



JD60-7-TB-US
Wireless Cellular Repeater
User's Manual



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Preface

This user's manual describes the installation, commissioning and maintenance of JD60-7-TB-US Wireless Cellular Repeater.






Please do read the user manual carefully before installing and maintaining the triple band repeater.

The information in this manual is subject to change without prior notice

Opinions are welcomed about the manual improvement.

1. Safety Warnings

Users must follow the below principles:

-  Repeater should follow system requirement of communication equipment, assure good groundings and lightning protection.
-  The power supply voltage of repeater should meet the standards of security requirement; any operation shall be carried out only after cutting off power in advance. Only the professional is authorized for the operation.
-  Do not dismantle machine, maintain or displace accessories by yourself, because in this way, the equipment may be damaged or even get an electric shock.
-  Do not open the repeater; touch the module of repeater, or to open the cover of module to touch the electronic component, the components will be damaged due to electrostatic.
-  Please keep away from heating-equipment, because the repeater will dissipate heat during operation. And do not cover repeater with anything that influences heat-dissipation.

2. Why repeater

2.1. Reason 1

- 1) Blind or weak signal areas are formed if the buildings are too far away from BTS, or the buildings themselves shield or absorb the signals.
- 2) There are too many complicated signals in the higher part of the buildings, therefore ping-pong switching effect has been formed and the signals fluctuate a lot, there are annoying noises during phone calls and there are dropped phone calls accordingly.
- 3) Elevators and basements are well-known blind areas.
- 4) Downtown areas of the cities, congested with many high-rise buildings are usually the weak or blind areas.

2.2. Reason 2

The remote villages, mountains, hills, valleys, etc. are mostly scarcely populated areas with quite few mobile users, so the main target is to send coverage to these areas, and it will not be cost effect to install a BTS tower, therefore a repeater is a quite good option.

Can we not use mobile phones? The answer is definitely NO. But it might be much more miserable that the communication can't be achieved due to no or weak signals though there is a mobile phone.

Will your customers stay comfortable when there is no smooth communication in your shops or restaurants?

Will your business be influenced if your clients couldn't call you through due to weak signals in offices?

Will your life be influenced if your mobile is always "out of service" at home when your friends call you?

How to solve the problems?

Best Solution:

Plug & play: Purchase a set of repeater solution and install it at your home, offices, and plug on the power and immediately you would be able to enjoy the full bar and high quality signals!

Question: Will repeater increase the RF radiation?

A: No, it will decrease instead.

As it can be searched easily through internet, the tower would “order” the mobile phone to increase its output power, in order to ensure successful connection when the mobile signal bar is few, there will be stronger mobile output power level when the mobile signal bar is less and the strongest one can reach 2W (GSM); moreover, the mobile phone is usually as near as less than 5cm to human body when people are in phone calls. Not only it influences badly the human bodies, but also run out of the battery power much more quickly; usually the mobile phone gets hot in such status.

The maximum power level of JD60-7-TB-US is 0.01~0.1W, and it decreases to be maximum 0.003W when reaching server antenna. And since the server antenna is installed over the ceiling or onto the wall, there are usually more than 3 meter away from the human body, 3meter away means at least 40dB propagation loss, or 10000 times less, 0.0000003W, therefore it is too weak to influence human bodies though it is still a very good signal for mobile phones.

And when a repeater is installed, it improves the mobile signals in the coverage, and the successful phone call can be connected easily with a much less power level of the mobile phone, thus it will reduce tremendously the RF radiation.

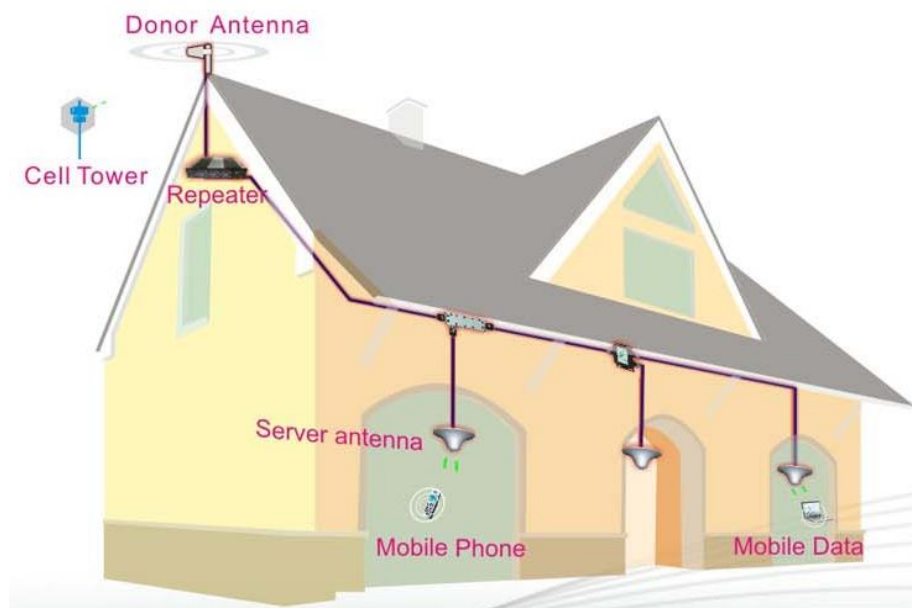
3. Introduction

This JD60-7-TB-US full duplex mobile communications repeater from JDTECK INC is the perfect solution for providing a wireless improvement in the cellular reception of a home, office, restaurant, VIP Room, apartment, building or shopping mall, in the quickest time possible. One repeater covers 300 to 600 square meters. It is designed to improve the call quality of an area by receiving, amplifying and re-transmitting signals of the base station into a specified area via the server antenna of the repeater.

This repeater has Manual Gain Control (MGC) feature that enables engineers to reduce the gain of the repeater manually if oscillation is detected or too strong input power level during installation, this will help to get the best coverage effect without any interference back to mobile network.

And to maintain safe and specific output signal levels during the repeater's operation, this repeater has a built-in signal oscillation detection circuit to adjust the gain automatically so as to avoid interference to the cellular network, also it gets color changing LED's indicate its environmental status: the Alarm LED's located on the front of the unit (Alarm Low & Alarm High) will change color from green to orange or red, (depending on the input power level) if the system detects signal oscillation in either band or, if the input signal is beyond a safe limit.

Below diagram shows how simple and fast repeater system is installed and works effectively: one wide band directional antenna, as a donor antenna, has been installed at the top of the roof to pick up good mobile signals from outside, and send through a 5D-FB cable to a JD60-7-TB-US repeater to be amplified significantly, then the output signals are divided into three signals by a 8dB coupler and a 2way splitter, sent to three indoor omni antennas and finally transmitted into the coverage area. Very clear phone call or high speed mobile data services are immediately effected within the area.



4. System Characteristics

4.1. Features:

- CE Certified
- Streamline shape
- Excellent out of band rejection.
- Wide power supply range and low power consumption
- High-integration (One board to contain low-noise amplifier, band pass filter, power amplifier module, both uplink and downlink one for all)
- Wide band repeater to support all signals within three systems.
- Manual gain control provides a variety of applications.
- MTBF>50000h, low failure rate

4.2. Appearance of the triple band repeaters



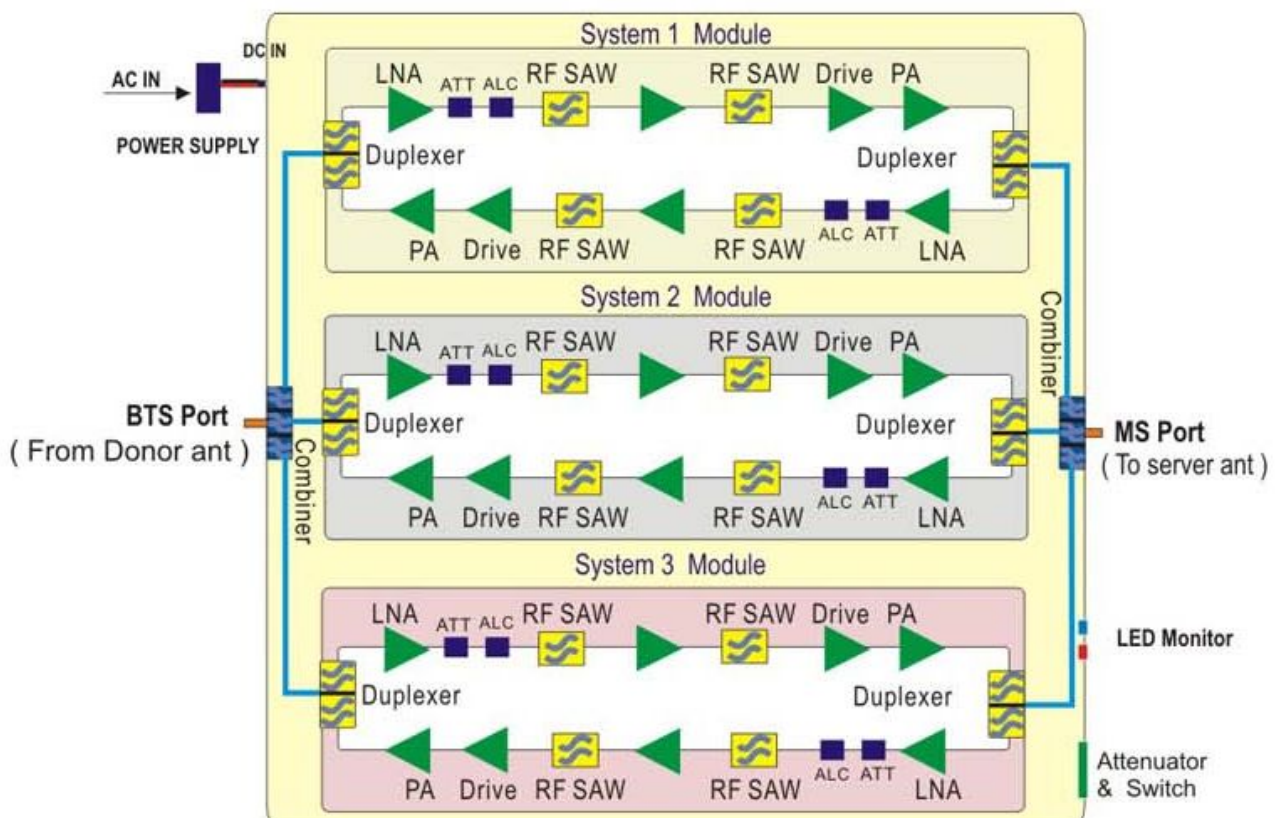
Figure 1 shows the front view (colors may differ from real products).



Figure 2 Front view of repeater

5. Block diagram and work principle

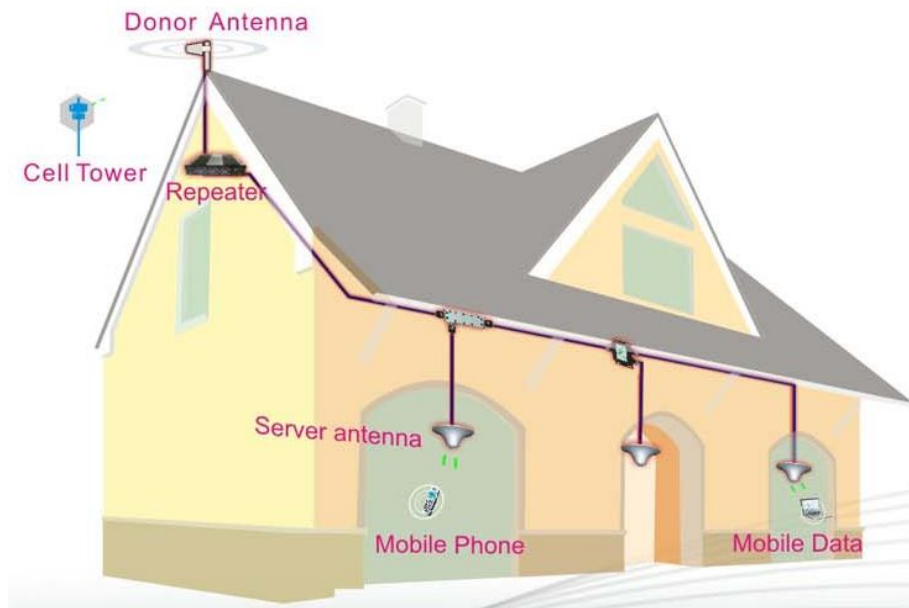
The triple band repeater is a bi-directional repeater that consists of three mobile systems, the three systems are combined together by a combiner, and each system gets their independent uplink and downlink power amplifying system, and each link consists of duplexer, LNA, Filter and PA. The triple band repeater downlink receives, amplifiers and retransmits the signals over the air from BTS to the coverage area; at the same time, the uplink receives, amplifies and retransmits the signals of MS back to BRS, therefore a successful communication is accomplished.



Modules in the system diagram:

- **Combiner:** a combiner helps to combine signals of three mobile systems together, and at the same time to keep independence of each system and avoid their interference of each other.
- **Duplexer:** The main purpose of duplexer is to combine downlink and uplink to share the same antennas, the duplexer is composed of one pair of band pass filter that can not only reject the spurious interference, but also increase the isolation of Uplink and Downlink
- **LNA:** LNA is the first active sub system of the repeater, of which low noise and high linearity is requested under strong input signals. LNA is the major sub system that determines the noise figure of the repeater system.
- **PA:** The power amplifier sub system helps the repeater to reach its targeted output power, linearity of which decides the linearity of the repeater
- **Power supply** is to supply power electricity to all repeater's modules

6. The repeater system



- **Donor Antenna:**

- 5~7dbi outdoor panel or 7~9dBi wide band Yagi are recommended as donor antenna.
- Function: Pick up donor signals from the BTS and send to the repeater by cable; the received signals' power level and quality influence a lot on the coverage effect. Donor antenna also transmit the uplink signals from the repeater to BTS.

- **Server Antenna:**

- 2~3dBi indoor omni ceiling or 5~7dBi indoor panel are recommended.
- Omni antenna (Indoor ceiling omni antenna or whip antenna), suitable to installed in the center and radiate all direction; It is better to use a directional panel antenna or Yagi when the coverage shape is long and narrow (corridors, long row of houses in two sides, tunnels or elevators or rural open space)

- **Cables:** LMR 300 or 400, 5D or 8D –FB coax cables are recommended.

- **Splitters or couplers:** when the building structure is too complicated or there is big loss due to thick walls, etc., splitters or couplers shall be used so that more antennas can be installed in more areas to distribute the signals to each corner of the coverage area.

- **Power Box** including electricity meter, air switch and groundings, some sites might need surge arrestors.

- **Note:** because this triple band repeater is a broadband repeater, so band in requirements contain antenna, splitter and coupler in this system is 880-960MHz and 1710-2170MHz.

- 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.

- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- This equipment complies with FCC radiation exposure limits set forth for uncontrolled environment .This equipment should be installed and operated with minimum distance 400cm between the radiator& your body.

7. The triple band repeater Main technical specification

7.1. Mechanical specification

SN	Item	specification
1	Dimensions	250x 330 x 53 mm
2	Weight	4.5kg
3	Environment Conditions	IP40
4	Cooling mode	Nature cooling

7.2. Environment Conditions

SN	Item	specification
1	Operating Temperature	-25°C to +55°C
2	Storage Temperature	-40°C to +80°C
3	Humidity	5% to 85%
4	Air Pressure	86 kPa to 106 kPa

7.3.RF technical specification

NO:

Uplink

Test Project	Test Condition		Index Require
Frequency Range	824~849MHz (GSM/CDMA)		
	1850~1910MHz (PCS/CDMA)		
	1710~1755MHz (AWS)		
Band Width	GSM/CDMA: 25MHz, PCS/CDMA: 60MHz, AWS: 45MHz		
Max .Gain	Testing in working band(without control)		63±1dB
ALC Output	Center frequency (deep control 10dB)		10±10dBm
ALC	Center frequency(deep control 1~20dB)		$ \Delta \leq 2.0\text{dB}$
AGC	Center frequency, deep control 15~20dB(red)		Shut off
Gain Flatness	Testing in working band	CDMA	$\leq 8\text{dB}$
		GSM/PCS	$\leq 10\text{dB}$
		AWS	$\leq 6\text{dB}$
Gain control error	Center frequency	1~10dB, 1dB step	$ \Delta \leq 1.0\text{dB}$
		11~20dB, 1dB step	$ \Delta \leq 1.5\text{dB}$
		21~30dB, 1dB step	$ \Delta \leq 2.0\text{dB}$
Intermodulation	Center frequency, double audio signal interval 600KHz (deep control 10dB)	9KHz~1GHz	$\leq -36\text{dBm}$
		1GHz~12.75GHz	$\leq -30\text{dBm}$
Spurious Emission Output inter-modulation	9KHz~1GHz		$\leq -36\text{dBm}$
	1GHz~12.75GHz		$\leq -30\text{dBm}$
Input V.S.W.R	Testing in working band		≤ 3.0
Output V.S.W.R	Testing in working band		≤ 3.0
Group Delay	Testing in working band		$\leq 0.5\mu\text{s}$
Noise Figure	Testing in working band(Max gain)		$\leq 8\text{dB}$

Downlink

Test Project	Test Condition		Index Require
Frequency Range	869~894MHz (GSM/CDMA)		
	1930~1990MHz (PCS/CDMA)		
	2110~2155MHz (AWS)		

Band Width	GSM/CDMA: 25MHz, PCS/CDMA: 60MHz, AWS: 45MHz		
Max .Gain	Testing in working band(without control)		67±1dB
ALC Output	Center frequency (deep control 10dB)		15±10dBm
ALC	Center frequency, deep control 1~20dB		$ \Delta \leq 2.0\text{dB}$
ALC	Center frequency	deep control 1~5dB	Orange
AGC		deep control 15~20dB	red and shut off
Gain Flatness	Testing in working band	CDMA	$\leq 8\text{dB}$
		GSM/PCS	$\leq 10\text{dB}$
		AWS	$\leq 6\text{dB}$
Gain control error	Center frequency	1~10dB,1dB step	$ \Delta \leq 1.0\text{dB}$
		11~20dB,1dB step	$ \Delta \leq 1.5\text{dB}$
		21~30dB,1dB step	$ \Delta \leq 2.0\text{dB}$
Intermodulation	Center frequency, double audio signal interval 600KHz (deep control 10dB)	9KHz~1GHz	$\leq -36\text{dBm}$
		1GHz~12.75GHz	$\leq -30\text{dBm}$
Spurious Emission Output inter-modulation	9KHz~1GHz		$\leq -36\text{dBm}$
	1GHz~12.75GHz		$\leq -30\text{dBm}$
Input V.S.W.R	Testing in working band		≤ 3.0
Output V.S.W.R	Testing in working band		≤ 3.0
Group Delay	Testing in working band		$\leq 0.5\mu\text{s}$
Noise Figure	Testing in working band(Max gain)		$\leq 8\text{dB}$

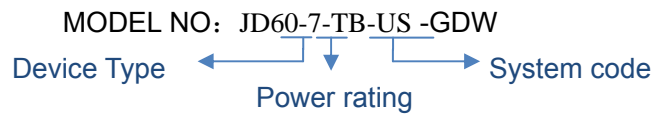
Remark:

- 1,Power supply 12V/5A
- 2,Shut off function, about 5 second

7.4. Requirements for adapters:

SN	Item	Minimum	Typical value	Maximum
1	Input Voltage Range	100 V	220 V	264 V
2	Output Voltage Range	47 Hz	50Hz	63 Hz
3	Total Power Consumption	50W		

7.5. Repeater Model List



Device Type	F: Wide band consumer repeater
Power rating	10: downlink output power is 10dBm 15: downlink output power is 15dBm 20: downlink output power is 20dBm
System code	C: GSM850 or CDMA800
	P: PCS or CDMA1900
	A: WCDMA1710-2155
	CP: dual band C (GSM850 or CDMA800) & P (PCS or CDMA1900)
	CPA: Triple band C (GSM850 or CDMA800) & P(PCS or CDMA1900) & A (WCDMA1710-2155)

8. Installation

The triple band repeater micro repeater should be used to cover the area indoor and the humidity and temperature of working can affect the reliability of repeater. So, temperature, humidity, dust, interference, power, space requirements and other factors should be considered during installation of repeater.

8.4. Installation Location Requirement

- 1) It is appreciated that the repeater is installed in a cool, dry and ventilated room without erosive gas and smoke and without leakage on its proof.
- 2) Besides above, a cool and ventilated wall of which sun-proof and waterproof is expected.
- 3) Besides above, common wall, tower or high pole is ok.
- 4) Installation height should be easy for RF cable wiring, heat dissipation, security and maintenance.
- 5) Have a set of independent and stable power supply.
- 6) Have lightning conductor in the building, tower or high pole with enough strength or stability.

8.5. Power requirement

Generally it is AC power supply, and the requirement of AC is 100~264VAC/50±5Hz

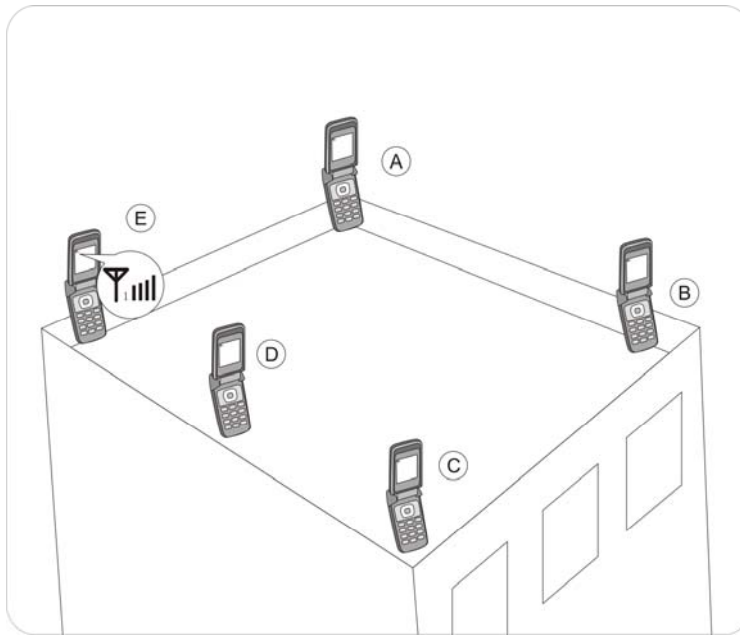
8.6. Installation tools and accessory

No.	Name	Specification	Quantity	Remark
1	Plastic Expansion Bolt	M5*24	6	Standard accessories
2	Tapping screw	M3*27	4	Standard accessories
3	reciprocating drill		1	Engineering-owned, punch the wall
4	Shot bit	M3	1	Engineering-owned, punch the wall

8.7. Installation of donor antenna

The repeater's main function is to improve weak RF signals to an area. A simple formula: Input power+ Gain= Output power. The signal strength from the outdoor antenna directly affects the efficiency of the indoor coverage. It is very important to choose the location of the outdoor antenna carefully. With this in mind, it is not

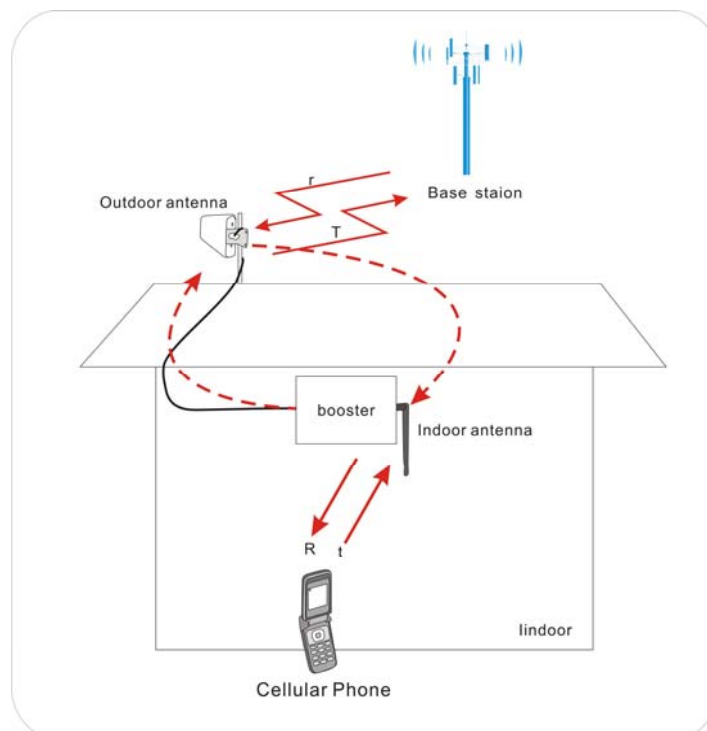
recommended the donor antenna to be installed in an attic.



- Testing the signal strength received from donor antenna mounted in site by mobile phone:
 - Please select the top of the building to install the donor antenna if the total floors are less than 7, and must select a place like balcony or platform lower than 7th floor for the donor antenna if the buildings are over 7 floors.
 - The mobile phone shall display full bar signals in location where the donor antenna is installed
 - The phone calls or data transmission are smooth and stable by 3 times testing in location where the donor antenna is to be installed
 - As shown from the above illustration, testing the signals from A to E, and select a best place that displays full bar signals to install the donor antenna.
- Selection the installation direction of donor antenna
 - The donor antenna shall point to the direction of the tower, and it would be much better to keep line of sight.
 - Please select the opposite directions for donor antenna and server antenna. If donor and server antennas have to be installed in the same direction, please install them only after the signal quality is tested and the self-oscillation is avoided. If the directional antenna is selected, the main directional angle should point to the tower antenna.
 - If the performance is poor due to weak signals or poor phone call quality after installation, please adjust the direction of donor antenna or change its installation position in order to obtain the best calling effect.
- Donor antenna installation ---Notes:
 - Do not install the donor antenna during the rainy day with lightning.
 - Please follow the instructions to install the donor antenna.
 - It is a must that the waterproof shall be done to connectors of donor antenna and feeder lines.
 - In order to avoid interference, please note that the donor antenna should be far away from the

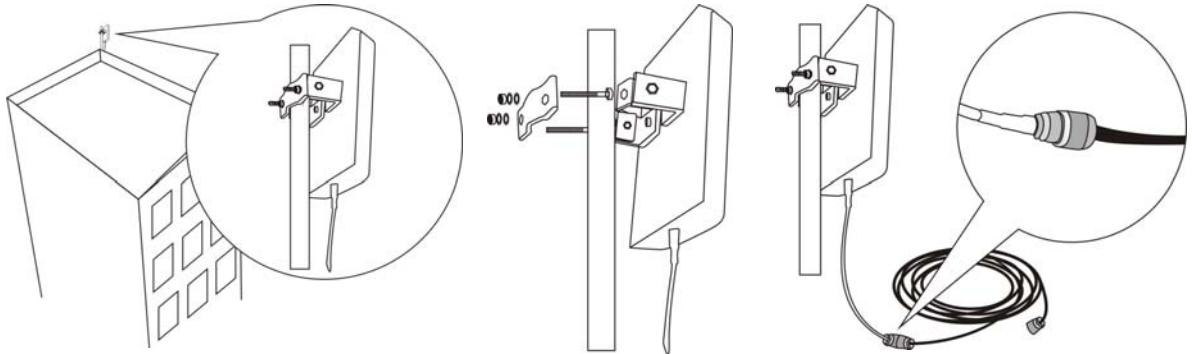
following objects.

- ◇ Metal
 - ◇ High-voltage line
 - ◇ RF antenna
 - ◇ High-voltage transformer
- Repeater is a two-way signal amplifier. So proper isolation between donor antenna and server antenna is necessary in order to avoid self-oscillation. About the definition for self-oscillation, take MIC and loudspeaker for example; if it is too close for each other, it could make big noise. So the repeater can run smoothly if the isolation between donor antenna and server antenna is 15 dB higher than the gain of booster. For example, if the booster gain is 60 dB, then the isolation between donor antenna and server antenna should be 75 decibel.
 - The minimum distance between donor antenna and server antenna is 10 meters, again the direction of donor and server antennas shall be opposite.
- As shown in the below illustration, the booster amplifies the signal R and signal T from the tower at the same time. If the distance between donor antenna and server antenna is less than the required distance, then the amplified signal R (T) will back to server antenna (donor antenna). So it will lead to self-oscillation and reduce the coverage area, also the bad calling quality could happen at the same time.

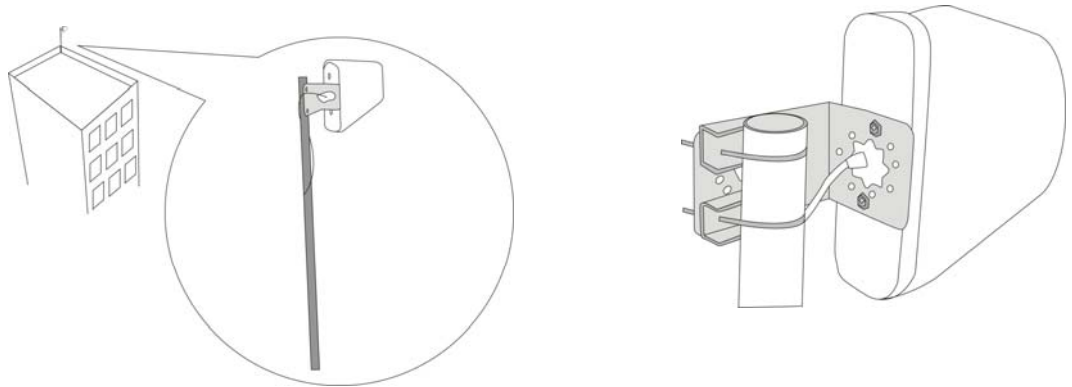


If isolation can't be achieved by the limited distance, the roof of the building or other barriers can be used to increase isolation.

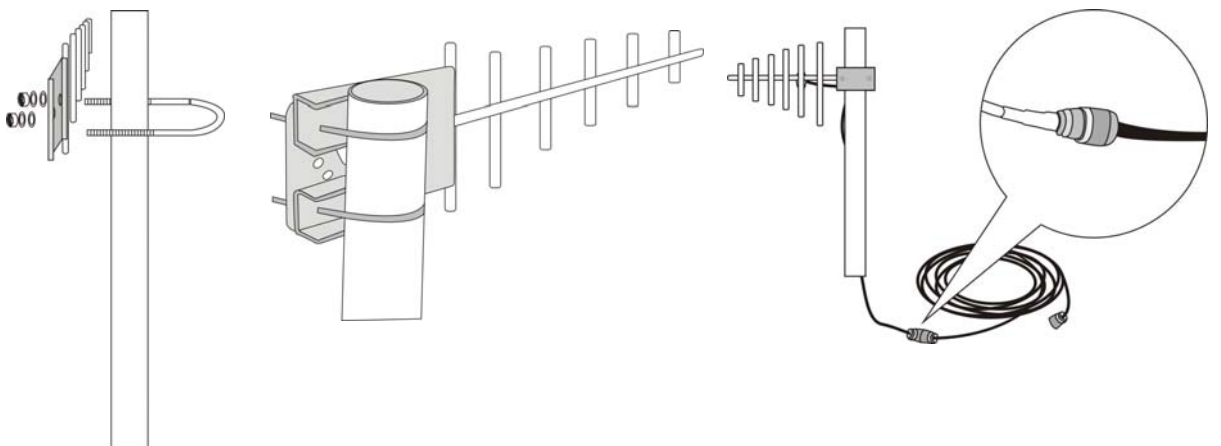
■ Installation of panel antenna as donor antenna



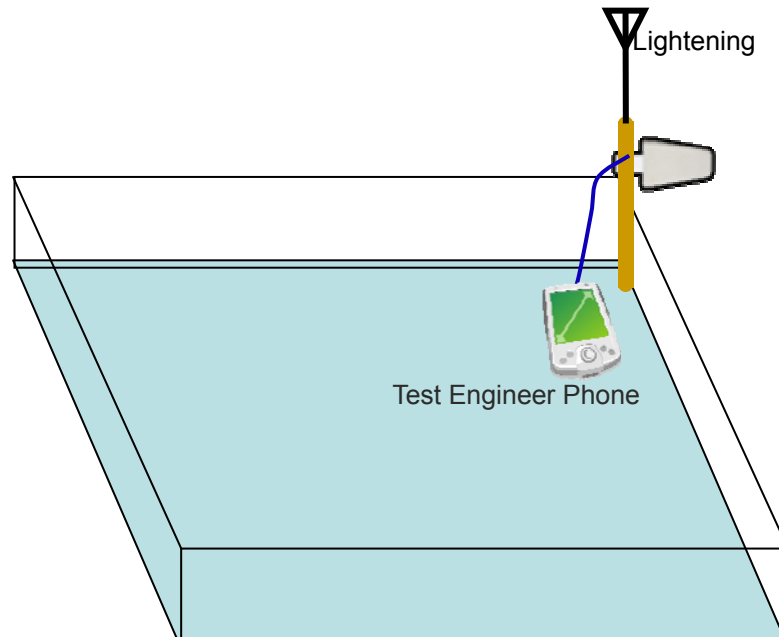
■ Installation of wide directional antenna as donor antenna



■ Installation of YAGI antenna as donor antenna



- Test the call quality of donor antenna



Fix the donor antenna after selecting the best position, and adjust slightly its height or angles in order to get the signals with suitable input power level and calling Quality

- **System Requirement of GSM or DCS**

- 1) The total input power level shall be around -50dBm , lowest shall be more than -80dBm
- 2) Test by mobile phone or data card by 3~5 times to make sure the calling quality is good in 95% of the time, and no handovers.
- 3) It is requested that the leading BCCH shall be 6dBi higher than the second (for professional engineering reference only).

- **System Requirement of WCDMA**

- 1) The total input power level shall be around -50dBm , lowest shall be more than -70dBm
- 2) Test by mobile phone or data card by 3~5 times to make sure E_c/I_o is more than -7dB , and no handovers.
- 3) E_c/I_o of adjacent carrier shall be 8dB less than that of donor carrier to avoid soft handover. The active PN shall be only 1.

8.5. Indoor antenna installation

Proper antennas shall be selected according to the site conditions and the requirement.

Omni antenna (Indoor ceiling omni antenna or whip antenna), suitable to installed in the center and radiate all directions



It is better to use a directional panel antenna or Yagi when the coverage shape is long and narrow (corridors, long row of houses in two sides, tunnels or elevators or rural open space)



8.6 Repeater Installation

8.7.1. Installation Steps

The triple band repeater shall be installed in indoor areas only

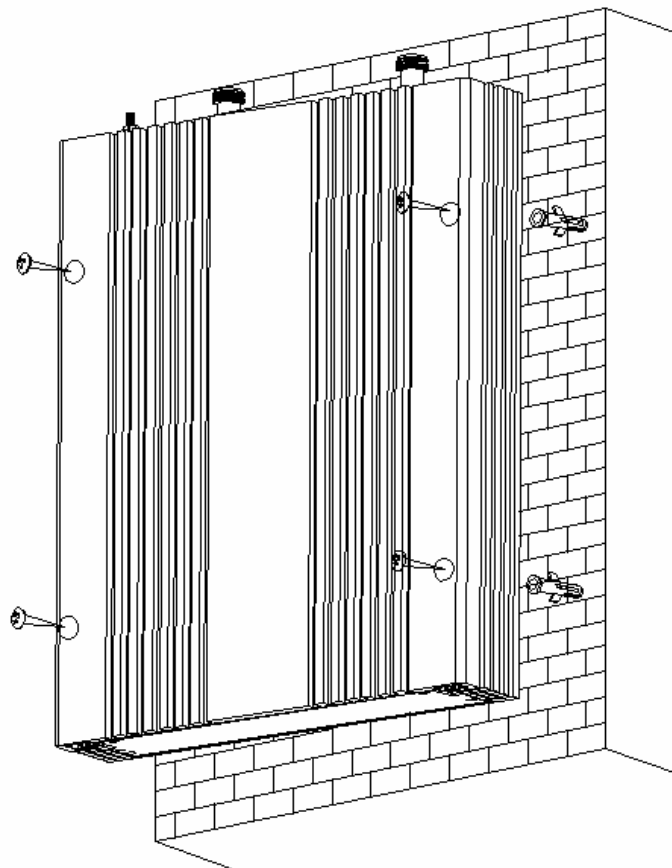
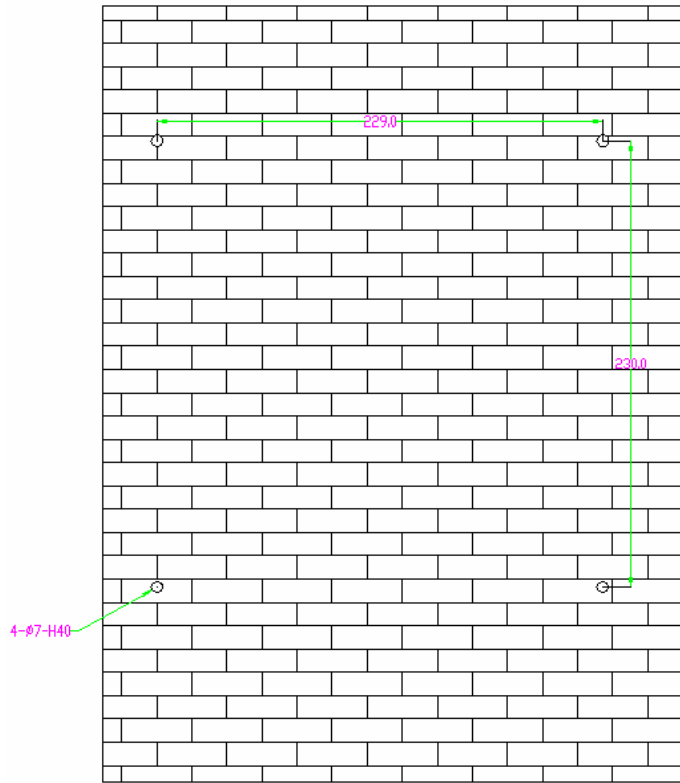
Drill holes on the selected place and install expansion bolts.

Align the holes on the installing support with the expansion bolts, keep the installing support vertical, place flat washers, spring washers, and nuts in turn, and tighten the nuts to fasten the installing support.

Place the repeater on the support and fasten it.

Connect cables and power cables to the repeater respectively.

After installing the repeater as described as above, power on the repeater to check the operation status.

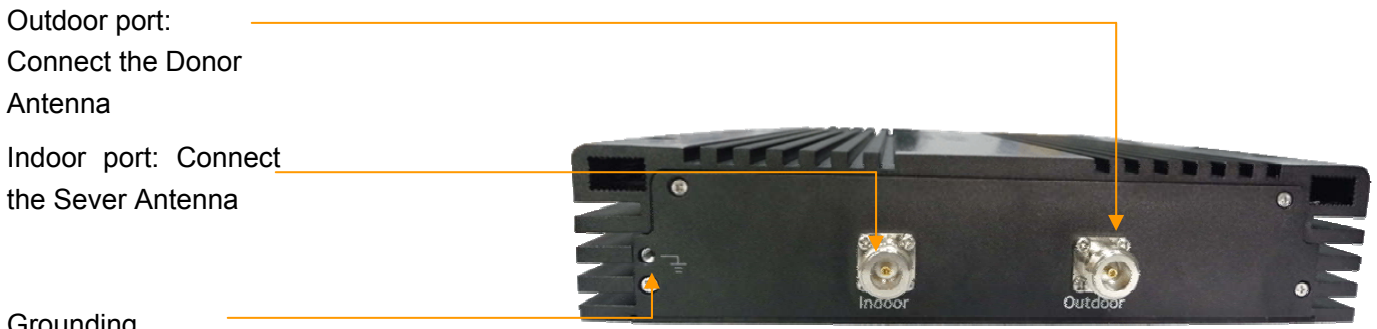


8.7.2. Repeater's ports description

Outdoor port: connected with the donor antenna by cable

Indoor port: connected with server antenna directly or by cable

DC IN: connected with power supply.



Note: The indicator LED and DIP Switch attenuation in the three system above, from left to right, respectively is GSM, DCS and WCDMA .

8.7.3. Accessories selection

Please pay attention to the two points of “frequency” and “impedance” during the selection of the accessories. All accessories shall support the repeater’s frequencies from feeder line, antenna and splitter to combiners etc. For example, the repeater’s frequency is GSM900+DCS1800+WCDMA, so all the accessories must support the 890MHz~2170MHz frequency. And the repeater’s impedance is 50ohm, so the accessories shall all be 50ohm. To use any other impedance of coax will put an extra load on your repeater, shorten its life span and decrease the system performance.

8.8. Repeater Settings

Please check very carefully all cable connections are correct and firm before running operation test and then carry out following tests

8.8.1. Switch on power

After power is on, check firstly the alarm and power LEDs.

- Status and definition of POWER indicators:

Status	Definition
Green	Normal
Off	DC power problem

- Status and Definition of ALARM indicators,

Status	ALARM
Green	It is working in linearity
	attention: Input signals may be not enough
Red	There are overloading or self oscillation, strong input signals, measures shall be taken
Orange	It is working in linearity
	Attention: Please adjust MGC to increase the attenuation value, till you find the "edge point" (I.E. the Alarm LED shall stay at green color, with intention of turning Orange), and let the repeater work at this point.
Off	Repeater break down

Remark:

Please note that Alarm LED works on repeater downlink signals only, I.E. the repeater input signals from BTS.

8.8.2. Manual Gain Control (MGC)



Uplink attenuation

Downlink attenuation

- Note: GSM as example, the rest two system is the same as GSM.
- DIP switch uplink attenuation setting:

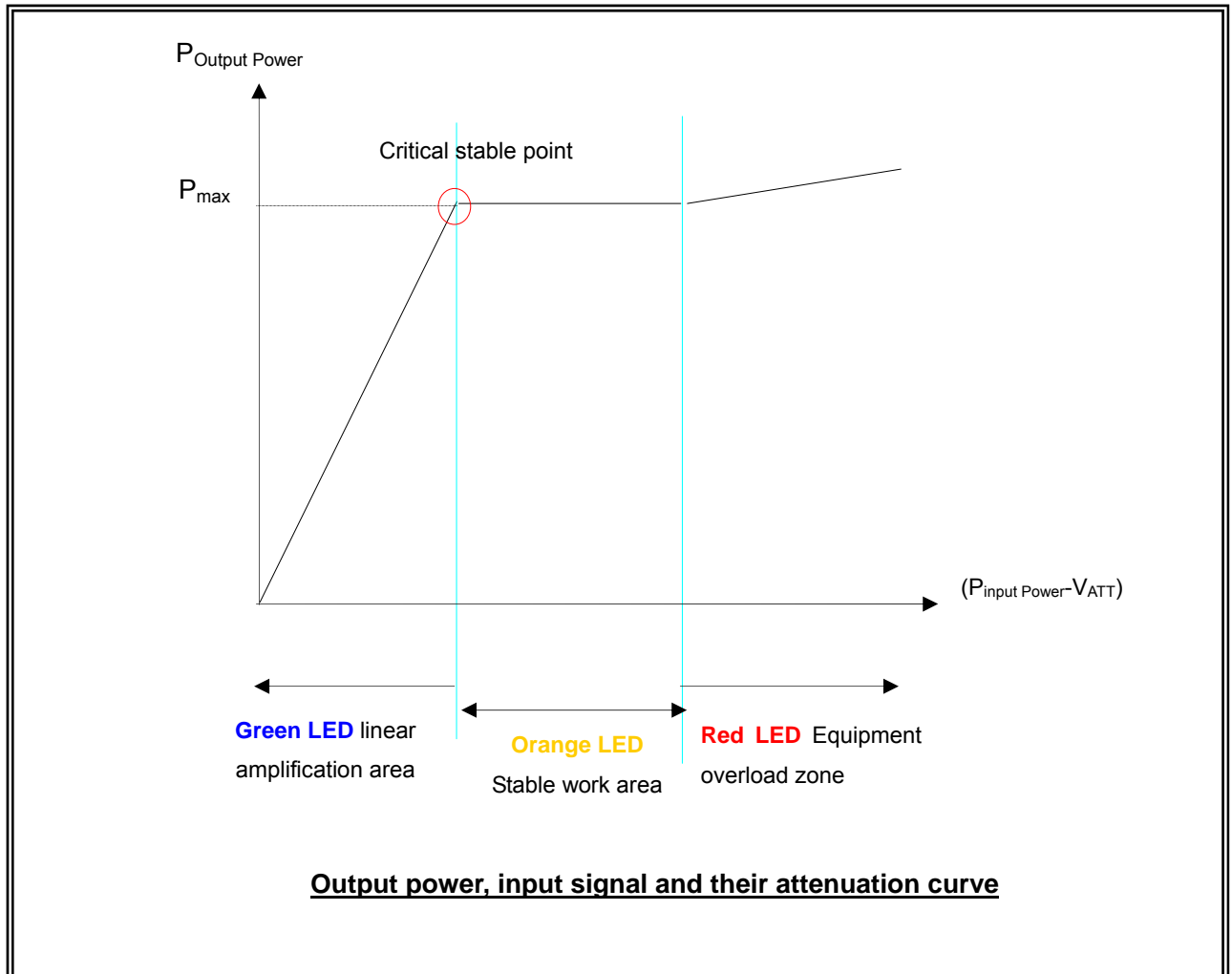
Att	1	2	3	4	5	Att.	1	2	3	4	5	Att.	1	2	3	4	5
0 dB	off	off	off	off	off	11dB	ON	ON	off	ON	off	22dB	off	ON	ON	off	ON
1 dB	ON	off	off	off	off	12dB	off	off	ON	ON	off	23dB	ON	ON	ON	off	ON
2 dB	off	ON	off	off	off	13dB	ON	off	ON	ON	off	24dB	off	off	off	ON	ON
3 dB	ON	ON	off	off	off	14dB	off	ON	ON	ON	off	25dB	ON	off	off	ON	ON
4 dB	off	off	ON	off	off	15dB	ON	ON	ON	ON	off	26dB	off	ON	off	ON	ON
5 dB	ON	off	ON	off	off	16dB	off	off	off	off	ON	27dB	ON	ON	off	ON	ON
6 dB	off	ON	ON	off	off	17dB	ON	off	off	off	ON	28dB	off	off	ON	ON	ON
7 dB	ON	ON	ON	off	off	18dB	off	ON	off	off	ON	29dB	ON	off	ON	ON	ON
8 dB	off	off	off	ON	off	19dB	ON	ON	off	off	ON	30dB	off	ON	ON	ON	ON
9 dB	ON	off	off	ON	off	20dB	off	off	ON	off	ON	31dB	ON	ON	ON	ON	ON
10 dB	off	ON	off	ON	off	21dB	ON	off	ON	off	ON						

- DIP switch downlink attenuation setting:

Att	6	7	8	9	10	Att.	6	7	8	9	10	Att.	6	7	8	9	10
0 dB	off	off	off	off	off	11dB	ON	ON	off	ON	off	22dB	off	ON	ON	off	ON
1 dB	ON	off	off	off	off	12dB	off	off	ON	ON	off	23dB	ON	ON	ON	off	ON
2 dB	off	ON	off	off	off	13dB	ON	off	ON	ON	off	24dB	off	off	off	ON	ON
3 dB	ON	ON	off	off	off	14dB	off	ON	ON	ON	off	25dB	ON	off	off	ON	ON
4 dB	off	off	ON	off	off	15dB	ON	ON	ON	ON	off	26dB	off	ON	off	ON	ON
5 dB	ON	off	ON	off	off	16dB	off	off	off	off	ON	27dB	ON	ON	off	ON	ON
6 dB	off	ON	ON	off	off	17dB	ON	off	off	off	ON	28dB	off	off	ON	ON	ON
7 dB	ON	ON	ON	off	off	18dB	off	ON	off	off	ON	29dB	ON	off	ON	ON	ON
8 dB	off	off	off	ON	off	19dB	ON	ON	off	off	ON	30dB	off	ON	ON	ON	ON
9 dB	ON	off	off	ON	off	20dB	off	off	ON	off	ON	31dB	ON	ON	ON	ON	ON
10 dB	off	ON	off	ON	off	21dB	ON	off	ON	off	ON						

8.8.3. GSM & DCS Band Settings

- **The curve about device working status**



$P_{Output Power}$: Output Power

$P_{input Power}$: Input Power

V_{ATT} : Attenuation value of attenuator

$P_{input Power} - V_{ATT}$: Input Power — Attenuation value of attenuator

P_{max} : Rate output power

- **Downlink gain setting**

First the alarm LED only indicates the downlink input power level, here we use color of Alarm LED to adjust the gain of the repeater. As for the downlink working performance, Alarm LED of "Green" color and with the intention of turning orange is a good working point, here we refer as "edge point". At this time, downlink output power and coverage effect are stable.

And the equipment must be as far as possible away from overloading status of "red" (the equipment would hold higher interference and depression ability at this stage). So we try our best to set the equipment near

“edge point” of green and intention of turning orange during engineering.

- **Setting of “edge point”:**

Switch on the power supply after connection with donor antenna and server antenna, and observe ALARM LED.

- If it shines “orange”, use 1dB as step to reduce the gain until “green” turns on, then increase the gain 1~3dB attenuation value until “orange” starts to turn on, then brings back 1~2dB till “green” is on, then fix the gain and the repeater’s downlink output power reaches the perfect status.
- If it shines “green” then,
 - ◆ To check whether the attenuation value has been set, if it is, use 1dB as step to increase gain until the “orange” turns on, then brings back 1~2dB till “green” is on again , then the repeater’s downlink output power reaches the perfect status.
 - ◆ But if attenuation is not set, it indicates that the input power is not enough.
 - ◇ Then please check coverage effect first, if the coverage effect is good, the engineering has reached expecting target
 - ◇ But if the coverage effect is not good, the donor antenna should be adjusted to get a stronger signals until “orange” intends to turn on or the effect reaches the target. At this stage, please make sure “Orange” color is not generated by self oscillation. Please take off the server antenna to test if it is self oscillation or not: if the Orange turns to be Orange, it is self oscillation; if it stays as Orange, it is not self oscillation.

- **Uplink gain setting**

Standard: uplink attenuation values =downlink attenuation values

Remark: Keep in mind that you do not want to have more than a 5dB difference between the uplink and downlink values for optimum system performance, and it is better to keep the same attenuation value of Uplink with that of Downlink.

8.8.4. WCDMA Band Settings

- **Testing Effective Downlink Path Loss**

The downlink path loss between node B and the donor antenna is as follows:

$$L_{D-link} = P_{node\ B} - P_{donor} \quad (P_{donor} \text{ is the downlink signal power received at the donor end})$$

Suppose: The maximum transmitting power of node B is 20 W and the overhead power accounts for 20%.

When there is no traffic, the transmitting power of node B is as follows:

$$P_{\text{node B}} = 20W * 20\% = 4W = 36 \text{ dBm}$$

The effective downlink path loss is as follows:

$$L_{\text{D-link}} = 36 - P_{\text{donor}}$$

Budgeting Maximum Uplink Low Noise Power Output at Donor Port of Repeater

Therefore the repeater UL gain shall be $G_{\text{up}} \leq L_{\text{D-link}} - \text{NF}$, (NF is the repeater Uplink Noise figure)

$$\text{Suppose } G_{\text{noise}} = L_{\text{D-link}} - \text{NF}.$$

● Downlink gain setting

There are three factors to be followed to set DL gain of indoor repeater:

- A. Meet with isolation requirement of $G1 = L_{\text{ISO}} - 10\text{dB}$.

The repeater's gain shall be less than "Isolation I -10dB", and if it allows, the gain shall be less than "Isolation I -15dB"

- B. Meet with UL noise G_{noise}

The UL noise from the repeater shall be less than the thermal noise floor when reaching BTS tower.

- C. The DL gain $G2$ shall be set so that the repeater can reach its full downlink output power

- D. Finally to set the gain $G_{\text{DL}} = \text{MIN} (G1, G_{\text{noise}} + 8\text{dB}, G2)$

$$\text{UL Gain } G_{\text{UL}} = \text{MIN} (G1, G_{\text{noise}}, G2)$$

Downlink gain setting procedures:

- A. Use engineering mobile phone to test the input signal strength at the repeater's BTS port, in order to get the exact values of $P_{\text{BTS PORT P-CPICH}}$.

- B. The gain to meet the targeted output power

$$\text{Set } G2 = P_{\text{DL MAX}} - P_{\text{BTS PORT Pilot CH}} - 5\text{dB}$$

"-5dB" explanation: pilot signal of WCDMA system only takes up 15% of the BTS total output power, and shall be set at 50% capacity, then the gain shall be set according to the input power level of Pilot CH in order to avoid breathing effect, therefore there will be 5dB left from the total output power to leave the capacity to traffic channels

- C. The Downlink maximum gain $G_{\text{DL}} \leq \text{MIN} (G2, G_{\text{noise}} + 8\text{dB}, L_{\text{ISO}} - 10\text{dB})$, usually the value shall be the equal value, but if the coverage size is not big, please reduce the gain to some degree.

“ $G_{\text{noise}} + 8\text{dB}$ ” explanation: The downlink gain can be maximum 8dB higher than uplink gain in indoor repeater solutions

- D. The attenuation should be less than 30 dB when you set the downlink gain of the repeater and it would be the best to attenuate less than 15dB range, and in case more than 15dB attenuation is needed, please use external attenuator.

- **Uplink gain setting**

UL maximum gain $G_{\text{UL}} \leq \text{MIN} (G_{\text{DL}}, G_{\text{noise}}, L_{\text{ISO}} - 10\text{dB})$

With the condition of meeting above formula, G_{UL} value is usually between G_{DL} and $G_{\text{DL}} - 4\text{dB}$

8.8.5. Adjusting System Isolation

When the repeater gain is set improperly, or the isolation between the donor antenna and the transmitting antenna is insufficient, self-oscillation often happens. A self-oscillated signal is a high amplitude signal of an in band frequency. Result of self oscillation: Slight self oscillation leads to non-linearity of repeater's output power, that would accordingly worsen the signal quality and cause noises, if it is more serious, there will be call drops, and the most serious one would lead to the collapse of BTS tower.

Below methods are available to check if the repeater has self oscillation or not: Compare the spectrums in below two test result:

Illustration 1 the repeater's output power is connected with a load

Illustration 2 the repeater's output power is connected with a server antenna

When there is no self oscillation, the two spectrums shall be quite similar

When there is self oscillation, some quite strong signals would be detected in Illustration 2, and many spurious signals would come out. Please try to reduce the gain of the repeater, you will see these spurious disappears immediately.

An effective way of eliminating self-oscillation is to reduce the gain, adjust the azimuth and down tilt of the antenna, and increase the system isolation.

the inequality $L_{\text{ISO}} - G_{\text{rep}} > 10\text{B}$ is not satisfied after the repeater gain is determined, take the following measures to increase the system isolation:

- a) Tune the azimuth of the donor antenna
- b) Tune the down tilt of the donor antenna

- c) Tune the azimuth of the transmitting antenna
- d) Tune the down tilt of the transmitting antenna
- e) Add isolation net at the back of the antenna

8.8.6. Detecting Repeater

When you cannot find the reason why the receiving or transmitting channel is abnormal, you can use a source-scanning spectrum analyzer to detect the repeater. (For the specifications, see the instructions for the repeater.) Note that the amplitude of the introduced signal must agree with the actual condition.

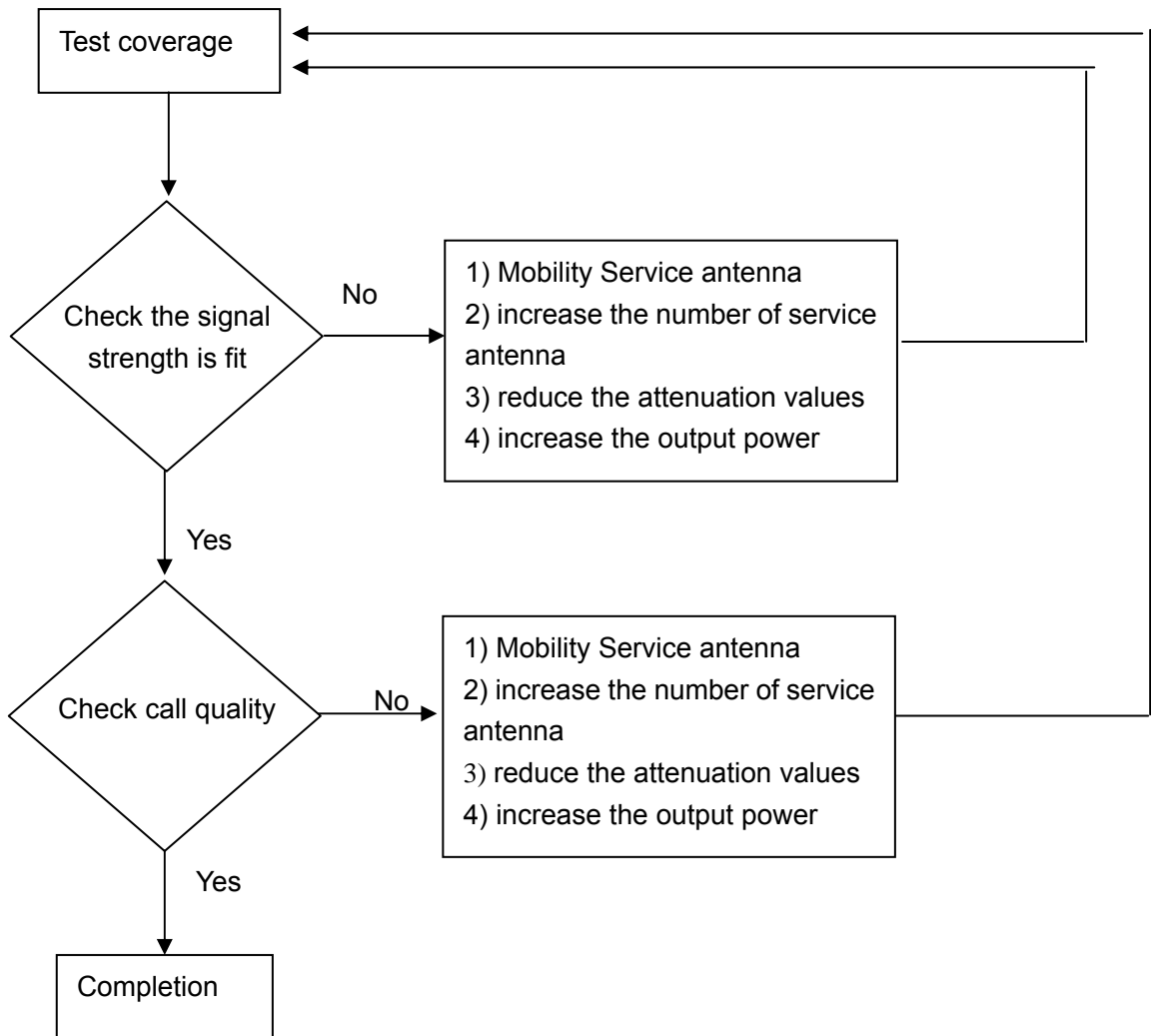
Note:

When testing the downlink power of the repeater, use couplers or attenuators to avoid burning out the tester.

8.9. System Test

8.9.1. Check whether the coverage is good

- 1) Have a test with mobile phone or data card (engineering mobile phone is preferred). If the signals in most areas have not been improved, please check below again:
 - ◆ The weak input signal leads to the low output power. Change the direction of donor antenna or its installation position or replace donor antenna with higher gain to increase input signal power level.
 - ◆ Check whether it is necessary to add more server antennas due to barriers, whether the repeater's power is enough; please install more server antennas or change with a repeater with higher power level.
- 2) If the signals in small part of the areas have not been improved, please check below:
 - ◆ Check whether the service antenna is installed correctly or not, you may try to move the antenna location improve coverage
 - ◆ Check if it is necessary to use use a directional antenna
 - ◆ Check whether it is necessary to add one or more antenna to enhance the coverage of special areas.



◆ Remark:

- ✧ **Reduce the attenuation values***---at the same time must ensure the isolation
- ✧ **Increase the output power*** ---recommended ways: adjust the donor antenna; increased input signal strength.

8.9.2. Repeater can not communicate in Power-ON status

The power is on but there is signal fluctuation

- 1) The power is on but it has a signal fluctuation or a flash signal. The phone call can not achieved.

It shall be caused by the insufficient isolation between donor antenna and serve antenna,

Please take below measures:

- Firstly check whether the alarm LED becomes red. The red light shows the insufficient isolation.
- Secondly adjust the antenna directions or locations or enlarge the distance between them
- Thirdly reduce the repeater's gain by ATT DIP if the above methods don't work

The best minimum distance between donor antenna and serve antenna should be more than 10

meters.

The following measures can also be tried:

- Use the roof of the building to enlarge the isolation (Please try to place the donor antenna and server antenna in different floors)
 - Use some obstacles.(Such as wall)
- 2) The repeater's power is on but the phone is not connected into the network and still can not communicate.
- **Reason 1:** There are loose or wrong connections in the repeater system.
 - ✧ **Solution:** Please try to fasten the connections between the different parts of the system.
 - **Reason 2:** The signals received by donor antenna of other operators nearby are too strong. (For example, the other operators' signals are 10 dB stronger than the needed signals.)
 - ✧ **Solution 1:** Change the direction of donor antenna or its installation position, so that the gap of signal strength between operators are reduced.
 - ✧ **Solution 2:** Use barriers (like buildings) to block signals of other operators.