Version

2

COMPROD COMMUNICATIONS LTD.

Customer Instruction Manual
Model # UDA-138225

VHF UNIDIRECTIONAL 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 Module Description

Based on the philosophy of Anytime, Anywhere, and Anyplace, the unidirectional amplifier module (UDA) is designed for an ease of use and being adaptable to various needs on the field. Recently developed technologies are applied and with the use of modern integrated circuits and RF components, the Comprod design ensures constant performances and reliable amplifier unit.

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

This amplifier module is aimed for the use in buildings, tunnel, government facilities, airports, providing the communication throughout.

The amplifier module helps to increase the coverage of RF communications in buildings or places where RF is unable to penetrate from the base station site. The Amplifier Module can be used in both Uplink or Downlink directions and connected to either a radiant cable, a distributed antenna system, or to the donor antenna.

Block Diagram Details

- The VHF Amplifier module contains 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. An MSA#2 setting position versus 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 unit can operate with AC or DC supplies. The main AC input accept 50/60Hz 100 to 260 Volt AC power source, then the Power Supply bloc converts AC to DC voltages for supporting

DC power needs of the VGA and PA. The unit can also be fed directly with the DC power, by selecting the AC/DC switch to DC position and connecting +48 Volts (1A) and +6 Volts (2A) to the DC input connector. The operator must ensure that his external DC power supplies are compliant with FCC Class A limits on the radiated and conducted emission.

- The unit does not have built-in 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.

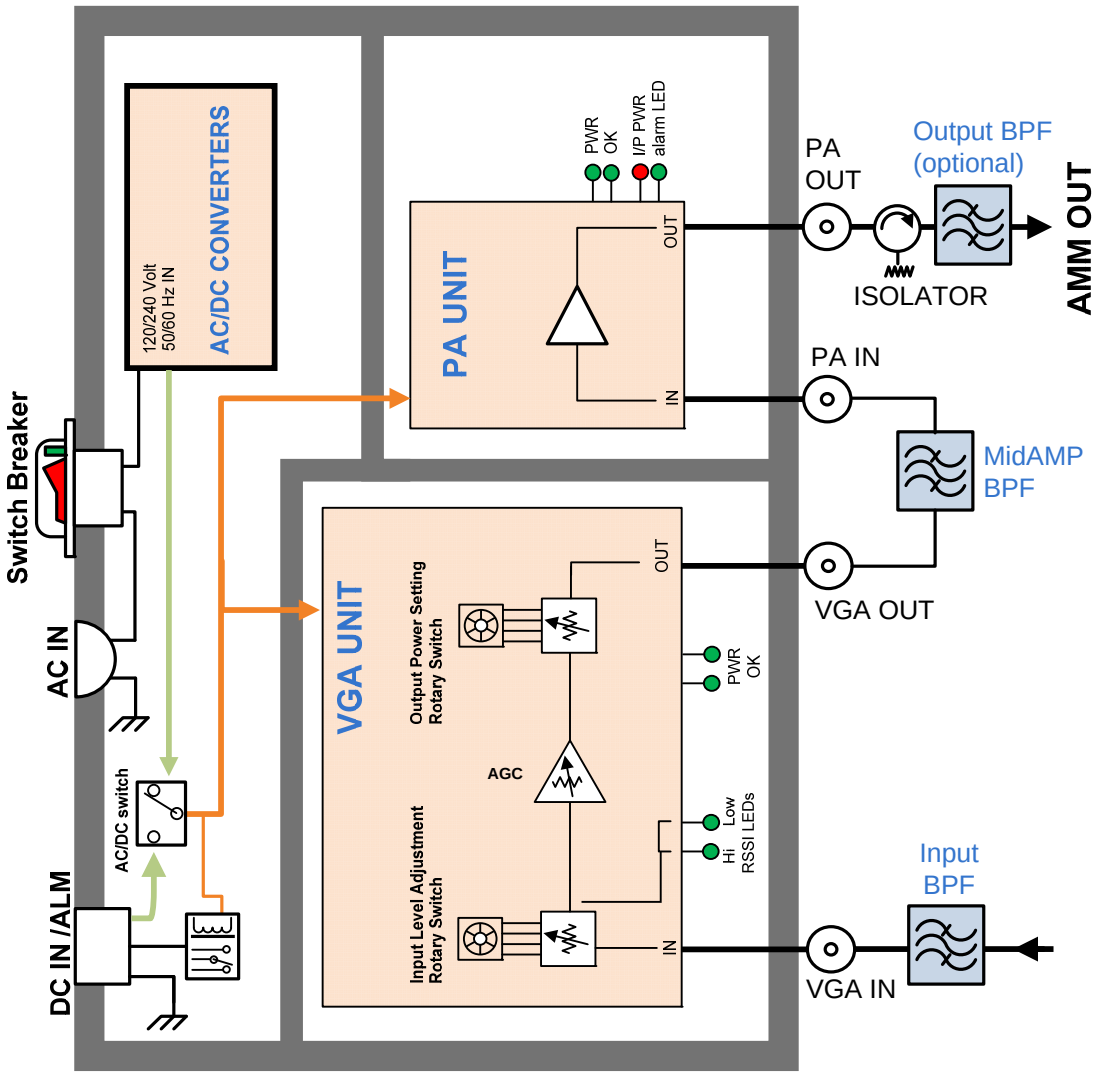


Figure 1: Bloc diagram of the VHF Amplifier with external filters
Note: the use of an isolator at the PA output is mandatory.

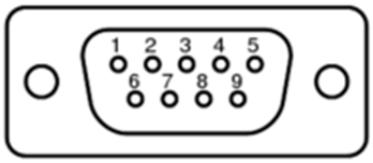
Power supplies and Alarms

The UDA can be fed with AC or DC power, via AC Input or DC Input ports, selected by mean of an AC/DC sliding switch.

The AC power source could be 50 or 60Hz, with a voltage ranging from 100V min. to 260V max.

The DC supplies of +48Volt/1.5A (+52Volt max) and +6Volt/2A (+12Volt max) should be provided via pins #1, #2 and #6 of the DC Input (D-sub 9 pins connector).

Power fails on the VGA and the PA can be detected via the states of NO1/COM1/NC1 and NO2/COM2/NC2, respectively. Their normal state indicates that there is no DC voltage detected on the relays coil, hence a fail of the power supply.



Pin 1: +48Volts Pin 2: +6Volt Pin 6: GND

Pins 3/4/5: NO1/COM1/NC1 Pins 7/8/9: NO2/COM2/NC2

Figure 2: DC input pins and Alarm pins on the D-Sub connector

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 –65 to -25dBm. If the input level is too high, the MSA#1 must be used to provide additional attenuation, and 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 -45dBm, 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. -48 to -43dBm.

Thus, if the received nominal input power is ranging from -45 to -15dBm, 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 -45dBm, 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 limited output power of the Amplifier module 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 defines the maximum operable power, since the PA will automatically shut down if higher output power is forced. The unit must not be re-adjusted for giving higher output. However, re-adjusting the MSA# 2 for lower output power is permitted, and the desired level could be easily obtained with-in ±1.0dB 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, or 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 with FCC and Industry Canada specs. (Diplexer loss not included)

COMPROD model number:	**UDA-138225**		
Frequency band:	**138-225 MHz**		
Power supplies:	**AC or DC 5.4V & 48V**		
Frequency (MHz)	**Max Operable Power Rating (dBm)**		
	CH Space 6.25KHz	CH Space 12.50KHz	CH Space 25.00KHz
138	29	29	29
145	30	30	30
155	31	31	31
175	31	31	31
215	30	30	30
225	29	29	29

VGA and PA output port termination

Due to the ALC loop, the VGA maximum gain can be as high as 85dB. During the installation, it is recommended to set the MSA#2 at the position F (max att.) then gradually increase the VGA output power to the desired level. The VGA input and output return loss are low (< -18dB) and can be connected directly to the diplexer or mid-stage filter.

The PA unit does have an input power detector. If more than +3dBm is detected at the input port, the PA drain voltage will be turned off, and the ALM red LED will turn ON. In order to bring the PA back to its normal operation state, the operator should decrease the PA input power at least 10dB, then reset the main power supply if necessary, and re-adjust the PA input power again to the desired level.

The PA output port is not well matched to 50 ohms (~ -13dB return loss). An isolator for connecting the PA output to a filter or diplexer is required.

THE VGA AND PA SHOULDN'T BE TURNED ON IF THEIR OUTPUT PORTS ARE NOT TERMINATED INTO A 50 OHMS LOAD.

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_IN_PWR	D6A D6B	Green LED ON = the out power is lower than 33dBm. PA at normal biasing. Red LED ON = the PA is turned off (input power too high such that the PA output power can be greater than +33dBm).	Green or Red

Specifications

Table IV: General specifications

Description	Condition	Min	Typ.	Max	Unit
Operating Range and Configuration					
Operable Frequency Range		138	-	225	MHz
Nominal Bandwidth	Configurable by the external channel filters and diplexers	-	-	-	MHz
Diplexer recommended insertion loss		-	-	2.0	dB
Channel Filter allowable Insertion Loss		-	-	4.0	dB
Gain & ALC					
Maximum Gain	-	100	-	-	dB
Nominal Gain (at -45dBm input power)	no filter nor diplexers	-	74	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)					
Limited Output Power	Composite power	31	33.5	36	dBm
Output 3rd Order IM Level	2 tones at +26dBm each	-	-	-14	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					
AC power source voltage	50/60Hz	100	-	260	Volt
DC power source voltages	+6Volt/2A and +48V/1A	+5.4V min to +12V Max ●		+48V min to +52V Max	
Mechanical					
Dimension in mm	(WxDxH)	330 x 175 x 54			
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

●: Using 12Volt biasing will cause higher temperature on the unit, thus installation having adequate heat evacuation is required.

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.

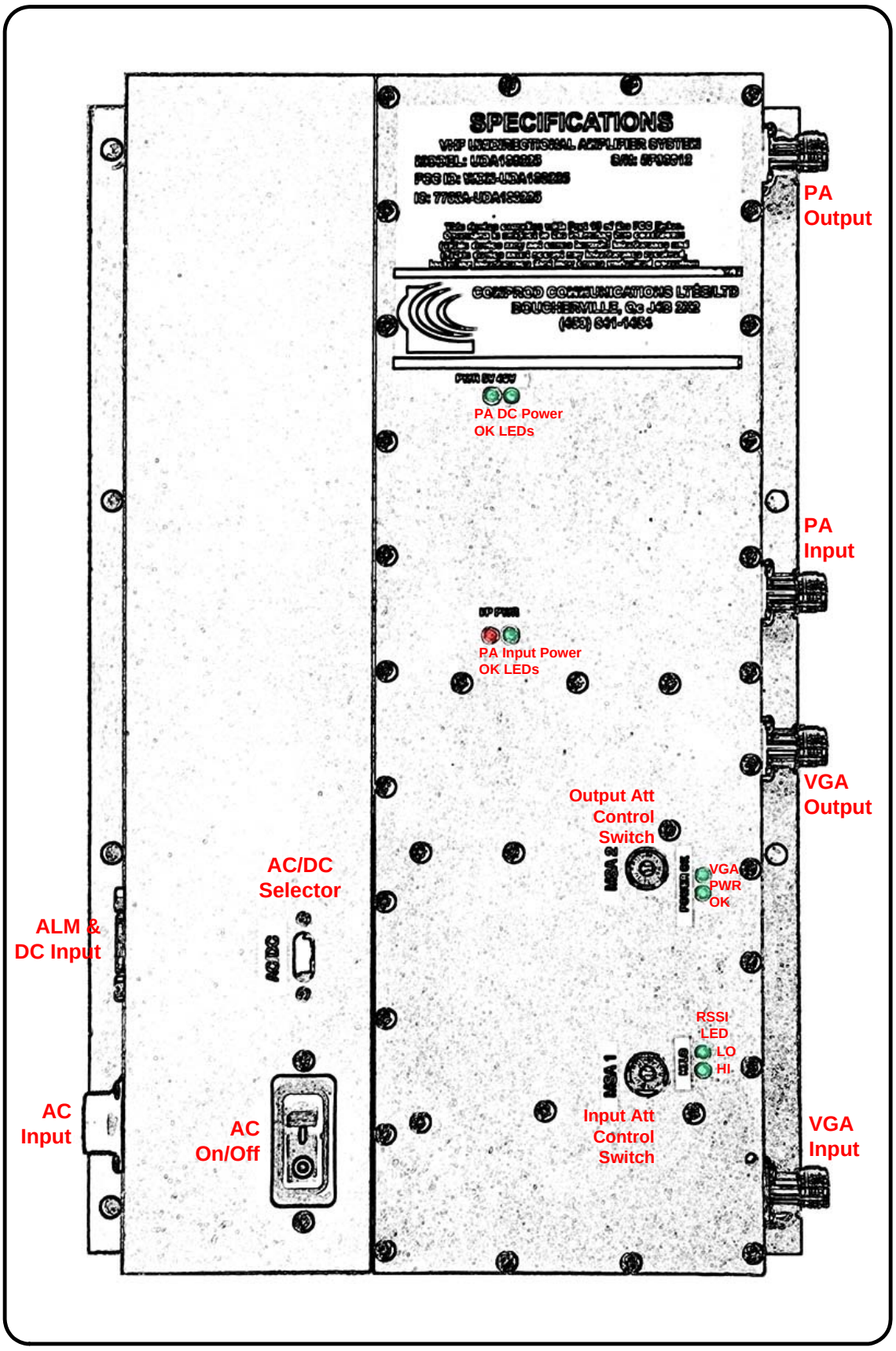


Figure 3: VHF Unidirectional Amplifier

Unpacking

1) The VHF UDA 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 VHF UDA is attenuator pads. They are used for padding the power on the UDA, reducing its final output level. Based on the size, cable, and location of the antennas, the operator can optimize the output level of the UDA 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 UDA. We recommend the installation of a lightning surge suppressor in the transmission line where it enters the building prior to the UDA. 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 UDA 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.

- In Bi-Directional configuration setup, 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 module to overload and oscillation will occur which may result in damage to the amplification module.

- 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.

UDA Installation

1) Verify that the frequencies listed on the Amplifier Box label agree with the channel assignments for the filter and/or the duplexer on use. 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 UDA on a grounded rack, in a cabinet or on the wall. The UDA is all-metal and the mounting screws can be used as attachment points for a ground wire.

3) If the UDA is used in a bi-directional scheme, check the isolation between the Donor antenna and the Distribution antennas. It should be 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 UDA to the AC power source. Turn on the UDA unit by pressing the power button on the UDA box. If DC power sources (+48 and +6 Volts) are applied to the D-Sub 9 pins connector, the UDA can be turned on by changing the AC/DC sliding switch to the DC position.

7) Verify if all power LEDs on the VGAs and PAs sections are on (green color). Verify if the PA_IN_PWR LEDs are on green.

8) 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".

9) The UDA 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 Amplifier Module

The Unidirectional Amplifier has its FCC/IC label on the front cover, as shown in the above picture. This label must not be removed.

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

UDA138225: Contains FCC ID: WDM-UDA138225
Contains IC: 7755A-UDA138225

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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