

# Technical User Manual **JDIR-37-87 / 40-90**

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*Band Selective Industrial Repeater*



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**WARNING! This is NOT a CONSUMER device.**

It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

For North American Market.

**User Warnings – MUST READ!**



1. This repeater must **ONLY** be used for the purpose it was intended for. Making any alternations to the design layout without first consulting with a trained technician can result in interference to the operator's network and liability by the end user.



2. Please read this entire manual carefully before using this product!



3. Only the power supply that came with the repeater should be used at all times. It is highly recommended that the repeater is grounded and lightning protection used.



4. Do not attempt to open any sealed part of the repeater. This will void the warranty and can cause an electric shock. Electrostatic can also cause damage to the internal components.



5. Please keep away from any heating-equipment, because the repeater will dissipate heat when working. Do not cover the repeater with anything that influences heat-dissipation.



6. Do not use an unauthorized antennas, cables and / or coupling devices not conforming with the ERP/EIRP and/or indoor-only use restrictions.

**IMPORATNT SAFETY INFORMATION**

Antennas used for the purpose of radiating signals indoors are limited to a maximum gain of 3 dBi. The outdoor antenna used for the purpose of communicating to the wireless infrastructure is limited to -2 dBi, or any combination of gain and loss that equates to -2 dBi at output. Each antenna must be positioned to observe minimum separation requirements from all users and bystanders.

The following guidelines should be used when considering separation distances.

**INDOOR** antennas must be placed such that, under normal conditions, personnel cannot come within 100 cm (~39.37 in.) from any inside antenna.

**OUTDOOR** antenna must be positioned such that, under normal conditions, personnel cannot approach closer than 120 cm. (~4ft.). A non- directional antenna having a maximum gain of -2 dBi is used, precautions should be taken to prevent personnel from routinely passing closer than specified.

## 1. Preface

Personal mobile communication is now part of daily life and persons have come to expect a robust network that meets their increased demand for an always-on network that provides seamless coverage and unlimited bandwidth at high speeds. Cellular repeaters are an integral part of achieving this goal.

A cellular tower in a non-metro environment typically supports a large capacity of users but is affected by a relatively small coverage footprint. Therefore, the average number of users who can access it is limited and a large amount of channel resources go unused. The best way of solving this problem is to use repeaters to extend the BTS coverage to fully utilize the telecommunication resources. Hence cellular repeaters are no longer considered as peripheral devices to cover blind areas in the network but as part of the core network itself. Extending coverage and maximizing the available network resources and revenue growth for the operator.

The complete coverage approach is not only a prerequisite for a high quality mobile cellular network, but also a factor that attracts users. From this point of view, a network operator should first consider providing a radio network architecture with complete coverage in mind. This includes seamless coverage in urban areas, heavy traffic areas, office buildings, super markets, and top grade hotels as the first step. Cellular repeaters successfully aid in accomplishing this.

With this in mind, JDTECK has focused on successfully developing advanced repeaters that are applicable to any mobile network and indoor distributed antenna system (DAS). Repeaters are available to support any technology or frequency used today.

Because a large amount of BTS or Node B devices are deployed in densely populated urban areas, there is usually no large blind area. Repeaters are simply used to provide coverage inside buildings, sub-ground locations or rural outdoor areas. Typically, radio frequency (RF) repeaters are used when optical fibers are not available in buildings or when using a fiber solution is not cost effective.

Since the number of repeaters on a cellular network usually increases with the number of buildings to be covered in a specific sector, multiple repeaters may end up feeding from one BTS or Node B. In view of this, the design of the DAS is extremely important to maintain an acceptable noise floor and thus achieve seamless integration to the macro network especially in densely populated areas.

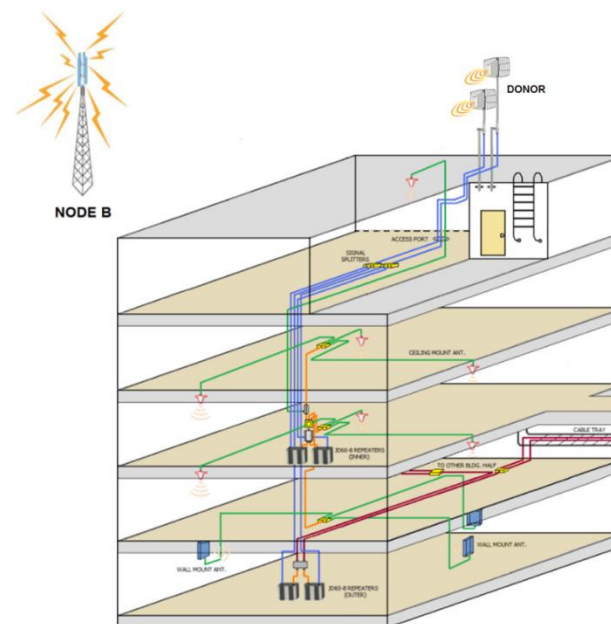


Figure 1 shows an **indoor** application of repeaters. (I-DAS)

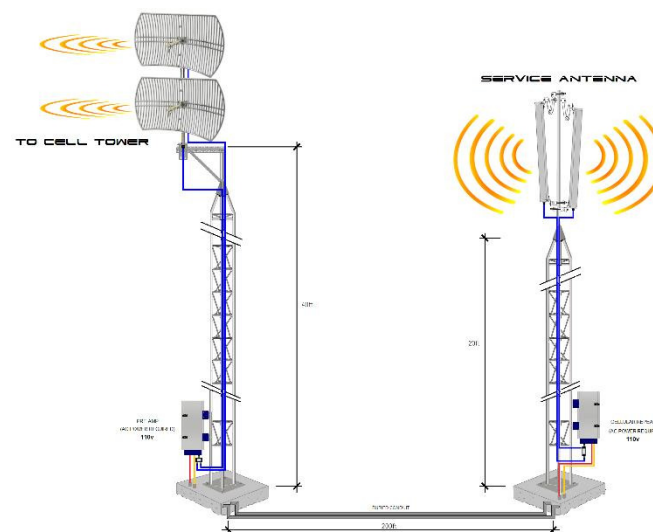


Figure 2 shows an **outdoor** application of repeaters. (O-DAS)

## 2. Introduction

This full duplex mobile communications repeater from JDTECK is the perfect solution for providing a wireless improvement in the cellular reception of a large office or apartment building, hotel, underground parking garage or remote outdoor location.

It is designed to improve the call quality of an area by receiving, amplifying, filtering and re-transmitting the signals from the base station into a specified area via a distributed antenna system (DAS) or distributed antenna grid.

To maintain safe and specific output signal levels, this repeater has built-in signal oscillation detection circuits with color changing LEDs to indicate its environmental status. The Alarm LEDs located inside the enclosure for both Downlink Alarm & Uplink will change color from green to amber or 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, the repeater will indicate this.

This repeater also has an automatic gain control (AGC) feature which will reduce the output power of the repeater if oscillation is detected. This range can vary from 10-15dB depending on the model of your repeater. If the reduction in gain needed to take the unit out of alarm exceeds the range of the AGC, then the end user can make use of yet another feature of this repeater called manual gain control (MGC). This allows the end user to further reduce the output gain of the repeater by using the DIP switches to manually attenuate (reduce) the repeater's output gain of either the uplink or downlink individually.

JDTECK's repeaters also feature a Network Safe / **MUTE** feature that automatically shuts-down the transmission side of the repeater to protect the cellular network if no adjustments are made to eliminate alarm readings on the repeater's LEDs. You will want to make sure the LEDs remain green at all times for optimum system performance.

The main cause of signal oscillation is when any of the indoor antennas are too close in proximity to the outdoor antenna on the roof.

Alarm LED status chart and recommended action:

**Green** – No system errors detected.

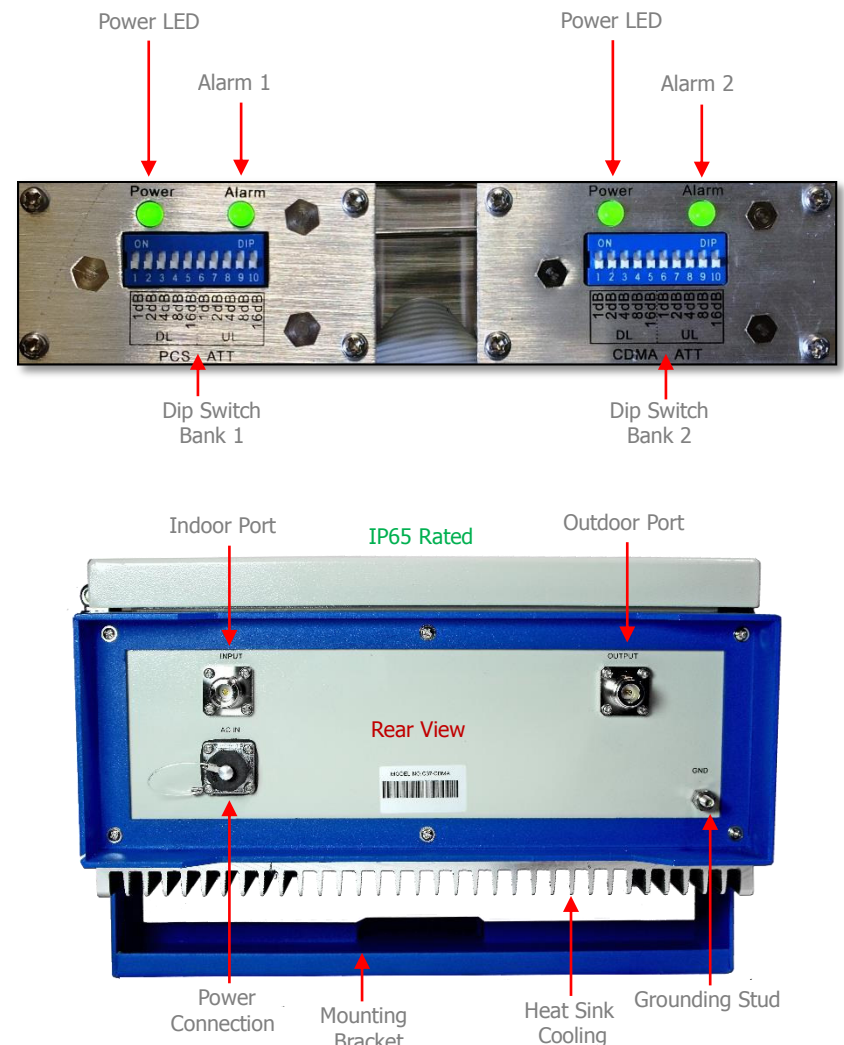
**Amber** – Mild detection of oscillation. (Add attenuation)

**Red** – Strong signal oscillation. (Add attenuation)

**Off** – Repeater is not transmitting / MUTE. (Add attenuation & cycle power)

## Features & Functions

- ✓ Stable Performance and Technical Parameters.
- ✓ Large cooling fins for heat dissipation.
- ✓ LED indicators to monitor environmental status.
- ✓ Supports all technologies including GSM, WCDMA, UMTS & LTE.
- ✓ ALC function. (Automatic Limit Control).
- ✓ AGC function. (Automatic Gain Control)
- ✓ MGC function. (Manual Gain Control)
- ✓ MUTE function. (Shuts down if no change in environmental conditions)
- ✓ Heat Sink. Cooling fins to dissipate heat quickly and efficiently



### 3. Installation

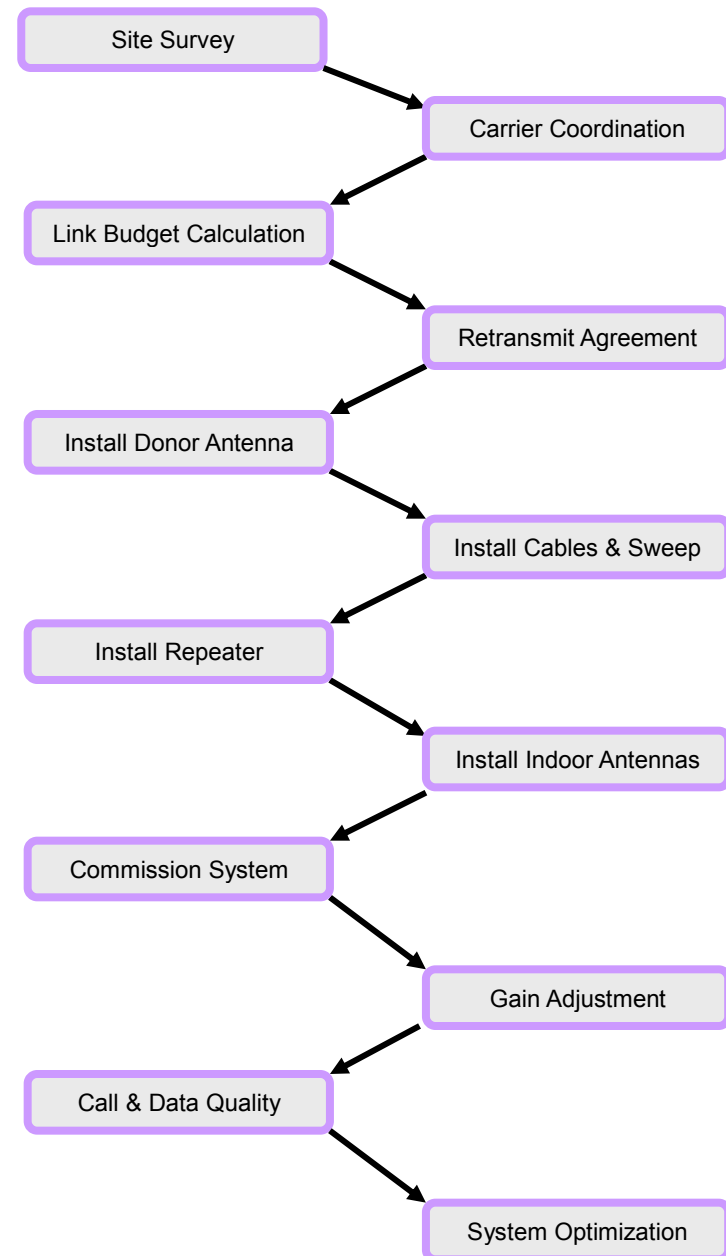
1. The repeater's main function is to improve weak RF signals to an area.
2. Selecting the appropriate accessories that are compatible with the frequency of the repeater is very important for optimal system performance. A 700MHz Repeater needs to be used with accessories that supports the 700MHz band. In the same way, choosing accessories in the 1900MHz Band needs to go with a 1900MHz Repeater etc. For multi-band repeaters, please ensure the peripheral components used supports all the frequencies needed.
3. The signal strength and quality at the outdoor antenna directly affects the efficiency of the indoor coverage. Therefore it is very important to choose the location of the outdoor antenna carefully. With this in mind, it is recommended that the donor antenna be installed in clear line of sight (LOS) to the serving sector/s.
4. The repeater is a two-way (full duplex) signal amplifier. Therefore there needs to be proper isolation between the outdoor antenna and indoor antenna in order to avoid signal oscillation of the repeater. (Feedback) There needs to be more than 15dB of isolation above the repeaters gain. For example, if the repeater gain is 80dB, then you need 95dB of isolation between outdoor antenna and indoor antenna.
5. The repeater gain is adjustable for both the uplink / downlink individually. Depending on the environment, the end-user may need to adjust the repeater gain to achieve optimum performance and desired coverage.
6. The repeater is designed to amplify the input signal, filter it and retransmit it to the desired area via service antennas. In order to reach the best performance, the outdoor signal should be better than -80dBm with an  $E_c/I_o < 6$  and an RSRQ of  $< 12$ dB. If the outdoor signal is very weak, then a pre-amplifier may be used.
7. Calculating the Link budget before setting the repeater gain.

#### Link budget calculation:

Outdoor signal strength – Loss of accessories (cable, connectors, splitters, Directional Couplers, Path Loss) + Antenna gain (outdoor antenna, indoor antenna) + Repeater gain = Indoor signal strength.

8. For all cellular applications, you need to use 50 Ohm rated coax. Besides affecting voice quality, using any other impedance of coax will put an extra load on your repeater and shorten its life span.

### 3.1 Installation Procedure



### 3.1 Installation Procedure – Cont.

- Check the contents supplied against your packing list & DAS design.
- Identify a suitable location where the donor antenna will be installed on the roof or at an elevated location free of any other antennas or immediate obstructions. Confirm this location has the best input signal for the carriers you would like to support using test equipment. Ensure the location is properly isolated from any of the indoor service antennas so as to avoid signal oscillation.
- Identify the location for the head-end equipment and that suitable AC power and a lightning ground is available. Using the DAS design provided, walk the entire space to confirm all the components and cable access paths of the DAS can be installed without any omissions.
- Install the donor antennas at the suitable location identified and start the cabling process. **DO NOT COIL UP** any excess coax you may have or create any service loops. These are detrimental to cellular performance. Be sure to weather proof all your external connections and fire stop all ports of entry.
- Carefully follow your DAS diagram to ensure all the components are installed according to the design. Any alterations made to the system layout without informing the DAS design engineer could result in system performance failure or interference to the macro.
- It's **EXTREMELY IMPORTANT** that all your cable terminations be done properly and line sweeps completed using the appropriate test equipment. (*Frequency Return Loss*) Directional couplers **MUST** be installed in the right direction and with the correct values as outlined in the DAS design. **DOUBLE-CHECK ALL YOUR WORK!** The extra time you invest to do so will pay-off with a smooth and successful commissioning process.
- If multiple repeaters are deployed, start by commissioning one repeater at a time. It's best to start with the frequencies that support voice communication, then move on to data (4G, 5G, LTE). Upon commissioning, quickly work towards getting the LEDs on the repeater to a green status by adding attenuation as needed. First on the DL, then on the UL.
- If signal oscillation or a strong input signal is between 1~4dB over the acceptable range then the Alarm LED for the respective band will turn amber (See manual gain adjustment). If the signal oscillation is between 10-15dB then the Alarm LED for the respective band will turn red and the circuit will then go into MUTE / Shutdown. This is as a result of not having enough isolation between the donor and service antennas or the input signal at the donor antenna is too strong.

### 3.2 Installation Procedure – Antenna Mounting.

In this case attenuate the DL gain on the repeater till the alarm LED goes green and then match the UL gain to the same gain value.



- Do not install the donor antenna near high voltage power lines.
- Please take the necessary safety measures when working on heights.
- Do not mount near or in the path of other antennas or satellite dishes.

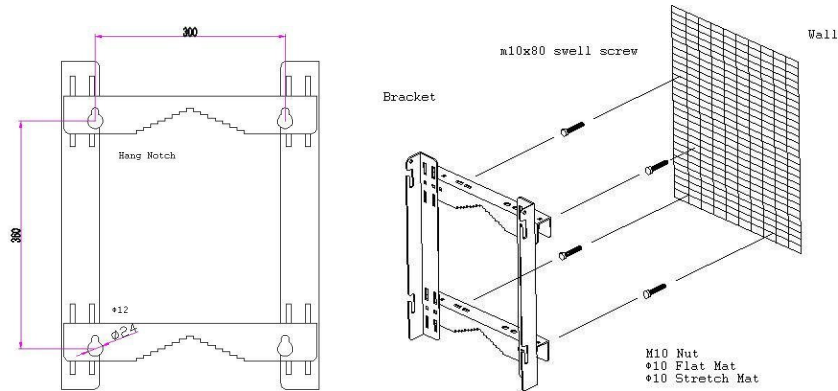


It is recommended that you mount your donor antenna in a spot that is free of any immediate obstructions. Making use of a dedicated mast or mounting bracket is recommended for optimum antenna performance.



### 3.3 Installation Procedure – Repeater Mounting.

The JDIR series repeater can be mounted on a wall or pole. First remove bracket from repeater and securely bolt bracket to the wall. Be sure to use a level so the bracket is straight when completed.



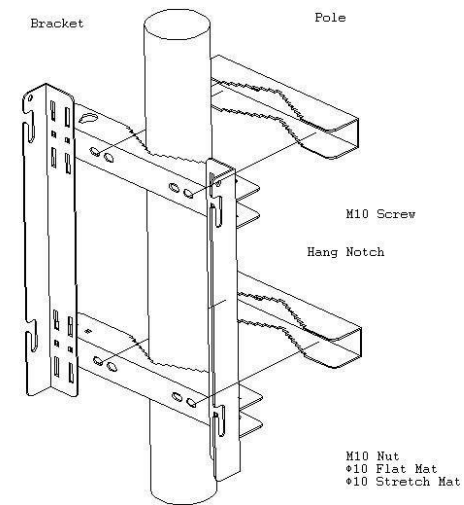
Once the bracket is secured to the wall, then slide repeater onto the bracket.



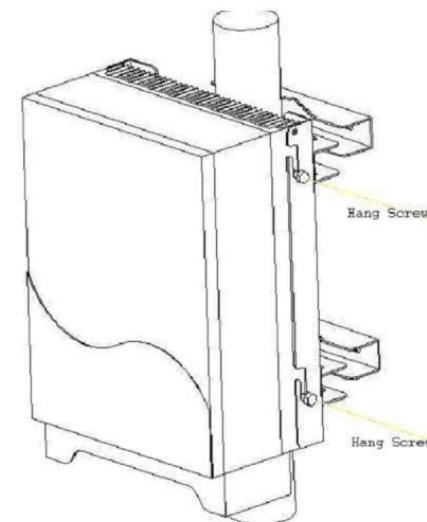
*Example of repeaters installed in communications closet.*

### 3.4 Installation Procedure – Repeater Mounting Cont.

For the pole mount option, remove the bolts for the 2 lateral cross bars and turn them 90 degrees so the notches face to the rear. Then reattach the bars using the same bolts.

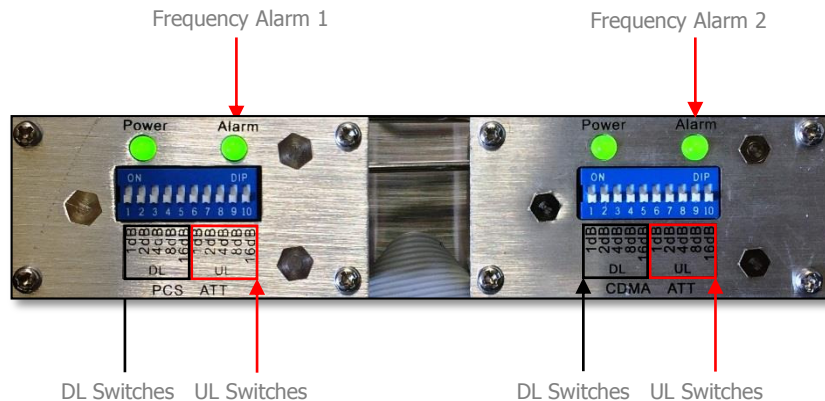


Once the bracket is secured to the wall, then slide repeater onto the bracket.



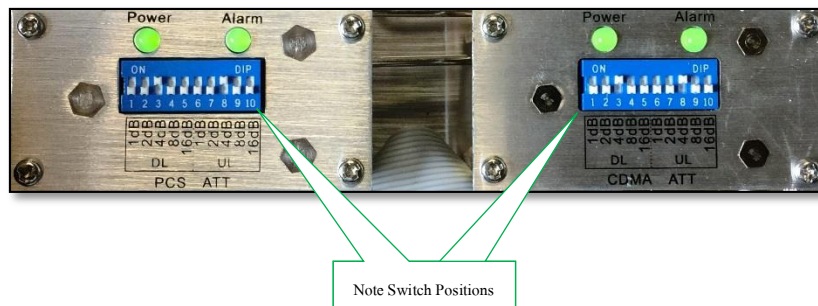
## 4. Manual Gain Adjustment ~ UL / DL

In order to meet and maintain safe environmental conditions for seamless network integration, this repeater 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 0dB to -31dB by 1dB increments in each band. There is a dip switch bank available for each frequency.



The DIP Switch control method is described as below.  
Switches 1-5 represents DL adjustment & 6-10 represents UL adjustment.

Example of the DL & UL  
Attenuated by 4dB



Avoid putting more than a 5dB difference between the Uplink and Downlink.

## 4.1 Manual Gain Adjustment ~ UL / DL – Con't.

### When do you adjust the Repeater Gain?

This repeater is equipped with an alarm feature that monitors the input gain. If the input gain is too high, the DL Alarm LED will change color from green to either amber or red indicating the intensity of the error. High input gain can occur if the donor antenna is in a location where the receive signal strength (RSSI) from the cell tower is extremely good (-50dB or better) or if signal oscillation is taking place. Signal Oscillation is when the amplified signal from the indoor service antenna is being received back into the donor antenna.

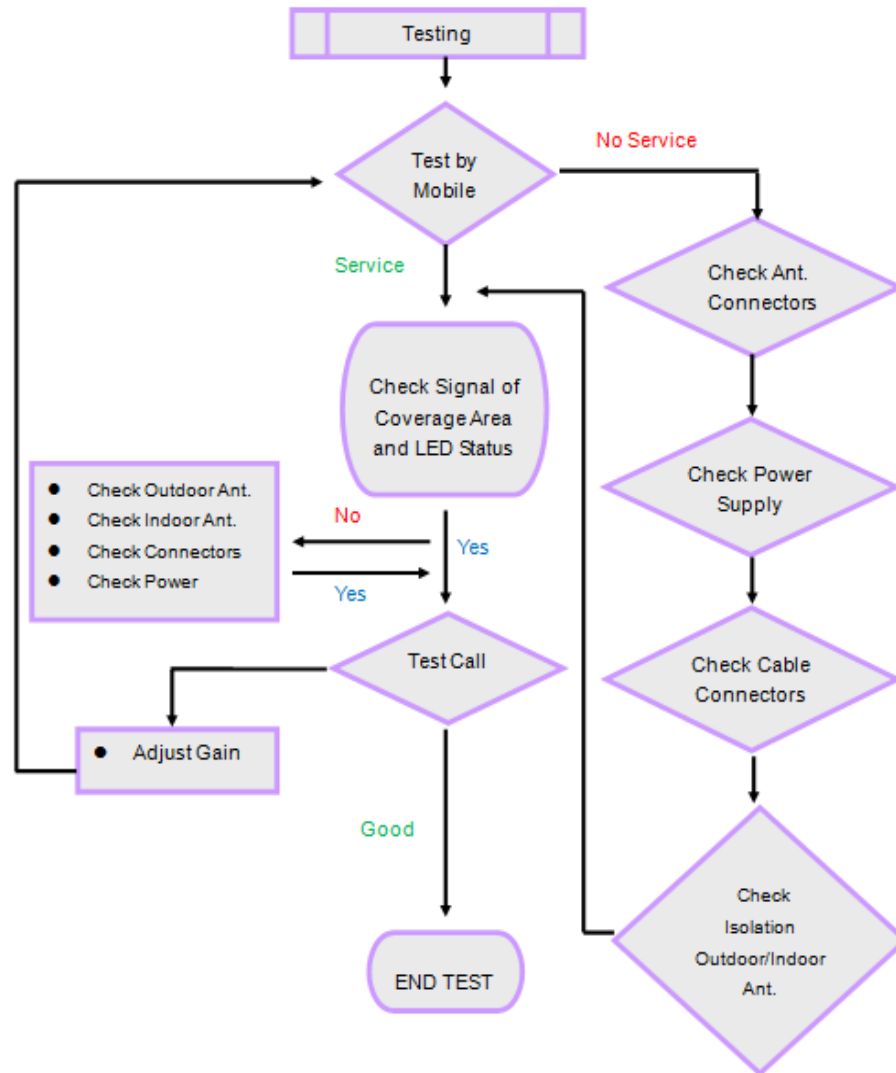
To determine the cause of your Alarm LED changing color, disconnect the indoor antenna / service line from the “**INDOOR / OUTPUT**” port of the repeater while the repeater is ON. If the LED does not change to green, then your input signal from the cell tower is very strong. At this point you attenuate the DL gain by 1dB increments till the LEDs turns green again. Then you must match the same attenuation value to the UL set of switches.

If after reconnecting the indoor / output service line the LED changes back to amber or red then signal oscillation is taking place. This is the result of your **Indoor / Service** and **Outdoor / Donor** antennas being too close to each other and should therefore have more separation or continue to add more attenuation.

When complete, try making some test calls throughout the desired area of coverage while monitoring the LEDs 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 gain 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.

We encourage you to call us if you are experiencing difficulty when commissioning your repeater system. We want to make sure you have seamless integration to the cellular network and optimal system performance. We are always happy to help. **1-866-4-JDTECK (53-8325).**

## 5. Testing



## 6. Troubleshooting

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

#### Answer:

1. Check the power on repeater 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 repeater 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. Why can't I make a call after installation, even though I can detect a signal?

#### Answer:

1. Check LED status of repeater to make sure alarms are green.
2. Change the location of outdoor / indoor antenna.
3. Reduce the UL gain of the repeater.

### Q4. The signal is not stable after turning on the repeater power.

#### Answer:

1. Check to see if the outdoor signal is stable or not.
2. Check the location of the donor antenna. Too close to other antennas.
3. Check the RF cable is broken or not and has no coils.
4. Confirm direction of donor antenna in relation to cell tower.

### Q5. Why is the LED on the front of the repeater not lit?

#### Answer:

1. Check the power source is normal or not.
2. MUTE feature is active. Attenuate gain of repeater and cycle power.

## 7. FCC Statement

### 1. FCC RF Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instruction for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

### 2. FCC Warning

**WARNING!** This is NOT a CONSUMER device.

It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

For North American Market.

## 8. Specifications.

| Electrical Specification         |                    | Uplink                                 | Downlink      |
|----------------------------------|--------------------|----------------------------------------|---------------|
| JDIR-37-87-700                   | LTE (Lower 700MHz) | 698~716 MHz                            | 728~746 MHz   |
|                                  | LTE (Upper 700MHz) | 776~787 MHz                            | 746~757 MHz   |
| JDIR-37-87-819<br>JDIR-40-90-819 | CDMA               | 824~849 MHz                            | 869~894 MHz   |
|                                  | PCS                | 1850~1910 MHz                          | 1930~1990 MHz |
| JDIR-37-87-AWS<br>JDIR-40-90-AWS | AWS                | 1710~1755 MHz                          | 2110~2155 MHz |
| Max .Gain                        | JDIR-37            | 85dB                                   | 87dB          |
|                                  | JDIR-40            |                                        | 90dB          |
| Max .Output Power                | JDIR-37            | 17±2dBm                                | 37±2dBm       |
|                                  | JDIR-40            | 19±2dBm                                | 43±2dBm       |
| Band width                       |                    | Selective / SAW Filter                 |               |
| Manual Gain Control              |                    | ≤ 31dB                                 |               |
| Intermodulation Products         | 9KHz~1GHz          | ≤ -36dBm                               | ≤ -45dBc      |
|                                  | 1GHz~12.75GHz      | ≤ -30dBm                               | ≤ -45dBc      |
| Spurious Emission                | 9KHz~1GHz          | ≤ -36dBm                               |               |
|                                  | 1GHz~12.75GHz      | ≤ -30dBm                               |               |
| Gain Flatness                    |                    | CDMA & LTE & AWS ≤ 8dB / PCS ≤ 10dB    |               |
| Noise Figure                     |                    | ≤ 5dB                                  |               |
| VSWR                             |                    | ≤ 1.5                                  |               |
| Group Delay                      |                    | ≤ 1.0μs                                |               |
| Frequency stability              |                    | ≤ 0.01ppm                              |               |
| CDMA System                      | Rho                | ρ > 0.980                              |               |
|                                  | ACPR               | Meet IS95 & CDMA2000                   |               |
| OSCILLATION<br>DETECTION         | MUTE Shutdown      | ≤ 5 sec                                |               |
| LED Alarm                        |                    | Standard                               |               |
| Power LED                        |                    | Power Indicator                        |               |
| ALC LED                          |                    | Orange @ ALC 1~5dB, Red @ ALC15dB~20dB |               |
| Mechanical Specifications        |                    | Standard                               |               |
| I/O Port                         |                    | N-Female                               |               |
| Impedance                        |                    | 50 ohm                                 |               |
| Operating Temperature            |                    | -25°C~+55°C                            |               |
| Environment Conditions           |                    | IP65                                   |               |
| Weight                           |                    | ≤ 35Kg                                 |               |
| Power Supply                     |                    | Input AC90~264V                        |               |
| FCC ID                           |                    | SQX-JDIR-37-700                        |               |
|                                  |                    | SQX-JDIR-37-819                        |               |
|                                  |                    | SQX-JDIR-37-AWS                        |               |

**Record your repeater settings here.**

| Downlink                                              |                   |                      | Uplink              |                    |                      |
|-------------------------------------------------------|-------------------|----------------------|---------------------|--------------------|----------------------|
| DIP                                                   | Modulation        | Value                | DIP                 | Modulation         | Value                |
| 1                                                     | LTE(Lower 700MHz) | <input type="text"/> | 6                   | LTE (Lower 700MHz) | <input type="text"/> |
| 2                                                     | LTE(Upper 700MHz) | <input type="text"/> | 7                   | LTE (Upper 700MHz) | <input type="text"/> |
| 3                                                     | CDMA              | <input type="text"/> | 8                   | CDMA               | <input type="text"/> |
| 4                                                     | PCS               | <input type="text"/> | 9                   | PCS                | <input type="text"/> |
| 5                                                     | AWS               | <input type="text"/> | 10                  | AWS                | <input type="text"/> |
| Total dB Attenuated                                   |                   | .....                | Total dB Attenuated |                    | .....                |
| <div> <div>Adjusted By:</div> <div>Date:</div> </div> |                   |                      |                     |                    |                      |

**Record your repeater settings here.**

| Downlink                                              |                   |                      | Uplink              |                    |                      |
|-------------------------------------------------------|-------------------|----------------------|---------------------|--------------------|----------------------|
| DIP                                                   | Modulation        | Value                | DIP                 | Modulation         | Value                |
| 1                                                     | LTE(Lower 700MHz) | <input type="text"/> | 6                   | LTE (Lower 700MHz) | <input type="text"/> |
| 2                                                     | LTE(Upper 700MHz) | <input type="text"/> | 7                   | LTE (Upper 700MHz) | <input type="text"/> |
| 3                                                     | CDMA              | <input type="text"/> | 8                   | CDMA               | <input type="text"/> |
| 4                                                     | PCS               | <input type="text"/> | 9                   | PCS                | <input type="text"/> |
| 5                                                     | AWS               | <input type="text"/> | 10                  | AWS                | <input type="text"/> |
| Total dB Attenuated                                   |                   | .....                | Total dB Attenuated |                    | .....                |
| <div> <div>Adjusted By:</div> <div>Date:</div> </div> |                   |                      |                     |                    |                      |

## NOTES

[illegible]