Signal Booster

User's Manual

Directory

1. Abbreviations

BTS	Base Transceiver Station
GSM	Global System for Mobile Communications
MS	Mobile Station
RF	Radio Frequency signals
UL	Uplink (Communication channel from mobile device to cell tower)
DL	Downlink (Communication channel from cell tower to mobile device)
Donor	Outdoor Antenna
LED	Light Emitting Diode

2. Safety Warnings

Users must follow the below principles：

-  Booster should follow system requirement of communication equipment, assure good groundings and lightning protection.
-  The power supply voltage of booster should meet the standards of security requirement; any booster-operator can operate only after cutting power in advance. Only the professional can operate electrified.
-  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 booster; touch the module of booster, even not 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 booster will dissipate heat when working. And do not cover booster with anything that influences heat-dissipation.

3. Why boosters

3.1. Application 1

1) Blind or weak signal areas are formed if the building is too far away from BTS, or the building itself shield or absorb the signals.
2) There are too many complicated signals in the higher part of the buildings, ping-pong switching effect has been formed, the signals fluctuate a lot thus there are annoying noises during phone calls and there are dropped phone calls.
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.

3.2. Application 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 booster 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 booster 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!

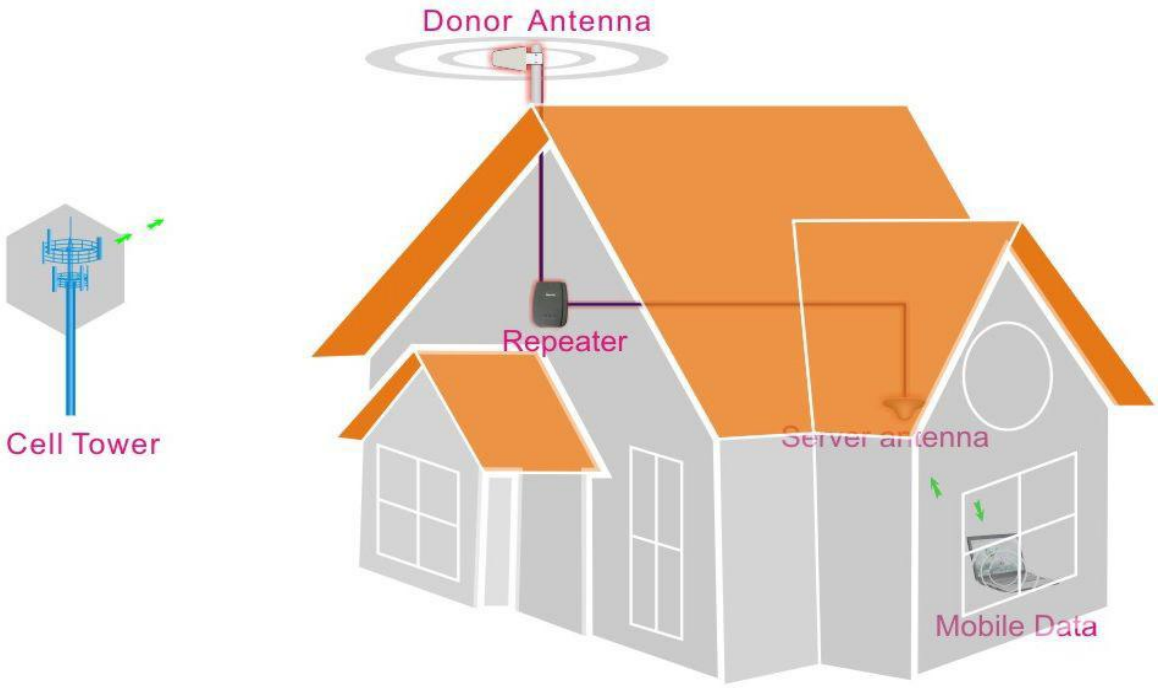

Figure 1 shows the applications of the Booster

Question: Will booster 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, smooth communication and clear phone call 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; 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 on 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 the booster is 10dBm~30dBm, and it decreases to be maximum 0.05W 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, 0.000005W, therefore it is too weak to influence human bodies though it is still a very good signal for mobile phones.

And when a booster 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 the RF radiation of the mobile phone tremendously.

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4. Introduction

Signal booster help end users to improve mobile signals for much better phone call quality and smoother data transmission.

Below are the main features.

1) The signal booster is an ideal solution for providing a cost effective improvement in cellular in-building coverage of Home, office, restaurant or building, in the quickest time possible.
2) Manual gain control (MGC 31dB range) available for both uplink and downlink to adjust the gain value for proper coverage during installation or maintenance.
3) To maintain safe and specific output signal levels and give alarms on self-oscillation, the booster has built-in AGC and ALC circuits, which can automatically control the gain of the booster depending upon the strength of input signals.
4) ALC available for both uplink and downlink to avoid deep self- oscillation from jamming the towers, saving your trouble from operators.
5) Wide band feature enables all devices operating within the wide frequency range of the booster to see an improvement in performance.
6) Multiple phones and other handheld devices throughout a building can benefit from a wireless booster. Supports many users / calls simultaneously.
7) Extended phone battery life. (Your phone does not need to put out as much power due to improved reception.)

LED indicate

To maintain safe and specific output signal levels, this booster has a built-in signal oscillation detection circuit with color changing LED's to indicate its environmental status. The Alarm LED's located on the front of the unit will change color from green to red, (depending on the intensity) if the system detects signal oscillation in either band or, if the input signal is beyond a safe limit so

as to avoid interference to the cellular network.
This booster also has an automatic Level control (ALC) feature that will reduce the output power of the booster if oscillation is detected. This range can vary from 25-30dB depending on the model of your booster. If the range of the ALC is less than the value of the gain the booster needs to be reduced by, then the end user can make use of yet another feature of manual gain control to further reduce the gain by using the dip switches to manually attenuate (reduce) the booster's output gain of either the uplink or downlink individually.
You will want to make sure the LED's remain green at all times for optimum system performance.
The main cause of signal oscillation is when the indoor antenna is too close in proximity to the outdoor antenna on the roof.
Alarm LED status chart and recommended action:
Green - System functioning well.
Red - Strong Signal Oscillation.

Composition of Application System:

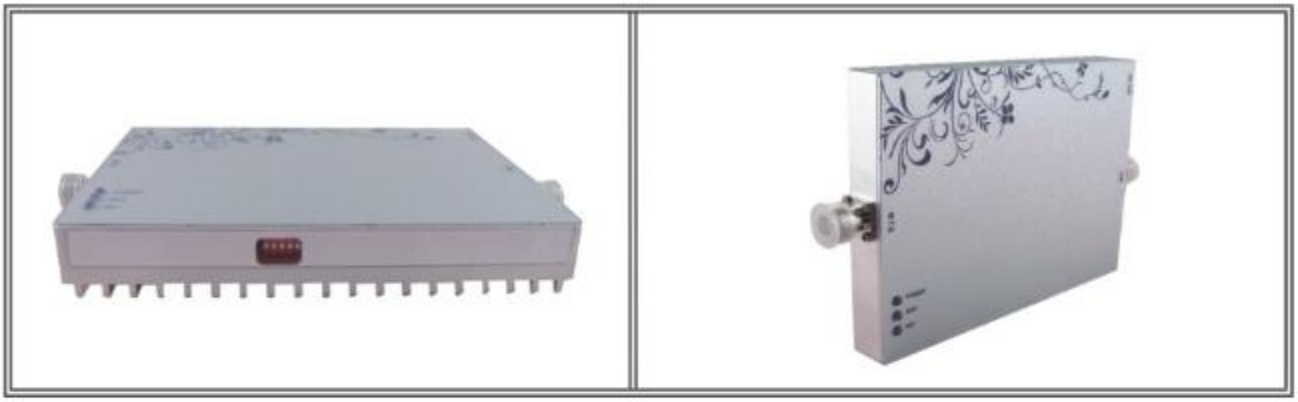
1) **Donor antenna:** Recommend to use wide band panel antenna (7~14dBi gain) or Yagi antenna, better to use antenna with good direction, high gain, and decoration shall be considered if it is in urban areas.
2) **Role:** It picks up signals from the tower, and sends to the booster through cables, at the same time, it transmits the amplified mobile signals from the booster to the tower.
3) **Server antenna:** Recommend to use indoor omni or panel antenna. Indoor omni is suitable for wide open areas where the signals can be radiated from the center to the surroundings, while indoor panel is suitable for those narrow and long areas, like tunnels, corridors, elevators, etc.
4) **Cables:** 5D-FB or 7D-FB coaxial cables.
5) **Power supply:** Booster power adapter, a desktop standard. Usually directly connected to a power outlet. But preferably equipped with an air switch, groundings, sometimes a surge arrestor shall be connected.

5. System Characteristics

5.1. Features

- CE, ROHS certified
- Very cost effective solution for immediate coverage
- Wide band booster to support all signals within mobile systems
- ETSI & 3GPP & 3GPP2 standards
- Support any cellular devices (voice & data & video)
- ALC function. (Auto Limit Control)& MGC function. (Manual Gain Control)
- Universal power range of 90V~265V
- low power consumption

5.2. Appearance of boosters

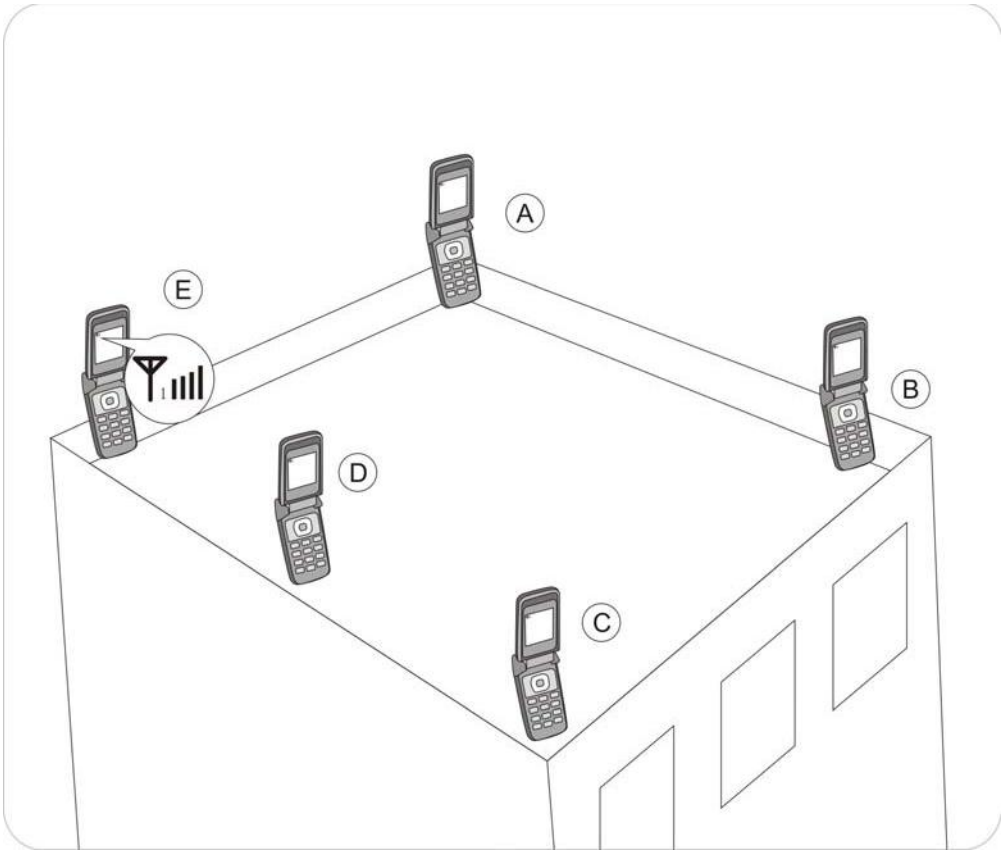


Product 1

Product 2

6. Installation

1) The booster's main function is to improve weak RF signals to an area. A simply 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 that the donor antenna be installed in an attic.



- Testing the signal strength which receipt from outdoor 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 displays full bar signals in site which installed the donor antenna.
  - ✧ The phone calls or data transmission are smooth and stable by

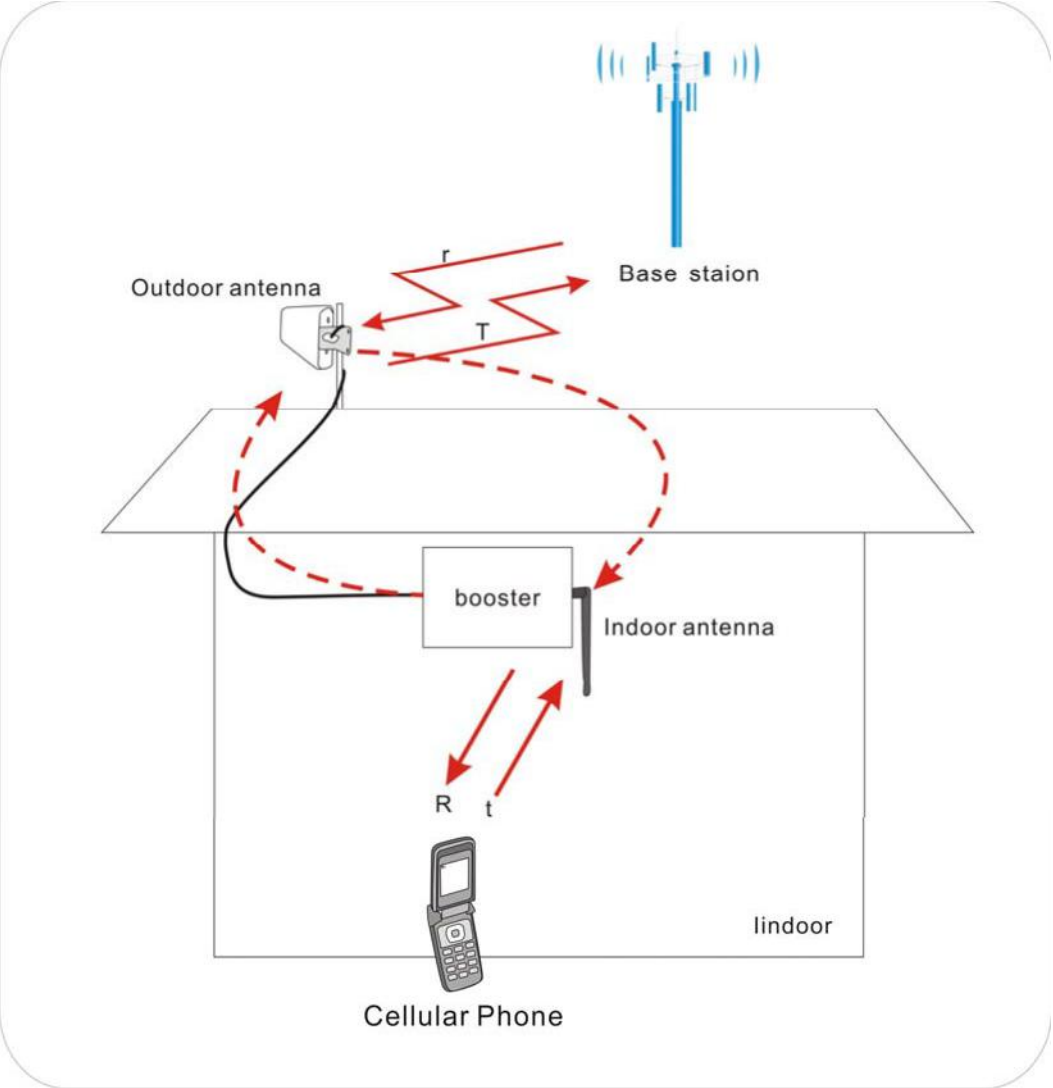
testing of 3 times.

✧ As shown from the above illustration, testing the signals from A to E, and select a best place which displays full bar signals to install the donor antenna.

- Selection the installation direction for donor antenna
  - If possible, the donor antenna points to the direction of the tower, it would be much better to keep line of sight.
  - Please select the opposite directions to install donor antenna and server antenna. If donor and server antenna have to be installed in the same directions, please install them only after the signal quality is tested and the self oscillation is avoided. If select the direction antenna, the main directional angle should toward to the tower antenna.
  - If the direction antenna is used as donor antenna, the main directional angle of the antenna should point to the direction of tower.
  - After installation, if the performance is poor due to weak signals or poor phone call quality, please adjust the direction of donor antenna or change the installation position of donor antenna in order to obtain the best calling effect.
- Installation donor antenna
  - 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

2) Booster 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 loud speaker for example, if it is too close for each other,

it could make big noise. So the booster 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 dB.



- The best distance (mini distance) between donor antenna and server antenna is 20 meters, the direction is opposite.

  As shown the above 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 result self-oscillation and reduce the coverage area, also the bad calling quality could happen at the same time.

If isolation can not be achieved by the distance due to the limited conditions, then we can use

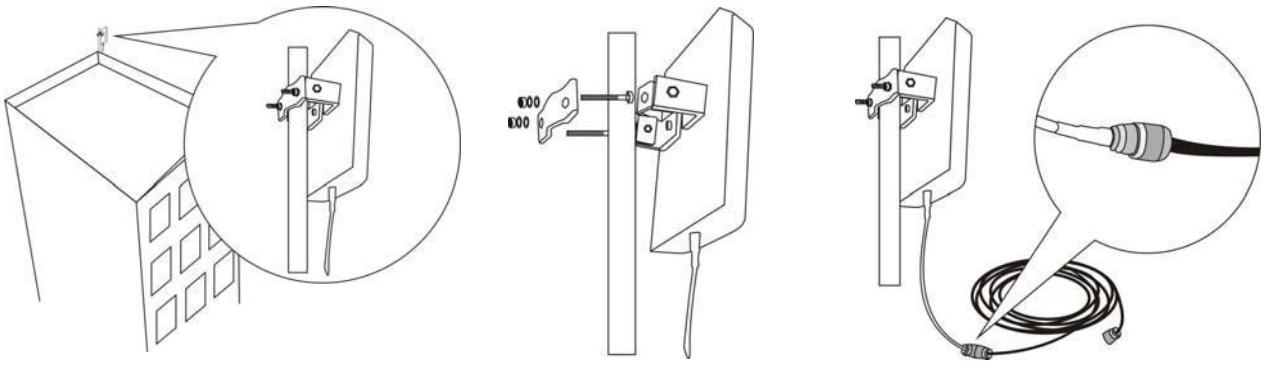
the roof of the building or other barriers. If the barrier is concrete or brick wall, also donor antenna and server antenna are in opposite direction, just one floor between up and down stairs will be able to meet the isolation requirement.

3) Accessories selection: Pay attention to below two points during selecting the accessories due to the booster belongs to high frequency communication system: frequency and impedance. All accessories shall support booster frequencies from feeder line, antenna and splitter to combiners etc. For example, the booster frequency is GSM900, so all the accessories must support the GSM900 frequency. And the booster impedance is 50ohm, so the accessories shall all be 50ohm. To use any other impedance of coaxial will put an extra load on your booster and shorten its life span.

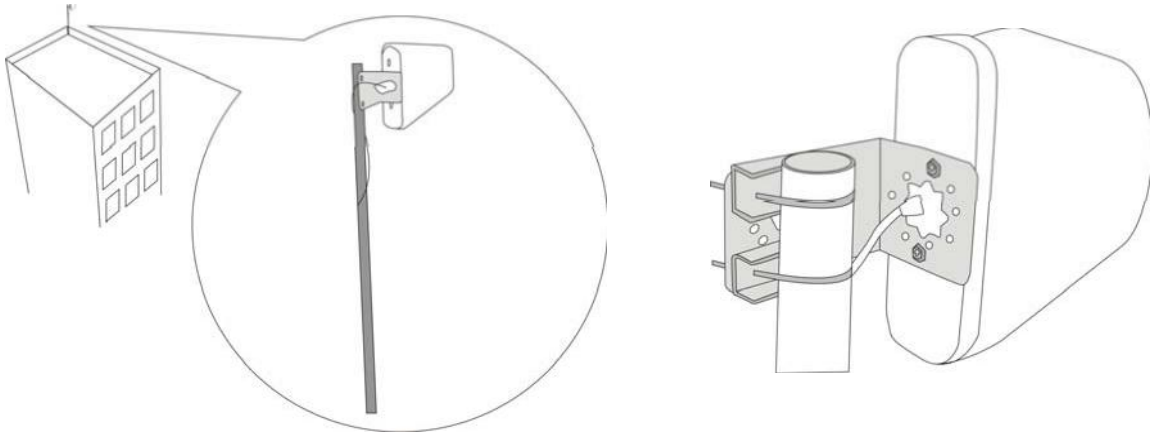
6.1. Antenna Installing and Cable Wiring

It is recommended that you mount your donor antenna in a spot that is free of any immediate obstructions. Making use of a pole or mounting bracket is recommended for optimum antenna performance.

6.1.1. Panel antenna Installing



6.1.2. Directional YAGI antenna Installing



6.1.3. The cable connection confirmation

✧ Confirmation the quality of the connector whether good or not. Check it by millimeter:

- When not connect the antenna and device, the resistance for the pin and the outer metal of the connector should be infinite.
- Testing the two connectors of the feeder, pin and pin should be connected; also the outer metal of the feeder connectors shall be connected, too.

✧ Check the connector whether well-connected or not. Connect the coupler, splitter, antenna and device with feeder connector then tighten it:

- The process for tighten and loosen connectors should be handy easily.
- After tighten the connector, no bending and deformation.

6.1.4. The connectors' connection confirmation

Please confirm the connectors are very well connected between the donor antenna, cable, booster and the server antennas.

✧ If the phone calls are still poor after booster commissioning, please check below points:

- Input donor signals are weak that leads to booster's low output power; please change the direction of the antenna or move the location when it is necessary to increase input signal level.
- Check if it is necessary to install more antennas to areas that have not been

covered.

- Check if the booster works fine or not, and if the booster's output power is enough or not？

✧ If only small areas have weak or no signals, please check below points:

- Check if the server antennas are not properly installed or not in the right position
- Check if more antennas shall be placed in the area with weak signals.
- Check if directional panel antenna shall be used to cover the area specifically.

6.2. Booster Installation

6.2.1. Method of Installation

The booster is fixed onto the wall through expansion bolts.

A. Drill holes on the selected place and install expansion bolts.

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

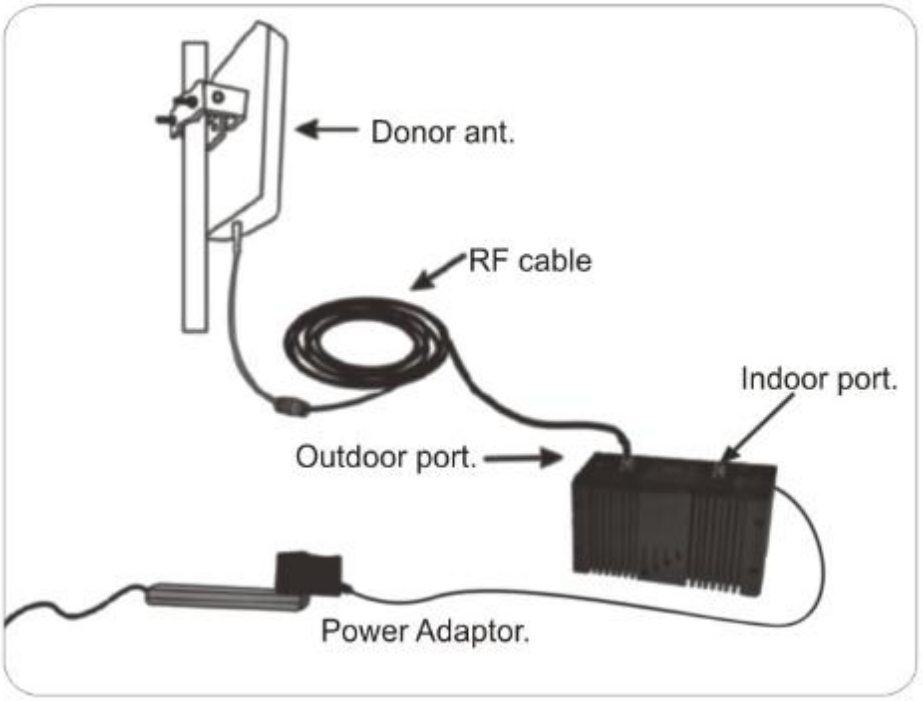
C. Place the booster on and fasten it.

D. Connect cables and power cables to the booster respectively.

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

6.2.2. Connection

A. BTS Port: donor antenna cable is connected with Outdoor Port;
B. MS Port: service whip antenna is connected with Indoor Port;
C. DC IN: connected with Power adaptor.



6.2.3. Booster Manual Gain Adjustment

The equipment is gain adjustable for both the uplink / downlink. Depending on the environment the end-user may need to adjust the gain to achieve optimum performance.

In order to meet safe environmental requirements for seamless network integration, this booster is equipped with a Dip Switch assembly that allows you to manually control the Uplink / Downlink gain individually. The UL / DL attenuator control range is from 31dB by 1dB increments.

When it is necessary to adjust the gain by attenuator, firstly please adjust Downlink gain according to input signals, secondly please adjust Uplink gain according to Downlink gain. The DIP Switches have default 'OFF' status; please push relevant switches to "ON" position if certain attenuation value needs to be achieved.

Product 1.

DIP switch 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						

About POWER、ISO、AGC indicators.

POWER LED	Green	Normal
	Off	DC power problem
ISO(ALARM LED)	Green	It is working in linearity.
	Red	There are strong input signal or severe self oscillation. Attention: input signal level is too high or the space of donor antenna and service antenna is not enough. please adjust the gain, If the red light still turning on that means over accepting of donor antenna or strong interference, then please adjust the place of donor antenna.
AGC	Green	There are good input signal.
	Off	Low input signal.

Product 2.

About ALARM and POWER indicators.

POWER LED	Green	Normal
	Off	DC power problem
ALARM LED	Green	Sys-1,Sys-2 or Sys-3, working in linearity
	Red	There are strong input signal or severe self oscillation. Attention: input signal level is too high or the space of donor antenna and service antenna is not enough. Please adjust the gain, If the red light still turning on that means over accepting of donor antenna or strong interference, then please adjust the place of donor antenna.
	Off	Repeater breaks down, Please re-plug in and check if Alarm LED turns red, if it is, please take measures to keep Alarm LED green; if it maintains off, it means the power break down.
Uplink MGC **Downlink MGC**		Digital display panel will show the real-time gain, "+"increase gain, "-"decrease gain. 
SEL		Select the different systems when you need, (only for Dual band, Tri band, Quad-band or Five band repeater.)

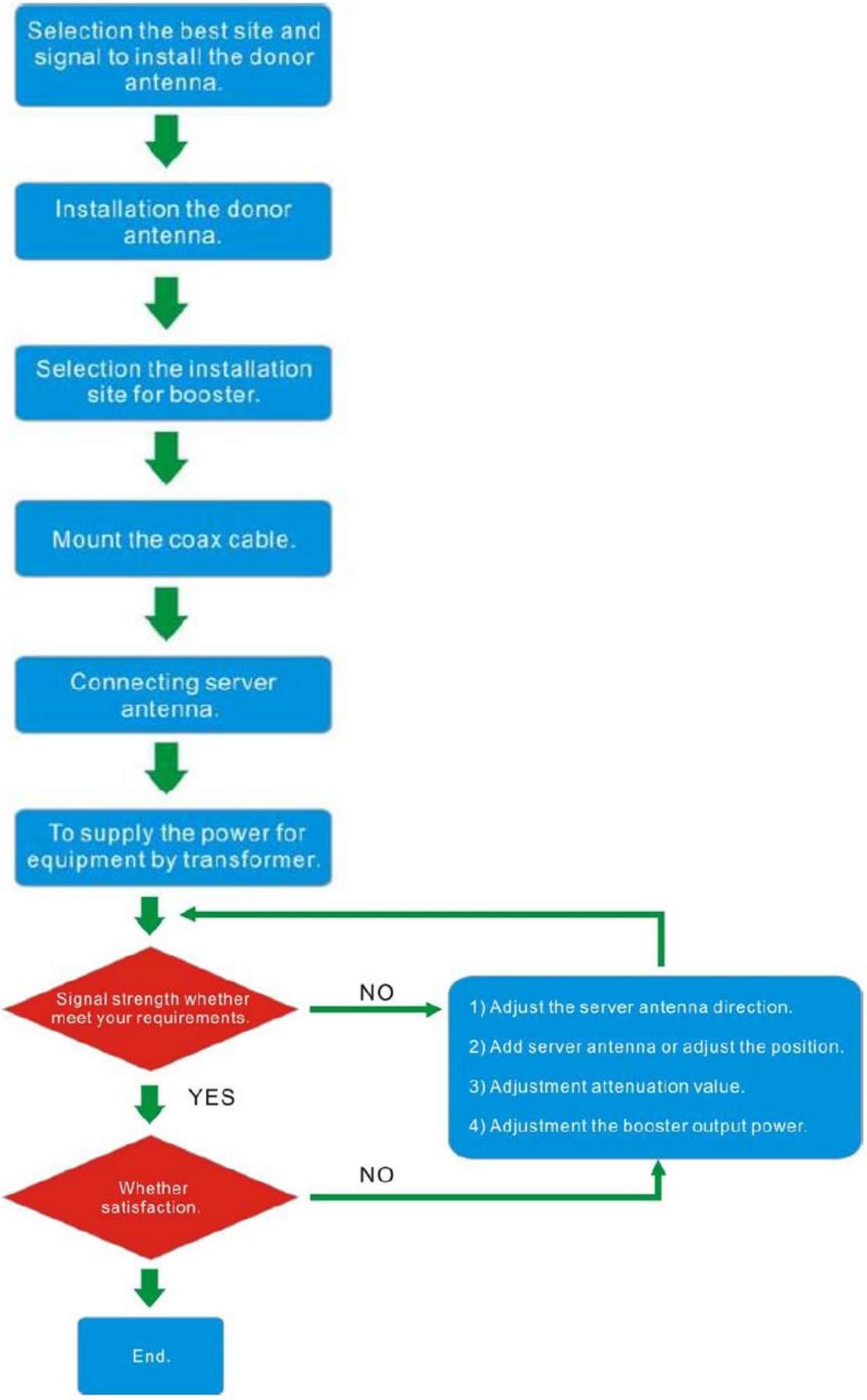
When do you adjust the Gain?

Your booster is also equipped with an alarm feature that monitors the input gain. If the input gain is too high, the Alarm LED will change color from green to red indicating the intensity. High input gain can occur if the donor antenna is in a location where the receive signal strength from the cell tower is extremely good (-50dBm or better) or if signal oscillation is taking place. Signal Oscillation is when the amplified signal from the indoor service antenna is feeding back to the donor antenna outside.

To determine what is the cause of your Alarm LED changing color you can disconnect the indoor antenna / service line from the Indoor port of the booster. If the LED does not change to green, then your input signal from the cell tower is very strong and it is highly recommended to attenuate the DL gain by 4dB, 8dB or 16dB till the LED's turns green again. Then you must match the same attenuation value to the UL, after which you can connect the indoor antenna / service line again.

Try making some test calls throughout the desired area of coverage while monitoring the LED's to see if it changes color. If you are showing strong signal strength but your calls are not going through, it could be that you need to attenuate your Uplink a bit more. Keep in mind however that you do not want to have more than a 5dB difference between the uplink and downlink values for optimum system performance.

7. Installation Procedure



8. Troubleshooting

Q1. Why is there still no signal after installing the equipment?

Answer:

1. Check the power on booster and power supply.
2. Check the connector of outdoor antenna is tight or not.
3. Check the connectors of RF cable are tight or not.
4. Check the outdoor signal is strong enough or not.
5. Check to make sure the antenna is installed correctly.
6. Check the connector of indoor antenna is tight or not.
7. Check the cable type is suitable or not.

Q2. Why the signal strength is too weak on the edge of area?

Answer:

1. Check the outdoor signal and antenna direction.
2. Check booster is full gain or not.
3. Check all of the connectors are tight.
4. Change the location of outdoor/indoor antenna.
5. Check the cable type is suitable or not.
6. Deploy more indoor antennas.

Q3. After running booster, why the signals are not stable?

Answer:

1. Checking the distance between donor antenna and server antenna are too close to each other? Check LED of booster to make sure alarms are green.
2. Checking the signals from donor antenna whether to be stable or not?
3. Connect the system again if it is incorrect connection.

Q4. Why the booster power LED is not bright?

Answer:

1. Checking the input AC power range indicated on power adapter whether is corresponding to the local power system.
2. Checking the power adapter whether connect the equipment correctly and stably or not.
3. Checking the power adapter whether damage or not. To test output voltage whether be corresponding to that indicated on power adapter or not by multimeter