CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

If this product is sold as part of a Hewlett-Packard integrated instrument system, the above warranty shall not be applicable, and this product shall be covered only by the system warranty.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

FREQUENCY COUNTER

5381A

SERIAL NUMBERS: 1548A

This manual applies directly to HP Model 5381A Frequency Counters having serial numbers prefixed 1548A. With changes described in Section IV, this manual also applies to instruments with serial numbers prefixed 1532A, 1520A, and 1404A.

For additional information about serial numbers, see INSTRUMENT IDENTIFICATION in Section I.

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HEWLETT hp PACKARD

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This section of the manual gives a description of the instrument, instrument identification information, and complete specifications.

1-3. INSTRUMENT DESCRIPTION

1-4. The HP Model 5381A Frequency Counter (see Figure 1-1) is a direct-counting frequency counter that has a range of 10 Hz to 80 MHz. Seven display digits are provided. Front-panel controls allow a selection of gate times and attenuation factors of the input signal. A rear-panel connector and associated selector switch allow connection of an external time base oscillator. This feature also allows ratio measurements to be made by the counter. Refer to Table 1-1 for all counter specifications.

1-5. INSTRUMENT IDENTIFICATION

1-6. Hewlett-Packard uses a two-section, nine-digit serial number (0000A00000) mounted on the rear panel to identify the instrument. The first four digits are the serial prefix and the last five digits refer to the specific instrument. If the serial prefix on your instrument differs from that listed on the title page of this manual, there are differences between the manual and your instrument. Any lower serial prefixes are documented in Section IV of this manual and higher serial prefixes are covered by a manual change sheet included with the manual.

1-7. SPECIFICATIONS

1-8. Table 1-1 lists all specifications of the frequency counter.

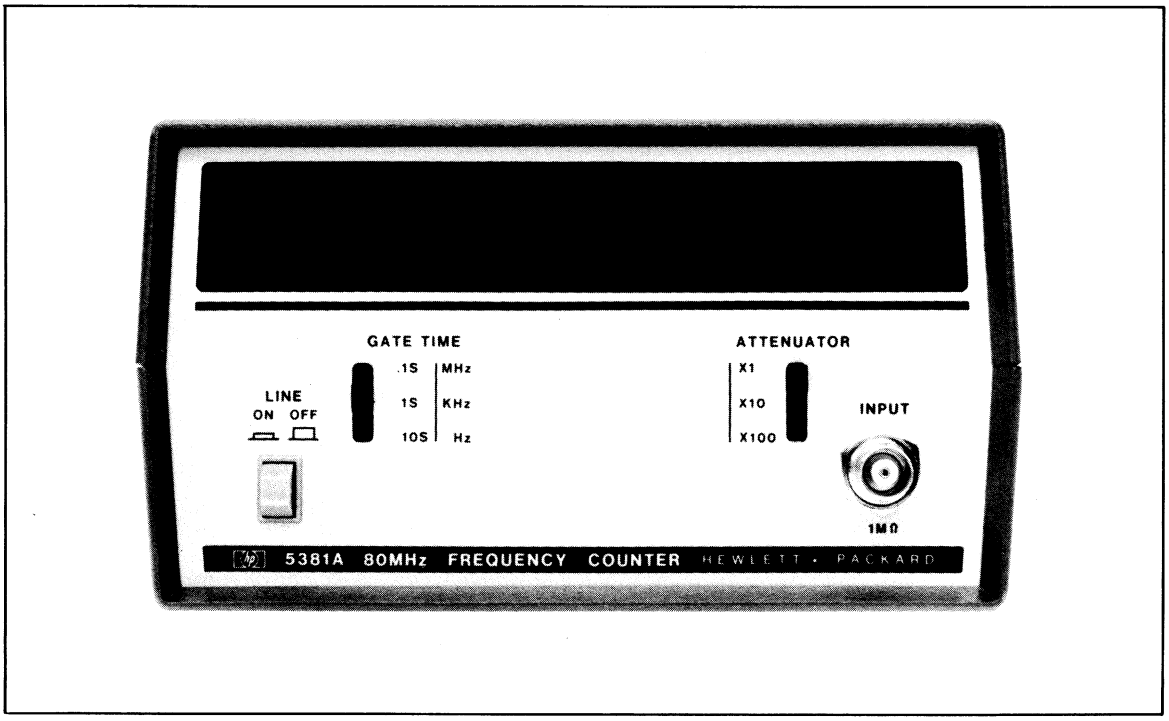


Figure 1-1. Model 5381A Frequency Counter

Table 1-1. Specifications

Frequency Range: 10 Hz to 80 MHz

Display: 7 Digit (LED's)

Input Impedance: 1 MΩ, <50 pf

Sensitivity: 25 mV (rms Sinewave) 30 Hz to 20 MHz
50 mV (rms Sinewave) 10 Hz to 80 MHz

Input Attenuator: Three Position (x1, x10, x100)

Maximum Input Levels:

Attenuator "x1"	DC to 40 Hz	200 V (dc + Peak ac)
	40 Hz to 100 kHz	250 V rms
	100 kHz to 5 MHz	2.5×10^7 V Hz
	>5 MHz	5 V rms
Attenuator "x10" "x100"	DC to 40 Hz	200 V (dc + Peak ac)
	40 Hz to 1 MHz	250 V rms
	1 MHz to 50 MHz	2.5×10^8 V Hz
	50 MHz to 80 MHz	5 V rms

Accuracy: ±1 Count ± Time Base Accuracy

Gate Times: Manually Selected .1 second, 1 second, 10 seconds

Resolution: 10 Hz at 0.1 second gate time
1 Hz at 1 second gate time
0.1 Hz at 10 second gate time

Time Base:

Internal

Frequency: 1 MHz Crystal
Aging: <0.3 ppm/Month
Temperature: ±10 ppm 0°C to 40°C
Line Voltage: ±1 ppm for 10% line variation

External Input

Frequency Range: 10 kHz to 2 MHz
Sensitivity: TTL Level or 2.5 V rms Sinewave
Maximum Input: 25 V rms dc to 2 MHz

Accessories Available:

10851A Rack Mounting Kit for mounting one HP Model 5381A, 5382A, 5383A or similar instrument in the center of a standard 48.26 cm (19.00 inches by 8.89 cm (3.5 inches) panel.

10852A Rack Mounting Kit for side by side mounting of two HP Model 5381A, 5382A, 5383A or similar instruments. Standard panel size 48.26 cm (19.00 inches) long by 8.89 cm (3.5 inches) high.

Operating Temperature: 0°C to 40°C

Power Requirements: 100, 120, 220, and 240 V rms (48 Hz to 440 Hz) (+5%—15%) 20 VA max.

Weight: Net: 4.75 lb (2,2 kg) Shipping: 6 lb (2,8 kg)

Dimensions: 3.5 in. H x 6.25 in. W x 9.75 in. D (89 mm x 160 mm x 248 mm)

SECTION II

INSTALLATION AND OPERATION

2-1. INTRODUCTION

2-2. This section of the manual provides information about unpacking, inspecting, storing, and shipping the frequency counter and gives instructions for operating the counter. Descriptions of all controls, connectors, and indicators are included.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, ask tha the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage such as scratches, dents, broken switches, etc. If the instrument is damaged or fails to meet performance tests, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately. Performance check procedures are located in Section III, and Sales and Service Offices are listed at the back of this manual. Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service Office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND SHIPMENT

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard Sales and Service Office can provide packaging material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice.

2-7. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

a. Maximum altitude: 25,000 ft.
b. Minimum temperature: -40°F (-40°C).
c. Maximum temperature: +130°F (+55°C).

2-8. LINE VOLTAGE SELECTION

2-9. The counter is supplied from the factory with the rear panel line voltage switches set for 120 volt, 48 to 440 Hz operation. If any other supply voltage is to be used, change the rear panel switch settings as follows:

a. Using a small screwdriver, a pencil, or other suitable tool, align the notches of the LINE VOLTAGE SELECTOR switches with the markings on the rear panel that correspond to the desired operating voltage (see Figure 2-1).

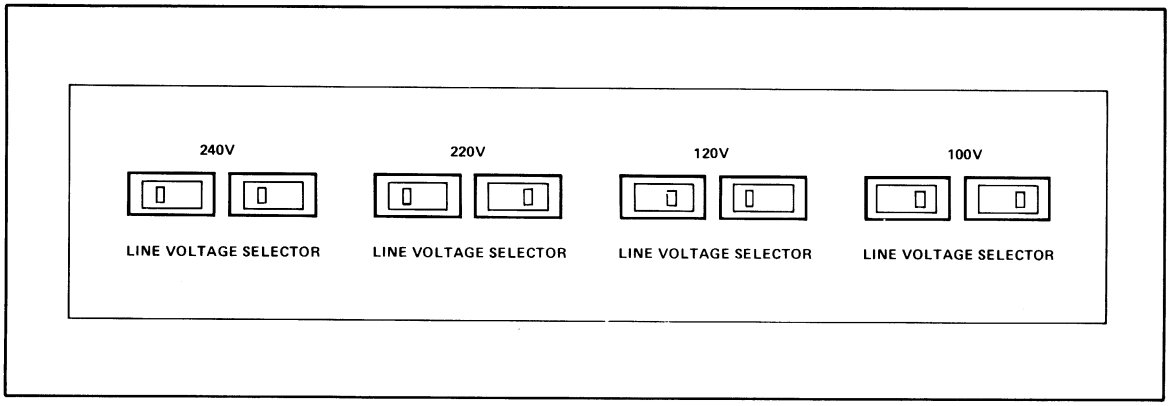


Figure 2-1. Line Voltage Selector Settings

b. Ensure that the correct fuse is installed. Use a Listed, 0.500 ampere, slow-blow fuse for 100-volt or 120-volt operation or a Listed, 0.250 ampere, slow-blow fuse for 220-volt or 240-volt operation.

2-10. If the counter is to be used in the USA with a 220-240 volt, 48-440 Hz power source, use a power cord with a Listed connector of the type shown in Figure 2-2.

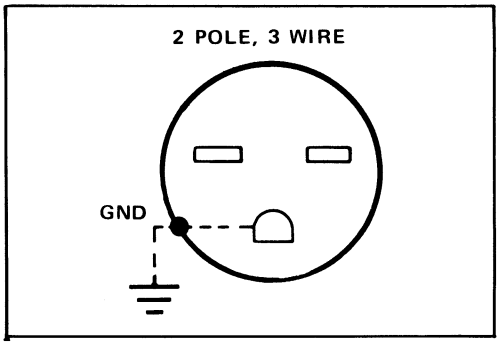


Figure 2-2. Power Cord Connector for 240-Volt Operation

2-11. OPERATION

2-12. Figures 2-3 and 2-4 describe the operation of each panel control, connector, and indicator. The following paragraphs describe proper cable and cable termination use, how to make ratio measurements with the counter, and how to optimize noise rejection with the ATTENUATOR.

2-13. Cable and Termination Requirements

2-14. To prevent miscounting due to noise, shielded cables should be used to make measurements. More specifically, a coaxial cable with a 50-ohm characteristic impedance and BNC connectors at each end are recommended for most measurements. At higher frequencies the 50-ohm cable becomes an important factor. Whenever the measured source has a 50-ohm output impedance (this is the case with most test oscillators), a 50-ohm feedthrough termination should be used. On the other hand, in cases where minimal source loading is desirable, the 50-ohm feedthrough termination should be omitted from the circuit. At frequencies up to approximately 10 MHz, and at all but the lowest signal levels, a 10:1 divider probe can be used to further reduce source loading.

2-15. Ratio Measurements

2-16. The counter will measure the ratio between the frequencies of two signals if one of the signals is applied to the rear-panel OSCILLATOR-EXT IN connector and the other signal is applied to the front-panel INPUT connector. Be sure to refer to Table 1-1 for signal level and frequency limits. The displayed value represents the ratio of one frequency to the other as shown by the following formula:

$$\frac{\text{freq at INPUT}}{\text{freq at OSCILLATOR-EXT IN}} = \frac{\text{Display Value}}{\chi}$$

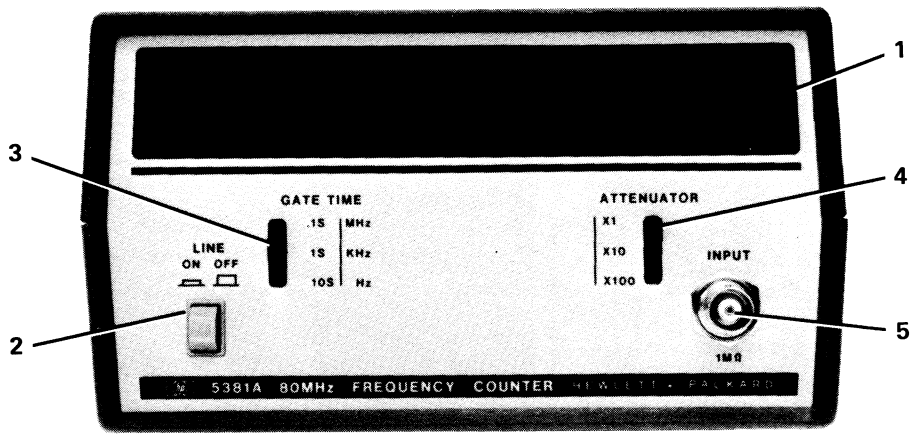
where χ = 1 if GATE TIME is .1s
10^3 if GATE TIME is 1s
10^6 if GATE TIME is 10s

Note that in the above formula the term " χ " changes by a factor of 1000 (10^3) for each change in GATE TIME setting. GATE TIME, itself, changes " χ " by a factor of 10, and the decimal point in the display shifts two places (10^2) for a total of 10^3. Note, also, that actual measurement time increases as the frequency applied to the OSCILLATOR-EXT IN connector decreases. If the frequency applied to the OSCILLATOR-EXT IN connector is 100 kHz, for example, and GATE TIME is set to 1s, actual measurement time will be 10 seconds.

2-17. Optimizing Noise Rejection

2-18. A measured signal may have a large harmonic content or noise from other sources. The presence of either can cause inaccurate or unstable displays from the counter. Measurement errors from these sources can be minimized or eliminated by proper use of the ATTENUATOR switch.

2-19. The ATTENUATOR should usually be set to "X100", then reduced, one step at a time, until a stable display is obtained. If the signal contains a high percentage of amplitude modulation, however, the above procedure may cause counting of only a portion of the cycles of the carrier signal. In these cases, the ATTENUATOR should be set to "X1" (be sure that the input amplitude does not exceed the limits specified in Table 1-1), then increased to "X10" or "X100" if this is possible without causing the displayed value to change or become unstable.



1. Display: Seven digits of LED (light-emitting diode) display are provided on the front panel. A decimal point illuminates in the proper position according to the setting of the GATE TIME switch, and an over-range indicator in the upper, left corner of the display illuminates when the counter overflows.

2. LINE switch: The ac power LINE switch is a push-on, push-off type; in the on position, the pushbutton is set further into the front panel.

3. GATE TIME switch: Gate time (measurement time) can be set at 0.1-second, 1-second, or 10 seconds with the GATE TIME switch. These positions give resolutions of 10 Hz, 1 Hz, and 0.1 Hz, respectively. If the GATE TIME switch is set to 1s, for example, it will take 1-second to make a measurement and the measured value will be displayed in 1 Hz increments. Manual resetting of the counter circuits occurs whenever the GATE TIME switch position is changed. Set the GATE TIME switch to provide the best compromise between measurement speed and resolution of the displayed value.

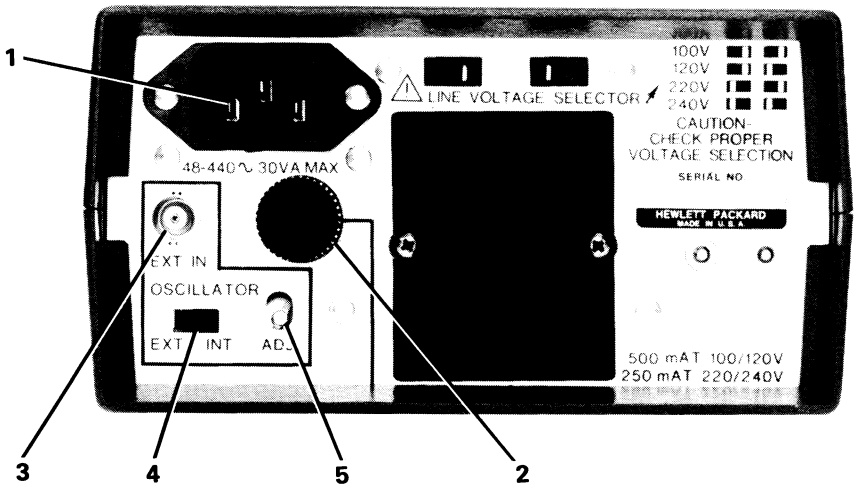
4. ATTENUATOR switch: The three-position attenuator switch provides for attenuation of input signals by factors of 10 and 100. The input signal is not attenuated when the switch is set to the "X1" position. The attenuator is used to extend the range of input signal levels that can be measured by the counter and to optimize noise rejection. Maximum sensitivity of the counter ranges from 25 millivolts rms with the attenuator set to "X1" to 2.5 volts rms with the attenuator set to "X100". If the amplitude of a measured signal is unknown or if signal noise causes the display to be unstable, set the ATTENUATOR to "X10" or "X100", then reduce the attenuation, if necessary, until a stable display is observed.

CAUTION

BE SURE THAT THE MAXIMUM ALLOWABLE INPUT VOLTAGES AS GIVEN IN TABLE 1-1, SPECIFICATIONS, ARE NOT EXCEEDED. DAMAGE TO THE COUNTER MAY OTHERWISE RESULT.

5. INPUT connector: Connect the signal to be measured to the BNC-type INPUT jack. Input impedance is 1.0 megohm.

Figure 2-3. Front Panel Operating Controls, Connectors, and Indicators



1. Power connector: Connect the source of ac power to the rear-panel power connector.

2. Fuse: A Listed, 0.500 ampere, slow-blow fuse is required for 100-volt or 120-volt operation; a Listed, 0.250 ampere, slow-blow fuse is required for 220-volt or 240-volt operation.

3. OSCILLATOR-EXT IN connector: An external oscillator can be used in place of the counter's internal time base oscillator. Connect the signal to the OSCILLATOR-EXT IN connector and set the OSCILLATOR-EXT/INT switch to EXT. See Table 1-1 for oscillator signal requirements.

4. OSCILLATOR-EXT/INT switch: set the EXT/INT switch to correspond with the source of the time base oscillator signal (see item 3, above).

5. OSCILLATOR-ADJ control: The ADJ control is used to set the frequency of the internal time base oscillator. Refer to the *Adjustments* paragraphs in Section III for information.

Figure 2-4. Rear-Panel Operating Controls and Connectors

SECTION III

MAINTENANCE

3-1. INTRODUCTION

3-2. This section of the manual provides all information necessary to service the counter. The following topics are included:

a. Theory of circuit operation.

b. In-cabinet performance checks.

c. Instrument access instructions.

d. Preventive maintenance.

e. General repair information.

f. Adjustment procedures

g. Troubleshooting instructions.

h. Replaceable parts lists.

i. A schematic diagram with support information.

3-3. THEORY OF CIRCUIT OPERATION

3-3A. The following paragraphs cover the detailed operation of the particular circuits used in this counter. For a more general description of how a counter functions and the techniques used in counting, refer to HP Application Note 172 "The Fundamentals of Electronic Frequency Counters." This application note is available from any HP Sales Office.

3-4. The input limiter, the input amplifier, and the Schmitt trigger circuits (see the block diagram of Figure 3-1) condition the measured input signals and ensure that subsequent digital circuits receive pulses with uniform rise and fall times. When the time base circuits open the main gate, these pulses pass through the main gate and are accumulated in the decade counter circuits. After the gate time elapses and the main gate closes, the counted data is stored in the data latches. The multiplexer circuits supply this stored data, one digit at a time, to the LED display. The display scan circuits synchronize the multiplexer circuits with the display enable lines, and this ensures that the proper BCD data digit is placed on the multiplexed data lines when the associated LED display digit is enabled.

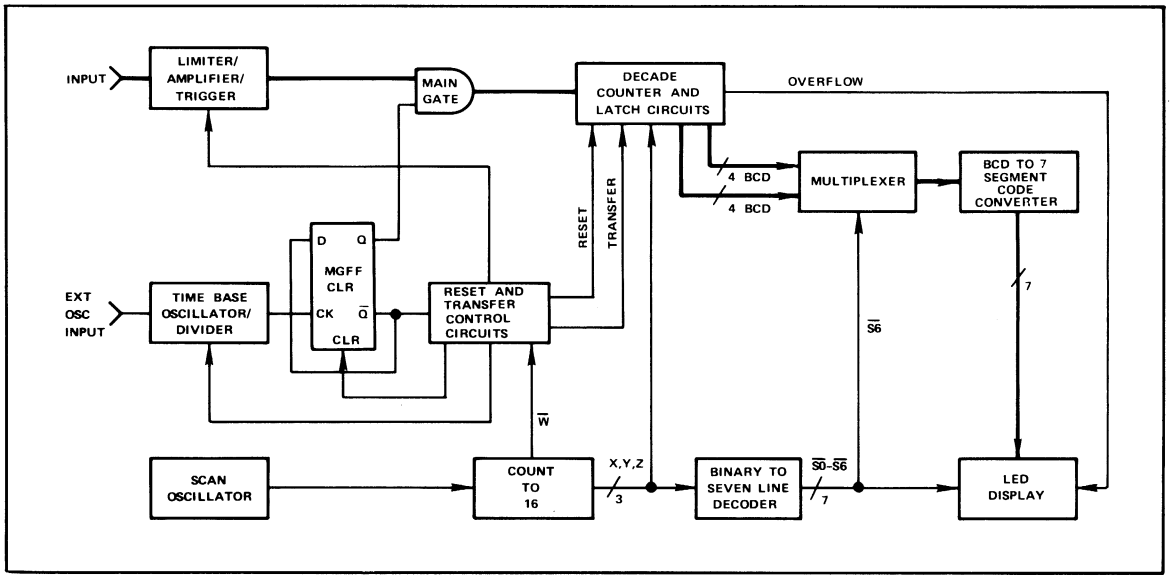


Figure 3-1. Simplified Block Diagram

3-5. Input Circuits

3-6. Diodes A1CR8 and A1CR9 limit input signal amplitude to a safe level for the subsequent circuits. Resistors A1R24 and A1R25 limit the current drawn by the diodes from high-voltage sources and, thus, reduce loading of these sources. Transistors A1Q4 and A1Q5 form a unity gain buffer amplifier that has a high input impedance, which reduces source loading, and a low output impedance to drive amplifier A1U14C. Amplifier A1U14C provides an approximate voltage gain of four and is direct coupled to A1U14B which functions as a Schmitt trigger. The balance adjustment, A1R19 provides control of the dc bias voltage applied to A1U14B which allows sensitivity to be optimized. The Schmitt trigger outputs are applied to differential amplifier A1Q1 and A1Q2, which provide sufficient gain to drive the main gate A1U7C.

3-7. Decade Counter, Latch, and Multiplexer Circuits

3-8. After the measured input signal passes through the main gate, A1U7C, it is accumulated in the decade counter circuits. Separate flip-flops within integrated circuits A1U6 and A1U10 count the least-significant decimal digit, and integrated circuit A1U9 counts the six more-significant digits. After the main gate closes, the TR (Transfer) signal transfers the data from A1U6 and A1U10 into storage latch A1U13. At the same time, the $\overline{TR}$ signal transfers the data in A1U9 into storage latches that are internal to A1U9. The stored data is then supplied to the display, one 4-bit BCD digit at a time, as controlled by the X, Y, Z, and $\overline{S6}$ signal lines from the display scanner. Circuits within A1U9 control the multiplexing operation for the six most-significant digits; the X, Y, and Z lines provide the address code. The four gates within integrated circuit A1U12 gate the least significant digit onto the data lines when the $\overline{S6}$ signal goes low. (When the $\overline{S6}$ signal is low, the Z, Y, and X lines supply a binary code of 110 to integrated circuit A1U9, the decade counter. This causes all data output lines to go to a high logic level which, in turn, allows the outputs of the gates in A1U12 to control the data lines.)

3-9. Time Base Oscillator and Divider

3-10. The time base oscillator and divider consists of integrated circuit A1U1 and associated components. The circuit provides an output at pin 1 (TP3) with a period that is determined by the oscillator crystal and the four-bit code applied to pins 11 through 14. A 1 MHz crystal is used, and the front-panel GATE TIME switch supplies the codes required to give a 0.1-second, 1-second, or 10-second gate time. The time base output at TP3 clocks the Main Gate flip-flop (MGFF), A1U3B, which controls the main gate, A1U7C. (Refer to the timing diagram of Figure 3-4.)

3-11. Display Scanner

3-12. The display scanner consists of all the circuits necessary to drive the LED (light-emitting-diode) displays. An oscillator with a frequency of approximately 20 kHz (A1U4B and A1U2F) supplies the input to a four-bit counter (A1U8). The four outputs of the counter supply a continuously cycling binary code that is used both for display scanning and counter timing.

3-13. Integrated circuit A1U11 decodes the three most significant outputs (the X, Y, and Z lines) from the four-bit counter and supplies outputs on seven separate lines, one drive line for each of the seven display digits. The X, Y, and Z lines also are used as the address lines to A1U9, where they control the multiplexing of data. This synchronizes the data output with the sequential enabling of the display digits. Integrated circuit A2U1 converts the four data bits from BCD to the seven-segment code required to drive the display. Data is supplied from circuit A2U1 to all seven display positions simultaneously, and the $\overline{S0}$ through $\overline{S6}$ lines enable only the single display position that corresponds to the data on the data lines at a given time. Transistors A2Q1 through A2Q7 provide sufficient current to drive the LED displays.

3-14. Reset and Transfer Control Circuits

3-15. The reset and transfer control circuits control the sequencing of the counter. (Refer to the timing diagram of Figure 3-4.) When the main gate closes at the end of a measurement and the Z signal line from the display scanner subsequently goes high, the Reset Control flip-flop (A1U3A) sets. The high Q output (pin 5) holds the time base IC (A1U1) in a preset condition of

maximum counts (i.e., the internal dividers are all preset to nines). The low $\overline{Q}$ output (pin 6) of the Reset Control flip-flop allows the $\overline{W}$ signal to control the output of gate A1U4C. (When the $\overline{Q}$ output is high, the output of gate A1U4C is always high.) The W, S4, S5, and S6 signals cause the following sequence of events to occur. (The $\overline{W}$ signal causes these events to occur during the middle of the $\overline{S4}$, $\overline{S5}$, and $\overline{S6}$ signals to ensure that these outputs are stable.) First, when the $\overline{W}$ and $\overline{S4}$ signals are low, the TR and $\overline{TR}$ signals are generated and used to transfer data from the decade counters to the storage latches. When the $\overline{W}$ and $\overline{S5}$ signals are low, the RSC signal is generated. The RSC signal resets the decade counters and, through A1U14A, presets the Schmitt trigger in the counter's input circuits. When the $\overline{W}$ and $\overline{S6}$ signals are low, the Reset Control flip-flop clears. This allows the time base reset line (A1U1, pin 6) to return high and a new measurement to be made.

3-16. RECOMMENDED TEST EQUIPMENT

3-17. Test equipment recommended for maintaining the counter is listed in Table 3-1. Equipment with equivalent characteristics may be substituted for the recommended equipment.

Table 3-1. Recommended Test Equipment

Instrument Type	Required Characteristics	Recommended Instrument
Electronic Counter	1 MHz frequency measurements and high stability time base.	HP 5382A-001
VHF Oscillator	Range: 80 MHz	HP 3200B
Test Oscillator	Range: 10 Hz to 10 MHz Output: 2.5 Vrms	HP 651B
RF Millivoltmeter	Frequency: 20 MHz to 80 MHz Range: 25 mV rms to 50 mV rms	HP 411A or HP 3406A
50-Ohm Feed-thru	50-Ohm termination, male-to-female BNC connectors	HP 11048A
Logic Probe	Logic level measurements	HP 10525T
Oscilloscope	1 MHz measurments	HP 180A/1801A/1820A

3-18. IN-CABINET PERFORMANCE CHECK

3-19. Use the performance check in Table 3-2 to verify proper operation of all circuits within the counter. The check should be used when improper operation or nonconformance to specifications is suspected.

3-20. INSTRUMENT ACCESS

3-21. Most maintenance operations required that the top and bottom covers be removed from the counter. Remove the covers according to the following procedure.

WARNING

DISCONNECT THE AC POWER CORD FROM THE COUNTER PRIOR TO REMOVING COVERS. EXPOSED TERMINALS WITHIN THE COUNTER (INCLUDING SEVERAL POINTS ON THE PRINTED-CIRCUIT BOARDS) CAN SUPPLY SUFFICIENT ENERGY TO CAUSE INJURY OR DEATH.

a. Position the instrument upside down and remove the four machine screws from the bottom of the instrument.

b. Lift the bottom cover from the instrument, then remove the printed circuit (with the front and rear panels attached) by pulling the boards straight out of the top cover.

c. Reassemble in reverse order of disassembly; ensure that the standoff spacers on top cover are aligned with the corresponding holes on the main circuit board.

Table 3-2. In-Cabinet Performance Check

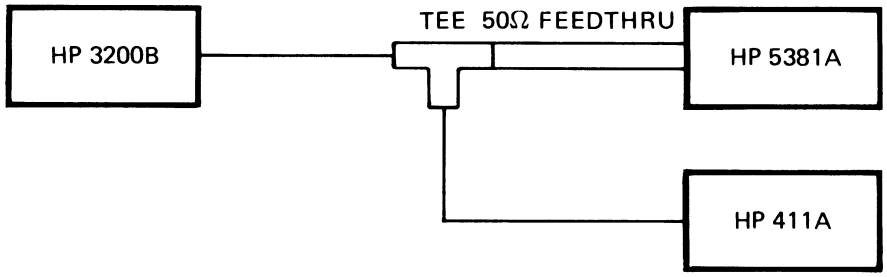
1. SENSITIVITY

Obtain the following test equipment:

HP 411A RF Millivoltmeter
HP 651B Test Oscillator
HP 3200B UHF Oscillator
HP 11048A 50-Ohm Feed-Thru

a. Set the counter's ATTENUATOR switch to X1.

b. Connect the test equipment to the counter as shown below.



c. Set the 3200B to provide an 80 MHz output at 50 mV rms as indicated on the 411A.

d. Counter's display should indicate 80 MHz and displayed value should be stable.

e. Set the 3200B to provide a 20 MHz output at 25 mV rms as indicated on the 411A.

f. Counter's display should indicate 20 MHz and displayed value should be stable.

g. Remove 3200B and 411A, and connect the 50Ω output of the 651B to the counter. Use a 50-ohm feed-thru at the couner's INPUT connector.

h. Set the 651B to provide an output of 10 Hz at 50 mV rms.

i. Counter's display should indicate 10 Hz and displayed value should be stable.

j. Set the 651B to provide an output of 30 Hz at 25 mV rms.

k. Counter's display should indicate 30 Hz and displayed value should be stable.

2. EXTERNAL OSCILLATOR INPUT

Obtain the following test equipment:

HP 651B Test Oscillator
HP 11048A 50-Ohm Feed-Thru

a. Set the counter's ATTENUATOR switch to X1, GATE TIME switch to .1s, and OSCILLATOR-EXT/INT switch to EXT.

Table 3-2. In-Cabinet Performance Check (Continued)

b. Connect the 50Ω output of the 651B to the counter's rear-panel OSCILLATOR-EXT IN connector through a Tee connector and a 50-ohm feed-thru termination.

c. Connect a cable between the unused end of the Tee connector and the counter's front-panel INPUT connector.

d. Set the 651B for an output of 2 MHz at 2.5 Vrms. The counter's display should be 01.00000 ±1 count.

e. Set the 651B for an output of 10 kHz at 2.5 Vrms. The counter's display should be 01.00000 ±1 count.

3. DISPLAY

Obtain the following test equipment:

HP 651B Test Oscillator
HP 11048A 50-Ohm Feed-Thru

a. With no signal applied, set the front-panel GATE TIME switch to each of its three settings. The decimal point should move to give the following displays:

00.00000 for .1s gate time,
0000.000 for 1s gate time,
000000.0 for 10s gate time.

b. Connect the 651B to the counter's INPUT connector. Use the 50-ohm feed-thru at the counter-end of the cable.

c. Adjust the 651B frequency and the counter GATE TIME switch until an eight has been observed in each of the seven display positions. This ensures that each display segment is operative.

3-22. PREVENTIVE MAINTENANCE

3-23. Periodically, perform the In-Cabinet Performance Check of Table 3-2 to verify proper operation of the counter. Additionally, whenever the covers are removed, check for broken or burned components, damaged wires, excess dust, etc.

3-24. GENERAL REPAIR

3-25. The following paragraphs provide general repair information for the counter.

3-26. COMPONENT REPLACEMENT. When replacing a circuit board component, use a low heat soldering iron. Heat must be used sparingly as damage to the circuit foil may otherwise occur. Mounting holes may be cleaned with a toothpick while heat is applied. After component removal and replacement, clean connections with a suitable cleaning solution.

3-27. INTEGRATED CIRCUIT REPLACEMENT. Two methods are recommended for removing integrated crcuits:

a. Solder Gobbler. Solder is removed from board by a soldering iron with a hollow tip that is connected to a vacuum source. The IC is removed intact, so it may be reinstalled if it is later proven not to be defective.

b. Clip Out. This method is used when an IC is proven defective. Clip leads close to case, apply heat, and remove leads with long-nose pliers. Clean board holes with a toothpick and cleaning solution.

3-28. ADJUSTMENTS

3-29. The counter requires two circuit adjustments: 1) the input amplifier balance adjustment and 2) the time base oscillator adjustment. Perform the adjustments according to the following procedures.

3-30. Amplifier Balance Adjustment

3-31. Adjust the input amplifier balance as follows:

a. Remove top and bottom covers from the counter as described in Paragraph 3-20. Be sure to observe WARNING note in Paragraph 3-20.

b. Connect the oscilloscope to TP6 on the A1 Main Board Assembly.

c. Connect the test oscillator 50Ω output to the front-panel INPUT connector (use a 50-ohm feed-through at the INPUT connector), and set the test oscillator to provide an output of approximately 30 mV rms at a frequency of 1 MHz.

d. Connect ac power to the counter. Be sure to observe the WARNING note in Paragraph 3-20.

e. Adjust potentiometer A1R19 until the oscilloscope shows that the signal at TP6 has a 50 percent duty cycle.

f. Remove ac power from the counter, remove test equipment, and install the counter in the top and bottom covers.

3-32. Oscillator Adjustment

3-33. Set the time base oscillator frequency as follows:

a. Connect ac power to the counter, depress the front-panel LINE switch, and allow 5 minutes for the oscillator to stabilize.

b. Connect the rear-panel oscillator output jack on the 5382A-001 (or equivalent, stable, 10 MHz source) to the counter's INPUT connector.

c. Set the counter's GATE TIME switch to 1s and adjust the rear-panel OSCILLATOR ADJ. control until the counter display indicates exactly 10 MHz. Note that the over range indicator is lit and the most significant digit is not displayed (00.00000).

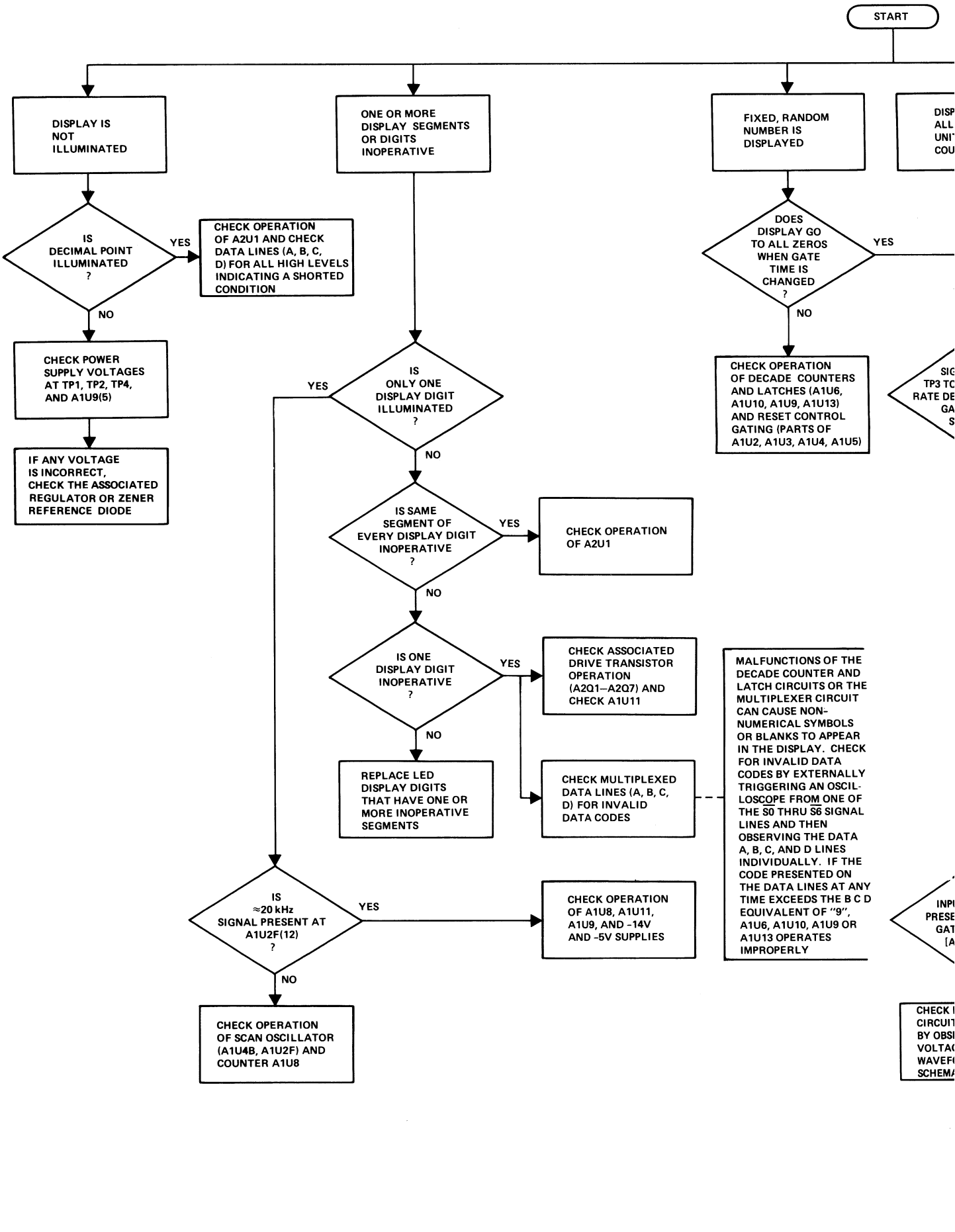
d. Remove ac power and disconnect test equipment.

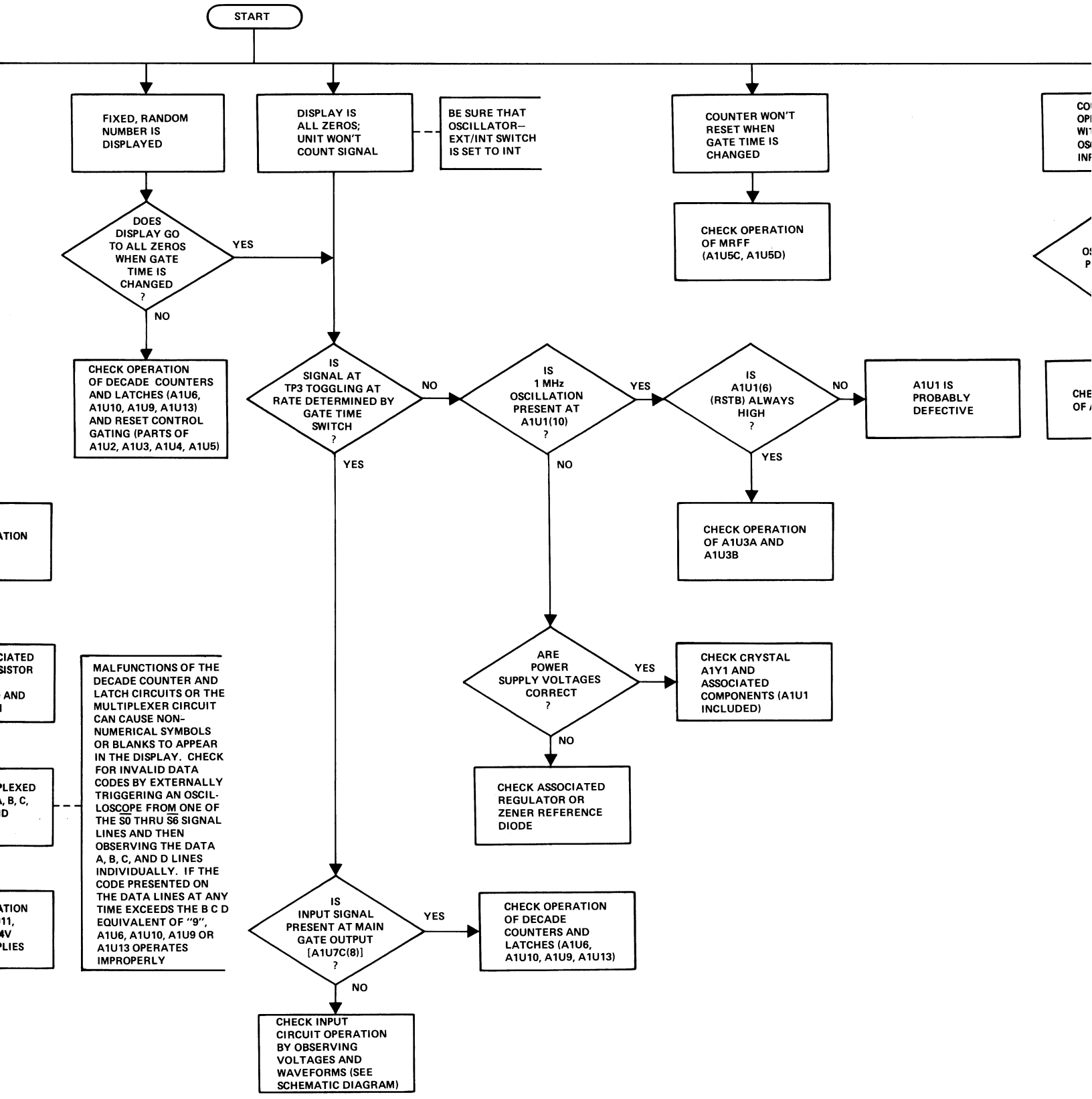
3-34. TROUBLESHOOTING

3-35. Malfunctions of the counter circuits produce several symptoms of trouble. The troubleshooting flowchart of Figure 3-2 lists these symptoms and provides a sequential test to isolate the trouble to a component or small group of components. To troubleshoot the counter, find the observed symptom at the top of the flowchart and perform the indicated circuit checks.

3-36. Additional information in the form of a timing diagram, Figure 3-4, and waveform illustrations (with the schematic diagram) is provided to aid troubleshooting.

Figure 3-2
TROUBLESHOOTING FLOW CHART


START
DISPLAY IS NOT ILLUMINATED
IS DECIMAL POINT ILLUMINATED ?
YES
CHECK OPERATION OF A2U1 AND CHECK DATA LINES (A, B, C, D) FOR ALL HIGH LEVELS INDICATING A SHORTED CONDITION
NO
CHECK POWER SUPPLY VOLTAGES AT TP1, TP2, TP4, AND A1U9(5)
IF ANY VOLTAGE IS INCORRECT, CHECK THE ASSOCIATED REGULATOR OR ZENER REFERENCE DIODE
ONE OR MORE DISPLAY SEGMENTS OR DIGITS INOPERATIVE
IS ONLY ONE DISPLAY DIGIT ILLUMINATED ?
YES
NO
IS SAME SEGMENT OF EVERY DISPLAY DIGIT INOPERATIVE ?
YES
CHECK OPERATION OF A2U1
NO
IS ONE DISPLAY DIGIT INOPERATIVE ?
YES
CHECK ASSOCIATED DRIVE TRANSISTOR OPERATION (A2Q1–A2Q7) AND CHECK A1U11
NO
REPLACE LED DISPLAY DIGITS THAT HAVE ONE OR MORE INOPERATIVE SEGMENTS
CHECK MULTIPLEXED DATA LINES (A, B, C, D) FOR INVALID DATA CODES
MALFUNCTIONS OF THE DECADE COUNTER AND LATCH CIRCUITS OR THE MULTIPLEXER CIRCUIT CAN CAUSE NON-NUMERICAL SYMBOLS OR BLANKS TO APPEAR IN THE DISPLAY. CHECK FOR INVALID DATA CODES BY EXTERNALLY TRIGGERING AN OSCILLOSCOPE FROM ONE OF THE S0 THRU S6 SIGNAL LINES AND THEN OBSERVING THE DATA A, B, C, AND D LINES INDIVIDUALLY. IF THE CODE PRESENTED ON THE DATA LINES AT ANY TIME EXCEEDS THE B C D EQUIVALENT OF "9", A1U6, A1U10, A1U9 OR A1U13 OPERATES IMPROPERLY
IS ≈20 kHz SIGNAL PRESENT AT A1U2F(12) ?
YES
CHECK OPERATION OF A1U8, A1U11, A1U9, AND -14V AND -5V SUPPLIES
NO
CHECK OPERATION OF SCAN OSCILLATOR (A1U4B, A1U2F) AND COUNTER A1U8
FIXED, RANDOM NUMBER IS DISPLAYED
DOES DISPLAY GO TO ALL ZEROS WHEN GATE TIME IS CHANGED ?
YES
NO
CHECK OPERATION OF DECADE COUNTERS AND LATCHES (A1U6, A1U10, A1U9, A1U13) AND RESET CONTROL GATING (PARTS OF A1U2, A1U3, A1U4, A1U5)


START
FIXED, RANDOM NUMBER IS DISPLAYED
DISPLAY IS ALL ZEROS; UNIT WON'T COUNT SIGNAL
BE SURE THAT OSCILLATOR–EXT/INT SWITCH IS SET TO INT
COUNTER WON'T RESET WHEN GATE TIME IS CHANGED
DOES DISPLAY GO TO ALL ZEROS WHEN GATE TIME IS CHANGED ?
YES
NO
CHECK OPERATION OF MRFF (A1U5C, A1U5D)
CHECK OPERATION OF DECADE COUNTERS AND LATCHES (A1U6, A1U10, A1U9, A1U13) AND RESET CONTROL GATING (PARTS OF A1U2, A1U3, A1U4, A1U5)
IS SIGNAL AT TP3 TOGGLING AT RATE DETERMINED BY GATE TIME SWITCH ?
NO
YES
IS 1 MHz OSCILLATION PRESENT AT A1U1(10) ?
YES
NO
IS A1U1(6) (RSTB) ALWAYS HIGH ?
NO
YES
A1U1 IS PROBABLY DEFECTIVE
CHECK OPERATION OF A1U3A AND A1U3B
ARE POWER SUPPLY VOLTAGES CORRECT ?
YES
NO
CHECK CRYSTAL A1Y1 AND ASSOCIATED COMPONENTS (A1U1 INCLUDED)
CHECK ASSOCIATED REGULATOR OR ZENER REFERENCE DIODE
MALFUNCTIONS OF THE DECADE COUNTER AND LATCH CIRCUITS OR THE MULTIPLEXER CIRCUIT CAN CAUSE NON-NUMERICAL SYMBOLS OR BLANKS TO APPEAR IN THE DISPLAY. CHECK FOR INVALID DATA CODES BY EXTERNALLY TRIGGERING AN OSCILLOSCOPE FROM ONE OF THE S0 THRU S6 SIGNAL LINES AND THEN OBSERVING THE DATA A, B, C, AND D LINES INDIVIDUALLY. IF THE CODE PRESENTED ON THE DATA LINES AT ANY TIME EXCEEDS THE B C D EQUIVALENT OF "9", A1U6, A1U10, A1U9 OR A1U13 OPERATES IMPROPERLY
IS INPUT SIGNAL PRESENT AT MAIN GATE OUTPUT [A1U7C(8)] ?
YES
NO
CHECK OPERATION OF DECADE COUNTERS AND LATCHES (A1U6, A1U10, A1U9, A1U13)
CHECK INPUT CIRCUIT OPERATION BY OBSERVING VOLTAGES AND WAVEFORMS (SEE SCHEMATIC DIAGRAM)

Fig

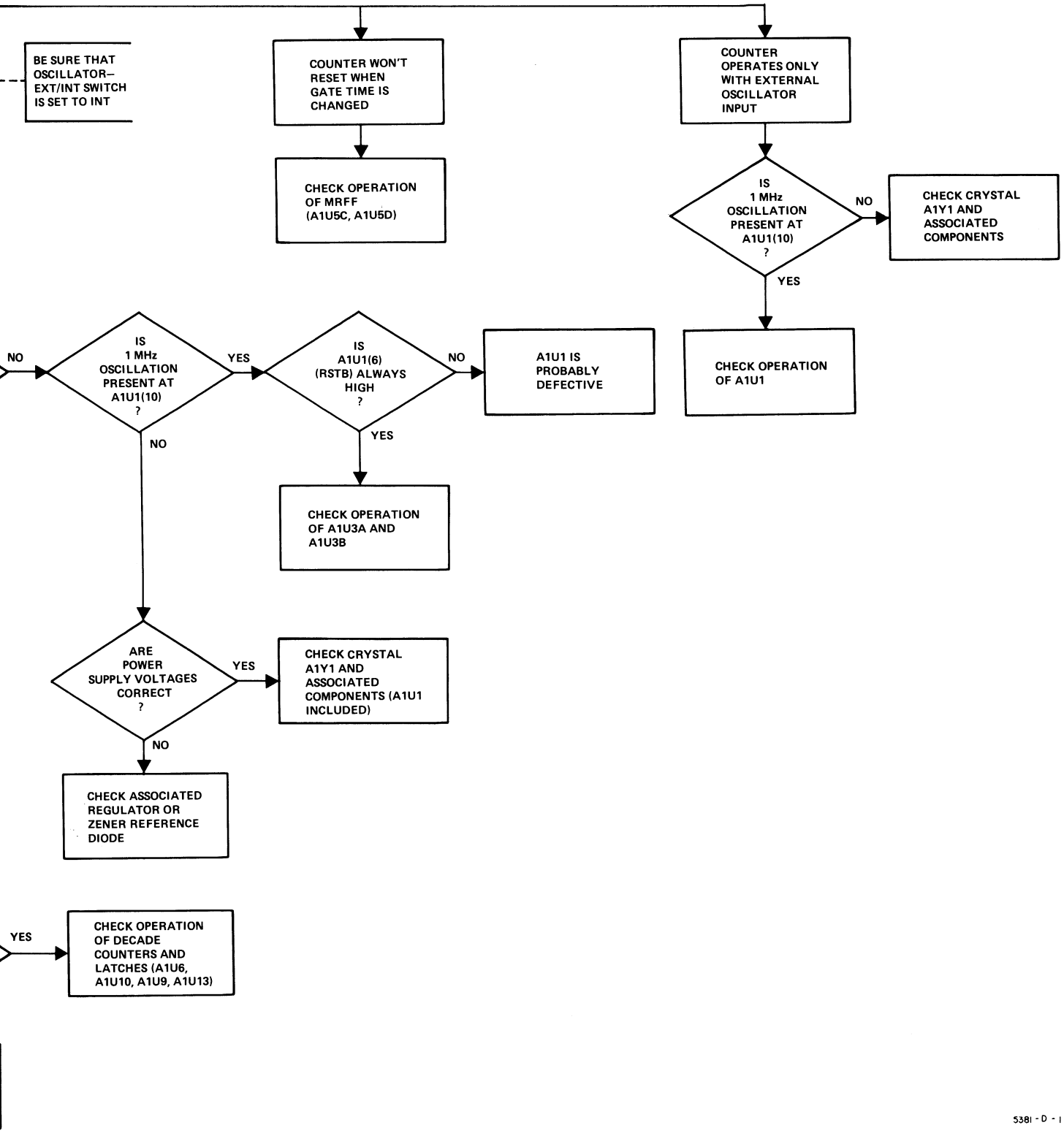


Figure 3-2. Troubleshooting Flow Chart

3-37. REPLACEABLE PARTS

3-38. Table 3-3 lists parts used in the counter in alphanumeric order of their reference designations and provides the following information for each part. Miscellaneous parts are listed at the end of Table 3-3.

a. Hewlett-Packard part number

b. Description of part (see abbreviations)

c. Total quantity used in the instrument

d. Typical manufacturer of the part in a five-digit code (see list of manufacturers in Table 3-4).

e. Manufacturer's part number.

3-39. Replacement LED Digital Display Units

3-40. The digital display LED units in each instrument are matched for uniform brightness. Correct replacement units to match the rest of the display units in a particular instrument can be identified by the part number on the display unit being replaced. Some are marked 5082-7731 or 1990-0452 with suffix letters of "C", "D", or "E". Refer to the listing below to determine the new equivalent part number for the correct replacement LED display unit.

FORMER PART NO.	NEW EQUIVALENT PART NO.
5080-7731C 1990-0452C	1990-0469
5082-7731D 1990-0452D	1990-0470
5082-7731E 1990-0452E	1990-0471

3-41. ORDERING INFORMATION

3-42. To obtain replacement parts, address order to your local Hewlett-Packard Sales and Service Office (see lists at the back of this manual for addresses). Identify parts by their Hewlett-Packard part number. 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.

3-43. SCHEMATIC DIAGRAM

3-44. Figure 3-3 defines the symbols and reference designation arrangement used on the schematic diagram of Figure 3-6. Additional information in the form of a timing diagram, Figure 3-4, and component locator illustrations, Figure 3-5, precede the schematic diagram of Figure 3-6.

REFERENCE DESIGNATIONS

A	= assembly	E	= miscellaneous electrical part	P	= electrical connector (movable portion); plug	U	= integrated circuit; microcircuit
AT	= attenuator; isolator; termination	F	= fuse			V	= electron tube
B	= fan; motor	FL	= filter	Q	= transistor; SCR; triode thyristor	VR	= voltage regulator; breakdown diode
BT	= battery	H	= hardware				
C	= capacitor	HY	= circulator	R	= resistor	W	= cable; transmission path; wire
CP	= coupler	J	= electrical connector (stationary portion); jack	RT	= thermistor		
CR	= diode; diode thyristor; varactor			S	= switch	X	= socket
				T	= transformer	Y	= crystal unit–piezoelectric
DC	= directional coupler	K	= relay	TB	= terminal board		
DL	= delay line	L	= coil; inductor	TC	= thermocouple	Z	= tuned cavity; tuned circuit
DS	= annunciator; signaling device (audible or visual); lamp; LED	M	= meter	TP	= test point		
		MP	= miscellaneous mechanical part				

ABBREVIATIONS

A	= ampere	avg	= average	CHAN	= channel	dc	= direct current
ac	= alternating current	AWG	= American wire gauge	cm	= centimeter	deg	= degree (temperature interval or difference)
ACCESS	= accessory			CMO	= cabinet mount only		
ADJ	= adjustment	BAL	= balance	COAX	= coaxial		
A/D	= analog-to-digital	BCD	= binary coded decimal	COEF	= coefficient	...°	= degree (plane angle)
AF	= audio frequency			COM	= common	°C	= degree Celsius (centigrade)
AFC	= automatic frequency control	BD	= board	COMP	= composition		
		BE CU	= beryllium copper	COMPL	= complete	°F	= degree Fahrenheit
AGC	= automatic gain control	BFO	= beat frequency oscillator	CONN	= connector	°K	= degree Kelvin
				CP	= cadmium plate	DEPC	= deposited carbon
AL	= aluminum	BH	= binder head	CRT	= cathode-ray tube	DET	= detector
ALC	= automatic level control	BKDN	= breakdown	CTL	= complementary transistor logic	diam	= diameter
		BP	= bandpass			DIA	= diameter (used in parts list)
AM	= amplitude modulation	BPF	= bandpass filter	CW	= continuous wave		
		BRS	= brass	cw	= clockwise	DIFF AMPL	= differential amplifier
AMPL	= amplifier	BWO	= backward-wave oscillator	cm	= centimeter		
APC	= automatic phase control			D/A	= digital-to-analog	div	= division
		CAL	= calibrate	dB	= decibel	DPDT	= double-pole, double-throw
ASSY	= assembly	ccw	= counterclockwise	dBm	= decibel referred to 1 mW		
AUX	= auxiliary	CER	= ceramic			DR	= drive

ABBREVIATIONS

DSB = double sideband
DTL = diode transistor logic
DVM = digital voltmeter
ECL = emitter coupled logic
EMF = electromotive force
EDP = electronic data processing
ELECT = electrolytic
ENCAP = encapsulated
EXT = external
F = farad
FET = field-effect transistor
F/F = flip-flop
FH = flat head
FIL H = fillister head
FM = frequency modulation
FP = front panel
FREQ = frequency
FXD = fixed
g = gram
GE = germanium
GHz = gigahertz
GL = glass
GND = ground(ed)
H = henry
h = hour
HET = heterodyne
HEX = hexagonal
HD = head
HDW = hardware
HF = high frequency
HG = mercury
HI = high
HP = Hewlett-Packard
HPF = high pass filter
HR = hour (used in parts list)
HV = high voltage
Hz = Hertz
IC = integrated circuit
ID = inside diameter
IF = intermediate frequency
IMPG = impregnated
in = inch
INCD = incandescent
INCL = include(s)
INP = input
INS = insulation
INT = internal
kg = kilogram
kHz = kilohertz
kΩ = kilohm
kV = kilovolt
lb = pound
LC = inductance-capacitance
LED = light-emitting diode
LF = low frequency
LG = long
LH = left hand
LIM = limit
LIN = linear taper (used in parts list)
lin = linear
LK WASH = lock washer
LO = low; local oscillator
LOG = logarithmic taper (used in parts list)
log = logarithm(ic)
LPF = low pass filter
LV = low voltage
m = meter (distance)
mA = milliampere
MAX = maximum
MΩ = megohm
MEG = meg (10^6) (used in parts list)
MET FLM = metal film
MET OX = metal oxide
MF = medium frequency; microfarad (used in parts list)
MFR = manufacturer
mg = milligram
MHz = megahertz
mH = millihenry
mho = mho
MIN = minimum
min = minute (time)
... ′ = minute (plane angle)
MINAT = miniature
mm = millimeter
MOD = modulator
MOM = momentary
MOS = metal-oxide semiconductor
ms = millisecond
MTG = mounting
MTR = meter (indicating device)
mV = millivolt
mVac = millivolt, ac
mVdc = millivolt, dc
mVpk = millivolt, peak
mV p-p = millivolt, peak-to-peak
mVrms = millivolt, rms
mW = milliwatt
MUX = multiplex
MY = mylar
μA = microampere
μF = microfarad
μH = microhenry
μmho = micromho
μs = microsecond
μV = microvolt
μVac = microvolt, ac
μVdc = microvolt, dc
μVpk = microvolt, peak
μVp-p = microvolt, peak-to-peak
μVrms = microvolt, rms
μW = microwatt
nA = nanoampere
NC = no connection
N/C = normally closed
NE = neon
NEG = negative
nF = nanofarad
NI PL = nickel plate
N/O = normally open
NOM = nominal
NORM = normal
NPN = negative-positive-negative
NPO = negative-positive zero (zero temperature coefficient)
NRFR = not recommended for field replacement
NSR = not separately replaceable
ns = nanosecond
nW = nanowatt
OBD = order by description
OD = outside diameter
OH = oval head
OP AMPL = operational amplifier
OPT = option
OSC = oscillator
OX = oxide
oz = ounce
Ω = ohm
P = peak (used in parts list)
PAM = pulse-amplitude modulation
PC = printed circuit
PCM = pulse-code modulation; pulse-count modulation
PDM = pulse-duration modulation
pF = picofarad
PH BRZ = phosphor bronze
PHL = Phillips
PIN = positive-instrinsic-negative
PIV = peak inverse voltage
pk = peak
PL = phase lock
PLO = phase lock oscillator
PM = phase modulation
PNP = positive-negative-positive
P/O = part of
POLY = polystyrene
PORC = porcelain
POS = positive; position(s) (used in parts list)
POSN = position
POT = potentiometer
p-p = peak-to-peak
PP = peak-to-peak (used in parts list)
PPM = pulse-position modulation
PREAMPL = preamplifier
PRF = pulse-repetition frequency
PRR = pulse repetition rate
ps = picosecond
PT = point
PTM = pulse-time modulation
PWM = pulse-width modulation
PWV = peak working voltage
RC = resistance capacitance
RECT = rectifier
REF = reference
REG = regulated
REPL = replaceable
RF = radio frequency
RFI = radio frequency interference
RH = round head; right hand
RLC = resistance-inductance-capacitance
RMO = rack mount only
rms = root-mean-square
RND = round
ROM = read-only memory
R&P = rack and panel
RWV = reverse working voltage
S = scattering parameter
s = second (time)
... ″ = second (plane angle)
S-B = slow-blow (fuse) (used in parts list)
SCR = silicon controlled rectifier; screw
SE = selenium
SECT = sections
SEMICON = semiconductor
SHF = superhigh frequency
SI = silicon
SIL = silver
SL = slide
SNR = signal-to-noise ratio
SPDT = single-pole, double-throw
SPG = spring
SR = split ring
SPST = single-pole, single-throw
SSB = single sideband
SST = stainless steel
STL = steel
SQ = square
SWR = standing-wave ratio
SYNC = synchronize
T = timed (slow-blow fuse)
TA = tantalum
TC = temperature compensating
TD = time delay
TERM = terminal
TFT = thin-film transistor
TGL = toggle
THD = thread
THRU = through
TI = titanium
TOL = tolerance
TRIM = trimmer
TSTR = transistor
TTL = transistor-transistor logic
TV = television
TVI = television interference
TWT = traveling wave tube
U = micro (10^{-6}) (used in parts list)
UF = microfarad (used in parts list)
UHF = ultrahigh frequency
UNREG = unregulated
V = volt
VA = voltampere
Vac = volts, ac
VAR = variable
VCO = voltage-controlled oscillator
Vdc = volts, dc
VDCW = volts, dc, working (used in parts list)
V(F) = volts, filtered
VFO = variable-frequency oscillator
VHF = very-high frequency
Vpk = volts, peak
Vp-p = volts, peak-to-peak
Vrms = volts, rms
VSWR = voltage standing wave ratio
VTO = voltage-tuned oscillator
VTVM = vacuum-tube voltmeter
V(X) = volts, switched
W = watt
W/ = with
WIV = working inverse voltage
WW = wirewound
W/O = without
YIG = yttrium-iron-garnet
Zo = characteristic impedance

NOTE

All abbreviations in the parts list will be in upper case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 3-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05381-60006	1	BOARD ASSEMBLY, MAIN (SERIES 1548)	28480	05381-60006
A1C1	0180-0480	1	CAPACITOR, FXD 4500UF +75-10% 25VDC AL	56289	36DX452G025AA2A
A1C2	0121-0105	1	CAPACITOR-V TRMR-CER 9/35PF 200V PC-MTG	0086S	304324 9/35PF N650
A1C3	0160-2265	1	CAPACITOR-FXD 22PF +-5% 500WVDC CER	28480	0160-2265
A1C4	0160-2055	14	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C5	0140-0192	1	CAPACITOR-FXD 68PF +-5% 300WVDC MICA	72136	DM15E680J0300WV1CR
A1C6	0180-0061	1	CAPACITOR-FXD 100UF+75-10% 16VDC AL	56289	30D107G016DC2
A1C7	0180-0058	1	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A1C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C9	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C10	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C11	0180-0291	2	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1C12	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C13	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C14	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C15	0180-0106	5	CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A1C16	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C17	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C18	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C18	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C19	0180-0106		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A1C20	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C21	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1C22	0180-0106		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A1C23	0180-0106		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A1C24	0150-0072	1	CAPACITOR-FXD 200PF +-5% 1000WVDC CER	28480	0150-0072
A1C25	0140-0204	1	CAPACITOR-FXD 47PF +-5% 500WVDC MICA	72136	DM15E470J0500WV1CR
A1C26	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C27	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A1C28	0160-0161	1	CAPACITOR-FXD .01UF +-10% 200WVDC POLYE	56289	292P10392
A1CR1	1906-0028	1	DIODE-MULT FULL WAVE BRIDGE RECTIFIER	04713	MDA922-3
A1CR2	1901-0040	5	DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A1CR3	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A1CR4	1901-0028	1	DIODE-PWR RECT 400V 750NA DO-29	04713	SR1358-9
A1CR5	1902-0579	1	DIODE-ZNR 5.11V 5% DO-15 PD=1W TC=-.009%	28480	1902-0579
A1CR6			NOT ASSIGNED		
A1CR7	1902-0202	1	DIODE-ZNR 15V 5% DO-15 PD=1W TC=+.057%	28480	1902-0202
A1CR8	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A1CR9	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A1L1	9100-2251	1	COIL-FXD MOLDED RF CHOKE .22UH 10%	24226	10/220
A1L2	9140-0137	1	COIL-FXD MOLDED RF CHOKE 1MH 5%	24226	19/104
A1Q1	1853-0015	3	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A1Q2	1853-0015		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A1Q3	1854-0071	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1Q4	1853-0015		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A1Q5	1855-0081	1	TRANSISTOR J-FET 2N5245 N-CHAN D-MODE SI	01295	2N5245
A1R1	0683-2435	1	RESISTOR 24K 5% .25W FC TC=-400/+800	01121	CB2435
A1R2	0683-3355	1	RESISTOR 3.3M 5% .25W FC TC=-900/+1100	01121	CB3355
A1R3	0683-5655	1	RESISTOR 5.6M 5% .25W FC TC=-900/+1100	01121	CB5655
A1R4	0683-2225	2	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A1R5	0761-0042	1	RESISTOR 68 5% 1W MO TC=0+-200	24546	FP32-1-T00-68R0-J
A1R6	0761-0026	1	RESISTOR 220 5% 1W MO TC=0+-200	24546	FP32-1-T00-221-J
A1R7	0683-1215	2	RESISTOR 120 5% .25W FC TC=-400/+600	01121	CB1215
A1R8	0683-5125	1	RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A1R9	0683-1215		RESISTOR 120 5% .25W FC TC=-400/+600	01121	CB1215
A1R10	0683-1525	1	RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
A1R11	0683-2225		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A1R12	0683-5605	1	RESISTOR 56 5% .25W FC TC=-400/+500	01121	CB5605
A1R13	0683-2205	1	RESISTOR 22 5% .25W FC TC=-400/+500	01121	CB2205
A1R14	0683-5115	3	RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A1R15	0683-2015	1	RESISTOR 200 5% .25W FC TC=-400/+600	01121	CB2015
A1R16	0683-3315	3	RESISTOR 330 5% .25W FC TC=-400/+600	01121	CB3315
A1R17	0683-3315		RESISTOR 330 5% .25W FC TC=-400/+600	01121	CB3315
A1R18	0683-3315		RESISTOR 330 5% .25W FC TC=-400/+600	01121	CB3315
A1R19	2100-3210	1	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	32997	3386P-Y46-103
A1R20	0683-1045	1	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
A1R21	0683-2025	2	RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A1R22	0683-2025		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
A1R23	1810-0125	1	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0125
A1R24	0686-5105	1	RESISTOR 51 5% .5W CC TC=0+412	01121	EB5105
A1R25	0683-3345	1	RESISTOR 330K 5% .25W FC TC=-800/+900	01121	CB3345

See introduction to this section for ordering information

Table 3-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R26	0683-5115		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A1R27	0683-5115		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A1R28	0683-7525	1	RESISTOR 7.5K 5% .25W FC TC=-400/+700	01121	CB7525
A1S1	3101-1667	1	SWITCH-SL SPDT-NS SUBMIN .5A 125VAC PC	28480	3101-1667
A1S2			NOT ASSIGNED		
A1S3	3101-0680	1	SWITCH-PB DPDT ALTNG 4A 250VAC	28480	3101-0680
A1U1	1820-1180	1	IC, DIGITAL *FACTORY SELECTED PART	28480	1820-1180
A1U2*	1820-0174	1	IC:TTL HEX INVERTER *FACTORY SELECTED PART	01295	SN7404N
A1U3	1820-0693	1	IC SN74S 74 N FLIP-FLOP	01295	SN74S74N
A1U4	1820-0661	1	IC SN74 32 N GATE	01295	SN7432N
A1U5	1820-0328	1	IC:TTL QUAD 2-INPT NOR GATE	01295	SN7402N
A1U6	1820-0629	2	IC SN74S 112 N FLIP-FLOP	01295	SN74S112N
A1U7*	1820-0681	1	IC SN74S 00 N GATE *FACTORY SELECTED PART	01295	SN74S00N
A1U8	1820-0099	1	IC:SN7493N	01295	SN7493N
A1U9	1820-0634	1	IC COUNTER	28480	1820-0634
A1U10	1820-0629		IC SN74S 112 N FLIP-FLOP	01295	SN74S112N
A1U11	1820-0214	1	IC:TTL BCD-TO-DECIMAL DECODER	01295	SN7442N
A1U12	1820-0269	1	IC:SN7403N	01295	SN7403N
A1U13	1820-0301	1	IC:SN7475N	01295	SN7475N
A1U14*	1820-1224	1	IC MC10216P RCVR *FACTORY SELECTED PART	04713	MC10216P
A1U15*	1826-0122	1	IC V RGLTR *FACTORY SELECTED PART	07263	7805UC
A1Y1	0410-0551	1	CRYSTAL, QUARTZ	28480	0410-0551
A2	05381-60002	1	BOARD ASSEMBLY, DISPLAY	28480	05381-60002
A2C1	0140-0149	1	CAPACITOR-FXD 470PF +-5% 300WVDC MICA	72136	DM15F471J0300WV1CR
A2C2	0160-0182	1	CAPACITOR-FXD 47PF +-5% 300WVDC MICA	28480	0160-0182
A2C3	0160-2254	1	CAPACITOR-FXD 7.5PF +-.25PF 500WVDC CER	28480	0160-2254
A2C4	0160-0194	1	CAPACITOR-FXD .015UF +-10% 200WVDC POLYE	56289	292P15392
A2C5	0180-0106		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	1500606X0006B2
A2CR1	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35	28480	1901-0040
A2DS1	1990-0452	7	DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A2DS2	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A2DS3	1990-0452 See		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452 See
A2DS4	1990-0452 Para		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452 Paragraph
A2DS5	1990-0452 3-39		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452 3-39
A2DS6	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A2DS7	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
A2E1	1251-3768	21	CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E2	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E3	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E4	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E5	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E6	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E7	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E8	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E9	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E10	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E11	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E12	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E13	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E14	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E15	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E16	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E17	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E18	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E19	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E20	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2E21	1251-3768		CONTACT-CONN U/W POST TYPE MALE DPSLDR	28480	1251-3768
A2J1	1250-1163	1	CONNECTOR-RF BNC FEM SGL HOLE RR	28480	1250-1163
A2L1	9100-1620	1	COIL-FXD MOLDED RF CHOKE 15UH 10%	24226	15/152
A2Q1	1853-0318	7	TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562
A2Q2	1853-0318		TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562
A2Q3	1853-0318		TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562
A2Q4	1853-0318		TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562
A2Q5	1853-0318		TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562

Table 3-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2Q6	1853-0318		TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562
A2Q7	1853-0318		TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562
A2R1	0683-9125	1	RESISTOR 9.1K 5% .25W FC TC=-400/+700	01121	CB9125
A2R2	0683-9135	1	RESISTOR 91K 5% .25W FC TC=-400/+800	01121	CB9135
A2R3	0683-9145	1	RESISTOR 910K 5% .25W FC TC=-800/+900	01121	CB9145
A2R4	1810-0041	1	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A2R5	0683-4715	7	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R6	0683-4715		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R7	0683-4715		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R8	0683-4715		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R9	0683-4715		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R10	0683-4715		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R11	0683-4715		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A2R12	0683-4705	11	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R13	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R14	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R15	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R16	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R17	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R18	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R19	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R20	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R21	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2R22	0683-4705		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
A2S1	3101-1598	2	SWITCH-SL DP3T-NS MINTR 1A 125VAC PC	28480	3101-1598
A2S2	3101-1598		SWITCH-SL DP3T-NS MINTR 1A 125VAC PC	28480	3101-1598
A2U1	1820-1037	1	IC SN74 46AN DECODER	01295	SN7446AN
			CHASSIS & MISCELLANEOUS PARTS		
C1	0160-3043	1	CAPACITOR-FXD 5000PF/5000PF +-20%	28480	0160-3043
F1	2110-0008	1	FUSE .5A 125V SLO-BLO 1.25X.25 UL (FOR 100/120V OPERATION)	75915	313.500
F1	2110-0201	1	FUSE .25A 250V SLO-BLO 1.25X.25 UL IEC (FOR 220/240V OPERATION)	75915	313.250S
J1	1251-2357	1	CONNECTOR-AC PWR HP-9 MALE FLG MTG	28480	1251-2357
J2	1250-0083	1	CONNECTOR-RF BNC FEM SGL HOLE FR	24931	28JR-130-1
S1			NOT ASSIGNED		
S2	3101-1609	1	SWITCH-SL 2-DPDT-NS STD 1.5A 250VAC SLDR	82389	11E-1036
T1	9100-3039	1	TRANSFORMER, POWER	28480	9100-3039
W1	7120-1348	1		28480	7120-1348
XF1	2110-0464	1	FUSEHOLDER-EXTR POST 20A 300V UL/IEC INCLUDES:	75915	345002-010
	2110-0465	1	FUSEHOLDER-EXTR POST UL/IEC .25X1.25FUSE	28480	2110-0465
	2950-0054	1	NUT-HEX-DBL-CHAM 1/2-28-THD .125-THK	28480	2950-0054
	0360-0001	1	TERMINAL-LUG-SLDR 6 SCR .141/.086 ID	78452	920
	0370-0914	1	BEZEL:PUSHBUTTON KNOB, JADE GREY	28480	0370-0914
	0370-2486	1	PUSHBUTTON(SOLID GRAY)	28480	0370-2486
	0510-0002	1	PRESS-IN NUT 6-32 .062-LG	28480	0510-0002
	0510-0076	1	NUT-SHMET 6-32-THD .63-WD STL	78553	C8599-632-248
			MISCELLANEOUS PARTS		
	9211-1760	1	CARTON CORRUGATED RSC 14.125 9.125 6 275	28480	9211-1760
	5040-7032	1	FOOT	28480	5040-7032
	05301-20005	1	STAND, TILT	28480	05301-20005
	05301-40001	1	FOOT	28480	05301-40001
	05381-00001	1	PANEL, FRONT	28480	05381-00001
	05382-00002	1	PANEL, REAR	28480	05382-00002
	05381-20003	1	COVER, TOP	28480	05381-20003
	05381-20004	1	COVER, BOTTOM	28480	05381-20004
	05381-20005	4	STANDOFF	28480	05381-20005

Table 3-4. Replaceable Parts

Mfr No.	Manufacturer Name	Address	Zip Code
0086S	STETTNER-TRUSH INC	CAZENOVIA, NY	13035
01121	ALLEN-BRADLEY CO	MILWAUKEE, WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS, TX	75231
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX, AZ	85008
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW, CA	94040
24226	GOWANDA ELECTRONICS CORP	GOWANDA, NY	14070
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD, PA	16701
24931	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS, IN	46227
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO, CA	94304
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE, CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS, MA	01247
72136	ELECTRO MOTIVE MFG CO INC	WILLIMANTIC, CT	06226
75915	LITTLEFUSE INC	DES PLAINES, IL	60016
78452	EVERLOCK CHICAGO INC	CHICAGO, IL	60622
78553	TINNERMAN PRODUCTS INC	CLEVELAND, OH	44129
82389	SWITCHCRAFT INC	CHICAGO, IL	60630

SYMBOLS

FRONT PANEL

REAR PANEL

INTERIOR AND PC BOARDS

WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE

POWER LINE GROUND

CIRCUIT COMMON GROUND

FLOATING GROUND

CHASSIS GROUND

KNOB CONTROL

SCREWDRIVER ADJUST

MAIN SIGNAL PATH

FEEDBACK PATH

TEST POINT

"AND" GATE

"OR" GATE

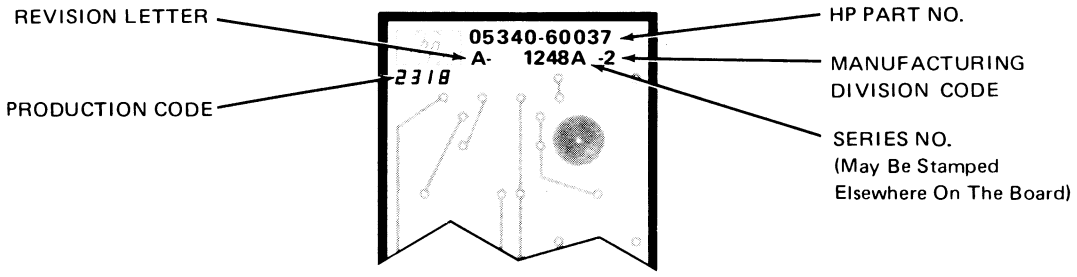
INVERTER

NAND GATE

NOR GATE

EXCLUSIVE NOR

PRINTED CIRCUIT BOARD IDENTIFICATION



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

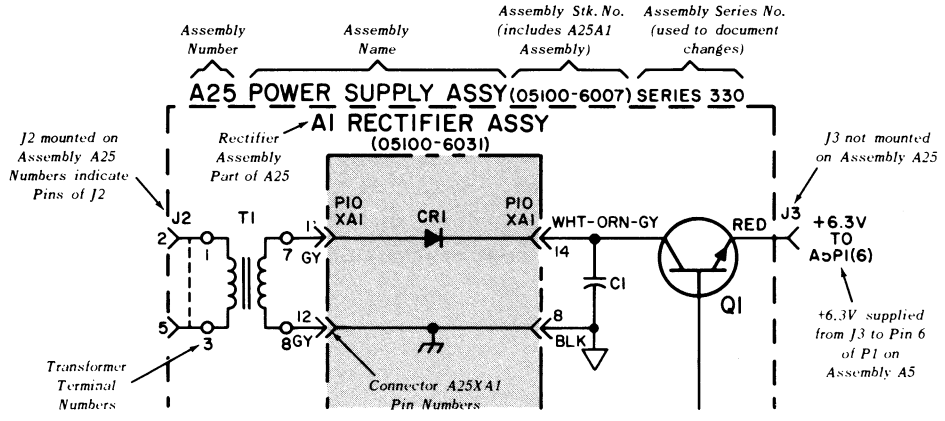
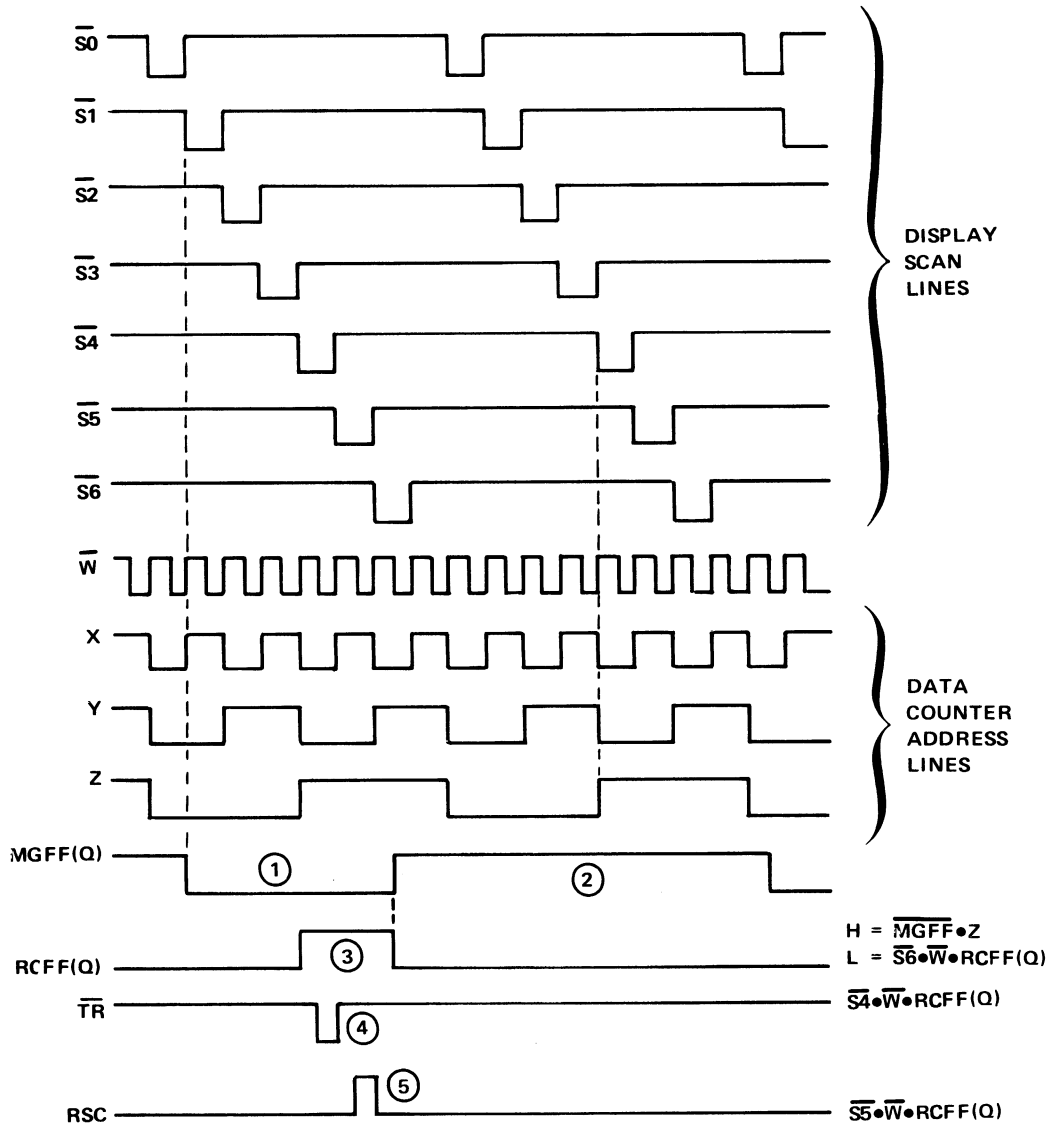


Figure 3-3. Schematic Diagram Notes



(1) MAIN GATE CLOSED.

(2) MAIN GATE OPEN.

(3) WHEN HIGH, TIME BASE DIVIDER PRESET TO ALL NINES; THIS ALLOWS A TIME BASE OUTPUT AND OPENING OF MAIN GATE ON FIRST OSCILLATOR CYCLE AFTER SIGNAL GOES LOW.

(4) TRANSFERS DATA TO STORAGE LATCHES.

(5) RESETS DATA COUNTER.

Figure 3-4. Instrument Timing Diagram

Figure 3-5. A1 Component Locator

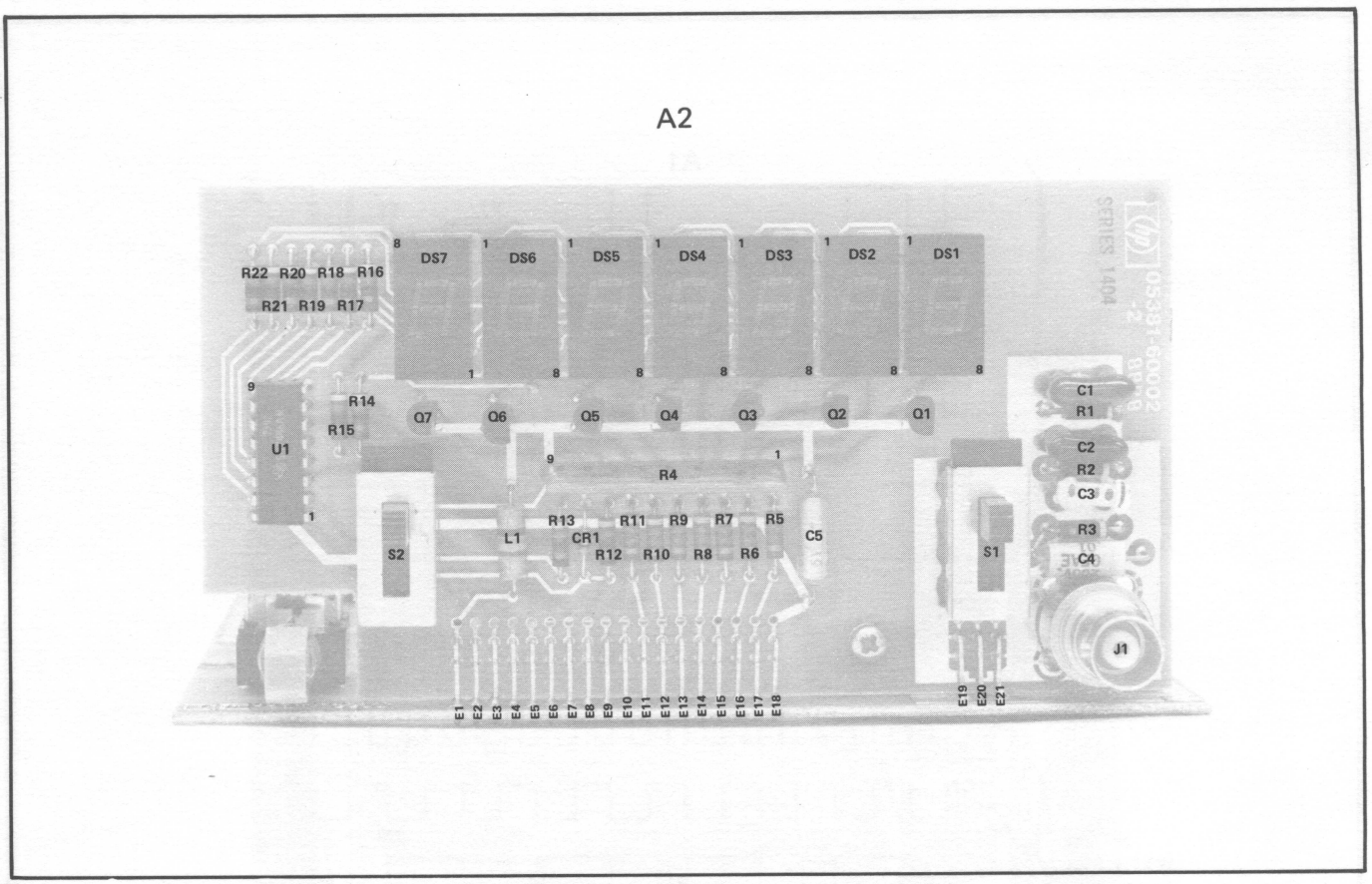


Figure 3-6. A2 Component Locator

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

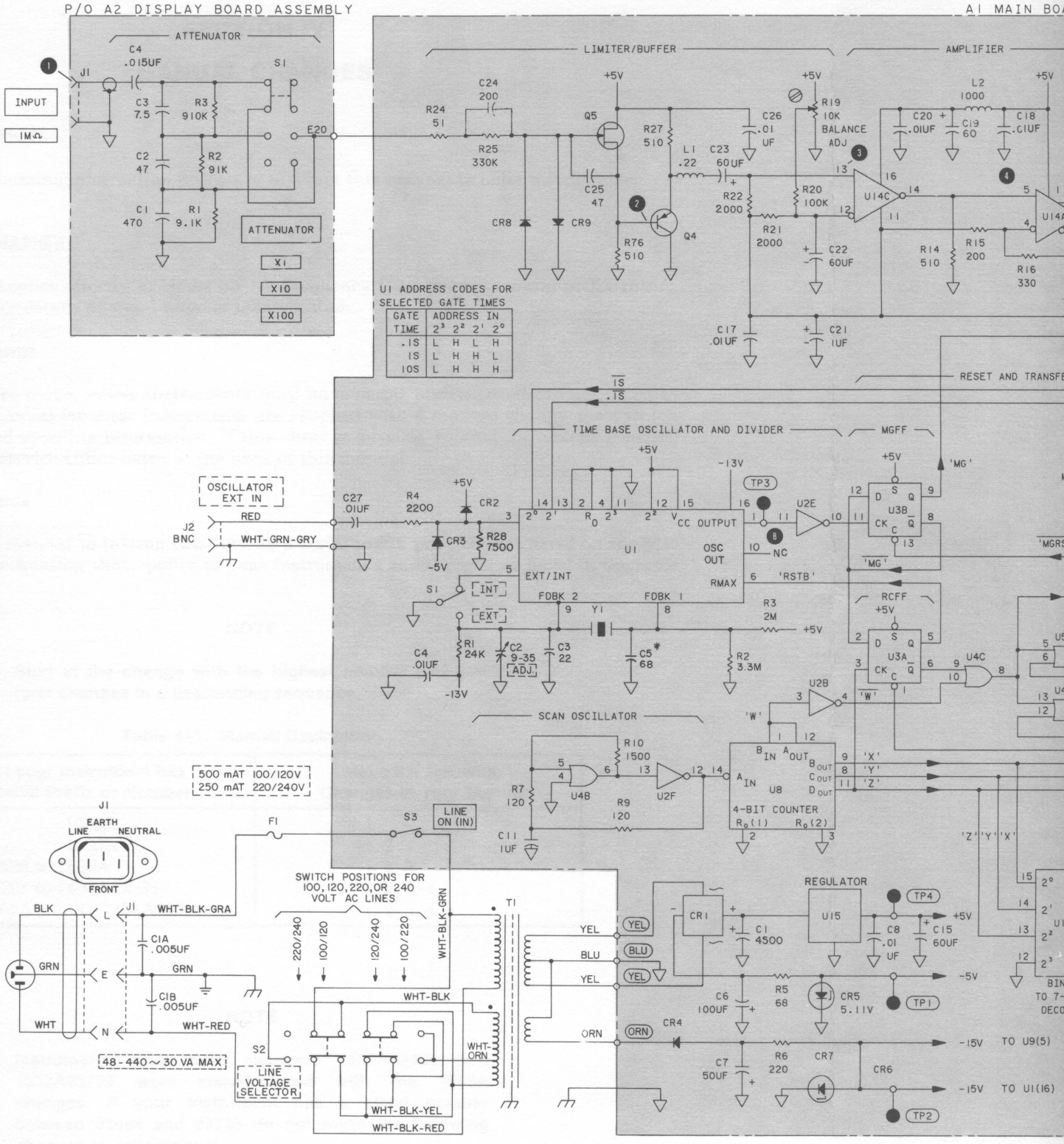
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

4. DISPLAY DS7 IS PHYSICALLY MOUNTED UPSIDE DOWN TO ALLOW ONE OF THE DECIMAL POINTS TO BE USED AS AN OVER RANGE INDICATOR.

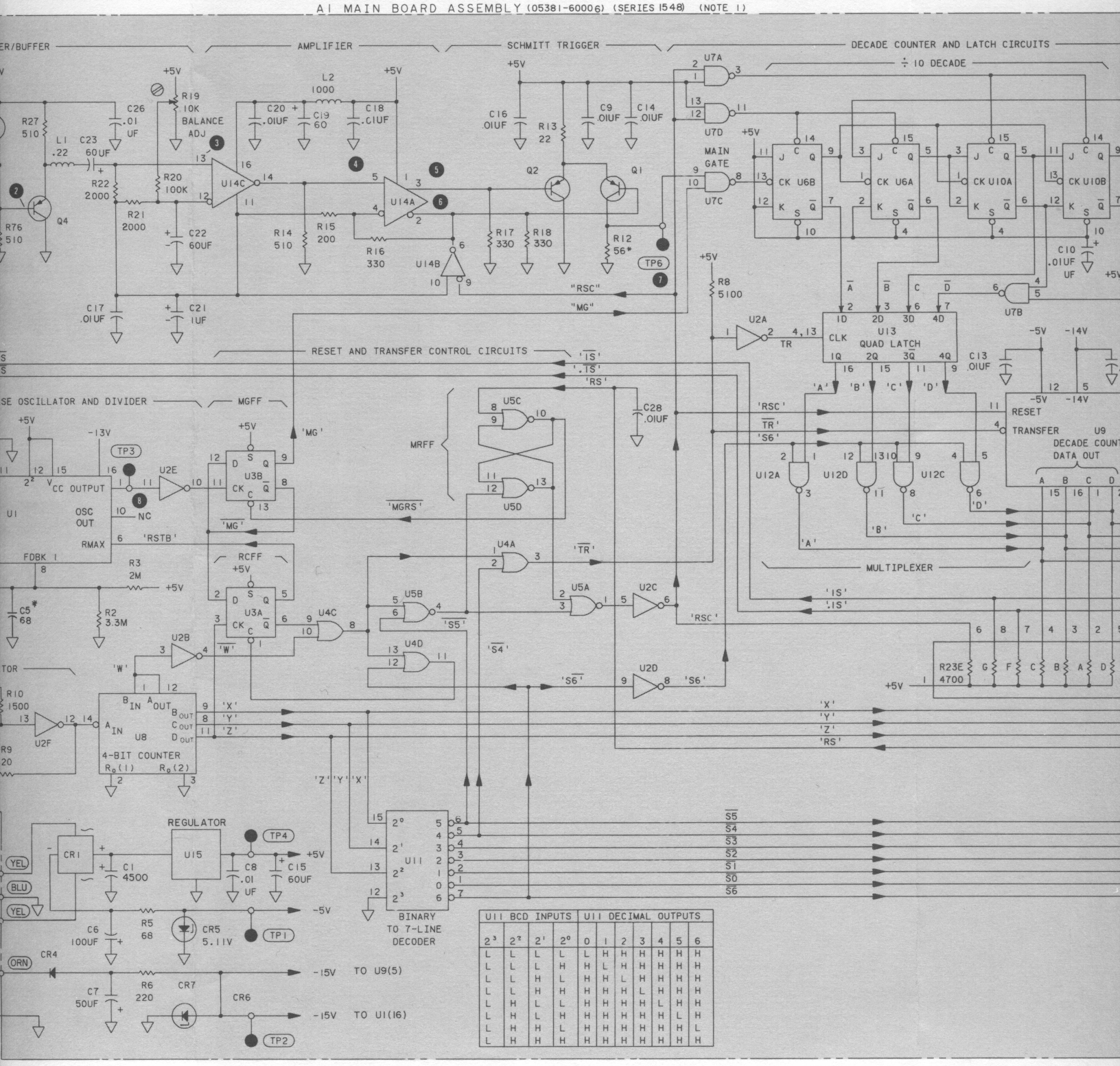
5. SEE A2 COMPONENT LOCATOR FOR E TERMINAL LOCATIONS.

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A1	
CR1,4	1906-0028
CR2,3,6,8,9	1901-0040
CR5	1902-0579
CR7	1902-0555
Q1,2,4	1853-0015
Q3	1854-0071
Q5	1855-0081
U1	1820-1180
U2	1820-0174
U3	1820-0693
U4	1820-0661
U5	1820-0328
U6,10,12	1820-0629
U7	1820-0681
U8	1820-0099
U9	1820-0634
U11	1820-0214
U13	1820-0301
U14	1820-1224
U15	1826-0122
A2	
CR1	1901 0040
Q1-7	1953-0318
U1	1820-1037
CR1	1901-0040
Q1-7	1953-0318
U1	1820-1037


P/O A2 DISPLAY BOARD ASSEMBLY
A1 MAIN BOA
ATTENUATOR
INPUT
1MΩ
J1
C4 .015UF
S1
C3 7.5
R3 910K
C2 47
R2 91K
C1 470
R1 9.1K
E20
ATTENUATOR
X1
X10
X100
LIMITER/BUFFER
AMPLIFIER
C24 200
R24 51
R25 330K
Q5
R27 510
L1 .22
C23 60UF
C26 .01 UF
+5V
R19 10K BALANCE ADJ
L2 1000
C20 .01UF
C19 60
C18 .01UF
C25 47
CR8
CR9
Q4
R76 510
R22 2000
R21 2000
R20 100K
U14C
U14A
R14 510
R15 200
R16 330
C17 .01UF
C21 1UF
U1 ADDRESS CODES FOR SELECTED GATE TIMES
GATE TIME | ADDRESS IN 2³ 2² 2¹ 2⁰
.1S | L H L H
1S | L H H L
10S | L H H H
RESET AND TRANSFE
.1S
1S
TIME BASE OSCILLATOR AND DIVIDER
MGFF
OSCILLATOR EXT IN
J2 BNC
RED
WHT-GRN-GRY
C27 .01UF
R4 2200
CR2
CR3
R28 7500
-5V
S1
INT
EXT
U1
EXT/INT
FDBK 2
FDBK 1
OSC OUT
RMAX
NC
TP3
U2E
U3B
'MG'
'RSTB'
'MGRS
RCFF
U3A
U4C
U2B
'W'
Y1
R3 2M
R1 24K
C2 9-35 ADJ
C3 22
C5 68
R2 3.3M
C4 .01UF
-13V
SCAN OSCILLATOR
R10 1500
R7 120
R9 120
U4B
U2F
C11 1UF
U8
4-BIT COUNTER
'X'
'Y'
'Z'
500 mAT 100/120V
250 mAT 220/240V
J1
EARTH
LINE
NEUTRAL
FRONT
F1
S3
LINE ON (IN)
SWITCH POSITIONS FOR 100,120,220,OR 240 VOLT AC LINES
220/240
100/120
120/240
100/220
WHT-BLK-GRN
T1
BLK
GRN
WHT
L
E
N
WHT-BLK-GRA
C1A .005UF
C1B .005UF
WHT-BLK
WHT-RED
48-440~30 VA MAX
S2
LINE VOLTAGE SELECTOR
WHT-ORN
WHT-BLK-YEL
WHT-BLK-RED
YEL
BLU
ORN
CR1
C1 4500
REGULATOR
U15
TP4
C8 .01 UF
C15 60UF
+5V
-5V
C6 100UF
R5 68
CR5 5.11V
TP1
CR4
C7 50UF
R6 220
CR7
CR6
-15V TO U9(5)
-15V TO U1(16)
TP2
TO 7-DECO

A1 MAIN BOARD ASSEMBLY (05381-60006) (SERIES 1548) (NOTE 1)



U11 BCD INPUTS				U11 DECIMAL OUTPUTS						
2^3	2^2	2^1	2^0	0	1	2	3	4	5	6
L	L	L	L	L	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H
L	H	L	L	H	H	H	H	L	H	H
L	H	L	H	H	H	H	H	H	L	H
L	H	H	L	H	H	H	H	H	H	L
L	H	H	H	H	H	H	H	H	H	H

AND LATCH CIRCUITS

ECADE

TP5

U1 BCD INPUTS				U1 SEGMENT OUTPUTS							DECIMAL VALUE
2^3	2^2	2^1	2^0	A	B	C	D	E	F	G	
L	L	L	L	L	L	L	L	L	H		0
L	L	L	H	H	L	L	H	H	H		1
L	L	H	L	L	L	H	L	L	H	L	2
L	L	H	H	L	L	L	L	H	H	L	3
L	H	L	L	H	L	L	H	H	L	L	4
L	H	L	H	L	H	L	L	H	L	L	5
L	H	H	L	L	H	L	L	L	L	L	6
L	H	H	H	L	L	L	H	H	H	H	7
H	L	L	L	L	L	L	L	L	L	L	8
H	L	L	H	L	L	L	H	H	L	L	9

ALL WAVEFORMS TAKEN WITH A 1 VOLT, 1 MHz INPUT SI
10:1 DIVIDER PROBE--OTHER OSCILLOSCOPE SETTINGS AR

1 INPUT CONNECTOR 1 μ SEC/DIV .1 V/DIV

2 A1Q4(BASE) 1 μSEC/DIV .05 V/DIV

0V

1.8V

5 A1U14A(3) 1 μSEC/DIV .05 V/DIV

6 A1U14A(2) 1 μSEC/DIV .05 V/DIV

3 A1U14C(13) 1 μSEC/DIV .05 V/DIV

4 A1U14A(5) 1 μSEC/DIV .05 V/DIV

3.3V

3.3V

7 TP6 .5 μSEC/DIV .05 V/DIV

CK U10A

CK U10B

C10 .01UF

R11 220Ω

+5V

U7B

-5V -14V +5V

C13 .01UF

C12 .01UF

RESET

TRANSFER U9 OVERFLOW

DECADE COUNTER X6

DATA OUT ADDRESS IN

INPUT

Q3

OF

E7 NOTE 5

R15 47

+5V

3,5,16

U1 BLD TO 7-SEGMENT CODE

R20 47

R16 47

R17 47

R18 47

R19 47

R22 47

R21 47

TO DS1 THRU DS7

FROM U1 TYPICAL (7 PLACES)

NOTE 4

DS7

DS6

DS5

DS4

DS3

R14 47

R13 47

.1S

1S

DATA 'D'

DATA 'C'

DATA 'B'

DATA 'A'

E8

E4

E2

E9

'1S'

'.1S'

E3

E5

S2

.1S/MHZ

1S/KHZ

10S/HZ

CR1

+5V

E6

+5V

'RS'

E10 'RS'

GATE TIME

+5V

E1

L1 15

C5 60UF

Q7

Q6

Q5

Q4

Q3

R11 470

R10 470

R9 470

R8 470

R7 470

S5

S4

S3

S2

E11 S5

E12 S4

E13 S3

E14 S2

E15 S1

E16 S0

E17 S6

E19

E21

E18 NOTE 5

R4 10K

H

G

F

E

D

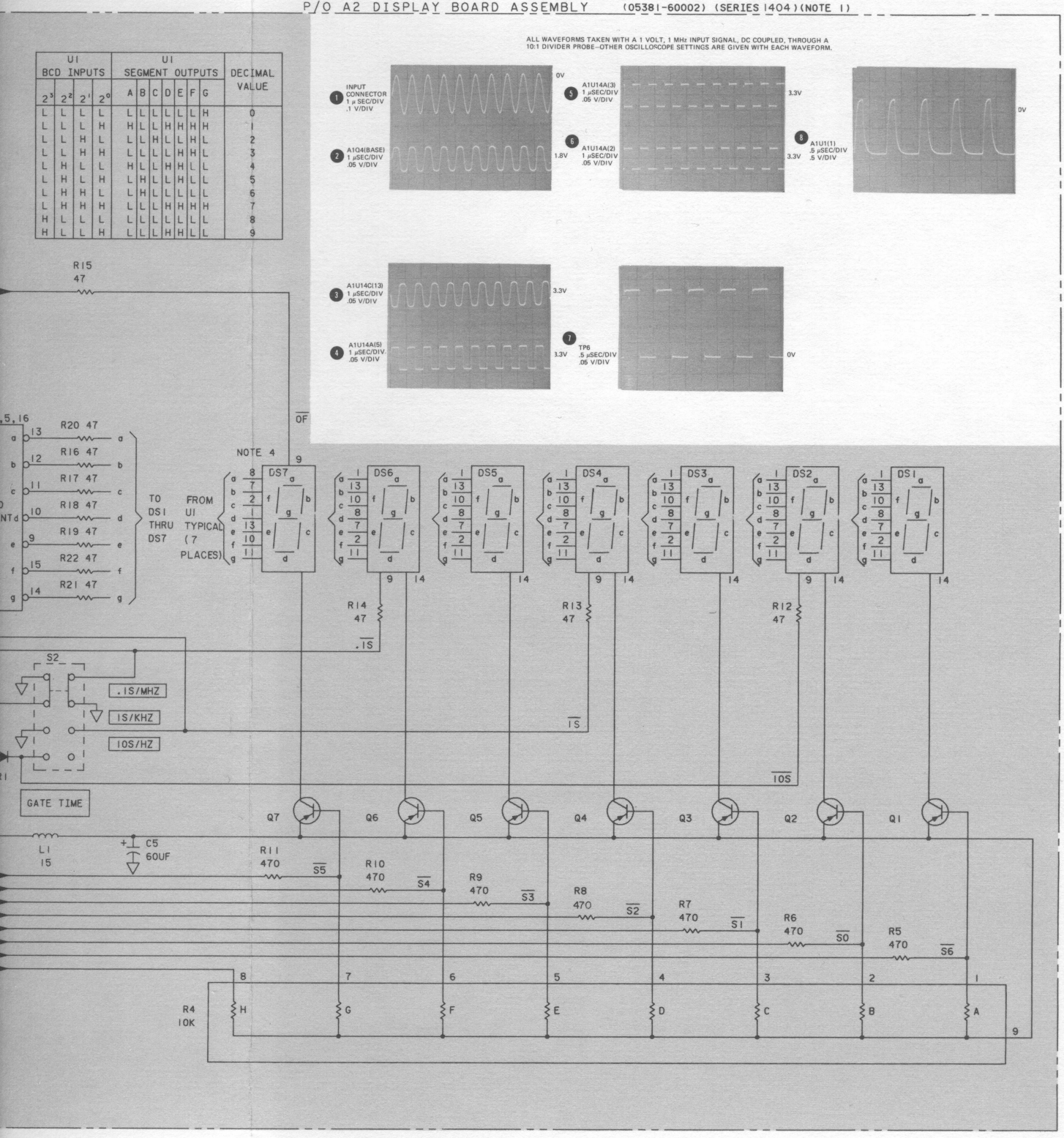


Figure 3-7. Overall Schematic Diagram

SECTION IV

MANUAL CHANGES

4-1. INTRODUCTION

4-2. This section contains information necessary to adapt this manual to older instruments.

4-3. MANUAL CHANGES

4-4. This manual applies directly to Model 5381A Frequency Counters with serial prefix 1548A. See paragraph 1-5 for details of serial number identification.

4-5. Newer Instruments

4-6. As changes are made, newer instruments may have serial prefixes that are not listed in this manual. The manual for these instruments are supplied with a manual change sheet which contains the required updating information. If this sheet is missing, contact the nearest Hewlett-Packard Sales and Service Office listed at the back of this manual.

4-7. Older Instruments

4-8. To adapt this manual to instruments having a serial prefix prior to that listed on the title page, perform the backdating that applies to your instrument's serial prefix as listed in the table below:

NOTE

Start at the change with the highest number and perform changes in a descending sequence.

Table 4-1. Manual Backdating

If your Instrument has Serial Prefix or Number	Make the following Changes to your Manual
1532A	1
1520A	1, 2
1404A02236 to 1520A	1, 2, 3
1404A01701 to 1404A02236	1, 2, 3, 4
1404A's up to 1404A01701	1, 2, 3, 4, 5

CHANGE 1

NOTE

Instruments with serial numbers 1532A03486 thru 1532A03735 were manufactured with the 1548A changes. If your instrument has a serial number between 03486 and 03735 do not make the following changes to your manual.

Page 3-10, Table 3-3:
For A1 change series number to 1532.

Add A1CR6 1901-0040 Diode: Switching 30V Max VRM 50 mA, 28480, 1901-0040.

Change A1CR7 to 1902-0555, Diode: Zener, 13V VZ, 1W Max PD, 04713, SZ 11213-173.

Page 3-17, Figure 3-6, Schematic Diagram:
Change SERIES number at top of A1 (05381-60006) to 1532.

Add A1CR6 between TP2 and A1R6. Delete the straight thru connection. Change the voltage to U9(5) to 14V. Change the voltage to U1(16) to 13V.

Change the voltage beside A1CR7 to 13V.

CHANGE 2

NOTE

Instruments with serial numbers 1520A02736 and above have the 1532A changes incorporated. If your instrument has a serial number from 02736 up, do not make the following change 2 to your manual.

Page 2-2, Paragraph 2-9, step d:
Change to the following: "Ensure that the correct fuse is installed. Use a Listed 0.250 ampere, slow-blow fuse for 100-volt or 120-volt operation or a Listed 0.125 ampere, slow-blow fuse for 220-volt or 240-volt operation."

Page 2-5, Figure 2-4, Rear View:
Change 48-440 ~ 30 VA MAX to 48-440 ~ 15 VA MAX.

Change fuse label to the following:
250 MaT 100/120V
125 MaT 220/240V

Change item 2 fuse value to .250 ampere and 0.125 ampere.

Page 3-12, Table 3-3, Chassis and Misc. Parts:
Change F1 from 2110-0008 to 2110-0018 1/4A (100/120V Operation).

Change the other F1 from 2110-0201 to 2110-0318 0.125 amp (220/240V Operation).

CHANGE 3

Page 3-10, Table 3-3, A1 Parts List:
Replace A1 parts list with Table 4-2.

Page 3-17, Figure 3-6, A1 Schematic Diagram with Component Locator:
Replace A1 schematic with Figure 4-1. Replace component locator with Figure 4-2.

CHANGE 4

Table 4-2, A1 Replaceable Parts:
Change A1R17 and A1R18 to 0683-5115, 510 ohms, 5% .25W CC Tubular, 01121 CB 5115.

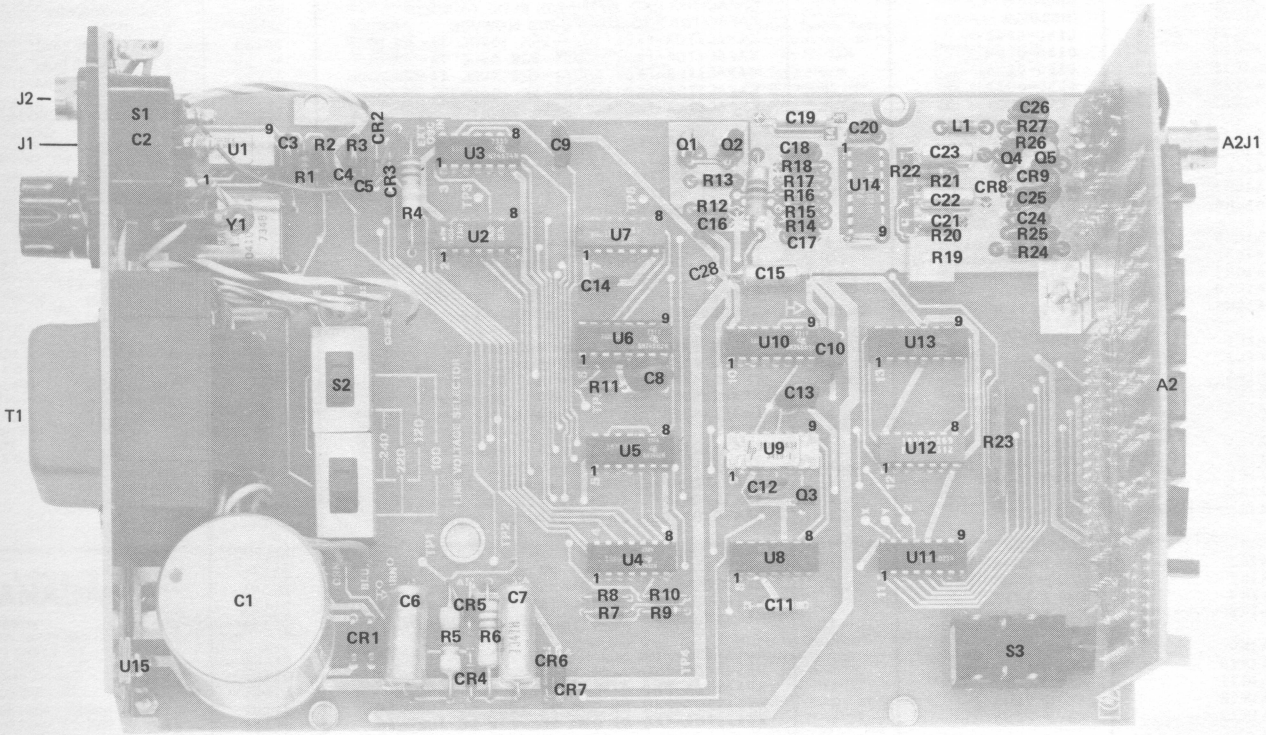
Figure 4-1, A1 Schematic:
Change A1R17 and A1R18 to 510 ohms.

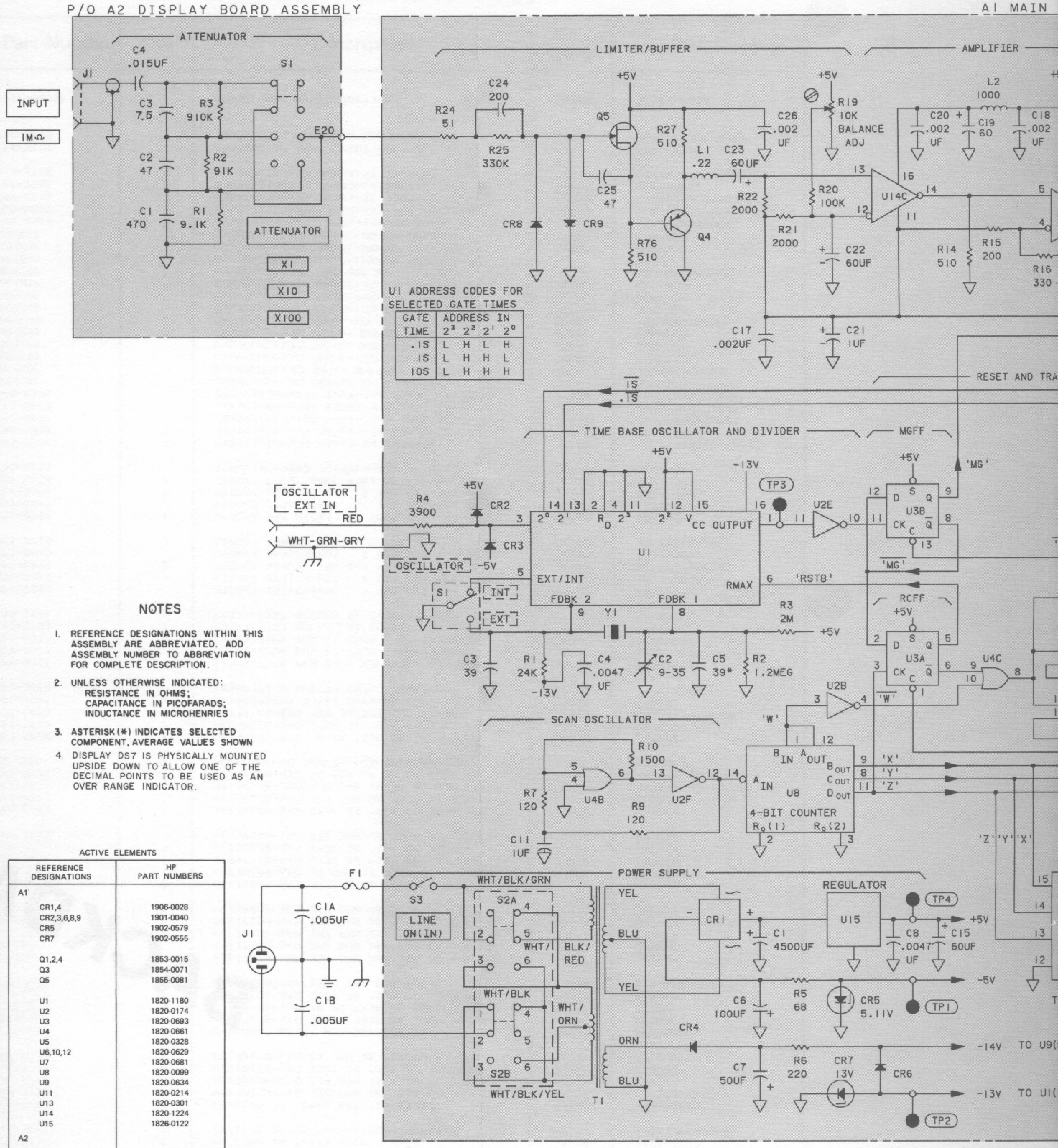
CHANGE 5

Table 4-2, A1 Parts List:
Change A1R4 to 0686-7525 7500 ohm 1/2W, Mfr. Part No. EB7525.

Change A1R21 and A1R22 to 0683-1025 1000 ohm 5%, .25W CC Tubular, 01121, CB 1025.
Note: Some instruments with serial no. 1407A01700 and below have 2000 ohm resistor for A1R21 and A1R22.

Figure 4-1, A1 Schematic Diagram:
Change A1R4 to 7500 ohms.
Change A1R21 and A1R22 to 1000 ohms, see above note.


J2
J1
S1
C2
U1
C3
R2
R3
CR2
R1
C4
C5
CR3
Y1
R4
U3
U2
C9
U7
C14
U6
C8
R11
U5
U4
R8
R10
R7
R9
C6
CR5
C7
CR1
R5
R6
CR6
CR4
CR7
C1
U15
T1
S2
Q1
Q2
C19
C20
C18
R18
R17
R16
R15
R14
C17
R13
R12
C16
C28
C15
U10
C10
C13
U9
C12
Q3
U8
C11
U14
R22
L1
C23
R21
C22
C21
R20
R19
CR8
C26
R27
R26
Q4
Q5
CR9
C25
C24
R25
R24
U13
U12
R23
U11
S3
A2J1
A2

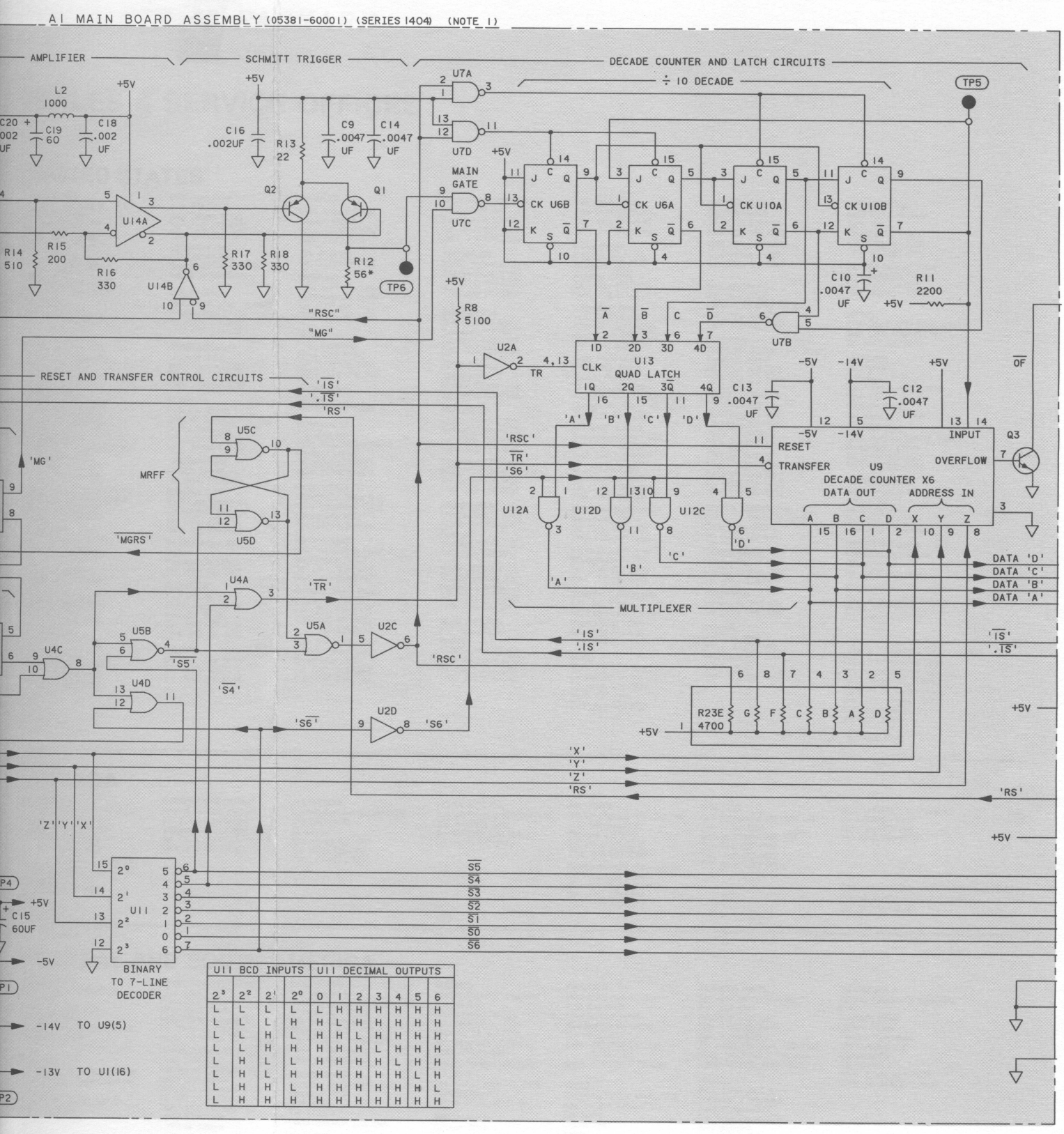


NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. DISPLAY DS7 IS PHYSICALLY MOUNTED UPSIDE DOWN TO ALLOW ONE OF THE DECIMAL POINTS TO BE USED AS AN OVER RANGE INDICATOR.

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A1	
CR1,4	1906-0028
CR2,3,6,8,9	1901-0040
CR5	1902-0579
CR7	1902-0555
Q1,2,4	1853-0015
Q3	1854-0071
Q5	1855-0081
U1	1820-1180
U2	1820-0174
U3	1820-0693
U4	1820-0661
U5	1820-0328
U6,10,12	1820-0629
U7	1820-0681
U8	1820-0099
U9	1820-0634
U11	1820-0214
U13	1820-0301
U14	1820-1224
U15	1826-0122
A2	
CR1	1901-0040
Q1-7	1953-0318
U1	1820-1037
CR1	1901-0040
Q1-7	1953-0318
U1	1820-1037



U11 BCD INPUTS				U11 DECIMAL OUTPUTS						
2^3	2^2	2^1	2^0	0	1	2	3	4	5	6
L	L	L	L	L	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H
L	H	L	L	H	H	H	H	L	H	H
L	H	L	H	H	H	H	H	H	L	H
L	H	H	L	H	H	H	H	H	H	L
L	H	H	H	H	H	H	H	H	H	H

Figure 4-1. Manual Backdating A1 Main Board, Schematic Diagram, Series 1404