INNOVATIVE COMMUNICATION SOLUTIONS

# Installation and Operating Manual

RigBooster PRO, Dual Band Outdoor BDA
BDA-CELLAB/PCSF-2/2W-80-OCA1

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## BDA OVERVIEW:

The BDA assembly enhances the coverage area of radio communications in buildings and RF shielded environments.
The unit features low noise figure and wide dynamic range. It is a multi-block system, based on a dual-duplexed (quadruplexer) path configuration with sharp out of band attenuation allowing improved isolation between the receiving and transmitting paths, plus Cellular and PCS paths.

## BDA CIRCUIT DESCRIPTION:

Refer to Figure 1 for the following discussion.

The BDA-CELLAB/PCSF-2/2W-80-OCA1 Downlink path receives RF signals from the base station, amplifies the signal and transmits the signal, without changing the frequency, into a Distributed Antenna System at the direction of the mobiles. The signal travels over a DAS medium that then dissipates the signal to the Mobile subscribers. The BDA-CELLAB/PCSF-2/2W-80-OCA1Uplink path receives RF signals at the Mobile side from the DAS system, then amplifies it, and transmits the amplified signal (without changing the without changing the frequency) to the base station. This Dual Band BDA supports two Uplink and two Downlink, CELL AB and PSC Full occupy distinct dedicated frequency bands.

For CELL AB Band, the frequency allocations are as follows:

***Uplink:*** *824-849 MHz*
***Downlink:*** *869-894 MHz*

For PCS Full Band, the frequency allocations are as follows:

***Uplink:*** *1850-1910 MHz*
***Downlink:*** *1930-1990 MHz*

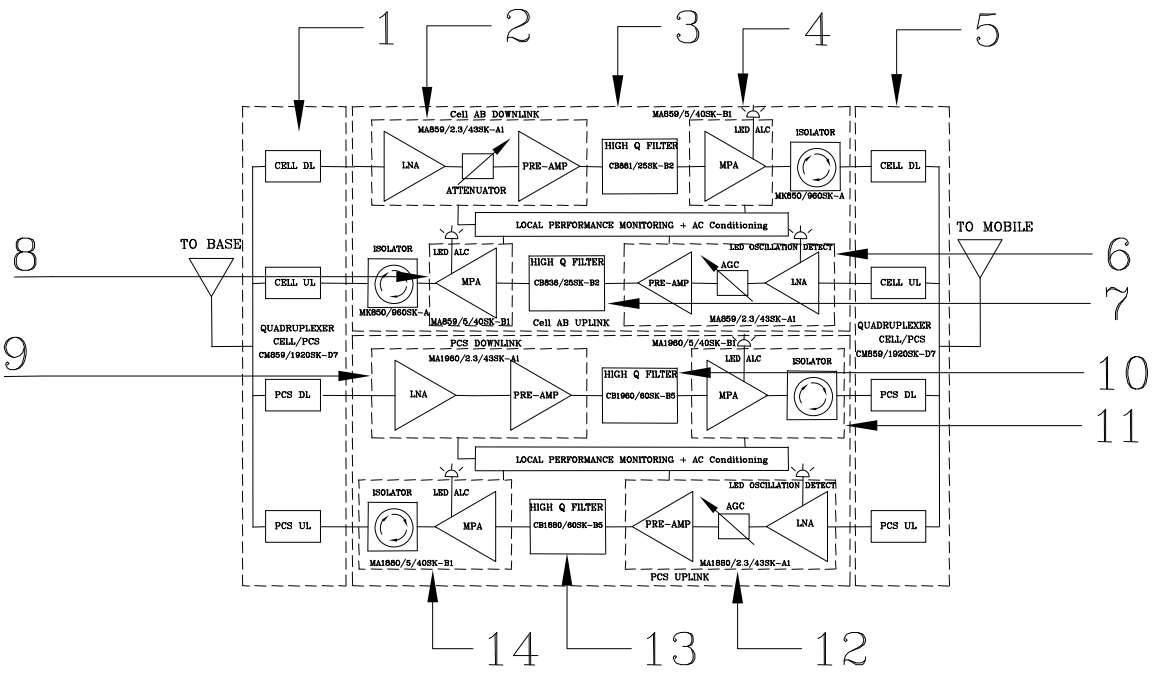
The Quad-duplexer isolates the paths and route each signal to the proper amplifying channel.

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

## OPTIONAL OSCILLATION DETECTS INDICATION:

For an added precaution against oscillations from insignificant antenna separation; a LED indication is inserted into the BDA’s path. This indication will warn the user to insert additional manual attenuation to eliminate the oscillation.

## Figure 1




### BDA BLOCK DIAGRAM

1. Input Base Quadruplexer – Features low insertion loss and separates UL from DL paths for CELL and PCS bands.
2. Downlink CELL LNA/Pre-Amp – Low noise figure amplifier with high linearity
3. Selector Filter CELL DL – Features high selectivity and provides required isolation at maximum gain.
4. Linear Power Amplifier CELL DL – includes ALC circuitry .
5. Output Mobile Quadruplexer – Features low insertion loss and separates UL from DL paths for CELL and PCS bands.
6. Uplink CELL LNA/Pre-Amp – Low noise figure amplifier with high linearity
7. Selector Filter CELL UL – Features high selectivity and provides required isolation at maximum gain.
8. Linear Power Amplifier CELL UL – includes ALC circuitry .
9. Downlink PCS LNA/Pre-Amp – Low noise figure amplifier with high linearity
10. Selector Filter PCS DL – Features high selectivity and provides required isolation at maximum gain.
11. Linear Power Amplifier PCS DL – includes ALC circuitry.
12. Uplink PCS LNA/Pre-Amp – Low noise figure amplifier with high linearity
13. Selector Filter PCS UL – Features high selectivity and provides required isolation at maximum gain.
14. Linear Power Amplifier PCS UL – includes ALC circuitry.

## ELECTRICAL SPECIFICATIONS:

| | |
|---|---|
| Frequency Range | : UL CELL AB 824-849 MHz<br>: UL PCS 1850-1910 MHz<br>: DL CELL AB 869-894 MHz<br>: DL PCS 1930-1990 MHz |
| Pass Band Gain @ normal operation | : 80 dB (Min.) |
| Variable Step Attenuator Range (2-dB steps) | : 0-30 dB |
| Pass band Ripple | : ±1.5 dB (Typ.) |
| Noise Figure @+25ºC at max gain | : 5.0 dB (Max.) |
| 3rd Order Intercept point<br>Uplink | :  +46 dBm (Typ.) |
| Downlink | :  +46 dBm (Typ.) |
| Output Power @ 1dB Compression | |
| Uplink | : +34 dBm (Typ.) |
| Downlink | : +34 dBm (Typ.) |
| Output Power ALC Set Point | |
| Uplink | : +27 dBm ±1 dB |
| Downlink | : +27 dBm ±1 dB |
| Isolation between Up/Down Link | : 100 dB (Min.) |
| Input/ Output Impedance | : 50 Ohms |
| VSWR (Input/Output) | : 1.5: 1 (Max.). |
| Power Supply | : 110VAC/0.8 Amp<br>: 240VAC/0.4 Amp<br>: 50 to 60 Hz |

By adding an additional filter this BDA can support the following bands:

## Table 1

| Frequency Band | Downlink Frequency Ranges | Uplink Frequency Ranges |
|---|---|---|
| CELL AB | 869-894 MHz | 824-869 MHz |
| CELL A | 869-880 MHz | 824-835 MHz |
| CELL B | 880-894 MHz | 835-849 MHz |
| PCS FULL | 1930-1990 MHz | 1850-1910 MHz |
| PCS A | 1930-1945 MHz | 1850-1865 MHz |
| PCS B | 1950-1965 MHz | 1870-1885 MHz |
| PCS C | 1975-1990 MHz | 1895-1910 MHz |
| PCS C-1 | 1982.5-1990 MHz | 1902.5-1910 MHz |
| PCS C-2 | 1975-1982.5 MHz | 1895-1902.5 MHz |
| PCS C-3 | 1975-1980 MHz | 1895-1900 MHz |
| PCS C-4 | 1980-1985 MHz | 1900-1905 MHz |
| PCS C-5 | 1985-1990 MHz | 1905-1910 MHZ |
| PCS D | 1945-1950 MHz | 1865-1870 MHz |
| PCS E | 1965-1970 MHz | 1885-1890 MHz |
| PCS F | 1970-1975 MHz | 1890-1895 MHz |

## MECHANICAL SPECIFICATIONS:

| | |
|---|---|
| Size | : 16.0 x 16.0 x 11.2 inch<br>(406 x 406 x 284.5 mm) |
| Weight | : 35 Lbs. (16.0kg.) approx. |

## ENVIRONMENTAL CONDITIONS:

The unit is designed for outdoor applications:

Operating temperature: -45ºC to +60ºC

Storage temperature: -50ºC to +90ºC

## FCC NOTE:

The Federal Communications Commission (FCC) has tested this product and found it to comply with their RF Exposure Requirements, pursuant to FCC Part 22 and 24.

## IC NOTE:

The Industry Canada (IC) has tested this product and found it to comply with their RF Exposure Requirements, pursuant to IC RSS-131.

## NOTE:

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.

## RF EXPOSURE WARNING

In order to comply with the FCC RF exposure requirements, the BDA-CELLAB/PCSF-2/2W-80-OCA1 antenna installation must comply with the following:

Yagi type or similar directional antenna must be installed so as to provide a **minimum** separation distance of 30cm (~12 inches) between the antenna and persons within the area. (This assumes an antenna with gain of 11 dBi, VSWR ≤ 1.5:1, Zo= 50 ohms)

The Omni directional (or leaky cable ) must be installed so as to provide a **minimum** separation distance of at least 20cm (~7.9 inches) between the indoor antenna connected to the RF booster and the human user's body within the area. (This assumes an antenna with gain of 0-2 dBi, VSWR ≤ 2:1, Zo= 50 ohms).


## BDA CONNECTIONS

The BDA AC power is accepted through a standard 3-wire male plug (IEC-320) with phase, neutral and ground leads. The AC power is wired to a high efficiency DC switching power supply, which is CE and UL approved. The power supply runs the amplifiers and the “Power On” lamp. The metal enclosure of the BDA is connected to ground.

A 7-pin reverse bayonet connector provides failure alarm output contacts (see diagrams on page 8) as well as a 12 VDC (250mA) auxiliary output.

For S1 Option: The BDA is equipped with both AC and DC voltage inputs for power operation. This gives the flexibility of powering the BDA with either an AC or DC source. If both sources are connected, the BDA will automatically select the stronger source for power. NOTE: (To insure that the DC source will be selected when both sources are connected, DC input voltage must be at least 27 VDC.)

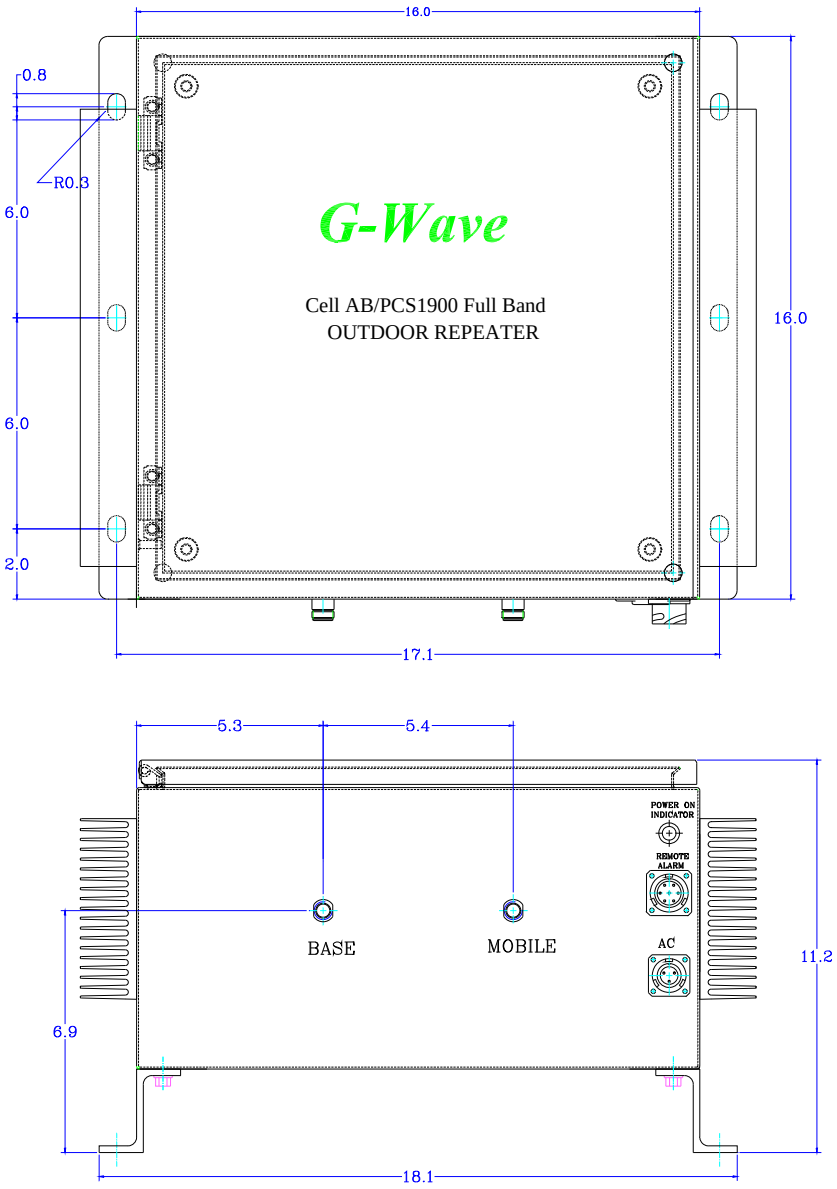
The RF connections are made via two type “N” female connectors. The RF connector labeled “BASE” must be connected to the antenna pointing towards the base station. The RF connection labeled “MOBILE” must be connected to the antenna facing the area to be covered by the BDA. *(Four additional “N” female connectors are included with the External filter option.)*

The RF connections must be made through cables with characteristic impedance of 50 ohms.

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

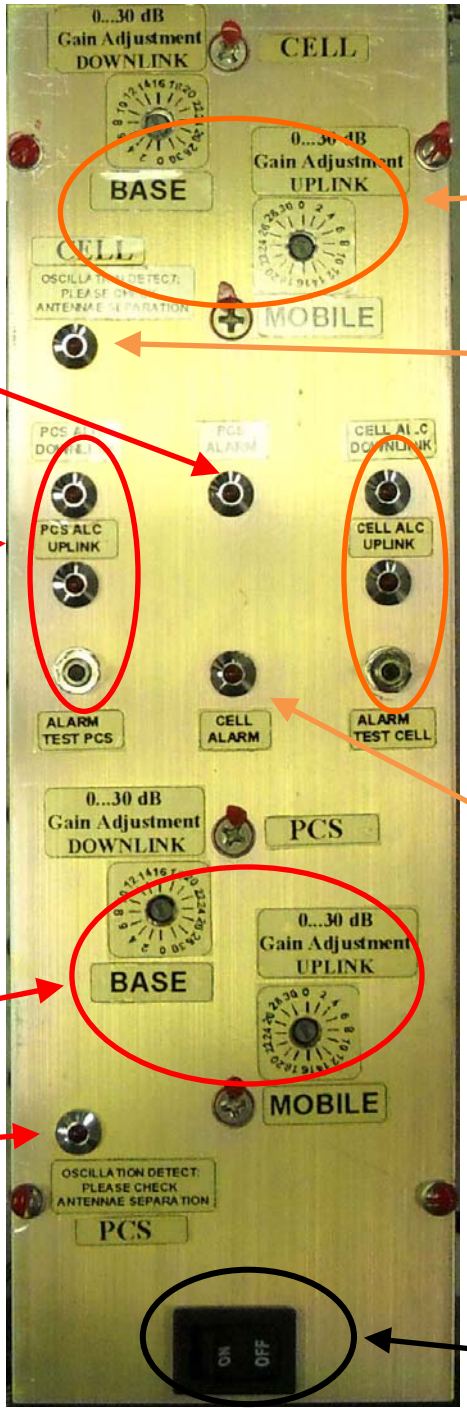
## BDA Mechanical Outline

**Figure 3**



## Figure 4
## Control Panel

The BDA has two momentary test switches to verify the alarm function. When the CELL or PCS test switch is depressed the control panel's CELL or PCS failure LED will illuminate. 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; or if there is no AC present. Two Oscillation detect LED's will warn the user to insert additional manual attenuation to eliminate an oscillation. The use of the ALC controls is covered in the "BDA OPERATION" section, on the next page.




**Cellular Uplink & Downlink Manual Adjustment**

**Oscillation Detect LED**

**ALARM PCS**

**PCS ALC LED's**

**CELL ALC LED's**

**ALARM CELL**

**PCS Uplink & Downlink Manual Adjustment**

**Oscillation Detect LED**

**Power Switch**

## BDA OPERATION

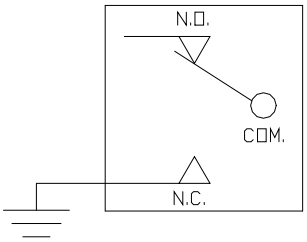
### Variable Step Attenuator

BDA gain can be reduced by up to 30 dB in 2 dB steps using the variable step attenuator (Figure 4). Gain adjustment is made with rotary switches accessible via the access door on the BDA enclosure. Arrows on the shafts of these switches point to the value of attenuation selected. BDA gain can be determined by subtracting the attenuation value from the gain reported on the BDA Test Data Sheet for that side of the unit. The attenuators are labeled for Uplink and Downlink.

### Alarm Function

The alarm monitors current of both uplink and downlink amplifiers in each path (PCS and Cellular). An alarm condition will occur in each path if either the uplink or downlink amplifiers are over or under its current tolerance or there is no supply power present.

(*Relay Shown in Non-Alarm Condition*)




### ALC (Automatic Level Control)

To minimize intermodulation products, the Uplink and Downlink amplifiers in the BDA contain an ALC feedback loop. The ALC circuit senses the output power and limits it to the factory-preset level of +26 dBm. A red indicator lamp located on each the control panel illuminates when output power meets or exceeds the ALC set point (Figure 4).

Note: Depending on the BDA's input signal, the red indicator lamp may not illuminate. In this case, position the "BASE" antenna in the direction of the closest Base station.

To establish proper operating gain on the Uplink and Downlink sides, start with the Downlink. Verify that the attenuator is set the maximum position of 30 dB. Observe the red indicator lamp on the Downlink amplifier. Decrease attenuation one step at a time until the lamp is lit. Then, using the Downlink step attenuator, increase the attenuation until the lamp goes off. Repeat the process for the Uplink. The level indicator is accurate to +/- 0.4 dB of the ALC set point. **Note**: ***The recommended operation of the BDA is when the factory set ALC is turned on. Operation of the BDA in the alarm condition will void the warranty, and output power should be immediately reduced using the variable step attenuator.***

**Operation of BDA-CELLAB/PCSF-2/2W-80-OCA1with greater than 0 dBm average power incident on the MOBILE or BASE ports can cause damage to the BDA.**

## Optional Features:

### OCAG: Automatic Gain Reduction

When this option is selected, the part number will be changed to BDA-CELLAB/PCSF-2/2W-80-**OCAG**. This option protects the BDA from oscillation due to service upgrades. Should the input RF signal increase due to a service upgrade, the unit will detect potential oscillation and automatically drop the system's gain by 30 dB, preventing interference until a service technician adjusts the system (antenna separation, location etc.)

### Lightning protector

When this option is selected, the part number will be changed to BDA-CELLAB/PCSF-2/2W-80-**OCA2.** This option protects the BDA from lightning through the RF BASE and MOBILE ports.

## OUTDOOR BDA INSTALLATION PROCEDURE


**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.

**IMPORTANT: DO NOT APPLY A.C. POWER TO THE BDA UNTIL CABLES ARE CONNECTED TO BOTH PORTS OF THE BDA AND THE ANTENNAS.**

**1.** Mount the BDA on the wall with the RF connectors pointing DOWN. Using appropriate screws and anchors, attach the BDA to the wall at the six mounting holes on the side flanges.

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

**3.** Connect the cable from the donor antenna to the BDA connector labeled "BASE" and the cable from the service antennas to the BDA connector labeled "MOBILE".

**4.** Connect the AC power cord to the BDA and then to the power source. Turn the BDA's power switch to the "ON" position. Verify that the "Power On" indicator is lit.
***NOTE: Due to the inconsistency of generators in the field, G-Wave recommends the use of a Power Line Conditioner on the AC source.**

**Installation of the BDA is now complete.**

## DIAGNOSTICS GUIDE

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

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 antennas.

**b. Excessive Intermodulation or Spurious**
Possible causes:
Amplifier oscillation caused by insufficient isolation. The isolation between two antennas 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 example, at the CELL B frequencies, the antenna isolation at 100 m separation is about 71 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 Dropout of some Channels**
Possible causes: One channel with very strong power dominates the RF output of the amplifier.