Errata

Title & Document Type: 3440A Digital Voltmeter Operating and Service Manual

Manual Part Number: 03440-90005

Revision Date: July 1970

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

-hp- Part No. 03440-90005

MODEL 3440A
DIGITAL VOLTMETER

Serials Prefixed: 981-
Appendix C, Manual Backdating Changes,
adapts manual to lower serial prefix numbers.

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P. O. Box 301, Loveland, Colorado, 80537 U.S.A

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Figure 1-1. Model 3440A Digital Voltmeter

Table 1-1a. Specifications (Basic Unit)

*Available Plug-in Units:
Model 3441A Range Selector
Model 3442A Automatic Range Selector
Model 3443A High Gain/Auto Range
Model 3444A DC Multi-Function Unit
Model 3445A AC/DC Range Unit
Model 3446A AC/DC Remote Unit

+3440A requires a plug-in to operate.

Sample Rate: 5 samples per second to 1 per 5 seconds with storage during samples and "Hold.
In "Hold," a sample may be initiated by applying a +10 volt pulse 20 μs wide or greater (ac coupled), or by contact closure.

DC Isolation: Signal common may be floated up to 500 volts dc from chassis ground.

BCD Output:
Output: 4-line BCD* (1-2-2-4) 6 columns consisting of 4 digits of data, polarity/function and decimal.
*4-line BCD (1-2-4-8) available on special order.

Impedance: 120K maximum, each line.
"0" state level: -24 volts.
"1" state level: -1 volt.

Reference Levels:
Positive: approximately -2.5 volts, 330 ohms

source impedance.
Negative: approximately -27 volts, 920 ohms
source impedance.

Print Command: Generated internally, hold-off level 12 vdc. Print level -2 vdc from 100 ohm source.

Hold-off Requirements: Anywhere from +6 volts to +15 volts max. from source impedance less than 2000 ohms. (Provided by -hp- 562A Digital Recorder.)

Power: 115 or 230 volts ±10%, 50 to 1000 Hz 20-30 watts depending on plug-in used.

Weight: Net, 18 lbs. (8 kg.); Shipping, 29 lbs. (13 kg.).

Dimensions: 16-3/4" wide, 5-7/32" high, 13-1/4" deep (426 x 133 x 337 mm).

Accessories Available:
K01-3440A Plug-in Extender.
J74-562A/AR Digital Recorder for use with -hp- 3440A accepting 1-2-2-4 BCD code. (Floating Operation) Includes special printwheel, 6 BCD column boards, input connector assembly with cable.
J75-562A/AR, same as J74-562A/AR except for single character function symbol.

Table 1-1b. Specifications (with -hp- Model 3441A Plug-in Unit)

Voltage Range: 4-digit presentation of 9.999, 99.99, and 999.9 volts full scale with 5% overrange capability and overrange indication.

Voltage Accuracy: ±0.05% of reading ±1 digit including line voltage variations of ±10% from nominal. A front panel adjustment on the 3440A insures accuracy over the temperature range between +15°C and +40°C and ±0.1% ±1 digit over the temperature range of 0°C to 15°C and 40°C to 50°C.

Voltmeter Input Impedance: Constant 10.2 meghms (to dc) all ranges.

Input Filter AC Rejection: 10, 100, and 1000 volt ranges: 30 db at 60 Hz, increasing at 12 db/ octave.

Input Filter Characteristics:
Response Time: Less than 450 msec to a step function to 99.95% of final value.

Common Mode Rejection:

<table>
<thead>
<tr>
<th>DC</th>
<th>10V Range</th>
<th>100V Range</th>
<th>1000V Range</th>
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<tbody>
<tr>
<td>60-</td>
<td>90 db</td>
<td>70 db</td>
<td>50 db</td>
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</table>

Polarity: Automatic indication.
SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The hp- Model 3440A Digital Voltmeter displays positive or negative dc voltages to four significant figures from 0.001 volt to 1050.0 volts. A Plug-in unit must be installed in the front panel compartment of the Model 3440A for measurements. Six Plug-in units are presently available for use with the Model 3440A.

1-3. INSTRUMENT DESCRIPTION.

1-4. The Model 3440A Digital Voltmeter is designed to measure dc voltages from 1 millivolt to 1000 volts with an accuracy of ±0.05% ±1 count for operating temperatures between +15°C and +40°C. Accuracy is maintained for overrange voltages of 5% on all ranges, and polarity is automatically indicated. The last completed measurement is displayed until a new measurement cycle is completed. This display storage feature prevents flickering of the readout during the measurement cycle. Measurement sampling time is controlled by the front panel SAMPLE RATE control. Selection of range is controlled by the RANGE switch on the Plug-in unit (see Paragraph 1-6). Mode of operation is also controlled by Plug-in controls.

1-5. Solid state components in the Model 3440A reduce the power consumption and internal heat dissipation, and increase instrument ruggedness. Nearly all circuit components are mounted on plug-in etched circuit boards, allowing easier access for maintenance.

1-6. PLUG-IN UNITS.

1-7. A Plug-in unit is necessary for operation and is an integral part of the voltmeter circuit. Available Plug-ins are listed below. Table 1-2 is a comparison chart of the various Plug-ins.

   a. hp- Model 3441A Range Selector provides manual selection of 10, 100 and 1000 volt range.

   b. hp- Model 3442A Automatic Range Selector provides manual, automatic and remote selection of 10, 100 and 1000 volt range.

   c. hp- Model 3443A High Gain/Auto Range Unit provides manual, automatic and remote selection of 100 and 1000 millivolt; 10, 100 and 1000 volt ranges.

   d. hp- Model 3444A DC Multi-Function Unit provides a manual ranging dc voltmeter, dc milliammeter and ohmmeter. Five ranges are provided for each function. (Full scale voltage ranges from 100 millivolts to 1000 volts; full scale current ranges from 100 microamperes to 1000 milliamperes; and full scale resistance ranges from 1000 ohms to 10 meg-ohms.

   e. hp- Model 3445A AC/DC Range Unit provides manual, automatic, and remote selection of 10, 100, and 1000 volt ranges for both ac and dc voltages.

   f. hp- Model 3446A AC/DC Remote Unit provides ac and dc measurements of 10 v, 100 v, and 1000 v full scale. Both range and function may be selected either manually or remotely.

1-9. INSTRUMENT AND MANUAL IDENTIFICATION.

1-10. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define differences between your instrument and the Model 3440A described in this manual.

1-11. If the first three digits of the serial number are prefixed with an E or a G, your instrument was produced in Europe. An E000-00000 serial number indicates that the instrument was manufactured in England; a G000-00000 serial number indicates that the instrument was manufactured in Germany.

Table 1-2. Plug-in Function Chart

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<th>DC VOLTS 1000V TO 1000V</th>
<th>DC VOLTS 100MV TO 1000V</th>
<th>DC AMPS</th>
<th>OHMS</th>
<th>REMOTE FUNCTION</th>
<th>AUTO RANGING</th>
<th>FLOATING INPUT</th>
<th>PRINTER OUTPUT</th>
<th>REMOTE RANGING</th>
<th>REMOTE TRIGGERING</th>
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* TRUE RMS VOLTAGE MEASUREMENTS: 1MV TO 300VOLTS (10CPM TO 10MC) USING THE &3400A.
SECTION II
INSTALLATION

2-1. INCOMING INSPECTION.

2-2. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument using the procedure outlined in Paragraph 5-3. If there is damage or a deficiency, see the warranty on the inside front cover of this manual.

2-3. INSTALLATION.

2-4. Once the Plug-in unit has been installed in the Model 3440A, the instrument is ready for operation. Connect the power cable supplied with the instrument and check for proper power source and power cable requirements.

NOTE

If the Model 3443A High Gain/Auto Range Unit or the Model 3445A AC/DC Range Unit is used as a Plug-in and your Model 3440A has a serial number below 415-00726, make the modification given in Paragraph 5-67. If your Model 3440A has a serial number below 347-00301, make the modification shown in Paragraph 5-70.

2-5. POWER SOURCE REQUIREMENTS.

2-6. The Model 3440A can be operated from a 115 or 230 volt, 50 to 1000 Hz ac source. Primary power requirements are set by the rear panel LINE VOLTAGE switch. Before plugging the Model 3440A into the power source, check that the designation on the two position LINE VOLTAGE switch matches the line voltage of your power source. The ac line fuse should be a 0.6 ampere, slow-blow type for both 115 and 230 volt modes of operation.

2-7. THREE-CONDUCTOR POWER CABLE.

2-8. To protect operating personnel, National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. The -hp- Model 3440A is equipped with a detachable three-conductor power cable, which, when plugged into the proper receptacle, grounds the instrument. The round, offset pin on the power cable connector is the ground connection. To retain the protection feature when operating the instrument from a two-conductor outlet, use a three-conductor to two-conductor adapter and connect the adapter wire to a suitable ground.

2-9. RACK AND BENCH CONSIDERATIONS.

2-10. The Model 3440A Digital Voltmeter is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument. However, the Hewlett-Packard modular instrument enclosure system enables easy conversion from bench to rack model and vice versa. Instructions for the conversion are included with a kit shipped with the instrument and which includes the conversion hardware. The rack mount for the voltmeter is an EIA standard width of 19 inches. When rack mounted in a rack using mounting flanges, additional support at the rear of the instrument should be provided if vibration or similar stress is likely.

2-11. REPACKAGING FOR SHIPMENT.

2-12. The following is a general rule for repackaging an instrument for shipment. If you have any questions, contact your local -hp- Sales and Service Office (see lists in Appendix B for locations).

NOTE

If instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number and serial number prefix.

a. Place instrument in original container if available. If original container is not available, a suitable container can be purchased from your nearest -hp- Sales and Service Office.

If original container is not used,

b. Wrap instrument in heavy paper or plastic before placing in an inner container.

c. Use plenty of packing material around all sides of instrument and protect panel faces with cardboard strips.

d. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

e. Mark shipping container with "Delicate Instrument," "Fragile" etc.
1. **SAMPLE RATE Control and Indicator**: Control varies the voltmeter sampling rate from 5 samples per second to 1 sample every 5 seconds. Stops sampling when placed in HOLD position. Indicator flashes once for each sample.

2. **LINE Switch**: Applies primary power to the instrument.

3. **INPUT**: Input voltage is applied between the High (red) and Common (green) terminals. A shorting bar provided with the instrument allows the input signal to be referenced to chassis ground when connected between the instrument Common (green) and chassis ground (black) terminals.

4. **INT CHECK 8000 Pushbutton**: Applies -8.000 volts to the input circuits for calibration.

5. **INT CHECK 8000 Screwdriver Adjust**: Adjusts Model 3440A for -8.000 display when INT CHECK 8000 is depressed.

6. **Illuminated Readout Display**: Indicates voltage magnitude.

7. **Mode Indicator**: Indicates instrument measurement units (V or MV) and OVERRANGE.

8. **Polarity Indicator**: Indicates input voltage polarity.

9. **Plug-in Unit**: Completes Model 3440A circuits and provides range and mode of operation selection.

10. **Plug-in Unit Locking Screw**: Locks Plug-in unit in place.

11. **Plug-in Unit RANGE Switch**: Selects full scale input. Controls decimal point and mode indicator.

12. **DIGITAL RECORDER**: Supplies displayed voltage in binary coded decimal form to a Digital Recorder providing a printed record.

13. **REMOTE CONTROL Connector**: Connects remote commands to instrument when a remotely operated plug-in is used. Also connects remote triggers. See Paragraph 3-9.

14. **INPUT**: Connected electrically in parallel with the front panel INPUT connector.

15. **ZERO**: Sets the digital readout on the front panel for a zero indication.

16. **AC POWER**: Connects to the primary power cable supplied with the instrument.

17. **AC VOLTAGE**: Sets the Model 3440A for either 115 or 230 volt operation.

18. **-35 VDC and 115/230 Volt Fuse**: The -35 vdc fuse is a 0.75 amperes fuse; the 115/230 volt fuse is a 0.6 amperes slow-blow fuse.
SECTION III
OPERATING INSTRUCTIONS

3-1. GENERAL.

3-2. The Model 3440A Digital Voltmeter will measure dc voltages to four significant figures. Inputs can be sampled at rates ranging from 5 samples per second to 1 sample per 5 seconds. When used with the appropriate plug-in-unit, range selection can be remotely controlled. The Model 3440A is designed to provide output information to a Digital Recorder. (Refer to plug-in manual for measurements other than dc voltages.)

3-3. FRONT AND REAR PANEL DESCRIPTION.

3-4. A description of front and rear panel controls and indicators is given in Figure 3-1.

3-5. OPERATING INSTRUCTIONS.

3-6. Figure 3-2 shows turn-on procedure. After initial turn-on instructions have been performed, refer to the Plug-in manual for operating instructions.

3-7. OVERRANGE OPERATION.

3-8. The Model 3440A can be operated with input signals 5% overrange with no loss in accuracy giving five-digit resolution at these points. The first significant figure will not be seen under these circumstances. For example, if the 10-volt range is selected and the input voltage is 10.500 volts, the front panel reading would be 0.500 volts and the OVERRANGE light will be lighted.

3-9. REMOTE CONTROL OF SAMPLE RATE AND RANGE SELECTION.

3-10. Sampling can be remotely controlled by placing SAMPLE RATE control in HOLD position: (1) Apply a +10 volt pulse at least 20 microseconds wide to pin 18 of the REMOTE CONTROL connector (J4) on rear panel; or (2) Close a switch between pins 17 and 18 of REMOTE CONTROL connector (J4). Mating connector for J4 is -hp- Part No. 1251-0084. Figure 6-10 shows the remote connections.

3-11. Refer to the Plug-in manual for remote ranging procedure.

3-12. DIGITAL RECORDER OUTPUT.

3-13. The digital recorder output (J2) on the rear panel supplies measurement data, function, polarity and range in a 6 column, 4 line, 1224 weight BCD output. -hp- Specification H02-3440A provides the same information in a 1248 weight BCD output. The first column of the printout indicates measurement function and polarity, columns two through five contain the measurement data, and column six indicates the range. Table 3-1 shows the printouts for each function and range.

Table 3-1. Function and Range Printouts

<table>
<thead>
<tr>
<th>FUNCTION (Col. 1)</th>
<th>PRINTOUT (Col. 2)</th>
<th>RANGE (Col. 3)</th>
<th>PRINTOUT (Col. 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ VOLTS</td>
<td>0</td>
<td>100 μA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 mV</td>
<td></td>
</tr>
<tr>
<td>- VOLTS</td>
<td>1</td>
<td>1000 μA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 mV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 Ω</td>
<td></td>
</tr>
<tr>
<td>+ AMPS</td>
<td>2</td>
<td>10 mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 kΩ</td>
<td></td>
</tr>
<tr>
<td>- AMPS</td>
<td>3</td>
<td>1000 mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 kΩ</td>
<td></td>
</tr>
<tr>
<td>AC VOLTS</td>
<td>4</td>
<td>10000 mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>10000 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10000 kΩ</td>
<td></td>
</tr>
<tr>
<td>OHMS</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVERRANGE</td>
<td>9</td>
<td>10 MΩ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3-14. The -hp- Model 562A Digital Printer is compatible with the Model 3440A, and the 562A-16C Cable Assembly included with the Model 562A mates with the J2 connector. The mating connector for J2 has -hp- Part No. 1251-0086. Figure 6-10 shows the J2 connections.

NOTE

The DIGITAL RECORDER OUTPUT is referenced to the front panel input connector and may be either floating or chassis grounded, depending on shorting bar position.
1. Insert Plug-in unit in the Model 3440A and rotate locking screw fully clockwise.
2. Set Plug-in unit RANGE switch to 10 V.
3. Turn instrument on and adjust SAMPLE RATE control to desired rate.
4. Allow instrument to warm up for approximately 30 minutes.
5. Short INPUT terminals.
6. Set the ZERO adjust on rear panel to obtain zero on all four digital readouts. Optimum adjustment occurs when all digits read zero and polarity is switching between (+) and (-). Remove input short.
7. Depress the INT CHECK 8000 pushbutton and adjust the INT CHECK 8000 Adjust (front panel) for a ~8000 indication on the Model 3440A display. Decimal point position depends on Plug-in RANGE switch, and does not affect this check.
8. Repeat step 7 two hours after turn on and then once every eight hours if instrument is left on continuously. If instrument is turned off after use, repeat entire turn-on procedure each time it is turned on. For optimum accuracy, perform step 7 before making a measurement.

Figure 3-2. Turn On Procedure
Figure 4-1. Simplified Block Diagram
SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

4-2. The measurement technique used in the Model 3440A is a sampling process. During each sample, the input voltage is compared with a very linear internally generated ramp voltage, producing a pulse upon coincidence. The reference (ground) is also compared with the ramp voltage producing another pulse. The time interval between these two pulses is measured and displayed on the front panel readout. Polarity is automatically indicated by the order in which these pulses are generated.

4-3. Refer to Figure 4-1, Simplified Block Diagram, and Figure 4-3, Detailed Block Diagram, for a description of the Model 3440A operation.

4-4. The input signal is applied to the Plug-in unit. Depending on the position of the Plug-in unit function and range switches, this signal is either modified by the Plug-in unit or applied to the Low Pass Filter and Attenuator A1. From the Low Pass Filter and Attenuator, the signal is returned to the Plug-in unit RANGE switch which selects the proper range and applies the signal to the Input Comparator A2. (Refer to Plug-in manual for discussion of the plug-in unit function.)

4-5. The Input Comparator A2 compares the input dc voltage from the plug-in unit with an internally generated ramp voltage. A pulse is produced when the ramp reaches the same level as the input voltage. Another pulse is produced when the ramp passes through zero (ground). These two pulses are applied to the Polarity Sensor and Count Gate A4. The Polarity Sensor lights the proper sign on the front panel display. The Count Gate controls the 400 Kc Synchronized Oscillator A9 and the Decade Counters (A5 - A8). During the time interval between the two comparator pulses, the decade counters count the oscillator pulses and display the total count on the front panel. The last completed count is stored in the display circuits until a new measurement is completed. This storage feature prevents the readout from flickering during the count.

4-6. LOGIC SYMBOLS.

4-7. Some of the circuits in the Model 3440A are explained in terms of logic symbology (AND Gates, OR Gates etc). All the basic information required to understand the logic symbology and circuits discussed in this section is given in Table 4-2.

4-8. The Model 3440A uses positive true logic unless otherwise noted. A zero or false state is approximately -15 to -35 volts (relatively negative). A one or true state is approximately 0 to -2 volts (relatively positive) unless otherwise noted.

4-9. TIMING.

4-10. During each sample, the Model 3440A follows a specific time sequence as shown in Table 4-1.

Table 4-1. Timing Sequence

<table>
<thead>
<tr>
<th>TIME</th>
<th>DESCRIPTION</th>
<th>CIRCUIT ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀ (0 msec)</td>
<td>Reset</td>
<td>Beginning of Sample</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voltage Comparator Reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ramp started</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decade Counters Reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transfer inhibited</td>
</tr>
<tr>
<td>T₁ (4 to 56 msec)</td>
<td>Input Voltage Comparison</td>
<td>Ramp Voltage equal to Input Voltage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Count Gate opened if Input Voltage positive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Count Gate closed if Input Voltage negative</td>
</tr>
<tr>
<td>T₂ (30 msec)</td>
<td>Reference Comparison</td>
<td>Ramp Voltage Zero</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Count Gate opened if Input Voltage negative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Count Gate closed if Input Voltage positive</td>
</tr>
<tr>
<td>T₃ (60 msec)</td>
<td>End of Ramp</td>
<td>End of Ramp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sample Rate Multivibrator reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transfer enabled</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Print Command generated</td>
</tr>
<tr>
<td>T₀ (85 msec)</td>
<td>Recovery</td>
<td>Ramp Capacitor recharged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ready for new sample</td>
</tr>
<tr>
<td>T₀ (200 ms to 5 sec (depends on sample rate setting)</td>
<td>Reset</td>
<td>Beginning of next sample.</td>
</tr>
</tbody>
</table>
### Logic Symbols

- Within a symbol indicates positive true logic
- Within a symbol indicates negative true logic
1 indicates true signal
0 indicates false signal

<table>
<thead>
<tr>
<th>Design</th>
<th>Logic Symbol</th>
<th>Description</th>
<th>Truth Table</th>
<th>Equivalent Circuit</th>
</tr>
</thead>
</table>
| **AND Gate** | ![AND Gate Diagram](image) | Both input signals (A and B) must be true simultaneously to produce a true output at C. | $A | B | C$
|   |   |   | 0 | 0 | 0 |
|   |   |   | 0 | 1 | 0 |
|   |   |   | 1 | 0 | 0 |
|   |   |   | 1 | 1 | 1 |
| **OR Gate** | ![OR Gate Diagram](image) | If either input signal (A or B) or both is true, the output at C is true. (A positive OR Gate is electrically equivalent to a negative AND Gate only when dc Gate is used.) | $A | B | C$
|   |   |   | 0 | 0 | 0 |
|   |   |   | 0 | 1 | 1 |
|   |   |   | 1 | 0 | 1 |
|   |   |   | 1 | 1 | 1 |
| **Exclusive OR Gate** | ![Exclusive OR Gate Diagram](image) | If either input signal (A or B), but not both, is true, the output at C is true. | $A | B | C$
|   |   |   | 0 | 0 | 0 |
|   |   |   | 0 | 1 | 1 |
|   |   |   | 1 | 0 | 1 |
|   |   |   | 1 | 1 | 0 |
| **Multiple Input Gate** | ![Multiple Input Gate Diagram](image) | Any combinations of inputs may be used with an AND or OR Gate to obtain a desired output. In the AND Gate shown, input A is ac coupled, input B is dc coupled and inverted, and input C is dc coupled without inversion. Inputs A and C must both be true, and input B must be false simultaneously to produce a true output at D. | $A | B | C | D$
|   |   |   | 0 | 0 | 0 | 0 |
|   |   |   | 0 | 1 | 0 | 0 |
|   |   |   | 1 | 0 | 0 | 0 |
|   |   |   | 0 | 1 | 0 | 0 |
|   |   |   | 0 | 0 | 0 | 0 |
|   |   |   | 1 | 0 | 1 | 1 |
|   |   |   | 1 | 1 | 0 | 0 |
|   |   |   | 1 | 1 | 1 | 0 |

Table 4-2. Explanation of Logic Symbology
<table>
<thead>
<tr>
<th>Design.</th>
<th>Logic Symbol</th>
<th>LOGIC SYMBOLS</th>
<th>Equivalent Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Delay</td>
<td><img src="image" alt="Symbol" /></td>
<td>Amount of delay depends on RC or RL time const.</td>
<td>RC or RL coupling</td>
</tr>
<tr>
<td>Amplifier</td>
<td><img src="image" alt="Symbol" /></td>
<td>True input at A produces amplified true output at B. An amplifier will function with either positive true or negative true signals.</td>
<td><img src="image" alt="Circuit" /></td>
</tr>
<tr>
<td>Phase Splitter</td>
<td><img src="image" alt="Symbol" /></td>
<td>True input at A produces true output at B and false output at B (read as &quot;B bar&quot; or &quot;B not&quot;).</td>
<td><img src="image" alt="Circuit" /></td>
</tr>
<tr>
<td>Flip-Flop</td>
<td><img src="image" alt="Symbol" /></td>
<td>Outputs C and C̅ are always in opposite states -- if C is true C̅ is false. A true input will cause the output directly across to go true -- true input at A sets output C true. With no input the flip-flop remains in the state set by the last input signal. The flip-flop is considered to be in the zero state if output C is false.</td>
<td><img src="image" alt="Circuit" /></td>
</tr>
<tr>
<td>Binary</td>
<td><img src="image" alt="Symbol" /></td>
<td>The binary is a flip-flop which changes state with every true input pulse at A. Since A is applied to the bases of both transistors, it is shown centered in the symbol. The negative pulse produces the same effect as a positive pulse applied to the opposite base. To preserve the positive logic, the reset pulse is shown inverted and applied to the opposite side.</td>
<td><img src="image" alt="Circuit" /></td>
</tr>
</tbody>
</table>

Table 4-2. Explanation of Logic Symbolology (Cont'd)
4-11. CONTROL CIRCUITS.

4-12. RAMP GENERATOR.

4-13. The Ramp Generator (Figure 4-2) generates a very linear ramp voltage which decreases from +12 volts to -12 volts. The Ramp Generator is started and stopped by the Ramp Gate (A3Q10, 11). When the ramp decreases to -12 volts, the Ramp Sensor generates a pulse to reset the Sample Rate Multivibrator (refer to Paragraph 4-18) and end the sample.

4-14. At time T₀, the Sample Rate Multivibrator output S goes true. This is inverted by the Ramp Gate placing a reverse bias on the anode of A3CR11. The ramp capacitor begins to discharge. A3QCR1A, A3Q15, and A3Q16 form a current amplifier to increase the linearity of the ramp. Transistor A3Q17 acts as a current source to ensure proper bias for breakdown diode A3QCR1B.

4-15. At T₂, the ramp reaches -12 volts, and the Ramp Sensor (A3Q7, 8) applies a positive pulse to the Sample Rate Multivibrator causing S to go false, ending the sample.

4-16. When S is false, the Ramp Gate forward biases A3CR11 recharging the ramp capacitor toward +12 volts. At time T₃, the ramp capacitor is fully charged, and the Model 3440A is ready for another sample.

4-17. Breakdown diode A3QCR1B establishes a second ramp identical in slope, but at a level 6.6 volts more negative than the first ramp. The second ramp helps to provide a constant current to the Input Comparator (refer to Paragraph 4-41).

4-18. SAMPLE RATE MULTIVIBRATOR.

4-19. The Sample Rate Multivibrator (Figure 4-4) controls sampling rate, Ramp Gate, Reset Pulse and Print Command.

4-20. When the Model 3440A is not sampling, the Sample Rate Multivibrator output S (read as "S bar" or "S not") is true. A3C5 then begins to discharge through A3R18, R6, and A3R8. When A3C5 discharges sufficiently, output S goes false. This is time T₀ and a sample is started. At time T₂, the ramp voltage reaches -12 volts; and a positive pulse from the Ramp Sensor causes S to go true, ending the sample.

Figure 4-2. Ramp Generator
SAMPLE RATE control R6 changes the discharge time of A3C5, allowing a variation in sample rate from 5 samples per second to 1 sample per 5 seconds.

4-21. When SAMPLE RATE control is in HOLD position (maximum clockwise), A3C5 is held at a slightly negative voltage by voltage divider A3R20 and A3R21, which keeps output $S$ true, preventing a sample. Under these conditions, applying a positive going pulse to the External Trigger sets $S$ false initiating one sample.

4-22. At time $T_0$, Recovery Amplifier A3Q2 is turned on by $S$, quickly recharging A3C5.

4-23. During a sample, Indicator Driver A3Q1 is turned off by $S$ causing SAMPLE RATE indicator DS8 to light.

4-24. RESET PULSE.

4-25. The negative reset pulse is generated at time $T_0$ by Reset Amplifier A3Q3. The reset pulse is applied to the Plug-in unit, Voltage Comparator A2, Count Gate A4, Decade Counter Assemblies A5 - A8, and Overrange Sensor A4. This negative reset pulse prepares these circuits for the start of the next sample by setting them to the zero state.

4-26. At time $T_0$, A3Q2 is switched to the one state. This positive going transition is differentiated and applied to the Reset Amplifier A3Q3. The differentiated pulse quickly drives A3Q3 into saturation, generating a short duration (20 microseconds) Reset Pulse.

4-27. TRANSFER PULSE.

4-28. The transfer pulse is used to transfer the count contained in the Decade Counters (A5 - A8) to the front panel display. This transfer is accomplished at time $T_2$ after the decade counters have completed the count. This prevents flickering of the front panel display.

4-29. At time $T_2$, Sample Rate Multivibrator output $S$ goes false. This signal is inverted by Ramp Gate (A3Q10, 11) which sets the Transfer Amplifier A3Q12 output false. The data contained in the decade counters is then transferred to the front panel display. At time $T_0$, output $S$ goes true, causing the Ramp Gate to set the Transfer Amplifier output true, preventing the further transfer of data to the front panel display. (Refer to Paragraphs 4-64 through 4-66 for discussion of count storage.)

4-30. PRINT COMMAND.

4-31. At the end of a sample, time $T_2$, the Print Command is generated to actuate a digital recorder. A signal from the Plug-in unit will inhibit this command preventing a printout during an automatic range change (refer to Plug-in manual for description).
4-32. At time $T_2$, Sample Rate Multivibrator output $S$ goes true, and is direct coupled to the Print Command AND Gate. Normally, the Print Inhibit line from the Plug-in is in the one state allowing the level from $S$ through AND Gate. This pulse is amplified by A3Q18 producing the Print Command. If the Plug-in is automatically changing range, the Print Inhibit line is in the zero state preventing the Print Command.

4-33. INPUT CIRCUITRY.

4-34. This section will discuss only the 10, 100 and 1000 volt dc ranges. For discussion of other ranges and functions, refer to the appropriate Plug-in manual.

4-35. LOW PASS FILTER AND ATTENUATOR.

4-36. The input signal is sent through the Plug-in unit to the Low Pass Filter and Input Attenuator A1. The Input Attenuator resistance and capacitance along with Input Comparator A2 capacitance form an RC filter which rejects ac voltages 30 db or more at 60 Hz. The three attenuator outputs (one for each of the three ranges – 10, 100, and 1000 volts) are returned to the RANGE switch in the Plug-in unit, which selects the proper amount of attenuation and Model 3440A decimal point position. The attenuated voltage is applied to the voltage comparator A2.

4-37. INTERNAL CALIBRATION.

4-38. The reference 8000 circuit provides an accurate reference for internal calibration of the Model 3440A. This calibration voltage is supplied from breakdown diode A3CR14 through a precision voltage divider to the INT CHECK 8000 pushbutton switch S3. When this switch is depressed, ~8.000 volts is applied to the Input Comparator A2, and the INT CHECK 8000 Adjust R3 (in Ramp Generator) is adjusted for a front panel display of ~8000 to insure that the Model 3440A is within specifications.

--- NOTE ---

Plug-in controls do not affect this check.

4-39. VOLTAGE COMPARATORS.

4-40. INPUT COMPARATOR.

4-41. The Input Comparator (see Figure 4-5) compares the input dc voltage from the plug-in unit with the ramp voltage. Prior to coincidence of the ramp voltage and the input, the ramp voltage is more positive than the input voltage. Under this condition, A2CR7 is reverse biased and a constant current is flowing through A2CR5A. A2CR5B is reverse biased until the ramp voltage decreases enough to forward bias it. Current is then drawn from A2C4. This current pulse is amplified and used to trigger the input flip-flop to the 1 state. I becomes false and A2Q9 saturates and reverse biases both A2CR5A and A2CR5B so that no more current will be drawn from the input.

4-42. CHARGE RESTORER.

4-43. When the ramp voltage and the input voltage reach coincidence, some charge is removed from A2C4. The Charge Restorer circuit (see Figure 4-6) is designed to replace this removed charge. This keeps the comparator circuit from loading the attenuator network.

---

Figure 4-5. Input Comparator

01765-2

4-7
Figure 4-6. Charge Restorer

4-44. During the time interval between \( T_0 \) and \( T_1 \), A2Q9 is cut off; A2CR17 and A2CR15 are biased on. Diodes A2CR10 and A2CR16 are both reverse biased. A2C18 charges through resistor A2R31 so that its voltage decreases with the ramp voltage and is nearly equal to the ramp voltage. A2C17 charges to a voltage nearly equal to the voltage across A2R39 and that part of A2R40 which is to the left of the wiper.

4-45. At \( T_1 \), when coincidence occurs, A2Q9 saturates; A2CR17 and A2CR15 are reverse biased and A2CR16 is forward biased. The right side of A2C17 is clamped to the voltage across A2C18 which is nearly equal to the input voltage. The charge on A2C17 flows through A2CR10 to replace the charge which was removed from A2C4.

4-46. The amount of charge restored to the input is slightly dependent on the input level due to stray capacitance from the left side of A2C17 to ground. A2R30 compensates for the effects of this stray capacitance by reducing the charge on A2C17 as the ramp voltage becomes more negative.

4-47. GROUND COMPARATOR.

4-48. The ground comparator (Figure 4-7) compares the ramp voltage to the circuit ground potential and generates a pulse at coincidence. The ramp voltage forward biases A2CR27A, keeping A2CR27B reverse biased. As the ramp voltage goes more negative than ground level, A2CR7B starts to conduct. This current is mostly supplied by capacitor A2C26 and is amplified by the ground amplifier. The amplifier signal triggers the Ground Flip-Flop into the G state. The change to the G state forward biases A2CR28 preventing either A2CR27A or A2CR27B from conducting for the remainder of the measurement cycle.

4-49. COUNTING AND READOUT CIRCUITS.

4-50. GATING.

4-51. The gating circuits have three functions:
   a. Control the Synchronized Oscillator by turning it on with the first comparator coincidence pulse, and turning it off with the second.
   b. Control the count enable gate to operate the units decade counter.
   c. Supply pulses used in the ranging logic of the automatic ranging plug-in units. (See Plug-in manual for a discussion of ranging.)

4-52. At time \( T_0 \), the reset pulse is applied to the count gate to insure it is in the zero state.

4-53. The first comparator pulse is applied to the OR Gate (Figure 4-8) and sets the count gate to the K state. The true K output enables the units decade counter, and the false K output starts the Synchronized Oscillator.

4-54. The second comparator pulse enables the AND Gate, and resets the count gate to the \( \overline{K} \) state. The true \( \overline{K} \) output turns off the Synchronized Oscillator, and the false K output disables the units decade counter.
4-55. SYNCHRONIZED OSCILLATOR.

4-56. The Synchronized Oscillator (A9Q5) is a grounded base Colpitts Oscillator with an emitter follower output (A9Q6). The false output from the \( K \) side of the count gate saturates the oscillator gate (A9Q4) and enables the oscillator circuit. \( K \) goes true with the second comparator pulse, and the Synchronized Oscillator is disabled.

4-57. With A9Q4 shut off, initial charges are set up on the oscillator capacitors so that oscillations always start at the same point on the waveform and at approximately full amplitude. By controlling the starting point of the oscillator, a ±1 count ambiguity at the start of the count is eliminated.

4-58. The Schmitt Trigger (A9Q7 thru A9Q8) is a regenerative bistable circuit whose state is dependent on the input amplitude. It converts the oscillator output to pulses with a fast rise time. The output pulses are counted by the decade counters (A5 thru A8).
4-59. DECADE COUNTERS.

4-60. The decade counters (A5 thru A8) count the pulses from the Synchronized Oscillator, and the final count is displayed on the front panel.

4-61. Four binaries are connected as shown in Figure 4-9 to make a decade counter. Binary A will change state with each input pulse. Binaries B thru D will follow the switching sequence in Table 4-3. Each input pulse will produce a unique combination of outputs. There are ten possible combinations and each one represents a decimal digit.

4-62. A true binary represents a certain number (A = 1, B = 2, C = 3, D = 4), and a false binary represents zero. The decimal digit is the sum of the binary values. For example: If D and A are true and B and C are false, the digit represented is $4 + 0 + 0 + 1 = 5$. Binary coded decimals are usually written with the least significant digit on the right (DCBA). (For clarity in showing signal flow, the binaries are shown in ABDC order.)

4-63. Table 4-3 shows the counting sequence. The arrow in each block shows the direction the binary has switched. Initially each binary is set to the zero state by the reset pulse (DCBA = 0000). The following action takes place when a series of pulses is applied to the counter:

a. The first pulse switches A to the "1" state. (DCBA = 0001 = 1.)

b. The second pulse switches A to the "0" state, and the output from A switches B to the "1" state. (DCBA = 0010 = 2.)

c. The third pulse switches A to the "1" state. (DCBA = 0011 = 3.)

d. The fourth pulse switches A to the "0" state; the output from A changes B to the "0" state; the output from B changes D and C to the "1" state. The resulting signal from C is applied to D and D to return B to the "1" state and D to the "0" state. Although D is connected to C, no switching occurs at C because C has not recovered from its recent switching. (DCBA = 0110 = 4.)

e. The fifth pulse switches A to the "1" state. (DCBA = 0111 = 5.)

f. The sixth pulse switches A to the "0" state; the output from A switches B to the "0" state; the output from B switches D to the "1" state. (DCBA = 1100 = 6.)

g. The seventh pulse switches A to the "1" state. (DCBA = 1101 = 7.)

h. The eighth pulse switches A to the "0" state; the output from A switches B to the "1" state. (DCBA = 1110 = 8.)

i. The ninth pulse switches A to the "1" state. (DCBA = 1111 = 9.)

---

Figure 4-9. Decade Counter

* DELAY IS INHERENT IN CIRCUIT.

MAIN SIGNAL PATH.

FEEDBACK PATH.
Table 4-3. Counting Sequence of Decade Counter

<table>
<thead>
<tr>
<th>DECIMAL COUNT</th>
<th>COUNTER STATE (■ CONDUCTION)</th>
<th>4-LINE CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WEIGHTING</td>
<td>D</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
4-64. DIGITAL STORAGE AND DISPLAY.

4-65. The binary coded outputs of the counters control neon lamps. The lamps activate a photocoupler matrix which is connected to the display tube. A lighted photocoupler element has a resistance of about 20,000 ohms, and an unlighted element has a resistance of several megohms. Each binary coded decimal output yields a unique low resistance path through the matrix. There are ten such paths, and each is connected to a digit in the display tube.

4-66. Two lamps are connected to each binary, one to each collector. The lamp in the conducting collector is lit, and the one in the non-conducting collector is extinguished (see Figure 4-10A). Ordinarily, the lamps would reverse every time the binary switched, and the readout would flicker during the counting and resetting process. However, two diodes are connected between the lamps so that the lamps can only change state when the diodes are properly biased (see Figure 4-10B). This prevents flickering in the readout.

4-67. First consider the circuit without the diodes connected (Figure 4-10A-1). Lamp A is lighted, and lamp A is dark. Since transistor A is not conducting, the voltage across lamp A is established by both the circuit of conducting lamp A and the collector voltage of transistor A. This voltage is typically 38 v, much lower than the lamp's firing potential of 70 v. So lamp A cannot fire.

4-68. When the binary changes state, the transistor A collector voltage drops to -1 volts, and the collector of transistor A rises to -30 volts. With transistor A cut off, the voltage at the junction of the two lamps increases to about 70 volts and lamp A fires. Lamp A has -30 volts on one side and -70 volts on the other, and is extinguished.

4-69. When the diodes are connected as shown in Figure 4-10B-1, the switching of the lamps can be stopped. With -1 volt applied, both diodes are forward biased, clamping the bottom side of both neon at -1 volt. The voltage across the extinguished neon is now held at the sustaining voltage of the lighted neon, and the lamps cannot change state.

4-70. At T2, the -30 volt transfer pulse is applied to the diodes, reverse biasing them. The diodes are now effectively removed from the circuit and the lamps change to the state of the binary. At T0, the transfer pulse is removed, and the lamps remain in that state until a new reading is transferred.

4-71. POLARITY SENSOR.

4-72. Both true Voltage Comparator pulses (I and G) are applied to the Polarity Sensor A4Q6. 7. This flip-flop remains in the state set by the last of these two pulses. At time T2, the transfer pulse goes false allowing the proper sign to light on the front panel display. (Refer to Paragraphs 4-64 through 4-66 for discussion of storage.)

4-73. OVERRANGE SENSOR.

4-74. The Overrange Sensor (A4Q8, A4Q9) is a flip-flop whose true output lights the overrange indicator. If the voltage to the Input Comparator exceeds 9.999 volts, the thousands decade counter will generate an overflow pulse, setting the overrange flip-flop to the true state. At T0, the overrange flip-flop is switched to the false state by the reset pulse.

4-75. DIGITAL RECORDER.

4-76. BCD information is supplied to the rear panel DIGITAL RECORDER jack from each binary. Range and function information is also supplied to this jack in BCD form by the Plug-in (refer to Plug-in manual for description). At time T2, the Model 3440A generates a Print Command to actuate the Digital Recorder, printing the data obtained during the last sample (refer to Paragraphs 4-30 through 4-32 for discussion of the Print Command).

4-77. POWER SUPPLY.

4-78. PRIMARY POWER.

4-79. Either 115 or 230 volt ac power is connected through fuse F1 (0.6 amp slow-blow) and switch S2 (or SAMPLE RATE control) to the primary of power transformer T1. Switch S6 connects S1 primaries in parallel for 115 volt operation or in series for 230 volt operation.

4-80. UNREGULATED POWER SUPPLIES.

4-81. Full wave rectifier A9CR6 - 9 produces -150 volts and +150 volts for driving neon lamps and digit display tubes.

4-82. REGULATED POWER SUPPLIES.

4-83. Full wave rectifier A9CR1 - 4 produces +12 volts which is shunt regulated by breakdown diode A9CR12.

4-84. Full wave rectifier A9CR1 - 4 also provides -35 volts which is series regulated by transistor Q1. Breakdown diode A9CR11 provides a reference voltage to the control amplifier A9Q1. 2. The -35 volt supply is adjusted by A9R12. F2, the -35 volt fuse, provides protection for the supply.
Figure 4-10. Lamp Control
Table 5-1. Recommended Test Equipment

<table>
<thead>
<tr>
<th>INSTRUMENT TYPE</th>
<th>REQUIRED CHARACTERISTICS</th>
<th>USE</th>
<th>RECOMMENDED MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Standard</td>
<td>Voltage Range: 0 - 1000 volts</td>
<td>Performance Checks</td>
<td>-hp- Model 749B</td>
</tr>
<tr>
<td></td>
<td>Accuracy: ±0.01% of reading</td>
<td>Adjustment</td>
<td></td>
</tr>
<tr>
<td>Digital Recorder</td>
<td>6-column print; 1-2-2-4 BCD</td>
<td>Performance Checks</td>
<td>-hp- Model 562A</td>
</tr>
<tr>
<td></td>
<td>Print Rate: 5 lines/second</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse Generator</td>
<td>Pulse Width: 20 μsec</td>
<td>Performance Checks</td>
<td>-hp- Model 214A</td>
</tr>
<tr>
<td></td>
<td>Amplitude: +10 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repetition Rate: Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wide Range Oscillator</td>
<td>Frequency: 60 cps</td>
<td>Performance Checks</td>
<td>-hp- Model 200CD</td>
</tr>
<tr>
<td></td>
<td>Amplitude: 1 volt p-p</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Voltmeter</td>
<td>Voltage Range: 0 - 10 volts</td>
<td>Performance Checks</td>
<td>-hp- Model 427A</td>
</tr>
<tr>
<td></td>
<td>Accuracy: ±2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Voltmeter</td>
<td>Voltage Range: 0 - 100 volts</td>
<td>Adjustment</td>
<td>-hp- Model 412A</td>
</tr>
<tr>
<td></td>
<td>Accuracy: ±1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Input Impedance: &gt;10 Megohms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic Counter</td>
<td>Range: to 400 Kc</td>
<td>Adjustment</td>
<td>-hp- Model 5532A</td>
</tr>
<tr>
<td>Transistor Power Supply</td>
<td>0 - 30 vdc; 0 - 15 ma</td>
<td>Troubleshooting</td>
<td>-hp- Model 721A</td>
</tr>
<tr>
<td>Oscilloscope</td>
<td>Bandwidth: Dc - 5 Mc</td>
<td>Troubleshooting</td>
<td>-hp- Model 175A</td>
</tr>
<tr>
<td></td>
<td>Dual Channel Capability: Delayed</td>
<td></td>
<td>-hp- Model 1781B</td>
</tr>
<tr>
<td></td>
<td>Sweep Capability</td>
<td></td>
<td>-hp- Model 1750A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-hp- 1003A 10:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Probe</td>
</tr>
<tr>
<td>Variable Transformer</td>
<td>Output Voltage: 103 to 127 vac (or 207 to 253 vac)</td>
<td>Performance Checks</td>
<td>Superior Electric Co.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjustment</td>
<td>Powerstat</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3PF116 (for 115 v line)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3PF216 (for 230 v line)</td>
</tr>
<tr>
<td>Toggle Switch</td>
<td>Single pole - single throw</td>
<td>Performance Checks</td>
<td>-hp- Part No. 3101-0001</td>
</tr>
<tr>
<td>Resistor</td>
<td>1.0 Megohm, 1/2 watt ±1%</td>
<td>Performance Checks</td>
<td>-hp- Part No. 0727-0276</td>
</tr>
<tr>
<td>15-Pin Extender Board</td>
<td></td>
<td>Troubleshooting</td>
<td>-hp- Part No. 5060-0049</td>
</tr>
<tr>
<td>22-Pin Extender Board</td>
<td></td>
<td>Adjustment</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

5-0
**SECTION V
MAINTENANCE**

5-1. **REQUIRED TEST EQUIPMENT.**

5-2. Recommended test equipment for maintaining and checking performance of the Model 3440A is listed in Table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

5-3. **PERFORMANCE CHECKS.**

5-4. Use the following front and rear panel procedures to verify proper operation of the Model 3440A. The Model 3440A and test equipment should be operated at 115/230 vac unless otherwise specified. If the Model 3440A is found to be out of specifications at any point in this procedure, refer to Paragraph 5-15, Adjustment and Calibration Procedures.

5-5. **CALIBRATION.**

a. Connect the Model 3440A to a variable line transformer as shown in Figure 5-1.

b. Set line voltage switch to 115 or 230 vac, and turn the 3440A on.

c. Allow the 3440A to warm up for at least 1/2 hour.

d. Short the INPUT terminals, and set plug-in RANGE switch to 10 v.

e. Adjust the rear panel ZERO control for a front panel indication of 0.000. Optimum adjustment is indicated by alternate flashing of the (+) and (-) indicators.

f. Remove shorting connection from input.

g. Depress INT CHECK 8000 pushbutton and adjust the INT CHECK 8000 adjustment for an indication of -8.000.

h. Connect a dc standard as shown in Figure 5-1, and set the dc standard output to 1.000 volts. The 3440A indication should be between 0.998 and 1.002.

j. Repeat step h for the values shown in Table 5-2. Then repeat the entire test on the 100 volt and 1000 volt ranges. The values shown in Table 5-2 may be used on the 100 volt test by moving the decimal point 1 or 2 places to the right.

k. Repeat steps h and j with line voltages of 103 and 127 vac (207 and 253 vac).

<table>
<thead>
<tr>
<th>DC STANDARD</th>
<th>MODEL 3440A</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>MAXIMUM</td>
</tr>
<tr>
<td>0.000</td>
<td>-0.001</td>
</tr>
<tr>
<td>1.000</td>
<td>0.998</td>
</tr>
<tr>
<td>2.000</td>
<td>1.998</td>
</tr>
<tr>
<td>3.000</td>
<td>2.997</td>
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<tr>
<td>4.000</td>
<td>3.997</td>
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<tr>
<td>5.000</td>
<td>4.996</td>
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<td>6.000</td>
<td>5.996</td>
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<td>6.995</td>
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<tr>
<td>8.000</td>
<td>7.995</td>
</tr>
<tr>
<td>9.000</td>
<td>8.994</td>
</tr>
<tr>
<td>10.000</td>
<td>9.994</td>
</tr>
</tbody>
</table>

* Indicates OVERRANGE lamp should be lighted.

5-6. **INPUT IMPEDANCE CHECK.**

a. Connect Model 3440A as shown in Figure 5-2.

b. Set RANGE switch on Plug-in to 10 v.

c. Set DC Standard to 10.00 volts.

![Figure 5-1. Calibration](image-url)
d. The Model 3440A readout should indicate between 9.090 and 9.122. This corresponds to an input resistance of 10.0 to 10.4 megohms where:

$$R_{\text{input}} = \left( \frac{E_{\text{displayed}}}{E_{\text{input}} - E_{\text{displayed}}} \right) R_{\text{series}}$$

5-7. EXTERNAL TRIGGER CHECK.

a. Set SAMPLE RATE to HOLD.

b. Connect an SPST toggle switch between pins 17 and 18 of REMOTE CONTROL connector (J4) on rear panel.

c. Observe that SAMPLE RATE indicator flashes each time the switch is closed.

d. Connect Model 3440A as shown in Figure 5-3.

e. Set pulse generator controls for a manually initiated 20 μsec 10 volt pulse.

f. Observe that SAMPLE RATE indicator flashes each time a pulse is initiated from the pulse generator.

5-8. DIGITAL RECORDER CHECK.

a. Connect Model 3440A as shown in Figure 5-4.

**NOTE**

Ensure that both Model 3440A and DC Standard are isolated from power line ground. Disconnect ground link between (+) and (−) terminals.

b. Set SAMPLE RATE to maximum.

c. Set DC Standard for Model 3440A readouts as shown in Table 5-3. Digital Recorder second thru fifth column printouts should correspond.

Table 5-3. Digital Recorder Check

<table>
<thead>
<tr>
<th>3440A DISPLAY</th>
<th>DIGITAL RECORDER PRINTOUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 1.111</td>
<td>011113</td>
</tr>
<tr>
<td>- 2.222</td>
<td>122223</td>
</tr>
<tr>
<td>+ 3.333</td>
<td>033333</td>
</tr>
<tr>
<td>+ 4.444</td>
<td>044443</td>
</tr>
<tr>
<td>+ 5.555</td>
<td>055553</td>
</tr>
<tr>
<td>+ 6.666</td>
<td>066663</td>
</tr>
<tr>
<td>+ 7.777</td>
<td>077773</td>
</tr>
<tr>
<td>+ 8.888</td>
<td>088883</td>
</tr>
<tr>
<td>+ 9.999</td>
<td>099993</td>
</tr>
<tr>
<td>+ 1.000</td>
<td>010000</td>
</tr>
<tr>
<td>+ 10.00</td>
<td>010002</td>
</tr>
<tr>
<td>+100.0</td>
<td>010001</td>
</tr>
<tr>
<td>+00.50*</td>
<td>900502</td>
</tr>
</tbody>
</table>

* Indicates 100.50 volt input; OVERRANGE lighted.

Figure 5-3. External Trigger Check
5-9. DC COMMON MODE REJECTION CHECK.

a. Connect Model 3440A and dc standard as shown in Figure 5-5.

b. Set RANGE to 10 V, and set dc standard output to 100 V.

c. Model 3440A should read less than ±0.003 V.

d. Set RANGE to 100 V.

e. Model 3440A should read less than ±0.03 V.

f. Set RANGE to 1000 V.

g. Model 3440A should read less than ±00.3 V.

5-10. AC COMMON MODE REJECTION CHECK.

a. Connect Model 3440A, ac voltmeter, and test oscillator as shown in Figure 5-6. Set 3440A RANGE to 10 V.

b. Using ac voltmeter as a monitor, set oscillator output to 7.07 V rms at 60 Hz.

c. Model 3440A should read less than ±0.003 V.

d. Set RANGE to 100 V.

e. Model 3440A should read less than ±0.03 V.

f. Set RANGE to 1000 V.

g. Model 3440A should read less than ±00.3 V.
5-11. INPUT FILTER RESPONSE TIME CHECK.

   a. Connect Model 3440A and a digital recorder as shown in Figure 5-4.

   NOTE

   Ensure that both Model 3440A and DC Standard are isolated from power line ground. Disconnect ground link between (\(\text{\(\mathcal{L}\)}\)) and (\(\text{\(\mathcal{R}\)}\)) terminals.

   b. Set the SAMPLE RATE to maximum and set the plug-in RANGE to 1000 volts. Turn the digital recorder on.

   c. The recorder should be printing zeros (000001 or 100001).

   d. Connect a 500 volt input from the DC standard.

   e. The printout should be within 0.05\% of its final value within 450 msec. This should be read on the third printout.

5-12. INPUT FILTER AC REJECTION CHECK.

   a. Connect the 3440A, a test oscillator, an rms voltmeter and the digital printer as shown in Figure 5-7.

   b. Set the test oscillator frequency to 60 Hz (cps) and adjust its amplitude for an indication of 7.07 v rms on the rms voltmeter.

   c. Set the 3440A SAMPLE RATE to 5 samples/sec, and set the plug-in RANGE switch to 10 v.
d. The 3440A display will be somewhat erratic, as the 3440A is sampling different points on the sine wave input. Monitor the digital recorder printout.

e. The digital recorder printout should be between +03163 and -03163. This corresponds to an ac rejection of 30 db where:

\[
\text{Rejection in db} = 20 \log \left( \frac{E_{in} \text{ rms}}{\Delta E \text{ displayed peak}} \right) \times 2.82
\]

5-13. INSTRUMENT COVER REMOVAL.

5-14. To remove either the top or bottom covers, remove the two Phillips-head screws which secure the cover to the instrument. Slide the cover approximately 1/2 inch to the rear of the instrument and lift free. To replace the cover, reverse the procedure.

5-15. ADJUSTMENT AND CALIBRATION PROCEDURES.

5-16. The following test and adjustment procedures should be performed only if it has been definitely determined by the Performance Checks given in Paragraphs 5-3 through 5-12 that the Model 3440A is out of specifications. Figure 5-8 shows the location of internal adjustments.

5-17. POWER SUPPLY A9 ADJUSTMENT.

a. Supply Model 3440A primary power through a variable transformer.

b. Set line voltage to 115/230 vac.

c. Set SAMPLE RATE control to HOLD.

d. Connect DC Voltmeter and AC Voltmeter to A9 (15).

e. Adjust A9R12 (-35 v adj) for DC Voltmeter reading of -35.0 vdc.

f. Vary line voltage from 103 to 127 (207 to 253) vac.

g. DC Voltmeter reading should not change more than ±0.2 vdc. AC Voltmeter reading should remain below 4 mv.

h. Connect DC Voltmeter to A9 (4). (See Figure 6-7.)

j. Reading should read between +145 and +160 vdc.

k. Connect DC Voltmeter to A9 (1).

m. Reading should read between -145 and -160 vdc.

n. Connect DC Voltmeter and AC Voltmeter to A9 (10).

o. DC Voltmeter should read between +11.0 and +14.0 vdc.

p. Vary line voltage from 103 to 127 (207 to 253) vac.

q. DC Voltmeter reading should not change more than ±0.3 vdc. AC Voltmeter reading should remain below 2 mv.

Section V
Paras 5-13 to 5-20

5-18. OSCILLATOR A9 FREQUENCY ADJUST.

a. Set SAMPLE RATE control to HOLD.

b. Connect a clip lead from A4Q2 base (see Figure 6-4) to circuit common. This causes synchronized oscillator to free run.

c. Connect Electronic Counter to A9TP1. (See Figure 6-7.)

d. Adjust A9C14 for an Electronic Counter reading of 400.0 KHz ±400 Hz.

5-19. GROUND COMPARATOR BALANCE AND CHARGE RESTORER ADJUST.

a. Set SAMPLE RATE control to maximum counterclockwise (but not LINE OFF).

b. Set RANGE switch on Plug-in to 10 v.

c. Short Model 3440A INPUT terminals.

d. Adjust R2 (ZERO) until readout is 0.000. Optimum adjustment is indicated by alternate flashing of the (+) and (-) lights.

e. If R2 has insufficient range to obtain a zero reading, proceed as follows:

1) Set R2 to mechanical midpoint.

2) Adjust A2R70 (Comparator Balance) until readout display is 0.000 (see Figure 5-8).

3) Repeat step d for fine adjustment.

f. Remove short from INPUT terminals.

g. Adjust A2R40 (charge restorer) until readout display is 0.000. Optimum adjustment is indicated by alternate flashing of the (+) and (-) lights.

h. Set SAMPLE RATE to approximately one sample per second.

i. Reading should remain at zero. If not, repeat steps c thru g.

5-20. CALIBRATION.

a. Set RANGE switch on Plug-in to 10 v.

b. Apply +8.000 volts from DC Standard to INPUT terminals.

c. Set front panel INT CHECK 8000 adjust to approximately the mechanical midpoint (this is a ten turn potentiometer).

d. Adjust A3R51 (Ramp Slope) for front panel display of +8.000. (See Figure 5-8.) Front panel INT CHECK 8000 adjust may be used for fine adjustment.

e. Set RANGE switch on Plug-in to 100 v.

f. Apply +80.000 volts from DC Standard to INPUT terminals.

g. Adjust A1R7 (100 v adj) for front panel display of +80.00. (See Figure 5-8.)

h. Set RANGE switch on Plug-in to 1000 v.
5-21. TROUBLESHOOTING.

5-22. Use the Troubleshooting Procedure only after determining that the difficulty cannot be removed by the Adjustment and Calibration Procedure, Paragraph 5-15.

5-23. Inspect the setup used when symptoms of malfunction were observed to be certain that the source of the trouble is not external to the Model 3440A.

5-24. Look for burned or loose components, loose connections, broken wires, or any other similar condition which suggests a source of trouble.

5-25. The following should be used to isolate the trouble to a particular circuit board:

- Front panel symptoms;
- Difficulties encountered during Adjustment and Calibration Procedure (Paragraphs 5-15 and 5-20);
- Simplified Block Diagram (Figure 4-1);
- Detailed Block Diagram (Figure 4-2);
- Troubleshooting Aid (Table 5-4);
- Waveform Time Sequence (Figure 5-10);
- Typical Waveforms (Figure 5-11).

5-26. When malfunctioning assembly is found, the trouble may then be traced to the individual components by using the procedures outlined in Paragraphs 5-27 through 5-50. The order of testing shown

Table 5-4. Troubleshooting Aid

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Display not lit</td>
<td>Fuse F1 (0.6 a slow-blow); 115/230 volt switch S6, LINE switch S2, Power Transformer T1 Power Supply A9</td>
</tr>
<tr>
<td>2. Display lit, no response to input</td>
<td>Power Supply A9, 35 volt fuse F2 (0.75a), Sample Rate Multivibrator (A3Q5, 6), Ramp Gate (A3Q10, 11), Ramp Generator (A3QCR1, A3Q15 - 17), Ramp Sensor (A3Q7, 8)</td>
</tr>
<tr>
<td>SAMPLE RATE not lit</td>
<td></td>
</tr>
<tr>
<td>3. Display lit, no response to input</td>
<td>Sample Rate Multivibrator (A3Q5, 6), Ramp Gate (A3Q10, 11), Ramp Generator (A3QCR1, A3Q15 - 17) Ramp Sensor (A3Q7, 8)</td>
</tr>
<tr>
<td>Power Supply voltages normal,</td>
<td></td>
</tr>
<tr>
<td>SAMPLE RATE lit continuously</td>
<td></td>
</tr>
<tr>
<td>4. SAMPLE RATE normal, display counting continuously, Polarity normal</td>
<td>Reset Amplifier (A3Q2, 3) AND Gate (A2CR22, 23), AND Gate Amplifier (A4Q1), Count Gate (A4Q2 - 4), Synchronized Oscillator Gate (A9Q4)</td>
</tr>
<tr>
<td>5. SAMPLE RATE normal, display will not change</td>
<td>Reset Amplifier (A3Q2, 3), Transfer Amplifier (A3Q12, AND Gate (A2CR22, 23), AND Gate Amplifier (A4Q1), Count Gate (A4Q2 - 4), Synchronized Oscillator (A9Q4 - 8), Decade Counter (A5 - A8)</td>
</tr>
<tr>
<td>6. SAMPLE RATE normal, display continuously counting, polarity always</td>
<td>Input Comparator (A2Q1 - 5, A2Q6 - 9)</td>
</tr>
<tr>
<td>indicates (+)</td>
<td></td>
</tr>
<tr>
<td>7. SAMPLE RATE normal, display continuously counting, polarity always</td>
<td>Ground Comparator (A2Q11 - 13, A2Q15, 16)</td>
</tr>
<tr>
<td>indicates (-)</td>
<td></td>
</tr>
<tr>
<td>8. Particular digit(s) displayed erratically</td>
<td>Decade Counter Assemblies (A5 - A8)</td>
</tr>
<tr>
<td>9. Improper tracking</td>
<td>Ramp Generator A3QCR1, A3Q15 - 17</td>
</tr>
<tr>
<td>10. No response to input with normal indication on INT CHECK 8000</td>
<td>Attenuator (A1) Plug-in Unit</td>
</tr>
</tbody>
</table>
5-27. POWER SUPPLY A9.

5-28. For power supply problems, check diodes (A9CR1 - 4, A9CR6 - 9, A9CR11, 12) and regulator transistors (Q1, A9Q1, A9Q2).

5-29. SAMPLE RATE AND RAMP GENERATOR TEST.

5-30. If SAMPLE RATE neon is either not lit or lit continuously, the problem is in the Ramp Generator circuits. The source of trouble is usually difficult to determine because of the feedback loop used to reset the Sample Rate Multivibrator. To locate the malfunction, use the following procedure:

a. Disconnect the emitter of A3Q8 (see Figure 6-3) from the circuit board. This breaks the feedback loop.

**CAUTION**

USE EXTREME CARE IN REMOVING THE LEAD AS IT IS VERY EASILY BROKEN.

b. Connect negative output of Transistor Power Supply to the emitter of A3Q8, using insulated miniature clip leads. Connect positive output to Model 3440A circuit common.

c. Set Transistor Power Supply to -11 and -13 vdc and observe the voltage levels at the points given in Table 5-5. The test voltages are approximate and a tolerance of ±20% is acceptable.

d. If the proper voltage is not present at any point, the malfunction is probably immediately before that point.

**NOTE**

Replacement of the A3QCR1A, B assembly or ramp capacitor C6 may require changing the value of R4*. See Paragraph 5-61.

Table 5-5. Sample Rate and Ramp Generator Test

<table>
<thead>
<tr>
<th>TRANSISTOR POWER SUPPLY VOLTAGE</th>
<th>-11</th>
<th>-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE RATE Neon</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>A3Q7 Base</td>
<td>+12.5</td>
<td>0</td>
</tr>
<tr>
<td>A3Q7 Collector</td>
<td>- 1.4</td>
<td>0</td>
</tr>
<tr>
<td>A3Q5 Collector</td>
<td>- 1.5</td>
<td>-14</td>
</tr>
<tr>
<td>A3Q6 Collector</td>
<td>-26</td>
<td>- 1.5</td>
</tr>
<tr>
<td>A3Q10 Base</td>
<td>0</td>
<td>- 6.6</td>
</tr>
<tr>
<td>A3Q10 Collector</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>A3Q11 Collector</td>
<td>-22</td>
<td>13</td>
</tr>
<tr>
<td>A3CR11 Cathode</td>
<td>-22.5</td>
<td>12</td>
</tr>
<tr>
<td>A3QCR1 Emitter</td>
<td>-18</td>
<td>12</td>
</tr>
<tr>
<td>A3QCR1 Anode</td>
<td>-24.5</td>
<td>5.5</td>
</tr>
<tr>
<td>A3Q17 Emitter</td>
<td>-24</td>
<td>-23</td>
</tr>
<tr>
<td>A3Q1 Base</td>
<td>- 4.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

5-31. RESET PULSE.

5-32. The reset pulse (see Figure 5-11B) is necessary for proper operation of most Model 3440A circuits. If the SAMPLE RATE neon is flashing and the reset pulse is not present, the trouble is probably A3Q2 or A3Q3 (see Figure 6-3).

5-33. COMPARATOR (A2).

5-34. INPUT COMPARATOR CHECK. (Refer to Figures 5-11 or 6-2.)

a. Check waveshape at A2TP2.

b. If waveshape at A2TP2 is incorrect, check waveshape at A2TP1. If the waveshape at A2TP1 is correct, the trouble is in A2Q7 or A2Q8.

c. If the waveshape at A2TP1 is incorrect, the trouble is in the input amplifier (A2Q1 thru A2Q5) or the input comparator (A2CR5A and B).

d. Check the input comparator by checking with an oscilloscope for a narrow positive pulse at the anode of A2CR5B.

e. Connect a clip lead from Pin 16 on the A3 board to signal common. This connection stops the instrument from sampling. With a DC Voltmeter, check the potentials listed in Table 5-6A. If the reading at any one collector is incorrect, either that transistor or its associated circuit is probably malfunctioning.

Table 5-6. Comparator Amplifier Voltages

<table>
<thead>
<tr>
<th>A Measuring Point</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2Q1 Collector</td>
<td>- 0.8 v</td>
</tr>
<tr>
<td>A2Q2 Collector</td>
<td>- 1.5 v</td>
</tr>
<tr>
<td>A2Q3 Collector</td>
<td>- 0.3 v</td>
</tr>
<tr>
<td>A2Q4 Collector</td>
<td>- 0.8 v</td>
</tr>
<tr>
<td>A2Q5 Collector</td>
<td>-18 v</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B Measuring Point</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2Q11 Collector</td>
<td>- 0.3 v</td>
</tr>
<tr>
<td>A2Q12 Collector</td>
<td>- 0.8 v</td>
</tr>
<tr>
<td>A2Q13 Collector</td>
<td>-20.5 v</td>
</tr>
</tbody>
</table>

5-35. GROUND COMPARATOR CHECK. (Refer to Figures 5-11 or 6-2.)

a. The ground comparator check is essentially the same as the input comparator check.

b. Check the ground flip-flop output at A2TP4 with an oscilloscope. Then check the amplifier output at A2TP3. If the output at A2TP3 is correct, the trouble is probably in A2Q15 or A2Q16. If the output at A2TP3 is incorrect, check the ground amplifier and the ground comparator.
c. Check with an oscilloscope for a narrow positive pulse at the anode of A2CR27B. If no pulse is present, the ground comparator is malfunctioning.

d. Connect a clip lead from A3 Pin 16 to signal common and measure the dc voltages listed in Table 5-6B. If any one of the collector readings is wrong, either that transistor or its associated circuit is probably malfunctioning.

e. Remove lead from A3 Pin 16.

5-36. ZERO OFFSET.

5-37. If the Model 3440A cannot be zeroed by adjusting A2R70 (see Figure 6-3), use the following procedure:

a. Clean the plug-in connector J6 and P6 with Type TF Freon (hp- Part No. 8500-0232).

b. If this does not help, short the INPUT terminals.

c. If the instrument cannot be zeroed by adjusting A2R70, the trouble is probably in the charge restorer (A2Q9), A2CR10, 11 or A2CR15 - 17.

d. If the instrument still cannot be zeroed, the problem is probably A2CR27 - 28, A2CR5 - 7, or A2R58 - 71.

5-38. INPUT FILTER AC REJECTION.

5-39. Poor ac rejection can be caused by defective A1C1, A2C1, or Plug-in unit.

5-40. INPUT IMPEDANCE.

5-41. Excessive leakage current can be caused by a defective A2CR10, A2C1, A2C4, A2CR5B, Input Attenuator or Plug-in unit.

5-42. COUNT GATE AND POLARITY SENSOR.

a. If neither Polarity Sensor (A4Q6 - 7) or count gate (A4Q1 - 4) is functioning properly disconnect A4R29 and A4R41. (See Figure 6-4.)

b. If count gate now functions properly, the trouble is probably the polarity sensor (A4Q6, 7).

c. If count gate still does not function properly, the trouble is probably A4Q1 - 4.

5-43. SYNCHRONIZED OSCILLATOR.

a. Connect clip lead from A4Q2 base to circuit common.

b. Check waveform (Figure 5-11T) at A9TP1 (see Figure 6-4).

c. If proper waveform is not observed, ground the collector of A9Q4.

d. If this causes the proper waveform to appear at A9TP1, the trouble is probably A9Q4.

e. If there is still no output at A9TP1, check the waveform at the collector of A9Q5. (See Figure 5-11S.)

f. Proper waveform at this point indicates the trouble is in the Schmitt Trigger (A9Q6 - 8). Improper waveform indicates the problem is the oscillator A9Q5.

--------------- NOTE ---------------

If the oscillator is unstable, check that the value of A9R24 is 10 kΩ.

5-44. DECADE COUNTERS A5 - A8.

a. Place suspected Decade Counter in A5 position. This sets up worst case conditions.

b. Connect clip lead from A4Q2 base to circuit common causing oscillator to free run.

c. Observe waveform (see Figure 5-11X) at A5 (10)

d. If proper waveform is observed, the trouble is probably Photoconductor Assembly V1, Digit Display Tube DS6, or Transfer Amplifier A3Q12.

e. If improper waveform is observed at this point, observe waveforms of each binary. (See Figures 5-11U thru 5-11W.)

f. Improper waveform indicates defective binary.

5-45. OVERRANGE.

5-46. OVERRANGE indicator problems can be caused by defective A4Q8, A4Q9, A4CR10, or A4DS3.

5-47. CALIBRATION LINEARITY.

5-48. If Model 3440A fails to track properly, check the following:

a. Oscillator A9 stability.

b. Ramp generator A3QCR1, A3Q15 - 17.

5-49. DIGITAL RECORDER.

5-50. If digital recorder fails to print properly, check the following.

a. Digital recorder;

b. Interconnecting cable between Model 3440A and digital recorder;

c. Decade counter binary outputs;

d. Print command A3Q18 (see Figure 5-11);

e. Plug-in unit.

5-51. ADJUSTMENT OF FACTORY SELECTED COMPONENTS.

5-52. Certain components within the 3440A are individually selected to compensate for slightly varying circuit parameters. These components are denoted by an asterisk on the schematic, and the typical value is shown. The following paragraphs describe the function of the factory selected components and give instructions for their selection. Normally, these
components should not be changed unless an associated component has been changed. Replacement of a transistor or diode may require the changing of an associated factory selected component.

5-53. A2R2*.

5-54. A2R2 adjusts the current drawn by the Input Comparator. If A2R2 is too high, the 3440A will have a positive zero offset of several counts; and A2R2 should be lowered from 1.33 MΩ to 1.1 MΩ. Ordinarily A2R2 shouldn't be changed.

5-55. A2R29*.

5-56. A2R29 is selected so that a small amount of charge is added to A2C17 in the Charge Restorer. This compensates for a small amount of charge lost from capacitive loading from A2R28 to ground. Once A2R29 has been selected at the factory, there should be no reason to change its value.

5-57. A2C17*.

5-58. A2C17 controls the amount of charge fed back by the Charge Restorer. If there is a zero offset that cannot be removed by ordinary adjustments, A2C17 may be adjusted. If the offset is positive, decrease A2C17; and if the offset is negative, increase A2C17. The limits of A2C17 are from 100 pf to 130 pf.

5-59. A3R18* AND A3R19*.

5-60. A3R18 and A3R19 set up a negative bias on the Sample Rate Multivibrator in order to give the SAMPLE RATE control (R6) the proper range. To decrease the Sample Rate, increase A3R18; and to increase the Sample Rate, increase A3R19.

5-61. R4*.

5-62. R4 brings the ramp slope adjustment into the range of the Ramp Slope potentiometer (A3R51). R4 is temperature coefficient matched to the Ramp Capacitor C6. If the readings are consistently high, and the Ramp Slope adjustment cannot bring the readings down, R4 should be lowered to 7100 Ω. If the assembly containing A3QCR1A and A3QCR1B is changed, it may be necessary to change R4. R4 should either be 7700 Ω (hp– Part No. 0811-0143) or 7100 Ω (hp– Part No. 0811-0980).

5-63. SERVICE AND REPAIR.

5-64. DECIMAL ASSEMBLY A10 AND FUNCTION ASSEMBLY A11 REMOVAL.

a. Remove Assemblies A2 and A3.

b. Remove A2 and A3 support bracket.

c. Remove screw holding Function Assembly A11. Assembly A11 can now be slid back for repair.

d. Remove Assemblies A4 through A8.

e. Remove two front-panel screws holding readout assembly.

5-65. ETCHED CIRCUIT BOARD REPAIR.

5-66. The Model 3440A uses plated through double sided etched circuit boards. To prevent damage to the circuit board and components, observe the following rules when soldering:

a. Use a low-heat (25 to 50 watts) soldering iron with a small tip (1/16" to 3/32" dia.).

b. To remove a component, clip a heat sink (long nose pliers, commercial heat sink tweezers etc.) on the component lead as close to the component as possible. Place the soldering iron directly on the component lead and pull on the lead. If a component is obviously damaged or faulty, clip the leads close to the component and then remove the leads from the board.

5-67. POWER SUPPLY MODIFICATIONS.

5-68. POWER SUPPLY (Model 3440A Below Serial Number 415-00726).

5-69. When using the Model 3440A with -hp– Model 3443A High Gain/Auto Range Unit, the values of A9R15 and A9R16 should be 1.2 K ohms, fixed composition ±10%, 1/2 watt (-hp– Part No. 0687-1221) to prevent overloading of the power supply. Instruments with serial numbers 415-00726 and above have been modified during production. This modification does not require recalibration of the Model 3440A.
5-70. DC ISOLATION (Model 3440A Below Serial Number 347-00301).

5-71. This modification raises the dc isolation voltage of the above instruments from 400 volts to 500 volts above chassis ground. Change the heat sink insulator used with Q1 to a new heat sink, insulator -hp- Part No. 1200-0091. This can be purchased from your local -hp- Field Sales and Service Office.

5-72. MODIFICATION PROCEDURE.

a. Refer to Figure 5-9; remove Transistor Q1 and its insulator -- taking care not to lose the mounting stud insulators.

b. File the emitter and base holes 1/8" larger in a direction as shown in Figure 5-9. Be sure to deburr and smooth the filed portion of the hole to insure against any shorting of the new insulator to the chassis.

c. Install the new insulator block with the red side making contact with the 3440A chassis. Position the insulator so that it does not interfere with the grommet containing the transformer wires. (If the insulator overlaps the wiring grommet, it will not make good thermal contact with the -hp- 3440A chassis.)

d. Install Q1. Rotate it 180° from its original orientation so that the emitter is now in the hole nearest A9 receptacle. Be sure to use the stud insulators removed in step a.

e. Turn the instrument bottom side up and rotate Q1 socket 180°. It may be necessary to install longer wires from A9 receptacle to Q1 socket. Refer to Figure 5-9 for the proper wire colors and connections.

f. This modification does not require recalibration of the Model 3440A.

Figure 5-9. DC Isolation Increase Modification
NOTES

1. TIME INTERVAL BETWEEN TIMES T₁ and T₀ IS DETERMINED BY INPUT VOLTAGE LEVEL (8.000 VOLTS SHOWN).

2. TIME INTERVAL GOING FROM TIME T₃ TO TIME T₀ IS DETERMINED BY SAMPLE RATE CONTROL SETTING.

3. REFER TO FIGURE 5-11 OR SCHEMATIC DIAGRAMS FOR VOLTAGE LEVELS OF WAVEFORMS.
Figure 5-10. Waveform Time Sequence (Cont'd)
Section V
Figure 5-11

A - SAMPLE RATE
MULTIVIBRATOR
A3Q5 base
1.0 volt/cm; 20 msec/cm

B - RESET PULSE
A3 (19)
10 volts/cm; 5 μsec/cm

C - RAMP GATE
A3Q11 Collector
10 volts/cm; 10 msec/cm

D - RAMP
A3 (6)
5.0 volts/cm; 10 msec/cm

E - RAMP SENSOR
A3Q7 base
5.0 volts/cm; .1 msec/cm
time T₂

F - INPUT AMPLIFIER
A2TP1
5.0 volts/cm; 0.1 msec/cm
time T₁; AC coupled

G - INPUT PULSE
A2TP2
5.0 volts/cm; 0.5 μsec/cm
time T₁; AC coupled

H - INPUT FLIP-FLOP
A2Q7 collector
10 volts/cm; 10 msec/cm

J - CHARGE RESTORER SWITCH
A2Q9 collector
10 volts/cm; 10 msec/cm

K - GROUND AMPLIFIER
A2TP3
5.0 volts/cm; 0.1 msec/cm
time T₂; AC coupled

L - GROUND PULSE
A2TP4
5.0 volts/cm; 0.5 μsec/cm
time T₂; AC coupled

M - GROUND FLIP-FLOP
A2Q15 collector
10 volts/cm; 10 msec/cm

NOTE: Each waveform starts at T₀ unless otherwise stated.
Figure 5-11. Typical Waveforms
N - POLARITY SENSOR
A4Q6 collector
10 volts/cm; 10 msec/cm

P - POLARITY SENSOR
A4Q6 collector
10 volts/cm; 20 msec/cm
-8.000 volt input

Q - AND GATE
A2 (13)
5.0 volts/cm; 10 msec/cm

R - COUNT GATE
A4Q2 collector
10 volts/cm; 10 msec/cm

S - SYNCHRONIZED OSCILLATOR
A9Q5 collector
5.0 volts/cm; .5 μsec/cm
AC coupled

T - SYNCHRONIZED OSCILLATOR
A9TP1
10 volts/cm; 1.0 μsec/cm
AC coupled

U - UNITS DECADE COUNTER
A5Q1 collector
5.0 volts/cm; 2.0 μsec/cm
AC coupled

V - UNITS DECADE COUNTER
A5Q3 collector
5.0 volts/cm; 5.0 μsec/cm
AC coupled

W - UNITS DECADE COUNTER
A5Q5 collector
5.0 volts/cm; 10 μsec/cm
AC coupled

X - UNITS DECADE COUNTER
A5 (10)
10 volts/cm; 10 μsec/cm
AC coupled

Y - TRANSFER PULSE
A3 (13)
10 volts/cm; 10 msec/cm

Z - PRINT COMMAND
A3 (21)
5.0 volts/cm; 10 msec/cm

Figure 5-11: Typical Waveforms (cont’d)
## PERFORMANCE CHECK CARD

**Hewlett-Packard Model 3440A**  
Digital Voltmeter  
Serial No. ______ — ______

<table>
<thead>
<tr>
<th>PARAGRAPH</th>
<th>DESCRIPTION</th>
<th>READING</th>
<th>TEST LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-5</td>
<td>Calibration</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Input: 0.000 V</td>
<td>______</td>
<td>-0.001 to +0.001</td>
</tr>
<tr>
<td></td>
<td>1.000 V</td>
<td>______</td>
<td>0.998 to 1.002</td>
</tr>
<tr>
<td></td>
<td>2.000 V</td>
<td>______</td>
<td>1.998 to 2.002</td>
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<tr>
<td></td>
<td>3.000 V</td>
<td>______</td>
<td>2.997 to 3.003</td>
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<tr>
<td></td>
<td>4.000 V</td>
<td>______</td>
<td>3.997 to 4.003</td>
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<td>6.995 to 7.005</td>
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<td>9.994 to 0.006</td>
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<td>5-6</td>
<td>Input Impedance Check</td>
<td>______</td>
<td>9.090 to 9.112</td>
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<td>5-7</td>
<td>External Trigger Check</td>
<td>______</td>
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<tr>
<td>5-8</td>
<td>Digital Recorder Check</td>
<td>______</td>
<td>011113</td>
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<td>Display: +1.111 V</td>
<td>______</td>
<td>122223</td>
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<td>-2.222 V</td>
<td>______</td>
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<td>+3.333 V</td>
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<td>+4.444 V</td>
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<td>+5.555 V</td>
<td>______</td>
<td>066666</td>
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<td>+6.666 V</td>
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<td>+7.777 V</td>
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<td>+10.00 V</td>
<td>______</td>
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<td>+100.00 V</td>
<td>______</td>
<td>010003</td>
</tr>
<tr>
<td></td>
<td>+00.50 V (Overrange)</td>
<td>______</td>
<td>900502</td>
</tr>
<tr>
<td>5-9</td>
<td>DC Common Mode</td>
<td>______</td>
<td></td>
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<tr>
<td></td>
<td>Rejection Check</td>
<td>______</td>
<td>±0.003 V</td>
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<td>Range: 10 V</td>
<td>______</td>
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<td></td>
<td>100 V</td>
<td>______</td>
<td>±000.3 V</td>
</tr>
<tr>
<td></td>
<td>1000 V</td>
<td>______</td>
<td>±0000.3 V</td>
</tr>
<tr>
<td>5-10</td>
<td>AC Common Mode</td>
<td>______</td>
<td>±0.003 V</td>
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SECTION VI
CIRCUIT DIAGRAMS

6-1. INTRODUCTION.

6-2. This section contains the circuit diagrams necessary for maintenance of the Model 3440A. Schematics, component location drawings, and a wiring diagram are included. The location drawings show the physical location of each component on each circuit board, and they accompany the appropriate schematic. The wiring diagram shows the connections between all the circuit boards and chassis components. Location grids are drawn on each diagram in this section, making the search for individual components easier. Figures 6-9 and 6-10 are wiring diagrams showing all the 3440A wiring.
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(HP Part No. 03440-66503)

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(hp Part No. 03440-66504)
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<td>G3</td>
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<td>G3</td>
<td>G3</td>
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<td>H5</td>
<td>--</td>
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<td>J5</td>
<td>J5</td>
<td>--</td>
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<td>28</td>
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<td>29</td>
<td>H4</td>
<td>H4</td>
<td>--</td>
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<td>30</td>
<td>H4</td>
<td>H4</td>
<td>--</td>
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<tr>
<td>31</td>
<td>H4</td>
<td>H4</td>
<td>--</td>
<td>--</td>
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<td>32</td>
<td>H4</td>
<td>H4</td>
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<td>33</td>
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**Diagram of A5 thru A8 Assembly Components**

**HP Part No. 05212-6016**

---

[Diagram Image]
SECTION VII

REPLACEABLE PARTS

7-1. INTRODUCTION.

7-2. This section contains information for ordering replacement parts. Table 7-1 lists parts in alphabetic order of their reference designators and indicates the description and -hp part number of each part, together with any applicable notes. Table 7-2 lists parts in alphabetic order of their -hp part number and provides the following information on each part:

a. Description of the part. (See list of abbreviations below.)

b. Typical manufacturer of the part in a five-digit code. (See Appendix A for list of manufacturers.)

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

7-3. Miscellaneous parts are listed at the end of Table 7-1.

7-4. ORDERING INFORMATION.

7-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers.

7-6. NON-LISTED PARTS.

7-7. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>m</td>
<td>nanosecond(s) = 10^{-9} seconds</td>
</tr>
<tr>
<td>ns</td>
<td>not separately replaceable</td>
</tr>
<tr>
<td>Ω</td>
<td>ohm(s)</td>
</tr>
<tr>
<td>V</td>
<td>volt(s)</td>
</tr>
<tr>
<td>A</td>
<td>ampere</td>
</tr>
<tr>
<td>N</td>
<td>newton</td>
</tr>
<tr>
<td>J</td>
<td>joule</td>
</tr>
<tr>
<td>W</td>
<td>watt(s)</td>
</tr>
<tr>
<td>F</td>
<td>farad(s)</td>
</tr>
<tr>
<td>H</td>
<td>henry(h)</td>
</tr>
<tr>
<td>L</td>
<td>henry(ies)</td>
</tr>
<tr>
<td>C</td>
<td>farad(ies)</td>
</tr>
<tr>
<td>G</td>
<td>gauss(ies)</td>
</tr>
<tr>
<td>Ω</td>
<td>ohm(s)</td>
</tr>
<tr>
<td>V</td>
<td>volt(s)</td>
</tr>
<tr>
<td>F</td>
<td>farad(s)</td>
</tr>
<tr>
<td>H</td>
<td>henry(ies)</td>
</tr>
<tr>
<td>O</td>
<td>ohm(s)</td>
</tr>
<tr>
<td>V</td>
<td>volt(s)</td>
</tr>
<tr>
<td>F</td>
<td>farad(s)</td>
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7-8. DECIMAL MULTIPLIERS

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<th>Multiplier</th>
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<tr>
<td>tera</td>
<td>T</td>
<td>10^{12}</td>
</tr>
<tr>
<td>giga</td>
<td>G</td>
<td>10^{9}</td>
</tr>
<tr>
<td>mega</td>
<td>M or Meg</td>
<td>10^{6}</td>
</tr>
<tr>
<td>kilo</td>
<td>k or K</td>
<td>10^{3}</td>
</tr>
<tr>
<td>hecto</td>
<td>h</td>
<td>10^{2}</td>
</tr>
<tr>
<td>deka</td>
<td>da</td>
<td>10</td>
</tr>
<tr>
<td>deci</td>
<td>d</td>
<td>10^{-1}</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Prefix</th>
<th>Symbols</th>
<th>Multiplier</th>
</tr>
</thead>
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<tr>
<td>centi</td>
<td>c</td>
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</tr>
<tr>
<td>milli</td>
<td>m</td>
<td>10^{-3}</td>
</tr>
<tr>
<td>micro</td>
<td>μ</td>
<td>10^{-6}</td>
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<tr>
<td>nano</td>
<td>n</td>
<td>10^{-9}</td>
</tr>
<tr>
<td>pico</td>
<td>p</td>
<td>10^{-12}</td>
</tr>
<tr>
<td>femto</td>
<td>f</td>
<td>10^{-15}</td>
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<tr>
<td>atto</td>
<td>a</td>
<td>10^{-18}</td>
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7-9. DESIGNATORS

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<td>FL</td>
<td>filter</td>
</tr>
<tr>
<td>HQ</td>
<td>heater</td>
</tr>
<tr>
<td>I</td>
<td>jack</td>
</tr>
<tr>
<td>J</td>
<td>relay</td>
</tr>
<tr>
<td>K</td>
<td>switch</td>
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<tr>
<td>L</td>
<td>transformer</td>
</tr>
<tr>
<td>M</td>
<td>meter</td>
</tr>
<tr>
<td>MP</td>
<td>plug</td>
</tr>
<tr>
<td>Q</td>
<td>transistor</td>
</tr>
<tr>
<td>OCR</td>
<td>transformer-diode</td>
</tr>
<tr>
<td>R</td>
<td>resistor</td>
</tr>
<tr>
<td>RT</td>
<td>relay</td>
</tr>
<tr>
<td>T</td>
<td>transformer</td>
</tr>
<tr>
<td>TB</td>
<td>terminal board</td>
</tr>
<tr>
<td>TC</td>
<td>thermocouple</td>
</tr>
<tr>
<td>TP</td>
<td>test point</td>
</tr>
<tr>
<td>TS</td>
<td>terminal strip</td>
</tr>
<tr>
<td>V</td>
<td>vacuum tube, neon bulb, photocell, etc.</td>
</tr>
<tr>
<td>W</td>
<td>wire</td>
</tr>
<tr>
<td>X</td>
<td>socket</td>
</tr>
<tr>
<td>XDS</td>
<td>lampholder</td>
</tr>
<tr>
<td>XF</td>
<td>fuseholder</td>
</tr>
<tr>
<td>Y</td>
<td>crystal</td>
</tr>
<tr>
<td>Z</td>
<td>network</td>
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Dupont de Nemours
<table>
<thead>
<tr>
<th>DESIGNATOR</th>
<th>DESCRIPTION</th>
<th>-hp- PART NUMBER</th>
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<tbody>
<tr>
<td>1</td>
<td>Side Frame Assembly</td>
<td>5060-0731</td>
</tr>
<tr>
<td>2</td>
<td>Panel: Front</td>
<td>03440-00201</td>
</tr>
<tr>
<td>3</td>
<td>Panel: Rear</td>
<td>03440-00202</td>
</tr>
<tr>
<td>4</td>
<td>Rear Side Cover: 5 x 11 FM</td>
<td>5000-0732</td>
</tr>
<tr>
<td>5</td>
<td>Front Side Cover: 5 x 11 FM</td>
<td>5000-0733</td>
</tr>
<tr>
<td>6</td>
<td>Cover Assembly: Top, 11 LM</td>
<td>5060-0739</td>
</tr>
<tr>
<td>7</td>
<td>Cover Assembly: bottom, 11 LM</td>
<td>5060-0751</td>
</tr>
<tr>
<td>8</td>
<td>Handle Assembly: Side</td>
<td>5060-0763</td>
</tr>
<tr>
<td>9</td>
<td>Retainer: Handle Assembly</td>
<td>5060-0766</td>
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<tr>
<td>10</td>
<td>Foot Assembly: Full Module</td>
<td>5060-0767</td>
</tr>
<tr>
<td>11</td>
<td>Stand: Tilt</td>
<td>1490-0030</td>
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<tr>
<td>12</td>
<td>Trim: Fluted Aluminum</td>
<td>5000-0051</td>
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<tr>
<td>13</td>
<td>Kit: Accessory</td>
<td>03440-84401</td>
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Figure 7-2. Chassis Part Location
<table>
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<th>REFERENCE DESIGNATOR</th>
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<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>C1</td>
<td>0170-0022</td>
<td>1</td>
<td>C: fxmy 0.1 µf 20% 600 vdcw</td>
<td>56289</td>
<td>148P175A</td>
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<tr>
<td>C2</td>
<td>0180-0047</td>
<td>1</td>
<td>C: fx dyst elect 500 µf 75 vdcw</td>
<td>56289</td>
<td>D2443</td>
</tr>
<tr>
<td>C3, C4</td>
<td>0180-0107</td>
<td>2</td>
<td>C: fx dyst elect 20 µf -10% +100% 200 vdcw</td>
<td>56289</td>
<td>90603</td>
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<td>C6</td>
<td>0160-0221</td>
<td>1</td>
<td>C: fx poly 2 µf 5% 50 vdcw</td>
<td>56289</td>
<td>obd</td>
</tr>
<tr>
<td>C7</td>
<td>0160-0161</td>
<td>5</td>
<td>C: fx my 0.01 µf 10% 200 vdcw</td>
<td>56289</td>
<td>obd</td>
</tr>
<tr>
<td>C8</td>
<td>0160-3333</td>
<td>1</td>
<td>C: fx dual 0.0005 µF 20% 1400V</td>
<td>08998</td>
<td>THD-8-502M-1.4KV</td>
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<tr>
<td>C9</td>
<td>0140-0147</td>
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<td>C: fx mica 180 pF ±5%</td>
<td>72136</td>
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<tr>
<td>DS1 thru</td>
<td>2140-0028</td>
<td>3</td>
<td>Lamp: Glow, neon frosted NE2E</td>
<td>24455</td>
<td>NE-2E</td>
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<tr>
<td>DS3</td>
<td></td>
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<td>Lamp: Glow, neon NE-2H</td>
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<td>NE-2H</td>
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<td>DS4, DS5</td>
<td>2140-0015</td>
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<td>Lamp: Glow, neon</td>
<td>74276</td>
<td>A219</td>
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<td>DS6, DS7</td>
<td>2140-0234</td>
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<td>Lamp: Glow, neon</td>
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<td>obd</td>
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<tr>
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<td>1450-0049</td>
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<td>Indicator: Lamp, glow neon</td>
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<td>313.00</td>
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<td>F1</td>
<td>2110-0016</td>
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<td>Fuse: cartridge 0.6 amp slo-blo</td>
<td>75915</td>
<td>F02GH750A</td>
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<tr>
<td>F2</td>
<td>2110-0033</td>
<td>1</td>
<td>Fuse: 0.75 amp 250 V</td>
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<tr>
<td>J1</td>
<td>0340-0097</td>
<td>2</td>
<td>Insulator: binding post, 3 hole in-line</td>
<td>-hp-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0340-0091</td>
<td>2</td>
<td>Insulator: binding post, 3 hole with pin</td>
<td>-hp-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5060-0625</td>
<td>1</td>
<td>Binding Post Assy: left hand link</td>
<td>-hp-</td>
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</tr>
<tr>
<td></td>
<td>5060-0634</td>
<td>2</td>
<td>Binding Post Assy: red 3/4' stud</td>
<td>-hp-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5060-0635</td>
<td>3</td>
<td>Binding Post Assy: blk 3/4' stud</td>
<td>-hp-</td>
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<tr>
<td>J2</td>
<td>1251-0087</td>
<td>1</td>
<td>Connector: female 50 pin miniature</td>
<td>02660</td>
<td>57-4057-40500 (375)</td>
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<tr>
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<td>1251-2357</td>
<td>1</td>
<td>Connector: power</td>
<td>82389</td>
<td>EAC-301</td>
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<td>J4</td>
<td>1251-0085</td>
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<td>Connector: female 36 pin miniature</td>
<td>02660</td>
<td>57-40360 (375)</td>
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<tr>
<td>J5</td>
<td>0340-0087</td>
<td>2</td>
<td>Insulator: binding post, 3 hole in-line</td>
<td>-hp-</td>
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<tr>
<td></td>
<td>0340-0091</td>
<td>2</td>
<td>Insulator: binding post, 3 hole with pin</td>
<td>-hp-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5060-0634</td>
<td>1</td>
<td>Binding Post Assy: red 3/4' stud</td>
<td>-hp-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5060-0635</td>
<td>3</td>
<td>Binding Post Assy: blk 3/4' stud</td>
<td>-hp-</td>
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<tr>
<td>J6</td>
<td>1251-1026</td>
<td>1</td>
<td>Connector: socket female 50 pin</td>
<td>75173</td>
<td>57-20500-25</td>
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<td>P7</td>
<td>1251-0324</td>
<td>1</td>
<td>Connector: test jack male red</td>
<td>00373</td>
<td>69026-1064</td>
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<tr>
<td>Q1</td>
<td>1850-0098</td>
<td>1</td>
<td>TSTR: Ge PNP selected</td>
<td>04713</td>
<td>SP-776</td>
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<td>Not assigned</td>
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<td></td>
</tr>
<tr>
<td>R2</td>
<td>2100-1439</td>
<td>1</td>
<td>R: var comp 1 kΩ 20% lin 0.3 W</td>
<td>71450</td>
<td>series 70</td>
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<tr>
<td>R3</td>
<td>2100-0436</td>
<td>1</td>
<td>R: var comp 200 Ω 20% lin 1/2 W</td>
<td>71450</td>
<td>VA-45</td>
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<td>R4*</td>
<td>0683-2015</td>
<td>3</td>
<td>R: fx comp 200 Ω 5% 1/4 W</td>
<td>01121</td>
<td>CB2015</td>
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<tr>
<td>R5</td>
<td>2100-2993</td>
<td>1</td>
<td>R: var 250 kΩ ±20% 1/4 W</td>
<td>71450</td>
<td>series 45</td>
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<tr>
<td>R6</td>
<td>0684-1001</td>
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<td>CB1001</td>
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<td>R: fx comp 10 kΩ ±5% 1/4 W</td>
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<td>CB1035</td>
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<td>0683-3335</td>
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<td>R: fx comp 33 kΩ ±5% 1/4 W</td>
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<td>CB3335</td>
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<td>R10</td>
<td>3101-1244</td>
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<td>Switch: push-button SPDT</td>
<td>87094</td>
<td>53-55480-120/A1H</td>
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<td>S1</td>
<td>3101-0053</td>
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<td>Switch: push-button SPDT</td>
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<td>NF4003</td>
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<td>S2</td>
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<td>11A-1242</td>
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<td></td>
<td></td>
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<td>S6</td>
<td>3101-1234</td>
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<td>Switch: slide 115/230 V</td>
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<td>11A-1242</td>
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<tr>
<td>T1</td>
<td>9100-0182</td>
<td>1</td>
<td>Transformer: power</td>
<td>-hp-</td>
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<tr>
<td>W1</td>
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<td>Semicon Device: diode, junction</td>
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| A7                  | Same as A5 |     |                                                  |                |
| A8                  | Same as A5 |     |                                                  |                |</p>
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<td>01121</td>
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**MISCELLANEOUS**

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Table 7-1. Replaceable Parts (Cont’d)

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<td>Insert: Units readout</td>
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<td>03440-48303</td>
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<td>Bezel: Window</td>
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<td>03440-30004</td>
<td>1</td>
<td>Operating and Service Manual</td>
<td>-hp-</td>
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<td>52121-83D</td>
<td>1</td>
<td>Holder: Decimal</td>
<td>-hp-</td>
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## Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H-1 (Name to Code) and H-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements appeared at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H Handbooks.

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<td>Humited Co.</td>
<td>Colton, Calif.</td>
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<td>Valley Stream, N. Y.</td>
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<td>Gallix Corp.</td>
<td>Cherry Hill, N. J.</td>
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<td>Croven, Ltd.</td>
<td>Whitby, Ontario, Canada</td>
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From: Handbook Supplements H-1 Dated January 1970

- 00015-49 Revised: May, 1970
- Model 344A
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<td>91299</td>
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<td>96054</td>
<td>HI-Q Div. of Aerovox Corp.</td>
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<td>Mansfield, Ohio</td>
<td>97446</td>
<td>Industrial Retaining Ring Co.</td>
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<td>Culver City, Calif.</td>
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<td>95238</td>
<td>Continental Conector Corp.</td>
<td>Woodside, N.Y.</td>
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<td>Columbus, Nebr.</td>
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<td>Dage Electric Co., Inc.</td>
<td>Franklin, Ind.</td>
<td>99402</td>
<td>Hoffman Electronics Corp.</td>
<td>San Diego, Calif.</td>
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</table>

The following HP Vendors have no number assigned in the latest supplement to the Federal Supply Code for Manufacturers Handbook.

003BB Precision Instrument Co. | Van Nuys, Calif. | 000QQ Cooltron | Oakland, Calif. |

From: Handbook Supplement H-1 Date Jan 1970
MANUAL BACKDATING CHANGES

MODEL 3440A

DIGITAL VOLTMETER

Manual Serial Prefixed: 919-
-hp- Part No. 03440-90004

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

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<td>951-14220 and below</td>
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CHANGE 1

Display and Ramp Assembly, Part No. 03440-66502, was used in instruments with Serial No. 421-00925 and below. The schematic diagram (Figure 6-3) and Table 7-1, Replaceable Parts, apply to A3 Assembly 03440-66502 with the following exceptions:

Delete:
- A3R65
- A3R64
- A3R63
- A3Q18
- A3QCR1
- A3CR15, 16
- Diode: silicon

Add:
- A3C4
- A3R15, 16
- A3Q14
- A3CR2
- A3CR12
- Diode: avalanche
- Diode: silicon
- R: fdx comp 100 kΩ
- TSTR: selected
- C: fdx 0.001 μF
- TSTR: 2N2712
- Diode: 1N914

Substitute the following Print Command Circuit in place of A3Q18, A3R63-65, and A3CR15, 16.

A3Q14 and A3CR12 replace A3QCR1 as shown.
Following is the component location drawing for Display and Ramp Assembly 03440-66502.

CHANGE 2

The schematic diagram and Replaceable Parts list on the following pages apply to Decade Counter Assembly, Part No. 5212L-4A, which was used in instruments with Serial No. 637-08625 and below. Later instruments use Part No. 05212-6016, which may be used as direct replacement for 5212L-4A.

CHANGE 3

Beginning with Serial No. 951-13651, the following parts were changed:
J3 changed from 1251-0148 to 1251-2357.
S6 changed from 3101-0033 to 3101-1234.
W1 changed from 8120-0078 to 8120-1348.
Rear panel changed from 03440-00202 to 03440-00203.
Old part numbers must be used in instruments Serial No. 919-13650 and below unless all four parts are replaced with new part numbers to conform to I.E.C. standards (No. 66).

CHANGE 4

A2Q3 changed from 1850-0096 to 1850-0074. New part is recommended replacement for all instruments.

CHANGE 5

Beginning with Serial No. 951-14221, the following changes were made:
R6 changed from 2100-0438 to 2100-2993.
S1, 3101-1244 added.
R10, 0683-3335 added.
Front panel changed from 03440-00201 to 03440-00204.
Old part numbers must be used in instruments Serial No. 951-14220 and below unless all parts are replaced with new part numbers to conform to I.E.C. standards (No. 66).
### A5 thru A8 ASSEMBLY

#### COMPONENT LOCATIONS

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