



**Intelibs, Inc.**

# Medium power Remote Unit Product manual

**MRU Operational Manual for GPS-iDAS Application**  
**Version: 1.3**  
**12-16-2016**

## Contents

1	Introduction .....	4
2	Product Description .....	7
2.1	External interface ports and Status Indicators .....	8
2.2	Modules .....	9
2.3	Mechanical Drawing .....	10
2.4	Technical Specifications .....	11
2.4.1	General specifications.....	11
2.4.2	Frequency allocation.....	11
2.4.3	RF specifications.....	14
2.4.4	Power Specifications .....	15
3	Installation .....	16
3.1	Installation Tools.....	16
3.2	Item Check List .....	16
3.3	Unit Mounting.....	17
3.4	Antenna.....	17
3.5	Power cable.....	18
3.6	Optic cable .....	18
4	Configuration and Maintenance .....	20
4.1	GUI connection .....	21
5	Human RF Exposure and Antenna placement guide .....	28

## **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.*

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

## **INFORMATION TO THE USER**

*This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.*

*This equipment generates, uses and can generate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.*
- Increase the separation between the equipment and receiver.*
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.*
- Consult the dealer for technical assistance.*

*Suitable for use in environmental air space in accordance with Section 300-22 (c) of the National Electrical Code, and Sections 2-128, 12-010 (3), and 12-100 of the Canadian Electrical Code, Part 1, C22.1.*

## 1 Introduction

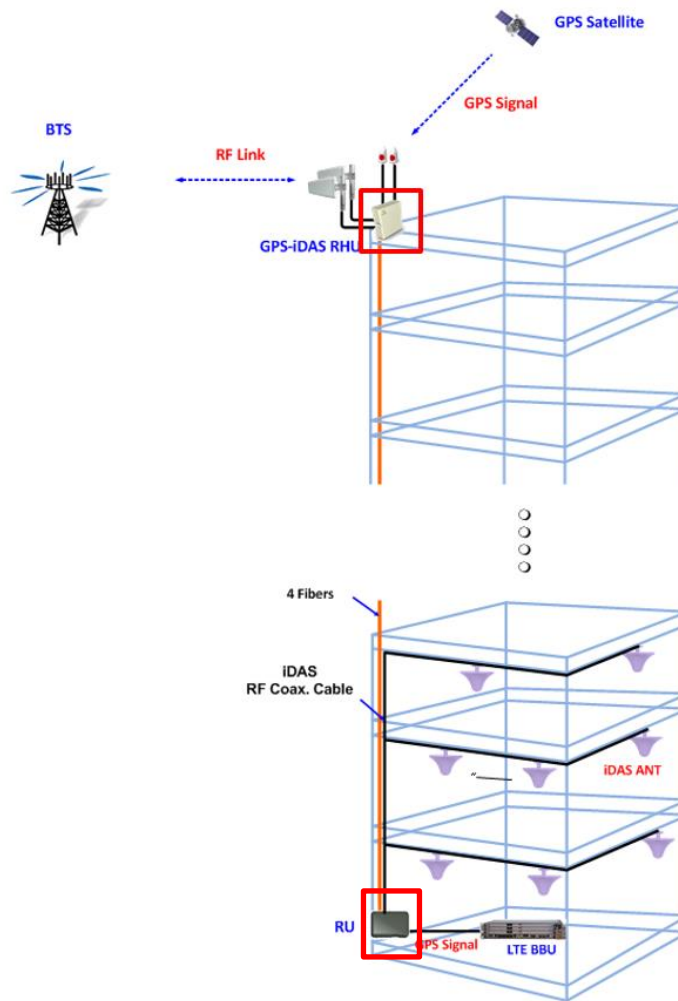
Medium power Remote Unit (MRU) is a part of the Hybrid Distributed Antenna Systems (HDAS) to provide remote RF coverage solution from the Radio Hub Unit (RHU) fed by the RF source via OTA or Wireline connection. MRU is built on a small form factor with a single antenna port for dual band frequencies with the following features:

1. Quadruple-Band support by one box with small form factor
2. Multiple Technology support
3. Low Power consumption fed by PoE or local AC adaptor
4. +33 dBm Down Link Tx Power (Composite power of +36dBm at Antenna port)
5. SNMP based remote management support
6. Single mode Fiber fed with 10 Km distance of 5dBo
7. Auto Gain Control (AGC), Auto power Limit Control (ALC), Auto Shut Down (ASD) and Auto Isolation detective Gain Control (IGC) function

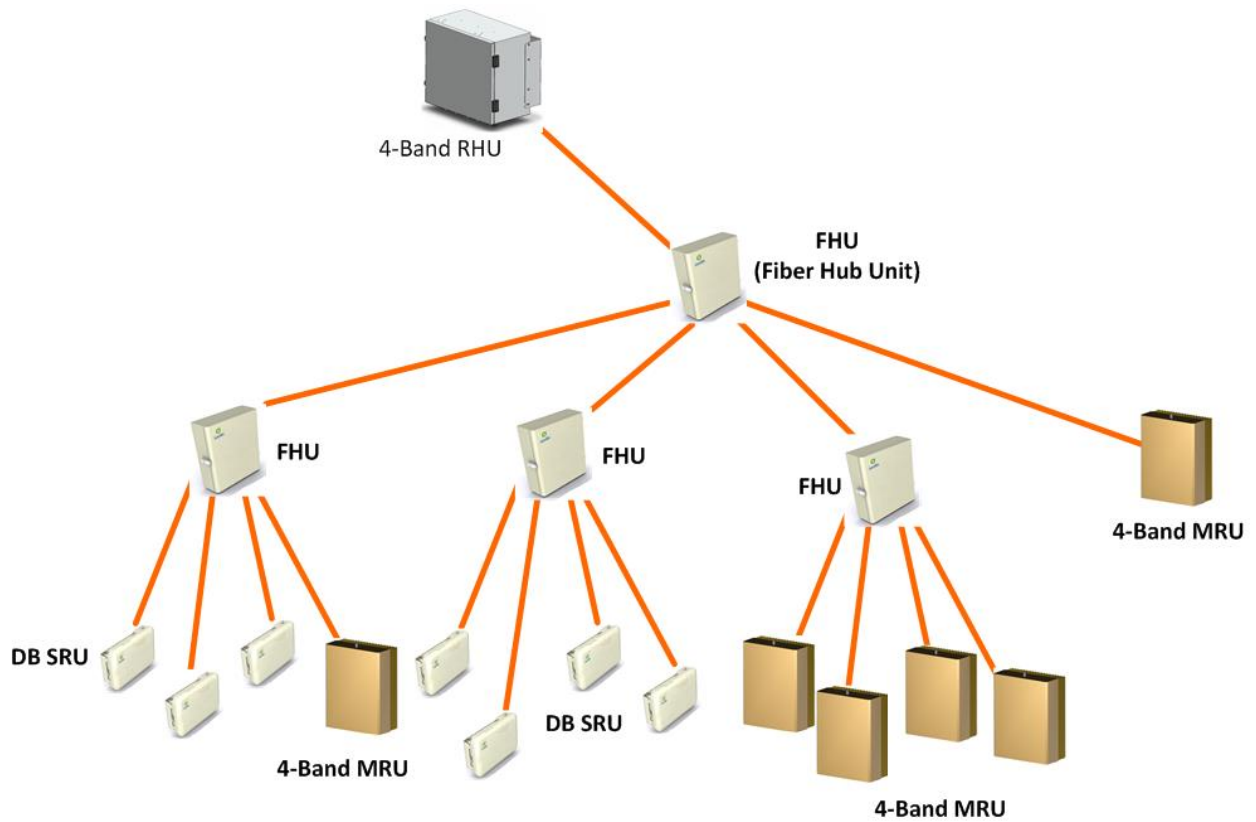
Including RHU, Hybrid DAS is comprised of the following subsystems:

- RHU (Radio Hub Unit): Interface unit between RF source and Remote Units, Convert RF signal into optical waves.
- FHU (Fiber Hub Unit): Fiber distribution and aggregation interface between RHU and multiple RUs. Each FHU supports up to 4 SRU/MRUs and total up to 16 SRU/MRUs by two level FHU configurations
- SRU (Small Remote Unit): Small power (23 dBm per band) remote unit
- MRU (Medium Remote Unit): Medium power (33dBm per band) remote unit
- RU (Remote Unit): High power (40 dBm per band) remote unit for outdoor/indoor
- MU (Master Unit): Element management server

As illustrated in Figure 1-1, Hybrid DAS network is comprised of RHU, FHU, MRU and SRU. Each RHU can support up to 16 SRU's that can cover up to 500Ksf<sup>2</sup> indoor space or 16MRU's that can be cover up to 800Ksf<sup>2</sup>.



(a) RHU-MRU configuration with GPS over fiber



(b) RHU-FHU-MRU/SRU configuration with GPS over fiber

Figure 1-1 Various network diagram using RHU/FHU/MRU/SRU

## 2 Product Description

As shown in Figure 2-1, MRU is a compact platform with the natural heat convection. As unified form factor, MRU services multiple technologies on a single platform with 4 band operating frequencies. It can be mounted on the wall. Variety of the service antenna can be used from small form factor antenna to indoor multi-band ceiling Omni antenna (or panel antenna).



Figure 2-1 MRU system

## 2.1 External interface ports and Status Indicators

MRU has main interface connections at topside of the enclosure, which includes optic, antennas and dc power input. The status LEDs and USB port for maintenance are located on left side. Figure 2-2 shows the top and bottom side of MRU.

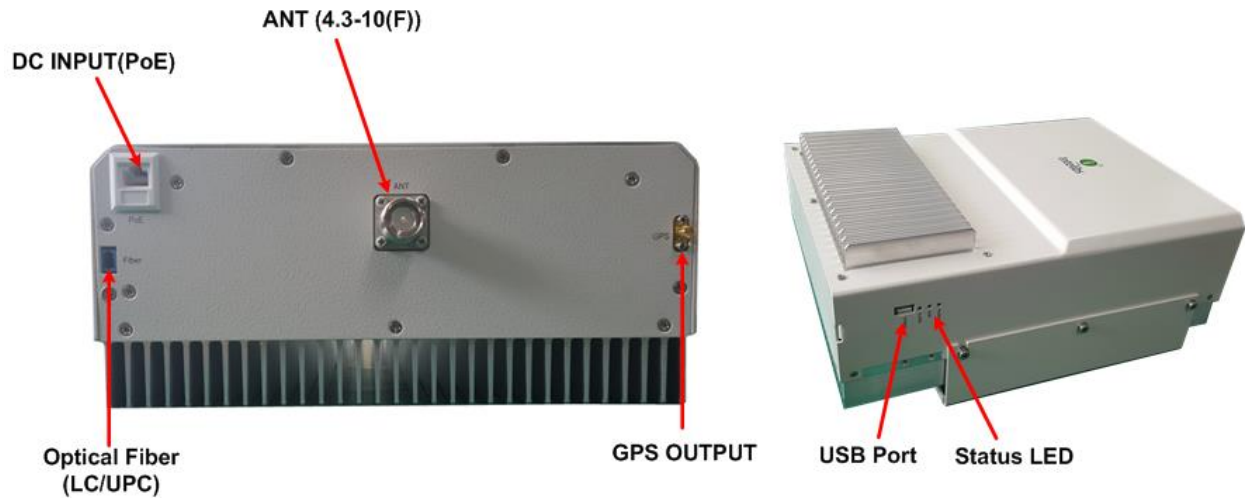


Figure 2-2 Top and bottom side of MRU

Table 2-1 Interface ports

Port	Connector type	Position	Description
Power	RJ-45	Top	+48V DC inlet, PoE adapter
Debug	USB-A	Left Side	Serial interface for local GUI and debugging
Optic	LC/UPC	Top	Optic fiber connection with FHU or RHU
GPS Out	SMA-Female	Top	GPS signal port to BBU
ANT	4.3-10-Female	Top	Omni ANT connection

Table 2-2 Status indicator LEDs

Name	Normal state	Abnormal state	Description
Power	Green	Off	Power injection status
RUN	Green/Blinking	Off	CPU working status
Alarm	Green	RED	Major Alarm indication



## 2.2 Modules

MRU is comprised of several internal modules such as 4 Band Multiplexer, DC/DC Converter, MRU Unit and 2 HPAs which include FSK modem and main controller. Figure 2-4 shows inside of MRU system.

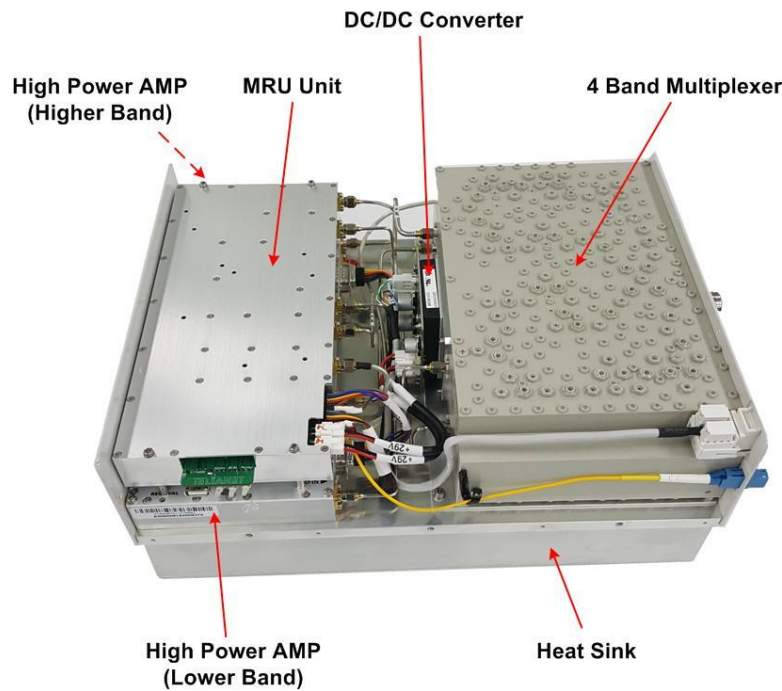


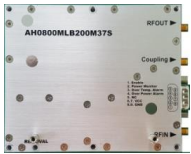




Figure 2-4 Inside of MRU

Table 2-3 Modules

Module	Picture	Description
DC/DC Converter		This module converts +48VDC of PoE cable into +29VDC and provide this DC power to each active module in MRU.
Low Band High Power Amplifier		This module amplifies low band signal such as 700/850MHz in order to get high energy and transmit high energy signal to Multiplexer filter. Composite power can be transmitted by this amplifier is 2W(33dBm/total).

High Band High Power Amplifier		This module amplifies high band signal such as 1900/2100MHz in order to get high energy and transmit high energy signal to Multiplexer filter. Composite power can be transmitted by this amplifier is 2W(33dBm/total).
RF/Optic Module		This module converts optic signal from RHU into DL RF signal and transfer to HPA. In case of Uplink, this module converts RF UL signal into optic signal to transfer to RHU. And this module amplifies RF signal to compensate optical loss. This module has wide band RF matching circuit to handle 4band signal. And optic wavelength of this module is 1550nm for Rx and 1310nm for Tx.
Quad Band Multiplexer		This module filters 4 band(8 path) signal and cut off unwanted signal strictly. This Quad band multiplexer filter is at the front-end and cutoff unwanted out of band noise signals. The combined port of this module is connected to coverage antenna cable.

2.3 Mechanical Drawing

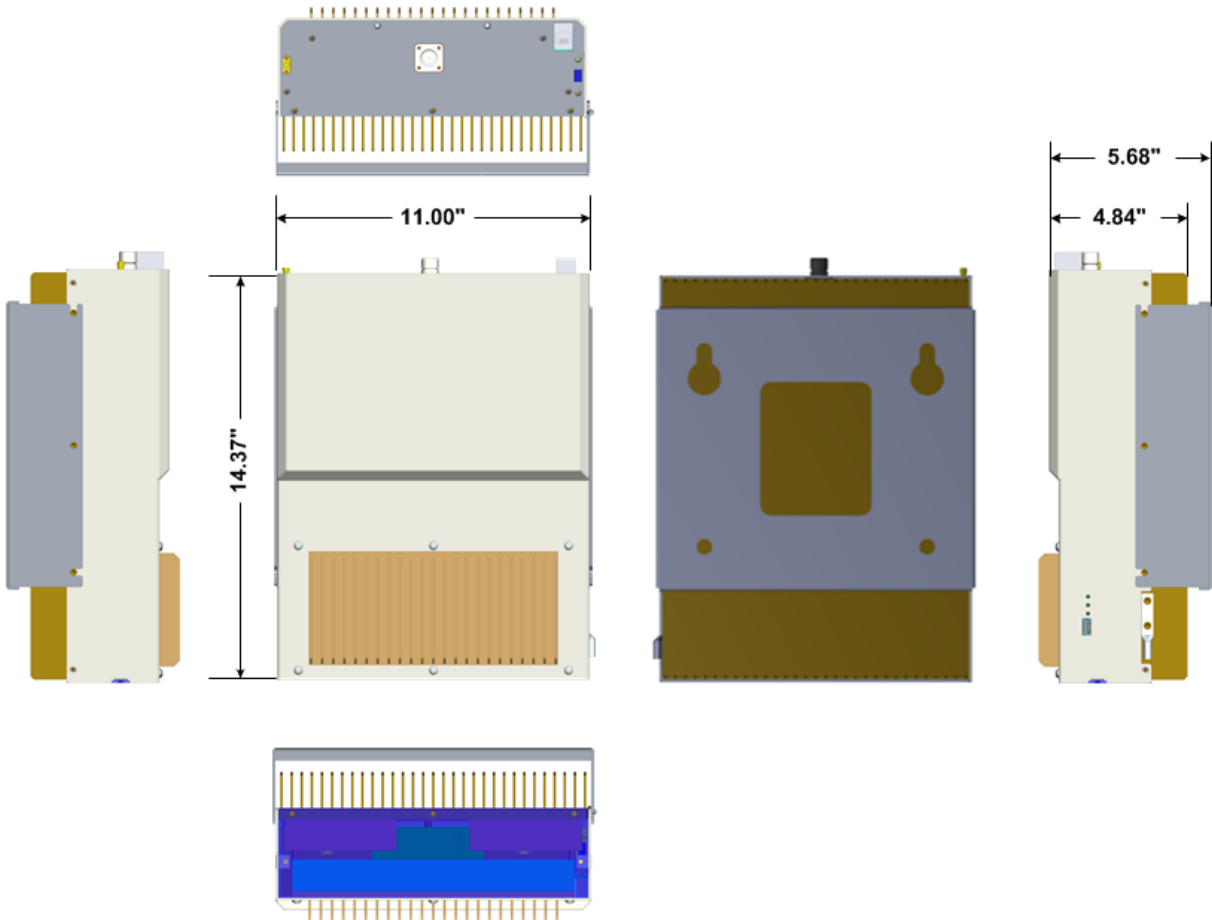


Figure 2-5 Exterior in 3-dimension

2.4 Technical Specifications

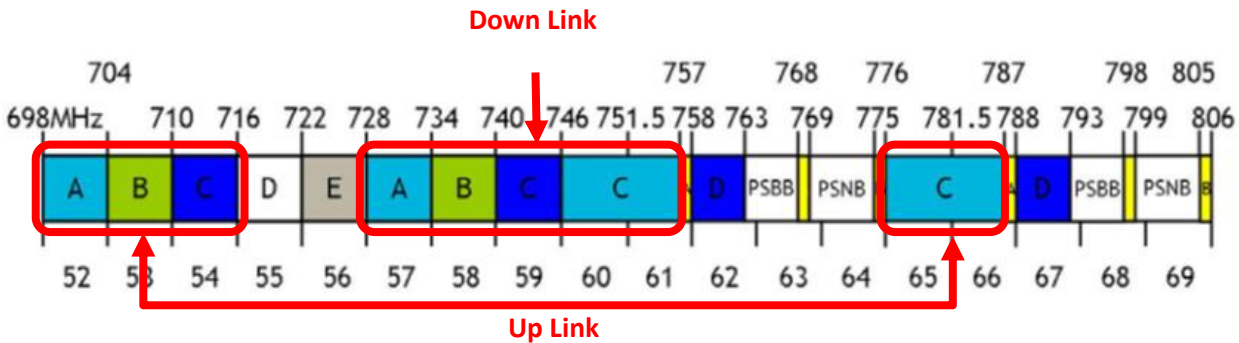
2.4.1 General specifications

Table 2-4 General Specifications

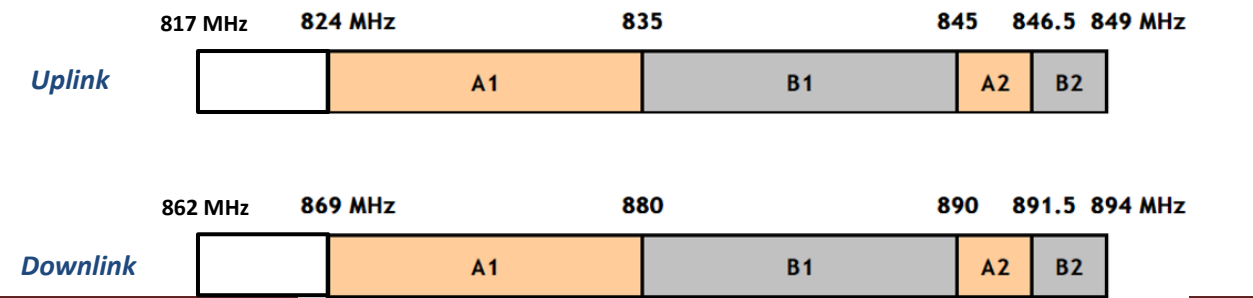
Specification	Values	Remarks
Dimensions	14.37(H) x 11.00(W) x 4.84(D) inch	without holder bracket
Weight	14 Kg (31 lb)	
ANT and RF connector	4.3-10 Female	
Optic port	LC/UPC type	
GUI port	USB A-type	
Input Supply Voltage	+48VDC	PoE adapter or AC/DC converter
Operating Temperature	-10 ~ +45 °C	
Humidity	5 ~ 80% Relatively	

2.4.2 Frequency allocation

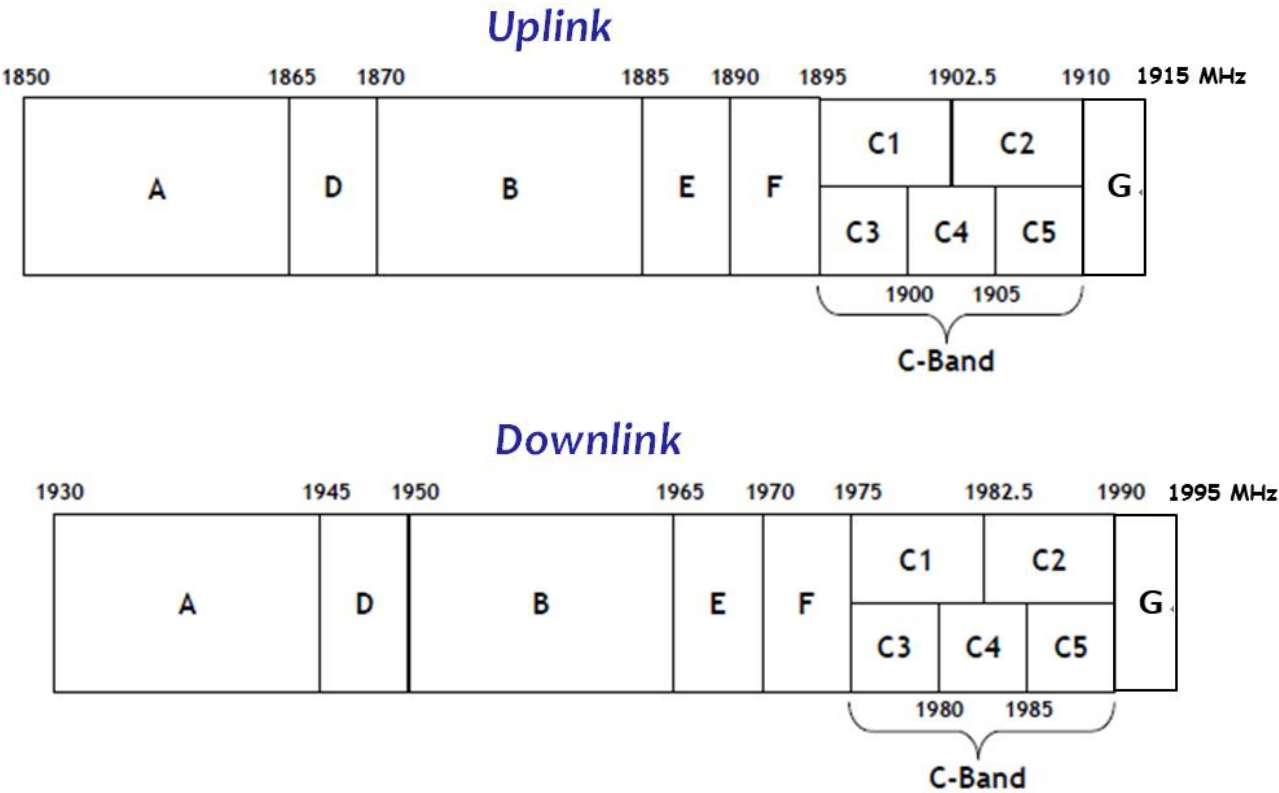
2.4.2.1 700MHz band



2.4.2.2 850MHz band

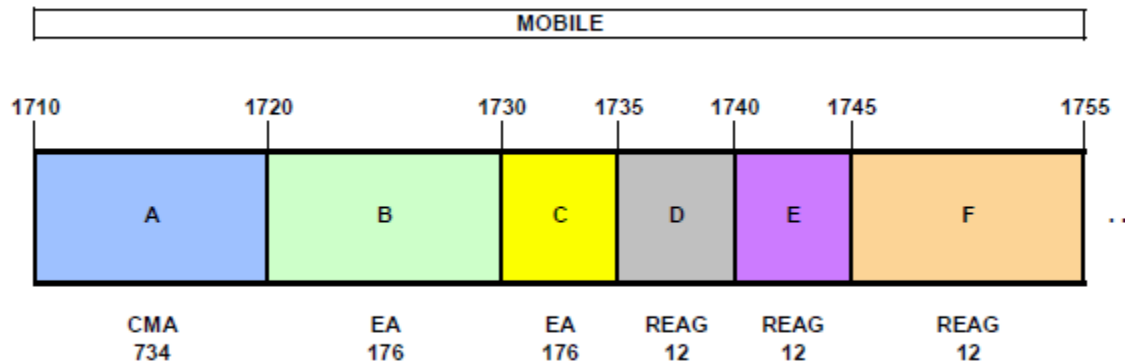


2.4.2.3 1900MHz band

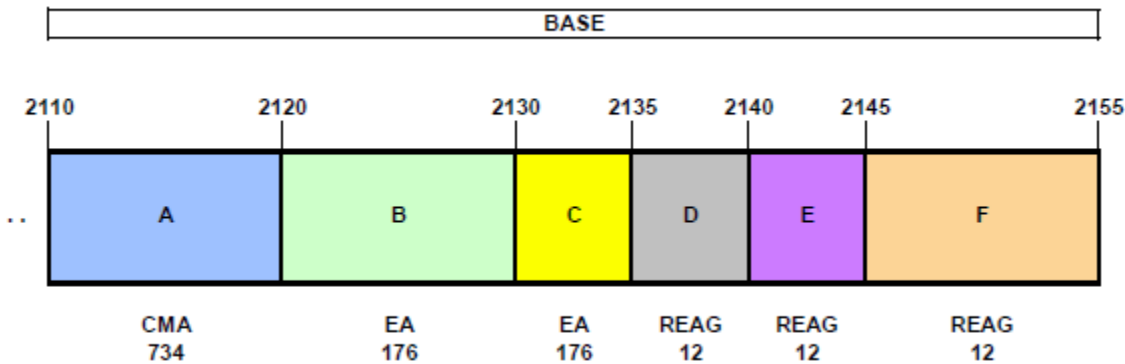


2.4.2.4 AWS band

Up Link



Down Link



## 2.4.3 RF specifications

### 2.4.3.1 iDAS MRU specifications

Table 2-5 Power specifications

Specification	Values		Remarks
Frequency Band	DL	700LTE: 728 ~ 757MHz PCS: 1930 ~ 1995MHz	850MHz: 862 ~ 894MHz AWS: 2110 ~ 2155MHz
	UL	700LTE: 698~716/776~787MHz PCS: 1850 ~ 1915MHz	850MHz: 817 ~ 849MHz AWS: 1710 ~ 1755MHz
System input level	DL	-15 ~ -5dBm/band	@ MRU optic output port
	UL	-45dBm/band max.	@ ANT input port of MRU
Composite Power	DL	+33dBm/Total(High/Low) +30dBm/band max.	@ Composite PWR of MRU
	UL	-5dBm/Band max.	@ Optic input port of MRU
System Gain	DL	45dB typ.(50dB max.)	@ Be able to compensate 5dBo fiber loss
	UL	45dB typ.(50dB max.)	
Gain Control Range	DL	0 ~ 30dB by 1dB step	@ ±0.7dB error at 0~25dB
	UL	0 ~ 30dB by 1dB step	
Noise Figure	UL	5dB typ. (8dB max.)	@ MRU → RHU
VSWR	DL/UL	1.5: 1 Max.	@ All of RF Port
Output spurious	DL/UL	Comply to 3GPP/3GPP2/FCC	@ Composite out power
System Delay	DL/UL	200nsec max.	
EVM	DL/UL	Less than 5%	@ CDMA, WCDMA, LTE signal
Optical wavelength	DL	1310nm	@ WDM included
	UL	1550nm	
Optical loss	DL/UL	5dBo max.	@ RHU ← → 4band RU
Supply Voltage & /Consumption	RU	+40 ~ +55VDC / 150W typ.	@ When all DL bands are transmitted by 1W
Connector type	RF	4.3-10 Female	@ ANT port
	Optic	LC/UPC	
	Power	RJ-45 for PoE	@ MS-Female for AC Input
	Debug	USB-A type	
Temperature	-10 ~ +45°C		@ Indoor type
Humidity	5 ~ 80% Relatively		

2.4.4 Power Specifications












Table 2-6 Power specifications

Item	Specification
Rated Input Voltage	+40 ~ +55 VDC typ.
Permissible range	Tolerance ±5%
Power consumption	150W typ. 170W max.

### 3 Installation

#### 3.1 Installation Tools

Table 3-1 Installation tools

Torque Wrench	4.3-10 Torque Wrench	ESD Gloves	Antenna cable w/ 4.3-10(M)
			
LC/UPC-LC/UPC Optic Fiber, 10m	Ground wire line	Optic connector cleaner	Wire Stripper & Cutter
			
Rubber Mallet	Digital Multi-meter	Screw Driver	
			

#### 3.2 Item Check List

Check that all the following items have been included with the box delivered. If anything is missing, please contact Intelibs.

Table 3-2 Item check list

MRU	AC/DC Power Adaptor w/ PoE Cable	Bracket
		



### 3.3 Unit Mounting

MRU should be installed vertically such as wall mounting because of heat dissipation. If MRU want to be installed on the rack horizontally, proper cooling devices like fan are required. The following diagrams illustrate the methods for mounting MRU in a typical wall. The brackets for wall mount are provided with MRU system.

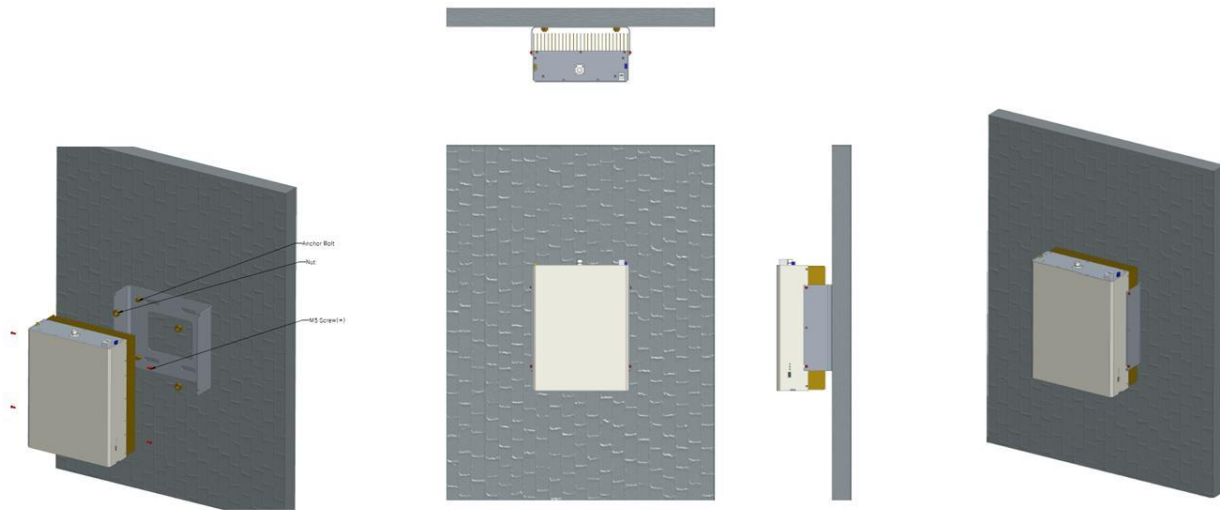


Figure 3-1 Wall mounting

### 3.4 Antenna

MRU uses various antennas depends on its application and environment. MRU provides one antenna port for 4-Band transmission at the top side of the system. Figure 3-2 shows antenna connection with 1/2inch coaxial cable in case of passive DAS.

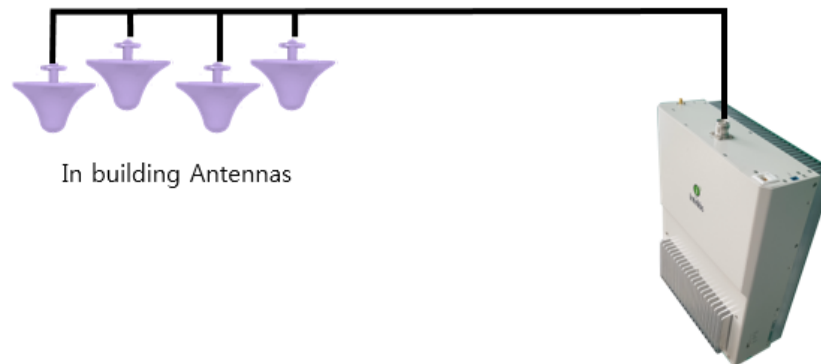


Figure 3-2 Antenna connection

3.5 Power cable

MRU uses +48V DC power by PoE passive injector. For DC power source, AC/DC converter or PoE (Power over Ethernet) adaptor can be used. Connect DC connector power cable to the “DC” port.

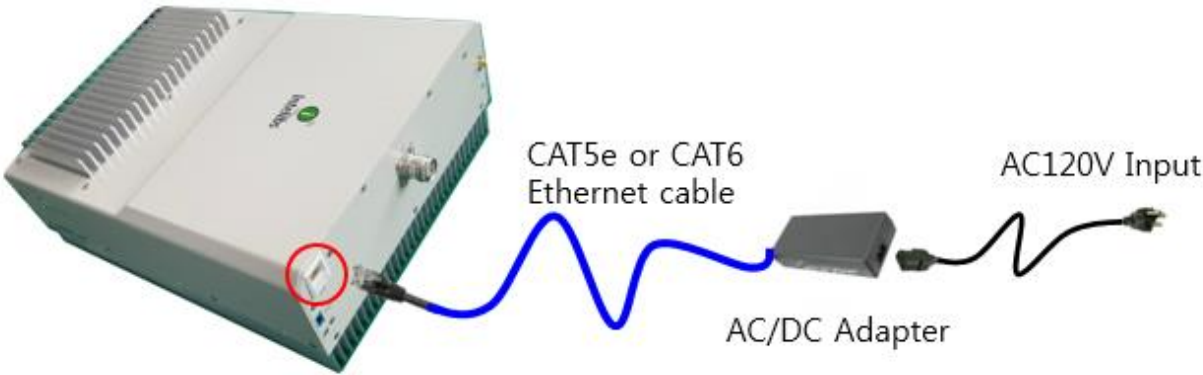


Figure 3-3 Power cable connection

3.6 Optic cable

MRU provides one optic port for upward direction, “Optic” port, and optic connector type is LC/UPC .

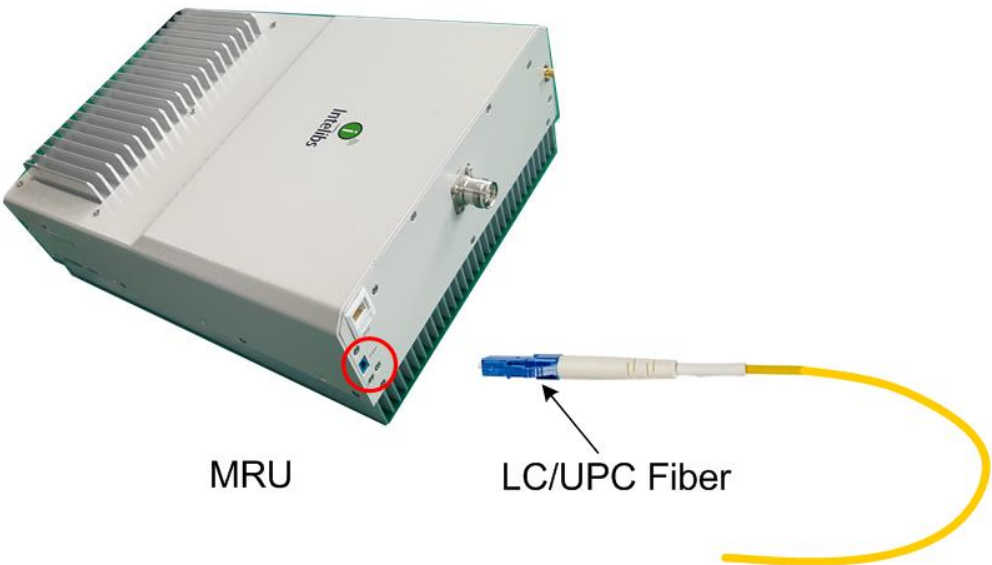


Figure 3-4 Optic cable connection

Figure 3-5 and 3-6 shows various optic connection of RHU-FHU-MRU equipment.

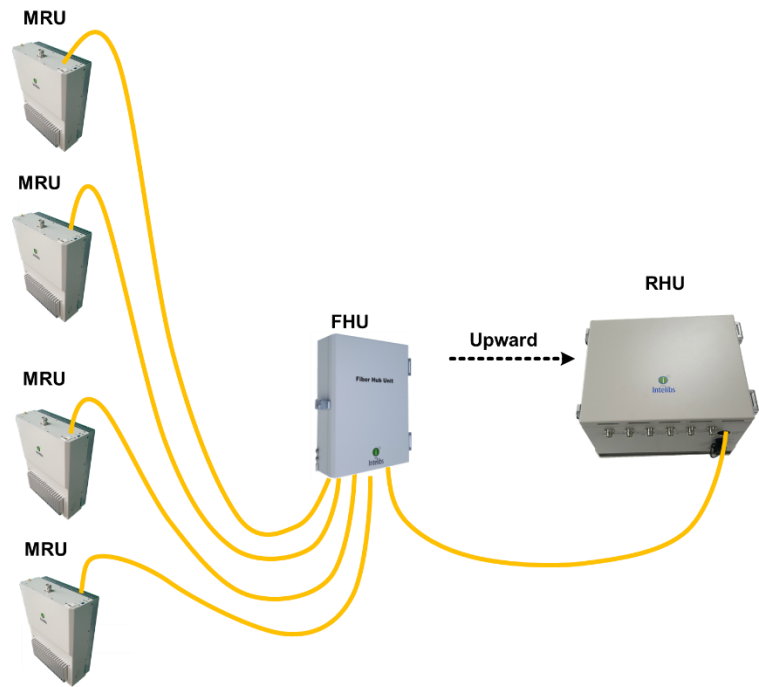


Figure 3-5 Optic cabling when cascading DAS systems with one FHU

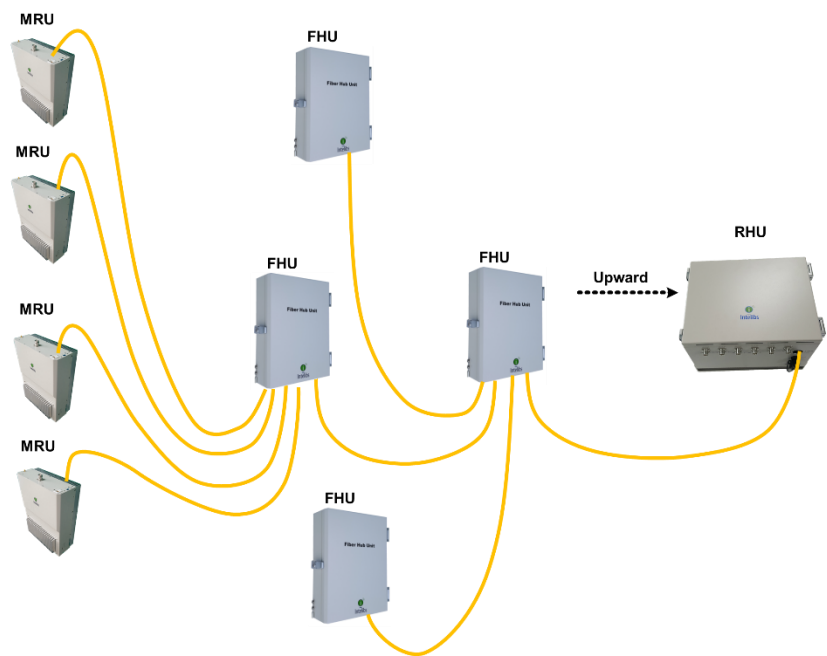


Figure 3-6 Optic cabling when cascading DAS systems with two-stage FHU

## 4 Configuration and Maintenance

SRU can be configured in three ways via remote internet connection or local serial port connection.

- Local management interface through the internet or serial connection
- Web interface through the internet
- SNMP interface through the internet

Master Unit is a remote management system that provides SNMP and Web interface, and maintains all functions of optical DAS system including configurations, monitoring, and real time alarm reporting.

The local management interface can be set up through IP network, serial interface, and Bluetooth.

The configuration and maintenance for SRU is performed by accessing RHU system through any interfaces provided by RHU.

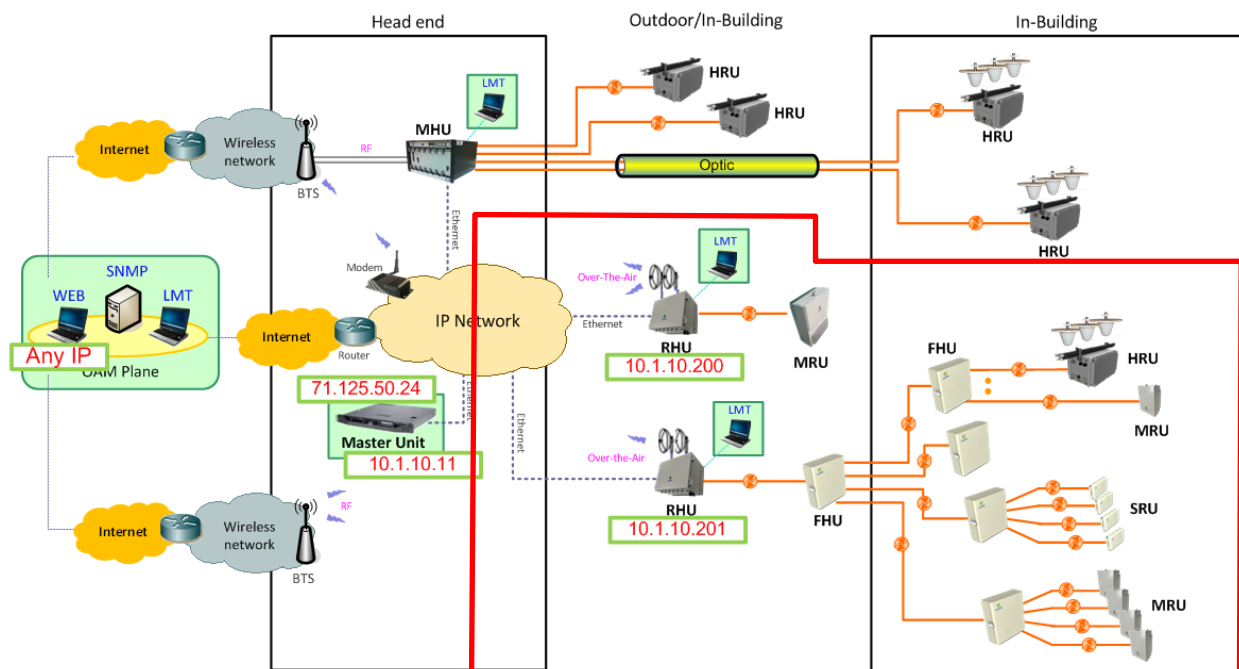


Figure 4-1 DAS management network and entities

Configuration guide below shows how to configure and manage MRU system. Figure 2-15 is an example DAS network for the configuration.

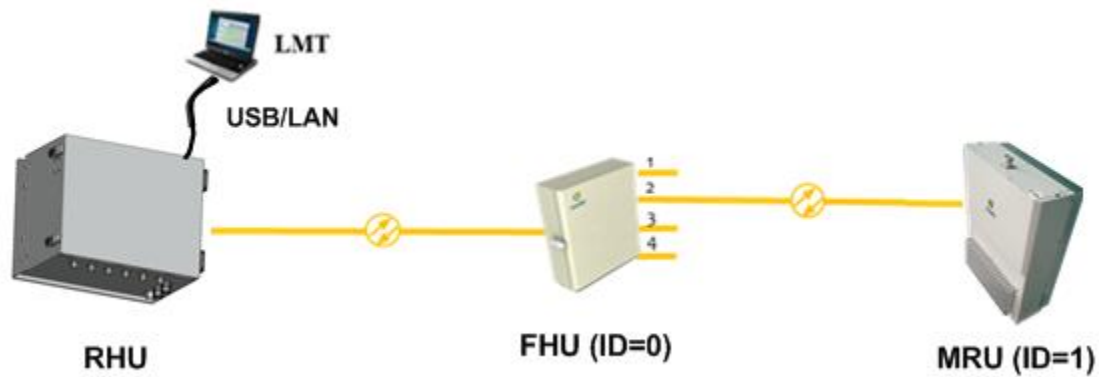
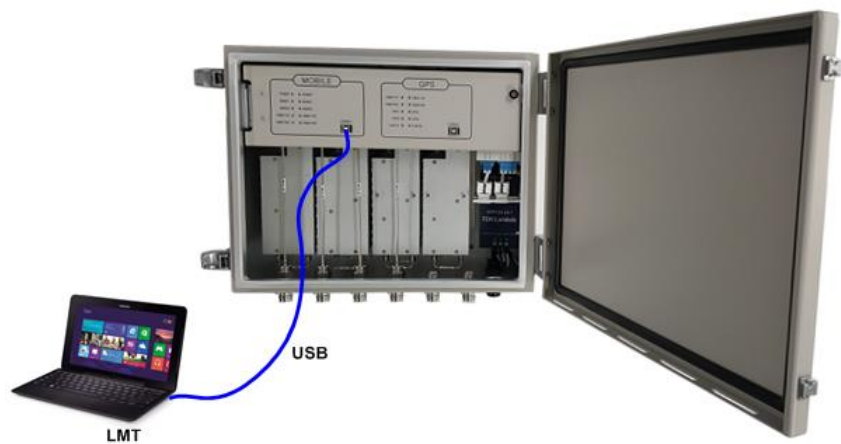


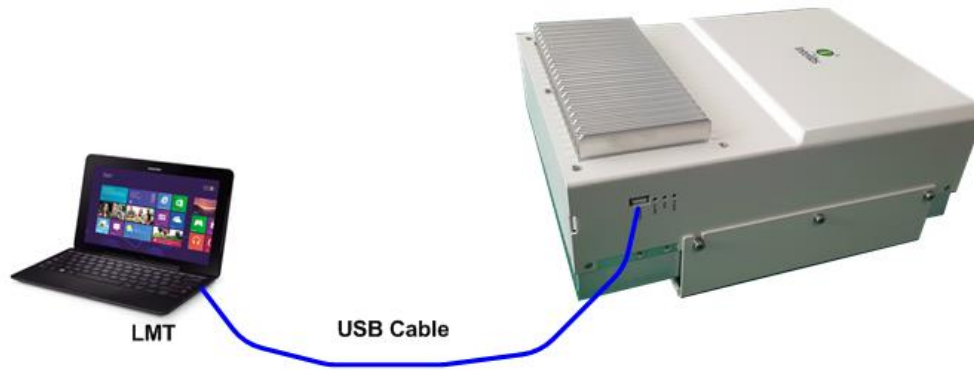
Figure 4-2 RHU/FHU/MRU network

4.1 GUI connection

The on-site local connection between LMT and RHU system can be established via USB interface.



[Laptop connection to MHU]



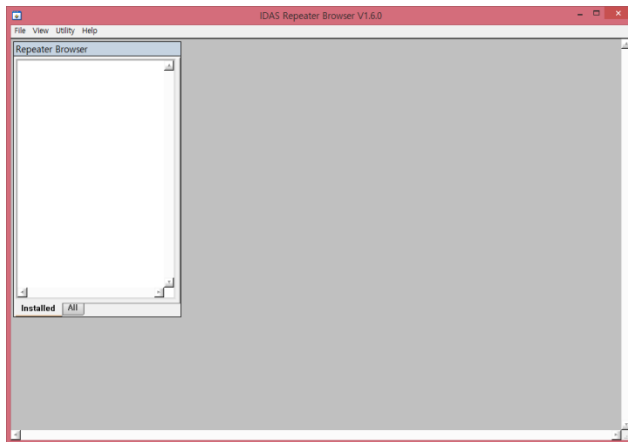
[Laptop connection to MRU]

Figure 4-3 USB connection

If the USB connection has been established, LMT is ready to start. Click the short cut icon on your laptop and follows the steps below.

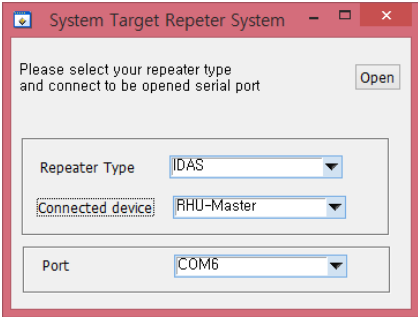
### Step 1

- Run the IDAS GUI.



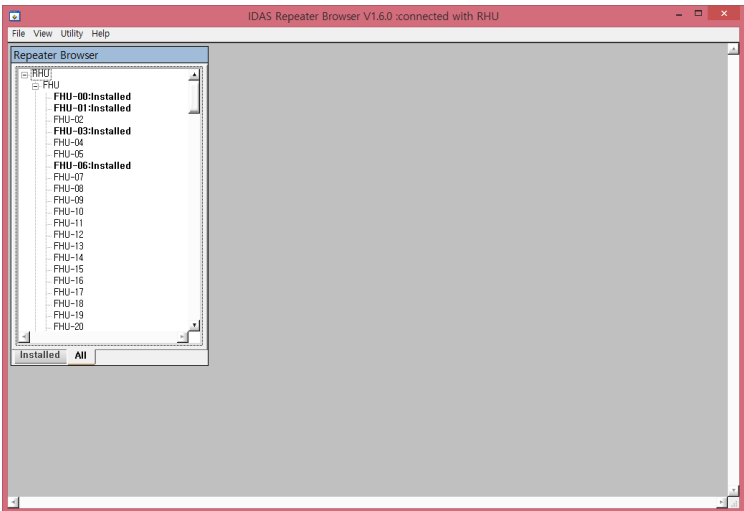
### Step 2

- Select the connection parameters as follows:
  - Choose [File → connect] from GUI window
  - Repeater Types: IDAS
  - Connected Device: choose one of RHU-Master, SRU, MRU or FHU
  - Connections
    - Serial Port: The port number established via USB



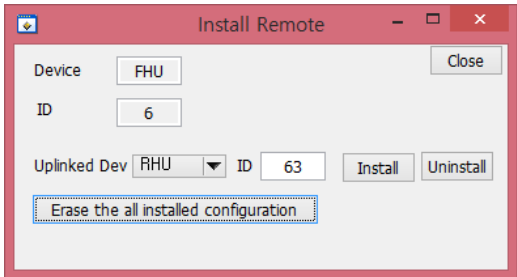
**Step 3**

- Select the “RHU-Master” on the above window
- If “Repeater Browser” window appears, click “ALL”



**Step 4**

- For setting ‘Remote Equipment’, double-click Remote name and set the configuration as below window.

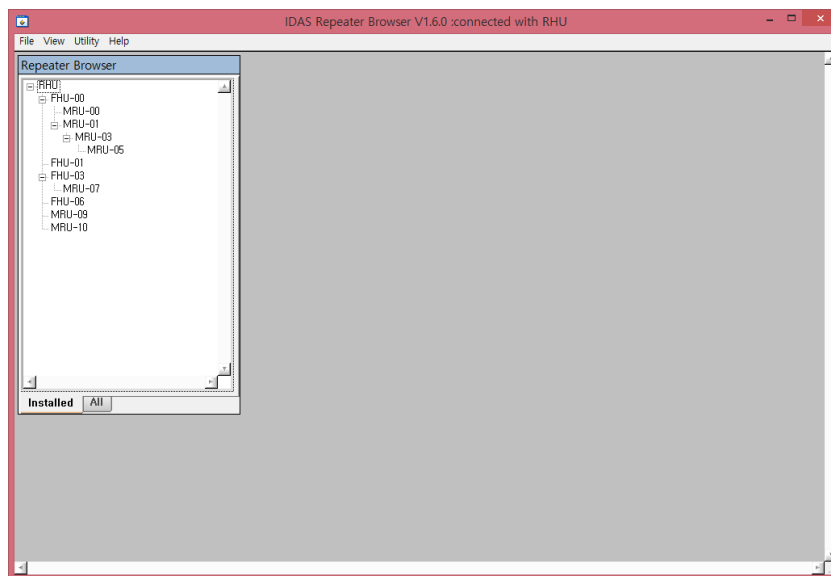


In this window

- Uplinked Dev : Uplink Device
- ID : Uplinked Device ID
- Install : Add the modules from uplink device
- Uninstall : Remove the modules from uplink device
- Erase the all installed configuration : Remove all modules.

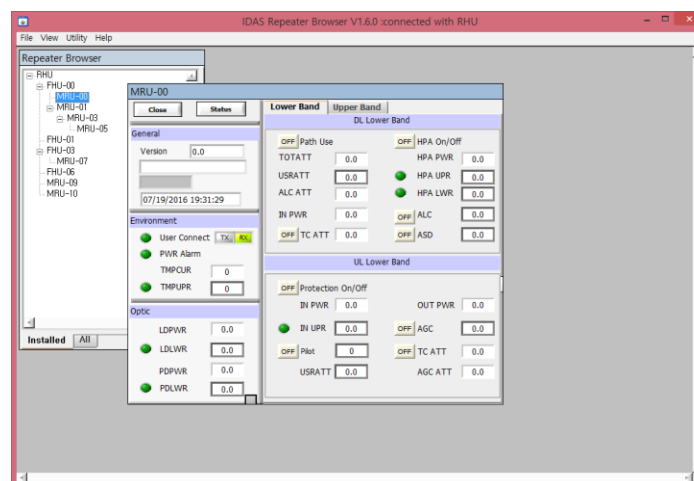
### Step 5

- Check the installed device as below browser



### Step 6

- Click "MRU" from above browser





If connection is established successfully, then all parameters of MRU can be set by LMT terminal, and all status information can be reported to LMT. MRU's status and parameters controllable by LMT are described in Table 4-1, 4-2, and 4-3.

Table 4-1 General/Environment/Optic

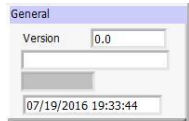
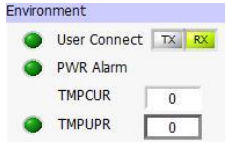
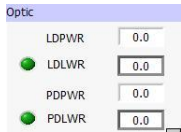
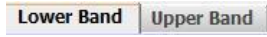
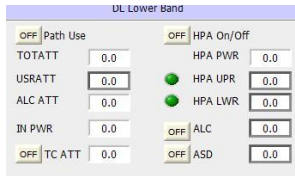
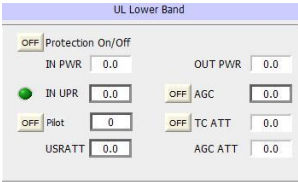
Status group	Parameters	Status	Control	Description
	Version	√		Firmware Version of the Unit
	DAS Type	√		The type of the DAS system
	Name	√	√	Set following information of the DAS - Name - Model Number - Serial Number
	Time/UpTime	√		Current time or Up-time display
	User Connect	√		Connection status with RHU
	PWR Alarm	√		Display DC Power Alarm
	TMPCUR	√		Current chassis temperature of the Unit
	TMPUPR	√	√	Set temperature upper limit, and display its value and alarm status.
	LDPWR	√		Current optical output power of LD (Laser Diode) to transmit to upper unit.
	LDLWR	√	√	Set the lower limit of output power of LD, and display its value and alarm status.
	PDPWR	√		Current optical receiving power of PD (Photo Detector) of optic module connected to MRU.
	PDLWR	√	√	Set the lower limit of PD power, and display its value and alarm status.

Table 4-2 DL Lower and Upper Band

Status group	Parameters	Status	Control	Description
	Lower Band	√		Selects Lower Band (700/850MHz) channel
	Upper Band	√		Selects Upper (1900MHz/AWS) channel
	Path Use	√	√	Turn On/Off of the usage of this path and display its status
	TOTATT	√		Downlink downlink total attenuation value
	USR ATT	√	√	Set user configurable downlink attenuation value
	ALC ATT	√		Attenuation value due to DL ALC function
	IN PWR	√		Display the downlink input level coming from upper unit
	TC ATT	√		Displays downlink temperature compensation attenuation value and enable/disable downlink temperature compensation function.

	HPA On/Off	√	√	Turn On/Off downlink HPA (High Power Amplifier).
	OUT PWR	√		Display downlink output power to ANT port
	OUT UPR	√	√	Set upper limit of downlink output power, and displays its value and alarm status
	OUT LWR	√	√	Set lower limit of downlink output power, and displays its value and alarm status
	ALC	√	√	Set ALC (Automatic Level Control) function's activation level, and enable/disable ALC.
	ASD	√	√	Set ASD (Automatic Shut Down) function's activation level, and enable/disable ASD.

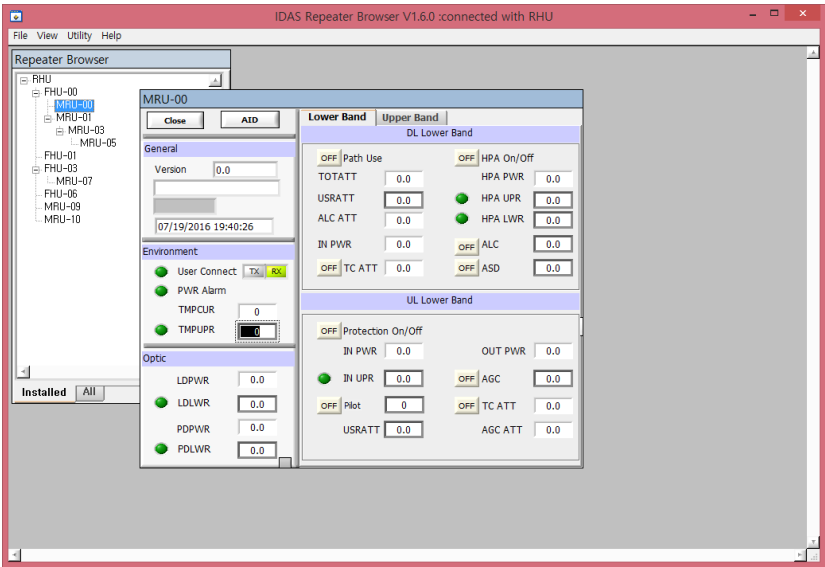
Table 4-3 UL Lower and Upper Band

Status group	Parameters	Status	Control	Description
	Protection On/Off	√	√	Enable/disable uplink protection function.
	IN PWR	√		Displays uplink receiving power from ANT port
	IN UPR	√	√	Set upper limit of uplink input power, and displays its value and alarm status
	Pilot	√	√	Enable/disable uplink Pilot signal and selects uplink CW channel.
	ATT	√	√	Set uplink attenuation, and displays its value.
	OPWR	√		Displays uplink output power that is transmitted from MRU
	AGC	√	√	Set AGC (Automatic Gain Control) function's activation level, and enable/disable AGC.
	TC ATT	√	√	Displays uplink temperature compensation attenuation value, and enable/disable uplink temperature compensation.
	AGC ATT			Displays attenuation value due to AGC (Automatic Gain Control) operation

Following is one example of LMT operation which sets the upper limit of MRU chassis' temperature.

### Step 1

- Click the box which is on the right side of "TMPUPR". A number in the box represents current upper limit of chassis' temperature and change the value. And then enter the key.

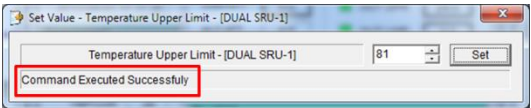


### Step 2

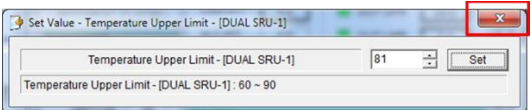
- Enter desired TMPUPR value by clicking arrow button or entering number. Then press "Set" button.



- Then the bottom of the window shows result of command.



- Press close button on the upper right corner of the window to exit the command window.



The small color box on the left side of "TMPUPR" represents current status of upper limit of MRU chassis' temperature. If the box is GREEN, operating status is in normal condition. If the box is RED, "TMPUPR" alarm occurred and remains.

# 5 Human RF Exposure and Antenna placement guide

Actual distance is determined upon gain of antenna used. Please maintain a minimum safe distance of at least 110 cm while operating near the service antennas with maximum permissive antenna gain up to 15 dBi and 10 dBi when 862 – 869 MHz frequency band is serviced.

## Two Year Limited Warranty

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Intelibs, Inc. ("Intelibs") offers a standard two year warranty from defects in material and installation. INTELIBS may at any time exclude from this Agreement any Hardware or Software which (1) has been modified, repaired or serviced by anyone other than Intelibs' service staff without the prior written approval of Intelibs, (2) has been subjected to unusual physical or electrical stress, whether such stress results from accident, neglect, misuse, lightning, failure of electrical power, air conditioning, humidity control, transportation, the making of specification or configuration changes requested by Customer, or any other cause other than ordinary use, and whether or not such stress is the fault of the Customer, (3) has been purchased from another Vendor and is networked, linked, attached or otherwise intended to work with the System or (4) has been moved from the place of installation. When the system has been improperly modified, repaired, stressed, used or moved as described above, Intelibs may, at its option and subject to the approval of the Customer, perform such corrective work, including any repairs, replacements and adjustments, as are in Vendor's opinion necessary to restore the System to the condition it would have been in if subjected only to normal wear and tear at the Customer's expense.

# Index

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3-Way Combiner .....	10	MU .....	4
AC Power specifications .....	14, 15	NMS Controller .....	10
AGC .....	26	Optic cable connection .....	18
Bluetooth .....	20, 21	OUT PWR .....	26
DAS management network .....	20	PDLWR .....	25
DAS Type .....	25	PDPWR .....	25
FC-APC .....	18	Power cable connection .....	18
FHU .....	4	PSU .....	25
IN ATT .....	25, 26	Rated Input Voltage .....	15
IN LWR .....	26	RHU .....	4
IN PWR .....	25, 26	RU .....	4
IN UPR .....	26	SNMPv3 .....	20
LDLWR .....	25	SRU .....	4
LDPWR .....	25	TMPCUR .....	25
Link Antenna connection .....	17	TMPUPR .....	25, 27
LMT .....	21, 25	Version .....	25
Local management interface .....	20	Web interface .....	20
Mounting methods .....	17		



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