

LMR250R01 Operating Manual

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Kisan Telecom

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IMPORTANT NOTE:

FCC RF Radiation Exposure Statement:

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

1. Introduction

1.1. General Introduction

As an equipment to clear RF shadows inevitably generated between the adjacent cells of LTE, LMR250R01C supports LTE and effectively repeats the signals between mobile terminals in weak coverage area and BTS.

This equipment is LTE MIMO Optical DAS that support 700MHz band simultaneously, and it is designed to support LTE with MIMO.

This equipment provides the cost effective and flexible wireless solution to service providers to improve quality of service for their subscribers.

The main objectives of LMR250R01C are as follows:

- Expansion of coverage
- Enhancement of service quality in areas such as tunnels or in-building
- Improvement in signal strength at places where the signal level is less than desired.
- Support dual bands of 700MHz.
- Support single mode of LTE band.
- RU power consumption and RU size optimization by built-in Crest Factor Reduction (CFR) technology for the LTE signal.

2. System Network Configuration

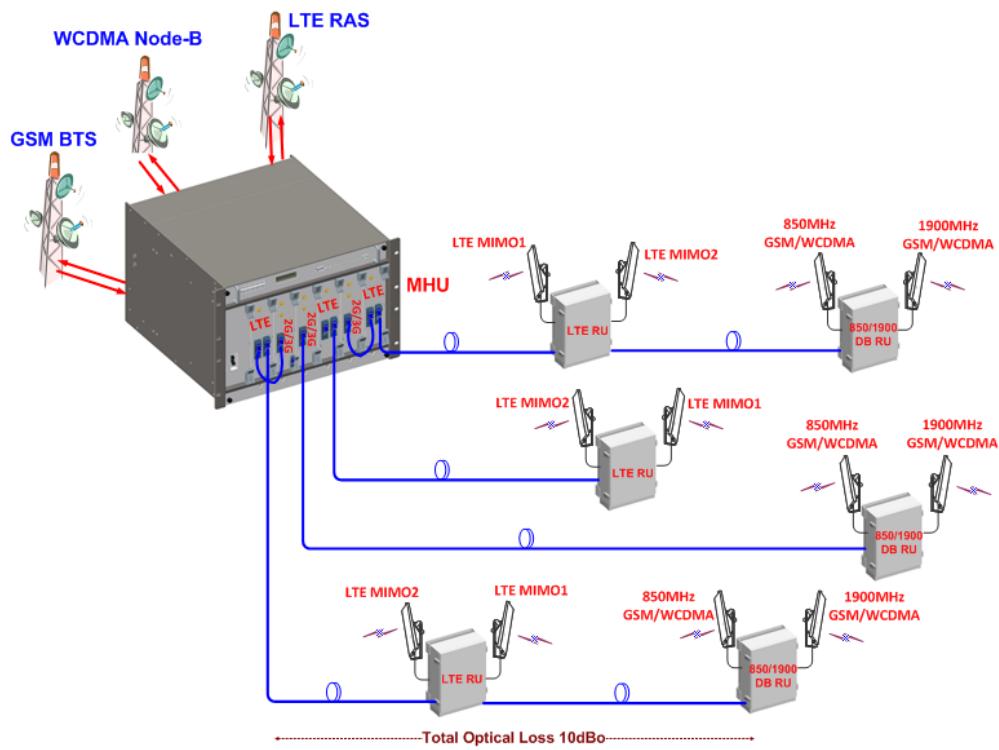
2.1. Network configuration

LMR250R01C repeater is equipment to clear RF shadows, to fill coverage gaps existing among the adjacent cells and to enhance the quality of service by extending coverage of LTE.

The network configuration of LMR250R01C is the case that 1 MHU is connected with 1 RU by optical cables, and the coverage antennas of 700MHz are connected to RU, and the link antennas of each band are connected to MHU.

⇒ System configuration

- MHU Capacity: 1 Optical Branch/MHU
- System Connection: single-mode Optical cable between MHU and RU
- Optic Wavelength: 1570nm for FWD, 1330nm for RVS
- Max loss of optic cable (between MHU and RU): 2 ~ 10dB
- 2 coverage ANT ports for MIMO on RU. (Separate ANT Ports for 700MHz)



[Network Configuration of LTE MIMO Optical DAS with DB DAS]

3. System Specifications

3.1. General Specifications

Item		LMR250R01
Enclosure Type		Cabinet
Dimension (mm)	W × H × D	471.7(H) X 263.4(W) X 304.8(D)mm
	Weight	26 Kg
Power Supply		110-120Vac (Tolerance $\pm 10\%$), 60Hz
Power Connector		MS Connector
RF In/Out Port		N Type Female, a side part
Optic Connector Type		SC, a side part
Optic Wavelength		FWD: 1570nm / RVS: 1330nm
Operating Temperature		-20°C ~ 50°C

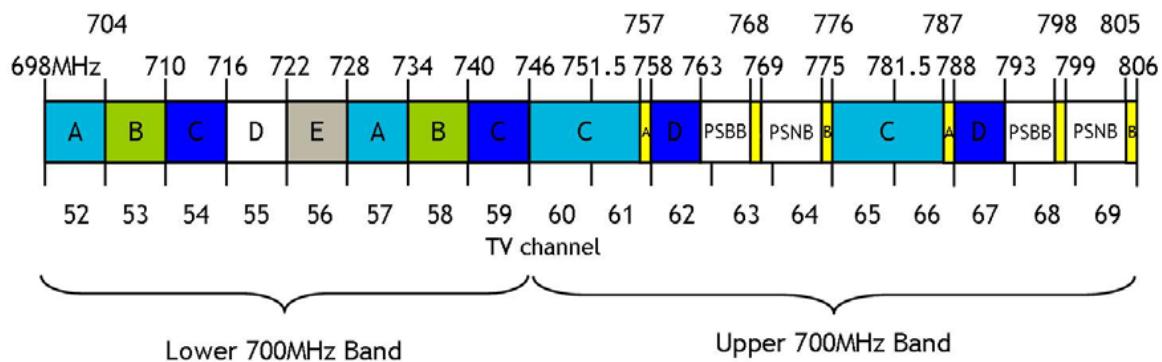
⇒ Environmental requirement

The repeater RU shall be operated in the temperature range of $-20^{\circ}\text{C} \sim +50^{\circ}\text{C}$.

3.2. System specifications

3.2.1. Frequency allocation

✧ 700MHz LTE Band



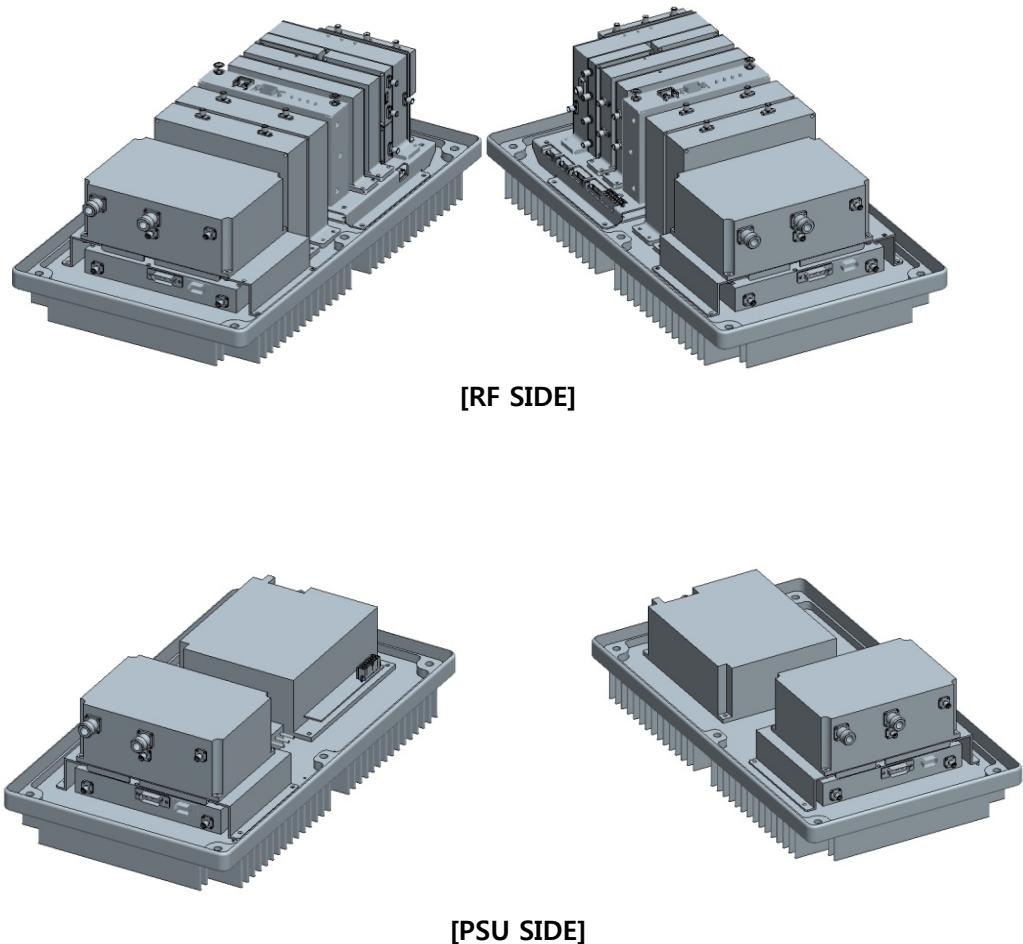
3.2.2. System Specifications

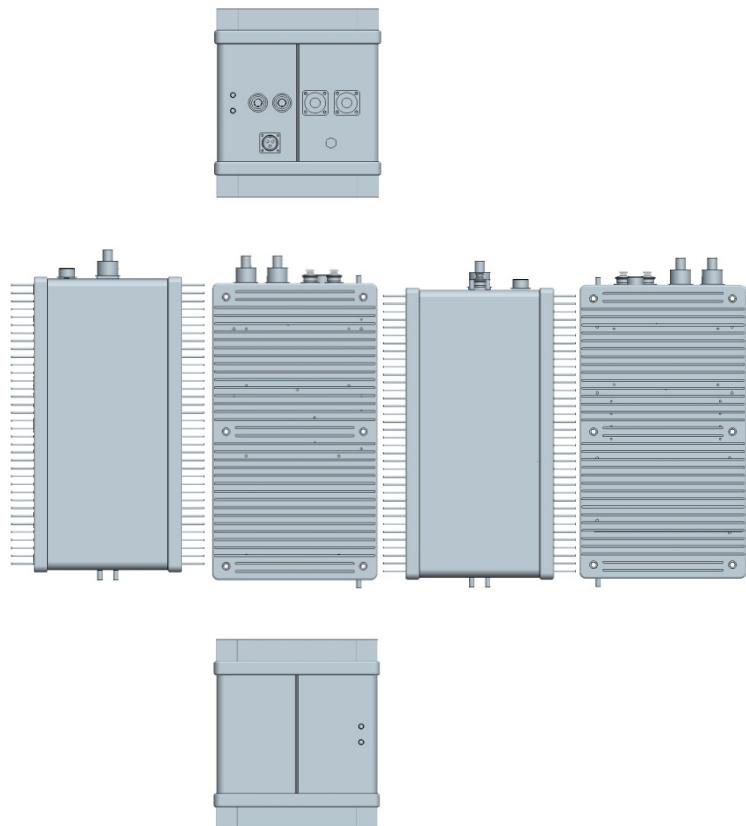
Item	Specification		Remarks
Tx Frequency Range	A / B / Upper C band selection in 728 ~ 757MHz		Refer to band allocation
Rx Frequency Range	A / B / Upper C band selection in 698 ~ 787MHz		Refer to band allocation
No of Carriers Supported	1 CH LTE Carrier Max.		
FWD Input Power	-10 ~ 0dBm/total, -5dBm/total is recommended at MHU IN		
FWD Output Power	40dBm/total for 700MHz RU ANT Port (MIMO0 / MIMO1)		
RVS Input Power	-50dBm/total max. at RU each ANT Port		
RVS Output Power	-20dBm/total max. at MHU each Rx ANT Port		
System Gain	FWD: 30dB ~ 50dB	RVS: 20dB ~ 30dB	
FWD Spurious	Comply to 3GPP, FCC regulation		
RVS Noise Figure	Comply to 17.5% of EVM by VzW test procedure		
Gain Control Range	FWD: 20dB by 1dB Step	RVS: 20dB by 1dB Step	RU OLC Gain
EVM (Error Vector Magnitude)	FWD: 12.5%	RVS: 17.5%	
Frequency Stability	0.01ppm		
Pass-Band Ripple	1dB max.		Any CH
System Delay	Max. 6usec		Without optical cable
Tx0-Tx1 Isolation	min. 40dBc		
Tx0-Tx1 Isolation	min. 40dBc		
Tx-Rx Isolation	100dB min. @Between RU Tx Output and MHU Rx Output		
Impedance	50 Ohm		
VSWR	1.5 : 1 max. @ All input/output ports		
Optical Wavelength	FWD: 1570nm	RVS: 1330nm	
RF I/O Connector	MHU: SMA-type Female	RU: N-type Female	

4. Mechanical Specifications

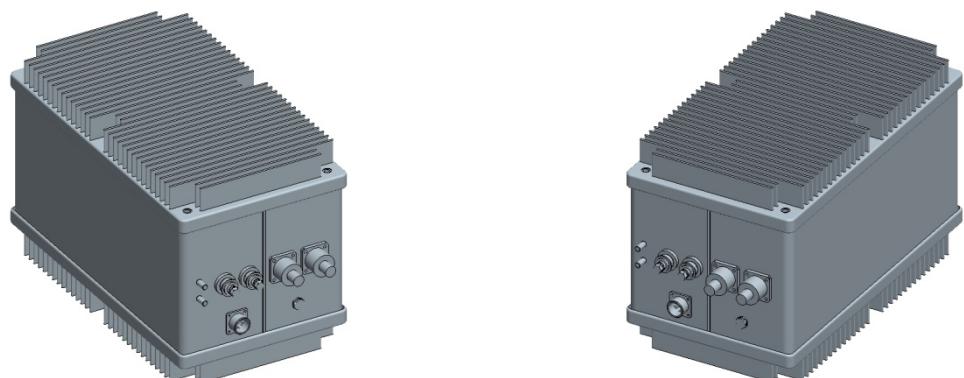
4.1. LMR250R01C RU

4.1.1. Mechanical Design





[OUT SIDE 2D-Shape]



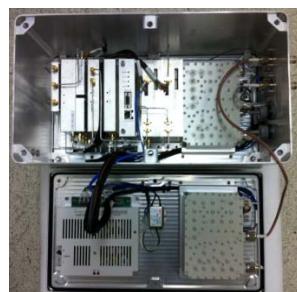
[OUT SIDE 3D-Shape]

4.1.2. Dimension

⇒ RU System picture and Size → 471.7(H) X 263.4(W) X 304.8(D) mm



[OutSide]



[Inner Side]



[Heat Sink Side]

4.1.3. Mechanical Specification

No	Item	Description
1	Dimension & Weight	<ul style="list-style-type: none"> ➢ Dimension: 471.7(H) X 263.4(W) X 304.8(D) mm ➢ (plinth included) ➢ Weight: 26 Kg
2	Method of Cooling	<ul style="list-style-type: none"> ➢ Natural convection (Heat-sink)
3	Door Locking Type	<ul style="list-style-type: none"> ➢ More than 10-point on each side using bolt lock
4	Optic Connector	<ul style="list-style-type: none"> ➢ Position: Cabinet inside ➢ Connector type: SC/APC
5	ANT PORT	<ul style="list-style-type: none"> ➢ located at the side of cabinet ➢ Connector Type: N Type Female
6	Power Input	<ul style="list-style-type: none"> ➢ Power: 110-120Vac, 60Hz ➢ Position: the side of cabinet ➢ Connector: MS connector
7	Ground	<ul style="list-style-type: none"> ➢ TBD
8	Waterproof condition	<ul style="list-style-type: none"> ➢ Comply to IPx6
9	Misc. Features	<ul style="list-style-type: none"> ➢ Easy to deploy ➢ Strand type (i.e., telegraph pole) ➢ Convectional Heat Sink

4.1.4. Description of LMR250R01C RU

[Forward path]

The LTE FWD MIMO0, MIMO1 and modem combined signals sent from the optic module of MHU is first divided into MIMO0, MIMO1 and modem signals at RFMUX in RU, then the FWD RF signals are amplified and filtered at the RFBS0 and RFBS1 module. The modem signal is conveyed to CPU of NMS controller through FSK modem. LTE signal is reduced by the Crest Factor passing through the CFR FPGA digital board inside RFBS0 and RFBS1. This technology enables reduction of PAPR for LTE signal increasing HPA efficiency. A higher efficiency HPA allows using a smaller enclosure with lower power consumption while decreasing OPEX for the service provider.

The LTE RF signals from the RFBS modules is linearly amplified up to high power level on HPA, passed through the Front-End Filter Unit, and finally transmitted through a coverage antenna.

[Reverse Path]

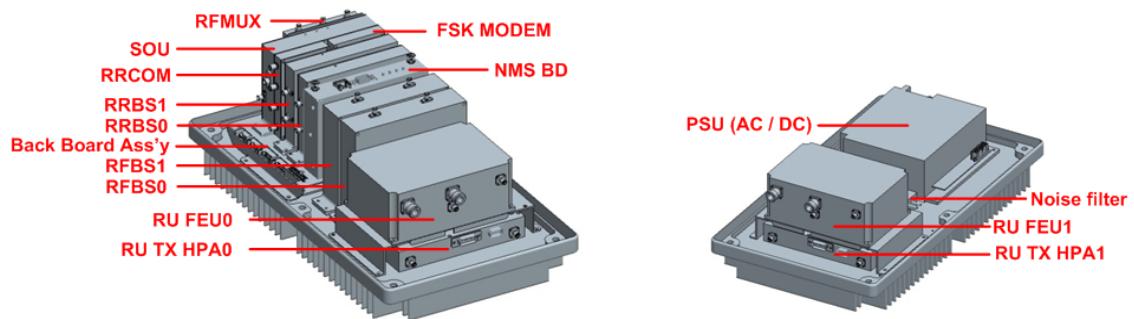
LTE Rx signals incoming from coverage antennas are first passed by the Front-End Filter Unit, amplified by a low noise and high gain amplifier, filtered in RRBS and RRBS1, and combined with modem signal and 10MHz at combiner(RRCOM). The combined signal is then transmitted to MHU through the optic module.

4.1.5. Port Configuration



No	Item	Description
1	AC INLET	110V AC Power Cable Connection Port
2	MIMO0 ANT Port	MIMO0 ANT RF Cable Connection Port
3	MIMO1 ANT Port	MIMO1 ANT RF Cable Connection Port
4	Optical Cable INLET	Optic cable connection Inlet
5	Goretex	

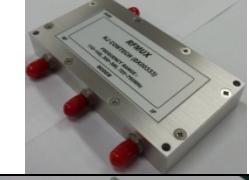
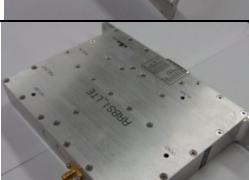
4.1.6. Module Composition of RU



⇒ Module operational voltage table

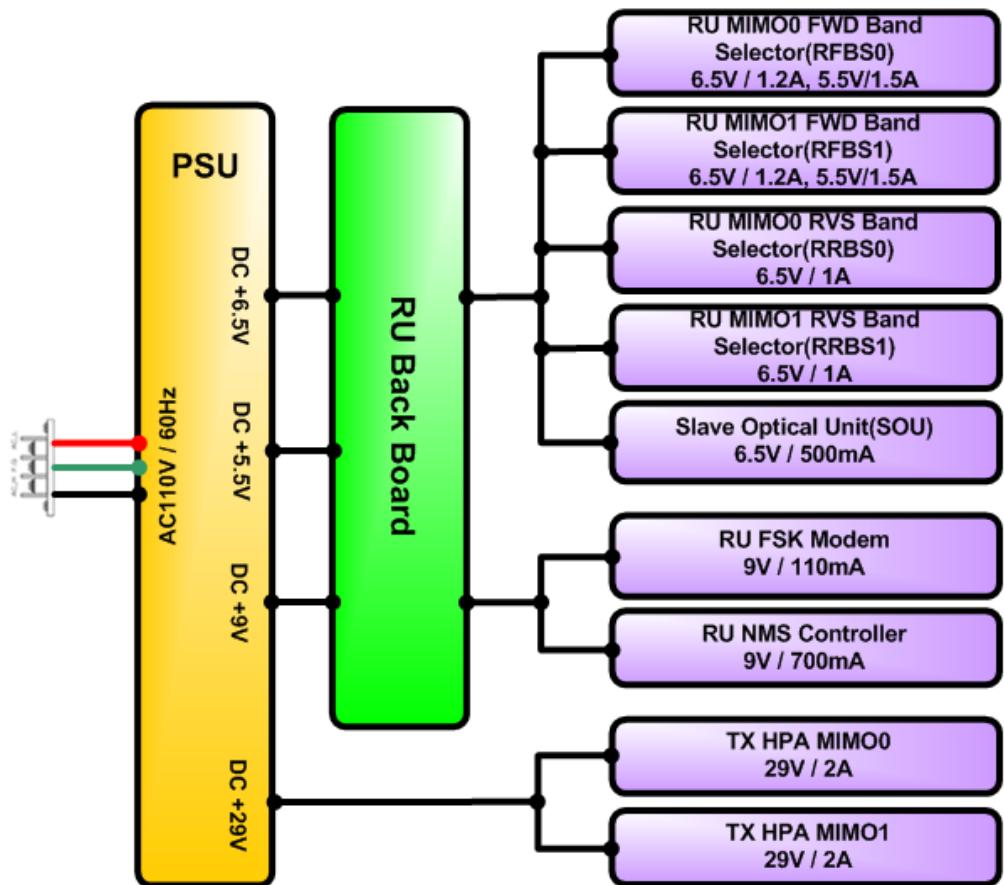
No	Module	Voltage Used	Remarks
1	RFMUX		
2	RF FWD Band Selector for MIMO0 (RFBS0)	5.5Vdc /6.5Vdc	
3	RF FWD Band Selector for MIMO1 (RFBS1)	5.5Vdc /6.5Vdc	
4	Slave Optical Transceiver Unit (SOU)	6.5Vdc	
5	RF Modem (FSK Modem)	9Vdc	
6	RU RVS COM for Signal combing (RRCOM)		
7	RU RVS Band Selector for MIMO0 (RRBS0)	6.5Vdc	
8	RU RVS Band Selector for MIMO1 (RRBS1)	6.5Vdc	
9	TX HPA for MIMO0	29Vdc	
10	TX HPA for MIMO1	29Vdc	
11	FE-Duplexer(Front-End Filter Unit) for MIMO0		
12	FE-Duplexer(Front-End Filter Unit) for MIMO1		
13	PSU (AC-DC)	AC 110V	INPUT
14	NMS Controller	9Vdc	
15	Back Board Ass'y	5.5Vdc /6.5Vdc /9Vdc	

4.1.7. Function of Modules

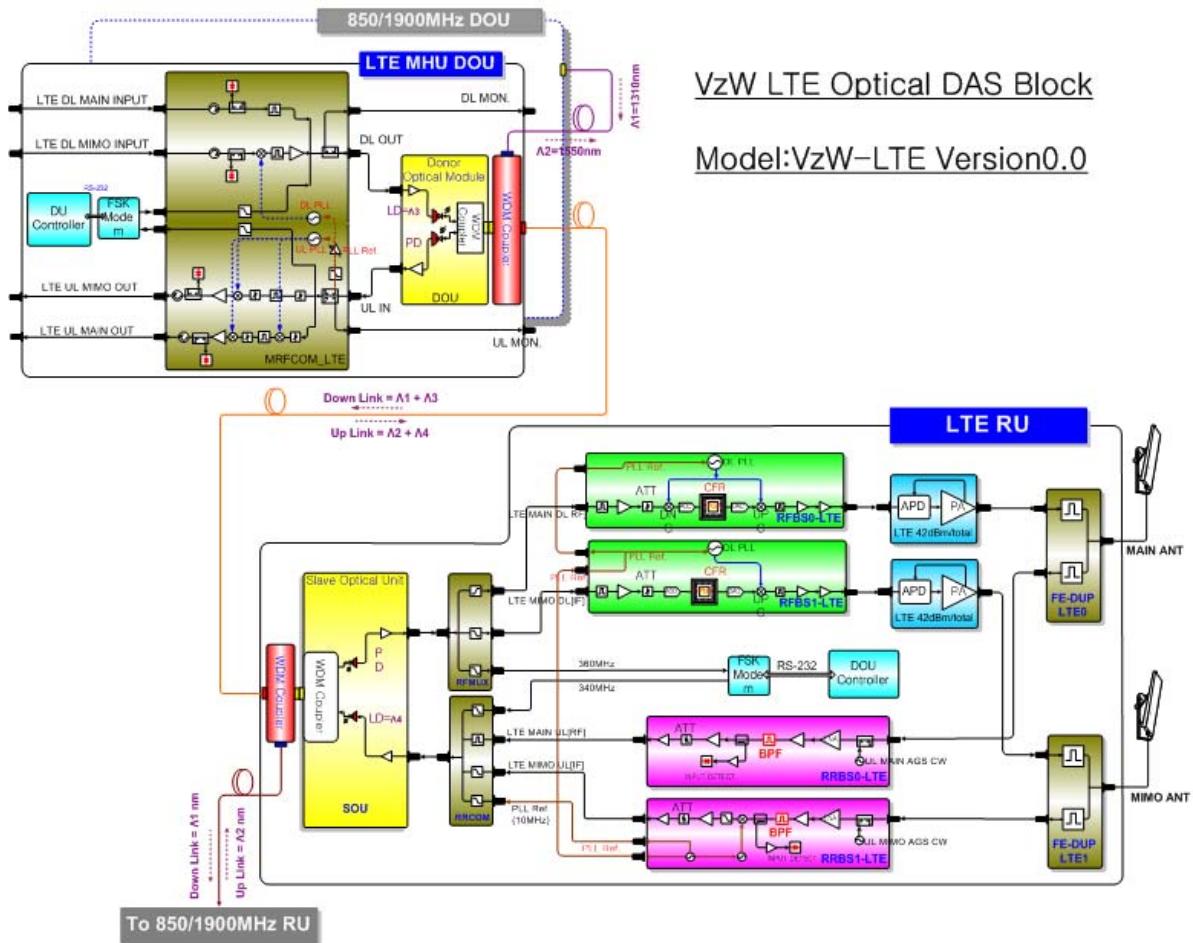
No	Module	Description
1		<p>[Divider] Divides signals into RF and modem signals and sends to RFBS/RFCHS and FSK modem.</p>
2		<p>[RFBS0] Controls the gain of TX0 path, filters FWD band, controls the crest factor of TX0 signal, and performs the ALC function. Output of the module is sent to HPA.</p>
3		<p>[RFBS1] Controls the gain of TX1 path, filters FWD band, controls the crest factor of TX1 signal, and performs the ALC function. Output of the module is sent to HPA.</p>
4		<p>[SOU] Performs E/O (or O/E) conversion for FWD and RVS signals. Wavelength: LD 1330[nm], PD 1570[nm]</p>
5		<p>[FSK Modem] Data modem for RU and MHU communication RU → MHU frequency: 340MHz MHU → RU frequency: 360MHz</p>
6		<p>[RRCOM] Combines RX0, RX1 and Modem signals, and provides the combined signal to optical module in order to perform E/O conversion.</p>
7		<p>[RRBS0] Amplifies RX0 signal by low noise high gain, filters for the desirable band and controls the RVS path gain of RU.</p>
8		<p>[RRBS1] Amplifies RX1 signal by low noise high gain, filters for the desirable band and controls the RVS path gain of RU.</p>

9		<p>[TX HPA for MIMO0] 16Watt(42dBm) High power amplifier built-in linearizer amplifies the TX0 signal to high power level and sends to RU ANT through the MIMO0 FE-Duplexer.</p>
10		<p>[TX HPA for MIMO1] 16Watt(42dBm) High power amplifier built-in linearizer amplifies the TX1 signal to high power level and sends to RU ANT through the MIMO1 FE-Duplexer.</p>
11		<p>[FE-Duplexer for MIMO0] Front end duplexer that passes through TX0 and RX0 frequency bands.</p>
12		<p>[FE-Duplexer for MIMO1] Front end duplexer that passes through TX1 and RX1 frequency bands.</p>
13		<p>[PSU] Converts AC 110V to DC 29V/9V/6.5V/5.5V, and distributes the necessary power to each modules.</p>
14		<p>[NMS Controller] Monitors the status of modules in RU and controls the configurable parameters of the RU modules.</p>
15		<p>[Interface BD] Provides operating voltage and monitors/controls signal to modules connected to interface B'D. Also provides a connection port to communicate with NMS B'D.</p>

⇒ Power Distribution Diagram



5. Block Diagram



6. Administration Program (RptMan-LMR250R01)

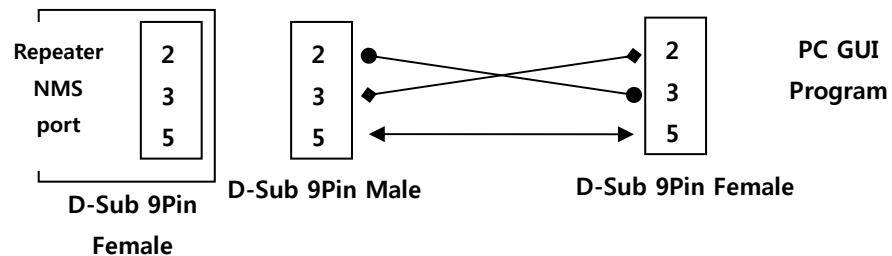
Administration program (RptMan-LMR250R01) is a management program for LMR250R01 and provides status monitoring and controlling functions to users.

6.1. System Requirement

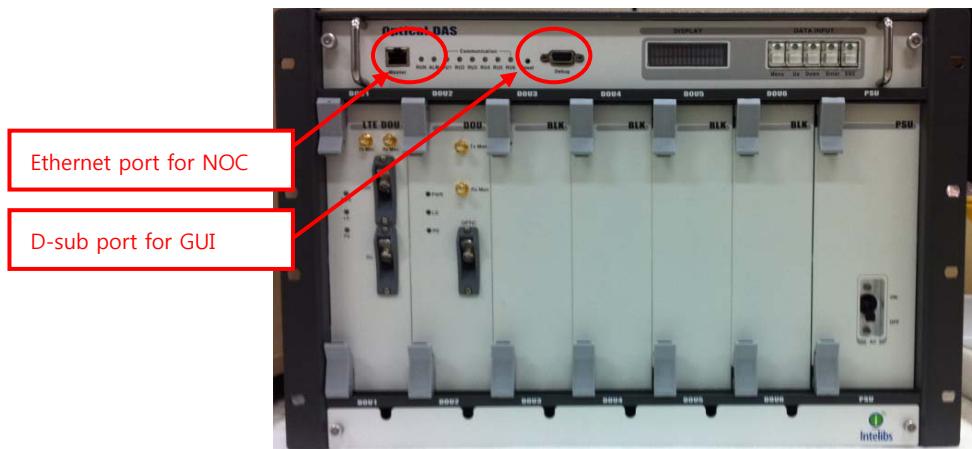
- ⇒ System: Desktop or laptop PC
- ⇒ OS: Windows XP or later version
- ⇒ Resolution: 1024 × 768 or more
- ⇒ Connection Cable: 9 pin serial cable (cross type)

6.2. Cable connection

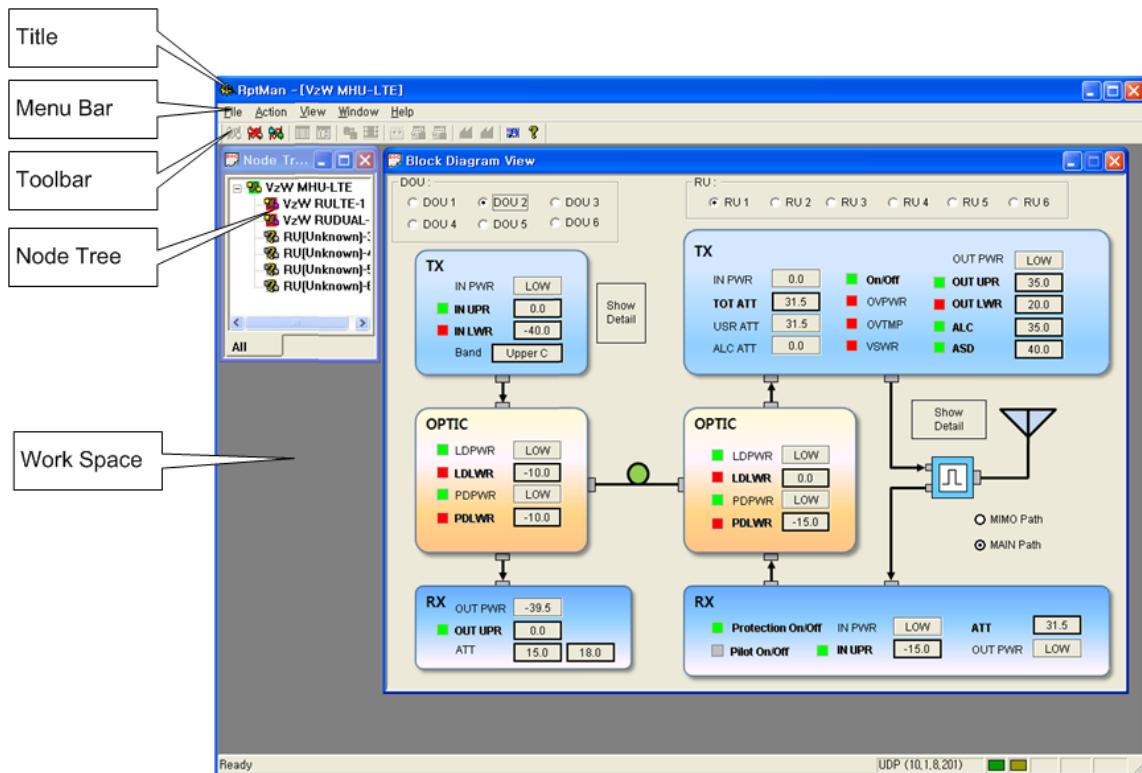
The cable connection between repeater and PC (GUI program) is illustrated below.



The NMS port of MHU provides two ports; one is a D-sub port for local GUI. The other is an Ethernet port for NOC (Network Operating Center).



6.3. Screen



Section	Description
Window Title	 <p>Displays the name of management program(GUI), i.e. RptMan-LMR250R01.</p>
	<p>Displays the type of equipment currently connected to the program (MHU or RU).</p>
Menu Bar	<p>File Action View Window Help</p> <p>Presents working menu for operators.</p>
	<p>It is associated with tool icons, which can activate the tool bar menus.</p>
Toolbar	 <p>Presents icons (button type) for frequently used commands.</p> <p>User-friendly icons are used.</p> <p>Icons are activated or disabled as to the status of repeater.</p>
Work Space	<p>Status information and control functions are provided with a block diagram view of MHU and RU.</p> <p>Provides the working space for windows or dialogs.</p>

6.4. Status Display

Status of repeater is displayed by LED's and values.

⇒ LED

■ Alarm:  blinking indicates ALARM,  indicates NORMAL

■ On/Off:  ON,  OFF

Exception) for HPA,  is ON,  is OFF

⇒ Value

■ Units are not displayed.

■ Value displayed in box ()

⇒ Control

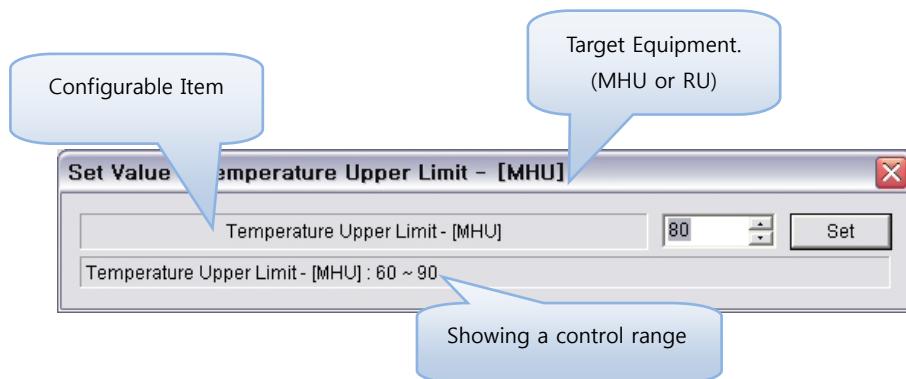
■ The shape of mouse cursor is changed to  on controllable parameters.

■ The texts of controllable LED or values are displayed in BOLD font.

6.5. Control Policy

⇒ System parameter can only be controlled one at a time.

⇒ Click a control item (button) to bring up a control popup dialog window.



⇒ Once a dialog popup window is opened, it stays there for repeated control until user closes the window.

6.6. Menu

Menu	Sub Menu	Function
File	Connect	Establishes connection between PC(GUI) and repeater
	Disconnect	Disconnects connection between PC(GUI) and repeater
	Exit	Finishes admin program.
Action	Power Table	Presents RF/Optic power table
	TC Table	Presents temperature compensation table
	Image Compression	Compress the firmware file (executable file of repeater)

		for download
	MHU image download	Downloads compressed firmware file to MHU equipment
	RU image download	Downloads compressed firmware file to RU equipment
	Factory Setting	Restores all parameter values to initial factory settings
	System action	Not available
	Gain Setting	Tx: set ATT to have 30dBm on the remote ANT output. Rx: set ATT to have 40dB of Rx total gain from RU to MHU including optical loss.
	Polling period	Controls the polling period between PC and repeater
View	Block window	Presents system window including MHU and RU
	MHU Window	Presents MHU status window in work space
	RU Remote Window	Presents RU status window in work space
Window	Cascade	Cascade or tile horizon arrangement of repeater status windows in work space
	Tile Horizon	
	Arrange icons	Arrange all icons under many window is opened
	Close all	Close all window
	Packet Debug	Presents debug window in workspace displaying packets between repeater and GUI program
Help	About RptMan.Dual	Displays the version information of GUI program, RptMan (Repeater Manager)

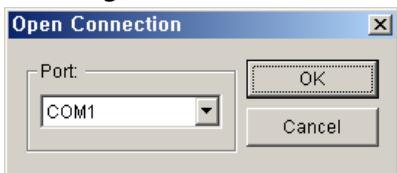
6.7. Toolbar

ITEM	ICON	Function
Communication Establishment		Establishes RS-232C connection to the repeater, then GUI starts to communicate and status of repeater are polled and displayed.
Communication Disconnection		Disconnects communication with connected repeater. Repeater status is not updated.
Polling Stop/Resume		Stops or resumes polling action of GUI program. (activated in toggling way)
Power Table		Presents RF/Optic power table
T/C table		Presents temperature compensation table
Debug Packet		Displays packet data between GUI and repeater like protocol analyzer and it may help debugging of software
Compression of image file		Compresses image file of repeater
Gain Setting		TX: set ATT to have 35dBm of output at the RU ANT Port RX: set ATT to have 40dB gain of Rx path → Tx/Rx Gain setting function carry out Tx/Rx gain setting including optical loss compensation automatically.

MHU Download		Download MHU firmware files to MHU equipment.
RU Download		Download RU firmware files to RU equipment.
MHU Factory Setting		Initialize MHU parameters to factory setting values.
RU Factory Setting		Restores RU parameters back to original factory setting values.
Help		Shows version information

6.8. Program operation

6.8.1. Initiating communication

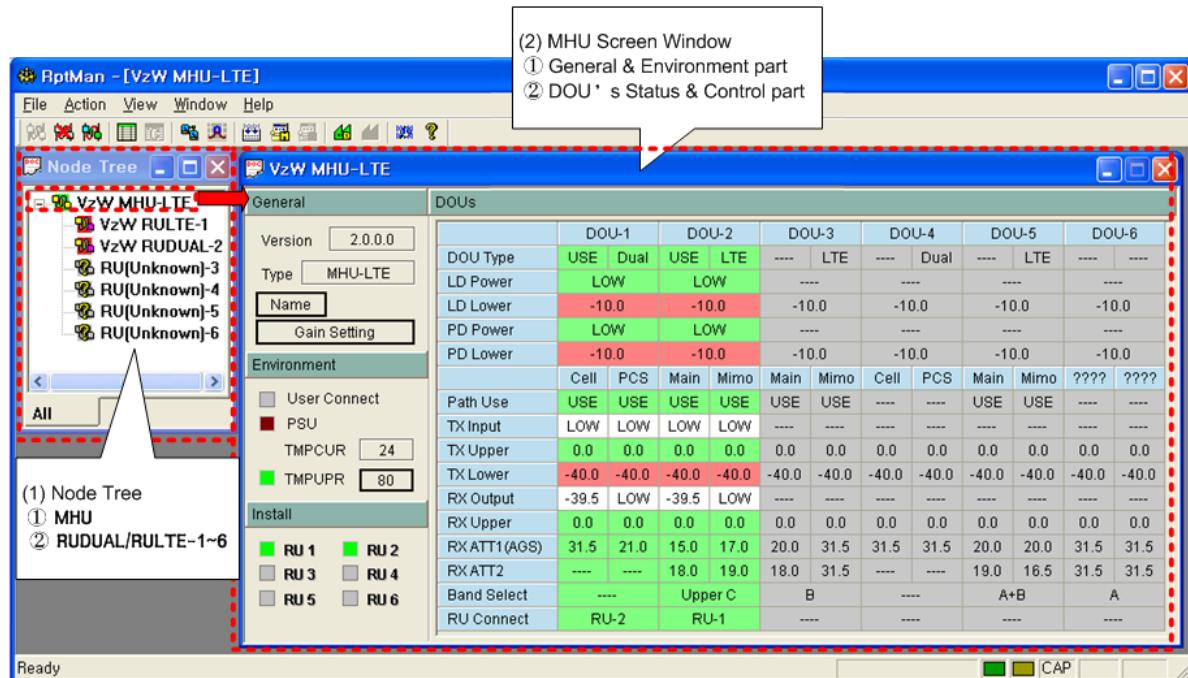


Function	Establishing communication between GUI and repeater	
Method	Click  button in toolbar of GUI program	
Description	Port	Combo box to set the com port (COM1, COM2, ...)
	OK Button	Initiates communication between GUI and repeater, then closes this popup window("Open Connection") When communication port is established correctly, you can see the communication status by blinking icons.  (right-bottom side of the main screen)
	Cancel Button	Cancels and closes the popup window

6.8.2. Disconnect

Function	Disconnecting GUI from repeater
Method	Click  button in toolbar of GUI program
Description	The communication between GUI on PC and repeater becomes disconnected.

6.8.3. LMR250R01 MHU Status Retrieval and Control

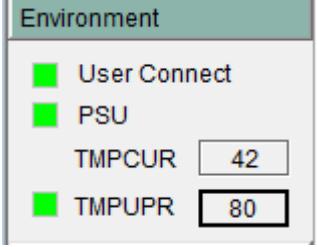
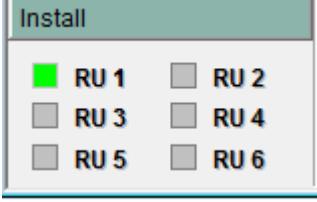
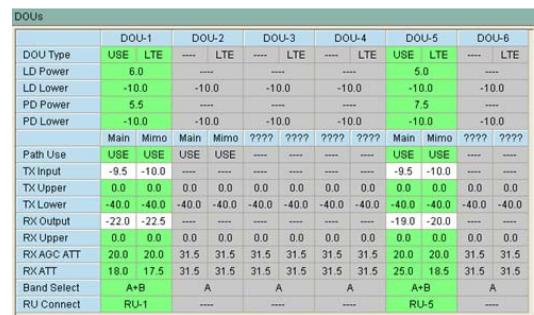


(1) Node Tree: This window displays the tree configuration of RUs connected with MHU

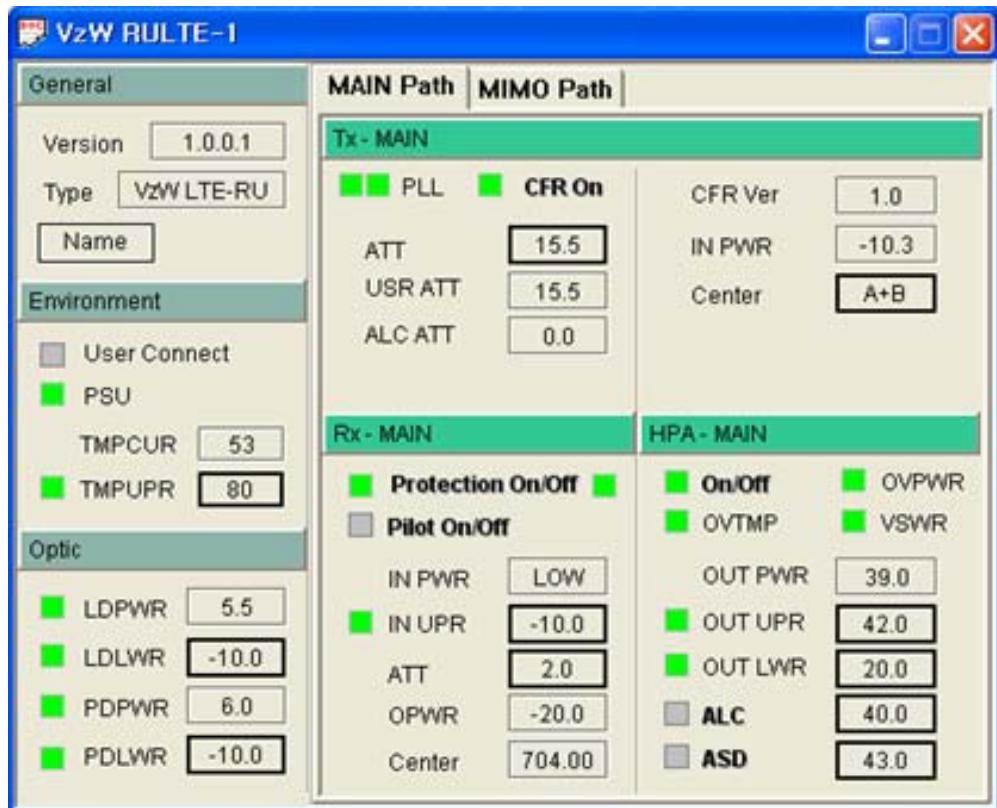
(1) Node Tree	① MHU	Press MHU to open the MHU screen
	② RULTE/RUDUAL-1 ~ 6	Press VzWRU-# to open each RU screen

(2) MHU Screen window

(2) MHU Screen	① General & Environment	This part includes common parameter of MHU like system information or environments
	② DOU Status/Control	<p>This screen provides information on 6DOUs</p> <ul style="list-style-type: none"> → LD Power & Lower limit value → PD Power & Lower limit value → Tx Input, Rx Output Power & Limit value → RU Install information

Group	Description
	<ul style="list-style-type: none"> ⇒ Version: Firmware Version ⇒ Type: Repeater unit type ⇒ Name: ID of MHU for the communication ⇒ Gain Setting <ul style="list-style-type: none"> ■ TX: sets ATT to have 35dBm of output at the RU ANT Port ■ RX: sets ATT to have 40dB gain of Rx path ■ Tx/Rx Gain setting function carries out Tx/Rx gain setting including automatic optical loss compensation.
	<ul style="list-style-type: none"> ⇒ User Connect: Connection status of COM port of repeater ⇒ PSU: Status of PSU ⇒ TMPCUR: Current temperature of the equipment ⇒ TMPUPR: set the upper threshold value of temperature (button) and alarm status (LED)
	<ul style="list-style-type: none"> ⇒ Install: This sets up the RU to communicate with MHU. Even when an RU is connected to MHU physically by optic cable, the RU cannot communicate with MHU if RU is not installed logically by GUI.
	<ul style="list-style-type: none"> ⇒ LD Power: Transmitted optical power level to RU ⇒ LD Lower: Lower limit level of the LD power ⇒ PD Power: Received optical power level from RU ⇒ PD Lower: Lower limit level of the PD power ⇒ TX Input: Tx level input from BTS ⇒ TX Upper: Upper limit of Tx input level ⇒ TX Lower: Lower limit of Tx input level ⇒ RX Output: Rx level output to BTS ⇒ RX Upper: Upper limit of Rx output level ⇒ RX Lower: Lower limit of Rx output level ⇒ RX AGC ATT: RX path ATT for optic AGC ⇒ RU install: display the RU installation status

6.8.4. LMR250R01 RU Status Retrieval and Control



Group	Description
General	<ul style="list-style-type: none"> ⇒ Version: Firmware version ⇒ Type: Type of repeater ⇒ Name: Set the Name, ID, Serial No. of repeater RU
Environment	<ul style="list-style-type: none"> ⇒ User Connect: Connection status of COM port of repeater ⇒ PSU: Status of PSU ⇒ TMPCUR: Current temperature in repeater RU ⇒ TMPUPR: Value/control of upper threshold of temperature (button) and alarm status (LED)

	<ul style="list-style-type: none"> ⇒ LDPWR: Value of LD power (box) and status of LD (LED) ⇒ LDLWR: Value/control of lower threshold of LD power (button) and lower alarm status of LD power (LED) ⇒ PDPWR: Value of PD power (box) and status of PD (LED) ⇒ PDLWR: Value/control of lower threshold of PD power (button) and lower alarm status (LED)
	<ul style="list-style-type: none"> ⇒ RU parameters for TX0(MAIN)/TX1(MIMO) band are displayed by the tab selection. Each band has the identical items which can be monitored and controlled.
	<ul style="list-style-type: none"> ⇒ PLL: Alarm LED for 2 PLL's ⇒ CFR On: On/Off status of Crest Factor Reduction function ⇒ CFR On: On/Off control the Crest factor reduction function ⇒ ATT: Sets ATT to control FWD gain, and shows its value. Displayed ATT value = USR ATT + ALC ATT ⇒ USR ATT: This is the main FWD Gain setting point. It is used for FWD auto gain setting or gain fine tuning ⇒ ALC ATT: When HPA output level is higher than ALC level it automatically controls FWD gain to maintain output level below HPA ALC level. ⇒ INPWR: Input total power level on CFR board ⇒ Center: Set the center frequency of FWD band by VzW Frequency band A/B/Upper C.
	<ul style="list-style-type: none"> ⇒ On/Off: Status/control the operation state of HPA ⇒ OVTMP: Alarm status of HPA Over-temperature ⇒ OVPWR: Alarm status of HPA Over-Power ⇒ VSWR: Alarm status of HPA VSWR ⇒ OUT PWR: Output power level of HPA(box) ⇒ OUT UPR: Display/control of upper threshold of HPA output power(button), alarm status(LED)

	<ul style="list-style-type: none"> ⇒ OUT LWR: Value/control of lower threshold of HPA output power(button), alarm status(LED) ⇒ ALC: Set ALC level for HPA output, and shows ALC on/off status of function(LED). ⇒ ASD(Auto Shutdown): ASD level(button), and shows ASD on/off status of function(LED).
	<ul style="list-style-type: none"> ⇒ Protection On/Off: In order to protect RU from over input RVS(Rx) signal power. In case that input signal is more than IN UPR level, RU shuts down and LED is changed to RED. And if input signal power is over than -45dBm, RU has the 10dB attenuation and MHU has the 10dB gain. ⇒ Pilot On/Off: Sets CW signal generation, and shows its status. It is used for RVS gain setting. ⇒ IN PWR: RVS power value at the LNA output point ⇒ IN UPR: Sets RVS input upper threshold, and shows the alarm status of input upper threshold. ⇒ OUTPWR: RVS RF output power of RRBS. ⇒ ATT: Sets ATT to control RVS gain, and shows it's value. ⇒ Center Freq: It indicates pilot signal frequency value. This value changes with FWD(Tx) center frequency automatically.

6.8.5. Firmware download

Firmware download is performed when system needs to be updated.

Downloading improper images (executable file of repeater CPU) may cause harmful damages to equipment.

The following steps should be taken for firmware download.

- ① Convert firmware source file (*.bin) to a downloadable file format.

Main menu: Action → Image Compression, toolbar: 

- ② Open a pop-up window showing the status of the target equipment for firmware download.

Step 1) Main menu View → Select Donor Windows or Remote Windows

Step 2) In Block View Dialog window, select Donor Windows or Remote Windows

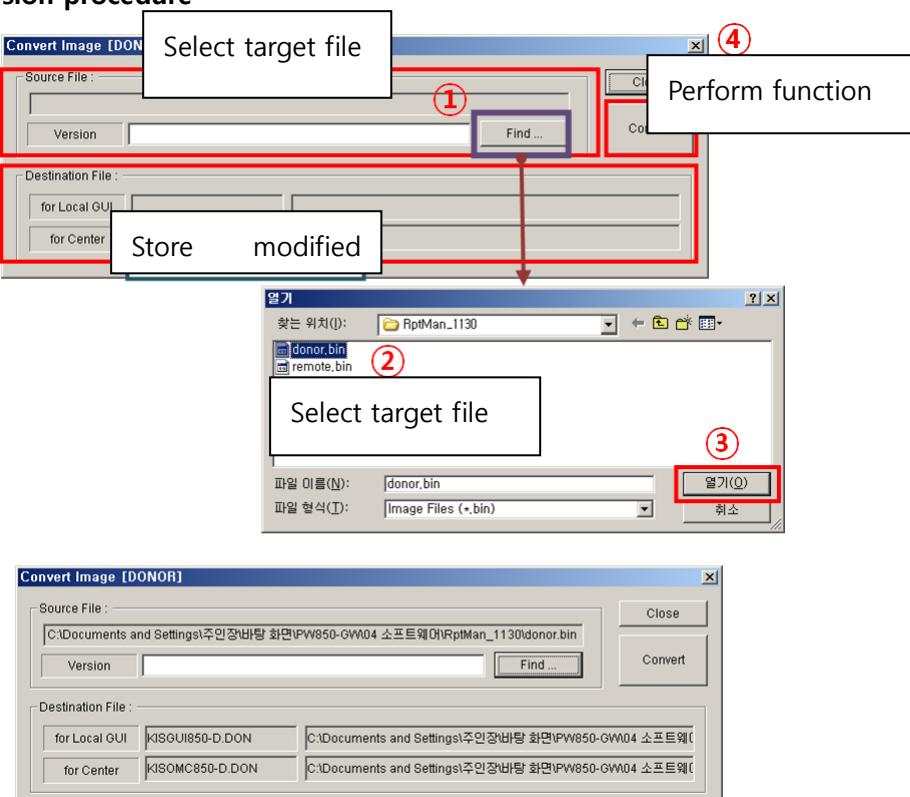
- ③ Download firmware to the target equipment.

Step 1) Main menu Action → select Image Download menu

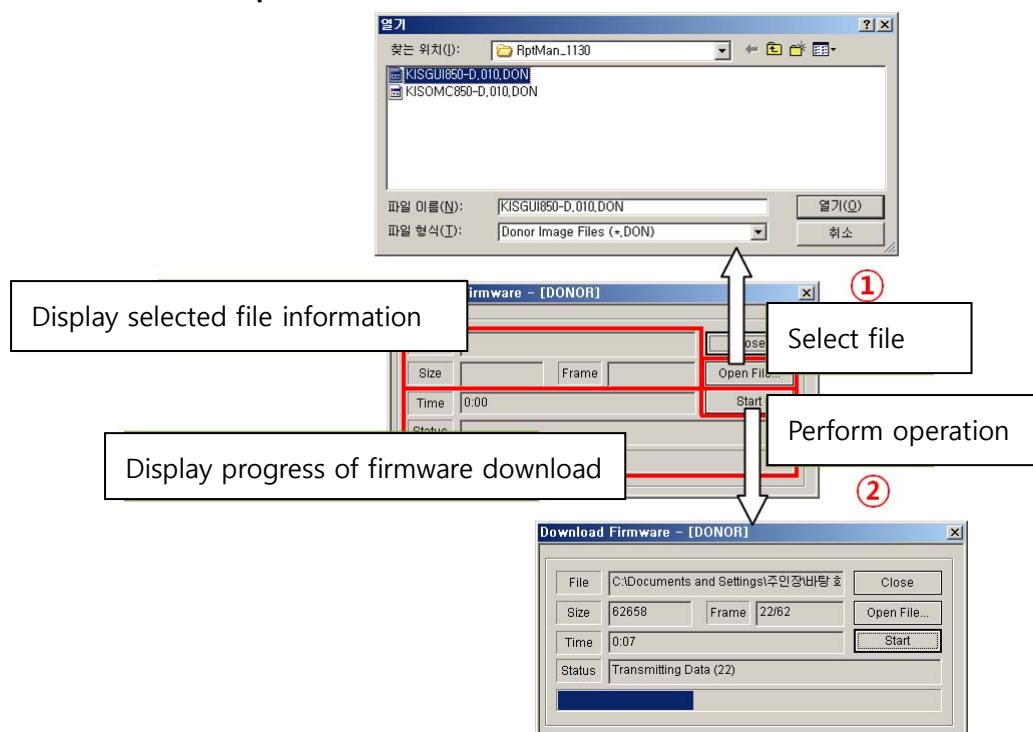
Step 2) In toolbar, select  for MHU, and select  for RU

Download firmware after selecting the firmware file for the target equipment.

File conversion procedure



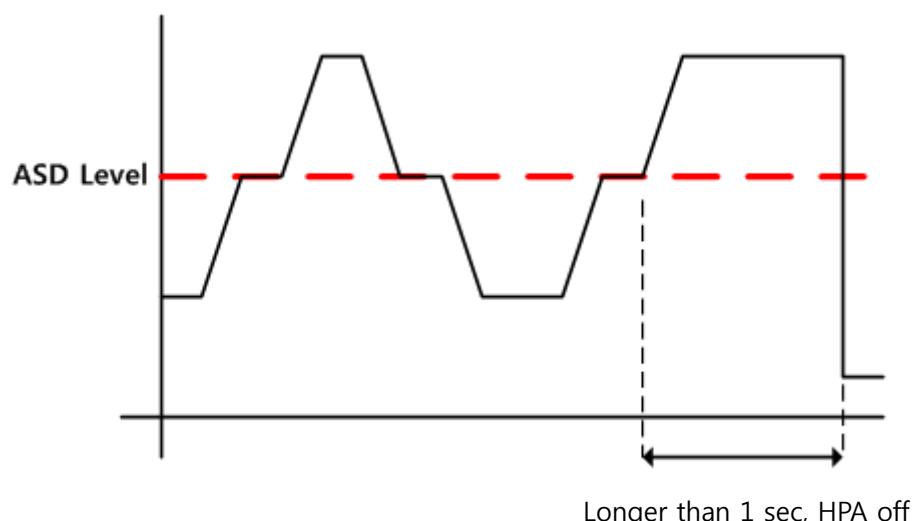
Download procedure



6.9. Additional features

6.9.1. ASD (Auto Shutdown) Function

1. If the power level is above the shut down level for longer than 1 second, turn off HPA.
2. During shutdown state, monitor RU input power. If the level is below 5dB from shut down level, turn on HPA automatically.
3. Monitor HPA output power in normal operation, and monitor RU input power during shut down.



6.9.2. ALC (Auto Level Control) Function

1. If the power level reaches the ALC level, prevent from transmitting higher than ALC level by using ATT control.
2. By storing the existing ATT value, the ATT value before ALC can be reused even when the power is reduced.

