

service instructions

4.1 PREPARATION FOR SERVICING

4.1.1 General

Included in this section are signal tracing procedures, alignment and adjustment procedures, voltage and resistance measurements, and replacement procedures. If any soldered parts are removed or replaced at terminals to which any diode or transistor is connected, be sure to attach an alligator clip to the diode or transistor lead. This clip acts as a heat sink to protect the diode or transistor.

Internally generated spurious signals may result from improper placement of certain components and rf leads in the hf oscillator, 17.5-MHz oscillator, and mixer compartments. Maintain proper lead dress and component place-

ment when probing in these compartments. Except for the vfo alignment (paragraph 4.4.14), it is recommended that servicing of the vfo should be performed only by authorized service agencies.

4.1.2 Chassis Removal From Cabinet

a. Disconnect the power plug and all connections to the rear panel jacks.

b. Lift the lid, and remove the two flat screws located at the front edge of the cabinet. (Do not remove the two outer screws.)

c. Remove the four mounting feet and the screw between the rear feet from the bottom of the receiver. (On the 51S-1B, remove the five screws from the bottom of the receiver.)

Table 4-1. Receiver Signal Levels

TEST POINT	TEST POINT FREQUENCY	SIGNAL LEVEL	REFERENCE
J8	1000 Hz	0.22 volt	1-watt af output
V12-1	1000 Hz	6.0 volts	1-watt af output
V14-2	1000 Hz	0.2 volt	1-watt af output
V13-1	1000 Hz	0.45 volt	10 milliwatts in 600 ohms
V14-7	1000 Hz	0.18 volt	10 milliwatts in 600 ohms
Above measurements with ac vtvm from test point to ground, and audio oscillator connected at test point.			
V8-1	500 kHz	35,000 microvolts	1-watt af output
V7-1	500 kHz	5000 microvolts	Agc threshold
V6-2	500 kHz	15,000 microvolts	Agc threshold
V5-1	500 kHz	450 microvolts	Agc threshold
V4-2	*2.9 MHz	200 microvolts	Agc threshold
V2-9	*6.1 MHz	30 microvolts	Agc threshold
V2-9	**14.1 MHz	100 microvolts	Agc threshold
V3-9	*14.6 MHz	100 microvolts	Agc threshold
For following measurements, signal generator and 51S-1 must be tuned to same frequency.			
V1-1	14.1 MHz	4.0 microvolts	Agc threshold
V1-1	6.1 MHz	1.5 microvolts	Agc threshold
J1	14.1 MHz	1.5 microvolts	Agc threshold
J1	6.1 MHz	0.5 microvolts	Agc threshold
*Radio tuned to 6.1 MHz			
**Radio tuned to 14.1 MHz			

d. From the rear, push the receiver chassis forward until the front panel protrudes from the cabinet about an inch.

e. Grasp the front panel at the edges, and slide the chassis out of the cabinet.

4.1.3 Chassis Removal From Rack Mount

a. Disconnect the power plug and all connections to the rear panel jacks.

b. Remove the two inner screws located on the top bracket immediately behind the mounting panel.

c. Remove the five screws that secure the chassis to the shelf of the rack mount.

d. Push the receiver chassis forward until the front panel protrudes about one inch beyond the style frame.

e. Grasp the front panel at the edges, and slide the chassis out of the rack mount.

4.2 RECEIVER SIGNAL TRACING

Table 4-1 lists significant test points and normal signal levels. All rf and if. measurements up to V8-1 are made on USB as follows: A signal generator with calibrated output attenuator is connected at the listed test point. A vacuum-tube voltmeter is connected to the agc bus. Signal generator output is increased until the read-

ing on the vtvm just starts to increase (agc threshold). The level indicated on the output attenuator at this point is the signal level listed in the table. The signal generator is tuned to the frequencies listed in TEST POINT FREQUENCY column. Signal voltage at V7-1 and all following are measured with agc threshold as reference level. Local audio signal levels are measured with 1-watt audio output as reference. Line audio signal levels are measured with 10 milliwatts into a 600-ohm balanced line terminated with a 600-ohm balanced load. All values are nominal and may vary ± 20 percent.

4.3 VOLTAGE AND RESISTANCE MEASUREMENTS

4.3.1 Vacuum Tube Measurements

Table 4-2 lists voltage and resistance measurements for all tube sockets of the 51S-1 except those of vfo tube V15. Do not open the vfo oscillator can. Ac voltages shown in table 4-2 apply to 51S-1/1F/1B. These are dc voltages for 51S-1A/1AF. Measurements are made under the following conditions:

a. All measurements are made with a vtvm and with all tubes in sockets. All measurements are made with RF GAIN at maximum

Table 4-2. Voltage and Resistance Measurements

TUBE	PIN NUMBER									
		1	2	3	4	5	6	7	8	9
V1	Dc volt	1.2	0	0	0	145	75	0		
	Ac volt				6.3					
	Ohms	11 megohm	0	0	0	10K	10K	0		
V2	Dc volt	164	-7	158	0	0	158	0	4.3	0
	Ac volt				19.5	12.8			*1.5	
	Ohms	8500	470K	9500	0	0	8500	0	1000	270K
V3	Dc volt ^b	160	-6.2	105	0	0	165	0	4.3	0
	Ac volt				19.5	12.9			*1.5	
	Ohms	8500	100K	60K	0	0	8500	5	1000	35
V4	Dc volt	-1.2	0	165	0	0	165	4.3	-0.32	-1.5
	Ac volt				6.4	12.5		*0.7		
	Ohms	250K	35	8500	0	0	8500	1000	5000	250K
V5	Dc volt	-1.2	0			162	168	5.4		
	Ac volt				6.4					
	Ohms	500K	0	0	0	8500	8500	320		

Table 4-2. Voltage and Resistance Measurements (Cont)

TUBE	PIN NUMBER									
		1	2	3	4	5	6	7	8	9
V6	Dc volt Ac volt Ohms	167 8500	0 0	0.25 680	0 25.5 0	0 25.5 0	167 8500	0.22 **300K	0.25 680	0 19.5 0
V7	Dc volt Ac volt Ohms	-1.2 390K	0 0	0 0	6.4 0	155 8500	70 18K	0.13 20		
V8	Dc volt Ac volt Ohms	-1.0 900K	0 0	0 19.5 9	0 13 0	162 8500	67 19K	0 0		
V9	Dc volt Ac volt Ohms	0 100K	0 0	25.6 0	19.5 0	140 8500	140 8500	1.6 76		
V10	Dc volt ^c Ac volt Ohms	140 8500	-10 100K	140 8500	13 0	19.5 0	145 8500	5	2.2 *1.4 220	0 0
V11	Dc volt Ac volt Ohms	13 0	3.3 1000	0 5	155 11.2K	0 0	155 11.2K	0 360K	3.1 1000	6.8 0
V12	Dc volt Ac volt Ohms	-12.3 240K	1.6 0	19.5 0	25.8 0	155 8000	146 12K	-12.3 240K		
V13	Dc volt Ac volt Ohms	-8.2 475K	0 0	19.5 0	13 0	153 8500	153 8500	0 0		
V14	Dc volt Ac volt Ohms	106 100K	0 a	0.96 2200	6.8 0	6.8 0	85 460K	a	7000	0
V15	Dc volt Ac volt Ohms	VFO TUBE -- MAKE NO ATTEMPT TO MEASURE -- THIS WOULD REQUIRE OPENING VFO CAN								
V16	Dc volt Ac volt Ohms	135 8500	-72 1 megohm	72 100K	6.8 0	13.2 0	118 115K	0 0	2.5 270	0 *1.4 0
V17	Dc volt Ac volt Ohms	-2.3 1 megohm	0 0	12.0 0	6.2 0	72 3.0 70K	50 150K	0 0		
* Oscillator injection voltage measured with vtm and rf probe. May vary from band to band. ** With Q-multiplier turned off. ^a Varies with AF GAIN setting. ^b 2 to 6 MHz only. ^c 0.2- and 1-M Hz bands only.										

(fully clockwise) setting. All voltage measurements are made with power applied and OFF-STBY-ON-CAL in ON position except for measurements of calibration oscillator V16B. Voltage measurements of V17, bfo, are made with EMISSION switch in USB, LSB, or CW position.

b. Resistances of less than 0.9 ohm are listed as zero. All resistance measurements are made with power plug P10 removed from J10, and EMISSION switch in USB position.

c. All measurements are made from tube socket pin to ground.

d. All measurements are nominal and may vary $\pm 10\%$.

4.3.2 Transistor Measurements

Make dc voltage measurements for transistor Q1 with a vtvm. Apply primary power to the receiver and set OFF-STBY-ON-CAL switch to ON. Operating voltages for Q1 should be as follows:

- Emitter to ground, +1.95 volts dc.
- Base to ground, +2.05 volts dc.
- Collector to ground, +16.5 volts dc.

All measurements are nominal and may vary by ± 10 percent.

4.4 ALIGNMENT

Refer to figures 4-1 and 4-2 for adjustment points. For alignment of T9, T11, T12, T13, T1, T2, T3, T14, T15, T7, use Walsco #2543 or General Cement #8282 alignment tool.

4.4.1 100-kHz Calibrator Adjustment

- Tune in Radio Station WWV or WWVH on a convenient frequency, 2.5, 5, 10, 15, 20, or 25 MHz.
- Move the EMISSION switch to AM position.

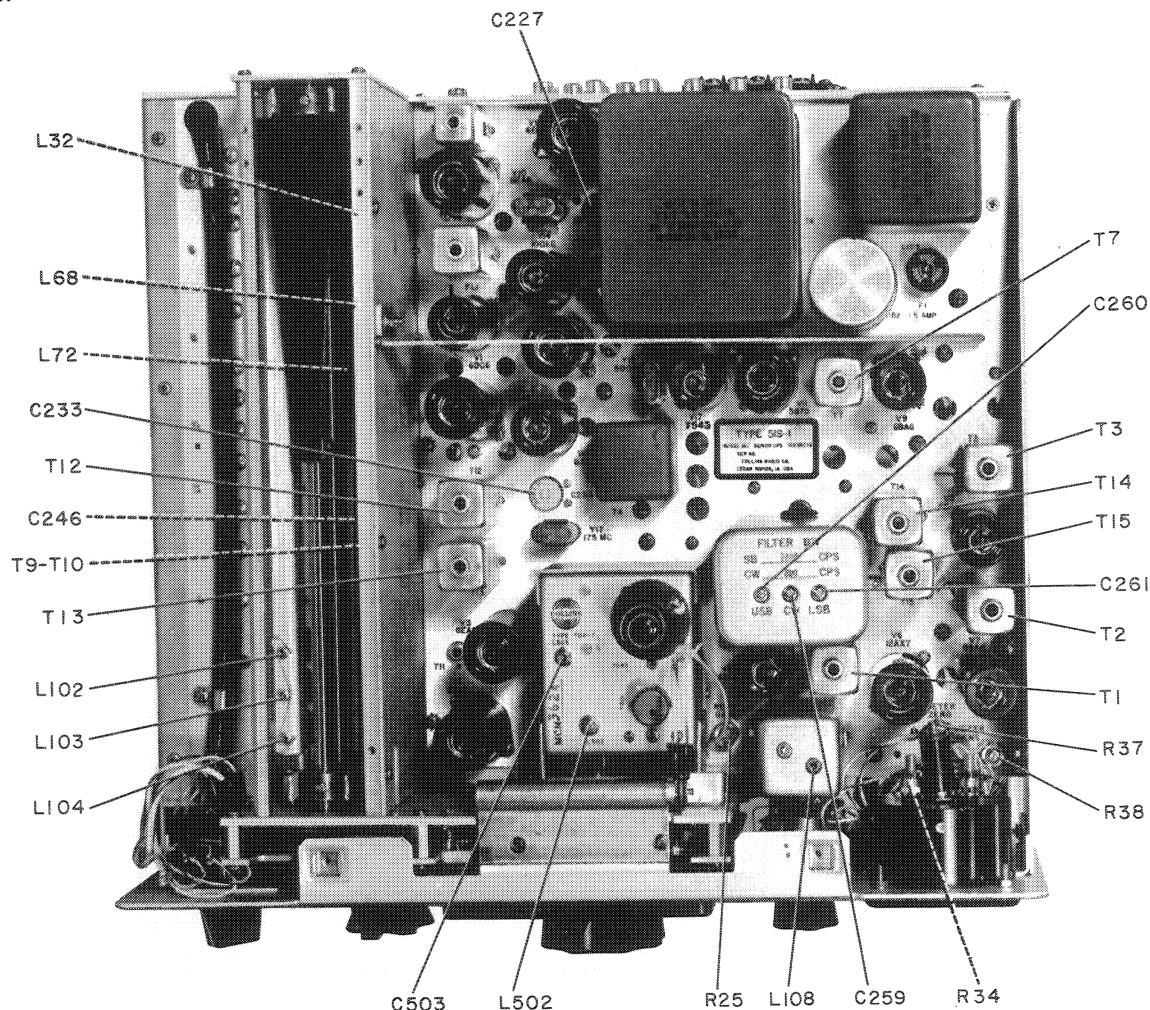


Figure 4-1. Top Chassis, Alignment and Adjustment Locations

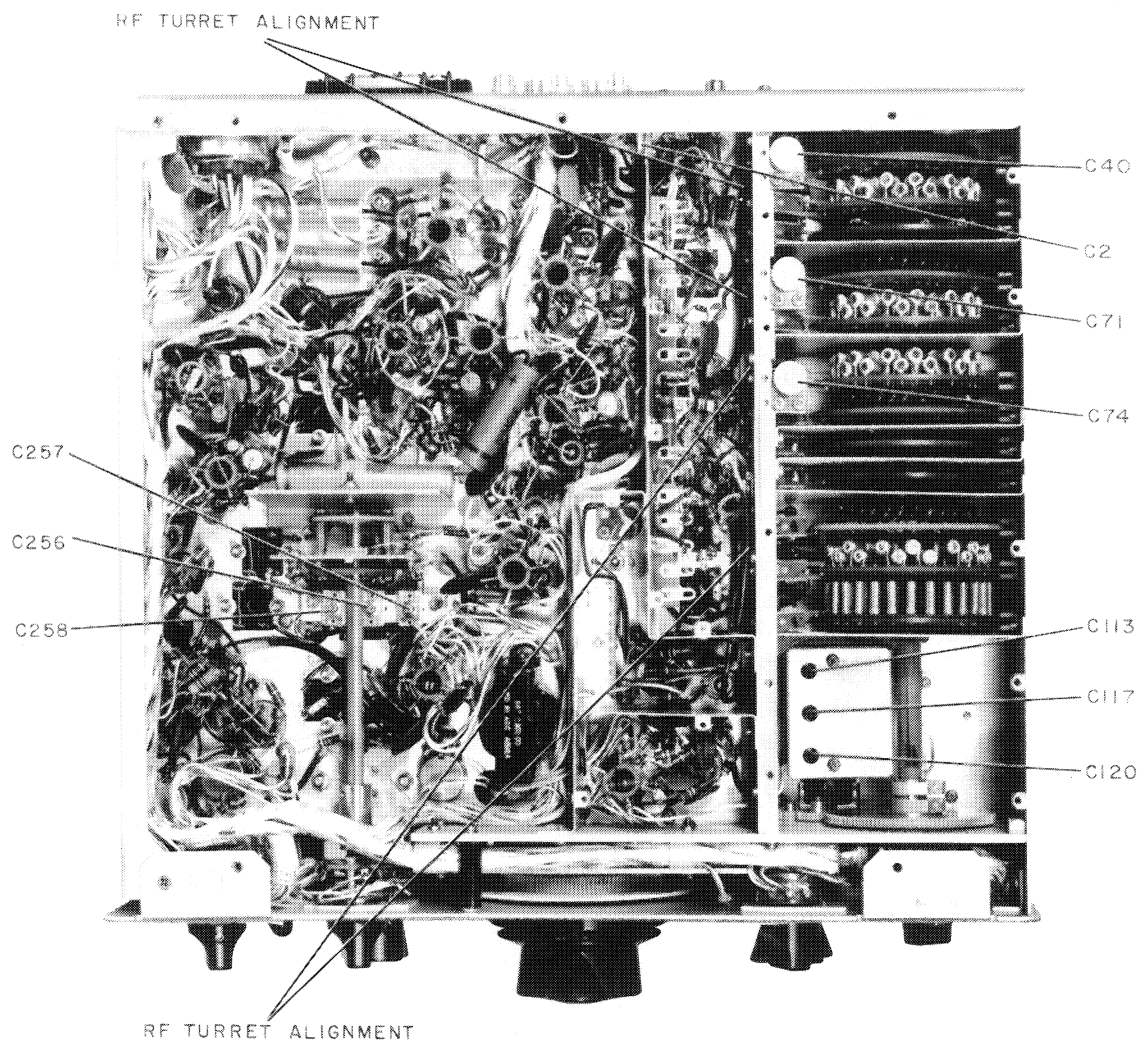


Figure 4-2. Bottom Chassis, Alignment and Adjustment Locations

c. Move the OFF-STBY-ON-CAL switch to CAL position.

d. Adjust C227, CAL ZERO, capacitor near the rear of the chassis to zero beat.

Note

Be careful not to zero beat one of the tone sidebands. Wait for the tone modulation of WWV or WWVH to go off before zeroing the calibrator.

4.4.2 RF Meter Zeroing

a. Set RF GAIN control, located on the front panel, to maximum (fully clockwise).

b. Move the meter switch to RF position.

c. Tune the 51S-1 to a clear, noise-free frequency and adjust R37, METER ZERO, to obtain an indication of 0 on the rf meter.

4.4.3 IF Alignment

- a. Connect a signal generator to the standoff side of R20 (the 33-ohm resistor that connects to pin 2 of V4).
- b. Set the 51S-1 EMISSION switch to LSB.
- c. Tune the signal generator around 500 kHz to zero beat in the 51S-1. Make sure that the 51S-1 vfo is tuned to a frequency which does not produce spurious signals in the output of the 51S-1.

Note

If receiver is equipped with optional 6-kHz mechanical filter in place of 5-kHz AM/IF transformer, skip the adjustment of T14 and T15 in step d, and skip steps f and g entirely.

- d. Set the EMISSION SWITCH TO AM. Peak transformers T1, T2, T7, T14, and T15 for maximum indication on the 51S-1 rf meter, adjusting the signal generator output for a consistent 20-db reading (as monitored on the 51S-1 rf meter).
- e. Turn on the signal generator modulation, and peak T3 for maximum audio output. Turn off modulation.
- f. Place swamping tools, composed of a 0.01-uf capacitor in series with a 1000-ohm resistor, across terminals 1 and 2 of transformers T14 and T15 (see figure 4-3 for terminal identification). Tune the top slugs of T14 and T15 for maximum reading on the

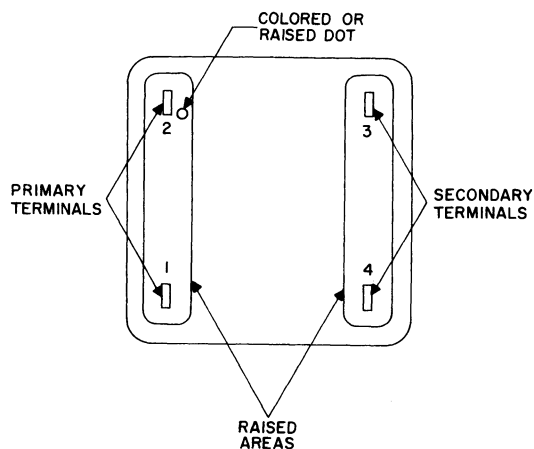


Figure 4-3. RF and IF Transformer Terminal Identification

51S-1 rf meter, again varying the signal generator output level for a consistent 20-db reading.

g. Move the swamping tools to terminals 3 and 4 of transformers T14 and T15. Tune the bottom slugs of T14 and T15 for maximum reading on the 51S-1 rf meter, again varying the signal generator output level for a consistent 20-db reading. Remove the swamping tools.

h. Set the 51S-1 EMISSION switch to USB and adjust the signal generator frequency to 502.500 kHz. A note of 2500 Hz should be heard at the 51S-1 output.

i. Connect a swamping tool, identical to that used above, across terminals 1 and 2 (primary) of T1.

Note

Keep the signal generator output level below that required for agc threshold during T1 and T2 tune up.

j. Peak the top slug of T1 (secondary) for maximum audio output. Move swamping tool to terminals 1 and 2 (primary) of T2 and repeat tuning procedure. Remove swamping tool.

k. Set 51S-1 EMISSION switch to LSB and adjust the signal generator frequency to 497.500 kHz. A note of 2500 Hz should be heard at the 51S-1 output.

l. Connect a swamping tool, identical to that used above, across terminals 3 and 4 of transformer T1. Peak the bottom slug of T1 for maximum audio output.

m. Move swamping tool to terminals 3 and 4 of T2 and repeat the tuning procedure (step l). Remove swamping tool.

n. Tune signal generator for a 1500-Hz beat note. Adjust trimmers C258 and C261 for maximum meter indication.

o. Repeat the above step (step n) with the 51S-1 EMISSION switch in the USB position,

except adjust trimmers C257 and C260 instead of C258 and C261.

p. Set the 51S-1 EMISSION switch to CW and tune signal generator for a peak in rf meter reading. Adjust C256 and C259 for maximum 51S-1 rf meter indication.

4.4.4 3- to 2-MHz Variable IF Alignment

Note

When adjusting C113, an insulated or non-metallic screwdriver should be used to prevent the shorting to ground of the +150 volts present on the capacitor adjustment shaft.

- a. Set the MEGACYCLES control of the 51S-1 to 4 MHz and the EMISSION switch to AM.
- b. Connect a signal generator to pin 9 of V3.
- c. Tune the 51S-1 to 4.9 MHz.
- d. Tune the signal generator to 2.1 MHz, the 51S-1 variable if. frequency.
- e. Set C113, C117, and C120 to half capacity. See figure 4-4.
- f. Adjust L102, L103, and L104 for an indication of maximum on the rf meter. The meter switch should be in the RF position during this operation. Keep the signal generator output level adjusted to obtain an indication of 20 db.
- g. Tune the 51S-1 to 4.1 MHz and the signal generator to 2.9 MHz.
- h. Adjust C113, C117, and C120 for an indication of maximum on the rf meter of the 51S-1. Maintain an indication of 20 db on the rf meter by adjusting the signal generator output level.
- i. Repeat steps c, d, f, g, and h until no increase in rf meter reading can be obtained at either the 4.1- or 4.9-MHz setting.

4.4.5 14.5- to 15.5-MHz Bandpass Alignment

- a. Connect a signal generator to pin 9 of V2.
- b. Set the frequency of the signal generator to exactly 15 MHz.
- c. Tune in the signal on the 51S-1 by setting the tuning dial to 4.5 MHz.

d. Connect a swamping tool, consisting of a 0.01-uf capacitor in series with a 1000-ohm resistor, across each of the primary windings of T12 and T13.

e. Adjust the top slugs, which are associated with the secondary windings, of T12 and T13 for an indication of maximum on the rf meter of the 51S-1. Keep the signal generator output level adjusted for an indication of 20 db on the rf meter.

f. Remove the swamping tools from the primary windings, and place one across each of the secondary windings of T12 and T13.

g. Adjust the bottom slugs, which are associated with the primary windings, of T12 and T13 for an indication of maximum on the rf meter of the 51S-1. Keep the signal generator output level adjusted for an indication of 20 db on the rf meter.

4.4.6 RF Alignment

- a. Remove the turret shield on the bottom of the 51S-1.
- b. Turn the MEGACYCLES control to 29- to 30-MHz range, and tune the 51S-1 to 29.000 MHz. Move the EMISSION switch to AM position.
- c. Set the main tuning slugs, L32, L68, and L72, to 0.794 m (5/16 inch) less than full insertion into the coils as measured from bottom of coil forms.
- d. Set the main trimmer capacitors, C40, C71, and C74, to 1/2 capacity. See figures 4-1 and 4-4.
- e. Connect a signal generator to ANT, J1, on the rear of the 51S-1. Connect a vtm to the 600Ω UNBAL jack, J11, on rear apron.
- f. With the signal generator modulation turned on, tune the signal generator until a 29-MHz signal is heard on the 51S-1.

Note

Throughout rf alignment, keep the output level of the signal generator adjusted to the minimum level that will produce a discernible audio signal at the output of the 51S-1; this level must be below agc threshold as indicated by zero reading on rf meter.

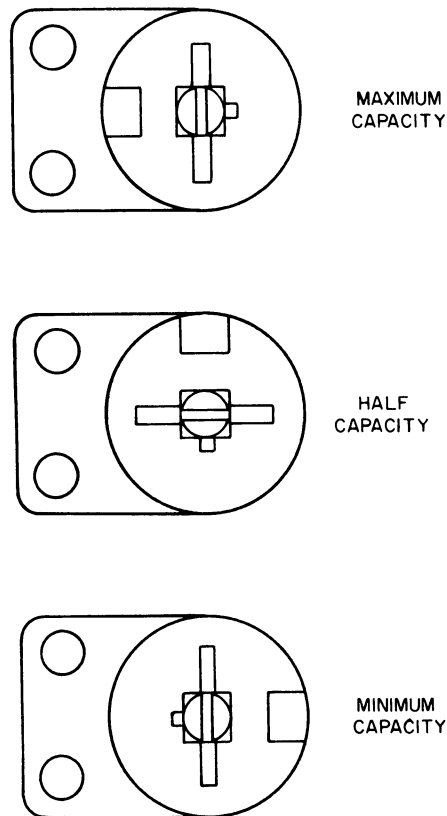


Figure 4-4. Trimmer Capacitor Settings

g. Insert the tuning tool through the slots in the turret side shield, and tune the slugs of the appropriate turret-mounted coils for maximum 51S-1 audio output.

h. Tune the 51S-1 and the signal generator to 29.9 MHz, and tune the main rf trimmer capacitors, C40, C71, and C74, for maximum 51S-1 audio output on vtm.

i. Tune the 51S-1 and the signal generator to 29 MHz on the 29- to 30-MHz band, and repeat step g above.

j. Move the MEGACYCLES control of the 51S-1 to the 2.0- to 3.0-MHz band, and tune to 2.0 MHz.

k. Tune the signal generator so as to receive a 2.0-MHz signal on the 51S-1.

l. Place swamping tool across first rf tuned circuit to ground. Adjust 2.0-MHz turret coils L39 and L74 for maximum audio output from the 51S-1.

m. Remove swamping tool and place across second rf tuned circuit to ground. Adjust L2 for maximum audio output from the 51S-1.

n. Tune the 51S-1 and signal generator to 2.9 MHz and adjust slug in L32 for maximum output from the 51S-1.

o. Remove swamping tool and place across first tuned circuit to ground. Adjust slugs in L68 and L72 for maximum output on the 51S-1.

p. Recheck 2.0 MHz and touch up alignment if necessary. The swamping tool must be used on the opposite front end rf stage from the one that is being tuned.

q. All the other bands are aligned by peaking the appropriate turret coil slugs at the low frequency end of the band. The 3.0-, 4.0-, and 5.0-MHz coils must be tuned using the swamping tool. The swamping tool is not needed on the 6- to 29-MHz bands.

r. Repeat for all bands up to and including 29 MHz.

4.4.7 Megahertz Oscillator Alignment

a. Connect the rf probe of a vtm to pin 8 of V2, and ground the vtm to the chassis of the 51S-1.

b. Set the MEGACYCLES control of the 51S-1 to the 6- to 7-MHz band.

c. Tune the slug of T9 for maximum rf voltage as indicated on the vtm. The slug of T9 is the slug farther from the chassis in the T9-T10 assembly.

d. Set the MEGACYCLES control of the 51S-1 to the 14- to 15-MHz band.

e. Tune the slug of T10 for maximum rf voltage as indicated on the vtvm. The slug of T10 is the slug closer to the chassis in the T9-T10 assembly.

f. Set the MEGACYCLES control of the 51S-1 to the 29- to 30-MHz band.

g. Tune trimmer C246 for maximum rf voltage as indicated on the vtvm.

h. Repeat steps b through g above.

4.4.8 17.5-MHz Oscillator Alignment

a. Connect a vtvm with rf probe to pin 8 of V3.

b. Set the MEGACYCLES control of the 51S-1 to the 4.0- to 5.0-MHz band.

c. Adjust T11 for 1.5 volts indicated on the vtvm.

d. Loosely couple a carefully calibrated receiver to the shield of V3.

e. Tune the calibrated receiver to 17.5 MHz, and turn on the 100-kHz calibration oscillator of the calibrated receiver.

f. Adjust C233 of the 51S-1 for zero beat as indicated on the calibrated receiver.

4.4.9 LF Oscillator Alignment

a. Set the MEGACYCLES selector on the 51S-1 to the 1.0- to 2.0-MHz band.

b. Connect a vtvm probe to pin 8 of V10.

c. Tune the slug of T16 for maximum rf voltage.

d. Couple a pickup loop around V10 and connect to a calibrated receiver.

e. Tune the calibrated receiver to 28.0 MHz and turn on the calibration oscillator of the calibrated receiver.

f. Adjust C2 of the 51S-1 for a zero beat in the calibrated receiver.

4.4.10 Megahertz Injection Frequency Adjustment

Note

Be sure the 51S-1 vfo is aligned properly before attempting to adjust the megahertz injection frequency. See paragraph 4.4.13 for vfo alignment.

a. Set the MEGACYCLES control of the 51S-1 to the 2.0- to 3.0-MHz band.

b. Couple a pickup loop around V15. Connect the pickup loop leads to a carefully calibrated receiver.

c. Tune the calibrated receiver to 3.5 MHz. Switch on the 100-kHz crystal calibrator of the calibrated receiver. With the tuning knob on the front of the 51S-1, tune for zero beat between the vfo of the 51S-1 and the crystal calibrator of the calibrated receiver. (The 51S-1 dial will be very near the low end of the band.)

d. Set the hairline of the 51S-1 to read zero on the kilohertz scale.

e. Turn off the calibrated receiver.

f. Move the OFF-STBY-ON-CAL switch of the 51S-1 to CAL position.

g. Set the EMISSION switch of the 51S-1 to USB position.

h. Insert the tuning tool through the slot in the turret side shield, and tune the appropriate turret-mounted, trimmer capacitor for zero beat as heard on the 51S-1.

i. Move the MEGACYCLES switch to the next higher band.

Note

Be careful not to disturb the tuning knob which was set in steps b, c, and d above.

j. Repeat steps h and i above until all bands above 2.0 MHz are aligned.

4.4.11 Receiver Gain Adjustment

- Connect a signal generator to J1, ANT, on the rear of the 51S-1 as shown in figure 4.5.
- Tune the signal generator and 51S-1 to 14.5 MHz.
- Set the EMISSION switch on the 51S-1 to LSB position.
- Set the RF GAIN control of the 51S-1 fully clockwise.
- Set the output level of the signal generator to 15 microvolts (1.5 microvolts at the junction of resistors R1 and R2 of test setup). Adjust receiver tuning for a beat note of approximately 1000 Hz.
- Connect a dc vtvm to the age line of the 51S-1.
- Adjust R25, RCVR GAIN, to the setting where the voltmeter indication starts to in-

crease from a steady reading. This is the age threshold.

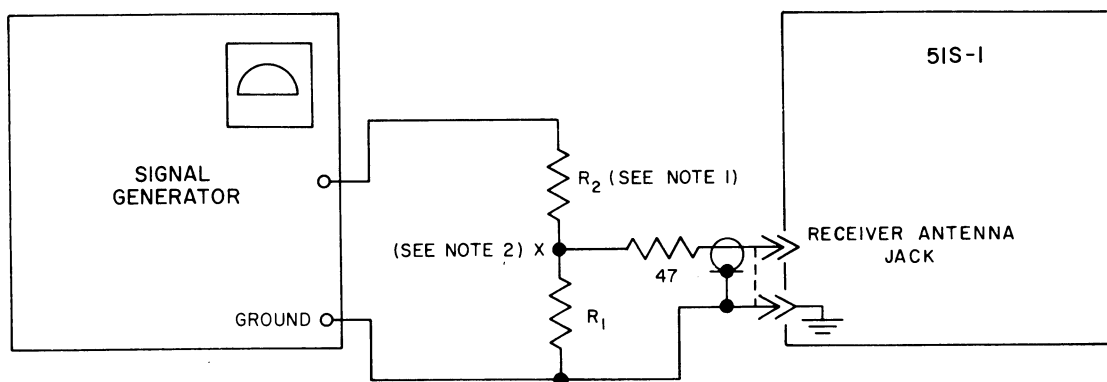
h. Repeat paragraph 4.4.2.

4.4.12 RF Meter Calibration

- Perform the alignment procedure of paragraph 4.4.11.
- Tune the signal generator and 51S-1 to 14.5 MHz. Set signal generator output to 1000 microvolts (100 microvolts at the junction of R1 and R2 of test setup).
- Set the meter switch of the 51S-1 in the RF position.
- Adjust R38, METER SENS, to obtain 40 db indicated on the rf meter of the 51S-1.

4.4.13 Q-Multiplier Alignment

- Tune the OFF-STBY-ON-CAL switch to CAL position.
- Set the EMISSION switch to USB position.
- Tune to zero beat with the calibrator signal at 6.5 MHz.



NOTES:

- R₁ MUST BE 5 OHMS OR LESS; R₂ MUST BE 9 TIMES R₁. THIS FORMS A 10:1 VOLTAGE DIVIDER (20DB PAD). R₁ + R₂ MUST EQUAL PROPER TERMINATION FOR SIGNAL GENERATOR USED. EXAMPLE: FOR HP606A, R₁ + R₂ = 50 OHMS.
- WITH THIS TERMINATION (20DB PAD), SIGNAL GENERATOR OUTPUT READS 10 TIMES ACTUAL OUTPUT AT "X".

C712-25-3

Figure 4-5. Receiver Gain Adjustment Test Setup

- d. Set the EMISSION switch to AM position.
- e. Turn the REJECTION TUNING on the front of the 51S-1 to the center calibration mark.
- f. Set the meter switch to RF position.
- g. Adjust L108 and R34 to obtain the lowest reading on the rf meter.

4.4.14 VFO Alignment

Vfo aging may cause a tuning dial calibration error of the same amount in the same direction for both 0 and 1000. To adjust for this condition, proceed as follows:

- a. Set the hairline to zero with the ZERO SET knob.
- b. Turn the EMISSION switch to LSB.
- c. Turn the OFF-ON-STBY-CAL switch to CAL.
- d. Set the receiver dial frequency at 7.200 MHz.
- e. Locate the vfo shaft collar (just forward of L502). Loosen the pair of setscrews nearest the gear plate on the vfo shaft collar.
- f. Align the 0 on the kHz dial with the hairline and lock the tuning control.
- g. Manually twist the vfo shaft and collar until a zero beat is heard.
- h. Tighten the setscrews. If the setscrews are no longer accessible, mark the collar and the tuning control shaft and move both together until each setscrew is accessible.
- i. Check calibration at 0 and 1000.

If the tuning dial does not calibrate at 0 and 1000 ± 0.750 kHz without resetting the hairline, the error usually can be compensated with trimmer inductor L502. Proceed as follows:

- a. Make sure the 51S-1 calibration oscillator has been aligned to Station WWV or WWVH.

Tune the calibrate signal to zero beat at 1000 on the dial.

- b. Set the hairline to zero with the ZERO SET knob.
- c. Tune the 51S-1 to zero beat at the low end of the band (near 0 on the dial).
- d. Note the dial error in kilohertz.
- e. Multiply the dial error frequency noted in step d above by 1.5. Add the dial error to 1.5 times the dial error, and move the dial this compensating amount (passing through zero). For example, if the dial reading noted in step d is 1.0 kHz, 1.0 kHz plus 1.5 kHz equals 2.5 kHz. The dial reading 2.5 kHz lower is 98.5. Conversely, if the step d reading is 99, the compensation point is 2.5 kHz higher, or 001.5.
- f. Leave the dial set as above, and adjust inductor L502 to zero beat with the calibration signal.

- g. Repeat steps a through f until no error is present at end points.

4.5 MEGACYCLES DRIVE CHAIN REPLACEMENT

Refer to figures 4-6 and 6-6. Figure 4-6 shows the MEGACYCLES dial drive chain properly strung over MEGACYCLES band-switch drive sprocket, idlers, and counter dial drive sprocket. Figure 6-6 shows an exploded view of the complete mechanical band-switching and tuning mechanism.

- a. Remove 51S-1 from cabinet. Turn 51S-1 on its side, and remove bottom shield plate from turret. Using a flashlight, locate the turret wafer printed circuit pad having a single round nib. Turn the MEGACYCLES control until this single-nibbed pad of each wafer is connected to the fixed turret contacts. This places the receiver in the 2.0- to 3.0-MHz position.
- b. Remove the large tuning knob, the MEGACYCLES knob, and the ZERO SET knob from

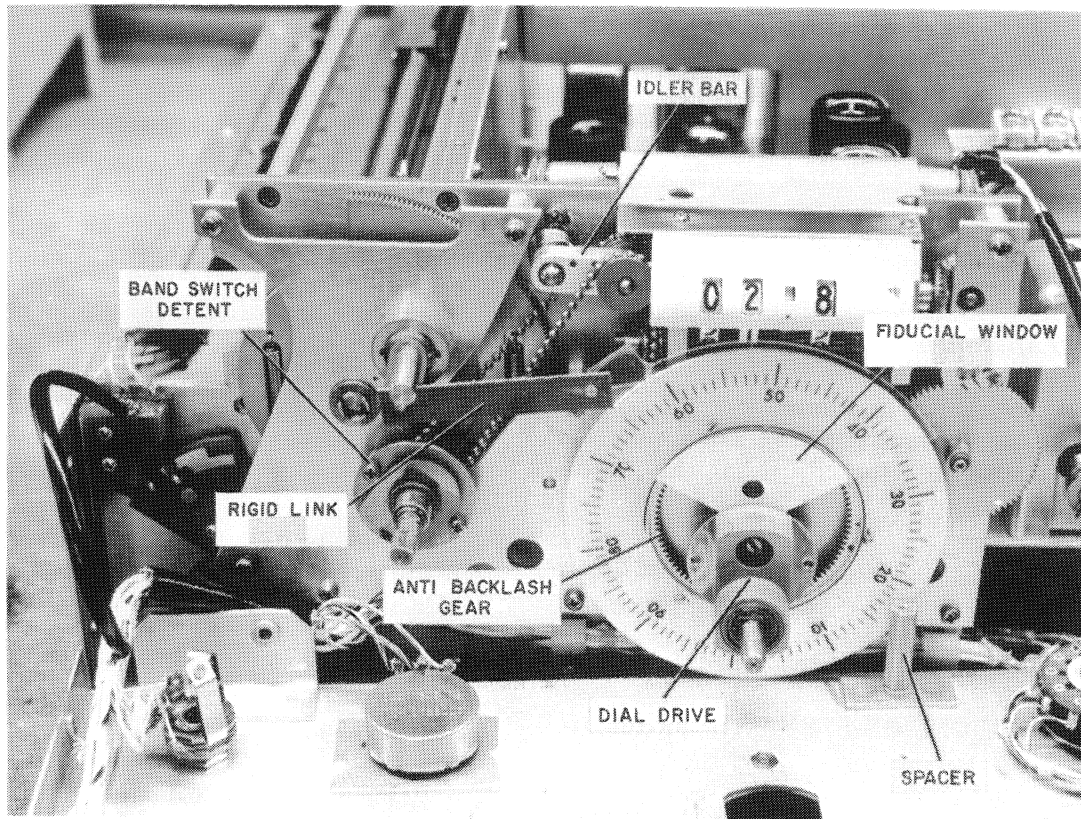


Figure 4-6. Band Indicator Bead Chain Stringing

their shafts. Remove the two small screws on either side of the tuning shaft. Loosen the coupling on the EMISSION switch shaft behind the detent plate and the first wafer. Remove the screw which secures the front gear plate to the panel, leaving the spacer fastened to the panel as shown in figure 4-6. At the front edge of each chassis side apron, remove the two screws which secure the front panel brackets to the side aprons. Remove the screw that secures the cable protecting rail to the front panel bottom bracket, and swing the rail aside. Move the panel out and down, taking care not to break any of the wiring between the back of the panel and the chassis. Remove zero set crank bar for easy access to the bead chain drive.

c. Remove the old bead chain. Remove the two screws holding the band-switch detent.

d. Thread the new chain over the MEGA-CYCLES drive sprocket and replace band-switch detent screws.

e. Press the idler bar downward, and thread the chain over the two idlers and under the counter drive sprocket. Release pressure on the idler bar. Idler bar should be horizontal after installation.

f. If the first two counter dials do not read 02., press the idler bar downward with one hand, and turn the counter dials manually with the other hand until the dials read 02. in the windows. Release pressure on the idler bar.

g. Replace panel, screws, knobs, and dust covers.

Note

If dial drive is removed, the antibacklash gear becomes unloaded. To preload, hold dial, and rotate front half of gear clockwise before meshing with drive pinion. Check to make sure EMISSION switch shaft grounding spring is under tension before tightening shaft coupler.

4.6 TURRET WAFER REPLACEMENT

If it is necessary to remove and replace turret wafers, refer to figure 6-6, and proceed as follows:

- a. Set MEGACYCLES control to 2 MHz. Remove the 51S-1 from its case, and stand the chassis on its side.
- b. Remove the turret bottom shield. Loosen the coupler clamp at the front end of the plastic turret shaft. This is the clamp farthest from the front panel. Do not loosen the clamp nearest the panel, or complete mechanical realignment will be necessary. This clamp is aligned at the factory.
- c. Grasp the shaft end near the coupler and push gently toward the rear. The shaft and its rear bearing should slide easily.

Caution

Take care that the shaft does not bind in any one of the turret wafers. Proceed carefully to move the shaft to the rear. Gently loosen any wafer which appears to be binding.

- d. Remove the defective wafer by withdrawing it straight out from the chassis.
- e. Grasp the replacement wafer edgewise with the thumb and forefinger placed across the wafer diameter, and insert it into the wafer guides. Be careful not to bind or twist the fixed turret contacts. Leave the wafer aligned so that its single-nibbed contact pad is in a row with those of the other turret wafers.

Caution

Do not touch the contact pads with the bare finger tips. Acids and oils normally present on the fingers will cause intermittent operation of the wafer pads and the turret contacts. Wear

clean rubber gloves, or handle as described in step e. If such an intermittent occurs, clean wafer with mild soap and warm water. Wipe dry with clean, lint-free cloth and replace.

- f. When the wafer or wafers have been replaced and coarsely aligned as to turret position, insert the shaft from the rear, and start it through the rear wafer. As the shaft is brought to the wafer each time, twist the shaft enough to align it with the wafer hole and move it through. Use caution not to place undue stresses on the wafers or their guides.

g. As the shaft proceeds through the turret wafers and the coupler end approaches the coupler, the bearing on the rear end of the shaft will be entering the rear chassis bearing. At this time, grasp the shaft bearing with the fingers of the right hand, and keep the wafers free as necessary with the left hand. Guide the end of the shaft into the coupler with the left hand. Turn the shaft slightly back and forth as necessary with the right hand until the key in the coupler aligns with the keyway in the shaft. Push together until the shaft bearing enters the rear chassis bearing. While pressing the shaft bearing with the fingers of the right hand, rock the MEGACYCLES control with the left hand until the shaft bearing is flush with the rear chassis bearing. Tighten the clamp on the shaft coupler.

- h. If two or more of the turret wafers are replaced at the same time, make sure all wafers are placed in the turret in proper order. Refer to figure 6-6. If new or repaired wafers are replaced in the turret, realign according to instructions of paragraph 4.4.6, 4.4.7, or 4.4.9.

Note

Wafers A2, A5, and A6 are identical in appearance as are A1, A4, and A7. However all turret wafers must be replaced in the exact position from which they were removed or complete realignment will be necessary. During removal, mark each wafer with pencil or tape, using care to keep all such foreign material off the circuit printing.

- i. Replace the turret bottom shield, and replace the 51S-1 in its cabinet.

4.7 LAMP REPLACEMENT

Dial lamp DS1 is removed from the light reflector by grasping the lamp base at the terminal end and pulling straight out. Slight movement of the lamp holder

toward the rear of the unit may be required to clear the retaining screw.

DS2 (meter lamp) is a built-in part of M1. Remove by grasping the lamp holder and pulling straight out until it snaps free.

section 5

specifications

5.1 51S-1/1A/1F/1AF/1B RECEIVER

The 51S-1/1A/1F/1AF/1B Receiver receives USB, LSB, AM, and CW signals in the range of 0.2 to 30.0 MHz. Coverage is continuous in thirty 1-megahertz bands. The model 51S-1 is mounted in a perforated wrap-around cabinet and equipped with an ac power supply capable of 115- or 230-volt, single-phase, 50- to 400-Hz operation. The 51S-1A is similar, except that it is fitted with a 28-volt dc transistorized power supply. The rack-mounted ac version is model 51S-1F (figure 5-1). The rack-mounted dc version is model 51S-1AF. The 51S-1B (figure 5-2) is similar to the 51S-1, but it has a rear-mounted junction box that provides military-type connectors for power, control, audio, and antenna lines (refer to figure 7-4 for schematic diagram).

5.2 REQUIREMENTS FOR OPERATION

The 51S-1 and 51S-1F Receivers require 115- or 230-volt, single-phase, 50- to 400-Hz power at approximately 125 watts. The 51S-1B requires 115-volt, single-phase, 50- to 400-Hz power at approximately 125 watts. The 51S-1A/1AF Receiver requires 28 volts dc at 4.5 amperes. The 51S-1/1A Receiver may be mounted on table or bench for fixed station operation, or may be mounted with a mounting plate similar to the 351E-4 on shelf, bench, or table in moving aircraft, ground vehicle, or boat. 51S-1/1F/1A/1AF Receivers require a 4- or 600-ohm speaker or headphones for local audio monitoring, but monitoring devices of any impedance may be matched with 600-ohm line-to-monitor transformers at remote locations up to several



TP4-5385-017

Figure 5-1. 51S-1F in Rack Mount, Overall View



51S-1B With 350D-5 Base Shockmount, Overall View
Figure 5-2

miles. Alternately, the 600-ohm line termination may be connected to telephone lines, or the 600-ohm local output may be used with a phone patch. The 51S-1B has the same local audio provisions as those described above, but the remote

audio line has a 150-ohm impedance (refer to figure 7-5). 51S-1 series receivers require an antenna with 50-ohm unbalanced feed; random length antennas may be used.

5.3 SPECIFICATIONS

Frequency range.....	0.2 to 30.0 megahertz in thirty 1-megahertz bands continuous coverage.
Modes.....	Upper sideband, lower sideband, AM or CW.
Power consumption.....	125 watts.
Type of service.....	Fixed station attended, or unattended, with provision for remote control of rf gain.
Rf input impedance	50 ohms, unbalanced.
500-kHz if. output at J9.....	50 mv minimum into 50-ohm load with 5-uv input signal.
Matching speaker impedance.....	4 or 600 ohms, unbalanced.

Balanced line output impedance.....	600 ohms balanced, center-tap ground reference or floating. (For 51S-1B, 150 ohms floating.)
Matching phone patch impedance (local).....	500 to 600 ohms.
Frequency stability.....	During temperature change from 0 to +50 °C, after 90 minutes warmup, audio output frequency will not vary more than ± 885 Hz for carrier frequencies from 2 to 7 MHz. From 7 MHz to 30 MHz, stability varies from 36 PPM ± 400 Hz at 7.00 MHz (652 Hz) to 27 PPM ± 400 Hz at 30 MHz (1210 Hz). For $\pm 10\%$ line voltage variation, frequency varies not more than ± 100 Hz.
Calibration accuracy.....	When zeroed to nearest 100 kHz calibration point, the frequency will be within ± 400 Hz.
Dial backlash.....	Not more than 150 Hz.
Audio-frequency response AM.....	100 to 2500 Hz ± 6 db (line channel). 200 to 2500 Hz ± 6 db (local channel).
SSB (high-frequency limit determined by filter bandwidth).....	350 to 3050 Hz ± 3.5 db (line channel). 350 to 3050 Hz ± 3.5 db (local channel).
Audio output distortion (SSB test signal 100-microvolt input, 1.0-watt local output, 1-mw (0 dbm) line output)	
Local.....	Not more than 10 percent.
Line.....	Not more than 3.0 percent.
Q-multiplier rejection notch depth.....	Not less than -40 dB.
Receiver sensitivity (nominal)	
AM.....	3.0 microvolts for not less than 10-db signal + noise/noise (2 to 30 MHz). 15.0 microvolts for not less than 10-db signal + noise/noise (0.5 to 2 MHz). 20.0 microvolts for not less than 10-db signal + noise/noise (0.2 to 0.5 MHz). With 55G-1 Preselector, 5.0 microvolts for not less than 10-db signal + noise/noise (0.2 to 2.0 MHz).

section 5
specifications

SSB and CW.....	0.6 microvolt for not less than 10-db carrier on carrier off (2 to 30 MHz).
	3.0 microvolts for not less than 10-db carrier on carrier off (0.5 to 2.0 MHz).
	4.0 microvolts for not less than 10-db carrier on carrier off (0.2 to 0.5 MHz).
	With 55G-1 Preselector, 1.0 microvolt for not less than 10-db carrier on carrier off (0.2 to 2.0 MHz).
Selectivity	
CW (at 6 db points).....	800 hertz bandwidth, nominal. (650 Hz minimum, 950 Hz maximum, 300-Hz maximum bandwidth optional).
SSB (at 3.5 db points).....	2.75 or 2.4 kHz bandwidth (3.1 kHz bandwidth optional).
AM (at 6 db points).....	5.0 kHz bandwidth minimum (6.0 kHz optional).
(at 60 db points).....	22.0 kilohertz bandwidth maximum.
Spurious responses (above 2 MHz)	
Internal spurious signals.....	Less than two microvolts equivalent signal.
Other spurious signals.....	Not less than 70 db down, except from 4.8 to 5.2 MHz, not less than 40 db down.
Image response.....	Not less than 50 db down from 2 to 25 MHz; not less than 40 db down from 25 to 30 MHz; referenced to midband.
Size.....	Cabinet version 196.85 mm (7.750 in) high by 374.65 mm (14.750 in) wide by 335.36 mm (13.203 in) deep. Rack-mounted version 221.44 mm (8.718 in) high by 482.60 mm (19.00 in) wide by 334.187 mm (13.187 in) deep (refer to figures 1-3 and 1-5).
Weight.....	28 pounds (12.70 kg), except 51S-1A/1AF.

5.4 TUBE AND SEMICONDUCTOR COMPLEMENT

Table 5-1. Tube and Semiconductor Complement

SYMBOL	FUNCTION	TYPE
V1	Rf amplifier	6DC 6
V2	First mixer and hf crystal oscillator	6EA 8
V3	Second mixer and 17.5 MHz oscillator	6EA 8
V4	Third mixer and remote gain gate	6EA 8
V5, V7, and V8	If. amplifiers	6BA 6
V6	Q-multiplier	12AX 7
V9	Agc amplifier	6BA 6
V10	Lf mixer and lf crystal oscillator	6EA 8
V11	If. cathode follower and agc cathode follower	5670
V12	Second local af amplifier	6BF 5
V13	Second line af amplifier	6AK 6
V14	First line af amplifier and first local af amplifier	12AX 7
V15	Variable-frequency oscillator	7543
V16	Lf mixer and calibration oscillator	6EA 8
V17	Beat-frequency oscillator	7543
CR1 thru CR4	Product demodulator	1N 34A
CR5, CR18, CR19, and CR20	Meter rectifiers	1N 270
CR6 thru CR13	Power supply rectifier	1N 1695
CR14	Agc rectifier	1N 482A
CR15	AM detector	1N 34A
CR16	Agc stabilizer	1N 482A
CR17	Muting transient suppressor	1N 67A
CR401 thru CR403	Dc power supply rectifier	2N637B
Q1	SSB/CW af amplifier	2N388 or 2N222A
Q401 thru Q404	Dc power supply switching	2N 637B

5.5 AVAILABLE ACCESSORIES

Table 5-2. Available Accessories

ITEM	FUNCTION	COLLINS PART NUMBER
55G-1 Tuner	0.2- to 2.0-MHz If preselector, with speaker	522-3982-002
312B-3 Speaker	Cabinet speaker	522-1166-00
351E-4 Mounting Plate	Mount on table or bench	522-1482-00
28-volt dc power supply conversion kit	Converts 51S-1 to 51S-1A	554-8355-00
351R-1 Rack Mount	Rack mounts 51S-1/1A Receiver	522-2665-00
Cabinet assembly	Cabinet mounts 51S-1F/1AF Receiver	553-2449-00
312C-1 Speaker	Rack-mounted speaker	522-3526-00
312C-2 Speakers	Two speakers rack mounted	522-3527-00
312C-3 Speakers	Three speakers rack mounted	522-3528-00
Shockmounting kit	51S-1/1A Shockmount	757-2787-001
Headset HS-1 (600 ohms)	Insert in front panel	273-0021-010

5.6 DIFFERENCE DATA

Table 5-3 lists differences and part numbers of various models of the 51S-() communications receivers.

5.7 SCHEMATIC CHANGE INFORMATION

The period covered by this instruction book is 15 January 1974 to 22 September 1975.

Each equipment that had circuit changes made during the period of time covered by this instruction book has the changes identified on the applicable sheet of the schematic diagram and in the parts list. Circuit changes are flagged on the schematic with a change identifier (←) pointed at the component, group of components, or a circuit enclosed by a dashed line. The broken line indicates that the component or circuit has been changed, and the number inside the identifier indexes the specific change. If several components are affected by the change, there will be more than one identifier with the same index number.

The change identification numbers are listed on a schematic changes page that is inserted as sheet A of figure 7-1. The description gives the differences and the reasons for the changes.

The reason for identifying changes in this manner is that the manufacturer has scrambled serial numbers on his amateur products during the period covered by this instruction book.

None of the changes have been made because the equipment has failed to meet the equipment specifications and are not recommended changes for all units. Equipment changes have been made to improve performance or reliability of radios that are built using different fabrication processes. These changes will not necessarily improve the operation of your equipment. The change identification number also is used in the parts list section of this instruction book. However in the parts list the identification number is enclosed in slashes (for example, /2/) instead of the ← symbol.

Table 5-3. 51S-() Descriptions

MODEL	*DESCRIPTION	COLLINS PART NUMBER
51S-1	Receiver mounted in cabinet complete with tubes and mechanical filters. Operates on 115/230 Vac. Equipped with 2.4-kHz SSB mechanical filter and 800-Hz CW filter.	522-2245-00
	Same as above except equipped with 2.75-kHz SSB mechanical filter.	522-2245-030
51S-1A	Same as 51S-1 above except operates on 28 Vdc. Equipped with 2.4-kHz SSB mechanical filter.	522-2546-00
	Same as 51S-1A listed above except equipped with 2.75-kHz SSB mechanical filter.	522-2546-030
51S1-B	Same as the 51S-1 listed above except it has a rear-mounted junction box that provides military-type connectors for power, control, audio, and antenna lines.	522-3857-001
51S-1F	Same as 51S-1 except for standard 48.260-m (19-in) rack mounting. Equipped with 2.4-kHz SSB mechanical filter and 800-Hz CW filter.	522-2498-00
	Same as 51S-1F listed above except equipped with 2.75-kHz SSB mechanical filter.	522-2498-030
51S-1AF	Same as 51S-1A except for standard 48.260-m (19-in) rack mounting. Equipped with 2.4-kHz SSB mechanical filter and 800-Hz CW filter.	522-3156-00
	Same as 51S-AF listed above except equipped with 2.75-kHz mechanical filter.	522-3156-030
*All models described in this table are available with the following options: Option 1: 300-Hz CW filter. Option 2: 6-kHz mechanical filter in place of 5-kHz AM/IF transformer. Option 3: 3.1-kHz mechanical filters vice either the 2.4- or 2.75-kHz mechanical filters.		