

3G Indoor Repeater GRS-1915D-SPR User Manual

January, 2009

Version 0.1

- INDEX -

1. SUMMARY	3
2. SYSTEM CONFIGURATION	5
2.1 3G Indoor Repeater Service Network Configuration	5
2.2 System Design and Operation	6
2.2.1 System Design.....	6
2.2.2 Downlink/Uplink Path	9
2.2.3 Frequency Selection	10
3. SPECIFICATIONS	11
3.1 System Capacity	11
3.2 System Specifications	12
3.3 Electrical and Environmental Specifications	12
3.4 Functions	13
4. SETUP	15
4.1. Equipment Needed for 3G Indoor Repeater Setup	15
4.1.1 Checkpoints before turning on the Repeater	15
4.1.2 System Setup	16
4.1.3 Open for Service.....	17
4.2.1 Necessary Testing and Measuring Equipment	19
4.2.2 Notice.....	19
4.2.3 Simple Troubleshooting Method	19
4.2.4 Troubleshooting Guide	20
4.2.5 Troubleshooting Guide Related to RF	21
4.2.6 Troubleshooting Guide Related to NMS	23

1. Summary

GRS-1915D-SPR is a 3G Indoor repeater, which has been designed to improve signals in blanket/shadow areas inside of buildings to transmit Sprint signals at PCS 1900MHz band.

Characteristics

PCS Band: 72dB Gain with 15dBm maximum composite output power.

Bandwidth: Entire PCS 1900 frequency A Block to F Block (45MHz). Bandwidth selection adjustable per user's situation.

- 5MHz, 10MHz, 15MHz Blocks
- Three continuous 5MHz, 10MHz, 15MHz block combinations (only continuous)
- See page 10 for more details.

Characteristics

GRS-1915D-SPR repeater is an indoor repeater with output power of 15dBm. Functional modules are classified as below:

- DPX Filters to combine the input/output signals for: CDMA
- Body (the whole module)
- AC/DC Adapter
- Controller to monitor each module in repeater.

Abbreviation

PAM: POWER AMPLIFIER MODULE

LNA: LOW NOISE AMPLIFIER

AGC: AUTO GAIN CONTROL

ALC: AUTO LIMIT CONTROL



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

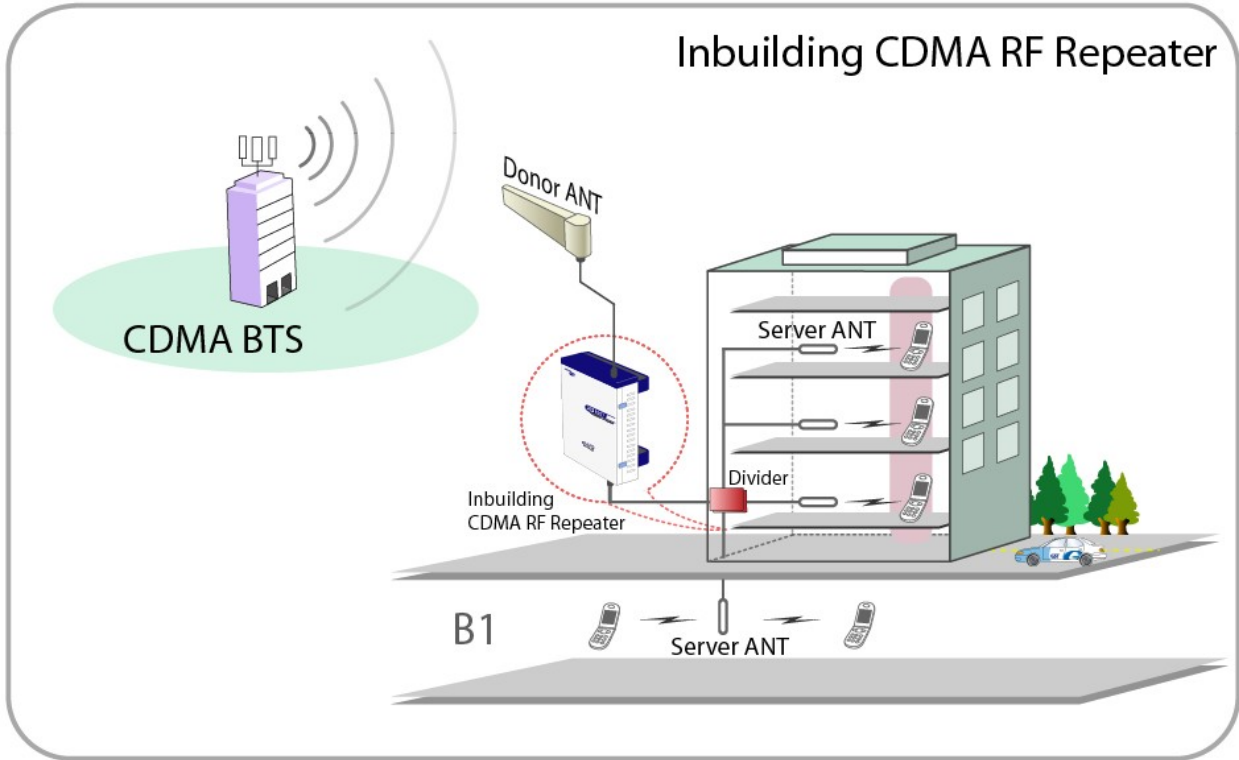
-Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

-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 20cm during normal operation. The gain of the antenna for pcs Band must not exceed 12 dBi.

2. System Configuration

2.1 3G Indoor Repeater Service Network Configuration



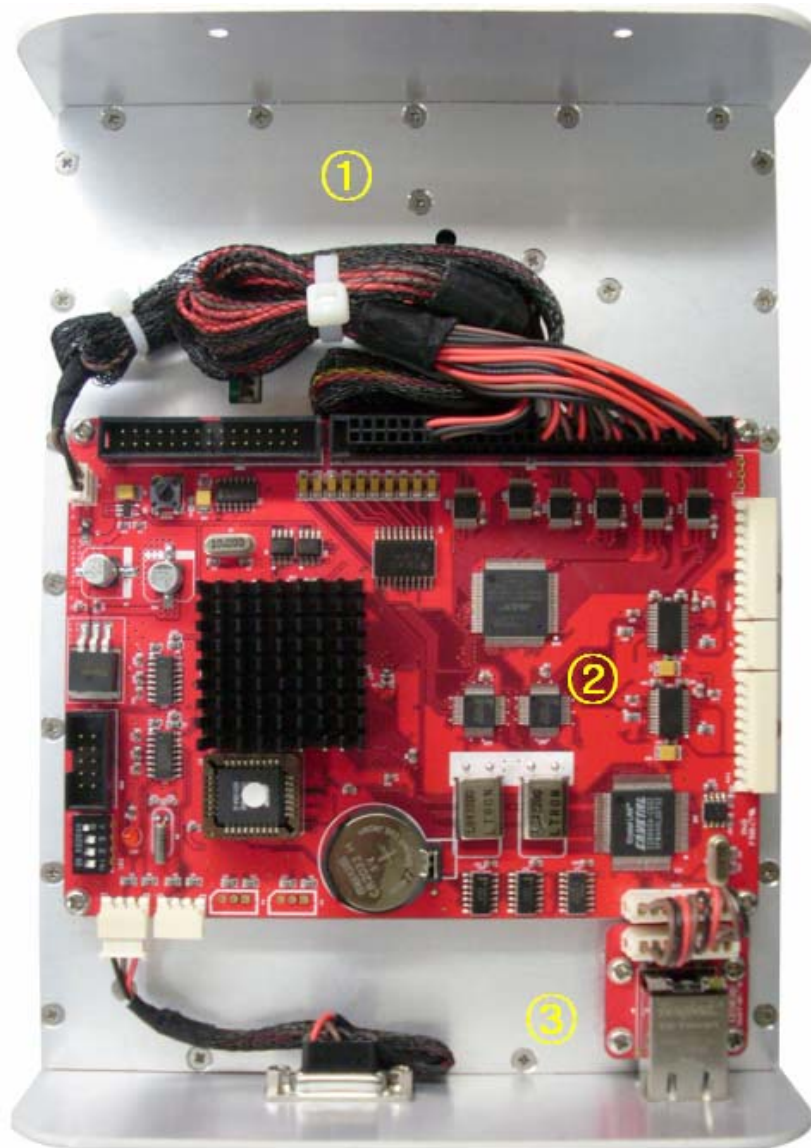
<Pic.1> 3G Indoor In-building Repeater Service Organization

2.2 System Design and Operation

2.2.1 System Design



<Pic.2> GRS-1915D-SPR repeater



<Pic.3> Internal Design

No	Part
1	Module
2	Control Board
3	Ethernet Board



<Pic.4> Outside Port Design

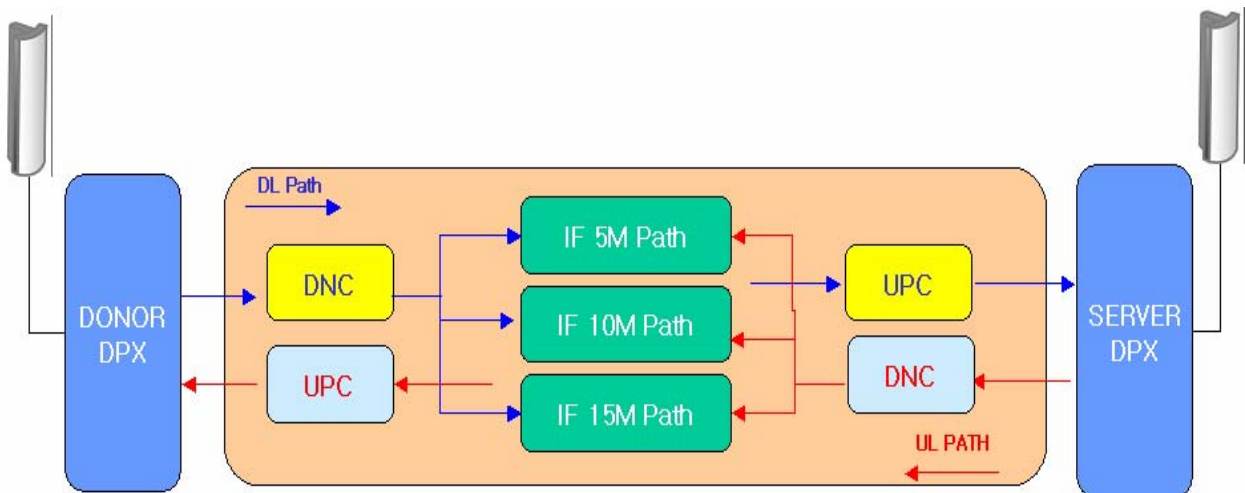
NO.	PORT
1	Server Antenna Port
2	Donor Antenna Port
3	DC Power Port
4	CLI Monitor Port
5	Ethernet Port
6	Grounding port

2.2.2 Downlink/ Uplink Path

GRS-1915D-SPR improves and strengthens signals in PCS 1900MHz band.

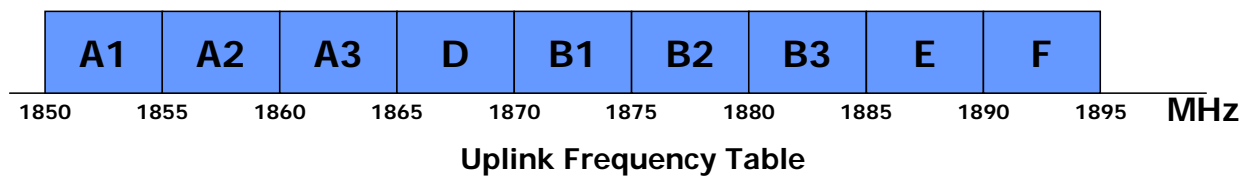
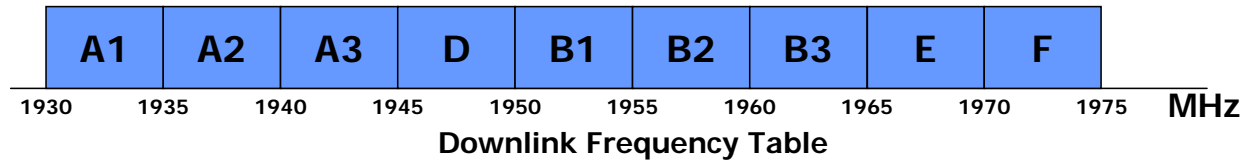
In downlink path, received from Donor Antenna signal is transferred through Duplexer (DPX) and Down Conversion (DNC) module, and after choosing one of 5MHz, 10MHz or 15MHz in IF path the signal is forwarded to Up Conversion (UPC) module. Then, improved signal is sent to Service Antenna through Diplexer (DPX).

Uplink path is vice versa to Downlink path.



<Pic.5> Block Diagram

2.2.3 Frequency Selection



<Pic.6 > 1900MHz Band Structure

PCS 1900 repeater has 5MHz, 10MHz, 15MHz Paths in IF division, so any of these bandwidths can be selected for providing service. 5MHz, 10MHz, 15MHz are only continuous bands.

But there are some cases when this choice is not applicable:

- Not continuous 3 Paths [5 MHz each], so total band is 15MHz
Ex) A1, D, E
- Not continuous 3 Paths [5 MHz each], so total band is 10MHz
Ex) A1, D
- Not continuous 3 Paths [5 MHz and 10M], so total band is 15MHz
Ex) A1,A2,E

3. SPECIFICATIONS

3.1 System Capacity

Item		Specification	Remark
Freq.	Downlink	1930MHz ~ 1975MHz	45MHz
	Uplink	1850MHz ~ 1895MHz	45MHz
Port	Donor	CDMA Tx / Rx	DPX
	Server	CDMA Tx / Rx	DPX
Capacity		OMNI	
Channel Capacity		5MHz, 10MHz 15MHz	Only continuous
Output Power		+15dBm / Total	

3.2 System Specifications

Parameter		Specification	Remark
Gain	Range	52dB ~ 72dB	
	Adjust Step	±1.0dB	
	Adjust Accuracy	±0.5dB	
Propagation Delay		< 5.0us	
Spurious Emission	F0±885kHz	< -45dBc	Δmarker: 29dB
	F0±1.98MHz	< -55dBc	Δmarker: 39dB
Out Band Spurious Emission		< -13dBm	RBW: 30MHz
Flatness		< 3dB	
Return Loss / VSWR		< 1.5 : 1	
Uplink Noise Figure		< 5dB @ Max gain < 12dB @ Min gain	
Roll off	±1.0MHz	> 50dBc	Test frequency measured from band edge
Characteristic Impedance		50Ω	

3.3 Electrical and Environmental Specifications

Item	Specification	Remark
RF Connector	N-Type Female	Donor & Server ANT Port
AC Supply	Input : 100-240VAC 50/60Hz 1.2A Output : +12V / 3.5A	AC/DC Adapter
Out Dimension	9.45(L)*8.27(W)*4.92(H)	Unit : inch
Net Weight	< 5	kgs
Material	Module	AL6063S-T5
	Cabinet	AL5052P
Operation Temperature	-10°C ~ +50°C	Convection cooling
Humidity	5% ~ 95%	Non-condensing
Dust Resistance	TELCORDIA GR63-CORE	

3.4 Functions

Parameter	Specification
Gain Control	<ul style="list-style-type: none"> Adjustable DL and UL Gain range 52~72dB Display default Gain and current Gain function
AGS Auto Gain Setting	
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 Limit 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
Band Select	<ul style="list-style-type: none"> To select either 5MHz/10MHz/15MHz

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 Control	<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 10degree)
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. SETUP

4.1. Equipment Needed for GRS-1915D-SPR Repeater Setup

Parameter	Item	Quantity	Remark
Major Component	GRS-1915D-SPR	1 EA	Provided by GST
Additional Components	CD which contains User Manual V0.1 and Installation Guide V0.1	1 EA	Provided by GST
	Ethernet Cable 6.6ft	1 EA	
	AC/DC Adapter	1 EA	
	Ground Cable 6.6ft	1 EA	
	Anchor Bolt (¼" X ½")	4 EA	
	Hex Lag Screw (¼" X 1½")	4 EA	
Antenna	Donor ANT	1 EA	Not Included
	Server ANT	1 EA	
RF Cable	Antenna connection Cable	TBD	Not Included
Testing and Measuring Equipment	Spectrum Analyzer	1 EA	Not Included

4.1.1 Checkpoints before turning on the Repeater

- 1) **System Power Check:** DC electrical power to the repeater should be 12V, input electricity only after power verification.
- 2) **Input RF Signal Range:** Optimal input RSSI into the repeater is -57dBm ~ -37dBm for 1900MHz CDMA. User should verify input condition of Donor ANT.
- 3) **Isolation check between DONOR/SERVER ANT:** Isolation condition of this equipment is 79dBc (Gain+7dB) for CDMA. User should check its condition before installation.

4.1.2 System Setup

- 1) This equipment is basically wall mountable.
- 2) Installer will have to connect the power supply (after verifying the input power) and RF cable to the Repeater and then it will be ready to use.
- 3) For grounding, there is a grounding terminal in main power supply which will be plugged into power outlet. There is also a separate grounding terminal on the repeater which should be connected to the on-site grounding terminal to ensure proper grounding.
- 4) Mounting of repeater should be done by at least two technicians to ensure a safe and proper installation.

4.1.3 Open for Service

1) Check points before open:

a. Verification of system installation status:

- Electricity, In/Out antennas, cable connection, and equipment mount status.

b. Verification of system accessories:

- User should check all necessary accessories.

c. 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:

a. Check external LED

1) RUN: Green light ON (Off: all lights 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

Display LED level bar

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

Less than ~ -85dBm: LED 1bar

-84dBm~-70dBm: LED 2 bars

-69dBm~-54dBm: LED 3 bars

-53dBm~-41dBm: LED 4 bars

More than -40dBm: LED 5 bars

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

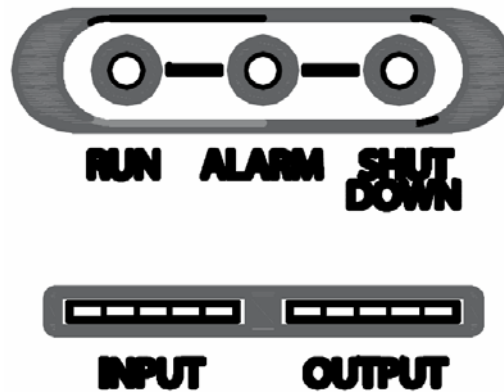
Less than ~ 7dBm: LED 1bar

+8dBm~+9dBm: LED 2bars

+10dBm~+11dBm: LED 3bars

+12dBm~+13dBm: LED 4bars

More than +14dBm: LED 5bars



<Pic.7> 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

4.2 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.

4.2.1 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. Troubleshooting should be performed by a trained technician.
- b. Parts that seem to be not used should not be disassembled.
- c. While troubleshooting, technician should use attenuator to check RF Signal output.

4.2.3 Simple Troubleshooting Method

- a. Verify LED Status, both on external LED's as well as internal module LED's
 - Normal operation: Green light On. Alarming: Red LED on
- b. Technician should check external and internal connectors to ensure that all connections are tightly secure. These connectors should be cleaned regularly.
- c. 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)

4.2.4 Troubleshooting Guide

Item	Check Point	Trouble shooting						
Note before system operation	* System Input power range	<table border="1" data-bbox="746 409 1548 577"> <thead> <tr> <th colspan="2" data-bbox="746 409 1548 463">Input Level</th> </tr> </thead> <tbody> <tr> <td data-bbox="746 463 1129 517">Downlink</td> <td data-bbox="1134 463 1548 517">-57dBm/Total ~ -37dBm/Total</td> </tr> <tr> <td data-bbox="746 517 1129 577">Uplink</td> <td data-bbox="1134 517 1548 577">-57dBm/Total ~ -37dBm/Total</td> </tr> </tbody> </table>	Input Level		Downlink	-57dBm/Total ~ -37dBm/Total	Uplink	-57dBm/Total ~ -37dBm/Total
Input Level								
Downlink	-57dBm/Total ~ -37dBm/Total							
Uplink	-57dBm/Total ~ -37dBm/Total							
Note before system operation	* System Gain	<table border="1" data-bbox="762 736 1532 904"> <thead> <tr> <th colspan="2" data-bbox="762 736 1532 790">Gain</th> </tr> </thead> <tbody> <tr> <td data-bbox="762 790 1182 844">Downlink</td> <td data-bbox="1187 790 1532 844">52 ~ 72dB</td> </tr> <tr> <td data-bbox="762 844 1182 904">Uplink</td> <td data-bbox="1187 844 1532 904">52 ~ 72dB</td> </tr> </tbody> </table>	Gain		Downlink	52 ~ 72dB	Uplink	52 ~ 72dB
Gain								
Downlink	52 ~ 72dB							
Uplink	52 ~ 72dB							
Note before system operation	* Output power at Server port	<table border="1" data-bbox="770 960 1524 1128"> <thead> <tr> <th colspan="2" data-bbox="770 960 1524 1014">Output power</th> </tr> </thead> <tbody> <tr> <td data-bbox="770 1014 1174 1068">Downlink</td> <td data-bbox="1179 1014 1524 1068">15dBm/Total</td> </tr> <tr> <td data-bbox="770 1068 1174 1128">Uplink</td> <td data-bbox="1179 1068 1524 1128">15dBm/Total</td> </tr> </tbody> </table>	Output power		Downlink	15dBm/Total	Uplink	15dBm/Total
Output power								
Downlink	15dBm/Total							
Uplink	15dBm/Total							
Check in Advance	* Check points before open for service	<ul style="list-style-type: none"> * Please check quantity of all accessories with specification before you set up. * Fit cable length in accordance with field condition. * Set up 1900MHz CDMA Donor antenna to secure Isolation (More than 79dBc) 						
Check after open	* Check points after open for service	<ul style="list-style-type: none"> * Check following status <ul style="list-style-type: none"> - 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 						

4.2.5 Troubleshooting Guide Related to RF

Symptom	Check Point	Troubleshooting
When repeater does not work properly	* Check Electricity Cord connection status	* Re-plug in Adapter cord
When in alarming	* DL over-input alarm	* Please Check following status - Proper maximum output power limit level - BTS input level (Spectrum Level) - Input RSSI value on Status Page - Downlink Attenuation level * Please reset Adapter upon completing Alarm troubleshooting
When in alarming	* DL over-output alarm	* Make sure output power is operating normally. * Reset Adapter upon completing Alarm troubleshooting.
When in alarming	* UL over-output alarm	* Please make sure output level is operating normally * Please reset Adapter upon completing Alarm troubleshooting
When in alarming	* Temperature alarm	* Check following status: - Setting level of maximum temperature limit - Temperature offset is normal or not. - Circumstances of temperature. * Reset Adapter upon completing Alarm troubleshooting
When in alarming	* RF OFF	* Verify that the HPA's are On. * 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.

When output power is no longer problem	<ul style="list-style-type: none"> * Technician should connect antenna with output port of repeater. * Please make sure all connectors are fastened 	<ul style="list-style-type: none"> * Reconnect the connector. * Change it if the connector is defective.
When output power is no longer problem	<ul style="list-style-type: none"> * Check the input level 	<ul style="list-style-type: none"> * Increase output power or check input change of BTS side.
When output power is no longer problem	<ul style="list-style-type: none"> * Check Gain of the unit 	<ul style="list-style-type: none"> * If the Gain is different from normal level, please contact A/S team.
When output power is no longer problem	<ul style="list-style-type: none"> * Cable connector loose. 	<ul style="list-style-type: none"> * 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	<ul style="list-style-type: none"> * Check input signal strength in the service area 	<ul style="list-style-type: none"> * Increase output power level of repeater by adjusting attenuation level.
In case of drop call or bad signal after set up	<ul style="list-style-type: none"> * If input signal strength is not a problem, please check delay of calling time. 	<ul style="list-style-type: none"> * Increase output level of Uplink signal, then set to optimal level.
In case of dropped call or bad signal after setup	<ul style="list-style-type: none"> * Check RSSI signal strength 	<ul style="list-style-type: none"> * 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.
Same as above	* Input level change or module overheating.	* Check input level from BTS side. * Check performance of each module. (Diagnosed by A/S team.)
Same as above	* Please check VSWR of the Cable is normal.	* Change to normal Cable.

4.2.6 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.
Link Fail	* CLI Connection, Cable status check	* Make sure 1:1 connection. * Follow instructions in the installation guide for this connection procedure.
Link Fail	* CLI connection Check by USB to Serial Cable	* Please verify Port number of PC communication. * Please check Cable connection status.