MODEL HA4 FINAL Q C TEST Q177J18 SERIAL NUMBER 5Ø4ØØØ 141Ø86 PURCHASED 1-3-62 WESTERN RDO SDIEGO

communications

OPERATING and SERVICE INSTRUCTIONS

HA-4

the hallicrafters co.

MANUFACTURERS OF ELECTRONIC EQUIPMENT CHICAGO 24 U. S. A.

TECHNICAL SPECIFICATIONS

POWER SOURCE	105 volts to 125 volts, 60 cycles AC, 1.5 watts
SPEED RANGE	Low: 8 WPM to 18 WPM. High: 16 WPM to 50 WPM.
KEYING MONITOR	Self-contained tone generator and permanent-magnet type speaker.
TRANSMITTER KEYING	High-voltage switching transistor normally open or normally closed to ground.
KEY LEVER INPUT	Three-circuit terminal strip mounted on the rear panel.
CONTROL OUTLET	Three-circuit terminal strip for transmitter connection.
DIMENSIONS	2.625 inches high by 7.500 inches wide by 5.750 inches deep.
NET WEIGHT	5.0 pounds.
SHIPPING WEIGHT	6.4 pounds.

Figure 1. Hallicrafters Model HA-4.

SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

The Hallicrafters Model HA-4 Transistorized T.O.Keyer *employs digital circuitry, similar to that found in modern digital computers, to form perfect code characters at any speed. Experienced operators appreciate its stability and precision of operation, and novice operators discover a new command of CW that leads to proficiency and unsuspected enjoyment. The keyer operates much in the same way as a tape transmitter; the dash-dot and mark-space ratios remain constant over the speed range, and the speed and mark-space adjustments are completely independent of one another.

The key lever is a remote control unit that may be placed in any convenient operating position. This conserves the operating area, permits ready mechanical adjustments, and allows the operator his choice of key levers.

Additional features of the keyer include: a pleasant monitor signal with volume control for practice, instruction, or monitoring . . . an exceptionally wide speed range . . . and complete immunity to line voltage fluctuations and RF pickup.

1-2. STANDARDS FOR THE INTERNATIONAL MORSE CODE.

The International Morse Code replaced the older Morse Code for radio communications when the tape perforator and keying head, along with the high-speed ink slip recorder, were developed for commercial service. This early automation of our CW is still widely employed, handling traffic comfortably at 300 WPM. The perforator and the keying head provide the perfect fist and the standards for CW which make it easy to send and receive with the proper scientific economy.

The relative duration of the dot and the space is called the mark-space ratio, which is usually adjusted for one-to-one. A dash is formed by bridging the space between two dots. The spaces between dots and dashes in a letter are uniform. A standard word is equivalent to 24 dots and spaces. Ten WPM is, therefore, 240 dots per minute, or four dots per second.

*Copyright property of The Hallicrafters Company. Patent application pending.

SECTION II

INSTALLATION

2-1. UNPACKING

After unpacking the Model HA-4 keying unit, examine it closely for any possible damage which may have occurred during transit. Should any sign of damage be apparent, file a claim immediately with the carrier stating the extent of the damage. Carefully check all shipping labels and tags for any special instructions before removing or destroying them.

2-2. LOCATION.

The keyer should be placed in a location which permits free circulation of air around the cabinet. Avoid excessively warm locations such as those near radiators and heating vents.

2-3. KEY LEVER.

Various styles of commercially built key levers are available for use with electronic keyers. Any of these are suitable for use with the Model HA-4 keying unit. Connections to the key and transmitter are made as shown in figure 2.

It can be noted by referring to the schematic diagram (figure 6) that the key lever is operated at a low negative potential. This makes the key assembly completely free from shock hazard.

2-4. REAR PANEL FUNCTIONS.

Terminal strips, a switch, and a potentiometer control are provided on the rear of the keyer for the following purposes:

1. Switch terminals marked plus, minus, and chassis are used to connect the keyer to the transmitter.

2. A terminal strip marked dashes, dots, and common is used to connect the key lever to the automatic keyer.

3. A Weight control is used to adjust the mark-space ratio of the keyer.

4. A slide switch is used to select high or low speed range.

IMPORTANT

The transmitter switching transistor is rated at 100 volts breakdown between collector and emitter. Also, 100 milliamperes is the maximum permissible current that can be keyed. Exceeding either of these maximum ratings will cause shortened life or complete failure of the transmitter switching transistor.

It is recommended that the unit be permanently connected to the station grounding system by connecting a ground lead to the terminal lug marked chassis on the rear panel. This will prevent the possibility of a shock hazard developing as a result of component failure.

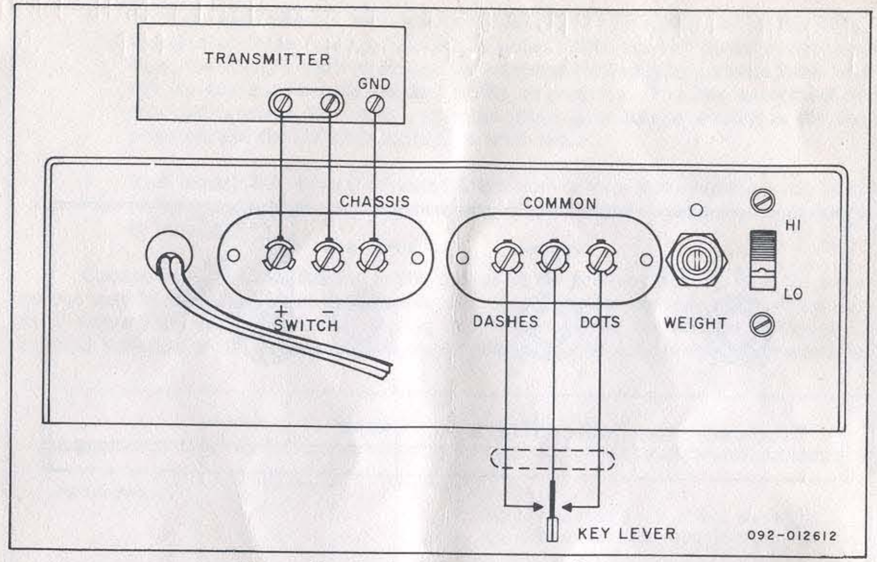

Figure 2. Typical Station Installation.

SECTION III

FUNCTION OF OPERATING CONTROLS

3-1. FUNCTION SWITCH.

The FUNCTION control is a four-position rotary switch which: (1) turns the unit on and off, (2) selects automatic operation, (3) selects semi-automatic operation, and (4) selects hold position for transmitter tuning (key down).

NOTE

The transmitter may also be tuned while the keyer unit is in the off position.

3-2. SPEED CONTROL.

The SPEED control provides a means of adjusting the keying speed. The High-Low range switch is used to select speed ranges between 8 WPM and 18 WPM in low range position or 16 WPM to 50 WPM in high range position.

3-3. VOLUME CONTROL.

The VOLUME control adjusts the amplitude of the keyed monitor tone.

3-4. WEIGHT CONTROL.

The Weight control (slotted shaft), located on the rear panel, sets the time relationship of a dot (or mark) to its following space. For normal CW work, the weight control is usually set for a ratio of one-to-one. Other ratios can be obtained to accommodate various transmitter keying characteristics or to suit personal preference (see figure 4).

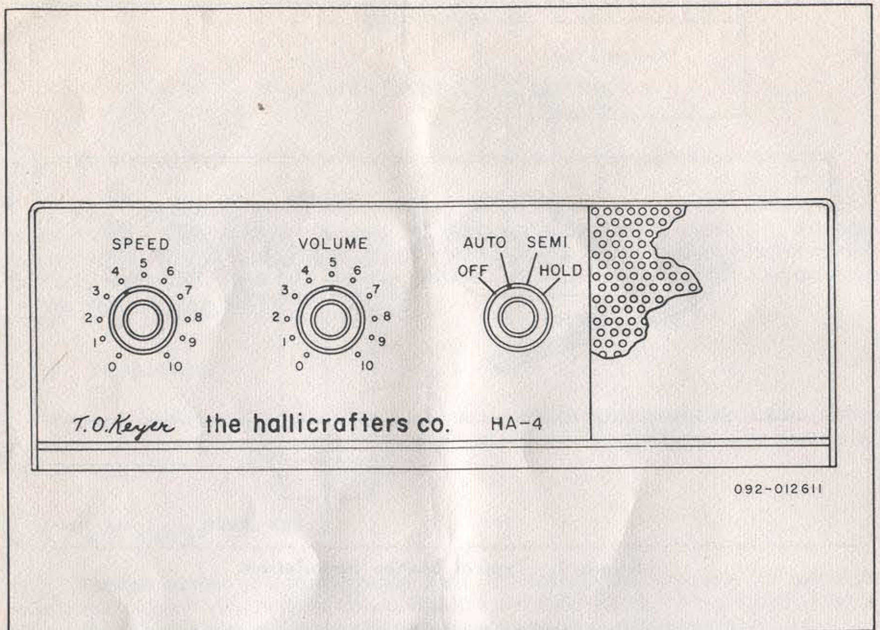

Figure 3. Model HA-1 Control Panel.

To adjust the Weight control, proceed as follows:

1. Turn the control to its maximum clockwise position; the unit will key a long mark with a short space.

2. Turn the control to its maximum counterclockwise position; the unit will key a short mark with a long space.

The effect of the adjustment on keying characteristics is especially evident when listening to the keyed monitor signal with the unit running at its highest speed.

To set the Weight adjustment for a one-to-one mark-space ratio, a 1000-ohm resistor, a fresh, 1-1/2-volt dry cell battery (ordinary flashlight cell), and a voltmeter will be needed.

Proceed as follows:

1. Connect one end of the resistor to the plus (+) terminal of the switch terminal strip.

2. Connect the positive test lead of the voltmeter directly to the terminal strip marked plus (+), and the negative test lead to the terminal strip marked minus (-).

3. Connect the positive terminal of the battery to the loose end of the resistor and the negative terminal of the battery to the minus (-) terminal of the switch terminal strip.

4. Turn the FUNCTION control to automatic.

5. With the key lever up, full battery voltage should be measured at the switch terminals. This voltage should be noted. With the key lever in dot position, the Weight control should be adjusted until exactly one-half the voltage is measured with the key in the up position. It is recommended that this adjustment be made with the High-Low Range switch in the High position and the SPEED control at mid-scale.

6. The Model HA-4 was adjusted for a one-to-one mark-space ratio at the factory and will need readjusting only if the Weight control was accidentally moved.

Connecting an oscilloscope to the output of the transmitter, so that the keyed output may be seen, is a more accurate means of setting the desired ratio. This permits adjustment of the over-all keying characteristic of the station, although the method detailed in the previous paragraph will generally suffice for most systems.

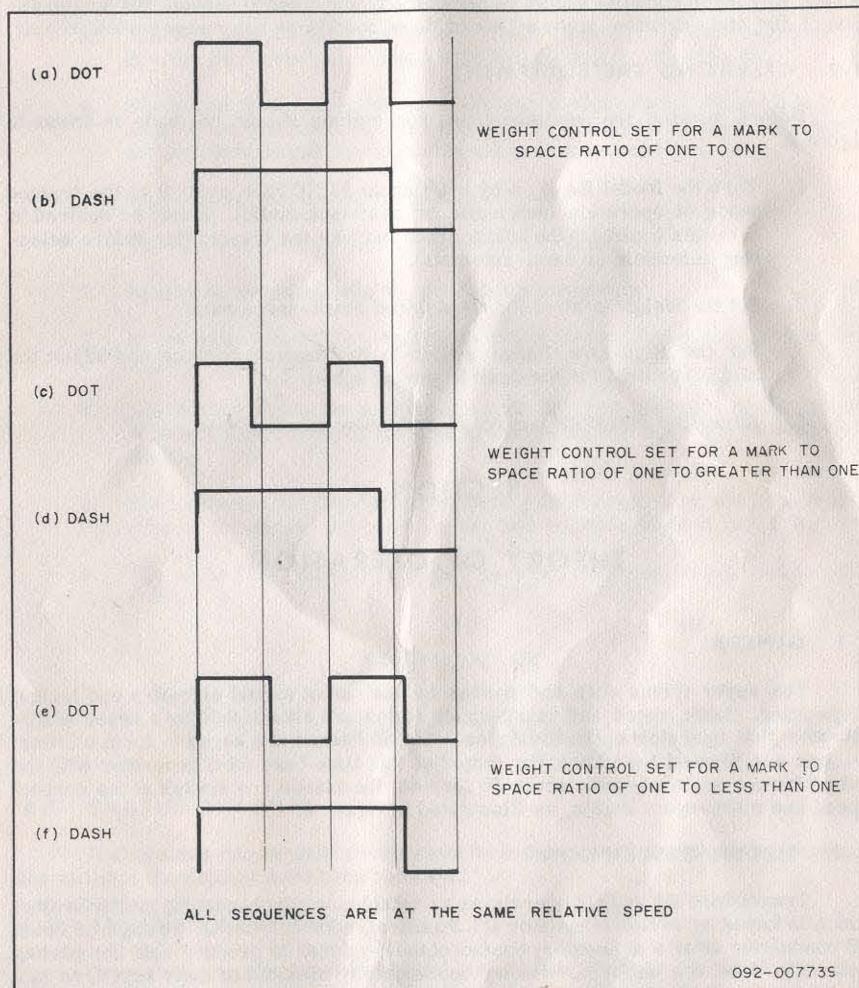

Figure 4. Dot-Dash-Space Relationships with Various Weight Control Settings.

SECTION IV

OPERATION

4-1. GENERAL.

Care should be exercised in the selection of a key lever for use with the Model HA-4 keying unit. One incorporating good mechanical construction, particularly at the pivot and contact points, is desirable and will provide long, reliable service.

Manufacturer's recommendations as to the key lever's adjustment should be followed closely for optimum performance. It is desirable to adjust the dot-dash contacts for the shortest possible excursion that will result in a reliable make-break action. Key lever controls should be periodically inspected to prevent the accumulation of dirt and oxidation, since either of these conditions can cause erratic keying.

4-2. OPERATING THE EQUIPMENT.

Before turning the equipment on, connections should be made as shown in figure 2.

1. Turn the Model HA-4 on by rotating the FUNCTION control to the desired mode of operation (automatic or semi-automatic). It may be desired to turn this control to the hold position and tune the transmitter before selecting automatic or semi-automatic.
2. Set the Weight control for the desired mark-space ratio.
3. Set the High-Low Range switch to the desired position and adjust the SPEED control for the desired keying speed.
4. Adjust the VOLUME control to a pleasing monitor tone.

SECTION V

THEORY OF OPERATION

5-1. GENERAL.

The keyer forms dots and dashes by the use of digital circuitry and logical sequencing. Basic speed and mark-space ratios are established by a keyed multivibrator that operates continuously as dots and dashes are keyed to form a letter. Dashes are formed by adding the output of this time base (dot) generator with the output from a scale-of-two circuit. So formed, the dashes are always at the correct speed and mark-space ratios, as illustrated in figure 4.

5-2. CIRCUIT DESCRIPTION.

Transistors Q1 and Q2 operate as an astable, or a free-running multivibrator, which is keyed by series transistor Q3. Positive feedback from Q6 through R6 holds Q3 conducting after a momentary contact of the key lever to produce self-completing dots. The dots are uniform, whether momentarily initiated or fully keyed, as in a series keying. Speed is controlled by negative base bias adjustment R32. Speed range is determined by the selection of resistors R37 and R38. Mark-space ratio is adjusted by variable resistor R31 with no effect upon speed.

Transistors Q4 and Q5 operate as a triggered bistable multivibrator, or a scale-of-two circuit. When armed, the multivibrator may be triggered by a positive pulse formed at the start of a dot from the collector of Q2. When so triggered, the collector of Q5 will flip and remain negative until another positive pulse is received. Operating in this manner, it bridges the space between two dots to form a perfect dash.

The monitor tone signal is produced by an LC audio oscillator keyed by Q6. The monitor tone level is controlled by R33.

The self-completing dot is formed in the following manner:

1. The key lever dot contact closes momentarily.
2. With forward base bias applied, Q3 conducts. At the same time, the bias applied through CR1 prevents Q5 from switching.
3. Multivibrator Q1 and Q2 operates. The collector of Q6 flips negative and, through R6, keeps Q3 conducting to form a self-completing dot.
4. The output from the collector of Q6 is applied through CR6 and R22 to the base of the transistor Q7 which conducts, providing a closed path across the switch terminal contacts marked plus and minus.

The self-completing dash is formed as follows:

5. The key lever dash contact closes momentarily.
6. Diode CR1 remains open to arm Q5 for triggering.
7. At the same time, Q3 conducts to start a self-completing dot, as described in steps 1 through 3 above.
8. The leading edge of the positive-going dot from the collector of Q2, through differentiator C4 and R15, forms a positive pulse to open Q5, causing Q4 to conduct.
9. The collector Q4 flips positive, keying Q6 through CR4, until the leading edge of the second dot provides another positive pulse to flip it negative.
10. The second dot, already initiated, goes through completion to end the dash cycle.

SECTION VI

SERVICE DATA

6-1. CHASSIS REMOVAL.

The chassis can be easily withdrawn from the cabinet after the four screws on the sides of the cabinet have been removed.

6-2. TROUBLESHOOTING.

Throughout the design of the Model HA-4 keyer, full consideration was given to keep maintenance problems at an absolute minimum. If a malfunction occurs, the schematic diagram and the theory of operation, Section V, will aid in isolating the source of trouble. For the physical location of component parts, refer to figure 5.

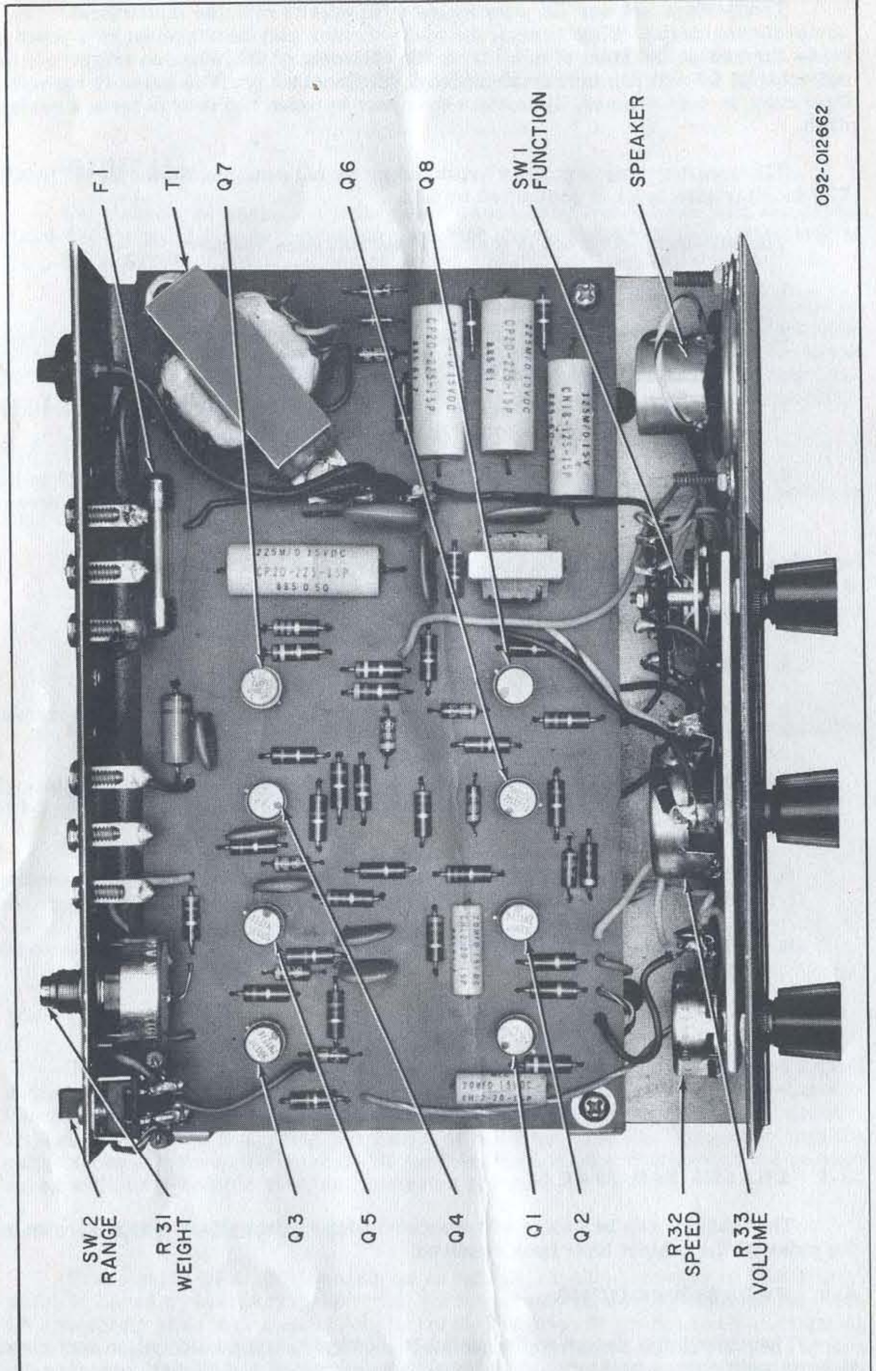

Figure 5. Internal Top View of Keyer.

NOTES

1. The frequency of the monitor tone is dependent to some degree on the current gain of the transistor used. For this reason, the tone oscillator transistor Q8 was selected at the factory. Each transistor is color coded according to the current gain. For Q8, brown, red, or orange may be used. The red coded transistor is the preferred one to be used, with the brown coded one giving a slightly higher pitched tone and the orange a lower pitched tone.

2. A higher gain transistor must be used in the multivibrator switching stage, Q3. For this reason, either a yellow, green, blue, or violet coded transistor may be used.

3. The remainder of the stages are non-critical, any color coded transistor may be used.

4. In the event of transistor replacement, it is recommended that the transistor be replaced with one of like color.

6-3. SERVICE AND OPERATING QUESTIONS.

For further information regarding operation or servicing of the Model HA-4 keyer, contact the dealer from whom the unit 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 the right. For the location of the one nearest you, consult your dealer or your local telephone directory.

Make no service shipments to the factory as The Hallicrafters Company will not accept responsibility for unauthorized shipments.

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

SERVICE REPAIR PARTS LIST

Schematic Symbol	Description	Hallicrafters Part Number
	CAPACITORS	
C1, 2	20 uf, 20%, 15V Electrolytic	045-000757
C3, 4, 5, 6, 7	.0039 uf, 20%, 1000V, Ceramic Disc	047-001517
C8	.02 uf, 500V, Ceramic Disc	047-001518
C9	.05 uf, 35%, 100V, Ceramic Disc	047-001519
C10, 11, 13	225 uf, 15V, Electrolytic	045-000759
C12	125 uf, 15V, Electrolytic	045-000758
C14	.02 uf, 500V, Ceramic Disc	047-100242
	RESISTORS	
R1, 4	1000 ohm, 10%, 1/2W	451-252102
R2, 3, 11, 14	680 ohm, 10%, 1/2W	451-252681
R5, 22, 35	390 ohm, 10%, 1/2W	451-252391
R6, 17	2200 ohm, 10%, 1/2W	451-252222
R7	22K ohm, 10%, 1/2W	451-252223
R8, 26	10K ohm, 10%, 1/2W	451-252103
R9, 16, 20	15K ohm, 10%, 1/2W	451-252153
R10, 15	5600 ohm, 10%, 1/2W	451-252562
R12, 13, 19	2700 ohm, 10%, 1/2W	451-252272
R18, 36	330 ohm, 10%, 1/2W	451-252331
R21	560 ohm, 10%, 1/2W	451-252561
R23	33K ohm, 10%, 1/2W	451-252333
R24	4700 ohm, 10%, 1/2W	451-252471
R25	47K ohm, 10%, 1/2W	451-252473
R27, 28	22 ohm, 10%, 1/2W	451-252220
R29	47 ohm, 10%, 1/2W	451-252470
R30	1500 ohm, 10%, 1/2W	451-252152
R31	1K ohm, Variable (Weight)	025-001992
R32	1K ohm, Variable (SPEED)	025-001988
R33	10 ohm, Variable (VOLUME)	025-001989
R34	12 ohm, 10%, 1/2W	451-252120
R37, 38	2200 ohm, 5%, 1/2W	451-251222
	TRANSISTORS	
Q1, 2, 3, 4, 5, 6, 8	2N1274	112-000123
Q7	2N398A	112-000124
	DIODES	
CR1, 2, 3, 4, 5, 6, 7, 10	1N295	019-301980
CR8, 9	1N294	019-002736
	TRANSFORMERS	
T1	Power	052-000893
T2	Tone Oscillator	055-000461
SW1	Rotary (4 Position) (FUNCTION)	060-002337
SW2A,B	Slide DPST (Range)	060-100229

SERVICE REPAIR PARTS LIST (CONT.)

Schematic Symbol	Description	Hallicrafters Part Number
	MISCELLANEOUS	
	Cabinet	066-003169
	Cabinet Cover	066-003145
CH1	Choke, RF (33 UH)	053-000626
	Foot, Rubber	016-200980
F1	Fuse w/pigtail (1/2 Amp. 3AG)	039-000651
	Knob, SPEED, VOLUME, and FUNCTION	015-001729
	Line Cord	087-100078
	Line Cord Lock	076-200397
	Speaker	085-000213

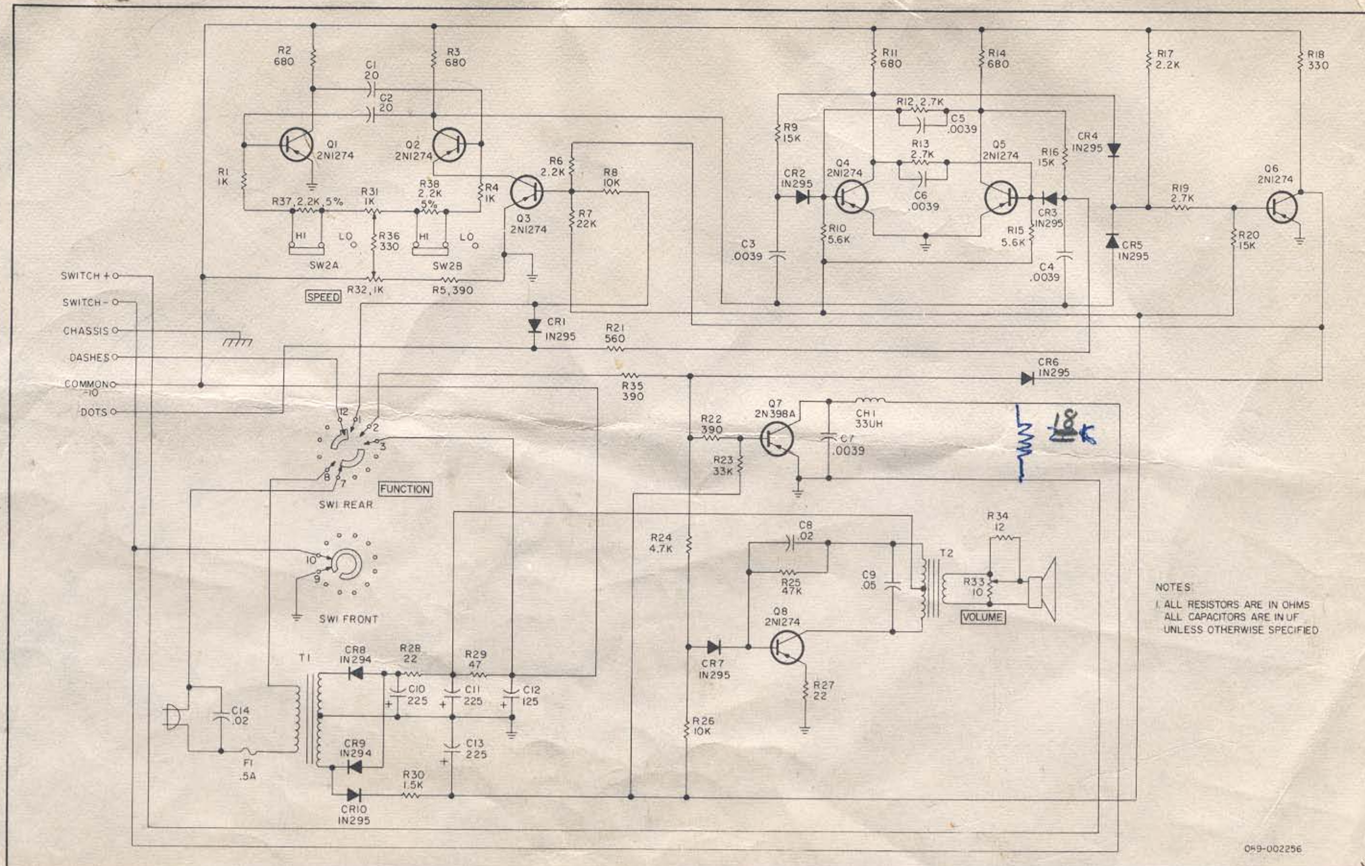

Figure 6. Schematic Diagram.

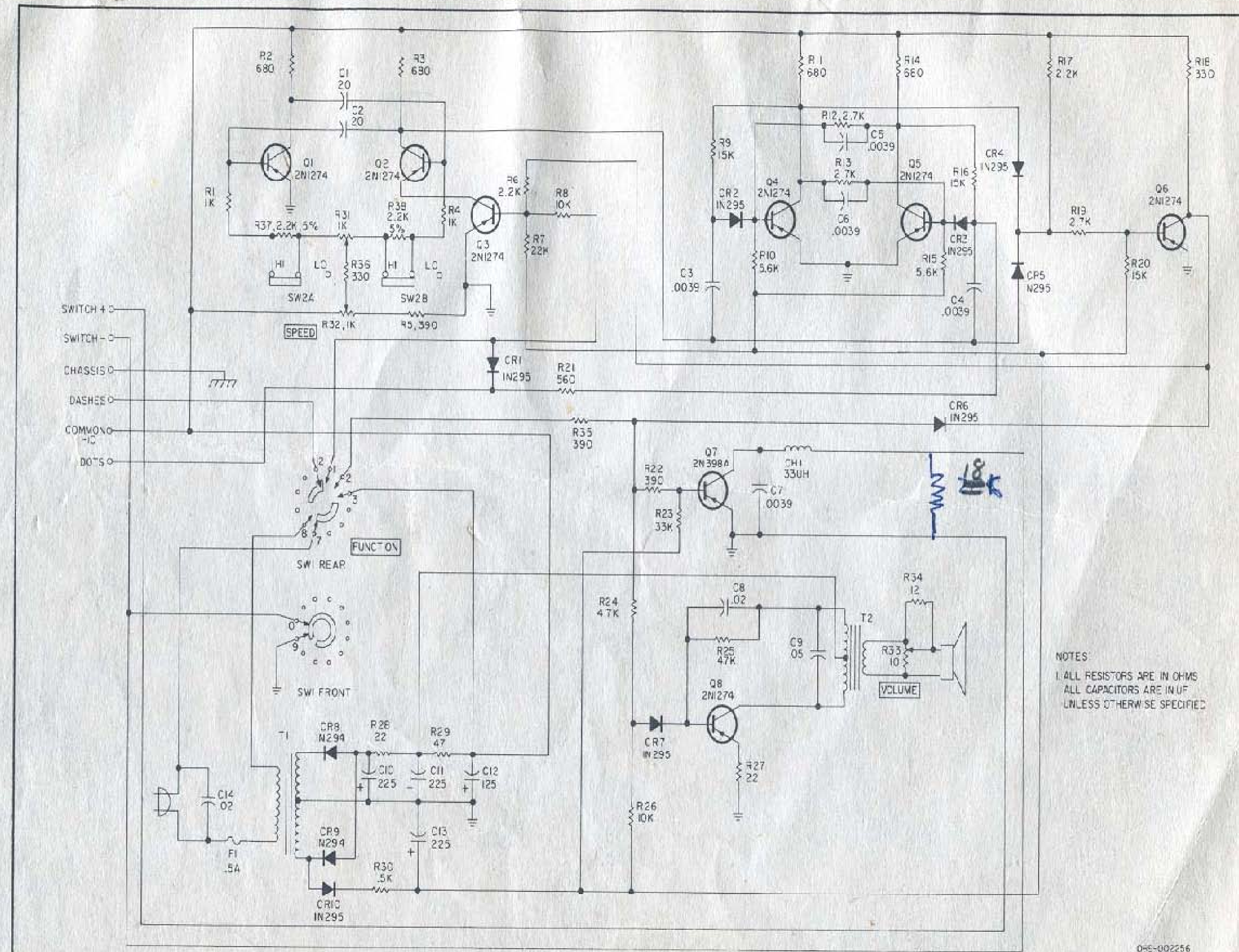

Figure 6. Schematic Diagram.

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 extend 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.

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