

**10~30dBm Series Repeater SYN-30L-S
With LCD Touch Screen
User Manual**

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Preface

This user manual describes the installation, commissioning and maintenance of the SYN-30L-S series band selective repeater, which could support any single mobile system.

Please read the user manual carefully before installing and maintaining the repeaters.

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

1. Safety Warnings

Users must follow the below principles:

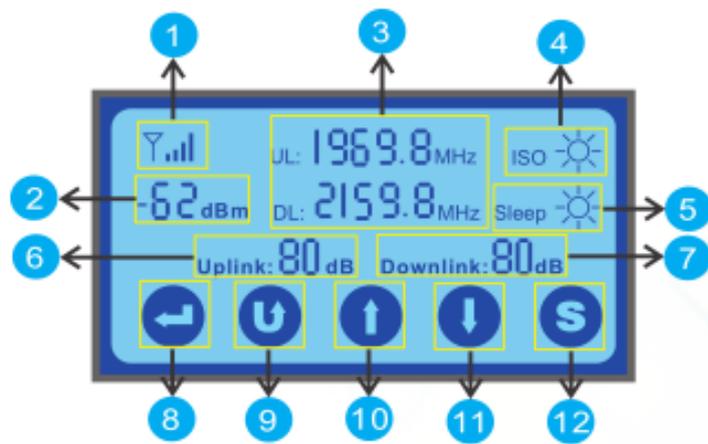
- Repeater should follow system requirement of communication equipment, assure good grounding and lightning protection.
- The power supply voltage of repeater should meet the standards of security requirement; any operation shall be carried out only after cutting off power in advance. Only the professional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

2. Introduction

The SYN-30L-S series repeater (including 15dBm, 20dBm, 23dBm, 27dBm, 30dBm) is a newly designed signal repeaters with intelligent functions. It 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 possibly. One repeater covers 300 to 4000 square meters.

The repeater introduces the features from the consumer electronic device, which could support the operation via LCD touch screen in the front panel. Also it has many intelligent function, such as antenna isolation detection, input&output signal strength indication, central frequency display and setting, uplink sleep and smart functions.

See the detailed introduction listed below:



1. 5 bars of the output signal strength indication, which shows you the maximum output power of the repeater. Each signal bar represents 5dB.
2. The specific value of the input signal strength measured in dBm, tell us the exact input signal level.
3. Shows the UL&DL central frequency of the supporting system.
4. Antenna Isolation Detection. When first power on the repeater, the repeater will detect the oscillation automatically between the outdoor antenna and indoor antenna.
5. Uplink Sleep Mode. The uplink of the repeater is in standby mode when there is no call or data transmission. It will activate immediately when a call a data session is initiated.
6. Show the UL maximum gain.
7. Show the DL maximum gain.
8. Enter for selection or confirm the settings.
9. Back to the previous page or cancel the settings.
10. Increase the gain or upward adjusting the central frequency.
11. Decrease the gain or downward adjusting the central frequency.
12. Smart function. The repeater could set the gain automatically to prevent the Alarm.

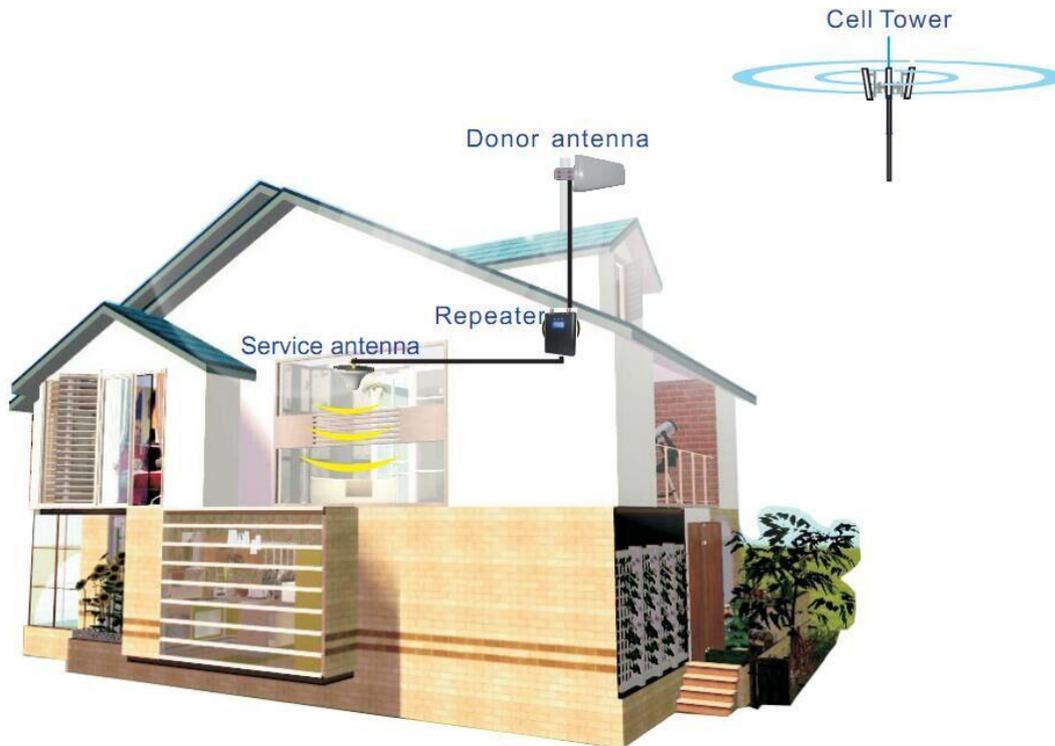
The repeaters has Manual Gain Control (MGC) feature that enables engineers to reduce the gain of the repeater manually via touch screen if oscillation is detected. Users could also use the “Smart” function as well, which will help to set to the suitable gain automatically without any interference to the mobile network.

In order to maintain safe and specific output signal levels, this repeater has 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 indicating its environmental status: the Alarm LED's located on the front of the unit will change color from green to orange or red, (depending on the input power level) when the system detects signal oscillation in the working band or the input signal is beyond a safe limit.

Our repeaters also feature a Network Safe / MUTE feature that automatically shuts off the repeater to protect the cellular network. Users shall make sure the LED's remain green at all times for optimum system performance.

Below diagram shows how simple and fast the repeater system is installed and works effectively:

One Yagi antenna, as donor antenna, is installed at the top of the roof to pick up good mobile phone signals from outside, and send through 5D-FB cable to repeater to amplify the signals significantly, then the output signals are sent to the indoor omni antennas and finally transmitted into the covering area. Very clear phone call or high speed mobile data are immediately achieved within the area.



3. System characteristics

3.1. Features

- Streamline shape.
- Industrial selective band to support the frequency of a specific operator. The central frequency is tunable among the working system via touch panel.
- 5 bars of the output signal strength indication, which shows the maximum output power of the repeater.
- The specific value of the input signal strength measured in dBm.
- Show the UL&DL central frequency of the supporting system.
- Antenna Isolation Detection with different status.
- Show the UL&DL maximum gain, and able to set the attenuation via touch panel.
- Smart function. The repeater could set the gain automatically to prevent the alarm.
- Uplink Sleep Mode.
- Auto shut off function as final step to avoid severe interference with mobile network .

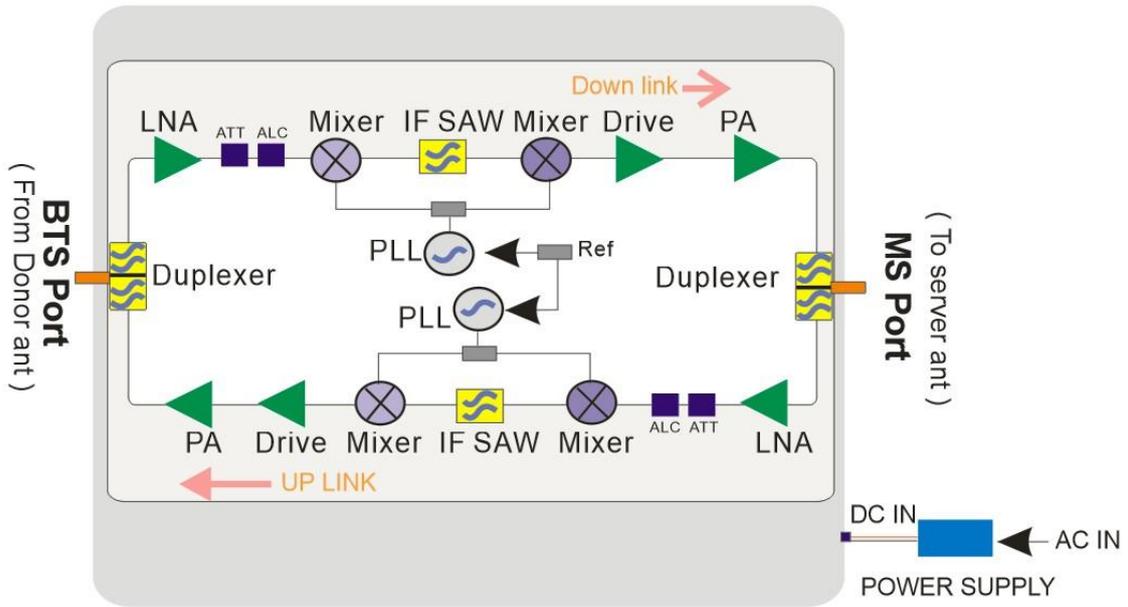
3.2. Appearance of the repeater



4. Block diagram and work principle

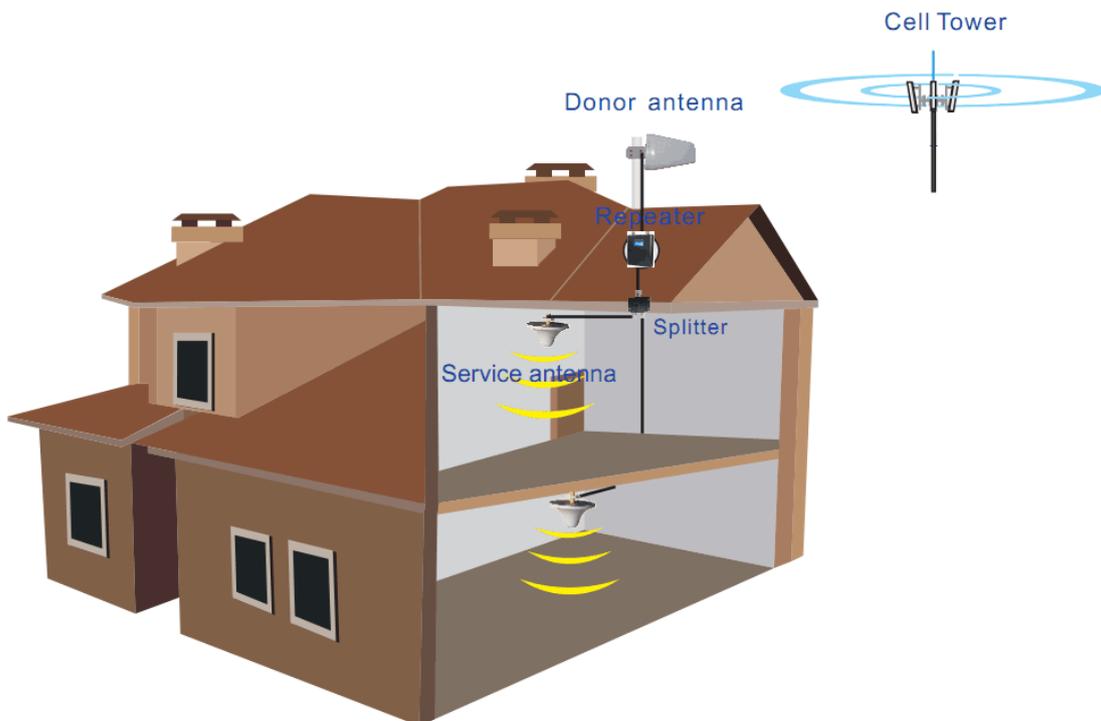
SYN-30L-S series repeater is basically a bi-directional amplifier, the downlink signals are received by the repeater from cell tower by the donor antenna, filtered by its internal duplexers and FC unit, amplified by low noise amplifier (LNA) and downlink PA unit, and then sent via the service antenna to the area to improve mobile signals for mobile phones.

The uplink signal of mobile devices from the coverage area is input via the service antenna, then filtered by duplexers and FC unit, amplified by the uplink low noise amplifier (LNA) and the uplink PA unit and finally sent via the donor antenna to the cell tower.



Single system repeater diagram

5. The repeater system



- **Donor Antenna:**
 - 7dbi outdoor panel or 9dBi wide band Yagi antenna is recommended as donor antenna.
 - Function: Pick up donor signals from the cell tower and send to the repeater by cable; the power level and quality of the received signals influence a lot on the coverage effect. Donor antenna also transmits the uplink signals from the repeater to cell tower.
- **Service Antenna:**
 - 3dBi indoor Omni ceiling or 7dBi indoor panel are recommended, whip antenna is also ok for 10dBm repeater, however the coverage size will be limited.
 - Omni antenna (Indoor ceiling Omni antenna or whip antenna), suitable to be installed in the center and radiate all direction; It is better to use a directional panel antenna or wide band 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, 3D, 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.

6. Main technical specification

RF technical specification

Electrical specification		Uplink	Downlink
Frequency Range		GSM900/DCS/WCDMA/LTE800 etc.	
Bandwidth		Any fixed bandwidth among the working system, upon request	
Max .Output Power	SYN-15L-S	≥12dBm	≥15dBm
	SYN-23L-S	≥15dBm	≥23dBm
	SYN-27L-S	≥20dBm	≥27dBm
	SYN-30L-S	≥20dBm	≥30dBm
Max .Gain	SYN-15L-S	≥65dB	≥70dB
	SYN-23L-S	≥70dB	≥75dB
	SYN-27L-S	≥75dB	≥75dB
	SYN-30L-S	≥75dB	≥80dB
Input Power		0dBm(Max) : Absolute	
MGC (Step Attenuation)		31dB / 1dB step	
Automatic Level Control		≥ 20dB	
Passband Ripple		≤2dB/3.84MHz; total≤ 4dB	
Out of Band Gain	$2.7 \leq f_{\text{offset}} < 3.5\text{MHz}$	<60dB	

	$3.5 \leq f_{\text{offset}} < 7.5\text{MHz}$	<45dB
	$7.5 \leq f_{\text{offset}} < 12.5\text{MHz}$	<45dB
	$12.5 \leq f_{\text{offset}}$	<35dB
Spurious Emission	9kHz~150kHz	$\leq -36\text{dBm}/1\text{ kHz}$
	150kHz~30MHz	$\leq -36\text{dBm}/10\text{ kHz}$
	30MHz~1GHz	$\leq -36\text{dBm}/100\text{ kHz}$
	1 GHz ~ Flow - 10 MHz	$\leq -30\text{dBm}/1\text{ MHz}$
	Flow - 10 MHz ~ Fhigh + 10 MHz	$\leq -15\text{dBm}/1\text{ MHz}$
	Fhigh + 10 MHz ~12.75 GHz	$\leq -30\text{dBm}/1\text{ MHz}$
ACRR		20dBc/30kHz@±5MHz
		20dBc/30kHz@±10MHz
Frequency stability		$\leq 0.01\text{ppm}$
Error Vector Magnitude		$\leq 12.5\%$
Peak Code Domain Error		$\leq -35\text{dB}$ @Spreading Factor 256
Noise Figure		$\leq 6\text{dB}$
V.S.W.R		≤ 1.8
Group Delay		$\leq 5\mu\text{s}$
Power Consumption		$\leq 15\text{W}$
Cooling		Heatsink Convection cooling
Intelligent Functions		Standard
ISO(Donor antenna and Service antenna)		Flickering per 1s when the Isolation is not enough; it lights up when is normal.
Uplink Sleep Mode		Flickering per 1s when there is no users in the coverage. The uplink circuit will shut off, and the ground noise will be less than -70dBm. Light up when there are users in the coverage.
Smart Mode		Automatically adjust the gain in both links according to the specific environment.
Input and Output signal strength		Shown Input signal strength with numeral number. Shown Output signal strength with signal bars.
LED Alarm		Standard
Power LED		Green @ Normal work
ALC LED		Green flickering @ ALC 1~10dB; Orange flickering@ ALC 11~20dB, Red flickering @ ALC above 21dB
Mechanical Specifications		Standard
I/O Port		N-Female
Impedance		50 ohm
Operating Temperature		-10°C ~+55°C
Environment Conditions		IP40
Dimensions		150*210*36mm
Weight		$\leq 2.5\text{KG}$
Power Supply		Input AC100~240V, output DC12V / 3A

7. Installation Guide

The SYN-30L-S series repeaters should be used to cover the indoor area only. Humidity and temperature shall affect the reliability of repeater. Thus the temperature, humidity, dust, interference, power, space requirements and other factors should be considered during installation.

7.1. Installation location requirement

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

7.2. Power requirement

Generally it is AC power supply, and the requirement of AC is 100~240V, 50/60Hz

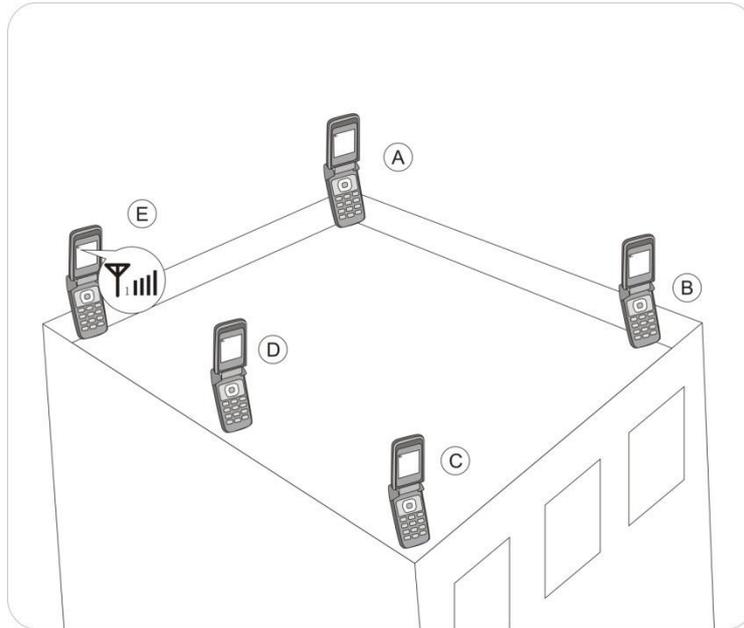
7.3. Installation tools and accessory

No.	Name	Specification	Quantity	Remark
1	Plastic Expansion Bolt	M4*25	2	Standard accessories
2	Tapping screw	M4*25	2	Standard accessories
3	Hanging folder		1	Standard accessories
4	reciprocating drill		1	Engineering-owned, punch the wall
5	Shot bit	M4	1	Engineering-owned, punch the wall

8. Antenna installation

8.1 Donor antenna installation

The repeater's main function is to improve weak RF signals. 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 good donor antenna location in order to get the best source signal.

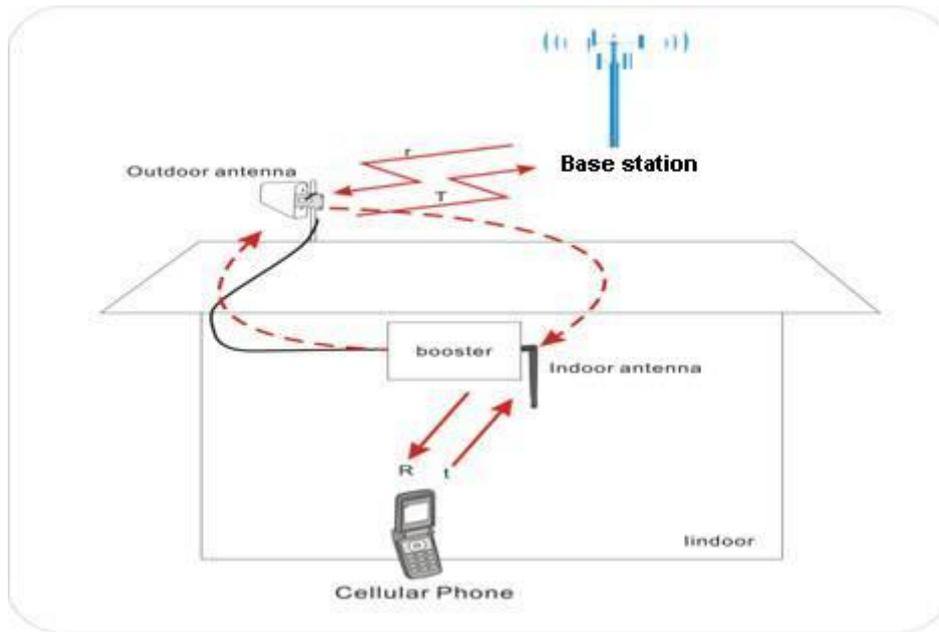


- Testing the signal strength received from donor antenna mounted in site by mobile phone:
 - As shown from the above illustration, testing the signals from A to E, and select a best place that displays full bar signals to install the donor antenna.

- Selecting 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 service antenna. If donor and service 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 performance is poor due to weak signals or poor phone call quality, please adjust the direction of donor antenna or change its position.

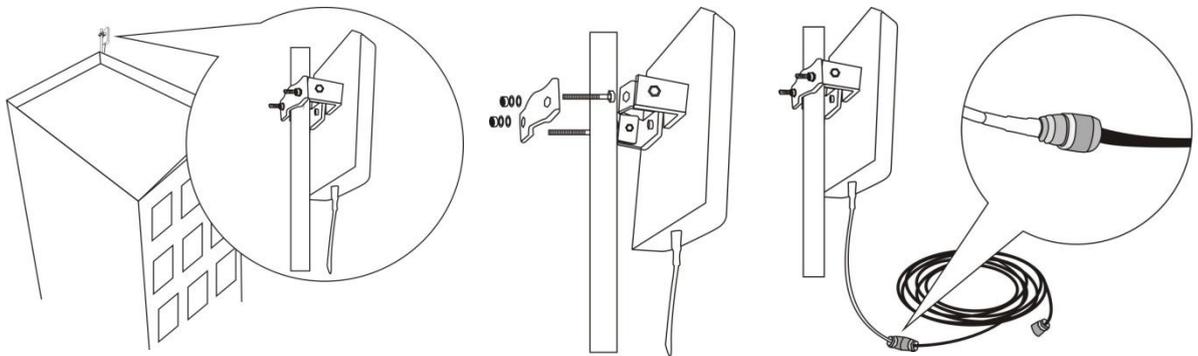
- The minimum distance between donor antenna and service antenna shall be more than 10 meters; again the direction of donor and service antennas shall be opposite.

As shown in the below illustration, the booster amplifies the downlink signal **R** from the tower and send to the indoor antenna hereafter. If the distance between outdoor antenna and indoor antenna is less than the required distance, the amplified signal **R** will go back from indoor antenna to outdoor antenna. So it will lead to self-oscillation and reduce the coverage area, also the bad calling quality could happen at the same time, and the worse is that the mobile network could be influenced badly and the operators will finally come to shut off the repeater system.

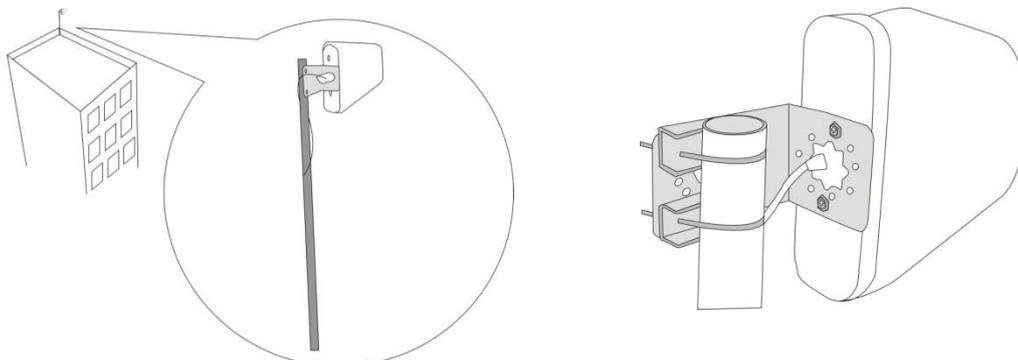


If isolation can't be achieved by the limited distance, the roof of the building or any other barriers can be used in between to increase isolation.

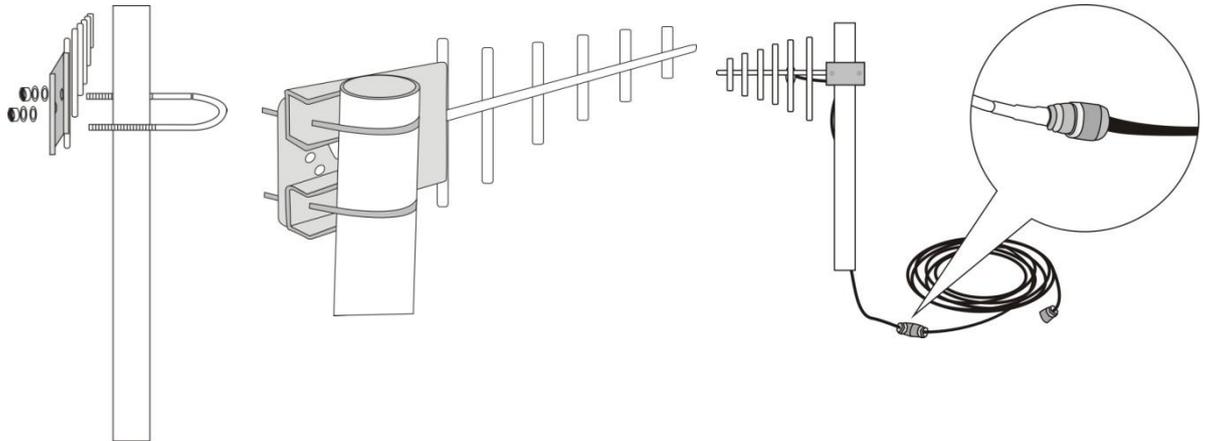
■ Installation of panel antenna as donor antenna



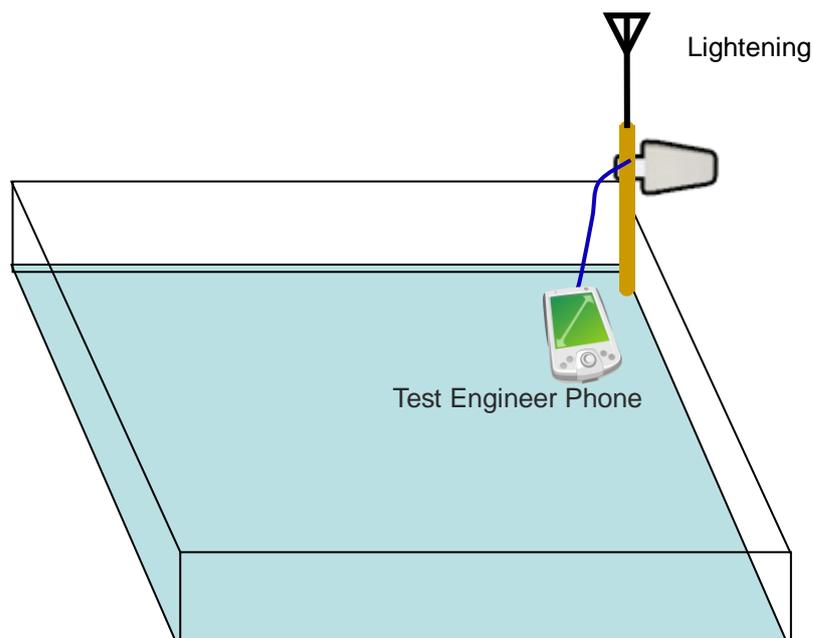
■ Installation of wide directional antenna as donor antenna



- Installation of YAGI antenna as donor antenna



- Test the call quality of donor antenna (for professional installation team only)



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.

8.2 Service antenna installation

Proper antennas shall be selected according to the site conditions. More than one antenna can be used with the repeater, especially for repeaters equal with or over 20dBm. A 30dBm repeater can be connected with up to 10 antennas in order to send the signals to larger areas and distribute the signals equally. Please consult professional engineers about the solution if you want to connect more than one antenna.

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



- 2) It is recommended 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).



9 Repeater installation

9.1 Installation steps

The SYN-30L-S series repeaters shall be installed in indoor areas only.

- 1) Connect the power supply and the cables properly to the correct ports.
- 2) Check again to make sure the repeater is installed firmly and repeater alarm LED stay in green.

9.1.1 Repeater's ports description

- 1) Outdoor port: connected to the donor antenna by cable.
- 2) Indoor port: connected to the service antenna directly or by cable.
- 3) DC IN: connected to the power supply(12V/3A).
- 4) ON/OFF: Power switch to turn on or turn off the repeater.

9.1.2 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 UMTS2100, so all the accessories must support the UMTS2100 frequency. 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.

9.2 Repeater settings

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

9.2.1 LED indicators' status and definition

After power is on, check first the POWER and ALARM LEDs.

- Status and definition of POWER indicator:

Status	Definition
Green	Normal
Off	DC power problem

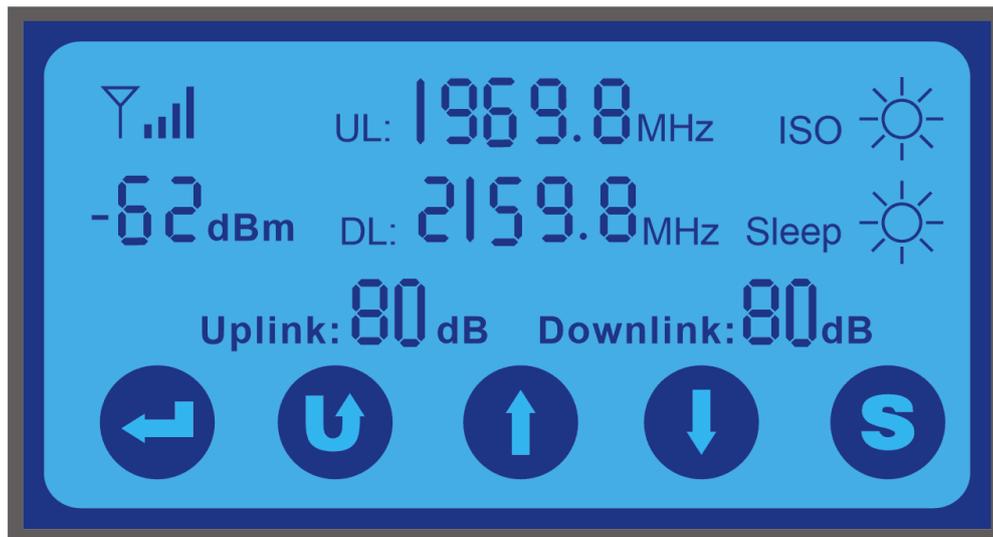
- Status and Definition of ALARM indicator:

Status	ALARM
Green	It is working in linearity
	Note: Input signals may be not enough, please refer to the figures shown in the device. Do not do anything if it is good; otherwise please adjust the repeater system to get better source signal.
Green Flickering	It is working with slight oscillation.
	AGC activate 1~10dB.
Orange Flickering	It is working with medium oscillation.
	AGC activate 11~20dB.
Red Flickering	It is working with deep oscillation.
	AGC activate 21~30dB, and it will shut off after 5 seconds of Red.

- Status and definition of ISO indicator:

Status	ISO
Common Display	It is working properly
ISO Flickering PER 3S	It is working with slight isolation
	Please adjust the distance/angle of the donor antenna and service antenna to keep with enough isolation. The longer distance, the better isolation.
ISO Flickering PER 1S	It is working with deep isolation
	Please adjust the distance/angle of the donor antenna and service antenna to keep with enough isolation. The longer distance, the better isolation.

9.2.2 Manual Gain Control (MGC)



Press “” icon, and till you reach to the uplink gain (the uplink gain figure is flickering), then press “”

to decrease the gain as per the request, you can also press “” to increase the gain once the setting is

not proper. Please do remember to press “” again to confirm the settings after setting to the right value.

The same operation for setting the downlink gain.

9.2.3 Central frequency adjustment

The repeater is able to adjust the central frequency from the touch screen with 100KHz step. For long press “” and “”, the adjusting step will be faster. See the detailed operations.

Press “” icon, and till you reach to the uplink central frequency (the UL central frequency figure is flickering), then press “” to upward adjusting the central frequency, or press “” to downward adjusting the central frequency. Please do remember to press “” again to confirm the settings after setting to the right value.

Remark: The uplink frequency and downlink frequency is correspondingly fixed, users only need to set either UL or DL central frequency, the other link will change automatically. If the adjusting range over 20MHz, we recommend you to make it two times. The suitable adjusting range is 10~15MHz per time.

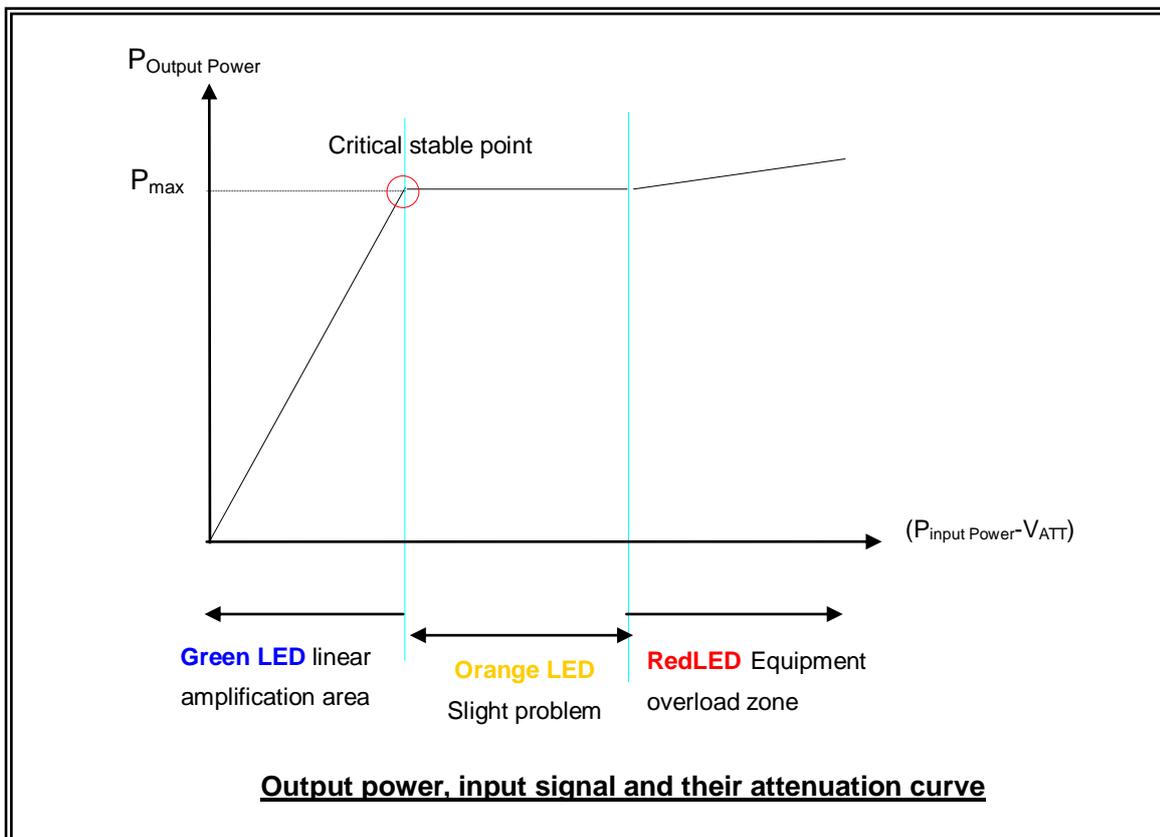
9.2.4 Smart function

The Smart function means that the repeater could set the gain automatically. Users could press  to turn on or turn OFF this function.

Remark: When the smart function is on, users could not able to set the gain manually. If you need to set the gain by hand, please first turn OFF the smart function, and then follow the instruction of MGC setting.

9.3 Commissioning

- 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**

Here we use color of Alarm LED to adjust the gain of the repeater. Alarm LED color must remain green. As for the downlink working performance, it is a good working status that Alarm LED maintains “Green”

with the intention of turning Orange; here we refer as “edge point”. At this time, downlink output power and coverage effect are stable.

- **Uplink gain setting**

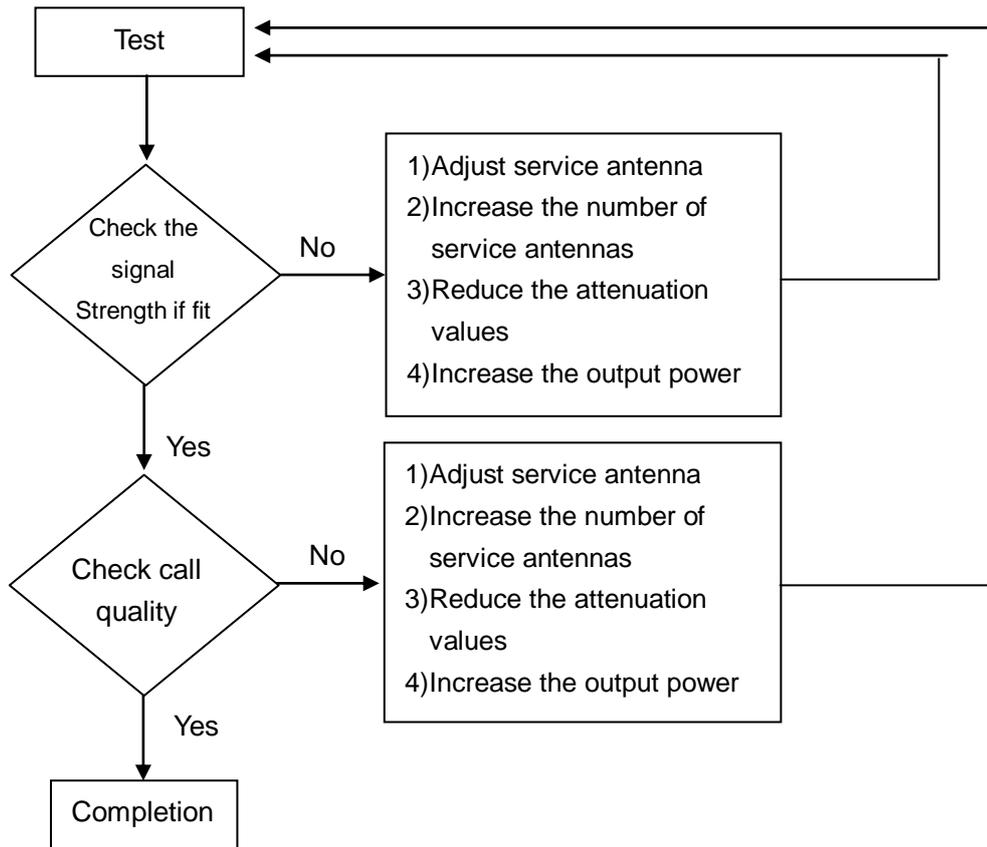
Standard: uplink attenuation values =downlink attenuation values

Remark: Avoid putting more than 5dB difference between the Uplink and Downlink. And Uplink gain must be equal to or less than DL gain, it can't be more in order to avoid interference to mobile network.

9.4 System Test

9.4.1 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 antenna to increase input signal power level.
 - ◆ Check whether it is necessary to add more service antennas since barriers block the signal penetration, also check whether the repeater's power is enough; please install more service antennas or replace with a repeater of 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 to improve coverage.
 - ◆ Check if it is necessary to adjust the direction of the service 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 direction / location, or replace with higher gain antenna to increase input signal strength.

9.4.2 Repeater can not communicate in POWER ON status

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

It shall be caused by the insufficient isolation between donor antenna and service antenna.

Please take below measures:

- Firstly check whether the alarm LED is orange. The orange light shows the insufficient isolation.
- Secondly adjust the antennas' directions or locations or enlarge the distance between them.
- Thirdly reduce the repeater's gain if the above methods don't work.

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 service antenna in different floors).
- Use some obstacles (Such as wall).

- 2) The repeater's power is on but the phone is still not able to connect to the network:

- **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 is reduced between operators.
 - ◇ **Solution 2:** Use barriers (like buildings) to block signals of other operators.
- 3) The repeater has ALARM OFF status
- **Reason:** the repeater breaks down.
 - ◇ **Solution:** Please check the power adaptor to see if it breaks down or not, then take off the plug and re-plug in, if alarm LED maintains off, the repeater break down is confirmed, then please consult local dealers for warranty.
 - **Reason 2:** There is self oscillation if alarm LED turns red after re-plugging in.
 - ◇ **Solution 1:** Change the direction or location of donor or service antennas to enlarge the distance.
 - ◇ **Solution 2:** Use barriers (like buildings) to increase isolation.
 - ◇ **Solution 3:** Reduce the repeater gain manually.

-----End-----