

HP 3551A

## Transmission Test Set



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## Errata

**Title & Document Type:** 3551A Transmission Test Set Operating and Service Manual

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### HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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# **OPERATING AND SERVICE MANUAL MODEL 3551A TRANSMISSION TEST SET**

Serial Number: 1425A00101 and higher

## **IMPORTANT NOTICE**

This loose leaf manual does not normally require a change sheet. All major change information has been integrated into the manual by page revision. In cases where only minor changes are required, a change sheet may be supplied.

If the Serial Number of your instrument is lower than the one on this title page, the manual contains revisions that do not apply to your instrument. Backdating information given in the manual adapts it to earlier instruments.

## **WARNING**

*These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.*

-hp- Part No. 03551-90002  
(Complete Manual, including Binder)

Binder Part No. 03551-90011  
(Includes Cover Inserts, No Pages)

3551A Manual Loose Leaf Pages only,  
Part No. 03551-90001

Microfiche Part No. 03551-90051

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Table 1-2. General Information.

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>RECEIVER:</b></p> <p>Level Measurements:</p> <p>Frequency range: 40 Hz to 60 kHz</p> <p>Dynamic range: + 15 dBm to - 70 dBm</p> <p>Resolution: 0.1 dB</p> <p>Sample rate: 10/second (NORMAL), 2/second (DAMPED)</p> <p>Detector type: average responding.</p> <p>Noise Measurements:</p> <p>Dynamic range</p> <p>Message circuit noise: 0 dBm to + 85 dBm.</p> <p>Noise-with-tone: 10 dBm to + 85 dBm (600 <math>\Omega</math>, 900 <math>\Omega</math>).</p> <p>Noise-to-ground: + 40 dBm to + 125 dBm.</p> <p>Resolution: 1 dB</p> <p>Sample rate: 2/second</p> <p>Detector type: Quasi RMS</p> <p>Weighting filters: C message, 3 kHz Flat, 15 kHz Flat, Program.</p> <p>Frequency Measurements:</p> <p>Frequency range: 40 Hz to 60 kHz</p> <p>Dynamic range: + 15 dBm to - 70 dBm.</p> <p>Resolution: 1 Hz (40 Hz to 10 kHz).</p> <p>10 Hz (10 kHz to 60 kHz).</p> <p>Sample rate: 10/second (NORMAL), 2/second (DAMPED)</p> <p><b>TRANSMITTER:</b></p> <p>Frequency range: 40 Hz to 60 kHz</p> <p>Ranges: 40 Hz to 600 Hz</p> <p>200 Hz to 6 kHz.</p> <p>2 kHz to 60 kHz</p> <p>1004 Hz fixed.</p> <p>Resolution: 1 Hz (40 Hz to 10 kHz).</p> <p>10 Hz (10 kHz to 60 kHz).</p> <p>Sample rate: 10/second</p> <p>Level range: + 10 dBm to - 60 dBm (40 Hz to 60 kHz).</p> <p>+ 6 dBm to - 60 dBm (Hold Tone).</p> <p>Resolution: 0.1 dB.</p> <p>Sample rate: 10/second.</p> | <p><b>GENERAL</b></p> <p>Monitor: built-in speaker, monitors received or transmitted signal.</p> <p>Balanced impedances: 135 <math>\Omega</math>, 600 <math>\Omega</math>, 900 <math>\Omega</math>.</p> <p>Maximum input/output voltage: 300 V dc metallic or 200 V peak longitudinal.</p> <p>Battery supply: 4 - 6 hours continuous operation on internal rechargeable batteries at 25°C. Battery drain is automatically turned off when discharged below proper operating level.</p> <p>Complete recharge in 12 hours.</p> <p>AC line: 100 V, 120 V, 200 V, 240 V <math>\pm</math> 10%;</p> <p>48 Hz to 66 Hz; 15 VA.</p> <p>Temperature range:</p> <p>Operating: 0°C to 55°C (32°F to 130°F).</p> <p>Storage: - 20°C to 65°C (- 4°F to 149°F).</p> <p>Relative humidity: 0 to 95% (&lt; 100°F, &lt; 40°C).</p> <p>Weight:</p> <p>Net: 6.6 kg (13 lb).</p> <p>Shipping: 7.3 kg (16 lb).</p> <p><b>Outline Drawing:</b></p> <p>NOTE: Dimensions in millimeters and (inches).</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## SECTION II

### INSTALLATION

#### 2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installation and interfacing the Test Set. Included are initial inspection procedures, power and grounding requirements, environmental information, installation instructions, interfacing and instructions for repackaging for shipment.

#### 2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of marks or scratches and operating correctly upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. If damage has occurred, file a claim with the carrier. Test the electrical performance of the instrument using the Performance Test Procedures outlined in Section V. If there is damage or deficiency see the warranty on the reverse side of the title page in this manual.

#### 2-5. POWER REQUIREMENTS.

2-6. The Test Set can be operated from the internal battery pack or from an external ac power source. Paragraph 2-7 explains the internal battery characteristics. Paragraph 2-13 explains the external ac power source characteristics.

#### NOTE

*The Test Set cannot be operated in the battery mode while an external ac power source is connected to the instrument.*

#### 2-7. Battery.

2-8. The internal battery pack consists of three rechargeable battery packs (+5 V, +12 V and -12 V) which provides four to six hours of continuous use without needing to be recharged. To recharge the battery, plug the Test Set into an external ac power source and press the POWER pushbutton labeled OFF or ~ AC. Recharging time for the batteries is approximately 12 hours.

2-9. The battery packs may be charged at temperatures between 5°C and 40°C (41°F to 104°F), but will accept a greater charge if the temperature is between 5°C and 25°C. Figure 2-1 shows the decrease in charge acceptance at temperatures up to 40°C. Charging at temperatures outside the specified range may cause the batteries to vent, with a resulting decrease in capacity.

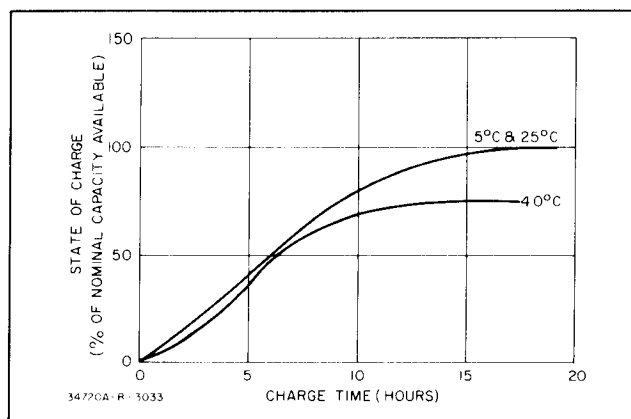


Figure 2-1. Battery Charge Acceptance vs. Temperature.

2-10. When possible the batteries should be stored in the discharged state. If the batteries are stored in the charged state they should be recharged for a period of 14 to 15 hours every 3 months. If this is not done, significant loss of battery capacity will occur. To minimize self-discharge during storage the batteries should be stored at a temperature of 20°C or lower. Although a nickel-cadmium battery will eventually lose all of its charge through self discharge it can be returned to service with a normal recharge.



*Permanent battery damage may result if the batteries are stored at high temperatures for a prolonged period.*

2-11. The cycle-life of the batteries is based, by the manufacturer, on an end point of 80% of the rated 225 milliampere-hour capacity. This is with a ten hour charge and discharge current of 22.5 milliamperes with discharge carried to the normal ten-hour end voltage (1.10 Volts/battery) of every cycle. Under these conditions a cycle-life in excess of 100 cycles can be expected.

2-12. The internal power supply has a sensing circuit which monitors the three battery voltages. If battery voltage falls below minimum operating level (approximately +4 V dc for the +5 V dc battery and ±10 V dc for the respective ±12 V dc batteries), the voltage is automatically switched off to all circuitry except the sensing circuit. See Paragraph 2-5 for recharging procedures. Section V contains information concerning replacement of the batteries.

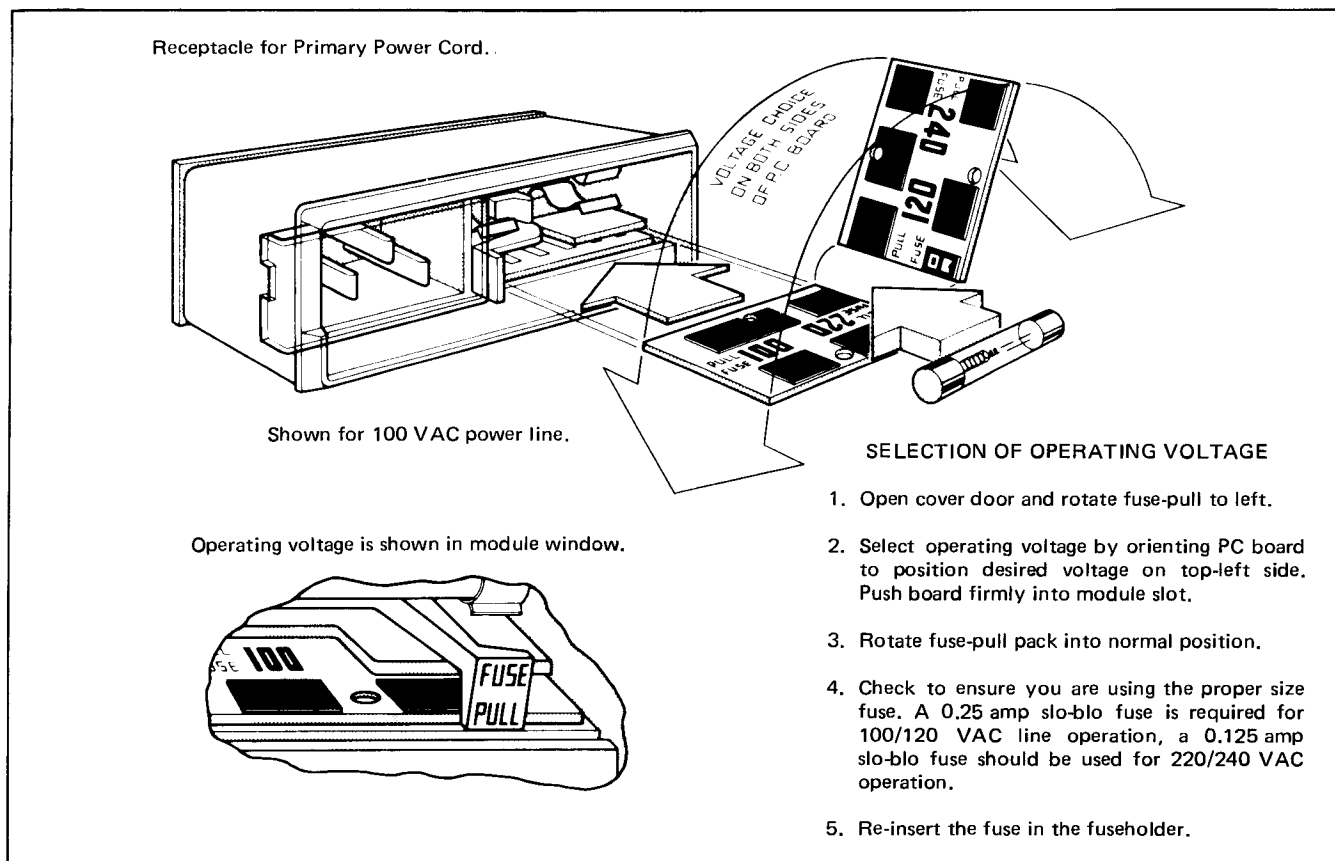


Figure 2-2. Voltage Selection.

### 2-13. AC Power.

2-14. The Test Set can be operated from any power source supplying 100 V ac, 120 V ac, 220 V ac or 240 V ac (- 10% + 5%), 48 Hz to 66 Hz. Power dissipation is 15 VA maximum. The Test Set is set for 120 V operation at the factory. If it is necessary to change the primary voltage setting, refer to Figure 2-2.



*If the instrument is not set for the proper primary voltage and not properly fused, it may be seriously damaged.*

### 2-15. Power Cords and Receptacles.

2-16. Figure 2-3 illustrates the standard configurations used for ac power cords. The -hp- part number directly above each drawing is the part number for an instrument power cord with a connector of that configuration. If the appropriate power cord is not received with your instrument, notify the nearest -hp- Sales and Service Office and a replacement cord will be provided.

### 2-17. Grounding Requirements.

2-18. To protect operating personnel, the National Elec-

trical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Test Set is equipped with a three conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power plug is the ground connection.

### WARNING

*For operator protection connect the front panel ground terminal to earth ground when operating in the battery mode.*

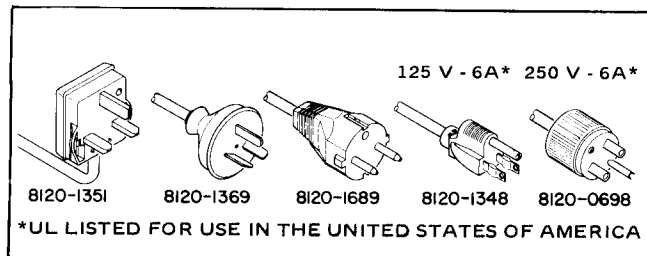


Figure 2-3. Power Cords.

## SECTION III

### OPERATING INSTRUCTIONS

#### 3-1. INTRODUCTION.

3-2. This section contains information and instructions necessary for proper operation of the Transmission Test Set. Included is a brief description of instrument capabilities, power and warm-up information, a functional description of all controls, indicators and connectors, and operating procedures.

#### 3-3. INSTRUMENT CAPABILITIES.

3-4. The Test Set is designed to measure frequency and level of tone or noise on telecommunication circuits, while simultaneously providing calibrated test signals. It is ideally suited for measurements on voice program and data circuits. The input is capable of accepting both two-wire and four-wire balanced lines. Frequency or level measurements of received signals can be made in either a bridged or terminated mode. Terminated impedances can be selected at 135 ohm, 600 ohm or 900 ohm. The source impedance of the calibrated test signals is always equal to the selected terminating impedance.

3-5. Additional features of the Test Set include: digital LED display of level and frequency of received signals or the calibrated test signal; automatic resolution, time constants and sample rate for tone and noise level measurements and frequency measurements; dial and hold facilities; a choice of four weighting filters (C message, 3 kHz flat, 15 kHz flat or program); and ac power operation or rechargeable battery pack.

#### 3-6. POWER AND WARM-UP.

3-7. The Test Set can be operated from an internal battery pack, or from an external ac power source. The internal battery pack will provide four to six hours of continuous use without needing to be recharged. The internal power supply contains a sensing circuit, which monitors the battery voltage. If the voltage drops too low for proper operation, the voltage is automatically switched off to all circuitry except the sensing circuit. To recharge the batteries, simply plug an external ac power source into the Test Set.

#### NOTE

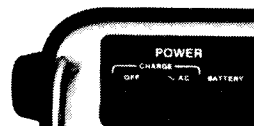
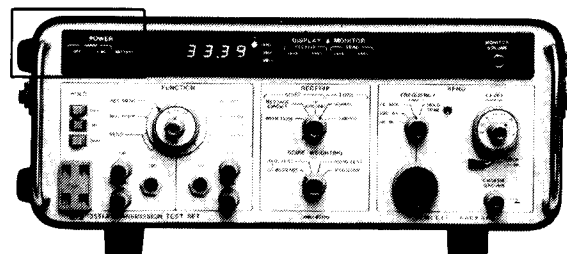
*Do not operate the Test Set in the BATTERY mode while it is connected to an external ac source. The instrument will not operate under these conditions. Refer to Section V for battery replacement. The Test Set can be operated from a 100 V, 120 V, 220 V or a 240 V external ac power source. Ensure that the ac*

*power module is set for the ac voltage used, and the proper fuse is used. For instructions on setting the power module and selecting the fuse, see Section II, Paragraph 2-5.*

3-8. The Test Set should be allowed to warm up for a minimum of five minutes before use. This allows the instrument to stabilize.

#### 3-9. FRONT PANEL CONTROLS.

3-10. In the following description the front panel controls, indicators and connectors have been divided into functional groups. The functional groups are: power, dial and hold, input/output function select, receive, send, and display and monitor. For step-by-step operation, refer to Paragraph 3-47.



#### 3-11. Power.

3-12. Input power to the Test Set is controlled by three pushbutton switches (OFF, AC and BATTERY).

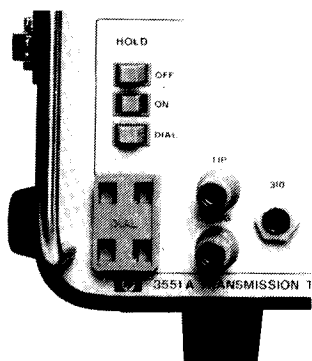
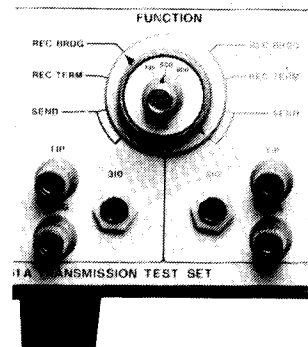
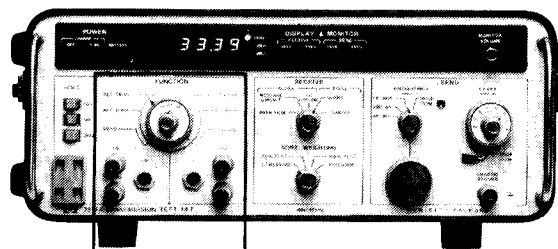
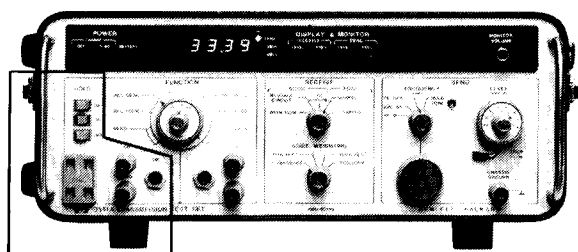
#### WARNING

*For operator protection connect the front panel ground terminal to earth ground when operating in the battery mode.*

To turn on the Test Set, press the AC pushbutton if external ac power is connected, or the BATTERY pushbutton if no external ac power is available.

#### NOTE

*Do not try operating the Test Set in the BATTERY mode while it is plugged into an external ac source. The instrument will not operate under these conditions. For information concerning warm-up conditions, refer to Paragraph 3-6. For information concerning external power and fuse specifications and selection, refer to Paragraph 2-5, Section II.*



### 3-13. Dial and Hold.

3-14. The dial and hold operation is controlled by three pushbutton switches (OFF, ON and DIAL). This operation allows the operator to connect a lineman's handset to the DIAL terminals, dial a line and connect a hold circuit across the dialed line. When the DIAL pushbutton is pressed, the two terminals labeled DIAL, are connected in parallel with the input/output terminals TIP and RING (labeled in black) and the 310 input/output jack (labeled in black). After the line has been seized, the ON pushbutton will connect an internal holding circuit in parallel with the same input/output terminals. To release the line, the pushbutton labeled OFF is pressed.

#### NOTE

*If a dry line is connected to the black input/output terminals, the HOLD OFF pushbutton must be pressed.*

### 3-15. Input/Output Function Select.

3-16. The input/output function select section contains the input/output terminals, the input/output function select switch, and the impedance switch.

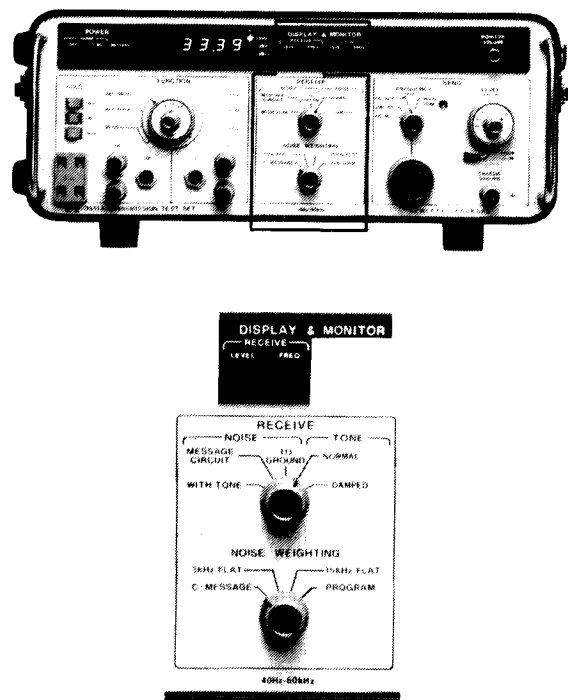
3-17. The Test Set has two sets of input/output terminals. Each set consists of a Western Electric 310 jack connected in parallel with two binding posts. The binding posts, labeled TIP and RING, will each accept a standard sized banana plug. The two binding posts for each set are spaced so they will also accept a standard sized dual banana plug (see Section II, Paragraph 2-24, for interfacing information).

3-18. Either set of the input/output terminals can be used to receive or send. When one set is connected for receiving, the other set is simultaneously connected for sending. The selection of terminals is determined by the position of the input/output function select switch.

3-19. The input/output function select switch has four positions for each set of terminals—two send (SEND) positions, and two receive (REC BRDG, REC TERM) positions. The send positions connect the corresponding terminal set to the Test Set Send Oscillator. The operator is then provided with a calibrated test signal at this terminal set (see Paragraph 3-35 and Table 3-6). The receive position connects the corresponding terminal set to the Test Set receive circuits. The operator can connect a transmission line to this terminal set for making desired frequency and level measurements (see Paragraph 3-21 and Table 3-3).

3-20. The Test Set input/output impedance is determined by the position of the input/output function select switch, and the IMP (impedance) switch. In the REC TERM

position and the SEND position of the input/output function select switch, the impedance of the corresponding terminal sets can be selected by the IMP switch. Three impedance selections are available—135 ohm, 600 ohm and 900 ohm. The impedance terminations are protected by a dc blocking capacitor. Accidental application of battery voltage, or ringing voltage to the input will not damage the instrument.



### 3-21. Receive.

3-22. The receive function of the Test Set is controlled by the RECEIVE NOISE/TONE switch, NOISE WEIGHTING switch, and DISPLAY MONITOR RECEIVE control. The Test Set is capable of measuring noise with tone, message circuit noise, noise to ground, and tone in the range of 40 Hz to 60 kHz. For noise measurements, there are four weighting filters available—C message, 3 kHz Flat, 15 kHz Flat and Program. All measurements can be made for level or frequency. The results of these measurements are displayed in digital form, and can be monitored by a speaker.

3-23. **Receive Noise/Tone.** The RECEIVE NOISE/TONE switch selects the receive mode of operation. There are three noise measuring modes available (noise with tone, message circuit noise, and noise to ground) and two tone modes (40 Hz - 60 kHz), NORMAL and DAMPED.

3-24. **Noise with Tone Mode.** Noise measurements with tone may be used to give a measure of the noise encountered by a continuous data signal, or the noise a

listener would hear during a speech burst. In the WITH TONE position of the RECEIVE NOISE/TONE switch, a sharp notch filter is switched into the Test Set input circuitry. The notch filter is designed to filter out a 1004 Hz signal applied at the transmitting station. Once the tone has been filtered out at the receive end, the noise can be applied to a weighting filter (usually C message), then measured. The dynamic measurement range in the noise with tone mode is 10 dBrn to 85 dBrn.

3-25. **Message Circuit Noise Mode.** In the MESSAGE CIRCUIT position of the RECEIVE NOISE/TONE switch, background noise can be measured with both input lines isolated from earth ground. The input lines can be either bridged or terminated. Terminating impedances are 135 ohms, 600 ohms, or 900 ohms. Any of the four weighting filters can be used. Dynamic range for the message circuit noise mode is 0 dBrn to 85 dBrn.

3-26. **Noise-to-Ground Mode.** In the TO GROUND position of the RECEIVE NOISE/TONE switch, the noise level between two balanced lines and ground can be measured. The signal is applied to ground through a 40 dB pad in the Test Set. The loss due to the 40 dB pad is automatically adjusted for in the Test Set display circuits. It is necessary to establish a good earth or system ground and connect it to the Test Set front panel ground binding post for this measurement. The dynamic range of the noise-to-ground mode is 40 dBrn to 125 dBrn.

3-27. Message circuit noise indications and noise-to-ground indications of a balanced line can be used to compute the balance of a line. The degree of balance, where the greater part of background noise is due to noise-to-ground, is given by the equation, Balance (in dB) = Message circuit noise minus noise-to-ground. For example, if the message circuit noise level is 26 dBrn and the noise-to-ground level of the same circuit is 90 dBrn, the balance is  $26 - 90 = 64$  dB.

3-28. **Tone Mode.** In the NORMAL position of the RECEIVE NOISE/TONE switch, tone level and frequency measurements can be made in the frequency range of 40 Hz to 60 kHz and a dynamic range of -70 dBm to +15 dBm. These measurements can be used for determining loss and attenuation distortion on message trunks and data service. Level measurements can also be used in conjunction with noise measurements to determine the signal-to-noise ratio on a circuit. In the tone mode the noise weighting filters are bypassed. In the DAMPED position, the sample period is extended to increase readability of the display when noise is present.

3-29. **Noise Weighting.** The RECEIVE NOISE WEIGHTING switch selects one of four weighting filters for noise measurements. The weighting filters are: C message, 3 kHz Flat, 15 kHz Flat, and Program.

3-30. **C Message.** The C message filter has a frequency response which simulates the effects of noise on the human ear. This weighting is also used to evaluate the effects of noise on voice-grade data circuits. The frequency response of this filter is shown in Figure 3-1.

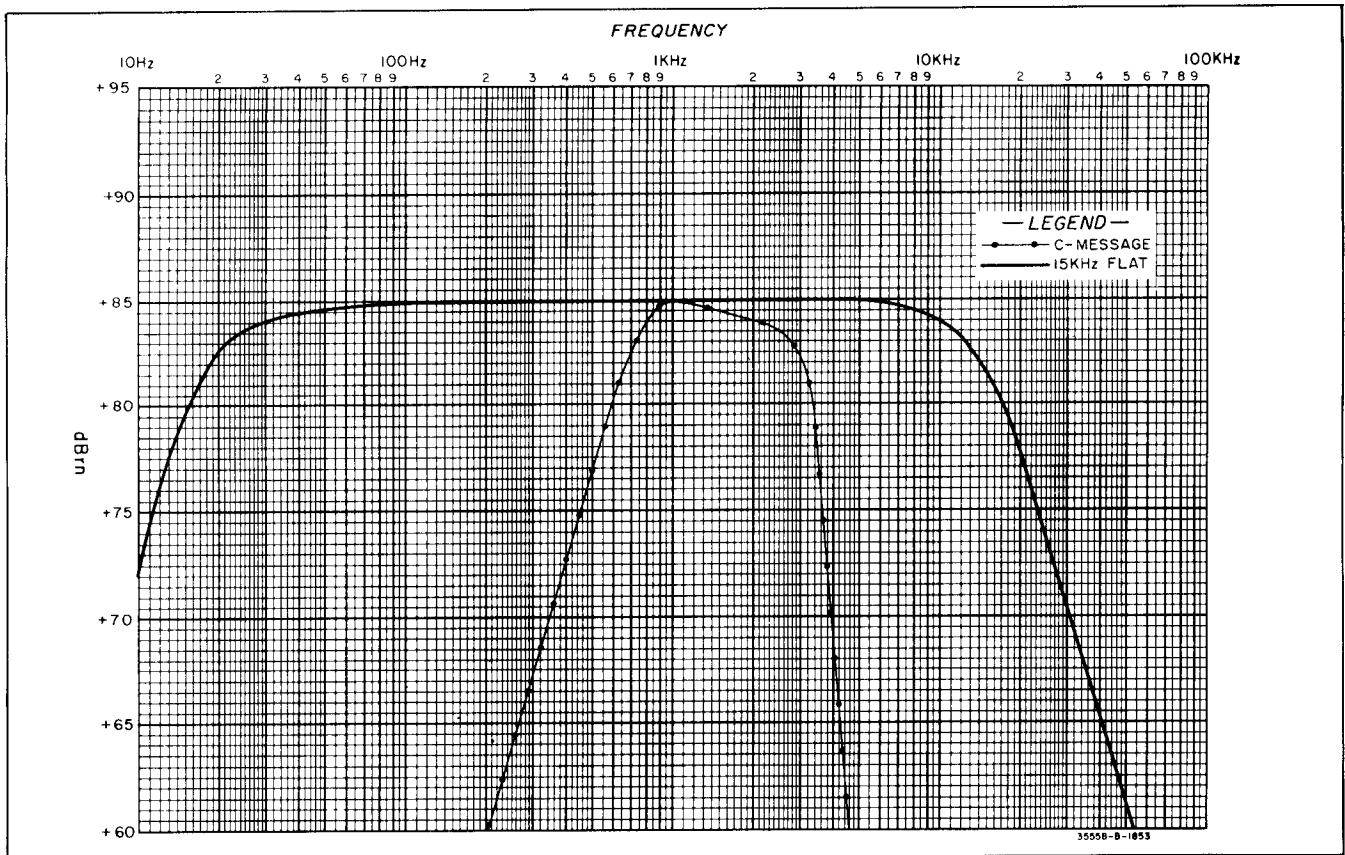


Figure 3-1. C-MSG and 15 kHz FLAT Weighting Curves.

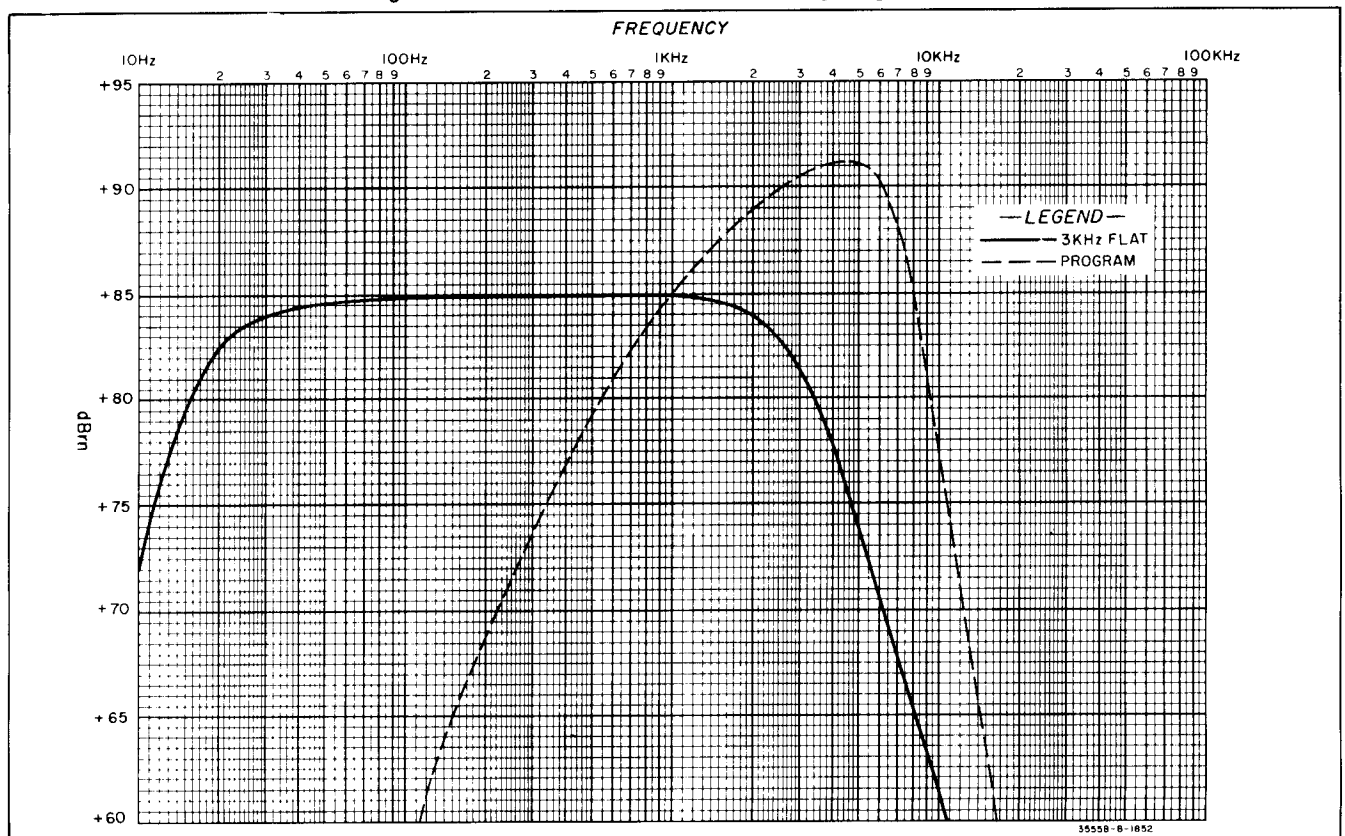


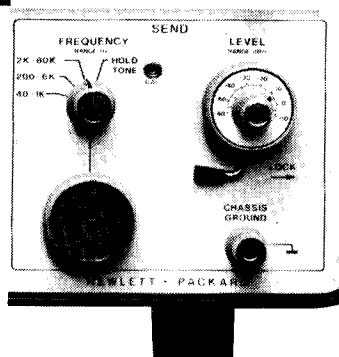
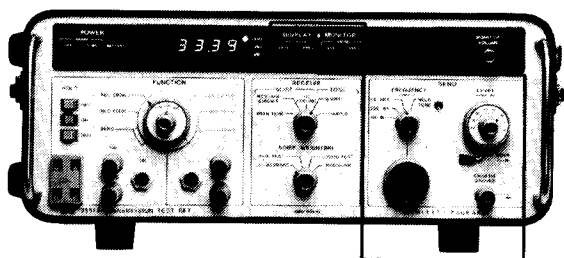
Figure 3-2. 3 kHz FLAT and Program Weighting Curves.

**3-31. 3 kHz Flat.** The 3 kHz Flat weighting filter is used on voice frequency circuits when investigating low-frequency noise, such as power induction. The frequency response of this filter is shown in Figure 3-2.

**3-32. 15 kHz Flat.** The 15 kHz Flat filter is used for unweighted measurements of noise on radio and television studio-transmitter and studio-remote audio links. The frequency response of this filter is shown in Figure 3-1.

**3-33. Program.** The Program filter is used for weighted measurements of noise on radio and television studio-transmitter and studio-remote audio links. The frequency response of this filter is shown in Figure 3-2.

**3-34. Display Monitor Receive.** The DISPLAY MONITOR RECEIVE pushbuttons select the display function desired for the received signal. Two functions, level or frequency, are available. Both level and frequency are fully auto-ranging. For a complete description of the display and monitoring operation, refer to Paragraph 3-40.



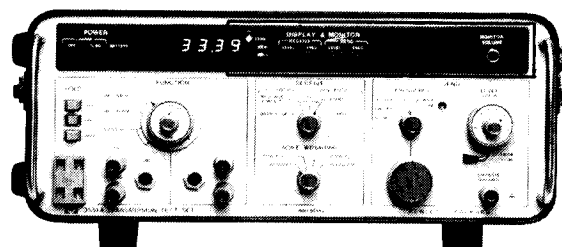
### 3-35. Send.

**3-36.** The send function of the Test Set provides the operator with a calibrated test signal at the output jack. The test signal can be variable in frequency from 40 Hz to 60 kHz, or a steady tone of 1004 Hz. The amplitude of the test signal is variable from -60 dBm to +10 dBm. Both frequency and amplitude can be monitored.

**3-37. Frequency.** The send frequency is controlled by the SEND FREQUENCY RANGE Hz switch and the frequency vernier control. There are three overlapping range positions, and one steady tone position. The range positions are 40 Hz to 600 Hz, 200 Hz to 6 kHz, and 2 kHz to 60 kHz. The hold tone position provides a 1004 Hz tone. A front panel screwdriver adjustment allows operator calibration of the tone. The frequency vernier is a dual (coarse and fine) frequency control.

**3-38. Level.** The send level is controlled by the SEND LEVEL RANGE dBm switch and the level vernier. There are seven range positions on the range switch: -60 to -50, -50 to -40, -40 to -30, -30 to -20, -20 to -10, -10 to 0, 0 to +10. The range of the level vernier is greater than 10 dBm.

**3-39. Display Monitor Send.** The DISPLAY MONITOR SEND pushbuttons select the display function desired for the send signal. Two functions, level or frequency, are available. Both level and frequency are fully autoranging. For a complete description of the display and monitoring operation, refer to Paragraph 3-40.



### 3-40. Display-Monitor.

**3-41.** The display monitor function of the Test Set is controlled by the DISPLAY MONITOR RECEIVE/SEND pushbuttons and MONITOR VOLUME vernier. It features a digital LED display for visual indications of frequency and level measurements, and a speaker for audio aid in identifying transmission line noise.

**3-42. Display.** The display provides digitally controlled LED readout of both the send frequency and level, and the receive frequency and level. Send and receive frequency indications are displayed in four digits expressed in kHz units. Send level measurements and receive tone level measurements are displayed in three digits expressed in dBm. Receive noise level measurements are displayed in two digits expressed in dBm.

3-43. For frequency measurements below 10 kHz, the resolution is 1 Hz. For frequency measurements above 10 kHz, the resolution is 10 Hz. Tone level measurements are displayed with a 0.1 dB resolution. Noise level measurements are displayed with a 1.0 dB resolution.

3-44. Sample rate for frequency measurements and tone level measurements is 10/sec in NORMAL position and 2/sec in DAMPED. The sample rate for noise measurements is 2/sec.

3-45. Ranging in both level and frequency measurements is fully automatic. If an out-of-range condition in input level occurs, it is indicated by blanking of the display digits and a flashing plus or minus sign. The flashing plus sign indicates the instrument input signal is too large. The flashing minus sign indicates the instrument input signal is too small. Table 3-1 lists the minimum and maximum input levels and their respective operating modes. Both frequency and level ranging occurs in either frequency measurements or level measurements. Consequently, blanking of frequency digits will occur if the level of the input signal is out-of-range.

**Table 3-1. Input Levels.**

| Operating Mode                                          | Minimum Level | Maximum Level |
|---------------------------------------------------------|---------------|---------------|
| Receive noise with tone                                 | 10 dBm        | 85 dBm        |
| Receive message circuit noise                           | 0 dBm         | 85 dBm        |
| Receive noise to ground                                 | 40 dBm        | 125 dBm       |
| Receive tone, send level and all frequency measurements | -70 dBm       | +15 dBm       |

**3-46. Monitor.** The audio monitor provides the operator audio indications of input signals. A monitor volume control is available for regulation of the audio signal. Care

should be taken not to use the audio facility at maximum volume for extended lengths of time while operating in the battery mode. This causes a large drain on the battery.

### 3-47. OPERATION.

3-48. Tables 3-2 through 3-7 list the step-by-step procedures for dial and hold operation, making level and noise measurements, operating the Test Set send unit, and making balance and transmission loss measurements. For a detailed description of each of the controls used in these procedures, refer to Paragraph 3-9. For power and warm-up information, refer to Paragraph 3-6.

**Table 3-3. Receive Tone Level and Frequency Measurements.**

| Step | Procedures                                                                        |
|------|-----------------------------------------------------------------------------------|
| 1.   | Turn the Test Set POWER on.                                                       |
| 2.   | Set the FUNCTION switch to REC BRDG or REC TERM for desired input terminals.      |
| 3.   | Set the IMP switch for the desired input impedance.                               |
| 4.   | Set the RECEIVE NOISE/TONE switch to the NORMAL position.                         |
| 5.   | If the display is too noisy to read, set the RECEIVE NOISE/TONE switch to DAMPED. |
| 6.   | Select the DISPLAY - MONITOR RECEIVE mode (LEVEL or FREQ) desired.                |
| 7.   | Connect the line to be measured to the input terminals chosen in Step 2.          |

**Table 3-2. Dial and Hold Operation.**

| Step | Procedures                                                                       |
|------|----------------------------------------------------------------------------------|
| 1.   | Turn the Test Set POWER on.                                                      |
| 2.   | Press the HOLD OFF pushbutton.                                                   |
| 3.   | Connect a linemans handset (butt-in) to the DIAL terminals.                      |
| 4.   | Set the FUNCTION switch to REC BRDG or REC TERM for the black labeled terminals. |
| 5.   | Set the IMP switch to the desired impedance.                                     |
| 6.   | Connect the line to the 310 jack or TIP RING terminals labeled in black.         |
| 7.   | Press the HOLD DIAL pushbutton and dial with the handset (butt-in).              |
| 8.   | Press the HOLD ON pushbutton to maintain connection during test.                 |

**Table 3-4. Message Circuit Noise and Noise with Tone Measurements.**

| Step | Procedures                                                                   |
|------|------------------------------------------------------------------------------|
| 1.   | Turn the Test Set POWER on.                                                  |
| 2.   | Set the FUNCTION switch to REC BRDG or REC TERM for desired input terminals. |
| 3.   | Set the IMP switch for the desired input impedance.                          |
| 4.   | Select the RECEIVE NOISE/TONE mode desired (MESSAGE CIRCUIT or WITH TONE).   |
| 5.   | Select the desired weighting filter.                                         |
| 6.   | Press the DISPLAY-MONITOR RECEIVE LEVEL pushbutton.                          |
| 7.   | Connect the line to be measured to the input terminals chosen in Step 2.     |

resistor produces 40 dB of attenuation. To correct for this loss, the controller supplies the display with a 40 dB correction factor (see Paragraph 4-75).

4-35. In the MESSAGE CIRCUIT and the NORMAL and DAMPED positions of the RECEIVE NOISE/TONE switch the receive signal bypasses the notch filter and load resistor. This signal is applied directly to the DISPLAY and MONITOR switching networks.

**Table 4-1. FET Switch Status for Input to Receive Circuit and Automatic Ranging.**

| Display Switch Positions              | FET Switch Status |        |        |        |        |
|---------------------------------------|-------------------|--------|--------|--------|--------|
|                                       | Q300              | Q301   | Q302   | Q304   | Q308   |
| Receive Level or Receive Freq Pressed | Open              | Closed | Open   | Open   | Closed |
| Send Level or Send Freq Pressed       | Closed            | Open   | Closed | Closed | Open   |

#### 4-36. Automatic Ranging Circuit.

4-37. **Tone Measurements.** The automatic measuring circuit compresses the 85 dBm dynamic range of the input signal (+ 15 dBm to - 70 dBm) to a 15 dB dynamic range required by the logger in the measuring circuit. This 15 dB range is a changing dc level, proportional to approximately + 5 dBm to - 10 dBm. There is approximately 46 dB of amplification between the ranging circuit and the logger, therefore, the signal from the ranging circuit must be maintained between - 41 dBm and - 56 dBm.

#### NOTE

*The 46 dB amplification is nominal for 135 ohms input impedance and will vary for 600 ohms and 900 ohms input impedance. In the following description, the dBm levels given are simplifications of the actual dBm levels from instrument to instrument and may vary  $\pm 4$  dB.*

**Table 4-2. Input Signal Level vs. Range and Logger Input Level.**

| Input Signal Level |          | Range | Signal Level to Logger |
|--------------------|----------|-------|------------------------|
| + 85 dBm           | + 15 dBm | R0    | + 5 to - 10            |
| + 80 dBm           | + 10 dBm |       |                        |
| + 75 dBm           | + 5 dBm  |       |                        |
| + 70 dBm           | 0 dBm    | R1    | + 5 to - 10            |
| + 65 dBm           | - 5 dBm  |       |                        |
| + 60 dBm           | - 10 dBm |       |                        |
| + 55 dBm           | - 15 dBm | R2    | + 5 to - 10            |
| + 50 dBm           | - 20 dBm |       |                        |
| + 45 dBm           | - 25 dBm |       |                        |
| + 40 dBm           | - 30 dBm | R3    | + 5 to - 10            |
| + 35 dBm           | - 35 dBm |       |                        |
| + 30 dBm           | - 40 dBm |       |                        |
| + 25 dBm           | - 45 dBm | R4    | + 5 to - 10            |
| + 20 dBm           | - 50 dBm |       |                        |
| + 15 dBm           | - 55 dBm |       |                        |
| + 10 dBm           | - 60 dBm | R5    | + 5 to - 10            |
| + 5 dBm            | - 65 dBm |       |                        |
| 0 dBm              | - 70 dBm |       |                        |

4-38. The signal to the ranging circuit is applied to both a resistive divider network and a 10 dB amplifier. The output of the 10 dB amplifier is applied to a second resistive divider network. Each resistive divider network has four outputs for a total of eight ranges (0 to 7) (Table 4-2). The input signal is attenuated or amplified and attenuated to provide a signal level between - 45 dBm and - 60 dBm. Table 4-3 lists each range and its attenuation, amplification and range code.

4-39. The signals from the resistive divider networks are applied to a range select block. The range select block selects the desired signal from the resistive dividers and applies this signal to a 4 dB amplifier. The 4 dB amplifier increases the - 45 dBm to - 60 dBm signal from the resistive dividers to the required - 41 dBm to - 56 dBm. The selection is determined by a 4-2-1 binary signal from the controller (Table 4-3).

**Table 4-3. Range Codes, Attenuation and Gain.**

| Range | Range Bits |       |       | Attenuation (dB) | Gain (dB) |
|-------|------------|-------|-------|------------------|-----------|
|       | ARNG2      | ARNG1 | ARNG0 |                  |           |
| 0     | 0          | 0     | 0     | 60               |           |
| 1     | 0          | 0     | 1     | 50               |           |
| 2     | 0          | 1     | 0     | 40               |           |
| 3     | 0          | 1     | 1     | 30               |           |
| 4     | 1          | 0     | 0     | 30               | 10        |
| 5     | 1          | 0     | 1     | 20               | 10        |
| 6     | 1          | 1     | 0     | 10               | 10        |
| 7     | 1          | 1     | 1     | 0                | 10        |

4-40. The binary code from the controller is determined by the signal to the logger. If this signal is not between + 5 dBm and - 10 dBm, the controller will not receive the proper signal from the measurement circuit and will change the binary code. This will cause the range select block to either range up or down. The process repeats until the proper signal is received by the controller. For a detailed discussion on the measurement circuits refer to Paragraph 4-50.

Example 1:

1. Input signal level ..... - 7 dBm
2. Initial range position\* ..... 0
3. Attenuation (Table 4-3) ..... 60 dB
4. Output of select blocks ..... - 67 dBm
5. Output of 4 dB amplifier ..... - 63 dBm
6. Input to logger ..... - 17 dBm
7. Controller ranges down to range 1.
8. Attenuation (Table 4-3) ..... 50 dB
9. Output of select block ..... - 57 dBm
10. Output of 4 dB amplifier ..... - 53 dBm
11. Input to logger ..... - 7 dBm

\*The Test Set will always be in the 0 range position at instrument turn-on.

- 7 dBm is within the dynamic range of the measuring circuit (+ 5 dBm to - 10 dBm).

## Example 2:

1. Input signal level ..... - 32 dBm
2. Initial range position ..... 5
3. Attenuation (Table 4-3) ..... 20 dB  
Gain (Table 4-3) ..... 10 dB
4. Output of select block ..... - 42 dBm
5. Output of 4 dB amplifier ..... - 38 dBm
6. Input to logger ..... + 8 dBm
7. Controller ranges up to range 4.
8. Attenuation (Table 4-3) ..... 30 dB  
Gain (Table 4-3) ..... 10 dB
9. Output of select block ..... - 52 dBm
10. Output of 4 dB amplifier ..... - 48 dBm
11. Input to logger ..... - 2 dBm

## Example 3:

1. Input signal level ..... - 7 dBm
2. Initial range position ..... 2
3. Attenuation (Table 4-3) ..... 40 dB
4. Output of select block ..... - 47 dBm
5. Output of 4 dB amplifier ..... - 43 dBm
6. Input to logger ..... + 3 dBm

4-41. As indicated by Examples 1 and 3, there is an overlap between ranges. A - 7 dBm signal can be measured with the ranging circuit in either range 1 or range 2. The total overlap between any two consecutive ranges is 5 dB. For example, the signal of Examples 1 and 3 could be - 5 dBm to - 10 dBm and either range 1 or range 2 would provide the proper level to the logger (Table 4-2).

4-42. If the input signal is above + 15 dBm, the ranging circuit will range to the top range (range 0) and an overrange condition will be displayed (flashing plus sign and blanked digits). If the input signal is below - 70 dBm, the ranging circuit will range to the bottom range (range 7) and an underrange condition will be displayed (flashing minus sign, and blanked digits).

**4-43. Noise Measurements.** Noise measurements are ranged identically to the tone measurements. However, the 0 to 85 dBm dynamic range is referenced to - 90 dBm so the dBm dynamic range is - 90 dBm to - 5 dBm. This range is 20 dB lower than tone measurements, therefore, the signal must be amplified 20 dB more between the ranging circuit and the logger. There is 15 dB gain in the noise weighting filters and 5 dB gain in the detector in the measuring circuits. The total amplification between the ranging circuit and the logger is 66 dB for noise measurements.

## Example 4:

1. Input signal level ..... - 8 dBm  
In dBm, referenced to - 90 dBm . - 82 dBm
2. Range position ..... 7
3. Attenuation (Table 4-3) ..... 0 dBm  
Gain (Table 4-3) ..... 10 dBm
4. Output of select block ..... - 72 dBm
5. Output of 4 dB amplifier ..... - 68 dBm
6. Input to logger ..... - 2 dBm

**4-44. Noise Weighting Filters.**

4-45. There are four noise weighting filters provided with the Test Set (C-Message, 3 kHz Flat, 15 kHz Flat and Program). The filter used is selected by the front panel NOISE WEIGHTING switch. The noise weighting circuitry consists of five active filters and the switching sequence which determines the number of active filters used for each weighting. All active filters are bypassed when the RECEIVE NOISE/TONE switch is in the RECEIVE TONE position or when one of the DISPLAY and MONITOR SEND pushbuttons is pressed.

4-46. Each active filter is a two-pole filter which utilizes both positive and negative feedback. The positive feedback is used to regulate the frequency response. The negative feedback is used to control the gain.

**4-47. Input Amplifier and Audio Amplifier.**

4-48. The input amplifier is an operational amplifier which provides approximately 40 dB of amplification in the 135 ohm position of the front panel IMP switch. Since all level indications are in dBm the gain of the amplifier is decreased slightly in the 600 ohm position and again in the 900 ohm position. This is accomplished by increasing the negative feedback by switching in larger resistance to ground in the amplifiers feedback line with the front panel IMP switch.

4-49. The output of the input amplifier is applied to both the measuring circuit and the audio amplifier. The audio amplifier consists of an operational amplifier and a complementary driver stage for driving an 8 ohm speaker. A front panel MONITOR VOLUME control regulates the amplifier gain.

**4-50. Measuring Circuits.**

4-51. There are two classes of measurements performed by the measuring circuits (frequency and level). The measuring circuits transpose the frequency or level information of the input signal to digital signals which are applied to the controller and display circuits. A mnemonic dictionary is included in Section VII (Tables 7-1, 7-2, and 7-3) for explanation of the mnemonics used in the following description.

**4-52. Frequency Measurements.** For frequency measurements, the input signal is buffered in the averaging detector and applied to a sine-wave-to-square-wave converter. The square wave output of the converter is applied to a comparator in the phase-lock loop.

4-53. The phase-lock loop consists of a voltage controlled oscillator (VCO), two dividing networks and a comparator (see Figure 4-3). The VCO output signal (MFREQ) is applied to the display circuitry for frequency display information (see Paragraph 4-61) and to the dividing networks. If the input frequency is greater than 10 kHz, the

$\div 10$  circuit is bypassed and only the  $\div 2$  circuit is used. If the input signal is less than 10 kHz, both the  $\div 10$  and the  $\div 2$  circuits are used. The selection of these circuits is determined by the H10KH and the H100K control signals from the controller. The controller bases the decision on the output frequency of the VCO (see Paragraph 4-64).

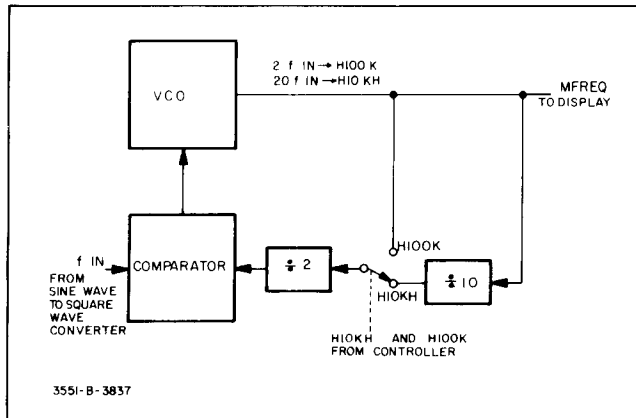


Figure 4-3. Phase-Lock Loop.

4-54. The output of the divide circuits is applied to the comparator in the phase-lock loop where it is compared with the signal from the sine-wave-to-square-wave converter. Any phase difference between these two signals will be developed as a dc error voltage and applied to the VCO to correct its frequency. The frequency of the VCO will therefore be equal to the input frequency multiplied by the  $\div$  number 2 or 20.

**4-55. Level Measurements.** There are two kinds of level measurements made (noise level and tone level). The noise level measurements use a quasi-rms detection process with a two/second reading rate. The tone level measurements use an average detection process with a reading rate of 10/second in the NORMAL position, and 2/second in DAMPED. Average detection level measurements are also performed for frequency measurements. This ensures the level of the signal input is large enough for proper instrument operation. Because there is no display of the level information in frequency measurements, the level measurement is performed very fast.

4-56. With both level measurements, the input signal is applied to an averaging detector and a peak detector. The output from the average detector is applied to a summer. The output from the peak detector is applied to a FET switch control. If the measurement to be made is a noise level measurement, the FET switch control signal (LNOIS) from the controller will be low. This will open the FET switch allowing the output of the peak detector to be applied to the summer. This increases the signal level to the logger approximately 5 dB. If the measurement to be made is a tone level measurement, LNOIS will be high and the peak detector output will be grounded.

4-57. In noise level measurements, the two signals applied to the summer from the peak detector and the averaging

detector are summed to provide the quasi-rms signal. This signal is then amplified, filtered and applied to a comparator in the logger circuit. In tone measurements, the signal applied to the summer from the averaging detector is amplified, filtered and applied to the comparator in the logger circuit.

4-58. The logger circuit consists of a comparator, a reference voltage circuit and an integrating capacitor (see Figure 4-4). At the beginning of the measurement sequence ( $T_0$ ,  $T_5$ ) the controller will set the HCAPD control signal high, closing the FET switch. This will allow the integrating capacitor to charge to the reference voltage. The controller then sets HCAPD low, opening the FET switch ( $T_1$ ,  $T_6$ ). The integrating capacitor discharges and the discharge voltage is applied to the comparator. The comparator compares the capacitive discharge signal with the signal from the summer. When these two signals are equal in level, the comparator will output a pulse (LXOVR) to the controller ( $T_5$ ,  $T_8$ ).

4-59. The controller measures the period between setting HCAPD low and receiving the LXOVR pulse. If LXOVR occurs during the first 5 ms after HCAPD goes low ( $T_1$ - $T_2$ ,  $T_6$ - $T_7$ ), the controller will interpret this as an overload condition and range the automatic ranging circuit up (see Paragraph 4-36). If LXOVR occurs between 5 ms and 20 ms after HCAPD goes low, ( $T_2$ - $T_5$ ,  $T_7$ - $T_{10}$ ), the controller interprets this as a valid signal and uses the exact time difference as the level information for the display (see Paragraph 4-70). If LXOVR occurs after 20 ms from HCAPD going low, the controller interprets this as an underload condition and ranges the automatic ranging circuit down.

4-60. As soon as LXOVR occurs, the controller will set HCAPD high and the measurement cycle will repeat. As noted on Figure 4-4, there is a 15 ms time interval in which the controller will accept LXOVR for level information to be displayed ( $T_2$ - $T_5$ ,  $T_7$ - $T_{10}$ ). This 15 ms time interval represents the 15 dB dynamic range of the measuring circuit as noted in Paragraph 4-37. Refer to Paragraph 4-70 for level display description.

#### 4-61. Display.

4-62. The display circuit consists of a data accumulator, a display ROM, a seven segment decoder and the LED display. The display circuit converts the information from the analog circuits or the controller into a digital readout. There are three display modes which correspond to the different measurement modes (frequency, tone level and noise level). For frequency measurements, the display readout is in kHz with four digits. Frequency resolution in the 10 kHz range is 1 Hz and in the 100 kHz range is 10 Hz. For tone level measurements, the display readout is in dBm with three digits and a resolution of 0.1 dB. For noise level measurements, the display readout is in dBm with two digits and a resolution of 1 dBm.

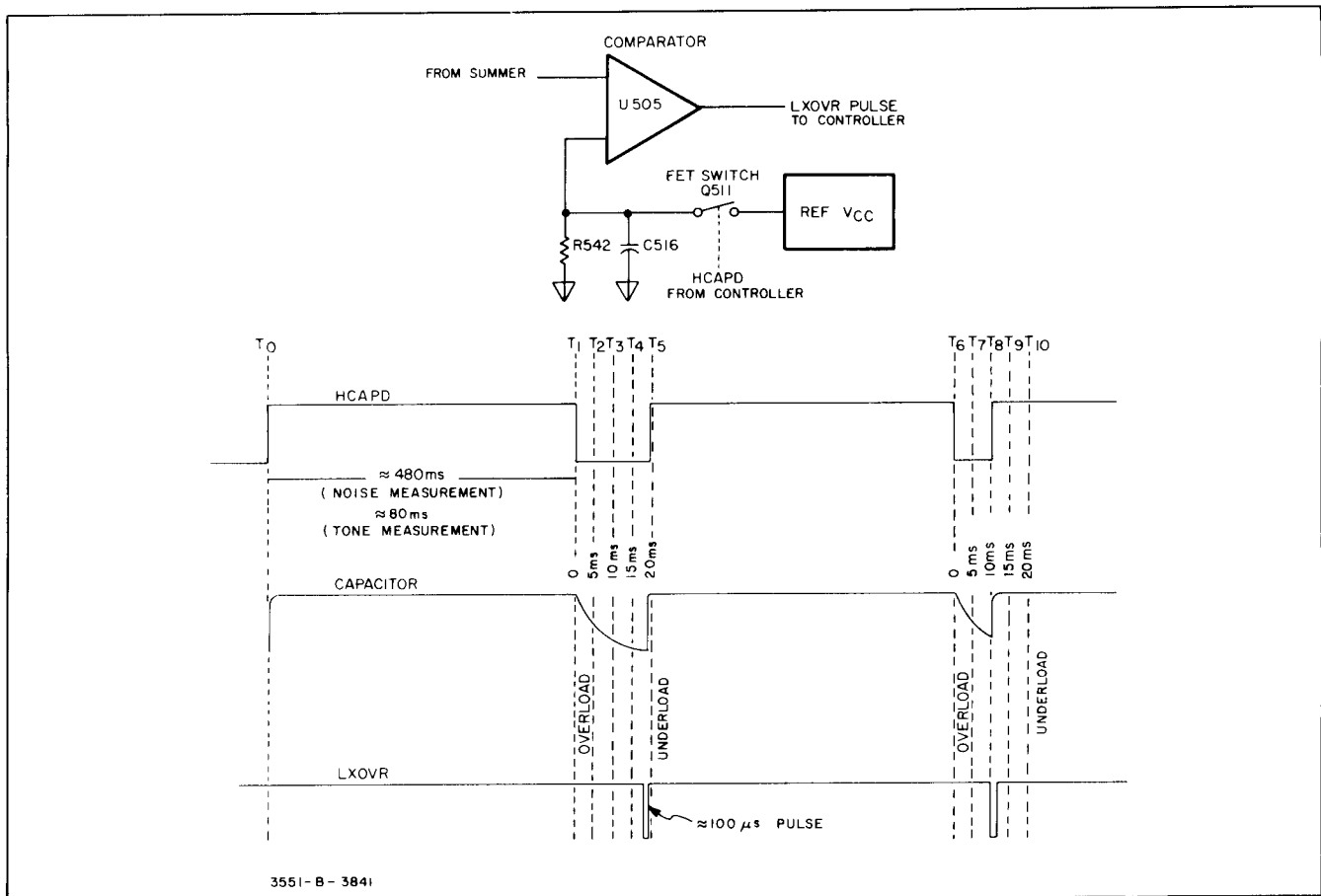


Figure 4-4. Logger.

4-63. The input signals for the display circuit are applied to the data accumulator. The data accumulator consists of a counter, data latches, a multiplexer, digit select decoder and output buffers (see Figure 4-5). At the beginning of the measurement, the controller will set the reset signal (HCTRT) high to initialize the counter and the digit select decoder.

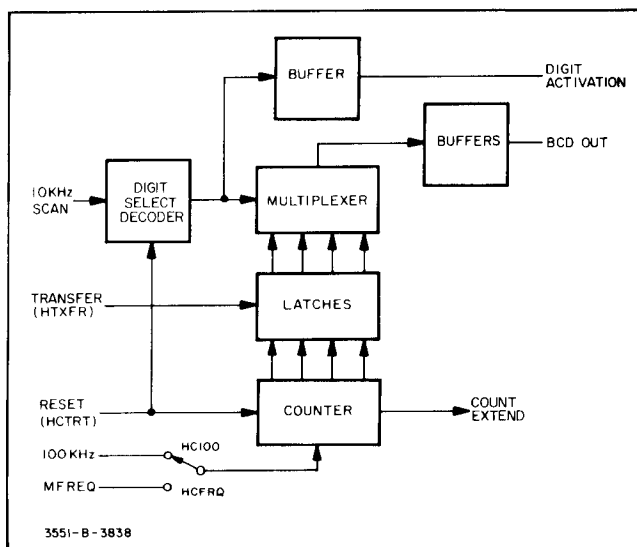


Figure 4-5. Data Accumulator.

4-64. **Frequency Measurements.** If the measurement to be made is a frequency measurement, the controller will set HCFRQ high and MFREQ (from the VCO in the measuring circuits, see Paragraph 4-50) will be input to the counter. The counter consists of four divide by 10 circuits. The output of each circuit is a BCD number representing one digit of the Test Set input frequency.

4-65. As noted in Paragraph 4-54, the MFREQ signal is equal in frequency to the Test Set input frequency multiplied by the divide number used. If, for example, the input frequency to the Test Set is 1000 Hz, the MFREQ frequency will be 20,000 Hz. This signal will be input to the counter for 50 ms. A 20,000 Hz signal input for 50 ms is equal to 1000 counts loaded into the counter. At the end of the 50 ms time period, the controller will set the transfer signal (HTXFR) high, storing the counter outputs in the latches.

4-66. The 10 kHz scan signal will gate each BCD signal from the latches, beginning with the most significant digit first, through the multiplexer to the output. At the same time that the 10 kHz scan gates the digits through the multiplexer, the gating signal is output to the display as a digit activation pulse.

4-67. The BCD output of the multiplexer is applied to the display ROM (Figure 7-12) where the polarity of the BCD

## SECTION V

### MAINTENANCE

#### 5-1. INTRODUCTION.

5-2. This section contains information and instructions necessary for maintenance of the Test Set. Included are a list of test equipment required, in-cabinet performance tests, adjustment procedures and disassembly information.

#### 5-3. RECOMMENDED TEST EQUIPMENT.

5-4. The equipment required for the maintenance of the Test Set is listed in Table 5-1. If the recommended model is not available, use a substitute that meets the required specifications given in the table.

#### NOTE

*Impedances matching networks are required to match the 50 ohm output of the 3320B Synthesizer used to supply the signals for these performance tests and the Test Set input im-*

*pedances. Figure 5-1 shows the network configurations for each impedance.*

#### 5-5. TEST RECORD.

5-6. A Performance Test Record is provided at the end of this section for the purpose of recording the Performance Tests. This form lists all the Performance Tests and their acceptable limits. The form can be removed from the manual and retained as a permanent record. It may be reproduced without written permission from Hewlett-Packard.

#### NOTE

*To ensure proper stabilization of all circuitry, allow a 30 minute warm-up period for the Test Set before beginning any performance tests or adjustment procedures.*

### PERFORMANCE TESTS

#### 5-7. PERFORMANCE TESTS.

5-8. The following performance tests compare the Test Set operation with the specifications listed in Table 1-1. These tests may be used for incoming inspection, periodic maintenance or to determine operation after repair. If the instrument fails to meet any of its specifications, perform the adjustment procedures outlined in Paragraph 5-34. During the Performance Tests, periodically vary the line voltage  $\pm 10\%$  with a power line transformer to determine operation at various ac line voltages.

#### 5-9. Receiver Level Accuracy.

5-10. This performance test determines if the Test Set meets the Receiver Level Measurement accuracy specifications listed in Table 5-2. These specifications are listed again in Table 5-2. The procedure for this performance test uses an oscillator to supply the signals over the frequency range and amplitude range specified. Where the accuracy specification is  $\pm 0.1$  dB, the oscillator signal is monitored with an ac voltmeter to ensure proper Test Set input level. The Test Set display indications are monitored to determine the Test Set accuracy.

Table 5-2. Receiver Level Measurement Accuracy.

| INPUT LEVEL (dBm) | FREQUENCY    |        |       |        |               |
|-------------------|--------------|--------|-------|--------|---------------|
|                   | 40 Hz        | 100 Hz | 1 kHz | 10 kHz | 20 kHz 60 kHz |
| +15               | $\pm 0.1$ dB |        |       |        | $\pm 0.3$ dB  |
| -30               |              |        |       |        |               |
| -65               | $\pm 0.3$ dB |        |       |        | $\pm 0.5$ dB  |
| -70               |              |        |       |        |               |

500 Hz  
135  $\Omega$  Impedance not specified below 500 Hz and -65 dBm

- Connect the equipment as shown in Figure 5-2.
- Set the Test Set front panel controls as follows:

HOLD ..... OFF  
FUNCTION  
(Black Input/Output Terminals) . REC TERM

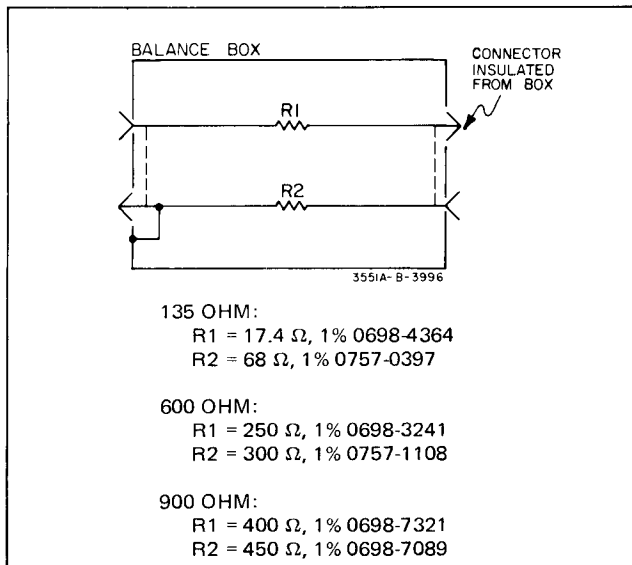


Figure 5-1. Impedance Box.

RECEIVE  
 NOISE/TONE. . . . . TONE NORMAL  
 DISPLAY & MONITOR ... RECEIVE LEVEL  
 IMP. . . . . 135  
 POWER. . . . . ~ AC

c. Adjust the 3320B for an output frequency of 500 Hz and an output signal level, monitored on the ac voltmeter, of 1.84 V ac.

d. The Test Set display should indicate +14.0 dBm  $\pm$  0.1 dB.

e. Repeat Steps c and d for the frequency settings listed in Table 5-3 under 135 impedance. The Test Set display

Table 5-3. Receiver Level Accuracy Test Frequencies.

|           | Impedance |        |        |
|-----------|-----------|--------|--------|
|           | 135       | 600    | 900    |
| Frequency | 500 Hz    | 100 Hz | 100 Hz |
|           | 1 kHz     | 1 kHz  | 1 kHz  |
|           | 10 kHz    | 1 kHz  | 1 kHz  |
|           | 20 kHz    | 10 kHz | 10 kHz |
|           | 40 kHz    | 20 kHz | 20 kHz |
|           | 60 kHz    | 40 kHz | 40 kHz |

indications and tolerances are listed in Table 5-4 in the column Input Level Settings, 1.84 V ac.

f. Repeat Steps c, d and e for the input level settings (under 135) and Test Set display indications listed in Table 5-4. For settings below a -23 dBm, disconnect the ac voltmeter and set the 3320B output level to the dBm settings listed under oscillator settings in Table 5-4.

g. Repeat Steps c, d, e and f for the 600 and 900 positions of the Test Set front panel IMP control. Use the 600 ohm and 900 ohm impedance box in series with the 3320B output.

#### 5-11. Transmitter Level Accuracy.

5-12. This performance test determines if the Test Set meets the Transmitter Level Accuracy specifications listed in Table 1-1. The specifications are listed again in Table 5-5. During normal operation to set the Test Set output signal level, the send oscillator output is internally applied to the receive circuits and indicated by the Test Set display. The send oscillator level controls are adjusted until the display

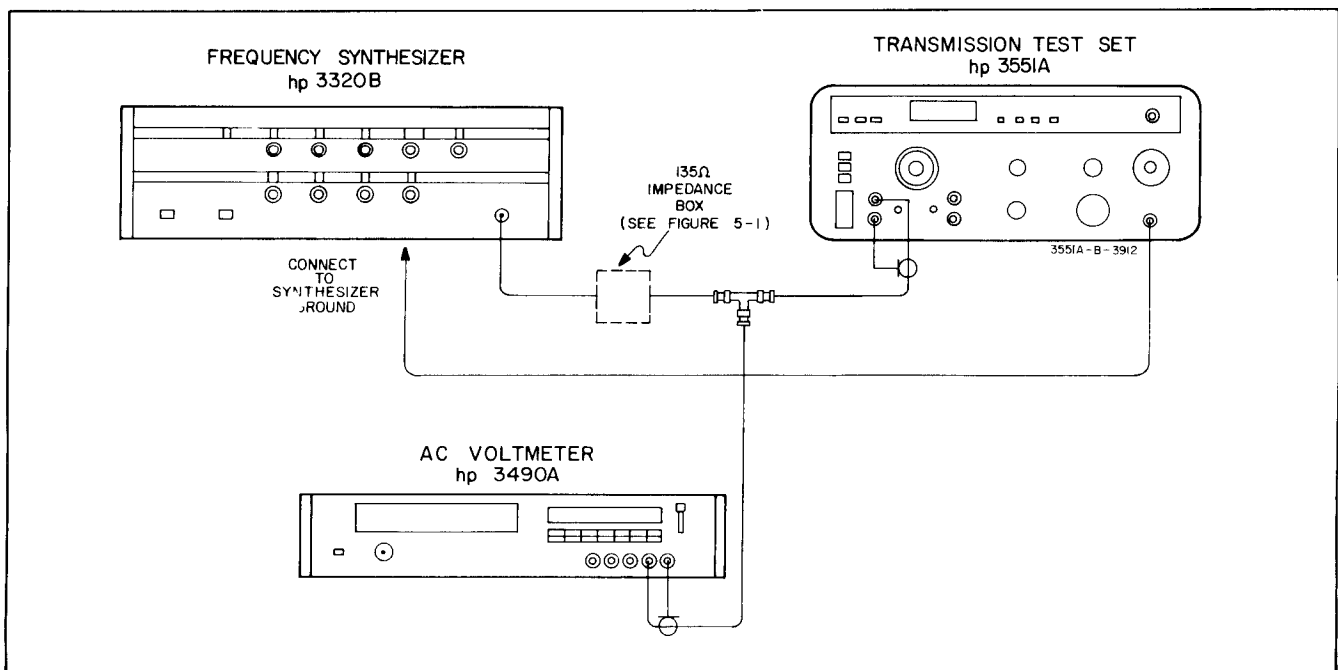


Figure 5-2. Receive Level Accuracy Test Setup.

Table 5-4. Receiver Level Accuracy Test Specifications.

| Input Level Settings<br>(AC Voltmeter, V ac) |        |        | Test Set Display                       |                                         |
|----------------------------------------------|--------|--------|----------------------------------------|-----------------------------------------|
|                                              |        |        | For Frequencies of<br>100 Hz to 20 kHz | For Frequencies of<br>40 kHz and 60 kHz |
| 135                                          | 600    | 900    |                                        |                                         |
| 1.84                                         | 3.88   | 4.75   | + 14.0 ± 0.1                           | + 14.0 ± 0.3                            |
| 1.46                                         | 3.08   | 3.78   | + 12.0 ± 0.1                           | + 12.0 ± 0.3                            |
| 1.16                                         | 2.45   | 3.00   | + 10.0 ± 0.1                           | + 10.0 ± 0.3                            |
| 0.922                                        | 1.95   | 2.38   | + 8.0 ± 0.1                            | + 8.0 ± 0.3                             |
| 0.733                                        | 1.55   | 1.89   | + 6.0 ± 0.1                            | + 6.0 ± 0.3                             |
| 0.582                                        | 1.23   | 1.50   | + 4.0 ± 0.1                            | + 4.0 ± 0.3                             |
| 0.462                                        | 0.975  | 1.19   | + 2.0 ± 0.1                            | + 2.0 ± 0.3                             |
| 0.367                                        | 0.775  | 0.949  | 0.0 ± 0.1                              | 0.0 ± 0.3                               |
| 0.260                                        | 0.548  | 0.672  | - 3.0 ± 0.1                            | - 3.0 ± 0.3                             |
| 0.0823                                       | 0.173  | 0.212  | - 13.0 ± 0.1                           | - 13.0 ± 0.3                            |
| 0.0260                                       | 0.0548 | 0.0672 | - 23.0 ± 0.1                           | - 23.0 ± 0.3                            |
| (synthesizer settings dBm)                   |        |        |                                        |                                         |
| - 28.7                                       | - 22.2 | - 20.4 | - 33.0 ± 0.3                           | - 33.0 ± 0.5                            |
| - 38.7                                       | - 32.2 | - 30.4 | - 43.0 ± 0.3                           | - 43.0 ± 0.5                            |
| - 48.7                                       | - 42.2 | - 40.4 | - 53.0 ± 0.3                           | - 53.0 ± 0.5                            |
| - 58.7                                       | - 52.2 | - 50.4 | - 63.0 ± 0.3                           | - 63.0 ± 0.5                            |

indicates the desired output level. For this reason, the level accuracy of the Test Set output is determined by the accuracy of the receive circuits. These circuits were tested in the previous performance test. It is only necessary, in this procedure, to test the frequency response of the Test Set output transformer and the overall range of the send oscillator level controls. The procedure uses a 3490A ac voltmeter to monitor the Test Set output signal at + 10 dBm over the specified frequency range. The range of the output level controls is then checked using the Test Set display.

a. Connect an ac voltmeter to the blue input/output terminals. Connect a 135 ohm resistor across these terminals.

b. Set the Test Set front panel controls as follows:

HOLD ..... OFF  
 FUNCTION  
 (Blue Input/Output Terminals) ..... SEND  
 IMP ..... 135  
 SEND FREQUENCY RANGE Hz. .... 40 - 1K  
 SEND LEVEL RANGE dBm. .... 0 to + 10  
 DISPLAY & MONITOR ..... SEND FREQ  
 POWER ..... ~ AC

Table 5-5. Transmitter Level Measurement Accuracies.

| OUTPUT LEVEL (dBm) | FREQUENCY |        |          |       |          |
|--------------------|-----------|--------|----------|-------|----------|
|                    | 40 Hz     | 100 Hz | 1 kHz    | 4 kHz | 60 kHz   |
| + 10               | ± 0.5 dB  |        | ± 0.2 dB |       | ± 0.5 dB |
| - 30               | ± 1 dB    |        | ± 0.3 dB |       | ± 1 dB   |
| - 60               |           |        |          |       |          |

500 Hz  
 135 Ω Impedance not specified below 500 Hz

c. Adjust the Test Set FREQUENCY vernier control for a Test Set display indication of 0.500 kHz.

d. Set the Test Set front panel DISPLAY & MONITOR control to SEND LEVEL.

e. Adjust the Test Set front panel SEND LEVEL vernier for a Test Set display of + 10.0 dBm.

f. The 3490A indication should be 1.16 V rms ± 0.03 V rms.

g. Repeat Steps c, d, e and f for the frequency settings listed in Table 5-3 under 135 impedance. For frequencies above 4 kHz, the 3490A tolerance should be ± 0.07 V rms.

h. Adjust the Test Set front panel SEND LEVEL vernier fully CW. The Test Set display indication should be greater than + 10.0 dBm.

i. Set the Test Set front panel SEND LEVEL RANGE dBm control to the - 10 to 0 position. The Test Set display indication should be greater than 0.0 dBm.

j. Repeat Step i for each of the remaining positions of the Test Set front panel SEND LEVEL RANGE dBm control. At each setting the Test Set display indication should be greater than the top indication of the range control position.

k. Set the Test Set front panel SEND LEVEL vernier fully CCW and the SEND LEVEL RANGE dBm control to the - 60 to - 50 position. The Test Set display indication should be less than - 60.0 dBm.

l. Set the Test Set front panel SEND LEVEL RANGE dBm control to the - 50 to - 40 position. The Test Set display indication should be less than - 50.0 dBm.

m. Repeat Step l for each of the remaining positions of the Test Set front panel SEND LEVEL RANGE dBm

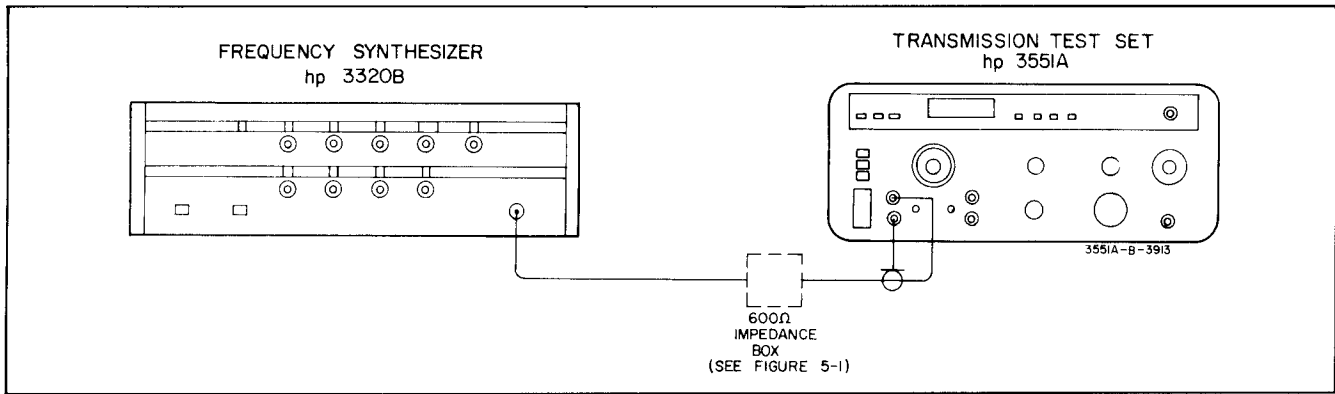


Figure 5-3. Frequency Accuracy Test Setup.

control. At each setting the Test Set display indication should be less than the bottom indication of the range control position.

### 5-13. Receiver Frequency Accuracy.

5-14. This performance test determines if the Test Set meets the Receiver Frequency Measurement Accuracy Specification listed in Table 1-1. The specification is  $\pm 1$  count. The procedure uses a 3320B Oscillator to supply the signals over the frequency range of the Test Set.

- Connect the equipment as shown in Figure 5-3.
- Set the Test Set front panel controls as follows:

HOLD ..... OFF  
 FUNCTION  
 (Black Input/Output Terminals) . REC TERM  
 IMP ..... 600  
 RECEIVE  
 NOISE/TONE. .... TONE NORMAL  
 DISPLAY & MONITOR .... RECEIVE FREQ  
 POWER ..... ~ AC

- Set the 3320B frequency to 40 Hz.
- The Test Set display should indicate 0.040 kHz  $\pm$  0.001 kHz.
- Repeat Steps c and d for the frequency settings and tolerances listed in Table 5-6.

**Table 5-6. Receiver Frequency Accuracy Test Frequencies and Specifications.**

| Synthesizer Frequency | Test Set Display  |
|-----------------------|-------------------|
| 100 Hz                | 0.100 $\pm$ 0.001 |
| 1 kHz                 | 1.000 $\pm$ 0.001 |
| 10 kHz                | 10.00 $\pm$ 00.01 |
| 20 kHz                | 20.00 $\pm$ 00.01 |
| 60 kHz                | 60.00 $\pm$ 00.01 |

### 5-15. Transmitter Frequency Accuracy.

5-16. This performance test determines if the Test Set meets the transmitter Frequency Accuracy specification listed in Table 1-1. The specification is  $\pm 1$  count. Under normal operation, to set the Test Set output frequency, the send oscillator output is internally applied to the receive circuits and indicated by the Test Set display. The send oscillator frequency controls are adjusted until the display indicates the desired frequency. For this reason the frequency accuracy of the Test Set output is determined by the receive circuits. These circuits were tested in the previous performance test. It is only necessary, in this test, to check the overall range of the send oscillator frequency controls. The procedure uses the Test Set display to monitor the frequency at the top and bottom of each range.

- Set the Test Set front panel controls as follows:

SEND FREQUENCY RANGE Hz. . . . 40 - 1 K  
 SEND LEVEL RANGE dBm . . . . . 0 to + 10  
 DISPLAY & MONITOR . . . . . SEND FREQ  
 POWER. . . . . ~ AC

- Adjust the Test Set SEND FREQUENCY vernier fully CCW. The Test Set display indication should be less than 0.040 kHz.
- Adjust the Test Set SEND FREQUENCY vernier fully CW. The Test Set display indication should be greater than 0.600 kHz.

d. Set the Test Set SEND FREQUENCY RANGE Hz control to the 200 - 6 K position. The Test Set display indication should be greater than 6.000 kHz.

e. Adjust the Test Set SEND FREQUENCY vernier fully CCW. The Test Set display indication should be less than 0.200 kHz.

f. Set the Test Set SEND FREQUENCY RANGE Hz control to the 2 K - 60 K position. The Test Set display indication should be less than 2.000 kHz.

g. Adjust the Test Set SEND FREQUENCY vernier fully CW. The Test Set display indication should be greater than 60.00 kHz.

### 5-17. Noise Weighting Filters Response.

5-18. This performance test determines if the Test Set meets the Weighting Filters Response specifications listed in Table 1-1. The specifications conform to the Bell System Technical Reference PUB 41009. This performance test uses the 3320B Synthesizer to provide the signal and the Test Set display is used to monitor the filter accuracies.

#### NOTE

*This performance test uses two groups of tables. Group 1, consisting of Tables 5-8, 5-10, and 5-12, will be used with Test Sets which contain A or B revisions of the A1 board. Part No. 03551-66501. Group 2, consisting of Tables 5-7, 5-9, and 5-11, will be used with C revisions or higher boards.*

a. Connect the 3320B through the 600 ohm impedance box to the Test Set black input/output terminals.

b. Set the Test Set front panel controls as follows:

HOLD ..... OFF  
 FUNCTION  
 (Black Input/Output Terminals) . REC TERM  
 IMP ..... 600  
 RECEIVE  
 NOISE/TONE. .... TONE NORMAL  
 NOISE WEIGHTING ..... C MESSAGE  
 DISPLAY & MONITOR ... RECEIVE LEVEL  
 POWER ..... ~ AC

c. Connect a ground lead from the input side of the impedance box to the Test Set chassis ground.

d. Adjust the 3320B to a frequency of 1 kHz at an amplitude of - 7.0 dBm. Verify a Test Set display of 83 dBm.

#### NOTE

*If the Test Set display is not 83 dBm, adjust the synthesizer output level until the display is correct. This reference input must be maintained during the entire test (Table 5-7). If your instrument requires the use of Table 5-8, the synthesizer output deviation from - 7 dB must be maintained throughout the test.*

e. Adjust the 3320B to a frequency and amplitude level settings shown in Table 5-7. After each synthesizer adjustment compare the Test Set Display to the readings shown in the Indication and Tolerances column.

#### NOTE

*Test Sets containing the A or B revision of the A1 board will not be able to display the third digit. These Test Sets should perform the C Message performance tests using Table 5-8.*

f. Set the Test Set front panel NOISE WEIGHTING control to the 3 kHz Flat position.

Table 5-7. Noise Weighting Filter, C Message.  
(For Expanded Display)

| Synthesizer Level (dBm) | Synthesizer Frequency (Hz) | Test Set Display Indication and Tolerances (dBm) C Message |
|-------------------------|----------------------------|------------------------------------------------------------|
| - 7.0                   | 60                         | 27.3 ± 2 dB                                                |
| - 7.0                   | 100                        | 40.5 ± 2 dB                                                |
| - 7.0                   | 200                        | 57 ± 2 dB                                                  |
| - 7.0                   | 300                        | 66.5 ± 2 dB                                                |
| - 7.0                   | 400                        | 71.6 ± 1 dB                                                |
| - 7.0                   | 500                        | 75.5 ± 1 dB                                                |
| - 7.0                   | 600                        | 78.3 ± 1 dB                                                |
| - 7.0                   | 700                        | 80.3 ± 1 dB                                                |
| - 7.0                   | 800                        | 81.5 ± 1 dB                                                |
| - 7.0                   | 900                        | 82.4 ± 1 dB                                                |
| - 7.0                   | 1,000                      | 83 dB REF                                                  |
| - 7.0                   | 1,200                      | 82.8 ± 1 dB                                                |
| - 7.0                   | 1,300                      | 82.5 ± 1 dB                                                |
| - 7.0                   | 1,500                      | 82 ± 1 dB                                                  |
| - 7.0                   | 1,800                      | 81.7 ± 1 dB                                                |
| - 7.0                   | 2,000                      | 81.7 ± 1 dB                                                |
| - 7.0                   | 2,500                      | 81.6 ± 1 dB                                                |
| - 7.0                   | 2,800                      | 81.1 ± 1 dB                                                |
| - 7.0                   | 3,000                      | 80.5 ± 1 dB                                                |
| - 7.0                   | 3,300                      | 77.8 ± 2 dB                                                |
| - 7.0                   | 3,500                      | 75.4 ± 2 dB                                                |
| - 7.0                   | 4,000                      | 68.5 ± 3 dB                                                |
| - 7.0                   | 4,500                      | 61.5 ± 3 dB                                                |
| - 7.0                   | 5,000                      | 54.5 ± 3 dB                                                |
| - 7.0                   | 10,000                     | < 41 dB                                                    |
| - 7.0                   | 40,000                     | < 23 dB                                                    |

Table 5-8. Noise Weighting Filter, C-Message.

| Synthesizer Level (dBm) | Synthesizer Frequency (Hz) | Test Set Display Indication and Tolerances (dBm) C-Message |
|-------------------------|----------------------------|------------------------------------------------------------|
| - 7.3                   | 60                         | 27 ± 2 dB                                                  |
| - 7.5                   | 100                        | 40 ± 2 dB                                                  |
| - 7.0                   | 200                        | 57 ± 2 dB                                                  |
| - 7.5                   | 300                        | 66 ± 2 dB                                                  |
| - 7.6                   | 400                        | 71 ± 1 dB                                                  |
| - 7.5                   | 500                        | 75 ± 1 dB                                                  |
| - 7.3                   | 600                        | 78 ± 1 dB                                                  |
| - 7.3                   | 700                        | 80 ± 1 dB                                                  |
| - 7.5                   | 800                        | 81 ± 1 dB                                                  |
| - 7.4                   | 900                        | 82 ± 1 dB                                                  |
| - 7.0                   | 1000                       | 83 REF                                                     |
| - 7.8                   | 1200                       | 82 ± 1 dB                                                  |
| - 7.5                   | 1300                       | 82 ± 1 dB                                                  |
| - 7.0                   | 1500                       | 82 ± 1 dB                                                  |
| - 7.7                   | 1800                       | 81 ± 1 dB                                                  |
| - 7.7                   | 2000                       | 81 ± 1 dB                                                  |
| - 7.6                   | 2500                       | 81 ± 1 dB                                                  |
| - 7.1                   | 2800                       | 81 ± 1 dB                                                  |
| - 7.5                   | 3000                       | 80 ± 1 dB                                                  |
| - 7.8                   | 3300                       | 77 ± 2 dB                                                  |
| - 7.4                   | 3500                       | 75 ± 2 dB                                                  |
| - 7.5                   | 4000                       | 68 ± 3 dB                                                  |
| - 7.5                   | 4500                       | 61 ± 3 dB                                                  |
| - 7.5                   | 5000                       | 54 ± 3 dB                                                  |
| - 7.0                   | 10,000                     | < 41                                                       |
| - 7.0                   | 40,000                     | < 23                                                       |

g. Adjust the 3320B to a frequency of 1 kHz at an amplitude of - 8.0 dBm. Verify a Test Set display of 82 dBm.

**NOTE**

*If the Test Set display is not 82 dBm, adjust the synthesizer output level until the display is correct. This reference input must be maintained during the entire test (Table 5-9). If your instrument requires the use of Table 5-10, the synthesizer output deviation from - 8 dB must be maintained throughout the test.*

h. Adjust the 3320B to the frequency and amplitude level settings shown in Table 5-9. After each oscillator adjustment compare the Test Set display to the readings shown in the table.

**NOTE**

*Test Sets containing the A or B revision A1 board should perform the 3 kHz Flat performance tests using Table 5-10.*

**Table 5-9. Noise Weighting Filter, 3 kHz Flat, 15 kHz Flat.  
(For Expanded Display)**

| Synthesizer Level (dBm) | Synthesizer Frequency (Hz) | Test Set Display and Tolerances (dBm) |             |
|-------------------------|----------------------------|---------------------------------------|-------------|
|                         |                            | 3 kHz Flat                            | 15 kHz Flat |
| - 8.0                   | 60                         | 82 ± 2 dB                             | 82 ± 2 dB   |
| - 8.0                   | 250                        | 82 ± 1 dB                             | 82 ± 1 dB   |
| - 8.0                   | 1,000                      | 82 REF                                | 82 REF      |
| - 8.0                   | 2,000                      | 81.5 ± 2 dB                           |             |
| - 8.0                   | 2,500                      | 80.5 ± 2 dB                           |             |
| - 8.0                   | 3,000                      | 79 ± 3 dB                             |             |
| - 8.0                   | 10,000                     |                                       | 81.2 ± 2 dB |
| - 8.0                   | 15,000                     |                                       | 79 ± 3 dB   |
| - 8.0                   | 20,000                     |                                       | 75.8 ± 3 dB |
| - 8.0                   | 30,000                     | < 42 dB                               | 69.7 ± 3 dB |
| - 8.0                   | 60,000                     | < 30 dB                               | < 57 dB     |

**Table 5-10. Noise Weighting Filters, 3 kHz Flat, 15 kHz Flat.**

| Synthesizer Level (dBm) | Synthesizer Frequency (Hz) | Test Set Display Indication and Tolerances (dBm) |             |
|-------------------------|----------------------------|--------------------------------------------------|-------------|
|                         |                            | 3 kHz Flat                                       | 15 kHz Flat |
| - 8.0                   | 60                         | 82 ± 2 dB                                        | 82 ± 2 dB   |
| - 8.0                   | 250                        | 82 ± 1 dB                                        | 82 ± 1 dB   |
| - 8.0                   | 1000                       | 82 REF                                           | 82 REF      |
| - 8.5                   | 2000                       | 81 ± 2 dB                                        |             |
| - 8.5                   | 2500                       | 80 ± 2 dB                                        |             |
| - 8.0                   | 3000                       | 79 ± 3 dB                                        |             |
| - 8.2                   | 10,000                     |                                                  | 81 ± 2 dB   |
| - 8.0                   | 15,000                     |                                                  | 79 ± 3 dB   |
| - 8.8                   | 20,000                     |                                                  | 75 ± 3 dB   |
| - 8.7                   | 30,000                     | < 42                                             | 69 ± 3 dB   |
| - 8.0                   | 60,000                     | < 30                                             | < 57        |

i. Set the Test Set front panel NOISE WEIGHTING control to the 15 kHz Flat position.

j. Adjust the 3320B for a frequency of 1 kHz at an amplitude of - 8.0 dBm. Verify a Test Set display of 82 dBm.

k. Repeat Step h for the 15 kHz Flat position.

l. Set the Test Set front panel NOISE WEIGHTING control to the PROGRAM position.

m. Adjust the 3320B for a frequency of 1 kHz at an amplitude of - 16.0 dBm. Verify a Test Set display of + 74 dBm.

**NOTE**

*If the Test Set display is not 74 dBm, adjust the synthesizer output level until the display is correct. This reference input must be maintained during the entire test (Table 5-11). If your instrument requires the use of Table 5-12, the synthesizer output deviation from - 16 dB must be maintained throughout the test.*

n. Adjust the 3320B to the frequency and amplitude level settings shown in Table 5-11. After each oscillator adjustment compare the Test Set display to the readings shown in the table.

**NOTE**

*Test Sets containing the A or B revision A1 board should perform the Program Performance Tests using Table 5-12.*

**Table 5-11. Noise Weighting Filter Program.  
(For Expanded Display)**

| Oscillator Level (dBm) | Oscillator Frequency (Hz) | Test Set Display Indication and Tolerances (dBm) Program |
|------------------------|---------------------------|----------------------------------------------------------|
| - 16.0                 | 100                       | 47.7 ± 2 dB                                              |
| - 16.0                 | 200                       | 56.7 ± 2 dB                                              |
| - 16.0                 | 300                       | 61.8 ± 2 dB                                              |
| - 16.0                 | 400                       | 65 ± 2 dB                                                |
| - 16.0                 | 500                       | 67.4 ± 1 dB                                              |
| - 16.0                 | 600                       | 69.3 ± 1 dB                                              |
| - 16.0                 | 700                       | 70.8 ± 1 dB                                              |
| - 16.0                 | 800                       | 72 ± 1 dB                                                |
| - 16.0                 | 900                       | 73.2 ± 1 dB                                              |
| - 16.0                 | 1,000                     | 74 REF                                                   |
| - 16.0                 | 1,500                     | 77.2 ± 1 dB                                              |
| - 16.0                 | 2,000                     | 78.8 ± 2 dB                                              |
| - 16.0                 | 2,500                     | 79.6 ± 2 dB                                              |
| - 16.0                 | 3,000                     | 80 ± 2 dB                                                |
| - 16.0                 | 4,000                     | 80.5 ± 2 dB                                              |
| - 16.0                 | 5,000                     | 80.5 ± 3 dB                                              |
| - 16.0                 | 6,000                     | 80.4 ± 3 dB                                              |
| - 16.0                 | 7,000                     | 79.8 ± 3 dB                                              |
| - 16.0                 | 8,000                     | 78 ± 4 dB                                                |
| - 16.0                 | 9,000                     | 72.5 ± 4 dB                                              |
| - 16.0                 | 10,000                    | 65.5 ± 4 dB                                              |
| - 16.0                 | 20,000                    | < 56 dB                                                  |
| - 16.0                 | 60,000                    | < 41 dB                                                  |

**5-19. Receiver Noise Accuracy.**

5-20. This performance test determines if the Test Set meets the Receiver Noise Measurement Accuracy Specifications listed in Table 1-1. The specifications are:

Message circuit noise:

$\pm 1$  dB (+ 20 dBrn to + 85 dBrn).

$\pm 2$  dB (0 dBrn to + 20 dBrn).

Noise-with tone:

$\pm 1$  dB (+ 20 dBrn to + 85 dBrn).

$\pm 2$  dB (+ 10 dBrn to + 20 dBrn).

Noise-to-ground:

$\pm 1$  dB (+ 60 dBrn to + 125 dBrn).

$\pm 2$  dB (+ 40 dBrn to + 60 dBrn).

This performance test uses a 3320B Oscillator to supply a reference signal at levels through the dynamic range of the Test Set.

a. Connect the 3320B through the 600 ohm impedance box to the Test Set black input/output terminals.

**Table 5-12. Noise Weighting Filter, Program.**

| Synthesizer Level (dBm) | Synthesizer Frequency (Hz) | Test Set Display Indication and Tolerances (dBrn) Program |
|-------------------------|----------------------------|-----------------------------------------------------------|
| - 15.7                  | 100                        | 48 $\pm$ 2 dB                                             |
| - 15.7                  | 200                        | 57 $\pm$ 2 dB                                             |
| - 15.8                  | 300                        | 62 $\pm$ 2 dB                                             |
| - 16.0                  | 400                        | 65 $\pm$ 2 dB                                             |
| - 16.4                  | 500                        | 67 $\pm$ 1 dB                                             |
| - 16.3                  | 600                        | 69 $\pm$ 1 dB                                             |
| - 15.8                  | 700                        | 71 $\pm$ 1 dB                                             |
| - 16.0                  | 800                        | 72 $\pm$ 1 dB                                             |
| - 16.2                  | 900                        | 73 $\pm$ 1 dB                                             |
| - 16.0                  | 1000                       | 74 REF                                                    |
| - 16.2                  | 1500                       | 77 $\pm$ 1 dB                                             |
| - 15.8                  | 2000                       | 79 $\pm$ 2 dB                                             |
| - 15.6                  | 2500                       | 80 $\pm$ 2 dB                                             |
| - 16.0                  | 3000                       | 80 $\pm$ 2 dB                                             |
| - 15.5                  | 4000                       | 81 $\pm$ 2 dB                                             |
| - 15.5                  | 5000                       | 81 $\pm$ 3 dB                                             |
| - 16.4                  | 6000                       | 80 $\pm$ 3 dB                                             |
| - 15.8                  | 7000                       | 80 $\pm$ 3 dB                                             |
| - 16.0                  | 8000                       | 78 $\pm$ 4 dB                                             |
| - 15.5                  | 9000                       | 73 $\pm$ 4 dB                                             |
| - 15.5                  | 10,000                     | 66 $\pm$ 4 dB                                             |
| - 15.0                  | 20,000                     | < 56                                                      |
| - 16.0                  | 60,000                     | < 41                                                      |

b. Set the Test Set front panel controls as follows:

HOLD. . . . . OFF  
 FUNCTION (Black Input/  
 Output Terminals). . . . . REC TERM  
 IMP . . . . . 600  
 RECEIVE  
 NOISE/TONE. . . . . MESSAGE CIRCUIT  
 NOISE WEIGHTING . . . . . 3 kHz FLAT  
 DISPLAY & MONITOR . . . . . RECEIVE LEVEL  
 POWER. . . . . ~ AC

c. Adjust the 3320B for 1 kHz and + 3.90 dBm. The Test Set display should indicate + 83 dBrn  $\pm$  1 dB.

d. Set the 3320B to -6.10 dBm. The Test Set display should indicate 73 dBrn  $\pm$  1 dB.

e. Repeat Step d for the 3320B output level settings and Test Set display indications and tolerances listed in Table 5-13.

f. Set the 3320B output level to + 3.90 dBm. Ground the Test Set GROUND terminal to earth ground.

g. Set the Test Set front panel RECEIVE NOISE/TONE control to the TO GROUND position. The Test Set display should indicate + 83 dBrn  $\pm$  1 dB.

h. Adjust the 3320B frequency to 400 Hz.

i. Set the Test Set front panel RECEIVE NOISE/TONE control to the WITH TONE position. The Test Set display indication should be + 83 dBrn  $\pm$  1 dB.

j. Adjust the 3320B for 1700 Hz. The Test Set display indication should be + 83 dBrn  $\pm$  1 dB.

k. Repeat Steps d and e.

l. Adjust the 3320B to 995 Hz and + 3.90 dBm. The Test Set display indication should be less than 33 dBrn.

m. Repeat Step l for a 3320B frequency setting of 1025 Hz.

n. Adjust the 3320B to 862 Hz and + 3.90 dBm. The Test Set display indication should be at least 80 dBrn.

o. Repeat Step n for a 3320B frequency of 1182 Hz.

**Table 5-13. Receiver Noise Accuracy Test Levels and Specifications.**

| Synthesizer Output Level (dBm) | Test Set Display Indication and Tolerances |
|--------------------------------|--------------------------------------------|
| - 16.10                        | + 63 dBrn $\pm$ 1 dB                       |
| - 26.10                        | + 53 dBrn $\pm$ 1 dB                       |
| - 36.10                        | + 43 dBrn $\pm$ 1 dB                       |
| - 46.10                        | + 33 dBrn $\pm$ 1 dB                       |
| - 56.10                        | + 23 dBrn $\pm$ 1 dB                       |
| - 66.10                        | + 13 dBrn $\pm$ 2 dB                       |

**5-21. Transmitter Harmonic Distortion.**

5-22. This performance test determines if the Test Set meets the Transmitter Harmonic Distortion specifications listed in Table 1-1. The specifications list the harmonic distortion in two categories—total harmonic distortion from 40 Hz to 20 kHz and discrete harmonics from 100 Hz to 4 kHz. The total harmonic distortion specifications are > - 50 dB below reference from 100 Hz to 4 kHz and > - 40 dB below reference from 40 Hz to 100 Hz and 4 kHz

to 20 kHz. The discrete harmonic distortion specification is  $> -55$  dB below reference from 100 Hz to 4 kHz. The harmonic distortion specification for the 1004 Hz hold tone is  $> -60$  dB below reference for total harmonic distortion.

5-23. This performance test uses the 331A distortion analyzer to test the total harmonic distortion and a wave analyzer to test the discrete harmonic distortion.

a. Connect the 331A to the Test Set blue input/output terminals. Connect a 135 ohm resistor across the distortion analyzer input terminals.

b. Set the Test Set front panel controls as follows:

HOLD ..... OFF  
FUNCTION  
(Blue Input/Output Terminals) ..... SEND  
IMP ..... 135  
SEND FREQUENCY RANGE Hz. ... 40 - 1K  
SEND LEVEL RANGE dBm ..... 0 to + 10  
DISPLAY & MONITOR ..... SEND FREQ  
POWER ..... ~ AC

c. Adjust the Test Set SEND FREQUENCY vernier for a Test Set display indication of 40 Hz.

d. Adjust the Test Set SEND LEVEL vernier for a convenient reference on the distortion analyzer meter.

e. Using the procedures outlined in the distortion analyzer's Operating and Service manual, measure the distortion of the Test Set output signal. The distortion should be more than 40 dB below the reference set in Step d.

f. Repeat Step e for the frequencies and specifications listed in Table 5-14.

g. Disconnect the 331A and connect the 3591A Selective Voltmeter to the Test Set blue input/output terminals. Set the 3591A input impedance to 135 ohms.

**Table 5-14. Transmitter THD Test Frequencies and Specifications.**

| Test Set Frequency | Specification (dB Below Reference) |
|--------------------|------------------------------------|
| 60 Hz              | $> 40$                             |
| 100 Hz             | $> 50$                             |
| 500 Hz             | $> 50$                             |
| 1 kHz              | $> 50$                             |
| 2 kHz              | $> 50$                             |
| 4 kHz              | $> 50$                             |
| 10 kHz             | $> 40$                             |
| 15 kHz             | $> 40$                             |
| 20 kHz             | $> 40$                             |
| 1004 Hz Hold Tone  | $> 60$                             |

h. Using the procedures outlined in the 3591A Operating and Service Manual, measure the second, third and

fourth harmonics of each of the frequencies listed in Table 5-15. The 3591A indications for all harmonics should be more than 55 dB below the reference.

**Table 5-15. Transmitter Discrete Harmonic Distortion Test Frequencies.**

| Test Set Frequency |
|--------------------|
| 100 Hz             |
| 500 Hz             |
| 1 kHz              |
| 2 kHz              |
| 4 kHz              |

## 5-24. Bridging Loss.

5-25. This performance test determines if the Test Set meets the Bridging Loss specification listed in Table 1-1. The specification is  $< 0.2$  dB. In this performance test a 3320B oscillator output is applied to a 3490A AC Voltmeter loaded by 900 ohms and a reference voltage is set up on the ac voltmeter. The input impedance of the Test Set is then bridged across the reference impedance to determine the bridging loss.

a. Connect the equipment as shown in Figure 5-4 with the Test Set disconnected.

b. Set the Test Set front panel controls as follows:

HOLD ..... OFF  
FUNCTION  
(Black Input Terminals) ..... REC BRDG  
POWER ..... ~ AC

c. Adjust the 3320B output for 100 Hz and a voltmeter indication of 1.000 V ac.

d. Connect the Test Set leads across the ac voltmeter input leads and the 900 ohm resistor. The ac voltmeter indication should not vary more than 20 mV ac.

e. Adjust the 3320B for 20 kHz. The voltmeter indication should not vary more than 20 mV ac.

f. Adjust the 3320B for 60 kHz. The voltmeter indication should not vary more than 20 mV ac.

## 5-26. Return Loss.

5-27. This performance test determines if the Test Set meets the Return Loss specification in Table 1-1. The specification is greater than 30 dB below reference from 500 Hz to 60 kHz for 135 ohm impedance and greater than 30 dB below the reference from 40 Hz to 20 kHz for the 600 ohm and 900 ohm impedance. To perform this test, it is necessary to construct a balanced bridge utilizing 0.1% resistors for each of the Test Set impedances. The bridge is shown in Figure 5-5. This performance test substitutes the impedance of the Test Set for a short in one leg of the

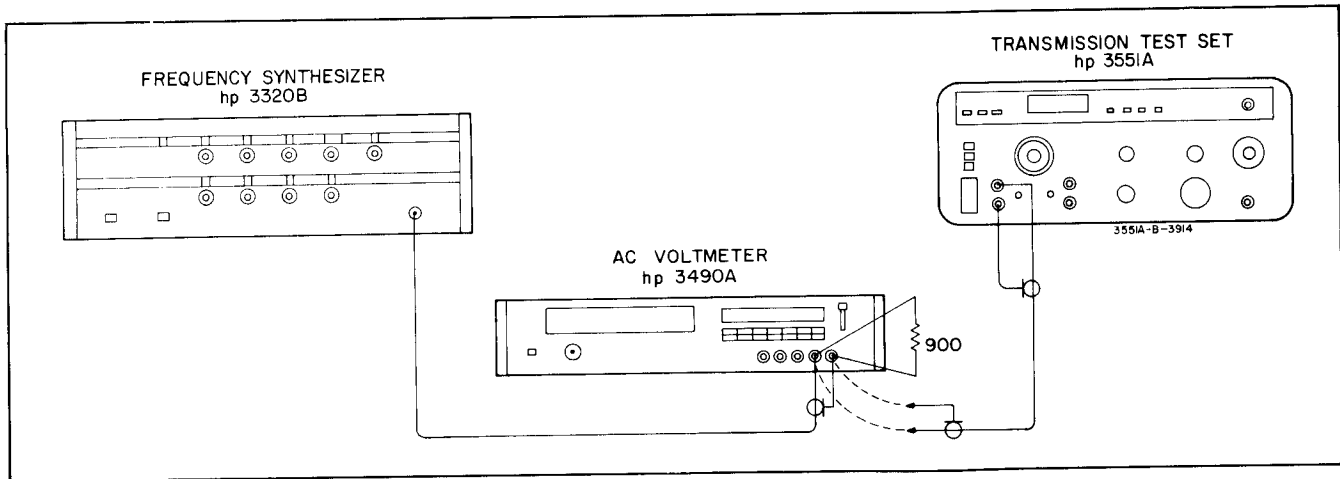


Figure 5-4. Bridging Loss Test Setup.

bridge. The short simulates maximum return loss. The difference voltage between the reference set while the short is in the bridge and when the Test Set impedance is placed in the bridge determines the return loss for the Test Set.

- a. Connect the equipment as shown in Figure 5-5 using 135 ohm resistors in the bridge.

**NOTE**

*The leads for the Test Set should be short clip leads and should be kept away from each other and from other leads. Keep all instruments away from other instruments in the test setup that may be referenced to earth ground.*

- b. Set the Test Set front panel controls as follows:  
 HOLD ..... OFF  
 FUNCTION  
 (Black Input/Output Terminals) . REC TERM  
 IMP ..... 135  
 POWER ..... ~ AC

- c. Close S1 in the test setup. Adjust the 3320B for 1 kHz and 1.000 V ac indication on the 3490A.

- d. Open S1 in the test setup. The indication on the 3490A should be less than 0.03 V ac.

- e. Disconnect R4 in the test setup and connect the Test Set black input terminals in its place.

- f. Close S1 and recheck the reference indication on the ac voltmeter. Open S1. The 3490A indication should be less than 0.031 V ac.

- g. Tune the 3320B from 500 Hz to 60 kHz. The 3490A indication should remain less than 0.031 V ac. If at any frequency the voltage indication is out of specification, recheck the reference voltage at that frequency.

- h. Repeat Steps c through g with the Test Set front panel IMP control in the 600 and 900 position. Use 600 ohm and 900 ohm resistors for the bridge circuitry

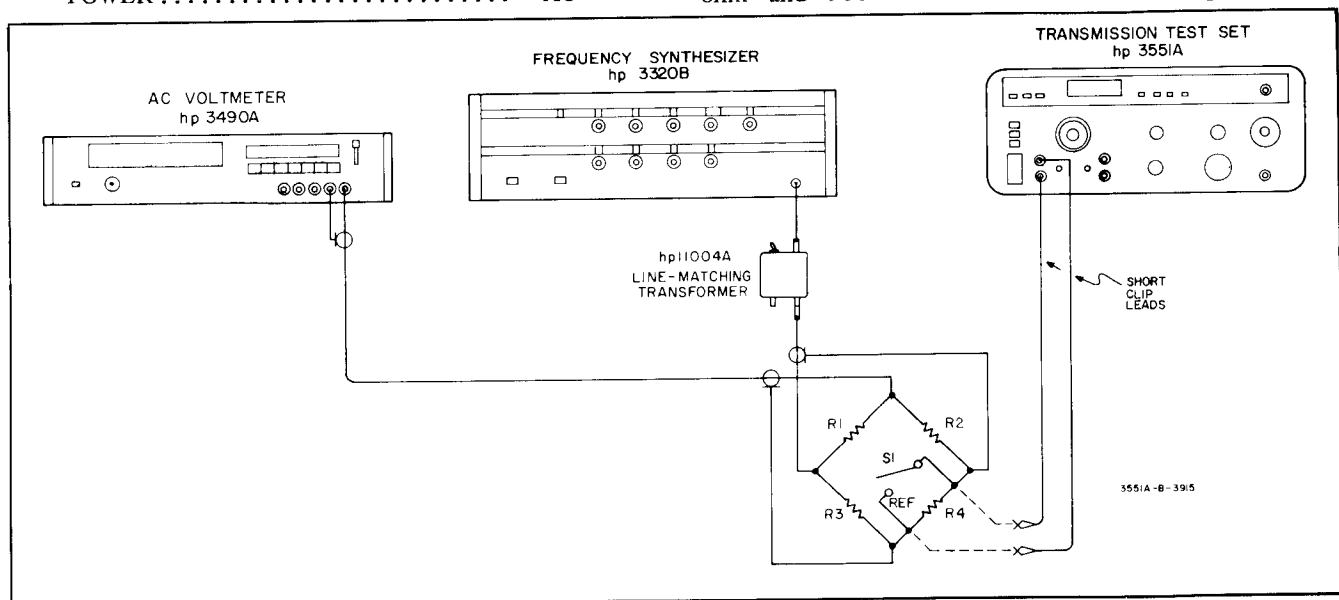


Figure 5-5. Return Loss Test Setup.

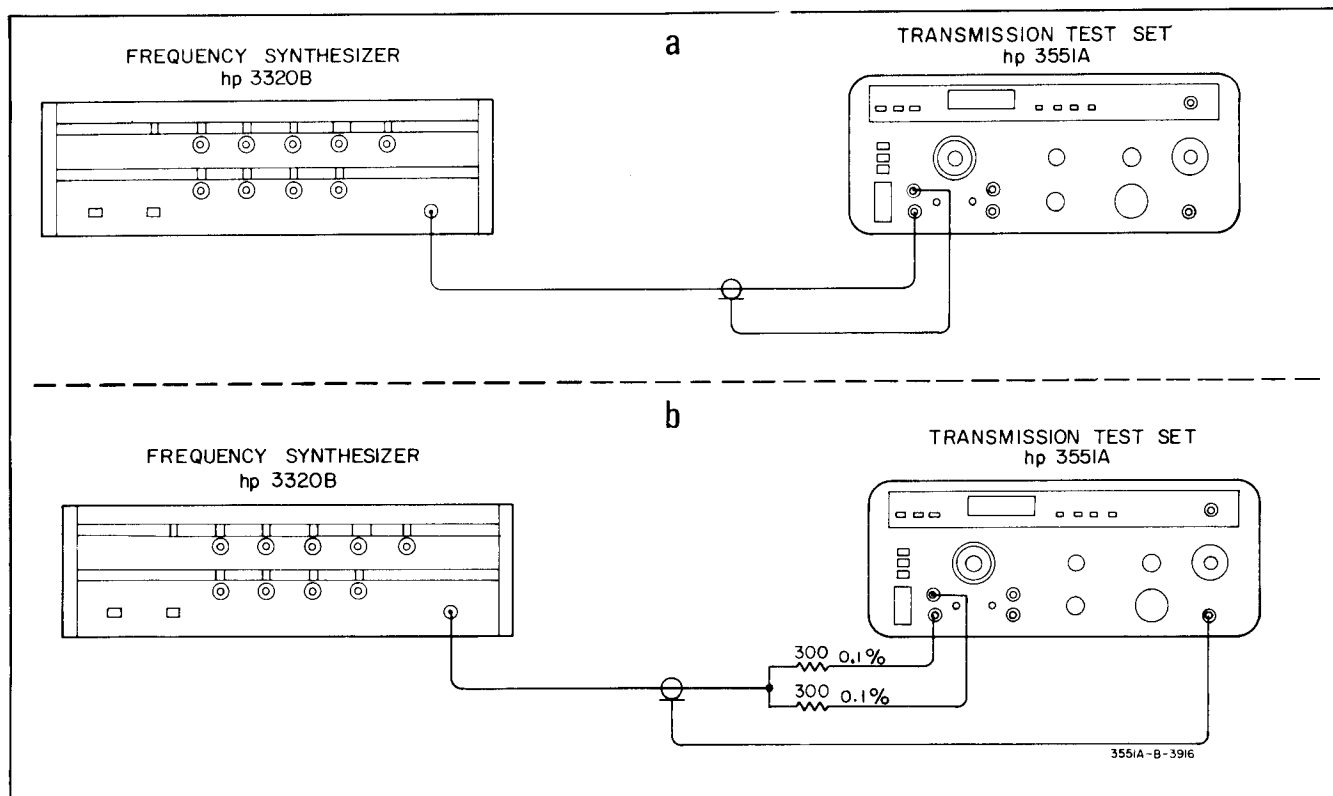


Figure 5-6(a,b). Receiver Balance Test Setup.

respectively. In Step g, tune the 3320B from 40 Hz to 20 kHz. All 3490A indications should be less than 0.031 V ac.

### 5-28. Longitudinal Balance.

5-29. This performance test determines if the Test Set meets the Longitudinal Balance specification listed in Table 1-1. The specification is greater than 60 dB below reference at 6 kHz for the receive mode and greater than 50 dB below the reference at 6 kHz for the send mode. Both the receiver balance and the transmitter balance are checked.

5-30. The procedure for the receiver balance uses a 3320B oscillator to supply an unbalanced signal to the Test Set balanced input. This supplies the Test Set with a maximum unbalance for a reference. The same signal is then applied equally between the Test Set input terminals and referenced to the Test Set ground. The difference between these signals as read on the Test Set display is the receiver balance.

5-31. The transmitter balance is tested in the same way except the Test Set serves as the oscillator and a 3490A external ac voltmeter serves as the monitor.

#### Receiver:

- a. Connect the equipment as shown in Figure 5-6(a).

- b. Set the Test Set front panel controls as follows:

HOLD ..... OFF  
 FUNCTION  
 (Black Input/Output Terminals) . REC BRDG  
 IMP ..... 600  
 RECEIVE  
 NOISE/TONE ..... TONE NORMAL  
 DISPLAY & MONITOR ... RECEIVE LEVEL  
 POWER ..... ~ AC

- c. Adjust the 3320B output for 6 kHz and a Test Set display indication of 0.0 dBm.

- d. Connect the test equipment as shown in Figure 5-6(b).

- e. The Test Set display indication should be greater than 60 dB below the 0.0 dBm reference of Step c.

#### Transmitter:

- a. Connect the 3490A to the Test Set blue input/output terminals. Connect a 135 ohm resistor across the Test Set terminals.

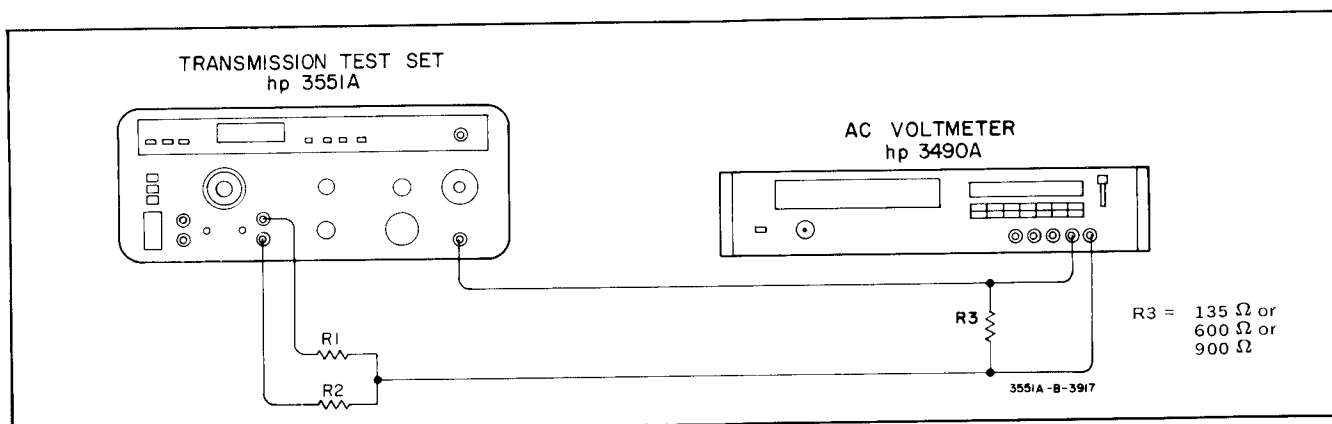


Figure 5-7. Transmitter Balance Test Setup.

- b. Set the Test Set front panel controls as follows:  
 HOLD ..... OFF  
 FUNCTION  
 (Blue Input/Output Terminals) ..... SEND  
 IMP ..... 135  
 SEND FREQUENCY RANGE Hz .. 2 K - 60 K  
 SEND LEVEL RANGE dBm ..... 0 to + 10  
 DISPLAY & MONITOR ..... SEND FREQ  
 POWER ..... ~ AC
- c. Adjust the Test Set SEND FREQUENCY vernier for 6 kHz on the Test Set display.
- d. Adjust the Test Set SEND LEVEL for a 1.00 V ac indication on the 3490A.
- e. Connect the equipment as shown in Figure 5-7. Use two 67.5 ohm resistors for R1 and R2.
- f. The ac voltmeter indication should be less than 3.0 mV ac.
- g. Repeat Steps a through f for the 600 and 900 positions of the Test Set IMP control. For the 600 position, use a 600 ohm resistor in Step a and two 300 ohm resistors

in Figure 5-7 for R1 and R2. For the 900 position use a 900 ohm resistor in Step a and two 450 ohm resistors in Figure 5-7 for R1 and R2.

### 5-32. Hold Current.

5-33. This performance test determines if the Test Set meets the hold circuit specification listed in Table 1-1. The specification is greater than 24 milliamps. This performance test uses a 6215A dc power supply to supply the current for the holding circuit.

- a. Connect the equipment as shown in Figure 5-8 with the Test Set disconnected.
- b. Set the 6215A supply to + 12 V as indicated by the dc voltmeter.
- c. Connect the Test Set. Press the Test Set front panel HOLD ON pushbutton and set the FUNCTION (black input/output terminal) to REC BRDG.
- d. The 3490A indication should be less than 7.2 V dc.

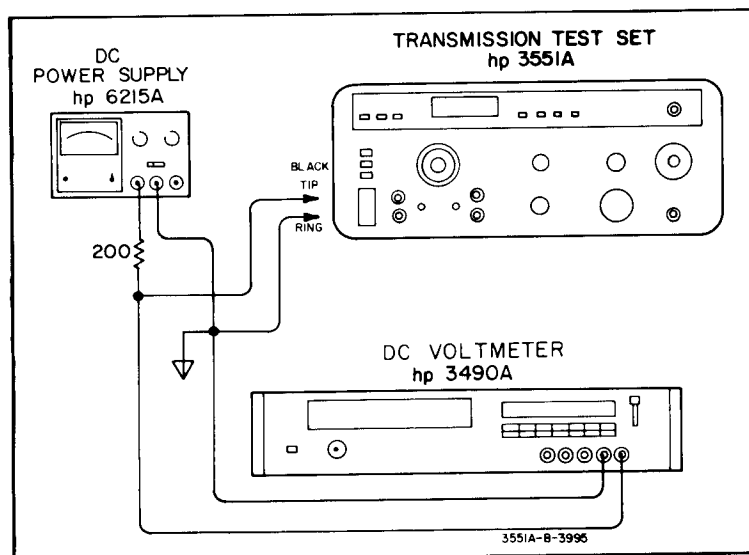


Figure 5-8. Holding Loss Test Setup.

## ADJUSTMENT PROCEDURES

### 5-34. ADJUSTMENT PROCEDURES.

5-35. The following is a complete set of adjustment procedures for the Test Set. These procedures can be used for periodic maintenance or if the Test Set has failed the performance tests. If proper performance cannot be achieved by the adjustment procedures, refer to the troubleshooting procedures in Section VII.

5-36. To remove the Test Set from the case refer to Paragraph 5-57. Figures 5-10, 5-11 and 5-12 show the adjustment locations for A1, A3 and A4 respectively. The adjustment procedures use the Test Set display for monitoring and adjustment tolerances.

5-37. The Test Set display should have the last 4 LSD digits operating to correctly adjust the Test Set to the tolerance given. Change the jumper wire locations on the A1 board (Figure 5-10) as required. Note the original location of the A1 jumpers, so that they may be returned to their original location after adjustment.

#### NOTE

*When the display is expanded the location of the decimal point is a function of the input frequency and not the dBm readings. On Test Sets that contain A or B revisions of the A1 board, Part No. 03551-66501, the jumpers may not be present. Where the display readings are different from the C revision boards, they will be given in parentheses.*

### 5-38. Receive Level Adjustment.

5-39. This adjustment procedure sets the 15 dB dynamic range of the measuring circuits. The Test Set is locked in range 1 and a signal level for the high end of the 15 dB range is applied to the input and adjusted in the measuring circuit. The input signal is then reduced for the low end of the dynamic range and adjusted for in the measuring circuit. This procedure is repeated until both ends are within specification.

a. Connect the 3320B, through the 600 ohm impedance box, to the Test Set black input/output terminals. Refer to Figure 5-9 for Test Set Connection.

b. Set the Test Set front panel controls as follows:

HOLD . . . . . OFF  
FUNCTION  
(Black Input/Output Terminals . . . REC TERM  
IMP . . . . . 600  
RECEIVE  
NOISE/TONE . . . . . TONE NORMAL  
DISPLAY & MONITOR . . . RECEIVE LEVEL  
POWER . . . . . ~ AC

c. Adjust the 3320B frequency for 1 kHz at an amplitude of + 8.79 dBm.

d. Connect the dc voltmeter to A1W10. Ground A1TP19 with a short clip lead. Adjust A1R524 for 0 V dc indication on the dc voltmeter.

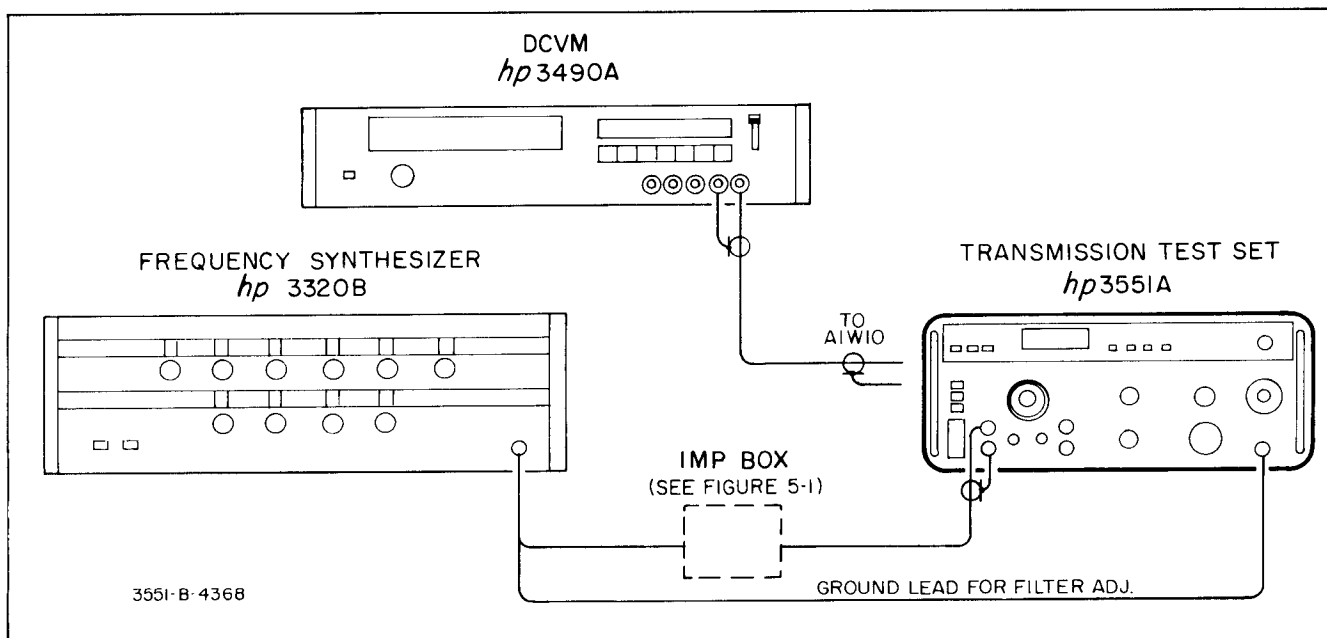
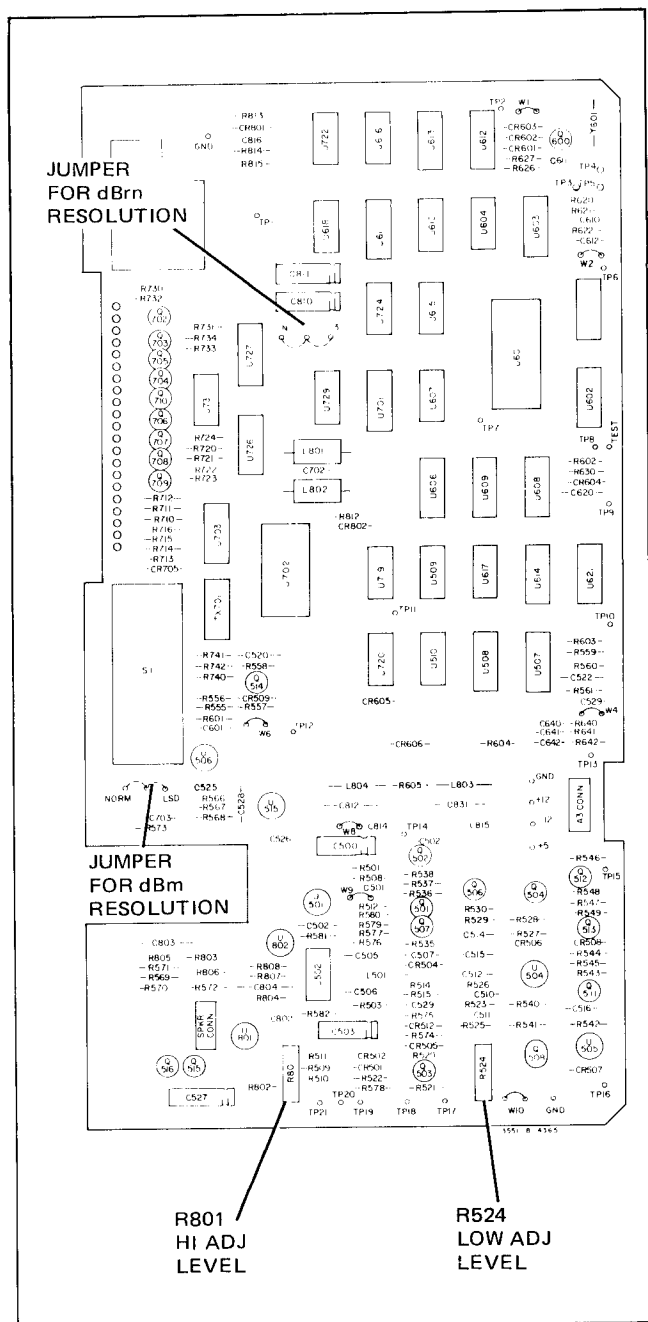


Figure 5-9. Receive Level and Noise Weighting Filters Adjustment.

Figure 5-10. A1 Adjustment Locator.  $\Delta 5$ 

e. Remove the ground clip from A1TP19 and the dc voltmeter from A1W10.

f. Short A1TP8 to ground.

g. Set the 3320B to + 14.79 dBm.

h. Adjust A1R801 on the Test Set for a display flashing between + .401 and + .399 dBm.

## NOTE

If + .399 to + .401 dBm cannot be reached, adjust A3R505 for a reading of + .410 dBm.

i. Set the 3320B to + 2.79 dBm.

j. Adjust A1R524 on the Test Set for a display of - .800  $\pm$  .002 dBm.

k. Repeat Step g through j until the Test Set is calibrated.

l. Set the 3320B to + 10.55 dBm.

m. Switch the 3551A IMP selector and the IMP box to 900 ohm.

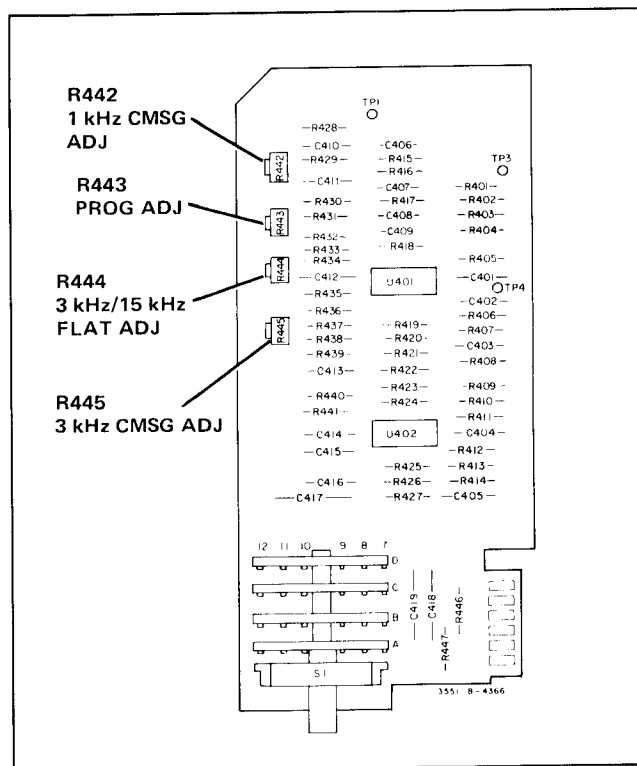
n. Adjust A3R508 for a display flashing between - .199 and - .201 dBm.

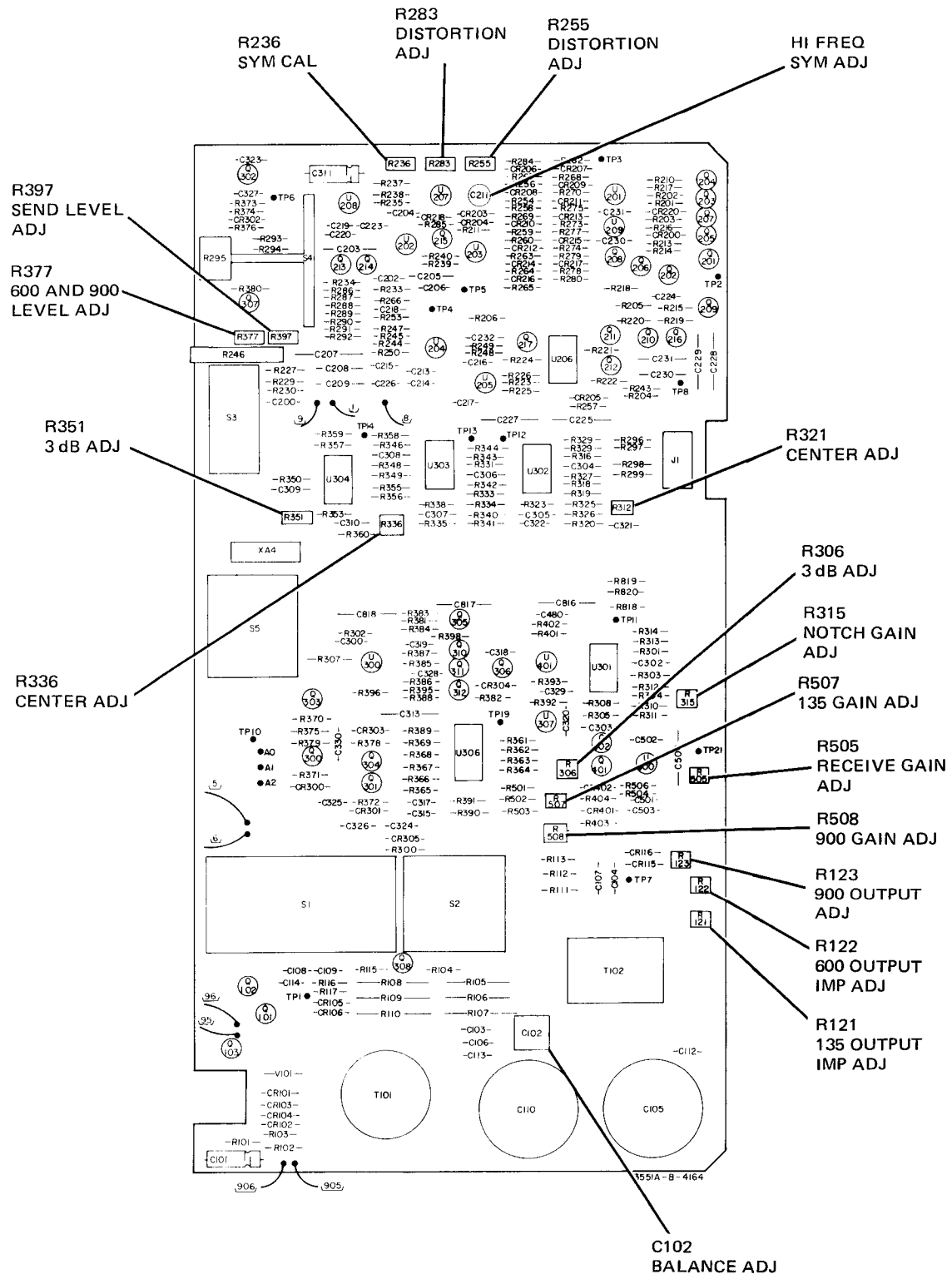
## NOTE

For Test Sets with the 03551-66503 (A3) board not containing R508, verify a display of - .2  $\pm$  .05 dBm. If the Test Set is not in tolerance, check R503 for the proper value.

o. Set the 3320B to + 2.31 dBm.

p. Switch the 3551A front panel IMP selector and the IMP box to 135 ohm.

Figure 5-11. A4 Adjustment Locator.  $\Delta 5$

Figure 5-12. A3 Adjustment Locator.  $\Delta_1$

- q. Adjust A3R507 for a display flashing between - .199 and - .201 dBm.

**NOTE**

*For Test Sets with the 03551-66503 (A3) board not containing R507, verify a display of  $-.2 \pm .05$  dBm. If the Test Set is not in tolerance, check R501 for the proper value.*

- r. Set the 3320B to 60 kHz.
- s. Remove A1TP8 short and observe the Test Set display for a reading of  $-.201 \pm .02$  dBm.

**NOTE**

*If the display is not in tolerance, record the value and proceed to the next step.*

- t. Set the 3320B to - 17.69 dBm and observe the Test Set for a display of  $- 2.201 \pm .02$  dBm.

**NOTE**

*If step s or t is not within tolerances, A3C315 and/or A3C317 may be padded using the values shown in Table 5-16. Increasing the value of A3C315 and/or decreasing the value of A3C17 will cause the test set to display a larger negative number. When the Test Set is turned back on after padding, the display may read a full decade higher (i.e., 22.01), this is due to the frequency control of the decimal point. Ignore the decimal point location and read the Test Set for  $2201 \pm 20$  counts.*

- u. Repeat Steps s and t until the Test Set readings are within tolerance.

- v. Set the 3320B to - 37.69 dBm and observe the Test Set for a display of  $- 4.201 \pm .02$  dBm.

**NOTE**

*If the display is not within tolerance, A3C318 may be padded using the values shown in Table 5-16. Increasing the value of C318 will cause the Test Set to display a larger relative number.*

**Table 5-16. Capacitor Padding Value.**

| A3C315 |           | A3C317 |           | A3C318 |           |
|--------|-----------|--------|-----------|--------|-----------|
| Value  | Part No.  | Value  | Part No.  | Value  | Part No.  |
| 300 pF | 0140-0200 | 10 pF  | 0160-0205 | 43 pF  | 0160-2200 |
| 430 pF | 0160-0939 | 12 pF  | 0140-0201 | 47 pF  | 0160-2307 |
| 460 pF | 0140-0232 | 15 pF  | 0140-0202 | 56 pF  | 0140-0191 |
| 470 pF | 0140-0145 | 18 pF  | 0160-2198 | 68 pF  | 0140-0192 |
| 510 pF | 0160-0362 |        |           |        |           |
| 560 pF | 0140-0178 |        |           |        |           |
| 620 pF | 0160-0363 |        |           |        |           |

**5-40. Noise Weighting Filters Adjustment.****NOTE**

*The Receive Level adjustment must be completed before performing the Noise Weighting Filters adjustment.*

5-41. This procedure sets the gain level for each of the noise weighting filters. The Test Set is set to the RECEIVE NOISE mode, and as each of the four weighting filters are switched into the signal path, the gain of each filter is adjusted to the desired level.

- a. Connect the 3320B to the Test Set as shown in Figure 5-9.

- b. Set the Test Set front panel as follows:

HOLD. . . . . OFF  
 FUNCTION  
 (Black Input/Output Terminal . . . REC TERM  
 IMP . . . . . 600  
 RECEIVE NOISE/  
 TONE . . . . . MESSAGE CIRCUIT NOISE  
 DISPLAY & MONITOR . RECEIVE LEVEL  
 NOISE WEIGHTING . . . . . C MESSAGE  
 POWER. . . . . ~ AC

- c. Adjust the 3320B for a 1 kHz frequency at an amplitude of - 5.21 dBm.

- d. Short A1TP8 to ground.

- e. Power OFF then power ON the 3551A to lock the Test Set on range 0.

- f. Adjust A4R442 for a test set display of + 7.390 to + 7.410 (flashing between + 73/+ 74).

- g. Set the Test Set Noise Weighting Control to the 3 kHz flat position.

- h. Adjust A4R444 for a Test Set display of + 7.390 to + 7.410 (flashing between + 73/+ 74).

- i. Set the Test Set Noise Weighting Control to the 15 kHz Flat position.

- j. Adjust A4R444 for a Test Set display of + 7.390 to + 7.410 (flashing between + 73/+ 74).

**NOTE**

*The 3 kHz and 15 kHz adjustments may need to be performed several times in order to achieve a balance between the two positions.*

- k. Set the Test Set NOISE WEIGHTING CONTROL to the Program position.

l. Adjust A4R443 for a display of + 7.390 to + 7.410 (flashing between + 73/+ 74).

m. Set the Test Set NOISE WEIGHTING CONTROL to the C Message position.

n. Adjust the 3320B for an output frequency of 3 kHz with an amplitude of - 3.21 dBm.

o. Adjust A4R445 for a display of + 7.390 to + 7.410 (flashing between + 73/+ 74).

p. Repeat adjustment Steps c, f, n and o for the C Message position until calibrated.

q. Remove A1TP8 short.

#### 5-42. Notch Filter Calibration.

##### NOTE

*The RECEIVE LEVEL and NOISE WEIGHTING FILTER adjustment must be completed before proceeding.*

5-43. This adjustment procedure sets the corner frequencies and the center of the Notch filters. A 3320B is used to supply precise frequencies and amplitudes to the test set input.

a. Connect the 3320B Frequency Synthesizer to the 3551A Test Set as shown in Figure 5-9.

b. Set the Test Set front panel controls as follows:

HOLD. . . . . OFF  
NOISE WEIGHTING . . . . . 15 kHz Flat  
FUNCTION  
(Black Input/Output Terminals). . . REC TERM  
RECEIVE NOISE/  
TONE . . . . . NOISE WITH TONE  
DISPLAY & MONITOR . . . RECEIVE LEVEL  
POWER. . . . . ~ AC

c. Adjust the 3320B frequency for 400 Hz at an amplitude of - 5.21 dBm.

d. Short A1TP8 to ground, then power OFF, power ON the 3551A Test Set.

e. Center pots (1 turn pots) A3R306, A3R321, A3R336, and A3R351. Refer to A3 adjustment locations shown on Figure 5-12.

f. Adjust A3R315 for a Test Set display + 7.395 to + 7.405 (flashing between + 73/+ 74).

g. Adjust the 3320B frequency to 1015 Hz.

h. Connect an ac voltmeter to A3TP13.

i. Set A3R306, A3R321 fully CW; A3R351 fully CCW.

j. Adjust A3R336 for a minimum ac voltmeter indication, typically less than 1 mV rms.

k. Disconnect the ac voltmeters from A3TP13 and re-connect to A3TP12. Adjust A3R321 for a minimum ac voltmeter indication, typically less than 1 mV rms.

l. Disconnect the ac voltmeter.

m. Adjust the 3320B frequency to 1182 Hz.

n. Adjust A3R306 for a display of + 7.395 to + 7.405 (flashing between + 73/+ 74).

o. Adjust the 3320B frequency to 862 Hz.

p. Verify display of + 7.275  $\pm$  .125 (+ 71 to + 74).

q. Remove the short at A1TP8.

#### 5-44. Receiver Balance Adjustment.

5-45. The adjustment procedure sets the Test Set input balance. The 3320B is used to supply the Test Set with a signal applied equally between the Test Set terminals and referenced to the Test Set ground. The Test Set is then adjusted for a minimum Test Set display indication.

a. Connect the test setup as shown in Figure 5-6(b).

b. Set the Test Set front panel controls as follows:

HOLD. . . . . OFF  
FUNCTION  
(Black Input/Output Terminals). . . REC TERM  
IMP . . . . . 600  
RECEIVE NOISE/  
TONE . . . . . TONE NORMAL  
DISPLAY & MONITOR . . . RECEIVE LEVEL  
POWER. . . . . ~ AC

c. Adjust the 3320B output frequency to 6 kHz at an amplitude of + 26.99 dBm.

d. Adjust A3C102 for a minimum Test Set display.

##### NOTE

*The display should be indicating less than - 4.2 (- 42 dBm). If the minimum display cannot be adjusted to less than this specification, then change A3C103\* and/or A3C108\* as follows (refer to Table 5-17 for padding values):*

1. If A3C102 is at a minimum capacitance, decrease the value of A3C103 or increase the value of A3C108.
2. If A3C102 is at a maximum capacitance, increase the value of A3C103 or decrease the value of A3C108.

**NOTE**

*A3C107 should only be padded if padding A3C104 will not cause the Test Set to meet the desired specifications.*

**5-54. Transmitter Level Display Adjustment.****NOTE**

*The RECEIVE LEVEL must be calibrated before performing the transmitter level adjustment.*

5-55. This adjustment procedure sets the level of the Test Set send oscillator to the Test Set display. The 3490A ac voltmeter is used to monitor the send oscillator output level and the signal to the Test Set display is adjusted for a display indication equal to the ac voltmeter indication.

a. Connect an ac voltmeter through a 600 ohm load to the Test Set blue input/output terminals.

b. Set the Test Set front panel controls as follows:

**FUNCTION**

(Blue Input/Output Terminals . . . . . SEND  
IMP . . . . . 600  
SEND FREQUENCY RANGE Hz. . . 200 - 6 K  
SEND LEVEL RANGE dBm . . . . . 0 to + 10  
DISPLAY & MONITOR . . . . . SEND FREQ  
POWER. . . . . ~ AC

c. Connect the Test Set chassis to the ring terminal.

d. Adjust the Test Set front panel SEND FREQUENCY vernier for a Test Set display indication of 1.000 kHz. Adjust the Test Set front panel SEND LEVEL vernier for an ac voltmeter indication of 0.775 V ac  $\pm$  0.002 V ac.

e. Press the Test Set front panel DISPLAY & MONITOR SEND LEVEL pushbutton.

f. Adjust A3R377 for a Test Set display indication of .000 dBm  $\pm$  .003 dBm.

g. Set the Test Set front panel IMP control to 135. Change the 600 ohm load on the ac voltmeter to a 135 ohm load.

h. Adjust the Test Set front panel SEND LEVEL vernier for an ac voltmeter indication of 0.367 V ac  $\pm$  0.002 V ac.

i. Adjust A3R397 for a Test Set display indication of .000 dBm  $\pm$  .003 dBm.

j. Set the Test Set front panel IMP control to 900 ohm. Change the 135 ohm load on the ac voltmeter to a 900 ohm load.

k. Adjust the Test Set front panel SEND LEVEL ver-

nier for an ac voltmeter indication of 0.9487 V ac  $\pm$  0.001 V ac. The Test Set display indication should be .000 dBm  $\pm$  .005 dBm. If not, adjust A3R377 until the reading is just within the specifications. Recheck the 600 ohm display level for .000  $\pm$  .005 dBm.

l. Set the Test Set output frequency for 60 kHz  $\pm$  1 kHz.

m. Adjust the Test Set IMP selector to 600 ohms and change the output termination to 600 ohms.

n. Adjust the Test Set SEND LEVEL vernier control for an output level of .775 V ac  $\pm$  0.002 V. The Test Set display should be .000 dBm  $\pm$  .2 dBm. If not, pad A3C323 or A3C327 until the display is within specifications. Refer to Table 5-17 for capacitor padding values.

**NOTE**

*The 60 kHz level will be raised by lowering the value of A3C323 or raising the value of A3C327.*

o. Recheck the 135 ohm 60 kHz display for .000 dBm  $\pm$  .2 dBm.

5-56. Return the green jumper leads used to expand the Test Set display to their original locations.

**5-57. DISASSEMBLY INFORMATION.**

5-58. The following paragraphs provide information for the removal of the Test Set case and printed circuit boards. Also included is information concerning proper installation of the Test Set internal power cable.

**5-59. Test Set Case Removal.**

a. To remove the case for access to the internal parts, remove the five phillips head screws shown in Figure 5-14.

b. Slide the front panel out from the case, disconnect the internal power cable and monitor plug from the case.

**5-60. Printed Circuit Card Removal.**

5-61. In order to repair the A1, A2, or A3 boards, the A1, A2 board assembly and shield must first be removed. The A3 and A4 board may be repaired still attached to the front panel and do not have to be removed unless replacement of the panel switches or the board is necessary. The following procedure provides the information necessary for disassembly of the A1 and A2 boards.

a. To remove the A1 and A2 boards, unplug the A1 to A3 ribbon connector and A1 speaker connection. Remove the ten phillips head screws as shown in Figure 5-15. Then remove the board assembly so as not to damage the Power and Display & Monitor switches.

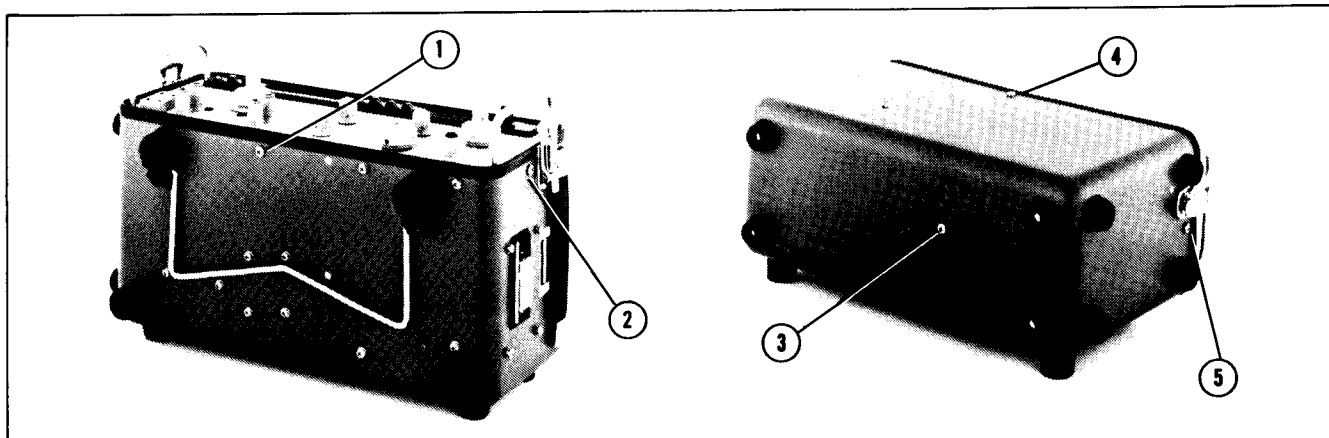


Figure 5-14. Case Disassembly.

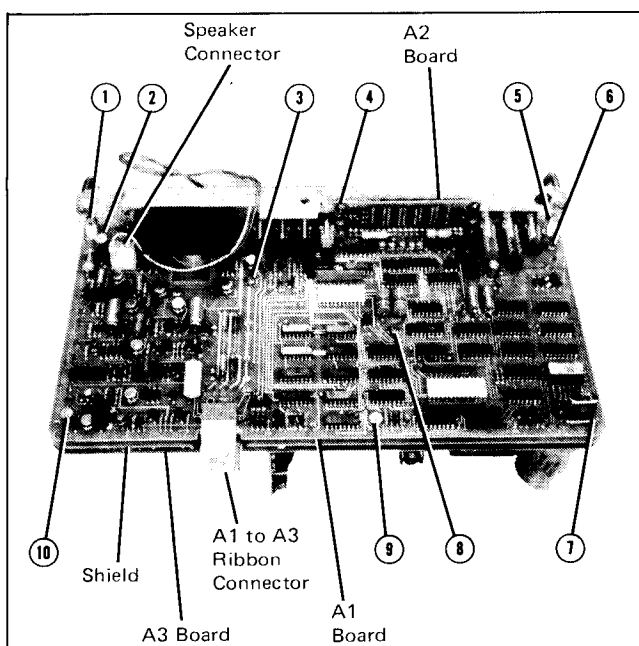


Figure 5-15. A1 and A2 Board Assembly Removal.

b. Turn the unit over to obtain access to the component side of the A3 board and remove the five phillips head screws shown in Figure 5-16. The shield should now be loose and can be easily removed.

**NOTE**

*No further disassembly of the Test Set is recommended.*

c. Reassembly of the unit can be done in the reverse order of assembly.

5-62. The internal Power Cable should be installed in the case and on the A1 board as shown in Figure 5-17.

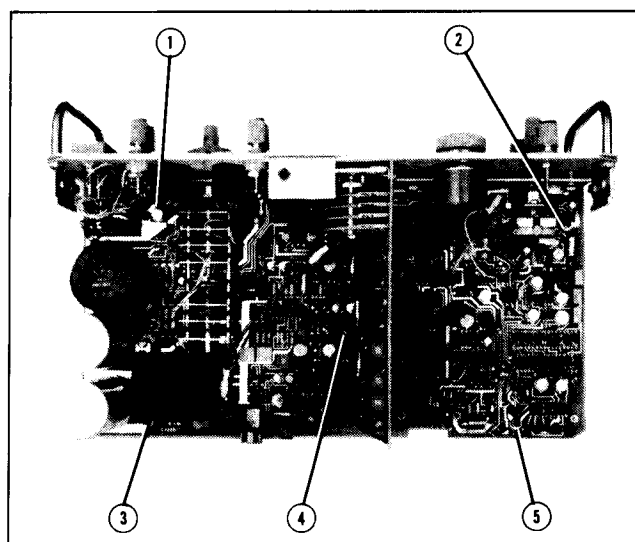


Figure 5-16. Shield Removal.

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                                                        | Mfr Code | Mfr Part Number     |
|-----------------------|----------------|-----|--------------------------------------------------------------------|----------|---------------------|
| A1                    | 03551-66501    | 1   | PC ASSY, LOGIC                                                     | 28480    | 03551-66501         |
| A1C500                | 0180-1800      | 2   | CAPACITOR-FXD; 130UF+100-10% 6VDC AL                               | 28480    | 0180-1800           |
| A1C501                | 016J-0763      | 1   | CAPACITOR-FXD 5PF +-10% 500WVDC MICA 0+                            | 28480    | 0160-0763           |
| A1C502                | 0180-1701      | 2   | CAPACITOR-FXD 6.8UF +-20% 6VDC CER                                 | 56289    | 150D685X0006A2      |
| A1C503                | 0180-1800      | 2   | CAPACITOR-FXD; 100UF+100-10% 6VDC AL                               | 28480    | 0180-1800           |
| A1C505                | 0160-0298      | 2   | CAPACITOR-FXD .0015UF +-10% 200WVDC POLYE                          | 56289    | 292P15292           |
| A1C506                | 0160-0156      | 20  | CAPACITOR-FXD .0039UF +-10% 200WVDC POLYE                          | 56289    | 292P39292           |
| A1C507                | 0160-0127      | 8   | CAPACITOR-FXD .1UF +-20% 25WVDC CER                                | 28480    | 0160-0127           |
| A1C508                | 0150-0093      | 20  | CAPACITOR-FXD .01UF +80-20% 100WVDC CER                            | 28480    | 0150-0093           |
| A1C510                | 0160-3622      | 8   | CAPACITOR-FXD .1UF +80-20% 100WVDC CER                             | 28480    | 0160-3622           |
| A1C511                | 016J-3622      | 8   | CAPACITOR-FXD .1UF +80-20% 100WVDC CER                             | 28480    | 0160-3622           |
| A1C512                | 0160-0127      | 3   | CAPACITOR-FXD .1UF +-20% 25WVDC CER                                | 28480    | 0160-0127           |
| A1C513                | 0160-3501      | 1   | CAPACITOR-FXD 4UF +-10% 50WVDC MET POLYC                           | 28480    | 0160-3501           |
| A1C514                | 0160-0127      | 1   | CAPACITOR-FXD .1UF +-20% 25WVDC CER                                | 28480    | 0160-0127           |
| A1C515                | 0160-0128      | 9   | CAPACITOR-FXD 2.2UF +-20% 25WVDC CER                               | 28480    | 0160-0128           |
| A1C516                | 016J-3548      | 9   | CAPACITOR-FXD .01UF +-1% 100WVDC MICA                              | 28480    | 0160-3548           |
| A1C520                | 0180-0309      | 2   | CAPACITOR-FXD; 4.7UF+-20% 10VDC TA                                 | 56289    | 150D475X0010A2      |
| A1C521                | 0160-2204      | 5   | CAPACITOR-FXD 100PF +-5% 300WVDC MICA                              | 28480    | 0160-2204           |
| A1C522                | 0180-1701      | 1   | CAPACITOR-FXD; 6.8UF +-20% 10VDC TA                                | 56289    | 150D685X0006A2      |
| A1C525                | 0180-0376      | 1   | CAPACITOR-FXD; .47UF+-10% 35VDC TA                                 | 56289    | 150D474X0035A2      |
| A1C526                | 0160-2204      | 1   | CAPACITOR-FXD 100PF +-5% 300WVDC MICA                              | 28480    | 0160-2204           |
| A1C527                | 0180-0303      | 1   | CAPACITOR-FXD 100PF +75-10% 3VDC AL                                | 56289    | 30D107G003CB2       |
| A1C528                | 0150-0014      | 45  | CAPACITOR-FXD .005UF 500VDC                                        | 28480    | 0150-0014           |
| A1C529                | 0160-0127      | 45  | CAPACITOR-FXD .1UF +-25VDC                                         | 28480    | 0160-0127           |
| A1C601                | 0160-0128      | 1   | CAPACITOR-FXD 2.2UF 25V                                            | 28480    | 0160-0128           |
| A1C610*               | 0160-2198      | 1   | CAPACITOR-FXD 20PF +/-5% 300WVDC MICA 0+<br>*FACTORY SELECTED PART | 28480    | 0160-2198           |
| A1C611                | 0160-3622      | 1   | CAPACITOR-FXD .1UF +80-20% 100WVDC CER                             | 28480    | 0160-3622           |
| A1C612*               | 0160-2198      | 1   | CAPACITOR-FXD 20PF +-5% 300WVDC MICA J+<br>*FACTORY SELECTED PART  | 28480    | 0160-2198           |
| A1C620                | 0180-0195      | 1   | CAPACITOR-FXD; .33UF+-20% 35VDC TA                                 | 56289    | 150D334X0035A2      |
| A1C640                | 0150-0093      | 1   | CAPACITOR-FXD .01UF +80-20% 100WVDC CER                            | 28480    | 0150-0093           |
| A1C641, C642          | 0150-0093      | 1   | CAPACITOR-FXD .01UF +80-20% 100WVDC CER                            | 28480    | 0150-0093           |
| A1C702, 703           | 0160-2204      | 1   | CAPACITOR-FXD 100PF 300VDC                                         | 28480    | 0160-2204           |
| A1C704                | 0180-1702      | 3   | CAPACITOR-FXD; 180JF+-20% 6VDC TA-SOLID                            | 56289    | 150D187X0006R2      |
| A1C801                | 0180-0374      | 3   | CAPACITOR-FXD; 100F+-10% 20VDC TA-SOLID                            | 56289    | 150D106X9020B2      |
| A1C802                | 0160-2204      | 1   | CAPACITOR-FXD 100PF +-5% 300WVDC MICA                              | 28480    | 0160-2204           |
| A1C803                | 0180-0374      | 1   | CAPACITOR-FXD; 100F+-10% 20VDC TA-SOLID                            | 56289    | 150D106X9020B2      |
| A1C804                | 0180-0374      | 2   | CAPACITOR-FXD; 100F+-10% 20VDC TA-SOLID                            | 56289    | 150D106X9020B2      |
| A1C810                | 0180-1702      | 2   | CAPACITOR-FXD; 180UF+-20% 6VDC TA-SOLID                            | 56289    | 150D187X0006R2      |
| A1C811                | 0180-1702      | 2   | CAPACITOR-FXD; 180UF+-20% 6VDC TA-SOLID                            | 56289    | 150D187X0006R2      |
| A1C812                | 0180-1746      | 2   | CAPACITOR-FXD; 150F+-10% 20VDC TA-SOLID                            | 56289    | 150D156X9020B2      |
| A1C813                | 0180-1746      | 2   | CAPACITOR-FXD; 150F+-10% 20VDC TA-SOLID                            | 56289    | 150D156X9020B2      |
| A1C814                | 0160-3622      | 1   | CAPACITOR-FXD .1UF +80-20% 100WVDC CER                             | 28480    | 0160-3622           |
| A1C815                | 0160-3622      | 1   | CAPACITOR-FXD .1UF +80-20% 100WVDC CER                             | 28480    | 0160-3622           |
| A1C816                | 0160-3622      | 1   | CAPACITOR-FXD .1UF +80-20% 100WVDC CER                             | 28480    | 0160-3622           |
| A1CR501               | 1901-0518      | 3   | DIODE-SCHOTTKY                                                     | 28480    | 1901-0518           |
| A1CR502               | 1901-0518      | 3   | DIODE-SCHOTTKY                                                     | 28480    | 1901-0518           |
| A1CR504               | 1901-0040      | 40  | DIODE-SCHOTTKY                                                     | 28480    | 1901-0040           |
| A1CR505               | 1901-0040      | 40  | DIODE-SWITCHING 2NS 30V 50MA                                       | 28480    | 1901-0040           |
| A1CR506               | 1902-3062      | 1   | DIODE-ZNR 3.92V 5% DU-7 PD=.4W TC=                                 | 04713    | SZ 10939-65         |
| A1CR507               | 1902-3041      | 1   | DIODE-ZNR 5.11V 5% DU-7 PD=.4W TC=                                 | 04713    | SZ 10939-98         |
| A1CR508               | 1901-0040      | 11  | DIODE-SWITCHING 2NS 30V 50MA                                       | 28480    | 1901-0040           |
| A1CR512               | 1901-0040      | 11  | DIODE-SWITCHING 2NS 30V 50MA                                       | 28480    | 1901-0040           |
| A1CR601               | 1901-0040      | 1   | DIODE-SWITCHING 2NS 30V 50MA                                       | 28480    | 1901-0040           |
| A1CR602               | 1901-0040      | 1   | DIODE-SWITCHING 2NS 30V 50MA                                       | 28480    | 1901-0040           |
| A1CR603, CR604        | 1901-0040      | 1   | DIODE-SWITCHING 2NS 30V 50MA                                       | 28480    | 1901-0040           |
| A1CR605, 606          | 0160-0040      | 1   | DIODE-SWITCHING 2NS 30V 50MA                                       | 28480    | 1901-0040           |
| A1CR705               | 1901-0518      | 1   | DIODE-SCHOTTKY                                                     | 28480    | 1901-0518           |
| A1CR801               | 1902-3182      | 1   | DIODE-ZNR 12.1V 5% DU-7 PD=.4W                                     | 04713    | SZ 10939-206        |
| A1CR802               | 1902-3149      | 1   | DIODE-ZNR 9.09V 5% DU-7 PD=.4W                                     | 04713    | SZ 10939-170        |
| A1J2                  | 1203-0423      | 3   | SOCKET:IC BLK 16 CONTACT                                           | 23880    | CSA2900-168         |
| A1J3                  | 1251-3405      | 1   | CONNECTOR, 4-CUNT, MALE, POST TYPE                                 | 27264    | 09-65-104112244-4A1 |
| A1L501                | 9100-1665      | 1   | COIL: 3.3 MH                                                       | 24226    | 221334              |
| A1L704                | 9140-0083      | 3   | COIL: FXD; MOLDED RF CHUKE; 400UH 10%                              | 0004A    | S-400J-I            |
| A1L801                | 9140-0083      | 3   | COIL: FXD; MOLDED RF CHUKE; 400UH 10%                              | 0004A    | S-400J-I            |
| A1L802                | 9140-0083      | 3   | COIL: FXD; MOLDED RF CHUKE; 400UH 10%                              | 0004A    | S-400J-I            |
| A1L803                | 9140-0137      | 2   | COIL: FXD; MOLDED RF CHUKE; 1MH 5%                                 | 24226    | 19/104              |
| A1L804                | 9140-0137      | 2   | COIL: FXD; MOLDED RF CHUKE; 1MH 5%                                 | 24226    | 19/104              |
| A1Q501                | 1853-0020      | 5   | TRANSISTOR PNP SI CHIP PD=300MW                                    | 28480    | 1853-0020           |
| A1Q502                | 1854-0071      | 36  | TRANSISTOR NPN SI PD=300MW FT=200MHZ                               | 28480    | 1854-0071           |
| A1Q503                | 1855-0378      | 1   | TRANSISTOR: J-FET N-CHAN, D-MODE SI                                | 28480    | 1855-0378           |
| A1Q504                | 1853-0066      | 5   | TRANSISTOR PNP SI CHIP TD=92 PD=200MW                              | 28480    | 1853-0066           |
| A1Q506                | 1355-3081      | 3   | TRANSISTOR: J-FET N-CHAN, D-MODE SI                                | 01295    | 215245              |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                              | Mfr Code | Mfr Part Number     |
|-----------------------|----------------|-----|------------------------------------------|----------|---------------------|
| A1Q507                | 1354-0071      | 1   | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q508                | 1355-0308      |     | TRANSISTOR; JFET; DUAL; N-CHAN D-MODE SI | 28480    | 1855-0308           |
| A1Q511                | 1355-0412      | 2   | TRANSISTOR; J-FET N-CHAN, D-MODE SI      | 28480    | 1855-0412           |
| A1Q512                | 1353-0020      |     | TRANSISTOR PNP SI CHIP PD=300MW          | 28480    | 1853-0020           |
| A1Q513                | 1354-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q514                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q515                | 1354-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q516                | 1353-0020      |     | TRANSISTOR PNP SI CHIP PD=300MW          | 28480    | 1853-0020           |
| A1Q600                | 1855-0081      |     | TRANSISTOR; J-FET N-CHAN, D-MODE SI      | 31295    | 2N5245              |
| A1Q702                | 1354-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q703                | 1354-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q704                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q705                | 1354-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ     | 28480    | 1854-0071           |
| A1Q706                | 1353-0093      | 5   | TRANSISTOR PNP SI CHIP TU-52 PD=360MW    | 28480    | 1853-0093           |
| A1Q707                | 1853-0093      |     | TRANSISTOR PNP SI CHIP TU-52 PD=360MW    | 28480    | 1853-0093           |
| A1Q708                | 1353-0093      |     | TRANSISTOR PNP SI CHIP TU-52 PD=360MW    | 28480    | 1853-0093           |
| A1Q709                | 1353-0093      |     | TRANSISTOR PNP SI CHIP TU-52 PD=360MW    | 28480    | 1853-0093           |
| A1Q710                | 1353-0093      |     | TRANSISTOR PNP SI CHIP TU-52 PD=360MW    | 28480    | 1853-0093           |
| A1Q801                | 1855 0216      |     | TRANSISTOR: J-FET P-CHAN D-MODE SI       | 28480    | 1855-0216           |
| A1R501                | 0698 3274      |     | RESISTOR 10K .125W 1%                    | 24546    | NE55                |
| A1R503                | 0757 0465      |     | RESISTOR 100K 1%                         | 24546    | C4 1/8--TO-1003-F   |
| A1R508                | 0698-6630      | 3   | RESISTOR 20K .1% .125W F TUBULAR         | 19701    | MF4C1/8-T9 2002-B   |
| A1R509                | 0698-7163      |     | RESISTOR 2.0081K .1% .125W F TUBULAR     | 19701    | MF4C1/8-T9-2008R1 B |
| A1R510                | 0757-0283      | 1   | RESISTOR 2K 1%                           | 24546    | C4-1/8--TO-2001-F   |
| A1R511                | 0698-6965      | 1   | RESISTOR 505 OHM .1% .125W F TUBULAR     | 19701    | MF4C1/8 T9-505R-B   |
| A1R512 Δ1             | 0698-4465      | 2   | RESISTOR 931 OHM 5% .25W CC TUBULAR      | 24546    | C4-1/8--TO 931R-F   |
| A1R513 Δ1             |                |     |                                          |          |                     |
| A1R514                | 0698-3152      | 2   | RESISTOR 3480 OHM 1%                     | 16299    | C4-1/8--TO-3481-F   |
| A1R515                | 0757-0472      | 2   | RESISTOR 200K 1%                         | 24546    | C4 1/8--TO-2003-F   |
| A1R520                | 0683 1055      | 2   | RESISTOR 1M 5% .25W CC TUBULAR           | 01121    | CB1055              |
| A1R521                | 0757 0453      | 1   | RESISTOR 30.1K 1%                        | 24546    | C4 1/8--TO-3012-F   |
| A1R522                | 0698-7880      | 1   | RESISTOR 28.7K 1%                        | 19701    | MF4C1/8--TO-2872-F  |
| A1R523                | 0698 6630      |     | RESISTOR 20K .1% .125W F TUBULAR         | 19701    | MF4C1/8-T9-2002-B   |
| A1R524                | 2100-3095      | 1   | RESISTOR-VAR TRMR 200 OHM 10% C SIDE ADJ | 32997    | 3006P-1 .201        |
| A1R525                | 0698-6630      |     | RESISTOR 20K .1% .125W F TUBULAR         | 19701    | MF4C1/8-T9-2002-B   |
| A1R526                | 0698 7082      | 1   | RESISTOR 100K 1%                         | 24546    | NE55                |
| A1R527                | 0757 0289      | 2   | RESISTOR 13.3K 1% .125W F TUBULAR        | 30983    | MF4C1/8-TO-1332 F   |
| A1R528                | 0757-0289      |     | RESISTOR 13.3K 1% .125W F TUBULAR        | 30983    | MF4C1/8-TO-1332 F   |
| A1R529                | 0683-2235      |     | RESISTOR 22K 5% .25W CC TUBULAR          | 01121    | CB2235              |
| A1R530                | 0683 4725      | 1   | RESISTOR 4.7K 5% .25W CC TUBULAR         | 01121    | CB4725              |
| A1R535                | 0683 4735      | 2   | RESISTOR 47K 5% .25W CC TUBULAR          | 01121    | CB4735              |
| A1R536 Δ41            | 0683-1035      | 23  | RESISTOR 10K 5% .25W CC TUBULAR          | 01121    | CB1035              |
| A1R542                | 0698 5358      |     | RESISTOR 866K .125                       | 28480    | 0698-5358           |
| A1R543                | 0683-1055      |     | RESISTOR 1M 5% .25W CC TUBULAR           | 01121    | CB1055              |
| A1R544 Δ2 Δ5          | 0698 3274      | 1   | RESISTOR 10K .1% .125W F TUBULAR         | 24546    | NE55                |
| A1R545                | 0698-6977      | 2   | RESISTOR 30K .1% .125W F TUBULAR         | 19701    | MF4C1/8-T9-4172 B   |
| A1R546 Δ55            | 0683 1035      |     | RESISTOR 10K 5% .25W CC TUBULAR          | 01121    | CB1035              |
| A1R556 Δ1             | 0698-4453      |     | RESISTOR 402 OHM 1% .125W F TUBULAR      | 24546    | C4-1/8 TO-590R-F    |
| A1R557, 558           | 0683 1035      |     | RESISTOR 10K 5% .25W CC TUBULAR          | 01121    | CB1035              |
| A1R559                | 0757-0465      | 5   | RESISTOR 100K 1% .125W F TUBULAR         | 24546    | C4-1/8--TO-1003-F   |
| A1R560                | 0698-4123      | 3   | RESISTOR 499 OHM 1% .125W F TUBULAR      | 16299    | C4-1/8--TO-499R F   |
| A1R561*               | 0683-2235      | 2   | RESISTOR 22K 5% .25W CC TUBULAR          | 01121    | CB2235              |
|                       |                |     | *FACTORY SELECTED PART                   |          |                     |
| A1R566 Δ5             | 0698-4435      |     | RESISTOR 2490 OHM 1%                     | 16299    | C4-1/8--TO-2491-F   |
| A1R567                | 0698-4510      | 1   | RESISTOR 84.5K 1% .125W F TUBULAR        | 24546    | C4 1/8--TO-8452-F   |
| A1R568                | 0757 0459      | 1   | RESISTOR 56.2K 1% .125W F TUBULAR        | 24546    | C4-1/8--TO-5622 F   |
| A1R569                | 0757 0416      | 2   | RESISTOR 511 OHM 1% .125W F TUBULAR      | 24546    | C4 1/8--TO-511R-F   |
| A1R570                | 0698 4435      | 4   | RESISTOR 2.49K 1% .125W F TUBULAR        | 16299    | C4-1/8--TO-2491-F   |
| A1R571                | 0757-0416      |     | RESISTOR 511 OHM 1% .125W F TUBULAR      | 24546    | C4-1/8--TO-511R-f   |
| A1R572                | 0698-4435      |     | RESISTOR 2.49K 1% .125W F TUBULAR        | 16299    | C4-1/8--TO 2491-F   |
| A1R573                | 0698-4435      |     | RESISTOR 2490 OHM 1%                     | 16299    | C4-1/8--TO-2491 F   |
| A1R574                | 0757 0472      | 2   | RESISTOR 200K 1%                         | 24546    | C4-1/8--TO-2003-F   |
| A1R575                | 0698 3152      |     | RESISTOR 3480 OHM 1%                     | 16299    | C4-1/8 TO-3481-F    |
| A1R576                | 0698 3228      | 3   | RESISTOR 49.9K 1%                        | 03888    | PME555              |
| A1R577                | 0757-0465      |     | RESISTOR 100K 1%                         | 24546    | C4-1/8--TO-1003 F   |
| A1R578                | 0698-4486      | 1   | RESISTOR 24.9K 1%                        | 24546    | C4-1/8--TO-2492-F   |
| A1R579                | 0683-1015      |     | RESISTOR 100.5% .25W                     | 01121    | CB1015              |
| A1R580                | 0757 0465      |     | RESISTOR 100K 1%                         | 24546    | C4-1/8--TO-1003-F   |
| A1R581                | 0698-3228      | 3   | RESISTOR 49.9K 1%                        | 03888    | PME555              |
| A1R582                | 0698-3228      |     | RESISTOR 49.9K 1%                        | 03888    | PME555              |
| A1R601                | 0757 0280      | 5   | RESISTOR 1K 1% .125W F TUBULAR           | 24546    | C4-1/8--TO-1001-F   |
| A1R602                | 0683-1035      |     | RESISTOR 10K 5% .25W CC TUBULAR          | 01121    | CB1035              |
| A1R603                | 0683-1035      |     | RESISTOR 10K 5% .25W CC TUBULAR          | 01121    | CB1035              |
| A1R604 Δ5             | 0683-4735      |     | RESISTOR 47K 5% .25W CC TUBULAR          | 01121    | CB4735              |
| A1R605 Δ5             | 0683 5145      | 1   | RESISTOR 510K 5% .25W                    | 01121    | CB5145              |
| A1R610                | 1810-0055      | 3   | CIRCUIT: PSIV: NON-RPRABLE IN            | 28480    | 1810 0055           |
| A1R611                | 1810 0055      |     | CIRCUIT: PSIV: NON-RPRABLE IN            | 28480    | 1810-0055           |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                            | Mfr Code | Mfr Part Number   |
|-----------------------|----------------|-----|----------------------------------------|----------|-------------------|
| A1R613                | 0683-1035      | 1   | RESISTOR 10K 5% .25W CC TUBULAR        | 01121    | C81035            |
| A1R620                | 0683-1865      | 1   | RESISTOR 18M 5% .25W CC TUBULAR        | 01121    | C81865            |
| A1R621                | 0683-1265      | 1   | RESISTOR 12M 5% .25W CC TUBULAR        | 01121    | C81265            |
| A1R622                | 0683-2435      | 1   | RESISTOR 24K 5% .25W CC TUBULAR        | 01121    | C82435            |
| A1R624                | 0683-1035      | 1   | RESISTOR 10K 5% .25W CC TUBULAR        | 01121    | C81035            |
| A1R625                | 0683-1035      | 1   | RESISTOR 10K 5% .25W CC TUBULAR        | 01121    | C81035            |
| A1R627                | 0683-1035      | 1   | RESISTOR 10K 5% .25W CC TUBULAR        | 01121    | C81035            |
| A1R630                | 0683-2265      | 1   | RESISTOR 22K 5% .25W CC TUBULAR        | 01121    | C82265            |
| A1R640                | 0683-1045      | 12  | RESISTOR 100K 5% .25W CC TUBULAR       | 01121    | C81045            |
| A1R641                | 0683-1045      | 12  | RESISTOR 100K 5% .25W CC TUBULAR       | 01121    | C81045            |
| A1R642                | 0757-0280      | 7   | RESISTOR 1K 1% .125W F TUBULAR         | 24546    | C4-1/8-T0-1001-F  |
| A1R701                | 1810-0055      | 7   | CIRCUIT; PSIV; NON-RPRABLE IN          | 28480    | 1810-0055         |
| A1R710                | 0757-0381      | 7   | RESISTOR 15 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-15R0-F |
| A1R711                | 0757-0381      | 7   | RESISTOR 15 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-15R0-F |
| A1R712                | 0757-0381      | 7   | RESISTOR 15 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-15R0-F |
| A1R713                | 0757-0381      | 5   | RESISTOR 15 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-15R0-F |
| A1R714                | 0757-0381      | 5   | RESISTOR 15 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-15R0-F |
| A1R715                | 0757-0381      | 5   | RESISTOR 15 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-15R0-F |
| A1R716                | 0757-0381      | 5   | RESISTOR 15 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-15R0-F |
| A1R720                | 0683-2015      | 5   | RESISTOR 200 OHM 5% .25W CC TUBULAR    | 01121    | C82015            |
| A1R721                | 0683-2015      | 1   | RESISTOR 200 OHM 5% .25W CC TUBULAR    | 01121    | C82015            |
| A1R722                | 0683-2015      | 1   | RESISTOR 200 OHM 5% .25W CC TUBULAR    | 01121    | C82015            |
| A1R723                | 0683-2015      | 1   | RESISTOR 200 OHM 5% .25W CC TUBULAR    | 01121    | C82015            |
| A1R724                | 0683-2015      | 1   | RESISTOR 200 OHM 5% .25W CC TUBULAR    | 01121    | C82015            |
| A1R730                | 0598-5842      | 1   | RESISTOR 16 OHM 5% .25W CC TUBULAR     | 01121    | C81605            |
| A1R731                | 0683-5105      | 4   | RESISTOR 51 OHM 5% .25W CC TUBULAR     | 01121    | C85105            |
| A1R732                | 0683-5105      | 4   | RESISTOR 51 OHM 5% .25W CC TUBULAR     | 01121    | C85105            |
| A1R733                | 0683-5105      | 4   | RESISTOR 51 OHM 5% .25W CC TUBULAR     | 01121    | C85105            |
| A1R734                | 0683-5105      | 4   | RESISTOR 51 OHM 5% .25W CC TUBULAR     | 01121    | C85105            |
| A1R740                | 0683-1035      | 4   | RESISTOR 10K 5% .25W CC TUBULAR        | 01121    | C81035            |
| A1R741                | 0683-1035      | 1   | RESISTOR 10K 5% .25W CC TUBULAR        | 01121    | C81035            |
| A1R742                | 0683-1035      | 1   | RESISTOR 10K 5% .25W CC TUBULAR        | 01121    | C81035            |
| A1R801                | 2100-3109      | 1   | RESISTOR-VAR TKMK 2KOHM 10% C SIDE ADJ | 32997    | 3006P-1-202       |
| A1R802                | 0698-6977      | 1   | RESISTOR 30K .1% .125W F TUBULAR       | 19701    | MF4C1/8-T9-4172-B |
| A1R803                | 0683-1005      | 1   | RESISTOR 10 OHM 5% .25W CC TUBULAR     | 01121    | C81005            |
| A1R804                | 0757-0273      | 2   | RESISTOR 3.01K 1% .125W F TUBULAR      | 24546    | C4-1/8-T0-3011-F  |
| A1R805                | 0698-6360      | 2   | RESISTOR 10K .1% .125W F TUBULAR       | 19701    | MF4C1/8-T9-1002-B |
| A1R806                | 0698-3279      | 2   | RESISTOR 4.99K 1% .125W F TUBULAR      | 16299    | C4-1/8-T0-4991-F  |
| A1R807                | 0698-6360      | 2   | RESISTOR 10K .1% .125W F TUBULAR       | 19701    | MF4C1/8-T9-1002-B |
| A1R808                | 0683-1015      | 2   | RESISTOR 100 OHM 5% .25W CC TUBULAR    | 01121    | C81015            |
| A1R812                | 0683-1025      | 1   | RESISTOR 1K 5% .25W CC TUBULAR         | 01121    | C81025            |
| A1R813                | 0757-0277      | 2   | RESISTOR 49.9 OHM 1% .125W F TUBULAR   | 24546    | C4-1/8-T0-4992-F  |
| A1R814                | 0598-3519      | 2   | RESISTOR 12.4K 1% .125W F TUBULAR      | 16299    | C4-1/8-T0-1242-F  |
| A1R815                | 0698-3279      | 2   | RESISTOR 4.99K 1% .125W F TUBULAR      | 16299    | C4-1/8-T0-4991-F  |
| A1S1                  | 3101-1848      | 1   | SWITCH, PUSHBUTTON: DISPLAY & MONITOR  | 28480    | 3101-1848         |
| A1S2                  | 3101-1847      | 1   | SWITCH, PUSHBUTTON: POWER              | 28480    | 3101-1847         |
| A1U501                | 1826-0109      | 4   | IC LIN AMPLIFIER                       | 34371    | HA2-2625-BU593    |
| A1U502                | 1826-0323      | 1   | IC OP AMP HA4741                       | 28480    | 1826-0323         |
| A1U503                | 1820-0223      | 1   | IC LIN LM301AH AMPLIFIER               | 27014    | LM301AH           |
| A1U504                | 1825-0043      | 1   | IC LIN LM307H AMPLIFIER                | 27014    | LM307H            |
| A1U505                | 1820-0223      | 1   | IC LIN LM301AH AMPLIFIER               | 27014    | LM301AH           |
| A1U506                | 1820-0223      | 1   | IC LIN LM301AH AMPLIFIER               | 27014    | LM301AH           |
| A1U507                | 1820-1188      | 1   | IC DGTL CD4046AE PHASE LOCK LOOP       | 02735    | CD4046AE          |
| A1U508                | 1820-1189      | 1   | IC DGTL MC14510CP COUNTER              | 04713    | MC14510CP         |
| A1U509                | 1820-0939      | 7   | IC DGTL CD4013AE FLIP-FLOP             | 86684    | CD4013AE          |
| A1U510                | 1820-0949      | 8   | IC DGTL;GATE                           | 86684    | CD4011AE          |
| A1U515                | 1820-0223      | 1   | IC LIN LM301AH AMPLIFIER               | 27014    | LM301AH           |
| A1U601                | 1818-2239      | 1   | IC MEMORY                              | 28480    | 1818-2239         |
| A1TX601               | 1200-0423      | 2   | SOCKET-IC 16-CONT                      | 28480    | 1200-0423         |
| A1U602                | 1820-1190      | 2   | IC DGTL MM74C173N FLIP-FLOP            | 27014    | MM74C173N         |
| A1U603                | 1820-1190      | 2   | IC DGTL MM74C173N FLIP-FLOP            | 27014    | MM74C173N         |
| A1U604                | 1820-0939      | 1   | IC DGTL CD4013AE FLIP-FLOP             | 86684    | CD4013AE          |
| A1U606                | 1820-0927      | 1   | IC DGTL CD4028AE DECODER               | 02735    | CD4028AE          |
| A1U607                | 1820-0949      | 1   | IC DGTL;GATE                           | 86684    | CD4011AE          |
| A1U608                | 1820-1241      | 2   | IC DGTL MC14512CP                      | 04713    | MC14512CP         |
| A1U609                | 1820-1241      | 2   | IC DGTL MC14512CP                      | 04713    | MC14512CP         |
| A1U610                | 1820-0939      | 3   | IC DGTL CD4013AE FLIP-FLOP             | 86684    | CD4013AE          |
| A1U611                | 1820-1145      | 1   | IC DGTL;BUFFER/DRIVER/LINE DRIVER      | 02735    | CD4049AE          |
| A1U612                | 1820-1123      | 1   | IC DGTL MK 5009P                       | 50088    | MC5009P           |
| A1U613                | 1820-1122      | 1   | IC DGTL MC14518CL COUNTER              | 04713    | MC14518CL         |
| A1U614                | 1820-1145      | 1   | IC DGTL;BUFFER/DRIVER/LINE DRIVER      | 02735    | CD4049AE          |
| A1U615                | 1820-0939      | 1   | IC DGTL CD4013AE FLIP-FLOP             | 86684    | CD4013AE          |
| A1U616                | 1820-0949      | 1   | IC DGTL;GATE                           | 86684    | CD4011AE          |
| A1U617                | 1820-0939      | 1   | IC DGTL CD4013AE FLIP-FLOP             | 86684    | CD4013AE          |
| A1U618                | 1820-0939      | 1   | IC DGTL CD4013AE FLIP-FLOP             | 86684    | CD4013AE          |
| A1U621                | 1820-1114      | 1   | IC DGTL MC14516CL COUNTER              | 04713    | MC14516CL         |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation                                                   | HP Part Number                                                | Qty                   | Description                                                                                                                                                                            | Mfr Code                                  | Mfr Part Number                                               |
|-------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------|
| A1U701<br>A1TX701<br>A1U702<br>A1U703<br>A1U719                         | 1820-1239<br>1200-0423<br>1818-2240<br>1820-1233<br>1820-0949 | 1<br>1<br>1           | IC DGTL MK 5007P COUNTER<br>SOCKET-IC 16-CONT<br>ROM, MOS<br>IC DGTL SN74L 47 N DECODER<br>IC;DGTL;GATE                                                                                | 50088<br>28480<br>28480<br>01295<br>86684 | MK5007P<br>1200-0423<br>1818-2240<br>SN74L47N<br>CD4011AE     |
| A1U720<br>A1U722<br>A1U724<br>A1U726<br>A1U727                          | 1820-0939<br>1820-0949<br>1820-0949<br>1820-1146<br>1820-1145 | 1                     | IC DGTL CD4013AE FLIP-FLOP<br>IC;DGTL;GATE<br>IC;DGTL;GATE<br>IC DGTL CD4050AE BUFFER<br>IC;DGTL;BUFFER/DRIVER/LINE DRIVER                                                             | 86684<br>86684<br>86684<br>02735<br>02735 | CD4013AE<br>CD4011AE<br>CD4011AE<br>CD4050AE<br>CD4049AE      |
| A1U729<br>A1U731<br>A1U801<br>A1U802                                    | 1820-0949<br>1820-0949<br>1820-0196<br>1826-0043              | 1                     | IC;DGTL;GATE<br>IC;DGTL;GATE<br>IC LIN REGULATOR<br>IC LIN LM307H AMPLIFIER                                                                                                            | 86684<br>86684<br>07263<br>27014          | CD4011AE<br>CD4011AE<br>723HC<br>LM307H                       |
| A1W1                                                                    | 03551-61601                                                   | 1                     | CABLE ASSY, FLAT                                                                                                                                                                       | 28480                                     | 03551-61601                                                   |
| A1Y601                                                                  | 0410-0561                                                     | 1                     | CRYSTAL                                                                                                                                                                                | 28480                                     | 0410-0561                                                     |
| A1A2                                                                    | 03551-66502                                                   | 1                     | PC ASSY, DISPLAY                                                                                                                                                                       | 28480                                     | 03551-66502                                                   |
| A1A2CR701<br>A1A2CR702<br>A1A2CR703<br>A1A2CR704                        | 1990-0416<br>1990-0416<br>1990-0416<br>1901-0040              | 3                     | LED-VISIBLE<br>LED-VISIBLE<br>LED-VISIBLE<br>DIODE-SWITCHING 2NS 30V 50MA                                                                                                              | 28480<br>28480<br>28480<br>28480          | 1990-0416<br>1990-0416<br>1990-0416<br>1901-0040              |
| A1A2CR706<br>A1A2CR707                                                  | 1901-0040<br>1901-0040                                        |                       | DIODE-SWITCHING 2NS 30V 50MA<br>DIODE-SWITCHING 2NS 30V 50MA                                                                                                                           | 28480<br>28480                            | 1901-0040<br>1901-0040                                        |
| A1A2K701                                                                | 0757-0401                                                     |                       | RESISTOR 100 OHM 1% .125W F TUBULAR                                                                                                                                                    | 24546                                     | C4-1/8-T0-101-F                                               |
| A1A2U701 Δ1<br>A1A2U702 Δ1<br>A1A2U703 Δ1<br>A1A2U704 Δ1<br>A1A2U705 Δ1 | 1990-0491<br>1990-0490<br>1990-0490<br>1990-0490<br>1990-0490 | 1<br>4                | DISPLAY AN SEG 1 CHAR .28 IN HIGH<br>DISPLAY NUM SEG 1 CHAR .3 IN HIGH<br>DISPLAY NUM SEG 1 CHAR .3 IN HIGH<br>DISPLAY NUM SEG 1 CHAR .3 IN HIGH<br>DISPLAY NUM SEG 1 CHAR .3 IN HIGH  | 28480<br>28480<br>28480<br>28480<br>28480 | 1990-0491<br>1990-0490<br>1990-0490<br>1990-0490<br>1990-0490 |
| A2                                                                      |                                                               |                       | SEE A1A2                                                                                                                                                                               |                                           |                                                               |
| A3 Δ1                                                                   | 03551-66513                                                   | 1                     | PC ASSY, INPUT AMPLIFIER                                                                                                                                                               | 28480                                     | 03551-66513                                                   |
| A3C101 Δ6<br>A3C102 Δ1<br>A3C103* Δ1                                    | 0121-0147                                                     | 1<br>1                | CAPACITOR; VAR; TRMR; CER; 2/19.3PF<br>NORMALLY NOT LOADED<br>*FACTORY SELECTED PART                                                                                                   | 74970                                     | 189-507-5                                                     |
| A3C104*                                                                 | 0160-2206                                                     | 1                     | CAPACITOR-FXD 163PF +-5% 300WVDC MICA<br>*FACTORY SELECTED PART                                                                                                                        | 28480                                     | 0160-2206                                                     |
| A3C105<br>A3C106<br>A3C107*                                             | 0180-0543<br>0150-0050                                        | 2<br>4<br>6           | CAPACITOR-FXD; 750F+100-20% 300VDC AL<br>CAPACITOR-FXD 1000PF +-80-20% 1000WVDC<br>NORMALLY NOT LOADED<br>CAPACITOR-FXD 39PF +-5% 300WVDC MICA                                         | 90201<br>28480                            | SPO 32-8428<br>0150-0050                                      |
| A3C108* Δ1                                                              | 0140-0190                                                     |                       | CAPACITOR-FXD 39PF +-5% 300WVDC MICA                                                                                                                                                   | 72136                                     | DM15E390J0300WV1CR                                            |
| A3C109<br>A3C110<br>A3C112<br>A3C113 Δ1<br>A3C200                       | 0150-0050<br>0180-0543<br>0150-0050<br>0150-0093              |                       | CAPACITOR-FXD 1000PF +-80-20% 1000WVDC<br>CAPACITOR-FXD; 750F+100-20% 300VDC AL<br>CAPACITOR-FXD 1000PF +-80-20% 1000WVDC<br>CAPACITOR-FXD .01UF +-80-20% 100WVDC CER                  | 28480<br>90201<br>28480<br>28480          | 0150-0050<br>SPO 32-8428<br>0150-0050<br>0150-0093            |
| A3C201 Δ1<br>A3C202<br>A3C203<br>A3C204<br>A3C205 Δ1                    | 0150-0093<br>0160-0156<br>0160-0938<br>0180-1743              | 1<br>3                | CAPACITOR-FXD .01UF +-80-20% 100WVDC CER<br>CAPACITOR-FXD 3900PF +-10% 200WVDC POLY<br>CAPACITOR-FXD 1000PF +-5% 100WVDC MICA<br>CAPACITOR-FXD .1UF +-20% 25WVDC CER                   | 28480<br>56289<br>53021<br>56289          | 0150-0093<br>292P39292<br>015C1E102J<br>150D104X9035A2        |
| A3C206<br>A3C207 Δ1<br>A3C208<br>A3C209<br>A3C210 Δ1<br>A3C211 Δ1       | 0160-0938<br>0160-3188<br>0160-4232<br>0160-4231<br>0121-0060 | 1<br>1<br>1<br>1<br>1 | CAPACITOR-FXD 1000PF +-5% 100WVDC MICA<br>CAPACITOR-FXD .27UF +-5% 50WVDC MET<br>CAPACITOR-FXD .047UF +-5-0% 50WVDC MET<br>CAPACITOR-FXD 4700PF +-5% 50WVDC MET<br>CAPACITOR-VAR 2-8PF | 53021<br>28480<br>28480<br>28480<br>73899 | 015C1E102J<br>0160-3188<br>0160-4232<br>0160-4231<br>DV11PS8A |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                              | Mfr Code | Mfr Part Number    |
|-----------------------|----------------|-----|------------------------------------------|----------|--------------------|
| A3C213                | 0150-0093      |     | CAPACITOR-FXD .01UF +80 -20% 100WVDC CER | 28480    | 0150-0093          |
| A3C214                | 0150-0093      |     | CAPACITOR-FXD .01UF +80 -20% 100WVDC CER | 28480    | 0150-0093          |
| A3C215*               | 0140-0176      |     | CAPACITOR-FXD 100PF + -2% 300WVDC MICA   | 72136    | DM15F101G0300WV1CR |
| A3C216                | 0160-3622      |     | CAPACITOR-FXD .1UF +80 -20% 100WVDC CER  | 28480    | 0160-3622          |
| A3C217                | 0160-0938      |     | CAPACITOR-FXD 1000PF + -5% 100WVDC MICA  | 53021    | D15C1E102J         |
| A3C218* Δ1 Δ5         | 0150-0045      | 1   | CAPACITOR-FXD 8.2PF 500VDC               | 95121    | TYPE OC            |
| A3C219                | 0150-0093      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C220                | 0160-2150      | 1   | CAPACITOR-FXD 33PF +-5% 300WVDC MICA     | 28480    | 0160-2150          |
| A3C223                | 0150-0093      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C224                | 0150-0093      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C225                | 0160-0229      | 2   | CAPACITOR-FXD: 33UF+-10% 15VDC TA-SOLID  | 56289    | 150D336X901082     |
| A3C226                | 0150-0093      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C227                | 0160-0229      |     | CAPACITOR-FXD: 33UF+-10% 15VDC TA-SOLID  | 56289    | 150D336X901082     |
| A3C228                | 0160-0228      | 7   | CAPACITOR-FXD: 22UF+-10% 15VDC TA-SOLID  | 56289    | 150D226X901582     |
| A3C229                | 0160-0228      |     | CAPACITOR-FXD: 22UF+-10% 15VDC TA-SOLID  | 56289    | 150D226X901582     |
| A3C230 Δ1 Δ3          | 0150-0093      |     | CAPACITOR-FXD .01UF 100WVDC              | 28480    | 0150-0093          |
| A3C231 Δ1 Δ3          | 0150-0093      |     | CAPACITOR-FXD .01UF 100WVDC              |          |                    |
| A3C232 Δ1             | 0160-0127      |     | CAPACITOR-FXD 1UF +-20% 25WVDC           | 28480    | 0160-0127          |
| A3C233, 234           | 0160-0127      |     | CAPACITOR-FXD: 1UF + -20% 25WVDC CER     | 28480    | 0160-0127          |
| A3C300                | 0160-2204      |     | CAPACITOR-FXD: 100PF + -5% MICA 300WVDC  | 28480    | 0160-2204          |
| A3C302-306            | 0160-3548      |     | CAPACITOR-FXD: .01UF + -1% 100WVDC MICA  | 28480    | 0160-3548          |
| A3C307                | 0160-3548      |     | CAPACITOR-FXD .01UF +-1% 100WVDC MICA    | 28480    | 0160-3548          |
| A3C308                | 0160-3548      |     | CAPACITOR-FXD .01UF +-1% 100WVDC MICA    | 28480    | 0160-3548          |
| A3C309                | 0160-3548      |     | CAPACITOR-FXD .01UF +-1% 100WVDC MICA    | 28480    | 0160-3548          |
| A3C310                | 0160-0127      |     | CAPACITOR-FXD 1UF +-20% 25WVDC CER       | 28480    | 0160-0127          |
| A3C311 Δ1             | 0180-0161      |     | CAPACITOR-FXD: 3.3UF +75-10% 35V AL      | 56289    | 150D335X0035B2     |
| A3C13                 | 0180-0106      |     | CAPACITOR-FXD 60UF +-20% 6VDC TA-SOLID   | 56289    | 150D606X0006B2     |
| A3C315* Δ1 Δ3         | 0140-0149      |     | CAPACITOR-FXD 470PF +-5% 300WVDC MICA    | 72136    | DM15F471J0300WV1CR |
| A3C317                | 0160-0205      | 4   | CAPACITOR-FXD 10PF +-5% 500WVDC MICA 0+  | 28480    | 0160-0205          |
| A3C318* Δ1 Δ3         | 0160-2200      |     | CAPACITOR-FXD 43PF +-5% 300WVDC MICA     | 28480    | 0160-2200          |
| A3C319                | 0160-0205      |     | CAPACITOR-FXD 10PF +-5% 500WVDC MICA 0+  | 28480    | 0160-0205          |
| A3C320                | 0160-0205      |     | CAPACITOR-FXD 10PF +-5% 500WVDC MICA 0+  | 28480    | 0160-0205          |
| A3C321                | 0150-0093      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C322                | 0150-0093      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C323* Δ1            |                |     | NORMALLY NOT LOADED                      |          |                    |
| A3C325                | 0160-2199      |     | CAPACITOR-FXD 30PF +-5% 300WVDC MICA     | 28480    | 0160-2199          |
| A3C326 Δ1             | 0160-0269      |     | CAPACITOR-FXD .1UF +-20% 500WVDC         | 28480    | 0160-0269          |
| A3C327 Δ1 Δ5          | 0140-0149      |     | CAPACITOR-FXD 470PF +-5% 300WVDC MICA    | 72136    | DM15F471J0300WV1CR |
| A3C328 Δ1             | 0160-2204      |     | CAPACITOR-FXD 100PF +-5% 300WVDC MICA    | 28480    | 0160-2204          |
| A3C330 Δ1             | 0160-3622      |     | CAPACITOR-FXD .1UF +80-20% 100WVDC CER   | 28480    | 0160-3622          |
| A3C480* Δ1            | 0160-2205      |     | CAPACITOR-FXD 120PF +-5% 300V            | 28480    | 0160-2205          |
| A3C501                | 0150-0093      |     | *FACTORY SELECTED PART                   |          |                    |
| A3C502 Δ1             | 0140-0209      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C503                | 0150-0093      |     | CAPACITOR-FXD 5PF 10% 500WVDC MICA 0+    | 72136    | DM15C050K0500WV1CR |
| A3C504 Δ1             | 0180-0100      |     | CAPACITOR-FXD .01UF +80-20% 100WVDC CER  | 28480    | 0150-0093          |
| A3C516                | 0180-0228      |     | CAPACITOR-FXD 4.7UF 10% 35VDC TA         | 56289    | 150D475X9035B2     |
| A3C817                | 0180-1704      | 1   | CAPACITOR-FXD: 22UF+-10% 15VDC TA-SOLID  | 56289    | 150D226X901582     |
| A3C818 Δ1             | 0160-2200      |     | CAPACITOR-FXD: 43PF                      | 28480    | 0160-2200          |
| A3CR100               | 1901-0758      |     | DIODE                                    | 28480    | 1901-0758          |
| A3CR101               | 1901-0028      | 4   | DIODE-PWR RECT 400V 750MA                | 04713    | SR1358-9           |
| A3CR102               | 1901-0028      |     | DIODE-PWR RECT 400V 750MA                | 04713    | SR1358-9           |
| A3CR103               | 1901-0028      |     | DIODE-PWR RECT 400V 750MA                | 04713    | SR1358-9           |
| A3CR104               | 1901-0028      |     | DIODE-PWR RECT 400V 750MA                | 04713    | SR1358-9           |
| A3CR105               | 1901-0050      | 4   | DIODE-SWITCHING 2NS 80V 200MA            | 28480    | 1901-0050          |
| A3CR106               | 1901-0050      |     | DIODE-SWITCHING 2NS 80V 200MA            | 28480    | 1901-0050          |
| A3CR115               | 1902-0554      | 2   | DIODE: ZENER; 10V VZ; 1W MAX PD          | 04713    | SZ 11213-140       |
| A3CR116               | 1902-0554      |     | DIODE: ZENER; 10V VZ; 1W MAX PD          | 04713    | SZ 11213-140       |
| A3CR200               | 1902-3048      | 1   | DIODE-ZNR 6.81V 5% 00-7 PD=.4W           | 28480    | 1902-0048          |
| A3CR201 Δ1            |                |     |                                          |          |                    |
| A3CR202 Δ1            |                |     |                                          |          |                    |
| A3CR203               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR204               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR205               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR206               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR207               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR208               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR209               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR210               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR211               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR212               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR213               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR214               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR215               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR216               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR217               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR218               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR220 Δ1            | 1901-0518      |     | DIODE-SCHOTTKY                           | 28480    | 1901-0518          |
| A3CR300               | 1901-3040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR301               | 1901-3040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |
| A3CR302               | 1901-3040      |     | DIODE-SWITCHING 2NS 30V 50MA             | 28480    | 1901-0040          |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                            | Mfr Code | Mfr Part Number     |
|-----------------------|----------------|-----|----------------------------------------|----------|---------------------|
| A3CR303               | 1901-0040      | 12  | DIODE-SWITCHING 2NS 30V 50MA           | 28480    | 1901-0040           |
| A3CR304               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA           | 28480    | 1901-0040           |
| A3CR305               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA           | 28480    | 1901-0040           |
| A3CR401               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA           | 28480    | 1901-0040           |
| A3CR402               | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA           | 28480    | 1901-0040           |
| A3J1                  | 1200-0423      |     | SOCKET: IC BLK 16 CONTACT              | 23880    | CSA2900-16B         |
| A3Q101                | 1854-0234      |     | TRANSISTOR NPN 2N3440 SI PD=1W         | 02735    | 2N3440              |
| A3Q102                | 1854-0234      |     | TRANSISTOR NPN 2N3440 SI PD=1W         | 02735    | 2N3440              |
| A3Q103 Δ1             | 1854-0071      |     | TRANSISTOR SI NPN                      | 28480    | 1854-0071           |
| A3Q201                | 1853-0086      |     | TRANSISTOR PNP SI CHIP PD=310MW        | 28480    | 1853-0086           |
| A3Q202                | 1853-0086      |     | TRANSISTOR PNP SI CHIP PD=310MW        | 28480    | 1853-0086           |
| A3Q203                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ   | 28480    | 1854-0071           |
| A3Q204                | 1854-0071      | 1   | TRANSISTOR NPN SI PD=300MW FT=200MHZ   | 28480    | 1854-0071           |
| A3Q205                | 1853-0086      |     | TRANSISTOR PNP SI CHIP PD=310MW        | 28480    | 1853-0086           |
| A3Q206                | 1853-0086      |     | TRANSISTOR PNP SI CHIP PD=310MW        | 28480    | 1853-0086           |
| A3Q207                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ   | 28480    | 1854-0071           |
| A3Q208                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ   | 28480    | 1854-0071           |
| A3Q209                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ   | 28480    | 1854-0071           |
| A3Q210                | 1853-0086      |     | TRANSISTOR PNP SI CHIP PD=310MW        | 28480    | 1853-0086           |
| A3Q211 Δ1             | 1853-0086      |     | TRANSISTOR PNP SI CHIP PD=310MW        | 28480    | 1853-0086           |
| A3Q212 Δ1             | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ   | 28480    | 1854-0071           |
| A3Q213                | 1855-0410      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1855-0410           |
| A3Q214                | 1855-0410      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1855-0410           |
| A3Q215                | 1855-0081      | 1   | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 01295    | 2N5245              |
| A3Q216 Δ1             | 1853-0086      |     | TRANSISTOR PNP SI                      | 28480    | 1853-0086           |
| A3Q217 Δ1             | 1855-0410      |     | TRANSISTOR J FET N-CHAN D-MODE         | 28480    | 1855-0410           |
| A3Q300                | 1855-0414      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 17856    | 2N4393              |
| A3Q301                | 1854-0414      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1854-0414           |
| A3Q302                | 1855-0410      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1855-0410           |
| A3Q303                | 1854-0233      |     | TRANSISTOR NPN 2N3866 SI PD=1W         | 02735    | 2N3866              |
| A3Q304                | 1855-0414      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 17856    | 2N4393              |
| A3Q305                | 1855-0414      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 17856    | 2N4393              |
| A3Q306                | 1853-0020      |     | TRANSISTOR PNP SI CHIP PD=300MW        | 28480    | 1853-0020           |
| A3Q307                | 1855-0410      | 1   | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1855-0410           |
| A3Q308                | 1855-0414      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 17856    | 2N4393              |
| A3Q310                | 1855-0377      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1855-0377           |
| A3Q311                | 1853-0020      |     | TRANSISTOR PNP SI CHIP PD=300MW        | 28480    | 1853-0020           |
| A3Q312                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ   | 28480    | 1854-0071           |
| A3Q401                | 1855-0410      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1855-0410           |
| A3Q402                | 1855-0410      |     | TRANSISTOR J-FET N-CHAN, D-MODE SI     | 28480    | 1855-0410           |
| A3R101 Δ6             | 0698-4367      | 1   | RESISTOR 20.5 1% .125W F               | 03888    | PME55-1/8-T0-20R5-F |
| A3R102* Δ1            |                |     | RESISTOR 2.7 OHM 5% .25W CC TUBULAR    | 01121    | C827G5              |
| A3R103                |                |     | RESISTOR 200K 1% .125W F TUBULAR       | 24546    | C4-1/8-T0-2003-F    |
| A3R104                |                |     | RESISTOR 67.3 OHM 1% .5W F TUBULAR     | 28480    | 0698-8558           |
| A3R105*               |                |     | *FACTORY SELECTED PART                 |          |                     |
| A3R106*               |                |     | RESISTOR 302 OHM 1% .5W F TUBULAR      | 28480    | 0698-8559           |
| A3R107*               |                |     | *FACTORY SELECTED PART                 |          |                     |
| A3R108*               |                |     | RESISTOR 454.6 OHM 1% .5W F TUBULAR    | 28480    | 0698-8561           |
| A3R109*               |                |     | *FACTORY SELECTED PART                 |          |                     |
| A3R110*               |                |     | RESISTOR 67.3 OHM 1% .5W F TUBULAR     | 28480    | 0698-8558           |
| A3R111                |                |     | *FACTORY SELECTED PART                 |          |                     |
| A3R112                |                |     | RESISTOR 302 OHM 1% .5W F TUBULAR      | 28480    | 0698-8559           |
| A3R113                |                |     | *FACTORY SELECTED PART                 |          |                     |
| A3R114 Δ1             | 0698-8561      | 1   | RESISTOR 454.6 OHM 1% .5W F TUBULAR    | 28480    | 0698-8561           |
| A3R115                |                |     | *FACTORY SELECTED PART                 |          |                     |
| A3R116, R117 Δ1       |                |     | RESISTOR 90.9 OHM 1% .125W F TUBULAR   | 24546    | C4-1/8-T0-90R9-F    |
| A3R121                |                |     | RESISTOR 210 OHM 1% .125W F TUBULAR    | 24546    | C4-1/8-T0-210R-F    |
| A3R122                |                |     | RESISTOR 340 OHM 1% .125W F TUBULAR    | 24546    | C4-1/8-T0-340R-F    |
| A3R123                |                |     | RESISTOR 200K 1% .125W F TUBULAR       | 24546    | C4-1/8-T0-2003-F    |
| A3R200 Δ1             |                |     | RESISTOR 505 OHM 1% .125W              | 24546    | NE55                |
| A3R201 Δ1             |                |     | RESISTOR-VAR 20 OHM .10                | 28480    | 2100-3426           |
| A3R202 Δ1             |                |     | RESISTOR-VAR TRMR 50 OHM 20% C TOP ADJ | 73138    | 72XR50M             |
| A3R203                |                |     | RESISTOR-VAR TRMR 50 OHM 20% C TOP ADJ | 73138    | 72XR50M             |
| A3R204 Δ1             | 0757-0442      | 1   | RESISTOR 10K 1% .125W                  | 24546    | C4-1/8-T0-1002-F    |
| A3R205 Δ1             |                |     | RESISTOR 1K 1% .125W F TUBULAR         | 24546    | C4-1/8-T0-1001-F    |
| A3R206 Δ1             |                |     | RESISTOR 10K 1% .125W                  | 24546    | C4-1/8-T0-1002-F    |
| A3R207 Δ1             |                |     | RESISTOR 10K 1% .125W                  | 03888    | PME55S              |
| A3R208 Δ1             |                |     | RESISTOR 49.9K 1% .125W F TUBULAR      | 03888    | PME55S              |
| A3R209 Δ1             |                |     | RESISTOR 49.9K 1% .125W F TUBULAR      | 24546    | C4-1/8-T0-1002-F    |
| A3R210 Δ1             |                |     | RESISTOR 10K 1% .125W                  |          |                     |
| A3R211                |                |     | RESISTOR 2K 1% .125W F TUBULAR         | 24546    | C4-1/8-T0-2001-F    |
| A3R212                |                |     | RESISTOR 1.5K 1% .125W F TUBULAR       | 24546    | C4-1/8-T0-1501-F    |
| A3R213 Δ1             |                |     | RESISTOR 5360 OHM 1% .125W F TUBULAR   | 16299    | C4-1/8-T0-5361-F    |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                              | Mfr Code | Mfr Part Number   |
|-----------------------|----------------|-----|------------------------------------------|----------|-------------------|
| A3R391                | 0683-4735      | 1   | RESISTOR 47K 5% .25W CC TUBULAR          | 01121    | CB4735            |
| A3R392                | 0698-6801      | 1   | RESISTOR 3.48K 1% .125W F TUBULAR        | 19701    | MF4C1/8-T9-3481-F |
| A3R393                | 0598-8182      | 1   | RESISTOR 2.21K 1% .125W F TUBULAR        | 30983    | MF4C1/8-T9-2211-F |
| A3R395                | 0757-0387      | 1   | RESISTOR 27.4 OHM 1% .125W F TUBULAR     | 30983    | MF4C1/8-T0-27K4-F |
| A3R396                | 0757-0442      | 1   | RESISTOR 10K 1% .125W F TUBULAR          | 24546    | C4-1/8-T0-1002-F  |
| A3R397                | 2100-3212      | 1   | RESISTOR-VAR TRMR 200 OHM 10% C SIDE ADJ | 32997    | 3389P-1-201       |
| A3R398 Δ1             | 0757-0449      | 1   | RESISTOR 20K 1% .125W                    | 24546    | C4-1/8-T0-2002-F  |
| A3R401                | 0757-0280      | 1   | RESISTOR 1K 1% .125W F TUBULAR           | 24546    | C4-1/8-T0-1001-F  |
| A3R401 Δ1 Δ5          | 0698-3497      | 1   | RESISTOR 6040 OHM 1% .125W F TUBULAR     | 16299    | C4-1/8-T0-604R-F  |
| A3R403, 404           | 0683-5145      | 1   | RESISTOR 510K 5% .25W CC TUBULAR         | 01121    | CB5145            |
| A3R501                | 0698-6323      | 1   | RESISTOR 100 OHM 1% .125W F TUBULAR      | 19701    | MF4C1/8-T9-100R-B |
| A3R502 Δ1             | 0698-6448      | 1   | RESISTOR-FXD 216.2 .001 .125W            | 24546    | NE55              |
| A3R503                | 0698-5369      | 1   | RESISTOR-FXD 262.4 .001                  | 28480    | 0698-5369         |
| A3R504                | 0698-3274      | 1   | RESISTOR 10K 1% .125W F TUBULAR          | 19701    | MF4C1/8-T9-1002-F |
| A3R505 Δ1             | 2100-3351      | 1   | RESISTOR-VAR TRMR 500OHM 10% C SIDE ADJ  | 73138    | 72XR500           |
| A3R506*               | 0757 0398      | 1   | RESISTOR 75 1% .125W F                   | 24546    | C4-1/8-T0-75R0-F  |
| A3R507, 508 Δ1        | 2100-3345      | 1   | RESISTOR-VAR 100HM 10% C TOP ADJ         | 73138    | 72PR10            |
| A3R818                | 0683-2405      | 3   | RESISTOR 24 OHM 5% .25W CC TUBULAR       | 01121    | CB2405            |
| A3R819                | 0684-1021      | 3   | RESISTOR 1K 10% .25W CC TUBULAR          | 01121    | CB1021            |
| A3R820                | 0757-0277      | 3   | RESISTOR 49.9 OHM 1% .125W F TUBULAR     | 24546    | C4-1/8-T0-4992-F  |
| A3S1, A3S2            | 03551-61901    | 2   | SWITCH, ASSEMBLY ROTARY:FUNCTION AND IMP | 28480    | 03551-61901       |
| A3S3                  | 3100-2753      | 1   | SWITCH, ROTARY: FREQ RANGE HZ            | 28480    | 3100-2753         |
| A3S4 Δ1               | 3100-3351      | 1   | SWITCH, ROTARY: LEVEL RANGE DBM          | 28480    | 3100-3351         |
| A3S5 Δ7               | 3100-3377      | 1   | SWITCH, ROTARY: RECEIVE NOISE/TONE       | 28480    | 3100-3377         |
| A3T101 Δ1 Δ3          | 9100-3489      | 1   | TRANSFORMER, RECEIVE                     | 28480    | 9100-3489         |
| A3T102                | 9100-3449      | 1   | TRANSFORMER, SEND                        | 28480    | 9100-3449         |
| A3U201 Δ1             | 1826-0218      | 1   | IC LIN AMPLIFIER                         | 02735    | CA3100T           |
| A3U202                | 1820-0478      | 4   | IC LIN LM308H AMPLIFIER                  | 27014    | LM308H            |
| A3U203                | 1820-0478      | 4   | IC LIN LM308H AMPLIFIER                  | 27014    | LM308H            |
| A3U204                | 1826-0109      | 1   | IC LIN AMPLIFIER                         | 34371    | HA2-2625-B0593    |
| A3U205                | 1820-0478      | 1   | IC LIN LM308H AMPLIFIER                  | 27014    | LM308H            |
| A3U206 Δ1             | 1826-0222      | 1   | IC LIN RC4136CP AMPLIFIER                | 0059R    | RC4136DP          |
| A3U207                | 1826-0043      | 1   | IC LIN LM307H AMPLIFIER                  | 27014    | LM307H            |
| A3U208                | 1826-0109      | 1   | IC LIN AMPLIFIER                         | 34371    | HA2-2625-B0593    |
| A3U209 Δ1             | 1826-0218      | 1   | IC LIN AMPLIFIER                         | 02735    | CA3100T           |
| A3U300                | 1826-0013      | 1   | IC LIN AMPLIFIER                         | 28480    | 1826-0013         |
| A3U301                | 1826-0222      | 1   | IC LIN RC4136CP AMPLIFIER                | 0059R    | RC4136DP          |
| A3U302                | 1826-0222      | 1   | IC LIN RC4136CP AMPLIFIER                | 0059R    | RC4136DP          |
| A3U303                | 1826-0222      | 1   | IC LIN RC4136CP AMPLIFIER                | 0059R    | RC4136DP          |
| A3U304                | 1826-0222      | 1   | IC LIN RC4136CP AMPLIFIER                | 0059R    | RC4136DP          |
| A3U306                | 1820-1315      | 1   | IC:DTL;MULTIPLEXER                       | 02735    | CD4051AE          |
| A3U307                | 1820-0478      | 1   | IC LIN LM308H AMPLIFIER                  | 27014    | LM308H            |
| A3U401                | 1826-0013      | 1   | IC LIN AMPLIFIER                         | 28480    | 1826-0013         |
| A3U500                | 1826-0109      | 1   | IC LIN AMPLIFIER                         | 34371    | HA2-2625-B0593    |
| A3V101 Δ6             | 1970-0073      | 1   | TUBE, ELCTR, 81-C90, SURGE V PT CTR      | 28480    | 1970-0073         |
| A3XA4                 | 1251-1941      | 1   | CONNECTOR; PC EDGE; 6-CONT; DIP SOLDER   | 71785    | 252-06-30-310     |
|                       |                |     | A3 MISCELLANEOUS                         |          |                   |
|                       | 03551-01203    | 1   | BRACKET, ANALOG SWITCH                   | 28480    | 03551-01203       |
|                       | 03551-26503    | 1   | PC BOARD, INPUT AMPLIFIER                | 28480    | 03551-26503       |
|                       | 03551-61602    | 1   | CABLE ASSY                               | 28480    | 03551-61602       |
|                       | 03551-61604    | 1   | CABLE ASSY                               | 28480    | 03551-61604       |
|                       | 03551-61603    | 1   | CABLE ASSY                               | 28480    | 03551-61603       |
|                       | 1200-0043      | 3   | INSULATOR; XSTR; TU- 3; .02 THK          | 28480    | 1200-0043         |
|                       | 1205-0250      | 1   | THERMAL-LINK; SGL; TU-5 PKG              | 28480    | 1205-0250         |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                               | Mfr Code | Mfr Part Number      |
|-----------------------|----------------|-----|-------------------------------------------|----------|----------------------|
| A4 35                 | 03551-66504    | 1   | PC ASSY, FILTER                           | 28480    | 03551-66504          |
| A4C401 404            | 0160-3024      | 4   | CAPACITOR-FXD 1700PF +/- 1% 100WVDC MICA  | 28480    | 0160-3024            |
| A4C405                | 0180-0197      | 2   | CAPACITOR-FXD 2.2UF +/-10% 20VDC TA       | 56289    | 150D225X9020A2       |
| A4C406                | 0160-3622      |     | CAPACITOR FXD .1UF +80-20% 100WVDC CER    | 28480    | 0160-3622            |
| A4C407                | 0140 0177      | 1   | CAPACITOR FXD 400PF +/- 1% 300WVDC MICA   | 72136    | DM15F401F0300WV1CR   |
| A4C408, C409          | 0160-2130      | 2   | CAPACITOR FXD 865PF +/- 1% 100WVDC MICA   | 28480    | 0160-2130            |
| A4C410, C411          | 0140 0163      | 6   | CAPACITOR-FXD 4751PF +/- 1%               | 72136    | DM20F4751F0300WV1CR  |
| A4C412                | 0180-0197      |     | CAPACITOR-FXD; 2.2UF +/-10% 20VDC TA      | 56289    | 150D225X9020A2       |
| A4C413 -- 416         | 0140-0163      |     | CAPACITOR-FXD 4751PF +/-1% 300WVDC MICA   | 72136    | DM20F4751F0300WV1CR  |
| A4C417                | 0170 0066      | 1   | CAPACITOR-FXD .027UF 200VDC               | 56289    | 292P27392            |
| A4C418, 419           | 0180-0228      |     | CAPACITOR-FXD 22UF +/-10% 15VDC TA- SOLID | 56289    | 150D226X9015B2       |
| A4C456                | 0150-0093      |     | CAPACITORFXD .01UF +80- 20% 100WVDC CER   | 28480    | 0150-0093            |
| A4Q409                | 1853-0086      |     | TRANSISTOR PNP SI CHIP                    | 28480    |                      |
| A4R401                | 0698-7372      |     | RESISTOR 108.94K .1% .125W F TUBULAR      | 30983    | MF4C1/8 T2-108441 B  |
| A4R402                | 0698 6943      | 5   | RESISTOR 20K .1% .125W F TUBULAR          | 19701    | MF4C1/8- T2-2002-B   |
| A4R403                | 0698-7376      | 1   | RESISTOR 11.397K .1% .125W F TUBULAR      | 30983    | MF4C1/8- T2-11397R B |
| A4R404                | 0698-7375      | 2   | RESISTOR 28.64K .1% .125W F TUBULAR       | 30983    | MF4C1/8-T2- 28641    |
| A4R405                | 0698-4205      | 1   | RESISTOR 21K 1% .125W F TUBULAR           | 16299    | C4-1/8-T0-2102-F     |
| A4R406                | 0698-4207      | 1   | RESISTOR 44.2K 1% .125W F TUBULAR         | 16299    | C4-1/8-T0 4422-F     |
| A4R407                | 0698-7371      | 2   | RESISTOR 20.605K .1% .125W F TUBULAR      | 30983    | MF4C1/8 T2-20605R B  |
| A4R408                | 0698 4488      | 1   | RESISTOR 26.7K 1% .125W F TUBULAR         | 24546    | C4 1/8- T0-2672-F    |
| A4R409                | 0698-7371      |     | RESISTOR 20.605K .1% .125W F TUBULAR      | 30983    | MF4C1/8- T2-20605R B |
| A4R410                | 0698-3158      |     | RESISTOR 23.7K 1% .125W F TUBULAR         | 16299    | C4-1/8-T0- 2372 F    |
| A4R411                | 0698-4445      |     | RESISTOR 5760 OHM .01%                    | 16299    | C4-1/8-T0-5761-F     |
| A4R412                | 0698-6943      |     | RESISTOR 20K .125W F TUBULAR              | 19701    | MF4C1/8-T2-2002-B    |
| A4R413                | 0698 7370      | 1   | RESISTOR 17.579K .1% .125W F TUBULAR      | 30983    | MF4C1/8-T2 17579R B  |
| A4R414                | 0757-0442      |     | RESISTOR 10K 1% .125W F TUBULAR           | 24546    | C4- 1/8-T0-1002 F    |
| A4R415                | 0757-0450      | 2   | RESISTOR 22.1K 1% .125W F TUBULAR         | 24546    | C4-1/8-T0-2212-F     |
| A4R416                | 0698-4482      |     | RESISTOR 17.4K 1% .125W F TUBULAR         | 03888    | PME55-1/8- T0-1742 F |
| A4R417                | 0698-7373      | 1   | RESISTOR 98.941K .1% .125W F TUBULAR      | 30983    | MF4C1/8-T2-98941R B  |
| A4R418                | 0698-7372      | 2   | RESISTOR 108.94K .1% .125W F TUBULAR      | 30983    | MF4C1/8- T2-108441-B |
| A4R419                | 0698-7375      |     | RESISTOR 28.64K .1% .125W F TUBULAR       | 30983    | MF4C1/8-T2- 28641-B  |
| A4R420                | 0698-3158      | 2   | RESISTOR 23.7K 1% .125W F TUBULAR         | 16299    | C4 1/8-T0-2372 F     |
| A4R421                | 0698-6943      |     | RESISTOR 20K .1% .125W F TUBULAR          | 19701    | MF4C1/8 T2-2002-B    |
| A4R422*               | 0757-0442      |     | RESISTOR 10K .01% .125W                   | 24546    | C4- 1/8-T0-1002-F    |
| A4R423*               | 0698-8191      |     | RESISTOR 12.5K .1% .125W F TUBULAR        | 19701    | MF4C1/8-T9-1251-B    |
| A4R424                | 0698-6943      |     | RESISTOR 20K .1% .125W F TUBULAR          | 19701    | MF4C1/8-T2 2002-B    |
| A4R425                | 0698-7368      |     | RESISTOR 36.901K .1% .125W F TUBULAR      | 30983    | MF4C1/8-T2 36901R-B  |
| A4R426                | 0698 7368      | 2   | RESISTOR 36.901K .1% .125W F TUBULAR      | 30983    | MF4C1/8- T2-36901R-B |
| A4R427                | 0757-0401      |     | RESISTOR 100 OHM 1% .125W F TUBULAR       | 24546    | C4-1/8- T0-101 F     |
| A4R428                | 0698-3557      | 1   | RESISTOR 806 OHM 1% .125W F TUBULAR       | 16299    | C4-1/8- T0-806R-F    |
| A4R429                | 0757-0443      | 1   | RESISTOR 11K 1% .125W F TUBULAR           | 24546    | C4- 1/8-T0-1102 F    |
| A4R430                | 0757-0469      | 1   | RESISTOR 150K 1% .125W F TUBULAR          | 24546    | C4-1/8-T0-1503-F     |
| A4R431                | 0698-3162      | 1   | RESISTOR 46.4K .01%                       | 16299    | C4-1/8-T0-4642-F     |
| A4R432                | 0698 3519      |     | RESISTOR 12.4K 1% .125W F TUBULAR         | 16299    | C4-1/8- T0-1242-F    |
| A4R433*               | 0757-0442      |     | RESISTOR 10K .01% .125W                   | 24546    | C4-1/8- T0-1002-F    |
| A4R434                | 0757-0448      |     | RESISTOR 15.2K .01%                       | 24546    | C4-1/8- T0-1822-F    |
| A4R435                | 0757-0465      |     | RESISTOR 100K 1% .125W F TUBULAR          | 24546    | C4-1/8-T0-1003-F     |
| A4R436                | 0698-3245      | 1   | RESISTOR 20.5K 1% .125W F TUBULAR         | 16299    | C4-1/8-T0-2052-F     |
| A4R437                | 0757-0455      | 1   | RESISTOR 36.5K 1% .125W F TUBULAR         | 24546    | C4-1/8-T0-3652-F     |
| A4R438                | 0698-7366      |     | RESISTOR 109.64K .1% .125W F TUBULAR      | 30983    | MF4C1/8-T2-109641-B  |
| A4R439                | 0698-7366      |     | RESISTOR 109.64K .1% .125W F TUBULAR      | 30983    | MF4C1/8-T2-109641 B  |
| A4R440                | 0698 6943      |     | RESISTOR 20K .1% .125W F TUBULAR          | 19701    | MF4C1/8-T2-2002-B    |
| A4R441                | 0698-7367      | 1   | RESISTOR 78.028K .1% .125W F TUBULAR      | 30983    | MF4C1/8-T2- 78028R-B |
| A4R442 -444           | 2100-3274      | 3   | RESISTOR VAR TRMR 5K 10% C SIDE ADJ       | 73138    | 72XR10K              |
| A4R445                | 2100 3207      |     | RESISTOR 5K .1% .50W                      | 32997    | 86X 1-502            |
| A4R446, 447           | 0757-0407      |     | RESISTOR 200 1% .125W F                   | 24546    | C4-1/8-T0-201 F      |
| A4R491                | 0684-1021      |     | RESISTOR 1K 10% .25W CC TUBULAR           | 01121    | CB1021               |
| A4S1                  | 3100-2750      | 1   | SWITCH ROTARY NOISE WEIGHTING             | 28480    | 3100-2750            |
| A4U401, 402           | 1826 0312      | 2   | IC LINEAR                                 | 28480    | 1826-0312            |

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                                  | Mfr Code | Mfr Part Number   |
|-----------------------|----------------|-----|----------------------------------------------|----------|-------------------|
| A5                    | 03551-66505    | 1   | PC ASSY, POWER SUPPLY                        | 28480    | 03551-66505       |
| A5C801                | 0180-2563      | 2   | CAPACITOR-FXD; 2600UF+75-10% 12VDC AL        | 28480    | 0180-2563         |
| A5C802                | 0180-2563      |     | CAPACITOR-FXD; 2600UF+75-10% 12VDC AL        | 28480    | 0180-2563         |
| A5C803                | 0180-2511      | 5   | CAPACITOR-FXD; 390 +100-10% 20VDC AL         | 90201    | MTV377N020E1JP    |
| A5C804                | 0180-2511      |     | CAPACITOR-FXD; 390 +100-10% 20VDC AL         | 90201    | MTV377N020E1JP    |
| A5C805                | 0180-2511      |     | CAPACITOR-FXD; 390 +100-10% 20VDC AL         | 90201    | MTV377N020E1JP    |
| A5C806                | 0180-2511      |     | CAPACITOR-FXD; 390 +100-10% 20VDC AL         | 90201    | MTV377N020E1JP    |
| A5C810                | 0180-2511      |     | CAPACITOR-FXD; 390 +100-10% 20VDC AL         | 90201    | MTV377N020E1JP    |
| A5C811                | 0180-0228      |     | CAPACITOR-FXD; 22UF+-10% 15VDC TA-SOLID      | 56289    | 1500226X901582    |
| A5C812                | 0150-0093      |     | CAPACITOR-FXD; .01UF +80-20% 100MVDC CER     | 28480    | 0150-0093         |
| A5C813                | 0180-0097      | 1   | CAPACITOR-FXD; 47UF+-10% 35VDC TA-SOLID      | 56289    | 1500476X903552    |
| A5C801                | 1901-0158      | 15  | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C802                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C803                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C804                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C805                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C806                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C807                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C808                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C809                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C810                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C811                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C812                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C813                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C814                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C815                | 1901-0158      |     | DIODE-PWR RECT 200V 750MA                    | 04713    | SR1358-3          |
| A5C816                | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA                 | 28480    | 1901-0040         |
| A5C817                | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA                 | 28480    | 1901-0040         |
| A5C818                | 1901-0040      |     | DIODE-SWITCHING 2NS 30V 50MA                 | 28480    | 1901-0040         |
| A5C819                | 1902-0766      | 1   | DIODE-ZNR 18.2V 5% 00-7 PD=.4W               | 04713    | SZ 10939-257      |
| A5C820                | 1901-0050      |     | DIODE-SWITCHING 2NS 80V 200MA                | 28480    | 1901-0050         |
| A5C821                | 1901-0050      |     | DIODE-SWITCHING 2NS 80V 200MA                | 28480    | 1901-0050         |
| A5F801                | 2110-0046      | 3   | FUSE .5A 125V                                | 71400    | TYPE GMW-1/2      |
| A5F802                | 2110-0046      |     | FUSE .5A 125V                                | 71400    | TYPE GMW-1/2      |
| A5F803                | 2110-0046      |     | FUSE .5A 125V                                | 71400    | TYPE GMW-1/2      |
| A5J1                  | 1200-0423      |     | SOCKET: IC BLK 16 CONTACT                    | 23880    | CSA2900-16B       |
| A5J2 Δ4               | 1251-3751      | 1   | CONNECTOR; 8-CUNT; MALE; POST TYPE           | 27264    | 08-65-1081        |
| A5J3                  | 1251-3745      | 3   | CONNECTOR PLUG: +5V INCLUDES THE FOLLOWING:  | 28480    | 1251-3745         |
|                       | 1251-3746      | 2   | CONTACT CONNECTOR                            | 28480    | 1251-3746         |
| A5J4                  | 1251-3745      |     | CONNECTOR PLUG: +12V INCLUDES THE FOLLOWING: | 28480    | 1251-3745         |
|                       | 1251-3747      | 4   | CONTACT CONNECTOR                            | 28480    | 1251-3747         |
| A5J5                  | 1251-3745      |     | CONNECTOR PLUG: -12V INCLUDES THE FOLLOWING: | 28480    | 1251-3745         |
|                       | 1251-3747      |     | CONTACT CONNECTOR                            | 28480    | 1251-3747         |
| A5K801                | 0490-0569      | 1   | RELAY                                        | 28480    | 0490-0569         |
| A5Q804                | 1853-0066      |     | TRANSISTOR PNP SI CHIP TO-92 PD=200MW        | 28480    | 1853-0066         |
| A5Q805                | 1853-0066      |     | TRANSISTOR PNP SI CHIP TO-92 PD=200MW        | 28480    | 1853-0066         |
| A5Q806                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ         | 28480    | 1854-0071         |
| A5Q807                | 1853-0066      |     | TRANSISTOR PNP SI CHIP TO-92 PD=200MW        | 28480    | 1853-0066         |
| A5Q808                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ         | 28480    | 1854-0071         |
| A5Q809                | 1853-0066      |     | TRANSISTOR PNP SI CHIP TO-92 PD=200MW        | 28480    | 1853-0066         |
| A5Q810                | 1854-0071      |     | TRANSISTOR NPN SI PD=300MW FT=200MHZ         | 28480    | 1854-0071         |
| A5R804                | 0813-0040      | 1   | RESISTOR 20 OHM 5% 5W PW TUBULAR             | 91637    | CW5-2-5W-T2-20R-J |
| A5R805                | 0612-0070      | 1   | RESISTOR 10 OHM 5% 5W PW TUBULAR             | 91637    | CW5-2-5W-T2-10R-J |
| A5R806                | 0811-3114      | 1   | RESISTOR 75 OHM 3% 5W PW TUBULAR             | 00213    | 15005             |
| A5R807                | 0811-1854      | 1   | RESISTOR 50 OHM 5% 5W PW TUBULAR             | 56289    | 243E50K5          |
| A5R809                | 0678-4494      | 2   | RESISTOR 35.7K 1% .125W F TUBULAR            | 24546    | C4-1/8-T0-3572-F  |

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                                | Mfr Code | Mfr Part Number  |
|-----------------------|----------------|-----|--------------------------------------------|----------|------------------|
| A5R810                | 0698-3451      | 2   | RESISTOR 133K 1% .125W F TUBULAR           | 16299    | C4-1/8-T0-1333-F |
| A5R811                | 0698-4489      | 1   | RESISTOR 28K 1% .125W F TUBULAR            | 24546    | C4-1/8-T0-2802-F |
| A5R812                | 0698-3162      | 1   | RESISTOR 46.4K 1% .125W F TUBULAR          | 16299    | C4-1/8-T0-4642-F |
| A5R813                | 0698-4502      | 1   | RESISTOR 64.9K 1% .125W F TUBULAR          | 24546    | C4-1/8-T0-6492-F |
| A5R814                | 0698-3451      | 1   | RESISTOR 133K 1% .125W F TUBULAR           | 16299    | C4-1/8-T0-1333-F |
| A5R815                | 0698-4494      |     | RESISTOR 35.7K 1% .125W F TUBULAR          | 24546    | C4-1/8-T0-3572-F |
| A5R816                | 0683-1045      |     | RESISTOR 100K 5% .25W CC TUBULAR           | 01121    | C81045           |
| A5R817                | 0683-1045      |     | RESISTOR 100K 5% .25W CC TUBULAR           | 01121    | C81045           |
| A5R818                | 0683-1045      |     | RESISTOR 100K 5% .25W CC TUBULAR           | 01121    | C81045           |
| A5R819                | 0683-1045      |     | RESISTOR 100K 5% .25W CC TUBULAR           | 01121    | C81045           |
| A5R820                | 0683-1045      |     | RESISTOR 100K 5% .25W CC TUBULAR           | 01121    | C81045           |
| A5R821                | 0683-1035      |     | RESISTOR 10K 5% .25W CC TUBULAR            | 01121    | C81035           |
| A5R822                | 0683-1045      |     | RESISTOR 100K 5% .25W CC TUBULAR           | 01121    | C81045           |
| A5R823                | 0683-1045      |     | RESISTOR 100K 5% .25W CC TUBULAR           | 01121    | C81045           |
| A5R824                | 0757-0427      |     | RESISTOR 1.5K 1% .125W F TUBULAR           | 24546    | C4-1/8-T0-1501-F |
| A5R825                | 0757-0427      |     | RESISTOR 1.5K 1% .125W F TUBULAR           | 24546    | C4-1/8-T0-1501-F |
| A5R826                | 0683-1015      |     | RESISTOR 100 OHM 5% .25W CC TUBULAR        | 01121    | C81015           |
| A5U801                | 1820-0430      | 1   | IC LIN LM309K REGULATOR                    | 27014    | LM309K           |
| A5U802                | 1826-0117      | 1   | IC LIN REGULATOR                           | 07263    | 7812KC           |
| A5U803                | 1826-0123      | 1   | IC LIN LM320K-12 REGULATOR                 | 27014    | LM320K-12        |
| A5 MISCELLANEOUS      |                |     |                                            |          |                  |
|                       | 03551-01205    | 1   | BRACKET, BATTERY CONNECTOR                 | 28480    | 03551-01205      |
|                       | 0380-0160      | 1   | STANDOFF                                   | 28480    | 0380-0160        |
|                       | 0490-0541      | 1   | RETAINER, SOCKET                           | 28480    | 0490-0541        |
|                       | 0490-0570      | 1   | SOCKET, RELAY                              | 28480    | 0490-0570        |
| CHASSIS PARTS         |                |     |                                            |          |                  |
| BT1                   | 1420-0220      | 1   | BATTERY PACK: 5V                           | 28480    | 1420-0220        |
| BT2                   | 1420-0221      | 2   | BATTERY PACK: 12V                          | 28480    | 1420-0221        |
| BT3                   | 1420-0221      |     | BATTERY PACK: 12V                          | 28480    | 1420-0221        |
| F1                    | 2110-0201      | 1   | FUSE .25A 250V SLO-BLO                     | 75915    | 313-250S         |
| J3                    | 1510-0091      | 4   | BINDING-POST; SINGLE; 3/8-32; JGK/RED; SGL | 28480    | 1510-0091        |
| J4                    | 1510-0091      |     | BINDING-POST; SINGLE; 3/8-32; JGK/RED; SGL | 28480    | 1510-0091        |
| J5                    | 1251-0687      | 2   | CONNECTOR; TEL; 3-CKT JACK .25 SHK DIA     | 82389    | MN-112B          |
| J6                    | 1510-0091      |     | BINDING-POST; SINGLE; 3/8-32; JGK/RED; SGL | 28480    | 1510-0091        |
| J7                    | 1510-0091      |     | BINDING-POST; SINGLE; 3/8-32; JGK/RED; SGL | 28480    | 1510-0091        |
| J8                    | 1251-0687      |     | CONNECTOR; TEL; 3-CKT JACK .25 SHK DIA     | 82389    | MN-112B          |
| J9                    | 1510-0087      | 1   | BINDING-POST, SINGLE, 6-32, JGK/BLK        | 28480    | 1510-0087        |
| J10                   | 1251-3954      | 2   | JACK                                       | 28480    | 1251-3954        |
| L1 -- L4 Δ1           | 9100-3551      | 4   | COIL:FXD 1UH                               | 24226    | 9493             |
| PM1                   | 0960-0444      | 1   | LINE MODULE                                | 28480    | 0960-0444        |
| R200                  | 2100-0669      | 1   | RESISTOR-VAR 50K 10% CC                    | 12697    | SERIES 63M       |
| R500                  | 2100-0352      | 1   | RESISTOR-VAR 50K-5K OHM 5% 2W              | 28480    | 2100-0352        |
| S1                    | 3101-1849      | 1   | SWITCH: PUSHBUTTON, HOLD                   | 28480    | 3101-1849        |
| T1                    | 9100-3451      | 1   | TRANSFORMER: POWER                         | 28480    | 9100-3451        |
| W2                    | 03570-61625    | 1   | CABLE ASSY                                 | 28480    | 03570-61625      |
| MISCELLANEOUS PARTS   |                |     |                                            |          |                  |
| Δ1,7                  | 03551-00221    | 1   | PANEL, FRONT                               | 28480    | 03551-00221      |
| Δ1                    | 03551-00212    | 1   | PANEL, FRONT, SUB                          | 28480    | 03551-00212      |
|                       | 03551-01201    | 1   | BRACKET, PRIMARY POWER MOUNTING            | 28480    | 03551-01201      |
|                       | 03551-01202    | 1   | CLAMP, CABLE                               | 28480    | 03551-01202      |
|                       | 03551-04101    | 1   | INSULATOR, LINE V                          | 28480    | 03551-04101      |
|                       | 03551-04301    | 1   | PLATE, PC BOARD MOUNTING                   | 28480    | 03551-04301      |
| Δ1                    | 03551-65001    | 1   | LOCK                                       | 28480    | 03551-65001      |
|                       | 03551-23701    | 1   | ROD, AUTO OFF                              | 28480    | 03551-23701      |
| Δ1                    | 03551-24710    | 1   | HOUSING, LOCK                              | 28480    | 03551-24710      |
| Δ1                    | 03551-24901    | 1   | HANDLE, LOCK                               | 28480    | 03551-24901      |
| Δ1                    | 03551-27901    | 1   | SCREW, LOCK                                | 28480    | 03551-27901      |
|                       | 03551-64101    | 1   | COVER ASSY                                 | 28480    | 03551-64101      |
| ΔA                    | 03551-64521    | 1   | CASE ASSY                                  | 28480    | 03551-64521      |
|                       | 0370-1003      | 1   | KNOB, MONITOR VOLUME                       | 28480    | 0370-1003        |
|                       | 0370-1005      | 2   | KNOB, IMP & SEND LEVEL RANGE               | 28480    | 0370-1005        |
|                       | 0370-1099      | 3   | KNOB, SEND FREQUENCY RANGE                 | 28480    | 0370-1099        |
|                       | 0370-1099      |     | KNOB, RECEIVE NOISE TONE                   | 28480    | 0370-1099        |
|                       | 0370-1099      |     | KNOB, NOISE WEIGHTING                      | 28480    | 0370-1099        |
|                       | 0370-1303      | 1   | KNOB, SEND FREQUENCY VERNIER               | 28480    | 0370-1303        |
|                       | 0370-1318      | 1   | KNOB, FUNCTION                             | 28480    | 0370-1318        |
| Δ1                    | 0370-1810      | 1   | KNOB, LEVER                                | 28480    | 0370-1810        |
|                       | 0370-2486      | 3   | PUSHBUTTON, COVER HOLD                     | 28480    | 0370-2486        |
|                       | 0370-2497      | 7   | PUSHBUTTON, COVER, POWER, DISPLAY & MONIT  | 28480    | 0370-2497        |
|                       | 0370-2627      | 1   | KNOB ASSY, SEND LEVEL VERNIER              | 28480    | 0370-2627        |
|                       | 1251-3167      | 1   | CONNECTOR; 4-CONT; FEM; POST TYPE          | 27264    | 09-50-3041       |
|                       | 1251-3301      | 1   | CONNECTOR; 8-CONT; FEM; POST TYPE          | 28480    | 1251-3301        |
|                       | 1460-1341      | 1   | SPRING WFRM STL                            | 28480    | 1460-1341        |
|                       | 4040-0985      | 1   | LENS DISPLAY                               | 28480    | 4040-0985        |
|                       | 5040-7695      | 1   | MOUNT, SPEAKER                             | 28480    | 5040-7695        |
|                       | 5060-7452      | 1   | DIAL CONT ASSY                             | 28480    | 5060-7452        |

See introduction to this section for ordering information

ΔA For Serial Numbers 1425A-00130 and below, case assembly part no. is 03551-64501 (see Figure 7-17 ΔA).

Table 6-3. Replaceable Parts

| Reference Designation | HP Part Number                                                             | Qty         | Description                                                                                                                                                                                                                                                                                                 | Mfr Code                                                                          | Mfr Part Number                                                                                                           |
|-----------------------|----------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
|                       | 525C-49A<br>8120-1518<br>9160-0229                                         | 1<br>1<br>1 | HANDLES<br>CABLE, POWER<br>SPEAKER<br><br>HANDLE, CARRYING (CONSISTS OF THE FOLLOWING PARTS):<br><br>HANDLE-PLASTIC W/STL INSR 4.25- L .25 THK<br>HANDLE-CMPNT .75-L<br>HANDLE-CMPNT .75-L<br>SCREW-MACH 4- 40 .375-IN-LG PAN--HD<br>NUT-HEX-DBL CHAM 4-40- THD<br>WASHER LK INTL T NO. 4 .115 IN ID .27 IN | 28480<br>28480<br>28480<br><br>12136<br>12136<br>12136<br>28480<br>28480<br>U1453 | 525C-49A<br>8120-1518<br>9160-0229<br><br>1876- 372<br>1875- 376-370<br>1875- 376-370<br>2200- 0143<br>2260- 0001<br>1904 |
|                       | 1440-0071<br>1440-0050<br>1440-0049<br>2200-0143<br>2260-0001<br>2190-0004 |             |                                                                                                                                                                                                                                                                                                             |                                                                                   |                                                                                                                           |

See introduction to this section for ordering information

## SECTION VII

### TROUBLESHOOTING AND CIRCUIT DIAGRAMS

#### 7-1. INTRODUCTION.

7-2. This section of the manual contains troubleshooting information and circuit diagrams for the Test Set. Included are digital troubleshooting procedures, functional block diagrams, schematic diagrams and component location diagrams.

#### 7-3. TROUBLESHOOTING.

7-4. The following troubleshooting information is designed to eliminate needless unrelated checks in locating instrument malfunctions. It should first be determined that a malfunction does exist and that it does not exist externally to the Test Set. Before troubleshooting, become familiar with the principles of operation (Section III) and the functional composition (Section IV).

7-5. The troubleshooting procedure is separated into three parts. The first part will separate the problem into two categories, i.e., analog or digital. If the problem is an analog problem, the procedure will also direct the user to the A1 or A3 board. The second part provides analog troubleshooting procedures. The digital troubleshooting procedures, using the ASM flow charts, form the third section. In all of the procedures the intent is to aid the user in finding the problem area associated with his system. Where a specific component or a particular area is given as the location of the malfunction, it should be remembered that these are only possible solution. The schematics should always be used in conjunction with the procedures to troubleshoot the system.

7-6. To isolate a malfunction between the analog and digital circuitry, use the following procedure:



*The Test Set utilizes several CMOS components. Improper troubleshooting techniques can damage these components. To minimize failures resulting from troubleshooting, observe the following rules.*

1. *Always use grounded soldering tips and grounded test fixtures.*
2. *Never insert or remove a CMOS device with the Test Set power on.*

3. *Do not load CMOS devices. The input impedance for the test devices must, in most cases, be greater than 50 k $\Omega$ .*

- a. Set the Test Set controls as follows:

```

FUNCTION . . . . . REC TERM
IMP . . . . . 600
RECEIVE NOISE/
  TONE . . . . . TONE NORMAL
HOLD. . . . . OFF
POWER. . . . . ~ AC
  
```

- b. Connect a 3320B through a 600 ohm balanced load to the Test Set input terminals.

- c. Adjust the 3320B to 1 kHz at a level of + 10.79 dBm.

#### NOTE

*The instrument's SEND OSC can be used to provide the input signal, if it is known to be operating properly. Refer to the analog troubleshooting section for verification of the Send Oscillator if it is to be used.*

- d. Press the DISPLAY & MONITOR Receive Level button and verify a display of 0 dBm.

- e. Press the DISPLAY & MONITOR Frequency Level button and verify a display of 1 kHz.

#### NOTE

*If both readings in Steps d and e are correct, perform the performance tests to verify proper operation. If either or both readings were wrong, continue to Step f.*

- f. Measure A1TP14 with the 180C Oscilloscope. The oscilloscope should indicate a 30 mV rms sine wave at 1 kHz. If the reading is bad refer to the analog troubleshooting section. The malfunction is most likely to have occurred on the A3 board.

- g. Measure A1TP12 with the 180C Oscilloscope. The oscilloscope should indicate a 1 kHz square wave 4 V p-p. If

the reading is incorrect, then refer to the analog troubleshooting section. The malfunction is most likely to have occurred on the A1 board. A correct reading would indicate that the Digital Troubleshooting procedures should be used.

### 7-7. ANALOG TROUBLESHOOTING.

7-8. The troubleshooting procedures are broken into two major groups, consisting of Receive Circuits and Send Circuits. To use the troubleshooting procedure, the symptom of a problem should first be isolated to one of these two groups, then the procedure for that group performed in the sequence given. Each procedure provides setup, test points, and representative voltages to aid in isolating the location of a malfunction. Waveforms and test points used within the procedures are shown on the analog block diagram. Schematics one through five and eight also have representative voltages shown at various points and should be used with the procedure to isolate the malfunction to the component level.

### 7-9. Receive Tone Circuits.

a. Connect a 3320B Oscillator to the Test Set black input/output terminals through a 600 ohm impedance box.

b. Adjust the 3320B to 1 kHz at a + 10.79 dBm output level.

c. Set the Test Set front panel controls as follows:

FUNCTION  
(Black Input/Output Terminals). . . .REC TERM  
IMP . . . . . 600  
DISPLAY & MONITOR . . . . . REC LEVEL  
RECEIVE NOISE/TONE . . . . . TONE NORMAL  
HOLD. . . . . OFF

d. The Test Set display should read 0 dBm. If this reading is not present refer to Table 7-1 for specific test points and voltage measurements.

#### NOTE

*If incorrect voltage readings are obtained at the test points, refer to Schematics 1, 3, 4 or 5 for component level troubleshooting. If correct readings are obtained at all tested points, the problem is most likely to be found in the logic section of the A1 board. Refer to the Digital Troubleshooting Section.*

### 7-10. Receive Noise Circuits.

### 7-11. Noise Weighting Filters.

#### NOTE

*RECEIVE TONE LEVEL should check good before proceeding.*

**Table 7-1. Receive Tone Test Points.**

| Test Point                  | Reading  |          |
|-----------------------------|----------|----------|
|                             | AC       | DC       |
| 1. Test Set Input Terminals | 774.6 mV | + 1.68 V |
| 2. A1W10C                   |          |          |
| 3. A3TP19                   | 1.6 mV   |          |
| 4. Attenuator Input         | 511.5 mV |          |
| 5. A3TP1                    | 511.8 mV |          |
| 6. A3TP10                   | 511.6 mV | - 2.54 V |
| 7. A3TP21                   | 130 mV   |          |
| 8. Pin 3, A3U500            | 2.6 mV   |          |
| 9. A1TP14                   | 130 mV   |          |
| 10. A1TP18                  |          |          |
| 11. A1TP19                  | 980 mV   |          |

a. Adjust the 3320B frequency to 1 kHz and amplitude level to + 5.79 dBm.

b. Set the Test Set front panel controls to:

FUNCTION  
(Black input/output terminals). . . .REC TERM  
IMP . . . . . 600  
DISPLAY MONITOR. . . . . REC LEVEL  
RECEIVE NOISE/  
TONE . . . . . MESSAGE CIRCUIT NOISE  
HOLD. . . . . OFF

c. Connect the 3320B to the Test Set black input terminals through the 600 ohm Balance Box (Figure 5-9).

d. Switch the NOISE WEIGHTING control through each of the four switch positions. Observe the Test Set display for + 84.9 to + 85.1 or flashing between + 84/+ 85 dBm. If any of the four switch positions are out of tolerance, then refer to Table 7-2 for specific test points and voltage measurements.

**Table 7-2. Noise Weighting Filters Test Points.**

| Test Point                  | Reading |          |
|-----------------------------|---------|----------|
|                             | AC      | DC       |
| 1. A1W10                    |         | + 2.84 V |
| 2. A4TP1                    | 3.6 mV  |          |
| 3. Pin 6, U401              | 3.6 mV  |          |
| 4. Pin 4, XA4               | 3.6 mV  |          |
| 5. A4TP5 (C Message Filter) | 3.6 mV  |          |
| 6. A4TP5 (3 kHz Flat)       | 1.07 mV |          |
| 7. A4TP5 (15 kHz Flat)      | 1.07 mV |          |
| 8. A4TP5 (Program)          | 1.07 mV |          |
| 9. A4TP3                    | 1.5 mV  |          |
| 10. A4TP2                   | 1.07 mV |          |
| 11. A4TP4 (Program)         | 2.8 mV  |          |
| 12. A4TP4 (C Message)       | 4.4 mV  |          |
| 13. A4TP4 (3 kHz Flat)      | 4.4 mV  |          |
| 14. A4TP4 (15 kHz Flat)     | 4.4 mV  |          |
| 15. A1TP14                  | 178 mV  |          |
| 16. A3TP21                  | 178 mV  | - 486 mV |
| 17. Pin 3, XA4              | 3.6 mV  |          |
| 18. Q402 Source             | 3.6 mV  |          |
| 19. A1TP19                  | 1.33 V  |          |
| 20. A1TP18                  |         |          |

c. Measure the voltage at the test points shown in Table 7-7. Refer to Schematic 2 for component level troubleshooting when a measurement is out of tolerance.

**Table 7-7. Send Oscillator Display Level Test Points.**

| Test Point                      | Reading<br>AC    |
|---------------------------------|------------------|
| 1. Q302 Drain<br>2. Q304 Source | 540 mV<br>512 mV |

## 7-20. Send Circuits, Troubleshooting Frequency and Distortion Problems.

7-21. The frequency of the Test Set is generated and controlled by the Send Oscillator. Problems with frequency or distortion are generally confined to the Oscillator circuitry shown on Schematic 2.

7-22. Typically, problems with the frequency rate can be attributed to failure of the active components in the Integrator, control circuit, or in the current switching networks. Two passive components, A3R210 and A3R211, establish the value of switching current which ultimately controls the frequency and output level. These resistor values as well as active component operation should be closely checked for problems involving frequency and/or distortion in the Test Set.

## 7-23. Measure Circuit Troubleshooting.

a. Set the Test Set controls as follows:

```

FUNCTION . . . . . REC TERM
IMP . . . . . 600
RECEIVE NOISE/
TONE . . . . . TONE NORMAL
HOLD . . . . . OFF
POWER . . . . . ~ AC

```

b. Connect a 3320B through a 600 ohm balanced load to the Test Set input terminals.

c. Adjust the 3320B to 1 kHz at a level 0 to + 10.79 dBm.

d. Check the measure circuit using the flow chart shown in Figure 7-2.

### NOTE

*A1TP14 must be checked good (Paragraph 7-9) before proceeding.*

7-24. The notes listed below provide information to aid in troubleshooting the Test Set.

a. U202 and U203 and associated circuitry, control Y Axis symmetry.

b. U205 and associated circuitry control X Axis symmetry.

c. The dc voltage to the emitters of A3Q205 and A3Q206 controls the amount of current used to charge the integrating capacitor. This voltage should not approach supply voltage.

d. The output of A3U205 is normally - 7 V dc.

e. A3U205 will provide compensation, whenever the average DCV at TP4 is above or below 0 V.

f. The current through the switching transistors A3Q211 and A3Q212 should be approximately equal.

g. A3U201 output should be a square wave with a small slope on the trailing edge.

h. The signal at TP2 and TP3 should be a square wave without distortion.

i. The voltage across A3CR200 should be switching from + 4 V to - 2.7 V with the signal changes at TP2.

## 7-25. Digital Troubleshooting.

7-26. The following troubleshooting procedures are designed to provide information for isolating digital malfunctions. These procedures contain a brief explanation of flow charts, an internal troubleshooting procedure for analyzing the controller output signals and operational flow charts for the controller and display section of the Test Set.

7-27. If a digital malfunction exists, study Paragraphs 7-28 through 7-31, then perform the internal test procedure (Paragraph 7-32). If this fails to locate the malfunction, go to the operational flow charts (Paragraph 7-38) and the schematics.

### NOTE

*For a better understanding of the following troubleshooting information, it is suggested that the controller theory of operation (Section IV, Paragraph 4-79) be read carefully before continuing to Paragraph 7-28.*

**7-28. Basic Flow Charts.** As explained in Section IV, Paragraph 4-83, the step-by-step operation of the controller is described by the algorithm. The algorithm is illustrated by a flow chart which can be compared to a computer or calculator program.

7-29. An example of a flow chart is shown in Figure 7-3. This flow chart is a hypothetical chart which illustrates the algorithm which may be used to turn on the Test Set. There are two geometrical figures represented in the flow chart. The rectangular box signifies instructions or groups of instructions which are performed during the state (time

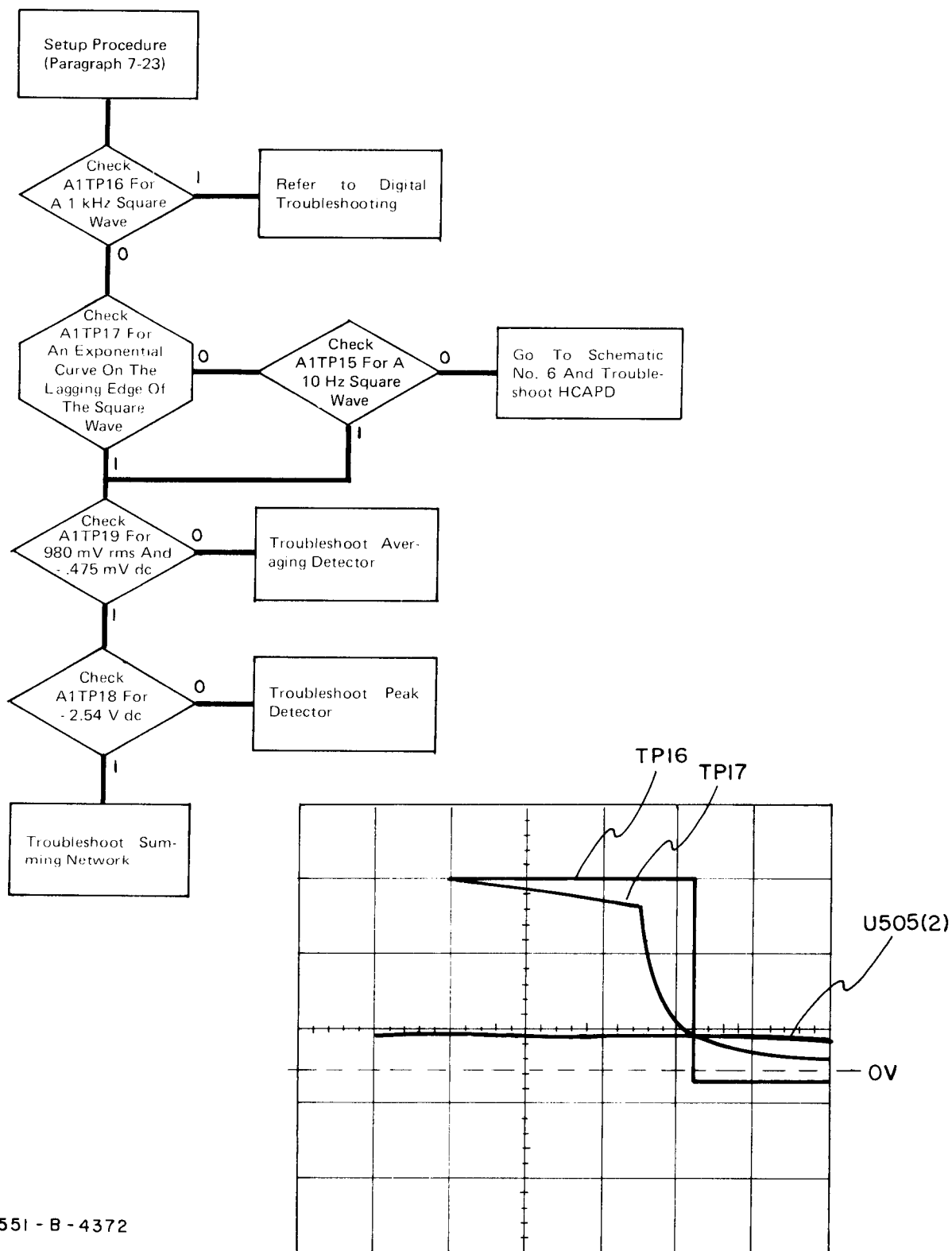
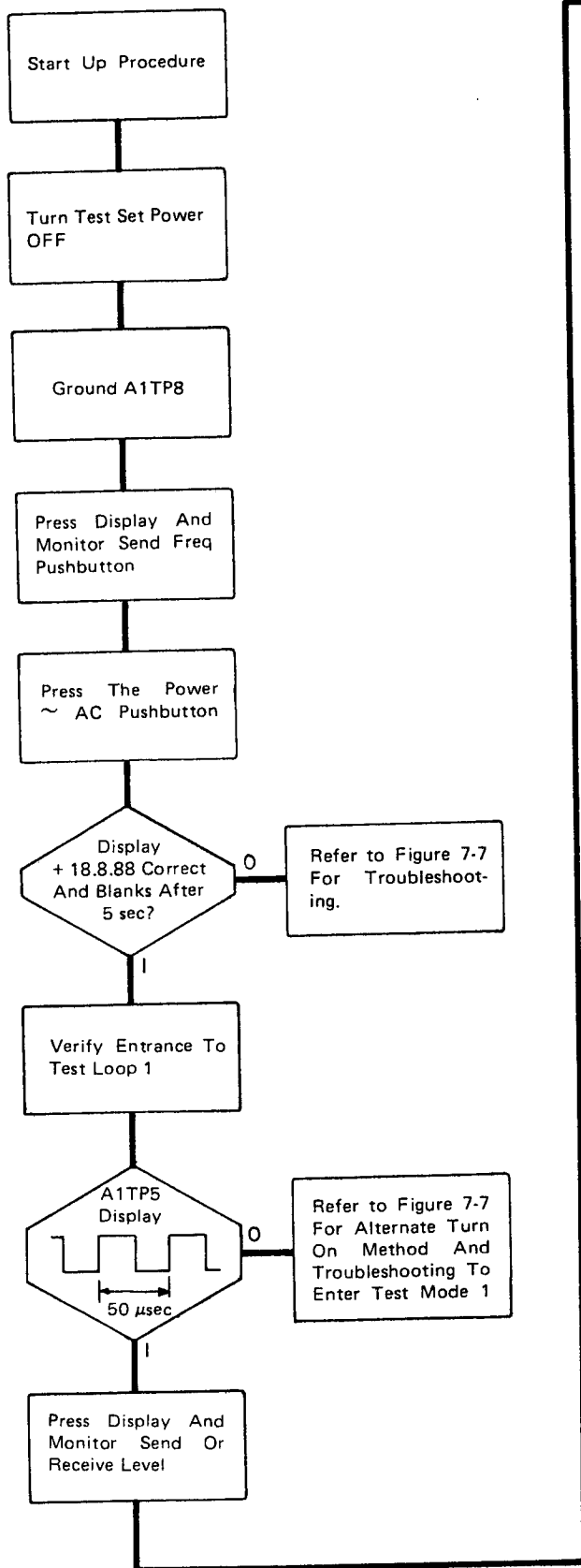


Figure 7-2. Measure Circuit Troubleshooting Flow Chart.

If the jumper wire for display brightening (Schematic 6, A1) is in the + 5 V position, the display will indicate + 10 as soon as the + 18.8.88 indication disappears. If the jumper wire is connected to U613 pin 12, the display will blank as soon as the + 18.8.88 indication disappears.

This verifies proper operation of the LED drive circuits. The display can be locked onto this indication by grounding A1TP9 if the five second interval is not adequate for verification. After verification, remove the ground from A1TP9.



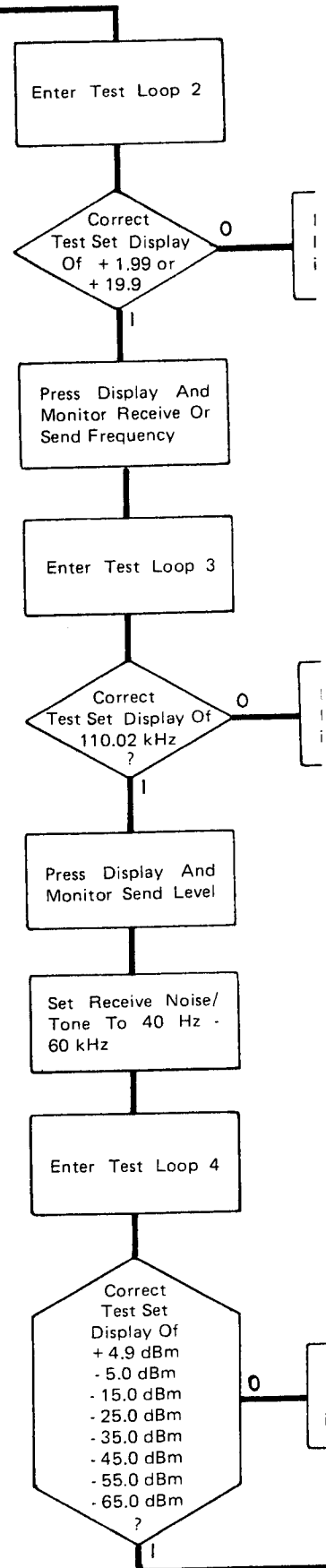
er wire for display brighten-  
tic 6, A1) is in the + 5 V po-  
display will indicate + 10 as  
+ 18.8.88 indication disap-  
jumper wire is connected to  
2, the display will blank as  
+ 18.8.88 indication disap-

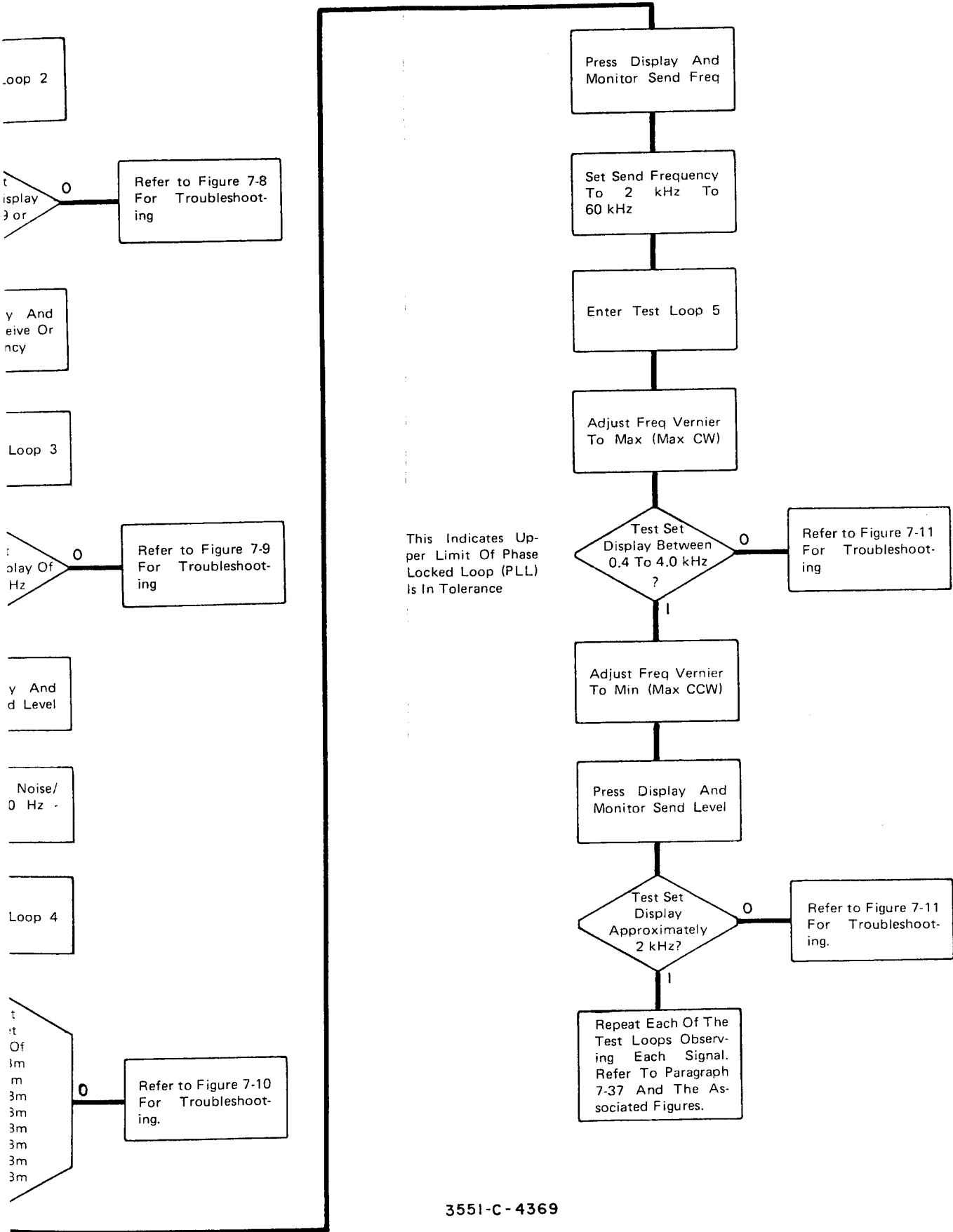
s proper operation of the  
circuits. The display can be  
this indication by grounding  
the five second interval is not  
r verification. After verifica-  
the ground from A1TP9.

Display Will Be On  
For 0.5 Seconds.  
Then All Digits And  
Decimal Points Will  
Blank. Display May  
Read + 1.998 Or  
+ 19.98 If Test Set  
Has C Revision Of  
A1 Board.

Display Will Remain  
Until Test Loop Is  
Exited

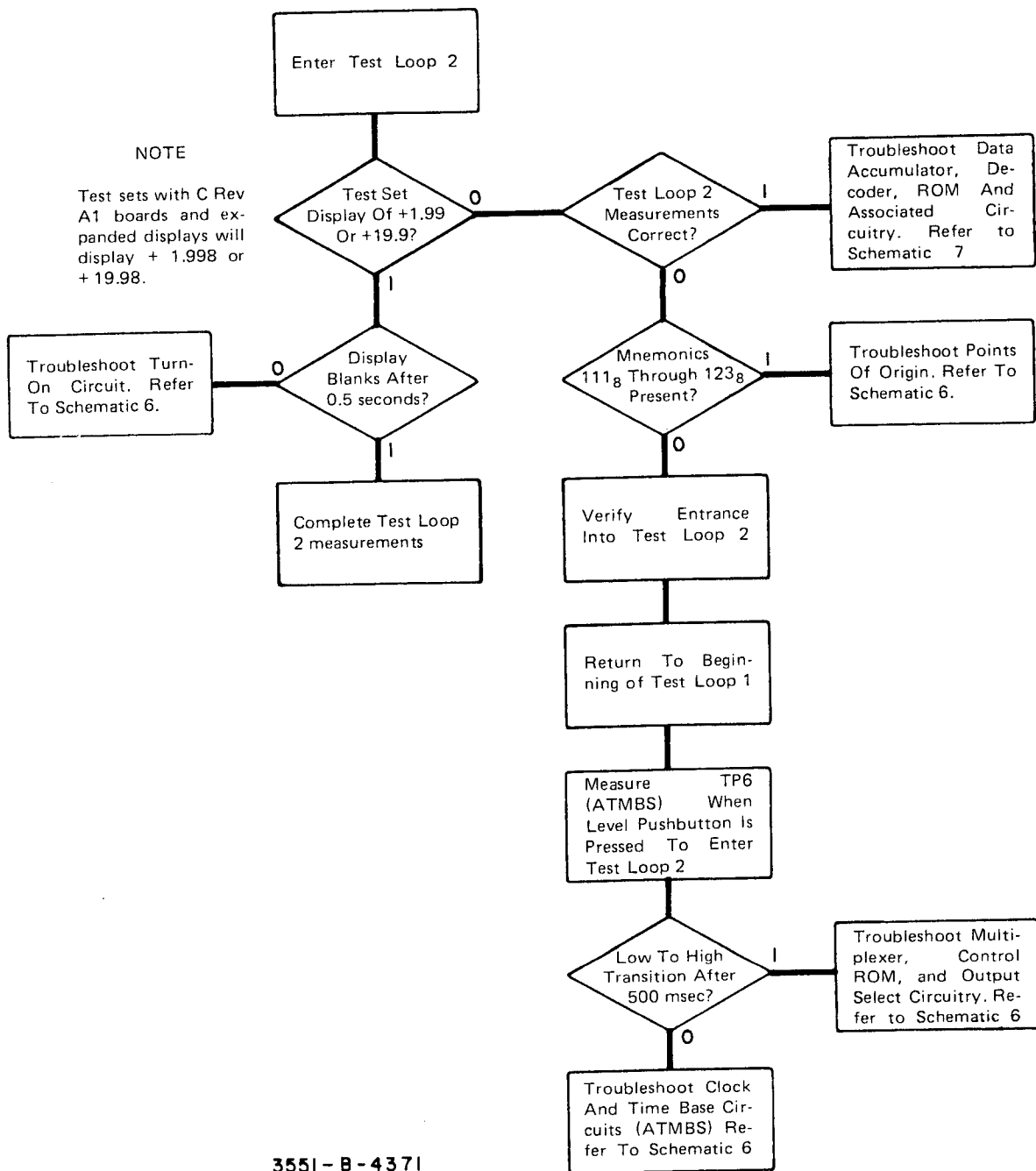
Sequence Will Cycle  
Until Test Loop Is  
Exited.





3551-C-4369

Figure 7-5. Simplified Test Loop Flow Chart.  
Rev. A 7-11/7-12



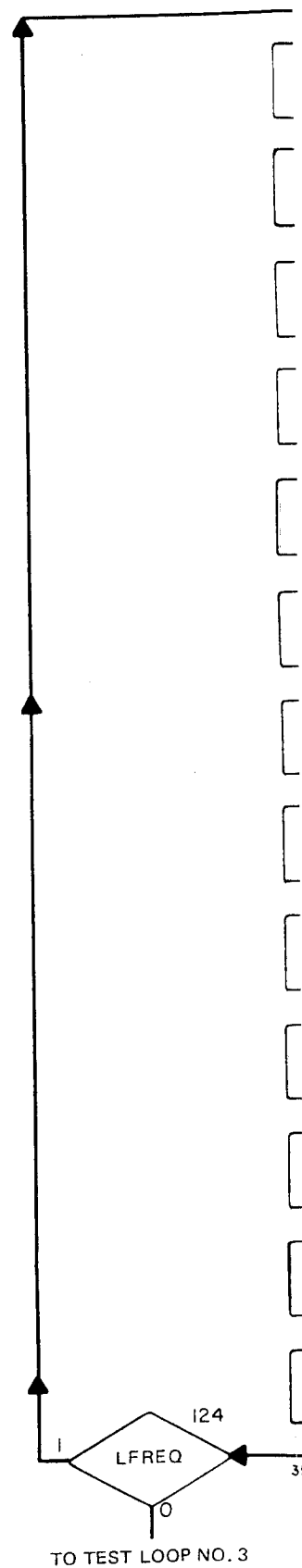
**INTRODUCTION.**

Test Loop No. 2 verifies the operation of the ROM output and the output storage registers. Once the controller has entered the loop, it will run between states 107 and 124 as long as LFREQ is high (DISPLAY & MONITOR RECEIVE LEVEL or SEND LEVEL pushbutton is pressed). There are 13 instruction states in this test loop; each state is approximately 10  $\mu$ sec long. To verify if the Test Set is in Test Loop No. 2, connect an oscilloscope to A1TP5 and verify that the repetition rate of HTBRT pulses is approximately 140  $\mu$ sec.

Connect the external trigger input of an oscilloscope to A1TP5 (HTBRT) and verify the shape and timing of the signals listed in Notes 1 through 12. If a malfunction is discovered, it must be corrected before going to the next step.

- NOTE 1. Signals were verified in Test Loop No. 1.
- NOTE 2. Verify HFRQC at A1U606 pin 1.
- NOTE 3. Verify H10KH at A1U509 pin 13.
- NOTE 4. Verify HTXFR at A1U701 pin 5.
- NOTE 5. Verify HSCLK at A1U606 pin 3.
- NOTE 6. Verify HC100 at A1U615 pin 1.
- NOTE 7. Verify HSPOL at A1U606 pin 4.
- NOTE 8. Verify HSIGN at A1U617 pin 1.
- NOTE 9. Verify HSBK at A1U606 pin 6.
- NOTE 10. Verify pulse at A1U617 pin 13.
- NOTE 11. Verify HRNGC at A1U606 pin 15.
- NOTE 12. Verify ARNGO at A1U621 pin 6.

If all signals have been verified at this point, exiting Test Loop No. 2 can be accomplished by pressing DISPLAY & MONITOR RECEIVE or SEND FREQ pushbutton.



FROM TEST LOOP NO. 1

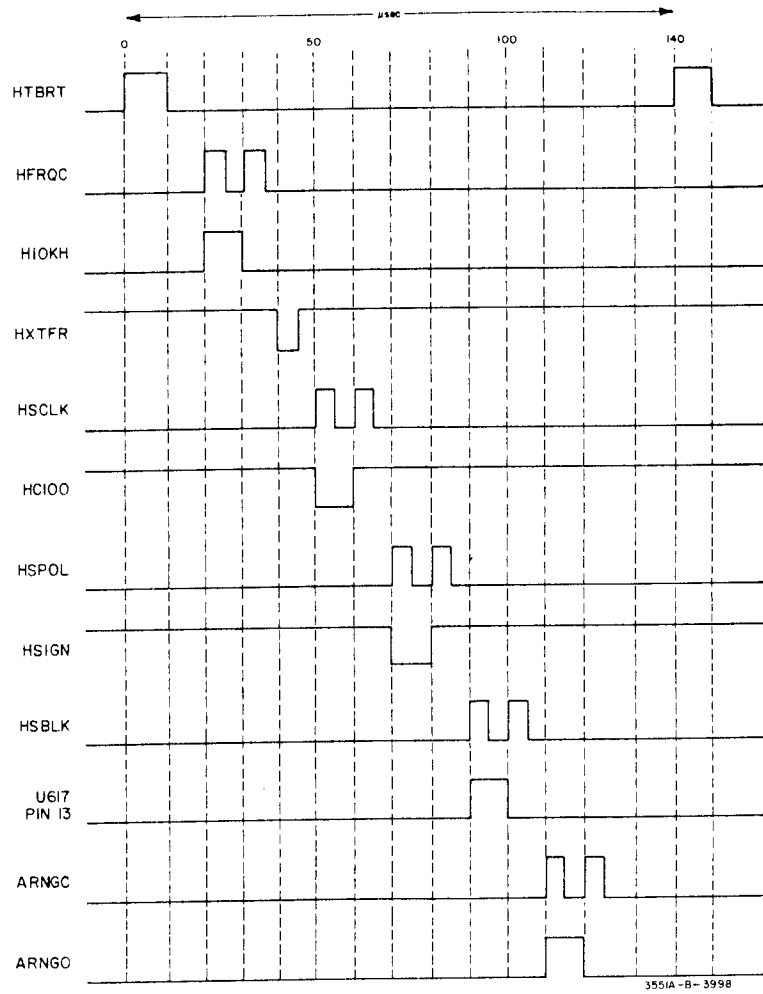
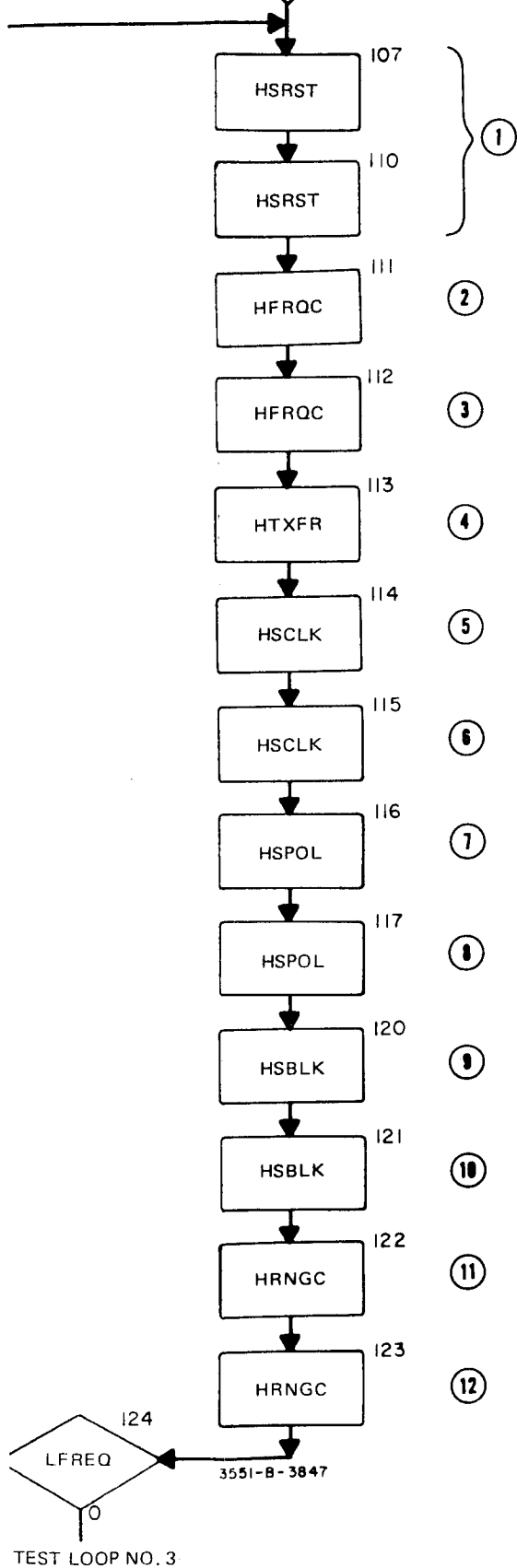
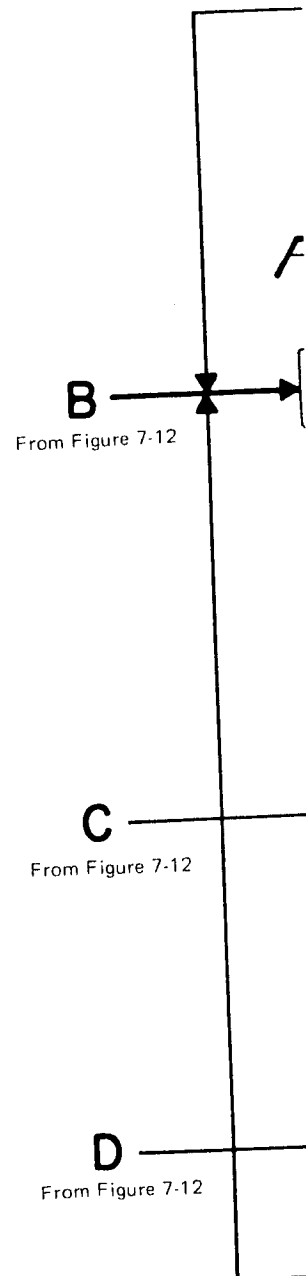


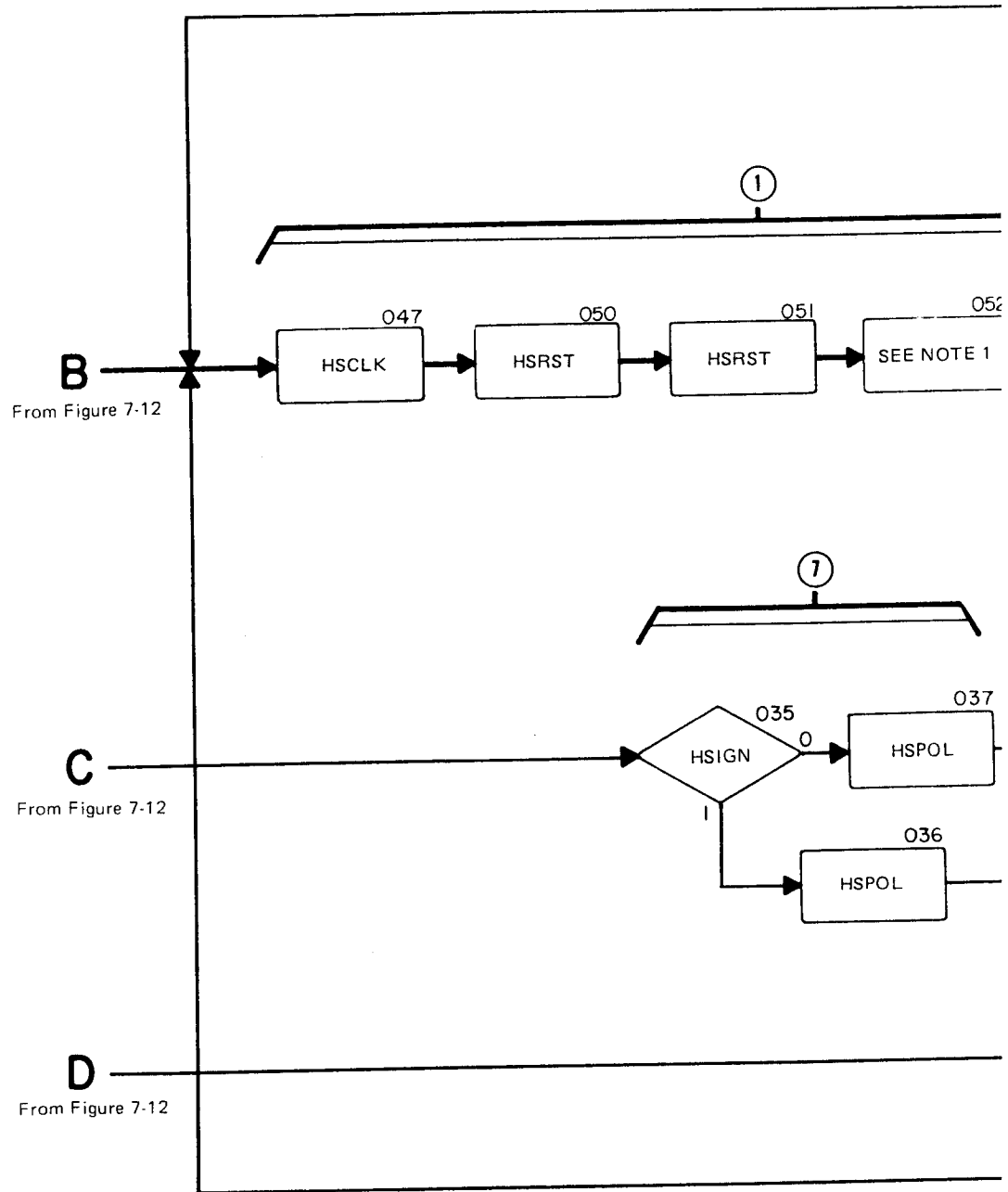
Figure 7-8. Test Loop Number 2.  
Rev. A 7-15/7-16

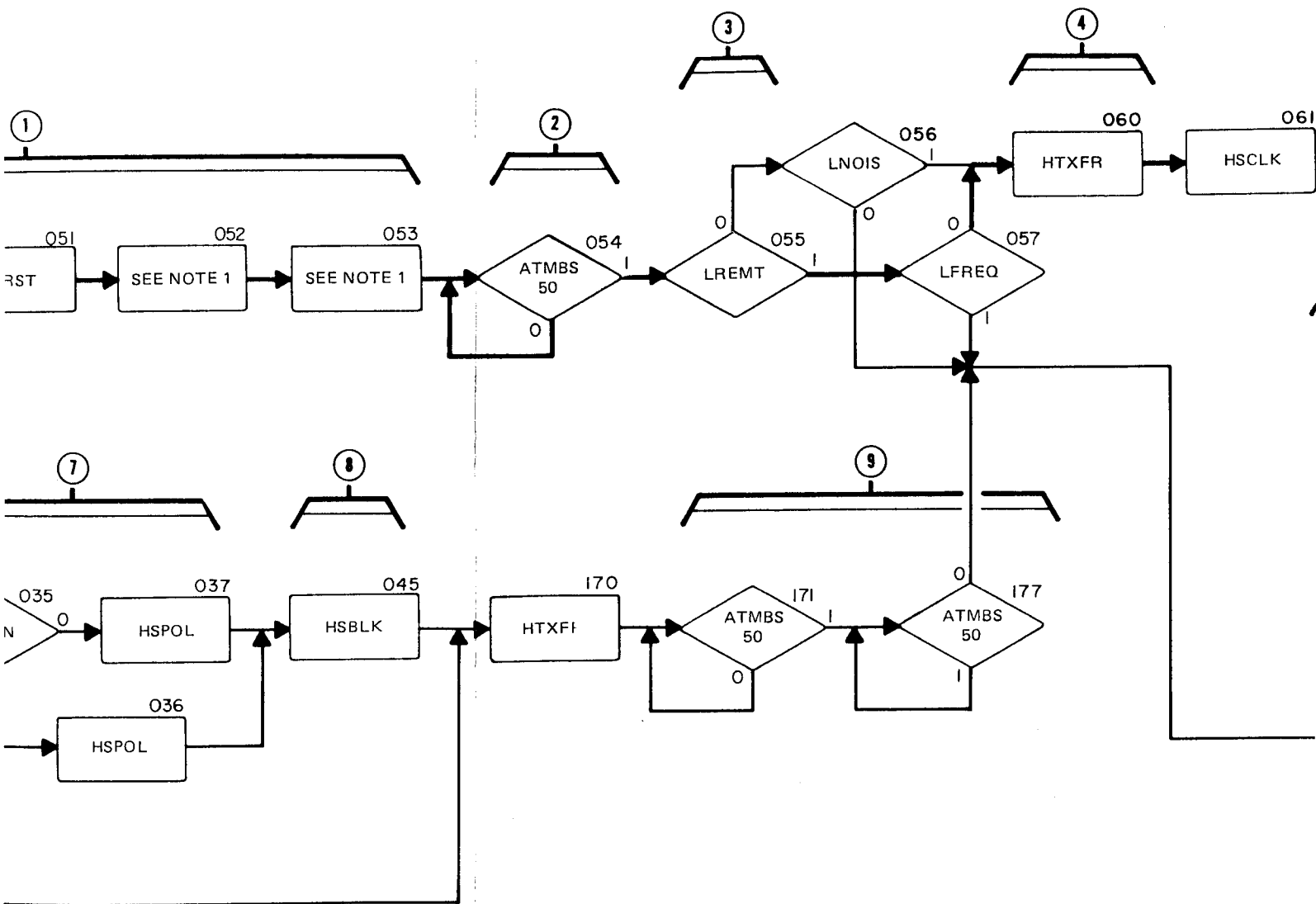
- ① Set counter in Data Accumulator to count input frequency.
- ② Wait period of 50 ms for frequency count.
- ③ 3553 Option.
- ④ Transfer count for frequency measurement.
- ⑤ Detection for frequency down-ranging
- ⑥ Detection for frequency up-ranging
- ⑦ Polarity blanking
- ⑧ Display blanking
- ⑨ Autoranging settling time (80 to 100 ms).
- ⑩ Manual frequency ranging for internal test routine.
- ⑪ Wait period for noise measurements (420 to 500 ms).

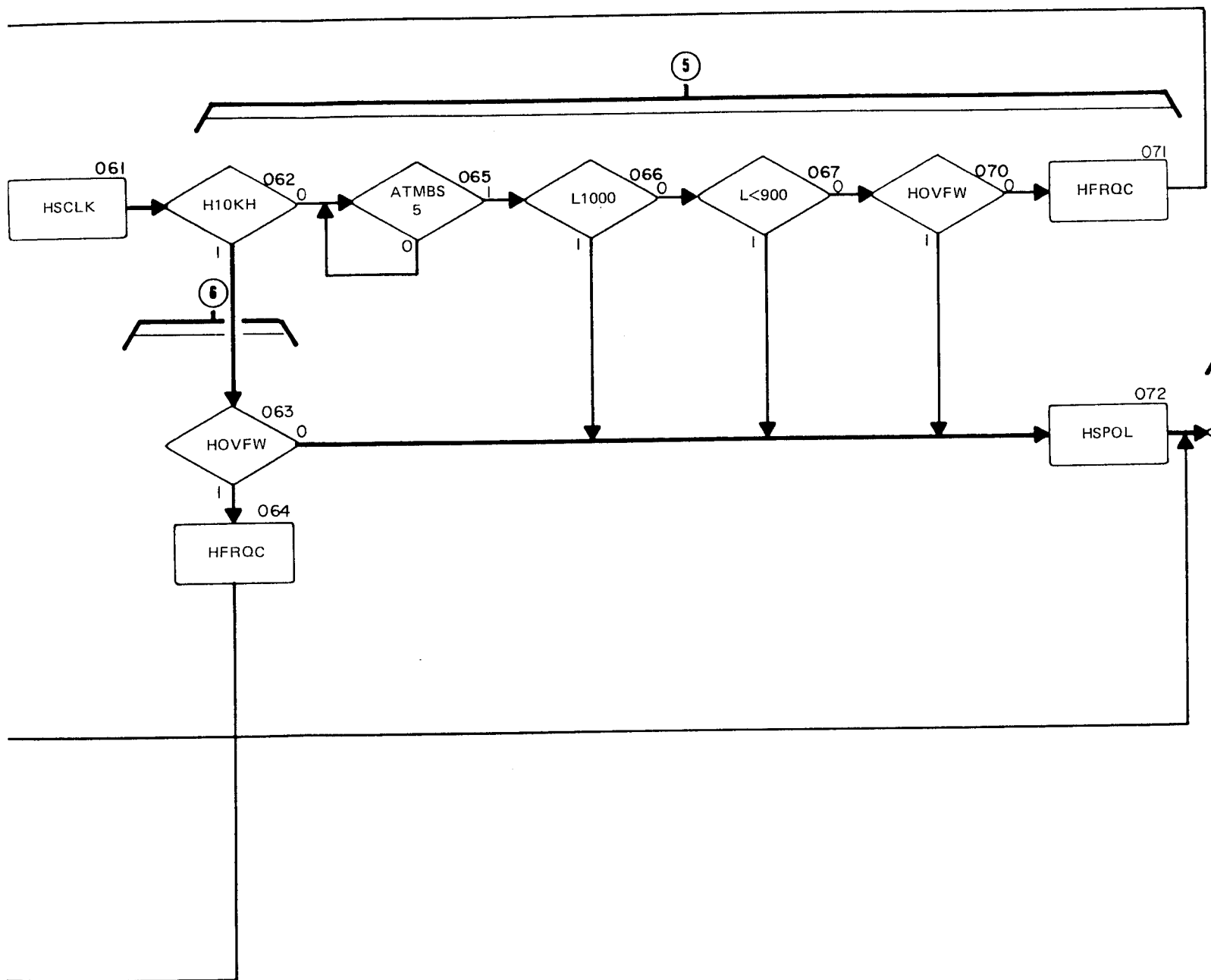


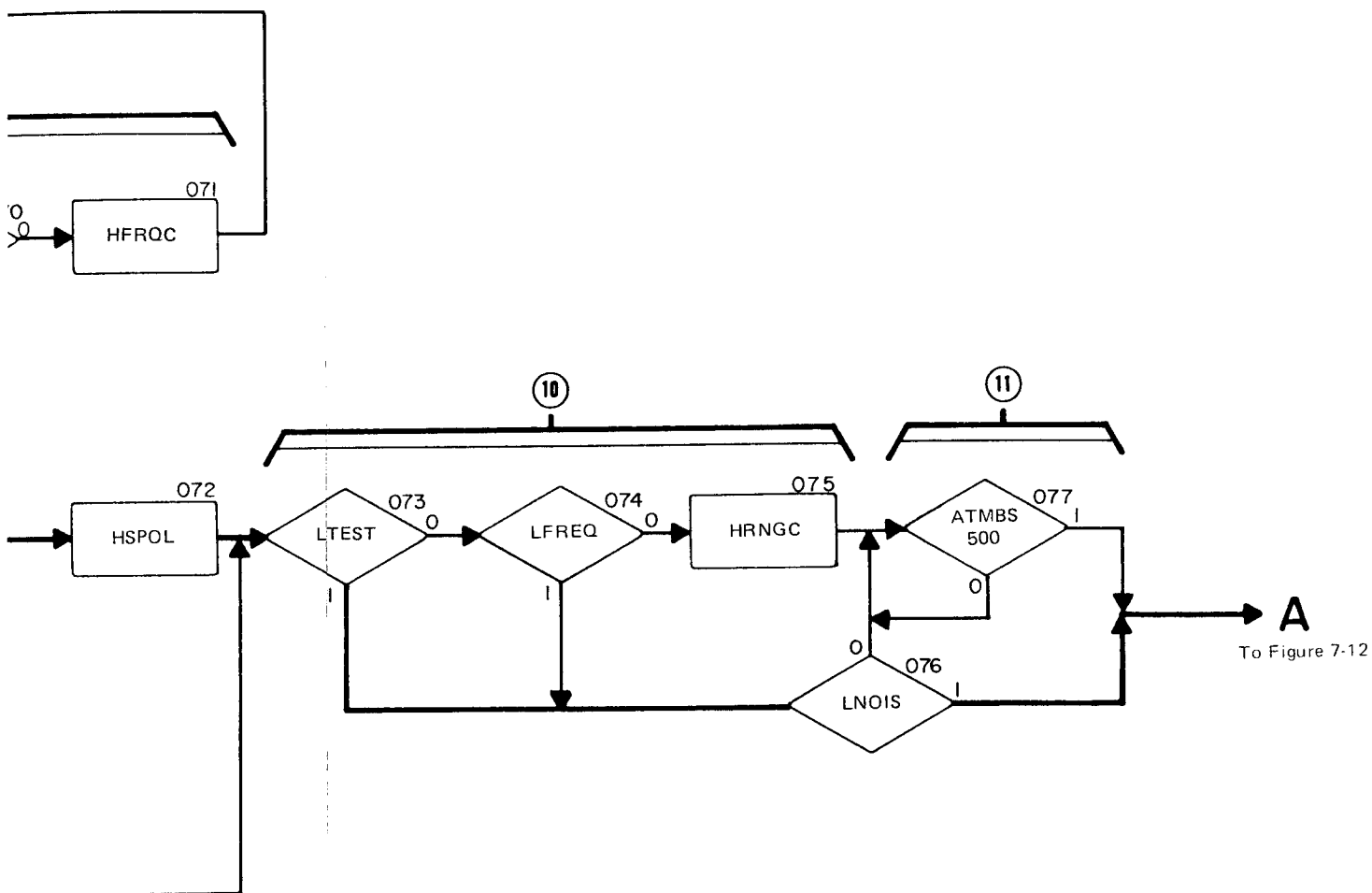
out fre-

rs).









3551A-D-3992

Figure 7-13. p/o Operational Flow Chart.  
Rev. A 7-25/7-26

## INTRODUCTION.

Test Loop No. 4 verifies the operation of the range up-down counter (A1U621), the automatic amplitude ranging circuits and the display ROM amplitude decoding process. The analog ranging circuits and amplitude measurement circuits will also be tested. Once the controller has entered the loop, it will run between states 137 and 150 or 151 as long as LFREQ is high (DISPLAY & MONITOR SEND LEVEL pushbutton pressed).

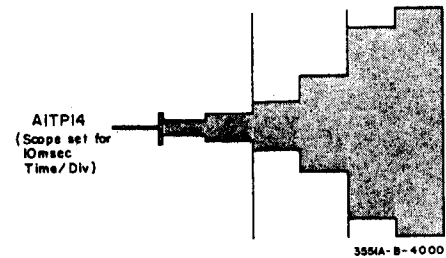
When LTEST is low (A1TP8 grounded) there is a 500 ms delay in the loop. When LTEST is high (A1TP8 ground removed) there is only a 15 ms delay. To verify if the Test Set is in Test Loop No. 4, connect an oscilloscope to A1TP5 with A1TP8 grounded and verify that the HTBRT pulse repetition rate is approximately 500 ms. Remove the ground from A1TP8 and verify that the HTBRT repetition rate is approximately 15 ms. To verify the operation of Test Loop No. 4, externally trigger the oscilloscope at A1TP5 and verify the signals in Notes 1 through 4 as shown in the timing diagram.

- NOTE 1. HSRST verified in Test Loop No. 1.
- NOTE 2. During this routine, the controller will load the 100 kHz clock into the Data Accumulator (A1U701) for 15 ms (1500 counts). The HTXFR pulse will transfer the counts to the display.
- NOTE 3. Connect an oscilloscope to A1U606 pin 15 and verify the signal (HRNGC). Verify ARNG0, ARNG1 and ARNG2 at A1U621 pins 6, 11 and 14 respectively.
- NOTE 4. a. Connect a ground lead to A1TP8. Set the Test Set front panel RECEIVE NOISE/TONE control to the TONE NORMAL position. The display indication should change as follows:
- + 4.9
  - 5.0
  - 15.0
  - 25.0
  - 35.0
  - 45.0
  - 55.0
  - 65.0

This sequence should repeat as long as LFREQ is high (DISPLAY & MONITOR SEND LEVEL is pressed).

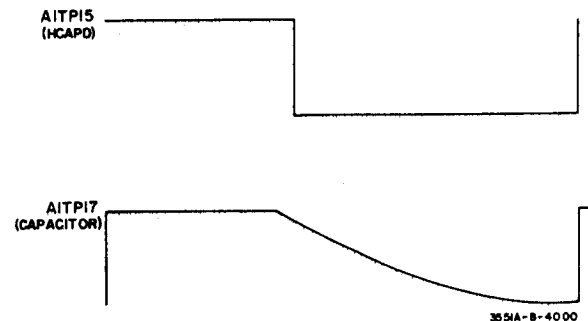
b. Remove the ground lead from A1TP8. Externally trigger the oscilloscope at

A1TP13. Connect the oscilloscope to A1TP14. Set the Test Set front panel SEND FREQUENCY RANGE Hz to the 200 - 6 K position and the SEND LEVEL RANGE dBm to the -30 to -20 position. The oscilloscope indication should be as follows:



This verifies proper operation of the Range Select Block A3U306.

c. Connect one channel of a dual channel oscilloscope to A1TP14 (HCAPD). The oscilloscope indication should be a square wave. Connect the other channel of the oscilloscope to A1TP17. The oscilloscope indication should be the charge and discharge pattern of A1C516. Verify the charge of A1C516 occurs while HCAPD is high and the discharge occurs while HCAPD is low.



If all signals have been verified at this point, exiting Loop No. 4 can be accomplished by pressing the DISPLAY & MONITOR SEND FREQ pushbutton. Set the Send Frequency Range switch to 2 kHz - 60 kHz position.

4 verifies the operation of the range up-down), the automatic amplitude ranging circuits and the amplitude decoding process. The analog ranging amplitude measurement circuits will also be tested. After has entered the loop, it will run between states 151 as long as LFREQ is high (DISPLAY & LEVEL pushbutton pressed).

low (A1TP8 grounded) there is a 500 ms delay in LTEST is high (A1TP8 ground removed) there is delay. To verify if the Test Set is in Test Loop No. 4, connect scope to A1TP5 with A1TP8 grounded and verify pulse repetition rate is approximately 500 ms. And from A1TP8 and verify that the HTBRT is approximately 15 ms. To verify the operation of, externally trigger the oscilloscope at A1TP5 and in Notes 1 through 4 as shown in the timing

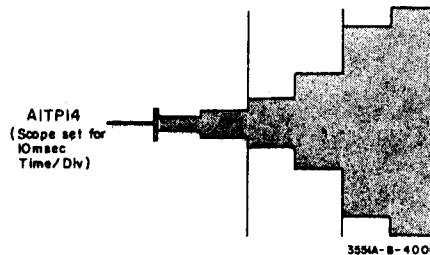
1. HSRST verified in Test Loop No. 1.
2. During this routine, the controller will load the 100 kHz clock into the Data Accumulator (A1U701) for 15 ms (1500 counts). The HTXFR pulse will transfer the counts to the display.
3. Connect an oscilloscope to A1U606 pin 15 and verify the signal (HRNGC). Verify ARNG0, ARNG1 and ARNG2 at A1U621 pins 6, 11 and 14 respectively.
4. a. Connect a ground lead to A1TP8. Set the Test Set front panel RECEIVE NOISE/TONE control to the TONE NORMAL position. The display indication should change as follows:

+ 4.9  
- 5.0  
- 15.0  
- 25.0  
- 35.0  
- 45.0  
- 55.0  
- 65.0

This sequence should repeat as long as LFREQ is high (DISPLAY & MONITOR SEND LEVEL is pressed).

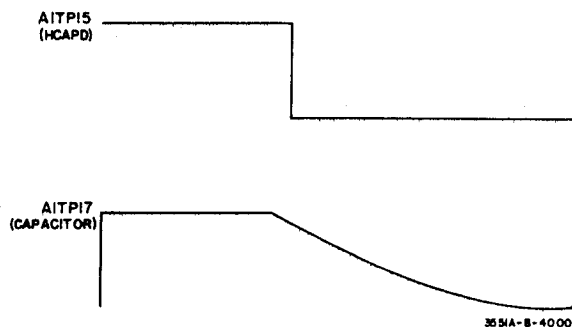
b. Remove the ground lead from A1TP8. Externally trigger the oscilloscope at

A1TP13. Connect the oscilloscope to A1TP14. Set the Test Set front panel SEND FREQUENCY RANGE Hz to the 200 - 6 K position and the SEND LEVEL RANGE dBm to the -30 to -20 position. The oscilloscope indication should be as follows:

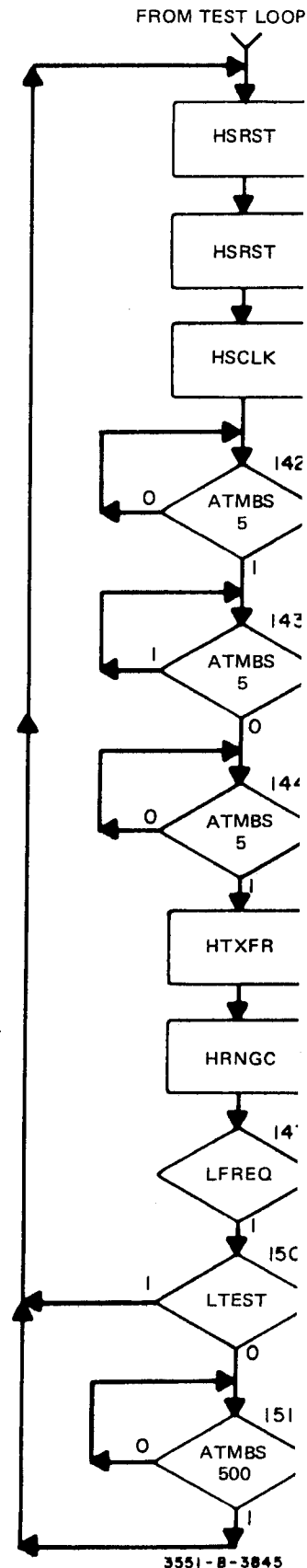


This verifies proper operation of the Range Select Block A3U306.

c. Connect one channel of a dual channel oscilloscope to A1TP14 (HCAPD). The oscilloscope indication should be a square wave. Connect the other channel of the oscilloscope to A1TP17. The oscilloscope indication should be the charge and discharge pattern of A1C516. Verify the charge of A1C516 occurs while HCAPD is high and the discharge occurs while HCAPD is low.



If all signals have been verified at this point, exiting Loop No. 4 can be accomplished by pressing the DISPLAY & MONITOR SEND FREQ pushbutton. Set the Send Frequency Range switch to 2 kHz - 60 kHz position.



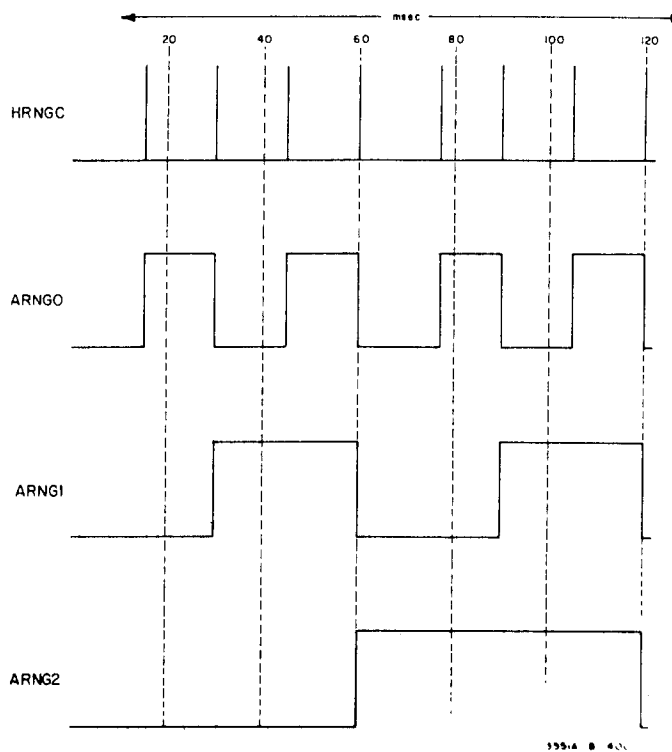
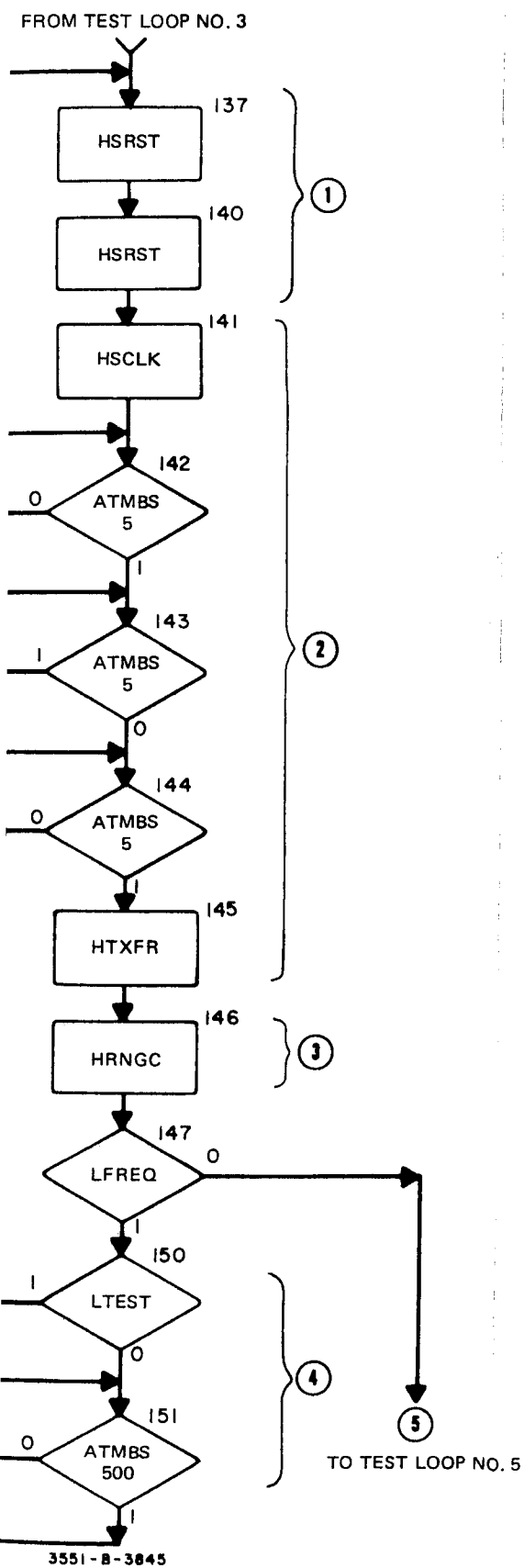
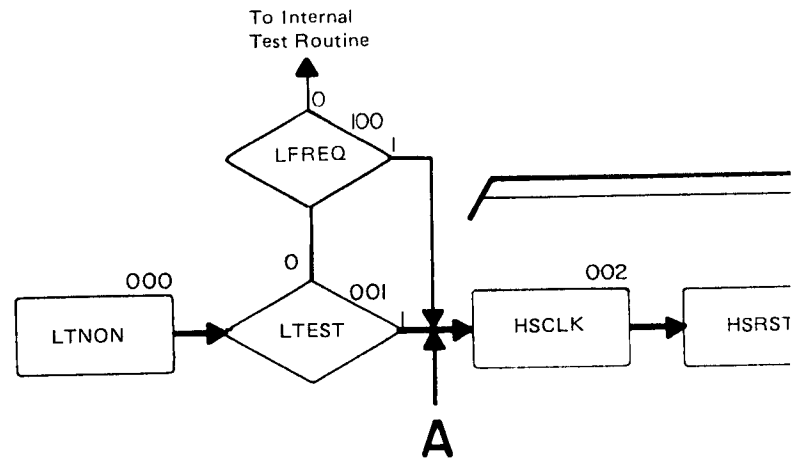


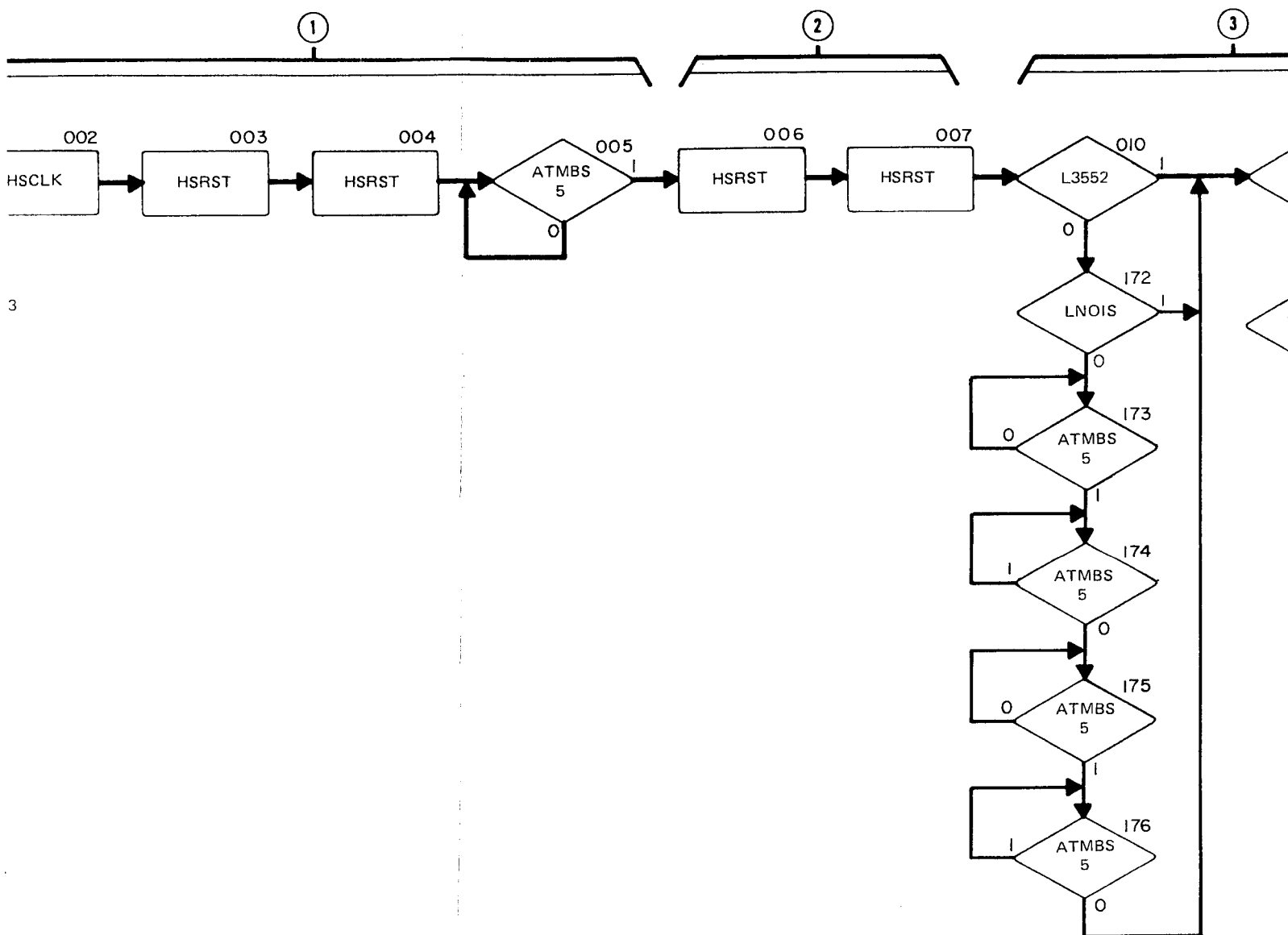
Figure 7-10. Test Loop Number 4.  
Rev. A 7-19/7-20

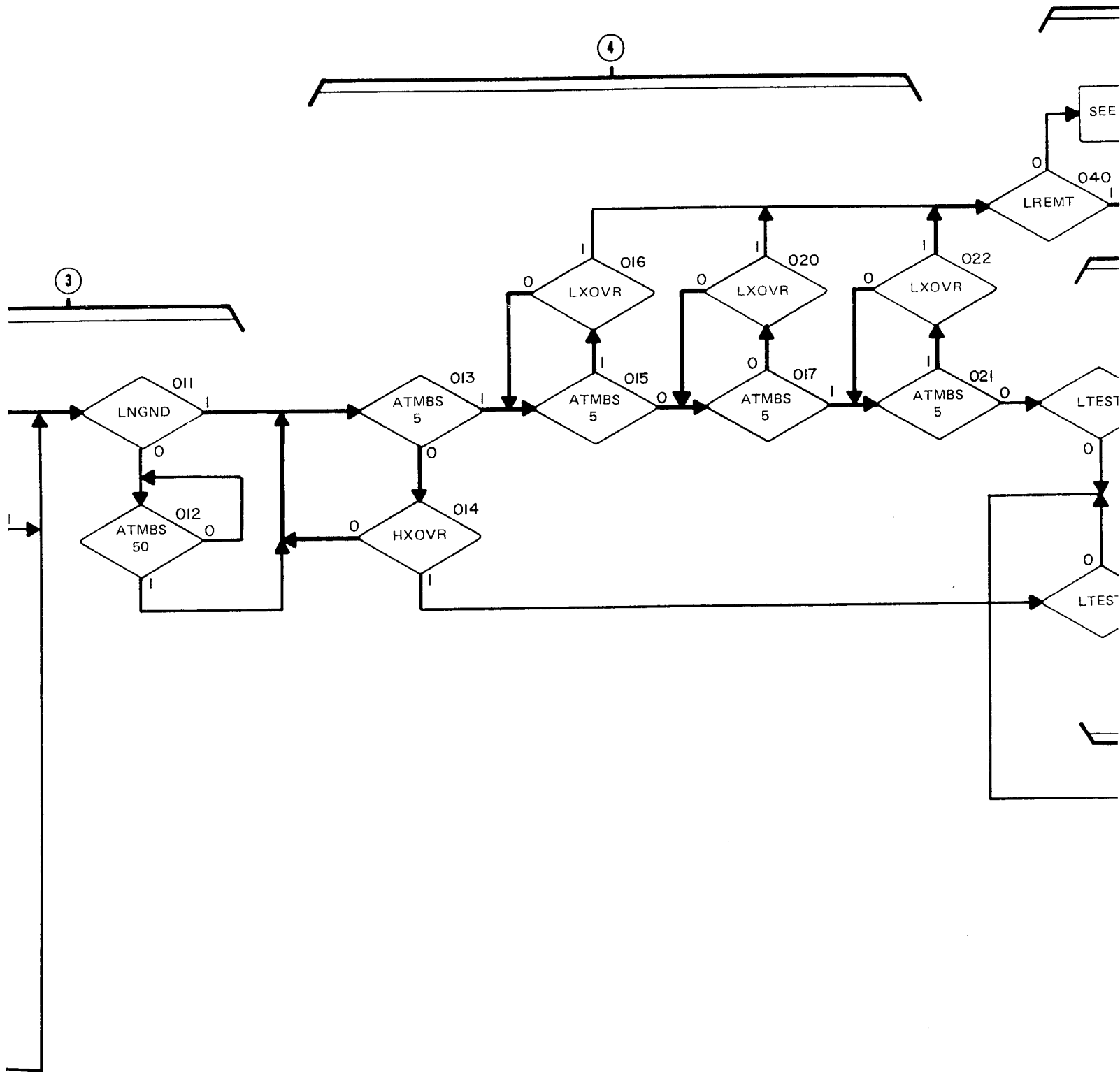
- ① Logger capacitor charge sequence.
- ② Reset counter in Data Accumulator.
- ③ Wait loop for counter in Data Accumulator
  - for level measurements, wait period = 0 ms.
  - for noise measurements, wait period = 0 ms.
  - for noise-to-ground measurements, wait period = 50 ms.
  - for 3552 noise measurements, wait period = 20 ms.
- ④ Check for LXOVR.
  - Address 014 = overload indication
  - Address 016 = + 5 dBm to 0 dBm level
  - Address 020 = 0 dBm to - 5 dBm level
  - Address 022 = - 5 dBm to - 10 dBm level
- ⑤ Normal path for level measurements.
- ⑥ Down-range path for level measurements.
- ⑦ Up-range path for level measurements.

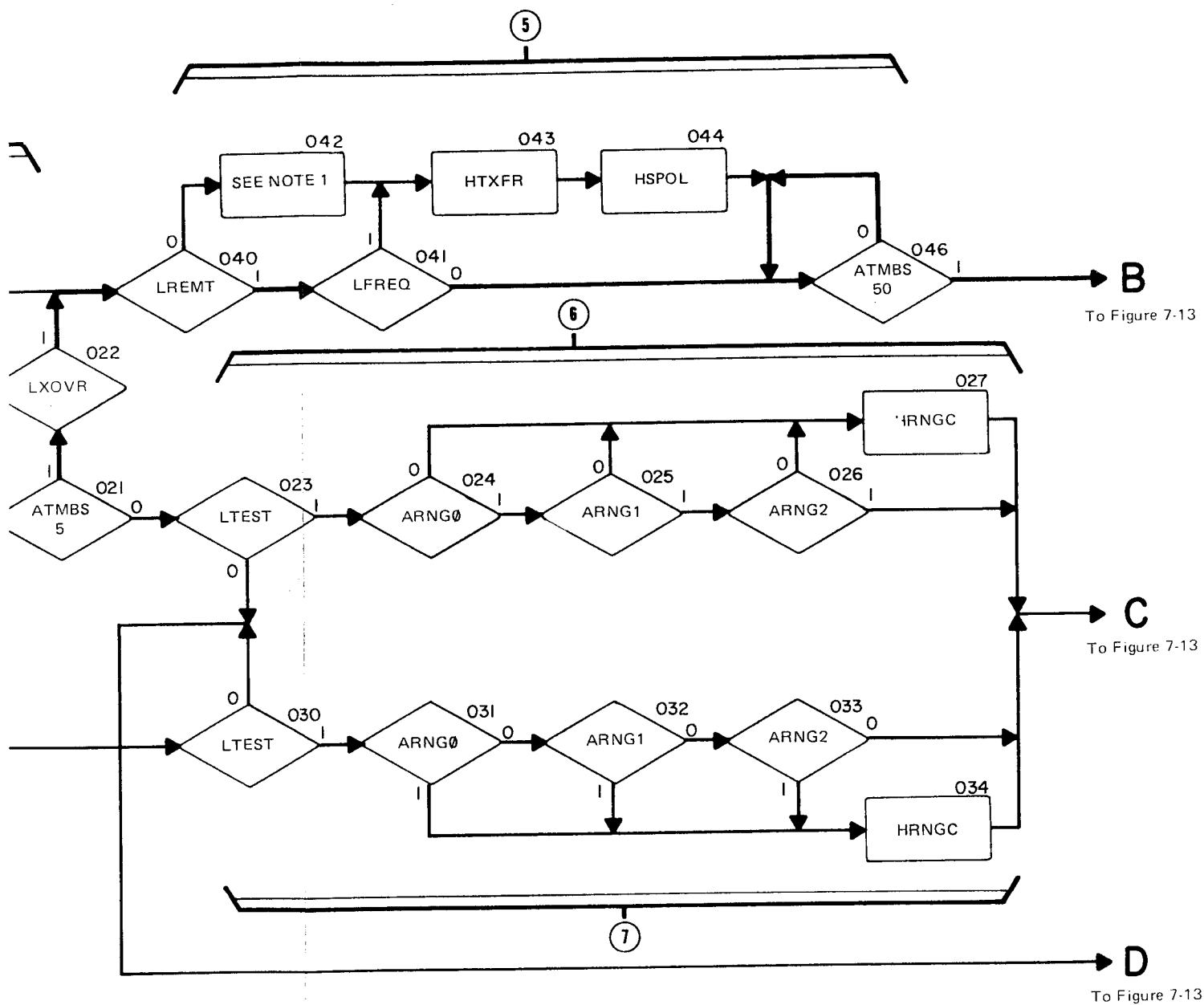
is.  
ns.  
period =  
t = 20 ms.



From Figure 7-13







355IA-D-3992

Figure 7-12. p/o Operational Flow Chart.  
Rev. A 7-23/7-24

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