



**VHF RECEIVER TRANSMITTER
LOW BAND
MODEL FM 60A
(25-54 Megacycles)**

MANUFACTURED BY THE HAMMARLUND MFG. CO.



Established 1910

INSTALLATION AND SERVICE MANUAL

**MARKETING & DISTRIBUTION
OUTERCOM ELECTRONICS CORP.
502 Charlottetown Mall
Charlotte, North Carolina
Telephone 333-8689 Area Code 704
Cable Address "outercom"**



FRONT VIEW MODEL FM 60A

SOME OTHER OUTERCOM PRODUCTS

CU-10A Telephone Remote Control Unit
Controls FM60-A (when equipped with RA-10A) over telephone line up to 15 miles or more (depending on line loss).

"Q-T" (Quite Tone)

Outercom's unique tone squelch system for protecting the base station dispatcher against annoyance signals from other system units on the same channel.

MR-60X Monitor Receiver

Receiver section only of FM60A, includes 117V. A.C. supply. Space provided for optional features such as tone squelch, selective call, etc. Up to six channels available on special order.

RA-10A Telephone Remote Adapter

Converts FM-60A to telephone line remote control.

FM 60A TECHNICAL SPECIFICATIONS (LOW BAND)

TRANSMITTER:

Frequency Range:	25-54 Mcs, on any single channel (not necessarily the same for receiving and transmitting)
FCC File No.	Hammarlund Type FM 60A
Power Output into 50 ohm load:	117V AC operation, 50 watts minimum 12V DC operation, 50 watts ($\pm 10\%$) 6V DC operation, 20 watts ($\pm 10\%$)
Duty Cycle: (Standard EIA)	117V AC — 1 min. on, 1 min. off 12V DC — 1 min. on, 4 min. off 6V DC — 1 min. on, 4 min. off
Crystal Multiplication:	Twelve Times
Frequency Stability:	0.002% (-30°C to $+60^{\circ}$ ambient temperature range)
Modulation:	16F3, ± 5 Kc deviation for 100% modulation at 1000 cps
Modulation Limiting:	Instantaneous and automatic, .25V rms input at 1000 cps for thresh-hold of limiting
Audio Response:	+1 to -3 db from 300 to 3000 cps, 1000 cps reference
Distortion:	Less than 10% at 3.5 deviation 1000 cps modulating frequency
Spurious and Harmonic Radiation:	At least 60 db down
Hum and Noise:	At least 40 db below ± 3.3 Kc deviation, 1000 cps reference
RECEIVER:	
Frequency Stability:	See transmitter specifications above
Sensitivity:	0.25 microvolt or less for 20 db quieting
Selectivity:	± 5 Kc (or greater) at 6 db down ± 17 Kc (or less) at 100 db down
Spurious Response Attenuation:	At least 90 db down
Audio Response:	+2 to -8 db from standard 6 db per octave de-emphasis curve from 300 to 3000 cycles 1000 cps reference
Audio Output:	At least 1.5 watt at less than 10% distortion built-in speaker
Hum and Noise Level:	Squelched, at least 50 db down from rated output Unsquclched, at least 40 db down from rated output
Squelch:	Signal to noise ratio type, front panel adjustable, .1 microvolt or less at thresh-hold
Duty Cycle:	Continuous
Crystal Frequency Formula:	25-45 Mc. Channel Frequency +10.7 Mc. 45-54 Mc. Channel Frequency -10.7 Mc.

TUBE COMPLEMENT		FUNCTION
6BZ6	Receiver	RF Amplifier
6BR8	Receiver	1st Mixer and 1st Oscillator
6BR8	Receiver	1st IF Amplifier (10.7 Mc) and Squelch Noise Amplifier
6BR8	Receiver	2nd Mixer and 2nd Oscillator
6BH6	Receiver	2nd IF Amplifier (1650 Kc)
6BH6	Receiver	1st IF Limiter
6BN6	Receiver	2nd IF Limiter/FM Detector
12AX7	Receiver	1st Audio Amplifier/Squelch DC Amplifier
6AQ5	Receiver	Audio Power Amplifier
6BR8	Transmitter	Crystal Oscillator and Phase Modulator
6AW8A	Transmitter	1st and 2nd Frequency Multiplier
12BY7	Transmitter	3rd Frequency Multiplier/Driver
6146	Transmitter	RF Power Amplifier
12AX7	Transmitter	1st and 2nd Audio Amplifier

SEMI-CONDUCTOR COMPLEMENT

(1)	1N 2482	Receiver Squelch Rectifier
(2)	2N 442	Power Supply Switching Transistors
(8)	1N 1490	Power Supply High Voltage Rectifiers
(1)	1N 1490	Power Supply Relay Rectifier (AC Operation Only)
(2)	1N 2482	Transmitter Modulation Limiters

POWER REQUIREMENTS:

Nominal Input Voltage	117 volts (50 to 400 cycles)	6V. DC*	12V. DC*
Receiving-Standby	50 watts	11.5 amps	5.75 amps
Receiving Ready to Transmit	70 watts	15 amps	7.5 amps
Transmitting	175 watts	25 amps	15 amps

SIZE: 13" wide, 7" high, 7³/₈" deep

WEIGHT: 21 lbs. less antenna and power cables

* DC voltage tests are made using Electronics Industry Association Standards which are:

- (a) for 6 volt systems, standby voltage is 6.5V. DC and transmit voltage is 6.4V. DC.
- (b) for 12 volt systems, standby voltage is 13.8V. DC and transmit voltage is 13.6V. DC.

DESCRIPTION

The FM 60A is a rugged, compact communications unit designed to operate from any 6 or 12 volt d.c. (negative or positive ground) vehicle power source or a 117 volt a.c. 50 to 400 cycle land station power source.

The FM 60A is designed for narrow-band phase/frequency modulation (± 5 KC deviation) operation in the frequency range of 25 to 54 megacycles. The receiver and transmitter sections are designed for single channel, crystal controlled operation. The transmitter and receiver may be operated on

the same channel (simplex frequency assignment) or on different channels (duplex frequency assignment).

All necessary components for 6 or 12 volt d.c. operation of either polarity or 117 volt AC operation are built into the basic communications unit. The proper circuitry is selected by the wiring of the external power plug thereby eliminating the need for jumpers or switches in the basic unit. The FM 60A may be interchanged in any 6, 12 or 117 volt system without modification and without regard to battery polarity.

OPERATING INSTRUCTIONS

CONTROL FUNCTIONS:

There are only three external controls. The left knob is a conventional volume control; the right knob controls the squelch. By turning the squelch knob clockwise, the sensitivity is increased and as this control is advanced clockwise, a point will be reached beyond which a loud hiss will be heard. However, there is a setting before this point where the receiver is operating at optimum sensitivity in a squelched (noiseless) condition.

The three-position power switch on the panel is "OFF" in the extreme left setting. In the center, or "STDBY" position, the receiver only is operating, and the transmitter filaments are turned off. In the "OPERATE" position, the receiver remains "ON" however the transmitter filaments are also "ON." After a warm-up period of about 20 seconds, the transmitter is ready for operation by depressing the "push-to-talk" switch on the microphone.

The "on-off" pilot lamp located to the left side of the power switch lights when the set is turned on. The pilot lamp on the right side lights only when the transmitter is on the air.

When the push-to-talk microphone switch is depressed, the transmitter section of the communication unit is actuated, the red transmit lamp lights and the receiver is muted. Release of the push-to-talk switch, turns the transmitter section off, extinguishes the red transmit lamp and actuates the receiver section. This sequence of events is in the "OPERATE" position of the power switch. When this switch is in the "STDBY" position the microphone push-to-talk circuitry is inoperative.

The use of the "STDBY" mode of operation is highly recommended where long periods of listening only is expected as lower power drain together with longer transmitter tube life will result.

The FM 60A is a highly efficient receiver-transmitter and will provide reliable communications over great distances if properly used. Radio operating is an art that is easily learned with practice.

The limitations of a system installation in any particular area may be learned through use. Every system, regardless of its frequency or power, will have some locations where it is not possible to communicate. However, within its range, trees, buildings, small hills and similar obstructions will have little or no effect on communications. The range of a system is dependent on a few important factors, such as location and height of base station antenna, power, and nature of surrounding terrain. The use of a half-wave rather than a quarter-wave base station antenna is highly recommended in all installations for best possible performance.

Assuming that the most efficient installation of the FM 60A is made, one important consideration remains. This is correct operating procedure and a few important notes in this regard are:

1. Before transmitting, listen to the receiver and make certain no one else is on the channel.
2. Let the mobile operator get in the practice of calling the base station for instructions. Since the base station is in a known, fixed location, the mobile operator can call when he knows he is in a good location.

3. Show each mobile operator how radio actually helps him in his work by eliminating doubts about delivery, reducing unnecessary travel, etc.

4. If you are trying to contact a mobile unit from the base station, remember that he may be in a poor radio-location, he may have both hands busy in heavy traffic, or he may have stopped in the local diner. If you do not contact him after one or two quick calls, wait a few minutes before calling again.

5. Keep messages short and brief. Know what you are going to say before you depress the microphone button. Many 100 word discussions can be reduced to 10 word messages by thinking and planning before going "on-the-air."

6. Adopt a system of routine and preventative maintenance with your serviceman.

7. Become familiar with the F.C.C. rules and regulations concerning operation of two-way radio for your particular class of service.

TRANSMITTER TUNE-UP PROCEDURE:

CAUTION

The plate cap of the type 6146 output stage is "hot" at all times when power is turned ON. This applies to both the "STANDBY" and "ON" positions of the power switch.

The transmitter duty cycle is one minute on, four minutes off; therefore, all adjustments should be made as quickly as possible, keying the transmitter only when ready for actual adjustment or measurement. To minimize interference, on-the-air testing (with antenna connected) should be kept to a minimum. The use of a 50 ohm dummy load is recommended for all but the final on-the-air use of the equipment.

If extended periods of testing and/or servicing the exciter stages of the transmitter are required it is recommended that the screen of the 6146 PA stage be grounded. All tests up to and including the grid of the final stage can be made.

TEST EQUIPMENT REQUIRED:

- A. 0-100 micro-ammeter (2000 ohm internal resistance) see schematic diagram for recommended test meter circuit.
- B. RF wattmeter with 52 ohm dummy load.

C. Modulation deviation meter.

D. Frequency meter with an accuracy of at least $\pm .001\%$.

1. With a 0-100 micro-ammeter connected from terminal 3 of J105 to ground (terminal 11) adjust L118 for maximum indication. (Position 3 of recommended test meter.)

2. With the micro-ammeter now connected from terminal 4 of J105 to ground, adjust L116 and L115 for maximum indication. (Position 4 of recommended test meter.)

3. With the micro-ammeter now connected across terminals 5 and 7 of J105, adjust C159 for maximum indication. The value of shunt R153 is such that a microammeter with an internal resistance of 2000 ohms will actually read 10 milliamperes at full scale. When making this adjustment, a minimum of 2.5 milliamperes should be obtained. (Position 5 of recommended test meter.)

4. With the micro-ammeter connected across terminals 9 and 10 of J105 (position 6 of recommended test meter), C153 set at maximum capacity (minimum loading CCW), C154 should be adjusted for minimum plate current. The value of meter shunt R149 is such that the micro-ammeter will read 200 milliamperes full scale. With the dummy load connected to the output terminal, C153 should be slowly reduced in capacity watching the plate current rise. This loading should be increased until a plate current reading not exceeding 160 milliamperes is achieved. Simultaneous with this loading adjustment the PA plate tuning condenser C154 should be continually readjusted for minimum plate current so that the final value of 160 milliamperes is achieved with this adjustment always set for the lowest possible plate current. Excessive loading as indicated by abnormally high plate current may be cured by the use of additional capacity in parallel with the antenna loading capacity, C153, or changing taps on L112. This is normally taken care of at the factory when the transmitter is tuned to the customer's frequency.

5. After making the above adjustments, the transmitter frequency should be set against a known standard. This adjustment is C183 associated with the crystal oscillator stage V113A.

6. After making the previous adjustments the deviation should be adjusted by applying a 1000 cycle tone of 1.0V rms amplitude to the microphone connector J104. Potentiometer R172 should be adjusted for ± 5 Kc deviation as indicated on a deviation meter. This adjustment should always follow step 5 above.

NOTE: Since this transmitter covers a frequency range of greater than 2 to 1, it is possible to tune one or more stages to the incorrect harmonic and still get drive and output. When making large changes in operating frequency or if it is not

possible to get proper drive at any stage, check for proper multiplier adjustment with an absorption wave meter or grid dip meter.

CRYSTAL MULTIPLICATION

The following information is listed as a guide which will be helpful when retuning a transmitter from one end of the band to the other.

- 2X Crystal Frequency, L118
- 6X Crystal Frequency, L115/L116
- 12X Crystal Frequency, C159, T109
- 12X Crystal Frequency, (Carrier) C153/L112

COMPLETE RECEIVER ALIGNMENT PROCEDURE

TEST EQUIPMENT REQUIRED:

- A. 0-100 micro-ammeter (2000 ohms internal resistance).
- B. DB Audio output meter.
- C. Low frequency signal generator covering 1650 KC, 10.7 MC and 10.7075 MC.
- D. High frequency FM signal generator covering 25 to 54 MCS.

1. (a) Connect a 1650 KC signal to pin 9 of V104A.
(b) Connect micro-ammeter from J105 pin 3 to ground. (Position 3 of recommended test meter.)
(c) Adjust top and bottom of T104 for maximum indication.
2. (a) Connect micro-ammeter from J105 pin 2 to ground. (Position 2 of recommended test meter.)
(b) Adjust top and bottom of T102 and T103 for maximum indication.
(c) As each adjustment is brought into resonance, the output of the signal generator should be decreased so as to produce a meter reading between 25 and 75 microamperes. This precaution is necessary so as to eliminate the possibility of overload which will result in false peak indications.
3. (a) Connect a 10.7 MC signal to pin 1 of V102A.
(b) Leave micro-ammeter connected to pin 2 of J105. (Position 2 of recommended test meter.)
(c) Adjust L106, L107 and L108 for maximum indication observing step 2(c) above.
4. (a) Connect a 10.7075 MC signal to pin 1 of V102A.
(b) Leave micro-ammeter connected to pin 2 of J105. (Position 2 of recommended test meter.)

- (c) Readjust L106 and L107 for maximum indication observing step 2(c) above. Do not re-align adjustment L107.
5. (a) Connect micro-ammeter from pin 1 of J105 to ground. (Position 1 of recommended test meter.)
(b) Adjust L103 (oscillator) for maximum indication.
6. (a) Connect signal generator on signal frequency to antenna terminal, J102.
(b) Connect micro-ammeter from J102 pin 2 to ground. (Position 2 of recommended test meter.)
(c) Adjust T101, ZF101 for maximum indication observing precaution outlined in step 2(c).
7. (a) With an input signal of approximately .5 microvolt, touch up T101, ZF101 and L108 for maximum quieting. This will approximate the same resonance points as maximum 1st limiter grid current indication.
8. (a) Adjust L109 for maximum hiss level keeping the front panel volume control below the overload point.
(b) With an on-channel frequency modulated signal applied to the input of the receiver, readjust L109 for maximum recovered audio.
(c) Some interaction between T104 and L109 is normal. The recommended procedure is to de-tune L109 off the peak of maximum output, adjust T104 for maximum grid current as indicated at position 3 of the recommended test meter and then adjust L109 in accordance with step (b) above. Do not touch the adjustments of T104 after L109 has been adjusted.

- 9.(a) Loosely couple an accurate 10.7 MC signal to the grid of V102A (Pin 1) and adjust L103 for an aural zero beat indication in the loud speaker with an on frequency signal applied to the antenna input terminal J102.
- (b) With the same unmodulated input signal follow step 7(a).
- (c) Adjust the FM detector coil L109 as outlined in steps 8(a) and 8(b). In lieu of this tech-

nique the modulation of an "on-frequency" base station or mobile transmitter may be used. In this instance L109 should be adjusted for maximum audio consistency with lowest distortion.

It is highly recommended that the service technician make a few practice runs on a normal operating unit. With a little practice the alignment may be accomplished in less time than that required to read the procedure outlined above.

RECEIVER ALIGNMENT PROCEDURE, FIELD SERVICE

The "Complete Receiver Alignment Procedure" will rarely be required in the field however it should be reviewed in order to become thoroughly familiar with the receiver section of the unit. Receiver field alignment should be accomplished as follows.

- 10.(a) With an input signal (unmodulated) strong enough to produce approximately 20 db

quieting of the thermal noise (hiss) adjust L103 to zero the first oscillator with the incoming signal as outlined in step 9(a).

NOTE: Frequency netting of the receiver is extremely important particularly when ignition noise is present. Follow the previous instructions carefully for best performance.

- 10.(b) Perform step 7(a) above.

CABLE INSTALLATION

Certain precautions must be observed when installing the FM 60A. It is very important that polarity be observed on vehicle installations. Using the power cable chart, at the rear of the manual, first, determine which cable is to be used. In most installations, you will find that modern vehicles employ a 12 volt negative ground system, therefore, be sure to use the cable required for 12 volt negative ground installations. If the vehicle is a positive ground system be sure to use the 12 volt positive ground cable, etc. Refer to rear of manual for cable connections for front mount installations.

New vehicles will generally be no problem so far as polarity is concerned. On older vehicles, the best policy is to use a volt meter and check the battery

voltage and polarity before proceeding with the installation. Experience will generally tell you what the voltage and polarity of the various make and type vehicles in the field are.

It is extremely important that polarity and voltage be observed because if the polarity is accidentally reversed, you will, almost without exception, burn out at least one of the power transistors. **TO PREVENT BURNING OUT POWER TRANSISTORS, OBSERVE VOLTAGE AND POLARITY.**

Once the proper cable has been installed in a vehicle, the FM 60A receiver-transmitter unit may be exchanged or inter-changed throughout the fleet with no modification or switch selection required.

COMMUNICATIONS UNIT INSTALLATION

There are generally three or four different ways that the unit may be mounted in the cab or in the area that is accessible to the driver. In most business and industrial applications, it will be found that it is most desirable to locate the receiver-transmitter somewhere in the cab of the truck or the front seat area of the vehicle. This has the advantage of short battery cables with less voltage drop and less chance of abrasion and wear.

FLOOR MOUNT:

Using the FM 60A receiver-transmitter as a pattern, place it on the floor of the vehicle and various locations until the most convenient location is found. The best location will be one where the driver can tell at a glance whether his set is on or off and where he can reach the controls on the front panel. When setting up this location, be sure

to give consideration to the length of the battery cable. After the location is found, secure the universal mounting bracket, Hammarlund Part No. PL26610-G1. When drilling through the floor of a vehicle, or through any other panel or part of it, use every precaution to avoid drilling through a gas line or electrical wiring, etc. Wherever it is not possible to use nuts and bolts, drill with a proper size drill for self tapping screws and, using a good long screw driver, drive the steel screws firmly into place. Always fasten parts securely to the vehicle to avoid noise from "shaky" installation.

UNDER-DASH MOUNT:

Using the radio as a template, find the best location under the dash of the vehicle. Take into consideration, special handles found on dump trucks and controls found on various types of vehicles in the field. After a practical location is found, secure the universal mounting bracket in place with the proper hardware. Use every precaution to make the battery cable as short as possible and route it in such a way that it will not interfere with the various controls under the dash. Wherever the cable goes through the chassis, use a heavy rubber grommet to prevent chafing and eventual short circuit. Extra precautions seldom take more time when the installation is being made, but can save many hours of future maintenance and possibly a dangerous situation for the driver.

REMOTE INSTALLATIONS:

Whenever it is not practical or desirable to have the radio unit mounted in view of the driver, it should be mounted remotely. In a passenger car the most practical place is usually in the trunk; however, there are certain vehicles that adapt themselves to other locations. Always, bear in mind that the battery cable should be as short as possible and use the same precautions discussed for the floor mount. Place the unit in such a way that it will not interfere with loading and unloading of the trunk and find the shortest route from the unit to the battery, running the cable along this route. Avoid sharp metal, protrusions, and use every means to protect the cable from abrasion. Whenever it is necessary to run the battery cable on the outside of the vehicle under the floor, stay clear of areas that get extremely hot, such as the exhaust pipe or the muffler. The cable connecting the unit to the remote head, should be run on the inside of the vehicle unless it is possible to employ metal flexible tubing.

Type CU-11A mobile remote control unit has been designed specifically for this purpose. This remote control unit consists of an "on-standby-off" power switch, a volume control, a squelch control, a built-in speaker and indicator lights. The CU-11A is shipped with installation instructions including the wiring connections of the rear mount cables. These cables differ from the front mount cable somewhat because the power switch on the front panel of the FM 60A is inoperative in a rear mount installation. This provides for complete power control of the unit from the dash of the vehicle including the battery saving switch feature. Refer to the complement chart of this instruction manual for other rear mount items, such as control and power cables, etc.

BATTERY CABLE INSTALLATION:

The battery cable should be run from the unit to the battery in as short a line as possible. Somewhere near the battery, mount the fuse holder and fuse with the two sheet metal screws furnished. Terminate the "hot" lead at the fuse holder, cutting off any extra cable. Using this extra cable, run a lead from the other side of the fuse holder to the "hot" side of the battery. Terminate this "hot" lead at the battery terminal, or on the starter post. Never connect to a voltage point on the vehicle that has wire smaller than the starter cable. Do not substitute a wire that is of smaller diameter than that furnished with the installation kit.

The ground lead in the trunk mount installations should be securely bonded in the immediate vicinity of the unit. Do not ground to upper braces and/or trunk lid mounting bolts. It is preferable to attach the ground lead to the floor of the trunk and solder same if at all possible. This will require an unusually large iron (500 watts preferably) and a good mechanical, as well as electrical connection is a must. In front mount installations the ground lead (black) should be securely fastened to the battery terminal or to the engine block.

ANTENNA INSTALLATION:

General installation instructions are furnished with the various antenna kits. However, there are certain precautions that must be observed when installing any antenna.

The most frequently used antenna will be the quarter wave whip. Although the ideal location for this antenna is the center of the roof of the vehicle, rarely will it be possible to so locate it.

Avoid mounting the base of the antenna on the bumper or in the vicinity of the rear bumper if at all possible. The preferred location is in the area of the trunk near the rear window. This is a happy compromise between the area of the bumper and the center of the roof.

If at all possible avoid mounting the antenna at the front of the vehicle where ignition noise pick-up may be excessive. In some cases the use of a "disguised" type may be beneficial and same may be had on special order. The "disguised" antenna is supplied complete with cable harness and mounting instructions.

NOTE: Before attempting to install the antenna in the vehicle, it is a good idea to try all pieces for fit to make sure that possible burrs or foreign matter might cause mating pieces to bind during final assembly.

ROUTING OF ANTENNA TRANSMISSION LINE:

Always route the transmission line through the area which provides maximum clearance. **AVOID SHARP BENDS.** As the cable may go under upholstery, metal fittings, etc., be sure to place it in such a way that it will not be squeezed when the fittings, frames, etc., are put back in place. After replacing all trim and metal work, the co-axial cable and roof top antenna should be checked for continuity between the center conductor and the whip. The co-axial cable should next be checked for lack of continuity between its inner and outer conductors.

ATTACHING CO-AXIAL CABLE CONNECTOR:

1. Cut cable off square at the proper length.
2. Cut off 1 $\frac{1}{8}$ " of outside plastic insulation jacket.

3. Comb out copper shield.
4. Cut inner insulation off to expose $\frac{5}{8}$ " of inner conductor.
5. Trim stranded shielding so it is about $\frac{1}{16}$ " shorter than the inner insulation. Slide coupling through and adapter on cable, folding the combed strands over the adapter.
6. Tin center conductor and screw plug on cable and adapter.
7. Solder shield strands through holes in plug and solder center conductor of the cable to the plug end.

Use enough heat to get a good solder joint. Avoid using so much heat that the solder will flow from the shell to the center conductor inside the plug. Avoid handling the cable and plug until the softened insulation between the center conductor and shield has had a chance to cool off and return to its firm state.

8. Recheck for continuity.

The above instructions on attaching the co-axial cable connector may be ignored when antenna cable assemblies are ordered complete with connectors, as same are already attached. Refer to the complement chart of this manual for further information.

NOTE: The antenna should be cut to its proper operating frequency. The preferred method is to use a test whip which may be adjusted for minimum standing wave ratio and the final adjustment length used as a cutting guide for the whip. The standard 8 ft. whip (prunable) will require cutting to exact length depending upon the operating frequency of the unit and/or the physical configuration of the vehicle to which it is attached. Low band test whip Hammarlund part number 53164-1 is highly recommended. If this is not available the whip may be cut in accordance with the following chart:

WHIP LENGTH CHARTS

FOR INSTALLATIONS LESS SPRING

Mc.	Inches	Mc.	Inches
29.7-31.5	96	42.0-44.0	68
31.5-36.5	84 $\frac{1}{2}$	44.0-48.0	62
36.5-39.0	79	48.0-52.0	57
39.0-42.0	72	52.0-54.0	55

FOR INSTALLATIONS WITH SPRING

Mc.	Inches	Mc.	Inches
28.4-29.7	96	40.0-42.0	68
29.7-34.0	84 $\frac{1}{2}$	42.0-45.0	62
34.0-37.0	79	45.0-50.0	57
37.0-40.0	72	50.0-54.0	53

FOR INSTALLATIONS REQUIRING LOADING COIL

(Spring Must Be Used)

Mc.	Inches	Antenna Specialists Coil No.
25.0-26.0	96	ASPA 87
26.0-27.0	96	ASP 87
27.0-27.7	84½	ASPB 87
27.7-28.4	84½	ASPA 87
28.4-29.0	80	ASPB 87

After the installation is complete, insert a "thru-line" RF watt meter between the FM 60A antenna output connector and the PL259 plug of the antenna transmission line. Tune the output stage of the FM 60A in accordance with previous instructions supplied in this manual. Check the reflected power which should normally not exceed 10%. Unusually high reflected power may be caused by one or more of the following reasons:

1. Incorrect whip length.
2. Damaged transmission line.

3. Break in outer shield of transmission line.
4. Antenna mounted in close proximity to other objects on the vehicle.
In the latter instance (4) modifying the whip length from the "free space" dimension may correct the condition.

FREQUENCY ADJUSTMENT:

The Federal Communications Commission requires that all transmitters of this type be checked for frequency upon installation and at least once every twelve months thereafter with an instrument having an accuracy of twice that of the equipment being measured. In this instance the measuring instrument should be rated at $\pm .001\%$.

All transmitters are adjusted to frequency prior to shipment, however, the installer is required by the FCC to make this test upon completion of the installation.

BASIC OUTERCOM COMPLIMENT CHART FM 60A

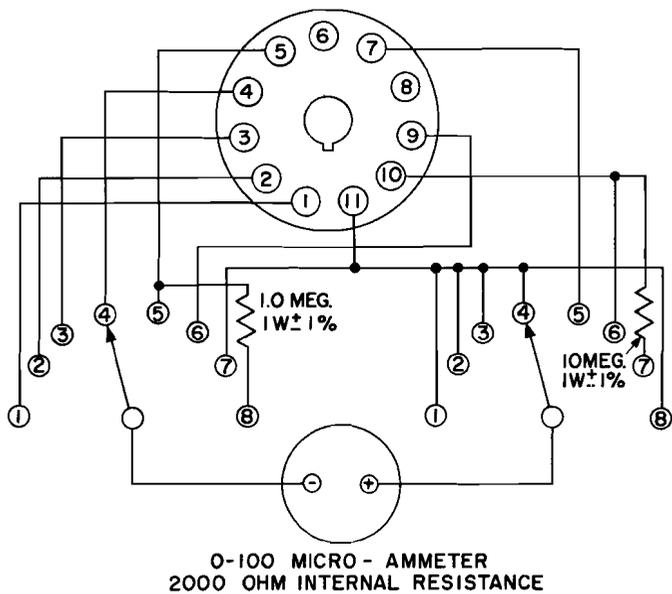
Hammarlund Type or Part Number

FM 60A Receiver/Transmitter unit, consists of Receiver, Transmitter, and Universal Power Supply in Cabinet with Channel Crystals, less microphone	53213-G1
Palm Microphone with Type T1 Carbon Cartridge	26681-1
Palm Microphone with Dynamic Cartridge and Transistorized Pre-amplifier	26681-2
Desk Microphone with Dynamic Cartridge and Medium Gain Built-in Transistorized Pre-amplifier	53026-1
Desk Microphone with Controlled Reluctance Cartridge, High Gain Built-in Transistorized Pre-amplifier and Q-T Over-ride Switch	53136-1
117V. AC Power Cord Assembly (Factory Wired)	26697-G1
6V. Front Mount Power Cable Kit. Consists of Connector, Cable, Fuse Holder and Fuse, Miscellaneous Hardware and Assembly Instructions for Positive or Negative Ground Systems	26698-G1
12V. Front Mount Power Cable Kit. Consists of Connector, Cable, Fuse Holder and Fuse, Miscellaneous Hardware and Assembly Instructions for Positive or Negative Ground Systems. Factory Wired	PL26698-G2
12V. Mobile Power Cable (Factory Wired), Includes Fuse Holder and Fuse and Miscellaneous Hardware	PL26698-G3
Universal Mounting Bracket for Mobile Applications, includes Mounting Hardware	26610-G1
CU-11A Mobile Remote Control Unit with Mounting Bracket and Built-in Speaker (Less Microphone)	53023-G1

BASIC OUTERCOM COMPLIMENT CHART FM 60A (Cont.)

	Hammarlund Type or Part Number
Mobile Remote Control Cable for Trunk Mount	53062-G1
12V. Rear Mount Cable Kit. Consists of Connector, Cable, Fuse Holder and Fuse, Miscellaneous Hardware and Assembly Instructions for Positive or Negative Ground Systems	53041-G3
12V. Rear Mount Cable (Factory Wired) includes Fuse Holder and Fuse and Miscellaneous Hardware	53041-G1
6V. Rear Mount Cable Kit. Consists of Connector, Cable, Fuse Holder and Fuse, Miscellaneous Hardware and Assembly Instructions for Positive or Negative Ground Systems	26698-G1
12V. Relay Power Kit (For Front or Rear Mount)	53064-G1
12V. Relay only for Power Kit	40405-2
Q-T Encoder — For Mobile Units	53072-G1
Q-T Decoder — For Base Station Units	53073-G1
Business Radio Type Swivel Base and 96-inch Prunable Stainless Steel Whip (not recommended below 29.7 MC.)	53159-1
15 ft. RG58U Transmission Line with PL259 attached	53160-1
25 ft. RG58U Transmission Line with PL259 attached	53160-2
Industrial/Public Safety Type 96-inch Prunable Stainless Steel Whip	53161-1
Industrial/Public Safety Exact Length (up to 96-inch) non-Prunable Stainless Steel Whip (Special Order)	53161-3
Industrial/Public Safety Type Swivel Base with Cadmium Hardware	53162-1
Industrial/Public Safety Double Cadmium Plated Spring	53163-2
Test Whip (for determining exact length of whip) will not fit Business Radio Type Base	53164-1
NOTE: Contact Outercom Electronics in Charlotte, N.C. for other special antenna requirements.	
RA-10A Telephone Remote Adapter, allows FM 60A to be used at Remote Base Station location and Controlled over Two Wire Telephone Line	53060-G1
CU-10A Telephone Remote Control Unit for controlling Receiving and Transmitting of FM 60A through RA-10A over Two Wire Telephone Line, includes circuitry for Low Impedance (including carbon) or High Impedance Microphone (microphone not included)	53065-G1

OUTERCOM TEST METER

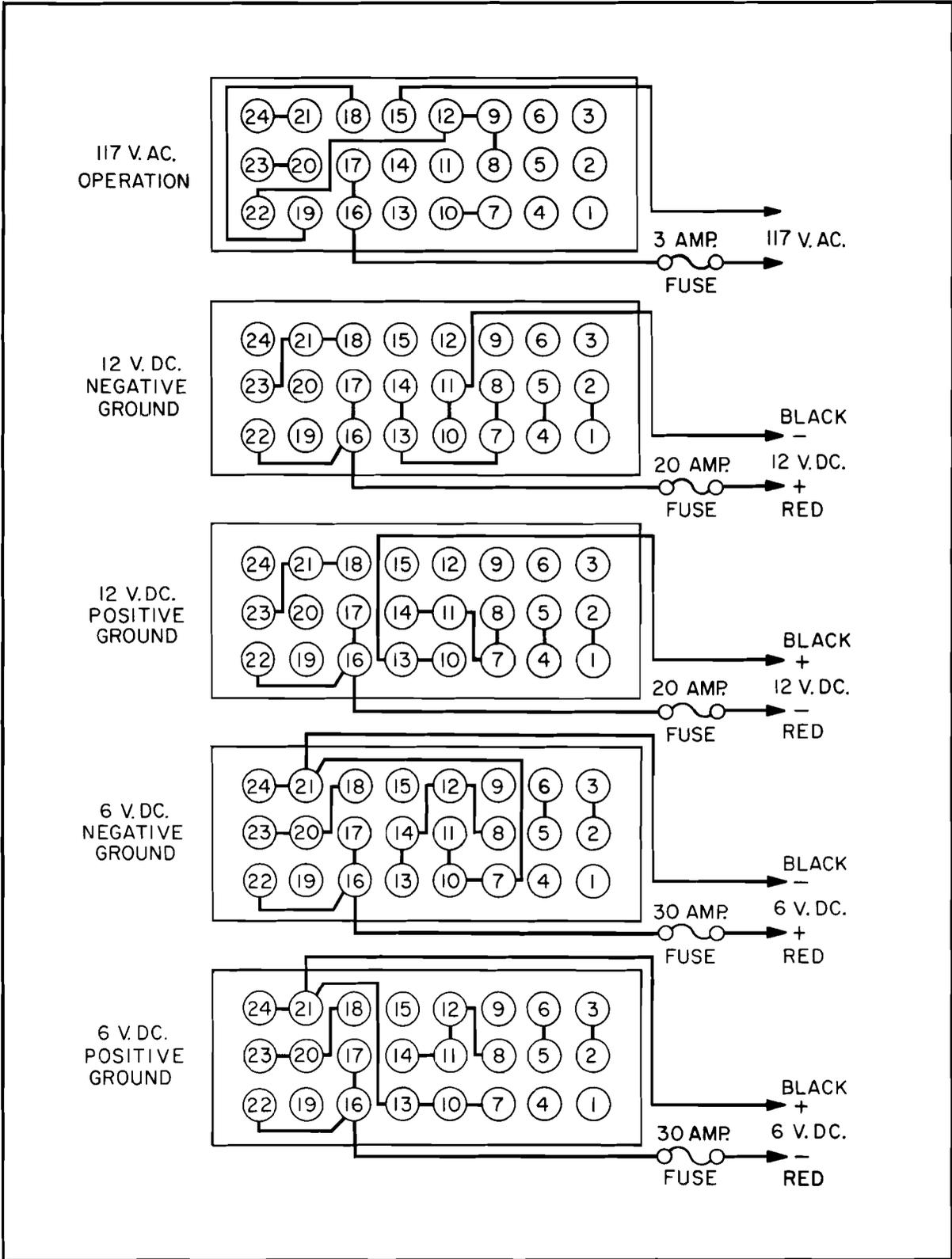


<u>RECEIVER</u>	<u>SW POSITION</u>	<u>TRANSMITTER</u>
1 ST OSCILLATOR GRID	1	1 ST MULTIPLIER GRID*
1 ST LIMITER GRID	2	2 ND MULTIPLIER GRID
2 ND LIMITER GRID	3	DRIVER GRID
—	4	PA GRID CURRENT
—	5	PA PLATE CURRENT
—	6	PA PLATE VOLTAGE
—	7	PA STANDBY GRID BIAS
—	8	

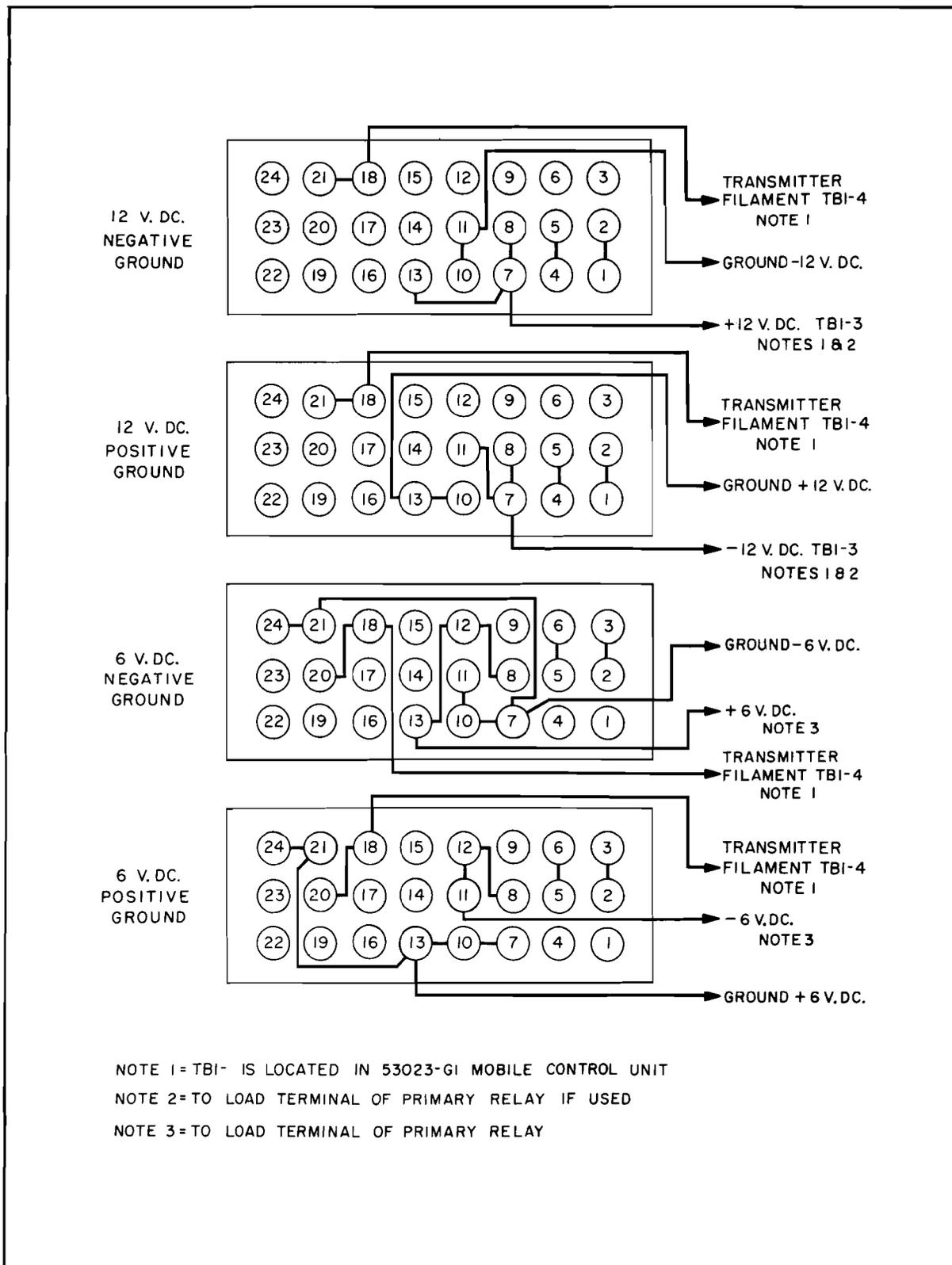
* THIS POSITION BLANK ON TRANSMITTER SECTION OF FM60A
POSITION 7-1000V. F. S.
POSITION 8 100V F. S.

NOTE: SWITCH - MALLORY 1321L
2 CKT 2 SECTION
2-11 POSITIONS
SWITCH STOP AT 8TH POSITION

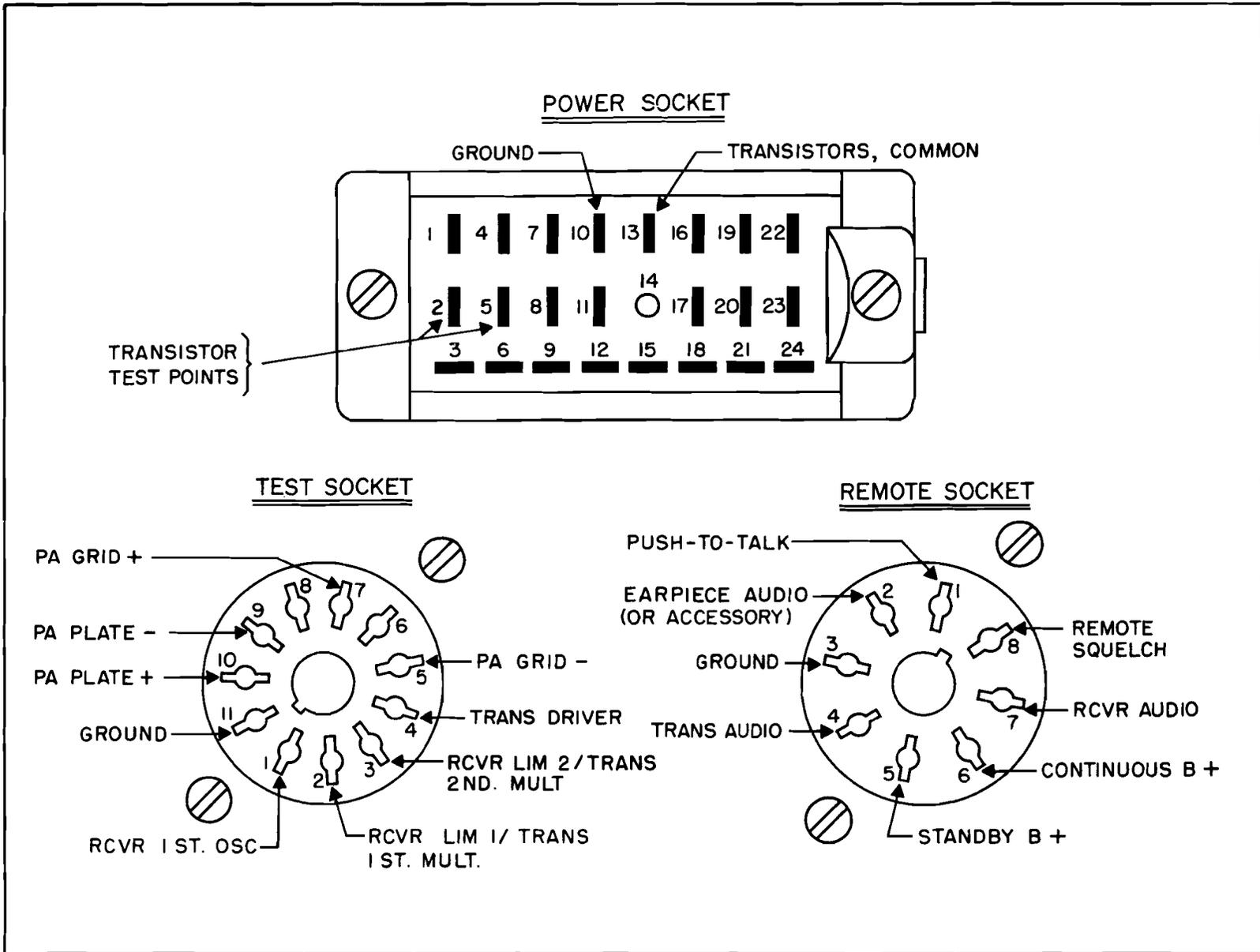
SCHMATIC (OUTERCOM RECOMMENDED TEST METER)



INPUT PLUG JUMPERS, FRONT MOUNT

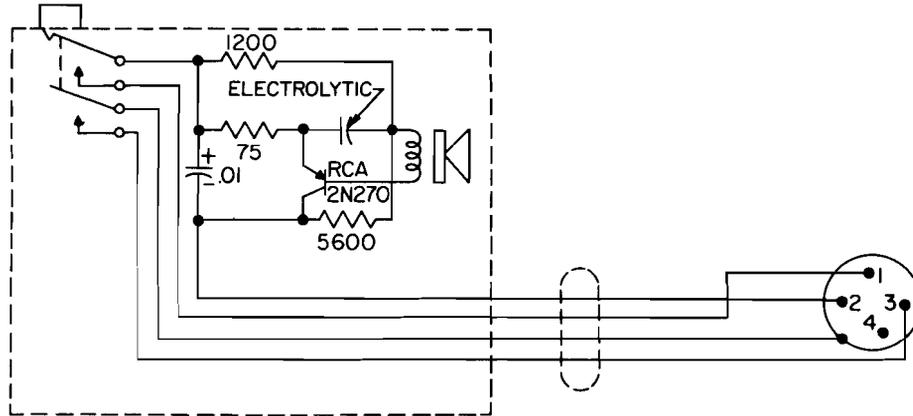


INPUT PLUG JUMPERS, REAR MOUNT

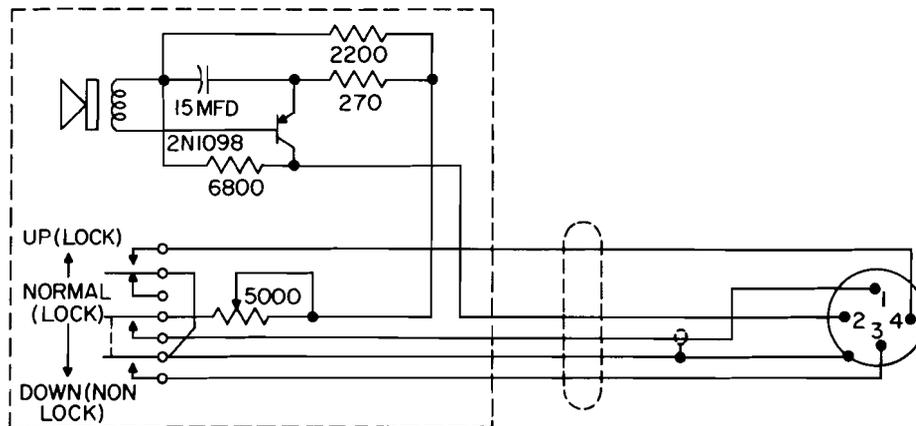


CONNECTOR TERMINALS AS VIEWED FROM REAR OF CHASSIS

DYNAMIC CARTRIDGE / TRANSISTOR AMPLIFIER DESK MICROPHONE PT. NO. 53026-1



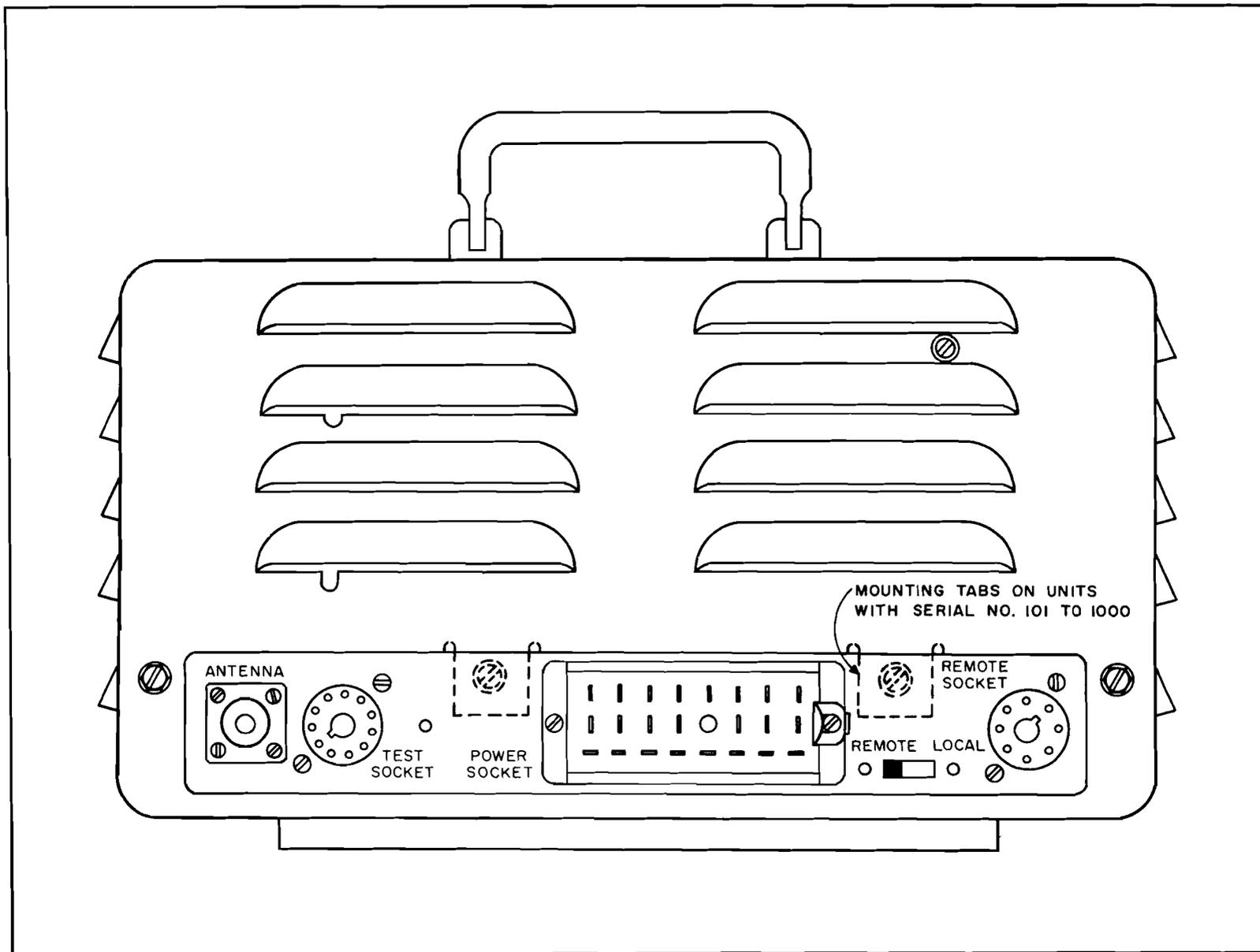
CONTROLLED MAGNETIC / TRANSISTOR AMPLIFIER DESK MICROPHONE PT. NO. 53136-1



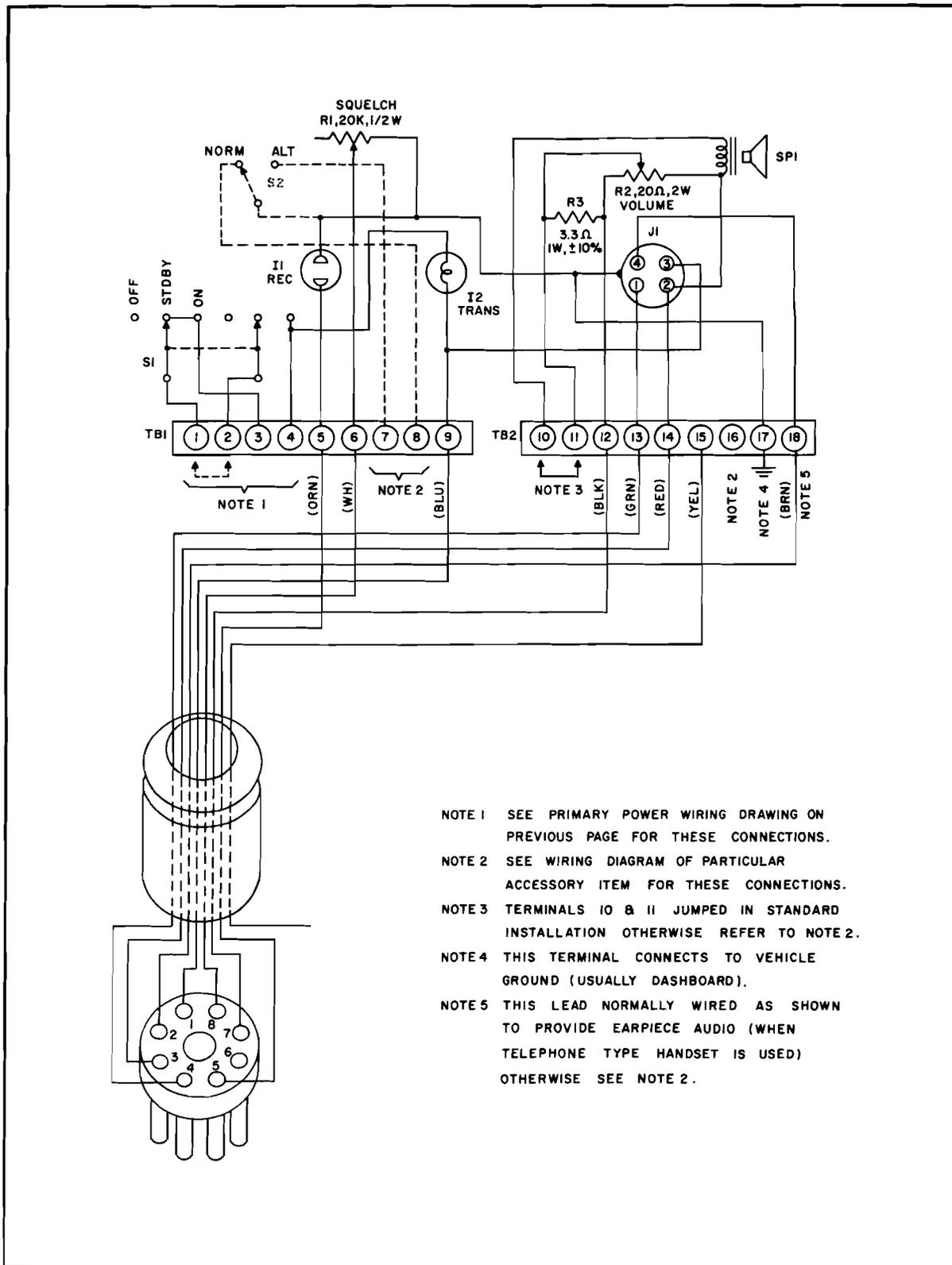
REPLACEMENT PARTS LIST

- DYNAMIC MICROPHONE ELEMENT PT. NO. K53030-1
- CONTROLLED MAGNETIC ELEMENT PT. NO. K53236-1
- SWITCH ASSEMBLY PT. NO. K53237-1
- CABLE, FOUR CONDUCTORS; ONE CONDUCTOR SHIELDED (OBTAIN LOCALLY)
- COILED CORD (SUPPLIED IN BULK OF 3 FT. LENGTH) PT. NO. K53032-1

DESK MICROPHONES, WIRING SCHEMATIC DIAGRAM



CABINET, REAR VIEW



CU-11A MOBILE CONTROL UNIT AND CABLE ASSEMBLY

VOLTAGE CHART FM60-A

RECEIVER SECTION

PIN#	V101	V102	V103	V104	V105	V106	V107	V108	V109
1	-0.2	-	-	-10	-	-	-	120 * 200	-
2	1.2	120	90	70	-	-	-	54 (1) 25 (2) * 40 (1) * 38 (2)	12 * 16
3	6.3V.AC	6.5	3.2	-	-	-	-	60 * 65	-
4	-	-	-	-	6.3V.AC	6.3V.AC	6.3V.AC	6.3V.AC	6.3V.AC
5	220	6.3V.AC	6.3V.AC	6.3V.AC	210	65	60	6.3V.AC	220 * 280
6	100	40	175	170	75	60	-	58 (1) 27 (2) * 45 (1) * 40 (2)	230 * 285
7	-	115	65	110	-	-	55	8 (1) 0 (2) * 0 (1) * -1.0 (2)	-
8	X	-	1.1	-	X	X	X	32 (1) 5.0 (2) * 0.5 (1) * 0 (2)	X
9	X	1.6	-	-6.0	X	X	X	-	X

TRANSMITTER SECTION

PIN#	V110	V111	V112	V113	V114
1	-	2.5	* 1.2	-	100 * 130
2	6.3V.AC	* -9.0	* -11	* 290	-
3	* 195	2.5	* 290	* 6.5	0.8 * 1.1
4	-	-	-	-	6.3V.AC
5	-40	-	6.3V.AC	6.3V.AC	6.3V.AC
6	-	6.3V.AC	-	* 180	70 * 80
7	-	* 290	* -26	* 160	-
8	-	* 160	* 155	-	.4 * .5
9	X	2.5	* 275	* -25	-

NOTES: (1) SQUELCH CONTROL FULL CLOCKWISE
 (2) SQUELCH CONTROL FULL COUNTERCLOCKWISE
 UNIT OPERATED ON 117V.AC FOR ABOVE TESTS
 RCA TYPE WV-77A VTVM USED FOR ALL ABOVE MEASUREMENTS
 * = VOLTAGES ARE FOR TRANSMIT CONDITION
 CAUTION: DO NOT MEASURE PLATE VOLTAGE AT CAP OF V110 (6146)
 TRANSMITTER GRID AND RECEIVER 1st. OSCILLATOR GRID CIRCUITS SHOULD BE MEASURED AT TEST SOCKET J105

VOLTAGE CHART FM60-A

RECEIVER SECTION
UNITS WITH R197 1.5K 10W RESISTOR

PIN #	V101	V102	V103	V104	V105	V106	V107	V108	V109
1	.2	-	-	-7	-	-	-	120 * 180	-
2	1.2	120	75	55	-	-	-	52(1) 25(2) * 40(1) * 36(2)	12 * 14
3	6.3V.AC	5.0	3.2	-	-	-	-	60 * 65	-
4	-	-	-	-	6.3V.AC	6.3V.AC	6.3V.AC	6.3V.AC	6.3V.AC
5	180	6.3V.AC	6.3V.AC	6.3V.AC	170	55	55	6.3V.AC	240 * 260
6	80	40	150	150	60	55	-	58(1) 25(2) 42(1) 40(2)	240 * 265
7	-	95	60	80	-	-	40	8(1) 4(2) 0(1) -0.5(2)	-
8	X	-	1.0	-	X	X	X	30(1) 5(2) .5(1) 0(2)	X
9	X	-0.5	-	-4.5	X	X	X	-	X

TRANSMITTER SECTION

PIN #	V110	V111	V112	V113	V114
1	-	2.5	* 1.2	-	100 * 130
2	6.3V.AC	* -9.0	* -11	* 290	-
3	* 195	2.5	* 290	* 6.5	0.8 * 1.1
4	-	-	-	-	6.3V.AC
5	-40	-	6.3V.AC	6.3V.AC	6.3V.AC
6	-	6.3V.AC	-	* 180	70 * 80
7	-	* 290	* -26	* 160	-
8	-	* 160	* 155	-	.4 * .5
9	X	2.5	* 275	* -25	-

NOTES: (1) SQUELCH CONTROL FULL CLOCKWISE
(2) SQUELCH CONTROL FULL COUNTERCLOCKWISE
UNIT OPERATED ON 117V. AC FOR ABOVE TESTS
RCA TYPE WV-77A VTVM USED FOR ALL ABOVE MEASUREMENTS
* = VOLTAGES ARE FOR TRANSMIT CONDITION
CAUTION: DO NOT MEASURE PLATE VOLTAGE AT CAP OF V110 (6146)
TRANSMITTER GRID AND RECEIVER 1st. OSCILLATOR GRID CIRCUITS SHOULD BE MEASURED AT TEST SOCKET J105

RESISTANCE CHART FM60-A

RECEIVER SECTION

PIN#	V101	V102	V103	V104	V105	V106	V107	V108	V109
1	1M	470K	120K	47K	47K	100K	0	380K	500K
2	180	>50K	400K	>80K	68 Ω	0	20K	2M	470 Ω
3	-	2.5K	10K	0	-	-	-	25K	-
4	0	0	-	0	-	-	-	-	-
5	730K	-	-	-	>30K	>70K	>70K	-	>30K
6	>100K	>30K	>30K	>30K	>100K	>70K	1.5 Ω	680K	>30K
7	0	>30K	160K	>80K	0	0	380K	4M	470K
8		0	220 Ω	0				20K* 2.2K**	-
9		>30K	50K	1M				0	-

TRANSMITTER SECTION

PIN#	V110	V111	V112	V113	V114
1	0	1K	220 Ω	220K	250K
2	-	>30K	100K	∞	1M
3	∞	1K	∞	470 Ω	3.3K
4	0	-	0	0	-
5	17K	0	-	-	-
6	0	-	0	∞	220K
7	-	∞	220K	∞	220K
8	0	∞	∞	6 Ω	1K
9		1K	∞	100K	0

* = SQUELCH CONTROL MAXIMUM CLOCKWISE POSITION

** = SQUELCH CONTROL MAXIMUM COUNTERCLOCKWISE POSITION

RCA TYPE WV-77A VTVM USED FOR ALL ABOVE MEASUREMENTS

LOCAL-REMOTE SWITCH IN LOCAL POSITION

OUTERCOM FM 60A

PARTS LIST

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
C101	Dur-Mica DM-15 270 MMF $\pm 5\%$, 300V	K23006-93
C102	Dur-Mica DM-15 $\pm 5\%$, 500V (See Note 1)	K23006
C103	Dur-Mica DM-15 270 MMF $\pm 5\%$, 500V	K23006-93
C104	Disc Ceramic .1 MF +80 -20%, 100V	M23034-29
C105	Dur-Mica DM-15 12 MMF $\pm 5\%$, 500V	K23006-94
C106, 107, 108	Disc Ceramic .01 MF +80 -20%, 500V	M23034-49
C109	Dur-Mica DM-15 $\pm 5\%$, 500V (See Note 1)	K23006
C110	Feed-Thru, Special	K23094-1
C111	Disc Ceramic .01 MF +80 -20%, 500V	M23034-49
C112, 113	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C114	Disc Ceramic .01 MF +80 -20%, 600V	M23034-19
C115, 116	Dur-Mica DM-15 270 MMF $\pm 5\%$, 500V	K23006-93
C117	Disc Ceramic .01 MF $\pm 20\%$, 500V	M23034-28
C118	Dur-Mica DM-15 100 MMF $\pm 5\%$, 500V	K23006-72
C119	Disc Ceramic .002 MF GMV, 1000V	M23034-41
C120	Dur-Mica DM-15 47 MMF $\pm 5\%$, 500V	K23006-71
C121	Temp. Comp. Disc. NPO, 6.8 MMF $\pm 5\%$, 1000V	K23010-35
C122	Dur-Mica DM-15 22 MMF $\pm 5\%$, 500V	K23006-95
C123	Dur-Mica DM-15 47 MMF $\pm 5\%$, 500V	K23006-71
C124	Dur-Mica DM-15 27 MMF .5 MMF 500V	K23006-64
C125, 126	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C127	Dur-Mica DM-15 47 MMF $\pm 5\%$, 500V	K23006-71
C128	Disc Ceramic .01 MF +80 -20%, 600V	M23034-19
C129, 130	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C131	Dur-Mica DM-15 47 MMF $\pm 5\%$, 500V	K23006-71
C132	Disc Ceramic .1 MF +80 -20%, 100V	M23034-29
C133	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C134, 135	Disc Ceramic .01 MF +80 -20%, 600V	M23034-19
C136	Temp. Comp. Disc. NPO, 2.2 MMF $\pm 5\%$, 1000V	K23010-34
C137	Dur-Mica DM-15 470 MMF $\pm 10\%$, 500V	K23006-96
C138	Disc Ceramic .02 MF +80 -20%, 500V	M23034-27
C139	Disc Ceramic .005 MF +80 -20%, 500V	M23034-37
C140	Dur-Mica DM-15 470 MMF $\pm 10\%$, 500V	K23006-96
C141	Dur-Mica DM-15 100 MMF $\pm 5\%$, 500V	K23006-72
C142	Disc Ceramic .01 MF +80 -20%, 600V	M23034-19
C143	Mylar .047 MF $\pm 20\%$, 400V	K23927-1
C144	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C145	Electrolytic 4 MF, 100V	M23091-11
C146, 147	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C148	Electrolytic 20 MF, 15V	M23091-10
C149	Disc Ceramic .01 MF GMV, 1000V	M23034-8
C150	Disc Ceramic .002 GMV, 1000V	M23034-41
C151, 152	Dur-Mica DM-15 $\pm 5\%$, 500V (See Note 1)	K23006
C153	Variable Air 9.0 - 143 MMF, 600V	K11725-G323
C154	Variable Air 4.5 - 35 MMF, 1200V	K11725-G324
C155	Dur-Mica DM-15 27 MMF $\pm 5\%$ MMF, 500V	K23006-64
C156	Dur-Mica DM-15 1 MMF $\pm 5\%$ MMF, 500V	K23006-36
C158	Dur-Mica DM-15 $\pm 5\%$, 500V (See Note 1)	K23006
C159	Variable Air 3.2-50 MMF	K34449-G12
C161	Disc Ceramic .005 +80 -20%, 500V	M23034-37
C162	Disc Ceramic 470 MMF +80 -20%, 500V	M23034-15
C163	Disc Ceramic .1 MF +80 -20%, 100V	M23034-29
C164, 167, 168	Disc Ceramic .005 MF +80 -20%, 500V	M23034-37
C169	Dur-Mica DM-15 2 MMF $\pm 5\%$ MMF, 500V	K23006-37
C170	Disc Ceramic .0015 MF GMV, 500V	M23034-42
C172	Dur-Mica DM-15 100 MMF $\pm 5\%$, 500V	K23006-72
C173	Disc Ceramic .0015 MF GMV, 500V	M23034-42
C174	Disc Ceramic .1 MF +80 -20%, 100V	M23034-29
C176	Dur-Mica DM-15 100 MMF $\pm 5\%$, 500V	K23006-72
C177, 178	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C179, A, B, C, D	Electrolytic 40-40-40-/450V, 40/25V	K15504-72
C180	Temp. Comp. Disc. NPO 4.7 MMF $\pm 5\%$, 100V	K23010-36
C181	Dur-Mica DM-15 24 MMF $\pm 5\%$ MMF, 500V	K23006-48
C182	Dur-Mica DM-15 10 MMF $\pm 5\%$ MMF, 500V	K23006-22
C183	Variable NPO 5-25 MMF, 350V	K23038-3
C184	Dur-Mica DM-15 270 MMF $\pm 5\%$, 500V	K23006-93
C185	Disc Ceramic .002 MF GMV, 1000V	M23034-41
C186	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31

OUTERCOM FM 60A

PARTS LIST (continued)

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
C187	Disc Ceramic .001 MF $\pm 10\%$, 1000V	M23034-22
C188	Disc Ceramic .01 MF +80 -20% , 600V	M23034-19
C189	Disc Ceramic .001 MF GMV, 500V	M23034-30
C190	Disc Ceramic .01 MF +80 -20% , 600V	M23034-19
C191	Dur-Mica DM-15 120 MMF $\pm 5\%$, 500V	K23006-97
C193	Dur-Mica DM-19 1000 MMF $\pm 5\%$, 300V	K23027-9
C194	Disc Ceramic .01 MF +80 -20% , 600V	M23034-19
C196	Disc Ceramic .01 MF +80 -20% , 500V	M23034-29
C197	Electrolytic 200 MF 25V NPDC	K23925-1
C198	Disc Ceramic .0015 MF $\pm 20\%$	M23034-42
C199	Feed-Thru, Special	K23094-1
C200, 201	Disc Ceramic .005 MF $\pm 20\%$, 500V	M23034-31
C202	Disc Ceramic .01 MF +80 -20% , 500V	M23034-49
C203, 204	Disc Ceramic .0015 MF GMV, 500V	M23034-42
C205	Electrolytic 40 MF, 450V	K23073-38
C206, 207	Disc Ceramic .1 MF +80 -20% , 100V	M23034-29
C208	Disc Ceramic .01 MF +80 -20% , 600V	M23034-19
C209	Disc Ceramic .002 MF GMV, 1000V	M23034-41
C210	Disc Ceramic .1 MF +80 -20% , 100V	M23034-29
C211	Temp. Comp. Disc. 100 MMF $\pm 20\%$, 1000V	K23010-40
C212, 213	Silver Mica 250 MMF, 350V	K23928-1
C214	Electrolytic 4 MF, 100V	M23091-11
C215	Electrolytic 50 MF, 25V	K23073-80
C216	Disc Ceramic .0015 MF $\pm 20\%$, 500V	M23034-42
C217, 218	Disc Ceramic .01 MF GMV, 1400V	M23034-26
C219	Dur-Mica DM-15 39 MMF $\pm 5\%$, 500V	K23006-124
C220, 221	Dur-Mica DM-15 $\pm 5\%$, 500V (See Note 1)	K23006
C222	Dur-Mica DM-15 $\pm 5\%$, 500V (See Note 2)	K23006
C223	Dur-Mica DM-15 68 MMF $\pm 5\%$, 500V	K23006-117
CAPACITOR NOTES		
<p>Note 1.</p> <p>The use of the following capacitors is to be determined from production order.</p> <p>UNITS WITH CHANNEL FREQUENCY 27 MC to 33 MC. The capacitors listed below are to be as follows: C102, C109, and C158 20 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-114. C220 100 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-72. C152, C221 47 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-71. C151 39 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-124.</p> <p>UNITS WITH CHANNEL FREQUENCY 32 MC to 42 MC. The capacitors listed below are to be as follows: C102, C109 and C158 12 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-94. C220 27 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-125. C151, C152 and C221 20 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-114.</p> <p>UNITS WITH CHANNEL FREQUENCY 40 MC to 54 MC. The following capacitors are not used: C102, C109, C151, C152, C158, C220 and C221.</p>		
<p>Note 2.</p> <p>C222 5 MMF $\pm 5\%$ 500V Dur-Mica DM-15 K23006-126. This capacitor is used when crystals Pt. No. 53037-3 (Channel Frequency 25 MC to 29.7 MC) or Pt. No. 53037-5 (Channel Frequency 45.01 MC to 54 MC) are used.</p>		
CR101, 102, 103 CR104 thru CR112	Silicon Diodes (1N2482)	K41211-1
I101	Diodes (1N1490)	K41212-1
I102	Light, Neon Pilot, Yellow	K40922-2
J101	Light, Neon Pilot, Red	K40922-1
J102	Socket, Power (24 Pin) Male	K41136-4
J103	Connector, Receptacle (Antenna)	K16111-1
J104	Socket (8 Pin) (Remote)	K16083-1
J105	Connector (Microphone)	K15972-1
K101	Socket (11 Pin) (Test)	K15944-8
L103	Relay, 3 PPDT 5 Amp.	K40404-1
L104	Coil, Xtal Trimming	K53169-1
L106	Coil, Oscillator Feed Back	K26621-1
L107	Coil, I.F. 10.7 MC	K26623-1
	Coil, I.F. 10.7 MC	K26624-1

OUTERCOM FM 60A

PARTS LIST (continued)

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
L108	Coil, I.F. 10.7 MC	K26622-1
L109	Coil, Quadrature Detector 1650 KC	K26639-1
L110	Choke, R.F.	K53141-1
L112	Coil, P.A. Plate	M53189-1
L113	Coil, RF 2MH	K53222-1
L114	Parasitic Suppressor Assembly	K53224-G1
L115	Coil, Driver Grid	K53169-1
L117	Coil, First Tripler Plate	K53169-1
L118	Coil, Doubler Plate	K53168-1
L119, 120	Choke, R.F.	K26633-1
L121	Choke, Audio 3.0 H	K26667-1
L122	Filter Reactor, 1.5 Hy	K26693-1
Q101, 102	Transistor (2N442)	K40764-1
RESISTORS		
NOTE: All Resistors Fixed $\pm 10\%$ $\frac{1}{2}W$ unless otherwise specified.		
R101	470K	K19309-113
R102	2.2K	K19309-57
R103	470K	K19309-113
R104	330 Ohms	K19309-37
R105	33K	K19309-85
R106	180 Ohms	K19309-31
R107	100K	K19309-97
R108	33K	K19310-85
R109	220 Ohms	K19309-33
R110	470 Ohms	K19309-41
R111, 112, 113	100K	K19309-97
R114	10K	K19309-73
R115	470K	K19309-113
R116, 117, 118	47K	K19309-89
R119	1 Meg	K19309-121
R120	68K	K19309-93
R121	47K	K19309-89
R122	470K	K19309-113
R123	68 Ohms	K19309-21
R124	100K	K19309-97
R125, 126	1.5K	K19309-53
R128	100K	K19309-97
R129	1K $\pm 10\%$ 1W	K19310-49
R130	47K	K19309-89
R131	1.5K	K19309-53
R132	33K $\pm 10\%$ 1W	K19310-85
R133	330K	K19309-109
R134	3.3 Meg	K19309-133
R135	Variable 20K $\pm 20\%$ $\frac{1}{2}W$	K26218-11
R136	2.2K	K19309-57
R137, 138	330K	K19309-109
R139	680K	K19309-117
R140	1 Meg	K19309-121
R141	Variable 500K $\pm 30\%$ $\frac{1}{2}W$	K26218-10
R142	33K	K19309-85
R143, 144	100K $\pm 10\%$ 1W	K19310-97
R145	33K 1W	K19309-77
R146	330K	K19309-109
R147	470K	K19309-113
R148	470 Ohms $\pm 10\%$ 1W	K19310-41
R149	1 Ohm $\pm 1\%$ $\frac{1}{2}W$	K19443-1
R151	8.2K $\pm 10\%$ 1W	K19310-71
R152	15K	K19309-77
R153	20 Ohms $\pm 5\%$ $\frac{1}{2}W$	K19309-188
R154	33K	K19309-85
R155	100 Ohms	K19309-25
R156	33K	K19309-85
R158	220K	K19309-105
R159	220 Ohms	K19309-33
R160	100K	K19309-97
R161	470 Ohms	K19309-41
R162, 163	100K	K19309-97
R164	47K $\pm 10\%$ 1W	K19310-89

OUTERCOM FM 60A

PARTS LIST (continued)

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
R165	15K	K19309-77
R166	220K	K19309-105
R167	3.3K	K19309-61
R168, 169	470K	K19309-113
R170	180K	K19309-103
R171	100K	K19309-97
R172	Variable 0.5 Meg $\pm 30\%$ 0.2W	K15380-7
R173	2.2 Meg	K19309-129
R174	220K	K19309-105
R175	1K	K19309-49
R176	220K	K19309-105
R177	15K $\pm 10\%$ 1W	K19310-77
R178	1K	K19309-49
R179	1 Ohm $\pm 10\%$ 5W	M19336-3
R180	50 Ohms 10W	K19430-15
R181	500 Ohms 10W	K19430-27
R183	120 Ohms	K19309-27
R184	470 Ohms	K19309-41
R185	1.5K	K19309-53
R186	470 Ohms	K19309-41
R187	27K $\pm 10\%$ 1W	K19310-83
R188	330K $\pm 10\%$ 1W	K19310-109
R189	47K $\pm 10\%$ 2W	K19304-58
R190	10K	K19309-73
R191	150K	K19309-101
R193, 194	1K	K19309-49
R195	3.3K	K19309-61
R196	47K	K19310-89
R197	1.5K $\pm 10\%$ 10W	K19337-6
R198	4.7K	K19309-371
SWITCHES		
S101	Slide (DPDT) (Remote Local)	K26619-1
S102	Toggle (DP-3 Pos.) (Off-Standby-Operate)	K26675-1
TRANSFORMERS		
T101	Antenna	K53038-1
T102, 103, 104	IF, 1650 Kc	K26648-1
T105	Audio Output	K26647-1
T107	Switching	M26672-1
T108	Power	P26649-2
T109	Coil Driver Plate	K53201-1
TUBES		
V101	Electron 6BZ6	K16388-1
V102, 103, 104	Electron 6BR8	K40907-1
V105, 106	Electron 6BH6	K16299-1
V107	Electron 6BN6	K40908-1
V108	Electron 12AX7	K16300-1
V109	Electron 6AQ5	K16387-1
V110	Electron 6146	K40898-2
V111	Electron 12BY7A	K40897-1
V112	Electron 6AW8A	K40911-1
V113	Electron 6BR8	K40907-1
V114	Electron 12AX7	K16300-1

OUTERCOM FM 60A

PARTS LIST (continued)

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
CRYSTALS		
Y101 Y102 Y103 Y103	(See Note 2) 2083.333 Kc to 4500.00 Kc (See Note 2) 9050 Kc 12300 Kc (See Note 1)	M53037 M53037-2 K26673-1 K26674-1
<p>Note 1. Substitute Pt. No. K26674-1 (12300 Kc Crystal) for Pt. No. K26673-1 (9050 Kc Crystal, "standard") when a harmonic of the 9050 Kc Crystal falls on the channel frequency ± 60 Kc.</p> <p>Note 2. Determine frequency from production order, for channel frequency 25 Mc to 29.7 Mc use Pt. No. M53037-3; for channel frequency 29.701 Mc to 45 Mc use Pt. No. M53037-4; for channel frequency 45.01 Mc to 54 Mc use Pt. No. M53037-5.</p>		
FILTERS		
ZF101 ZF102 ZF103	RF, Assembly Crystal Assembly (See Note 1)	P53172-61 K26677-1 PL53221
<p>Note 1. Determine frequency from production order, use Pt. No. PL53221-G1 for channel frequency 25 Mc to 37 Mc; use Pt. No. PL53221-G2 for channel frequency 37 Mc to 54 Mc.</p>		
MISCELLANEOUS ITEMS		
	Knob, Volume and Squelch Cable, Power #8 Stranded (rear mount) Cable, Power #14 Stranded (rear mount) Connector, Female 24 Terminal (6 and 12 V Cables) Connector, Female 24 Terminal (117V Cable) Fuseholder, Mobile Screw, Self Tapping #8 x 1/2" for Fuseholder Solderless Terminal for Mobile Cable Fuse Cartridge, 20 Amp (12V Mobile) Fuse Cartridge, 30 Amp (6V Mobile) Rubber Channel (Cabinet Louvres) Terminal, Battery Handle, Cabinet Cable, Power 2 #10GA (6V Cables) (front mount) Cable, Power 2 #12GA (12V Cables) (front mount) Spacer Mount Screw, Self Tapping #12 x 1/2" (for mounting universal bracket)	K26609-1 K16546-1 K16547-1 K41137-1 M41131-1 K51024-1 K10081-10 K35090-9 K51025-2 K51025-1 K50043-1 K35090-10 K50073-2 K16543-1 K16542-1 K50013-2 K10160-1

CU-11A MOBILE REMOTE CONTROL OF FM 60A

The power plug connections for a "rear-mount" cable differ from a "front-mount" due to the fact that the power switch on the front panel of the communications unit is out of the circuit on rear mount installations. All power control, including the battery saving feature is controlled from the remote head.

When installing the control head on the dash

of the vehicle be sure to connect terminal #17 to a good ground.

The volume control on the communications unit should be set high enough for some reserve volume at the operators position but not so high that the output stage of the unit will overload. This can be easily checked by listening to the un-squelched hiss. Overload of the output stage is indicated when the hiss becomes "broken up" or "choppy."

REPLACEMENT PARTS LIST

SYMBOL	DESCRIPTION	PART NO.
I1	Neon Pilot Light, Amber	K40922-2
I2	Incandescent Pilot Light, Red	K40923-1
R1	Var. 20K $\pm 20\%$, $\frac{1}{2}$ W	K26218-11
R2	Var. 20 Ohms $\pm 20\%$, 2W	K15372-4
R3	3.3 Ohms $\pm 10\%$, 1W	M19305-99
SP1	Speaker, 4" x 6", 3.2 Ohms	M26646-1
SI	Switch, Toggle (DP 3 POS.) (ON-STDBY-OFF)	K26675-1
MISCELLANEOUS ITEMS FOR FM 60A		
<i>Connectors</i>	Connector, Female, 24 Terminal (6V and 12V Cables) Connector, Male (Remote Cable) Plug Cap (Remote Cable)	K41137-1 K41141-1 K41142-1
<i>Cables</i>	Cable, Power #8 GA (12V Cables) (Rear Mount) Cable, Filament #14 GA (Rear Mount) Cable, Remote 8 #22 GA	K16546-1 K16547-1 K16545-1
<i>Terminals</i>	Solderless Terminal for Mobile Cable (Rear Mount) Terminal, Battery (Rear Mount) Terminal, Filament (Rear Mount) Solderless Terminal (Remote, Cable)	K35090-14 K35090-13 K35090-12 K35090-11

THE HAMMARLUND MANUFACTURING COMPANY Standard Warranty

The Hammarlund Manufacturing Company, warrants this equipment to be free from defects in workmanship and materials under normal and proper use and service for the uses and purposes for which it is designed, and agrees to repair or replace, without charge, all parts thereof showing such defects which are returned for inspection to the Company's factory, transportation prepaid, within a period of 90 days from date of delivery, provided such inspection discloses to the satisfaction of the Company that the defects are as claimed, and provided also, that the equipment has not been altered, repaired, subjected to misuse, negligence or accident, or damaged by lightning, excessive current or otherwise, or had its serial number or any part thereof altered, defaced, or removed. Tubes shall be deemed to be covered by the manufacturer's standard warranty applicable thereto, and such items shall be and are hereby excluded from the provisions of this warranty. Pilot lamps and fuses are not guaranteed for length of service.

Except as herein specifically provided, no warranty, express or implied, other than that of title, shall apply to any equipment sold hereunder. In no event shall the Company be liable for damages by reason of the failure of the equipment to function properly or for any consequential damages.

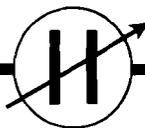
This Warranty is valid for the original owner of the equipment, and is contingent upon receipt of the Warranty Registration Card by the Company. No equipment shall be returned to the factory for repairs under warranty unless written authorization is obtained by the Company, and the equipment is shipped prepaid by the owner. The Company maintains Authorized Service Stations, names and locations of which will be sent upon request of the owner.

The Hammarlund Manufacturing Company

A Giannini Scientific Co.

53 West 23rd Street, New York 10, N. Y.

Export Department: 13 East 40th Street, New York 16, N. Y.



The policy of the Hammarlund Manufacturing Company, is one of continued improvement in design and manufacture wherever and whenever possible, to provide the highest attainable quality and performance. Hence, specifications, finishes, etc. are subject to change without notice and without assumption by Hammarlund of any obligation or responsibility to provide such features as may be changed, added or dropped from previous production runs of this equipment.

FM 60A ERRATA

THE FOLLOWING PRODUCTION RUN CHANGES ARE IN VARIANCE WITH THE PRELIMINARY SCHEMATIC DIAGRAM INCLUDED IN THIS MANUAL. THE PARTS LIST IS CORRECT AS OF THE RELEASE DATE OF THIS MANUAL.

1. Capacitor C196 was .1MF +80 -20% 100V, is now .01MF +80 -20% 500V.
2. Resistor R145 was 15K $\pm 10\%$ $\frac{1}{2}$ W, is now 33K $\pm 10\%$ 1W. Only a few units were shipped with the original values referenced above. Field changeover of all such units is recommended.
3. Resistor R197, 1500 OHMS $\pm 10\%$ 10W has been added in the "C" receiver B+ line to improve stability at high DC input voltages.
4. Resistor R198, 4.7 OHMS $\pm 10\%$ $\frac{1}{2}$ W has been added in series with the V110 control grid lead to improve transmitter final stage stability at certain frequencies. This resistor should be added if any instability is observed.

The policy of the Hammarlund Manufacturing Company, is one of continued improvement in design and manufacture wherever and whenever possible, to provide the highest attainable quality and performance. Hence, specifications, finishes, etc. are subject to change without notice and without assumption by Hammarlund of any obligation or responsibility to provide such features as may be changed, added or dropped from previous production runs of this equipment.

Hammarlund Manufacturing Company

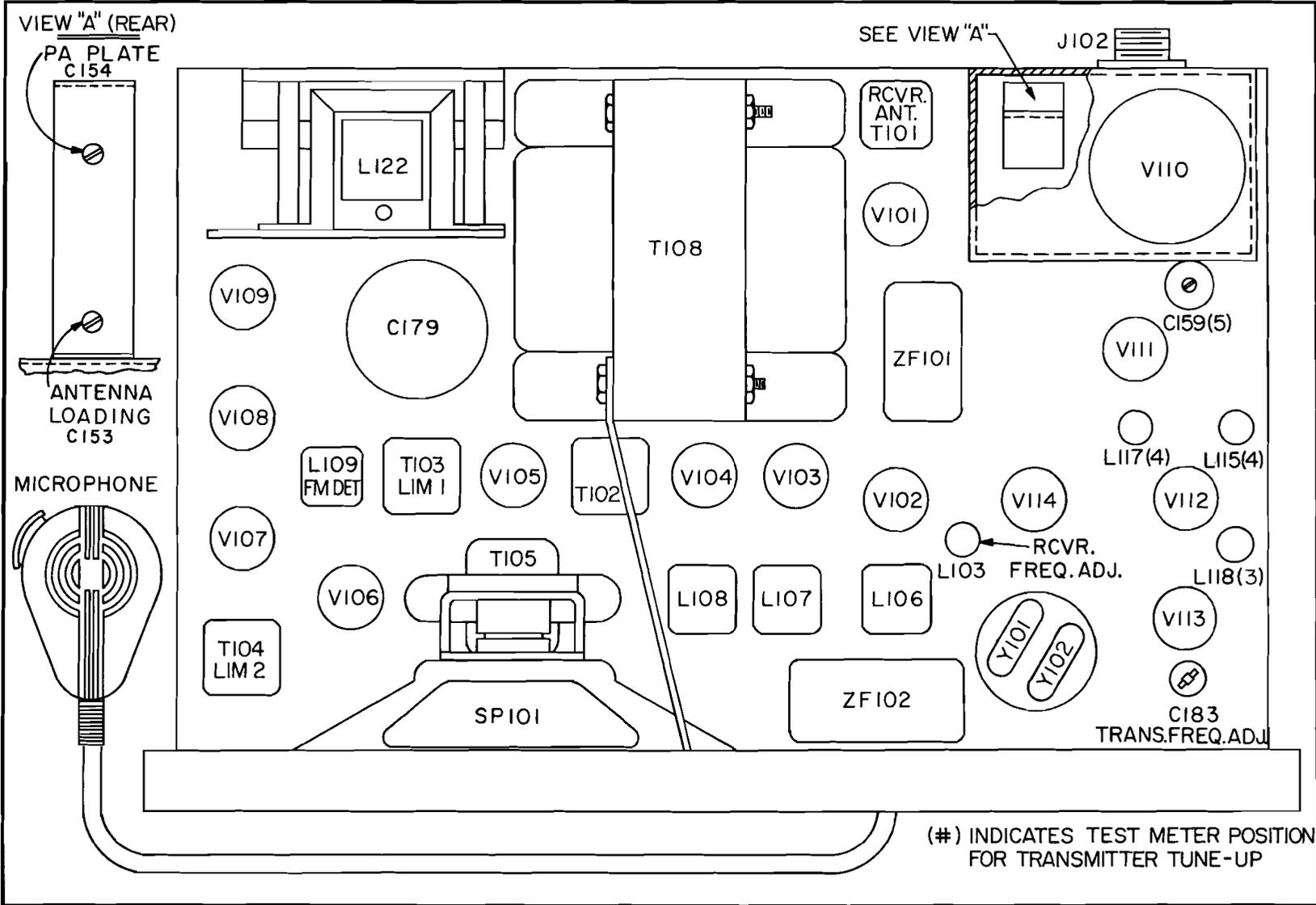
A Giannini Scientific Co.

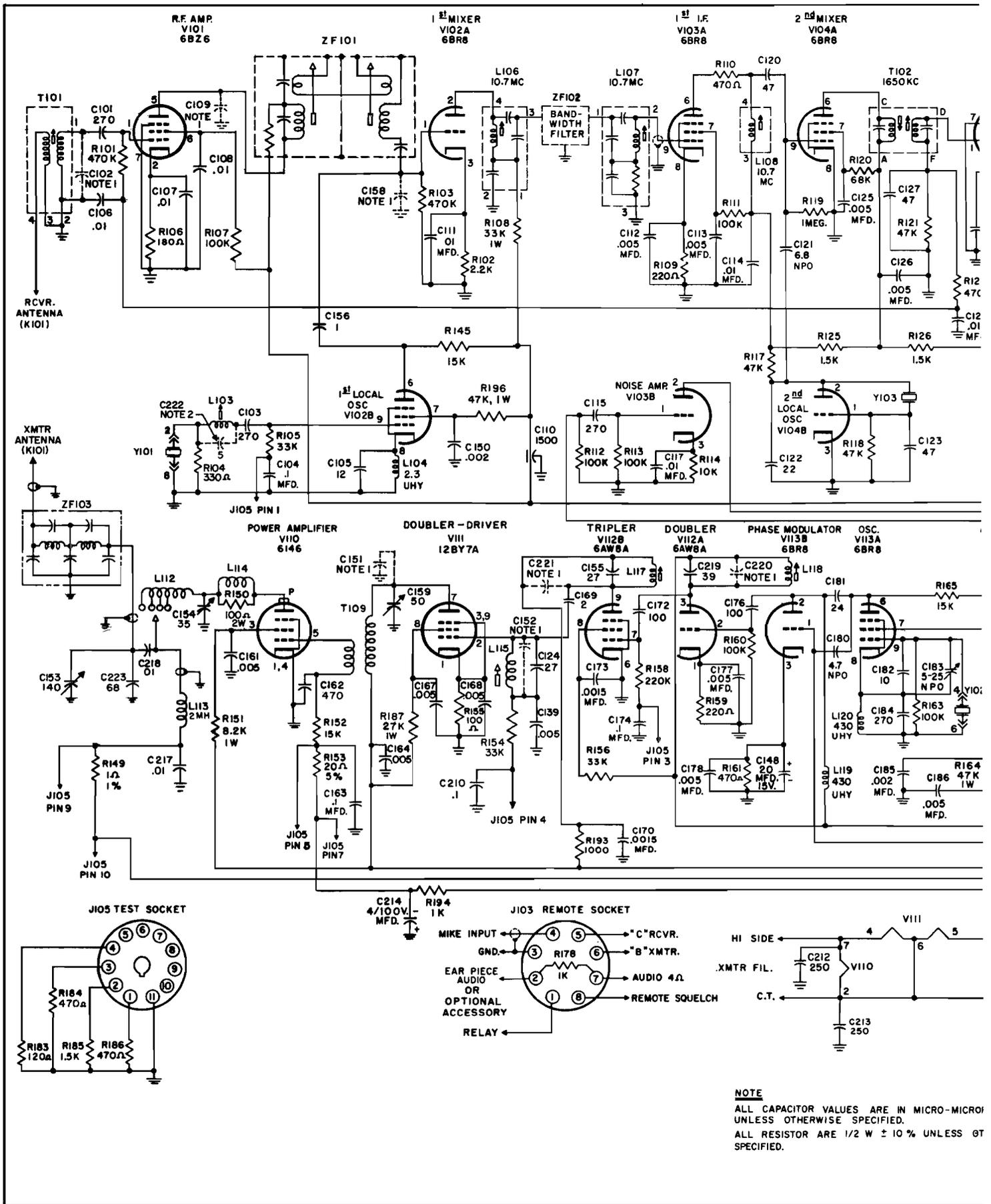
53 West 23rd Street, New York 10, N. Y.

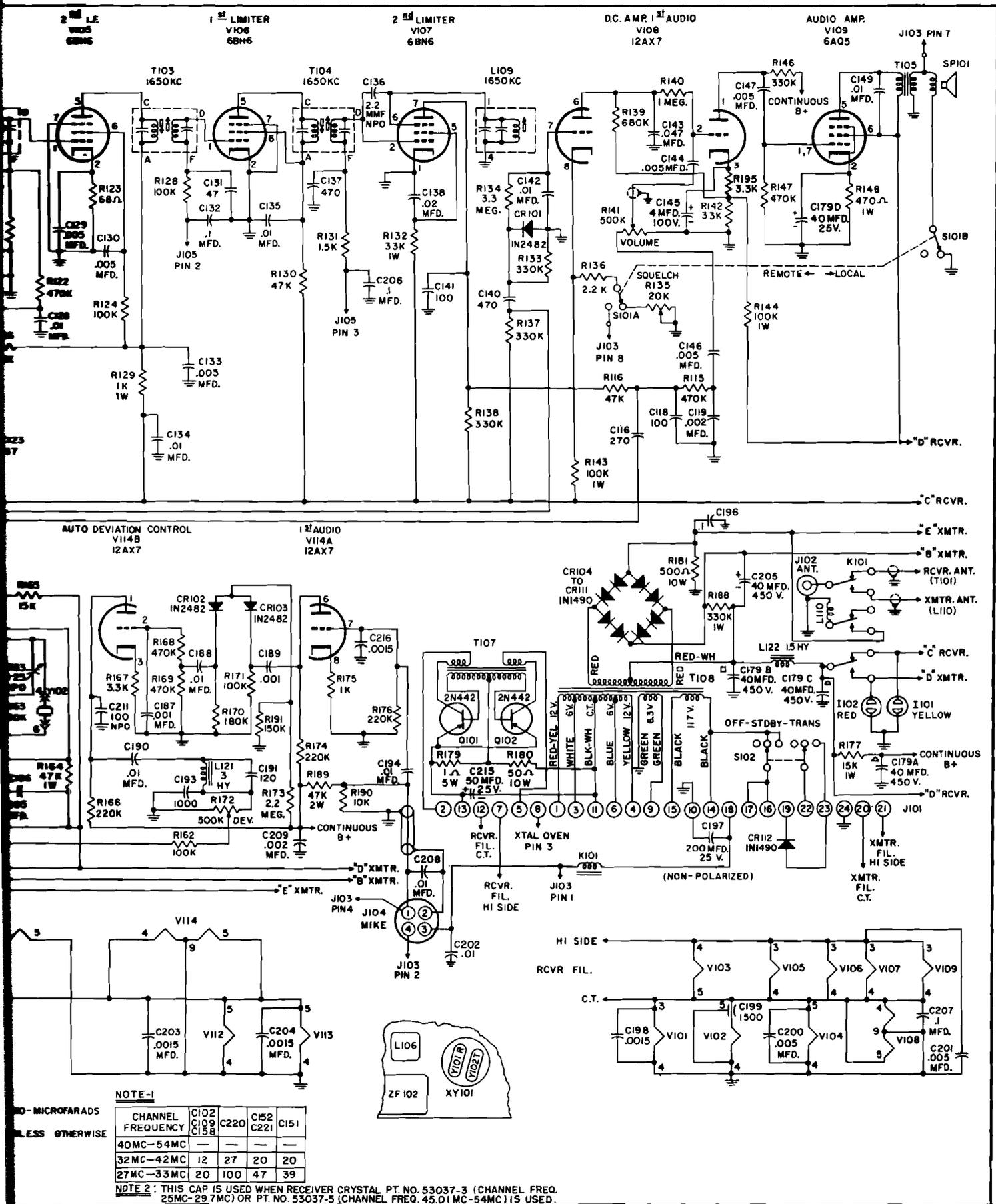
Export Department: 13 East 40th Street, New York 16, N. Y.

DO NOT MAKE ANY RETURNS WITHOUT AUTHORIZATION FROM EITHER NEW YORK OFFICE OR FACTORY. ALL AUTHORIZED RETURNS SHOULD BE SHIPPED TO FACTORY, HAMMARLUND MANUFACTURING CO., MARS HILL, NORTH CAROLINA. DO NOT SHIP TO NEW YORK OFFICE.

COMPONENT LOCATION DIAGRAM







PRELIMINARY SCHEMATIC DIAGRAM