ATTACHMENT E.

- USER MANUAL -

Installation Guide
+20dBm BDA for WiMAX

Standard Release V1.0 Issue Sept 16, 2008

What's inside

Pre-installation Consideration

Installation

Installation Procedure

Operating Software

MTI Co., Ltd.

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Abbreviation & Acronyms

AC	Alternating Current
AGC	Automatic Gain Control
ALC	Automatic Level Control
ANT	Antenna
ATTN	Attenuation or Attenuator
BDA	Bi-Directional Amplifier
BPF	Band Pass Filter
BTS	Base Station
CH, Ch	Channel
CPL	Coupler or Coupling (same as Coup)
Coup	Coupler or Coupling (same as CPL)
CPU	Central Processing Unit (same as Controller)
dB	Decibel measurement of gain and loss
dBm	Decibel measurement of power, reference to 1mW
D/C	Directional Coupler
DNC	Down Converter
DPX	Duplexer
DMM	Digital Multimeter
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
EVM	Error Vector Magnitude
FA	Frequency Allocation
FREQ	Frequency
FWD	Forward
GND	Ground or Grounding
GUI	Graphical User Interface
HPA	High Power Linear Amplifier
IF	Intermediate Frequency
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LNK	Link
NMS	Network Management System
PSU	Power Supply Unit
REV	Reverse
RF	Radio Frequency
RSSI	Receive Sensitivity Strength Indication
RTC	Real Time Clock
RX	Receive
SVC	Service
TEMP	Temperature
TX	Transmit
VSWR	Voltage Standing Wave Ratio

1 Pre-installation Consideration

DO NOT OPEN THE DOOR OF THE UNIT WHEN IT IS IN OPERATION WITHOUT PROPER PERMISSION FROM THE AUTHORITIES. DANGEROUSLY HIGH VOLTAGES APPEAR WITHIN THE EQUIPMENT. EXTREME CARE MUST BE TAKEN TO AVOID ELECTRIC SHOCK.

DO NOT FASTEN OR UNFASTEN THE COAXIAL CABLE CONNECTOR ON THE BDA WITH UNDER THE UNIT POWERED EQUIPMENT. EXTREME CARE MUST BE TAKEN TO AVOID ELECTRIC SHOCK.

MAKE SURE THAT POWER SUPPLIER IN BDA UNIT IS TURNED OFF PRIOR TO CONNECTING THE COAXIAL CABLE TO THE CABLE ENTRY CONNECTOR ON BDA ENCLOSURE.

Prepare the proper ground prior to installation of the BDA; the ground must be independent from that for other equipment (Do not use common ground with others). The ground must be connected with AWG 6 or AWG 8 multi-wired cable. The cord must not be parallel to other electrical or RF cable. Do not apply the electric power without connecting output port of BDA to Antenna or Dummy Load. The system will be stabilized in 5 minutes after power is switched on. Before operation of the BDA, ensure that RF connectors and cables are not damaged and properly connected.

1.1 Introduction

The mobile coverage extension solution is used to extend coverage to specific areas within a building, multiple buildings, or subway. This coverage extension system solution features useful combination that distributes wireless coverage over RF cable and antennas, making the best choice for signal quality, flexibility, and overall performance. The mobile coverage extension product family offers service providers a flexible, low cost, easy installation to improve customer retention and offer enhanced services to meet increasing subscriber demands.

1.2 Site Selection

Depending on RF environment and size of space, output power of the BDA and number of antennas are decided for optimum service. For instance, an OMNI antenna (service) is connected to a small BDA for a small room, two or three OMNI antennas are connected to a medium BDA, or several antennas are distributed in couple of floors of a building if a large BDA is installed.

Recommendation to choose installation topology as below;

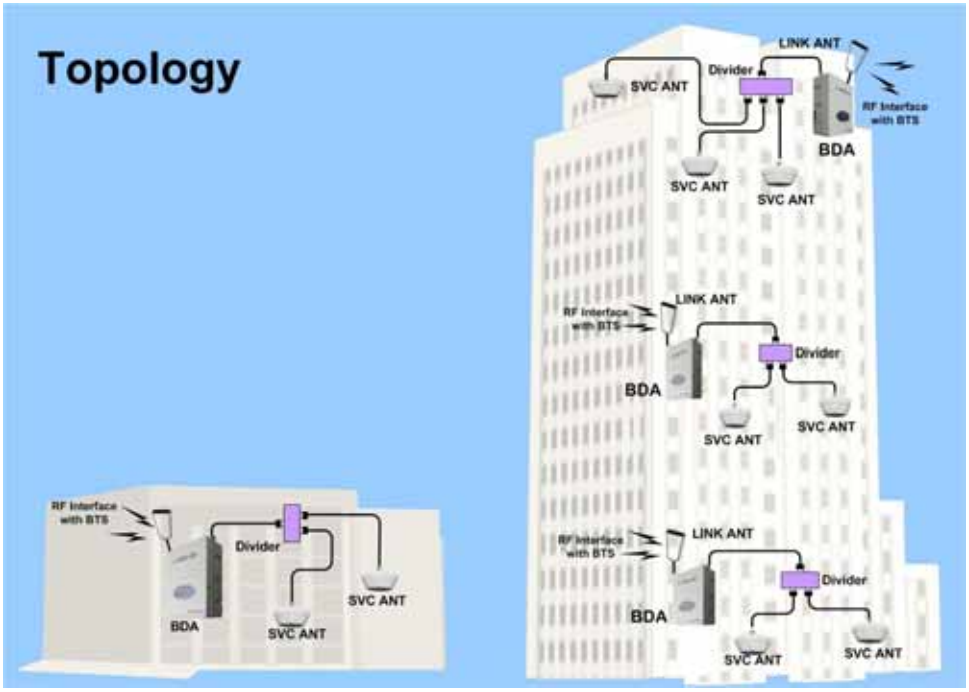


Figure 1 BDA Solution for in-building

- Less interference from other BTS Cells
- Easy access and maintenance of the equipment
- Avoiding direct sunlight to protect equipment
- Easy access to electrical power
- A shadow and cool environment

1.3 Antenna Installation

Recommendation to choose installation location as below;

- Use proper and reliable connectors.
- Ensure that connections of antenna and feeder cable is proper, so that antenna VSWR is at least 1.38 : 1(equal to 16dB of return loss).
- Ensure that antenna radiation beam pattern is normal before antenna installation. There are cases that antenna beam pattern is abnormal though antenna input VSWR is normal and this problem cannot be recognized with an Analyzing Equipment.
- Secure and water-tight connection between cable and antenna.
- Cables with low loss.
- Elimination of pulling stress or kinks in cable.
- Proper radius of curvature in cable placement.
- Secure proper isolation between link antenna and service antenna.
- There must not be any obstacles to reflect signal from the direction that antenna is radiating signal.
- Tightly fix link antenna to prevent movement against wind or other external factors.
- For more information regarding detailed specifications and installation of antenna, contact the antenna supplier.

1.3.1 Ceiling mounting of patch antenna

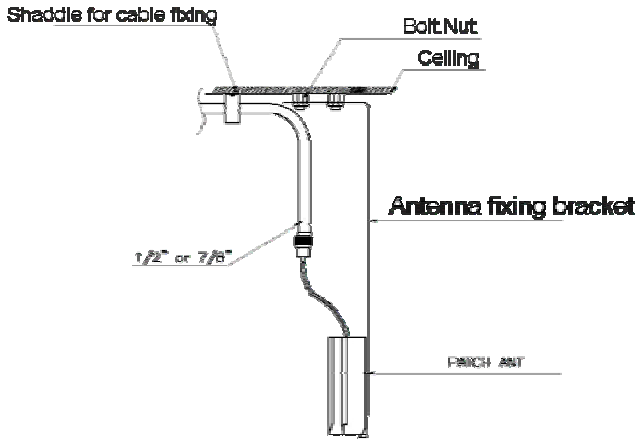


Figure 2 Ceiling mount of patch antenna

1.3.2 Ceiling mount for Omni antenna

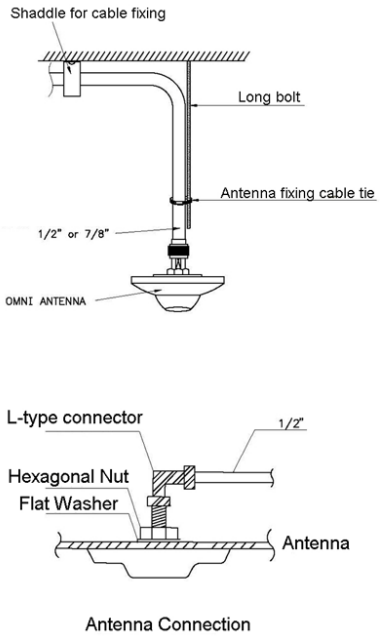


Figure 3 Ceiling mount of omni antenna

1.3.3 Wall mount for patch antenna

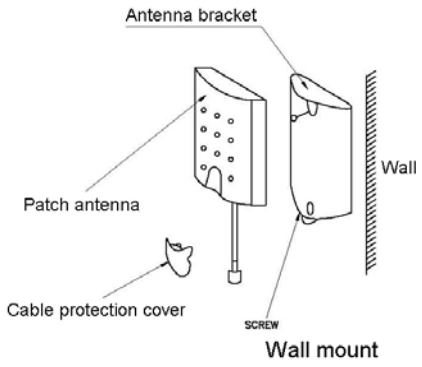


Figure 4 Wall mount of patch antenna

1.3.4 Pole mount for Yagi antenna

Figure 5 Pole mount of Yagi antenna

1.4 Electrical Power

- Power source must be stable and maintain enough capacity. It must also be protected against surge and lightning.
  - 100Vac
- A AWG 6 or AWG 8 multi-wired cord must be used for grounding. The cable for grounding must not be placed paralleled to other cables.

1.5 Initial Check

- Unpacking
  Prior to unpacking, check the containers for damage. If any damage or mis-handling is evident, request that the carriers be present to witness the unpacking and further inspection.
  Carefully open the containers, remove the top layer of shock absorbing material, and lift the equipment out of its container.

- Mechanical Inspection
  Check the equipment for damage. Inspect the housing and panel surfaces for scratches and dents. Check that all external fasteners are securely in place and that no obvious attempt has been made to remove any of these.

- Damage
  If the equipment is damaged or fails to meet specifications upon receipt, notify MTI Co., Ltd. immediately.

- Storage
  The equipment should be placed in its original container for storage, and should be stored in a cool, clean and dry environment.

1.6 Check list of Supplied Items

- BDA : 1unit
- AC power cord: 1 set

Figure 6 BDA with AC power cord

1.7 Accessories for installation of the units

- Laptop PC : 1 unit
- USB Cable : 1 unit
- AC Power Extender : 1 unit
- AC Power Cord for BDA : 1 set
- RF Coaxial Cable : 3 set of RG cable for Analyzing equipment.
- Adapter; 3 units of N-male to SMA-female, 1 unit of N-female to N-female, SMA-female to SMA-female
- Other accessories to install the BDA, such as fixed attenuations (5dB, 10dB & 15dB); it depends on the situation of the site.

1.7.1 Test Equipment for installation

- WiMAX Signal Analyzer(E4445A)
- WiMAX Signal Generator(E4438C)
- VSA (Vector Signal Analyzing Software VSA89600 in PC)
- Network Analyzer
- Power Meter
- 30dB High Power Fixed Attenuator
- High Power Termination
- Digital Multimeter
- Laptop PC
- RF Connection Cable Set
- 10dB/1dB Step Attenuator for 2.5GHz
- Noise Figure Meter
- Noise Figure Source

1.7.2 Required Testing Equipment & Tools

- Spectrum Analyzer 1 set (Spectrum analyzer for CDMA, E4445A for WiMAX)
- Signal Generator 1 set (CDMA sig gen for CDMA, E4438C, VSA for WiMAX)
- Site Master 1 set (Anritsu S331A or equivalent)
- Laptop PC 1 set (Pentium-class PC, 90MHz or higher recommended, Window 95 or more recent)
- Digital Multi-meter 1 set

1.8 Electrical Specification

1.8.1 Specification

Item		Specification	Remark
Input Frequency		2642 ~ 2672MHz	Fixed FH Channel
Output Frequency		2642 ~ 2672MHz	
Operating Bandwidth		30MHz	
VSWR		1.5:1	DL/UL
Input	DL	-25 ~ -55dBm/Total	
	UL	MAX –55dBm/ Total	
Gain Adjustment Range	DL	45~75dB	
	UL	45~75dB	
Gain Adjustment Step		1dB Step	DL/UL
Gain Adjustment Tolerance		< ±0.7dB	DL/UL
Max. Output	DL	> 20dBm/Toltal	
	UL	> 20dBm/Toltal	
AGC	DL	30dB	
	UL	30dB	
Shut Down	DL	23dBm/Total	
	UL	23dBm/Total	
Impedance (IN/OUT)		50Ω	
Spectral Mask	In-Band	US FCC 04-135 & 27.53 Compliance	
	Out-Band	US FCC 04-135 & 27.53 Compliance	
System Delay		< 3.0us	DL/UL
Noise Figure(DL/UL)		≤5dB	@ Max. Gain
		≤12dB	@ Min. Gain
Flatness		< 3dB	pk-pk @ BW 30MHz
Frequency Stability		< ±0.02ppm	DL/UL
EVM		<5% (DL:64QAM, UL:16QAM)	Source Comparison
Sync. Signal Detection level (DL)		Min : -75dBm	@ BDA Input
Size(mm)		190 * 250 * 80 (7.6 * 10 * 3.2 inch)	
Weight		< 6 kg	
Power Consumption		< 40 W	@Instant Max. Power

1.8.2 Functions

Item	Specification
VSWR Alarm	1.5:1
Over Power Alarm	@ Max. Output +2dB
AGC(Auto Gain Control)	30dB
AGD(Auto Gain Difference of DL/UL)	0 ~ 10

2 Installation

2.1 Cable Connection to BDA

2.1.1 Connection of RF cable to BDA

Input and output of BDA is fit for interface with N-type RF cable. Signal of RAS DL/UL path at antenna connection cable is fed/transmitted to/from “LINK ANT” at BDA bottom side of enclosure and amplified signal from BDA is fed/transmitted to/from “SERVICE ANT” port to service area at BDA bottom side of enclosure.(Refer to Figure 10).

- Interfacing with link and service antenna

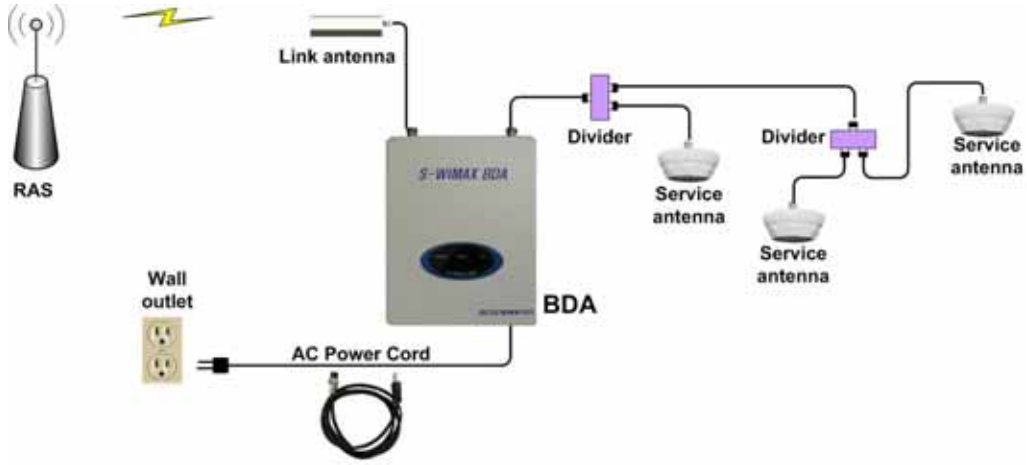


Figure 7 Interfacing with Link antenna and Service antenna

- RG 400 or similar quality of coaxial cable (50ohm) is recommended for the link and service antenna connection.
- “LINK ANT” and “SERVICE ANT” antenna port of BDA is to be connected to the link and service antenna with RF cable. Refer to the above figure for the connection port at the unit.

Figure 8 Interfacing port of top side

2.1.2 Connection of electrical power cable to BDA

AC Power (100V ± 20%) is supplied to the unit with the AC Power cable. Before connection of ground cable, don't plug the AC power cable into the wall outlet of AC power source. Connect by using grounding cable between CHASSIS Port locating left side of the BDA and Ground bar. plug the AC power cable into the wall outlet of AC power source.

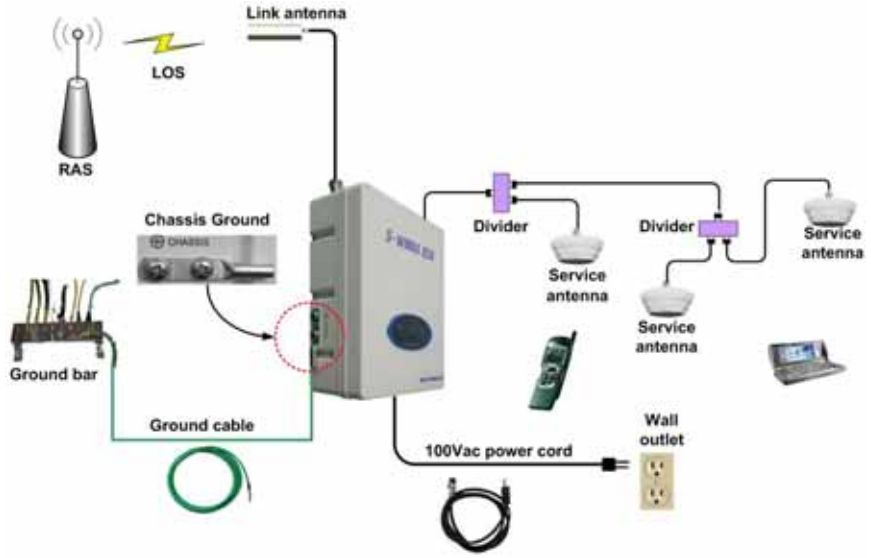


Figure 9 Cable Connection of BDA

2.1.3 Connection of Laptop PC to BDA

The BDA should be connected to a laptop PC with the USB cable to control BDA locally. Plug the USB cable from the laptop PC into the USB connector in the BDA. Refer to operating software chapter for monitoring and controlling the unit.

Figure 10 Connection of Laptop PC

2.2 Cable Connection to BDA

2.2.1 Connection of RF cable and electrical power cable to BDA

Service antenna port is to be connected to the “SVC ANT” port of BDA with RF cable. “LINK ANT” port of BDA also connected to link antenna with 50ohm feeder. Refer to the below figure for the connection port at the unit.
AC Power (100V ± 20%) is supplied to the unit with the AC Power cord. Plug the AC power cord into the connector. Before apply the power source, Connect grounding cable between CHASSIS port locating left side of the BDA and Ground bar. Refer to the following figure for the connection port on the BDA.

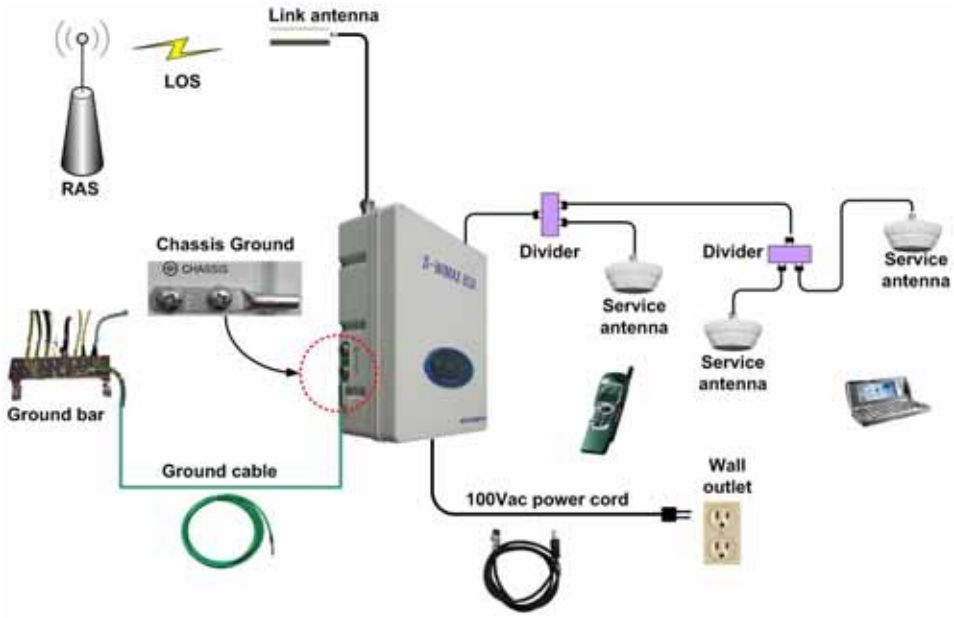


Figure 11 Cable Connection of the BDA

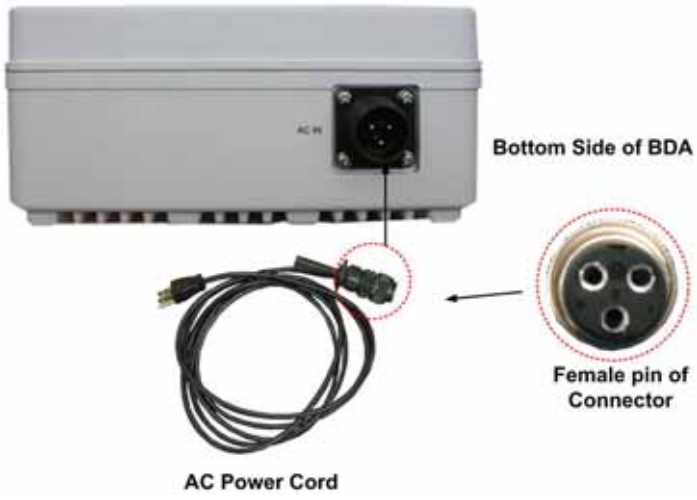


Figure 12 Interfacing port of BDA bottom side

2.2.2 Connection of Laptop PC to BDA

The BDA should be connected to a note PC with the USB cable direct to laptop PC for local GUI. Plug the USB cable from the Laptop PC into the USB port of the BDA. Refer to the following figure for the connection port in the unit.

Figure 13 Connection of Laptop PC in BDA

3 Installation Procedure

3.1 Installation procedure for BDA

3.1.1 Enclosure

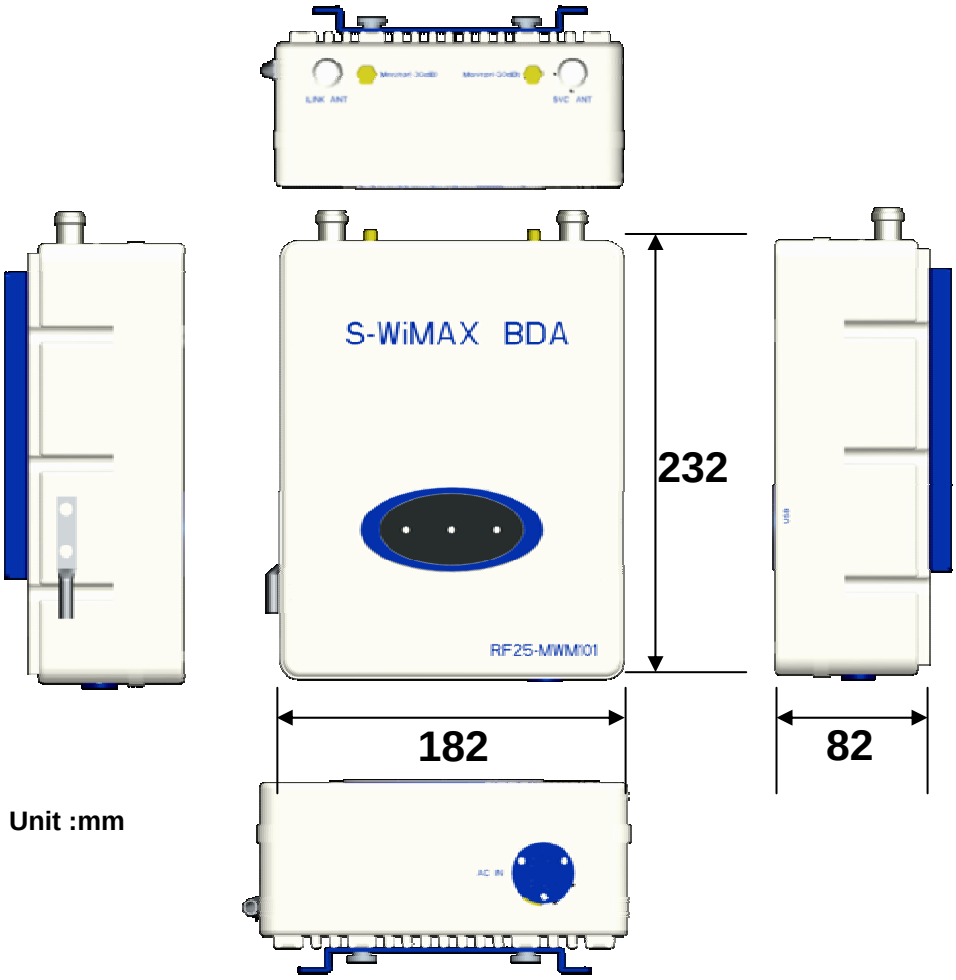


Figure 14 Assembling of the BDA

- Ensure that BDA, cables and connectors inside the box are properly equipped before starting installation.
- Unscrew the ground lug from the “CHASSIS” port of BDA and insert ground wire into the lug. Screw up the ground lug to the place as it was and connect the other end of the ground wire to a ground bar prepared in the site.
- Ensure that AC input power is in the range of the specification (typical AC 110V: range AC 90V ~ AC120V).
- Connect the AC power cord of the power cable to the input port on the bottom of the BDA and check if LED on the front of the BDA.

3.1.2 Connection of electrical power cable

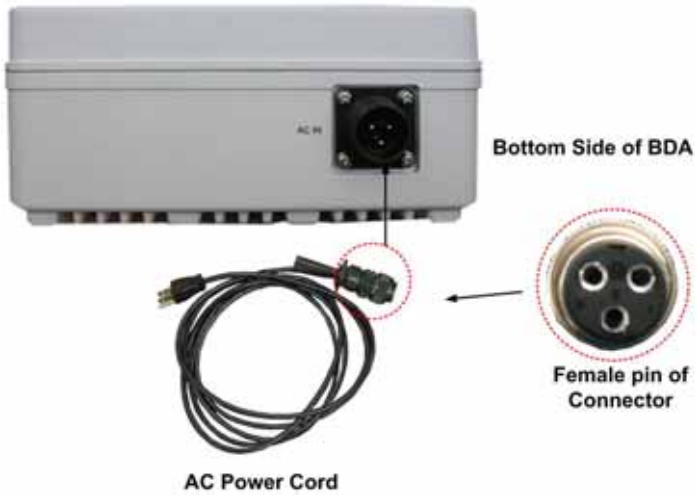


Figure 15 Assembly of electrical power cable of the BDA

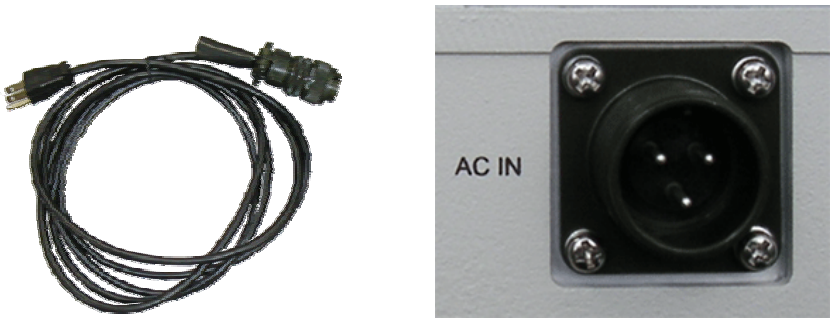


Figure 16 Electrical power cable connection of the BDA

- Ensure that AC input power is in the range of the specification (typical AC 110V, range: AC 90V ~ AC 120V).
- Connect the power cable to the power connector on the bottom panel of the BDA and then check if 'Power' LED on the front of the BDA is green and 'RUN' LED is blinking.
- Connect a Laptop PC to the BDA and execute the Operating Software (GUI).
- **Minimize Gain value in the down and up link** on the Operating Software of the Laptop PC to protect the FWD HPA & FWD Transceiver of the BDA.
- Check if VSWR of Link antenna is within the range of specification.(Less than 1.38, equal to 16dB of Return Loss)
- If the VSWR of Link antenna is not good, check antenna connection status and cable.

3.1.3 Installation procedure

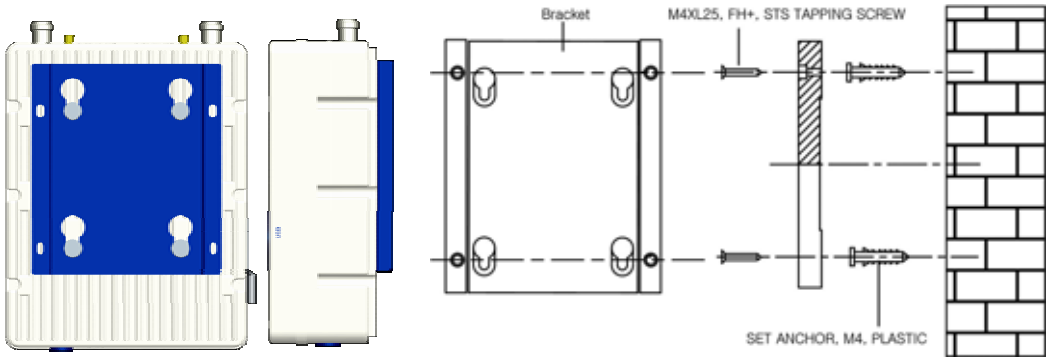


Figure 17 Install bracket of the BDA on the wall

Decide on a suitable site for installing the BDA. It is best to have it near to the power supply and outdoor antenna. Avoid direct sunlight and humidity, and keep it under where with good ventilation allowance. BDA installation was described following procedure.

First, Drilling on the wall in proper side.
Second, Insert the BDA mount pilot in hall and Fix the BDA mount as above.
Third, Hang up the BDA.
Forth, Connecting the Antenna cable.
Fifth, Install on a suitable site for the indoor or the outdoor antenna as a fixed antenna.
Sixth, plug the cord on to the AC outlet.

3.1.4 Connection and checking of RF output power

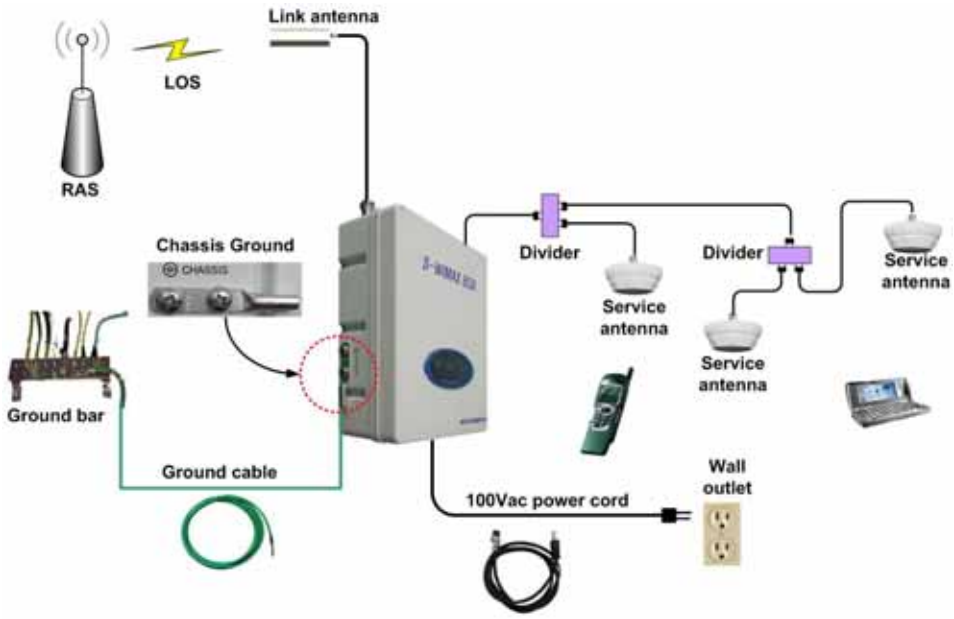


Figure 18 Cable arrangement at the BDA

- Connect coaxial cable to the "SVC ANT" port and the 50Ω coaxial cable connected to measure the output power from the monitor port("SVC ANT" port side) of BDA with a Spectrum Analyzer.
- Connect the AC power cable to the power connector on the bottom panel of the BDA and then check if 'Power' LED on the front of the BDA is green and 'RUN' LED is blinking.
- Measure input power with a Spectrum Analyzer at BDA input or GUI and compare it with the expected level. For instance, suppose input power of the BDA is -55dBm/Total. Output power of monitor port should be +20dBm/Total.
- **Set proper forward gain** in the Operating Software. As the forward input power of the BDA is -55dBm, FWD Gain of BDA must be 75dB to output +20dBm/Total.
- Enable FWD_HPA. And then check output power of the BDA using Spectrum Analyzer. Forawrd Output power of the MCU must be less than +20dBm, where **typical output power is +20dBm**.

3.2 Installation Procedure for network

3.2.1 Total network configuration

3.2.1.1 Network configuration

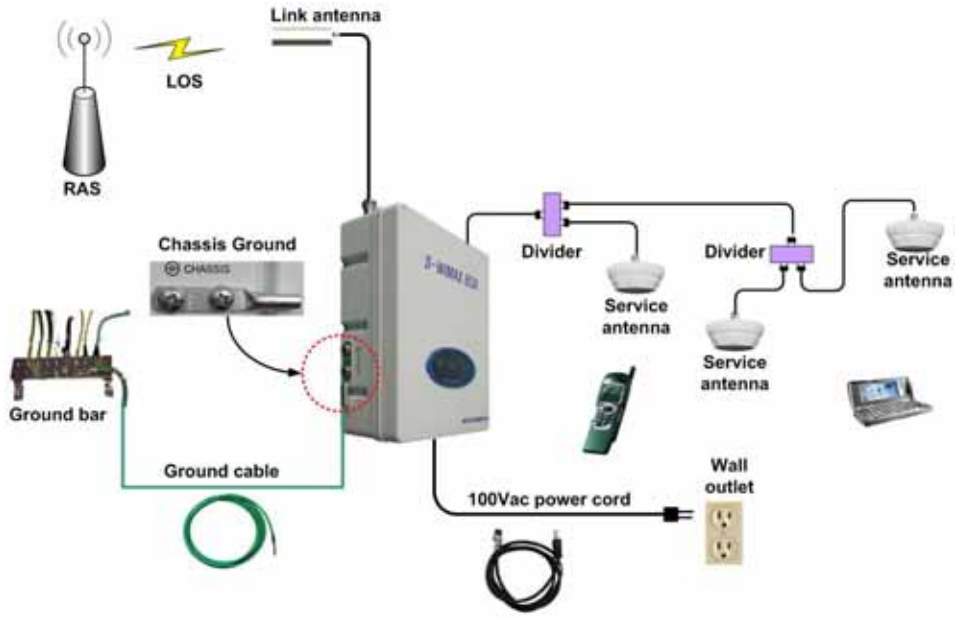
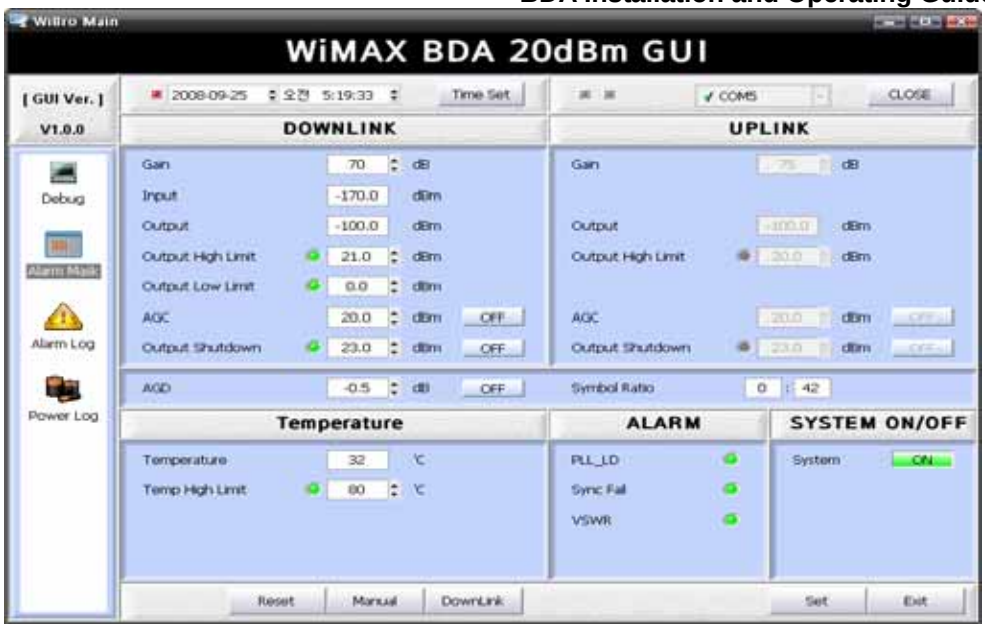


Figure 19 Total network configuration for indoor

- Ensure that modules, cables and connectors inside the unit are properly equipped before starting installation.
- Unscrew the ground lug from the “CHASSIS” port of BDA, and insert ground wire into the lug. Screw up the ground lug to the place as it was and connect the other end of the ground wire to a ground bar prepared in the site.
- Ensure that AC input power is in the range of the specification (typical AC 110V: range AC 90V ~ AC120V).
- Connect the power plug of the power cable to the power input port on the bottom of the BDA, and check if ‘POWER’ LED on the front of the BDA is green and ‘RUN’ LED is blinking.
- Connect coaxial cable to 50Ω antenna or attenuator for testing.
- Connect Laptop PC to BDA controller as figure 13. connection of Laptop PC in BDA.
- Connect the AC power cord of the power cable to the input port on the bottom of the BDA.

3.2.2 Network adjustment procedure

The BDA should be connected to a laptop PC with the USB cable to control BDA locally. Plug the USB cable from the laptop PC into theUSB port of the BDA controller. Execute GUI program at laptop PC. Refer to operating software guide for monitoring and controlling the unit.



- Feed -55dBm/total of WiMAX signal (using a signal generator) to 'LINK ANT' port of BDA and adjust gain(75dB max) in the DOWNLINK (UPLINK) path, so that the output power of the BDA becomes +20dBm. Access the BDA and check if output power of the BDA is +20dBm. If not, adjust gain in the DOWNLINK (UPLINK) path.
- If you don't want maximum output power(+20dBm), decrease DOWNLINK gain or UPLINK gain.
- Set difference between gain of down link and gain of up link (AGD). If don't need difference between down link and up link, set "0".
- Temperature alarm threshold.
- If the parameters have proper value, enable HPA and UDC module.
- Check if the alarm generated or not.

3.3 Operation Software Guide

3.3.1 Installation of Operating Software

3.3.1.1 System Requiremets

- PC Installed Microsoft Internet Explorer 5.01 or later version
- WINDOWS 98/2000/XP or equivalent operating system
- Personal computer with a 500MHz microprocessor or better (INTEL PENTIUM Processor recommended)
- 128 MB or more of RAM
- 100MB of hard disk space available
- Available serial port
- USB driver or CD driver

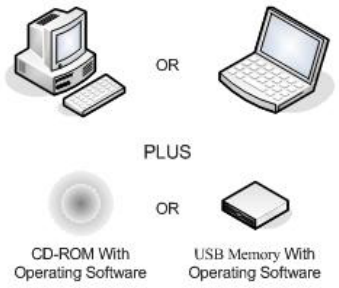


Figure 20 Required Items for Installation

3.3.1.2 Starting Installation of the Operating Software

■ **Installation of Operating Software**

- Double click ‘Setup.exe’ in the folder of ‘D:\SDMCenter-Eng-Setup’ operating software.

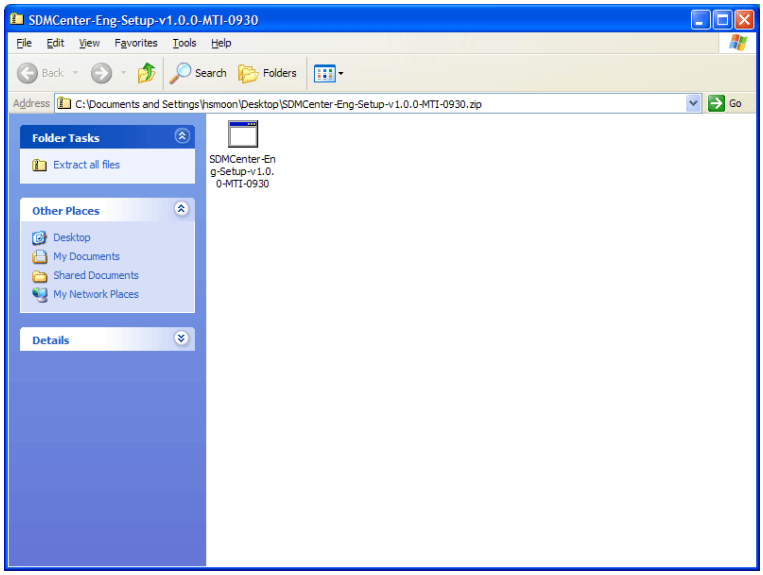


Figure 21 Installation of Operating Software (GUI)

- The below windows shows installation starting of the operating software.

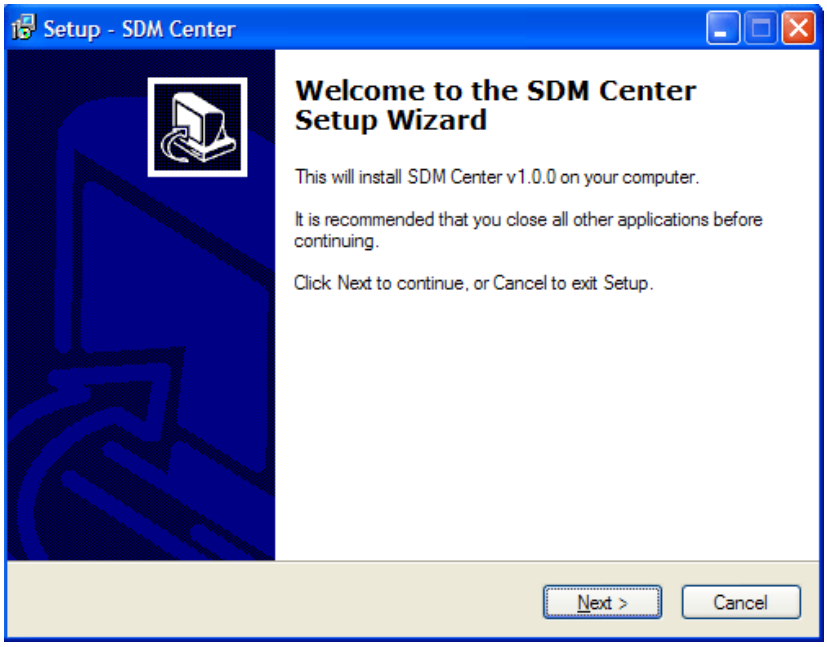


Figure 22 Installation starting of Operating Software

- The setup program generates a folder automatically and installs the program in the folder of 'C:\Program Files\SDM Center'. If you prefer another folder, you can choose it where the program is installed by clicking the 'Browse…' button. Click 'Next' button when the folder is chosen.

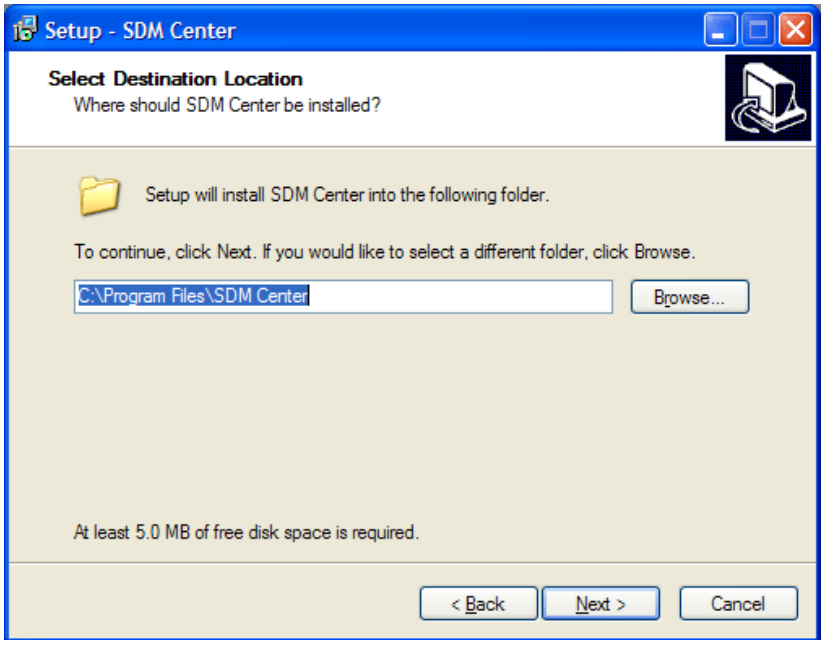


Figure 23 Selection Folder of Operating Software Installation

- The following window is displayed for creation of a shortcut in a Start Menu folder.

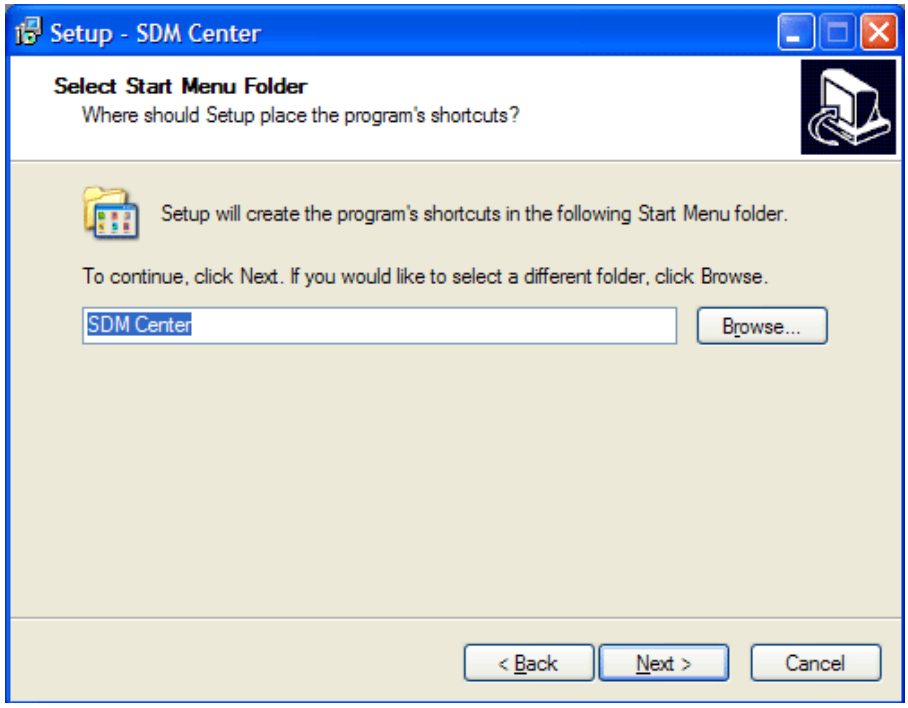


Figure 24 Creation of a shortcut in a start menu folder

- The Setup review window is displayed as follow.

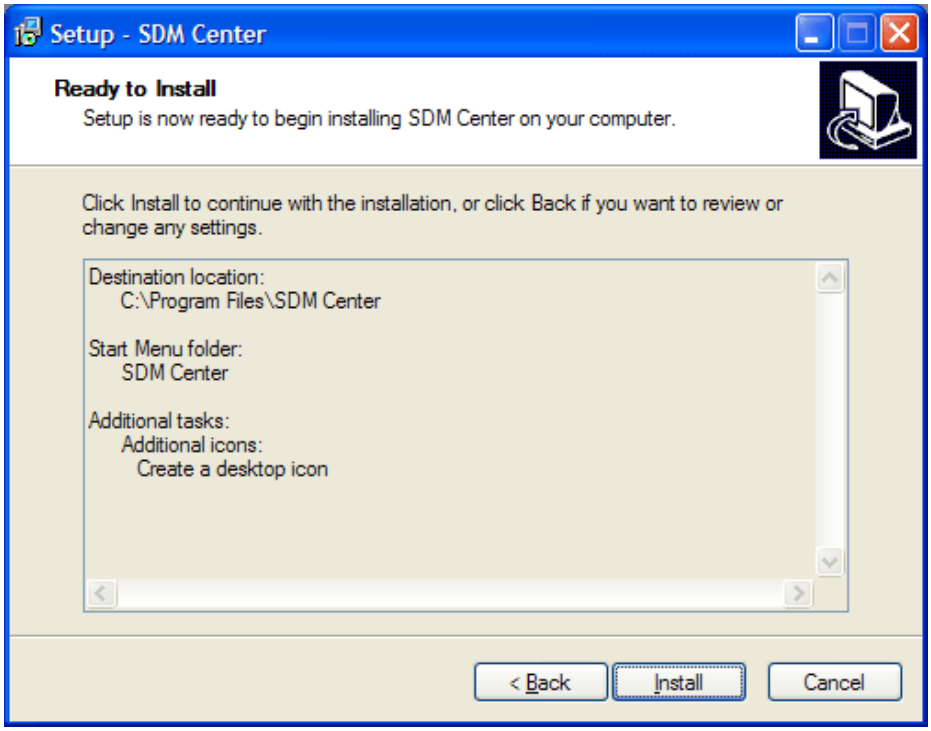


Figure 25 Setup review window

- The following window shows progress of Installation.

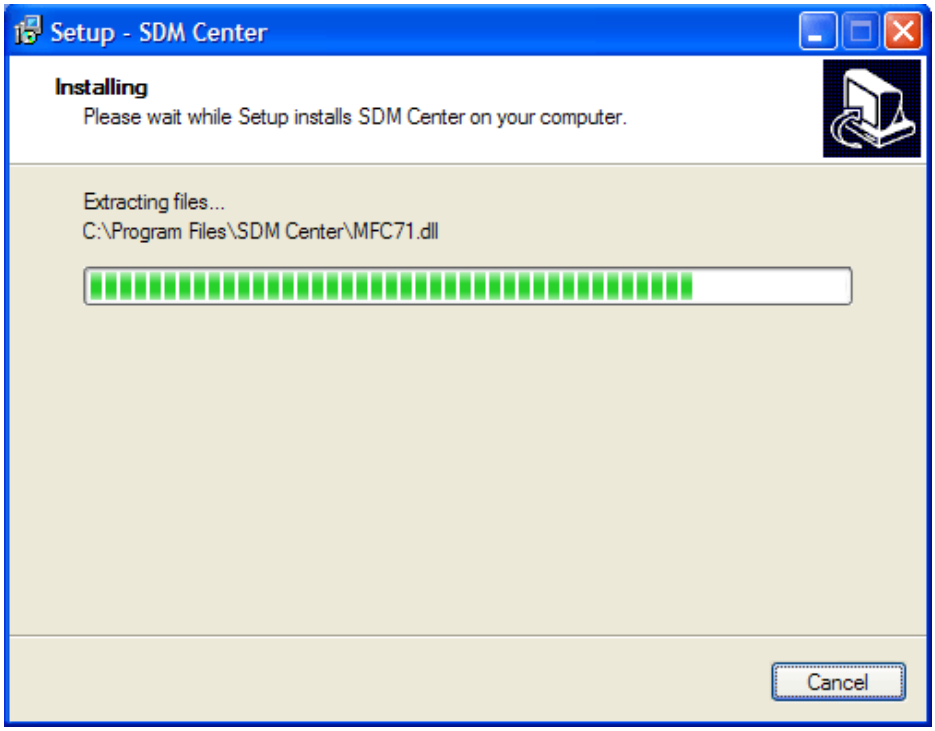


Figure 26 Progress view of installation

- The following window is displayed when installation is completed.

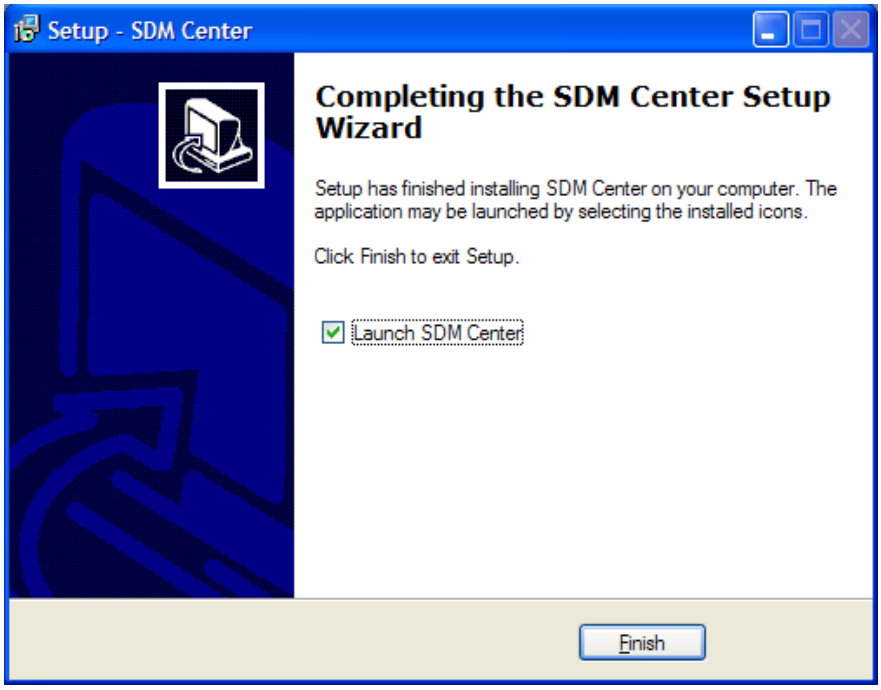


Figure 27 Installed completed

- The following two initial operating window is displayed when 'finish' button is clicked.

Figure 28 Display launcher Window

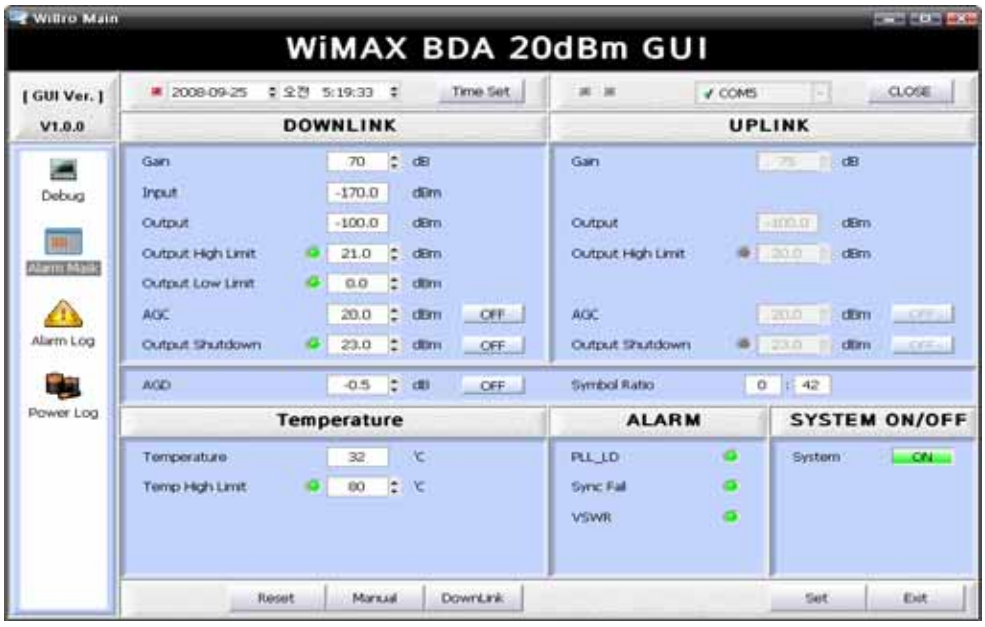


Figure 29 Initial window

3.3.2 Starting of Operating Software

- The Software will be started by double clinking ‘SDM Center’ icon of your Desktop or laptop.

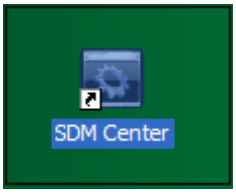


Figure 30 Starting of Operating Software

3.3.3 COM Port Set-up

- Prior to control the SDM Center program, vacant communication port, which is not occupied with other device, should be secured. This can be checked via control panel of Window OS. Conventionally, every communication devices have to occupy the unique resource "COM port" of PC even though such a COM port number are changed according to each PCs. Therefore, if you choose such an occupied COM port by other devices as the COM port of SDM Center program, you will encounter a port collision and not be able to run the SDM Center program properly. In order to run the SDM Center program normally, you should select an available COM port except COM port occupied by other programs.

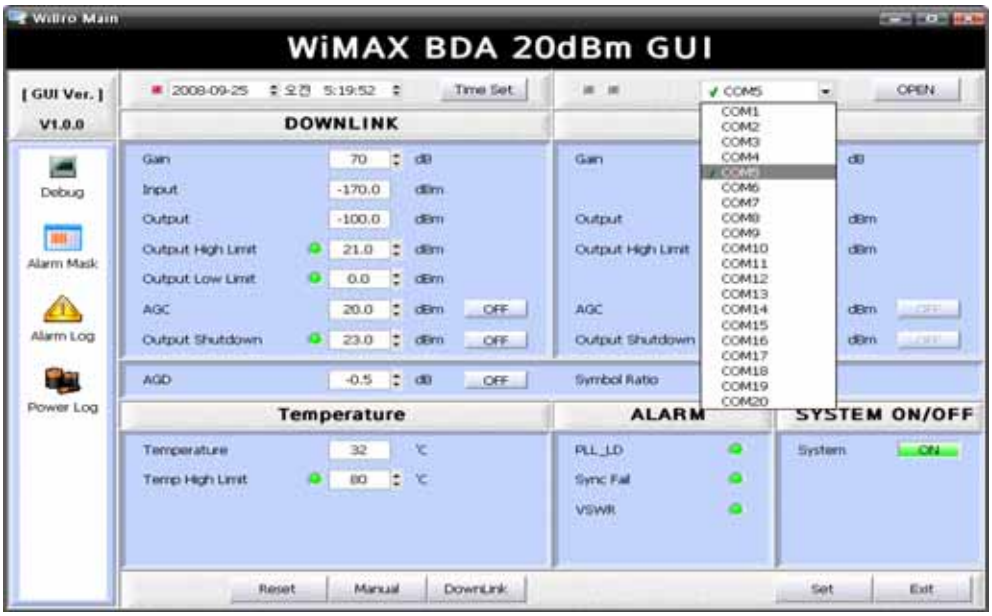
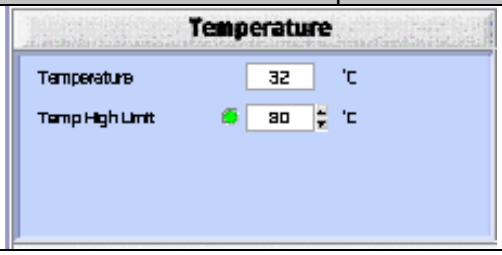


Figure 31 COM port set-up

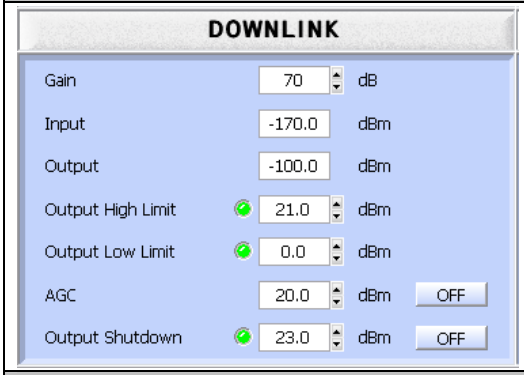
3.3.4 Operational Description

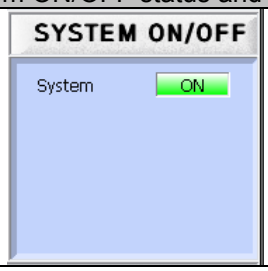
3.3.4.1 Parameter Setting and Status Monitoring

■ Temperature limit setting and monitoring

Status and setup	
	■ It is to change parameters. ☞ Display current temperature of BDA ☞ High temperature limit of the BDA for threshold of high temperature alarm.

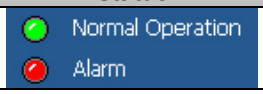
■ Monitoring and Control

Status and setup	
	■ It displays parameters and control parameters of down link. ☞ Display Gain, Input Level, Output High Limit, Output Low Limit, AGC and Shutdown level and ON/OFF for Down Link. ☞ Control Gain, Output high limit, Output Low Limit, AGC Level and Output Shutdown Level.
AGD status and Setup	
■ It is to display and control AGD(Auto Gain Difference) status between DL and UL path.	
Down/Up Link status and change	
	■ It is to change down or up link control. ☞ Reset CPU operation. ☞ Parameters setup by manual. ☞ If click 'DownLink' button, It will change to UpLink button.
Status and setup	
■ It is to control parameter setup or exit GUI program.	

Status and setup	
	■ It displays parameters and control parameters of up link. ☞ Display Gain, Input Level, Output High Limit, Output Low Limit, AGC and Shutdown level and ON/OFF for Down Link. ☞ Control Gain, Output high limit, Output Low Limit, AGC Level and Output Shutdown Level.
System ON/OFF status and setup	
	■ It is to change parameters. ☞ Display current temperature of BDA ☞ High temperature limit of the BDA for threshold of high temperature alarm.

Up/Down Link status and change	
	■ It is to change down or up link control. ☞ Reset CPU operation. ☞ Parameters setup by manual. ☞ If click 'UpLink' button, It will change to DownLink button.

3.3.4.2 Alarm Description

Status	
	
■ It is to display alarm status in the BDA. Red color means "Alarm."	
DOWN link and UP link alarms	
	☞ PLL lock or unlock alarm status of the BDA. ☞ Synchronization detectin fail alarm status of the BDA. ☞ VSWR alarm status of the BDA.

3.3.4.3 Sub-function Menu

	Debug windows shows Tx/Rx communication data between CPU and operating software.
	Administrator can mask an alarm. Masked alarms can be monitored.
	User can log the alarm history into CPU and can monitor all alarms occurred in the unit.
	User can periodically check the logged input/ output power status stored in the memory of BDA CPU.

- Debug

  Debug windows shows Tx/Rx communication data between CPU and operating software.

  - Click 'Debug' button in sub-functions menu.

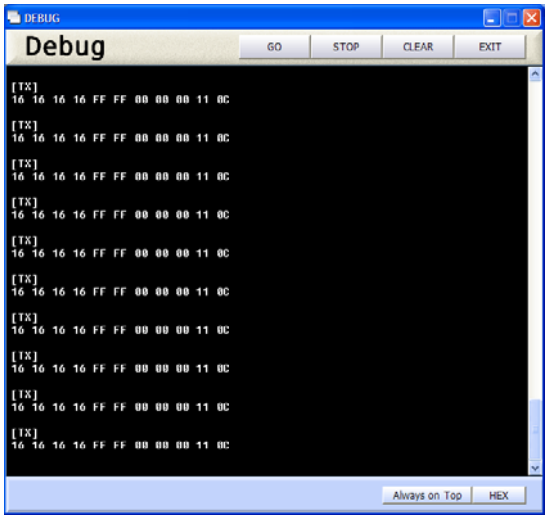


Figure 32 Debug Window

- sub-functions of debug

Go	Start the display of Tx/Rx communication data.
Stop	Stop the display of Tx/Rx communication data.
Clear	Clear the display of Tx/Rx communication data.
Exit	Exit the debug windows.

■ Alarm Log

✓ User can log the alarm history into CPU.
✓ User can monitor all alarms occurred in the unit.
✓ Alarm log will be updated whenever it is changed comparing with the existing one.

- Click 'Alarm Log' button in Sub-Function Menu.

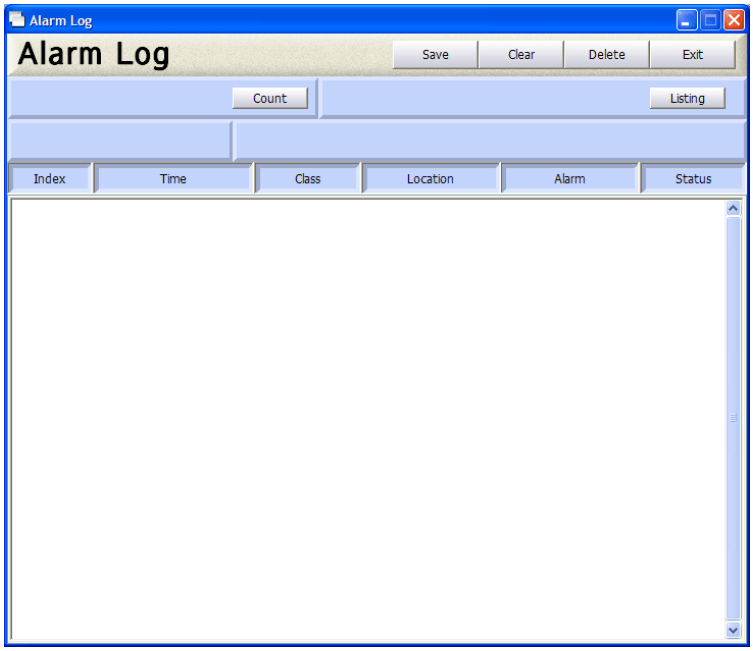


Figure 33 Alarm Log Window

- Sub-function of Alarm Log

Save	Save overall alarms logged as Excel file format.
Clear	Clear overall alarms displayed in the windows.
Delete	delete overall alarms logged.
Exit	Exit the Alarm Log windows

- Power Log
  - ✓ User can periodically check the logged input/ output power status stored in the memory of BDA CPU.

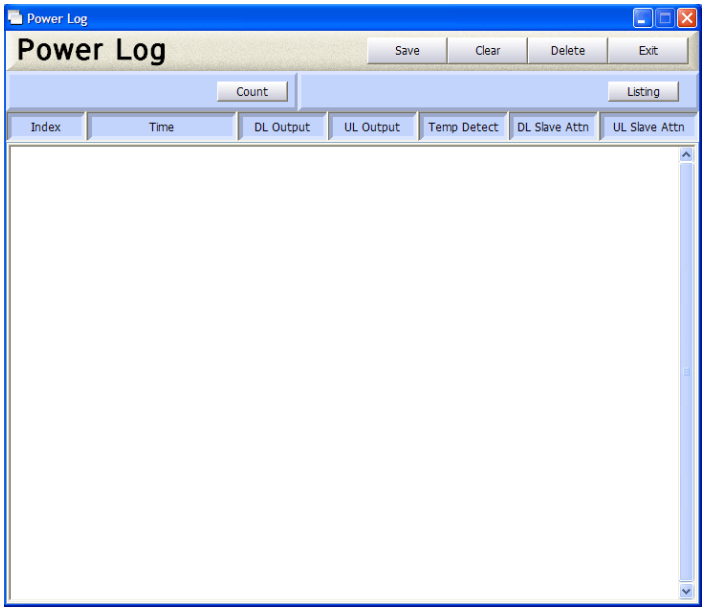


Figure 34 Power Log Window

- Sub-function of Power Log

Save	Save overall Power logged as Excel file format.
Clear	Clear overall Power displayed in the windows.
Delete	delete overall Power logged.
Exit	Exit the power Log windows.

- Alarm Mask
  - ✓ Click 'Alarm Mask' button in the Sub-Function Menu.
  - ✓ Select alarm items can be inactivated.

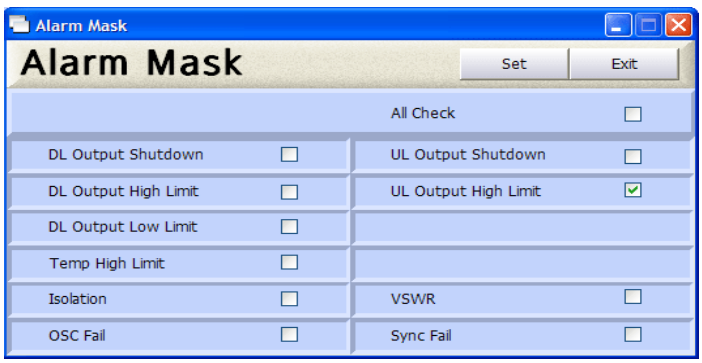


Figure 35 Alarm Mask Window

4 Appendices. Alarm Reference List

Alarms	Related Module or Unit	Alarm Level	Description
Shutdown	☞ When Over Power Alarm occurs, shutdown and retrial of enabling is repeated five times. If Over Power Alarm still continues, there are no more retrials and Shutdown Alarm is displayed. Cause of the problem must be removed and the repeater unit must be manually switched on.		
DL shutdown	HPA	Critical	☞ This alarm is to protect HPA, confining output power of HPA.
UL Shutdown	HPA	Critical	☞ This alarm is to protect BTS, confining reverse power of HPA.
Over Temperature	☞ These alarms occur when detection level of the temperature is higher than that set in the GUI. The repeater unit is operating normally.		
Over Temperature	Inside of BDA	Minor	☞ It occurs when detection level of the temperature is higher than specified value.
DL/UL PLL_LD	Transceiver	Major	☞ This alarm is to protect transceiver. ☞ This alarm occurs when PLL of the transceiver is unlocked. ☞ If this alarm occurs when transceiver is not operating normally.