

ATTACHMENT E.

- USER MANUAL -

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3G Indoor Repeater GRS-TRIR-SPR User Manual

AUGUST , 2010

Version 0.1

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1. SUMMARY

GRS-TRIR-SPR is an Digital RF repeater, which iDEN 800/900 and US PCS Band Service. This system has 90dB gain in the iDEN 800/900 band and PCS band respectively with 25dBm and 24dBm maximum power each

GRS-TRIR-SPR receives RF signal from BTS and transmits it to the blanked and shadowed area, thus providing and improving voice and image data services. GRS-TRIR-SPR's goal is to support BTS's functions proportionately.

GRS-TRIR-SPR communicates with BTS wirelessly, thus saving additional costs for its maintenance.

GRS-TRIR-SPR consists of RF/IF part Module, PA Module, Wave Module, Digital Filter module, and I/O & Control module 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 GRS-TRIR-SPR, its application, maintenance and troubleshooting, installation and operation etc.

This equipment is indoor use and all the communication wirings are limited to inside of the building.

CAUTION

RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN IN CORRECT TYPE.

DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS

Abbreviation

PCS : Personal Communication System

RF: Radio Frequency

BTS: Base Transceiver Station

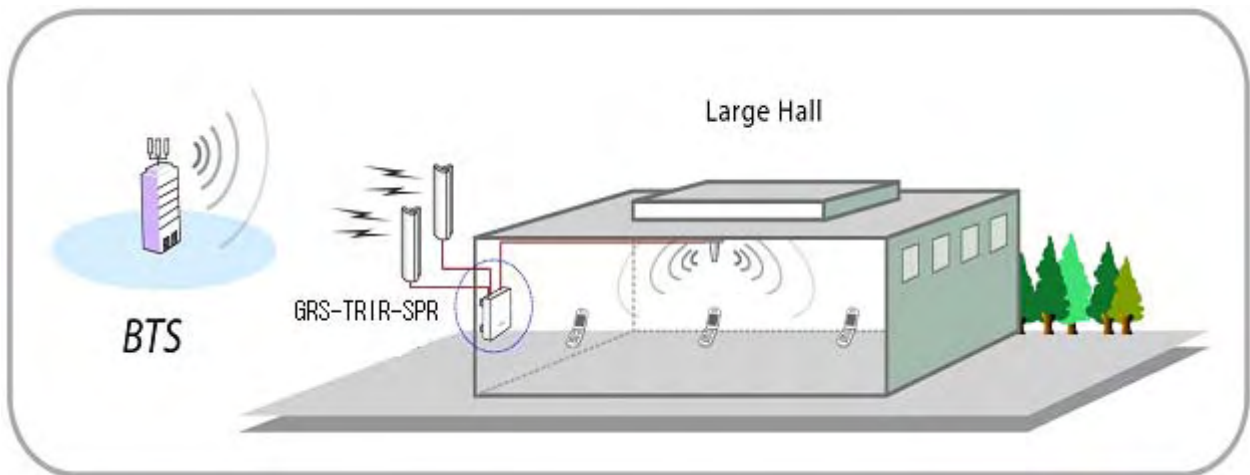
IF: Intermediate Frequency

I/O : Input/Output

2. System Configuration

2.1 GRS-TRIR-SPR Service Organization

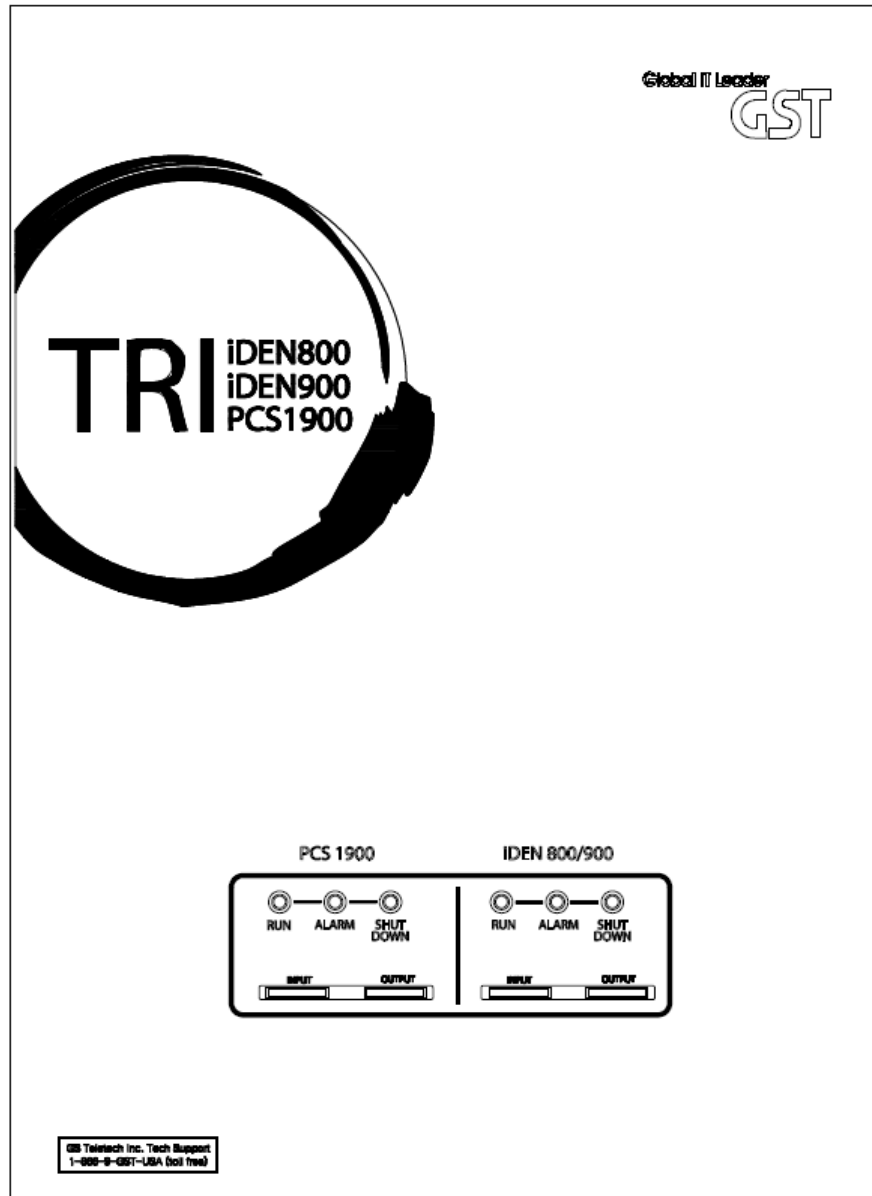
GRS-TRIR-SPR decreases blanked and shadowed areas and extend cell coverage by re-transmitting signal. The signal is received from BTS via Antenna directly, thus excluding additional expenses for signal transmission (like cabling). Service organization of TRI Band(iDEN 800,900 and CDMA) In-building RF 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 and iDEN 800/900 Service Organization

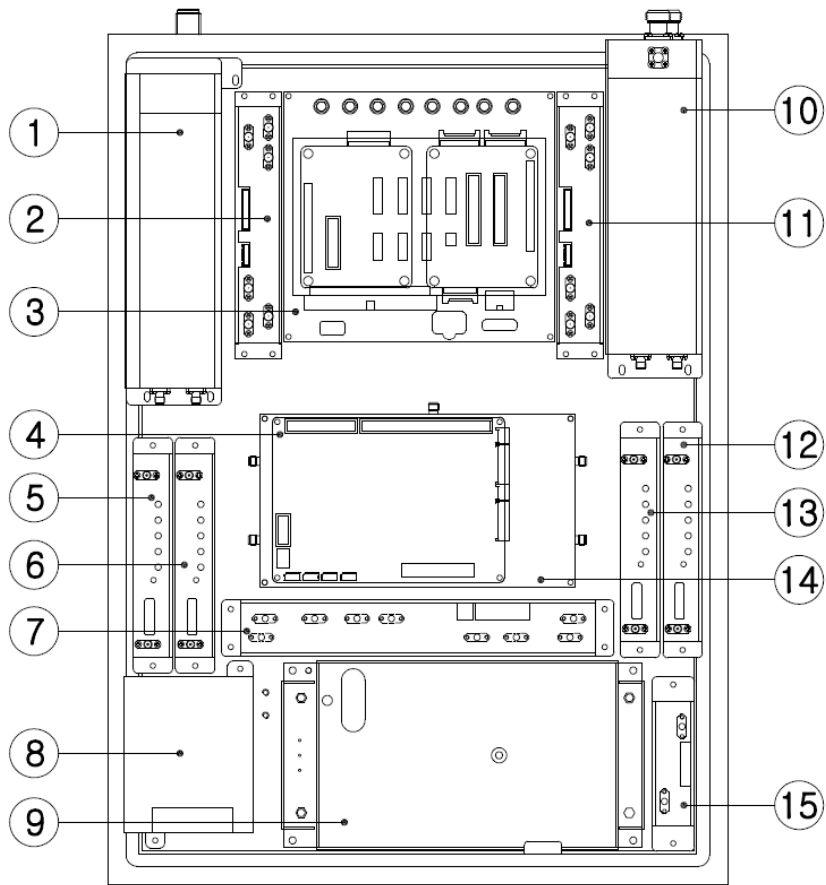
2.2 System Design and Operation

2.2.1 System Design

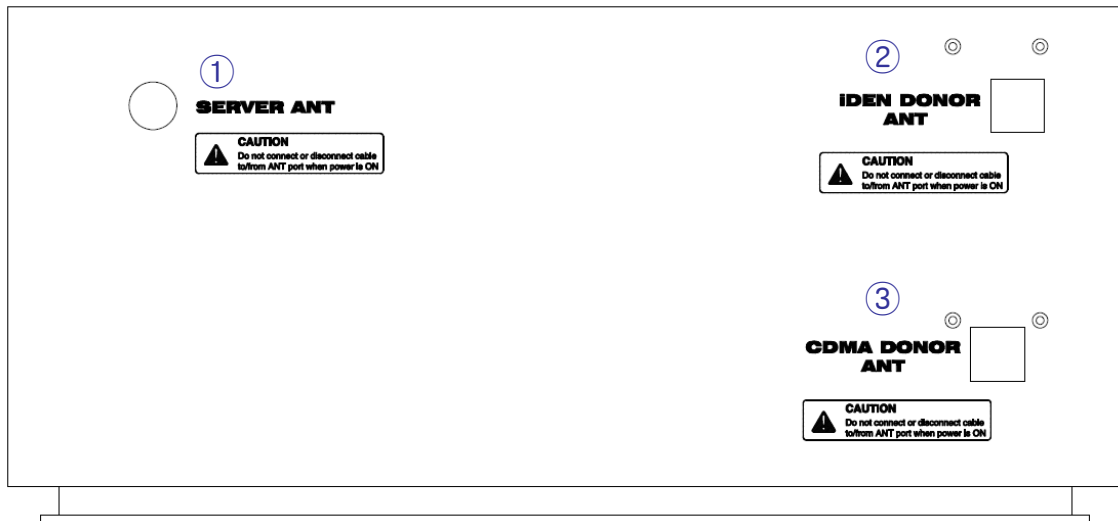


<Pic.2> GRS-TRIR-SPR Repeater

NO	DESCRIPTION
1	CAVITY(SER.)
2	IDEN RX
3	IDEN DFM
4	RCU
5	PCS TX PAM
6	IDEN TX PAM
7	PCS DRIVE
8	SUB POWER
9	MAIN POWER
10	CAVITY(DONOR)
11	IDEN TX
12	PCS RX
13	IDEN RX
14	PCS DFM
15	WAVE DETECT



<Pic.3> Internal Design



<Pic.4> Outside Port Design

NO	DESCRIPTION
①	SERVER ANT PORT
②	iDEN DONOR ANT PORT
③	PCS DONOR ANT PORT
④	AC POWER PORT
⑤	DC 12V PORT
⑥	CLI MONITOR PORT
⑦	ETHERNET PORT

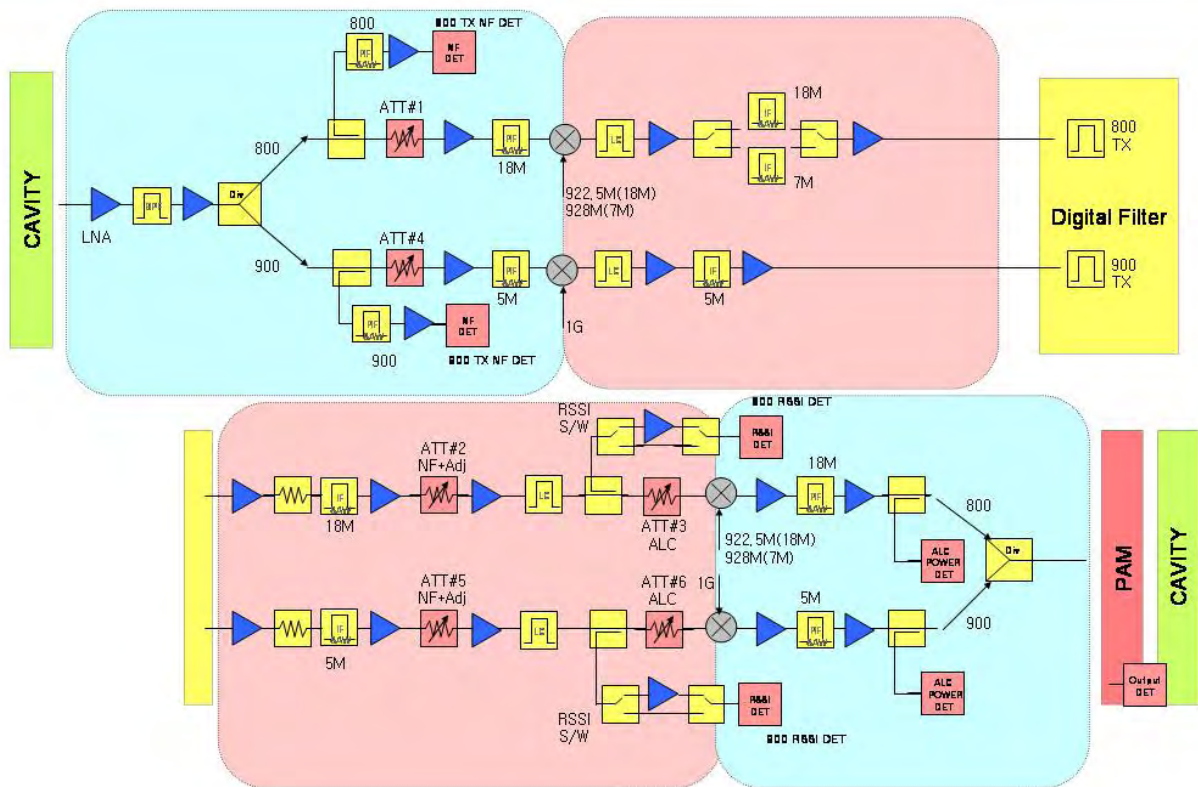
2.2.2 Downlink Path

Downlink and Uplink Gain Budgets have similar structure.

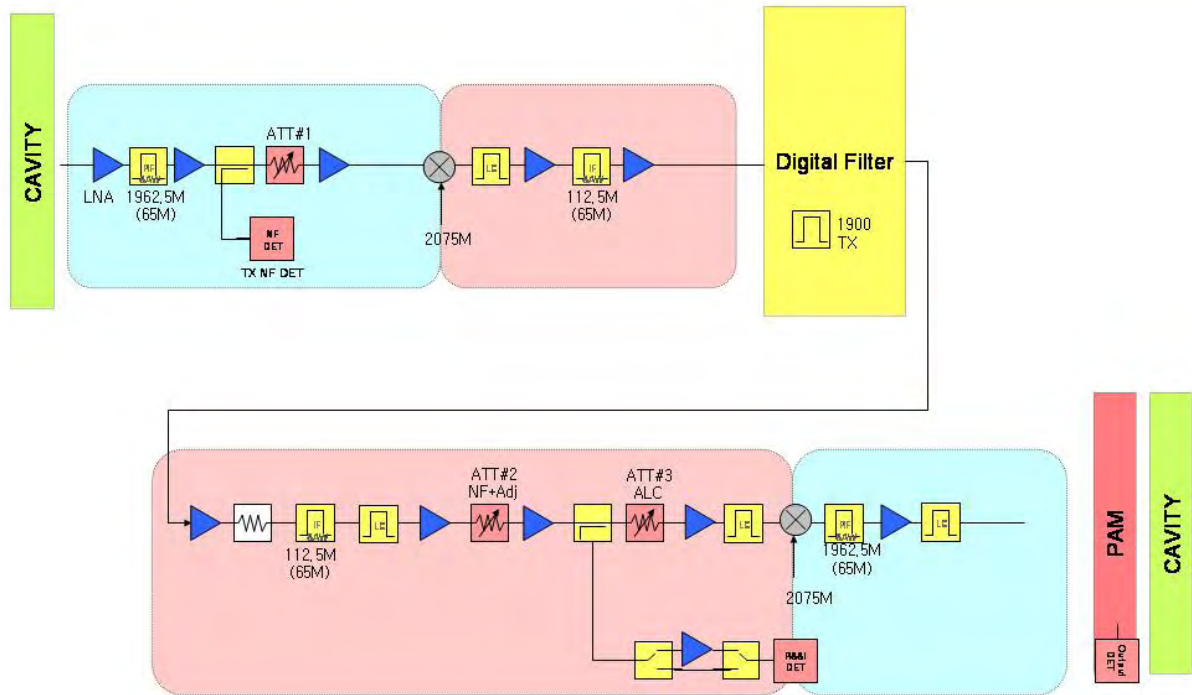
In case of Downlink Path, RF signal is received from Donor Antenna, and through FWD division, then the signal is transferred to IF division, where desirable Band is selected by Digital Filter. Selected Band is transferred to RF division again, and through FWD HPA, after that the signal is transmitted to User through Server Antenna.

CDMA is used two attenuators for AGC compensation. AGC attenuation range of CDMA is 40dB. AGC attenuation range of iDEN 800/900 is 30dB.

IDEN TX Path(800/900) Block



PCS TX Path Block



<Pic.5> Downlink Block Diagram

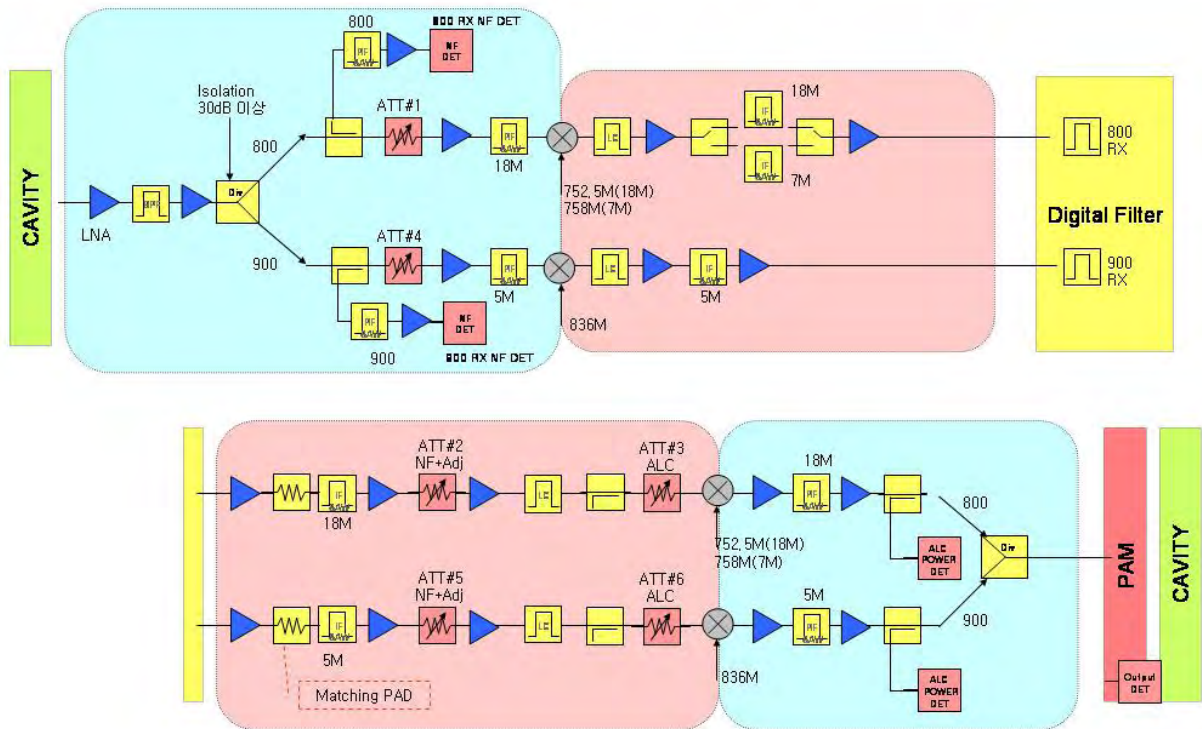
2.2.3 Uplink Path

Uplink Path is similar in structure to Downlink Path.

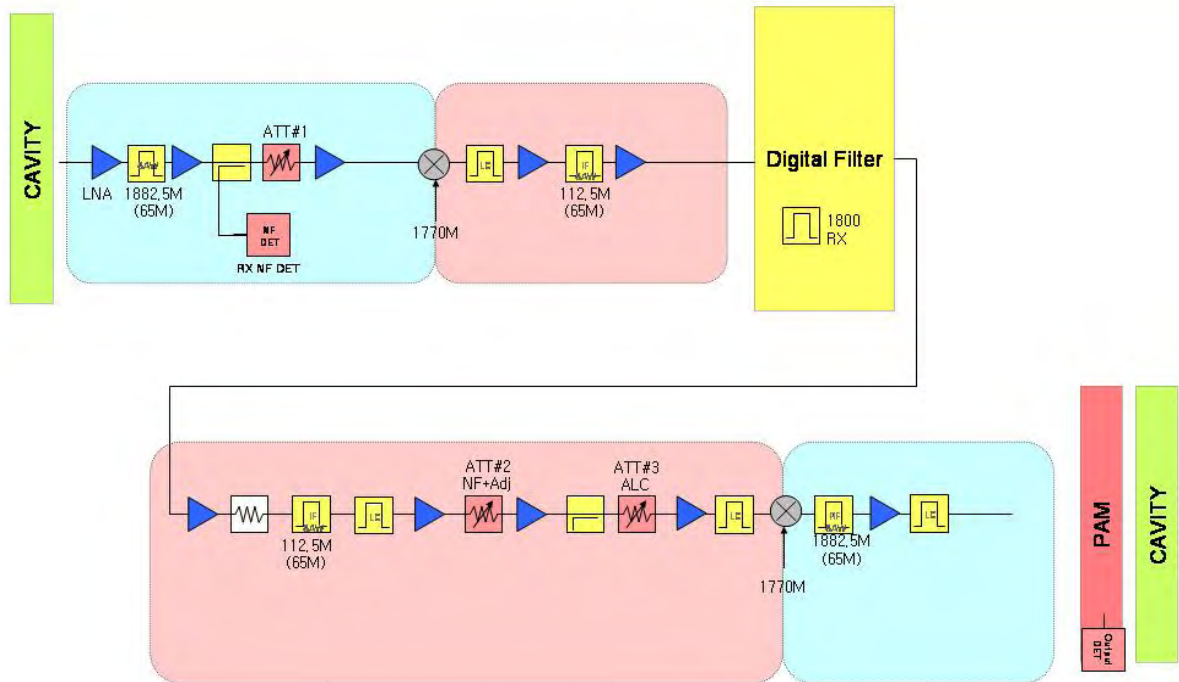
In case of Uplink Path, RF signal is received from Server Antenna, and through RVS division, then the signal is transferred to IF division, where desirable Band is selected by Digital Filter. Selected Band is transferred to RF division again, and through RVS HPA, after that the signal is transmitted to BTS through Donor Antenna.

CDMA is used two attenuators for AGC compensation. AGC attenuation range of CDMA is 40dB. AGC attenuation range of iDEN 800/900 is 30dB.

IDEN RX Path(800/900) Block



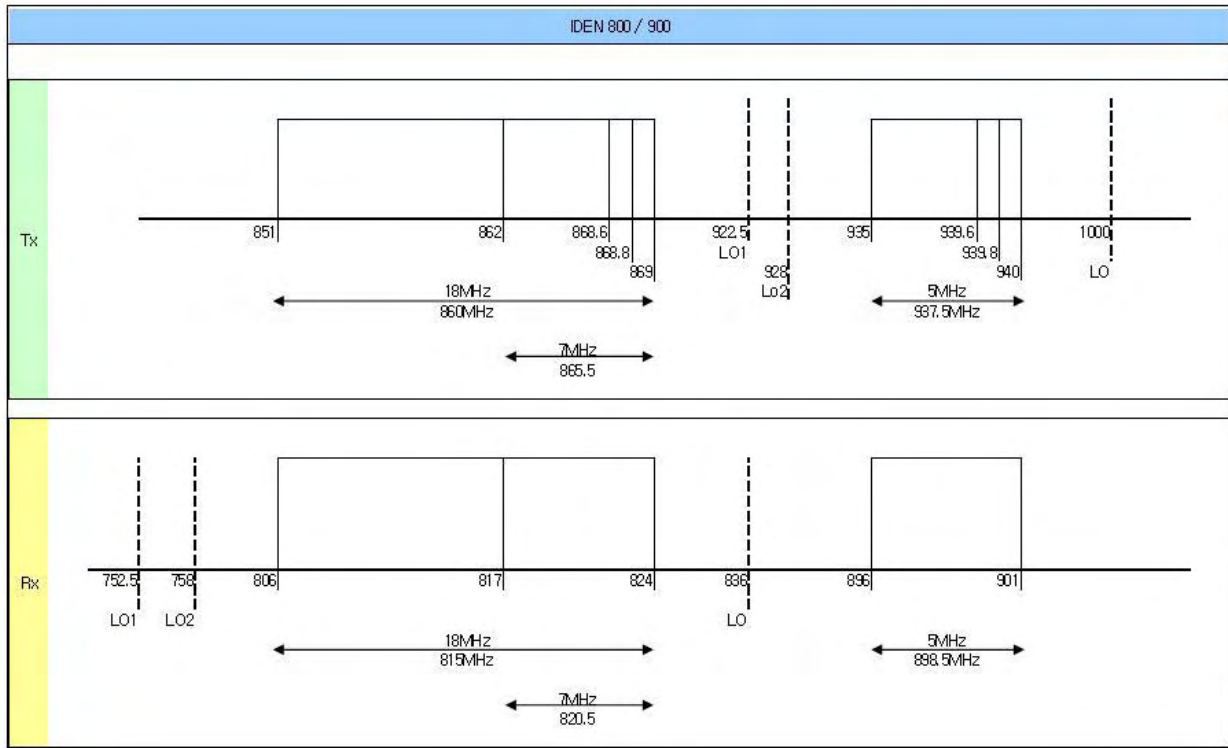
PCS RX Path Block



<Pic.6> Uplink Block Diagram

2.2.4 Frequency Selection

<IDEN 800/900 BAND>



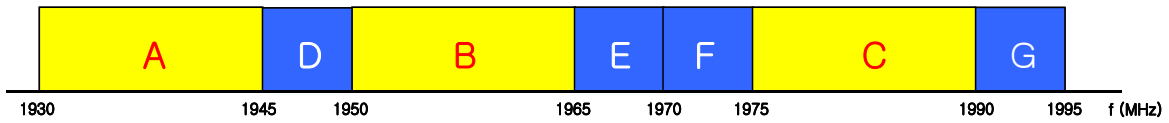
GRS-TRIR-SPR IDEN800 BAND has 18MHz, 7MHz Paths in IF division, so any of these bandwidths can be chosen for providing service.

Also, by adding Channel Select Function, it enables users to select band offset sophisticatedly.

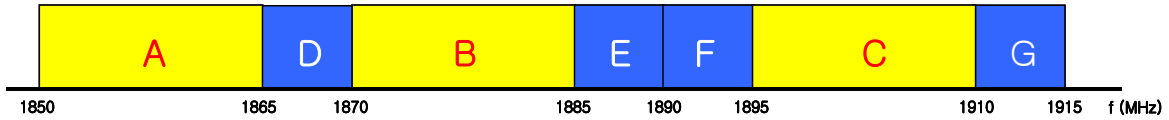
iDEN 800/900 Band can be changed bandwidth to 4MHz at 200kHz step of right band edge.

	Max bandwidth	Min Bandwidth	Step
iDEN 800	18M	4M	200kHz
	7M	4M	
iDEN 900	5M	4M	

<US PCS BAND>



< Forward Band Structure >



< Reverse Band Structure >

<Pic.7> 1900MHz PCS Band Structure

GRS-TRIR-SPR CDMA BAND has 5MHz, 10MHz, 15MHz, 20MHz Paths in IF division, so any of these bandwidths can be chosen for providing service.

ITEM	BANDWIDTH	NOTE
Band Select	5MHz	Any of these bandwidths from A to G can be chosen
	10MHz	
	15MHz	
	20MHz	
	5MHz + 5MHz	
	5MHz + 5MHz + 5MHz	
	10MHz + 5MHz	
	15MHz + 5MHz	

Also, by adding Channel Select Function, it enables users to select bands sophisticatedly. Each band has 1.25 MHz Bandwidth and if users select all the 15 bands, GRS-TRIR-SPR can serve 18.75 MHz bandwidth to users.

A1				A2				A3				D			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400
B1				B2				B3				E			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800
F				C1				C2				C3			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
825	850	875	900	925	950	975	1000	1025	1050	1075	1100	1125	1150	1175	1200
G															
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>													
1225	1250	1275													

3. SPECIFICATIONS

3.1 System Specifications(Applicable to both Uplink & Downlink)

Item		Specification	Remark
Down Link Frequency	IDEN800	851MHz~869 MHz	18 MHz BAND
		Minimum Bandwidth : 4.6MHz	@ 200kHz Step
		862MHz~869 MHz	7 MHz BAND
	IDEN900	Minimum Bandwidth : 4.6MHz	@ 200kHz Step
		935MHz~940MHz	5 MHz BAND
		935MHz~939.8MHz	4.8 MHz BAND
CDMA (PCS)	935MHz~939.6MHz	4.6 MHz BAND	
	CDMA (PCS)	1930MHz ~ 1995MHz	65MHz
Up Link Frequency	IDEN800	806MHz ~ 824MHz	18 MHz BAND
		Minimum Bandwidth : 4.6MHz	@ 200kHz Step
		817MHz ~ 824MHz	7 MHz BAND
	IDEN900	Minimum Bandwidth : 4.6MHz	@ 200kHz Step
		896MHz ~ 901MHz	5 MHz BAND
		896MHz ~ 900.8MHz	4.8 MHz BAND
CDMA (PCS)	896MHz ~ 900.6MHz	4.6 MHz BAND	
	CDMA (PCS)	1850MHz ~ 1915MHz	65MHz
Port	Donor 0	CDMA TX / RX	Duplex
	Donor 1	IDEN TX / RX	4-Plex
	Server	CDMA / IDEN TX / RX	6-Plex
Capacity		OMNI	
CDMA Channel Capacity	Compose	5MHz, 10MHz, 15MHz, 20MHz	3 Non-contiguous
	-3dB BW	4.5MHz, 9MHz, 14MHz, 19MHz	
Output Power	IDEN	+25dBm	Composite Power
	CDMA (PCS)	+24dBm	
Input Power Range	IDEN	-65dBm	
	CDMA (PCS)	-66dBm	
Gain	IDEN	Range	60dB ~ 90dB
		Adjust Step	±1.0dB
		Adjust Accuracy	±0.5dB
	CDMA (PCS)	Range	50dB ~ 90dB
		Adjust Step	±1.0dB
		Adjust Accuracy	±0.5dB
Pass Band Ripple	IDEN	< ±1.25dB	2.5dB(±1.25dB)
	CDMA (PCS)	< ±1.25dB	
Propagation Delay	CDMA	< 8.0us	
	IDEN	< 8.5us	
Spurious Emission	F0±885kHz	< -45dBc	Δmarker: 29dB
	F0±1.98MHz	< -50dBc	Δmarker: 34dB
Out Band Spurious Emission		< -13dBm	RBW: 30MHz
Adjacent Channel Power	@ CHOFFSET 25kHz	> 50dBc	Degradation of 3dB for eight (8) IDEN carriers
	@ CHOFFSET 50kHz	> 55dBc	
	@ CHOFFSET 500kHz	> 55dBc	
	@ CHOFFSET 1MHz	> 55dBc	
	@ CHOFFSET 2MHz	> 55dBc	
IDEN 800/900 Flatness		< ±1.25dB	800 ~ 900MHz
Return Loss / VSWR		> 14dB / < 1.5 : 1	
Noise Figure	CDMA	< 4.5dB @ Max gain, < 12 dB @ Min gain	(FWD, RVS common)
	IDEN	< 5dB @ Max gain, < 12 dB @ Min gain	

Wave form quality (p)		> 0.912	CDMA (PCS)
Roll off	CDMA (PCS)	±1.0MHz	Test frequency measured from band edge
	IDEN	±0.5MHz	
Characteristic Impedance		50Ω	
RF Connector		N-Type Female	
Power	AC	MS3102A-10SL (3Pin)	MIL-C-5015 Type
Connector	DC	SCK-16-2P (2Pin)	Circular Type
AC Supply		110VAC ~ 125VAC, 60Hz 6.0A	± 10%
DC Supply		-40VDC ~ -60VDC, & 20VDC ~ 30VDC	Optional
Net Weight		Less than 65	lbs
Material	Module	AL6063S-T5	
	Cabinet	AL5052P	
Operation Temperature		-10 °C ~ +50 °C	Convection cooling
Humidity		5% ~ 95%	Non-condensing
Dust Resistance		TELCORDIA GR63-CORE	
Vibration Resistance		1G, 10~150Hz, 0.1 Octaves/min	
Output Display Range	IDEN	+28dBm ~ 0dBm	
	CDMA (PCS)	+28dBm ~ 0dBm	
RSSI Display Range	IDEN	-95dBm ~ -30dBm	
	CDMA (PCS)	-95dBm ~ -30dBm	
ALC Limit Range	IDEN	30 ~ 0dB	(FWD, RVS common)
	CDMA (PCS)	40 ~ 0dB	
AGC Limit Range	IDEN	30 ~ 0dB	(FWD, RVS common)
	CDMA (PCS)	40 ~ 0dB	

3.2 Electrical and Environmental Specifications

ITEM	SPECIFICATION	REMARK
Power & Consumption	120 VAC 60Hz	
Connector Type	N-type female	
Size	393 X 540 X 225	
Weight	max 65 lbs	
Reliability, MTBF	100,000 hours	
Enclosure	NEMA4	
Operating Temperature	-10°C ~ +50°C	
Rel. Humidity	0% ~ 90%	
Industry Standards	TIA-97, TIA-98, IS-98D, IS-2000	
Regulatory Approvals	FCC, Part24 CDN-IC	
Safety Approvals	UL1950 or Equiv	

3.3 Functions

ITEM	FUNCTIONS
Gain Control	<ul style="list-style-type: none"> • Adjustable DL and UL Gain range 50~90dB(PCS) • Adjustable DL and UL Gain range 60~90dB(iDEN800/900) • Display default Gain and current Gain function
AGC (Auto Gain Control)	<ul style="list-style-type: none"> • 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. • Used with the Automatic Setup (Auto Gain Setting)
ALC (Auto Level Control)	<ul style="list-style-type: none"> • To limit output power as far as default range • Used for DAS configuration and when oscillation/isolation is a concern • 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
AGS (Auto Gain Setting)	<ul style="list-style-type: none"> • Operate when User control (Only system initialize) • Decrease attenuator value for 3dB from minimum gain • In case of attenuator value is from 0dB to 3dB when AGS ended <ul style="list-style-type: none"> - AGC on (DL) - Gain balance on - PAM on - Shutdown on • In case of attenuator value is over 3dB when AGS ended <ul style="list-style-type: none"> - AGC off (ALC on) - Gain balance on - PAM on - Shutdown on
Gain Balance	<ul style="list-style-type: none"> • Downlink ATT is applied to Uplink during AGC state

	<ul style="list-style-type: none"> • Setting and maintenance of output level • Additional attenuation to ALC Level
Band Select	<ul style="list-style-type: none"> • To select either 5MHz/10MHz/15MHz/20MHz (PCS) • To select either 18MHz/7MHz (IDEN 800)
Power Monitoring Function	<ul style="list-style-type: none"> • Monitoring repeater's output level
DL Input control	<ul style="list-style-type: none"> • Monitoring Donor ANT input power of DL
Automatic Recovery	<ul style="list-style-type: none"> • When repeater is shutdown, it periodically recovers output power of repeater then monitors alarming
Security	<ul style="list-style-type: none"> • Support HTTPS for Web Browser security • User authentication through User ID and Password
Temperature Monitoring	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Monitoring VSWR of Donor ANT Port (Every one and half minute) • Reporting VSWR Alarm and Shutdown when the rate is 3.5:1
IP address report via E-mail	<ul style="list-style-type: none"> • When in PPP reconnection, E-mail which includes HTML to connect to newly assigned IP Address, reports to operator.
DHCP Client	<ul style="list-style-type: none"> • Automatic IP assignment
DHCP Server	<ul style="list-style-type: none"> • Server function for automatic IP assignment
Web GUI	<ul style="list-style-type: none"> • Remote and local user browser support through Web Browser
SNMP Agent	<ul style="list-style-type: none"> • NMS report via SNMPv2 Trap
LED Display	<ul style="list-style-type: none"> • LED displays power and operation status on front side of repeater system • Input and Output signal levels are verified by LED bars

4. SET UP

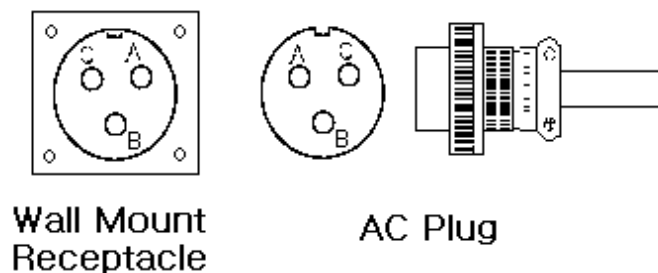
4.1 System Set up

4.1.1 Constitution (Based on 1 set)

PARAMETER	ITEM	QUANTITY
Major Accessory	GRS-TIRI-SPR	1 EA
Additional Components	Main power input cable	1 EA
	Fixable screw	1 SET
	Mountable brackets	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.
- 2) **Input condition optimization:** DL input condition is -60 ~ -30dBm. User should verify input condition of Donor ANT.
- 3) **Isolation check between DONOR/SERVER ANT:** Isolation condition of this equipment is 97dBc (Gain+7dB). User should check its condition before installation.



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

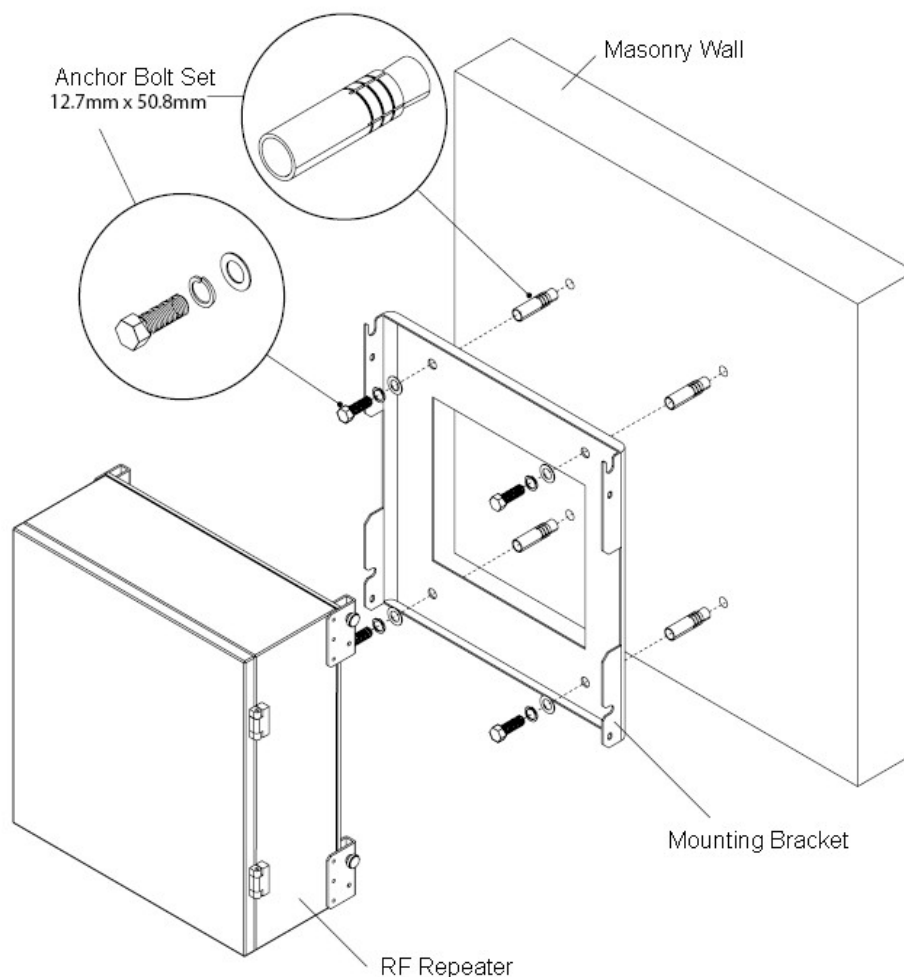
<Pic.8> MS 3100 A 10SL-3 (Wall Mount Receptacle) & MS3010 A 10SL-3(Plug)

CAUTION

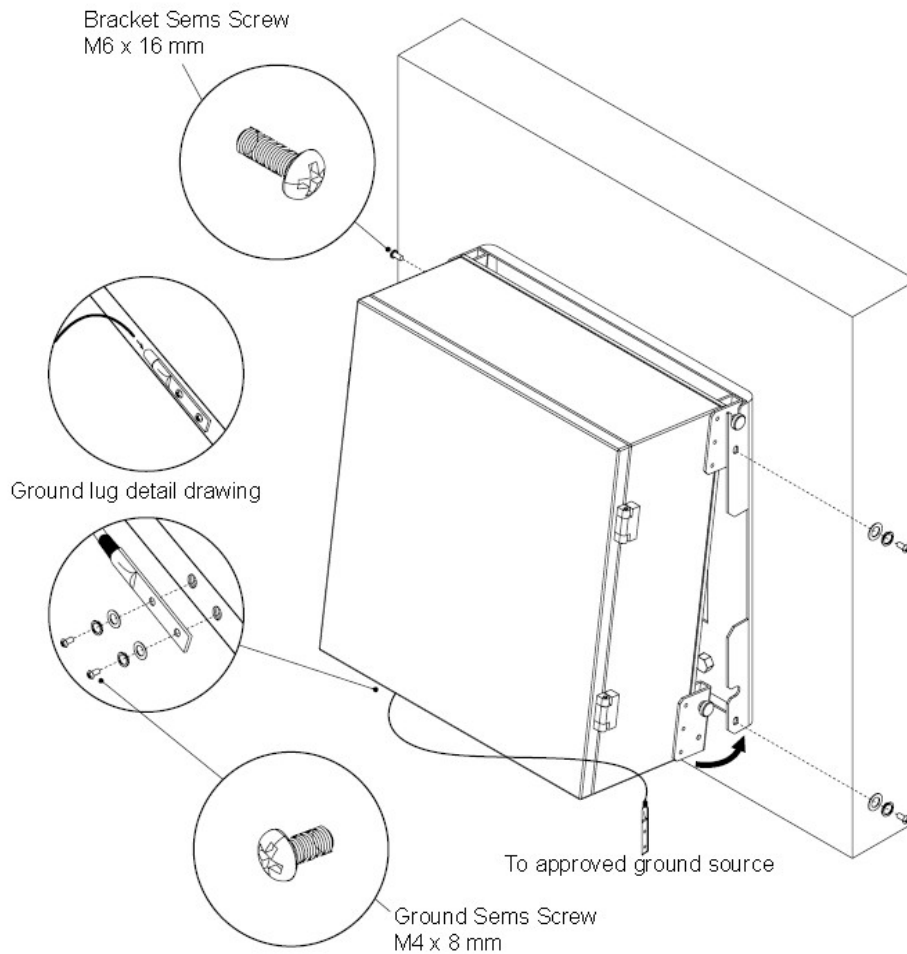
DOUBLE POLE/NEUTRAL FUSING

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.
- 5) The socket-outlet shall be installed near the equipment and shall be easily accessible.
- 6) Round terminals located on the side of a 0.75 mm² (18 AWG) or more wires Using permanently connected to earth.



<Pic.9> Case Mounts - Step 1



<Pic.10> Case Mounts - Step 2

4.1.4 Open for Service

1) Check points before open

a. Verification of system installation status

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

b. Verification of system accessories

- User should check whole necessary accessories.

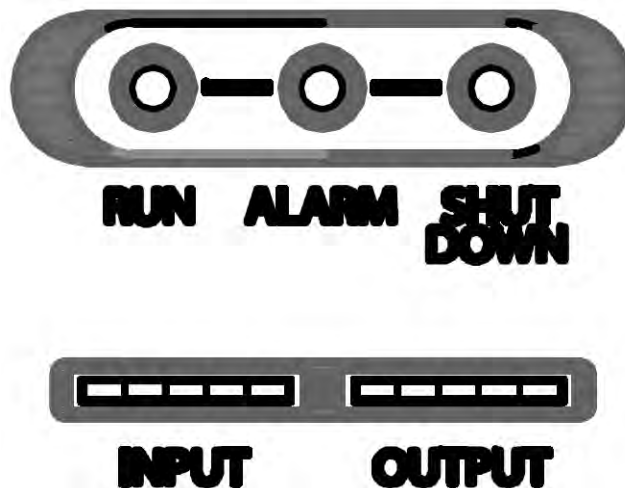
c. Check receipt signal level

- 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 status
- ④ Number of LED bar on front side of repeater will show input power signal level
 - Less than -86dBm: LED 1 bar
 - 85dBm ~ -70dBm: LED 2 bar
 - 69dBm ~ -54dBm: LED 3 bar
 - 53dBm ~ -41dBm: LED 4 bar
 - More than -40dBm: LED 5 bar
- ⑤ Number of LED bar on front side of repeater will show output power signal level
 - Less than +9dBm: LED 1 bar
 - +10dBm ~ +14dBm: LED 2 bar
 - +15dBm ~ +19dBm: LED 3 bar
 - +20dBm ~ +24dBm: LED 4 bar
 - More than +25dBm: LED 5 bar




<Pic.11> Front LED

b. Verification of operation status

- User should verify following status with Output monitoring terminal, which is provided by Spectrum Analyzer
- Output power generation status, system spurious emission characteristics.

- c. 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 measuring device.
- d. Verification of upper-level NMS operation status

MPE Information

	<p>Warning: Exposure to Radio Frequency Radiation The radiated output power of this device is far below the FCC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact during normal operation is minimized. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna should not be less than 30cm during normal operation. The gain of the antenna is 12 dBi. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.</p>
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