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# Mechanical Filter Conversion Kit

354A-1 For use with Collins

51J-2 and 51J-3 Receivers

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## I DESCRIPTION

The 354A-1 Mechanical Filter Conversion Kit consists of a Mechanical Filter adapter unit and all other parts necessary to install the unit in a Collins 51J-3 or 51J-2 Receiver. This kit provides a means of incorporating one, two, or three Mechanical Filters in the receiver i-f amplifier strip. The adapter will fit all 51J-3 Receivers, but it will fit only those 51J-2 Receivers having serial numbers of 501 and higher. It will not fit any 51J-1 Receivers.

The adapter unit consists of an aluminum chassis 5 in. high, 3 in. long, and 2-1/4 in. deep, which mounts two type 6BA6 miniature tubes, three Mechanical Filter receptacles, and a mechanical linkage to the filter-selector switch.

A dual concentric shaft replaces the original receiver bfo control shaft. The outer member of this shaft is used to operate the adapter filter-selector switch, and the inner member is used for bfo control. The filter-selector switch lever is coupled to the outer member and extends from behind the BFO PITCH knob, as shown in Figure 9.

The adapter unit mounts on the receiver chassis in the space normally occupied by XV107, the first i-f amplifier tube socket, and T103, the following i-f transformer. The adapter is fastened to the holes in the receiver chassis which are exposed when XV107 and T103 are removed. In Figure 2 the adapter unit is shown installed in a receiver.

The adapter uses two 6BA6 i-f amplifiers. One of these tubes is supplied with the equipment, and the other is obtained from the receiver in the conversion process. The input tube in the adapter drives a Mechanical Filter, and the filter is followed by the adapter output tube, which compensates for the transmission loss of the filter.

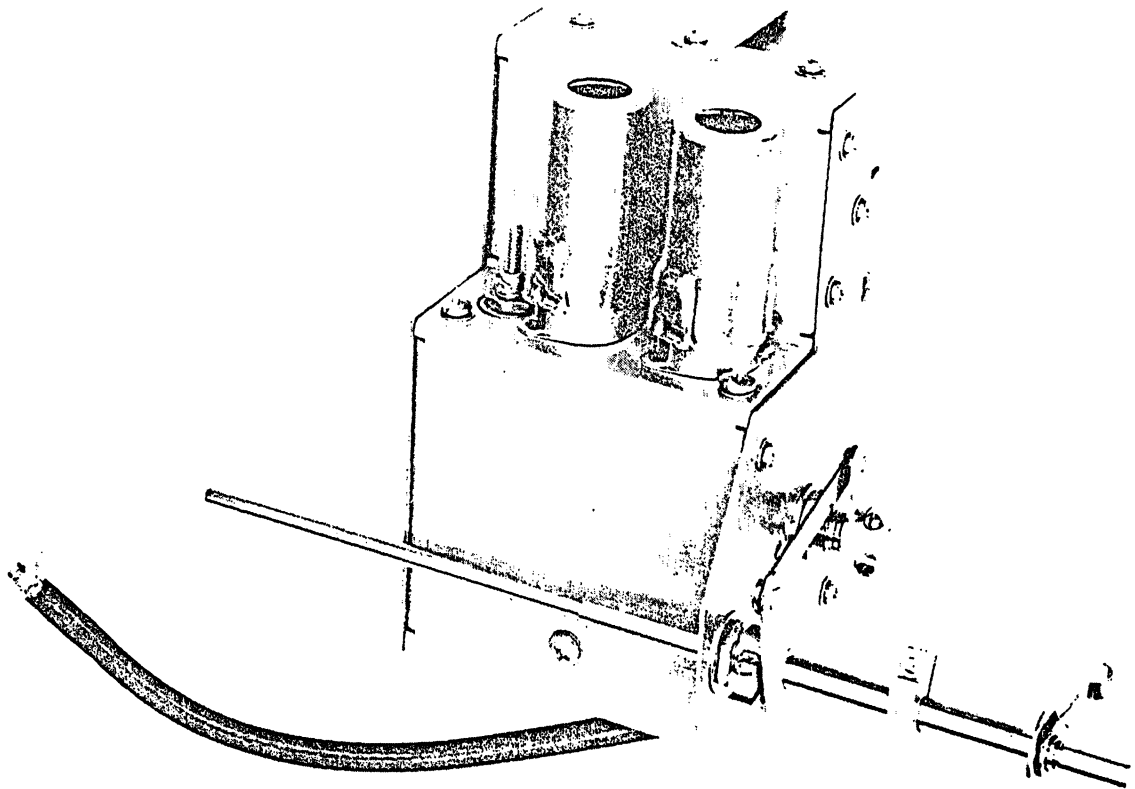


Figure 1. 354A-1 Adapter Unit

Part IV, Theory of Operation, contains a description of the Mechanical Filter. The plate circuit of the output tube is connected in the grid circuit of the next i-f amplifier tube in the receiver.

When the adapter is installed, its gain is the same as that of the tube replaced, but the receiver selectivity corresponds to that of the Mechanical Filter used. The adapter will accommodate three filters, any one of which may be selected by means of the front-panel switch. Mechanical Filters available for use with the adapter are types F500B-14, F500B-31, and F500B-60, which have nominal bandwidths of 1.4 kc, 3.1 kc, and 6.0 kc, respectively. Only one or two filters may be used, if desired, but at least one filter must be in place for the adapter to operate.

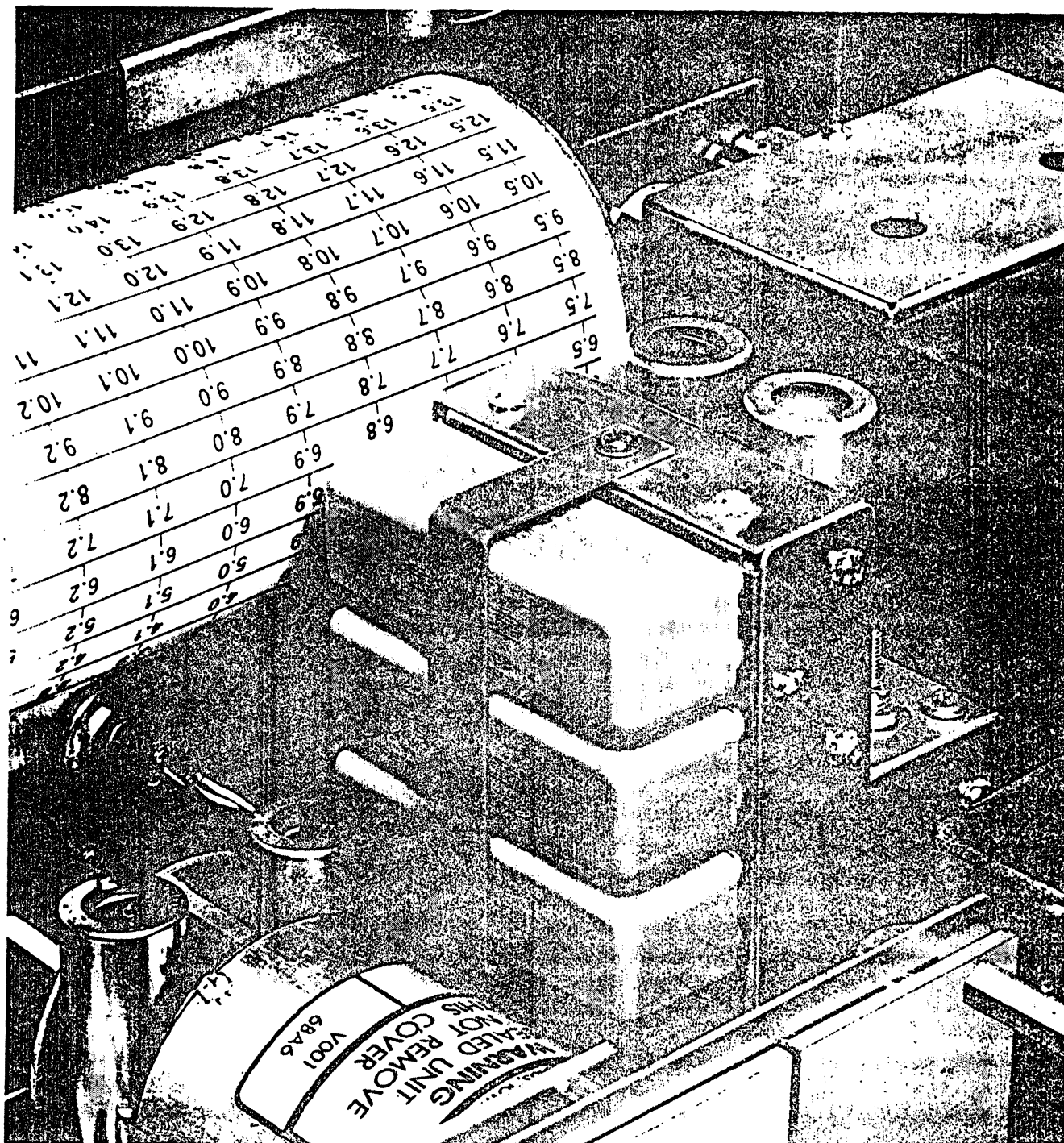


Figure 2. 354A-1 Adapter Unit Installed in Receiver

## II INSTALLATION

These instructions are for the modification of either 51J-3 or 51J-2 receivers. Portions of some procedures are enclosed in brackets ( [ ] ) and are to be performed only if the receiver type specified in the bracket is the same as that being modified. For example: That portion of procedure 2 which reads "[51J-3: Also remove..., etc....]" is used only if a 51J-3 is being modified. All instructions not enclosed by brackets are to be used for both 51J-2 and 51J-3 Receivers.

The following tools and equipment will be required for the modification:

Phillips screwdriver	Soldering iron
Standard (flat-bladed) screwdriver	Rosin-core solder
No. 4, 6, and 8 spline wrenches	D-c vacuum-tube voltmeter
(long-handled No. 4 spline wrench recommended)	Detuning network, consisting of 0.01-uf capacitor and 4700-ohm resistor in series, with clip leads
Diagonal cutting pliers	Non-metallic alignment screw-drivers, 3/16-in. and 5/16-in. dia. (or standard 51J alignment tool)
1/4-in. nut driver	
5/16-in. nut driver	
Two 1/2-in. end wrenches	Small screwdriver
Long-nosed pliers	

Read the entire installation procedure before starting; and check off each step as it is completed ( ☒ ).

CAUTION: Use only rosin-core solder and a clean, tinned soldering iron in making connections.

### A. Preparing Receiver Chassis for Adapter Mounting:

This first group of procedures includes removal of the first i-f amplifier tube socket, the following i-f transformer, and associated resistors, capacitors, and wiring.

- ( ☐ ) 1. Unplug the receiver power cord from the 115-volt line. Disconnect and remove any wires attached to the terminals at the rear of the receiver. Remove the receiver from its rack or cabinet by first removing the screws at the edges of the panel.
- ( ☐ ) 2. Remove the top cover plate by first loosening the three screws or wing nuts at the rear. [51J-3: Also remove the bottom plate by first removing the screws from the bottom and rear faces of the plate. Do not replace the plate until the completion of alignment (Group D).]
- ( ☐ ) 3. Referring to Figure 6, locate the BFO PITCH knob, shaft, and coupler. Loosen the two knob set screws with a No. 8 spline wrench. Remove and save the knob.
- ( ☐ ) 4. Loosen the four set screws in the coupler. Remove and discard the BFO PITCH shaft and coupler.
- ( ☐ ) 5. Referring to Figure 6, locate tube V107, i-f transformer T103, and tube V108. Remove V107 tube shield (by pressing down and turning counterclockwise), and discard. Remove tube V107, mark it for identification, and save.
- ( ☐ ) 6. Remove V108 tube shield and save. Remove tube V108, mark it for identification, and save. Under the chassis, find the wiring to V107, T103, and V108. This wiring is shown in Figure 7 (51J-2) or Figure 8 (51J-3).
- ( ☐ ) 7. At V107 socket, pin 4, unsolder and remove the insulated wire [51J-2: two wires] from the pin. Bend the wire(s) back out of the way for connection later.

- ( ) 8. IMPORTANT: FIRST READ THIS PROCEDURE THROUGH. Then do the work indicated.

All resistors, capacitors, and connecting wires shown in Figure 7 (51J-2) or Figure 8 (51J-3) (use correct figure) must be removed.

Exception: [51J-2: Do not remove the connections shown at T102 now.]

CAUTION: Only the connections actually shown are to be removed. Other receiver wiring (not shown) will be found connecting to some terminals; this wiring must be left connected.

Wires shown in Figure 7 (51J-2) or Figure 8 (51J-3) connecting to the following points should be removed by unsoldering: tie-points A and B; pin 1 of V108. [51J-3: Also tie-point C and terminal 4 of T102.] All other connections shown may be cut.

Remove and discard the following components:

R126 -- 27K, 1/2-watt resistor ("K" means thousand ohms)  
R134 -- 47K, 1/2-watt resistor  
R135 -- 2200-ohm, 1/2-watt resistor  
R136 -- 10K, 1/2-watt resistor  
R170 -- 100-ohm, 1/2-watt resistor  
C190 -- 0.01-uf tubular capacitor  
C191 -- 0.01-uf tubular capacitor  
C192 -- 1-uuf or 2-uuf tubular capacitor  
C193 -- 0.01-uf tubular capacitor

[51J-3: R158 -- 220K, 1/2-watt resistor]

[51J-3: R159 -- 220K, 1/2-watt resistor]

[51J-3: Coax cable connecting terminal 4 of T102 to pin 1 of V107; Cut lacing cord ties to remove cable.]

[51J-2: R159 -- 100-ohm, 1/2-watt resistor (if used)]

[51J-2: R175 -- 100K, 1/2-watt resistor (if used)]

[51J-2: R176 -- 100K, 1/2-watt resistor (if used)]

- ( ) 9. I-f transformer T103 is held to the chassis by two 1/4-in. nuts. [51J-3: two additional 5/16-in. nuts] located between T103 terminal slots. Remove and discard these nuts and lockwashers. Lift the transformer from the chassis top and discard. Tie-points A and B will remain in position, supported by connections to receiver wiring.
- ( ) 10. Remove and discard V107 tube socket, base shield, and the two lockwashers between the base shield and the chassis by removing the two screws in the socket above the chassis. Discard the screws.

#### B. Mounting Adapter and Linkage:

In this group of procedures, the adapter chassis will first be mounted temporarily to position the bushing assembly, after which the adapter will be removed and the bushing assembly tightened. Then the adapter will be finally installed in preparation for wiring.

- ( ) 11. During the procedures to follow, the dial drum markings should be protected against accidental damage. Cover that part of the drum above the adapter location (see Figure 6 for adapter location) with several thicknesses of paper about 5 in. wide. Secure the paper to the front panel at the top and to the gear panel at the bottom with tape. Do not tape directly to the drum.
- ( ) 12. The mechanical assembly is shown in Figure 9. Do not insert the Mechanical Filter(s) until installation is complete.
- Mount the bushing assembly (bushing B, spring C, washer E, and nut F) on the adapter front plate as shown in detail A of Figure 9, but do not tighten the nut fully. Adjust the nut so that the bushing assembly can be moved in its hole by hand, yet tightly enough that it will not slip easily.
- ( ) 13. Install the large-hole end of the new flexible coupler A on the bfo transformer. Tighten the two coupler set screws.

- ☐ 14. Temporarily mount the adapter on the chassis by passing the coax cable from the adapter through V107 socket hole and inserting the adapter terminals into the slots formerly used by T103 (see Fig. 10 or 11). Three adapter mounting screws will pass through holes at positions N1, N2, and N3.
- ☐ 15. Tie-points A and B need not be mounted now. Install a 4-40 nut on each adapter mounting screw, position the adapter so that the adapter terminals are centered as shown, and tighten the nuts moderately. Check to see that all terminals are clear of the metal chassis.
- ☐ 16. Insert control tubing R through the front-panel BFO PITCH hole, through gear panel M, and through bushing assembly B-C-E-F, positioning the bushing if necessary.
- ☐ 17. Insert shaft T from the front panel through tubing R into coupler A. Tighten the two coupler set screws.
- ☐ 18. Adjust the position of the bushing assembly for alignment between the gear panel hole and the coupler. Control tubing R and shaft T should each turn freely without binding.  
  
 Note: In some cases, perfect mechanical alignment will require a slight repositioning of the bfo transformer, T106. To do this, loosen the four nuts below the chassis which hold T106, move T106 as required, and retighten the nuts. Check below the chassis to see that T106 terminals are clear of the chassis.
- ☐ 19. Without disturbing the position of the bushing assembly, loosen the front two coupler set screws, and remove shaft T and tubing R.
- ☐ 20. Remove the three 4-40 nuts holding the adapter, and remove the adapter from the chassis. Save the nuts.
- ☐ 21. Without changing the location of the bushing assembly, tighten nut F securely.
- ☐ 22. The link assembly consists of switch arms H and J joined by link K. Attach switch arm J (the arm with two set screws) to the shaft projecting from the adapter. Position J so that the ends of the arm bushing and shaft are flush and the arm is pointing straight up with the switch in center position. Tighten the two set screws securely.
- ☐ 23. Leave switch arm J in its center (3-kc) switch position.
- ☐ 24. The 5/16-in. clamp G is mounted on the bushing of switch arm H. Do not tighten the clamp screw now. Check to see that control tubing R can pass easily through the bushing hole of H.
- ☐ 25. Again mount the adapter on the receiver chassis with the three 4-40 nuts, centering the adapter terminals as before. Tighten the nuts moderately.
- ☐ 26. Insert control tubing R through washer P, through the front panel, through the gear panel, through 1/4-in. clamp L, through switch-arm and clamp assembly H-G, and through bushing assembly B-C-E-F.
- ☐ 27. With switch lever S resting lightly against washer P and the front panel, hold clamp L against the gear panel and tighten its set screw, using a long-handled No. 4 spline wrench, if available. If not, use a short spline wrench held by long-nosed pliers.
- ☐ 28. Holding lever S horizontal, position clamp assembly H-G so that link K is parallel to the gear panel, and tighten the set screw in clamp G, using a No. 4 spline wrench.
- ☐ 29. Operate switch lever S through 1-kc, 3-kc, and 6-kc positions to check installation.
- ☐ 30. Insert shaft T through control tubing R and into coupler A. Leave a small gap (about 1/16 in.) between the end of shaft T and the end of the bfo transformer shaft within the coupler. These shafts must not touch or noisy electrical operation will result.
- ☐ 31. Temporarily install the original BFO PITCH control knob on the large end of shaft T. Tighten the two set screws. The knob position will be correctly set during alignment.
- ☐ 32. Referring to Figure 10 (51J-2) or Figure 11 (51J-3), and remove 4-40 nut N1 only. Two single-lug tie-points are furnished. Mount the type shown as tie-point D in Figure 10 (51J-2) or 11 (51J-3), and position as shown. Add a lockwasher and nut N1. Tighten moderately. (Discard unused tie-point.)

- ☐ 33. In the same way, mount original tie-point B under the lockwasher and nut N2 in the position shown.
- ☐ 34. In the same way, mount original tie-point A under lockwasher and nut N3 in the position shown.  
     [ 51J-3: If any of the three wires connecting to A are taut, remove the tension by either pulling the wire from the cable slightly or by moving the position of the lacing-cord tie.]

### C. Electrical Wiring:

In this group of procedures, the adapter will be connected to the receiver circuitry, and broadbanding capacitors will be added to the two remaining i-f transformers.

- ☐ 35. [ 51J-2: The original coax connection to T102 (Figure 7) must be removed. Remove the four screws, lockwashers, and nuts (save this hardware), securing filter choke L123 to the chassis side. Carefully move L123 on its connecting wires so as to expose T102 wiring connections. Protect the yellow meter rectifier from damage with a piece of cardboard.]
- ☐ 36. [ 51J-2: Unsolder and remove the coax ground lead from lug L; unsolder and remove the coax center wire from terminal 4 of T102. Discard the coax cable. Do not replace L123 yet.]
- ☐ 37. As shown in Figure 10 or 11 (use correct figure), position the coax cable from the adapter, and connect and solder the center wire to terminal 4 of T102.
- ☐ 38. [ 51J-2: Connect and solder the coax ground wire to lug L.]  
     [ 51J-3: Connect and solder the coax ground wire to terminal 1 of tie-point C.]
- ☐ 39. [ 51J-2: Mount filter choke L123 in its original position with the original four screws, lockwashers, and nuts.]
- ☐ 40. Connect and solder one end of the furnished length of striped red-and-white insulated wire to terminal 2 of L123.
- ☐ 41. Route this wire down and along chassis as shown, and connect and solder the remaining end to terminal 5 of the adapter. Tie this wire to receiver wiring at one or two points with lacing cord.
- ☐ 42. Tie the adapter coax cable to receiver wiring at one or two points with lacing cord.
- ☐ 43. Connect and solder the insulated black-and-white wire [ 51J-2: two wires ], removed in procedure 7, to terminal 1 of tie-point D.

In procedures 44 through 47, make connections with No. 20 gauge bare wire (the smaller of the two sizes furnished) insulated by plastic tubing. Tubing should cover each wire to within about 1/16 in. from the soldered connection at each end.

- ☐ 44. Connect and solder a wire from terminal 1 of tie-point D to terminal 2 of the adapter.
- ☐ 45. Connect and solder a wire from terminal 1 of tie-point A to terminal 1 of the adapter.
- ☐ 46. Connect and solder a wire from terminal 2 of tie-point A to terminal 4 of the adapter.
- ☐ 47. Connect and solder a wire from terminal 1 of tie point B to terminal 7 of the adapter.
- ☐ 48. Connect and solder a short, bare wire (same size wire as used above) directly from terminal 6 of adapter to pin 1 of V108.
- ☐ 49. Connect and solder a short, bare, heavy wire (No. 16 gauge) directly from terminal 3 of adapter to terminal 2 of tie-point B.
- ☐ 50. Referring to Figure 6, locate i-f transformers T104 and T105 on top of the receiver chassis. Locate their terminals below the chassis, as shown in Figure 3 (p. 7).
- ☐ 51. Refer to Figure 3 to find small ceramic capacitors C196 and C201. [ 51J-2: These capacitors are not used on some models. If not used, omit procedures 51 and 52.] Unsolder, remove, and discard C196 from terminals 1 and 4 of T104.



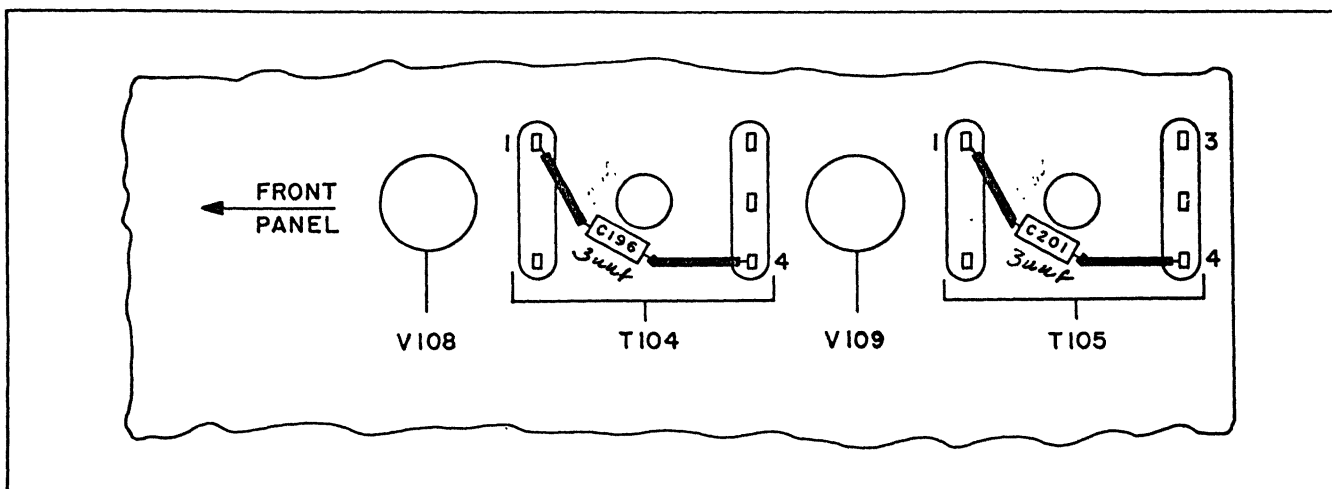


Figure 3. Broadbanding Wiring, Bottom View

- ( ) 52. Unsolder, remove, and discard C201 from terminals 1 and 4 of T105.

In procedures 53 and 54, C196 and C201 will each be replaced by one of the ceramic capacitors furnished. [51J-3: Use only the two 3-uuf (orange dot) capacitors.] [51J-2: Use only the two 4-uuf (yellow dot) capacitors.] Use plastic tubing on capacitor leads, and position the capacitor bodies so that they will not touch the chassis or other components.

- ( ) 53. Connect and solder new capacitor C196 between terminals 1 and 4 of T104, as shown in Figure 3.
- ( ) 54. Connect and solder new capacitor C201 between terminals 1 and 4 of T105. Discard the two unused capacitors.

Wiring is now completed.

- ( ) 55. On the receiver front panel install the 1 KC 3 KC 6 KC decal opposite switch lever S as shown in Figure 9. Lever S is horizontal in the 3 KC position. Follow the instructions on page 18.
- ( ) 56. Install the furnished 6BA6 tube and shield in the rear adapter tube socket (nearest bfo transformer).
- ( ) 57. Install the original V107 tube (6BA6) and new tube shield in the front adapter socket.
- ( ) 58. Insert the Mechanical Filter(s) into the face of the adapter in the positions indicated in Figure 9, keeping the filter parallel to the adapter so that all pins enter the socket at the same time. Moderate pressure will be required.
- ( ) 59. Install the filter bracket over the filter(s) as shown in Figure 9 by slipping the bracket onto the peg below the filter(s) and fastening the bracket with the top center screw.
- ( ) 60. Install the original V108 tube (6BA6) and the tube shield in V108 tube socket.

This completes the actual installation. The following alignment procedures must now be performed to obtain proper operation of the modified receiver.

#### D. Alignment:

In this last group of procedures, the modified 500-kc i-f strip and the bfo will be aligned using the 500-kc harmonic of the receiver's own 100-kc standard oscillator as a signal generator. However, if a 500-kc signal generator is available, it will be somewhat more convenient to use. Set it at 500 kc using a standard such as WWV. Connect it between pin 7 of V106 and the chassis (locate V106 from Figure 6). Turn the receiver on, switch to the 3-kc Mechanical Filter, and proceed, omitting procedures 62, 63, 64, 68, and 77.

[51J-2: CAUTION: REMOTE terminals at the rear of the chassis are "hot" when the receiver is operating.]

☐ 61. [51J-2: Remove the receiver's partial bottom plate by first removing the six screws and ten nuts which secure it.]

☐ 62. Insert the receiver power plug in a 115-v a-c outlet. Attach headphones or speaker and an antenna to the receiver. Turn the receiver on, and switch to the 3 KC position. It should now be possible to receive signals.

☐ 63. The receiver's 100-kc standard oscillator must now be calibrated. Turn the crystal standard (CALIBRATE) switch to ON, and allow ten minutes for warm up.

☐ 64. Set the controls as follows: SELECTIVITY, 0; BFO, OFF; RF GAIN, maximum; AVC, OFF.

Turn the CALIBRATE switch off and tune in the best signal from Station WWV on 5, 10, 15, or 20 mc. Wait for the period during which modulation is absent (one minute in five), turn the CALIBRATE switch on, and with a screwdriver adjust the CAL screw on the front panel for zero beat.

If zero beat is not within the range of the front-panel screw, adjust this screw so that the plates of variable air capacitor C224 (below chassis) are a little less than half meshed. Then adjust ceramic trimmer C169 (located on top of chassis, marked CAL.) for zero beat with WWV.

☐ 65. Remove the antenna. Set the receiver dial at 6.05 mc ( $\pm 10$  kc).

☐ 66. To eliminate noise from the receiver front end during alignment, turn the receiver off, and connect a wire from pin 1 of V102 to the chassis, using a short clip lead (see Figure 6 to find V102).

☐ 67. A single insulated wire or coax connects to terminal 3 of T105 (see Figure 3). The other end connects to a standoff tie-point. To measure diode-detector output voltage, connect a d-c vacuum-tube voltmeter from this tie-point to the chassis. Switch the meter to read negative d-c voltage on a 5- or 10-volt range. Turn the receiver on.

☐ 68. Connect one end of an insulated wire to pin 7 of V106 (see Figure 6 to find V106). Couple into the 100-kc oscillator circuit by forming a small loop in the other insulated end and inserting it into the compartment below the chassis occupied by V104 wiring. The position of V104 (100-kc oscillator tube) is shown in Figure 6. Keep the wire near the wall which separates the compartment from the 70E-15 Oscillator. With the CALIBRATE switch on, the VTVM connected in procedure 67 should now indicate detector output voltage.

☐ 69. Set the receiver controls as follows: SELECTIVITY, 0; BFO, OFF; RF GAIN, maximum; AVC, OFF; CALIBRATE, ON.

**CAUTION:** The No. 1 terminals of i-f transformers T104 and T105 carry plate voltage. The receiver should be turned off while connections to these points are made.

Connect a detuning network consisting of a 0.01-uf capacitor in series with a 4700-ohm resistor from terminal 1 of T104 to the chassis.

☐ 70. Tune the secondary of T104 by carefully adjusting the bottom slug for maximum indication on the VTVM (the bottom slug adjustment is accessible below the chassis or down through the top of the transformer can using a 3/16-in. diameter fiber screwdriver). Keep the VTVM reading below 4 volts during this and following procedures by adjusting the position of the insulated pickup loop (or by adjusting the level of the external signal generator, if used). Remove the detuning network.

☐ 71. Connect the detuning network from terminal 4 of T104 to the chassis. Tune the top slug, or primary, of T104 for maximum indication on the VTVM (the top slug is adjusted with a 5/16-in. diameter fiber screwdriver from the top of the transformer can). Remove the detuning network.

☐ 72. Connect the detuning network from terminal 1 of T105 to the chassis. Tune the secondary (bottom slug) of T105 for maximum indication on the VTVM. Remove the detuning network.

☐ 73. Connect the detuning network from terminal 4 of T105 to the chassis. Tune the primary (top slug) of T105 for maximum indication on the VTVM. Remove the detuning network.

☐ 74. Refer to Figure 10 (51J-2) or Figure 11 (51J-3) to locate T101. Above the chassis locate the hole for T101 tuning. Tune T101 (not T102) for maximum VTVM indication.

( ) 75. Peak the adapter plate coil by adjusting the slug screw (L301) located on the Mechanical Filter adapter chassis next to the tubes for maximum VTVM indication. Remove the VTVM connections.

( ) 76. Align the bfo as follows:

Switch the bfo on. From the top of the chassis, adjust the core in T106 (see Figure 6) to produce a beat note. Turn the BFO PITCH knob clockwise or counterclockwise until the pitch of the beat note rises to a maximum.

Without rotating the knob, loosen the set screws in the knob. Without rotating the shaft, rotate the knob on the shaft until the knob mark is 90 degrees from the panel mark. Tighten the set screws. Set the knob mark at the panel mark. The bfo tuning capacitor plates are now half meshed. Adjust the core of T106 to zero beat.

( ) 77. Turn the receiver off. Disconnect the end of the insulated wire (which was added in procedure 68) from pin 7 of V106, and remove the wire.

( ) 78. Disconnect and remove the wire (which was added in procedure 66) from pin 1 of V102 to the chassis.

Alignment is now complete. Remove the connections from the external generator (if used). Replace the receiver bottom and top plates. The modified receiver is now ready for use.

### III OPERATION

The operating controls will function as before, but for some types of reception, a slightly different tuning technique should be employed to obtain best results with the improved selectivity. Tuning procedure and the unique advantages of the Mechanical Filter will be outlined for some common types of signals.

#### A. CW:

Use the F500B-14 Mechanical Filter (1 KC position) for cw reception. Signals may be tuned in the normal manner, but even without the crystal filter, the receiver will have true single-signal response. Transmitter drift or chirp may become more noticeable because of the increased selectivity of the receiver. The crystal filter may be used in conjunction with the Mechanical Filter for certain interference problems.

#### B. A-M Phone:

The F500B-31 or F500B-60 Mechanical Filter (3 KC and 6 KC positions, respectively) should be used for phone reception. The F500B-31 passband is wide enough to pass only one sideband and the carrier of a phone signal. So in tuning a signal, detune the receiver from the center of the signal until the "S" meter reading just begins to drop off. The receiver is now tuned to one sideband and the carrier. If the receiver is further detuned, the carrier will drop out of the passband, and the sideband will remain as unintelligible "monkey chatter." When the receiver is so detuned, it will sound very noisy, since the avc voltage will be reduced and the receiver gain will be at maximum.

To eliminate interference on one sideband of a signal, tune to the other sideband. If interference is present on both sidebands, or if the signal is undergoing selective fading, use the following method for local carrier reinsertion. Detune the signal in either direction to a point where the modulation just becomes unintelligible. Then back off the RF GAIN, turn the AVC off, turn the BFO on, and set the AUDIO GAIN near maximum. Slowly rotate the BFO knob until the modulation becomes readable. Use the RF GAIN to control volume, and leave the AUDIO GAIN near maximum.

The F500B-60 (6 KC position) bandpass is wide enough to pass both sidebands of a communications quality signal; and the receiver may be tuned in the normal manner. For receiving wider-bandwidth signals, or for receiving under conditions of interference, use the same tuning techniques as outlined above for the F500B-31.

#### C. Single Sideband:

The F500B-31 Mechanical Filter (3 KC position) should be used for single-sideband suppressed-carrier reception. Set the AUDIO GAIN to near maximum, the AVC switch to OFF, and adjust the RF GAIN for comfortable volume. Tune in the station for maximum volume, and turn the BFO on. Rotate the BFO knob until the modulation becomes intelligible. For subsequent operation, leave the BFO in the same position, and tune in the station as if it were transmitting a full carrier.

#### D. FSK Teletype:

The F500B-14 Mechanical Filter (1 KC position) should be used for fsk teletype reception. The signal is tuned in by the normal procedure, but the position of the signal in the passband of the receiver is much less critical than before.

#### IV THEORY OF OPERATION

A photograph of the Mechanical Filter is shown in Figure 4; and in Figure 5 the frequency response curves are compared with those obtained by conventional means. With the crystal filter off, selectivity of the modified receiver is essentially that of the Mechanical Filter in use.

In the modified receiver, the crystal filter is still available for use in conjunction with any switch-selected filter.

The Mechanical Filter achieves its unusual selectivity by a combination of electrical and mechanical elements. The filter is composed of three general sections: the input transducer, the resonant section, and the output transducer. The input and output sections of the filter are identical, and function to convert the electrical signal to a mechanical form, and vice versa.

The input signal is impressed on a small coil which surrounds a nickel wire. By means of magnetostriction, the magnetic field variations are converted to mechanical vibrations.

One end of the nickel wire is welded to the first of a series of disks which comprise the resonant section of the filter. There are six of these disks composed of a special alloy which has a very sharp resonance and excellent frequency stability. The vibrations of the nickel wire cause the end disk to vibrate, and these vibrations are coupled to the other disks by wires welded to their edges.

The output end of the filter is identical to the input end and is composed of a nickel wire and a coil. Here the magnetostriction action of the nickel wire functions to convert the mechanical vibrations of the disk into a varying magnetic field. The coil intercepts this field and supplies the output voltage.

The entire unit is housed in a hermetically-sealed case smaller than a normal i-f transformer.

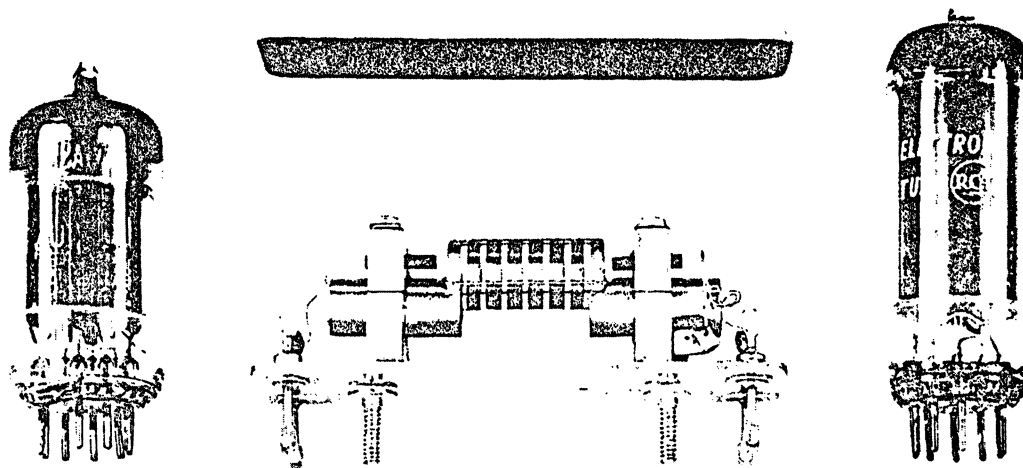
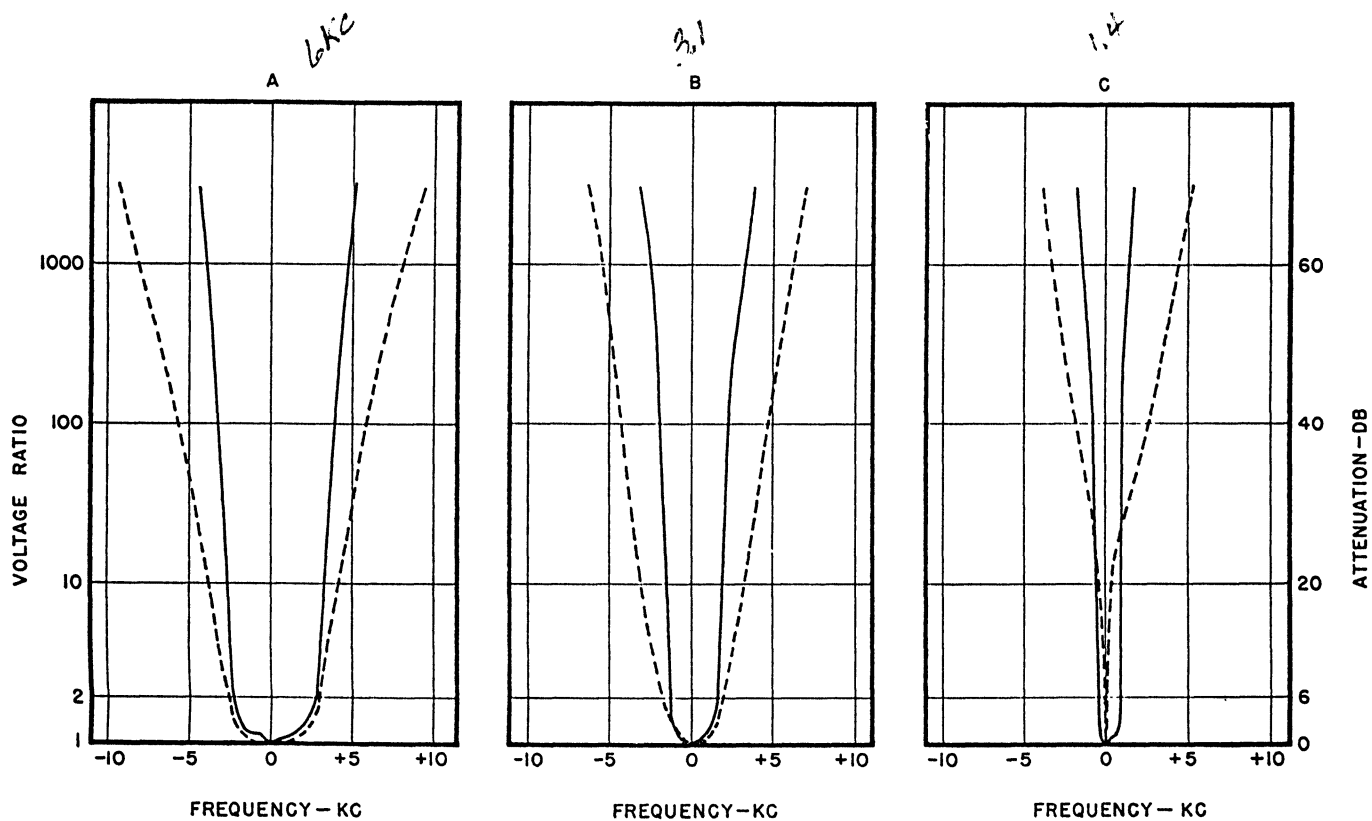


Figure 4. Mechanical Filter, Case Removed



- A. Broadest selectivity position (0) compared with F500B-60 Mechanical Filter selectivity  
 B. Broad crystal position (1) compared with F500B-31 Mechanical Filter selectivity  
 C. Sharpest crystal position (4) compared with F500B-14 Mechanical Filter selectivity

----- Normal receiver  
 ————— With 354A-1 Adapter

Figure 5. Selectivity Curves, 51J Receiver

## V MAINTENANCE

The adapter voltage and resistance measurements shown in Table I will be an aid in locating most troubles which might occur. However, should obscure troubles arise, only a trained and competent communications receiver repairman should be allowed to service the receiver or adapter. The Mechanical Filter itself is a sealed unit, just as a vacuum tube is, and no attempt should be made to open the case.

TABLE I

### Adapter Resistance and Voltage Measurements

The figures given in this table are for a typical adapter. Because of component tolerances, measurements may vary as much as 20 per cent from those given.

Each measurement is taken from the specified terminal to ground. For voltage readings, tube pin connections are made with the use of a standard 7-pin miniature tube test-point socket, which plugs in between a tube and its socket. **CAUTION:** Use only a type which can be inserted through a shield base and into a tube socket without forcing, or the tube socket will be damaged. Resistance readings can be made directly at the adapter tube sockets, with tubes removed.

Resistance measurements taken with no a-c input, power switch ON, gain controls on full, AVC ON, and all other switches off.

Voltage measurements taken with 115-volt a-c input, power ON, no signal input, RF GAIN full on, AUDIO GAIN off, AVC ON, all other switches off. Measurements made with VTVM having 11 megohms input resistance.

At adapter terminals (see Figure 10 or 11 for terminal numbers):

Terminal No.	Resistance (ohms)		Voltage	
	51J-3	51J-2	51J-3	51J-2
1	75	76	0.6	0.5
2	0	0	ac 6.3	ac 6.3
3	0	0	0	0
4	26K	30K	155	210
5	28K	34K	198	210
6	500K	500K	-1.7	-1.5
7	49K	49K	-1.8	-1.6

Resistance and voltage measurements continued on p. 14.

TABLE I (Cont'd)

## Adapter Resistance and Voltage Measurements

At adapter tube pins:

Tube	Pin No.	Resistance (ohms)		Voltage	
		51J-3	51J-2	51J-3	51J-2
V301 (front 6BA6)	1	56K	60K	-1.6	-1.6
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	ac 6.3	ac 6.3
	5	28K	33K	154	209
	6	22K	22K	45	62
	7	0	0	0	0
V302 (rear 6BA6)	1	20	20	0	0
	2	270	270	2.0	2.4
	3	0	0	0	0
	4	0	0	ac 6.3	ac 6.3
	5	29K	35K	193	205
	6	68K	75K	90	110
	7	270	270	2.0	2.4



TABLE II

## Parts List

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C301	Resonates filter input coil	CAPACITOR, mica; 240 uuf $\pm 2\%$ , 500 wv	912-0520-00
C302	Resonates filter output coil	CAPACITOR, mica; 240 uuf $\pm 2\%$ , 500 wv	912-0520-00
C303	V302 cathode bypass	CAPACITOR, ceramic; 0.01 uf, 600 wv	913-1188-00
C304	V302 screen bypass	CAPACITOR, ceramic; 0.01 uf, 600 wv	913-1188-00
C305	V302 plate bypass	CAPACITOR, ceramic; 0.01 uf, 600 wv	913-1188-00
C306	Resonates L301	CAPACITOR, mica; 270 uuf $\pm 5\%$ , 500 wv	912-0524-00
C307	Output coupling	CAPACITOR, mica; 100 uuf $\pm 10\%$ , 500 wv	912-0493-00
C308	V301 screen bypass	CAPACITOR, ceramic; 0.01 uf, 600 wv	912-1188-00
C309	V301 plate bypass	CAPACITOR, ceramic; 0.01 uf, 600 wv	912-1188-00
C310	Grid decoupling	CAPACITOR, ceramic; 0.01 uf, 600 wv	912-1188-00
L301	Output coil	COIL, slug-tuned; tunes 500 kc with approx. 300 uuf	278-9005-00
R301	V302 screen dropping	RESISTOR; 39K $\pm 10\%$ , 1 watt	745-3419-00
R302	Loads L301	RESISTOR; 120K $\pm 10\%$ , 1/2 watt	745-1174-00
R303	V302 plate decoupling	RESISTOR; 1000 ohms $\pm 10\%$ , 1/2 watt	745-1352-00
R304	Grid return	RESISTOR; 470K $\pm 10\%$ , 1/2 watt	745-1198-00
R305	V302 cathode bias	RESISTOR; 270 ohms $\pm 10\%$ , 1/2 watt	745-1062-00
R306	V301 divider	RESISTOR; 27K $\pm 10\%$ , 1/2 watt	745-1412-00
R307	V301 screen divider	RESISTOR; 47K $\pm 10\%$ , 1 watt	745-3422-00
R308	"S" meter bridge	RESISTOR; 100 ohms $\pm 10\%$ , 1/2 watt	745-1044-00
R309	V301 plate decoupling	RESISTOR; 2200 ohms $\pm 10\%$ , 1/2 watt	745-1100-00
R310	V108 grid decoupling	RESISTOR; 10K $\pm 10\%$ , 1/2 watt	745-1128-00
S301	Filter selector, input end	SWITCH, rotary; 3-position, 2-pole	269-9016-00
S302	Filter selector, output end	SWITCH, rotary 3-position, 2-pole	269-9016-00
V302	Adapter output i-f amplifier	TUBE; type 6BA6	255-0185-00

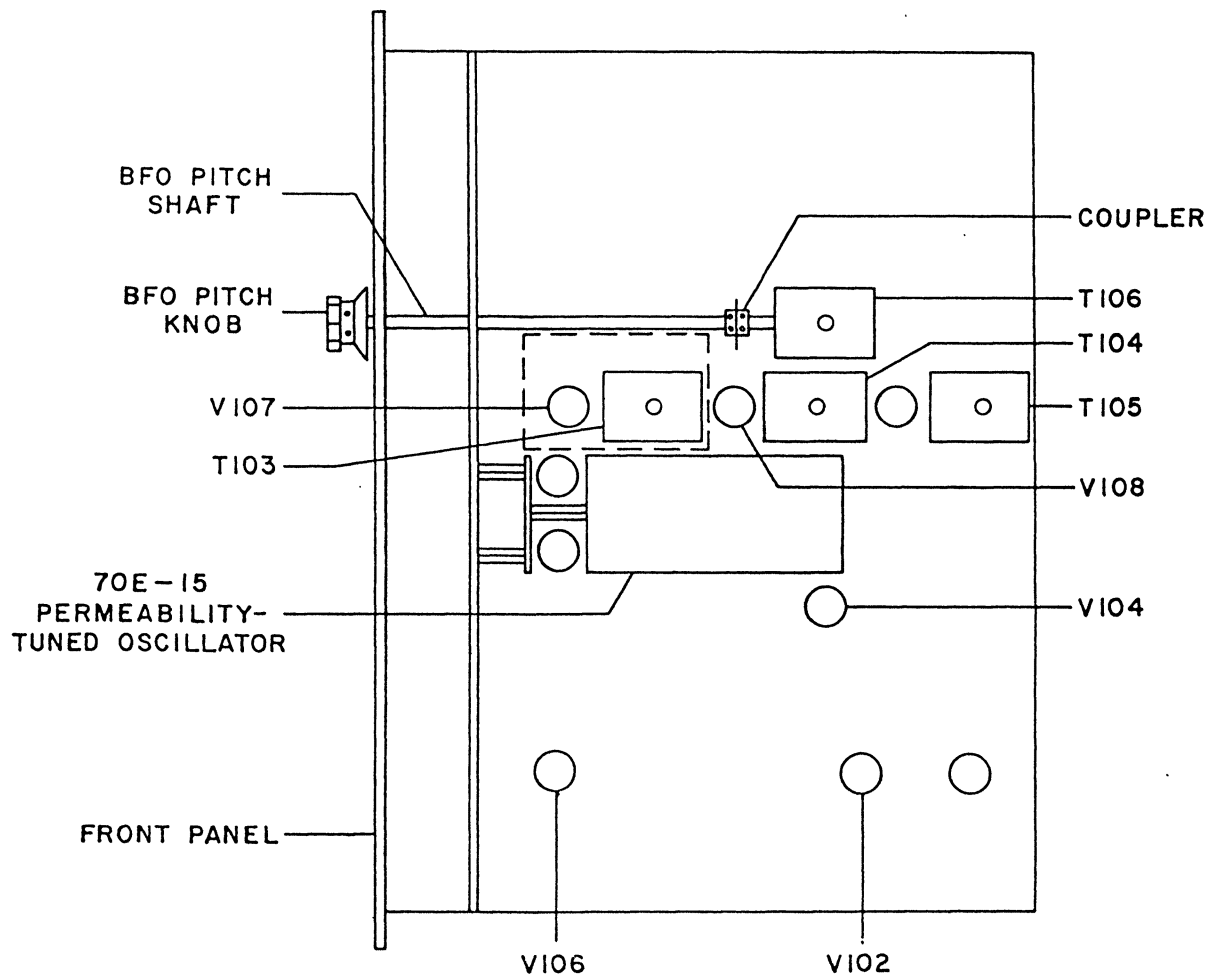
Parts List continued on p. 16

TABLE II (Cont'd)

## Parts List

## Accessories

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
FL301	Bandpass filter, 1.4 kc band-width	FILTER, mechanical; type F500B-14	522-9030-002
FL302	Bandpass filter, 3.1 kc band-width	FILTER, mechanical; type F500B-31	522-9008-002
FL303	Bandpass filter, 6.0 kc band-width	FILTER, mechanical; type F500B-60	522-9009-002
V301	Adapter input i-f amplifier (not supplied. Use 6BA6 tube removed from receiver, V107)	TUBE; type 6BA6	255-0185-00



NOTE: ADAPTER LOCATION SHOWN BY DOTTED LINES

Figure 6. 51J Receiver, Top View

#### APPLICATION INSTRUCTIONS FOR BANDWIDTH-SELECTION DECAL

1. Remove the heavy backing paper from the decal, leaving only the dry tissue decal to work with.
2. Mix four parts of decal cement with one part of clean water.
3. Wipe or brush a medium coat of solvent mixture on the area to which the decal will be applied.
4. Place the decal in position to the right of the BFO Pitch Control knob as shown in Figure 9.
5. Cover the decal with a damp cloth and immediately press thoroughly and evenly with the fingers, using care not to slide the properly-positioned decal.
6. Do not disturb the cloth for about twenty seconds. Allowing the cloth to remain will keep the tissue under control.
7. Remove the cloth and the tissue. Again cover the panel with a damp cloth and press gently and evenly with the fingers.
8. After one minute, remove the cloth and pat the transfer dry with a fresh, soft cloth.

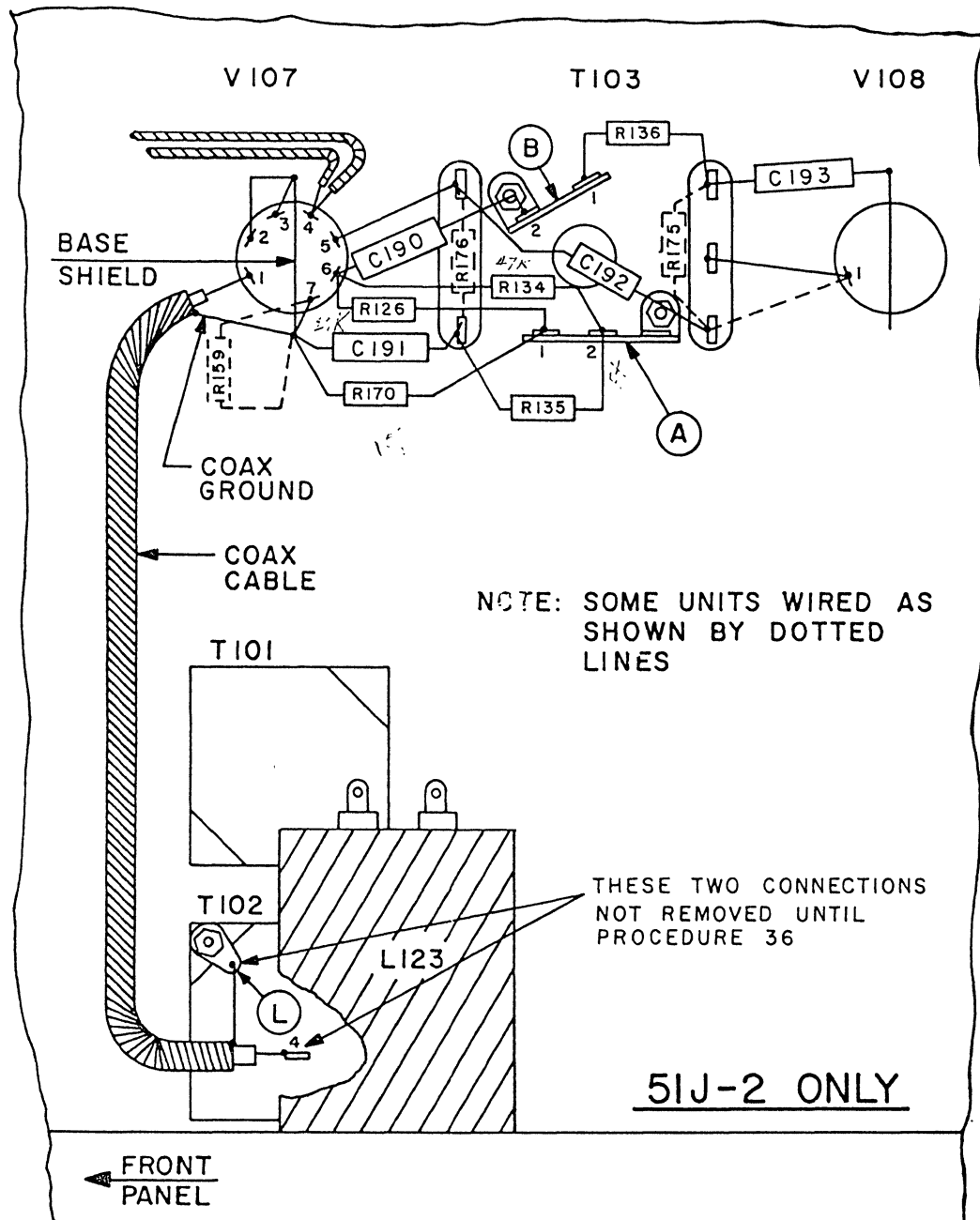


Figure 7. Unmodified 51J-2 Adapter Area, Bottom View

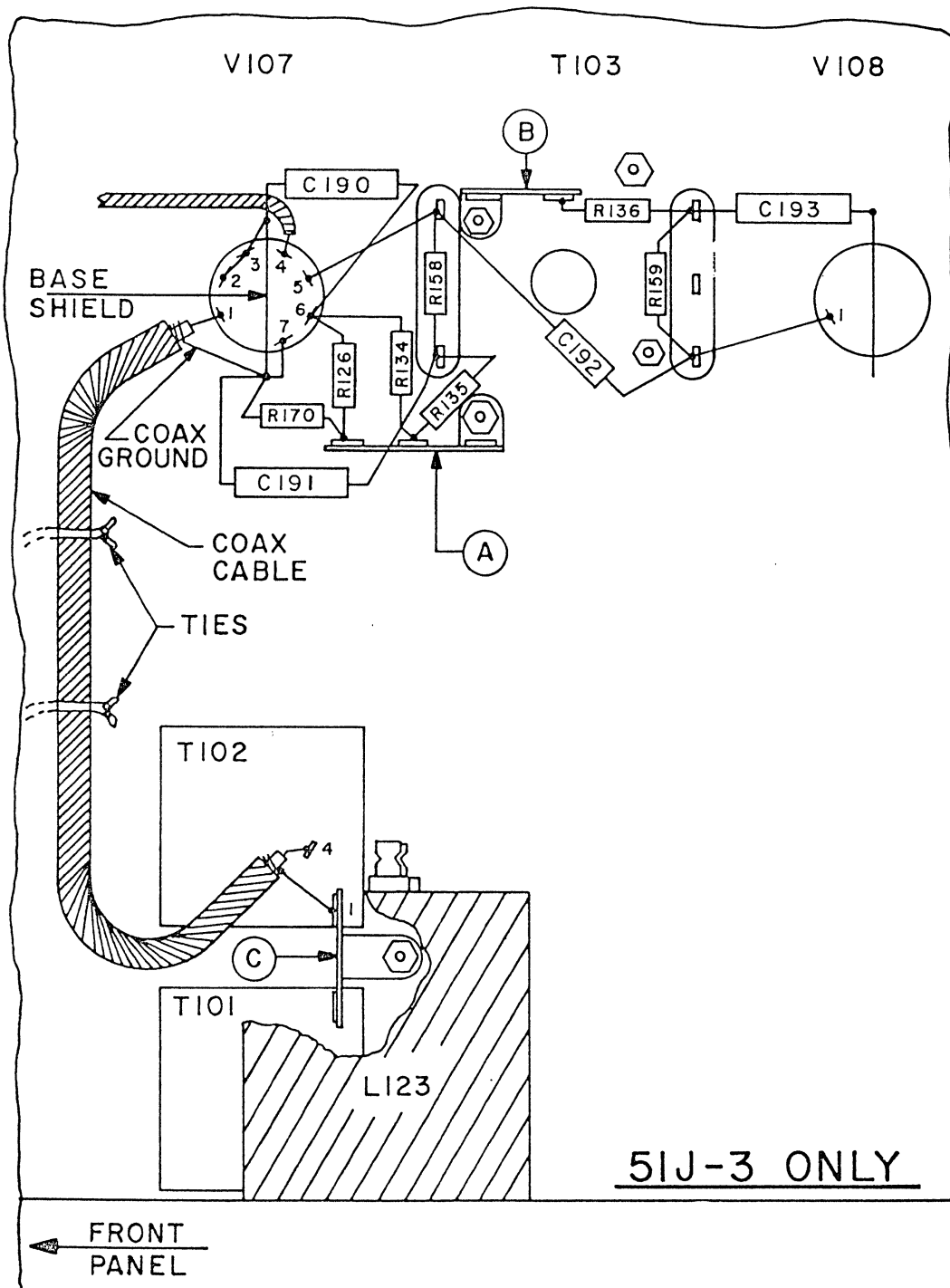


Figure 8. Unmodified 51J-3 Adapter Area, Bottom View

ITEM	PART NAME	PART NUMBER
A	Flexible coupling	015-0054-00
B	Bushing	596-3234-002
C	Spring	596-3224-001
D	Adapter chassis	596-3246-005
E	Washer	310-9001-00
F	Nut	334-4060-00
G	Clamp	504-7537-002
H	Switch arm	506-3187-002
J	Switch arm	596-3235-002
K	Link	596-3225-001
L	Clamp	506-3189-002
M	Gear panel	--
N	Front panel	--
P	Washer	310-0061-00
R	Control tubing	596-3221-001
S	Switch lever	596-3220-001
T	Shaft	596-3229-002
U	BFO PITCH control knob	281-0004-00

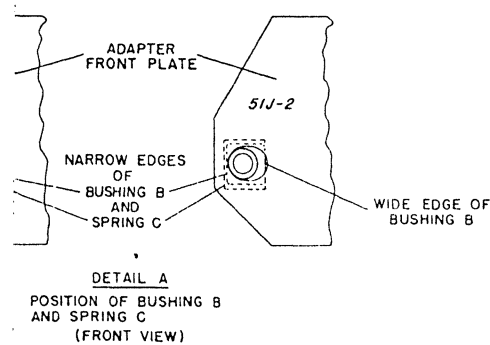
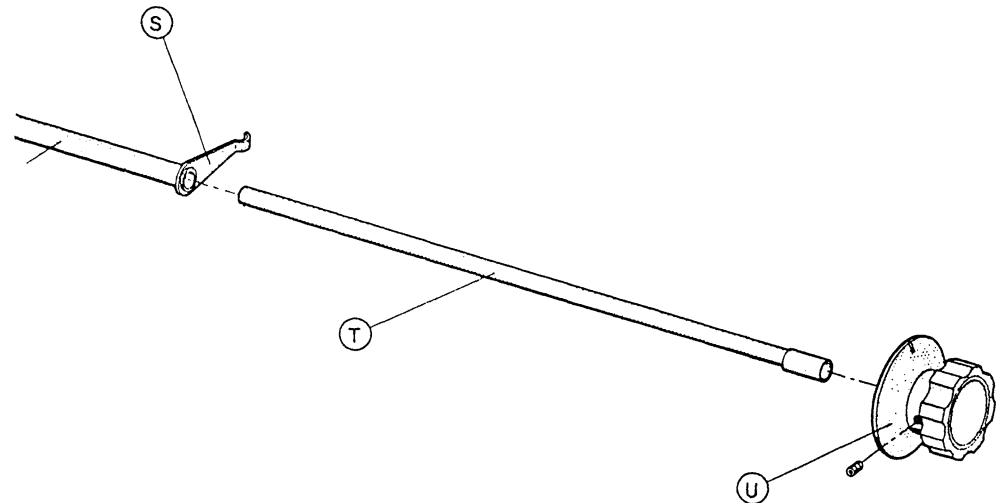
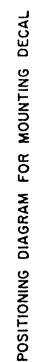


Figure 9. Mechanical Assembly, 354A-1 Adapter Unit





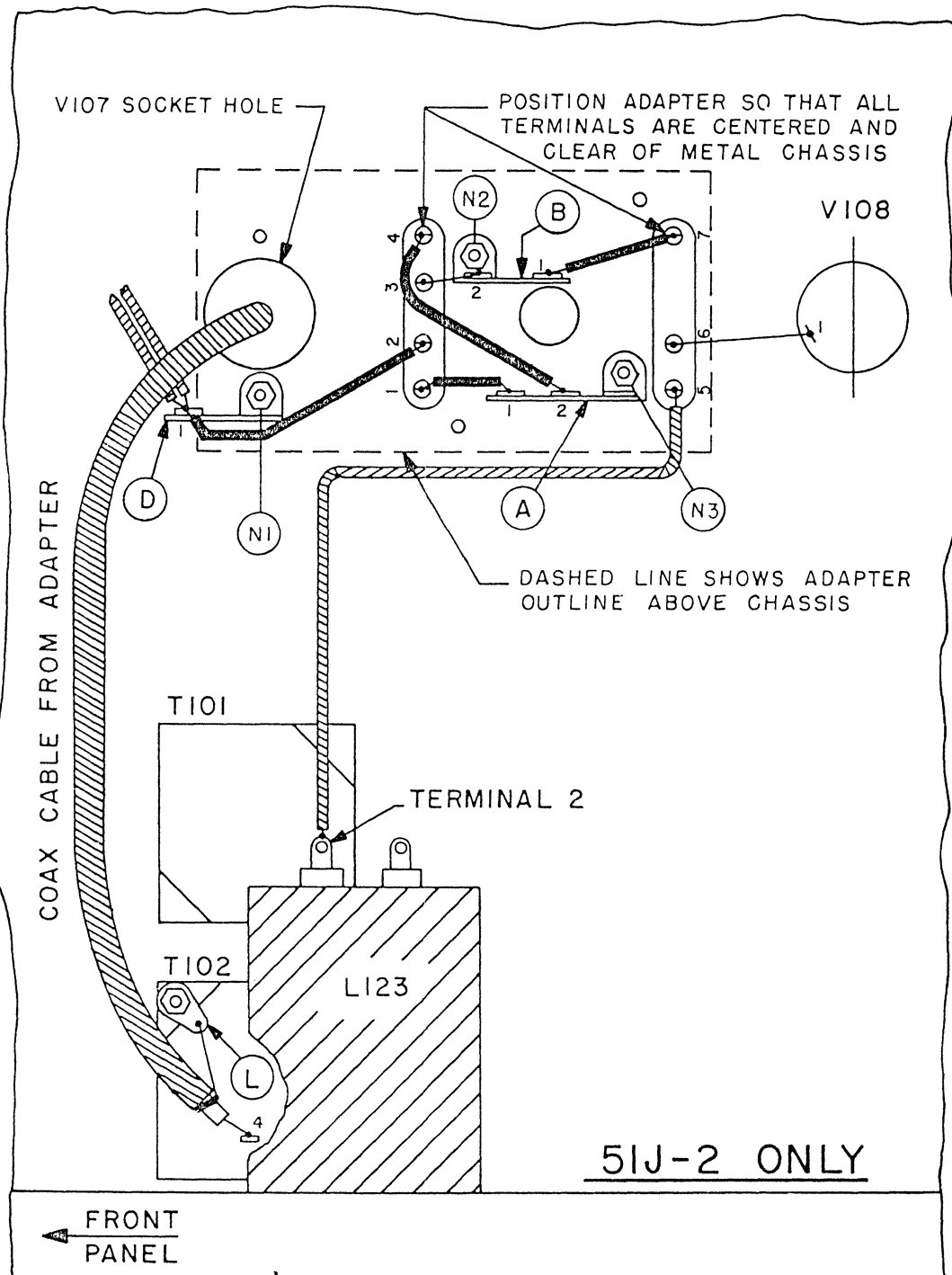


Figure 10. Modified 51J-2 Adapter Area, Bottom View

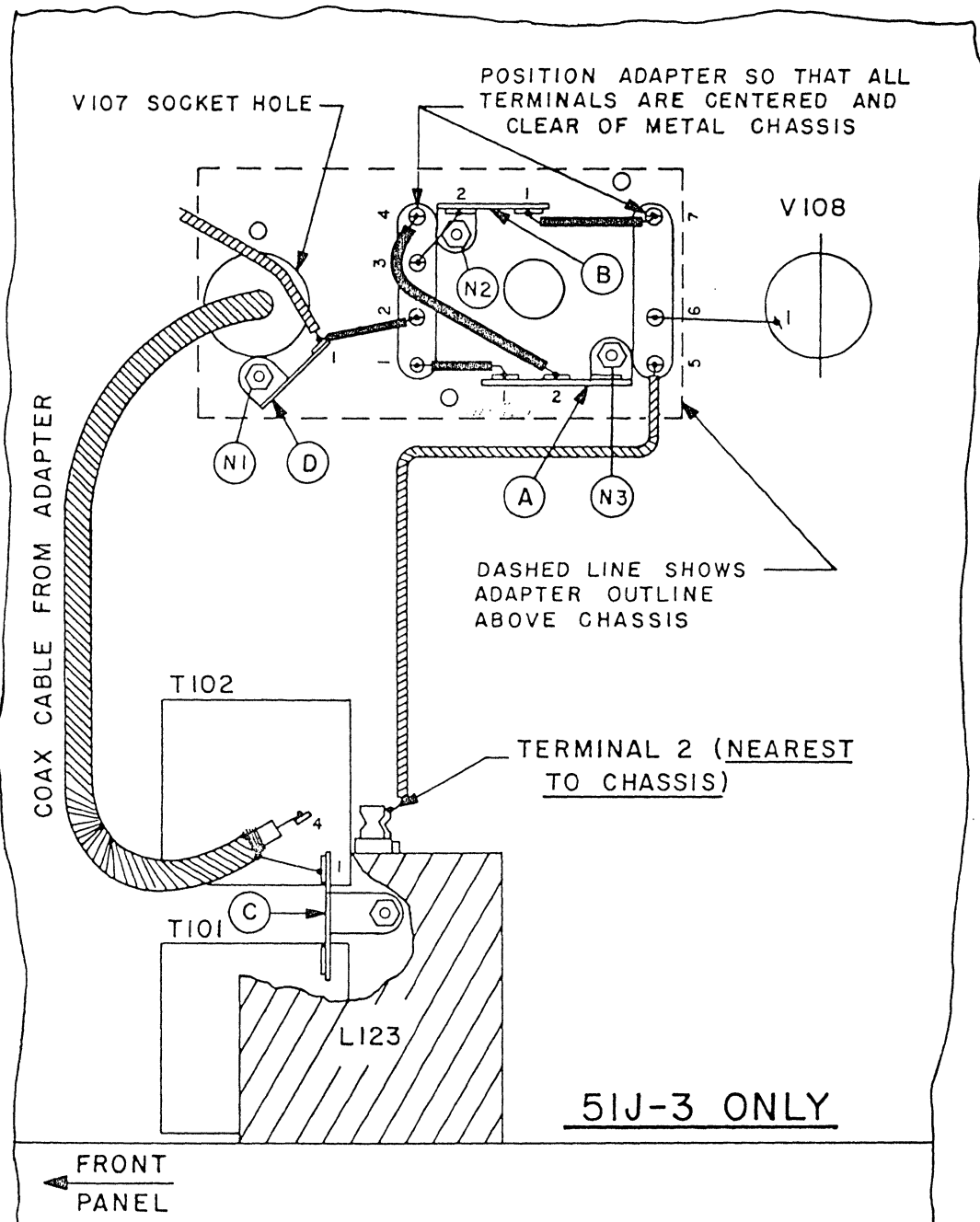


Figure 11. Modified 51J-3 Adapter Area, Bottom View

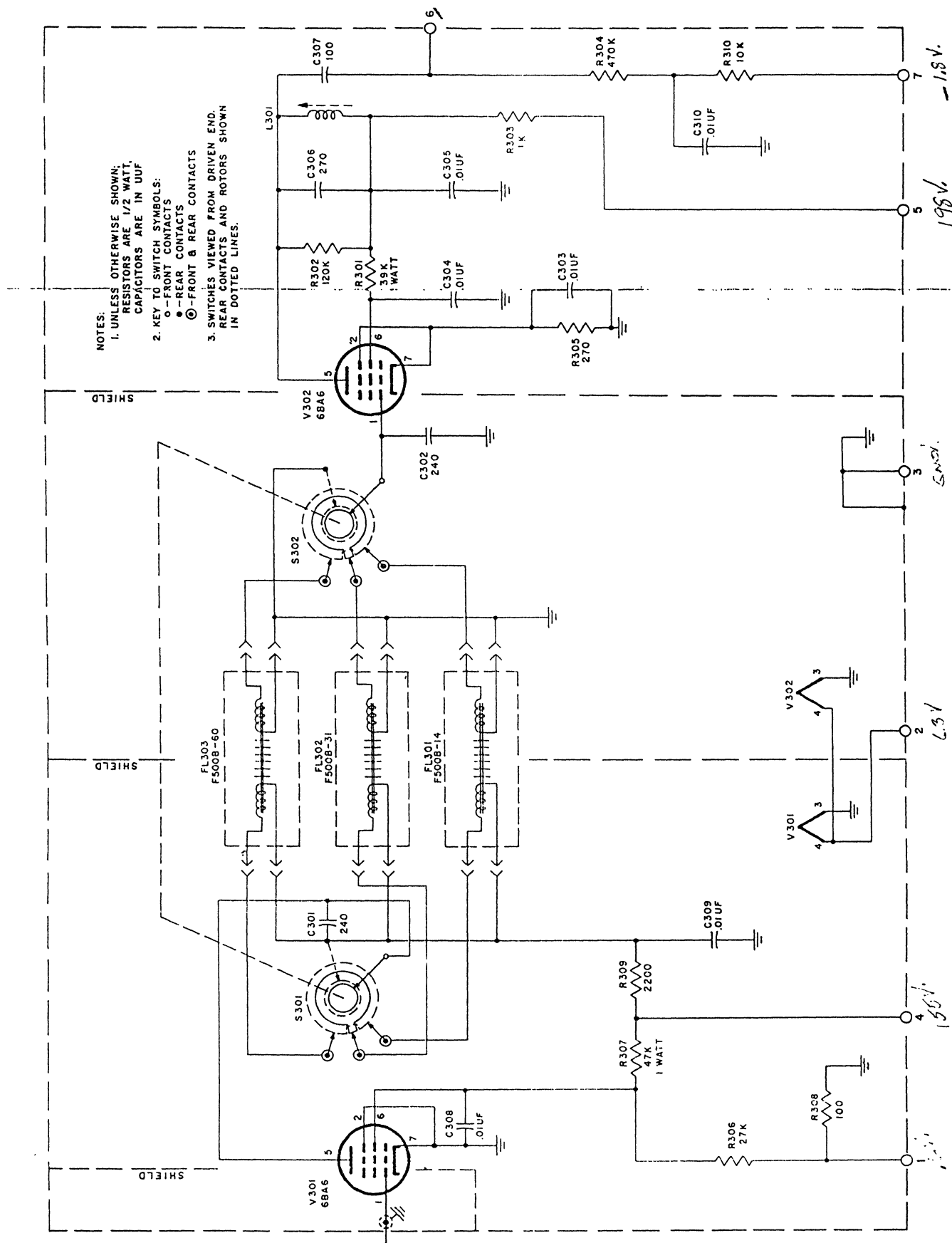


FIGURE 12. 354A-1 ADAPTER UNIT, SCHEMATIC DIAGRAM

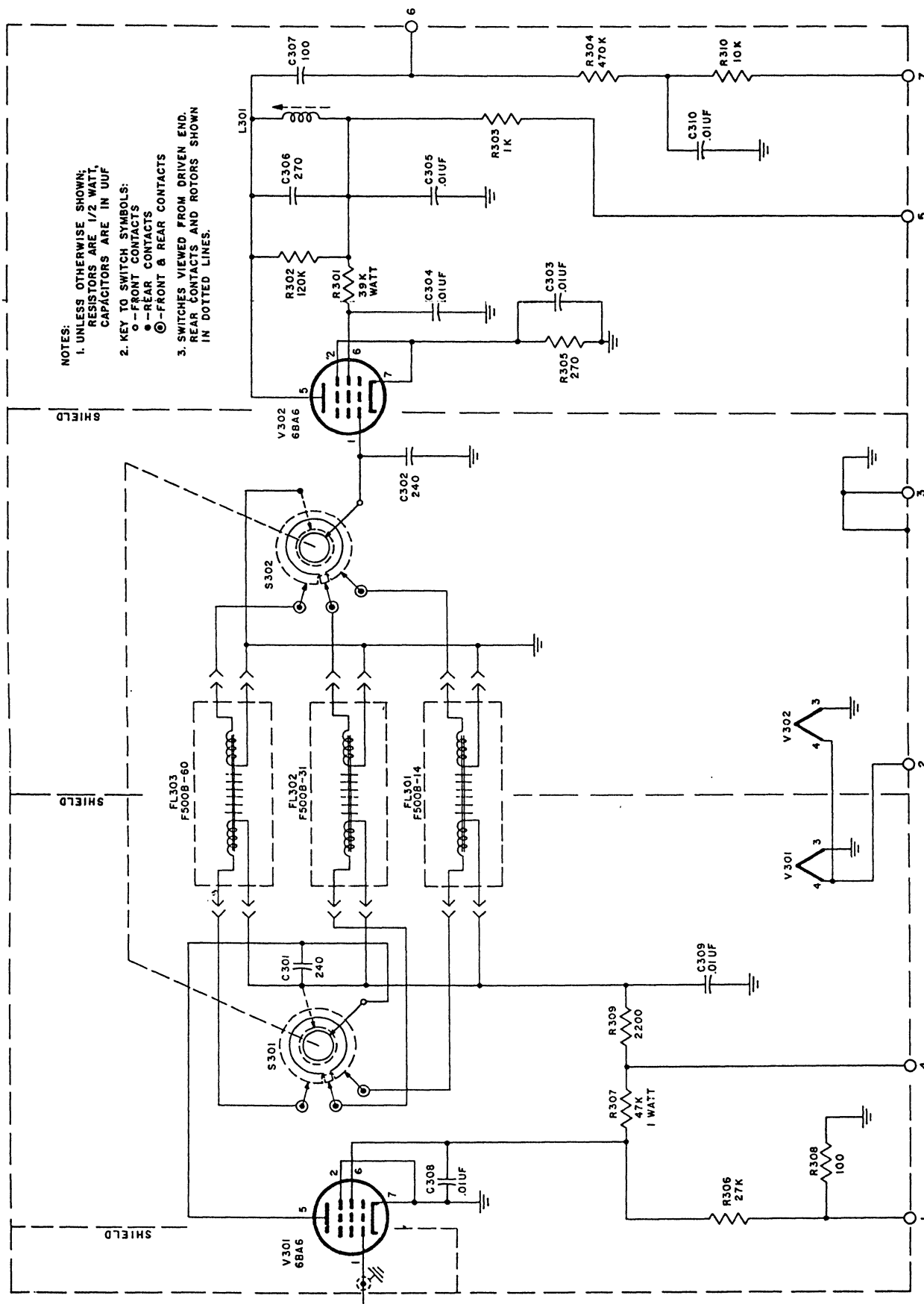


FIGURE 12. 354A-1 ADAPTER UNIT, SCHEMATIC DIAGRAM