OPERATING AND SERVICE INSTRUCTIONS FOR...

COMMUNICATIONS TRANSCEIVER MODEL FPM-300 MK II

the hallicrafters co.

A Subsidiary of Northrop Corporation

WARRANTY

"The Hallicrafter's Company warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to our authorized radio dealer, wholesaler, from whom purchased, or, authorized service center, intact, for examination, with all transportation charges prepaid within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extended to units which have been repaired or altered outside of our factory or authorized service center, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products."

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OPERATING AND SERVICE INSTRUCTIONS

FOR

COMMUNICATIONS TRANSCEIVER MODEL FPM-300 MK II

Manufactured By:

The Hallicrafters Co.
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SECTION I
GENERAL DESCRIPTION

1-1. INTRODUCTION. Hallicrafters Model FPM-300 MK II (figure 1-1) is a precision-built, high performance transceiver of advanced design. Complete coverage is provided for single-sideband (SSB) and continuous wave (CW) operation in the 80-, 40-, 20-, 15-, and 10-meter amateur bands. The transceiver is a hybrid system utilizing the most desirable features of solid state and tube circuitry in its design. The system consists of two vacuum tubes, three integrated circuits, 19 bi-polar transistors, 14 FET transistors, three bridge rectifiers, six zener reference diodes, and 19 general purpose diodes. The single conversion heterodyning system employs bi-lateral signal frequency and intermediate frequency amplifier stages.

A 25 kHz crystal controlled signal source provides an accurate frequency reference for maintaining true dial calibration.

Clean single sideband transmission without severe flat-topping of the final amplifier stage is assured by two separate control circuits within the transceiver. Amplified automatic level control (AALC) monitors the final amplifier grid circuit to control signal frequency and intermediate frequency amplifier stage gain accordingly. Transmitter audio circuit levels are also controlled by audio limiter action ahead of the modulator stage to handle the wide range of signal levels received from the microphone.

The FPM-300 Transceiver is a complete desk-top or mobile amateur radio station, requiring only a 117V/234Vac or 12 Vdc power source, antenna, and microphone or key to place it in operation.

Other features of the FPM-300 include:

- Choice of voice operated transmission (VOX) or push-to-talk (PTT) for SSB operation, and semi-automatic break-in control for CW operation.
- Accurately calibrated variable frequency oscillator (VFO) with good mechanical and temperature stability.



Figure 1-1. Model FPM-300 MK II Transceiver.

- Double reduction planetary drive tuning mechanism with wide spaced knob skirt calibration marks representing approximately one kHz of incremental tuning.
- Constant tuning rate on all bands.
- Six pole crystal lattice 9 MHz filter of 2.1 kHz Bandwidth for optimum selectivity and single sideband response.
- Product detector with crystal controlled beat frequency oscillator (BFO) injection for maximum stability.
- Upper and lower sideband operation on all bands, 80 through 10 meters.
- Keyed side tone for monitoring CW transmissions.
- Built-in 25 kHz, crystal controlled calibrator for exact dial calibration.
- "S" meter for receiver tuning and plate current metering for transmitter tuning and operating convenience. No panel switching required.
- Accessory fan kit available for cooler, more efficient operation.
- Self-contained power supply with power cable connector strapping for 117V/234 Vac or 12 Vdc operation.

1-2. TELEVISION INTERFERENCE (TVI) SUPPRESSION.

The FPM-300 Transceiver has been designed and constructed to suppress spurious radiation that may cause television interference. The TVI problem was given full consideration in the design and layout of the chassis. Components have been specifically selected to avoid undesired resonances and are arranged to prevent parasitic oscillations.

There are, however, some types of TVI that cannot be prevented within the transmitter itself. This is particularly true in fringe reception areas. In such cases, a good commercial low pass filter connected at the transceiver antenna connector is recommended. For a more complete discussion of measures that may be used to handle special problems of this type, refer to the "Radio Amateur's Handbook" published by the American Radio Relay League.

1-3. ACCESSORY ITEMS. The following items are available to complement the FPM-300 Transceiver in various installations and operating modes.

MR-300 Mobile Mounting Kit

This kit of parts facilitates installation of the FPM-300 Transceiver in mobile applications. The kit consists of the DC power cable required and a suitable under-the-dash hanger with hardware. Wing screws permit installation and removal of the transceiver without removing the hanger itself from the vehicle.

HA-60 Blower Kit

This unit is intended to provide additional cooling of the FPM-300. The rear panel of the transceiver is pre-punched for the blower housing and four mounting screws (see figure 3-1). Power for the HA-60 is obtained from the "BLOWER" receptacle on the rear apron of the transceiver. The kit includes a quiet running fan, finger guard, power cord with plug, and mounting hardware. The use of the HA-60 is highly recommended for both base station and mobile installations.

SECTION II
SPECIFICATIONS

Table 1. Tube and Transistor Complement with Functions.

REF SYMBOL	TYPE	FUNCTION
V101	12BY7A	Transmitter Driver
V102	6KD6	Transmitter Power Amplifier
Q101	2N1522	DC/DC Converter
Q102	2N1522	DC/DC Converter
Q201	40841	Transmitter IF Amplifier
Q202	40841	Receiver IF Amplifier
Q203	40841	Receiver IF Amplifier
Q204	SE4002	9 MHz AVC Amplifier
Q205	SE4002	AVC Amplifier
Q206	MPS6515	"S" Meter Amplifier
Q207	MPS6515	Transmitter IF Amplifier
Q208	MPS6523	Transmitter Audio Amplifier
Q209	MPS6515	Microphone Amplifier
Q210	2N5458	Microphone Pre-Amplifier
Q211	MPS404	Relay Control Amplifier
Q212	SE4002	1750 Hz Tone Oscillator
Z201	MC1496G	Product Detector
Z202	LM370	Transmitter Audio Compression Amplifier and VOX Relay Control
Q301	MPS6531	Relay Control Amplifier
Q401	40468A	VFO
Q402	40468A	VFO Buffer Amplifier
Q403	40468A	Injection Frequency Amplifier
Q404	40468A	Injection Frequency Amplifier
Q405	SE5025	Heterodyne Crystal Oscillator
Q406	40468A	Buffer Amplifier
Q407	MPS6515	Receiver Audio Amplifier
Q408	A138	Receiver Audio Amplifier
Q409	MPS6516	Receiver Audio Amplifier
Q410	2N4077	Receiver Audio P.A.
Q411	2N4078	Receiver Audio P.A.
Q412	2N5458	Carrier Crystal Oscillator
Q413	2N5458	Carrier Crystal Oscillator

Table 1. Tube and Transistor Complement with Functions (Cont).

REF SYMBOL	TYPE	FUNCTION
Q501	40841	Receiver RF Amplifier
Q502	40841	Transmitter RF Amplifier
Q503	MPS6515	ALC Control Amplifier
Q504	SE4002	ALC Control Amplifier
Q701	2N5458	100 kHz Marker Crystal Oscillator
Z701	MFC6020	Frequency Divider

Table 2. General Specifications.

Tuning Ranges: Full frequency coverage of the amateur bands in eight ranges as follows:

Band (meters)	Frequency (MHz)
80	3.45 to 4.05
40	6.95 to 7.55
20	13.95 to 14.55
15	20.95 to 21.55
10	27.95 to 28.55
10	28.45 to 29.05
10	28.95 to 29.55
10	29.45 to 30.05

Heterodyne Oscillator Crystals: Type CR-55A/U and *CR-72/U in HC-18/U Holder.

Tuning Range (MHz)	Crystal Frequency (kHz)
3.45 to 4.05	None
6.95 to 7.55	21,500.000
13.95 to 14.55	28,500.000
20.95 to 21.55	35,500.000
27.95 to 28.55	*42,500.000 (crystal not supplied)
28.45 to 29.05	43,000.000
28.95 to 29.55	*43,500.000 (crystal not supplied)
29.45 to 30.05	*44,000.000 (crystal not supplied)

Types of emission: SSB - selectable USB/LSB with suppressed carrier.
CW - keyed audio tone

Frequency control: Self contained VFO. Tunes 4950 to 5550 kHz.

Transmission control: SSB operation:
PTT - manual (push-to-talk)
VOX - voice operated control
CW operation:
VOX - semi-automatic break-in

Table 2. General Specifications (Cont).

Dial calibration:	10 kHz increments, 600 kHz tuning range.
Calibration accuracy:	Less than a 3 kHz error across the dial after indexing at high frequency end of dial; band-to-band calibration error less than ±3 kHz.
	Internal 25 kHz, crystal controlled calibrator.
Frequency stability:	Less than 500 Hz drift in first hour, after 15 minute warm up; less than 100 Hz per hour thereafter.
Tube complement:	2
Diodes:	25
Transistors:	19
FETs:	14
Integrated circuits:	3
Bridge rectifiers:	3
Mixer modules:	2
Connector data:	MIC jack - standard 1/4-inch, three-conductor phone plug.
	PHONES jack - standard 1/4-inch, two-conductor phone plug.
	KEY jack - standard 1/4-inch, two-conductor phone plug.
	ANTENNA connector - MIL type PL-259 with adapter UG-175/U for RG-58A/U cable.
	RELAY connector - standard RCA type phono connector.
	BLOWER connector - Cinch Jones type P-302-CCT
	POWER connector - Cinch Jones Type S-318-CCTL (18-pin receptacle)
Fuse requirement:	117Vac operation - 4A, SB 3AG type
	234Vac operation - 2A, SB 3AG type
	13.4Vdc operation - 20A (Buss type NON or equal) fuse or fast action circuit breaker in positive lead.
Power source:	105-125Vac/210-250Vac 50/60 cycles.
	Outlet capable of 300 watts with good regulation.
	11.0 - 15.5 Vdc (13.4V nom.) Supply capable of 20A load with good regulation.
Dimensions (HWD):	5-1/2 x 12-3/4 x 10-3/4 inches
Net weight:	25 pounds
Shipping weight:	27 pounds

Table 3. Transmitter Specifications.

Power input:	SSB - 250 watts PEP
	*CW - 180 watts maximum
Power output:	SSB - 100 watts PEP minimum (slightly lower on the 15 and 10 meter bands).
Output impedance:	50 ohms nominal. Adjustable 40 to 70 ohms when essentially non-reactive.
Type of sideband generation:	Solid-state modulator with 9 MHz, 6-pole crystal filter (Nominal BW - 2.1 kHz)
Microphone input:	High impedance. Input sensitivity 10 millivolts maximum for PEP output.
Audio response, overall:	500 to 2500 (6 dB)
Distortion products:	Intermodulation - 26 dB below PEP
Unwanted sideband rejection:	50 dB (800 to 2200 Hz)
Carrier suppression:	50 dB below PEP output.
Spurious emission:	50 dB minimum below PEP output (non-harmonic).
Harmonic suppression:	40 dB below PEP output.
CW side tone:	1750 Hz nominal.

*CW drive (MIC/CW LEVEL control) must be adjusted to not exceed a maximum plate current of 300 mA in order to obtain rated power shown and be consistent with reasonable P.A. tube life.

Table 4. Receiver Specifications.

Antenna input:	50 ohms nominal
Audio output impedance:	8 ohms
Sensitivity:	1 microvolt or less for 15 dB signal-to-noise ratio
Audio Output:	One watt with less than 10% distortion (THD)
Single conversion system:	9 MHz intermediate frequency
Crystal lattice filter:	Six-pole, symmetrical passband; center frequency - 9000 kHz BW - 2.1 kHz (3 dB) and 5 kHz (60 dB);
AVC figure of merit:	60 dB or more RF signal input change for less than 10 dB change in audio output
Internal spurious:	Typically less than 1 microvolt equivalent CW signal
IF rejection:	60 dB minimum
Image and spurious rejection:	50 dB minimum

SECTION III
INSTALLATION

3-1. UNPACKING. Carefully remove the equipment from the carton and packing material and examine the unit for possible damage that may have occurred in transit. If the equipment has been damaged, file a claim immediately with the carrier, stating the extent of the damage. Carefully check all shipping labels and tags for special instructions before removing or destroying them.

3-2. LOCATION. The FPM-300 Transceiver may be set up as a base station or mobile installation. In either installation it is very important that the transceiver be placed in an operating position that provides unobstructed circulation of air through the ventilation openings in the cabinet. Avoid excessively warm locations such as dead air spaces in a bookcase or cabinet or near the hot air vents of the home or automobile heating systems.

3-3. ANTENNA. The FPM-300 Transceiver is designed to terminate in a 50-ohm unbalanced transmission line. While a non-reactive 50-ohm load is preferred for optimum results, a VSWR of 2:1 can be accommodated by the transmitter with acceptable results. Many of the popular dipole or beam antennas using 50-ohm transmission lines give excellent results.

For more detailed information on the subject of antennas, refer to the "Radio Amateur's Handbook" or the "ARRL Antenna Book", both published by the American Radio Relay League.

IMPORTANT

Some form of lightning protection that complies with the local code requirements should be provided.

The antenna connection is located at the rear of the transceiver, as shown in figure 3-1. The connector mates with MIL type PL-259 (49190) UHF series coaxial connectors. Use 50-ohm MIL type RG-58/U coaxial cable or equivalent for the feed line to the station antenna system or linear power amplifier.

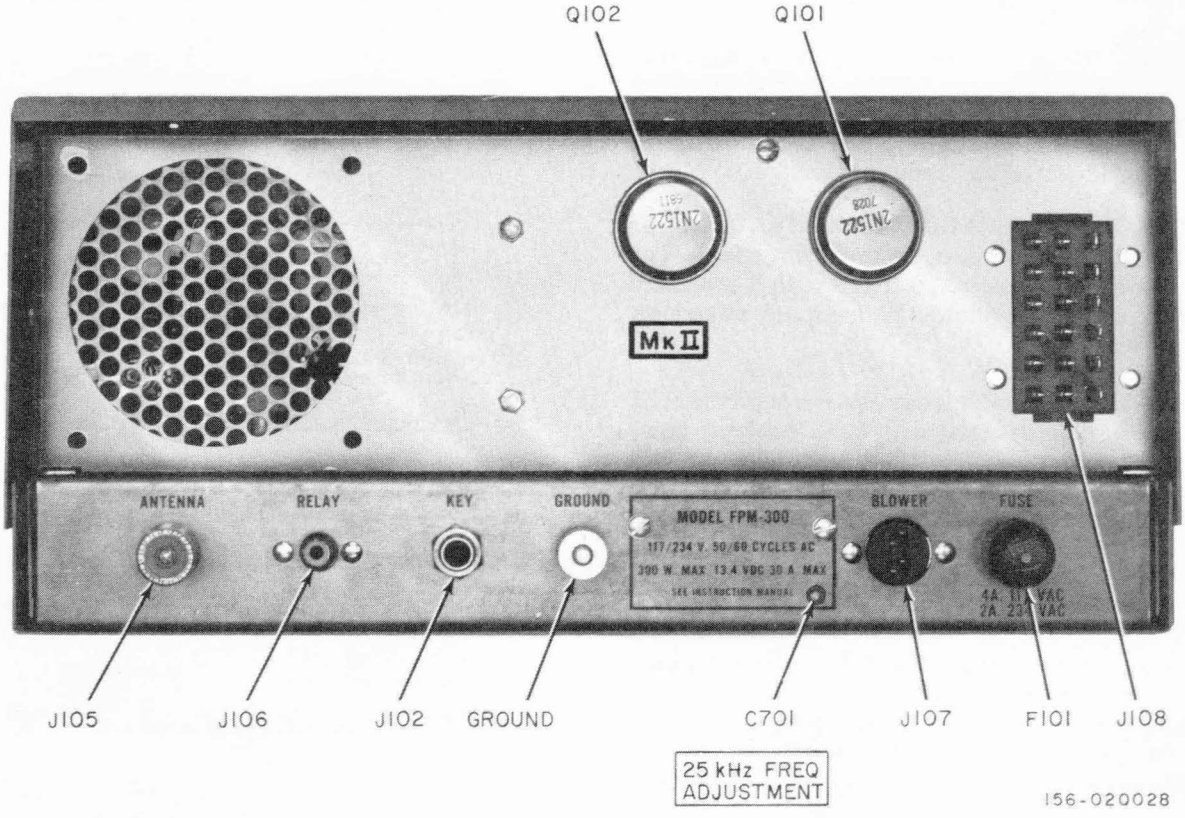


Figure 3-1. Rear View of Model FPM-300 MK II Transceiver.

Station antenna systems with terminating impedances other than 50 ohms will require an impedance matching device capable of safely handling 150 watts PEP RF power.

CAUTION

Never operate the FPM-300 Transceiver as a transmitter without a matched antenna or adequate dummy load termination. Illuminating lamps will not present a constant load impedance. Damage to the power amplifier tube and matching network components is possible if the equipment is operated as an unloaded transmitter. Do not operate the transmitter into an antenna system having a high VSWR on its transmission line.

3-4. GROUNDS. In the interest of safety, it is strongly recommended that the FPM-300 be grounded to a cold water pipe or good electrical earth ground. Station equipment that is left unbonded between units or between the equipment and ground may assume potential differences that could present a shock hazard. An external chassis ground terminal is provided on the FPM-300 rear chassis apron for this purpose. A ground lead of No. 16 wire or 1/8-inch tubular braid is recommended.

3-5. MICROPHONE. Any good quality, high impedance crystal or dynamic type microphone may be used. Best results will usually be achieved with a communications type microphone designed with a restricted voice frequency range.

The MIC receptacle is located at the lower left side of the cabinet near the front panel. The microphone cable must be fitted with a standard 1/4-inch, three conductor phone plug wired as shown in figure 3-2.

The microphone circuit shown with the PTT switch may also be used with VOX control; however some microphones fitted with push-to-talk switches also mute the microphone element until the switch is pressed. Hence, VOX operation is not possible unless the microphone switch is altered accordingly.

3-6. KEYER. The station keyer is connected to the transceiver at the KEY jack (J102) located on the rear chassis apron. The key jack accepts a standard 1/4-inch, two conductor phone plug. Wire the plug so that the key base connects to the plug sleeve which is at ground potential.

3-7. HEAD PHONES. A communications type headset of either high or low impedance may be used with the transceiver to provide private listening or more exacting communications work. The PHONES jack (J101) mates with a standard 1/4-inch, two conductor phone plug. When the headset is utilized the transceiver speaker is disabled. An external station speaker having an 8-ohm voice coil impedance may be connected to the PHONES jack if desired.

3-8. RELAY. The relay connector (J106) provides for an optional single conductor relay controlled circuit to chassis ground. The circuit is grounded when the transceiver is in the transmit state and open when in the receive state. This circuit may be used to control grid bias on a linear power amplifier stage, for example, to obtain cut-off bias during receive or standby periods. The connector mates with the RCA type phono connectors.

3-9. BLOWER. The blower outlet supplies power for the optional HA-60 Blower Kit. The blower assembly is highly recommended for installations where abnormal ambient temperatures or poor ventilating conditions are encountered. Power at 117Vac is supplied by the outlet continuously when operating from either 117V or 234Vac source. Square wave power at 117Vac is supplied from this outlet during transmission periods only when operating the transceiver from a 13.4 Vdc source.

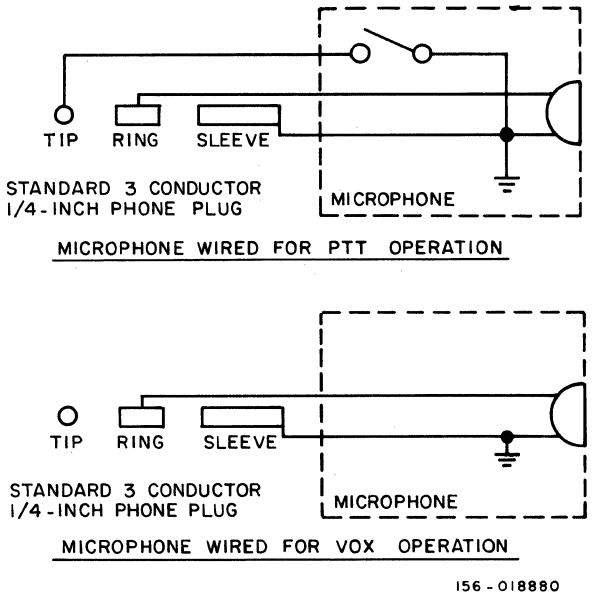


Figure 3-2. Microphone Wiring for Push-to-Talk and VOX Transmitter Control.

Hallicrafters HA-60 Blower Kit is available as an accessory and plugs into the BLOWER socket. If a 117Vac cooling fan is substituted for the HA-60 blower assembly, the fan must be rated for 117V, 50/60 cycles ac and operate at 30 watts to be compatible with FPM-300 Transceiver.

3-10. FUSE. Two fuse ratings are required to properly protect the transceiver circuits. The correct fuse is determined by the ac line voltage used to power the transceiver. Use a 4 ampere "slow-blow" 3AG size fuse for 117Vac sources or a 2 ampere "slow-blow" 3AG size fuse for 234Vac sources. Fuse requirements for 13.4Vdc operation are outlined in paragraph 3-13, Mobile Installation.

3-11. 117V/234Vac STRAPPING OPTION. The FPM-300 Transceiver is shipped from the factory wired and fused for 117Vac operation. If the transceiver is to operate from a 234Vac source the wire links on the underside of the power transformer must be altered as follows:

CAUTION

The transceiver must not be connected to the power source while performing the following steps.

1. Turn the transceiver over on its back and release the two cabinet cover hasps. Use a 1/4-inch socket type driver to remove the nine retaining screws holding the bottom cover to the chassis assembly. Lift the cover free and set it aside to expose the underside of the chassis.

2. Cut and remove the two wire links between terminals 1 to 2 and 3 to 4 on the power transformer. See figures 6-2 and 7-2.

3. With a short length of No. 18 tinned copper wire, jumper the two center terminals (2 to 3) on the transformer. Solder the connections carefully to provide a good electrical connection.

4. Replace the bottom cover and retaining hardware. Replace all hardware (nine screws) as the shield grounds to the cover are important. Refasten the cover hasps before turning the transceiver right side up.

NOTE

Change fuse rating as described in paragraph 3-10 to match the supply voltage used.

3-12. BASE STATION INSTALLATION. The FPM-300 Transceiver may be operated as a base station with or without a linear power amplifier stage.

The transceiver may be operated from 117V or 234V, 50-60 cycle ac mains or from a 13.4Vdc battery source of power. Generally a base station installation implies operation from ac mains so the ac line cord supplied with the transceiver will be used. If a dc source is used for power, use the dc power cable which is available as an accessory item.

The FPM-300 Transceiver is shipped from the factory strapped and fused for 117Vac operation. If the installation requires 234Vac operation make the modification described in paragraphs 3-10 and 3-11 before connecting power to the transceiver.

Connect the multi-pin plug of the line cord to the power receptacle (J108) at the rear of the transceiver before connecting the line cord plug to the power source. (See figure 3-1.) Never insert or remove the multi-pin plug when the line cord is connected to the ac power source.

With the antenna system and ground wire connected to the transceiver, as outlined in paragraphs 3-3 and 3-4, the key or microphone connected to their respective receptacles, and the line cord connected to the source of power, the station is ready for operation. The internal speaker may be used or headphones plugged into the PHONES jack for reception.

Figure 3-3 presents a typical base station cabling diagram, including linear power amplifier, for the FPM-300 Transceiver. The difference between the power output capability of the FPM-300 and the drive level required by the linear amplifier may dictate the use of some fixed amount of attenuation between the units, in the form of an RF power pad designed for 50-ohm input and output terminations.

3-13. MOBILE INSTALLATION. The FPM-300 Transceiver may be installed in vehicles having a 12-volt dc power source capable of supplying up to 20 amperes with good voltage regulation. To complete the mobile installation, a model MR-300 Mobile Installation Kit, 20-ampere fuse block with fuse, suitable battery connectors and mobile antenna system will be required. The FPM-300 Transceiver is wired for vehicles having the negative side of the battery grounded to the frame.

The exact details of the installation will vary with the make of vehicle. In general, the following recommendations will apply to all mobile installations.

1. Install the transceiver in a position that provides unobstructed circulation of cooling air through the cabinet vents. Avoid conditions where the car heater discharge could be fed through the transceiver vents. For installations lacking adequate ventilation, the HA-60 Blower Kit is recommended to provide additional cooling capacity.

2. Install the antenna system in the manner recommended by the antenna manufacturer. The antenna coaxial connector mates with MIL type PL-259 (49190) UHF series cable connectors and is located on the rear apron of the transceiver. The use of a reliable 50-ohm VSWR bridge, connected in the transmission line at all times, is highly recommended to obtain optimum antenna efficiency and transmitter performance.

3. It is recommended that the length of the primary leads (dc power cable supplied with kit) to the transceiver be kept short to minimize the voltage drop between the battery and the transceiver. Install a fuse block (not supplied) close to the positive battery terminal and connect it in the positive lead wire of the dc power cable. The wire color coding of the dc cable is red or white for (+) positive battery terminal and brown or black for (-) negative battery terminal. The fuse block also provides a convenient means of disconnecting the battery supply when desired. Make all terminal connections secure to avoid contact heating and loss of voltage across the terminal. A Buss type NON 20 ampere fuse with fuse block to match is recommended for battery and equipment protection. DO NOT USE FUSE TYPES WITH DELAYED BLOWING FEATURES USED FOR MOTOR PROTECTION.

CAUTION

USE CARE WHEN MAKING CONNECTIONS TO THE BATTERY IN THE VEHICLE. THE POWER IN A BATTERY CAN CAUSE DANGEROUS BURNS AND EVEN EXPLOSION IF SHORT CIRCUITED.

Remove the fuse from the fuse block before connecting the dc power cable connector to the FPM-300 Transceiver. Never insert or remove the multi-pin plug when the dc cable is energized by the battery.

Only after becoming familiar with the use and function of the controls, as outlined in Sections IV and V should an operational check be performed. It is recommended that the automobile engine be running while operating the transceiver in the transmit mode to prevent drawing power from the battery. Short transmission periods during tune up and adjustment are recommended to avoid undue interference on the air.

NOTE

Before operating the FPM-300 Transmitter, make the final amplifier bias adjustment for proper idle plate current as outlined in paragraph 8-3.

3-14. MOBILE NOISE SUPPRESSION. Most current production automobiles have fairly well designed ignition systems that are compatible with their AM and FM radio receivers. A detailed run down on the source and cure for ignition noise is beyond the scope of this manual. Current handbooks on the subject, such as "The Mobile Manual for Radio Amateurs", published by the American Radio Relay League is recommended.

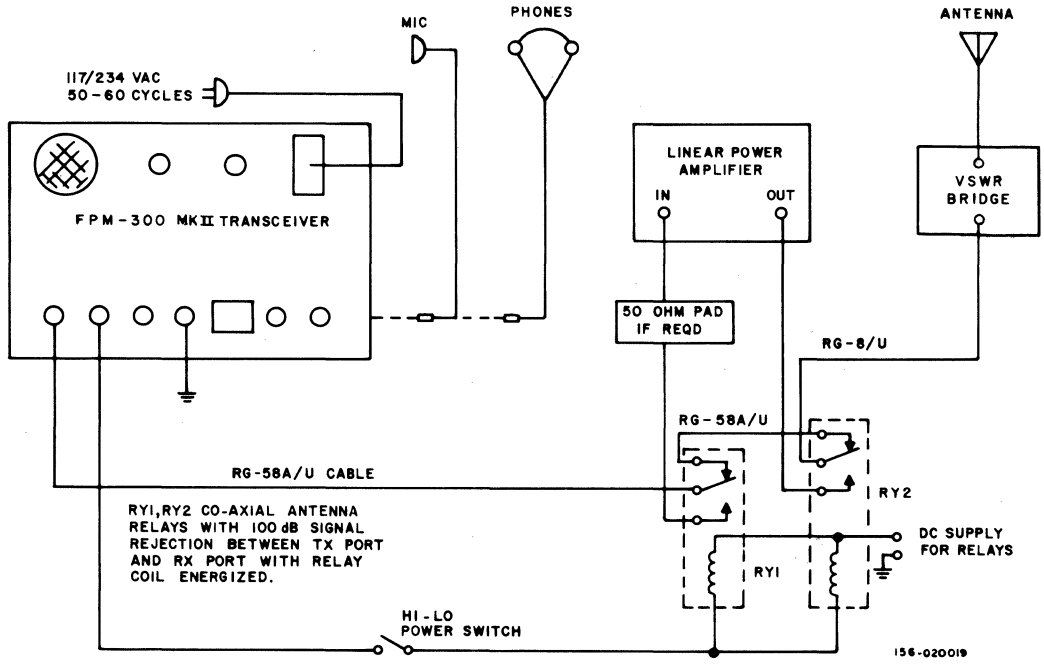


Figure 3-3. Base Station Installation with Linear Amplifier.

SECTION IV
OPERATING CONTROLS

4-1. GENERAL. All controls utilized during normal operation of the FPM-300 MK II Transceiver are located on the front panel (see figure 4-1). A brief description of each control follows.

4-2. TUNING Control. The tuning control knob is located just below the dial display. The control drives the VFO capacitor, which is the frequency determining element of the transceiver. The frequency to which the transceiver is tuned is displayed on the large dial in two scales calibrated 0 to 500 kHz and 500 to 1000 kHz. The 0-50 kHz extensions of the dial scale permit reading beyond the 100 kHz end calibration marks of the dial by an additional 50 kHz. This may represent out of band calibration data on some bands or frequency overlap as in the case of the 10 meter band segment. The correct dial scale used to read frequency is determined by the setting of the BAND selector knob which presents the first digits of the operating frequency.

The following examples will aid in developing the readout technique:

A. Set the BAND selector at 3.5, and set the tuning knob so that the 500-1000 kHz scale indicates 650. The dial frequency then reads out as 3.650 MHz or 3650 kHz.

B. Set the BAND selector at 14.0 and leave the tuning knob set as before. The dial frequency now reads out as 14.150 MHz or 14,150 kHz, since the 0-500 kHz scale is now used on this band. Basically, 14 MHz is obtained from the BAND selector calibration and 150 kHz is obtained from the 0-500 kHz scale by addition.

4-3. REC. GAIN/PWR OFF Control. The REC. GAIN/PWR OFF control is a combination RF sensitivity control and power on-off switch. In the full counterclockwise position all power is disconnected from the transceiver. Turning the control clockwise activates the transceiver and increases the sensitivity of the receiver. The REC. GAIN control varies the RF gain of the receiver at the RF amplifier stage and 9 MHz IF amplifier stage. Maximum receiver sensitivity is obtained with the control turned fully clockwise.

4-4. CAL. Control. The CAL. control varies the frequency of the VFO over a narrow range of frequency. This adjustment permits the dial calibration to be set precisely on frequency. With the aid of the 25 kHz calibrator, the dial calibration can be zero'd in at any 25 kHz point on the dial.



156-018837

Figure 4-1. Front Panel View of FPM-300 MK II Transceiver.

4-5. REC. AUDIO/PULL CAL Control. This combination volume control and switch serves two functions. The REC. AUDIO control adjusts the audio output level from the speaker or headphones. Clockwise rotation of the control increases the audio output level. The switch portion of the control is activated by pulling the control knob away from the panel. The switch turns on the 25 kHz calibrator unit. The resulting 25 kHz marker signals appearing across the dial may then be used to zero out dial calibration errors at these points on the dial with the CAL control adjustment.

4-6. MODE Control. The MODE control is a four-position switch used to select the mode of transmission or reception. The control is set to LSB or USB for single side band operation, depending upon which side band is selected for voice communication. The control is set to TUNE when tuning the transmitter for CW or SSB operation, and to CW for code transmission.

4-7. FUNCTION Control. The FUNCTION control is a four-position switch used to select the transceiver function desired. In the REC position the receiver portion of the transceiver is placed in operation. In the STBY position the heater of the PA tube and driver tube are energized to place the transceiver in standby readiness for transmission as well as reception. PTT or VOX operation are inhibited in this position to avoid unintentional transmission. In the PTT position push-to-talk SSB operation is permitted, and in the VOX position voice control SSB is permitted and if CW is selected on the MODE control, automatic CW operation is permitted.

4-8. MIC/CW LEVEL Control. The MIC/CW LEVEL control adjusts the transmitter audio level to the modulator stage to control microphone sensitivity for SSB transmission and to control CW carrier level for the tune and CW operation modes.

4-9. BAND Selector. The BAND selector is an eight-position rotary switch used to select the desired operating frequency range. The panel markings refer to the low frequency limit (in megahertz) of that band.

4-10. PRE-SELECTOR Control. The PRE-SELECTOR control drives a three-section variable capacitor which tunes both receiver and transmitter circuits to a frequency within a given band. In the receive mode, the receiver antenna stage and mixer stage are tuned to frequency; while in the transmit mode, the control tunes the mixer, RF amplifier and driver stages to frequency. The segmented dial scale provides for an initial setting when changing bands.

For general receiver tuning, the control is adjusted for maximum receiver sensitivity; however, for transceiver operation, the control is adjusted for maximum transmitter output during transmitter tune-up and should always be left at this setting for the receive mode.

4-11. PA TUNE Control. The PA TUNE control drives a variable capacitor that tunes the pi-network used to couple the PA stage to the antenna load. The control is calibrated in band segments to permit presetting the capacitor near resonance when changing bands.

4-12. PA LOAD Control. The PA LOAD control drives a variable capacitor that provides a small load adjustment for the final amplifier stage. For nominal 50-ohm antenna loads the control will set near mid-position. Turning the control counterclockwise decreases the loading on the final and clockwise increases the loading.

SECTION V
TUNING PROCEDURE

5-1. GENERAL. The operating procedure for the FPM-300 Transceiver is not complicated; however, normal care should be exercised when operating the equipment to realize the true performance designed into the equipment. Before applying power to the equipment for the first time, recheck the critical items of the installation.

- Is the station antenna system connected and compatible with the load impedance requirements of the transceiver?
- Is the supply cable between the transceiver and the power source in place and is the power transformer primary strapping correct for the AC supply voltage? If the installation is mobile, are the primary power leads correctly connected to the DC power source?

NOTE

Before operating the transmitter portion of the transceiver, the bias adjustment control (R112) must be set for correct idle plate current. Refer to the basic transmitter tune-up procedure (paragraph 5-4C).

5-2. RECEIVER OPERATION. The transmitter group of controls, not specifically mentioned below, have no direct bearing on receiver operation and may be disregarded for receiver operation.

A. Preset the front panel controls as follows:

REC. GAIN/PWR OFF. . . . . PWR OFF
CAL. . . . . Center white mark
REC. AUDIO/PULL CAL. . . . As required (knob pushed in)
MODE . . . . . USB or LSB as desired
FUNCTION . . . . . Set at REC.
PRE-SELECTOR . . . Set at band segment in use
BAND. . . . . Set at desired band

B. Set the REC. GAIN/PWR OFF control fully clockwise. The dial and meter faces on the transceiver will be illuminated. The receiver should become operational immediately as all circuits are transistorized in this mode of operation.

C. Use of the PRE-SELECTOR control - As the receiver is tuned across the band, an occasional readjustment of the PRE-SELECTOR control is necessary. Always adjust the control for maximum "S" meter reading on signal or for maximum background noise without signals present. When the PRE-SELECTOR control has been set during transmitter tune-up on the frequency, the control must remain at that setting for the receiver mode. The exact setting is more critical for transmitter operation than for reception.

D. Use of the REC. GAIN control - Normally, the REC. GAIN control is set fully clockwise to obtain full Automatic Gain Control (AGC) action for uniform speaker output while tuning in stations of varying signal strengths across the band. While AGC is customarily employed for SSB reception, AGC may also be used to advantage for CW code reception. The control must be set at the fully clockwise position to obtain normal "S" meter readings. The operator will notice, however, that the "S" meter deflection falls off on signal as the REC. GAIN control is rotated counterclockwise from its maximum setting. Manual control of the receiver sensitivity, at times, is desirable, and the operator may set the REC. GAIN control as required for these occasions.

5-3. DIAL CALIBRATION.

A. Preset the front panel controls as follows:

REC.GAIN/PWR OFF . . . . . .Fully clockwise
CAL . . . . . .Center white mark
REC.AUDIO/PULL CAL . . . . . .Set REC.AUDIO fully counterclockwise, then pull knob out away from the front panel. Set REC.AUDIO control as required.
MODE . . . . . .USB or LSB as required
FUNCTION . . . . . .Set at REC
BAND . . . . . Set at desired band
PRESELECTOR. . . . . .Tune for maximum "S" meter deflection

B. To calibrate the dial for average accuracy over the entire amateur band, set the dial to the highest 100-kHz point on the band (4000 kHz on 80 meters, 7300 kHz on 40 meters, etc.). Set the MODE switch for the sideband used on the amateur band selected.

C. For better than average dial calibration accuracy, set the dial at the 25-kHz point on the dial nearest the desired frequency and leave the MODE switch set for the sideband in use.

D. Adjust the CAL control for zero beat. It may be necessary to advance the REC. AUDIO control setting to recover sufficient audio near zero beat. After calibrating the dial, switch the calibrator off. (Push the REC. AUDIO knob in toward the panel.)

5-4. BASIC TRANSMITTER TUNE-UP. The FPM-300 Transceiver can be tuned-up on several frequency segments that are outside the amateur bands. Care must be exercised not to transmit on these frequencies. The receiver group of controls, not specifically mentioned below, have no direct bearing on the transmitter tune-up procedures and may be disregarded for transmitter operation.

A. Preset the FPM-300 front panel controls as follows:

REC. GAIN/PWR OFF . . . Clockwise to actuate switch
MODE . . . . . LSB or USB as required
FUNCTION . . . . . STBY (tube heaters now energized)
MIC/CW LEVEL . . . . . Fully counterclockwise
BAND . . . . . Set at desired band
PRESELECTOR . . . . Set at band segment in use
PA TUNE . . . . . Set at band segment in use
PA LOAD . . . . . Set at 5
Tuning Control . . . . . Set to frequency

WARNING

When the top cover of the transceiver is raised, high voltage is present at the power connector and at the tube socket for the power amplifier tube.

B. If the tranceiver's FUNCTION control has just been set at STBY, allow a few minutes for the driver and final stage tubes to reach operating temperature before proceeding with the transmitter tune-up.

C. Set the FUNCTION control to PTT and press the push-to-talk switch on the microphone. The idle plate current of the final amplifier stage should indicate on the meter at the reference line marked IDLE PLATE MA. If the meter indicates considerably above or below the 40 milliampere mark, release the microphone button and set the idle plate current as follows:

1. Release the two cabinet cover hold down hasps and raise the hinged cover to gain access to the bias adjustment control located in the final amplifier compartment.

2. Use a 5-inch screwdriver or insulated tool having a 1/8-inch wide blade and insert it through the perforated compartment cover and engage the screwdriver slot of the bias adjustment control (R112).

3. With the MODE control at LSB or USB and the MIC/CW LEVEL control fully counterclockwise press the microphone button and adjust the bias control for 40 milliamperes (IDLE reference on the meter scale). Remove the adjustment tool and close and latch the cabinet cover.

D. Set the MODE control at TUNE and check to see that the final amplifier PA TUNE and PA LOAD controls are preset as outlined in paragraph 5-4A. Watching the meter, turn the MIC/CW LEVEL control clockwise slowly until the plate current rises to about 150 milliamperes. Adjust the PA TUNE control first, tuning for plate current dip. Then adjust the PRESELECTOR control for maximum plate current. Keep the plate current at approximately 150 milliamperes by readjusting the MIC/CW LEVEL control when necessary. If the MIC/CW LEVEL control is advanced too far the PRESELECTOR control adjustment will be broad and not well defined. The driver and final amplifier stages are now resonant, but the final amplifier stage requires a loading check and possible adjustment.

E. PRESET LOADING. When operating the transceiver into a 50-ohm antenna load having a reasonable VSWR (less than 2 to 1) the PA LOAD control may be pre-set as follows with excellent results.

1. On the 40, 20 and 15 meter bands, pre-set the control at 5.

2. On the 80 and 10 meter bands which cover a relatively large frequency range as a percentage of the operating frequency, start with the PA LOAD control set at 5 when operating at the mid-band frequency, and move the PA LOAD control setting toward 1 as the frequency of operation moves toward the low frequency end of the band. Conversely, move the PA LOAD control setting toward 10 as the operating frequency is shifted toward the high frequency end of the band. After any PA LOAD control setting change, the PA TUNE control must be adjusted for the dip in plate current with the MODE control at TUNE and the MIC/CW LEVEL control set for a plate current of 150 to 200 milliamperes.

NOTE

During the next step of the transmitter tuning procedure, the final amplifier tube operates at its highest plate dissipation The plate dissipation at this time is higher than for continuous operation on either SSB or CW at full power output. For this reason, it is recommended that full carrier power be applied only for the length of time needed to evaluate the loading adjustment. DO NOT APPLY FULL POWER WHEN TUNING FOR MORE THAN 30 SECONDS AT A TIME.

F. LOADING ADJUSTMENT WITH VSWR BRIDGE. If the station is equipped with a VSWR bridge a more precise method of loading the final amplifier is possible.

1. Follow the tuning procedure in paragraph 5-4D to obtain an average loading condition.

2. Set the MODE control at CW and the FUNCTION control at VOX. Set the VSWR bridge for forward metering.

3. Close the key circuit and adjust the MIC/CW LEVEL control for 250-300 milliamperes plate current. Vary the PA LOAD control for the maximum forward VSWR bridge meter reading. Retune the PA TUNE control as the loading adjustment is changed to maintain resonance. Open the key occasionally, if the adjustment is not accomplished in approximately 30 seconds, to avoid excessive heating of the final amplifier tube. Opening the key circuit returns the transceiver to the receive state.

5-5. CW OPERATION

A. Before keying the transceiver, make sure the following controls have been correctly set for CW operation:

MODE ..... Set at CW
FUNCTION ..... Set at VOX
BAND ..... Set at desired band
Tuning Control ..... Set to desired frequency
PRESELECTOR ... Adjusted per paragraph 5-4
PA TUNE ..... Adjusted per paragraph 5-4
PA LOAD ..... Adjusted per paragraph 5-4
MIC/CW LEVEL .. Set fully counterclockwise

B. Assuming that the transmitter has been properly loaded and tuned to frequency, as described in the basic transmitter tune-up procedure, close the key. The plate current meter should indicate at the IDLE mark. Advance the MIC/CW LEVEL control until the plate current reaches 300 milliamperes maximum. Make one final adjustment of the PA TUNE control for plate current dip to be sure the final is tuned to resonance. Make this adjustment a habit; tubes last longer, and a cleaner output signal is obtained.

C. With the key open the receiver continues to operate until the key is again closed. Open the key and observe the delay before the receiver is again active. This delay time may be set as desired with the yellow DELAY control (R263) located on the plug-in 9 MHz Function Module inside the cabinet (figure 8-1). The delay period increases as the DELAY control is turned CCW.

D. The FPM-300 Transceiver also provides a CW side tone signal through the speaker or headphones, which is keyed along with the transmitter, for monitoring purposes.

NOTE

The side tone signal may be reduced in volume by substituting a higher value of resistance for R260 located on the 9 MHz Transceiver Function Module (see figure 7-5). The side tone signal may be disabled by cutting the S.T. jumper.

5-6. PUSH-TO-TALK SSB OPERATION.

A. Before closing the microphone's PTT button make sure the following controls have been correctly set for SSB operation.

MODE ..... Set at USB or LSB, as required
FUNCTION ..... Set at PTT
BAND ..... Set at desired band
Tuning Control ..... Set to desired frequency
PRESELECTOR. . . . Adjusted per paragraph 5-4
PA TUNE ..... Adjusted per paragraph 5-4
PA LOAD ..... Adjusted per paragraph 5-4
MIC/CW LEVEL .. Set fully counterclockwise

B. Assuming that the transmitter has been properly loaded and tuned to frequency as described in the basic transmitter tune-up procedure, press the microphone push-to-talk switch. The plate current meter indicates idle plate current at this time. Speak into the microphone at a normal voice level and advance the MIC/CW LEVEL control until the plate current meter on the transceiver panel begins to kick up to about 100 to 150 milliamperes on voice peaks. This is the correct working level. The microphone gain control setting is less critical because of the compression action of the speech compressor and the AALC circuitry; however, the actual control setting still depends upon the type of microphone, the operator's voice characteristics and operating habits. Sufficient microphone gain is built into the FPM-300 Transceiver to handle the usual range of levels associated with communication type microphones. Do not attempt to judge PEP input by observation of plate current as meter damping allows current peaks of only 100 to 150 milliamperes to indicate on the meter

when running full input power. Higher readings would simply indicate increased distortion, not useful power output.

C. Release the microphone switch button. The transceiver returns to the receive function. The meter on the transceiver now monitors the strength of the incoming signals in the usual "S" units of measurement; S-9 represents approximately a 50-microvolt signal. To obtain a calibrated "S" meter reading the REC. GAIN control must be set fully clockwise.

5-7. VOICE CONTROLLED SSB OPERATION. The operating procedure outlined for basic transmitter tune-up (paragraph 5-4) and push-to-talk sideband (paragraph 5-6) also apply for voice controlled, single-sideband operation. The following adjustments, therefore, are intended to apply only to the adjustment of the VOX control system.

A. To avoid unintentional transmission while adjusting the VOX system controls, set the MIC/CW LEVEL control fully counterclockwise.

B. To gain access to the VOX controls, loosen the two cabinet cover hasps and raise the cabinet cover. The controls are located on the vertically mounted PC board.

C. Set the FUNCTION control at VOX and the MODE control at either USB or LSB as required. Preset the red anti-TRIP control (R243) fully clockwise (figure 8-1).

D. The VOX sensitivity control has been factory set for approximately 5 millivolts microphone input to trip the control relay. If adjustment is required set the green VOX SENS control fully counterclockwise and while talking into the microphone, turn the control clockwise until the control relay closes on the first syllable of speech. The transceiver switches from the receive mode to the transmit mode when the relay closes. Use just enough VOX gain to accomplish the desired results. Advancing the control too far makes the system unstable and oversensitive to speaker feedback, and too little sensitivity creates a relatively high signal level at the antenna relay contacts when switching to the transmit mode.

E. Adjust the yellow DELAY control for the desired drop-out delay. The delay period increases as the DELAY control is turned counterclockwise. The delay period should be long enough to prevent changeover between words, but not long enough to miss the other operator's quick reply.

F. Set the REC. AUDIO control for the desired listening level and advance the red ANTI-TRIP control counterclockwise until the received signals do not actuate the control relay. Excessive anti-trip gain or a major increase in the established listening level may lock out the voice control system.

G. With the VOX controls adjusted, either method of control may be selected by setting the FUNCTION control at PTT for manual control or at VOX for voice control. To place the transmitter in operation, speak into the microphone and set the MIC/CW LEVEL control while observing the plate current meter (paragraph 5-6B).

H. Lower the cabinet cover and relock the hold-down hasps.

NOTE

Some microphones, equipped for push-to-talk control, have shorting contacts in the switch to disable the microphone element when the pushbutton is released. VOX operation is not feasible unless this circuitry is disconnected within the microphone. (Ref. Paragraph 3-5)

SECTION VI
THEORY OF OPERATION

6-1. GENERAL. The FPM-300 Transceiver consists of a single conversion receiver and transmitter in the signal path of the system. To achieve true, on frequency transceiver operation, the VFO, heterodyne crystal oscillator, and carrier frequency oscillator all contribute to the transmit and receive functions. Sideband selectivity for both transmit and receive is controlled by a six pole crystal lattice filter operating at 9 MHz. Bilateral circuitry in the RF amplifier stage and IF amplifier stage permits equal performance with fewer components and consequently a smaller size package is made available. The heterodyning frequency signal is generated by the VFO directly on the 80 meter band and indirectly by pre-mixing with the heterodyne crystal oscillator for the remaining bands. Refer to figure 6-1 for the block diagram of the system and figures 6-2 through 6-6 for schematic diagrams.

6-2. RECEIVER SECTION. The signal (f1) at the antenna connector is fed to the receiver RF amplifier stage (Q501) through the antenna relay (K102) located in the transmitter final amplifier section. The signal is amplified and fed to the signal frequency mixer (U501) where the signal is heterodyned to the IF amplifier frequency (f2). On 80 meters the IF frequency (f2) is equal to the sum of the signal frequency (f1) and the VFO, or injection frequency (f3). On all other bands, the IF frequency (f2) is the difference between the injection frequency (f3) and the signal frequency (f1). Since the VFO and the injection frequency (f3) vary with the signal frequency (f1), the resulting IF frequency is a 9 MHz fixed frequency at 8998.7 or 9001.5 kHz depending upon the sideband in use. The RF amplifier and mixer tuned circuits are selected by the BAND selector (S501 and S502) and tuned by the PRESELECTOR tuning control (C501A and C501B).

The IF signal (f2) generated by the mixer (U501) is amplified by the receiver IF amplifier (Q202) and fed to the crystal lattice filter (FL201). The receiver IF amplifier (Q202) shares the same tuned circuits (L201 and L202) and filter (FL201) as the transmitter IF amplifier (Q201) on a bilateral basis. The IF signal (f2) having passed through the crystal lattice filter, is further amplified by a second receiver IF amplifier stage (Q203) and then fed to an integrated circuit product detector (Z201) where it is demodulated to audio frequencies (f5).

The product detector (Z201) receives its demodulating injection signal X4 from the two carrier frequency crystal oscillators (Q412 and Q413). The two crystal oscillator frequencies, 8998.7 kHz and 9001.5 kHz, are also the crystal lattice filter (FL201) response frequencies 25 dB down the skirts of the filter. The correct frequency for USB or LSB reception is shown in the heterodyne system chart in figure 6-1.

Automatic gain control of the receiver is accomplished by generating a DC control voltage from the IF amplifier signal and applying it as a control bias to the receiver RF amplifier stage (Q501) and the two IF amplifier stages (Q202 and Q203). To generate the DC control voltage, the IF signal (f2) is amplified by the AVC amplifier (Q204), detected by the diode detector (D202) and again amplified at DC in the AVC amplifier (Q205).

The detected signal amplitude is controlled by the REC. AUDIO control (R101) and amplified to speaker level by pre-amplifier devices Q407, Q408 and Q409 and power amplifier devices Q410 and Q411. The speaker impedance is 8-ohms. The headphone output is taken directly from the speaker output, the speaker load being removed by a switch in the HEADPHONE jack when the headset plug is inserted.

6-3. TRANSMITTER SECTION. The audio frequency signal (f4) generated by the microphone is amplified by a two stage audio amplifier (Q210 and Q209) and fed to an audio compression amplifier (Z202). The threshold level of the compressor is controlled by the white COMPRESSION LEVEL ADJ (R245) which controls the gain of audio amplifier Q208. The processed transmitter audio (f4) is then fed to a ring modulator (D204, D205, D206 and D207) which modulates the selected USB or LSB carrier oscillator signal (X4) generated by one of the crystal oscillators (Q412 or Q413). The resulting double-sideband suppressed carrier signal (f2) near 9 MHz is amplified by the first 9 MHz transmitter IF amplifier (Q207).

The unwanted sideband of the double-sideband signal is attenuated by more than 50 dB as the signal passes through the crystal lattice filter (FL201); therefore, a single-sideband suppressed carrier signal results. The signal is blocked for the transmit function at both the receiver IF amplifier stages (Q202 and Q203) with bias voltage switching, and the signal proceeds to the signal frequency mixer U501.

At the signal frequency mixer (U501) the signal (f2) is heterodyned with the injection frequency (f3) to produce the final transmitter output signal frequency (f1). The output signal frequency (f1) is amplified by the transmitter amplifier (Q502), driver (V101) and final P.A. stage (V102) to obtain the desired power level.

The output signal is fed through the Pi network in the final amplifier stage to transform the tube impedance to the antenna transmission line impedance (50 ohms nominal), and also provide the required harmonic suppression. From the Pi network the signal passes through the antenna relay (K102) to the transmitter ANTENNA output connector.

6-4. METERING. The transceiver circuits are metered by one multipurpose meter in the FPM-300 Transceiver. The meter (M101) serves as an "S" meter while the transceiver is in the receive mode and as a plate current meter for the final amplifier tube when in the transmit mode.

In the receive mode the meter is energized by the "S" meter amplifier (Q206) through diode D211. The "S" meter amplifier samples the AVC voltage supplied by the AVC amplifier (Q205). The black "S" METER ADJ control (R228) sets the meter zero when the receiver is not receiving signals.

In the transmit mode, the meter reads the final amplifier cathode current by reading the voltage across the meter shunt resistors (R113 and R114) in the final amplifier cathode through the meter calibration resistor R115.

6-5. AALC SYSTEM. The amplified automatic level control (AALC) circuits are utilized only in the transmit mode. To properly employ the peak capability of the linear power amplifier, the stage must operate up to and slightly into the control grid current region and yet not overdrive into unwanted distortion known as "flat-topping".

AALC action goes into effect when transmitting single-sideband signals at peak levels where the control grid current begins to flow in the final tube (V102). The grid current pulses generate a small signal voltage across the resistance in R123 and BIAS ADJ control (R112). The signal voltage is amplified to usable levels by the SSB ALC amplifier (Q504) and rectified by diodes D503 and D504 in the ALC detector to become a varying DC bias voltage. The bias voltage drives the ALC control transistor Q503 which varies the gain of the transmitter amplifier (Q502) and 9 MHz transmitter IF amplifier stage (Q201) to reduce the stage gain as the ALC bias voltage decreases. The AGC action on the RF and IF amplifier stages makes the transition from the desired drive level to the overdrive level less critical, which results in a more stable and powerful signal.

6-6. VOX CONTROL. The FPM-300 Transceiver features automatic control of the receive-transmit changeover function for either SSB phone or CW code operation. For either mode of operation, the automatic control is utilized when the FUNCTION control is set at VOX. When operating SSB, the changeover from receive to transmit occurs with the first syllable spoken into the microphone. The audio signal (f4) is amplified by the first and second microphone amplifier stages (Q210 and Q209) and the integrated circuit Z202. The amplified audio signal (f4), with the sensitivity adjusted by the green VOX SENS control (R265), is converted to a negative going DC control voltage within the integrated circuit which is amplified by the relay control amplifiers (Q211 and Q301) to actuate control relay K101 and antenna relay K102. Closing these relays puts the transmitter on the air.

The delay resistors R262 and R263 (DELAY control) and the storage capacitor C248 determine the dropout time or delay available to keep the transmitter active between the spoken words by sustaining the negative DC control voltage supplied to the base of the relay amplifier transistor (Q211).

The sound from the speaker that reaches the microphone during reception would normally trigger the VOX relay. To avoid this condition, a sample of the receiver audio (f5) is taken from the receiver audio P.A. output and rectified by diodes D209 and D210 to produce a positive going DC anti-trip voltage. This potential, when adjusted for correct amplitude by the red ANTI-TRIP control (R243), cancels the negative going DC control voltage generated by the VOX amplifier stages. As a result, the relays do not close when the microphone picks up sound from the speaker. When the operator adds his voice to the system, the negative DC control voltage developed by the VOX amplifier stages increases and exceeds the established anti-trip potential, and the relays close as desired.

When operating with keyed CW, the changeover from the receive to the transmit mode of operation starts with the closing of the key.

The CW output of the transmitter is a keyed 1750 Hz tone generated by the tone oscillator (Q212). The audio tone (X6) is fed to the integrated circuit (Z202) in the same manner as the microphone output for SSB operation to produce the CW carrier signal. The audio tone (X6) is also fed to the receiver audio amplifier stages which are turned back on in transmit in the CW mode to supply the sidetone signal to the speaker or headset for monitoring purposes. The sidetone signal fed to the integrated circuit (Z202) also activates the VOX circuitry, as for SSB operation, to close the control relays.

The VOX delay circuits, for CW operation, hold the transceiver in the transmit mode between short breaks during CW keyings, but release the control relay for receiver operation at the end of transmission. The delay period for the CW control is adjusted, in the same manner as for SSB, by the yellow DELAY control (R263).

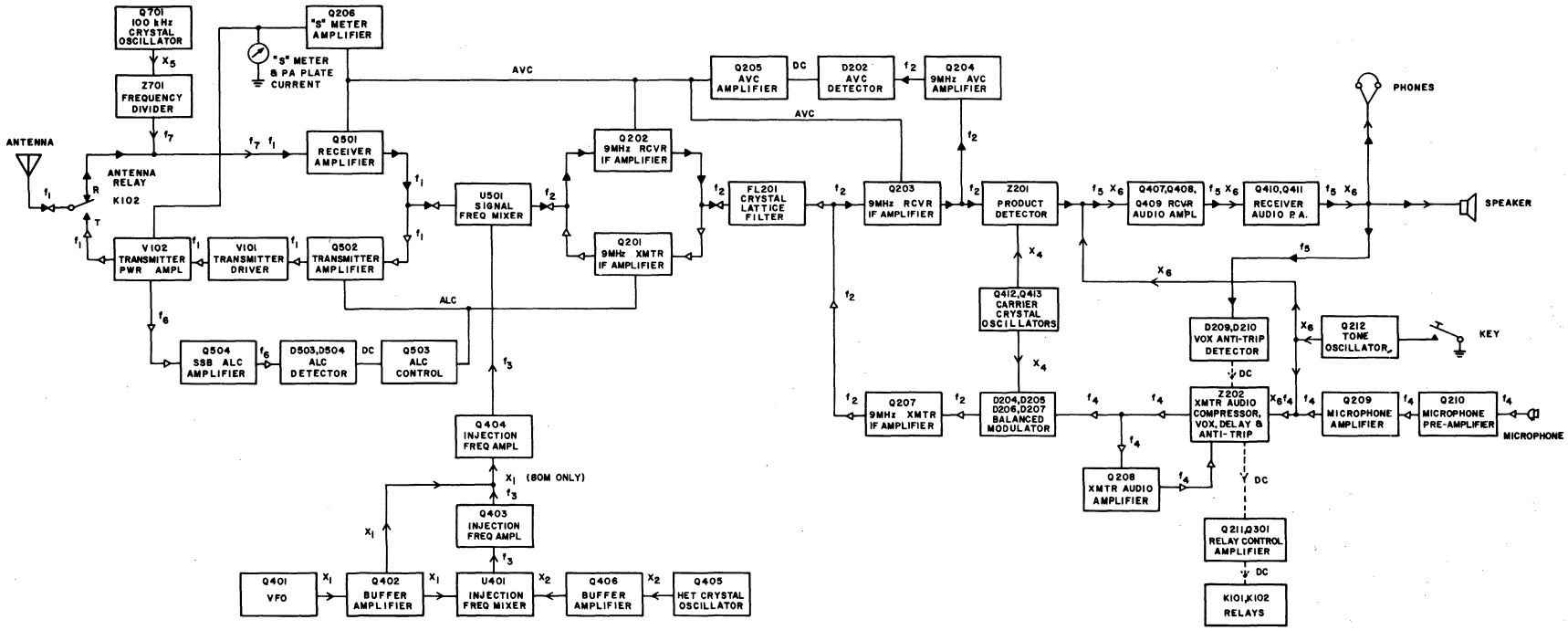


Figure 6-1. Block Diagram of Model FPM-300 MK II Transceiver.

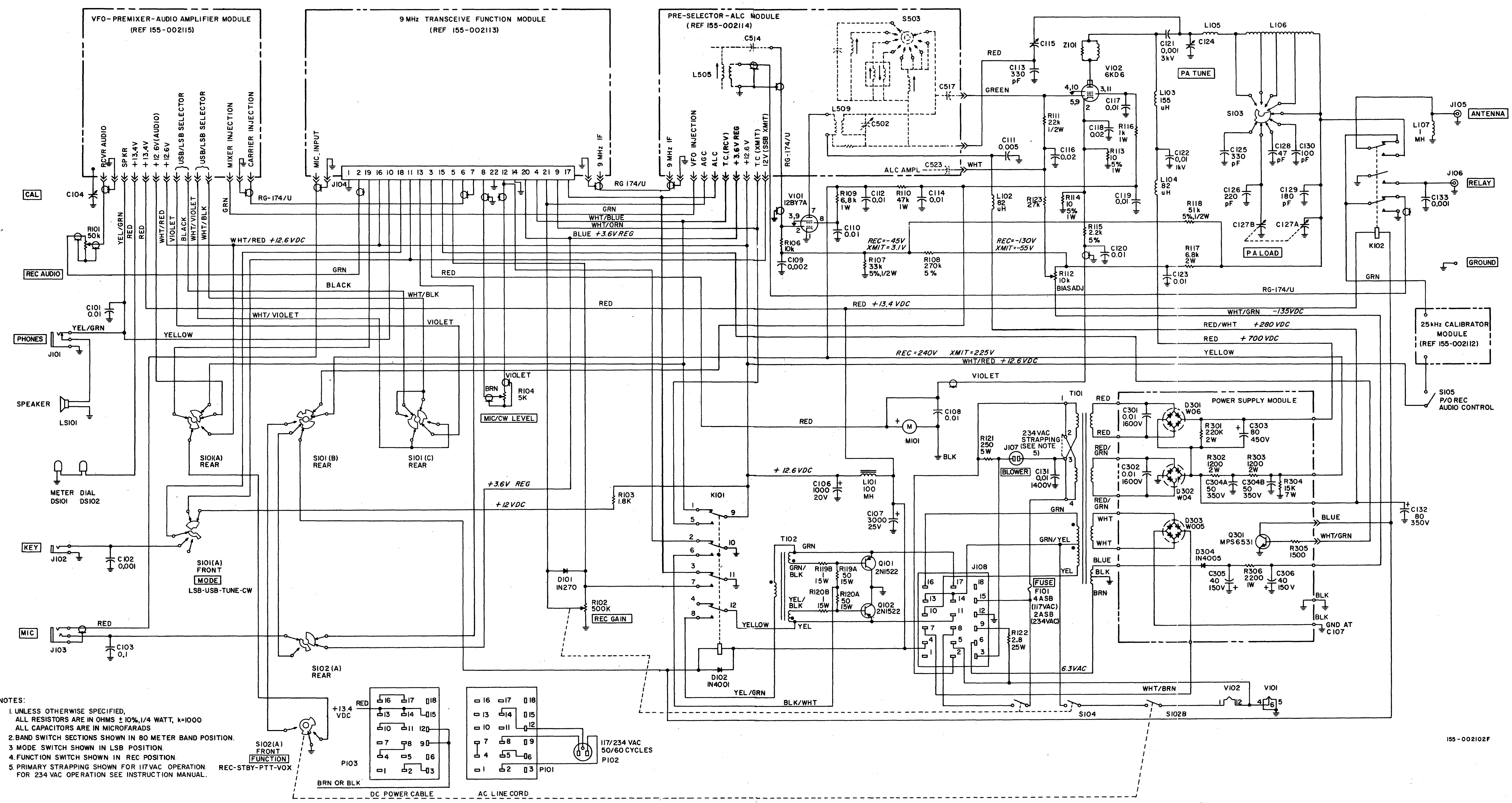
HETERODYNE SYSTEM						
BAND (METERS)	FREQUENCY f_1 (kHz)	HETERODYNE OSC X_2 (MHz)	INJECTION FREQ f_3 (KHz)	VFO X_1 (kHz)	CARRIER OSC X4 OR IF AMPL FREQ f_2 (kHz) UPPER SB	LOWER SB
80	3450	NONE	5550	5550	8998.700	9001.500
	4050		4950	4950		
40	6950	21.500	15950		9001.500	8998.700
	7550		16550			
20	13950	28.500	22950			
	14550		23550			
15	20950	35.500	29950			
	21550		30550			
10	27950	42.500	36950			
	28550		37550			
10	28450	43.000	37450			
	29050		38050			
10	28950	43.500	37950			
	29550		38550			
10	29450	44.000	38450			
	30050		39050			

SYMBOLS
f_1 = SIGNAL FREQUENCY (AMATEUR BANDS)
f_2 = IF FREQUENCY (9000 kHz NOMINAL)
f_3 = PRE-MIXER INJECTION FREQUENCY
f_4 = TRANSMITTER AUDIO
f_5 = RECEIVER AUDIO
f_6 = ALC AUDIO FREQUENCY
f_7 = 25 KHz CALIBRATOR FREQUENCY
X_1 = VFO (4950 TO 5550 kHz)
X_2 = HETERODYNE OSCILLATOR(7 CRYSTAL FREQUENCIES
X_3 = PRE-MIXED INJECTION
X_4 = CARRIER OSCILLATOR(2 CRYSTAL FREQUENCIES)
X_5 = 100KHz CALIBRATOR CRYSTAL OSCILLATOR
X_6 = TONE OSCILLATOR (1750 Hz)

SIGNAL PATH LEGEND
TRANSMITTER SIGNAL
RECEIVER SIGNAL
COMMON SIGNAL
OSCILLATOR OR INJECTION SIGNAL
VOX SIGNAL

MIXER FUNCTIONS		
MIXER	IN RECEIVE	IN TRANSMIT
U501	$f_1 + f_3 = f_2$ OUTPUT(80M ONLY)	$f_2 - f_3 = f_1$ OUTPUT (80M ONLY)
	$f_3 - f_1 = f_2$ OUTPUT	$f_3 - f_2 = f_1$ OUTPUT
U401	NON-OPERATIVE (80M ONLY)	NON-OPERATIVE (80M ONLY)
	$X_2 - X_1 = f_3$	$X_2 - X_1 = f_3$

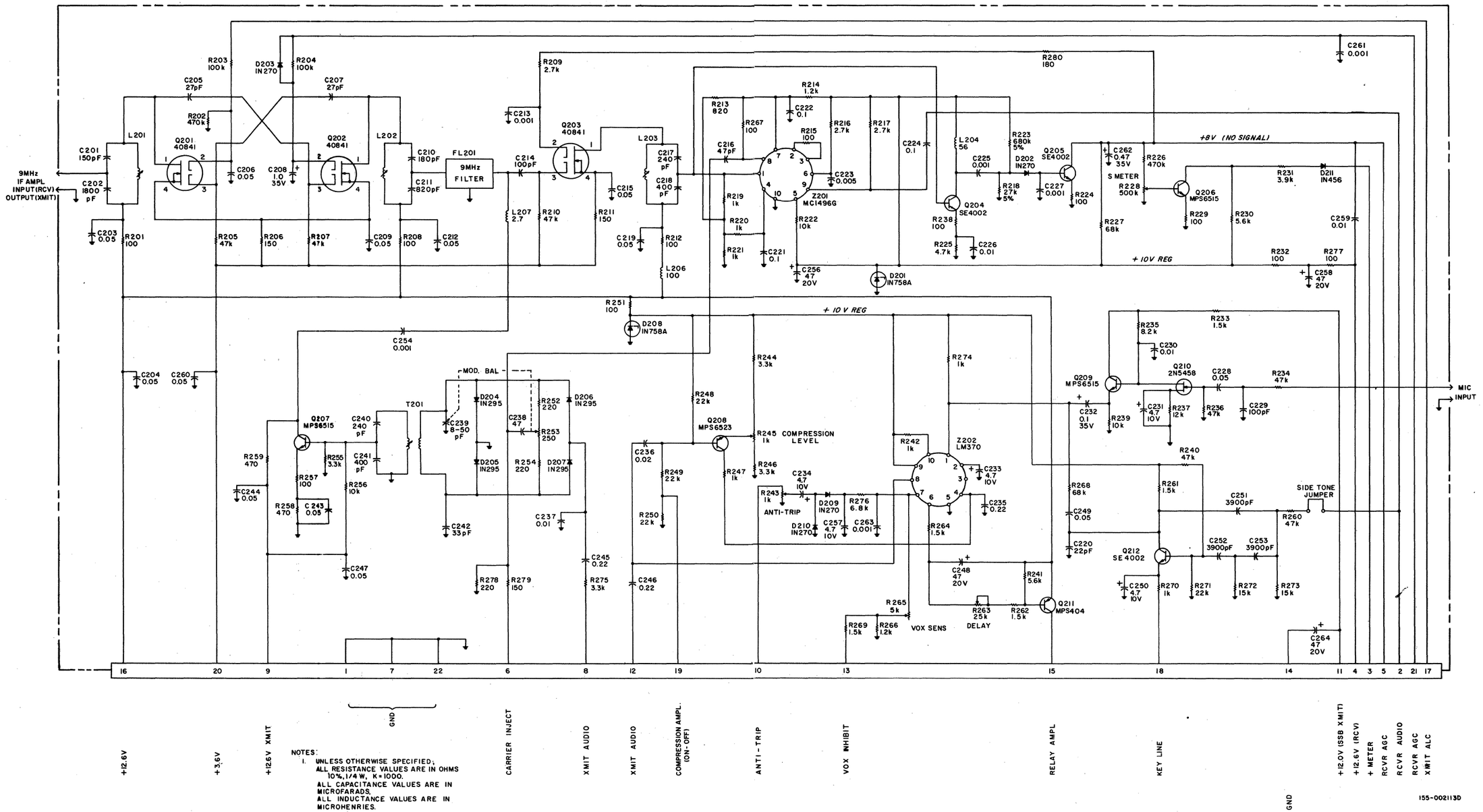
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NOTES:

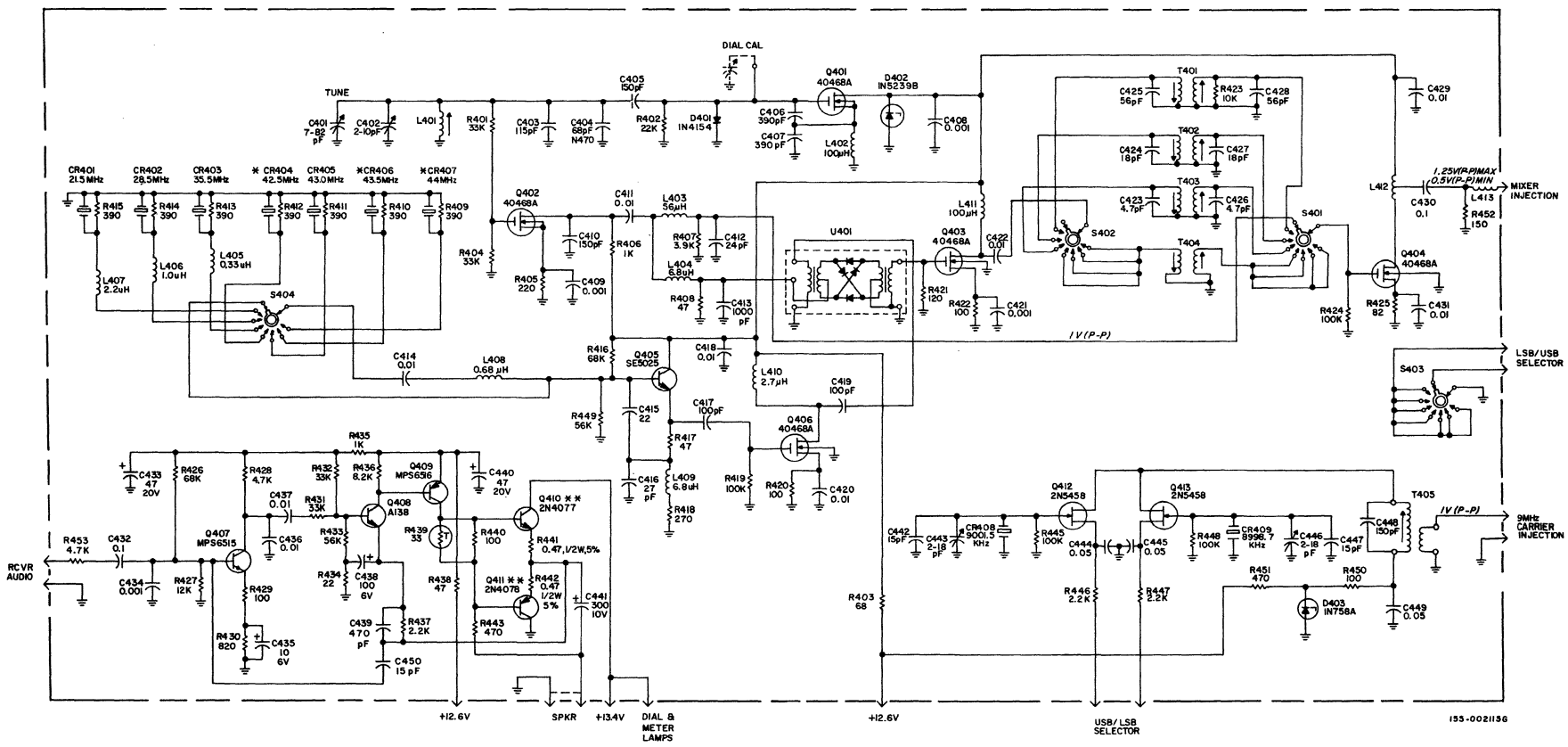
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS ± 10%, 1/4 WATT, k=1000 ALL CAPACITORS ARE IN MICROFARADS
2. BAND SWITCH SECTIONS SHOWN IN 80 METER BAND POSITION.
3. MODE SWITCH SHOWN IN LSB POSITION.
4. FUNCTION SWITCH SHOWN IN REC POSITION.
5. PRIMARY STRAPPING SHOWN FOR 117VAC OPERATION. FOR 234 VAC OPERATION SEE INSTRUCTION MANUAL.

Figure 6-2. Schematic Diagram, Model FPM-300 MK II Transceiver.



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS 10%, 1/4 W, K=1000. ALL CAPACITANCE VALUES ARE IN MICROFARADS. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

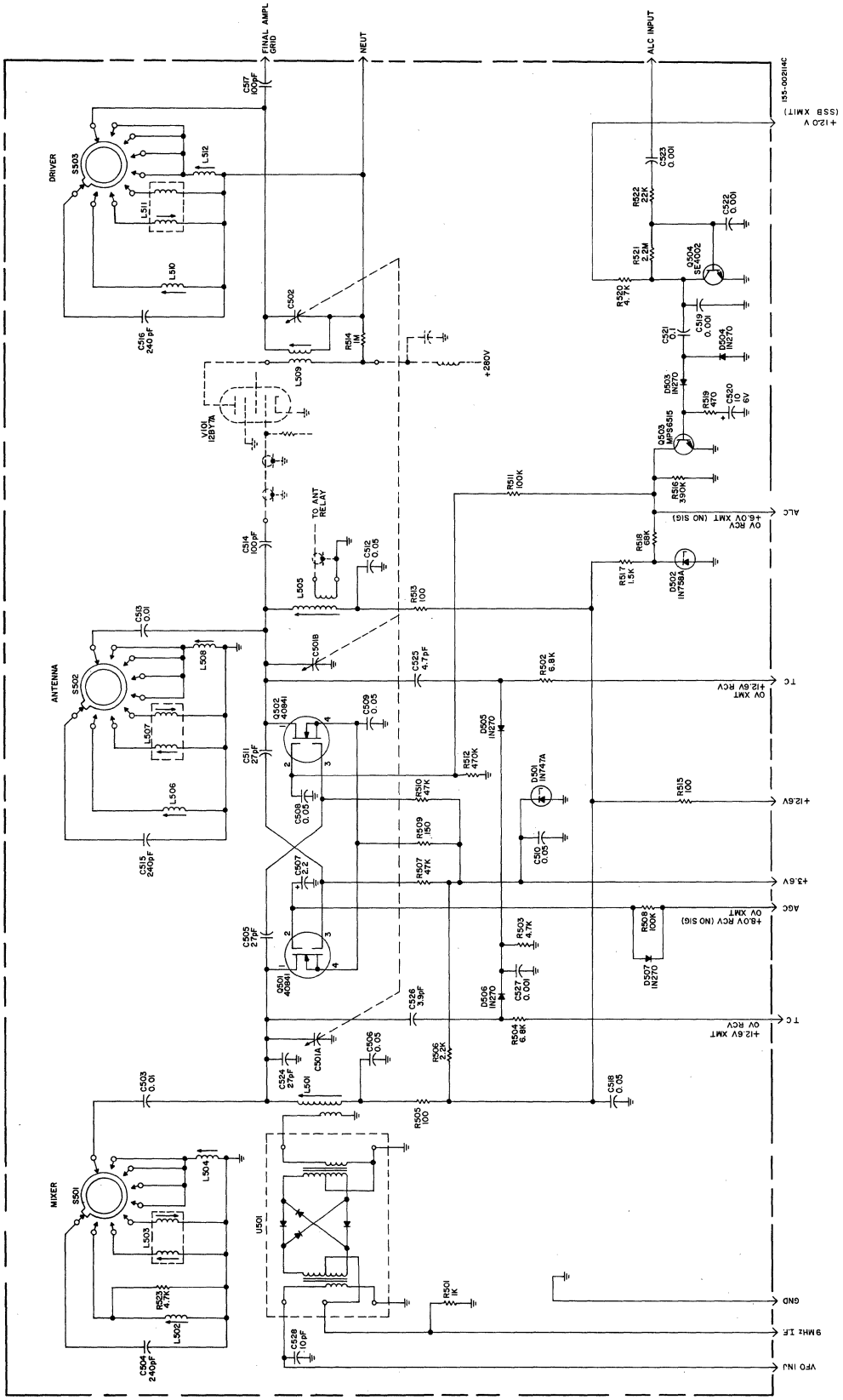
Figure 6-3. Schematic Diagram, 9 MHz Transceive Function Module.



NOTES:

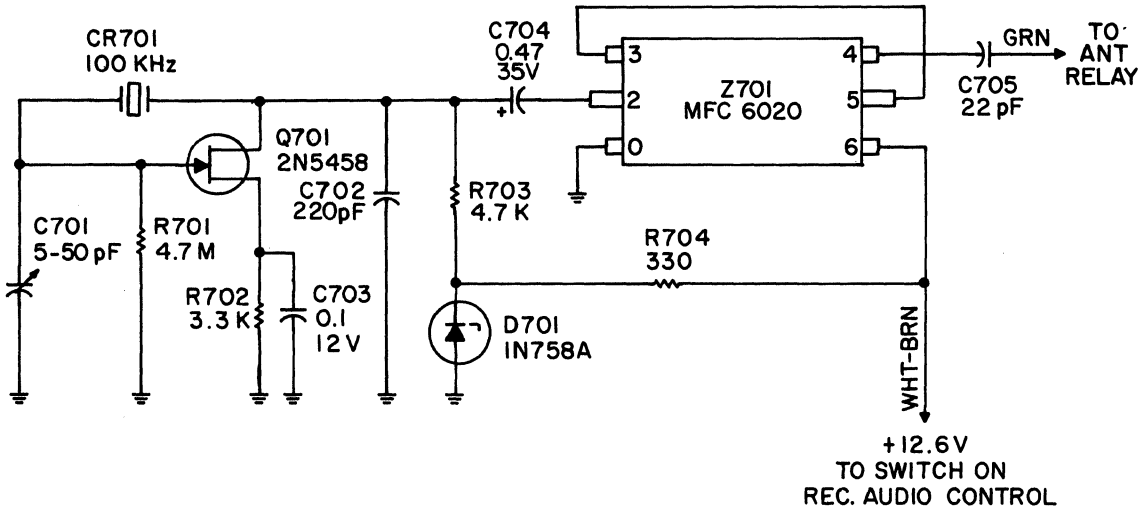
1. UNLESS OTHERWISE SPECIFIED:
   RESISTORS ARE IN OHMS, ±10%, 1/4 WATT, K=1000.
   CAPACITORS ARE IN MICROFARADS.
2. BAND SWITCH SECTIONS ARE SHOWN IN THE 80 METER BAND POSITION.
3. * PLUG-IN CRYSTALS FOR 10 METER BAND SEGMENTS AVAILABLE BUT NOT SUPPLIED.
4. * * TRANSISTORS Q410 AND Q411 ARE A MATCHED PAIR. (MATCHED PAIR CARRY TYPE NO. 2N4079).

Figure 6-4. Schematic Diagram, VFO/Pre-Mixer/Audio Amplifier Module.



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   RESISTORS ARE IN OHMS, ±10%, 1/4W, K=1000, M=MEGOHM.
   CAPACITORS ARE IN MICRO FARADS.
2. BAND SWITCH SECTIONS S502, S503, AND S503 ARE SHOWN IN THE 80 METER BAND POSITION.
3. PHANTOM COMPONENTS (DOTTED LINES) ARE CHASSIS MOUNTED.

Figure 6-5. Schematic Diagram, Pre-Selector/ALC Module.



NOTE:
UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, 1/4 WATT, K=1000, M=MEGOHM
ALL CAPACITORS ARE IN MICROFARADS.

155-002112B

Figure 6-6. Schematic Diagram, 25 kHz Calibrator Module.

SECTION VII
SERVICE DATA

7-1. COVER AND CHASSIS REMOVAL.

A. Cabinet Cover Removal. Release the two cabinet cover hold down hasps. Unsolder the speaker leads, and remove the two hinge screws and spacers to release the cabinet cover. When replacing the cover, use the longer spacer with the right hand hinge screw. Resolder the yellow-green speaker wire to the ungrounded terminal.

B. Bottom Cover Removal. Turn the transceiver bottom side up and release the two cover hold down hasps. Remove nine sheet metal screws retaining the bottom cover and lift cover clear. Note when replacing the bottom cover, use all mounting hardware as some screws serve as electrical grounds and are part of the RF shielding required for stable operation of the equipment.

C. Chassis Removal. Remove top and bottom covers as outlined in paragraphs A and B.

7-2. DIAL AND METER LAMP REPLACEMENT. The two lamps can be reached for replacement by releasing the cabinet hold down hasps and lifting the hinged cabinet cover. Replace dial and meter lamps with type 47 brown bead lamps only (150 milliampere 6.3V lamp).

7-3. FINAL AMPLIFIER TUBE REPLACEMENT. Access to the final amplifier tube is obtained by removing the cabinet cover as described in paragraph 7-1A and the final amplifier compartment cover, held in place with six screws. The tube may be removed after removing the plate clip and moving the parasitic suppressor to one side.

7-4. DRIVER AMPLIFIER TUBE REPLACEMENT. Access to the drive stage tube is obtained by removing the cabinet bottom as described in paragraph 7-1B. The tube shield contains a heat conducting wrapper which must be sandwiched in between the tube and shield to properly cool the tube.

7-5. TROUBLESHOOTING. When designing this transceiver, full consideration was given to keep maintenance problems at an absolute minimum; therefore, maintenance and repair problems are generally confined to the checking and replacement of tubes and semiconductor devices which are defective. Malfunctions of this nature are for the most part easily isolated and corrected. However, it is entirely possible that a more obscure malfunction may arise. In this event, only thoroughly trained technical personnel should attempt to service equipment of this complexity.

A recommended aid to troubleshooting the FPM-300 Transceiver is a general-coverage receiver which can be used to provide a quick check on the various oscillator circuits within the transceiver. A lead connected to the antenna of this receiver, when placed in the proximity of the oscillator circuit to be checked, determines the presence or absence of a signal from the stage in question.

If a malfunction occurs when operating on one particular band and/or mode of operation, the unit should be checked on all other bands and in all other modes of operation to isolate the difficulty. A careful study of the block diagram (figure 6-1) will give a quick clue as to which stages should be checked. The voltage and resistance charts (figures 7-3 and 7-4), schematic diagrams (figures 6-2 through 6-6) and component layout (figures 7-1, 7-2, 7-5 through 7-10) will also aid in isolating and correcting a malfunction.

7-6. SERVICE AND OPERATING QUESTIONS. For further information regarding operation or servicing of the FPM-300 Transceiver, contact the dealer from whom the unit was purchased. The Hallicrafters Co. maintains an extensive system of Authorized Service Centers where any required service is performed promptly and efficiently at no charge, if this equipment is delivered to the service center within 90 days from date of purchase by the original buyer and the defect falls within the terms of the warranty. It is necessary to present the bill of sale in order to establish warranty status. After the expiration of the warranty, repairs are made for a nominal charge. For the location of the one nearest you, consult your dealer or your local telephone directory.

Make no service shipments to the factory unless instructed to do so by letter, as The Hallicrafters Co. will not accept responsibility for unauthorized shipments.

The Hallicrafters Co. reserves the privilege of making revisions in current production of equipment, and assumes no obligation to incorporate such revisions in earlier models.

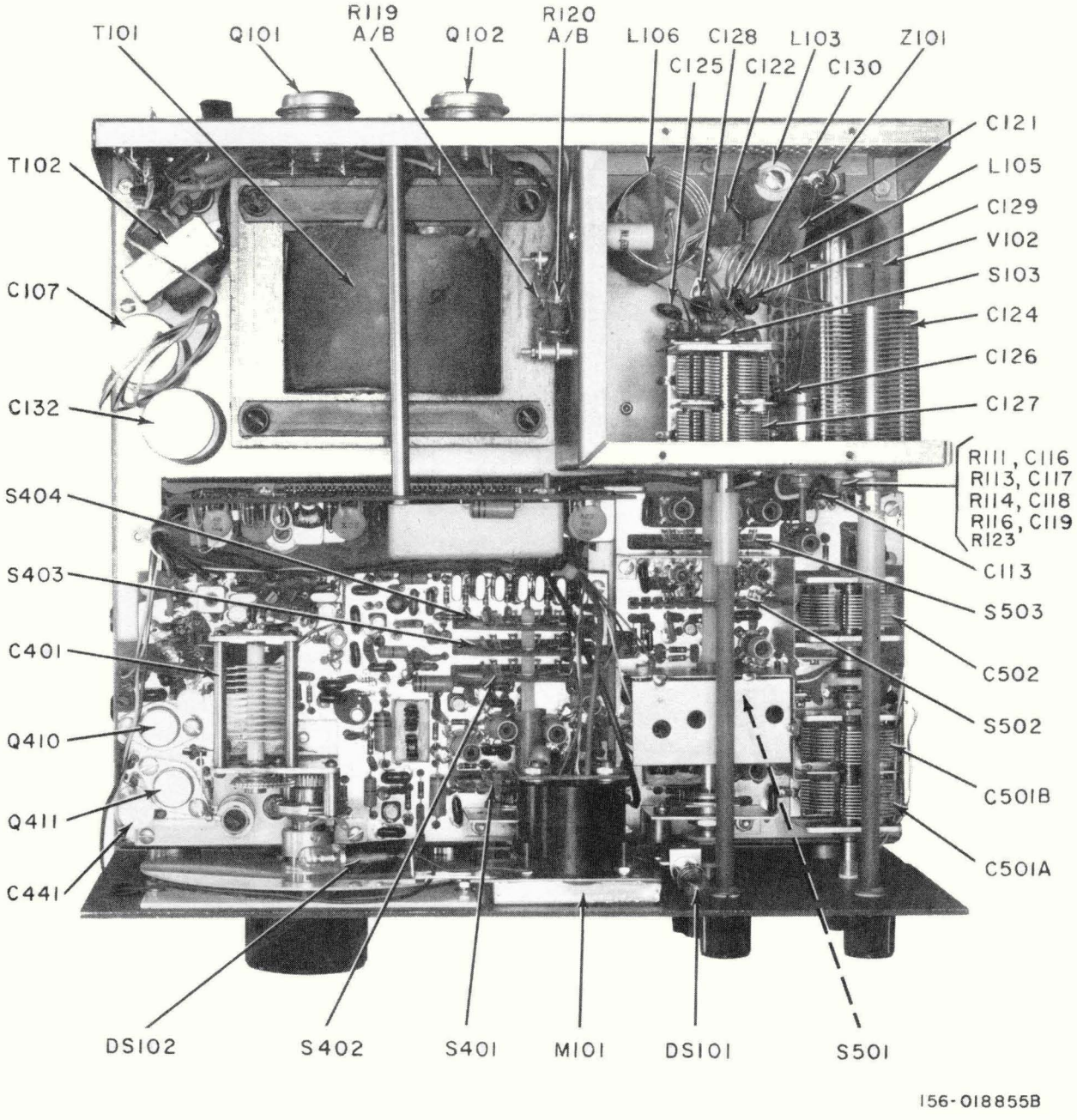
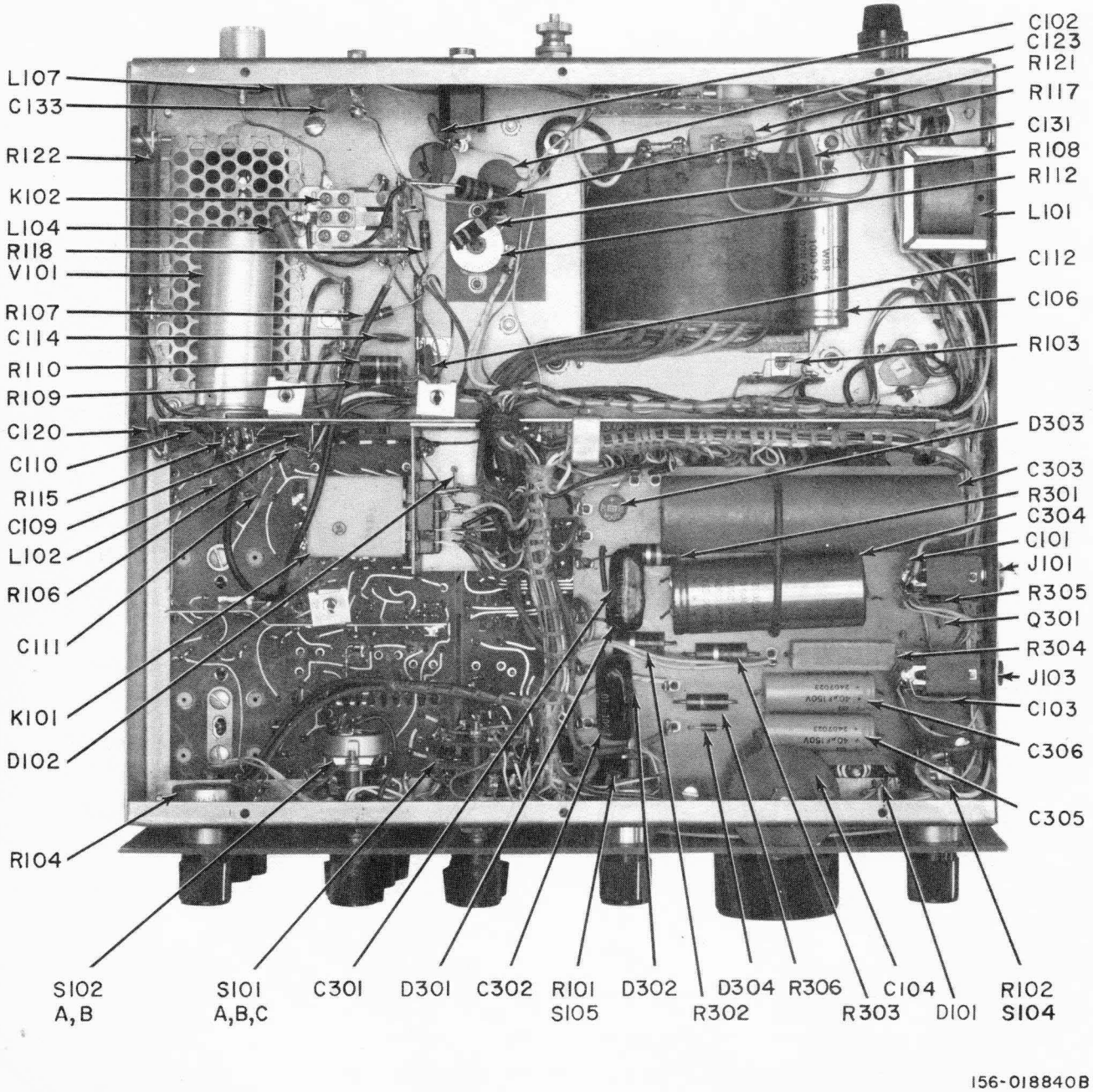
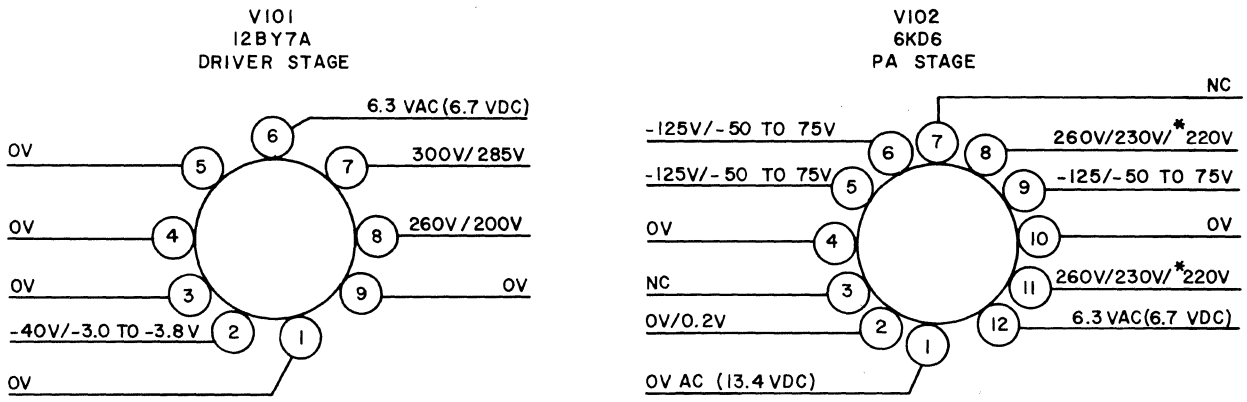


Figure 7-1. Component Locations, Top View.



156-018840B

Figure 7-2. Component Locations, Bottom View.

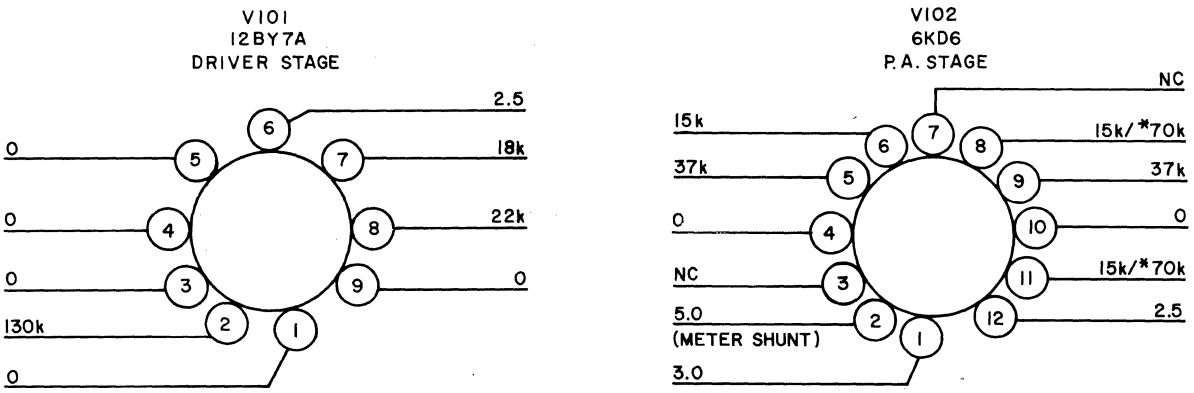


NOTES:

1 - SUPPLY VOLTAGE -120V OR 240V AC., 13.4 VDC.
2 - MEASUREMENT TAKEN FROM SOCKET PIN TO CHASSIS.
3 - VOLTAGES ARE POSITIVE DC UNLESS OTHERWISE SPECIFIED.
4 - VOLTAGES TAKEN WITH ELECTRONIC TYPE VOLTMETER. ALL READINGS EXCEPT GRID VOLTAGES MAY BE OBTAINED WITH 20,000 OHM/VOLTMETER.
5 - NC = NO CONNECTION (CAUTION - CIRCUIT VOLTAGE APPEARS ON SOME UNUSED PINS.)
6 - UNLESS OTHERWISE SPECIFIED, THE FIRST VOLTAGE LISTED IS FOR RECEIVE CONDITION AND THE SECOND VOLTAGE IS FOR TRANSMIT (NO SIGNAL)
7 - DATA SHOWN FOR FOLLOWING CONTROL SETTINGS:
MODE ——— USB OR LSB
FUNCTION — PTT
*MODE ——— TUNE
MIC/CW LEVEL—FULL CCW

156-018874

Figure 7-3. Voltage Chart.



NOTES:

1 - RESISTANCE MEASUREMENTS MADE WITH POWER CORD DISCONNECTED.
2 - ALL MEASUREMENTS ARE MADE FROM TUBE SOCKET PIN TO CHASSIS. READINGS LESS THAN ONE OHM ARE SHOWN AS ZERO. k=1000
3 - NC = NO CONNECTION.
4 - UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE SHOWN FOR THE FOLLOWING CONTROL SETTINGS.
MODE ——— USB OR LSB.
FUNCTION — PTT
* MODE ——— TUNE

156-018873

Figure 7-4. Resistance Chart.

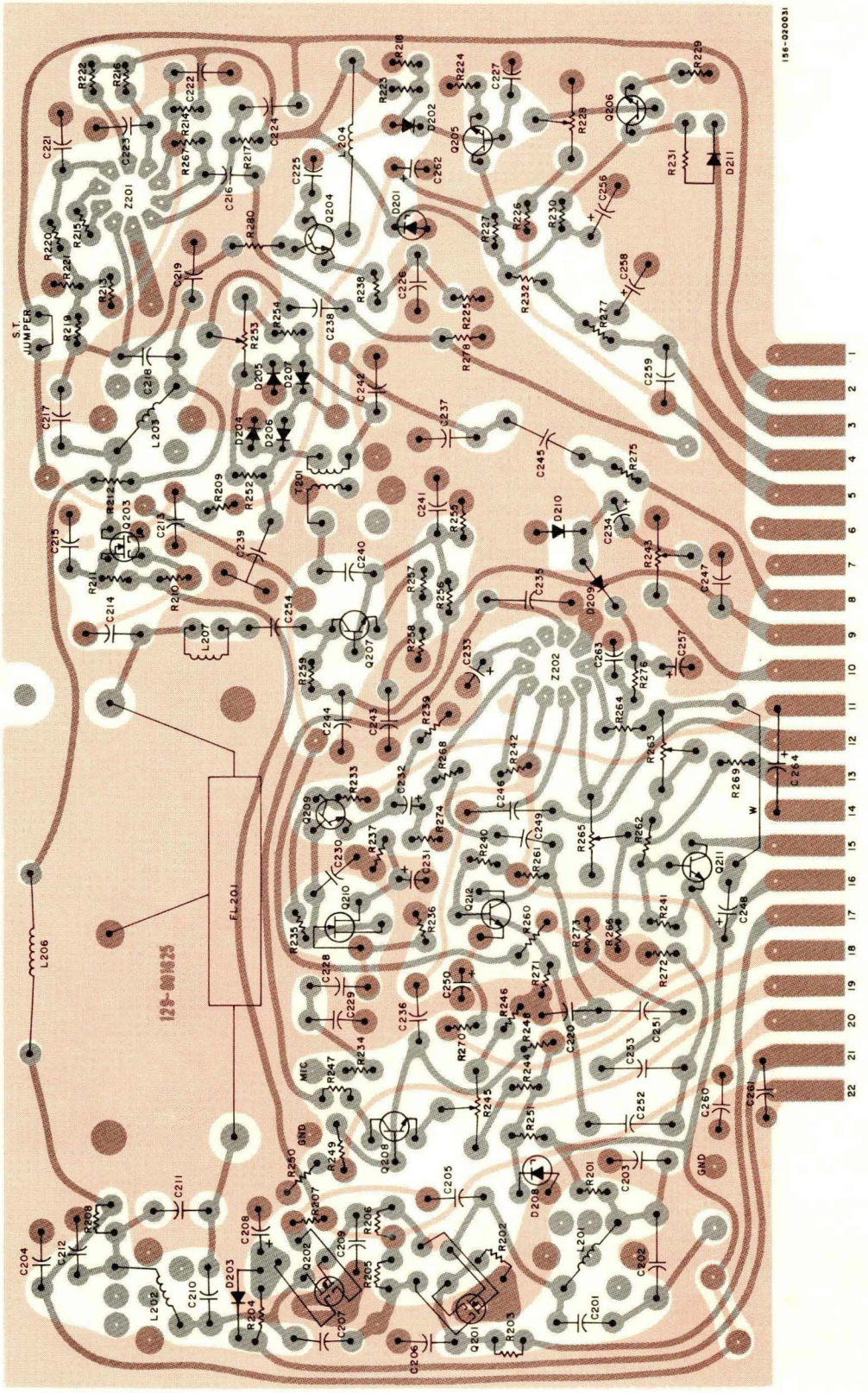


Figure 7-5. Component Layout, 9 MHz Transceive Function Module.

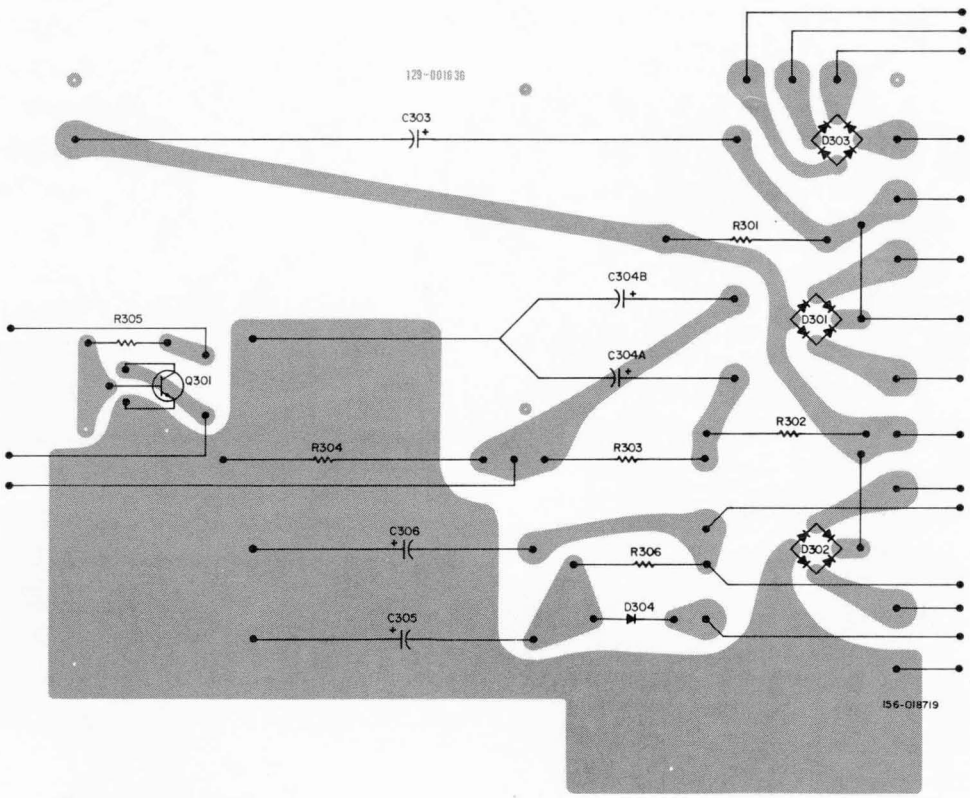


Figure 7-6. Component Layout, Power Supply Module.

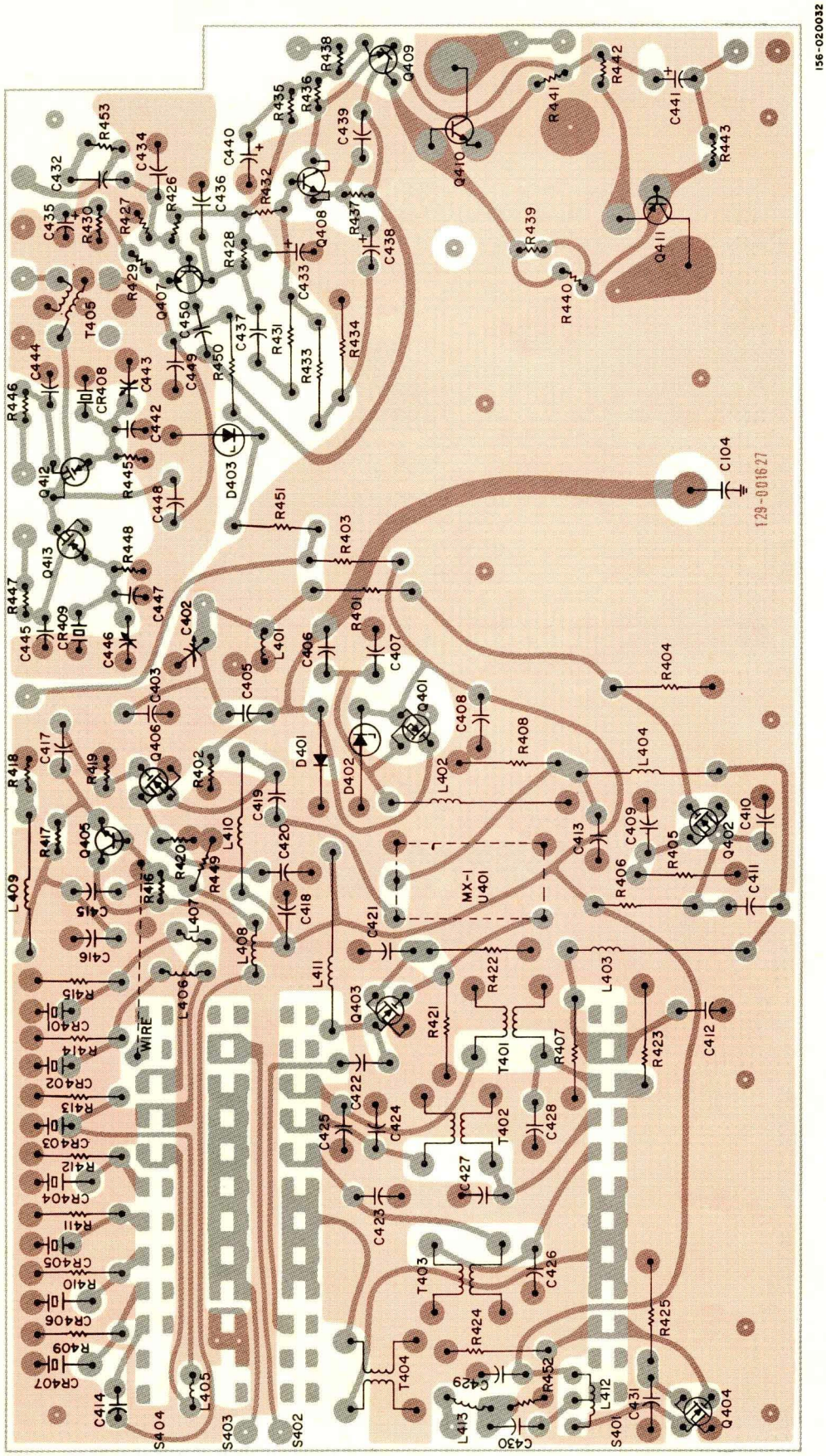


Figure 7-7. Component Layout, VFO/Pre-Mixer/Audio Amplifier Module.

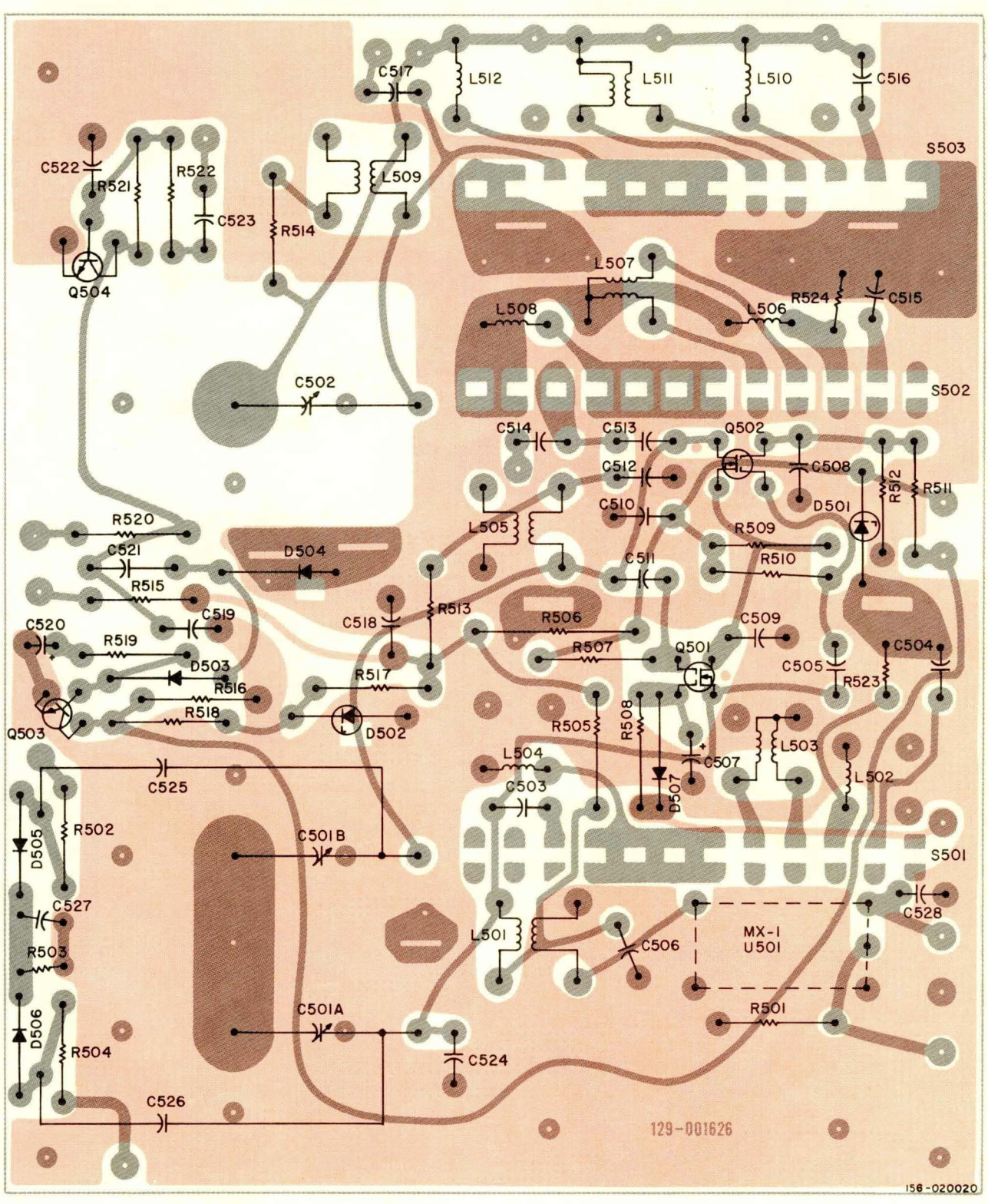


Figure 7-8. Component Layout, Pre-Selector/ALC Module.

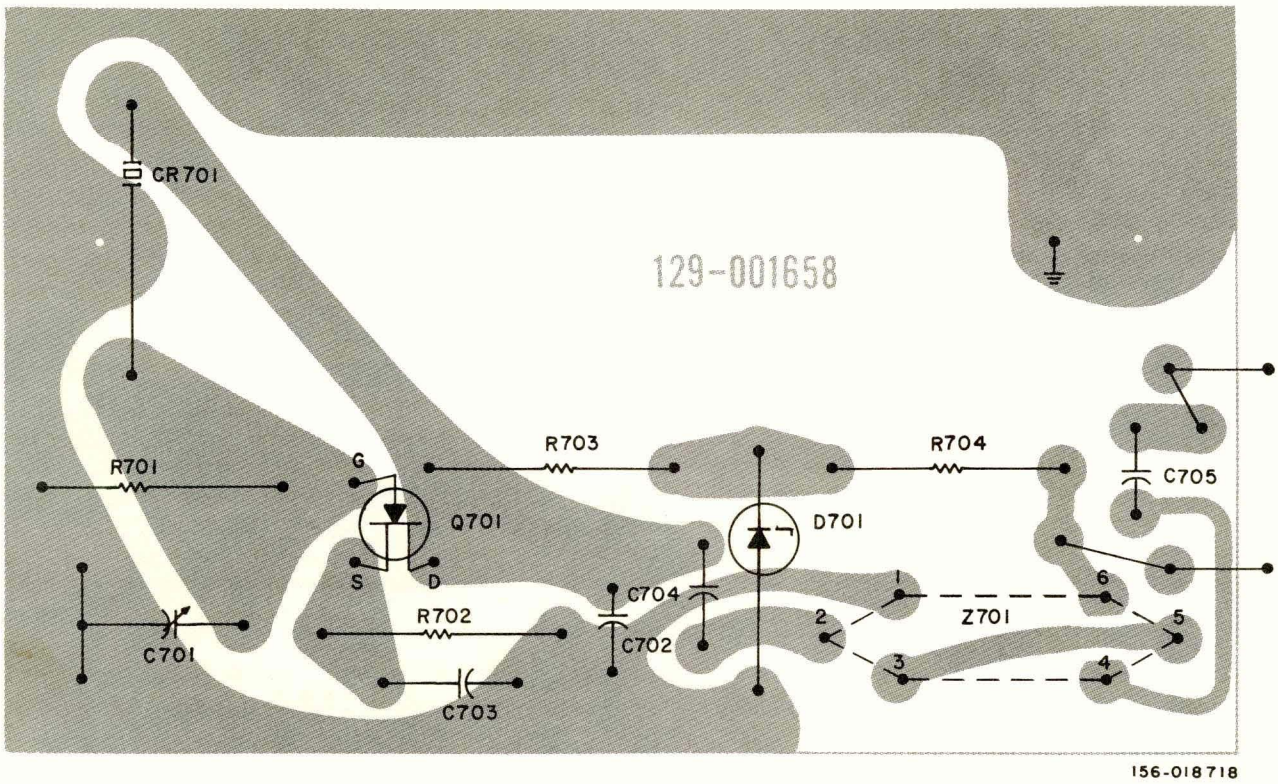


Figure 7-9. Component Layout, 25 kHz Calibrator Module.

SECTION VIII
ALIGNMENT PROCEDURE

8-1. GENERAL. The FPM-300 Transceiver has been carefully aligned and tested at the factory and with normal usage, should not require other than the usual attention given to electronic equipment. Service or replacement of a major component or circuit may require subsequent realignment, but under no circumstances should realignment be attempted unless the malfunction has been analyzed and definitely determined as misalignment. Service work should be performed by persons experienced in this work, using the proper test equipment.

CAUTION

Never operate the FPM-300 Transceiver as a transmitter without a matched antenna or adequate dummy load termination. Illuminating lamps will not present a constant load impedance. The power amplifier tube and Pi network components can be damaged if the equipment is operated as a transmitter unloaded.

WARNING

THE VOLTAGES USED IN THE FPM-300 TRANSCEIVER ARE LETHAL. AVOID UNNECESSARY EXPOSURE TO HIGH VOLTAGE CIRCUITS WHEN MAKING CIRCUIT ADJUSTMENTS OR VOLTAGE CHECKS. SERIOUS RADIO FREQUENCY BURNS WILL RESULT IF THE PLATE OR ANTENNA OUTPUT ENDS OF THE FINAL AMPLIFIER Pi NETWORK ARE CONTACTED WHILE TRANSMITTING.

NOTE

Do not make any adjustments unless the operation of the transceiver is fully understood and adequate test equipment is available. Refer to figure 8-1 for the location of all alignment adjustments.

8-2. EQUIPMENT REQUIRED. The following equipment is required for the proper alignment of the FPM-300 Transceiver.

- RF Signal Generator; Hewlett-Packard Model 606A, or equivalent, having up to 1 volt output at an impedance of 50 to 70 ohms and a frequency coverage to 30 MHz.
- A Vacuum Tube Voltmeter (VTVM); Hewlett-Packard Model 410B, or equivalent, having an RF probe good to 40 MHz.
- A dummy load; 50 ohms non-reactive; rated at 250 watts average power. Bird wattmeter or equivalent.
- AF Signal Generator; Hewlett-Packard Model 200 AB, or equivalent.
- AF Voltmeter; Ballantine Model 300, or equivalent, capable of measuring 1- to 10-millivolt levels.
- A general coverage receiver covering the frequency range from 3 to 30 MHz with a 100 kHz calibrator.

8-3. METER ZERO AND BIAS ADJUSTMENT. The final amplifier bias must be checked and, if necessary, set before any extensive checks are made on the transmitter portion of the FPM-300 Transceiver. Correctly setting the bias ensures normal plate dissipation for the final amplifier and driver tubes. Adjust the BIAS ADJ control (R112) located on the chassis deck inside the power amplifier compartment as follows:

A. Preset the following controls as indicated:

MODE . . . . . USB or LSB
FUNCTION . . . . . PTT
MIC/CW LEVEL . . . . . .Fully counterclockwise

B. Rotate the REC. GAIN control beyond the power switch action point and allow the transceiver tubes sufficient time to reach operating temperature.

C. Disconnect the antenna to obtain zero signal input and check meter zero setting. If the pointer does not rest at the zero index mark, release the cabinet cover hasps, raise the cabinet cover and adjust the black S METER ADJ control (R228) located on the plug-in board for zero meter readings. Reconnect the antenna.

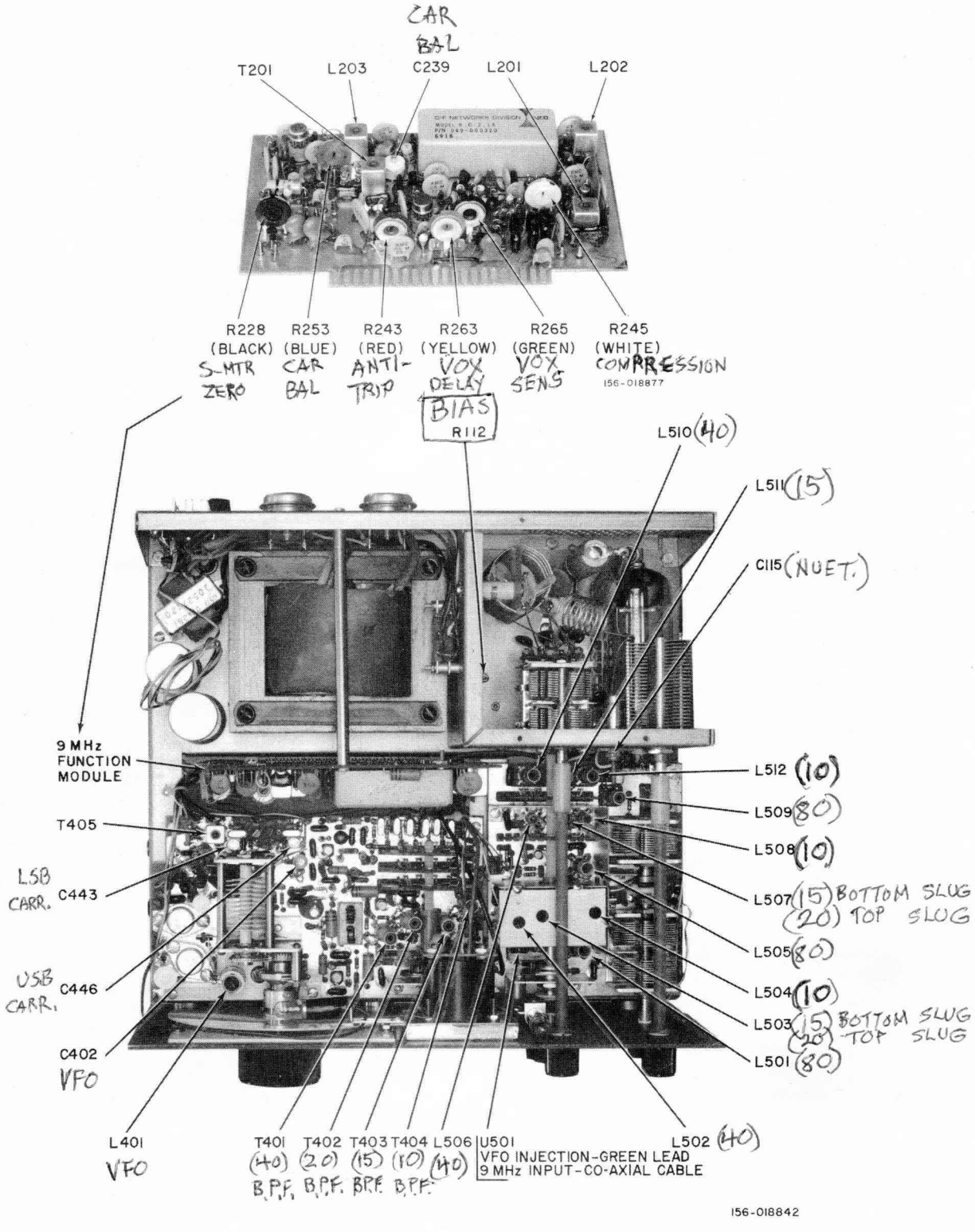


Figure 8-1. Alignment Adjustments.

D. Close the microphone push-to-talk button. The idle plate current of the final amplifier stage should cause the meter pointer to index with the IDLE mark on the meter scale, if the bias voltage is correct.

If the plate current indicates above or below the reference line, raise the cabinet cover and set the BIAS ADJ control (R112) (Screw driver adjustment) so that the pointer lines up with the reference mark. (40 milliamperes).

NOTE

The bias adjustment may be made without removing the perforated shield cover over the final compartment. Use an alignment screw driver or narrow blade (1/8-inch) screwdriver having a 5-inch long shank. Select a shield cover perforation directly over the adjustment control slot and insert the screwdriver blade in the control adjustment slot.

8-4. CARRIER BALANCE ADJUSTMENT. The transceiver should be allowed to reach operating temperature before making the carrier balance adjustment. Raise the cabinet cover (Release two cabinet hasps) to gain access to the carrier balance adjustments R253 (Blue) and C239.

A. Tune-up the transceiver for SSB operation using an antenna load or dummy load for the transmitter.

B. Set the MIC/CW LEVEL control fully counterclockwise to remove all audio from the modulator stage. With the MODE control set for either USB or LSB and the FUNCTION control set for PTT, close the microphone push-to-talk switch and adjust the carrier balance controls (Capacitor C239 and potentiometer R253) for minimum residual transmitter carrier output. A sensitive oscilloscope or VTVM RF probe connected across the 50-ohm antenna output of the transceiver or a general coverage receiver (equipped with "S" meter) may be used to monitor the carrier level for the adjustment. To obtain the optimum balance, adjust the balance controls for minimum carrier level while switching the MODE control between USB and LSB to obtain a good null for both sidebands.

8-5. CRYSTAL CALIBRATOR ADJUSTMENT. The crystal oscillator trimmer (C701) is used to warp the 100 kHz crystal exactly to frequency with the WWV signal as a reference. (See figure 3-1).

A. Set the FUNCTION control to REC., disconnect the antenna from the transceiver and interconnect the transceiver antenna output with the antenna terminal of a general coverage receiver.

B. Tune in WWV on the general coverage receiver with the receiver operating in the AM mode.

C. Pull the REC. AUDIO knob out away from the transceiver panel to turn on the calibrator.

D. Proper coupling to the crystal calibrator produces a usable beat note between the 25 kHz marker (frequency divider output of calibrator) frequency harmonics and the signal from station WWV. Carefully adjust the calibrator trimmer (C701) until the 25 kHz calibrator harmonic is at zero beat with station WWV. This adjustment should be made only during periods when station WWV's signal is not modulated to avoid confusing beats with the modulation frequencies.

8-6. FINAL AMPLIFIER NEUTRALIZATION.

A. Neutralization Check - Run the neutralization check with the transceiver chassis bottom cover and final amplifier compartment cover in place (all hardware in place) and terminated with a dummy load (or antenna having a low VSWR). Tune up the transceiver in the CW mode (refer to paragraph 5-5) at 3900 kHz and 21,250 kHz for the check.

Adjust the MIC/CW LEVEL control for approximately 50 VRMS RF output with key down. Carefully tune the PA TUNE control through resonance and observe the plate current dip and RF output voltage maximum. If both occur at the same setting or with an error of less than 5 VRMS out of 50V reference level, the amplifier stage is neutralized.

B. Neutralizing Procedure - If the neutralization check outlined above indicates a need for adjustment, raise the cabinet cover to gain access to the neutralizing capacitor (C115) adjustment located between the PA TUNE and PA LOAD capacitor shafts at the final amplifier compartment. Proceed as outlined for the neutralization check and adjust the neutralizing capacitor (in 1/4-turn steps) until the plate current dip and the RFO maximum coincide at the two test frequencies. The cabinet cover does not have to be in place for the check, however the final compartment cover must be in place to provide the RF shielding required.

8-7. VFO CALIBRATION ALIGNMENT.

A. Mechanical Index - Check the dial reference for maximum VFO capacitor setting by carefully turning the dial beyond the 550 or 1050 kHz calibration point to the dial index reference mark. At this setting the VFO capacitor plates should mesh at maximum capacity exactly. If they do not, loosen the dial hub set

screws (2 each) and index the dial with the reference mark at the maximum capacity setting. Reset the two set screws.

B. VFO Calibration (Trimmer adjustment only) - A trimmer capacity correction is indicated if the dial calibration check across the dial, at the 100 kHz check points consistently falls to one side of the pointer and cannot be corrected by the CAL control. Recalibrate the VFO as follows:

1. Preset the following controls as indicated:

BAND selector 3.5
REC. GAIN . . . . . .Maximum clockwise
REC. AUDIO . . . .As required (Pull control knob out away from panel.)
MODE selector . . . . . At USB
FUNCTION control . . . . . REC
PRESELECTOR . . . . . Center 80M segment
CAL. . . . . .Center white mark in panel slot

2. Set the dial at exactly 3500 kHz (VFO = 5500 kHz). Carefully adjust trimmer C402 for exactly zero beat.

3. Check the calibration across the dial at the 100 kHz check points. If the error is less than approximately 3000 Hz, the calibration is within acceptable limits. If the error increases and exceeds 3000 Hz at the high frequency end of the dial (VFO = 5000 kHz) the VFO will require a coil adjustment in addition to the trimmer adjustment.

C. VFO Calibration (Trimmer and coil adjustment) - If the dial error progressively increases in the same direction with the high frequency end of the dial running out more than 2000 Hz, both coil L401 and trimmer C402 require adjustment. Recalibrate the VFO as follows:

1. Set the transceiver controls as in step 1, paragraph 8-7, B.

2. Set the tuning dial for exactly 4000 kHz (VFO = 5000 kHz) and adjust coil L401 for zero beat.

3. Set tuning dial for exactly 3500 kHz (VFO = 5500 kHz) and adjust trimmer C402 for zero beat.

4. Repeat steps 2 and 3 until both the 3500 and 4000 kHz settings are exactly on frequency.

5. Check the calibration across the dial at the 100 kHz points. If the frequency error is less than 3000 Hz, the calibration is within acceptable limits. If the error is in excess of 3000 Hz at any of the mid-dial points, with the end limits at zero error, the VFO capacitor C401 should be "knifed". This operation should not be attempted by other than qualified personnel thoroughly familiar with the technique.

8-8. VFO/PRE-MIXER BAND PASS TRANSFORMER ALIGNMENT. This operation consists of adjusting transformers T401, T402, T403, and T404.

A. Check the injection level at the signal mixer (U501) with an oscilloscope probe or VTVM probe connected to a pin connector of the green injection lead interconnecting the VFO/Premixer board and the Preselector board. Connect probe ground to near by switch index bracket. The injection levels on 80 meters, 40 meters, and 20 meters run approximately 1 volt (peak-to-peak) on an oscilloscope or 0.35 VRMS on a VTVM. On 10 and 15 meters, the injection runs approximately 0.6V to 1.0V (peak-to-peak) or 0.2V to 0.35 VRMS. If these injection levels are obtained and the level remains essentially constant across the tuning range of the VFO, no adjustment should be required.

B. If adjustment is required, check the 80 meter band injection (1V p-p or 0.35 VRMS) to determine that the VFO injection is normal before attempting to adjust a band which has a pre-mixed injection signal.

C. Preset the tuning dial at approximately mid-band and adjust transformer T401 on the 40 meter band, T402 on the 20 meter band, T403 on the 15 meter band and T404 on the 10 meter band (10 meter band alignment will require all crystal segments to properly adjust T404). Adjust both cores in each transformer for maximum injection level to the signal mixer U501 (green lead pin connector). Do not run either of the cores between the windings. Correctly adjusted, the cores will be located below the bottom winding and above the top winding in each transformer. For the 10 meter band adjustment, switch the BAND selector back and forth from segment to segment and adjust the cores on T404 to maintain as near constant injection as possible as well as attempting to obtain the maximum level available. This transformer will be the most difficult to master of the four band pass transformers. If a single segment of the ten meter band is used alone, the transformer may be peaked for that segment.

8-9. IF AMPLIFIER ALIGNMENT. This operation consists of adjusting coils L201, L202, L203 and transformer T201 on the 9 MHz Transceive Function (plug-in) module.

A. Disconnect coaxial cable at the Preselector module and connect the signal generator output to the cable ends. Connect a 8-ohm audio output load to the PHONES jack. (Inserting phone plug will automatically disable speaker.)

B. Set FUNCTION selector at REC, REC. GAIN and REC. AUDIO maximum clockwise, and MODE selector at either USB or LSB.

C. Set up signal generator without modulation at 9 MHz and adjust its frequency for maximum recovered audio output using a signal level that produces 0.5 watt audio output. If approximately 1 to 2 microvolts are required to obtain 0.5 watt of audio no adjustment should be required. If adjustment is required, adjust the cores of coils L201, L202 and L203 for maximum output. Disconnect signal generator and reconnect coaxial cable to Preselector pin connectors. (Shield connection to ground pin, center conductor connector to insulated pin.)

D. Connect a 50-ohm dummy load and VTVM or oscilloscope to the ANTENNA connector (J105). Connect the AF signal generator to the microphone input and monitor the input voltage with the Ballantine voltmeter. Set the AF signal generator to 1000 Hz and adjust the level to 10 millivolts at the MIC connector.

E. Tune-up the transceiver (USB or LSB mode) into the dummy load (3800 kHz is recommended) and adjust the MIC/CW LEVEL for 50 VRMS RF output at the antenna load. Adjust core of transformer T201 for maximum RF output. Set MIC/CW LEVEL full counterclockwise and check suppressed carrier level. Adjust carrier balance controls C239 and R253 (if required) per paragraph 8-4.

F. Advance the MIC/CW LEVEL control and set up the 50 VRMS RF output level. Vary the AF signal generator output from zero to the level at which the RF transmitter output levels off (maintain 50 VRMS maximum output with MIC/CW LEVEL) indicating audio limiting action. Adjust the COMPRESSION LEVEL control (R245) so that limiting of the transmitter output occurs at an AF signal generator level of 10 millivolts. With the MIC/CW LEVEL control full clockwise, full transmitter output should occur at a 1000 Hz microphone input level of 10 millivolts or less, thus permitting full transmitter power output before audio limiting occurs.

8-10. ALIGNMENT OF MIXER, RF AMPLIFIER AND DRIVER STAGES. The final amplifier bias adjustment must be properly set per paragraph 8-3 before extensive operation of the transmitter is attempted. It is assumed that the signal generating stages of the FPM-300 Transceiver are functioning properly. Use the internally generated signal of the transceiver to align the mixer, amplifier and driver stages of the transceiver as follows: (bottom chassis cover and final amplifier compartment cover in place)

A. Connect a 50-ohm dummy load and VTVM or oscilloscope to the ANTENNA connector (J105). Set the FUNCTION selector at PTT,MIC/CW LEVEL full ccw (minimum output). Center the PA LOAD control at 5 for the following adjustments. (Check pointer index at maximum preselector capacitor setting before proceeding with alignment.)

B. Set the BAND SELECTOR at 3.5, the tuning dial at 3500, and index the PRESELECTOR at the right hand edge of the 80 (meter) segment. Preset the PA TUNE control in the 80 segment.

C. Set the MODE selector at TUNE. Advance the MIC/CW LEVEL control and adjust the PA TUNE control for maximum output. Maintain an output signal level of approximately 50 VRMS as the alignment progresses. Adjust cores of coils L501, L505 and L509 for maximum output. The 80-meter coils are common to the remaining bands circuitry, therefore, they must be in alignment before the higher frequency bands can be aligned.

D. Set the BAND selector at 7.0 and PA TUNE control at the 40 (meter) segment. Repeat the PA tuning and drive level procedure and adjust the cores of coils L502, L506 and L510 for maximum output.

E. Set the BAND selector at 21.0, and the PA TUNE and PRESELECTOR controls at the 15 (meter) segments. Repeat the PA tuning and drive level procedure and adjust the core of coil L511, and the bottom cores of coils L503 and L507 for maximum output. Note that the core of L511 is located at the bottom side of the coil when properly adjusted. (Core tunes two bifilar wound coils.) A small core adjustment tool capable of adjusting through the center of the top cores of coils L503 and L507 will be required to make their adjustment.

F. Set the BAND selector at 14.0 and the PA TUNE and PRESELECTOR controls at the 20 (meter) segments. Repeat the PA tuning and drive level procedure and in addition adjust the PRESELECTOR control for maximum

output before adjusting the top side cores of coils L503 and L507 for maximum output. Do not change the adjustment of driver coil L511, as it is to be adjusted only on the 15 meter band.

G. Repeat steps E and F until no further increase in output level can be obtained by core adjustment.

CAUTION

The top core settings for coils L503 and L507 in the 20 meter band should not run too far into the coil windings. If the cores are set too deep into the coil, the 15 meter inductance will be abnormally affected. If this happens, reset the top side cores well out of the coils and repeat the procedure from step E on.

H. Set the BAND selector at 28.5 and the PA TUNE and PRESELECTOR controls at the 10 (meter) segments. Repeat the PA tuning and drive level procedure and adjust the cores of coils L504, L508 and L512 for maximum output.

8-11. BFO/CARRIER OSCILLATOR ALIGNMENT. This operation consists of adjusting the core of carrier oscillator transformer T405 and setting crystal warping trimmers C443 and C446 to place the oscillators exactly on frequency.

A. Set the core of transformer T405 before setting the oscillators to exact frequency. Connect the oscilloscope probe or VTVM probe to the junction of resistors R278 and R279 on the 9 MHz Transceive Function plug-in module. Set the FUNCTION selector at REC and check the injection voltage for the LSB and USB settings of the MODE control. If the injection voltages are approximately 1.0 V peak-to-peak (0.35 VRMS) and the crystal oscillators start without hesitation in either side band position, no adjustment should be necessary. If adjustment is required, adjust the core of transformer T405 clockwise from the maximum injection voltage obtained (low inductance side of resonance) to the specified injection level.

B. The BFO/carrier frequencies have been accurately set at the factory to match the characteristics of the 9MHz crystal lattice filter and normally do not require adjustment. To adjust the frequency of the BFO/carrier crystal oscillators, operate the transceiver in the VOX/USB mode and apply a 10mV, 1000 Hz tone from an audio frequency signal generator. Adjust the MIC/CW level control to produce approximately 1/2 of full power output (50 VRMS @ 50 ohms). Adjust the audio frequency tone input to 500 Hz and adjust C446 until power is reduced by 3dB (1/4 full power). Set the transceiver to LSB mode and again adjust power to 1/2 full power with 1000 Hz tone input. Adjust the audio frequency tone to 500 Hz and adjust C443 until the power is reduced by 3dB. This completes the adjustment of the carrier oscillators.

SERVICE REPAIR PARTS LIST

*All Resistors are FIXED, COMPOSITION; 10%, 1/4 W unless otherwise stated.

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
	CHASSIS COMPONENTS	
	*Resistors	
R101/S105	Variable, 50 K Ohm, (REC. Audio) w/PULL CAL Switch	025-002964
R102/S104	Variable, 500 K, Ohm (REC. GAIN) w/PWR-OFF Switch	025-002962
R103	1.8 K Ohm	451-152182
R104	Variable, 5 K Ohm (MIC/CW LEVEL)	025-002963
R105	18 K Ohm, 5%	451-151183
R106	10 K Ohm	451-152103
R107	33 K Ohm, 5%, 1/2 W	451-251333
R108	270 K Ohm, 5%	451-151274
R109	6.8 K Ohm, 1 W	451-352682
R110	47 K Ohm, 1 W	451-352473
R111	22 K Ohm, 1/2 W	451-252223
R112	Variable, 10 K Ohm (BIAS ADJUST)	025-002863
R113, 114	10 Ohm, 5%, 1 W	451-351100
R115	2.2 K Ohm, 5%	451-151222
R116	1 K Ohm, 1 W	451-352102
R117	6.8 K Ohm, 2 W	451-652682
R118	51 K Ohm, 5%, 1/2 W	451-251513
R119 A/B, 120 A/B	Wire-wound, tapped 50 Ohms, 1 Ohm	024-001808
R121	Wire-wound, 250 Ohm, 5 W	445-012251
R122	Wire-Wound, 2.8 Ohm, 5%, 25 W	024-001801
R123	27 K Ohm	451-152273
	Capacitors	
C101, 108,120, 134	0.01 μF, 20%, 25 V, Ceramic	047-002794-017
C102, 133	0.001 μF, 20%, 500 V, Ceramic	047-001671
C103	0.1 μF, 20%, 25 V, Ceramic	047-002794-020
C104	Variable, 3 - 11.5 pF (CAL.)	048-000714

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
C106	1000 μF, -10% +100%, 20 V Electrolytic	045-001631
C107	3000 μF, -10% +150%, 25 V Electrolytic	045-001617
C109	0.002 μF, 20%, 500 V, Ceramic	047-000395
C110, 112, 114, 117, 119, 123	0.01 μF, 20%, 500 V Ceramic	047-000354
C111	0.005 μF, 20%, 500 V,Ceramic	047-000442
C113	330 pF, 2%, 500 V, Mica	506-110331-334
C115	Variable, 0.8 - 13 pF, 2500 V (PA NEUTRALIZER)	044-000520
C116, 118	0.02 μF, 20%, 500 V, Ceramic	047-000471
C121	0.001 μF, 20%, 3 KV, Ceramic	047-000397
C122	0.01 μF, 20%, 1000 V, Ceramic	047-001608
C124	Variable, 18.7 - 312 pF (PA TUNE)	048-000715
C125	330 pF, 2%, 500 V, Mica	506-310331-333
C126	220 pF, 2%, 500 V, Mica	506-310221-333
C127	Variable (PA LOAD)	048-000713
C128	47 pF, 2%, 500 V, Mica	506-310470-331
C129	180 pF, 2%, 500 V, Mica	506-310181-333
C130	100 pF, 2%, 500 V, Mica	506-310101-331
C131	0.01 μF, GMV, 1400 V, Ceramic	047-000752
C132	80 μF, -10% +50%, 350 V, Electrolytic	045-001615
	Coils and Transformers	
L101	Reactor, Filter, 100 mH	056-000956
L102, 104	Choke, RF, 82 μH	053-000667
L103	Choke, RF, 155 μH	053-000426
L105	Coil, RF	050-004381
L106	Coil, RF, 7.6 μH	050-004372
L107	Choke, RF, 1 mH, 10%	053-000598

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
T101	Transformer, Power	050-004286
T102	Transformer, Driver	050-004287
	Electron Tubes	
V101	Type 12BY7A	090-001192
V102	Type 6KD6	090-001741
	Semiconductors	
Q101, 102	Transistor, Type 2N1522	019-004757
D101	Diode, Type 1N270	019-005141
D102	Diode, Type 1N4001	019-003420
	Switches	
S101	Rotary (MODE)	060-003226
S102	Rotary (FUNCTION)	060-003224
S103	Wafer, BAND SW	062-000356
S104	(Refer to R102)	
S105	(Refer to R101)	
	Connectors	
J101	Jack, Telephone, Type 11J-1021 (PHONES)	036-000390
J102	Jack, Phone, 2-Conductor, Type 11J-1024 (KEY)	036-000392
J103	Jack, Phone, Type N112B (MIC)	036-000480
J104	Connector (For 9 MHz Function module)	010-004496
J105	Connector, Antenna	010-002663
J106	Jack, Phono (RELAY)	036-000041
J107	Socket, electrical (BLOWER)	010-004211
J108	Connector, Plug, 18 pin	036-000372
P101, P103	Connector, Female, 18 pin w/shell and cable clamp	010-003000
	AC Power cord E/W P102 (less P101)	087-010009
	AC Power cord assembly (complete)	087-011133

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
	Miscellaneous	
K101	Relay, Control	021-000667
K102	Relay, Antenna	021-001406
F101	Fuse, Slo-Blo, 4A, 125 V	039-000448
M101	Meter	082-000893
DS101, 102	Lamp, Incandescent	039-000004
LS101	Speaker	085-000323
Z101	Suppressor, Parasitic	050-004373
	PRINTED CIRCUIT BOARD ASSEMBLY, 9 MHz FUNCTION MODULE	
	*Resistors	
R201, 208, 212, 215, 224, 229, 232, 238, 251, 257, 267, 277	100 Ohm	451-152101
R202, 226	470 K Ohm	451-152474
R203, 204	100 K Ohm	451-152104
R205, 207, 210, 234, 236, 240, 260	47 K Ohm	451-152473
R206, 211, 279	150 Ohm	451-152151
R209, 216, 217	2.7 K Ohm	451-152272
R213	820 Ohm	451-152821
R214, 266	1.2 K Ohm	451-152122
R218	27 K Ohm, 5%	451-151273
R219, 220, 221, 242, 247, 270, 274	1 K Ohm	451-152102

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
R222, 239, 256	10 K Ohm	451-152103
R223	680 K Ohm, 5%	451-151684
R225	4.7 K Ohm	451-152472
R227, 268	68 K Ohm	451-152683
R228	Variable, 500 K Ohm (S METER)	025-002968-012
R230, 241	5.6 K Ohm	451-152562
R231	3.9 K Ohm	451-152392
R233, 261, 262, 264, 269	1.5 K Ohm	451-152152
R235	8.2 K Ohm	451-152822
R237	12 K Ohm	451-152123
R243	Variable, 1 K Ohm (ANTI-TRIP)	025-002968-204
R244, 246, 255, 275	3.3 K Ohm	451-152332
R245	Variable, 1 K Ohm (COMP LEVEL)	025-002968-904
R248, 249, 250, 271	22 K Ohm	451-152223
R252, 254, 278	220 Ohm	451-152221
R253	Variable, 250 Ohm (MOD BAL)	025-002968-602
R258, 259	470 Ohm	451-152471
R263	Variable, 25 K Ohm (DELAY)	025-002968-408
R265	Variable, 5 K Ohm (VOX SENS)	025-002968-506
R272, 273	15 K Ohm	451-152153
R276	6.8 K Ohm	451-152682
R280	180 Ohm	451-152181
	Capacitors	
C201	150 pF, 2%, 500 V, Mica	506-110151-334
C202	1800 pF, 2%, 500 V, Mica	506-310182-334

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
C203, 204, 206, 209, 212, 215, 219, 243, 244, 247	0.05 µF, 20%, 25 V, Ceramic	047-002794-019
C205, 207	27 pF, 2%, 500 V, Mica	506-110270-333
C208	1.0 µF, 20%, 35 V, Electrolytic	045-001537-022
C210	180 pF, 2%, 100 V, Mica	506-910181-314
C211	820 pF, 2%, 100 V, Mica	506-110821-314
C213, 254, 261	0.001 µF, 20%, 500 V, Ceramic	047-001671
C214, 229	100 pF, 2%, 500 V, Mica	506-110101-334
C216, 238	47 pF, 2%, 500 V, Mica	506-110470-333
C217, 240	240 pF, 2%, 500 V, Mica	506-110241-334
C218, 241	400 pF, 2%, 500 V, Mica	506-110401-334
C220	22 pF, 5%, 100 V, Mica	506-910220-211
C221, 222, 224	0.1 µF, 20%, 12 V, Ceramic	047-002794-008
C223	0.005 µF, -20%+80%, 500 V, Ceramic	047-001381
C225, 227, 263	0.001 µF, GMV, 500 V, Ceramic	047-002795
C226, 230, 237, 259	0.01 µF, 20%, 25 V, Ceramic	047-002794-017
C228, 249, 260	0.05 µF, 20%, 12 V, Ceramic	047-002794-007
C231, 233, 234, 250, 257	4.7 µF, 20%, 10 V, Electrolytic	045-001537-074
C232	0.1 µF, 20%, 35 V, Electrolytic	045-001537-016
C235, 245, 246	0.22 µF, 20%, 12 V, Ceramic	047-002794-009
C236	0.02 µF, 20%, 25 V, Ceramic	047-002794-018
C239	5 - 60 pF, Trimmer (Carrier Bal.)	044-001153
C242	33 pF, 2%, 500 V, Mica	506-110330-333

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
C248, 256, 258, 264	47 μF, 20%, 20 V, Electrolytic	045-001537-053
C251, 252, 253	3900 pF, 2%, 300 V, Mica	506-310392-324
C262	0.47 μF, 20%, 35 V, Electrolytic	045-001537-020
	Coils, Transformers and Filters	
L201, 202, 203	Coil, IFT, 9 MHz	050-004359
L204	Choke, RF, 56 μH, 10%	050-002311
L206	Choke, RF, 100 μH, 10%	053-000644
L207	Choke, RF, 2.7 μH	053-000670
T201	Coil, IFT, 9 MHz	050-004358
FL201	Filter, 9 MHz	049-000320
	Semiconductors	
Q201, 202, 203	Transistor, type 40841	019-004796
Q204, 205, 212	Transistor, type SE-4002	019-005156
Q206, 207, 209	Transistor, type MPS-6515	019-005028
Q208	Transistor, type MPS-6523	019-004762
Q210	Transistor, type 2N5458	019-004782
Q211	Transistor, type MPS-404	019-004787-001
D201, 208	Diode, type 1N758A	019-002901
D202, 203, 209, 210	Diode, type 1N270	019-005141
D204, 205, 206, 207	Diode, type 1N295	019-001980
D211	Diode, type 1N456	019-002964
Z201	Integrated Circuit, type MC1496G	058-001026
Z202	Integrated Circuit, type LM370	058-001027
	PRINTED CIRCUIT BOARD, POWER SUPPLY FILTER	
	*Resistors	
R301	220 K Ohm, 2W	451-652224
R302, 303	1.2 K Ohm, 2W	451-652122

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
R304	15 K Ohm, Wire-wound, 5%, 7 W	024-001812
R305	1.5 K Ohm	451-152152
R306	2.2 K Ohm	451-452222
	Capacitors	
C301, 302	0.01 μF, 10%, 1600 V, Ceramic	047-002502
C303	80 μF, -10%+50%, 450 V, Electrolytic	045-001532
C304	50-50 μF, -10%+50%, 350 V, Electrolytic	045-001534
C305, 306	40 μF, -10%+100%, 150 V, Electrolytic	045-001616
	Semiconductors	
D301	Rectifier	019-004754-004
D302	Rectifier	019-004754-003
D303	Rectifier	019-004754-001
D304	Diode, Type 1N4005	019-004055
Q301	Transistor, Type MPS-6531	019-004756
	PRINTED CIRCUIT BOARD, VFO/PREMIXER	
	*Resistors	
R401, 404, 431, 432	33 K Ohm	451-152333
R402	22 K Ohm	451-152223
R403	68 Ohm	451-152680
R405	220 Ohm	451-152221
R406, 435	1 K Ohm	451-152102
R407	3.9 K Ohm	451-152392
R408, 417, 438	47 Ohm	451-152470
R409 thru 415	390 Ohm	451-152391
R416, 426	68 K Ohm	451-152683
R418	270 Ohm	451-152271

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
R419, 424, 445, 448	100 K Ohm	451-152104
R420, 422, 429, 440, 450	100 Ohm	451-152101
R421	120 Ohm	451-152121
R423	10 K Ohm	451-152103
R425	82 Ohm	451-152820
R427	12 K Ohm	451-152123
R428, 453	4.7 K Ohm	451-152472
R430	820 Ohm	451-152821
R433, 449	56 K Ohm	451-152563
R434	22 Ohm	451-152220
R436	8.2 K Ohm	451-152822
R437, 446, 447	2.2 K Ohm	451-152222
R439	Thermistor, 33 Ohm, Type B832001 P/3	024-001813
R441, 442	Wire-wound, 0.47 Ohm, 5%, 1/2 W	453-011000-047
R443, 451	470 Ohm	451-152471
R452	150 Ohm	451-152151
	Capacitors	
C401	Variable, 7-82 pF (TUNE)	048-000720
C402	Variable, 2-10 pF (VFO Trim)	044-000664
C403	115 pF, 2%, 500 V, Mica	506-121150-334
C404	68 pF, 5%, 100 V, N470, Ceramic	047-002647-001
C405, 410, 448	150 pF, 2%, 500 V, Mica	506-110151-334
C406, 407	390 pF, 2%, 500 V, Mica	506-110391-334
C408, 409, 421, 434	0.001 μF, 20%, 500 V, Ceramic	047-001671

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
C411, 414, 418, 420, 422, 429, 431, 436, 437	0.01 µF, 20%, 25 V, Ceramic	047-002794-017
C412	24 pF, 2%, 500 V, Mica	506-110240-331
C413	1000 pF, 2%, 100 V, Mica	506-110102-314
C415	22 pF, 2%, 500 V, Mica	506-110220-331
C416	27 pF, 2%, 500 V, Mica	506-110270-333
C417, 419	100 pF, 2%, 500 V, Mica	506-110101-334
C423, 426	4.7 pF, ±0.5 pF, 500 V, Mica	506-140470-731
C424, 427	18 pF, ±0.5 pF, 500 V, Mica	506-110180-731
C425, 428	56 pF, 2%, 500 V, Mica	506-110560-333
C430, 432	0.1 µF, 20%, 12 V, Ceramic	047-002794-008
C433, 440	47 µF, 20%, 20 V, Electrolytic	045-001537-053
C435	10 µF, 20%, 6 V, Electrolytic	045-001537-091
C438	100 µF, -10%+100%, 6 V, Electrolytic	045-001634
C439	470 pF, 2%, 500 V, Mica	506-110471-334
C441	300 µF, -10%+100%, 10 V, Electrolytic	045-001635
C442, 447, 450	15 pF, ±0.5 pF, 500 V, Mica	506-910150-731
C443, 446	Adjustable, 2-18 pF	044-000654
C444, 445	0.05 µF, 20%, 12 V, Ceramic	047-002794-007
C449	0.05 µF, 20%, 25 V, Ceramic	047-002794-019
	Coils and Transformers	
L401	Coil, VFO	050-004378
L402, 411	Choke, RF, 100 µH, 10%	053-000644
L403	Choke, RF, 56 µH, 10%	050-002311
L404, 409	Choke, RF, 6.8 µH	050-001245
L405, 413	Choke, RF, 0.33 µH	050-002459
L406	Choke, RF, 1.0 µH	053-000654

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
L407	Choke, RF, 2.2 μH	053-000534
L408	Choke, RF 0.68 μH	050-004464
L410	Choke, RF, 2.7 μH	053-000670
L412	Coil, RF, 30 μH	050-004382
T401	Coil, RF, 40 Meter Bandpass	050-004374
T402	Coil, RF, 20 Meter Bandpass	050-004375
T403	Coil, RF, 15 Meter Bandpass	050-004376
T404	Coil, RF, 10 Meter Bandpass	050-004377
T405	Coil, IFT, 9 MHz	050-004358
	Semiconductors	
Q401, 402, 403, 404, 406	Transistor, Type 40468A	019-004764
Q405	Transistor, Type SE5025	019-004119
Q407	Transistor, Type MPS 6515	019-005028
Q408	Transistor, Type A138	019-004763
Q409	Transistor, Type MPS6516	019-005007
Q410, 411	Transistor, Type 2N4079 Matched PR-2N4077/ 2N4078	019-004760
Q412, 413	Transistor, Type 2N5458	019-004782
D401	Diode, Type 1N4154	019-003713
D402	Diode, Type 1N5239B	019-004691
D403	Diode, Type 1N758A	019-002901
U401	Balanced Mixer Assembly, MX-1	150-018555-001
	Switches	
S401	Wafer, Band SW (Bandpass)	062-000358
S402, 403, 404	Wafer, Band SW (Bandpass, USB/LSB select, crystal select)	062-000357
	Crystals	
CR401	Quartz, 21.5 MHz	019-004746
CR402	Quartz, 28.5 MHz	019-004747
CR403	Quartz, 35.5 MHz	019-004748
CR404	Quartz, 42.5 MHz (28.0 band)	019-004750

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
CR405	Quartz, 43.0 MHz	019-004749
CR406	Quartz, 43.5 MHz (29.0 band)	019-004751
CR407	Quartz, 44.0 MHz (29.5 band)	019-004752
CR408	Quartz, 9001.500 kHz	019-004709
CR409	Quartz, 8998.700 kHz	019-004710
	PRINTED CIRCUIT BOARD ASSEMBLY, PRESELECTOR ALC MODULE	
	*Resistors	
R501	1 K Ohm	451-152102
R502, 504, 518	6.8 K Ohm	451-152682
R503, 520, 523	4.7 K Ohm	451-152472
R505, 513, 515	100 Ohm	451-152101
R506	2.2 K Ohm	451-152222
R507, 510	47 K Ohm	451-152473
R508, 511	100 K Ohm	451-152104
R509	150 Ohm	451-152151
R512	470 K Ohm	451-152474
R514	1 Megohm	451-152105
R516	15 K Ohm	451-152153
R517	1.5 K Ohm	451-152152
R519	470 Ohm	451-152471
R521	2.2 Megohm	451-152225
R522	22 K Ohm	451-152223
	Capacitors	
C501	Variable (PRESELECTOR)	048-000712
C502	Variable (DRIVER)	048-000711
C503, 513	0.01 µF, 20%, 25 V, Ceramic	047-002794-017

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
C504, 515, 516	240 pF, 2%, 500 V, Mica	506-110241-334
C505, 511, 524	27 pF, 5%, 500 V, Mica	506-110270-233
C506, 508 509, 510, 512, 518	0.05 μF, 20%, 25 V, Ceramic	047-002794-019
C507	2.2 μF, 20%, 20 V, Electrolytic	045-001537-045
C514, 517	100 pF, 5%, 500 V, Mica	506-110101-234
C519, 522, 523	0.001 μF, 20%, 500 V, Ceramic	047-001671
C520	10 μF, 20%, 6 V, Electrolytic	045-001537-091
C521	0.1 μF, 20%, 25 V, Ceramic	047-002794-020
C525	4.7 pF, ±0.5 pF, 100 V, Mica	506-940470-711
C526	3.9 pF, ±0.5 pF, 100 V, Mica	506-940390-711
C527	0.001 μF, GMV, 500 V, Ceramic	047-002795
C528	10 pF, ±0.5 pF, 500 V, Mica	506-910100-731
	Coils, RF	
L501, 505	Coil, RF, 80M Ant. & Mixer	050-004368
L502, 506	Coil, RF, 40M Ant. & Mixer	050-004369
L503, 507	Coil, RF, 20M & 15M Ant. & Mixer	050-004370
L504, 508	Coil, RF, 10M Ant. & Mixer	050-004371
L509	Coil, RF, 80M Driver	050-004364
L510	Coil, RF, 40M Driver	050-004365
L511	Coil, RF, 20M & 15M Driver	050-004366
L512	Coil, RF, 10M Driver	050-004367
	Semiconductors	
Q501, 502	Transistor, Type 40841	019-004796
Q503	Transistor, Type MPS6515	019-005028
Q504	Transistor, Type SE4002	019-005156
D501	Diode, Type 1N747A	019-004765
D502	Diode, Type 1N758A	019-002901

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
D503 thru 507	Diode, Type 1N270	019-005141
U501	Balanced Mixer Assembly, MX-1	150-018555-001
	Switches	
S501, 502 503	Wafer, Band SW (Mixer, Antenna, Driver)	062-000357
	25 kHz CALIBRATOR MODULE	
	*Resistors	
R701	4.7 Megohm	451-152475
R702	3.3 K Ohm	451-152332
R703	4.7 K Ohm	451-152472
R704	330 Ohm	451-152331
	Capacitors	
C701	Trimmer, 5-60 pF	044-001153
C702	220 pF, 5%, 500 V, Mica	506-910221-234
C703	0.1 μF, 20%, 12 V, Ceramic	047-002794-008
C704	0.47 μF, 20%, 35 V, Electrolytic	045-001537-020
C705	22 pF, $\pm$0.5 pF, 100 V, Mica	506-910220-713
	Semiconductors & Misc.	
Q701	Transistor, Type 2N5458	019-004782
D701	Diode, Type 1N758A	019-002901
Z701	Integrated Circuit, Type MFC6020	058-001035
CR701	Crystal, Quartz, 100 kHz, PE Type 2	019-004781
	Miscellaneous Mechanical Parts	
	Fuse holder (for F101)	006-000837
	Dial Window (for M101)	022-000783
	Pilot light shield (for DS102)	086-000037
	Shaft, straight, non-metallic (for PA TUNE and PA LOAD controls)	074-003372
	Tube shield (for 12BY7A)	069-000863

REFERENCE SYMBOL	PART NAME AND DESCRIPTION	HALLICRAFTERS PART NUMBER
	Heat transfer shield insert (for tube shield)	069-001020
	Cover assembly case	150-019266-001
	Front Panel Assembly	150-019258-001
	Bottom assembly cover	150-019265-001
	Accessory Item	
	Cable Assembly, Power, DC (P/O Mobile Mounting Kit MR-300)	087-011134