

Notchcell 20W Operating Manual Programmable Type

Version 1.0

CONTENT

1. OVERVIEW	3
2. SPECIFICATIONS	4
2.1 NOTCHCELL 20W	4
2.2 ANTENNA	5
3. INSTALLATION	6
3.1 GENERAL	6
3.2 TECHNICAL SPECIFICATION	7
3.3 INSTALLING INFORMATION	11
4. OPERATION	29
4.1 ISOLATION TEST POCEDURE OF ANTENNA	29
5. GRAPHIC USER INTERFACE	31
5.1 INTRODUCTION	31
5.2 GETTING STARTED	32
5.3 CONNECTING TO THE NOTCHCELL	33
5.4 SETUP & STATUS MODE SYSTEM DISPLAY	35
5.5 REPEATER SET USING GUI	37
APPENDIX A. SYSTEM PARAMETERS	49
A.1 SYSTEM STATE WINDOW	49
A.2 MENU SELECTION WINDOW	52
APPENDIX B. MODEM	55
B.1 SYSTEM WINDOW	55
B.2 MODEM WINDOW	57

1. Overview

NOTCHCELL repeater can be used in CDMA service hole spots like in-buildings, underground and tunnels to cover its service area. This repeater system designed for dual and simultaneous service, namely, it receives signals from the base station through donor antenna, amplifies the signals and re-transmits it to one or other mobile terminals. Also, it amplifies the signals which comes from mobile terminals through distributor antenna and re-amplifies it to base station.

Using local OMT(Operation and Maintenance Terminal) which is connected between repeater control board and personal or laptop computer, it is possible to check or to control repeater status. With wireless modem which is in the repeater, it also enables to monitor Sprint WNMC(Wireless Network Management Center) in a remote place.

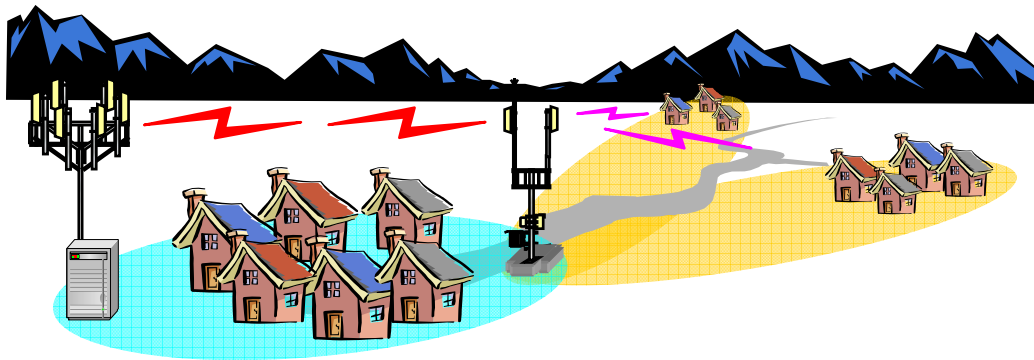


Figure 1.1 NOTCHCELL repeater

2. Specifications

2.1 Notchcell 20W Repeater

ITEM		SPECIFICATION	
		DOWN-LINK	UP-LINK
Repeater Type		Band Selective (5,10,15,20,5+5,10+5,15+5MHz)	
Frequency Range		1930 ~ 1990MHz	1850 ~ 1910MHz
CDMA Frequency Error		< ± 0.05 ppm	
Rho (Pilot Only)		> 0.912	
RF Output Power		43dBm / Total	28dBm / Total
RF Input Level	Operating	~ -30dBm	~ -30dBm
	Maximum (abnormal)	+10dBm	
System Gain		65~95dB	
Gain Control		0 ~ 30dB/1dB step	
ALC(Automatic Level Control)		13~43dBm	-
ASD(Automatic Shut Down)		15~45dBm	-
Spurious Emission	$F_c \pm 885$ kHz	Min. 45dBc	
	$F_c \pm 1.98$ MHz	Min. 50dBc	
	$F_c \pm 2.25$ MHz	Max. -13dBm	
Noise Power In-band		Max. -13dBm / RBW, 1.23MHz	
Noise Figure		Max. 5dB	
Ripple In Band		Max. 3dB	
Selectivity	5M	3dB : Min. 4MHz, 40dB : 6MHz	
	10M	3dB : Min. 9MHz, 40dB : 11MHz	
	15M	3dB : Min. 14MHz, 40dB : 16MHz	
	20M	3dB : Min. 19MHz, 40dB : 21MHz	
System Group Delay		Max. 5 microseconds	
V.S.W.R		Max. 1.5 : 1	
RF Measurement Port		30dB \pm 1dB	
Impedance		50 Ω	
Cooling		Air Convection / Heat sink	
RF Connector	Antenna Port	Type-N female	
	Coupling Port	Type-SMA female	
Local OMT		RS-232C	
Wireless Modem		1X modem, SNMP	

Table 2.1 Specifications of Notchcell 20W

2.2 Antenna

DESCRIPTION	SPECIFICATION	
	DONOR ANTENNA	DISTRIBUTOR ANTENNA
Frequency range	1850-1990 MHz	1850-1990 MHz
Polarization	Horizontal / Vertical	Vertical
Gain	17dBd ± 1dB	17dBd ± 1dB
Horizontal beam width	20° ± 3°	45°
Vertical beam width	20° ± 3°	7°
VSWR	< 1.5	< 1.5
First sidelobe suppression	> 15dB	> 15dB
Impedance	50 Ohm	50 Ohm
Front-to-back ratio	> 45dB	> 45dB
Max. Power rating	100 W	250 W
Mounting	Pole or wall	Pole or wall
Radome (color)	FRP	FRP (Grey)
Wind load (at 150 km/h)	Front: 534 N Side: 107 N Rear: 534 N	Front: 534 N Side: 107 N Rear: 534 N

Table 2.2 Specifications of Antennas

RF EXPOSURE INFORMATION

The antenna used for this transmitter must not exceed 21dBi and must be installed to provide a minimum separation distance of 1.5m from all persons.

3. Installation

3.1 General

3.1.1 Overview

This standard provides a reasonable and efficient installation method for the RF repeater in consideration of site conditions and particularity of the installation process.

3.1.2 Structure

- Technical details: Description on the configuration and standard for the main box.
- Installation of cabinet: Description on the installation method of main box and PSU (Power Supply Unit) box.
- AC power supply: Description on the AC input to the AC distribution panel.
- Grounding: Description on the grounding of the main box and PSU box.
- Power feeder cable: Description on the installation method of antenna and power feeder cable.

3.1.3 Scope of application

- This standard presents all sorts of information on the repeater and the installation standard for the reasonable and efficient construction as well as the smooth process.
- This standard presents general technical conditions for power supplies, groundings, and other execution designs.
- This standard presents the installation of equipments, construction and details to be considered under the site conditions.
- All construction works must be performed in conformity to this standard, but are subject to the site conditions.

3.1.4 Safety management

3.1.4.1 Objective

This safety regulation defines the requirements for eliminating dangerous causes and preventing accidents in workers' conducting their duties at the site.

3.1.4.2 Scope of application

Site representatives, safety managers or site supervisors are responsible for safety of the site workers and the public. They shall take the full measures to prevent possible accidents.

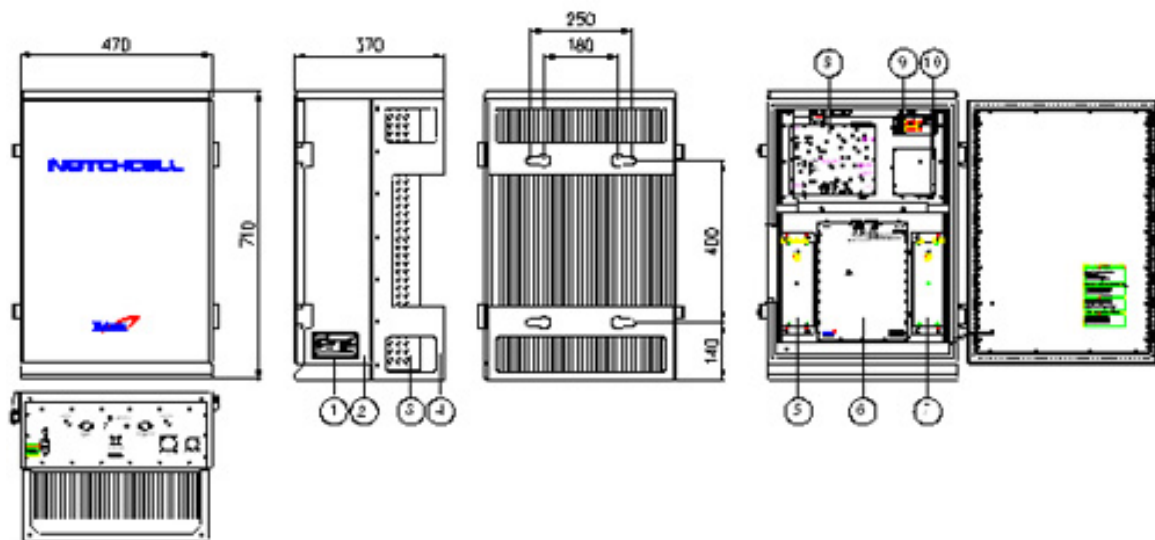
3.2 Technical specification

3.2.1 Environmental Conditions

ITEM	STANDARD
Power supply	110Vac ± 20% / 50/60Hz ±5% or +24Vdc battery backup available (option)
Operating temperature	- 30 ~ +50
Humidity	95 %
Consumption power	400W(Normal) / 700W(Max.)
Rainfall	100 mm/Hr
Water proof	NEMA 4x
Wind pressure	60m/s

3.2.2 Mechanical specification

3.2.2.1 Main box

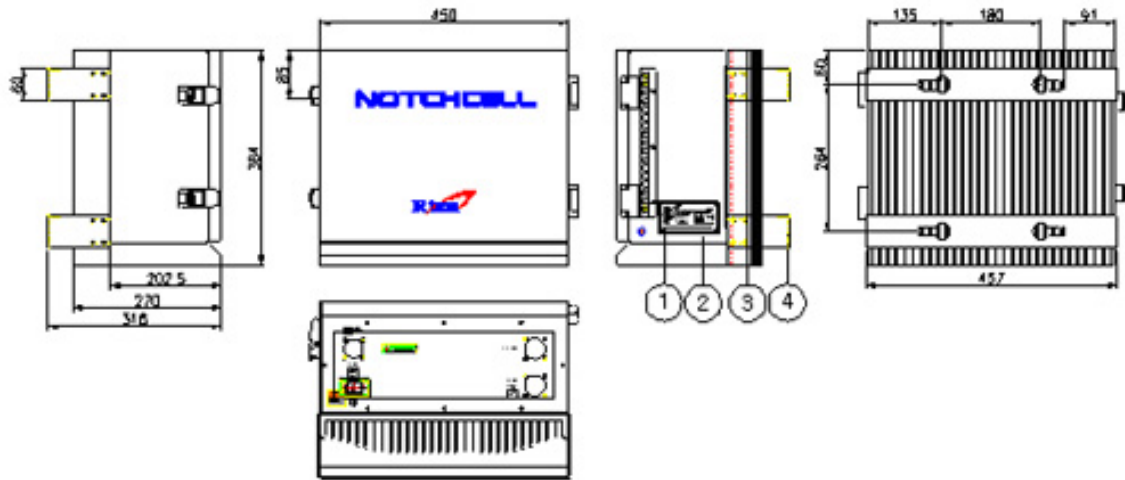


NO.	Title	NO.	Title
1	Name Plate	6	DL Amplifier
2	Base	7	Duplexer(Mobile station)
3	Heat Sink	8	UDC(Up Down Converter)
4	MTG Bracket	9	DC/DC Converter
5	Duplexer(Base station)	10	UL Amplifier

Figure 3.1 Main box

ITEM	SPECIFICATION
RF Connector	N-female
Size (W x H x D)	710 X 470 X 370 mm / 27.95 x 18.50 x 14.57 inch
Weight	Less than 50Kg / Less than 110 lbs

3.2.2.2 PSU box



NO.	Title	NO.	Title
1	Name Plate	3	Heat Sink
2	Base	4	MTG Bracket

Figure3.2 PSU box

ITEM	SPECIFICATION
Size (W x H x D)	450 X 385 X 315 mm / 17.72 X 15.16 X 12.40 inch
Weight	Less than 25Kg / Less than 55lbs

3.2.2.3 Donor antenna

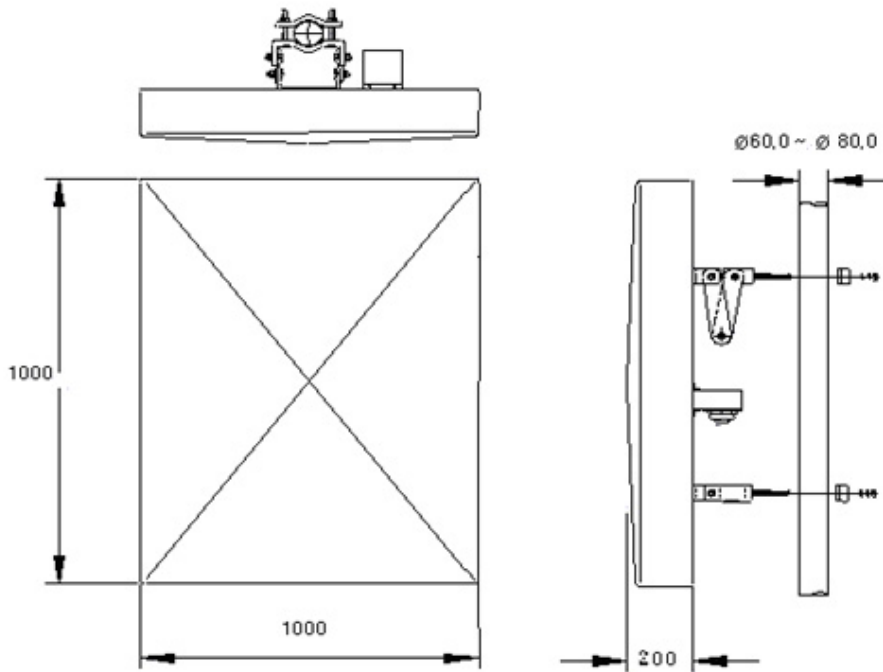


Figure3.3 Donor antenna

ITEM		SPECIFICATION
RF Connector		1 X 7/16-female
Size (W x H x D)	Antenna	1020 X 675 X 116 mm / 40.16 X 26.57 X 4.57 inch
	Shipping box	1130 X 785 X 270 mm / 44.49 X 30.91 X 10.63 inch
Weight		Less than 20 kg / Less than 45 lbs

3.2.2.4 Distributor antenna

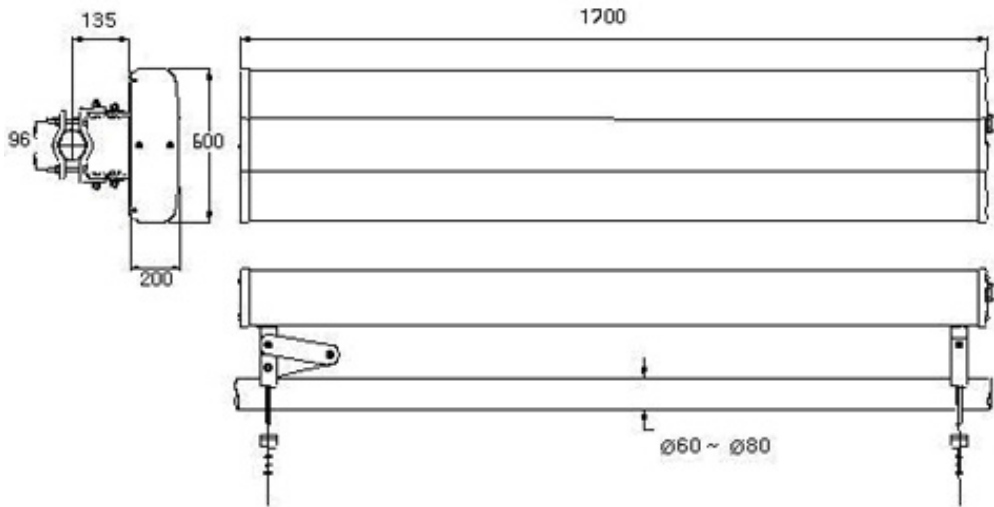


Figure3.4 Distributor antenna

ITEM		SPECIFICATION
RF Connector		1 X 7/16-female
Size (W x H x D)	Antenna	1500 x 300 x 110 mm / 59.06 X 11.81 X 4.33
	Shipping box	1560 x 320 x 190 mm / 61.47 X 12.60 X 7.48
Weight		Less than 10 kg / Less than 22 lbs

3.2.2.5 Mount Pole (Option Item)

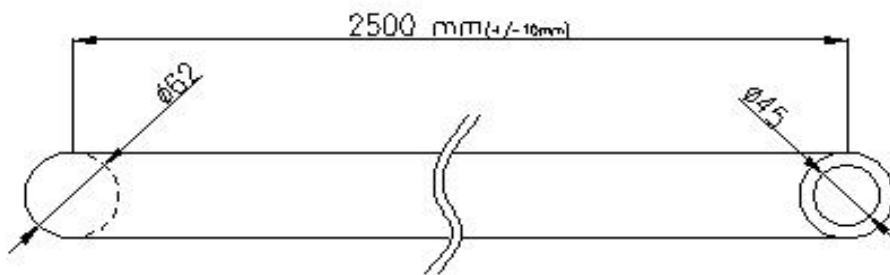


Figure3.5 Mount pole

ITEM	SPECIFICATION
Length	2500 mm or 2900 mm / 98.43 or 114.17 inch
Weight	Less than 6 kg / Less than 13.23 lbs

3.3 Installing information

3.3.1 Installation site

3.3.1.1 Right-of-way

- The repeater shall be installed in the location owned or leased by the carrier.
- If the repeater is installed on the roof, spaces for the installation must be considered.

3.3.1.2 Conditions for the Installation space

Installation of the repeater requires the following spaces.

1) Roof

Do not install the repeater near heavy equipments or water tanks for load distribution.
Establishes the repeater in order for the good air circulation of the rear side.
Make sure there is a passage for the equipments to carry the repeater.

2) Field

Select the installation location on a higher ground level to prevent the repeater from being inundated.
Install the repeater at a distance of at least 5m from the stream or the river.
Make sure there is a passage and parking space for vehicle to carry the repeater.
Install the repeater in where there is no obstacle visually and physically.
Make sure to level the slope when installing on a slope in a mountain area.

3.3.1.3 Precautions

Check the followings before installing the repeater.

1) Roof

Avoid the location in which any accidental or intentional damage may occur.
Do not install the repeater on the weak slab.
Do not install the repeater on the building with the seriously damaged wall.

2) Field

Do not install the repeater on poor ground, sandy soil, or muddy ground.
Do not install the repeater in a ditch, river, or frequently flooded area.
Do not install the repeater on any locations that are easily frozen.
Do not install the repeater near the road.
Make sure to installation after securing safety facilities if installing it near the road.
Do not install the repeater in damp and humid areas.
Take proper measures against salt when installing the repeater in the coast.

3.3.1.4 Carrying and loading

Be careful not to cause any accident when loading the cabinet or carrying it to the installation site and not to be damaged when handling it.

To prevent corrosion, carry the cabinet in silver vinyl or a wooden box.

Warning: To prevent all possible damage, do not unpack the box until the cabinet is carried to the installation location.

Do not load excessive material on the top or cover of the packing.

3.3.2 Installing support

The RF repeater can be installed on a roof, an electric pole, or a large steel tower.

See the standard of the constructor for the installation on the steel tower or the electric pole.

3.3.3 Installing the repeater

The installation methods of the repeater vary depending on the types of support (steel tower), location, and demand of the carrier. This standard specifies the general supporting methods and is subject to the types of support.

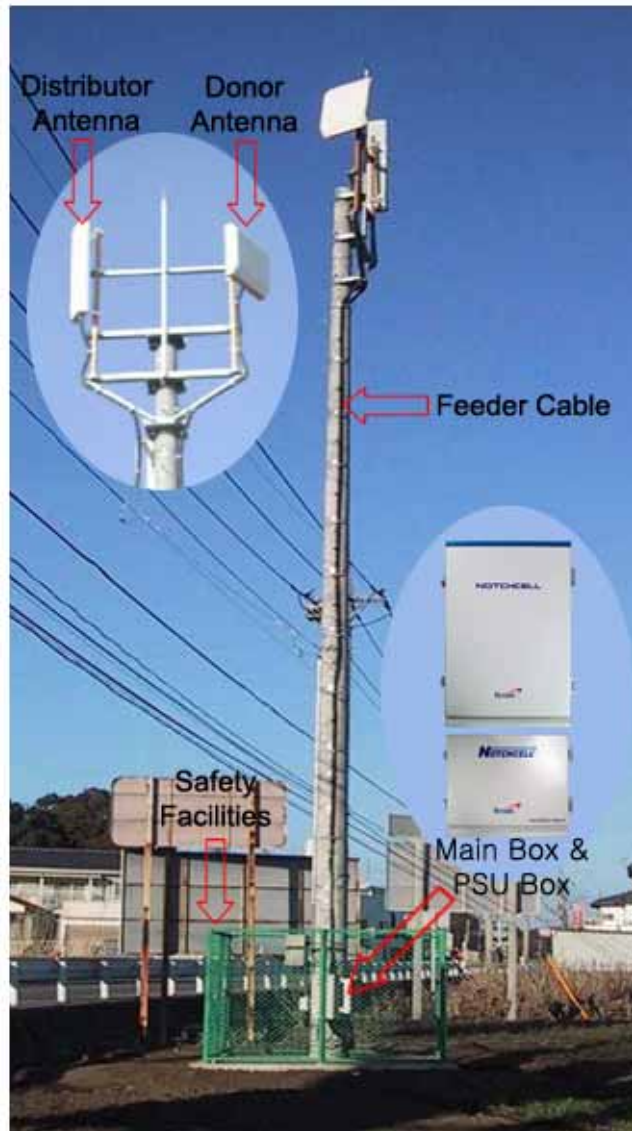


Figure3.6 Definition of assemblies (ex. electric pole)

3.3.3.1 General

- Check the level of ground when installing the repeater.
- Check if there is enough space for maintenance.
- If required, install branches to secure the safety of the steel tower.
- Fasteners must be melted and zinc plated.
- Use two nuts for a bolt to prevent the connection from becoming loose.
- If the repeater is installed too high, set up the safety scaffold.

3.3.3.2 Installing band

- When installing the repeater on a cylindrical support such as steel pipe and steel pole, manufacture and install the band in accordance with the size of the support.
- When installing the repeater on the roof, the standard height to the bottom of the repeater shall be 1.2m.
- Install the AC distribution panel near the repeater or in the rear of the repeater.

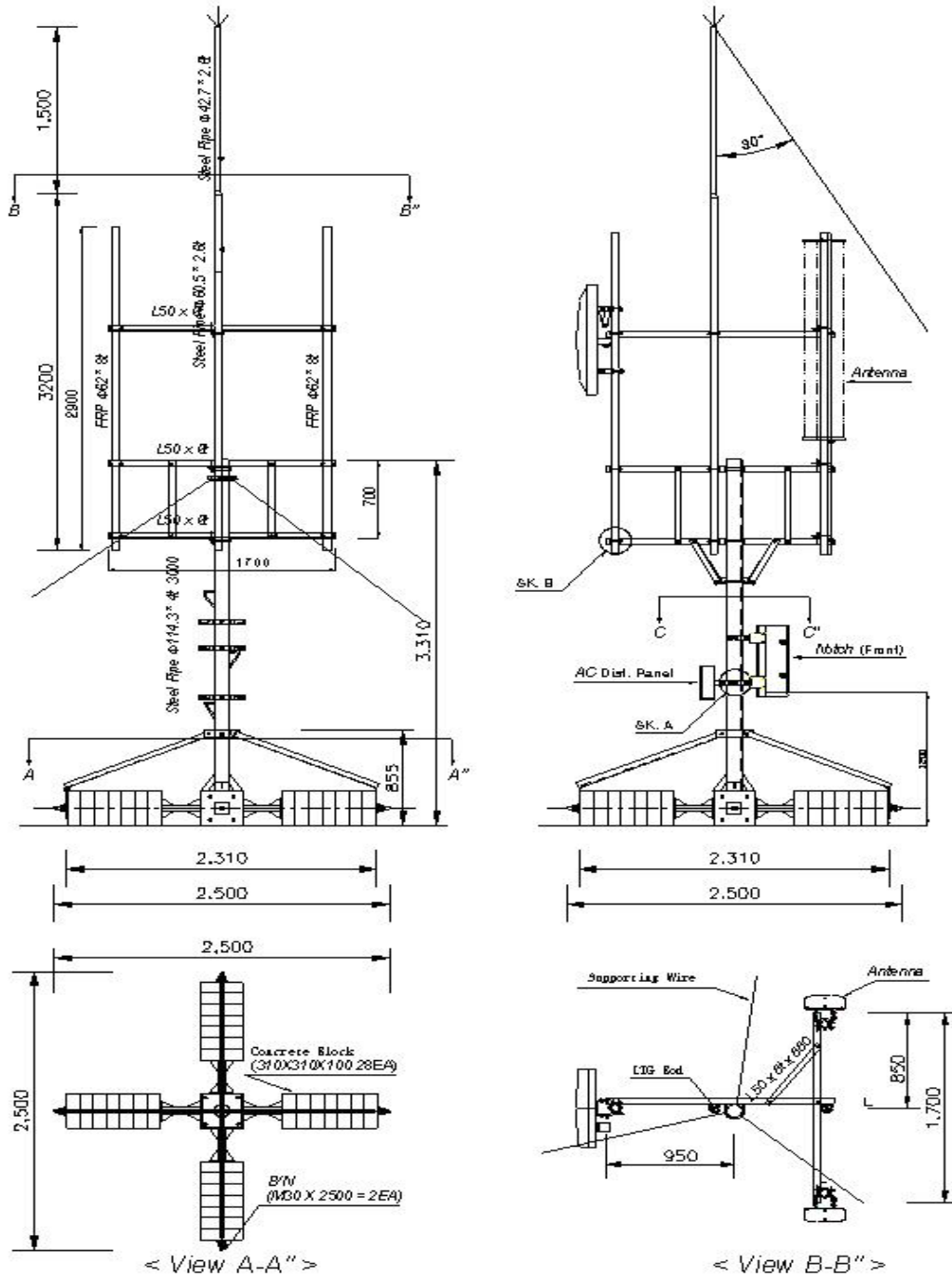


Figure 3.7 Band installation diagram 1 (steel tower type)

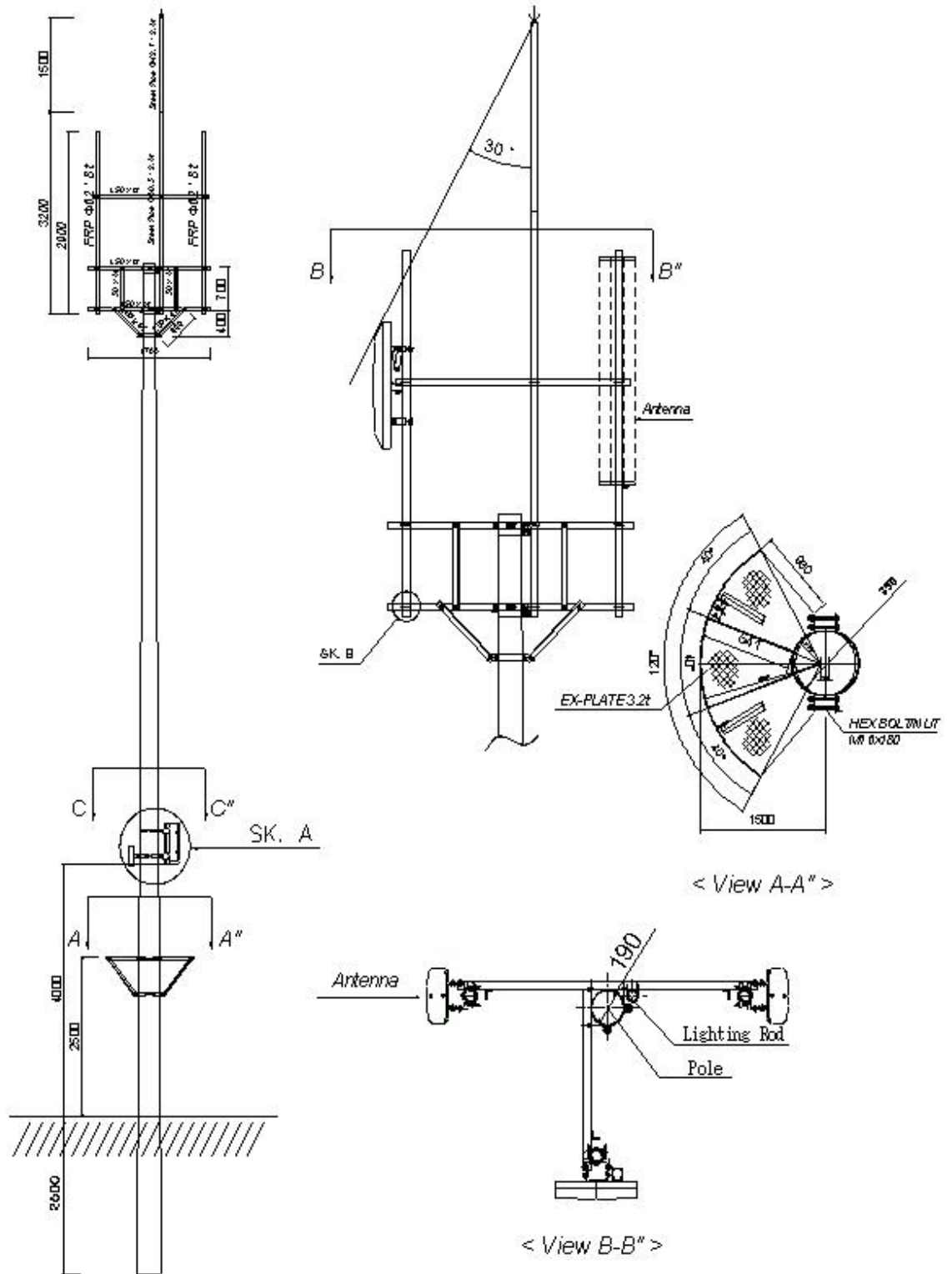


Figure 3.8 Band installation diagram 2 (electric pole type)

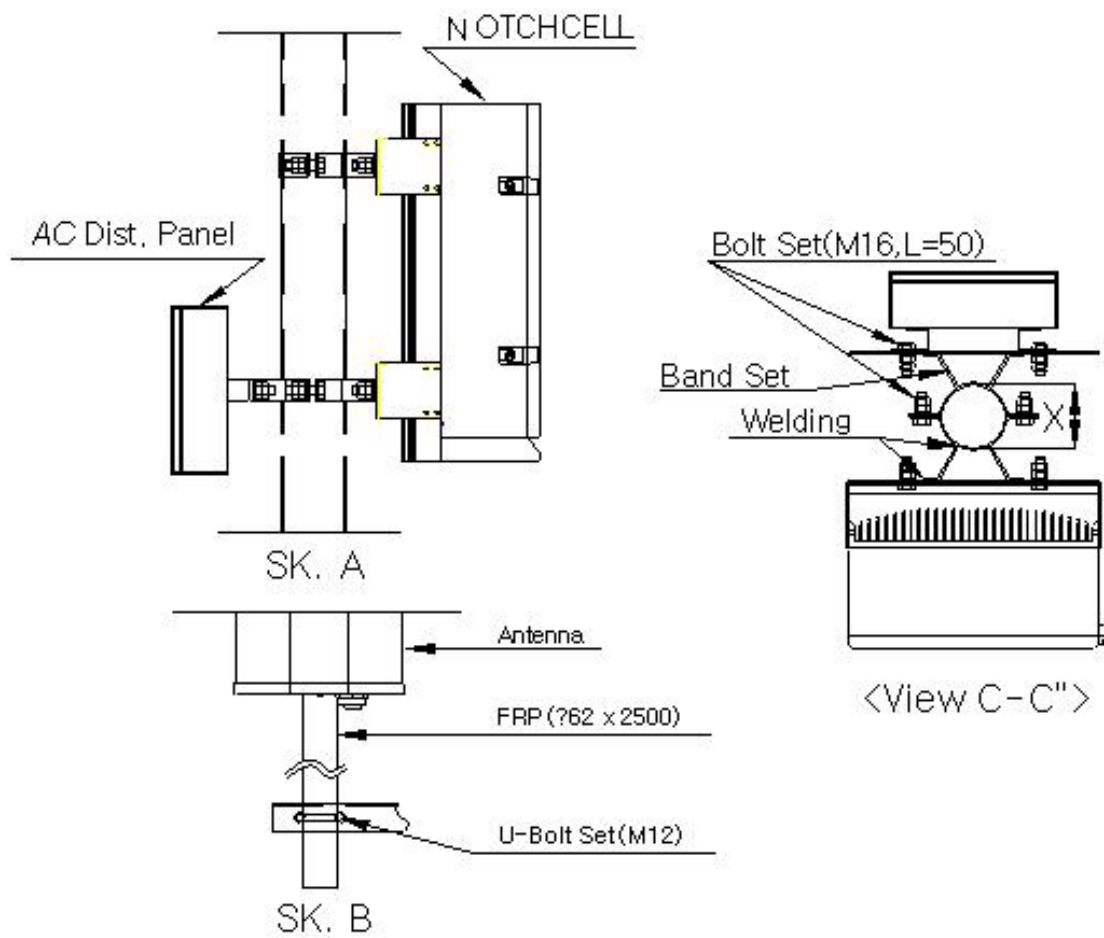


Figure 3.9 Band installation diagram 3 (location of repeater)



Figure 3.10 Band set

3.3.3.3 Installing L-Type angle

- The AC distribution panel shall be, in principle, on the left of the repeater.
- When installing the repeater on the roof, the standard height to the bottom of the repeater shall be 1.2m, and 4m when on a field.

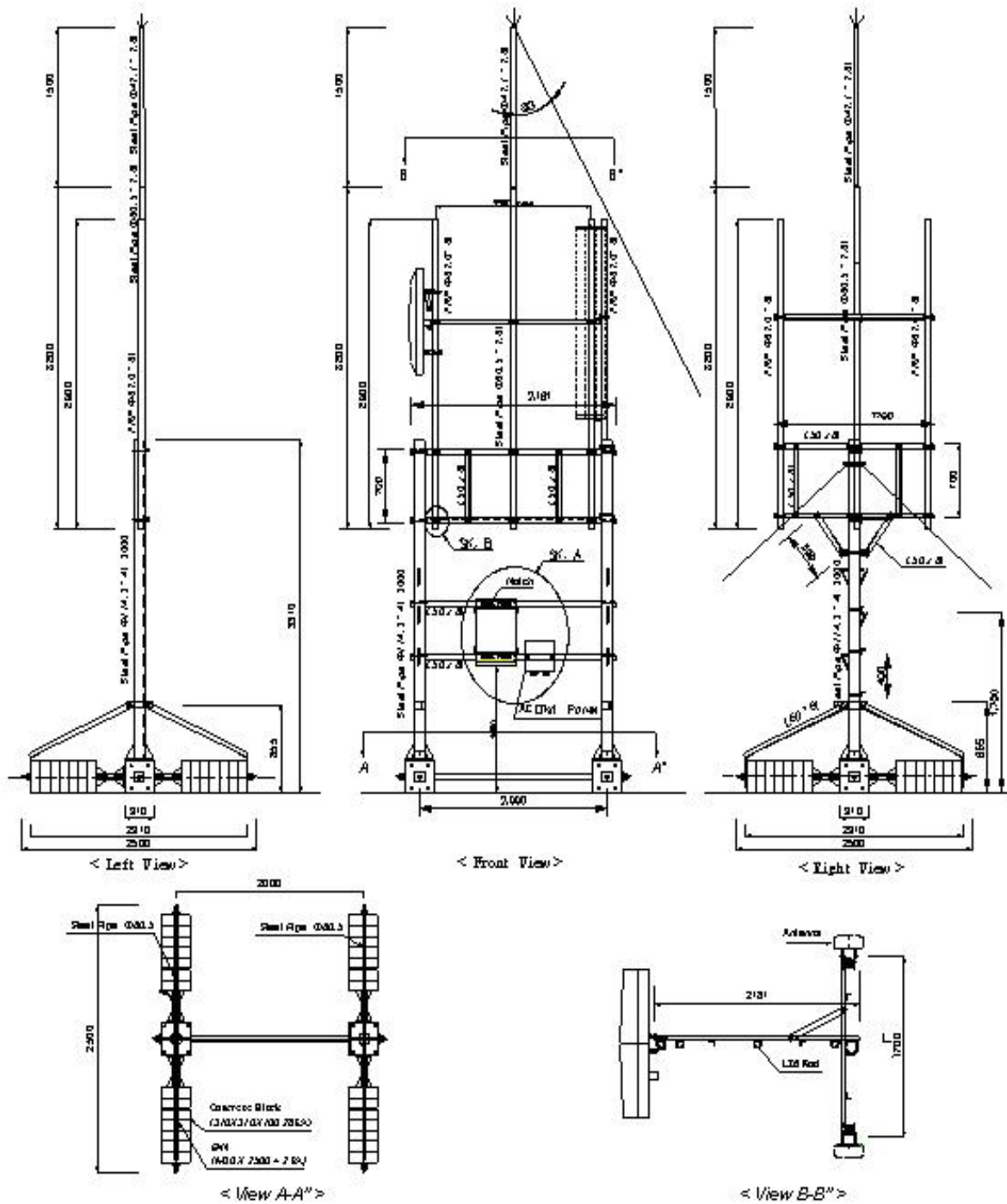


Figure 3.11 L-Type installation diagram 1 (steel tower type)

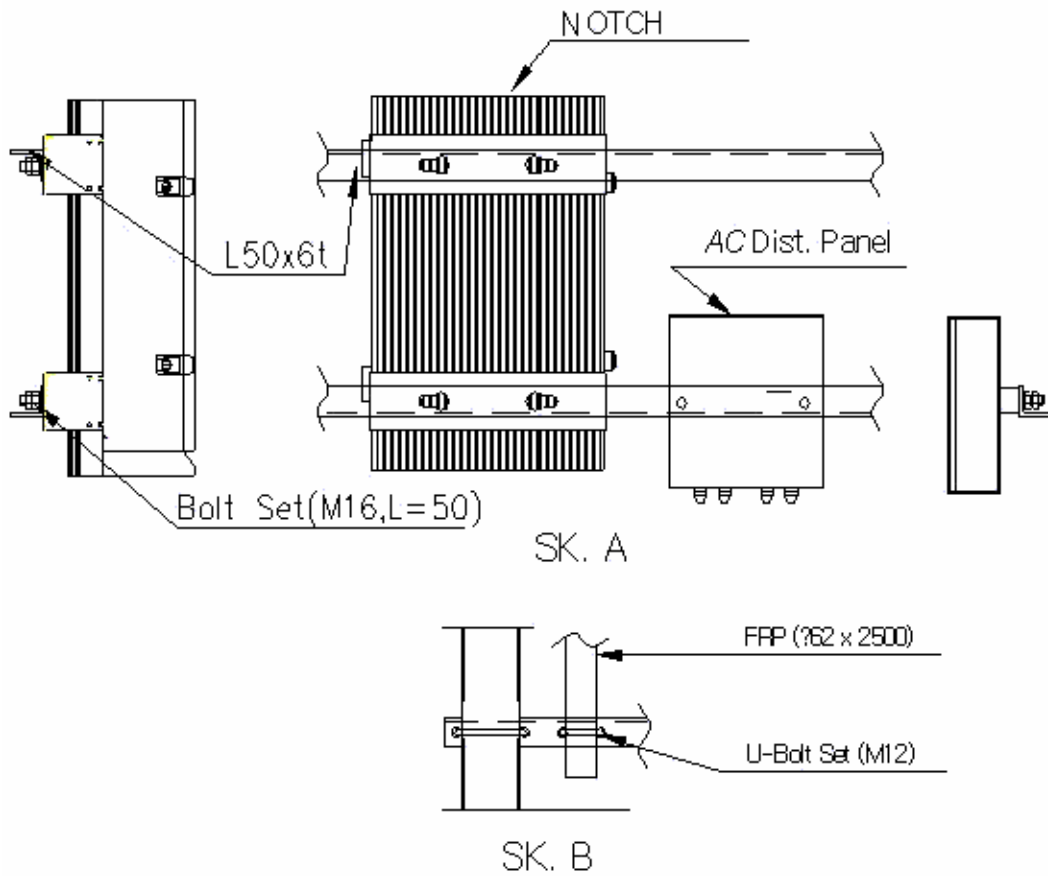


Figure 3.12 L-Type installation diagram 2 (location of repeater)

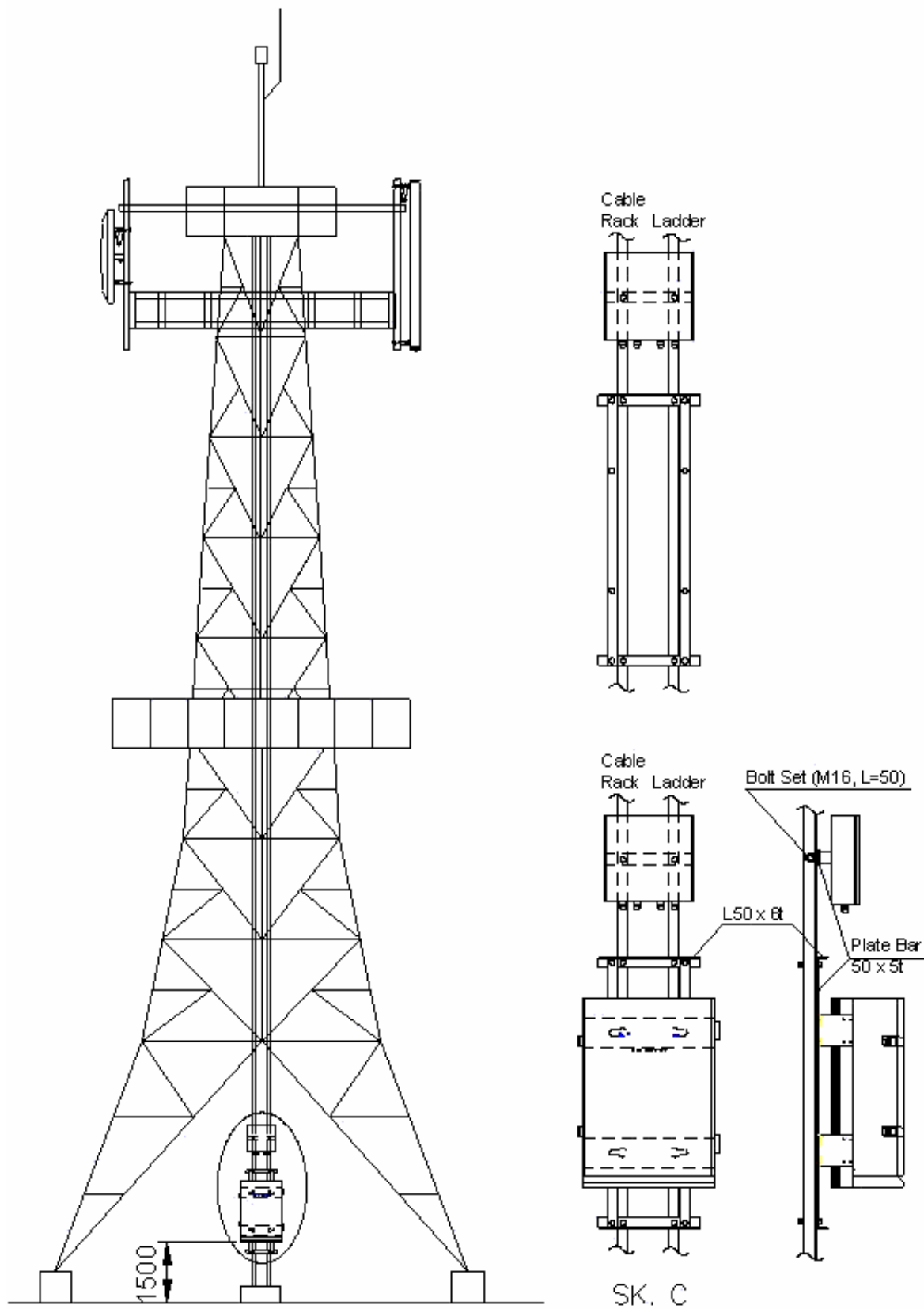


Figure 3.13 L-Type installation diagram 3 (steel tower type)

3.3.4 Installing AC power cable

3.3.4.1 AC distribution panel

Install the AC distribution panel on the steel tower to supply AC power to PSU of the repeater.

1) AC distribution panel specification

The AC distribution panel consists of a Breaker (30A), a Surge-Protector (40KA), a two - hole outlet, and terminal blocks.

The cabinet shall be waterproof and equipped with cable bushings on the bottom.

See “Chapter 3.3.3 Installing the repeater” to install the AC distribution panel.

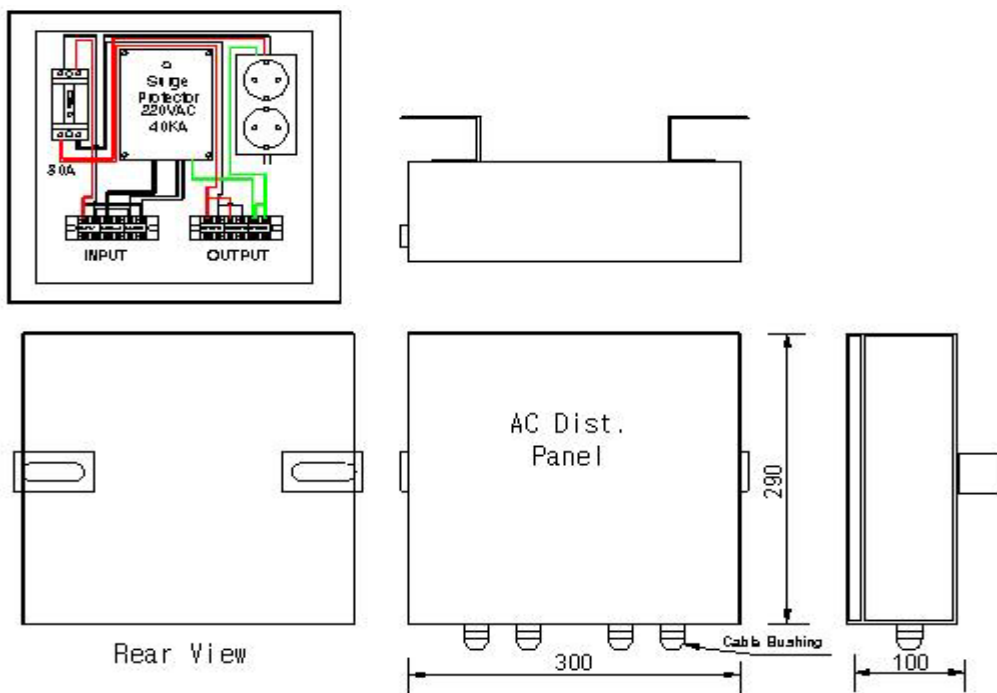


Figure 3.14 AC Distribution Panel Diagram 1



Figure 3.15 AC Distribution Panel Diagram 2

3.3.4.2 Installing AC power cable

- Connect the CV 5.5mm² ~ CV 22mm² x 2C power cable from the accumulative wattmeter to the AC distribution panel with the Ring Type Terminal Lugs and Flexible Conduits.
- Use the Fork Type Terminal Lugs when connecting the AC power cable.
- No cable will have contact points inside the conduit, and distribution/connection shall be allowed only in the AC distribution panel.
- Use 22mm flexible conduit when installing the power cable.
- Fix the conduit firmly on the wall or the ground with Saddle.
- Fill up the vacant cable busing holes on the AC distribution panel with silicon.
- Fit the end of the flexible conduits with the conduit caps or by taping.
- All the Flexible Conduits must be sealed tight.

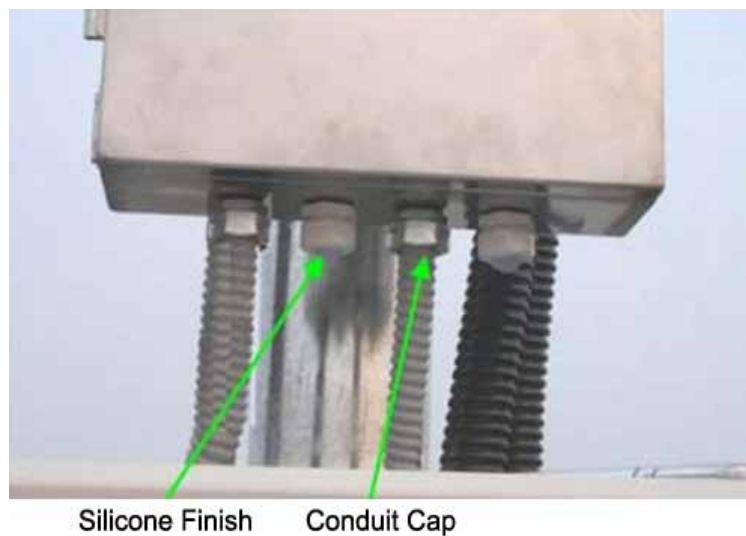


Figure 3.16 Flexible Conduit End Fitting

3.3.5 Grounding

Three types of grounding are applied - system grounding, arrester grounding, and steel tower grounding.

The arrester and the fixing studs are installed on the bottom of the repeater.

The steel tower grounding and arrester grounding shall be in conformity to the standard of the steel tower manufacturer.

3.3.5.1 General

- Use the GV cable for the grounding.
- Branch point shall be finished with C-tap and the heat shrink tube. When branching off outside, make sure to prevent the inflow of rain.
- Grounding shall be, in principle, connected from the Under Ground grounding.
- Install the grounding cable with PVC Flexile Pipe and Flexible Conduits for the external protection.

3.3.5.2 System grounding

- The Under Ground shall be made with up to 3 ground bars or with ground resistance of 20Ω or lower.
- After excavating the ground to 70Cm from the surface, cast the ground bars at a distance of at least 3m between one another.
- Connect the ground bars to the PVC Pipe with Bare Wire(38mm^2) and C-Tap.
- Connect GV 38mm^2 x 1C to the stud on the bottom of the cabinet with the underground bar.
- Use the 1 Hole Terminal Lugs, and finish with the Green Shrink Tube.
- For the arrester grounding of the steel tower, connect GV 38mm^2 x 1C from the Under Ground

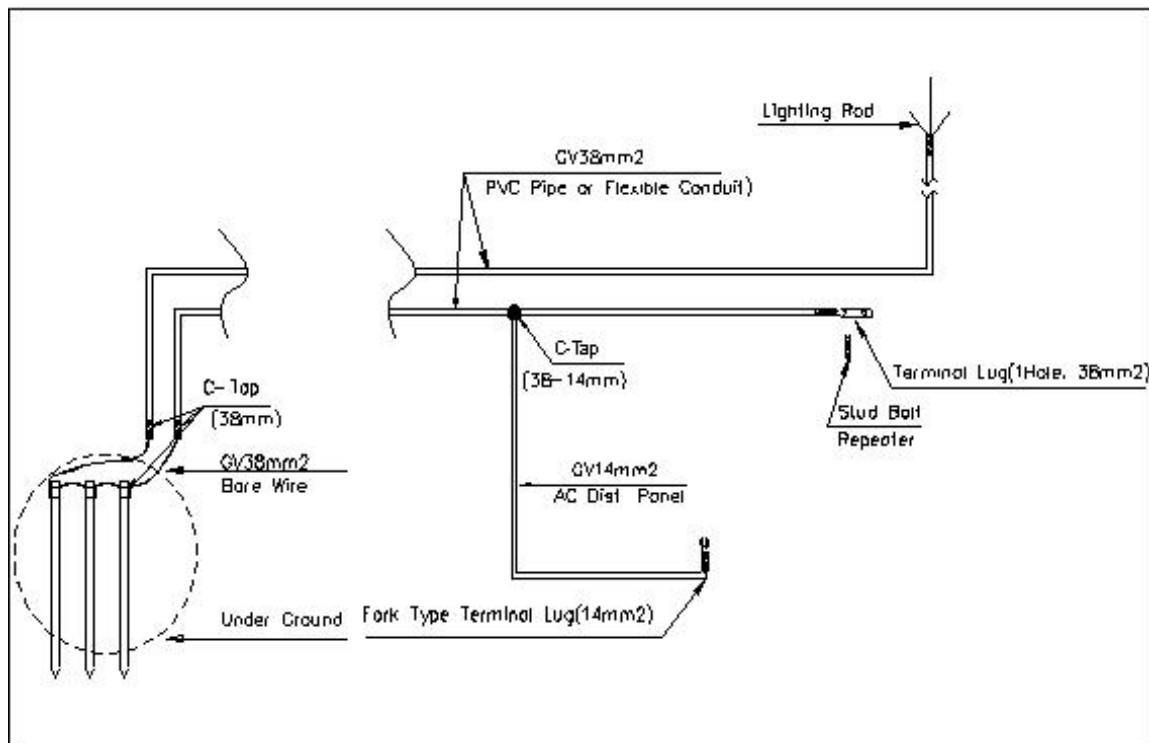


Figure 3.17 Ground Cable Diagram

3.3.5.3 AC distribution panel grounding

For Surge Protector ground of the AC distribution panel, connect GV 14mm² cable to the repeater cabinet grounding cable (GV 38mm²), branching it off with C-Tap (38-14mm).

Connect to the ground Terminal Block in the AC distribution panel with the Fork Type Terminal Lug.

3.3.6 Installing the feeder cable

3.3.6.1 Installing the feeder cable

1) Connection between the antenna and the repeater

Use two RF Repeater Antennas.

Install a pair of 1/2" cable from the arrestor on the bottom of the repeater cabinet to the Antenna.

The Standard of feeder cable between the Antenna and the repeater shall be conformed to that of the carrier.

The Connector for the feeder cable and the connector for the 36mm → #36 Flexible Conduit End Cap are installed on the bottom of the repeater and the RF Antenna.

2) Connecting the feeder cable connector

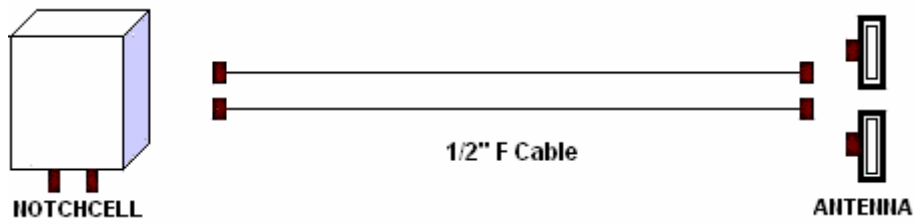


Figure 3.18 1/2" Feeder Cable Diagram

ITEM		ARRESTER	1/2" F CABLE		ANTENNA
Connector	Type	N - Female	N - Male	N - Male	N - Female
	Quantity	-	2	2	-
Feeder Cable Weight	Type	-	1/2" F Cable		-
	Quantity	-	2'		-

3) Cautions in the installation of the feeder cable

Install the cable in the shortest distance, if possible, between the Antenna and the repeater.

The selected cable path must not affect the appearance of the building or the station.

When installing the repeater in a general building, select the cable path in which the feeder cable is not damaged by outsiders or other factors.

Select the feeder cable path with less curves and attach the feeder cable tag.

The VSWR in the power feeder must not higher than the standard at the completion of the work.

Do not use the damaged feeder cable.

4) Installing/ tying the feeder cable

The installation of the feeder cable is sensitive to the bend radius and humidity.

Therefore, the following regulations shall be observed.

Maintain the minimum bend radius. (Higher than the standard presented by the manufacturers)

The cable must not be entangled.

Do not apply excessive force to the feeder cable to prevent bent insulated conductors or dug coverings.

The outer connecting part of the connector must be waterproof.

Tie the cable at every 50cm.

Tie the cables firmly so that they shall not be affected by external impact.

Use the bending machine if required to bend the cable.

Cut the feeder cable with a hacksaw and clean out the cut area.

5) Feeder cable connector

The followings shall be observed at the assembly of the feeder cable connector.

Cut the feeder cable carefully to prevent the inflow of water, steel and lead strip, or dust.

Clean the connector and the gasket connector to keep airtight.

Do not apply excessive force nor work in a hurry.

Avoid connection work at the time of rain. If it is unavoidable, be careful to prevent the inflow of rain to the connecting part of the feeder cable connector.

All the connector parts must be waterproof.

Install the 1/2" feeder cable by inserting it into the shield cable and 36mm flexible conduit. In case of the 7/8" feeder cable, install the cable only.

The installation of the 1/2" feeder cable is as follows

Cut the 1/2" feeder cable, Shield cable and 38mm Flexible Conduit in a necessary length.

Insert 1/2" feeder cable into the Shield cable, and then assemble the connectors at both ends.

Compress the Shield cable on the Antenna side with the Heat Shrink Tube.



Figure 3.19 Shield Cable and Connector

Assemble the Conduit End Cap (repeater accessory) at both ends of 36mm Flexible Conduit.

Insert the assembled 1/2" feeder cable (shield cable) into the 36mm Flexible Conduit.

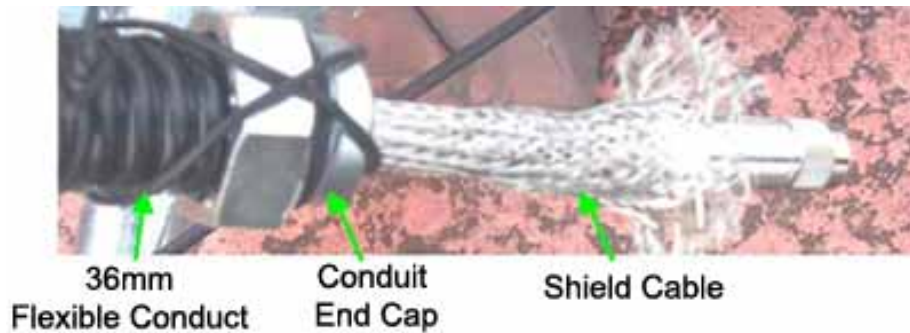


Figure 3.20 Feeder Cable at Repeater Side

After installing and tying the cable, connect the connector to the bottom of the antenna and then apply the Conduit End Cap.



Figure 3.21 Connector on the Antenna Side

Compress the Shield cable on the repeater with the heat shrink tube.

Connect the feeder cable connector to the arrestor onto the bottom of the repeater, and then apply the Conduit End Cap.



Figure 3.22 Installing the connector on the repeater side

3.3.7 Installing Antenna

3.3.7.1 Precautions

Antenna is a precise material. Make sure of no damage or deformation on it through the careful installation.

Do not apply excessive force nor work in a hurry.

The retainers shall be zinc plated.

Set the accurate direction of the antenna with the transit when setting up antenna support and its installation direction.

Select the location where radiating or receiving the radio wave from the antenna is not disturbed by neighboring buildings or other topographical features or where bad influences can be excluded.

Select the location where the antenna is electrically isolated enough from spurious wave or high voltage cable that may block the radio wave radiation or reception.

Load generated by the Antenna must be evenly distributed on the steel tower. It must be also applied on the main material of the steel tower.

Each Antenna supporting bar must be fixed under the safety angle (60°) of lighting rod.

3.3.7.2 Installing Antenna

Fix the Antenna firmly to stand against external impact and wind.

For isolation, FRP (Φ62x2900) shall be used as the Antenna fixing bar.

The Antenna shall be installed at a distance of minimum 1.5m from the Donor Antenna and the Distributor Antenna.

Fix the Donor and Distributor antenna-fixing bar (FRP) onto at least 3 spots on the steel tower with the U- Bolt

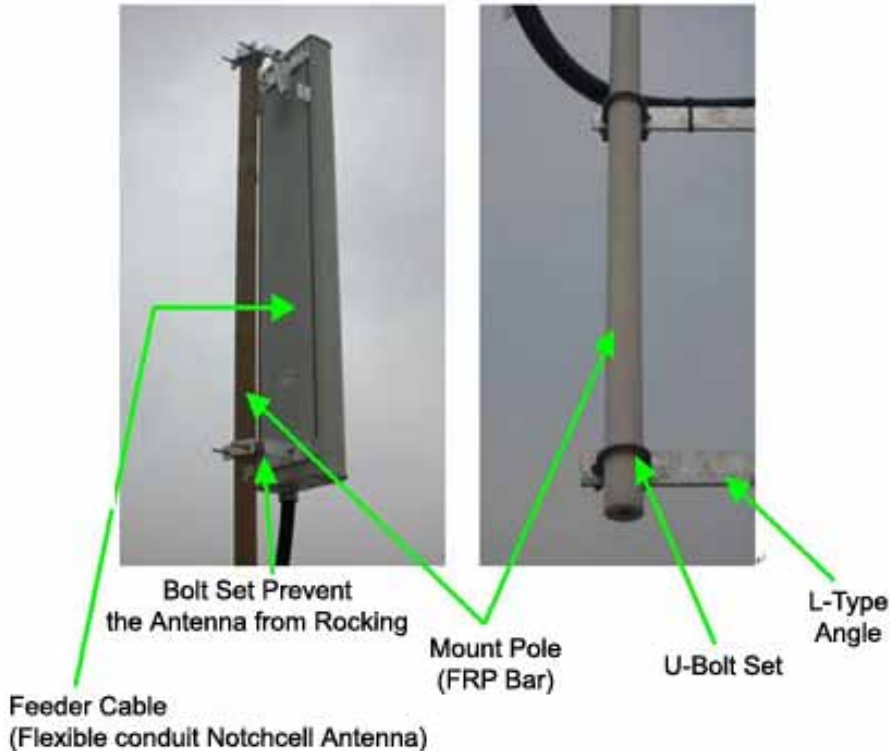


Figure 3.23 Antenna Installation

4. Operation

4.1 Isolation test procedure of Antenna

4.1.1 Isolation Measurement using for Signal Generator and Spectrum Analyzer.

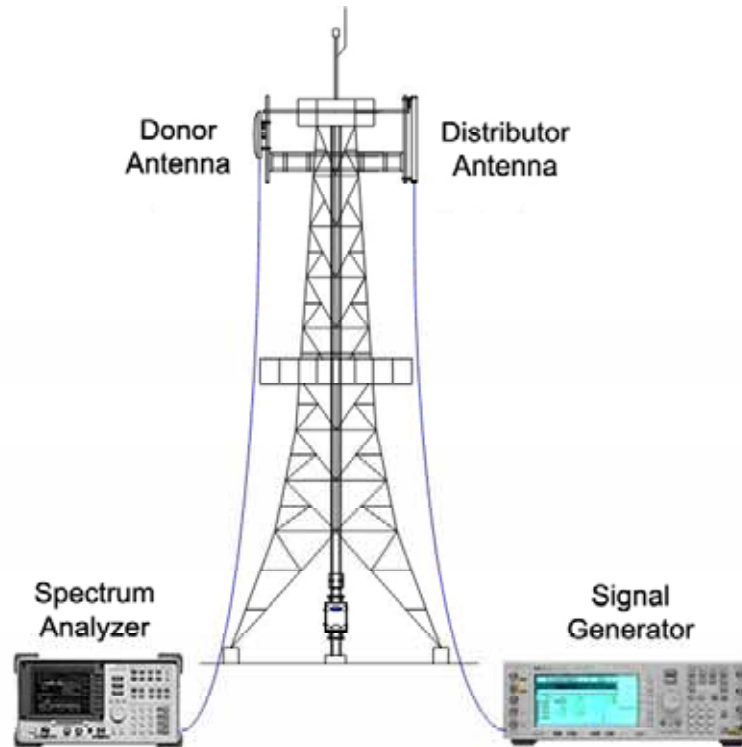


Figure 4.1 Isolation test with S/G & S/A

The followings are isolation check procedures on the field site, using signal analyzer and spectrum generator.

- a Set-up the equipment as shown in Figure 4.1 Isolation test
- b Set up the analyzer for the highest possible sensitivity (more than -100dBm) for 0 dBm source-power.
- c Set the analyzer to "peak search mode".
- d After calibrated cable loss between Measurement Equip and Antenna, set the output-power of the generator to 0 dBm .
- e Turn on Signal Generator Output
- f Measure the Antenna Isolation, using spectrum analyzer. The minimum isolation is the highest value of the curve (excepting carriers transmitted by surrounding BS).
- g Change measurement-ports to check for the opposite direction by repeating the measurement procedure.
- h Repeat the test for the opposite path of the repeater. Step a to g.

*Isolation per carrier frequency is worse value.

4.1.2 Isolation Check using Isolation Check Menu

Notchcell 20Watt repeater isolation can be checked in the field without signal generator and spectrum analyzer. Details are as followings.

1. Generate CW signal, using band guard pilot generator up link path(Repeater output power : 30dBm)
2. Check power value which CW signal feeds back from donor to distributor antenna.
3. Isolation value = measured power value + output value 30 dBm
4. See more detailed measurement procedures at chapter 5.5.6 Isolation checking.

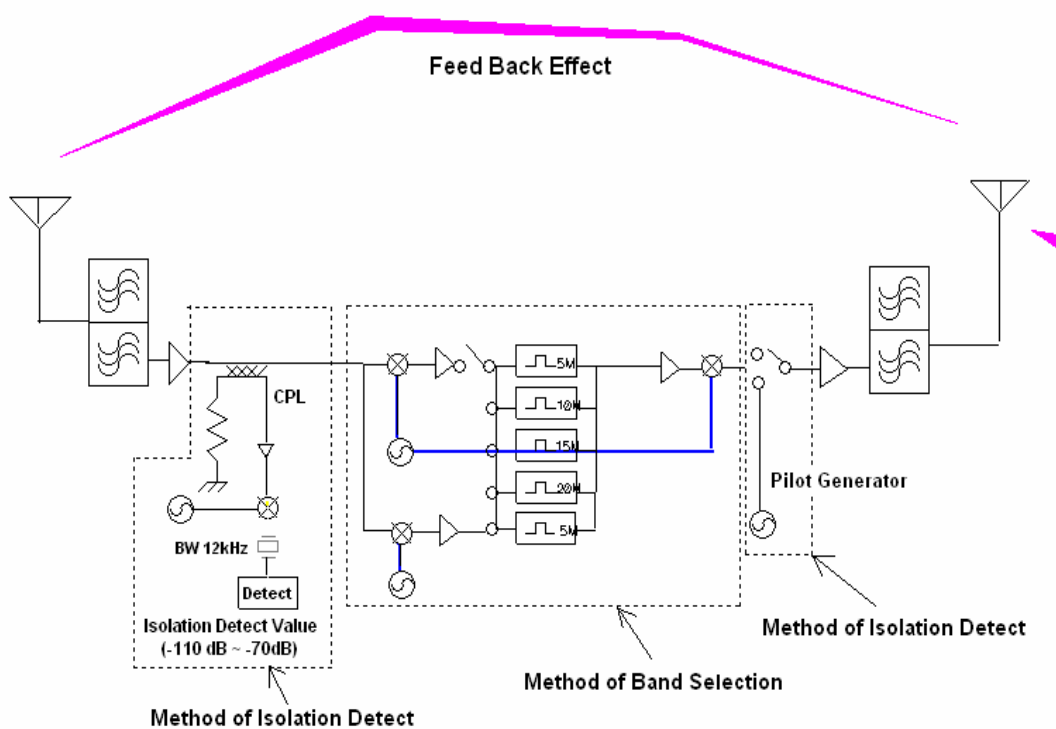


Figure 4.2 Isolation Check Block Diagram

5. Graphic User Interface

5.1 Introduction

This standards provides you how to install Notchcell 20Watts repeater software which is programmable type and how to maintain it.

5.1.1 Compatibility

Notchcell programmable type GUI(Graphic User Interface) can be used regardless of output power.

GUI program is based on windows 2000 or XP and the version of software and firmware is as following,.

Product	Software version	Firmware version
NOTCHCELL 20W	1.1.0	1.1.1.0

5.2 Getting Started

5.2.1 Necessities

- GUI software program
- Computer
- RS232 cable for Notchcell and PC connection

5.2.2 System Requirements

Windows 2000/XP	Free serial port or USB to RS232 converter
128 MB RAM	10 MB free space on hard drive
Pentium III processor	monitor (minimum 1024 X 768)
Mouse, keyboard	CD-ROM drive

5.2.3 Software Installation

- To install GUI

1. Click "setup.exe" file which is in GUI program folder and then install GUI program.

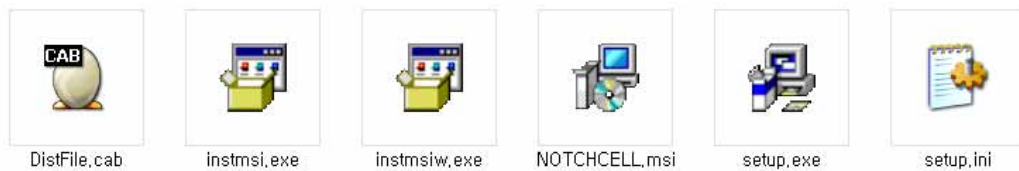


Figure 5.1 GUI Program Folder

2. Follow the on-screen instructions.

GUI program will be installed at C:\Program Files\NOTCHCELL folder.

5.3 Connecting to the NOTCHCELL

5.3.1 Local Connection

How to setup a connection directly (local) to the Notchcell.

1. Connect RS232C cable with Notchcell “**LOCAL OMT**” port.
2. Connect adapter with PC serial port.

When it comes to USB, use USB to RS232C adapter.



Figure 5.2 Local connection

5.3.2 AC Power ON

1. Check the status of Notchcell power cable connection.



Figure 5.3 AC Power cable connection

2. Open PSU box door and AC input switch as “ON” status.



Figure 5.4 AC Power ON

3. Check whether AC and DC fail LED color which is located in power supply unit will be green or not.



Figure 5.5 Power Alarm LED

- **Note** : “BATT. FAIL” color will be green when battery properly connected with “DC IN(24V)” and power supply unit “EXT. BATT. Input” switch should be “ON” status.

5.4 Setup & Status Mode System Displays

Notchcell GUI consists of “Setup Mode” which enables system control and “Status Mode” which indicates system status. More details about GUI parameter, check Appendix A – System Parameters.

5.4.1 Setup Mode

Repeater can be controlled in Setup mode. In Setup pop-up window, you can input the value and control Bandwidth/Band, DL/UL Path, ALC, Shut down and attenuation. When you are going to change the setting value, you should click “Set” button which is in up-right side in the GUI screen.

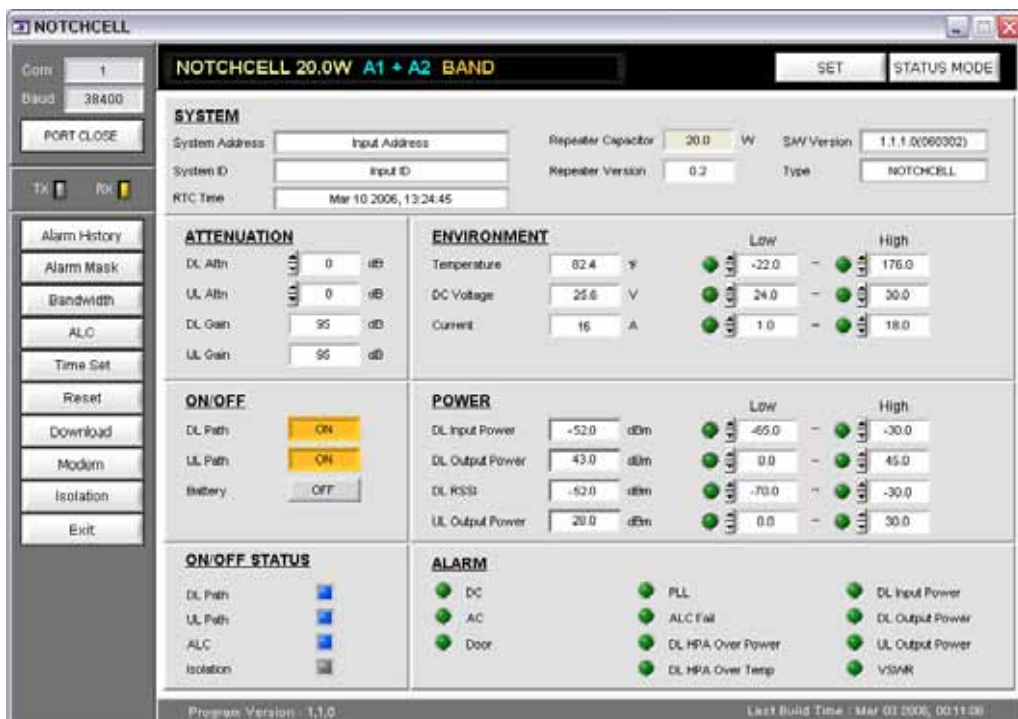


Figure 5.6 Setup mode window

5.4.2 Status Mode

When you are going to check repeater status, click “Status mode” button which is in the up-right side in the screen. And then check the value which is displayed in “Status mode” and you can change output value, using attenuation value.

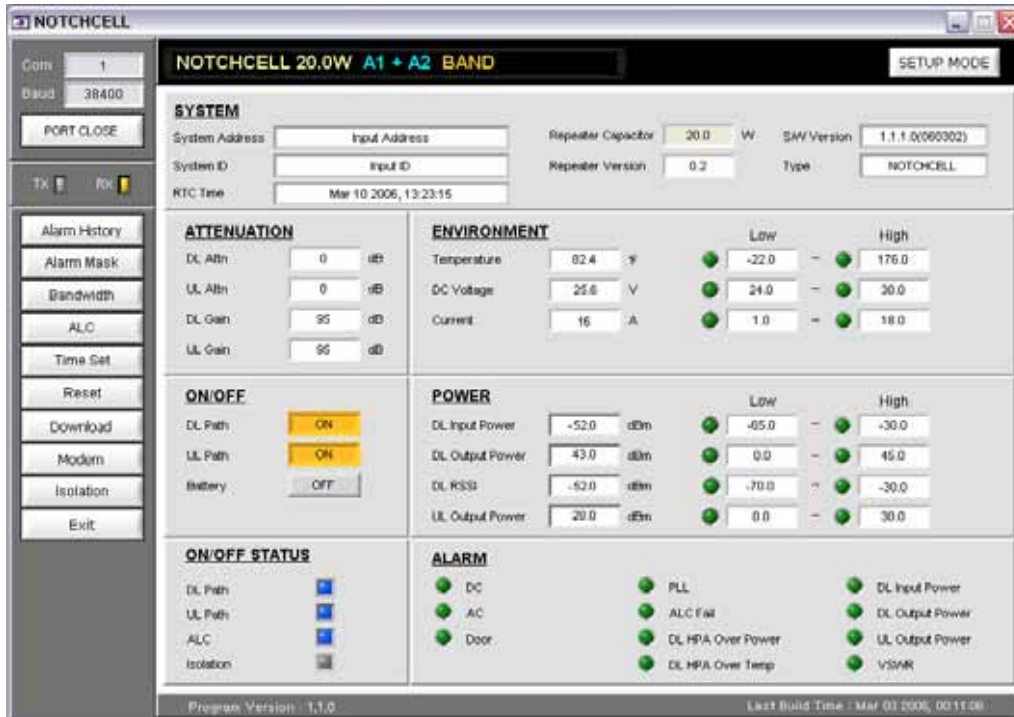


Figure 5.7 Status mode window

5.5 Repeater Set Using GUI

5.5.1 Executing GUI program

Execute Notchcell GUI program. (Installation details are in Chapter 5.2.3)

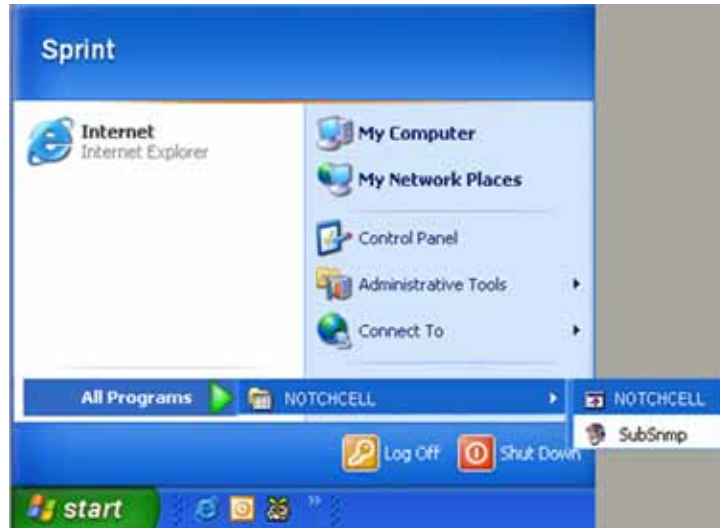


Figure 5.8 Execute GUI on Windows XP

5.5.2 User Check

When you execute GUI program, you can see login pop-up window.
(ID : operator / Password : spcs)



Figure 5.9 login pop-up window

5.5.3 Communication Port and Speed Configuration

You should set the communication speed and port between your computer and Notchcell for mutual communication.

User can set communication speed and port which control button is located upper left-side in the main window screen. After that, communication is started. (Communication Speed : 38,400 bit / second)

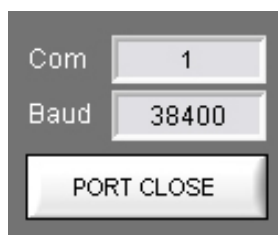


Figure 5.10 Communication Port and Speed Configuration

► **Note** : How to check computer communication port

1. Go to "Windows Control Panel".
2. Go to "Function and Maintenance Management"
3. Go to "System"
4. Go to "Hardware"
5. Go to "System Management"
6. Go to "Port"
7. Check "Communication Port"

5.5.4 GUI Communication

When it is properly communicated between computer and repeater MCU board, Tx / Rx yellow LED will be lit which is located the left-upper end in the GUI screen.



Figure 5.11 Communication Check LED

5.5.5 Bandwidth & Band Setting

When you click “Bandwidth” which is located left end in main window menu bar, you can see bandwidth and band configuration pop-up window.

Then, set the band and bandwidth, considering the field condition. (See the following table 5.1)

Bandwidth	Band
5 MHz	A1, A2, A3, D, B1, B2, B3, E, F, C3, C4, C5
10 MHz	A1A2, A2A3, A3D, DB1, B1B2, B2B3, B3E, EF, FC3, C3C4, C4C5
15 MHz	A1A2A3, A3DB1, DB1B2, B1B2B3, B2B3E, B3EF, EFC3, FC3C4, C3C4C5
20 MHz	A1A2A3D, A2A3DB1, A3DB1B2, DB1B2B3, B1B2B3E, B2B3EF, B3EFC3, EFC3C4, FC3C4C5
5+5 MHz	A1+D,A2+D,B2+D,B3+D,E+D,F+D,C3+D,C4+D,C5+D, A1+E,A2+E,A3+E,DE.B1+E,B2+E,C3+E,C4+E,C5+E, A1+F,A2+F,A3+F,D+F,B1+F,B2+F,B3+F,C4+F,C5+F
10+5MHz	A1A2+D, B2B3+D, B3E+D, EF+D, FC1+D, C3C4+D, C4C5+D, A1A2+E, A2A3+E, A3D+E, DB1+E, B1B2+E, C3C4+E, C4C5+E, A1A2+F, A2A3+F, A3D+F, DB1+F, B1B2+F, B2B3+F, C4C5+F
15+5MHz	B2B3E+D, B3EF+D, EFC3+D, FC3C4+D, C3C4C5+D A1A2A3+E, A2A3D+E, A3DB1+E, DB1B2+E, C3C4C5+E A1A2A3+F, A2A3D+F, A3DB1+F ,DB1B2+F, B1B2B3+F

Table 5.1 Available Band and Bandwidth

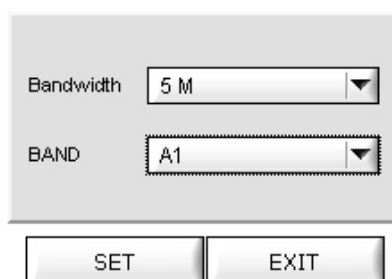


Figure 5.12 Bandwidth Set Pop-up Window

► **Note** : How to set bandwidth

For example, you are in A1, A2 band,

Click “Bandwidth” which is located in left end menu bar.

According to the above table 5.1., band is A1, A2 10MHz bandwidth, select “10M” as bandwidth.

Select ” A1+A2” in the band bar.

Click "SET" button to fix bandwidth and band.

Click "EXIT" button for exiting bandwidth pop-up window.

5.5.6 Isolation Checking

When you click “Isolation” button which is located left side menu bar, the following pop-up window which is for isolation check between donor and distributor antennas will be opened. “Isolation pilot power” value stands for isolation antenna value.

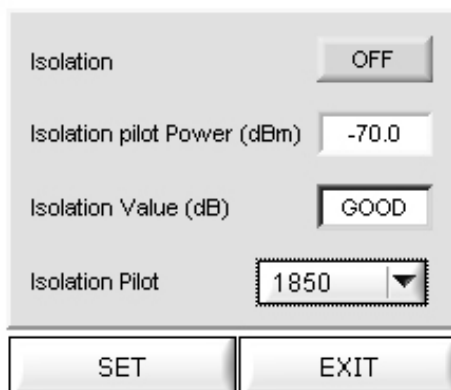


Figure 5.13 Isolation checking window

► **Note** : How to check isolation.

Considering your location, check whether the repeater bandwidth and band are properly set.

Select “Isolation” in the menu bar.

Set “Isolation Pilot” value as UL path frequency which is used in the field.

Click “Isolation” button and make it as “ON” status. Then, click “SET” button.

The value which is in isolation value pop-up window is current system isolation value.

- When isolation value will be over 110, it is displayed as “Good”.

When it is under 75, it is displayed as “Bad”.

From 110 to 75, isolation value will be displayed.

Following the above procedures, you should set the isolation only one time.

5.5.7 Gain & Attenuation Value Setting

Following the above 5.5.6 isolation value setting, repeater gain can be set like below. Maximum repeater gain is 95dB.

You can set attenuation value, controlling DL / UL ATTN. value which you are going to be output value.

- Maximum Gain(dB) = Isolation Value(dB) – Margin (Margin \geq 15dB)
- Repeater Gain(dB) = User's targeting Repeater Output Power(dBm) - Input power(dBm)
- Attenuation Value(dB) = 95(dB) – Repeater Gain(dB)

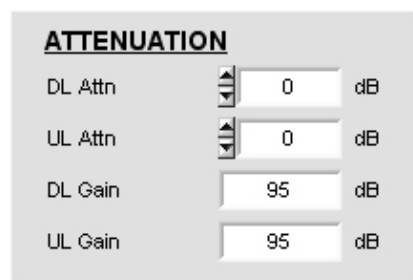


Figure 5.14 Gain setting window

► **Note** : How to set gain & attenuation value

Example 1) Field isolation value is 100. Down Link Path repeater input value is -55dBm. User's target output is 30dBm.

Maximum available gain = 100(dB)–15(dB) = 85dB

Therefore, maximum gain value is 85dB.

Repeater Gain setting :

Repeater Gain(dB) = 30(dBm) – (-55(dBm)) = 85(dB)

When an user is going to use output 30dBm, repeater gain needs 85dB.

Attenuation Value setting :

Attenuation Value(dB) = 95(dB) – 85(dB) =10(dB)

Set "DL Attn" value as 10 in the GUI and click "SET" button which is located up-right end. On status mode, you can check "DL Attn" value is 10 and "DL Gain" value is 85.

Example 2) Field isolation value is 100. Repeater input value is -65 dBm.

User's target output is 30dBm.

Maximum available gain = $100(\text{dB}) - 15(\text{dB}) = 85\text{dB}$

Repeater Gain setting :

Repeater Gain(dB) = $30(\text{dBm}) - (-65(\text{dBm})) = 95(\text{dB})$

Current input level -65dBm. Therefore, when an user is going to use output; 30dBm, repeater gain needs 95dB. Considering maximum repeater gain;85dB, you can not set 30dBm as repeater output value.

► **Note** : Taking the above example 2, how to use repeater output as 30dBm.

Change the direction of donor antenna for better input signal.

(minimum -55dBm)

Set antennas isolation value as 110.

5.5.8 ALC(Auto Level control) & Shut-Down Setting

When you click “ALC” button which is located in left side menu bar, ALC, shutdown set and ON/OFF control pop-up window will be displayed.

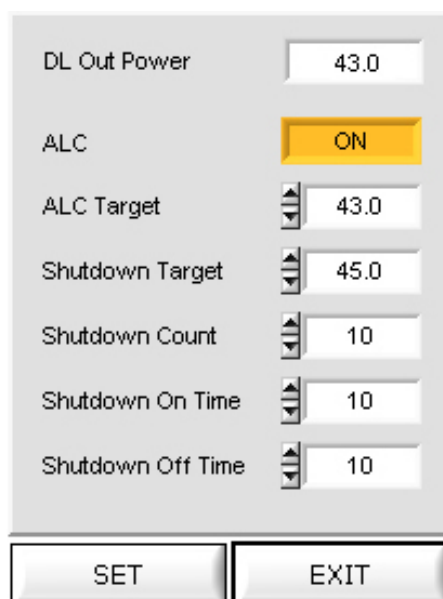
In the pop-up window, you can set downlink path output power like the above 5.5.7.

When DL output value will be over than shutdown target set value, the repeater will be shutdown.

Normally, shutdown target value will be set 3dB higher than ALC target value.

About how to set shutdown count, shutdown on time and shutdown off time, please refer it to Appendix A, Chapter A.2.4. ALC.

After input the value, click “SET” button for confirmation which is located in down side in the ALC Set pop-up window.



The screenshot shows a pop-up window with the following settings:

DL Out Power	43.0
ALC	ON
ALC Target	43.0
Shutdown Target	45.0
Shutdown Count	10
Shutdown On Time	10
Shutdown Off Time	10

At the bottom of the window are two buttons: SET and EXIT.

Figure 5.15 ALC Set Pop-up Window

► **Note** : How to set ALC / Shutdown Target Value.

When user set downlink path output power is 40dBm :

About ALC, DL output power value is 40dBm. Therefore, set ALC target value as 40.

Normal field situation, shutdown target value will be 43, 3dB higher than ALC target value.

► **Note** : How to work ALC and ASD

If the ALC gets activated with system output exceeding ALC Target values, you need to use the USER ATT to adjust the output to meet the range of the upper settings. If the output exceeds the Attenuation range (30dB), the ALC FAIL alarm will occur. If the system output exceeds the Shutdown Target value due to lack of attenuation, then the ASD (Auto Shut Down) will be activated.

If output exceeds the Shutdown target values and makes the repeater shut down, the repeater goes back to the active status after the 'Shutdown-on' time. If the output of the repeater is higher than the set target value, the repeater will be deactivated again after the set 'Shut down-off' time.

The repeater repeats the process by the Shutdown count. If the output of the repeater still exceeds the target value after the repetitive work, the repeater will turn completely off.

5.5.9 How to Set Alarm Range

Set input / output RF power maximum and minimum value of Down Link/Up Link.

When you are going to change the value, input the value and click “SET” button which is located in up side control pop-up window.

You can check down link and up link input / output values at status mode.

POWER		Low	High
DL Input Power	<input type="text" value="-52.0"/> dBm	<input type="text" value="-65.0"/> ~ <input type="text" value="-30.0"/>	
DL Output Power	<input type="text" value="43.0"/> dBm	<input type="text" value="0.0"/> ~ <input type="text" value="45.0"/>	
DL RSSI	<input type="text" value="-52.0"/> dBm	<input type="text" value="-70.0"/> ~ <input type="text" value="-30.0"/>	
UL Output Power	<input type="text" value="28.0"/> dBm	<input type="text" value="0.0"/> ~ <input type="text" value="30.0"/>	

Figure 5.16 Controlling Input/output

► **Note : How to set Alarm range**

* We would like to recommend you how to set alarm range as followings,.

Make the gap between downlink path input power value and downlink input power alarm range will be 5dB.

For example, when input power is -50dBm, alarm range will be from -55 to -45dBm.

Make the gap between downlink output power and downlink path output power value will be 3dB.

For example, when output power is 30dBm, alarm range will be from 27 to 33 dBm.

Uplink output power alarm range will be from 0 to 30 dBm.

5.5.10 Modem Setting

When you click “Modem” button which is located in left side menu bar, you can see the following picture for basic modem set.

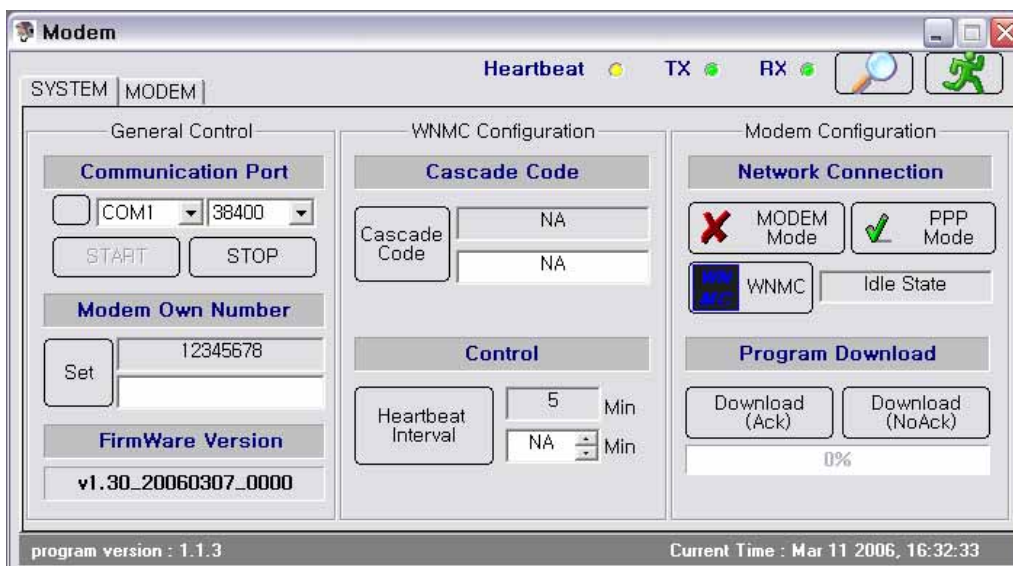


Figure 5.17 Modem System Window

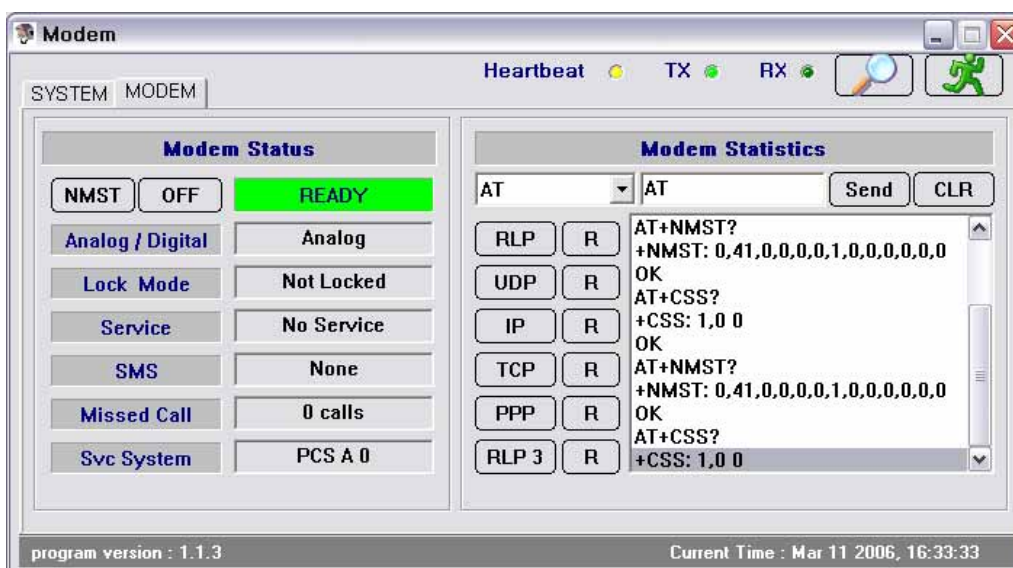


Figure 5.18 Modem Status Window

► **Note** : How to check whether wireless modem properly works.

Click “Modem” which is located in left side menu bar.

When you see pop-up window like figure 5.17, make communication port configuration same as GUI setting.

Click “START” button.

Check every parameters are same as your target value.(You can see more details at appendix B B1.4)

- Modem Own Number : This is own number of WNMC (Wireless Network Management Center) and your modem can make a phone call with this number.
- Cascade Code : This is ID where the repeater is installed.

When the set value should be changed or updated, input new proper system value in cascade code and click “SET” button. After that, site ID will be newly updated and update confirmation pop-up message will be displayed.

- Control(Heartbeat Interval) : Controller periodically sends its information to WNMC. We call it “Heartbeat”. Heartbeat time gap can be set from 3 to 59 minutes.

Click “Modem” button which is located in left side of modem system window.

Click “NMST” button.

Check “Ready” button will be activated as green color which is beside “NMST” button.

Check modem status parameters. When displays are same as the followings, it means that wireless modem setting is OK.

Analog / Digital	Digital
Lock Mode	-
Service	In Service
SMS	-
Missed Call	-
Svc System	PCS + Band Name + Numeric 4 or 5 Digits

5.5.11 Default Alarm History

When an alarm is happened, alarm type and time are recorded in the alarm history. To save repeater status check time, you can delete all alarming history for next default setting.

More detail alarm history window parameters are in appendix A, Chapter A.2.1.

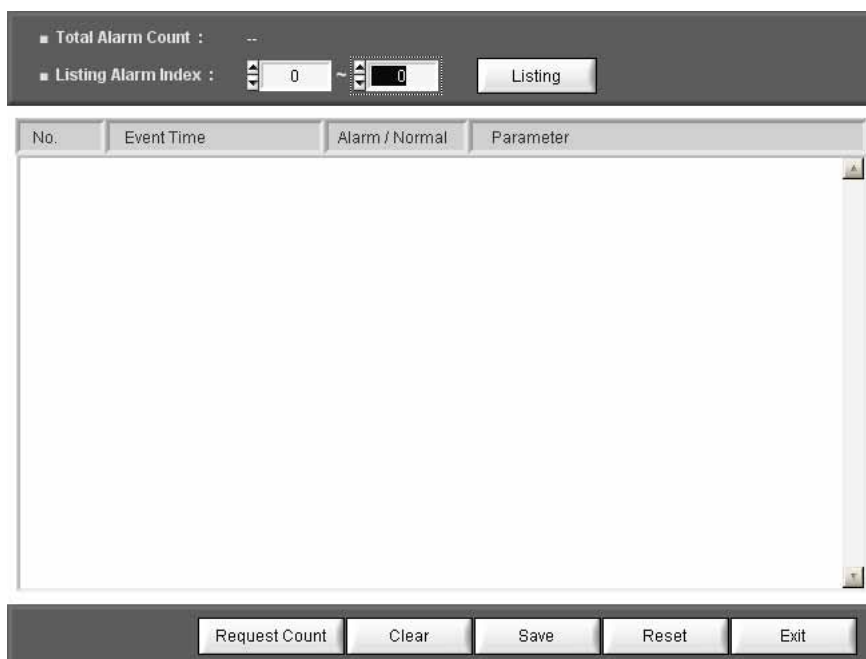


Figure 5.19 Alarm History Window

► **Note** : How to delete alarm history

Click “Alarm History” button in the menu bar.

Click “Reset” button for all deletes.

Click “Request Count” button and check whether alarm history is completely deleted or not.

5.5.12 Repeater Reset

Click “Reset” button in the menu bar and check whether the repeater is properly operated or not.

Appendix A. System Parameters

A.1 System state window

On the top side of GUI, repeater model name, current bandwidth and band are displayed. On the left side, there are “SET MODE” and “STATUS MODE” buttons.

A.1.1 SYSTEM

- System Address : Indicates where the repeater is installed.
- System ID : Allocated number from base station. (from 0 to 16383)
For example, when PCS & A band system ID is 0, Service will be indicated as “PCS B 0”.
- RTC Time: Display current time which currently set in MCU.
When repeater time is incorrect, you can change it correctly, using Time Set in the menu bar.
- Repeater Capacitor : Repeater output
- Repeater Version : H/W version
- S/W Version : Repeater program(firmware) version
- Type : Repeater type

A.1.2 ATTENUATION

- DL / UL ATTN : On “SET Mode”, user can set downlink & uplink path attenuation.
- DL / UL GAIN : On “STATUS Mode”, user can check DL/UL attenuation system gain which is set on “SET Mode”

A.1.3 ENVIRONMENT

- Env. Temp. : It displays system temperature.
- DC Volt : It displays voltage status of power supply unit.
- Current : It displays using system current volume
- Battery Volt : It displays voltage status of power supply unit

A.1.4 ON / OFF

- DL / UL HPA : Downlink and uplink power amplifiers ON / OFF.
- Battery : Battery ON / OFF(Battery is optional)

A.1.5 POWER

- DL In Power : Set alarm range and display downlink path input power.
- DL Out Power : Set alarm range and display downlink path output power.
- UL Out Power : Set alarm range and display uplink path output power.

A.1.6 STAUS (ON / OFF)

- DL / UL Path : It displays the status of system DL/UL path. Path on status is blue, off status is grey color.
- ALC : It displays ALC operation status. ALC on status is blue, off status is grey color.
- Isolation : It displays isolation operation status. Isolation on status is blue, off status is grey color. When isolation "ON" status, UL path turns automatically "ON" status.

A.1.7 ALARM

- DC / AC Alarm : Appears when DC/AC voltage exceeds the upper/lower values set in the “**ENVIRONMENT**” window.
- Door alarm: Appears when the housing door of the repeater is open.
- Battery Fail Alarm: This alarm stays unseen in the alarm indication window until you turns the battery on in the “**ON/OFF**” window. This alarm appears when the battery voltage values exceed the upper/lower values set in the “**ENVIRONMENT**” window.
- PLL Alarm : Appears when PLL is unlocked.
- ALC Fail Alarm : This alarm appears when output during ALC operation is larger/smaller than ALC High/Low limit values due to lack of attenuation. To clear the alarm, you need to turn off the ALC operation mode or make the output stay in the ALC setting range.
- DL HPA Over Power Alarm: Appears to protect the equipment when system output surges abruptly. At this time, AMP will be shut down as well.
- DL HPA Over Temp. Alarm: Appears when DL HPA’s internal temperature surpasses 90 degree.
- DL Input Power Alarm: Appears when the repeater’s DL input is out of the upper/lower values set in the “**POWER**” window. The alarm types include Low and High alarms.
- DL / UL Output Power Alarm: Appears when the repeater’s DL input is out of the upper/lower values set in the “**POWER**” window. The alarm types include Low and High alarms.
- VSWR Alarm: Appears when the reflected wave of output compared to input exceeds the setting range of the VSWR Limit (1:3) or antenna VSWR and Feeder Cable VSWR are faulty.

A.2 Menu Selection Window

A.2.1 Alarm History

This window shows details on alarms stored in the system.

- Total Alarm Count : Indicates the number of alarms stored in the current MCU. Each count refers to alarm(s) occurring in the same timeframe. The number can be up to 250.
- Listing Alarm Index : Lets you set the number of alarms seen on the screen. When you set a desired number and press the 'listing' button, the screen will show related alarms.
- Clear : Deletes alarms from the screen. When you press the Clear button, alarms will not be deleted from the MCU.
- Save : Stores the alarm history seen on the screen.
- Reset : Deletes all and every alarm from the current screen and the MCU alike.
- Exit : Closes the alarm history window.

A.2.2 Alarm Mask

This function enables you not to display frequently-made / unnecessary alarms with masking.

A.2.3 Bandwidth Setting

Set bandwidth and band name which are proper to current repeater field condition.

A.2.4 ALC (Auto Level Control)

This function lets you control ALC settings and the ON/OFF status. To change a setting, you need to enter a value and click the SET button at the lower part of the Control Window.

- ALC Target : DL output value which you are going to maintain.
- Shutdown Target : When repeater DL output value will be over than initial set value, the repeater will be shutdown.
- Shutdown Count : Set the number of shutdown times. When DL output value will be over than certain value, the repeater will be completely shutdown.
- Shutdown On Time : When the repeater output value is over than shutdown target value, finally it is shutdown. Shutdown on time means repeater re-boot time after shutdown.
- Shutdown Off Time : When output value will be higher than target value, the repeater will be shutdown again, after spending shutdown off time.

A.2.5 Time Set

When you click the Set button in the window, MCU automatically reads the time of the PC for time setting. The set time appears on the RTC Time on the SYSTEM window

A.2.6 Reset

This function clears communication status, rebooting the MCU. When you press the Reset button, current communication status is reset. It leads to MCU rebooting and then resets the communication status. Then, the information on the current system is displayed on the screen.

A.2.7 Download

When the firmware is upgraded, you can download a new firmware program to the MCU.

Downloaded files should be in Binary code.

► **Note** : How to do firmware download

When you click the Download at the menu window.

Click the File to open in the Download window.

Click a file to be upgraded.

If a desired file is selected in the "File Path Name", you can press the Start button for upgrade.

After the upgrade, you can click the Exit button to complete the downloading.

A.2.8 Modem

This window shows the basic settings required for communication with wireless modems and other essential information for your reference.

► **Note** : More details are in the appendix B.

A.2.9 Isolation

Checking isolation between donor and distributor antennas, measured figure will be displayed.

A.2.10 Exit

This function enables you to close the GUI program. As the status of the program is stored in MCU, you can see its latest status when executing the program later.

Appendix B. Modem

B.1 System Window

B.1.1 General Control

- Communication Port : Connects MCU to the modem port.
- Modem Own Number : Refers to the modem number, with which you can call using a modem.
- Firmware Version : Refers to the version of currently used software.

B.1.2 WNMC Configuration

- Cascade Code : Refers to the ID designated by operator where the repeater is installed. The ID is composed of ten-digit characters and figures.

-

► **Note** : How to display cascade ID (ex :XX##YY\$\$\$\$)

XX : First two-digit characters showing the installation site of the repeater.

If the repeater is installed in Boston, XX is seen as 'BS'.

: Shows whether the repeater is installed inside/outside of a building: In Building System (Indoor type)/Macro System (Outdoor type).

YY : Shows device types (Repeater/cell site).

If the system is found as repeater, YY is 'XR'; if it is a cell site, YY is 'XC'.

\$\$\$\$: Refers to integers (1 ~ 9,999) indicating the number of repeaters installed in XX.

If 24 repeaters are installed in Boston (BS), \$\$\$\$ is '24'.

B.1.3 Control

The Control window is to set the periodic interval of the Heartbeat. This function lets you set the time interval of the Heartbeat to 3 ~ 59 minutes.

B.1.4 Modem Configuration

- Network Connection :

Modem Mode : This button lets you see the modem status. When you press the button, the Modem Status window, the Modem Configuration window, the Modem Statistics window, and the Modem Status window are activated. With the [NMST] button in the Modem Status window, you can see modem status.

PPP Mode : Stands for Point to Point Protocol, which helps set connection between the MCU and WNMC. PPP connection is automatically set. Facing connection failure, MCU retries until the connection is successful. When PPP is fully set, the Modem Status window, the Modem Configuration window, and the AT Command window are automatically de-activated.

WNMC : This button lets you clear PPP connection. You can see whether PPP is connected/disconnected depending on the icon color of the WNMC button. You can see the connection status in the window next to the WNMC button. You can have access to the PPP and verify the 'Disconnected' status and press the "WNMC" button. At this time, you need to check if the status window next to the "WNMC" button is changed: Disconnected ->calling-> PPP Connected. If the connection fails to be set in 60 seconds, the status will be 'Disconnected' due to timeout. In this case, you can press the " WNMC " button again to set the connection. With PPP set, MCU is connected to the Internet, enabling SNMP Trap messages to be sent to WNMC whenever alarms and Heartbeats occur.

- Program Download : Lets you download a new firmware version to the MCU when firmware is upgraded. Downloaded files should be in Binary format and downloading methods are split into Ack and NoAck.

Download (Ack) : Receives Ack (acknowledge messages) for each message that is transmitted to calculate Check Sum. When errors are generated during file transmission, the transferring will be immediately stopped. This method requires roughly one more minute than the NoAck method.

Download (NoAck) : Calculates Check Sum for each message that is transmitted when Ack may not be received. Ack messages are received when the transmitted messages are completely sent. This method reduces one minute to download than the Ack method.

B.2 Modem Window

B.2.1 Modem Status

- **NMST Button** : Refers to AT command to report current modem status with AT + NMST commands programmed in the button. When you press the button, modem status information is displayed.
- **Analog / Digital** : Shows transferring methods of the modem (Analog/digital types). When the modem uses analog communication method, 'Analog' is displayed; if it uses Digital communication method, 'Digital' is displayed.
- **Lock Mode** : Shows whether the current modem is locked/unlocked. 'Locked' means the current modem is locked; 'Not Locked', the modem is unlocked.
- **Service** : Shows whether the current modem is available for calling. 'No Service' means the modem is not available; 'In Service' means the modem is available for you to try a call.
- **SMS(Short Message Service)** : Refers to the two-way wireless data-calling service according to GSM (Global System for Mobile Communications), sending data at up to 150-byte length between terminals. Using this service, you can send/receive messages composed of characters and/or figures between terminals or networks. This service type includes short message transferring, emergent message indication, date/time recording, and message indication. SMS has two status of "None" and "Exist":
 - "None " means there are no received SMS messages;
 - Exist " means SMS messages have been received.
- **Missed Call**: Refers to the count of failed communication trials by the modem.
- **Service System** : Consists of three items of "Band Class", "Band", and "System ID".

B.2.2 Modem Statistics

This window enables you to manually control the modem using AT commands. Seen in the modem statistics, such protocols as RLP, TCP, UDP, PPP, IP, and RLP3 are supported by a built-in operating system (Installed in protocol stacks including integrated RLP, TCP, UDP, PPP, IP, RLP3, etc.) installed in MCU. Using the protocols, the modem can have access to communication network

NOTCHCELL 20W Repeater Operating Manual

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