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UNCLASSIFIED

TECHNICAL MANUAL

for

CONTINUOUS RF TUNER

MODEL HFR-2

(TN-376A/UR)



THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N. Y.

OTTAWA, CANADA

★

NOTICE

THE CONTENTS AND INFORMATION CONTAINED IN THIS INSTRUCTION MANUAL IS PROPRIETARY TO THE TECHNICAL MATERIEL CORPORATION TO BE USED AS A GUIDE TO THE OPERATION AND MAINTENANCE OF THE EQUIPMENT FOR WHICH THE MANUAL IS ISSUED AND MAY NOT BE DUPLICATED EITHER IN WHOLE OR IN PART BY ANY MEANS WHATSOEVER WITHOUT THE WRITTEN CONSENT OF THE TECHNICAL MATERIEL CORPORATION.



THE TECHNICAL MATERIEL CORPORATION

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2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
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3. TMC Part Number.
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2. TMC Part Number.
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4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

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All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

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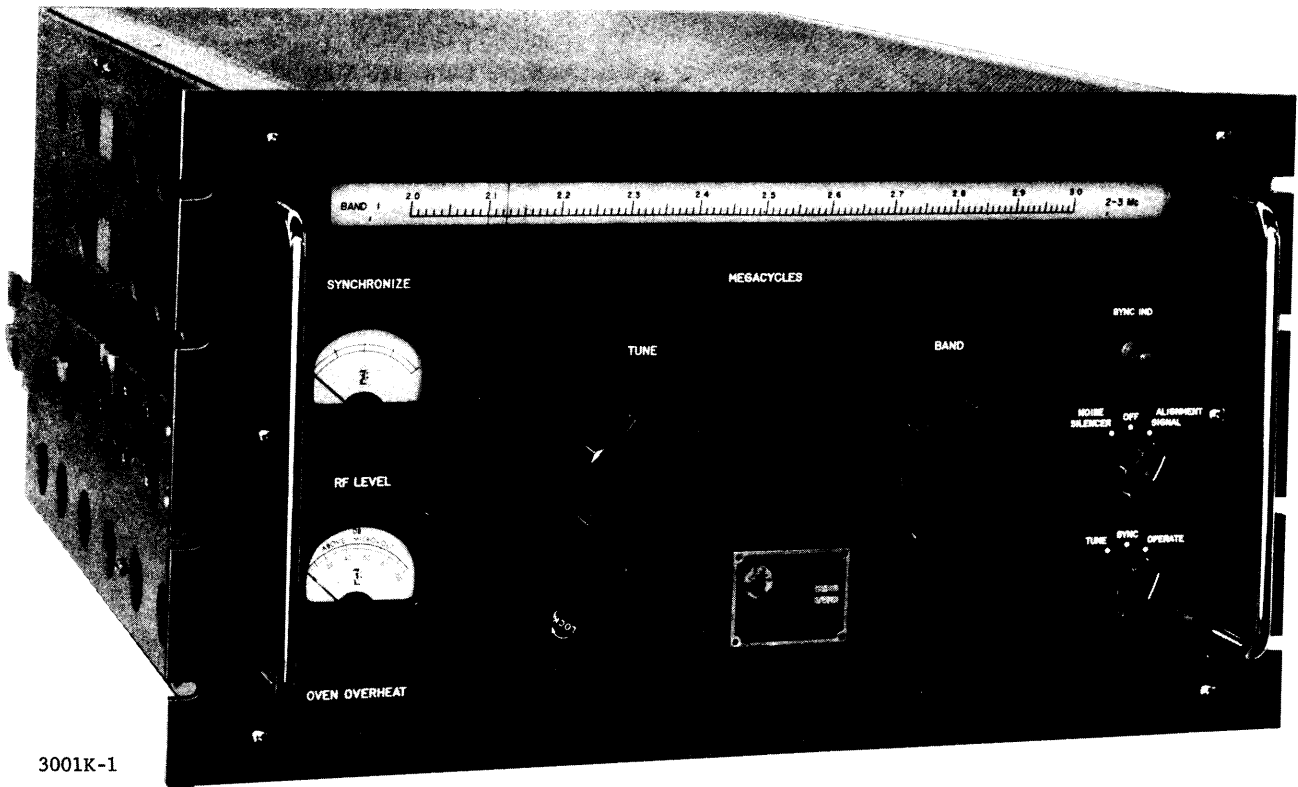
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Figure 1-1. Continuous RF Tuner, Model HFR-2

SECTION 1 GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

Continuous RF Tuner, Model HFR-2 (figure 1-1), is an r-f tuner and first i-f amplifier capable of receiving r-f signals in the frequency range of 2- to 32-megacycles. The HFR is capable of SSB, ISB, DSB with suppressed carrier, AM, FSK, CW, MCW, and PULSE or PHASE modulated signal reception. The HFR-2 comprises three major sections: HFR-2/T (front end and high frequency oscillator); HFR-2/N (1.75 mc i-f output amplifier, and noise silencer); and HFR-2/C (alignment signal generator, SYNCHRONIZE meter amplifier, and low voltage power supply).

a. HFR-2/T. - Turret bandswitching is employed in the unit. Tuned circuit elements are placed adjacent to their respective tuning capacitor and tubes, thus providing greater sensitivity and a high signal-to-noise ratio. One r-f tuner strip and one oscillator tuner strip containing the tuned circuit elements for each of the eight r-f receiver bands are mounted on a revolving turret. Turret contacts engage fixed contacts on the main chassis and thus connect the required tuning elements. Input signals are fed through four steps of r-f amplification and combine with the high frequency oscillator output signal to produce a 1.75 mc i-f.

The 2- to 32-mc frequency range covered by the HFR is divided into eight r-f bands:

BAND 1	2 - 3 mc
BAND 2	3 - 4 mc
BAND 3	4 - 6 mc
BAND 4	6 - 8 mc
BAND 5	8 - 12 mc
BAND 6	12 - 16 mc
BAND 7	16 - 24 mc
BAND 8	24 - 32 mc

Selection of the desired frequency is by means of front-panel BAND and TUNE controls.

Maximum stability of the high frequency oscillator (HFO) contained in the HFR is achieved through the use of a proportional oven control. In synthesized operation, HFO Varicap circuits receive a d-c correction voltage from an associated control synthesizer; the amplitude and polarity of the correction voltage holds the HFO at the exact required frequency. In non-synthesized operation (continuous coverage), the

correction voltage is disabled and the HFO circuits are free-running. Synthesized or non-synthesized operation of the HFO circuits is selected by a front panel TUNE/SYNC/OPERATE control. Additionally, the HFO may be synchronized to the high frequency oscillator of an associated tuner (space diversity operation).

b. HFR-2/N. - An i-f output amplifier provides two stages of amplification to 1.75 mc signals from the mixer stage contained in the HFR-2/T. The output of the i-f amplifier circuit is made available for connection to associated i-f amplifier and detector units. A modified Lamb noise silencer is used, in conjunction with the i-f output amplifier, to nullify the effects of impulse noise contained in the 1.75 mc signal. The noise figure is 6 db or better over the band; with a 1 μ V signal and a 7.5 kc bandwidth, the output signal plus noise-to-noise ratio is 15 db or better. The noise silencer can be circumvented by means of a NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch.

c. HFR-2/C. - An alignment signal generator, consisting of a balanced modulator and a mixer circuit permits calibration and sensitivity checks when the HFR is used with an associated control synthesizer (such as TMC Model HFS). Alignment signal strength is indicated on the RF LEVEL meter. Use of the alignment signal generator is controlled by the setting of the NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch.

In synthesized operation, a SYNCHRONIZE meter and a SYNC IND lamp on the HFR indicate system synchronization. When the system is synchronized, the SYNC lamp will light; the polarity and amount of d-c correction voltage required to keep the system synchronized will be indicated on the SYNCHRONIZE meter. When the system is not synchronized, the SYNC lamp will not be lit and the SYNCHRONIZE meter will read zero (center scale).

A, B+, and primary AC voltages required for HFR operation are provided by an external power supply. A low voltage power supply contained in the HFR provides the required power for the proportional oven control and heater circuits, and also for the frequency standard in the associated external control synthesizer (if used).

Table 1-1 lists the electron tube and semiconductor complement in the HFR.

1-2. PHYSICAL DESCRIPTION.

The HFR is provided with a front panel for installation in a 19-inch wide equipment rack. All controls,

indicators, and meters necessary for operation of the HFR are located on the front panel; plug-in jacks are located on the rear panel and permit installation for single-receiver or diversity operation. Tile-lock

slide mechanisms, provided with the HFR, facilitate troubleshooting and maintenance without disconnecting the HFR from its associated equipment. Removable top and bottom dust covers are provided.

TABLE 1-1. ELECTRON TUBE AND SEMICONDUCTOR COMPLEMENT

REFERENCE DESIGNATION SYMBOL	TYPE	FUNCTION
V1001	417A	First RF Amplifier
V1002	6AH6	Second RF Amplifier
V1003	6BA6	Third RF Amplifier
V1004	6BA6	Fourth RF Amplifier
V1005	6S4A	Mixer
V1006	6AH6	Isolation Amplifier
V1007	6AB4	HF Oscillator
V1201	6BA6	Amplifier
V1202	6BE6	Amplifier
V1203	6BE6	Amplifier
V1204	6AH6	Amplifier
V1205	6AH6	Amplifier
V1301	7360	Converter
V1302	6EW6	Buffer Amplifier
V1303	0A2	Voltage Regulator
V1304	12AU7	DC Amplifier
CR1001	1N463	AGC Delay
CR1201	1N463	DC Clamp
CR1202	1N463	DC Clamp
CR1203	1N463	AVC Rectifier
CR1204	1N463	AVC Rectifier
CR1205	1N34A	AVC Rectifier
CR1206	1N34A	AVC Rectifier
CR1207	1N34A	AVC Rectifier
CR1301	1N1582R	Rectifier
CR1302	1N1582R	Rectifier
CR1303	1N1582	Rectifier
CR1304	1N1582	Rectifier

TABLE 1-1. ELECTRON TUBE AND SEMICONDUCTOR COMPLEMENT (CONT)

REFERENCE DESIGNATION SYMBOL	TYPE	FUNCTION
CR1305	1N3323B	Voltage Regulator
CR1306	DZ20426	Voltage Regulator
Q1	2N338	Proportional Oven Control
Q2	2N336	Proportional Oven Control
Q3	2N1701	Proportional Oven Control
Q4	2N1702	Proportional Oven Control
Q5	2N1702	Proportional Oven Control

1-3. TECHNICAL SPECIFICATIONS.

Frequency Range:	2- to 32-mc, synthesized, in 100 cycle steps. 2- to 32-mc, continuous coverage, non-synthesized.
Type of Reception:	SSB, ISB, DSB with suppressed carrier, AM, FS, CW, PULSE, and PHASE.
Stability:	Synthesized stability of 1 part in 10^8 for 24 hours for a change in ambient temperature of 15°C within the limits of 0° to 50°C . Unsynthesized stability of 20 to 50 parts in 10^6 without AFC.
Input Impedance:	50 ohms nominal, unbalanced.
Noise Figure and Sensitivity:	6 db or better over the band; with a $1\ \mu\text{V}$ signal and a 7.5 kc bandwidth the output signal to noise ratio is 15 db or better.
Image Ratio:	80 db referenced to $1\ \mu\text{V}$ input signal.
Spurious Response as defined by CCIR:	Better than 120 db referenced to $1\ \mu\text{V}$. For synthesized operation, all spurious will be no greater than $.01\ \mu\text{V}$ when referred to the antenna.
Input Power:	115/230 volts AC, 48 to 62 cps, single phase; 6.3 vac; +200 vdc.
Dimensions:	Width 19 inches Height 10-1/2 inches Length 19-3/4 inches
Weight:	Approximately 58 pounds.

SECTION 2 INSTALLATION

2-1. INITIAL INSPECTION.

The HFR is tested at the factory and is carefully packaged to prevent damage during shipment. Upon receipt of the equipment, inspect the packing case and its contents for damage that might have occurred during transit. Unpack the equipment carefully and inspect all packaging material for parts that may have been shipped as loose items. With respect to damage to the equipment for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

2-2. POWER REQUIREMENTS.

The HFR operates with 115- or 230-volts ac power. The unit is normally wired for operation on 115 vac power input; if a 230 vac power source is to be used, the wiring of the transformer must be modified, as shown in figure 2-1.

2-3. MECHANICAL INSTALLATION.

The HFR is equipped with a standard 19-inch wide front panel and is designed for installation in an equipment cabinet. Refer to figure 2-2 and install the unit in the rack as follows:

- a. Pull out center sections of tracks, located in the equipment rack, until they lock in extended position.
- b. Position slide mechanisms of HFR in tracks, and ease unit into rack until release fingers engage holes in tracks.

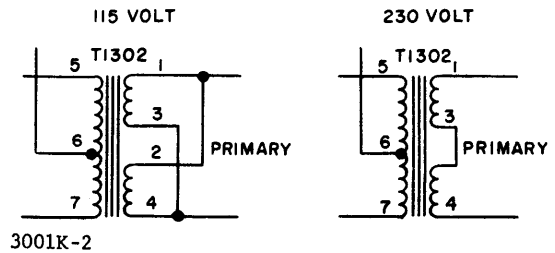


Figure 2-1. Transformer Wiring Diagram, HFR

- c. Depress release fingers and slide unit completely into rack.

NOTE

To prevent the cables from snagging, attach cable retractors (located inside the rack) to the cables before sliding the unit into the rack.

- d. Make necessary cable and electrical connections, as described in paragraph 2-4.
- e. Secure front panel of HFR to rack with screws and washers.

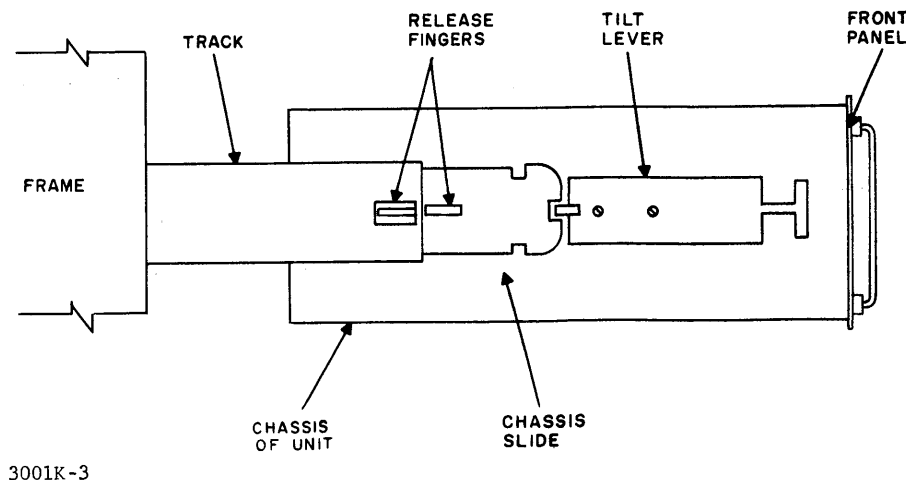


Figure 2-2. Tilt-Lock Slide Mechanism Details

2-4. ELECTRICAL INSTALLATION.

a. INTERCONNECTIONS. - Refer to the inter-connect cabling diagram provided in the associated system manual and make the cabling connections between the HFR and related units as indicated. All

connections to the HFR are made at the rear panel (refer to figure 2-3 and table 2-1).

b. INITIAL ADJUSTMENTS. - The HFR is checked at the factory in accordance with the manufacturer's specifications and therefore no initial adjustments are required before installation and operation.

TABLE 2-1. REAR PANEL DESIGNATIONS, HFR

ITEM NO. (Figure 2-3)	REAR PANEL DESIGNATIONS	FUNCTION
1	ANT. J1001	Connection for antenna lead-in.
2	ALIGNMENT SIGNAL J1002	Connection for signal generator; used to supply required signal to r-f amplifiers during troubleshooting and alignment. (Normally connected to J1309, Item No. 10.)
3	POWER J1305	Main external power supply connection.
4	1.75 IF OUTPUT J1312	Connects 1.75 mc output signal to associated unit.
5	250 KC IN J1303	Connection for 250-kc input signal from associated synthesizer.
6	DC LOOP IN J1307	Connection for d-c correction voltage from associated synthesizer.
7	HFO OUT J1302	Connects HFO signal to associated synthesizer.
8	HFO SYNC OUTPUT J1313	Provides connection of HFO signal to an associated tuner for space-diversity operation (master tuner).
9	2 MC IN J1304	Connection for 2-mc input signal from the associated synthesizer.
10	SIG. GEN. OUT J1309	Connection for signal generator; used to supply required signal to r-f amplifiers during troubleshooting and alignment. (Normally connected to J1002, Item No. 2.)
11	HFO SYNC INPUT J1310	Provides connection of HFO signal from an associated tuner for space-diversity operation (slave tuner).
12	J1316	Not used in the HFR (outlet provided for automatic modification).

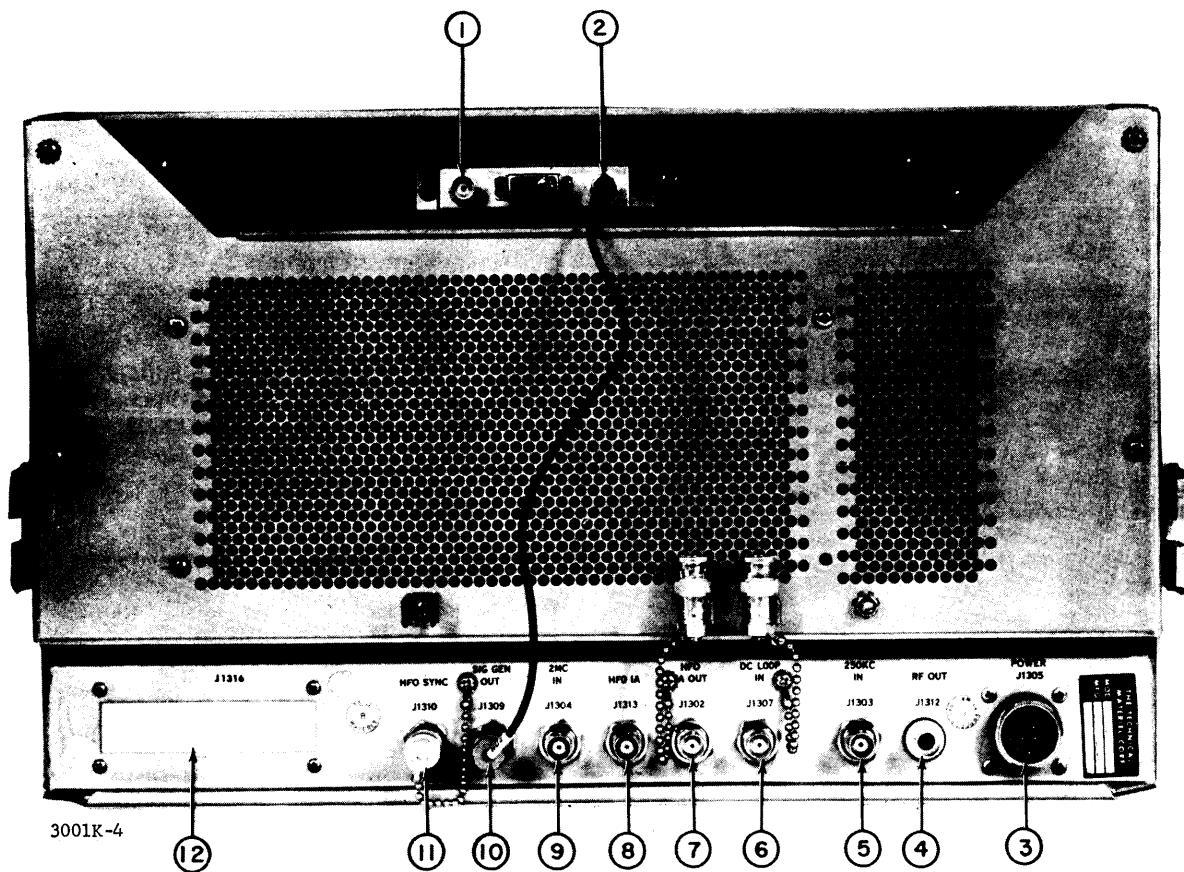


Figure 2-3. Rear Panel, HFR

SECTION 3 OPERATOR'S SECTION

3-1. OPERATION OF UNIT.

a. CONTROL FUNCTIONS. - Front panel controls and indicators (figure 3-1) of the HFR are arranged to permit: ease of tuning through any of eight r-f bands to the desired frequency within the 2- to 32-mc range, non-synthesized continuous coverage operation or synthesized operation in 100-cycle steps, and alignment and sensitivity checks of the HFR. All operating controls are located on the front panel and are identified. Table 3-1 lists the controls and indicators, and the functions of each.

b. OPERATING PROCEDURE. - Operation of the HFR consists primarily of tuning to the desired frequency by means of the BAND and TUNE controls, as indicated in table 3-1. Procedures for synchronizing the HFR with other units of a receiver system for

synthesized or diversity operation are included in the technical manual for the associated receiver system.

3-2. OPERATOR'S MAINTENANCE.

The operator should observe whether front-panel indicator lamps, MEGACYCLES dial light, meters, and controls are in good condition and functioning properly.

NOTE

In the event of an over temperature condition within the high frequency oscillator (HFO) oven, the OVEN OVERHEAT indicator will light, and will continue to cycle in the vicinity of 85°C. While no damage to the high frequency oscillator oven will result, the defective components should be repaired or replaced within 48 hours.

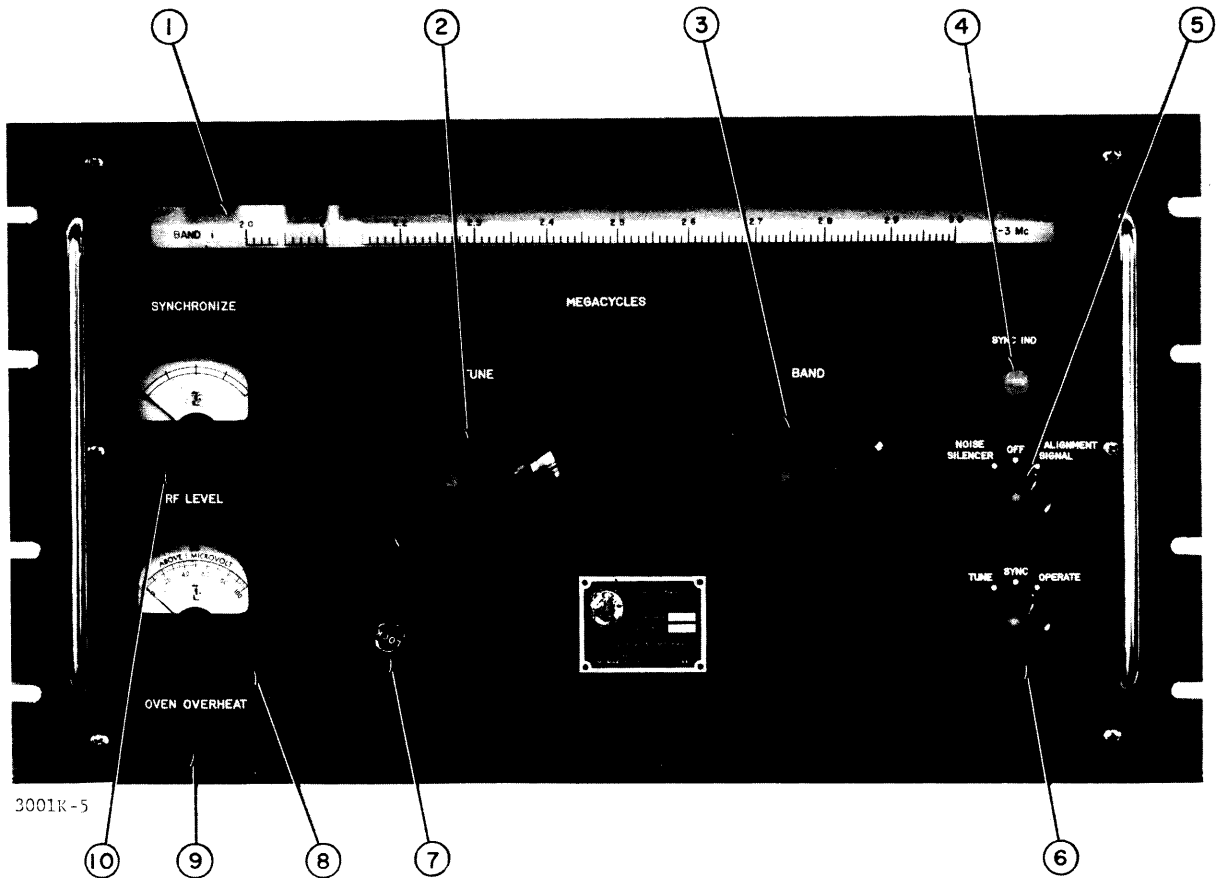


Figure 3-1. Panel Controls, HFR

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TABLE 3-1. CONTROL FUNCTIONS, HFR

ITEM NO. (Figure 3-1)	PANEL DESIGNATION	FUNCTION																
1	MEGACYCLES dial	Displays RF BAND, selected by BAND control (item 3).																
2	TUNE control	Moves slide-rule pointer along MEGACYCLES dial (item 1) to indicate frequency to which HFR is tuned. TUNE control is fitted with a LOCK (item 7).																
3	BAND switch	<p>Rotates illuminated drum of MEGACYCLES dial (item 1) to display selected RF band. RF bands are as follows:</p> <table data-bbox="945 592 1328 806"> <tr> <td>BAND 1</td> <td>2 - 3 mc</td> </tr> <tr> <td>BAND 2</td> <td>3 - 4 mc</td> </tr> <tr> <td>BAND 3</td> <td>4 - 6 mc</td> </tr> <tr> <td>BAND 4</td> <td>6 - 8 mc</td> </tr> <tr> <td>BAND 5</td> <td>8 - 13 mc</td> </tr> <tr> <td>BAND 6</td> <td>12 - 16 mc</td> </tr> <tr> <td>BAND 7</td> <td>16 - 24 mc</td> </tr> <tr> <td>BAND 8</td> <td>24 - 32 mc</td> </tr> </table>	BAND 1	2 - 3 mc	BAND 2	3 - 4 mc	BAND 3	4 - 6 mc	BAND 4	6 - 8 mc	BAND 5	8 - 13 mc	BAND 6	12 - 16 mc	BAND 7	16 - 24 mc	BAND 8	24 - 32 mc
BAND 1	2 - 3 mc																	
BAND 2	3 - 4 mc																	
BAND 3	4 - 6 mc																	
BAND 4	6 - 8 mc																	
BAND 5	8 - 13 mc																	
BAND 6	12 - 16 mc																	
BAND 7	16 - 24 mc																	
BAND 8	24 - 32 mc																	
4	SYNC IND lamp	Lights to indicate that the system is synchronized. This indicator functions only when HFR is operating synthesized.																
5	NOISE SILENCER/OFF/ALIGNMENT SIGNAL switch	<p>When set at NOISE SILENCER, activates noise silencer circuits, disables alignment signal generator, and connects ANT jack to first RF amplifier circuit.</p> <p>When set at OFF, disables noise silencer, disables alignment signal generator, and connects ANT jack to first RF amplifier circuit.</p> <p>When set at ALIGNMENT SIGNAL, activates alignment signal generator and connects it to first RF amplifier, disconnects ANT jack from r-f amplifier, and disables noise silencer.</p>																
6	TUNE/SYNC/OPERATE switch	<p>When set at TUNE, grounds d-c correction voltage from synthesizer, allowing HFO to free-run, and de-energizes AUDIO SYNC TONE relay (part of receiver in which HFR is used) to remove sync tone from receiver audio circuit.</p> <p>When set at SYNC, grounds d-c correction voltage from synthesizer, allowing HFO to free-run, and energizes AUDIO SYNC TONE relay to inject sync tone into receiver audio circuit.</p> <p>When set at OPERATE, causes associated synthesizer circuits to stabilize HFO for synthesized operation in 100-cycle steps, and de-energizes AUDIO SYNC TONE relay to remove sync tone from receiver audio circuit.</p>																
7	LOCK control	Locks TUNE control (item 2) in position.																

TABLE 3-1. CONTROL FUNCTIONS, HFR (CONT)

ITEM NO. (Figure 3-1)	PANEL DESIGNATION	FUNCTION
8	RF LEVEL meter	Meter indicates strength of antenna input signal or alignment signal in db above 1 μ V.
9	OVEN OVERHEAT lamp	When lit, indicates the control circuit for high frequency oscillator oven has failed.
10	SYNCHRONIZE meter	Meter indicates amount and polarity of DC voltage required to keep the HFO synchronized. When system is out of synchronization, meter reads zero (center scale). Meter functions only when HFR is operating synthesized and TUNE/SYNC/OPERATE switch (item 6) is set at OPERATE.

SECTION 4

PRINCIPLES OF OPERATION

4-1. CIRCUIT ANALYSIS.

Block diagram figure 4-1 illustrates the three sections (HFR-1/T, HFR-1/N, and HFR-1/C) of the HFR and the major components of each section.

Signals within the range of 2-mc to 32-mc that are applied to the r-f amplifier chain undergo four stages of amplification and are mixed with an HFO frequency of 3.75 mc to 33.75 mc to produce a 1.75 mc i-f at the output of mixer V1005. A front panel RF LEVEL meter, associated with the AGC circuit, indicates incoming signal strength. Isolation amplifier V1006 isolates the HFO from mixer V1005 and from the alignment signal generator stage to prevent HFO frequency modulation.

The 1.75 mc i-f signal from V1005 is amplified by V1201, and applied simultaneously to i-f amplifiers V1202 and V1203 and to the noise silencer stage comprising gate amplifiers V1204 and V1205. Negative pulses corresponding to the impulse noise contained in the i-f signal are generated in the noise silencer stage and fed back to V1202 and V1203 so that noise does not appear in the amplified output. When the NOISE SILENCER/OFF/ALIGNMENT SIGNAL control knob is set at OFF, relay K1201 grounds the negative pulse output of the noise silencer stage thereby making the noise silencer ineffective.

The alignment signal generator, comprising balanced modulator V1301 and mixer V1302, combines the HFO output signal with a 2 mc and a 250 kc signal from the associated synthesizer to produce an alignment signal for calibration and sensitivity checks. The exact frequency of the alignment signal coincides with the setting of the BAND and TUNE controls.

D-c correction voltage required to maintain system synchronization is extended to SYNCHRONIZE meter amplifier V1304 from the associated synthesizer. V1304 amplifies the DC correction voltage and applies it to the SYNCHRONIZE meter which in turn displays the amount and polarity of the DC correction voltage. When the TUNE/SYNC/OPERATE control knob is set at TUNE or SYNC, switch S1002 grounds the d-c correction voltage from the synthesized unit thereby making the SYNCHRONIZE meter amplifier circuit ineffective.

Voltage regulator V1303 furnishes a constant 150 vdc for the HFO plate circuit, and the low voltage power supply incorporated in the HFR furnishes:

a. Plus 28 vdc for the proportional oven control and for the frequency standard in the associated synthesizer.

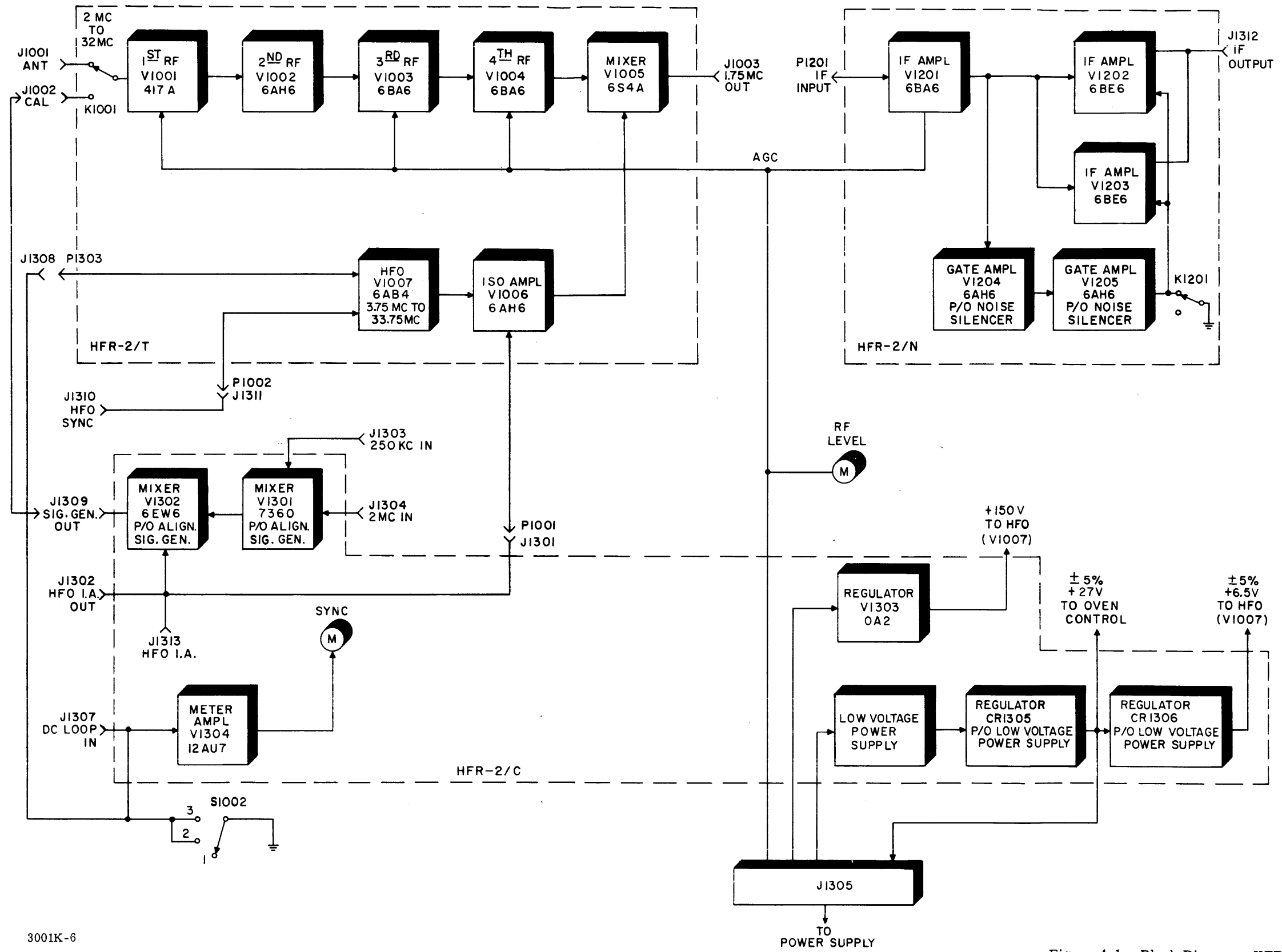
b. Plus 32 vdc for the HFO oven heater circuits.

c. Regulated 6.3 vdc for the HFO (V1007) filament.

4-2. DETAILED CIRCUIT ANALYSIS, HFR-2/T.

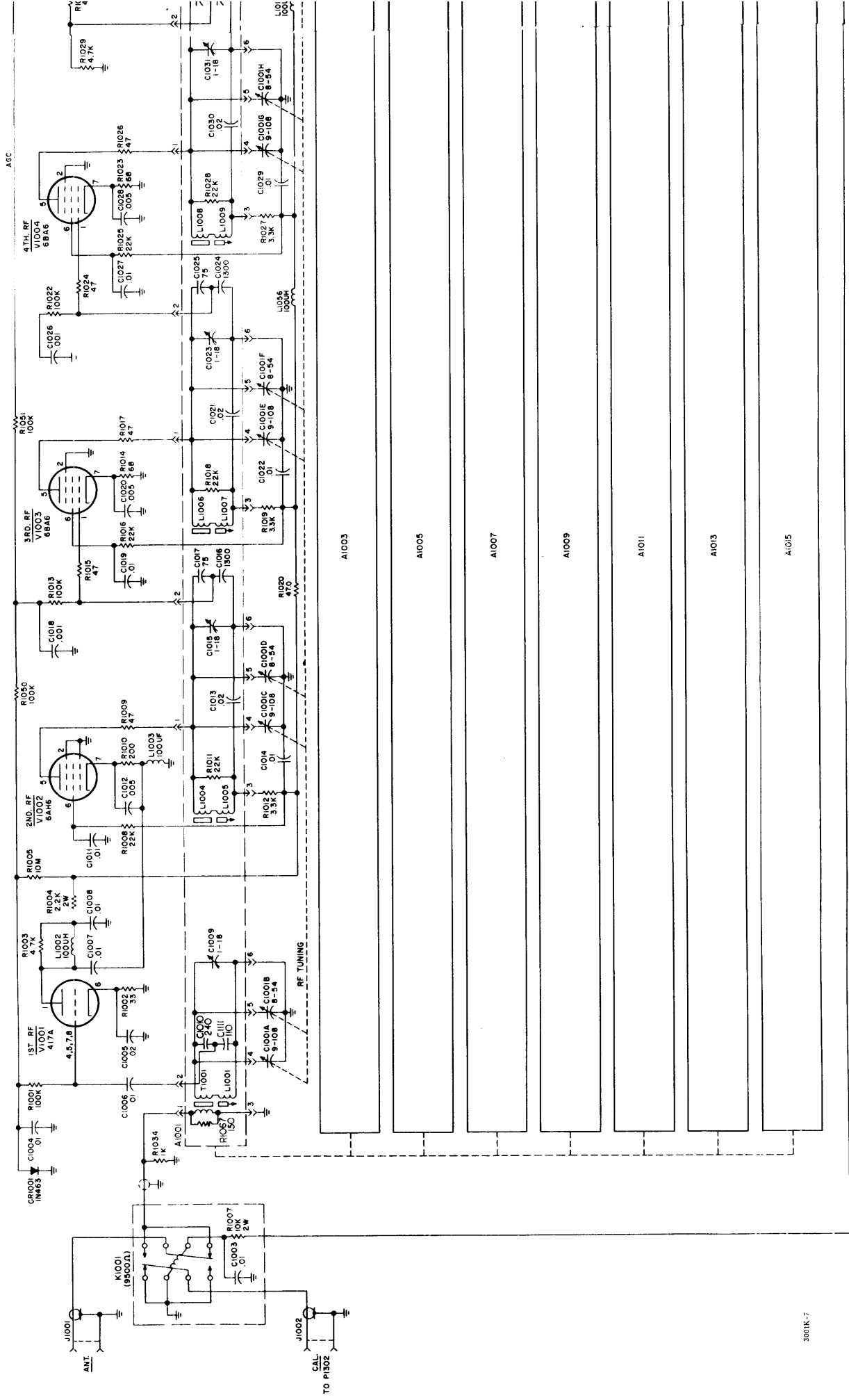
a. INPUT CIRCUIT AND RF AMPLIFIER CHAIN. - See figure 4-2. The input circuits and rf amplifier chain comprise ANT-CAL relay K1001; r-f tuner strips A1001 through A1015 (corresponding to the eight receiver bands); r-f amplifiers V1001, V1002, V1003, and V1004; and tuning capacitor C1001. Depending upon the position of relay K1001, alignment or antenna input signals within the range of 2 mc to 32 mc are extended through one of eight tuned r-f circuits (A1001 through A1015), amplified by V1001, V1002, V1003, and V1004, odd assembly designations, and applied to mixer V1005. Turret contacts engage fixed chassis contacts to connect the required elements of amplifiers V1001 through V1004, RF tuner strips A1001 through A1015, and tuning capacitor C1001. Simplified schematic diagram (figure 4-3) shows the circuit components between V1002 and V1003 in the BAND 1 position (RF tuner A1001 engaged); circuit configurations for RF tuner strips A1003 through A1015 and other sections of tuning capacitor C1001 are similar. C1016 and C1017 form a capacitive voltage divider that determines the drive and impedance presented to the following stage. C1001C and C1001D are the main tuning capacitors for this stage. R1012 and C1014 form a decoupling network. Swamping resistor R1011 adjusts the circuit Q for the required bandpass. R1009 and R1015 are parasitic suppressors. C1015 is the trimmer for this stage, and is adjusted at the high end of the tuning range. Bypass capacitor C1013 places the "bottom" of the tank at RF ground. L1004 is a fixed toroid coil. L1005 is a slug tuned coil adjusted at the low end of the tuning range.

V1003 and V1004 are conventional tuned r-f stages. V1001, a low noise triode, is cascade connected to the cathode circuit of grounded grid amplifier V1002. Low noise rather than gain is the primary consideration of these stages. AGC from the associated i-f unit is applied to V1001, V1003, and V1004 through a delay circuit, as shown in figure 4-4; maximum delay is given to low gain amplifier V1001. CR1001 clamps the junction of R1001 and R1005 at a very slight positive potential which is developed across the voltage divider formed by CR1001 and C1001. Weak AGC voltages have little or no effect on V1001; with normal AGC voltages, CR1001 is cut off and V1001 receives a delayed AGC that is developed across resistors R1050 and R1051. AGC is felt with decreasing effect by V1004, V1003, and V1001.



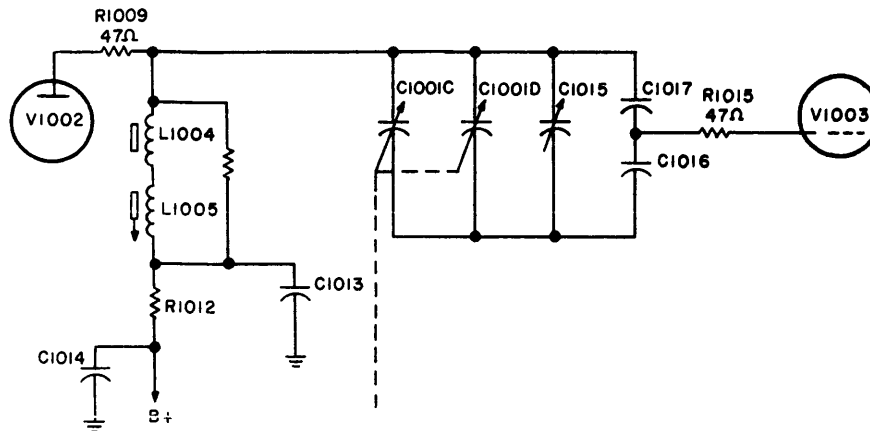
3001K-6

Figure 4-1. Block Diagram, HFR



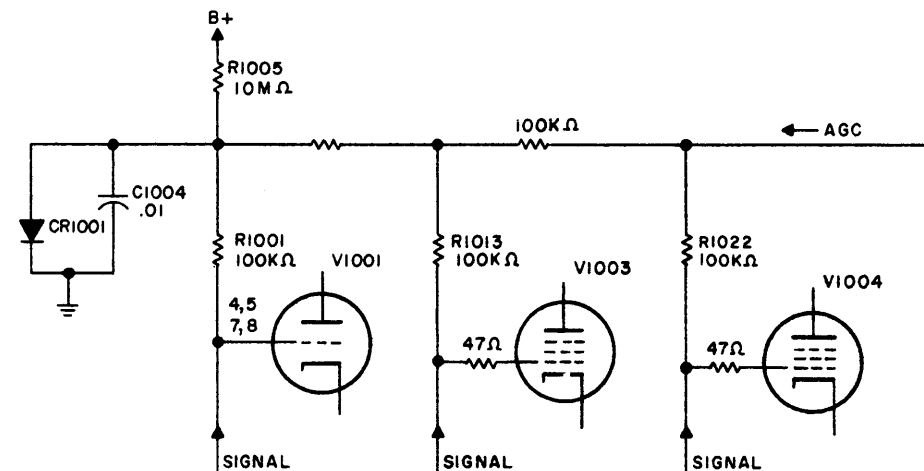
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010653001K



3001K-8

Figure 4-3. V1002 and V1003 Stages (A1001 Tuner Strip Engaged)



3001K-9

Figure 4-4. AGC, Simplified Schematic Diagram

b. **FIRST MIXER CIRCUIT.** - See figure 4-2. The first mixer circuit comprises triode V1005 and transformer T1002. The amplified output signal from V1004 and the HFO output signal from the plate of V1006 are applied to the V1005 control grid and cathode circuits respectively.

Transformer T1002, resonant at 1.75 mc and designed to allow the full bandpass of more than 15 kc, couples the V1005 output signal to jack J1003. Cathode bias places the control grid of V1005 at about -11 volts negative with respect to the cathode, and both input signals are held below 1 volt; this combination reduces intermodulation products in the converted output signal about 60 db below the desired output signal.

c. **HFO AND ISOLATION AMPLIFIER.** - See figure 4-2. The HFO and isolation amplifier circuit comprises high frequency oscillator V1007; isolation amplifier V1006; tuning capacitor C1002, oven heaters HR1001 and HR1002; thermistor RT1001; proportional oven control A1301; a Varicap circuit consisting of

C1048, C1049, C1051, C1052, C1053, R1004, and R1045; and oscillator tuner strips A1002 through A1016, even assembly designations. Turret contacts engage fixed chassis contacts to connect V1007 and HFO CYND INPUT jack J1311 to the required elements of oscillator tuner strips A1002 through A1016, tuning capacitor C1002, and the Varicap circuit.

The HFO is a modified Colpitts (Vacker) circuit enclosed in an oven that is closely regulated by proportional oven control A1301. Oven temperature is maintained at $75^{\circ}\text{C} \pm 1/2$ degree in the following manner:

(1) Changes in oven temperature cause corresponding changes in the resistance of thermistor RT1001.

(2) A1301 responds to resistance changes of RT1001 and changes the conduction through oven heaters HR1001 and HR1002 accordingly to maintain a constant oven temperature.

In synthesized operation, HFO frequency is controlled by the Varicap circuit shown in simplified schematic figure 4-5. A d-c correction voltage from the synthesizer unit biases C1049 and C1051 thereby changing the capacity shunting C1002A and C1002B. Figure 4-5 shows the Varicap and tuning capacitors connected to oscillator tuner strip A1002 (BAND 1 position); circuit configurations for oscillator tuner strips A1004 through A1016 are similar. Both sections of C1002 are not utilized with all tuner strips; regardless of the tuner strip engaged, at least one Varicap control is inserted to "pull" the frequency as required.

Isolation amplifier V1006 presents a constant load to the grid of V1007 and thus prevents HFO frequency modulation.

4-3. DETAILED CIRCUIT ANALYSIS, HFR-2/N.

a. 1.75 MC IF OUTPUT AMPLIFIER. - See figure 4-5. The i-f output amplifier comprises amplifiers V1201, V1202, and V1203; and transformers T1201, T1202, and T1203. 1.75 mc first i-f (with full bandpass) from mixer V1005 is coupled to V1201 grid by transformer T1201. A 15K ohm swamping resistor in the secondary of T1201 assures that full bandpass is preserved. The amplified output signal from V1201 is coupled to the grids of push-pull amplifiers V1202 and V1203 by transformer T1202, is amplified, and is coupled to 50 ohm output jack J1312 by transformer T1203. Control grids 1 of V1202 and V1203 are configured to cut off these stages when negative spikes are received from the noise silencer (refer to paragraph 4-3, b). These control grids do not affect the operation of V1202 or V1203 except in the presence of impulse noise.

b. NOISE SILENCER. - See figure 4-6. The noise silencer comprises high gain cascade connected

amplifiers V1204 and V1205; a self contained AGC system containing diodes CR1202, CR1203, and CR1204; and a pulse detector and spike generator circuit containing diodes CR1205, CR1206, and CR1207. V1204 and V1205 stages contain their own AGC loop to improve stability. The output of i-f amplifier V1201 is coupled to the grid of V1204 by capacitor C1205, amplified by V1204 and V1205, and applied to the AGC loop and to the pulse detector and spike generator circuit. Figure 4-7 is a simplified schematic diagram of the pulse detector and spike generator.

The amplified 1.75 mc i-f output signal from V1205 is coupled to the cathode of CR1207 and to the anode of CR1206 by C1228 and C1229 respectively. On negative excursions of the input signal, C1227 discharges through CR1205. On positive excursions however, a positive voltage is developed at the cathode of CR1206. Filtering and voltage reduction takes place in network composed of R1233, C1230, R1232, C1227, and R1231; trimmer C1231 adjusts the voltage output of this rectifier filter network. The positive voltage output of this network is applied as back bias on diode CR1207. When impulse noise is present in the input signal, the positive impulses drive CR1207 deeper into cutoff. If the impulse noise is of sufficient amplitude, the negative impulses causes CR1207 to conduct and sharp negative spikes are developed across C1226 and R1234. These negative spikes are applied to control grids 1 of i-f amplifiers V1202 and V1203 by means of L1203 and the coupling network comprising R1213 and C1201. L1203 traps out the 1.75 mc carrier to prevent feedback; CR1201 clamps the negative spikes below zero reference. V1202 and V1203 are cut off for the duration of the negative spike thus preventing noise from appearing in the i-f output. When the NOISE SILENCER/OFF/ALIGNMENT SIGNAL control knob is set at OFF, relay K1201 grounds the negative spikes and the noise silencer has no effect on V1202 and V1203 stages.

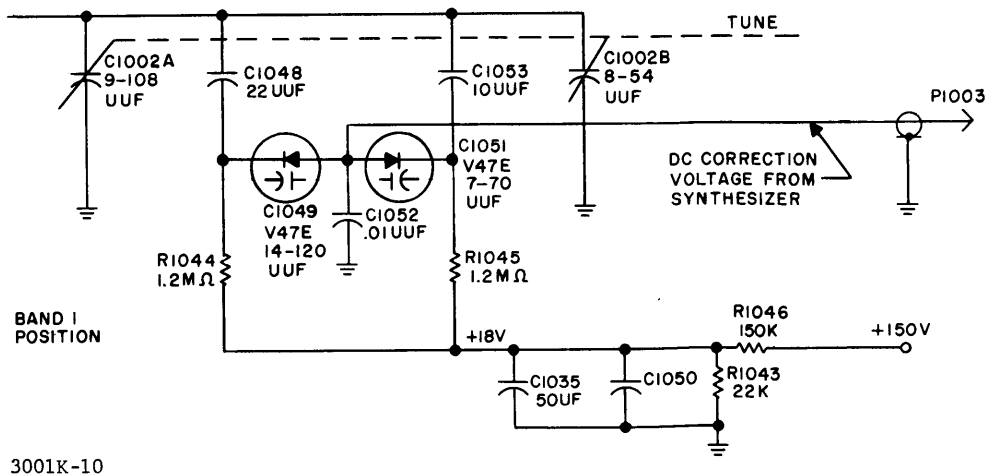
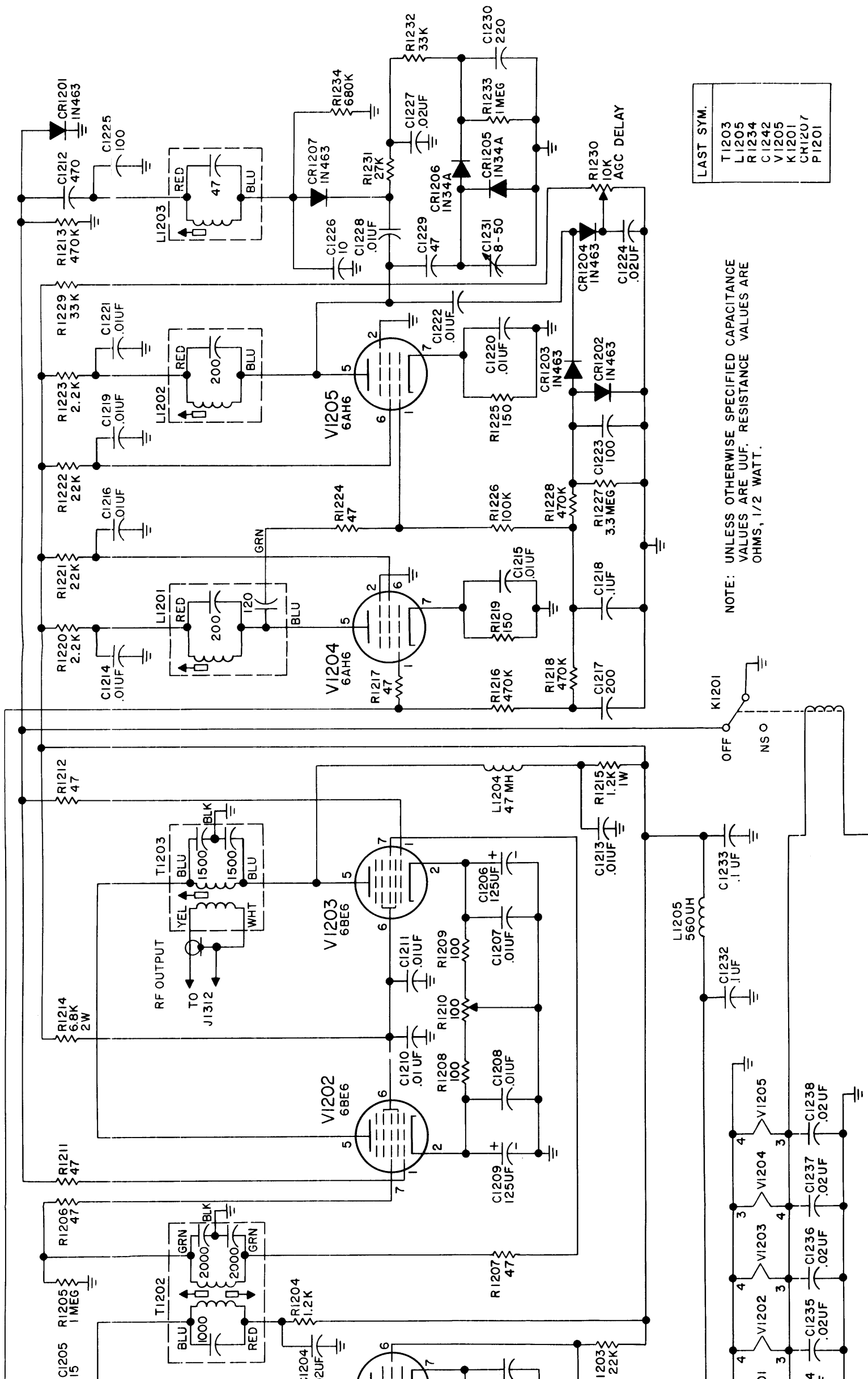


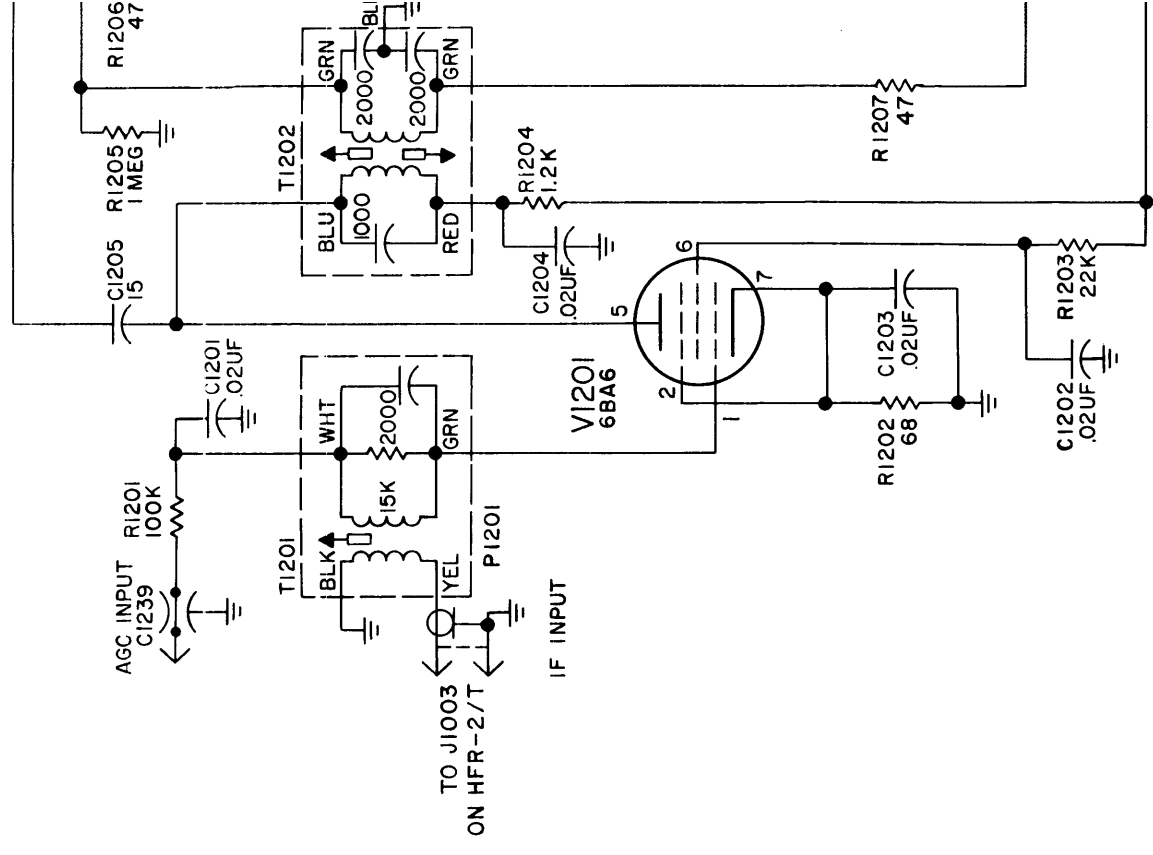
Figure 4-5. Varicap, Simplified Schematic Diagram



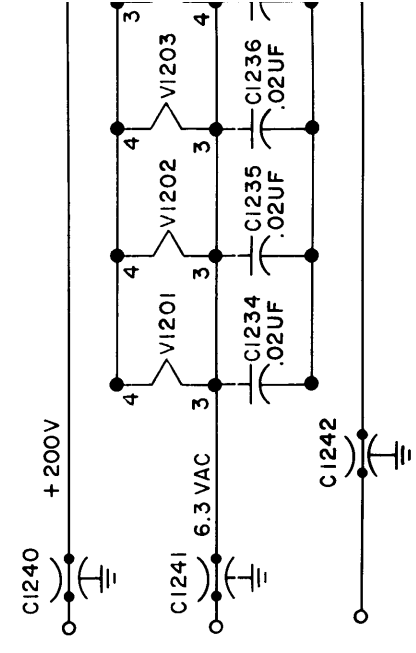
LAST SYM.	
T	1203
L	1205
R	1234
C	1242
V	1205
K	1201
CRI	1207
PI	1201

NOTE: UNLESS OTHERWISE SPECIFIED CAPACITANCE VALUES ARE UUF. RESISTANCE VALUES ARE OHMS, 1/2 WATT.

Figure 4-6. Schematic Diagram, HFR-2/N

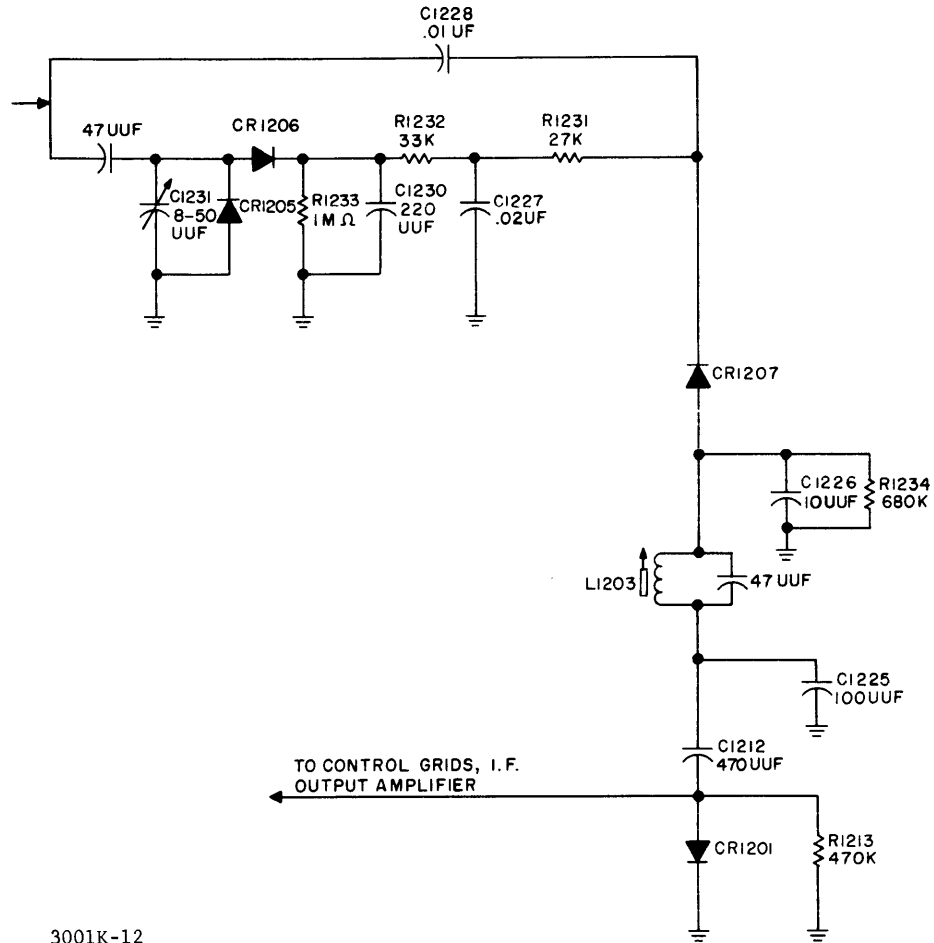


TO J1003
ON HFR-2/T



300IK-11

01065300IK

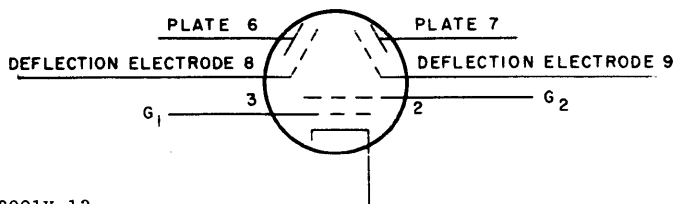


3001K-12

Figure 4-7. Pulse Detector and Spike Generator, Simplified Schematic Diagram

4-4. DETAILED CIRCUIT ANALYSIS, HFR-2/C.

a. ALIGNMENT SIGNAL GENERATOR. - See figure 4-9. The alignment signal generator comprises balanced modulator V1301 and mixer V1302. V1301 is a beam deflection tube, arranged as shown in figure 4-8. Total beam current is determined by the voltages on G₁ (pin 3) and G₂ (pin 2). However, the amount of current collected by plate 6 or 7 is determined by the difference of potential between deflection electrodes 8 and 9. If there is no difference in potential on the deflection electrodes, there is no plate current.



3001K-13

Figure 4-8. Electrode Arrangement, V1301

A 2-mc and a 250-kc signal from the associated synthesizer are applied to the control grid (pin 3) and to deflection electrode 8 respectively of V1301. Unbalance of deflection electrodes 8 and 9, due to application of the 250 kc signal, results in V1301 mixer action. Transformer T1301 couples the difference frequency output signal (1.75 mc) to the cathode circuit of mixer V1302. V1302 mixes this 1.75 mc signal with the V1006 output signal (HFO frequency) which is applied to the control grid of V1302 by means of jack J1301. The V1302 output signal is coupled to SIG GEN OUT jack J1309.

Voltage divider networks comprising R1307 through R1310 and R1319 fix the deflection electrodes of V1301 at equal DC potential; with no 250 kc signal on deflection electrode 8, there is no output signal. Plate voltage for V1301 and V1302 is controlled by the setting of the NOISE SILENCER/OFF/ALIGNMENT SIGNAL control knob; in the OFF or NOISE SILENCER position, the alignment signal generator is circumvented.

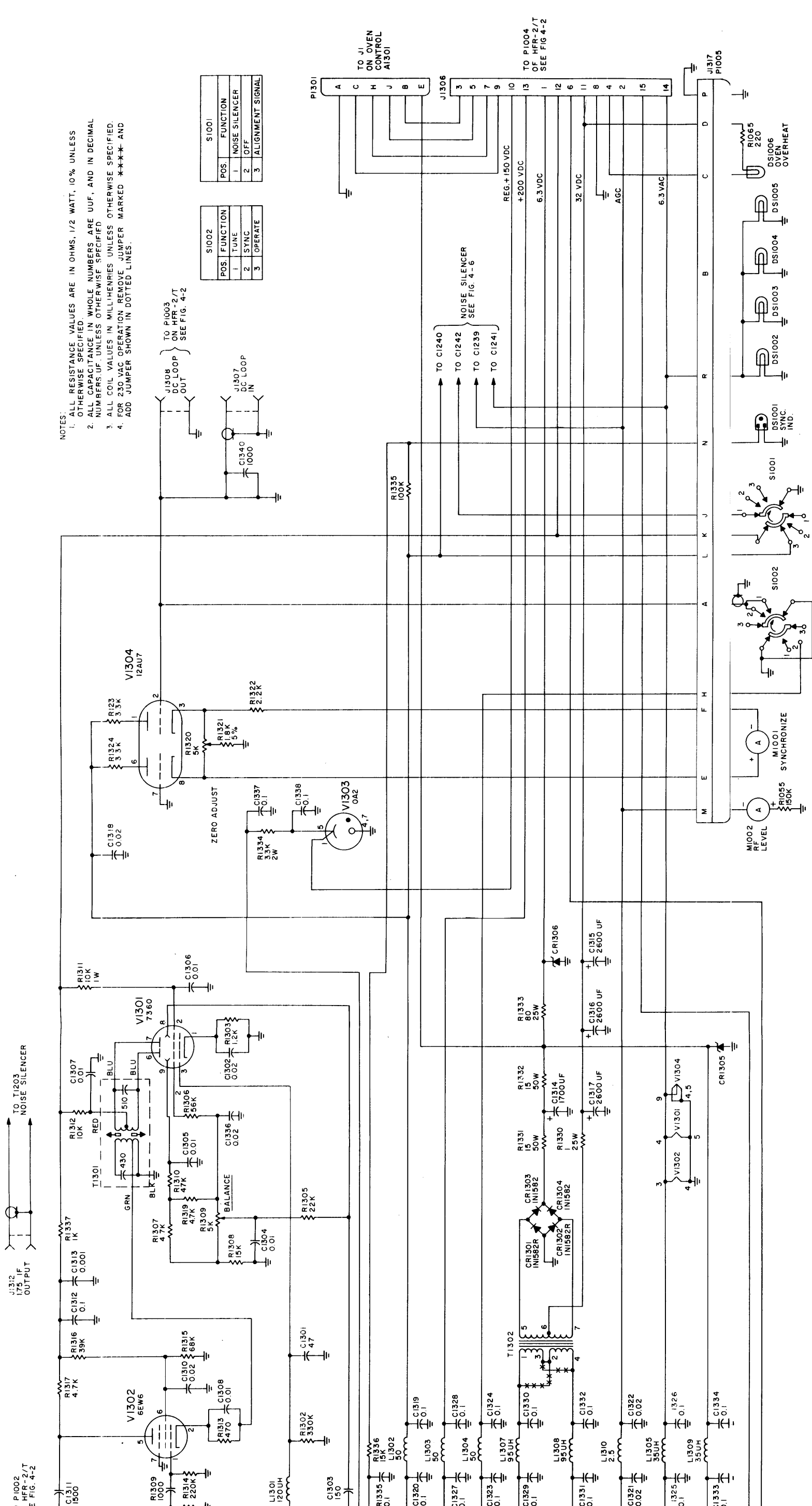
b. SYNCHRONIZE METER AMPLIFIER. - See figure 4-9. The SYNCHRONIZE meter amplifier circuit comprises dual triode V1304, SYNCHRONIZE

meter M1001, and variable resistor R1320. Dual triode V1304 is configured as a balanced bridge in which one half (pins 1, 2, and 3) acts as the variable element. Resistor R1320 is adjusted so that meter M1001 reads zero (center scale) when the control grid (pin 2) of V1304 is grounded. DC correction voltage from the associated synthesizer, applied to J1307 and extended to pin 2 of V1304, creates an unbalanced condition, and current flows through M1001. The off-center reading of M1001 is an indication of the amount and the polarity of d-c correction voltage required to maintain the HFO at the correct frequency.

c. SYNC IND LAMP. - See figure 4-9. The SYNC IND lamp, mounted on the front panel, is controlled from the associated synthesizer. When the system is synchronized, pin N of jack J1305 is ungrounded, and the B+ applied to the high side of SYNC IND lamp DS1001 causes the lamp to light. When the system is not synchronized, a ground applied to pin N of J1305 reduces the voltage on the high side of DS1001, and the lamp does not light.

d. LOW VOLTAGE POWER SUPPLY. - See figure 4-9. The low voltage power supply consists of transformer T1302 and a full wave bridge rectifier comprising diodes CR1301, CR1302, CR1303, and CR1304. Line voltage (115- or 230-vac) applied to the primary of transformer T1302 is stepped down to 61 vac in the secondary, rectified by the full wave bridge, and dropped and regulated at 28 vdc $\pm 5\%$ by resistors R1331 and R1332 and diode CR1305. Plus 28 vdc is extended through plug P1301 to the proportional oven control and through jack J1305 to the frequency standard unit of the associated synthesizer. Plus 28 vdc is further dropped by resistor R1333 and regulated at 6.3 vdc by diode CR1306; 6.3 vdc is extended through jack J1306 to the HFO (V1007) filament.

In addition to their normal function ~~the~~ ^{the} full wave bridge rectifier, diodes CR1301 and CR1302 act as a full wave rectifier to supply 32 vdc for the HFO oven heater circuits. Current flow is from ground, through diode CR1302 or diode CR1301, through the center tap of transformer T1302, through resistor R1330 and jack J1306, to the HFO oven heater circuits.

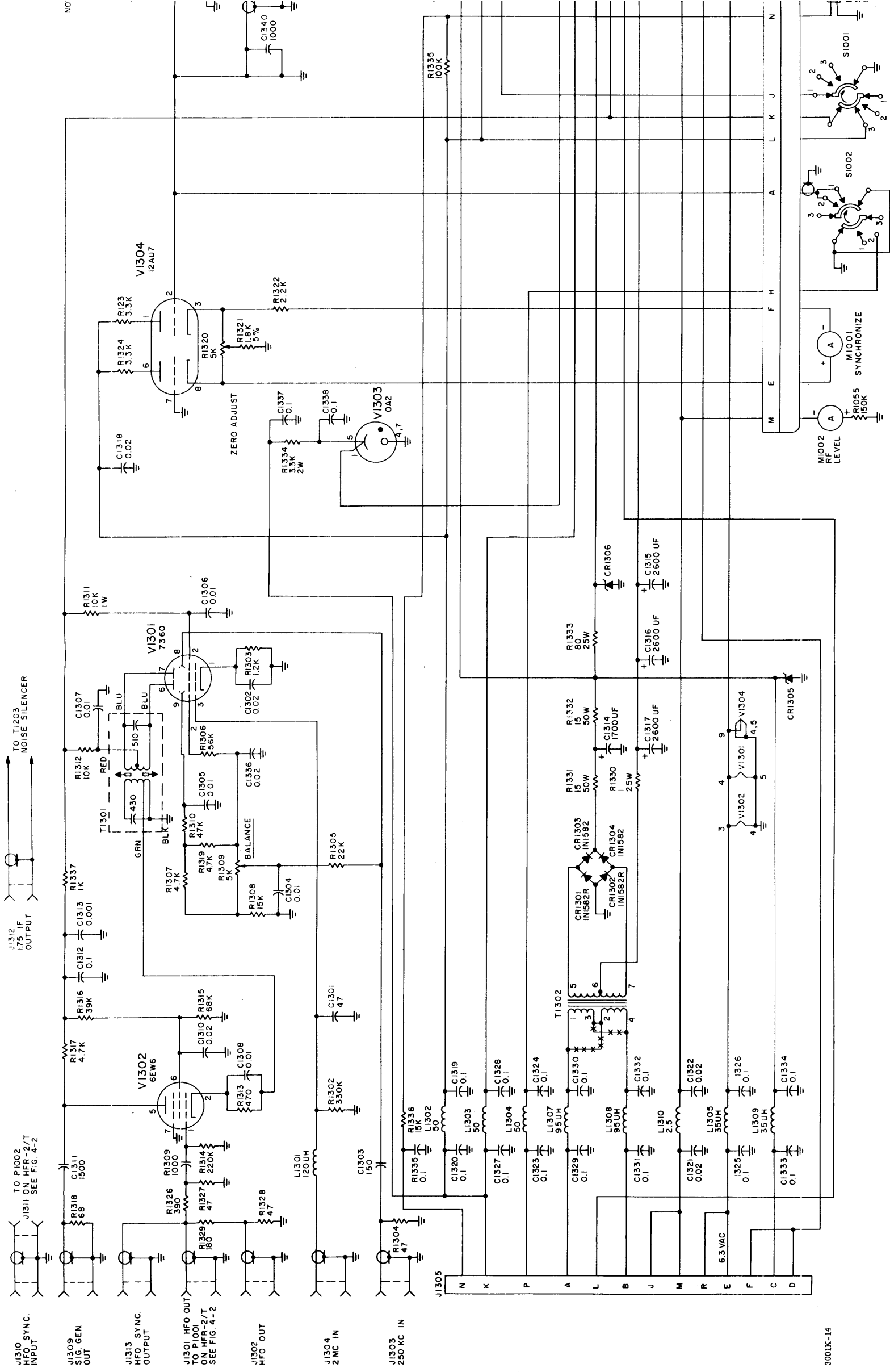


- NOTES:
1. ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, 10% UNLESS OTHERWISE SPECIFIED.
 2. ALL CAPACITANCE IN WHOLE NUMBERS ARE UUF, AND IN DECIMAL NUMBERS OF UNLESS OTHERWISE SPECIFIED.
 3. ALL COIL VALUES IN MILLI-HENRIES UNLESS OTHERWISE SPECIFIED.
 4. FOR 230 VAC OPERATION REMOVE JUMPER MARKED ***** AND ADD JUMPER SHOWN IN DOTTED LINES.

POS.	FUNCTION
1	NOISE SILENCER
2	OFF
3	ALIGNMENT SIGNAL

POS.	FUNCTION
1	TUNE
2	SYNC
3	OPERATE

Figure 4-9. Schematic Diagram, HFR-2/C



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SECTION 5 MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

Periodically, remove the HFR from the rack and inspect for general cleanliness and condition of connections at the rear of the unit. Remove all covers, and check all components for discoloration, damaged wiring, broken or loose solder connections, and corrosion. Clean the components with a soft brush, vacuum cleaner, or clean, dry, filtered, compressed air. Check all hardware for tightness. Inspect tube sockets for any signs of damage or deterioration; inspect tube pins for bent or damaged condition.

WARNING

Electrical parts may be cleaned with any good dry-cleaning fluid, or with trichlorethylene. When using trichlorethylene or carbon tetrachloride, be sure that adequate ventilation exists in the area, and avoid prolonged skin contact with the fluid. Use caution when applying trichlorethylene near painted surfaces, as the fluid may act as a paint remover.

NOTE

Examine the BAND and TUNE gear assemblies contained in the region between the front panel and oven (see figures 5-8 and 5-9). If any of

the gears show signs of becoming dry, coat them heavily with a molybdenum disulphide compound such as Molykote-Type G made by the Alpha Corporation of Greenwich, Conn.

5-2. TROUBLESHOOTING.

a. GENERAL. - When the HFR has been working satisfactorily and suddenly fails, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures. In these cases, it is unnecessary to follow a lengthy and orderly course of troubleshooting in order to localize and isolate the faulty part.

Ascertain that all tubes are in proper working order, and that the HFR is receiving proper supply voltages. This simple procedure may eliminate further investigation.

Examine the HFR, section by section, for burned out components, charring, corrosion, arcing, excessive heat, dirt, dampness, etc.

Refer to figures 5-1 through 5-3 for locating major components of the HFR. (Also refer to Section 4, and to Schematic Diagrams, Section 7).

Test equipment and special tools used for troubleshooting (and for alignment procedures, paragraph 5-4) are listed in table 5-1.

TABLE 5-1. TEST EQUIPMENT AND SPECIAL TOOLS

ITEM	MANUFACTURER
TEST EQUIPMENT	
Signal generator (Hewlett Packard, Model 606A, or equivalent)	Measurements, Model 82, or equivalent.
Vacuum Tube Voltmeter, with RF probe	Hewlett Packard, Model 410B, or equivalent.
Electronic Counter	Hewlett Packard, Model 524C, or equivalent.
Power Supply (tested)	TMC, Model HFP-1.
Thermometer	Rascher & Betzold #14-4470.
High Sensitivity Oscilloscope	Tektronix, Model 545, or equivalent.
Pad (for use with signal generator)	Measurements Model 80-2H3.
Cable (for use with signal generator)	TMC CA-480-3-48.
Cable (for use with electronic counter)	TMC CA-480-3-48.

TABLE 5-1. TEST EQUIPMENT AND SPECIAL TOOLS (CONT)

ITEM	MANUFACTURER
Cable (for use with power supply)	TMC CA-704.
Connector Plug (for use with power supply)	TMC PL212-3, modified (strap terminals U and P).
Line cord for AC power (for use with power supply)	CA-696 modified.
47 ohm 1/2 watt resistor	CA-696 modified.
TOOLS	
Alignment tool	TMC TP114
Alignment tool	TMC TP115
3/16" Spintite	Xcelite #HS-6 modified (3/16" hole drilled through plastic handle).
1/4" Spintite	Xcelite #HS-8 modified (3/16" hold drilled through plastic handle).
5/15" Spintite	Xcelite #HS-10 modified (3/16" hole drilled through plastic handle).
1/8" Blade screwdriver 8" long.	Xcelite R188 modified (hollow ground to .013").
Miniature tube puller (7 pin)	Kellems #1116
Noval tube puller (9 pin)	Kellems #1316

b. **VOLTAGE AND RESISTANCE MEASUREMENTS.** - Nominal tube socket voltage measurements are provided in table 5-2; proportional oven control, and J1 connector voltage measurements are provided in table 5-3. Tube socket resistance measurements are listed in table 5-4.

NOTE

Large deviations from the nominal values should be investigated. Proportional oven control components are accessible only through unit disassembly, and therefore should be tested only as a last resort.

c. **LOCALIZING TROUBLES.** - Table 5-5 outlines a systematic approach for localizing troubles to a functional component of the HFR. Procedures given in table 5-5 assume that there is an input signal, but no output signal for all eight bands. If, however a no-output signal condition is confined to one band, table 5-5 should be ignored, and troubleshooting should start with paragraph 5-2, d. In the case of weak or distorted output signals, only the procedures given in paragraph 5-2, d through 5-2, f and the alignment procedures given in paragraph 5-4 need to be used.

Before connecting the power cable to J1305 as indicated in table 5-5, a resistance check should be made in order to prevent unnecessary damage to equipment caused by shorted B+ and a-c lines, reduce shock hazard, and circuit failures.

Using Simpson 260 ohmmeter (or equivalent), the following resistance to ground measurements should result:

- (1) RF Power Plug P1004 disconnected.

Pin "K" = 20K ohms, S1001 at "ALIGNMENT SIGNAL"
= 32K ohms, S1001 at "OFF"

- (2) RF Power Plug P1004 connected.

Pin "K" = 10K ohms, S1001 at "ALIGNMENT SIGNAL"
= 27K ohms, S1001 at "OFF" and
= 27K ohms, BAND switch on BAND 1, Tune r-f tuning from stop-to-stop.

- (3) Pin "A" = Infinite (open)
- (4) Pin "B" = Infinite (open)
- (5) Pin "L" = 0 (short)
- (6) Pins "D" & "F" = 0 (short)
- (7) Pins "E" & "R" = 0 (short)
- (8) Pin "C" = 85 ohms (ohmmeter must be polarized positive).

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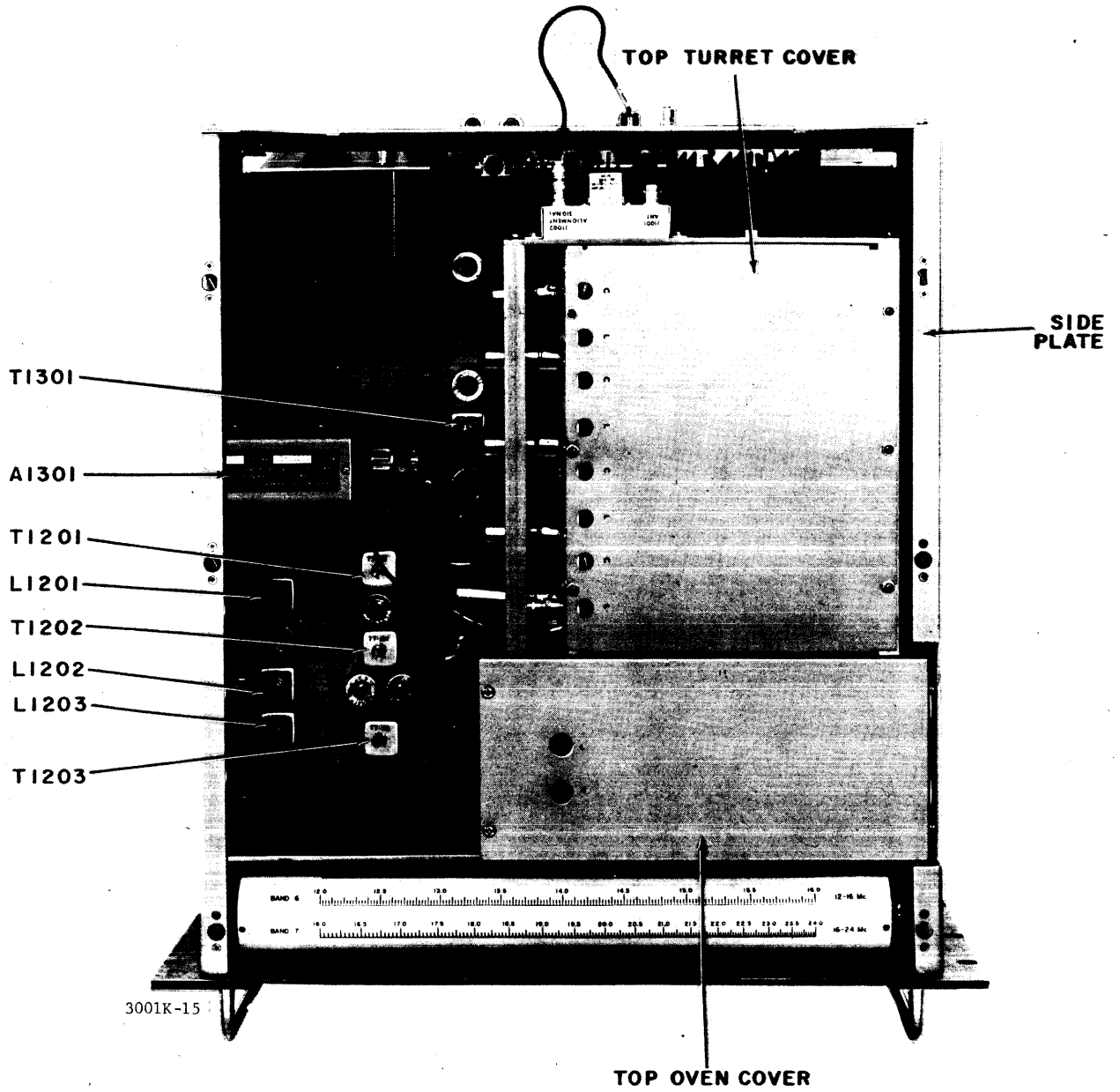


Figure 5-1. HFR, Location of Components, Top View

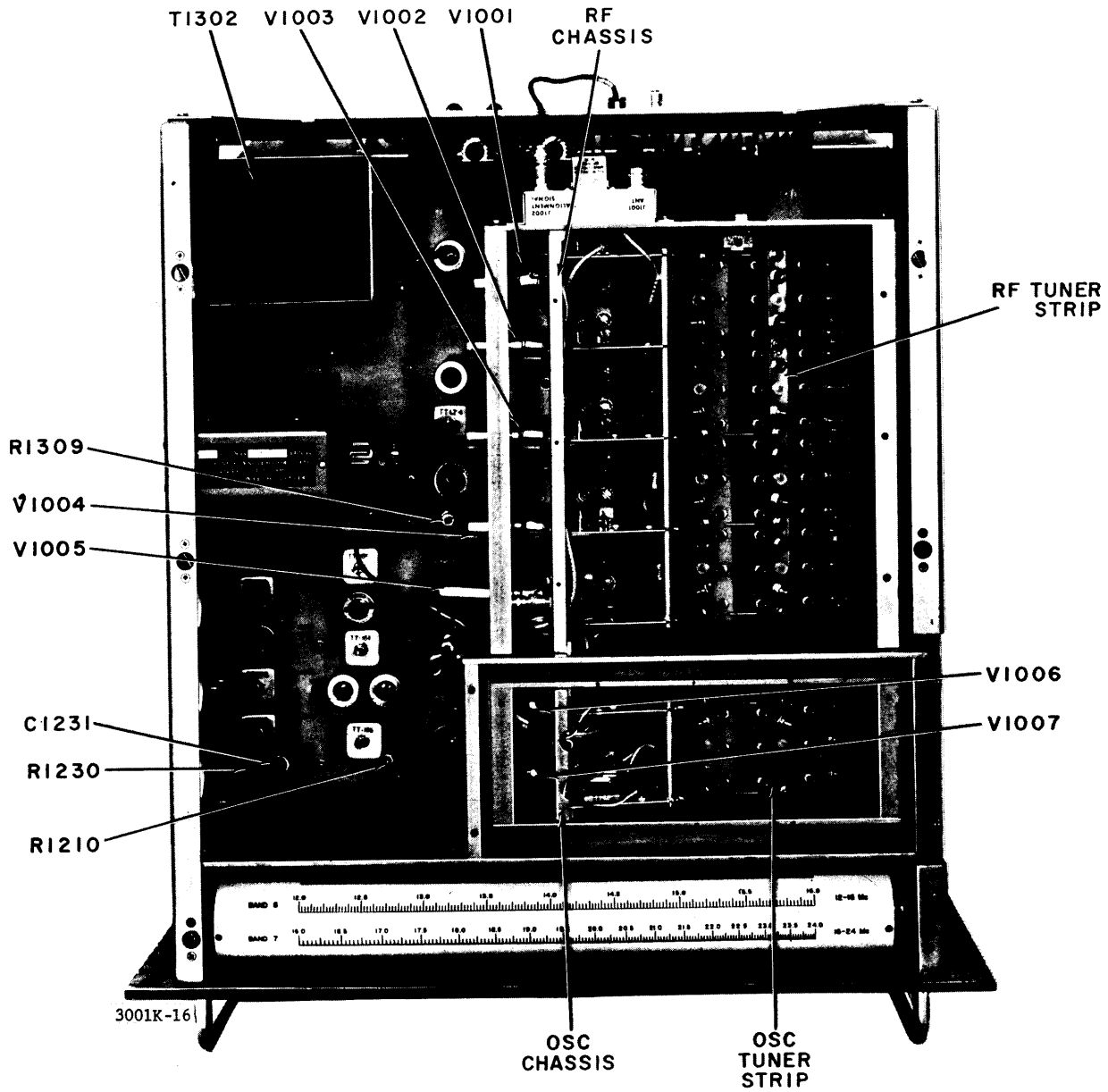


Figure 5-2. HFR, Location of Components, Top View with Turret Cover and Oven Cover Removed

657-15-9

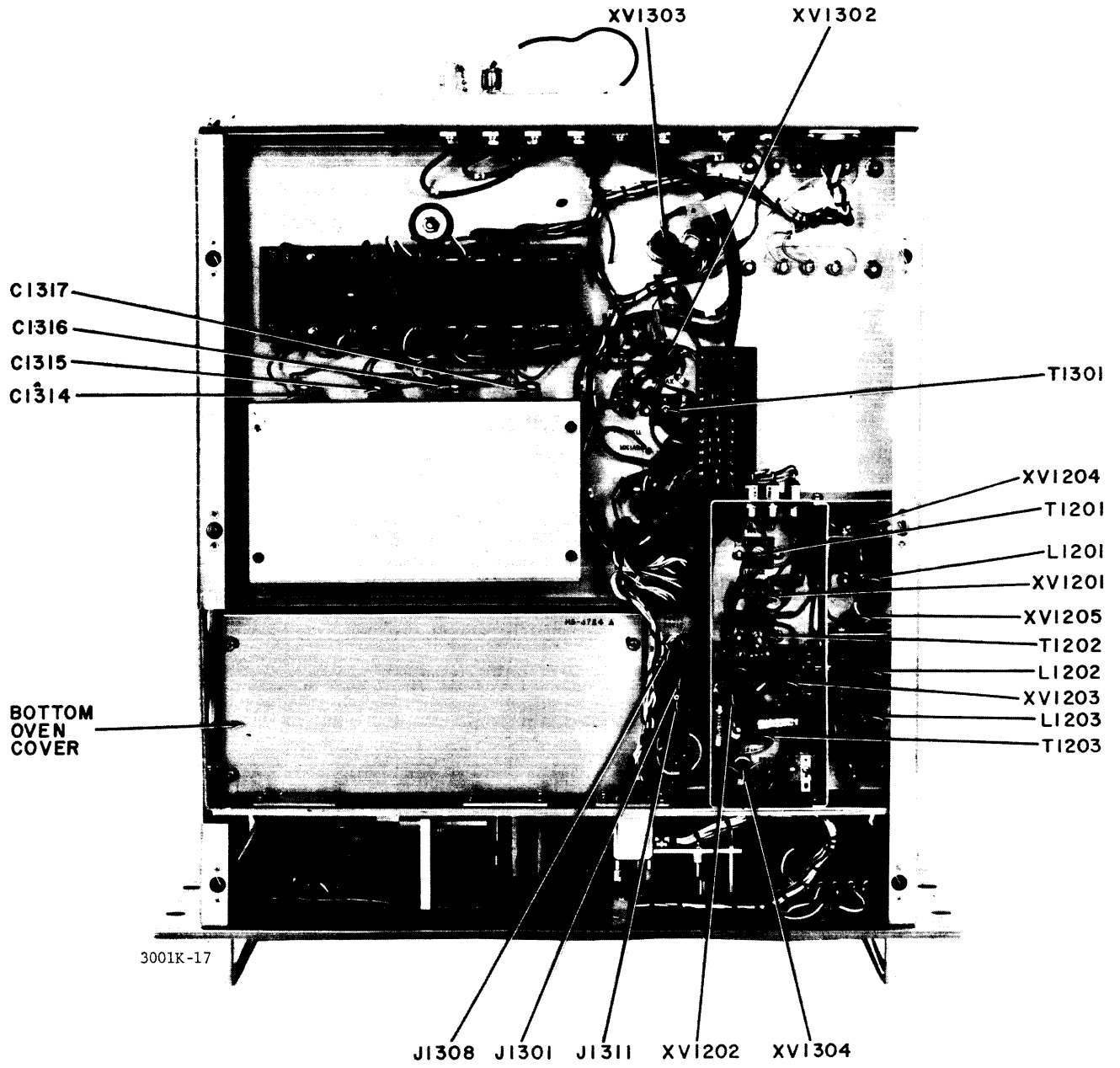


Figure 5-3. HFR, Location of Components, Bottom View

TABLE 5-2. HFR, TUBE SOCKET VOLTAGE MEASUREMENTS

TUBE SYMBOL	FUNCTION	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V1001 417A	1st RF Amplifier	+118	-	0	+0.43	+0.43	+0.91	+0.43	+0.43	6.3 A-C
V1002 6AH6	2nd RF Amplifier	0	0	0	6.3 A-C	+154	+154	+1.7	-	-
V1003 6BA6	3rd RF Amplifier	+0.3	0	0	6.3 A-C	+159	+97	+0.95	-	-
V1004 6BA6	4th RF Amplifier	+0.2	0	0	6.3 A-C	+155	+107	+0.92	-	-
V1005 6S4A	1st Mixer	-	+10.5	0	6.3 A-C	0	0	-	-	+187
V1006 6AH6	Isolation Amplifier	0	+1.72 (I)	0	6.3 A-C	+140	+140	+1.72 (I)	-	-
V1007 6AB4	HF Oscillator	+112	-	0	+6.3	-1.5 to -2.5 (II)	-1.5 to -2.5 (II)	0	-	-
V1201 6BA6	1.75 MC IF Amplifier	0 (III)	+1.1	6.3 A-C	0	+177	+103	+1.1	-	-
V1202 6BE6	1.75 MC Push-Pull IF	0	+1.45 (IV)	6.3 A-C	0	+180	+83	0	-	-
V1203 6BE6	1.75 MC Push-Pull IF	0	+1.45 (IV)	6.3 A-C	0	+180	+83	0	-	-
V1204 6AH6	1st Noise Silencer Amp.	0	0	0	6.3 A-C	+170	+142	+1.6	-	-
V1205 6AH6	2nd Noise Silencer Amp.	0	0	6.3 A-C	0	+170	+143	+1.6	-	-
V1301 7360	Balanced Modulator	+3.5	+160	0	6.3 A-C	0	+165	+165	+38 (V)	+38 (V)
V1302 6EW6	RF Align. Output	0	+3	6.3 A-C	0	+186 (V)	+120 (V)	0	-	-
V1303 OA2	+150V Voltage Regulator	+150	-	-	0	+150	-	0	-	-
V1304 12AU7	Meter Sync.	+183	0 (VI)	+9.1 (VII)	0	0	+183	0	+9.1 (VII)	6.3 A-C

(I) J1313 terminated 47Ω. (II) After Alignment, BAND 1 to 8. (III) At zero signal. (IV) R1210 Adjusted for balance. (V) R1309 Adjusted for balance, S1001 on ALIGN. SIGNAL. (VI) S1002 on Tune. (VII) R1320 adjusted for balance. 6.3v a-c voltages are ±10%.

TABLE 5-3. HFR, PROPORTIONAL OVEN CONTROL VOLTAGE MEASUREMENTS

SYMBOL & TYPE	FUNCTION	EMITTER		BASE		COLLECTOR		DIODES	
		ROOM TEMP.	OVEN TEMP.	ROOM TEMP.	OVEN TEMP.	ROOM TEMP.	OVEN TEMP.	CATHODE	ANODE
Q1 2N338	1st D-C Amplifier	+0.75	+0.75	+0.15	+1.3	+6.9	+3.6		
Q2 2N336	2nd D-C Amplifier	+6.0	+3.6	+6.9	+3.6	+6.8	+15.0		
Q3 2N1701	Driver	+5.3	+3.0	+6.0	+3.6	+5.4	+19.0		
Q4 2N1702	Output	+0.32	+0.17	+5.3	+3.0	+5.4	+19.0		
Q5 2N1702	Output	+0.32	+0.17	+5.3	+3.0	+9.2	--24.0		
CR-1 1N1820	Voltage Regulator							+18.0	0
CR-2 1N758	Voltage Regulator							+9.3	0
CR-3 SG22	Emitter Bias							0	0.75
J1	Connector	Pin A 0	Pin H +0.15 to +1.3	Pin C +9.3	Pin E +28.0	Pin J +5.4 to +19.0	Pin B +9.2 to +24.0		

Room Temperature = 25°C approx. Voltages taken within the first 2 min. after energizing unit.
 Oven Temperature = 72°C to 78°C. Initial setting stabilized to ±1/2°C. Voltages then taken.
 All voltages are ±10% and referred to ground.

TABLE 5-4. HFR, RESISTANCE MEASUREMENTS

TUBE SYMBOL	TYPE	FUNCTION	SOCKET PIN NUMBERS									
			1	2	3	4	5	6	7	8	9	
V1001	417A	RF AMP	38K#		0#	440K#	440K#	33#	440K#	440K#	440K#	0#
V1002	6AH6	RF AMP	0#	0#	0#	0#	38K#	60K#	200#			
V1003	6BA6	RF AMP	330K#	0#	0#	0#	38K#	60K#	68#			
V1004	6BA6	RF AMP	250K#	0#	0#	0#	38K#	60K#	68#			
V1005	6SA4	MIXER		4.17K#	4.7K#	0#	0#	4.7K#				38K#
V1006	6SA4	ISO. AMP.	47K#	0#	0#	0#	39K#	54K#	180#			
V1007	6AB4	HF. OSC.	47K#	0#	0#	0#	100K#	100K#	0#			
V1201	6BA6	IF AMP	120K	68	FIL	0	6K	25K	68			
V1202	6BE6	IF GATE	47	***	FIL	0	6K	10K	1M			
V1203	6BE6	IF GATE	47	***	FIL	0	6K	10K	1M			
V1204	6AH6	GATE AMP	1.5M	0	0	FIL	6K	25K	150			
V1205	6AH6	GATE AMP	580K	0	FIL	0	7K	25K	150			
V1301	7360	1ST MIXER	1.2K	16K	50	FIL	0	20K	20K	20K	40K	65K
V1302	6EW6	2ND MIXER	220K	470	FIL	0	16K	28K	0			
V1303	OA2	VOLTAGE REGULATOR	13K			0	13K		0			
V1304	12AU7	METER AMP	10K	*	**	0	0	10K	0	**	**	FIL

CONDITIONS:

- All Resistances to ground.
 - All power turned off.
 - Measurements taken with Hewlett Packard Model 410 or equivalent.
S1001 set at OFF, and S1002 set at TUNE.
- * Depends on setting of S1002. Either 0 or 600K.
** Depends on setting of R1320. Between 1.8K and 7K.
*** Depends on setting of R1210. Between 100 and 200 ohms.

TABLE 5-5. TROUBLESHOOTING CHART

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1	Connect power supply to J1305 of HFR.	All tubes should light.	<p>If indication is normal, proceed to step 2.</p> <p>If indication is abnormal, check filament voltage (table 5-2). If filament voltage is incorrect, perform point-to-point voltage and resistance measurements; locate and repair or replace faulty component as required. Replace faulty tubes as required. Remove test equipment and restore HFR to service.</p>
2	<p>Using Signal Generator inject a 2-mc unmodulated signal at J1001. Adjust signal generator for 1 mv input signal. Ground AGC of HFR, and tune HFR to 2 mc.</p> <p>Using AC voltmeter, measure signal voltage across primary of T1201.</p>	Voltmeter reading should be 14.5 MV.	<p>If indication is normal, refer to paragraph 5-2, f.</p> <p>If indication is abnormal, proceed to step 3.</p>
3	With signal generator connected as in step 2, HFR tuned to 2 mc and AGC grounded, measure signal voltage across R1029 with AC voltmeter.	Voltmeter reading should be 1.0 V.	<p>If indication is normal, proceed to step 4.</p> <p>If indication is abnormal, proceed to paragraph 5-2, d.</p>
4	With signal generator connected as in step 2, HFR tuned to 2 mc and AGC grounded, measure signal voltage at pin 2 of V1005 with AC voltmeter.	Voltmeter reading should be 1.3 V.	<p>If indication is normal (and indication for step 3 is normal), mixer stage is defective. Perform point-to-point voltage and resistance measurements of V1005 circuitry; locate and repair or replace faulty component as required. Remove test equipment and restore HFR to service.</p> <p>If indication is abnormal, refer to paragraph 5-2, e.</p>

- (9) Pin "N" = 125K ohms, S1301 on "ALIGNMENT"
 = 145K ohms, S1301 on "OFF"
- (10) Pin "P" = Infinite, S1302 on "TUNE" and "OPERATE"
 = 125 ohms, S1302 at "SYNC"
- (11) Pins "M" & "J" = 200K ohms (ohmmeter must be polarized negative).

d. TESTING RF CHAIN. - Proceed as follows:

(1) Connect HFR to power supply (HFP) as shown in connection diagram figure 5-4.

(2) Set TUNE/SYNC/OPERATE and NOISE SILENCER/OFF/ALIGNMENT SIGNAL controls of HFR at TUNE and OFF respectively.

(3) Connect signal generator and VTVM as shown in connection diagram figure 5-4.

NOTE

When performing step 4, HFR must be tuned very carefully to obtain maximum output.

(4) Tune signal generator and HFR to test frequencies of each r-f band as listed in table 5-6. Simultaneously attenuate signal generator for VTVM reading of 1.0 v; input signal voltages should agree with those given in table 5-6.

(5) Use stage-by-stage gain illustration (figure 5-5) in conjunction with table 5-6 as an aid in locating troubles.

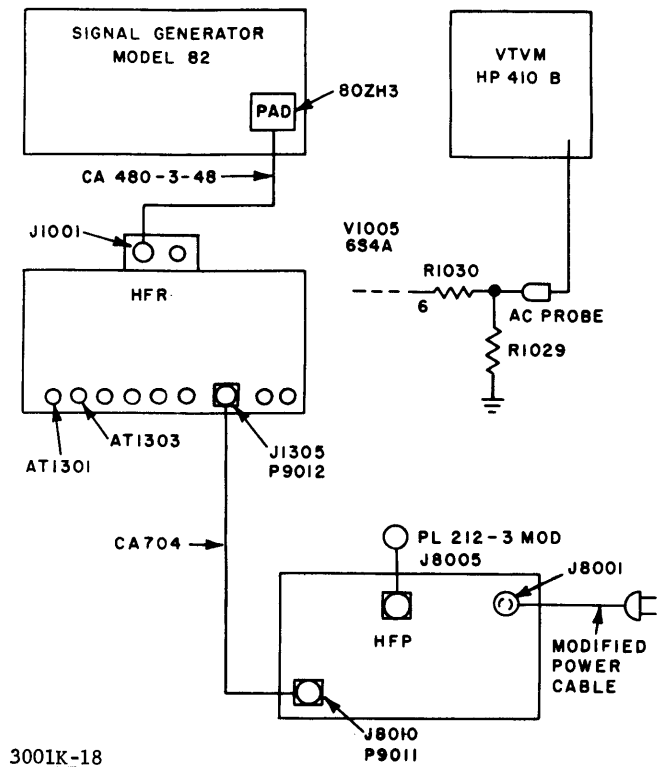


Figure 5-4. Connection Diagram, Testing RF Chain

TABLE 5-6. GAIN, RF STAGES

Output shall be 1.0 v (grid 6S4A mixer V1005). Input shall be 1000 μ v or less (read pad calibration mark). The gain shall be 1000 or more, exceptions are as shown on table.

BAND	FREQ. MC	μ V INPUT LIMITS (FOR 1.0 V OUTPUT)	μ V INPUT TYPICAL	TYP. GAINS (FOR REF.)
1	2	500 to 1000	800	1250
	3	450 to 1000	500	2000
2	3	800 to 1600	1600	625
	4	500 to 1200	1000	1000
3	4	500 to 1100	800	1250
	6	330 to 1000	330	3000
4	6	500 to 1100	1090	920
	8	450 to 1000	500	2000
5	8	500 to 1000	600	1675
	12	330 to 1000	330	3000
6	12	500 to 1000	600	1675
	16	330 to 1000	400	2500
7	16	500 to 1100	800	1250
	24	450 to 1000	500	2000
8	24	450 to 1000	500	2000
	32	500 to 1300	1200	835

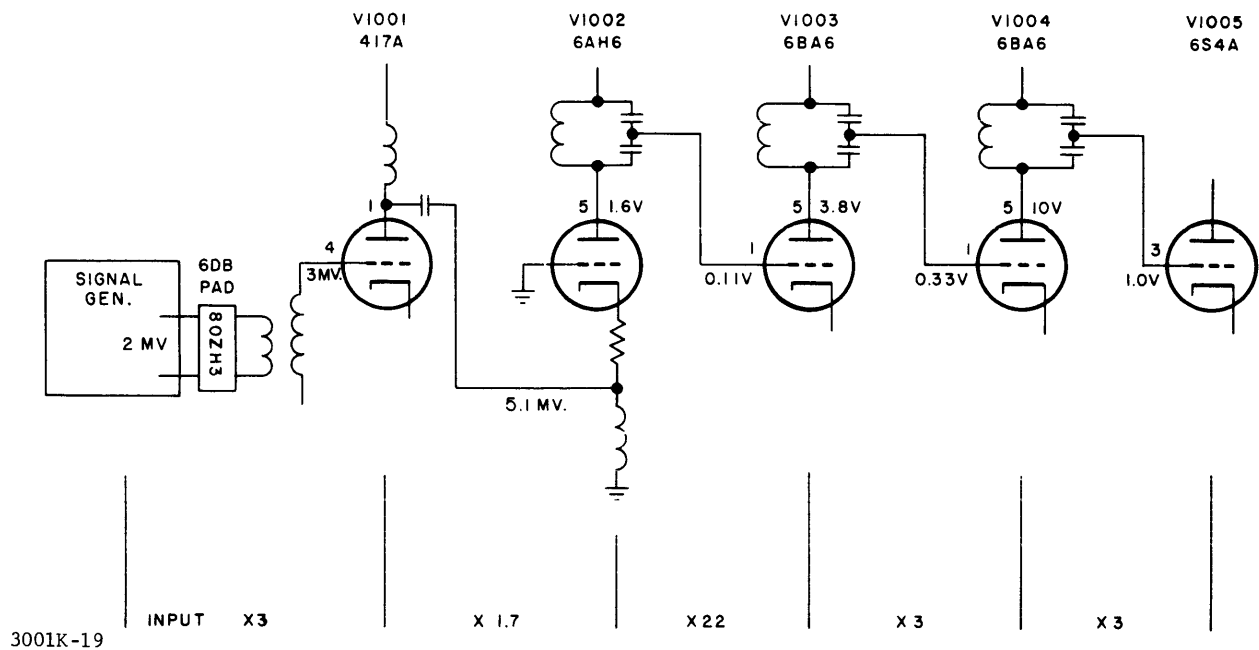


Figure 5-5. Gain of RF Stages

e. TESTING OSCILLATOR OUTPUT. - Proceed as follows:

- (1) Connect power supply to J1305 of HFR.
- (2) Ensure that input to ANT jack J1001 is zero, or that J1001 is disconnected.
- (3) Set TUNE/SYNC/OPERATE and NOISE SILENCER/OFF/ALIGNMENT SIGNAL controls at TUNE and OFF respectively.
- (4) Tune HFR to several frequencies throughout the tuning range, and measure output across R1031, J1313, J1302, and J1310 with VTVM; readings should agree with those given in table 5-7.

TABLE 5-7. OSCILLATOR OUTPUT VOLTAGES

ACROSS	MINIMUM	MAXIMUM
R1031	0.75v	1.3v
J1313	0.2v	0.5v
J1302	40mv	100mv
J1310	20mv	110mv

f. TESTING IF OUTPUT AMPLIFIER. - Proceed as follows:

- (1) Connect signal generator to P1201.
- (2) Tune signal generator for 1.75 mc unmodulated signal; adjust signal generator for 14.5 mv input signal.

(3) Using AC voltmeter, check gain of each stage, as shown in figure 5-6.

g. TESTING OVEN TEMPERATURE AND STABILITY. - Proceed as follows:

CAUTION

BAND control knob must not be turned, during this operation.

(1) Connect power supply to HFR, and allow HFR to warm up for 1-1/2 hours. Approximate time required for oven temperature to stabilize is 1-1/2 hours.

(2) Insert thermometer into oven through hole marked "C". Lower thermometer gently until it comes to rest (figure 5-1).

(3) Allow sufficient time for thermometer to register oven temperature, and note temperature reading. Oven temperature should be between 72°C and 78°C.

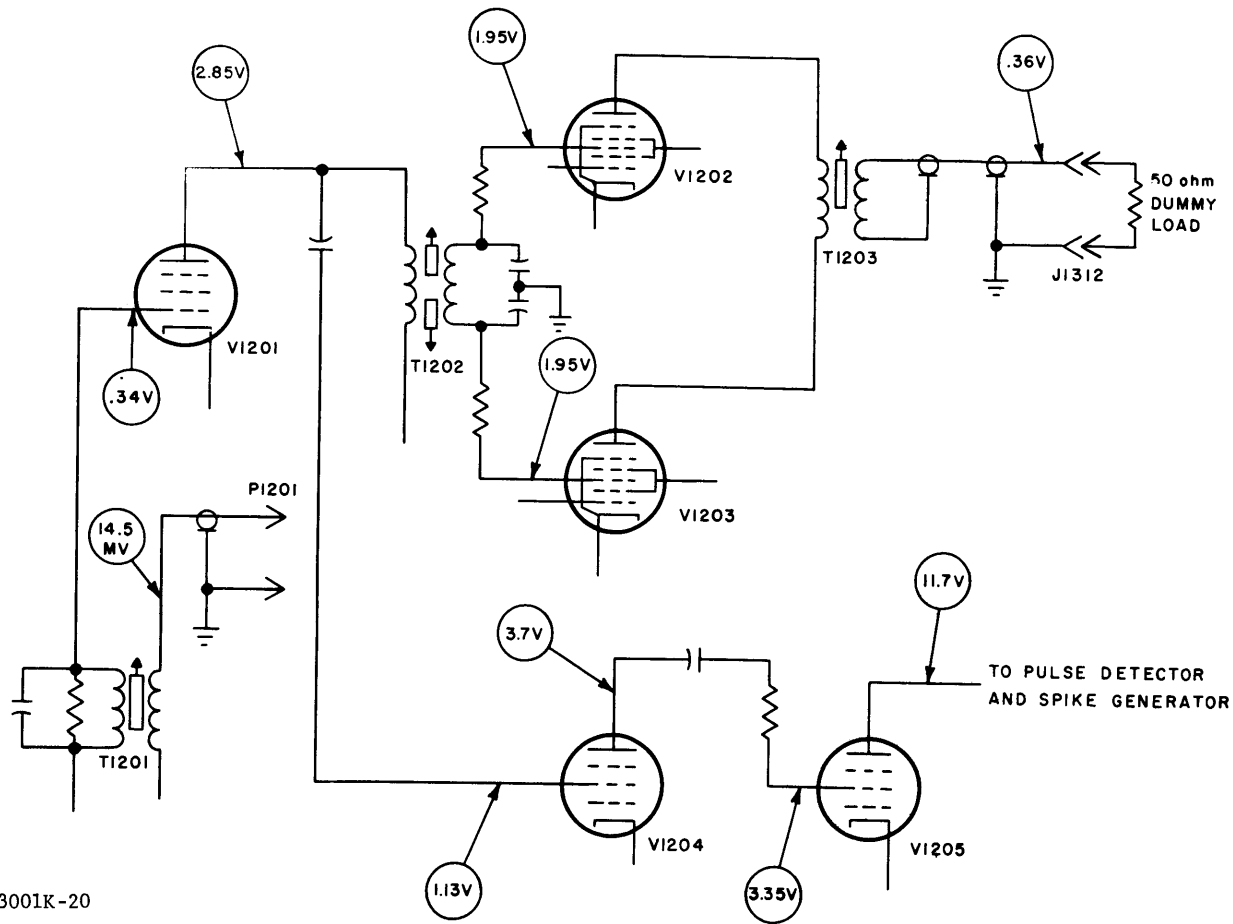
(4) Repeat steps 2 and 3 several times.

(5) Compute average of readings taken in steps 3 and 4; difference between lowest reading and computed average is the oven stability.

(6) Oven stability should be $\pm 0.5^{\circ}\text{C}$.

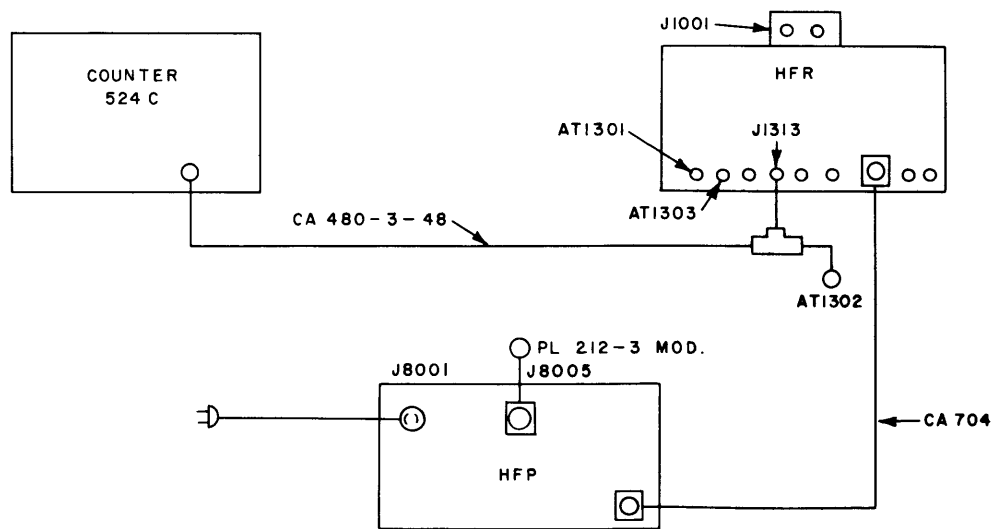
h. CALIBRATION MEGACYCLE DIAL. - Proceed as follows:

(1) Connect electronic counter and associated power supply to HFR as shown in connection diagram figure 5-7.



3001K-20

Figure 5-6. Gain of IF Stages



3001K-21

Figure 5-7. Connection Diagram, Calibrating MEGACYCLE Dial

(2) Ensure that input to ANT jack J1001 is zero or that J1001 is disconnected.

(3) Set TUNE/SYNC/OPERATE and NOISE SILENCER/OFF/ALIGNMENT SIGNAL controls of HFR at TUNE and OFF respectively.

(4) Tune HFR to low and high frequencies of each r-f band, and note counter indications. MEGACYCLE dial calibration should be as shown in table 5-8.

5-3. REPAIR.

Repair of the HFR consists primarily of component replacement; the replacement component must be

identical to defective one (same part number). When replacing diodes, use long-nosed pliers or alligator clips to hold wire leads while soldering, thus transferring heat from the junction and preventing damage to the component.

NOTE

When circuit components of the r-f tuner strips or oscillator tuner strips fail, necessary time-consuming realignment procedures involved with replacement of singular components makes replacement of the entire tuner strip more practical.

TABLE 5-8. HFR, MEGACYCLE DIAL CALIBRATION DATA

BAND	± TOLERANCE IN Kc/s	± DIAI. DIVISION	+% OF F
1	10	1	1
2	10	1	1
3	20	2	1
4	20	2	1
5	40	2	1
6	40	2	1
7	80	.8	1
8	80	.8	1

a. REMOVAL OF RF CHASSIS. - The R-F chassis is secured to bar nuts on mounting plates #4 and #5 (see figures 5-8 and 5-9) with four screws, one at each corner of the RF chassis. Proceed as follows:

(1) Remove top turret cover (see figure 5-1) to afford access to RF chassis wiring.

(2) Remove plug P1201 from J1003.

(3) Ensure that all capacitor leads, ground leads, and leads to or from other parts of the main chassis are disconnected and properly tagged or noted.

(4) Remove screws securing R-F chassis to bar nuts, and remove RF chassis.

b. REMOVAL OF OSCILLATOR CHASSIS. - The oscillator chassis is secured to bar nuts on mounting plates #2 and #3 (see figures 5-8, 5-9, and 5-11) with four screws, one at each corner of the oscillator chassis. Proceed as follows:

(1) Remove top oven cover (see figure 5-1), insulating pad, and inner oven cover to afford access to oscillator chassis wiring, mounting screws, and tubes.

(2) Remove oscillator tube V1007 and isolation amplifier tube V1006 (see figure 5-2) from their sockets.

(3) Ensure that capacitor leads, ground leads, and all leads to or from other parts of the main chassis are disconnected and properly tagged or noted.

(4) Remove screws securing oscillator chassis to bar nuts, and remove oscillator chassis by lifting slightly outward and then upward.

c. REMOVAL OF RF TUNER STRIPS AND OSCILLATOR TUNER STRIPS. - RF tuner strips and oscillator tuner strips are mounted on the revolving

turret with mounting screws as shown in figure 5-10. Removal does not require any special procedure.

d. REMOVAL OF RF TUNING CAPACITOR AND OSCILLATOR TUNING CAPACITOR. - Remove RF and oscillator tuning capacitors as shown in figure 5-11.

e. REMOVAL OF OVEN HEATER ELEMENT. - Refer to figures 5-8 and 5-9, and proceed as follows:

(1) Remove top oven cover, insulating pad, and inner oven cover.

(2) Remove brace, bottom oven cover, and insulating pad; remove side insulating pads.

(3) Remove side plate (see figure 5-1) to afford access to heater element mounting screws.

(4) Disconnect oven heater wires (see figure 5-9).

(5) Remove screws securing heater element to mounting plates #2 and #3 (see figure 5-8).

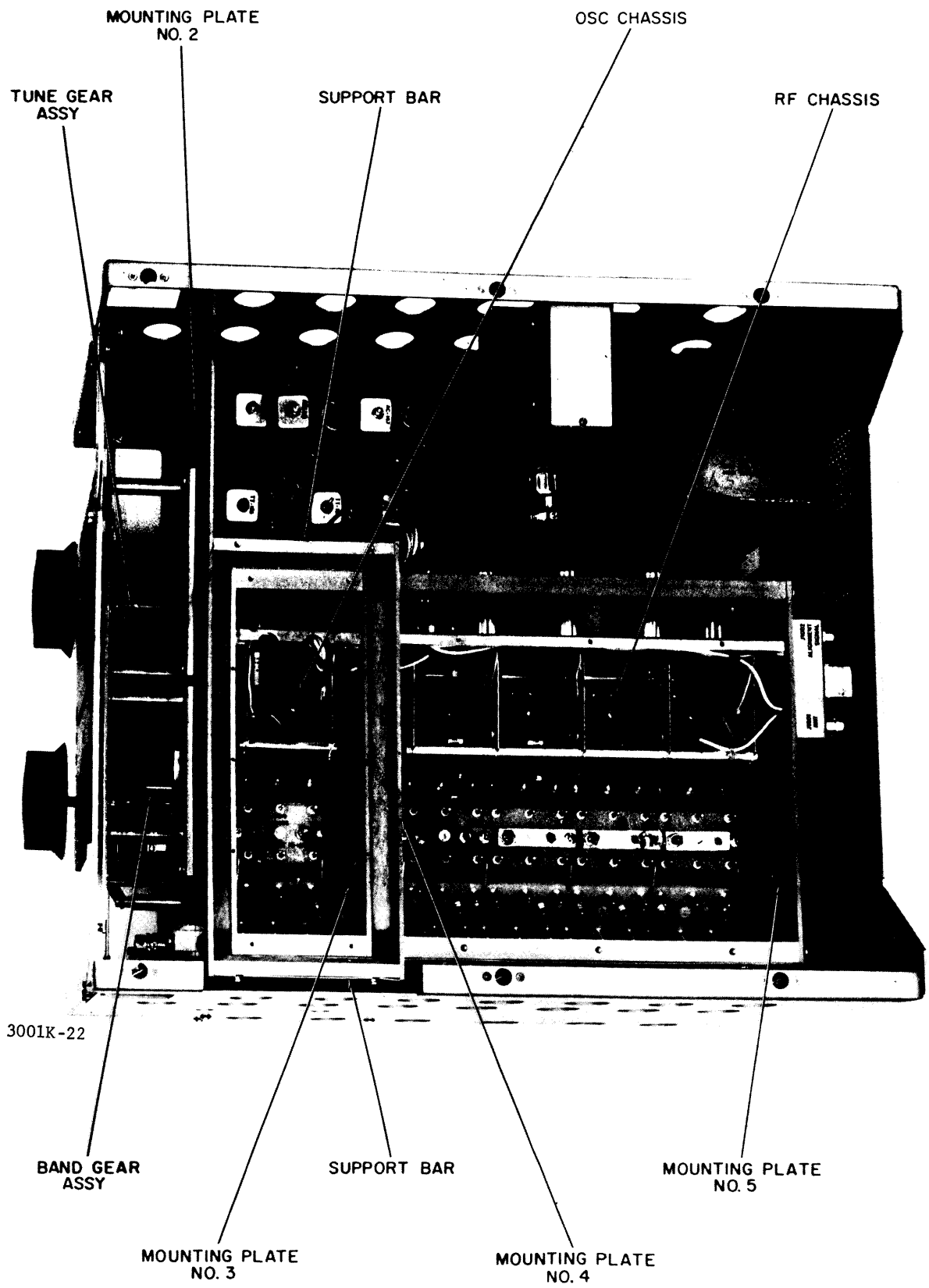
(6) Rotate lower support bars slightly to facilitate removal of heater element.

(7) Slide heater element off mounting plates #2 and #3 from underside of main chassis.

f. REPLACEMENT OF TUNER CABLE. - Replacement of tuner cable is accomplished by recabling in accordance with information given in figure 5-12.

5-4. ALIGNMENT.

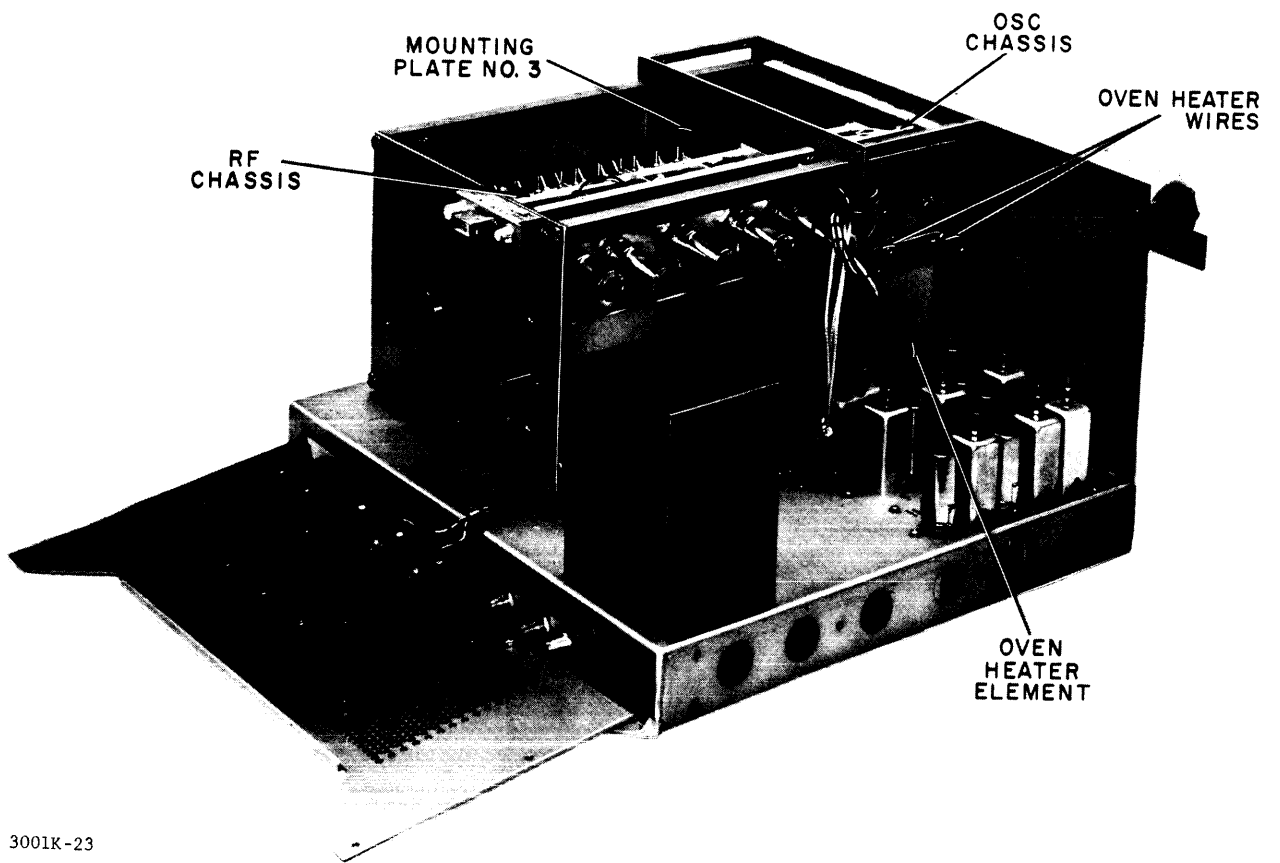
The alignment procedures for each section of the HFR are outlined in tables 5-9 through 5-14. Refer to figure 5-13 for location of alignment controls and adjustments, for identification of RF and oscillator inductors and capacitors.



658.16-1

Figure 5-8. HFR Assembly, Top View

657.15-7



3001K-23

Figure 5-9. HFR Assembly, Rear Oblique View

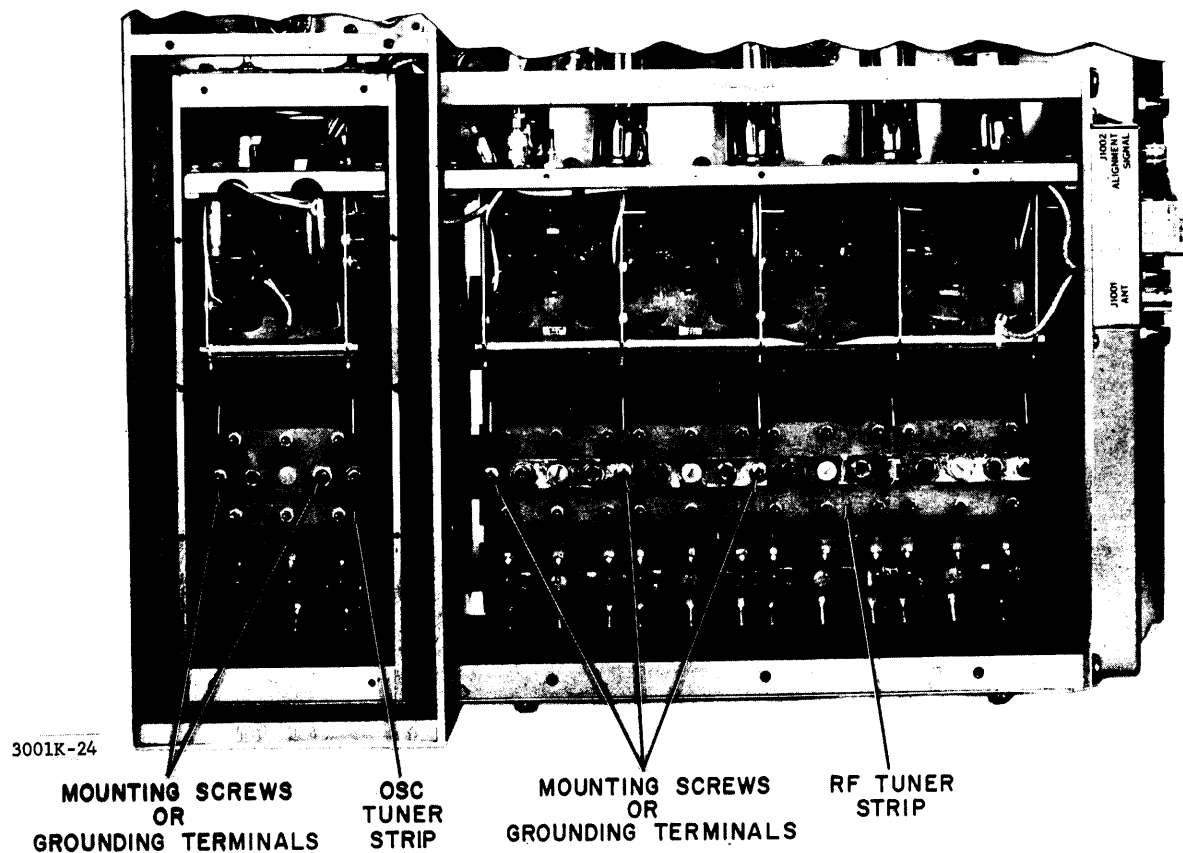
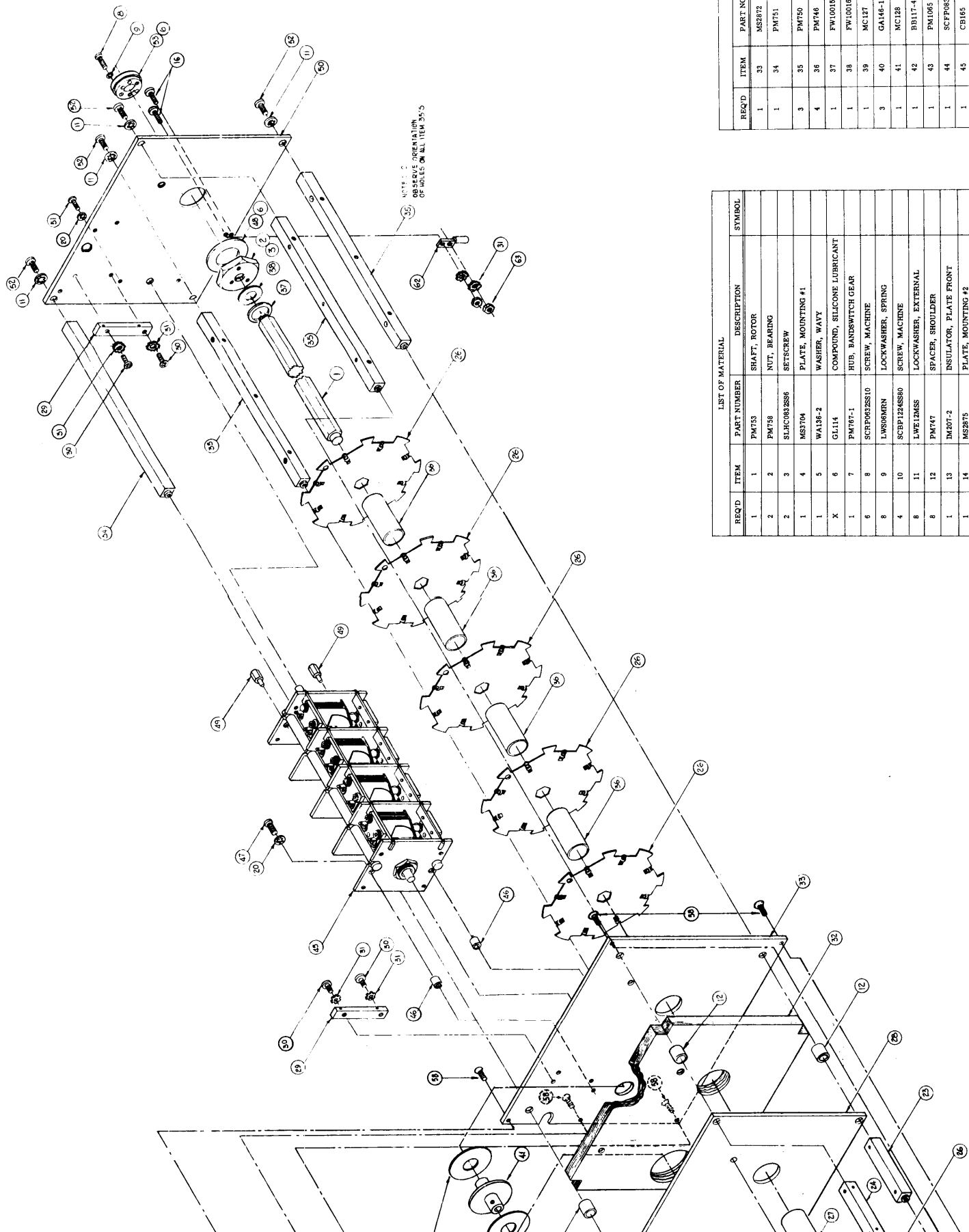


Figure 5-10. RF Tuner Strip and Oscillator Tuner Strip, Installation

TABLE 5-9. ALIGNMENT, RF CIRCUITS

STEP	OPERATION
1	Connect signal generator and VTVM as shown in figure 5-14.
2	Tune HFR to 2 mc; set TUNE SYNC OPERATE control knob of HFR at TUNE.
3	Set signal generator for 2 mc unmodulated signal. Attenuate signal generator for 1V output. NOTE When performing step 4, a clear and distinct indication of tuning should result on each stage except the automatic stage (L1001) where the circuit is so broadly tuned that it will appear sluggish. Observe VTVM carefully as the peaking will appear to be very small in amplitude.
4	Using tool TP115, tune inductors, L1001, L1005, L1007, and L1009 for maximum output on VTVM, simultaneously reducing signal generator output as needed to maintain approximately 0.5V on VTVM (this keeps circuits from overloading and produces a good indication of peaking).
5	Tune HFR to 3 mc; set signal generator to 3 mc, and attenuate as required.
6	Using tool TP114, tune capacitors C1009, C1015, C1023, C1031 for maximum output; the same conditions as in step 4 will prevail.
7	Repeat steps 3 through 6 until no further improvement is discernible on VTVM.
8	Tune HFR and signal generator to low and high frequencies (in that order) of each band, and align each band in accordance with instructions given in steps 3 through 7.

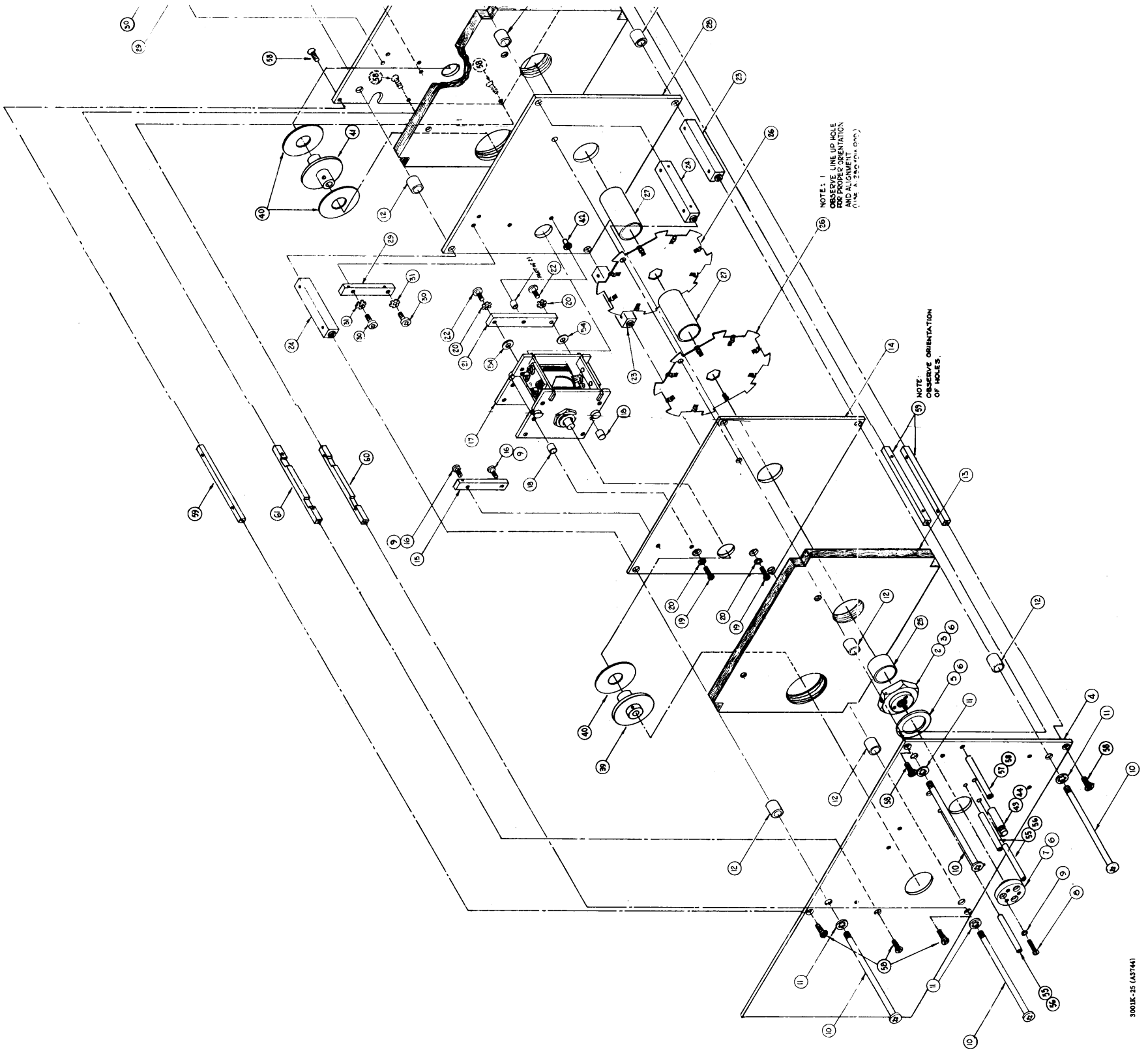


NOTE: 1. OBSERVE LINE UP HOLES AND ORIENTATION AND ALIGNMENT (USE A 3/16\"/>

REQ'D	ITEM	PART NUMBER	DESCRIPTION	SYMBOL
1	1	PM753	SHAFT, ROTOR	
2	2	PM758	NUT, BEARING	
2	3	SLICR32886	SETSCREW	
1	4	MS704	PLATE, MOUNTING #1	
1	5	WA138-2	WASHER, WAVY	
X	6	GL114	COMPOUND, SILICONE LUBRICANT	
1	7	PM767-1	HUB, BANDSWITCH GEAR	
6	8	SCFP0832810	SCREW, MACHINE	
8	9	LW8088RN	LOCKWASHER, SPRING	
4	10	SCBP1224880	SCREW, MACHINE	
8	11	LWELMS	LOCKWASHER, EXTERNAL	
8	12	PM747	SPACER, SHOULDER	
1	13	MS27-2	INSULATOR, PLATE FRONT	
1	14	MS2875	PLATE, MOUNTING #2	
1	15	PM759	BAH NUT, FRONT	
4	16	SCFP0832855	SCREW, MACHINE	
1	17	CB184	CAPACITOR, OSCILLATOR	C106A C106B
2	18	TE117-50	SPACER	
2	19	SCBP0832812	SCREW, MACHINE	
8	20	LW108MS	LOCKWASHER, INTERNAL #8	
1	21	MS2857	MOUNTING, PLATE AND DOWEL	
2	22	SCBP0832817	SCREW, MACHINE	
2	23	PM762	SUPPORT, BAR	
2	24	PM763	SUPPORT, BAR	
1	25	PM748-1	SPACER, SLEEVE	
7	26	PM755	DISC, REPARATOR	
2	27	PM748-2	SPACER, SLEEVE	
1	28	MS2876-2	PLATE, MOUNTING #3	
3	29	PM761	BAR NUT	
6	30	SCFP0832887	SCREW, MACHINE	
8	31	LW608RN	LOCKWASHER, EXTERNAL	
1	32	MS208-2	INSULATOR, PLATE REAR	

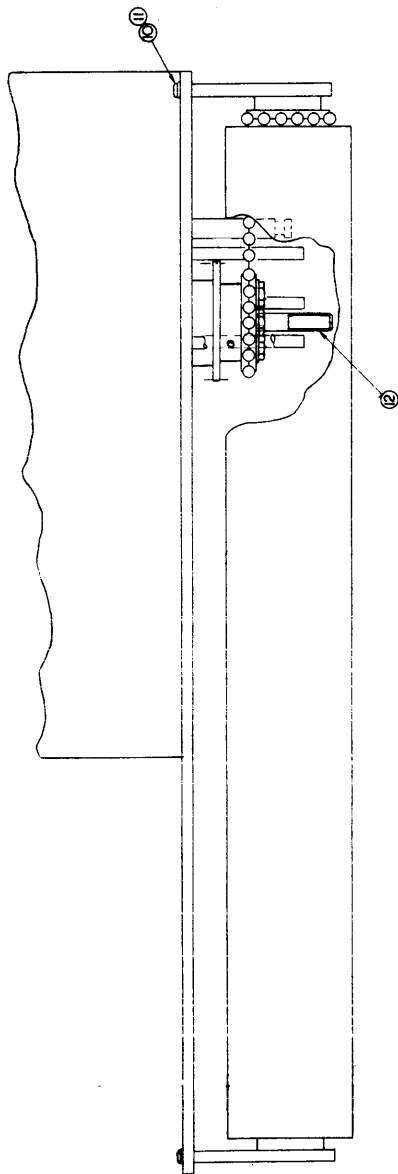
REQ'D	ITEM	PART NO.	DESCRIPTION	SYMBOL
1	33	MS2872	PLATE, MOUNTING #4	
1	34	PM751	SUPPORT BAR, PLATE (TOP LEFT)	
3	35	PM750	SUPPORT BAR, PLATE	
4	36	PM746	SPACER, SLEEVE	
1	37	FW10018AE	WASHER, FLAT	
1	38	FW10018AE	WASHER, FLAT	
1	39	MC127	COUPLING, FLEXIBLE	
3	40	GA146-1711	GASKET	
1	41	MC128	COUPLING, FLEXIBLE	
1	42	BE117-4	NYLON PANEL BEARING	
1	43	PM1065	POST, MOUNTING	
1	44	SCFP0832888	SCREW, MACHINE	
1	45	CB165	CAPACITOR, RF TUNING	C106A C106B
2	46	TE117-44	SPACER	
2	47	SCFP0832814	SCREW, MACHINE	
1	48	WA138-1	WASHER, WAVY	
2	49	PM757	STUD, HEX	
1	50	MS2445	PLATE, MOUNTING #2	
2	51	SCBP0832816	SCREW, MACHINE	
4	52	SCBP12248810	SCREW, MACHINE	
1	53	PM767-2	HUB, BANDSWITCH GEAR	
2	54	FW088RN	WASHER, FLAT	
3	55	TECH40881R	SPACER, THREADED	
3	56	SCFP0832889	SCREW, MACHINE	
1	57	TECH40881R	SPACER, THREADED 2-3/8 LG.	
1	58	SCFP0832886	SCREW, MACHINE	
3	59	PM754	SUPPORT, BAR, COVER	
1	60	PM1081-1	SUPPORT, COVER	
1	61	PM1081-2	SUPPORT, COVER	
1	62	SC107-3	BOLT, SPADE	
2	63	NTH0832818	NUT, HEX	

Figure 5-11. Tuner Frame Assembly, Exploded View



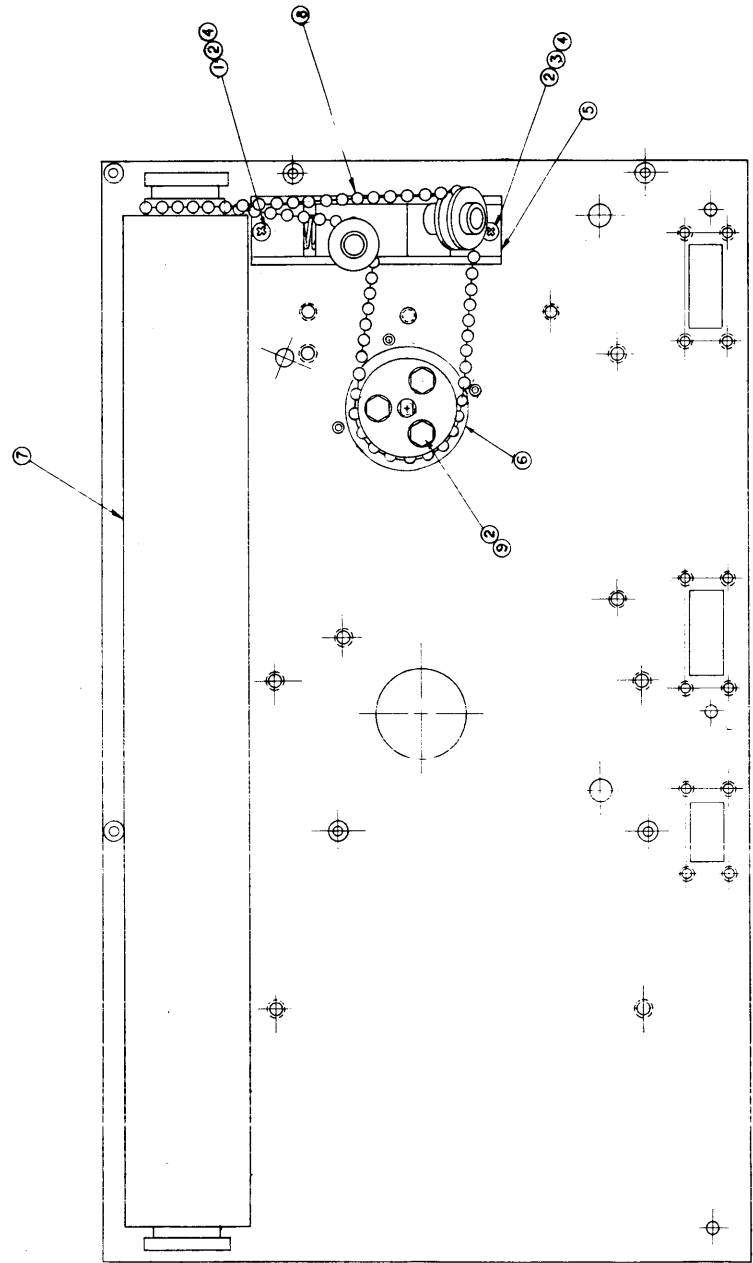
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CHAIN ASSEMBLY PROCEDURE

1. ASSEMBLE CHAIN TO SPROCKET ON ITEM 9.
2. ASSEMBLE CHAIN TO SPROCKET ON ITEM 7 BEFORE ASSEMBLING TO MOUNTING PLATE #1. (SEE FIGURE 5-11, ITEM 4, FOR MOUNTING PLATE #1)
3. ASSEMBLY MUST BE SUCH THAT THE SECTION OF THE CHAIN COILING OFF THE TOP OF ITEM 9 SPROCKET, GOES TO THE BACK OF ITEM 7 SPROCKET.
4. ADJUST ITEM 5 UNTIL SLACK ON ITEM 8 IS TAKEN UP AND SPRING IN ITEM 5 IS UNDER SLIGHT COMPRESSION. TIGHTEN ITEMS 1 & 3.
5. TO INDEX DRUM AND TURNSET CORRECTLY, PROCEED AS FOLLOWS: PRESS SLIDE UP (AGAINST SPRING TENSION) AS FAR AS POSSIBLE, AND SIMULTANEOUSLY ROTATE DRUM TO DESIRED POSITION BY PERMITTING BALL CHAIN TO SLIP ON THE TURN DIAL SHIM SPROCKET.
6. INSERT ITEM 12 INTO ITEM 9 UNTIL SHAFT MOTORS TIGHTEN SET SCREW. CHECK POSITION OF SHAFT TO BE DETERMINED AND ADJUSTED FOR AUTOMATION ONLY.



REQ'D	ITEM	PART NUMBER	DESCRIPTION	SYMBOL
1	1	SCB08328M12	SCREW, MACHINE	
5	2	LW10888	LOCKWASHER, INTERNAL #8	
1	3	SCB0838M7	SCREW, MACHINE	
2	4	FROGHER	WASHER, FLAT	
1	5	A3528	SLIDE ASSEMBLY	
1	6	A3529	GEAR & SPROCKET ASSEMBLY	
1	7	A3843	TUNER DIAL ASSEMBLY	
1	8	CJ100-2	BEAD CHAIN	
3	9	SCB08328S16	SCREW, MACHINE, BEK HEAD	
4	10	SCB04408S8	SCREW, MACHINE	
4	11	LWB04M8S	WASHER, LOCK EXT.	
1	12	PM1030	SHAFT	

3001K-25A (A3744)

Figure 5-12. Tuner Cable Detail

TABLE 5-10. ALIGNMENT, HFO CIRCUITS

STEP	OPERATION			
	<p style="text-align: center;">NOTE</p> <p>If alignment is to be performed as part of troubleshooting procedures, the top oven cover, insulating pad, and inner cover should be removed to afford access to HFO circuitry. P1301 should also be disconnected. Connect power supply to HFR and align the HFO circuits in accordance with steps 2 through 7 of this procedure. When the trouble is cleared, replace the inner cover, insulating pad, and top oven cover, and realign the HFO in accordance with steps 1 through 7. Normal frequency drift is approximately -1.2% of the indicated frequency.</p>			
1	Connect power supply to HFR, and allow HFR to warm up for 1-1/2 hours. Oven temperature should be between 72°C and 78°C and stability must be within 0.5°C. When oven stability is attained, proceed to step 2.			
2	Connect counter as shown in figure 5-14. Signal generator and VTVM should not be connected, and there should be no input to ANT jack J1001.			
3	Set TUNE/SYNC/OPERATE control knob of HFR at TUNE.			
4	Tune HFR to 2 mc, and adjust inductor L1013 for indication of 3.7500 mc on counter.			
5	Tune HFR to 3 mc, and adjust capacitor C1047 for indication of 4.7500 mc on counter.			
6	Repeat steps 4 and 5 until further adjustment becomes unnecessary.			
7	Using procedures set fourth in steps 4, 5, and 6, align all bands as indicated below.			
	BAND	ALIGNMENT FREQUENCY	COUNTER INDICATION	ADJUSTMENT
	1	2 mc 3 mc	3.7500 4.7500	L1013 C1047
	2	3 mc 4 mc	4.7500 5.7500	L1021 C1073
	3	4 mc 6 mc	5.7500 7.7500	L1053 C1093
	4	6 mc 8 mc	7.7500 9.7500	L1054 C1113
	5	8 mc 12 mc	9.7500 13.7500	L1055 C1132
	6	12 mc 16 mc	13.7500 17.7500	L1042B C1151
	7	16 mc 24 mc	17.7500 25.7500	L1147B C1172
	8	24 mc 32 mc	25.7500 33.7500	L1052B C1193

TABLE 5-11. ALIGNMENT, 1.75 MC IF

STEP	OPERATION
1	Connect signal generator and RF VTVM to pins 3 and 9, respectively, of V1005.
2	Place short jumper between green and white lugs of T1201.
3	Set signal generator for 1.75 mc unmodulated signal; maintain signal generator output at minimum required for adequate indication of tuning.
4	Adjust T1002 for maximum indication on meter.
5	Remove jumper from T1201.
6	Adjust T1201 for minimum indication on meter. Tighten locknut.
7	Disconnect RF VTVM from V1005, and connect it to pin 5 of V1201; adjust signal generator output for reading of 1 volt on meter.
8	Connect short jumper across green lugs of T1202.
9	Adjust bottom slug of T1202 for maximum indication on meter. Tighten locknut.
10	Remove jumper and adjust top slug of T1202 for minimum indication on meter. Tighten locknut.
11	Place 50 ohm dummy load on J1312.
12	Disconnect RF VTVM from V1201; connect VTVM across dummy load.
13	Adjust T1203 for maximum indication on meter. Tighten locknut.
14	Connect DC VTVM to pin 2 of V1202, then V1203; DC voltages should be equal (approximately 1.45 volts). Adjust R1210 until voltages are equal.
15	Check 3 db bandwidth; it should be approximately ± 10 kc at 1.75 mc.
16	After all other circuits of the HFR have been aligned, repeat T1201, T1202, using the output of the RF turret from J1003, and using the RF LEVEL meter as an indicator.
17	Remove all test equipment, and restore HFR to service.

TABLE 5-12. ALIGNMENT, NOISE SILENCER

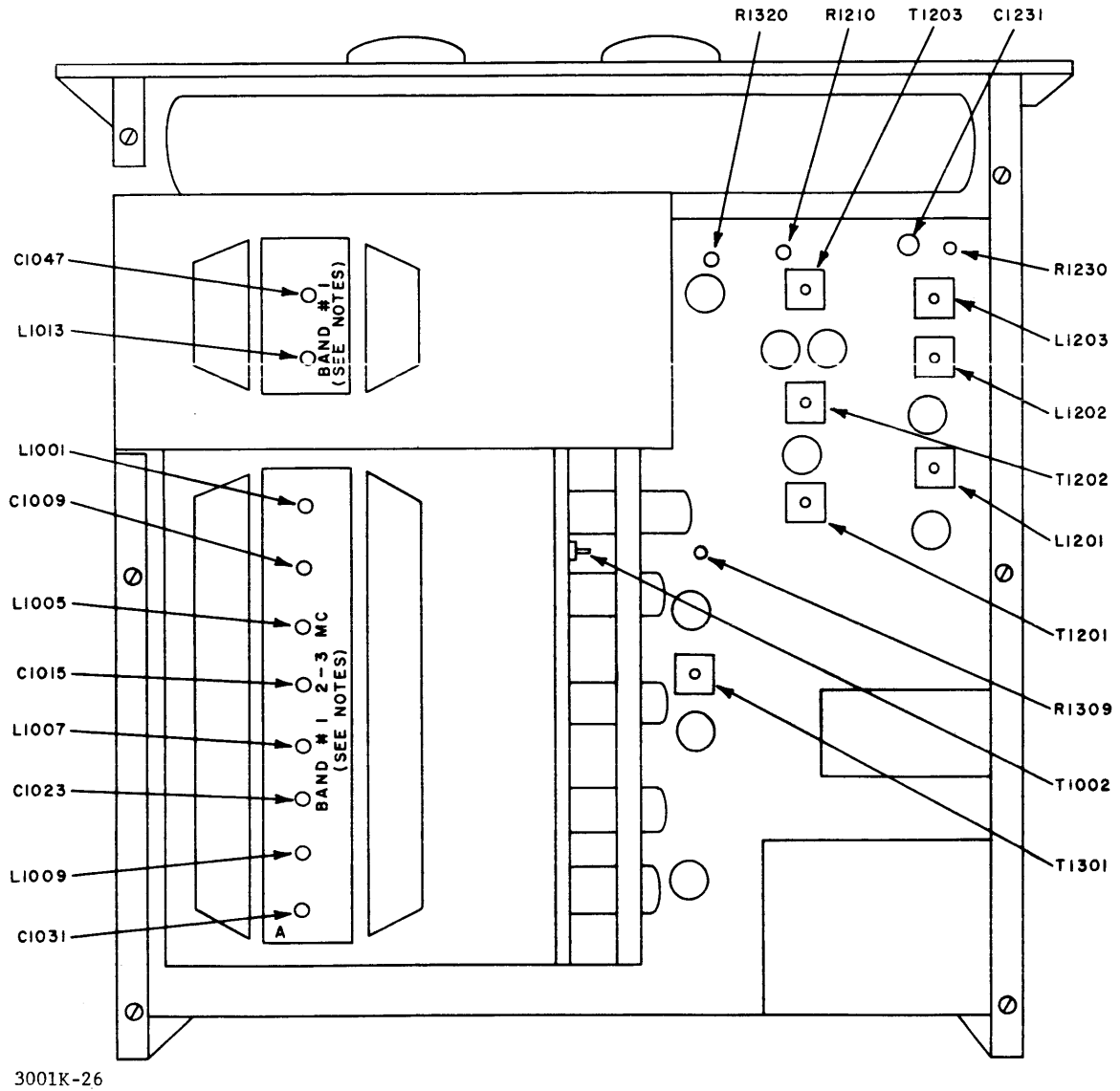
STEP	OPERATION
1	Connect signal generator and RF VTVM to P1201 and pin 5 of V1201 respectively; adjust signal generator output to provide 1.75 mc signal at 1.0V RMS or 2.8V peak-to-peak VTVM reading. Note signal generator output.
2	Set NOISE SILENCER/OFF/ALIGNMENT SIGNAL control knob of HFR at NOISE SILENCER.
3	Arrange VTVM to measure -DC volts and connect it to pin 1 of V1205. Adjust R1230 for mechanical center. Check that signal generator output level is same as that noted in step 1.

TABLE 5-12. ALIGNMENT, NOISE SILENCER (CONT)

STEP	OPERATION
4	Adjust L1201 then L1202 for maximum negative voltage and tighten locknuts. Adjustment of L1202 will be broad.
5	Connect VTVM to pin 5 of V1205; switch to AC range. Adjust R1230 for indication of 10 volts RMS, and tighten locknut.
6	Connect sensitive VTVM or scope to red lug of L1203; adjust L1203 for minimum indication at 1.75 mc.
7	Adjust signal generator output for 1.75 mc, 50% to 80% modulated with 1 kc; adjust output level to that noted in step 1.
8	Connect sensitive scope across 50 ohm dummy load at J1312; carefully adjust C1231 for a notch at crest of modulated signal as shown in figure 5-15, <u>A</u> .
9	Adjust C1231 until notch just disappears as shown in figure 5-15, <u>B</u> .
10	Remove test equipment and dummy load; reconnect P1201, and the plug to J1312. Restore HFR to service.

TABLE 5-13. ALIGNMENT, ALIGNMENT SIGNAL GENERATOR

STEP	OPERATION
1	Remove 2.0 mc input and 250 kc input to J1304 and J1303 respectively.
2	Connect signal generator and AC voltmeter to J1303 and pin 2 of V1302 respectively.
3	Set NOISE SILENCER/OFF/ALIGNMENT SIGNAL control knob at ALIGNMENT SIGNAL.
4	Tune signal generator for 1.75 mc unmodulated signal; use sufficient output for AC voltmeter indication.
5	Detune T1301 by turning slugs to maximum counterclockwise position.
6	Adjust top and bottom slugs of T1301 for maximum indication on AC voltmeter; tighten locknuts.
7	Disconnect signal generator and AC voltmeter from J1303 and V1302; connect signal generator and AC voltmeter to J1304 and pin 3 of V1301 respectively.
8	Tune signal generator for 2 mc unmodulated signal; use sufficient output so that AC voltmeter indicates approximately 3.0V.
9	Remove AC voltmeter from V1301, and connect it to unmarked terminal between green and black lugs of T1301.
10	Adjust R1309 for minimum AC voltmeter indication, decreasing scale of AC voltmeter as required. Tighten locknut.
11	Remove test equipment, and restore HFR to service.



NOTES

INDUCTORS AND CAPACITORS FOR RF AND OSC. TUNER STRIPS

BAND	#1	#2	#3	#4	#5	#6	#7	#8
RF TUNER STRIP	L1001	L1014	L1023	L1028	L1033	L1038	L1043	L1048
	C1009	C1056	C1076	C1095	C1115	C1134	C1153	C1174
	L1005	L1015	L1024B	L1029B	L1034B	L1039B	L1044B	L1049B
	C1015	C1059	C1079	C1098	C1118	C1137	C1155	C1176
	L1007	L1017	L1025B	L1030B	L1035B	L1040B	L1045B	L1050B
	C1023	C1063	C1083	C1102	C1122	C1141	C1160	C1181
	L1009	L1019	L1026B	L1031B	L1036B	L1041B	L1046B	L1051B
	C1031	C1067	C1087	C1106	C1126	C1145	C1165	C1186
OSC TUNER STRIP	L1013	L1021	L1053	L1054	L1055	L1042B	L1047B	L1052B
	C1047	C1073	C1093	C1113	C1132	C1151	C1172	C1193

Figure 5-13. Alignment Controls and Adjustments

TABLE 5-14. ALIGNMENT, SYNCHRONIZE METER AMPLIFIER AND LOW VOLTAGE POWER SUPPLY

STEP	OPERATION
A. SYNCHRONIZE METER AMPLIFIER	
1	Turn S1302 to the "Tune" position.
2	Adjust R1320 for zero center; tighten locknut.
B. LOW VOLTAGE POWER SUPPLY	
1	Using VTVM, measure the voltage at CR1305; voltage should be 27 VDC \pm 1.6 V.
2	Measure the voltage at CR1306; voltage should be 6.5 VDC \pm 0.33V.
3	Disconnect all test equipment.

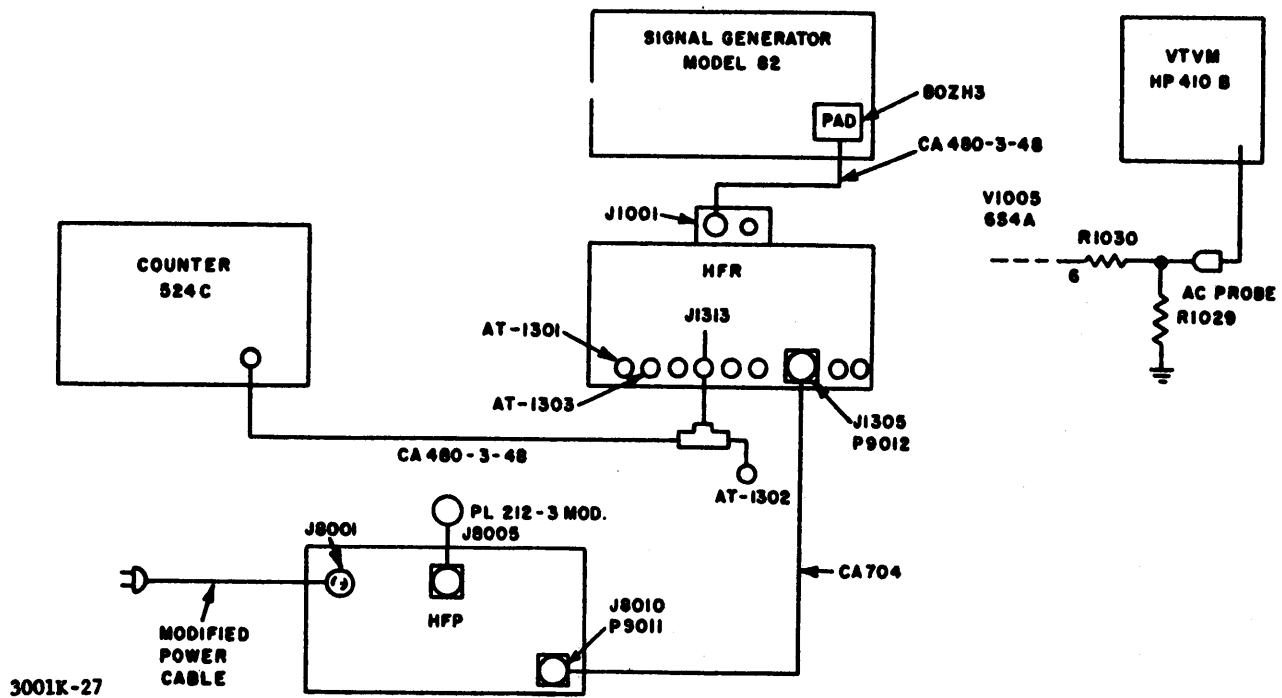


Figure 5-14. Connection Diagram, Aligning RF Chain and HFO

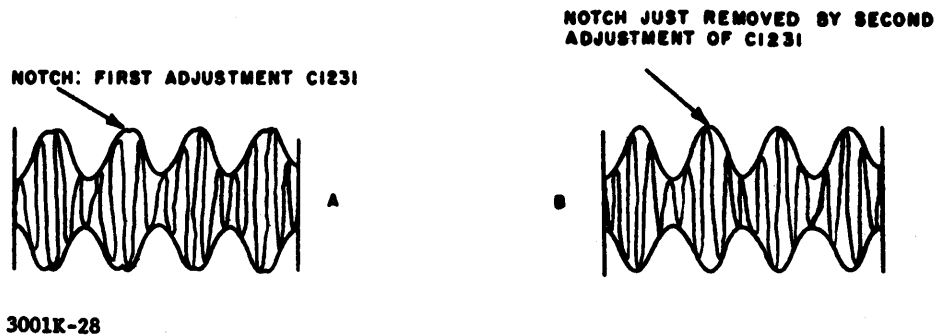


Figure 5-15. Scope Picture, Noise Silencer Alignment

SECTION 6 PARTS LIST

6-1. INTRODUCTION.

The parts list presented in this section is a cross-reference list of parts identified by a reference designation and TMC part number. In most cases, parts appearing on schematic diagrams are assigned reference designations in accordance with MIL-STD-16. Wherever practicable, the reference designation is marked on the equipment, close to the part it identifies. In most cases, mechanical and electro-mechanical parts have TMC part numbers stamped on them.

To expedite delivery when ordering any part, specify the following:

a. Generic name.

b. Reference designation.

c. TMC part number.

d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

For replacement parts not covered by warranty (refer to warranty sheet in front of manual), address all purchase orders to:

The Technical Materiel Corporation
Attention: Sales Department
700 Fenimore Road
Mamaroneck, New York

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
AT1301	DUMMY LOAD, ELECTRICAL: 47 ohm resistance, BNC connector type.	DL100-4
AT1302	Same as AT1301.	
AT1303	Same as AT1301.	
A1001	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #1: consists of one insulated board; 15 capacitors, C1009, C1010, C1013, C1015, C1016, C1017, C1021, C1023, C1024, C1025, C1030, C1031, C1032, C1033, C1111; 4 resistors, R1011, R1018, R1028, R1067; 7 coils, L1001, L1004, L1005, L1006, L1007, L1008, L1009; 1 transformer, T1001; misc. hardware, wire and sleeving.	AX490
A1002	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #1: consists of one insulated board; 6 capacitors, C1043, C1044, C1045, C1046, C1047, C1054; 2 coils, L1012, L1013; misc. hardware, wire and sleeving.	AX482
A1003	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #2: consists of one insulated board; 14 capacitors, C1056, C1057, C1058, C1059, C1060, C1061, C1062, C1063, C1064, C1065, C1066, C1067, C1068, C1069; 3 resistors, R1052, R1053, R1054; 7 coils, L1014, L1015, L1016, L1017, L1018, L1019, L1020; 1 transformer, T1003; misc. hardware, wire and sleeving.	AX491
A1004	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #2: consists of one insulated board; 6 capacitors, C1070, C1071, C1072, C1073, C1074, C1075; 2 coils, L1021, L1022; misc. hardware, wire and sleeving.	AX483

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
A1005	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #3: consists of one insulated board; 14 capacitors, C1076, C1077, C1078, C1079, C1080, C1081, C1082, C1083, C1084, C1085, C1086, C1087, C1088, C1089; 3 resistors, R1006, R1021, R1066; 4 coils, L1023, L1024A, B, L1025A, B, L1026A, B; 1 transformer, T1004; misc. hardware, wire and sleeving.	AX492
A1006	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #3: consists of one insulated board; 5 capacitors, C1090, C1091, C1092, C1093, C1094; 2 coils, L1027, L1053; misc. hardware, wire and sleeving.	AX484
A1007	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #4: consists of one insulated board; 14 capacitors, C1095, C1096, C1097, C1098, C1099, C1100, C1101, C1102, C1103, C1104, C1105, C1106, C1107, C1108; 3 resistors, R1056, R1057, R1058; 4 coils, L1028, L1029A, B, L1030A, B, L1031A, B; 1 transformer, T1005; misc. hardware, wire and sleeving.	AX493
A1008	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #4: consists of one insulated board; 5 capacitors, C1109, C1110, C1112, C1113, C1114; 2 coils, L1032, L1054; misc. hardware, wire and sleeving.	AX485
A1009	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #5: consists of one insulated board; 14 capacitors, C1115, C1116, C1117, C1118, C1119, C1120, C1121, C1122, C1123, C1124, C1125, C1126, C1127, C1128; 3 resistors, R1059, R1060, R1061; 4 coils, L1033, L1034A, B, L1035A, B, L1036A, B; 1 transformer, T1066; misc. hardware, wire and sleeving.	AX494
A1010	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #5: consists of one insulated board; 5 capacitors, C1129, C1130, C1131, C1132, C1133; 2 coils, L1037, L1055; misc. hardware, wire and sleeving.	AX486
A1011	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #6: consists of one insulated board; 14 capacitors, C1134, C1135, C1136, C1137, C1138, C1139, C1140, C1141, C1142, C1143, C1144, C1145, C1146, C1147; 3 resistors, R1062, R1063, R1064; 4 coils, L1038, L1039A, B, L1040A, B, L1041A, B; 1 transformer, T1007; misc. hardware, wire and sleeving.	AX496
A1012	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #6: consists of one insulated board; 5 capacitors, C1148, C1149, C1150, C1151, C1152; 1 coil, L1042A, B; misc. hardware, wire and sleeving.	AX487
A1013	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #7: consists of one insulated board; 16 capacitors, C1153, C1154, C1155, C1156, C1157, C1158, C1159, C1160, C1161, C1162, C1163, C1164, C1165, C1166, C1167, C1168; 4 coils, L1043, L1044A, B, L1045A, B, L1046A, B; 1 transformer, T1008; misc. hardware, wire and sleeving.	AX497
A1014	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #7: consists of one insulated board; 5 capacitors, C1169, C1170, C1171, C1172, C1173; 1 coil, L1047A, B; misc. hardware, wire and sleeving.	AX488

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
A1015	TERMINAL BOARD SUB-ASSEMBLY, RADIO FREQUENCY, BAND #8: consists of one insulated board; 17 capacitors, C1174, C1175, C1176, C1177, C1178, C1179, C1180, C1181, C1182, C1183, C1184, C1185, C1186, C1187, C1188, C1189, C1196; 4 coils, L1048, L1049A, B, L1050A, B, L1051A, B; 1 transformer, T1009; misc. hardware, wire and sleeving.	AX498
A1016	TERMINAL BOARD SUB-ASSEMBLY, OSCILLATOR, BAND #8: consists of one insulated board; 5 capacitors, C1190, C1191, C1192, C1193, C1194; 1 coil, L1052A, B; misc. hardware, wire and sleeving.	AX489
A1017	HEATING ELEMENT, ELECTRICAL: operating voltage 10 to 25 V per leg, 8.4 to 52 watts per leg, 0.084 to 2.08 amperes per leg; 6 solder lug type terminals; consists of HR1001, HR1002, RT1001, S1003.	RR131
A1301	OVEN, PROPORTIONAL CONTROL: power source, + 32 volts unregulated, + 28 volts regulated, 4 amperes; temperature requirements 0 to 50° ambient, 72 initial setting, ± 1/2 C stability. (See HFR-1/T Spare Parts List)	PO240
C1001A, B, C, D, E, F, G, H	CAPACITOR, VARIABLE, AIR: RF tuning; counterclockwise rotation; section 1A, 0.0 to 50.0 uuf, ± 1 uuf; section 1B, 0.0 to 100.0 uuf, + 1.5 uuf; section 2A, 3A, 4A, trim to ± 0.75 uuf; section 2B, 3B, 4B, trim to ± 1 uuf; rotation at 5, 25, 50, 75, 95%; rated for 700 V RMS, 60 cycles.	CB165
C1002A, B	CAPACITOR, VARIABLE, AIR: oscillator tuning; counterclockwise rotation; section 1A, 0.0 to 50.0 uuf, ± 1 uuf; section 1B, 0.0 to 100.0 uuf, ± 1 uuf; rotation at 5, 10, 20, 25, 30, 40, 50, 60, 70, 75, 80, 90, 95 percent; rated for 700 V RMS, 60 cycles.	CB164
C1003	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
C1004	Same as C1003.	
C1005	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, + 60% - 40%; 150 WVDC.	CC100-35
C1006 thru C1008	Same as C1003.	
C1009	Non-replaceable item. Part of A1001, Part No. AX490.	
C1010	Non-replaceable item. Part of A1001, Part No. AX490.	
C1011	Same as C1003.	
C1012	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 500 uuf, GMV; 500 WVDC.	CC100-15
C1013	Non-replaceable item. Part of A1001, Part No. AX490.	
C1014	Same as C1003.	
C1015 thru C1017	Non-replaceable item. Part of A1001, Part No. AX490.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1018	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100 uuf, GMV; 500 WVDC.	CC100-29
C1019	Same as C1003.	
C1020	Same as C1012.	
C1021	Non-replaceable item. Part of A1001, Part No. AX490.	
C1022	Same as C1003.	
C1023 thru C1025	Non-replaceable item. Part of A1001, Part No. AX490.	
C1026	Same as C1018.	
C1027	Same as C1003.	
C1028	Same as C1012.	
C1029	Same as C1003.	
C1030 thru C1033	Non-replaceable item. Part of A1001, Part No. AX490.	
C1034	CAPACITOR, FIXED, MICA DIELECTRIC: 2,000 uuf, $\pm 2\%$; 500 WVDC; straight wire leads.	CM112F202G5S
C1035	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 50 uf, +50% - 15%; 60 WVDC; polarized; tubular case.	CE107-1
C1036	Same as C1018.	
C1037	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +80% - 20%; 500 WVDC.	CC100-24
C1038 thru C1041	Same as C1003.	
C1042	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, $\pm 2\%$; 500 WVDC; straight wire leads.	CM112F102G5S
C1043 thru C1047	Non-replaceable item. Part of A1002, Part No. AX482.	
C1048	CAPACITOR, FIXED, MICA DIELECTRIC: 22 uuf, $\pm 5\%$; 500 WVDC; char. C.	CM15C220J
C1049	CAPACITOR, VOLTAGE VARIABLE, SILICON: 14 to 120 uuf range; 50 WVDC; hermetically sealed glass to metal.	CX106-12
C1050	Same as C1034.	
C1051	CAPACITOR, VOLTAGE VARIABLE, SILICON: 7 to 70 uuf range; 65 WVDC; hermetically sealed glass to metal.	CX106-11

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1052	Same as C1003.	
C1053	CAPACITOR, FIXED, MICA DIELECTRIC: 10 uuf, $\pm 10\%$; 500 WVDC; char. B.	CM15B100K
C1054	Non-replaceable item. Part of A1002, Part No. AX482.	
C1055	Same as C1037.	
C1056 thru C1069	Non-replaceable item. Part of A1003, Part No. AX491.	
C1070 thru C1075	Non-replaceable item. Part of A1004, Part No. AX483.	
C1076 thru C1089	Non-replaceable item. Part of A1005, Part No. AX492.	
C1090 thru C1094	Non-replaceable item. Part of A1006, Part No. AX484.	
C1095 thru C1108	Non-replaceable item. Part of A1007, Part No. AX493.	
C1109	Non-replaceable item. Part of A1008, Part No. AX485.	
C1110	Non-replaceable item. Part of A1008, Part No. AX485.	
C1111	Non-replaceable item. Part of A1001, Part No. AX490.	
C1112 thru C1114	Non-replaceable item. Part of A1008, Part No. AX485.	
C1115 thru C1128	Non-replaceable item. Part of A1009, Part No. AX494.	
C1129 thru C1133	Non-replaceable item. Part of A1010, Part No. AX486.	
C1134 thru C1147	Non-replaceable item. Part of A1011, Part No. AX496.	
C1148 thru C1152	Non-replaceable item. Part of A1012, Part No. AX487.	
C1153 thru C1168	Non-replaceable item. Part of A1013, Part No. AX497.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1169 thru C1173	Non-replaceable item. Part of A1014, Part No. AX488.	
C1174 thru C1189	Non-replaceable item. Part of A1015, Part No. AX498.	
C1190 thru C1194	Non-replaceable item. Part of A1016, Part No. AX489.	
C1195	NOT USED	
C1196	Non-replaceable item. Part of A1015, Part No. AX498.	
C1201	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, + 60% - 40%; 150 WVDC.	CC100-35
C1202	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, + 80% - 20%; 500 WVDC.	CC100-24
C1203	Same as C1201.	
C1204	Same as C1202.	
C1205	CAPACITOR, FIXED, MICA DIELECTRIC: 15 uuf, ± 10%; 500 WVDC; char. B.	CM15B150K
C1206	CAPACITOR, FIXED, ELECTROLYTIC: 125 uf, - 10% + 150% at 120 cps at 25° C; 15 WVDC; polarized; insulated tubular case.	CE105-125-15
C1207	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, ± 10%; 500 WVDC.	CC100-16
C1208	Same as C1207.	
C1209	Same as C1206.	
C1210	Same as C1207.	
C1211	Same as C1207.	
C1212	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, ± 5%; 500 WVDC; char. C.	CM15C471J
C1213 thru C1216	Same as C1207.	
C1217	CAPACITOR, FIXED, MICA DIELECTRIC: 200 uuf, ± 5%; 500 WVDC; char. C.	CM15C201J
C1218	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, + 80% - 20%; 300 WVDC.	CC100-37
C1219 thru C1222	Same as C1207.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1223	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, $\pm 10\%$; 500 WVDC; char. B.	CM15B101K
C1224	Same as C1202.	
C1225	Same as C1223.	
C1226	CAPACITOR, FIXED, MICA DIELECTRIC: 10 uuf, $\pm 10\%$; 500 WVDC; char. B.	CM15B100K
C1227	Same as C1201.	
C1228	Same as C1207.	
C1229	CAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, $\pm 10\%$; 500 WVDC; char. B.	CM15B470K
C1230	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, $\pm 10\%$; 500 WVDC; char. B.	CM15B221K
C1231	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 8 to 50 uuf; 350 WVDC.	CV109-6
C1232	Same as C1218.	
C1233	Same as C1218.	
C1234 thru C1238	Same as C1201.	
C1239	CAPACITOR, FIXED, CERAMIC DIELECTRIC: feed thru type; 1,000 uuf, $\pm 20\%$; 500 WVDC.	CK70AW102M
C1240 thru C1242	Same as C1239.	
C1301	CAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, $\pm 5\%$; 500 WVDC.	CC21SL470J
C1302	Same as C1201.	
C1303	CAPACITOR, FIXED, MICA DIELECTRIC: 150 uuf, $\pm 10\%$; 500 WVDC; char. B.	CM15B151K
C1304 thru C1308	Same as C1207.	
C1309	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, $\pm 3\%$; 100 WVDC; straight wire leads.	CM111D102H1S
C1310	Same as C1202.	
C1311	CAPACITOR, FIXED, MICA DIELECTRIC: 1,500 uuf, $\pm 10\%$; 500 WVDC; char. B.	CM20B152K
C1312	Same as C1218.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1313	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 uuf, GMV; 500 WVDC.	CC100-29
C1314	CAPACITOR, FIXED, ELECTROLYTIC: 1,700 uf; 75 WVDC; polarized; tubular case.	CE112-2
C1315	CAPACITOR, FIXED, ELECTROLYTIC: 2,600 uf; 50 WVDC; polarized; tubular case.	CE112-3
C1316	Same as C1315.	
C1317	Same as C1315.	
C1318	Same as C1202.	
C1319	Same as C1218.	
C1320	Same as C1218.	
C1321	Same as C1202.	
C1322	Same as C1202.	
C1323 thru C1335	Same as C1218.	
C1336	Same as C1201.	
C1337	Same as C1218.	
C1338	Same as C1218.	
C1339	NOT USED	
C1340	Same as C1313.	
CR1001	SEMICONDUCTOR DEVICE, DIODE: silicon; 175 V max. peak inverse voltage; 30 ma at 25° C and 15 ma at 150° C; two axial wire lead type terminals; hermetically sealed glass case.	1N463
CR1201 thru CR1204	Same as CR1001.	
CR1205	SEMICONDUCTOR DEVICE, DIODE: germanium; max. peak inverse voltage 60 V; continuous average forward current 50 ma; max. peak forward current 150 ma; max. surge current 500 ma; max. inverse current 500 ua at 50 volts or 30 ua at 10 volts.	1N34A
CR1206	Same as CR1205.	
CR1207	Same as CR1001.	
CR1301	SEMICONDUCTOR DEVICE, DIODE: silicon; 100 V max. peak inverse voltage; 300 ma max. continuous forward current at 150° C; one solder stud, one 10-32 thd stud type terminals; hermetically sealed metal and glass case.	1N1582R
CR1302	Same as CR1301	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR1303	SEMICONDUCTOR DEVICE, DIODE: silicon; 100 V max. peak inverse voltage; 300 ma max. continuous forward current at 150° C; one solder stud, one 10-32 thd stud type terminals; hermetically sealed metal and glass case.	1N1582
CR1304	Same as CR1303.	
CR1305	SEMICONDUCTOR DEVICE, DIODE: silicon; Zener type; 27 V, ± 5% nominal Zener voltage; 1,500 ma max. DC Zener current at 75° C; one solder stud, one 10-32 thd stud type terminals; hermetically sealed metal and glass case.	1N3323B
CR1306	SEMICONDUCTOR DEVICE, DIODE: silicon; Zener type; 6.5 V, ± 20%; nominal Zener voltage; 1,350 ma max. DC Zener current at 75° C; one solder stud, one 10-32 thd stud type terminals; hermetically sealed glass case.	VR101-6.5S5
DS1001	LAMP, GLOW: 110/125 volts, 1/15 watt; midget flange base; T-2 type bulb.	BI111-1
DS1002	LAMP, INCANDESCENT: 6-8 volts, 0.25 amps; bayonet base; T-3-1/4 bulb.	BI101-44AF
DS1003 thru DS1005	Same as DS1002.	
DS1006	LAMP, INCANDESCENT: 28 volts AC/DC; 0.04 amp; single contact, midget flange base, T-3-1/4 bulb.	BI110-7
EV1001	SHIELD, ELECTRON TUBE	TS103U01
EV1002	SHIELD, ELECTRON TUBE	TS102U02
EV1003	Same as EV1002.	
EV1004	Same as EV1002.	
EV1005	SHIELD, ELECTRON TUBE	TS103U03
EV1201 thru EV1205	Same as EV1002.	
EV1301	Same as EV1005.	
EV1302	Same as EV1002.	
EV1303	SHIELD, ELECTRON TUBE	TS102U03
EV1304	SHIELD, ELECTRON TUBE	TS103U02
HR1001	Non-replaceable item. Part of A1017, Part No. RR131.	
HR1002	Non-replaceable item. Part of A1017, Part No. RR131.	
J1001	CONNECTOR, RECEPTACLE, ELECTRICAL: RF type; 1 round female contact, straight type; series BNC to BNC.	UG625*/U

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J1002	CONNECTOR, RECEPTACLE, ELECTRICAL: RF type; 1 round male contact, straight type; series BNC to BNC.	JJ211
J1003	Same as J1002.	
J1301	Same as J1002.	
J1302	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 round female contact, straight type; series BNC to BNC.	JJ172
J1303	Same as J1302.	
J1304	Same as J1302.	
J1305	CONNECTOR, RECEPTACLE, ELECTRICAL: 14 number 16 male contacts, rated at 17.0 amperes.	JJ200-2
J1306	CONNECTOR, RECEPTACLE, ELECTRICAL: female; 3 number 16 contacts rated at 20 amps, 12 number 20 contacts rated at 7.5 amps.	JJ256-2S
J1307	Same as J1302.	
J1308	Same as J1002.	
J1309	Same as J1302.	
J1310	Same as J1302.	
J1311	Same as J1002.	
J1312	CONNECTOR, RECEPTACLE, ELECTRICAL	UG657*/U
J1313	Same as J1302.	
J1314 thru J1316	NOT USED	
J1317	CONNECTOR, RECEPTACLE, ELECTRICAL	JJ242-5S
K1001	RELAY, ARMATURE: coil operating voltage, 110 VDC; coil resistance 9,100 ohms DC; contact rating 26.5 VDC; 3 amps, non-inductive; double pole, double throw.	RL143-1
K1201	RELAY, ARMATURE: coil operating voltage 6 volts; contact rating 26 volts, 3 amps, non-inductive; single pole, double throw.	RL145
L1001	Non-replaceable Item. Part of A1001, Part No. AX490.	
L1002	COIL, RADIO FREQUENCY: fixed; 100 uh, +5%, 2.6 ohms DC resistance, 345 ma current rating; molded case.	CL275-101
L1003	Same as L1002.	
L1004 thru L1009	Non-replaceable Item. Part of A1001, Part No. AX490.	
L1010	Same as L1002.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L1011	COIL, RADIO FREQUENCY: fixed; 1.0 uh, \pm 5%; 0.062 ohms DC resistance; 2,300 ma current rating; molded case.	CL275-1RO
L1012	Non-replaceable item. Part of A1002, Part No. AX482.	
L1013	Non-replaceable item. Part of A1002, Part No. AX482.	
L1014 thru L1020	Non-replaceable item. Part of A1003, Part No. AX491.	
L1021	Non-replaceable item. Part of A1004, Part No. AX483.	
L1022	Non-replaceable item. Part of A1004, Part No. AX483.	
L1023	Non-replaceable item. Part of A1005, Part No. AX492.	
L1024A, B	Non-replaceable item. Part of A1005, Part No. AX492.	
L1025A, B	Non-replaceable item. Part of A1005, Part No. AX492.	
L1026A, B	Non-replaceable item. Part of A1005, Part No. AX492.	
L1027	Non-replaceable item. Part of A1006, Part No. AX484.	
L1028	Non-replaceable item. Part of A1007, Part No. AX493.	
L1029A, B	Non-replaceable item. Part of A1007, Part No. AX493.	
L1030A, B	Non-replaceable item. Part of A1007, Part No. AX493.	
L1031A, B	Non-replaceable item. Part of A1007, Part No. AX493.	
L1032	Non-replaceable item. Part of A1008, Part No. AX485.	
L1033	Non-replaceable item. Part of A1009, Part No. AX494.	
L1034A, B	Non-replaceable item. Part of A1009, Part No. AX494.	
L1035A, B	Non-replaceable item. Part of A1009, Part No. AX494.	
L1036A, B	Non-replaceable item. Part of A1009, Part No. AX494.	
L1037	Non-replaceable item. Part of A1010, Part No. AX486.	
L1038	Non-replaceable item. Part of A1011, Part No. AX496.	
L1039A, B	Non-replaceable item. Part of A1011, Part No. AX496.	
L1040A, B	Non-replaceable item. Part of A1011, Part No. AX496.	
L1041A, B	Non-replaceable item. Part of A1011, Part No. AX496.	
L1042A, B	Non-replaceable item. Part of A1012, Part No. AX487.	
L1043	Non-replaceable item. Part of A1013, Part No. AX497.	
L1044A, B	Non-replaceable item. Part of A1013, Part No. AX497.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L1045A, B	Non-replaceable item. Part of A1013, Part No. AX497.	
L1046A, B	Non-replaceable item. Part of A1013, Part No. AX497.	
L1047A, B	Non-replaceable item. Part of A1014, Part No. AX488	
L1048	Non-replaceable item. Part of A1015, Part No. AX498.	
L1049A, B	Non-replaceable item. Part of A1015, Part No. AX498.	
L1050A, B	Non-replaceable item. Part of A1015, Part No. AX498.	
L1051A, B	Non-replaceable item. Part of A1015, Part No. AX498.	
L1052A, B	Non-replaceable item. Part of A1016, Part No. AX489.	
L1053	Non-replaceable item. Part of A1006, Part No. AX484.	
L1054	Non-replaceable item. Part of A1008, Part No. AX485.	
L1055	Non-replaceable item. Part of A1010, Part No. AX486.	
L1056	Same as L1002.	
L1057 .1, .2, .3, .4, .5, .6	CORE, TOROID: bead type; powered iron.	CI120-1
L1058 .1, .2, .3, .4, .5, .6	Same as L1057.	
L1059 .1, .2, .3, .4, .5, .6	Same as L1057.	
L1060 .1, .2, .3, .4, .5, .6	Same as L1057.	
L1061 .1, .2, .3, .4, .5, .6	Same as L1057.	
L1062 .1, .2, .3, .4, .5, .6	Same as L1057.	
L1201	COIL, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; consists of one 200 uuf and one 120 uuf capacitor.	AC147
L1202	COIL, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; consists of one 200 uuf capacitor.	AC146

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L1203	COIL, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; consists of one 47 uuf capacitor.	AC145
L1204	COIL, RADIO FREQUENCY: fixed; 47,000 uh, $\pm 5\%$; 452 ohms DC resistance; 27 ma current rating; molded case.	CL275-473
L1205	COIL, RADIO FREQUENCY: fixed; 560 uh, $\pm 10\%$; 7.9 ohms DC resistance; 100 ma current rating; molded case.	CL140-5
L1301	COIL, RADIO FREQUENCY: fixed; 120.0 uh, $\pm 10\%$; 3.2 ohms DC resistance; molded case.	CL240-120
L1302	COIL, RADIO FREQUENCY: fixed; 50.0 uh, $\pm 5\%$; 110 ohms DC resistance; 75 ma current rating; molded case.	CL226-5
L1303	Same as L1302.	
L1304	Same as L1302.	
L1305	COIL, RADIO FREQUENCY: fixed; 35 uh, $\pm 5\%$; 1 ohm DC resistance.	CL292
L1306	NOT USED	
L1307	COIL, RADIO FREQUENCY: fixed; 95 uh, $\pm 5\%$; 1 ohm DC resistance.	CL291
L1308	Same as L1307.	
L1309	Same as L1305.	
L1310	COIL, RADIO FREQUENCY: fixed; 2.5 uh, $\pm 10\%$; 26 ohms DC resistance; 100 ma current rating; molded case.	CL140-1
M1001	METER, ARBITRARY SCALE: movement 0-1 ma; approx. resistance, 2,000 ohms; black scale on white background rectangular case.	MR160
M1002	METER, AUDIO LEVEL: 0-100 db above \pm micro-volt scale; 0-50 ua movement, linear scale, approx. resistance, 2,000 ohms; standard 2-3/16" rectangular case.	MR161
P1001	CONNECTOR, PLUG, ELECTRICAL: RF; 1 round female coaxial contact, straight type; miniature bayonet lock series.	PL204
P1002	Same as P1001.	
P1003	Same as P1001.	
P1004	CONNECTOR, PLUG, ELECTRICAL: male; 3 number 16 contacts rated at 23 amps, 12 number 20 contacts rated at 7.5 amps.	PL228-2P
P1005	CONNECTOR, PLUG, ELECTRICAL	PL225-5D
P1201	Same as P1001.	
P1301	CONNECTOR, PLUG, ELECTRICAL: miniature type; 9 female contacts, straight type; w/cable clamp.	PL189-9S

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P1302	Same as P1001. Part of W1301.	
P1303	CONNECTOR, PLUG, ELECTRICAL: miniature type; 9 female contacts, straight type; w/cable clamp. Part of W1301.	PL244-1
R1001	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF104K
R1002	RESISTOR, FIXED, COMPOSITION: 33 ohms, $\pm 10\%$; 1/2 watt.	RC20GF330K
R1003	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 10\%$; 1/2 watt.	RC20GF472K
R1004	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, $\pm 10\%$; 2 watts.	RC42GF222K
R1005	RESISTOR, FIXED, COMPOSITION: 10.2 megohms, $\pm 10\%$; 1/2 watt.	RC20GF106K
R1006	Non-replaceable item. Part of A1005, Part No. AX492.	
R1007	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, $\pm 10\%$; 2 watts.	RC42GF103K
R1008	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF223K
R1009	RESISTOR, FIXED, COMPOSITION: 47 ohms, $\pm 10\%$; 1/2 watt.	RC20GF470K
R1010	RESISTOR, FIXED, COMPOSITION: 200 ohms, $\pm 10\%$; 1/2 watt.	RC20GF201K
R1011	Non-replaceable item. Part of A1001, Part No. AX490.	
R1012	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, $\pm 10\%$; 1/2 watt.	RC20GF332K
R1013	Same as R1001.	
R1014	RESISTOR, FIXED, COMPOSITION: 68 ohms, $\pm 10\%$; 1/2 watt.	RC20GF680K
R1015	Same as R1009.	
R1016	Same as R1008.	
R1017	Same as R1009.	
R1018	Non-replaceable item. Part of A1001, Part No. AX490.	
R1019	Same as R1012.	
R1020	RESISTOR, FIXED, COMPOSITION: 470 ohms, $\pm 10\%$; 1/2 watt.	RC20GF471K
R1021	Non-replaceable item. Part of A1005, Part No. AX492.	
R1022	Same as R1001.	
R1023	Same as R1014.	
R1024	Same as R1009.	
R1025	Same as R1008.	
R1026	Same as R1009.	
R1027	Same as R1012.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L1203	COIL, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; consists of one 47 uuf capacitor.	AC145
L1204	COIL, RADIO FREQUENCY: fixed; 47,000 uh, $\pm 5\%$; 452 ohms DC resistance; 27 ma current rating; molded case.	CL275-473
L1205	COIL, RADIO FREQUENCY: fixed; 560 uh, $\pm 10\%$; 7.9 ohms DC resistance; 100 ma current rating; molded case.	CL140-5
L1301	COIL, RADIO FREQUENCY: fixed; 120.0 uh, $\pm 10\%$; 3.2 ohms DC resistance; molded case.	CL240-120
L1302	COIL, RADIO FREQUENCY: fixed; 50.0 uh, $\pm 5\%$; 110 ohms DC resistance; 75 ma current rating; molded case.	CL226-5
L1303	Same as L1302.	
L1304	Same as L1302.	
L1305	COIL, RADIO FREQUENCY: fixed; 35 uh, $\pm 5\%$; 1 ohm DC resistance.	CL292
L1306	NOT USED	
L1307	COIL, RADIO FREQUENCY: fixed; 95 uh, $\pm 5\%$; 1 ohm DC resistance.	CL291
L1308	Same as L1307.	
L1309	Same as L1305.	
L1310	COIL, RADIO FREQUENCY: fixed; 2.5 uh, $\pm 10\%$; 26 ohms DC resistance; 100 ma current rating; molded case.	CL140-1
M1001	METER, ARBITRARY SCALE: movement 0-1 ma; approx. resistance, 2,000 ohms; black scale on white background rectangular case.	MR160
M1002	METER, AUDIO LEVEL: 0-100 db above \pm micro-volt scale; 0-50 ua movement, linear scale, approx. resistance, 2,000 ohms; standard 2-3/16" rectangular case.	MR161
P1001	CONNECTOR, PLUG, ELECTRICAL: RF; 1 round female coaxial contact, straight type; miniature bayonet lock series.	PL204
P1002	Same as P1001.	
P1003	Same as P1001.	
P1004	CONNECTOR, PLUG, ELECTRICAL: male; 3 number 16 contacts rated at 23 amps, 12 number 20 contacts rated at 7.5 amps.	PL228-2P
P1005	CONNECTOR, PLUG, ELECTRICAL	PL225-5D
P1201	Same as P1001.	
P1301	CONNECTOR, PLUG, ELECTRICAL: miniature type; 9 female contacts, straight type; w/cable clamp.	PL189-9S

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P1302	Same as P1001. Part of W1301.	
P1303	CONNECTOR, PLUG, ELECTRICAL: miniature type; 9 female contacts, straight type; w/cable clamp. Part of W1301.	PL244-1
R1001	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF104K
R1002	RESISTOR, FIXED, COMPOSITION: 33 ohms, $\pm 10\%$; 1/2 watt.	RC20GF330K
R1003	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 10\%$; 1/2 watt.	RC20GF472K
R1004	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, $\pm 10\%$; 2 watts.	RC42GF222K
R1005	RESISTOR, FIXED, COMPOSITION: 10.2 megohms, $\pm 10\%$; 1/2 watt.	RC20GF106K
R1006	Non-replaceable item. Part of A1005, Part No. AX492.	
R1007	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, $\pm 10\%$; 2 watts.	RC42GF103K
R1008	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF223K
R1009	RESISTOR, FIXED, COMPOSITION: 47 ohms, $\pm 10\%$; 1/2 watt.	RC20GF470K
R1010	RESISTOR, FIXED, COMPOSITION: 200 ohms, $\pm 10\%$; 1/2 watt.	RC20GF201K
R1011	Non-replaceable item. Part of A1001, Part No. AX490.	
R1012	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, $\pm 10\%$; 1/2 watt.	RC20GF332K
R1013	Same as R1001.	
R1014	RESISTOR, FIXED, COMPOSITION: 68 ohms, $\pm 10\%$; 1/2 watt.	RC20GF680K
R1015	Same as R1009.	
R1016	Same as R1008.	
R1017	Same as R1009.	
R1018	Non-replaceable item. Part of A1001, Part No. AX490.	
R1019	Same as R1012.	
R1020	RESISTOR, FIXED, COMPOSITION: 470 ohms, $\pm 10\%$; 1/2 watt.	RC20GF471K
R1021	Non-replaceable item. Part of A1005, Part No. AX492.	
R1022	Same as R1001.	
R1023	Same as R1014.	
R1024	Same as R1009.	
R1025	Same as R1008.	
R1026	Same as R1009.	
R1027	Same as R1012.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1028	Non-replaceable item. Part of A1001, Part No. AX490.	
R1029	Same as R1003.	
R1030	Same as R1009.	
R1031	RESISTOR, FIXED, COMPOSITION: 270 ohms, $\pm 10\%$; 1/2 watt.	RC20GF271K
R1032	RESISTOR, FIXED, COMPOSITION: 3,900 ohms, $\pm 10\%$; 1/2 watt.	RC20GF392K
R1033	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, $\pm 10\%$; 1/2 watt.	RC20GF122K
R1034	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF102K
R1035	RESISTOR, FIXED, COMPOSITION: 130 ohms, $\pm 5\%$; 1/2 watt.	RC20GF131J
R1036	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF223J
R1037	Same as R1003.	
R1038	Same as R1033.	
R1039	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF473K
R1040	Same as R1001.	
R1041	RESISTOR, FIXED, COMPOSITION: 10 ohms, $\pm 10\%$; 1/2 watt.	RC20GF100K
R1042	Same as R1041.	
R1043	Same as R1036.	
R1044	RESISTOR, FIXED, COMPOSITION: 1.2 megohms, $\pm 5\%$; 1/2 watt.	RC20GF125J
R1045	Same as R1044.	
R1046	RESISTOR, FIXED, COMPOSITION: 150,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF154K
R1047	Same as R1009.	
R1048	RESISTOR, FIXED, COMPOSITION: 100 ohms, $\pm 10\%$; 1/2 watt.	RC20GF101K
R1049	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF103K
R1050	Same as R1001.	
R1051	Same as R1001.	
R1052 thru R1054	Non-replaceable item. Part of A1003, Part No. AX491.	
R1055	RESISTOR, FIXED, COMPOSITION: 150,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF154J
R1056 thru R1058	Non-replaceable item. Part of A1007, Part No. AX493.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1059 thru R1061	Non-replaceable item. Part of A1009, Part No. AX494.	
R1062 thru R1064	Non-replaceable item. Part of A1011, Part No. AX496.	
R1065	RESISTOR, FIXED, COMPOSITION: 220 ohms, $\pm 10\%$; 1 watt.	RC32GF221K
R1066	Non-replaceable item. Part of A1005, Part No. AX492.	
R1067	Non-replaceable item. Part of A1001, Part No. AX490.	
R1201	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF104K
R1202	RESISTOR, FIXED, COMPOSITION: 68 ohms, $\pm 10\%$; 1/2 watt.	RC20GF680K
R1203	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF223K
R1204	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, $\pm 10\%$; 1/2 watt.	RC20GF122K
R1205	RESISTOR, FIXED, COMPOSITION: 1 megohm, $\pm 10\%$; 1/2 watt.	RC20GF105K
R1206	RESISTOR, FIXED, COMPOSITION: 47 ohms, $\pm 10\%$; 1/2 watt.	RC20GF470K
R1207	Same as R1206.	
R1208	RESISTOR, FIXED, COMPOSITION: 100 ohms, $\pm 10\%$; 1/2 watt.	RC20GF101K
R1209	Same as R1208.	
R1210	RESISTOR, VARIABLE, COMPOSITION: 100 ohms, $\pm 10\%$; 1/2 watt.	RV106UX10B101A
R1211	Same as R1206.	
R1212	Same as R1206.	
R1213	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF474K
R1214	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, $\pm 10\%$; 2 watts.	RC42GF682K
R1215	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, $\pm 10\%$; 1 watt.	RC32GF122K
R1216	Same as R1213.	
R1217	Same as R1206.	
R1218	Same as R1213.	
R1219	RESISTOR, FIXED, COMPOSITION: 150 ohms, $\pm 10\%$; 1/2 watt.	RC20GF151K
R1220	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, $\pm 10\%$; 1/2 watt.	RC20GF222K
R1221	Same as R1203.	
R1222	Same as R1203.	
R1223	Same as R1220.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1224	Same as R1206.	
R1225	Same as R1219.	
R1226	Same as R1201.	
R1227	RESISTOR, FIXED, COMPOSITION: 3.3 megohms, $\pm 10\%$; 1/2 watt.	RC20GF335K
R1228	Same as R1213.	
R1229	RESISTOR, FIXED, COMPOSITION: 33,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF333K
R1230	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, $\pm 10\%$; 1/2 watt.	RV106UX10B103A
R1231	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF273K
R1232	Same as R1229.	
R1233	Same as R1205.	
R1234	RESISTOR, FIXED, COMPOSITION: 680,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF684K
R1301	NOT USED	
R1302	RESISTOR, FIXED, COMPOSITION: 330,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF334K
R1303	Same as R1204.	
R1304	Same as R1206.	
R1305	Same as R1203.	
R1306	RESISTOR, FIXED, COMPOSITION: 56,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF563K
R1307	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 10\%$; 1/2 watt.	RC20GF472K
R1308	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF153K
R1309	RESISTOR, VARIABLE, COMPOSITION: 5,000 ohms, $\pm 10\%$; 1/2 watt.	RV106UX10B502A
R1310	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF473K
R1311	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, $\pm 10\%$; 1 watt.	RC32GF103K
R1312	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF103K
R1313	RESISTOR, FIXED, COMPOSITION: 470 ohms, $\pm 10\%$; 1/2 watt.	RC20GF471K
R1314	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF224K
R1315	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF683K
R1316	RESISTOR, FIXED, COMPOSITION: 39,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF393K
R1317	Same as R1307.	
R1318	Same as R1202.	
R1319	Same as R1307.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1320	Same as R1309.	
R1321	RESISTOR, FIXED, COMPOSITION: 1,800 ohms, $\pm 5\%$; 1/2 watt.	RC20GF182J
R1322	Same as R1220.	
R1323	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, $\pm 10\%$; 1/2 watt.	RC20GF332K
R1324	Same as R1323.	
R1325	NOT USED	
R1326	RESISTOR, FIXED, COMPOSITION: 390 ohms, $\pm 10\%$; 1/2 watt.	RC20GF391K
R1327	Same as R1206.	
R1328	Same as R1206.	
R1329	Same as R1326.	
R1330	RESISTOR, FIXED, WIREWOUND: 1.0 ohms, $\pm 10\%$; 25 watts.	RE70G1R00
R1331	RESISTOR, FIXED, WIREWOUND: 15 ohms, $\pm 1\%$; 50 watts.	RE75G15R0
R1332	Same as R1331.	
R1333	RESISTOR, FIXED, WIREWOUND: 80 ohms, $\pm 10\%$; 25 watts.	RE70G80R0
R1334	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, $\pm 10\%$; 2 watts.	RC42GF332K
R1335	Same as R1201.	
R1336	Same as R1308.	
R1337	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, $\pm 10\%$; 1/2 watt.	RC20GF102K
RT1001	Non-replaceable item. Part of A1017, Part No. RR131.	
S1001	SWITCH, ROTARY: 1 section, 3 position; contacts rated for 1 amp, 28 volts DC or 5 amps, 110 volts AC.	SW112
S1002	Same as S1001.	
S1003	Non-replaceable item. Part of A1017, Part No. RR131.	
T1001	Non-replaceable item. Part of A1001, Part No. AX490.	
T1002	TRANSFORMER, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; 2.45 uh, ± 0.04 uh to 4.15 uh.	TT194
T1003	Non-replaceable item. Part of A1003, Part No. AX491.	
T1004	Non-replaceable item. Part of A1005, Part No. AX492.	
T1005	Non-replaceable item. Part of A1007, Part No. AX493.	
T1006	Non-replaceable item. Part of A1009, Part No. AX494.	
T1007	Non-replaceable item. Part of A1011, Part No. AX496.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T1008	Non-replaceable item. Part of A1013, Part No. AX497.	
T1009	Non-replaceable item. Part of A1015, Part No. AX498.	
T1201	TRANSFORMER, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; consists of one 2,000 uuf capacitor, one 15,000 ohm resistor.	TT166
T1202	TRANSFORMER, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; consists of two 2,000 uuf and one 1,000 uuf capacitor.	TT164
T1203	TRANSFORMER, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; consists of two 1,500 uuf capacitors.	TT165
T1301	TRANSFORMER, RADIO FREQUENCY: tuned; 1.75 mc operating frequency; primary inductance 8.7 to 9.5 uh; secondary inductance 11 to 12 uh; consists of one 430 uuf and one 510 uuf capacitor.	TT174
T1302	TRANSFORMER, POWER, STEP-DOWN: primary input 115/230 volts, 50/400 cps, single phase; secondary 61 volts, center tap at 4 amps; hermetically sealed rectangular steel case.	TF244
V1001	TUBE, ELECTRON: single triode; 9 pin miniature.	417A
V1002	TUBE, ELECTRON: sharp-cutoff pentode; 7 pin miniature.	6AH6
V1003	TUBE, ELECTRON: remote-cutoff pentode; 7 pin miniature.	6BA6
V1004	Same as V1003.	
V1005	TUBE, ELECTRON: medium-triode; 9 pin miniature.	6S4A
V1006	Same as V1002.	
V1007	TUBE, ELECTRON: high-mu triode; 7 pin miniature.	6AB4
V1201	Same as V1003.	
V1202	TUBE, ELECTRON: pentagrid converter; 7 pin miniature.	6BE6
V1203	Same as V1202.	
V1204	Same as V1002.	
V1205	Same as V1002.	
V1301	TUBE, ELECTRON: beam deflection; 9 pin miniature.	7360
V1302	TUBE ELECTRON: sharp-cutoff pentode; 7 pin miniature.	6EW6
V1303	TUBE, ELECTRON: voltage regulator; 7 pin miniature.	OA2
V1304	TUBE, ELECTRON: medium-mu twin-triodes; 9 pin miniature.	12AU7
W1301	CABLE ASSEMBLY, RADIO FREQUENCY: consists of 13 inch length of RG174/U coaxial cable and 2 connectors, P1302, P1303.	CA480-84-13
W1302	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various colors and lengths of MIL type MWC wire and RG174/U cable; one connector, J1305.	CA702

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XV1001	SOCKET, ELECTRON TUBE: 9 pin miniature.	TS103P01
XV1002	SOCKET, ELECTRON TUBE: 7 pin miniature.	TS102P01
XV1003	Same as XV1002.	
XV1004	Same as XV1002.	
XV1005	Same as XV1001.	
XV1006	Same as XV1002.	
XV1007	Same as XV1002.	
XV1201 thru XV1203	Same as XV1002.	
XV1204	SOCKET, ELECTRON TUBE: 7 pin miniature.	TS155P01
XV1205	Same as XV1204.	
XV1301	Same as XV1001.	
XV1302	Same as XV1002.	
XV1303	Same as XV1002.	
XV1304	Same as XV1001.	
XDS1001	LIGHT, INDICATOR: with white lens; accepts T-3-1/4 single contact, midget flange lamp.	TS154-5
XDS1002	LAMPHOLDER: accepts T-3-1/4 bayonet base lamp; no mounting bracket.	TS107-3
XDS1003	LAMPHOLDER: accepts T-3-1/4 bayonet base lamp; 1 terminal, no mounting bracket/case ground.	TS107-4
XDS1004	Same as XDS1002.	
XDS1005	Same as XDS1003.	
XDS1006	LIGHT, INDICATOR: with red transparent lens; sub-miniature bayonet base.	TS153-1

SECTION 7
SCHEMATIC DIAGRAMS

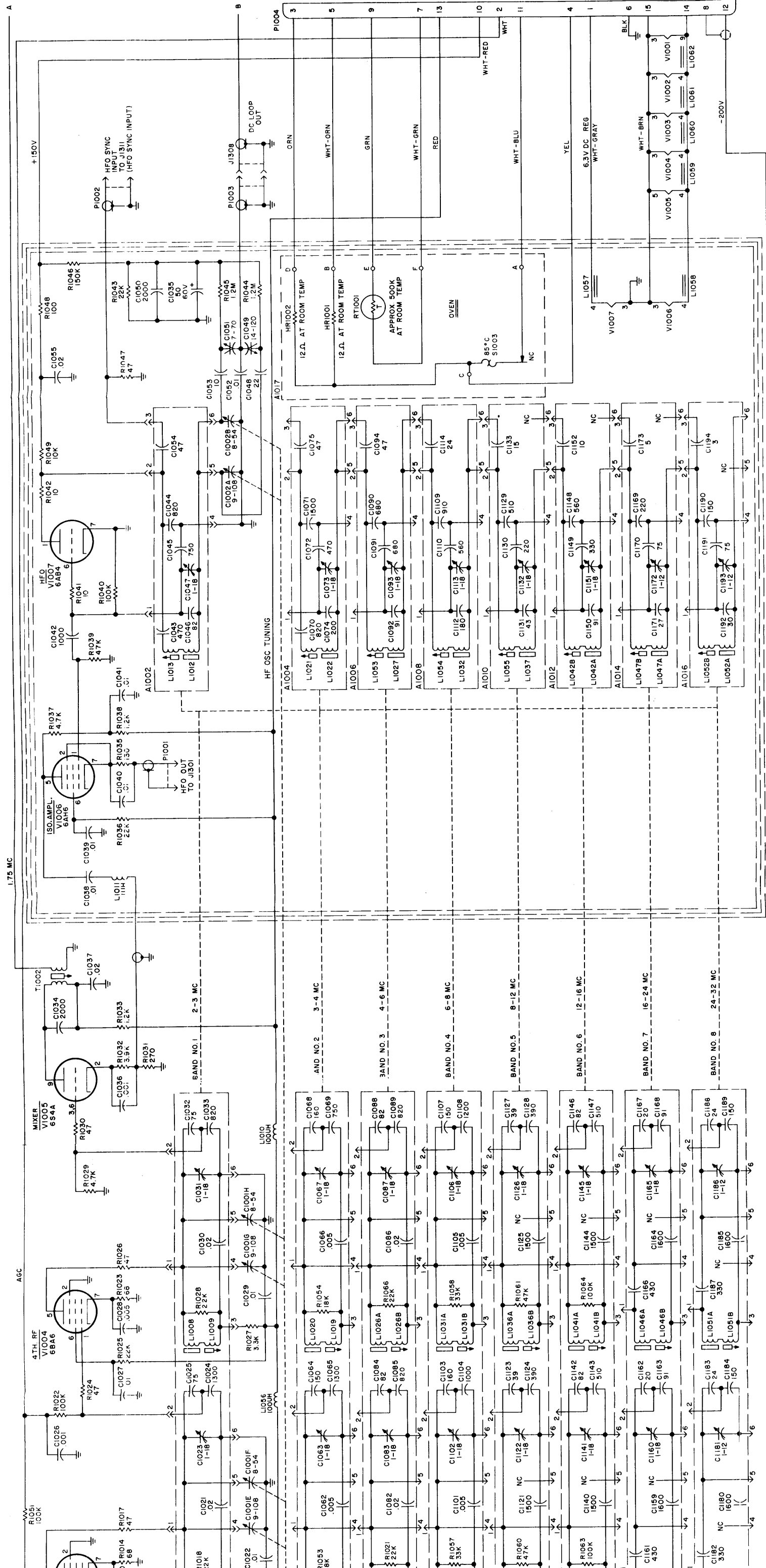
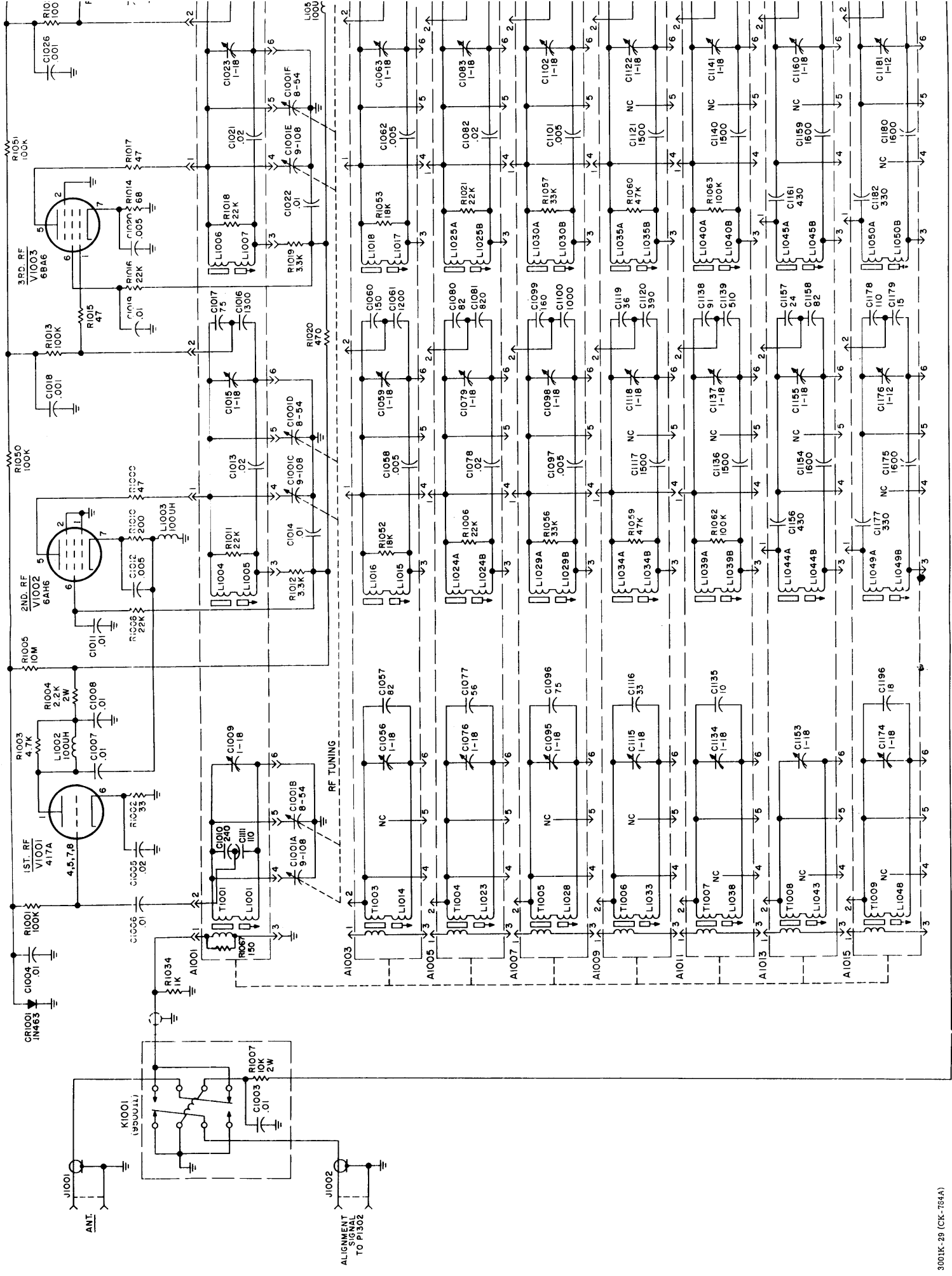


Figure 7-1. HFR, Schematic Diagram (Sheet 1 of 2)



3001K-28 (CK-T84A)

010653001K

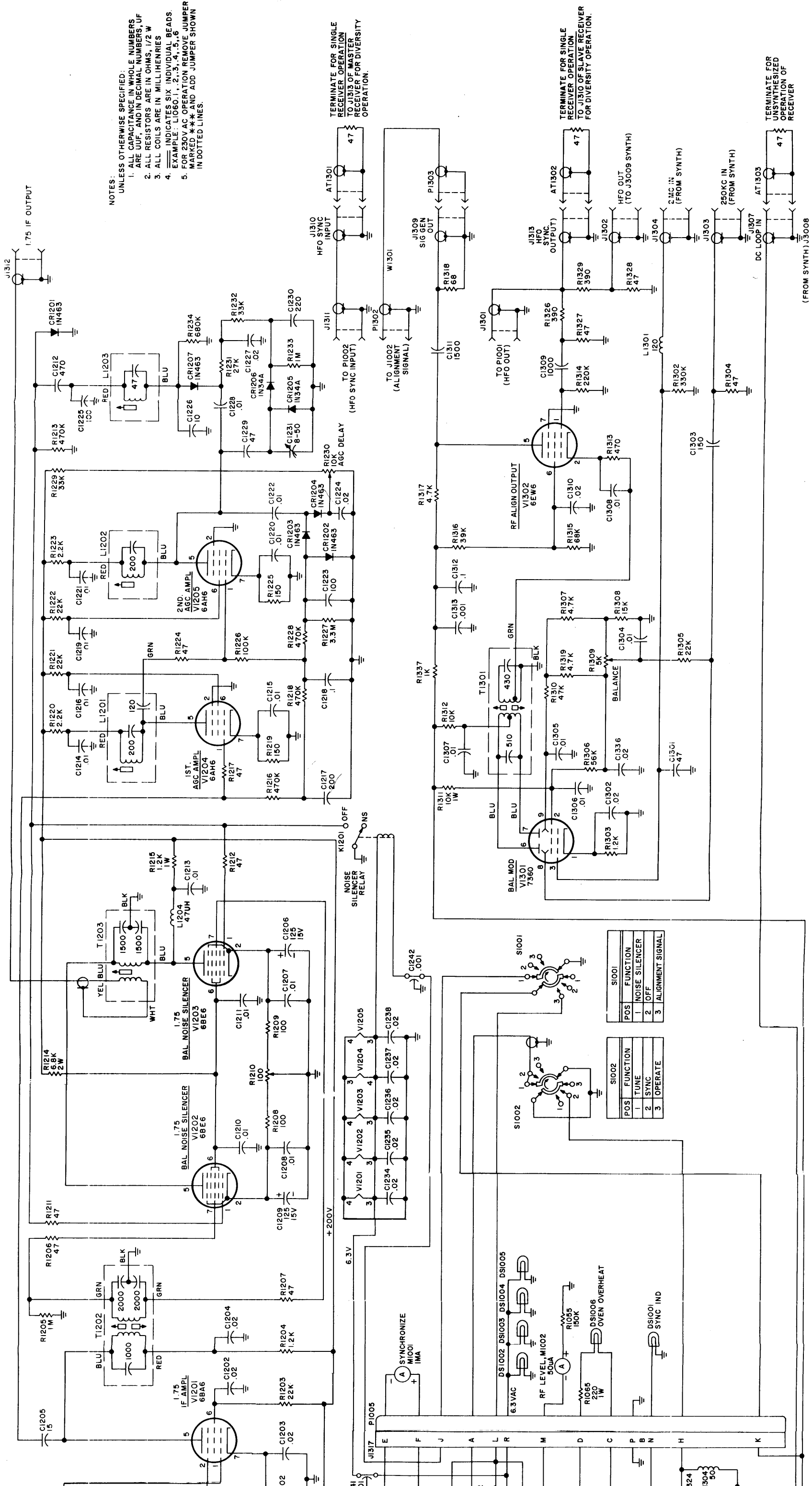
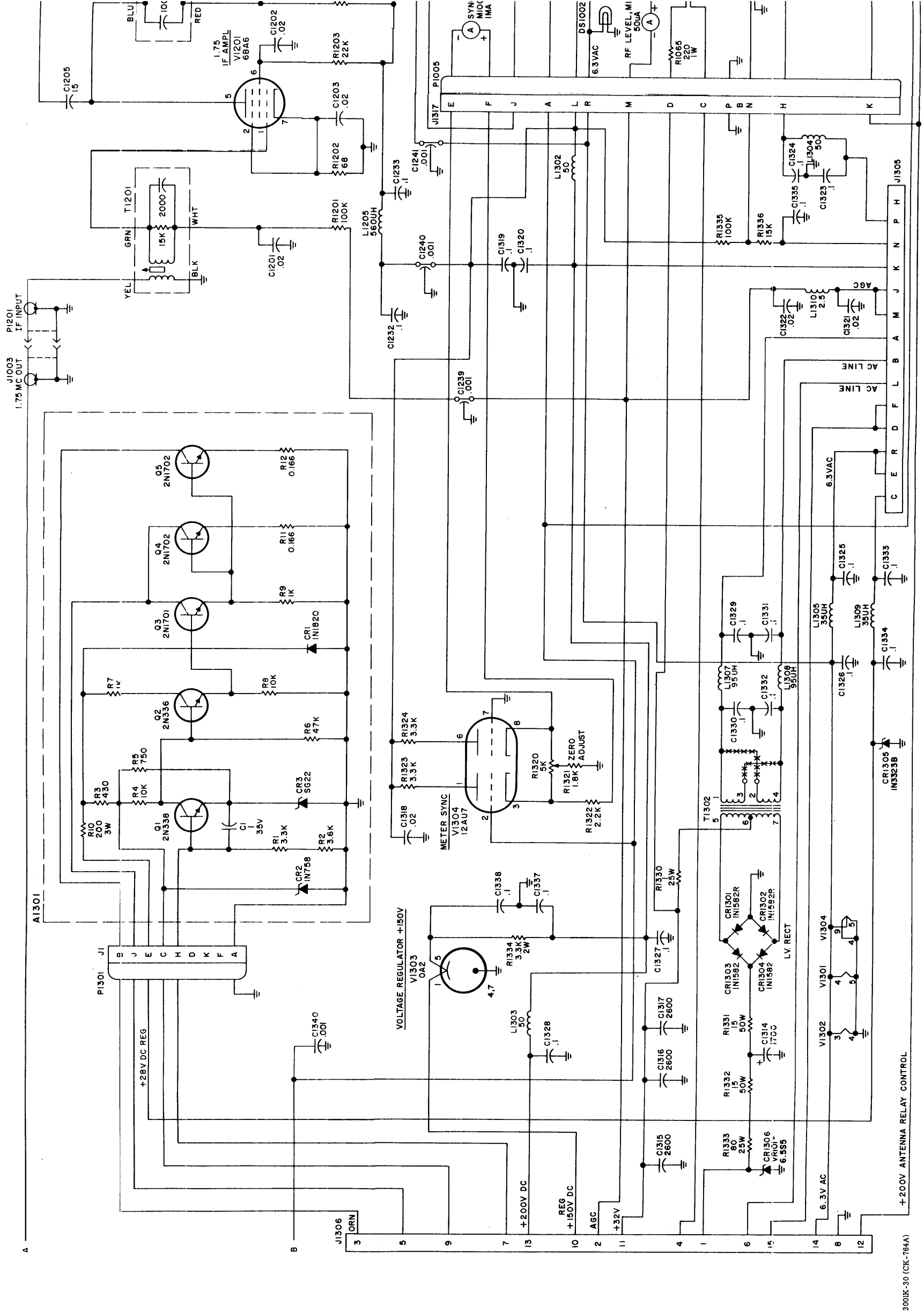


Figure 7-1. HFR, Schematic Diagram (Sheet 2 of 2)



3001K-30 (CK-764A)

010653001K

CONTINUOUS RF TUNER

MODEL HFR-2B

Continuous RF Tuner HFR-2B differs from Continuous RF Tuner HFR-2 only in the fact that the tuner gear assembly (AX-513) has been replaced with a heavy-duty gear assembly (AX-578-1)

The HFR-2 instruction manual (IN-3001K) will apply as written.

ADDENDUM #1

TO TECHNICAL MANUAL FOR CONTINUOUS RF TUNER MODEL HFR-2 (TN-376A/UR)

1. SUBJECT: DESCRIPTION OF CONTINUOUS RF TUNER MODEL HFRR-2B.

TMC Model HFRR-2B CONTINUOUS RF TUNER is the same as Model HFR-2 with the addition of a heavy duty gear assembly and remote control circuits. These circuits respond to signals from associated equipment and adapt the HFR-2 to function as a modular unit of TMC's TechniMatiC* receiver systems.

2. GENERAL.

There are two automated functions in the HFRR-2B that are controlled by remote equipments. The first controls band selection (positioning the band switch at one of eight band positions). The second controls specific frequency tuning (positioning the tuning dial on the selected band). Each function is independently operated and controlled.

3. TUNING DIAL.

Electro-mechanical positioning of the tuning dial is accomplished in five operations. They are: 1. Determination of ultimate dial position, the desired frequency; 2. Engagement of a magnetic clutch that disengages the front panel manual TUNE control mechanism; 3. Proper cw or ccw

*Trademark applied for.

rotation of the bi-directional servo motor to move the dial; 4. Feedback monitoring of the servo motor to govern its speed and ultimate position; 5. Monitoring end-of-dial conditions to insure servo motor stoppage and reversal of directional rotation to prevent the indicator from going off scale.

Motor B1001, tachometer-generator G1001, high and low frequency limit switches S1004 and S1005 (respectively), and magnetic clutch MP1001 are mechanically linked, figure 2, to the dial tuning shaft. Since none of these components are unique, a detailed discussion of their operation is not necessary.

4. BAND SWITCH.

Electro-mechanical positioning of the band switch is accomplished in seven operations (maximum). They are: 1. Determination of ultimate band position (the desired frequency band); 2. Sensing present band position (if in desired band, no further action is taken); 3. Energizing the detent cam release solenoid so the motor can rotate the shaft; 4. De-energizing detent cam release solenoid when desired band position is nearly reached; 5. Opening cam switch; 6. Removal of motor drive voltage; 7. Shaft rotation until detent slug stops the cam and shaft in the exact band switch position.

Motor B1002, homing switch S1007, detent release solenoid L1063, and cam switch S1006 (figure 1) are mechanically linked to the band switch shaft. Since the homing switch is the only unique component in the circuit,

it is discussed in the following paragraph. See figure 1.

Assume initially the band switch is in the band 1 position, with the corresponding homing switch also at the band 1 position as shown in figure 1. When a different band setting is desired, a voltage is applied to a set of contacts on the homing switch corresponding to the desired band.

Assuming that the desired band setting is band 4, a voltage is applied to the band 4 contacts of the homing switch. This voltage, routed through the shorting arm of the switch to a common contact, permits the band switch drive motor to rotate. The band switch drive motor shaft thus rotates the band switch and the homing switch to the selected band setting. This is achieved when the drive motor removes the homing switch shorting arm from the voltage bearing band 4 contacts. At that point, voltage is removed from the common contact, causing the drive motor to stop rotating, now at the selected band 4 setting.

5. PHYSICAL.

The HFRR-2B is identical in front panel appearance as the HFR-2. However, due to the automated circuitry incorporated in the HFRR-2B, the rear, top and bottom views are slightly different.

6. HFRR-2B WIRING SCHEMATIC.

The HFRR-2B is wired in accordance with drawing number CK-769 (attached).

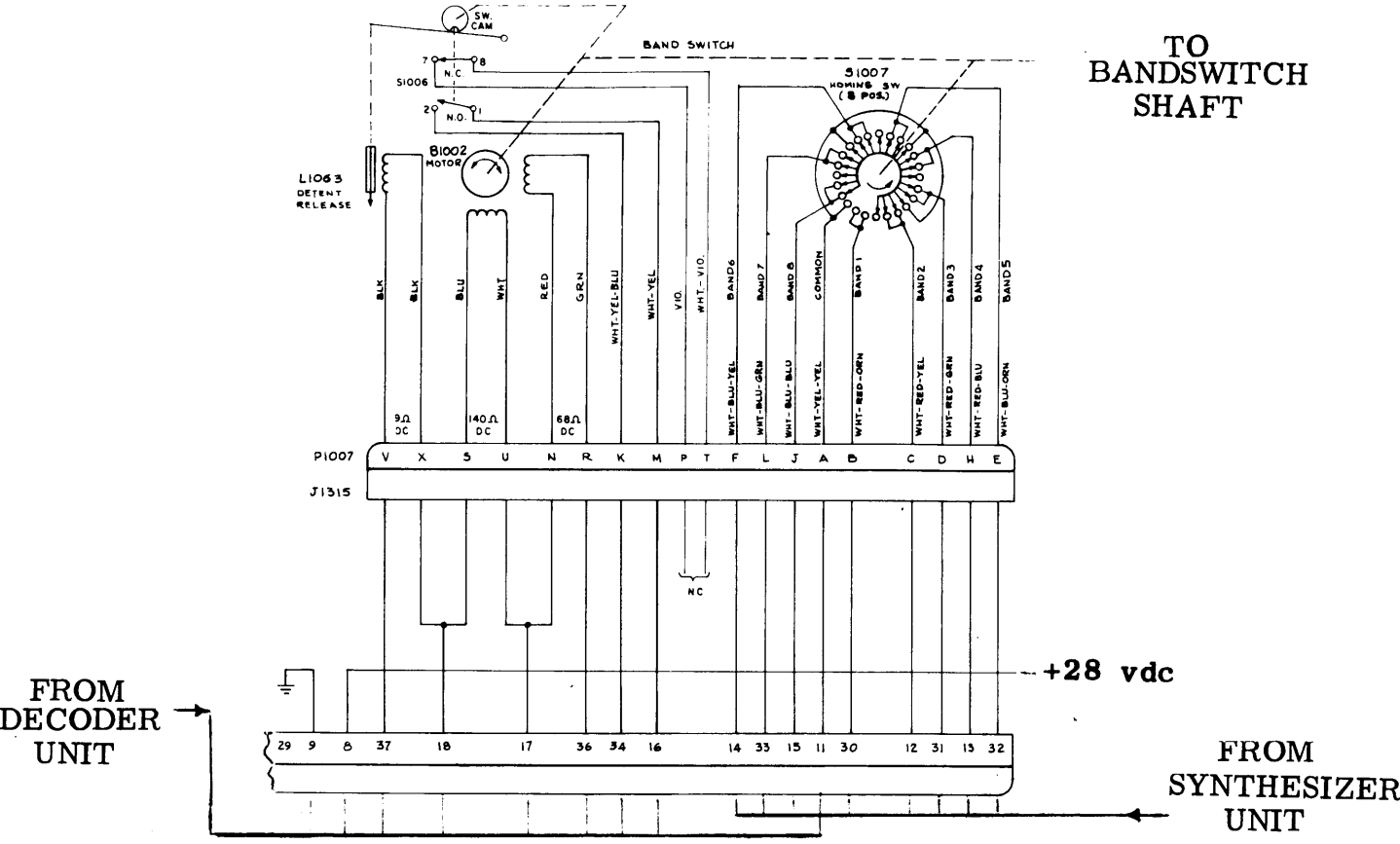


Figure 1. AUTOMATED BAND SWITCH, CIRCUIT DIAGRAM

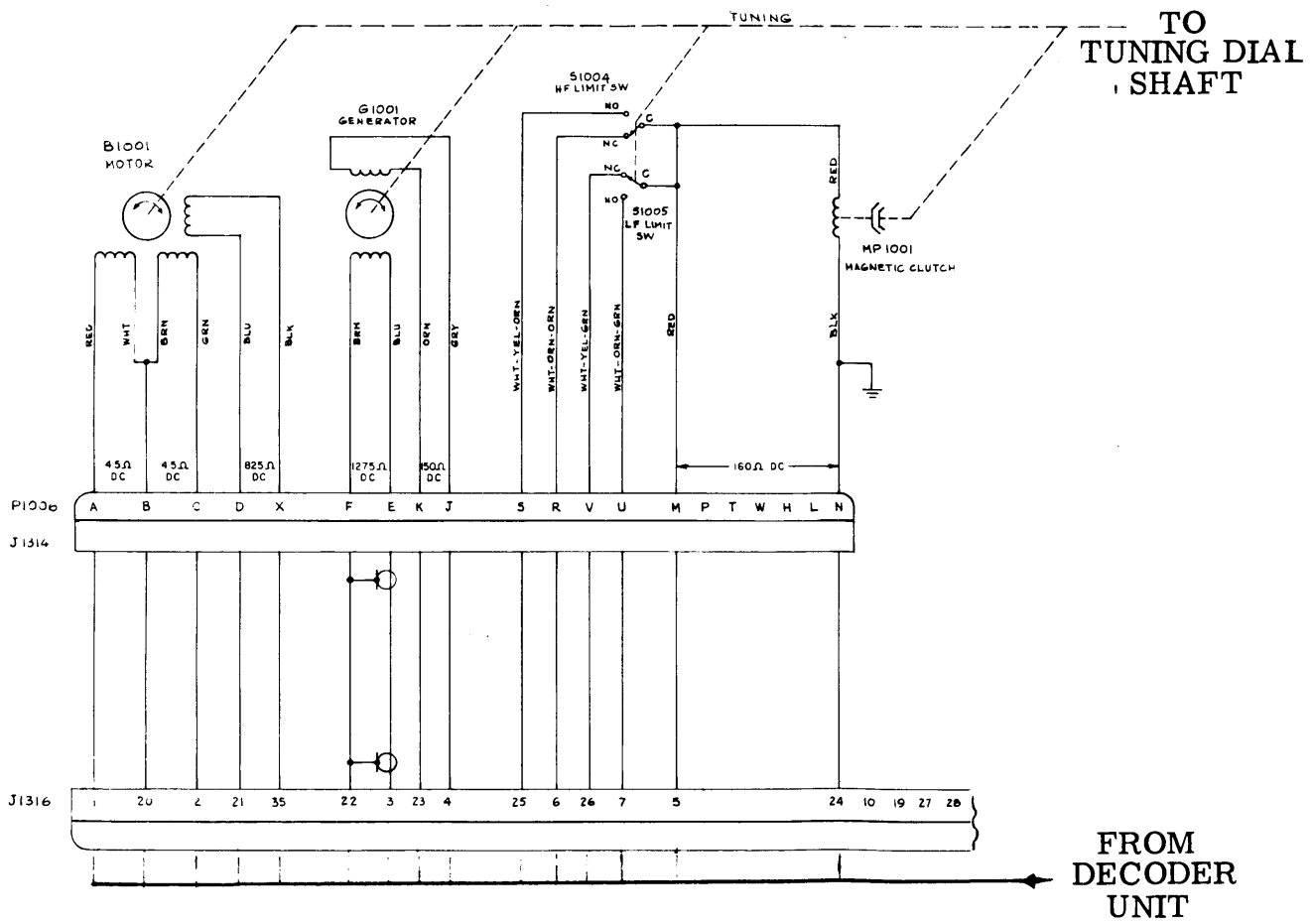


Figure 2. AUTOMATED TUNE CONTROL, CIRCUIT DIAGRAM

7. MAINTENANCE.

Maintenance and troubleshooting of the HFRR-2B is the same as that for the HFR-2.

Troubleshooting the automated portion of the unit will consist of continuity and resistance checks. The schematic diagram includes d-c resistance values of the automated circuit wiring.

8. PARTS LIST.

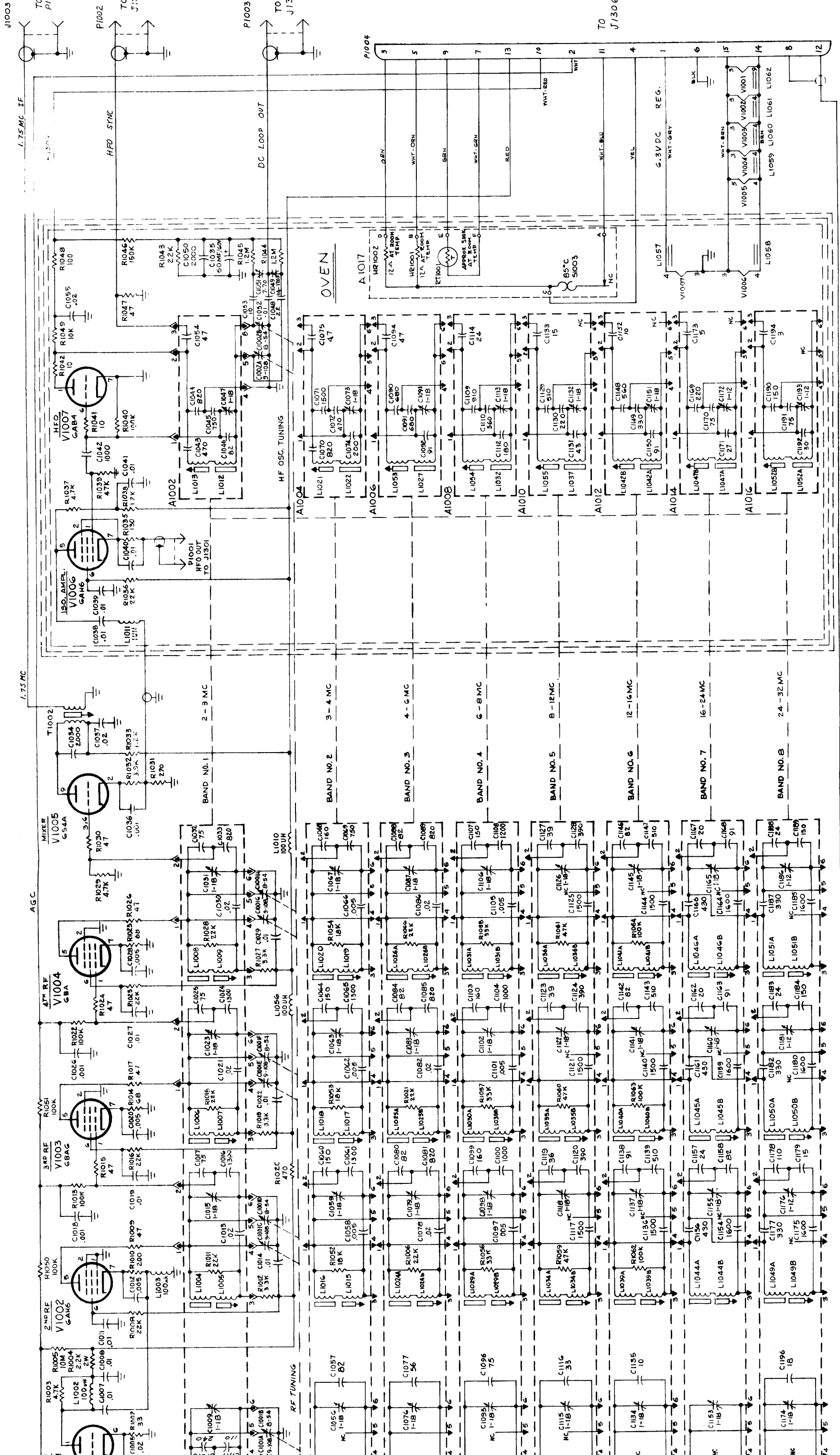
The HFRR-2B parts list is the same as that for the HFR-2, with the addition of items shown in table 1.

Table 1. CONTINUOUS RF TUNER, MODEL HFRR-2B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
B1001	MOTOR, CONTROL, SERVO: fixed phase-115 volts, 0.063 amps, 6.4 watts; control phase, series connected, 40 volts, 0.182 amps, 6.4 watts; motor control frequency 50/60 cps, no load speed 3,200 RPM; max. power output 1.1 watts, 1,600 RPM at max. power output; operating temperature range 0°C to +55°C; anodized black case.	MO123
B1002	MOTOR, INDUCTION: AC; 115 volts, +10%; 50/60 cps; 1 phase int. duty; counterclockwise rotation; 1,755 RPM; black anodized case.	MO122-1
G1001	GENERATOR, TACHOMETER: 60 cycle fixed phase, 26 volts, 0.121 amps, power input 2.86 watts; motor control - 50/60 cps, 0-3,600 RPM; operating temperature range 0°C to +55°C; stainless steel case.	BN100
J1314	CONNECTOR, RECEPTACLE, ELECTRICAL: 20 number 20 female contacts, gold over silver plated spring tempor phosphor bronze; rated for 1,900 volts RMS at sea level; sub-miniature type.	JJ242-6S
J1315	Same as J1314.	
J1316	CONNECTOR, RECEPTACLE, ELECTRICAL: 25 male crimp pins removable style contacts, rated for 5 amps, 500 V RMS; connector shape polarization.	JJ313-2
L1063	SOLENOID, ELECTRICAL: pull type; 1 coil; average current rating 6.5 amps, coil resistance 9 ohms, 115 volts 60 cycle AC; 1/2" axial plunger stroke; 2 wire lead type terminals; steel case.	SZ101
MP1001	CLUTCH, MAGNETIC: coil rated for 24 VDC, 3.5 watts nominal.	CZ100
P1006	CONNECTOR, PLUG, ELECTRICAL: 20 number 20 male contacts, gold over silver plated brass; rated for 1,900 volts at sea level, 7.5 amps max.; sub-miniature type, anodized aluminum hood.	PL255-6P

Table 1. CONTINUOUS RF TUNER, MODEL HFRR-2B (cont)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P1007	Same as P1006.	
S1004	SWITCH, SENSITIVE: with retainer; SPDT; current rating 5.0 amps at 125/250 VAC; 7 amps resistive; 4 amps inductive at 28 VDC; plastic body.	SW353-2
S1005	Same as S1004.	
S1006	SWITCH, PUSH: actuator; DPDT; silver contacts; momentary plunger, solder end terminals.	SW347
S1007	SWITCH SECTION, WAFER: rotary; 1 pole, 24 positions max. per pole, shorting type; indexing 15°; contacts rated for 0.0025 ohms max.; silver alloy terminals.	WS133



TO SHEET 2

TO +32V LINE

J1003 TO P1201 (SHEET 2)

P1002 TO J1301

P1003 TO J1308

TO J1306

OVEN

HF OSC. TUNING

BAND NO. 2

BAND NO. 3

BAND NO. 4

BAND NO. 5

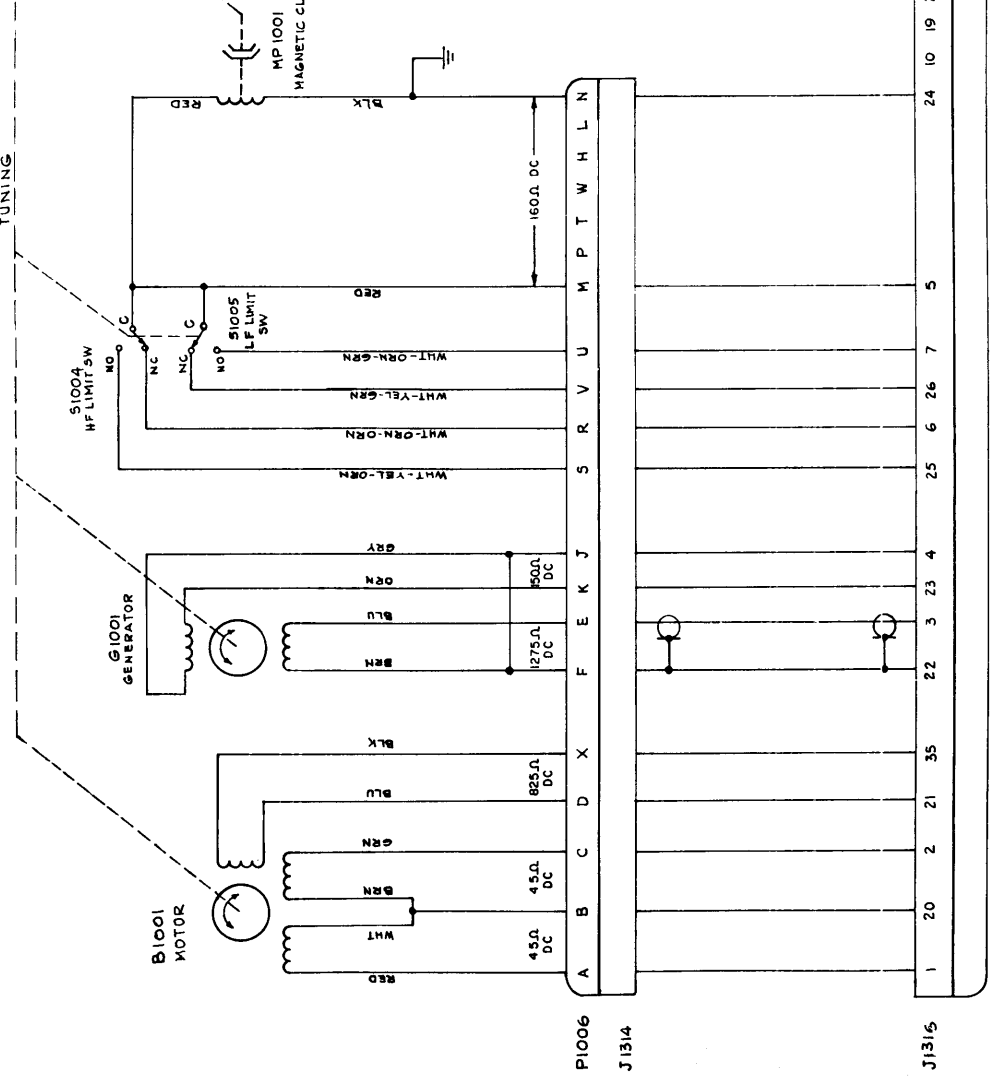
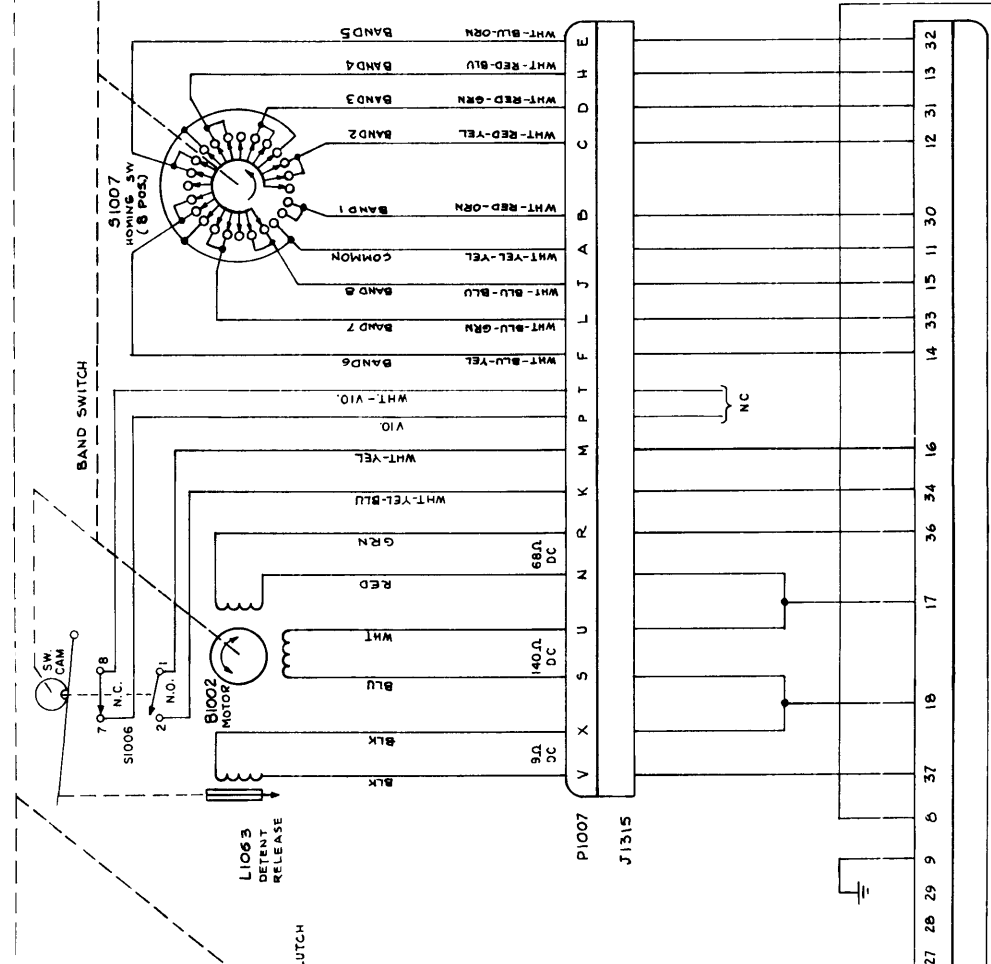
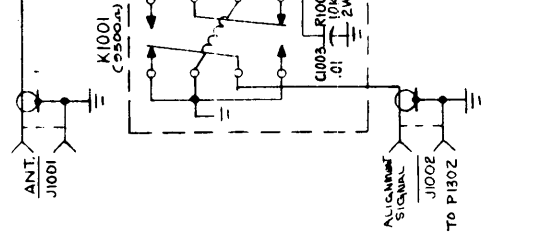
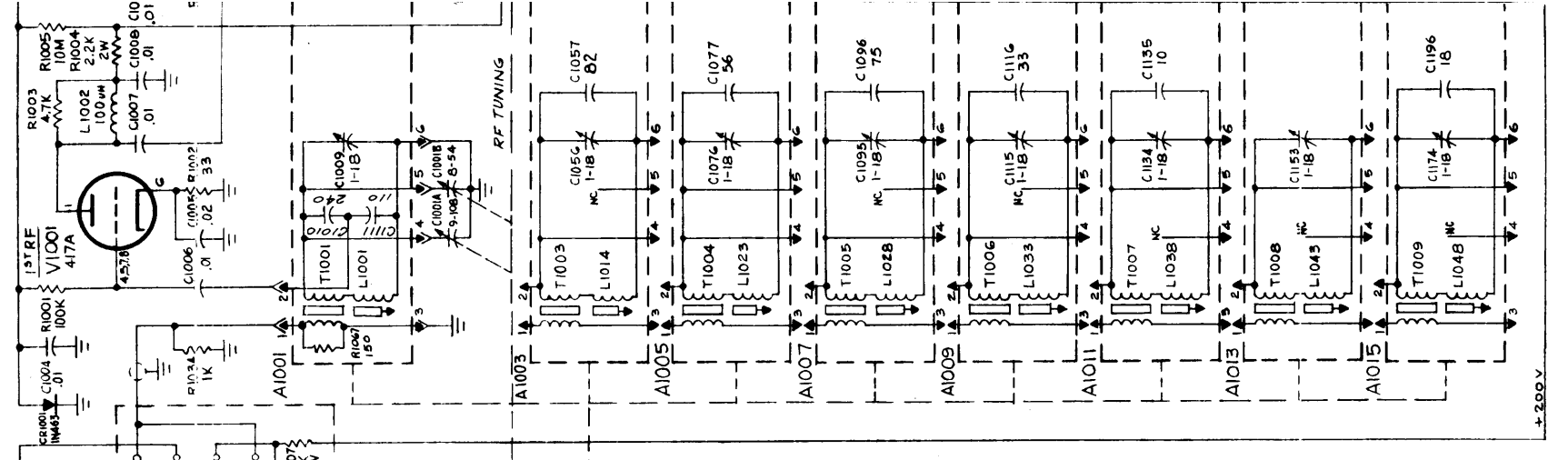
BAND NO. 6

BAND NO. 7

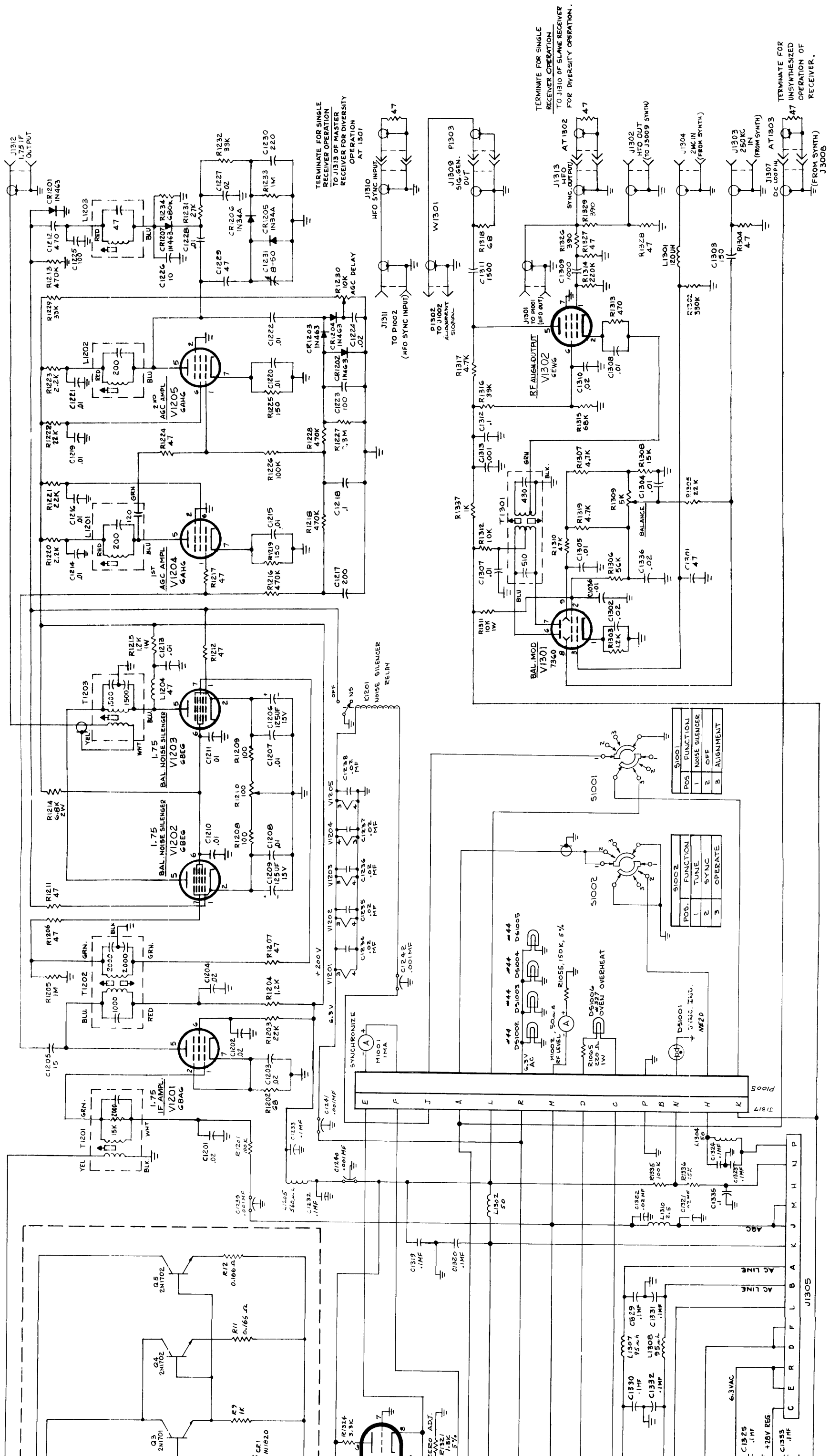
BAND NO. 8

RF TUNING

DC LOOP OUT



CK-769E
(Sheet 1 of 2)



TERMINATE FOR SINGLE RECEIVER OPERATION TO J1313 OF MASTER RECEIVER FOR DIVERSITY OPERATION AT 1301

TO P1002 (HFO SYNC INPUT) J1311

TO J1002 ALIGNMENT SIGNAL J1302

TO P1002 (HFO SYNC INPUT) J1311

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

TO J1002 ALIGNMENT SIGNAL J1302

POS.	FUNCTION
1	NOISE SILENCER
2	OFF
3	ALIGNMENT

POS.	FUNCTION
1	TUNE
2	SYNC
3	OPERATE

TERMINATE FOR SINGLE RECEIVER OPERATION TO J1310 OF SLAVE RECEIVER FOR DIVERSITY OPERATION.

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

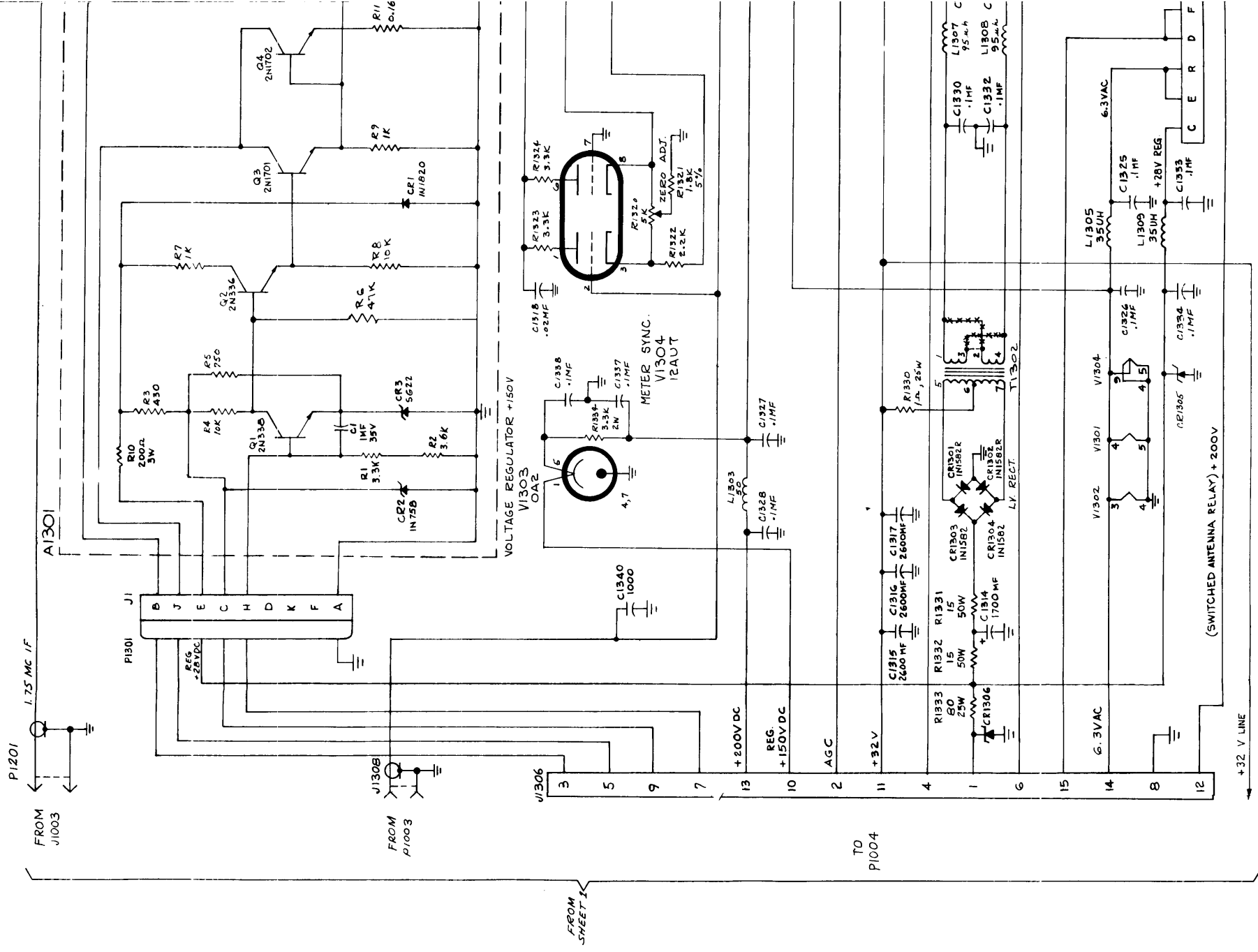
TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302

TO J1302 (HFO OUT) J1302



CK-769E
(Sheet 2 of 2)