POWERWAVE®
TECHNOLOGIES

INSTALLATION & SERVICE MANUAL

LDA9301-30
30-WATT
LINEAR DISCREET AMPLIFIER

935-940 MHz

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Section 1

GENERAL DESCRIPTION

1-1. INTRODUCTION

This manual contains information and procedures for installation, operation, and maintenance of Powerwave's 30-watt LDA9301-30 Linear Discrete Amplifier. The manual is organized into six sections as follows:

Section 1. General Description
Section 2. Installation
Section 3. Operating Instructions
Section 4. Principles of Operation
Section 5. Maintenance
Section 6: Troubleshooting

1-2. GENERAL DESCRIPTION

The LDA9301-30 is a single channel linear discrete power amplifier that operates from 935 to 940 MHz. The amplifier is modular in design, and is ideally suited for use in RAM-Mobitex base stations. The LDA9301-30 provides 30 watts of RF power, a 12-volt auxiliary output connection, and a fail-safe bypass mode. The amplifier consists of a DC power supply, a microprocessor control circuit, and a single stage of amplification to provide a gain minimum of 10 dB. The microprocessor control circuit controls all fail-safe bypass modes that provide protection in the event of an RF overpower input/output, an over-temperature, or loss of AC power.

1-3. FUNCTIONAL AND PHYSICAL SPECIFICATIONS

Functional and physical specifications for the LDA9301-30 amplifier are listed in table 1-2.

1-4. EQUIPMENT CHANGES

Powerwave Technologies, Inc. reserves the right to make minor changes to the equipment without notice, including but not necessarily limited to component substitution and circuitry changes. Such changes may or may not be incorporated in this manual, although it is our intention to keep each manual as up-to-date as possible. To that end, we ask that you, our customer, share with us information acquired in field situations which might be of assistance to another user. If you share it with us, we'll pass it around.

1-5. ORDERING INFORMATION

Table 1-1 following gives the part numbers and descriptions to be used when ordering either an entire amplifier or a replacement fan.

Table 1-1. Major Amplifier Components

MODEL NUMBER	DESCRIPTION
LDA9301-30	30-Watt Linear Discreet Amplifier, 935-940 MHz.
800-00838-001	Fan Assembly.

Table 1-2. LDA9301-30 Amplifier Functional Specifications

Frequency Range	935-940 MHz.
Gain	10 dB minimum at 30 watts output (44.8 dBm)
Gain vs. Frequency	±0.25 dB
Second Harmonic	<60 dBc
Operation Mode	Single channel
Bypass Mode	Engages on overtemperature shutdown, loss of AC power, or loss of input power.
Modulation Format	GMSK, CW
Noise Power Output	-90 dBm
Output Power Range	20-44.8 dBm
VSWR S11, S22	<1.5:1
Operating Voltage	120 Vac, 47-63 Hz
Current Draw	2.5 amps maximum
Operating Temperature Range	0 °C - +60 °C
Storage Temperature Range	-40 °C - +85 °C
Auxiliary Output	+12 Vdc ± 0.25 V, 500 mA
Connectors	
RF	Type N Female mounted at rear of chassis
AC	Male IEC 320 mounted at rear of chassis
DC (Auxiliary Output)*	Radio Shack number 274-222
Cooling	Fan with air intake at the front of the unit
LED Display	POWER ON (green), AMP ON (green)
Fuses	AC line: 3 A, 250 V, AGC-3 DC Auxiliary: 1 A, 250 V, AGC-1
Dimensions (see figure 1-1)	Width: 19 inches Height: 5.22 inches Depth: 12.38 inches (includes handles)

*30-inch mating extension provided

Section 2

INSTALLATION

2-1. INTRODUCTION

This section contains installation recommendations, unpacking, inspection, and installation instructions for the LDA9301-30 amplifier. Carefully read all material in this section prior to equipment unpacking or installation. Also read and review the operating procedures in Section 3 prior to installing the equipment. It is important that the licensee perform these tasks correctly and in good faith. If applicable, carefully read Parts 73 and 74 of the Federal Communications Commission (FCC) rules to determine how they apply to your installation. DON'T TAKE CHANCES WITH YOUR LICENSE.

2-2. ELECTRICAL SERVICE RECOMMENDATIONS

Powerwave Technologies recommends that proper AC line conditioning and surge suppression be provided on the primary AC input to the amplifier. All electrical service should be installed in accordance with the National Electrical Code, any applicable state or local codes, and good engineering practice. Special consideration should be given to lightning protection of all systems in view of the vulnerability of most transmitter sites to lightning. Lightning arrestors are recommended in the service entrance. Straight, short ground runs are recommended. The electrical service must be well grounded.

Each amplifier system should have its own circuit breaker, so a failure in one does not shut off the whole installation. Circuit breakers should be thermal type, capable of handling an inrush current of 5 amps per amplifier, in a load center with a master switch.

2-3. UNPACKING AND INSPECTION

This equipment has been operated, tested and calibrated at the factory. Only in the event of severe shocks or other mistreatment should any substantial readjustment be required. Carefully open the container(s) and remove the amplifier module(s). Retain all packing material that can be reassembled in the event that the unit must be returned to the factory.

CAUTION

Exercise care in handling equipment during inspection to prevent damage caused by rough or careless handling.

Visually inspect the amplifier module for damage that may have occurred during shipment. Check for evidence of water damage, bent or warped chassis, loose screws or nuts, or extraneous packing material in the connector or fans. Inspect the rear panel connector for bent connector pins. If the equipment is damaged, a claim should be filed with the carrier once the extent of any damage is assessed. We cannot stress too strongly the importance of IMMEDIATE careful inspection of the equipment and the subsequent IMMEDIATE filing of the necessary claims against the carrier if necessary. If possible, inspect the equipment in the presence of the delivery person. If the equipment is damaged, the carrier is your first area of recourse. If the equipment is damaged and must be returned to the factory, write or phone for a return authorization. Powerwave may not accept returns without a return authorization. Claims for loss or damage may not be withheld from any payment to Powerwave, nor may any payment due be withheld pending the outcome thereof. WE CANNOT GUARANTEE THE FREIGHT CARRIER'S PERFORMANCE.

2-4. INSTALLATION INSTRUCTIONS (Refer to figures 1-1 and 2-1)
The LDA9301-30 amplifier is designed for installation in a rack or cabinet that permits access from the rear for connection of AC power, RF, and auxiliary 12 Vdc cables and for fuse replacement.

To install the amplifier proceed as follows:

1. Insert amplifier in equipment rack or cabinet and secure in place with four screws.

2. Connect 50-ohm antenna cable to RF OUTPUT connector on rear of amplifier.

3. Connect the transceiver/exciter output to RF INPUT connector on rear of amplifier.

4. Connect 30-inch 12 Vdc cable to 12VDC connector on rear of amplifier, if it is to be used.

WARNING

Verify that the LINE switch on the front of the amplifier is in the **off (O)** position before applying AC power to the amplifier. Perform step 5 (following) before connecting the AC line cord to the power source.

5. Connect AC line cable to power connector J1 on rear of amplifier.

6. Check your work before applying AC voltage to the system. Make certain all connections are tight and correct, and that the front panel on/off switch is in the off (O) position.

8. The AC line cord may now be plugged into the AC power outlet.

9. Refer to section 3 for initial turn-on and checkout procedures.

Section

4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

This section contains a functional description of the LDA9301-30 Amplifier.

4-2. RF INPUT SIGNAL

The LDA9301-30 amplifier has a power amplifier module that provides a minimum of 10 dB of gain. A microprocessor uses detector circuitry to detect RF power and provide bypass mode protection in the event of an RF input/output overpower situation, an overtemperature situation, the loss of AC power, or an amplifier module failure. Input VSWR to the LDA9301-30 should not exceed 2:1 for best performance.

4-3. RF OUTPUT LOAD

The load impedance should be as good as possible (2:1 or better) in the working band for good power transfer to the load.

4-4. FUNCTIONAL DESCRIPTION

The LDA9301-30 amplifier (see interconnect diagram figure 4-1 and block diagram figure 4-2) is a linear, single channel amplifier that operates in the frequency band from 935 MHz to 940 MHz. The amplifier specifications are listed in table 1-2. Each amplifier is self-contained and is functionally independent of other amplifiers. The amplifier is designed to achieve high peak power output, and for redundancy in unmanned remote locations. Each amplifier in the system can simultaneously transmit carrier frequencies at an average total power output of 30 watts.

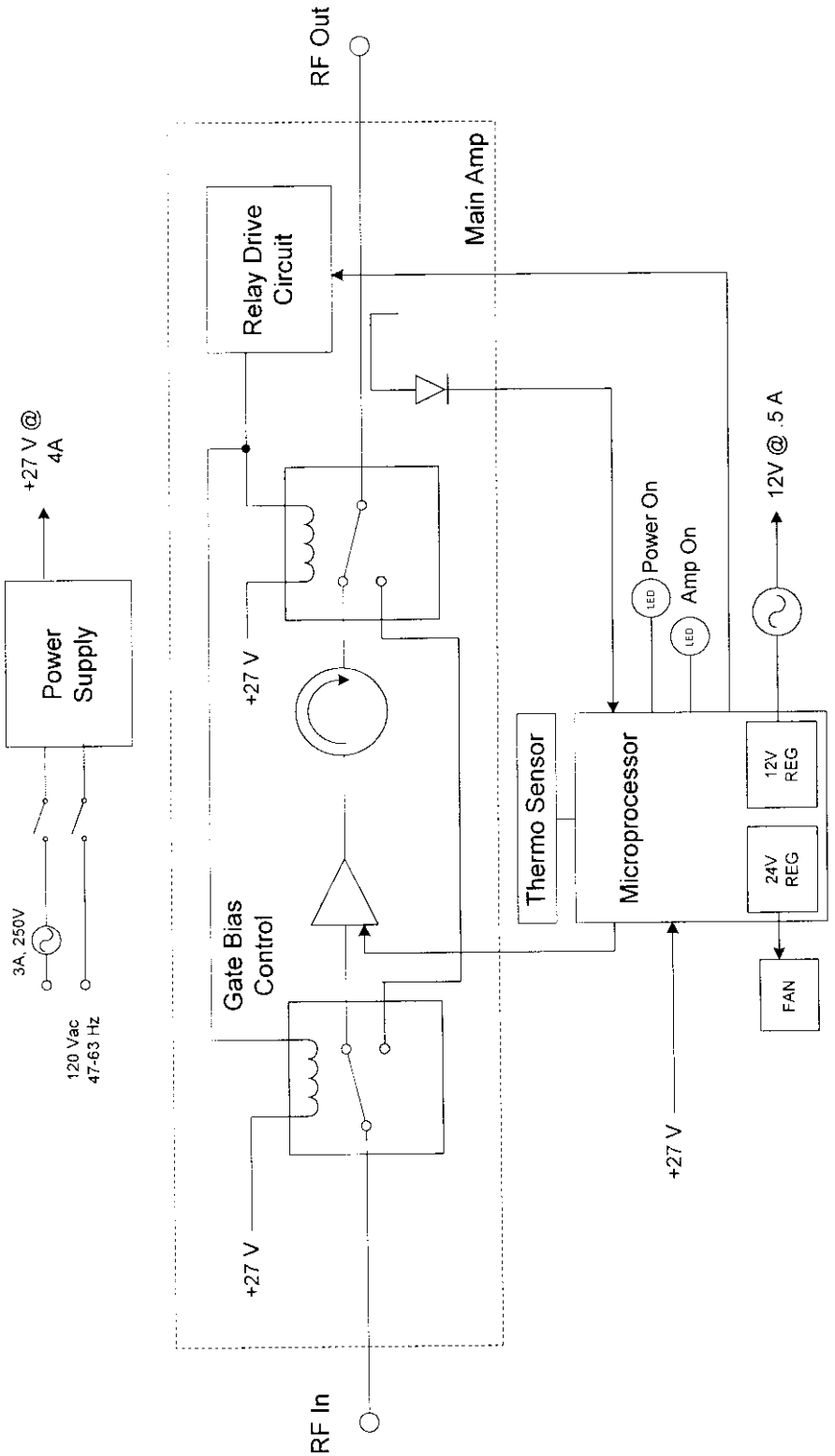

Figure 4-2. LDA9301-30 Amplifier Block Diagram

4-5. LDA9301-30 AMPLIFIER

The amplifier has an output of 30 watts power with 2nd harmonics suppressed to better than -60 dBc below carrier level. The amplifier is comprised of:

- Microprocessor board/alarm monitoring
- One gain stage
- Display LEDs
- Power Supply

4-5.1. MAIN AMPLIFIER

The input and output of the amplifier utilizes a single-stage, class AB amplifier module which provides approximately 10 dB of gain in the 5 MHz frequency band from 935 MHz to 940 MHz. The module contains two fail-safe SPDT relays that operate such as to provide the amplification mode and the bypass mode. A driver circuit operates the two relays. The amplifier module operates on +27 Vdc, and a bias voltage of +5 Vdc, and is mounted directly on a heat sink. The alarm logic controls the +5 Vdc bias voltage which shuts down or turns on the main amplifier. A TTL signal controls the relay driver circuit.

4-5.2. LOOP CONTROL

The loop control circuitry consists of a microprocessor (see paragraph 4-2), which monitors the RF output power and provides the bypass mode protection in the event of an RF input/output overpower situation, an overtemperature situation, the loss of AC power, or an amplifier module failure.

The RF output power from the model LDA9301-30 amplifier is monitored by the microprocessor. A coupled detector monitors the final RF output level and generates a DC voltage (VFWD) proportional to the RF output level. VFWD is fed back to the microprocessor. The microprocessor compares this voltage to a reference voltage and determines whether the main amplifier is working properly or not. The microprocessor also provides over-temperature protection for the amplifier. The RF module in the amplifier is mounted on a heatsink. The module has a temperature-sensing IC mounted on it which constantly monitors heat and converts it to a DC voltage. This voltage is sent to the microprocessor which shuts down the amplifier should the temperature exceed the specified temperature range. When the amplifier has sufficiently cooled down, the microprocessor re-enables the amplifier.

4-5.3. BYPASS MODE

Immediately after the amplifier is turned on, the unit will initialize in bypass mode for five seconds to detect any fault. Subsequently, the bypass mode is engaged on an overtemperature shutdown, loss of AC power, or loss of input power; the green AMP ON front panel LED will go off. The unit will then attempt to restart approximately every 15 minutes after fault detection. Cycling power will restart the unit and, if successful, the green AMP ON front panel LED will come on. Power level shutdown threshold is factory-set at 23 dBm with an internal adjustment capability of up to 43 dBm. Output power detection assumes that input power will be present during all normal operational modes. Loss of input power will result in loss of output power, causing the bypass to engage.

4-5.4. AMPLIFIER COOLING

Although the amplifier module contains its own heat sink, it is cooled with forced air. A fan, located on the front of the amplifier and operating continuous duty from internally applied DC, provides forced air cooling by drawing ambient air in through the front of the amplifier and exhausting hot air out the rear of the amplifier. The fan is field replaceable.

4-6. POWER DISTRIBUTION

Primary AC power (120 Vac 47-63 Hz) for the LDA9301-30 amplifier is provided by the host system. The AC input is fused at three (3) amps. The unit has a built-in power supply that provides all internal power required. In addition, 12 Vdc is also provided at the rear of the amplifier at the 12VDC connector; it is fused at one (1) amp.

Section 5

MAINTENANCE

5-1. INTRODUCTION

This section contains periodic maintenance and performance test procedures for the LDA9301-30 amplifier. It also contains a list of test equipment required to perform the identified tasks.

NOTE

Check your sales order and equipment warranty before attempting to service or repair the unit. Do not break the seals on equipment under warranty or the warranty will be null and void. Do not return equipment for warranty or repair service until proper shipping instructions are received from the factory.

5-2. PERIODIC MAINTENANCE

Periodic maintenance requirements are listed in Table 5-1. Table 5-1 also lists the intervals at which the tasks should be performed.

WARNING

Wear proper eye protection to avoid eye injury when using compressed air.

Table 5-1. Periodic Maintenance

TASK	INTERVAL	ACTION
Cleaning Air Vents	30 Days	Inspect and clean per paragraph 5-4
Inspection Cables and Connectors	12 Months	Inspect signal and power cables for frayed insulation. Check RF connectors to be sure that they are tight.
Performance Tests	12 Months	Perform annual test per paragraph 5-5.

5-3. TEST EQUIPMENT REQUIRED FOR TEST

Test equipment required to test the amplifier system is listed in Table 5-2. Equivalent test equipment may be substituted for any item.

NOTE

All RF test equipment must be calibrated to 0.05 dB resolution. Any deviation from the nominal attenuation must be accounted for and factored into all output readings.

Table 5-2. Test Equipment Required

NOMENCLATURE	MANUFACTURER	MODEL
Signal Generator	H.P.	8648B
30 dB Attenuator, 150 Watt	Narda	
Low Pass Filter	K&L Microwave, Inc.	HP3L 340-1100 – N/NP
Spectrum Analyzer	H.P.	8562E
20 dB Directional Coupler	HP	
Power Meter / Sensor	H.P.	437B / 8482A
Linear Discreet Amplifier, 40 dB Power Gain		
Isolator		

5-4. CLEANING AIR INLETS/OUTLETS

The air inlets and outlets should be cleaned every 30 days. If the equipment is operated in a severe dust environment, they should be cleaned more often as necessary. Disconnect AC power source before removing fans. If dust and dirt are allowed to accumulate, the cooling efficiency may be diminished. Using either compressed air or a brush with soft bristles, loosen and remove accumulated dust and dirt from the air inlet panels.

5-5. PERFORMANCE TEST

Performance testing should be conducted every 12 months to ensure that the amplifier system meets the operational specifications listed in table 1-2. Also verify system performance after any amplifier is replaced in the field. The test equipment required to perform the testing is listed in table 5-2, and the test setup is shown in figure 5-1.

NOTE
The frequencies used in this test are typical for an amplifier with a band from 935 MHz to 940 MHz.

5-5.1. AMPLIFIER PERFORMANCE TEST.

This test is applicable to a subrack equipped with one to five plug-in LDA9301-30 amplifier modules. Perform the tests applicable to your system. To perform the test, proceed as follows:

1. Connect test equipment as shown in figure 5-1.

NOTE
Set the offset of the power meter properly.

2. Turn on signal generator and set frequency to 937.5 MHz.
3. Set input power to unit under test (UUT) at 32.0 dBm.
4. Turn on 120 V AC.

GAIN TEST

5. Verify that power to the UUT is set for 32.0 dBm.
6. Verify that the UUT delivers a minimum of 42.0 dBm.

2nd HARMONIC TEST

7. With the power amplifier set at 30 watts (44.8 dB) power output, use the spectrum analyzer and check the frequency band from 935 MHz to 940 MHz for 2nd harmonic. The 2nd harmonic should be -60 dBc maximum.

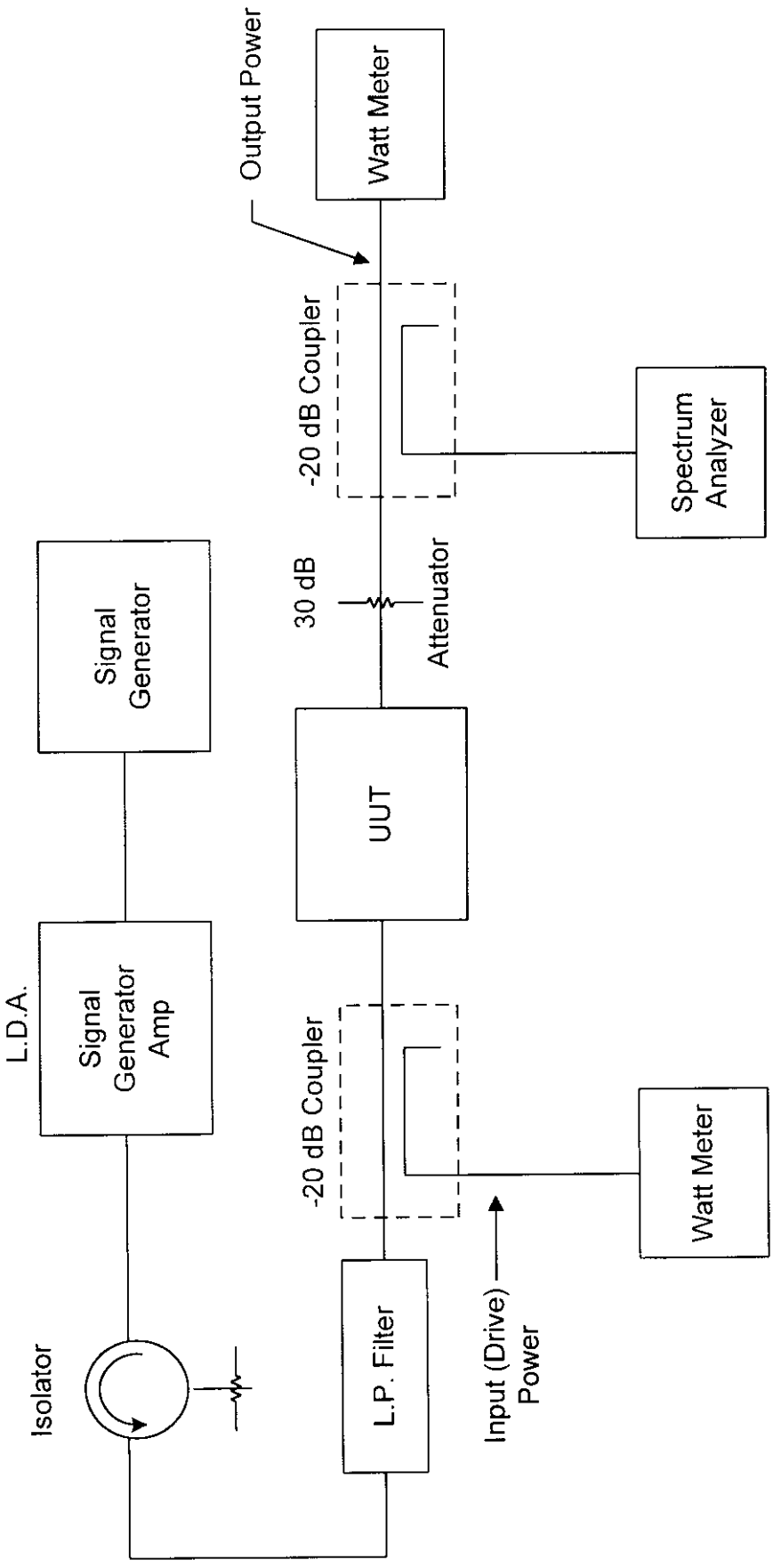

Figure 5-1. Amplifier Test Setup Diagram

5-6. FIELD REPLACEABLE PARTS

The following parts can be replaced in the field on site by a qualified technician with experience maintaining RF power amplifiers and similar equipment:

1. LDA9301-30 Amplifier
2. Cooling Fan
3. 1- and 3-Amp Fuses

5-6.1. LDA9301-30 AMPLIFIER

To replace an LDA9301 amplifier, proceed as follows:

1. Disconnect AC line cord from rear of amplifier.
2. Disconnect RF INPUT and RF OUTPUT lines.
3. Disconnect 12VDC line if connected.
4. Loosen four screws that secure amplifier module to rack or cabinet.

CAUTION

When removing the amplifier from the subrack, it is very important to support the amplifier such that the rear of the module does not suddenly drop when the guide rail disengages from the track. A drop such as this could damage the rear of the amplifier.

2. Use the handles on the front of the module, and with a steady even pressure, pull the module out of the rack or cabinet.

5-6.2. COOLING FAN

To replace the cooling fan, proceed as follows:

1. Verify that AC LINE switch is in the "O" position.

2. Pull out four snap-fastener plungers that secure fan to amplifier module. Disconnect fan power connector from amplifier module.

3. Install replacement fan in reverse order of steps 1 and 2 above.

5-6.3. FUSES

The LDA9301-30 amplifier is equipped with two fuses, both located on the rear panel, as follows:

	120 Vac INPUT F1	**12 Vdc OUTPUT F2**
Manufacturer:	Bussman	Bussman
Manufacturer's Number:	AGC-3	AGC-1
Rating:	3 amps, 250 V	1 amp, 250 V
Size:	1/4 inch diameter 1-1/4 inches long	1/4 inch diameter 1-1/4 inches long

Section 6

TROUBLESHOOTING

6-1 INTRODUCTION

This section contains a list of problems which users have encountered and a few suggested actions that may correct the problem. If the suggested corrective action does not eliminate the problem, please contact your Powerwave field representative or the factory for further instructions.

NOTE

Check your sales order and equipment warranty before attempting to service or repair the unit. Do not break the seals on equipment under warranty or the warranty will be null and void. Do not return equipment for warranty or repair service until proper shipping instructions are received from the factory.

6-2 TROUBLESHOOTING

Refer to table 6-1 for troubleshooting suggestions.

Table 6-1. Troubleshooting.

SYMPTOM	SUGGESTED ACTION
POWER ON indicator (green) is not lit	1. Verify that LINE switch is in the on (O) position 2. Check that power connection is secure. 3. Check 3-amp fuse F1 on rear of amplifier. 4. Check for proper AC line voltage.
AMP ON indicator (green) is not lit	1. Check that RF INPUT connector is properly attached. 2. Verify that RF input signal is present. 3. Verify that RF input power is in operational range. 4. If steps 1-3 are not effective, wait 15 minutes and repeat; bypass mode may have been activated.

6-3 RETURN FOR SERVICE PROCEDURES

When returning products to Powerwave, the following procedures will ensure optimum response.

6-3.1 Obtaining an RMA

A Return Material Authorization (RMA) number must be obtained prior to returning equipment to the factory for service. Please contact our Customer Service Department at (949) 757-0530 to obtain this number. Failure to obtain this RMA number will result in considerable delays in receiving repair service.

6-3.2 Repackaging for Shipment

To ensure safe shipment of the amplifier, it is recommended that the package designed for the amplifier be used. The original packaging material is reusable. If it is not available, contact Powerwave's Customer Service Department for packing materials and information.