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Mobile Communications

DESCRIPTION AND MAINTENANCE 138-174 MHz, 300 MW TRANSMITTER

Maintenance Manual

ERICSSON

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LBI-30816

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ILLUSTRATIONS

DESCRIPTION

MASTR® Executive II transmitters are crystal controlled, phase modulated transmitters designed for single frequency operation in the 138-174 MHz frequency band. This solid state, high reliability transmitter uses one integrated circuit and discrete components to provide 300 milliwatts of transmitted RF power. The transmitter consists of:

Exciter Board; with audio, modulator, amplifier and multiplier stages.

Power Amplifier/Antenna Switch Assembly; with PA final, solid state antenna switch and low pass filter assembly.

Figure 1 is a block diagram of the transmitter showing the exciter and power amplifier/antenna switch assembly.

The exciter contains the oscillator, audio IC, modulator and multipliers to provide 250 milliwatts of modulated RF power to the power amplifier.

The power amplifier/antenna switch assembly includes a single transistor stage to provide rated output power, a solid state switch to switch the antenna between the transmitter and receiver and a low pass filter with a 20 dB pad for connecting the antenna to the optional monitor receiver.

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. Unplug cable W216 (exciter output).
2. Remove the six screws holding the Exciter Board to the mounting frame and gently lift Exciter Board out of radio.

To remove the pA Board:

NOTE

The PA heat sink assembly pivots 90 to permit access to the PA board.

1. Remove screws holding hinged PA heat sink to swing down PA heat sink.
2. Remove PA top cover and unplug the exciter/PA cable W216; unsolder the PA/low pass filter cable W214 from H9 and shield from ground.

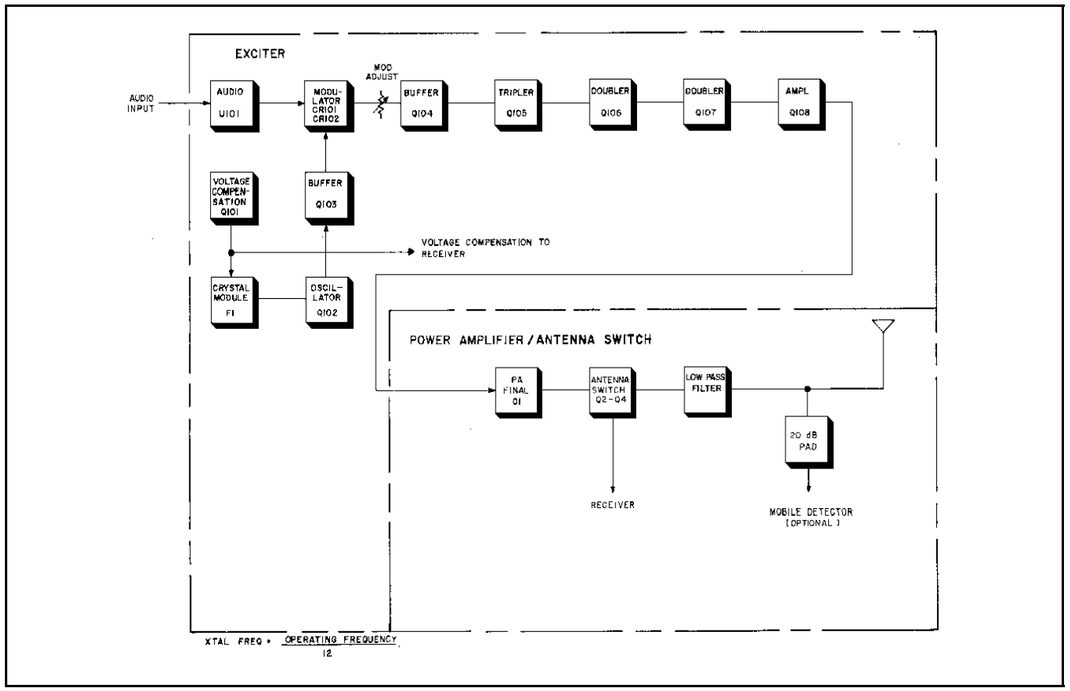

Figure 1 - Transmitter Block Diagram

3. Unplug receiver/PA cable W217; Unplug power cable W215 from System Board.
4. Remove screws and cable clamps on W215, W216 and W217.
5. Remove the four PA Board mounting screws and lift the board out.

PA TRANSISTOR REPLACEMENT:

1. Turn the PA Board over.
2. Unsolder one lead at a time with a 25 watt soldering iron. Use a scribe to hold the lead away from the printed circuit board until the solder cools.
3. Lift out the transistor and remove the old solder from the printed circuit board with a de-soldering tool such as a SOLDA-PULLT®. Special care should be taken to prevent damage to the printed circuit board runs.
4. Trim the new transistor leads (if required) to the lead length of the removed transistor.
5. Apply a coat of silicon grease around the transistor body and slide heat sink over transistor body. Align the leads as shown on the Outline Diagram.
6. Make sure that the transistor leads are formed so that the leads can be soldered to the printed circuit pattern, starting from the inner edge of the mounting hole.
7. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board. Use care not to use excessive heat that causes the printed circuit board runs to lift up from the board. Check for shorts and solder bridges before applying power.

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CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor or may cause low power output.

TROUBLESHOOTING

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

CAUTION

Before bench testing the 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): l5.5 Volts

These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limits 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 of 0 to 6 amperes: Input voltages must not exceed the limits shown, even for transient peaks of short duration.

TEST EQUIPMENT

1. An audio oscillator
2. A deviation monitor
3. A Multimeter and AC voltmeter
4. GE Test Set Models 4EX3Al1 or 4EX8K12
5. Wattmeter, 50 ohm connected to antenna jack J2 (1 watt element recommended)
6. Frequency Counter

TRANSMITTER ALIGNMENT

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Place crystal module for F1 on Exciter Board (crystal frequency - operating frequency ÷ 12).
2. For a large change in frequency or a badly misaligned transmitter, preset all slugs to the top of the coil forms.
3. Connect the black plug to the Exciter Board metering jack. Set the polarity to + and set the range to the Test 1 position (1-Volt position for 4EX8E12) for all adjustments.
4. All adjustments are made with the transmitter keyed. The transmitter is keyed by applying a ground to test point TP17 on the System Board. Unkey the transmitter between steps to avoid unnecessary heating.
5. Set tuning slugs in L101, L102 and T101 through T108 to top of coil forms.

ALIGNMENT PROCEDURE

STEP	METER POSITION	TUNING CONTROL	METER READING	PROCEDURE
1.	A (MULT-1)	L101, L102, & T101	See Procedure	Tune L101 then L102 for maximum meter reading on highest frequency. Then with lowest frequency selected, tune T101 for a dip in meter reading.
2.	B (MULT-1)	T102, T101 & T103	See Procedure	T102, T101 & T103 See Procedure Tune T102 for maximum meter reading and re-adjust T101 for maximum meter reading. Then tune T103 for a dip in meter reading.
3.	C (MULT-3)	T104, T103 & T105	See Procedure	Tune T104 for maximum meter reading and re-adjust T103 for maximum meter reading. Then tune T105 for a dip in meter reading.
4.	F (AMPL-1)	T106 & T105	Maximum	Tune T106 for maximum meter reading, and then re-adjust T105 for maximum meter reading.
5.	G (Rel. Power Out)	T107 & T108	Maximum	Tune T107 and then T108 for maximum meter reading. Then, alternately re-tune T107 & T108 for maximum meter reading.
6.	F (AMPL-1 DRIVE)	T105 & T106	Maximum	Re-adjust T105 and T106 for maximum meter reading.
7.		T105, T106, T107 & T108	Maximum	Re-adjust for maximum reading on the wattmeter connected to antenna jack.

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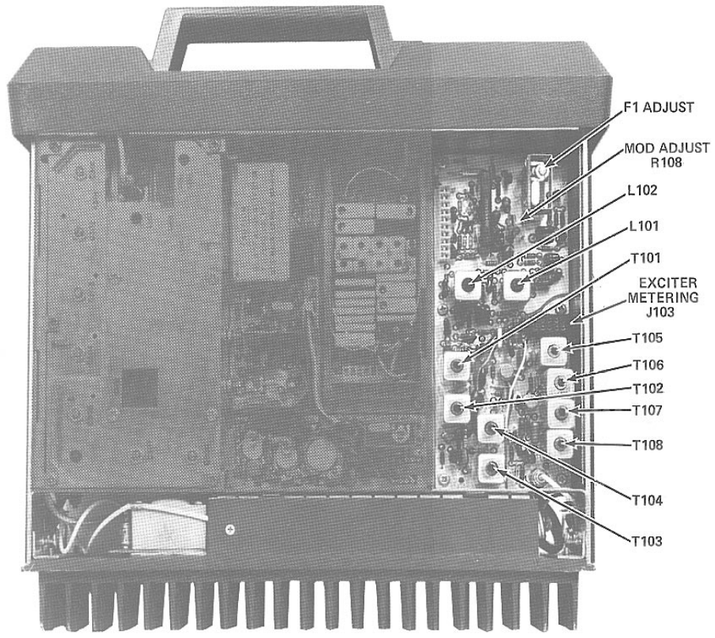


MODULATION LEVEL ADJUSTMENT

MOD ADJUST control R108 has been adjusted to the proper setting before shipment and should not normally require readjustment.

PROCEDURE

1. Connect the audio oscillator and meter across P902-4 (Mic-Hi) through a 0.5 µF (or larger) DC blocking capacitor and P902-5 (Mic Lo) on the Exciter Board. If not using GE Test Set, connect audio oscillator and meter across P902-4 (Mic Hi) through a 0.5 microfarad (or larger) DC blocking capacitor and P902-5 (Mic Lo) on the Exciter Board.
2. Adjust the audio oscillator for 1 Volt RMS at 1000 Hz. Adjust R3 on Vehicular Repeater System board to maximum clockwise position.
3. Key transmitter by placing a ground on test point TP17 on the System Board.

DEVIATION ADJUSTMENT

1. Set MOD ADJUST control R108 for a 4.75 kHz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.

NOTE

If the deviation reading plus (+) or minus (-) differs more than 0.5 kHz, recheck Step 1 as shown in the Transmitter Alignment Chart.

2. Using a deviation monitor, check the symmetry of the modulator at 300 Hz using the highest and lowest assigned operating frequencies. If more than 0.5 dissymmetry exists, tune L102 to optimize symmetry. **NOTE:** L102 should not be adjusted more than - 1/8 turn from the previous setting. If a deviation monitor is not available, adjust L102 1/8 turn counterclockwise.
3. Reduce audio level of audio oscillator (1000 Hz) to produce 3 kHz deviation at P902-4. Output of the audio oscillator must be between 75 and 120 mV rms. If not, a problem exists in the Exciter board. Verify operation of the Tx audio IC.
4. Connect the audio oscillator to the System board input coming from VOL SQ HI. Adjust the output level of the audio oscillator to produce 300 mV for Delta/RANGR radios or 1 volt rms for MII radios.
5. Set up System board to pass audio to the Exciter board.
6. Adjust R3 on the System board to produce 3 kHz deviation.

OSCILLATOR FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should he set using 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 30°C (86°F).

The oscillator should be reset only when the frequency shows deviation in excess of the following limits:

A. ±0.6 PPM, when the radio is at 30°C (86°F).

B. ±5 PPM at any other temperature within the range of -30°C to +75°C (-22F to +167F)

If an adjustment is required, Proceed as follows:

If the radio is at an ambient temperature of 30°C (86°F) , set the oscillator for the correct operation frequency.

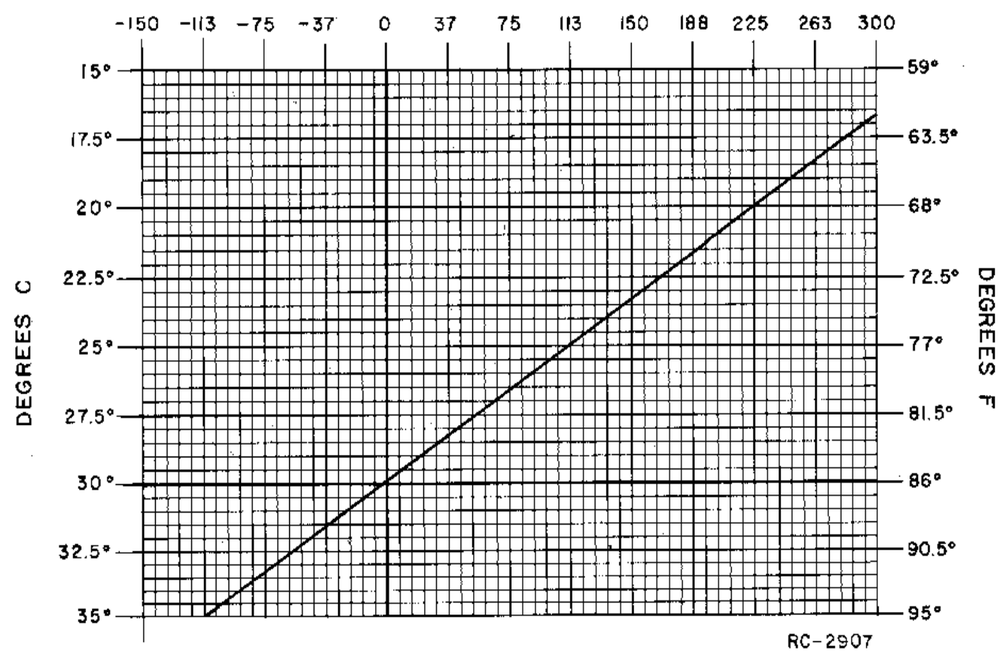
If the radio is not at an ambient temperature of 30°C, setting errors can be minimized as follows:

A. To hold the setting error to ±0.6 PPM (which is considered reasonable for 5 PPM crystal oscillators) :

1. Maintain the radio at 30°C and set the oscillator to desired frequency, or
2. Maintain the radio at 30°C (+5°C, -15°C) offset the operating frequency as a function of actual temperature, by the amount shown in Figure 2.

For example: Assume the ambient temperature of the radio is 20°C (68°F). At that temperature, the curve shows a correction factor of 225 Hz.

Set C3 on the selected crystal module for a reading of 225 Hz higher than the licensed operating frequency. If a negative correction factor is obtained (at temperatures above 30°C) , set the oscillator for the indicated frequency lower than the licensed operating frequency.



ALIGNMENT PROCEDURE

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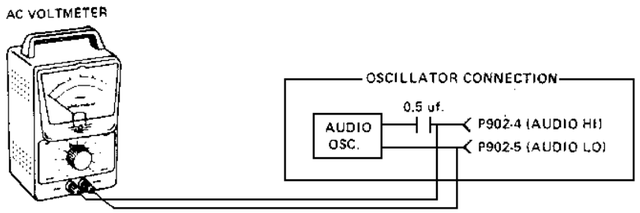

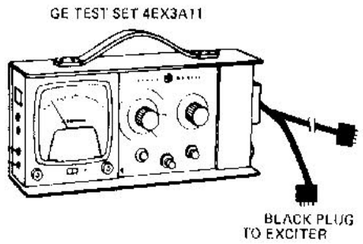

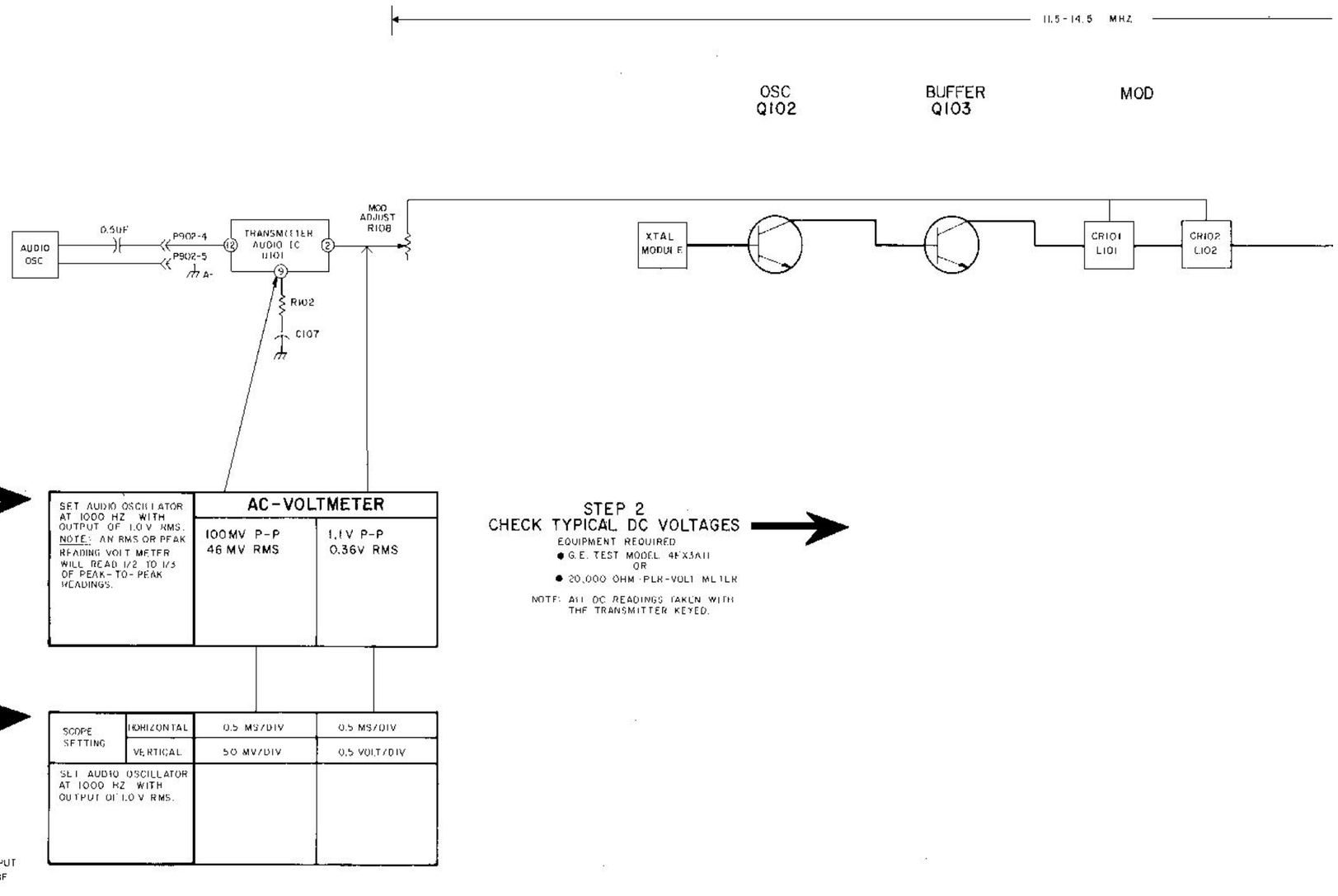

STEP 3
CHECK AUDIO AC VOLTAGES

EQUIPMENT REQUIRED
- AUDIO OSCILLATOR
- AC VOLTMETER

SET AUDIO OSCILLATOR AT 1000 HZ WITH OUTPUT OF 1.0 V RMS. NOTE: AN RMS OR PEAK READING VOLT METER WILL READ 1/2 TO 1/3 OF PEAK-TO-PEAK READINGS.	AC-VOLTMETER	
	100MV P-P 46 MV RMS	1.1V P-P 0.36V RMS

STEP 4
AUDIO & OSC WAVEFORMS

EQUIPMENT REQUIRED
- AUDIO OSCILLATOR
- OSSILLOSCOPE

SCOPE SETTING	HORIZONTAL	0.5 MS/DIV	0.5 MS/DIV
	VERTICAL	50 MV/DIV	0.5 VOLT/DIV
SET AUDIO OSCILLATOR AT 1000 HZ WITH OUTPUT OF 1.0 V RMS.			

STEP 5
AUDIO SENSITIVITY

CHECK AUDIO SENSITIVITY BY REDUCING GENERATOR OUTPUT UNTIL DEVIATION FALLS TO 3.0K Hz VOLTAGE SHOULD BE LESS THAN 120 MILLIVOLT.

STEP 2
CHECK TYPICAL DC VOLTAGES

EQUIPMENT REQUIRED
- G.E. TEST MODEL 4EX3A11
  OR
- 20,000 OHM PER-VOLT METER

NOTE: ALL DC READINGS TAKEN WITH THE TRANSMITTER KEYED.

TROUBLESHOOTING PROCEDURE

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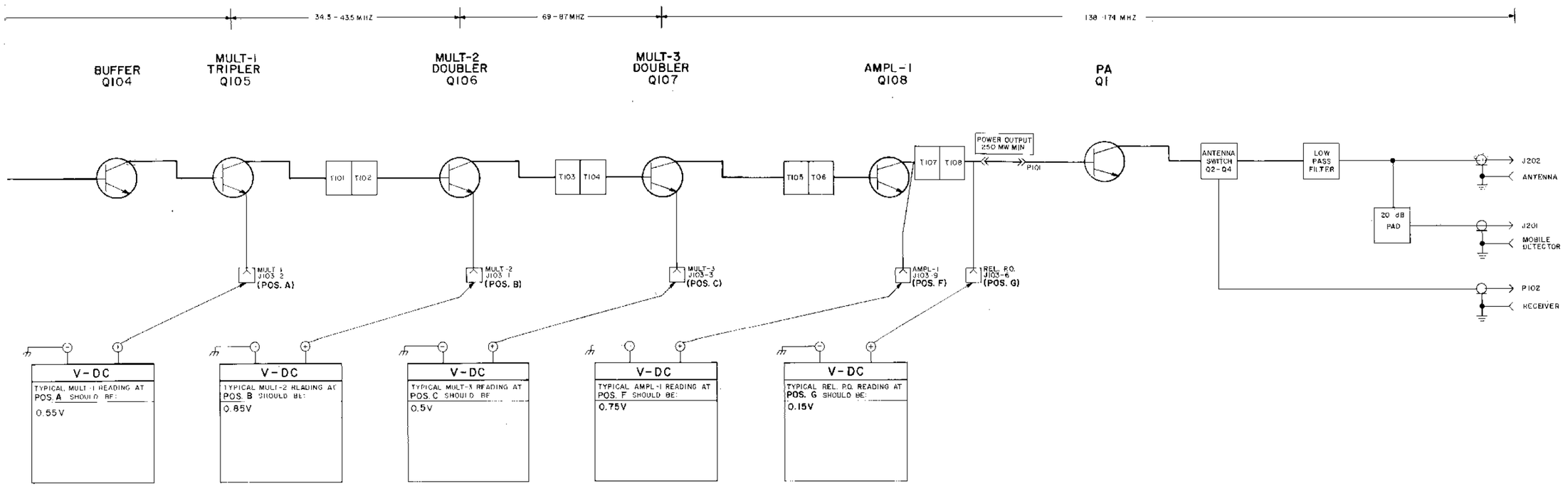

STEP 1 - QUICK CHECKS

METER POSITION OF TEST SET	PROBABLE DEFECTIVE STAGE		
	HIGH METER READING	LOW METER READING	ZERO METER READING
		EXCITER	
A (MULT-1)	Q104, Q105 T101	Q104, Q105	Q104, Q105 T101
B (MULT-2)	Q106, T103	Q106, T101 T102	T101, T102, Q106, T103
C (MULT-3)	Q107, T105	T103, T104 Q107	T103, T104, Q107, T105
F (AMPL-1)	Q108, C149	T105, T106, Q108	T105, T106, Q108, L108