

# Sierra ROU 40W

## Multi-Operator/Multi-Band DAS User Manual

VER 1.0



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## FCC WARNING

This equipment generates or uses radio frequency energy. Changes or modifications to this equipment may cause harmful interference unless the modifications are expressly approved in the instruction manual. The user could lose the authority to operate this equipment if an unauthorized change or modification is made.

## INFORMATION TO THE USER

The head end unit must always be connected to the Base Station using a direct cabled connection. This system has not been approved for use with a wireless connection via server antenna to the base station.

## Part 27.5

Antennas must be installed in accordance with FCC 27.50. With 17dBi gain antennas the height of the antenna above average terrain (HAAT) must not exceed 915m. For difference gain antennas refer to the relevant rules.

## Booster Warning Label

**WARNING.** This is **NOT** a **CONSUMER** device. It is designed for installation by **FCC LICENSEES** and **QUALIFIED INSTALLERS**. You **MUST** have an **FCC LICENSE** or express consent of an FCC Licensee to operate this device. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

Specification or recommendation about Antennas is not available or not mention in this manual.

As per default antennas, cables or coupling devices, contact [www.frtek.net](http://www.frtek.net) for further information.

## 1. Overview

### 1.1 SIERRA Overview

This manual is created for operators who is using or will use Sierra DAS system to give an information and an instructions how to figure out the system.

Operator shall be acknowledged, experienced and properly educated about the overalls of repeater system and the experience of the installation & maintenance of DAS system.

### 1.2 Use of recommendation and warning



#### Booster Warning Label

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#### Warning

Use of unauthorized antennas, cables, and/or coupling devices not conforming with ERP/EIRP and/or indoor-only restrictions is prohibited.



#### Caution

This symbol indicates cautions which operators shall be careful while installing and managing systems

### 1.3 System Features

Sierra is an in-building/outdoor DAS system and provides 4 bands of service; 700MHz (LTE, 27MHz), 850MHz (WCDMA, LTE 32MHz), 1.9GHz (WCDMA, LTE 65MHz), 2.1GHz (WCDMA, LTE, 45MHz) at the same time. The system is scalable to extend additional 2 bands services - 2.3GHz and 2.5GHz frequencies. Sierra system is configured and features:

#### A. ROU : Remote Optic Unit

– Type

1. ROU 10W : 700MHz SISO, 700MHz MIMO, 850MHz SISO, 1.9GHz SISO, 2.1GHz SISO, 2.1GHz MIMO
2. SROU 10W : 2.3GHz SISO, 2.3GHz MIMO, 2.5GHz SISO, 2.5GHz MIMO(Future ordering option)

- Conversion and amplification of digital optical signal into an RF signal (Downlink)
- Converting the RF signal into a digital optical signal (Uplink)
- Optic interfaces with MHU
- Node Isolation : Bypass to avoid impact on service of lower nodes in case of failure of upper nodes or power off condition
- System Delay Equalizer (110us)

## 1.4 System Port Configuration

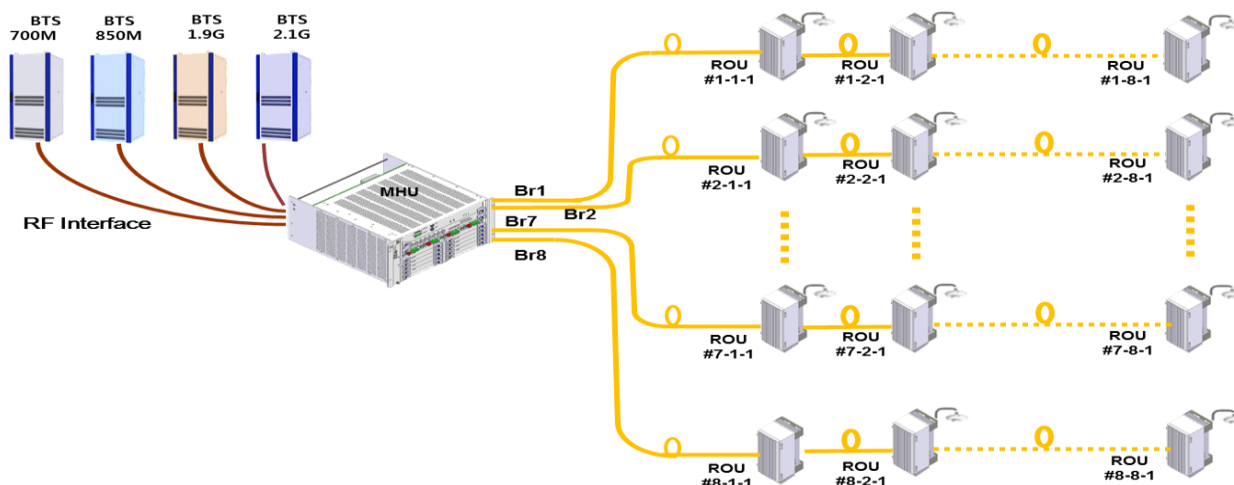
- Unauthorized cables and devices would give damages to the system.  
Approved devices and cables are recommended to use.

### A. ROU 40W Port Configuration

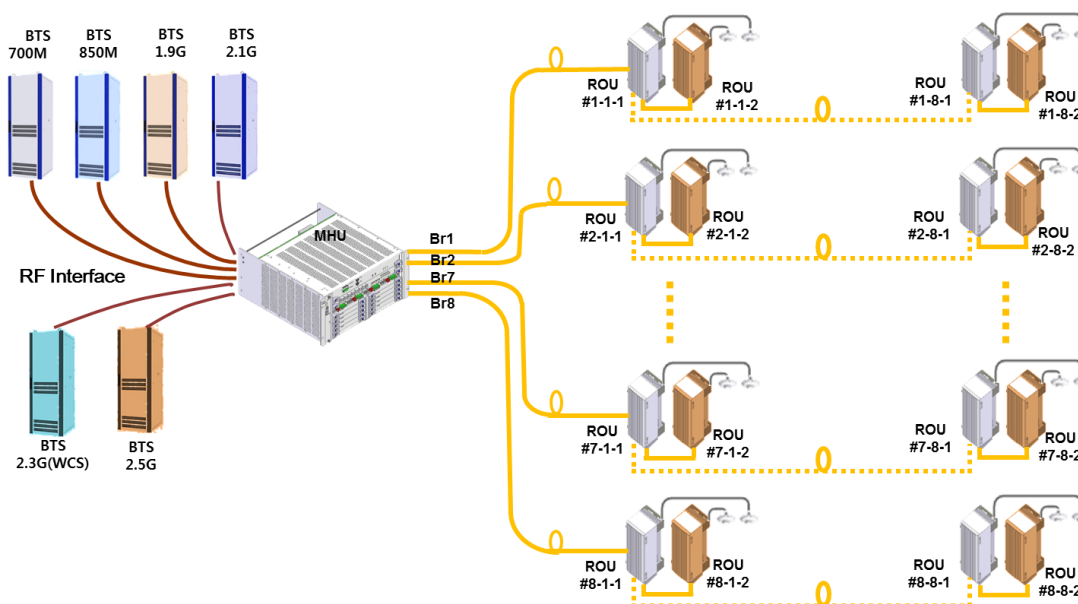
| Port Type      | Description  | Port Location                 |
|----------------|--|-------------------------------|
| Input Power    | Single AC Power Input  | Bottom side                   |
| Antenna        | 6 ports (700MHz SISO, 700MHz MIMO, 850MHz SISO, 1.9GHz SISO, 2.1GHz SISO, 2.1GHz MIMO) |                               |
| Optic Cable    | Optic Cable inputs – 3 ports (TR, IR, EX)  |                               |
| BATTERY        | Pb BATT, Li-BATT inputs – 2 ports  |                               |
| External Fan   | External Fan Power Input – Single port   |                               |
| Power Ground   | Single port  |                               |
| Telecom Ground | 2 ports  | 1 for each<br>Left/Right side |

## 2. System Network Configuration

- The Sierra basic network configuration:



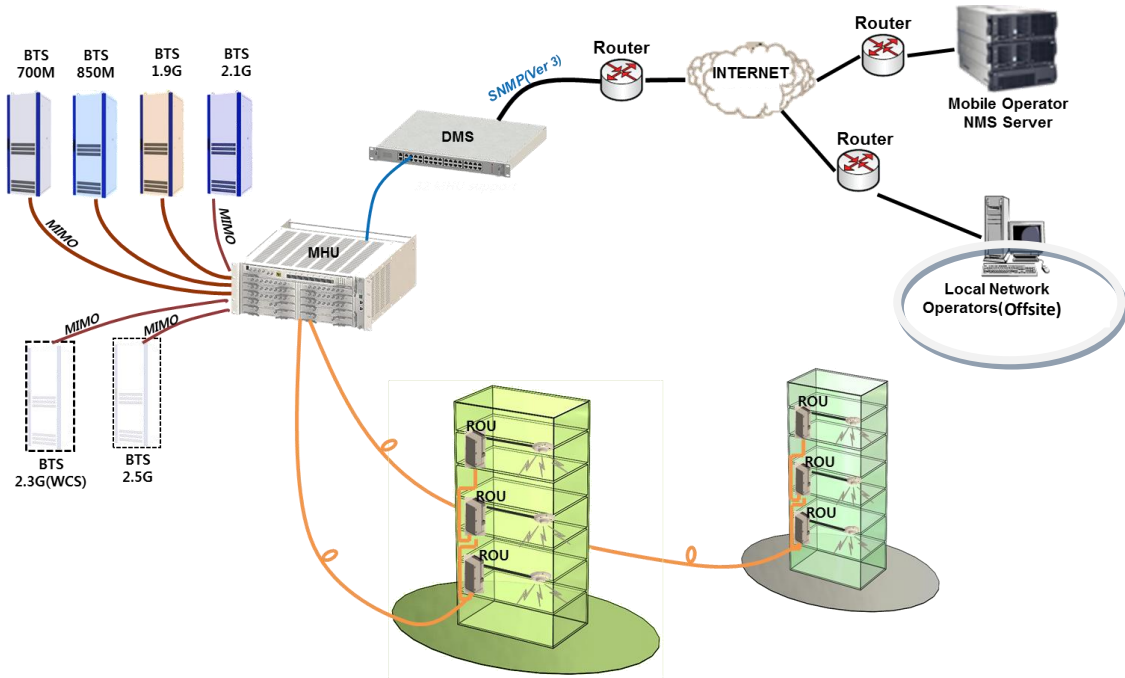
- Network configuration with SROU 10W expansion:



- MHU is interfacing with BTS(Base Transceiver Station) via RF cable and it has 8 optical interfaces with ROUs via optical cable.
- ROU is interfacing with MHU using optic cable and can be cascaded with up to 8 ROUs.
- As for the scalability of Sierra, the total number of ROUs per each BR port is limited up to max. 8.
- SROU is interfacing with ROU through an optic cable and is installed in the same site of ROU.

- MHU capacity can be scalable up to max. 64 ROUs plus 64 SROUs.

The network topology of Sierra is configured as follows;



### Main features of Sierra

| Function                   | ROU 40W                             |
|----------------------------|-------------------------------------|
| Input power                | 120V                                |
| Interface (Input)          | Optic                               |
| Interface (Output)         | RF                                  |
| Service Band Accommodation | LTE, Cellular, PCS, AWS, SMR, WCDMA |
| Type                       | 10W : Indoor type                   |
| Cascading                  | Maximum 8                           |
| Back-up Battery            | Supported                           |

### Advanced features of SIERRA

- Various network configurations (RF Interface with BTS. Various types of ROU configurations)
- Support for 700MHz(LTE,28MHz),850MHz(SMR, Cellular,25MHz),1.9GHz(PCS,65MHz), 2.1GHz(LTE, 45MHz) service/ In-building, etc.
- 4+2 bandwidth services on one ROU system
- Improving system efficiency by using the DPD, APD technology
- Node Isolation (ROU) to prevent service interruption from lower nodes



### 3. System Architecture

#### 3.1 Architecture

##### A. Types of Model

Sierra equipment is configured as shown below; the model name is as follows.

| No. | Equipment | Part Number |
|-----|-----------|-------------|
| 1   | ROU 40W   | FR-RMDL40U  |

##### B. Design Considerations

- MHU and ROU use both an internal FAN and an external FAN to increase the cooling effect
- Definition of service

|         | Service | SISO       | MIMO           |
|---------|---------|------------|----------------|
| ROU 40W | 700MHz  | Applicable | Applicable     |
|         | 850MHz  | Applicable | Not Applicable |
|         | 1.9GHz  | Applicable | Not Applicable |
|         | 2.1GHz  | Applicable | Applicable     |

- Sierra provides a port connected to external battery in both ROU and MHU.
- RF Connector of MHU is a SMA female type and RF connector of ROU is a DIN-Type female type.
- The unit of this system is modular type in order for an easy module replacement and a maintenance User is easy to plug-in or plug-out.
- Each units of this system are anti-insect , anti-dust and anti-pollution design structured.
- Each units of this system is designed to bear the vibration test regulation.
- Providing LTE Timing Advance function (0~110us).

## B. Structure and Shape per each equipment

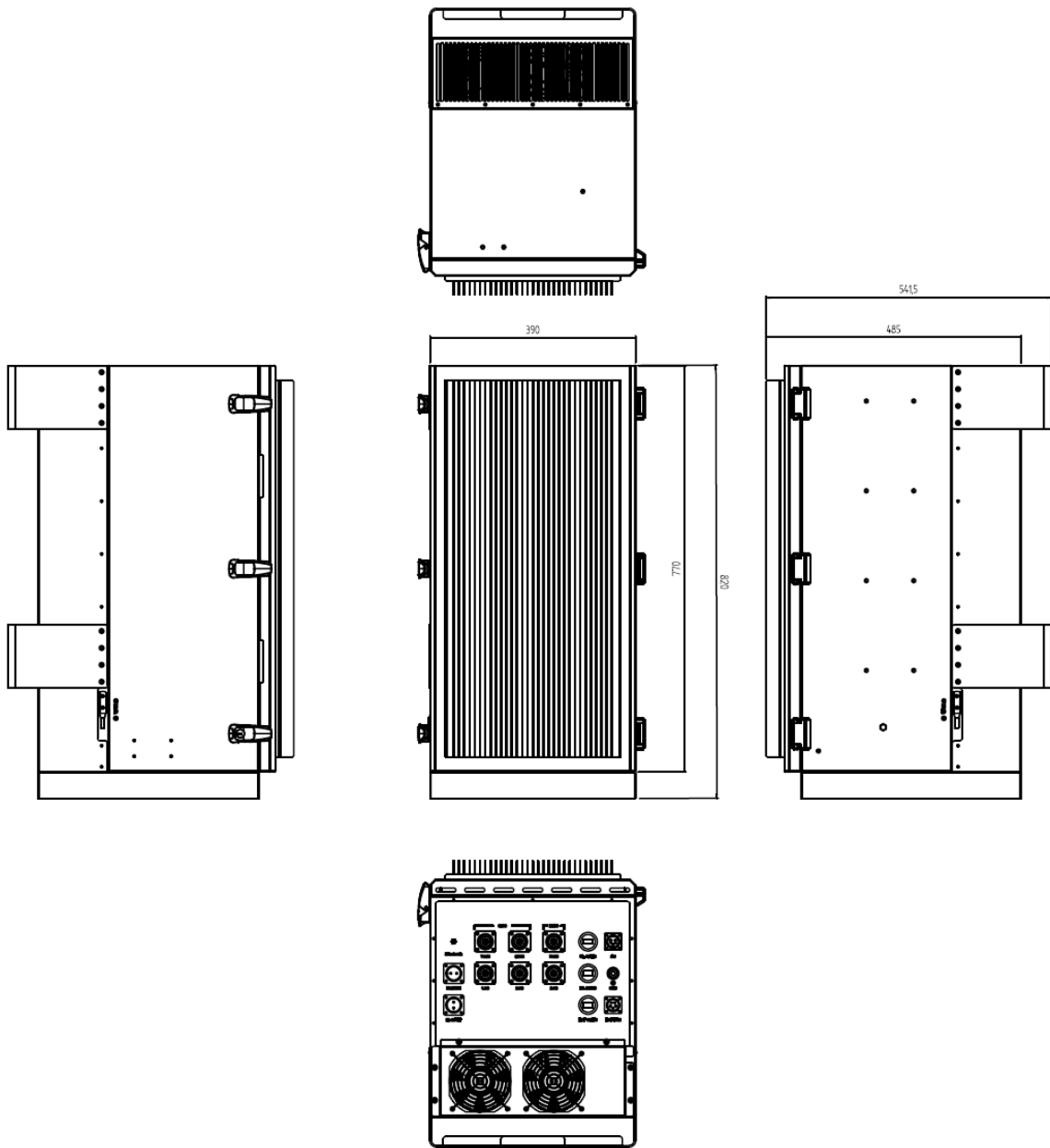
### (1) ROU 40W Structure and Shape

ROU 40W is designed as an indoor or outdoor type repeater. Physical dimension is designed to meet the requirements of user convenience and small installation space. Power supply uses an AC 120V, in case power failure occurs; it has an battery backup ports at PSU with an AWG(American Wire Gauge) 6 ground terminal rug. External Interface Specifications and size are as follows;

| Features        | Item              | Quantity                   | Interface spec  | Remarks                    |
|-----------------|-------------------|----------------------------|-----------------|----------------------------|
| Interface SPEC  | AC 120V           | 1                          | MS Connector    |                            |
|                 | Pb-BATTERY        | 1                          | MS Connector    |                            |
|                 | Li-Battery        | 1                          | MS Connector    |                            |
|                 | Antenna Port      | 6                          | DIN-Type Female |                            |
|                 | Optic Port        | 3                          | SMA Female      |                            |
|                 | External FAN Port | 1                          | MS Connector    |                            |
| Size            | L*W*H (inch)      | 17.4"L x 15.35"W x 32.28"H |                 | W/O rack mounting brackets |
|                 |                   |                            |                 | With bracket               |
| Weight          | pound             |                            | 194lb           | 40W                        |
| PWR Consumption | Watt              |                            | 1400            | In lab test condition      |



[ROU 40W Front View]



[ROU 40W external appearance]

## 4. System Specification

### 4.1 System Specification

This DAS system is designed for US market and it can support 700MHz SISO/MIMO, 850MHz SISO, 1900MHz SISO, 2100MHz SISO/MIMO and is going to support the 2300MHz SISO/MIMO, 2500MHz SISO/MIMO service(under development)

Main ROU can support 700MHz, 850MHz, 1900MHz and 2100MHz, Sub ROU can support 2300MHz and 2500MHz signal.

#### 4.1.1 Functional Specification

SIERRA meets the following features and performance features, the details are not specifically mentioned shall follow functional and performance requirements of “3GPP TS25.1 / TS25.104”, “3GPP TS25.1 / TS25.106”, “3GPP TS25.1 / TS36.104”.

SIERRA incorporates the following basic functional requirements.

- 1) MHU is connected with ROUs by optical cable for RF (wired) and ROU shall be installed and operated at the shade area. LTE, Cellular, PCS, AWS signal transmission between 2 devices will operate through Single-mode optical fiber. (Optic: supportable for 5.7Gbps)
- 2) The radio quality of LTE, Cellular, PCS, AWS serviced by SIERRA is the same level as the radio quality of the base station.
- 3) When the mobile terminal enters the adjacent base station, SIERRA supports a continuous call (hand over) of the terminal.

#### 4.1.2 System Specification per Band(ROU40W)

##### A. 700MHz (28MHz), SISO/MIMO

- Frequency Features

| SPEC           |    | Performance Requirements     | Remarks            |
|----------------|----|------------------------------|--------------------|
| Frequency Band | TX | 728 ~ 757MHz                 | 28MHz, LTE Service |
|                | RX | 699 ~ 716MHz<br>777 ~ 787MHz |                    |

- Output Features

| SPEC         |    | Performance Requirements | Remarks |
|--------------|----|--------------------------|---------|
| Output Level | TX | +46dBm/Total             |         |

|  |    |             |  |
|--|----|-------------|--|
|  | RX | +5dBm/Total |  |
|--|----|-------------|--|

- Noise Figure and Features

| SPEC                                     |                           | Performance Requirements | Remarks         |
|--|---------------------------|--------------------------|-----------------|
| Noise Figure (NF)                        | RX                        | 7dB or under             | Max Gain        |
| Unwanted emission features (within band) | 10W                       | ±5.05MHz                 | -14dBm or under |
|  |                           | ±10.05MHz                | -14dBm or under |
|  |                           | ±15.5MHz                 | -16dBm or under |
| ACLR                                     | BW <sub>channel</sub>     | 45dBc                    |                 |
|  | 2 * BW <sub>channel</sub> | 45dBc                    |                 |

- Other Performance Requirements

| SPEC              | Performance Requirements | Remark |
|-------------------|--------------------------|--------|
| VSWR              | 1.5 : 1 or under         |        |
| TX, RX Separation | 100dBc or more           |        |

**B. 850MHz (32MHz), SISO**

- Frequency Features

| SPEC           |    | Performance Requirements              | Remarks             |
|----------------|----|---------------------------------------|---------------------|
| Frequency Band | TX | 869~890MHz(862 ~ 868, 891~894MHz N/A) | 22MHz(out of 32MHz) |
|                | RX | 817 ~ 849MHz                          |                     |

- Output Feature

| SPEC         |    | Performance Requirements | Remarks |
|--------------|----|--------------------------|---------|
| Output Level | TX | +46dBm/Total             |         |
|              | RX | +5dBm/Total              |         |

- Noise Figure and Features

| SPEC  |                       | Performance Requirements | Remarks         |
|---|-----------------------|--------------------------|-----------------|
| Noise Figure(NF)                                    | RX                    | 7dB or under             | Max. Gain       |
| Unwanted Emission Features (Within band-LTE Signal) | 10W                   | ±5.05MHz                 | -14dBm or under |
|   |                       | ±10.05MHz                | -14dBm or under |
|   |                       | ±15.5MHz                 | -16dBm or under |
| ACLR  | BW <sub>channel</sub> | 45dBc                    |                 |

|  |                           |       |  |
|--|---------------------------|-------|--|
|  | 2 * BW <sub>channel</sub> | 45dBc |  |
|--|---------------------------|-------|--|

## - Other Performance Requirements

| SPEC              | Performance Requirements | Remarks |
|-------------------|--------------------------|---------|
| VSWR              | 1.5 : 1 or under         |         |
| TX, RX Separation | 100dBc or more           |         |

**C. 1.9GHz (65MHz), SISO**

## - Frequency Features

| SPEC           |    | Performance Requirements | Remarks |
|----------------|----|--------------------------|---------|
| Frequency Band | TX | 1930 ~ 1995MHz           | 65MHz   |
|                | RX | 1850 ~ 1915MHz           |         |

## - Input/output Features

| SEPC         |    | Performance Requirements | Remarks |
|--------------|----|--------------------------|---------|
| Output Level | TX | +46dBm/Total             |         |
|              | RX | +5dBm/Total              |         |

## - Noise Figure and Unwanted Emission Features

| SPEC   |                           | Performance Requirements | Remarks         |
|--|---------------------------|--------------------------|-----------------|
| Noise Figure(NF)                                       | RX                        | 7dB or under             | Max. Gain       |
| Unwanted Emission Features<br>(Within band-LTE Signal) | 10W                       | ±5.05MHz                 | -14dBm or under |
|  |                           | ±10.05MHz                | -14dBm or under |
|  |                           | ±15.5MHz                 | -16dBm or under |
| ACLR   | BW <sub>channel</sub>     | 45dBc                    |                 |
|  | 2 * BW <sub>channel</sub> | 45dBc                    |                 |

## - Other Performance Requirements

| SPEC              | Performance Requirements | Remarks |
|-------------------|--------------------------|---------|
| VSWR              | 1.5 : 1 or under         |         |
| RX, TX Separation | 100dBc or more           |         |

### D. 2.1GHz (45MHz), SISO/MIMO

#### - Frequency Features

| SPEC           |    | Performance Requirements | Remarks |
|----------------|----|--------------------------|---------|
| Frequency Band | TX | 2110 ~ 2155MHz           | 45MHz   |
|                | RX | 1710 ~ 1755MHz           |         |

#### - Output Features

| SPEC         |    | Performance Requirement | Remarks |
|--------------|----|-------------------------|---------|
| Output Level | TX | +46dBm/Total            |         |
|              | RX | +5dBm/Total             |         |

#### - Noise Figure and Unwanted Emission Features

| SEPC                                     |                           | Performance Requirements | Remarks         |                        |
|--|---------------------------|--------------------------|-----------------|------------------------|
| Noise Figure (NF)                        | RX                        | 7dB or under             | Max. Gain       |                        |
| Unwanted Emission Features (Within Band) | 10W                       | ±5.05MHz                 | -14dBm or under | Max. Output RBW 100KHz |
|  |                           | ±10.05MHz                | -14dBm or under |                        |
|  |                           | ±15.5MHz                 | -16dBm or under | Max. Output RBW 1MHz   |
| ACLR                                     | BW <sub>channel</sub>     |                          | 45dBc           |                        |
|  | 2 * BW <sub>channel</sub> |                          | 45dBc           |                        |

#### - Other Performance Requirements

| SPEC              |  | Performance Requirements | Remarks |
|-------------------|--|--------------------------|---------|
| VSWR              |  | 1.5 : 1 or under         |         |
| RX, TX Separation |  | 100dBc or more           |         |

\* Standard conditions of the above is 1SET standard each MHU/ROU



**E. EMS Interface Specification**

- (1) Protocol : MHU ↔ ROU(Optic)
- (2) MHU ↔ ROU (Optic)
- (3) ROU ↔ ROU (Optic)
- (4) Top surveillance : PC base EMS
- (5) Debugger interface: USB2.0(MHU, ROU)

**F. Optical characteristic requirements**

(1) Transmitter

| SPEC                 |    | Performance Requirements | Remarks |
|----------------------|----|--------------------------|---------|
| Center wavelength    | TX | 1270 ± 1nm               |         |
|                      | RX | 1330 ± 1nm               |         |
| Optical Output Power |    | - 5 dBm or more          |         |

(2) Receiver

- Receiving element Type: InGaAs PIN Photodiode
- Max receive input range: 0dBm
- Max Rx Sensitivity: -15dBm

(3) Fiber optic cable

- Type: Single-mode fiber
- Loss: 0.25dB/km (1240 ~ 1620nm) or under

**4.1.4 Mechanical condition**

**4.1.4.1 Structure and Shape**

- MHU and ROU are to be designed considering the convenience of workers and space of installation site. The appearance of SIERRA design should be streamlined.

| Equipment | Type           | Option         |
|-----------|----------------|----------------|
| ROU 40W   | Enclosure Type | Indoor/outdoor |

- SIERRA is enabling to use an internal fan, only ROU uses an external fan.
- SIERRA provides a port connected to external battery to ROU.
- RF Connector of MHU is SMA Female and RF Connector of ROU is DIN-Type Female
- Components of the system should be modular. Each component to be fitted to the structure that can be

easily mounted and separated. Replacement and maintenance should be facilitated.

- Each device must be designed as a structure that cannot be dust, contaminants and insects that attack.
- Each device of the system is to be designed to withstand a specified vibration test.
- All parts of the cabinet should be smoothly processed in order to prevent physical damage during maintenance
- Providing Timing Advance function (0~100us).

#### 4.1.4.2 Manufacturing and Processing

- Sealing material has a strong characteristic to heat, does not tear or damage to the chemical.
- Internal and external wiring are designed as wire wrapping method or a connector connection. A structure that can withstand the vibrations.
- The printed circuit board is to use the product at least equal to the epoxy resin or glass. Solder is sophisticated; it is elegant in appearance after soldering. The electrical insulating film treatment is to prevent a reduction in corrosion and pollution prevention and moisture and insulation resistance due to the wiring between the accumulations of dust. The manufacturer was consulting us before choosing the colors.
- Internal and external surfaces of the coating cabinet have a uniform color.
- Exterior of the cabinet is designed to withstand foam (Blistering), exfoliation (Peeling) and cracks for 5 years or more.
- It is designed and manufactured with taking into account the carbon emissions reduced (reduced power consumption, reduced material use, and so on)

#### 4.1.4.3 Materials and components

- Passive device has a stable characteristic for the frequency and temperature changes. Active element is industrial or equal to or more semiconductor. The integrated circuit is a solidified device.
- The type of wire is flame retardant coating wire, and SIERRA uses a wire having a sufficient current capacity and withstand voltage.
- Coaxial cable connected between each of the components is shielded cable coated with aluminum or brass.
- All metal used in the present device are designed to withstand a localized corrosion, including general corrosion, stress corrosion (Stress Corrosion) and crack (Cracking).
- Plastics being used should not be melt by Solvent and there should be no crack, molting and color when it exposed to ammonia.
- Plastics should not be cracked when chemical materials which is being used for cable assembly such as filling compound, insulator, etc.)

- Housing, component, PCB, solder, cable, etc. that are applied to the device shall be in accordance with current RoHS (Restriction of Hazardous Substances Directive).

**4.1.5 Electrical conditions**

- MHU, ROU operate normally in the commercial power supply (AC120 / 60Hz). (Considering of the photoelectric composite cable power input)
- ROU can be operated with the external back-up battery only
- The power wiring should be attached to the inside of the door, designed to prevent damage.
- There is a function of overvoltage and overcurrent protection in the DC inputs.
- Withstand voltage is applied to the input and output 3KV for 1 minute, the leakage current is less than 10mA.
- Leakage current is less than 3.5mA in the phase transition (120V).
- There should be no damage in case of 5 times surge voltage shock - 4kV at AC input port and 4kV at DC input port.
- Grounding of equipment is separated; communication ground and power ground.
- Fuse must be able to determine whether or not a problem with the naked eye, it can be replaced without dismantling the equipment.
- All parts used in this repeater meet the conditions of FCC Regulations Title 47, Part 15, Subject J, and EMI Class B.
- Ground cables equivalent to #6AWG should be installed with a ground table into an enclosure.

**4.1.6 Management and monitoring**

- SIERRA can be configured up to the GUI for 1pc of MHU,64 pcs ROUs. Status Monitoring and Control is enabled.
- SIERRA is designed to maintain the previous states such as setting up the device parameters and operating conditions during recovery after a power outage.
- SIERRA is upper interworking by MHU and EMS Server
- A system control is possible by an operator using a Local GUI or Web GUI.

**4.2.6 Environmental conditions**

- When a specified temperature and humidity test, should not cause any traces of condensation inside the unit.
- Even if not in working order, SIERRA is designed not to be occurring internal condensation and functional depression.
- When subjected to prescribed vibration test, should not have any performance and mechanical damage of the system.
- When conducting prescribed waterproof test, the sign of water penetration inside the device should not be.
- MHU environment testing depends on the ambient operating standards
- Environmental test items and items iterations depends on the testing procedure of the business environment.
- Major environmental test conditions are as follows

| Contents                     |         | Performance Requirements                         | Remark   |
|------------------------------|---------|--|--|
| Operational environment test | Indoor  | - Temp' : -10 ~ +60°C<br>- Humidity : 0 ~ 95% RH | - Output Change : Within ±3dB<br>- Internal/external of enclosure has no changes or problems     |
|                              | Outdoor | - Temp' : -40 ~ +60°C<br>- Humidity : 0 ~ 95% RH | - Output Change : Within ±3dB<br>- Internal/external of enclosure has no changes or problems     |
| Vibration Test               |         | - 10 ~ 150Hz, Gravity Speed 2G (IEC 60068-2-6)   | - System performance is no change<br>- Internal/external of enclosure has no changes or problems |
| Noise Testing                |         | - GR-65-Core(4.6), Level 2                       | - 65dBA or under<br>(When use external Fan)  |

## 5. Operational Program

### 5. Overview

#### 5.1 Program overview

This operational program is designed to monitor and control the SIERRA.

The operational program communicates via the USB-B Type Port of equipment.

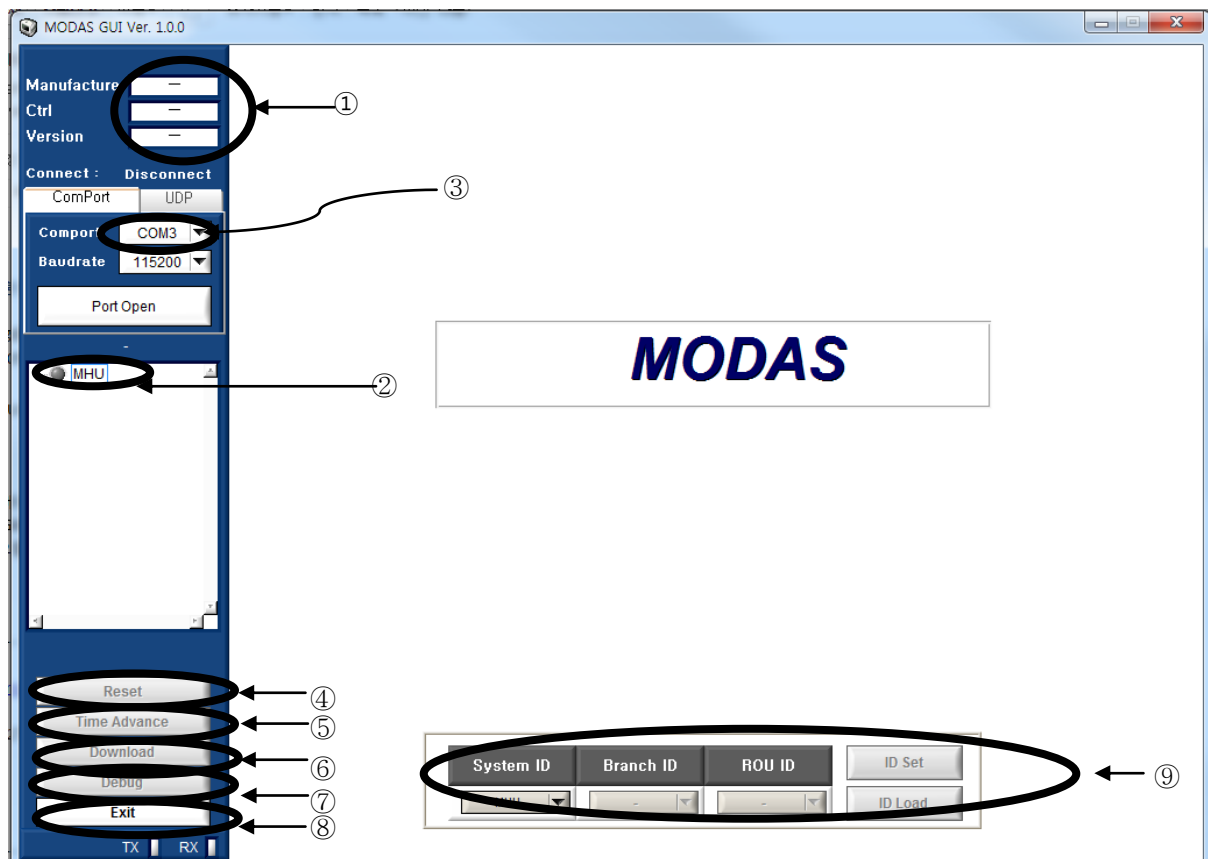
#### 5.2 Screen configuration

##### 5.2.1 GUI

This equipment is available to monitor and control via the GUI at the Local.

GUI Configuration, Monitoring, and Control items are shown in the following figure.

(Possible future changes)



[Main Screen]

- ① Environment Information – Showing equipment manufacturer, control manufacturer and information of version.
- ② Tree Information
  - Showing the connection status of current equipment.

– Green LED signifies regular equipment, Yellow LED equipment signifies Link Fail, Red LED signifies Alarm, Grey LED signifies equipment.

–When you do double-click of mouse left button, you can check status of equipment.

③ Com Port

– Showing the PC connection port which was connected currently.

– Automatically re-search connected RS-232C port when you click the Refresh.

– When you click Port Open and Port Close, RS-232 Port will do <Connection> and <Close>.

④ Reset – Showing the controller DTU and reset screen of system.

⑤ Time advance setting – Showing Time advance setting.

⑥ Download – Showing CPU F/W Download window per equipment.

⑦ Debug – Showing Debug Screen.

⑧ Exit – Terminate the program.

⑨ ID setting – Read the ID of the connected equipment, and sets the ID.

### 5.4 ROU Status Verification and Control

- [Status Mode] to request information on the Status ROU equipment is 1Sec intervals.
- Clicking the [Setup Mode] button at the top, [Set] button is activated. Enter to [Settings mode], and now stop the Status Request and to Control the ROU items.
- If the setting is successfully completed, [Setting success] message will be shown at the window.
- When clicking the [Close] button at the top of the window, the screen is shut down and return to the [GUI Main] screen.

#### 5.4.1 700MHz

– 700MHz Details (SISO – MIMO Items are the same)

|        | Items                  | Unit                       | Remark         |
|--------|------------------------|----------------------------|----------------|
| 700MHz | Link Path              | 700MHz / 2.3GHz            | Status         |
|        | Insert                 | Insert / None              | Status         |
|        | TX Detect AMP          | dBm                        | Status         |
|        | TX Detect RRFU         | dBm                        | Status         |
|        | TX ATT                 | dB                         | Status/Control |
|        | TX FB ATT              | dB                         | Status/Control |
|        | TX SD (High)           | dBm                        | Status/Control |
|        | TX SD Alarm (High)     | Alarm : Red, Normal: Green | Status         |
|        | TX ALC (High)          | dBm                        | Status/Control |
|        | TX ALC (Offset)        | dBm                        | Status/Control |
|        | TX SD On/Off (High)    | ON/OFF                     | Status/Control |
|        | TX ALC On/Off (High)   | ON/OFF                     | Status/Control |
|        | TX ALC On/Off (Offset) | ON/OFF                     | Status/Control |
|        | RX Detect RRFU         | dBm                        | Status         |

|  |                  |     |                |
|--|------------------|-----|----------------|
|  | RX Detect RRFU 2 | dBm | Status         |
|  | RX ATT           | dB  | Status/Control |
|  | RX ATT 2         | dB  | Status/Control |

[700MHz Details]

5.4.3 850MHz

– 850MHz Details

| Items                              |                        | Unit                       | Remark         |
|------------------------------------|------------------------|----------------------------|----------------|
| 850MHz                             | Insert                 | Insert / None              | Status         |
|                                    | TX Detect AMP          | dBm                        | Status         |
|                                    | TX Detect RRFU         | dBm                        | Status         |
|                                    | TX ATT                 | dB                         | Status/Control |
|                                    | TX FB ATT              | dB                         | Status/Control |
|                                    | TX SD (High)           | dBm                        | Status/Control |
|                                    | TX SD Alarm (High)     | Alarm : Red, Normal: Green | Status         |
|                                    | TX ALC (High)          | dBm                        | Status/Control |
|                                    | TX ALC (Offset)        | dBm                        | Status/Control |
|                                    | TX SD On/Off (High)    | ON/OFF                     | Status/Control |
|                                    | TX ALC On/Off (High)   | ON/OFF                     | Status/Control |
|                                    | TX ALC On/Off (Offset) | ON/OFF                     | Status/Control |
|                                    | RX Detect RRFU         | dBm                        | Status         |
|                                    | RX ATT                 | dB                         | Status/Control |
|                                    | RX Overpower           | Alarm : Red, Normal: Green | Status         |
|                                    | 10MHz PLL              | Alarm : Red, Normal: Green | Status         |
|                                    | TX Delay               | us                         | Status/Control |
|                                    | RX Delay               | us                         | Status/Control |
|                                    | Over Power             | Alarm : Red, Normal: Green | Status         |
|                                    | VSWR                   | Alarm : Red, Normal: Green | Status         |
|                                    | Over Temp              | Alarm : Red, Normal: Green | Status         |
|                                    | HPA Temp               | °C                         | Status         |
|                                    | Amp On/Off             | ON/OFF                     | Status/Control |
| DTU TX Power (Block SMR ~ Block D) |                        | Status                     |                |

[850MHz Details]

5.4.4 1.9GHz

– 1.9GHz Details

| Items  |                | Unit          | Remark         |
|--------|----------------|---------------|----------------|
| 1.9GHz | Insert         | Insert / None | Status         |
|        | TX Detect AMP  | dBm           | Status         |
|        | TX Detect RRFU | dBm           | Status         |
|        | TX ATT         | dB            | Status/Control |
|        | TX FB ATT      | dB            | Status/Control |

|  |                                    |                            |                |
|--|------------------------------------|----------------------------|----------------|
|  | TX SD (High)                       | dBm                        | Status/Control |
|  | TX SD Alarm (High)                 | Alarm : Red, Normal: Green | Status         |
|  | TX ALC (High)                      | dBm                        | Status/Control |
|  | TX ALC (Offset)                    | dBm                        | Status/Control |
|  | TX SD On/Off (High)                | ON/OFF                     | Status/Control |
|  | TX ALC On/Off (High)               | ON/OFF                     | Status/Control |
|  | TX ALC On/Off (Offset)             | ON/OFF                     | Status/Control |
|  | RX Detect RRFU                     | dBm                        | Status         |
|  | RX ATT                             | dB                         | Status/Control |
|  | RX Overpower                       | Alarm : Red, Normal: Green | Status         |
|  | 10MHz PLL                          | Alarm : Red, Normal: Green | Status         |
|  | TX Delay                           | us                         | Status/Control |
|  | RX Delay                           | us                         | Status/Control |
|  | Over Power                         | Alarm : Red, Normal: Green | Status         |
|  | Amp On/Off                         | ON/OFF                     | Status/Control |
|  | DTU TX Power (Block SMR ~ Block D) |                            | Status         |

[1.9GHz Details]



## 5.4.5 2.1GHz

## 2.1GHz Details (SISO – MIMO Items are the same)

|        | Items                          | Unit                       | Remark         |
|--------|--------------------------------|----------------------------|----------------|
| 2.1GHz | Link Path                      | 2.1GHz / 2.5GHz            | Status         |
|        | Insert                         | Insert / None              | Status         |
|        | HPA USE                        | Enable / Disable           | Status/Control |
|        | TX Detect AMP                  | dBm                        | Status         |
|        | TX Detect RRFU                 | dBm                        | Status         |
|        | TX ATT                         | dB                         | Status/Control |
|        | TX FB ATT                      | dB                         | Status/Control |
|        | TX SD (High)                   | dBm                        | Status/Control |
|        | TX SD Alarm (High)             | Alarm : Red, Normal: Green | Status         |
|        | TX ALC (High)                  | dBm                        | Status/Control |
|        | TX ALC (Offset)                | dBm                        | Status/Control |
|        | TX SD On/Off (High)            | ON/OFF                     | Status/Control |
|        | TX ALC On/Off (High)           | ON/OFF                     | Status/Control |
|        | TX ALC On/Off (Offset)         | ON/OFF                     | Status/Control |
|        | RX Detect RRFU                 | dBm                        | Status         |
|        | RX ATT                         | dB                         | Status/Control |
|        | RX Overpower                   | Alarm : Red, Normal: Green | Status         |
|        | 10MHz PLL                      | Alarm : Red, Normal: Green | Status         |
|        | TX Delay                       | us                         | Status/Control |
|        | RX Delay                       | us                         | Status/Control |
|        | Over Power                     | Alarm : Red, Normal: Green | Status         |
|        | VSWR                           | Alarm : Red, Normal: Green | Status         |
|        | Over Temp                      | Alarm : Red, Normal: Green | Status         |
|        | HPA Temp                       | °C                         | Status         |
|        | Amp On/Off                     | ON/OFF                     | Status/Control |
|        | DTU TX Power(Block A ~Block F) |                            | Status         |

## [2.1GHz Details]

## 6. System Installation

### 6.1 ROU 40W Installation

#### 6.3.1 ROU 40W Configuration

ROU 40W is configured of 6 pcs RF modules, Digital Board, CPU, PSU, Optic Switch and Optic module.

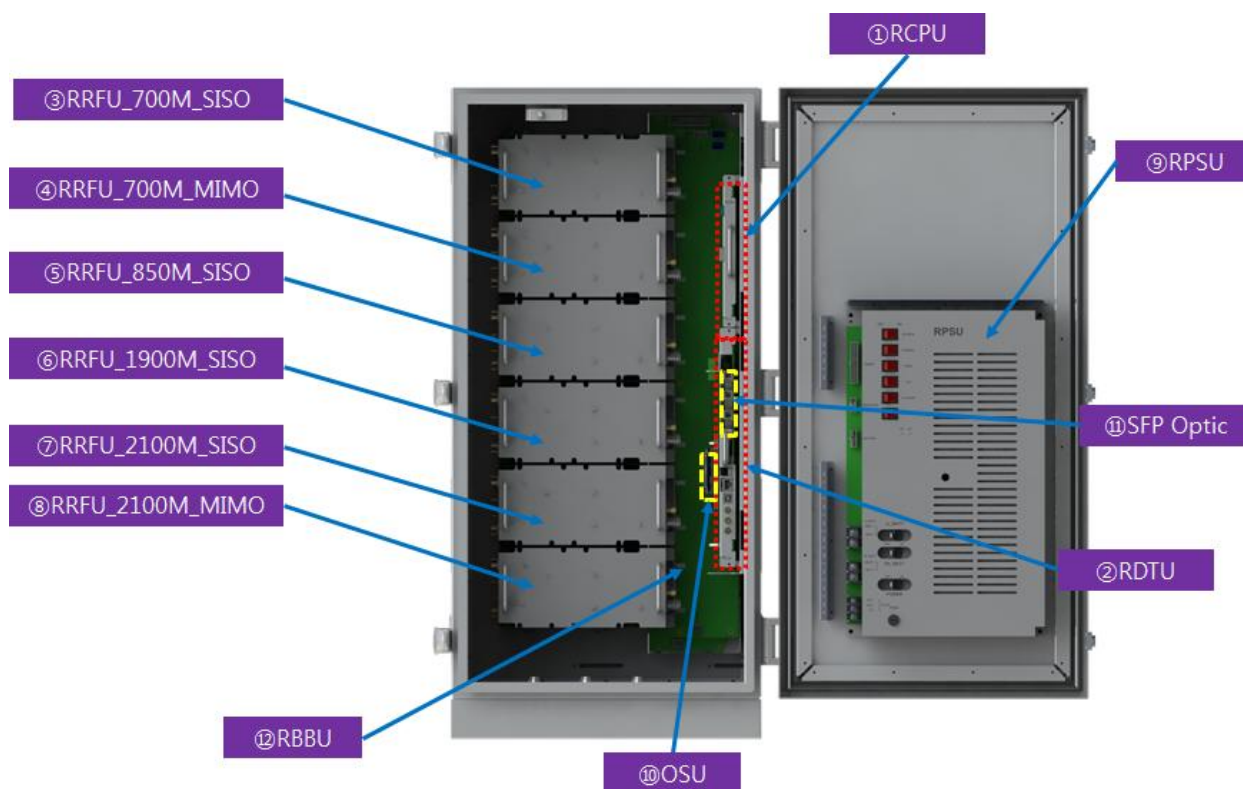
ROU 40W supports 4 bands and is expandable to 2 more bands - 700MHz and 2.1GHz with MIMO service

ROU 40W can service up to 4 service providers per each band and the maximum output per band is up to 40W.

The definition of ROU 40W module is as following.

ROU 40W is powered by AC 120V(55 ~ 65Hz) and it also connects to battery backup port depending on the installation environment. AC 120V power connector is located under the outdoor enclosure and the connector recommended is MS3106A-16-10S(F) connecting to power distribution panel.

 Maximum output per each service provider shall be limited up to 10W.

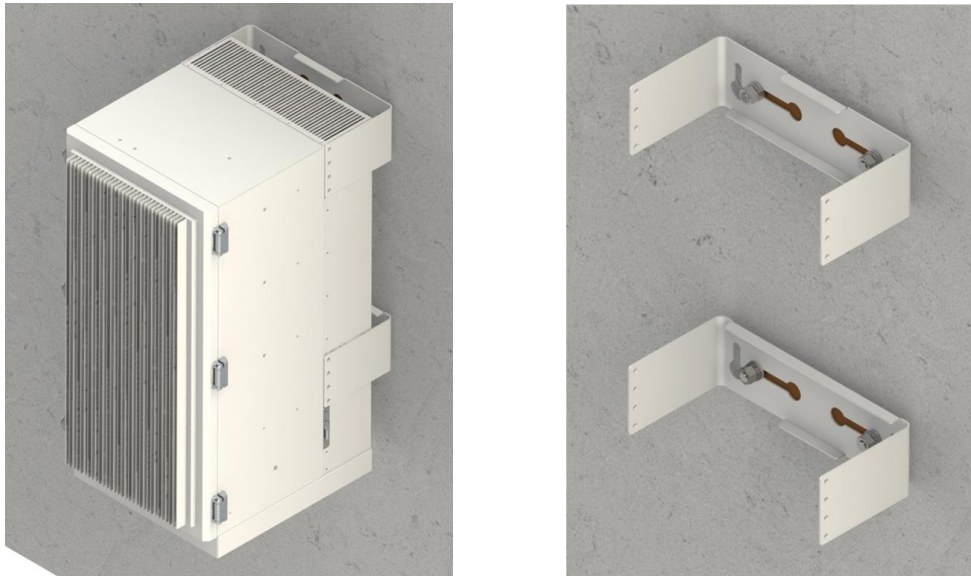


[ROU 40W Units Configuration]

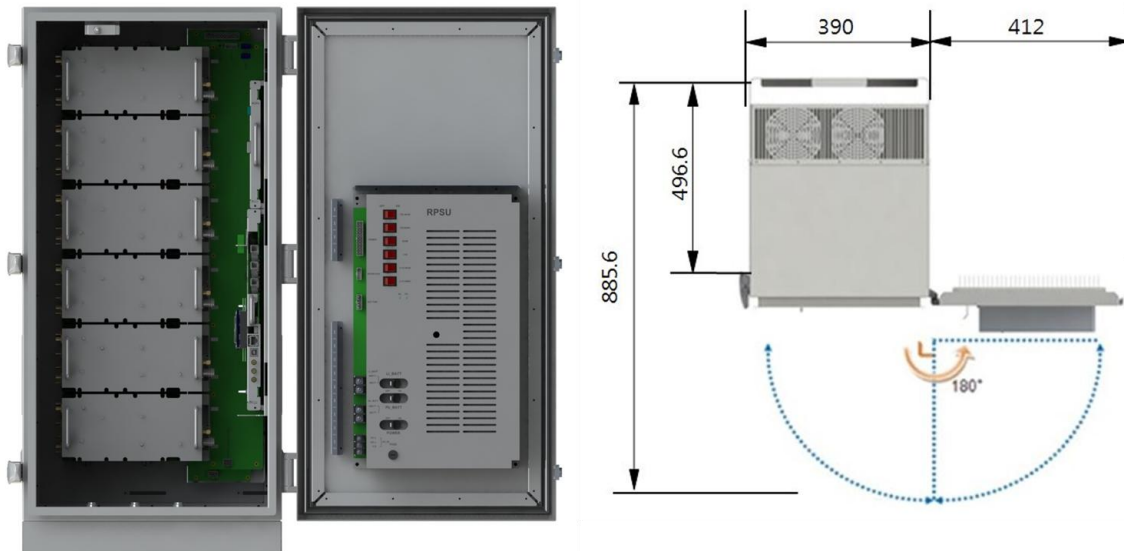
| NO | Module          | Description   | Unit | Q'ty |
|----|-----------------|---|------|------|
| ①  | RCPU            | Monitor and control each modules status, Local GUI & Web GUI support  | EA   | 1    |
| ②  | RDTU            | Digital Signal Processing(O/E, E/O Conversion), DPD and Filter Function support                             | EA   | 1    |
| ③  | RRFU_700M_SISO  | 700M(LTE) TX/RX Signal Amplification and Transmission Filter, Sub DTU, RF Converter, HPA Unified Structure  | EA   | 1    |
| ④  | RRFU_700M_MIMO  | 700M(LTE) TX/RX Signal Amplification and Transmission Filter, Sub DTU, RF Converter, HPA Unified Structure  | EA   | 1    |
| ⑤  | RRFU_850M_SISO  | 850M(LTE) TX/RX Signal Amplification and Transmission, Sub DTU, RF Converter, HPA Unified Structure         | EA   | 1    |
| ⑥  | RRFU_1900M_SISO | 1900M(LTE) TX/RX Signal Amplification and Transmission Filter, Sub DTU, RF Converter, HPA Unified Structure | EA   | 1    |
| ⑦  | RRFU_2100M_SISO | 2100M(LTE) TX/RX Signal Amplification and Transmission Filter, Sub DTU, RF Converter, HPA Unified Structure | EA   | 1    |
| ⑧  | RRFU_2100M_MIMO | 2100M(LTE) TX/RX Signal Amplification and Transmission Filter, Sub DTU, RF Converter, HPA Unified Structure | EA   | 1    |
| ⑨  | RPSU            | Input: AC 120V, Pb, Li-BATT Supported   | EA   | 1    |
| ⑩  | OSU             | Optical Path Switching Function   | EA   | 1    |
| ⑪  | SFP Optic       | 1270/1330nm@10Gbps Optic Signal Transmission  | EA   | 1    |
| ⑫  | MBBU            | ROU 10W Unit PWR Supply and Signal Interface  |      |      |

### 6.3.2 ROU 40W Installation

ROU 40W is designed as wall mount type and there shall be 412mm space at the right side of system in order for easy maintenance in case of door open.

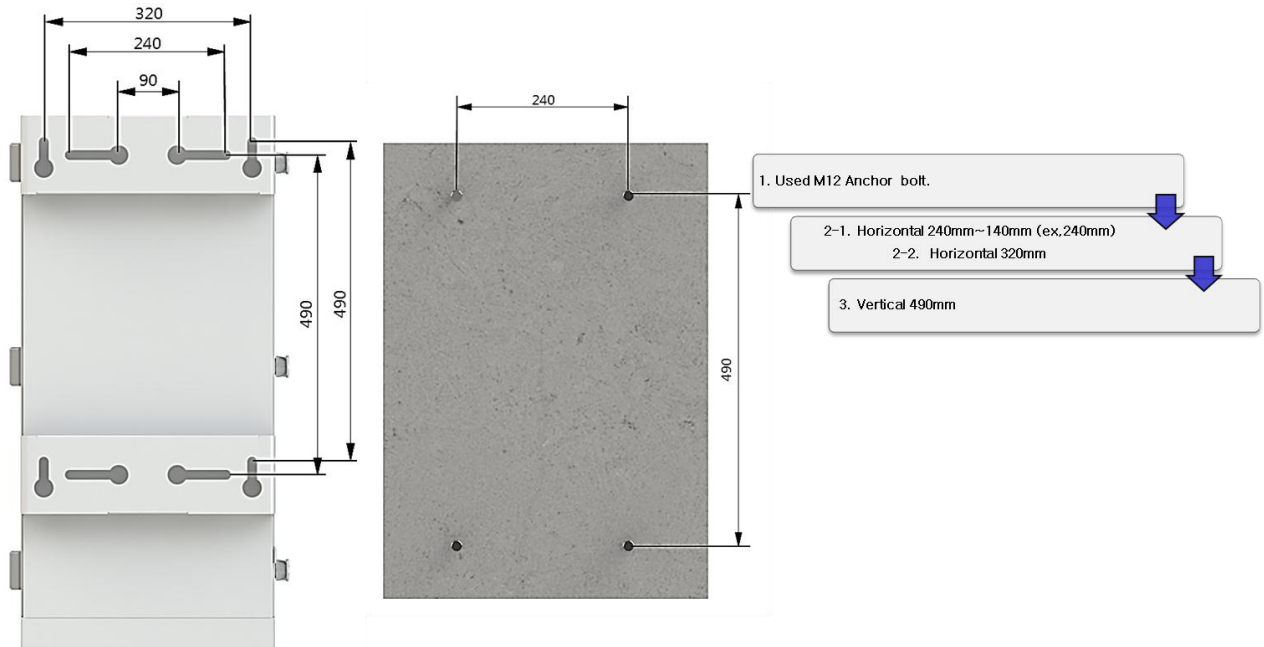


[ROU Wall Mount Installation Picture]



[ROU Open view]

ROU 40W is using an anchor bolt for wall mount installation and is fixed.  
 The brief picture for wall mounting is as following.

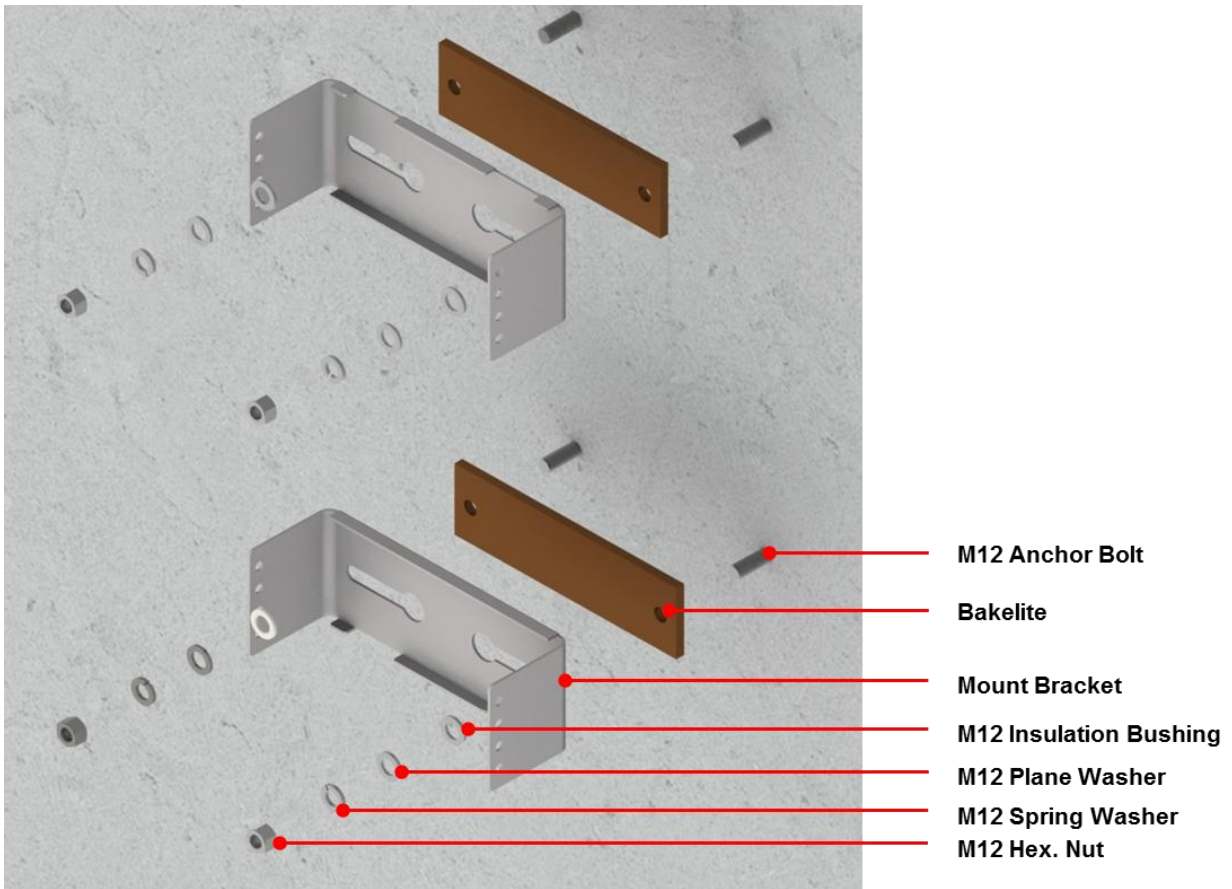


[ROU 40W Anchor bolt Assembly]

The picture below is mounting bracket assembly drawing for ROU 10W wall mount installation.

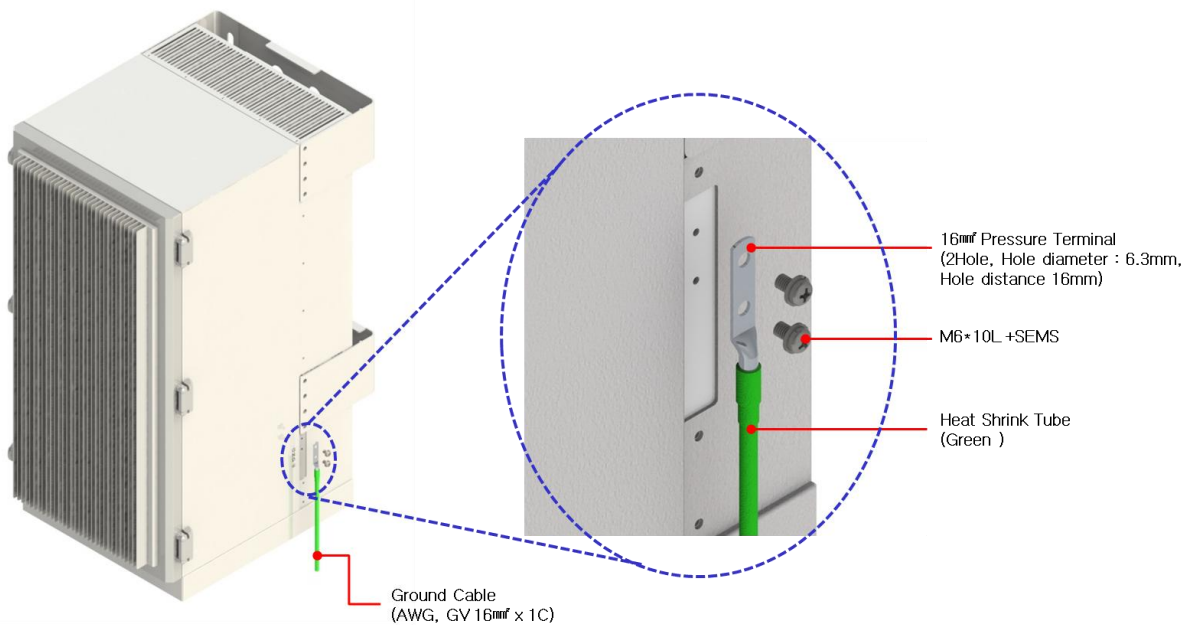
Assembly order is as following.

- Insert Bakelite to M12 Anchor bolt.
- Locate ROU 40W in accordance with M12 Anchor bolt.
- Insert M12 Insulation Bushing, M12 Plane washer, M12 Spring washer.
- Tightening them using M12 nut spanner.



[ROU 40W Wall Mount Installation Assembly Drawing(Excluding enclosure image) ]

ROU 40W connects the ground of outdoor enclosure and the ground of building for the safety of system from electricity risk and protects system and system operation.



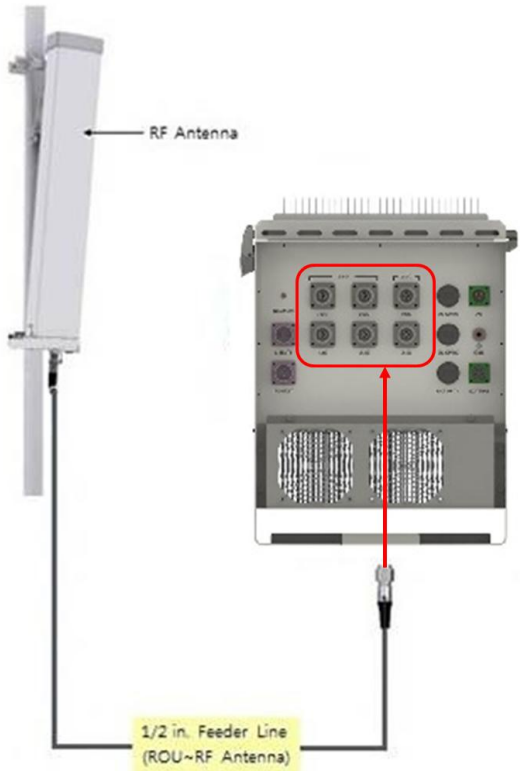
[ROU 40W Ground Cable Connection ]

ROU 40W is configured of 6 modules and It has 6 antenna ports assigned for each band at the bottom of the enclosure.

Antenna port connector type is Din connector and the maximum antenna output port is 40W.

The brief drawing which connects to the antenna of ROU 40W is as following.

Antenna shall be used for ROU 40W by approval of service provider or officially approved and antenna type can be selective by the installation environment.



[ROU 40W Antenna Cable Connection ]



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## 7. Alarm and Troubleshooting

### (1) AC (MHU, ROU)

#### ■ Phenomenon

- PSU LED : PSU AC LED Off
- Alarm window : GREEN → RED

#### ■ Causes

- Input power 120V/AC is not normally enters

#### ■ Appropriate Measures

- Solution : Check the Input power 120V/AC

- Measures : Check the input power 120V/AC, if there is no problems, check the operation by replacing PSU.

### (2) DC (MHU, ROU)

#### ■ Phenomenon

- PSU LED : PSU DC LED RED
- Alarm window : GREEN → RED

#### ■ Causes

- PSU output voltage decreases 85% or under

#### ■ Appropriate Measures

- Solution : Replacing PSU

- Measures : Check the operation by repacing PSU

### (3) LD Alarm (MHU, ROU)

#### ■ Phenomenon

- Alarm window : GREEN → RED

#### ■ Causes

- LD of optical module is not normal

#### ■ Appropriate Measures

- Solution : Replacing optical module

- Measures : Check the operation by repacing optical module

### (4) PD Alarm (MHU, ROU)

#### ■ Phenomenon

- Alarm window : GREEN → RED

#### ■ Causes

- PD of optical module is not normal

#### ■ Appropriate Measures

- Solution : Clean optical connector and check optical cable or replacing optical moduel

- Measures : Clean optical connector, check the optic cable and fix the problem.

If there is no falut, replace the optical module.

### (5) TX/RX PLL (MHU, ROU)

#### ■ Phenomenon

– Alarm window : GREEN → RED

■ Causes

- MHU: Has the problem at TX PLL in MUDC(750M/800M/1.9G/2.1G)
- ROU 10W: Has the problem at TX PLL in RRFU intergrated moduel Converter

■ Appropriate Measures

- Solution : MHU- Replacing MRFU(750M/800M/1.8G/2.1G)  
ROU - Replacing RRFU intergrated module Converter(750M/800M/1.8G/2.1G)
- Measures : MHU- Check the operation by repacing MUDC(750M/800M/1.8G/2.1G) of Path(alarm occuring)  
ROU 10W- Check the operation by repacing RRFU intergrated module converter(750M/800M/1.8G/2.1G)

**(6) Internal FAN (MHU, ROU 10W)**

■ Phenomenon

– Alarm window : GREEN → RED

■ Causes

- Occuring some problems at internal fan

■ Appropriate Measures

- Solution : Check and replace the FAN
- Measures : Check the operation by chekcing and repacing the fan

**(7) External FAN (MHU, ROU)**

■ Phenomenon

– Alarm window : GREEN → RED

■ Causes

- Occuring some problems at external fan

■ Appropriate Measures

- Solution : FAN Check and replace
- Measures : Check the operation by chekcing and repacing the fan

**(8) TX S/D(High) (ROU)**

■ Phenomenon

– Alarm window : GREEN → RED

■ Causes

- TX output is higher than alarm setting value

■ Appropriate Measures

- Solution : Set appropriate TX ATT
- Measures : Setting the TX ATT in accordance with environment and truning ALC on to prevent to be S/D.

**(9) DTU Status (MHU, ROU)**

■ Phenomenon

– Alarm window : GREEN → RED

■ Causes

- Occur the problems at harbness connected DTU board or DTU board

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**■ Appropriate Measures**

- Solution : Replacing the harness connected DTU, if it still has the problem, replace the DTU board
- Measures : Check the operation by replacing the harness connected DTU or DTU board.

**(10) DTU Link Fail (MHU, ROU)****■ Phenomenon**

- Alarm window : GREEN → RED

**■ Causes**

- Occur the problems of link fail between DTU board and CPU

**■ Appropriate Measures**

- Solution : Check Reference clock or Check the connectivity between DTU board and Back Board
- Measures : Check the connectivity status of DTU board and replace DTU board.

**(11) VSWR (ROU)****■ Phenomenon**

- Alarm window : GREEN → RED

**■ Causes**

- Occur the problems at antenna input port or AMP

**■ Appropriate Measures**

- Solution : Check antenna inputport connection status, if there is no fault, replace the AMP
- Measures : Check the antenna input port and if there is no fault, replace the AMP and confirm it works.

**(12) Over Power (ROU)****■ Phenomenon**

- Alarm window : GREEN → RED

**■ Causes**

- Has the problem at RRFU intergrated module output

**■ Appropriate Measures**

- Solution : Although it set the static output by controlling ATT, if it still has the problem, RRFU intergrated moduled should be replaced
- Measures : Check the operation by chekcing and repacing the RRFU intergrated module

**(13) Over Temp (ROU)****■ Phenomenon**

- Alarm window : GREEN → RED

**■ Causes**

- RRFU's intergrated module temperature is more than 85 °C

**■ Appropriate Measures**

- Solution : Checm the tempartrue table. Even though it is set appropriate temarature, still has a problem. APD AMP should be replaced.
- Measures : Check the operation by replacing the RRFU intergrated module

**(14) Battery (ROU)****■ Phenomenon**

- Alarm window : GREEN → RED

**■ Causes**

- Battery has some problems.
-

- Appropriate Measures
  - Solution : Replacing the Battery
  - Measures: Check the operation by replacing the Battery