



***SERVICE  
MANUAL***

***PA8-1AA  
RF POWER  
AMPLIFIER***

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L-PA8-1AA-S/B9

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## POWER AMPLIFIER SPECIFICATION

### PA8-1AA

Frequency: 806-870 MHz  
 Voltage: 11-17 VDC  
 Input Power: 1-3 Watts  
 Output Power: 12-25 Watts  
 Mode: FM

PARAMETER	MIN	TYPICAL	MAX	CONDITIONS	METHODS OF MEASUREMENT
Frequency Range	806 MHz		870 MHz		
Standby current drain			1 mA	No Rx or TX signal	Current through DC supply line
Transmit current drain			5.0 A	3W input, 15W output	Current through DC supply line
Receive path attenuation			1.0 dB		Measured from RF output connector to RF input Connector
Carrier Output Power Rating @ 3W	15 Watts		25 Watts	3 Watts input	TIA/EIA-603 2.2.1
Carrier Output Power Rating @ 1W	12 Watts		25 Watts	1 Watt input	TIA/EIA-603 2.2.1
Transmitter Stability into VSWR	3:1			No Spurious Outputs	TIA/EIA-603 2.2.18
Reflected power			120mW	3 Watt input, power reflected back to the radio	

Duty Cycle: Intermittent (TIA/EIA-603), (Typically 25% Max.)

## **THEORY OF OPERATION**

The PA8-1AA RF Power Amplifier is designed to amplify an RF signal with a frequency range of 806 - 870 MHz from 1-3 Watts at the input to 12-25 Watts at the output. The amplifier is a part of a half duplex system. Therefore in transmit mode it amplifies an output signal of a transceiver to an antenna. In the receive mode it creates a path from the antenna back to the transceiver. There are no tuning components in the amplifier. It is designed to cover its specified frequency range.

## **SAFETY INFORMATION**

### **ELECTROMAGNETIC INTERFERENCE/COMPATIBILITY**

NOTE: Nearly every electronic device is susceptible to electromagnetic interference (EMI) if inadequately shielded, designed or otherwise configured for electromagnetic compatibility.

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

### **FOR VEHICLES WITH AN AIR BAG**

Do not place a portable radio or amplifier in the area over an air bag or in the air bag deployment area. Air bags inflate with great force. If a portable radio or amplifier is placed in the air bag deployment area and the air bag inflates, the radio or amplifier may be propelled with great force and cause serious injury to occupants of the vehicle.

### **POTENTIALLY EXPLOSIVE ATMOSPHERES**

Turn off your two-way radio when you are in any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas (for example, Factory Mutual Approved). Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

### **BLASTING CAPS AND AREAS**

To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: "Turn off two-way radio". Obey all signs and instructions.

NOTE: The areas with potentially explosive atmospheres referred to above include fueling areas such as: below decks on boats; fuel or chemical transfer or storage facilities; areas where the air contains chemicals or particles, such as grain, dust or metal powders; and any other area where you would normally be advised to turn off your vehicle engine. Areas with potentially explosive atmospheres are often but not always posted.

## **MOBILE RADIO OPERATION AND EME EXPOSURE**

To assure optimal radio performance and that human exposure to radio frequency electromagnetic energy is within the guidelines referenced earlier in this document, transmit only when people inside and outside the vehicle are at least the minimum distance away from a properly installed, externally-mounted antenna. For this amplifier, that distance is at least two feet.

### **Mobile Antenna Installation**

Install the vehicle antenna external to the vehicle and in accordance with:

- a) The requirements of the antenna manufacturer/supplier
- b) Instructions in the Radio Installation Manual

### **NOTE:**

This Amplifier has been tuned to the frequency specified. There is no internal adjustment.

### **CAUTION!**

Check the amplifier upon receipt for visible damage. If any is noticed, please call TPL at 800 HI POWER to request an RMA number (Return Material Authorization). If purchased through a dealer, ask them to follow this procedure for best results.

**EXPENSIVE COMPONENTS MAY BE DESTROYED IF THE AMPLIFIER IS TURNED ON IN A DAMAGED CONDITION.**

## **TYPE ACCEPTANCE**

TPL Communications commercial amplifiers are FCC type accepted for use in the Land and Marine mobile/fixed services. The technician installing this amplifier must hold a General Radio Telephone permit and be familiar with the pertinent FCC rules and regulations.

Harmonic, and other spurious, signals from this amplifier are attenuated beyond FCC requirements.

For further details, consult the appropriate publications.

## INSTALLATION

Mount the amplifier as close to the antenna as practical. Keep coaxial cable runs short, avoiding sharp bends and pinching. The antenna should be matched to an VSWR of better than 1.2:1 for best results. Higher VSWR will degrade the performance.

Mount the amplifier away from sources of heat, and where air can freely circulate around it. In mobile applications, avoid mounting the amplifier in the engine compartment or near the exhaust pipe or catalytic converter.

In any mobile installation, it is important to securely fasten the unit. An improperly mounted piece of equipment is subject to damage as it moves about and can cause serious injuries in an accident. Use bolts through the holes in the amplifier flange to fasten the unit to a secure mounting surface.

Provide 13.8 VDC power to the amplifier using a supplied cable, (if provided,) or refer to drawings **102162** and **102162-2** in the appendix for details on how to make the correct connections. Wire the DC power connector (Cinch 4 pin female), for the amplifier, directly to the battery if possible. Do not use present vehicle wiring. Use #14 AWG if possible and certainly no lighter than #18 AWG. To avoid a possible fire, or other damage, make sure you install a fuse or automotive circuit breaker at the battery end of the wire. Use the same size as the internal fuse listed in the specifications.

Connect the radio transceiver to the “RF INPUT” terminal and the antenna to the “RF OUTPUT” terminal on the amplifier, with 50-ohm coaxial cable and Mini UHF plugs as appropriate.

This amplifier produces sufficient power to cause significant heating of low quality, or improperly rated, coaxial cable and fittings. Use high quality cables and fittings to reduce heating and keep losses low.

## OPERATING PRECAUTIONS

**CAUTION:** This amplifier produces RF voltages that can cause painful and dangerous RF burns. Use cautions! Connect and disconnect all RF connections with DC power and drive power off.

**DRIVE POWER:** RF power transistors and modules, although quite rugged in most respects, are easily damaged by overdrive. Be careful not to overdrive this amplifier, even for an instant. Higher than rated drive power may destroy the transistors and VOID ANY WARRANTY.

**SUPPLY VOLTAGE:** The maximum operating voltage is 17 Volts. When using an adjustable power supply, make sure the voltage is not adjusted above this voltage.

**CASE TEMPERATURE:** High power can mean high temperatures. Mount the amplifier where air can easily circulate over it and where clothing, blankets, etc., will not accidentally be placed over it.

**TERMINATIONS:** The efficiency of this amplifier will degrade if it is operated into anything but a 50 Ohm load. Lowered output, increased current drain, higher operating temperature, and reduced life may result.

## **CIRCUIT DESCRIPTION**

The amplifier is comprised of a few main blocks (see Block Dia. # **102167**). A brief description of each follows:

### **RF Sensor.**

This circuit senses the presence of an RF signal from transceiver on the input of the amplifier. When an RF signal is detected by the RF detector D6, D7, it activates transistors Q2 and Q1. The transistor Q1 applies a bias voltage (Vb) to the Power Amplifier module and Solid State Antenna Switch Relay.

### **RF Power Amplifier**

This stage provides approximately 10 db gain utilizing an RF hybrid module (U1) with input and output impedance of 50 Ohms. The attenuator ATT1 insures a proper drive level for the RF hybrid module. Pins 3 and 4 of U1 are connected to regulated voltage Vr from the Power Supply circuit and pin 2 is controlled by voltage Vb from the Carrier Operated Solid State Relay. The voltage Vb establishes an ON / Off state of U1. DC isolation is accomplished by L5, L6, L7 and by-pass capacitors C13 - C23. There are no tuning components. The Power Amplifier module provides broadband operation.

### **Low Pass Filter 1 (LPF1) and Low Pass Filter 2 (LPF2)**

LPF1 and LPF2 are low pass filters providing attenuation of frequencies at the 2<sup>nd</sup> harmonic and above.

### **Carrier Operated Solid State Relay (Antenna Switch Relay)**

This circuit directs the RF signal through the proper path in Transmit (Tx) and Receive (Rx) modes. In Tx mode the RF input signal from a transceiver is directed through forward biased PIN diode D1 to the Power Amplifier. The output signal from the LPF1 passes through forward biased D4 and LPF 2 to the RF output connector. In Rx mode there is no bias voltage applied to the PIN diodes which creates a signal path from the antenna to the transceiver

## Power Supply and Transient Voltage Suppression circuit

The power supply provides the regulated supply voltage  $V_r$  to the rest of the circuitry. It consists of the low dropout voltage regulator U2 and high current pass transistor Q3. DC isolation of the  $V_{cc}$  voltage is accomplished through L8, C28, C34. D5 is a zener transient voltage suppressor which protects the RF Power Amplifier from high voltage, high energy transients.

## Maintenance and Repairs

The amplifier does not normally require any maintenance or adjustments. In case of a serious failure, it is recommended that the amplifier be returned to the TPL Service Department. If the unit is out of warranty and it is desired to do a field repair, it is suggested that the complete Printed Circuit Board assembly be replaced. The series pass regulator transistor Q3, and the RF amplifier module U1, may be replaced without removing the board, should a failure occur. These parts are available from the Service Department listed on the last page of this manual. If further detailed servicing is required, a schematic diagram is also available.

### Replaceable Parts

Item Description	Designator	Quantity	Mfr. Part Number
DC Power Transistor	Q3	1	D45H11
RF Hybrid Module	U1	1	MHW282-1
PC Board Assembly	PCB1	1	T-102171
RF Cable Assembly	J1-W1, J2-W2	2	81AA-M-W
DC Power Connector	J3	1	F1-126A
Fuse	F1	1	J2-131



### **Fault Isolation Procedure**

For part locations, refer to the silk screen on the printed circuit board. In order to isolate a fault to one of the above field replaceable parts, it is suggested that the technician follow a step-by step procedure as follows:

- 1) Check that 13.8 VDC is present at the DC connector. If not, recheck the source voltage and the J3 input connector.
- 2) Remove the cover and check that the internal fuse is OK.
- 3) Check that source voltage is at the emitter of the PNP transistor, Q3. If so, check the transistor using standard procedures. The base should be .7 volts less than the emitter. The collector should be at approximately 11 volts. If Q3 does not check out properly, it should be replaced. If the transistor, Q3, tests good, but the collector voltage is low, this indicates excess current drain on the board or a failed regulator, U2. In either case the board must be replaced.
- 4) Check with an ohm meter that the input and output cables and connectors have continuity and are not shorted to ground. If defective, replace.
- 5) Place a watt meter and 50 ohm load on the amplifier output. Apply 3 watts to the amplifier input. Check for minimum 15 watts at the output. If not, check U1 for 11 volts on pins 3 and 4, and approximately 10 volts on pin 2. If these voltages are present but there is no output, this indicates that the hybrid, U1, is probably bad and should be replaced.
- 6) With the above conditions, if the bias voltage  $V_b$  is low, or if  $V_b$  is high but there is still no output, this indicates a board failure and the main board should be replaced.
- 7) Retest to specification requirements and replace the cover.

## **WARRANTY**

TPL Communications has tested and found this unit to function properly and to operate within the parameters of its stated specifications.

TPL Communications warrants that this product is free from defects in material and workmanship. If found to be defective within two years from the customer's date of purchase, the manufacturer, at its discretion, will either repair or replace the unit at no cost, provided the unit is delivered by the owner to the manufacturer intact. Warranty does not apply to any product which has been subjected to misuse, neglect, accident, improper installation, or used in violation of instructions furnished by manufacturer; nor does it extend to units which have been repaired or altered outside our service department, or where the serial number has been removed, defaced or changed.

## **SERVICE**

For parts or service on this amplifier, contact:

**TPL COMMUNICATIONS**  
Customer Service Department  
PHONE: (323) 256-3000 or (800) HI POWER  
FAX: (323) 254 3210

For further information on TPL Products, visit our Web site at:

[www.tplcom.com](http://www.tplcom.com)