JL20

LTE RF Repeater

OPERATION MANUAL

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Important Safety Precautions

The JL20 unit is powered by 12VDC. Only personnel who have received relevant training from Juni are authorised to open any part or section of the JL20. To prevent electrical shock when installing or maintaining the equipment, **ensure the supply of VDC (and/or VAC) is removed** by switching off the power from the power source before accessing any section of the equipment.

Only when the Repeater is fully installed and all cable connections are made should the power be turned on. Ensure all installation items are complete before turning on the Repeater.

Ensure the total input power to the Repeater is within the range -75dBm ~ -30dBm. Input powers outside this range may affect Repeater performance.

Ensure frequencies are configured correctly. Incorrect frequency settings can severely affect Repeater performance.

When installing the Repeater, ensure the heat-sink section of the Repeater is not exposed to direct sunlight. Where possible, have the heat-sink section of the Repeater facing a northerly direction.

Always observe the warning labels and markings present on the equipment. If unsure, contact Juni America on +1 800 216 0466 for advice.

The JL20 can weigh up to 5kg. Ensure the correct procedures are used in moving or lifting the equipment to avoid injury.

1. Introduction

Juni offers a full turn-key solution for LTE Indoor RF repeater. This includes customer service which is supported by Juni call center (+1 800 216 0466) and installation service. It is designed to support SOHO and large office coverage area.

It offers quick install by providing everything needed for installation including system, donor and coverage antennas, required cables, and installation hardware.

Designed for “Plug and Play” installation, the JL20 provides improvements to call quality and data speed by eliminating problems such as weak and unstable receive and transmit signals in areas where base station signals cannot penetrate – such as indoor areas, underground parking stations and subway tunnels.

The JL20 will receive RF signals from a LTE Base Station, amplify this signal then transmit this amplified signal to the desired coverage area. The maximum output power of the JL20 is rated at 20dBm for both the downlink and uplink paths.

The JL20 also includes a combination of AGC, ALC, and Shutdown/Recovery control circuitry that ensure superior performance, providing consistent service in areas requiring enhanced coverage.

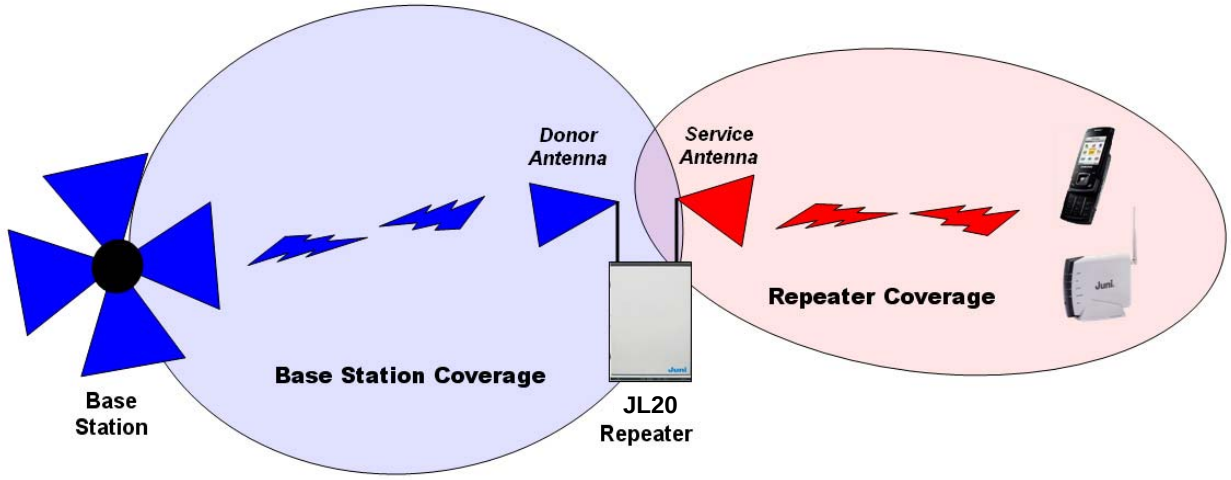
The JL20 is also compatible with the Juni Web GUI software platform to allow remote access to the LMT (Local Maintenance Terminal), providing simple, yet comprehensive monitoring and control of the Repeater.

With the Juni Web GUI solution, the user can monitor and control the Repeater site using only a web browser anywhere there is an internet connection. Using SNMP communication, the NOC is also notified of specific alarms.

2. System Description

2.1 Configuration

The basic configuration of the JL20 is to receive and amplify the base station signal, then re-transmit this amplified signal to provide coverage for the desired area as shown in the figure below.



[Figure 1] JL20 Repeater Configuration

As can be seen from figure 1, the JL20 includes two antennas, the Donor and Service antennas. The Donor Antenna receives and transmits signals from/to the Base Station while the Service Antenna transmits and receives signals to and from the Mobile Station. The Mobile Station may include handsets, mobile phones, wireless modems and other CPE (Customer Premises Equipment).

In addition to the basic Repeater configuration shown above, the JL20 may be used for other applications such as In-building coverage, tunnel coverage and any other applications that require coverage enhancements for a small area.

2.2 Applications

The JL20 is capable of providing solutions for Indoor and SOHO applications. This section outlines the most typical application scenario suitable for the JL20 Repeater system.

2.2.1 In-Building Coverage Application

[Figure 2] In-Building Coverage Application

Because the service antennas are located inside the building, it is often necessary to allow for aesthetic installations. Small cone type omni antennas are included in the package for use in setting up coverage.

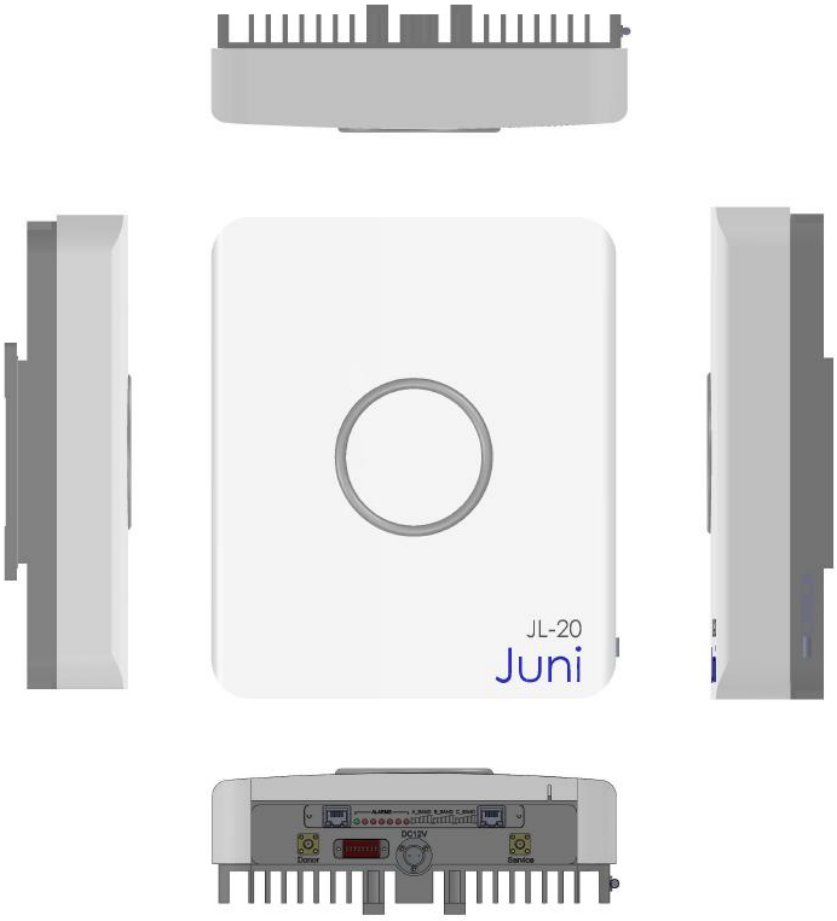
[Figure 3] Cone Type Antennas for Indoor Use

2.3 General Appearance of the JL20 Repeater

The JL20 Repeater is housed inside a one-body cabinet designed to maximize strength and heat dissipation. The cabinet is rated at IP43 and is suitable for indoor use.

The design of the cabinet allows for wall mounting of the Repeater via the use of mounting brackets (supplied). Please see section ***3 "Installation"*** for detailed instructions on the installation of the JL20 Repeater.

2.3.1 General Appearance



[Figure 4] General Appearance of the JL20 Repeater

2.3.2 Mechanical Drawing

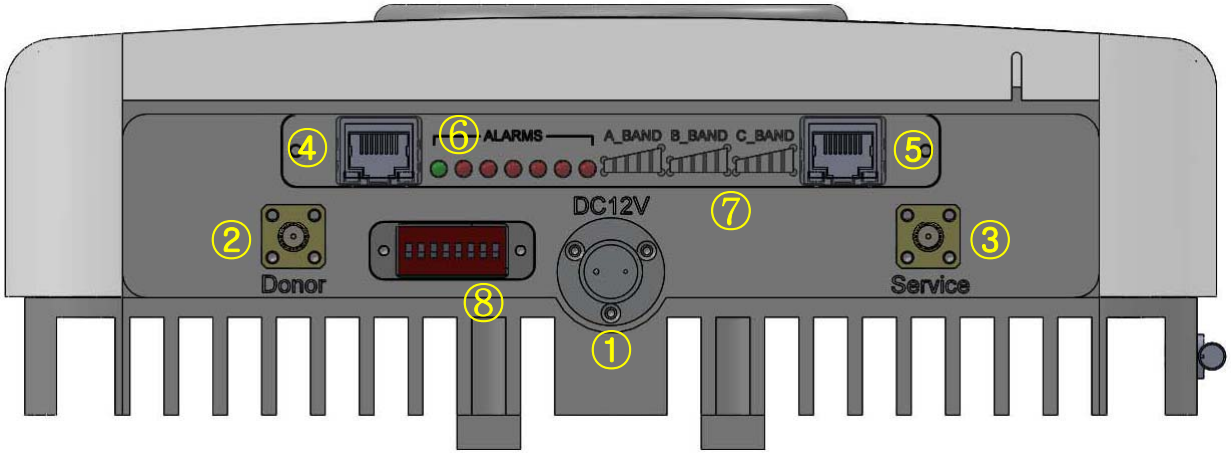
All measurements are shown in inches.

[Figure 5] JL20 Layout – Mechanical Drawing

2.4 Port & LED Description

The JL20 Repeater has 5 (five) connection ports, 2 (two) LEDs, and 1 (one) DIP switch located on the bottom of the cabinet.

These ports allow for RF, power and monitoring connections as well as Frequency band settings.



[Figure 6] Connection Ports of the JL20 Repeater

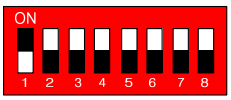
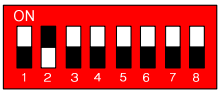
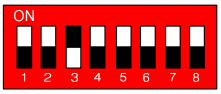
No.	Name	Description
1	DC12V	Connects to the 100~120VAC or 200~240VAC power source. Port type: 2-pin Military Standard port.
2	Donor	Connects to the Donor Antenna. Port type: SMA-type female
3	Service	Connects to the Service Antenna. Port type: SMA-type female
4	Remote Ethernet	RJ45 connection to the modem for Web GUI.
5	Local Ethernet	RJ45 connection for local GUI
6	Alarms	Alarm indicator LEDs. Refer to ***Section 2.6***
7	RSSI LEDs	Signal strength indicator LEDs for each frequency band
8	DIP Switch	Used to configure frequency bands. Refer to ***Section 2.5***

[Table 1] Port Descriptions

2.5 Frequency Band Setting

The DIP Switch described in the previous section comprises of 8 switches. Switches 1 ~ 3 determine the frequency bands, switch 4 enables/disables the AGC function, switch 5 enables/disables the UL Gain Offset function and switches 6~8 are not used.

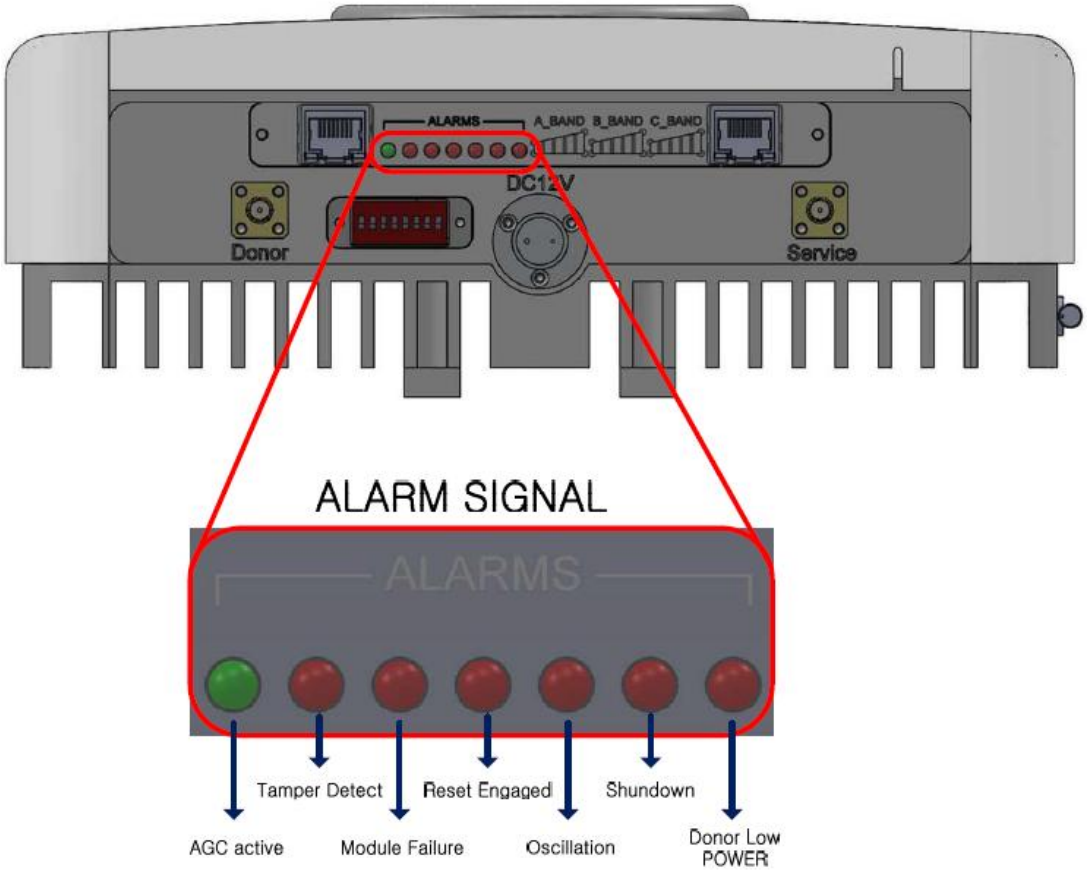
The following table outlines the DIP switch configurations required for the different frequency bands. In the illustrations, the position of the actual switch is displayed by the colour “white”.

BW	Downlink	Uplink	DIP SWITCH
A Band	728 ~ 734	698 ~ 704	
B Band	734 ~ 740	704 ~ 710	
C Band	746 ~ 756	777 ~ 787	

[Table 2] DIP Switch Settings

2.6 Alarm Descriptions

The JL20 has a set of LED’s to indicate the current status of the Repeater. If there is an alarm condition, this can be seen by the ALARM LEDs as described below.



[Figure 7] ALARMS LED

Name	Description
AGC active	Lights green when the AGC function is active
Tamper Detect	Lights red when the case/cabinet is opened under normal operation
Module Failure	Lights red when a PSU or Synthesizer alarm occurs
Reset Engaged	Lights red when the MCU is reset
Oscillation	Lights red when the oscillation alarm occurs
Shutdown	Lights red when the Auto Shutdown function is enabled and engaged.
Donor Low Power	Lights red when the DL input signal level is below -75dBm.

[Table 3] ALARM LED Descriptions

3. Installation

3.1 Transportation to the Site

During transportation of the Repeater to the site, the following points need to be considered.

- While transporting the Repeater unit, ensure the Repeater is packaged in its original packaging supplied by Juni.
- Prevent any unnecessary shock applied to the Repeater units while loading/unloading to/from the vehicle.
- During transportation, it is advised to prevent or minimize any movement of the packed Repeater units.

3.2 Handling of the Repeater

- As the JL20 Repeater is heavy, the installer should be careful and seek assistance while attempting to lift/carry/move the unit.
- To avoid the risk accidental fire or electric shock, do not expose the Repeater to rain or any other wet condition during installation.

3.3 Installation Conditions

- Avoid direct sunlight and place the Repeater in a well ventilated location.
- The environment temperature should be in the range of 32°F ~ 113°F (0°C ~ +45°C).
- Ground connections must be made to all metal cabinets for safety.
- Avoid any vibration.
- The VSWR of the cable which connects the Repeater to the antenna should be less than 1:1.4.
- The cable loss between the Repeater ports and the antenna should be less than 3dB for optimal performance.
- Although the Repeater cabinet is rated as IP43, it is advised to use waterproofing tape around the connection area of the antenna and power ports.

3.4 Inspection before Installing the Repeater

- Check if there is any physical damage on the Repeater cabinet. If any damage is found, it is advised to perform close inspection on the operating features and RF signal test to verify Repeater performance.
- Check if there are any loose RF cables inside and/or outside the Repeater.
- Check if there's any part of the cabinet exposed to water or other liquid substances.
- Before installing the Repeater, check the serial number of the units to be installed.
- Confirm the correct accessories have been supplied.

3.5 Installation Procedure

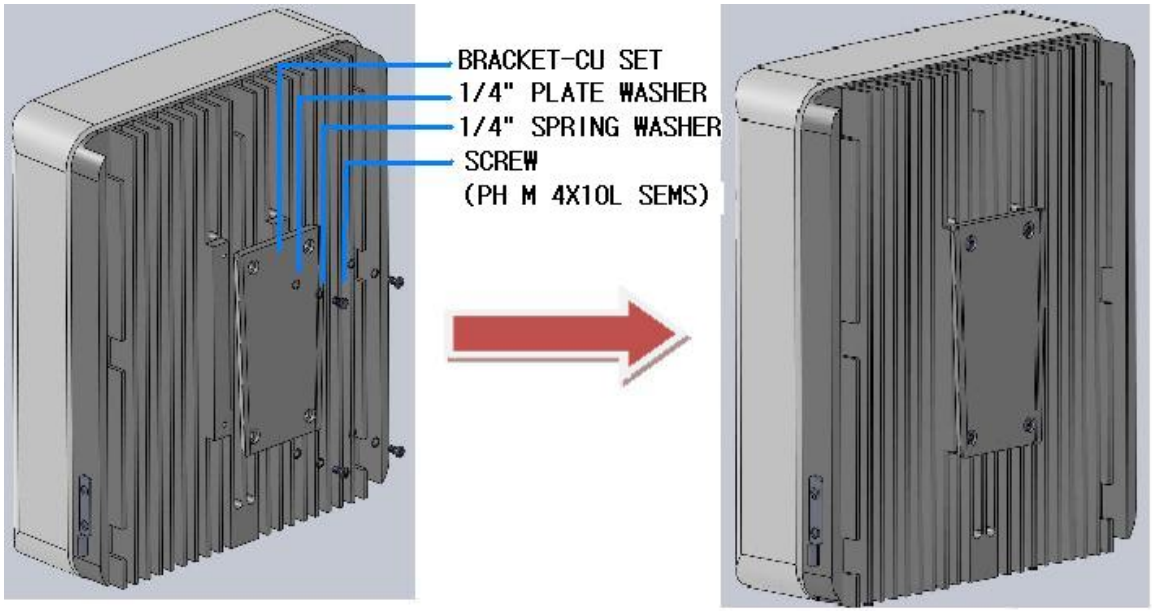
3.5.1 Repeater Cabinet Installation

The JL20 can be mounted on a wall or the ceiling. This section describes how the Repeater can be mounted on three different surfaces – lumber, drywall (gypsum, plasterboard) and concrete.

On all surfaces, the mounting is achieved by combining the two mounting brackets – one for the Repeater (Bracket A) and one for the surface (Bracket B).

[Figure 8] Mounting Brackets A (shown on left) & B (shown on right)

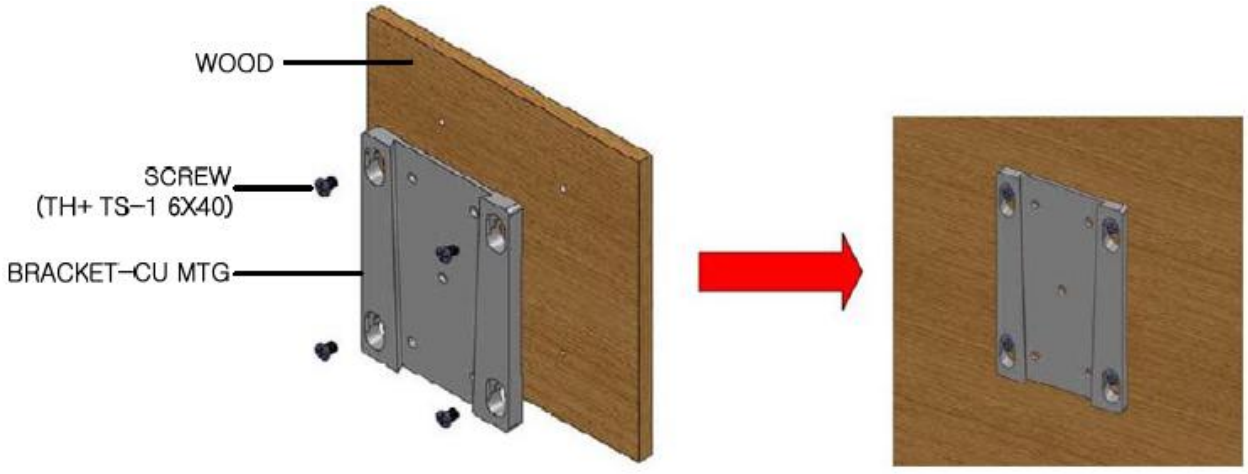
To install Bracket A to the back of the Repeater, see the figure below.



[Figure 9] Installing Bracket A

3.5.1.1 Lumber Mounting

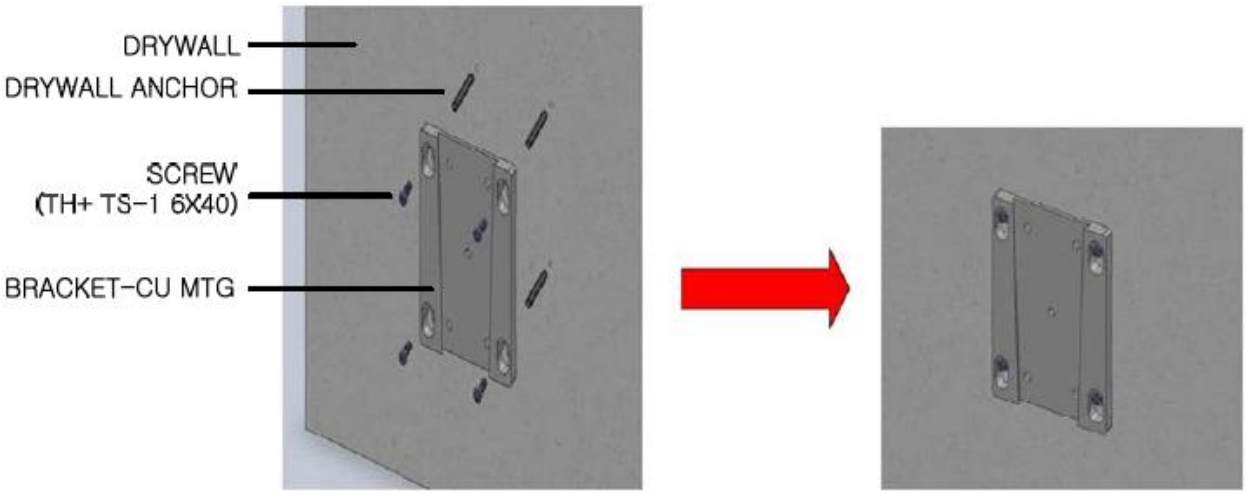
1) Using the timber screws specified in the figure below, firmly attach the Bracket B to the desired location.



[Figure 10] Mounting Bracket – Lumber Mounting

3.5.1.2 Drywall (Gypsum/Plasterboard) Mounting

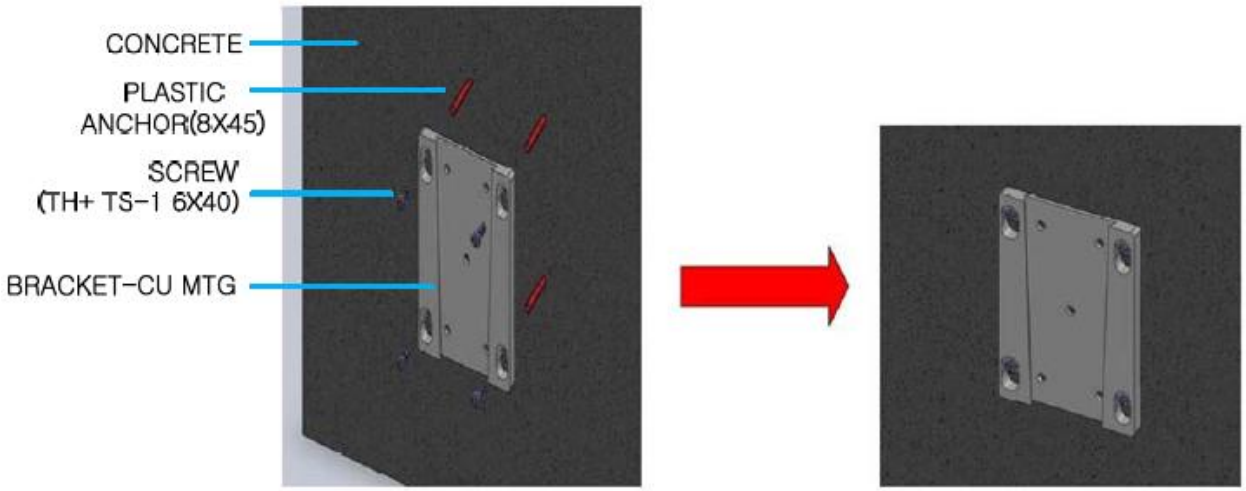
1) Using the Bracket B as a template, mark the location of the four holes to be screwed.
2) Screw the drywall anchors to the four marked holes as shown below.
3) Firmly attach the Bracket B to the drywall using the anchor screws as shown below.



[Figure 11] Mounting Bracket – Drywall Mounting

3.5.1.3 Concrete Mounting

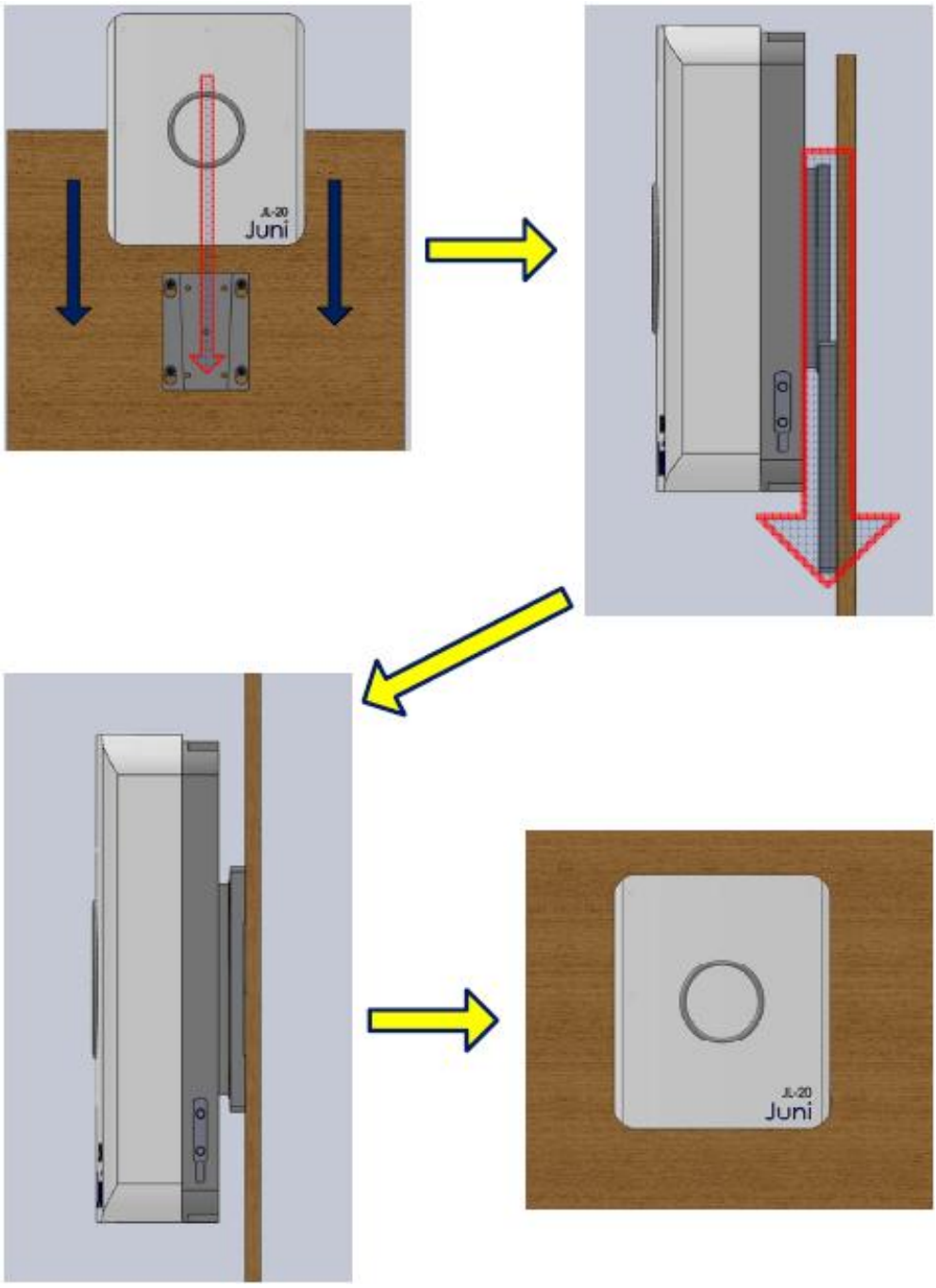
1) Using the Bracket B as a template, mark the location of the four holes to be drilled.
2) Drill four □6mm holes 30~40mm deep. Insert plastic anchors into the holes.
3) Firmly attach the Bracket B to the surface by using the screws as shown below.



[Figure 12] Mounting Bracket – Concrete Mounting

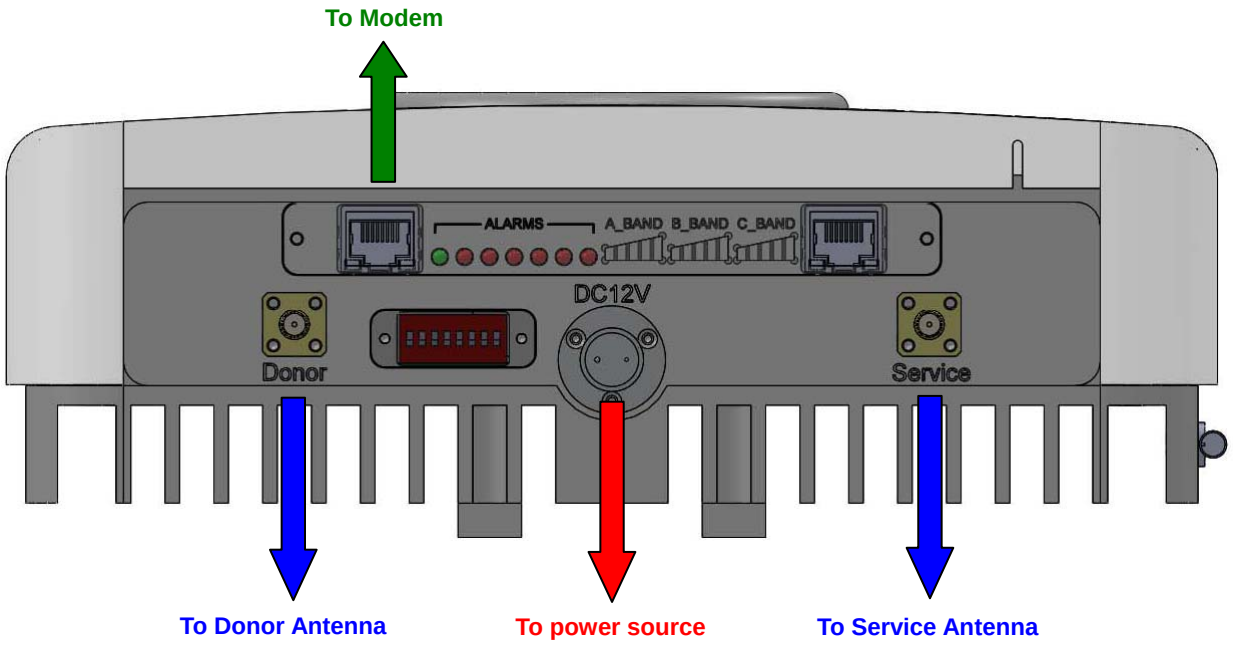
3.5.1.4 Mounting Complete

Once Brackets A and B have been both installed, complete the mounting process by combing the two brackets as shown below.



[Figure 13] Mounting Complete

3.5.2 Repeater Cable Connections



[Figure 14] Cable Connections

1) Confirm the Repeater unit has been mounted firmly and securely onto the mounting bracket.
2) Confirm that the Repeater is connected to the common ground using the Earth Terminal located on the bottom of the Repeater.
3) Connect the Donor antenna cable to the “Donor” port of the Repeater. The “Donor” port is an SMA-type female connection.
4) Connect the Service antenna cable to the “Service” port of the Repeater. The “Service” port is an SMA-type female connection.
5) Connect the DC Power adapter to the “DC12V” port of the Repeater. The AC power source should be 110VAC or 220VAC.
6) Connect an Ethernet cable from the “Remote Ethernet” port to the modem.
7) Confirm all connections are correct and firm.

3.5.3 Powering Up the JL20

CAUTION

Before supplying power to the unit, ensure the AC power source is correct and stable. Confirm there is sufficient earth connection to the cabinet by connecting an earth cable to the Earth Terminal on the bottom of the Repeater unit.

1) Confirm the AC voltage of the source is 110VAC or 220VAC.
2) Confirm the Power adapter is working correctly and supplying 12VDC.
3) Confirm all connections are firm and correct.
4) Turn the Repeater ON by switching on the power source.

3.6 Cautions during Installation

1) Ensure AC power is isolated before commencing ANY work.
   - Only personnel who have received relevant training from Juni are authorized to open any part or section of the JL20.
   - To prevent electrical shock when installing or maintaining the equipment, ENSURE THE SUPPLY OF AC IS REMOVED by switching off the AC from the source before accessing ANY section of the equipment.
2) Ensure the earth connections are made.
   - Attach all grounding cables to the Earth Terminals using the appropriated Crimp Tool.
   - Confirm the ground connection complies with the specifications for protection against electrical shocks.
3) Supply power to the equipment only after the correct cable connections are made.
   - All cable connections should be made correctly before supplying AC power to the equipment.
4) Ensure AC mains power cable is weather protected.
   - The AC mains power cable should be enclosed in UV resistant conduit.
   - Care should be taken to ensure no part of the power cable is exposed.

3.7 Storage of the Repeater

- When storing the Repeater, it is recommended to pack the Repeater in its original packaging supplied by Juni.
- The Repeater should not be stored in a high temperature or humid environment. Avoid direct sunlight.

3.8 Maintenance

- The Repeater should not require regular maintenance under normal operation, however, it is recommended to check the condition of the Repeater occasionally for any abnormal alarms.
- The Repeater can be remotely monitored and controlled using the Juni Web GUI system.
- If the Repeater requires cleaning, avoid static electricity and use a dry cloth.

3.9 Safety Instructions

- To avoid the risk of accidental electric shock, do not touch the contact terminals on the power supply unit or the control board during normal operation. If replacement is required, the power of the Repeater should be turned 'OFF' before taking any action.
- To avoid the risk of accidental fire or electric shock, do not expose this product to rain or any other wet condition during installation or maintenance.
- Only a qualified technician should service this Repeater. Opening or removing covers may expose you to dangerous voltage and/or other risks. Incorrect assembly may cause electric shock when the appliance is subsequently used.
- **Observe ALL warning and caution labels on the equipment and in this document.**

Appendix 1. System Specifications

- **RF Specifications**

Parameter		Specification	Comments
Freq. Range	DL	728-734MHz [A band] 734-740MHz [B band] 746-756MHz [C band]	LTE Technology
	UL	698-704MHz [A band] 704-710MHz [B band] 777-787MHz [C band]	
Occupied Bandwidth		5/10 MHz	Each band
ACLR		TS 36.106	
Frequency Stability		≤ 0.01ppm	
Max. Output Power		DL: 20dBm/Total, UL: 20dBm/Total	
Gain		DL & UL: 80dB	1dB Steps
Gain Accuracy		± 1dB	
EVM		≤ 5%	64QAM
Pass Band Ripple		≤ 2dB p-p	
Input VSWR		< 1.5:1	
Noise Figure		≤ 6dB	
DL Input Range		-75 ~ -30dBm/each band	
Impedance		50 ohm	
System Delay		< 3μsec	
Spurious Emissions		Meets FCC Requirements	

[Table 4] RF Specifications

Appendix 1. System Specifications

- **Mechanical & Environmental Specifications**

Characteristics	Specification	Remarks
Size	9.76 x 11.57 x 3.48 inch (248 x 294 x 88.3 mm)	W x H x D
Weight	< 11.02 lb. (< 5kg)	
Power Supply	12VDC, 5A	
Power Consumption	≤ 60W	
Temperature Range	32°F ~ 113°F (0°C ~ +40°C)	Heat sink Cooling
Relative Humidity	5~ 95%	
Antenna Ports	SMA-Type Female	
Cabinet Rating	IP43	
LMT Connections	Ethernet	

[Table 5] Mechanical & Environmental Specifications

Appendix 2. JL20 Commissioning & Setup Checklist

1. Pre-Installation Performance Tests			
No	**Details**	**Result**	**Remarks**
1.1	Determine 3 test spots near the Repeater site. These spots should include problem areas with little or no existing coverage.		
1.2	Make a mobile call using a test phone or establish a data connection using a customer approved CPE or modem. Record the measurements below.		
	Spot 1	Tx: Rx: Data:	
	Spot 2	Tx: Rx: Data:	
	Spot 3	Tx: Rx: Data:	

[Table 6] Pre-Installation Performance Tests

APPENDIX 2:

COMMISIONING AND SETUP

2. Installation			
No	**Details**	**Result**	**Remarks**
2.1	Confirm that the Repeater is mounted firmly and securely.		
2.2	Check ground cable connections.		
2.3	Check 12VDC input to the Repeater.		
2.4	Check Repeater cable connections.		
2.4.1	Connection between “Donor” port and the Donor Antenna.		
2.4.2	Connection between “Service” port and the Service Antenna.		
2.5	Check all connector ports are weatherproof. Antenna ports may require application of amalgamating (or similar) tape.		

[Table 75] Installation

3. Initial Checks

No	Details	Result	Remarks
3.1	Check Repeater is powered ON correctly.		
3.2	Check LED status.		
3.3	Check for unexpected conditions such as abnormal noise or heat.		
3.4	Check for any abnormal alarms using the LMT.		

[Table 8] Initial Checks

APPENDIX 2:

COMMISIONING AND SETUP

4. Commissioning and System Setup			
No	**Details**	**Result**	**Remarks**
4.1	Input Power. Using a spectrum analyzer, measure the input power level into the Repeater and confirm the level is within acceptable range. Record this value.		
4.2	Gain Setup. Using the value recorded in the previous step, set the gain of the Repeater to achieve the desired output power. Record this value.		
4.3	Measure the output power level using a spectrum analyzer. Confirm this value corresponds to the value displayed on the LMT.		
4.4	Check and record the Base Station noise level.		
4.5	Check for abnormal alarms using the LMT.		
4.6	Check RF performance.		
4.7	Check AGC operation.		
4.8	Check Automatic Shutdown operation.		

[Table 97] Commissioning and System Setup

5. Post-Installation Performance Tests			
No	**Details**	**Result**	**Remarks**
5.1	Using the 3 test spots from “Pre-Installation”,		
5.2	Make a mobile call using a test phone or establish a data connection using a customer approved CPE or modem. Record the measurements below.		
	Spot 1	Tx: Rx: Data:	
	Spot 2	Tx: Rx: Data:	
	Spot 3	Tx: Rx: Data:	

[Table 108] Post-Installation Performance Tests

Appendix 3. Risk Assessment and Control Form

Hazard	Risk assessment	HAZPAK ID	Risk management
1	Electrical Shock due to damaged or poorly maintained electrical leads and cables	**5**	Ensure all electrical leads and cables from the source to the product is in good condition and regularly checked for defects. Any defective leads, cables or connections should be replaced immediately after ensuring AC is isolated.
2	Electrical Shock due to lack of isolation procedures	**5**	Ensure there exists a simple and practical method of isolating AC power from the product. ALL work to be performed on the product must be done after AC isolation has been confirmed.
3	Personal injury due to slipping, tripping and falling.	**5**	Personnel must take care when installing, operating or removing equipment. Ensure the installation area before AND after product installation is free from loose cords, cables and leads. Any excess cables or leads must be stored in a manner that will pose no trip hazards during normal working conditions. This product may require installation above ground on a pole or a mast. When working from height, ensure a proper installation and/or work platform is used to prevent falls. Persons working from height should also wear safety harnesses BEFORE ascending to height.
4	General Occupational Health and Safety including Hazardous Materials	**6**	Goods are labeled as required. Always read the Operations Manual before using the product. If in any doubt, consult your supervisor before use.

[Table 119] Risk Assessment and Control

MPE Information

	Warning: Exposure to Radio Frequency Radiation The radiated output power of this device is far below the FCC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact during normal operation is minimized. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna should not be less than 25cm during normal operation. The gain of the antenna is 12 dBi.The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.