# SECTION V
# MAINTENANCE

## 5-1. INTRODUCTION.

5-2. This section contains the information necessary for maintenance of the Model 3400A RMS Voltmeter. Included are performance checks, adjustment and calibration procedures, and troubleshooting procedures.

## 5-3. TEST EQUIPMENT.

5-4. The test equipment required for the maintenance of the Model 3400A is listed in Table 5-1. If the recommended model is not available, use any substitute that meets the required characteristics.

## 5-5. PERFORMANCE CHECKS.

5-6. The Performance Checks are in-cabinet tests that compare the Model 3400A with its given specifications. These checks may be used for incoming inspection, periodic maintenance, and for specification checks after a repair. A Performance Check Test Card is provided at the end of this section for recording the performance of the instrument during the Performance Checks. The card may be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check. If the instrument fails to meet any of its specifications, perform the Adjustment and Calibration Procedures outlined in Paragraph 5-15.

NOTE

Allow a 30-minute warmup period before making performance checks. During the performance checks, periodically vary the Model 3400A line voltage ±10% with a power line transformer to assure that the instrument operates correctly at various ac line voltages.

## 5-7. ACCURACY, LINEARITY, AND DC OUTPUT CHECK.

5-8. The accuracy, linearity, and dc output test setup is illustrated in Figure 5-1. A Voltmeter Calibrator -hp- Model 738B and a DC Voltmeter -hp- Model 3440A/3443A) are required for this test.

a. Connect test setup illustrated in Figure 5-1.

b. Set Model 3400A RANGE switch to 0.001 position.

c. Adjust Voltmeter Calibrator for 0.001 volt, rms 400 Hz output; set the DC Voltmeter to measure 1 volt.

d. If Model 3400A does not indicate within values listed under "meter reading" in Table 5-2, perform low frequency calibration procedure, Paragraph 5-21. Record 3400A readings.

e. Dc output as indicated on dc voltmeter should be within values listed under "3400A DC output" in Table 5-2.

f. Continue to check accuracy, linearity, and dc output using Table 5-2.

Table 5-2. Accuracy, Linearity, and DC Output Check Data

| VOLTMETER CALIBRATOR OUTPUT (V) | 3400A VOLTAGE RANGE (V) | 3400A METER READING (V) | 3400A DC OUTPUT (V) |
|---|---|---|---|
| 0.001 | 0.001 | 0.000990 to 0.00101 | 0.992 to 1.008 |
| 0.003 | 0.003 | 0.00297 to 0.00303 | 0.942 to 0.957 |
| 0.01 | 0.01 | 0.00990 to 0.0101 | 0.992 to 1.008 |
| 0.03 | 0.03 | 0.0297 to 0.0303 | 0.942 to 0.957 |
| 0.1 | 0.1 | 0.0990 to 0.101 | 0.992 to 1.008 |
| 0.3 | 0.3 | 0.297 to 0.303 | 0.942 to 0.957 |
| 1.0 | 1.0 | 0.990 to 1.01 | 0.992 to 1.008 |
| 0.9 | 1.0 | 0.89 to 0.91 | 0.892 to 0.908 |
| ~~0.8~~ | 1.0 | 0.79 to 0.81 | 0.792 to 0.808 |
| 0.7 | 1.0 | 0.69 to 0.71 | 0.692 to 0.708 |
| ~~0.6~~ | 1.0 | 0.59 to 0.61 | 0.592 to 0.608 |
| ~~0.5~~ | 1.0 | 0.49 to 0.51 | 0.492 to 0.508 |
| ~~0.4~~ | 1.0 | 0.39 to 0.41 | 0.392 to 0.408 |
| 0.3 | 1.0 | 0.29 to 0.31 | 0.292 to 0.308 |
| 0.2 | 1.0 | 0.19 to 0.21 | 0.192 to 0.208 |
| 0.1 | 1.0 | 0.090 to 0.11 | 0.092 to 0.108 |
| 3.0 | 3.0 | 2.97 to 3.03 | 0.942 to 0.957 |
| 10.0 | 10.0 | 9.90 to 10.10 | 0.992 to 1.008 |
| 30.0 | 30.0 | 29.7 to 30.3 | 0.942 to 0.957 |
| 100.0 | 100.0 | 99.0 to 101.0 | 0.992 to 1.008 |
| 300.0 | 300.0 | 297.0 to 303.0 | 0.942 to 0.957 |

Table 5-1. Required Test Equipment

| INSTRUMENT TYPE | REQUIRED CHARACTERISTICS | USE | RECOMMENDED MODEL |
|---|---|---|---|
| DC Voltmeter | Accuracy: ±0.1% full scale<br>Voltage Range: 10 mV to 100 V | Performance Checks<br>Adjustment and Calibration | -hp- Model 3440A/3443A Digital Voltmeter |
| Voltmeter Calibrator | Voltage Range: 1 mV to 300 V rms<br>Frequency: 400 Hz | Performance Checks<br>Adjustment and Calibration<br>Troubleshooting | -hp- Model 738B Voltmeter Calibrator |
| Oscillator | Frequency Range: 10 Hz to 10 MHz<br>Output: 1 mV to 3 V<br>Frequency Response: 0.25% (expand scale) | Performance Checks<br>Adjustment and Calibration<br>Troubleshooting | -hp- Model 652A Test Oscillator |
| Oscilloscope | Sensitivity: 0.005 v/cm<br>Bandwidth: dc to 20 MHz | Adjustment and Calibration<br>Troubleshooting | -hp- Model 140A/1402A/1420A |
| Pulse Generator | Pulse Width: variable to 10 μsec<br>Pulse Amp: ±10 volts peak, variable<br>Pulse Rate: 250 to 1000 pps | Performance Checks | -hp- Model 214A Pulse Generator |
| Frequency Counter | Range: 250 to 1000 Hz<br>Accuracy: ±1 count<br>Time Interval: 1 μsec | Performance Checks | -hp- Model 5233L Electronic Counter |
| Peak Responding Voltmeter | Voltage Range: 0.5 V to 300 V<br>Accuracy: ±3% full scale | Performance Checks | -hp- Model 410C Voltmeter |
| Average Responding Voltmeter | Voltage Range: 0.001 to 300 V<br>Accuracy: 1% full scale | Adjustment and Calibration<br>Troubleshooting | -hp- Model 400E/EL Voltmeter |
| Current Supply/ Ohmmeter | Output: 5 mA of current into 100Ω<br>Ohm Range: 1Ω to 10 MΩ<br>Accuracy: ±5% | Troubleshooting | -hp- Model 412A DC Vacuum Tube Voltmeter |
| RMS Responding Voltmeter | Range: 1 mV full scale | Performance Checks | -hp- Model 3400A RMS Voltmeter |
| Resistor | 200 kΩ, metal film, 1/4 W 1% | Performance Checks | -hp- Part No. 0757-0782 |
| Resistor | 499 kΩ, metal film, 1/4 W 1% | Troubleshooting | -hp- Part No. 0757-0327 |
| Capacitor | 1 μF | Troubleshooting | -hp- Part No. 0180-0269 |
| 50Ω Feedthru Termination | Resistor: fixed comp 50Ω ±5% 1/4 W | Performance Checks | -hp- Model 11048B 50Ω Feedthru |
| BNC-T-Adapter | - - | Performance Checks<br>Adjustment and Calibration | -hp- Part No. 1250-0072 |
| Adapter | 410C to Dual Banana | Performance Checks | -hp- Model 11018A |
| Extender Board | 15 pin programmable | Troubleshooting | -hp- Part No. 5060-6038 |

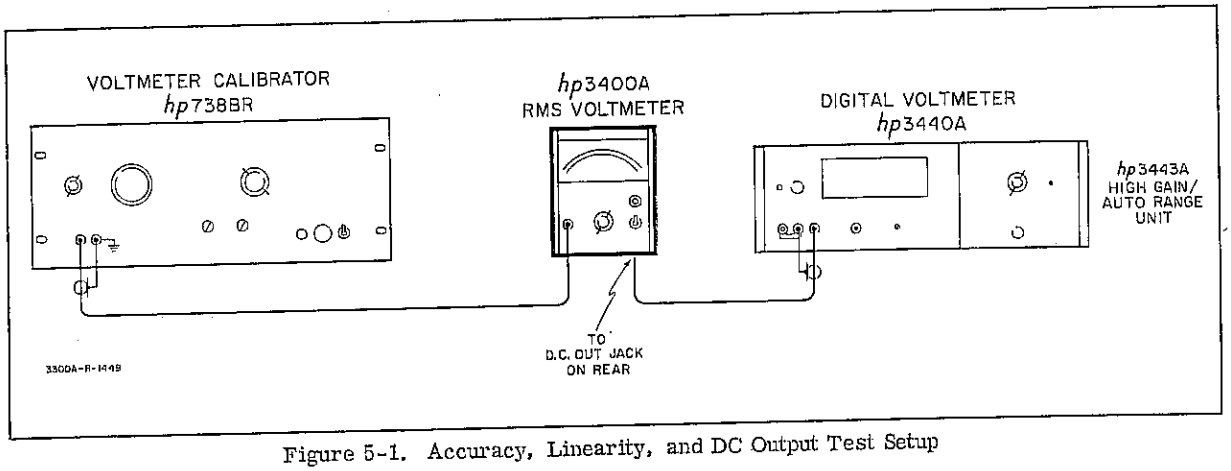



Figure 5-1. Accuracy, Linearity, and DC Output Test Setup

## 5-9. FREQUENCY RESPONSE CHECK.

NOTE

Connect 50Ω feedthru termination directly to 3400A INPUT to eliminate loss in output cable at high frequency.

a. Connect test setup illustrated in Figure 5-2.

b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to 1 volt position.

c. Set Test Oscillator for 400 Hz output and adjust output amplitude for the reading obtained in Paragraph 5-8 step d on the Model 3400A.

d. Switch the Test Oscillator monitor switch to expand mode and set a convenient reference level.

e. Adjust test oscillator output frequency to values listed under "frequency" in Table 5-3; adjust oscillator output voltage to maintain reference level set in step d. If Model 3400A does not indicate within values under "meter reading" in Table 5-3, perform high frequency calibration procedures, Paragraph 5-25.

Table 5-3. Frequency Response Check

| FREQUENCY | METER READING |
|---|---|
| 15 Hz | 0.95 to 1.05 |
| 45 Hz | 0.95 to 1.05 |
| 100 Hz | 0.99 to 1.01 |
| 900 kHz | 0.99 to 1.01 |
| 1.2 MHz | 0.98 to 1.02 |
| 1.8 MHz | 0.98 to 1.02 |
| 2.2 MHz | 0.97 to 1.03 |
| 2.8 MHz | 0.97 to 1.03 |
| 3.2 MHz | 0.95 to 1.05 |
| 9.8 MHz | 0.95 to 1.05 |

## 5-10. INPUT IMPEDANCE CHECK.

## 5-11. RESISTANCE CHECK.

a. Connect the Test Oscillator, 50 ohm feedthru and -hp- Model 3400A to position A in Figure 5-3.

b. Set 3400A to 1 volt range and Test Oscillator to 400 Hz.

c. Adjust Test Oscillator output for 1 volt indication on Model 3400A.

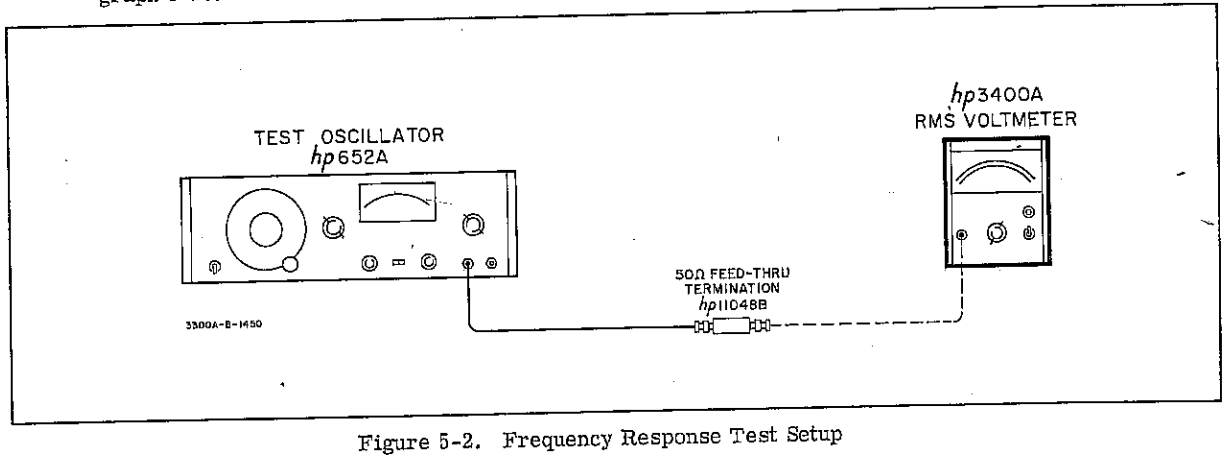



Figure 5-2. Frequency Response Test Setup

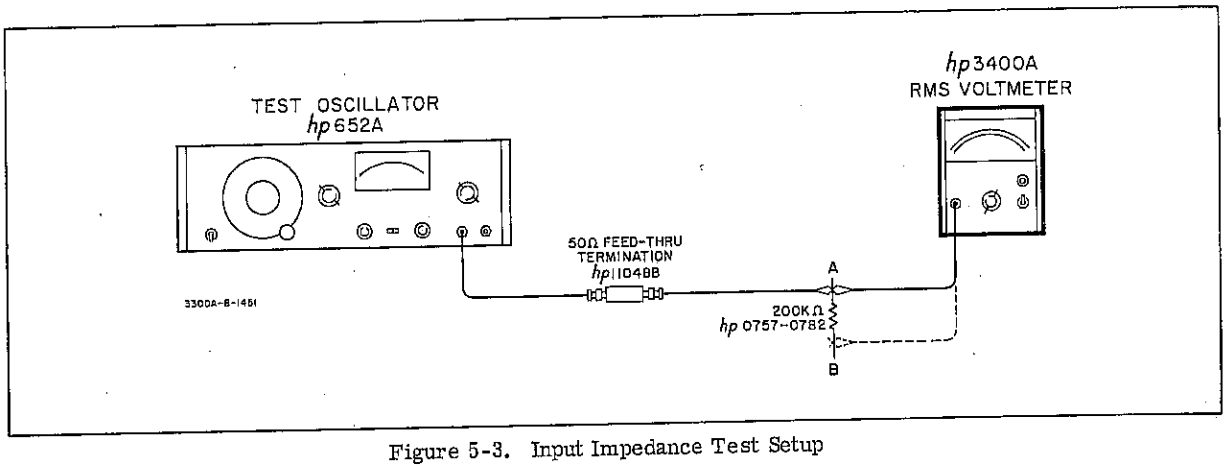



Figure 5-3. Input Impedance Test Setup

d. Connect Model 3400A to position B in Figure 5-3. The 3400A meter reading should change less than 0.02 volts (2 minor divisions). This corresponds to an input impedance of 10 megohms.

5-12. CAPACITANCE CHECK.

a. Connect Test Oscillator, 50 ohm feedthru and Model 3400A to position B in Figure 5-3. Insert the resistor lead directly into the BNC connector on the 3400A as an adapter adds capacitances to the measurement.

b. Set 3400A to 0.001 volt range and Test Oscillator to 400 Hz.

c. Adjust Test Oscillator output for full scale indication on Model 3400A. Switch the Test Oscillator Switch to Expand mode and set a convenient reference level.

d. Change Test Oscillator frequency to 16 kHz, maintaining the reference level set in step c. The Model 3400A reading should be greater than 0.707 volts. This corresponds to an input shunt capacity of less than 50 pF.

e. Set Model 3400A Range switch to 1 V position and repeat step c.

f. Change Test Oscillator frequency to 40 kHz, maintaining the reference level set in step c. The Model 3400A reading should be greater than 0.707 volts. This corresponds to an input shunt capacity of less than 20 pF.

5-13. CREST FACTOR CHECK.

a. Connect test setup as illustrated in Figure 5-4.

b. Set Model 3400A Range switch to 1 volt position.

c. Adjust Pulse Generator for pulse output with the following characteristics:

Pulse Rate - 990 pps as indicated on electronic counter.

Pulse Width - 10 μsec as indicated on electronic counter in time internal mode.

Pulse Amplitude - 7.07 volts as indicated on Model 410C.

NOTE

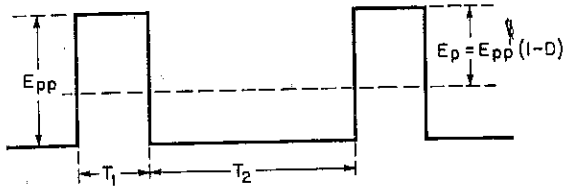
The 410C responds to the positive peak above the average of the input waveform. Since the Model 410C is calibrated to read the rms value of a sine wave a correction factor is required to measure pulse amplitude. The correction factor under these conditions is:

$$E_{410C} = \frac{E_{pp}}{\sqrt{2}\left(1+\frac{T_1}{T_2}\right)}$$

see waveform below

$$E_{410C} = \frac{E_p \dfrac{T_2}{T_1+T_2}}{\sqrt{2}\left(1+\frac{T_1}{T_2}\right)}$$

$$E_{410C} = 7.07\ V$$



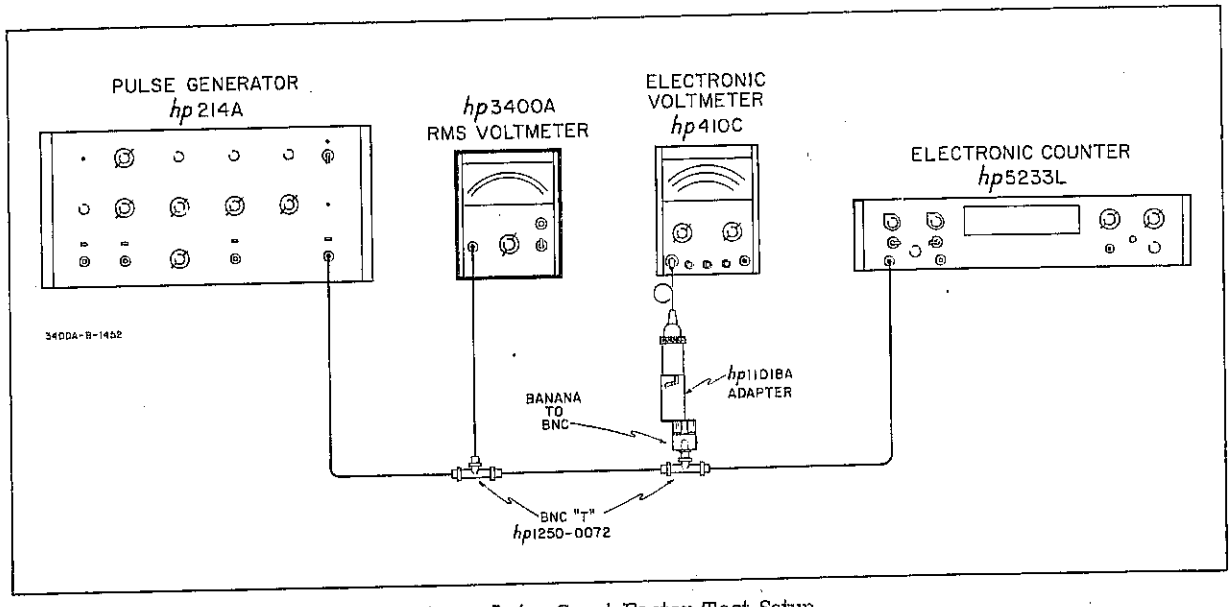
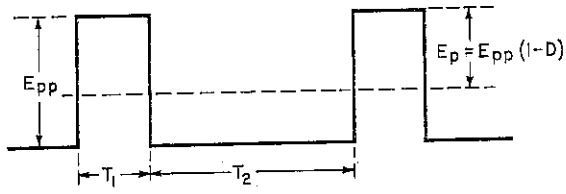



Figure 5-4. Crest Factor Test Setup

This corresponds to a crest factor of 10 where:

$$E_{rms} = E_{pp}\sqrt{D(1-D)} \quad \text{where } D = \frac{T_1}{T_1+T_2}$$




$$C.F. = \frac{E_p}{E_{rms}}$$

$$C.F. = \frac{E_{pp}(1-D)}{E_{pp}\sqrt{D(1-D)}}$$

$$C.F. = \sqrt{\frac{1-D}{D}}$$

d. The Model 3400A should indicate 1 volt, ±4% (includes the ±3% accuracy of 410C).

e. Adjust pulse generator pulse rate to 250 pps as indicated on electronic counter. This corresponds to a crest factor of 20.

f. Model 3400A should indicate 0.5 volt, ±4% (includes the ±3% accuracy of 410C.)

5-14. OUTPUT NOISE CHECK.

a. Connect 50 ohm feedthru to 3400A INPUT.

b. Connect another RMS Voltmeter to DC output.

c. Set -hp- Model 3400A to 0.001 volt range.

d. The reading on the RMS Voltmeter should not exceed 1 mV.

## 5-15. ADJUSTMENT AND CALIBRATION PROCEDURES.

5-16. The following is a complete adjustment and calibration procedure for the Model 3400A. These procedures should be conducted only if it has previously been established by Performance Checks, Paragraph 5-5 to 5-14, that the Model 3400A is out of adjustment. Indiscriminate adjustment of the internal controls to refine settings may actually cause more difficulty. If the procedures outlined do not rectify any maladjustments that may exist, and you have carefully rechecked your connections and settings, refer to Paragraph 5-29, Troubleshooting Procedures for possible cause and recommended corrective action.

5-17. MECHANICAL METER ZERO.

5-18. The mechanical meter zero screw is located on the instrument front panel. If the meter pointer does not indicate zero when the instrument power has been off for at least one minute, mechanically zero the meter following the procedure outlined below.

a. Turn instrument power off; disconnect input signal and any cable connected to J2 (DC OUT) at rear of instrument and allow one minute for meter pointer to stabilize.

b. Rotate zero adjust CW until pointer is to left of zero, moving up scale. Continue until pointer is at zero. If pointer overshoots zero, repeat operation.

c. When the pointer is exactly at zero, rotate the adjusting screw slightly counterclockwise to remove tension on pointer suspension. If the meter pointer moves to the left during this adjustment, repeat steps b and c.

5-19. POWER SUPPLY CHECKS.

5-20. Power supply voltage and ac ripple tolerances are listed in Table 5-4. Test points are also indicated in this table. When making ripple voltage measurements, it may be desirable to use a battery powered A. C. Voltmeter (H-P 403B) to avoid any undesirable ground loop currents.

5-21. LOW FREQUENCY CALIBRATION.

5-22. AMPLIFIER GAIN ADJUSTMENT.

a. Connect test setup illustrated in Figure 5-1.

b. Set Model 3400A RANGE switch to 0.01 volt position.

c. Adjust Voltmeter Calibrator for 0.01 volt rms, 400 Hz output; set DC Voltmeter to read 1.0.

d. Remove Model 3400A top cover; adjust R4 (CAL) for 1.0 volt as indicated on DC Voltmeter. If R4 (CAL) does not have enough range to calibrate the dc output, the value of R3 should be changed. The range of R3 is from 820 ohms to 2.16 k ohms.

e. Adjust R6 (FULL-SCALE ADJUST) for Model 3400A full-scale meter indication.

5-23. 1/10 SCALE ADJUSTMENT.

a. Connect test setup illustrated in Figure 5-1; omit the DC Voltmeter.

b. Set Model 3400A RANGE switch to 0.1 volt position and adjust Voltmeter Calibrator for 0.01 volt rms, 400 Hz output.

NOTE

The 1/10 SCALE ADJUST should be set slightly low (needle's width) to reduce meter (needle) offset with shorted input.

c. Adjust R7 (1/10 SCALE ADJUST) for Model 3400A 1/10 scale meter indication. Change value of R8 if it is necessary to increase the adjustment range of R7. The range of R8 is from approximately 270 ohms to 430 ohms. See Table 5-7.

5-24. 1 VOLT ADJUSTMENT.

a. Connect test setup illustrated in Figure 5-1; omit the DC Voltmeter.

b. Set Model 3400A RANGE switch to 1 volt position.

c. Adjust voltmeter calibrator for 1.0 volt rms, 400 Hz output.

d. Remove right side cover (INPUT side) and adjust R104 (1 V ADJUST) for Model 3400A full-scale meter indication.

Table 5-4. Power Supply Checks

| POWER SUPPLY | TEST EQUIPMENT AND CHECK POINT | DC VOLTAGE SPECIFICATIONS | REGULATION (Vary Line Voltage Between 103.5 and 126.5 vac) | RIPPLE SPECIFICATIONS |
|---|---|---|---|---|
| -17.5 Vdc | Connect DC Voltmeter, AC Voltmeter, or Oscilloscope between violet lead on video amplifier (A4) board and chassis ground. | -16.8 to 18.2 Vdc | ±0.5 volt from nominal reading at 115 Vac line. | 400 μV rms or 1.1 mV p-p |
| +75 Vdc | Connect DC Voltmeter, AC Voltmeter, or Oscilloscope between red/wht/blue on video amplifier A4 and chassis ground. | 70.0 to 78.0 Vdc | ±1 volt from nominal reading at 115 Vac line. | 400 μV rms or 1.1 mV p-p |
| -6.3 Vdc | Connect DC Voltmeter, AC Voltmeter, or Oscilloscope between Q3 emitter (grey lead) and chassis ground. | -5.9 to -6.5 Vdc | ±0.1 volt from nominal reading at 115 Vac line. | 750 μV rms or 2.0 mV p-p |

5-25. HIGH FREQUENCY CALIBRATION.

5-26. AMPLIFIER GAIN ADJUSTMENT.

NOTE

The Test Oscillator used in this procedure should be calibrated at the end of its output cable.

a. Connect test setup illustrated in Figure 5-2.

b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to 0.001V position.

c. Adjust Test Oscillator output frequency for 400 Hz; output voltage for 90% of full scale as indicated on Model 3400A meter.

d. Switch the Test Oscillator monitor switch to expand mode and set a convenient reference level.

e. Change Test Oscillator frequency to 10 MHz. Adjust Test Oscillator output voltage to maintain reference level set in step d.

f. Adjust C405 (10 MHz ADJUST) on A4 board for 90% full scale as indicated on the Model 3400A meter. Replace right side cover; readjust C405 if meter reading varies after replacing the cover.

g. Vary oscillator between 3 and 10 MHz; maintaining reference level set in step d. If the Model 3400A meter reading varies below 85% or above 95% of full scale, repeat step f until optimum response is obtained between 3 and 10 MHz.

5-27. INPUT ATTENUATOR ADJUSTMENT.

NOTE

The Test Oscillator used in this procedure should be calibrated at the end of its output cable.

a. Connect test setup illustrated in Figure 5-2.

b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to 1 volt position.

c. Adjust Test Oscillator output frequency for 400 Hz, output voltage for 90% full scale as indicated on Model 3400A meter.

d. Switch the Test Oscillator monitor switch to expand mode and set a convenient reference level.

e. Change Test Oscillator frequency to 100 kHz; adjust Test Oscillator output voltage to maintain reference level set in step d.

g. Vary oscillator between 100 kHz and 10 MHz; maintain test oscillator output voltage to reference level set in step d. If Model 3400A meter reading varies more than ±1% to 1 MHz, ±2% from 1 MHz to 2 MHz, ±3% from 2 MHz to 3 MHz, or ±5% from 3 MHz to 10 MHz, readjust C102 until optimum response is obtained.

5-28. SECOND ATTENUATOR ADJUSTMENT.

NOTE

The Test Oscillator used in this procedure should be calibrated at the end of its output cable.

a. Connect test setup illustrated in Figure 5-2.

b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to a 0.3 volt position.

c. Adjust Test Oscillator output frequency for 400 Hz; output voltage for 90% full scale as indicated on Model 3400A meter.

d. Switch the Test Oscillator monitor switch to expand mode and set a convenient reference level.

e. Change Test Oscillator output frequency to 3 MHz; adjust output voltage to maintain reference level set in step d.

f. Adjust C303 (10 MC .3V ADJ) for 90% full scale as indicated on Model 3400A meter.

g. Vary Test Oscillator between 3 MHz and 10 MHz; maintain test oscillator output voltage to reference level set in step d. If Model 3400A meter reading varies below 85% or above 95% of full scale, repeat steps e and f until optimum response is obtained between 3 and 10 MHz.

## 5-29. TROUBLESHOOTING PROCEDURES.

5-30. This section contains procedures designed to assist in the isolation of malfunctions. These operations should be undertaken only after it has been established that the difficulty cannot be eliminated by the Adjustment and Calibration Procedures, Paragraph 5-15. An investigation should also be made to ensure that the trouble is not a result of conditions external to the Model 3400A.

5-31. Conduct a visual check of the Model 3400A for possible burned or loose components, loose connections, or any other condition which might suggest a source of trouble.

5-32. Table 5-5 contains a summary of known problems by front panel symptoms.

circuit parameters, rather only to localize the malfunction. Therefore, it is quite possible that additional measurements will be required to completely isolate the problem. Amplifier gain and biasing may vary slightly from instrument to instrument; therefore, it should not be necessary to precisely duplicate waveforms or values described.

NOTE

Do not use an extender board on the Chopper Amplifier Board (A6).

5-34. CHECKING THERMOCOUPLES TC401 AND TC402.

5-35. The following procedure will allow you to check the thermocouples for proper operation in the -hp- Model 3400A RMS Voltmeter.

NOTE

This check will not yield any information concerning thermocouple operation for either sluggish or overshoot-undershoot response on 3400A meter. If a 3400A has the above symptoms replace thermocouples.

5-36. To perform these checks, supply 5 mA of current to the heaters of the thermocouples. The -hp- Model 412A DC Vacuum Tube Voltmeter in ohms function on X100 range is ideal for this application. Instruments required for these checks are as follows:

One -hp- Model 412A DC Vacuum Tube Voltmeter.

One DC Voltmeter with 10 mV F. S. capability such as another -hp- 412A or 3440A/3443A Digital Voltmeter.

If the thermocouples fail any of the following checks replace the thermocouples according to procedures outlined in Paragraph 5-37.

a. Turn the instrument off and remove the A6 board.

NOTE

See Figure 6-3 for component locations.

b. Connect test leads of 412A, in ohms function on X100 range, between ground and junction of C413 and C415 on A4 board (this step checks the resistance of heater in TC401). 412A should indicate between 76.5 to 103.5 ohms. If not within limits, replace the matched set of thermocouples (-hp- Part No. 0853-0003).

c. Leave the 412A connected as in Step b (412A is used to supply 5 mA of current to heater of TC401 in this step). Connect a DC Voltmeter as follows:

Negative lead to pin 11 on A6 socket.
Positive lead to pin 13 on A6 socket.

Voltmeter should indicate between +6.5 mV and +9 mV. Note the indication for future reference. If within the test limits, leave DC Voltmeter connected and proceed to step d page 5-14.

Table 5-5. Front Panel Symptoms

| SYMPTOMS | POSSIBLE CAUSE |
|---|---|
| 1/2 scale readings on all RANGE switch settings and input voltages. | Chopper Amplifier (A6), Check C612. |
| 3 to 5% meter offset on all ranges with shorted input. | R7 (1/10 SCALE ADJ) misadjusted. C405 (10 MHz ADJ) misadjusted. |
| 400 Hz calibration low and frequency response falls off above 50 kHz. | Q401 or Q402 shorted. |
| Switching transients exceed 5% of full scale with shorted input. | Check collector voltage of Q201 (should not exceed 9.0 V). |
| Instrument has been overloaded. | Check Q201, Q401, Q402 and TC401. See Paragraph 5-34 for details on TC401. |
| Meter jitter exceeds 0.5% of full scale. | Check Q601, Photochopper Assembly (neons) see Figure 5-9. Verify the value of R606 to be 3.3 kΩ (-hp- Part No. 0683-3325). |
| Full-scale difference from range to range. | Check resistors in second attenuator. |
| Meter pegs full scale. | Check thermocouples. See Paragraph 5-34 for details. |
| Overshoot, undershoot or sluggish response on meter. | Replace Thermocouples. See Paragraph 5-37. |

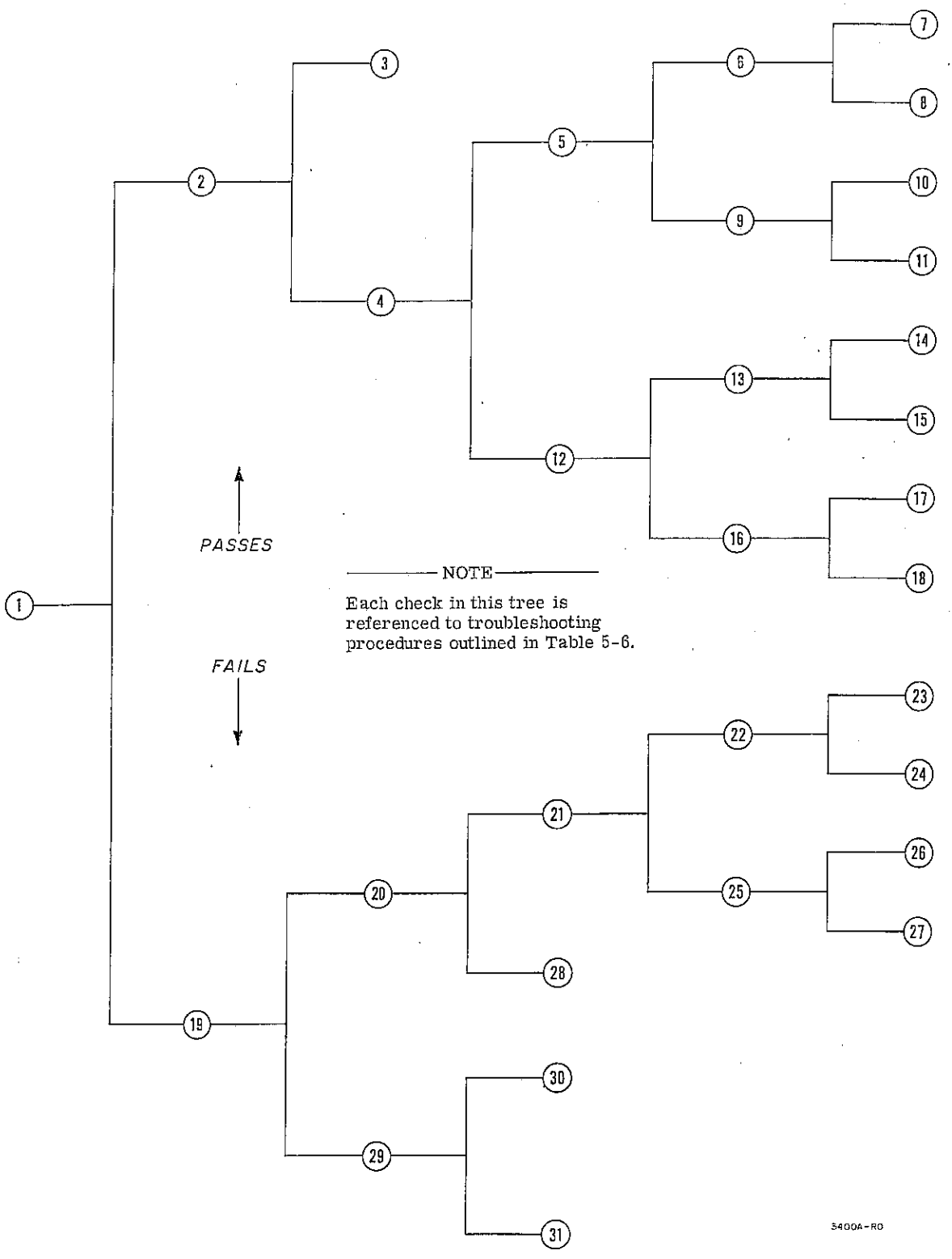
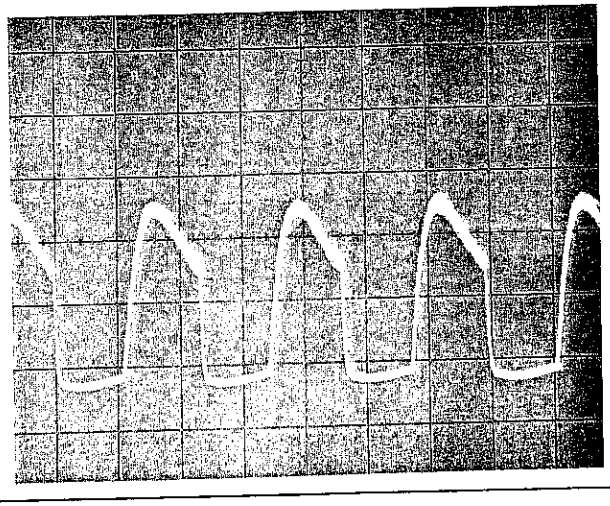



Figure 5-5 Troubleshooting Tree

Table 5-6. Troubleshooting Procedure

| CHECK | PROCEDURE | ACTION |
|---|---|---|
| (1) | Apply a 1 volt 400 Hz signal and set the 3400A to the 1 volt range. Measure ac signal at junction of C413 and C415. The reading should be between 240 mV and 280 mV RMS.<br><br>——NOTE——<br><br>Do not use an extender board for measurements on Chopper Amplifier board A6. | PASSES: Proceed to (2)<br>FAILS: Proceed to (19)<br>(Trouble proceeding the Chopper Amplifier) |
| (2) | Measure ac signal at junction of C605 and Demodulator V503 and V504. Refer to Figure 5-6 for waveform. | PASSES: Proceed to (3)<br>FAILS: Proceed to (4)<br>(Trouble in the Chopper Amplifier). |

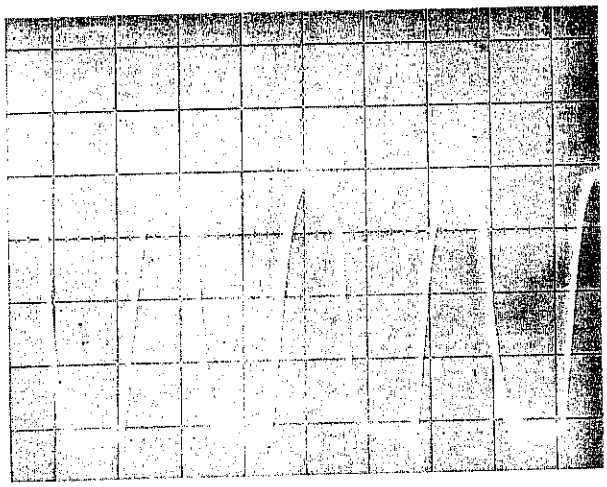


POSITIVE SIDE OF C605
Full Scale deflection
Sweep = 5 ms/cm
Vertical = 0.5 V/cm
DC coupled
use 10:1 probe

Figure 5-6. Input to Demodulator

Table 5-6. Troubleshooting Procedure (Cont'd)

| CHECK | PROCEDURE | ACTION |
|---|---|---|
| (3)<br>(4) | Investigate meter (M1), R5, and R6 for opens.<br><br>Remove the input to 3400A. Unsolder red lead from pin 13 (A6) and insert a +10 mV dc signal from 738BR through a 499 kΩ resistor (-hp- Part No. 0757-0327) to pin 13. Measure ac signal at positive side of C605. Refer to Figure 5-7 for waveform. | PASSES: Proceed to (5)<br>FAILS: Proceed to (12) |

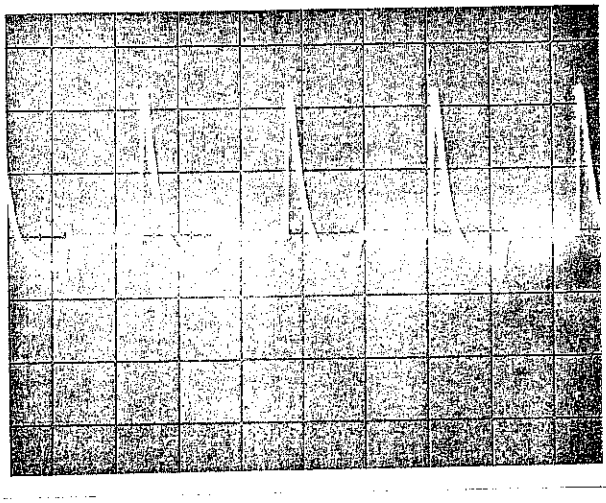


POSITIVE SIDE OF C605
Insert +10 mV signal through 499 kΩ
resistor to pin 13 on A6
Sweep = 5 ms/cm
Vertical = 2.0 V/cm
DC coupled
use 10:1 probe

Figure 5-7. Input to Demodulator (feedback loop open)

Table 5-6. Troubleshooting Procedure (Cont'd)

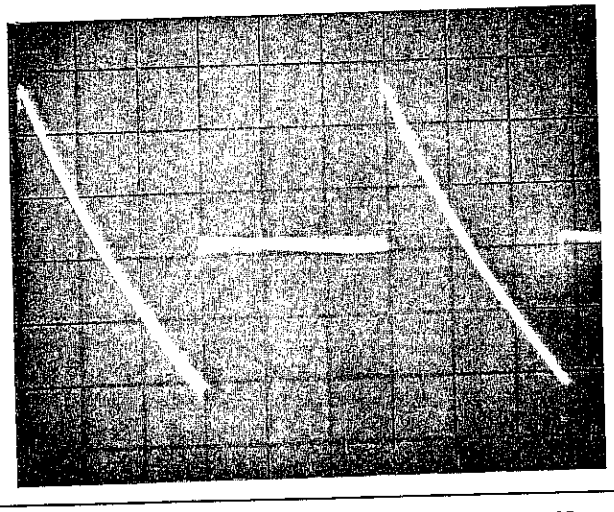
| CHECK | PROCEDURE | ACTION |
|---|---|---|
| ⑤ | Measure the dc signal at emitter of Q605. Reading should be approximately -2.35 Vdc. | PASSES: Proceed to ⑥<br>FAILS: Proceed to ⑨ |
| ⑥ | Measure the dc signal at pin 9 (A6). Reading should be approximately -1.65 Vdc. | PASSES: Proceed to ⑦<br>FAILS: Proceed to ⑧ |
| ⑦ | Investigate R619, R4, and thermocouples. See Paragraph 5-34 for thermocouple check. | |
| ⑧ | Investigate Q606 and associated circuit. | |
| ⑨ | Measure the ac signal at base of Q605. Refer to Figure 5-8 for waveform. | PASSES: Proceed to ⑩<br>FAILS: Proceed to ⑪ |



BASE OF Q605
Insert +10 mV signal through 499 kΩ
resistor to pin 13 on A6
Sweep = 5 ms/cm
Vertical = 0.2 V/cm
AC coupled
use 10:1 probe

Table 5-6. Troubleshooting Procedure (Cont'd)

| CHECK | PROCEDURE | ACTION |
|---|---|---|
| (10) | Investigate Q605, CR604, and R615. | |
| (11) | Investigate demodulator V503 and V504. See Paragraph 5-39 for photochopper check. Check chopper neon voltage. Refer to Figure 5-9 for waveform. Current variation through neons may cause meter jitter. For proper chopper action, neon firing potential (most negative point on waveform) is normally between 50V and 60V. If the waveform displays noise (nonlinearity) at both extremities, jitter will occur on the meter. If the waveform displays a noise replace the neon subassembly as outlined in Paragraph 5-41. | |

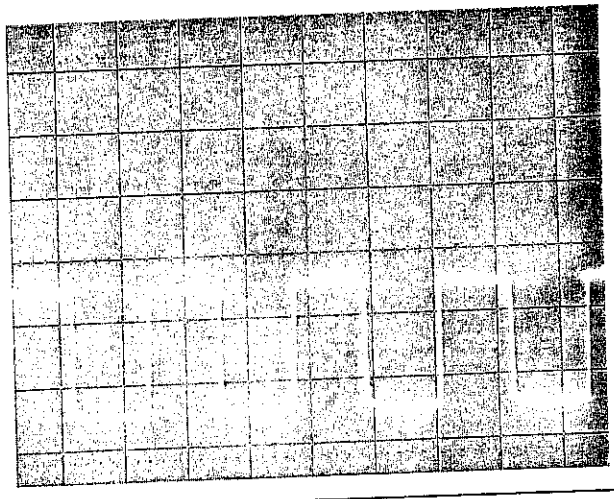


PIN 3 OR 5 ON A6
Sweep = 2 ms/cm
Vertical = 20 V/cm
DC coupled
use 10:1 probe

Figure 5-9. Neon Drive Voltage

Table 5-6. Troubleshooting Procedure (Cont'd)

| CHECK | PROCEDURE | ACTION |
|---|---|---|
| (12) | Measure the ac signal at collector of Q602. Refer to Figure 5-10 for waveform. | PASSES: Proceed to (13)<br>FAILS: Proceed to (16) |

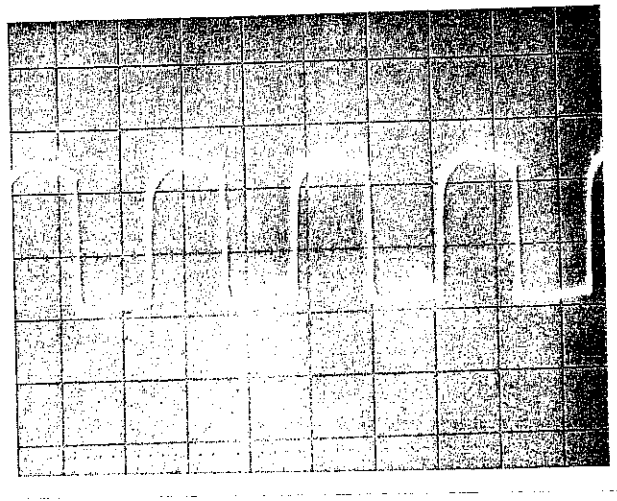


COLLECTOR OF Q602
Insert + 10 mV signal through
499 kΩ resistor to pin 13 on A6
Sweep = 5 ms/cm
Vertical = 0.5 V/cm
DC coupled
use 10:1 probe

Figure 5-10. Collector of Q602 (feedback loop open)

Table 5-6. Troubleshooting Procedure (Cont'd)

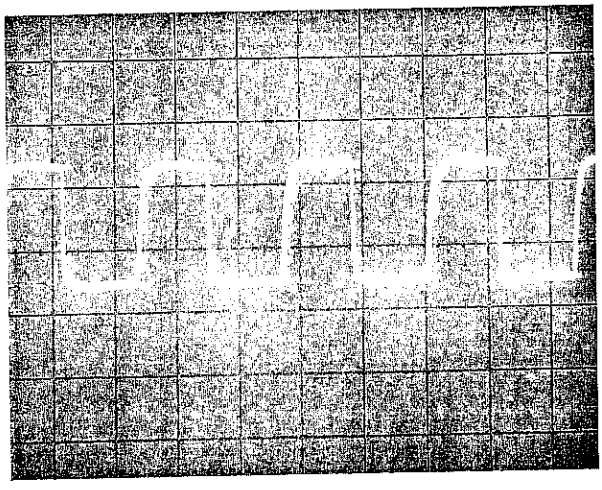
| CHECK | PROCEDURE | ACTION |
|---|---|---|
| 13 | Measure the ac signal at base of Q604. Refer to Figure 5-11 for waveform. | PASSES: Proceed to (14)<br>FAILS: Proceed to (15) |



BASE OF Q604
Insert + 10 mV signal through
499 kΩ resistor to pin 13 on A6
Sweep = 5 ms/cm
Vertical = 5 V/cm
AC coupled
no probe required

Table 5-6. Troubleshooting Procedure (Cont'd)

| CHECK | PROCEDURE | ACTION |
|---|---|---|
| (14) | Investigate Q604, C605, (and demodulator), V503 and V504. See Paragraph 5-39 for photochopper check. Check chopper neon voltage. Refer to Figure 5-9 for waveform. See check number (11) for details. | |
| (15) | Investigate Q603 and associated circuit. | |
| (16) | Increase the level of the inserted signal to +0.2 Vdc. Measure the ac signal at the base of Q601. Refer to Figure 5-12 for waveform. | PASSES: Proceed to (17)<br>FAILS: Proceed to (18) |



BASE OF Q601
+.2V signal through 499 kΩ
resistor to pin 13 on A6
Sweep = 5 ms/cm
Vertical = 5 mV/cm
AC coupled
no probe required

Figure 5-12. Base of Q601 (feedback loop open)

Table 5-6. Troubleshooting Procedure (Cont'd)

| CHECK | PROCEDURE | ACTION |
|---|---|---|
| (17) | Investigate Q601 and associated circuit. | |
| (18) | Investigate V501, V502, C601, C602 and R601. See Paragraph 5-39 for photochopper check. Check chopper neon voltage. Refer to Figure 5-9 for waveform. See check number (11) for details. | |
| (19) | Measure the ac signal at the output of impedance converter A2 (negative side of C205). The reading should be approximately 0.96 mV rms. | PASSES: Proceed to (20)<br>FAILS: Proceed to (23) |
| (20) | Measure the ac signal at the input to video amplifier A4 positive side of C402. The reading should be approximately 0.96 mV rms. | PASSES: Proceed to (21)<br>FAILS: Proceed to (28) |
| (21) | Measure the ac signal at the base of Q404. The reading should be approximately 155 mV rms. | PASSES: Proceed to (22)<br>FAILS: Proceed to (25) |

Table 5-6. Troubleshooting Procedure (Cont'd)

| CHECK | PROCEDURE | ACTION |
|---|---|---|
| (22) | Measure the ac signal at the negative side of C427. The reading should be approximately 32 mV rms. | PASSES: Proceed to (23)<br>FAILS: Proceed to (24) |
| (23) | Investigate C413 and C415. | |
| (24) | Investigate Q404, Q405, and Q406 circuit. Also check thermocouples. See Paragraph 5-34 for thermocouple check. | |
| (25) | Measure the ac signal at emitter of Q402. Reading should be 1.85 mV rms. | PASSES: Proceed to (26)<br>FAILS: Proceed to (27) |
| (26) | Investigate Q401 and Q402 circuit. | |
| (27) | Investigate Q403 circuit. | |
| (28) | Investigate second attenuator circuit A3. | |
| (29) | Measure the ac signal at the input to the impedance converter pin 7 on A2 board. The reading should be approximately 1 mV rms. | PASSES: Proceed to (30)<br>FAILS: Proceed to (31) |
| (30) | Investigate the impedance converter or power supply. See Table 5-4 for specifications on power supply. | |
| (31) | Investigate the input attenuator A1. | |

d. Remove leads of 412A, connected in step b, and connect 412A between sliver-colored lead on R4 (CAL pot on chassis) and pin 14 on A6 socket (this step checks the resistance of heater in TC402. 412A should indicate between 76.5 to 103.5 ohms.

e. Leave 412A connected as in step d (412A is used to supply 5 mA of current to heater of TC402 in this step). Note indication on DC Voltmeter connected between pins 11 and 13 on A6 socket. Indication should be negative with respect to reading in step c and within 1 mV of that reading.

f. Remove the DC Voltmeter and 412A from 3400A. Connect the 412A between pins 11 and 14 on A6 socket (this steps checks for thermocouples shorted to ground through cover. Indication of 412A should be greater than 200 kΩ. If less than 200 kΩ, look for short to ground.

5-37. THERMOCOUPLE REPLACEMENT.

CAUTION

EXERCISE EXTREME CARE WHEN REMOVING OR REPLACING THE AMPLIFIER PRINTED CIRCUIT

5-38. Should a thermocouple be defective, it is necessary to replace both as a matched pair (see Section VII, Table of Replaceable Parts) for part number. To replace thermocouples, perform the following steps:

a. Turn instrument power off and remove right-side (INPUT side) and top covers.

b. Remove the four lead connection to the A4 amplifier board.

1. Black coaxial cable (two leads)
2. Violet lead
3. White lead/blue lead.

c. Remove the three mounting screws on the amplifier board.

d. Gently pull bottom of board out at the same time relieving stress on thermocouple cable until the board will drop down and the top will clear main frame. Carefully fold board down to expose the four nuts holding the thermocouple shield.

e. Remove four shield nuts; lift shield off. Remove thermocouples, noting orientation.

f. Leads on new thermocouples must be shaped before inserting into PC board. During the

g. Place the red dots on the thermocouples face down on the A4 Video Amplifier Board. If one of the thermocouples has an additional colored dot place it in the TC402 position.

h. Carefully insert new thermocouple leads and solder.

i. Reverse steps e, d, c, b. Note: the violet lead goes to the lower of the two top connectors on the A4 board.

j. After thermocouple replacements perform a complete adjustment and calibration procedure as outlined in Paragraph 5-15.

5-39. CHECKING PHOTOCHOPPER ASSEMBLY A5.

NOTE

The following procedure should also be performed after replacing a neon subassembly to verify proper position of neons.

5-40. The following procedure verifies proper operation of the Photochopper Assembly. If the Photochopper fails any of the tests below replace the entire Photochopper Assembly (-hp- Part No. 1990-0223) or the neon subassembly (-hp- Part No. 1990-0224) according to procedures outlined in Paragraph 5-41. See Figure 5-9 to check operation of the neons. To check the photochopper assembly proceed as follows:

a. Remove the Chopper Amplifier board A6.

b. Lift the following component leads from the A6 board.

Negative side of C601
Positive side of C605
Negative side of C606
Base of Q605

c. Place the A6 board on a programmable extender board (-hp- Part No. 5060-6038). Remove pin 13 lead on extender board closest to the A6 board.

d. Place a 1 $\mu$F capacitor (-hp- Part No. 0180-0269) across the input leads of an ohmmeter (note the polarity of capacitor and ohmmeter leads).

e. Connect the ohmmeter between pin 13 and ground.

f. Turn on the 3400A. The ohmmeter should indicate > 10 k$\Omega$ (this checks the dynamic series resistance of the modulator).

g. Turn off the 3400A, and disconnect ohmmeter.

h. Ground pin 13 on A6 board. Connect ohmmeter between ground and junction of V501 and V502.

i. Turn on the 3400A. The ohmmeter should indicate < 7 k$\Omega$ (this checks the dynamic parallel resistance of modulator).

j. Turn off the 3400A. Disconnect all connections made in step h.

k. Connect ohmmeter between ground and V503 lead going to base of Q605.

l. Turn on the 3400A. The ohmmeter should indicate > 10 k$\Omega$ (this checks the dynamic series resistance of demodulator).

m. Turn off the 3400A. Disconnect ohmmeter.

n. Ground V503 lead going to base of Q605 and connect ohmmeter between ground and the junction of V503 and V504.

o. Turn on the 3400A. The ohmmeter should indicate < 10 k$\Omega$ (this checks the dynamic parallel resistance of demodulator).

p. Turn off the 3400A. Disconnect ohmmeter and reconnect all component leads disconnected in step b.

q. Replace chopper amplifier board.

5-41. REPLACEMENT OF NEON SUBASSEMBLY -hp- PART NO. 1990-0224.

5-42. To replace neon subassembly, proceed as follows:

a. Remove chopper amplifier assembly (A6).

b. Disconnect the photochopper cable at pins 2, 3, 4, and 5 on PC board.

c. Remove two phillips head screws on top cover of the photochopper block.

NOTE

Note the orientation of neon subassembly. The neon subassembly does not lie flat but at an angle within the photochopper block.

d. Remove the neon subassembly.

NOTE

Clean the neon lamps with a tissue to remove finger prints before inserting new neon subassembly in photochopper block.

e. With a new neon subassembly, feed the cable through the hole in the PC board. Place the new neon subassembly into photochopper block in the same orientation as the old neon subassembly.

f. Replace the top cover and two phillips head screws in photochopper block.

g. Reconnect the cable to pins 2, 3, 4 and 5. The larger black lead in the cable connects to pin 2. Other leads identifications are as follows:

White lead to pin 3
Green and red lead to pin 4
Thin black lead to pin 5.

h. Replace chopper amplifier board.

## 5-43. SERVICING ETCHED CIRCUIT BOARDS.

5-44. The -hp- Model 3400A has five etched circuit boards. Use caution when removing them to avoid damaging mounted components. The assembly and -hp- Part No. are silk screened on the interior of the circuit board to identify it. Refer to Section VII for parts replacement and -hp- part number information.

5-45. The etched circuit boards are a plated-through type. The electrical connection between sides of the board is made by a layer of metal plated through the component holes. When working on these boards, observe the following general rules:

a. Use a low-heat (25 to 50 watts) small-tip soldering iron and a small diameter rosin core solder.

b. Circuit components can be removed by placing the soldering iron on the component lead on either side of the board and pulling upon lead. If a component is obviously damaged, clip leads as close to component as possible and then remove. Excess heat can cause the circuit and board to separate or cause damage to the component.

c. Component lead hole should be cleaned before inserting new lead.

d. To replace components, shape new leads and insert them in holes. Reheat with iron and add solder as required to insure a good electrical connection.

e. Clean excess flux from the connection and adjoining area.

CAUTION

WATER, COMMERCIAL CLEANERS, OR DETERGENTS WILL CAUSE PERMANENT DAMAGE TO PHOTOCHOPPER ASSEMBLY A5.

f. To avoid surface contamination of the printed circuit, clean with weak solution of warm water and mild detergent after repair. Rinse thoroughly with clean water. When completely dry, spray lightly with Krylon (#1302 or equivalent).

Table 5-7. Factory Selected Components

| DESIGNATOR | FUNCTION | VALUE | | |
|---|---|---|---|---|
| | | LOW | NORMAL | HIGH |
| C205 | Adjust low frequency (10 Hz) response. | --- | 100 μF (selected) | --- |
| C302 | Adjust high frequency (10 MHz) of Second Attenuator on 0.001 V and 1 V ranges. | 5 pF | 12 pF | 15 pF |
| C304 | Adjust high frequency (3 MHz to 10 MHz) of Second Attenuator on 0.3 V and 300 V ranges. | --- | 24 pF | 39 pF |
| C305 | Adjust high frequency (10 MHz) of Second Attenuator on 0.01 V and 10 V ranges. | --- | 5 pF | 12 pF |
| C427 | See NOTE on schematic. | --- | 200 μF (selected) | --- |
| R3 | Adjust the range of R4 (CAL). | 820 Ω | 1200 Ω | 2.16 kΩ |
| R8 | Adjust the range of R7 (1/10 SCALE ADJ). | --- | 390 Ω (selected) | --- |
| R419 | Adjust voltage at collector of Q406 (no signal input, 1.5 to 2.5 Vdc). | 270 | 300 | --- |