Version

1

COMPROD COMMUNICATIONS LTD.

Customer Instruction Manual
Model # UBDA3845 / UBDA4551

UHF BI-DIRECTIONAL AMPLIFIER

Technical Manual

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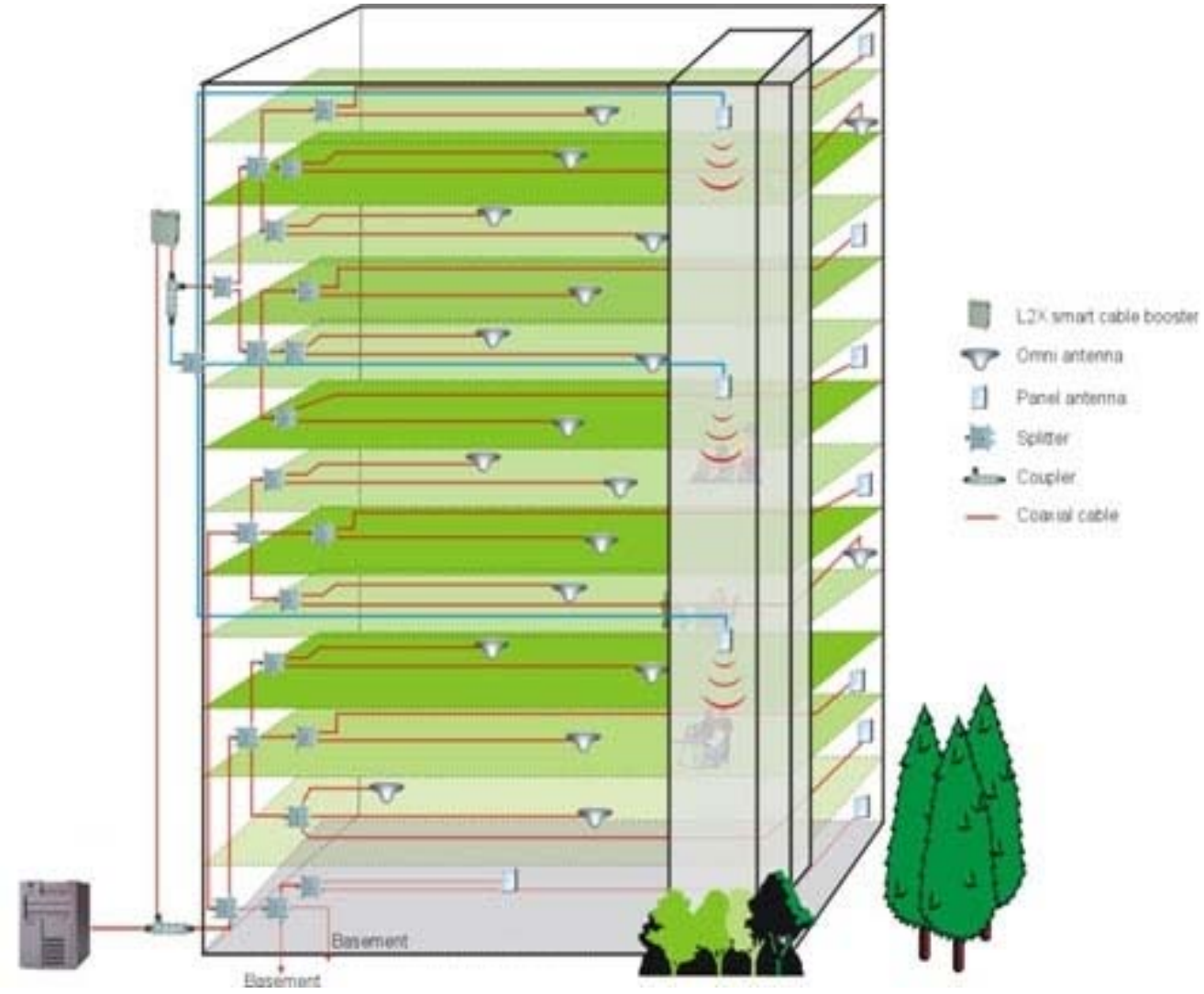
IMPORTANT:
The integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Subpart B – Unintentional Radiators. Final product must comply with unintentional radiators before declaring compliance of their final product to Part 15 of the FCC Rules and Industry Canada ICES-003.

Class B Amplifier Box Description

1) This Amplifier is designed around the philosophy of Anytime, Anywhere, and Anyplace and uses Class "AB" Amplifiers, designed for a more constant and reliable Amplifier unit. Designed to be used in buildings, tunnel, government facilities, airports, providing the communication throughout. Typically, the Amp box will be connected to either radiant cable or a distributed antenna system. (Example below)

2) An Amplifier box is used increase the coverage of RF communications in buildings or places were RF is unable to penetrate from the base station site.



Specifications

Our UHF amplifier have been designed with government agencies in mind. These are our highest level of performance and quality for continuous duty solutions while providing maximizing coverage.

Available in rack mount, nema stainless steel, or painted steel nema enclosures.

Block Diagram Details

- The Downlink path receives signals from the donor antenna, and then amplifies them as they pass through the unit to the distribution system.

- The Uplink path receives signals from the distribution system, and then amplifies them as they pass through the unit to the donor antenna.

- Uplink and Downlink paths contain each a Variable Gain Amplifier (VGA) followed by a fixed gain Power Amplifier (PA). A mid-stage access allows channel filter to be inserted, in order to reject adjacent channel signals and to improve the main signal quality.

- The VGA is basically a low noise amplifier featured Automatic Gain Control (AGC) circuit . The AGC circuit measures composite power level at the VGA input and adjusts automatically the gain, in order to maintain constant the signal level at the VGA output. Since the VGA output power is constant, the PA composite output power is also maintained constant at the factory set level.

- The VGA provides also Input Level Adjustment and Output Power Setting by mean of two Manually Set Attenuators (MSA#1 and MSA#2).

  The MSA#1 allows additional attenuation and hence maintains the VGA under linear condition if the input signal is too strong (greater than -25dBm). It is also used for adjusting the input signal to the optimum level (please see *VGA Max Input Level and Optimum Input Level Setting*).

  The MSA#2 attenuator allows to adjust the VGA power, thus the PA output power can be also changed to the desired level, which can be differed to the factory set level. An MSA#2 setting table vs. VGA output power is supplied with the unit. The PA linear gain is also provided.

- The Class-AB PA provides good performance for both linearity and efficiency. This amplifier is heat sink mounted and produces a high compression point and 3rd order Intercept point.

- The Power Supply bloc converts AC to DC voltages for supporting DC power needs of both Uplink and Downlink amplifiers.

- The unit can accept 50/60Hz 100 to 260 Volt AC power source, but does not have UPS/Battery system. In case of need for inconsistency in the AC line power, surge protection, short Black outs, crossover time from line AC to generator power, circuit breaker for short circuit and over load protection, etc., an external UPS/Battery system is recommended.

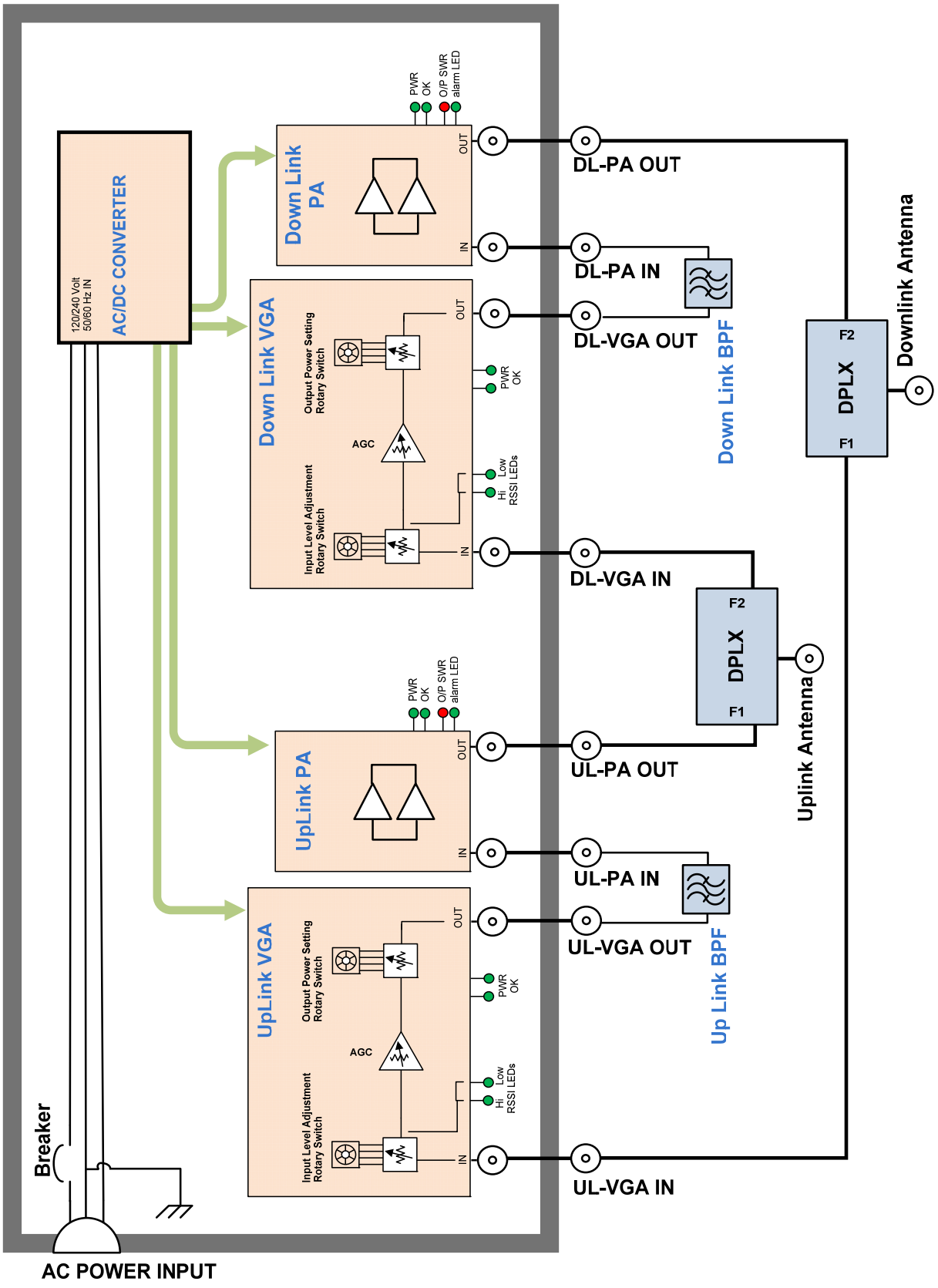


Figure 1: Bloc diagram of the UHF Amplifier with external filter/diplexer connection

VGA Max Input Level and Optimum Input Level – MSA#1 Setting

The VGA can maintain constant its output power for any composite input level from –60 to -25dBm. If the input level is too high, the MSA#1 must be used to provide additional attenuation, then decrease the input signal to the correct level. The MSA#1 attenuation can be set from 0 to 30dB per 2dB step, by mean of a hexadecimal switch (16 positions from "0" to "F").

When it is possible, it is recommended to set the nominal input power to -40dBm, such a setting allows maximum dynamic range of the AGC circuit, and the VGA output power will be constant even if several sub-carriers are suddenly added on or dropped from the main signal.

The VGA displays two RSSI LED (Received Signal Strength Indicator LED) labeled HI and LOW. When both LED are on, the input composite power should be with-in the optimum range, .i.e. -42 to -38dBm.

Thus, if the received nominal input power is ranging from -42 to -8dBm, it is possible to set the VGA input to the optimum level, by changing the MSA#1 setting from 0 to 30dB of attenuation.

If the received nominal level is lower than -42dBm, the MSA#1 should be set at 0dB attenuation.

Table I: MSA#1 and MSA#2 attenuation versus Hexadecimal Rotary Switch Position

Dial	MSA #1 Att. (dB)	MSA #2 Att. (dB)
0	0	0
1	2	1
2	4	2
3	6	3
4	8	4
5	10	5
6	12	6
7	14	7
8	16	8
9	18	9
A	20	10
B	22	11
C	24	12
D	26	13
E	28	14
F	30	15

Output Power Level – MSA#2 Setting

The preset level of the MSA#2 is Factory set with a 2 carrier input while monitoring IM products, such that these IM products do not exceeding -13 dBm at the diplexer common port. This Factory set gives the maximum operable power, therefore the unit must not be re-adjusted for giving higher output. However, re-adjusting for lower output power is permitted, and the desired level could be easily obtained with-in ±0.5dB of accuracy.

Since the PA unit has fixed gain, the output power could be settled to the desired level by mean of the MSA#2 on the VGA unit. The MSA#2 attenuation can be set from 0 to 15dB per 1dB step, via a hexadecimal switch (16 positions from "0" to "F").

The output power re-setting must be done with the presence of the channel filters and diplexers in the uplink and downlink paths. Since the VGA does have extra gain, a total insertion loss up 5dB on the channel filter(s) still is acceptable, with no deterioration on the power level, nor the IM products.

Depending upon the carrier frequency and channel spacing, the maximum operable power can be varied as shown below in Table II.

Table II: Max operable power ratings to comply to FCC and Industry Canada specs. (Diplexer loss not included)

COMPROD model number:	**UBDA3845**		
Frequency band:	**380 - 445MHz ●**		
DC supplies:	**5.4 Volt / 52 Volt**		
Frequency Range (MHz)	**Max Operable Power Rating (dBm)**		
	CH Space 6.25KHz	CH Space 12.50KHz	CH Space 25.00KHz
380 - 400	27.00	31.50	32.00
401 - 445	28.50	32.00	32.00

● NOTE: the 406.0-406.1MHz will not be included

COMPROD model number:	**UBDA4551**		
Frequency band:	**450 - 512MHz**		
DC supplies:	**5.4 Volt / 52 Volt**		
Frequency Range (MHz)	**Max Operable Power Rating (dBm)**		
	CH Space 6.25KHz	CH Space 12.50KHz	CH Space 25.00KHz
450-460	27.50	30.50	30.50
460-490	27.50	31.00	33.00
490-512	26.50	28.50	29.50

VGA and PA output port termination

Due to the ALC loop, the VGA maximum gain can be as high as 120dB. If the VGA output is not connected, (or terminated by a highly reflected load), the last stage of amplification (i.e. the PA driver) can be damaged. In such a case, the VGA still works but it won't be able to drive the PA unit to the nominal output power. The operator should pay attention to the diplexer and channel filter connection, since an incorrect channel filter may reflect the output power backward and hence cause VGA damage.

The PA unit does have an output protection circuit. If more than +26dBm is detected as returned power on the output port, the PA gain and output power will be reduced, and the ALM red LED will turn ON. In order to bring the PA back to its normal operation state, the operator should turn off the power supply and verify the PA output connection before turn on the unit again.

IT IS RECOMMENDED THAT THE VGA AND PA SHOULDN'T BE TURNED ON IF THEIR OUTPUT PORTS ARE NOT CORRECTLY LOADED.

Visual Interface LEDs

The VGA has 4 visual interface LEDs: two for the biasing voltage status and two for the optimum input power level adjustment.

The PA has 4 visual interface LEDs: two for the biasing voltage status and two (working in Exclusive OR logic) indicating quality of the PA output connection.

Table III: LED description

Location	LED name	Designation	Description	Color
VGA Unit	+5V_B	D1A	ON = the +5V_B is present in the VGA	Green
VGA Unit	+5V_A	D1B	ON = the +5V_A is present in the VGA	Green
VGA Unit	P_IN LO	D2A	ON =the input power is lower than or equal to the desired level	Green
VGA Unit	P_IN HI	D2B	ON =the input power is higher than or equal to the desired level	Green
PA Unit	+5_PA	D5A	ON = the +5V are presents in the PA section	Green
PA Unit	+48V_PA	D5B	ON = the +52V is present in the PA section	Green
PA Unit	PA_OUT_SWR	D6A D6B	Green LED ON = the reflected power is lower than 26dBm. PA at normal biasing. Red LED ON = if the reflected power is equal to or higher than +26dBm. PA still working but at reduced output power.	Green or Red

Table IV: General specifications

Description	Condition	Min	Typ.	Max	Unit
Operating Range and Configuration					
Operable Frequency Range ● **406.0-406.1 MHz will not be included.**	UBDA3845 ●	380	-	445	MHz
	UBDA4551	450	-	512	MHz
1dB Nominal bandwidth centered at Fo (MHz)	Configurable by the external channel filters and diplexers	-	2	-	MHz
Lo and Hi freq at -70dB min rejection	Configurable by the external channel filters and diplexers	Fo-4	-	Fo+4	MHz
Bandwidth at-20dB gain loss from nominal gain	**With no filters nor diplexers**	145	155	215	MHz
Diplexer recommended insertion loss		-	-	2.0	dB
Channel Filter allowable Insertion Loss		-	3.0	5.0	dB
Gain & ALC					
Maximum Gain	-	115	-	-	dB
Nominal Gain (at -40dBm input power)	no filter nor diplexers	-	73	76	dB
Input Manual Attenuation range	2dB step	0	-	30	dB
Automatic Gain Control Range	Linear	35	-	-	dB
Output Level Manual adjustment Range	1dB step	0	-	15	dB
Output Power and Noise (diplexer loss not included)					
Output P1dB (U/L and D/L)	Single tone	37	38	-	dBm
Output 3rd Order IM Level	Two-tone at +27dBm	-	-	-16	dBm
Rated Mean Output Power (diplexer loss not included)	**Please see Notice**	-	32.5	-	dBm
Noise Figure	Room Temp	-	2	4	dB
Port Impedance and Return Loss					
Input / Output nominal impedance	VGA and PA In/Out	-	50	-	ohm
Input / Output return loss	50 ohms terminations	-12	-	-	dB
Power Supply and DC Power Consumption					
AC power source voltage	50/60Hz	100	-	260	Volt
Mechanical					
Dimension in mm	(WxDxH)	~ 210 x 210 x 360			
Operating Temperature		-20	-	+55	∘C
Others					
Max Input Power no damage on the VGA	MSA#1 = 0dB att.	+14	-	-	dBm
	MSA #1 >= 16dB	+30	-	-	dBm

NOTICE:
The Manufacturer's rated output power of this equipment is for single carrier operation. For situation when multiple carrier signals are present, the rating would have to be reduced by

3.5dB, 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.

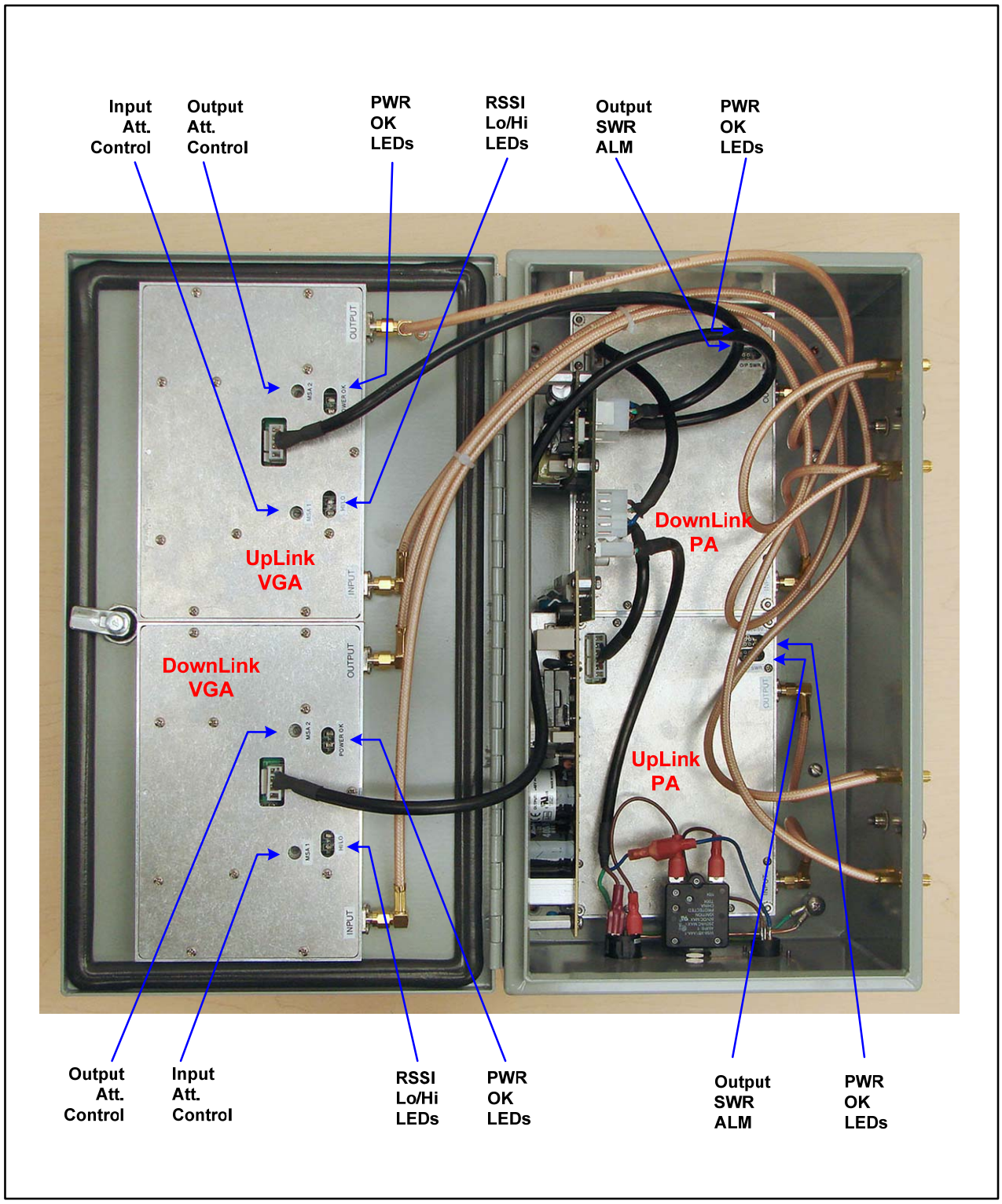


Figure 2: Amplification Module – Inside view

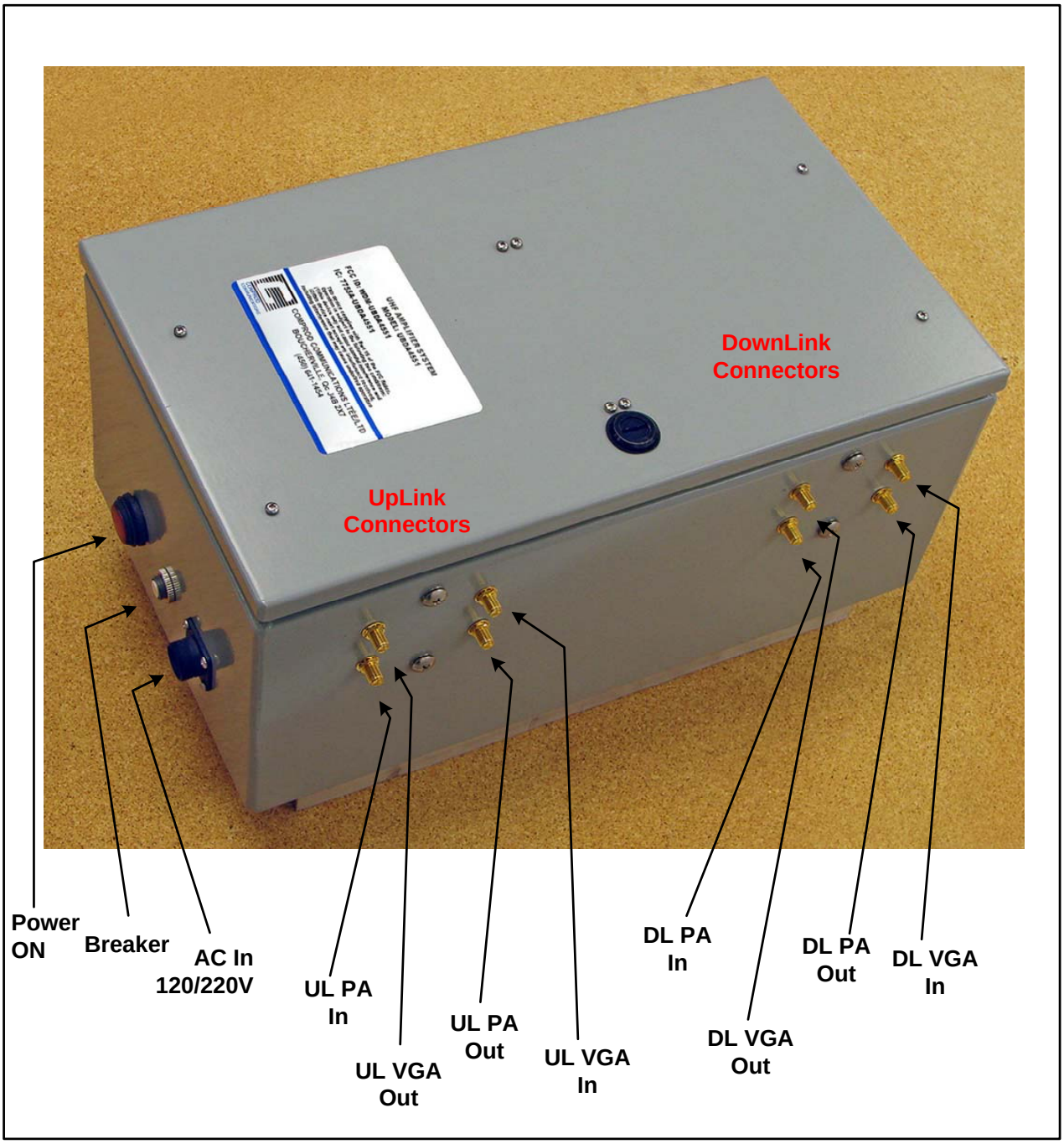


Figure 3: Amplification Module - Outside view

Unpacking

1) The UHF BDA should be unpacked soon after delivery and carefully inspected for possible shipping damage. It is the customer's responsibility to file claims with the freight carrier if damage is suspected and is usually limited to a certain time period after delivery.

2) Carefully compare the packing slip(s) against the package contents to verify the receipt of all expected items.

3) Retain all product documentation and make sure that manuals are forwarded to the appropriate site management, installation and service personnel.

Accessories

The optional accessory supplied with the UHF BDA is attenuator pads. They are used for padding the power on the BDA, reducing its final output level. Based on the size, cable, and location of the antennas, the operator can optimize the output level of the BDA by using the attenuator MSA#2 on the VGA unit. In case of need, the 3dB and 6 dB supplied pads can be added between the diplexer and the VGA input, or at the VGA output.

Lightning Protection

Although relatively rugged, lightning can damage the internal working mechanisms inside the BDA. We recommend the installation of a lightning surge suppressor in the transmission line where it enters the building prior to the BDA. The suppressor should be grounded to the building ground buss at the transmission line entry point. Chose a suppressor that will handle the expected amount of input power from the BDA to the donor antenna.

Antenna Installation

Buildings that are not designed or upgraded for antenna systems need special attention for antenna mountings, equipment installation and Cable runs. There are many variables involved in the design of a DAS system (distributed antenna system).

-Structural requirements for the location of the outdoor antenna (Donor); masts towers, building structure for the wind and ice loading.

-Protection of antennas and cables from building occupants and general human interaction.
- Installers/designers must be aware of general seating, foot traffic areas and different access points.
- All Antennas must be designed for the working frequency, which ensure meeting the exposure requirements.

-The Donor antenna and distribution antennas must be have 20 dB + the Maximum gain of the amplifier of isolation between them. Less Isolation will cause the amplifier to overload and oscillation will occur which may result in damage to the Amplifier.

- Antennas should be mounted following the manufactures guild lines for RF connection and being affixed to the building or location of desired signal.

- All cables used in the DAS system shall be 50 ohms and clamped properly to insure the cables 50 ohm impedance characteristics. Improper clamps will change the impedance of the cable at that location thus changing the efficiency of the system.

- Antenna placement through the DAS system is important to impose a balanced distributed signal. The use of proper valued (dB) decouples, power dividers, and signal taps is important to promote a balanced system.

BDA Installation

1) Verify that the frequencies listed on the Amplifier Box label agree with the channel assignments for the Duplexer Box. If they are not the same, contact the factory for advice and instructions. Please read the Warnings and Notices at the bottom of the next page before proceeding.

2) Mount the BDA system on a grounded rack, in a cabinet or on the wall. The BDA system is all-metal and the mounting screws on the Filter & Diplexer Housing can be used as attachment points for a ground wire.

3) Check the isolation between the Donor antenna and the Distribution antennas is 20dB above the Gain of the Amplifier.

4) Connect the Donor Antenna Port and Antenna Output to Distribution Network port through the Duplexer Box using solid-shield or double-braided 50 ohm coaxial cable with suitable connectors.

5) Verify the MSA#1 setting of both Up-link and Down-link VGA. These attenuators should be set at maximum attenuation (i.e. dial at position "F").

6) Install the external UPS/Battery system if it is need. Connect the BDA to the AC power source. Turn on the BDA unit by pressing the power button on the bottom of the BDA box. Verify if the power button light is on. Inside the BDA box, verify if all power LEDs on the VGAs and PAs are on (green color). Verify if the PA_OUT_SWR LEDs are on green.

7) After the unit is on, verify the RSSI LEDs on both Down-link and Up-link VGA. At 30dB attenuation at the input, normally only the LOW LED could be on. Decrease the MSA#1 attenuation gradually (i.e. do not jump directly from "F' to "0" position) until both LOW and HI LEDs are on. If the HI LEDs cannot be on even at MSA#1 = 0dB attenuation, verify if the input signal is present and at the expected level, then just leave the MSA#1 dial at "0".

8) The BDA output powers are now at its maximum operable level in both up-link and down-link direction. By mean of the MSA#2 (and if needed, use additional attenuator pads), optimize the output power to the desired (lower) level, according to the specific distribution system environment.

Installation is now complete.

Labeling Instruction

Figure 4: Label position on the BDA unit

The UHF Bi-directional Amplifier is delivered as a system with the Filter & Diplexer Unit. The BDA has its FCC/IC label on the front door, as shown in the above picture. This label must not be removed.

If the BDA unit is installed in a host device where this label is not visible, the host device should have visible label with the following text:

UBDA3845:	Contains FCC ID: WDM-UBDA3845 Contains IC: 7755A-UBDA3845
UBDA4551:	Contains FCC ID: WDM-UBDA4551 Contains IC: 7755A-UBDA4551

The figure below shows the assembly of the BDA unit and the Filters & Diplexer Housing unit as a system. Notice that the Filters & Diplexer Housing serves as the main support, where the BDA unit is mounted on.

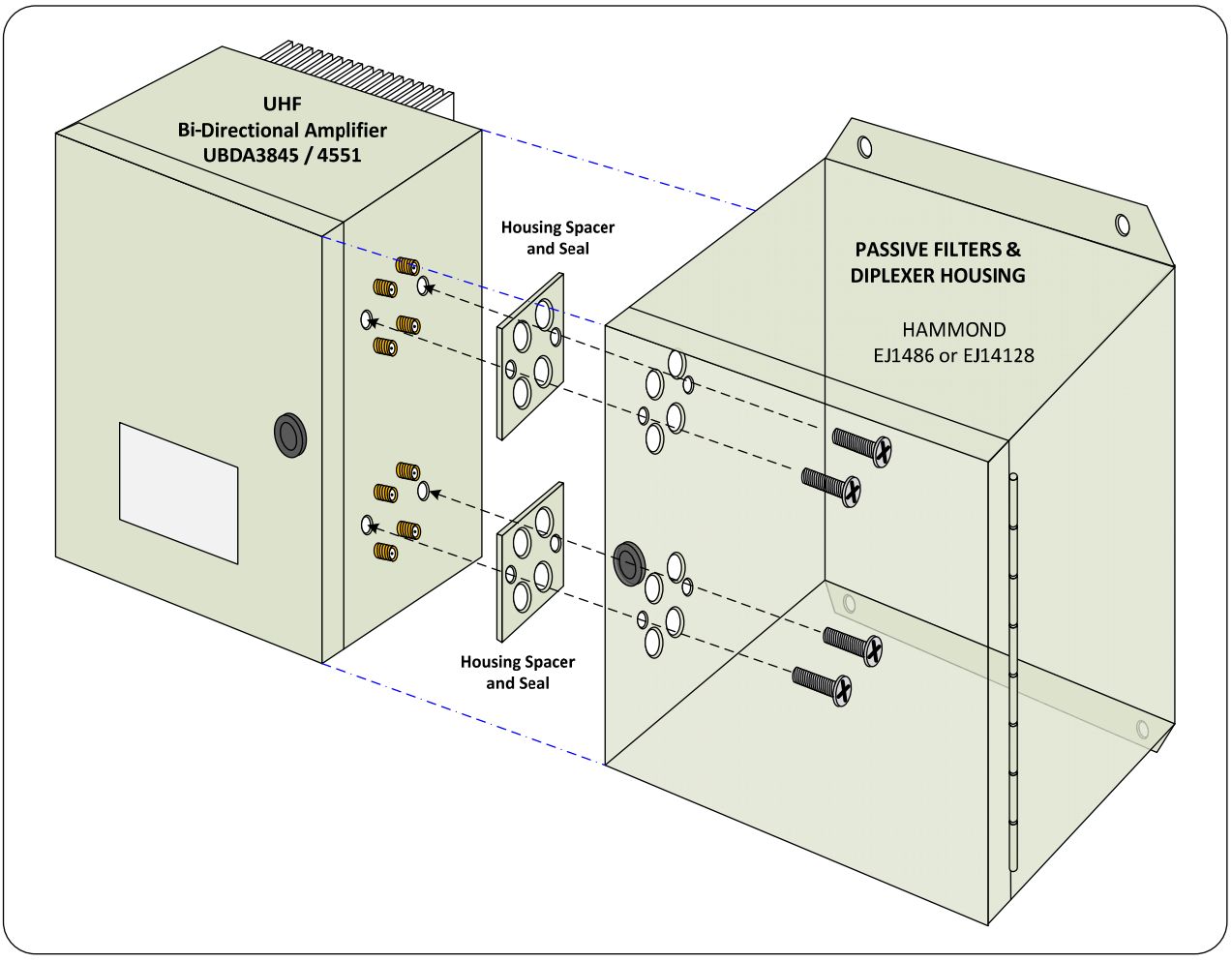


Figure 5: BDA and Filters & Diplexer Housing Assembly

Warnings and Notices

WARNING: Changes or modifications not expressly approved by Comprod Communications could void the user's authority to operate the equipment

⚠ *WARNING*: *To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 66 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.*

Notice:
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Notice:
"This device has been designed to operate with the antennas having a maximum gain of 3.5 dBd or 5.65 dBi. Antennas having a gain greater than 3.5 dBd or 5.65 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms."

"To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication

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