Report No. : HCT-R07-031

ATTACHMENT C.

- USER MANUAL -

SPRINT User Manual iDEN_15dBm

May, 2007

- INDEX -

1. SUMMARY

iDEN repeater is located in blanket / shadow area of insider of building to transmit iDEN800MHz, iDEN900MHz BTS signal simultaneously.

There are two types of RF Repeater for iDEN band as each 15dBm, and 25dBm output power in system 65dB Gain, and 30dBm output power in system 80dB Gain.

This User Manual is the Repeater having 80dBGain / +15dBm output power.

Bandwidth

- Downlink 851MHz~869MHz, Uplink 806MHz~824MHz (18MHz Band)

- Downlink 862MHz~869MHz, Uplink 817MHz~824MHz (7MHz Band)

To avoid paging signal interference at 940MHz side, IF Converter shift SAW filter edge by 200KHz, 400KHz. (TX Edge only, not whole bandwidth).

Also, This Repeater is equipped for Output power control by AGC/ALC, Gain Control by Attenuator adjustment, Remote Control by using Web UI and Remote Firmware Up-grade.

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

2. SYSTEM STRUCTURE

2.1 Network structure for iDEN 15dBm RF Repeater

Below picture shows a Network structure for iDEN In-building RF Repeater in a real site. Donor ANT takes a position on the direction to BTS which be linked, and Server ANT is available to be located in designated area for service by using RF cable deployments and dividers as blow.
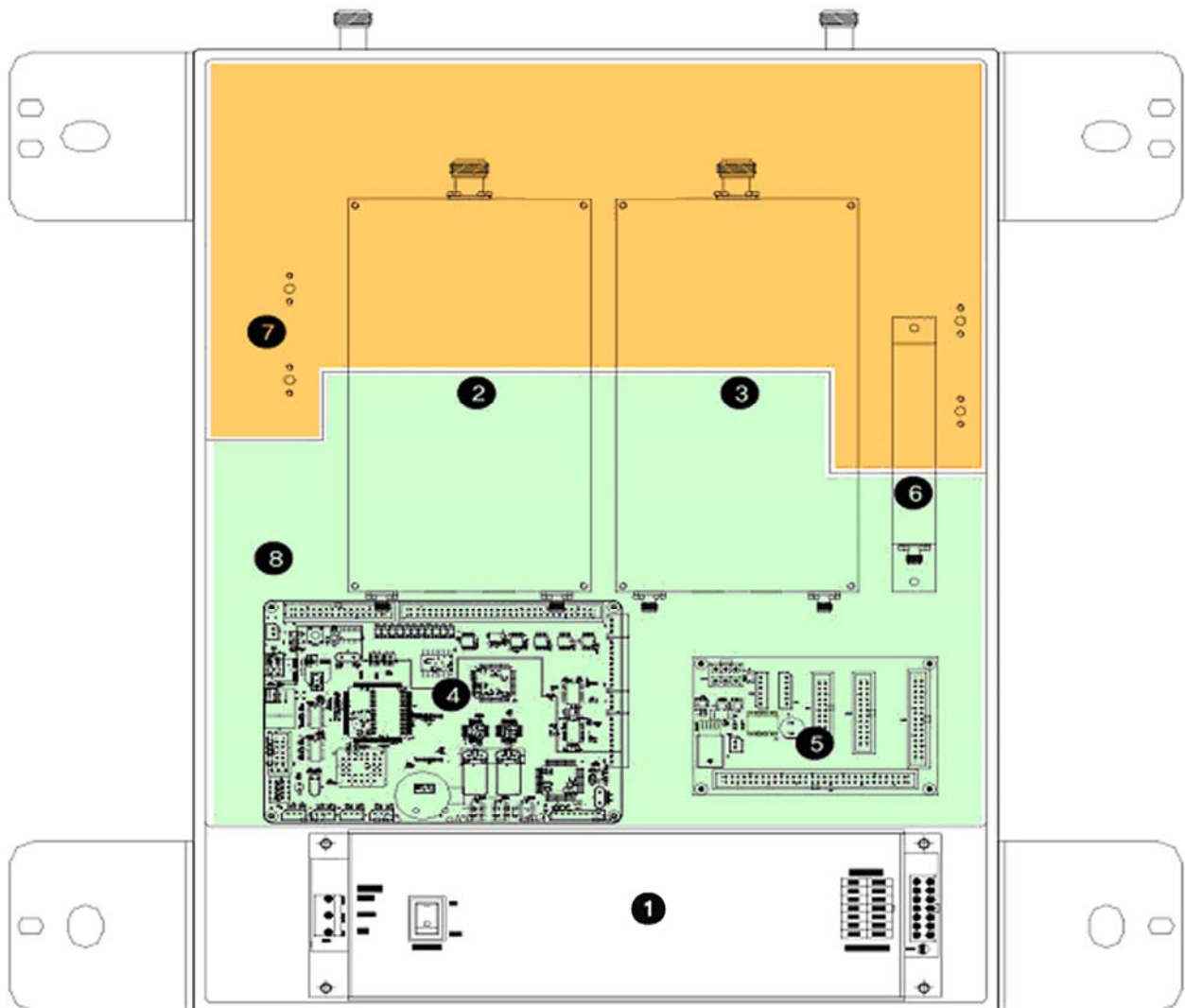
One thing that we consider is Path losses between Repeater port and ANT in case of dividing by dividers and RF cables. They should be equally managed.
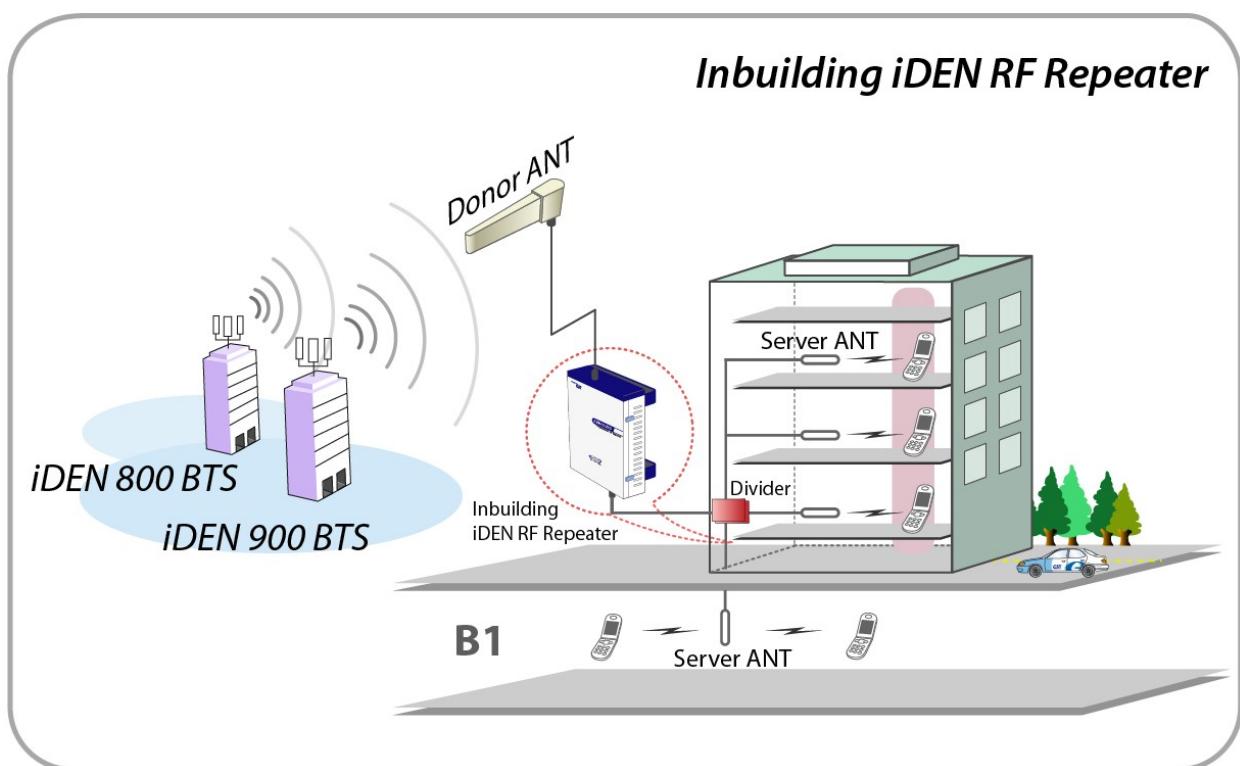
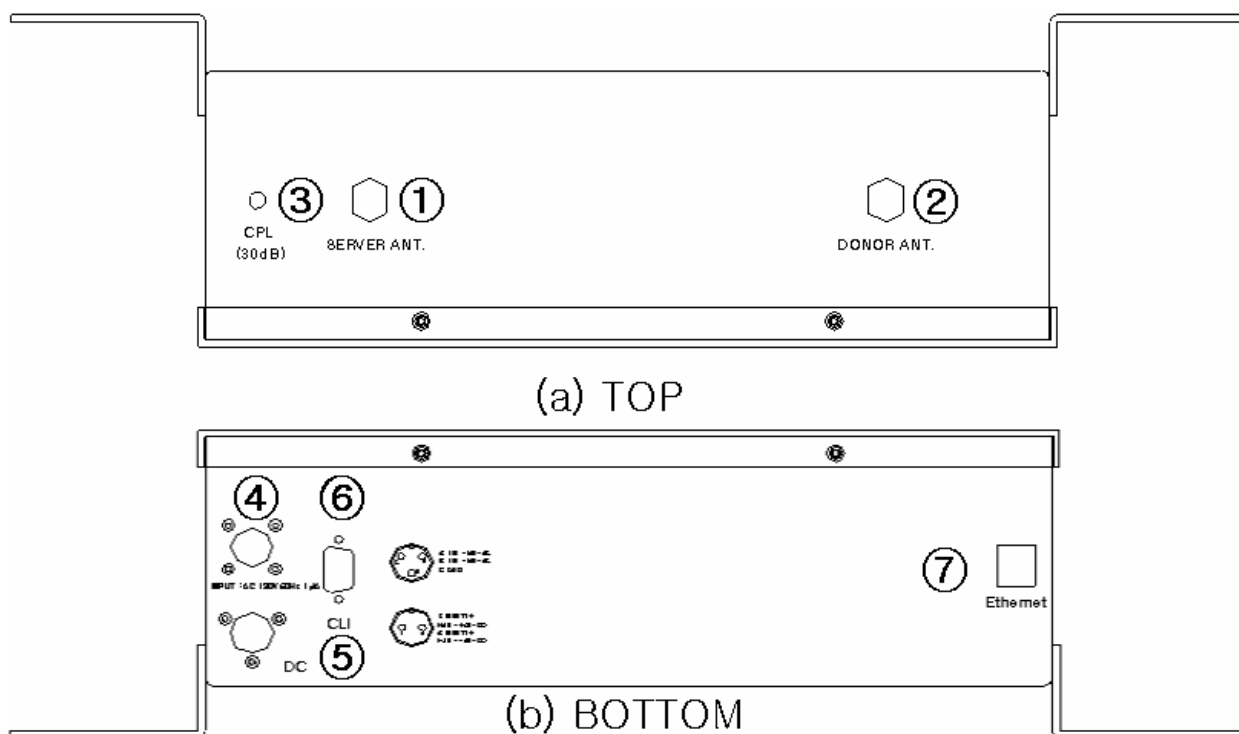**<Pic.1> iDEN In-building Repeater Service Organization**

2.2 System Design and Operation

2.2.1 System design

NO.	PART	NO.	PART
①	PSU MODULE	⑤	I'O BOARD MODULE
②	CAVITY FILTER MODULE	⑥	WAVE MONITORING MODULE
③	CAVITY FILTER MODULE	⑦	RVS PATH PART
④	NMS MODULE	⑧	FWD PATH PART

<Pic.2> iDEN 15dBm internal design

NO.	PORT	NO.	PART
①	SERVER ANT PORT	⑤	DC POWER PORT
②	DONOR ANT PORT	⑥	CONTROL PORT
③	MONITOR PORT	⑦	ETHERNET PORT
④	AC POWER PORT		

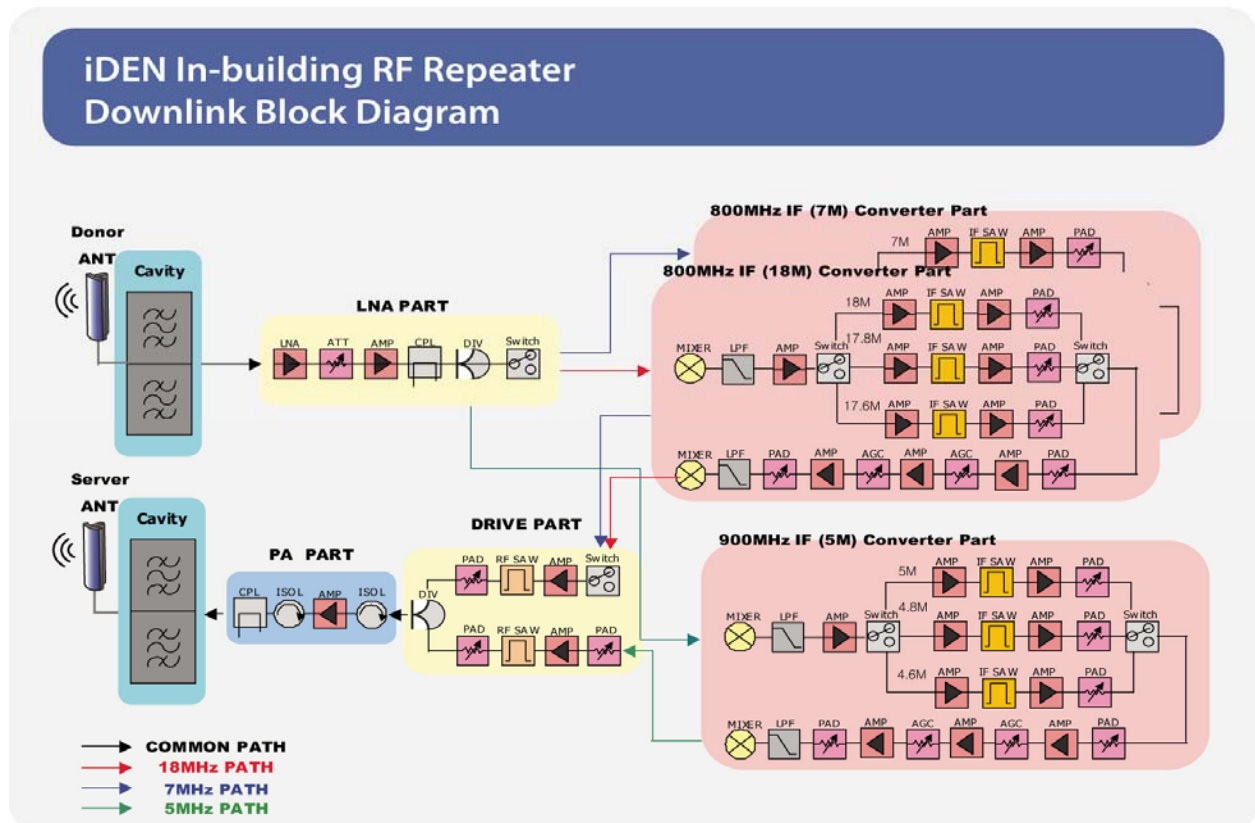**<Pic.3> iDEN 15dBm PORT design**

2.2.2 Downlink Path

There are four (4) parts of downlink Block in iDEN In-building RF Repeater.

- Filter part for Multiplex four (4) bands as each 800MHz and 900MHz TX/RX in Front End of Donor/Server

- LNA part of Donor/Service path to process signals of 800MHz and 900MHz bands.

- If Converter part having several bands of SAW Filter paths to adjust Band Edge of high frequency as 200KHz and 400KHz each. In case of 800MHz band, extra Switching Filters equipped to individually select 18MHz and 7MHz

- Power Amplifier part for power amplifier and Level Monitoring/VSWR monitoring to adjust desirable output power of Repeater

Downlink frequency contains lots of signals such as Paging signal, DCS etc through Donor ANT. So Out band signals should be minimized by SAW filters having excellent Roll off characteristics for the best optimized operation.

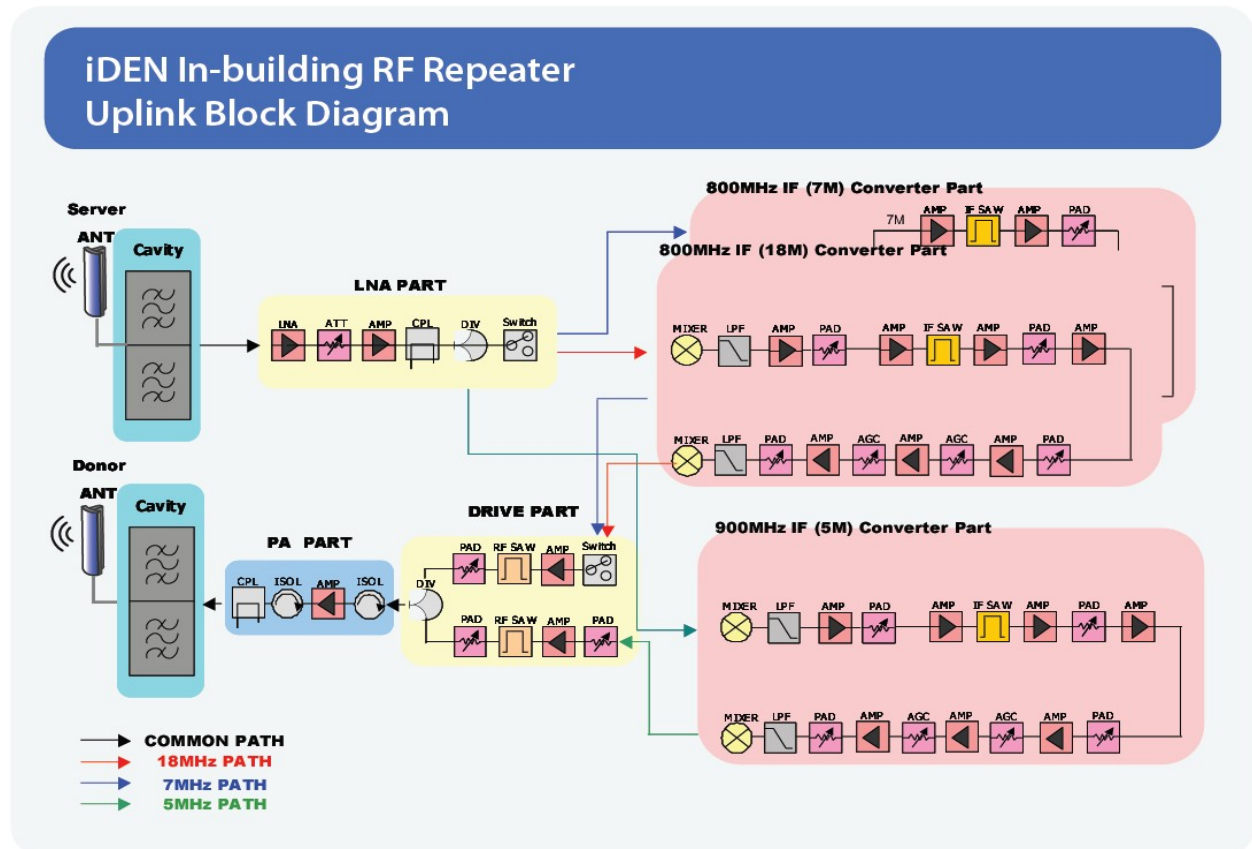**<Pic.4> iDEN In-building RF Repeater Downlink Block Diagram**

2.2.3 Uplink Path

Uplink Block of iDEN In-building RF Repeater is separated as four (4) parts.

- Filter part for Multiplex four (4) bands as each 800MHz and 900MHz TX/RX in Front End of Donor/Server

- LNA Part of two(2) paths for processing 800MHz and 900MHz signals

- 800MHz IF Converter part and 900MHz IF Converter part of 5MHz band having Switching filter parts for selecting each 18MHz and 7MHz.

- Power Amplifier part for power amplifier and Level Monitoring/VSWR monitoring to adjust desirable output power of Repeater

800MHz IF Converter part is designed to select single path, and it can be minimizing signal interference between paths, and power consumption according to controls of electric power in each SAW Filter part.


<Pic.5> iDEN In-building RF Repeater Uplink Block Diagram

2.2.4 Adjustable Band Edge functional circuit configuration

In case of IDEN using the bandwidth of 800MHz and 900MHz, many of Out of Band Signals is input via Donor ANT Outdoor. The most worried signal among them is Paging Signal. Commercial Paging Signal of 929MHz~932MHz, 940MHz~941MHz, having the strength of Max. -15dBm, is to be inputted into Donor ANT. Among this two kind of Paging Signal Band, 929MHz~932MHz bandwidth is possible for sufficient Rejection via SAW Filter, But 940MHz~941MHz is difficult to gain big decreasing volume even if use SAW Filter because Band Edge is as close as to be folded to 935MHz~940MHz of being the frequency of iDEN900MHz Downlink.

To prepare for this environment, Down Link of iDEN Repeater is designed to have additional Roll Off characteristic by decreasing band of SAW Filter in the station adjacent to paging signal, for it having the function of Adjust Band Edge that can decrease c of high frequency by 200 kHz, 400 kHz each.
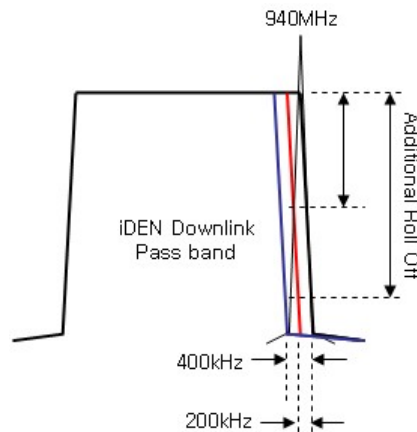
<Pic.6> Additional Roll off through Adjust Band Edge

3. SPECIFICATIONS

3.1 System specifications

Characteristic				Specification
Frequency Range	Forward	800MHz	18 MHz BAND	851~869 MHz
			17.8 MHz BAND	851~868.8 MHz
			17.6 MHz BAND	851~868.6MHz
			7 MHz BAND	862~869 MHz
			6.8 MHz BAND	862~868.8 MHz
			6.6 MHz BAND	862~868.6MHz
		900MHz	5 MHz BAND	935~940MHz
			4.8 MHz BAND	935~939.8MHz
			4.6 MHz BAND	935~939.6MHz
	Reverse	800MHz	18 MHz BAND	806~824 MHz
			7 MHz BAND	817~824 MHz
		900MHz	5 MHz BAND	896~901 MHz
System Group Delay				< 8 μs
Characteristic Impedance				50 ohm
VSWR				Max.1.5 : 1
Input Power Range				-53 ~ -23dBm (FWD, RVS common)
Gain Range				40dB ~ 65 dB
Noise Figure				< 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				31.6mW / 15dBm @ Composite Power 800MHz:12dBm, 900 MHz:12dBm
Spurious Emissions				< -13dBm
IF Frequency				FWD: 70 MHz, RVS: 70 MHz
Adjacent Channel Power	@CH offset 25 KHz			> 50 dBm @ Degradation of 3dB for eight iDEN carriers
	@CH offset 50 KHz			> 55 dBm @ Degradation of 3dB for eight iDEN carriers
	@CH offset 500 KHz			> 55 dBm @ Degradation of 3dB for eight iDEN carriers
	@CH offset 1MHz			> 55 dBm @ Degradation of 3dB for eight iDEN carriers

	@CH offset 2 MHz	> 55 dBm @ Degradation of 3dB for eight iDEN carriers
Adjust Band Edge	@ 869 MHz	868.8MHz/868.6MHz
	@ 940 MHz	939.8MHz/939.6MHz
Band Select		Local Shift & RF Switching
Roll Offs		> 65dBc

3.2 Electrical and Environment Specifications

Items	specification
Size(mm) / Type	16(W)*18(L)*7(H) / Inch
Power	AC 120V 60Hz 3.0A
Temperature / Weight	0℃ ~ +50℃/45.42 lbs
Connector TYPE	N Type Female

3.3 Functions

Parameter	Specification
Gain Control	• Adjustable DL and UL Gain range 40~65dB • Display default Gain and current Gain function
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
Band Select	• In case of 800MHz FWD Band, it enables User to select one of 18MHz, 17.8MHz, 17.6MHz/ 7MHz, 6.8MHz, and 6.6MHz according to GUI setting. • In case of 900MHz FWD Band, it enables User to select one of 5MHz, 4.8MHz, 4.6MHz according to GUI setting. • In case of 800MHz RVS Band, it enables User to select one of 18MHz/ 7MHz according to GUI setting.

|	
	• In case of 900MHz RVS Band, it enables User to select 5MHz according to GUI setting.
Band Edge Adjust	• To shift Band edge of DL high frequency side by 200kHz, 400kHz step
Power Monitoring Function	• Monitoring repeater's output 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
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 10degree)
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	• Server function for automatic IP assignment
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
Major accessory	iDEN 30dBm repeater	1 EA
Additional components	Main power input Cable	1 EA
	Mountable Bracket	1 EA
	Fixable Screw	1 SET
	Ground Cable	1 EA
	Ethernet Cable(cross)	1 EA
User Manual	Manual	1 EA

4.1.2 Notice

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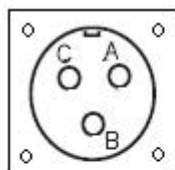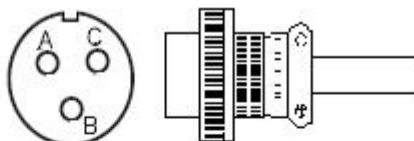

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A: AC 110V
B: AC 110V
C: GND
```

<Pic.7> MS 3100 A 10SL-3 (Wall Mount Receptacle) & MS3010 A 10SL-3(Plug)

2) Input condition optimization: DL input condition of iDEN is -53 ~ -23dBm.

3) Isolation check between DONOR/SERVER ANT: Isolation condition of this equipment is 80dBc (Gain+15dB). User should check its condition before installation.

4) This equipment is basically wall mountable installation.
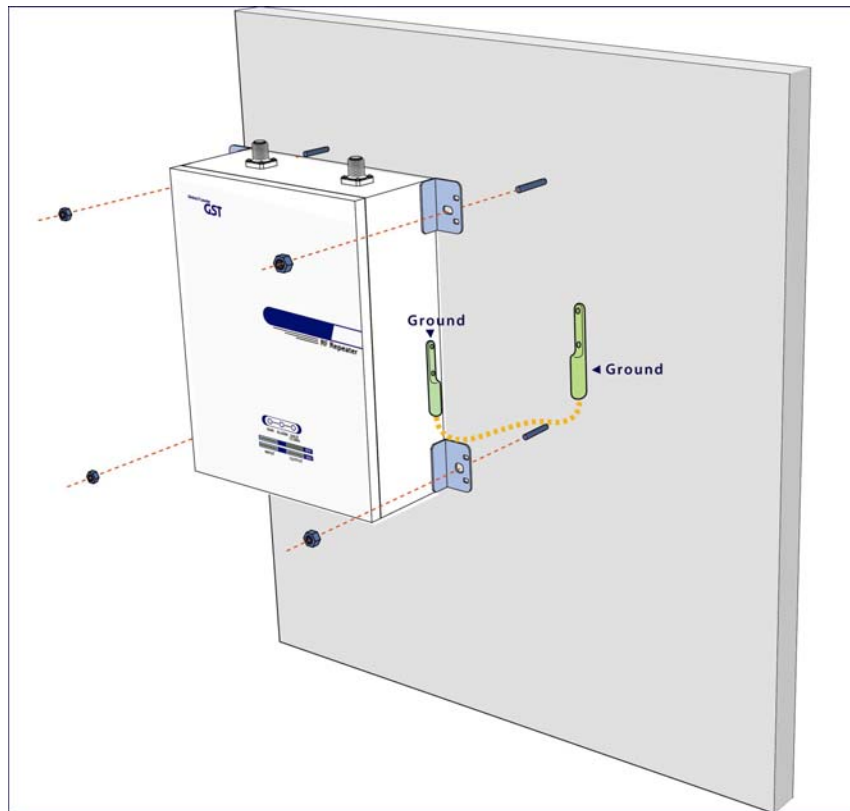
<Pic.8> Wall mounted iDEN In-building RF Repeater
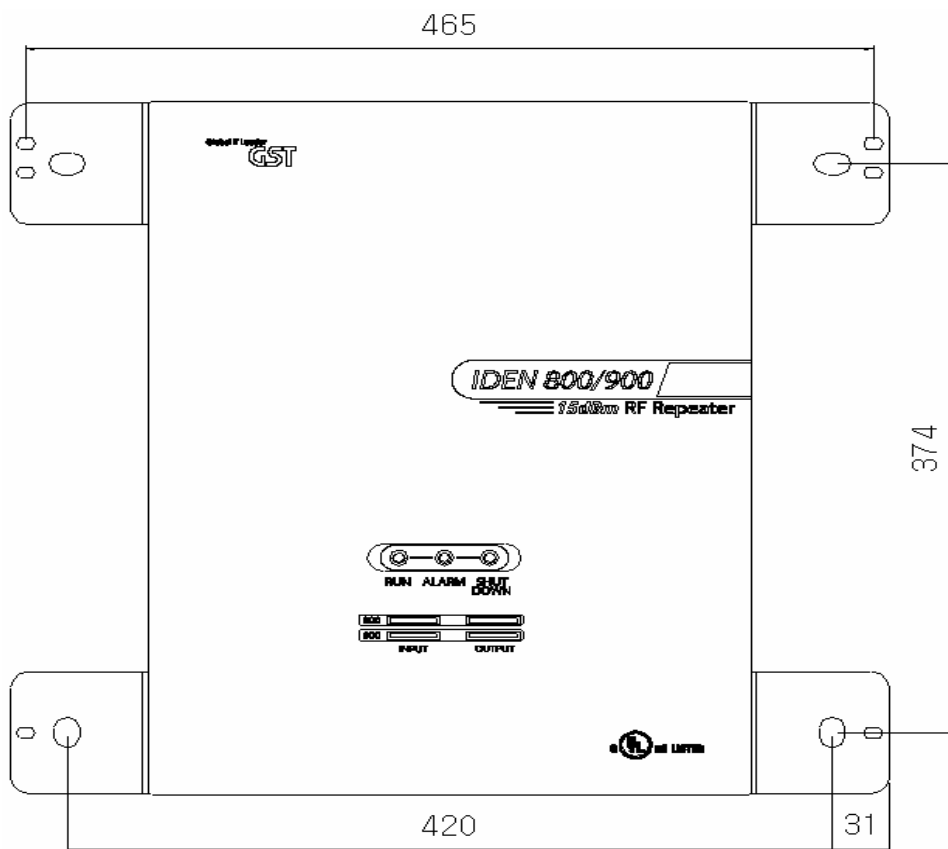
<Pic.9> Hole sizes of iDEN In-building RF Repeater

4.1.3 System set up

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

2) 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.

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

4.1.4 Open for service

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

④ iDEN

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

   -57dBm -48dBm: LED 1bar

   -47dBm~-43dBm: LED 2 bars

   -42dBm~-38dBm: LED 3 bars

   -37dBm~-33dBm: LED 4 bars

  Up than –32dBm: LED 5 bars

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

   -10dBm~-6dBm: LED 1bar

   -5dBm~-1dBm: LED 2bars

  0dBm~+4dBm: LED 3bars

   +5dBm~+9dBm: LED 4bars

  Up than +10dBm: LED 5bars
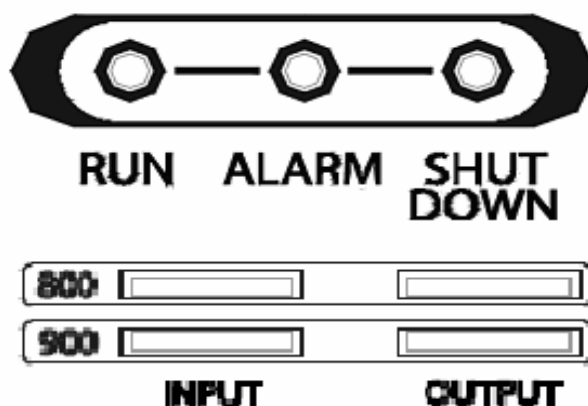
<Pic.10> iDEN In-building RF Repeater front LED

b. Verification via Debug Program

  User should check operation status of repeater system via Debug Program.

 c. Verification of operation status

   Use should verify following status with Output monitoring terminal, which is provided by

   Spectrum Analyzer.

    - Output power generation status, system spurious emission characteristics.

 d. Verification of signal quality and strength in service area

     User should verify signal strength and quality of in-service coverage area by using cell phone or other terminal.

 e. Verification of upper-level NMS operation status

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.

5. WEB USER INTERFACE

5.1 IP Address verification and Explorer setting

5.1.1 IP Address verification

(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

17
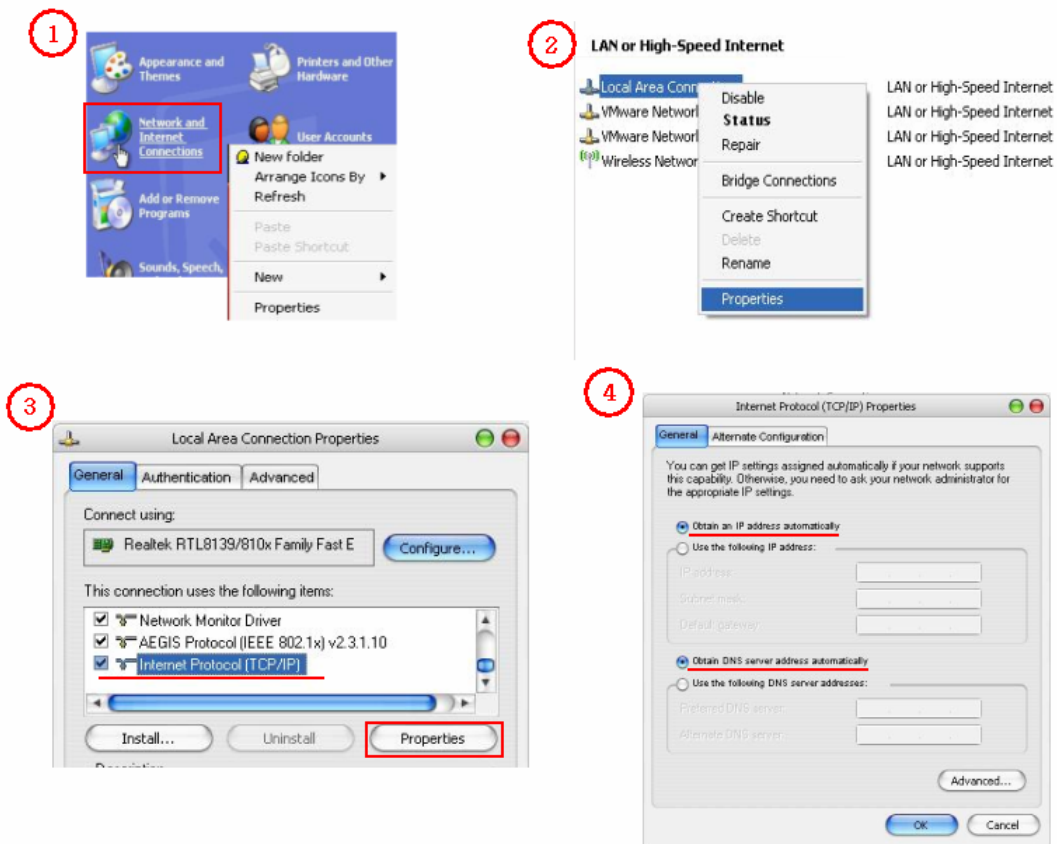
(5) Verify assigned IP address at local connection.

(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.
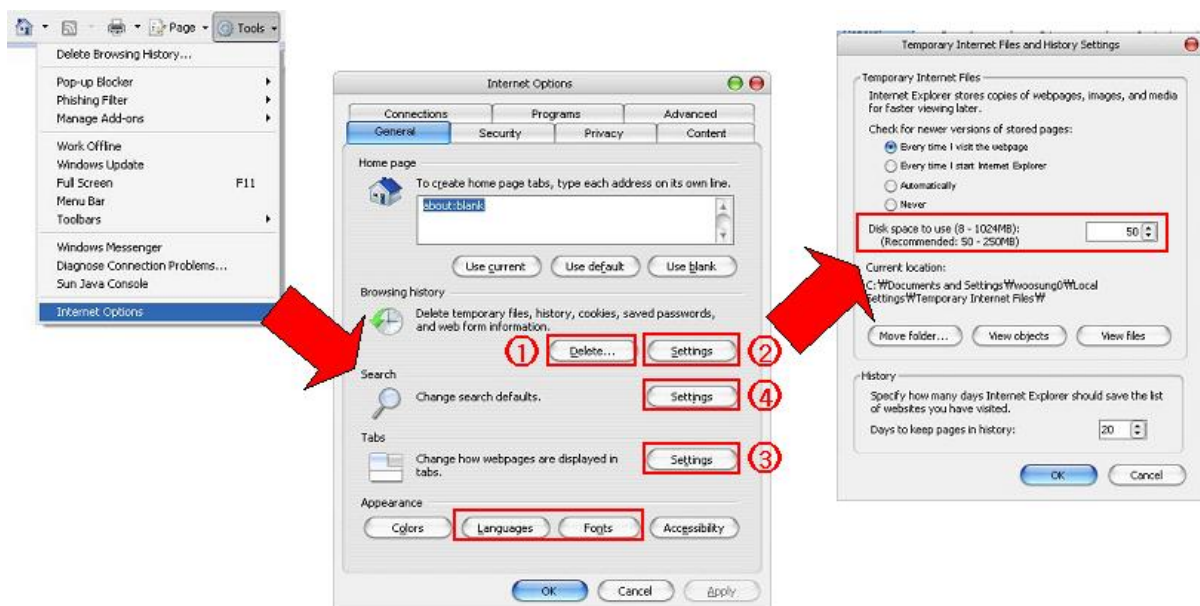
5.2 Web UI

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

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.

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.

The smallest field replaceable unit alarming

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.

► Logout
► Status
► RF Configuration
► Alarm Configuration
► Communications Configuration
► User Management
► Logs
► Sub System / Mailing List
► Troubleshooting
► Remote Software Upgrade
► System Reset

Reset