

APPENDIX B
OPERATING/SERVICE/INSTRUCTION MANUAL

SERVICE
MANUAL
HMS SERIES
UHF
RF POWER
AMPLIFIERS

TPL COMMUNICATIONS

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GENERAL SPECIFICATIONS:

FREQUENCY RANGE: 400 - 512 MHz.

OPERATING MODE : FM

MODEL	POWER INPUT	NOMINAL POWER OUTPUT
PA6-2EF-HMS	80-200mW	300W
PA6-2BF-HMS	5-12W	300W
PA6-2GF-HMS	20-45W	300W

OPERATING TEMPERATURE RANGE: -20° to +50° Celsius.

OPERATING VOLTAGE: 110 VAC Standard, 220 VAC Optional.

EIA DUTY CYCLE: 100%

RECEIVER INSERTION LOSS: 1 dB maximum, when optional receive relay is specified.

HARMONIC ATTENUATION: Meets FCC Type Acceptance requirements.

FUSING: 15 Amperes for 110 Volt operation, 7.5 Amperes for 220 Volt operation.

OPTIONS:

TPL HMS power amplifiers are available in several options and configurations, when specified at the time of order.

Repeater Configuration (standard):

Supplied without a carrier operated relay (COR).

Base Station Configuration:

Supplied with a COR.

INSTALLATION: This unit is designed for mounting in a standard 19" rack. When picking a location in the rack, consideration must be given to RF power output cable lengths, as well as cooling considerations.

Mount the unit where dust and other debris are not likely to clog the cooling fins. Avoid mounting the amplifier directly above hot pieces of equipment that could artificially raise the amplifier temperature.

Connect the radio transmitter to the "RF INPUT" terminal and the antenna to the "RF OUTPUT" terminal on the amplifier, with 50 Ohm coaxial cable and TYPE N plugs. TYPE N plug assembly is shown on the following pages.

Plug the AC line cord into the system AC power receptacle.

For safety, make sure the rack and all equipment connecting to the amplifier have proper AC grounds. Do not rely on coaxial cable shields for AC grounding.

Assure the installation has proper lightning protection.

MAINTENANCE

Major components of the HMS amplifiers can be easily removed and replaced.

Removal of the RF Amplifier.

The RF amplifier assembly can be removed using the following steps:

1. Disconnect the cables from the RF input and RF output terminals on the rear of the amplifier.
2. Disconnect the power and signal connector on the right side of the amplifier.
3. Remove 6 screws, connecting the amplifier heat sink to the chassis. See the top view of the amplifier.
4. Remove 2 screws, connecting the amplifier heat sink to the rear panel. See the rear view of the amplifier.
5. Remove the RF amplifier from the top.

Removal of the Power Supply.

The power supply can be used using the following steps:

1. Make sure that AC power is disconnected from the HMS unit.
2. Remove the screws holding the rear panel. There are two screws on each side, two on the top, and one on the bottom.
3. Carefully disconnect the cables from the interconnect board.
4. Remove the rear panel.
5. Disconnect the two molex connectors from the power supply.
6. Disconnect the AC and DC power cables to the supply.
7. Remove the 4 screws on the bottom of the HMS unit that connect the power supply.
8. Remove the power supply through the rear of the HMS unit.

METERING AND TEST POINTS

The following signals and voltages are indicated on the front panel meter, a liquid crystal display. The voltage to be monitored is selectable via the front panel momentary contact toggle switch. The display has two lines of text. The top line indicates the parameter to be measured while the bottom line indicates the measured value and its units. Refer to the front panel drawing in the illustrations section for the location of the meter and switch. The following is a list of display positions and functions:

Display Position	Function
HMS STATUS	Meter default position
FWD PWR	Output RF Forward Power Level
RFL PWR	Output RF Reverse (Reflected) Power Level
RF INPUT	Input RF Power Level (Relative Reading Only)
DRIVER V	DC Voltage Driver Amplifier
FINAL V	DC Voltage, Final Amplifier
A CURR	Amplifier "A" DC Amperes
B CURR	Amplifier "B" DC Amperes
TOT CURR	Total DC Amperes

The switch can be toggled in either direction. If the switch is not toggled for approximately three minutes the display reverts to the HMS STATUS position.

The primary purpose for the front panel switch is to provide a tool for maintenance of the RF amplifier system. A table for recording values for each parameter shown by the panel meter is included as appendix I of this manual. It is strongly recommended that these parameters be entered in the table upon initial installation of the RF amplifier and at regularly scheduled intervals after that. In case of a system failure, values can be recorded in the table and the table faxed to TPL Communications. This will greatly aid our technical personnel to make any necessary repairs to the system.

In addition to the front panel metering, system monitoring is provided by front panel indicators. Five indicators are used and have the following functions and characteristics.

Indicator	Function/Characteristic
RF ON Lamp	Steady green light indicating that RF is being supplied to the amplifier
SWR Lamp	Flashing red alarm when output load VSWR is too high
OTEMP Lamp	Flashing red alarm when amplifier chassis is too warm
LOPWR Lamp	Flashing red alarm when RF output power is too low
FANS Lamp	Flashing red alarm when fans are not operating.

REMOTE MONITORING

The monitored functions are described in other sections. These same functions, some of which are displayed by LED's on the front panel, are available in the REMOTE MONITOR connector on the rear panel. The outputs are as follows:

OPERATOR ADJUSTMENTS

A display contrast adjustment is provided on the front panel, between the LCD display and the meter select switch. This is a ten turn pot.

Other operator adjustments are accessible through the rear panel. These are potentiometer P1 through P8 and switch SW1. Their functions are as follows.

Ref. Desig	Function/Adjustment
P1	RF output power level adjustment. This is a 10 turn potentiometer
P2	Zero adjustment for side "B" power amplifier current calibration.
P3	SWR threshold set to determine the alarm level for the front panel indicator
P4	Determines the threshold for a valid input RF power level
P5	Low RF power output threshold set to determine the alarm level for the front panel indicator.
P6	Meter calibration potentiometer for RF power output.
P8	Zero adjustment for side "A" power amplifier current calibration.
SW1	Determines the method of RF output power control. The up position provides regulated DC control. The down position provides RF feedback leveling control.

A basic understanding of RF principles is necessary before making any adjustments to the unit. This includes knowledge of the relationship of forward and reflected power relative to SWR etc. Adjustment also requires the familiarity and use of test equipment. If in doubt consult your dealer or the factory about changes.

- P6 Toggle the front panel switch until the top line of the display reads FWD PWR. With the proper RF termination still in place, monitor the RF forward power output on a calibrated power meter. Set P1 to provide nominal power output. Adjust P6 so that the front panel meter is in agreement with the calibrated power meter. Note this power reading. Note: the recommended output power range is from the specified maximum output level to one half that value. Consult the factory if a lower power level is required. In all cases, a spectrum analyzer should be used to assure that no spurious signals are generated when the power level is changed.
- P7 Toggle the front panel switch until the top line of the display reads FWD PWR. Attach a 3:1 SWR load to the output and note the forward power. Toggle the front panel switch until the top line of the display reads RFL PWR and adjust P7 so that the front panel meter reads the reflected power. This should be set to read 1/4 the forward power level noted above.
- P3 The optimum setting for this SWR threshold adjustment is to have the alarm trigger with a 3:1 SWR. It may however be set anywhere at the users discretion. With the 3:1 SWR used in the previous step still terminating the amplifier, apply normal RF drive and adjust the potentiometer until the front panel SWR lamp begins to flash. The lamp should extinguish when the SWR is reduced or the normal load is connected.

RF Amplifier PA6-2GF-HMS

The model PA6-G2F-HMS RF amplifier consists of an input attenuator, RF driver, four final stages, low pass filter, dual directional coupler, RF detector, RF signal splitter, RF signal combiner, and a thermistor. It amplifies a 400 to 512 MHz RF input to produce a 300W RF output. The driver has a gain of approximately 10 dB, and the combined gain of the final stages along with the filter and coupler is approximately 8 dB.

DC Power to the driver stage is controlled by a darlington transistor. This transistor allows power to be reduced by high temperature, high VSWR conditions, or the control potentiometer, P1.

A detector is present on the RF input. This detector provides a measure of the amplitude of the RF input to the control board.

A two way power splitter divides the input signal evenly between the driver and the detector.

A dual directional coupler on the output provides outputs to the control board which indicate the amplitude of forward and reflected RF output power.

A thermistor measures the operating temperature on the heatsink

FAN DETECTOR(Q11,Q12) The fan, when rotating, outputs a square wave at approximately 1Khz. The negative half of the square wave is rectified and filtered, keeping the appropriate transistor off. Loss of the square wave causes the negative bias to be lost causing the respective transistor Q11, or Q12 to be turned on. Either transistor turned on activates the FANS LED alarm.

Digital Panel Meter Board. (101921)

The digital panel meter board accepts test signals from the control board, multiplexes these signals to an analog to digital converter, and formats and outputs the signals to a liquid crystal display (LCD). The major components of the panel meter board are: input filters, voltage regulator, analog to digital converter, and controller. On the rear of the board there is a 14 pin header and a potentiometer. The header connects directly with the LCD display unit on the front panel. The potentiometer is accessible by a hole in the front panel. This potentiometer controls the contrast of the display.

VOLTAGE REGULATOR U1. This is a precision voltage reference. It provides the reference to the analog to digital converter and 5VDC to the other circuits on the board.

ANALOG TO DIGITAL CONVERTER (ADC) U2. This circuit is a twelve bit analog to digital converter and multiplexer. The input multiplexer, controlled by the HC05 controller selects the analog input to be tested. The ADC converts the analog input to a 12 bit digital word. This digital word is output to the controller in serial format.

MICRO-CONTROLLER U3. The micro controller selects the input data, controls the ADC and outputs the digital data to the front panel display unit. A two position header, JP1, allows the panel meter to be used for either HMS or LMS series amplifiers. A shunt across JP1 causes the LMS series to be selected. Otherwise the HMS series is selected.

**TUNING ADJUSTMENT PROCEDURE
FOR MODEL PA6-2EF, PA6-2BF, PA6-2GF**

STEP	ADJUST	FUNCTION	INSTRUCTIONS
1.	Set up amplifier in accordance with test set-up diagram. minimum specified RF power at the desired frequency. Set SW1 on the rear panel to the up (DC Feedback) position, and set P1 for maximum VD on test meter.		
2.	C11 Driver Boards	Output Tuning	Adjust for maximum power out.
3.	C1 Driver Boards	Input Tuning	Adjust for maximum power out.
4.	C11 Final Boards	Output Tuning	Adjust for maximum power out.
5.	C1 Final Boards	Input Tuning	Adjust for maximum power out.
6.		Overall tuning	Adjust input drive to actual operating power and repeat all steps for optimum performance.
7.			Set SW1 on the rear panel to the down RF feedback position. Set power output as described in the section: Operator Adjustments.