ATTACHMENT E.

- USER MANUAL -

INFORMATION TO USER :

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CAUTION

Changes or modifications not expressly approved
by the manufacturer responsible for compliance
could void the user's authority to operate the equipment

- INDEX -

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1. SUMMARY

US PCS 1900 RF repeater is an analog RF repeater, which improves PCS network.

US PCS 1900 RF repeater receives RF signal from BTS and transmits it to the blanked and shadowed area, thus providing and improving voice and image data services. US PCS 1900 RF repeater's goal is to support BTS's functions proportionately.

US PCS 1900 RF repeater communicates with BTS wirelessly, thus saving additional costs for its maintenance.

US PCS 1900 RF repeater consists of PA (Downlink, Uplink), IF, LNA (Downlink, Uplink), I/O & Control divisions, which are supplied with Alarm LED, thus providing quick and easy maintenance and troubleshooting of the repeater.

This manual describes in general structure of US PCS1900 repeater, its application, maintenance and troubleshooting, installation and operation etc.

Abbreviation

PAM: POWER AMPLIFIER MODULE
LNA: LOW NOISE AMPLIFIER
AGC: AUTO GAIN CONTROL
ALC: AUTO LIMIT CONTROL

Ethernet Instruction " This equipment is indoor use and all the communication wirings are limited to inside of the building" or similar texts.

For PLUGGABLE EQUIPMENT, the socket-outlet shall be installed near the equipment and shall be easily accessible.

Replaceable batteries instruction

CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECTIVE TYPE.
DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS

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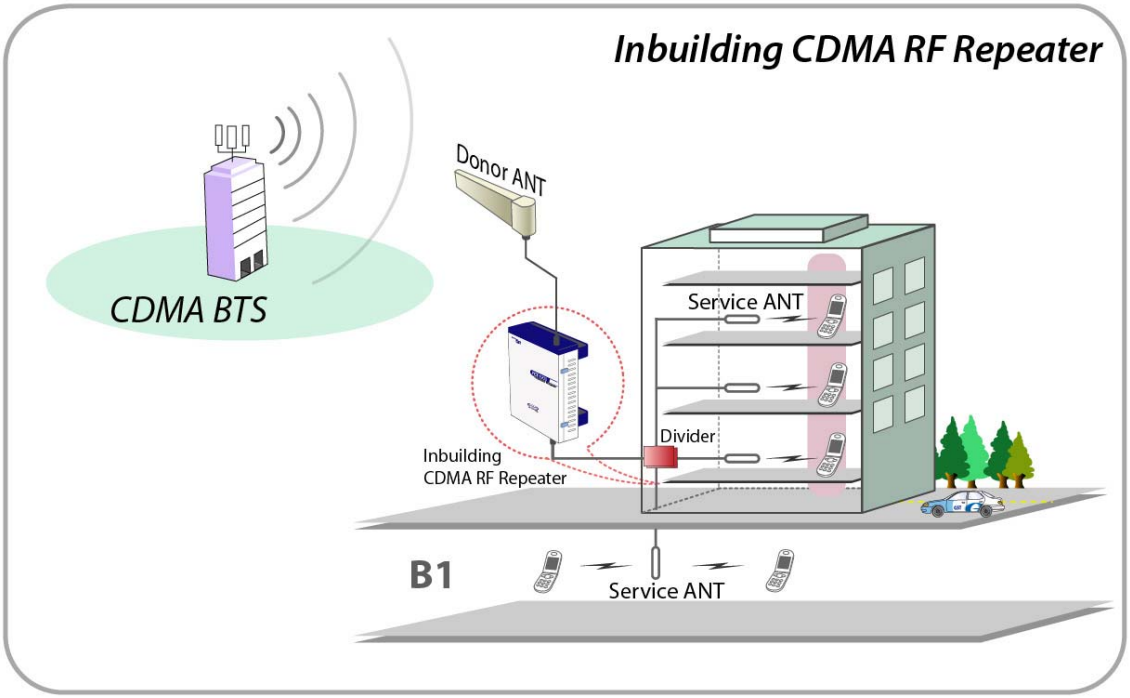
2. System Configuration

2.1 US PCS 1900 service organization

US PCS 1900 repeater decreases blanked and shadowed areas and extends cell coverage by re-transmitting signal. The signal is received from BTS via Antenna directly, thus excluding additional expenses for signal transmission (like cabling). Service organization of CDMA In-building RF repeater is shown at the picture below. Donor Antenna is directed to BTS, and being divided at Service Antennas are installed in the building and parking place. Pass Loss should be taken into consideration while dividing and cabling.



<Pic.1> US PCS 1900 Service organization

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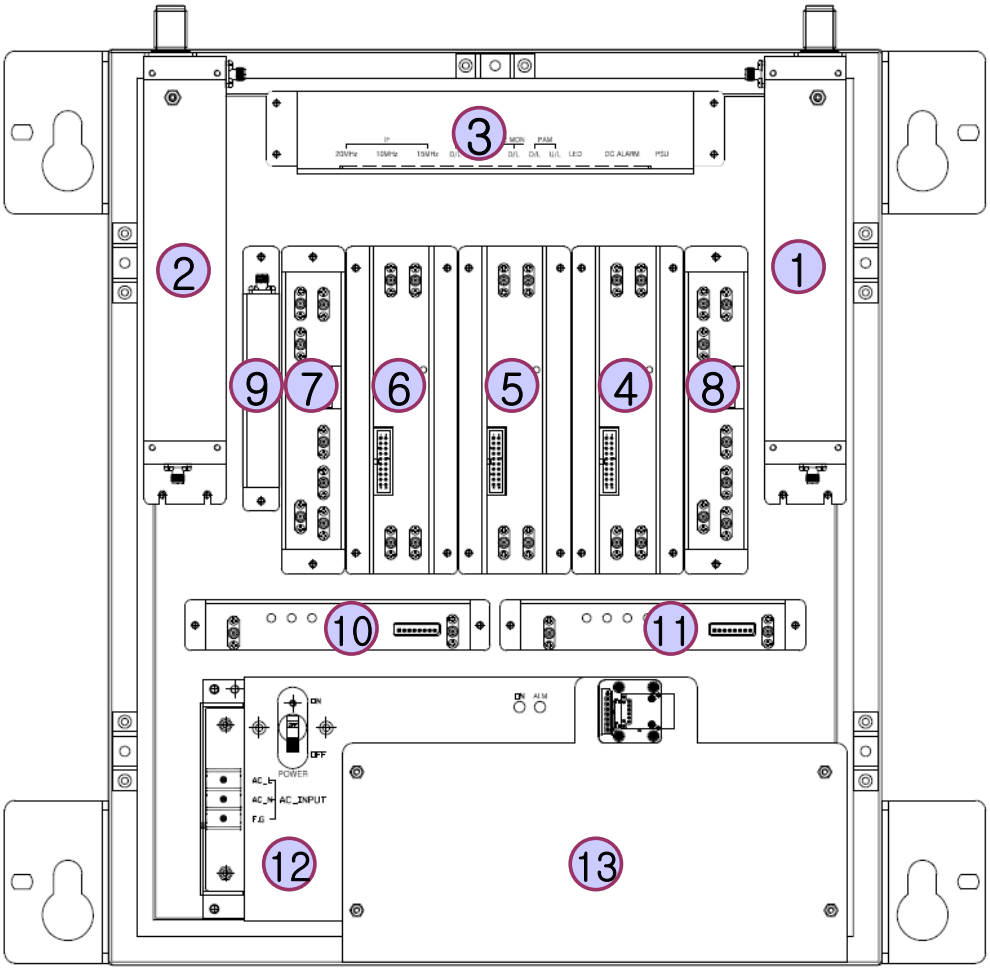
2.2 System Design and Operation

2.2.1 System design



① Donor Cavity	② Service Cavity	③ I/O & NMS Board	④ IF-10MHz
⑤ IF-15MHz	⑥ IF-20MHz	⑦ RVS LNA	⑧ FWD LNA
⑨ Waveform Detector	⑩ FWD PAM	⑪ RVS PAM	⑫ Power Supply
⑬ HUB			

<Pic.2> Repeater's inside structure

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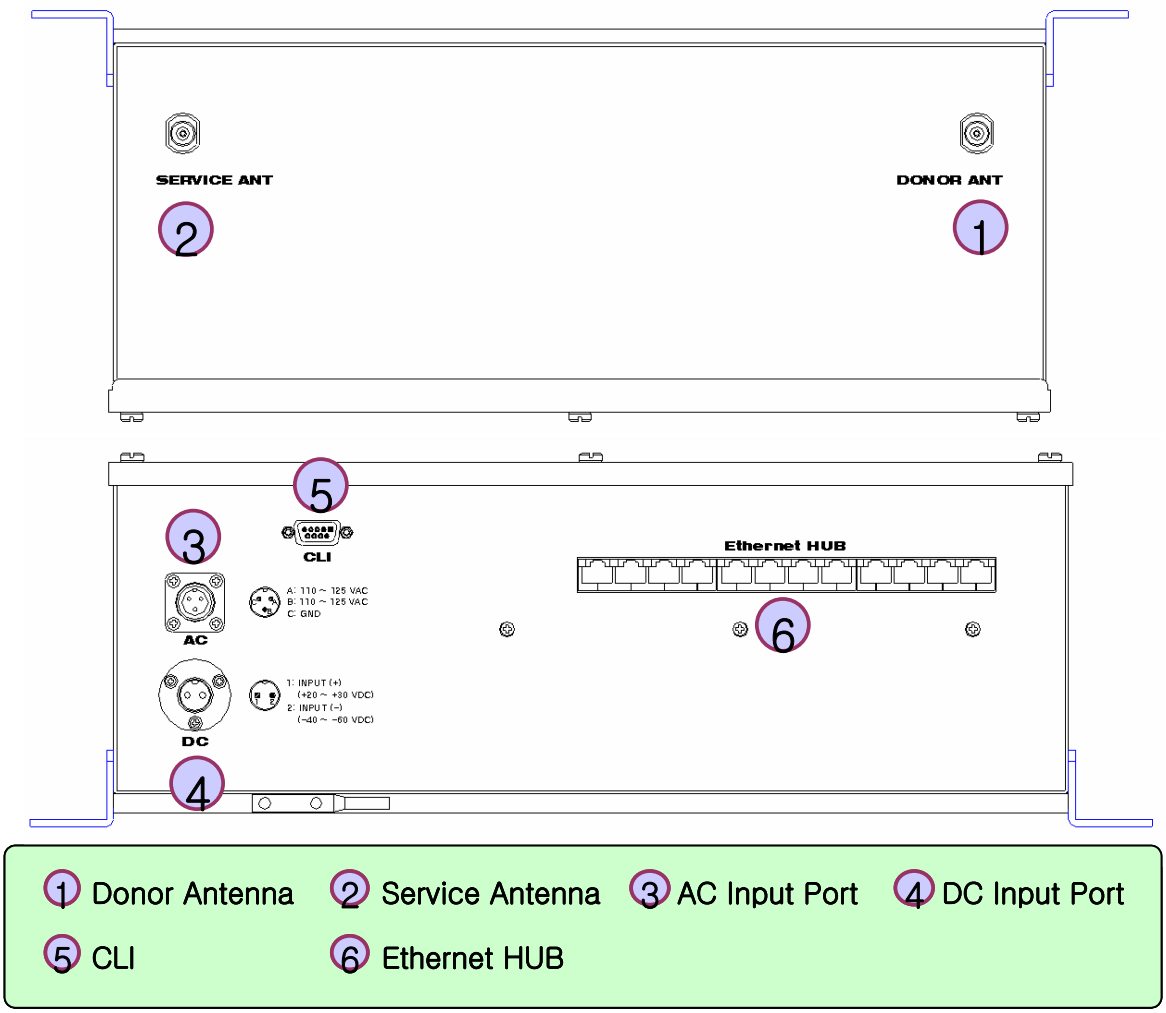
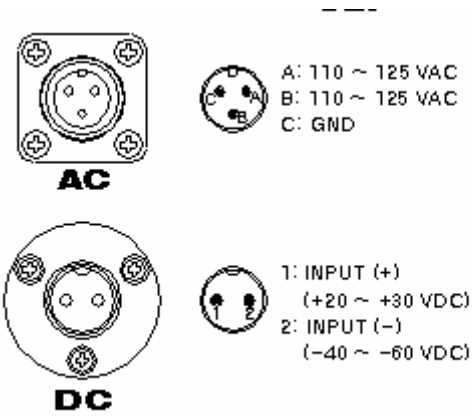


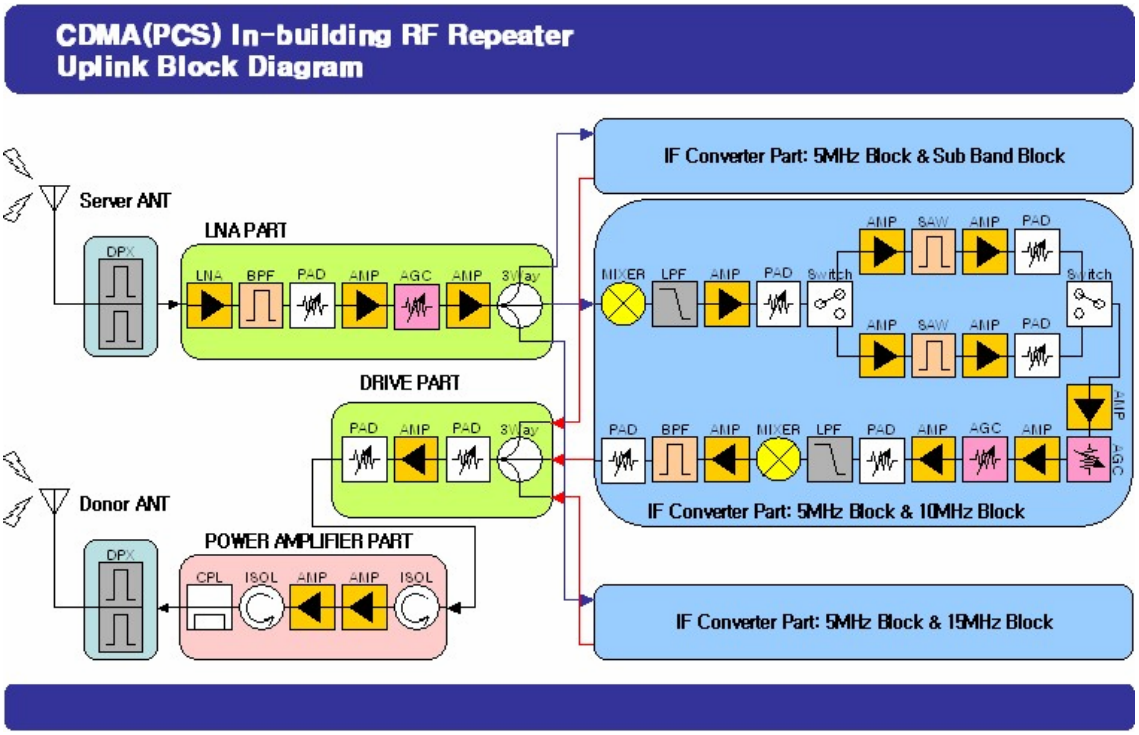
<Pic.3> Repeater's Top and Bottom panels



<Pic.4> AC & DC ports

2.2.2 Uplink Path

FWD and RVS Gain Budgets have similar structure. In case of Uplink Path, RF signal is transmitted from Service Antenna to Service Cavity Filter and RVS LNA division, then the signal is transferred to IF division, where desirable Band is selected by passing 6 Paths of RF Switch and SAW filter. Selected Band is got together in FWD LNA division, and then transmitted to Donor Antenna passing through Digital ATT (10dB ATT Range) and Donor Cavity Filter. Then the signal is transmitted to BTS through Donor Antenna.



<Pic.5> Uplink Block Diagram

2.2.3 Downlink Path

Downlink Path is organized in reverse order of Uplink Path.

In case of Downlink Path, RF signal is transmitted from Donor Antenna to Donor Cavity Filter and FWD LNA division, then the signal is transferred to IF division, where desirable Band is selected by passing 6 Paths of RF Switch and SAW filter. Attenuation range is 40dB in Digital Attenuator. Selected Band is transmitted to FWD Drive Am and Service Cavity Filter, after that the signal is transferred to Service Antenna.

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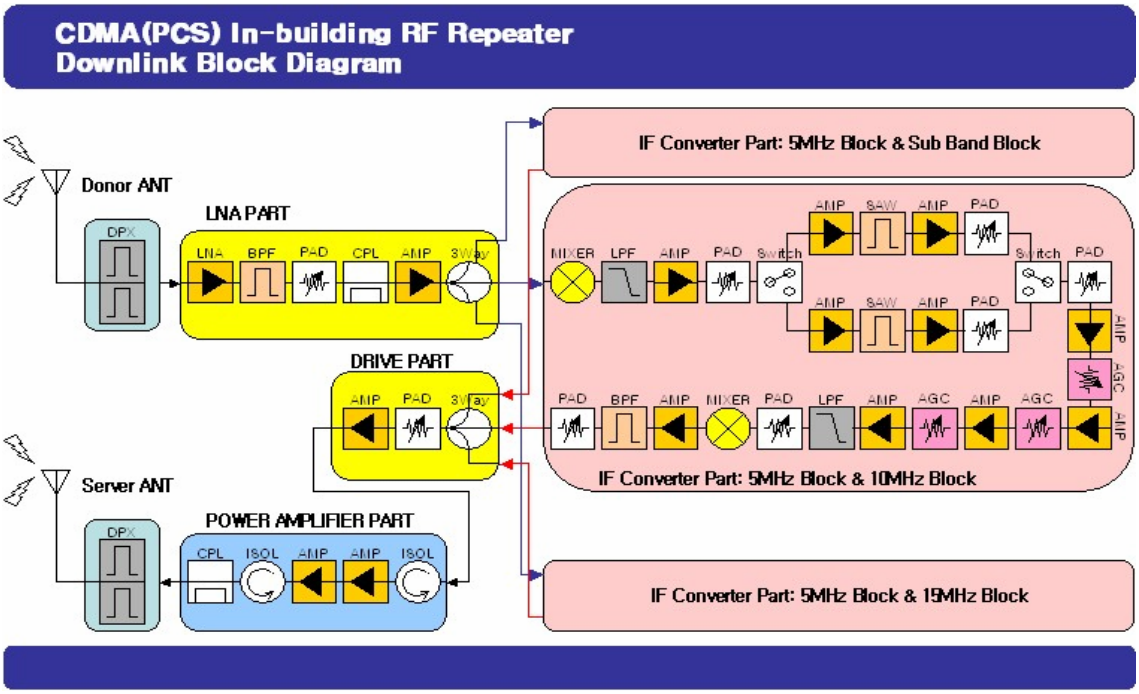
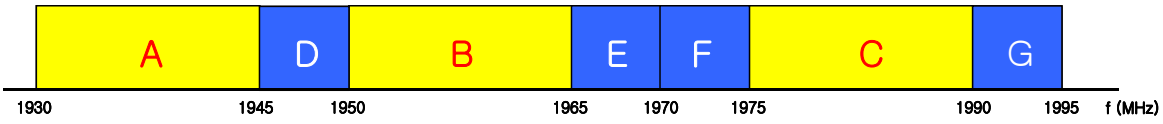
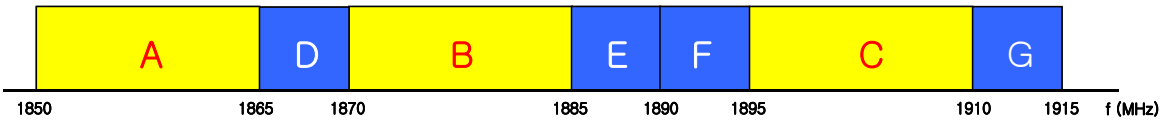


<Pic.6> Downlink Block Diagram

2.2.4 US PCS Frequency Selection



< Forward Band Structure >



< Reverse Band Structure >

<Pic.7> PCS Band Structure

US PCS 1900 repeater has 5MHz, 10MHz, 15MHz, 20MHz Paths in IF division, so any of these bandwidths can be chosen for providing service. But there are some cases when this choice is not applicable.

- Not continuous 4 Paths [5 MHz each], so total band is 20MHz (i.e. A1A3B2C1, A1A2B1B2)

3. Specifications

3.1 System Specifications (applicable to both Uplink & Downlink)

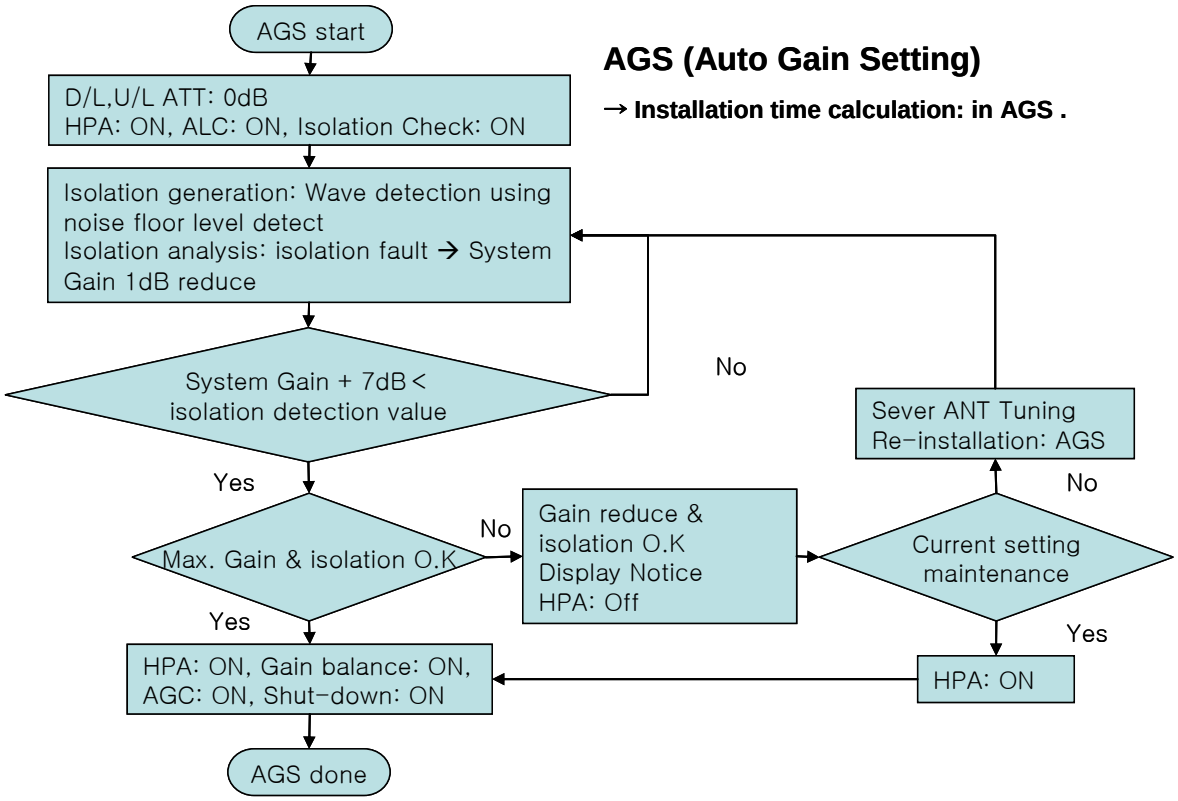
Characteristics		Specification
Frequency Range	Forward	1930 ~ 1995MHz
	Reverse	1850 ~ 1915MHz
System Group Delay		< 5㎲
Characteristic Impedance		50 ohm
VSWR		Max1.5 : 1
Input Power Range		-100 ~ -20dBm (for both Uplink and Downlink)
System Isolation		> 90dB
Gain Range		40dB ~ 80 dB
Noise Figure		< 4.5 dB @ Max Gain <12 dB @Min Gain
Gain Adjustment Step(Accuracy)		1dB(±0.5dB)
Pass Band Ripple		2.5dB(±1.25dB)
Maximum Output Power		250mW / 24dBm
Spurious Emissions		>45 dBc @885kHz >55 dBc @1.98kHz <-13dBm @Fc±2.25MHz (RBW: 1MHz)
IF Path		5MHz/10MHz/15MHz/20MHz
IF Frequency		FWD: 200 MHz, RVS: 120MHz
Band Select		Local Shift & RF Switching
Roll Offs		> 50dBc @1MHz
Waveform Quality Factor		min 0.912

3.2 Electrical and Environment Specifications

Characteristics	Specification
Size(inch) / Type	16.1(W) x 17.7(L) x 6.89(H)
Power	AC 120V 60Hz 3.0A

Temperature / Weight	-10℃ ~+50℃/35.1lbs
Connector TYPE	N Type Female

3.3 Functions

Parameter	Specification
Gain Control	• Adjustable DL and UL Gain range 40~80dB • Display default Gain and current Gain function
AGS Auto Gain Setting	• AGS (Auto Gain Setting) Use convenient Set-up 
AGC Auto Gain Control	• It always operates in Downlink AGC ON status • To maintain same Downlink output power despite flexible input signal strength. • To add or subtract Attenuation level referring to AGC Power Limit level.
ALC Auto Limit Control	• To limit output power as far as default range • Set up via GUI • Automatic Gain decrement when output power of repeater is higher than default level • Automatic Gain recovery when output power of repeater is reduced. • Shutdown when output power is higher than default level in Minimum Gain • Automatic Recovery Algorithm conversion after Shutdown status

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Gain Balance	• Downlink ATT is applied to Uplink during AGC state • Setting and maintenance of output level • Additional attenuation to ALC Level
Oscillation Check	• Isolation Check in initial set up or Reset • Monitoring Oscillation comparing to minimum/maximum Noise Floor level • When Oscillation occurred, repeater attempts to stabilize Isolation through Gain control function. • Shutdown repeater when Oscillation still goes in Minimum Gain • Automatic Recovery Algorithm conversion after Shutdown status
Spurious Emission Alarm	• Noise Floor Observation in case of ±2.25MHz down at the center • In case of Noise level > –13dBm, Spurious Emission is stabilized automatically • In case of Oscillation Spurious Emission Alarming in Minimum Gain, repeater will be shutdown • Automatically Switch to Recovery Algorithm at Shutdown
Band Select	• To select either 5MHz/10MHz/15MHz/20MHz
Power Monitoring Function	• Monitoring repeater's output level
DL Input control	• Monitoring Donor ANT input power of DL
Automatic Recovery	• When in repeater shutdown, it periodically recovers output power of repeater then monitors alarming
Security	• Support HTTPS for Web Browser security • User authentication through User ID and Password
Temperature control	• Monitoring temperature of repeater • Maximum and minimum set up is possible. Shutdown in over temperature • Automatic recovery after temperature becomes normal. (Hysteresis 10 degree)
VSWR Monitoring	• Monitoring VSWR of Donor ANT Port (Every one and half minute) • Reporting VSWR Alarm and Shutdown when the rate is 3:1 • Automatic Recovery Algorithm conversion after Shutdown status
IP address report via E-mail	• When in PPP reconnection, E-mail which includes HTML to connect to newly assigned IP Address, reports to operator.
DHCP Client	• Automatic IP assignment
DHCP	• Server function for automatic IP assignment

Server	
Web GUI	• Remote and local user browser support through Web Browser
SNMP Agent	• NMS report via SNMPv2 Trap
LED Display	• LED displays power and operation status on front side of repeater system. • DL input and output signal level is verified by LED bar.

4. SET UP

4.1 System Set up

4.1.1 Constitution (based on 1 SET)

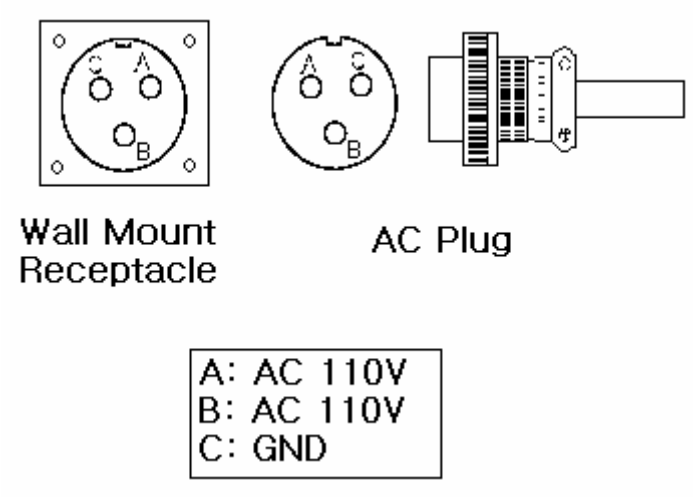
Parameter	Item	Quantity	Remark
Major accessory	CDMA 24dBm repeater	1 EA	Manufacture company supply
Additional components	Ethernet Cable (cross) Power Supply Cable Fixable Screw x 4 (Size: φ1/2", length: 2") Ground Cable CD which contains User Manual and installation Guide	1 EA 1 EA 1 SET 1 EA 1 EA	Manufacture company supply
User Manual	Installation Guide (Book)	1 EA	Manufacture company supply
Antenna	Donor ANT Server ANT	1EA 1EA	Establishment construction company preparation
RF Cable	Antenna connection Cable	TBD	Establishment construction company preparation
Repeater quality confirmation equipment	Spectrum Analyzer	1EA	Establishment construction company preparation

4.1.2 Notice

1) System Power check: Major electricity is AC110V, therefore please input electricity after power verification.

2) Input condition optimization: DL input condition is -56 ~ -16dBm. User should verify input condition of Donor ANT.

3) Isolation check between DONOR/SERVICE ANT: Isolation condition of this equipment is 95dBc (Gain+ 15dB). User should check its condition before installation.



<Pic. 8> MS 3100 A 10SL-3 (Wall Mount Receptacle) & MS3010 A 10SL-3(Plug)

4.1.3 System set up

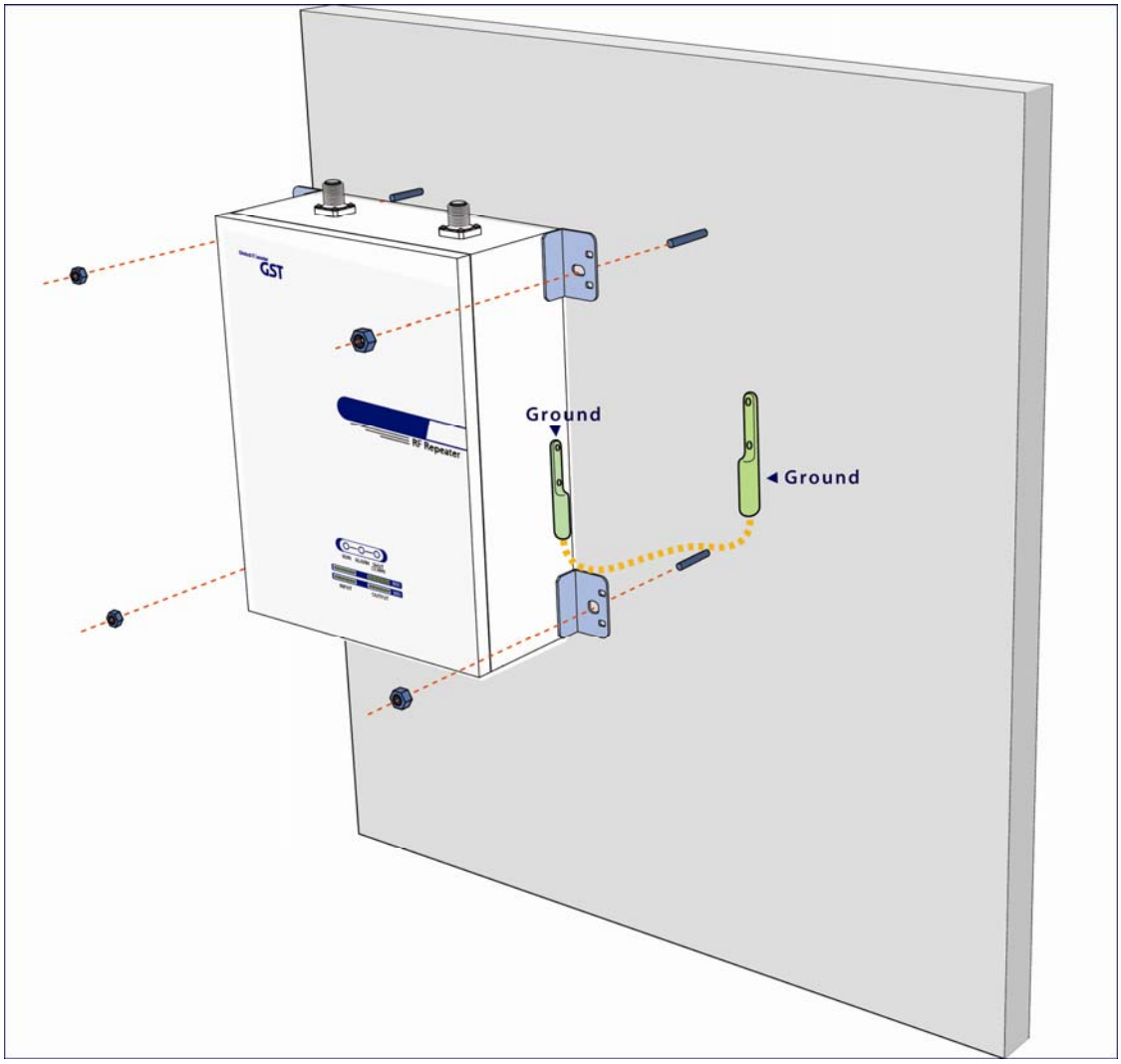
1) This equipment is basically wall mountable installation.

2) Once aforementioned process is done, open for service get ready.

3) For grounding, there is a grounding terminal in main power supply side and the grounding terminal on a site and unit should be connected same.

4) System installation work is basically performed more than two people and should be careful for unexpected accident.

4.1.4 Open for service



<Pic.9> Case mounts

1) Check points before open

a. Verification of system installation status

Electricity, In/out antenna, coaxial cable connection, equipment mounts status.

b. Verification of system accessories

User should check whole necessary accessories.

c. Check receipt signal level

User should check whether receipt environmental condition is in accordance with system specification, so that system operation will be optimized.

2) Check points after open

a. Check by external LED

① RUN: Green light ON (Off: Green light off)

② ALARM: Green light in normal status, Red light in alarming

③ SHUT DOWN: Green light in normal status, Red light in Shutdown

⑤ Number of LED bar on front side of repeater will show input signal level.

Less than -56dBm: LED 1bar

-56dBm~-48dBm: LED 2bars

-48dBm~-39dBm: LED 3 bars

-39dBm~-31dBm: LED 4 bars

-31dBm~-23dBm: LED 5 bars

Number of LED bar in output power side will show output power signal level

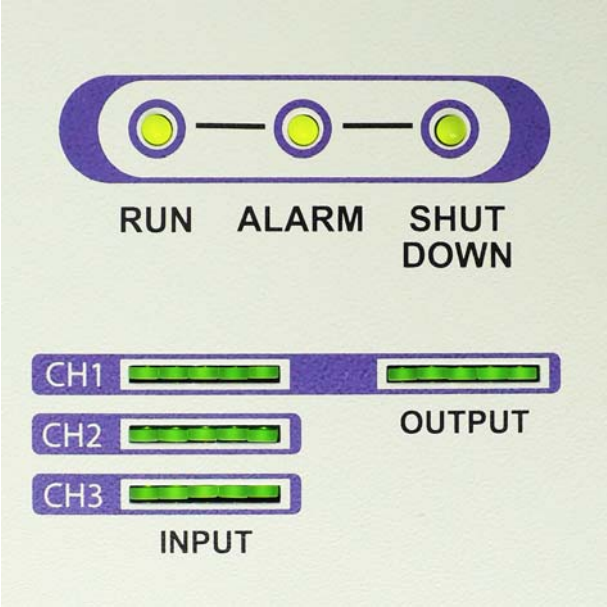
Less than +15dBm: LED 1bar

+16dBm~+17dBm: LED 2 bars

+18dBm~+19dBm: LED 3 bars

+20dBm~+22dBm: LED 4 bars

More than +23dBm: LED 5 bars



<Pic.10> Front LED Indicator

4.2 Troubleshooting

In case, abnormal operation is detected, user should check abnormal parts via remote accessible

function or field debug, then conduct repair after turn it off.

4.2.1 Necessary Testing and measuring equipment

a. RF Power Meter: 10Watt Max, 50ohm

b. Signal Generator: 3GHz

c. Spectrum Analyzer: 3GHz

d. Multi Meter

4.2.2 Notice

a. Trouble shooting should be performed with drastic knowledge basis.

b. Unsure parts should not be disassembled.

c. When in trouble shooting, technician should use attenuator to check output side.

4.2.3 Note at set up process / Check point after open for service

<table>
<tr><th>Item</th><th>Check Point</th><th>Trouble shooting</th></tr>
<tr><td>Note before system operation</td><td>* System Input power range</td><td>
<table>
<tr><th colspan="2">Input Level</th></tr>
<tr><td>Down Link</td><td>-100dBm/Total ~ -20dBm/Total</td></tr>
<tr><td>Up Link</td><td>-100dBm/Total ~ -20dBm/Total</td></tr>
</table>
</td></tr>
<tr><td>Same as above</td><td>* System Gain</td><td>
<table>
<tr><th colspan="2">Gain</th></tr>
<tr><td>Down Link</td><td>40 ~ 80dB</td></tr>
<tr><td>Up Link</td><td>40 ~ 80dB</td></tr>
</table>
</td></tr>
</table>

<table>
<tr>
<td>Same as above</td>
<td>* Output power at edge port side</td>
<td>
<table>
<tr><th colspan="2">Output power</th></tr>
<tr><td>Down Link</td><td>24dBm/Total</td></tr>
<tr><td>Up Link</td><td>24dBm/Total</td></tr>
</table>
</td>
</tr>
<tr>
<td>Check in Advance</td>
<td>* Check points before open for service</td>
<td>* Please check quantity of all accessories with specification before you set up.
* Fit cable length in accordance with field condition.
* Set up Donor antenna to assure enough Isolation (More than 87dBc)</td>
</tr>
<tr>
<td>Check after open</td>
<td>* Check points after open for service</td>
<td>* Check following status
- Fixable level of antenna support pole
- Connection status between antenna and RF cable
- RF Cable construction and fixed status
- fix of repeater and installation status
- Electricity construction and proper AC power status
- Plug status and electricity voltage status
- wall socket and voltage status
- Grounding (EARTH) status
- Direction of Donor antenna
(PN Offset and neighborhood BTS to be considered.)
- Ground status of repeater (unit itself)
- Coaxial cable construction status
- Connector combiner connection status
- Cable connection status against leakage of water</td>
</tr>
</table>

4.2.4 Trouble shooting guide related to RF

Symptom	Check Point	Troubleshooting

When repeater does not work properly	* Checking Electricity Cord connection status	* Re-plug in AC power cord
Same as above	* Checking electricity input to AC power outlet.	* Please verify AC power input by using DVM (Digital Voltage Meter)
When in alarming	* DL over-input alarm	* Please Check following status - Proper maximum output power limit level - BTS input level (Spectrum Level) - Input RSSI value at Status mode - Downlink Attenuation level - Downlink Attenuation Table * Please reset AC power upon complete Alarm trouble shooting
When in alarming	* DL over-output alarm	* Please make sure output power is operated normally. * Please reset AC power upon complete Alarm trouble shooting.
When in alarming	* UL over-output alarm	* Please make sure output level is operated normally * Please reset AC power upon complete Alarm trouble shooting
When in alarming	* VSWR alarm	* Please Check following status - Antenna port connection - Whether inner-output cable is damaged or not. * Please reset AC power upon complete Alarm trouble shooting
When in alarming	* IF Module alarm	* Please verify IF Module LED is On. * When LED is Off, module should be defective.
When in alarming	* DL, UL PAM alarm	* Please reset AC power upon complete Alarm trouble shooting

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When in alarming	* DC matter/Current alarm	* Please verify DC power by using DVM (Digital Voltage Meter) * Please reset AC power upon complete Alarm trouble shooting.
When in alarming	* UL Oscillation	* Please check Isolation between Donor and Server. * Please reset AC power upon complete Alarm trouble shooting.
When in alarming	* DL / UL LNA alarm	* Please check connection status of LNA. * Please reset AC power upon complete Alarm trouble shooting
When in alarming	* Temperature alarm	* Please Check following status - Setting level of maximum temperature limit - Temperature offset is normal or not. - Circumstance temperature. * Please reset AC power upon complete Alarm trouble shooting
When in alarming	* DL low-input alarm	* Please reset AC power upon complete Alarm trouble shooting
When in alarming	* DL low-output alarm	* Please Check following status - Output power level is normal or not. - Whether minimum output limit level is normal. * Please reset AC power upon complete Alarm trouble shooting
When in alarming	* RF OFF	* Please reset AC power upon complete Alarm trouble shooting
When output power is no longer strong or problem	* Technician should verify category of alarm at the front side of repeater.	* When Red light on the Shutdown LED, technician should troubleshoot the alarm via Notebook computer.

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Same as above	* Technician should connect antenna with output port of repeater. * Please make sure all connectors are fastened	* Reconnect the connector. * Please change it if the connector is detective.
Same as above	* Check the input level not to be too low.	* Increase output power or check input change of BTS side.
Same as above	* Check Gain of the unit	* If the Gain is different from normal level, please contact A/S team.
Same as above	* Cable loose or over loss.	* Please contact installer or service provider upon verification.
In case of drop call or bad signal after set up	* Check receipt signal strength in the service area not to be too low.	* Increase output power level of repeater by adjusting attenuation level.
Same as above	* If receipt signal strength is not a problem, please check delay of calling time.	* Please increase output level of Uplink signal, then setting by optimal level..
Same as above	* Check receipt signal strength	* Please contact network management team or service provider
In case, output Signal wavelength is not shown flat or looks like oscillation	* Check connection fastened between antenna and cable (Signal wavelength should be flat and stable if technicians shake CABLE. If not, it is connection problem.)	* If connection is not proper, please make sure connector and cable to be re-connected then check the output power again.
Same as above	* Input level change or module blazing .	* Check input level from BTS side. * Check performance of each module. (Diagnosed by A/S team.)
Same as above	* Please check VSWR of the Cable is normal.	* Change to normal Cable.

4.2.4 Trouble shooting guide related to NMS

Symptom	Check Points	Troubleshooting
Link fail	* Communication problem	* In case of Ethernet, check set up level of IP, Gateway and so on, when you use Ethernet.
Same as above	* CLI Connection, Cable status check	* Make sure 1:1 connection.
Same as above	* CLI connection Check by USB to Serial Cable	* Please verify Port number of PC communication. * Please check Cable connection status.

5. WEB USER INTERFACE

5.1 IP Address verification and Explorer setting

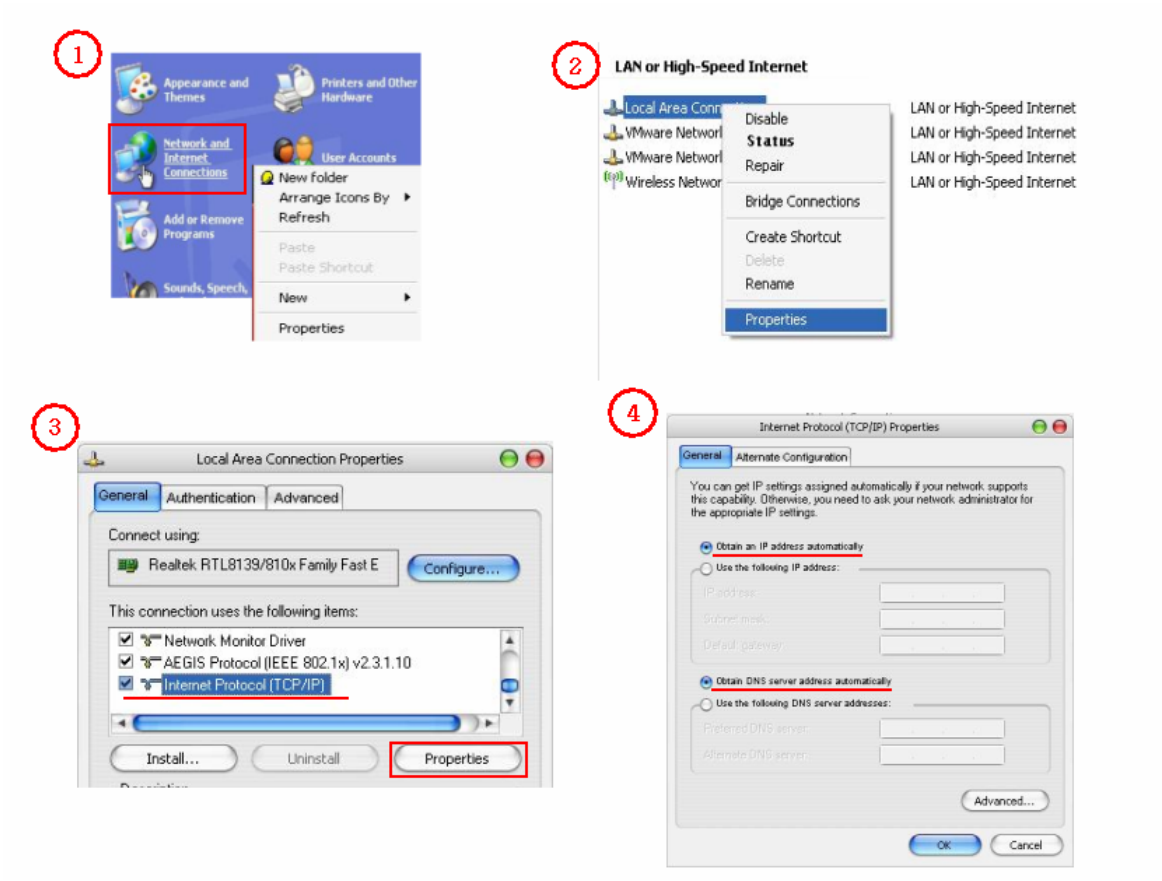
5.1.1 IP Address verification and Explorer setting

(1) Start->Control Panel->Network Connections

(2) Double-click Local Area Connections at LAN or High Speed internet

(3) Click Internet Protocol (TCP/IP) at General tap and click Properties.

(4) Apply automatic IP address assignment at local connection

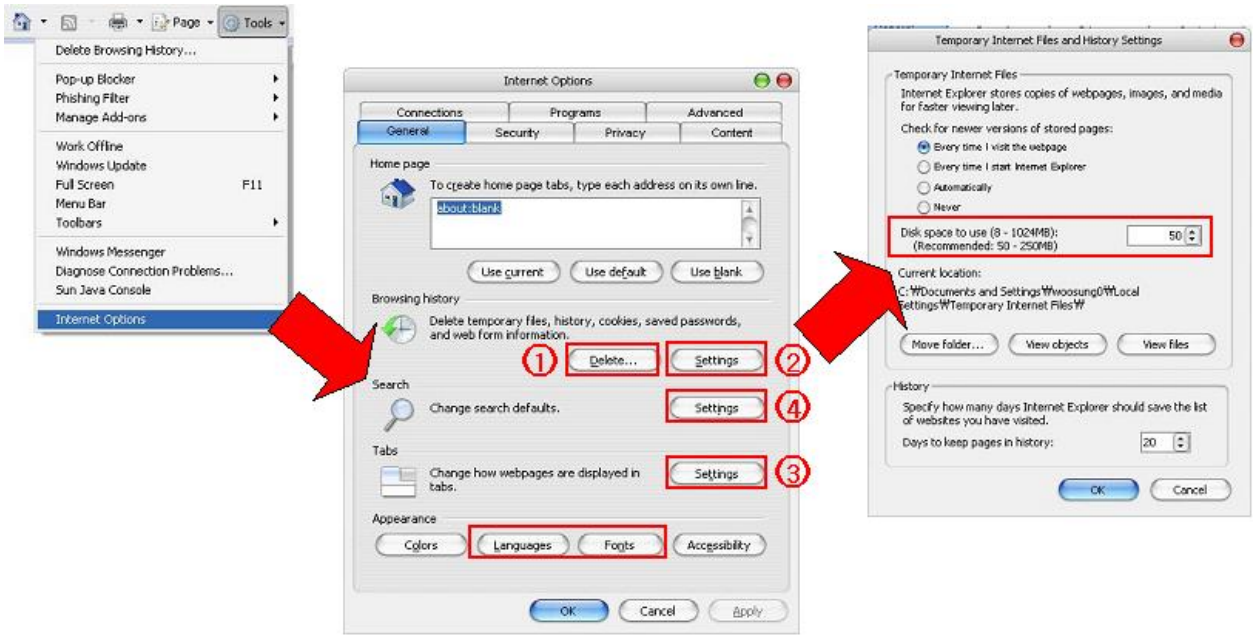


(5) Verify assigned IP address at local connection.

(Unless IP address is not assigned, please click repair.)

5.1.2 Explorer option setting

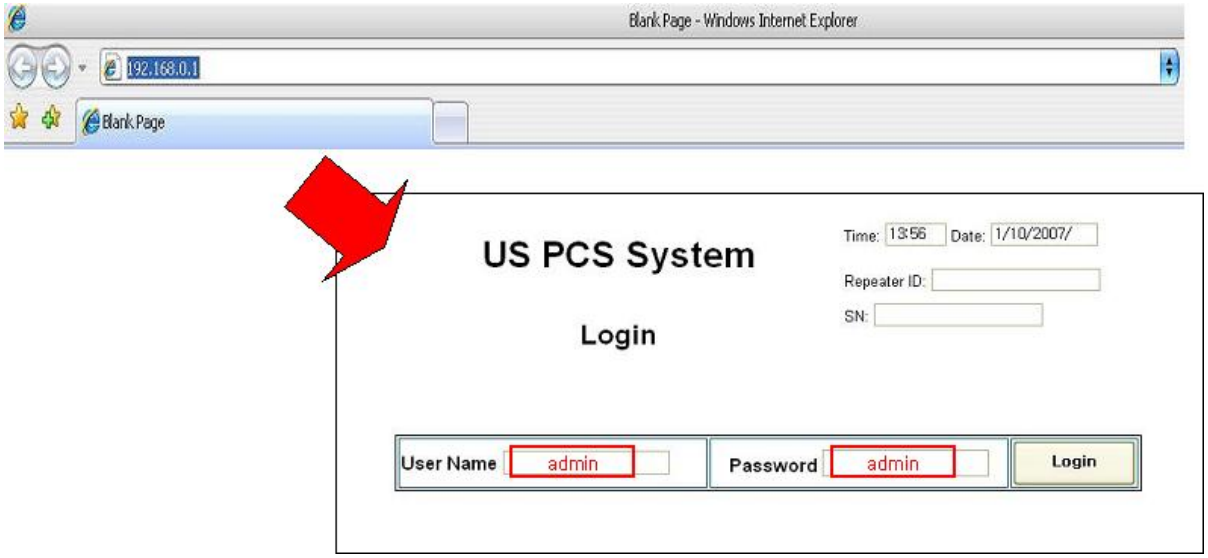
- Proceed step by step as indicated in below. All files and records should be removed.
- Set up mode will be displayed after (2) click.
- Please proceed along following set up mode screen shot.



5.2 PCS Web UI

5.2.1 Web UI connection

- Input desirable IP address.
- Default Use Name and Password for Web UI is 'admin'.



5.2.2 Link menu

- Following screen shot is located left-top side of main menu and those are linked to relative window.

1. Logout
2. Status : It displays current status of Repeater
3. RF Configuration : It can control Repeater parameters
4. Alarm Configuration : It displays arising alarms
5. Communication Configuration : It displays communication mode in connection with Repeater
6. User Management : User addition and deletion
7. Logs : History data for setting & controls, each route
8. Sub System/Mailing List : Mailing List
9. Troubleshooting : Q&A
10. Remote Software Upgrade : Software upgrade
11. System Reset : Reset

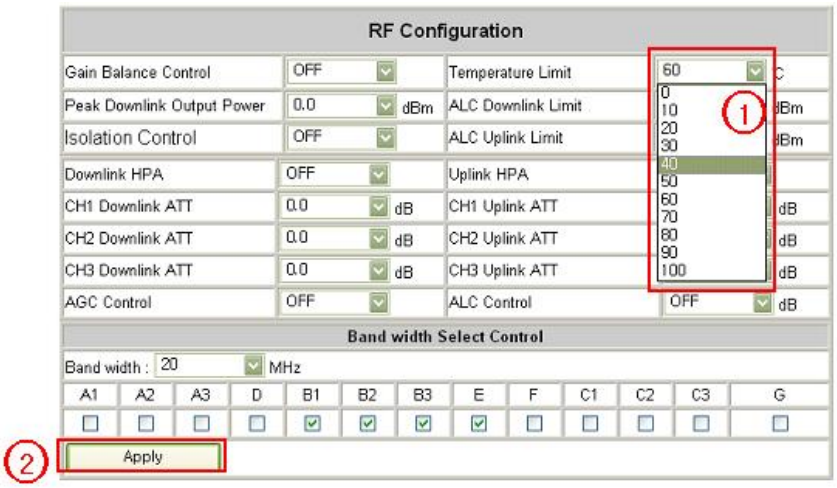
5.3 Web UI control

5.3.1 Status

- Currently setting level check at this menu tap.

5.3.2 RF Configuration

- Setting level can be changed at this menu tap.
- (1) Level change
- (2) Click Apply button



5.3.3 Alarm Configuration

- (1) On/Off function for entire alarm report
- (2) Alarm status
- (3) On/Off function for individual alarm category
- (4) Alarm SNMP Mapping
- User may set and change its level per it field condition and click apply button.

5.3.4 Communication Configuration

- This provides all necessary information related to network
- To provide relative information about DHCP and modem

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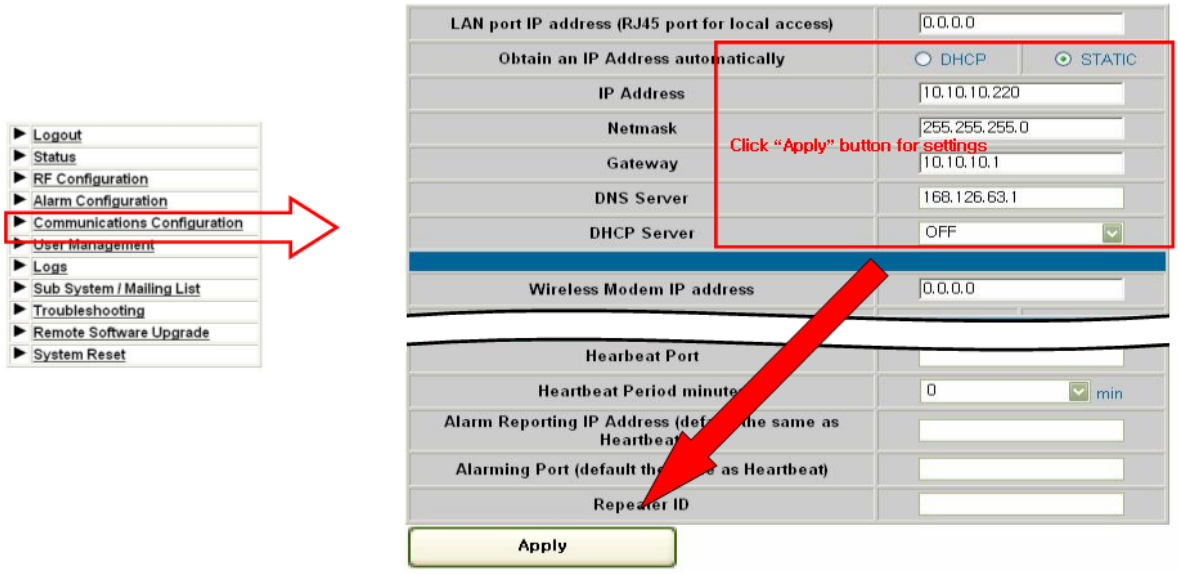
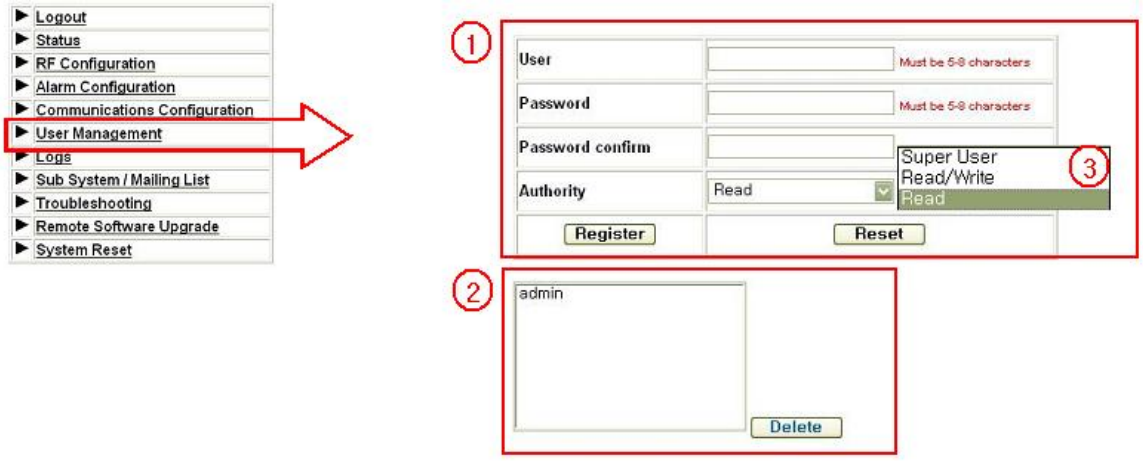


5.3.5 User Management

- Add and Remove user, Assigning accessibility
  - (1) User Registration: Click Register after input required information
  - (2) User Removal: Click Delete upon click of user name you wish to remove.
  - (3) Super User: Accessible to all kinds of information path

    Read/Write: Accessible to all kinds of information path except for User management path.

    Read: Checking status only. No control



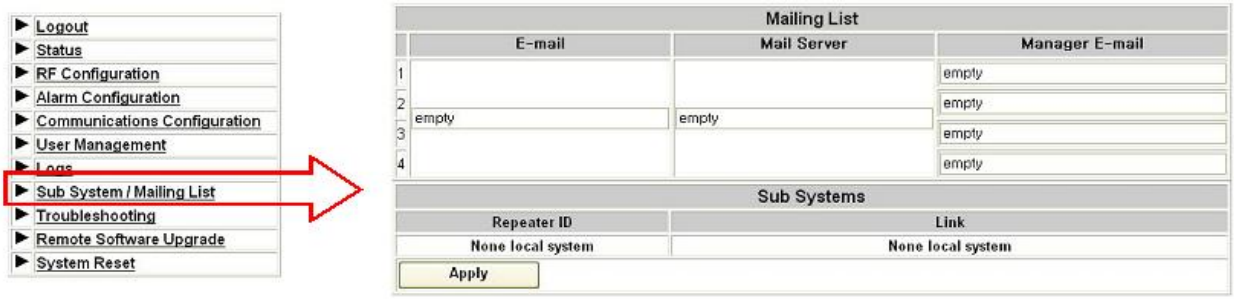
5.3.6 Logs

- All users' access record will be saved as a log.

Date & Time	User	Operation	Description
1/3/1996 - 7:26:41	admin	Login	Login
1/3/1996 - 23:45:3	admin	Login	Login
1/3/1996 - 23:45:10	admin	logs	Checked
1/3/1996 - 23:45:18	admin	Status	Checked
1/3/1996 - 23:45:21	admin	RF Configuration	Checked
1/3/1996 - 23:45:24	admin	logs	Checked
1/3/1996 - 23:45:30	admin	RF Configuration	Checked
1/3/1996 - 23:45:33	admin	Status	Checked
1/3/1996 - 23:45:38	admin	RF Configuration	Checked

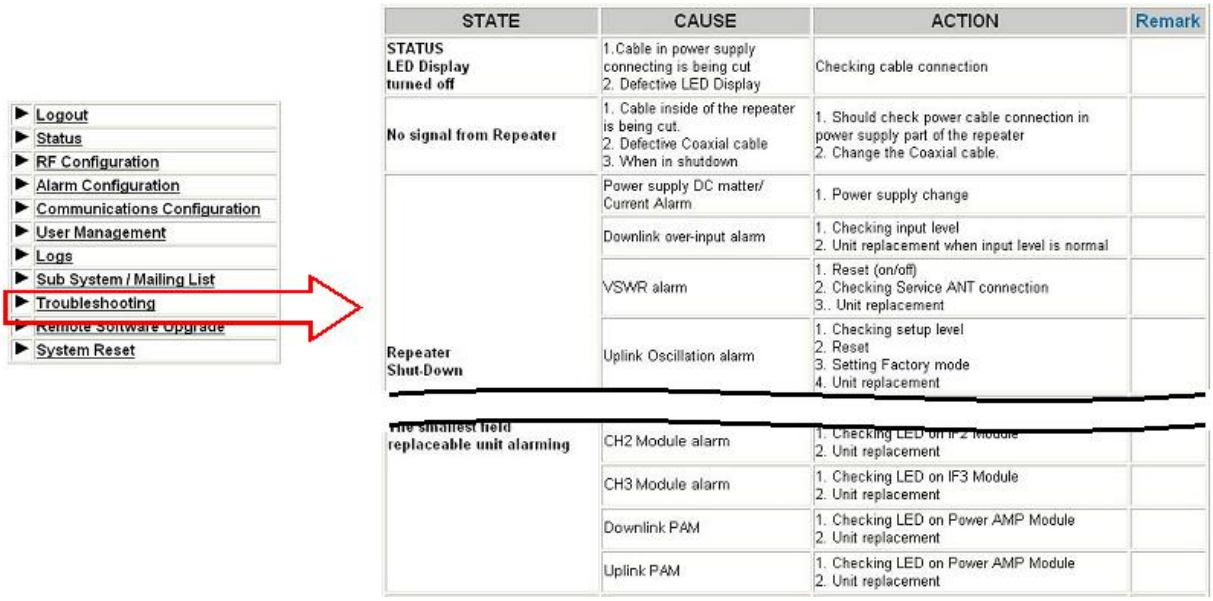
5.3.7 Sub System / Mailing List

- Set up e-mail address the place you wish to receive alarm.



5.3.8 Troubleshooting

Following is a trouble shooting table, which is frequently occurred to repeater and treatment method.



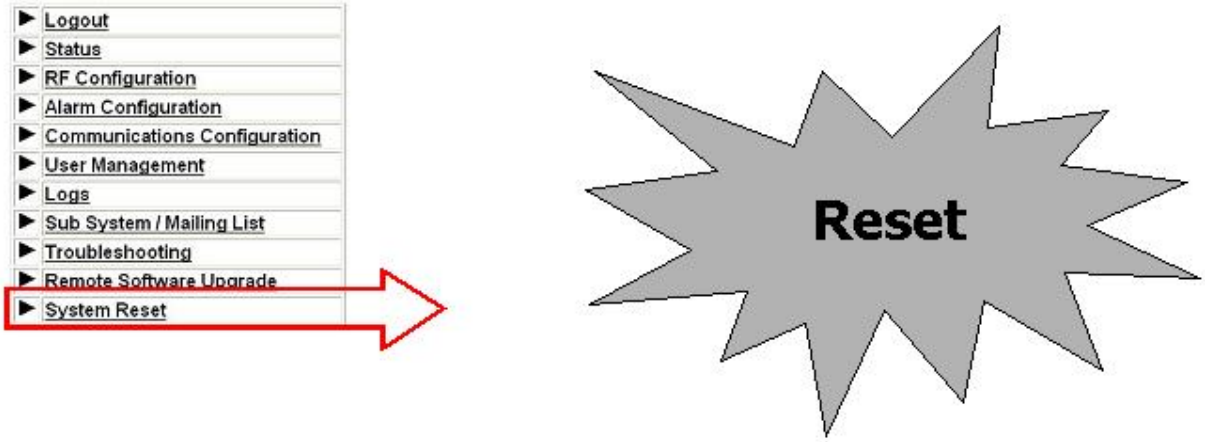
STATE	CAUSE	ACTION	Remark
STATUS LED Display turned off	1.Cable in power supply connecting is being cut 2. Defective LED Display	Checking cable connection	
No signal from Repeater	1. Cable inside of the repeater is being cut. 2. Defective Coaxial cable 3. When in shutdown	1. Should check power cable connection in power supply part of the repeater 2. Change the Coaxial cable.	
Repeater Shut-Down	Power supply DC matter/ Current Alarm	1. Power supply change	
	Downlink over-input alarm	1. Checking input level 2. Unit replacement when input level is normal	
	VSWR alarm	1. Reset (on/off) 2. Checking Service ANT connection 3.. Unit replacement	
	Uplink Oscillation alarm	1. Checking setup level 2. Reset 3. Setting Factory mode 4. Unit replacement	
The smallest field replaceable unit alarming	CH2 Module alarm	1. Checking LED on IF2 Module 2. Unit replacement	
	CH3 Module alarm	1. Checking LED on IF3 Module 2. Unit replacement	
	Downlink PAM	1. Checking LED on Power AMP Module 2. Unit replacement	
	Uplink PAM	1. Checking LED on Power AMP Module 2. Unit replacement	

5.3.9 Remote Software Upgrade

- Upload repeater operation program.

5.3.10 System Reset

- Reset repeater.



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