

Assembly
and
Operation
of the



CW TRANSCEIVER

MODEL HW-16



TABLE OF CONTENTS

Introduction.	2
Parts List.	2
Step-By-Step Assembly	
Circuit Board Assembly.	6
Chassis Parts Mounting.	10
Wiring Chassis Top.	21
Wiring Chassis Bottom.	22
Final Wiring.	30
Initial Test.	39
Alignment.	40
Final Assembly.	44
Operation.	45
In Case Of Difficulty.	48
Troubleshooting Chart.	49
Specifications.	52
Circuit Description.	54
Chassis Photographs.	57
Circuit Board X-Ray View.	59
Replacement Parts Price List.	60
Factory Repair Service.	63
Schematic.(fold-out from page). . . .	63

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022



INTRODUCTION

The Heathkit Model HW-16 CW Transceiver is a high performance and economical amateur radio receiver and transmitter. Although it is designed with the Novice Class operator in mind, this Transceiver is also an excellent piece of equipment for the General Class operator. The Transceiver provides full break-in CW communications in the lower 250 kHz segments of the 80-, 40-, and 15-meter bands.

The transmitter is crystal-controlled, using 80-meter crystals on 80- or 40-meter bands, and 40-meter crystals on 40- or 15-meter bands. The Transceiver also has provisions for an external VFO.

Input power to the final stage is adjustable for 50 to 90 watts input. A 75 watt marker on the meter, which indicates plate current, represents maximum power for Novice Class operation. All three stages of the transmitter are grid-block keyed. The only tuning required when changing bands or frequency is adjusting the final Tune capacitor.

The receiver uses dual conversion for excellent image rejection and the receiver's front end is

crystal controlled for excellent stability. For high selectivity, the receiver uses a 500 Hz crystal filter. The receiver is automatically muted each time the key is depressed, providing full break-in operation. No external antenna relay is required, as antenna switching is accomplished within the Transceiver.

The following equipment will be necessary for the initial test and alignment of the Transceiver.

1. An 11 megohm input VTVM (a 20 K Ω /V VOM may also be used).
2. A 50 Ω nonreactive dummy load that is capable of 100 watts dissipation, such as the Heathkit Cantenna, Model HN-31.
3. Crystals:
 - 7,030 MHz or slightly higher frequency.
 - 3500 kHz or slightly higher frequency.
 - 3750 kHz or slightly lower frequency.

NOTE: Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

NOTE: The numbers in parentheses in the Parts List are keyed to the numbers on the Parts Pictorial (fold-out from Page 5) to aid in parts identification.

To order replacement parts, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit.

PART No.	PARTS Per Kit	DESCRIPTION
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RESISTORS

1/2 Watt		
(1) 1-41	3	10 Ω (brown-black-black)
1-54	1	15 Ω (brown-green-black)
1-66	2	150 Ω (brown-green-brown)
1-42	1	270 Ω (red-violet-brown)
1-6	1	470 Ω (yellow-violet-brown)
1-9	4	1000 Ω (brown-black-red)
1-13	1	2700 Ω (red-violet-red)
1-14	4	3300 Ω (orange-orange-red)
1-18	2	5600 Ω (green-blue-red)
1-20	4	10 K Ω (brown-black-orange)
1-21	1	15 K Ω (brown-green-orange)
1-22	3	22 K Ω (red-red-orange)
1-25	5	47 K Ω (yellow-violet-orange)
1-60	1	68 K Ω (blue-gray-orange)
1-26	5	100 K Ω (brown-black-yellow)

PART No.	PARTS Per Kit	DESCRIPTION
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Resistors (1/2 Watt) (cont'd.)

1-121	1	120 K Ω (brown-red-yellow)
1-29	2	220 K Ω (red-red-yellow)
1-99	2	240 K Ω (red-yellow-yellow)
1-31	1	330 K Ω (orange-orange-yellow)
1-33	1	470 K Ω (yellow-violet-yellow)
1-35	2	1 megohm (brown-black-green)
1-36	3	1.5 megohm (brown-green-green)
1 Watt		
(2) 1-2-1	1	1000 Ω (brown-black-red)
1-5-1	1	22 K Ω (red-red-orange)
1-7-1	3	47 K Ω (yellow-violet-orange)
1-8-1	1	68 K Ω (blue-gray-orange)

PART No.	PARTS Per Kit	DESCRIPTION	PART No.	PARTS Per Kit	DESCRIPTION
2 Watt			Other Capacitors		
(3)1-13-2	1	220 Ω (red-red-brown)	(11)21-29	1	4.7 pf tubular
1-17-2	1	6800 Ω (blue-gray-red)	(12)31-31	1	3-12 pf trimmer
1-11-2	2	22 K Ω (red-red-orange)	(13)26-113	2	54 pf variable
1-18-2	2	33 K Ω (orange-orange-orange)	COILS		
1-10-2	1	47 K Ω (yellow-violet-orange)	NOTE: Do not remove coils from their envelopes until they are called for in the assembly steps.		
1-24-2	2	100 K Ω (brown-black-yellow)	(14)40-79	1	40-meter oscillator coil
Other Resistors			(15)40-360	1	15-meter heterodyne oscillator coil
(4)3-19-5	1	330 Ω 5 watt	40-363	1	15-meter RF coil
3-9-7	1	100 Ω 7 watt	40-795	1	80-meter RF coil
CAPACITORS			40-796	1	40-meter RF coil
Resin			40-797	2	40/80-meter heterodyne oscillator coil
(5)20-130	2	12 pf	(16)40-798	1	80/40/15-meter final coil
20-99	1	22 pf	(17)40-799	1	VFO shielded coil
20-96	2	36 pf	40-801	1	80-meter driver coil (shielded)
20-101	1	47 pf	40-802	1	40-meter driver coil (shielded)
20-110	2	75 pf	40-803	1	15-meter driver coil (shielded)
20-102	5	100 pf	(18)40-800	1	Crystal filter coil (shielded)
20-104	1	130 pf	CHOKES		
20-108	2	200 pf	(19)45-30	3	.5 mH RF choke
20-106	2	390 pf	(20)45-3	1	1 mH RF choke
20-107	2	680 pf	(21)45-19	1	Parasitic RF choke (wound on 47 Ω yellow-violet-black)
20-122	3	1000 pf	TRANSFORMERS		
(6)27-47	1	.1 μ fd	51-55	1	AF output transformer
Disc			(22)52-71	1	IF transformer
(7)21-3	4	10 pf	(23)52-102	1	Bandpass coupler transformer
21-7	1	33 pf	54-179	1	Power transformer
21-49	1	68 pf 4KV	DIODES-TRANSISTOR		
21-139	1	150 pf 2KV or 4KV	(24)56-26	1	1N191 crystal diode (brown-white-brown)
21-56	2	470 pf	(25)57-27	6	Silicon diode
21-14	6	.001 μ fd	(26)417-150	1	2N1274 transistor
21-71	2	.001 μ fd 1.4 KV			
21-36	1	.002 μ fd			
21-57	33	.005 μ fd			
21-35	1	.005 μ fd 1.6 KV			
21-31	8	.02 μ fd			
Electrolytic					
(8)25-54	1	10 μ fd			
(9)25-80	1	20-20 μ fd			
(10)25-179	1	50-40-80-80 μ fd			
25-17	2	50 μ fd			



PART No.	PARTS Per Kit	DESCRIPTION	PART No.	PARTS Per Kit	DESCRIPTION
TUBES			Sockets-Jacks-Plugs (cont'd.)		
411-26	1	12AX7	(41)434-112	2	7-pin circuit board type tube socket
411-63	2	6CL6	(42)434-121	1	12-pin compactron tube socket
411-124	2	6EA8	(43)436-4	2	Phone jack
411-170	2	6EW6	(44)438-3	1	Phone plug
411-171	1	6HF8	(45)438-4	3	Phono plug
411-185	1	6GE5	(46)431-10	2	3-lug terminal strip
CRYSTALS			431-11	1	5-lug terminal strip
(27)404-206	1	3396.4 kHz product detector	431-12	3	4-lug terminal strip
404-301	1	9.045 MHz	431-16	2	2-lug terminal strip
404-302	1	12.545 MHz	431-55	1	6-lug terminal strip
404-303	1	26.545 MHz	(47)481-1	1	4-prong metal capacitor mounting wafer
404-305		Matched set of crystals consisting of the following:	(48)481-4	2	3-prong fiber capacitor mounting wafer
404-241	1	3395.150 kHz	(49)206-54	2	Tube shield
404-242	1	3395.450 kHz			
LAMPS			COAXIAL CABLE-WIRE-SLEEVING		
412-1	2	6 volt incandescent	343-7	1	Coaxial cable
(28)412-34	1	Neon	344-50	1	Black hookup wire
CONTROLS-SWITCHES			344-51	1	Brown hookup wire
(29)10-33	1	200 Ω control (RF Gain)	344-52	1	Red hookup wire
11-78	1	15 K Ω control (Power-Level)	344-54	1	Yellow hookup wire
(30)19-72	1	500 K Ω control with switch (AF Gain and Off-On)	344-55	1	Green hookup wire
(31)60-4	1	SPDT slide switch (Rel-Pwr-Plate)	344-56	1	Blue hookup wire
(32)63-436	1	4-section band switch	344-59	1	White hookup wire
(33)65-10	1	3 ampere circuit breaker	340-3	1	Large bare wire
			340-8	1	Small bare wire
			346-4	1	Sleeving
SOCKETS-JACKS-PLUGS			HARDWARE		
(34)434-2	1	Octal tube socket	#3 Hardware		
(35)434-38	1	Large crystal socket	(50)250-49	26	3-48 x 1/4" screw
(36)434-42	3	Phono socket	(51)254-7	29	#3 lockwasher
(37)434-43	2	9-pin, shielded tube socket	(52)252-1	26	3-48 x 3/16" nut
(38)434-74	1	Small crystal socket	#4 Hardware		
(39)434-79	4	9-pin circuit board type tube socket	(53)250-34	2	4-40 x 1/2" screw (retain in envelope)
(40)434-90	2	Miniature pilot lamp socket with bracket	(54)252-15	2	4-40 x 3/16" nut (retain in envelope)

PART No.	PARTS Per Kit	DESCRIPTION	PART No.	PARTS Per Kit	DESCRIPTION
#6 Hardware			METAL PARTS		
(55) 250-138	8	6-32 x 3/16" screw	90-358	1	Top cover
(56) 250-56	36	6-32 x 1/4" screw	(81) 100-43	1	Dial hub assembly
(57) 250-116	4	6-32 x 1/4" black screw	200-485-1	1	Chassis
(58) 250-8	10	#6 sheet metal screw	203-479-1	1	Front panel
(59) 250-162	4	6-32 x 1/2" screw	(82) 204-102	1	Shield bracket
(60) 254-1	59	#6 lockwasher	205-260	1	Plate, chassis bottom
(61) 252-3	44	6-32 x 1/4" nut	(83) 206-334	1	Small shield plate
(62) 252-22	4	6-32 speednut	(84) 206-335	1	Large shield plate
(63) 259-1	3	#6 solder lug	(85) 206-336	1	RF shield
(64) 259-6	3	#6 small solder lug			
#8 Hardware			MISCELLANEOUS		
(65) 250-16	1	8-32 x 3/16" setscrew	73-1	1	3/8" rubber grommet
(66) 250-92	1	8-32 x 5/8" screw	73-4	1	5/16" rubber grommet
(67) 253-9	4	#8 small flat washer	75-24	1	Line cord strain relief
(68) 253-45	2	#8 large flat washer	89-1	1	Line cord
(69) 254-2	5	#8 lockwasher	85-173-1	1	Circuit board
(70) 252-4	5	8-32 nut	(86) 100-624	1	Dial drive assembly
(71) 252-28	1	8-32 knurled nut	(87) 407-121	1	Meter
(72) 259-24	4	#8 wire lug	464-29-5	1	Dial
			453-39	1	Shaft, 5-13/16" long
			462-122	3	Gray knob with skirt and pointer
			462-258	2	Dark green knob
			462-189	1	2" gray knob
			446-59	1	Escutcheon
			(88) 346-25	1	Black tubing
			(89) 260-7	4	IF transformer clip
			261-9	4	Rubber foot
			489-1	1	Sandpaper
			490-5	1	Nut starter
			490-1	1	Alignment tool
			391-34	1	Identification label
			597-260	1	Parts Order Form
			597-308	1	Kit Builders Guide
				1	Manual (See front cover for part number.)
					Solder
Other Hardware					
(73) 251-1	3	6-32 spade bolt			
(74) 252-7	7	Control nut			
(75) 253-10	8	Control flat washer			
(76) 254-4	6	Control lockwasher			
(77) 254-5	1	Thin control lockwasher			
(78) 259-10	1	Control solder lug			
(79) 455-9	1	Bushing			
(80) 259-20	1	Terminal pin			



INITIAL TEST

Before applying power to the Transceiver, complete the preliminary resistance checks given in this section. Perform these checks to be sure there are no short circuits or open connections that would cause damage to the Transceiver components. During the Initial Test, checking the pilot lamps, tube filaments, and the tone oscillator circuit indicates that the power supply and receiver output stage are operating.

For initial testing and alignment of the Transceiver, the equipment listed below, or their equivalents, are necessary.

1. An 11 megohm input VTVM (a 20 K Ω /V VOM may also be used).
2. A 50 Ω nonreactive dummy load that is capable of 100 watts dissipation, such as the Heathkit Cantenna, Model HN-31.
3. Crystals:
 - 7.030 MHz or slightly higher frequency.
 - 3500 kHz or slightly higher frequency.
 - 3750 kHz or slightly lower frequency.

If the following resistances are taken with a VOM, the probes (polarity) may need to be reversed to obtain the proper resistance readings.

Check the following resistances. Wait for meter to reach full reading. If any of the resistance readings are lower than specified refer to the In Case Of Difficulty section on Page 48. Refer to Figure 1-1 (fold-out from Page 38) for test and adjustment points.

- () Pin 7 of tube socket V9 to ground - over 100 K Ω .
- () Pin 3 of tube socket V9 to ground - over 20 K Ω .
- () Pin 6 of tube socket V8 to ground - over 15 K Ω .
- () Pin 6 of tube socket V7 to ground - over 15 K Ω .

Figure 1-2 (fold-out from Page 38) shows the initial test setup.

- () Cut the speaker wires to the length required for your installation. Refer to Figure 1-2A to attach a phono plug to the speaker wires.
- () Connect an 8 Ω speaker, such as the Heathkit Communications Speaker, Model SB-600, or HS-24, to the SPKR phono socket on the rear of the chassis.
- () Connect the 50 Ω dummy load to the ANT phono socket on the rear of the chassis. If necessary, refer to Figure 1-2A and attach a phono plug to the 50 Ω dummy load antenna.

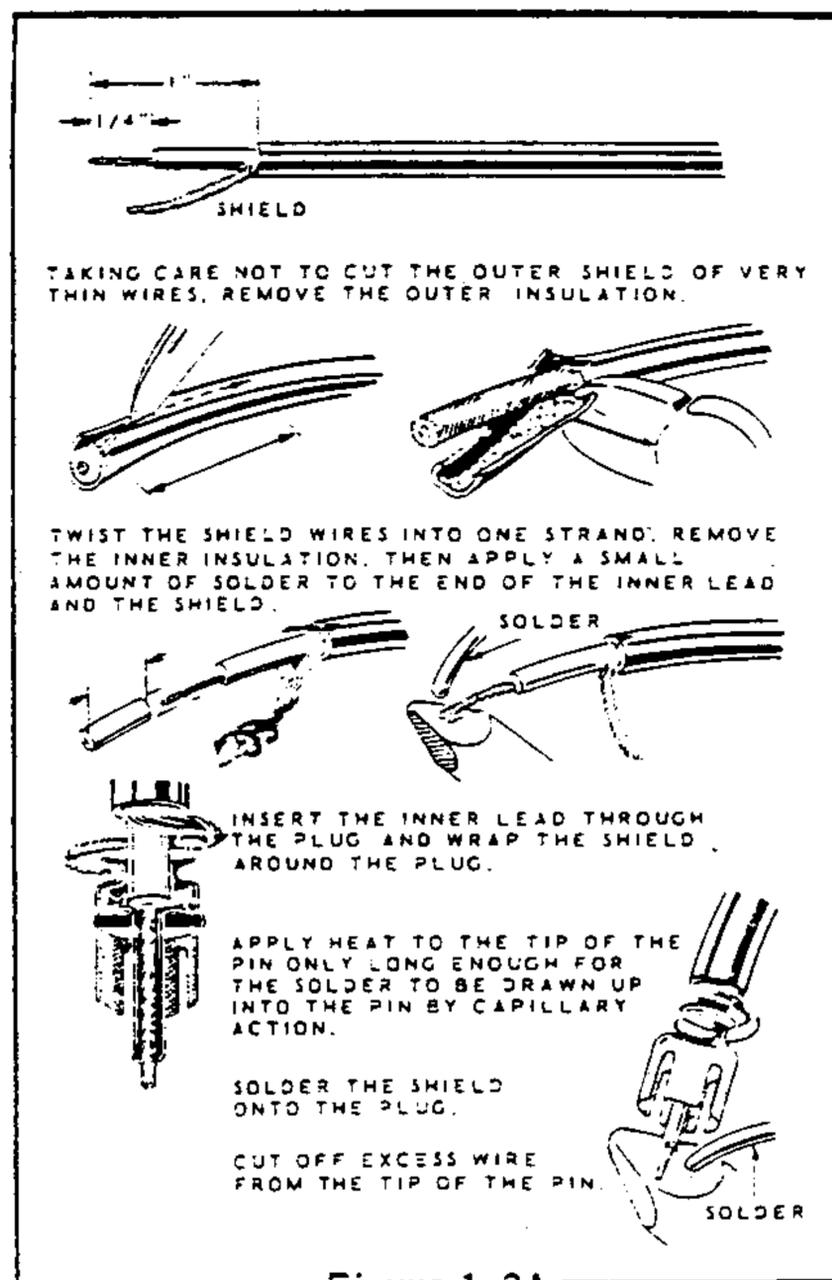


Figure 1-2A



NOTE: The Heathkit Electronic Keyer, Model HD-10, can be used with this Transceiver.

Be sure that your keyer has a phone plug that mates with the Key jack on the Transceiver or prepare a wire and phone plug assembly as follows:

- () Cut a wire to the length required for your installation. Refer to Figure 1-2B and prepare the wire and phone plug assembly for connecting your key to the Transceiver KEY jack. Connect the other end of the wire to the terminals of your key.

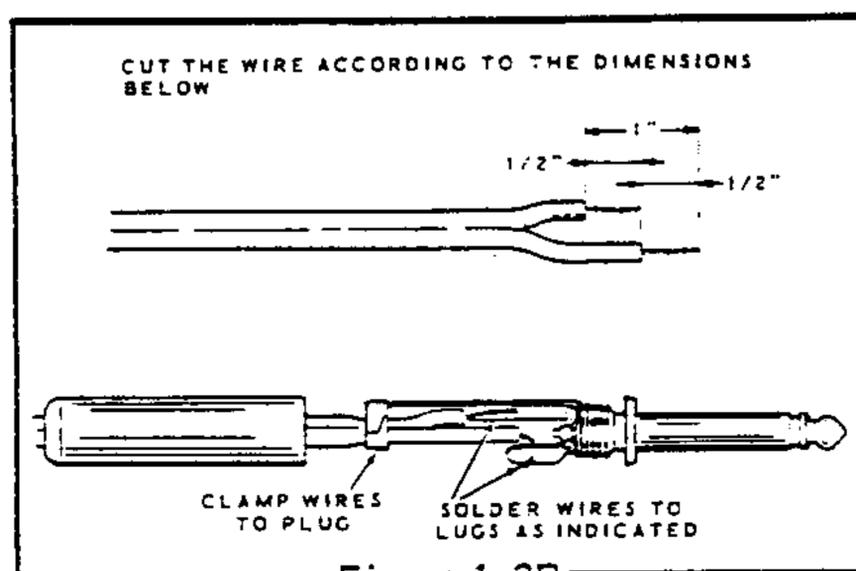


Figure 1-2B

- () Connect your key to the Transceiver KEY jack. When the equipment is on and the key is open, there is about 80 V DC across the terminals.
- () Be sure that the AF GAIN control is in the OFF position and connect the line cord to a 120 volt 50/60 Hz AC outlet.

CAUTION: BEFORE APPLYING POWER TO THE TRANSCEIVER, NOTE THAT LETHAL VOLTAGES ARE PRESENT BOTH ABOVE AND BELOW THE CHASSIS. DO NOT TOUCH ANY HIGH VOLTAGE POINTS WITH YOUR HANDS. USE WELL INSULATED TOOLS FOR ANY ADJUSTMENTS ON THE CHASSIS.

- () Turn the AF GAIN control to the 12 o'clock position.
- () Wait a few minutes to allow the tubes to warm up and then check all pilot lamps and tube filaments. All should be lit and the tube envelopes should begin to feel warm.

CAUTION: After the Transceiver has been operating for 1/2 hour or more, the tube envelopes may get hot enough to burn your fingers.

- () When you close the key, a tone should be audible in the speaker. If no tone is heard, refer to the In Case Of Difficulty section of the Manual.

ALIGNMENT

NOTE: The coils and transformers in your Transceiver have been preset at the factory. Only slight readjustments should be necessary during the following alignment procedure.

TRANSMITTER ALIGNMENT

- () Check that the 50 Ω dummy load is connected to the ANT socket and that the line cord is connected to the 120 volt AC outlet.

NOTE: Two crystal sockets are supplied in order to accommodate two different types of plug-in crystals. Only one crystal can be used at a time. Refer to the Operation section of this Manual for crystal information and the differences in the two sockets.

CAUTION: Never use a crystal with a VFO nor more than one crystal at the same time, because the Transceiver may transmit on two frequencies simultaneously.

- () Plug a 40-meter crystal (7.030 MHz or slightly higher) into the proper crystal socket on the front panel.
- () Set the front panel controls as follows:
 - AF GAIN - 12 o'clock position.
 - BAND - 21.0.
 - PWR LEVEL - fully counterclockwise.
 - REL PWR-PLATE - REL PWR.



If you do not get the results specified while you are performing the following steps, refer to the In Case Of Difficulty section of the Manual.

- () Close the key and adjust the TUNE capacitor for a maximum meter reading.
- () Set the REL PWR-PLATE switch to the PLATE position. The meter should read approximately 100, which indicates a V9 plate current flow of approximately 100 ma.
- () Turn the PWR LEVEL control clockwise to check that the meter pointer moves up-scale.
- () Turn the AF GAIN control OFF.
- () Set the Transceiver on its side with the power transformer at the bottom.
- () Turn the AF GAIN control to 12 o'clock position.

Refer to Figure 1-1 for the test and adjustment points.

- () Set the VTVM to the -150 VDC scale. Hold the DC probe of the VTVM on lug 3 of terminal strip B and connect the common probe to the chassis.
- () Close the key and, from the top of the chassis, adjust the slug in crystal oscillator coil L8 for a maximum reading on the VTVM. Then turn the slug clockwise one turn.

NOTE: Leave the negative (-) probe of the VTVM connected to the chassis until directed to remove it.

- () Lay the Transceiver down with the bottom of the chassis facing up.

NOTE: The Heath Company has provided an alignment tool with this kit. Use this alignment tool to adjust the position of the slugs in all adjustable coils except crystal oscillator coil L8.

- () Connect the DC probe of the VTVM to lug 1 of terminal strip M, close the key, and adjust the slug in 15-meter driver coil L9 for a maximum reading on the VTVM. Do not disconnect the DC probe of the VTVM from lug 1 of terminal strip M.

- () Set the BAND switch to the 7.0 MHz position and check that the REL PWR-PLATE switch is in the REL PWR position.
 - () Close the key and adjust the TUNE capacitor for a maximum REL PWR reading, then adjust the slug in 40-meter coil L10 for a maximum reading on the VTVM.
 - () Set the BAND switch to the 3.5 MHz position.
 - () Remove the 40-meter crystal and install an 80-meter crystal (3500 kHz or slightly higher frequency).
 - () Close the key and adjust the TUNE capacitor for a maximum REL PWR reading, then adjust the slug in 80-meter driver coil L11 for a maximum reading on the VTVM.
 - () Turn the AF GAIN control to the OFF position and disconnect the line cord from the 120 volt AC outlet.
 - () Use a screwdriver with an insulated handle and short lug 1 of electrolytic capacitor DA to chassis.
 - () Disconnect both probes of the VTVM from the Transceiver.
 - () Disconnect the red wire which is protected with black sleeving, from lug 2 of tube socket V9, and then position the sleeving over the exposed end of the wire.
 - () Remove the .001 μ fd 1.4 KV disc capacitor lead and the .5 mH choke lead from lug 1 of electrolytic capacitor DA and solder these two free leads to each other.
- CAUTION: The exposed ends of the wire and leads must not touch anything.
- () Locate the 5600 Ω (green-blue-red) resistor which has one lead connected to the ANT jack: temporarily connect a jumper wire across this resistor.
 - () Set the Transceiver on its side with the power transformer at the bottom.



- () Set the REL PWR-PLATE switch to the REL PWR position.
- () Set the BAND switch to the 21.0 position.
- () Remove the 80-meter crystal and install the 40-meter crystal.
- () Connect the Transceiver line cord to the 120 volt AC outlet and turn the AF GAIN control to the 12 o'clock position.
- () Close the key and adjust the TUNE capacitor for a maximum reading on the meter.
- () Use a screwdriver with an insulated handle and adjust neutralizing capacitor U from the top of the chassis for a minimum reading on the meter.
- () Turn the AF GAIN control to the OFF position and disconnect the Transceiver line cord from the 120 volt AC outlet.
- () Lay the Transceiver down with the bottom of the chassis up.
- () Use a screwdriver with an insulated handle to short lug 1 of electrolytic capacitor DA to chassis.
- () Remove the jumper wire that was temporarily connected across the 5600 Ω resistor. If the jumper wire was soldered to the resistor leads, check that the permanent resistor connections have not been disturbed.
- () Reconnect the free end of the red wire to lug 2 of tube socket V9 (S-2) and reposition the sleeving on the wire so that the sleeving extends through the chassis hole.
- () Separate the .001 μ fd 1.4 KV disc capacitor lead from the .5 mH choke lead and reconnect these two leads to lug 1 of electrolytic capacitor DA (S-3).
- () Disconnect the 50 Ω dummy load.
- () Disconnect the hand key and remove the crystal from the Transceiver.

This completes the Alignment of the Transmitter section.

RECEIVER ALIGNMENT

Refer to Figure 1-3 (fold-out from Page 49) for the following steps.

- () Connect the Transceiver line cord to a 120 volt AC outlet. Preset the front panel switches and controls as follows:

REL PWR-PLATE - REL PWR.
 RF GAIN - Maximum clockwise.
 PWR LEVEL - Maximum counterclockwise.
 AF GAIN - Maximum clockwise.
 TUNE - Maximum counterclockwise.
 BAND - 3.5
 Main Tuning Dial -100.

NOTE: The circuit board TEST POINT is located near tube socket V2.

- () Set the VTVM to the -50 VDC scale. Connect the positive (+) probe of the VTVM to the lead at the TEST POINT on the circuit board, and connect the negative (-) probe to the chassis.

NOTE: Coils L1, L2, L3, L4, L5, L6 and T3 are located on the circuit board; coil L7 is located on the chassis.

- () Adjust the slug in coil L6 for a maximum VTVM reading.
- () Set the BAND switch to the 7.0 position and adjust the slug in L5 for a maximum VTVM reading.
- () Set the BAND switch to the 21.0 position.
- () From the top of coil L4, turn the slug counterclockwise as far as it will go. Do not remove the slug from the coil form. Then adjust the slug in L4 for a maximum VTVM reading by turning the slug clockwise.
- () Set the BAND switch to the 3.5 position.
- () Disconnect both probes of the VTVM from the Transceiver.
- () Set the VTVM to the 1.5 VAC scale, and connect the VTVM AC probes across the speaker terminals.



- () Connect an antenna to the ANT jack and tune in a steady CW signal; or, if a signal generator is available, connect the signal generator to the ANT jack, tune the signal generator to 3600 kHz, and tune the Main Tuning Dial so that the signal is heard.
- () Adjust the TUNE capacitor for a maximum VTVM reading.
- () Adjust the slug in coil T3 for a maximum VTVM reading.

NOTE: The following instructions for aligning coils L1, L2, and L3 are based on the assumption that you are using an antenna and receiving a steady CW signal rather than using a signal generator.

- () Adjust the slug in coil L3 for a maximum VTVM reading.
- () Set the BAND switch to the 7.0 position and tune the Main Tuning Dial near 100 (7.1 MHz) so that a signal is heard.
- () Adjust the TUNE capacitor for a maximum VTVM reading.
- () Adjust the slug in coil L2 for a maximum VTVM reading.
- () Set the BAND switch to the 21.0 position and tune the Main Tuning Dial near 100 (21.1 MHz) so that a signal is heard.
- () Adjust the TUNE capacitor for a maximum VTVM reading.
- () Adjust the slug in coil L1 for a maximum VTVM reading.
- () Return the BAND switch to the 3.5 position.
- () Disconnect the antenna or signal generator and then connect the 50 Ω dummy load to the ANT phono socket.
- () Plug a 3500 kHz crystal or one slightly higher in frequency into the proper crystal socket.
- () Set the PWR LEVEL control to its maximum counterclockwise position, and set the RF GAIN and AF GAIN controls to their maximum clockwise positions.

- () Set the Main Tuning Dial to the exact frequency of the crystal installed. For example: If the frequency of the crystal is 3550 kHz, the BAND switch is set to 3.5 (for 3500 kHz) and the Main Tuning Dial is set at 50 (for 50 kHz). When the frequencies of the BAND switch and the Main Tuning Dial are added together they must equal the frequency of the crystal.
- () Connect the key to the KEY jack on the back of the chassis.
- () Close the key and adjust the TUNE capacitor for a maximum REL PWR reading on the front panel meter.
- () Adjust the trimmer capacitor on the side of the VFO variable capacitor so that a signal is heard in the speaker. This tone is the CW spot signal from your transmitter and will be in addition to the CW sidetone.
- () Remove the 3500 kHz crystal and plug in a 3750 kHz crystal or one slightly lower in frequency.
- () Set the Main Tuning Dial to the frequency of the crystal.
- () Carefully adjust the slug in VFO coil L7 until the spot signal is heard in the speaker. Only 1/4 turn or less should be required since the coil is preset at the factory.
- () Repeat the previous nine steps, checking calibration near 3500 kHz and 3750 kHz. If necessary, repeat the previous nine steps several times to get the signal at the proper frequency at both ends of the dial (near 3500 kHz and 3750 kHz).

This completes the alignment of all three bands of your Transceiver. CAUTION: Do not attempt to align coils T1 and T2.

- () A further check can be made with a crystal calibrator, if one is available. The Heathkit 100 kHz Crystal Calibrator Model HD-20 can be used for checking the calibration or for more accurate calibrating. Check the calibration at 3500 kHz, 3600 kHz, and 3700 kHz by connecting the calibrator to the Transceiver ANT jack.



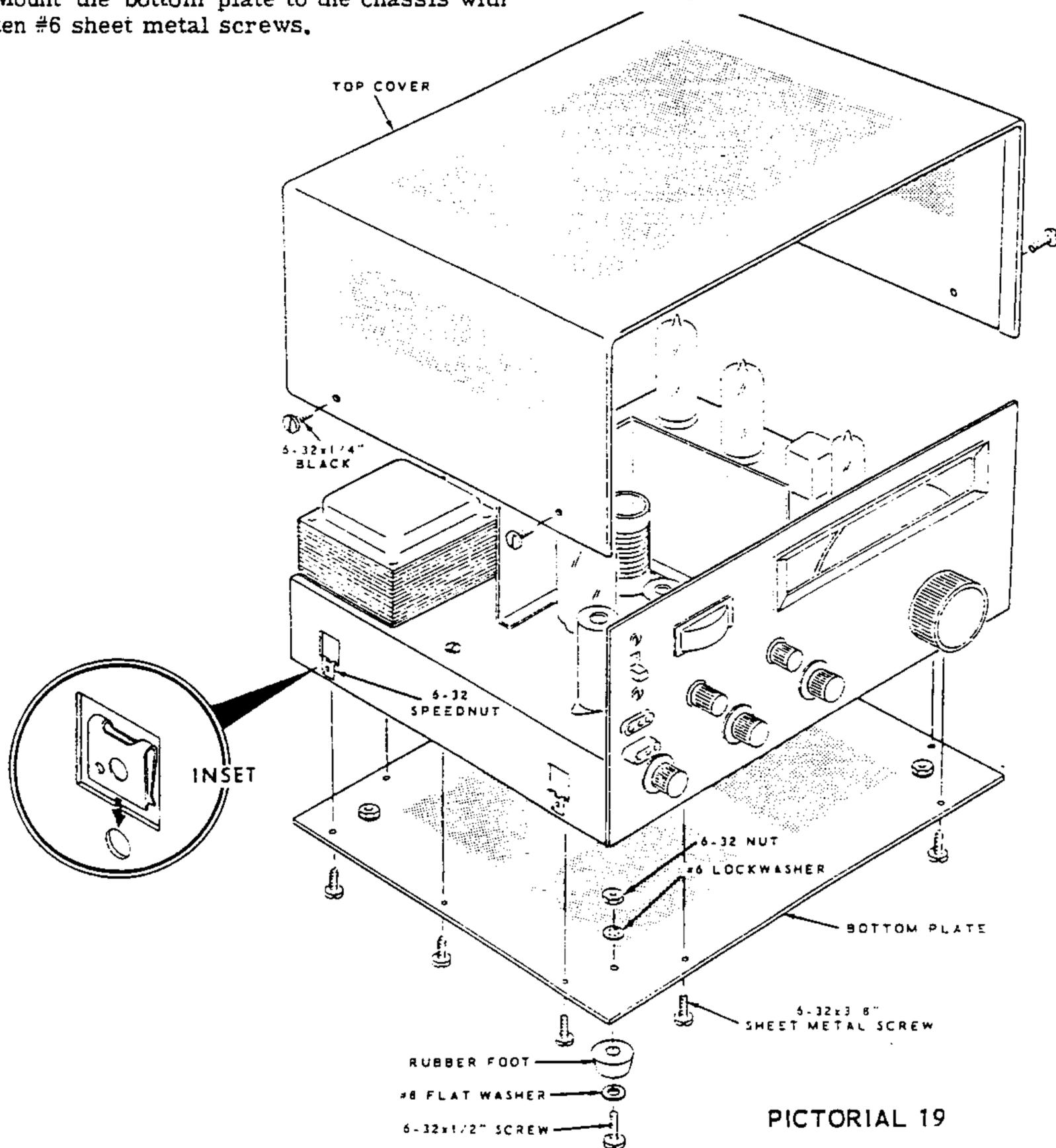
FINAL ASSEMBLY

Refer to Pictorial 19 for the following steps.

- (\) Install four 6-32 speednuts on the chassis. Be sure the flat surface of each speednut is on the outside of the chassis.
- () Install four rubber feet on the bottom plate. Use four 6-32 x 1/2" screws, four #8 small flat washers, four #6 lockwashers, and four 6-32 nuts.
- () Mount the bottom plate to the chassis with ten #6 sheet metal screws.

NOTE: In the next step, place the rolled edge of the top cover in front of the front panel.

- () Place the top cover over the chassis and secure it with two 6-32 x 1/4" black screws on each side.
- () Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the rear of the chassis between the two screws at the left of the SPKR jack.



PICTORIAL 19

OPERATION

NOTE: An Amateur Radio Operator and Station License is required to place the transmitter section of this Transceiver on the air. Information regarding licensing and amateur frequency allocations may be obtained from publications of the Federal Communications Commission or the American Radio Relay League.

Refer to Figure 1-4 (fold-out from Page 49) for connecting accessories and for grounding to the Transceiver.

- () Connect a true earth ground to the GND connector at the rear of the chassis. To create a true earthground connection, drive a metal stake into the earth and route a wire from the stake to your Transceiver.
- () Connect an 8 ohm speaker to the SPKR socket at the rear of the chassis.
- () Connect a manual key or electronic key to the KEY jack at the rear of the chassis.
- () Connect a 50 ohm antenna to the ANT socket. Refer to the section on Antennas.
- () Connect the additional accessories you wish to use, such as headphones to the PHONES jack and a VFO to the VFO phono socket and to the VFO power socket.

NOTE: A Novice Class operator can only transmit signals created by a crystal controlled oscillator. Do not use a VFO unless you are properly licensed to do so.

ANTENNAS

The pi network circuit of the Transceiver will match a pure resistive load of 50 Ω .

The simplest type of antenna that falls into this impedance range is the "dipole," constructed so that its length is 1/2 wave at the frequency of operation. The 50 Ω impedance range of antennas also includes beam, vertical, and dipole types.

The following paragraphs tell you how to construct a dipole antenna fed by a 50 Ω coaxial line. This combination will give very satisfactory operation with this Transceiver. Figure 1-5 illustrates a half-wave dipole antenna and lists the proper antenna lengths for the center frequencies of the 80-, 40-, and 15-meter bands.

The best material for antenna wire is number 14 gauge hard-drawn copper wire. Number 14 or number 12 gauge enameled copper-clad steel wire may also be used, but it is subject to rust and corrosion. Soft-drawn copper wire is not satisfactory because it tends to stretch, and stretching increases the length of the antenna which lowers the resonant frequency.

50 ohm coaxial cable, such as RG-58, may be used for the transmission line. A coaxial transmission line is heavier and more expensive, but it has less feedline radiation than a twin lead transmission line.

Any type of antenna insulator may be used, but the small "egg" type insulators are economical and readily available. The antenna and insulators may be supported by any wire or rope.

When cutting the antenna to the frequency desired, cut the antenna wire a foot longer than is required. When the antenna is installed in its permanent location, a SWR (standing-wave ratio) bridge, such as the Heathkit Reflected Power Meter and SWR Bridge, can be used to check the amount of mismatch present between the transmitter and the antenna. The excess antenna

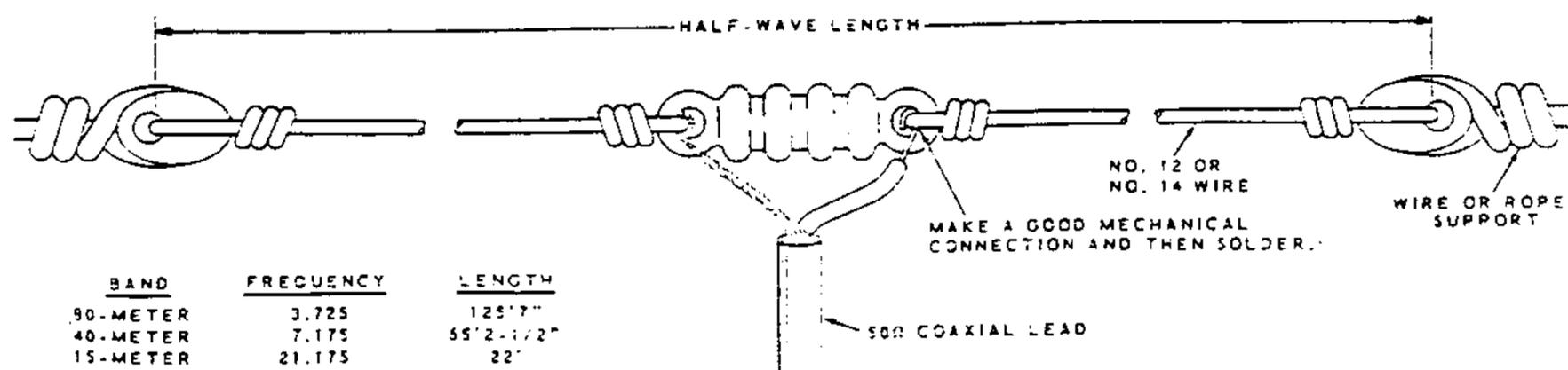


Figure 1-5



wire may be cut off in 2" to 3" pieces and then reinstalled to check the SWR of your installation at the desired operating frequency. An SWR of less than 2:1 is necessary for your Transceiver.

Much has been published on the subject of antennas and excellent articles can be found in the ARRL Handbook, Radio Handbook, and in many issues of CQ and QST magazines.

OPERATION WITH CRYSTALS

The Transceiver may be operated satisfactorily using the following crystals:

<u>BAND</u>	<u>FUNDAMENTAL CRYSTALS</u>
80-meter	80-meter (3500-3750 kHz).
40-meter	80- or 40-meter (3500-3625 kHz or 7000-7250 kHz).
15-meter	40-meter (7000-7083 kHz).

Crystal Information:

Crystal socket X1 - Pin spacing .486".
Pin diameter .050".

Crystal socket X2 - Pin spacing .486".
Pin diameter .093".

Novice operation imposes restrictions on operating frequencies as follows:

<u>BAND</u>	<u>FREQUENCY kHz</u>	<u>USE CRYSTAL FREQUENCY kHz</u>
80-meter	3700-3750	3700-3750
40-meter	7150-7200	7150-7200 or 3575-3600
15-meter	21,100-21,250	7034-7083

Novice power input is limited to 75 watts. Therefore, the plate current should be set at or below the red mark on the meter by adjusting the PWR LEVEL control after peaking relative power.

The transmitter frequency must be crystal controlled. In the operating instructions to follow, the final amplifier is loaded to 125 ma for Novice operation, which is within the present Novice power limitation.

CAUTION: Be sure to check the latest FCC regulations on frequency allocations. When ordering crystals be sure to stay well within amateur band edge limits to avoid violations.

OPERATION WITH VFO

When using an external VFO, be sure there is no crystal in either crystal socket on the front panel of the Transceiver. Use a VFO with grid block keying that is compatible with the keying system of the Transceiver. The Heathkit Model HG-10 VFO is designed to match the operation of this Transceiver and to plug directly into it. To use the HG-10 VFO, just plug its power cable into the VFO power socket on the Transceiver and connect the RF cable to both units.

The Transceiver VFO power socket supplies 6.3 V AC, 300 V DC, and about -65 V DC (with key-up) for an external VFO with grid-block keying. See the Schematic and the lettering on the Transceiver rear panel for the filament, bias and B+ connections.

CONTROL FUNCTIONS

The functions of the front panel controls are outlined below. Read the following paragraphs carefully to become familiar with the operation of each control before operating this Transceiver.

Rel Pwr-Plate

This slide switch connects the meter either across the output circuit or into the final amplifier of the transmitter section. When this switch is in the REL PWR position and the key is held down, the meter indicates the relative power output. Use this position for peaking the RF power output with the Tune control. When the switch is in the PLATE position, the meter indicates power input to the final amplifier. The meter is inoperative in the receive condition.

RF Gain

This control varies the amount of gain in the RF and IF amplifier stages of the receiver section.



Pwr Level

This control varies the input power of the final amplifier. When the REL PWR-PLATE switch is in the PLATE position, the PWR LEVEL control is used to adjust the power input. The red mark on the meter scale indicates 75 watts, which is the limit for Novice operation. For operation with General Class or higher license, higher plate current may be used.

AF Gain

This control turns the Transceiver on or OFF and varies the audio output of the receiver.

Tune

This control adjusts the pi network to resonate the final amplifier of the transmitter section. It also adjusts for maximum received signal.

Band

The BAND switch selects one of the three amateur bands to which this Transceiver can be tuned.

Main Tuning

This control tunes the receiver section to the desired station. The frequency is read by adding the BAND switch reading and the Main Tuning dial reading. For example: BAND switch is set to 3.5, Main Tuning dial reads 52; therefore, the frequency being received is 3552 kHz or 3.552 MHz. Again, if the BAND switch is set to 21.0 and the Main Tuning dial reads 205, the received signal is at 21,205 MHz. This knob does not affect the transmitter.

TRANSCEIVER OPERATION

- () Plug the line cord into a 120 volt 50/60 Hz AC outlet.
- () Check the SPKR, ANT, KEY, and GND connections.
- () Set the front panel controls as follows:
 - REL PWR-PLATE - REL PWR.
 - AF GAIN - 12 o'clock.
 - RF GAIN - Fully clockwise.
 - PWR LEVEL - Fully counterclockwise.

CAUTION: Do not plug in two crystals at one time.

- () Select a crystal and plug it into the proper crystal socket. If you desire to contact a specific station, select a crystal equal to or near the frequency of that station.
- () Depress the key and adjust the TUNE control for a maximum REL PWR meter indication.
- () Place the REL PWR-PLATE switch to the PLATE position and check the input current reading.

NOTE: Novice Class operators must not exceed the red mark on the meter scale. This indicates 75 watt limitation for Novice transmission.

- () Adjust the plate current to the desired level with the PWR LEVEL control.
- () Place the REL PWR-PLATE switch to the REL PWR position and readjust the TUNE control for a maximum REL PWR meter readings.
- () Return the REL PWR-PLATE switch to the PLATE position and check that the meter reading does not exceed the allowable limit.

The Transceiver is now ready to receive and transmit.

OPERATING REMINDERS

1. Operation of the transmitter with an improperly tuned amplifier (not tuned to resonance) may result in component failure. Always re-tune after changing crystals or VFO frequency.
2. Operation of the transmitter without a proper antenna or a dummy load will result in component failure.
3. Use caution and observe rules of safety in taking voltage and current measurements.
4. Do not cover the cabinet ventilation holes.



IN CASE OF DIFFICULTY

Review the Operation section of the Manual.

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.
2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Proper Soldering Techniques section of the Kit Builders Guide.
3. Check to be sure that all tubes and cable connections are in their proper locations. Make sure that all tubes light up properly.
4. Check the tubes with a tube tester or by substitution of tubes of the same types that are known to be good.
5. Check the values of the parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.
6. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.
7. If, after careful checks, the trouble is still not located and a voltmeter is available, check the voltage readings against those shown on the Schematic (fold-out from Page 63). All voltage readings were taken with an 11 megohm vacuum tube voltmeter. Voltages may vary as much as $\pm 10\%$.
8. A review of the Circuit Description will help you to know where to look for trouble.

NOTE: To aid in servicing or troubleshooting the Transceiver, refer to the Circuit Board X-Ray View on Page 59 and Chassis Photographs on Pages 57 and 58.

Breaks in the foil of the circuit board can be detected by placing a bright light under the foil side of the board and looking through the board from the lettered side. A break will appear as a hairline crack in the foil.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty section of the "Kit Builders Guide", and to the "Factory Repair Service" information on Page 63 of this Manual.



TROUBLESHOOTING CHART

NOTE: References will often be made to previous Symptoms and Causes. Therefore, each Symptom is identified by a number, and each Possible Cause has an identifying letter. If you are directed, for example, to "check items 3A through 3D," refer to Symptom number 3, Possible Causes A, B, C, and D.

SYMPTOMS	POSSIBLE CAUSE
1. No power: pilot lamps and tube filaments do not light, no B+ or bias voltage.	A. AF GAIN control in OFF position. B. Line cord disconnected from 120 VDC source. C. Circuit breaker open. D. Defective AC switch on AF GAIN control. E. Black leads of power transformer open. F. Open primary winding of power transformer.
2. Pilot lamps and tube filaments light, bias voltage OK, but no B+ voltage.	A. Red lead of power transformer open. B. Diodes D202, D203, D204, and/or D205 defective. C. Capacitors C202 and/or C204 shorted. D. Resistors R202 and/or R203 shorted. E. Resistor R204 open.
3. Pilot lamps and tube filaments light, B+ voltage OK, but no bias voltage.	A. Diode D201 defective. B. Brown wires of power transformer open. C. Resistor R201 open. D. Capacitor C201 shorted. E. Short between bias circuit and chassis.
4. Bias and B+ voltage OK, but pilot lamps and tube filaments do not light.	A. Yellow and/or yellow-green wires of power transformer open. B. Short across filament circuit.
5. Low B+ voltage OK, but no 600 volts.	A. Rectifier D204 and/or D205 open.
6. Low resistance reading from pin 7 of tube socket V9 to ground.	A. Resistors R202 or R203 shorted. B. Rectifiers D202 and/or D203 shorted. C. Capacitor C19 shorted.
7. Low resistance reading from pin 3 of tube socket V9 to ground.	A. Resistor R9 shorted. B. Resistors R2, R8, and/or R69 shorted. C. Capacitors C3, C13, C14, or C92 shorted. D. Key closed or shorted.



SYMPTOMS	POSSIBLE CAUSE
8. Low resistance reading from pin 6 of tube socket V8 or tube socket V7 to ground.	<ul style="list-style-type: none"> A. Resistors R7, R13, R14, R203, and/or R205 shorted. B. Capacitors C4, C6, C12, and/or C13 shorted.
9. Tone not audible in the speaker.	<ul style="list-style-type: none"> A. Audio amplifier tube V6A defective. B. Coupling capacitor C85 open. C. Power amplifier tube V6B defective. D. Capacitor C91 shorted. E. Audio transformer T4 defective. F. Speaker or speaker connections defective. G. PHONES jack open. H. Headphones connected into PHONES jack.
10. Tone not audible in the headphones, speaker OK.	<ul style="list-style-type: none"> A. PHONES jack open or shorted. B. Headphones defective.
11. Side tone oscillator does not oscillate or Transceiver is apparently operating, but tone for monitoring the keyed signal is not heard.	<ul style="list-style-type: none"> A. Open connection from neon lamp NE-2H and capacitor C86 to bias voltage source. B. Neon lamp NE-2H defective. C. Capacitor C86 defective. D. Capacitor C84 open. E. Resistors R63 or R64 open.
12. No RF output at final. (Driver output appears to be OK.)	<ul style="list-style-type: none"> A. Check items 2A through 2D. B. RF choke L16 open. C. Parasitic choke, coil L15 and resistor R11 open. D. Final amplifier tube V9 defective. E. Bias voltage too high at grid V9. F. BAND switch defective.
13. Bias voltage at V7, V8, and V9 is too high.	<ul style="list-style-type: none"> A. Resistors R8, and/or R9 shorted.
14. No RF output from driver (Oscillator appears to be OK.)	<ul style="list-style-type: none"> A. Driver tube V8 defective. B. Resistors R5 or R7 open. C. BAND switch defective.



SYMPTOMS	POSSIBLE CAUSE
15. No signal from crystal oscillator V7.	<ul style="list-style-type: none"> A. Check items 2A through 2D. B. Resistors R1 and/or R3 defective. C. Capacitors C1 or C4 defective. D. Defective crystal at crystal socket X1 or X2. E. Crystal oscillator tube V7 defective.
16. No signal at the grid of RF amplifier V1.	<ul style="list-style-type: none"> A. Capacitors C26, C27, C28, C29, C31, and/or C32 shorted. B. Diode D1 shorted. C. Inner lead of the coaxial cable connected to diode D1 shorted to the shield of the coaxial cable. D. Resistor R18 shorted.
17. No signal at the grid of Heterodyne Mixer V2A.	<ul style="list-style-type: none"> A. RF amplifier V1 defective. B. Capacitor C42 open. C. BAND switch defective.
18. No signal injection from the Heterodyne oscillator V2B.	<ul style="list-style-type: none"> A. Wire disconnected from BAND switch (wafer C, lug 3). B. Heterodyne oscillator tube V2B defective.
19. Bias switch Q1 does not conduct when receiving. No audio output.	<ul style="list-style-type: none"> A. Transistor Q1 is defective. B. Resistor R44 and/or R45 shorted.
20. Meter is inoperative or indicates backwards.	<ul style="list-style-type: none"> A. Leads connected to the meter are reversed. B. PLATE-REL PWR switch is improperly wired.
21. REL PWR-PLATE meter switch is in PLATE position, transmitter is apparently operating, but meter reads 0.	<ul style="list-style-type: none"> A. Capacitors C33 and/or C25 shorted. B. Resistor R15 shorted. C. Choke L17 open. D. Diode D1 defective or wired in reverse. E. REL PWR-PLATE switch defective. F. Rel Pwr-Plate meter defective.
22. REL PWR-PLATE switch is in REL PWR position, transmitter is apparently operating, but meter reads 0.	<ul style="list-style-type: none"> A. Capacitors C33 and/or C34 are shorted. B. Resistor R17 is shorted. C. Diode D2 is defective. D. REL PWR-PLATE switch is defective. E. Rel Pwr-Plate meter is defective.



SYMPTOMS	POSSIBLE CAUSE
23. REL PWR-PLATE switch is in REL PWR position, transmitter is apparently operating, but meter is pegged to full scale.	A. Jumper wire across R16 was not removed. B. Diode D2 shorted.
24. Loud oscillation in speaker or headphones when AF Gain is turned clockwise.	A. Blue transformer lead positioned too close to circuit board.
25. TUNE does not peak.	A. Final tank coil L12 has leads interchanged. B. Capacitor C26, C27, C28, C29, C31, or C32 defective. C. Crystal or VFO frequency not within specified range.
26. Sidetone is too loud.	A. Resistance value of R63 too small, replace with a 1 megohm (brown-black-green) 1/2 watt resistor.

SPECIFICATIONS

TRANSMITTER

RF Power Input.	50 to 90 watts (adjustable).
Frequency Control.	80-meter crystal or VFO on 80-meter band. 80- or 40-meter crystal, or VFO on 40-meter band. 40-meter crystal or VFO on 15-meter band.
Keying.	Grid-block, break-in, with automatic antenna switching and receiver muting.
Output Impedance.	50 Ω unbalanced, SWR not to exceed 2:1.
Side Tone.	Neon relaxation oscillator.



RECEIVER

Sensitivity.	Less than 1 microvolt for 10 db signal-plus-noise to noise ratio.
Selectivity.	500 Hz at 5 db down.
Image Rejection.	70 dB or better.
IF Rejection.	35 dB or better.
Intermediate Frequency.	3396 kHz.
Antenna Impedance.	50 Ω unbalanced.
External Speaker Impedance.	8 Ω .

GENERAL

Frequency Coverage.	3.5 to 3.75 MHz. 7.0 to 7.25 MHz. 21.0 to 21.25 MHz.
Power.	120 VAC 50/60 Hz.
Transmitter Tube Complement.	6CL6 Crystal oscillator. 6CL6 Driver 6GE5 Final.
Receiver Tube Complement.	6EW6 RF amplifier. 6EA8 Heterodyne mixer-oscillator. 6EA8 VFO mixer-oscillator. 6EW6 IF amplifier. 12AX7 Product detector-oscillator. 6HF8 1st audio and audio output.
Transistor Complement.	2N1274 muting circuit.
Dimensions.	13-3/4" wide x 11-1/2" deep x 6-1/2" high.
Net Weight.	20 lbs.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.



CIRCUIT DESCRIPTION

Refer to the Block Diagram (fold-out from Page 50) and to the Schematic Diagram (fold-out from Page 63) while reading this Circuit Description.

Note that the receiver circuits are across the bottom and the transmitter circuits are across the top of the Schematic and Block Diagrams.

TRANSMITTER

Tube V7 is a modified Pierce crystal oscillator which combines the functions of an oscillator and a buffer amplifier. It creates the basic signal which is amplified by tube V8, the driver stage. The driver stage also serves as a frequency tripler on the 15-meter band. The final amplifier, tube V9, increases the power sufficiently for transmission. Closing the key removes the cutoff bias from the grids of all three transmitter stages.

Crystal Oscillator

The screen grid of pentode V7 serves as the plate of a crystal-controlled triode oscillator. The oscillator operates at the fundamental frequency of an 80- or 40-meter crystal.

The complete pentode acts as an amplifier for the oscillator signal on the control grid. The plate load is a tuned tank circuit on 40-meter signals, but the coil acts as an RF choke on 80-meters. (Capacitor C7 couples the signal to the driver stage.)

Driver

Driver tube V8 operates as a straight amplifier on either 40 or 80 meters. On 15 meters, V8 acts as a frequency tripler. The proper broadband plate tank circuit is selected with the Band switch. The output signal is coupled through capacitor C15 to the final amplifier.

Final Amplifier

Final amplifier tube V9 operates as a neutralized amplifier with its input and output circuits tuned to the same frequency. It is necessary to cancel the plate-to-grid capacity by using capacitors C21 and C22 to pass a small amount of the output into the grid circuit as an out-of-phase neutralizing signal. A parasitic choke made up of coil L15 and resistor R11 is used in the plate circuit to suppress high frequency parasitic oscillations.

The Power Level control on the front panel adjusts the screen voltage of tube V9 to control the power output. When the Plate-Rel Pwr meter switch is in the Rel Pwr position, the meter measures a sample of RF voltage taken from voltage divider resistors R16 and R17 and rectified by diode D2. The meter reading is proportional to the RF output voltage at the antenna.

In the Plate position of the Plate-Rel Pwr meter switch, the meter indicates final cathode current (plate current and screen current) by measuring the voltage drop across resistor R15.

In the transmit condition, cathode current flows through resistor R15, coil L17, and diode D1 to the cathode of tube V9 (pins 4 and 10). This provides forward bias to D1 and allows any RF coupled from the pi network circuit via C23 to be bypassed to ground through diode D1 and capacitors C16 and C17. This prevents the transmitter output from reaching the receiver RF amplifier grid during transmit.

During receive operation, diode D1 has no bias. It is effectively an open circuit at the low signal voltages received. Signals are coupled through C23 to the grid of receiver RF amplifier tube V1. Diode D1 acts as an antenna relay.

Pi Network Output Circuit

The output network is used in both the transmit and receive modes. Different pi network configurations are switched into the output circuit by



the Band switch. On the 80-meter band, the entire coil L12 is used; capacitors C26 and C27 are paralleled with capacitor C28; and capacitors C29 and C31 are paralleled with capacitor C32, which is a fixed loading capacitor. On the 40-meter band, a few turns of coil L12 are shorted; the shunting capacitances are reduced by switching capacitors C27 and C29 out of the circuit. On the 15-meter band, most of coil L12 is shorted; the shunting capacitances are reduced further by switching capacitors C26 and C31 out of the circuit.

Grid-Block Keying Circuits

With a key-up condition, a large negative voltage is placed on the grids of tubes V7, V8, and V9. This bias voltage cuts these tubes off, therefore the transmitter has no output.

The key-down condition shorts resistor R69, which removes the cutoff bias voltage from tubes V7 and V8. At the same time, the bias at V9 is reduced to an operating level.

RECEIVER

The receiver employs one RF amplifier, a fixed-tuned heterodyne oscillator and heterodyne mixer, a manually-tuned VFO, a VFO mixer, an IF amplifier, a crystal controlled product detector, and two audio amplifiers. In addition, there is a transistor-type bias switch with a manual RF Gain control.

RF Amplifier

The received signal from the antenna passes through the pi network and is amplified by RF amplifier tube V1. The plate load is a broadband tank circuit. All received signals in the selected band of frequencies are coupled through capacitor C42 to Heterodyne Oscillator-Mixer tube V2. The amount of RF amplification is controlled by the RF Gain control. It controls the amount of cathode bias on RF amplifier tube V1. The RF Gain control also affects IF amplifier V4.

Heterodyne Oscillator-Mixer

The RF signal at the grid of heterodyne mixer tube V2A is mixed with a signal generated by heterodyne oscillator V2B. The Band switch selects the proper crystal and plate coil for the oscillator. The signal produced in the heterodyne oscillator is capacitively coupled to the heterodyne mixer within the tube. Here, all signals passed by the pi network and RF amplifier are mixed with the heterodyne oscillator signal. The output signal is coupled to the grid of the VFO mixer through T1, the bandpass coupler. This bandpass coupler passes desired signals in the range of frequencies from 5546 kHz to 5296 kHz.

Variable Frequency Oscillator-Mixer

The signal input to V3A at the VFO mixer grid is mixed with the signal from VFO tube V3B. Capacitor C53 tunes the VFO from 1900 kHz to 2150 kHz. The VFO signal is coupled through C56 to the cathode of the VFO mixer where the bandpass signals from the preceding stage are mixed with the signal from the VFO. The resultant signal is an IF of 3396 kHz. A highly selective crystal filter couples the output of the VFO mixer to the grid of the IF amplifier.

IF Amplifier-Product Detector And BFO

Amplifier V4 is a conventional IF stage which amplifies the 3396 kHz signal passed by the crystal filter. The amount of IF amplification is controlled by the RF Gain control, which controls the amount of cathode bias on V4. The RF Gain control also affects RF amplifier tube V1.

Coil T3, which is tuned to resonance by a small capacitor, serves as the plate load for IF amplifier V4. The signal from the plate of V4 is coupled through capacitor C73 to the grid of product detector stage V5A.

Tube V5B is a crystal-controlled BFO that produces a 3396.4 kHz signal. The BFO signal couples from the cathode of V5B to the cathode of V5A through capacitor C72. The product detector produces an audio signal equal to the



difference in frequency between the BFO and IF of the two input signals. The output of the product detector couples through the AF Gain control to audio amplifier V6A. The AF Gain control varies the volume of the output signal.

AF Gain Control

AF Gain control R61 is connected in series with DC blocking capacitor C75 and resistor R53 as an audio (signal) voltage divider which shunts plate load resistor R54. Turning AF Gain control R61 in a clockwise direction increases the proportion of the audio signal being coupled to audio amplifier V6A. The greater the signal input to the audio amplifier, the greater the volume of the output signal.

Audio Amplifier-Audio Power Amplifier

The cathode circuit of audio amplifier V6A is connected to a side-tone oscillator, neon lamp and capacitor C86. When the key is depressed, the sidetone oscillator provides an audio signal at the cathode of audio amplifier V6A. This is for monitoring purposes and allows you to monitor the message you are transmitting. The amplified signal from the plate of audio amplifier V6A is coupled through capacitor C85 to the grid of audio power amplifier V6B.

Audio power amplifier V6B couples through a transformer to either a speaker or headphones. The speaker is left connected at all times. When

the headphones are plugged in, their high impedance causes the speaker to be effectively muted. For operation with headphones only, a shorted phono plug must be inserted in SPKR Jack.

Bias Switch

Transistor Q1 is a bias switch for receiver muting. When receiving, Q1 conducts and provides operating bias to the cathode of V1 and V4. Depressing the key causes the base-emitter junction of Q1 to become reverse biased and cut off. Because of this, the cathode voltage of V1 and V4 rises and cuts off the receiver RF and IF stages.

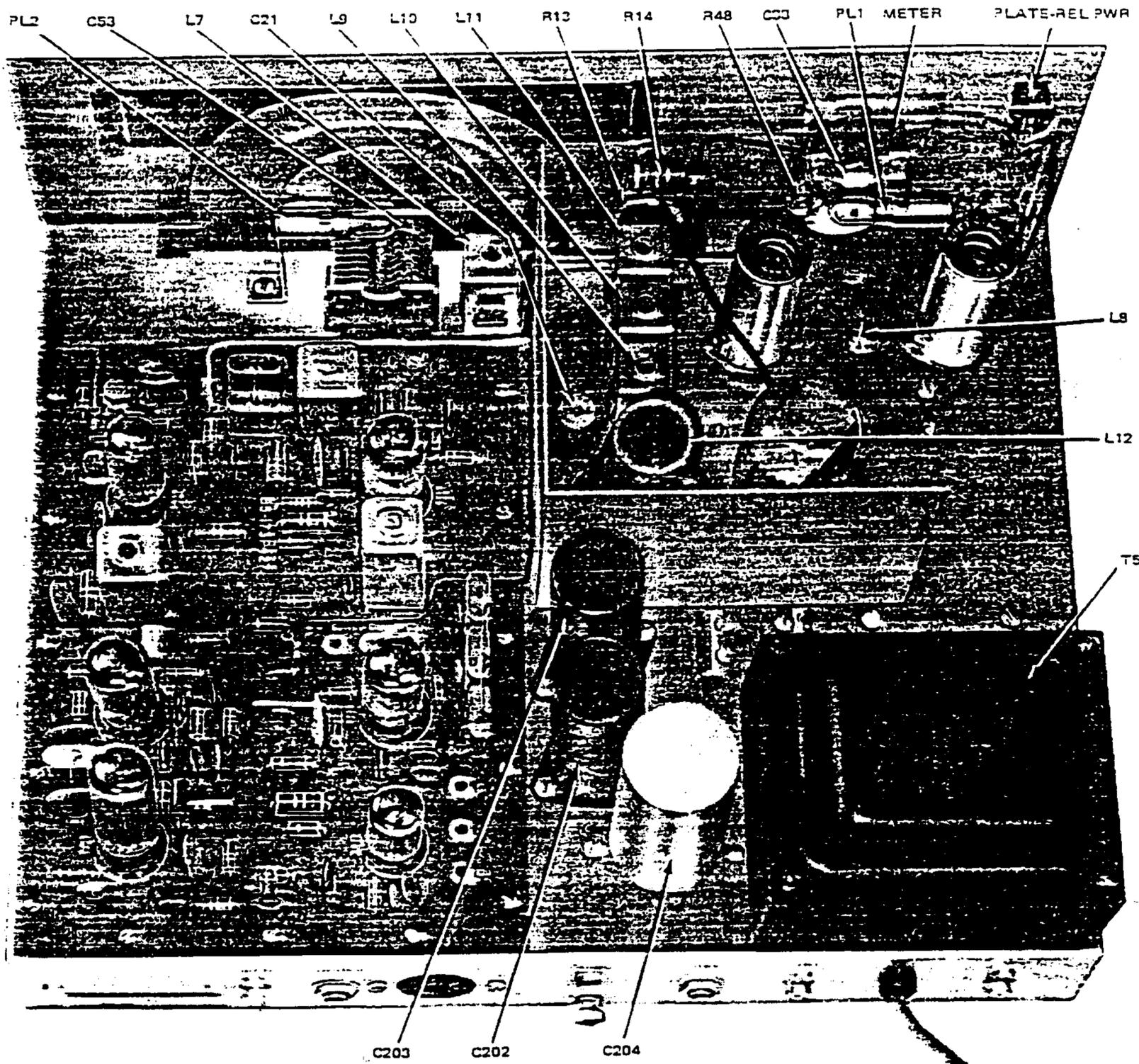
POWER SUPPLY

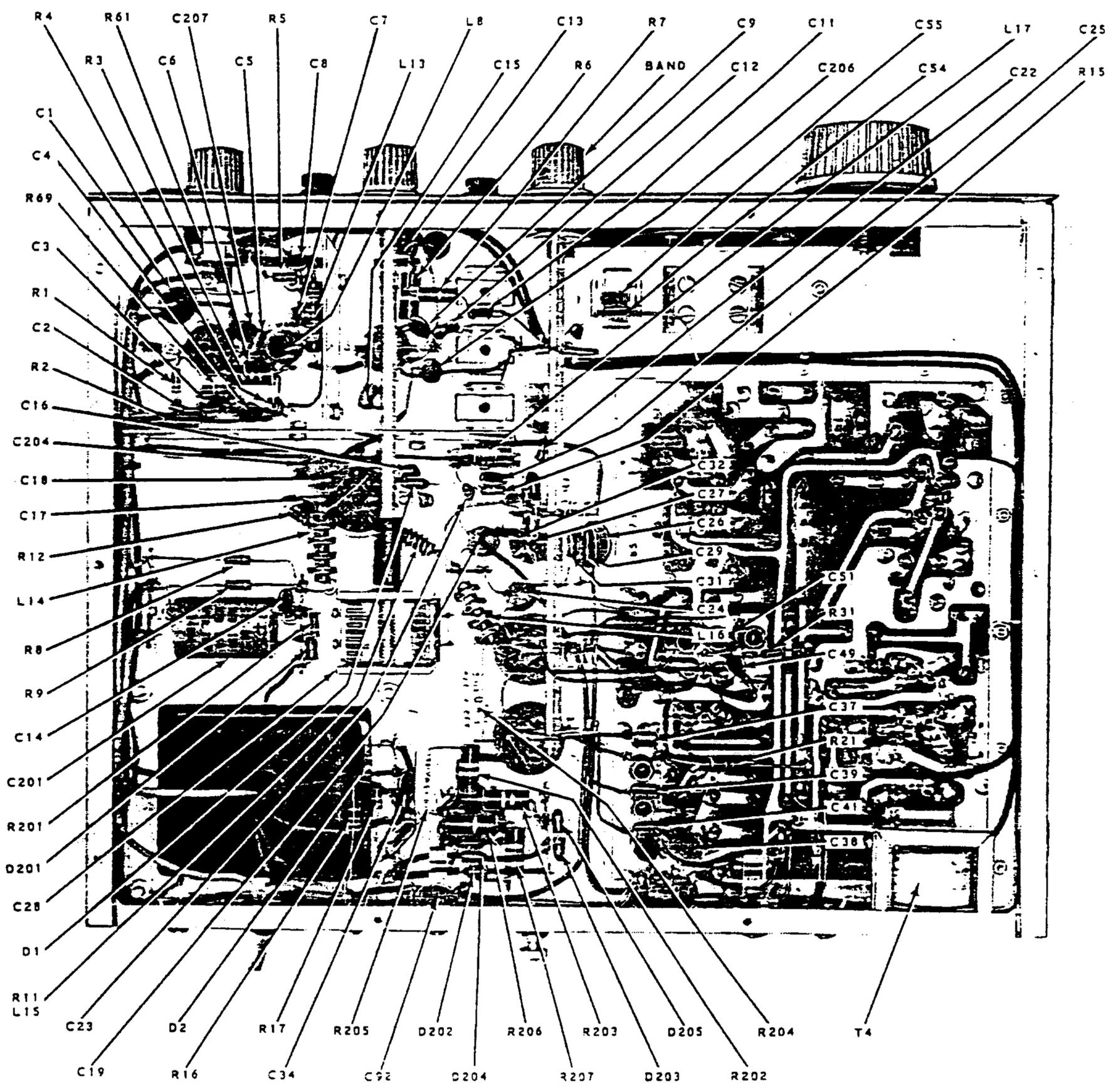
The power supply consists of a half-wave rectifier, a voltage doubler and a filament supply. The half-wave rectifier produces -120 V DC for the grid-block keying bias. This is filtered by capacitor C201 and resistor R201. The voltage doubler circuit produces 600 V DC for the final amplifier plate and 300 V DC which is further filtered and dropped to supply low voltage B+ to the receiver and transmitter sections. Filament voltage is supplied directly by a low voltage winding on power transformer T5.

The primary of the power transformer is protected by a circuit breaker and controlled by an On-Off switch operated with the AF Gain control.

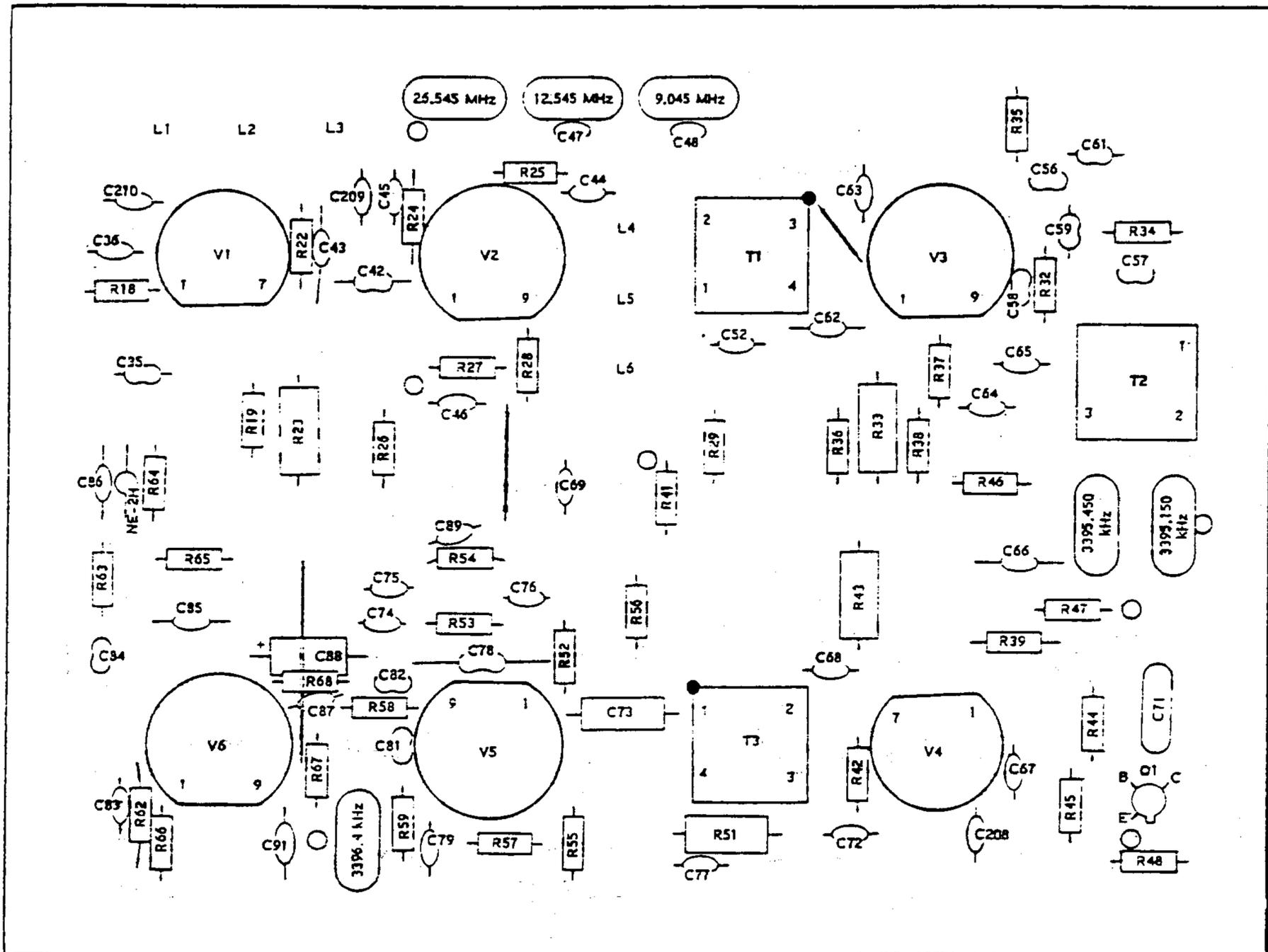


CHASSIS PHOTOGRAPHS





CIRCUIT BOARD X-RAY VIEW (VIEWED FROM FOIL SIDE)





REPLACEMENT PARTS PRICE LIST

To order parts, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to Replacement Parts in the Kit Builders Guide.

PART No.	PRICE Each	DESCRIPTION
-------------	---------------	-------------

RESISTORS

1/2 Watt

1-41	.10	10 Ω
1-54	.10	15 Ω
1-66	.10	150 Ω
1-42	.10	270 Ω
1-6	.10	470 Ω
1-9	.10	1000 Ω
1-13	.10	2700 Ω
1-14	.10	3300 Ω
1-18	.10	5600 Ω
1-20	.10	10 KΩ
1-21	.10	15 KΩ
1-22	.10	22 KΩ
1-25	.10	47 KΩ
1-60	.10	68 KΩ
1-26	.10	100 KΩ
1-121	.10	120 KΩ
1-29	.10	220 KΩ
1-99	.15	240 KΩ
1-31	.10	330 KΩ
1-33	.10	470 KΩ
1-35	.10	1 megohm
1-36	.10	1.5 megohm

1 Watt

1-2-1	.10	1000 Ω
1-5-1	.10	22 KΩ
1-7-1	.10	47 KΩ
1-8-1	.10	68 KΩ

2 Watt

1-13-2	.20	220 Ω
1-17-2	.20	6800 Ω
1-11-2	.20	22 KΩ
1-18-2	.20	33 KΩ
1-10-2	.20	47 KΩ
1-24-2	.20	100 KΩ

Other Resistors

3-19-5	.15	330 Ω 5 watt
3-9-7	.15	100 Ω 7 watt

PART No.	PRICE Each	DESCRIPTION
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CAPACITORS

Resin

20-130	.15	12 pf
20-99	.15	22 pf
20-96	.15	36 pf
20-101	.15	47 pf
20-110	.15	75 pf
20-102	.15	100 pf
20-104	.15	130 pf
20-108	.20	200 pf
20-106	.30	390 pf
20-107	.40	680 pf
20-122	.30	1000 pf
27-47	.20	.1 μfd

Disc

21-3	.10	10 pf
21-7	.10	33 pf
21-49	.20	68 pf 4 KV
21-139	.20	150 pf 2 KV or 4 KV
21-56	.10	470 pf
21-14	.10	.001 μfd
21-71	.15	.001 μfd 1.4 KV
21-36	.10	.002 μfd
21-57	.10	.005 μfd
21-35	.15	.005 μfd 1.6 KV
21-31	.10	.02 μfd

Electrolytic

25-54	.40	10 μfd
25-80	1.00	20-20 μfd
25-179	2.65	50-40-80-80 μfd
25-17	1.05	50 μfd

Other Capacitors

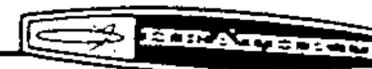
21-29	.15	4.7 pf tubular
31-31	1.05	3-12 pf trimmer
26-113	1.55	54 pf variable

COILS

40-79	.45	40-meter oscillator coil
40-360	.40	15-meter heterodyne oscillator coil
40-363	.40	15-meter RF coil
40-795	.40	80-meter RF coil
40-796	.40	40-meter RF coil
40-797	.40	40/80-meter heterodyne oscillator coil
40-798	1.10	80/40/15-meter final coil
40-799	.55	VFO shielded coil
40-801	.60	80-meter driver coil (shielded)



PART No.	PRICE Each	DESCRIPTION	PART No.	PRICE Each	DESCRIPTION
Coils (cont'd.)			CONTROLS-SWITCHES		
40-802	.55	40-meter driver coil (shielded)	10-33	.35	200 Ω control (RF Gain)
40-803	.55	15-meter driver coil (shielded)	11-78	1.70	15 K Ω control (Power-Level)
.00	.80	Crystal filter coil (shielded)	19-72	.95	500 K Ω control with switch (AF Gain and Off-On)
CHOKES			60-4	.20	SPDT slide switch (Rel-Pwr-Plate)
45-30	.40	.5 mH RF choke	63-436	4.70	4-section band switch
45-3	.30	1 mH RF choke	65-10	.45	3 ampere circuit breaker
45-19	.40	Parasitic RF choke, wound on 47 Ω (yellow-violet-black)	SOCKETS-JACKS-PLUGS		
TRANSFORMERS			434-2	.10	Octal tube socket
51-55	1.75	AF output	434-38	.20	Large crystal socket
52-71	.65	IF	434-42	.10	Phono socket
52-102	2.25	Bandpass coupler	434-43	.20	9-pin, shielded tube socket
54-179	10.25	Power	434-74	.15	Small crystal socket
DIODES-TRANSISTOR			434-79	.15	9-pin, circuit board type tube socket
56-26	.30	1N191 crystal diode	434-90	.20	Miniature pilot lamp socket with bracket
57-27	.60	Silicon diode	434-112	.10	7-pin circuit board type tube socket
417-150	1.05	2N1274 transistor	434-121	.20	12-pin, compactron tube socket
TUBES			436-4	.35	Phone jack
411-26	1.20	12AX7	438-3	.45	Phone plug
411-63	1.90	6CL6	438-4	.10	Phono plug
411-124	1.50	6EA8	431-10	.10	3-lug terminal strip
411-170	1.20	6EW6	431-11	.10	5-lug terminal strip
411-171	2.00	6HF8	431-12	.10	4-lug terminal strip
411-185	1.95	6GE5	431-16	.10	2-lug terminal strip
CRYSTALS			431-55	.10	6-lug terminal strip
404-206	5.00	3396.4 kHz product detector	481-1	.10	Capacitor mounting wafer, 4-prong metal
404-301	5.00	9.045 MHz	481-4	.10	Capacitor mounting wafer, 3-prong fiber
404-302	5.00	12.545 MHz	206-54	.30	Tube shield
404-303	5.00	26.545 MHz	COAXIAL CABLE-WIRE-SLEEVING		
404-305	9.45	Matched set of crystals consisting of the following:	343-7	.05/ft	Coaxial cable
404-241		3395.150 kHz	344-50	.05/ft	Black hookup wire
404-242		3395.450 kHz	344-51	.05/ft	Brown hookup wire
LAMPS			344-52	.05/ft	Red hookup wire
412-1	.15	6 volt incandescent	344-54	.05/ft	Yellow hookup wire
412-34	.55	Neon	344-55	.05/ft	Green hookup wire
			344-56	.05/ft	Blue hookup wire
			344-59	.05/ft	White hookup wire
			340-3	.05/ft	Large bare wire
			340-8	.05/ft	Small bare wire
			346-4	.05/ft	Sleeving



PART No.	PRICE Each	DESCRIPTION	PART No.	PRICE Each	DESCRIPTION
HARDWARE			METAL PARTS		
#3 Hardware			90-358	2.80	Top cover
250-49	.05	3-48 x 1/4" screw	100-43	.25	Dial hub assembly
254-7	.05	#3 lockwasher	200-485-1	4.15	Chassis
252-1	.05	3-48 x 3/16" nut	203-479-1	1.00	Front panel
#4 Hardware			204-102	.10	Shield bracket
250-34	.05	4-40 x 1/2" screw	205-260	.90	Plate, chassis bottom
252-15	.05	4-40 x 3/16" nut	206-334	.30	Small shield plate
#6 Hardware			206-335	.45	Large shield plate
250-138	.05	6-32 x 3/16" screw	206-336	.90	RF shield
250-56	.05	6-32 x 1/4" screw	MISCELLANEOUS		
250-116	.05	6-32 x 1/4" black screw	73-1	.10	3/8" rubber grommet
250-8	.05	#6 sheet metal screw	73-4	.10	5/16" rubber grommet
250-162	.05	6-32 x 1/2" screw	75-24	.10	Line cord strain relief
254-1	.05	#6 lockwasher	89-1	.35	Line cord
252-3	.05	6-32 x 1/4" nut	85-173-1	3.70	Circuit board
252-22	.05	6-32 speednut	100-624	1.20	Dial drive assembly
259-1	.05	#6 solder lug	407-121	3.10	Meter
259-6	.05	#6 small solder lug	464-29-5	1.15	Dial
#8 Hardware			453-39	.10	Shaft, 5-13/16"
250-16	.05	8-32 x 3/16" setscrew	462-122	.20	Gray knob with skirt and pointer
250-92	.05	8-32 x 3/8" screw	462-258	.30	Dark green knob
253-9	.05	#8 small flat washer	462-189	.60	2" gray knob
253-45	.05	#8 large flat washer	446-59	1.45	Escutcheon
254-2	.05	#8 lockwasher	346-25	1.05/ft	Black tubing
252-4	.05	8-32 x 3/8" nut	260-7	.05	IF transformer clip
252-28	.10	8-32 nut	261-9	.05	Rubber foot
259-24	.05	#8 wire lug	489-1	.15	Sandpaper, #24 or #28
Other Hardware			331-6	.15	Solder
251-1	.05	6-32 spade bolt	490-5	.10	Nut starter
252-7	.05	Control nut	490-1	.10	Alignment tool
253-10	.05	Control flat washer		2.00	Instruction Manual (See front cover for part number.)
254-4	.05	Control lockwasher	The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.		
254-5	.05	Thin control lockwasher			
259-10	.05	Control solder lug			
455-9	.15	Bushing			
259-20	.05	Terminal pin			

SPECIFICATIONS

TRANSMITTER

RF Power Input.	50 to 90 watts (adjustable).
Frequency Control.	80-meter crystal or VFO on 80-meter band, 80- or 40-meter crystal, or VFO on 40-meter band, 40-meter crystal or VFO on 15-meter band.
Keying.	Grid-block, break-in, with automatic antenna switching and receiver muting.
Output Impedance.	50 Ω unbalanced, SWR not to exceed 2:1.
Side Tone.	Neon relaxation oscillator.

RECEIVER

Sensitivity.	Less than 1 microvolt for 10 db signal-plus- noise to noise ratio.
Selectivity.	500 Hz at 6 db down.
Image Rejection.	70 dB or better.
IF Rejection.	35 dB or better.
Intermediate Frequency.	3396 kHz.
Antenna Impedance.	50 Ω unbalanced.
External Speaker Impedance.	8 Ω .

GENERAL

Frequency Coverage.	3.5 to 3.75 MHz. 7.0 to 7.25 MHz. 21.0 to 21.25 MHz.
Power.	120 VAC 50/60 Hz.
Transmitter Tube Complement.	6CL6 Crystal oscillator. 6CL6 Driver 6GE5 Final.
Receiver Tube Complement.	6EW6 RF amplifier. 6EA8 Heterodyne mixer-oscillator. 6EA8 VFO mixer-oscillator. 6EW6 IF amplifier. 12AX7 Product detector-oscillator. 6HF8 1st audio and audio output.
Transistor Complement.	2N1274 muting circuit.
Dimensions.	13-3/4" wide x 11-1/2" deep x 6-1/2" high.
Net Weight.	20 lbs.

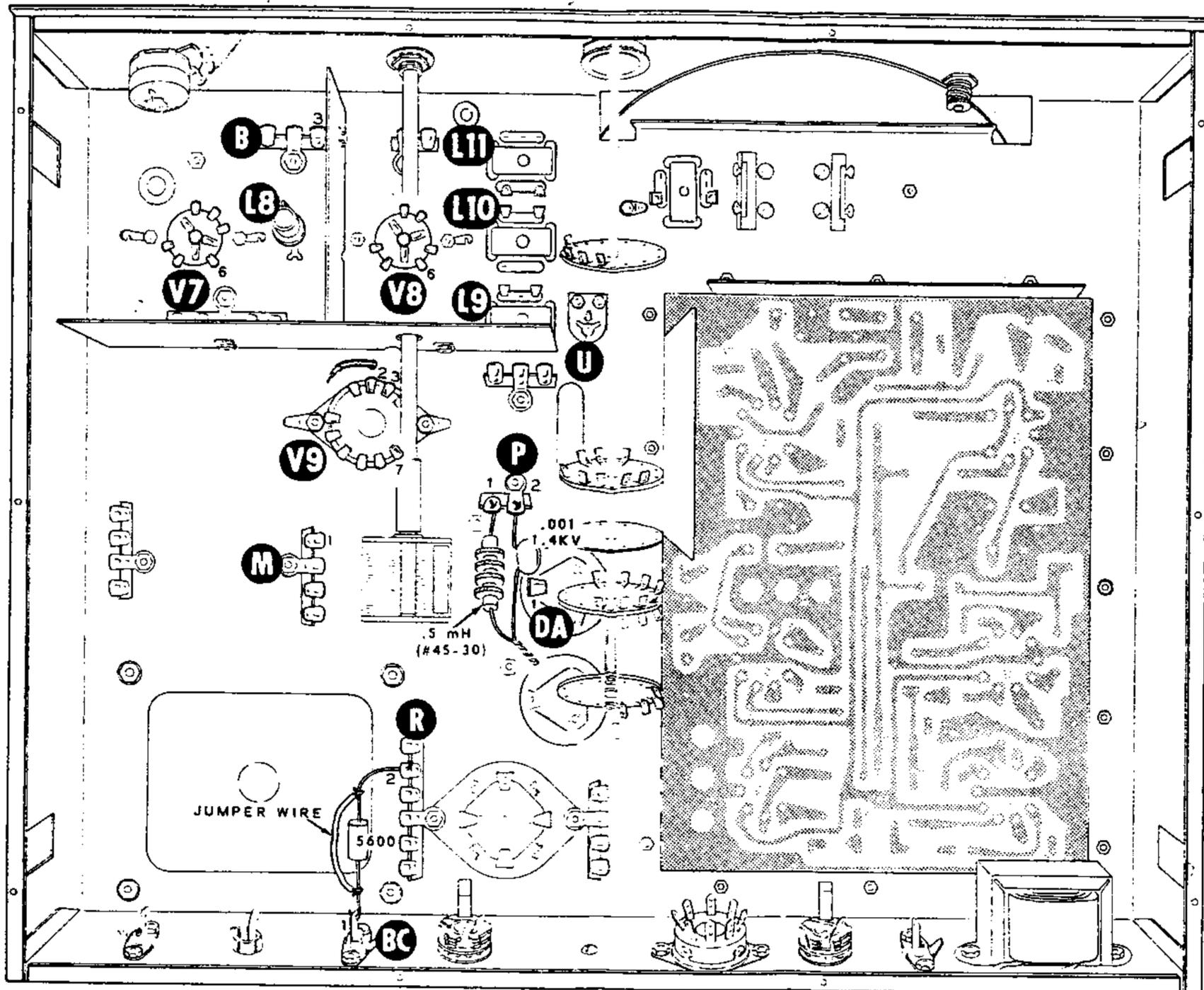


FIGURE 1-1

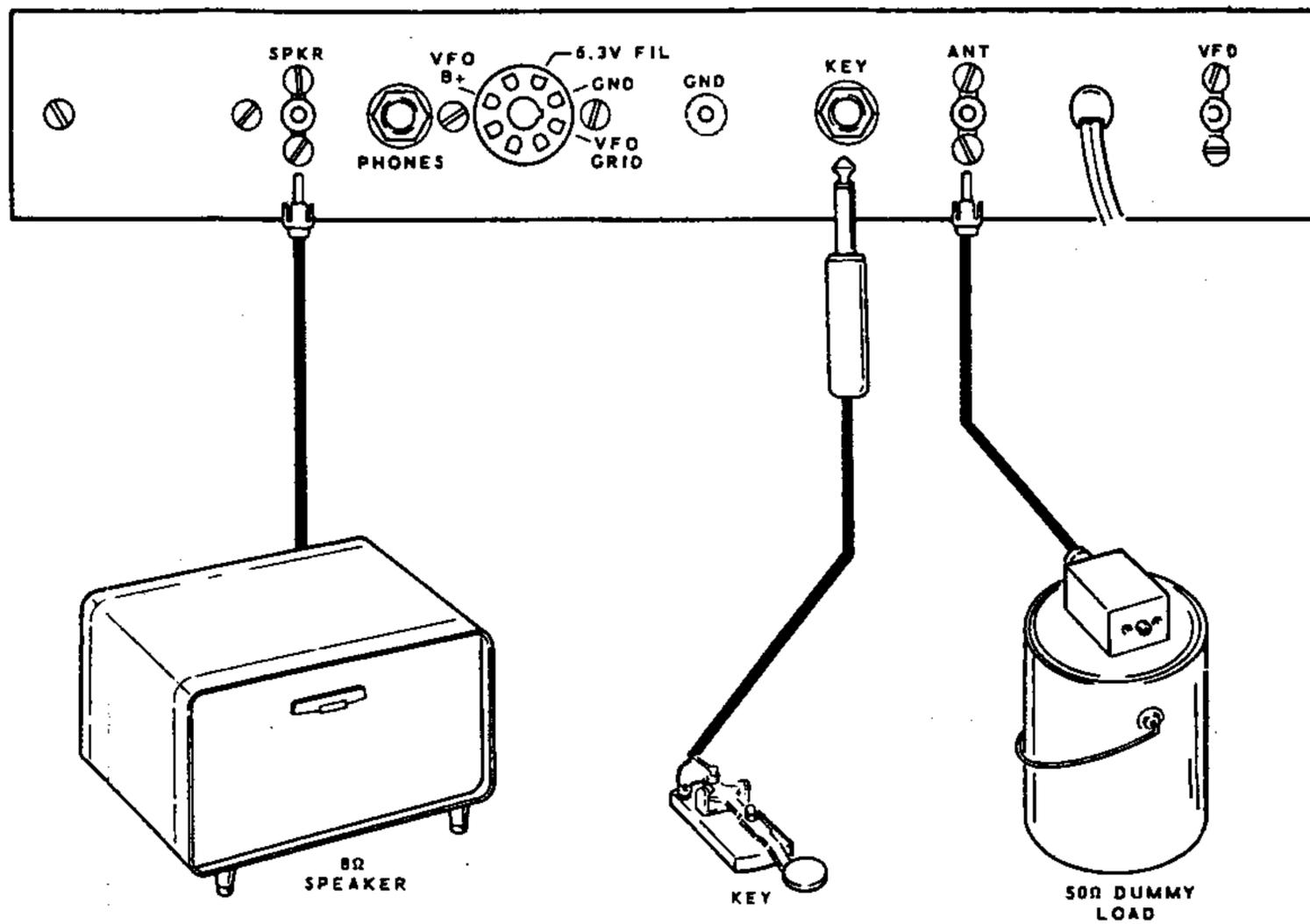


FIGURE 1-2

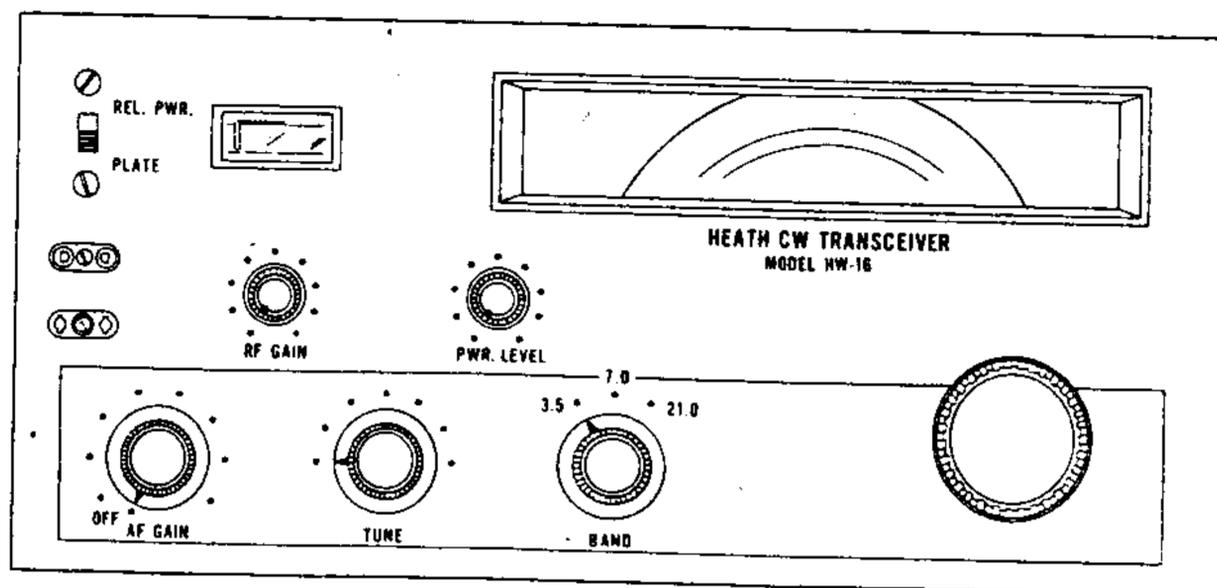
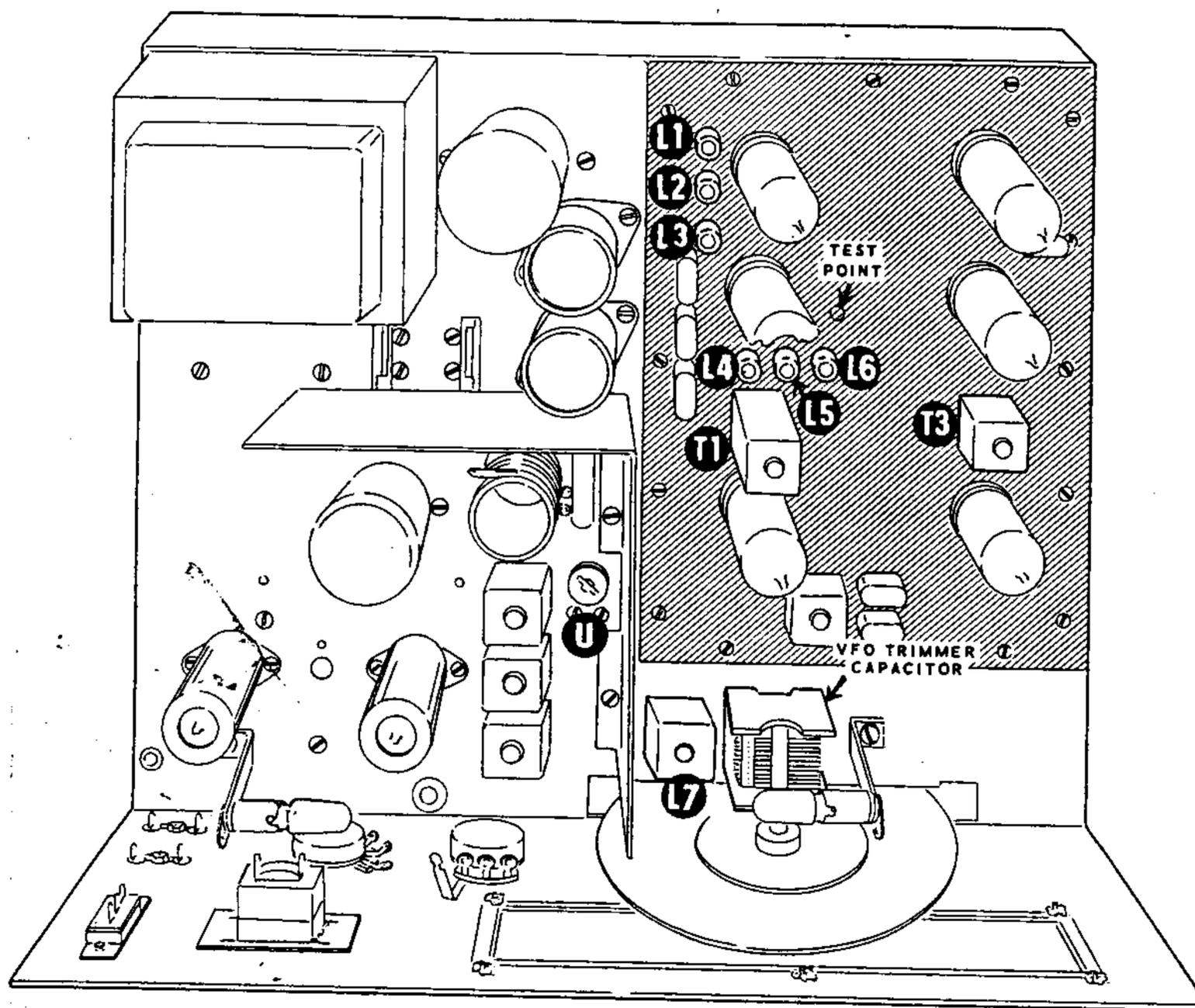
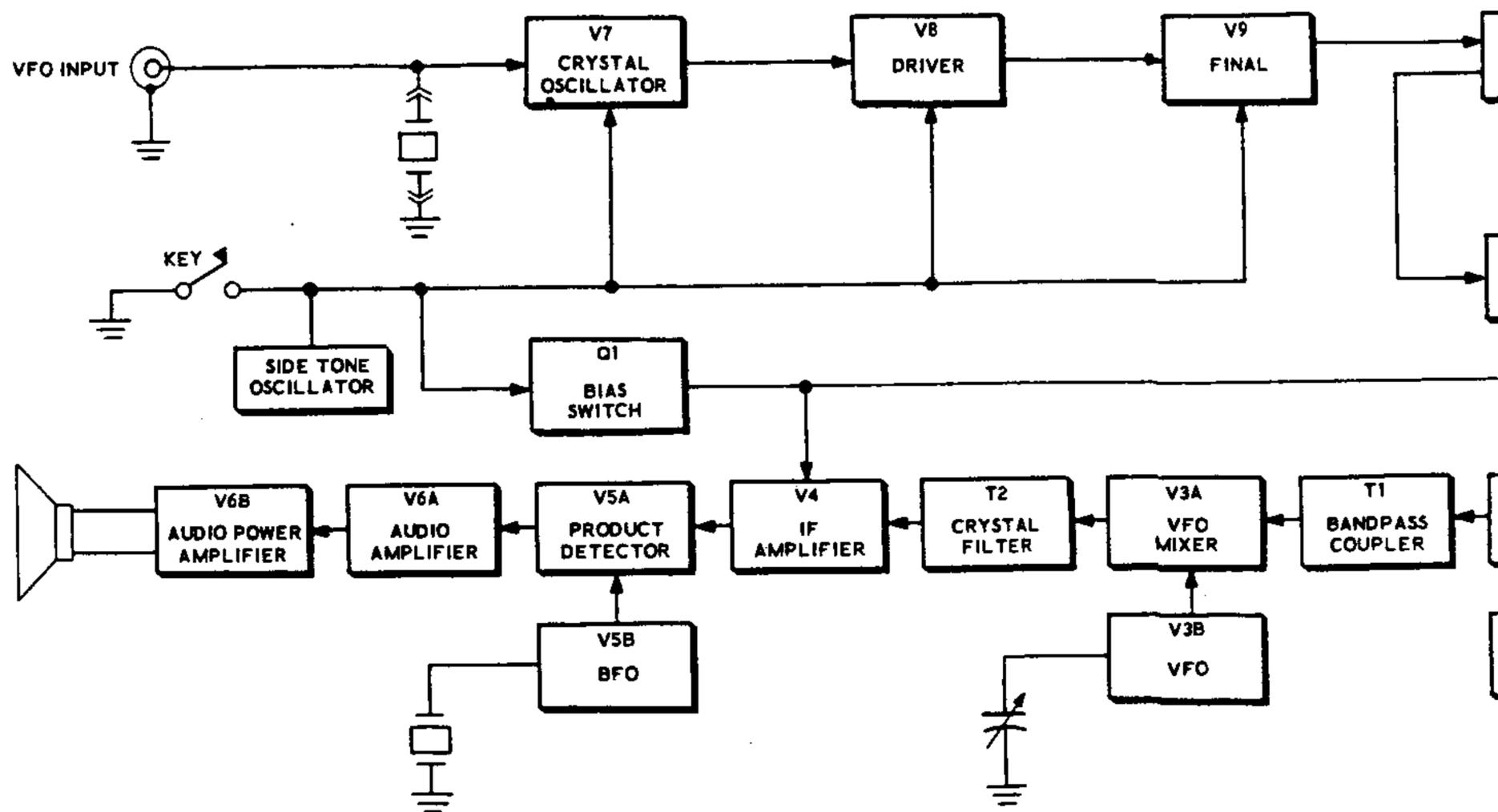
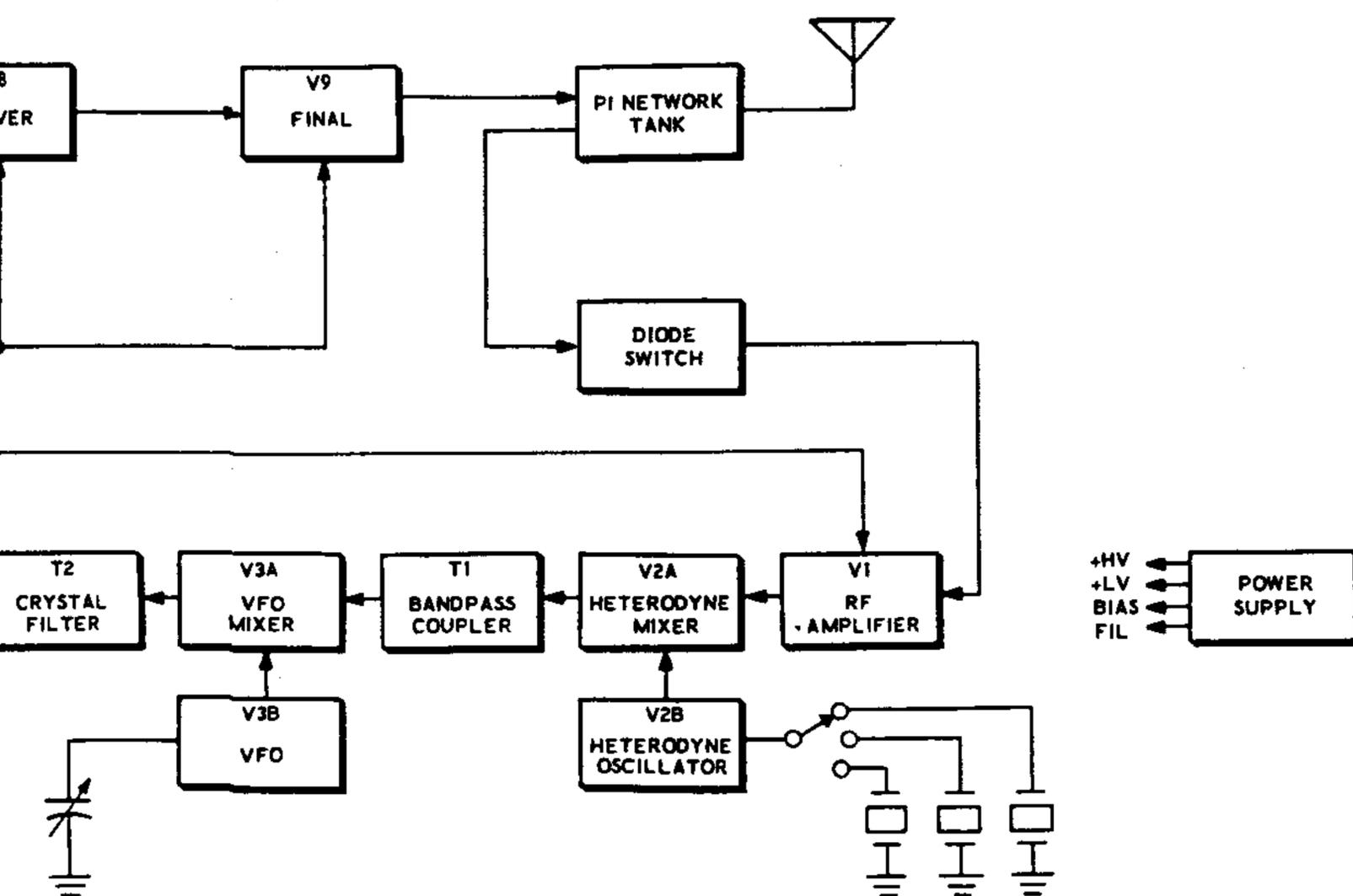


FIGURE 1-3



BLOCK DIAGRAM



BLOCK DIAGRAM

SCHEMATIC OF THE HEATHKIT® CW TRANSCEIVER MODEL HW-16

NOTES:

1. RESISTOR, CAPACITOR AND DIODE NUMBERS ARE IN THE FOLLOWING GROUPS:
0-99 PARTS OF TRANSMITTER AND RECEIVER CIRCUITS IN CLOCKWISE ROTATION
201-299 PARTS OF POWER SUPPLY CIRCUIT FROM RIGHT TO LEFT.
2. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K = 1,000, MEG = 1,000,000).
3. ALL CAPACITOR VALUES ARE IN μFD UNLESS MARKED OTHERWISE.
4. THIS SYMBOL INDICATES A DC VOLTAGE WITH KEY UP.
 THIS SYMBOL INDICATES A DC VOLTAGE WITH KEY DOWN.
5. ALL VOLTAGES TAKEN WITH AN 11 MEGOHM VTVM FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY $\pm 10\%$ WITH A LINE VOLTAGE OF 120 VAC AND CONTROLS SET AS FOLLOWS:
RF GAIN - FULL CLOCKWISE; PWR LEVEL - FULL CLOCKWISE;
BAND SWITCH - 3.5 MHz; AF GAIN - FULL CLOCKWISE.
6. ALL SWITCH WAFERS SHOWN IN FULL COUNTERCLOCKWISE POSITION, AS VIEWED FROM THE KNOB END OF THE SHAFT.
7. REFER TO THE CHASSIS PHOTOGRAPHS AND CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.
8. THE BANDSWITCH PANEL MARKINGS ARE IN MEGAHERTZ. THE BANDSWITCH SCHEMATIC CONTACTS ARE IDENTIFIED IN WAVELENGTHS.
3.5 MHz CORRESPONDS TO 80 METERS
7 MHz CORRESPONDS TO 40 METERS
21 MHz CORRESPONDS TO 15 METERS

