PrimAer 39GHz

Operating Manual

Document Reference

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Please read this Manual prior to installation and operation. Use the system only in accordance with the contents and directions of this Manual.

- The specification and information regarding the products in this manual are subject to change due to updates to system functionality or system revision changes without notice. For the latest revision of this manual or for technical inquiries, please contact below :

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Revision History

Version	Issue Date	Details of Revision	Author	Authorizing Manager
V 0	Sep. 6, 2021.	Initial Release	Soo Hyeon, Jeong	Jun Hyun, Lee

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Used Abbreviations

DU	**D**onor **U**nit
SU_C	**S**ervice **U**nit_**C**ascade
SU_E	**S**ervice **U**nit_**E**nd
GUI	**G**raphical **U**ser **I**nterface
SISO	**S**ingle **I**nput **S**ingle **O**utput
MIMO	**M**ultiple **I**nput **M**ultiple **O**utput
ALC	**A**uto **L**evel **C**ontrol
AGC	**A**uto **G**ain **C**ontrol
EVM	**E**rror **V**ector **M**agnitude
3GPP	**3**rd **G**eneration **P**artnership **P**roject
DIFM	**D**onor **I**nter**F**ace **M**odule
DAOM	**D**onor **A**nalog **O**ptic **M**odule
EMS	**E**lement **M**anagement **S**ystem
SIFM	**S**ervice **I**nter**F**ace **M**odule
SAOM	**S**ervice **A**nalog **O**ptic **M**odule
NC	**N**ot **C**onnect

Chapter 1

Safety & Certification Notice

Safety & Certification Notice

1.1 FCC Warning Statements

1.1.1 FCC Part 15.105 statement

- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this 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 39 should only be operated by approved or certified integrator(or 'Integrator'). The integrator who is tasked with handling, installation, operation, and servicing of PrimAer 39 System must follow the instructions in the Manual prior to handling.

- To avoid any injury, the integrator must turn off the main power switch before installing the system or performing any maintenance related work.
- PrimAer 39 is not a field service unit. The only access compartment is to insert a USIM for modem or resetting the Ethernet port.
- 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 FRTek. Do not alter or make any modifications or fit any spare parts which are not sold or recommended by FRTek. This could cause

fires, electric shock, or other injuries.

- Read and follow 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 39 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.
- This device is part of an Industrial Signal Booster/Distributed Antenna System that supports FR2 5G NR modes for the n260 band.. Professional installation required.

Warning

The antenna (or antennas) must be installed so as to maintain at all times a distance minimum of at least 48 cm between the radiation source (antenna) and any individual. This device may not be installed or used in conjunction with any other antenna or transmitter.

Warning

Follow all general and regional installation and safety regulations relating to performing work on high voltage installations. Also, follow 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

Please be informed that the external temperatures of the unit can be extremely high.

Warning

Product contains "Laser Radiation". Do not look directly into the laser or with any optical instruments.

Warning

Condensation : Silica gel is applied inside the initial packaging. Please apply silica gel when packaging is required to avoid condensation. (During operation, internal condensation is prevented

by turning the power ON)

- **[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 with IP66 standard, test data available upon request.

Note

ACCESS RESTRICTED LOCATION: Equipment location should comply with the following:

- access should only be granted to **AUTHORIZED PERSONNEL** or **CERTIFIED USERS** who have been trained on the installation and operation of PrimAer 39

- FRTek recommends that the equipment be mounted at least 20ft above the ground

Chapter 2

System Overview

System Overview

2.1 System Overview

2.1.1 Overview

PrimAer 39 is a 5G repeater system that can provide and/or enhance high quality telecommunications service both in-building & outdoors. PrimAer 39 System can provide mmWave 39GHz frequency band coverage to all venues.

PrimAer 39 system provides coverage for in-building and outdoor environments. A "proper RF design" will provide a more accurate representation of the expected coverage.

This system can service mmWave 39GHz frequency band service and can be used for public and private facilities.

39GHz Wireless Optic DAS system installation location:

- Shopping mall
- Hotel
- Campus
- Airport
- Subway
- Stadium and convention center

System frequency band :

- mmWave 39GHz SISO/MIMO (37.6GHz ~ 38.6GHz, BW 1,000MHz)

PrimAer 39 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 39 Design Consideration

PrimAer 39 model name and configure is as below.

Item	Model No.	FCC ID	Type
Donor Unit	FR-R5G39AO38ADU	2AFEG-R5G39AO38ADU	Outdoor Enclosure type
Service Unit	FR-R5G39AO33ASUC	2AFEG-R5G39AO33ASUC	

(Cascade)			
Service Unit (End)	FR-R5G39AO33ASUE	2AFEG-R5G39AO33ASUE	
Rectifier	FR-ERECD48A	-	

PrimAer DU receives the 39GHz 5G signal from the gNB over the air. The DU then amplifies the signal and provides 5G service to the SU. The SU then extracts the TDD sync signal received from the gNB and sends to each unit.

For outdoor usage, the DU, SU, and Rectifier are designed within IP66 specification so that dust, pollutants, and insects cannot penetrate.

Item	DU	SU(Cascade)	SU(End)	Rectifier
Input Power	DC -53.3V 2.44A (-48 ~ -53.3V) (from Rectifier)	DC -53.3V 2.44A (-48 ~ -53.3V) (from Rectifier)	DC -53.3V 2.44A (-48 ~ -53.3V) (from Rectifier)	AC 100V ~ 6.8A, 240V ~ 2.85A
Interface(Input)	RF	Optic	Optic	-
Interface(Output)	Optic	RF	RF	Power
Service	mmWave 39GHz 5G NR			-
Type	In-building / Outdoor	In-building / Outdoor	In-building / Outdoor	In-building / Outdoor

2.2 System Network Configuration

PrimAer 39 network configuration shown below.

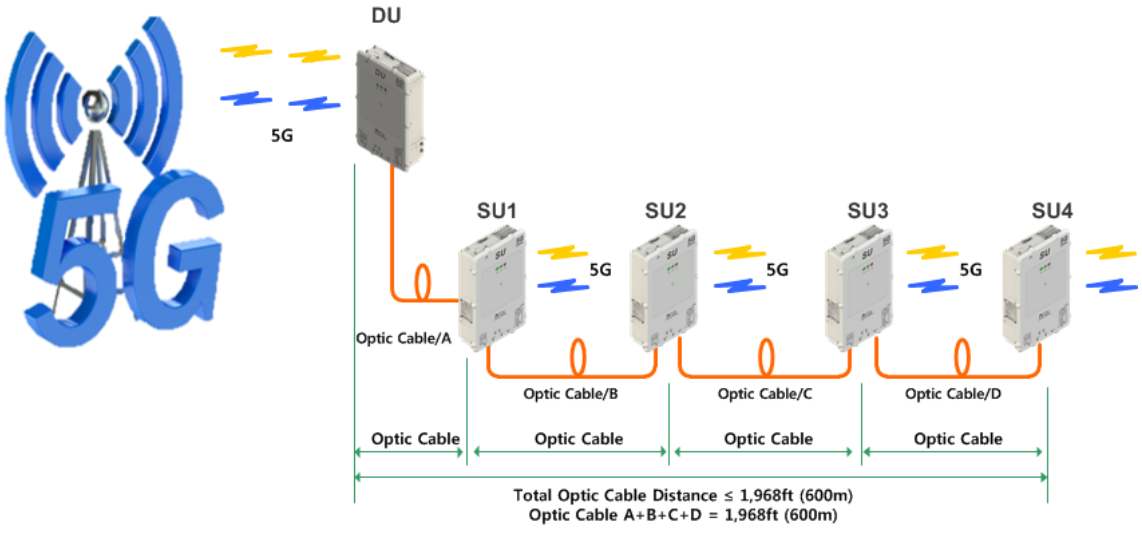


Figure 1. Network Configuration

PrimAer 39 receives a 39GHz mmWave signal over the air from a 5G gNB to the DU. The DU then converts the mmWave signal to IF over fiber and amplifies the signal. The SU then converts the IF to 5G mmWave signal for service.

PrimAer 39 is comprised of 3 units, the DU, SU, and Rectifier. The Rectifier supplies DC power to the DU and SU through a power cable. Also, the DU and SU's are connected with a single fiber-optic cable, and multiple SU's can also be connected in series with a single fiber-optic cable.

The DU can support antenna beam steering ±50° (Up/down/left/right) through the GUI.

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

Chapter 3

System Configuration

System Configuration

3.1 DU Function 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 gNB signal over the air, converts it to an optical signal, and sends it to the SU via Fiber-Optic cable. (Downlink). It also converts the optical signal received from the SU via fiber-optic cable and converts this back to 39GHz 5G RF which is sent to the gNB through the internal antenna. (Uplink).

The DU is comprised of an antenna, DIFM, DAOM, and EMS board. The rectifier powers the DU through the power port with -53.3V DC power.

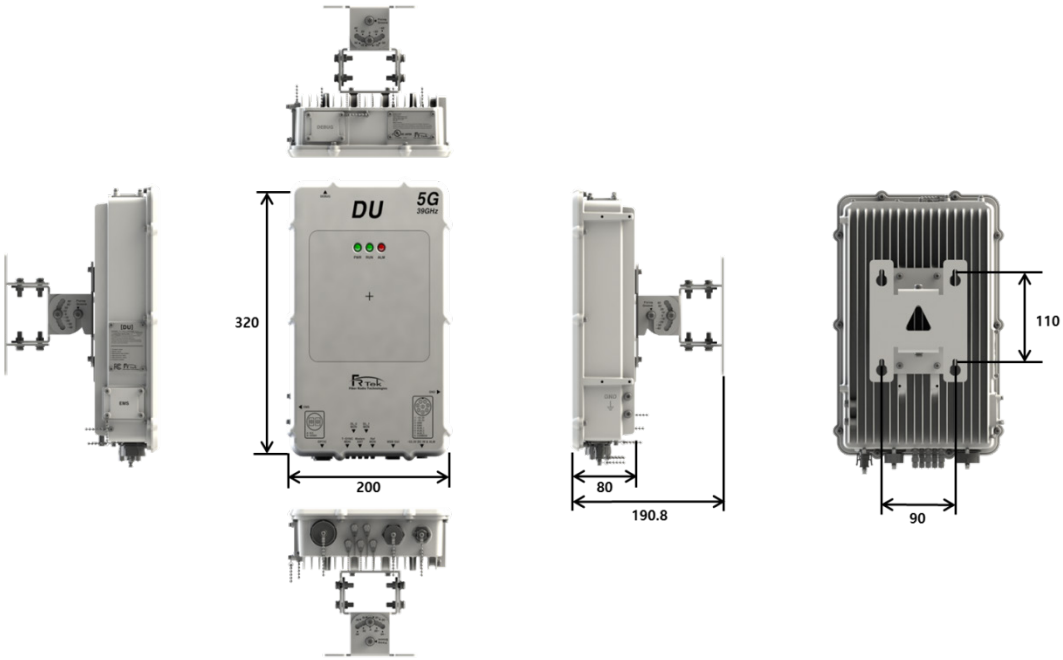


Figure 2. DU Figure

Item	Content	Remark
Size	200 x 320 x 190.8mm (7.87 x 12.59 x 7.51")	Including bracket

Weight	Approx. 5.66kg (12.4lb)	Including bracket
Input Interface	Internal Antenna	19.37 dBi (Max.)
Output Interface	Optic	1 Port

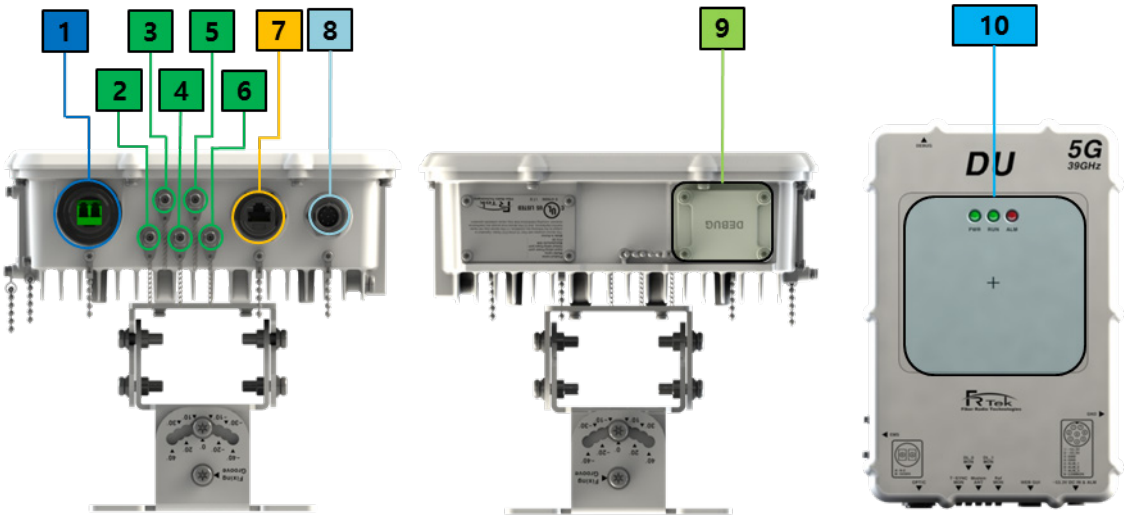


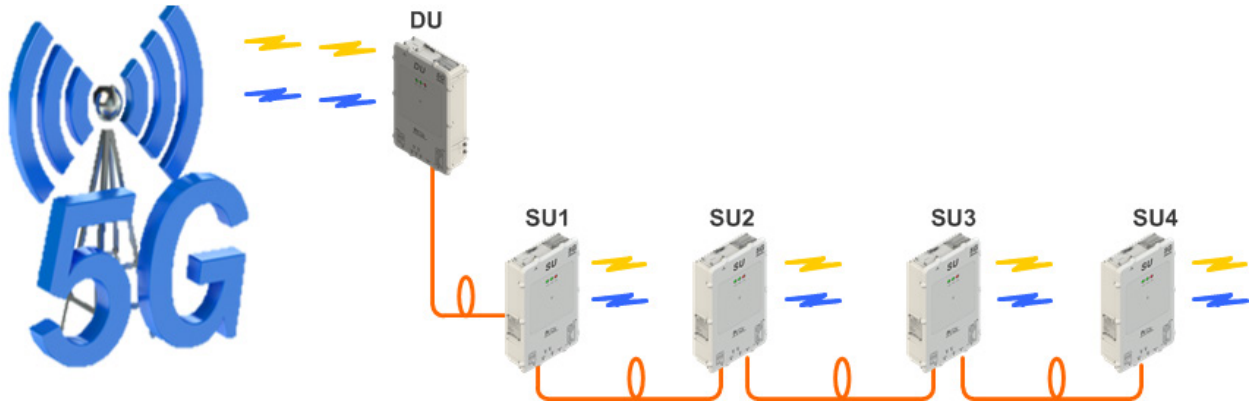
Figure 3. DU Port Configuration

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 122.88MHz Reference signal
⑦	Port to connect WEB GUI
⑧	Port to supply -53.3V(-48V ~ -53.3V) power from the Rectifier
⑨	Port to connect Local GUI (Not used after installation)
⑩	Internal Antenna (centered on +), transmit/receive RF wireless signal & status lights

3.2 SU Function and Configuration

The SU is in a single enclosure with a mounting bracket on the back enabling wall or pole attachment. The SU receives an optical signal from the DU via Fiber-Optic cable, converts it to a 39GHz RF signal, and sends the 5G signal through the antenna. (Downlink). It also converts the 39GHz RF signal received from the UE into an optical signal and sends it 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. Cascade can be up to 4 SUs, but the SU_E can only be at the end of the chain.



The SU is comprised of an antenna, SIFM, and SAOM module. The rectifier powers the SU through the power port with -53.3V DC power

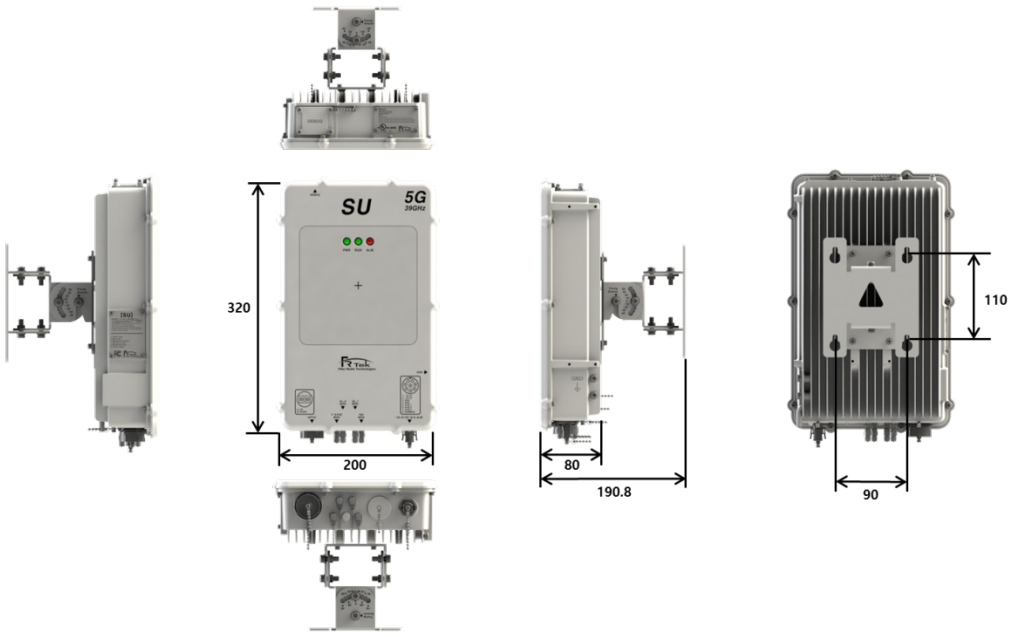


Figure 4. SU Figure

Item	Content	Remark
Size	200 x 320 x 190.8mm (7.87 x 12.59 x 7.51")	Bracket included
Weight	Approx. 5.68kg (12.5lb)	Bracket included
Input Interface	Internal Antenna	19.37 dBi
Output Interface	Optic	1-2 Ports

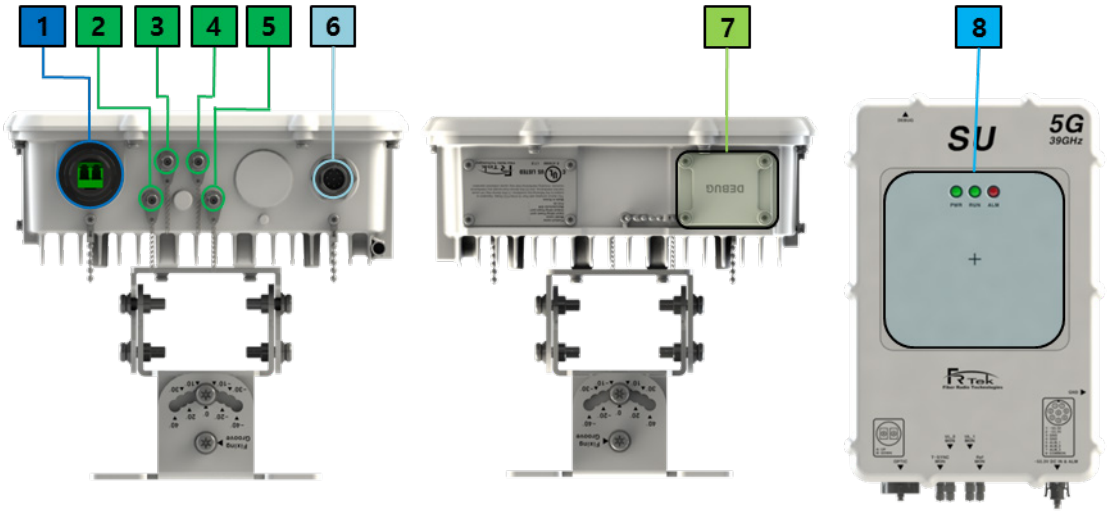


Figure 5. SU Port Configuration

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 122.88MHz Reference signal
⑥	Port to supply -53.3V(-48V ~ -53.3V) power from the Rectifier
⑦	Port to connect Local GUI (Not used after installation)
⑧	Internal Antenna (centered on +), transmit/receive RF wireless signal & status lights

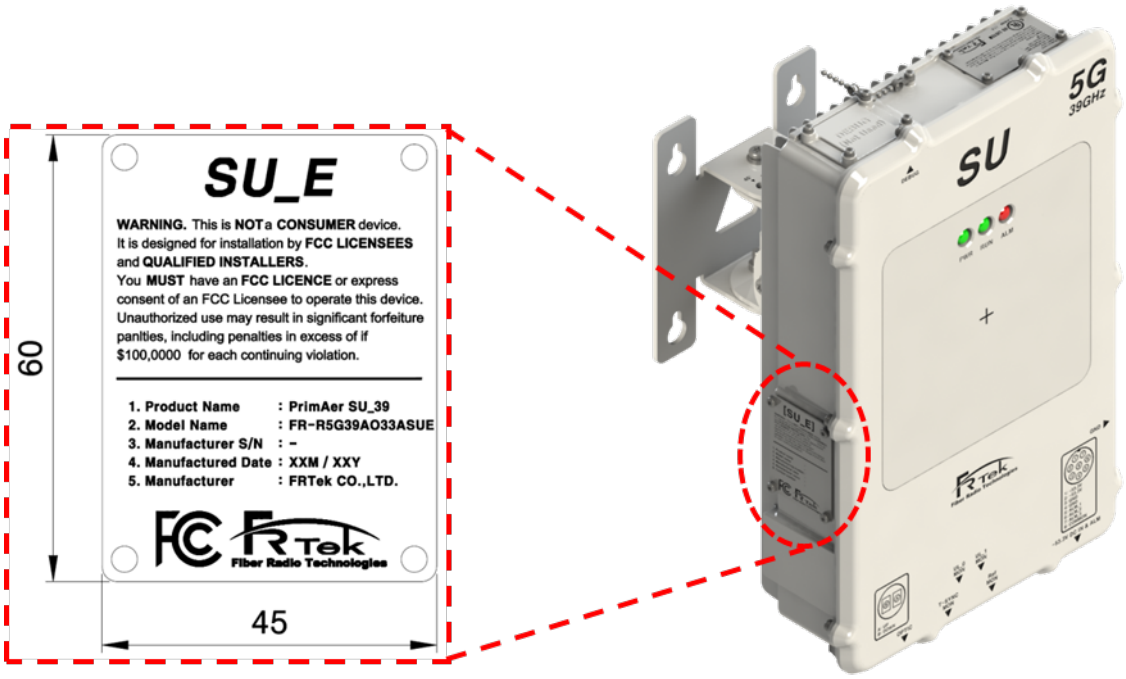


Figure 6. SU_C & SU_E Distinction (Cascade & End)

The difference between the SU_C and the SU_E is the optical switch in the SU_C. The SU_E can only be used at the end of the series and is marginally less expensive. (The SU_C can be used at the end as well). The SU_C and the SU_E are distinguishable with the label on the side of the unit as shown above.

3.3 Rectifier Function and Configuration

The Rectifier is the power supply for the DU and SU. The Rectifier is in a single enclosure with a mounting bracket on the back enabling wall or pole attachment.

It receives input AC 100 ~ 240V power, and outputs DC -53.3V(-48V ~ -53.3V) voltage to total of 5 ports (Port 1 ~ 4, Battery connection port). It supplies power to the DU, SU, and optional battery backup through a power cable.

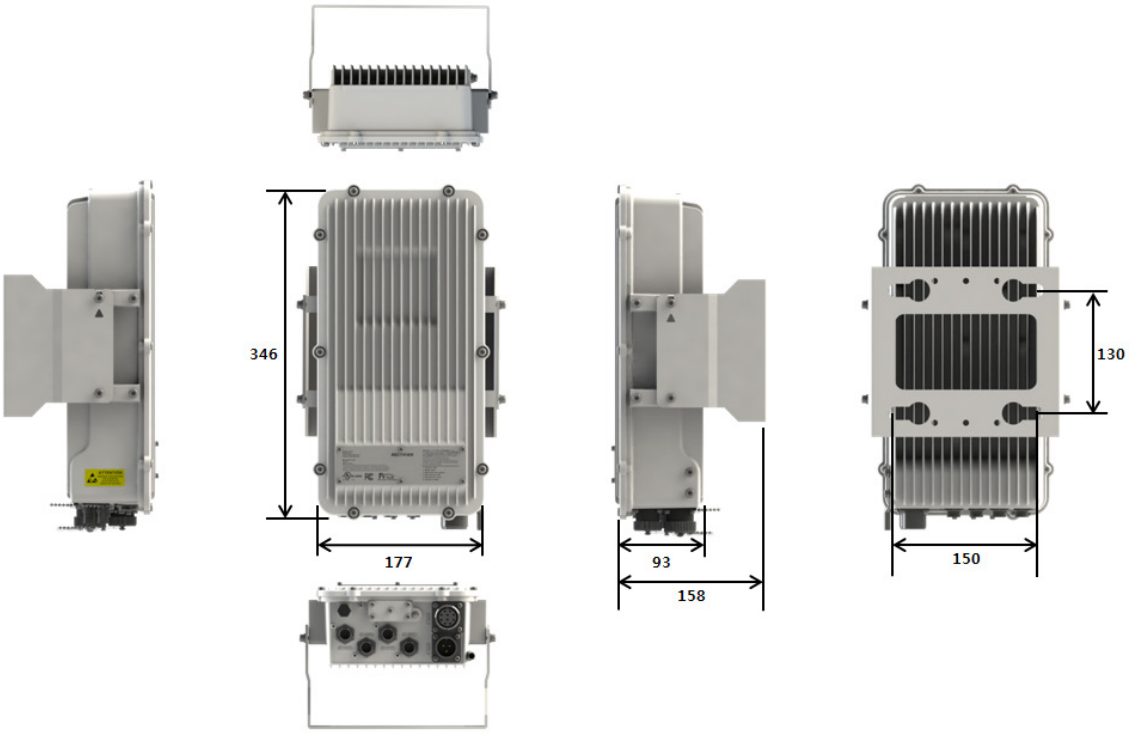


Figure 7. Rectifier Figure

Item	Content	Remark
Size	177 x 346 x 161mm (6.97 x 13.62 x 6.34")	Including bracket
Weight	Approx. 5.4kg (11.9lb)	Including bracket
Input Interface	AC 100V ~ 6.8A, 240V ~ 2.85A	
Output Interface	DC -53.3V 2.44A (Port 1~4) DC +53.3V 2A (Battery)	DC -48V ~ -53.3V

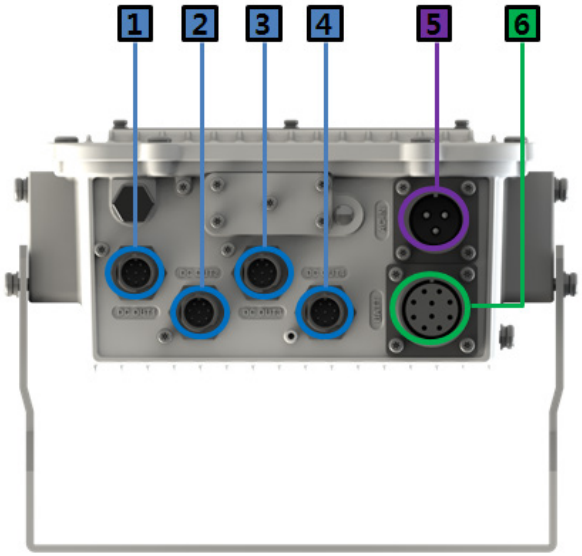


Figure 8. Rectifier Port Configuration

No	Content
①	DC -53.3V(-48V ~ -53.3V) output port 1
②	DC -53.3V(-48V ~ -53.3V) output port 2
③	DC -53.3V(-48V ~ -53.3V) output port 3
④	DC -53.3V(-48V ~ -53.3V) output port 4
⑤	AC 100 ~ 240V input port
⑥	Battery connection port

Chapter 4

System Specification

System Specification

4.1 System Specification

PrimAer 39 is a 2X2 MIMO Repeater for 5G NR service, and is designed to operate within an 1,000MHz bandwidth (N260) of the 39GHz frequency band. This system satisfies the following functions and performance characteristics, and if not specially mentioned, satisfies 3GPP performance standard.

- This system's DU transmits/receives RF signal over the air with the gNB, and the SU provides RF coverage which is not serviced by the gNB.

4.1.1 Downlink Specification

Item	Specification	
	DU DL (Input Part)	**SU DL (Output Part)**
Input Frequency	BW 1GHz among 37.6GHz~40GHz	IF ± 500MHz
Output Frequency	IF ± 500MHz	BW 1GHz among 37.6GHz~40GHz
Input Level	-71.5dBm ~ -46.5dBm	-
Output Level (EIRP)	-	SISO : +38.5dBm MIMO : +41.5dBm
EIRP Tolerance	-	±3dBm
Antenna Gain	19.37 dBi	19.37 dBi
System Delay	Below 0.5us (DU to 1 SU)	
EVM	≤ 8 %(64QAM) – 3GPP standard	
MIMO	2x2 MIMO support (±45º polarization wave antenna)	
Beam Steering Angle	Up to ±50º (Up/Down/Left/Right)	

4.1.2 Uplink Specification

Item	Specification	
	DU UL (Output Part)	**SU UL (Input Part)**
Input Frequency	IF ± 500MHz	BW 1GHz among 37.6GHz~40GHz
Output Frequency	BW 1GHz among 37.6GHz~40GHz	IF ± 500MHz
Input Level	-	-71.5dBm
Output Level (EIRP)	SISO : 38.5dBm MIMO : 41.5dBm	-

EIRP Tolerance	±3dBm	-
System Delay	Below 0.5us (DU to 1 SU)	
EVM	≤ 8 %(64QAM) – 3GPP standard	
MIMO	2x2 MIMO support (±45º polarization wave antenna)	
Beam Steering Angle	Up to ±50º (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		
SU_End		
Rectifier		

- The PrimAer 39 units should be installed in a place that can be readily accessed for maintenance.
- PrimAer 39 is designed to IP66 standards.

4.2.2 Material and Components

- The enclosure, components, PCB, solders, cables, etc applied for each unit of PrimAer 39 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 functionality built in.
- In case of black out, the equipment RF setting value automatically returns to the previous status prior to the black out.
- The equipment grounds are located on both sides of the enclosure.
- The components used in PrimAer 39 satisfy the EMI terms of FCC regulation Title 47, Part 15, Subject J, Class A.
- The enclosure needs to be grounded using a #6AWG wire

Unit	Operating Voltage Range	Output Voltage/Current Range	Remark

Rectifier	AC 100V ~ 240V 60Hz (57 ~ 63Hz)	Port 1: -53.3V/2.44A Port 2: -53.3V/2.44A Port 3: -53.3V/2.44A Port 4: -53.3V/2.44A Battery: +53.3V/2A	DC Out Range -48V ~ -53.3V

4.4 Environmental Specification

Items	Condition of application	Performance Requirements
Storage Environment	• Temperature: -40 ~ +85℃ • Humidity: 5 ~ 95%	No change of system function
Operation Environment	• Temperature: -40 ~ +55℃ • Humidity: 0 ~ 90%	- Output change : within ±3dB - No abnormalities on enclosure inside/outside

Chapter 5

System Installation

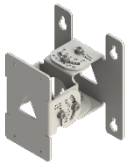
System Installation

This manual provides detailed instructions on the installation of PrimAer 39. The user needs to understand the manual and should be certified on PrimAer 39. This chapter explains how to connect all necessary cables and how to install each piece of equipment. (DU, SU, and Rectifier).

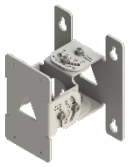
5.1 Kits & Tools

PrimAer 39 is provided with below listed equipments and components. (Quantity differs according to order)

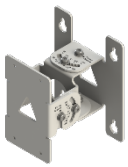
<DU>

<table>
<tr><th>No.</th><th>Kits</th><th>No.</th><th>Kits</th></tr>
<tr><td rowspan="2">1</td><td>DU</td><td rowspan="2">2</td><td>Wall Mount Bracket (DU/SU)
Preassembled with DU</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td rowspan="2">3</td><td>Torx Pin Sems Screw (SUS)
1) M4 X 10L, 4EA
2) M6 X 20L, 8EA</td><td rowspan="2">4</td><td>Optical Mating Connector</td></tr>
<tr><td>  </td><td>  </td></tr>
</table>

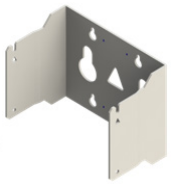
<SU_C>

No.	Kits	No.	Kits
1	SU_C 	2	Wall Mount Bracket (DU/SU) Preassembled with SU_C 
3	Torx Pin Sems Screw (SUS) 1) M4 X 10L, 4EA 2) M6 X 20L, 8EA 	4	Optical Mating Connector 

<SU_E>

No.	Kits	No.	Kits
1	SU_E 	2	Wall Mount Bracket (DU/SU) Preassembled with SU_E 
3	Torx Pin Sems Screw (SUS) 1) M4 X 10L, 4EA 2) M6 X 20L, 8EA 	4	Optical Mating Connector 

<Rectifier>

No.	Kits	No.	Kits
1	Rectifier 	2	Wall Mount Bracket (Rectifier) 
3	Torx Pin Sems Screw (SUS) (For Rectifier) M5 X 12L, 4EA 	All components for Rectifier are preassembled	

<Cable>

No.	Kits	No.	Kits
1	DC Power Cable * Cable length of the DC power cable is less than 6m 	2	Rectifier AC Cable 

When PrimAer 39 is purchased with the Pole Bracket Option, the additional equipments and components are listed below. (Quantity differs according to order)

<Pole Mount Bracket>

No.	Kit	No.	Kit
1	Pole Mount Bracket	2	Torx Pin Sems Screw (SUS) M6 X 20L, 4EA
			

Other Tools/Supplies recommended for installation are below.

No.	Tools	No.	Tools
1	Hole Torx Drivers, 4 Types (5 point Star Bix Tamper-Proof) (1) M3: T10H (2) M4: T20H (3) M5: T25H (4) M6: T30H	2	Screw Driver No. 3 (+)
			
3	Insulated Driver	4	Hammer Drill
			
5	Concrete Drill Bit (8mm)	6	Hand Safety Gloves
			
7	Rubber Hammer	8	HEX, Direct Screw (Self Tapper)

			(Diameter: 5.5~6mm, Length: 40~80mm)
			
9	Plastic Wall Plug (Size according to Hex screw)	10	⌀ 6.5mm Plain Large Washer
			
11	Level	12	Tape Measure
			
13	Ground Wire Line	14	LC-APC type Optic Fiber
			
15	ESD Gloves	16	6AWG Lug Crimper
			
17	SUS BAND - 4 required (*Size according to Pole diameter)		
			

Item		Torque Spec
Screw	M3	4.34~6.08 lbf-in
	M4	9.55~12.15 lbf-in
	M5	21.70~25.17 lbf-in
	M6	36.02~40.36 lbf-in
	Steel Band Fixing Screw	48.5 lbf-in
Others	SMA Type Connector	1Nm=8.85 lbf-in
	SMA CAP(Term)	3.47~5.21 lbf-in

The PrimAer 39 is suitable for installation under these environments:

- Network Telecommunication Facilities

- Locations where the NEC(National Electrical Code) applies

- OSP (Outside Plant)

The PrimAer 39 is suitable for installation under these grounding environments :

- CBN (Common Bonding Network)

- IBN (Isolated Bonding Network)

Warning

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

Warning

The unit should be placed on the height that is not accessible to the general public

5.2 DU Installation

5.2.1 Product Installation

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

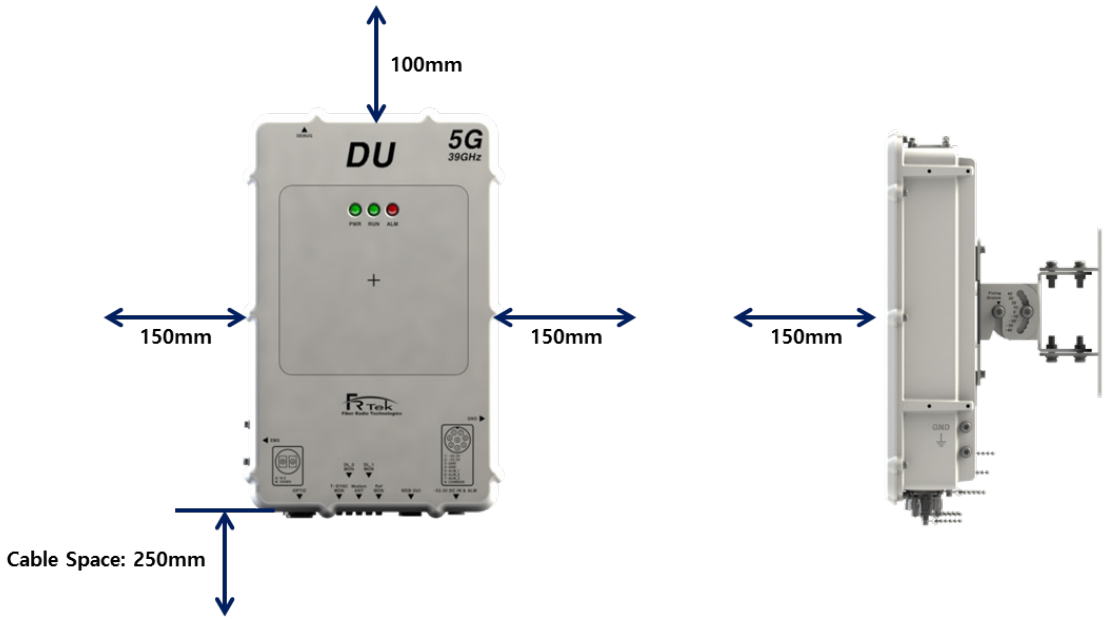


Figure 9. Required Space for DU Installation

The DU mounting bracket allows for tilting vertically and horizontally. It requires a minimum of 3.9"(100mm) space from top, 5.9"(150mm) space from both sides, and 9.8"(250mm) space from below for cables connection. It also requires a minimum of 5.9"(150mm) space from the front side.

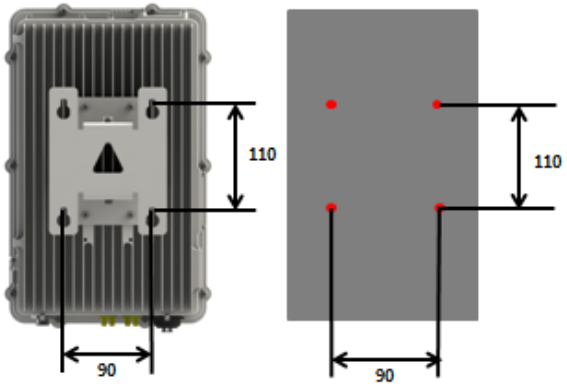


Figure 10. DU Anchor Bolt Assembly for Wall Installation