User’s manual

PSR-9536-A

PSR-9536-B

V01

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Terms and Abbreviations

ALC	Automatic Level Control
BDA	Bi-Directional Amplifier
BMS	Battery Management System
BTS	Base Transceiver Station
CW	Continuous Wave (un-modulated signal)
DAS	Distributed Antenna System
DL	Downlink
DTU	DigiTal Unit
HPA	High Power Amplifier
IF	Intermediate Frequency
LNA	Low Noise Amplifier
LTE	Long Term Evolution
MS	Mobile Station
MUX	Multiplexer
OFDM	Orthogonal Frequency-Division Multiplexing
OFDMA	Orthogonal Frequency-Division Multiple Access
PA	Power Amplifier
PAR (PAPR)	Peak to Average Power Ratio (Crest Factor)
PLL	Phase Locked Loop
PSU	Power Supply Unit
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RB	Resource Block
RF	Radio Frequency
RRFU	Radio Frequency Unit
SC-FDMA	Single Carrier-Frequency Division Multiple Access
SoC	State of Charge
SQE	Signal Quality Estimate
SW	Software
UE	User Equipment
UL	Uplink
VSWR	Voltage Standing Wave Ratio

FCC Notices

Part 90 Class A (B9A)

FCC Part 90 Signal booster This is a 90.219 CLASS A DEVICE
This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signalboosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

Part 90 Class B (B9B)

FCC Part 90 Signal booster This is a 90.219 CLASS B DEVICE

This is **NOT** a **CONSUMER** device. It is designed for installation by **FCC LICENSEES** and **QUALIFIED INSTALLERS**. You **MUST** have an **FCC LICENSE** or express consent of an FCC Licensee to operate this device. You **MUST** register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signalboosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

FCC Part 15.21

Changes or modifications not expressly approved by the party responsible for compliance could **"void"** the user's authority to operate this equipment.

FCC Part 15.105 Class A

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.

Radio frequency Radiation Exposure Limits

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 40cm during normal operation. This device must not be co-located or operating in conjunction with any other antenna or transmitter.

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

Home/ personal use are prohibited.

Prior to equipment use the service must be registered with the FCC.
This can be done through the FCC's website at https://signalboosters.fcc.gov/signal-boosters

Warnings and Hazards

Opening PSR could result in electric shock and may cause severe injury. Working with the repeater while in operation, may expose the technician to RF electromagnetic fields that exceed FCC rules for human exposure. Visit the FCC website at www.fcc.gov/oet/rfsafety to learn more about the effects of exposure to RF electromagnetic fields. Operating PSR with antennas in very close proximity facing each other could lead to severe damage to the repeater.

IC Notices

RSS-GEN, Sec. 7.1.2 – (transmitters)

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionneravec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention desautres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotroperayonnée quivalente (p.i.r.e.) ne dépassepas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

RSS-GEN, Sec. 7.1.2 – (detachable antennas)

This radio transmitter (identify the device by certification number, or model number if Category II)has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste,ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

RF Radiation Exposure

This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 40cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. RF exposure will be addressed at time of installation and the use of higher gain antennas require larger separation distances.

L'antenne (ou les antennes) doit être installée de façon à maintenir à tout instant une distance minimum de au moins 40cm entre la source de radiation (l'antenne) et toute personne physique. Cet appareil ne doit pas être installé ou utilisé en conjonction avec une autre antenne ou émetteur.

1. Introduction

PSR is an innovative channelized digital repeater for public safety FirstNet and 700MHz and 800MHz wireless communication, in a small and large building for emergencies.

Thanks to the accumulated digital filter technology, up to 64 narrowband filters with independent gain and output adjustment can be configured and work together, up to 32 in each of 700 and 800 bands, while minimizing adjacent channel interference.

Also, in case of having different bandwidth by region, PS700 / PS800 frequency band can be adjusted and designed to detect and adjust system gain. All functions of the repeater are implemented in Web-based GUI to maximize the convenience of management.

User should follow instructions which are described in FCC notices in case of class B device.

1.1 Features

- Supports Public Safety frequency 700MHz, 800MHz bands including FirstNet
- Supports FCC Part 90 Class A narrowband and Class B wideband
- Supports up to **32 non-contiguous** narrow band channels in total
- Selectively removes interference channels adjacent to the service bands with digital filters.
- Compatible with NFPA & IFC (International Fire Code)
- Best-in-class low power consumption
- Battery Backup
- Web GUI interface
- User-configurable alarm functions supporting dry contact interface
- Low profile & light weight
- NEMA 4, IP66 compliant enclosure
- Interference cancellation
- Antenna monitoring mechanism
- Isolation measurement
- Spectrum display

1.2 Outlook

1.2.1 PSR

The following picture shows the mechanical information of PSR.

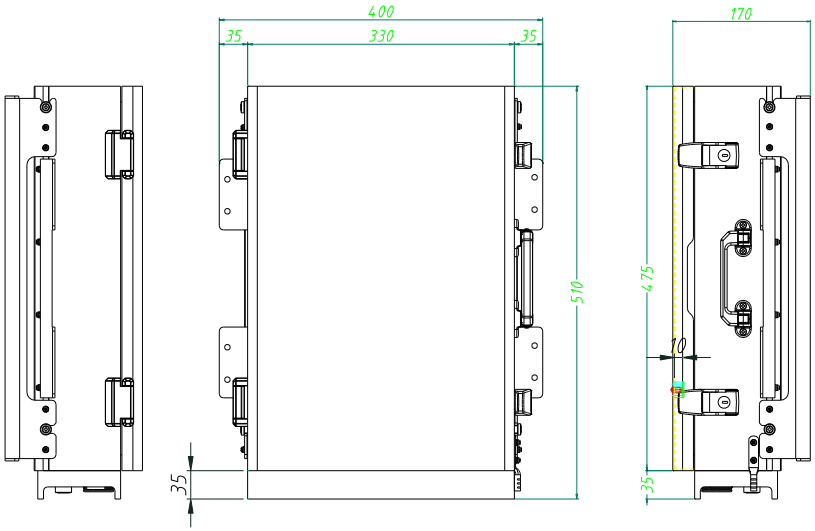


Figure 1 - 1 Mechanical drawing

Figure 1 - 2 Outlook

1.3 System RF block diagram

Following diagram shows simplified RF block of PSR.

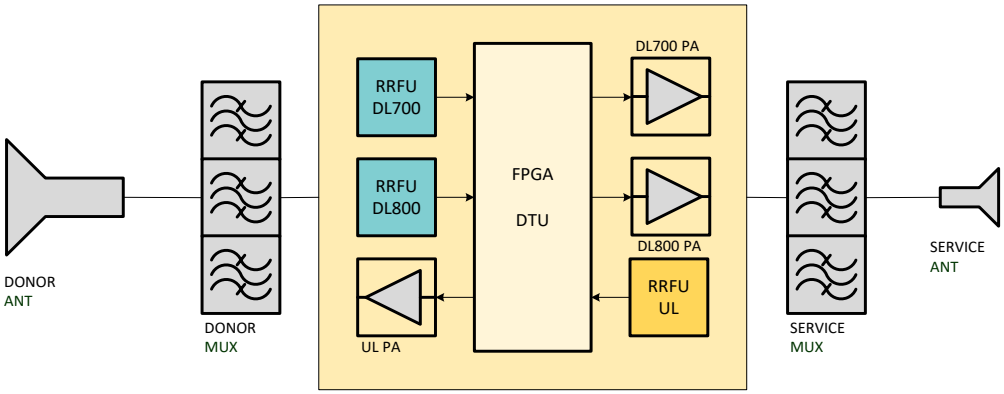


Figure 1 - 3 System RF block diagram

For the downlink, received RF signal from BTS to DONOR antenna port is converted to IF signal at RRFU, and goes to FPGA for digital signal processing. The signals from FPGA is converted again so that the frequency of the output signal is exactly the same with the original ones. Finally the signal is amplified & transmitted to service area.

Uplink works the similar way but with the opposite direction when it comes to the signal flow. Received RF signal from mobile to SERVICE antenna port is converted to IF signal at RRFU, and goes to FPGA for digital signal processing. The signals from FPGA is converted again so that the frequency of the output signal is exactly the same with the original ones. Finally the signal is amplified & transmitted to the BTS.

1.4 Frequency diagram

Frequency bands of PSR series can be configured and operated separately for the three different bands, FirstNet, PS700 and PS800.

There are 2 different class types of the device as defined in FCC Part 90, Signal Booster classifications.

Each frequency band is shown below.

Class A

Available frequency ranges ;

- Not available @ FirstNet
- 769~775/ 799~805MHz @ PS700
- 851~869/ 806~824MHz @ PS800 (861-869MHz : For IC only)

Available CH bandwidths ;

- 6.25/ 12.5/ 25/ 50/ 75kHz

Class Bq

Available frequency ranges ;

- 758~768/ 788~798MHz @ FirstNet
- 769~775/ 799~805MHz @ PS700 **(For FCC only)**
- 851~861/ 806~816MHz @ PS800 **(For FCC only)**

Available CH bandwidths ;

- 5/ 10 MHz @ FirstNet
- 100/ 200kHz @ PS700, PS800

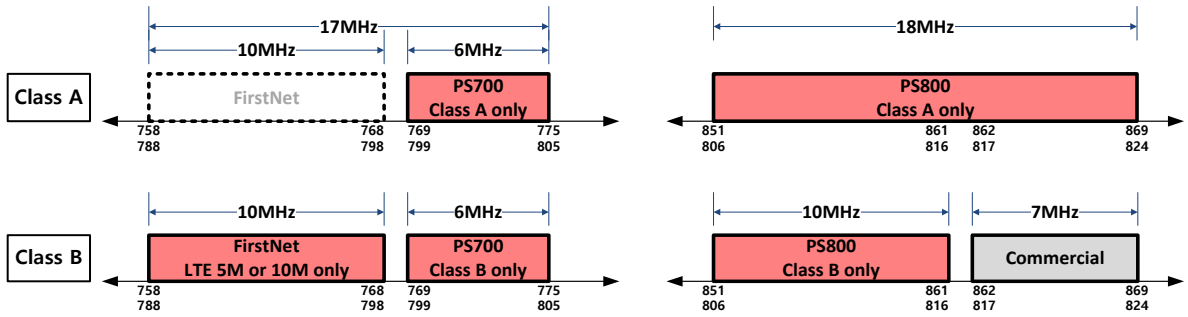


Figure 1 - 4 Frequency diagram

2. System overview

The following picture shows the mechanical

2.1 Interior

PSU(DC Power Supply Unit) is located at the top of PSR, while the All-in-one integrated module is at the bottom side.

All-in-one integrated module consists of RRFU+MUX+PA, carrier board, CPU and DTU.

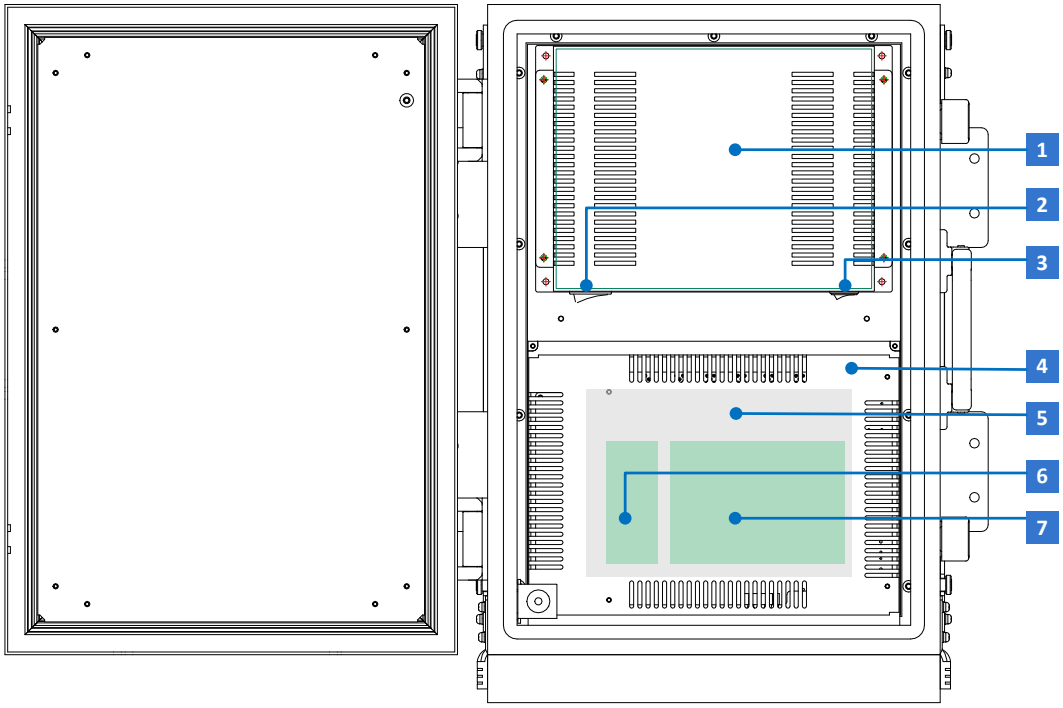


Figure 2 - 1 Interior

No.	Description
1	PSU
2	AC power switch
3	Battery switch
4	All-in-one module
5	RRFU + MUX + PA
6	Carrier board
7	DTU

Table 2 - 1 Description/ interior

2.1.1 PSU

PSU can be operated in either ac-dc or dc-dc.

- ac-dc converting part operating from 100-220 of free ac voltage input to dc output.
- dc-dc converting part operating from external dc + 24V voltage input to dc output.

The maximum available power consumption is around 170W.

2.1.2 RRFU

RRFU consists of RF blocks that perform appropriate amplification, attenuation and frequency conversion for each of the downlink and uplink frequency bands.

2.1.3 MUX

MUX is a front-end filter component that can isolate the various RF signals from one antenna input and operate with stable isolation for each frequency band.

2.1.4 PA

A power amplifier is an electronic amplifier designed to increase the magnitude of power of a given input signal.

2.1.5 Carrier board

Carrier board is usually necessary when additional features or hardware interfaces are required, modem interface for instance.

2.1.6 DTU

DTU is a core part that performs functions such as digital filtering, gain control, and interference signal cancellation.

2.2 External Interface

All external connectors are located at the bottom side of the product.

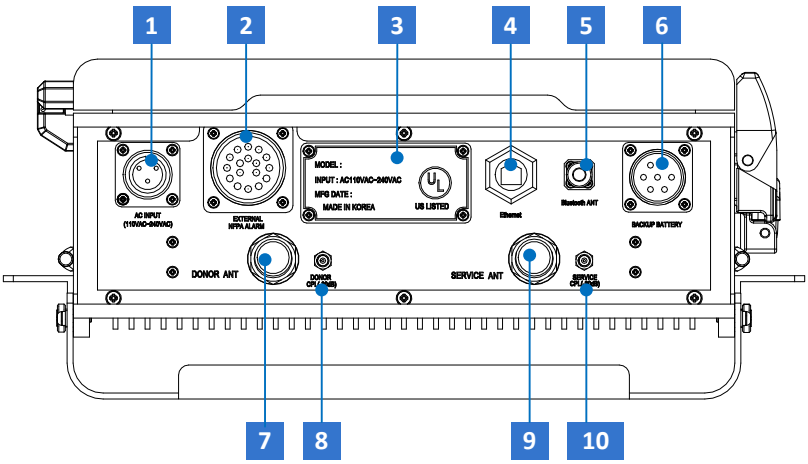


Figure 2 - 2 External interface

No.	Description
1	AC INPUT
2	EXTERNAL NFPA ALARM
3	NAMEPLATE WITH UL MARK
4	ETHERNET
5	BLUETOOTH ANT
6	BACKUP BATTERY
7	SERVICE ANT
8	DL CPL
9	DONOR ANT
10	UL CPL

Table 2 - 2 Description/ External interface

2.2.1 AC INPUT

AC power is supplied through the standard 3pin plug(MS3102E_16-10)) with AC_N, AC_L, and Ground. The AC power supports ac 110 ~ 240V of free voltage ac power source.

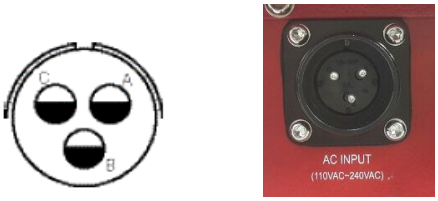


Figure 2 - 3 AC INPUT Port

AC INPUT	
MS3102E_16-10	
A	AC_N
B	GND
C	AC_L

Table 2 - 3 Pin description/ AC INPUT

2.2.2 EXTERNAL NFPA ALARM

PSR can be connected to the extra alarm box to monitor 5 major alarms (ac, battery, antenna, amplifier, and system alarms) and 1 more reserved alarm defined by user.
The total number of alarms is 6.

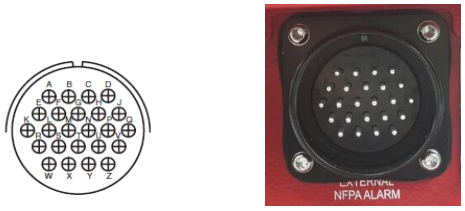


Figure 2 - 4 EXTERNAL NFPA ALARM Port

EXT, Alram	
MS3102E_24-28	
A	Normal AC Power_Normal Open
B	Loss of normal AC Power_Normal Open
C	Battery charger failure_Normal Open
D	Low battery capacity (70%)_Normal Open
E	Donor antenna malfunction_Normal Open
F	Active RF emitting device malfunction_Normal Open
G	System component malfunction_Normal Open
H	NC
J	Normal AC Power_Normal Close
K	Normal AC Power_Common
L	Loss of normal AC Power_Normal Close
M	Loss of normal AC Power_Common
N	Battery charger failure_Normal Close
P	Battery charger failure_Common
Q	Low battery capacity (70%)_Normal Close
R	Low battery capacity (70%)_Common
S	Donor antenna malfunction_Normal Close
T	Donor antenna malfunction_Common
U	Active RF emitting device malfunction_Normal Close
V	Active RF emitting device malfunction_Common
W	System component malfunction_Normal Close
X	System component malfunction_Common
Y	EXT Shutdown Alarm
Z	GND

Table 2 - 4 Pin description/ EXTERNAL NFPA ALARM

2.2.3 NAMEPLATE WITH UL MARK

It shows the basic information of PSR, such as product model number, frequency range, gain & power, and UL/FCC approved marks.

Figure 2 - 5 Nameplate

2.2.4 ETHERNET

It is strongly recommended that PSR must be connected to the Internet via ETHERNET port 24/7 for maintaining the best quality of service by using WEB GUI.
The GUI port can be used to communicate directly with PSR using an RJ-45 crossover cable. The waterproof cap must first be unscrewed to gain access to the GUI port.

Figure 2 - 6 ETHERNET Port

Ethernet	
M20 RJ45	
1	GND
2	TX+
3	TX-
4	RX+
5	NC
6	NC
7	RX-
8	NC
9	NC
10	GND

Table 2 - 5 Pin description/ ETHERNET

2.2.5 BLUETOOTH ANT

SMA interface is reserved for connecting external Bluetooth IoT device when it is available, depending on the situation.

Figure 2 - 7 BLUETOOTH ANT

2.2.6 BACKUP BATTERY

The battery switch on the PSU must be switched ON position. This will enable the repeater to charge the battery backup unit when AC power is present.

PSR can be connected to the battery to provide power during a power failure, and this port connects to the battery via dedicated cable. The circuit breaker switch on the battery must be set to OFF before connecting it to PSR to prevent damage to the repeater or the battery itself and personal injury.

Please contact Technical Support for assistance if you are unfamiliar with the installation procedure of the battery box

Figure 2 - 8 Battery Switch

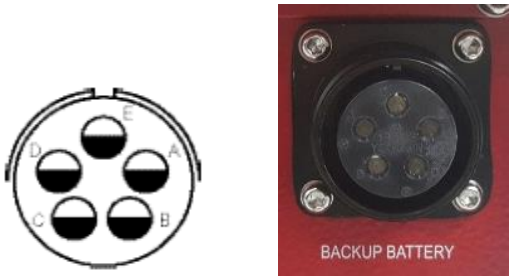


Figure 2 - 9 BACKUP BATTERY

Backup Battery	
MS3102E_18-11	
A	TXD+
B	P-
C	P+
D	RXD
E	NC

Table 2 - 6 Pin description/ BACKUP BATTERY

2.2.7 RF port

Figure 2 - 10 RF ports

The RF connections are made via two 4.3-10 mini-DIN female connectors.
The RF connector labeled “DONOR” must be connected to the antenna towards BTS side. The DONOR port can receive both 700 and 800MHz public safety signals. The RF connection labeled “SERVICE” must be connected to the antenna facing the area to be covered by PSR.
Available RF power coupling is -30dB.

2.2.8 Grounding

The grounding terminal is located at the lower both side of PSR, and can support a ground cable up to 1.25mm² (16AWG) in diameter and should be permanently connected to a grounding bar.

The grounding cable should be properly connected before powering on the equipment, by using ground cable contained in the box.

Figure 2 - 11 Ground Cable Terminal

2.3 Function features

2.3.1 ICS

In order to ensure that the output power radiated from the service antenna does not flow into the donor antenna, sufficient isolation between the antennas must be ensured, otherwise the radiated signals feed through to the donor antenna side and amplified again, resulting in system oscillation and other disturbances.

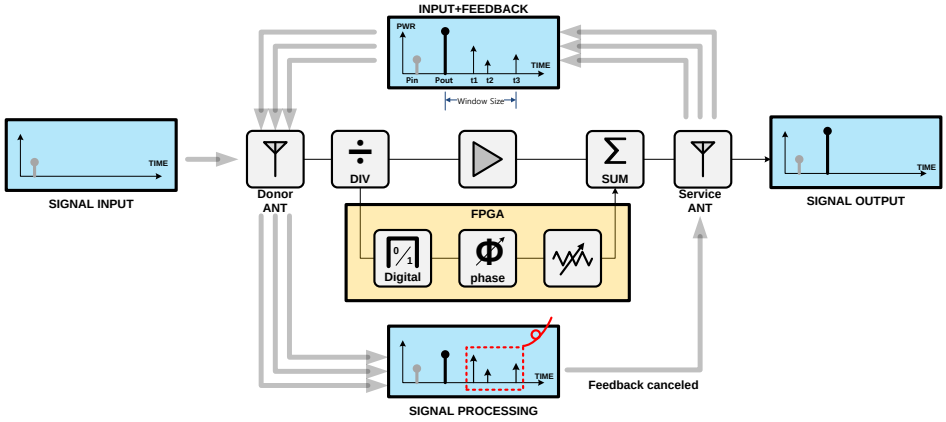


Figure 2 - 12 Concept of ICS

PSR offers Interference Cancellation System (ICS) function for proper working without system oscillation, even the place where the isolation between these antennas is insufficient.

It is equipped with an ICA (Interference Cancellation Algorithm) function to obtain isolations between the Donor and the Service Antenna, remove feedback or interference signals, and ensure the system reliability.

2.3.2 Isolation measurement

Another option against the isolation problem is to make sure isolation value and take advantage of it when it comes to set up the system gain.

Isolation value can be measured correctly in real-time whether there is an input signal or not.

However, measurable ISO range is limited by the current gain, and measured ISO value is in the range of -20dB< gain<20dB, and typically has ±3dB tolerance on average.

2.3.3 Antenna monitoring

As shown in the figure, the multiple numbers of service antennas can be used for PSR installed together with couplers or dividers. However, normal RF power may not be radiated by the service antennas when there's a problem with service antenna itself, or due to the poor connection between antenna and RF cable, or other similar kinds of RF mismatching issues.

To implement antenna monitoring, the service antenna has a specially designed power monitoring circuit inside, which provides continuous monitoring of antenna power. If a problem happens on power radiation, it is reported to the CPU through the Bluetooth chip to enable further follow-up action.

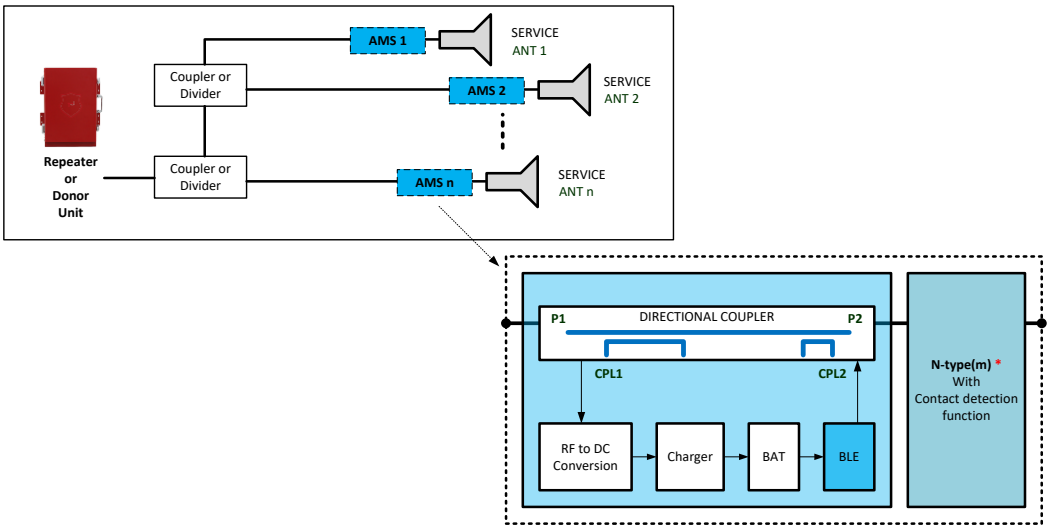


Figure 2 - 13 Concept of antenna monitoring

Monitoring circuit reports antenna status to CPU periodically and the user can monitor the individual service status by using WEB UI.

2.3.4 Single / Dual band

There are 3 independent bands for PSR, and could work as a single band PSR by enabling either one the band. Service band can be extended to dual band or full band by choosing dual band option. It is necessary to run 'install wizard' again with dual band license key to upgrade PSR as a dual band device.

	FirstNet	PS700	PS800
Single band			
SINGLE band 1	√		
SINGLE band 2		√	
SINGLE band 3			√
Dual band			
DUAL band 1	√	√	
DUAL band 2	√		√
DUAL band 3		√	√
Full band	√	√	√

Table 2 - 7 Options for single/dual band

2.3.5 Channel filter

FirstNet band can be configured by either single 10MHz LTE or 2 contiguous 5MHz LTE bands, and one of the channels can be turned off.

Up to 32 non-contiguous narrow band channels can be selected for both PS700/PS800 band, and each channels can be turned on/off by WEB GUI.

Both wideband and narrow band channels have been designed based on 3GPP and FCC regulation.

2.3.6 Spectrum analyzing

Spectrum display function is so useful usually for commissioning, or when troubleshooting is necessary due to the wireless complexity around the site where PSR is installed.

Spectrum displaying can cover the range of ;

- DL input / DL output & UL input / UL output separately or at the same time
- FirstNet/ PS700/ PS800 separately or full span of PSR band at the same time

2.3.7 External backup battery monitoring

The charging voltage of a lithium-ion battery must be controlled very precisely, and it is essential to continuously monitor the voltage, current, and residual amount of the battery. Battery system consists of 3 or 6 pieces of battery modules, and each modules supports BMS(Battery Management System) that enables to monitor the current status of the whole battery system.

BMS offers the features regarding battery management ;

- Charging status (Fully discharged/ Charging with percentage / Fully charged)
- Available battery capacity
- Residual number of charging
- Charging voltage and current

3. INSTALLATION

3.1 Outdoor Installation

- Please inspect the outdoor environment in order to identify the best environment for the installation of the he repeater system and antennas.
- DO NOT physically mount any equipment at this moment.

- The donor antenna should be located in the area with the strongest signal reception and away from any barriers, such as hills and mountains, high buildings or signboards.
- You can use WEB GUI information to measure received strength signal intensity.
- An ideal location should have outdoor signal strength greater than -80dBm.
- You also may use a mobile phone, spectrum analyzer to get a strength value if they are available.
- Ideally, the donor antenna should face the base station of the operator of the signal that is intended to amplify.
- Depending on the application and the environment, the donor antenna used can be a directional or panel. (Please contact administrator for optional accessories).

- Please note that the antenna isolation between the donor antenna and the service antennas.
- In order to avoid repeater oscillation, the isolation should be at least 15dB more than the gain of the repeater. For PSR, the isolation should be at least 110dB if PSR is set to the maximum gain value (95dB).

- PSR comes with IP66 housing; therefore the repeater unit is capable to be located both indoor and outdoor. If it is to be located outdoor, it should be installed in a shaded area and avoid direct contact with the sun. Also make sure if AC power plug is available and near to the repeater unit.

3.2 Indoor Installation

- Especially for the installation process of the indoor coverage, please determine the number of the service antennas that will be required by calculating the required indoor coverage area, the building construction and the signal path loss.
- For the best performance, service antennas should be installed on the ceiling or on the wall at least two meters from the floor.
- Installation on the wall may however obstruct the signal and shorten the signal range. Ideally, the service antennas should be placed central to the area that requires coverage.

3.3 Cable Installation Planning

- Plan the installation of the cable considering the locations of the donor antenna, PSR and service antennas.
- 7/8” or 1/2” cable is recommended for your installation, and please ensure that the cable has been equipped with appropriate connectors.

3.4 Mounting and Installation

Locating Donor antenna

- Please install the donor antenna in the previously selected location. Choose a mount type for the donor antenna that suits your preferences and the environmental conditions.
- You may need to re-locate or rotate the donor antenna in order to find the best direction providing the strongest signal strength.

Mounting PSR

- Verify that PSR and mounting hole are in good condition
- Place PSR mounting bracket template up against the wall and mark off mount holes
- Drill the appropriate size holes and install the included wall anchors
- Remove the wall mount bracket from the repeater and bolt the wall mount bracket to the wall
- Place the repeater onto the wall mount bracket and secure the bracket to the repeater
- Connect the GND cable

Routing the Cable

- Route the cable between the donor antenna and the repeater unit.
- Ensure that all connections are tightly fastened.
- Ensure that the cable is fastened on the wall or to a cable tray, and secure the connectors to avoid water decay of the cables.
- Connect the cable to the connector marked ‘DONOR’ on PSR and the other end to the service antenna.

Locating Service antenna

- Please install service antenna(s) in the previously selected location(s).
- Route the cable between the repeater unit and the service antenna.
- Ensure that all connections are tightly fastened.
- Ensure that the cable is fastened on the wall or to a cable tray, and secure the connectors to avoid water decay of the cables.
- In the case of multiple service antennas, use appropriate power splitters to split the signal.
- Route the cable accordingly.
- Connect the cable to the connector marked ‘SERVICE’ on PSR and the other end to the service antenna.

Connecting power cable

- Connect the power cable of the adaptor to PSR where it is marked ‘AC INPUT’ and plug the adaptor into the power plug.
- Turn the ac power switch ON.

4. Connecting WEB GUI

PSR can be monitored and controlled by WEB GUI, take descriptions below as a guide to finish system parameter setting and commissioning.

Figure 4 - 1 ETHERNET Port

4.1 Recommended specs to client

- Browser :
  Google Chrome is strongly recommended for the proper operation of all listed functionality.
- Screen Resolution :
  Width 1024px and Height 768px +
- Operating System :
  Windows 8+, Mac OS
- Network :
  Ethernet or Wi-Fi Connected (internal network possible)
- Mobile Device not supported

4.2 WEB GUI CONNECTION

User can choose the type of class and the type of filters for each frequency band by using Install wizard.

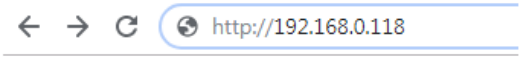
Step 1:
Connect ETHERNET port to RJ45 port on user laptop with the supplied RJ45 cable to set up a physical connection.

Step 2:
Local connection terms regarding Internet Protocol version 4 (TCP/IPv4) is required to set up as following ;

Item.	Description
IP Address	192.168.0.1
Subnet Mask	255.255.255.0
Gateway	192.168.0.1

Table 4 - 1 Local connection terms

Step 3:
Open a browser window and enter the IP address of the device in the address bar. Chrome browser is recommended for optimal resolution.



Step 4:
After entering ID and password, press the Sign in button. Please contact system administrator for ID and password. (default ID: Admin)

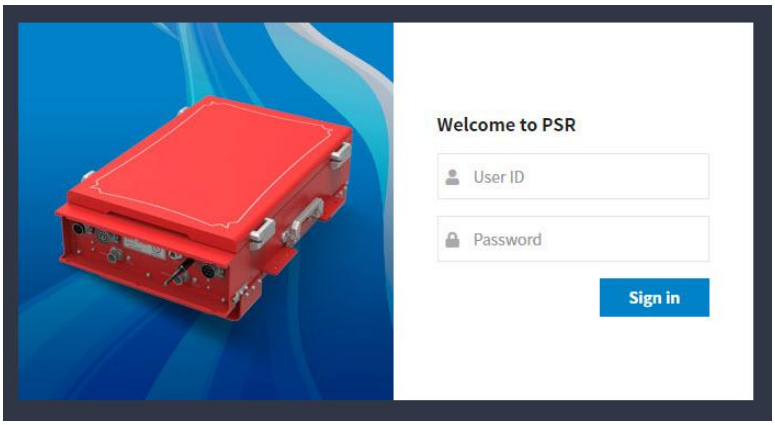


Figure 4 - 2 WEB GUI/ Log in menu

4.3 Main window

Main window consists of 2 parts ;

- Global Navigation Bar (Green)
- Dashboard – SETUP – ALARM HISTORY (Orange)

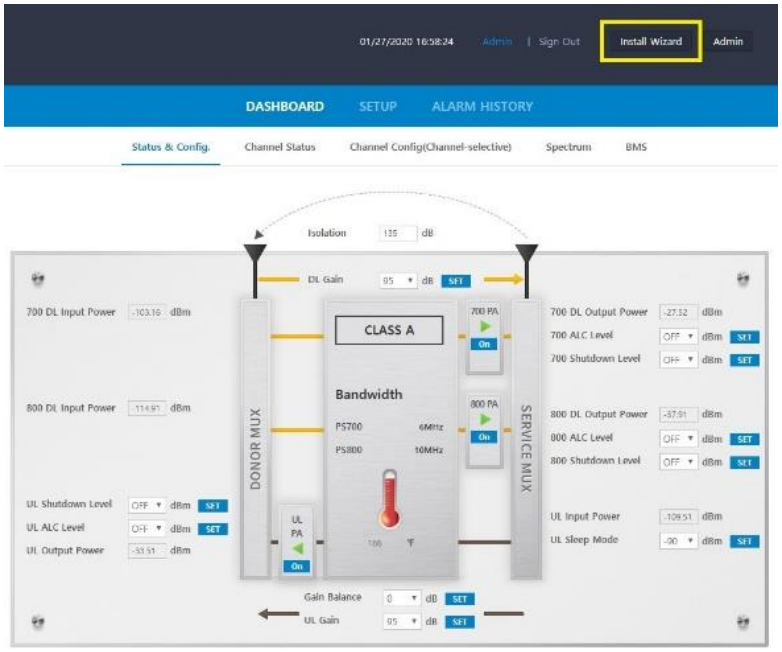


Figure 4 - 3 WEB GUI/ Main window

4.3.1 Global Navigation Bar

It shows the basic information of the product at the top of the menu.

Figure 4 - 4 WEB GUI/ Global Navigation Bar

4.4 Dashboard

4.4.1 Dashboard _ Status & Config

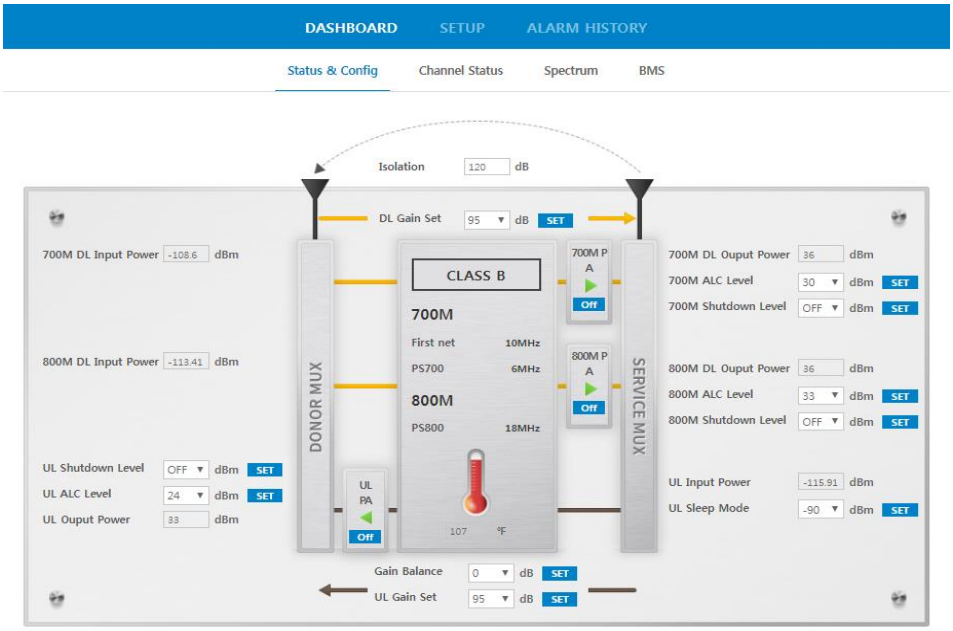


Figure 4 - 5 WEB GUI/ Dashboard _ Status & Config

Status & Config shows the basic status & control items of PSR.

System status

- Isolation reading measured by internal DSP
- Downlink input / output power
- Uplink input / output power
- System temperature
- FILTER option that is currently available (default filter option is 800)
  - When 700 license is available, “700M PA” will be displayed in the above of “800M PA”

System control

- Downlink / Uplink PA
- Downlink / Uplink Gain
- Gain balance
- Downlink / Uplink ALC level
- Downlink / Uplink shutdown level
- Uplink sleep mode level

4.4.2 Dashboard _ Alarm & Dry Contact

These are the main alarm items that can be officially listed from the equipment, and reference values can be set for each state and alarms.
It shows GREEN for normal range and RED for the out of range, and you can adjust the threshold values depending on the situation.

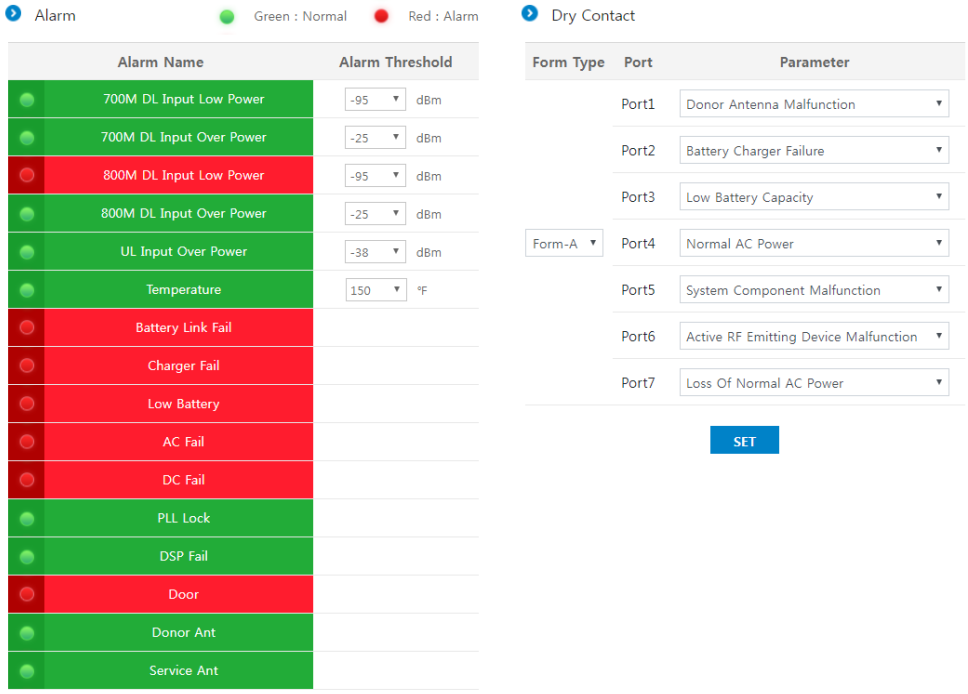


Figure 4 - 6 Dashboard _ Alarm & Dry Contact

4.4.3 Dashboard _ Dry Contact

This function is used to check the status of the system and the external alarm box by connecting them with dedicated cable. You can specify the type of cable and the alarm entries you would like to use for each pin port.

- Donor Antenna Malfunction
- Battery Charger Failure
- Low Battery Capacity
- Normal AC Power
- System Component Malfunction
- Active RF Emitting Device Malfunction
- Loss Of Normal AC Power
- Reserved

4.4.4 Dashboard _ Channel Status

Users can determine PSR's operation status intuitively by monitoring input/output conditions and gain status implemented in the form of bars for each channel.

Up to 32 channel states can be visually identified for each band 700 and 800.

Downlink and Uplink channel numbers can be checked separately.

Additional information (Frequency, Gain, Input, Output) can be checked in real time if the mouse is over the channel.
(However, the 700M band can be verified after activating Dual-Band License)

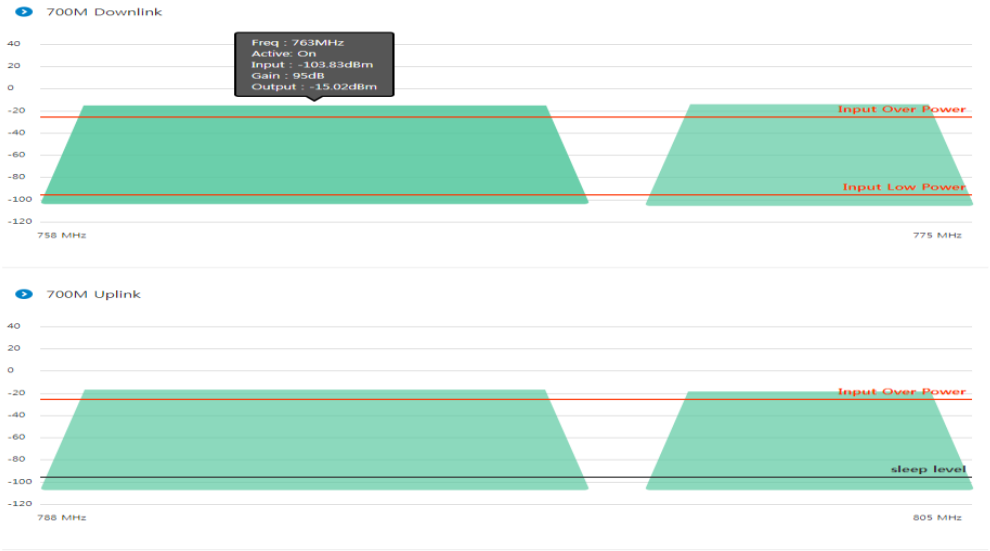


Figure 4 - 7 Dashboard _ Channel Status (Wide Band) 1

Figure 4 - 8 Dashboard _ Channel Status (Wide Band) 2

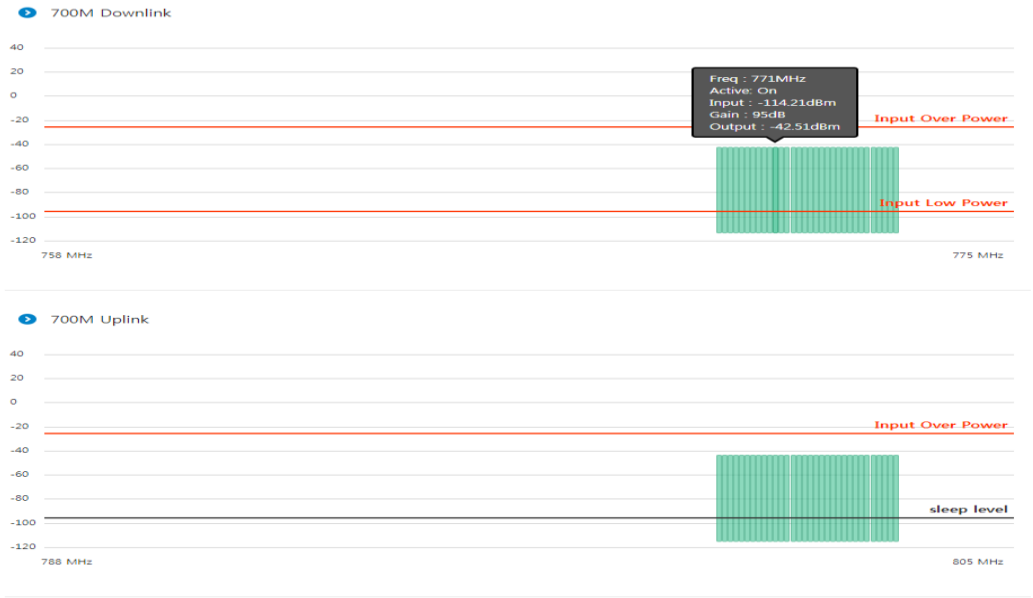


Figure 4 - 9 Dashboard _ Channel Status (Narrow Band) 3

Figure 4 - 10 Dashboard _ Channel Status (Narrow Band) 4

4.4.5 Dashboard _ Channel Config (Channelized)

When choosing Class A, totally 32 channels will be activated and you can set the frequency, bandwidth of the each channels, and you also can enable or disable specific channels.

To simplify the channel setup process, you can use 'Quick Config' function to input individual channel info.

If you enter the 1st channel & offset, the rest of the channels will be defined automatically with the same amount of frequency offsets.

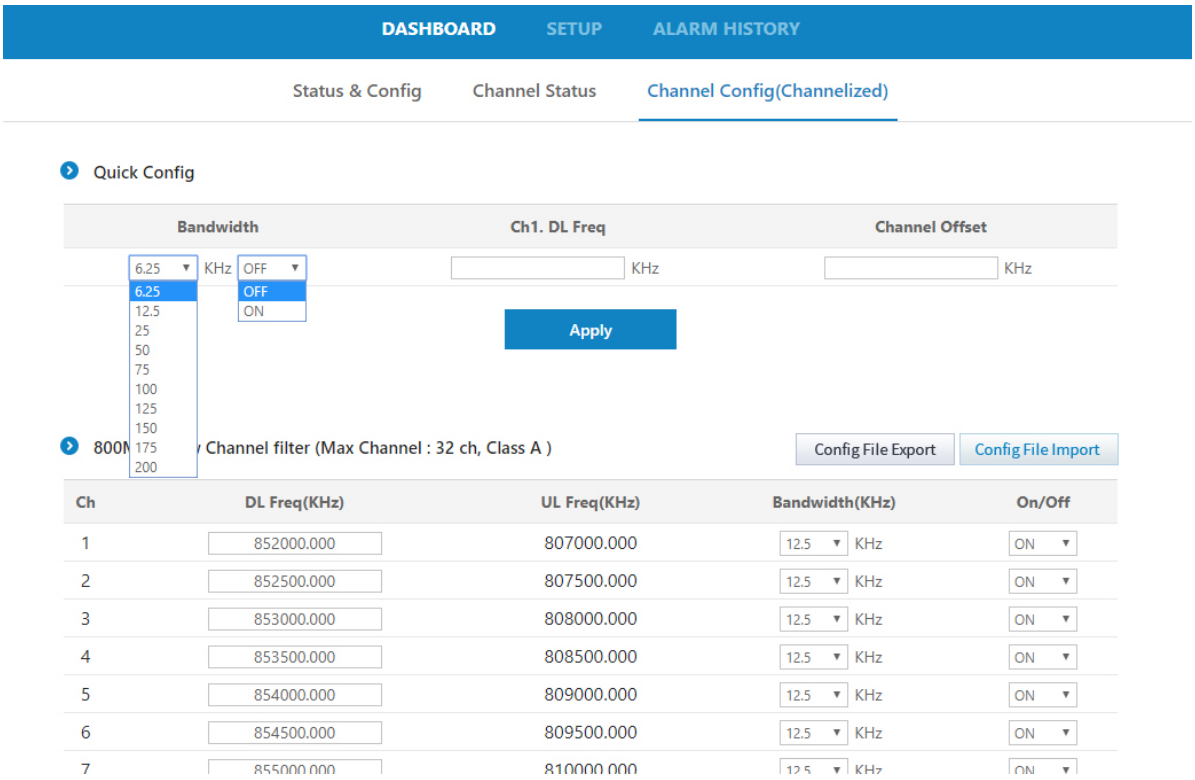


Figure 4 - 11 Dashboard _ Channel Config1

Enter the frequency interval for each channel in the Channel Offset area and then press the Apply button. Starting with the Downlink Frequency value of Channel 1, the values of 32 channels are entered for each Channel Offset value.

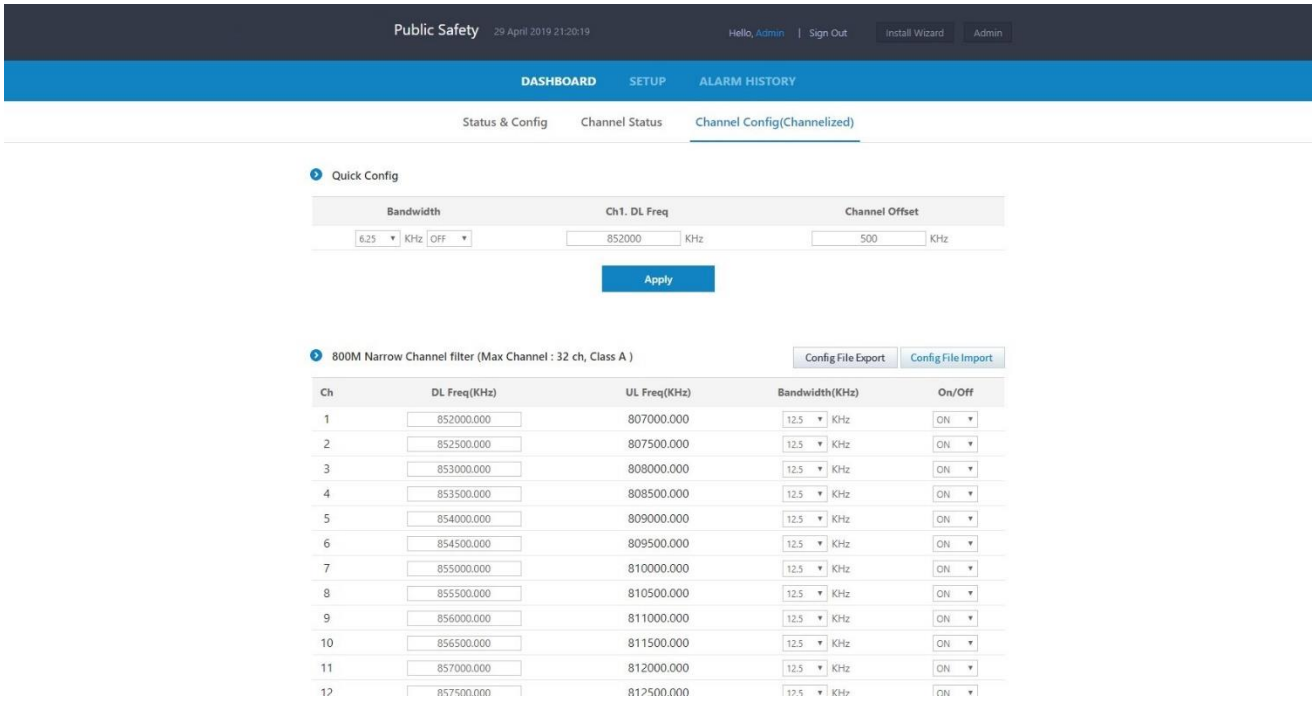


Figure 4 - 12 Dashboard _ Channel Config2

4.4.6 Dashboard _ Spectrum

Spectrum monitoring function is implemented that enables real-time detection of input/output signals of PSR.

Figure 4 - 13 Dashboard _ Spectrum

- Display mode options
  - 3 options (Both DL & UL / DL only/ UL only)
  - INPUT(yellow-colored) and OUTPUT(green-colored) displays are available for both DL &UL
  - 4 traces in total (DL/UL & INPUT /OUTPUT spectrum can be monitored at the same time)

- Frequency range options
  - FirstNet
    - DL Center freq. = 763MHz / Span=10MHz / 758MHz ~ 768 MHz
  - FirstNet+PS700
    - DL Center freq. = 766MHz / Span=10, 20MHz / 756MHz ~ 776 MHz
  - PS700

- DL Center freq. = 772MHz / Span=10, 20, 30MHz / 757MHz ~ 787 MHz

- Full span [UL start frequency ~ DL stop frequency]
  - DL Center freq. = 813MHz / Span=116MHz / 755MHz ~ 871 MHz
- PS800
  - DL Center freq. = 860MHz / Span=10, 20MHz / 850MHz ~ 870 MHz

- RBW options
  - 6.25kHz/ 12.5kHz/ 25kHz/ 50kHz/ 100kHz/ 200kHz/ 400kHz

- Min/ Max hold function available for 4 individual traces

4.5 SETUP

4.5.1 SETUP _ Network

There are 2ways of setting up the network, the wide area (WAN) and the local area (LAN).
IP Address can be setup automatically by using DHCP settings or by manually as well, for both IP Version 4 and IP Version 6 settings.

Fill in the blanks of IP address, Subnet mask, Gateway and DNS server address each by each. Note that the DNS server address will not be assigned automatically because it could be changed depends on overall network DHCP settings. In addition, you could use it as local area purpose by setting it up based on specific local area network definitions.

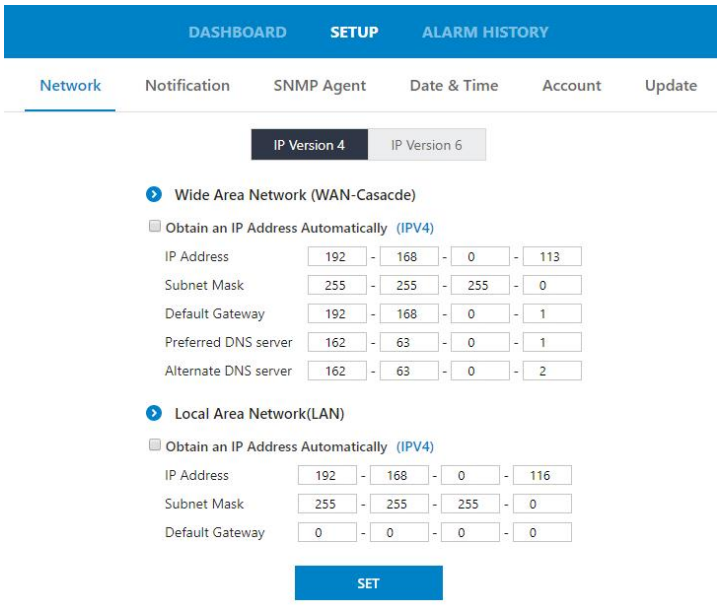


Figure 4 - 14 SETUP _ IPV4

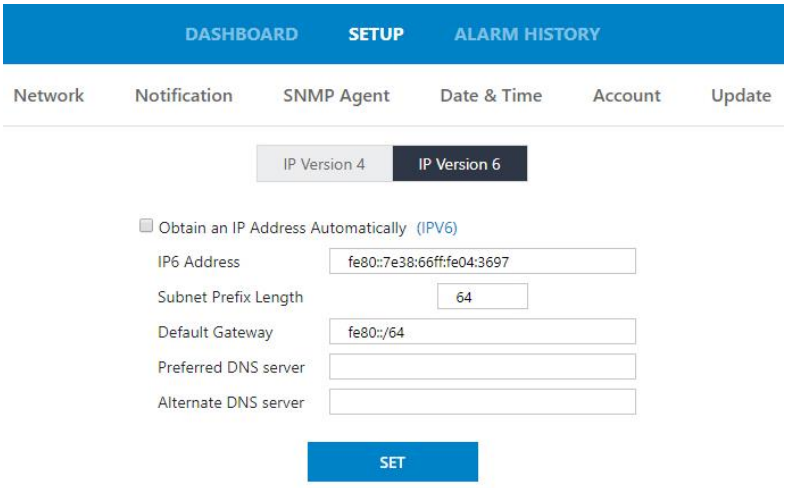


Figure 4 - 15 SETUP _ IPV6

4.5.2 SETUP _ Notification

You can set up a target server that can notify the system's heartbeat data.

- **MIB Selection**

Two types of custom MIBs (MIBs) can be set up separately from the designated unique target MIBs (Standard MIBs). For standard MIB, it automatically sets to the default target server.

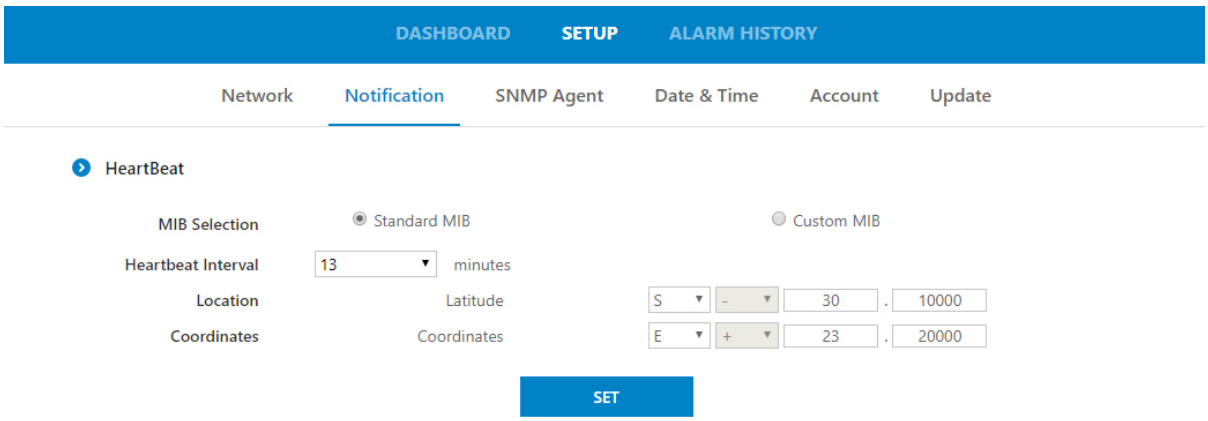


Figure 4 - 16 WEB GUI/ SETUP _ Notification1

- **Manager IP**

For Custom MIB, the entry appears and enter the IP address of the target server.

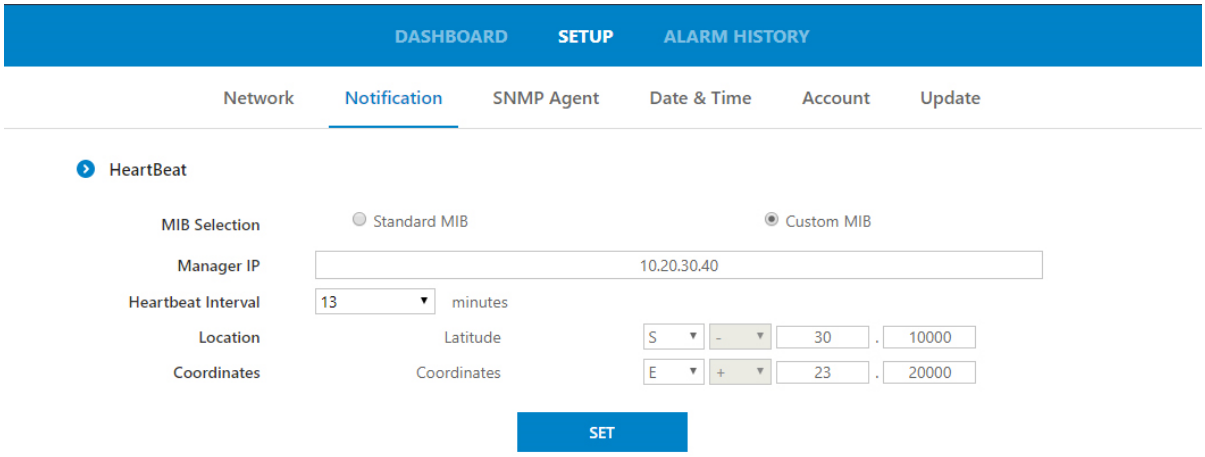


Figure 4 - 17 SETUP _ Notification2

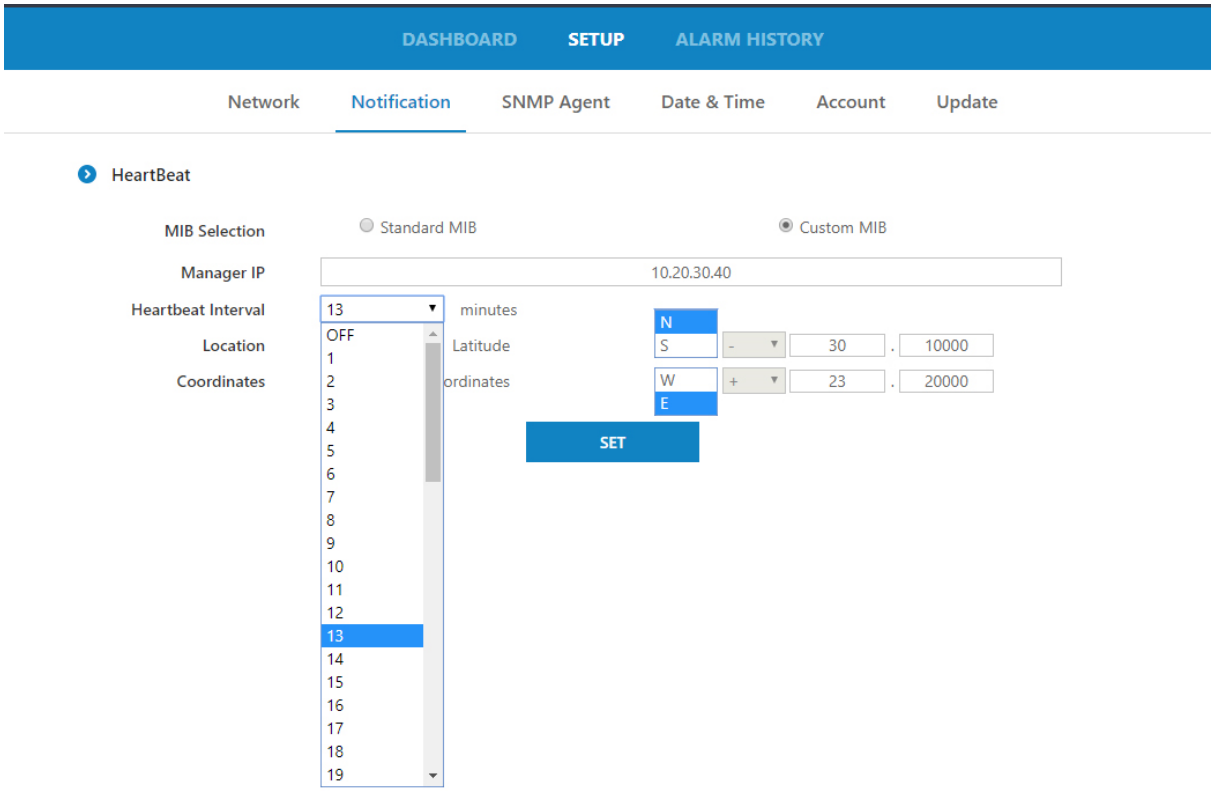


Figure 4 - 18 WEB GUI/ SETUP _ Notification3

- **Heartbeat Interval**

Sets the interval of the Heartbeat data that is sent to the MIB Target Server.

- **Location**

Mark the location of the system in latitude & longitude so that you can aware of the location of the Heartbeat.

4.5.3 SETUP _ SNMP Agent

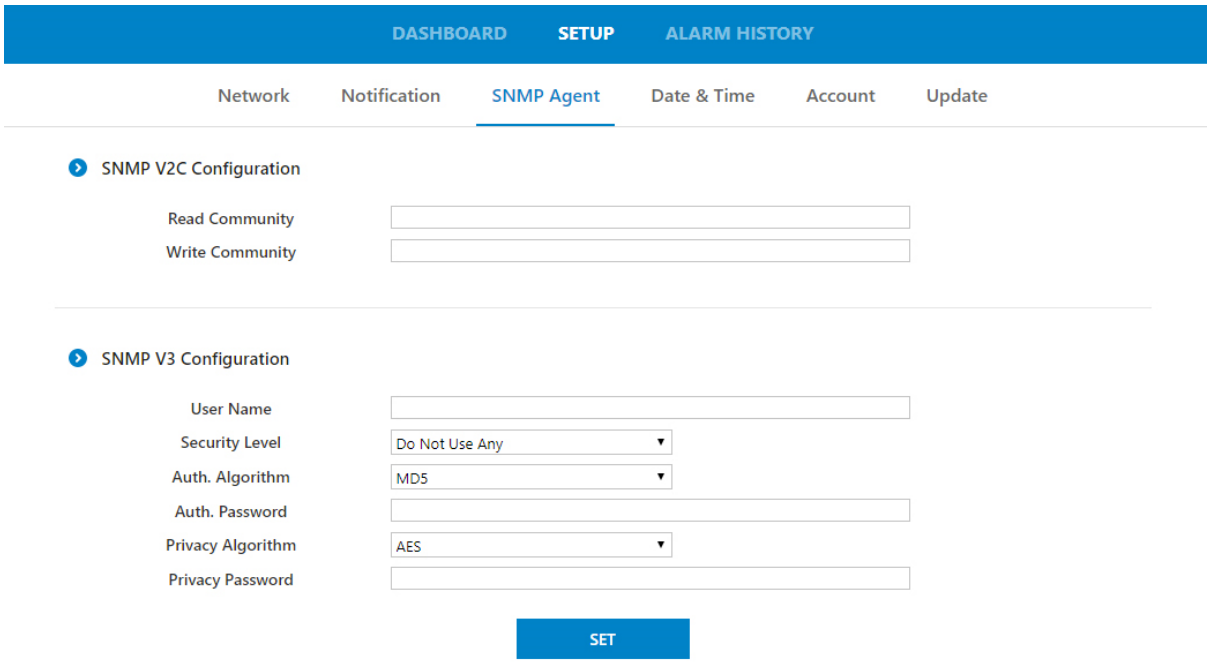


Figure 4 - 19 WEB GUI/ SETUP _ SNMP Agent

Supports both SNMP V2C and V3.

- **V2C**

You need to enter the community strings to set up both Read & Write community.

- **V3**

Enter the authorized user's name, authentication algorithm, authentication password, privacy algorithm, and privacy password.

4.5.4 SETUP _ Date & Time

Set up the 'Network Time Protocol Server' for time synchronization between systems over the data network. You can select from the list or enter it manually.

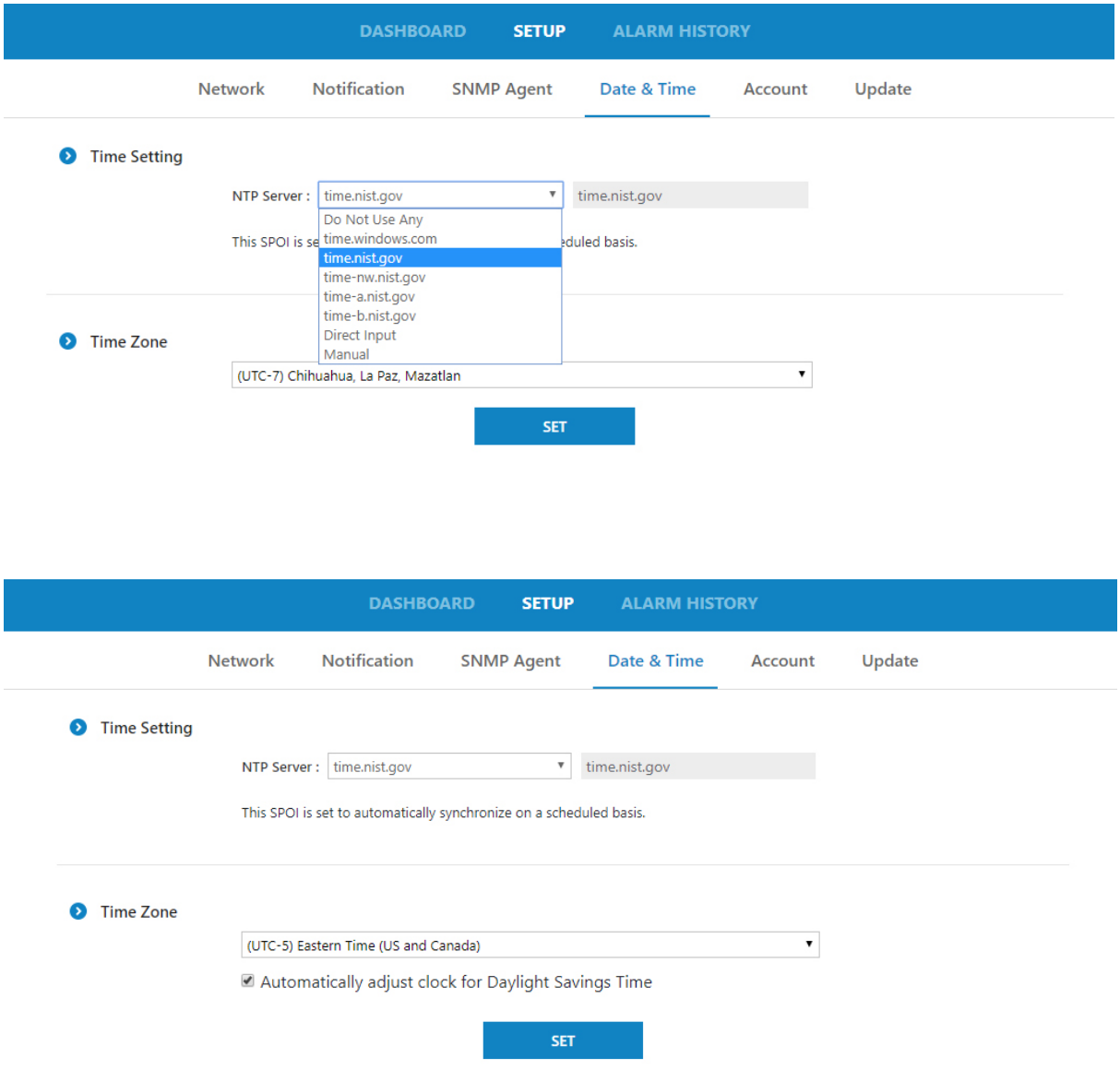


Figure 4 - 20 SETUP _ Date & Time1

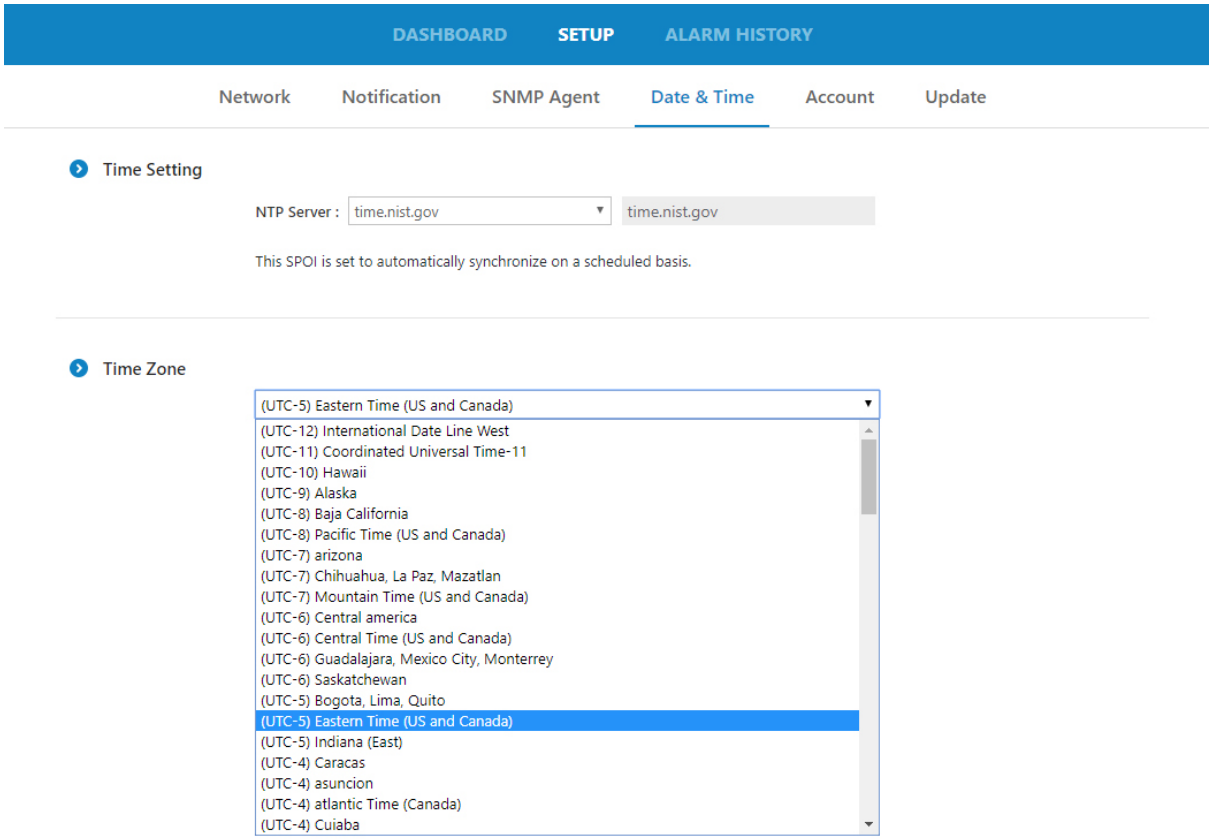


Figure 4 - 21 SETUP _ Date & Time2

You can set the time zone to be used depending on the condition where PSR installed. Select whether Daylight Time Saving is enabled or disabled depending on the individual region.

4.5.5 SETUP _ Account

You can add/manage the type of users who would like to access to the Web GUI.
There are 3 kinds of security levels for log-in, Read only / Read & Write / Administrator.

Changing password is not allowed due to the security issue, so the ID must be deleted and registered again if that is the case.

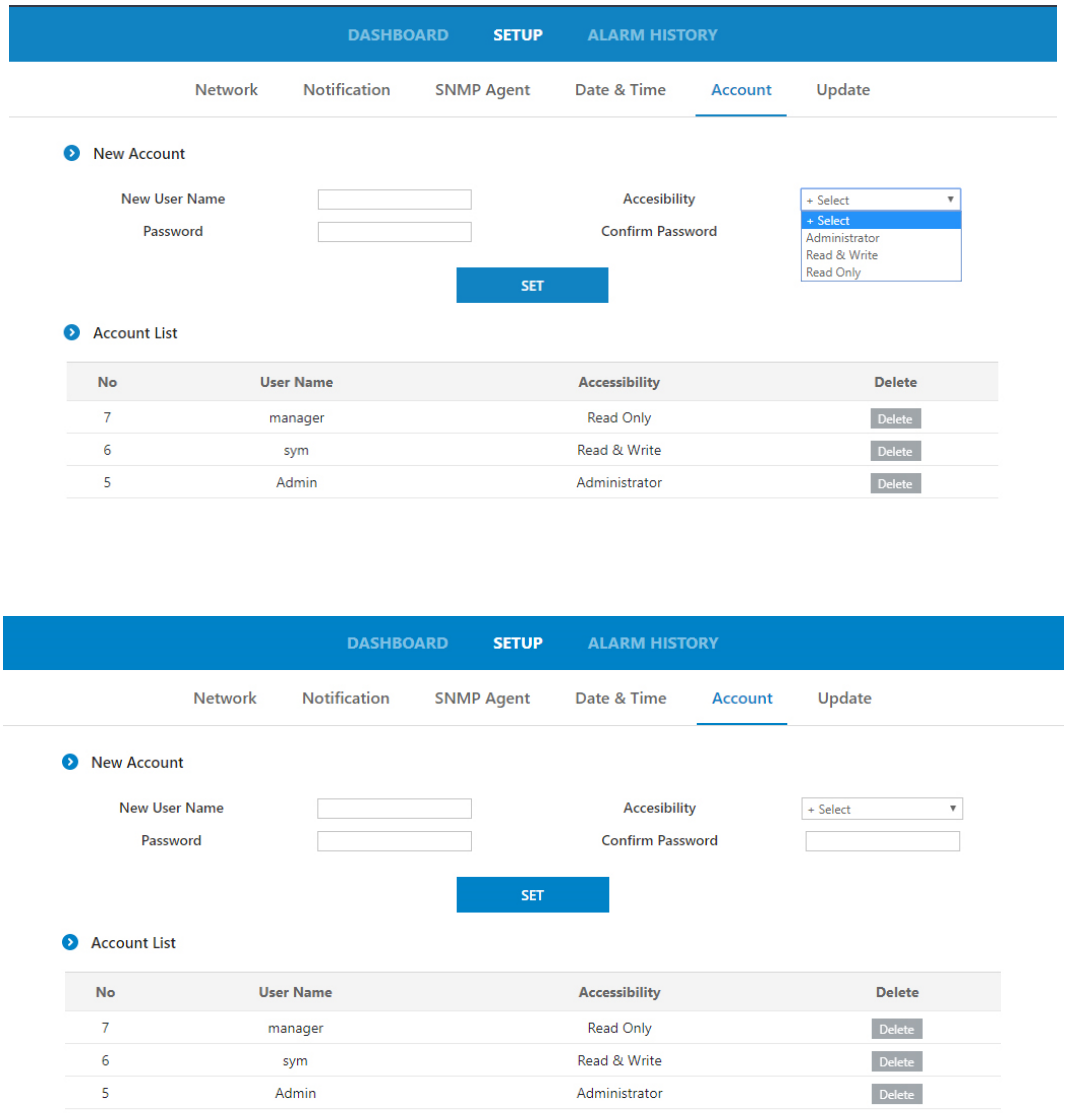


Figure 4 - 22 WEB GUI/ SETUP _ Account

4.5.6 SETUP _ Update

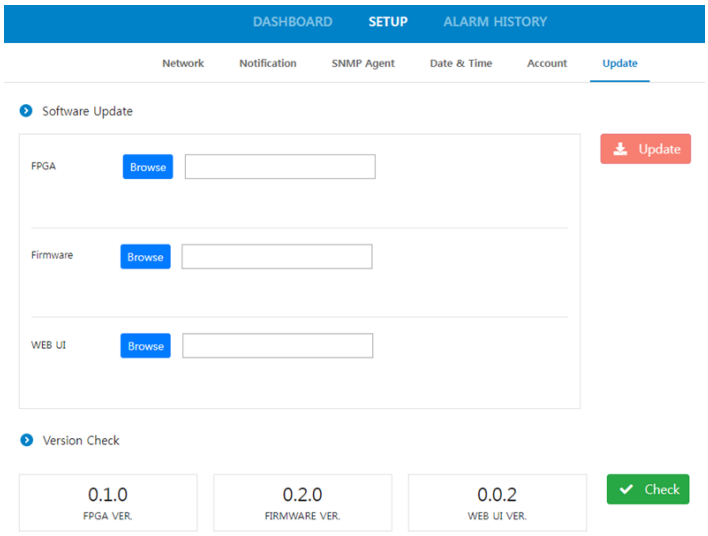


Figure 4 - 23 WEB GUI/ SETUP _ Update

Software can be upgraded via WEB GUI.

- FPGA
- Firmware
- Web UI

Click the browse button of the file you want to download, then select the file.

File name must start with the following rule otherwise firmware upgrading won't work.

- FPGA: Must start with "***".
- Firmware: Start with "***".
- Web UI: Start with "***".

Press 'update' button to go proceed, and after finishing update, then press 'check' button to make sure if the firmware version is the latest.

4.6 ALARM HISTORY

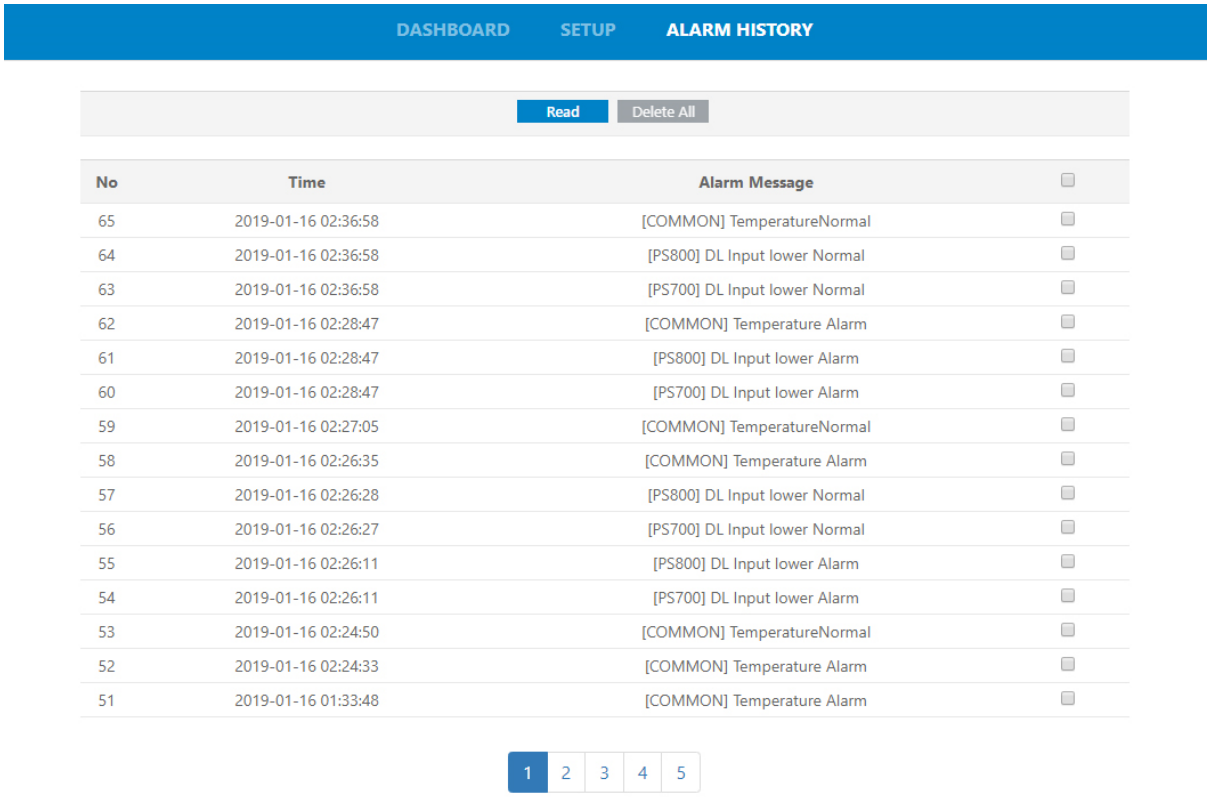


Figure 4 - 24 WEB GUI/ ALARM HISTORY

When an alarm event occurs, the record is saved along with the date and time information of the alarm.

User can easily check which part of the system block (PS700,PS800 or common path) has triggered the alarm, and what kind alarm has been created.

Each alarm information can be managed by the system administrator only.

5. Install Wizard/ Commissioning

“install wizard” makes it easier for user to set up the environment in more convenient way. Commissioning procedure can be followed at the end of the wizard.
Start the setup with the following start screen below and go through each step.

5.1 Start

You will be asked if it is ok to proceed for double checking purpose, because the overall system settings will be affected. Select YES to move on to the next menu.

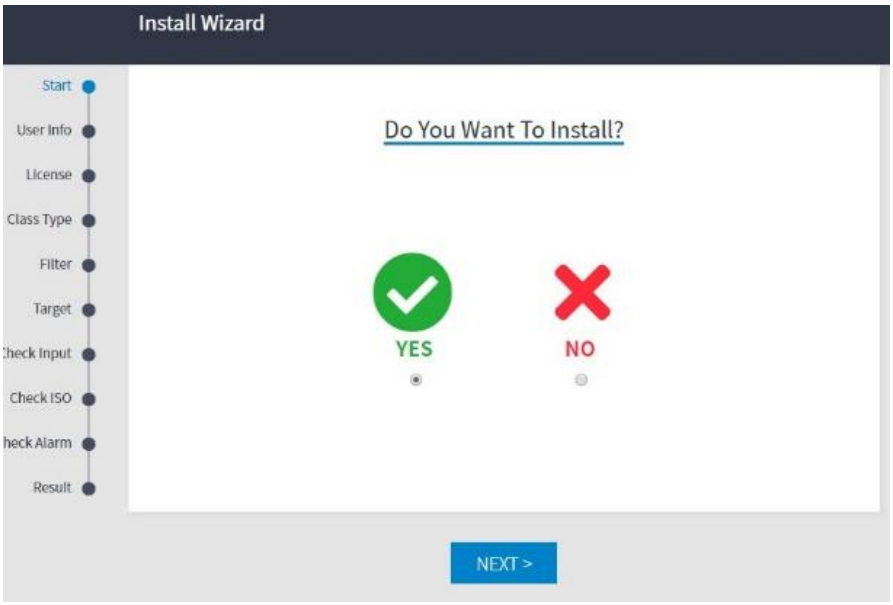


Figure 5 - 1 Install wizard/ Start

5.2 User info

Enter the information on which the equipment is installed.
Please enter the installation date and time, location, installer information and equipment number, etc. and proceed to the next step.

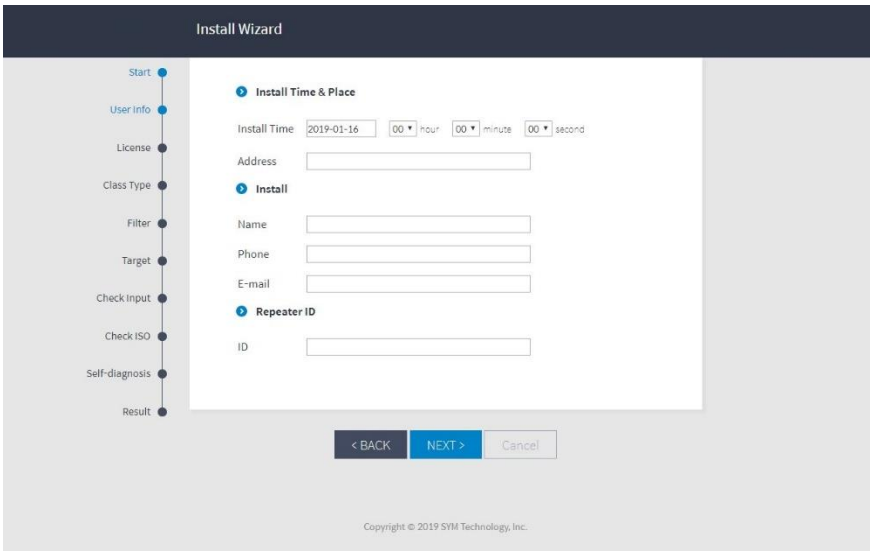


Figure 5 - 2 Install wizard/ User info

5.3 License

Additional functions of the system can be activated after entering the license key depending on whether each item is enabled, menus and functions may be limited. There are 5 options that requires license key ; ICS, Antenna Monitoring, Dual Band, Channel Filter, Spectrum function. Check and select the items before moving on to the next step.

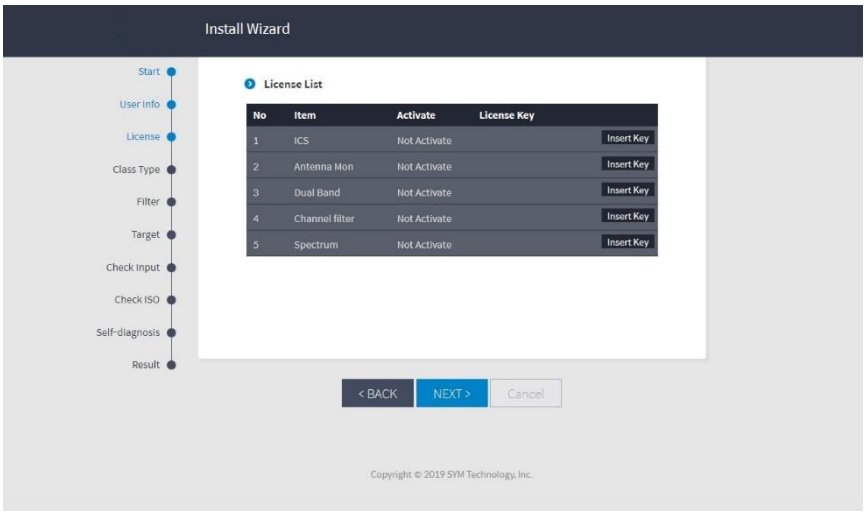


Figure 5 - 3 Install wizard/ License

5.4 Class Type

Select the class based on the type of bandwidth (Channel or band) that will be used.

Class A activates the Channel selective option and Class B enables the Band-Selective function. Check and select the type and move on to the next step.

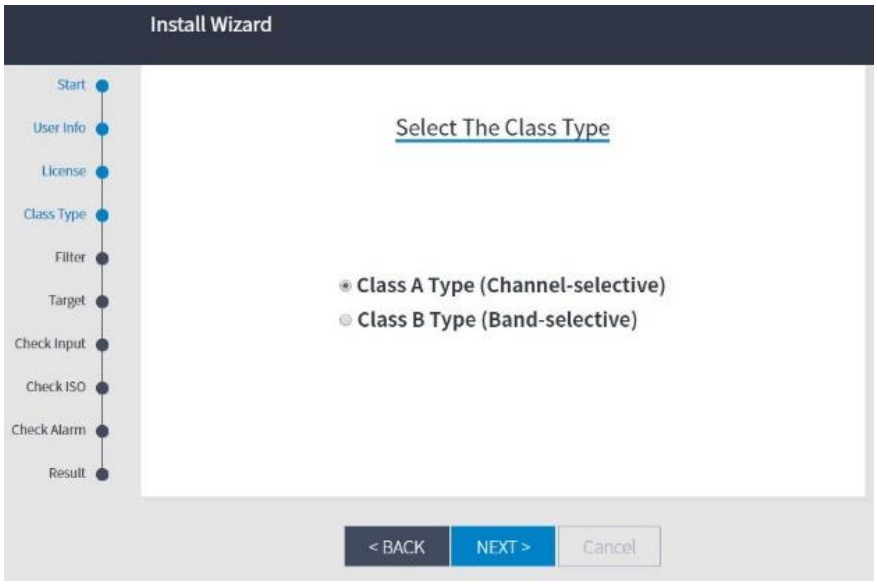


Figure 5 - 4 Install wizard/ Class Type

5.5 Filter

Select the class based on the type of bandwidth (Channel or band) that will be used.

Class A activates the Channel selective option and Class B enables the Band-Selective function. Check and select the type and move on to the next step.

When choosing Class A, totally 32 channels will be activated and you can set the frequency, bandwidth of the each channels, and you also can enable or disable specific channels.

To simplify the channel setup process, you can use 'Quick Config' function to input individual channel info.

If you enter the 1st channel & offset, the rest of the channels will be defined automatically with the same amount of frequency offsets.

Check and select the items before moving on to the next step.

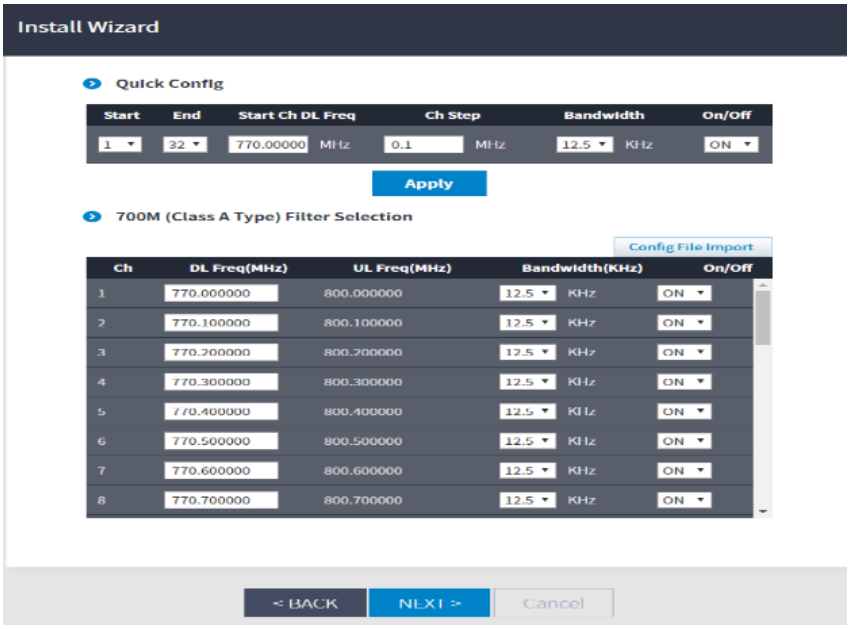


Figure 5 - 5 Install wizard/ Filter1

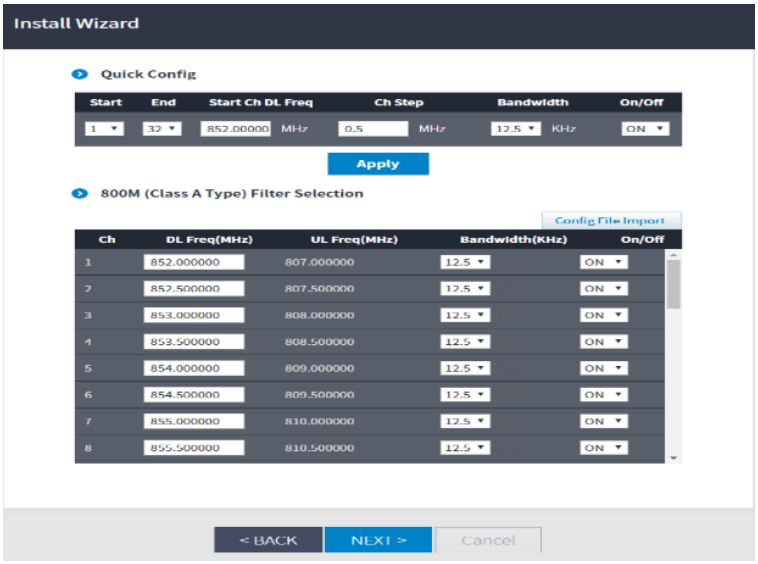


Figure 5 - 6 Install wizard/ Filter2

When setting Class B, the Band-Selective function will be activated, the bandwidth options are shown in the table.

700MHz	**First Net**
	LTE 10M
	LTE5M + LTE5M
	LTE5M + Not Used
	Not Used + LTE5M
	OFF
	PS700M
	LTE 6M
	OFF
800MHz	**PS800M**
	18M
	10M
	9M
	3M
	0FF

Table 5 - 1 Description/ List of class B filter

Check and select the items before moving on to the next step.

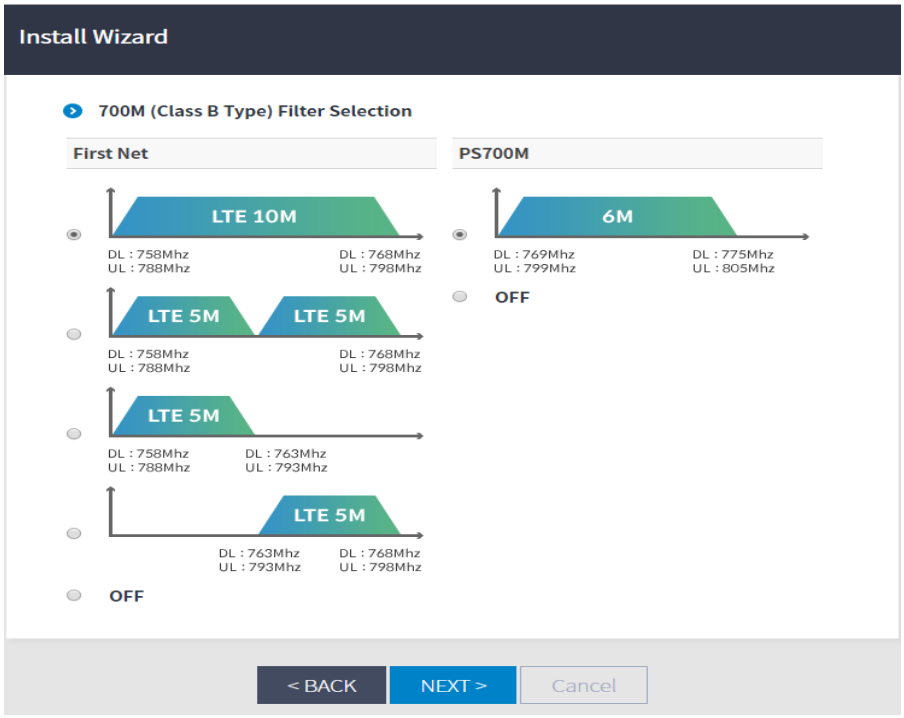


Figure 5 - 7 Install wizard/ Filter3

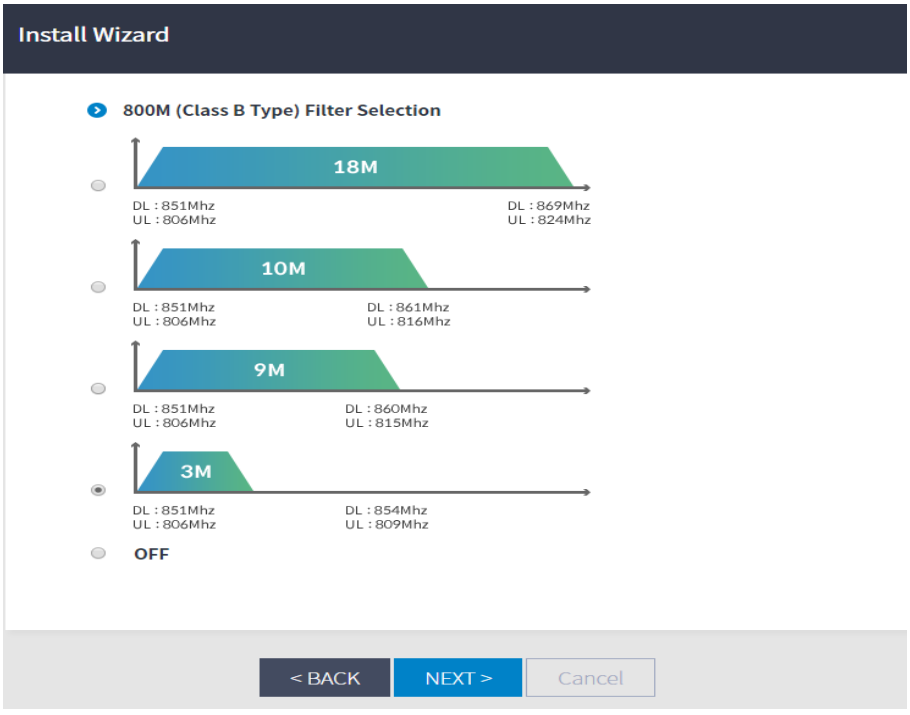


Figure 5 - 8 Install wizard/ Filter4

5.6 Target

Set the key values of the equipment, such as Gain, ALC Level, and Sleep Mode. The values must be carefully chosen for proper working, and you also can change the values after completing the setup wizard. Check and select the items before moving on to the next step.

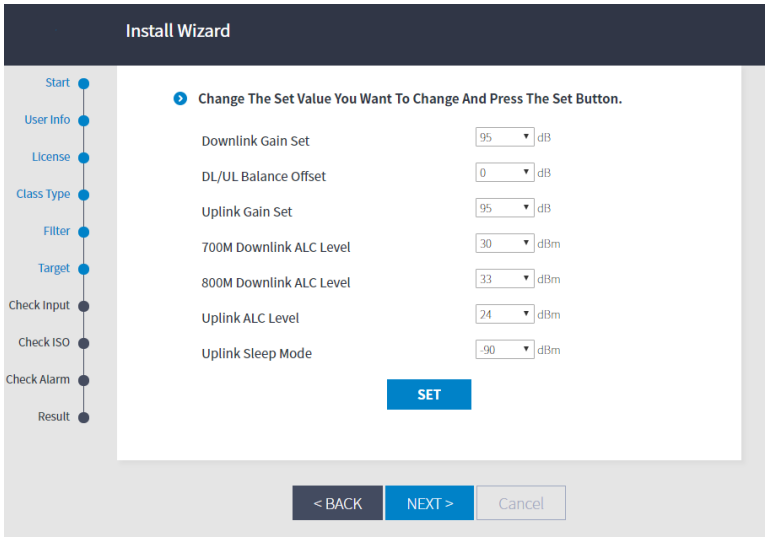


Figure 5 - 9 Install wizard/ Target

5.7 Check Input

Measure the input power of the Donor Antenna. Please adjust the antenna position and press the "Self-diagnosis Start" button to check the Input Power reading which is more than -80dBm is recommended.
If the input power reading is within the recommended range, it will show Green, otherwise Red.
Checking input power is not a must at this stage and installer may skip this page.

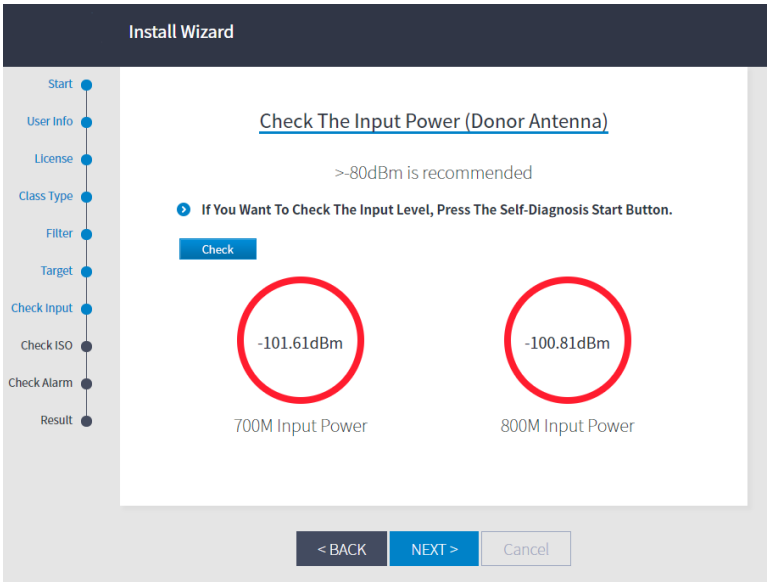


Figure 5 - 10 Install wizard/ Check Input

5.8 Check ISO

Measure the Isolation value.
1. Press the "Reset" button to disable both Downlink & Uplink amplifiers.
2. Turn on the Downlink amplifier only and check the Isolation value.
   Or turn on both Downlink and Uplink amplifiers and check Isolation value.

Installer can choose either one of above check options.
Recommended isolation value is greater than 120dB
If the check result is more than 120dB, the button color will be changed to green.
Checking isolation is not a must at this stage and installer may skip this page.

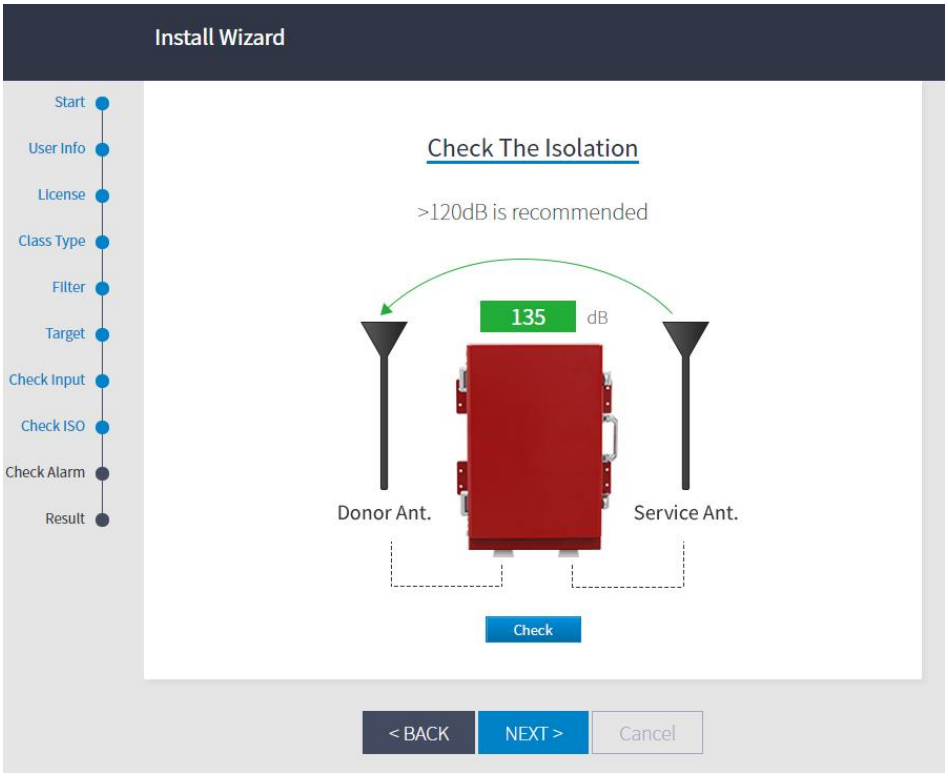


Figure 5 - 11 Install wizard/ Check ISO

5.9 Self-diagnosis

These are the main alarm items that can be listed from the equipment, and reference values can be set for each state and alarms. It shows GREEN for normal range and RED for the out of range.
You can adjust the threshold values depending on the situation.

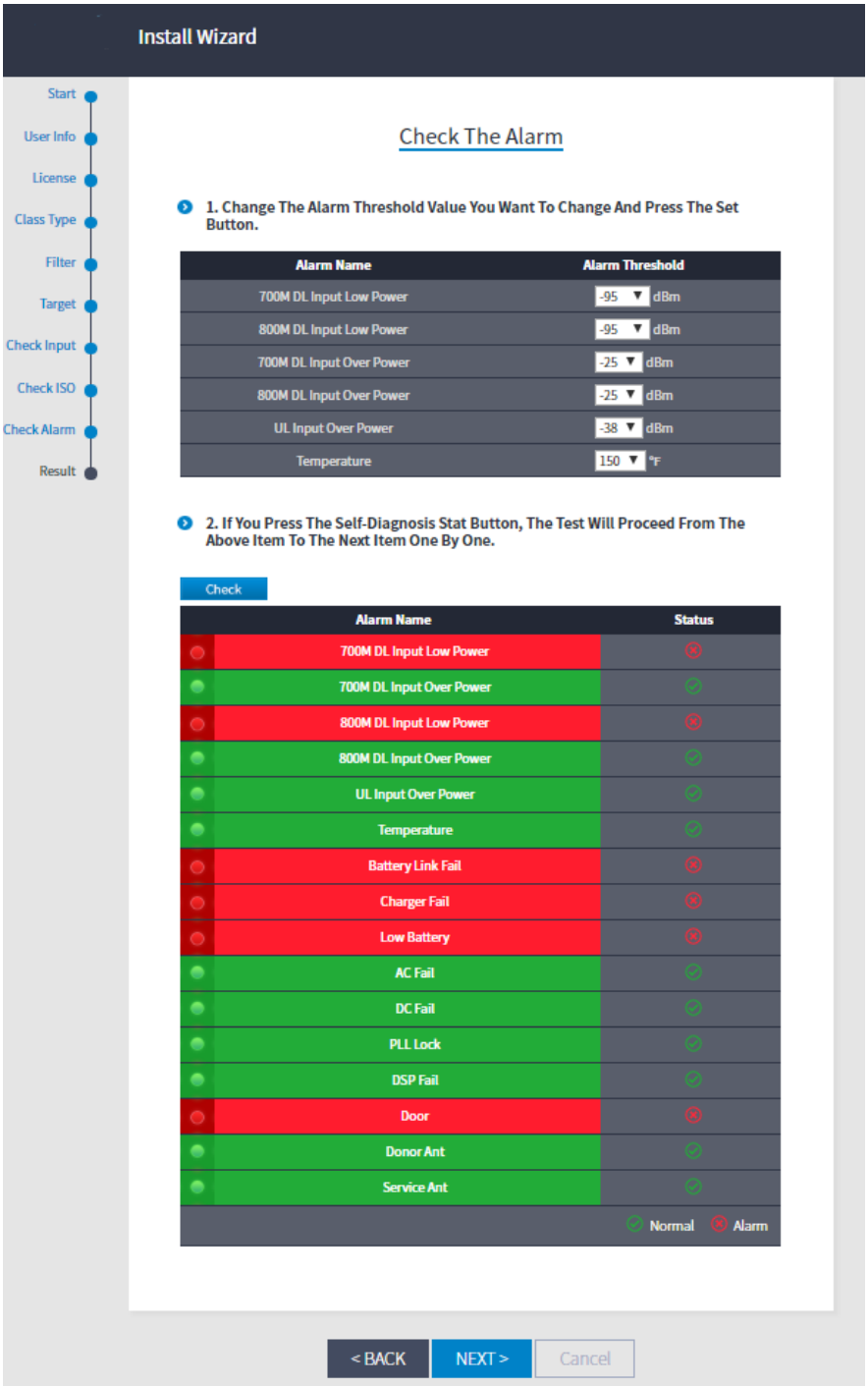


Figure 5 - 12 Install wizard/ Self-diagnosis

5.10 Result

The setup results are organized and printed on the screen, and the format of the report will be defined later.

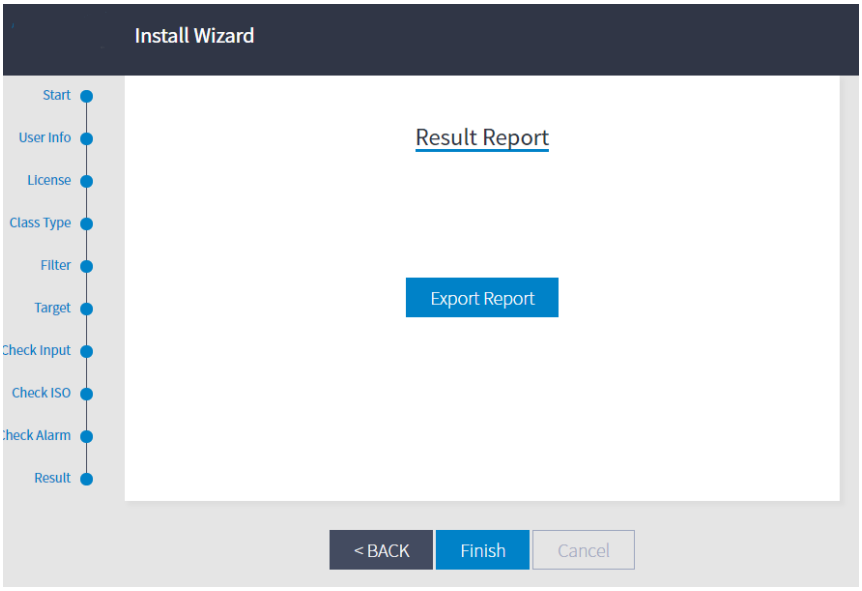


Figure 5 - 13 Install wizard/ Result

Install Wizard report file can be created and exported to Microsoft excel format (*.xls), including the following contents.

- User Info
- License List
- CLASS (700M, 800M)
- Target
- Result for Check the Input Power
- Result for Check the Isolation
- Result for Check the Alarm

6. APPENDIX

6.1 Specifications

6.1.1 Electrical Specifications

Items	Filter	Specification
Frequency range (DL/UL)	FirstNet	758 - 768 MHz / 788 - 798 MHz @ Class B only
	PS700	769 - 775 MHz / 799 - 805 MHz @ Class A & Class B : For FCC only
	PS800	851 - 869 MHz / 806 - 824 MHz @ Class A (861-869MHz : For IC only) 851 - 861 MHz / 806 - 816 MHz @ Class B : For FCC only
Bandwidth	FirstNet	10 MHz
	PS700	6 MHz
	PS800	18MHz / 10MHz
Occupied filter bandwidth	FirstNet	9 MHz @10MHz , 4.5 MHz @5MHz
	PS700	6 MHz
	PS800	18MHz / 10MHz
Maximum number of channels	FirstNet	1CH @10 MHz or 2CH@5MHz
	PS700	32 @narrowband
	PS800	32 @narrowband
Linear Gain (DL/UL)		95 / 95 dB
Gain Flatness		± 2.0 dB
Narrowband filter roll-off		≥ 60dBc @ filter bandwidth edge + 3*filter bandwidth
Maximum Output power (DL/UL)	FirstNet	33dBm / 30dBm
	PS700	33dBm / 30dBm
	PS800	33dBm / 30dBm
	FirstNet+PS700	33dBm / 30dBm
	FirstNet+PS700+PS800	36dBm / 30dBm
Output power tolerance		± 1.0 dBm
Max Input power without damage		+10 dBm
Max Input power without over drive		-20 dBm
Frequency Stability		≤ 0.01 ppm
Spurious Emission		≤ -13dBm/1kHz @ 9kHz≤f_offset< 150kHz
		≤ -13dBm/10kHz @ 150kHz≤f_offset< 30MHz
		≤ -13dBm/100kHz @ 30MHz≤f_offset< 1GHz
		≤ -13dBm/1MHz @ 1GHz≤f_offset< 12.75GHz
		☞ 'pass band ±10MHz' band ranges are excluded.
System Delay	FirstNet	≤ 4.5 usec
	PS700	≤135usec@6.25kHz, ≤75usec@12.5kHz, ≤45usec@25kHz, ≤30usec@50kHz,
	PS800	≤28usec@75kHz, ≤55usec@100kHz, ≤35usec@200kHz
VSWR		< 1.5:1
Noise Figure	UL only	≤ 6dB @ UL max gain
FirstNet only		
Out of Band Gain	FirstNet	≤ 60 dB @ 0.2MHz≤f_offset_CW< 1.0MHz
		≤ 45 dB @ 1.0MHz≤f_offset_CW< 5.0MHz
		≤ 45 dB @ 5.0MHz≤f_offset_CW< 10.0MHz
		≤ 35 dB @ 10.0MHz≤f_offset_CW
Operating band unwanted emissions	FirstNet	≤ -7 ~ -14 dBm @ 0.05MHz≤f_offset_CW< 5.05MHz / RBW=100kHz
		≤ -14 dBm @ 5.05MHz≤f_offset_CW< 10.05MHz / RBW=100kHz
		≤ -16 dBm @ 10.05MHz≤f_offset_max / RBW=100kHz
ACRR	FirstNet	≥ 20 dB / ≥ 20 dB
EVM	FirstNet	≤ 8% RMS
DC Power		
Type of Power Supply	PSU	ac-DC (DC-DC) Power Supply (Dual mode)
Input	PSU	110 ~ 240 Vac or DC +24V
Output (Voltage/ Current)	PSU	30.3V/ 3.9A, 5.9V/10A
DC rating (Watts)	PSU	177 W
Dimension	PSU	245 * 169 * 51 [mm]
System DC Power Consumption (W)	System	120W

Table 6 - 1 Electrical spec

6.1.2 Mechanical Specifications

Housing		Specification
Type of outlook		PSR-9536
Dimension	Bracket excluded	W*H*D = 330 *510 *134 [mm] [13*20*5.3[in]]
	Bracket included	W*H*D = 400 *510 *170 [mm] [15.7*20*6.7[in]]
Weight	Bracket included	17 kg [37.5lb] typ.
Painting color		RED
IP grade		IP66
Cooling		Convection
Interface ports	**Port name**	
RF Connector	DONOR PORT	Mini-DIN 4.3-10 (female)
	SERVICE PORT	Mini-DIN 4.3-10 (female)
	DONOR COUPLED	SMA (female), [For uplink output monitoring -30dB]
	SERVICE COUPLED	SMA (female), [For downlink output monitoring -30dB]
	_	SMA (female, 4hole) @ [Not available]
Ac input	AC INPUT	MS3102E_16-10 (connector receptacle mil spec, 3pin)
External NFPA alarm	EXTERNAL NFPA ALARM	MS3102E_24-28 (connector receptacle mil spec, 24pin)
Ehternet	ETHERNET	M20 RJ45 (Ethernet LAN RJ-45 waterproof)
Backup battery	BACKUP BATTERY	MS3102E_18-8S (connector receptacle mil spec, 8pin)
Grounding	GND	1 ground lug with 2 fixing holes on the right side

Table 6 - 2 Mechanical spec

6.1.3 Functional Specifications

ITEMS	SPEC
ICS	G=I+0dB
Antenna monitoring	By using energy harvesting
Isolation measurement	DL&UL path both
Spectrum Display	Digital In/out DL&UL path both
Channel filter	Digital filter
External Back-up battery Monitoring(RJ45)	Backup Battery Charger Fail Alarm, Backup Battery Low Alarm
DU/UL output monitoring	-30dB coupled / SMA(F)

Table 6 - 3 Functional spec