

ATTACHMENT E.

- USER MANUAL -

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GSTeletech
CoverCell 25K Repeater
USERS MANUAL

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Version 1.1

Global IT Leader
GST

WARNINGS, CAUTIONS, AND GENERAL NOTES

This product conforms to FCC Part 15, Section 21 of the FCC (Federal Communications Commission) rules. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Indicates a procedure or practice, which, if ignored, may result in damage to the system or a system component. Do not perform any procedure preceded by a WARNING until you thoroughly understand the described conditions (e.g., To reduce the risk of burn, allow hot devices to cool before handling).

Warning

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 operating in a commercial environment. This equipment generates, uses, and radiates radio frequency energy and, if not installed and used in accordance with this operator's 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 their expense.

Safety Considerations

When installing or using this product, observe all safety precautions during handling and operation. Failure to comply with the following general safety precautions and with specific precautions described elsewhere in this manual violates the safety standards of the design, manufacture, and intended use of this product. GSTeletech assumes no liability for the customer's failure to comply with these precautions.

WARNING

WARNING calls attention to a procedure or practice, which if ignored, may result in damage to the system or system component. Do not perform any procedure preceded by a WARNING until described conditions are fully understood and met.

If You Need Help

If you need additional copies of this manual, or have questions about system options, or need help

with installation and using of the system, please contact GSTeletech' Customer Support.

GSTeletech Inc. Customer Support
6900 College Boulevard, Suite 850
Overland Park, KS 66211, USA
Toll Free: 1-866-9 GST USA
Phone: 913 469 6699
bdelozier@gsteletechinc.com

Service

Do not attempt to modify or service any part of this product other than in accordance with procedures outlined in this Operator's Manual. If the product does not meet its warranted specifications, or if a problem is encountered that requires service, notify GSTeletech customer support department. Service will be rendered according the GSTeletech warranty and repair policy. The product shall not be returned without contacting GSTeletech and obtaining a return authorization number from the Customer Support department.

When returning a product for service, include the following information: Owner, Model Number, Serial Number, Return Authorization Number (obtained in advance from GSTeletech Customer Support Department), service required and/or a description of the problem encountered.

The GSTeletech Quality Plan includes product test and inspection operations to verify the quality and reliability of our products.

GSTeletech uses every reasonable precaution to ensure that every device meets published electrical, optical, and mechanical specifications prior to shipment. Customers are asked to advise their incoming inspection, assembly, and test personnel as to the precautions required in handling and testing ESD sensitive components. Physical damage to the external surfaces voids warranty.

These products are covered by the following warranties:

1. **General Warranty**

GSTeletech warrants to the original purchaser all standard products sold by GSTeletech to be free of defects in material and workmanship for the duration of the warranty period of one (1) year from date of shipment from GSTeletech. During the warranty period, GSTeletech obligation, at our option, is limited to repair or replacement of any product that GSTeletech proves to be defective. This warranty does not apply to any product, which has been subject to alteration, abuse, improper installation or application, accident, electrical or environmental over-stress, negligence in use, storage, transportation or handling.

2. **Specific Product Warranty Instructions**

All GSTeletech products are manufactured to high quality standards and are warranted against defects in workmanship, materials and construction, and to no further extent. Any claim for repair or replacement of a device found to be defective on incoming inspection by a customer must be made within 30 days of receipt of the shipment, or within 30 days of discovery of a defect within the warranty period.

This warranty is the only warranty made by GSTeletech and is in lieu of all other warranties, expressed or implied, except as to title, and can be amended only by a written instrument signed by an officer of GSTeletech. GSTeletech sales agents or representatives are not authorized to make commitments on warranty returns.

In the event that it is necessary to return any product against the above warranty, the following procedure shall be followed:

- a. Return authorization shall be received from the GSTeletech Customer Support prior to returning any device. Advise the GSTeletech Customer Support of the model, serial number, and the discrepancy. The device shall then be forwarded to GSTeletech, transportation prepaid. Devices returned freight collect or without authorization may not be accepted.

- b. Prior to repair, GSTeletech Customer Support will advise the customer of GSTeletech test results and will advise the customer of any charges for repair (usually for customer caused problems or out-of-warranty conditions).

If returned devices meet full specifications and do not require repair, or if non-warranty repairs are not authorized by the customer, the device may be subject to a standard evaluation charge. Customer approval for the repair and any associated costs will be the authority to begin the repair at GSTeletech. Customer approval is also necessary for any removal of certain parts, such as connectors, which may be necessary for GSTeletech testing or repair.

- c. Repaired products are warranted for the balance of the original warranty period, or at least 90 days from date of shipment.

3. Limitations of Liabilities

GSTeletech liability on any claim of any kind, including negligence, for any loss or damage arising from, connected with, or resulting from the purchase order, contract, or quotation, or from the performance or breach thereof, or from the design, manufacture, sale, delivery, installation, inspection, operation or use of any equipment covered by or furnished under this contract, shall in no case exceed the purchase price of the device which gives rise to the claim.

EXCEPT AS EXPRESSLY PROVIDED HEREIN, GSTELETECH MAKES NO WARRANTY OF ANY KIND, EXPRESSED OR IMPLIED, WITH RESPECT TO ANY GOODS, PARTS AND SERVICES PROVIDED IN CONNECTION WITH THIS AGREEMENT INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. GSTELETECH SHALL NOT BE LIABLE FOR ANY OTHER DAMAGE INCLUDING, BUT NOT LIMITED TO, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH FURNISHING OF GOODS, PARTS AND SERVICE HEREUNDER, OR THE PERFORMANCE, USE OF, OR INABILITY TO USE THE GOODS, PARTS AND SERVICE.

GSTeletech test reports or data indicating mean-time-to-failure, mean-time-between-failure, or other reliability data are design guides and are not intended to imply that individual products or samples of products will achieve the same results. These numbers are to be used as management and engineering tools, and are not necessarily indicative of expected field operation. These numbers assume a mature design, good parts, and no degradation of reliability due to manufacturing procedures and processes.

Handling the GST Repeater

1. Use ESD precautions when dealing with the modules within the repeater so that units are not damaged.
2. Opening the unit voids warranty.
3. Disconnecting any component within the repeater when powered can damage or destroy the equipment and will void the warranty.

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1. OVERVIEW

COVERCELL 25K is a dual band repeater which can receive and transmit cellular and PCS signals in the shadow area, which BTS signals cannot reach. This system has 79dB and 85dB gain in the cellular band and PCS band respectively with 17dBm and 19dBm maximum power each.

On the following condition, the band select function can be performed on each path in each band.

- Cellular: A1+A2 or B1+B2
- PCS: 5MHz, 10MHz, 15MHz consecutive block select
- Specific setting is possible using GUI

The basic structure of CoverCell 25K illustrates that each module is built-in on each path in a body. The functions of each module are as follow.

- 4-Plex Cavity Filter: Duplexing input and output signals in the Cellular and PCS frequency ranges and band combining.
- Cellular Drive Module: including LNA, Local and PAM in the cellular band
- PCS Drive Module: including LNA, Local, and PAM in the PCS band
- Digital Filter: implementing the bandwidth setting and filtering using a digital technology each band
- PSU (Power Supply Unit): Converting AC 120V to respective voltages for each module
- Control Board: Checking and controlling each module
- IO Board: playing a role as a terminal between PSU and each module

2. SYSTEM CONFIGURATION

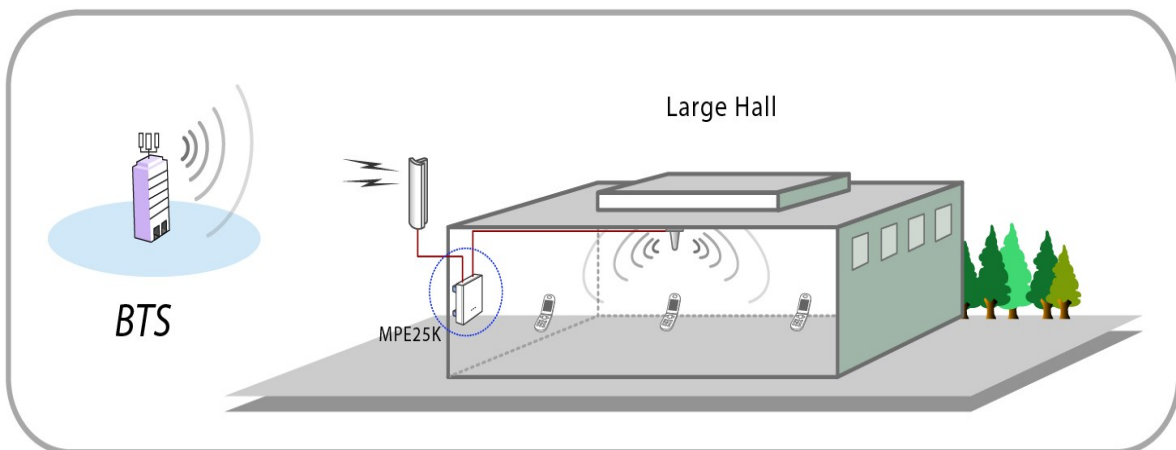
2.1 COVERCELL 25K REPEATER NETWORK SERVICE CONFIGURATION

CoverCell 25K RF Repeater receives cellular 800MHz and PCS 1900MHz BTS signals through a donor antenna installed outside of a building. The signals are amplified, filtered, and transmitted through a coverage antenna inside of a building. In the reverse, it receives terminal signals through a coverage antenna and transmits the signals to cellular and PCS BTSs through a donor antenna.

CoverCell 25K RF Repeater has following functions;

- Type of Modulation : CDMA (Cellular, PCS)
- Frequency/ Band Select using cavity filters
- Bandwidth Setting using PLL, Digital Filter
- Output Control using AGC/ALC
- Gain Control using attenuators

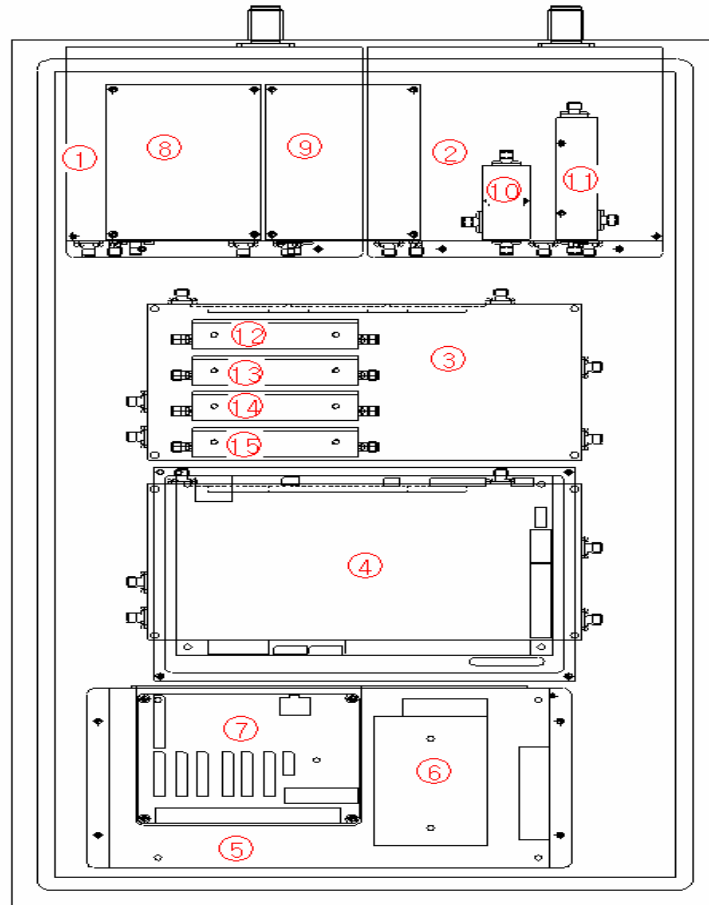
Figure 1 illustrates CoverCell 25K network configuration in a site. As seen in the Figure 1, the donor antenna is installed towards PCS and cellular BTSs and the coverage antenna is located in a place to cover approximately 25,000 square feet.



[Figure 1] COVERCELL 25K RF Repeater Operating Example

2.2 SYSTEM DESIGN AND OPERATIONS

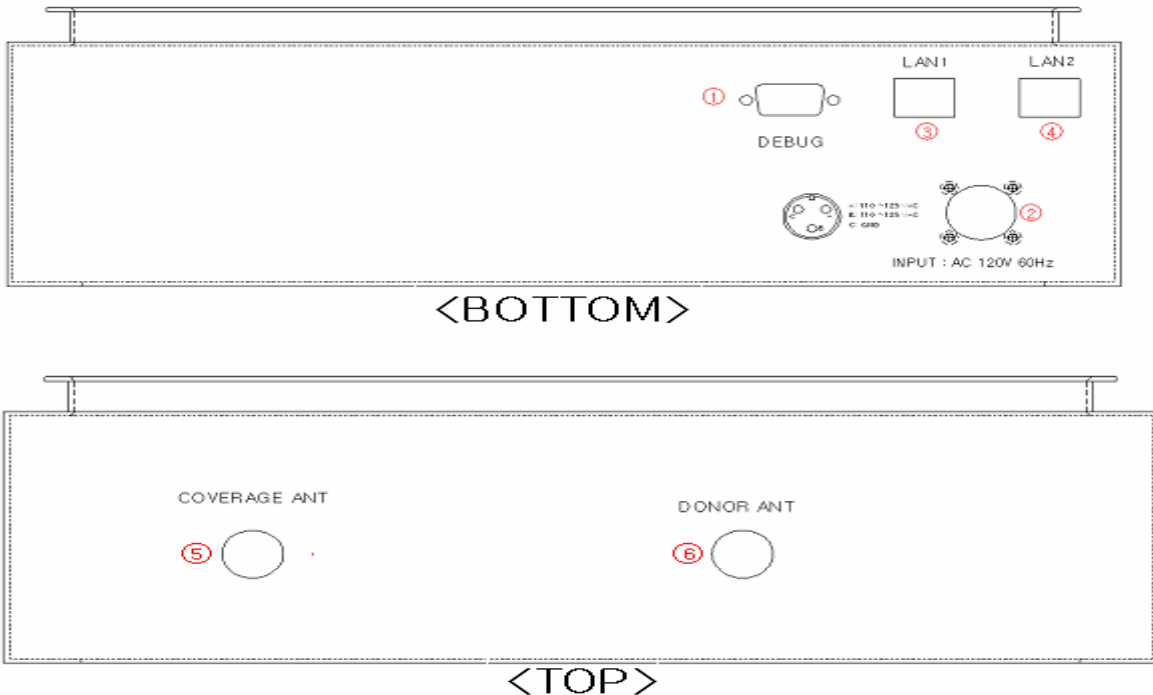
2.2.1 SYSTEM DESIGN



NO	PART	FUNCTIONS
1	Donor 4-Plex Cavity Filter	Downlink Input, Uplink Output, path separated
2	Coverage 4-Plex Cavity Filter	Downlink Output, Uplink Input, path separated
3	Cellular Drive Module	LNA/ PAM, Service Band Select
4	RCU (Upper)	Repeater Control and High-level Communication
	PCS Drive Module (Middle)	LNA / PAM , Service Band Select
	Digital Filter (Lower)	Deciding Bandwidth in the Selected Band
5	7.5V Power Supply Unit	Drive Module Power Supply

6	5V Power Supply Unit	Digital Filter Power Supply
7	IO Board	Terminal board for controlling a repeater
8	PCS Wave Detector	PCS Service Band noise detect
9	Cellular Wave Detector	Cellular Service Band noise detect
10	PCS Coupling	PCS RX Service Signal Extract
11	Cellular Coupling	Cellular RX Service Signal Extract
12	Cellular DL_BPF	Blocking IF external signals
13	Cellular UL_BPF	Blocking IF external signals
14	PCS_DL_BPF	Blocking IF external signals
15	PCS_UL_BPF	Blocking IF external signals

[Figure 2] COVERCELL 25K RF Repeater Internal Structure

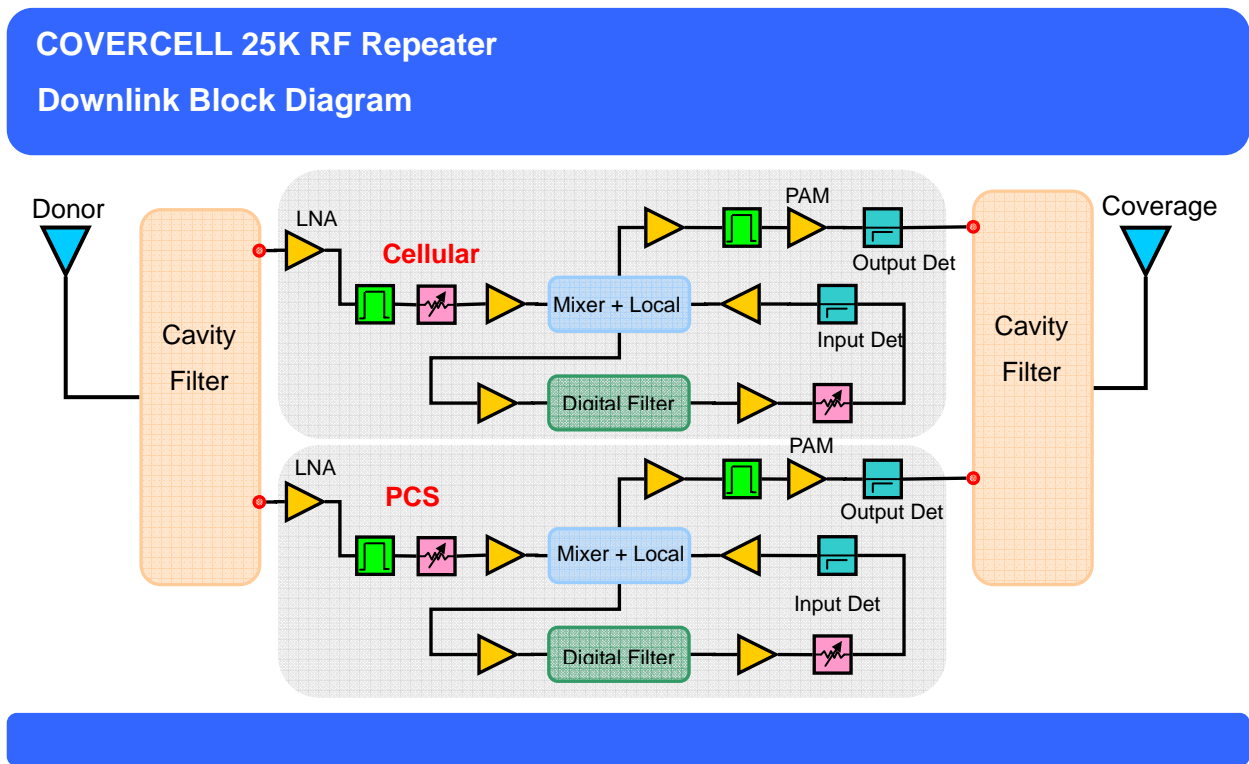


[Figure 3] COVERCELL 25K RF Repeater Port

NO	PORT	FUNCTIONS
1	Debug Port	GUI Connecting port, 9pin D-sub
2	AC Power port	AC 120V 60Hz
3	LAN1	High-level Communication port
4	LAN2	High-level Communication port
5	Coverage ANT	Antenna for terminals
6	Donor ANT	Antenna for BTS

2.2.2 Downlink Block Diagram

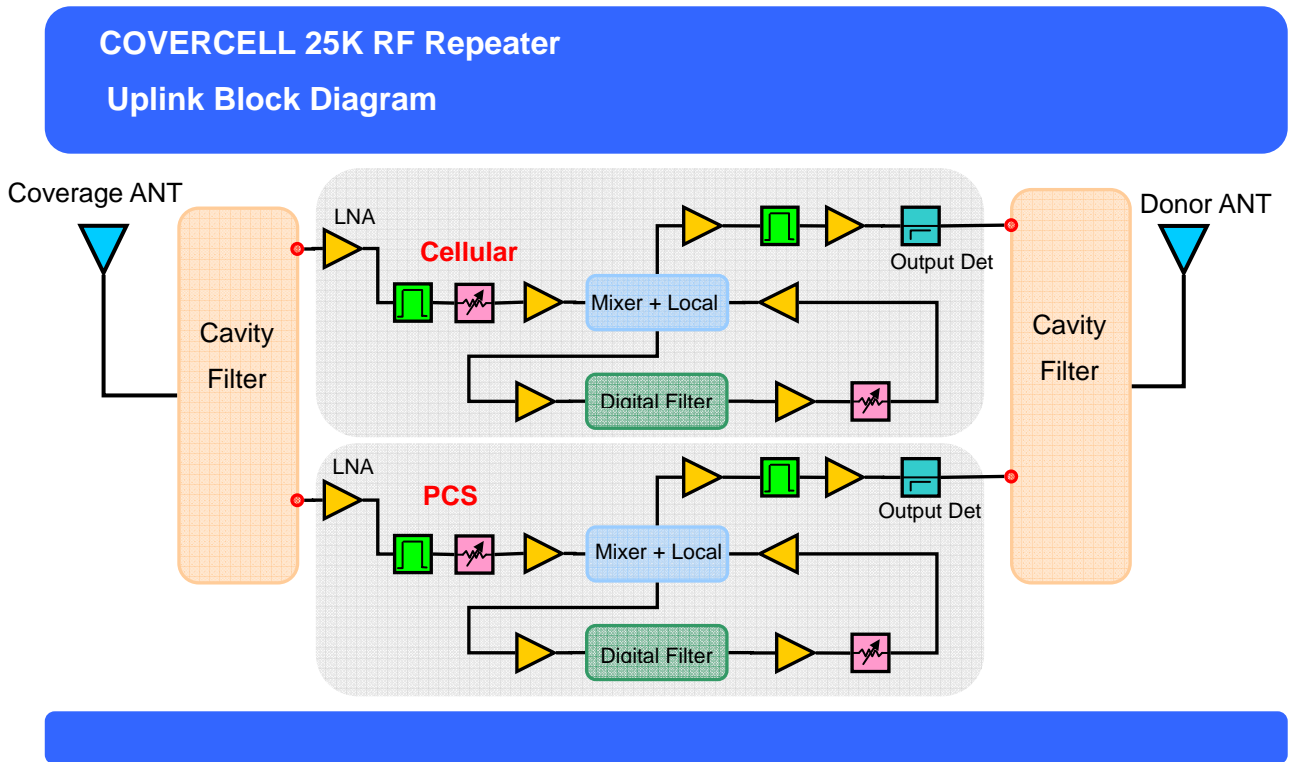
CoverCell 25K is a dual band repeater that can handle cellular and PCS signals. Basically RF modules are separated from each path and band. One module can handle all the functions except 4 plexer and digital filter. Also one integrated chip which includes local and mixer consists a block and input detect process is performed to prevent external signals from affecting other signals after signals are through a digital filter.



[Figure 4] COVERCELL 25K RF Repeater Downlink Block Diagram

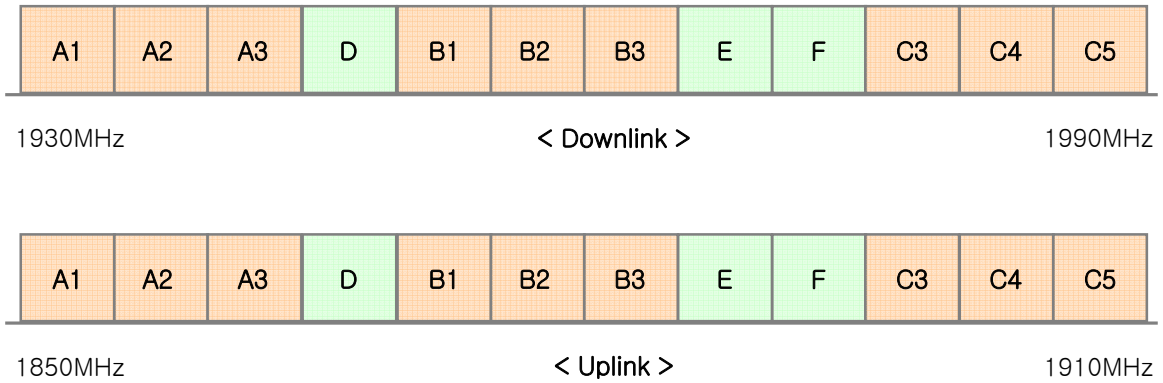
2.2.3 Uplink Block Diagram

The uplink path of CoverCell 25K does not use the input detect function. The gain of a donor antenna is high enough. Then, the last output power level is not necessarily high. Consequently, PAM is not necessary. The ALC function is monitoring the last output power and maintaining the output power to increase stability of the system.



[Figure 5] COVERCELL 25K RF Repeater Uplink Block Diagram

2.2.5 Frequency Selection



[Figure 7] PCS Band Structure

Based on the band select function, 5MHz, 10MHz, and 15MHz bands can be selected on the following condition.

- Any 5MHz bands can be chosen in the all the blocks.
- 10MHz or 15MHz band can be selected in any combinations In the consecutive bands
- C1, C2 select is not supported.

3. SPECIFICATIONS

3.1 System Specifications

Item		Downlink	Uplink	Remark
Cellular Frequency (MHz)	A1	869 ~ 880	824 ~ 835	
	A2	890 ~ 891.5	845 ~ 846.5	
	B1	880 ~ 890	835 ~ 845	
	B2	891.5 ~ 894	846.5 ~ 849	
PCS Frequency (MHz)		1930 ~ 1990	1850 ~ 1910	Refer to Figure 7
Sub Band Filtering		A1+A2 or B1+B2		
		5, 10, 15MHz BW (tunable)		
Gain	Cellular	79dB	84dB	
	PCS	85dB	74dB	
Flatness		5dB peak to peak		Channel power
Input Range	Cellular	-49dBm ~ -81dBm	Max -73dBm	
	PCS	-48dBm ~ -85dBm	Max -67dBm	
Output Power	Cellular	17dBm	17dBm	
	PCS	19dBm	17dBm	
AGC Range	Cellular	23dB		
	PCS	28dB		
Roll off	Cellular	$\geq 45\text{dBc} @ \pm 2\text{MHz}$		
		$\geq 30\text{dBc} @ \pm 0.375\text{MHz}$		
	PCS	$\geq 30\text{dBc} @ \pm 1.5\text{MHz}$		
Group Delay		$\leq 5\mu\text{s}$		
Single & 2-tone	Cellular	$\leq -30\text{dBm} @ \pm 0.88\text{MHz}$		
	PCS	$\leq -40\text{dBm} @ \pm 1.2\text{MHz}$		
Noise Figure		$\leq 10\text{dB} @ \text{Max, Mean, Min Gain}$		
Input Inter-modulation		$\leq 10\text{dB}$		
Adjacent Channel Power	Cellular	$\geq 45\text{dBc} @ 750\text{kHz}$		
		$\geq 45\text{dBc} @ 1.98\text{MHz}$		
	PCS	$\geq 45\text{dBc} @ 885\text{kHz}$		
		$\geq 45\text{dBc} @ 1.98\text{MHz}$		
Radiated Spurious Emissions		$\leq -13\text{dBm}$		
Frequency Error		$\pm 300\text{Hz} @ \text{cellular}, \pm 150\text{Hz} @ \text{PCS}$		
Signal Quality		Rho > 0.98		

3.2 Mechanical Specifications

Item	Specification	Remark
RF Connector	N-Type Female	Donor & Coverage ANT Port
AC Power Connector	MS3102A-10SL (3Pin)	
AC Supply	AC 120V 60Hz	
Out Dimension	17 x 12 x 4.6	Inch
Net Weight	16.5	Kg
Operation Temperature	-10°C ~ +50°C	Convection cooling
Humidity	5% ~ 85%	Non-condensing

3.3 Functions

Item	Description
Gain Control	<ul style="list-style-type: none"> Gain can be controlled between 40dB and 65dB Setting gain and current gain can be displayed.
AGC (Auto Gain Control)	<ul style="list-style-type: none"> Regardless of input changes output would be maintained constantly by controlling its gain. AGC Value Setting Through GUI ON/OFF Setting Through GUI
ALC (Auto Limit Control)	<ul style="list-style-type: none"> User configurable output limit function ALC Level setting through GUI Output is greater than a setting value, and then automatically the gain is reduced. Output is reduced, and then automatically the gain is recovered. The repeater output is greater than a setting value with a minimum gain. Then the repeater would shut down.
Band Select	<ul style="list-style-type: none"> User can select A-Band or B-Band in the cellular band. User can select consecutive 5, 10, 15MHz block in the all the 60MHz block of the PCS band.
Output Detect Function	<ul style="list-style-type: none"> The output of each path is displayed on GUI
Spurious Check	<ul style="list-style-type: none"> In order for a repeater not to emit spurious waves more than -13dBm out of band, monitoring the noise power. If spurious waves are greater than -13dBm, controlling its gain If spurious waves are greater than -13dBm with Minimum Gain, Repeater shuts down Recovery Algorithm is working after shutdown

Oscillation Check	<ul style="list-style-type: none"> • When Initial Setup or Reset, Checking Isolation • While Operation, Monitoring Oscillation through Highest and Lowest values comparison of Noise Floor • When Oscillation happens, automatically try stabilizing Isolation through Repeater Gain Control • If Oscillation still occurs with Minimum Gain, Repeater Shuts down • Recovery Algorithm is working after shutdown
DL Input Detect Function	<ul style="list-style-type: none"> • Monitoring downlink donor antenna input power • Alarming if input range is abnormal or no signal is inputted.
Auto Recovery	<ul style="list-style-type: none"> • When Repeater Shuts down, regularly recovering its output power and checking its alarming situations
Temperature Monitoring Function	<ul style="list-style-type: none"> • Monitoring current temperature • User Configurable up limits and down limits <p>When the current temperature is out of range, Repeater shuts down</p> <ul style="list-style-type: none"> • When Temperature falls in the normal range, automatically it recovers its functions.
VSWR Monitoring	<ul style="list-style-type: none"> • When the VSWR of Forward output is abnormal, alarming and shutdown. • Recovery Algorithm is working after shutdown
Power Supply Monitoring	<ul style="list-style-type: none"> • PSU current monitoring and the total current is over the standard, Alarming
Voltage Out of Range Monitoring	<ul style="list-style-type: none"> • PSU Low and High Power Alarm Function
LED Display	<ul style="list-style-type: none"> • Repeater status is displayed through front LED

4. INSTALLATION

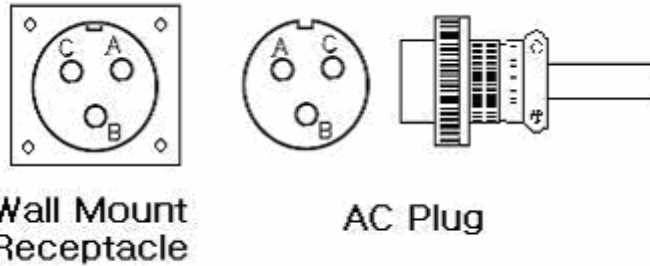
4.1 SYSTEM INSTALLATION

4.1.1 Contents of Box (1 SET)

Category	Contents	Quantity
Repeater	COVERCELL 25K Repeater	1 EA
Accessory	Power Cable	1 EA
	Mounting Bracket	1 EA
	Screws	1 SET
USER MANUAL	MANUAL	1 EA

4.1.2 Caution

- 1) System Main Power Check: the main input power of this repeater is AC110V



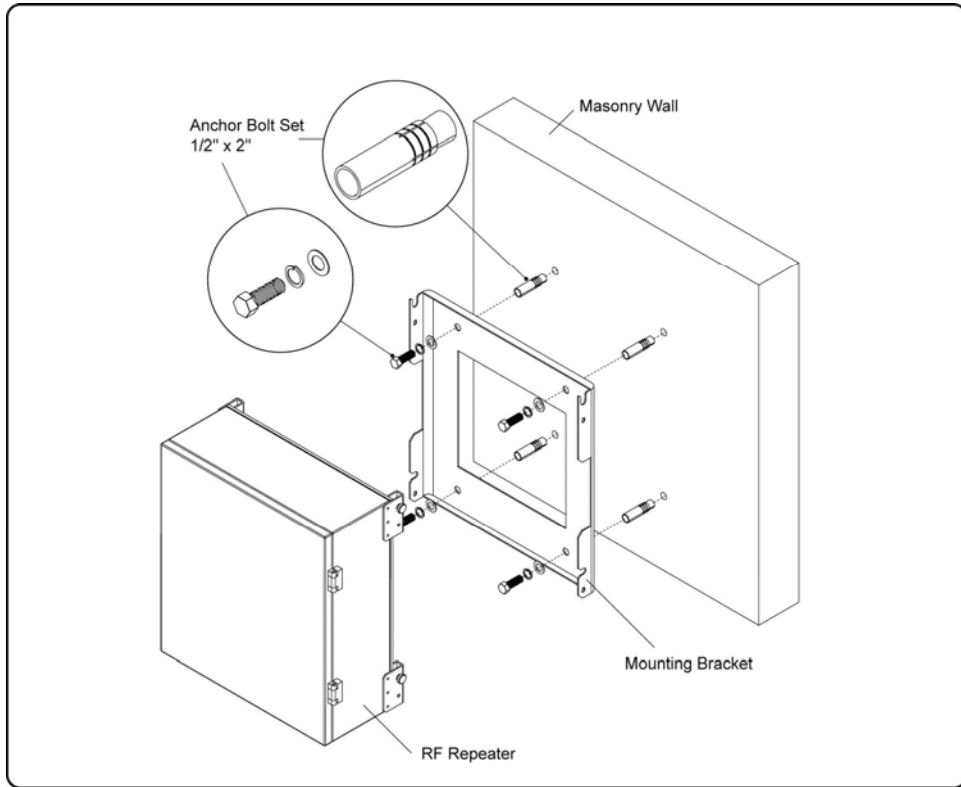
A : 110V ~ 125VAC

B : 110V ~ 125VAC

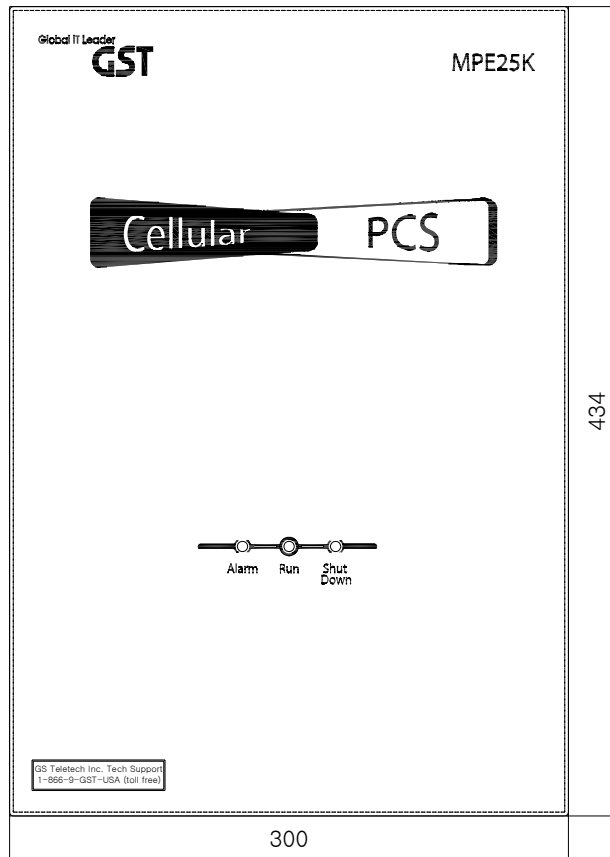
C : GND

[Figure 8] MS 3100 A 10SL-3 (Wall Mount Receptacle) & MS3010 A 10SL-3(Plug)

- 2) Input Condition Optimization:
 - A. Cellular Forward Input Condition: -81 ~ -49dBm
 - B. PCS Forward Input Condition: -85 ~ -48dBm
 - C. Adjusting system input condition to be optimized after comparing a donor antenna input condition to A and B
- 3) Measuring Isolation between Donor/Coverage Antennas
 - A. Cellular: $\geq 96\text{dBc}$ (Gain +15dB)
 - B. PCS: $\geq 100\text{dBc}$ (Gain+15dB)
 - C. Checking the above conditions, adjusting system input condition to be optimized.
- 4) The standard installation of this repeater is vertically wall-typed.



[Figure 9] Dual-band In-building Repeater



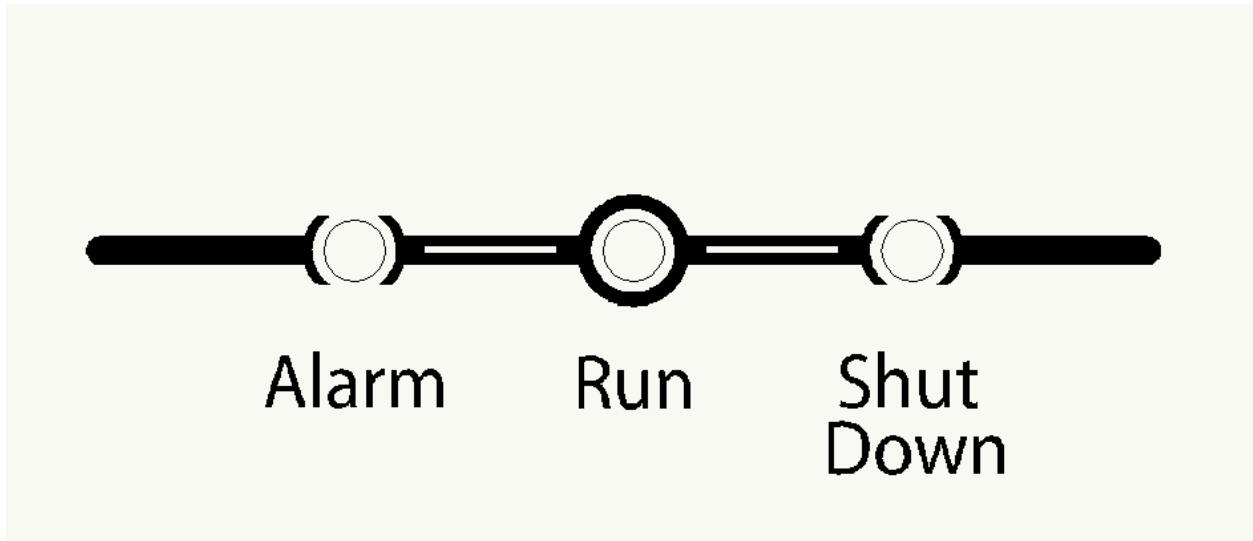
[Figure 10] Dual-band In-building Repeater

4.1.3 System Initiation

1) Check points after connecting networks

A. External LED

- ① RUN: When Power On, green light blinks. Otherwise, the lamp is off.
- ② ALARM: When alarming situations happen, the yellow light is on. Otherwise, it is off.
- ③ SHUT DOWN: When Shut Down situations occur, the yellow light is on. Otherwise, it is off.



[Figure 11] dual-band In-building Repeater Repeater Front LED

B. Checking through Debug Program

C. Checking output power

Checking output status through output monitoring port and the characteristics of unnecessary waveforms using a spectrum analyzer

D. Checking service quality status in the service area

Checking service signal quality status using terminals in the service area

4.2 TROUBLESHOOTING

When the repeater is abnormal, diagnosing with remote control or site debug functions. If major alarms go off, turn it off and contact customer service at GS Teletech.

- a. Troubleshooting should be performed by trained technicians.
- b. No internal or external parts should be disassembled or tampered with for any reason.
- c. While troubleshooting, technician should use attenuator to check RF Signal output.