INNOVATIVE COMMUNICATION SOLUTIONS

# INSTALLATION
# AND
# OPERATING MANUAL

## RHBDA-454.7/467.5-0.1/8W-55-A

### RACK MOUNTABLE BI-DIRECTIONAL AMPLIFIER

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## RHBDA OVERVIEW:

The RHBDA assembly enhances the coverage area of radio communications in buildings and RF shielded environments. The RHBDA has dual RF paths (Forward/Reverse) to improve coverage in two distinct frequency bands.

The unit features low noise figure and wide dynamic range. It is based on a dual duplexed path configuration with sharp out of band attenuation allowing improved isolation between the receiving and transmitting paths.

## RHBDA BLOCK DIAGRAM DESCRIPTION:

Refer to figure 1 for the following discussion.

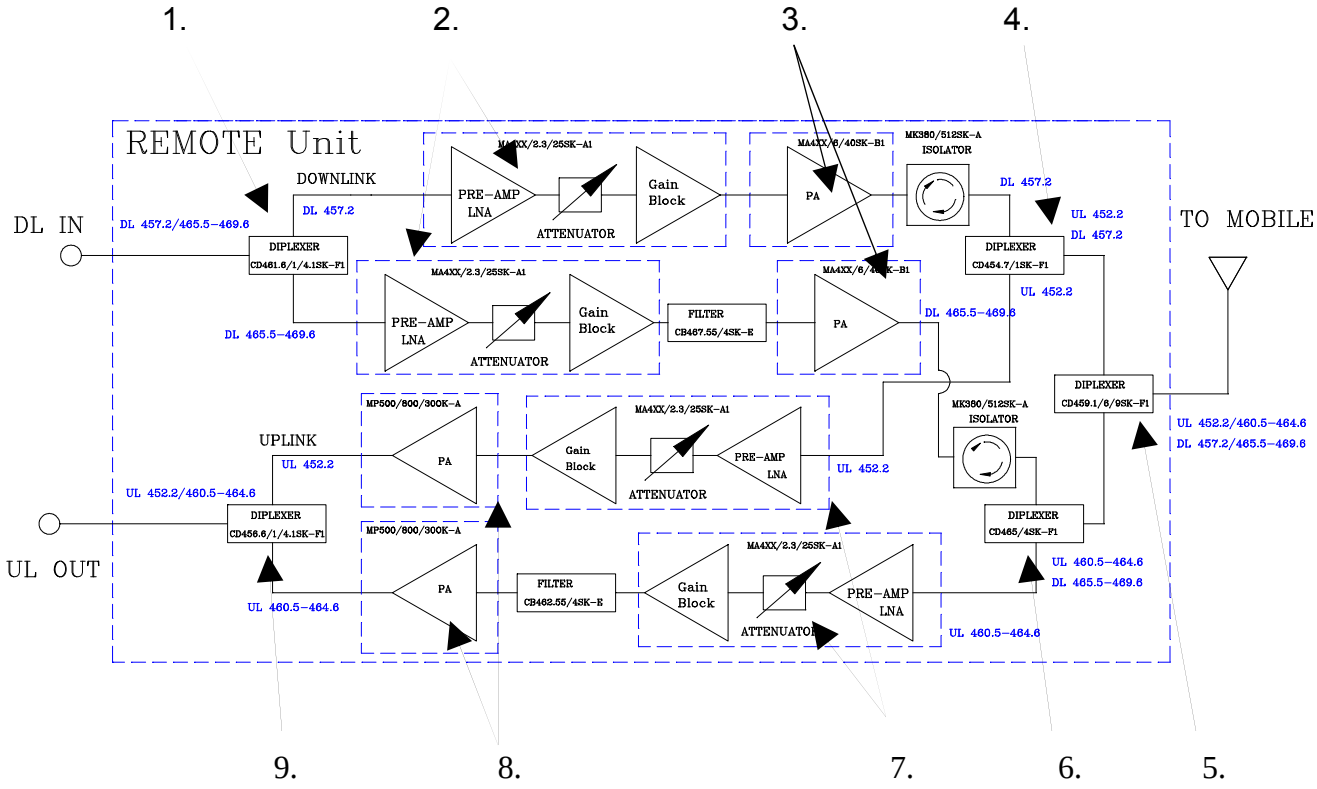
The RHBDA Downlink path receives RF signals from the base station at a Head-end Optic Fiber Unit*, and translates it to an Optical signal. The signal travels over a fiber optic medium, subsequently receives the signal at the Remote Unit, translates it to back to a RF signal then amplifies it, and transmits the signal to the subscriber. The RHBDA Uplink path receives RF signals at the Remote Unit from the subscriber then amplifies it, and translates it to an Optical signal. The signal travels over a fiber optic medium to the Head-end Fiber Optic Unit. The Head-end Fiber Optic Unit receives the signal, translates it to back to a RF signal then transmits the signal to the base station. The Uplink and Downlink occupy two distinct frequency bands. For example, the frequency bands are as follows: 451.7-452.7 & 460.5-464.6 MHz for the Uplink and 456.7-457.7 & 465.5-469.6 MHz for the Downlink. Five Diplexers isolate the paths and route each signal to the proper amplifying channel.

A selectable Automatic Level Control (ALC) allows for output power limiting. A variable step attenuator gives 0 – 30 dB of attenuation in 2 dB steps on the Remote Uplink path and two 0 – 30 dB of attenuation in 2 dB steps on the Remote Downlink path. The use of these controls is covered in the “OPERATION” section, later in this document.

## Optional DC Input Power Option (S1)

The RHBDA is equipped with both AC and DC voltage inputs for power operation. This gives the flexibility of powering the RHBDA with either an AC or DC source. If both sources are connected, the RHBDA will automatically select the stronger source for power.

# Figure 1




**RHBDA BLOCK DIAGRAM**
**RHBDA-454.7/467.5-0.1/8W-55-A**

1. Input Downlink Diplexer – has low bandpass insertion loss and high selectivity for two distinct Downlink frequency bands.

2. Downlink Pre-amp's – are low noise amplifiers that drive the Downlink PA's and offer 25dB Gain.

3. Downlink PA's – are power amplifiers with an ALC circuit which offer 30dB Gain.

4. Output Downlink Diplexer - has low bandpass insertion loss and high selectivity for two distinct Downlink frequency bands.

5. Uplink/Downlink Combiner – is Diplexed configured and has low bandpass insertion loss and high selectivity for the Uplink and Downlink frequency bands.

6. Input Uplink Diplexer – has low bandpass insertion loss and high selectivity for two distinct Uplink frequency bands.

7. Uplink Pre-amp's – are low noise amplifiers that drive the Uplink LPA"s and offer 25dB Gain.

8. Uplink LPA's – are low power amplifier's with an ALC circuit which offer 30dB Gain.

9. Output Uplink Diplexer - has low bandpass insertion loss and high selectivity for two distinct Uplink frequency bands.

## ELECTRICAL SPECIFICATIONS:

| | |
|---|---|
| Frequency Range | : UL 451.7-452.7 & 460.5-464.6MHz<br>DL 456.7-457.7 & 465.5-469.6MHz |
| Pass band Gain @ min attenuation | : 55 dB (Min.) |
| Variable Step Attenuator Range (2-dB steps) | : 0-30 dB |
| Pass band Ripple | : ±2.0 dB (Typ.) |
| . | |
| Noise Figure (Uplink) **@+25°C at max gain** | : 6.0 dB (Typ.) |
| 3rd Order Intercept point | |
| Downlink | : +52 dBm (Typ.) |
| Output Power (Composite)* | |
| Downlink | : +31 dBm (Typ.) |
| Uplink | : +5 dBm (Typ.) |
| Isolation between Up/Down Link | : 100 dB (Min.) |
| Input/ Output Impedance | : 50 Ohms |
| *SFDR | : 100 dB/Hz$^{2/3}$ |
| VSWR (Input/Output) | : 1.5: 1 (Max.) |
| Power Supply | : 110VAC/1.6Amps<br>: 220VAC/0.8 Amps<br>: 50 to 60 Hz |

**The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.*

## MECHANICAL SPECIFICATIONS:

| | |
|---|---|
| Size | : 19.0 x 13.0 x 7.0 inch<br>: (482.2 x 330.2 x 178 mm) |
| RF Connectors | : N-type Female |
| Weight | : 36.0 Lbs. (16.4 kg.) approx. |

## ENVIRONMENTAL CONDITIONS:

The unit is designed for indoor applications:

Operating temperature: - 20°C to + 55°C

Storage temperature: - 50°C to + 90°C

## RF EXPOSURE WARNING

In order to satisfy the FCC RF exposure requirements, the RHBDA/antenna installation must comply with the following:

The outdoor antenna (Yagi type or similar directional antenna) must be installed so as to provide a minimum separation distance of 0.6 meters (60 cm) between the antenna and persons within the area. (This assumes a typical antenna with gain of [10.1 dBi, VSWR ≤ 1.5:1, Zo= 50 ohms, and a cable attenuation of between 1-10 dB).

The indoor antenna (omni directional) must be installed so as to provide a minimum separation distance of 0.6 meters (60 cm) between the antenna and persons within the area. (This assumes a typical wide-beam type antenna with gain of 0-2 dBi, VSWR ≤ 2:1, Zo= 50 ohms, and a cable attenuation of between 1-10 dB).

## RHBDA CONNECTIONS

The RHBDA Remote AC power is accepted through a standard 3-wire male plug (IEC-320) with phase, neutral and ground leads (See Figure 3). The AC power is wired to a high efficiency DC switching power supply which is CE and UL approved. The Remote power supply runs the amplifiers, the Power ON lamp, and Fiber Optic Transceiver. The metal enclosure of the RHBDA is connected to ground.

An optional 9-pin D-Sub connector provides failure alarm output contacts (see diagram next page) as well as an optional 12 VDC (250mA) auxiliary output.

The RF connections are made via one type “N” female connector on the back panel (See Figure 3). The RF connection on the Remote Unit labeled “MOBILE” must be connected to the antenna facing the area to be covered by the RHBDA. The Fiber Optic connections are made via SC/APC female connectors. The Fiber Optic connector’s on each Remote Unit labeled “Fiber-In” and “Fiber-Out” are the fiber connections going to and from a Fiber Optic Head-end Unit.

The RF connections must be made through cables with characteristic impedance of 50 ohms. The Fiber Optic connections must be made through Singlemode cables with SC/APC connectors.

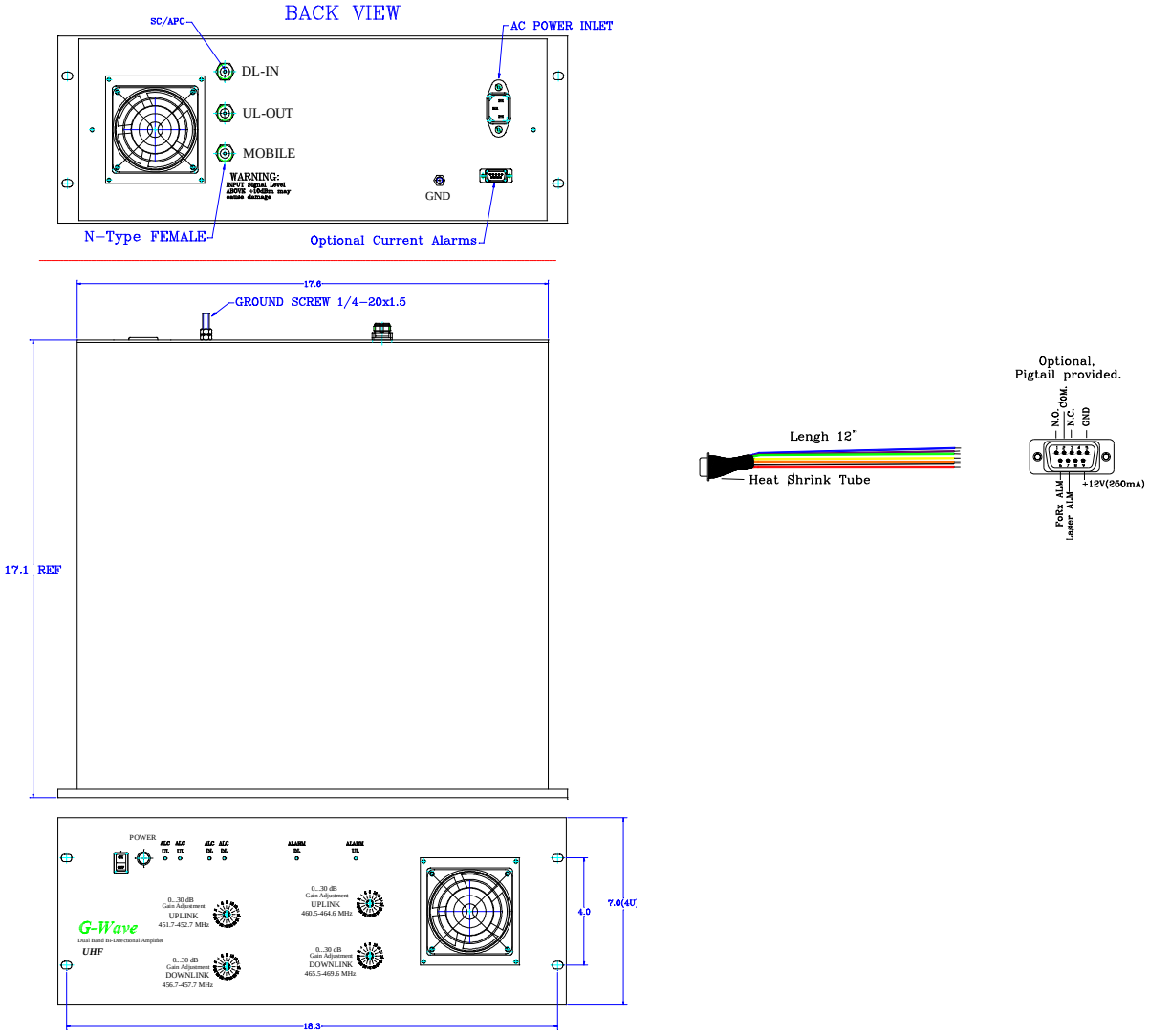
The OPTIONAL 9-pin D-Sub connector provides failure alarm output contacts (see diagram next page) as well as an optional 12 VDC (250mA) auxiliary output.

For S1 Option: The RHBDA is equipped with both AC and DC voltage inputs for power operation. This gives the flexibility of powering the RHBDA with either an AC or DC source. If both sources are connected, the RHBDA will automatically select the stronger source for power. NOTE: (To insure that the AC source will be selected when both sources are connected, DC input voltage must be ≤ 27 VDC.)
***Note: We do not guarantee specifications below 26.5 VDC*.**

**The isolation between the base station antenna and the mobile antenna should be at least 12 dB higher than the RHBDA gain. Isolation less than this value can cause gain ripple across the band. Isolation equal to or less than the RHBDA gain will give rise to oscillations which will saturate the amplifiers and possibly cause damage to the RHBDA.**

# Figure 2

## RHBDA Mechanical Outline

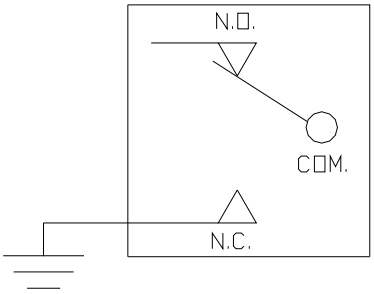



# Figure 2a

## Conditions for Optional Alarm

The alarm monitors current of both uplink and downlink amplifiers. An alarm condition will occur, if either uplink or downlink amplifiers are over or under its current tolerance.

(Relay Shown in Alarm Condition)



# RHBDA INSTALLATION

## DO NOT APPLY A.C. POWER TO THE RHBDA UNTIL CABLES ARE CONNECTED TO BOTH PORTS OF THE RHBDA AND THE ANTENNAS.

1. Side the RHBDA into the 19" accessible rack. Mount the RHBDA to the rack. Using appropriate screws, attach the RHBDA to the rack at the four mounting holes on the Front panel.

2. Ensure that the isolation between the donor antenna and the service antenna is at least 12 dB greater than the RHBDA gain. **(Use the higher of the Uplink and Downlink gains reported on the RHBDA test data sheet).**

3. Connect the cable from the service antennas to the RHBDA connector labeled "MOBILE" and connect the cable going to the Base RF Signal Source to the RHBDA connector labeled "UL OUT", and the cable coming from the Base RF Signal Source to the RHBDA connector labeled "DL IN".

4. Verify that all attenuation settings are positioned at 30 dB.

5. Connect the AC power cord to the Rack Unit. Turn the power switch to the "ON" position. Verify that each **Green** "Power ON" lamp, Laser alarms LED's are illuminated.

Installation of the Rack RHBDA's is now complete. To adjust the gain controls to suit the specific signal environment, refer to the next section of the manual.

***Note: For repeat installations of existing equipment, make sure the attenuation is positioned to its maximum setting (30 dB). After verification of the attenuation, follow the above steps starting with step 1.***

# RHBDA OPERATION

Refer to Figure 3 & 4 for adjustment access location, connectors and labels.

## Variable Step Attenuator

RHBDA gain can be reduced by up to 30 dB in 2 dB steps using the variable step attenuator. Gain adjustment is made with rotary switches accessible via the access on the front panel of the RHBDA enclosure (See Figure 3). Arrows on the shafts of these switches point to the value of attenuation selected. RHBDA gain can be determined by subtracting the attenuation value from the gain reported on the RHBDA Test Data Sheet for that side of the unit. The attenuators are labeled for Uplink and Downlink.

## ALC (Automatic Level Control)

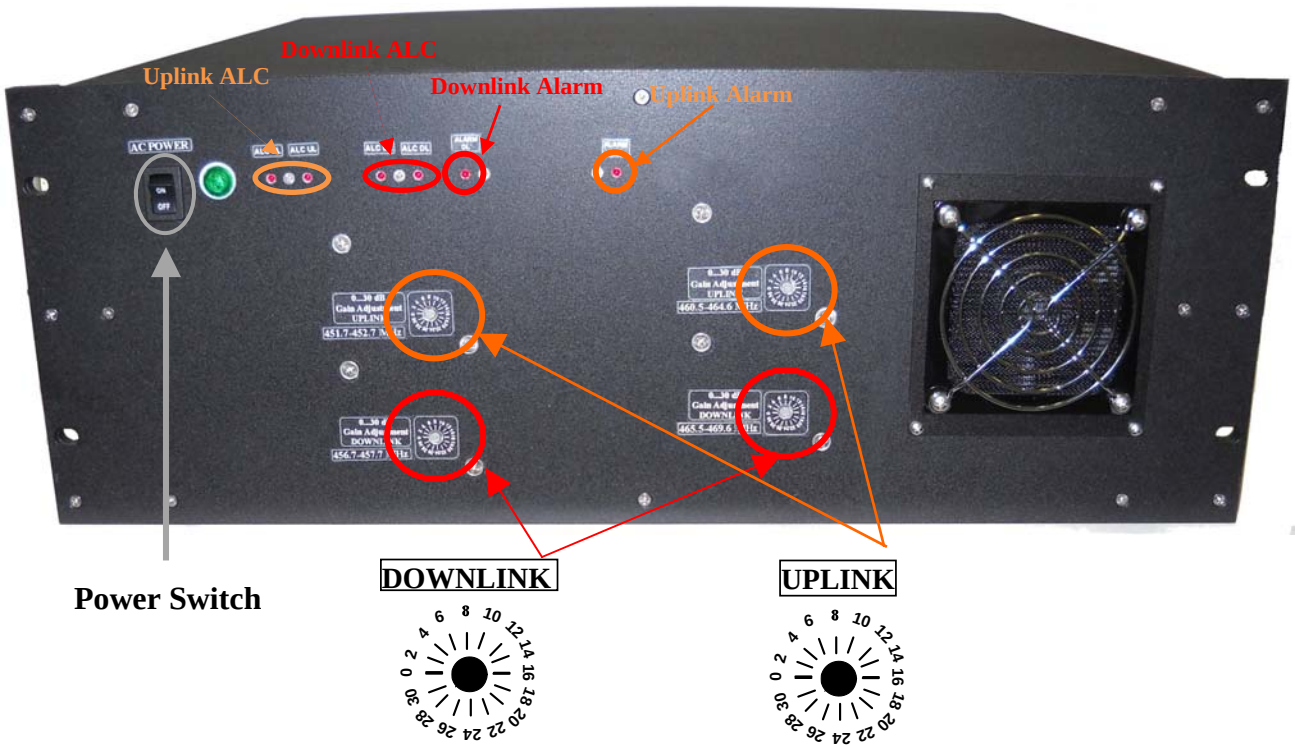
To minimize intermodulation products, each amplifier in the RHBDA contains an ALC feedback loop. The ALC circuit senses the output power and limits it to the factory preset level of +5 dBm for the Uplink (not to overload a Fiber Transceiver) and +31 dBm for the Downlink.

Four red indicator lamps are located on the Front panel which illuminate when the output power exceeds the ALC set point.

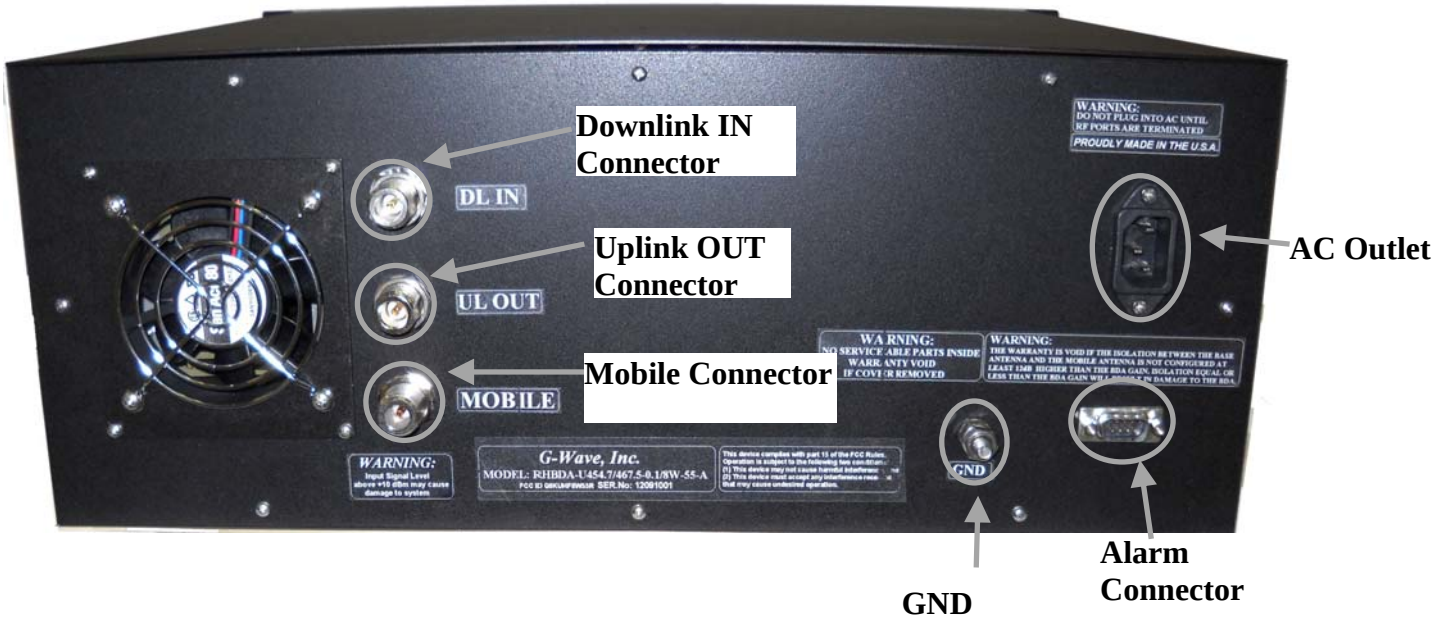
To establish proper operating gain on the Remote Units, start with the Downlink. Observe the red indicator lamp on the front panel. Units are shipping with maximum attenuation. Decrease attenuation one step at a time until the lamp is lit. Once the ALC lamp is lit, increase the attenuation until the lamp goes off. The Uplink ALC function is to avoid overloading the fiber optic transceiver. Setting the attenuation of the Uplink will depend on minimum and maximum distance from the mobile to server antennas. The level indicator is accurate to +/- 0.4 dB of the ALC set point.

**Operation of RHBDA-454.7/467.5-0.1/8W-55-A at minimum attenuation with greater than -30 dBm average power incident on the MOBILE port may cause damage to the RHBDA.**

## Figure 3
## Front Panel Adjustment




## Figure 4
## Back Panel



# DIAGNOSTICS GUIDE

The RHBDA provides long term, care-free operation and requires no periodic maintenance. There are no user-serviceable components inside the RHBDA.

This section covers possible problems that may be related to the installation or operating environment.

## a. Gain Reduction

Possible causes: Bad RF cables and RF connections to antennas, damaged antennae.

## b. Excessive Intermodulation or Spurious

Possible causes:
Amplifier oscillation caused by insufficient isolation. The isolation between two antennae is given by the equation:
Isolation = 92.5 + 20 Log (F x D) – Gt – Gr
Where:
F = frequency (GHz)
D = separation (Km)
Gt = transmit antenna gain (in the direction of the receive antenna).
Gr = receive antenna gain (in the direction of the transmit antenna).

For the UHF 450 MHz frequencies, the antenna isolation at 100 m separation is approximately 65.6 dB for omni-directional antennas (0 dB gain). To increase isolation, the antennas should have higher directivity and must be pointed away from each other.

## c. Occasional Drop-out of some Channels

Possible causes: One channel with very strong power dominates the RF output of the amplifier.

## d. Laser Alarm Occurs

Possible causes:
Fiber cable interface is not secure or dirty.
Take out each fiber cable and clean the connector and connector assembly with alcohol or equivalent fiber cleaner, to make sure no dirt or dust inhibits the link operation.



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