INNOVATIVE COMMUNICATION SOLUTIONS

Installation and Operating Manual

VHF, Bi-Directional Amplifier
BDA-VHF-33/33-80-20RU18

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BDA OVERVIEW:

The BDA assembly extends the coverage area of radio communications in buildings and RF shielded environments.

The unit features low noise figure and wide dynamic range. It is based on a duplexed path configuration with sharp out of band attenuation allowing improved isolation between the receiving and transmitting paths. Due to significant size of the diplexers and/or High "Q" filters needed to achieve specified gain, the system is built as Amplifier 19" Drawer and external filters, assembled into a 19", 20U cabinet.

VHF Part Number Description:

BDA-V(XXX)/(YYY) – 33/ 33-80-(ZZZ)

	V(XXX)	(YYY)	33	33	80	(ZZZ)
BDA	High Band Center Frequency [MHZ]	Low Band Center Frequency [MHZ]	UL Composite Power [dbm]	DL Composite Power [dbm]	Gain	Enclosure

Table 1

BDA Block Diagram Description:

Refer to Figure 1, on page 4 for the following discussion.

The BDA Downlink path receives RF signals from the base station and amplifies and transmits them to the subscriber. The BDA Uplink path receives RF signals from the subscriber and amplifies and transmits them to the base station. The Uplink and Downlink occupy two distinct frequency bands. For example, a sample frequency band in VHF is as follows: *158-159 MHz for the Uplink and 154-156 MHz for the Downlink.* Two diplexers isolate 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 – 31 dB of attenuation in 1 dB steps. The use of these controls is covered in the "OPERATION" section, page 10.

Optional Equipment Overview:

a) Visual Alarms

All G-Wave BDAs feature visual alarms as a standard. LEDs are provided for UL and DL alarms, ALC UL and DL alarms as well as Power indicator.

b) DC Input Power Option (S1)

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.

c) Remote Monitoring via 9-Pin Dry Contact Connector (RM9)

A 9-Pin dry contact will be provided to hard wire into a building's alarm system. Dry contact will provide alarms for ALC and amplifier failure.

Block Diagram Drawing:

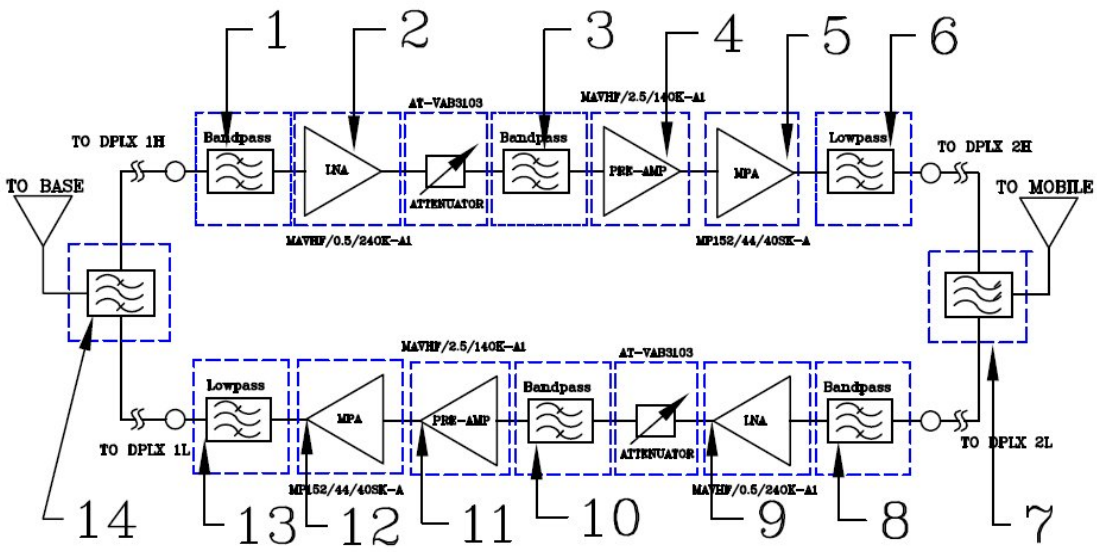


Figure 1

1. First stage Internal Filter Downlink -This highly selective filter provides additional rejection for increased isolation.
2. Downlink LNA- Is a low noise amplifier which offers 26 db Gain and establishes the Noise Figure of the downlink path.
3. Internal Filter Downlink - This highly selective filter gives additional rejection for increased isolation.
4. Downlink Pre-amp - Is a low noise amplifier that drives the downlink MPA and offers 16dB Gain.
5. Downlink MPA - Is a medium power amplifier with an ALC circuit which offers 42dB Gain.
6. Low Pass Filter Downlink- This low pass filter provide a rejection of harmonics.
7. Output Diplexer – Has a low bandpass insertion loss and high selectivity for one distinct downlink/uplink frequency band.
8. First stage Internal Filter Uplink - This highly selective filter gives additional rejection for increased isolation.
9. Uplink LNA- Is a low noise amplifier which offers 26 db Gain and establishes the Noise Figure of the Uplink path.
10. Internal Filter Uplink - This highly selective filter gives additional rejection for increased isolation.
11. Uplink Pre-amp - Is a low noise amplifier that drives the Uplink MPA and offers 16dB Gain.
12. Uplink MPA - Is a medium power amplifier with an ALC circuit which offers 42dB Gain.
13. Low Pass Filter Downlink- This low pass filter provide a rejection of harmonics.
14. Input Diplexer – Has a low bandpass insertion loss and high selectivity for one distinct downlink/uplink frequency band.

Electrical Specifications:

BDA-VHF-33/33-80-20RU18

Specifications	Typical
Frequency Range	: 138-174 MHz
Bandwidth	: 1-5 MHz
Minimum passband separation	: 2 MHz
Pass band Gain @ min attenuation	: 80 dB (Max.)
Variable Step Attenuator Range (1-dB steps)	: 0-31 dB
Gain Flatness	: ±1.5 dB (Typ.)
Noise Figure @ +25ºC at Max. gain	: 5.5 dB (Max.) 5.0 dB (Typ.)
3rd Order Intercept point @ 2 tones +30dbm each	: +54 dbm
Composite Output Power	: +33 dBm (Typ.)
Output Power ALC Set	: +33 dBm (Typ.)
Input/ Output Impedance	50 Ohms
VSWR (Input/Output)	1.5: 1 (Max.)
Power Supply	110VAC/1.1 Amp; 240VAC/0.5 Amp 50 to 60 Hz

Mechanical Specifications:

Size	: 40.0 x 21.0 x 22 inch
RF Connectors	: N-Type Female
Weight	: < 212 lb / (84 kg) approx. (Additional Filter Rack not included)

Environmental Conditions:

The unit is designed for indoor applications:

Operating temperature: - 20°C to +50°C

Storage temperature: - 40°C to +85°C

FCC NOTE:

The product has been tested and found to comply with the Booster requirements per FCC Part 90

This is a Class B device.

IC NOTE:

The product has been tested and found to comply with the Zone Enhancer requirements per RSS-131.

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.

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

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.

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.

RF EXPOSURE WARNING:

In order to comply with the FCC RF exposure requirements, the BDA-VHF-33/33-80-20RU18 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 12 inches (30 cm) between the antenna and persons within the area. (This assumes an antenna with gain of 5.65 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 8 inches (20 cm) 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).

Mechanical Outline Drawings:

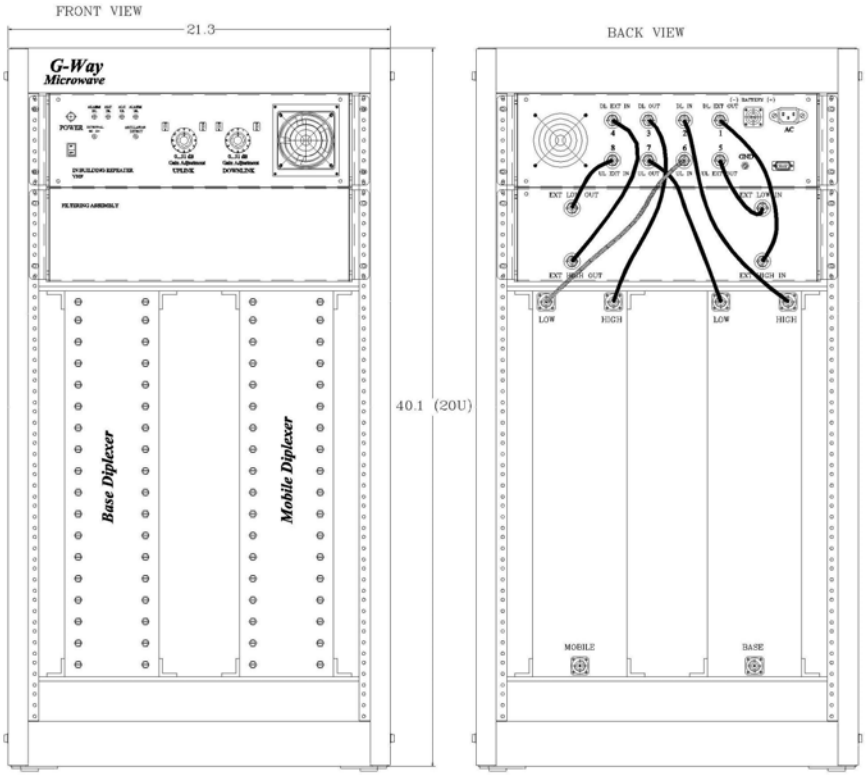
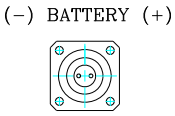
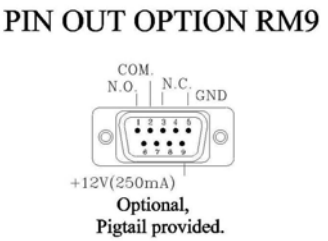


Figure 2



Optional DC Power Input (S1)



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 or if there is no DC power present.

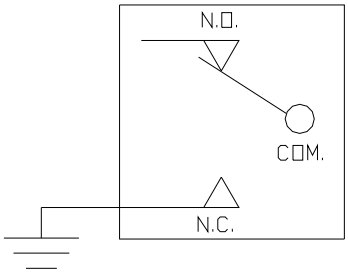


Figure 2a
Relay Shown in Non-Alarm Condition

Optional Battery Back-Up Configuration:

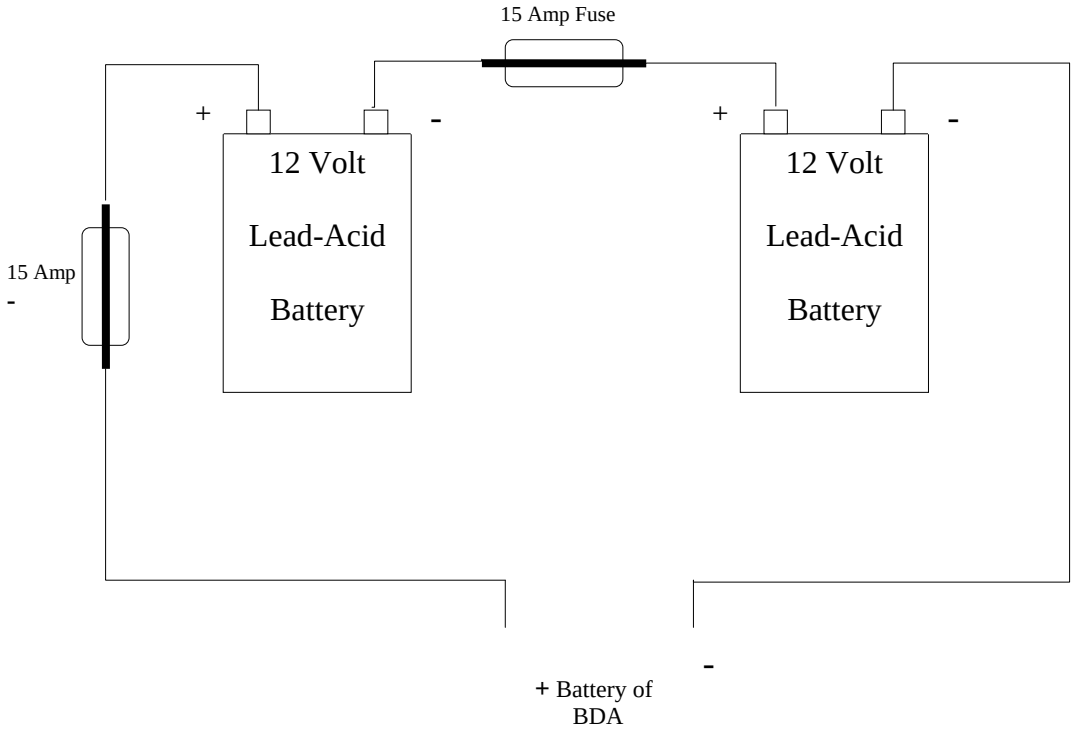


Figure 3: Optional Battery Back-Up Configuration

Battery Back-Up Time	Recommend Battery Rated Capacity (20 Hour Rate)	Typical DC Current Rating for BDA-XXX-33/33-80
1.5 Hour	*4.3 Amp Hours*	2.3 Amps
2.5 Hours	*7.2 Amp Hours*	2.3 Amps
3 Hours	*8.6 Amp Hours*	2.3 Amps
5 Hours	*14.4 Amp Hours*	2.3 Amps

Note: We do not guarantee specifications under Battery Back-Up power.

BDA Installation:

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.

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

1. Set the BDA Rack on the floor or mount on a wall (where applicable). Using appropriate screws and anchors, attach the BDA to the wall at the four mounting holes on the side flanges. *(Special version not shown in this manual).*

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. See main Panel of the BDA and verify that both of the Uplink and Downlink attenuation is set to 31 dB via dial Attenuator.

5. Connect the AC power cord to the BDA and then to the power source. Verify that the “Power ON” lamp is illuminated.

Installation of the BDA 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 (31 dB). After verification attenuation, follow the above steps starting with step 1.

BDA Operation:

Refer to figure 4 for adjustment access location and label.

Variable Step Attenuator

BDA gain can be attenuated, for Uplink and Downlink separately, up to 31 dB in 1 dB steps using the variable step attenuator (Figure 4). To adjust the attenuation up to 11 dB, use the dialer on the front panel. To adjust the attenuation up to 31 dB, set the thumbnail switch to +10 dB, and then dial in the remaining attenuation via the dialer. BDA gain may 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.

Attenuation	System Gain	Attenuator Position
0	80	Both thumbnail switches down and the dialer on zero
5	75	Both thumbnail switches down and the dialer on five
10	70	Both thumbnail switches down and the dialer on ten
15	65	One thumbnail switch up and the dialer on five
20	60	One thumbnail switch up and the dialer on ten
25	55	Two thumbnail switches up and the dialer on five
31	49	Two thumbnail switches up and the dialer on eleven

Table 2

ALC (Automatic Level Control)

To minimize intermodulation products, each amplifier in the BDA contains an ALC feedback loop. The ALC circuit senses the output power and limits it to the factory preset level of +33 dBm.

The ALC function is integrated in each amplifier. A red indicator lamp located on each amplifier illuminates when output power exceeds the ALC set point.

To establish proper operating gain on the Uplink and Downlink sides, start with the Downlink. Verify that the attenuation is set for 31 dB (minimum system gain). Observe the red indicator lamp on the Downlink amplifier. Units are shipped with maximum attenuation. Decrease attenuation one step at a time until the lamp is lit. Then, 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.

Operation of the BDA at minimum attenuation with greater than -45 dBm average power incident on either BASE or MOBILE port can cause damage to the BDA.

WARNING:
Input Signal Level above +10 dBm may cause damage to system

Variable Adjustment Access/ LED Description:

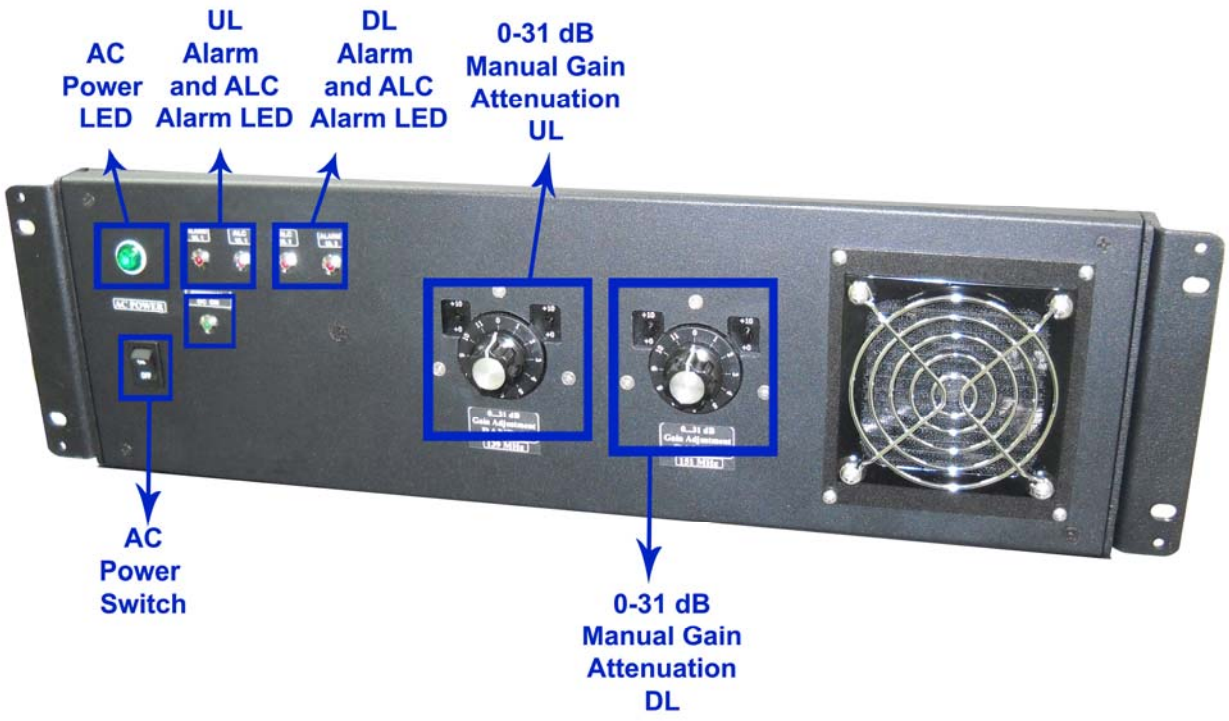


Figure 4
Visual Alarms and Manual Gain Adjustment

Diagnostic Guide:

The BDA provides long term, care-free 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: Defective 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 VHF frequencies, the antenna isolation at 100 m separation is about 65.5 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.