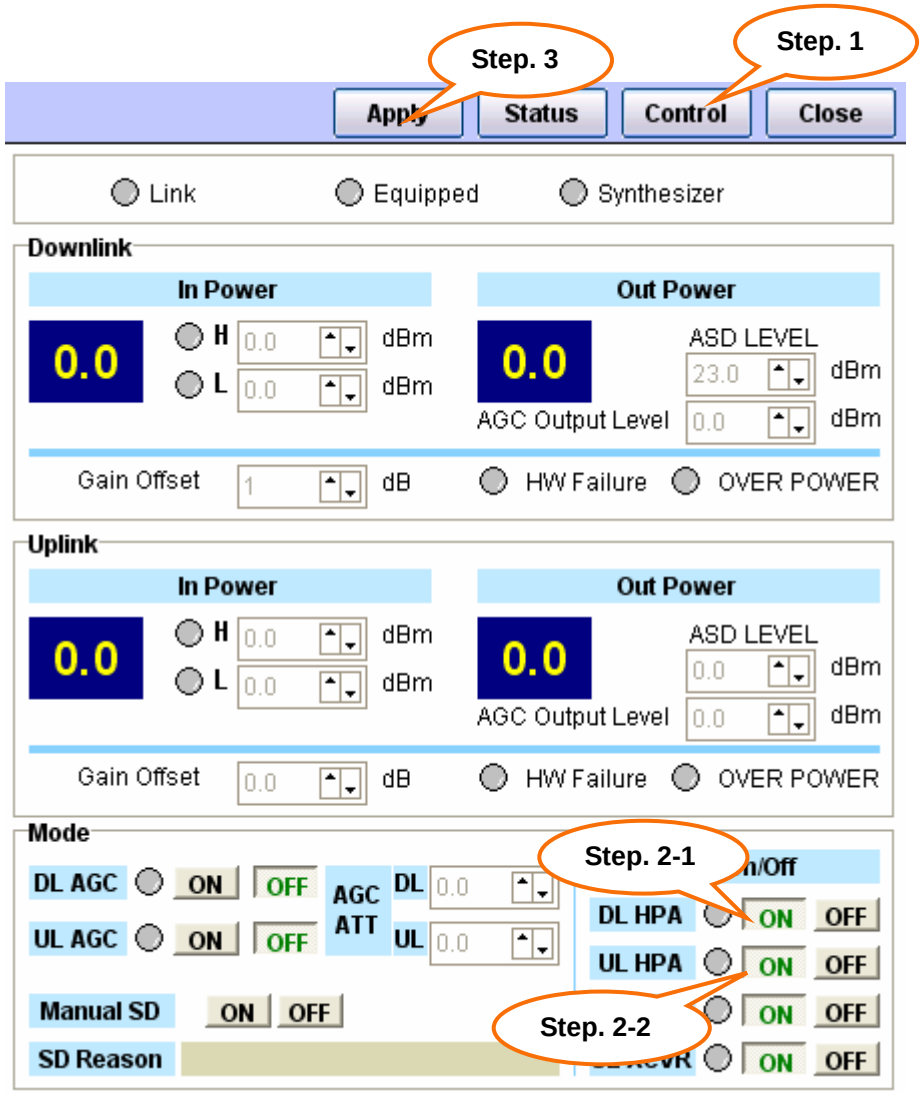


Figure 27 HPA ON/OFF

STEP	
1.	Click on “Control” to change mode to Control.
2-1.	Click the ‘ON’ or ‘OFF’ button if you need to set DL of HPA ON or OFF.
2-2.	Click the ‘ON’ or ‘OFF’ button if you need to set UL of HPA ON or OFF. (*The green LED turns on when you set it ‘ON’.)
3.	Click ‘Apply’.

4.6.6 XCVR ON/OFF

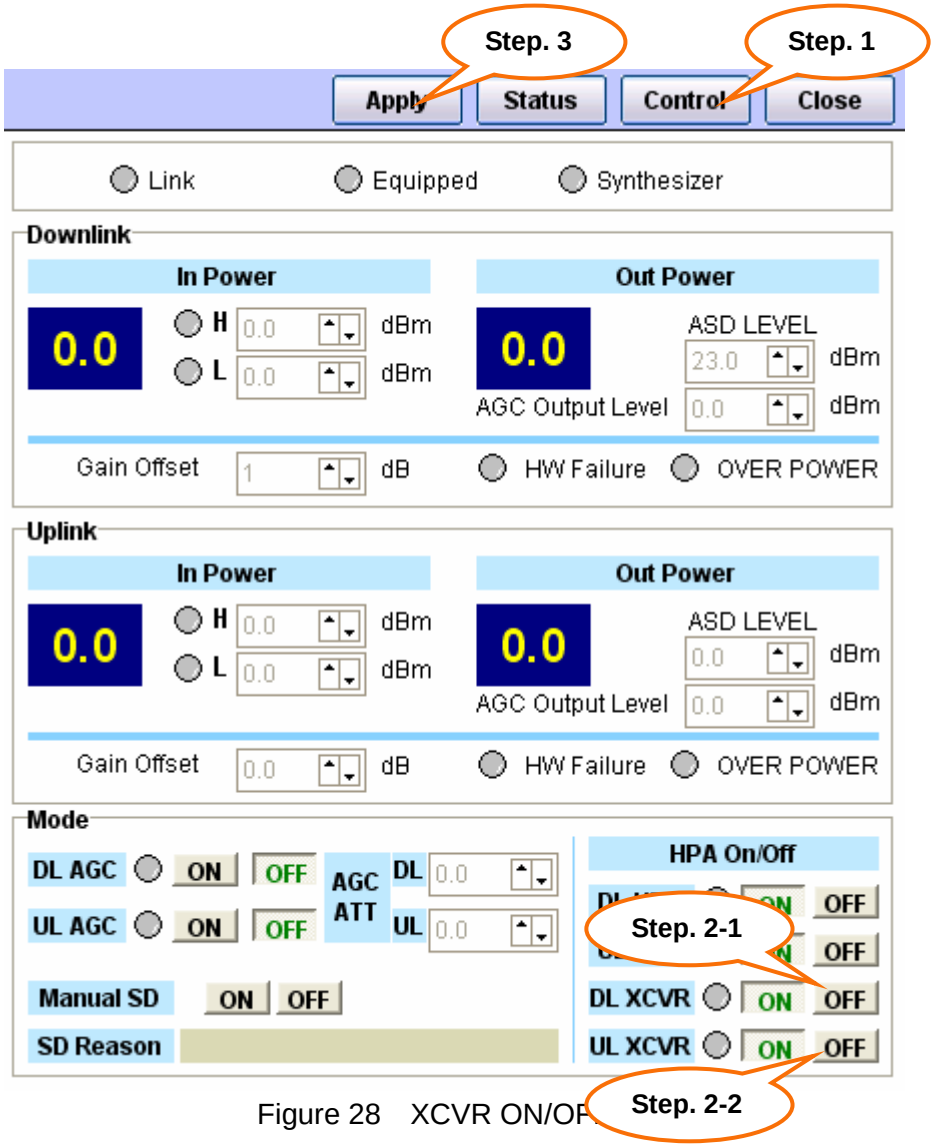


Figure 28 XCVR ON/OFF

STEP	
1.	Click on “Control” to change mode to Control.
2-1.	Click ON or OFF to change if you need to set DL of XCVR on or off.
2-2.	Click ON or OFF to change if you need to set DL of XCVR on or off. (*The green LED turns on when you set it ‘ON’.)
3.	Click ‘Apply’.

4.6.7 MANUAL Shut Down ON

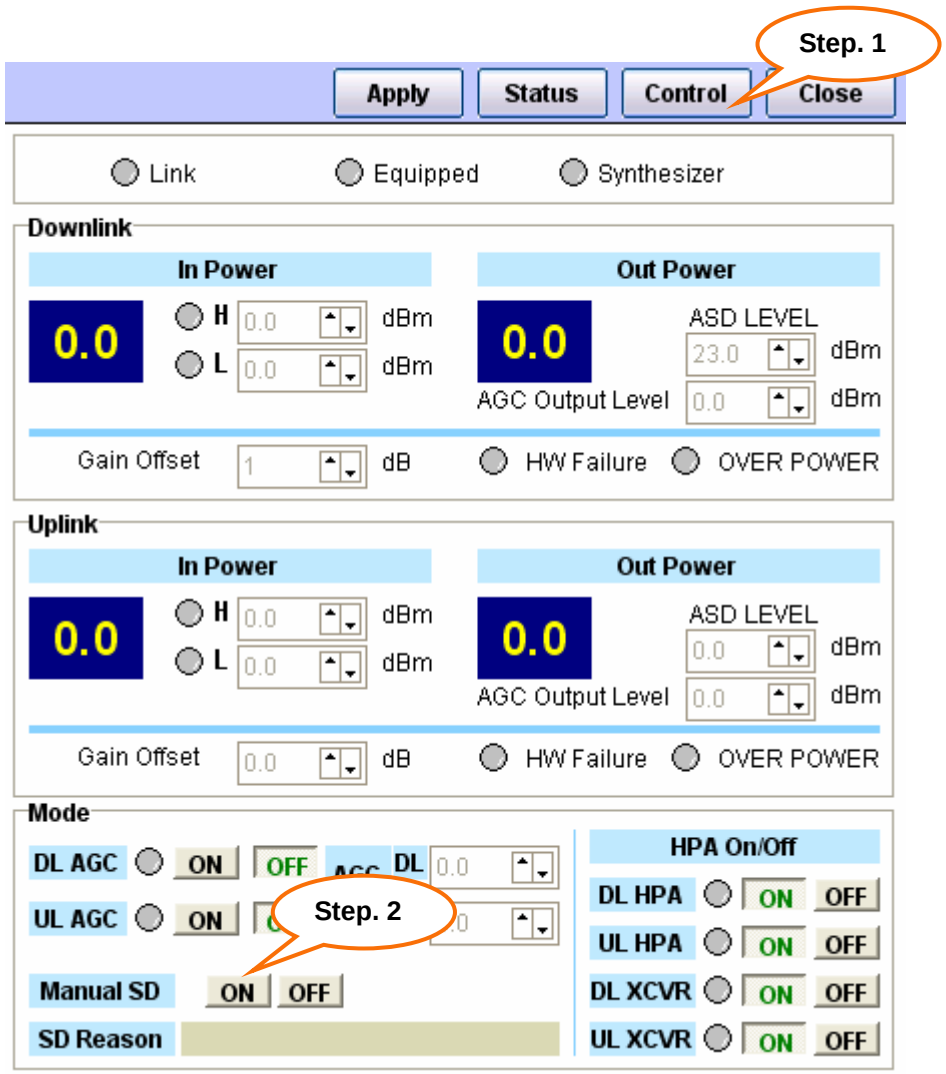


Figure 29 Manual Shut Down On

STEP	
1.	Click on “Control” to change mode to Control.
2.	Click the button to set it ‘ON’.

- When manual shutdown is on, DL HPA, UL HPA, DL XCVR and UL XCVR are all changed to the ‘ON’ state.

4.6.8 MANUAL Shut Down OFF

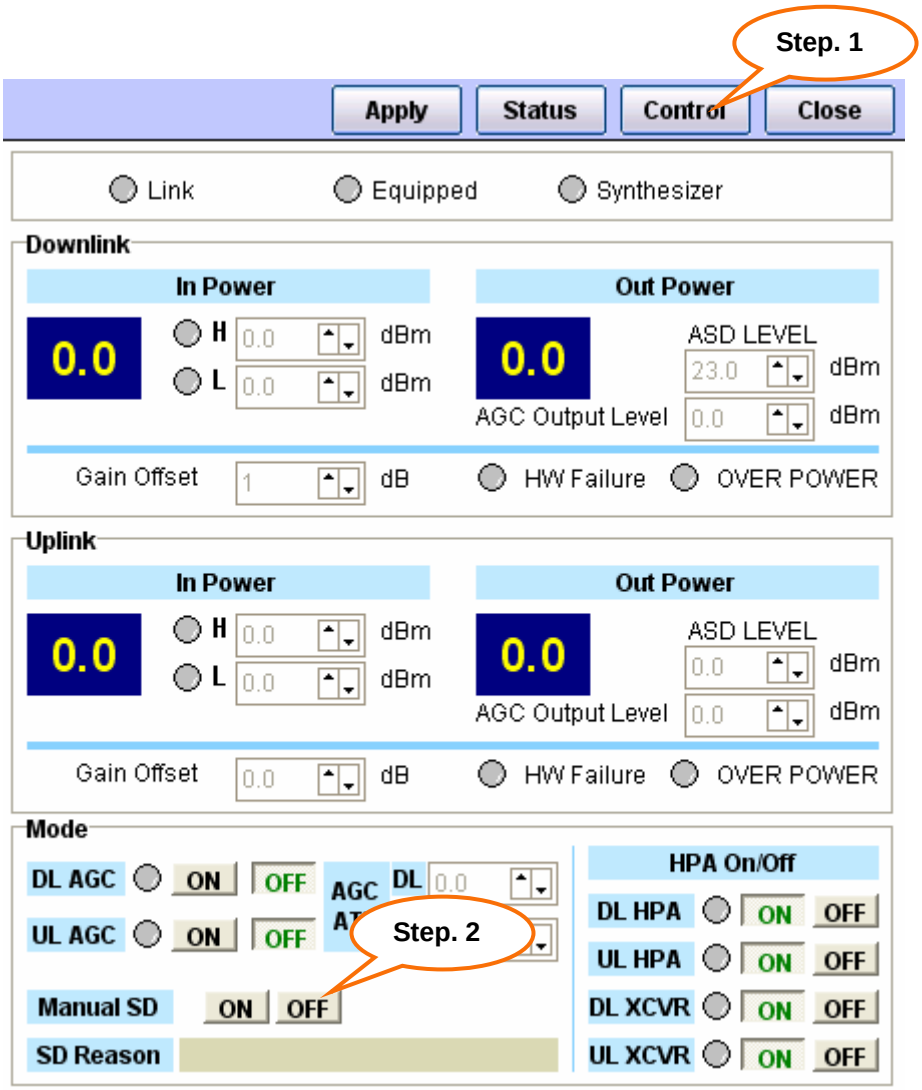


Figure 30 Manual Shut Down Off

STEP	
1.	Click on “Control” to change mode to Control.
2.	Click the button to set it ‘ON’.

- When manual shutdown is on, DL HPA, UL HPA, DL XCVR and UL XCVR are all changed to the ‘ON’ state.

4.6.9 Automatic Shut Down

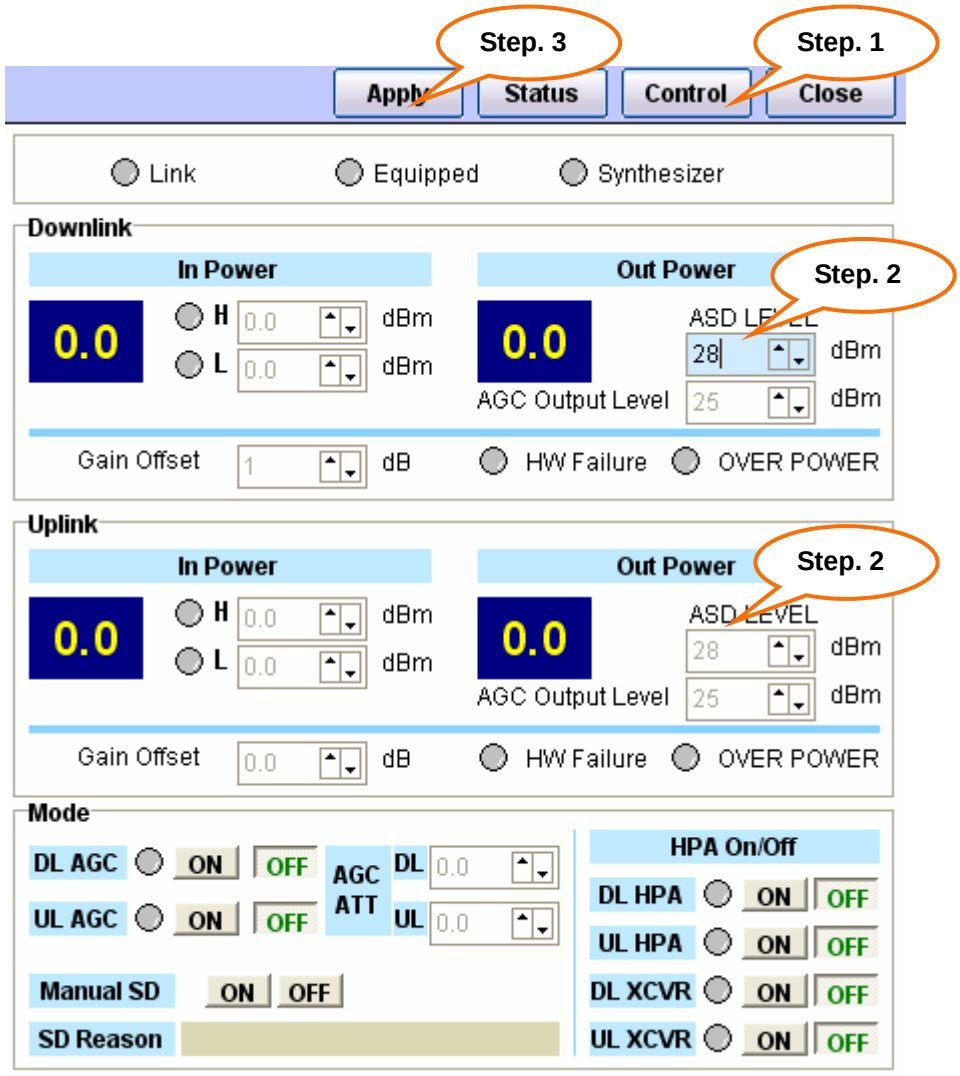


Figure 31 Setting Up ASD for Overpower

STEP	
1.	Click on “Control” to change mode to Control.
2.	Set ASD level.
3.	Click ‘Apply’.

- If there is any condition for shutdown, shutdown will be activated and the reason for ASD will be displayed. (Oscillation Detected, Spurious Emission)
- If the device is in permanent shutdown mode, reset the device or turn the manual shutdown only after resolving the issue that caused shutdown.
- 2 dB Hysteresis needs to be met before shutdown is deactivated to prevent the unit from ping-ponging between ON and OFF.

4.6.10 FILTERS

- If you click each module, the section for setting a filter will be displayed as below.

1) PCS

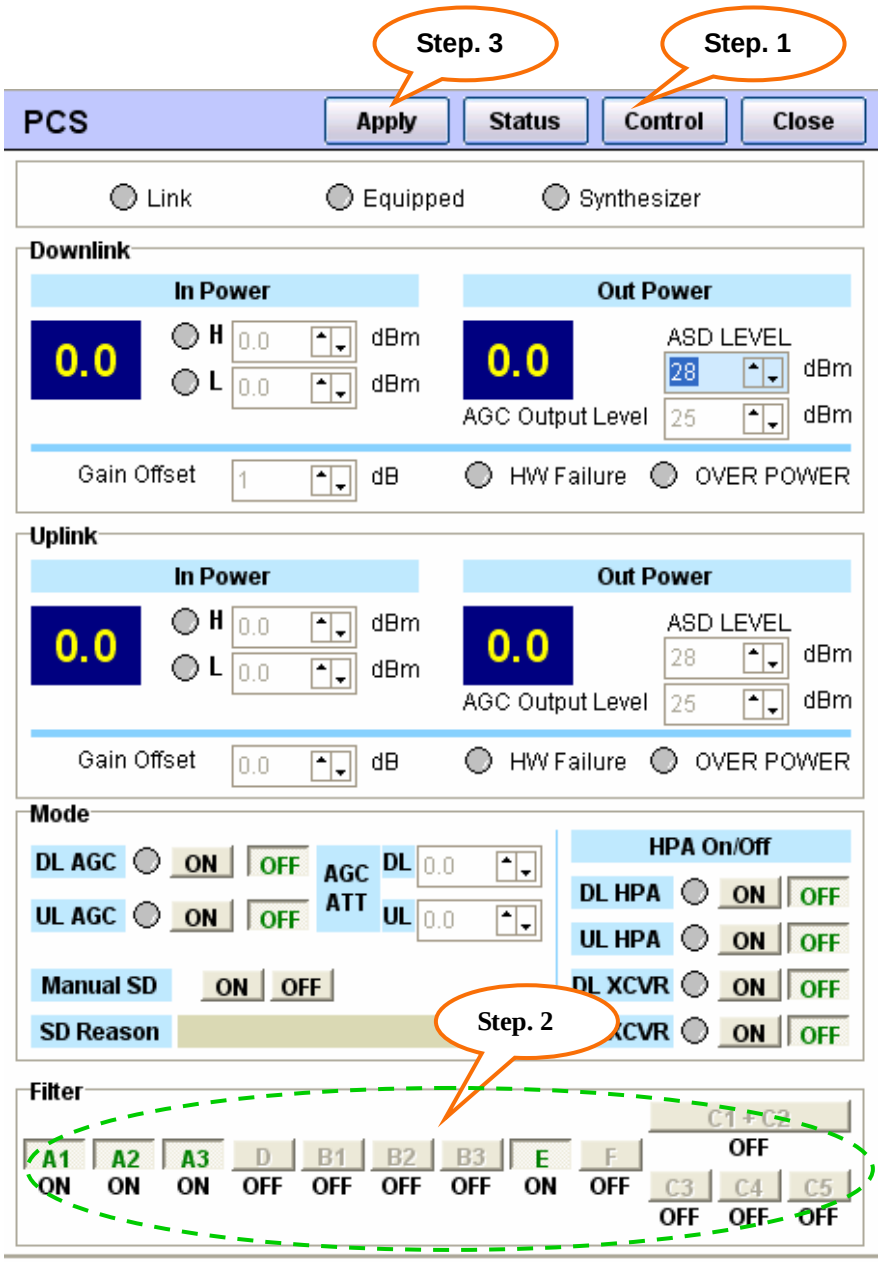
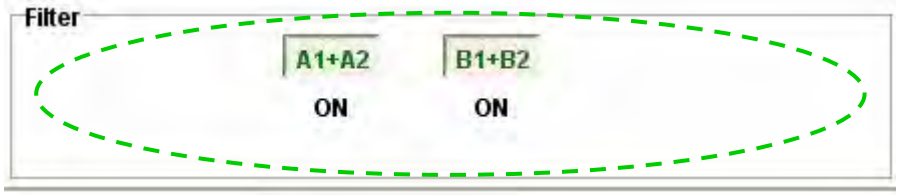


Figure 32 Filter Selection

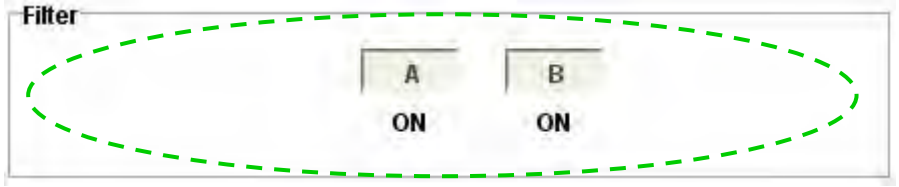
STEP	
1.	Click on “Control” to change mode to Control.
2.	Select desired band(s).
3.	Click ‘Apply’.

2) Cellular



3) LTE-C

4) LTE-A&B



4.7 SUB Functions

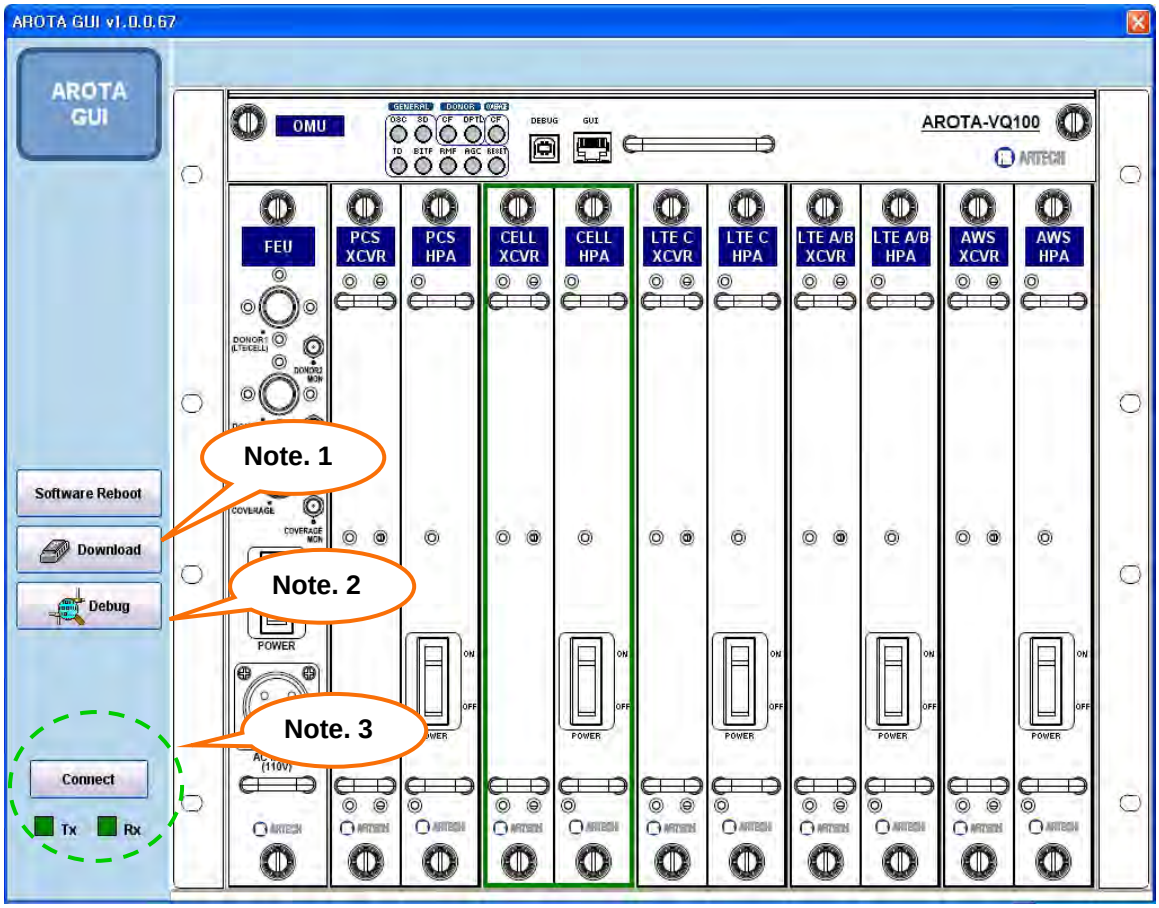


Figure 33 Main Window (Sub Functions)

Note.	Description
1	If you click 'Download', a pop-up will come on to upgrade a firmware of each module and main board.
2	If you click 'Debug', a pop-up will come on to check the status of communication link between GUI and main board.
3	If you click 'Serial' or 'USB' as a connection method of GUI and press 'Port Open', communication will starts with main board.

4.7.1 DOWNLOAD

4.7.1.1 Download Screen

It describes each function to upgrade a firmware in each module.

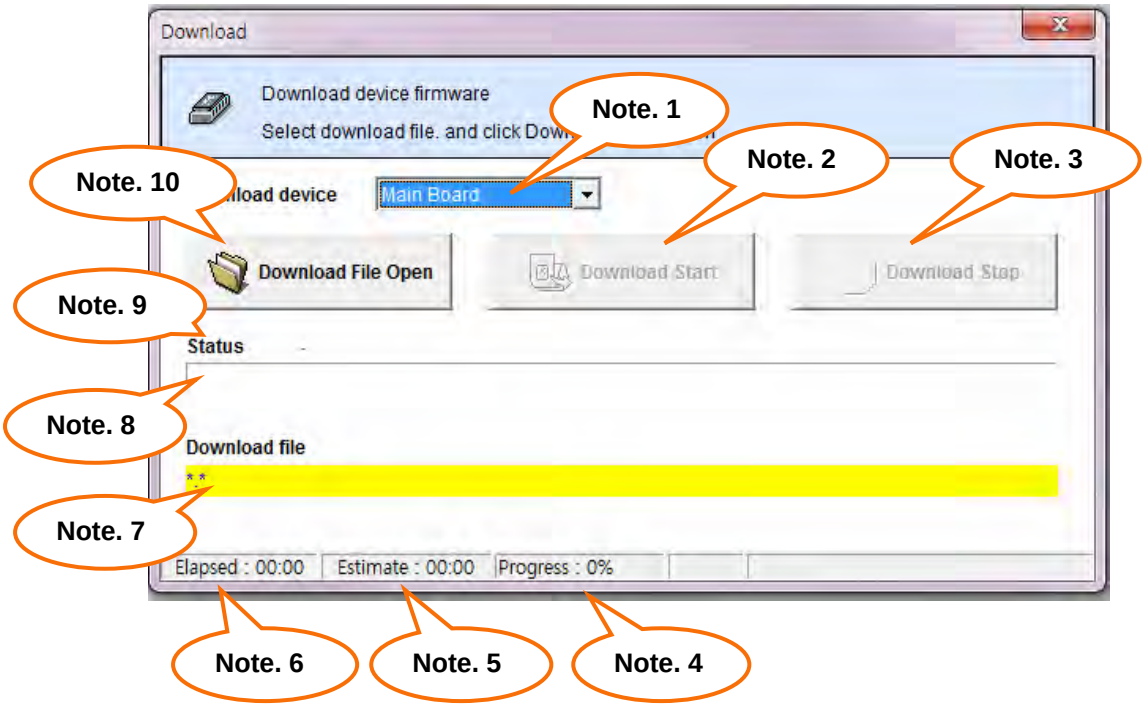
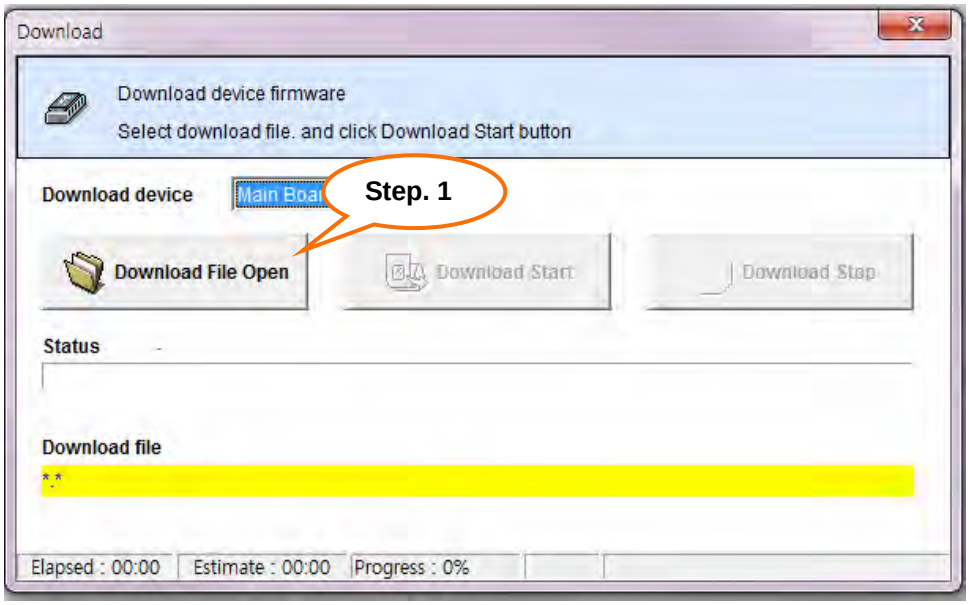


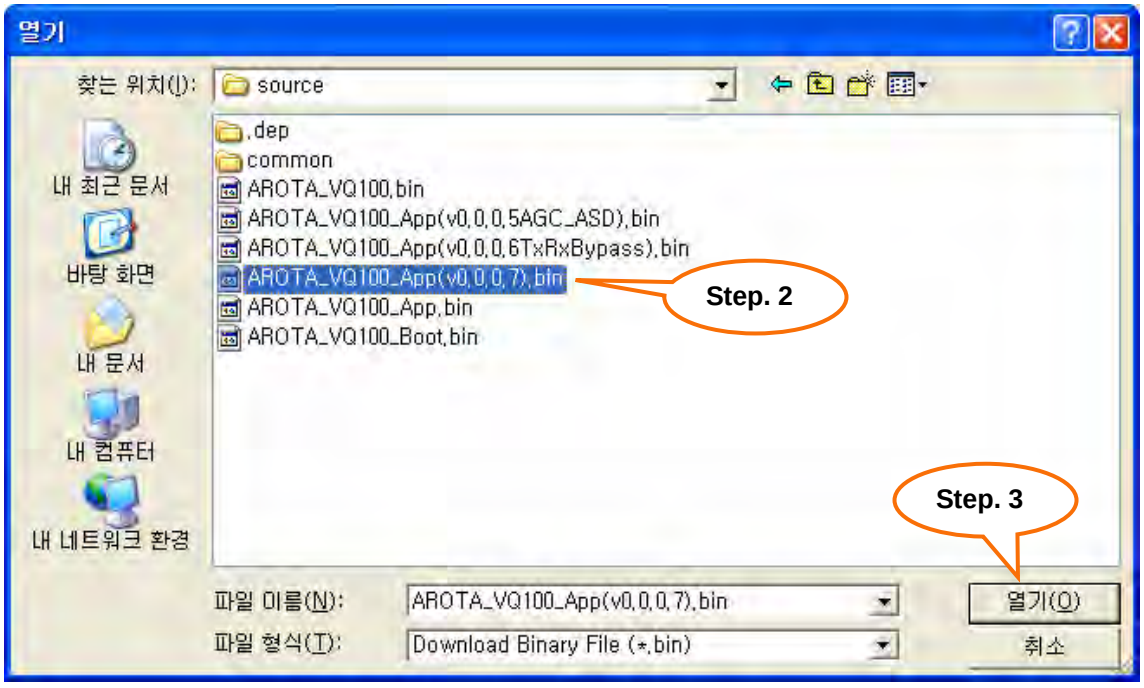
Figure 34 Download Screen

Note.	Description
1	Select a module for downloading
2	The button to start downloading the selected binary file into the module
3	The button to stop downloading
4	Display the percentage of download progress
5	Display estimated time for finishing download.
6	Display time elapsed for download
7	Display filename of selected binary file.
8	Display downloading progress
9	Display Status
10	The button to choose a binary file to download

4.7.1.2 Downloading

1. Download File Open

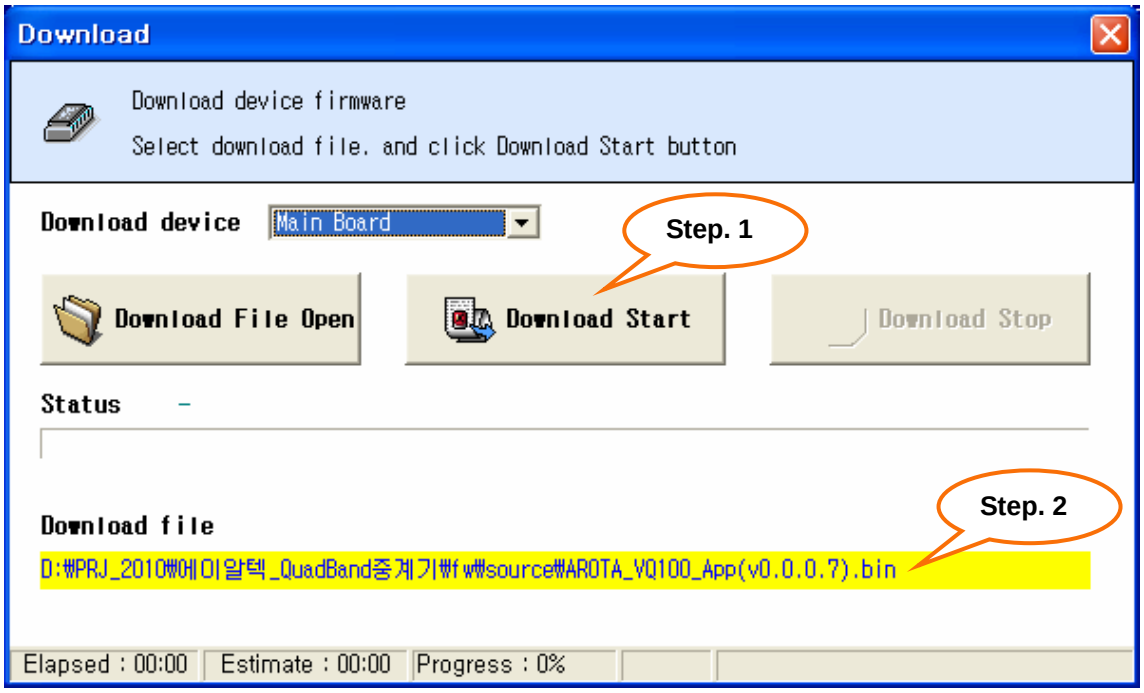




Download File Open

STEP	
1.	Click “Download File Open”.
2.	Select a file.
3.	Press the ‘Open’ button.

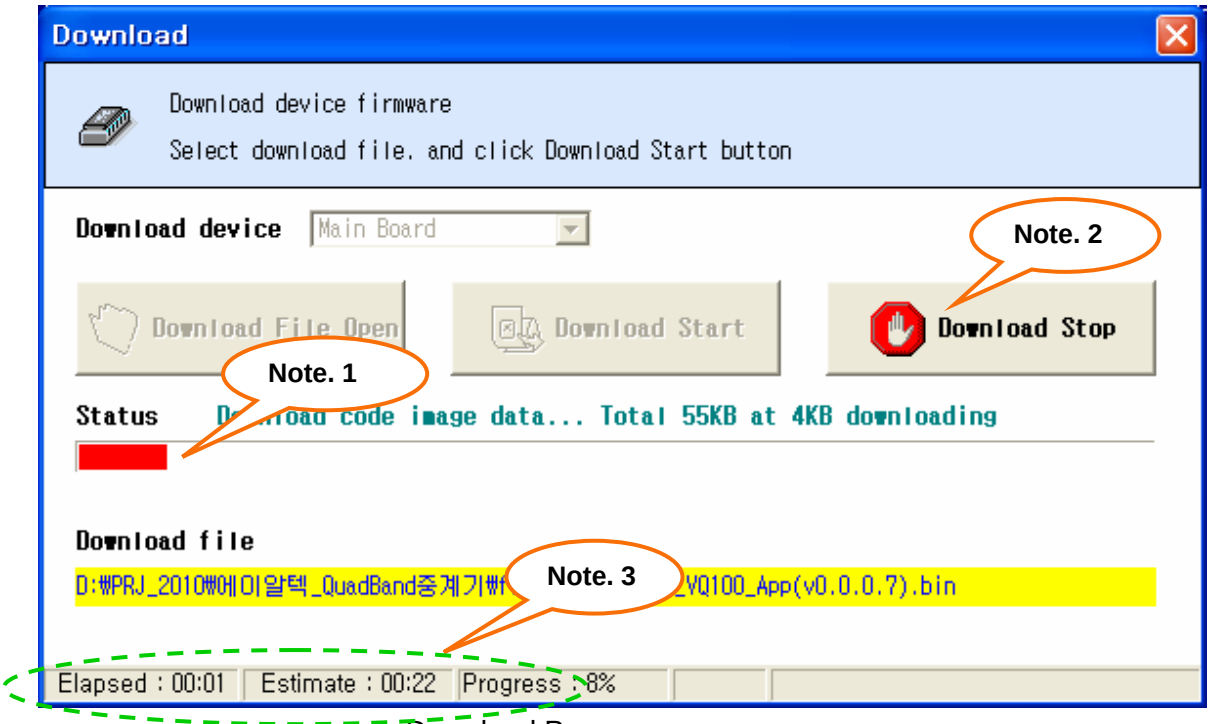
2. Download Start



Download Start

STEP	
1.	Once you select a file, the download Start button will be active. If you click it, it will start downloading.
2.	It shows the file name of selected download file.

■ **Description of downloading progress**



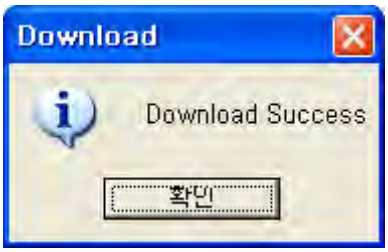
Download Progress

Note.	Description
1	If you start downloading, the progress will be displayed in the ‘Status’ section..
2	If you want to stop downloading, press the ‘Download Stop’ button.
3	Elapsed time, estimated time and the percentage of progress to download are displayed on the bottom status bar.

- If you click the ‘Download Stop’ button, the pop-up will be come out in below Figure..

Download stop message

- If download is completed, there will be appeared like below window.



Download Success message

4.7.2 DEBUG

It is a screen to debug AIDs in communication link between GUI and main board.

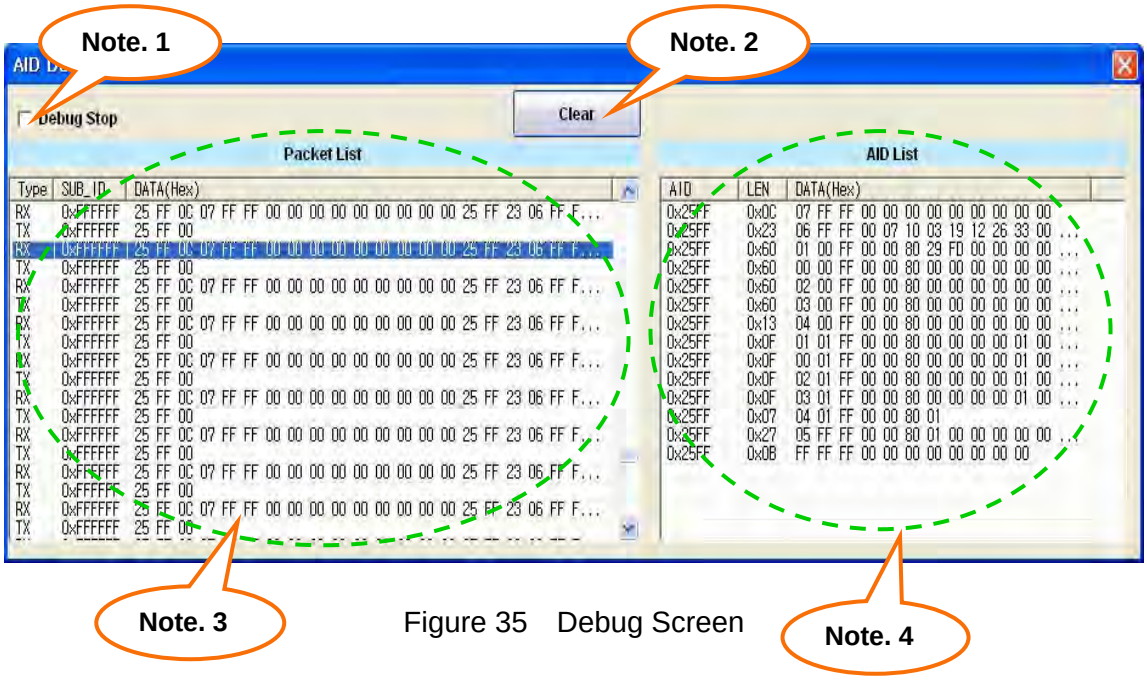


Figure 35 Debug Screen

Note.	Description
1	The checkbox which stops updating during communication
2	Delete all contents on the list.
3	The list which shows the packets between GUI and main board. If you click some content, details about it are displayed as in section No 4.
4	The list which shows separated AID contents of the packet selected in No 3.

5. Product Description

5.1 System Architecture

The system is designed to be installed in a standard 19” rack with easy handling, assembly, and installation. For simple maintenance and configuration, the modules can be inserted and removed from the front side without using any tool.

The system modules are shown below.

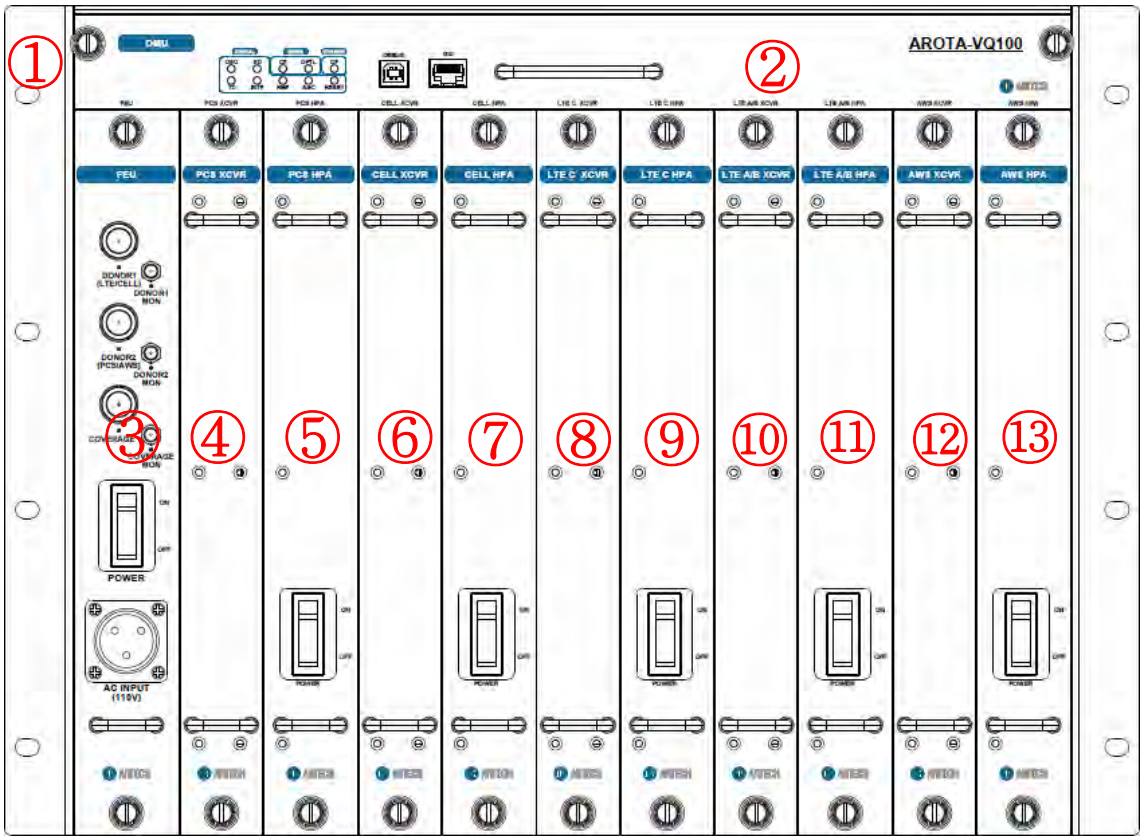
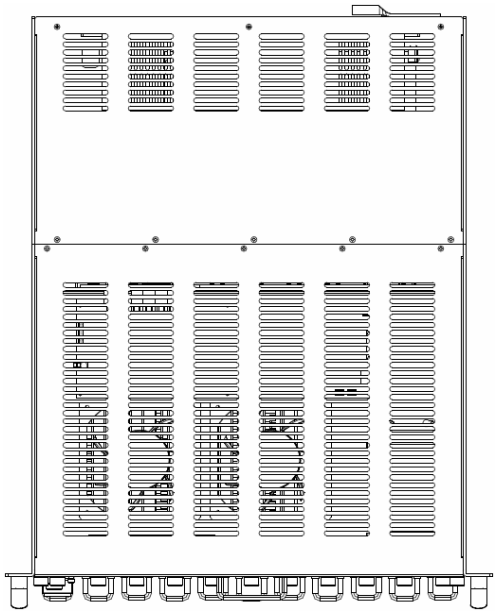


Figure 36 Shelf Front Side Cards

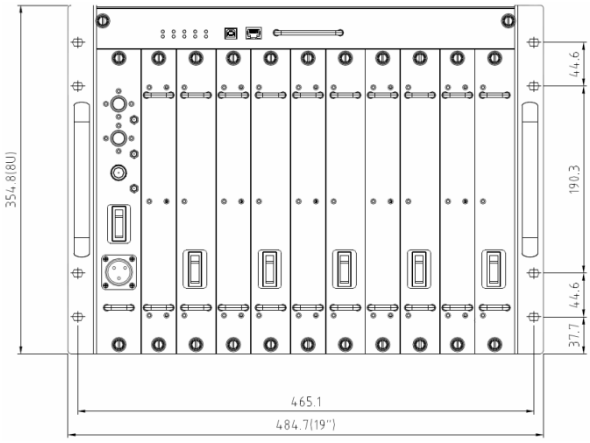
Table 10 Modules on the Front of SHELF

Num	Name		Num	Name
①	Shelf		⑧	LTE A/B XCVR
②	OMU		⑨	LTE A/B HPA
③	FEU		⑩	LTE C XCVR
④	PCS XCVR		⑪	LTE C HPA
⑤	PCS HPA		⑫	AWS XCVR
⑥	Cellular XCVR		⑬	AWS HPA
⑦	Cellular HPA			

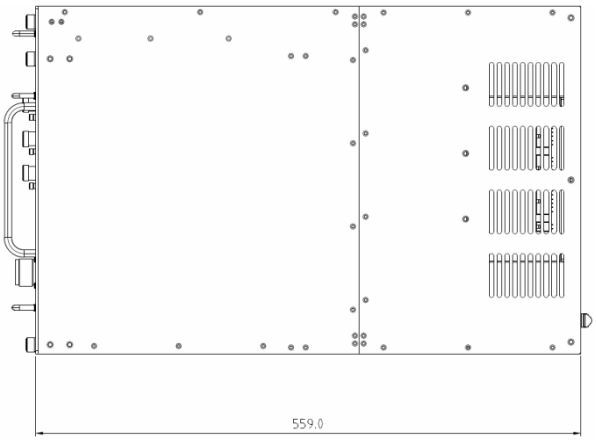
5.2 Product Views and Physical Dimensions



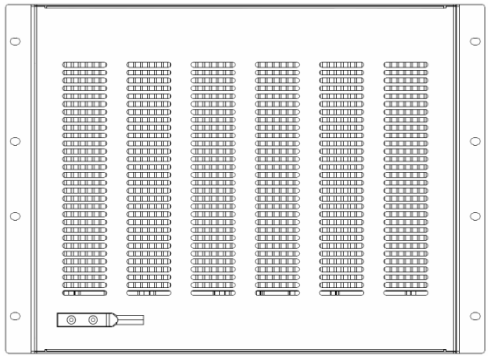
[View of top]



[View of front]



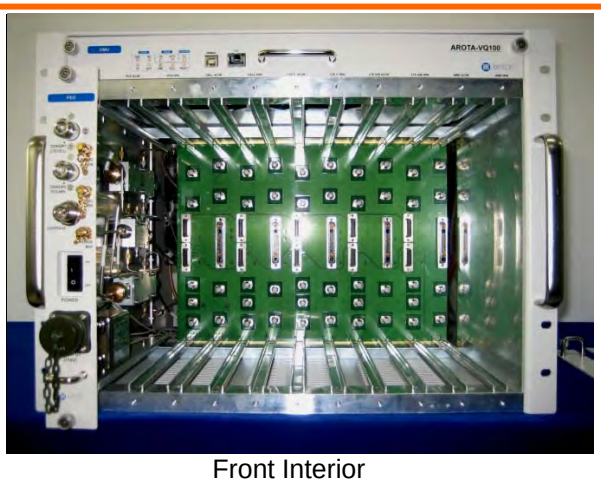
[View of side]



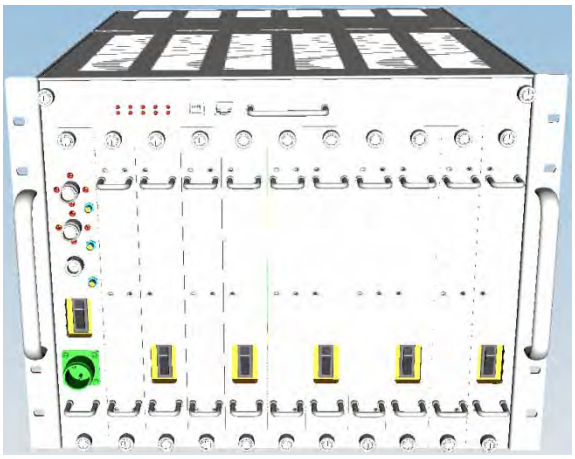
[View of rear]

Figure 37 System Dimension

Front



Front Interior



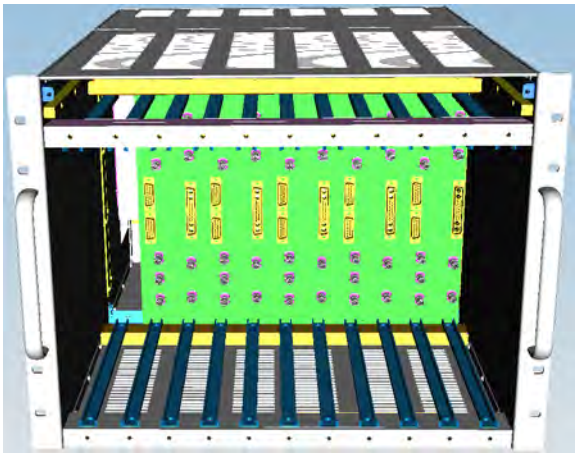


Figure 38 Shelf: Front

On the back side of the shelf, 2-hole ground lug is equipped for 18㎟ ground cable.

Back

Back Side Interior

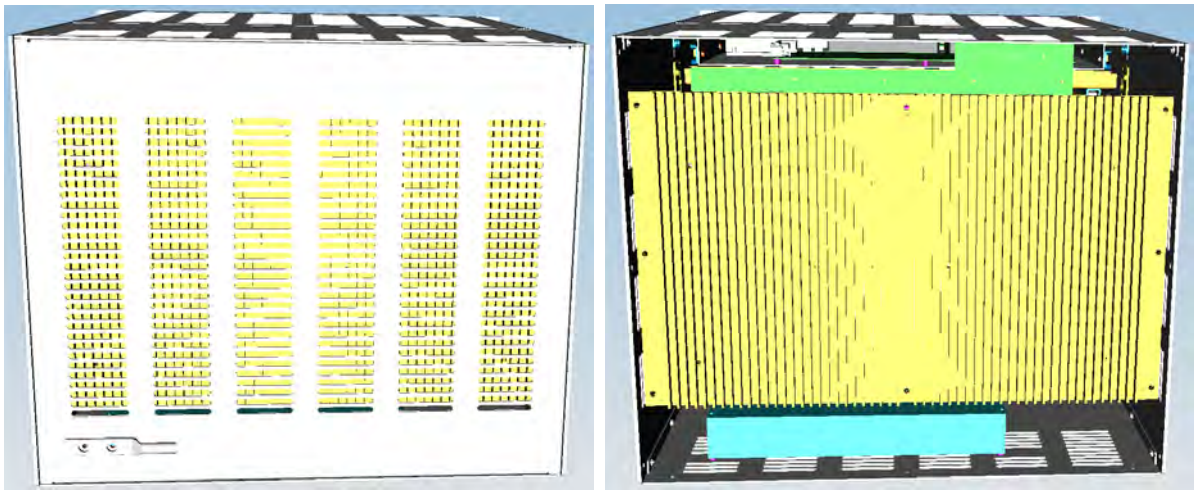
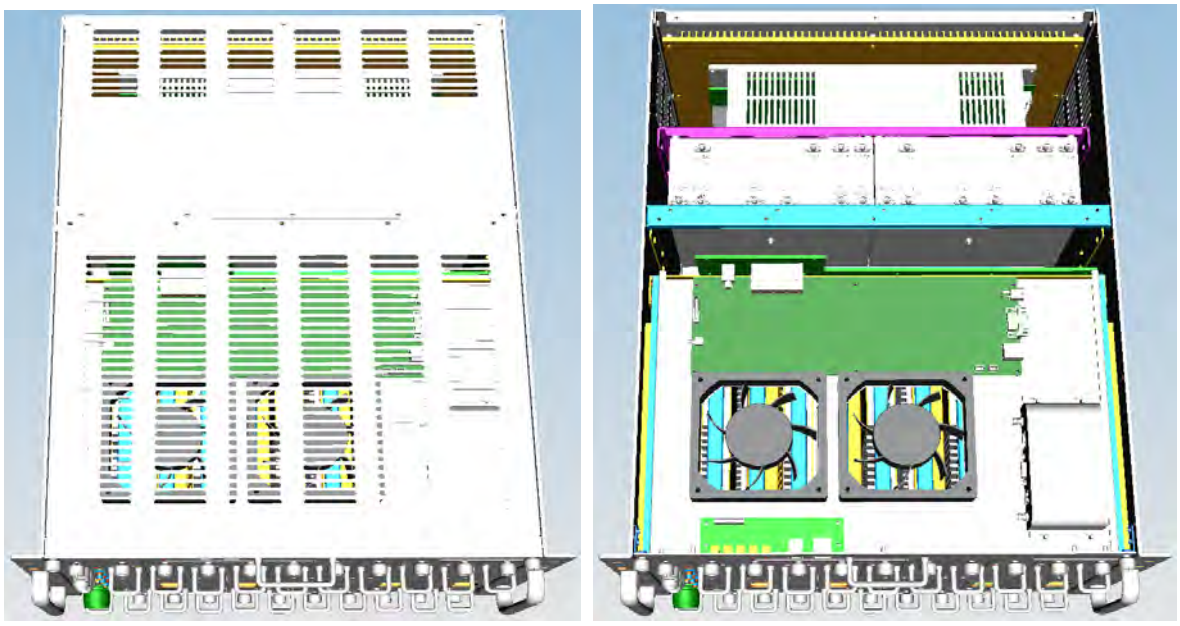


Figure 39 Shelf: Back Side

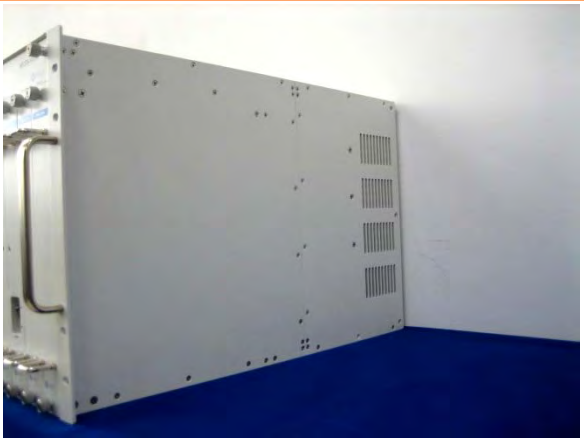
Top



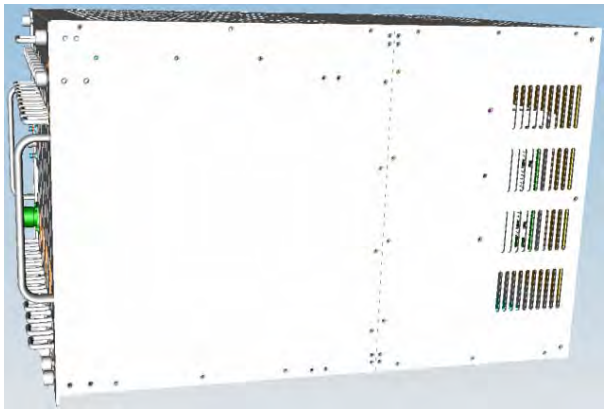
Top

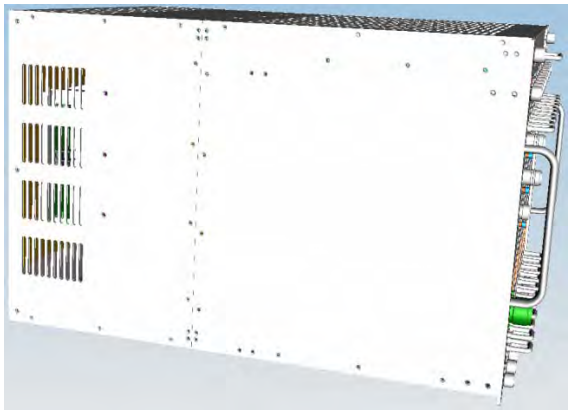
Figure 40 Shelf: Top Side

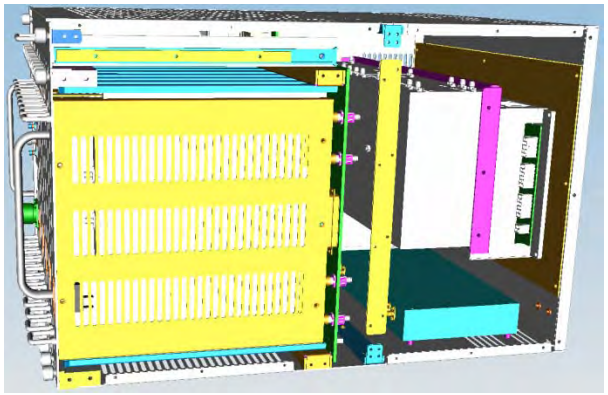
Left Side



Right Side







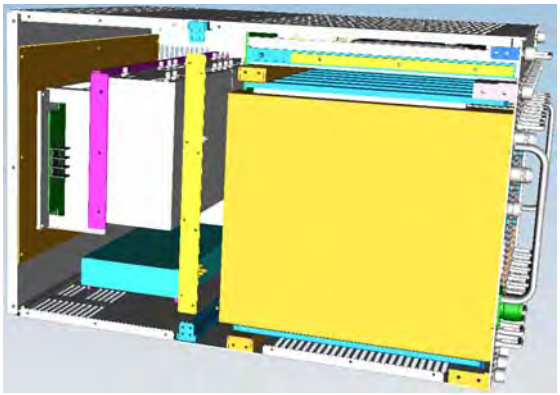
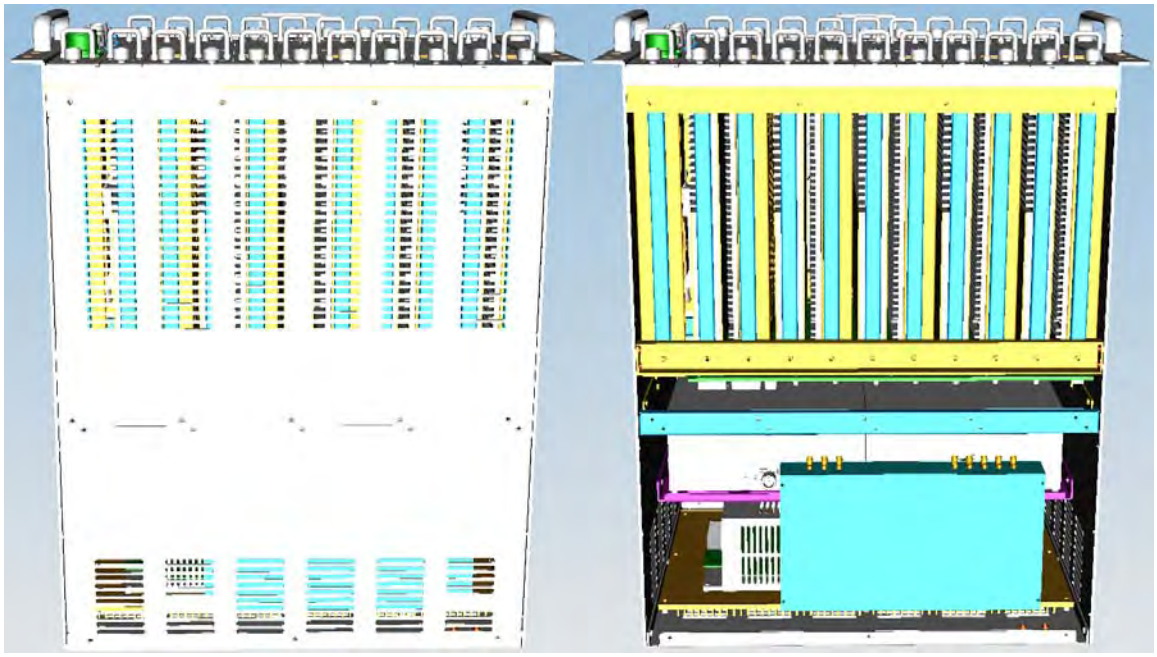


Figure 41 Shelf: Sides



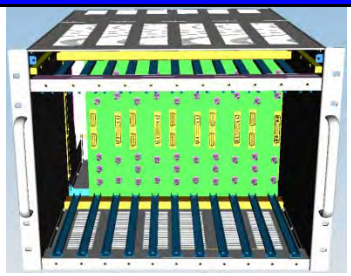
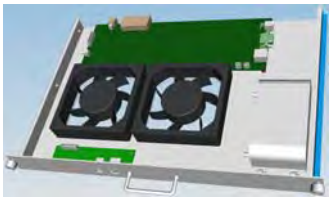
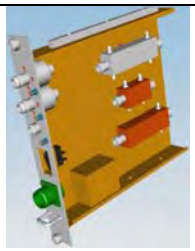
Bottom

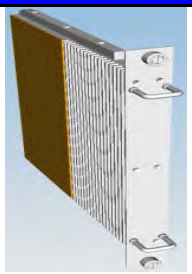
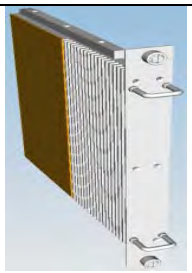
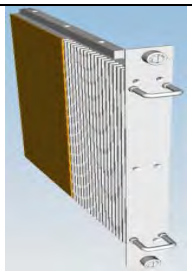
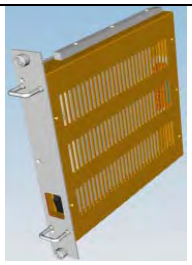
Figure 42 Shelf: Bottom Side

5.3 Unit Description

The table below describes each modules in the system.

Table 11 Units

Num	Unit Name	Illustration	Modules
1	Shelf		Chassis/Panels /Cables MUX Back Board Assembly PSU Alarm Monitoring Unit Weight : 31.15Kg(Including FEU)
2	OMU		Housings/Panels /Cables NMS board Wireless Modem Alarm LED Fan Weight : 1.44Kg
3	FEU		Housings/Panels/ Connectors/Cables Couplers Arrestor

Num	Unit Name	Illustration	Modules
4	PCS XCVR		Housings/Panels RF Transceiver DSP board Weight : 2.79Kg
5	PCS HPA		Housings/Panels HPA Weight : 3.01Kg
6	Cellular XCVR		Housings/Panels RF Transceiver DSP board Weight : 2.82Kg
7	Cellular HPA		Housings/Panels HPA Weight : 2.83Kg
8	LTE A/B XCVR		Housings/Panels RF Transceiver DSP board Weight : 2.83Kg
9	LTE A/B HPA		Housings/Panels HPA Weight : 3.01Kg

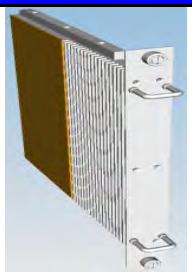
Num	Unit Name	Illustration	Modules
10	LTE C XCVR		Housings/Panels RF Transceiver DSP board Weight : 2.82Kg
11	LTE C HPA		Housings/Panels HPA Weight : 3.01Kg
12	AWS XCVR	TBD	Housings/Panels RF Transceiver DSP board Weight : TBD
13	AWS HPA	TBD	Housings/Panels HPA Weight : TBD

Table 12 Power Consumption Per Unit

Item	Currents		Condition
Shelf	884	mA	
PCS	1256	mA	Max Gain.
Cellular	566	mA	
LTE C	1016	mA	
LTE AB	996	mA	
Total Current	4718	mA	
Power Consumption	518.98	W	Input: AC110V

5.3.1 Shelf

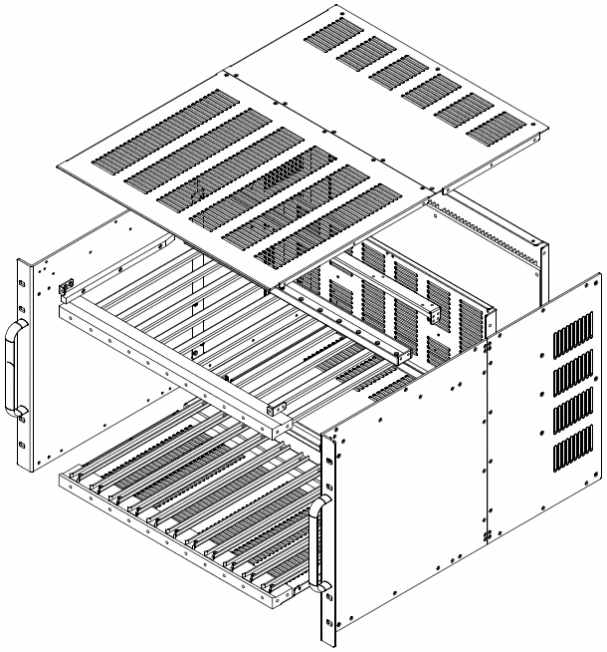


Figure 43 Shelf Case

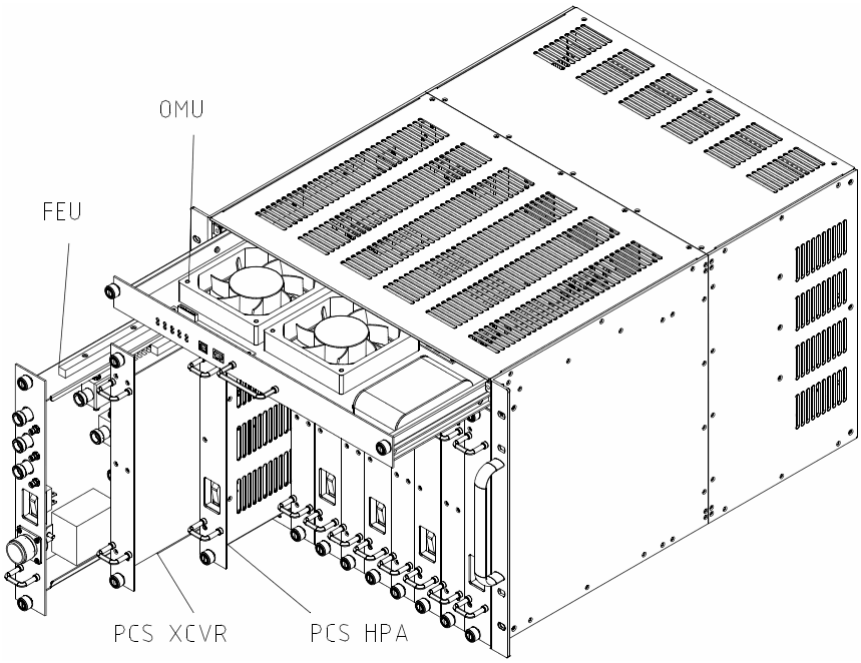


Figure 44 Shelf: Equipping Module Cards

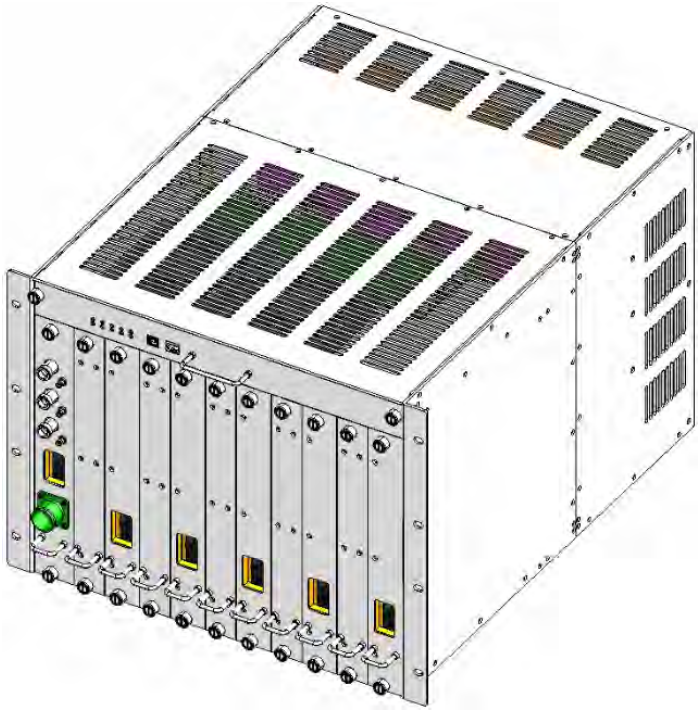


Figure 45 Shelf: Fully Equipped

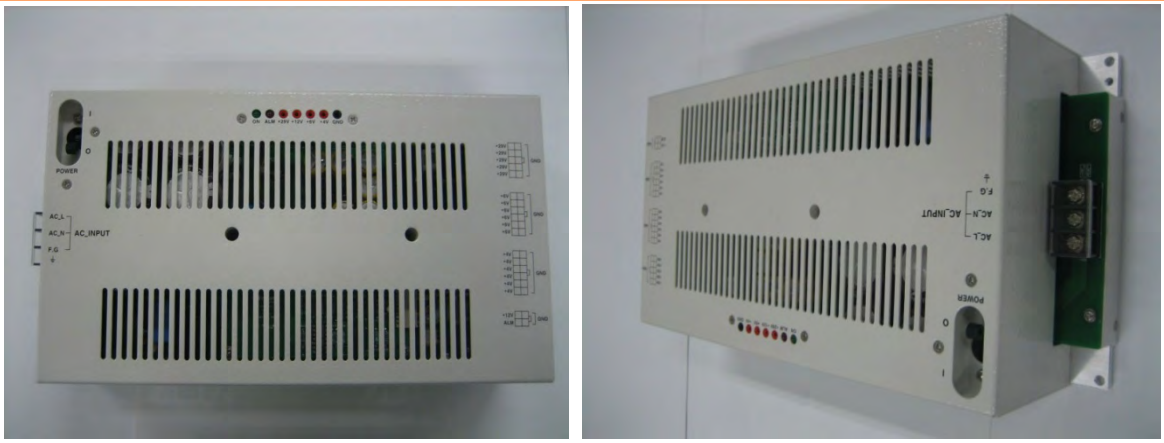
5.3.1.1 PSU (Power Supply Unit)

The PSU supplies +29V, +12V, +6V and +4V to each modules by converting 110V AC. The PSU also includes ON/OFF switch as well as a fuse to protect from a surge. LED for status indication and monitoring port for DC output levels are provided.

Table 13 PSU Capacity

Output Voltage	Max. Current	Usage	Power Consumption
+29V	16A	HPA	700W
+12V	1.5A	Wireless MODEM, FAN	
+6V	23A	RF Transceiver Board, Alarm Monitoring Unit, DSP Board, NMS, SNMP, LED Board	
+4	20A	DSP Board	

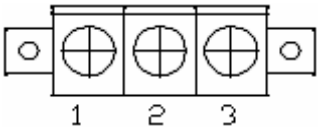
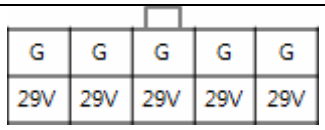
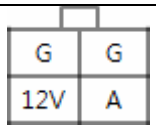
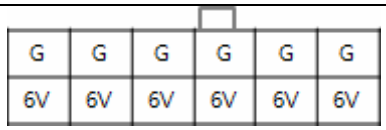
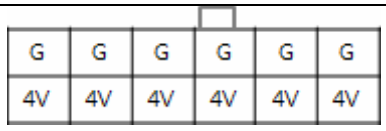
PSU and its pin maps are shown below.



외관도 PSU Location

Figure 46 PSU

Table 14 PSU Pin Map

I/O	Voltage	Pin Map	Remarks
INPUT	AC110V		1. AC_L 2. AC_N 3. F.G
OUTPUT	+29V		G: Ground
	+12V		G : Ground A : Alarm
	+6V		G: Ground
	+4		G: Ground

5.3.1.2 MUX(Multiplexer)

MUX filters out the out of band signals. For the uplink, MUX filters out signals from HPA to antenna so that the system would transmit any RF to other bands. For downlink, it suppresses out of band signals other than air-coupled signals from the donor base stations.

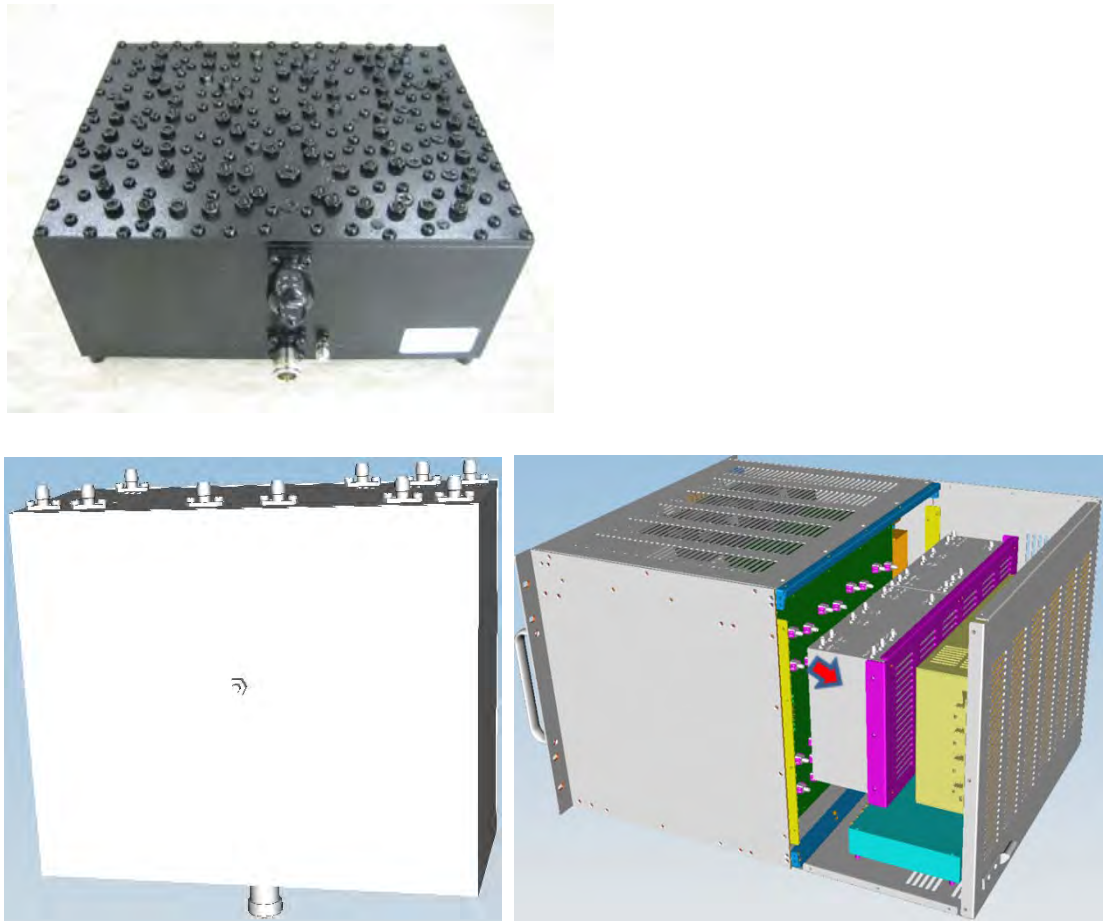
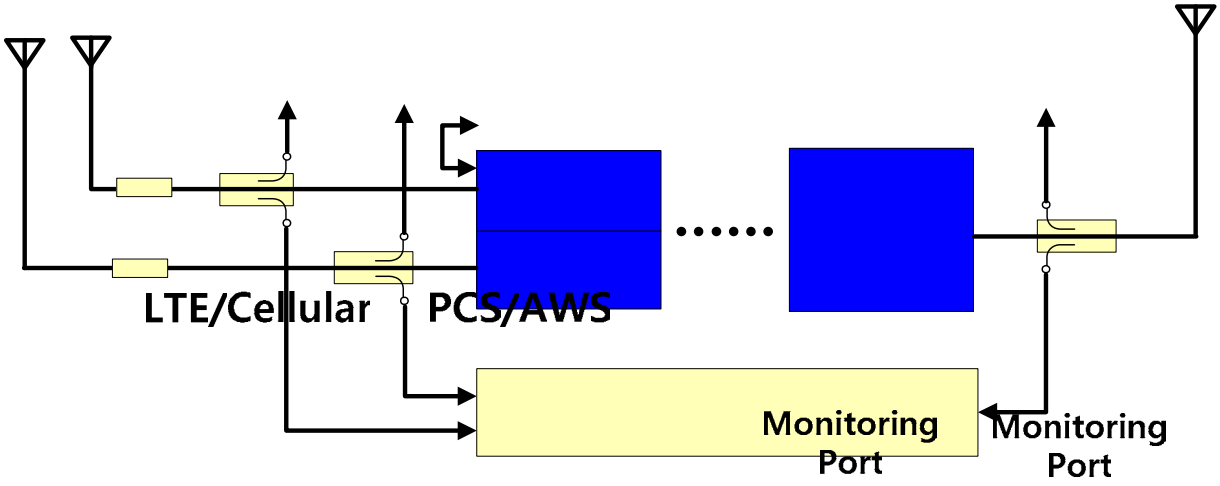


Figure 47 MUX

The main function of Multiplexer and interface diagram between Arrester and Coupler are as below.



1. UL Multiplexer

   - Consists of a block to multiplex RF signal in LTE A/B Band, LTE C-Band, and Cellular Band and another Block to multiplex RF signals from PCS and AWS.

   - Wireless MODEM Connection Port.

2. DL Multiplexer Block

   - Multiplexes Cellular & PCS, LTE A/B, LTE C, and AWS Band.

5.3.1.3 Alarm Monitoring Unit

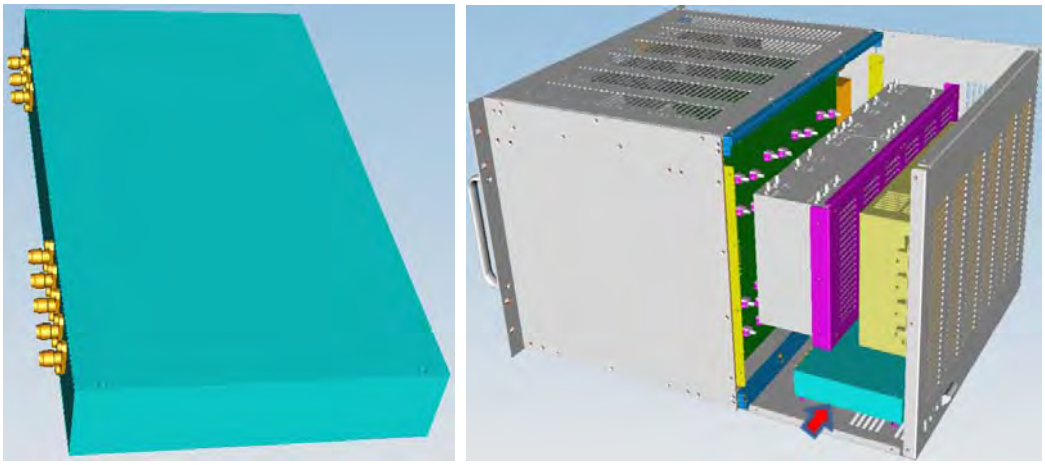


Figure 48 Alarm Monitoring Unit

The unit includes various detection circuits that generate alarm and status monitoring signals. A built-in OCXO module provides 10MHz reference signal. The Alarm Monitoring Unit consists of two functional parts of alarm monitoring and generation and distributing 10MHz reference signal.

1. Alarm Monitoring and Generation Part

   Monitors the following items and issues alarms if it goes out of specifications.

   - UL : Out-of-band emission out of spec
   - DL : Low Isolation, Spurious emission out of spec, Interferer power exceeded

2. 10MHz Clock Distribution Part

   Distributes 10MHz Reference Clock to XCVR.

5.3.1.4 Wireless Modem

Wireless Modem

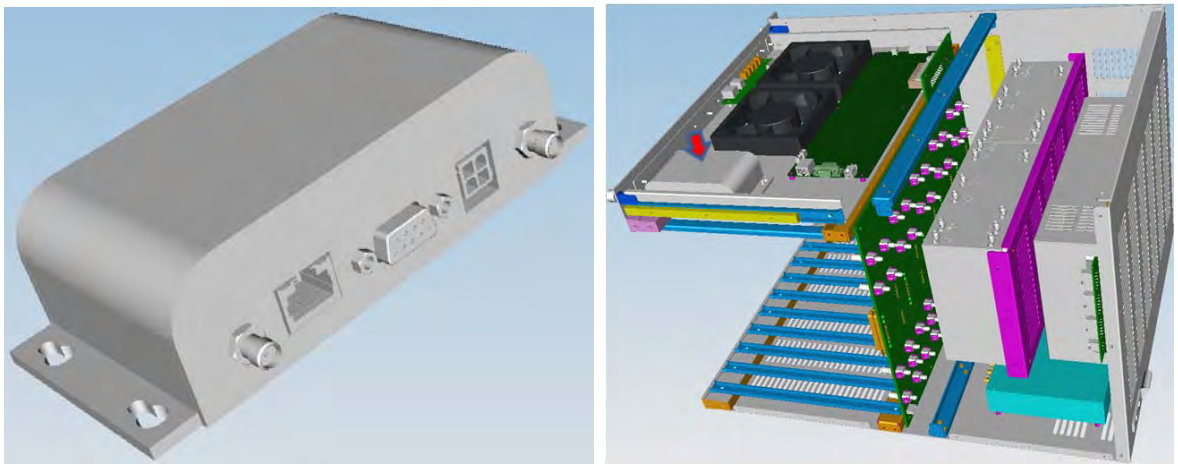
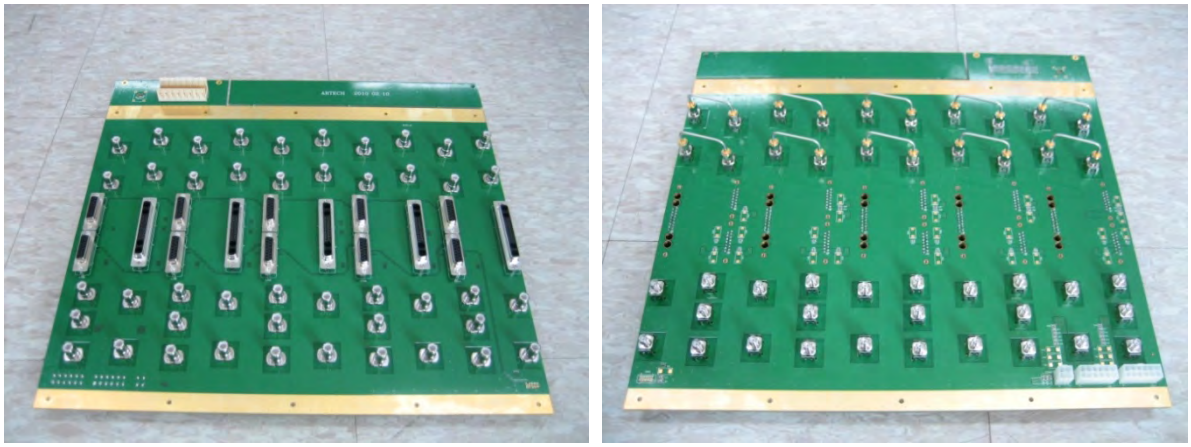


Figure 49 Wireless MODEM

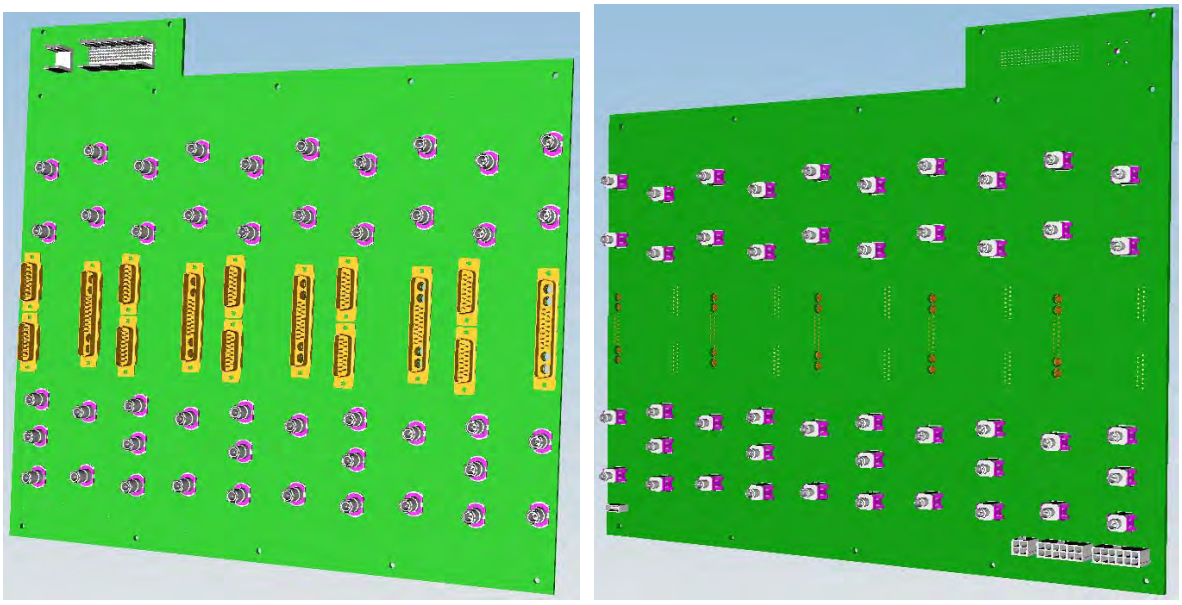
The wireless modem installed is Sierra Wireless AirLink™ Raven. The location of the wireless modem is within OMU Unit as shown in Figure 49.

5.3.1.5 Back Board

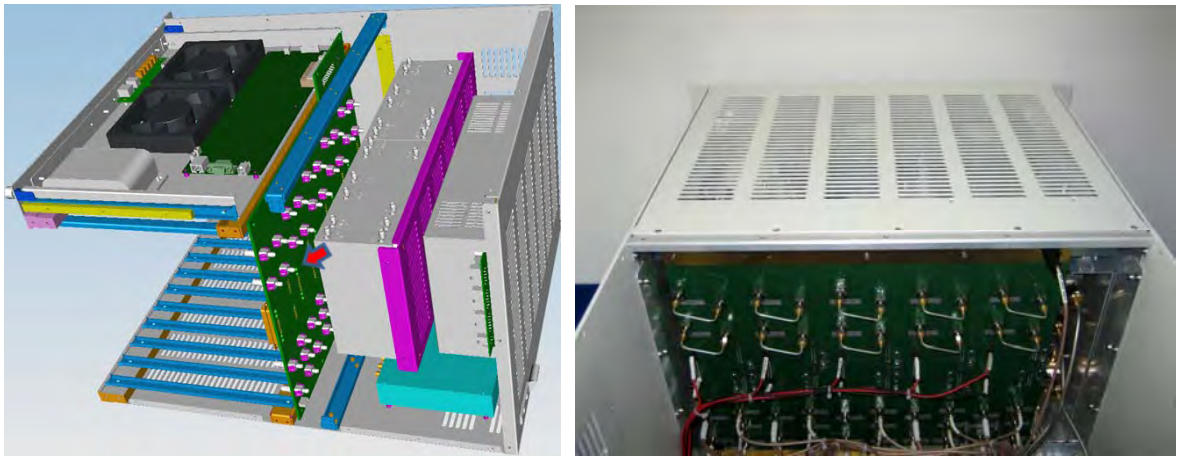
The back board collects control and monitoring signals from the modules and sends them to NMS. It also supplies DC power from PSU to each modules.



Front Back



Front Back



Location Picture

Figure 50 Back Board

5.3.1.6 Ground

For grounding, 14SQ Copper connector is available on the back side of the shelf.

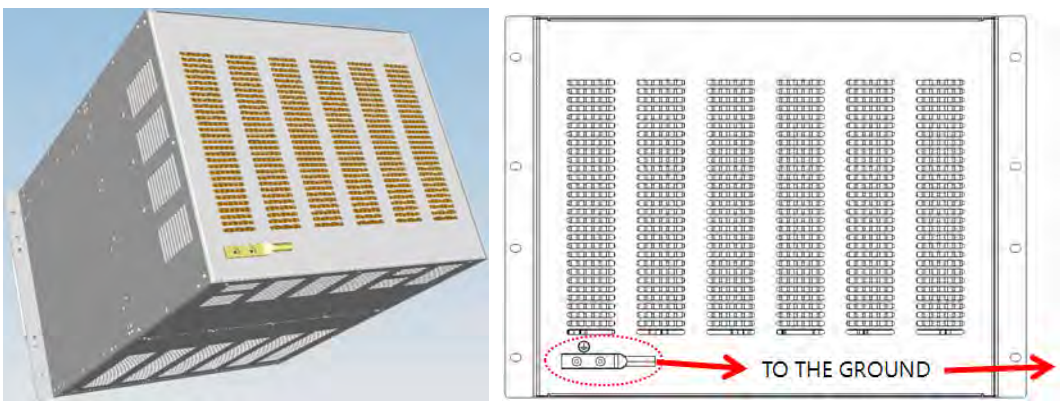


Figure 51 Ground Connector

5.3.2 OMU(Operating and Management Unit)

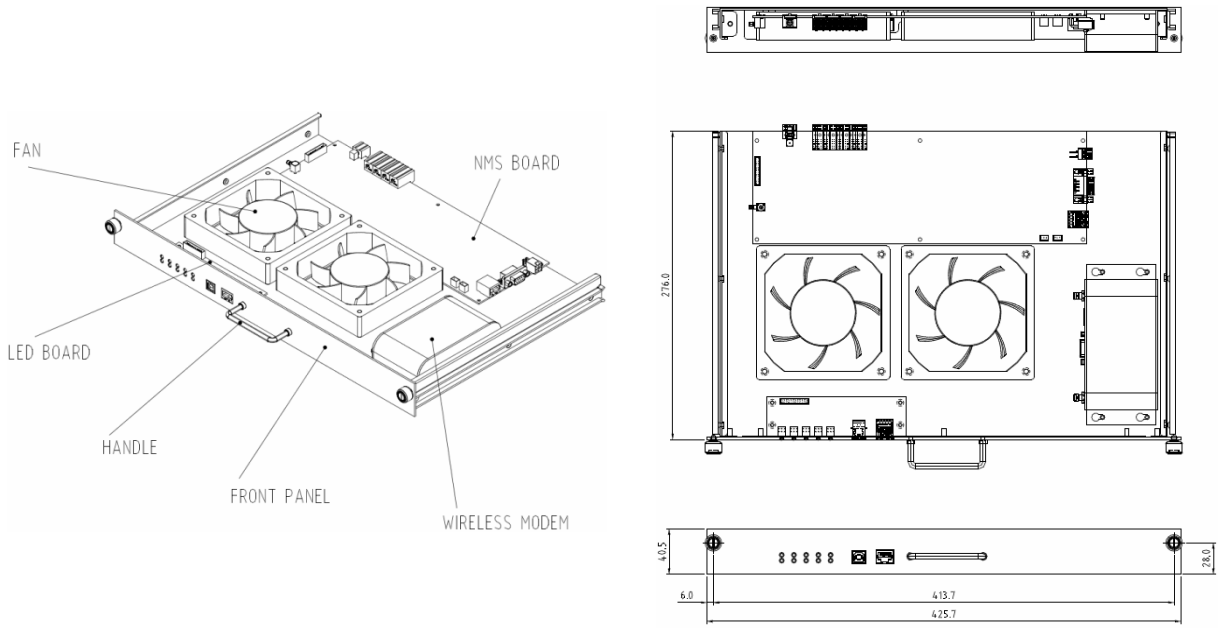
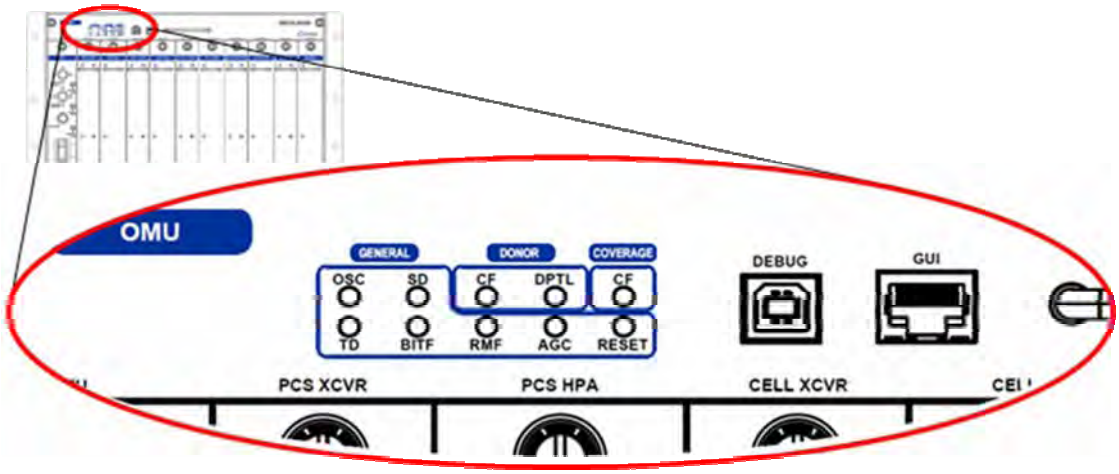


Figure 52 OMU

OMU is responsible for monitoring and controlling the system as NMS. It connects to an upper management system such as NOC using the installed wireless modem.

The physical connection with a PC is done via USB Port on the OMU. It also provides RJ-45 port. For visual monitoring purposes LED's are located on the front side of OMU. OMU also houses 2 fans for cooling the system..



DEBUG : USB Connection with a PCS for NMS Control and GUI Connection.

GUI : Ethernet Port for an upper management system such as NOC. It can also be used to access wireless modem with internally wired D-Sub 9-pin connector.

ALARM LED : The LED's on the front side are described in the table below.

Table 15 ALARM LED

Category	Item	Description
GENERAL	OSC	: Normal : Oscillation Alarm
	SD	: Normal : Shut Down Alarm
	TD	Not used
	BITF	: Normal : Built-in Module Fail
	RMF	: Normal : Replaceable Module Fail
	AGC	Toggle : AGC Status : AGC OFF
	RESET	: Normal : RESET
DONOR	CF	: Normal : Down Link Circuitry Fail
	DPTL	: Normal : Down Link Power too low
COVERAGE	CF	: Normal : Up Link Circuitry Fail

5.3.3 FEU(Front End Unit)

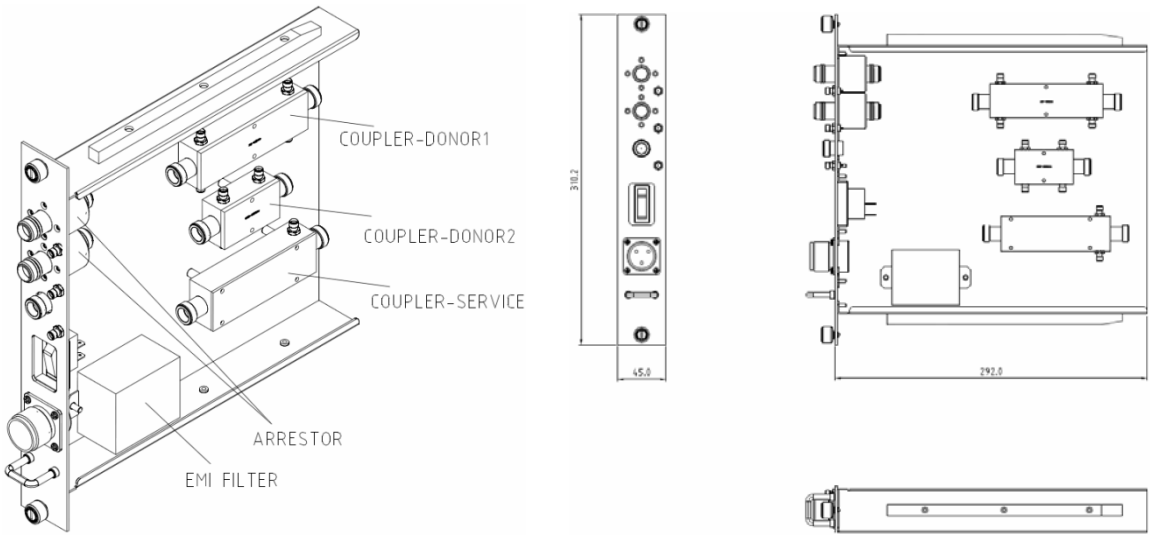


Figure 53 FEU

FEU is directly connected to antennas. It consists of an arrester, coupler, and EMI filter.

5.3.4 XCVRs(Transceivers)

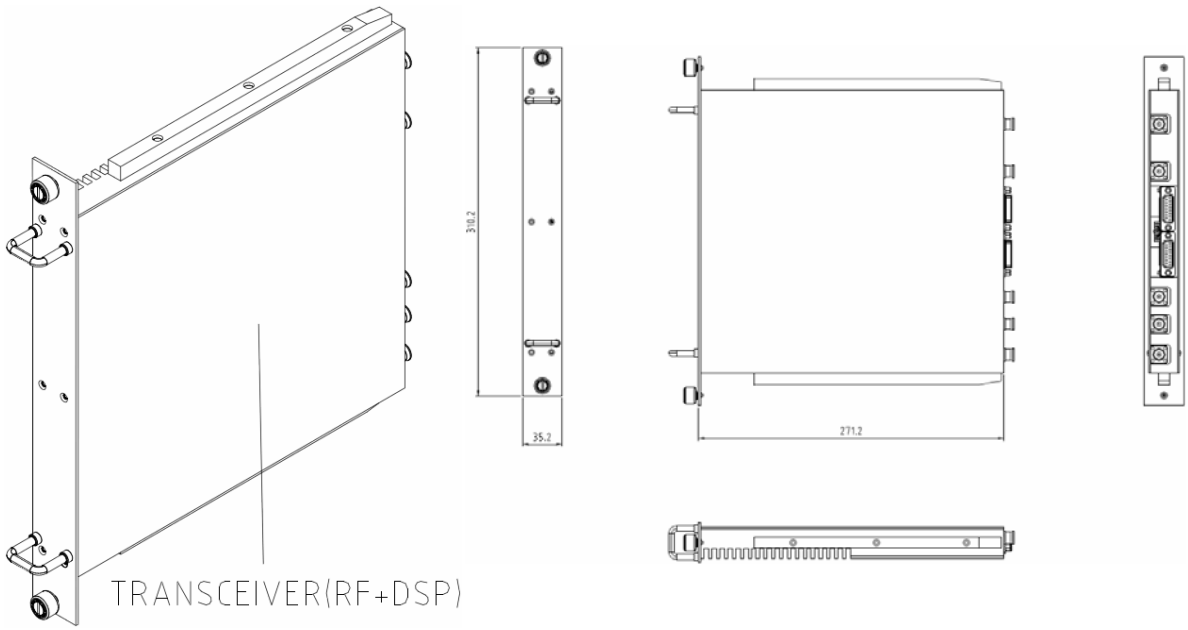


Figure 54 XCVR

5.3.5 HPAs(High Power Amplifiers)

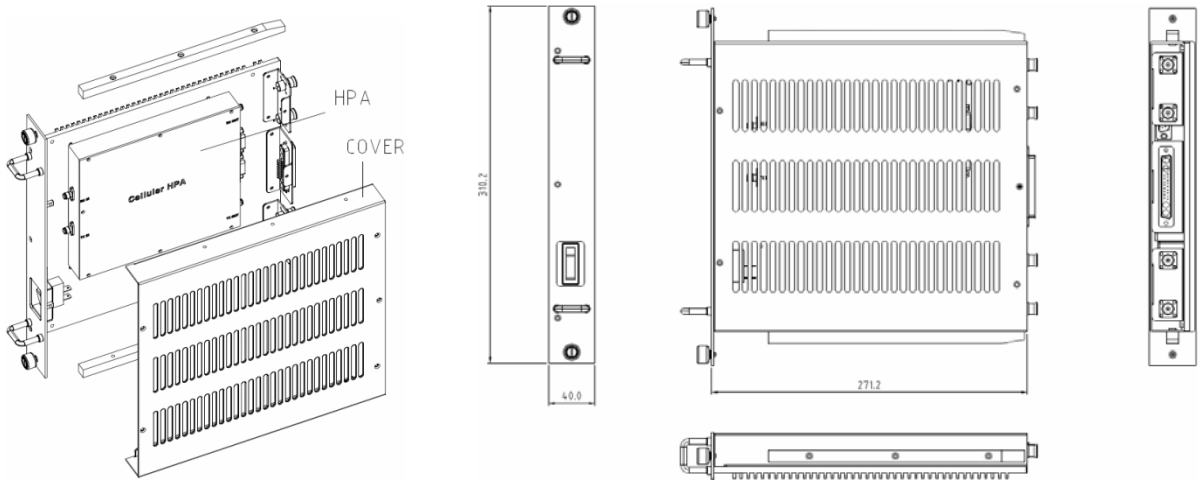
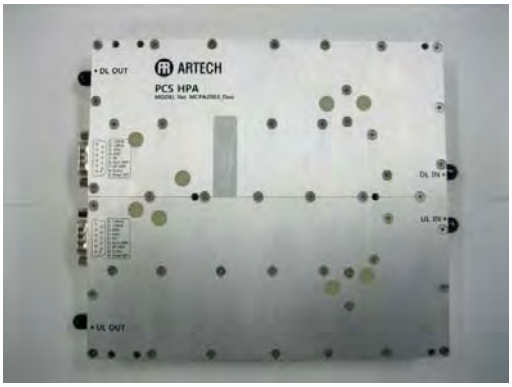


Figure 55 HPA



The HPA amplifies RF signal from the RF board to a maximum output power. The HPA has a separate power switch for shutting it down in necessary.
The HPA unit houses both downlink and uplink amplifiers.

Table 16 HPA

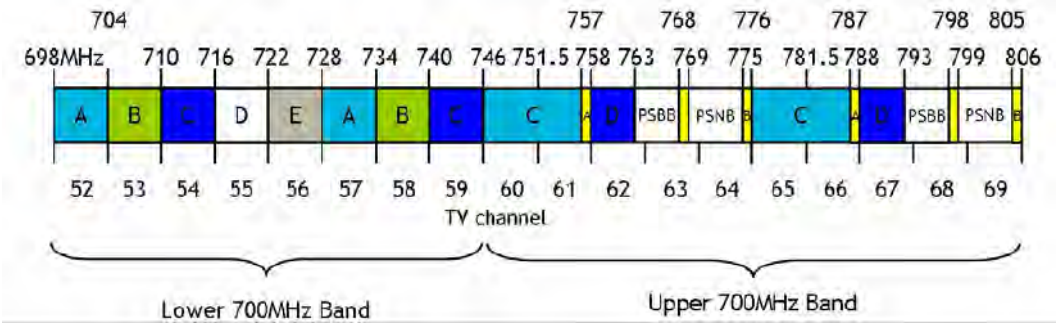
Category	Item	Remarks
LTE/CELL/ PCS	Alarm	DL : Over Power Alarm, Shutdown Alarm, UL : Over Power Alarm, Shutdown Alarm, DL Fault Alarm, UL Fault Alarm
	Fault Detect	Alarm Generation for Abnormal HW condition - Detect : Temperature Sensing + Current Sensing
	Connector	RF : Trumpet (Male) Power and Digital : D_Sub 9Pin (Male)

6 System Specifications

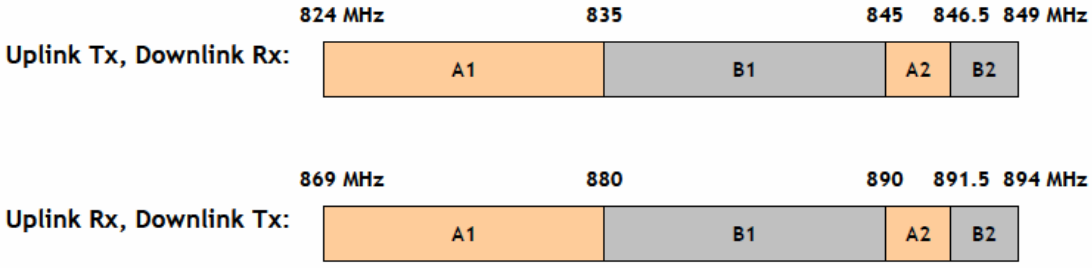
6.1 General Specifications

6.1.1 Tx/Rx Frequencies

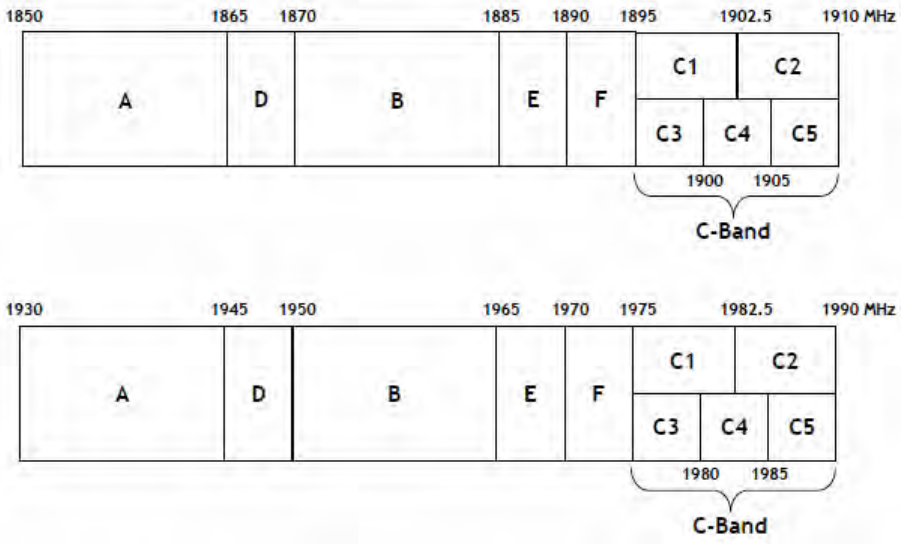
6.1.1.1 LTE



6.1.1.2 Cellular



6.1.1.3 PCS



6.1.2 General Specifications

Category	Specifications	Remarks
Antenna Port	Donor ANT Port : 2 (LTE & Cellular, PCS & AWS) Coverage ANT Port : 1 (Quad Band)	
Carrier	LTE : 1x10MHz and 2x5MHz Cellular : 15 Continuous Carrier in A1-A2 & B1-B2 PCS : 15 Continuous Carrier in 20MHz AWS : TBD	
Composite Output Power	LTE : 27dBm @ANT Port Cellular : 25dBm @ANT Port PCS : 30dBm @ANT Port	Total Carrier
Local GUI Interface	RJ-45	
Debug Port	USB	
Characteristic Impedance	50 ohm	

6.2 Electrical Specifications

6.2.1 Cellular

6.2.1.1 DL & UL Common Specifications

Category	Specification	Remarks
System Time Delay	Max. 6μs @each filter	
Gain Offset	±3dB	
AGC Dynamic Range	30dB	
AGC Error/Control Step	Reference ± 2.0 dB/1dB Step	

6.2.1.2 DL Specifications

Category		Specification	Remarks
Output Power/Tolerance		25dBm @ANT Port/±2dB Max.	
Input Power Range		-60dBm ~ -30dBm @ANT Port	
Gain Control Range		55 ~ 85dB	
Flatness		5dB p-p Max.	
Out-of-Band Rejection	Sub-band Selectivity	45dBc Min @±1.5MHz from each cellular sub-band edge	Out-of-Band Rejection
	A2 Band Rejection	30dBc Min. @890.25MHz & 891.25MHz	
Spurious Emission Limit		-13dBm/1KHz @9KHz~150KHz	Total Carrier,

Category		Specification	Remarks
		-13dBm/10KHz @150KHz~30MHz -13dBm/100KHz @30MHz~1GHz -13dBm/1MHz @1GHz~12.75GHz	ITU Category A
Noise Figure.		7.0dB 이하 @Max Gain & each freq block	
EVM	1x	17.5% Max	
	EVDO	14.75% Max.	

6.2.1.3 UL Specifications

Category		Specification	Remarks
Output Power/Tolerance		25dBm @ANT Port/±2dB Max.	
Input Power Range		-60dBm ~ -30dBm @ANT Port	
Gain Control Range		55 ~ 85dB	
Flatness		5dB p-p Max.	
Out-of-band Rejection	Sub-band selection	45dBc Min. @±1.5MHz from each cellular sub-band edge	Out-of-band Rejection
	A2 Band Rejection	30dBc Min. @845.25MHz & 846.25MHz	
Spurious Emission Limit		-13dBm/1KHz @9KHz~150KHz -13dBm/10KHz @150KHz~30MHz -13dBm/100KHz @30MHz~1GHz -13dBm/1MHz @1GHz~12.75GHz	Total Carrier, ITU Category A
Noise Figure.		7.0dB Max. @ Max Gain & each freq block	
EVM	1x	17.5% Max	
	EVDO	17.5% Max	

6.2.2 PCS

6.2.2.1 DL & UL Common Specifications

Category	Specification	Remarks
System Time Delay	6μs Max. @each filter	
Gain Offset	±3dB	
AGC Dynamic Range	30dB	
AGC Error/Control Step	Reference ± 2.0 dB/1dB Step	

6.2.2.2 DL Specifications

Category	Specification	Remarks
Output Power/Tolerance	30dBm @ANT Port/±2.0dB Max.	
Input Power Range	-70dBm ~ -40dBm @ANT Port	
Gain Control Range	70 ~ 100dB	
Flatness	5dB p-p Max.	
Out-of-Band Rejection	45dBc Min. @±2.0MHz from each PCS sub-band edge	Sub-band selectivity

Category		Specification	Remarks
Spurious Emission Limit		-13dBm/1KHz @9KHz~150KHz -13dBm/10KHz @150KHz~30MHz -13dBm/100KHz @30MHz~1GHz -13dBm/1MHz @1GHz~12.75GHz	Total Carrier, ITU Category A
Noise Figure.		7.0dB Max. @Max Gain & each freq block	
EVM	1x	17.5% Max	
	EVDO	14.75% Max.	

6.2.2.3 UL Specifications

Category		Specification	Remarks
Output Power/Tolerance		30dBm @ANT Port±2.0dB Max.	
Input Power Range		-70dBm ~ -40dBm @ANT Port	
Gain Control Range		70 ~ 100dB	
Flatness		5dB p-p Max.	
Out-of-Band Rejection		45dBc Min. @±2.0MHz from each PCS sub-band edge	Sub-band selectivity
Spurious Emission Limit		-13dBm/1KHz @9KHz~150KHz -13dBm/10KHz @150KHz~30MHz -13dBm/100KHz @30MHz~1GHz -13dBm/1MHz @1GHz~12.75GHz	Total Carrier, ITU Category A
Noise Figure.		7.0dB Max. @ Max Gain & each freq block	
EVM	1x	17.5% Max	
	EVDO	17.5% Max	

6.2.3 LTE

6.2.3.1 DL & UL Common Specifications

Category	Specification	Remarks
System Time Delay	6μs Max. @each filter	
Uplink Gain Offset	-2dB relative to the downlink gain	
AGC Dynamic Range	30dB	
AGC Error/Control Step	Reference ± 2.0 dB/1dB Step	

6.2.3.2 DL Specifications

Category	Specification	Remarks
Output Power/Tolerance	27dBm @ANT Port/±2dB Max.	
Input Power Range	-66dBm ~ -36dBm @ANT Port	
Gain Control Range	63 ~ 93dB	
Flatness	1dB p-p Max.	
Out-of-Band Rejection	45dBc Min. @±1MHz from each LTE sub-	Sub-band Selectivity

Category	Specification	Remarks
	band edge	
Spurious Emission Limit	-13dBm/1KHz @9KHz~150KHz -13dBm/10KHz @150KHz~30MHz -46dBm/6.5KHz @763MHz~775MHz -13dBm/100KHz @30MHz~1GHz -13dBm/1MHz @1GHz~12.75GHz	
Noise Figure.	7.0dB Max. @Max Gain & each freq block	
EVM	12.5% Max.	

6.2.3.3 UL Specifications

Category	Specification	Remarks
Output Power/Tolerance	27dBm @ANT Port/±2dB Max.	
Input Power Range	-66dBm ~ -36dBm @ANT Port	
Gain Control Range	63 ~ 93dB	
Flatness	1dB p-p Max.	
Out-of-Band Rejection	45dBc Min. @±1MHz from each LTE sub-band edge	Sub-band selectivity
Spurious Emission Limit	-13dBm/1KHz @9KHz~150KHz -13dBm/10KHz @150KHz~30MHz -46dBm/6.5KHz @793MHz~805MHz -13dBm/100KHz @30MHz~1GHz -13dBm/1MHz @1GHz~12.75GHz\	
Noise Figure.	7.0dB Max. @Max Gain & each freq block	
EVM	17.5% Max.	

6.3 LED & Alarm Specifications

Category		Specification	Remarks
LED	General	Tamper detected	
		Built-in test failure	
		Replaceable module failure	
		AGC active	
		Reset engaged	
		Oscillation detected	
		Shutdown	
	Donor Issues	Circuitry failure	
		Donor power too low	
	Coverage Issues	Circuitry failure	
Alarm	General	Tamper detected	
		Power supply out of range	
		Communication failure	
		Field replaceable module failure	
		Reset alarm	
		Manual shutdown alarm	
		Heartbeat	
	Uplink	Oscillation detected	
		Power at coverage port too high	
		Synthesizer failure	
		Hardware failure	
		Software failure	
		Out of band emission of spec	
	Downlink	Donor power too high/low	
		Low isolation	
		Synthesizer failure	
		Hardware failure	
		Software failure	
		Spurious emission out of spec	
		Interferer power exceeded	

6.4 Mechanical and Environmental Specification

6.4.1 Mechanical Specifications

Category	Specification	Remarks
Installation	Indoor	
Cooling	Forced Convection (FAN)	
Shelf Size	19” Rack Mount, Height (8U), Depth (559mm)	
Weight	61kg(Fully equipped except for AWS)	
RF Connector	Donor ANT Port : N(Female) – 2port Coverage ANT Port : N(Female) – 1port Monitor Port : SMA(Female) – 3port	Monitoring Port : 30dB±2dB
Ethernet Port	RJ45	GUI Port
Power Connector	Circular Type (3pin)	

6.4.2 Environmental

Category	Specification	Remarks
Temperature	Operational Temperature : -5~50^{O}C	
Humidity	40% relative humidity at 50^{O}C	
waterproof	IP40	

7 Troubleshooting

7.1 General

Power supply out of range

Cause : Faulty Main Power Supply
Remedy : Check Input AC power. If AC Power is ok, replace PSU.

Field replaceable Module fail

Cause : Issues with XCVR or HPA
Remedy : Check which band is having trouble from GUI.
Turn off HPA Power Switch and Replace the HPA.
Replace XCVR if alarm persists after HPA replacement.

7.2 Downlink

Donor Power too high/low

Cause : Input Power level to donor antenna is too high.
Remedy : Check input power level to donor and thresholds for alarm for proper threshold setting.
Check all connectors to/from donor antenna.
Check donor base-station is operating normally.

Low Isolation

Cause : Low Isolation between Donor Antenna and Service Antenna
Remedy : Reseat XCVR and HPA. Make sure captive panel screw is well tightened.
Check for unintended changes in donor or coverage antenna.
Adjust Antennas for good isolation between Donor and Service Ant.

Synthesizer Failure

Cause : Faulty Frequency Synthesizer.
Remedy : Check Sysnthesizer from which band is issuing the alarm.
Replace the XCVR.
If alarms are on for all XCVR, replace the shelf.

Hardware Failure

Cause : Faulty PSU or Alarm Monitoring unit
Remedy : Replace Shelf

Software Failure

Cause : Software Download Failure

Remedy : SW Reboot
Download Software again.
Replace the shelf.

Spurious emissions out of spec

Cause : Spurious emissions exceed FCC limit

Remedy : Check for any failure for each band.
Repleace HPA for the band in alarm
Replace shelf if HPA replacement does not remove the alarm.

Interferer power exceeded

Cause : Interference level is too high.

Remedy : Confirm interference by connecting spectrum analyzer to monitoing port of FEU. Identify and remove interference source.

7.3 Uplink

Oscillation Detected

Cause : Low Isolation between Donor Antenna and Service Antenna

Remedy : Reseat XCVR and HPA. Make sure captive panel screw is well tightened.
Check for unintended changes in donor or coverage antenna.
Adjust Antennas for good isolation between Donor and Service Ant.

Power at coverage port too high

Cause : Input power to coverage antenna is too high Oscillation detected

Remedy : From GUI, check if Uplink Input Power Upper Threshold value is set at a proper level.
Consider re-locating coverage antenna.
Please refer to troubleshooting guide for Oscillation Dectected.

Synthesizer Failure

Cause : Faulty Frequency Synthesizer.

Remedy : Check Sysnthesizer from which band is issuing the alarm.
Replace the XCVR.
If alarms are on for all XCVR, replace the shelf.

Hardware Failure

Cause : Faulty PSU or Alarm Monitoring unit

Remedy : Replace Shelf

Software Failure

Cause : Software Download Failure

Remedy : SW Reboot

Download Software again.

Replace the shelf.

Out of band emissions out of spec

Cause : Out of Band emission level exceeds the specification around service band.

Remedy : From GUI, check which band is at fault.

Replace XCVR with alarm

8 Glossaries

ACLR : Adjacent Channel Leakage Ratio
AGC : Automatic Gain Control
ASD : Automatic Shut Down
ATT : Attenuation
B/D : Board
BITF : Built-In Test Failure
CF : Communication Failure
CRC : Cyclic Redundancy Check
CW : Continuous Wave
DC : Direct Current
DL : Down Link
DPTL : Donor Power Too Low
EVM : Error Vector Magnitude
FEU : Front End Unit
FW : Firm Ware
GUI : Graphic User Interface
H/W : Hardware
HPA : High Power Amplifier
MUX : Multiplexer
NOC : Network Operating Center
OMU : Operating and Management Unit
OSC : Oscillation
PA : Power Amplifier
PD : Photo Diode
PSU : Power Supply Unit
PWR : Power
RF : Radio Frequency
RMF : Replaceable Module Failure
RX : Receiver
S/W : Switch
SD : Shut Down
SNMP : Simple Network Management Protocol
TD : Tamper detected
TX : Transmitter
UL : Up Link
Ver : Version
XCVR : Transceiver

- Appendix

ARTECH

The Prevention Means of Saturation

1. Overview

This device has an ASD(Automatic ShutDown) function to maintain linear operation. When saturation or over-modulation occurs, ASD will be applied for device protection and make spurious emission not to exceed FCC standard.

2. Operation

2.1 Linear Operation Range

It is a possible range for the device to operarte normally with linear operation. The device applies AGC so that linear operation works up to maximum input power in below table.

2.2 Saturation Point

When linear operation is out of range, caused by overpower input signal such as pulsed signal that is entered to the device, ASD will be applied for device protection and make spurious emission not to exceed FCC standard. Accordingly, Saturation Point is defined as ASD level to make ASD operating. The ASD level values are shown below.

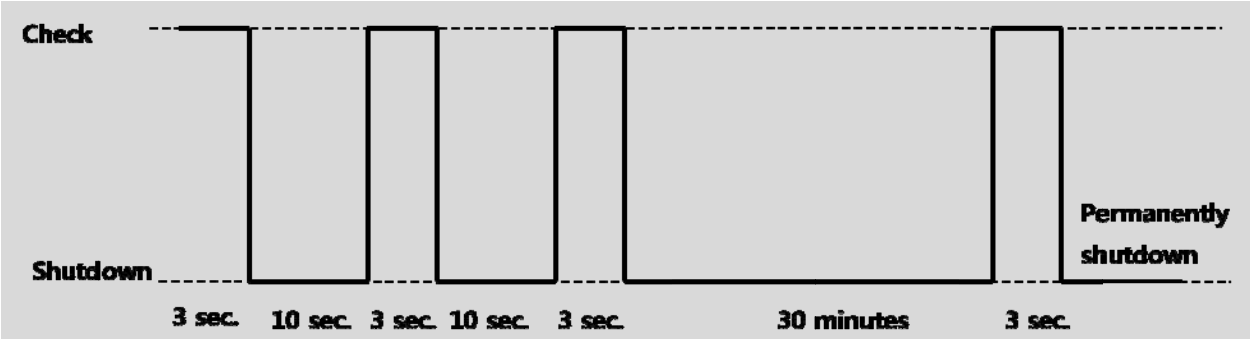
Band	Input Power (Linear Operation Range)	Rated Output Power	Max Gain	Over Power Alarm	ASD Level (Saturation Point)
LTE AB	Under -36dBm	27dBm	93dB	29dBm	30dBm
LTE C	Under -36dBm	27dBm	93dB	29dBm	30dBm
Cellular	Under -30dBm	25dBm	85dB	27dBm	28dBm
PCS	Under -40dBm	30dBm	100dB	32dBm	33dBm

3. ASD(Automatic ShutDown) Operation

3.1 ASD Algorithm

When power out of range or spurious emission exceeds FCC limits, shutdown will be operating within 4 seconds and recheck after 10 seconds. If shutdown arises 3 times, check again after 30 minutes. In this case, if it is in shutdown condition, it goes permanently shutdown.

At this time, if you control the On/Off, reset and manual shutdown parts of device, it will be cleared.



3.2 Notice

During re-checking process, if ASD condition is not satisfied, all previous checking values of ASD parameter should be cleared and then provide normal service. If ASD condition is satisfied again, go back to the first checking step and start to recheck.

※ ASD condition

- Oscillation
- Spurious Emission out of FCC limit