MOBILE RADIO

DESCRIPTION AND MAINTENANCE

806—825 MHz MASTR® EXECUTIVE II, 10-WATT TRANSMITTER

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DESCRIPTION

MASTR® Executive II transmitter are crystal controlled, frequency modulated transmitters designed for one through four frequency operation in the 806-825 MHz frequency band. This solid state high reliability transmitter uses two integrated circuits, an FM ICOM module and discrete components to provide 10-watts of transmitted RF power. The gransmitter consists of:

- Exciter Board with audio processor, oscillator board, FM ICOMS and frequency multiplier/amplifier stages.
- Power Amplifier Assembly; with amplifiers, PA final, power control, and low pass filter assembly.

Figure 1 is a block diagram of the MASTR Executive II transmitter showing the exciter and PA board.

In addition to providing 70 milliwatts of RF power to the PA in the transmit mode, the exciter also provides 15 milliwatts RF injection to the receiver 1st mixer in the receive mode.

The exciter contains the audio processor and the frequency multiplier/amplifier necessary to generate the transmitted RF carrier frequency. (This same frequency is always used to generate the receives 1st (IF frequency). The FM ICOMS are located on a separate oscillator board located adjacent to the exciter board. The oscillator board is plugged into the exciter.

The power amplifier assembly utilizes four transistors to provide rated output power, a low pass filter, and a power control circuit to adjust the output power level for desired output. The radio operates in vehicles with negative ground only.

MAINTENANCE

DISASSEMBLY

To service the transmitter remove the two retaining screws from the front cap assembly and pull radio out of case assembly.

To remove exciter board:

(1) Remove exciter top cover and unplug cables from exciter output jacks J101 and J102.

(2) Remove the six screws holding the exciter board to the mounting frame and gently lift exciter board out of radio.

PA ASSEMBLY REMOVAL AND REPLACEMENT

NOTE

Component placement and connections on the printed wire board are very critical on the fixed tuned PA. For this reason it is recommended that the entire PA assembly be returned to the factory for servicing

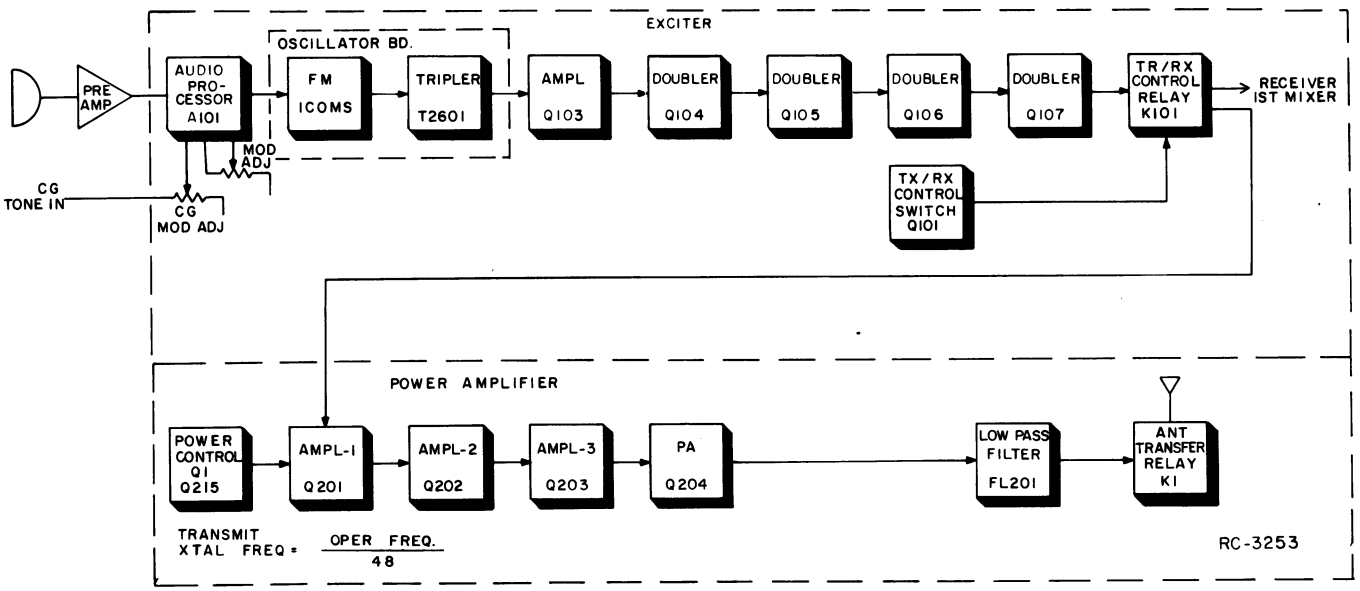


Figure 1 - Transmitter Block Diagram

WARNING

The RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic, or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Be extremely careful to avoid damaging transistor when working with PA assembly.

To remove PA assembly:

1. Disconnect PA RF input cable from J1,
2. Unplug DC power input cable from J203 and J204.
3. Using a Phillips head screwdriver remove screw securing RF output cable to PA assembly and unplug RF output cable from J202 on Low Pass Filter.
4. Remove the two end screws securing the hinged PA assembly to the chassis and remove PA assembly.

To replace PA assembly, perform the above procedures in reverse order.

TROUBLESHOOTING

A Troubleshooting Procedure, including QUICK CHECKS, permits rapid fault located in the exciter and power amplifier.

10-VOLT REGULATOR U2601

SYMPTOM	PROCEDURE
No 10-Volt output	1. Check input voltage (A+) at P902-8 and U2601-1. 2. Remove the Power/Control cable from J901. Check for shorts from Pins 3, 7 and 14 to A-. These readings should be no less than 100 ohms. 3. Check Pass transistor Q2601. 4. Replace U2601.
Regulator output too high	1. Check Q2601. 2. Replace U2601.

MODULATION LEVEL ADJUSTMENT

CAUTION

Before bench testing the MASTR Executive II Mobile Radio, be sure of the output voltage characteristics of your bench power supply.

To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:

Transmitter unkeyed: 20 Volts
Transmitter keyed (50 ohm resistive load): 18 Volts
Transmitter keyed (no load or non-resistive load): 15.5 Volts

These voltage are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limit shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 18 Volt figure.

Routine transmitter tests should be performed at EIA Standard Test Voltages (13.8 VDC for loads less than 6.0 amperes). Input voltages must not exceed the limits shown, even for transient peaks of short duration.

Many commonly used bench power supplies cannot meet these requirements for load regulation and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering (such as Lapp Model 73) may be unable when operated in parallel with a 12-Volt automotive storage battery.

TEST EQUIPMENT

1. Audio oscillator (GE Model 4EX6A10)
2. Frequency deviation meter
3. Multimeter AC Voltmeter
4. GE Test Set Models 4EX3A11 or 4EX8K12
5. Frequency Counter
6. Oscilloscope
7. 50-ohm Wattmeter

The MOD ADJUST Control R103 was adjusted to the proper setting before shipment and should not normally require readjustment. This setting permits approximately 75% modulation for the average voice level.

NOTE

The Modulation Level Adjustment procedures should be repeated each time the Channel Guard Tone frequency is changed.

PROCEDURE

1. Connect the audio oscillator and the meter across P902-4 (Mike High) through a 0.5 microfarad (or larger) DC blocking capacitor, and P902-5 (Mike-Low) on the exciter board.
2. Adjust the audio oscillator for 1-Volt RMS at 1000 Hz.
3. For transmitters without Channel Guard, set MOD ADJUST R103 for a 4.5-kilohertz swing with the deviation polarity that provides the highest reading as indicated on the frequency deviation meter. If the deviation reading plus (+) or minus (-) differs by more than 0.5 kHz, recheck Steps 1 and 2 as shown in the Transmitter Alignment Chart.
4. For transmitters with Channel Guard, set Channel Guard MOD ADJUST for zero tone deviation. Next, with the 1-Volt signal at 1000 Hz applied, set MOD ADJUST R103 for a 3.75 kHz deviation. Then remove the signal from the audio oscillator and set Channel Guard MOD ADJUST for 0.75 kHz tone deviation.
5. For multi-frequency transmitters, set the deviation as described in Step 3 or 4 on the channel producing the largest amount of deviation.

PA POWER INPUT

For FCC purposes, the PA power input can be determined by measuring the PA supply voltage and PA current, and using the following formula:

$$P_i = \text{PA voltage} \times \text{PA current}$$

where:

P_i is the power input in watts.

PA voltage is measured with DC Voltmeter at Feed thru Capacitor C219.

PA current is measured with the Test Set in Position F in the Test 1 position, and with the HIGH SENSITIVITY button pressed (10 amperes full scale).

Example:

P_i = 13.0 Volts x 4.55 amperes = 35 watts.

FM ICOM FREQUENCY ADJUSTMENT

NOTE

Always verify correct adjustment of FM ICOMS before setting modulation levels.

First, check the frequency to determine if any adjustment is required. The frequency should be set with a frequency meter or counter with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained, and with the entire radio as near as possible to an ambient temperature of 27.5°C (81.5°F).

FM ICOMs should be reset only when the frequency shown deviation in excess of the following limits:

A. ±0.5 PPM, when the radio is at 27.5°C (81.5°F).

B. ±2 PPM at any other temperature within the range of +5°C to +55°C (+23°F to 131°F).

C. The specification limit (±2 PPM) at any temperature within the ranges of -40°C to 5°C (-40°F to +23°F) or +55°C to +70°C (+131°F to +158°F).

If the radio is at an ambient temperature of 27.5°C (81.5F), set the oscillator for the correct operating frequency.

If the radio is not at an ambient temperature of 27.5°C, setting errors can be minimized as follows:

To hold setting error to ±0.35 PPM (which is considered reasonable for 2 PPM ICOMs):

1. Maintain the radio at 27.5°C (±5°C) and set the oscillator to desired frequency, or
2. Maintain the radio at 27.5°C (±10°C) and offset the oscillator, as a function of actual temperature, by the amount shown in Figure 2.

For example: Assume the ambient temperature of the radio is 23.5°C (74.3°F). At that temperature, the curve shows a correction factor of 0.2 PPM. (At 806 MHz, 1 PPM is 806 Hz. At 825 MHz, 1 PPM is 825 Hz).

With an operating frequency of 806 MHz, set the oscillator for a reading of 162 Hz (0.2 x 806 Hz) higher than the licensed operating frequency. If a negative correction factor is obtained (at temperatures above 27.5°C) set the oscillator for the indicated PPM lower than the licensed operating frequency.

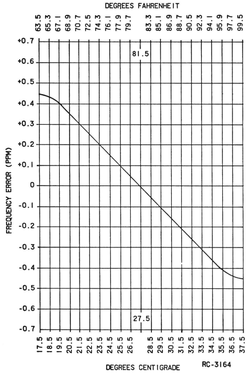
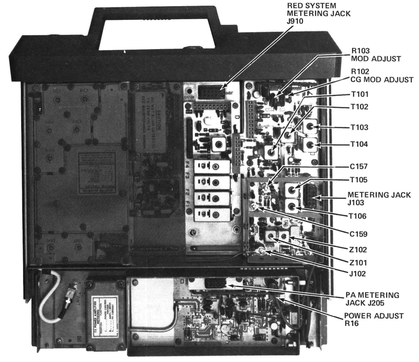


Figure 2 - Frequency Offset Chart



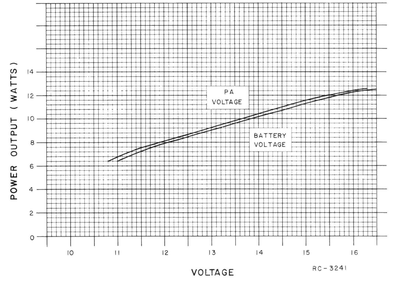


Figure 3 - Power Output Setting Chart

TRANSMITTER ALIGNMENT

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Place all FM ICOMs on oscillator Board, (crystal frequency = operating frequency ÷ 48).
2. For a large change in frequency or a badly mis-aligned transmitter, preset all slugs (including Z101 and Z102) to the top of the coil form. Set R16 (Power Adjust) fully CCW.
3. Set C157 and C159 to minimum capacity (not meshed).

NOTE

The tuning frequency for multi-frequency transmitters is determined by the operating frequency and the frequency spread between transmitters.

4. For multi-frequency transmitters with a frequency spread less than 1.5 MHz tune the transmitters to the lowest frequency. For a frequency spread exceeding 1.5 MHz but less than 3 MHz, tune the transmitters using a center frequency tune up ICOM.
5. Connect the red plug on the GE Test Set to the SAS Board metering jack, and the black plug to the Exciter metering jack. Set the polarity to +, and set the range to the Test 1 position (1-Volt position for 4EX8K12) for all adjustments.

NOTE: With the Test Set connected to the PA metering jack, the voltage reading at position "F" with the HIGH SENSITIVITY button pressed may be converted to PA collector current by reading the current as 10 amperes full scale.

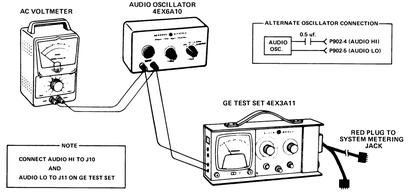
ALIGNMENT PROCEDURE

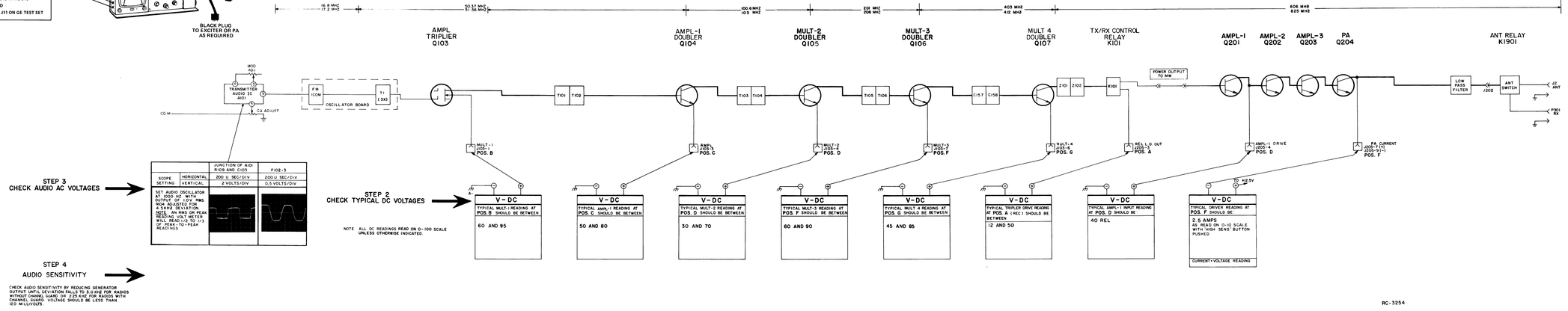
STEP	METER POSITION	TUNING CONTROL	METER READING	PROCEDURE
				NOTE: When aligning transmitter, proceed as instructed below. DO NOT retune a previously tuned control unless specifically directed to do so.
1.	B (MULT-1)	T2601, T101	See Procedure	Tune T2601 for maximum meter reading. Then tune T101 for a dip (small) in meter reading.
2.	C (AMPL)	T102, T103	See Procedure	Tune T102 for maximum meter reading, then tune T103 for a dip (small) in meter reading.
3.	D (MULT-2)	T104, T105	See Procedure	Tune T104 for maximum meter reading and then tune T105 for a dip in reading.
4.	F (MULT-3)	T106, C157	See Procedure	Tune T106 for maximum meter reading and then tune C157 for a dip in reading.
5.	G (MULT-4)	C159, Z101	See Procedure	Tune C159 for maximum meter reading, and then tune Z101 for a dip in reading.
6.	A (Rel. Power Out)	Z102	Maximum	Tune Z102 for maximum meter reading.
7.	C (AMPL)	T101, T102	Maximum	Alternately tune T101 and T102 for maximum meter reading.
8.	D (MULT-2)	T103, T104	Maximum	Alternately tune T103 and T104 for maximum meter reading.
9.	F (MULT-3)	T105, T106	Maximum	Alternately tune T105 and T106 for maximum meter reading.
10.	G (MULT-4)	C157, C159	Maximum	Tune C157 and C159 for maximum meter reading.
11.	D (INPUT DRIVE)	Z101, Z102	Maximum	Plug Test Set into PA metering jack and alternately tune Z101 and Z102 for maximum meter reading.
12.	WATT METER	R16	10 Watts	Key transmitter and Power Adjust control for a reading of approximately 10 watts as indicated on wattmeter.
13.	D (INPUT DRIVE)	Z101, Z102	Maximum	Alternately tune Z101 and Z102 for maximum meter reading.
14.	WATT METER	R16		With the battery voltage at 13 Volts set Power Adjust potentiometer R16 on the PA board for rated power output.

STEP 1 - QUICK CHECKS

METER POSITION GE TEST SET	PROBABLE DEFECTIVE STAGE		
	HIGH METER READING	LOW METER READING	ZERO METER READING
EXCITER			
A (REL PWR)		Q106, Q107	Q103-Q107, CR102, C174, R153-R155, R157
B (MULT-1)	Q103, T101 10-Volt Regulator	T1 (Osc. Mod) Q103	T1, (Osc. Mod), T1 T101, Q103
C (MULT-2)	Q105, T105	Q105, T104 T103	T104, T105, T103 Q105
F (MULT-3)	Q106, C155	Q106, T105, T106	T106, T105, L105 Q106
G (MULT-4)	Q107, Z101, Z102	Q107, C157, C159	Q107, C157, C159 Z101, Z102
POWER AMPLIFIER			
"E" (POWER CONTROL)		Q215, R16 Q1, VR1	Q215, Q1, R16
"D" (AMPL-1 INPUT)		Low Output from Exciter, CR1	No Output from Exciter, C1, C1
"F" (PA CURRENT)	Q204, L22, L23, R11	Q203, Q204, Low Output from Exciter	No Output From Exciter, Q201-Q204 Check POS, C, & D (K101, Q101, CR100 in Exciter)

TEST EQUIPMENT SETUP





TROUBLESHOOTING PROCEDURE

806—825 MHz, 10-WATT TRANSMITTER