



hallicrafters

OPERATING AND SERVICE INSTRUCTIONS

VARIABLE
FREQUENCY
OSCILLATOR
MODEL HA-5

WARRANTY

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

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

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

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

the hallicrafters CO.

092-014557



Figure 1. View of Variable Frequency Oscillator.

SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

The new Hallicrafters Model HA-5 is a compact, self-contained, Variable Frequency Oscillator (VFO) designed as a crystal substitute for use with any conventional, 80 through 2 meter*, amateur transmitter.

Heterodyne operation plus voltage regulation of the tunable and crystal oscillators insures maximum frequency stability. A 30 to 1 tuning ratio, in conjunction with an easy-to-read back-lighted dial calibrated directly in operating frequency for each band, provides precise frequency adjustment.

For ease and flexibility of operation, a single control turns the power ON and selects the desired output frequency range.

A convenient front panel CAL switch permits instantaneous spotting of the transmitter frequency with the station receiver.

*The unit, as supplied, does not include heterodyne crystals for the 6-meter or 2-meter bands. Should operation be desired on either of these bands, the heterodyne crystals may be purchased and installed. Refer to the parts list for the correct crystal type, frequency, and part number.

SECTION II

SPECIFICATIONS

TUBES	6U8A Tunable Oscillator, Crystal Oscillator 6BA7 Mixer 6AQ5A Output Amplifier OA2 Voltage Regulator
RECTIFIERS	Silicon (2)
OUTPUT IMPEDANCE	5600 ohms shunted by 100 $\mu\mu$ F cable capacitance
OUTPUT VOLTAGE	30V nominal
STABILITY	Better than 500 cycles of set frequency over a one hour period (after 15-minute warmup)
POWER CONSUMPTION	30 watts at 117 volts (nominal), 60 CPS, alternating current
DIMENSIONS (H x W x D)	5-5/8 inches x 7 inches x 9-1/32 inches
NET WEIGHT	7 pounds
SHIPPING WEIGHT	8-1/2 pounds

SECTION III

INSTALLATION

3-1. UNPACKING.

After unpacking the VFO, examine it closely for damage which may have occurred in transit. Should damage be apparent, immediately file a claim with the carrier stating the extent of the damage. Carefully check all shipping labels and tags for instructions before removing them.

3-2. LOCATION.

The VFO is supplied with a 30-inch output cable. The unit should be located so that this cable will be of adequate length to interconnect the VFO and the transmitter. When locating the VFO, avoid excessively warm locations. For proper ventilation, allow at least one inch of clearance between the back of the VFO and the wall.

NOTE

The output cable distributed capacity is part of the resonating capacitance of the output stage. The length of this cable should not be varied if proper performance of the VFO is to be obtained.

3-3. POWER SOURCE.

The Model HA-5 VFO is designed to operate from a 105-volt to 125-volt, 60-cycle, AC power source. Power consumption is 30 watts.

NOTE

If in doubt about your power source, contact your local power company prior to inserting the power cord into an AC power outlet. Connecting the VFO to the wrong power source may cause extensive damage to the unit and entail costly repairs.

3-4. TYPICAL SYSTEM CONNECTION.

A two-screw type terminal strip is provided at the rear of the chassis to connect the VFO into a station control system. See figures 2 and 3.

Two jacks are provided at the rear of the chassis to connect the VFO output to the transmitter. One jack is used for the 80-meter through 10-meter output, while the other jack is used for the 6-meter and 2-meter output.

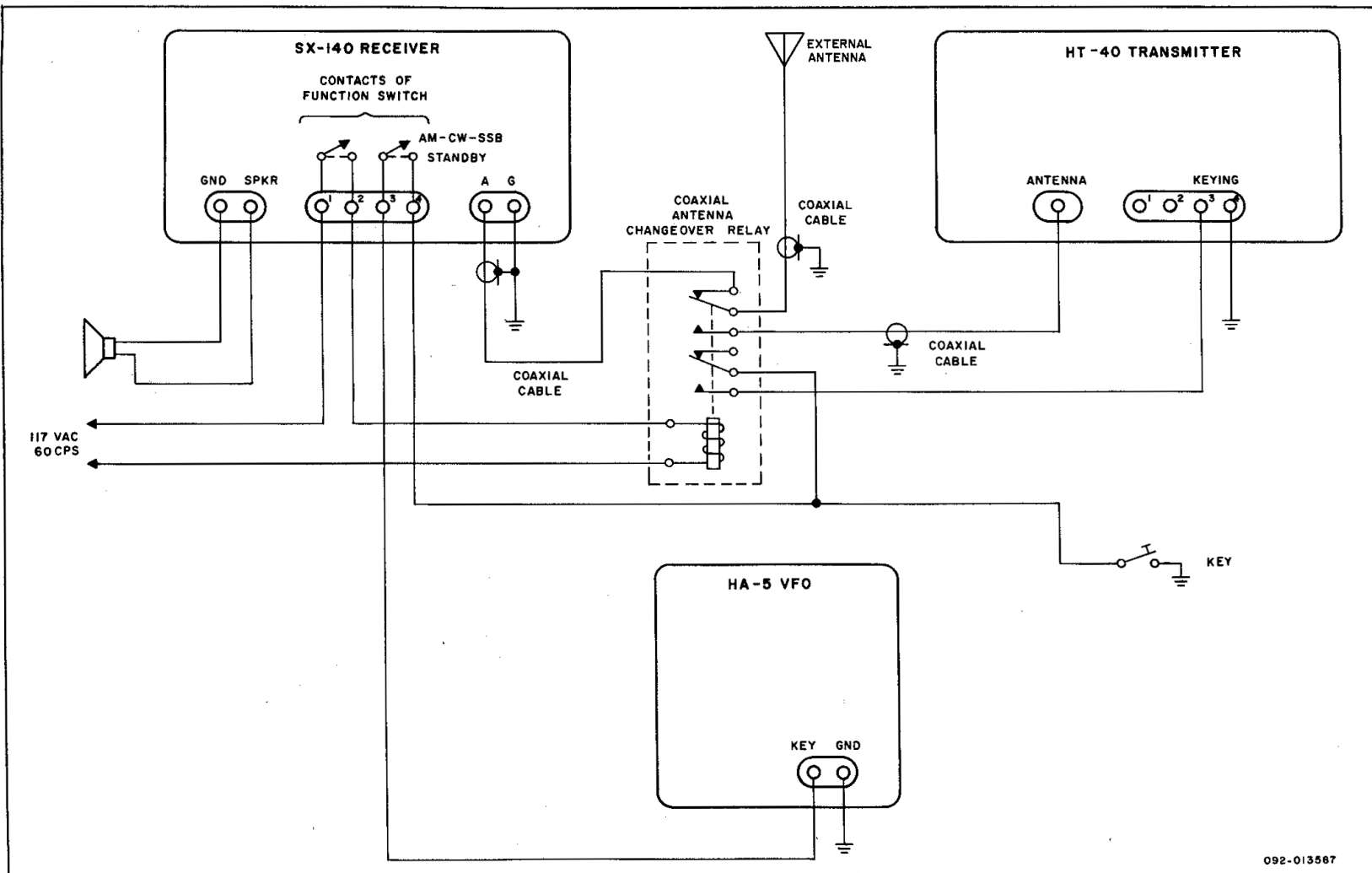


Figure 2. Typical Station Setup.

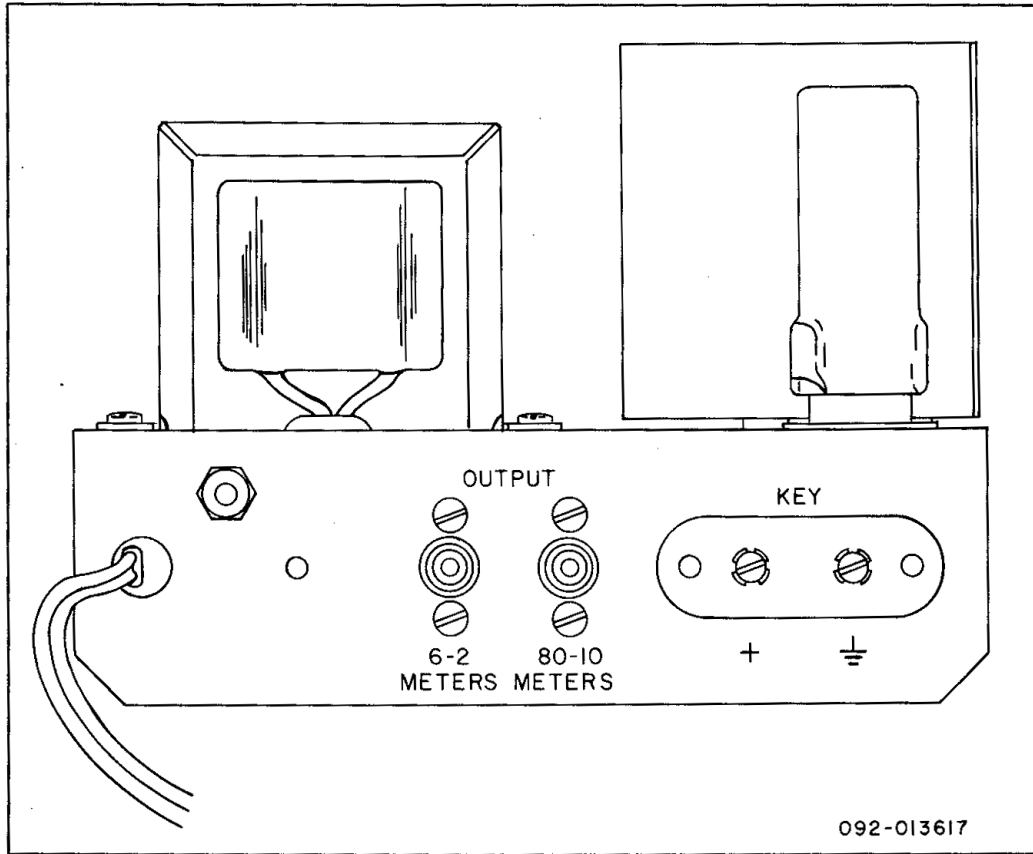


Figure 3. Rear View of VFO.

SECTION IV

FUNCTION OF OPERATING CONTROLS

4-1. GENERAL.

Each control of the VFO performs a definite function which contributes to the versatility of the equipment. Full appreciation of the VFO is to be expected only after becoming familiar with each of these controls. A brief description of each control is contained in the following paragraphs (see figure 4).

4-2. BAND SELECTOR CONTROL.

The BAND SELECTOR control is an eight-position rotary switch which turns the power ON and selects the desired operating band.

4-3. TUNING CONTROL.

The main TUNING control is a variable capacitor that determines the 5.0-MC to 5.5-MC oscillator frequency. This control engages and moves the dial when setting the desired frequency.

4-4. CAL-OFF CONTROL.

The CAL-OFF control is a SPDT slide switch. In the CAL position, the VFO keying circuit is removed from the rear terminals and the VFO is keyed on, producing the desired output frequency. This enables the transmit frequency to be preset without keying the transmitter on.

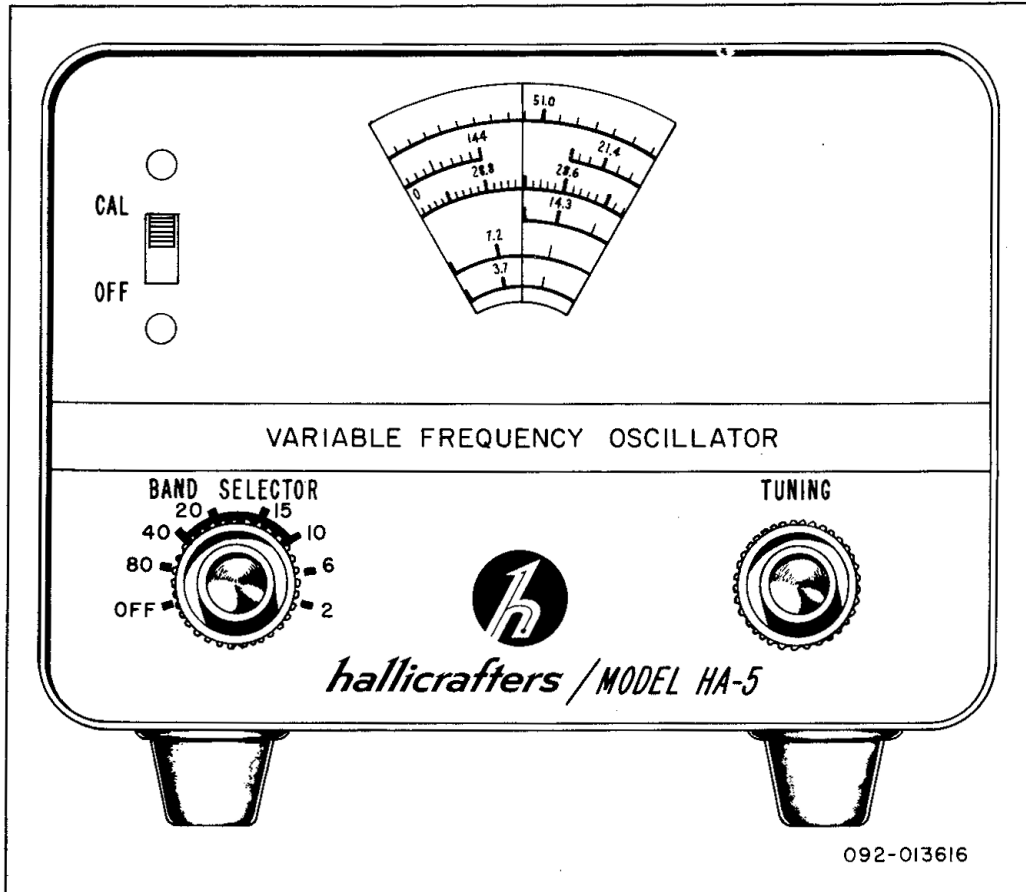


Figure 4. Front Panel View of VFO.

With the switch in the OFF position, the VFO keying circuit is returned to the keying terminals on the rear apron where it may be keyed by the station control system.

4-5. SERVICE AND OPERATING QUESTIONS

For further information regarding operation or servicing of the unit, contact The Hallicrafters dealer from whom it was purchased. The Hallicrafters Company maintains an extensive system of Authorized Service Centers where any required service will be performed promptly and efficiently at a nominal charge. All Hallicrafters Authorized Service Centers display the sign shown at right. Consult your dealer or telephone directory for the location nearest you.



Do not make any service shipments to the factory unless instructed to do so by letter. The Hallicrafters Company will not accept the responsibility for any unauthorized shipments.

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

SECTION V

OPERATION

5-1. GENERAL.

Set the BAND SELECTOR switch to the desired band (this also turns the VFO power ON). Allow a few minutes for the unit to reach operating temperature.

With the transmitter in standby, tune the VFO to the desired frequency as indicated on the calibrated dial. If desired, you may zero-beat your receiving frequency by setting the CAL-OFF switch to the CAL position. Adjust the VFO tuning control for the lowest possible tone (i.e., zero-beat) as heard in the station speaker. When this condition exists, the transmitter frequency exactly coincides with the receiver frequency. Set the CAL switch to OFF.

Turn the transmitter switch to OPERATE and proceed with the manufacturers recommended tuning procedure.

5-2. DIAL SCALE.

Figure 5 shows the Model HA-5 dial calibrations. The calibrations indicate the carrier frequency of the transmitter output stage, not the VFO output. The following table lists the amateur bands, the VFO output frequency, and the multiplication necessary to obtain the desired transmitter output frequency.

The major dial calibrations for each band are 100 KC apart. On the 10-meter band, intermediate calibration marks are furnished at 20-KC intervals. Since the 100-KC points on the 80, 40, 20, and 10 meter bands are in alignment, the intermediate calibrations for 10 meters can be used for these bands. On 80 and 40 meters the 10 meter minor calibration marks represent 5 KC and on 20 meters, 10 KC. On the 15, 6, and 2 meter bands, the intermediate calibration marks are directly given on each band.

Amateur Band	Dial Calibration	Actual VFO Output Freq	Multiplication Required in Transmitter
80 meters	3.5 - 4.0 MC	3.5 - 4.0 MC	None
40 meters	7.0 - 7.3 MC	7.0 - 7.3 MC	None
20 meters	14.0 - 14.3 MC	7.0 - 7.150 MC	X2
15 meters	21.0 - 21.4 MC	7.0 - 7.333 MC	X3
10 meters	28.0 - 29.7 MC	7.0 - 7.425 MC	X4
*6 meters	50.0 - 53.0** MC	8.333 - 8.833 MC	X6
*2 meters	144 - 148 MC	8.0 - 8.222 MC	X18

*Accessory Heterodyne crystals required for 6 or 2 meter operation. They may be purchased from your local dealer or directly from The Hallcrafters Co. See Parts List for type, frequency, and part number.

**The 6M range is limited to 53 MC in order to provide the best possible bandspread on all ranges.

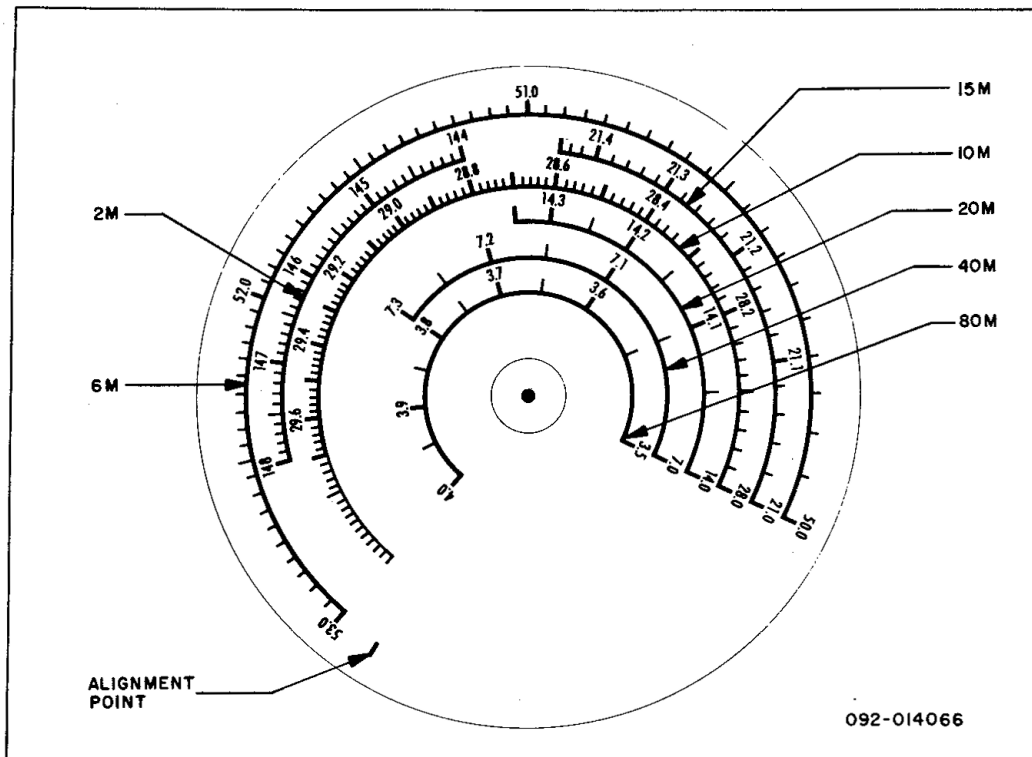


Figure 5. Dial Scale Calibrations.

SECTION VI

SERVICE DATA

6-1. CRYSTAL, TUBE, AND DIAL LAMP REPLACEMENT.

To gain access to the tubes and dial lamps, remove the chassis from the cabinet (see paragraph 6-2). The location of the crystals, tubes, and the dial lamp is shown in figure 7.

6-2. CHASSIS REMOVAL.

The chassis may be removed from the cabinet by removing the four thread-forming screws from the bottom of the cabinet. When removing the chassis from the cabinet, care should be taken not to damage any of the components.

6-3. DIAL CORD RESTRINGING.

Remove the chassis from the cabinet to restring the dial cord (see paragraph 6-2). Rotate the tuning drum fully clockwise (tuning capacitor plates fully meshed). Care should be taken not to damage the capacitor plates. Refer to figure 6 for the stringing procedure. To restring the dial: tie a non-slip loop on one end of the cord, attach this loop to the tuning drum at point A. Follow the arrows and the number sequence; make certain that the cord makes one complete loop around the drum before going to the control shaft. Keep just enough tension on the dial cord during stringing to prevent it from slipping off the tuning drum. Tie the free end of the dial cord to the dial spring with a non-slip knot so that when the spring is attached to the tuning drum at point B it remains expanded about 1/4 inch.

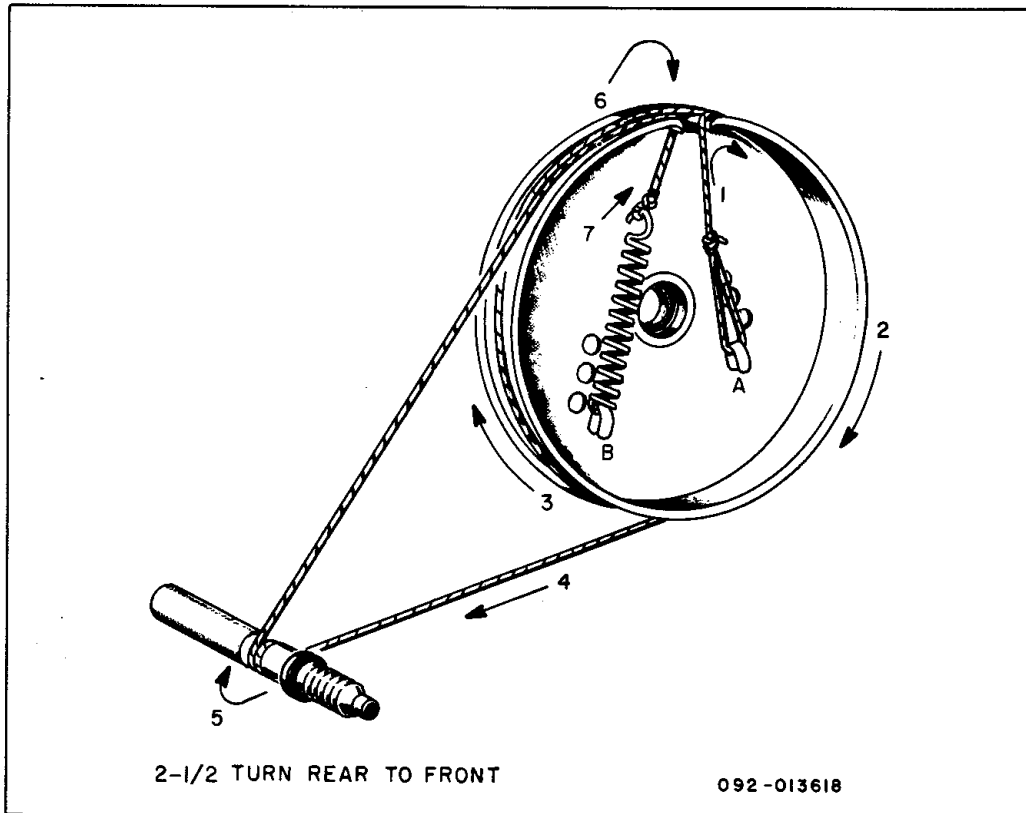


Figure 6. Dial Stringing Detail.

SECTION VII

THEORY OF OPERATION

Tube V1A (1/2 6U8A) is a variable oscillator tuning 5.0 MC to 5.5 MC. The series tuned combination of C3 (tuning capacitor) and L1 set the frequency. C1A and C1B are temperature compensating capacitors that provide long term frequency stability.

Tube V1B (1/2 6U8A) is an untuned crystal oscillator designed for standard CR-18/U crystals. The BAND SELECTOR selects the proper crystal for each band.

The outputs of the oscillators are heterodyned in the mixer, V2 (6BA7), producing sum and difference frequencies. A double-tuned transformer in the mixer plate (L2 on 80 meters, L3 on 40 meters through 10 meters, and L4 on 6 meters and 2 meters) selects the proper heterodyned frequency (crystal minus tunable) and provides essentially constant output over the frequency range.

Tube V3 (6AQ5A) amplifies the desired signal to a level of sufficient amplitude to drive a transmitter oscillator or buffer amplifier.

Keying is accomplished by opening the cathode circuits at the mixer and output amplifier stages. In the key-up condition, resistor R22 (47K ohm) limits the voltage across the key terminals to less than 40 volts.

The power supply is transformer operated and consists of two silicon rectifiers connected in full wave. Resistor R20 is a surge limiting resistor and, in addition, acts as a fuse, protecting the rectifiers and transformer in the event of a B+ short. Tube V4, an OA2 gaseous regulator tube, provides B+ regulation for both oscillators.

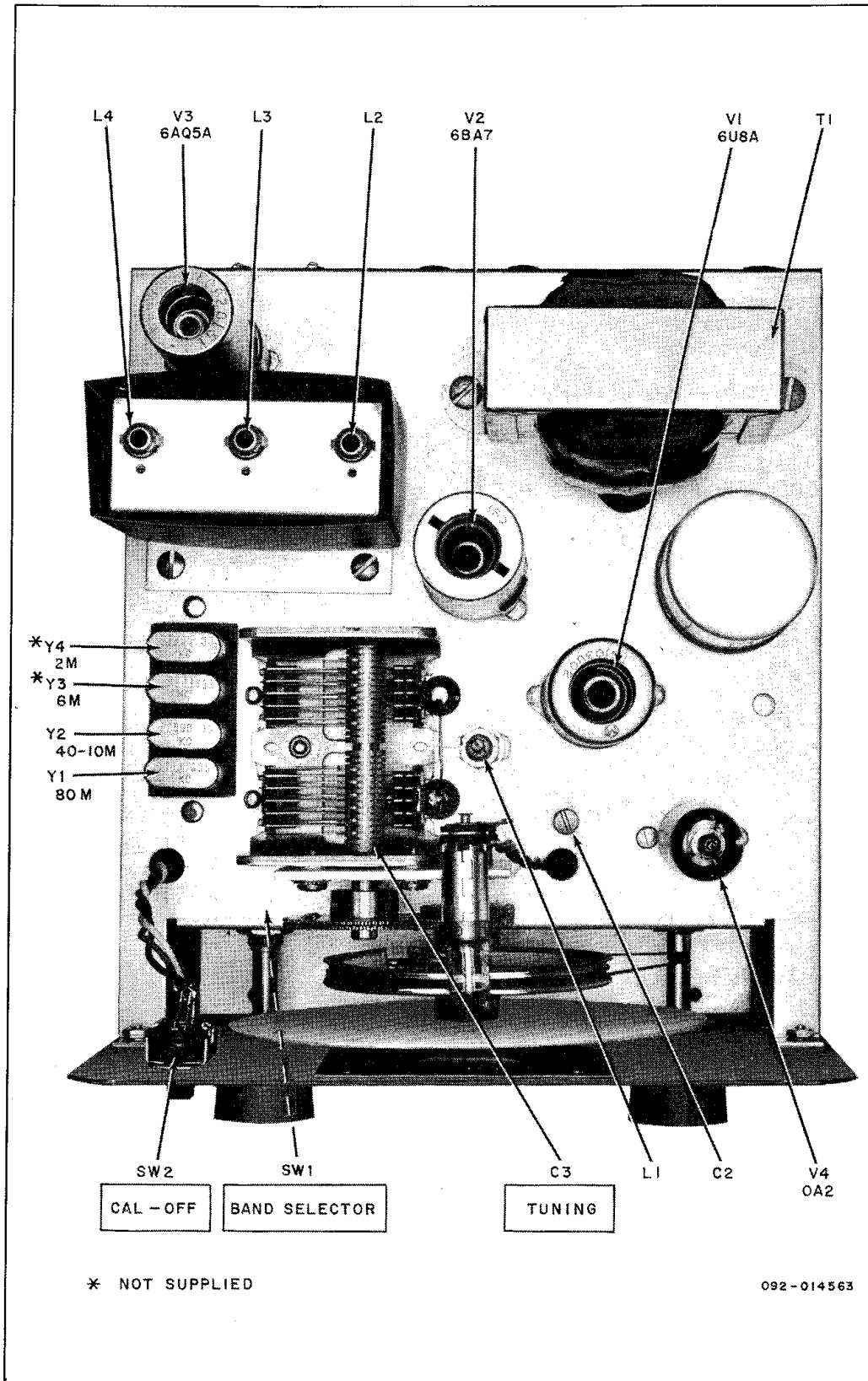


Figure 7. Top View of VFO Chassis.

SECTION VIII

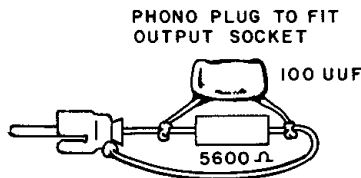
ALIGNMENT

8-1. GENERAL.

The Model HA-5 VFO has been carefully aligned at the factory by specially trained personnel using precision equipment. Alignment of the VFO should not be required unless the VFO has been tampered with or component parts have been replaced in either the oscillator circuits or the mixer tuning stage.

Methods of aligning the mixer and variable frequency oscillator stages are described in the following paragraphs of this alignment procedure. Tools and equipment required to perform the following VFO alignment are:

1. A communications receiver with a 100-KC crystal calibrator capable of receiving WWV and tuning either 5.0 MC to 5.5 MC or 3.5 MC to 4.0 MC, within ± 1 KC or better.
2. A small screwdriver for adjusting oscillator coil L1 and trimmer capacitor C2.
3. A non-metallic alignment tool for adjusting the slugs in the mixer output coils.
4. An RF voltmeter to measure the RF output voltage.
5. A 5600 ohm, 1 watt resistor and a 100 $\mu\mu\text{f}$ capacitor for the RF LOAD.



RF LOAD USED DURING
ALIGNMENT

092-014012

8-2. PREFERRED OSCILLATOR ALIGNMENT (Receiver Tuned 5.0 MC to 5.5 MC).

1. Remove the VFO from the cabinet.
2. Insert the output test load into the 80 - 10 meter output jack.
3. Set the receiver for CW reception at 5.0 MC (zero beat WWV).
4. Calibrate the receiver 100-KC standard to WWV.
5. Set the VFO CAL-OFF switch to the CAL position.
6. Loosen the dial-locking set screws and set TUNING capacitor C3 so that its plates are fully meshed. Align the dial calibration mark with the indicator line on the dial window. (The dial calibration mark is directly to the left of the 53.0-MC mark on the dial. See figure 5.) Tighten the dial-locking screws.
7. Turn the unit ON (BAND SELECTOR switch setting is unimportant).
8. Set the tuning dial to the 53.0-MC calibration mark and the adjust oscillator coil, L1, to zero beat with exactly 5.0 MC on your receiver.

9. Tune the receiver to 5.5 MC.
10. Set the dial to the 50-MC calibration mark and adjust the trimmer capacitor, C2, to zero beat.
11. Repeat steps 8, 9, and 10 until both calibration points (53 MC and 50 MC on the VFO dial) are aligned so that 53 MC zero beats with 5 MC on the receiver and 50 MC zero beats with 5.5 MC on the receiver. The dial scale is correctly calibrated when this condition exists.

8-3. ALTERNATE OSCILLATOR ALIGNMENT (Receiver Tuned 3.5 MC to 4.0 MC).

1. Repeat steps 1 through 6 of paragraph 8-2.
2. Set the BAND SELECTOR switch to the 80-meter position.
3. Set the receiver to 4.0 MC.
4. Set the VFO to 4.0 MC and adjust oscillator coil L1 to zero beat with the receiver.
5. Set the receiver to 3.5 MC.
6. Set the VFO to 3.5 MC and adjust trimmer capacitor C2 to zero beat.
7. Repeat steps 2, 3, 4, and 5 until both 80-meter end frequencies (4.0 MC and 3.5 MC on the VFO dial) are aligned to zero beat on the receiver at 4.0 MC and 3.5 MC. The dial scale is correctly calibrated when this condition exists.

8-4. MIXER ALIGNMENT.

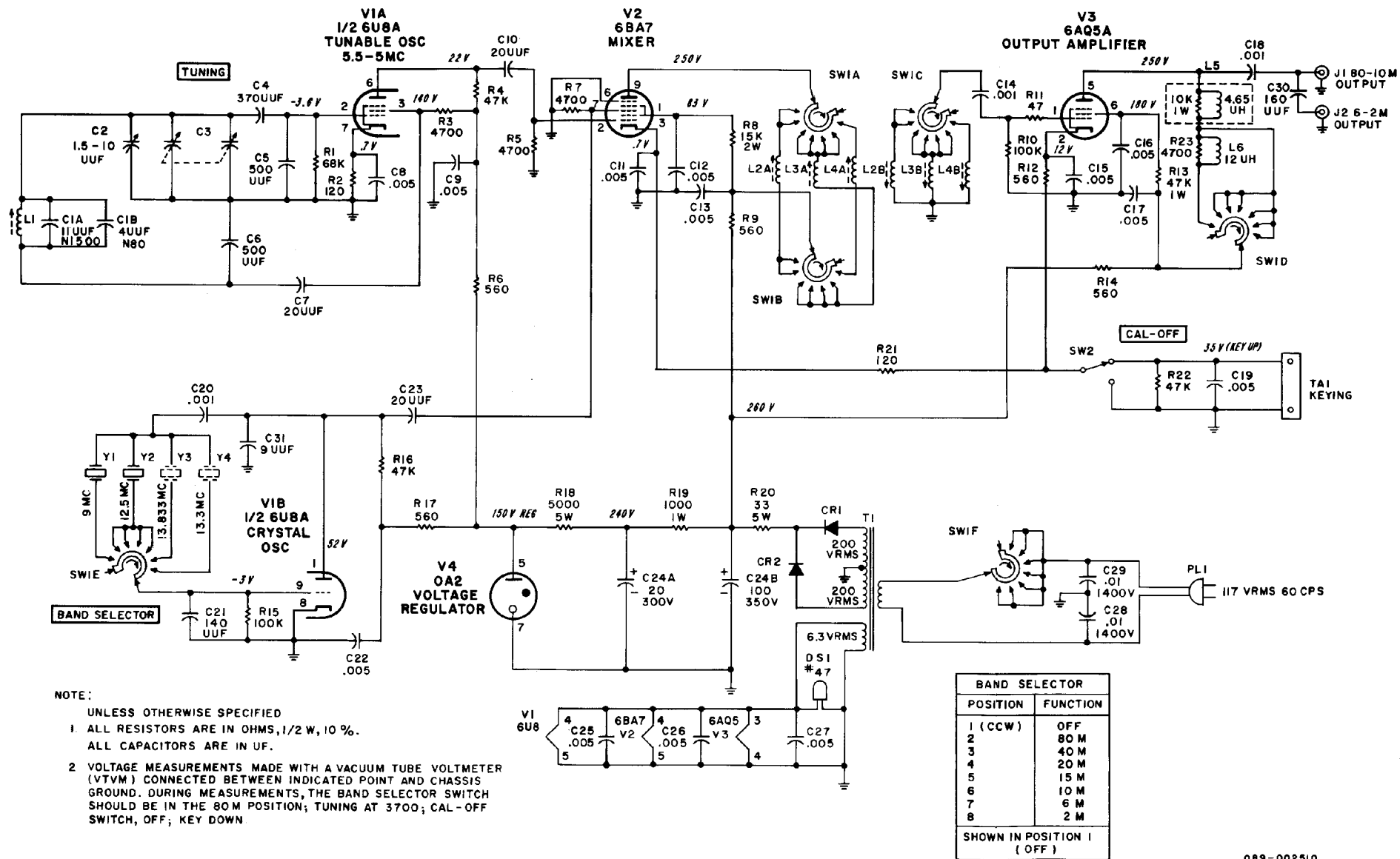
1. Repeat steps 1 and 2 of paragraph 8-2.
2. Set the VFO CAL-OFF switch to the CAL position.
3. Set the BAND SELECTOR switch to the 80-meter position.
4. Connect the RF voltmeter across the test load.
5. Set the VFO dial to 3.8 MC and peak L2A and L2B for maximum output voltage developed across the test load.
6. Set the BAND SELECTOR switch to the 10-meter position.
7. Set the VFO dial to 29.2 MC and peak L3A and L3B for maximum output voltage developed across the test load.
8. Insert the output test load into the 6 and 2 meter output jack and connect the RF voltmeter across the test load.
9. Set the BAND SELECTOR switch to the 6-meter position.
10. Set the VFO dial to 50.25 MC and peak L4A and L4B for maximum output voltage developed across the test load.

SERVICE REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number	Schematic Symbol	Description	Hallicrafters Part Number
CAPACITORS			DIODES, ELECTRON TUBES AND CRYSTALS		
C1A	11 $\mu\mu\text{f}$, $\pm 0.5 \mu\mu\text{f}$, 500V, N1500, Ceramic	479-012110	CR1,2	Rectifier, Silicon (Type CER 71)	027-000302
C1B	4 $\mu\mu\text{f}$, $\pm 0.25 \mu\mu\text{f}$, 500V, N80, Ceramic	491-101040-43	V1	Electron Tube, Type 6U8A, Tunable and Crystal Oscillators	090-901285
C2	Variable, 1.5 $\mu\mu\text{f}$ to 10 $\mu\mu\text{f}$, Trimmer	044-000542	V2	Electron Tube, Type 6BA7, Mixer	090-900815
C3	Variable, TUNING	048-000509	V3	Electron Tube, Type 6AQ5A, Output Amplifier	090-901331
C4	370 $\mu\mu\text{f}$, 1%, 300V, Duramica	493-110371-424	V4	Electron Tube, Type OA2, Voltage Regulator	090-900001
C5,6	500 $\mu\mu\text{f}$, 1%, 300V, Duramica	493-110501-424	Y1	Crystal, 9.0 MC (80M)	019-002831-1
C7	20 $\mu\mu\text{f}$, 2%, 300V, Duramica	481-151200	Y2	Crystal, 12.5 MC (40-10M)	019-002831-2
C8,9,11,12,13,15,16,17,19,22,25,26,27	0.005 μf , 500V, GMV, Ceramic Disc	047-100168	Y3	Crystal, 13.833 MC (6M)	019-002831-3
C10,23	20 $\mu\mu\text{f}$, 10%, 500V, Ceramic Disc	047-001617	Y4	Crystal 13.3 MC (2M)	019-002831-4
C14,18,20	0.001 μf , 10%, 500V, Ceramic Disc	047-100586	MISCELLANEOUS		
C21	140 $\mu\mu\text{f}$, 1%, 300V, Duramica	493-110141-242		Base, Tube Shield (V1&V2)	069-001417
C24A&B	Dual, 100 μf , 350V; 20 μf , 300V; Electrolytic	045-000812		Base, Tube Shield (V3)	069-001550
C28,29	0.01 μf , 1400V, GMV, Ceramic Disc	047-200752		Cabinet Assembly	150-003307
C30	160 $\mu\mu\text{f}$, 2%, 300V, Duramica	481-161161		Connector, Male	010-100231
C31	9 $\mu\mu\text{f}$, 2%, 300V, Duramica	481-131090		Core, Coil Tuning	003-007508
	*RESISTORS			Crystal Mounting Board Assembly	150-003281
R1	68K ohm	451-252683		Dial and Pulley Assembly	150-002621
R2,21	120 ohm	451-252121		Dial Cord	038-000049
R3,5,7,23	4700 ohm	451-252472	XDS1	Dial Light Socket	086-000572
R4,16,22	47K ohm	451-252473		Foot, Rubber	016-001946
R6,9,12,14,17	560 ohm	451-252561		Front Panel Assembly	150-003306
R8	15K ohm, 2 watt	451-652153		Gear Assembly (Spur)	150-002569
R10,15	100K ohm	451-252104	J1,2	Gear Plate Assembly	150-003311
R11	47 ohm	451-252470		Gear Drive	026-001031
R13	47K ohm, 1 watt	451-352473		Grommet, Rubber (3/8-inch)	016-100366
R18	5000 ohm, 5 watt, Wire Wound	445-012502		Grommet, Rubber (1/4-inch)	016-100976
R19	1000 ohm, 1 watt	451-352102		Iron Core	003-004564
R20	33 ohm, 5 watt, Wire Wound (Fuse Type)	024-001398		Jack, Output (Phono Type)	036-100041
				Knob, BAND SELECTOR	015-001486
				Knob, TUNING	015-001464
			DS1	Lamp, Dial Light (No. 47)	039-100004
			PL1	Line Cord	087-100078
				Line Cord Lock	078-100974
				Output Cable Assembly	087-007205
				Plug, Output Connector	010-002352
				Retainer Track, Trim Strip	067-010291
				Shaft, Tuning	074-002695
				Shield, Tube (V1)	069-201190
				Shield, Tube (V2)	069-201189
				Shield, Tube (V3)	069-100355
			XV1,2	Socket, Tube (9-pin miniature)	006-000947
			XV3,4	Socket, Tube (7-pin miniature)	006-000946
L1	Coil, Oscillator	051-003333		Spring, Pulley	075-100163
L2A&B	Coil, Mixer (80 meter)	051-003325		Switch, Rotary (BAND SELECTOR)	060-002351
L3A&B	Coil, Mixer (40 meter)	051-003326		Switch, Slide, SPDT (CAL-OFF)	060-200737
L4A&B	Coil, Mixer (6 meter and 2 meter)	051-003327	SW1	Trim Strip	007-000820
L5	Coil, RF Plate (Inc 10K ohm, 1 watt resistor)	051-003332	SW2	Window, Dial	022-000657
L6	Choke, RF Plate (12 UH, $\pm 10\%$, 200 MA)	053-000612			
T1	Transformer, Power	052-000895			

* All RESISTORS are carbon type, 1/2 watt, 10% unless otherwise specified.

COILS AND TRANSFORMERS



089-002510

Figure 8. Schematic Diagram of Model HA-5 Variable Frequency Oscillator.

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