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# PrimAer 28GHz

## Operating Manual

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### Document Reference

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## Used Abbreviations

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|             |  |
|-------------|--|
| <b>DU</b>   | <b>D</b> onor <b>U</b> nit   |
| <b>SU_C</b> | <b>S</b> ervice <b>U</b> nit_ <b>C</b> ascade                                |
| <b>SU_E</b> | <b>S</b> ervice <b>U</b> nit_ <b>E</b> nd                                    |
| <b>GUI</b>  | <b>G</b> raphical <b>U</b> ser <b>I</b> nterface                             |
| <b>SISO</b> | <b>S</b> ingle <b>I</b> nput <b>S</b> ingle <b>O</b> utput                   |
| <b>MIMO</b> | <b>M</b> ultiple <b>I</b> nput <b>M</b> ultiple <b>O</b> utput               |
| <b>ACLR</b> | <b>A</b> djacent <b>C</b> hannel <b>L</b> eakage <b>P</b> ower <b>R</b> atio |
| <b>ALC</b>  | <b>A</b> uto <b>L</b> evel <b>C</b> ontrol                                   |
| <b>AGC</b>  | <b>A</b> uto <b>G</b> ain <b>C</b> ontrol                                    |
| <b>EVM</b>  | <b>E</b> rror <b>V</b> ector <b>M</b> agnitude                               |
| <b>3GPP</b> | <b>3</b> rd <b>G</b> eneration <b>P</b> artnership <b>P</b> roject           |

# ***Chapter 1***

## **Safety & Certification Notice**

- 
- 1.1 FCC Warning Statements**
  - 1.2 Certification Notice**



# Safety & Certification Notice

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## 1.1 FCC Warning Statements

### 1.1.1 FCC Part 15.105 statement

- PrimAer has been tested and found to comply with the limits for a Class A digital device.
- These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
- PrimAer generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the FCC guidelines, may cause harmful interference to radio communications.
- Operation of this type of equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### 1.1.2 FCC Part 15.21 statement

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

### 1.1.3 Health and Safety Warnings

- PrimAer should only be operated by approved integrator. The integrator should observe all written warnings that are in the Operating Manual.
- The integrator who is tasked with handling, installation, operation, and servicing of the PrimAer System must acquaint themselves with the Operator's Manual prior to handling. Control and configuration of this system should be set up according to purpose of use (Refer to the manufacturer's product information), it has to satisfy prescribed request items.
- To avoid serious injury, the integrator must turn off the main power switch before installing the system or performing any maintenance related work.
- FRTek advises that this product not be disassembled without the assistance or guidance of FRTek staff. Failure to do so may result in electric shock, malfunction of unit, or severe injury. Do not disassemble, repair or modify product.

- Due to power dissipation, the remote unit may reach very high temperatures. Do not operate this equipment on or close to any flammable or combustible materials. Always use caution when servicing the unit.
- This product should only be used for the purpose specified by the manufacturer. Do not alter or make any modifications or fit any spare parts which are not sold or recommended by the manufacturer. This could cause fires, electric shock, or other injuries.
- Read and obey all the warning labels attached to the unit. Make sure that all warning labels are visible and are kept in a legible condition.
- The network provider needs to ensure that PrimAer is operated within the FCC OET Bulletin 65 standards regarding RF Emissions to avoid health hazards associated with radiation from the antennas in the unit. Suggested remedies are "RF hazard" type signs.

Do not use any solvents, chemicals, or cleaning solutions containing alcohol, ammonia, abrasives, or any corrosive type products on the unit

 **Warning**

---

Home/ personal use are prohibited

 **Warning**

---

Obey all general and regional installation and safety regulations relating to performing work on high voltage installations. Also, obey regulations and guidelines covering correct use of tools and personal protective equipment.

 **Warning**

---

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

 **Warning**

---

Product contains "Laser Radiation". Never stare into the beam. Do not view it directly or with any optical instruments.

 **Warning**

---

Please be informed that the external temperatures of the unit can reach very high temperatures. Please be careful. The label is attached to the front of the equipment and the PSU (Power Supply Unit).

 **Warning**

---

RF Radiation Exposure

 **Warning**

---

This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.

 **Warning**

---

This equipment should be installed and operated with a minimum distance of 40 cm between the radiator and your body.

- **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.

- **[FCC] BOOSTER WARNING LABEL**

**WARNING.** This is **NOT** a **CONSUMER** device. It is designed for installation by **FCC LICENSEES** and **QUALIFIED INSTALLERS Only**. 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 violation.

## 1.2 Certification Notice

For **PLUGGABLE EQUIPMENT**, the socket-outlet shall be installed near the equipment and shall be easily accessible.

- **FCC** : This equipment complies with the applicable sections of Title 47 CFR Parts 15 & 30
- **UL** : This equipment complies with UL Standard for safety for information technology equipment, including electrical business equipment.
- **FDA/CDRH** : This equipment uses a LASER according to FDA/CDRH Rules. This product conforms to all applicable standards of 21 CFR Chapter 1, Subchapter J, Part 1040.

Designed to comply IP66 standards with test data available upon request



**RESTRICTED ACCESS LOCATION:** location for equipment where both of the following apply:

- access can only be gained by **AUTHORIZED PERSONS** or by **USERS** who have been instructed about the reason for the restrictions applied to the location and about any precautions that shall be taken; and
- access is through the use of a **TOOL** or lock and key, or other means of security, and is controlled by authority responsible for the location

## ***Chapter 2***

### **System Overview**

- 
- 2.1 System Overview**
  - 2.2 System Network Configuration**

# System Overview

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## 2.1 System Overview

### 2.1.1 Overview

PrimAer 28 is a 5G DAS (Distributed Antenna System) system that can provide and/or enhance high quality telecommunications service both in-building & outdoors. The PrimAer System can provide mmWave 28GHz frequency band coverage to both public area/facilities and private areas/facilities.

Some examples of locations that the PrimAer 28 system would be installed, but not limited to:

- Shopping Malls
  - Hotels
  - Campuses
  - Airports
  - Subways
  - Stadiums and Convention Centers
- Utility poles near roads

The PrimAer system provides coverage for in-building and outdoor environments. A “proper RF design” will provide a more accurate representation of the expected coverage.

System capable frequency :

- mmWave 28GHz SISO/MIMO  
(27.5GHz ~ 28.35GHz, BW 850MHz)

The PrimaER system is configured with a Donor Unit (DU), a Service Unit (SU\_C: Cascading unit or SU\_E: End unit), and a Rectifier. 1 DU can operate up to 4 service units connected in a cascade configuration.

### 2.1.2 PrimAer 28GHz Design Consideration

PrimAer 28 is configured as below, and the model name is as below.

| Item                      | Model Name     | FCC ID            | Type                   |
|---------------------------|----------------|-------------------|------------------------|
| Donor Unit                | FR-R5GAO38ADU  | 2AFEG-R5GAO38ADU  | Outdoor Enclosure type |
| Service Unit<br>(Cascade) | FR-R5GAO33ASUC | 2AFEG-R5GAO33ASUC | Outdoor Enclosure type |
| Service Unit<br>(End)     | FR-R5GAO33ASUE | 2AFEG-R5GAO33ASUE | Outdoor Enclosure type |
| Rectifier                 | FR-ERECD48A    | -                 | Outdoor Enclosure type |

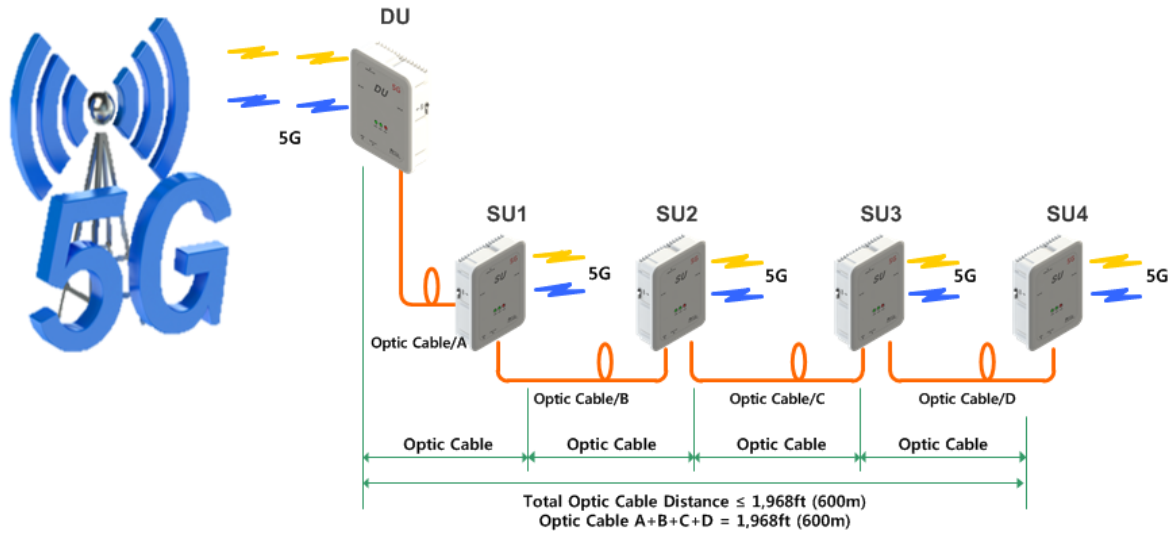
The PrimAer DU receives the 28GHz 5G signal from the Base Station wirelessly, The DU then amplifies the signal and provides 5G service to the SU. The SU then extracts the TDD sync signal received from the base station and sends to each unit.

The modules on each unit are designed so that the configurations can be easily attached and detached for module replacement and maintenance. For outdoor purposes, the DU, SU, and Rectifier are designed with IP66 structure so that dust, pollutants, and insects cannot invade.

| Item              | DU                            | SU(Cascade)                   | SU(End)                       | Rectifier                |
|-------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------|
| Input Power       | DC -53.3V<br>(from Rectifier) | DC -53.3V<br>(from Rectifier) | DC -53.3V<br>(from Rectifier) | AC 100V ~ 240V           |
| Interface(Input)  | RF                            | Optic                         | Optic                         | -                        |
| Interface(Output) | Optic                         | RF                            | RF                            | Power                    |
| Service           | mmWave 28GHz 5G NR            |                               |                               | -                        |
| Type              | In-building /<br>outdoor      | In-building /<br>outdoor      | In-building /<br>outdoor      | In-building /<br>outdoor |

## 2.2 System Network Configuration

PrimAer 28GHz network configuration shown below.



**Figure 1. Network Configuration.**

PrimAer receives a 28GHz wireless signal from a 5G base station to the DU, down converts to IF over fiber, amplifies the signal then the SU up converts IF to 5G mmWave service.

PrimAer is configured with 3 units, the DU, SU, and Rectifier. The Rectifier supplies DC power to the DU and SU, and is connected to the DU and SU with a power cable. Also, the DU and SU is connected with a single fiber-optic cable, and multiple SU's can also be connected in series through a single fiber-optic cable.

The DU can support antenna beam forming to  $\pm 50^\circ$  (Up/down/left/right) through GUI.

The DU and SU can support antenna beam steering to  $\pm 50^\circ$  (Up/down/left/right) through GUI.

The DU and SU have Beamwidth  $\pm 30^\circ$  in H-Plane/ $\pm 15^\circ$  in V-Plane

The DU and SU have internal Dual Polarized Antennas that support MIMO.



## ***Chapter 3***

### **System Configuration**

- 
- 3.1 DU Figure and Configuration**
  - 3.2 SU Figure and Configuration**
  - 3.3 Rectifier Figure and Configuration**
  - 3.4 DU, SU, Rectifier Connecting**

# System Configuration

## 3.1 DU Figure and Configuration

The DU is in a single enclosure with a mounting bracket on the back enabling wall or pole attachment. The DU receives a MIMO 5G base station signal over the air, converts it into an optical signal, and sends it to the SU over the Fiber-Optic cable. (Downlink) It also converts the optic signal received from SU over the fiber-optic cable converts this to 28GHz 5G RF which is sent to the base station through the antenna. (Uplink)

The DU is configured with the antenna, DIFM, DAOM, EMS boards. The rectifier powers the DU through the power port with -53.3V DC power.

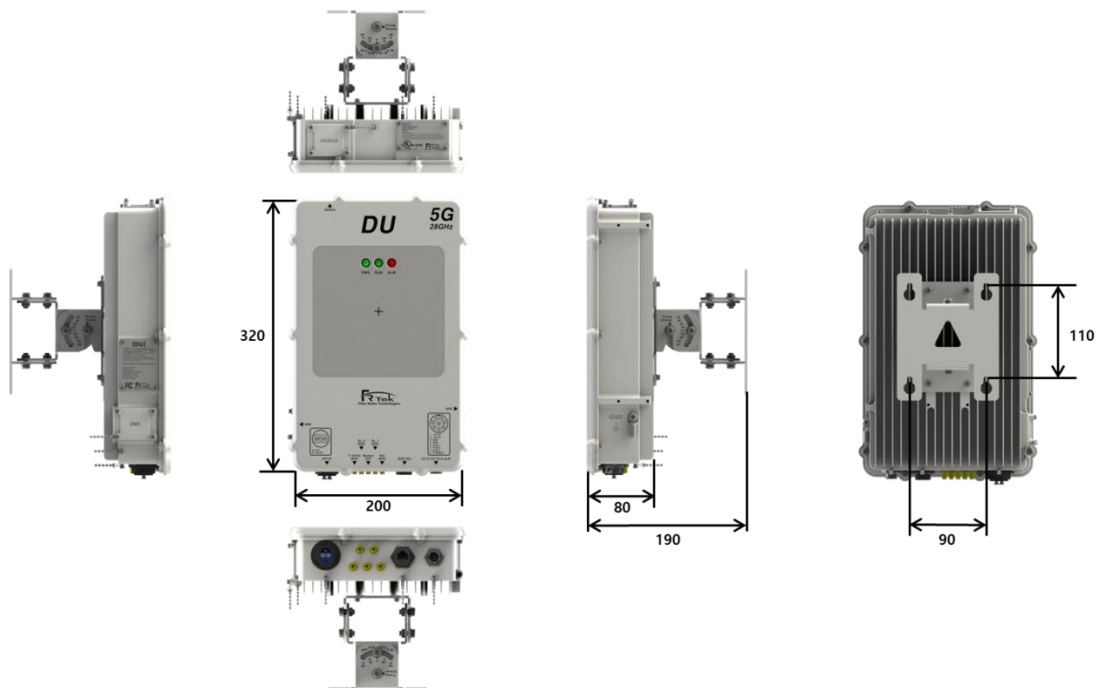
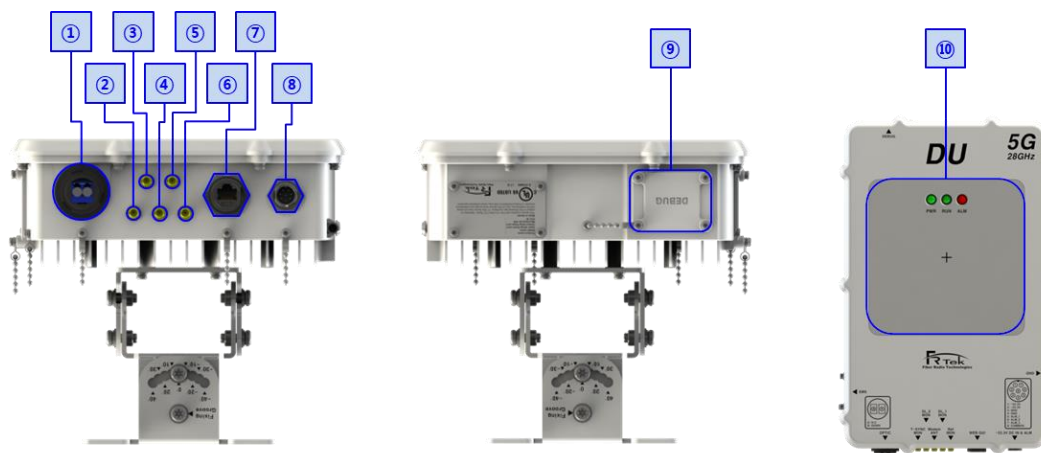


Figure 2. DU Figure.

| Item            | Content                                  | Remark           |
|-----------------|--|------------------|
| Size            | 200 x 320 x 190mm (7.87 x 12.59 x 7.48") | Bracket included |
| Weight          | Approx. 5.48kg (12.08lb)                 | Bracket included |
| Input Interface | Intenna                                  | 18dBi            |

|                  |       |         |
|------------------|-------|---------|
| Output Interface | Optic | 2 Ports |
|------------------|-------|---------|


**Figure 3. DU Port Configuration.**

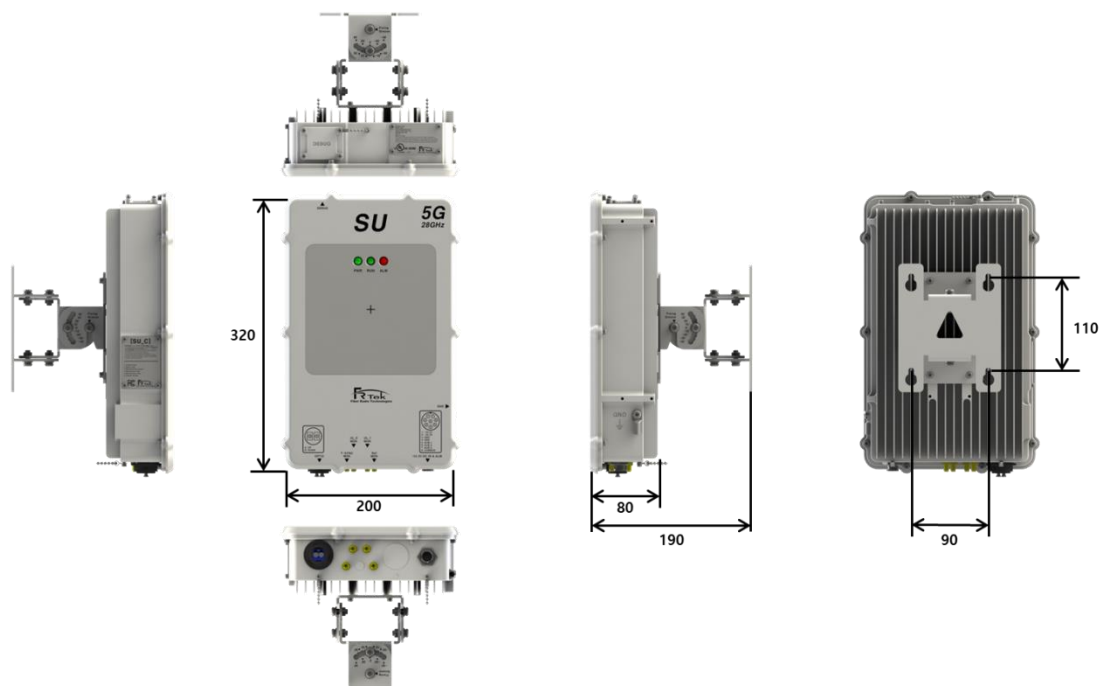
| No | Content   |
|----|---|
| ①  | Port that transmit/receives optic signal                |
| ②  | Port to monitor T-SYNC                                  |
| ③  | Port to monitor Downlink SISO Path RF signal            |
| ④  | Antenna port to transmit external signal from the Modem |
| ⑤  | Port to monitor Downlink MIMO Path RF signal            |
| ⑥  | Port to monitor internal 10MHz Reference signal         |
| ⑦  | Port to connect WEB GUI                                 |
| ⑧  | Port to supply -53.3V power from the Rectifier          |
| ⑨  | Port to connect GUI (Connected when cover is open)      |
| ⑩  | Internal Antenna, transmit/receive RF wireless signal   |

### 3.2 SU Figure and Configuration

The SU consists of One enclosure with a mounting bracket enabling wall attachment. The SU receives optic signal from the DU through Fiber-Optic cable, converts into 28GHz RF signal and sends the 5G signal through the antenna. (Downlink) It also converts the 28GHz RF signal received from the UE into optic signal and sends to the DU through Fiber-Optic cable. (Uplink)

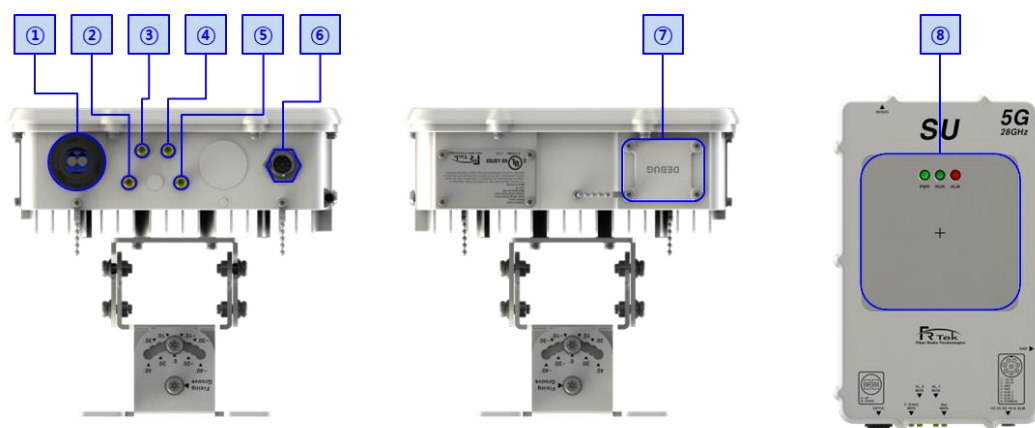
When cascading there is the SU\_C that connects between the DU and SU\_E, the figure and configuration is the same.

The SU is configured with the Intenna, SIFM, SAOM module. The rectifier powers the SU through the power port with -53.3V DC power



**Figure 4. SU Figure.**

| Item             | Content   | Remark           |
|------------------|---|------------------|
| Size             | 200 x 320 x 190mm (7.87 x 12.59 x 7.48")                            | Bracket included |
| Weight           | CASECADE: Approx. 5.78kg (12.74lb)<br>END: Approx. 5.48kg (12.08lb) | Bracket included |
| Input Interface  | Intenna   | 18dBi            |
| Output Interface | Optic   | 1-2 Ports        |



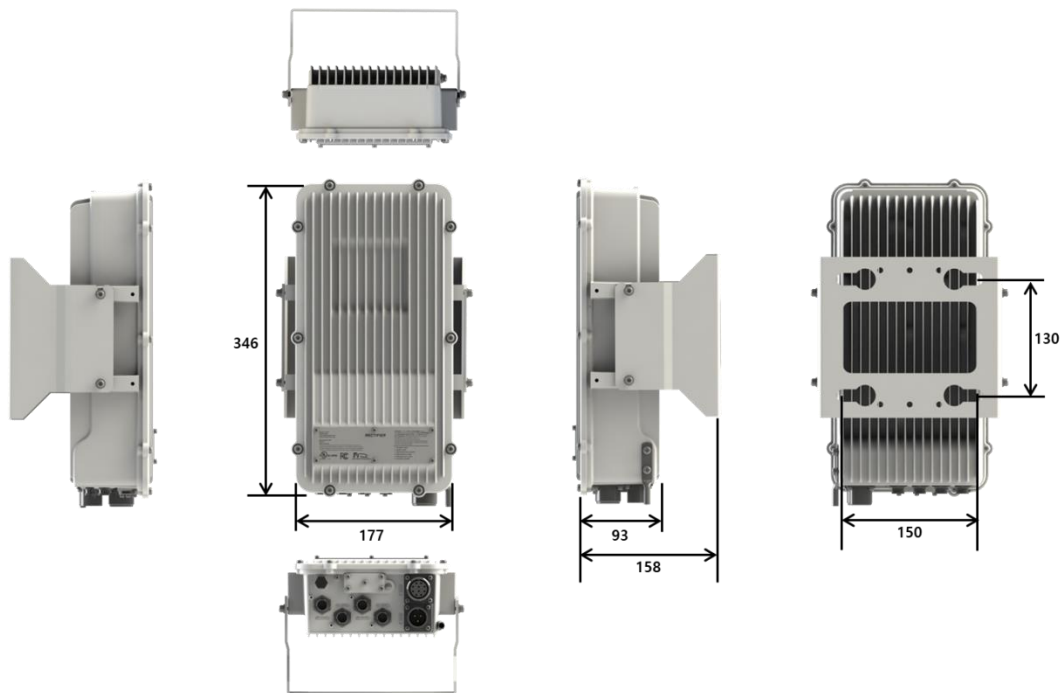
**Figure 5. SU Port Configuration.**

| Item | Content  |
|------|--|
| ①    | Port to transmit/receive optic signal                  |
| ②    | Port to monitor T-SYNC                                 |
| ③    | Port to monitor Downlink SISO Path RF signal           |
| ④    | Port to monitor Downlink MIMO Path RF signal           |
| ⑤    | Port to monitor internal 10MHz Reference signal        |
| ⑥    | Port to supply -53.3V power from the Rectifier         |
| ⑦    | Port to connect to GUI (Connect when cover is open)    |
| ⑧    | Internal antenna, transmit/receives RF wireless signal |

### 3.3 Rectifier Details and Configuration

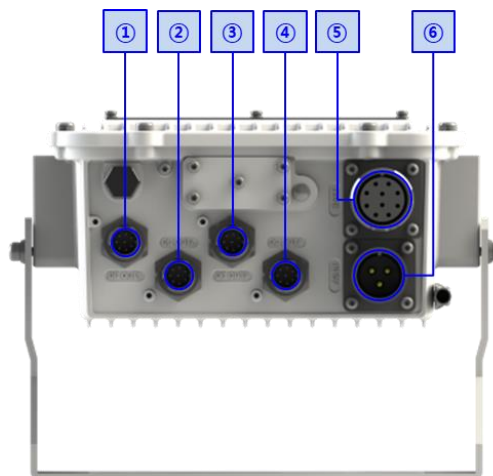
The Rectifier is a unit to supply power to the DU and SU. The Rectifier consists of One enclosure with a mounting bracket enabling wall attachment

It receives input AC 100 ~ 240V power, and outputs DC -53.3V voltage to total of 5 ports (Port 1 ~ 4, AC 100 ~ 240V input, Battery connection as shown in Figure 7). It supplies power to the DU and SU through a power cable.



**Figure 6. Rectifier Figure.**

| Item             | Content                                  | Remark           |
|------------------|--|------------------|
| Size             | 177 x 346 x 158mm (6.97 x 13.62 x 6.22") | Bracket included |
| Weight           | Approx. 5.4kg (11.9lb)                   | Bracket included |
| Input Interface  | AC 100 ~240V                             |                  |
| Output Interface | DC -53.3V                                |                  |



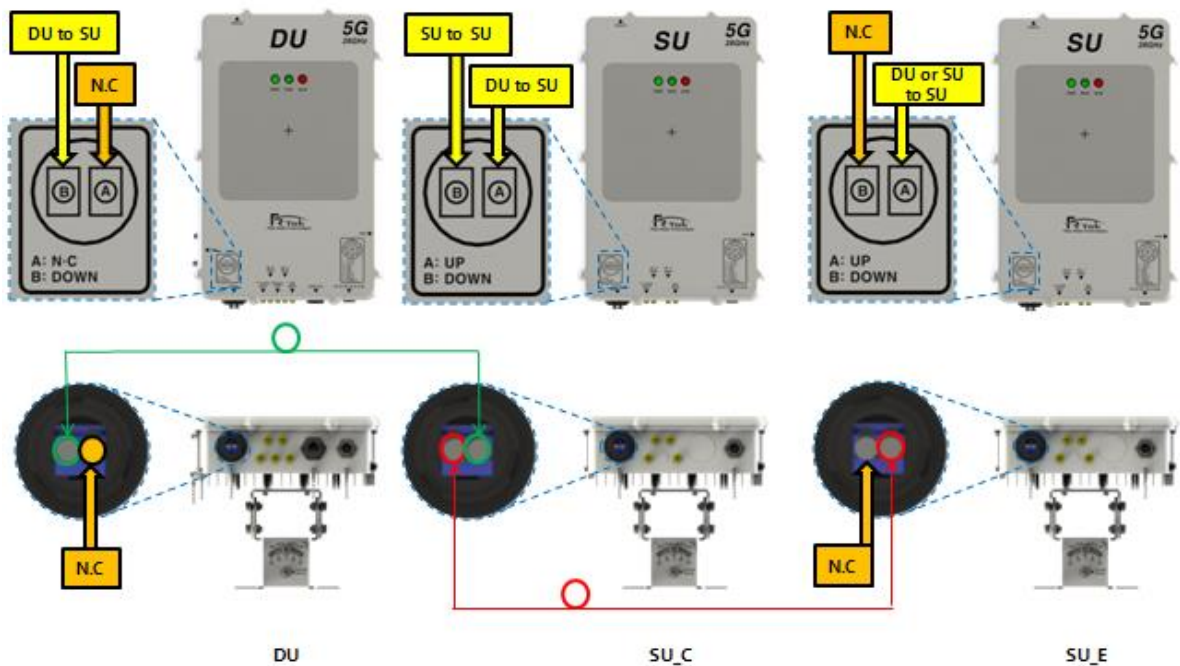
**Figure 7. Rectifier Port Configuration.**

| No | Content                  |
|----|--------------------------|
| ①  | DC -53.3V output port 1  |
| ②  | DC -53.3V output port 2  |
| ③  | DC -53.3V output port 3  |
| ④  | DC -53.3V output port 4  |
| ⑤  | AC 100 ~ 240V input port |
| ⑥  | Battery connection port  |

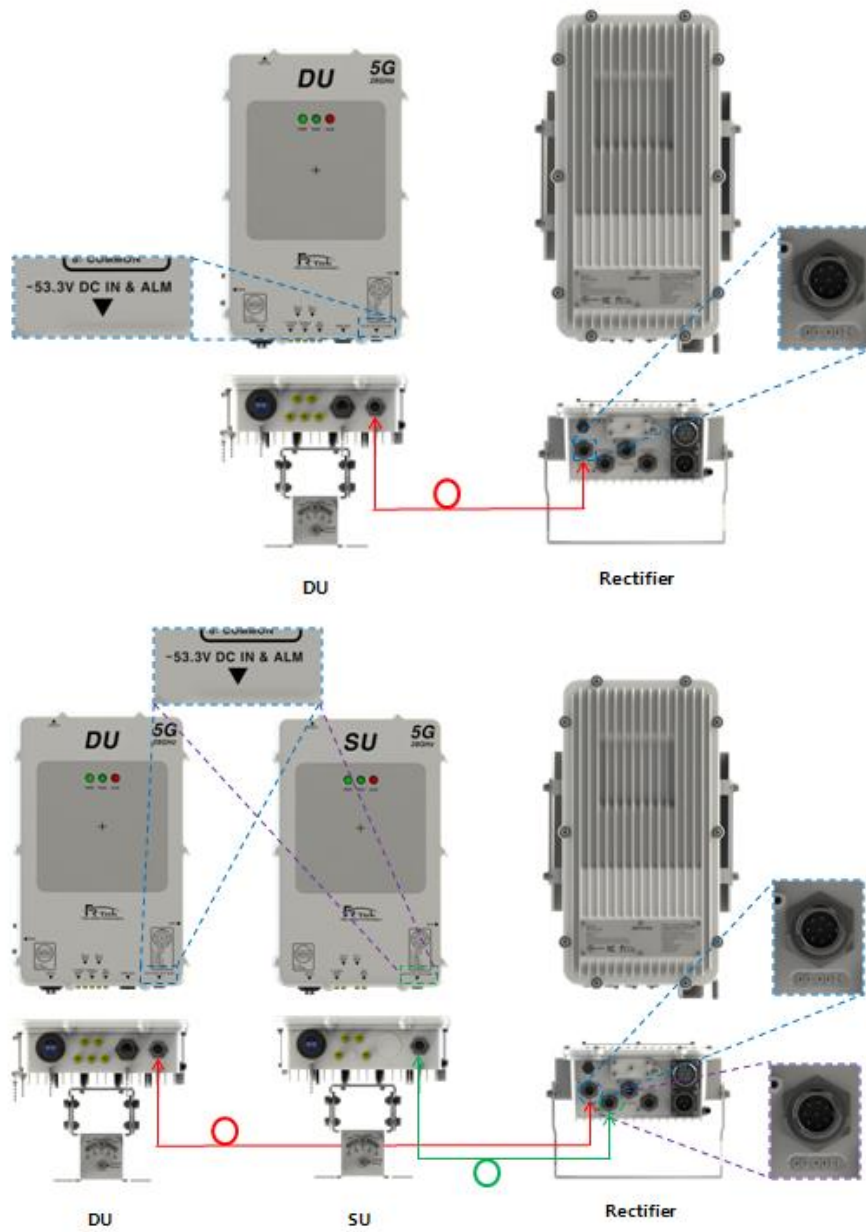
### 3.4 DU, SU, Rectifier Connecting

The DU and SU are connected with a Fiber-Optic cable. The Rectifier is connected with the DU and SU with a power cable. Each cable connection method is as below.

Do not plug fiber into PORT "A : NC" for the DU and PORT "B : DOWN" for the SU\_E because it is a non functioning port.



**Figure 8. DU, SU Wiring Method - Fiber-Optic Cable**



**Figure 9. DU, SU, Rectifier Wiring Method – Power Cable**



# ***Chapter 4***

## **System Specification**

- 
- 4.1 System Specification**
  - 4.2 Instrumental Specification**
  - 4.3 Electrical Specification**
  - 4.4 Environmental Specification**
  - 4.5 Antenna Specification**

# System Specification

## 4.1 System Specification

The PrimAer 28 is a 2X2 MIMO equipment for US 5G NR service, and is designed to operate 850MHz bandwidth in the mmWave 28GHz frequency band. This system satisfies the following functions and performance characteristics, and if not specially mentioned satisfies 3GPP performance request.

- This system's DU transmit/receives RF signal wirelessly with the base station, and the SU is installed in radio-shaded areas to eliminate radio-shade.
- The wireless quality of 5G NR service in this system satisfies at least 80% performance of the base station wireless quality.
- This system supports continuous communication hand over on the UE when the UE is moving to an adjacent base station.

### 4.1.1 Downlink Specification

| Item                | Specification                                     |   |
|---------------------|---|---|
|                     | DU DL (Input Part)                                | SU DL (Output Part)                     |
| Input Frequency     | 27.925GHz ± 425MHz                                | 5GHz± 425MHz                            |
| Output Frequency    | 5GHz ± 425MHz                                     | 27.925GHz± 425MHz                       |
| Input Level         | -72dBm ~ -42dBm                                   | -                                       |
| Output Level        | -   | SISO: +38dBm±2<br>MIMO: +41dBm±2        |
| Antenna Gain        | 18dBi<br>(H-Plane 30Deg, E-Plane 15Deg)           | 18dBi<br>(H-Plane 30Deg, E-Plane 15Deg) |
| System Delay        | Below 0.5us (DU to 1 SU)                          |   |
| ACLR                | ≥ 25dBc   |   |
| EVM                 | ≤ 8%  |   |
| MIMO                | 2x2 MIMO support (±45° polarization wave antenna) |   |
| Beam Steering Angle | ±50° (Up/Down/Left/Right)                         |   |

### 4.1.2 Uplink Specification

| Item                | Specification                                     |                    |
|---------------------|---|--------------------|
|                     | DU UL (Output Part)                               | SU UL (Input Part) |
| Input Frequency     | 5GHz± 425MHz                                      | 27.925GHz± 425MHz  |
| Output Frequency    | 27.925GHz± 425MHz                                 | 5GHz± 425MHz       |
| Input Level         | -   | -72dBm ~ -42dBm    |
| Output Level        | SISO: +38dBm±2<br>MIMO: +41dBm±2                  | -                  |
| System Delay        | Below 0.5us (DU to 1 SU)                          |                    |
| ACLR                | ≥ 25dBc   |                    |
| EVM                 | ≤ 8%  |                    |
| MIMO                | 2x2 MIMO support (±45° polarization wave antenna) |                    |
| Beam Steering Angle | ±50° (Up/Down/Left/Right)                         |                    |

## 4.2 Instrumental Specification

### 4.2.1 Structure and Type

| Unit Name  | Type           | Option              |
|------------|----------------|---------------------|
| DU         | Enclosure type | In-building/outdoor |
| SU_Cascade | Enclosure type | In-building/outdoor |
| SU_End     | Enclosure type | In-building/outdoor |
| Rectifier  | Enclosure type | In-building/outdoor |

- The PrimAer 28GHz components should be installed in a place that can be readily accessed for maintenance.
- The PrimAer 28GHz is designed to IP66 standards.

### 4.2.2 Material and Components

- The passive devices used for each unit of the PrimAer 28GHz have stable characteristics on frequency and temperature change, the active devices are industrial or equivalent semiconductors, and the integrated circuits are solidified devices.
- The wires used for each unit of the PrimAer 28GHz are flame resistant sheathed wires and uses wires with sufficient current capacity and voltage withstanding.
- The coaxial lines connecting between components within each unit of the PrimAer 28GHz are used

with cable shielded with aluminum or copper material sheath.

- The metal used for each unit of the PrimAer 28Ghz are designed to withstand not only commonly known corrosion, but also localized corrosion including stress corrosion and cracking.
- The plastic used should not melt by solvent, and is created so that crack, melt or color change do not occur when exposed to ammonia.
- The plastic is created so that it does not crack when exposed to materials(eg. insulation, filing compound, etc).
- The enclosure, components, PCB, solders, cables, etc applied for each unit of the PrimAer 28GHz comply with RoHS (Restriction of hazard materials).

### 4.3 Electrical Specification

- The power from the Rectifier operates normally on commercial power(AC100 ~240V/60Hz).
- It has over-power, over-voltage protection function on the user power.
- In case of black out, the equipment RF setting value automatically returns to the previous status right before the black out.
- The equipment ground is located on both sides of the enclosure.
- The components used in the PrimAer 28 satisfy the EMI terms of FCC regulation Title 47, Part 15, Subject J, Class A.
- A grounding rod capable of grounding the grounding wire conforming to #6AWG must be attached to the enclosure.

| Unit      | Operating Voltage Range                | Output Voltage/Current Range   | Remark |
|-----------|--|--|--------|
| Rectifier | AC 100Vac~240Vac<br>60Hz ( 57 ~ 63Hz ) | Port 1: -53.5V/2.44A<br>Port 2: -53.5V/2.44A<br>Port 3: -53.5V/2.44A<br>Port 4: -53.5V/2.44A<br>Battery: -53.5V/3A |        |

## 4.4 Environmental Specification

- There must not be any condensation traces inside the equipment when proceeding with specified temperature and humidity tests.
- It must be designed so that there are no internal condensation and function reduction due to humidity and internal/external temperature difference when it is not operated normally.
- When proceeding specified vibration test, there should be no system performance or equipment damage.
- When proceeding specified waterproof test, there should be no trace of moisture penetration inside the equipment.
- Environmental test must be conducted in accordance with room temperature standard(in-building standard, for external enclosure outdoor standard).
- For the environment test items and method repeat cycle follow the operator environment test procedure.

PrimAer 28 main environment terms are as below.

| Item                       |             | Application Term                                       | Performance Requirements  |
|----------------------------|-------------|--|---|
| Operation environment test | In-building | - Temperature : -10 ~ +50°C<br>- Humidity : 0 ~ 90% RH | - Output change : within $\pm 3$ dB<br>- No abnormalities on enclosure inside/outside |
|                            | Outdoor     | - Temperature : -25 ~ +55°C<br>- Humidity : 0 ~ 90% RH | - Output change : within $\pm 3$ dB<br>- No abnormalities on enclosure inside/outside |

## 4.5 Antenna Specification

- Antenna beam steering +/-50 degrees of beam steering
- Antenna Max Gain :  $3 + 10\text{Log}(4 \times 8) = 18\text{dBmi}$

### 4.5.1 DU Antenna

| Item                              | Specification  | Remark |
|-----------------------------------|--|--------|
| Antenna pitch                     | 5.2mm (0.2")   |        |
| Lattice                           | Rectangular  |        |
| Type                              | Patch  |        |
| Feed                              | Dual (port1, port2)  |        |
| Excitation                        | Single-ended   |        |
| Gain                              | Typical 3dB per element  |        |
| 32 elements for each polarization | - 4 x 8 elements for port 1 (SISO path) 18dBmi(Max)<br>- 4 x 8 elements for port 2 (SISO path) 18dBmi(Max)<br>- 4 x 8 elements for port 1 + port 2 (MIMO path) 21dBmi(Max) |        |
| Dummy elements                    | Included   |        |
| Frequency bandwidth               | 24.25 ~ 29.5GHz  |        |
| Beam Width                        | $\pm 30^\circ$ in H-Plane<br>$\pm 15^\circ$ in V-Plane   |        |

### 4.5.2 SU Antenna

| Item                              | Specification  | Remark |
|-----------------------------------|--|--------|
| Antenna pitch                     | 5.2mm (0.2")   |        |
| Lattice                           | Rectangular  |        |
| Type                              | Patch  |        |
| Feed                              | Dual (port1, port2)  |        |
| Excitation                        | Single-ended   |        |
| Gain                              | Typical 3dB per element  |        |
| 32 elements for each polarization | - 4 x 8 elements for port 1 (SISO path) 18dBmi(Max)<br>- 4 x 8 elements for port 2 (SISO path) 18dBmi(Max)<br>- 4 x 8 elements for port 1 + port 2 (MIMO path) 21dBmi(Max) |        |
| Dummy elements                    | Included   |        |
| Frequency bandwidth               | 24.25 ~ 29.5GHz  |        |
| Beam Width                        | $\pm 30^\circ$ in H-Plane<br>$\pm 15^\circ$ in V-Plane   |        |

## ***Chapter 5***

### **System Installation**







- 
- 5.1 Tools**
  - 5.2 DU Installation Method**
  - 5.3 SU Installation Method**
  - 5.4 Rectifier Installation Metho**

# System Installation

" This manual provides detailed instructions on the installation of the PrimAer 28GHz DAS. The user needs to understand the manual and have expert knowledge on repeater systems.. This chapter explains how to connect all necessary cables and how to install each piece of equipment. (DU, SU and Rectifier).

## 5.1 Tools







Tools recommended for installation are below.

| No. | Tools  | No. | Tools   |
|-----|--|-----|---|
| 1   | Hole(*Security) Torx Drivers, 4 Type<br>(1) M3: T10H<br>(2) M4: T20H<br>(3) M5: T25H<br>(3) M6: T30H | 2   | Screw Driver<br>No. 3 (+)   |
|     |                   |     |  |
| 3   | Spanners (19mm)  | 4   | Hammer Drill  |
|     |                   |     |  |
| 5   | M12 Set Anchor<br>(1) M12, Nut<br>(2) M12, Spring Washer<br>(3) M12, Plain Washer                    | 6   | Concrete Drill Bit<br>(1)Diameter: 17mm<br>(2)Diameter: 8mm                           |
|     |                   |     |  |
| 7   | M12 Anchor Punch   | 8   | Bakelite  |



|    |   |    |   |
|----|---|----|---|
|    |    |    |    |
| 9  | Insulation Busing   | 10 | Hammer  |
|    |    |    |    |
| 11 | Rubber Hammer   | 12 | HEX, Direct Screw<br>(Diameter: 6mm, Length:<br>40mm)                                 |
|    |   |    |    |
| 13 | Plastic Wall Plug<br>(Diameter: 8mm, Length: 40mm)                                  | 14 | Ø 6.5 Plain Large Washer  |
|    |  |    |  |
| 15 | SUS BAND<br>(*Size according to Pole diameter)                                      | 16 | Tape Measure  |
|    |  |    |  |
| 17 | Level Bar   | 18 | Hand Safety Gloves  |
|    |  |    |  |

Other cables and components required for installation are below.

| No. | Tools  | No. | Tools  |
|-----|--|-----|--|
| 1   | Rectifier AC Cable   | 2   | DC Input Cable   |
|     |   |     |   |
| 3   | Ground Wire Line   | 4   | SC-APC type Optic Fiber  |
|     |   |     |   |
| 5   | SMA type 10dB Attenuator   | 6   | ESD Gloves   |
|     |  |     |  |

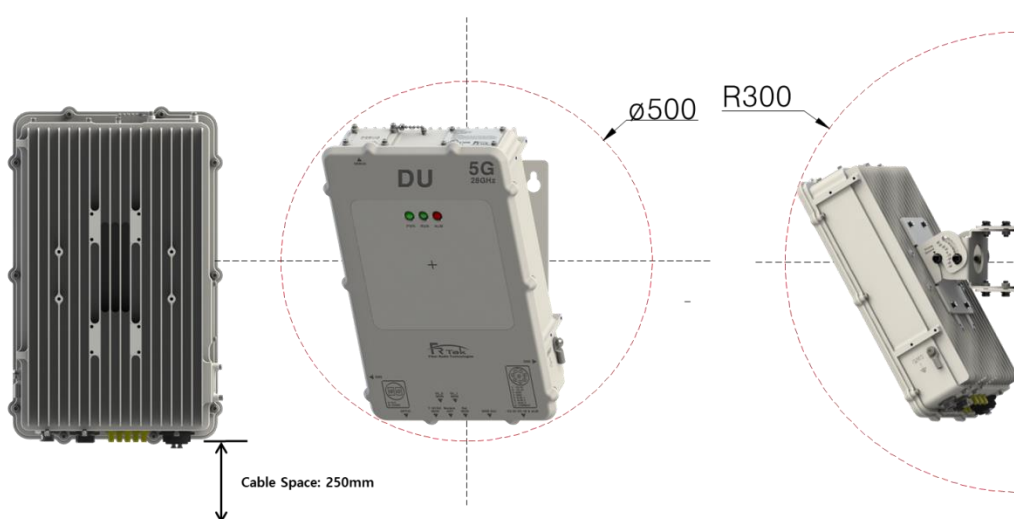
 **Warning**

System ground must be connected to a building-installed ground point for proper protection..

## 5.2 DU Installation

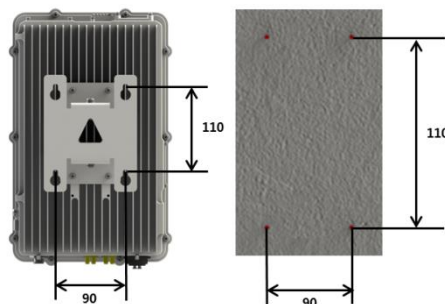
### 5.2.1 Product Installation

The DU can be installed on the wall or pole mounted using brackets/clamps.



**Figure 10. Required Space for DU Installation**

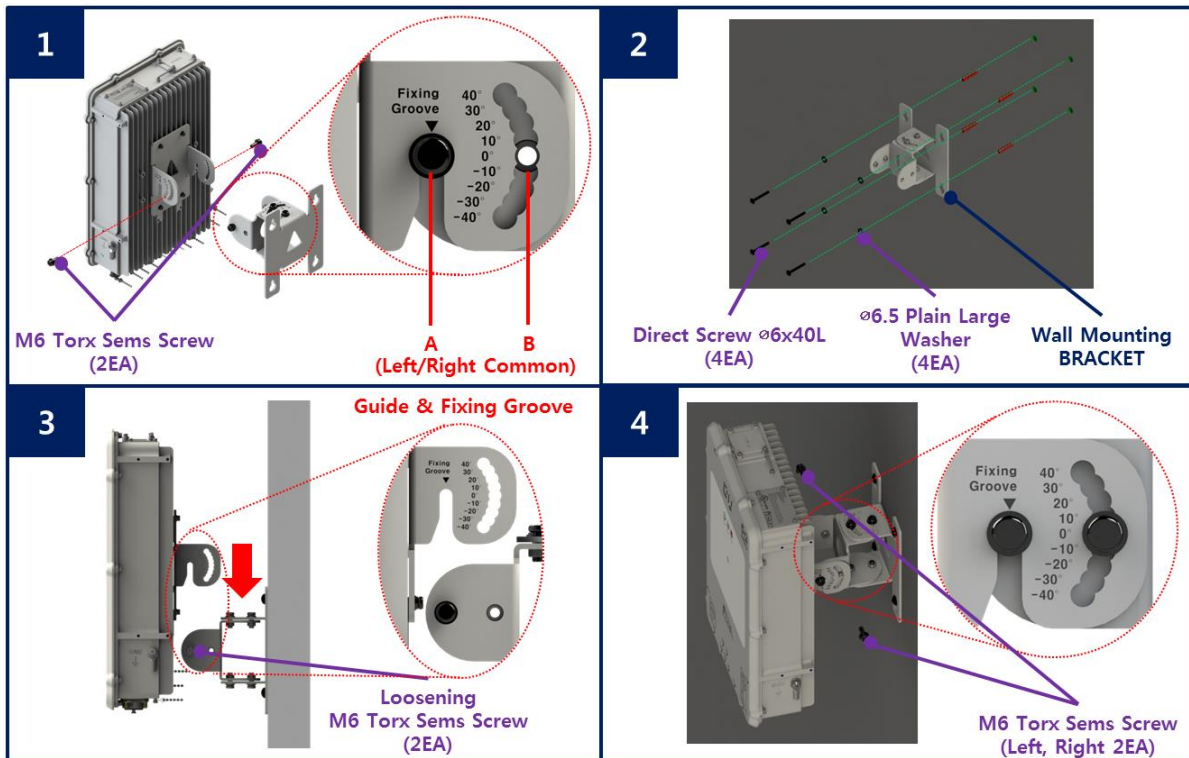
The DU mounting bracket allows for tilting vertically and horizontally. It requires a minimum of 19.68 inches(500mm) in diameters around the unit from the front view and 11.81 inches(300mm) in radius from the side view of installation.



**Figure 11. DU Anchor Bolt Assemble for Wall Installation**

Above picture is a simple drawing for the anchor bolt installation. The Assembly order is shown below.

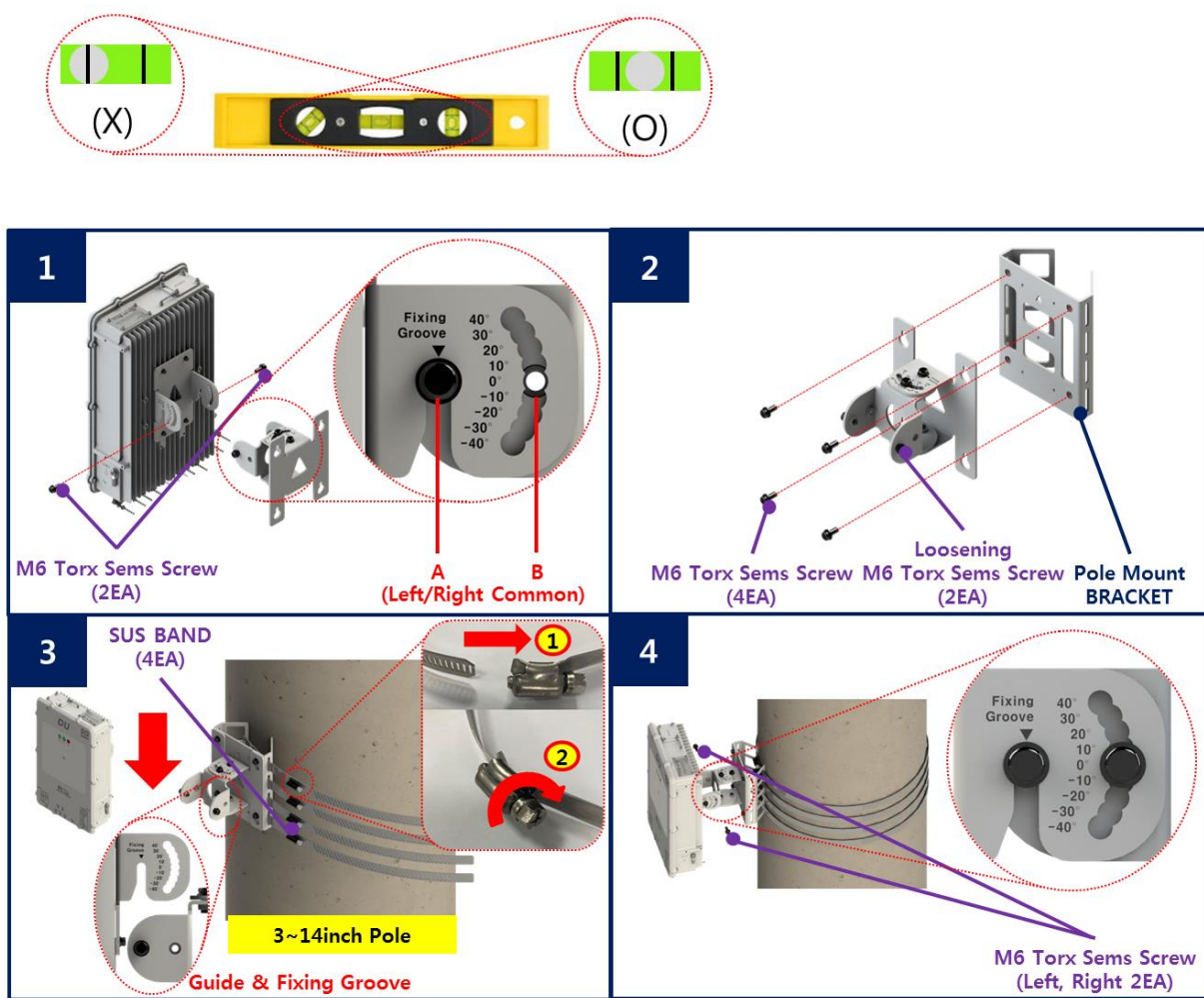
1. Mark position on the wall. Horizontally 90mm and vertically 110mm.
2. Use hammer drill & concrete 8mm drill bit to drill a hole with a depth of 40mm or more on the marked positions.
3. Remove dust from the holes.
4. Use rubber hammer to fix anchors to the holes drilled on the wall.



**Figure 12. DU Wall Installation Assemble**

Above picture is an assembly drawing of the DU wall installation. The Assembly order is shown below.

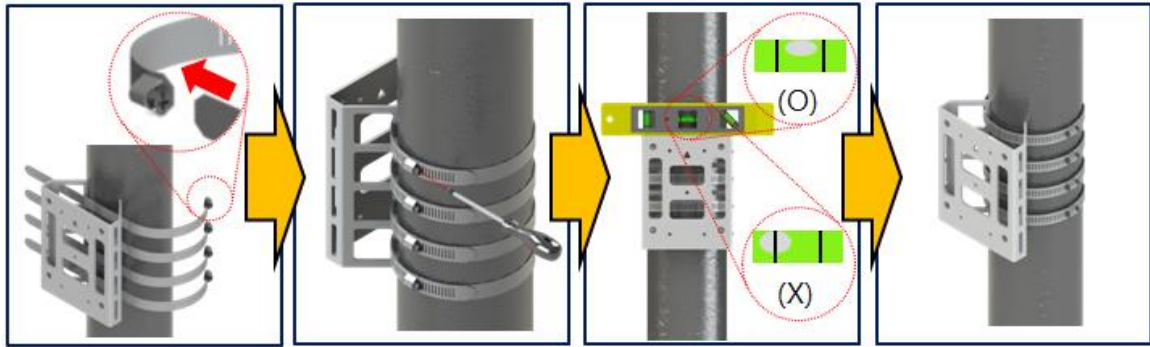
1. Totally unscrew M6 Torx Sems Screw (2ea) of "B" to separate Wall Mount Bracket from the DU. (Unscrew M6 Torx Sems Screw (2ea) of "A" only enough for the Wall Mount Bracket to be separated)
2. Place the Wall Mount Bracket and the  $\phi 6.5$  Plain Large Washers(4ea) according to the Anchor Bolt and assemble using HEX, Direct Screws(4ea).
3. Place the DU according to the "Guide & Fixing Groove" picture.
4. Screw back the M6 Torx Sems Screw (2ea) of "B" and re-screw the M6 Torx Sems Screw (2ea) of "A".
5. Check with the lever bar to confirm that the horizontal/vertical angles are correct.



**Figure 13. DU Pole Installation Assemble**

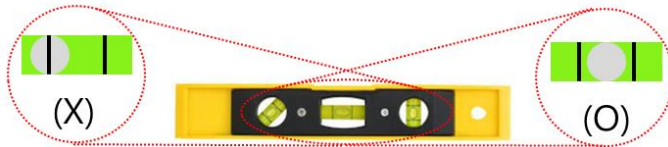
Above picture is an assembly drawing of the DU pole installation. Assembly order is shown below.

1. Totally unscrew M6 Torx Sems Screw (2ea) of "B" to separate Wall Mount Bracket from the DU. (Unscrew M6 Torx Sems Screw (2ea) of "A" only enough for the Wall Mount Bracket to be separated)
  2. Use M6 Torx Sems Screw (4ea) to assemble the Wall Mount Bracket and Pole Mount Bracket.
  3. Use + driver to assemble the Bracket and SUS Band (4ea) on the pole.
- Place the DU according to the "Guide & Fixing Groove" picture. (Pole diameter can apply from 3~14")  
SUS band should be assembled as shown below.

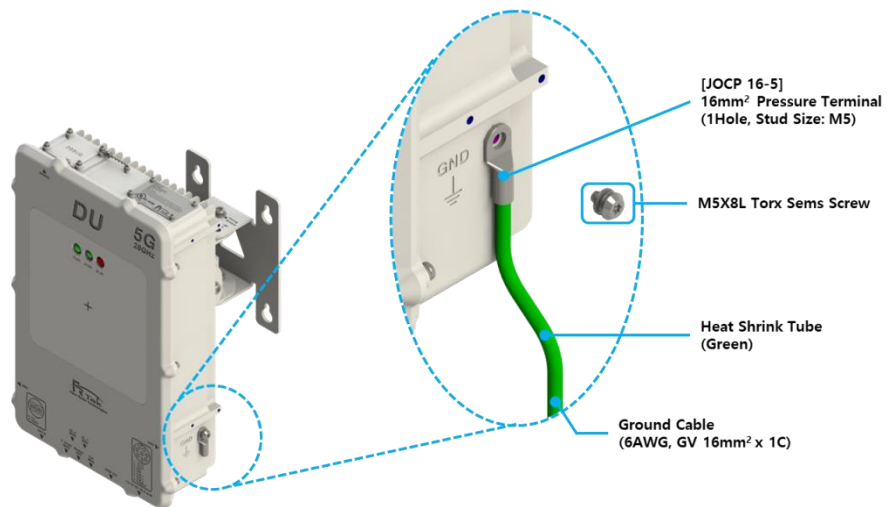


4. Screw back the M6 Torx Sems Screw (2ea) of "B" and re-screw the M6 Torx Sems Screw (2ea) of "A".

5. Check with the lever bar to confirm that the horizontal/vertical angles are correct.



### 5.2.2 Ground Cable Connection

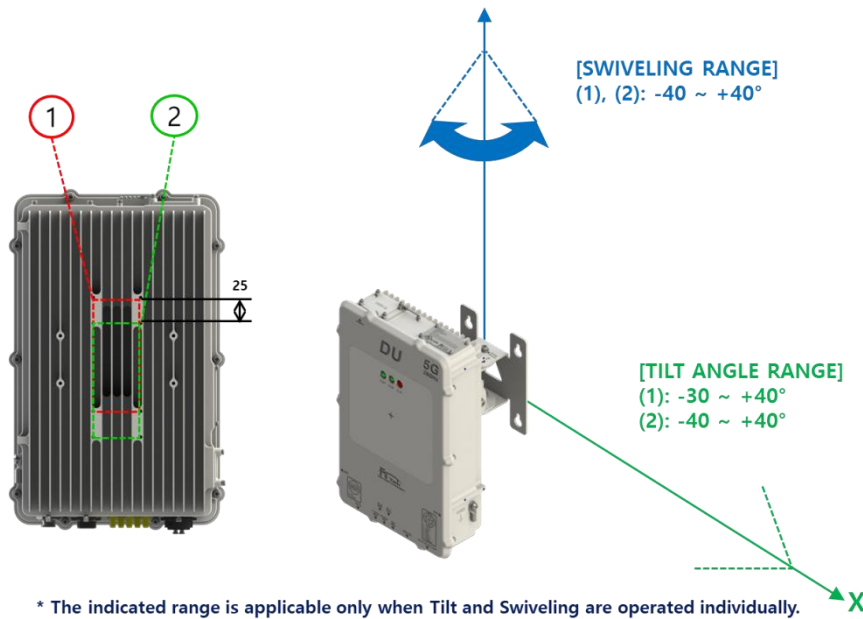


**Figure 14. DU Ground Cable Connection**

In order to protect the DU, connect enclosure grounding with building grounding in order to prevent DU from electrical danger.

### 5.2.3 Antenna Tilt

The DU transmits and receives 5G signal from the gNB to provide service in poor coverage areas. The DU has an "intenna" (integrated antenna), so does not require any additional antenna installation. It can be tilted up/down and left/ right, using the mounting bracket.

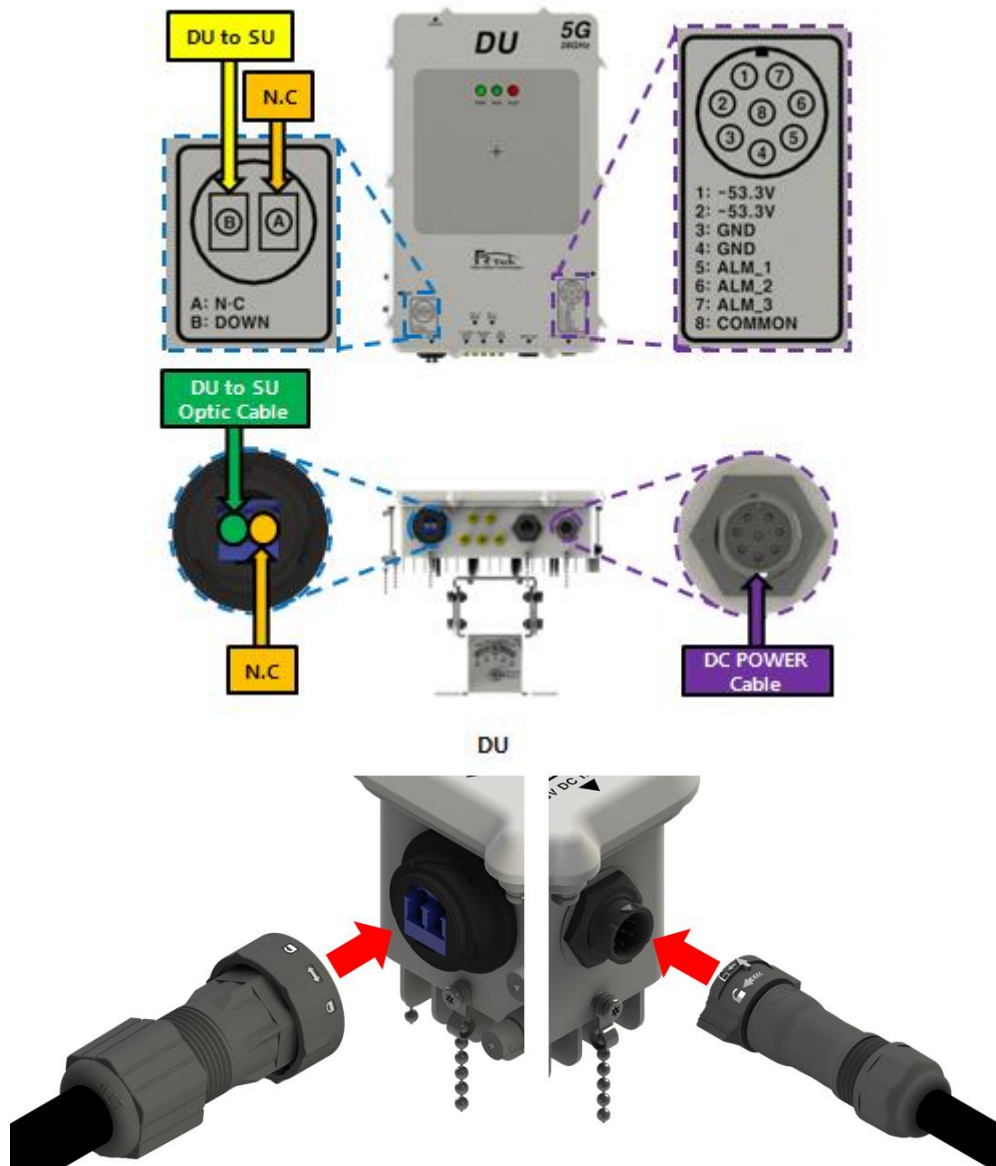


**Figure 15. DU Tilt**

The above diagram shows the DU rotation angle, up/down/left/right. The DU is placed outdoors and installed at an optimal location to transmit/receive 5G signal from the base station and can be tilted as above picture.



### 5.2.4 Optic Cable & Power Cable Connection



**Figure 16. DU Optic Cable and Power Cable Connection**

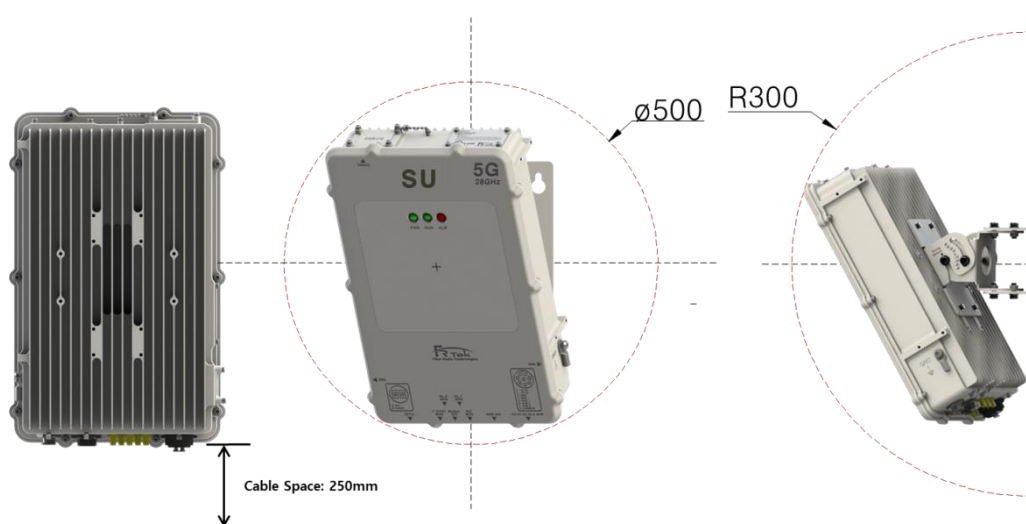
The DU is a designated outdoor equipment so it must be waterproofed after connection with the optic cable and power cable.



## 5.3 SU Installation

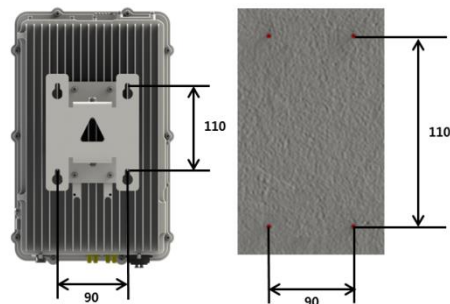
### 5.3.1 Product Installation

The DU can be installed on the wall or pole mounted using brackets/clamps.



**Figure 17. Required Space for SU Installation**

The SU mounting bracket allows for tilting vertically and horizontally. It requires a minimum of 19.68 inches(500mm) in diameters around the unit from the front view and 11.81 inches(300mm) in radius from the side view of installation

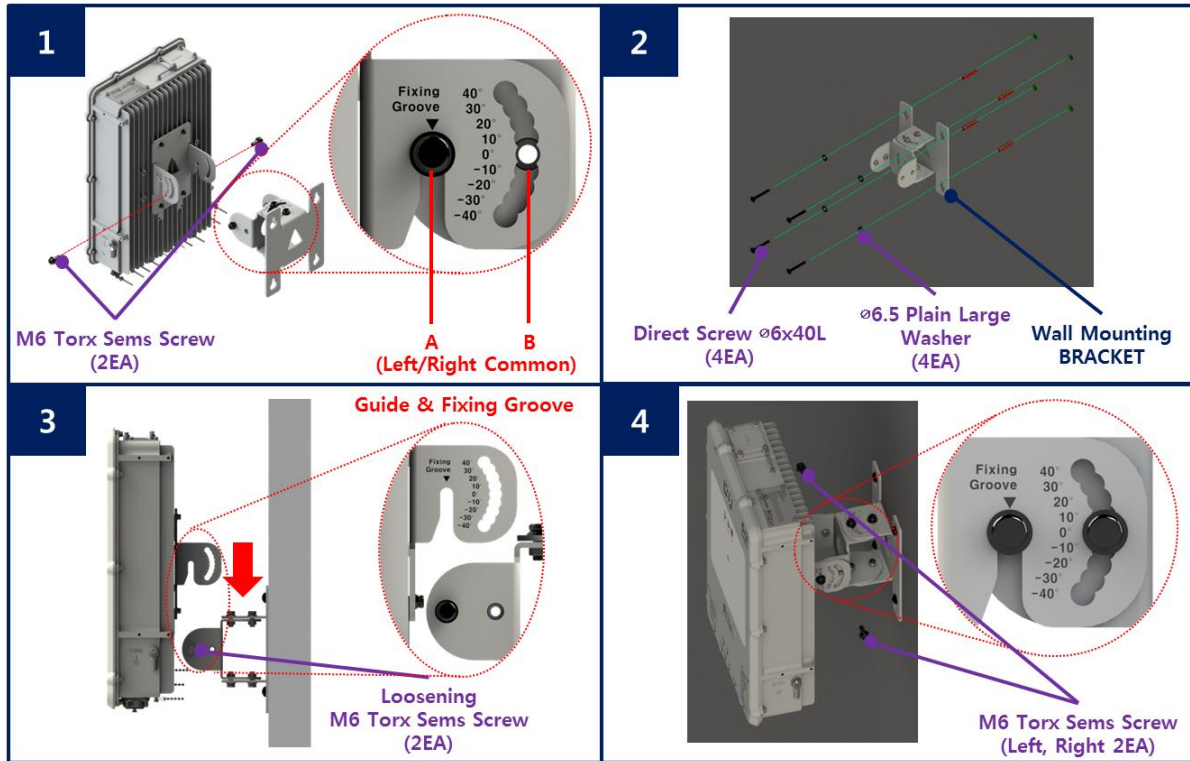


**Figure 18. SU Anchor Bolt Assemble**

Above picture is a simple drawing for the anchor bolt installation. The Assembly order is shown below.

1. Mark position on the wall. Horizontally 90mm and vertically 110mm.
2. Use hammer drill & concrete 8mm drill bit to drill a hole with a depth of 40mm or more on the marked positions.
3. Remove dust from the holes.

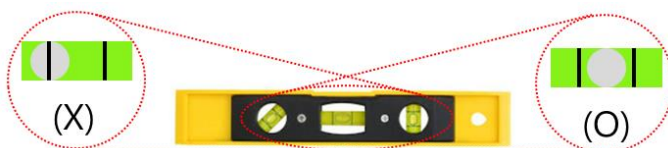
4. Use rubber hammer to fix anchors to the holes drilled on the wall.

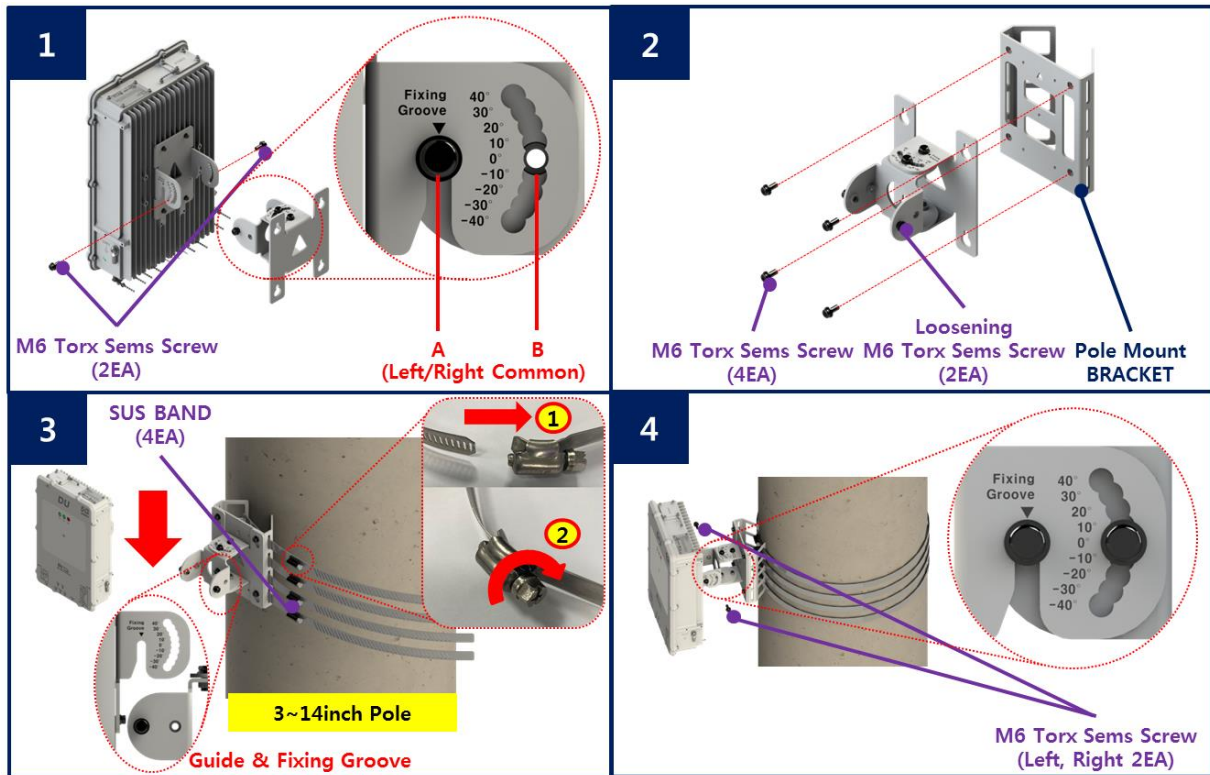


**Figure 19. SU Wall Installation Assemble**

Above picture is an assembly drawing of the SU wall installation. The Assembly order is shown below.

1. Totally unscrew M6 Torx Sems Screw (2ea) of "B" to separate Wall Mount Bracket from the DU. (Unscrew M6 Torx Sems Screw (2ea) of "A" only enough for the Wall Mount Bracket to be separated)
2. Place the Wall Mount Bracket and the ø6.5 Plain Large Washers(4ea) according to the Anchor Bolt and assemble using HEX, Direct Screws(4ea).
3. Place the SU according to the "Guide & Fixing Groove" picture.
4. Screw back the M6 Torx Sems Screw (2ea) of "B" and re-screw the M6 Torx Sems Screw (2ea) of "A".
5. Check with the lever bar to confirm that the horizontal/vertical angles are correct.

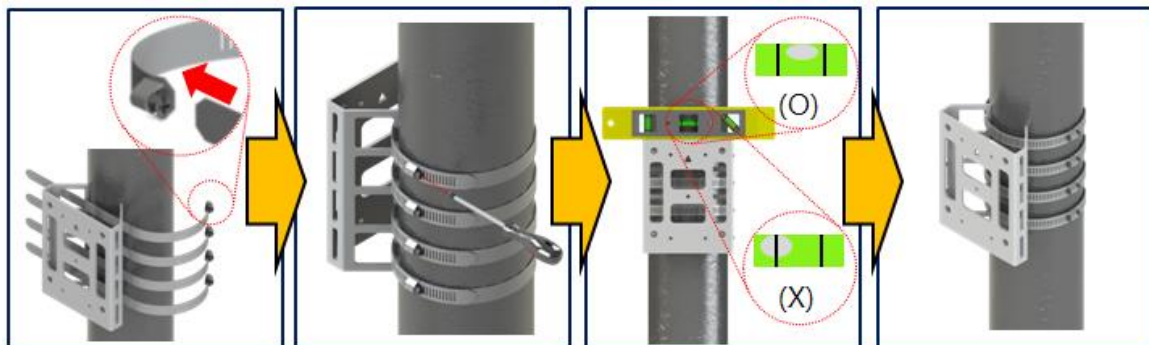




**Figure 20. SU Pole Installation Assemble**

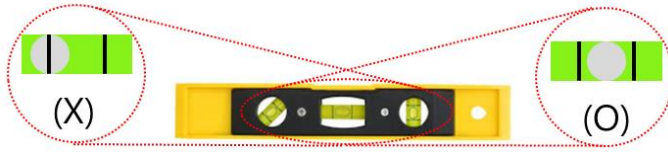
Above picture is an assembly drawing of the SU pole installation. Assembly order is shown below.

1. Totally unscrew M6 Torx Sems Screw (2ea) of "B" to separate Wall Mount Bracket from the DU. (Unscrew M6 Torx Sems Screw (2ea) of "A" only enough for the Wall Mount Bracket to be separated)
2. Use M6 Torx Sems Screw (4ea) to assemble the Wall Mount Bracket and Pole Mount Bracket.
3. Use + driver to assemble the Bracket and SUS Band (4ea) on the pole.  
Place the SU according to the "Guide & Fixing Groove" picture. (Pole diameter can apply from 3~14")  
SUS band should be assembled as shown below.

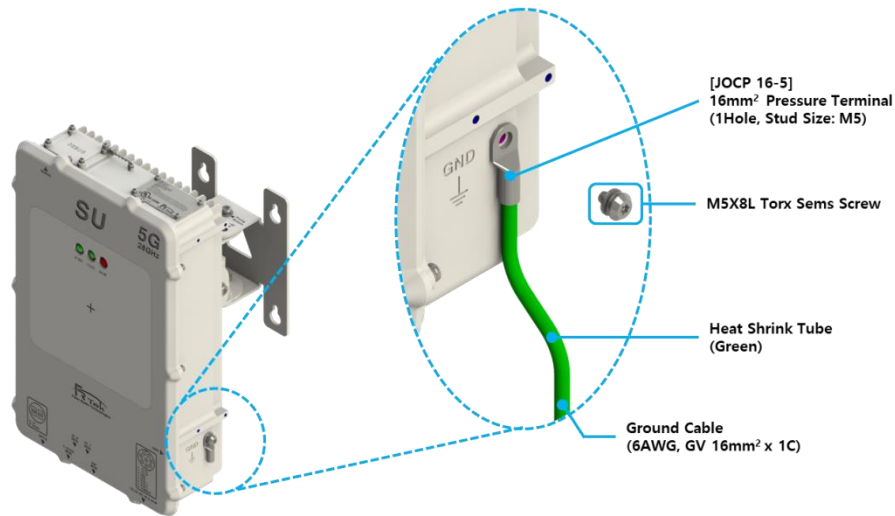


4. Screw back the M6 Torx Sems Screw (2ea) of "B" and re-screw the M6 Torx Sems Screw (2ea) of "A".

5. Check with the lever bar to confirm that the horizontal/vertical angles are correct.



### 5.3.2 Ground Cable Connection

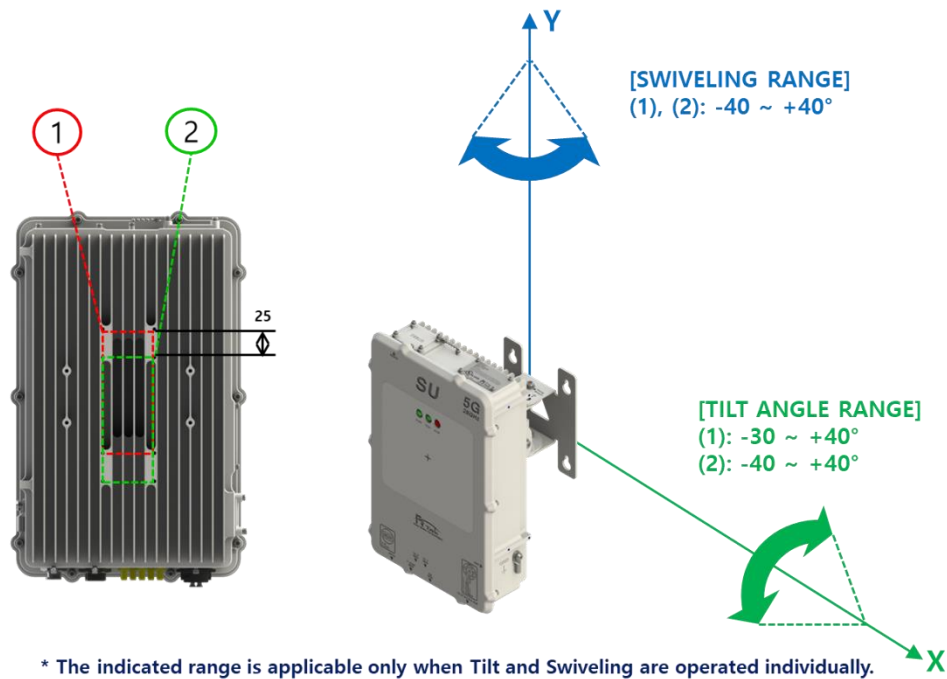


**Figure 21. SU Ground Cable Connection**

In order to protect the SU, connect enclosure grounding with building grounding in order to prevent SU from electrical danger.

### 5.3.3 Antenna Tilt

The SU services to radio shaded areas. Since the SU is an "*intenna*", it does not require additional antenna installation. It can be rotated and tilted up, down, left, and right using mounting bracket.



**Figure 22. SU Tilt.**

The above picture shows the SU rotation angles, (up/down/left/right). The SU can be mounted either indoors or outdoors in an optimized location that enables it to transmit and receive the 5G signal from the base station.



### 5.3.4 Optic Cable & Power Cable Connection

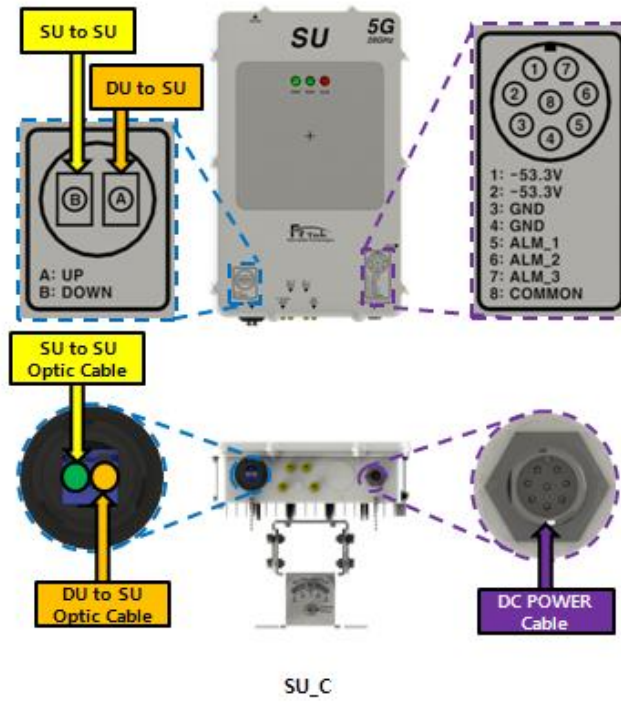
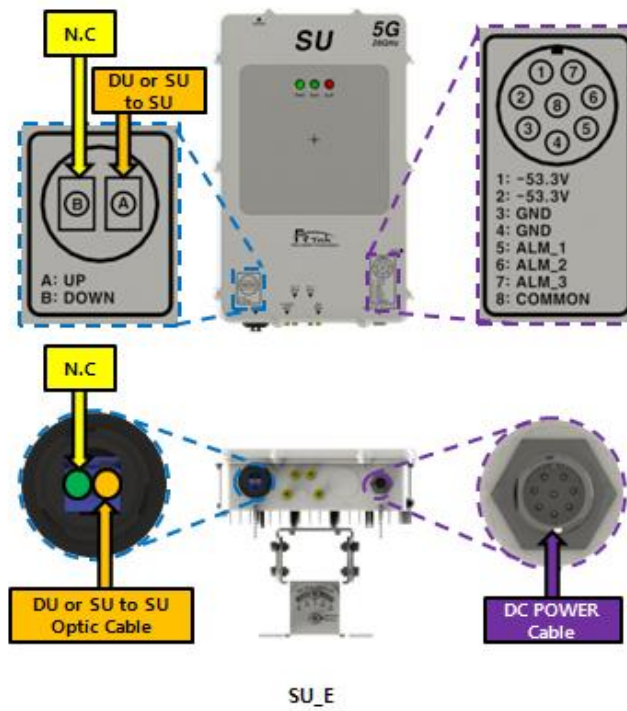
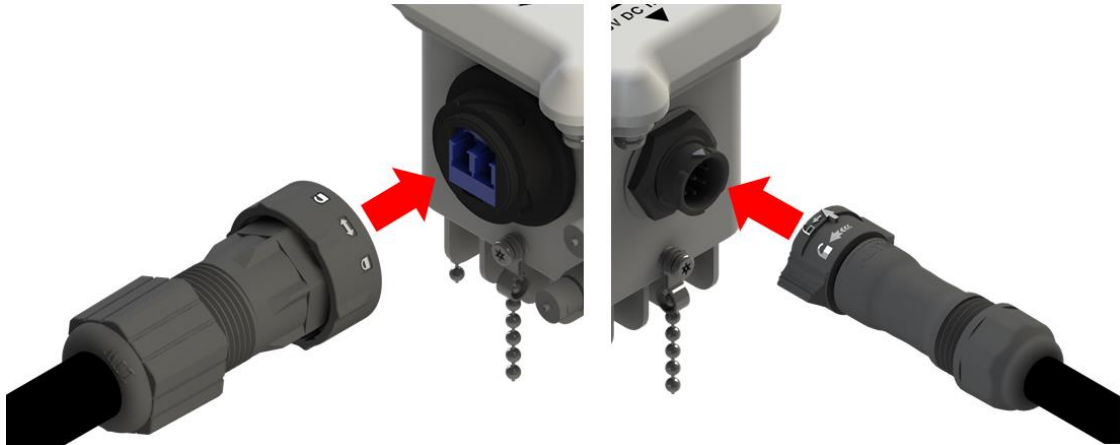


Figure 23. SU\_C Optic Cable and Power Cable Connection





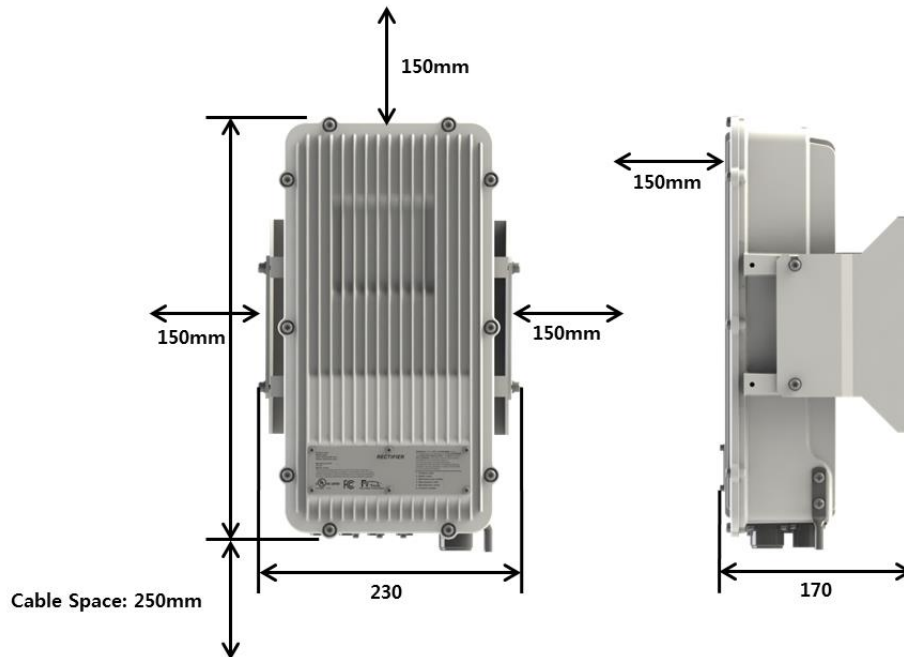
**Figure 24.SU\_E Optic Cable and Power Cable Connection**

Since the SU can be placed either outdoors or in-building, it must be made waterproof after connected with the RF cable and power cable.

## 5.4 Rectifier Installation

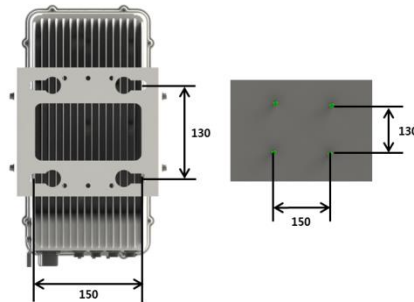
### 5.4.1 Product Installation

The Rectifier can be installed on the wall or pole mounted using brackets/clamps.



**Figure 25. Required Space for Rectifier Installation**

For convenience of the Rectifier installation, it requires more than 5.91 inch(150mm) space from the front, top, right and left side of the equipment and 9.84 inch(250mm) space from the bottom side of equipment for cable connection space.

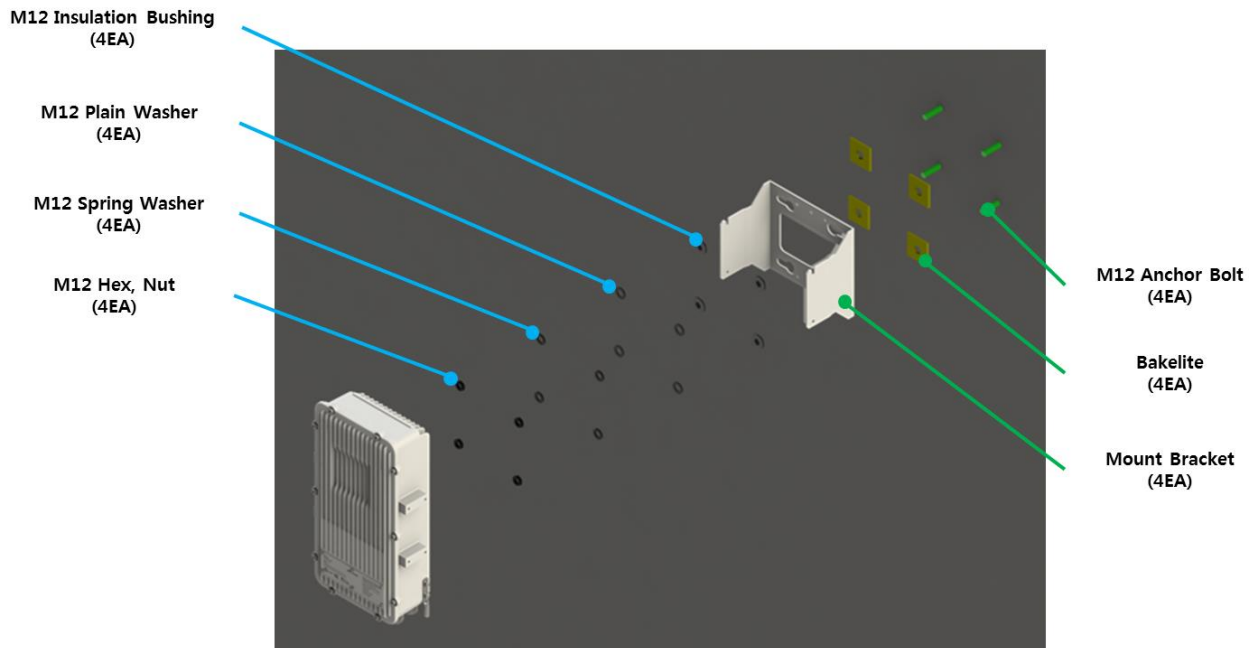


**Figure 26. Rectifier Anchor Bolt Assemble**

Above picture is a simple drawing for the anchor bolt installation. The Assembly order is shown below.

1. Mark position on the wall. Horizontally 150mm and vertically 130mm.
2. Use hammer drill & concrete 17mm drill bit to drill a hole with a depth of 55mm or more on the marked positions.
3. Remove dust from the holes.
4. Use Anchor Punch to fix anchors to the holes drilled on the wall.



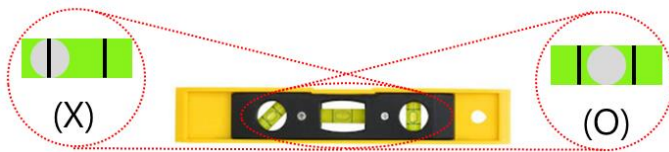


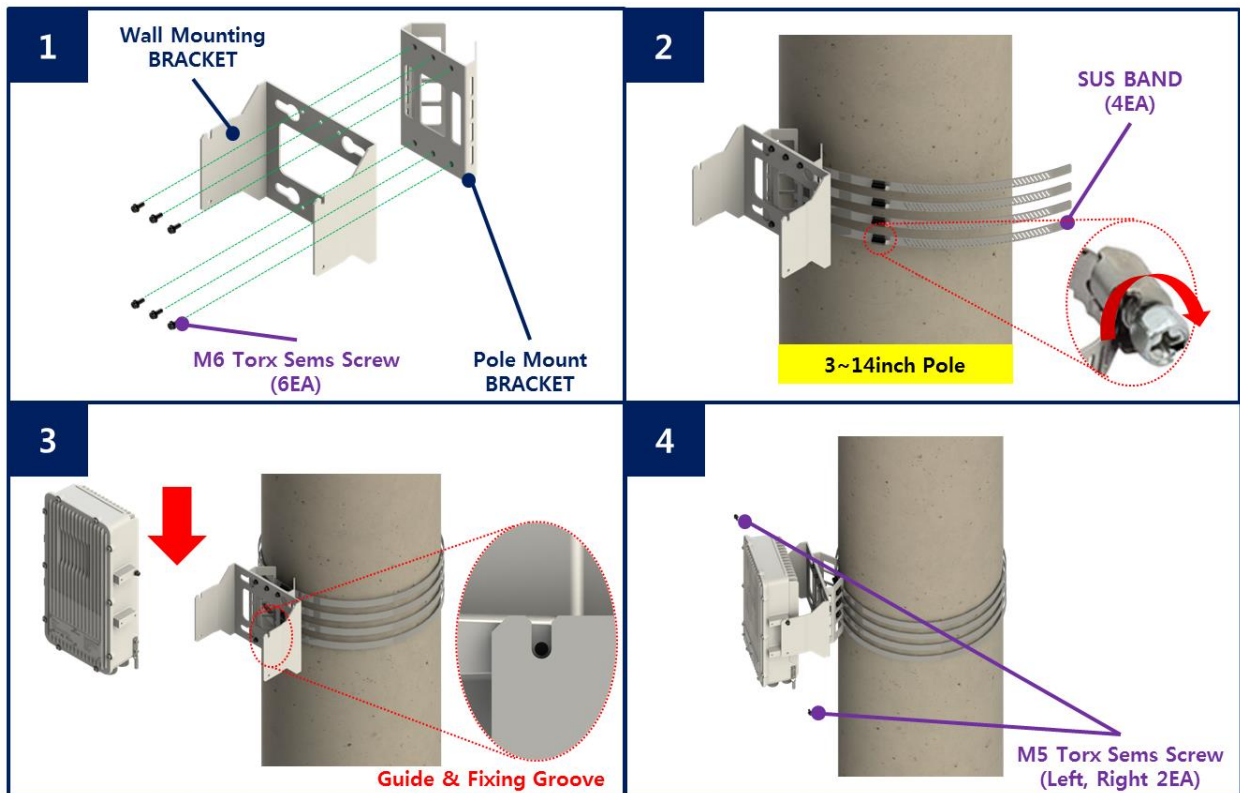
**Figure 27. Rectifier Wall Installation Assemble**

Above picture is an assembly drawing of the Rectifier wall installation. Please note that the above image is to help understand the proper installation. the Rectifier ASSY and bracket are not separated during installation.

Assembly order is as shown below.

1. Place Bakelite (4ea) on the M12 Anchor Bolt, place Mount Bracket according to M12 Anchor Bolt.
2. Insert M12 Insulation Bushing (4ea), M12 Plain Washer (4ea), M12 Spring Washer (4ea), M12 HEX, Nut and assemble with 19mm spanner.
3. Check with the lever bar to confirm that the horizontal/vertical angles are correct.

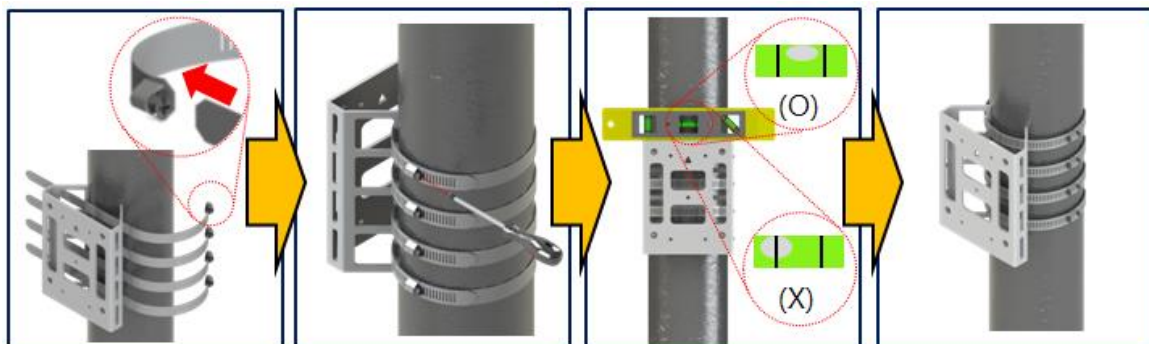




**Figure 28. Rectifier Pole Installation Assemble**

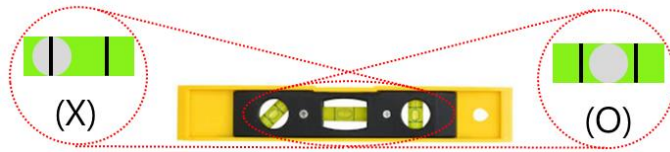
Above picture is an assembly drawing of the Rectifier pole installation. Assembly order is shown below.

1. Separate the Wall Mount Bracket from the Rectifier and assemble to Pole Mount Bracket using M6 Torx Sems Screw (6ea)
2. Use + driver to assemble the Bracket and SUS Band (4ea) on the pole.  
SUS band should be assembled as shown below.

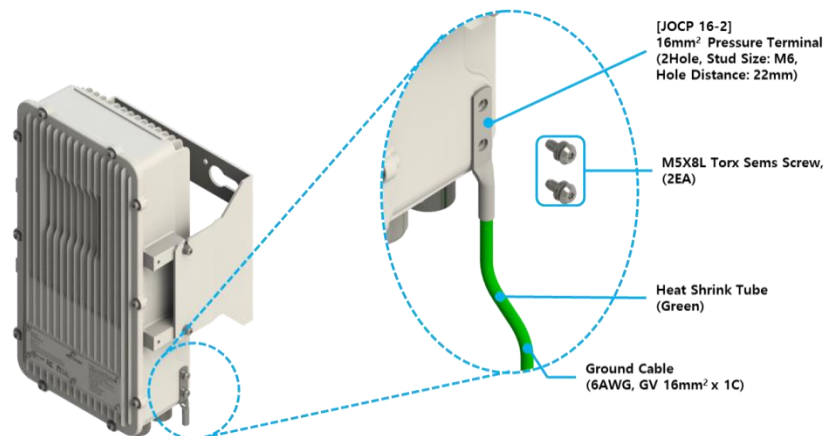


3. Place the Rectifier according to the "Guide & Fixing Groove" picture. (Pole diameter can apply from 3~14")
4. Screw the M5 Torx Sems Screw (2ea)

5. Check with the lever bar to confirm that the horizontal/vertical angles are correct.



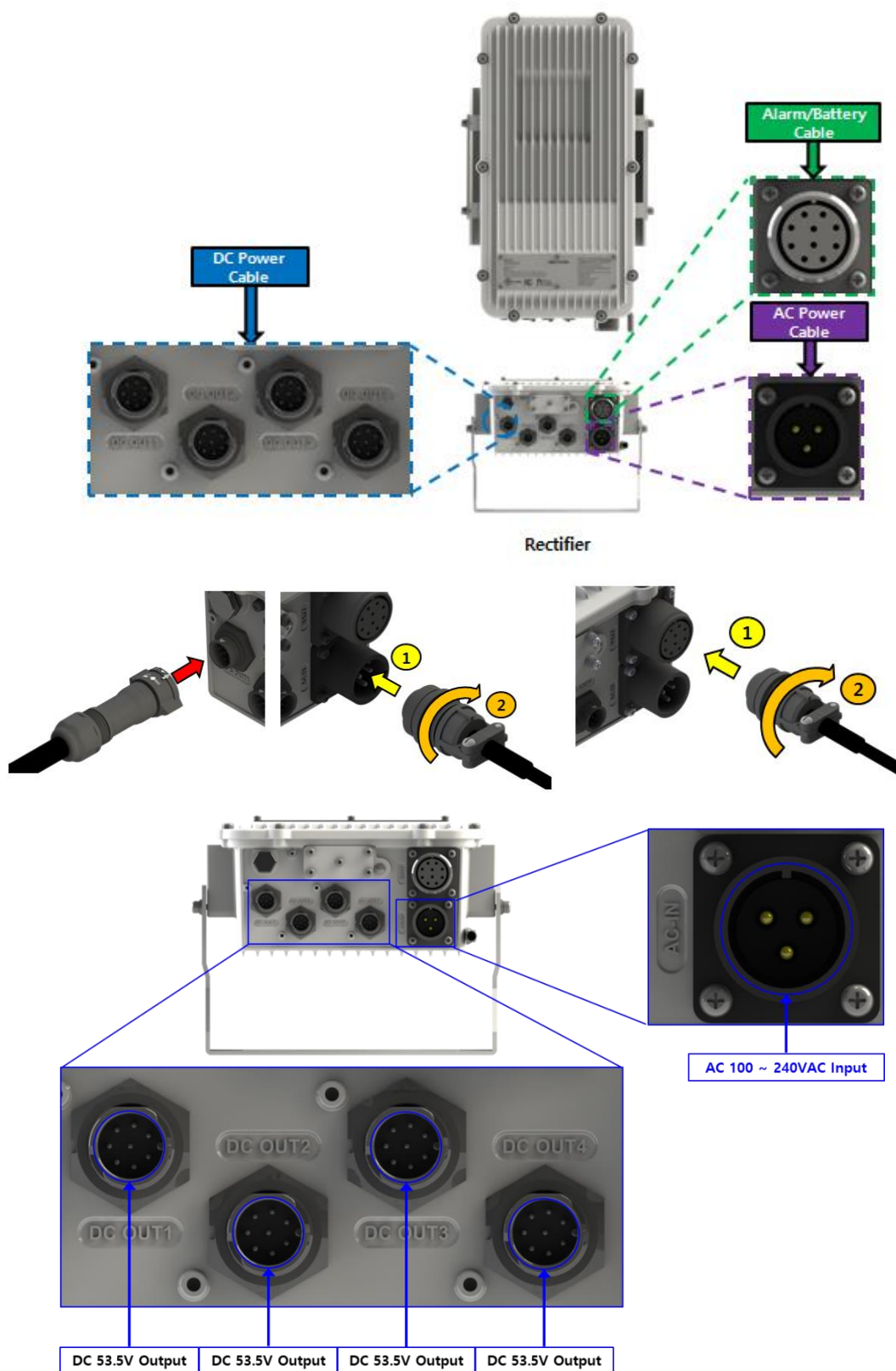
### 5.4.2 Ground Cable Connection



**Figure 29. Rectifier Ground Cable Connection**

In order to protect the Rectifier, connect enclosure grounding with building grounding in order to prevent Rectifier from electrical danger.

**5.4.3 Power Cable Connection**

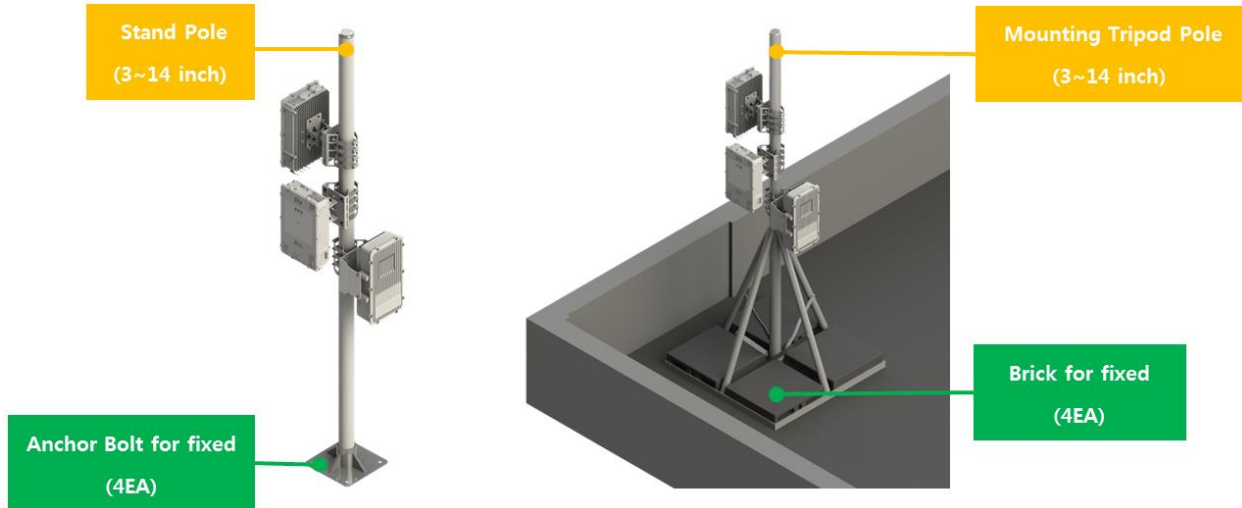


**Figure 30. Rectifier Power Cable Connection**

Connect the AC input power cable to the AC-IN port, and connect the DU, SU(Cascade), SU(End) cable for DC input to the DC OUT port 1~4.

Since the Rectifier is an outdoor unit, it must be waterproofed after connecting with power cable.

#### 5.4.4 Other Installation Environment



**Figure 31. Standing Pole or Mounting Tripod Pole**

When Wall or Electrical Pole installation is not available for the DU, SU, and Rectifier, then can use a Standing Pole or Mounting Tripod Pole for configuration.

## ***Chapter 6***

### **Local GUI(Graphical User Interface)**

---

#### **6.1 GUI Configuration**

# Local GUI(Graphical User Interface)

“ Chapter 6 is to provide product setting method and information to users operating the PrimAer 28. The repeater manager who will use the operation manual is required to have professional knowledge and construction operation experience on repeater systems. ”

- The GUI program is an operation program created for system control and monitoring..
- The GUI program is communicated using USB-B type port on each equipment.
- Through the main screen of each unit, the user can monitor and control the entire system operation status.

## 6.1 GUI Configuration

### 6.1.1 DU Main Screen

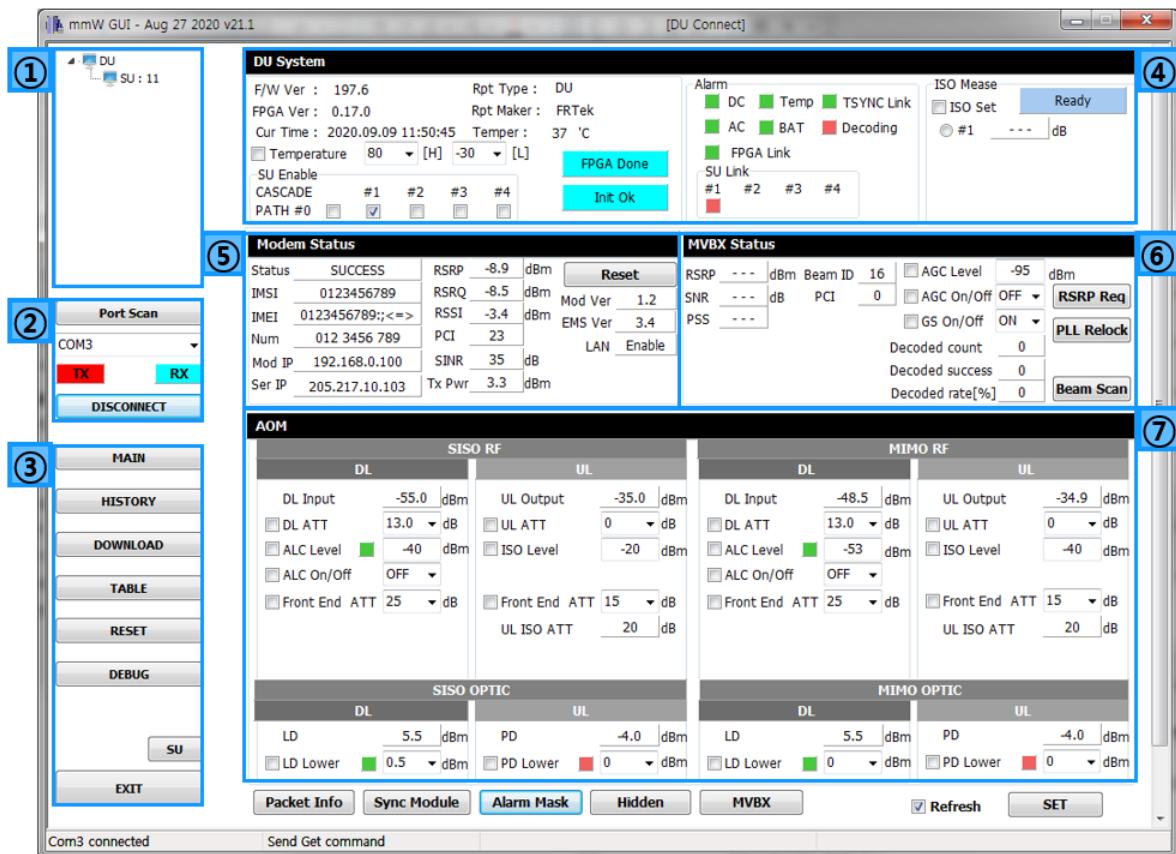


Figure 32. DU Main Screen

① **Tree List**

This item is to check all equipments on the current configured system. Also, it can monitor real-time on each unit's alarm status through each unit item alarm.

② **GUI Connection**

This is where the unit and PC can be connected. When pressing the arrow that checks 'Comport' and clicking the 'Auto' button, the unit & PC connected comport will automatically be renewed, and when pressing the 'CONNECT' button, the button status will change to 'DISCONNECT', allowing access to the GUI.

③ **Function List**

This item is to use implemented additional functions. The 'History' function, temperature/power 'Table' manage function, the firm ware download function, and the 'Debug' function can be used.

- History : Item to use 'Alarm History' function. Item to check connected unit's alarm history.
- Table : Item to create/manage output table and temperature table per each unit.
- Download : Item to download firmware per each unit.
- Debug : Item to check real-time debug messages from the CPU configured for each unit

④ **DU System**

This item is to check DU system information and alarm, the information list is as below.

- F/W Ver : MCU Firmware Version
- FPGA Ver : FPGA Firmware Version
- Cur Time : Current Time
- Rpt Type : Repeater Type
- Rpt Maker : Repeater Maker
- Temper : Current Temperature
- Temperature H : Temperature Upper Setting



- Temperature L : Temperature Lower Setting
- SU Enable : DU & SU , SU & SU Cascade connection
- SU Link : DU & SU, SU & SU Cascade connection
- DL/UL Test : DL/UL fixed mode setting for testing on TDD operation mode
- ISO Mease : Item to check Isolation between DU and SU
- DC Alarm : Alarm to monitor DC input power -53.5V status of the DU
- Temp Alarm : DU internal temperature
- TSYNC Link Alarm : TDD sync signal of outside base station signal
- AC Alarm : Alarm to monitor Rectifier AC input power 100 ~ 240V status
- BAT Alarm : Alarm to monitor battery operation status
- Decoding Alarm : Alarm to monitor T-Sync status
- FPGA Link : Alarm to monitor status between FPGA and CPU

### ⑤ Modem Status

This item is to monitor the modem's RSRP, RSRQ real-time and control modem reset.

### ⑥ MVBX Status

This item can monitor signal information from the OTA of the base station such as PSS SNR, RSRP real-time, and can check sync acquisition and RSRP AGC functions.

- RSRP : Item to check RSRP of the input signal from the DU
- SNR : Item to check SNR of the input signal from the DU
- PSS : Item to check PSS of the input signal from the DU
- Beam ID : Item to check the base station's strongest signal with beamforming function through

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- PCI : Item to check connected base station's PCI through DU beamforming function
- AGC Level : Item to set signal strength of RSRP to operate AGC function
- AGC On/Off : Item to control AGC function On/Off
- GS On/Off : Item to check T-Sync acquisition information
- Decoded count : Item to check T-Sync acquisition information
- Decoded success : Item to check T-Sync acquisition information
- Decoded rate[%] : Item to check T-Sync acquisition information

- RSRP Req : Item to recheck RSRP of the input signal from the DU
- PLL Relock : Item to reset PLL from the DU
- Beam Scan : Item to reoperate DU beamforming function

### ⑦ AOM

This item is configured with the 'LD' alarm and 'PD' alarm which can monitor the DU's internal analog optic module RF & optic's SISO path / MIMO path DL/UL real-time RF output, and converted analog optic signal transmission/reception strength, along with Array Ant. atten control, ATT control, ALC limit level setting, and ALC on/off.

- DL Output : AOM SISO RF, AOM MIMO RF DL output real-time monitoring
- DL ATT : AOM SISO RF, AOM MIMO RF DL Atten control
- ALC Limit Level : AOM SISO RF DL/UL, AOM MIMO RF DL/UL Auto Limit Control limit level setting
- ALC On/Off : AOM SISO RF DL/UL, AOM MIMO RF DL/UL Auto Limit Control function On/Off control
- UL Output : AOM SISO RF, AOM MIMO RF UL output real-time monitoring
- UL ATT : AOM SISO RF, AOM MIMO RF UL Atten control
- UL ISO ATT : AOM SISO/MIMO IF UL Isolation Atten monitoring
- Front End ATT : Array Ant. DL/UL SISO/MIMO Atten control
- LD : AOM SISO OPTIC DL, AOM MIMO DL LD Power real-time monitoring
- LD Lower : AOM SISO OPTIC DL, AOM MIMO DL LD Power lower value setting & alarm showing
- PD : AOM SISO OPTIC UL, AOM MIMO UL LD Power real-time monitoring
- PD Lower : AOM SISO OPTIC UL, AOM MIMO UL PD Power lower value setting & alarm showing

## 6.1.2 SU Main Screen

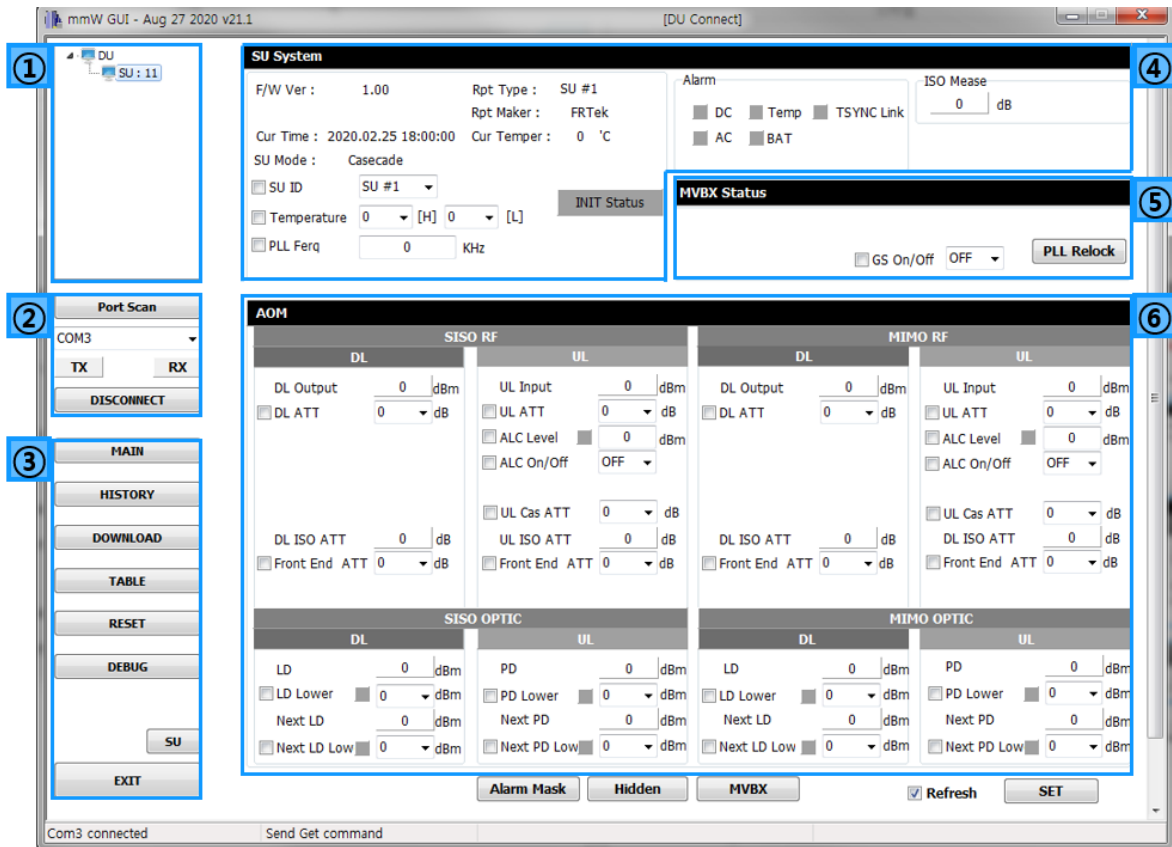


Figure 33. SU Main Screen

### ① Tree List

This item is to check all equipments of the currently configured system. Also, this item can real-time monitor each unit's alarm status through each unit item's alarm.

### ② GUI Connection

This is where the unit and PC can be connected. When pressing the arrow that checks 'Comport' and clicking the 'Auto' button, the unit & PC connected comport will automatically be renewed, and when pressing the 'CONNECT' button, the button status will change to 'DISCONNECT', allowing access to the GUI.

### ③ Function List

This item is to use implemented additional functions. The 'History' function, temperature/power 'Table' manage function, the firm ware download function, and the 'Debug' function can be used.

- History : Item to use 'Alarm History' function. Item to check connected unit's alarm history.
- Table : Item to create/manage output table and temperature table per each unit.
- Download : Item to download firmware per each unit.
- Debug : Item to check real-time debug messages from the CPU configured for each unit.

### ④ SU System

This item is to check SU system information and alarm, the information list is as below.

- F/W Ver : MCU Firmware Version
- FPGA Ver : FPGA Firmware Version
- Cur Time : Current Time
- Rpt Type : Repeater Type
- Rpt Maker : Repeater Maker
- Cur Temper : Current Temperature
- Temperature H : Temperature Upper Setting
- Temperature L : Temperature Lower Setting
- SU ID : Item to set the ID to connect SU cascade to upper DU or SU
- DL/UL Test : DL/UL fixed mode setting for testing on TDD operation mode
- INT Status : Initialize Status, MCU booting and connection status when DU is ON
- DC Alarm : Alarm to monitor DC input power -53.5V status of the DU
- Temp Alarm : DU internal temperature
- TSYNC Link Alarm : TDD sync signal of outside base station signal
- AC Alarm : Alarm to monitor Rectifier AC input power 100 ~ 240V status
- BAT Alarm : Alarm to monitor battery operation status

### ⑤ MVBX Status

This item is to monitor base station information SSP, SNR, RSRP real-time.

## ⑥ AOM

This item is configured with the 'LD' alarm and 'PD' alarm which can monitor the SU's internal analog optic module RF & optic's SISO path / MIMO path DL/UL real-time RF output, and converted analog optic signal transmission/reception strength, along with Array Ant. atten control, ATT control, ALC limit level setting, and ALC on/off.

- DL Output : AOM SISO/MIMO IF DL output real-time monitoring
- DL ATT : AOM SISO/MIMO IF DL Atten control
- DL ISO ATT : AOM SISO/MIMO IF DL Isolation Atten monitoring
- UL Output : AOM SISO/MIMO IF UL output real-time monitoring
- UL ATT : AOM SISO/MIMO IF UL Atten control
- UL Cas ATT : AOM SISO/MIMO IF UL Cascade Atten control
- ALC Limit Level : AOM SISO/MIMO IF ALC limit level setting
- ALC On/Off : AOM SISO/MIMO IF ALC function On/Off control
- Front End ATT : Array Ant. DL/UL SISO/MIMO Atten control
- LD : AOM SISO/MIMO DL LD Power real-time monitoring
- LD Lower : AOM SISO/MIMO DL LD Power lower value setting and alarm display
- PD : AOM SISO/MIMO UL PD Power real-time monitoring
- PD Lower : AOM SISO/MIMO UL PD Power lower value setting and alarm display
- Next LD : Cascaded SU AOM SISO/MIMO DL LD Power real-time monitoring
- Next LD Lower : Cascaded SU AOM SISO/MIMO DL LD Power lower value setting and alarm display
- Next PD : Cascaded SU AOM SISO/MIMO UL PD Power real-time monitoring
- Next PD Lower : Cascaded SU AOM SISO/MIMO UL PD Power lower value setting and alarm display

## **PrimAer 28GHz Operating Manual**

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