



hallicrafters

OPERATING AND SERVICE INSTRUCTIONS

VARIABLE
FREQUENCY
OSCILLATOR
MODEL HA-5

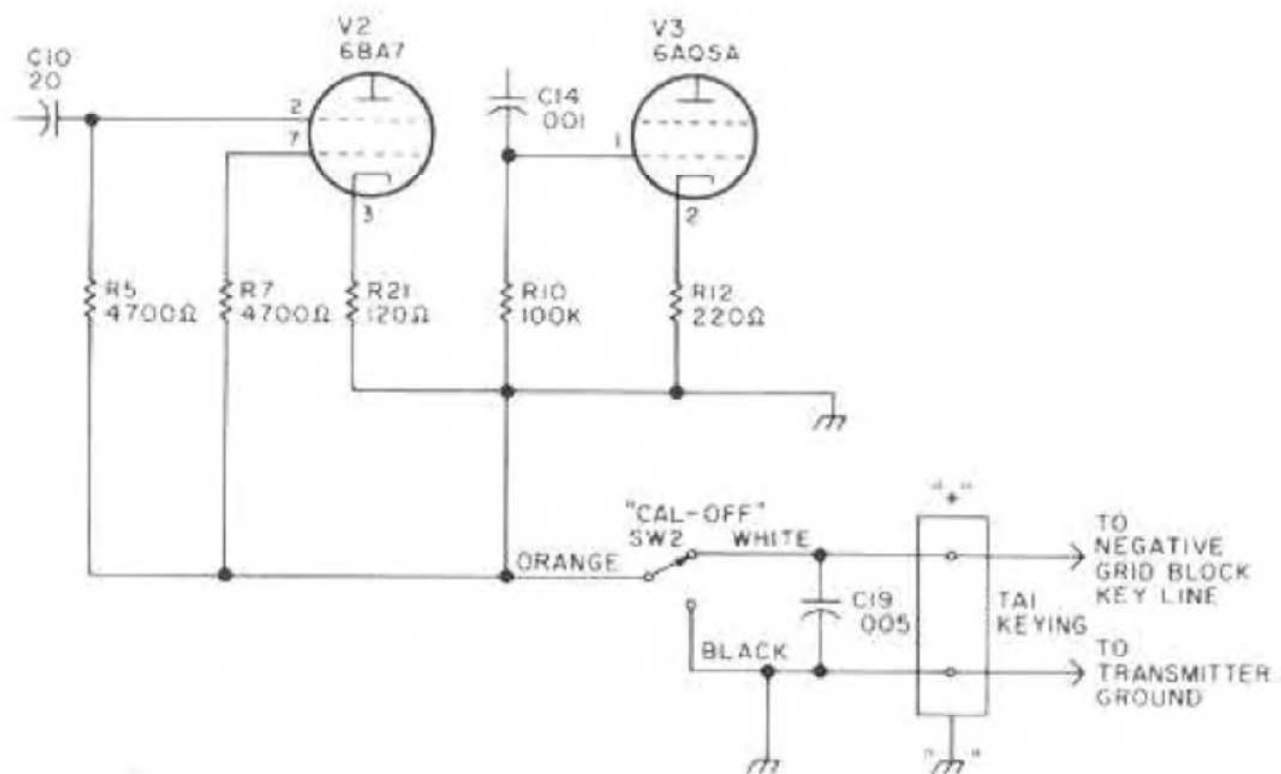
ERRATA SHEET

MODEL HA-5

After the Instruction Manual was printed but prior to production, certain minor electrical changes were made to improve equipment performance. Please incorporate the information contained below into the Instruction Manual for future reference.

1. In the parts list, delete capacitors C1A, C1B, and C8 and resistors R2 and R11.
2. In the parts list, change capacitor C17 from 0.005 μf to 0.002 μf , 20%, 500V, Ceramic Disc type, part number 047-100395.
3. In the parts list, add capacitor C1, 15 $\mu\mu f$, 500V, N750, Ceramic Tubular type, part number 491-106150-95.
4. In the parts list, add capacitor C32, 4 $\mu\mu f$, 500V, Ceramic Tubular type, part number 491-101040-43.
5. In the parts list, add capacitor C33, 5 $\mu\mu f$, 300V, Plastic Mica type, part number 481-162050.
6. In the parts list, add capacitors C34, C35, and C37, 100 $\mu\mu f$, 300V, Plastic Mica type, part number 482-162101.
7. In the parts list, add capacitor C36, 1 $\mu\mu f$, Composition type, part number 047-200403-2.
8. In the parts list, change resistor R4 from 47K ohms to 10K ohms, part number 451-252103.
9. In the parts list, change resistor R8 from 15K ohms, 2 watt to 22K ohms, 2 watt, part number 451-652223.
10. In the parts list, change resistor R12 from 560 ohms to 220 ohms, part number 451-252221.
11. In the parts list, change resistor R13 from 47K ohms, 1 watt to 18K ohms, 1 watt, part number 451-352183.
12. On page -9-, figure 7, in the upper left-hand corner, change reference L4 to L2; near to the right of this, change reference L2 to L4.

Form Number 094-903188B
Pack with Instruction
Manual 094-902858



HALLICRAFTERS HA-5 GRID-BLOCK KEYING CONVERSION: The Hallicrafters HA-5 vfo is cathode-keyed. This conversion will enable the rig to be grid-block-keyed with a minimum of surgery to the unit. Begin by disconnecting cathode resistors R12 and R21 from the orange lead of the "Cal-Off" switch, grounding them to chassis. Open R22 at the TA1 keying terminal strip. Disconnect R5, R7, and R10 from chassis, and connect their junction to the orange lead of the "Cal-Off" switch. To reconvert to cathode keying, disconnect the ungrounded ends of R5, R7, R10, and R22, leaving them bent out, while installing new R5, R7, and R10 resistors whose long leads will more readily reach to the orange "Cal-Off" switch lead. The grid-block transmitter lead (negative) then connects to the terminal marked "+", and the transmitter ground connects to the terminal marked "ground" on the vfo keying terminal strip.—Tuckerman S. Jalet AA1C, Stamford CT.



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 μ 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.

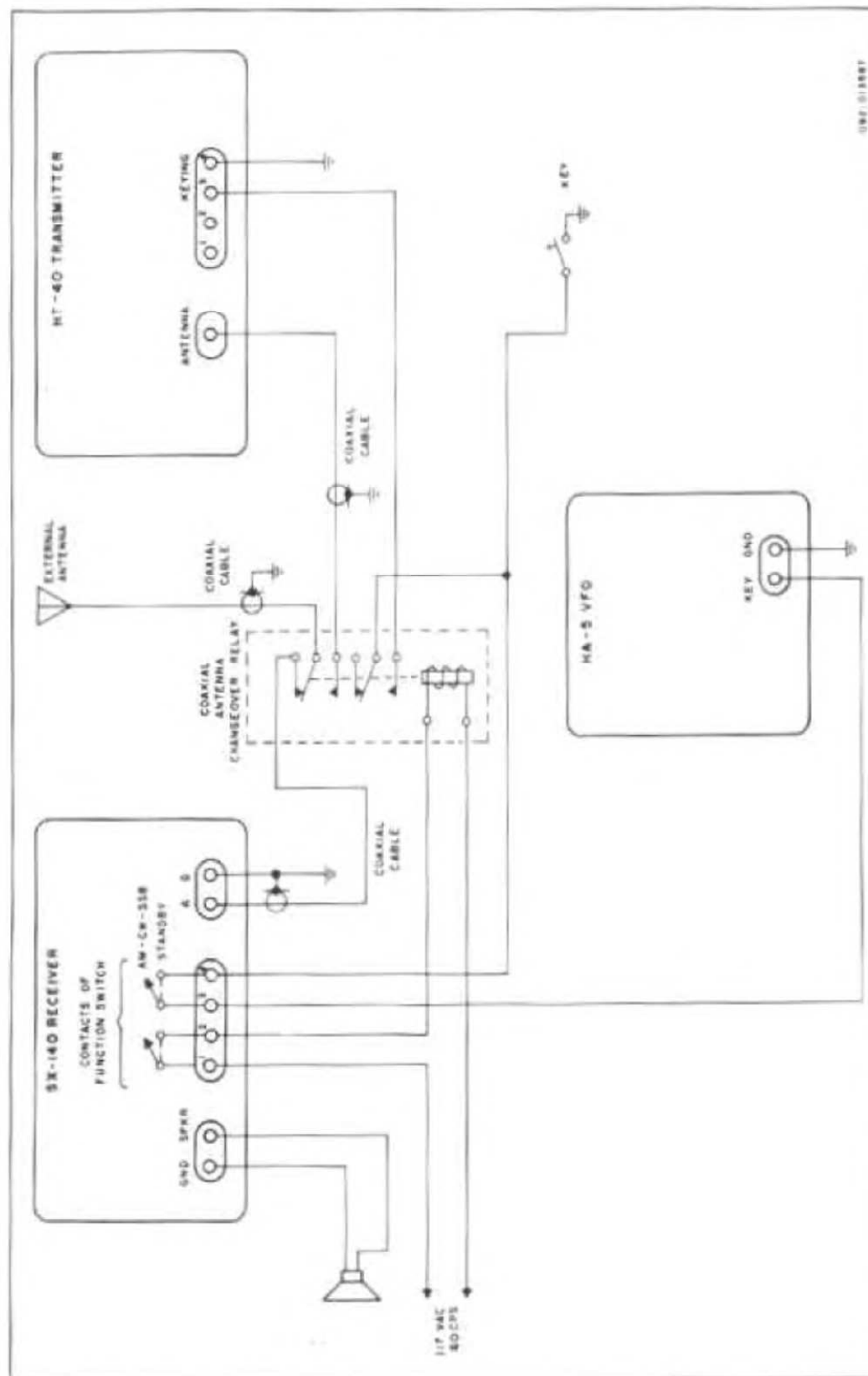
NOTE

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.



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Figure 2. Typical Station Setup.

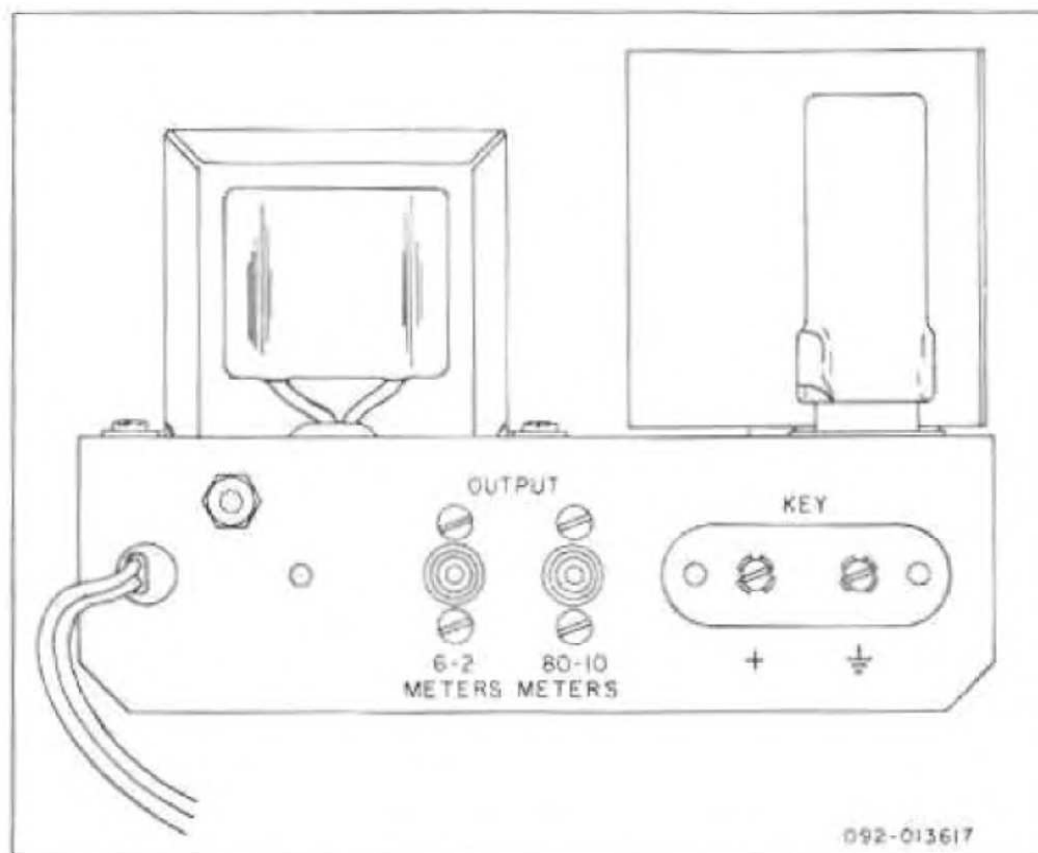


Figure 3. Rear View of VFO.

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 pre-set without keying the transmitter on.

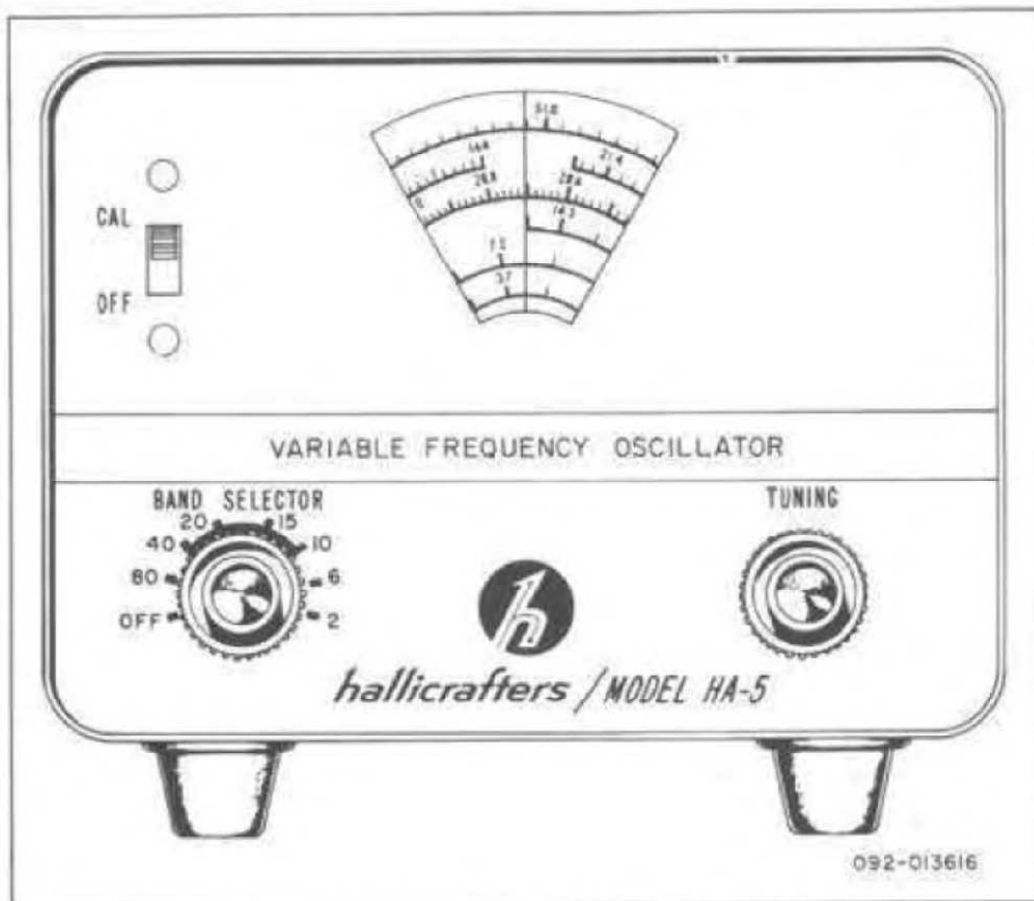


Figure 4. Front Panel View of VFO.

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 Halli-crafters 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 bandsread on all ranges.

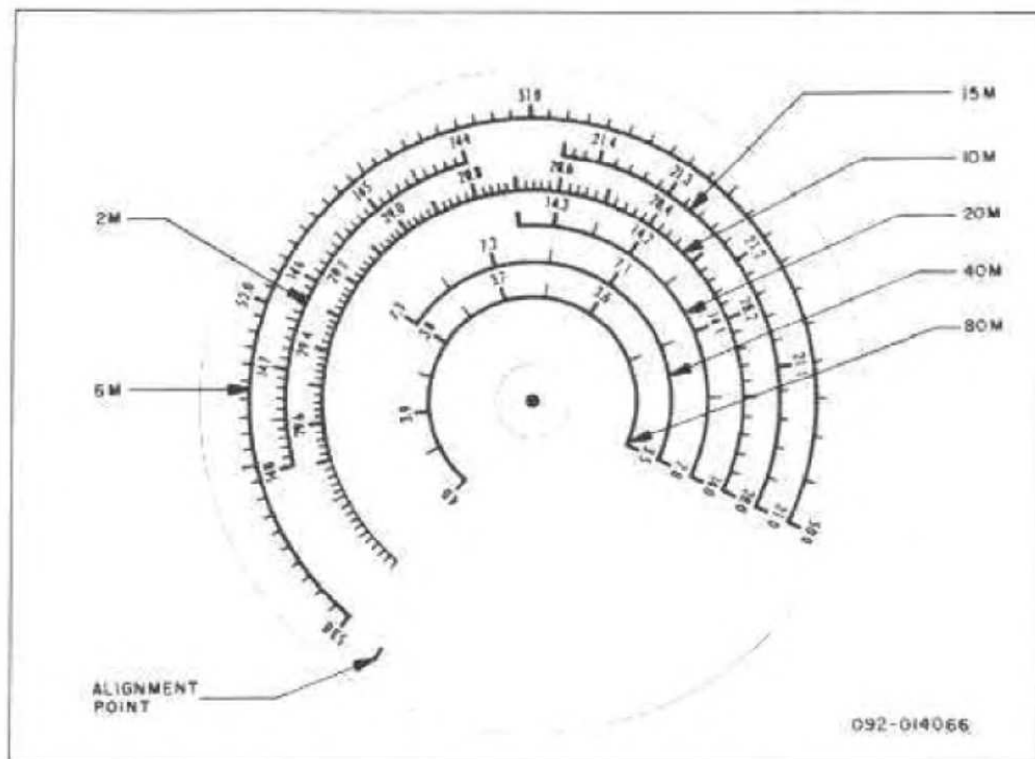


Figure 5. Dial Scale Calibrations.

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.

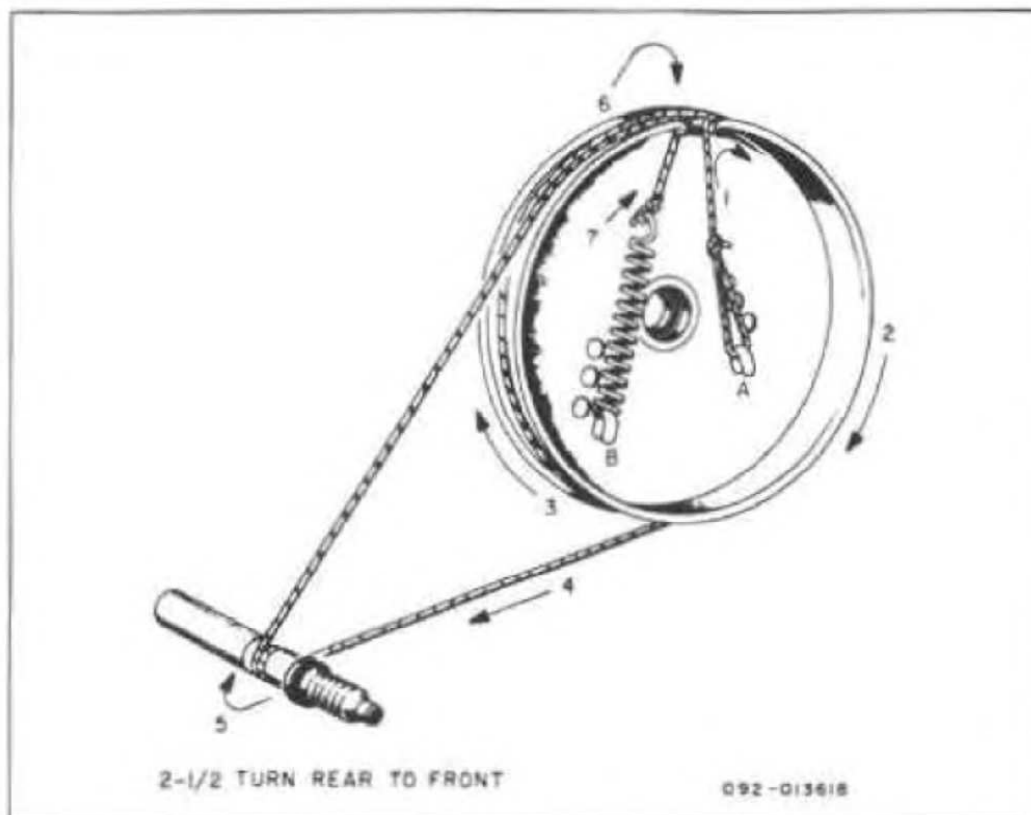


Figure 6. Dial Stringing Detail.

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.

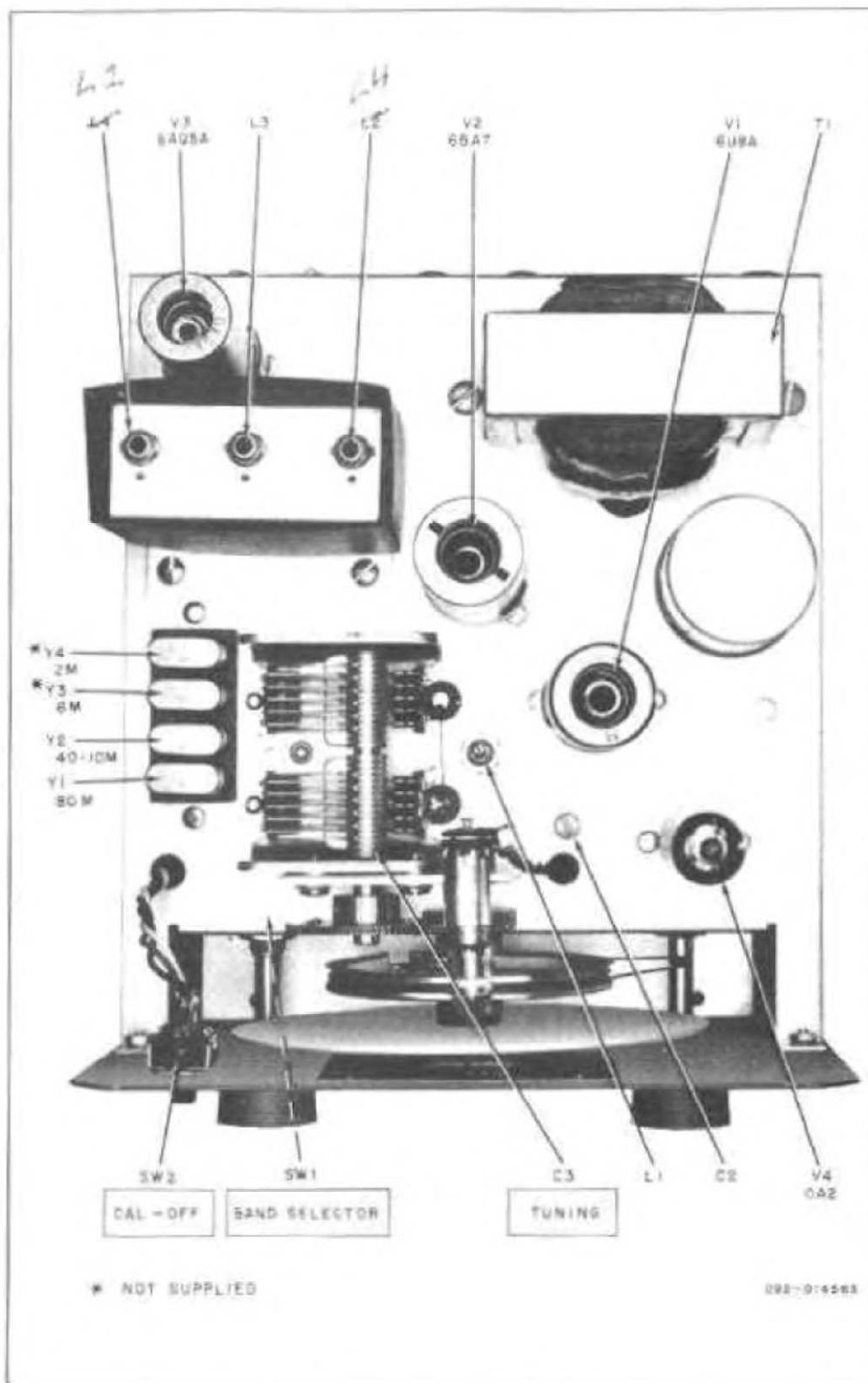


Figure 7. Top View of VFO Chassis.

SECTION VIII

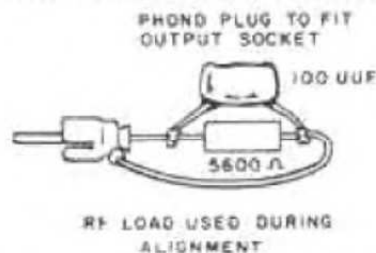
ALIGNMENT

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 μ mf capacitor for the RF LOAD.



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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 8 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	Hallcrafters Part Number	Schematic Symbol	Description	Hallcrafters Part Number
CAPACITORS			DIODES, ELECTRON TUBES AND CRYSTALS		
C1A	11 μ f, ± 0.5 μ f, 500V, N1500, Ceramic	479-012110	CR1,2	Rectifier, Silicon (Type CER 71)	027-000302
C1B	4 μ f, ± 0.25 μ f, 500V, N80, Ceramic	491-101040-43	V1	Electron Tube, Type 6UBA, Tunable and Crystal Oscillators	090-901285
C2	Variable, 1.5 μ f to 10 μ f, Trimmer	044-000542	V2	Electron Tube, Type 8BA7, Mixer	090-900615
C3	Variable, TUNING	048-000509	V3	Electron Tube, Type 6AQ5A, Output Amplifier	090-901331
C4	370 μ f, 1%, 300V, Duramica	493-110371-424	V4	Electron Tube, Type OA2, Voltage Regulator	090-900001
C5,6	500 μ f, 1%, 300V, Duramica	493-110501-424	Y1	Crystal, 9.0 MC (80M)	019-002831-1
C7	20 μ 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 μ f, 500V, GMV, Ceramic Disc	047-100168	Y3	Crystal, 13.833 MC (6M)	019-002831-3
C10,23	20 μ f, 10%, 500V, Ceramic Disc	047-001517	Y4	Crystal 13.3 MC (2M)	019-002831-4
C14,18,20	0.001 μ f, 10%, 500V, Ceramic Disc	047-100586	MISCELLANEOUS		
C21	140 μ f, 1%, 300V, Duramica	493-110141-242		Base, Tube Shield (V1&V2)	069-001417
C24A&B	Dual, 100 μ f, 350V; 20 μ f, 300V; Electrolytic	045-000812		Base, Tube Shield (V3)	069-001550
C28,29	0.01 μ f, 1400V, GMV, Ceramic Disc	047-200752		Cabinet Assembly	150-003307
C30	160 μ f, 2%, 300V, Duramica	481-161161		Connector, Male	010-100231
C31	9 μ 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	150-002821
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	451-352153		Gear Assembly (Spur)	150-002569
R10,15	100K ohm	451-252104		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	J1,2	Iron Core	003-004564
R20	33 ohm, 5 watt, Wire Wound (Fuse Type)	024-001398		Jack, Output (Phono Type)	036-100041
* All RESISTORS are carbon type, 1/2 watt, 10% unless otherwise specified.				Knob, BAND SELECTOR	015-001486
COILS AND TRANSFORMERS				Knob, TUNING	015-001484
L1	Coil, Oscillator	051-003333	DS1	Lamp, Dial Light (No. 47)	039-100004
L2A&B	Coil, Mixer (80 meter)	051-003325	PL1	Line Cord	067-100076
L3A&B	Coil, Mixer (40 meter)	051-003326		Line Cord Lock	076-100974
L4A&B	Coil, Mixer (6 meter and 2 meter)	051-003327		Output Cable Assembly	087-007205
L5	Coil, RF Plate (Inc 10K ohm, 1 watt resistor)	051-003332		Plug, Output Connector	010-002352
L6	Choke, RF Plate (12 UH, $\pm 10\%$, 200 MA)	053-000612		Retainer Track, Trim Strip	067-010291
T1	Transformer, Power	052-000895		Shaft, Tuning	074-002895
				Shield, Tube (V1)	069-201190
				Shield, Tube (V2)	069-201189
				Shield, Tube (V3)	069-100355
				Socket, Tube (9-pin miniature)	006-000947
				Socket, Tube (7-pin miniature)	006-000946
				Spring, Pulley	075-100163
				Switch, Rotary (BAND SELECTOR)	060-002351
				Switch, Slide, SPDT (CAL-OFF)	060-200737
				Trim Strip	007-000820
				Window, Dial	022-000657

