
10dBm~30dBm Series Pico Repeater User's Manual

J3 Seires

Preface

This User Manual provides installation, configuration, operation and maintenance guidance of the repeater. Specifications are also provided at the end of this User Manual in order to help users better understand the repeater. Please read the manual thoroughly and follow the instructions outlined in this manual to ensure a long life span and a trouble-free repeater unit.

Warranty

Lightning protection must be done for all outdoor antennas. Damage to power modules, as a result of lightning is not covered by the warranty.

Switching on the AC or DC power prior to connection of antenna cables is considered as an incorrect installation process and therefore faults arising thereafter are also not covered under the warranty.

This entire manual should be read and understood before operating or maintaining the repeater system. We assume no liability for customer's failure to comply with the precautions mentioned. This warranty will not cover such failures to comply.

Safety Information

Do not operate equipment in an explosive environment. Appropriate AC or DC power needs to be supplied to the repeater. To avoid power supply spark, please perform the grounding connection of the equipment. In order to avoid equipment damage or human injury by lightning, static electricity and other phenomenon of leakage electricity, we suggest all products must do the electric-discharge of the electrical grounding in setup process. Incorrect power settings can damage the repeater and may cause electrical related injury to the user.

Acknowledgment

Thank you for purchasing our repeaters. Strict quality control system procedures are implemented to ensure you a high quality product; with numerous cellular operators acknowledging the product to be a high performance, low interference, transparent and simple to operate and maintain.

This document is written to customer service personnel or the end users, who install, configure and commission the repeater system in a cellular network.

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1. Introduction

1.1 Appearance of the Repeater

The 10~30dBm Series Repeater is compact in size and light in weight. Hence, the installation of the Repeater is easy, simply just plug and play. With the control panel in front of the repeater, the repeater status can be seen during installation.



Figure 1 LED Indicators

1.2 General Installation Layout

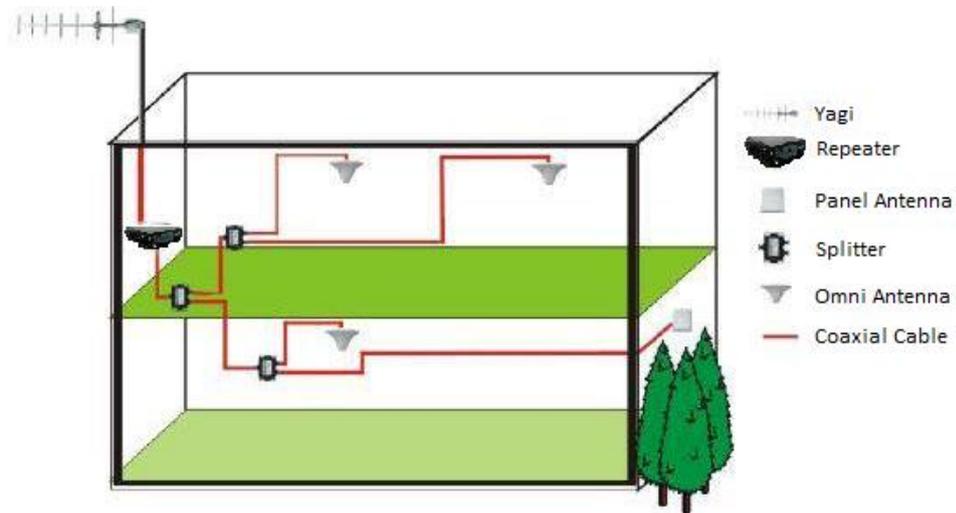


Figure 2 Profile

For indoor application, a typical installation layout of the Repeater is shown in Figure 2. The Yagi antenna is used as the donor antenna, and is connected to the repeater. Omni and panel antennas are being used as the service antennas.

The donor antenna is placed outside of the building, while the repeater is placed inside the building to extend radio coverage to the dead zones.

1.3 Advantages

◆ *Fast & easy Installation*

The installation of a repeater is easy and simple. With its plug and play design, installation simplicity, and operational user friendliness, these features appeal greatly to many operators for the purpose of indoor coverage or for temporary coverage during network optimization.

◆ *Smart Function*

Compare to the worldwide repeater brand, the 10~30dBm series repeater has a smart function which can be activated via the front panel. This function can prevent UL interference and self-oscillation caused by insufficient isolation between donor and service antennas, and also setup parameters to keep optimal condition automatically; the only thing for users is just activating this function by front panel.



Notify that the users can't adjust by manual setting when smart function is initiated.

◆ ***Auto Level Control***

The 25dB ALC is used to maintain steady output power even when the donor source signal fluctuates. Also when the ALC is activated, the ISOLATION LED indicator would be lighted in orange, which means the Isolation may not be enough. It also prevents UL interference and self-oscillation from insufficient isolation between donor and service antennas.

◆ ***Antenna isolation testing***

The 10~30dBm series product also has a repeater mounted antenna isolation detection function. Equipment installation completed boot automatically after the onset detection transceiver antenna isolation, if transceiver antenna isolation can not meet the installation requirements, the device will automatically reduce the gain to guarantee the equipment in normal working, not self-excitation vibration, guarantee not to interference protection of base station, repeater itself. At the same time alarm exhibit of lanterns bright red light alarm. Device LED gain display panel will display device is reduced after the equipment current gain state, which has the advantages of convenient construction, but also to protect the base station equipment, and does not generate interference.

2. Installation

2.1 Isolation

Isolation is an important concept for the repeater system, and it is one of the factors that affect the location of the donor antenna and server antenna. In the repeater system, the isolation must be enough, which means the donor antenna cannot be installed too close to the repeater. But what is isolation? The isolation is the propagation loss between the donor antenna and the service antenna which needs at least 15dB higher than the gain value of the repeater. Non-compliance to this criterion would result in poor signal quality or poor signal strength in the coverage area and the amplifier of the repeater may also be damaged.

$$\text{Isolation} \geq \text{Repeater Gain} + 15 \text{ dB}$$

2.1.1 Self-Oscillation Resistance

Self-oscillation is a phenomenon that would occur when the isolation for the repeater system is not enough. In other words, insufficient isolation between donor and server antennas would result in self-oscillation. Which means part of the signal that is being amplified by the repeater radiates back towards the donor antenna and got picked up by the donor antenna and went through the repeater amplification process again. Severe oscillation would result in poor signal quality and even damage the repeater. Self-oscillation will deteriorate the signals inside the coverage area and interfere towards the BTS.

2.1.2 The Isolation Value

The precise estimation of the isolation value can be obtained via a physical test measurement. This test measurement is done at the actual environment where the donor antenna and the server antenna are installed for a repeater system. The test measurement procedures are as follows:

1. Connect the signal generator (SG) to the donor antenna and transmit a signal with a frequency (For GSM900, uplink is 890~915MHz and downlink is 935~960MHz. Choose frequency 920MHz to do the test. For DCS1800, uplink is 1710~1785MHz and downlink is 1805~1880MHz. Choose frequency 1795MHz to do the test. For WCDMA2100, system uplink is 1920~1980MHz and downlink is 2110~2170MHz.

Choose frequency 1995MHz to do the test. In simple words, choose the idle frequency of the system to do the test) of certain power level from the SG.

2. Connect the spectrum analyzer (SA) to the service antenna and scan for the known frequency (The frequency used by the signal generator). Mark the received power level on the SA.
3. Subtract the power level received at the spectrum analyzer from the output power (OP) level of the signal generator to obtain the isolation value.

$$\text{Isolation (dB)} = \text{OP from the SG} - \text{Received Power on the SA}$$

Transmit a strong OP from the SG is recommended (excess of 20dBm) for easy recognition and detection by the SA.

2.2 Precautions and Preparation

1. Ensure the power applied to the repeater is within its working range. A separate circuit breaker is recommended.
2. Ensure the donor antenna is installed at the location where signal from the donor BTS (Node B) is good enough.
3. Ensure there's sufficient isolation between the donor and server antenna.
4. The repeater is designed for indoor application. Ensure the location of the repeater is dry and ventilative.
5. Ensure there are adequate resources to handle the weight of the repeater.

Tools Required for Installation

The suggested tools required for a successful installation are:

1. Signal Generator.....x1
2. Site Master.....x1
3. Laptop.....x1
4. Engineering Mobile.....x1
5. Multi-meter.....x1
6. Electrical Drill.....x1
7. Hammer.....x1
8. Spanner.....x1
9. Screwdriver.....x1
10. Waterproof Sealant.....x1

2.3 Donor Antenna Installation

The location of the donor antenna strongly influences the performance of the RxLev (RSCP for 3G) and RxQuality (Ec/No) of the intended coverage area.

The donor antenna is usually installed outside of the building, pointing towards the donor BTS (NodeB) for best reception of the receiving signal. When choosing the location for the donor antenna, there are 3 criteria need to be met:

For 2G Systems

1. *The Rxlev of the signal, at the input to the BTS port of the repeater is suggested to be in the range of -55dBm to -70dBm*
2. *The RxQuality index ranging from 0 to 2 is required.*

3. *The Rxlev of primary BCCH is at least 6dB higher than the BCCH of neighboring BTS sites.*

For 3G Systems

1. *The RSCP of the donor signal is suggested to be in the range of -60dBm to -70dBm.*
2. *$(E_c/N_0)_{AS_CPICH} \cong -7dB$; AS_CPICH is the Pilot Channel in Active Set (Serving Cell)*
3. *$(E_c/N_0)_{AS_CPICH} - (E_c/N_0)_{MS_CPICH} \geq 6dB$*

The donor antenna should be installed at least 3 meters above the ground but not higher than 7th floor of any building. If the donor antenna is located at a high floor, it would be difficult to obtain a dominant BTS signal from the nearby BTS.

A lightning rod is necessary when the donor antenna is located at a relative high position. An arrestor could be connected between repeater and donor antenna for better protection. Waterproofing of the antenna installation is also important, and it can be done with the following process:

1. *Use the donor antenna cable to form a half loop at the point of entry into the house so that rain water would drop off instead of flowing inside along the cable, and also also form a half loop before the antenna cable connects to the repeater as the waterproof measure.*
2. *Secure the cable entry point. Seal the donor antenna's connector and repeater's connector with a waterproof sealant.*

2.4 Server Antenna Installation

Find the right spot to install the service antenna so the required coverage can be fully covered by the repeater. However, the following three points should be considered while installing the service antenna.

1. Do not install the repeater near metal or obstacles that may influence its coverage performance.
2. It is suggested to install the repeater at least 2m above the floor for the best coverage.
3. The server antenna should not be installed too close to the donor antenna to avoid issues with isolation.

2.5 Repeater Installation

2.5.1 Installing the Repeater

- Use the hanger that comes with the repeater package, and place the hanger on the wall where repeater is going to be installed, use the hole on the hanger to secure the hanger on to the wall. (There are many different types of repeater with varied size, please measure it before drilling the hole in the wall.) Below is just a sample for one of the type.

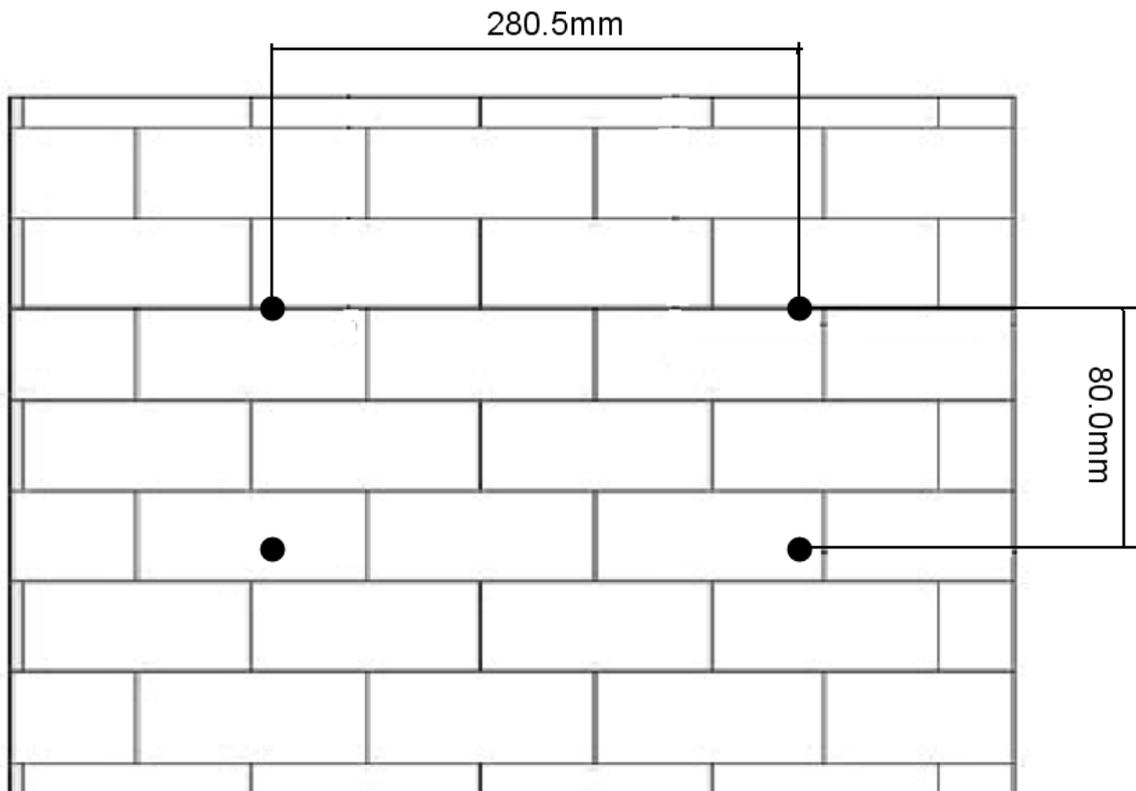
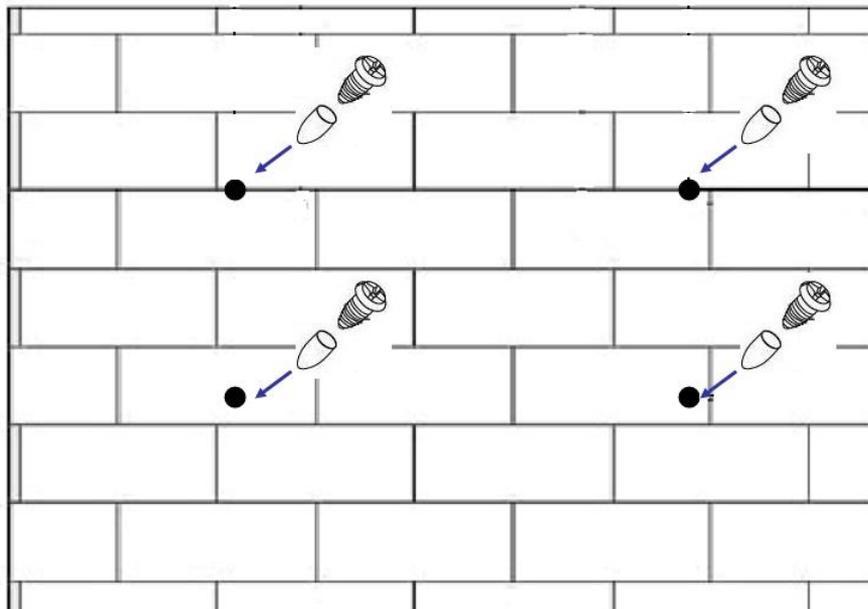
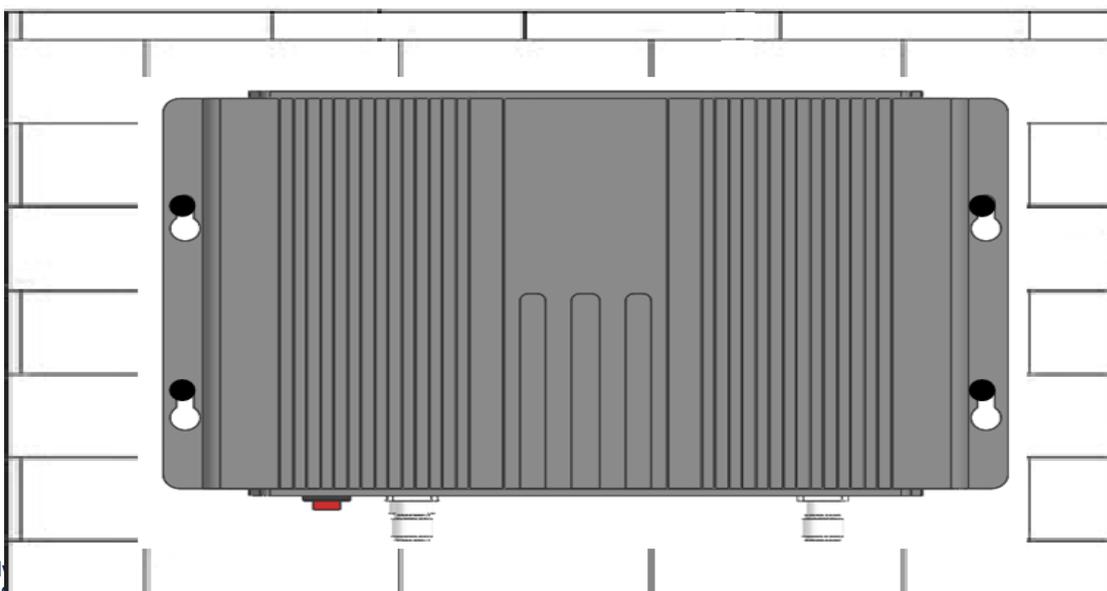


Figure 3 Mark the holes

- Fasten the holder on the wall by screws.



- Use the back of the repeater to hang on the Hanger and complete the installation.
- Connect the donor antenna cable to the **BTS** port of the repeater and the server antenna cable to the MS port of the repeater.
- A lightning arrester needs to be connected to the repeaters' BTS port when the donor antenna is installed in a high position. Grounding is essential for the arrester to work.
- Plug the power cable to the repeater first before plugging in the power cable to the mains socket. Use the power cable that comes with the package.



3. Commissioning

This chapter outlines the process to optimize the performance of the repeater. The gain setting, isolation concept, and downlink output power.

3.1 Downlink Output Power

The downlink output power of the repeater mainly depends on the input signal power and the repeater gain. The gain is the amplifying indicator for both uplink and downlink in the repeater, and it can be adjusted. Hence, the output power of the repeater can be estimated.

$$\text{Signal Input Power} + \text{DL Gain} = \text{DL Output Power}$$

For any given input signal power, its corresponding output is increased by the gain of the repeater. To ensure the maximum output power, the following condition should be met.

$$\text{DL Gain} = \text{Min} [(\text{DL Output Power} - \text{Input Power}), \text{Max. DL Gain}]$$

If the input signal amplified by the gain set exceeds the rated set output limit, the ALC (Automatic Level Control) will be triggered. The ALC ensures that the maximum output power of repeater is maintained at a certain point and does not overdrive the repeaters amplification circuit.

3.2 Repeater Configuration

The 10~30dBm series repeaters are designed with plug and play ability. The configuration for these repeaters is not necessary, simply just switch the Smart function on, and the repeater would auto adjust its gains according to the environment condition.

3.2.1 Start-up the Repeater

Note: It is suggested that only when isolation is 15dB higher than repeater's gain then the repeater can be switched on.

- Make sure power supply cable is connected to the repeater properly, and the voltage is within repeater's voltage working range: 110/220V \pm 20%
- Plug the power cord into the proper socket. Once the repeater is on, it requires

several seconds for initialization.

When Repeater is close to the BTS, hence there is a high input power at the donor antenna. Even with the smart ability of the auto gain adjustment, it is still recommended to add an RF attenuator at repeater's BTS port to avoid interference to the BTS.

3.2.2 Repeater Settings

After switching on the repeater, the repeater would automatically adjust both uplink and downlink gain value based on the repeater installation environment if the smart function is turned on. The repeater can also be adjusted manually via the front control panel.

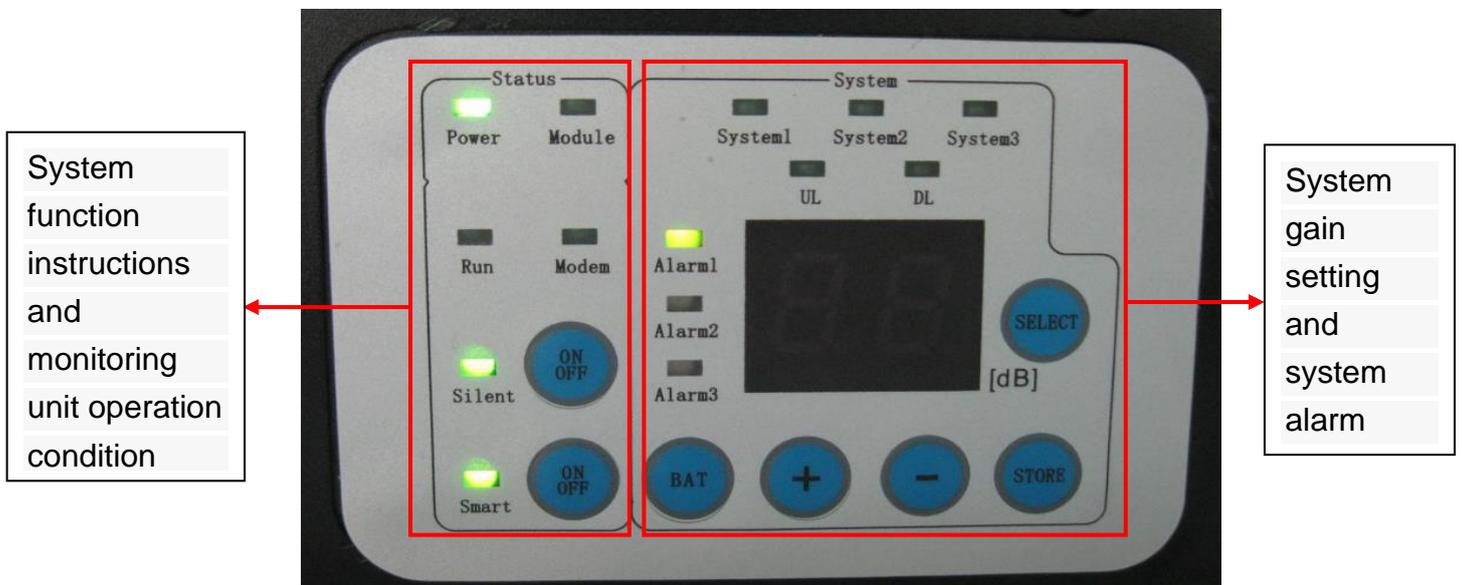
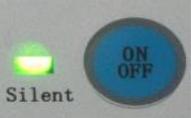


Figure 4 Front panel of the repeater

Buttons Functions

The functions of the buttons on the front panel are listed in the table below.

Button	Function	Explanations
	Select UL or DL	Press the button to select between either uplink (UL) or downlink (DL) for the band, the indicator represents either UL or DL you are at and intending to operate.

	<p>Store the Changes</p>	<p>Press the button to confirm the selection, press again and the LED keeps blinking, means now in the mode of setting.</p> <p>After setting the attenuation, press the store button again and the value would be stored into the repeater, and the LED would stop blinking and display the value, the process is then complete.</p>
	<p>Increase or decrease the Gain</p>	<p>Press the button increase or decrease the attenuation by 1dB/step, and the LED monitor would display the current gain value; press the store button to complete the settings.</p>
	<p>Activate or Deactivate the Smart function</p>	<p>Press the button to activate the smart, intelligent indicator will be lit, and according to the memory button effect. If the light goes out that without this function</p>
	<p>Activates or deactivates the uplink sleep function</p>	<p>Press the button to activate the Silent Mode, Silent indicator will on, and according to the memory button effect. If the light goes out that without this function (Optional).</p>
	<p>Battery backup switch button</p>	<p>Equipment without AC power supply, equipment monitoring unit battery backup started working, press this button to manually close the battery backup power</p>

The LED monitor

The LED monitor is composed by 2 digits which displays the current gain value, when LED is blinking, the system is in the mode of setting the attenuation.

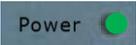


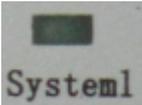
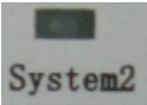
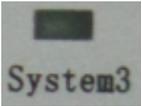
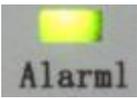
When LED shows 88 and keeps blinking, the system is in initializing status (it takes 12 seconds to complete the initialization)

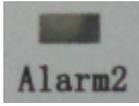
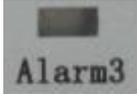
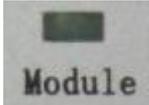
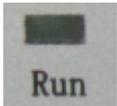


The Indicators

There are four kinds of indicators on the front panel, and they are listed:

Indicator	Status
Power Indicator 	 Indicates that the power supply is normal.
UL/DL Indicator 	This UL/DL Indicator indicates either the LED monitor is displaying the UL band or the DL band.
Smart Function Indicator 	 indicates the Smart Function is OFF
	 indicates the Smart Function is ON
Silent Function	This indicator lights, uplink sleep function.

<p>Indicator</p> 	<p>This indicator is off, said uplink no sleep function</p>
<p>System1 Indicator</p> 	<p>When the indicator is green, That is the first system operation. (If it is a single system device, only system 1 indicator lights; If multiple system, system 1 standards for the lowest frequency of the system indicator)</p>
<p>System2 Indicator</p> 	<p>When the indicator is green, it shows the second operation system. If it is a single system equipment, the bright lights can not choose. If the system is double device, the light that selection for double system frequency is highest the system operation. If 3 system equipment, the lights indicate selection 3 system inside the system second high frequency operation)</p>
<p>System3 Indicator</p> 	<p>When the indicator is green, it is one of the third operation system (If it is a single system equipment, the light is not bright, not be selected. If the system is double equipment, this light is not bright, also can not choose. If three system equipment, the light is said to select one of third systems, the system for three system equipment inside the highest frequency of the system.)</p>
<p>Alarm1 Indicator</p> 	<p>When the indicator is green, it is in normal status. When the indicator is red, it means system 1 the output power is out of AGC range.</p>
<p>Alarm2 Indicator</p>	<p>When the indicator is green, it is in normal status. When the indicator is red, it means the output power of system 2 is</p>

	<p>out of AGC range. (If it is a single system equipment, the light is not bright. If the system is double equipment this light red is the highest frequency of the system with alarm. If the lamp is three system equipment red indicates the frequency of second tall the system with alarm)</p>
<p>Alarm3 Indicator</p> 	<p>When the indicator is green, it is in normal status.</p> <p>When the indicator is red, it means the output power of system3 is out of AGC range. (If it is a single system equipment, the light is not bright. If the system is double equipment, this light is not bright. If three system equipment this light red is the frequency of the highest system with alarm)</p>
<p>Module Indicator</p> 	<p>With remote monitoring equipment with the indicating lamp, the lamp Green said monitoring module and RF module communication is normal, if the red said monitoring module and RF module communication is not normal</p>
<p>Run Indicator</p> 	<p>With remote monitoring equipment with the indicating lamp, the lamp Green said monitoring module in normal operation</p>
<p>Modem Indicator</p> 	<p>With remote monitoring equipment with the indicating lamp, the lamp Green said monitoring module in the modem operating normally</p>

An Example of Setting

(To set attenuation for the uplink)

Step 1 : Press **SELECT** till the indicator stops at uplink.

Step 2 : Press **STORE** and LED monitor starts blinking.

Step 3 : Press “+”, “-” to an intended gain value.

Step 4 : Press **STORE** to set the value and the LED stop blinking and showing the gain value at the moment, the process is done.

4. Maintenance

4.1 Status, Alarms possible Solutions

The following table lists the meaning of the Alarm that is on the front panel and the possible solution correct it

ALARM LED	Cause	Solution
Alarm -1 Green Alarm -2 Green	AGC active	Work normally
Alarm -1 Red Alarm -2 Red	AGC Warning	<ol style="list-style-type: none"> 1. Decrease gain value 2. Increase the distance between donor and server antenna. If 1 and 2 can't work, please return to seller for repairing.

The following table lists the alarms may appear on monitor screen when using OMT tool, please process the alarm according to the solution indication.(Optional for selective type of repeater)

Alarm	Cause	Solution
DL AGC ALARM	<ol style="list-style-type: none"> 1. High input level at the BTS port of the repeater, AGC is active and more than 30dB attenuation has been applied. 2. An isolation condition may also have occurred. 	<ol style="list-style-type: none"> 1. Decrease the gain by adjusting the manual attenuation accordingly to clear the alarm. 2. Increase the separation distance of the donor and service antenna.
PA Failure	The power of PA is not stable	<ol style="list-style-type: none"> 1. Check whether the input DC power is stable. If the DC is not stable, an UPS with square wave is recommended.

		<ol style="list-style-type: none"> Restart this repeater. If input DC power is correct and alarm still exists, return the unit to place of purchase for repair.
<p>Power Module Alarm</p>	<ol style="list-style-type: none"> Input AC power is not stable. Repeater's power supply module has been damaged 	<ol style="list-style-type: none"> Check whether the input AC power is stable, it should be within 110/220V ± 20%. If the AC is not stable, an UPS with square wave is recommended. In the condition input AC power is correct and alarm still exists, return the unit to place of purchase for repair.
<p>PLL Unlock</p>	<p>The PLL circuit cannot lock onto the programmed frequencies. The operating frequencies of repeater may have been accidentally shifted from the OMT software.</p>	<ol style="list-style-type: none"> Execute the Default Setting through OMS. Refer to OMT User's Manual for more detail. If the alarm cannot be solved, it means repeater has been damaged. Please return the unit to place of purchase for repair.

4.2 Troubleshooting

This table offers the fundamental guidelines for troubleshooting advice for the 10~30dBm series. Before sending the repeater back to the factory for service, please check the troubleshooting measures listed below first.

Status	Possible Reason	Solution
No amplification after repeater installed.	<ol style="list-style-type: none"> 1. No AC power. 2. Donor Signal is poor 	<ol style="list-style-type: none"> 1. Check if the power cord is plugged into the repeater and the socket properly. 2. Ensure signal strength and signal quality at the donor antenna is good enough.
Coverage decreased after certain period.	<ol style="list-style-type: none"> 1. Donor signal strength decreased. 2. The quality of feeder cable system decreased due to oxidization especially in harsh conditions, or cable damage by mice or insects. 3. Change of indoor structure or upholstery. 	<ol style="list-style-type: none"> 1. Check the signal strength at donor antenna. Re-locate the Donor Antenna to solve problem. 2. Check the VSWR of the feeder cable system to find out the faulty point and then replace it 3. Reconsider the position of antennas and the layout of cables if such change occurs.
Bad Rx Quality inside the coverage area	<ol style="list-style-type: none"> 1. Self-oscillation occurred severely. ISOLATION LED may be lighted in red. 2. Poor Rx Quality from donor source 	<ol style="list-style-type: none"> 1. Check the isolation between donor and service antenna. 2. Adjust the donor antenna direction or relocate the donor antenna.
Call drop frequently	<ol style="list-style-type: none"> 1. Self-oscillation occurred. 2. Signal handover frequently. 3. Donor BTS problem 	<ol style="list-style-type: none"> 1. Check the isolation between donor and service antenna. Turn on the Intelligent Mode 2. Make sure the Rx Lev for primary BCCH \geq than 1st neighbor BCCH 6dB 3. Consult the operator's RF engineer.

4.3 Replacement

The procedures of repeater replacement are:

- Disconnect the power cord.
- Disconnect the donor antenna and the service antenna cables.
- Lift the repeater off the wall

If another repeater is not replaced immediately, protect the open-ended cables due to water hazard.

5. Appendix

5.1 Abbreviations

AGC	Automatic Gain Control
BCCH	Broadcast Control Channel
BTS	Base Transceiver Station
DL	Downlink
Ec/No	Signal Quality for 3G
E-GSM	Extended GSM
GSM	Global System for Mobile communication
LED	Light Emitting Diode
LNA	Low noise Amplifier
MS	Mobile Station
Min	Minimum
OMT	Operation & Maintenance Terminal
OP	Output power
PA	Power Amplifier
PLL	Phase Locked Loop
RF	Radio Frequency
RSCP	Signal Strength for 3G
RSSI	Receive Signal Strength Indication
RxQ	Receive signal Quality for 2G
RxLev	Receive signal Level for 2G
SA	Spectrum Analyzer
SG	Signal Generator
SIM	Subscriber Identity Module
TEMP	Temperature
UL	Uplink
VSWR	Voltage Standard Wave Ratio