

Smart-Cell Repeater User Manual

33dBm

April, 2016

Version 1.2

- INDEX -

1.	INTRODUCTION	4
1.1.	Warning.....	4
1.1.1.	FCC Warning Statements.....	4
1.1.2.	IC Warning state	6
1.1.3.	etc.....	8
1.2.	GST Smart-Cell Repeater Advantages	9
1.3.	Repeater Operation	9
1.4.	Abbreviation.....	10
2.	SYSTEM CONFIGURATION.....	11
2.1.	Smart-Cell Repeater Service Network Configuration	11
2.2.	System Design and Operation.....	12
2.2.1.	System Design.....	12
2.2.2.	Downlink/ Uplink Path	13
2.2.3.	700MHz Frequency Selection (LTE)	14
2.2.4.	800MHz Frequency Selection (iDEN).....	15
2.2.5.	850MHz Frequency Selection (Cellular).....	15
2.2.6.	1900MHz Frequency Selection (PCS).....	15
2.2.7.	2100MHz Frequency Selection (AWS).....	17
2.2.8.	2600MHz Frequency Selection (BRS).....	17
2.2.9.	2500MHz Frequency Selection (TD-LTE)	18
3.	SYSTEM SPECIFICATIONS.....	20
3.1.	RF Performance	20
3.2.	System Specifications.....	21
3.3.	Electrical and Environmental Specifications.....	22
3.4.	Functions	22
4.	SETUP.....	25
4.1.	Equipment Needed for Repeater Setup.....	25
4.1.1.	Check points before turning on the Repeater	25
4.1.2.	Open for Service.....	26
4.1.3.	Signal Strength LED Check.....	27
4.2.	Setting up the Repeater	28

4.2.1.	Quick GUI/Configuration.....	28
4.2.2.	Quick Setup.....	28
4.3.	Web UI Ranges Table.....	29
4.4.	Troubleshooting.....	30
4.4.1.	Simple Troubleshooting Method.....	30
4.4.2.	Alarm Information.....	30
4.4.3.	Troubleshooting Guide Related to RF.....	33
4.4.4.	Troubleshooting Guide Related to NMS.....	38

1. INTRODUCTION

SmartCell is a repeater, which has been designed to improve signals in blanket/shadow areas inside of buildings to transmit Provider's variety frequencies. User may choose filtering configuration according to the specific site circumstances.

1.1. Warning

1.1.1 FCC Warning Statements

1) FCC Part 15.19 :

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

2) FCC Part 15.105 :

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 expense.

3) FCC Part 15.21 :

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

4) FCC Part 27.5

Antennas must be installed in accordance with FCC 27.50 and SRSP 518.

Please note that EIRP based on antenna gain after accounting for cable loss should be less than 50 Watt (47 dBm) for Donor side. For Service side, with 3dBi gain antennas the height of the antenna above average terrain (HAAT) must not exceed 14.496 m. For different gain antennas refer to the relevant rules.

5) FCC Warning Label

WARNING. This is NOT a CONSUMER device. It is designed for installation by FCC LICENSE and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device.

Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

1.1.2. IC Warning state

1) RSS-GEN, Sec. 7.1.2 – (transmitters)

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada.

Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs,

il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

2) RSS-GEN, Sec. 7.1.2 – (detachable antennas)

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3) RSS-131 Section 5.3 User Manual

The user manual shall contain the following information on the enhancer:

- a. The nominal passband gain (dB);
- b. The nominal bandwidth;
- c. The rated mean output power;
- d. The input and output impedances, and;

The following notice: "The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device."

4) RF Radiation Exposure

This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of at least 100 cm with 15dBi antenna gain between the radiator and your body. This transmitter

must not be co-located or operating in conjunction with any other antenna or transmitter. RF exposure will be addressed at time of installation and the use of higher gain antennas require larger separation distances.

5) RSS-102 RF Exposure

L'antenne du donneur a une antenne 15dBi gain. Antenna doit être installé pour maintenir en tout temps un minimum de distance d'au moins 100 cm entre la source de rayonnement (antenne) et toute personne physique.

Cet appareil ne doit pas être installé ou utilisé en conjonction avec une autre antenne ou émetteur.

1.1.3. etc.

- 1) Use of unauthorized antennas, cables, and/or coupling devices not conforming with ERP/EIRP and/or indoor-only restrictions is prohibited.)
- 2) Home/ personal use are prohibited.

1.2. GST Smart-Cell Repeater Advantages

- It provides selectable RF power levels for any wireless technology / band.
- It has individual monitoring multiple technology.
- FPGA digital filtering provides optimized RF performance.
- It allows modification of technology via customer interface.
- It is easily installed.
- Frequency is easy to add / delete / change.
- It has scalable single and multi-service design.
- Customer data service is improved by adding 4G (LTE)
- It meets all Verizon's technology requirements.
- **It guarantees 5 year warranty for all individual components.**
- Its modular design is a customer friendly and efficient.

1.3. Repeater Operation

Simple replacing of the amplifier unit allows changing the service. Smart-Cell repeater provides service at 700MHz, 800MHz, 850MHz, 1900MHz, 2100MHz, 2500MHz and 2600MHz. One PSU supplies electricity to maximum 4 amplifier units

Frequency	Service	Device Name	Remarks
700	LTE	SMT-L33	
800	iDEN	SMT-I33	
850	Cellular	SMT-C33	
1900	PCS	SMT-P33	
2100	AWS	SMT-A33	
2500	TD-LTE	SMT-T33	
2600	BRS	SMT-B33	

1.4. Abbreviation

DFM	Digital Filter Module
PSU	Power Supply Unit
ALC	Auto Level Control
SNMP	Simple Network Management Protocol
AOC	Auto Oscillation Check
SDM	Synchronous Detect Module

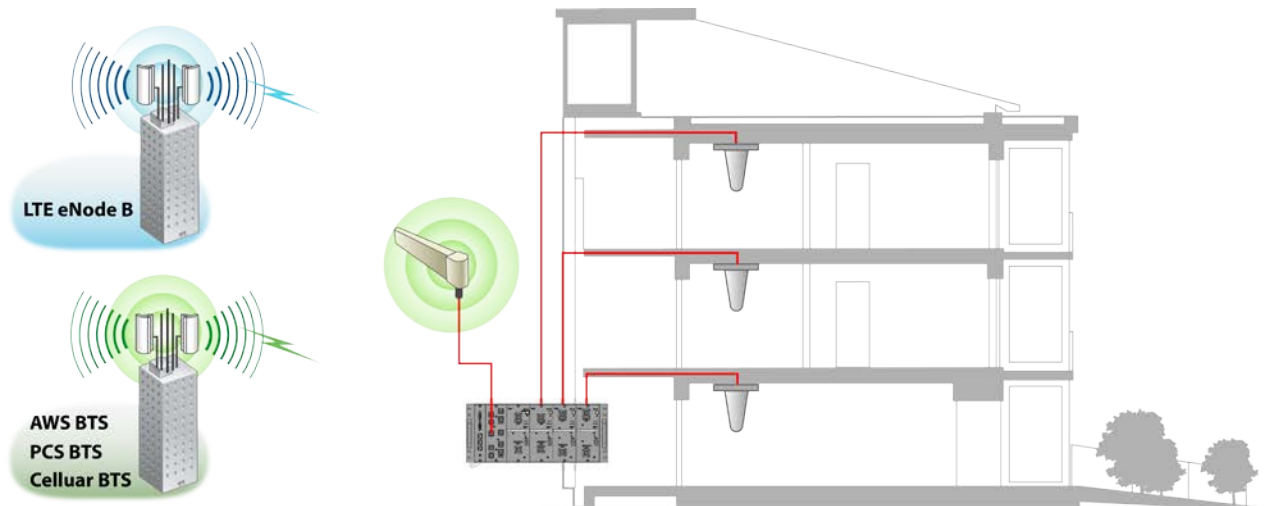


Caution: Risk of explosion if battery on the controller board is replaced by incorrect type.

2. SYSTEM CONFIGURATION

2.1. Smart-Cell Repeater Service Network Configuration

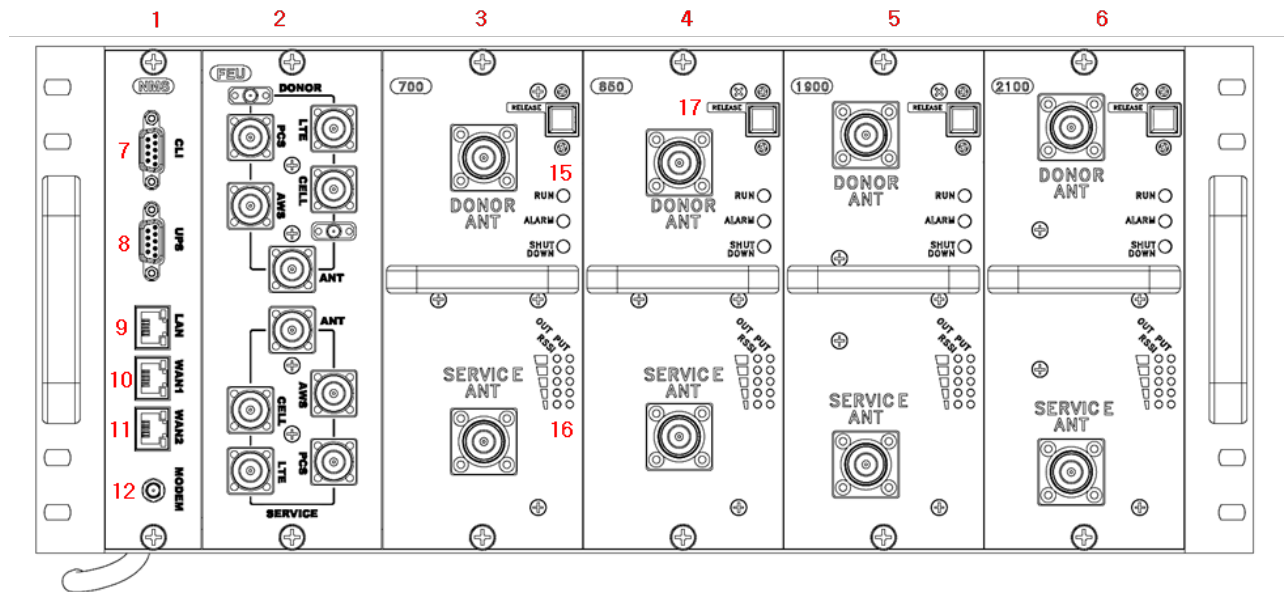
Smart-Cell RF Repeater is designed for improving coverage and capacity of Verizon's LTE & CDMA services nationwide. The repeater can provide coverage for all troubled areas such as suburban, shadow areas, backside of mountains, urban and metropolitan locations. GST products are easy to install, have remote status monitoring and control functions (NMS System) via wired line and wireless modems.



<Figure 1> In-building Repeater Service Organization

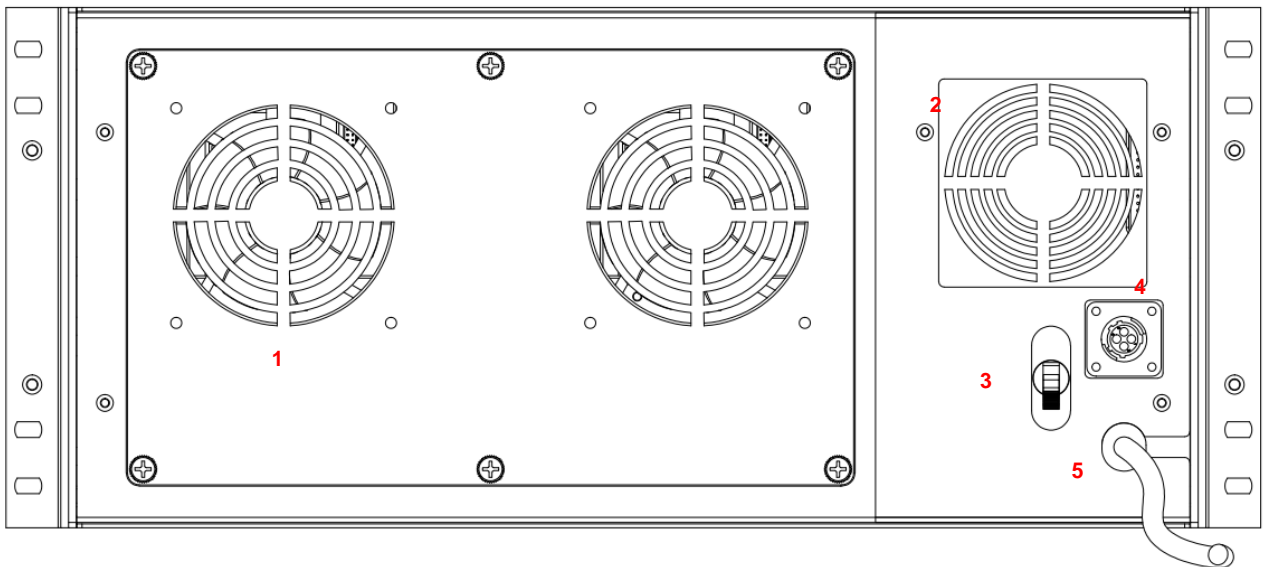
2.2. System Design and Operation

2.2.1. System Design



<Figure 2> Smart-Cell Repeater Front Design

NO.	PART	NO.	PART
1	SNMP	10	WAN 1
2	FEU (Cavity Filter) , optional	11	WAN 2
3	Service Unit #1	12	Modem Connector
4	Service Unit #2	13	Donor Port
5	Service Unit #3	14	Coverage Port
6	Service Unit #4	15	Status LED (RUN/Alarm/Shutdown)
7	CLI	16	Input / Output LED
8	UPS	17	Release Button
9	LAN		



<Figure 3> Repeater Port Design (Rear View)

NO.	PORT	NO.	PORT
1	Main FAN	4	DC 12V output (for EMB)
2	PSU FAN	5	Power Cable
3	Main Switch		

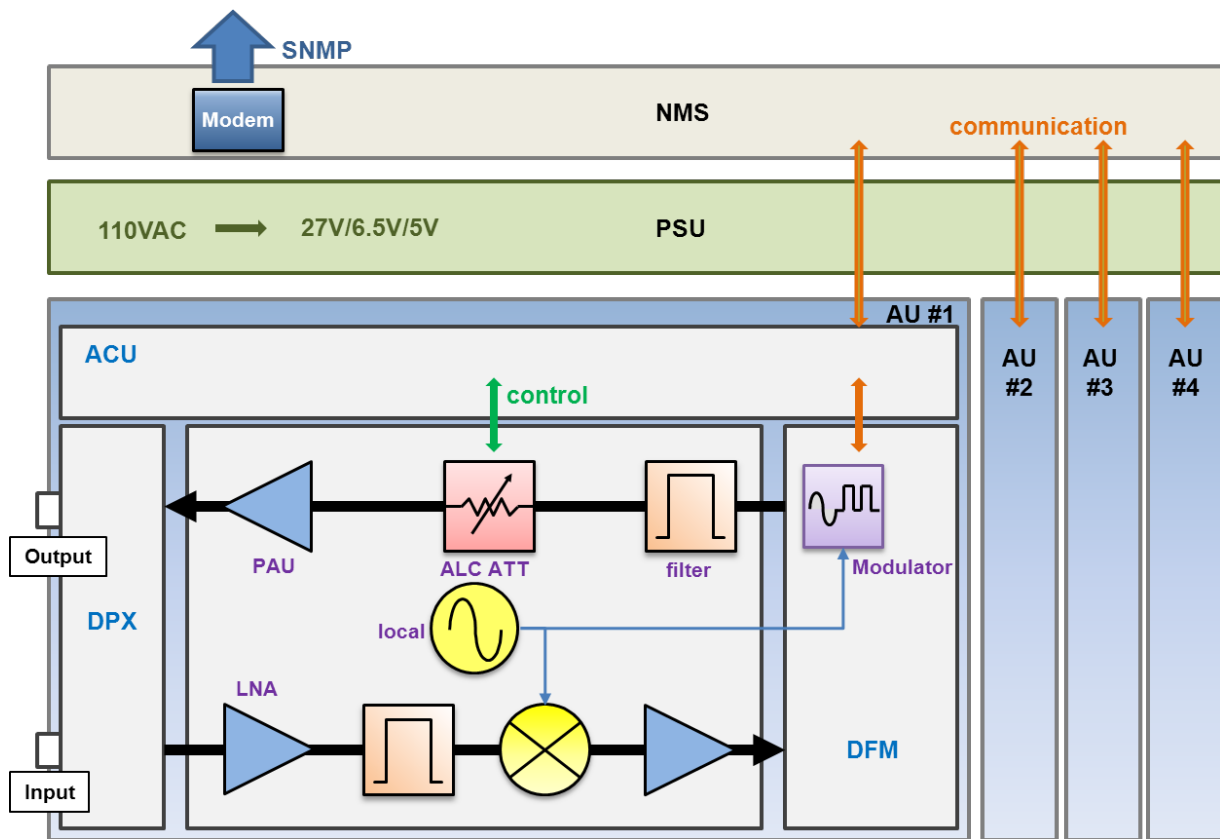
2.2.2. Downlink/ Uplink Path

The Smart-Cell repeater improves service in the 700MHz, 800MHz, 850MHz, 1900MHz, 2100MHz, 2500MHz and 2600MHz frequency bands. User may select frequency band according to the site peculiarities. After receiving a weak signal from donor antenna, the repeater improves and sends securely isolated signal out to service antenna.

Amplifier unit is designed for correspondent operation with digital filter module (DFM). (except for 2500MHz-SMT-T33)

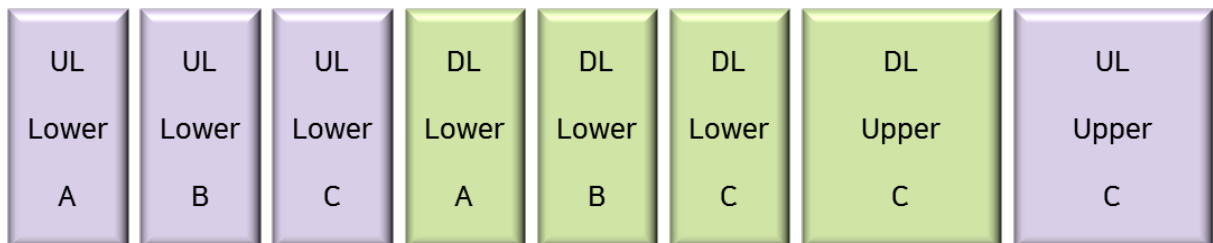
The AMP unit consists of a down and up converters, cavity filter and power amplifier (PAU).

In Downlink Path, a weak RF signal is received from Donor Antenna. Being converted from RF to IF signal, it is transferred to the DFM, where after digitalizing by DA converter, signal is filtered by FPGA. After filtering digital, signal is converted into analog RF signal with modulator. Transmit to amplifier. Desirable signal is amplified and outputted through Service Antenna. Uplink path works vice versa.



<Figure 4> Smart-Cell Repeater Block Diagram (except 2500MHz)

2.2.3. 700MHz Frequency Selection (LTE)

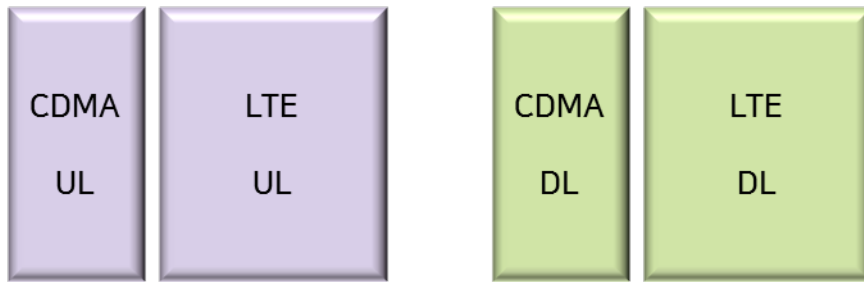


<Figure 5> Smart-Cell Repeater 700 Block Diagram

700MHz Amp Unit provides a service that meets the 3GPP2 LTE standard. Support up to two non-contiguous blocks. And each block has the minimum 5MHz bandwidth.

BAND	DL	UL	Remarks
Lower A	731	701	LTE 5MHz
Lower B	737	707	LTE 5MHz
Lower C	743	713	LTE 5MHz
Upper C	751	782	LTE 10MHz

2.2.4. 800MHz Frequency Selection (iDEN)

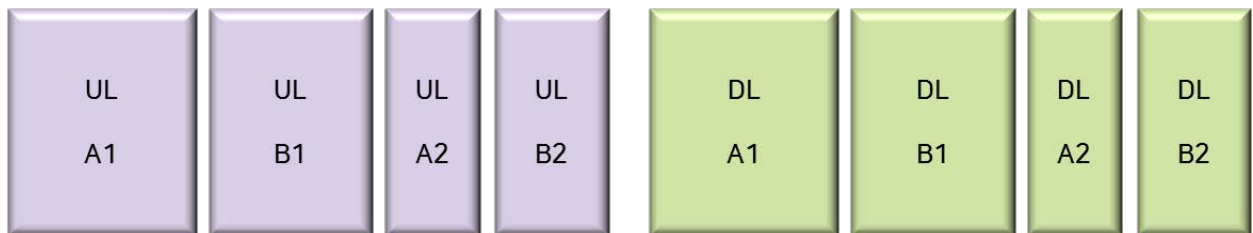


<Figure 6> Smart-Cell Repeater 800 Block Diagram

800MHz Amp Unit has service Cellular 1FA and provides LTE 5MHz (25RB) by default. On / Off control of the service Block is possible. Each block's bandwidth are as follows.

(CDMA[UL] – 1.25MHz, LTE[UL] – 4.505MHz, CDMA[DL] – 1.25MHz, LTE[DL] – 4.505MHz)

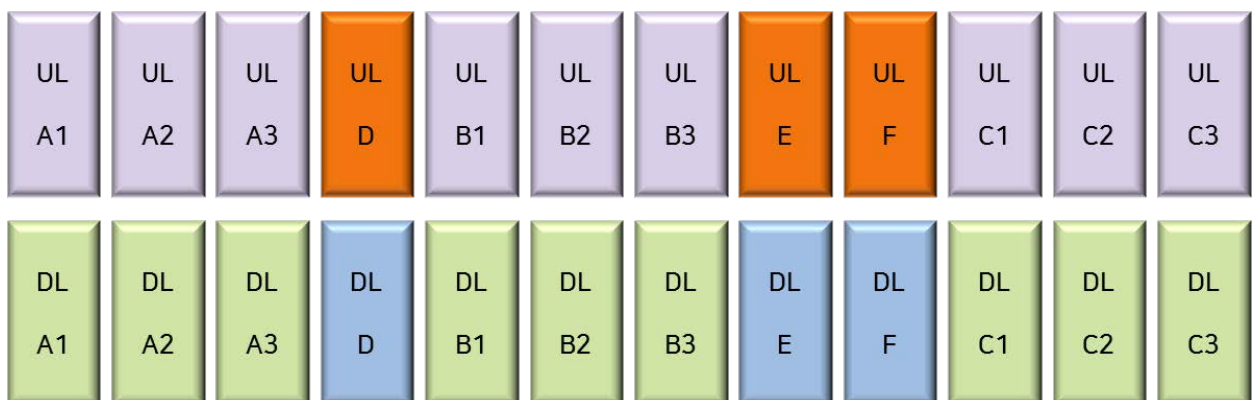
2.2.5. 850MHz Frequency Selection (Cellular)



<Figure 7> Smart-Cell Repeater 850 Block Diagram

850MHz Cellular service provides by default, and supports up to two non-contiguous blocks. Each block's bandwidth are as follows, and it is possible to choose any combination of any band. (A1 - 11MHz, B1 - 10MHz, A2 - 1.5MHz, B2 - 2.5MHz.)

2.2.6. 1900MHz Frequency Selection (PCS)

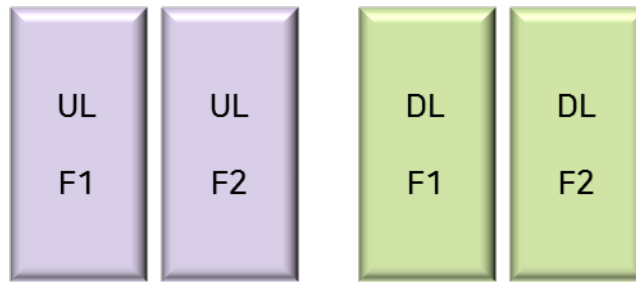


<Figure 8> 1900MHz Band Frequency

1900MHz AMP Unit is basically complied with PCS Band block, where maximum three non-contiguous filtering configurations are available. Each sub block is adjustable per 1.25MHz bandwidth step up to 20MHz. Following table shows user selectable channel numbers.

BAND		DL CENTER [MHz]	CHANNEL	BAND		DL CENTER [MHz]	CHANNEL
A	A1	1931.25	25	guard		1965	700
		1932.5	50	E		1966.25	725
		1933.75	75			1967.5	750
	guard	1935	100			1968.75	775
	A2	1936.25	125	guard		1970	800
		1937.5	150	F		1971.25	825
		1938.75	175			1972.5	850
	guard	1940	200			1973.75	875
	A3	1941.25	225	guard		1975	900
		1942.5	250	C		1976.25	925
		1943.75	275			C1	1977.5
	guard	1945	300				1978.75
	D	1946.25	325	guard	1980		1000
		1947.5	350	C2	1981.25	1025	
1948.75		375	1982.5		1050		
B	guard	1950	400		1983.75	1075	
	B1	1951.25	425	C3	1985	1100	
		1952.5	450		1986.25	1125	
1953.75		475	1987.5		1150		
guard	1955	500	1988.75	1175			
B2	1956.25	525					
	1957.5	550					
	1958.75	575					
	guard	1960					600
	B3	1961.25					625
		1962.5					650
1963.75		675					

2.2.7. 2100MHz Frequency Selection (AWS)



<Figure 7> 2100MHz Band Frequency

2100 Amp Unit has basically satisfies the CDMA standard, and supports non-contiguous 2 block. If you select "contiguous button", Web UI has select the contiguous F band. And you don't select "Contiguous button", Web UI has select the each band of F1 and F2. Frequency range of each band as follows.

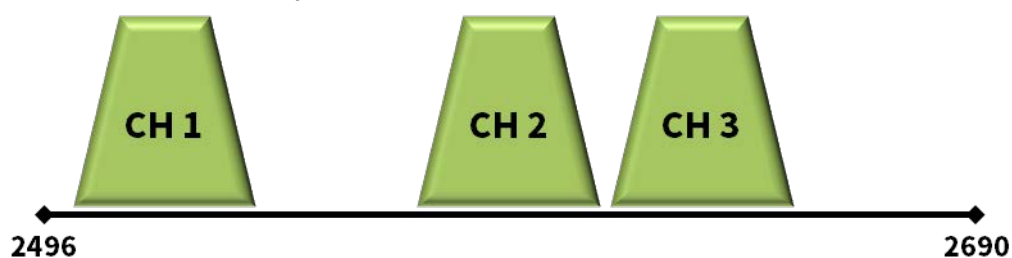
BAND		Downlink		Uplink	
		Start	Stop	Start	Stop
F	F1	2145.15	2149.85	1745.15	1749.85
	F2	2150.15	2154.85	1750.15	1754.85

2.2.8. 2600MHz Frequency Selection (BRS)

2600MHz AMP Unit is basically complied with Band block, where maximum two non-contiguous filtering configurations are available. Each sub block is adjustable per 5MHz bandwidth step up to 40MHz.

RF Downlink	Center Frequency	start	stop	RF Uplink	Center Frequency	start	stop
A1'	2622.5	2620	2625	A1	2502.5	2500	2505
A2'	2627.5	2625	2630	A2	2507.5	2505	2510
A3'	2632.5	2630	2635	A3	2512.5	2510	2515
A4'	2637.5	2635	2640	A4	2517.5	2515	2520
A5'	2642.5	2640	2645	A5	2522.5	2520	2525
A6'	2647.5	2645	2650	A6	2527.5	2525	2530
A7'	2652.5	2650	2655	A7	2532.5	2530	2535
A8'	2657.5	2655	2660	A8	2537.5	2535	2540
A9'	2662.5	2660	2665	A9	2542.5	2540	2545
A10'	2667.5	2665	2670	A10	2547.5	2545	2550
A11'	2672.5	2670	2675	A11	2552.5	2550	2555
A12'	2677.5	2675	2680	A12	2557.5	2555	2560
A13'	2682.5	2680	2685	A13	2562.5	2560	2565
A14'	2687.5	2685	2690	A14	2567.5	2565	2570

2.2.9. 2500MHz Frequency Selection (TD-LTE)



2500MHz AMP Unit is basically complied with LTE Band block 41, where maximum three non-contiguous filtering configurations are available. Following table shows user selectable channel numbers.

Ch. Name	Start	Center	Stop	Bandwidth	Regulatory Ch.
L01	2497.80	2506.80	2515.80	18.00	BRS1,A1,A2,A3
L09	2501.30	2510.30	2519.30	18.00	BRS1,A1,A2,A3,B1
L16	2504.60	2513.60	2522.60	18.00	A1,A2,A3,B1
L23	2507.80	2516.80	2525.80	18.00	A1,A2,A3,B1,B2
L30	2511.10	2520.10	2529.10	18.00	A2,A3,B1,B2,B3
L35	2514.60	2523.60	2532.60	18.00	A3,B1,B2,B3
L02	2517.60	2526.60	2535.60	18.00	A3,B1,B2,B3,C1
L10	2521.10	2530.10	2539.10	18.00	B1,B2,B3,C1
L17	2524.40	2533.40	2542.40	18.00	B1,B2,B3,C1,C2
L24	2527.60	2536.60	2545.60	18.00	B2,B3,C1,C2,C3
L31	2530.90	2539.90	2548.90	18.00	B3,C1,C2,C3
L36	2534.40	2543.40	2552.40	18.00	B3,C1,C2,C3,D1
L03	2537.40	2546.40	2555.40	18.00	C1,C2,C3,D1
L11	2540.90	2549.90	2558.90	18.00	C1,C2,C3,D1,D2
L18	2544.20	2553.20	2562.20	18.00	C2,C3,D1,D2,D3
L25	2547.40	2556.40	2565.40	18.00	C3,D1,D2,D3
L04	2574.10	2583.10	2592.10	18.00	A4,B4,C4,D4
L12	2578.10	2587.10	2596.10	18.00	A4,B4,C4,D4,G4
L19	2582.10	2591.10	2600.10	18.00	B4,C4,D4,G4
L26	2584.00	2593.00	2602.00	18.00	B4,C4,D4,G4,F4
L32	2586.10	2595.10	2604.10	18.00	C4,D4,G4,F4
L37	2589.90	2598.90	2607.90	18.00	C4,D4,G4,F4,E4
L05	2593.90	2602.90	2611.90	18.00	D4,G4,F4,E4
L06	2619.80	2628.80	2637.80	18.00	BRS2,E1,E2,E3
L13	2623.30	2632.30	2641.30	18.00	BRS2,E1,E2,E3,F1
L20	2626.60	2635.60	2644.60	18.00	E1,E2,E3,F1

L27	2629.80	2638.80	2647.80	18.00	E1,E2,E3,F1,F2
L33	2633.10	2642.10	2651.10	18.00	E2,E3,F1,F2,F3
L38	2636.60	2645.60	2654.60	18.00	E3,F1,F2,F3
L07	2639.60	2648.60	2657.60	18.00	E3,F1,F2,F3,H1
L14	2643.10	2652.10	2661.10	18.00	F1,F2,F3,H1
L21	2646.40	2655.40	2664.40	18.00	F1,F2,F3,H1,H2
L28	2649.60	2658.60	2667.60	18.00	F2,F3,H1,H2,H3
L34	2652.90	2661.90	2670.90	18.00	F3,H1,H2,H3
L39	2656.40	2665.40	2674.40	18.00	F3,H1,H2,H3,G1
L08	2659.40	2668.40	2677.40	18.00	H1,H2,H3,G1
L15	2662.90	2671.90	2680.90	18.00	H1,H2,H3,G1,G2
L22	2666.20	2675.20	2684.20	18.00	H2,H3,G1,G2,G3
L29	2669.40	2678.40	2687.40	18.00	H3,G1,G2,G3

3. SYSTEM SPECIFICATIONS

3.1. RF Performance

Item		Specification	Remark
Frequency	700MHz	DL : 728.5MHz ~ 745.5MHz 746MHz ~ 756MHz UL : 698.5MHz ~ 715.5MHz 777MHz ~ 787MHz	5MHz / 10MHz
	800MHz	DL : 862MHz ~ 863.8MHz 864MHz ~ 868.6MHz UL : 817MHz ~ 818.8MHz 819MHz ~ 823.6MHz	1.8MHz + 4.8MHz
	850MHz	DL : 869MHz ~ 894MHz UL : 824MHz ~ 849MHz	25MHz
	1900MHz	DL : 1930MHz ~ 1990MHz UL : 1850MHz ~ 1910MHz	60MHz
	2100MHz	DL : 2145MHz ~ 2155MHz UL : 1745MHz ~ 1755MHz	10MHz
	2500MHz	2496MHz ~ 2690MHz	194MHz
	2600MHz	DL : 2620MHz ~ 2690MHz UL : 2500MHz ~ 2570MHz	70MHz
Maximum Input Power		-27dBm	
Output Power (ANT Port)		+33dBm / 2W Total	

3.2. System Specifications

Parameter		Specification	Remark
Gain	Range	60dB ~ 90dB	
	Adjust Step	±0.5dB	
	Adjust Accuracy	±1dB	
Flatness	700MHz	< 3.0dBp-p	
	800MHz		
	2500MHz		
	2600MHz		
	850MHz	< 5.0dBp-p	
	1900MHz		
	2100MHz		
Propagation Delay		≤ 6us	
VSWR		1.7 : 1	
Noise Figure	Max Gain	< 7dB	
ACP	750MHz	> 45dBc @±5MHz/10MHz	
	800MHz	> 45dBc ±750KHz	CDMA
		> 50dBc@±1.98KHz	LTE
	850MHz	> 45dBc @±5MHz/10MHz	
		> 45 dBc ±885KHz	
	1900MHz	> 52dBc@±1.98KHz	
		<-13dBm@Fc±2.25MHz (RBW: 1MHz)	
	2100MHz	> 45 dBc ±750KHz	
2500MHz	> 52dBc@±1.98KHz		
2600MHz	<-13dBm@Fc±2.25MHz (RBW: 1MHz)		
Roll off	700MHz	±1MHz	> 45dBc
	800MHz	±1MHz	> 45dBc
	850MHz	±1MHz	> 45dBc
		±250kHz	> 30dBc
	1900MHz	±1MHz	> 50dBc

	2100MHz	±1MHz	> 40dBc	
	2500MHz	±1MHz	> 50dBc	
	2600MHz	±1MHz	> 50dBc	
Characteristic Impedance			50Ω	

3.3. Electrical and Environmental Specifications

Item		Specification	Remark
RF Connector		N-Type Female	Donor & Server ANT Port
AC Supply		AC 110V 60Hz 3.0A	
Out Dimension		3.1" x 15.5" x 7.7"	AMP unit
		19" x 19" x 7.9"	System (Rack mount)
Weight	700MHz	13.0lbs	5.89 kg
	800MHz	11.5lbs	5.21 kg
	850MHz	11.5lbs	5.21 kg
	1900MHz	11.5lbs	5.21 kg
	2100MHz	10.0lbs	4.53 kg
	2500MHz	12.0lbs	5.44 kg
	2600MHz	11.5lbs	5.21 kg
	FEU	23	19" rack + NMS + PSU (except AMP units and FEU)
Operation Temperature		-10°C ~ +50°C	Convection cooling
Humidity		5% ~ 95%	Non-condensing
Vibration Resistance		1G, 10~150Hz 0.1 Octaves/min	
MTBF		50,000 hours	

3.4. Functions

Parameter	Specification
Gain Control	<ul style="list-style-type: none"> Adjustable DL and UL Gain range 60dB ~ 90dB. Display default Gain and current Gain function
ALC	<ul style="list-style-type: none"> To limit output powers as far as default range.

Auto Limit Control	<ul style="list-style-type: none"> • 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 the minimum gain. • Automatic Recovery Algorithm conversion after shutdown status.
Band Select	<ul style="list-style-type: none"> • 700MHz : Lower A(5MHz)/Lower B(5MHz)/ Lower C(5MHz)/Upper C(10MHz) • 800MHz: 5MHz/10MHz • 850MHz : A1(11MHz)/B1(10MHz)/A2(1.5MHz)/B2(2.5MHz) • 1900MHz : 1.25MHz ~ 20MHz/1.25MHz step • 2100MHz: 5MHz/10MHz • 2500MHz: 20MHz • 2600MHz: 5MHz/10MHz/15MHz/20MHz
Power Monitoring	<ul style="list-style-type: none"> • Monitoring repeater's output level.
Oscillation Check	<ul style="list-style-type: none"> • Isolation Check in initial set up or Reset. • When Oscillation occurred, repeater attempts to stabilize Isolation through Gain control function. • Shutdown repeater when oscillation still occurs in the minimum Gain. • Automatic Recovery Algorithm conversion after shutdown status.
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.
AOC Auto Oscillation Check Function	<ul style="list-style-type: none"> • AOC Use for prevented oscillation

	<pre> graph TD Start[AOC on] --> D1{Isolation Detect < Isolation Limit} D1 -- Yes --> D2{ALC Attenuation >= 30dB} D2 -- Yes --> Shutdown[Shutdown] D2 -- No --> D3{Isolation Detect < Isolation Limit-4} D3 -- Yes --> A5[ALC Attenuation +5dB] A5 --> A1[ALC Attenuation +1dB] D3 -- No --> D4{Isolation Detect > Isolation Limit-3} D4 -- Yes --> Aminus1[ALC Attenuation -1dB] Aminus1 --> D1 D4 -- No --> D1 </pre>
<p>VSWR Monitoring</p>	<ul style="list-style-type: none"> Monitoring VSWR of Service ANT Port. Reporting VSWR Alarm and Shutdown when the rate is 3:1.
<p>DHCP Client</p>	<ul style="list-style-type: none"> Automatic IP assignment.
<p>DHCP Server</p>	<ul style="list-style-type: none"> Server function for automatic IP assignment.
<p>Web GUI</p>	<ul style="list-style-type: none"> Remote and local user browser support through Web Browser.
<p>SNMP Agent</p>	<ul style="list-style-type: none"> NMS report via SNMPv2 Trap.
<p>LED Display</p>	<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. SETUP

4.1. Equipment Needed for Repeater Setup

Parameter	Item	Quantity	Remark
Major Component	Smart-Cell Repeater	1 EA	Provided by GST
Additional Components	WALL Mounting Bracket	1 EA	Provided by GST
	CD which contains User Manual V.1.0 and Installation Guide V.1.0	1 EA	
	Ethernet Cable 6.6ft (2m)	1 EA	
	Ground Cable 6.6ft (2m)	1 EA	
	Ground SEMs Screw M4 x 8mm	4 EA	
	Bracket SEMs Screw M6 x 10mm	4 EA	
	Lag Screw 12.7mm x 50.8mm	4 EA	
	FEU-AMP unit cable	8 EA	
FEU-Wall Bracket cable	2 EA		
Antenna	Donor ANT	1 EA	Not Included
	Service ANT	1 EA	
RF Cable	Antenna connection Cable	TBD	Not Included
Testing and Measuring Equipment	Spectrum Analyzer	1 EA	Not Included

4.1.1. Check points before turning on the Repeater

1) System Power Check

- ① AC electrical power to the repeater should be 110V, input electricity only after power verification.

2) Input RF Signal Range

- ① Optimal input RSSI into the repeater is -57dBm ~ -27dBm for 700MHz/850MHz/1900MHz/2100MHz/2500MHz/2600MHz. User should verify

input condition of Donor ANT. If the input RSSI exceeds -27dBm, impose the using external attenuators should be used.

3) Isolation check between DONOR/SERVEICE ANT

- ① Isolation condition of this equipment is 105dBc (Gain+15dB). User should check its condition before installation.

4.1.2. Open for Service

1) Check points before open:

- ① Verification of system installation status :
 - Electricity, In/Out antennas, cable connection, and equipment mount status.
- ② Verification of system accessories :
 - User should check all necessary accessories.
- ③ Check receipt signal level :
 - Installer should check whether environmental conditions are in accordance with system specification to ensure that system operation will be optimized.

2) Check points after open:

- ① Check external LED
 - RUN: Green light ON (Off: all lights off)
 - ALARM: Green light in normal status, Red light in alarming
 - SHUT DOWN: Green light in normal status, Red light in Shutdown status

4.1.3. Signal Strength LED Check

Number of LED bars	Input Signal Level	Output Power Signal Level
LED 1 bar	Less than -86dBm	Less than +5dBm
LED 2 bars	-85dBm ~ -79dBm	+6dBm ~ +10dBm
LED 3 bars	-78dBm ~ -72dBm	+11dBm ~ +15dBm
LED 4 bars	-71dBm ~ -65dBm	+16dBm ~ +20dBm
LED 5 bars	More than -64dBm	More than +21dBm



<Figure 9> Modular Repeater Front LED

4.2. Setting up the Repeater

4.2.1. Quick GUI/Configuration

Use the following steps to commission the Repeater after all the cabling and antennas are fixed in place and the Repeater is supplied with proper electrical power. The repeater will need a good quality stable Downlink RSSI input level in the range of -85dBm to -60dBm.

- 1) Connect your laptop to the repeater with a Crossover Ethernet cable.
- 2) Verify that your laptop has all wireless connections off and is Obtaining an IP address automatically, or is using a proper fixed IP address such as: Use the following IP address: 172.16.6.81 with a Subnet Mask of 255.255.255.252.
- 3) Open Internet Explorer and go to: 172.16.6.81
- 4) User name: admin
- 5) Password: admin

4.2.2. Quick Setup

- 1) Go to the RF Configuration page.
- 2) Before the Amplifier (HPA) can be turned on, set the Uplink and Downlink attenuation (ATT) to the maximum value and click Apply.
- 3) Select the correct Band Block and set the ALC Downlink and Uplink Limits to the desired level and click Apply. (To adjust the Output Power, change the ALC Downlink and Uplink Limits to the desired levels).
- 4) To check the Repeater's status, click on the Status page.
- 5) To change the Repeater's gain/attenuation, adjust the Uplink and Downlink attenuation in equal amounts not more than 5dB at a time and click Apply.

4.3. Web UI Ranges Table

GUI Feature	Range	Description
Downlink and Uplink Output Power Display	Below 0dBm to 35dBm	The output Power of the Repeater
Downlink Low RF Power	2dB to 10dB	Threshold for Low RF Power
Downlink and Uplink Attenuation Control	0dB to 30dB	Reduces Gain Internally
Downlink and Uplink ALC Limit	0dBm to 33dBm	Limits Output Power
Downlink RSSI Display	-100dBm to -27dBm	Downlink Receive Level at Donor Antenna Port
Downlink Low RSSI	-93dBm to -57dBm	Threshold for Low RSSI
Downlink and Uplink AMP Control	On/Off	High Powered Amplifier
Gain Balance Control	On/Off	Equalizes Uplink and Downlink Gain
Gain Balance Value	0dB to 15dB	Subtract Uplink Gain by G/B Value
Shutdown Control	On/Off	Shutdown if Major Alarm is Reported
Auto Gain Setting	On/Off	Automatic Gain Setting for the Repeater
Auto Oscillation Check	On/Off	Preventing Oscillation
Temperature Display	32 to 260.6 Degrees	Internal Repeater Temperature
AMP Temperature Upper Limit	0 to 299 Degrees	Threshold for Temperature Alarm
Band Blocks Used/Bandwidth	Each AMP	The Channel the Repeater will be using
Delay Alarm Report	0 or 5 Minutes	Time Delay of Reporting after Alarm is Detected

4.4. Troubleshooting

In case of abnormal operation, technician should diagnose abnormality via remote access or directly connecting to repeater using Ethernet cable. If technician is required to conduct repairs due to major alarm, repeater should first be powered off, and then technician should prepare the proper measurement equipment before trying to fix the problem. In most cases of major repairs, GST will simply replace the unit and conduct repairs at the appropriate facility.

4.4.1. Simple Troubleshooting Method

- 1) Verify LED Status, both on external LED's as well as internal module LED's
 - Normal operation: Green light on. Alarming: Red LED on.
- 2) Technician should check external and internal connectors to ensure that all connections are tightly secure. These connectors should be cleaned regularly.
- 3) If technician thinks there is a serious problem, call after sales team for over-the-phone technical support. 1-866-9-GST-USA (1-866-947-8872)

4.4.2. Alarm Information

Alarm Name	What causes this alarm	Troubleshooting Methods
Downlink Spurious emissions out of spec	Downlink Output Power exceeds Downlink Upper Limit	* The Downlink Output Power should not exceed the maximum composite power spec for this unit. * If the Downlink Output Power is not exceeding the composite power spec for this unit, try to increase the Downlink Upper Limit on the RF Configuration Page. * Add equal amounts of Uplink and Downlink attenuation until the Downlink Output Power is less than the Downlink Upper Limit. * Set the ALC Downlink Limit on the RF Configuration Page to a value lower than the Downlink Upper Limit
Downlink	Downlink path gain is	* By default, if the Downlink Low Output Variance is

Hardware failure	6dB less than RSSI plus Output Power	<p>set to 10dB, the Repeater will not report this alarm.</p> <p>* Increase the Downlink Low Output Variance on the RF Configuration Page.</p>
Downlink Donor power too low	Input RSSI from Donor site is 8dB less than Downlink Low Input Limit	<p>* By default, if the RSSI Lower Limit is set to -93dBm, the Repeater will not report this alarm.</p> <p>* Decrease the Downlink Low RSSI Limit level on the RF Configuration Page.</p> <p>* Increase the RSSI level into the Repeater.</p>
Downlink VSWR	When the VSWR Ratio on the Server Port is greater than 3 : 1	<p>* "Sweep the line" to check for loose or damaged connectors and/or cabling.</p> <p>* If after checking the entire Server side, the VSWR alarm still exists and the system is working fine, Disable the alarm on the Alarm Configuration page.</p>
Downlink Donor power too high	Downlink Input Power exceeds - 25dBm	<p>* Check the direction of donor antenna</p> <p>* Even if higher input power after the modifying direction of donor antenna, Be adding an attenuator at the Donor port.</p>
Downlink Synthesizer failure	Synthesizer (in Downlink path) has occur Failure	<p>* By using a switch on the back of the repeater, resets the power</p> <p>* Call to GST's Tech Support Team and exchange the AMP unit.</p>
Downlink Interfere power exceeded	If an external signal is higher than the in band signal, more than 15dB signal	<p>* Call the GST's Tech Team, resolved in accordance with the procedure.</p>
Uplink Out of band emissions out of spec	Uplink Output Power exceeds Uplink Upper Limit	<p>* The Uplink Output Power should not exceed the maximum composite power spec for this unit.</p> <p>* If the Uplink Output Power is not exceeding the composite power spec for this unit, try to increase the Uplink Upper Limit on the RF Configuration Page.</p>

		<ul style="list-style-type: none"> * Add equal amounts of Uplink and Downlink attenuation until the Uplink Output Power is less than the Uplink Upper Limit. * Set the ALC Uplink Limit on the RF Configuration Page to a value lower than the Uplink Upper Limit
Uplink Power at coverage port too high	Uplink Input Power is higher than -25dBm	<ul style="list-style-type: none"> * Check the direction of Coverage antenna * When another device is connected to the Coverage port as DAS System 1) Add an attenuator on Coverage port, or 2) Uplink to adjust the output of the additional equipment.
Uplink Synthesizer failure (Uplink Hardware failure)	Synthesizer (in uplink path) has occur Failure	<ul style="list-style-type: none"> * By using a switch on the back of the repeater, resets the power * Call to GST's Tech Support Team and exchange the AMP unit.
Uplink (Downlink) Software failure	When an alarm occurs in DFM's at the AMP unit.	<ul style="list-style-type: none"> * By using a switch on the back of the repeater, resets the power * Call to GST's Tech Support Team and exchange the AMP unit.
Oscillation detected/Low isolation	Insufficient isolation is detected when the Repeater is at minimum gain	<ul style="list-style-type: none"> * Verify that the Donor antenna is on the same side of the building as the Donor site, and if needed, raise the Donor antenna up on a pole. * Change the types of antennas used, such as Yagi to Corner-Reflector for outdoors, and Omni to a Panel for indoor use. * Move the closest indoor service antenna farther away from the outside Donor antenna. * Close the repeater door if opened and verify that the

		closest indoor coverage antenna is not in the same room as the repeater.
Field Replaceable module failure	Filter service has not matches between Amp Unit and DFM	* Call to GST's Tech Support Team to verify that all the settings are correct.
Tamper Detected	When mount information (in the system) is changed	* After 5 minutes clear automatically. * If you want to disable, you can on the Alarm Configuration page.
Communication Failure	If the communication between the NMS Board and Amp Unit would not operating normally	* SNMP board or AMP unit need to reset. * Open the rear cover and check the each cable.
Power Supply out of range	The internal Power Supply detects improper Voltage	* If the system is working fine, disable the alarm on the Alarm Configuration page. * Call to GST's Tech Support Team to verify that all the settings are correct.
Over Temperature	Internal AMP temperature exceeds the Temperature Limit	* Verify that the Temperature Limit is set between 176 °F ~ 201 °F on the RF Configuration page. (Default Value is 163°F)
Reset alarm	When the unit has reset	* After 30 seconds clear automatically.
Manual Shutdown	When the operates shutdown algorithm, after re-check	* By using a switch on the back of the repeater, resets the power * Reset the AMP unit, By Web UI.
FAN	in the event of a fan failure	* Replace the fan

4.4.3. Troubleshooting Guide Related to RF

Item	Check Point	Troubleshooting
Check before system operation	System input power range	-Downlink: -100dBm ~ -27dBm -Uplink: -100dBm ~ -27dBm
	System gain (DL/UL)	- 60dB ~ 90dB
	Output power at server port	- Downlink: 33dBm ± 2dB - Uplink: 33dBm ± 2dB
	Check points before open for service	-Please check quantity of all accessories with specification before you set up -Fit cable length in accordance with field condition
Check after system operation	Check points after open for service	Check following status; -Verify that the antennas are securely mounted and pointed in the correct directions -Connection status between antennas and RF cable -Verify that the Repeater is securely mounted -Proper AC power status -Grounding status of electrical circuit -Coaxial cable (RF) construction status -Connectors and combiners connection status -Cable connection status against leakage of water
When repeater does not work properly	Check electricity cord connection status	-Re-plug in Adapter cord

When in alarming	DL VSWR alarm	Please Check following status; -Make sure Server Antenna Port is disconnected. -Please reset Adapter upon completing Alarm troubleshooting
	DL over-output alarm	-Make sure output power is operating normally -Please Reset Adapter upon completing Alarm troubleshooting
	UL over-output alarm	-Please make sure output level is operating normally -Please reset Adapter upon completing Alarm troubleshooting
	Temperature alarm	Check following status; -Setting level of maximum temperature limit -Temperature offset is normal or not -Circumstances of temperature -Please Reset Adapter upon completing Alarm troubleshooting
	RF off	-Verify that the HPA's are On -Please Reset Adapter upon completing Alarm troubleshooting
When output power is no longer 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
	-Technician should connect antenna with output port of repeater -Please make sure all connectors are fastened	-Reconnect the connector -Change it if the connector is defective

	Check the input level	-Increase output power or check input change of BTS side
	Check gain of the unit	-If the Gain is different from normal level, please contact A/S team
	Cable connector loose	-It is possible for connectors to get too tight and damage the equipment or throughput -Please contact installer or service provider upon verification
In case of dropped call or bad signal after set up	Check input signal strength in the service area	-Increase output power level of repeater by adjusting attenuation level
	If input signal strength is not a problem, please check delay of calling time	-Increase output level of Uplink signal, then set to optimal level.
	Check RSSI signal strength	-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, reconnect cable and connector and then check the output power again
	Input level change or module overheating	-Check input level from BTS side. -Check performance of each module (Diagnosed by A/S team)
	Please check VSWR of the cable is normal	-Change to normal Cable

4.4.4. Troubleshooting Guide Related to NMS

Symptom	Check Points	Troubleshooting
Link Fail	Communication problem	-In case of Ethernet, verify IP addressing, DHCP function, and that cookies are deleted -Verify that a crossover Ethernet cable is being used
	CLI connection, cable status check	-Make sure 1:1 connection -Follow instructions in the installation guide for this connection procedure
	CLI connection Check by USB to serial cable	-Please verify port number of PC communication -Please check cable connection status

If technician thinks there is a serious problem, call after sales team for over-the-phone Technical support. **1-866-9-GST-USA (1-866-947-8872).**