Errata

Title & Document Type: **5510A Automatic Compensator Operating and Service Manual**

Manual Part Number: **05510-90016**

Revision Date: **February 1981**

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HP References in this Manual

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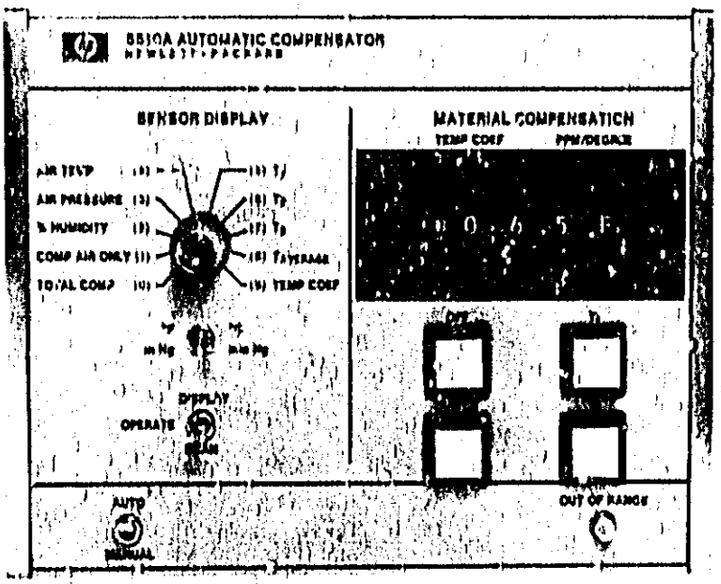
OPERATING AND SERVICE MANUAL

AUTOMATIC COMPENSATOR

5510A



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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

AUTOMATIC COMPENSATOR

5510A

SERIAL PREFIX: 2044A

This manual applies directly to Hewlett-Packard Model 5510A Automatic Compensators with Serial Prefix 2044A.

SERIAL PREFIXES NOT LISTED

For serial prefixes above 2044A, a Manual Change sheet is included with this manual. For serial prefixes below 2044A, refer to Section VII, Manual Changes.

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RADIO FREQUENCY INTERFERENCE
STATEMENT

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

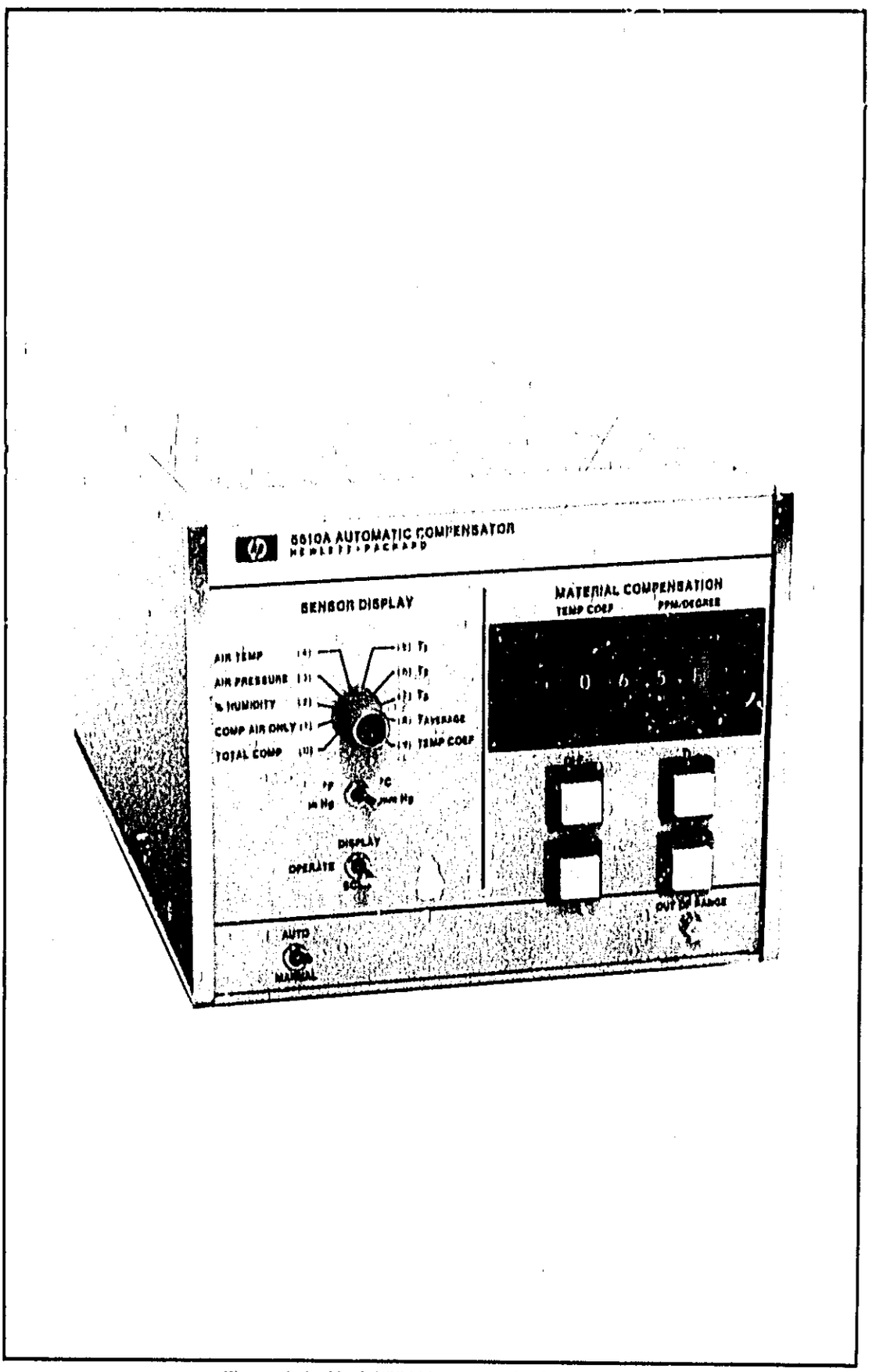


Figure 1-1. Model 5510A Automatic Compensator

GENERAL INFORMATION

SECTION I

1-1. SCOPE OF MANUAL

1-2. This manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 5510A Automatic Compensator.

1-3. INTRODUCTION

1-4. This section covers instrument identification, a description, specifications, equipment supplied and available accessories.

1-5. DESCRIPTION

1-6. The Hewlett-Packard Model 5510A Automatic Compensator is used with HP Laser Interferometer systems to automatically correct for the effects of atmospheric conditions and workpiece temperatures. The compensator greatly simplifies the process of compensation by eliminating the need for operator calculations. The compensator increases the accuracy of the laser measurements in dynamic environmental conditions.

1-7. Controls are included to select and display the total compensation factor or any of the outputs of the individual sensors. Other controls include an English — Metric switch, material coefficient thumbwheel switch, and an auto-manual switch. When used with an auxiliary digital recorder such as the HP 5055A, the sensor measurements can be recorded along with the interferometer measurements. To allow recording of all of the sensor measurements, a scan mode is included for sequential selection of the sensor outputs. Up to three material sensors can be used to give individual or averaged material temperatures. Front panel pushbutton switches are used to select any combination of the material sensor outputs.

1-8. EQUIPMENT SUPPLIED AND AVAILABLE ACCESSORIES

1-9. The compensator is supplied with an air probe, and an interconnecting cable HP 562A-16C. No power cable is required as the compensator draws its power from the laser display unit. The 5510A requires at least one 10563A Material Sensor (up to 3 may be used) which is available as an accessory. When permanent records of the compensation factors are required, the HP 5056A Digital Recorder can be added to the HP 5505A Laser Display. For digital recorder interconnecting information, refer to the Laser Measurement System Manual. A High Accuracy Material Temperature Sensor 10563A Option 001 is also available.

1-10. OPTION 010

1-11. Option 010 consists of the 5510A plus a cable for interfacing with the 5501A Laser Transducer System. Cable 05510-60022 interfaces with the 5510A and the 10755A Compensation Interface. When using the 5510A Opt 010, the 10740A-60005 cable supplied with the 10740A is used to connect the 5510A to ±15 volts via the 10740A coupler.

1-12. INSTRUMENT IDENTIFICATION

1-13. Hewlett-Packard instruments have a 2-section, 10-character serial number (0000A00000), which is located on the rear panel. The 4-digit serial prefix identifies instrument changes. If the serial prefix of your instrument differs from that listed on the title page of this manual, there are differences between this manual and your instrument. Instruments having lower serial prefixes than that listed on the title page are documented in Section VII, and higher serial prefixes are covered with manual change sheets included with the manual. If the change sheet is missing, contact the nearest Hewlett-Packard Sales and Service Office listed on the inside rear cover of this manual.

1-14. MANUAL MICROFICHE

1-15. On the title page of this manual, below the manual part number, is a "MICROFICHE" part number. This number may be used to order 4x6-inch microfilm transparencies of the manual. The microfiche package also includes the latest manual changes supplement as well as all pertinent Service Notes.

1-16. SPECIFICATIONS

1-17. Electrical and mechanical specifications for the compensator are given in Table 1-1.

Table 1-1 5510A Specifications

SENSORS

Air Temperature:
Thermistor type. Mounted in remote capsule with removable magnetic base. Calibration vernier at rear panel connector. Cable length 4.5 metres (15 feet). Option 002 cable 14 metres (46 feet).

Accuracy:
±0.2°F (±0.1°C) over range of 55—105°F (13—40°C).

Pressure:
Barometric capsule mounted in 5510A cabinet. Can be remotely situated. Calibration vernier in cabinet.

Accuracy:
±0.03 in. Hg (±.75 mm Hg) over range of 22—31 in. Hg (560—700 mm Hg).

Humidity:
Solid state sensor mounted in remote air temperature capsule. Calibration vernier at rear panel connector.

NOTE

If the humidity sensor is kept in an extremely dry place, allow it to stabilize in normal atmosphere for 2 hours so it will indicate the correct humidity.

Accuracy:
±10 percentage points over range of 20%—100% RH.

Overall Wavelength Compensation Accuracy:
Errors do not exceed the following values over the stated ranges:

Sensor	Measurement Accuracy
Air Temperature	±0.2 ppm
Air Pressure	±0.6 ppm
Humidity	±0.3 ppm
Total Wavelength Compensation Measurement Error (worst case)	±1.0 ppm

Laser Interferometer/Automatic Compensator System Accuracy:
(Excluding material expansion and contraction.)
English Units: ±1.5 ppm ±1 count in least significant digit.
Metric Units: ±1.5 ppm ±2 counts in least significant digit.

Material Temperature:
Thermistor type. Mounted in remote, oil-immersible "button" with magnetic base. Maximum power output 30 microwatts. Rear panel connectors for three. Calibration vernier at rear panel connector. Cable length 4.5 metres (15 feet).
10563A Option 002 14 metre (46 feet) cable
10563A Option 003 20 metre (65.5 feet) cable

Accuracy:

Range	Maximum Sensor Error	Measurement Error
55—105°F (13—40°C)	±0.2°F (±0.1°C)	Depends on material coefficient of expansion

Sensors of higher accuracy over a limited temperature range are available as 10563A Opt 001. Please contact your local HP Sales office for details.

10563A Option 001 High Accuracy Material Temperature Sensor:
Thermistor Type. Mounted in oil-immersible button with magnetic base.
Temperature Range: 66—76°F (18.8—24.4°C)
Maximum Sensor Error: ± .050°F (0.028°C)
Environmental Temperature: 60—80°F (15.6—27.0°C)
Calibration: Same as standard 10563A Sensor

GENERAL

Total Compensation Factor Range: ±700 ppm
Warning light indicates out of range condition.
Coefficient of Expansion Range: ±20.0 ppm/°F or °C

Sensor Read-Out (with 5505A Laser Display):
Air Temperature: °F or °C
Air Pressure: in. or mm mercury
Relative Humidity: percent
Material Temperature (1, 2, and 3): °F or °C
Average Material Temperature: °F or °C
Temperature Coefficient of expansion: ppm/°F or °C
Compensation Number: ppm
Compensation Number (air only): ppm
In the SCAN mode these parameters are read-out at a rate of 2 per second.

Environmental (operating):
Temperature: 32—130°F (0—55°C)
Humidity: 0—95% RH
Vibration: 0.010 in. peak-to-peak at 10—55 Hz for 15 min. on each axis.

Power Requirement:
Power is supplied by 5505A Laser Display via connector cable

Dimensions:
6¼ inches high, 7¾ inches wide, 11 inches deep (159 mm × 197 mm × 280 mm) without sensors. With sensors connected depth is increased by 3 inches (76 mm).

Weight:
10.8 lbs. (4.9 kg).

Accessories Available:
1. Material Temperature Assembly, 10563A includes 4.5 metre (15 feet) cable.
2. High Accuracy Material Temperature Sensor, 10563A. Option 001 includes 4.5 metre (15 feet) cable.

INSTALLATION

SECTION II

INSTALLATION AND REMOTE PROGRAMMING

2-1. INTRODUCTION

2-2. This section provides instructions for unpacking, inspection, preparation for use, storage, shipment, and remote programming.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the instrument for visible damage (scratches, dents, etc.). If the instrument is damaged, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Keep the shipping carton and packing material for the carrier's inspection. The HP Sales and Service Office will arrange for repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. PREPARATION FOR USE

CAUTION

SWITCH LINE POWER OFF BEFORE CONNECTING OR DISCONNECTING SENSORS FROM THE COMPENSATOR. SENSOR CIRCUITS MAY BE DAMAGED IF SENSORS ARE CONNECTED OR DISCONNECTED FROM THE COMPENSATOR WITH POWER ON.

2-6. Power Requirements

2-7. Power is supplied by the 5505A Laser Display via the interconnecting cable.

2-8. 5505A Interconnection

2-9. The 5510A connects to the 5505A with interconnecting cable HP 562A-16C. This cable has identical 50-pin connectors on either end. To interconnect the 5510A and 5505A, proceed as follows:

a. On 5505A, set power switch to OFF.

b. Using cable HP 562A-16C, connect either 50-pin plug to the 5510A jack marked DISPLAY.

c. Connect the other cable plug to the 5505A jack marked COMPENSATION.

2-10. When the 5510A is used with the 5501A Laser Transducer System, it is supplied as Option 010 and includes a 05510-60022 interface cable. See the 5501A System Manual for details.

2-11. Material Sensor Connection

2-12. The material sensors connect to the 5510A jacks marked T1, T2, or T3. For sensor placement instructions, refer to Paragraph 3-12.

2-13. Air Probe Connection

2-14. The air probe connects to the rear panel jack on the 5510A marked AIR. For sensor placement considerations, refer to Paragraph 3-12.

2-15. ENVIRONMENT

2-16. Maximum and minimum allowable operating temperatures are listed in Table 1-1. Since the barometer can be damaged at high altitudes, air shipments of the 5510A should be arranged in pressurized cabins. Conditions should be limited as follows:

a. Maximum altitude: 10,000 ft.
b. Maximum temperature +75°C (+167°F)
c. Minimum temperature: -40°C (-40°F)

2-17. Operational Check

2-18. To determine if the instrument is operating properly, the check procedures in Section III or the performance check in Section V may be used. Contact the nearest HP Sales and Service Office (see manual back cover) for information relative to warranty claims.

2-19. 5510A Mounting

2-20. The Automatic Compensator can be set on a bench or work surface, or rack-mounted in a 5060-8762 Rack Adapter Frame. Also available is a Half Filler Panel 5060-8760. In any installation, the compensator may be installed at any angle up to 30° from its normal position. At angles greater than this, gravity acts on the barometric transducer so as to create a noticeable error. Such installation errors may be calibrated out if these installation angles are required.

2-21. PACKAGING FOR RESHIPMENT

2-22. Original Packaging

2-23. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard Sales and Service Offices listed at the rear of this manual.

2-24. If the instrument is being returned to Hewlett-Packard for service, attach a tag indicating the type of service required, return address, model number, and full serial number. Mark the container FRAGILE to assure careful handling.

2-25. In any correspondence refer to the instrument by model number and full serial number.

2-26. Other Packaging Methods

2-27. If it becomes necessary to reship an instrument, good commerical packaging should be used. Contract packaging companies in many cities can provide dependable custom packaging on short notice. The following general instructions should be followed when repackaging with commercially available materials.

a. If shipping to a Hewlett-Packard Service Office or Center, attach a tag indicating the type of service required, return address, model number, and full serial number.

b. Wrap the instrument in heavy paper or plastic.

c. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

d. Use enough shock-absorbing material(3- to 4-inch layer)around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the control panel with a cardboard.

e. Seal the shipping container securely.

f. Mark the shipping container FRAGILE to assure careful handling.

2-28. STORAGE

2-29. If the instrument is to be stored for an extended period of time, it should be enclosed in a clean, sealed container.

2-30. REMOTE PROGRAMMING

2-31. The 5510A Automatic Compensator can be remotely programmed through the AUX connector J6 on the 5510A rear panel. Use 50-pin male mating connector HP Part Number 1251-0086 (Amphenol type 57-30500-375). If the interface to other equipment requires a 50-pin type 1251-0086 connector, an HP 562-16C cable may be used. The following controls are programmable.

a. SENSOR DISPLAY switch
b. English — Metric (°F, in Hg - °C mm Hg) switch
c. DISPLAY OPERATE (not SCAN)
d. OFF (material temperature sensors OFF)
e. T1
f. T2
g. T3

2-32. The following controls are not programmable:

a. AUTO-MANUAL switch
b. TEMP COEFF thumbwheel switch
c. SCAN function of DISPLAY-OPERATE-SCAN switch

2-33. To remote program the 5510A refer to Table 2-1 below.

2-34. 5505A Modification

2-35. If your 5505A Laser Display has a serial number of 1108A-00205 or below, a modification is required on the 5505A to make it compatible with the 5510A. This modification consists of adding a wire from COMPENSATION jack J3(24) to AUX jack J4(4). Instruments with serial numbers 1108A-00206 and above have been modified at the factory.

Table 2-1. Remote Programming

Remote Control Line	Control* Level L = LOW H = HIGH	Function			
Select External Mode J6-15	H	Enables the front panel SENSOR DISPLAY switch and disables the remote control lines.			
	L	Disables the front panel SENSOR DISPLAY switch and enables the remote control lines MB1, MB2, MB4, and MB8.			
Remote SENSOR DISPLAY Select (J6-15 must be low)		Program as follows:			
	To Program:	MB1	MB2	MB4	MB8
MB1 J6-14	(0) TOTAL COMP	L	L	L	L
MB2 J6-13	(1) COMP AIR ONLY	H	L	L	L
MB4 J6-12	(2) % HUMIDITY	L	H	L	L
MB8 J6-32	(3) AIR PRESSURE	H	H	L	L
	(4) AIR TEMP	L	L	H	L
	(5) T1	H	L	H	L
	(6) T2	L	H	H	L
	(7) T3	H	H	H	L
	(8) T AVERAGE	L	L	L	H
	(9) TEMP COEFF	H	L	L	H
T1 switch J6-29	L	Selects T1 material temperature probe if probe is plugged in (T1 lamp will light).			
	H	Returns T1 control to front panel switch.			
T2 Switch J6-30 or T3 Switch J6-31	Same as T1 above except for material temperature probe 2 or 3				
OFF Switch (Material temperature OFF) J6-16	L	Selects OFF switch function by disabling T1, T2, and T3 selections			
	H	Returns OFF control to the front panel switch.			

*Control Levels:
A high or OFF level is an open circuit or a voltage from 2.4V to 5V.
A low or on level is a ground or a voltage from 0 to 0.4V.

Table 2-1. Remote Programming (Continued)

Remote Control Line	Control* Level L = LOW H = HIGH	Function
DISPLAY-OPERATE switch J6-33 NOTE To remotely program the DISPLAY-OPERATE function, the front panel switch must be set to OPERATE. The SCAN function cannot be selected remotely.	L	Selects DISPLAY mode.
	H	Selects OPERATE mode.
English — Metric Switch J6-34 NOTE To remotely program this function, the front panel switch must be set to °F.	L	Selects °C mm Hg Metric units.
	H	Selects °F in Hg English units.

*Control Levels:
A high or OFF level is an open circuit or a voltage from 2.4V to 5V.
A low or on level is a ground or a voltage from 0 to 0.4V.

OPERATION

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains operating information for the 5510A Automatic Compensator. Included are operation, compensation, operating procedures, interpretation of the display, and identification of controls and indicators.

CAUTION

SWITCH LINE POWER OFF BEFORE CONNECTING OR DISCONNECTING SENSORS FROM COMPENSATOR. SENSOR CIRCUITS MAY BE DAMAGED IF SENSORS ARE CONNECTED OR DISCONNECTED FROM COMPESNATOR WITH POWER ON.

3-3. WAVELENGTH COMPENSATION

3-4. The wavelength of the light emitted by the laser used as the standard in the distance measurement) depends on its velocity in air. This in turn depends upon air temperature, pressure, and relative humidity. Air that is less dense (for example low pressure, high temperature air) results in a higher velocity of light, and thus, a longer laser wavelength. The thumbwheel switches on the 5505A display unit allow the user to compensate for this variation in wavelength. If the 5510A is used, it will automatically and continuously compensate for these variations.

3-5. The distance shown on the laser display at any time is equal to the product of the laser wavelength (in units of inches or millimeters) and the number of quarter wavelengths of the laser light motion counted since RESET was last pressed. In practice, this operation is done in two steps. First, the number of wavelengths counted is multiplied by the ratio of the wavelength in air to the wavelength in a vacuum. This result is then multiplied by the vacuum wavelength of the laser light (in appropriate units). This is,

$$\text{distance} = \text{wavelengths} \times \frac{\text{air wavelength}}{\text{vacuum wavelength}} \times \text{vacuum wavelengths (in appropriate units)}$$

3-6. The vacuum wavelength is a constant which is "hard-wired" into the instrument arithmetic unit. The ratio of air wavelength to vacuum wavelength is a number always slightly less than 1 which depends on ambient conditions. As an example, for air temperature = 77°F, air pressure = 30.00 inches Hg., and relative humidity = 50%, this ratio is equal to 0.9997329. For operating environment specified for the laser, no change will ever occur for the first three digits of the ratio. These digits (i.e., 0.999) are therefore fixed within the instrument. The last four digits are dialed in the 5505A thumbwheel switches for manual compensation or automatically computed when a 5510A is used.

3-7. When the 5510A is used, the laser display is automatically and continuously corrected for air conditions (and material temperatures when desired). The compensator has an air temperature sensor, humidity sensor, and a barometer. A thumbwheel switch is included to allow entry of the coefficient of expansion of the workpiece material. Up to three temperature sensors can be used to measure and average the workpiece temperature. The compensator uses the atmospheric measurements, the workpiece temperature measurements, and the coefficient of expansion to compute the overall compensation factor for the Laser Interferometer. The compensator maintains a 1.1 ppm environmental correction accuracy within an ambient temperature range of 55° to 105°F (13-40°C), barometric pressure range of 22 to 31 inches of mercury (560-790 mm Hg), and a humidity range of 10 to 100%. Display of these measurements can be either in English or Metric units.

3-8. EXPANSION COEFFICIENT

3-9. Ideally, all distance measurements with the laser would be done in a temperature controlled room held at exactly 68°F. Then all parts would be at their "true" size and the compensation number determined above could be used directly. For part temperatures other than 68°F, the best method of correction is to change the effective laser wavelength by changing the compensation thumbwheels an amount just sufficient to correct for thermal expansion or contraction. To accomplish this, the coefficient of expansion and temperature of the measured part must be known. For example, assume a steel part is being measured (or a steel machine is being calibrated). The coefficient of expansion of steel can be found from a table to be 6.5 ppm/°F. Also, assume that part temperature has been measured and found to be 80°F, or 12°F above the reference temperature of 68°F. Then it is clear that the part is 6.5 ppm/°F x 12°F or 78 ppm larger in its present state than it would be at 68°F. Assume the part is precisely 1-inch long at 68°F. If we measured that part at 80°F, the display would indicate 1.000078-inch. But we want the display to indicate 1.000000-inch, i.e., the "true" size of the part. We can force the display to indicate the "true" number if we decrease the compensation number by 78 ppm from its strict air wavelength value. In effect, we thus compensate for the temperature of the part and measure it at its reference temperature size. When the 5510A is used, the coefficient of expansion is entered on the 5510A thumbwheel switch, then the material sensors are selected and the 5510A automatically corrects the compensation number for material variations. For further information on compensation, refer to the 5526A/B Compensation Factor Handbook and the 5526A/B System Manual.

3-10. MODES OF OPERATION

3-11. When the 5510A is connected to the 5505A, the system has four operating modes:

a. Display mode. The 5510A measurements or compensation numbers are displayed by the 5505A.

b. Scan Mode. The 5505A scans and displays each position of the SENSOR display switch. In addition, the scanned data is routed to the rear panel AUX jack. When a digital recorder is used, the sensor measurements may be scanned for a permanent record prior to printing the laser measurement. The scan rate is 2 per second.

c. Manual-Operate mode. When the DISPLAY-OPERATE-SCAN switch is set to OPERATE and the AUTO-MANUAL switch is in MANUAL, the Laser Interferometer system is operative and uses the compensation number entered into the 5505A Laser Display front panel thumbwheel switches.

d. Auto-Operate mode. When the DISPLAY-OPERATE-SCAN switch is set to OPERATE and the AUTO-MANUAL switch is in the AUTO position, the Laser Interferometer system is operative and uses the compensation number supplied by the 5510A Automatic Compensator.

3-12. SENSOR PLACEMENT

CAUTION

THE AIR PROBE SHOULD NOT BE IMMERSED IN LIQUID OR SUBJECTED TO SMOKE, OIL SPRAY, OR DUST. NEVER PLACE YOUR FINGERS ON THE HUMIDITY ELEMENT BEHIND THE NYLON SCREEN. AVOID DROPPING THE AIR PROBE OR SUBJECTING IT TO SHARP BLOWS. IF THE NYLON SCREEN BECOMES CLOGGED, REMOVE IT FROM THE HOUSING AND USE A MILD DETERGENT AND WATER TO CLEAN THE SCREEN. USE COMPRESSED AIR TO DRY THE SCREEN, THEN REINSTALL IN THE HOUSING.

3-13. The Air Sensor should be placed as close as possible to the laser beam. The closer the beam is to the openings in the upper part of the probe, the greater the accuracy of the compensation number. When positioning the air probe, it should always be placed within one inch of the laser beam, otherwise the accuracy will suffer. The Air Probe base contains a magnet to aid in securing it to magnetic materials. For other materials that require fixturing, light clamping can be used.

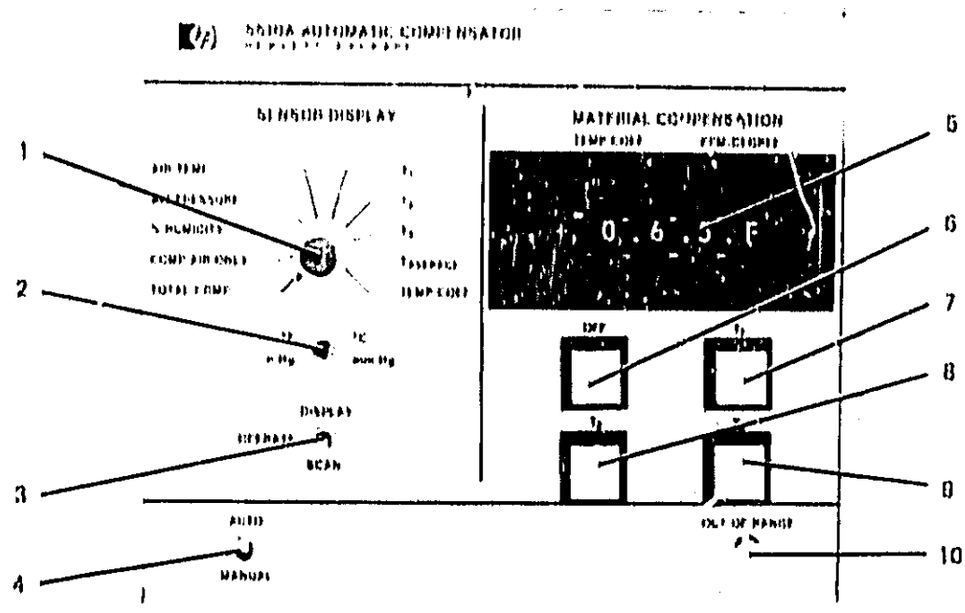
3-14. The Material Sensor is sealed and can be immersed in oil or water. The probe face of the material sensors should be kept free of chips and cleaned with solvent. The material probes contain a magnet to aid in securing it to ferrous materials. For other materials that require fixturing, a clamp can be used. If two or more material sensors are used, they should be placed so as to determine the average temperature of the workpiece. After a probe is attached to the workpiece, allow sufficient time for the probe temperature to stabilize at the workpiece temperature.

3-15. CONTROLS AND INDICATORS

3-16. Figure 3-1 explains the purpose of the 5510A controls and indicators. Figure 3-2 shows the rear panel connectors.

NOTE

The air pressure transducer, normally located in the 5510A cabinet, will ONLY operate correctly in a vertical position (as it is installed in the 5510A).



1. SENSOR DISPLAY selector. When the DISPLAY-OPERATE-SCAN switch is set to DISPLAY, the SENSOR DISPLAY switch selects a measurement or factor to be displayed on the 5505A Laser Display. These measurements or factors are as follows:

   a. TOTAL COMP. Compensation number in parts per million (includes compensation for workpiece temperature).

   b. (1) COMP AIR ONLY. Compensation number in parts per million due to air measurements only.

   c. (2) % HUMIDITY. Percentage of relative humidity.

   d. (3) AIR PRESSURE. Barometric pressure in either inches or mm of mercury as determined by the in Hg - mm Hg switch.

   e. (4) AIR TEMP. Air temperature in degrees Fahrenheit or Centigrade as determined by the °F - °C switch.

   NOTE

   The 5505A will display a reference temperatue of 68°F (20.0°C) when a material sensor is not connected to the 5510A. However, the pushbutton will only light for those sensors which are connected. If the air probe is not connected, the 5505A will display a reference temperature of 82.4°F (28.0°C) and a humidity of 10%.

   f. (5) T1. Material temperature measurement of sensor No. 1 in Fahrenheit or Centigrade as determined by the °F - °C switch.

   g. (6) T2. Same as T1 but for sensor No. 2.

   h. (7) T3. Same as T2 but for sensor No. 3.

   i. (8) T AVERAGE. Average temperature of the sensors selected with the white pushbutton switches (T1, T2, T3).

   j. (9) TEMP COEFF. PPM degree setting on Material Compensation thumbwheel switch.

Figure 3-1. Front Panel Controls and Indicators

2. "F °C" and "in Hg · mm Hg" switch. Selects either English or Metric units for the display. Only operative in positions (3) through (8) of the SENSOR DISPLAY switch. Setting of this switch does not affect the compensation number.

3. DISPLAY-OPERATE-SCAN switch. In DISPLAY position, the 5505A Laser Display will display the setting of the SENSOR DISPLAY swich. When set to OPERATE, the Laser Interferometer system is operative; the source of the compensation numbers will be determined by the setting of the AUTO-MANUAL switch. In SCAN position, each position of the SENSOR DISPLAY switch is scanned and displayed on the 5505A. In addition, the scanned data is supplied to the 5505A rear panel RECORDER jack for external printout.

4. AUTO-MANUAL switch. Determines the source of compensation numbers used by the 5505A Laser Display. If set to AUTO, the 5510A, supplies compensation numbers to the 5505A. When set to MANUAL, compensation numbers must be set manually at the 5505A front panel.

5. MATERIAL COMPENSATION thumbwheel switch. Used to enter material temperature coefficients in ppm/degree of Fahrenheit or Centigrade.

6. OFF indicator switch. When lit, indicates that all material temperature sensors are OFF. When pushed, disconnects all material temperature sensors.

NOTE

Whenever power-up of the compensator occurs and the Material Temperature Sensor(s) are connected, switches T_1, and/or T_2, and/or T_3 will have to be engaged (lit) to activate the sensor(s). The MATERIAL TEMPERATURE SENSORS do not automatically become active at power-up since T_1, T_2 and T_3 switches disengage when the 5510A COMPENSATOR loses power. If power goes off, and then the 5510A is re-powered it is necessary to depress the appropriate Material Temperature Sensor switch(es) to activate the sensor(s).

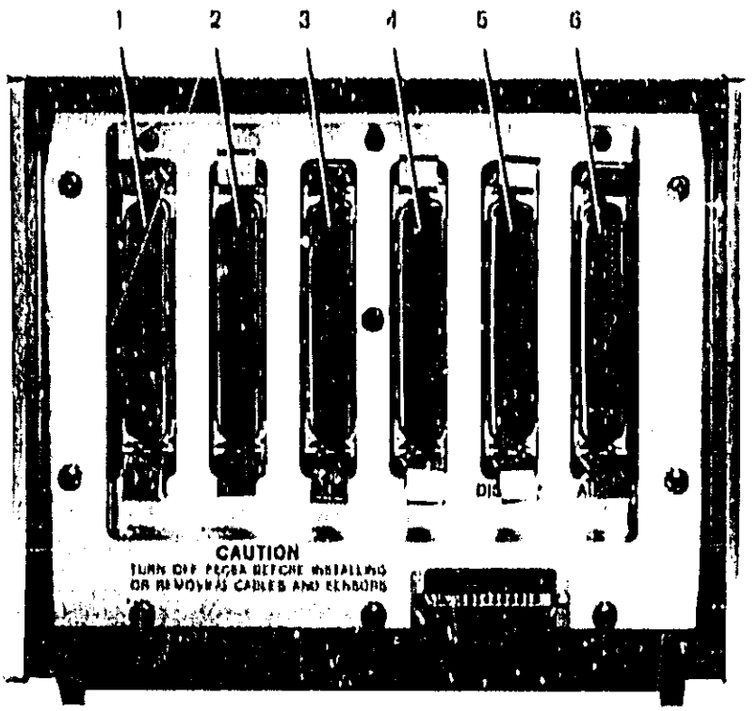
7. T1 Indicator and Switch. When lit, indicates that temperature sensor 1 is operative, when pushed, selects sensor 1.

8. T2 Indicator and Switch. Same as above for T2 sensor.

9. T3 Indicator and Switch. Same as 7 above for T3 sensor.

10. OUT OF RANGE indicator. Indicates that measurement conditions are out of the range of the compensator.

Figure 3-1. Front Panel Controls and Indicators (Continued)



CAUTION

TURN OFF 5505A BEFORE INSTALLING OR REMOVING CABLES AND SENSORS DAMAGE TO SENSORS MAY OCCUR IF POWER IS ON.

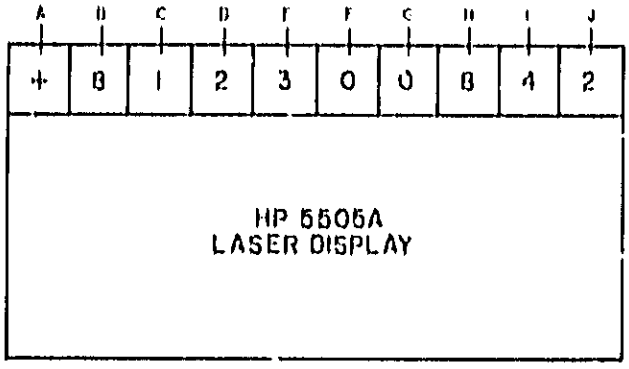
1. AIR connector. Accepts Air Probe assembly plug.

2,3 T1, T2, T3 Connectors. Accepts Material Temperature assembly plugs
4.

5. DISPLAY connector. Used to interconnect the 5510A to the 5505A. Use HP cable 562A-16C (supplied).

6. AUX connector. Output connector for interface with computer equipment. See Figure 8-24 for schematic diagram.

Figure 3-2. Rear Panel Connectors



A In the DISPLAY-TEMP COEFF mode, the left most column indicates sign of temperature coefficient set on thumbwheel switch with DIRECTION SENSE switch on 5505A set to F1. In all other positions of the DISPLAY switch the sign is of no significance.

B. Number displayed corresponds to blue numbers on the 5510A SENSOR DISPLAY switch. When SENSOR DISPLAY is set to TOTAL COMP, this digit may be blanked.

C. Indicates status of Material Temperature probe 1 (T1) as follows:

SENSOR DISPLAY switch	DISPLAY
TOTAL COMP	1 indicates that T1 is selected. Blank indicates T1 is not selected.
(1) through (4)	Always 0
(5)	Always 1 with or without sensor connected.
(6)	Always 0
(7)	Always 0
(8)	1 indicates that T1 is selected. 0 indicates that T1 is not selected.
(9)	Always 0

D. Similar to C above for T2, except that the displayed number will be 2.

E. Similar to C above for T3, except that the displayed number will be 3.

F. Always zero. No significance.

G,H, Data digits for various measurements.
I,J.

Figure 3-3. Interpreting the 5505A Display during the 5510A Display Mode

EXAMPLES OF DISPLAY OPERATION
(5505A NORMAL switch lit, DIRECTION SENSE to F, UNIT to A/4)
(5510A DISPLAY mode switch selected)

SENSOR DISPLAY Switch	DISPLAY	INTERPRETATION
TOTAL COMP	• 1 2 0 0 5 5 2 0	Total compensation is 552.0 parts per million (ppm) with sensors T1 and T2 selected.
TOTAL COMP	• 0 7 3 4 2	Total compensation is 734.2 ppm with no material sensors selected.
TOTAL COMP	• 2 0 0 6 3 0 0	Total compensation factor is 630.0 ppm. T2 is selected.
COMP AIR ONLY	• 1 0 0 0 0 7 3 4 2	Air compensation factor 1 734.2 ppm. The 1 indicates that SENSOR DISPLAY switch is in position 0).
% HUMIDITY	• 2 0 0 0 0 0 0 4 1	Humidity is 41%. The 2 indicates SENSOR DISPLAY switch position.
AIR PRESSURE (in. Hg selected)	• 3 0 0 0 0 2 9 7 8	Air pressure is 29.78 inches of mercury (in Hg).
AIR PRESSURE (mm Hg selected)	• 3 0 0 0 0 7 5 6 4	Air pressure is 756.4 mm Hg.
AIR TEMP (°F selected)	• 4 0 0 0 0 0 7 5 7	Air Temp is 75.7°F.
AIR TEMP (°C selected)	• 4 0 0 0 0 0 2 4 2	Air Temp is 24.2°C.
T1 (°F selected) (T1 Probe connected)	• 5 1 0 0 0 0 9 2 3	Material temperature probe 1 is 92.3°F.
T1 (°C selected) (T1 Probe connected)	• 5 1 0 0 0 0 3 3 2	Material temperature probe 1 is 33.2°C.
T1 (°C selected) (probe disconnected)	• 5 1 0 0 0 0 2 0 0	Reference temperature of 20.0°C (68°F). Displayed when probe is disconnected. NOTE: T1 indicator is not lit.
T2 (°F selected) (Probe connected)	• 6 0 2 0 0 0 7 6 7	Material temperature probe 2 is 76.7°F.
T3 (°C selected) (Probe connected)	• 7 0 0 3 0 0 2 2 6	Material temperature probe 3 is 22.6°C. The 3 denotes material temp. probe 3 is selected.

Figure 3-3. Interpreting the 5505A Display during the 5510A Display Mode (Continued)

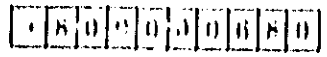
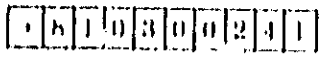
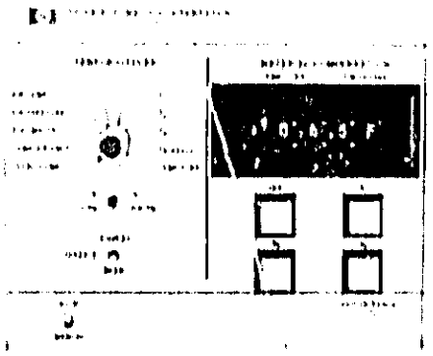
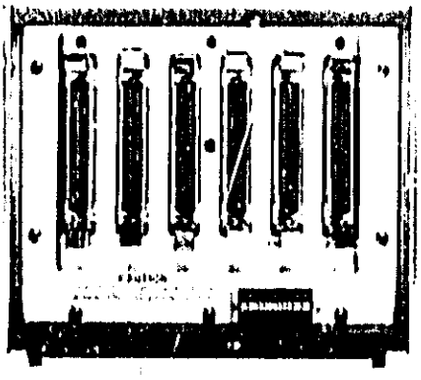
T AVERAGE (°F selected)		None of the temperature probes are selected. The 68°F reading is the reference temperature.
T AVERAGE (°F selected)		Average temperature of probes 1, 2, and 3 is 78.3°F.
T AVERAGE (°C selected)		Average temperature of probes 1 and 3 is 24.1°C.
TEMP COEFF (+12.6C on thumbwheel switch)		Temperature Coefficient is +12.6 ppm/°C.

Figure 3-3. Interpreting the 5505A Display during the 5510A Display Mode (Continued)





HOOKUP

On 5505A Laser Display, turn power switch to off.

1. Using cable supplied (HP 362A-16C), connect either end to DISPLAY jack on 5510A Automatic Compensator. Connect the other end of the cable to COMPENSATION jack on 5505A Laser Display.

2. Connect 50-pin plug of the Air Probe assembly to AIR jack on 5510A rear panel.

3. Connect 50-pin plug of the Material Temperature Probe to T1, T2, or T3 jack on 5510A. Connect additional Material Temperature Probes as desired.

CHECKOUT

4. Set 5505A Laser Display controls as follows:

Power Switch	ON
DIRECTION SENSE switch	F
UNITS switch	A-I
NORMAL pushbutton	In

5. Set 5510A Automatic Compensator DISPLAY-OPERATE-SCAN switch to DISPLAY.

6. Checkout the display as follows:

   a. Set SENSOR DISPLAY selector to (2), (3), and (4), and check for approximately correct displays of air temperature humidity, and pressure. See Figure 3-3 for interpretation of display

   b. Change °F - °C switch and check that readings obtained in step a agree in English and Metric units.

   c. Using the 5526A B Compensation Charts Handbook, determine the air compensation factor using measurements obtained in step a above.

   d. Set SENSOR DISPLAY to (1) AIR COMP ONLY. Check that display agrees with value determined in step c above. Any difference is probably due to interpolation errors in calculation plus the accuracy of the 5510A. The computed value and the display should be within ±5 ppm.

Figure 3-4. Operating Procedures

7. Set SENSOR DISPLAY to (5) T1. The T1 pushbutton should light if a sensor is connected to the rear panel connector T1. If sensor is connected, the display should read the probe temperature. Placing your finger on the probe will cause a temperature change. If a probe is not connected, the T1 pushbutton light should be out and the display should read 68°F or 20.0°C.

8. Repeat step 7 for T2 and T3.

9. Set SENSOR DISPLAY to (8) T AVERAGE and push the OFF pushbutton. The OFF pushbutton should light and the display should read 68°F (20.0°C). If T1 is connected, push T1 pushbutton, it should light and the display should change to T1 temperature. Push the OFF switch and repeat for T2, then T3. Push the T1, T2, and T3 switches and check that display indicates the average temperature of the probes connected to the rear panel.

10. Set SENSOR DISPLAY to (9) TEMP COEFF. The display should read the value set into the thumbwheel switch including the sign + or -.

11. Set DISPLAY-OPERATE-SCAN switch to SCAN. Check that display steps through all readings of the SENSOR DISPLAY switch. If digital recorder is available connect it to 5505A and check for proper printout.

12. Refer to 5526A/B Compensation Charts and calculate the total compensation number including material compensation. Use readings obtained from the 5510A. Set SENSOR DISPLAY to TOTAL COMP and check that display agrees with calculated value. Differences in the display and the calculated value should be within ±5 ppm.

OPERATION

13. Set 5505A and 5500A/B to make desired measurement.

14. Set 5510A as follows:

DISPLAY-OPERATE-SCAN switch	OPERATE
AUTO-MANUAL switch	AUTO
°F - °C switch	for desired units
T1, T2, T3 switches	push desired sensors
TEMP COEFF	to match temp COEFF of workpiece material

15. If possible place Air Probe Assembly within 1-inch of the laser beam keeping away from oil spray and dust. See Paragraph 3-12 for sensor placement considerations.

16. Place Material Temperature sensors on workpiece material. See Paragraph 3-12. Allow a few minutes for the probe temperatures to stabilize to the workpiece temperature.

17. When desired, the SCAN switch may be depressed to scan or print out the sensor readings and compensation factors for a permanent record.

18. Set DISPLAY-OPERATE-SCAN switch to OPERATE. The Automatic Compensator is now ready to continuously supply total compensation factors to the 5505A Laser Display. All readings shown now will be automatically and continously compensated for the wavelength of light in the ambient atmosphere and, if desired, for the temperature of the workpiece.

Figure 3-4. Operating Procedures (Continued)

THEORY

SECTION IV
THEORY OF OPERATION

4-1. This section contains theory of operation for the 5510A Automatic Compensator.

4-2. DUAL SLOPE INTEGRATION

4-3. The 5510A Automatic Compensator operation is similar to a digital voltmeter using dual slope integration. The compensator changes physical phenomena (air temperature, humidity, pressure, and material temperature) to an equivalent current level which is digitized for use by the 5505A Laser Display. The Laser Display uses this information as a compensation factor. The analog-to-digital conversion uses an integrating amplifier, a digitally controlled current switch, a threshold detector, and a counter. Figure 4-1 is a simplified block diagram of the dual slope integrator.

4-4. The integrating amplifier consists of an operational amplifier with a feedback capacitor, see Figure 4-2. When a steady state input current is applied, the output voltage is a ramp function. If the input current is flowing toward the amplifier, the output ramp is negative going. Conversely, if the input current flows away from the input, the output ramp is positive. The slope of the output ramp is a function of the magnitude of the input current. Thus, the greater the input current, the steeper the output ramp. The output voltage from the integrator V_0 is proportional to $I_{in} \bullet t$ where t is the time during which the input current flows.

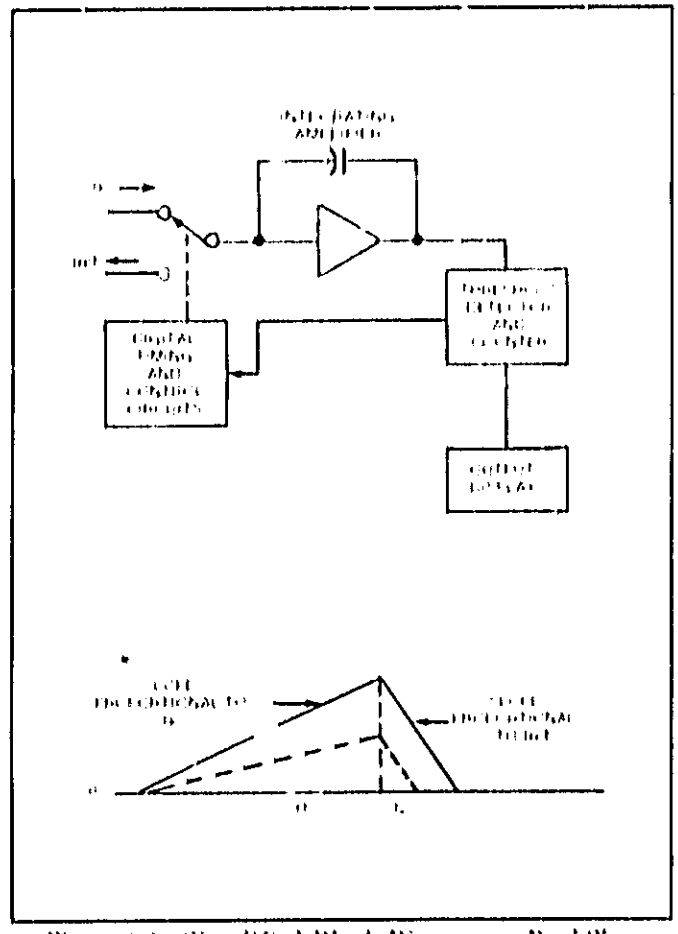


Figure 4-1. Simplified Block Diagram — Dual Slope Integrator and Typical Waveform

4-5. Refer to Figure 4-1 and assume an unknown value of current I_X (proportional to the unknown input voltage) is switched into the integrator input. The Digital Timing and Control circuit allows I_X to flow for fixed time t_1. When t_1 has elapsed, the circuit switches allow $-I_{ref}$ to flow into the integrator input. Coincident with switching in the $-I_{ref}$ current, a time interval counter is started to measure the time (t_2) required for the integrator output to return to zero. The threshold detector determines the exact time that the integrator crosses zero.

4-6. At the end of the cycle, the time interval t_2 is proportional to the input current I_X. The dotted lines on the waveform represent an input of smaller value of I_X. As the waveform shows, in a fixed time of t_1, the dotted line reaches a lower magnitude. Since the down slope is proportional to I_0 and I_0 is a fixed value, then $I_X \bullet t_1 = I_{ref} \bullet t_2$ or $I_X = \frac{I_{ref}}{t_1} \bullet t_2$. The time t_2 is stored in a digital counter and available for display or for use by other circuits.

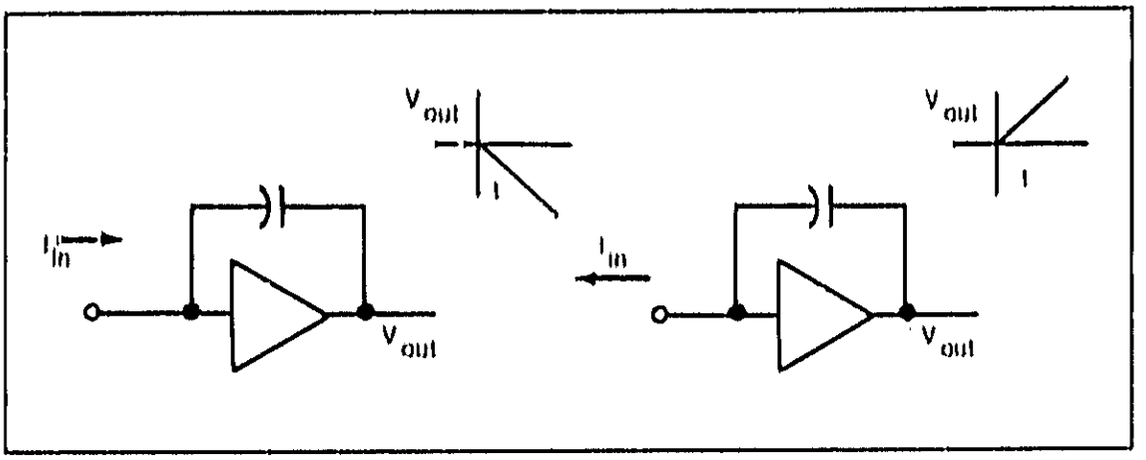


Figure 4-2. Basic Integrator Operation

4-7. The 5510A has an air temperature sensor, humidity sensor, barometric pressure transducer, and one to three material temperature sensors. In most cases, these sensors or transducers provide voltage outputs which are connected to voltage-to-current converters and current switches. The current converter outputs drive the dual slope integrator input. The dual slope integrator used in the 5510A is similar to that previously described. A typical output waveform is shown in Figure 4-3. The first operation is recentering. This cycle of operation sets the integrator to zero. When the start conversion pulse is received, the number 0999 is preset into the counter, and the negative reference current ($-I_R$) is switched into the integrator input. The counter counts down to zero at a rate of 250 kHz giving a t_1 of 4 milliseconds for the first-half cycle time. At the end of the first-half cycle, the input to the integrator is turned off for a short period of time. Nothing happens during this time in the recenter cycle, however, this interval will be used later to preset the counter. During the second-half of the C1 cycle, a positive reference current (I_R) is switched on and returns the integrator voltage back to zero.

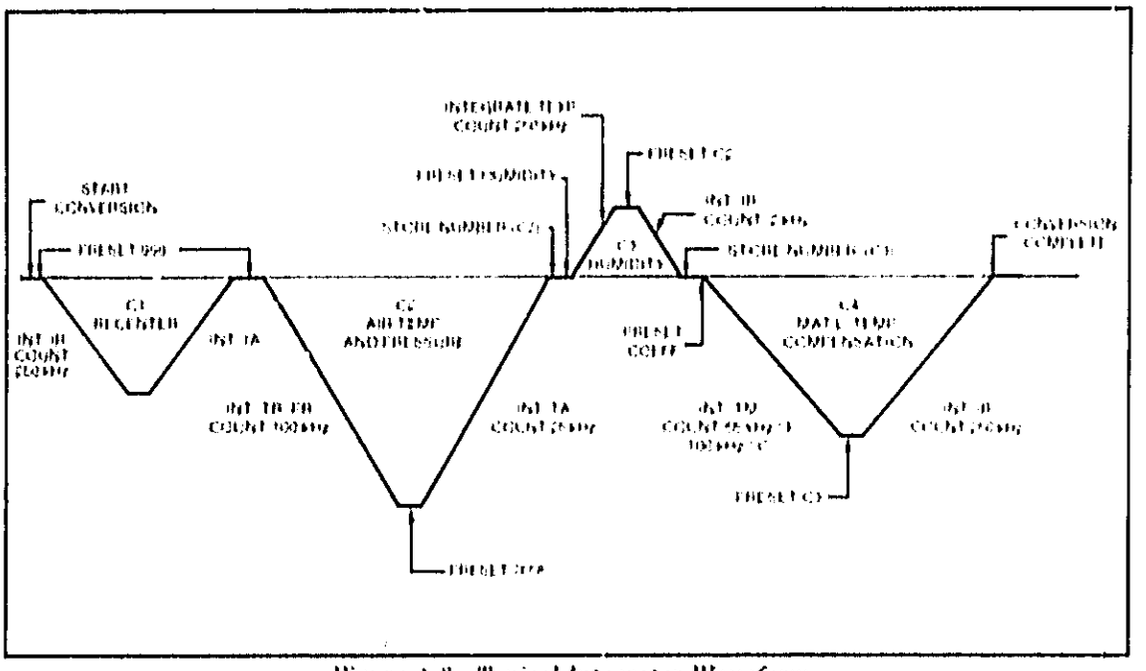


Figure 4-3. Typical Integrator Waveform

4-8. The next part of the cycle is C2, the air temperature and pressure conversion. The counter is preset to 0880 and a current proportional to the sum of the air pressure (P_R) and air temperature (T_R) is integrated. The counter counts down at a rate of 100 kHz giving a t_2 of 10 milliseconds. At the end of this period, the number 7658 is preset into the counter and a current proportional to the absolute temperature (T_A) is integrated. During this time, the counter

counts down at a rate of 25 kHz. At the end of this cycle, the number remaining in the counter is transferred to a buffer storage and the counter is preset to a number which represents 10 times the relative humidity. With this number in the counter, a current is turned on which is proportional to exponential temperature (T_{exp} or ke^{TA}). The counter counts down at a rate of 250 kHz. At the end of this time, which is determined by the humidity, the result of the C1 cycle is preset back into the counter (from buffer storage). The reference current is turned on and the counter counts at a rate of 2 kHz. At the end of this cycle, the number is again transferred to storage. At this point, the computation is complete for the laser wavelength compensation at ambient air temperature, pressure, and humidity.

4-9. The C4 cycle changes the air compensation number so that it is corrected for the effects of workpiece temperature. The number from the coefficient of expansion thumbwheel switch is preset into the counter. The counter counts at 55 kHz, if the coefficient switch is set to °F, or 100 kHz when set to °C. The current that is switched into the integrator is proportional to the difference between the measured temperature and 68°F. At the end of this half-cycle, the air compensation number from C3 is preset into the counter and I_R is integrated while the counter counts down at a 250 kHz. When the integrator output crosses zero, the counter contains the total compensation number and the conversion is complete.

4-10. OVERALL BLOCK DIAGRAM

4-11. Figure 8-6 shows the functional block diagram of the 5510A Automatic Compensator. Overall, the compensator makes atmospheric measurements and material temperature measurements and supplies a compensation number to the 5505A Laser Display. The following paragraphs describe the overall block diagram.

4-12. Material Temperature Sensor 10563A A17

4-13. Material temperature sensor 10563A consists of a sensor probe, interconnecting cable, and a material temperature buffer assembly. The sensor probe is a sealed unit consisting of a probe housing, two thermistors, and a magnet. Two thermistors are used to provide better linearity across the rated temperature range. The material temperature buffer provides isolation between the probe and the material temperature averager circuits. In addition, the buffer contains a calibration control to compensate for differences in thermistor outputs.

4-14. Material Temperature Averager A6

4-15. This assembly receives the outputs of the material temperature probes and determines which sensor outputs will be averaged. Control of the sensors are by means of front panel switches T1 through T3. When a switch is lit, it indicates that an output from the corresponding material temperature probe is connected into the averager. This is shown on the block diagram, Figure 8-6. When a sensor switch is pressed, control assembly A9 routes the control signals to A6. For example, when T1 is selected, the control assembly A9 activates the T1 CONT (T1 control) line which connects the output of material temperature probe No. 1 to the summing amplifier network at the input of A6. Although this is shown as a switch on the block diagram, the actual switching is done electronically. The summing network output connects to a voltage-to-current converter. A current switch is used to switch the temperature averager output to the integrator input as determined by the $\overline{\text{TM CONT}}$ (Temperature Material Control) line. The $\overline{\text{TM CONT}}$ line is activated as determined by the control sequence.

4-16. Pressure Transducer and Buffer A4

4-17. The pressure transducer is located in the 5510A but may be removed for remote sensing. The transducer consists of an aneroid barometer coupled to a precision potentiometer. The potentiometer output connects to a voltage to current converter. A current switch is used to connect the pressure signal to the integrator input when required by the control assembly A9. A9 supplies a $\overline{\text{PR CONT}}$ (Pressure Control) signal when the pressure data is required during the program sequence.

4-18. Air Sensor 10564A A18

4-19. The air sensor assembly consists of a sensor probe, interconnecting cable, and a buffer assembly. The sensor probe consists of a humidity sensor, an air temperature sensor, and an amplifier assembly. The humidity sensor is a hygrometric circuit element that senses the relative humidity by changes in impedance. Changes in relative humidity cause the surface resistivity to vary which in turn causes an 80 Hz current to vary as a function of humidity. The air temperature sensor is made up of two thermistors. The thermistor outputs drive an isolation amplifier which in turn connects to air temperature assembly A5.

4-20. Humidity Assembly A7

4-21. This assembly receives the output of the humidity sensor and supplies this data in digital form to preset ROM Assembly A10. The humidity signal input to A7 is routed through an AC to DC converter. An exponential analog-to-digital converter is required since the humidity sensor output varies logarithmically. The ADC output connects to a scanner circuit which supplies 4-line BCD data in a serial output form to Preset ROM A10.

4-22. Air Temperature Assembly A5

4-23. This assembly receives the output of the air temperature assembly and supplies four outputs:

a. TR (a current proportional to the relative temperature).

b. +TA (a current proportional to the plus absolute temperature).

c. -TA (a current proportional to the minus absolute temperature).

d. An output for TEXP (a current proportional to the expotential temperature).

4-24. The TR circuits consist of a voltage-to-current converter and a current switch. The TR output is proportional to the difference between the actual air temperature and 82.4° F (28° C). Hence, the name relative temperature. The $\overline{\text{TR CONT}}$ (relative temperature control) line determines when the TR output is connected to the integrator input. The -TA (absolute temperature) circuits consist of a voltage-to-current converter, a current offset, and a current switch. The current offset adds an additional current to the TR so that its output is proportional to the absolute temperature.

4-25. Integrator Assembly A3

4-26. The integrator assembly receives the outputs of the various current switches as determined by the control circuits. The operation of dual-slope integration is described in Paragraph 4-2. The integrator assembly contains an integrating amplifier circuit. Its output is monitored by positive and negative threshold detectors to determine the integrator slope polarity and when the integrator voltage returns to zero.

4-27. Reference Current Assembly A2

4-28. This assembly contains two voltage-to-current converters and two current switches. The voltage to current converters convert + and - 1 volts to reference current $+I_R$ and $-I_R$. The current switches are activated by control board A9 to select either $-I_R$ or $+I_R$ depending upon the desired integrator output slope.

4-29. Preset Read-Only-Memory Assembly A10

4-30. This assembly provides the numbers to preset counter assembly A11. A10 also scans the humidity and the material expansion coefficient into the counter. There are 10 ROM number select lines which are controlled by A9. A9 determines which select line is required during the sequence. When a select line is enabled, one 4-digit number from the ROM is preset into the counter. The ROM number is scanned out bit parallel-character serial with the least significant

digit first. When a LDH (load humidity) is generated by A9, the humidity number is scanned into the counter via the ROM. When a LD COEFF (load coefficient) is generated by A9, the coefficient number is sent to the counter.

4-31. Coefficient Buffer Assembly A14

4-32. The coefficient buffer assembly provides connections for the front-panel thumbwheel switches. It provides a means of manually entering the sign of the material expansion coefficient, the material expansion coefficient, and the units (°C or °F) of the coefficient.

4-33. Preset Counter Assembly A11

4-34. The preset counter assembly contains a series of input gates, four up-down counters, four storage buffers, and four output buffers. The counters are used in conjunction with the A3 Integrator board to convert analog data into digital data, and are used with various clock frequencies to produce specific time intervals.

4-35. Interface Driver Assembly A12

4-36. The driver assembly receives the parallel data consisting of four BCD digits from the Preset Counter Assembly A11. It also receives the readout mode, the T1, T2, T3 control signals, the sign of the coefficient, and the scan and display signals. The driver uses these inputs and supplies the Laser Display unit with both mode information and compensation data. The driver converts the parallel input data to serial output. In addition, the driver performs various timing and decoding functions associated with the Laser Display and Compensator interface.

4-37. Control Board Assembly A9

4-38. A9 determines the sequence of operation necessary to perform the analog-to-digital conversion. It performs the following functions; generates control signals for the ROM numbers, controls the frequency select numbers, determines the current switch sequences, determines the direction of the count, receives the POS and NEG comparator outputs from the integrator, generates start preset signals, loads the buffers from the counter, and stores the mode bits. In addition, the control board receives the front-panel switch signals and the signals from the mode select board. These are used to determine the mode of operation. The integrator board supplies the POS and NEG comparator outputs to the control board.

4-39. Mode Select Assembly A13

4-40. The mode select assembly contains the front-panel SENSOR DISPLAY switch and a series of gating circuits that permit local or external control of the sensor display mode. An external control device connected to AUX connector J6 can override the SENSOR DISPLAY switch and control the display mode.

4-41. Time Base Assembly A6

4-42. The time base assembly contains a 10 MHz crystal-controlled oscillator and a series of dividers that provide clock frequencies of 250 kHz, 100 kHz, 55.55 kHz, 50 kHz, 25 kHz, 10 kHz, 2 kHz, and 1.0 Hz. Additional dividers provides the 2 Hz START CONV (Start Conversion) pulses for the A9 Control board.

4-43. Voltage Reference Assembly A1

4-44. The voltage reference assembly receives +15V and -15V power from the 5605A Laser Display and provides regulated sources of +10V, -10V, +4V, and -4V. All output voltages are adjustable.

4-45. 5510A AUTOMATIC COMPENSATOR ASSEMBLY DESCRIPTIONS

4-46. The assemblies used in the 5510A Automatic Compensator are described in the following paragraphs. Schematic diagrams and photographs of each assembly are contained in Section VIII of this manual.

4-47. Voltage Reference Assembly A1

4-48. The voltage reference assembly (Figure 8-7) receives +15V and -15V from the 5505A Laser Display and provides regulated outputs of +10V, -10V, +4V, and -4V. These outputs provide accurate reference levels for the A2 Current Reference Assembly, A3 Integrator Assembly, and other boards involved in the analog-to-digital conversion process.

4-49. Voltage regulator U3 provides the +10V output to pin 5 of the board and to the input of voltage regulator U4. The regulated +10V supply is also used to power operational amplifier U2. Resistor R8 is a current sensing element that limits the output current of U3 to approximately 150 milliamperes so that a short circuit on the +10V line will not damage the regulator. Potentiometer R2 determines the output voltage and is set to obtain +10.00 ±.05 volts at pin 5. Because the current sensing resistor is in series with the regulator output, voltage adjustments should be made only when operating under a normal load.

4-50. Operational amplifier U1 controls transistor Q1, a series regulator that reduces the -15V source to a -10V level. Potentiometer R14 is adjusted to obtain -10.00 ±.05 volts at pin 4.

4-51. Voltage regulator U4 and transistor Q2 work in the same manner to provide the +4V and -4V reference levels. Potentiometers R5 and R6 are set to obtain +4.000 ±.001 volts at pin 7. Potentiometer R16 is adjusted to obtain -4.000 ±.001 volts at pin 8.

4-52. Current Reference Assembly A2

4-53. The current reference assembly (Figure 8-8) receives two precise 4V reference signals from Voltage Reference board A1 and two control signals from Control board A9. It produces positive and negative reference currents for the A3 Integrator board.

4-54. The -4V reference voltage is applied to the inverting input of amplifier U2, and it is converted into a constant-current output. The +IR output is routed to a shunt/series gate gate formed by field-effect transistors Q5 and Q9. Potentiometer R13 determines the magnitude of the positive reference current reaching the integrator bus. When the +$\overline{\text{IR CONT}}$ is high, transistors Q1 and Q3 are cut off and transistor Q7 conducts. The positive voltage on the collector of Q3 is blocked by CR1 and the gate of Q5 goes to 0 volts. Q5 conducts and shunts the +IR current to ground. At the same time, the conduction of Q7 places a bias of approximately -15V on the gate of Q9. Q9 is cut off and the +IR line is disconnected from the integrator bus.

4-55. When +$\overline{\text{IR CONT}}$ goes low, Q1 and Q3 conduct while Q7 is cut off. The conduction of Q3 applies approximately -15V to the gate of Q5 and it is biased to cutoff. Since Q7 is not conducting, the positive voltage on its collector is blocked by CR3 and no bias is applied to the gate of Q9. Q9 conducts to connect the +IR current to the integrator bus.

4-56. Amplifier U1 and the shunt/series gate formed by Q6 and Q10 operate in the same manner to provide the -IR current to the integrator bus. Potentiometer R16 determines the magnitude of the negative current reaching the integrator bus.

4-57. Integrator Assembly A3

4-58. The integrator assembly (Figure 8-9) contains an integrating amplifier, a pair of threshold detectors, and a pair of "out of range" detectors. It also contains a transistor driver for the OUT OF RANGE indicator on the front panel. Transistor Q1, operational amplifier U1, and capacitor C1 form an integrating amplifier with a linear operating range of +10V to -10V. The output voltage at pin 6 of U1 is proportional to the input current multiplied by the time the input current flows. During a measurement, the time that the integrator bus current flows is known so the voltage reached by the integrator is determined by the magnitude of the current. Since the

currents applied to the integrator bus are analog representations of temperature, pressure, or humidity, the final voltage reached by the integrating amplifier is also an analog representation of temperature, pressure, or humidity. The analog voltage level is converted to digital form by applying a known reference current (+IR or -IR) to bring the integrating amplifier output back to zero volts and running a digital counter during the time that the reference current flows. The resulting number in the counter is a digital representation of temperature, pressure, or humidity, and it is transmitted to the 5505A Laser Display for further processing.

4-59. The output of the integrating amplifier is routed through R9 to voltage follower U4, and the through R14 to threshold detectors U2 and U3. Diodes CR2, CR3, CR4, and CR6 limit the maximum voltage to the threshold detectors to approximately ±5 volts. The output of the integrating amplifier is also routed to an "out of range" detector formed by operational amplifiers U5 and U6. Amplifier U5 has a -10V reference applied to its inverting input and the integrator output applied to its non-inverting input. If the integrator output goes more negative than -10V, the output of U5 goes negative. Although the output at pin 6 is not used, the compensation output on pin 8 causes the output of U6 to go negative. This output is coupled through CR8 to pin 1 of U7A and causes the output of U7B to go low. Transistor Q2 conducts to illuminate the OUT OF RANGE indicator. Operating in a similar manner, U6 has a +10V reference applied to its non-inverting input and the integrator output applied to its inverting input. If the integrator output swings more positive than +10V, the output of U6 goes low and the OUT OF RANGE indicator is illuminated. The OUT OF RANGE indicator is turned off when START CONV goes low.

4-60. The output of voltage follower U4 is coupled through R14 to the inverting inputs of the threshold detectors U2 and U3. Amplifier U2 has a fixed reference of -20 millivolts applied to its non-inverting input and its output is low when the integrator output is more positive than -20 millivolts. When the integrator output goes below -20 millivolts, the output of U2 goes high to provide the NEG signal for the A9 Control board. Threshold detector U3 has a fixed reference of +20 millivolts applied to its non-inverting input and its output is high when the integrator output is less positive than +20 millivolts. When the integrator output goes above +20 millivolts, the output of U3 goes low to provide the POS signal for the A9 Control board.

4-61. Pressure Buffer Assembly A4

4-62. The pressure buffer assembly (Figure 8-10) receives an analog voltage representing atmospheric pressure and converts the voltage to an analog current. Upon receipt of a PR CONT (Pressure Control) signal from the A9 Control Board, the analog current is connected to the A3 Integrator Board. The integrator board controls an analog-to-digital conversion process on the A11 Preset Counter Board by controlling the length of time that the counter runs.

4-63. Pressure transducer MT1 is essentially a sealed bellows assembly attached to the wiper of a 3000 ohm potentiometer. The potentiometer wiper is centered when the bellows is subjected to an absolute pressure of 26.50 inches (673.1 mm) of Hg. One end of the potentiometer winding is tied to a +4V source and the other end is tied to a -4V source. At the reference pressure of 26.50 inches, the wiper is centered and the output voltage to the A4 Pressure Buffer Board is zero. Pressures above 26.50 inches move the wiper toward the negative reference voltage, and pressures lower than 26.50 inches move the wiper toward the positive reference voltage.

4-64. The analog voltage representing atmospheric pressure is routed to U3, a voltage follower on the A4 Pressure Buffer Board. The voltage follower drives U2, a voltage-to-current converter that provides the analog current for the A3 Integrator Board. A second voltage-to-current converter is controlled by potentiometer R3 to compensate for zero offsets in the pressure transducer and in the A4 board. The offset control is adjusted to provide a zero output current to the integrator bus when the pressure transducer is subjected to an absolute pressure of 26.50 inches of Hg. Then, with the pressure transducer vented to the atmosphere, gain control R17 is adjusted so that the displayed number is equal to the measured atmospheric pressure.

4-65. The PR CONT (pressure control) signal from the A9 Control board is used to connect the output of the A4 Pressure Buffer board to the integrator bus. When a pressure reading is required, PR CONT goes low. This action cuts off transistor Q4 to remove a shunt to ground, and turns on Q5 to connect the output to the integrator bus. When PR CONT goes high, the opposite condition exists; Q5 is cut off and Q4 shunts the output current to ground.

4-66. Air Temperature Assembly A5

4-67. The air temperature assembly (Figure 8-11) receives TR (temperature relative) and BR (bridge relative) analog voltages from the 10564A Air Sensor, and a series of control signals from the A9 Control board. It sends analog output currents to the integrator bus and an exponential voltage (VEXP) to the A7 Humidity board. The exponential voltage is used as a correction factor for the humidity reading produced by the A7 board. The term "relative" is applied to the temperature signals because they represent measurements made from a fixed reference temperature of 28°C (82.4°F). Since the calculations made for air temperature compensation are based upon absolute temperature, the A5 board adds a fixed offset current that represents the difference between 28°C and absolute zero (-273°C). When the "relative" temperature current is added to the fixed offset current, the result is a signal that represents absolute temperature.

4-68. The TR signal from the 10564A Air Sensor is an analog representation of the relative temperature. It enters the A5 board on pin 13 and is connected to a shunt/series gate formed by field-effect transistors Q15 and Q18. When the TR CONT signal is high, transistors Q6 and Q9 are cut off and Q12 conducts. With the collector of Q12 near -15V, the negative bias on the gate of Q18 cuts it off and the TR signal is disconnected from the integrator bus. At the same time, the positive voltage on the collector of Q9 is blocked by CR2 and there is no bias on the gate of Q15. Q15 conducts and shunts the TR signal to ground. When TR CONT goes low, Q6 and Q9 conduct and Q12 is cut off. With Q9 conducting, the collector is near -15V. This negative level cuts off Q15 to remove the shunt to ground. With Q12 cut off, the positive level on its collector is blocked by CR5; Q18 conducts to connect the TR signal to the integrator bus.

4-69. The BR signal from the 10564A Air Sensor is an analog representation of the bridge relative temperature. It is used in conjunction with a fixed +4V source to generate the +TA, -TA, TEXP, and VEXP signals. Operational amplifier U3 is a voltage-to-current converter with two signals applied to its inverting input. The fixed voltage determined by TA potentiometer R11 represents the difference between the reference temperature of 28°C and absolute zero. The BR signal routed through R6 represents the difference between the reference temperature of 28°C and the temperature sensed by the 10564A. The two signals are added at the input of U3 to produce a signal representing absolute temperature. The output of U3 is inverted by U6 to produce the +TA current that is coupled to Q4 and Q5. This same signal, when gated through Q5, is inverted by U4 to produce the -TA signal. Potentiometer R34 (-TA) permits a slight gain adjustment so that -TA can be precisely matched to +TA.

4-70. The application of +TA and -TA signals to the integrator bus is controlled by the +TA CONT and -TA CONT lines. When both lines are high, field-effect transistors Q4 and Q19 are biased to cutoff. Q5 and Q16 are conducting. Neither temperature signal reaches the integrator bus. When +TA CONT goes low, Q1 and Q2 conduct while Q3 is cut off. The conduction of Q2 applies approximately -15V to the gate of Q5 and cuts it off. Cutting Q3 off removes the bias on the gate of Q4 and this action connects the +TA signal to the integrator bus. To apply -TA to the integrator bus, -TA CONT must be low and +TA CONT must be high. The +TA signal goes through Q5 and is inverted by U6. The shunt/series gate formed by Q16 and Q19 operates exactly like the gate formed by Q15 and Q18. It removes the shunt to ground and connects the -TA signal to the integrator bus.

4-71. Operational amplifier U1 provides a constant-current source that drives a matched pair of temperature stabilized transistors in U2. The upper transistor is operated on the exponential portion of its base-emitter characteristic curve to generate an exponential function of the BR signal. The output of this transistor is inverted by amplifier U5, and the amplifier output is coupled directly to pin 10 to provide the VEXP signal for the A7 Humidity board. The output of U5 is also coupled through R31 to the shunt/series gate formed by Q17 and Q20. This gate operates exactly like the shunt/series gates previously described; the TEXP CONT signal from the A9 Control board controls the application of the TEXP signal to the integrator bus.

4-72. The two transistors in U2 are housed in a miniature oven that provides a reasonably stable operating temperature, but additional stability is provided by placing the lower transistor in the negative feedback loop of amplifier U1. If current increases through the two transistors because of a rise in temperature, the current through the lower transistor increases the negative feedback to U1 and reduces the amplifier output.

4-73. Material Temperature Average Assembly A6

4-74. The material temperature averager (Figure 8-12) receives from one to three analog voltages from the 10563A Material Temperature Sensors and converts the average of the voltage into an analog current for the integrator bus. When more than one sensor is available, front-panel switches on the 5510A Automatic Compensator permit the selection of individual temperature readings or the average of any combination of readings.

4-75. With a 10563A connected to the rear-panel T1 connector, the TM1 analog voltage is connected to pin 10 of the A6 board. The sensor also provides the $\overline{\text{SET T1 EBL}}$ signal for the A9 Control board. If the front-panel OFF indicator is pressed, the $\overline{\text{T1 CONT}}$ line will be high. Transistors Q1 and Q4 will be cut off, Q8 will be conducting, and the negative bias applied to the gate of field-effect transistor Q8 will bias it to cutoff. The high signal on $\overline{\text{T1 CONT}}$ also permits the base of Q7 to go high and cut it off. This cuts off Q14 and causes Q20 to conduct and illuminate the front-panel OFF indicator. The positive level on the collector of Q14 is blocked by CR7, so there is no bias on Q15. Q15 conducts and the input to voltage follower U2 is shunted to ground. This condition is equivalent to a standard temperature condition of 68°C (20°C), and no material temperature compensation current will be applied to the integrator bus.

4-76. When the front-panel T1 switch is illuminated, the $\overline{\text{T1 CONT}}$ signal goes low. Transistors Q1 and Q4 conduct and Q8 is cut off. Removal of the negative bias on the gate of Q8 causes it to conduct. At the same time, the low $\overline{\text{T1 CONT}}$ signal through CR3 causes Q7 and Q14 to conduct. The negative level on the collector of Q14 cuts off Q20 to extinguish the OFF lamp. It also biases Q15 to cutoff and removes the ground at the input to voltage follower U2. The analog voltage representing the T1 material temperature goes through U2 and U1, a voltage-to-current converter. The output of U1 is routed through GAIN control R52 to a shunt/series gate formed by Q10 and Q21.

4-77. When the $\overline{\text{TM CONT}}$ signal is high, Q10 is conducting and Q21 is cut off. The output of voltage-to-current converter U1 is shunted to ground and the A6 board is disconnected from the integrator bus. When the A9 Control board is ready for a material temperature compensation operation, the TM CONT line goes low. Transistors Q16 and Q17 conduct and Q18 is cut off. The negative level on the collector of Q17 biases Q10 to cutoff and the shunt to ground is removed. The positive level on the collector of Q18 is blocked by CR10. With no bias on the gate of Q21, it conducts to connect the analog material temperature current to the integrator bus.

4-78. The TM2 and TM3 material temperature signals are controlled in the same manner by the front-panel T2 and T3 switches. When two or more sensors are selected, the signals are automatically averaged by means of the resistive adder formed by R32, R33, and R34.

4-79. Humidity Assembly A7

4-80. The humidity assembly (Figure 8-13) receives the alternating current VH (Voltage Humidity) signal from the 10564A Air Sensor and converts it into two and a half BCD digits that represent the relative humidity in percent. The two and a half BCD digits are gated via the A10 Preset ROM board to the A11 Preset Counter. The analog-to-digital conversion is accomplished by charging an RC circuit to a voltage proportional to the relative humidity, and then counting 10 kHz clock pulses during the time required to discharge the RC circuit. The count is stored in a buffer register and gated to the A10 board when an LDH (Load Humidity) signal is received from the A9 Control board. The counting circuits operate over two ranges and the proper range is automatically selected. The low range is used for relative humidity reading of 10% to 60%, and the high range is used for readings of 50% to 100%.

4-81. The VH signal arriving at pin 4 is coupled through C1 to an ac-to-dc converter formed by U16 and U17. The output of U16 is rectified by CR2 and CR3, and capacitor C6 is charged in a positive direction to the peak amplitude of the rectified voltage. This voltage is coupled to the non-inverting input of voltage follower U17. The output of U17 is routed through field-effect transistor Q3 to an RC circuit in the 10564A Air Sensor and to the non-inverting input of voltage comparator U18.

4-82. When a humidity conversion is not in process, control flip-flop U7B is set. The high Q output cuts off Q2 and Q4. Since the high level on the collector of Q4 is blocked by CR4, Q3 conducts to allow charging of the RC circuit. The positive level of the non-inverting input to voltage comparator U18 will be higher than the reference level supplied to the inverting input, so the output of U18 will be high. This supplies one enabling input to gate U2C, but the low Q output of control flip-flop U7B inhibits the 10 kHz clock pulses at U2C.

4-83. When operating in the low range (10% to 50%), the negative-going leading edge of the START CONV pulse presets decade counter U15 to 0, presets U14 to 1, and resets flip-flop U7A. This sets the counter to 010 and represents a humidity of 10%. The positive-going trailing edge of the START CONV pulse resets control flip-flop U7B and the low Q output causes Q2 and Q4 to conduct. The negative bias applied by Q4 cuts off Q3. This action disconnects the charging current and allows the RC circuit to start discharging. At the same time, the high $\overline{Q}$ output from U7B enables U2C and the 10 kHz clock pulses are gated to decade counters U14 and U15. The +5V tied to the CET and CEP inputs of U15 allows it to count at all times. When U15 reaches a count of 9, the TC output goes high and enables U14 during the next clock pulse. On the tenth clock pulse, U14 counts from 1 to 2 while U15 returns to zero. Since the counters were preset to 010, this would occur as the humidity count goes from 019 and 020. Counting continues until stopped by voltage comparator U18. If the count goes beyond 099, the TC output of U14 is inverted by U1F to provide a clock pulse for flip-flop U7A. This steps the count to 100 and the high Q output of U7A is gated through U8B to drive Q5. Q5 produces the $\overline{\text{HOF}}$ signal for the A3 Integrator board and causes the front-panel OUT OF RANGE indicator to illuminate.

4-84. Voltage comparator U18 has a positive reference voltage applied to its inverting input. The reference level is derived from a voltage divider supplied with +10V at pin 5 and with the VEXP signal (temperature correction) at pin 6. Since the RC circuit connected to the non-inverting input is normally more positive than the reference input, the output of U18 is normally high. When the RC circuit discharges to the point where the voltage on pin 3 goes below the reference level on pin 2, the output of U18 goes low. This immediately inhibits the flow of 10 kHz clock pulses through U2C and leaves decade counters U14 and U15 with a count representing the relative humidity. The low output of U18 also sets control flip-flop U7B. The high Q output of U7B causes Q3 to conduct, and the RC circuit is recharged to a level representing the relative humidity. The low $\overline{Q}$ output of U7B inhibits gate U2C to prevent further counting when the output of U18 goes high.

4-85. The BCD digits stored in decade counters U14 and U15, and the 0 or 1 stored in flip-flop U7A are gated into nine buffer storage flip-flops by the 100 Hz clock signal. The least significant digit of the humidity count is gated from U15 to the four flip-flops in U5 and U13. These flip-flops, in turn, supply the BCD information to NAND U6A, U6C, U12A, and U12C. Upon receipt of an LDH signal from the A9 Control board and a PD1 signal from the A10 Preset ROM board, the BCD digit is gated to the A10 board as the RB1, RB2, RB4, and RB8 signals. In a similar manner, the second BCD digit from U14 is gated through U13B, U13C, U13A, and U12B upon receipt of the PD2 signal. The most significant digit from U7A (limited to 0 or 1) is gated through U6B by the PD3 signal.

4-86. Range selection is automatically accomplished by a series of gates that control the range flip-flop U9A. When operating in the low range, the Q output of U9A is low. If decade counters U14 and U15 reach a count of 60, the high Q outputs of U9B and U10B cause NAND gate U3D to switch. This, in turn, switches U2A, U2B, and U3C to provide a high D input to U9A. The next 100 Hz clock pulse causes the Q output of U9A to go high and accomplish three different operations. It cuts off Q6 and Q7 to produce the RS (Range Select) signal for the 10564A Air Sensor. The positive-going transition is coupled through R10 and C7 to cause a momentary conduction of Q1. Q1 discharges C6 to ensure that the RC circuit does not retain a voltage level that would produce an excessively high count on the next conversion. The third operation is to place a high

level on pin 5 of decade counter U14. This, when combined with the +5V tied to pin 3, causes U14 to be preset to 5 when the next START CONV signal arrives. This presets the counter to 050 and the counting circuits count from 50 to 100 while operating in the high range. If the humidity decreases to 50%, the combination of a 0 in the least significant digit and a 5 in the second digit provides the seven high inputs required to switch NAND gate U4. The output of U4 goes low, the output of U3B goes high, and the output of U3C goes low. The next 100 Hz clock pulse causes the Q outputs of U9A to go low and return the counters to the low range.

4-87. Time Base Assembly A6

4-88. The time base assembly (Figure 8-14) is basically a 10 MHz crystal-controlled oscillator with a series of counters to divide the crystal frequency down to the desired clock frequencies. Some of the clock signals are connected directly to other boards, however, all clock frequencies used by the A11 Preset Counter board are gated by control signals from the A9 Control board.

4-89. Transistor Q1 and crystal Y1 form the oscillator that provides the 10 MHz time base. The oscillator output is buffered by amplifier Q2 and divided by decade counter U5 to produce a 1 MHz clock. The 1 MHz clock is routed to the A9 Control board and to counters U4, U1, and U3 on the A8 board. Decade counter U4 divides by two to obtain a 500 kHz output and divides by 10 to obtain a 100 kHz output. The 500 kHz clock is routed to U8 where it is divided by nine to produce a 55.55 kHz clock that is gated to the A11 Preset Counter. The 500 kHz clock is also routed to flip-flop U7A where it is divided by two to obtain a 250 kHz clock signal. The 250 kHz clock can be gated to the A11 board as a $\overline{\text{CNT DN}}$ or a $\overline{\text{CNT UP}}$ signal.

4-90. The 1 MHz clock input to U1 is divided by 10 to provide a 100 kHz clock for U3, and U3 provides outputs of 50 kHz and 10 kHz. The 50 kHz clock is divided by flip-flop U7B to produce a 25 kHz clock. Both the 50 kHz and 25 kHz clocks can be gated to the A11 board as $\overline{\text{CNT DN}}$ or $\overline{\text{CNT UP}}$ signals. The 25 kHz clock is also routed directly to the A10 Preset ROM board. The 10 kHz clock from U3 is routed directly to the A7 Humidity board, and is reduced to a 2 kHz clock by U2. The 2 kHz clock can also be used as a $\overline{\text{CNT DN}}$ or $\overline{\text{CNT UP}}$ signal.

4-91. The 2 kHz clock from U2 is reduced to 100 Hz by U6 and the Q0 output at pin 14 of U10. This is routed directly to the A7 Humidity board. It is further reduced to 20 Hz at the Q3 output on pin 11 of U10. The 20 Hz input to U11 is normally divided by 10 to provide the 2 Hz START CONV signal. If desired for test purposes, a jumper can be installed between the FAST test points to provide a 10 Hz START CONV cycle rate.

4-92. A9 Control Board

4-93. This assembly (Figure 8-15) generates control signals for the ROM numbers, frequency select numbers, current switches, and determines the sequences and count directions. The control board also generates start-preset, loads the buffers from the counters on A11, and stores the mode bits. Operating conditions for A9 are determined by the display and scan switches and the signals from mode select board A13.

4-94. The control board contains the following major circuits:

1. Sub-Cycle Shift Register U14A, U14B, U13A, and U13B.
2. Conversion-Cycle Shift Register U12A, U12B, U11A, and U11B.
3. Display Control U10 and U17A.
4. Presettable Decade U8 and Mode Status Decoder U7.
5. Overwait Timer U16 and U6D.
6. Temperature Enable Latches U10B, U9B, U10D, U9A, U10C, and U9C.
7. Decoding Matrix consisting of the gates at the right side of the schematic diagram.
8. Count Up-Count Down detector.
9. Last Cycle Decoder U30.

4-05. Overall, the control board controls the sequences during the various modes of operation. The control sequences are determined by the front panel control settings or remote program instructions. For example, when the 5510A is set for TOTAL COMP-OPERATE OR DISPLAY, the control board configures the circuits to make four conversion cycles as shown in Figure 4-3. These four cycles are: recenter, air temperature and pressure, humidity, and material temperature. Note that each conversion cycle has four subcycles: preset low, first half integration, preset high, and second half integration. When the 5510A is set to % HUMIDITY-DISPLAY, only two conversion cycles are required, thus the control board sets up a two cycle sequence consisting of a recentering cycle and a humidity cycle.

4-06. Two shift registers are used to step the control board through the required conversion cycles and subcycles. U14A/B and U13A/B comprise the subcycle shift register while U12A/B and U11A/B make up the conversion-cycle shift register. Table 4-1 shows the states of the conversion cycle shift register for the total comp conversion cycle. For each conversion cycle, there are four subcycles. Table 4-2 shows the states of the subcycle shift register for the various subcycles.

Table 4-1. Conversion Cycle Shift Register

Conversion Cycle	U12A	U12B	U11A	U11B
Recentering (C1)	1	0	0	0
Air Temp and Pressure (C2)	0	1	0	0
Humidity (C3)	0	0	1	0
Material Temp Compensation	0	0	0	1

Table 4-2. Subcycle Shift Register

Subcycle	U14A	U14B	U13A	U13B
Preset Low	1	0	0	0
1st Half	0	1	0	0
Preset High	0	0	1	0
2nd Half	0	0	0	1

1 = Q high and $\overline{Q}$ low
0 = Q low and $\overline{Q}$ high

4-07. The control process starts with the arrival of the 2 millisecond $\overline{\text{START CONV}}$ (start conversion) pulse at A9 pin A8. This pulse comes from Time Base A8 and occurs at a 2 Hz per second rate. When the 5510A is in the OPERATE mode, the $\overline{\text{START CONV}}$ pulse clocks U10B causing U17A to momentarily pull U8(1) low, resetting U8 to "0000". The $\overline{\text{START CONV}}$ pulse also sets both the subcycle and conversion-cycle shift registers to 1000. The $\overline{\text{START CONV}}$ pulse also passes through U11F and U4A to generate a $\overline{\text{START PRESET}}$ signal which is sent to the A10 PRESET ROM Assembly from pin A7. With the two registers at 1000, the control board is in the recenter conversion cycle at preset low subcycle. Gates U23B and U21D are activated so that a ROMN 0999 signal at pin A5 is sent to A10. This allows A10 to preset 0999 into counter board A11. When the control board receives a PRESET COMPLETE signal at pin A24, U26(8) goes low to clock the subcycle shift register to 0100. This activates -$\overline{\text{IR CONT}}$ at pin B10 and 11250 kHz at pin A12. Integrator A3 integrates the positive reference current for 4 msec. The counter A11 counts down from 0999 at the 250 kHz rate until the counter underflows. With the counter underflow, a $\overline{\text{BORROW}}$ pulse is applied to A9 at pin B20. With a low at U6(10), U6(8) goes high, U17D(11) goes low to clock the subcycle shift register. This sets the subcycle shift register to the preset high and subcycle 0010. The $\overline{\text{BORROW}}$ pulse is also routed to U20A to generate a low $\overline{\text{START-PRESET}}$ output at pin A7. Thus, the $\overline{\text{BORROW}}$ pulse terminates the first half subcycle and starts a preset cycle of the ROM.

4-08. During this particular cycle, no ROM numbers are enabled. When the preset-complete signal comes in on A9(24), the subcycle shift register advances to the second half integration (0001) of the recentering cycle.

4-09. During the second half, -$\overline{\text{IR CONT}}$ is enabled since U13B $\overline{Q}$ is low and A9(B18), the NEG comparator input is high. NEG enables U26A, and U13B $\overline{Q}$ enables U37A. With -$\overline{\text{IR CONT}}$ activated, integrator comp or comp air conversion cycles by showing the control function, the corresponding active gates and the Control Board Outputs. Table 4-4 through 4-8 give the functions and active gates for the other modes of operation.

Table 4-2. Total Compensation or Comp Air Only Conversion Cycle (Mode 0 or 1)

Function	Conversion Cycle Shift Register				Subcycle Shift Register				Active Gates	Control Board Outputs NOTE 1	
	U12A	U12B	U11A	U11B	U14A	U14B	U13A	U13B		A9 Pin	Function
Reenter - Preset Low	1	0	0	0	1	0	0	0	U23B, U21D	A5	ROMN 0000
Reenter - 1st Half					0	1	0	0	25C 31B 26D	B10, A12	+IR CONT, 250 kHz
Reenter - Preset High					0	1	1	0			
Reenter - 2nd Half					0	0	0	1	37A 26B	B21	-IR CONT
Air - Preset Low	0	1	0	0	1	0	0	0	21D	A5	ROMN 0001
Air - 1st Half					0	1	0	0	28B 28A 28D	B12	100 kHz
					1	1	1	1	21B 33B 33A	B11, B15	TR CONT, PR CONT
Air - Preset High					0	0	1	0	25D 35C	A25	ROMN 3658
Air - 2nd Half					0	0	0	1	32D 21A•32C•32B	B9, B10	+TA CONT, -TA CONT
					1	1	1	1	31C	B3	2H 25 Hz
Humidity - Preset Low	0	0	1	0	1	0	0	0	37D	B21	LDH
Humidity - 1st Half					0	1	0	0	32A, 25C, 31B	B11, A12	TEXP, 250 kHz
Humidity - Preset High					0	0	1	0	35A 35D	A14	Select B8
Humidity - 2nd Half					0	0	0	1	37A (26A•26B)	B10, B21	+IR CONT • -IR CONT
					1	1	1	1	31D	A3	2H 2 Hz
*MODE 1 ENDS HERE. MODE 0 ENDS HERE IF NO TEMP SENSOR ENABLED											
Matl Temp - Preset Low	0	0	0	1	1	0	0	0	37C	B23	LD COEFF
Matl Temp - 1st Half					0	1	0	0	27C 27D	B22	TM CONT
					1	1	1	1	28B•28A [•28D•(27A•28C)]	B12• B8	H 100 • H 55
Matl Temp - Preset High					0	0	1	0	35A 35D	A14	Select B8
Matl Temp - 2nd Half					0	0	0	1	31A 37A (26A•26B)	B7, B19• B21	2H 250, +IR CONT • -IR CONT)

NOTE 1: In A9 pin column; • means OR and a, means AND

Table 4-4. % Humidity Conversion Cycle (Mode 2)

Function	Conversion Cycle Shift Register				Subcycle Shift Register				Active Gates	Control Board Outputs	
	U12A	U12B	U11A	U11B	U14A	U14B	U13A	U13B		A9 Pin	Function
	1	0	0	0	1	0	0	0	Recenter Cycle (See Modes 0 or 1)		
MODE 2 CYCLE 1											
Humidity									Mode Select Switch 35B 36A		Sets board for Humidity conversion in second cycle
Humidity - Preset Low	0	1	0	0	1	0	0	0	37D	B24	LDH
Humidity - 1st Half					0	1	0	0	23D, 23C, 25C, 34B	A12	HI 250
					1	1	1	1	36B, 36D, 25A, 26D	B19	-HR CONT
Humidity - Preset High					0	0	1	0			
Humidity - 2nd Half					0	0	0	1	32D, 31C, 37A, 26B	B4, B21	2H 25, -HR CONT

Table 4-5. Air Pressure Conversion Cycle (Mode 3)

Function	Conversion Cycle Shift Register				Subcycle Shift Register				Active Gates	Control Board Outputs	
	U12A	U12B	U11A	U11B	U14A	U14B	U13A	U13B		A9 Pin	Function
	1	0	0	0	1	0	1	0	Recenter Cycle (See Modes 0 or 1)		
MODE 3 CYCLE 2											
Air Pressure									29 38C 36A		MM • in Hg
Air Pressure Preset Low	0	1	0	0	1	0	0	0	39B • 39F	A30 • A27	ROMN 2703 • ROMN 2180
Air Pressure 1st Half					0	1	0	0	33D 21B 33A	B15	PR CONT
					1	1	1	1	23D 23C 25C 34B	A12	HI 250 kHz
Air Pressure Preset High					0	0	1	0	29 30E • 30D	A23 • A22	ROMN 6731 • ROMN 2650
Air Pressure 2nd Half					0	0	0	1	32D 31C•21C•31B•1E	B3 • B5	2H 25 • 2H 250
					1	1	1	1	37A 26A • 26B	B19 • B21	-HR CONT • -HR CONT

Table 4-6. Air Temp Conversion Cycle (Mode 4)

Function	Conversion Cycle Shift Register				Subcycle Shift Register				Active Gates	Control Board Outputs	
	U12A	U12B	U11A	U11B	U14A	U14B	U13A	U13B		A9 Pin	Function
MODE 4 CYCLE 2											
Air Temp	1	0	0	0	1	0	0	0	Recenter Cycle (See Modes 0 or 1) 24H		
Air Temp - Preset Low	0	1	0	0	1	0	0	0	21D	A5	ROMN 0800
Air Pressure - 1st Half					0	1	0	0	21B 33C 43D	B14	TR CONT
									38D 38C 38B 28A 28D	B12	1H 100 4C
									27A 28C 15D 15A	B8	1H 55 2F
Air Pressure - Preset High					0	0	1	0	24 34D • 31E	A21• A13	ROMN 0280 • ROMN 821
Air Pressure - 2nd Half					0	0	0	1	37A 26A • 26B	B10• B21	•TR CONT • -TR CONT
									32D 31C	B3	2H 25

Table 4-7. T1, T2, T3, Tave Conversion Cycle (Modes 5, 6, 7, 8)

Function	Conversion Cycle Shift Register				Subcycle Shift Register				Active Gates	Control Board Outputs	
	U12A	U12B	U11A	U11B	U14A	U14B	U13A	U13B		A9 Pin	Function
	1	0	0	0	1	0	0	0	Recenter Cycle (See Modes 0 or 1)		
MODE 5 6 7 8 CYCLE 2											
T1•T2•T3• T AVE (Matl Temp)									23D 23C		
Matl Temp - Preset Low	0	1	0	0	1	0	0	0	21D	A5	ROMN 0800
Matl Temp - 1st Half					0	1	0	0	27B 27C 27D	B22	TM CONT
									15A 38D 38C 38B	B12	1H 100
									28A 28D 27A 28C	B8	1H 55
Matl Temp - Preset High					0	0	1	0	24 34F • 31C	A11• A6	ROMN 022 • ROMN 0680
Matl Temp - 2nd Half					0	0	0	1	37 26A • 26B 31D•31C	B10• B21, B3	-TR • TR, 2H 25

Table 4-8. Temperature Coefficient Conversion Cycle (Mode 0)

Function	Conversion Cycle Shift Register				Subcycle Shift Register				Active Gates	Control Board Outputs	
	U12A	U12B	U11A	U11B	U14A	U14B	U13A	U13B		A9 Pin	Function
MODE 0 CYCLE 2											
Temp Coeff	1	0	0	0	1	0	0	0	Recenter Cycle (See Modes 0 or 1) 25A 36C' 36D		
Temp Coeff - Preset Low	0	1	0	0	1	0	0	0	36B 43C'	B23	LDCOEFF
Temp Coeff - 1st Half					0	1	0	0	25C' 34B 26D	A12	1H 25, -IR
Temp Coeff - Preset High					0	0	1	0	25D 24 43E 34C'	A11, A6	ROMN 0200, ROMN 0680
Temp Coeff - 2nd Half					0	0	0	1	32D 34C', 31B	B3, B5	2H 25, 2H 50
									37, 26B	B21	-IR CONT

4-100. DISPLAY CONTROL CIRCUITS. U10 and U17A supply information to U8 and U7 as to the status of the SCAN-OPERATE-DISPLAY switch

4-101. PRESETTABLE DECADE AND MODE STATUS DECODER. U8 receives information from the Mode Select Board A13 and the Display Control Circuits. Decoder U7 receives 8421 information on the A inputs and supplies control outputs to the decoding matrix. Table 4-9 shows a truth table for U7.

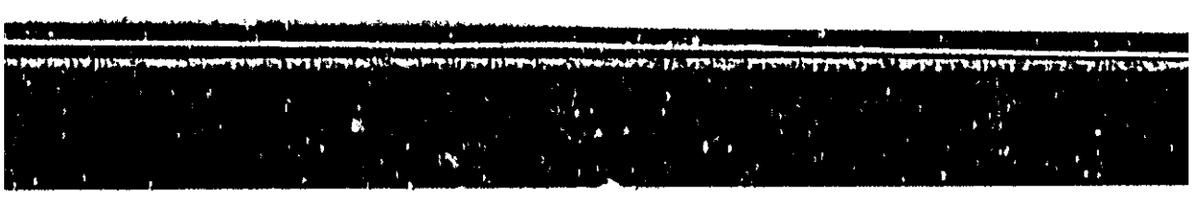
Table 4-9. Decoder A9U7 Truth Table

Mode	U7 Input				U7 Output Active pin low
	A0	A1	A2	A3	
0	L	L	L	L	13
1	H	L	L	L	12
2	L	H	L	L	11
3	H	H	L	L	5
4	L	L	H	L	9
5	H	L	H	L	3
6	L	H	H	L	4
7	H	H	H	L	5
8	L	L	L	H	6

4-102. OVERWAIT TIMER. U9 is a 150 msec multivibrator which is turned on at the beginning of the first half. U16 is enabled when in the preset low subcycle (U16 pin 5 high) and a preset complete pulse at A9 pin A24 is received. After 150 msec, U16 gives a positive pulse at U6D13B. If U6B12 is high, indicating that the integrator has not moved from zero, (A9, B17 high and B18 low), U6D11 simulates a borrow pulse and terminates the first half cycle. This keeps the cycle continuous even if the integrator stays in the dead band.

4-103. INTEGRATOR RECENTER CIRCUIT. U17B, CR7, and C9 comprise a recenter circuit to recenter the integrator in the middle of the dead band at the end of the second half or when the overwait circuit operates. This is gated thru U4C' or U4D to +IR CONT or -IR CONT. Flip-flop U3D -13C' stores information as to whether the last integrator crossing was POS or NEG.

4-104. TEMPERATURE SENSOR ENABLE LATCHES. This circuit consists of three flip-flops, U10B-U9B, U10D-U9A, and U10C'-U9C'. The SET ENABLE signals at pins A29, A28, and A26 are received from a jumper on the material sensor buffers and the selection of the front panel material temperature switches. If the sensor is plugged into the compensator rear panel and a front panel material temperature switch is selected, then the corresponding Flip-flop on A9 is set. The three enable inputs at U20 pins 9, 13, and 5 are anded with mode 0 or 8 via U6B. This gives a



corresponding output at A9 pins B30, B31, and B32. The Flip-Flops (U10 and U9) are initially reset by C31 when power is first applied or the Material Sensor OFF switch is selected.

4-106. COUNT UP-COUNT DOWN DETECTOR. U32 receives NEG and POS from the integrator comparators along with the mode and cycle status and determines if the circuits should count up or down during the second half. The 2ND CNT UP CTRL signal is high if the counter is to count up and low if the counter is to count down.

4-108. LAST CYCLE DETECTOR. U30 detects when the last cycle occurs and enables U2 pin 8 and disables U3 pin 5. This allows U10-Q1 to generate a $\overline{\text{CONV COMPT}}$ (conversion complete) pulse at the end of the last cycle selected and prevents a START PRESET pulse.

4-107. Preset ROM Assembly A10

4-109. The preset read-only memory (ROM) assembly provides all constants used in presetting the A11 Preset Counter, and also provides a means for strobing humidity and material expansion coefficients into the counter. In Figure 8-16, the preset numbers available are shown at the top of the diode matrices associated with U1 through U10. Each of the diode matrices provides four hard-wired BCD digits that are transmitted one digit at a time to the counter. When loading a preset number into the counter, Control Board A9 selects a group of four decimal digits by causing one of the ROMN lines to go high. If ROMN1 goes high, Nand gates 1A, U1B, U1C, and U1D are enabled and the number 0000 stored in the diode matrix associated with U1 can be strobed into the counter. All number groups are transmitted in BCD form with the least significant digit transmitted first.

4-110. The loading process starts with a START PRESET signal from Control Board A9. Flip-Flop U11B is set at the end of the START PRESET pulse when the positive transition of the clock input causes the Q output to go high. This action enables the D input of U11A and the Q output of U11A goes high at the end of the next 25 kHz $\overline{\text{clock}}$ pulse. The Q output of U11A is routed back to reset U11B after the first clock pulse following $\overline{\text{START PRESET}}$.

4-110. When the Q output at pin 5 of U11A goes high, the output of U1C (previously enabled by the ROMN1 signal) goes low and pulls the cathodes of CR5 and CR6 low. The corresponding ROM bit lines are pulled down to approximately 0.7V. Since CR5 and CR6 are tied to ROM bit lines with binary weights of 1 and 8, pulling those lines low produces a BCD representation of the number 9. When the bit line tied to CR5 goes low, transistor Q1 is cut off, Q2 is driven into conduction, and the $\overline{\text{R1}}$ lines goes low. The $\overline{\text{R2}}$, $\overline{\text{R4}}$, and $\overline{\text{R8}}$ are controlled in a similar manner to produce BCD outputs to the A11 Preset Counter.

4-111. The Q output of U11A also goes to pin 9 of Nand gate U13C. When Q goes high, the Nand gate is enabled and the leading edge of the next clock pulse (via U15F and U16E) produces the $\overline{\text{LD0}}$ signal. The $\overline{\text{LD0}}$ signal tells the counter to load the BCD number available on the $\overline{\text{R1}}$, $\overline{\text{R2}}$, $\overline{\text{R4}}$, and $\overline{\text{R8}}$ lines. At the end of the same clock pulse, the $\overline{\text{LD0}}$ signal will terminate, U11A will be reset, and U12B will be set. The Q output of U12B causes the output of Nand gate U11B to go low and establish the second BCD digit on the $\overline{\text{R1}}$, $\overline{\text{R2}}$, $\overline{\text{R4}}$, and $\overline{\text{R8}}$ lines. The Q output also enables Nand gate U13D. On the next clock pulse, U13D produces the $\overline{\text{LD1}}$ signal that tells the counter to load the second BCD digit. This sequence is repeated until the fourth (most significant) digit is transferred to the counter. At the end of the clock pulse that produces $\overline{\text{LD3}}$, the Q output of flip-flop U14B will go low. The same low-to-high transition of the clock input to U14A causes the Q output of U14A to go high and produce the PRESET COMPLETE signal for the A9 Control Board.

4-112. The A10 Preset ROM Board also controls the clocking of humidity numbers and material expansion coefficient numbers into the preset counter. These numbers reach the A10 board on the $\overline{\text{RH1}}$, $\overline{\text{RH2}}$, $\overline{\text{RH4}}$, and $\overline{\text{RH8}}$ lines, and control the output levels on the $\overline{\text{R1}}$, $\overline{\text{R2}}$, $\overline{\text{R4}}$, and $\overline{\text{R8}}$ lines. In each case, four BCD digits are loaded into the preset counter. The first (least significant) digit is always a zero, and the next three digits are supplied by the humidity board or the front panel thumbwheel switches.

4-113. When a humidity number is to be loaded into the A11 Preset Counter, the A9 Control Board sends an LDH (Load Humidity) signal to the A7 Humidity Board and to the A11 board.

This signal enables the transmission of numbers from the humidity board, but the actual transmission does not take place until numbers are requested one at a time by the A10 Preset ROM Board. This happens after the Control Board sends a START PRESET signal to the ROM board. Using the same sequence previously described for loading ROM numbers, the Q outputs of flip-flops U11A, U12B, U12A, and U14B go high one at a time. This produces no action from the ROM diode matrices because the A9 Control Board holds the ROMN1 through ROMN10 lines low. The first 25 kHz clock pulse after START PRESET causes the Q output of U11A to go high and sends the $\overline{LD0}$ signal to the preset counter. Since the A7 Humidity Board has not been instructed to transmit a BCD number, the $\overline{R1}$, $\overline{R2}$, $\overline{R4}$, and $\overline{R8}$ lines remain high and a zero is loaded into the A11 Preset Counter.

4-114. The second 25 kHz clock pulse resets U11A and sets U12B. The $\overline{Q}$ output of U12B is inverted by U16D to produce the PD1 signal. The PD1 signal, when combined with the LD1 signal on the humidity board gates the first humidity number to the $\overline{R1}$, $\overline{R2}$, $\overline{R4}$, and $\overline{R8}$ lines. At the same time the Q output of U12B produces the $\overline{LD1}$ signal and the BCD digit provided by the humidity board is loaded into the preset counter. The process continues until the PD3 and LD3 signals load the third digit from the humidity board into the preset counter. Then, on the first 25 kHz clock pulse after START PRESET, flip-flop U14A generates the PRESET COMPLETE signal to terminate the loading sequence.

4-115. Material expansion coefficient numbers are loaded into Preset Counter A11 in exactly the same way that humidity numbers are loaded. The three BCD digits are provided by front-panel thumbwheel switches. The LOAD COEFF signal from the A9 Control Board enables transmission of the numbers from the A14 Coefficient Buffer Board to the A10 Preset ROM Board and the PD1, PD2, and PD3 signals from A10 gate one digit at a time through A10 to the A11 Preset Counter.

4-116. Preset Counter Assembly A11

4-117. The preset counter assembly (Figure 8-17) consists of a series of input gates, four up/down counters, four storage buffers, and four output buffers. The counters are used with the A3 Integrator board to convert analog data into digital data, and are used with various clock frequencies to produce specific time intervals. Digital data in the counters may be transferred to storage buffers. From there it may be routed to the output buffers that are connected to the A12 Interface Driver board, or it may be saved and used later to preset the counters. Integrated circuits U1 through U8 form the input gates used to preset BCD numbers into counters U9 through U12. The storage buffer consists of the 16 flip-flops in U13 through U20, and the output buffer consists of the 16 flip-flops in U21 through U24.

4-118. Input gates U1 and U2 operate together as a four-pole, double-throw switch that gates four binary (one BCD digit) bits into up/down counter U9. When the SELECT BS (Select Buffer Storage) line is low, gates U1A, U1B, U2A, and U2B are disabled and data from the $\overline{Q}$ outputs of U13 and U14 does not reach the preset inputs of the counter. At the same time, gates U1F, U1C, U2C, and U2F are enabled by the output of inverter U26B. When ground-true data forming the first BCD digit appears on the $\overline{R1}$, $\overline{R2}$, $\overline{R4}$, and $\overline{R8}$ lines, it is converted to positive-true data at the outputs of U1 and U2. For an example, assume that the first BCD digit from the A10 Preset ROM board is 0001. This would make $\overline{R1}$ low and $\overline{R2}$, $\overline{R4}$, and $\overline{R8}$ high. With $\overline{R1}$ low, the output of gate U2F would be low and the output of U2E would be high. With $\overline{R2}$ high, the output of gate U2C would be high and the output of U2D would be low. $\overline{R4}$ and $\overline{R8}$ would produce the same results at the outputs of gate U1. An $\overline{LD0}$ (Load Digit Zero) signal from the A10 Preset ROM board loads the data appearing at the outputs of U1 and U2 into counter U9. After the second BCD digit is placed on the $\overline{R1}$, $\overline{R2}$, $\overline{R4}$, and $\overline{R8}$ lines, the $\overline{LD1}$ signal loads the data into counter U10. $\overline{LD2}$ and $\overline{LD3}$ load the third and fourth digits into U11 and U12 respectively.

4-119. Up/down counters U9, U10, and U11 are decade counters and up/down counter U12 is a four-bit binary counter. Assuming that $\overline{CNT\ UP}$ clock pulses are received from the A8 Time Base board, counter U9 starts at the preset number, counts up to 9 and produces a carry pulse. On the next $\overline{CNT\ UP}$ clock pulse, U9 returns to zero while the carry pulse causes U10 to count up 1 step. The carry pulses from U10 advance counter U11, and the carry pulses from U11 advance U12. Since U12 is a four-bit binary counter, it is capable of counting up to 15 and will not produce a carry pulse until it reaches a count of 15. This cannot happen in normal operation. Since the

CARRY pulse from U12 is routed to the A3 Integrator board where it causes the OUT OF RANGE indicator to illuminate, a binary counter is used for U12 so that it can be preset to a 9 without producing a false OUT OF RANGE indication. CNT DN (Count Down) clock pulses cause the counters to step in the opposite direction. When U9 reaches zero it produces a borrow pulse that counts U10 down one step. After U10, U11, and U12 are counted down to zero, U12 produces the BORROW signal that is routed to the A9 Control board to indicate the zero crossing of the preset counter.

4-120. After the required counting operations are completed, a TRANSFER signal from the A9 Control board clocks the outputs of the counters into the buffer storage register formed by flip-flops U13 through U20. The Q outputs of these flip-flops are routed to the D inputs of another 16 flip-flops in the output buffer. A CONV COMPL (Conversion Complete) signal from the A9 Control board clocks the four BCD digits into the output buffer. From there, the 16 bits are routed to the A12 Interface Driver board.

4-121. During the computation cycle, it is necessary to store the counter output data while the counters are used to count clock pulses and produce specific time intervals. The stored data must then be returned to the counters for further processing. This is accomplished by routing the Q outputs of the buffer storage register to the input gates. When the SELECT BS (Select Buffer Storage) signal goes high, the output of inverter U25C enables gates U1A, U1B, U2A, and U2B. This places the data in U13 and U14 on the preset inputs of counter U9, and an LD0 signal from the A10 Preset ROM board loads the data into the counter. Counters U10, U11, and U12 are loaded in the same way by the LD1, LD2, and LD3 signals respectively.

4-122. Interface Driver Assembly A12

4-123. The interface driver assembly (Figure 8-18) receives four BCD digits from the A11 Preset Counter and gates these digits to the 5505A Laser Display. It also transmits the readout mode, the T1, T2, and T3 control signals and the sign of the material expansion coefficient to the display. The shifting operations are controlled by signals from the A9 Control board and from the 5505A Laser Display.

4-124. When the 5510A Automatic Compensator finishes a program, the A9 Control board generates a CONV COMP (Conversion Complete) pulse that loads four BCD digits into the output buffer of the A11 Preset Counter. It also goes to the A12 board where it presets flip-flop U12A, and clears U10A and U10B. The Q output of U12A and Q output of U12B switch U4D and U17B to drive Q9 into conduction. This holds the clock inputs to U16, U15, U13, and U14 in the low state. The data in the output buffer of the preset counter appears in parallel form at the A12 board and provides the input signals for quad-D flip-flops U16, U15, U13, and U14. The A9 Control board provides the READOUT MODE 1, READOUT MODE 2, READOUT MODE 4, and READOUT MODE 8 signals to indicate the type of data, and the T1 CONT, T2 CONT, and T3 CONT signals to indicate which material temperature sensors are enabled. With the control switch in either the DISPLAY or SCAN position, the output of U17C enables the D input to flip-flop U12B. When a PROG COMPL (Program Complete) signal is received from the 5505A Laser Display, it is inverted by U18D to provide clock pulses for U12A and U12B. The Q output of U12A goes low, transistor Q9 is cut off, and the positive-going transition of its collector clocks the A11 Preset Counter data into U16, U15, U13, and U14. The clock pulse to U12B causes the Q output to go low. This signal is inverted twice to provide the EXT PRG SEL (External Program Select) and C TRIG EBL (Compensator Trigger Enable) signals that perform two functions in the display. It turns off the display internal program clock with C TRIG EBL, and turns off the display internal program ROM generator with EXT PRG SEL. At the same time, the Q output of U12B goes high to enable NAND gate U17A. When the next CONV COMP signal goes low, it is inverted by U1F to switch U17A low, output of U17A cuts off Q10 and COMP TRIG goes high.

4-125. Flip-flops U19A and U19B provides a two-bit counter for generating a three-step display program for the 5505A. The first CONV COMP signal clears U19A and U19B, both Q are high. This causes W EXT to go low, and V EXT and PRG LAST STEP remain high. When the first step (X interchange E) is completed display, the display sends the ARITH STEP COMPL signal back to the compensator. This clocks U19B, its Q output goes low, and W EXT goes high. With W EXT and V EXT high, the display executes the second step (display X) and returns another ARITH STEP COMPL. This causes the Q output of U19B to go high and the positive transition

clocks U10A to make its Q output go high. $\overline{\text{W EXT}}$ and $\overline{\text{V EXT}}$ go low to signal the third program step (X interchange D) for the display. Since V EXT and PRG LAST STEP are the same signal, it also tells the display that this is the last program step. Upon completion of the last step, the display returns a PROG COMPL signal. If the compensator is operating in the SCAN mode, Nand gate U5C is enabled by the SCAN signal and the Q output of U12B. The PROG COMPL signal switches U5C and U18C to drive Q2 into conduction. This produces the MAN PRINT signal and the 5505A generates a print command.

4-126. When the X-Interchange-E instruction is decoded, the display generates the EB signal. It is high only during execution of the instruction and it removes the clear signal from four-bit counter U3. During this period, the display also produces 12 SHIFT E pulses to clock U3. The 12 SHIFT E pulses are counted by U3 to produce a straight binary count on its QA, QB, QC, and QD outputs. The three least-significant bits of the binary count are routed to U2 to provide a binary-to-decimal decoder with a range of 0 to 7. Only four of the decoder outputs are used to control the output disabling function of U16, U15, U13, and U14. The first three SHIFT E pulses produce U2 outputs of 0, 1, and 2. Since these outputs are not connected, no data is gated from the A11 Preset Counter to the display. On the fourth SHIFT E pulse, pin 10 of U2 goes low and the output of U9D goes low. The Output Disable signal is removed from U16 and the data available on the four input lines is gated to the 5505A Laser Display on the ACOMP D1, ACOMP D2, ACOMP D4, and ACOMP D8 lines. In a similar manner, the fifth, sixth, and seventh SHIFT E pulses enable the outputs of U15, U13, and U14 to complete the transmission of four BCD digits from the preset counter to the display.

4-127. If $\overline{\text{T3 CONT}}$ is low, the ninth SHIFT E pulse will strobe a 3 to the display. This is accomplished because Q4 and Q7 are cut off and the 1C0 and 2C0 inputs to multiplexer U6 are high. The 1C0 and 2C0 inputs to multiplexer U7 are grounded. The Address A and Address B inputs to both multiplexers are low, so the 1C0 and 2C0 inputs are enabled to the 1Y and 2Y outputs respectively. When the output of U6B goes low, the BCD code of 0011 is strobed to the ACOMP B8, ACOMP B4, ACOMP B2, and ACOMP B1 lines respectively. If T3 CONT is high during the ninth SHIFT E pulse, a zero is strobed to the display. The tenth and eleventh SHIFT E pulses work in a similar manner to strobe T2 and T1 data to the display. The twelfth SHIFT E pulse strobes the READOUT MODE 1, READOUT MODE 2, READOUT MODE 4, and READOUT MODE 8 data through U6 and U7 to the display. This provides the most significant digit for the display and indicates the readout mode of the compensator.

4-128. When the compensator is in the OPERATE mode, the $\overline{\text{SCAN}}$ and $\overline{\text{DISPLAY SW}}$ signals are high. The D input to flip-flop U12B is low and Q output at pin 8 is high. This makes the C TRIG EN L line high, and the 5505A Laser Display operates on an internal program. During execution of the internal program, there is a MULT COMP (Multiply by Compensation) step that requires the four BCD digits clocked into U16, U15, U13, and U14. This data is gated to the display by the MULT COMP and $\overline{\text{ACOMP D0}}$, $\overline{\text{ACOMP D1}}$, ACOMP D2, and $\overline{\text{ACOMP D3}}$ signals from the display. When MULT COMP goes high, all four Nand gates in U8 are enabled. Then $\overline{\text{A COMP D0}}$ goes low to switch U8A and U9D. This removes the Output Disable signal from pins 1 and 2 of U16 and gates the first BCD digit to the display. $\overline{\text{ACOMP D1}}$, ACOMP D2, and $\overline{\text{ACOMP D3}}$ work in the same manner to gate the next three BCD digits from U15, U13, and U14 to the display.

4-129. Mode Select Assembly A13

4-130. The mode select assembly (Figure 8-19) contains the front-panel SENSOR DISPLAY switch and a series of gating circuits that permit local or external control of the sensor display mode. An external control device connected to AUX connector J6 can override the SENSOR DISPLAY switch and control the display mode.

4-131. When the $\overline{\text{SEL EXT MODE}}$ line is high, the inverted output of U3F effectively grounds the wiper of switch S1 and permits S1 to control the operating mode. The high $\overline{\text{SEL EXT MODE}}$ signal also provides an enabling input to And gates U1A, U1B, U2A, and U2B. The grounded wiper of S1 produces a BCD digit representing the switch position, and the information appears at the outputs of Nor gates U5, U6B, U6C, and U4A. When combined with the enabling signal into U1 and U2, the switch position information appears as a positive-true BCD digit on the P0, P1, P2, and P3 lines. It is routed to the A9 Control board.

4-132. When an external control device grounds the SEL EXT MODE line, the high output of U3F effectively removes the ground from the wiper of SENSOR DISPLAY switch S1 and enables gates U1F, U1C, U2F, and U2C. The switch outputs are disabled and the MB1 EXT, MB2 EXT, MB4 EXT, and MB8 EXT signals from the external control device are gated to the P0, P1, P2, and P3 lines.

4-133. Coefficient Buffer Assembly A14

4-134. The coefficient buffer assembly (figure 8-20) contains a single integrated circuit, 12 diodes, and 5 sockets for connections to the front-panel thumbwheel switches. It provides a means of manually entering the sign of the material expansion coefficient, the material expansion coefficient, and the units (°C or °F) of the coefficient.

4-135. When thumbwheel switch S1A is set to "+", the SIGN COEFF line is ungrounded. It goes high to indicate to the A9 Control board and A12 Interface Driver that the material expansion coefficient is positive. When the thumbwheel switch is set to "-", the SIGN COEFF line is grounded to indicate a negative coefficient of expansion. Thumbwheel switch S1E works in a similar manner to indicate whether the material expansion coefficient is in PPM/DEGREE C or in PPM/DEGREE F.

4-136. Thumbwheel switches S1B, S1C, and S1D provide three BCD digits via the A10 board to the A11 Preset Counter board. The digits are gated one at a time on the RB1, RB2, RB4, and RB8 lines when a LD COEFF signal is received from the A9 Control board and the individual PD1, PD2, and PD3 signals are recieved from the A10 Preset ROM board.

4-137. Material Temperature Sensor Assembly A17

4-138. The material temperature sensor assembly (figure 8-21) contains a lamp driver and an amplifier controlled by the resistance of two thermistors in the temperature probe. Since a given system may use one, two, or three material temperature sensors, the pertinent signals on the A17 schematic diagram are labeled TX CONT, TX SW, SET TX EBL, TX LAMP, and TMX. The following discussion assumes that the sensor is plugged into the T1 connector and will substitute a 1 for the X.

4-139. When the material temperature sensor is plugged into the T1 connector, the jumper between pins 47 and 45 on the A17 board connect the front-panel T1 switch to the SET T1 EBL input on the A9 Control board. If the T1 switch is closed, it sets a flip-flop on the control board. When the control board requires T1 information, it outputs a T1 CONT signal to the A6 Material Temperature Averager, the A17 Material Temperature Sensor, and the A12 Interface Driver. On the A17 board, the T1 CONT signal causes Q1 and Q2 to conduct and illuminate the front-panel T1 indicator.

4-120. The TM1 signal from pin 35 of the A17 board is connected to pin 10 of the A6 Material Temperature Averager. When T1 CONT goes low, the TM1 signal is gated from the A6 board to the integrator bus.

4-141. Air Temperature/Humidity Assembly A18

4-142. The air temperature/humidity assembly (figure 8-22) contains a air/humidity buffer, a humidity amplifier, and an air probe. The air temperature/humidity buffer contains an RC circuit used by the A7 Humidity board, an oscillator for driving the humidity sensor, and an amplifier whose output is determined by the resistance of two thermistors. The RC circuit formed by R3, R4, and C1 is used to control the analog-to-digits conversion process for the humidity reading produced by the A7 board. Amplifier U5 has a feedback network designed to produce an oscillating output of approximately 80 Hz. This ac signal is routed through C1 on the humidity amplifier to the humidity sensor in the air probe.

4-143. Amplifier U1 on the temperature/humidity buffer assembly is a current source with a small adjustment range. The -4V supply provides the reference for a voltage-to-current converter, and the adjustment potentiometer R15 allows the gain (in mV/°C) of the temperature sensor to be adjusted, by adjusting the current into U2. U2 allows an offset correction for the

resistance sensing circuit U2 and U3, which provide an analog voltage proportional to resistance. Since the resistance of the thermistors varies as the temperature varies, the analog voltage routed to U4 varies with the temperature. The offset control (R25) is set to produce zero volts at the junction of R35 and R37 when the thermistors are stabilized at 28°C (82.4°F). Then gain control R15 is set to produce a display of 40°C (104°F) when the thermistors are stabilized at 40°C (104°F).

4-144. The analog voltage at the junction of R35 and R37 on the air temperature/humidity buffer is routed to U4, and amplified with a fixed gain of 11. The output of U4 provides the BR (Bridge Relative) signal for the A5 Air Temperature board. The analog voltage from U4 is also routed to U6, a voltage-to-current converter. The analog current from U6 is also routed to the A5 board where it is gated to the integrator bus by the TR CONT signal.

4-145. The humidity amplifier assembly contains two field-effect transistors that ground the humidity sensor terminals when power is first applied, and an amplifier with controllable gain settings. The humidity sensor in the air probe is designed to operate on alternating current and it can be damaged by direct current. Since dc may be applied when power is first turned on, protection is provided by the circuit formed by Q1, Q2, and Q3. When power is first applied, Q1 is cut off and the +15 source is blocked by diode CR3. With no bias on the gates, Q2 and Q3 conduct and effectively ground both terminals of the humidity sensor. Approximately one-half second later, the negative charge on C3 reaches the level required to forward bias Q1. It conducts and the negative voltage on the collector is routed through CR3 to the Gates of Q2 and Q3. This biases both transistors to cutoff, and the humidity sensor receives its normal ac signal.

4-146. The ac output from the humidity sensor is amplified by U1 to produce the V1I (Voltage Humidity) signal for the A7 Humidity board. When the digital counter on the A7 board is operating in the low range, the RS (Range Select) signal goes to -15V. The negative bias routed through diode CR4 cuts off Q4. This removes R5 and R7 from the feedback loop of U1 and the amplifier operates at the low gain setting. When the A7 Humidity board switches to the high range, the RS signal goes to +5V. This level is blocked by CR4, and the absence of a bias on the gate of Q4 allows it to conduct. This places R5 and R7 in parallel with R6, and U1 operates at the high gain setting.

4-147. MNEMONICS DICTIONARY

4-148. Table 4-10 contains a list of mnemonics used to identify signals in the 5510A Automatic Compensator. The table includes the mnemonics, a definition of the mnemonic, and a description of the signal.

Table 4-10. 5510A Mnemonics

Mnemonic	Definition	Description
ACOMP B1 ACOMP B2 ACOMP B4 ACOMP B8	Automatic compensation Bit 1 Automatic compensation Bit 2 Automatic compensation Bit 4 Automatic compensation Bit 8	This makes up a four-line BCD code for transmitting a digit to the 5505A in the operate mode for automatic compensation.
$\overline{\text{A COMP D0}}$ $\overline{\text{A COMP D1}}$ $\overline{\text{A COMP D2}}$ $\overline{\text{A COMP D3}}$	Auto. Comp. enable Digit 0 Auto. Comp. enable Digit 1 Auto. Comp. enable Digit 2 Auto. Comp. enable Digit 3	Enables interface driver to output compensation numbers.
A COMP ENABLE	Automatic compensation enable	Enables the automatic compensator.
$\overline{\text{ARITH STEP COMPL.}}$	Arithmetic step complete	Indicates that the step of the program is complete.
$\overline{\text{BORROW}}$	Borrow	Output from up/down counter indicating underflow.
BR	Bridge relative temp. output	Voltage from air temperature bridge circuit.
E1 E2 E4 E8	External digit bit 1 External digit bit 2 External digit bit 4 External digit bit 8	For connecting to the external register inputs of the 5505A.
$\overline{\text{COMP TRIG}}$	Compensation trigger	Starts the program for displaying the compensation number.
$\overline{\text{CNT DN}}$	Count down	A selected frequency sent to the counter.
$\overline{\text{CNT UP}}$	Count up	A selected frequency sent to the counter.
$\overline{\text{CONV COMPL.}}$	Conversion complete	Indicates data is ready for use by 5505A.
$\overline{\text{C TRIG EBL.}}$	Compensation trigger enable	Enables input from an external compensation source.
$\overline{\text{CARRY}}$	Carry	From counter indicating overflow of data.
$\overline{\text{DISPLAY SW}}$	Display switch	Selects display mode of operation.
EB	Enable E register	Enables data from an external register to enter 5505A.
$\overline{\text{HOF}}$	Humidity overflow	Indicates >100% humidity or an error.
EXT PROG	External program	See external program select.
$\overline{\text{+IR CONT}}$	Positive reference current control	Selects + reference current to integrator.
$\overline{\text{-IR CONT}}$	Negative reference current control	Selects - reference current to integrator

Table 4-10. 5510A Mnemonics (Continued)

Mnemonic	Definition	Description
LD COEFF	Load coefficient	Enables coefficient number to be loaded into counter via ROM board.
LDH	Load humidity	Enables the humidity buffer for loading the humidity digits into the counter.
$\overline{\text{LD0}}$	Load digit zero	Loads digit zero of humidity buffer into counter.
$\overline{\text{LD1}}$	Load digit one	Loads digit one of humidity buffer into counter.
$\overline{\text{LD2}}$	Load digit two	Loads digit two of humidity buffer into counter.
$\overline{\text{LD3}}$	Load digit three	Loads digit three of humidity buffer into counter.
$\overline{\text{MAN PRINT}}$	Manual print	Activates manual print of 5505A.
MB1 EXT MB2 EXT MB4 EXT MB8 EXT	Mode bit one external Mode bit two external Mode bit four external Mode bit eight external	Mode bits for external control of the 5510A in display function.
MULT COMP	Multiply by compensation	A program step in the 5505A program.
$\overline{\text{METRIC COEFF}}$	Metric coefficient switch	Selects coefficient parts per degree F or C.
$\overline{\text{METRIC DISPLAY SW}}$	Metric display switch	Selects degrees Fahrenheit or Celsius.
NEG	Negative output from integrator	
NON ZERO	Non zero	Indicates when integrator is out of zero band.
PD1	Preset digit one	Enable line for loading humidity digit 1 into the counter.
PD2	Preset digit two	Enable line for loading humidity digit 2 into the counter.
PD3	Preset digit three	Enable line for loading humidity digit 3 into the counter.
PD0	Preset digit zero	Enable line for loading humidity digit not used into the counter.
$\overline{\text{POS}}$	Postive output from integrator	Low when integrator output is above +20 mV.
$\overline{\text{PR CONT}}$	Pressure control	Connects pressure buffer output to integrator bus.

Table 4-10. 5510A Mnemonics (Continued)

Mnemonic	Definition	Description
PRESET COMPL.	Preset complete	Occurs four 25 kHz clock pulses after start preset indicates Romn # is loaded into the counter.
PROG COMPL.	Program complete	Indicates completion of 5505A program.
P1 P2 P3 P0	Parallel entry bit 1 Parallel entry bit 2 Parallel entry bit 3 Parallel entry bit 0	This is a four line code from the mode selector board for determining operating mode.
$\overline{RB1}$	ROM buffer input bit one	Four line code input to ROM board bit 1.
$\overline{RB2}$	ROM buffer input bit two	Four line code input to ROM board bit 2.
$\overline{RB4}$	ROM buffer input bit four	Four line code intput to ROM board bit 4.
$\overline{RB8}$	ROM buffer input bit eight	Four line code input to ROM board bit 8.
RC	Relative humidity resistor cap.	Time constant for converting relative humidity to a digital number.
READOUT MODE 1 READOUT MODE 2 READOUT MODE 4 READOUT MODE 8		Four line code from control board indicating operating mode 0 through 9.
ROM 0200	Read only memory select line 0200	Selects ROM 0200 to be coded on RB1-8 lines.
ROM 0280	Read only memory select line 0280	Selects ROM 0280 to be coded on RB1-8 lines.
ROM 0680	Read only memory select line 0680	Selects ROM 0680 to be coded on RB1-8 lines.
ROM 0824	Read only memory select line 0824	Selects ROM 0824 to be coded on RB1-8 lines.
ROM 0880	Read only memory select line 0880	Selects ROM 0880 to be coded on RB1-8 lines.
ROM 2100	Read only memory sleet line 2100	Selects ROM 2100 to be coded on RB1-8 lines.
ROM 2650	Read only memory sleet line 2650	Selects ROM 2650 to be coded on RB1-8 lines.
ROM 2703	Read only memory select line 2703	Selects ROM 2703 to be coded on RB1-8 lines.
ROM 6731	Read only memory select line 6731	Selects ROM 6731 to be coded on RB1-8 lines.

Table 4-10. 5510A Mnemonics (Continued)

Mnemonic	Definition	Description
$\overline{R1}$ $\overline{R2}$ $\overline{R4}$ $\overline{R8}$	ROM digit bit 1 ROM digit bit 2 ROM digit bit 4 ROM digit bit 8	Four line code for a ROM number this is output of ROM board.
RS	Range selector	Selects high or low humidity range.
$\overline{SCAN}$	Scan	Repeats program during scan to display the conversion modes.
SELECT BS	Select buffer storage	Allows loading a stored number into the preset counter.
$\overline{SEL\ EXT\ MODE}$	Select external mode	Allows remote mode selection.
$\overline{SET\ T1\ EBL}$	Set temperature sensor 1 enable	Enables T1 control if sensor is plugged in.
$\overline{SET\ T2\ EBL}$	Set temperature sensor 2 enable	Enables T2 control if sensor is plugged in.
$\overline{SET\ T3\ EBL}$	Set temperature sensor 3 enable	Enables T3 control if sensor is plugged in.
$\overline{SHIFT\ E}$	Shift external register	Shift pulses for transfer of data to the 5505A.
$\overline{SIGN\ COEFF}$	Sign of coefficient	Indicates coefficient expansion + or -.
SIGN E	Sign External register	Conveys the sign of data in an external register.
$\overline{START\ CONV}$	Start conversion	25 Hz clock which starts the conversion cycle.
$\overline{START\ PRESET}$	Start preset	Enables the ROM board for loading counter.
$\overline{+TA\ CONT}$	Positive ambient temperature control	Selects + current for integrator bus.
$\overline{-TA\ CONT}$	Negative ambient temperature control	Selects - current for integrator bus.
$\overline{TEXP\ CONT}$	Exponential temperature control	Enables the exponential temperature current on to integrator bus.
T EXT	T external	T program bit for remote control of 5505A program.
$\overline{T\ LAMP}$	Turn on for lamp	Turns on lamp associated with sensor enabled.
$\overline{TM\ CONT}$	Temperature material sensors	Turns on material sensor current to integrator bus.

TAble 4-10. 5510A Mnemonics (Continued)

Mnemonic	Definition	Description
$\overline{\text{TM OFF LAMP}}$	Temperature material sensors off lamp	Turns off all material sensor control lines.
$\overline{\text{TM OFF SW}}$	Temperature material sensors off switch	Turns off all material sensor control lines.
TM1 TM2 TM3	Temperature material sensor 1 Temperature material sensor 2 Temperature material sensor 3	Voltage from sensors.
Th	Temperature relative	This voltage proportional to relative temperature.
$\overline{\text{TRANSFER}}$	Transfer	Transfers data into buffer storage from counter.
$\overline{\text{TR CONT}}$	Temperature relative control	Turns on relative temperature current to integrator bus.
$\overline{\text{T1 CONT}}$ $\overline{\text{T2 CONT}}$ $\overline{\text{T3 CONT}}$	Temperature sensor 1 control Temperature sensor 2 control Temperature sensor 3 control	Turns on voltage from sensors into averager input and turns off TM OFF lamp. Turns on T1, T2, and T3 lamps.
U EXT	U external	U program bit for external programming of 5505A.
VH	Voltage humidity	ne voltage from humidity amplifier.
VEXP	Voltage exponential of temp.	An exponential voltage of the relative temperature used to correct the humidity reading due to partial pressure of water vapor in air.
1H 55 1H 100 1H 250	First half 55 Hz control First half 100 Hz control First half 250 Hz control	Control lines for selecting the frequency to be counted during integration
1D1 1D2 1D4 1D8	First digit bit 1 First digit bit 2 First digit bit 4 First digit bit 8	A four-line coded number from the counter digit #1.
2D1 2D2 2D4 2D8	Second digit bit 1 Second digit bit 2 Second digit bit 4 Second digit bit 8	A four-line coded number from the counter digit #2.
2H	Second half	Indicates second half of integration cycle.
2H CNT U CTRL.	Second half count up control	Tells counter to count up or down.
2H2 2H25 2H50 1H250	Second half 2 kHz control Second half 25 kHz control Second half 50 kHz control Second half 250 kHz control	Control lines for selecting the frequency to be counted during integration.

Table 4-10. 5510A Mnemonics (Continued)

Mnemonic	Definition	Description
3D1 3D2 3D4 3D8	Third digit bit one Third digit bit two Third digit bit four Third digit bit eight	A four-line coded number from the counter digit #3.
0D1 0D2 0D4 0D8	Zero digit bit one Zero digit bit two Zero digit bit four Zero digit bit eight	A four-line coded number from the counter digit #0.
25 kHz 1 kHz 10 kHz 100 Hz 20 Hz 1 MHz		Clock frequencies
T1 SW T2 SW T3 SW	Temperature sensor 1 switch Temperature sensor 2 switch Temperature sensor 3 switch	Enables the sensor control line.

MAINTENANCE

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains maintenance and service information, including a table of assemblies, recommended test equipment, calibration procedures, and a performance check.

5-3. ASSEMBLY DESIGNATIONS

5-4. Table 5-1 lists the designations, name, and HP part number of assemblies used in this instrument.

Table 5-1. Assembly Identification

Assembly	Description	HP Part No.
A1	Voltage Reference Assembly	05510-60001
A2	Current Reference Assembly	05510-60002
A3	Integrator Assembly	05510-[illegible]003
A4	Pressure Buffer Assembly	05510-6[illegible]4
A5	Air Temperature Assembly	05510-600[illegible]5
A6	Material Temperature Assembly	05510-60006
A7	Humidity Assembly	05510-60007
A8	Clock and Time Base Assembly	05510-60008
A9	Control Board Assembly	05510-60009
A10	Preset Read-Only-Memory Assembly	05510-60010
A11	Preset Counter Assembly	05510-60011
A12	Interface Driver Assembly	05510-60012
A13	Mode Select Assembly	05510-60013
A14	Coefficient Buffer Assembly	05510-60014
A15	Connector Board Assembly	05510-60015
A16	Motherboard Assembly	05510-60016
A17	Material Temperature Sensor Assembly	10503A
A18	Air Temperature/Humidity Sensor Assembly	10504A

5-5. TEST EQUIPMENT

5-6. Test equipment recommended for calibrating and maintaining the compensator is listed in Table 5-2.

Table 5-2. Recommended Test Equipment

Instrument Type	Required Characteristics	Recommended Type
Precision Digital Voltmeter	±15 volts ±0.05% ±1 digit	HP 3440A/3441A
DC Vacuum Tube Voltmeter	±15 volts ±1%	HP 412A
Oscilloscope	50 MHz bandwidth, 50 mV/cm sensitivity	HP 180A/1801A/1820A
Precision Power Supply	5 volts ±0.002% of setting ±0.0004% of range)	HP 740B
Calibration Kit (Note A)	See Note A	K12-5510A
Cable		K14-5510A
Regulated Vacuum Source	Absolute pressures from atmospheric pressure to 22 inches of Hg. Adjustable to 0.05 inches of Hg or better.	
Barometer	Accuracy of 0.01 inch of Hg or better	
Quartz Thermometer and 2 Thermometer Probes	20°C to 40°C, accuracy 0.02°C (.04°F)	HP 2801A and HP 2850A
Temperature Stabilized Bath		Benco Grant Model SBTX
Refrigeration Unit		Benco Grant Model CC15
Beaker	2" diameter, 5" high	
Fluorinert Liquid		FC-40
Humidity Chamber		

NOTE A: The K12-5510A Calibration Kit consists of:
1. 05510-01005 Test Controller Assembly
2. 05510-02001 Current to Voltage Converter Assembly

5-7. ASSEMBLY INTERCONNECTION IDENTIFICATION

5-8. Throughout this manual, connections to printed circuit assemblies are referred to in abbreviated form. For example, connection to pin 10 on A3 is denoted as A3(10).

5-9. CALIBRATION PROCEDURES AND PERFORMANCE CHECKS

5-10. The following procedures calibrate the 5510A and the external sensors. The procedures can also be used as a performance check to verify the instrument specifications. The calibrations should be performed once a year or when repairs are made that affect the calibration.

5-11. Internal Calibration

5-12. The following procedures calibrate the analog circuits in the 5510A mainframe. The procedures require the use of the K12-5510A calibration kit consisting of test controller board 05510-01005 and current to voltage converter board 05510-02001. This calibration should be performed once each year or when repairs are made on analog circuits A1, A2, A3, A5, A6, and A7. Figure 5-1 shows the location of the adjustment points. To calibrate the analog circuits, proceed as follows:

a. Turn off power on 5505A Laser Display.

b. At 5510A rear panel, remove all sensor connections. Using cable 562-16C, connect 5510A rear-panel 50-pin connector marked DISPLAY to Model 5505A Laser Display rear-panel 50-pin connector marked COMPENSATION.

c. Remove top cover from 5510A and remove Integrator Assembly A3 05510-60003 (orange extractor). Install special 05510-02001 current-to-voltage converter board in place of integrator assembly. Set all switches on this board to the down or off position.

d. Remove assembly A0 05510-60009 (white extractor), and install 05510-01005 test-controller board assembly in its place. Set currents off (switches in the down position).

e. Turn on Model 5505A Laser Display unit and allow about 10 minutes for Model 5510A internal temperature to stabilize.

f. Connect digital voltmeter to the BNC connector marked "V REF" on the current-to-voltage converter test board.

g. Set the +10 switch to the up or ON position. Adjust A1R2 (+10 ADJ) for a DVM reading of 10.00 ±.05 volts.

h. Set the +10 switch to OFF or down position and set the -10 switch to ON. Adjust A1R14 (-10 ADJ) for a DVM reading of -10.00 ±.05 volts.

i. Set -10 switch to the OFF position and turn on the +4 switch. Adjust A1R5 (+4 ADJ) and A1R6 (+4 FINE) for a DVM reading of 4.000 ±.001 volts.

j. Set +4 switch to the OFF position and turn on -4 switch. Adjust A1R16 (-4 ADJ) for a DVM reading of -4.000 ±.001 volts.

k. Set -4 switch to the OFF position. Remove digital voltmeter connection from "V REF" connector and connect 412A Voltmeter to the connector marked "V OUT". Check that the switch located just above this connector is in the OFF or down position.

l. Adjust the potentiometer marked "OFFSET ADJ" on current to voltage converter assembly for a 0 ±.05 mV reading using 412A Voltmeter.

m. On the current-to-voltage converter, set the switch adjacent to V OUT to the I ON position. Set all current control switches on the test-controller board (which is installed in the A0 assembly) to the off position. The 412A should read less than 1 mV. If the reading is greater than 1 mV it means that one of the current switches in the integrator input circuit is leaky. One at a time, remove and then reinsert, the A2 05510-60002), A4 05510-60004), A5 05510-60005), and the A6 assembly 05510-60006). The defective current switch is on the board which, when removed, causes the voltmeter reading to drop to below 1 mV.

n. Remove 412A Voltmeter connection from "V OUT" and connect DVM to "V OUT".

o. On the test-controller assembly, set on (up position) the +IR current. Adjust A2R13 (+IR) for a DVM reading of -3.750 ±.001 volts.

p. On the test-controller assembly, set +IR to off (down position) and turn on the -IR current. Adjust A2R16 (-IR) for a DVM reading of +3.750 ±.001 volts.

q. On the test-controller assembly, set -IR to off and turn on the PR current. Digital voltmeter should read between -4 and -7 volts.

r. On the test-controller assembly, set PR to off and turn on the +TA current. Adjust A5R11 (TA) for a DVM reading of -4.822 ±.001 volts.

s. On the test-controller assembly, set +TA to off and turn on the -TA current. Adjust A5R34 (-TA) for a DVM reading of +4.822 ±.001 volts.

t On the test-controller assembly, set -TA to off and turn on the TEXP current. Adjust A5R10 (EM) for a DVM reading of -7.138 + 012 -.008 volts.

NOTE

The following steps involve supplying a precise voltage to the Model 5510A. This can be accomplished by calibrating the output of a high resolution power supply with the digital voltmeter used in this procedure, or using an adjustable dc standard such as the HP Model 7401B. This latter method is described below.

u. Set the Model 7401B Precision Power Supply for a voltage of 2.640 volts. This simulates an air temperature of 16°C. Set the output switch on the Model 7401B to off. Connect the + output terminal on the 7401B to the metal bracket inside the 5510A between the A8 and A7 assemblies. This is the 5510A circuit ground. Connect the - output from the 7401B to either pin 21 of rear-panel AUX jack (J1), to pin 12 of the A5 assembly, or to test point BR on A5.

NOTE

Electrical connection to rear-panel jacks can be easily made through use of a mating connector HP Part Number 1251-0086 (or CINCH 57-30500-375 (383)).

v. Turn on Model 7401B output. The switch on the test controller board should be set to TEXP. Adjust A5R9 (ES) for a DVM reading of -3.575 ±.015 volts.

w. Set output control on Model 7401B power supply to off. Reverse the leads on the 7401B output connector so that now the negative terminal is connected to the Model 5510A circuit ground, and the positive terminal is connected into the circuit.

x. Set the Model 7401B for an output of +1.980 volts and set output to ON. This simulates an air temperature of 35°C.

y. On the test-controller assembly, set TEXP to off and turn on the +TA current. The DVM should read between -4.961 and -4.971 volts.

z. On the test-controller assembly, set +TA to off and turn on the TEXP current. The DVM should read between -11.7 and -12.3 volts. Turn off Model 7401B power supply output switch, and remove its connection to the 5510A.

aa. On test-controller assembly, turn off the TEXP current. Set the output of Model 7401B to off. Connect the 7401B negative lead to the Model 5510A circuit ground. Connect the 7401B positive lead to rear panel AUX connector pin 22 through a 10k ohm 5% 1/4 watt resistor HP Part No. 0683-1035. Set 7401B voltage to 1.980 volts and turn output on. On the test-controller assembly turn on the TR current. The DVM should read -1.98 ±0.01V.

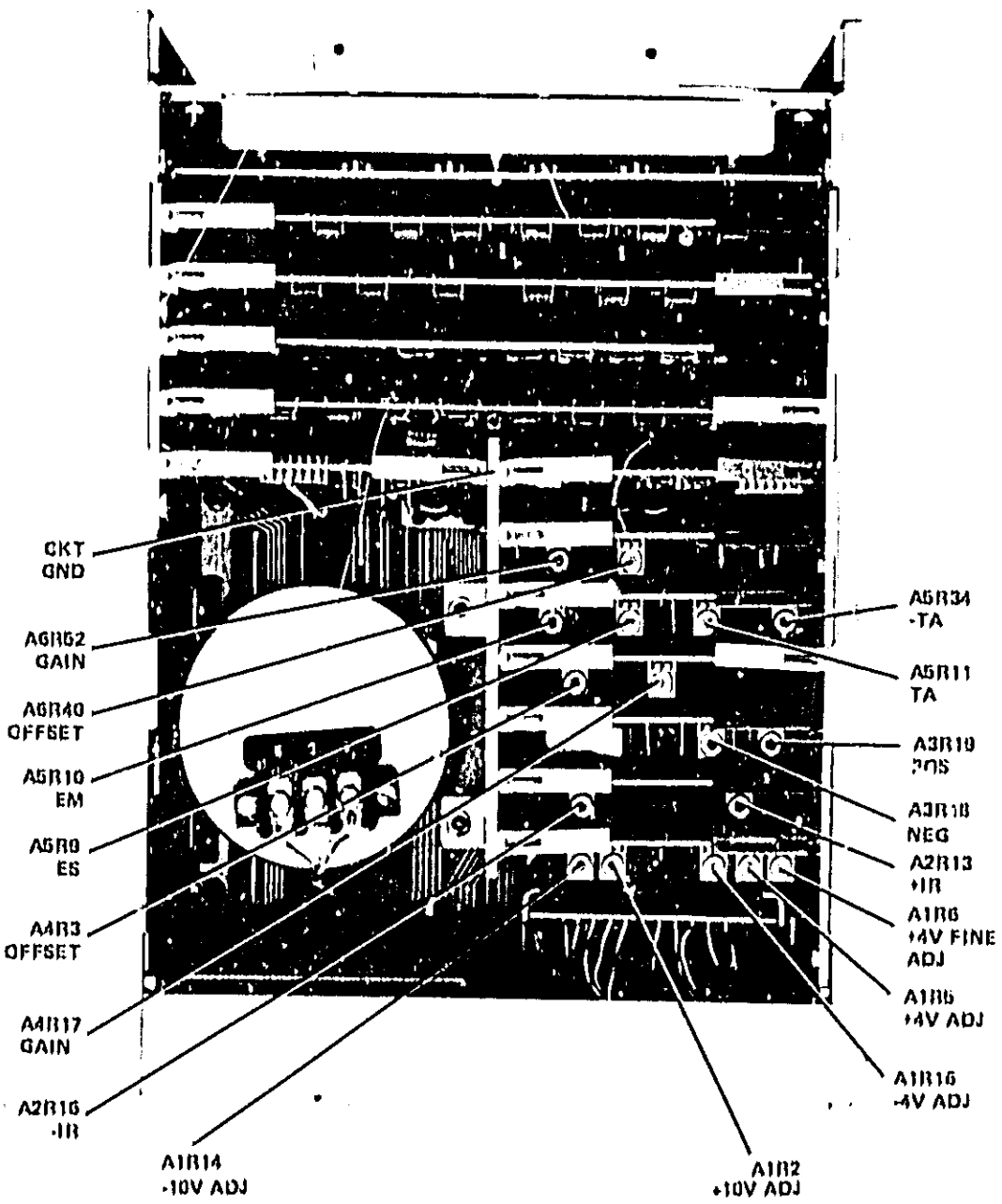


Figure 5-1. Adjustment Locations

ah. On test-controller assembly set TR switch off and turn on current TM. Adjust A6R40 (OFFSET) for a DVM reading of 0 ±1 mV.

ae. With its output turned off, set the Model 740B for a voltage of 4.4 volts. Connect the + output terminal on the 740B to the 5510A circuit ground as described in step u. Connect the negative output terminal to either pin 35 of the T1 jack (J2) or pin 10 of A6.

ad. Set TM and T1 on the test-controller assembly to on. Turn on the 740B output voltage. Adjust A6R52 (GAIN) for a DVM reading of 3.000 ±.001 volts. Turn off 740B output, and remove its connections to the 5510A.

ae. Turn off 5505A power. Remove current to voltage converter test assembly and replace it with Integrator assembly A3 (05510-60003). Remove test-controller assembly and replace it with Control Board assembly A9 (05510-60009).

af. Connect 10563A material temperature sensor probe to rear panel jack marked T1(J2).

ag. Turn on 5505A power. On 5510A front panel set controls as follows:

DISPLAY/OPERATE/SCAN switch ..... DISPLAY
SENSOR DISPLAY switch T1

ah. Check reading displayed on a Model 5505A. If it is greater than 68°F or 20°C proceed to the next step. If it is not, warm the material sensor probe in your hand until the temperature is about 70°F/21°C or greater. The purpose of this is to cause the integrator output waveform to go positive after the recentering cycle, and enable the following adjustments to be made.

ai. Connect B Channel input of an Oscilloscope (HP Model 180A or equivalent) with a 1-to-1 probe to the test point at the top of the A3 integrator assembly marked I. Connect ground to the test point marked G. Connect the external trigger input of the oscilloscope to the test point on the A8 time base assembly marked SC (Start Conversion TP2). Also, on the A8 assembly, connect the two test points marked FAST together.

aj. Set the oscilloscope controls as follows:

MODE ..... NORMAL
TRIGGER SOURCE ..... EXTERNAL
TRIGGER SLOPE ..... POSITIVE
VERTICAL (B CHANNEL) ..... 5 mV per div. (without probe)
HORIZONTAL ..... 1 msec per div.
INPUT ..... DC coupled

ak. Adjust oscilloscope vertical position control so that initial and final values of the first (that is negative going) triangle wave are equidistant from the center line on the oscilloscope graticule. See Figure 5-2.

al. Set A3R19 (POS) and A3R18 (NEG) to the center of their range.

am. Adjust A3R19 (POS) until the initial dc value of the first triangle wave coincides with the center line on the oscilloscope graticule. Now adjust A3R18 (NEG) until the final dc value of the first triangle wave coincides with the center line on the oscilloscope graticule. See Figure 5-3.

an. Connect the other input channel of the oscilloscope to the test point adjacent to the word NEG on the board. Set this channel for a sensitivity of 5 volts per division. Set sweep speed to 50 μsec/div and DISPLAY to CHOP. Check to see that the transition of the waveform from the NEG terminal occurs when the voltage at the I terminal is at -20 mV ±5 mVdc with respect to its initial (horizontal line) value. See Figure 5-4.

no. Remove oscilloscope probe from NEG test point and connect it to the test point adjacent to POS.

np. Trigger oscilloscope internally using CHOP B trigger from positive going triangular wave signal from "I" test point. When this is done properly, the waveform of Figure 5-5 will be observed.

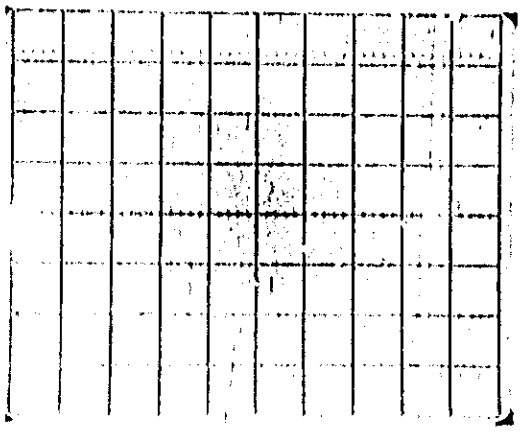


Figure 5-2. Signal at A3TP"I" Vert. Sens. 5 mV/div., Horiz. 1 msec/div. External trigger from A8TP2.

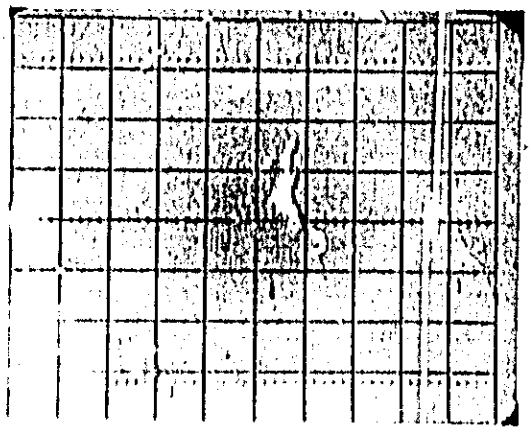


Figure 5-3. A3TP"I" after adjustment.

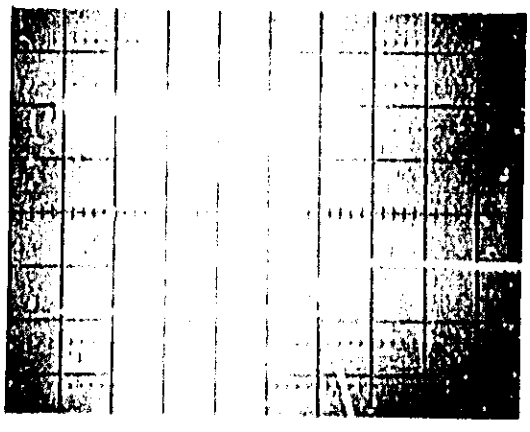


Figure 5-4. A3TP"I" and A3TP "NEG"
Channel A Vert. 5 V/div.
Channel B Vert. 5 mV/div.
Horiz. 50 μsec/div.
Ext Trigger from A8TP"SC".

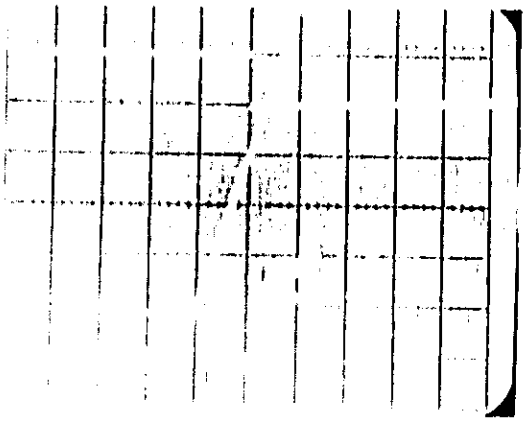


Figure 5-5. A3TP"I" and A3TP "OS"
Channel A Vert. 5 V/div.
Channel B Vert. 5 mV/div.
Horiz. 50 μsec/div.
Internal trigger, + Slope.

aq. Check to see that the transition of the signal from the POS terminal occurs when the signal from the I terminal +20 mV ±5 mVdc with respect to its initial (horizontal line) value.

ar. Remove oscilloscope and test lead connections from 5510A. This completes calibration of the 5510A mainframe.

5-13. Internal Air Pressure Sensor Calibration

5-14. The following procedure is used to calibrate the internal air pressure sensor (barometer).

CAUTION

THE RANGE OF THE BAROMETRIC TRANSDUCER IS 22 TO 31 INCHES OF HG. DO NOT SUBJECT THE UNIT TO ABSOLUTE PRESSURES GREATER THAN 31.2 INCHES OR LESS THAN 21.8 INCHES OF HG.

5-15. Equipment Required

a. Regulated vacuum source capable of supplying absolute pressures over the range of 22 inches of Hg to atmospheric pressure. Must be adjustable to 0.05 inches of Hg or better.

b. Barometer with an accuracy of 0.01 inch of Hg or better.

c. 5510A Automatic Compensator (Calibrated).

d. 5505A Laser Display.

e. Regulated pressure source if checks are to be made above ambient pressure.

NOTE

The entire vacuum setup must be leak-free, and capable of holding a constant pressure to within 0.01 inch of Hg for several minutes. Before making any calibration adjustments, the effects of hysteresis on both the 5510A barometer and the standard barometer should be minimized. This can be done by lightly tapping the case of the aneroid barometer in the 5510A and tapping near the top of the mercury column to assure that the meniscus takes on a uniform shape.

5-16. Air Pressure Sensor Calibration Procedure

5-17. Use the following procedure to calibrate the air pressure sensing subsystem.

a. Remove the top and bottom covers from the 5510A. Connect 5510A to 5505A and set SENSOR DISPLAY to AIR PRESSURE.

b. Connect regulated vacuum source to 5510A barometer inlet port (bottom of unit) and to the standard barometer.

c. Adjust vacuum source to 26.50 ±0.01 inches of Hg as measured by the standard barometer.

d. Set the pressure buffer offset (A4R3) so that the pressure displayed by the 5505A agrees with the standard barometer to within 0.01 inches of Hg. (Refer to Figure 5-1 for location of controls.)

e. Adjust vacuum source for 22.00 ±0.01 inches of Hg as measured by the standard barometer.

f. Set pressure buffer gain (A4R17) so that the 5505A Display agrees with the standard barometer to within 0.01 inches of Hg.

g. Return vacuum system to atmospheric pressure and verify that the 5505A display agrees with the standard barometer to within 0.03 inches of Hg.

NOTE

If the required accuracy is not attained, a correction factor for the transducer must be introduced. Note the error at atmospheric pressure and adjust pressure buffer offset (A41R3) to eliminate one-half of the error. Then repeat steps e through g.

5-18. Remote Material Temperature Sensor Calibration

5-19. The following test equipment is required to calibrate the 10563A Material Temperature sensor.

a. A 5510A Automatic Compensator that has been calibrated.

b. 5505A Laser Display.

c. 2801A Quartz Thermometer or equivalent.

d. 2850 Thermometer Probe (two probes and baths will reduce the time required for calibration).

e. Benco Grant Model SB2X Temperature Stabilized Bath or equivalent.

f. Benco Grant Model CC15 Refrigeration Unit or equivalent.

NOTE

For higher accuracy, the K13-5510A Temperature Sensor Calibration Kit can be used to provide a resolution of 0.01 degree (F or C) while calibrating material or air temperature sensors.

5-20. Procedure

5-21. Use the following procedure to calibrate the 10563A Material Temperature Sensor.

a. Connect the 5510A to the 5505A.

b. Connect the 10563A Material Temperature Sensor to the T1 input on rear panel of the 5510A.

NOTE

If more than one 10563A sensor is to be calibrated, connect only one at a time.

c. Remove top cover of the 10563A buffer assembly.

d. Set 5510A Automatic Compensator controls as follows:

Control	Position
SENSOR DISPLAY	(6) T1
°F - °C	°C
DISPLAY-OPERATE-SCAN	DISPL../
AUTO-MANUAL	AUTO

e. Apply power to the 5505A.

f. Adjust the water bath for 20.00° Centigrade as read on the quartz thermometer.

g. Immerse the sensor heads of all 10563A units to be calibrated in the bath, and allow at least 1/2-hour for the temperature to stabilize.

h. On the buffer assembly, adjust offset control 10563-60001 (R18) for a display reading of 20.0° Centigrade.

i. Turn 5505A power off.

j. Disconnect 10563A from the 5510A, and connect next unit to T1 (if more than one sensor is to be calibrated).

k. Apply power to 5505A and repeat step h for the buffer assembly.

l. When all sensors are adjusted for 20° Centigrade, adjust water bath for a temperature of 40.00° Centigrade and allow at least 1-1/2 hours for the temperature to stabilize.

m. On the buffer assembly, adjust gain control 10563-60001 (R12) for a display reading of 40.0° Centigrade.

n. Turn 5505A power off.

o. Disconnect 10563A from the 5510A, and connect next unit to T1 (if more than one sensor is to be calibrated).

p. Apply power to the 5505A and repeat step m for the buffer assembly.

q. When all sensors have been adjusted for 40° Centigrade, adjust bath temperature to 28.00° Centigrade and allow at least 1-1/2 hours for the temperature to stabilize.

r. Check each sensor for a display reading of 28 Centigrade.

s. Reassemble the Material Temperature Sensors.

5-22. Remote Air Temperature and Humidity Sensor Calibration

5-23. The following test equipment is required to calibrate the 10564A Remote Air Temperature and Humidity Sensor.

a. A 5510A Automatic Compensator that has been calibrated.

b. 5505A Laser Display.

c. 2801A Quartz Thermometer or equivalent.

d. 2850 Thermometer Probe.

e. Benco Grant SH2X Temperature Stabilized Bath or equivalent.

f. Laboratory beaker 2 inches in diameter and 6 inches high, or a glass bottle with a sealing lid through, which a connection can be made to the sensor board.

g. Benco Grant Model CC15 Refrigeration Unit or equivalent.

h. Special Cable K11-5510A.

i. One pint of Flourinert liquid FC-40.

j. One humidity chamber.

k. 64 megohm resistor (can be constructed from HP 0698-3686 and HP 0730-0150 resistors).

l. 2.2 megohm resistor (HP 0683-5089).

m. 5 megohm variable resistor.

NOTE

For higher accuracy, the K18-5510A Temperature Sensor Calibration Kit can be used to provide a resolution of 0.01 degree (°F or °C) while calibrating material or air temperature sensors.

5-24. Use the following procedure to calibrate the 10564A remote air temperature sensor.

a. Connect the 5510A to the 5505A.

b. Connect the 10564A Remote Air Temperature and Humidity Sensor to the AIR connector on rear panel of the 5510A.

c. Remove the plastic cover from the sensor head.

d. Remove the vertical printed circuit board.

CAUTION

DO NOT HANDLE OR TOUCH THE WHITE PART OF THE SENSOR. HANDLE BY THE TERMINALS ONLY OR PERMANENT DAMAGE WILL OCCUR.

e. Carefully remove the two bolts holding the humidity sensor and remove the sensor element.

f. Connect special K14-5510A cable between the 10564-60004 board and the socket on the 10564-60003.

g. Remove the cover from the 10564A Air Sensor buffer amplifier board (10564-60001).

h. Set 5510A Automatic Compensator controls as follows:

Control	Position
SENSOR DISPLAY	AIR TEMP
°F - °C	°C
DISPLAY/OPERATE/SCAN	DISPLAY
AUTO/MANUAL	AUTO

i. Apply power to the 5505A.

j. Set bath temperature to 28 ±0.1° Centigrade and place beaker of Flourinert inside the bath. Do not allow water to enter the beaker.

k. Immerse thermistors on the 10564-60001 board in the Flourinert and cover to prevent evaporation and maintain a stable temperature.

l. Allow 1-1/2 hours for bath temperature to stabilize.

m. Set the 10564-60001 offset control (R27) for a display reading that is within 0.01° Centigrade of the quartz thermometer reading.

n. Set bath temperature to 40 ±0.1° Centigrade and allow 1-hour for bath temperature to stabilize.

o. Set 10564-60001 gain control (R15) for a display reading that is within 0.01° Centigrade of the quartz thermometer reading.

p. Set bath temperature to 20 ±0.1° Centigrade and allow 2 hours for the temperature to stabilize.

q. Verify that the 5505A display agrees with the quartz thermometer display to within 0.10° Centigrade.

5-25. Use the following procedure to calibrate the 10564A humidity sensor.

NOTE

This procedure should follow the air temperature sensor calibration procedure. If done separately, perform steps a through e of Paragraph 5-17.

a. Set 5510A Automatic Compensator controls as follows:

Control	Position
SENSOR DISPLAY	% HUMIDITY
DISPLAY/OPERATE/SCAN	DISPLAY
AUTO/MANUAL	AUTO

b. Set potentiometers R5 and R36 on the 10564-60001 board and potentiometer R7 on the 10564-60003 board to the center position.

c. Disconnect shunt resistor across the humidity sensor by unsoldering one end.

d. Clip 64 megohm resistor across the terminals of the 10564-60004 in place of the sensor. Clip leads should be less than 4 inches long.

e. Set (HM) R36 for a display reading of 15.

f. Remove the 64 megohm resistor and connect the 2.2 megohm resistor across the terminals.

g. Set (HS) R5 for a display reading of 54.

h. Remove the 2.2 megohm resistor and connect the 5 megohm variable resistor across the terminals.

i. Vary the resistance from minimum to maximum and verify that the display goes below 40 and above 60.

j. Set variable resistor to obtain a reading of less than 50. Then gradually change the resistance so that the display increases and approaches 60. When the first reading of 60 occurs, stop moving the variable resistor. Then set potentiometer (HH) R7 on the 10564-60003 board so that the display again reads 60.

k. Repeat step j as necessary until the display consistently settles between 59 and 61 immediately after the first display of 60 is observed.

l. Reinstall the humidity sensor on the 10564-60003 board, reconnect the shunt resistor, and reinstall cover.

5-26. Humidity Linearity Calibration Check

5-27. Use the following procedure to check the calibration of the humidity sensor.

a. Place sensor in a humidity chamber and allow to stabilize at a relative humidity of 33%. Display must agree to within ±10 percentage points.

b. Repeat test at a relative humidity of 71%.

c. Repeat test at room humidity.

5-26. TROUBLESHOOTING

5-29. The 5510A uses both analog and digital circuits. The sensors are analog with the results being converted to digital data for use by the 5526A. The control of the 5510A operation is accomplished with digital circuits. It is therefore necessary that parts of the digital section operate properly before any results can be obtained.

5-30. General Diagnostic

5-31. With the 5510A set to display, select conversion mode 3 through 9 one at a time and check for proper display of numbers as described in Figure 3-3. If trouble exists, three conditions may be experienced during this test. 1. The entire unit does not work; 2. one particular conversion mode fails to operate; 3. two or more conversion modes fail. Prior to performing troubleshooting, see Section IV for circuit theory of the individual board.

5-32. Failure of the entire unit can be divided into two parts. The data not being transferred to the 5526A and the data not being converted to digital. Failure of the data to get to the 5526A could be caused by the interface card A12 or the buffer and buffer loader on A11. Failure to convert the data has more components involved. An example will be used to explain the problem. The following example is based on conversion mode 4 only. The details given are taken from Table 4-5. Check that A8 time base generates pulse rates of 2 Hz, 25 Hz, 250 kHz, and 100 Hz, or 55 Hz (depending upon the position of the °F/°C switch). Check that A9 generates a pulse or pulses on the following lines (this may be viewed with a logic probe): +$\overline{\text{IR CONT}}$, ROMN-0880, -$\overline{\text{IR CONT}}$, HI 250 Hz, $\overline{\text{TR CONT}}$, 2H 25, Start preset, XFR, and Conversion Complete, HI 100, or HI 55, ROMN 0280, or ROMN 0824 (depending upon position of °F/°C switch). Check that A10 generates preset complete, load digit $\overline{\text{LD0}}$, $\overline{\text{LD1}}$, $\overline{\text{LD2}}$, $\overline{\text{LD3}}$, and has ROMN data transferred out of the ROMN lines $\overline{\text{R1}}$, $\overline{\text{R2}}$, $\overline{\text{R3}}$, and $\overline{\text{R4}}$. Check that A11 generates Borrow or Carry (dependent upon whether the temperature is above or below the reference point.

5-33. In addition to the digital section listed above, the following analog circuits must be operating. A1 voltages of +10 and +4 volts. A2 voltage to current converter and A3 the integrator must both be working. This requires a current to voltage converter and a test controller calibration kit (K12-5510A) or the two boards can be checked by removing A9 and pulsing with a pulse generator or temporarily grounding +$\overline{\text{IR CONT}}$ or -$\overline{\text{IR CONT}}$ while monitoring $\overline{\text{POS}}$ and NEG from A3. Table 5-3 shows the integrator level associated with the $\overline{\text{POS}}$ and NEG indicators. It also shows the movement of the integrator associated with a pulse being applied to +$\overline{\text{IR CONT}}$ or -$\overline{\text{IR CONT}}$. The width of the center level as indicated is ±40 mvolts. A pulse of 80 msec at TTL levels is required to move the integrator across this level. If the integrator is located in either the + or - level, several pulses should be applied until the level is centered. After the integrator has been centered, both + and - integrator operation should be checked.

POS - NEG Indicator	Integrator Level	CONTROL LINE +IR	CONTROL LINE -IR
$\overline{\text{POS}}$ 0	+	↓	↑
NEG 0			
$\overline{\text{POS}}$ 1	Center		
NEG 0			
$\overline{\text{POS}}$ 1	-		
NEG 1			

Direction Integrator will move when pulse applied.

5-34. This example is applicable to conversion modes 3-9. All of these conversion modes use a 2-cycle conversion. For mode 1 and 0, the 5510A does a 3-cycle and 4-cycle conversion respectively. The lines activated and numbers involved are increased. Refer to Table 4-3 for the necessary data. The information given with regards to logic activity but not considered timing discrepancies. Problems associated with timing can best be observed by using the HP Model 5000A

or 16011. logic analyzer display. An understanding of the operation of these devices and a knowledge of the board (i.e., A8, A10, etc., as given in the board descriptions is necessary for troubleshooting. The remaining items to check in this example is the temperature sensing device A18 and the air temperature board A5. These devices are analog in nature therefore standard troubleshooting methods should be used. This example has been .. representative overview of one conversion mode of operation.

5-35. Single mode conversion failure can be diagnosed in the same manner. Multiple mode conversion failures can be looked at individually and then a comparison of the common elements determined. There are common elements in the digital and the analog sections for some modes of operation. This is especially true for full compensation and air compensation only. An understanding of the conversion techniques used and the portion of the cycle in which these elements are used is the best way to troubleshoot the unit. Reference should be made to the individual circuit descriptions and Tables 4-3 through 4-8 for application of the conversion elements.

PARTS LIST

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains a list of replaceable parts, information for ordering, and a general description of the HP part numbering system. Also included is a list of abbreviations used in the parts lists.

6-3. REPLACEABLE PARTS LIST

6-4. Table 6-2 lists replaceable parts for the instrument. Parts are listed in alpha-numerical order by reference designation starting with A1 and ending with chassis and miscellaneous parts. Table 6-3 contains a list of manufacturers and their codes.

6-5. The replaceable parts lists include the following information.

a. Reference designator (when applicable).

b. HP part number.

c. Total quantity (QTY) used in the instrument. The quantity appears in the QTY column the first time that the part is listed.

d. Description of the part (see list of abbreviations Table 6-1).

e. Typical manufacturer of the part in a five-digit code (see list of manufacturers in Table 6-3).

f. Manufacturer's part number.

6-6. ORDERING INFORMATION

6-7. To obtain replacement parts, address order of inquiry to your local Hewlett-Packard Sales and Service Office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part number.

6-8. 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.

6-9. HP PART NUMBER ORGANIZATION

6-10. Although there are some variations and exceptions, the following number categories generally describe the current system of parts identification.

6-11. Component Parts and Materials

6-12. Generally, the prefix of HP part numbers identifies the type of device. Eight digit part numbers are used, where the four digit prefix identifies the type of component, part, or material and the four digit suffix indicates the specific type. Following is a list of some of the more commonly used prefixes for component parts. The list includes HP manufactured parts and purchased parts.

Prefix	Component/Part/Material
0121-	Capacitors, Variable (mechanical)
0122-	Capacitors, Voltage Variable (semiconductor)
0140-	Capacitors, Fixed }
0150-	Capacitors, Fixed } Non-Electrolytic
0160-	Capacitors, Fixed }
0180-	Capacitors, Fixed Electrolytic
0330-	Insulating Materials
0340-	Insulators, Formed
0370-	Knobs, Control
0380-	Spacers and Standoffs
0410-	Crystals
0470-	Adhesives
0490-	Relays
0510-	Fasteners
0674- thru 0778-	Resistors, Fixed (non wire wound)
0811- thru 0831-	Resistors (wire wound)
1200-	Sockets for components
1205-	Heat Sinks
1250-	Connectors (RF and related parts)
1251-	Connectors (non RF and related parts)
1410-	Bearings and Bushings
1420-	Batteries
1820-	Monolithic Digital Integrated Circuits
1826-	Monolithic Linear Integrated Circuits
1850-	Transistors, Germanium PNP
1851-	Transistors, Germanium NPN
1853-	Transistors, Silicon PNP
1854-	Transistors, Silicon NPN
1855-	Field-Effect-Transistors
1900- thru 1912-	Diodes
1920- thru 1952-	Vacuum Tubes
1980-	Semiconductor Photosensitive and Light-Emitting Diodes
3100- thru 3106	Switches
8120-	Cables
9100-	Transformers, Coils, Inductors, and Filters

6-13. For example, 1854-0037, 1854-0221, and 1851-0192 are all NPN transistors. The first two are silicon and the last is germanium.

6-14. General Usage Parts

6-15. The following list gives the prefixes for HP manufactured parts used in several instruments, e.g., side frames, feet, top and bottom covers, etc. These are eight-digit part numbers with the four digit prefix identifying the type of parts as shown below.

Type of Part	Prefix
Sheet Metal	5000- to 5019-
Machined	5020- to 5039-
Molded	5040- to 5059-
Assemblies	5060- to 5079-
Components	5080- 5099-

6-16. For example, power splitter 5088-7003 is a component and pc board support 5040-0170 is a molded part

6-17. Specific Instrument Parts

6-18. These are HP manufactured parts for use in individual instruments or series of instruments. For these parts, the prefix indicates the instrument and the suffix indicates the type of part. For example, 05510-60001 is an assembly used in the 5510A. Following is a list of suffixes commonly used.

Type of Part	P/N Suffix
Sheet Metal	-00000 to -00499
Machined	-20000 to -20499
Molded	-40000 to -40499
Assembly	-60000 to -60499
Component	-80000 to -80299
Documentation	-00000 to -00249

Table 6-1. Abbreviations and Reference Designations

REFERENCE DESIGNATIONS

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

ABBREVIATIONS

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

Table 6-1. Abbreviations and Reference Designations (Continued)

ABBREVIATIONS (CONTINUED)

EMI	electromagnetic interference
EDP	electronic data processing
ELECT	electrolytic
ENCAP	encapsulated
EXT	external
F	farad
FET	field effect transistor
FF	flip flop
FH	flat head
FOLH	foldover 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	included
INP	input
INS	insulation
INT	internal
kg	kilogram
kHz	kilohertz
KNB	knurled
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	lockwasher
LO	low (local oscillator)
LOG	logarithmic taper (used in parts list)
log	(logarithmic)
LPF	low pass filter
LV	low voltage
m	meter (distance)
mA	milliampere
MAX	maximum
MEG	megohm
MEG	meg (10⁶) (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) or 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
mVp-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	op amp (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 intrinsic negative
PIV	peak inverse voltage
pk	peak
PL	phase lock
PLO	phase lock oscillator
PM	phase modulation
PNP	positive negative positive
POLY	polycarbonate
PORC	porcelain
POS	positive (potentiometer tuned in parts list)
POSN	position
POT	potentiometer
p-p	peak to peak
PP	peak to peak (used in parts list)
PRM	pulse repetition modulation
PRE AMPL	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
RMD	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)
VFD	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
VXO	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^{1}
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 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05510-60001	1	VOLTAGE REFERENCE ASSY	28480	05510-60001
A1C1	0170-0024	5	CAPACITOR-FXD, [illegible]	56289	292P22392
A1C2	0170-0024		CAPACITOR-FXD, [illegible]	56289	292P22392
A1C3	0160-0163	5	CAPACITOR-FXD .001UF ±5% 100VDC	56289	292P22392
A1C4	0160-0163		CAPACITOR-FXD .001UF ±5% 200VDC	56289	292P22392
A1C5	0170-0024		CAPACITOR-FXD, .22UF ±20% 200VDC	56289	292P22392
A1C6	0180-0376	1	CAPACITOR-FXD, 100UF ±10% 20VDC TA-SOLID	56289	150D106X9020B2
A1C7	0180-0106	1	CAPACITOR-FXD, 6.8UF ±20% 6VDC TA-SOLID	56289	150D685X9006B2
A1C10*	0160-2107	3	CAPACITOR-FXD 100PF ±5% 300VDC	28480	0160-2107
A1C11*	0160-2107	3	CAPACITOR-FXD 100PF ±5% 300VDC	28480	0160-2107
A1Q1	1853-0017	9	TRANSISTOR 2N2904A PNP SI	01295	2N2904A
A1Q2	1853-0017		TRANSISTOR 2N2904A PNP SI	01295	2N2904A
A1Q3	1854-0210		TRANSISTOR NPN 2N2222 SI TO-18	02037	2N2222
A1Q4	1854-0210		TRANSISTOR NPN 2N2222 SI TO-18	02037	2N2222
A1R1	0683-3335	3	RESISTOR-FXD 3.3MOHM ±5% .25W CC	01121	CB3355
A1R2	2103-2489	1	RESISTOR-VAR TRMR 5KOHM 10% C	16701	ET50X502
A1R3	0757-0949	1	RESISTOR-FXD 11K 2% .125W F TUBULAR	24546	C4-1/8-TO-1102-G
A1R4	0757-0944	2	RESISTOR-FXD 68K 2% .125W F TUBULAR	24546	C4-1/8-TO-6802-G
A1R5	2100-2621	1	RESISTOR-VAR, TRMR, 2KOHM 10% C	16701	ET50X202
A1R6	2100-2612	4	RESISTOR-VAR, TRMR, 100 OHM 10% C	16701	ET50X101
A1R7	0757-0944		RESISTOR-FXD, 6.8K2% .125W F TUBULAR	24546	C4-1/8-TO-6801-G
A1R8	0698-0001	2	RESISTOR-FXD, 4.7 OHM5% .5W CC TUBULAR	01121	EB4705
A1R9	0698-0001		RESISTOR-FXD, 4.7 OHM5% .5W CC TUBULAR	01121	EB4705
A1R10	0683-10 6		RESISTOR-FXD 100 OHM5% .25W CC	01607	CB1015
A1R11	0683-1015		RESISTOR-FXD 100 OHM 5% .25W CC	01607	CB1015
A1R12	0811-2277	21	RESISTOR-FXD, 10K±1% .025W PWW TUBULAR	20940	140-1/40-T-1002-B
A1R13	0811-2277		RESISTOR-FXD, 10K±1% .025W PWW TUBULAR	20940	140-1/40-T-1002-B
A1R14	2100-2632		RESISTOR-VAR, TRMR, 100 OHM 10% C	16701	ET50X101
A1R15	0757-0941	6	RESISTOR-FXD, 5.1K2% .125W F TUBULAR	24546	C4-1/8-TO-5101-G
A1R16	2100-2632		RESISTOR-VAR, TRMR, 100 OHM 10% C	16701	ET50X101
A1R17	0757-0941		RESISTOR-FXD, 5.1K2% .125W F TUBULAR	24546	C4-1/8-TO-5101-G
A1R18	0811-2277		RESISTOR-FXD, 10K±1% .025W PWW TUBULAR	20940	140-1/40-T-1002-B
A1R19	0811-2277		RESISTOR-FXD, 10K±1% .025W PWW TUBULAR	20940	140-1/40-T-1002-B
A1R20	0757-0924	39	RESISTOR-FXD, 1K2% .125W F TUBULAR	24546	C4-1/8-TO-1001-G
A1R21	0757-0924		RESISTOR-FXD, 1K2% .125W F TUBULAR	24546	C4-1/8-TO-1001-G
A1R22	0757-0900	1	RESISTOR-FXD, 301 OHM2% .125W F	24546	C4-1/8-TO-301-G
A1R23	0757-0900		RESISTOR-FXD, 100 OHM2% .125W F	24546	C4-1/8-TO-101-G
A1U1	1826-0011	21	INTEGRATED CIRCUIT LIN VOLTAGE	07263	741HM
A1U2	1826-0011		INTEGRATED CIRCUIT LIN VOLTAGE	07263	741HM
A1U3	1826-0054	2	INTEGRATED CIRCUIT LIN VOLTAGE TO-78	02037	MC1456H
A1U4	1826-0054		INTEGRATED CIRCUIT LIN VOLTAGE TO-78	02037	MC1456H
	5040-0744	2	EXTRACTOR-IPC BOARD, BROWN	28480	5040-0744
	5040-0756	12	EXTRACTOR-IPC BOARD, WHITE	28480	5040-0756
A2	05510-60002	1	CURRENT REFERENCE ASSY	28480	05510-60002
A2C1	0180-1746	16	CAPACITOR-FXD, 10UF ±10% 20VDC TA-SOLID	56289	150D106X9020B2
A2C2	0180-1746		CAPACITOR-FXD, 10UF ±10% 20VDC TA-SOLID	56289	150D106X9020B2
A2C3	0140-0176	12	CAPACITOR-FXD, 100PF ±2% 300VDC	72136	DM15F101G030WV1CR
A2C4	0140-0176		CAPACITOR-FXD, 100PF ±2% 300VDC	72136	DM15F101G030WV1CR
A2C5	0160-2307	18	CAPACITOR-FXD, 47PF ±5% 300VDC	28480	0160-2307
A2C6	0160-2307		CAPACITOR-FXD, 47PF ±5% 300VDC	28480	0160-2307
A2C7	0160-2307		CAPACITOR-FXD, 47PF ±5% 300VDC	28480	0160-2307
A2C8	0160-2307		CAPACITOR-FXD, 47PF ±5% 300VDC	28480	0160-2307
A2CR1	1901-0040	129	DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A2CR2	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A2CR3	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A2CR4	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A2Q1	1853-0036	10	TRANSISTOR, PNP SI	28480	1853-0036
A2Q2	1853-0036		TRANSISTOR, PNP SI	28480	1853-0036
A2Q3	1854-0210	39	TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A2Q4	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A2Q5	1855-0020	24	TRANSISTOR, JFET N-CHAN D-MODE SI	28480	1855-0020
A2Q6	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE SI	28480	1855-0020
A2Q7	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A2Q8	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A2Q9	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE SI	28480	1855-0020
A2Q10	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE SI	28480	1855-0020
A2R1	0811-2277		RESISTOR, FXD, 10K±1% .025W PWW TUBULAR	20940	140-1/40-T-1002-B
A2R2	0683-1005	10	RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1005
A2R3	0683-1005		RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1005

*A1C10 AND C11 MAY BE OMITTED IN SOME INSTRUMENTS

See Introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,125W FMR TUBULAR	[illegible]	140-1/8C-1-1002-F
[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,125W FMR TUBULAR	[illegible]	140-1/8C-1-1002-F
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, 750 OHM 1% .125W F	24546	CA-1/8-T0-751-F
[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,125W FMR TUBULAR	[illegible]	140-1/8C-1-1002-F
[illegible]	[illegible]		RESISTOR, FXD, 750 OHM 1% .125W F	24546	CA-1/8-T0-751-F
[illegible]	[illegible]	21	RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	19701	MF4C1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	19701	MF4C1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	19701	MF4C1/8-T0-[illegible]-F
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible] 1% .125W FMR TUBULAR	[illegible]	140-1/8C-1-[illegible]-F
[illegible]	[illegible]	1	RESISTOR, VAR, TRMR, [illegible] OHM 10% C	19701	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	19701	MF4C1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W FMR TUBULAR	[illegible]	140-1/8C-1-[illegible]-F
[illegible]	[illegible]		RESISTOR, VAR, TRMR, [illegible] OHM 10% C	19701	[illegible]
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, 10K 1% .125W F TUBULAR	24546	CA-1/8-T0-1002-F
[illegible]	[illegible]		RESISTOR, FXD, 13K 1% .125W F TUBULAR	24546	CA-1/8-T0-1302-F
[illegible]	[illegible]	17	RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]	17	RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
	5040-0750	2	EXTRACTOR-PC BOARD, RED	28480	5040-0750
	5040-0756		EXTRACTOR-PC BOARD, WHITE	28480	5040-0756
[illegible]	05510-60003	1	INTEGRATOR ASSY	28480	05510-60003
[illegible]	[illegible]	2	CAPACITOR, FXD, [illegible] 100WVDC	28480	0160-[illegible]
[illegible]	0160-2197	1	CAPACITOR FXD, 33PF 5% 300WVDC	28480	0160-2197
[illegible]	0160-1746		CAPACITOR FXD, 15UF 10% 20VDC TA SOLID	56289	150D156X9020B2
[illegible]	0160-1746		CAPACITOR FXD, 15UF 10% 20VDC TA SOLID	56289	150D156X9020B2
[illegible]	[illegible]	1	CAPACITOR, FXD, [illegible]	[illegible]	[illegible]
[illegible]	0160-1746		CAPACITOR FXD, 15UF 10% 20VDC TA SOLID	56289	150D156X9020B2
[illegible]	0160-1746		CAPACITOR FXD, 15UF 10% 20VDC TA SOLID	56289	150D156X9020B2
[illegible]	[illegible]	1	CAPACITOR, FXD, [illegible] 300WVDC	28480	[illegible]
[illegible]	0160-1746		CAPACITOR FXD, 15UF 10% 20VDC TA SOLID	56289	150D156X9020B2
[illegible]	0160-1746		CAPACITOR FXD, 15UF 10% 20VDC TA SOLID	56289	150D156X9020B2
[illegible]	[illegible]	[illegible]	CAPACITOR, FXD, [illegible] 200WVDC	56289	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR, FXD, .01UF [illegible] 50WVDC	28480	0160-[illegible]
[illegible]	[illegible]		CAPACITOR, FXD, .01UF [illegible] 50WVDC	28480	0160-[illegible]
[illegible]	[illegible]	1	CAPACITOR, FXD, [illegible] 100WVDC	28480	0160-[illegible]
[illegible]	[illegible]		CAPACITOR, FXD, [illegible] 100WVDC	28480	0160-[illegible]
[illegible]	[illegible]		CAPACITOR, FXD, .01UF [illegible] 50WVDC	28480	0160-[illegible]
[illegible]	[illegible]		CAPACITOR, FXD, .01UF [illegible] 50WVDC	28480	0160-[illegible]
[illegible]	[illegible]		DIODE, SWITCHING, SI, [illegible] MAX VF 50MA	28480	[illegible]
[illegible]	[illegible]	[illegible]	DIODE, [illegible]	28480	1902-[illegible]
[illegible]	[illegible]		DIODE, [illegible]	28480	1902-[illegible]
[illegible]	[illegible]		DIODE, SWITCHING, SI, [illegible] MAX VF 50MA	28480	1901-0040
[illegible]	[illegible]		DIODE, SWITCHING, SI, 30V MAX VF 50MA	28480	1901-0040
[illegible]	[illegible]		DIODE, SWITCHING, SI, 30V MAX VF 50MA	28480	[illegible]
[illegible]	[illegible]		DIODE, SWITCHING, SI, 30V MAX VF 50MA	28480	1901-0040
[illegible]	[illegible]		DIODE, SWITCHING, SI, [illegible] MAX VF [illegible]	28480	1901-0040
[illegible]	[illegible]	[illegible]	TRANSISTOR, [illegible], SI, NPN DUAL	28480	[illegible]
[illegible]	[illegible]	[illegible]	TRANSISTOR, PNP SI	28480	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] 1% .125W F TUBULAR	24546	CA-1/8-T0-[illegible]-F
[illegible]	[illegible]		RESISTOR, FXD, [illegible] OHMS 5% .25W CC TUBULAR	01121	CB[illegible]
[illegible]	[illegible]		RESISTOR, FXD, 10 OHMS 5% .25W CC TUBULAR	01121	CB1005
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible] OHMS 5% .25W CC TUBULAR	01121	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] OHMS 5% .25W CC TUBULAR	01121	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, 10 OHMS 5% .25W CC TUBULAR	01121	CB1005
[illegible]	[illegible]		RESISTOR, FXD, 10 OHMS 5% .25W CC TUBULAR	01121	CB1005
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, 20K 1% .125W F TUBULAR	24546	CA-1/8-T0-2002-F

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9	05510-60004	1	PRESSURE SUPPLY ASSY	28480	05510-60004
A9C1	0180-1746		CAPACITOR-FXD, 100UF +10% 20VDC TA SOLID	56289	150D107X9020B2
A9C2	0180-1746		CAPACITOR-FXD, 100UF +10% 20VDC TA SOLID	56289	150D107X9020B2
A9C3	0180-1746		CAPACITOR-FXD, 100UF +10% 20VDC TA SOLID	56289	150D107X9020B2
A9C4	0180-1746		CAPACITOR-FXD, 100UF +10% 20VDC TA SOLID	56289	150D107X9020B2
A9C5	0140-0174		CAPACITOR-FXD, 1000PF +-5% 300VDC	72136	DM15E102J300WV1CR
A9C6	0140-0174		CAPACITOR-FXD, 1000PF +-5% 300VDC	72136	DM15E102J300WV1CR
A9C7	0140-0174		CAPACITOR-FXD, 1000PF +-5% 300VDC	72136	DM15E102J300WV1CR
A9C8	0140-0307		CAPACITOR-FXD, 4700PF +-5% 300VDC	28480	0140-0307
A9C9	0140-0307		CAPACITOR-FXD, 4700PF +-5% 300VDC	28480	0140-0307
A9CR1	1901-0040		DIODE-SWITCHING-SI, 30V MAX VRM 50MA	28480	1901-0040
A9CR2	1901-0040		DIODE-SWITCHING-SI, 30V MAX VRM 50MA	28480	1901-0040
A9Q1	1853-0035		TRANSISTOR-PNP SI	28480	1853-0035
A9Q2	1854-0213		TRANSISTOR-NPN SI	28480	1854-0213
A9Q3	1854-0213		TRANSISTOR-NPN SI	28480	1854-0213
A9Q4	1855-0020		TRANSISTOR-JFET N-CHAN D-MODE SI	28480	1855-0020
A9Q5	1855-0020		TRANSISTOR-JFET N-CHAN D-MODE SI	28480	1855-0020
A9R1	0683-1005		RESISTOR-FXD, 10 OHMS +5% 1C TUBULAR	01121	CB1005
A9R2	0683-1005		RESISTOR-FXD, 10 OHMS +5% 1C TUBULAR	01121	CB1005
A9R3	2100-0522	1	RESISTOR-VAR, TRMR, 2K OHM 10% C	28480	2100-0522
A9R4	0683-1005		RESISTOR-FXD, 10 OHMS +5% 1C TUBULAR	01121	CB1005
A9R5	0683-1005		RESISTOR-FXD, 10 OHMS +5% 1C TUBULAR	01121	CB1005
A9R6	0757-0465	1	RESISTOR-FXD, 10.0K OHM +-1% .125W F TUBULAR	28480	0757-0465
A9R7	0698-3451	1	RESISTOR-FXD, 133K OHM +-1% .5W F TUBULAR	19701	MF4C1/2-133K-1%
A9R8	0757-0477	1	RESISTOR-FXD, 237K OHM +-1% .125W F TUBULAR	28480	0757-0477
A9R9	0757-0419	1	RESISTOR-FXD, 5.11K OHM +-1% .125W F TUBULAR	28480	0757-0419
A9R10	0698-3453	1	RESISTOR-FXD, 464K OHM +-1% .5W F TUBULAR	19701	MF4C1/2-464K-1%
A9R11	0811-2777		RESISTOR-FXD, 13K OHM +-.25% PWW TUBULAR	28480	0811-2777
A9R12	0811-2557	1	RESISTOR-FXD, 5K OHM +-.25% PWW TUBULAR	28480	0811-2557
A9R13	0698-0610		RESISTOR-FXD, 200K OHM +-1% .5W F TUBULAR	19701	MF4C1/2-200K-1%
A9R14	0757-0410	1	RESISTOR-FXD, 511 OHM +-1% .125W F	28480	0757-0410
A9R15	0757-0283	1	RESISTOR-FXD, 2K OHM +-1% .125W F TUBULAR	28480	0757-0283
A9R16	0811-2477		RESISTOR-FXD, 13K OHM +-.25% PWW TUBULAR	28480	0811-2477
A9R17	2100-2574		RESISTOR-VAR, TRMR, 500 OHM 10% C	28480	2100-2574
A9R18	0757-0440		RESISTOR-FXD, 100K OHM +-1% .125W F TUBULAR	28480	0757-0440
A9R19	0757-0435		RESISTOR-FXD, 20K OHM +-1% .125W F TUBULAR	28480	0757-0435
A9R20	0757-0442		RESISTOR-FXD, 30K OHM +-1% .125W F TUBULAR	28480	0757-0442
A9R21	0757-0279		RESISTOR-FXD, 1K OHM +-1% .125W F TUBULAR	28480	0757-0279
A9R22	0757-0460		RESISTOR-FXD, 100K OHM +-1% .125W F TUBULAR	28480	0757-0460
A9R23	0757-0464		RESISTOR-FXD, 147K OHM +-1% .125W F TUBULAR	28480	0757-0464

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R24	0757-0944		RESISTOR, FXD, 10K2% .125W F TUBULAR	24546	C4-1/8-T0-1002-G
A5R25	0757-0944		RESISTOR, FXD, 21K2% .125W F TUBULAR	24546	C4-1/8-T0-2102-G
A5R26	0757-0956		RESISTOR, FXD, 422K2% .125W F TUBULAR	24546	C4-1/8-T0-4223-G
A5U1	1820-0223		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
A5U2	1820-0223		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
A5U3	1820-0223		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
	4040-1762	1	EXTRACTOR-PC BOARD, YELLOW	28480	4040-0762
	4040-0762		EXTRACTOR-PC BOARD, WHITE	28480	4040-0762
A6	05510-60005	1	A/D TEMPERATURE ASSY	28480	05510-60005
A6C1	0180-1746		CAPACITOR-FXD 150UF+10%-10% 20VDC TA SOLID	56289	150D157X9020B2
A6C2	0180-1746		CAPACITOR-FXD 150UF+10%-10% 20VDC TA SOLID	56289	150D157X9020B2
A6C3	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6C4	0140-0176		CAPACITOR-FXD .0039UF+-2% 300VDC	72136	DM15D392G300WV1A
A6C5	0160-3277		CAPACITOR-FXD .01UF+-10% 50VDC	28480	0160-3277
A6C6	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6C7	0160-0939	2	CAPACITOR-FXD .033UF+-5% 100VDC	28480	0160-0939
A6C8	0160-3277		CAPACITOR-FXD .01UF+-10% 50VDC	28480	0160-3277
A6C9	0160-0939		CAPACITOR-FXD .033UF+-5% 100VDC	28480	0160-0939
A6C10	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6C11	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6C12	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6C13	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6C14	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6C15	0160-2107		CAPACITOR-FXD .47UF+-5% 100VDC	28480	0160-2107
A6CR1	1901-0040		DIODE, SWITCHING, 5V, 30V MAX VRM 50MA	28480	1901-0040
A6CR2	1901-0040		DIODE, SWITCHING, 5V, 30V MAX VRM 50MA	28480	1901-0040
A6CR3	1901-0040		DIODE, SWITCHING, 5V, 30V MAX VRM 50MA	28480	1901-0040
A6CR4	1901-0040		DIODE, SWITCHING, 5V, 30V MAX VRM 50MA	28480	1901-0040
A6CR5	1901-0040		DIODE, SWITCHING, 5V, 30V MAX VRM 50MA	28480	1901-0040
A6CR6	1901-0040		DIODE, SWITCHING, 5V, 30V MAX VRM 50MA	28480	1901-0040
A6CR7	1901-0040		DIODE, SWITCHING, 5V, 30V MAX VRM 50MA	28480	1901-0040
A6U1	1853-0034		TRANSISTOR, PNP 5V	28480	1853-0034
A6U2	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U3	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U4	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6U5	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6U6	1853-0034		TRANSISTOR, PNP 5V	28480	1853-0034
A6U7	1853-0034		TRANSISTOR, PNP 5V	28480	1853-0034
A6U8	1853-0034		TRANSISTOR, PNP 5V	28480	1853-0034
A6U9	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U10	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U11	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U12	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U13	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U14	1854-0210		TRANSISTOR, 2N2222 NPN 5V	04713	2N2222
A6U15	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6U16	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6U17	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6U18	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6U19	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6U20	1855-0020		TRANSISTOR, JFET N-CHAN D-MODE 5V	28480	1855-0020
A6R1	0683-1035		RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1035
A6R2	0683-1035		RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1035
A6R3	0698-4037	1	RESISTOR, FXD, 46.4 OHM1% .125W F	16299	C4-1/8-T0-46R4-F
A6R4	0757-0929		RESISTOR, FXD, 1.6K2% .125W F TUBULAR	03292	C4-1/8-T0-1601-G
A6R5	0757-0968		RESISTOR, FXD, 20K2% .125W F TUBULAR	24546	C4-1/8-T0-2002-G
A6R6	0698-5186	1	RESISTOR, FXD, 41.2K±1% .125W F TUBULAR	19701	MFF1216-15-41221-F
A6R7	0698-5553	1	RESISTOR, FXD, 2.49K±1% .125W F TUBULAR	19701	MFF1216-15-24901-F
A6R8	0757-0944		RESISTOR, FXD, 10.2K .125W F TUBULAR	24546	C4-1/8-T0-1022-G
A6R9	2100-0033	1	RESISTOR, VAR, TRMR, 1K OHM 10% C	11237	199A102
A6R10	2100-2514	1	RESISTOR, VAR, TRMR, 200 OHM 10% C	11237	199A201
A6R11	2100-2514		RESISTOR, VAR, TRMR, 1.2K OHM 10% C	11237	199A122
A6R12	0757-0288	1	RESISTOR, FXD, 9.09K±1% .125W F TUBULAR	19701	MFF1216-13-9091-F
A6R13	0757-0935		RESISTOR, FXD, 2K2% .125W F TUBULAR	24546	C4-1/8-T0-2001-G
A6R14	0683-2005		RESISTOR, FXD, 20 OHM5% .25W CC TUBULAR	01121	CB2005
A6R15	0757-0952	2	RESISTOR, FXD, 27K2% .125W F TUBULAR	24546	C4-1/8-T0-2702-G
A6R16	0811-2537		RESISTOR, FXD, 5K±1% .5W PWW TUBULAR	20940	242-1/2-L-5001-F
A6R17	0757-0952		RESISTOR, FXD, 15K2% .125W F TUBULAR	24546	C4-1/8-T0-1502-G
A6R18	0757-0924		RESISTOR, FXD, 1K2% .125W F TUBULAR	24546	C4-1/8-T0-1001-G
A6R19	0811-2284		RESISTOR, FXD, 1K±1% .5W PWW TUBULAR	20940	242-1/2-L-1001-F
A6R20	0757-0279	1	RESISTOR, FXD, 3.01K±1% .125W F TUBULAR	24546	C4-1/8-T0-3101-F

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5R21	0757-0944		RESISTOR: FXD; 10K Ω ±1.5% ½ W; TUBULAR	24546	CB-1/2-1C-1002-G
A5R22	0698-6630		RESISTOR: FXD; 23.2K Ω ±1% ½ W; TUBULAR	19701	MFR-1/2-TX-2322-F
A5R23	0757-0944		RESISTOR: FXD; 47K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-4702-G
A5R24	0698-6630		RESISTOR: FXD; 23.2K Ω ±1% ½ W; TUBULAR	19701	MFR-1/2-TX-2322-F
A5R25	0757-0944		RESISTOR: FXD; 10K Ω ±1.5% ½ W; TUBULAR	24546	CB-1/2-1C-1002-G
A5R26	0757-0945	8	RESISTOR: FXD; 20K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2002-G
A5R27	0698-6630		RESISTOR: FXD; 23.2K Ω ±1% ½ W; TUBULAR	19701	MFR-1/2-TX-2322-F
A5R28	0698-3161	1	RESISTOR: FXD; 28.2K Ω ±1% ½ W; TUBULAR	16299	CB-1/2-1C-2822-F
A5R29	0757-0956		RESISTOR: FXD; 22K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2202-G
A5R30	0698-6630		RESISTOR: FXD; 23.2K Ω ±1% ½ W; TUBULAR	19701	MFR-1/2-TX-2322-F
A5R31	0757-0440	1	RESISTOR: FXD; 7.5K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-7501-F
A5R32	0757-0401	2	RESISTOR: FXD; 100 Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1001-F
A5R33	0698-6630		RESISTOR: FXD; 4.02K Ω ±1% ½ W; TUBULAR	19701	MFR-1/2-TX-4021-F
A5R34	2100-3413	1	RESISTOR: VAR; CONT; 200 Ω ±10%	02111	1-1602-201
A5R35	0757-0948		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-F
A5R36	0757-0944		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-G
A5R37	0757-0948		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-F
A5R38	0757-0935		RESISTOR: FXD; 1K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1001-F
A5R39	0757-0935		RESISTOR: FXD; 1K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1001-F
A5R40	0757-0935		RESISTOR: FXD; 1K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1001-F
A5R41	0757-0952		RESISTOR: FXD; 15K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1502-G
A5R42	0757-0944		RESISTOR: FXD; 1K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1001-F
A5R43	0757-0952		RESISTOR: FXD; 15K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1502-G
A5R44	0757-0944		RESISTOR: FXD; 1K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1001-F
A5R45	0757-0952		RESISTOR: FXD; 15K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1502-G
A5R46	0757-0929		RESISTOR: FXD; 1K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1001-F
A5R47	0757-0948		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-F
A5R48	0757-0948		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-F
A5R49	0757-0948		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-F
A5R50	0757-0949		RESISTOR: FXD; 47K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-4702-F
A5R51	0757-0949		RESISTOR: FXD; 47K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-4702-F
A5R52	0757-0944		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-F
A5R53	0757-0948		RESISTOR: FXD; 12K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1202-F
A5R54	0757-0948		RESISTOR: FXD; 10K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-1002-F
A5R55	0757-0946				
A5R56	0757-0956		RESISTOR: FXD; 22K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2202-G
A5R57	0757-0956		RESISTOR: FXD; 22K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2202-G
A5R58	0757-0956		RESISTOR: FXD; 22K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2202-G
A5R59	0757-0956		RESISTOR: FXD; 22K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2202-G
A5R60	0757-0956		RESISTOR: FXD; 22K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2202-G
A5R61	0757-0956		RESISTOR: FXD; 22K Ω ±1% ½ W; TUBULAR	24546	CB-1/2-1C-2202-G
A5U1	1820-0223		INTEGRATED CIRCUIT, LIN, DP AMPL	27014	LM301A
A5U2	1826-0021	1	INTEGRATED CIRCUIT, LIN, TEMP	07263	U5UF726322
A5U3	1820-0223		INTEGRATED CIRCUIT, LIN, DP AMPL	27014	LM301A
A5U4	1820-0223		INTEGRATED CIRCUIT, LIN, DP AMPL	27014	LM301A
A5U5	1820-0223		INTEGRATED CIRCUIT, LIN, DP AMPL	27014	LM301A
A5U6	1820-0223		INTEGRATED CIRCUIT, LIN, DP AMPL	27014	LM301A
	4040-0751	1	EXTRACTOR/PC BOARD, GREEN	28480	4040-0751
	4040-0756		EXTRACTOR/PC BOARD, WHITE	28480	4040-0756
A5Y1					
A6	05510-60006	1	MATERIAL TEMPERATURE AVERAGER ASSY	28480	05510-60006
A6C1	0180-1746		CAPACITOR: FXD, 150UF+-10% 20VDC TA SOLID	56289	150D157X9020B2
A6C2	0180-1746		CAPACITOR: FXD, 150UF+-10% 20VDC TA SOLID	56289	150D157X9020B2
A6C3	0160-2307		CAPACITOR: FXD, 47PF+-5% 300VDC	28480	0160-2307
A6 4	0160-2307		CAPACITOR: FXD, 47PF+-5% 300VDC	28480	0160-2307
A6C5	0160-0176		CAPACITOR: FXD, 100PF+-2% 300VDC	72136	DM15F101G300WV1CR
A6CR1	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR2	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR3	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR4	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR5	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR6	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR7	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR8	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR9	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR10	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6Q1	1853-0010		TRANSISTOR, PNP SI	28480	1853-0010
A6Q2	1853-0010		TRANSISTOR, PNP SI	28480	1853-0010
A6Q3	1853-0010		TRANSISTOR, PNP SI	28480	1853-0010
A6Q4	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A6Q5	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A6Q6	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
[illegible]	[illegible]		TRANSISTOR PNP SI	28480	1853-0010
[illegible]	1855-0020		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-[illegible]
[illegible]	[illegible]		TRANSISTOR 2N2222 NPN SI	04713	2N2222
[illegible]	[illegible]		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0020
[illegible]	[illegible]		TRANSISTOR 2N2222 NPN SI	04713	2N2222
[illegible]	[illegible]		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0020
[illegible]	[illegible]		TRANSISTOR 2N2222 NPN SI	04713	2N2222
[illegible]	[illegible]		TRANSISTOR 2N2222 NPN SI	04713	2N2222
[illegible]	[illegible]		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-[illegible]
[illegible]	[illegible]		TRANSISTOR PNP SI	28480	1853-0016
[illegible]	[illegible]		TRANSISTOR 2N2222 NPN SI	04713	2N2222
[illegible]	[illegible]		TRANSISTOR 2N2222 NPN SI	04713	2N2222
[illegible]	[illegible]		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0020
[illegible]	[illegible]		TRANSISTOR 2N2222 NPN SI	04713	2N2222
[illegible]	[illegible]		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0020
[illegible]	[illegible]		RESISTOR FXD 10 OHM 5% .25W CC TUBULAR	01121	CB1005
[illegible]	[illegible]		RESISTOR FXD 15 OHM 5% .25W CC TUBULAR	01121	CB1[illegible]
[illegible]	[illegible]	5	RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]	16	RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	[illegible]	[illegible]-1/8-T9-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	[illegible]	[illegible]-1/8-T9-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	[illegible]	[illegible]-1/8-T9-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]	1	RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR VAR [illegible]	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W PWW TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W PWW TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .25W PWW TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]	1	RESISTOR FXD [illegible] F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]		RESISTOR VAR [illegible]	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR FXD [illegible] .125W F TUBULAR	24546	C4-1/8-T0-[illegible]
[illegible]	[illegible]	2	RESISTOR FXD 150 OHM 5% .5W CC TUBULAR	01121	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, VOLTAGE	27014	LM310H
	[illegible]	1	EXTRACTOR PC BOARD, BLUE	28480	[illegible]
	4040 0756	1	EXTRACTOR PC BOARD WHITE	28480	4040 0756

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7	05510-60007	1	PUPULATED ASSY	28480	[illegible]
A7C1	0160-1761	1	CAPACITOR-FXD, 0.001UF +100% -0% 1500VDC TA-SPECIAL	56289	[illegible]
A7C2	0160-0210	4	CAPACITOR-FXD, 0.001UF +-10% 1500VDC TA	56289	[illegible]
A7C3	0160-0210		CAPACITOR-FXD, 0.001UF +-10% 1500VDC TA	56289	[illegible]
A7C4	0160-0210		CAPACITOR-FXD, 0.001UF +-10% 1500VDC TA	56289	[illegible]
A7C5	0160-0176		CAPACITOR-FXD, 3300PF +-5% 3.5KVDC	72136	[illegible]
A7C6	0160-3291	1	CAPACITOR-FXD, 0.01UF +-10% 1500VDC TA-SPECIAL	56289	[illegible]
A7C7	0160-2267		CAPACITOR-FXD, 47PF +-5% 300VDC	28480	[illegible]
A7C8	0160-0176		CAPACITOR-FXD, 3300PF +-5% 3.5KVDC	72136	[illegible]
A7C10	0160-0153	2	CAPACITOR-FXD, 0.001UF +-10% 2.5KVDC	56289	[illegible]
A7C11	0160-0176	1	CAPACITOR-FXD, 3300PF +-5% 3.5KVDC	28480	[illegible]
A7C12	0160-2107		CAPACITOR-FXD, 47PF +-5% 300VDC	28480	[illegible]
A7C13	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7C14	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7C15	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7C16	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7C17	1902-3055		DIODE, ZENER, 5.62V 5%, 400MW MAX	28480	[illegible]
A7C18	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR7	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR8	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR9	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR10	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR11	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR12	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR13	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7CR14	1901-0050		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	[illegible]
A7G1	1854-0215		TRANSISTOR, 2N2222, NPN SI	04713	[illegible]
A7J1	1853-0036		TRANSISTOR, PNP SI	28480	[illegible]
A7Q2	1855-0520		TRANSISTOR, JFET N-CHAN E-MODE SI	28480	[illegible]
A7Q3	1854-0215		TRANSISTOR, 2N2222, NPN SI	04713	[illegible]
A7Q4	1854-0215		TRANSISTOR, 2N2222, NPN SI	04713	[illegible]
A7Q5	1853-0036		TRANSISTOR, PNP SI	28480	[illegible]
A7Q6	1854-0215		TRANSISTOR, 2N2222, NPN SI	04713	[illegible]
A7R1	0757-0465		RESISTOR, FXD, 1000 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R2	0683-1005		RESISTOR, FXD, 10 OHMS +-5% CC TUBULAR	01121	[illegible]
A7R3	0683-1005		RESISTOR, FXD, 10 OHMS +-5% CC TUBULAR	01121	[illegible]
A7R4	0683-1005		RESISTOR, FXD, 10 OHMS +-5% CC TUBULAR	01121	[illegible]
A7R5	0757-0311	2	RESISTOR, FXD, 2.61K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R6	0757-0316	2	RESISTOR, FXD, 3.32K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R7	0757-0455		RESISTOR, FXD, 511 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R8	0757-0279	1	RESISTOR, FXD, 1.21K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R9	0757-0279		RESISTOR, FXD, 1.21K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R10	0757-0455		RESISTOR, FXD, 511 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R11	0757-0279		RESISTOR, FXD, 1.21K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R12	0683-1035	2	RESISTOR, FXD, 1MEG +-5% CC TUBULAR	01121	[illegible]
A7R13	0757-0317		RESISTOR, FXD, 3.57K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R14	0683-1055		RESISTOR, FXD, 1MEG +-5% CC TUBULAR	01121	[illegible]
A7R15	0757-0344		RESISTOR, FXD, 19.6K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R16	0757-0424		RESISTOR, FXD, 100K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R17	0757-0442		RESISTOR, FXD, 1.00K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R18	0757-0442		RESISTOR, FXD, 1.00K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R19	0757-0451		RESISTOR, FXD, 402 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R20	0757-0465		RESISTOR, FXD, 1000 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R21	0757-0456		RESISTOR, FXD, 562 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R22	0757-0429		RESISTOR, FXD, 196 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R23	0757-0442		RESISTOR, FXD, 1.00K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R24	0757-0455		RESISTOR, FXD, 511 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R25	0757-0455	1	RESISTOR, FXD, 511 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R26	0757-0455		RESISTOR, FXD, 511 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R27	0757-0442		RESISTOR, FXD, 1.00K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R28	0757-0435		RESISTOR, FXD, 261 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R29	0757-0452		RESISTOR, FXD, 634 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R30	0757-0465		RESISTOR, FXD, 1.00K +-1% 1/8W F TUBULAR	28480	[illegible]
A7R31	0757-0438		RESISTOR, FXD, 316 +-1% 1/8W F TUBULAR	28480	[illegible]
A7R32	0757-0442		RESISTOR, FXD, 1.00K +-1% 1/8W F TUBULAR	28480	[illegible]
A7U1	1820-0174	9	INTEGRATED CIRCUIT, DGTL, DTL HEX	01295	SN7404N
A7U2	1820-0067	6	INTEGRATED CIRCUIT, DGTL, DTL GP TRIPLE	27014	DM7413N
A7U3	1820-0063	23	INTEGRATED CIRCUIT, DGTL, DTL GP QUAD	27014	DM7400N
A7U4	1820-1065	1	INTEGRATED CIRCUIT, DGTL, DTL LP D	27014	DM74L74N
A7U5	1820-0552	22	INTEGRATED CIRCUIT, DGTL, DTL LP DUAL D	27014	DM74L74N
A7U6	1820-0567		INTEGRATED CIRCUIT, DGTL, DTL LP TRIPLE	27014	DM74L10N
A7U7	1820-1552		INTEGRATED CIRCUIT, DGTL, DTL LP DUAL D	27014	DM74L74N
A7U8	1820-0556		INTEGRATED CIRCUIT, DGTL, DTL LP DUAL D	27014	DM74L74N

See Introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP [illegible]	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DUAL D	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DUAL D	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP TRIPLE	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP TRIPLE	27014	[illegible]
[illegible]	[illegible]	[illegible]	INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]	[illegible]	INTEGRATED CIRCUIT, GATE, TTL DECADE	[illegible]	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, LP AMPL	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, LP AMPL	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, LP AMPL	27014	[illegible]
	[illegible]	[illegible]	EXTRACTOR, PC BOARD, VIOLET	[illegible]	[illegible]
	[illegible]		EXTRACTOR, PC BD, WHITE	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] BASE ASSY	28480	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible] TA-SOLID	56289	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible] TA-SOLID	56289	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible]	[illegible]	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]	[illegible]	COIL, FXD, MOLDED RF CHOKE, [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	TRANSISTOR, NPN SI	28480	[illegible]
[illegible]	[illegible]		TRANSISTOR, NPN SI	28480	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, 10 OHMS [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible]	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	RESISTOR, FXD, [illegible]	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		RESISTOR, FXD, [illegible] TUBULAR	[illegible]	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]	[illegible]	INTEGRATED CIRCUIT, GATE, TTL DECADE	[illegible]	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DUAL D	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]	[illegible]	INTEGRATED CIRCUIT, GATE, TTL LP [illegible]	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP DECADE	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP TRIPLE	27014	[illegible]
[illegible]	[illegible]	[illegible]	INTEGRATED CIRCUIT, GATE, TTL LP [illegible]	27014	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL DEX	[illegible]	[illegible]
[illegible]	[illegible]		INTEGRATED CIRCUIT, GATE, TTL LP [illegible]	27014	[illegible]
[illegible]	[illegible]	[illegible]	SOCKET, [illegible] DC-WAY PKG	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	CRYSTAL, QUARTZ [illegible]	28480	[illegible]
	[illegible]	[illegible]	EXTRACTOR, PC BOARD, GRAY	28480	[illegible]
	[illegible]		EXTRACTOR, PC BOARD, WHITE	28480	[illegible]
[illegible]	[illegible]	[illegible]	CENTRAL BOARD ASSY	28480	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible] TA	56289	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible] TA-SOLID	56289	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible] TA	56289	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible]	56289	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]		CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible]	28480	[illegible]
[illegible]	[illegible]	[illegible]	CAPACITOR-FXD, [illegible]	56289	[illegible]

See introduction to this section for ordering information.

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9C16	0160-3880		CAPACITOR-FXD 2200PF ±20% 500VDC CER	56289	2KV22D2
A9C17-A9C18	0160-4824		CAPACITOR-FXD 01UF ±20% 50VDC CER	28480	0160-4824
A9C19	0180-2278		CAPACITOR-FXD 33UF ±10% 10VDC TA TDL	04200	1500335X9010B2
A9CR1	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A9CR2	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A9CR3	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A9CR4	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A9CR5	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A9CR6	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A9CR7	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A9Q1	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A9U1	1810-0055	2	CIRCUIT, PSIV, RES-NETWORK 16	28480	1810-0055
A9U2	1810-0055		CIRCUIT, PSIV, RES-NETWORK 16	28480	1810-0055
A9R3	0757-0946		RESISTOR, FXD, 10K2E ±12% F TUBULAR	24546	C4-1/8-T0-1002-G
A9R4	0757-0955		RESISTOR, FXD, 23K2E ±12% F TUBULAR	24546	C4-1/8-T0-2322-G
A9R5	0757-0935		RESISTOR, FXD, 3K2E ±12% F TUBULAR	24546	C4-1/8-T0-3021-G
A9R6	0757-0948		RESISTOR, FXD, 13K2E ±12% F TUBULAR	24546	C4-1/8-T0-1302-G
A9R7	0757-0952		RESISTOR, FXD, 15K2E ±12% F TUBULAR	24546	C4-1/8-T0-1502-G
A9R8	0757-0932		RESISTOR, FXD, 2.32K2E ±12% F TUBULAR	24546	C4-1/8-T0-2321-G
A9R9	0757-0936		RESISTOR, FXD, 3.32K2E ±12% F TUBULAR	24546	C4-1/8-T0-3321-G
A9R10	0757-0935		RESISTOR, FXD, 3K2E ±12% F TUBULAR	24546	C4-1/8-T0-3021-G
A9R11	0757-0948		RESISTOR, FXD, 13K2E ±12% F TUBULAR	24546	C4-1/8-T0-1302-G
A9R12	0757-0952		RESISTOR, FXD, 15K2E ±12% F TUBULAR	24546	C4-1/8-T0-1502-G
A9R13	0757-0948		RESISTOR, FXD, 13K2E ±12% F TUBULAR	24546	C4-1/8-T0-1302-G
A9R14	0757-0924		RESISTOR, FXD, 1K2E ±12% F TUBULAR	24546	C4-1/8-T0-1001-G
A9R15	0757-0948		RESISTOR, FXD, 13K2E ±12% F TUBULAR	24546	C4-1/8-T0-1302-G
A9U1	1820-1416		IC SCHMITT-TRIG TTL LS INV HEX SINP	01295	SN74LS14N
A9U2	1820-0584	11	INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U3	1820-0583		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74LC0N
A9U4	1820-0585		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L03N
A9U5	1820-0587		INTEGRATED CIRCUIT DGTL TTL LP TRIPLE	27014	DM74L10N
A9U6	1820-0583		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74LC0N
A9U7	1820-0627	4	INTEGRATED CIRCUIT, DGTL, TTL LP	07263	U7B93L01559
A9U8	1820-0629		INTEGRATED CIRCUIT, DGTL, TTL DECADE	07263	U7B93L10559
A9U9	1820-0587		INTEGRATED CIRCUIT, DGTL, TTL LP TRIPLE	27014	DM74L10N
A9U10	1820-0596		INTEGRATED CIRCUIT, DGTL, TTL LP DUAL D	27014	DM74L74N
A9U11	1820-0596		INTEGRATED CIRCUIT, DGTL, TTL LP DUAL D	27014	DM74L74N
A9U12	1820-0596		INTEGRATED CIRCUIT, DGTL, TTL LP DUAL D	27014	DM74L74N
A9U13	1820-0077	1	INTEGRATED CIRCUIT, DGTL, TTL DUAL D	01295	SN7474N
A9U14	1820-0077	1	INTEGRATED CIRCUIT, DGTL, TTL DUAL D	01295	SN7474N
A9U15	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U16	1820-0476	1	INTEGRATED CIRCUIT, DGTL, TTL	07263	U6A96U0559
A9U17	1820-0765	3	INTEGRATED CIRCUIT, DGTL, TTL QUAD 2	01295	SN7402N
A9U18	1820-0588	2	INTEGRATED CIRCUIT, DGTL, TTL LP DUAL	27014	DM74L2CN
A9U19	1820-0583		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74LC0N
A9U20	1820-0585		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L03N
A9U21	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U22	1820-0591		INTEGRATED CIRCUIT, DGTL, TTL LP 4-WIDE	27014	DM74L54N
A9U23	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U24	1820-0627		INTEGRATED CIRCUIT, DGTL, TTL LP	07263	U7B93L01559
A9U25	1820-0583		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74LC0N
A9U26	1820-0769		INTEGRATED CIRCUIT, DGTL, TTL QUAD 2	01295	SN7403N
A9U27	1820-0583		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74LC0N
A9U28	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U29	1820-0627		INTEGRATED CIRCUIT, DGTL, TTL LP	07263	U7B93L03559
A9U30	1820-0586		INTEGRATED CIRCUIT, DGTL, TTL LP HEX	27014	DM74L04N
A9U31	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U32	1820-0585		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L03N
A9U33	1820-0583		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74LC0N
A9U34	1820-0586		INTEGRATED CIRCUIT, DGTL, TTL LP HEX	27014	DM74L04N
A9U35	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U36	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U37	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U38	1820-0584		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD	27014	DM74L02N
A9U39	1820-0586		INTEGRATED CIRCUIT, DGTL, TTL LP HEX	27014	DM74L04N
A9U40	1820-0591		INTEGRATED CIRCUIT, DGTL, TTL LP 4-WIDE	27014	DM74L54N
	4040-0756		EXTRACTOR-PC BOARD, WHITE	28480	4040-0756
A10	05510-60010		PRESET READ-ONLY-MEMORY ASSY	28480	05510-60010
A10C1	0160-4824		CAPACITOR-FXD 01UF ±20% 50VDC CER	28480	0160-4824
A10C2	0160-4824		CAPACITOR-FXD 01UF ±20% 50VDC CER	28480	0160-4824
A10C3	0160-4824		CAPACITOR-FXD 01UF ±20% 50VDC CER	28480	0160-4824
A10C4	0160-4824		CAPACITOR-FXD 01UF ±20% 50VDC CER	28480	0160-4824
A10C5	0160-4824		CAPACITOR-FXD 01UF ±20% 50VDC CER	28480	0160-4824
A10C6	0160-4824		CAPACITOR-FXD 01UF ±20% 50VDC CER	28480	0160-4824
A10CR1 THRU A10CR50	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM DOMA	28480	1901-0040
A10Q1	1854-0019		TRANSISTOR, NPN SI	28480	1854-0019
A10Q2	1854-0019		TRANSISTOR, NPN SI	28480	1854-0019
A10Q3	1854-0019		TRANSISTOR, NPN SI	28480	1854-0019

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1DS4	1854-0015		TRANSISTOR: NPN SI	28480	1854-0015
A1DS5	1854-0015		TRANSISTOR: NPN SI	28480	1854-0015
A1DS6	1854-0015		TRANSISTOR: NPN SI	28480	1854-0015
A1DS7	1854-0015		TRANSISTOR: NPN SI	28480	1854-0015
A1DS8	1854-0015		TRANSISTOR: NPN SI	28480	1854-0015
A1DR1	0757-0438		RESISTOR: FXD, FILM 2K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-2001-F
A1DR2	0757-0438		RESISTOR: FXD, FILM 2K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-2001-F
A1DR3	0757-0438		RESISTOR: FXD, FILM 2K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-2001-F
A1DR4	0757-0438		RESISTOR: FXD, FILM 2K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-2001-F
A1DR5	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR6	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR7	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR8	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR9	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR10	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR11	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR12	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR13	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR14	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR15	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1DR16	0757-0464		RESISTOR: FXD, FILM 47K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-4702-F
A1U1	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U2	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U3	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U4	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U5	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U6	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U7	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U8	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U9	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U10	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U11	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U12	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U13	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U14	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U15	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1U16	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U17	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U18	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U19	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U20	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U21	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U22	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U23	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U24	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U25	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U26	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U27	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U28	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U29	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U30	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A1U31	1820-0301		INTEGRATED CIRCUIT, DGTL: TTL QUAD	01295	SN7475N
A1U32	1820-0301		INTEGRATED CIRCUIT, DGTL: TTL QUAD	01295	SN7475N
A1U33	1820-0301		INTEGRATED CIRCUIT, DGTL: TTL QUAD	01295	SN7475N
A1U34	1820-0301		INTEGRATED CIRCUIT, DGTL: TTL QUAD	01295	SN7475N
A1U35	1820-0174		INTEGRATED CIRCUIT, DGTL: TTL HEX	01295	SN7404N
A1U36	1820-0583		INTEGRATED CIRCUIT, DGTL: TTL LP QUAD	27014	DM74L00N
A1W1	5040-0748	1	JUMPER: ELECTRICAL BOARD, BLACK	28480	5040-0748
	5040-0750		JUMPER: ELECTRICAL BOARD, WHITE	28480	5040-0750
A11	05510-60011	1	PRESET COUNTER ASSY	28480	05510-60011
A11C1	0140-0199	1	CAPACITOR: FXD 24PF +-5% 300WVDC	72136	DM15F240J0300WVICR
A11C2	0140-0208	1	CAPACITOR: FXD 68PF +-5% 300WVDC	72136	DM15F680J0300WVICR
A11C3 thru C10	0160-4824		CAPACITOR: FXD .01UF +50% -20% 50VDC CER	28480	0160-4824
A11C11	0160-4824		CAPACITOR: FXD .01UF +50% -20% 50VDC CER	28480	0160-4824
A11C12 thru C14	0180-0559		CAPACITOR: FXD 33UF +10% 10VDC TA	04713	1500336X9010C2
A11C15	0180-0559		CAPACITOR: FXD 33UF +10% 10VDC TA	04713	1500336X9010C2
A11R1	0757-0455		RESISTOR: FXD, FILM 20K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-2002-F
A11R2	0757-0455		RESISTOR: FXD, FILM 30K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-3002-F
A11R3	0757-0455		RESISTOR: FXD, FILM 20K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-2002-F
A11R4	0757-0459		RESISTOR: FXD, FILM 33K OHM ±1% .125W F TUBULAR	24546	CEA-1/8-T0-3302-F
A11U1	1820-0590	10	INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U2	1820-0590		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U3	1820-0590		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U4	1820-0590		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U5	1820-0590		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U6	1820-0590		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U7	1820-0590		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U8	1820-0590		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL	27014	DM74L51N
A11U9	1820-0648	3	INTEGRATED CIRCUIT, DGTL: TTL DECADE	01686	SN74192N
A11U10	1820-0648		INTEGRATED CIRCUIT, DGTL: TTL DECADE	01686	SN74192N
A11U11	1820-0648		INTEGRATED CIRCUIT, DGTL: TTL DECADE	01686	SN74192N
A11U12	1820-0733	1	INTEGRATED CIRCUIT, DGTL: TTL 4-BIT	01686	SN74198N
A11U13	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A11U14	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A11U15	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N
A11U16	1820-0556		INTEGRATED CIRCUIT, DGTL: TTL LP DUAL D	27014	DM74L74N

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1U27	1820-0584 4040-0749 4040-0750		INTEGRATED CIRCUIT, DGTL, TTL LP QUAD FASTACTUATOR HOUSING, RETAIN FASTACTUATOR HOUSING, DOOR	27014 28480 28480	DM74LS27N 5040-0749 5040-0750
A1F	08510-60015		INTERFACE COVER ASSY	28480	08510-60015
A1FC1 A1FC2 thru A1FC8 A1FC9 thru A1FC10 A1FC11	0180-0210 0160-4814 0160-4814 0180-0229 0180-0229 1901-0028	1 1	CAPACITOR-FXD 3.3UF ±10% 15VDC TA CAPACITOR-FXD 0.01UF ±20% 50VDC CER CAPACITOR-FXD 0.01UF ±20% 50VDC CER CAPACITOR-FXD 33UF ±10% 10VDC TA CAPACITOR-FXD 33UF ±10% 10VDC TA DIODE-SWITCHING 75V 400MW MAX 200 MA	56289 51406 28480 04200 04200 28480	150D335X9010B2 0160-4814 0160-4814 150D335X9010B2 150D335X9010B2 1901-0028
A1Q1 A1Q2 A1Q3 A1Q4 A1Q5 A1Q6	1853-0001 1853-0001 1853-0001 1853-0001 1853-0001 1853-0001	 	DIODE, SWITCHING, SI, 30V MAX VRM 50MA DIODE, SWITCHING, SI, 30V MAX VRM 50MA DIODE, SWITCHING, SI, 30V MAX VRM 50MA DIODE, SWITCHING, SI, 30V MAX VRM 50MA DIODE, SWITCHING, SI, 30V MAX VRM 50MA DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480 28480 28480 28480 28480 28480	1901-0040 1901-0040 1901-0040 1901-0040 1901-0040 1901-0040
A1Q7 A1Q8 A1Q9 A1Q10 A1Q11 A1Q12	1853-0001 1854-0210 1854-0210 1854-0210 1854-0210 1854-0210	 	DIODE, SWITCHING, SI, 30V MAX VRM 50MA TRANSISTOR, 2N2222 NPN SI TRANSISTOR, 2N2222 NPN SI TRANSISTOR, 2N2222 NPN SI TRANSISTOR, 2N2222 NPN SI TRANSISTOR, 2N2222 NPN SI	28480 04713 04713 04713 04713 04713	1901-0040 2N2222 2N2222 2N2222 2N2222 2N2222
A1Q13 A1Q14 A1Q15 A1Q16 A1Q17 A1Q18	1854-0210 1854-0210 1854-0210 1854-0015 1854-0210 1854-0210	 	TRANSISTOR, 2N2222 NPN SI TRANSISTOR, 2N2222 NPN SI TRANSISTOR, 2N2222 NPN SI TRANSISTOR, NPN SI TRANSISTOR, 2N2222 NPN SI TRANSISTOR, 2N2222 NPN SI	04713 04713 04713 28480 04713 04713	2N2222 2N2222 2N2222 1854-0015 2N2222 2N2222
A1R1 A1R2 A1R3 A1R4 A1R5	0757-0931 0757-0935 0757-0935 0757-0935 0757-0931	 	RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-2001-F C4-1/8-T0-1001-F C4-1/8-T0-1001-F C4-1/8-T0-1001-F C4-1/8-T0-2001-F
A1R6 A1R7 A1R8 A1R9 A1R10	0757-0931 0757-0935 0757-0931 0757-0924 0757-0924	 	RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-2001-F C4-1/8-T0-1001-F C4-1/8-T0-2001-F C4-1/8-T0-1001-F C4-1/8-T0-1001-F
A1R11 A1R12 A1R13 A1R14 A1R15	0757-0924 0757-0924 0757-0942 0757-0969 0757-0959	 	RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 130K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 750K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 300K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-1001-F C4-1/8-T0-1001-F C4-1/8-T0-1303-F C4-1/8-T0-7503-F C4-1/8-T0-3003-F
A1R16 A1R17 A1R18 A1R19 A1R20	0757-0969 0757-0959 0757-0969 0757-0931 0757-0959	 	RESISTOR, FXD, 750K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 300K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 750K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 300K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-7503-F C4-1/8-T0-3003-F C4-1/8-T0-7503-F C4-1/8-T0-2001-F C4-1/8-T0-3003-F
A1R21 A1R22 A1R23 A1R24 A1R25	0757-0946 0757-0946 0757-0946 0757-0946 0757-0924	 	RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-3002-F C4-1/8-T0-3002-F C4-1/8-T0-3002-F C4-1/8-T0-3002-F C4-1/8-T0-1001-F
A1R26 A1R27 A1R28 A1R29 A1R30	0757-0946 0757-0946 0757-0946 0757-0946 0757-0946	 	RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 30K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-3002-F C4-1/8-T0-3002-F C4-1/8-T0-3002-F C4-1/8-T0-3002-F C4-1/8-T0-3002-F
A1R31 A1R32 A1R33 A1R34 A1R35	0757-0931 0757-0931 0757-0931 0757-0931 0757-0931	 	RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-2001-F C4-1/8-T0-2001-F C4-1/8-T0-2001-F C4-1/8-T0-2001-F C4-1/8-T0-2001-F
A1R36 A1R37 A1R38 A1R39 A1R40	0757-0924 0757-0924 0757-0931 0757-0924 0757-0924	 	RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 2K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR	24546 24546 24546 24546 24546	C4-1/8-T0-1001-F C4-1/8-T0-1001-F C4-1/8-T0-2001-F C4-1/8-T0-1001-F C4-1/8-T0-1001-F
A1R41 A1R42 A1R43 A1R44 A1U1	0757-0924 0757-0924 0757-0924 0757-0924 1820-0566	 	RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR RESISTOR, FXD, 1K2Ω ±1.0% .125W F TUBULAR INTEGRATED CIRCUIT, DGTL, TTL LP HEX	24546 24546 24546 24546 27014	C4-1/8-T0-1001-F C4-1/8-T0-1001-F C4-1/8-T0-1001-F C4-1/8-T0-1001-F DM74LS06N
A1U2 A1U3 A1U4 A1U5 A1U6	1820-0827 1820-0716 1820-0583 1820-0066 1820-0506	 1 1 2	INTEGRATED CIRCUIT, DGTL, TTL LP INTEGRATED CIRCUIT, DGTL, TTL 4-BIT INTEGRATED CIRCUIT, DGTL, TTL LP QUAD INTEGRATED CIRCUIT, DGTL, TTL TRIPLE 3 INTEGRATED CIRCUIT, DGTL, TTL DUAL 4	07263 01295 27014 01295 27014	U7893LO1554 SN74S194N DM74LS00N SN74LS10N DM82S64N

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1U47	1820-0510		INTEGRATED CIRCUIT, LOGIC, TTL QUAD 4	27014	DM74LS04N
A1U48	1820-0510		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD	27014	DM74LS04N
A1U49	1820-0511	1	INTEGRATED CIRCUIT, LOGIC, TTL QUAD 2	01295	SN74S00N
A1U50	1820-0510	1	INTEGRATED CIRCUIT, LOGIC, TTL 6-INPUT	01295	SN74S10N
A1U51	1820-0509		INTEGRATED CIRCUIT, LOGIC, TTL QUAD 2	01295	SN74S02N
A1U52	1820-0511		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD D	27014	DM74LS00N
A1U53	1820-0509	4	INTEGRATED CIRCUIT, LOGIC, TTL QUAD D	27014	DM8551N
A1U54	1820-0509		INTEGRATED CIRCUIT, LOGIC, TTL QUAD D	27014	DM8551N
A1U55	1820-0509		INTEGRATED CIRCUIT, LOGIC, TTL QUAD D	27014	DM8551N
A1U56	1820-0509		INTEGRATED CIRCUIT, LOGIC, TTL QUAD D	27014	DM8551N
A1U57	1820-0514	1	INTEGRATED CIRCUIT, LOGIC, TTL QUAD 2	01295	SN74S00N
A1U58	1820-0510		INTEGRATED CIRCUIT, LOGIC, TTL DUAL	01295	SN74S74N
A1U59	1820-0511		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD D	27014	DM74LS00N
	0360-0120		TERMINAL-SOLDER LUG	28480	0360-0120
	0360-0121		TERMINAL-SOLDER LUG	28480	0360-0121
A11	05510-60011	1	MAIN SELECT ASSY	28480	05510-60011
A1 C1	0121-0044		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C2	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C3	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C4	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C5	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C6	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C7	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C8	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C9	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1C10	0121-0042		FIXED, ELECTROLYTIC (AL), 1250 UF, +75-10% 6 VDCW	56582	EA-178-10-1002-6
A1DS1	2180-0023	1	SWITCH-DISPLAY	28480	2180-0023
A1U1	1820-0510		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD	27014	DM74LS04N
A1U2	1820-0510		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD	27014	DM74LS04N
A1U3	1820-0509		INTEGRATED CIRCUIT, LOGIC, TTL LP D/F	27014	DM74LS74N
A1U4	1820-0508		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD	27014	DM74LS00N
A1U5	1820-0509		INTEGRATED CIRCUIT, LOGIC, TTL LP B	27014	DM74LS08N
A1U6	1820-0510		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD	27014	DM74LS02N
A1A	05510-60014	1	CORRELATION BUFFER ASSY	28480	05510-60014
A1A1R1	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R2	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R3	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R4	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R5	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R6	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R7	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R8	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R9	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R10	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R11	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R12	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A1R13	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1A2J1	1251-3581	5	CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-310
A1A2J2	1251-3581		CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-310
A1A2J3	1251-3581		CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-310
A1A2J4	1251-3581		CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-310
A1A2J5	1251-3581		CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-310
A1A2U1	1820-0508		INTEGRATED CIRCUIT, LOGIC, TTL LP QUAD	27014	DM74LS00N
A1A3	05510-60015	1	CONNECTOR BOARD ASSY	28480	05510-60015
A1A3J1	1251-2735	6	CONNECTOR, 50-CONT, FEM, MICRO RIBBON	71785	57-40500-A-383
A1A3J2	1251-2735		CONNECTOR, 50-CONT, FEM, MICRO RIBBON	71785	57-40500-A-383
A1A3J3	1251-2735		CONNECTOR, 50-CONT, FEM, MICRO RIBBON	71785	57-40500-A-383
A1A3J4	1251-2735		CONNECTOR, 50-CONT, FEM, MICRO RIBBON	71785	57-40500-A-383
A1A3J5	1251-2735		CONNECTOR, 50-CONT, FEM, MICRO RIBBON	71785	57-40500-A-383
A1A3J6	1251-2735		CONNECTOR, 50-CONT, FEM, MICRO RIBBON	71785	57-40500-A-383
	0360-0122	7	TERMINAL-SOLDER STANDOFF, 4-40, .188 LG, .094	71279	1300-18
	0360-0119	12	TERMINAL-SOLDER STANDOFF, 2-56, .188 LG, .062	00656	9226BB-B-0756

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1	05510-60016	1	MOTHER BOARD ASSY	28480	05510-60016
A1A1A1	1251-1633	1	CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-330
A1A1A2	1251-1633	11	CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-330
A1A1A3	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-33-008
A1A1A4	1251-1633		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-330
A1A1A5	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A6	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A7	1251-13 9		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A8	1251-138		CONNECTOR, PC EDGE, 18-CONT, DIP SOLDER	09574	3VH18/1JV12
A1A1A9	1251-2455	2	CONNECTOR, PC EDGE, 18-CONT, DIP SOLDER	09574	3VH18/1JV12
A1A1A10	1251-2459		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
	1251-1388				
A1A1A10	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A11	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A11	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A12	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A12	1251-1388		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-008
A1A1A13	1251-2556	1	CONNECTOR, PC EDGE, 43-CONT, DIP SOLDER	81312	HPD43D-548
	0380-0347	4	STANDOFF, A-32, .375 LG, .062	28480	0380-0347
A1T	10263A		MATERIAL TEMPERATURE SENSOR SERIES 10K A		
A1TA1	10563-60001	1	BOARD ASSY:TEMP, BUFFER	28480	10563-60001
A1TA1C1	0160-0116	8	CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
A1TA1C2	0160-0116		CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
A1TA1C3	0160-0116		CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
A1TA1C4	0160-0116		CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
A1TA1C5	0160-3879		CAPACITOR, FXD, .01UF+-50% 50WVDC	28480	0160-3879
A1TA1C6	0160-3879		CAPACITOR-FXD, .01UF+-20% 50WVDC	28480	0160-3879
A1TA1C7	0160-3879		CAPACITOR-FXD, .01UF+-20% 50WVDC	28480	0160-3879
A1TA1C8	0160-3879		CAPACITOR-FXD, .01UF+-20% 50WVDC	28480	0160-3879
A1TA1Q1	1853-0010		TRANSISTOR, PNP SI	28480	1853-0010
A1TA1Q2	1854-0210		TRANSISTOR, 2N2222 NPN SI	04713	2N2222
A1TA1R1	0811-2277		RESISTOR, FXD, 10K 1% .025W PWW TUBULAR	20940	140-1/40-E-1002-B
A1TA1R2	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=+412	01607	EB 2405
A1TA1R3	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=+412	01607	EB 2405
A1TA1R4	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=+412	01607	EB 2405
A1TA1R5	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=+412	01607	EB 2405
A1TA1R6	0757-0444	7	RESISTOR, FXD, 12.1K 1% .125W F TUBULAR	24546	CA-1/8-T0-1212-F
A1TA1R7	0757-0448		RESISTOR, FXD, 100K 1% .125W F TUBULAR	24546	CA-1/8-T0-1003-G
A1TA1R8	0698-6630		RESISTOR, FXD, 20K 1% .125W F TUBULAR	30983	MFAC1/8-T9-2002-F
A1TA1R9	0757-0278	2	RESISTOR, FXD, 1.78K 1% .125W F TUBULAR	24546	CA-1/8-T0-1781-F
A1TA1R10	0698-6630		RESISTOR, FXD, 20K 1% .125W F TUBULAR	30983	MFAC1/8-T9-2002-F
A1TA1R11	0757-0317	2	RESISTOR, FXD, 1.33K 1% .125W F TUBULAR	24546	CA-1/8-T0-1331-F
A1TA1R12	0811-2284		RESISTOR, FXD, 1K 1% .025W PWW TUBULAR	20940	140-1/40-E-1001-F
A1TA1R13	2100-1771	2	RESISTOR, VAR, 1MEG, 1K OHM 5E MM	28480	2100-1771
A1TA1R14	0757-0446		RESISTOR, FXD, 10K 1% .125W F TUBULAR	24546	CA-1/8-T0-1002-G
	0811-2277		RESISTOR, FXD, 10K 1% .025W PWW TUBULAR	20940	140-1/40-E-1002-B
A1TA1R15	0757-0446		RESISTOR, FXD, 10K 1% .125W F TUBULAR	24546	CA-1/8-T0-1002-G
A1TA1R16	0811-2277		RESISTOR, FXD, 10K 1% .025W PWW TUBULAR	20940	140-1/40-E-1002-B
A1TA1R17	0811-2537		RESISTOR, FXD, 5K 1% .025W PWW TUBULAR	20940	140-1/40-E-5001-B
A1TA1R18	2100-1776	2	RESISTOR, VAR, 1MEG, 20K OHM 5E MM	28480	2100-1776
A1TA1R19	0698-6630		RESISTOR, FXD, 20K 1% .125W F TUBULAR	30983	MFAC1/8-T9-2002-F
A1TA1R20	0757-0401		RESISTOR, FXD, 100 OHM 1% .125W F	24546	CA-1/8-T0-101-F
A1TA1R21	0757-0440		RESISTOR, FXD, 4.75K 1% .125W F TUBULAR	24546	CA-1/8-T0-4751-G
A1TA1R23	0757-0446		RESISTOR, FXD, 10K 1% .125W F TUBULAR	24546	CA-1/8-T0-1002-G
A1TA1R25	0757-0446		RESISTOR, FXD, 10K 1% .125W F TUBULAR	24546	CA-1/8-T0-1002-G
A1TA1R26	0698-6401	2	RESISTOR, FXD, 65.1K 1% .125W F, TUBULAR	30983	MFAC1/8-T9-6512-F
A1TA1R27	0698-3515		RESISTOR, FXD, 150 OHM 5% .5W CC TUBULAR	01121	EB1515
A1TA1R28	0811-2456	3	RESISTOR, FXD, 60K 1% .025W PWW TUBULAR	20940	140-1/40-E-6002-B
A1TA1U1	1820-0223		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
A1TA1U2	1820-0223		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
A1TA1U3	1820-0223		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
A1TA1U4	1826-1335	1	INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM308AH
	10563-20004	1	SHELL	28480	10563-20004
	10563-20005	1	SHELL COVER	28480	10563-20005

See introduction to this section for ordering information.

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A[illegible]	[illegible]	1	PC-BD ASSEMBLY,DIGITAL TEMP,INCR-DECR/ANNL	28480	10561-60002
A[illegible]	10561A		DIGITAL-AIR-TEMP/HUMIDITY,		
A[illegible]	[illegible]	1	BOARD ASSEMBLY BUFFER	28480	10564-60001
C[illegible]	0160-3669	1	CAPACITOR-FXD, 6UF+-2% 100WVDC	28480	0160-3669
C[illegible]	0180-0116		CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
C[illegible]	0180-0116		CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
C[illegible]	0180-0116		CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
C[illegible]	0180-0116		CAPACITOR-FXD, 6.8UF+-10% 35VDC TA-SOLID	04200	150D685X9035B2
C[illegible]	0160-3879		CAPACITOR-FXD, .01UF+-20% 50VDC	28480	0160-3879
C[illegible]	0160-3879		CAPACITOR-FXD, .01UF+-20% 50VDC	28480	0160-3879
C[illegible]	0160-3879		CAPACITOR-FXD, .01UF+-20% 50VDC	28480	0160-3879
C[illegible]	0160-3879		CAPACITOR-FXD, .01UF+-20% 50VDC	28480	0160-3879
C[illegible]	0160-3164	4	CAPACITOR-FXD, .01UF+-10% 200VDC	56289	292P103X9
C[illegible]	0160-3164		CAPACITOR-FXD, .033UF+-10% 200VDC	56289	292P333X9
C[illegible]	0160-3879		CAPACITOR-FXD, .01UF+-20% 50VDC	28480	0160-3879
C[illegible]	0160-3879		CAPACITOR-FXD, .01UF+-20% 50VDC	28480	0160-3879
C[illegible]	0160-3164		CAPACITOR-FXD, .01UF+-10% 200VDC	56289	292P103X9
DS[illegible]	2140-3054	1	LAMP, INCAND, MSCP T-1-3/4, 14V	28480	346A525
J[illegible]	1251-0102	1	CONNECTOR, 50-CONT, MALE, MICRO RIBBON	71785	57-0093-01-376
R[illegible]	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=0+412	01607	EB 2405
R[illegible]	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=0+412	01607	EB 2405
R[illegible]	2100-2986	1	RESISTOR, VAR, TRMR, 200KOHM 5% WW	28480	2100-2986
R[illegible]	0757-0930	1	RESISTOR, FXD, 1.8K 2% 125W F TUBULAR	24546	C4-1/8-TO-1801-G
R[illegible]	0811-2277		RESISTOR, FXD, 10K 1% .025W PWW TUBULAR	20940	140-1/40-E-1002-B
R[illegible]	0811-2284		RESISTOR, FXD, 1K 1% .025W PWW TUBULAR	20940	140-1/40-E-1001-B
R[illegible]	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=0+412	01607	EB 2405
R[illegible]	0683-2405		RESISTOR, FXD, 24 OHM 5% 5W CC TC=0+412	01607	EB 2405
R[illegible]	0757-0444		RESISTOR, FXD, 12.1K 1% 125W F TUBULAR	24546	C4-1/8-TO-1212-F
R[illegible]	[illegible]		RESISTOR, FXD, 20K,1% ,125W F TUBULAR	24546	MFAL1/8-TX-2002-B
R[illegible]	0757-0[illegible]		RESISTOR, FXD, 3.74K1% ,125W F TUBULAR	24546	C4-1/8-TO-3741-F
R[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,025W PWW TUBULAR	20940	140-1/40-E-1002-B
R[illegible]	[illegible]		RESISTOR, FXD, 3.32K1% ,125W F TUBULAR	24546	C4-1/8-TO-3321-F
R[illegible]	2100-2773		RESISTOR, VAR, TRMR, 200OHM 5% SM	28480	2100-2773
R[illegible]	0757-0442	2	RESISTOR, FXD, 10K1% ,125W F TUBULAR	24546	C4-1/8-TO-1002-F
R[illegible]	[illegible]		RESISTOR, FXD, 1K,1% ,025W PWW TUBULAR	20940	140-1/40-E-1001-B
R[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,025W PWW TUBULAR	20940	140-1/40-E-1002-B
R[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,025W PWW TUBULAR	20940	140-1/40-E-1002-B
R[illegible]	0757-0[illegible]	1	RESISTOR, FXD, 562 OHM1% ,125W F	24546	C4-1/8-TO-561-G
R[illegible]	0757-0[illegible]		RESISTOR, FXD, 200K1% ,125W F TUBULAR	24546	C4-1/8-TO-2003-F
R[illegible]	[illegible]		RESISTOR, FXD, 5K,1% ,025W PWW TUBULAR	20940	140-1/40-E-5001-B
R[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,025W PWW TUBULAR	20940	140-1/40-E-1002-B
R[illegible]	[illegible]		RESISTOR, FXD, 20K,1% ,125W F TUBULAR	20940	MFAL1/8-TX-2002-B
R[illegible]	2100-2774		RESISTOR, VAR, TRMR, 500OHM 5% SM	28480	2100-2774
R[illegible]	[illegible]		RESISTOR, FXD, 499K1% ,025W PWW TUBULAR	20940	A15-1/16-E-4992-B
R[illegible]	0757-0[illegible]		RESISTOR, FXD, 27K2% ,125W F TUBULAR	24546	C4-1/8-TO-2702-G
R[illegible]	[illegible]		RESISTOR, FXD, 2.74K1% ,125W F TUBULAR	24546	C4-1/8-TO-2741-F
R[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,025W PWW TUBULAR	20940	140-1/40-E-1002-B
R[illegible]	0757-0[illegible]		RESISTOR, FXD, 20K1% ,125W F TUBULAR	24546	C4-1/8-TO-2003-F
R[illegible]	[illegible]		RESISTOR, FXD, 10K,1% ,125W F TUBULAR	24546	C4-1/8-TO-1002-F
R[illegible]	[illegible]		RESISTOR, FXD, 5K,1% ,025W PWW TUBULAR	20940	140-1/40-E-5001-B
R[illegible]	[illegible]		RESISTOR, FXD, 20K,1% ,125W F TUBULAR	24546	MFAL1/8-TX-2002-B
R[illegible]	0757-0[illegible]		RESISTOR, FXD, 2.49K ,125W F TUBULAR	24546	C4-1/8-TO-2491-F
R[illegible]	[illegible]		RESISTOR, FXD, 499K ,125W F TUBULAR	24546	MFAL1/8-TX-5002-F
R[illegible]	2100-2778	1	RESISTOR, VAR, TRMR, 10K OHM 5% SIDE ADJ	28480	2100-2778
R[illegible]	[illegible]		RESISTOR, FXD, 499K1% ,062W PWW TUBULAR	20940	A15-1/16-E-4992-B
U[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
U[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
U[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
U[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, DUAL OP AMPL	27014	LM1458N
U[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
U[illegible]	[illegible]		INTEGRATED CIRCUIT, LIN, OP AMPL	27014	LM301A
W[illegible]	[illegible]	1	CONTACT,ELECTRICAL SHIELD	28480	0211B-CC01
	[illegible]	1	SHIELD	28480	10564-20005
	[illegible]	1	COVER-SHIELD	28480	10564-20006
A[illegible]	[illegible]	1	PC-BD ASSEMBLY	28480	10564-60002

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A2A1	10544-60001	1	ASSEMBLY-ETCH ANNEALED	28480	10544-60001
A1A2A1C1	0160-3540		CAPACITOR-FXD, CER DI 470PF +80-20% 100VDC Z5U	28480	0160-3540
A1A2A1C2	0160-0176		CAPACITOR-FXD, POLYE 0.1UF +-5% 200VDC	56289	192P10492DH5
A1A2A1C3	0160-0111	1	CAPACITOR-FXD, CER DI 1000PF +-5% 300VDC TA	56289	C067E103J302S
A1A2A1CR1	1902-3234	1	DIODE, ZENER 5.62V VZ, .4W MAX	28480	1902-3234
A1A2A1CR2	1901-0040		DIODE, SWITCHING 5NS 30V MAX VRM 50MA	28480	1901-0040
A1A2A1CR3	1901-0040		DIODE, SWITCHING 5NS 30V MAX VRM 50MA	28480	1901-0040
A1A2A1CR4	1901-0040		DIODE, SWITCHING 5NS 30V MAX VRM 50MA	28480	1901-0040
A1A2A1L1	9100-0710		INDUCTOR-RF CH 2.5UH 5%	04713	SMC2522
A1A2A1Q1	1853-0020		TRANSISTOR PNP SI TO-18	28480	1853-0020
A1A2A1Q2	1855-0020		TRANSISTOR JFET N-CHAN D-MODE SI	28480	1855-0020
A1A2A1Q3	1855-0020		TRANSISTOR JFET N-CHAN D-MODE SI	28480	1855-0020
A1A2A1Q4	1855-0020		TRANSISTOR JFET N-CHAN D-MODE SI	28480	1855-0020
A1A2A1R1	0757-0346	1	RESISTOR 1.82K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-5602-G
A1A2A1R2	0757-0346		RESISTOR 1.82K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-5602-G
A1A2A1R3	0757-0346		RESISTOR 1.82K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-5602-G
A1A2A1R4	0757-0441		RESISTOR 5.11K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-5111-G
A1A2A1R5	0757-0346	1	RESISTOR 1.82K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-5602-G
A1A2A1R6	0683-3355		RESISTOR 3.3MEG +-5% 1/4W CC TUBULAR	01121	CB3355
A1A2A1R7	2100-2255	1	RESISTOR-VAR, WWW, 200ADJ0M 10% C	15801	4100W104
A1A2A1R8	0757-0431		RESISTOR 4.64K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-4301-G
A1A2A1R9	0757-0431		RESISTOR 4.64K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-4301-G
A1A2A1R10	0757-0465		RESISTOR 10K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-1002-G
A1A2A1R11	0757-0479		RESISTOR 19.6K +-1% 1/8W F TUBULAR	28480	CA-1/8-10-1962-G
A1A2A1R12	0683-6765	1	RESISTOR 6.8MEG +-5% CC TUBULAR	01121	CB6765
A1A2A1U1	1826-0035		INTEGRATED CIRCUIT, LIN, OP AMP -3 TO	27014	LM318AH
A1A2A1J1	1251-0477	1	CONNECTOR, PC EDGE, 8-CONT, DIP SOLDER	71785	252-08-20-100
A1A2A2	10544-60004	1	ASSEMBLY-ETCH BOARD	28480	10544-60004
A1A2A2MP1	0340-0141	1	INSULATOR-THERMAL	28480	0340-0141
A1A2A2R1	0683 2755	1	RESISTOR,FXD, 27M 5% CC 0.25W	28480	0683 2755
A1A2A2XU1	0380-0071	1	INSERT-STUD, HEX TC, 8/32 HEAD	77068	0U1551J1
A1A2A2XU2	0380-0071	1	INSERT-STUD, HEX TC, 8/32 HEAD	77068	0U1551J1
A1A2A2MISC	1250-0774	1	CONNECTOR-RF BNC 50 OHM	00779	31348-2 OR 9310-1 SERIES
A1A2A2MISC	0360-1715	16	LABEL	28480	0360-1715
A1A2A2MISC	10544-60001	1	HOLDER	28480	10544-60001
A1A2A2MISC	10544-00007	1	PLATE STEEL	28480	10544-00007
A1A2A2MISC	10544-00003	1	BAFFLE	28480	10544-00003
A1A2A2MISC	10544-20007	1	HOUSING BASE AIRSENSOR	28480	10544-20007
A1A2A2MISC	10544-20006	1	HOUSING COVER AIRSENSOR	28480	10544-20006

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
DS1	1460-0167	1	LIGHT IND, LENS CAP, WHT TL LENS	08717	1073X W
DS1	2140-0382	1	LAMP, INCAND, BULB T 1, 5V	08806	555
DS1	2140-0384	1	LAMP, INCAND, BULB T 1 3/4, 10V	28480	2140-0384
DS1	1460-0163	1	LIGHT IND, HOLDER	08717	1026 W BODY
DS2 THRU DS5			NOT ASSIGNED		
DS6 THRU DS9	2140-0468	4	LAMP INCANDESCENT 10V	28480	2140-0468
J1			PART OF A15		
J2			PART OF A15		
J3			PART OF A15		
J4			PART OF A15		
J5			PART OF A15		
J6			PART OF A15		
J7			NOT ASSIGNED		
MP1	0960-0156	1	MAGNETIC TRANSDUCER	28480	0960-0156
P1	05510-20017	1	RIBBON/BLANK PC	28480	05510-20017
S1			TELEVISION DISPLAY) PART OF A15,		
S2 (F) (C)	3101-0182	1	SWITCH, TGL, SPDT 5A/125VAC	09353	7101
S3 (OPEN DISPSCAN)	3101-0850	1	SWITCH, TGL, SPDT 2A/250VAL/DC	09353	7107P
S4 (AUTO MANUAL)	3101-1804	1	SWITCH, TGL, DPDT 2A/250VAC	09353	7316 PRI
S5 (WATT COEFF)	3100-3017	1	SWITCH-PUSHBUTTON	28480	3100-3017
S6 (OFF)	3101-0438	4	SWITCH, PB 1-STA MICT SPST	28480	3101-0438
S6 MISC	3131-0454	4	LENS,CAP,WHITE PLASTIC(7 PARTS)	28480	01-4551-4
S7 (F1)	3101-0438		SWITCH, PB 1-STA MICT SPST	28480	01-151
S7 MISC	3131-0454		LENS,CAP,WHITE PLASTIC(7 PARTS)	28480	01-4551-4
S8 (F2)	3101-0438		SWITCH, PB 1-STA MICT SPST	28480	01-151
S8 MISC	3101-0454		LENS,CAP,WHITE PLASTIC(7 PARTS)	28480	01-4551-4
S9 (F3)	3101-0438		SWITCH, PB 1-STA MICT SPST	28480	01-151
S9 MISC	3131-0454 6		LENS,CAP,WHITE PLASTIC(7 PARTS)	28480	01-4551-4
W1	5062A-1062	1	CABLE ASSY	28480	5062A-1062
W2	8120-0101	1	CABLE, SPLD 3-COND 20AWG	28480	8120-0101
W3	05510-60021	1	CABLE ASSY,FRONT PANEL	28480	05510-60021
XA1A	1251-4331	1	CONNECTOR, PC EDGE, 22-CONT, SOLDER EYE	71785	251-22-30-161
			MISCELLANEOUS PARTS		
	0370-1097	1	KNOB, BASE, PTR, .5 DM, .06A, SGL LEGAL (SENSOR DISPLAY)	28480	0370-1097
	0403-0151	1	GUIDE, PC BOARD, 1 L .75 W LEXAN	28480	0403-0151
	0403-0157	1	GUIDE, PC BOARD, 1 L .75 W LEXAN	28480	0403-0157
	0403-0153	2	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0153
	0403-0154	4	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0154
	0403-0155	1	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0155
	0403-0156	1	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0156
	0403-0157	1	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0157
	0403-0158	1	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0158
	0403-0159	1	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0159
	0403-0160	11	GUIDE, PC BOARD, 1 L .25 W LEXAN	28480	0403-0160
	5003-8915	2	COVER,SIDE	28480	5003-8915
	5060-0703	2	FRAME ASSY,6 X 11 SN	28480	5060-0703
	5060-8917	2	COVER,TOP	28480	5060-8917
	05510-20017	1	FRAME,REAR PT, GRAY	28480	05510-20017
	05510-00016	1	PANEL,REAR	28480	05510-00016
	05510-00002	1	PANEL,FRONT	28480	05510-00002
	05510-00003	1	SUPPLY,SPACER BOARD	28480	05510-00003

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	05510-00004	1	MOUNTING EAR, LARGE	28480	05510-00004
	05510-00005	1	MOUNTING EAR, SMALL	28480	05510-00005
	05510-00006	1	MOUNTING EAR CENTER	28480	05510-00006
	05510-00008	1	PADDLE LOCK CAP	28480	05510-00008
	05510-00012	1	CENTERPEAK PANEL	28480	05510-00012
	05510-20025	1	PANEL THUMBWHEEL	28480	05510-20025
	0360-0113	4	SCREW MACHINE	28480	0360-0113
	0360-0688				

See introduction to this section for ordering information

Table 6-3. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
01121	ALLEN BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
03296	NYLON MOLDING CORP	SPRINGFIELD NJ	07081
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
05406	INDUSTRIAL ELECTRONIC ENGINEERS INC	VAN NUYS CA	91405
05574	VIKING INDUSTRIES INC	CHATSWORTH CA	91311
06540	AMATOM ELEK HARDWARE DIV OF MITE	NEW ROCHELLE NY	10802
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
08717	SLOAN CO THE	SUN VALLEY CA	91352
08806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND OH	44112
09353	C AND K COMPONENTS INC	WATERTOWN MA	02172
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
19701	MEPCO/ELECTRA CORP (MF RES)	MINERAL WELLS TX	76067
20940	MICRO-OHM CORP	EL MONTE CA	91731
24226	CORANDA ELECTRONICS CORP	CORANDA NY	13070
24546	CORNING GLASS WORKS (C STYLE RES)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP (VAR RES)	SAN DIEGO CA	92121
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71279	CAMBRIDGE THERMIONIC CORP	CAMBRIDGE MA	02138
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VILLAGE IL	60007
72136	ELECTRO MOTIVE MFG CO INC	WILLIMANTIC CT	06226
73168	FENWAL INC	ASHLAND MA	01721
80207	UNIMAX SWITCH CORP (MAXIM-MAXSON SUB	WALLINGFORD CT	06492
81312	WINCHESTER ELEK DIV LITTON IND INC	OAKVILLE CT	06779
91506	AUGAT INC	ATTLEBORO MA	02703

BACK DATING MANUAL CHANGES

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to apply to older instruments.

7-3. MANUAL CHANGES

7-4. This manual applies directly to Model 5510A Automatic Compensators with serial prefix 2044A. Refer to paragraph 1-6 for serial number identification. For newer instruments, change sheets are used to update the manual. For older instruments, this section provides backdating information.

7-5. Newer Instruments

7-6. As production changes are made, newer instruments may have serial prefixes above 2044A. The manual for these instruments is supplied with manual change sheets which contain the required updating information. If the change sheets are missing, contact the nearest HP Sales and Service Office listed at the back of this manual.

7-7. Older Instruments

7-8. To adapt this manual to instruments having serial prefixes below 2044A, refer to Table 7-1 for backdating changes that apply to your instrument serial prefix.

Table 7-2. Backdating Changes

If Your Instrument Has Serial Prefix or Serial Number	Make the Following Changes to Your Manual
1128A	3-10
1136A	3-18
1204A	3-17
1216A	3-16
1228A	3-15
1232A	3-14
1312A	3-13
1408A	3-12
1536A	3-11
1728A	3-10
1912A	3-9
1940A serial numbers up to 01102	3-8
1940A serial numbers 01102, 01103, 01105, 01106, 01108, 01109, 01111, 01118, 01119	3-7
1948A	3-6
2008A serial numbers up to 01221	3-5
2008A serial numbers 01121 to Serial Prefix 2020A	3, 4
2020A	3
10563A-1812 (A17A1)	2
10564-A-1812 (A18A1)	1

CHANGE 1

Page 6-18, Table 6-2, A18A1 Replaceable Parts:
Change A18A1C2 thru A18A1C5 to 0180-0228, CAPACITOR-FXD, 22UF +10% 15VDC TA, 56289, 150D226X9015B2.
Change A18A1R1, A18A1R2, A18A1R7 and A18A1R8 to 0683-1005, RESISTOR-FXD, 10 OHM 5% .25W CC TUBULAR, 01121, CB1005.

Page 8-30, Figure 8-22, A18 Schematic:
Change A1C2 thru A1C5 to 22UF.
Change A1R1, A1R2, A1R7 and A1R8 to 10 ohms.

CHANGE 2

Page 6-17, Table 6-2, A17A1 Replaceable Parts:
Change A1C1 thru A1C4 to 0180-0228, CAPACITOR-FXD, 22UF ±10% 15VDC TA-SOLID, 56289, 150226X9015B2.
Change A1R2 thru A1R5 to 0683-1005, RESISTOR-FXD, 10 OHMS 5% .25W CC TUBULAR, 01121, CB1005.

CHANGE 3

Page 6-5, Table 6-2, Replaceable Parts:
Change A1C3 and A1C4 to 0170-0024, 2, Capacitor, Fxd, 022UF+-#20%, 200WVDC, 56289, 202P2302.
Change A1R10 and A1R11 to 0683-0335, Resistor, Fxd, 3.3 ohm, 5%, .25W CC, 01121, CB3305.
Change A1U3 to 1826-0011, IC, LIN, Voltage, 07263, 741M.
Change A1U4 to 1820-0277, IC, LIN, VOLTAGE, 04713, MC1460R.
Delete A1Q3 and A1Q4.

Page 8-7, A1 Voltage Reference Assy Schematic Diagram:
Replace schematic diagram with Figure 7-4.

CHANGE 4

Units before 2020A did not have the standoff added to the back of the front panel to hold the A13 board in place. Prior to this change, the rotary switch assembly was used to mount the board to the front panel.

Page 6-21, Table 6-2, Replaceable Parts:
Delete 2360-0113, 1, Screw Machine 6-32 X .25.

CHANGE 5

Page 1-2, Table 1-1, 5510A Specifications:
Under SENSORS, Air Temperature:
Delete Option 002 cable 14 metres (46 feet).

Under Material Temperature Sensor:
Delete the optional cables 10563A Opt 002 and 003.

CHANGE 6

Page 8-25, Figure 8-15, A9 Control Board Schematic:
Change U13 to 1820-0908, MC7479P.
Change board series number to 1940A.

Page 6-13, Table 6-2, Replaceable Parts:
Change U13 to 1820-0908, IC Dual D, 04713, MC7479P.

Page 1-1:
Delete paragraphs 1-9a and 1-9b and replace with:

1-9a. OPTION 010

1-9b. Option 010 consists of the 5510A plus a cable for interfacing with the 5501A Laser Transducer System. Cable 5080S-61082 interfaces with the 5510A and the 10765A Compensation Interface. When using the 5510A Opt 010, the 10740-60005 cable supplied with the 10740A is used to connect the 5510A to ±15 volts via the 10740A Coupler.

Page 1-2, Table 1-1, 5510A Specifications:
Under Sensors, Air Temperature:
Change cable length to 20 metres (65.5 feet). 10563A Option 002 cable length is 4.5 metres (15 ft).

Under Material Temperature Sensor:
Change cable length to 20 metres (65.5 feet). 10563A Option 002 cable length is 4.5 metres (15 ft).

Under Accessories Available:
Change Material Temperature Assy Description to:

1. Material Temperature Assembly 10563A (includes 20 metre (65.5 feet) cable). 10563A Option 002 includes 4.5 metre (15 feet) cable.
2. High Accuracy Material Temperature Sensor, 10563A Option 001 (includes 20 metre (65.5 feet) cable.

CHANGE 7

For this prefix and below, the 10563A was supplied as a standard item with the 5510A.

Page 1-1, Paragraph 1-9:
Change to read: "The compensator is supplied with one material temperature sensor, one air probe, and an interconnecting cable HP 5062A-16C. No power cable is required as the compensator draws its power from the laser display unit. When permanent records of the compensation factors are required, the HP 5055A Digital Recorder can be added to the HP 5505A Laser Display. For digital recorder interconnecting information, refer to the Laser Measurement System Manual. Two additional material temperature sensors are available as options.

Page 1-2, Table 1-1, 5510A Specifications:
Under SENSORS, AIR TEMPERATURE, change cable length to 15 ft. Delete Option 002.

Under Material Temperature Sensor, add "one supplied with the 5510A. Change cable length to 15 feet."

Under Accessories Available, Material Temperature Assembly change cable length to 15 feet.

Page 1-1:
Delete paragraphs 1-9a and 1-9b.

CHANGE 8

Some units in this serial prefix range had a blank no. 24 added between J5 pins 1, 26 and A15P1 pin 1. These boards were in the series 1948A.

CHANGE 9

Page 6-20, Table 6-2, Replaceable Parts:
Add L2, 9140-0137, Coil, Fxd, Molded RF Choke, 1MH, 5%, 24226, 10-101
Add J8, 05510-60019, Integrator Bus Assy, 28480, 05510-60019.

Page 6-12, Table 6-2, Replaceable Parts:
Delete A9C11 thru A9C19.

Page 6-13, Table 6-2, Replaceable Parts:
Delete A10C1 thru A10C7.

Page 6-14, Table 6-2, Replaceable Parts:
Delete A11C3 thru A11C13.
Change A11U9 thru A11U11 to 1820-0911, IC, TTL DECADE, 01295, SN74L192N.
Change A11U12 to 1820-0912, IC, TTL 4-Bit, 01295, SN74L193N.

Page 6-15, Table 6-2, Replaceable Parts:
Delete A12C2 thru A12C10.

Page 8-25, Figure 8-15, A9 Schematic Diagram:
Change series number to 1284A.

Delete A9C11 thru A9C19.

Page 8-27, Figure 8-16, A10 Schematic Diagram:
Change series number to 1120A.
Delete A10C1 thru A10C7.

Page 8-20, Figure 8-17, A11 Schematic Diagram:
In Table of Active Elements, change U9-11 to 1820-0911, SD10743. Change U12 to 1820-0912 SD10744.

Change series number to 1228A.

Delete A11C3 thru A11C13.

Page 8-31, Figure 8-18, A12 Schematic Diagram:
Change series number to 1228A.
Delete A12C2 thru A12C10.

Page 8-15, Figure 8-16, A4 Schematic Diagram:
Change series number to 1216A for A16. On A16, delete L1 and L2 and replace with straight-thru connections. Move L1 and L2 off the board in series with the black wire (L1) and the WHT (L2) wire respectively.

CHANGE 10

Page 6-20, Table 6-2, Replaceable Parts:
For S6 thru S9, change the part number to 3101-1805, Switch, PB, 1-Station, SPST, 80207, 01-151.
Change S6 thru S9 Misc to 3101-1806 to 3101-1806, Lens Cap, White, 80207, 01-951W.

For DS6 thru DS9, change part number to 2140-0384, Lamp Incandescent 10V, 28480, 2140-0384.

CHANGE 11

Page 6-8, Table 6-2, A5 Replaceable Parts:
Change A5R4 to 0757-0827, RESISTOR-FXD, 2K 2% .125W F TUBULAR, 24546, C4 1/8-TO-1601-G.

Page 6-13, Table 6-2, A9 Replaceable Parts:
Change A9U1 to 1820-0586, INTEGRATED CIRCUIT, DGTL, TTL, LP HEX, 27014, DM74L04N.

Page 8-17, Figure 8-11, A5 Schematic:
Change R4 to 2000.
Change Series Number to 1128A.

Page 8-25, Figure 8-15, A9 Schematic Diagram:
In list of Active Elements, change U1 to 1820-0586, DM74L04N.

CHANGE 12

Page 6-5, Table 6-2:
Add: A1C8/0140-0196/3/CAPACITOR-FXD, 150 PF ±5% 300WVDC/72136/ DM15F151J0300WVICR.
Add: A1C9/0140-0196/1/CAPACITOR-FXD, 150PF ±5% 300WVDC/72136/ DM15F151J0300WVICR.
Change: A1U3 from 1826-0011 to 1820-0277/INTEGRATED CIRCUIT, LIN, VOLTAGE/ 04713/MC1460R.

Page 6-17, Table 6-2:
Change: A17A1C5, A17A1C6, A17A1C7, A17A1C8 from Part No. and Mfr. No. 0160-3870 to 0160-3277.

Page 6-18, Table 6-2:
Change A18A1C6, A18A1C7, A18A1C8, A18A1C11, A18A1C12 Part No. and Mfr. No. from 0160-3870 to 0160-3277.

Page 8-9, Figure 8-7:

Mark page 8-9, Figure 8-7 and photo as OBSOLETE and insert Figure 7-4 of this section in front of page 8-9 as its replacement.

CHANGE 13

Page 6-19, Table 6-2:
Change A18A2A2R1 to 47 Meg, 0698-8217, RESFXD 47M 5%CC 0.125W 01121, BB4765.

Page 8-39, Figure 8-23:
Change A18A1A2 Assembly R1 to 47 Meg from 22 Meg.

CHANGE 14

Page 6-20, Table 6-1, Chassis Parts:
Change DS1 from 2140-0384 to 2140-0058.
Change S6, S7, S8, and S9 from 3101-1805 to 3101-0715.
Change MISC items for S6, S7, S8, S9 from 3101-1806 to 3101-1317.
Change 05510-00016 to 05510-00001.
Change W3 from 05510-60021 to 05510-60017.

CHANGE 15

Page 6-12, Table 6-1:
Change A7U15 from 1820-0660 to 1820-0086, Mfr Code 27014, Mfr Part No. DM86L75N.

Page 6-14, Table 6-1:
Change A11U9,10,11 from 1820-0911 to 1820-0546, Mfr Code 28480, Mfr Part No. 1820-0546.
Change A11U12 from 1820-0912 to 1820-0233, Mfr Code 01295, Mfr Part No. SN74193N.
With these changes, A11 board series number is 1128A.

Figure 8-17:
Change board series number to 1128A.
Change Table of Active Elements to: U9-11, 1820-0546, U12, 1820-0233.

CHANGE 16

Page 6-12, Table 6-1:
Replace A9 parts lists with Table 7-2.

Figure 8-15:
Replace A9 schematic with Figure 7-3.

Page 6-15, Table 6-1:
Replace A12 parts list with Table 7-3.

CHANGE 17

Figure 8-13:
Delete A7R32 1000 ohm resistor. Indicate tht Q6 collector connects directly to pin B.

Page 6-11, Table 6-1:
Delete A7R32.

CHANGE 18

Page 7-3, Table 7-2:
Change A9U4 from 1820-0585 to 1820-0583, Mfr Code 12040, Mfr Part No. DM74L00N.

Page 6-20, Table 6-1, Chassis Parts:
Delete L1 and L2.

Figure 8-10:
At left side of schematic, delete L1 and L2. In Reference Designations table, delete L1 and L2.

CHANGE 19

Page 7-3, Table 7-2:
Delete A9C10.
Change A9C7 to 0140-0198, C:FXD MICA 200 PF, 5% 28480, 0140-0198.
Change A9R15 to 0757-0948, R:FXD FLM 10K OHM 2% 1/8W, 28480, 0757-0948.
Change A9R16 to 0757-0952, R:FXD FLM 15K OHM 2% 1/8W, 28480, 0757-0952.

Page 6-19, Table 6-1:
Delete A18A2A2R1.

Page 7-5, Figure 7-1:
Change R16 to 15K.
Change R15 to 10K.
Change C7 to 200 PF.
Delete C10.

Figure 8-22, Air Probe Assy:
Delete A18A1A1R1 47 MEG OHM resistor.

The following changes were in some units with Serial Prefix 1128A.

Page 7-3, Table 7-2:
Change A9C9 to 0160-0104, CAPXD MYLAR 0.015 uF 10%, 56289, 192P153X9-PTS.
Change A9U13 and A9U14 to 1820-0586, Mfr Code 12040, Mfr Part No. DM741.74N.
Change A9U17 and A9U26 to 1820-0585, Mfr Code 12040, Mfr Part No. DM741.83N.

Page 7-5, Figure 7-1:
Change A9C9 to 0.015 uF.

Table 7-2. Replaceable Parts for A0 Control Board (Series 1128A)

Reference Designation	HP Part Number	Description	Mfr. Code	Mfr. Part Number
A0	05510-60000	CONTROL BOARD ASSY	28480	05510-60000
A0C1	0180-0210	C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A0C2	0180-0229	C:FXD ELECT 33 UF 20% 10VDCW	28480	0180-0229
A0C3	0180-0210	C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A0C4	0140-0176	C:FXD MICA 100 PF 5%	28480	0140-0176
A0C5	0160-0164	C:FXD MICA MY 0.0022 UF 10% 200VDCW	56289	192P22202-PTS
A0C6	0160-0342	C:FXD MICA 800 PF 1% 300VDCW	04062	RDM15F801F3C
A0C7	0160-0342	C:FXD MICA 800 PF 1% 300VDCW	04062	RDM15F801F3C
A0C8	0160-0300	C:FXD MY 0.0027 UF 200VDCW	56289	192P27202-PTS
A0C9	0160-0180	C:FXD MY 0.033 µF 5% 200VDCW	56289	192P33352-PTS
A0C10	0160-0183	C:FXD MICA 130 PF 1% 300VDCW	28480	0160-0183
A0CR1	1901-0040	DIODE:SILICON 30MA 30WV	07263	FDG1088
A0CR2	1901-0040	DIODE:SILICON 30MA 30WV	07263	FDG1088
A0CR3	1901-0040	DIODE:SILICON 30MA 30WV	07263	FGD1088
A0CR4	1901-0040	DIODE:SILICON 30MA 30WV	07263	FGD1088
A0CR5	1901-0040	DIODE:SILICON 30MA 30WV	07263	FDG1088
A0CR6	1901-0040	DIODE:SILICON 30MA 30WV	07263	FDG1088
A0CR7	1820-0225	IC:ZENER DIODE	28480	1820-0225
A0Q1	1854-0210	TST:SI NPN	80131	2N2222
A0R1		PART OF 1810-0055		
A0R2		PART OF 1810-0055		
A0R3		PART OF 1810-0055		
A0R4		PART OF 1810-0055		
A0R5		PART OF 1810-0055		
A0R6	0757-0948	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A0R7		PART OF 1810-0055		
A0R8	0757-0955	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A0R9	0757-0835	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0835
A0R10		NOT ASSIGNED		
A0R11	0757-0948	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A0R12		NOT ASSIGNED		
A0R13	0757-0952	R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A0R14		PART OF 1810-0055		
A0R15	0757-0932	R:FXD FLM 2.2K OHM 2% 1/8W	28480	0757-0932
A0R16	0757-0936	R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936
A0R17	0757-0835	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0835
A0R18	0757-0948	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A0R19	0757-0952	R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A0R20	0757-0948	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A0R21		PART OF 1810-0055		
A0R22		PART OF 1810-0055		
A0R23	0757-0924	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0924
A0R24		PART OF 1810-0055		
A0R25	0757-0952	R:FXD FLM 15K OHM 2% 1/8W	28480	0757-0952
A0R26		PART OF 1810-0055		
A0R27	0757-0948	R:FXD FLM 10K OHM 2% 1/8W	28480	0757-0948
A0R28	0757-0955	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0955
A0U1	1820-0586	IC:TTL LP HEX INVERTER	12040	DM741.04N
A0U2	1820-0584	IC:TTL LP QUAD 2-INPUT NOR GATE	12040	DM741.02N
A0U3	1820-0583	IC:TTL LP QUAD 2-INPUT NAND GATE	12040	DM741.00N
A0U4	1820-0585	IC:TTL LP QUAD 2-INPUT NAND GATE	12040	DM741.03N

Table 7-2. Replaceable Parts for A0 Control Board (Series 1128A)

Reference Designation	HP Part Number	Description	Mfr. Code	Mfr. Part Number
A0U5	1820-0587	IC:TTL, LP TRIPLE 3-INPUT NAND GATE	12040	DM74L10N
A0U6	1820-0583	IC:TTL, LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A0U7	1820-0627	IC:TTL, LP BCD TO DEC. DECODER	07263	U7B03L01650X
A0U8	1820-0660	IC:TTL, LP PRESETT SYNC DEC CNTR	07263	U7B03L10650X
A0U9	1820-0587	IC:TTL, LP TRIPLE 3-INPUT NAND GATE	12040	DM74L10N
A0U10	1820-0586	IC:TTL, LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A0U11	1820-0586	IC:TTL, LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A0U12	1820-0586	IC:TTL, LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A0U13	1820-0077	IC:TTL	01295	SN7474
A0U14	1820-0077	IC:TTL	01295	SN7474
A0U15	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U16	1820-0875	IC:TTL, MONOSTABLE MV	07263	960050
A0U17	1820-0260	IC:TTL	01295	SN7403N
A0U18	1820-0588	IC:TTL, LP 4-INPUT NAND GATE	12040	DM74L20N
A0U19	1820-0583	IC:TTL, LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A0U20	1820-0585	IC:TTL, LP QUAD 2-INPUT NAND GATE	12040	DM74L03N
A0U21	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U22	1820-0501	IC:TTL, LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N
A0U23	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U24	1820-0627	IC:TTL, LP BCD TO DEC. DECODER	07263	U7B03L01650X
A0U25	1820-0583	IC:TTL, LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A0U26	1820-0260	IC:TTL	01295	SN7403N
A0U27	1820-0583	IC:TTL, LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A0U28	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U29	1820-0627	IC:TTL, LP BCD TO DEC. DECODER	07263	U7B03L01650X
A0U30	1820-0586	IC:TTL, LP HEX INVERTER	12040	DM74L04N
A0U31	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U32	1820-0585	IC:TTL, LP QUAD 2-INPUT NAND GATE	12040	DM74L03N
A0U33	1820-0583	IC:TTL, LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A0U34	1820-0586	IC:TTL, LP HEX INVERTER	12040	DM74L04N
A0U35	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U36	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U37	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U38	1820-0581	IC:TTL, LP QUAD 2-INPUT NOR GATE	12040	DM74L02N
A0U39	1820-0586	IC:TTL, LP HEX INVERTER	12040	DM74L04N
A0U40	1820-0501	IC:TTL, LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N
A0 MISC	0340-0756	EXTRACTOR:PC BOARD, WHITE	28480	0340-0756

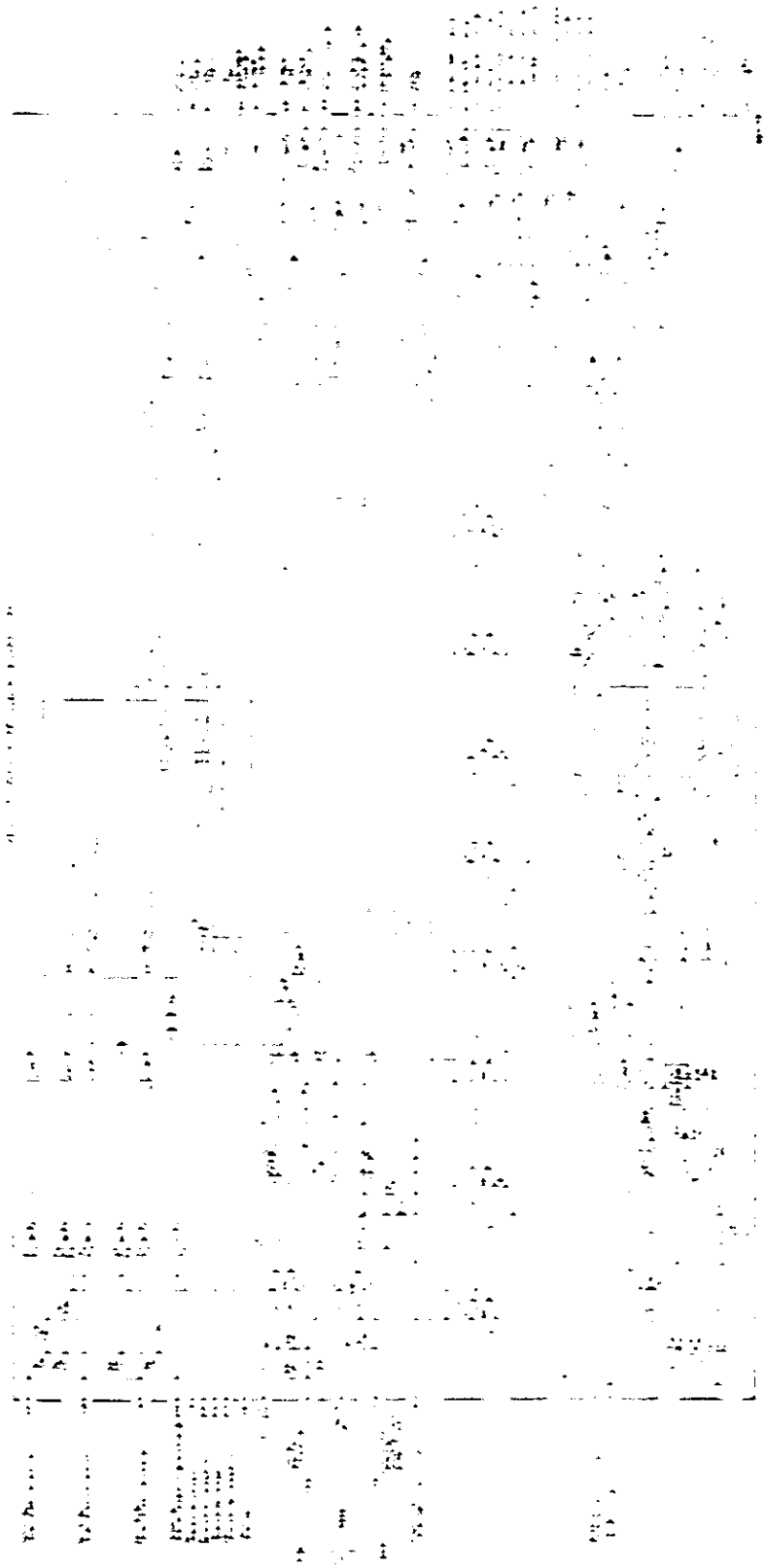


Figure 7-1. A9 Control Board Assembly

Table 7-3. Replaceable Parts for A12 Interface Driver (Series 1128A)

Reference Designation	HP Part Number	Description	Mfr. Code	Mfr. Part Number
A12	05510-60012	INTERFACE DRIVER ASSY	28480	05510-60012
A12C1	0180-0374	C:FXD TANT 10 UF 10% 20VDCW	56289	150D106X0020B2-DYS
A12CR1	1901-0028	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A12Q1	1853-0010	TSTR:SI PNP (SELECTED FROM 2N3251)	28480	1853-0010
A12Q2	1853-0010	TSTR:SI PNP (SELECTED FROM 2N3251)	28480	1853-0010
A12Q3	1853-0010	TSTR:SI PNP (SELECTED FROM 2N3251)	28480	1853-0010
A12Q4	1854-0210	TSTR:SI NPN	80131	2N2222
A12R1	0757-0835	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0835
A12R2	0757-0835	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0835
A12R3	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R4	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R5	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R6	0757-0835	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0835
A12R7	0757-0855	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0855
A12R8	0757-0872	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0872
A12R9	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R10	0757-0855	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0855
A12R11	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R12	0757-0872	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0872
A12R13	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R14	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R15	0757-0835	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0835
A12R16	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R17	0757-0855	R:FXD FLM 20K OHM 2% 1/8W	28480	0757-0855
A12R18	0757-0872	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0872
A12R19	0757-0872	R:FXD FLM 100K OHM 2% 1/8W	28480	0757-0872
A12R20	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R21	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R22	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R23	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R24	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R25	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R26	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R27	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R28	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R29	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R30	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12R31	0757-0824	R:FXD MET FLM 1K OHM 2% 1/8W	28480	0757-0824
A12R32	0757-0831	R:FXD FLM 2K OHM 2% 1/8W	28480	0757-0831
A12U1	1820-0054	IC:TTL QUAD 2-INPUT NAND GATE	01295	SN7400N
A12U2	1820-0583	IC:TTL LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A12U3	1820-0583	IC:TTL LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A12U4	1820-0591	IC:TTL LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N
A12U5	1820-0587	IC:TTL LP TRIPLE 3-INPUT NAND GATE	12040	DM74L10N
A12U6	1820-0591	IC:TTL LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N
A12U7	1820-0586	IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A12U8	1820-0586	IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A12U9	1820-0591	IC:TTL LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N
A12U10	1820-0591	IC:TTL LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N
A12U11	1820-0591	IC:TTL LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N

Table 7-3. Replaceable Parts for A12 Interface Driver (Series 1128A)

Reference Designation	HP Part Number	Description	Mfr. Code	Mfr. Part Number
A12U12	1820-0501	IC:TTL LP 4W 3-2-2-3 INPT, AND OR GATE	12040	DM74L54N
A12U13	1820-0586	IC:TTL LP HEX INVERTER	12040	DM74L04N
A12U14	1820-0174	IC:TTL HEX INVERTER	01295	SN7404N
A12U15	1820-0586	IC:TTL LP HEX INVERTER	12040	DM74L04N
A12U16	1820-0586	IC:TTL LP HEX INVERTER	12040	DM74L04N
A12U17	1820-0583	IC:TTL LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A12U18	1820-0583	IC:TTL LP QUAD 2-INPUT NAND GATE	12040	DM74L00N
A12U19	1820-0627	IC:TTL LP BCD TO DEC. DECODER	07263	U7B03L0159X
A12U20	1820-0627	IC:TTL LP BCD TO DEC. DECODER	07263	U7B03L0159X
A12U21	1820-0443	IC:TTL LP 4-BIT BINARY COUNTER	01295	SN74L93N
A12U22	1820-0054	IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12 MISC	4040-0760	EXTRACTOR:PC BOARD, RED	28480	4040-0760
A12 MISC	4040-0756	EXTRACTOR:PC BOARD, WHITE	28480	4040-0756

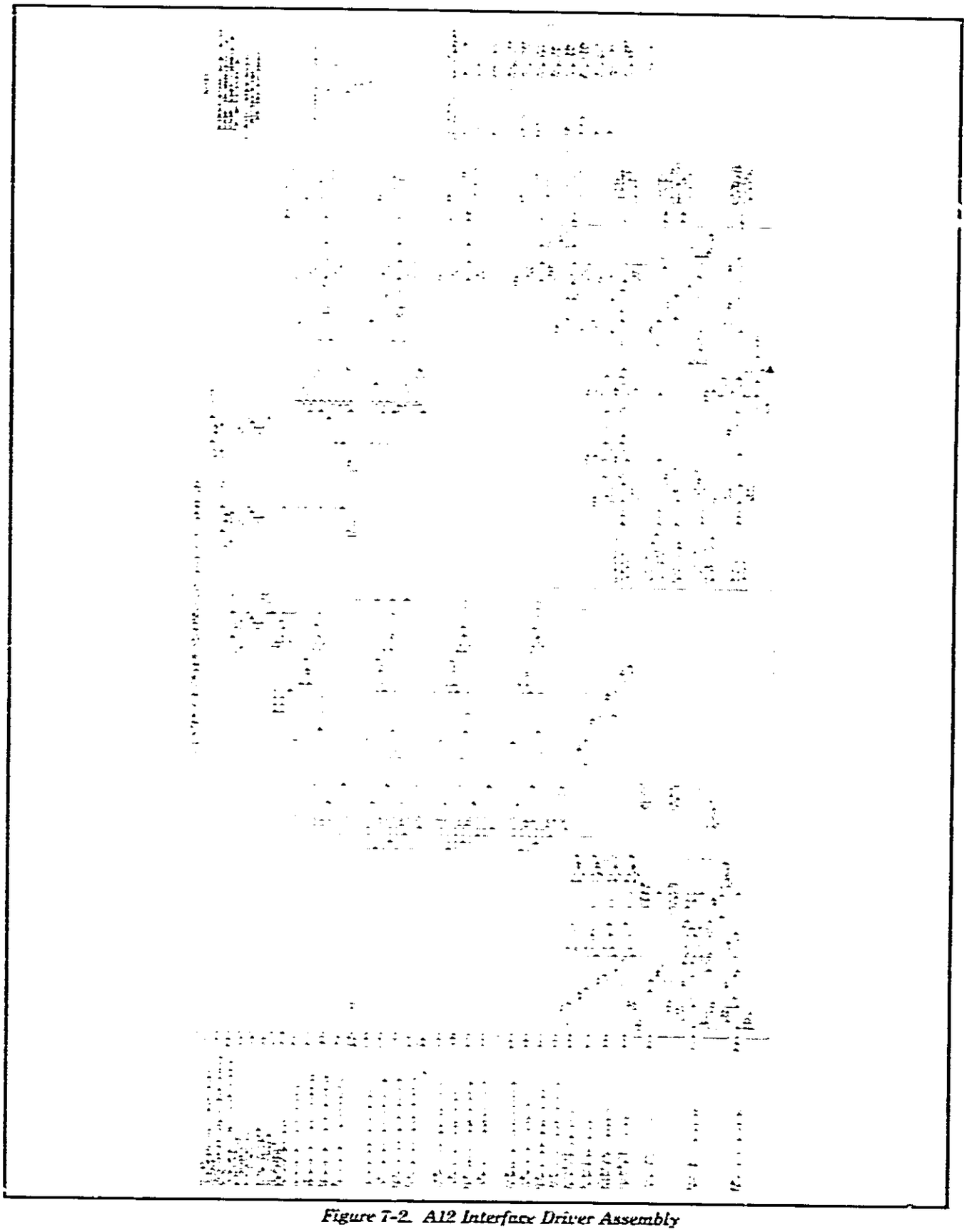


Figure 7-2. A12 Interface Driver Assembly

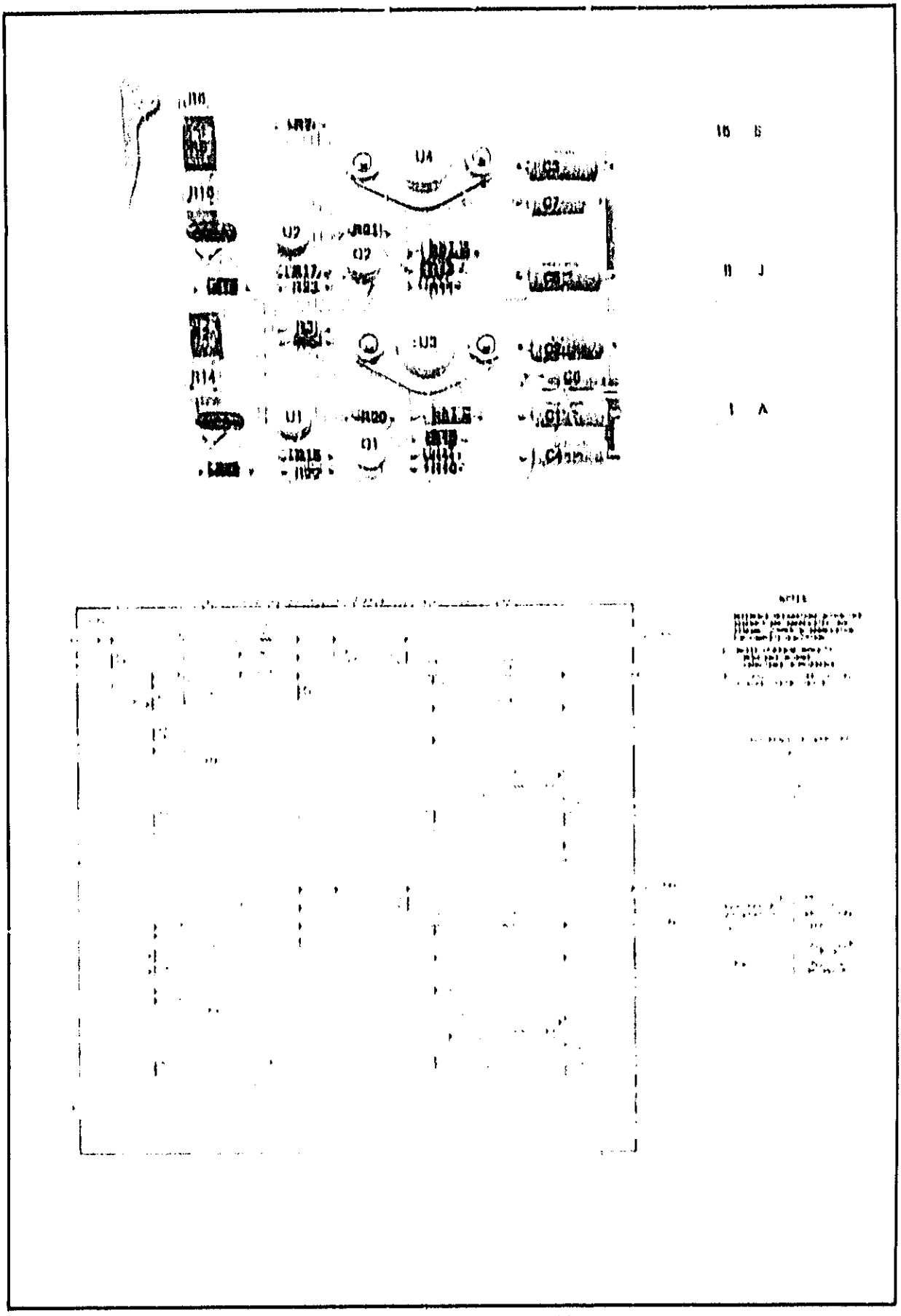


Figure 7-3. A1 Voltage Reference Assembly, Series 1128A

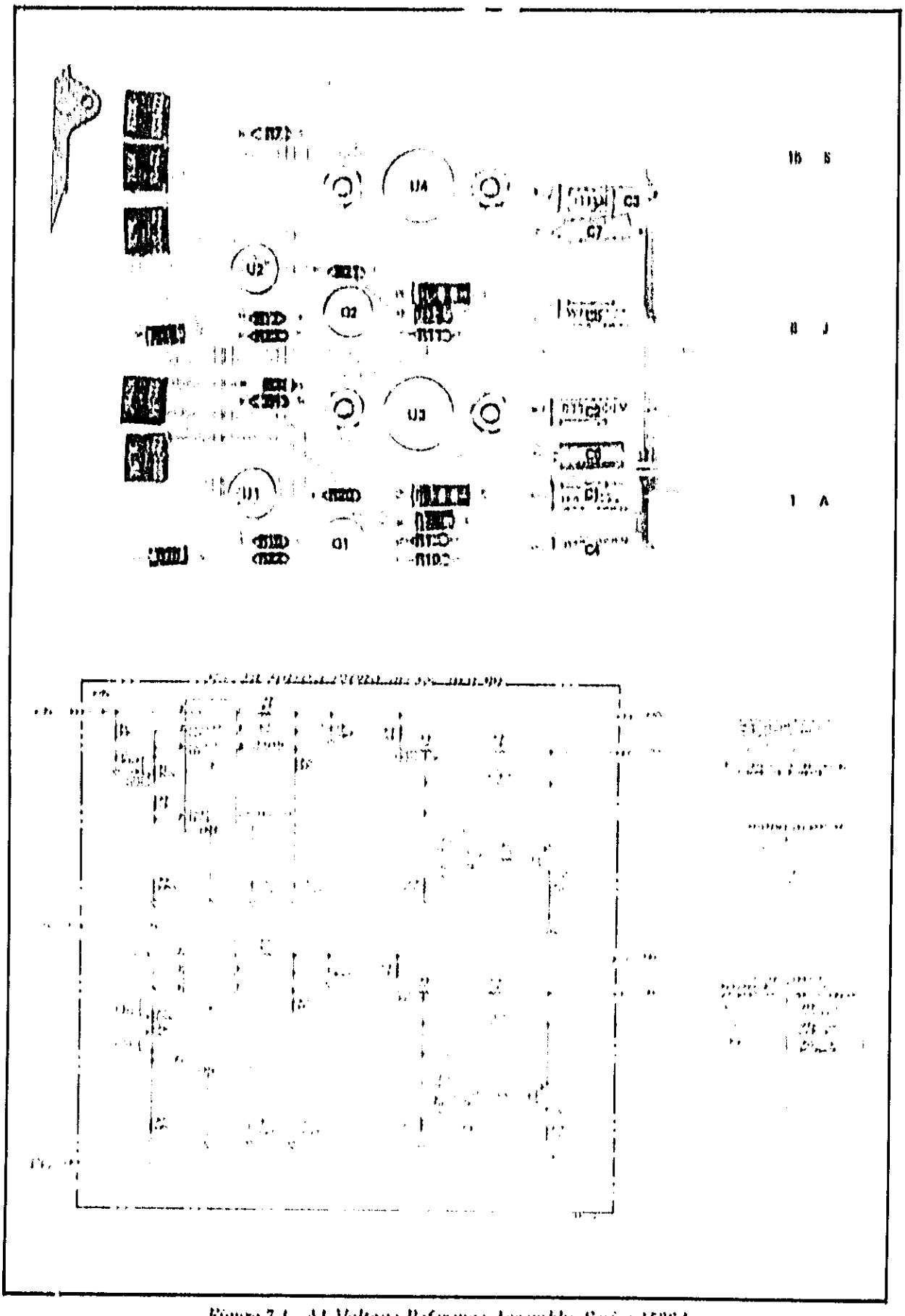


Figure 7-4. A1 Voltage Reference Assembly, Series 1536A

SCHEMATIC DIAGRAMS

SECTION VIII
CIRCUIT DIAGRAMS

8-1. INTRODUCTION

8-2. This section contains the following:

a. Schematic diagrams.

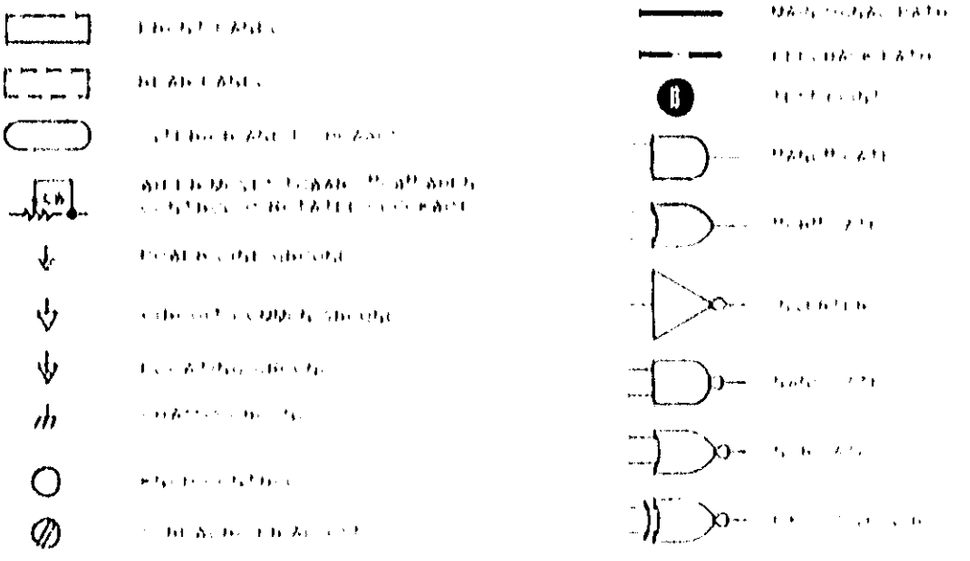
b. Tables of active elements.

c. Component locators.

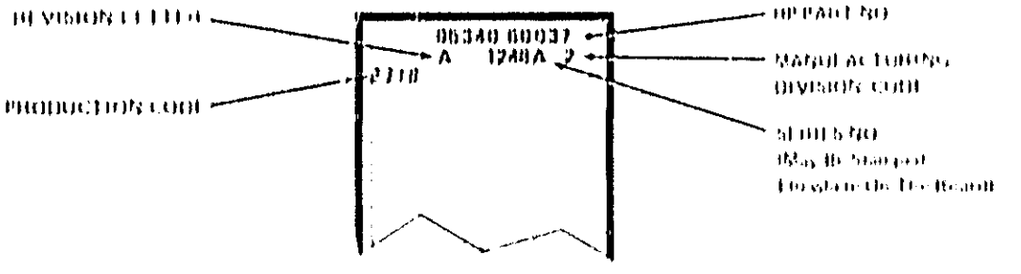
d. Interconnecting information.

Table 8-1. Schematic Diagram Notes

SYMBOLS



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	J4	J4

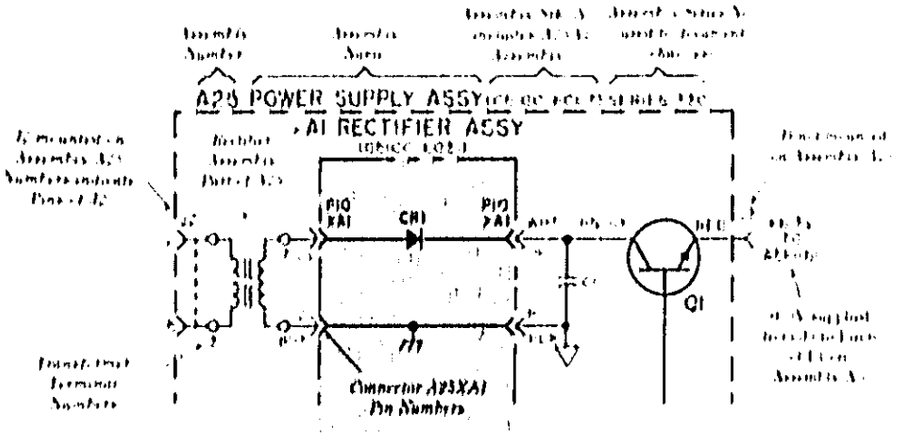


Figure 8-1. Schematic Diagram Notes

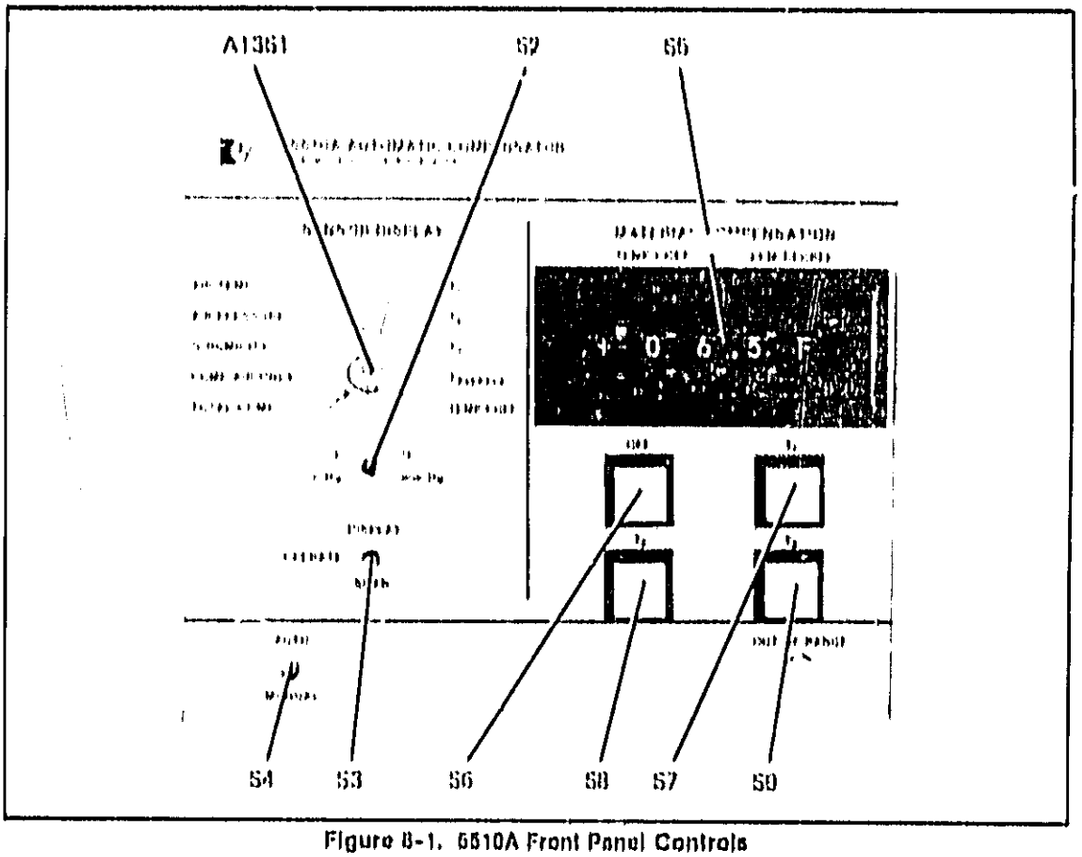


Figure 8-1. 5510A Front Panel Controls

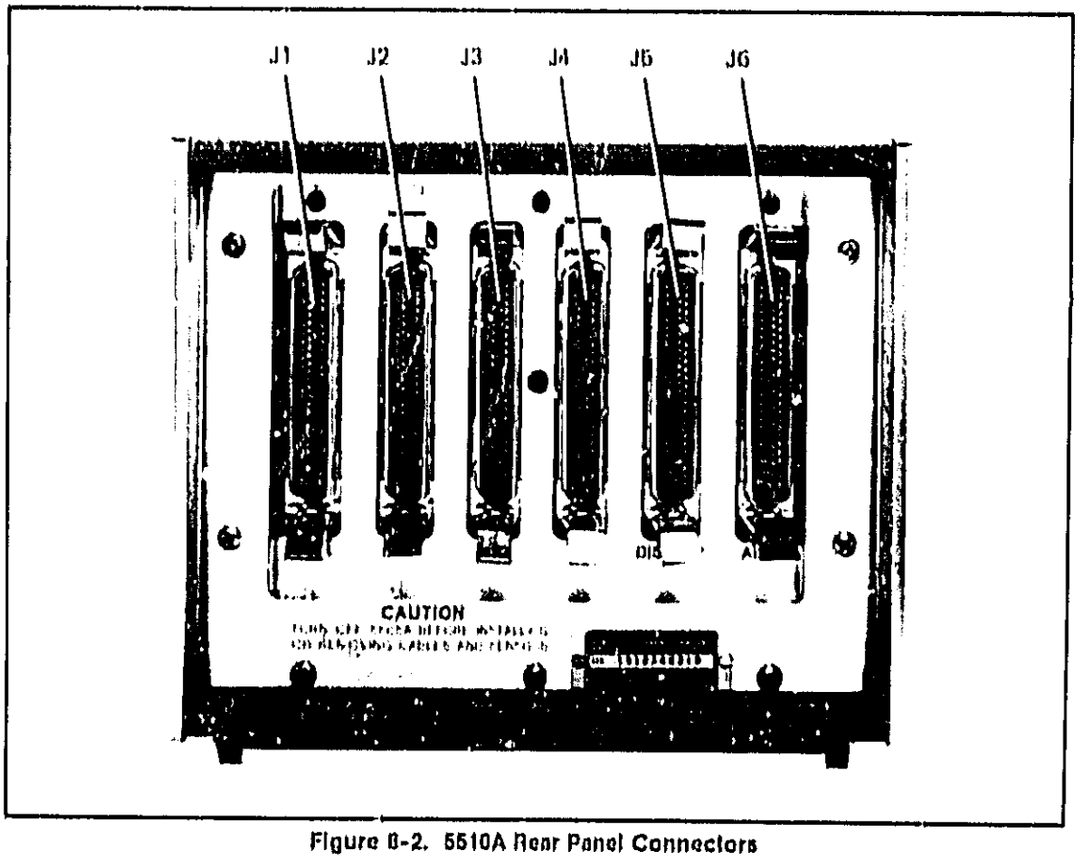


Figure 8-2. 5510A Rear Panel Connectors

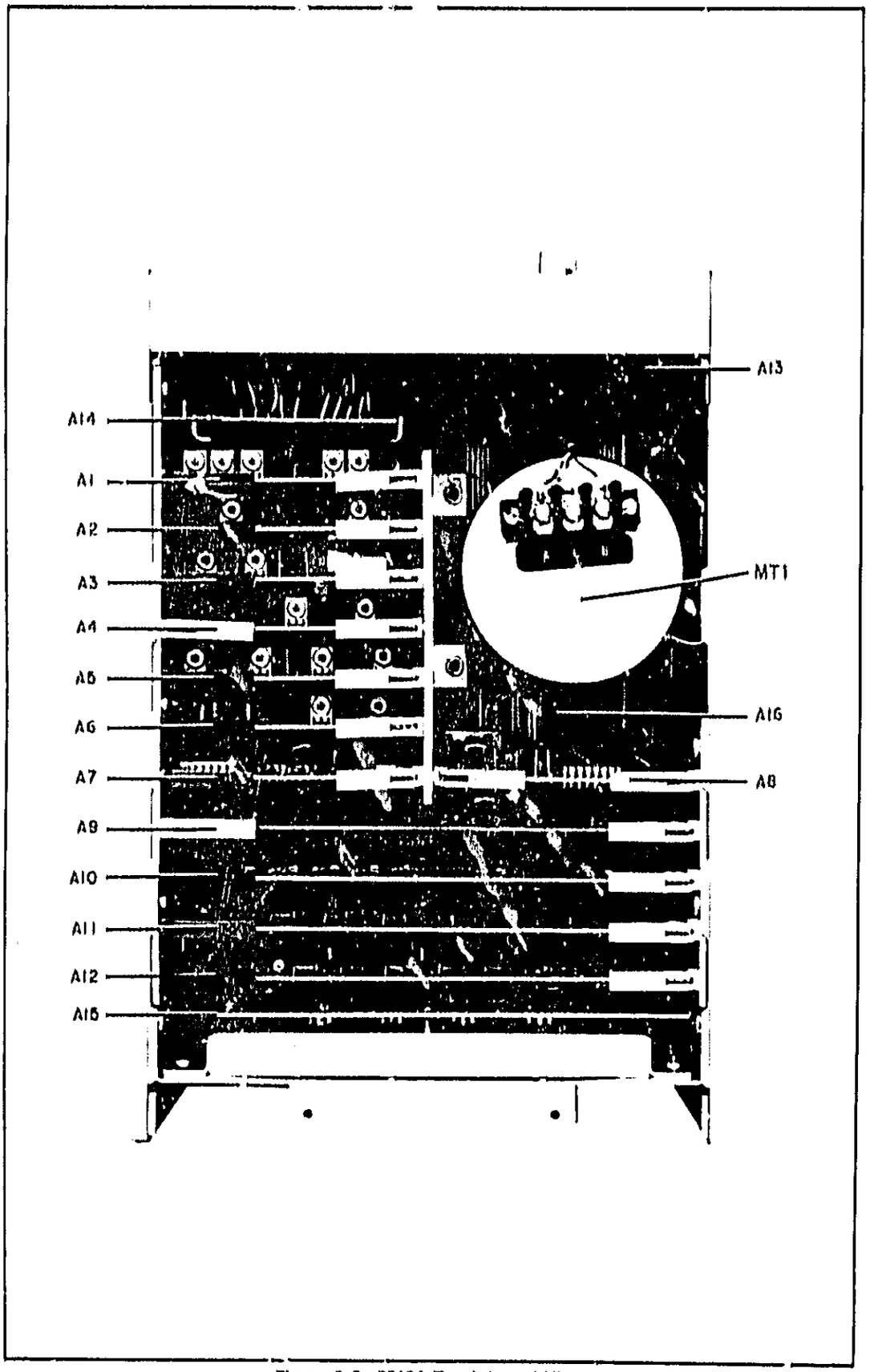


Figure 8-3. 5510A Top Internal View

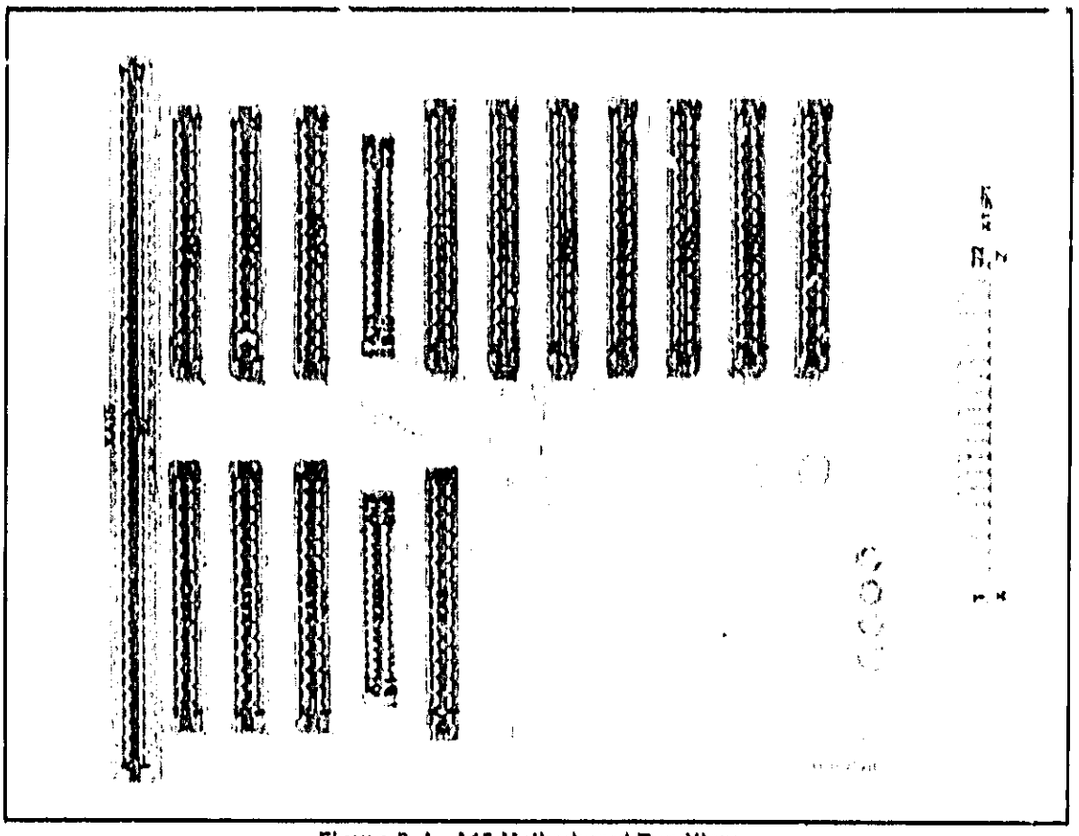


Figure 8-4. A16 Motherboard Top View

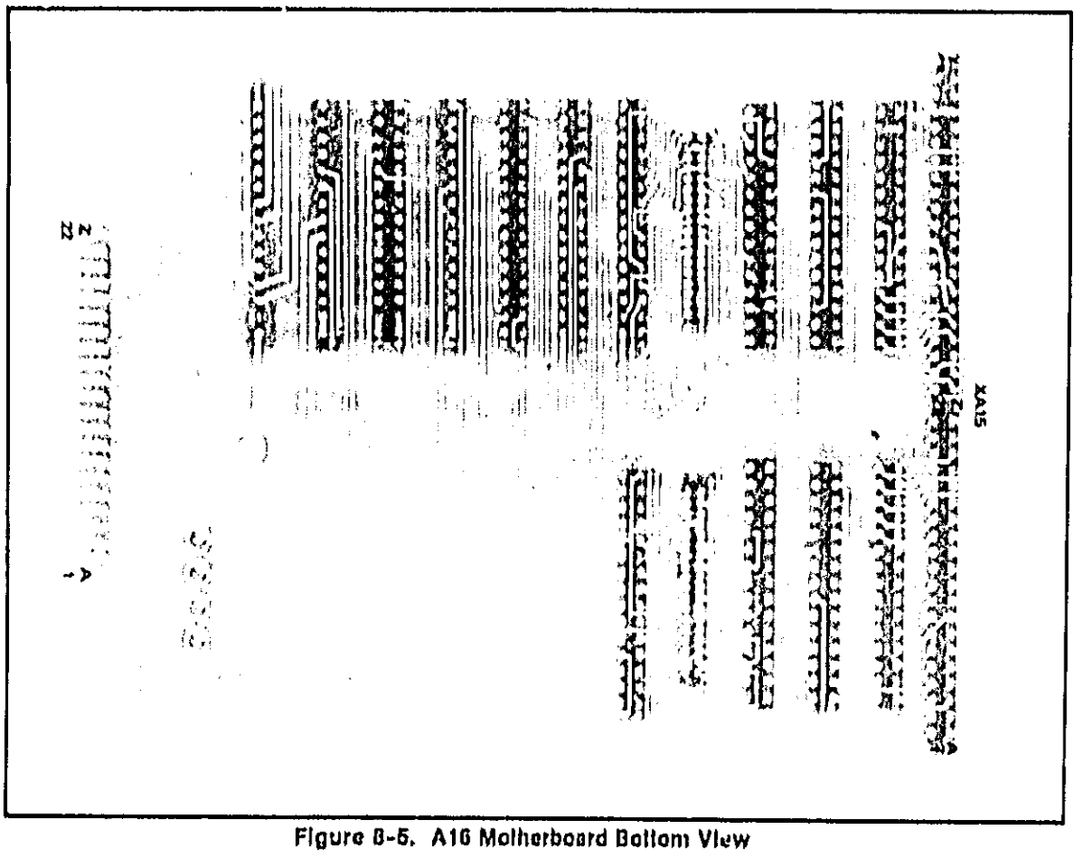


Figure 8-5. A16 Motherboard Bottom View

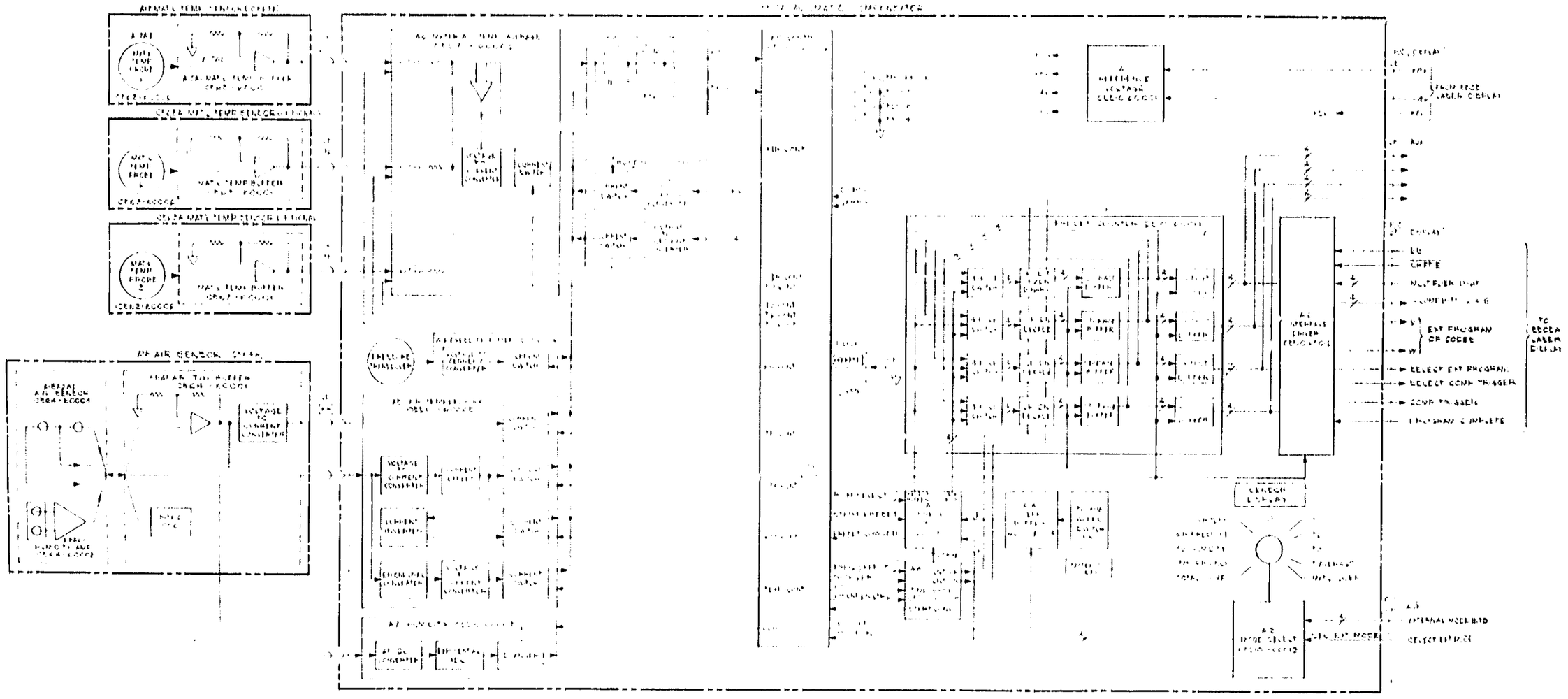
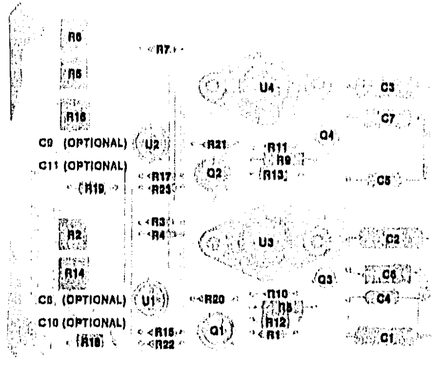


Figure 8-6. 5510A Automatic Compensator, Block Diagram



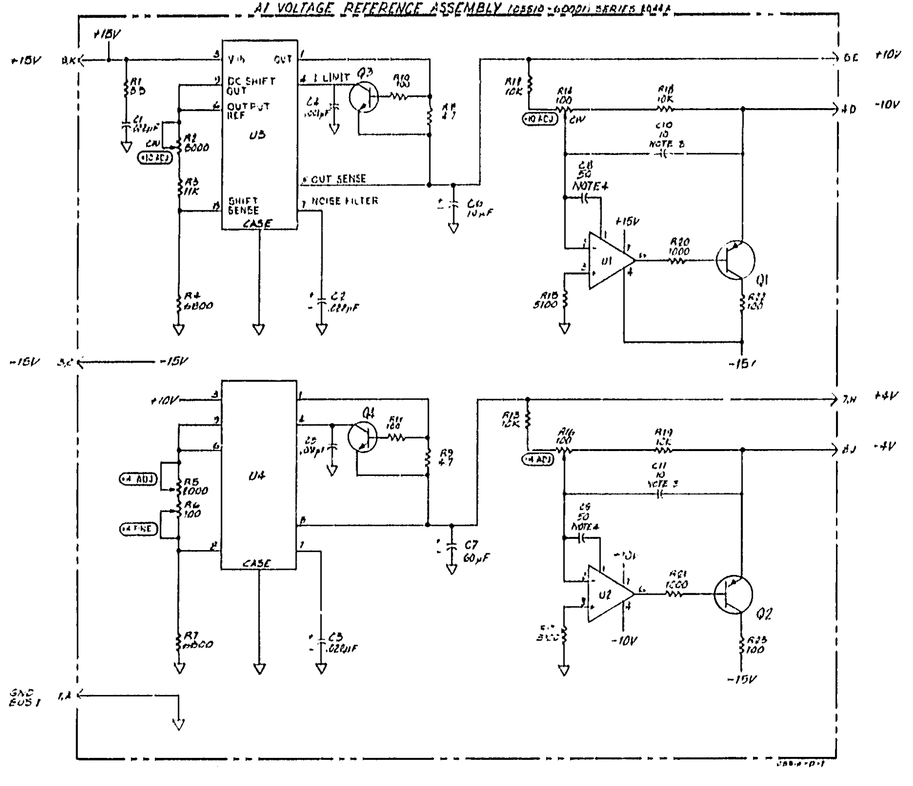
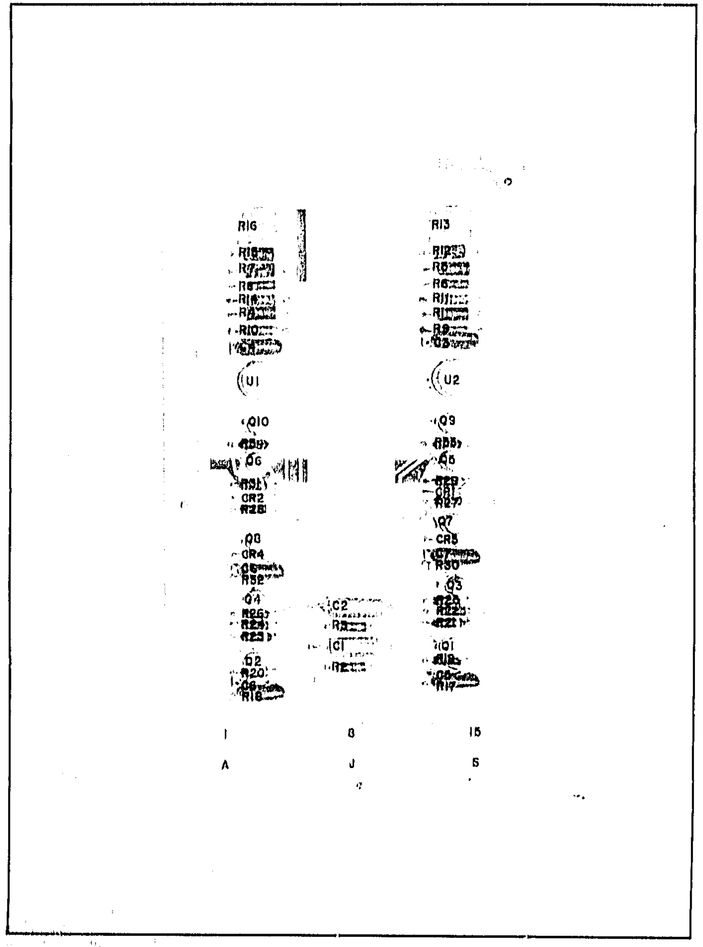
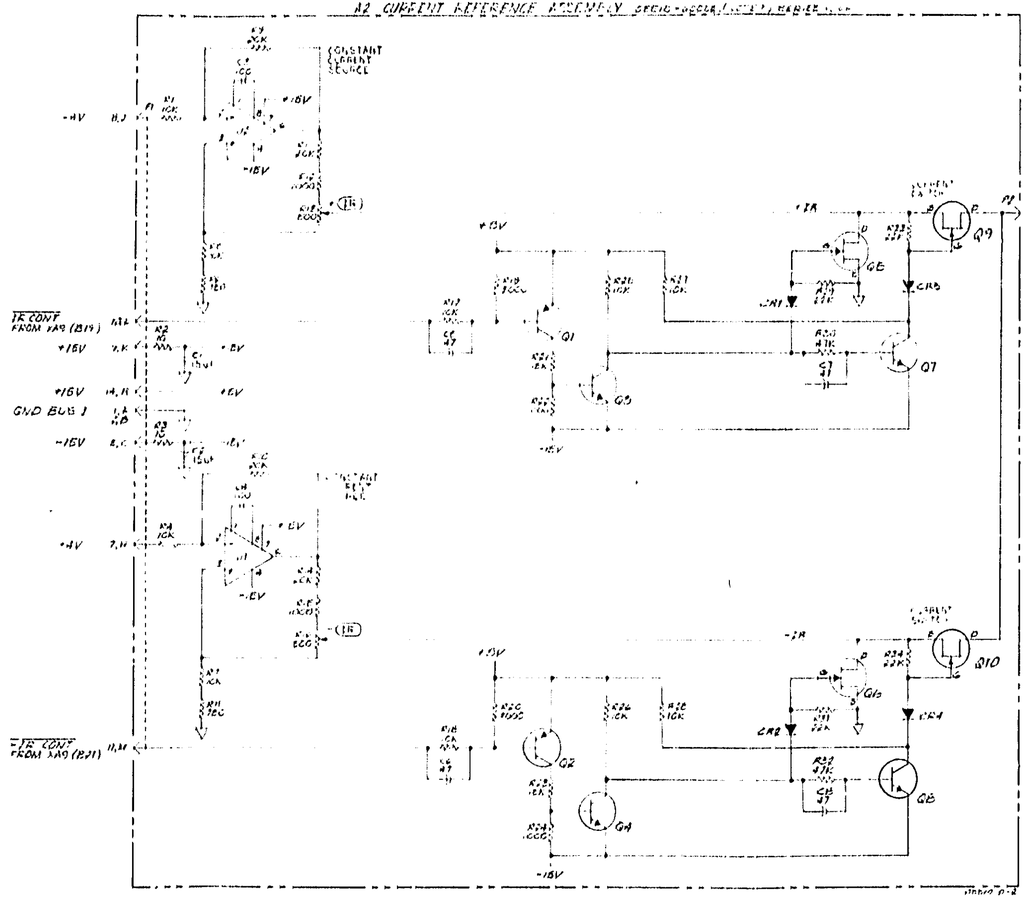


Figure 8-7. A1 Voltage Reference Assembly





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

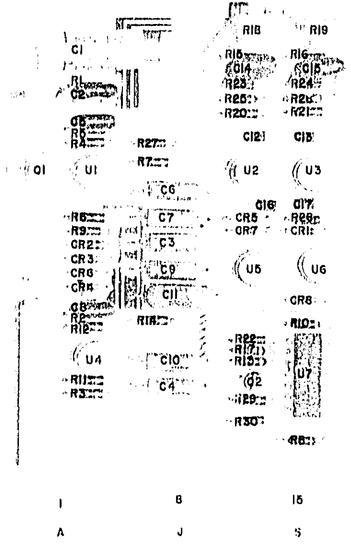
REFERENCE DESIGNATIONS

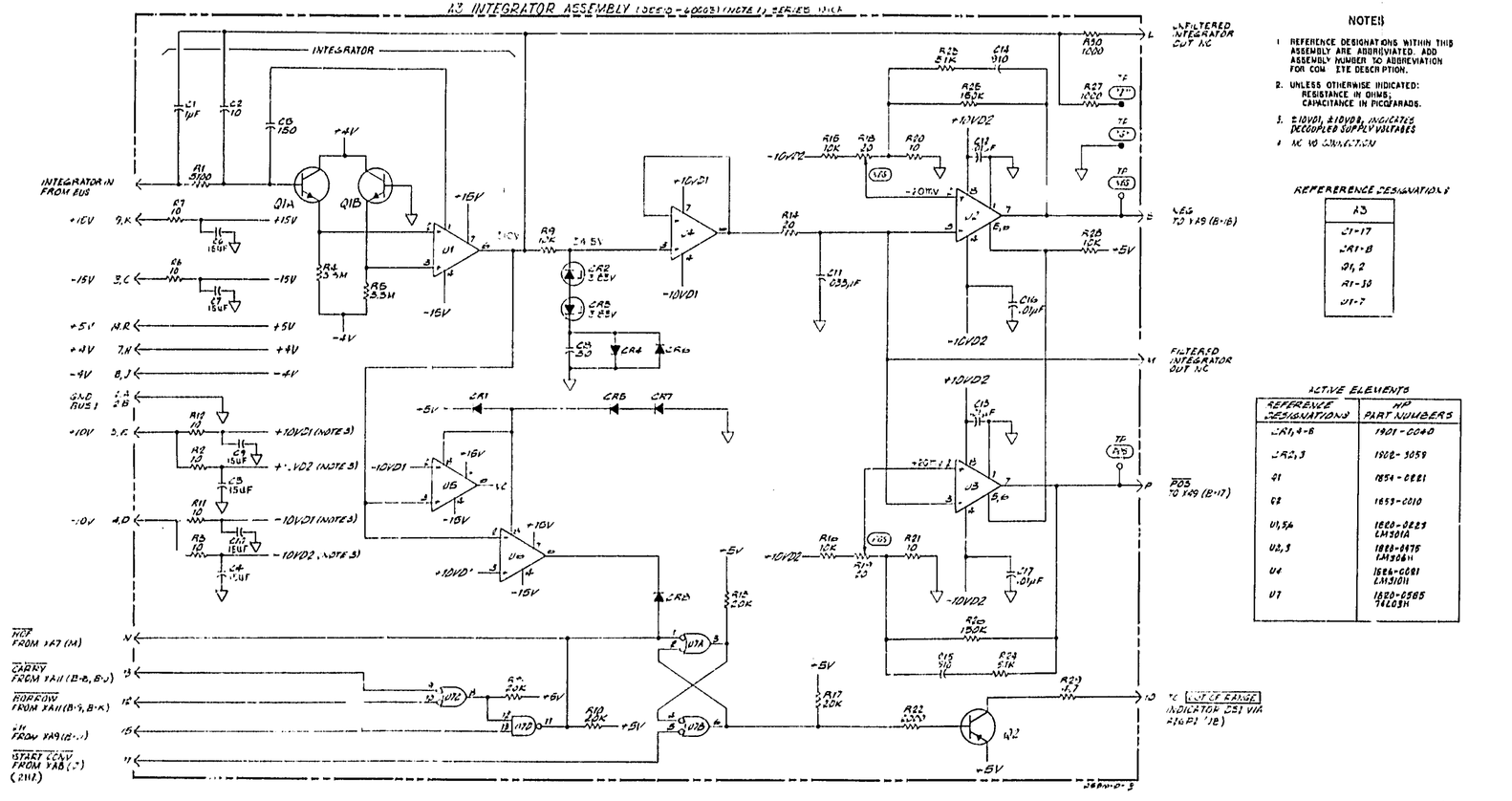
A2
C1-8
C9-14
C15-18
R1-24
U1, 2

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1-6	1901-0040
Q1, 2	1854-0034
Q3, 4, 7, 8	1854-0213 TYPE E22
Q5, 6, 9, 10	1855-0020
U1, 2	1820-0215 CA3011A

Figure 8-8. A2 Current Reference Assembly





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.
3. ±10VD1, ±10VD2, INDICATES DECOUPLED SUPPLY VOLTAGES
4. NC NO CONNECTION

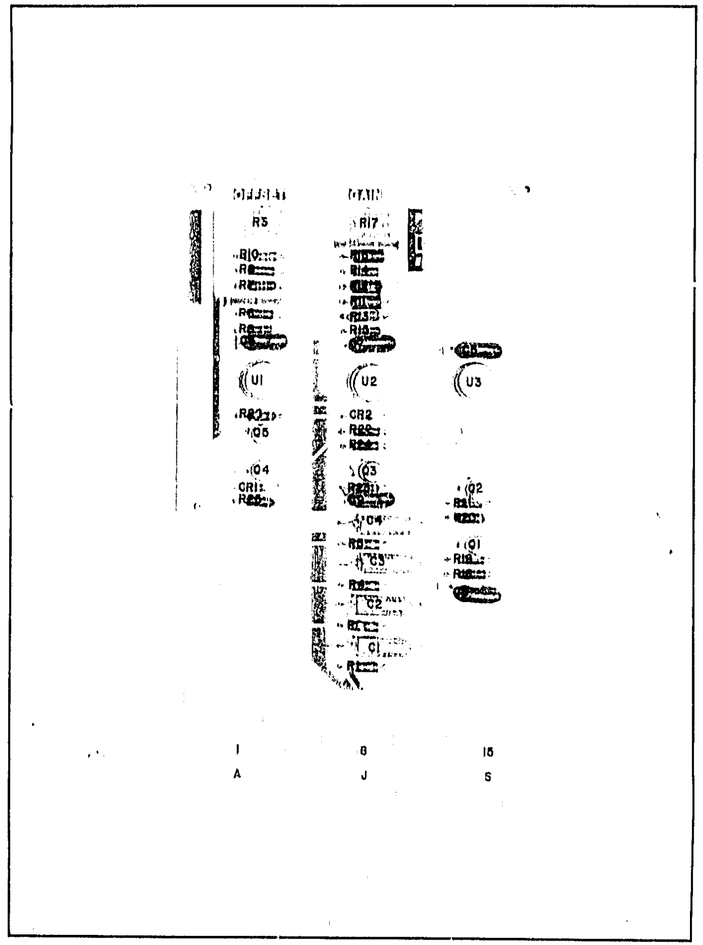
REFERENCE DESIGNATIONS

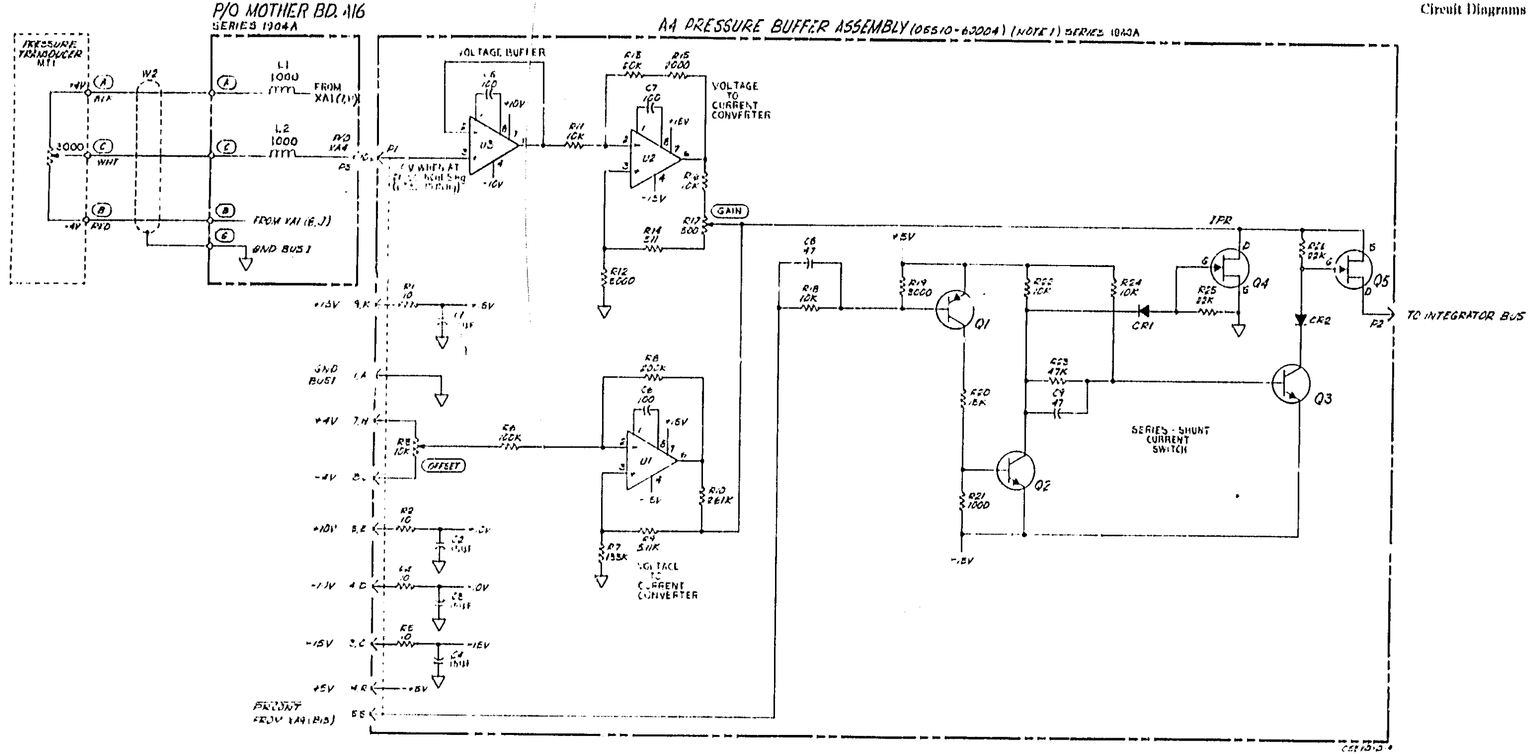
A3
J1-17
XA1-8
J1, 2
A1-30
U1-7

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1, 4-6	1901-0040
CR2, 3	1902-3059
Q1	1854-0221
Q2	1853-0010
U1, 5, 6	1820-0223 LM301A
U2, 3	1826-0076 LM306H
U4	1826-0081 LM310H
U7	1820-0565 74L02N

Figure 8-8. A3 Integrator Assembly





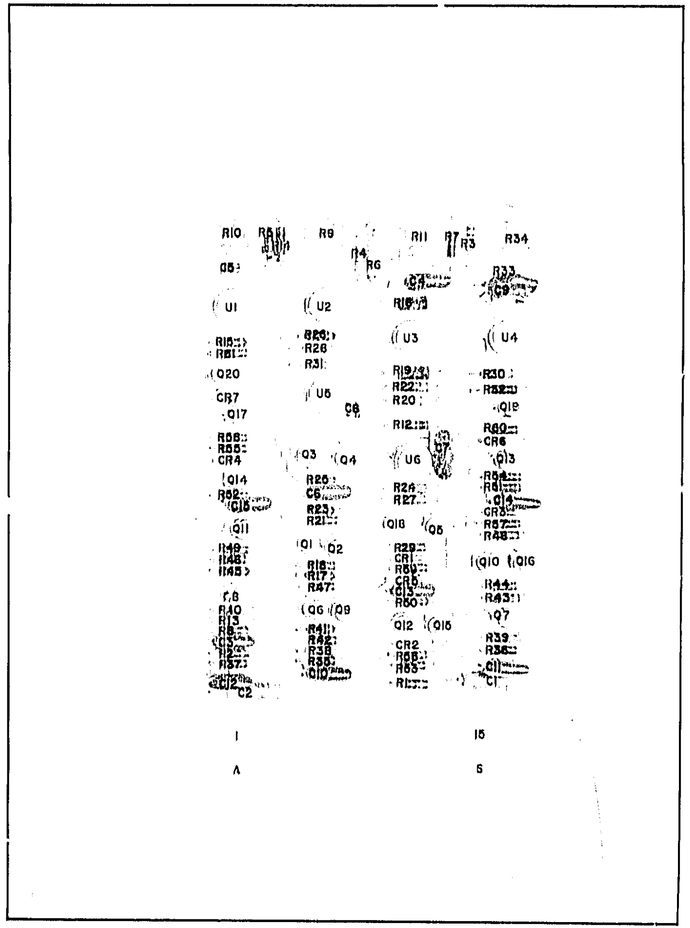
REFERENCE DESIGNATIONS

A4	NO PREFIX
CR1-9	L1-2
CR10-2	
Q1-5	
R1-126	
U1-3	

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1, 2	1901-1040
Q1	1853-0054
Q2,3	1854-0610 2N2222
Q4, 5	1853-0080
U1-3	1820-0723 LM301A

Figure 8-10. A4 Pressure Buffer Assembly



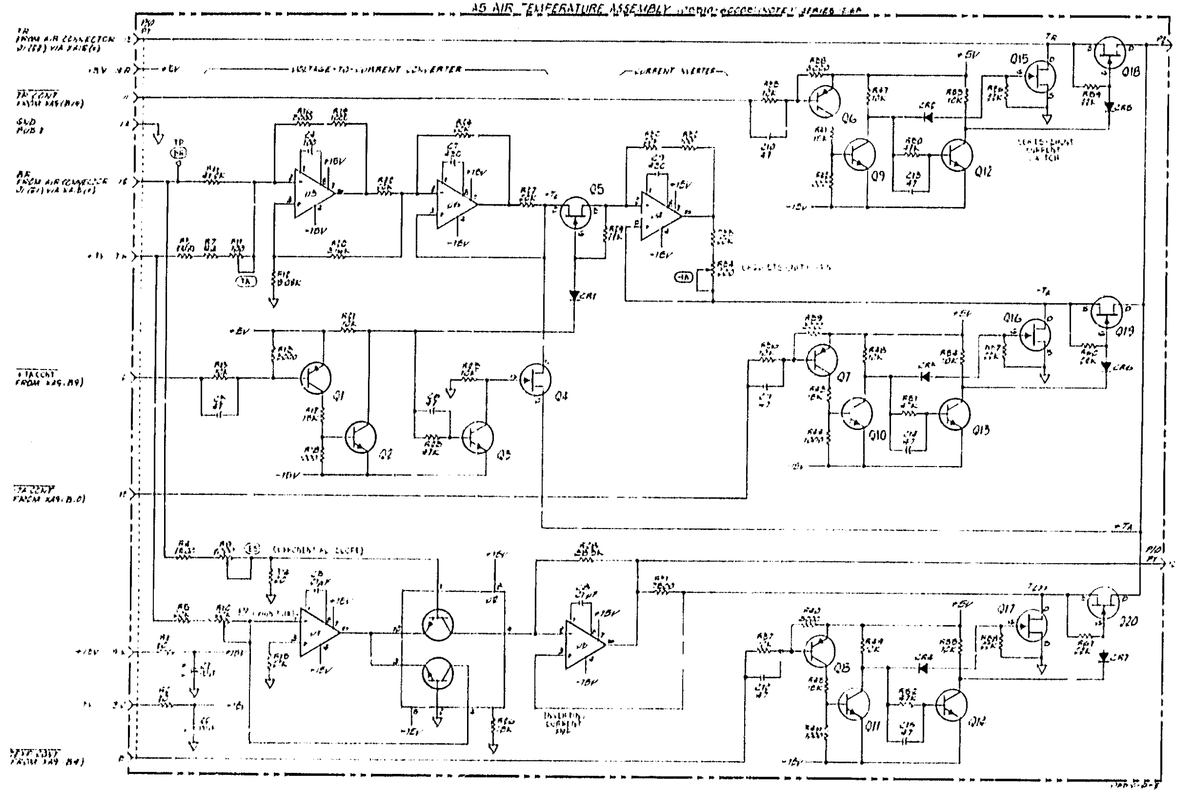
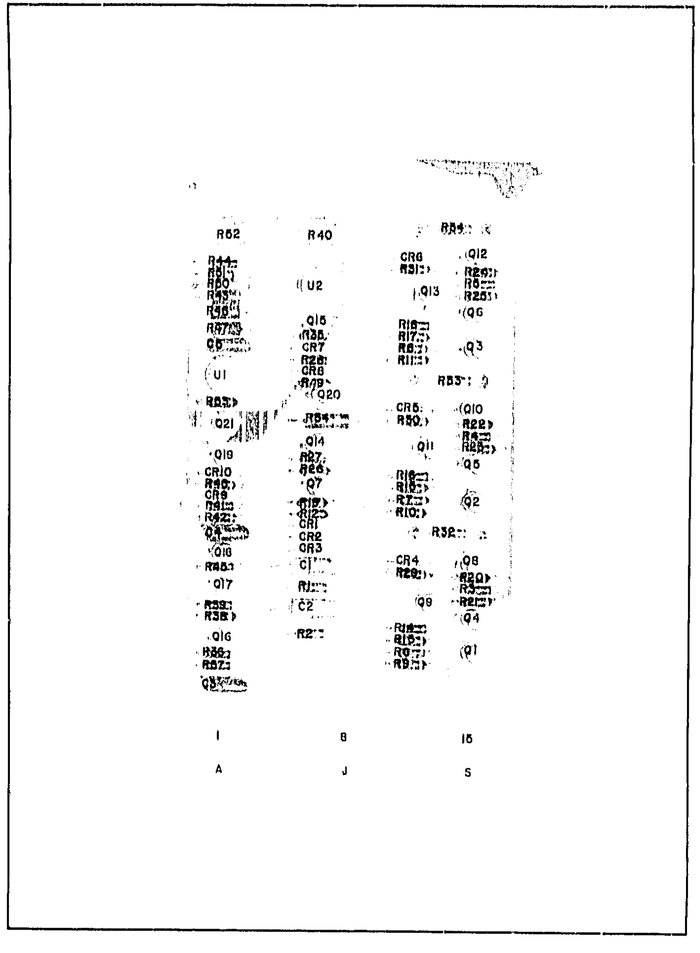


Figure 8-11. A5 Air Temperature Assembly



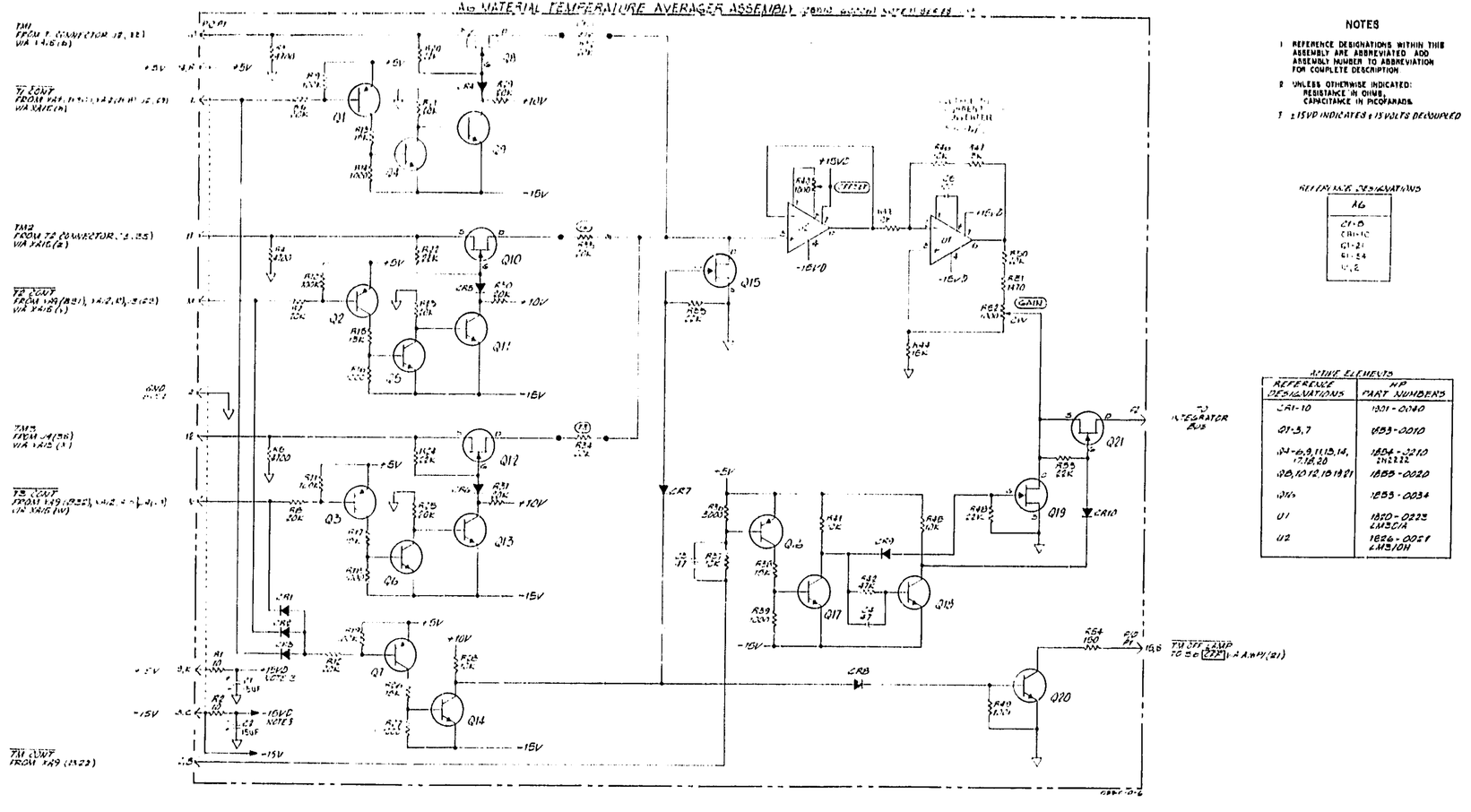
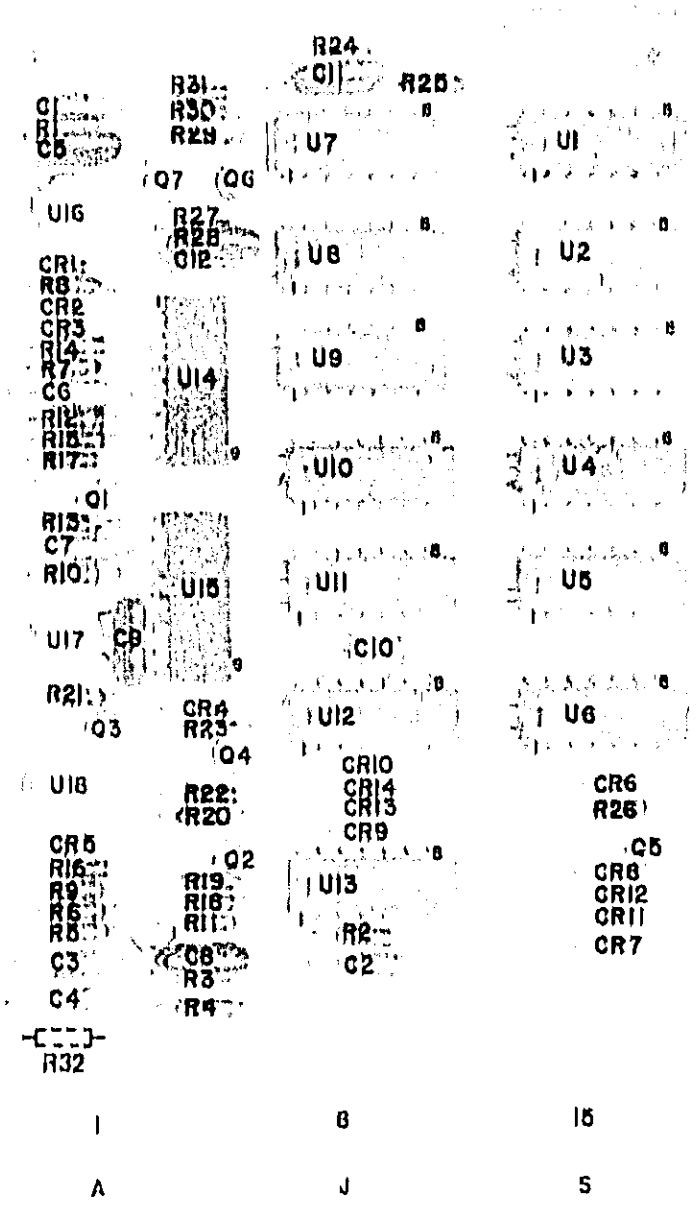


Figure 8-12. A6 Material Temperature Averager Assembly



Part of Figure 8-13. A7 Humidity Assembly

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;
3. 70 mV @ 10% HUMIDITY OR 60%
   120 mV @ 20% HUMIDITY
   240 mV @ 30% HUMIDITY

REFERENCE DESIGNATIONS

A7
C1-12 CR1-14 Q1-Q7 R1-32 U1-18

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1-4,6-14	1901-0040
CR5	1902-3059
Q1,4,5,7	1854-0210 2N2222
Q2,6	1853-0034
Q3	1855-0020
U1	1820-0174 SN7404N
U2,6,12,13	1820-0587 74L10N
U3	1820-0583 74L00N
U4	1820-0580 74L30N
U5,7,8,9,10,11	1820-0596 74L74N
U14	1820-0986 8GL75N
U15	1820-0660 93L10
U16,17,18	1820-0223 LM301A

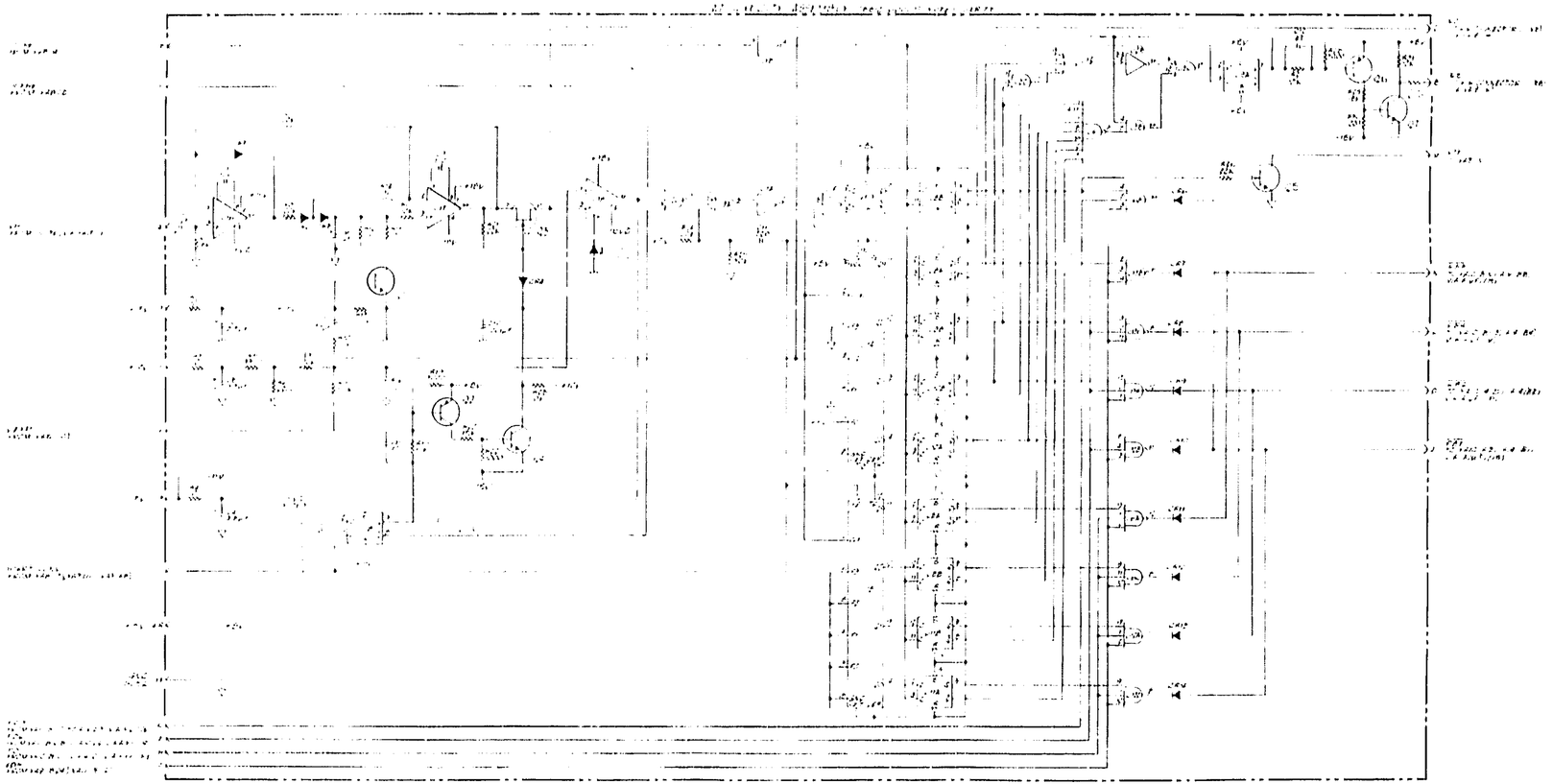
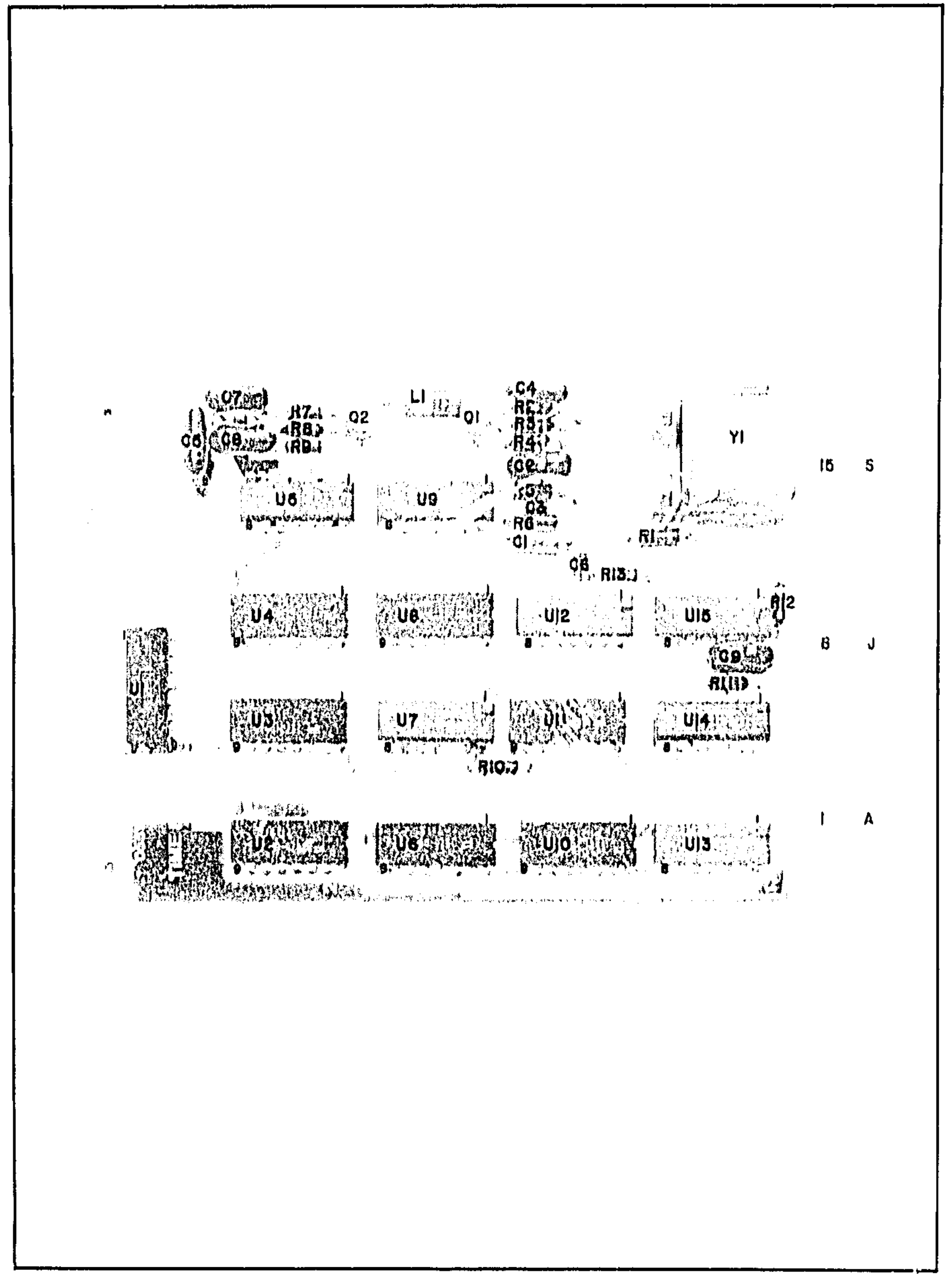
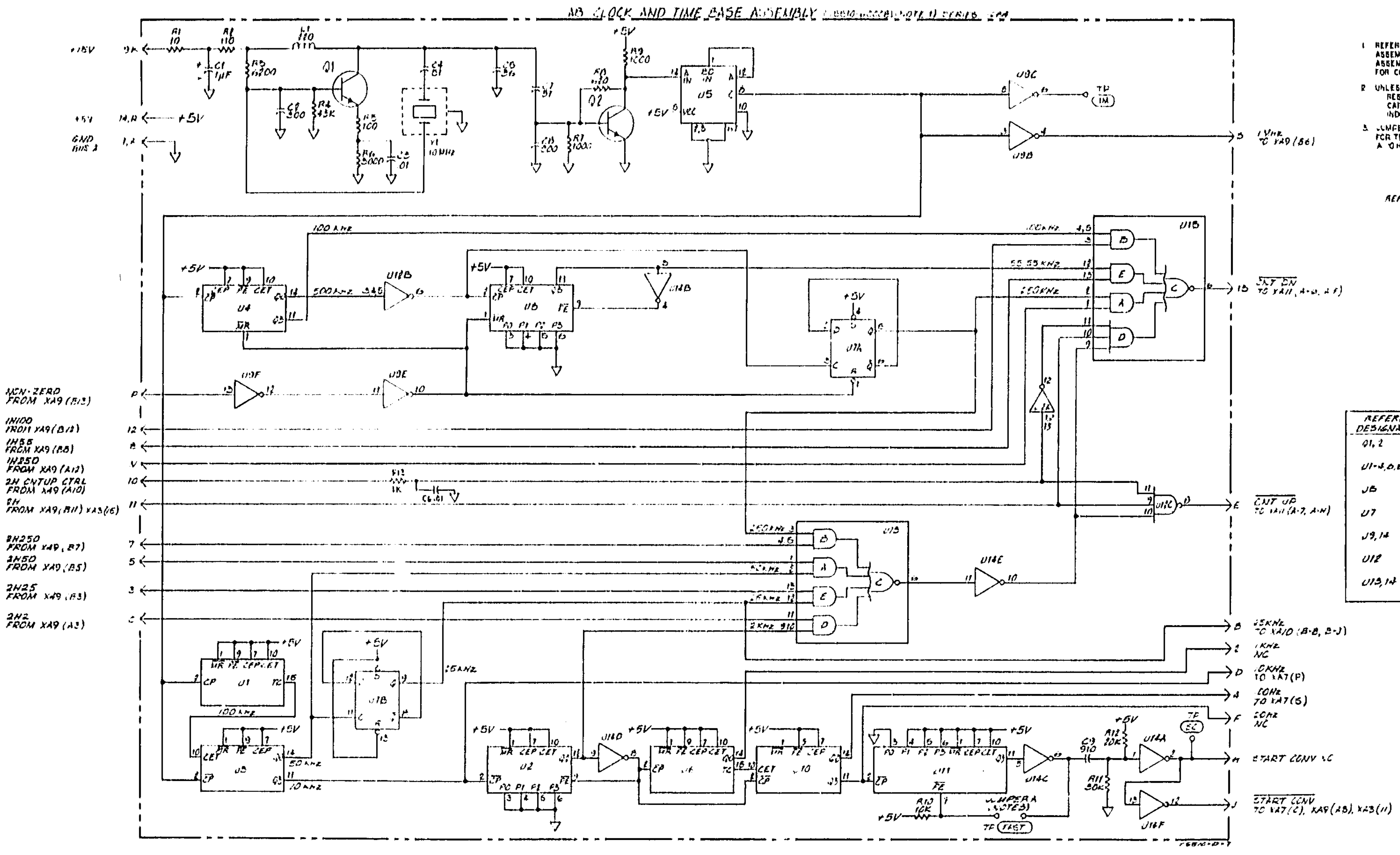


Figure 8-13. A7 Humidity Assembly





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. JUMPER A CAN BE INSTALLED FOR TEST PURPOSES TO ALLOW A 0Hz CYCLE RATE START CONV

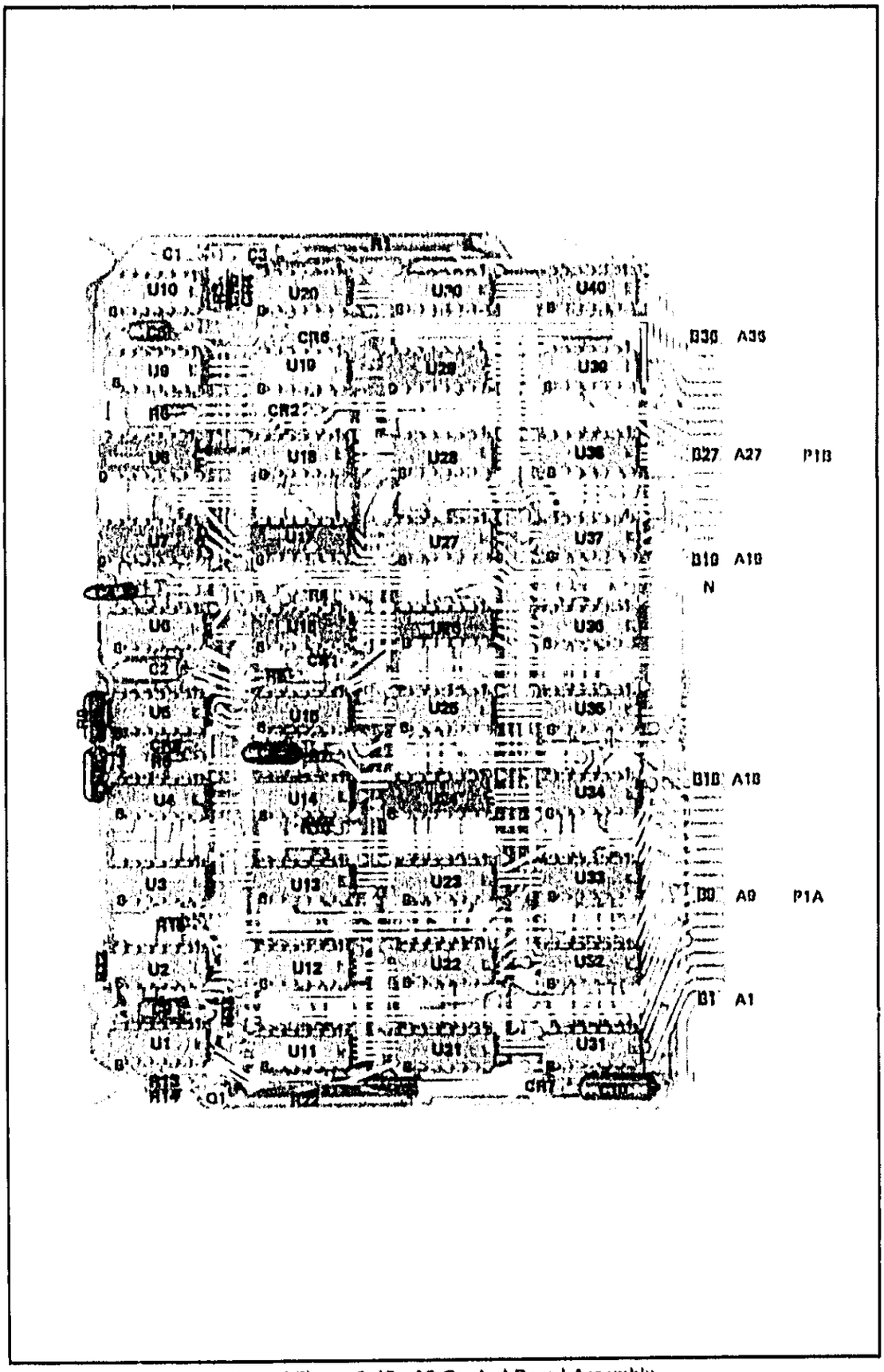
REFERENCE DESIGNATIONS

A8
C1-9
L1
Q1, 2
R1-13
U1-15
Y1

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1, 2	1854-0019
U1-4,6,8,10,11	1820-0966 EGLTEN
U5	1820-0058 SN7490N
U7	1820-0594 74L74
U9, 14	1820-0174 SN7404N
U12	1820-0587 74L10
U13, 14	1820-0591 74L04N

Figure 8-14. A8 Time Base Assembly



Part of Figure 8-15. A8 Control Board Assembly

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

REFERENCE DESIGNATIONS

A9
C1-10 CR1-7 Q1 R1-16 U1-40

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1-7	1901-0040
Q1	1854-0210
U1	1820-1416 SN74LS14N
U2,15,21,23,26,31 35,36,37,38	1820-0584 DM74L02N
U3,6,19,25,27,33	1820-0583 DM74L00N
U4,20,32	1820-0585 DM74L03N
U7,24,29	1820-0627 93L01
U8	1820-0669 93L10
U5, 9	1820-0587 DM74L10N
U10,11,12	1820-0596 DM74L74N
U13	1820-0077 SN7476N
U14	1820-0077 SN7474N
U16	1820-0875 9600
U17,26	1820-0269 SN7403N
U18	1820-0588 DM74L20N
U22,40	1820-0591 DM74L54N
U30,34,39	1820-0586 DM74L04N

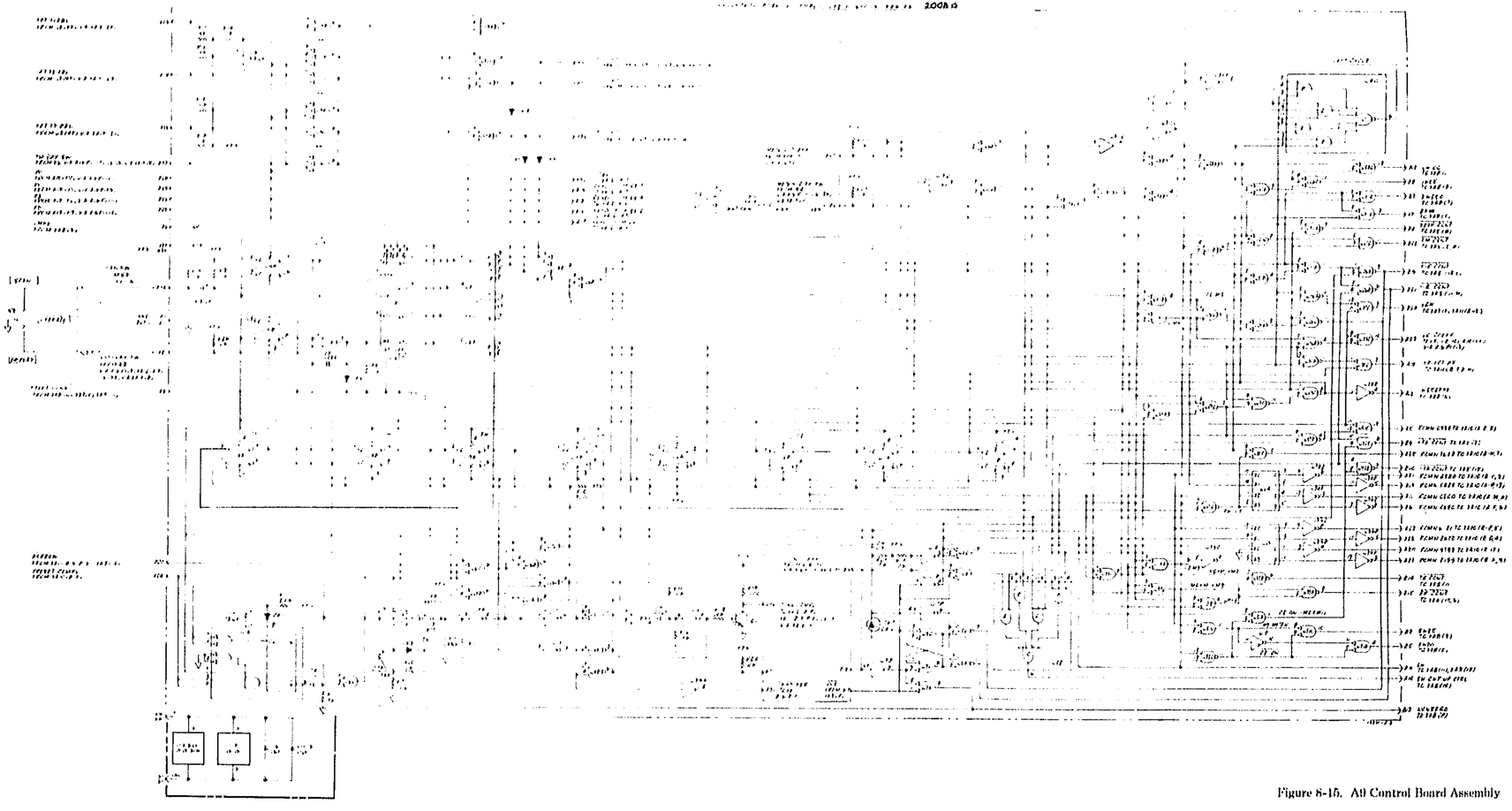
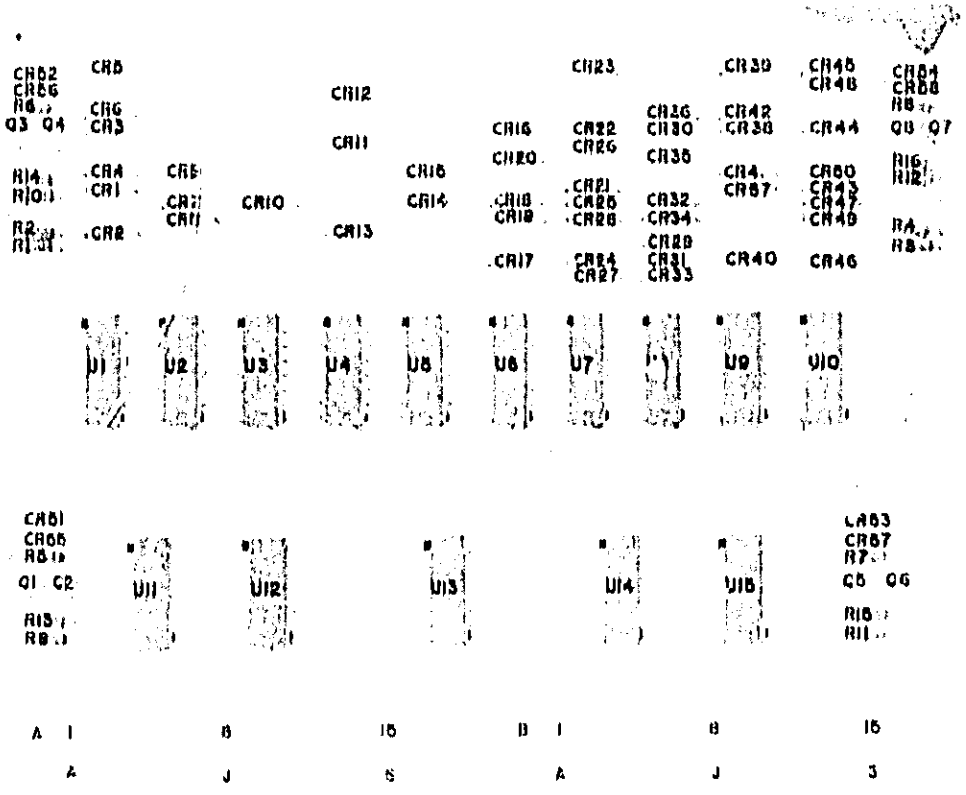


Figure 8-15. A9 Control Board Assembly



Part of Figure 8-16. A10 Preset ROM Assembly

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;

REFERENCE DESIGNATIONS

A10
CR1-68
Q1-8
R1-16
U1-16

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1-68	1901-0040
Q1-8	1854-0010
U1-10,13	1820-0583 DM74L00N
U11,12,14	1820-0586 DM74L74N
U16	1820-0586 DM74L04N

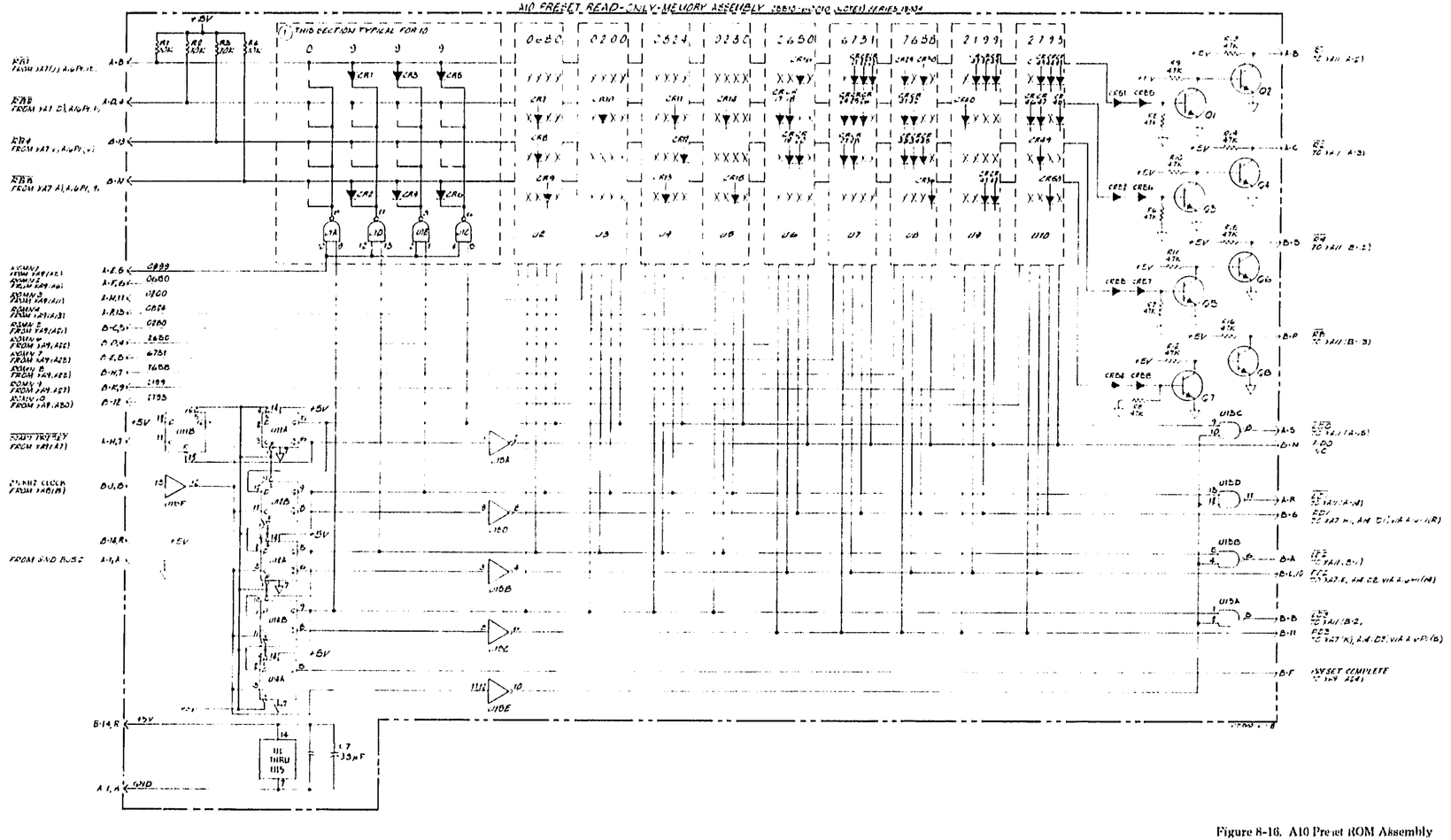
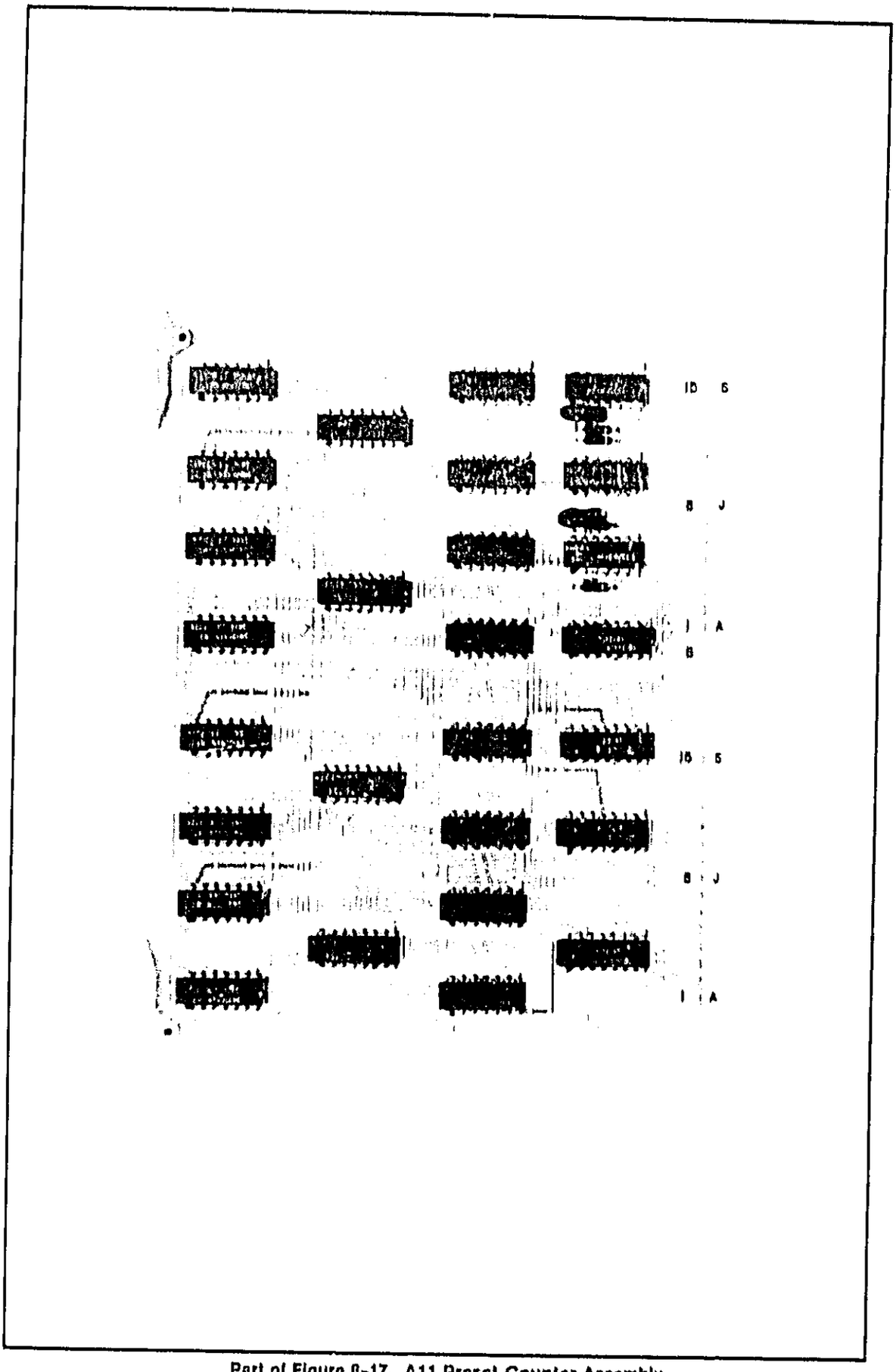


Figure 8-16. A10 Preset ROM Assembly



Part of Figure 8-17. A11 Preset Counter Assembly

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

REFERENCE DESIGNATIONS
A11
C1,2 R1-4 U1-27

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
U1-8	1820-0590 SN74L51
U9-11	1820-0546 SN74192
U12	1820-0233 SN74193
U13-20	1820-0596 SN74L74
U21-24	1820-0301 SN7475
U25	1820-0174 SN7404
U26	1820-0583 SN74L00
U27	1820-0584 SN74L02

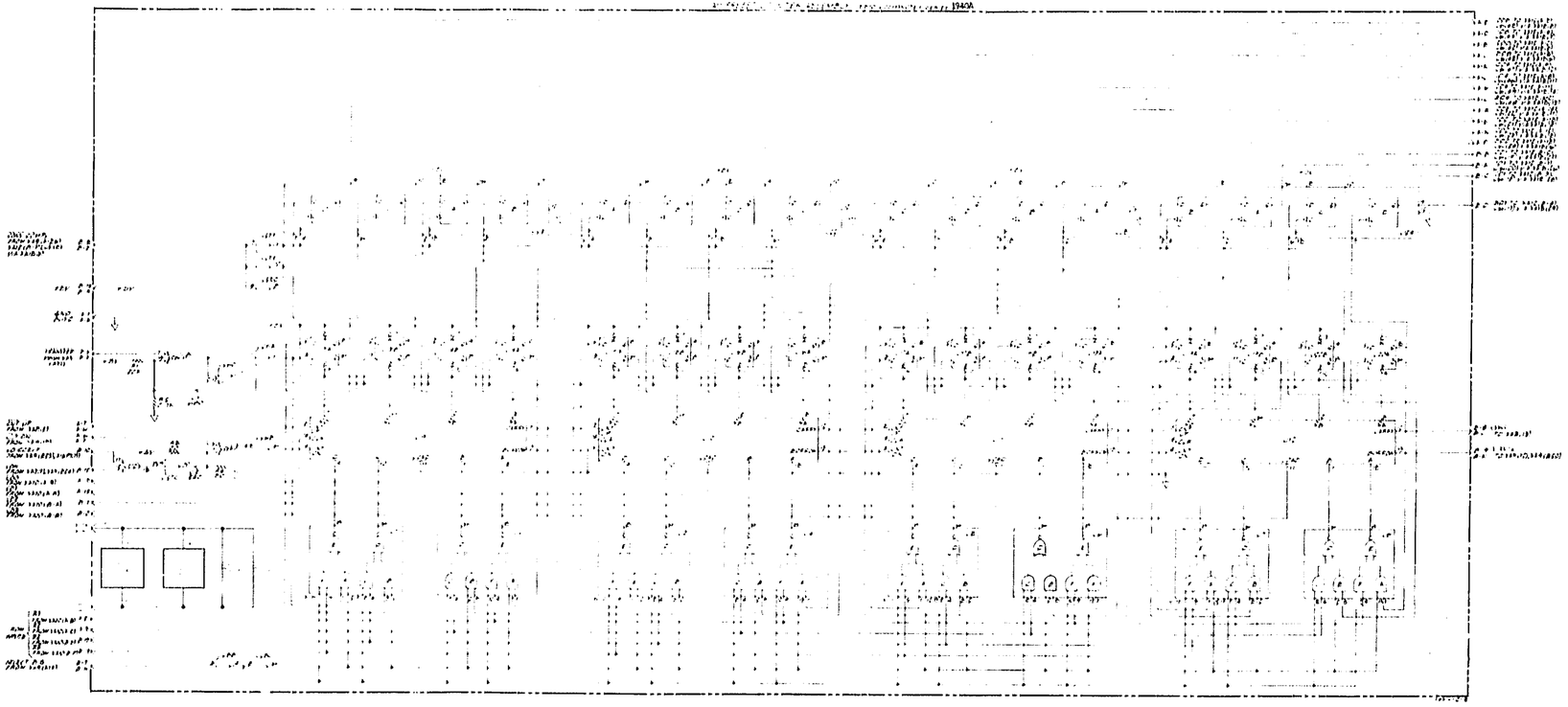
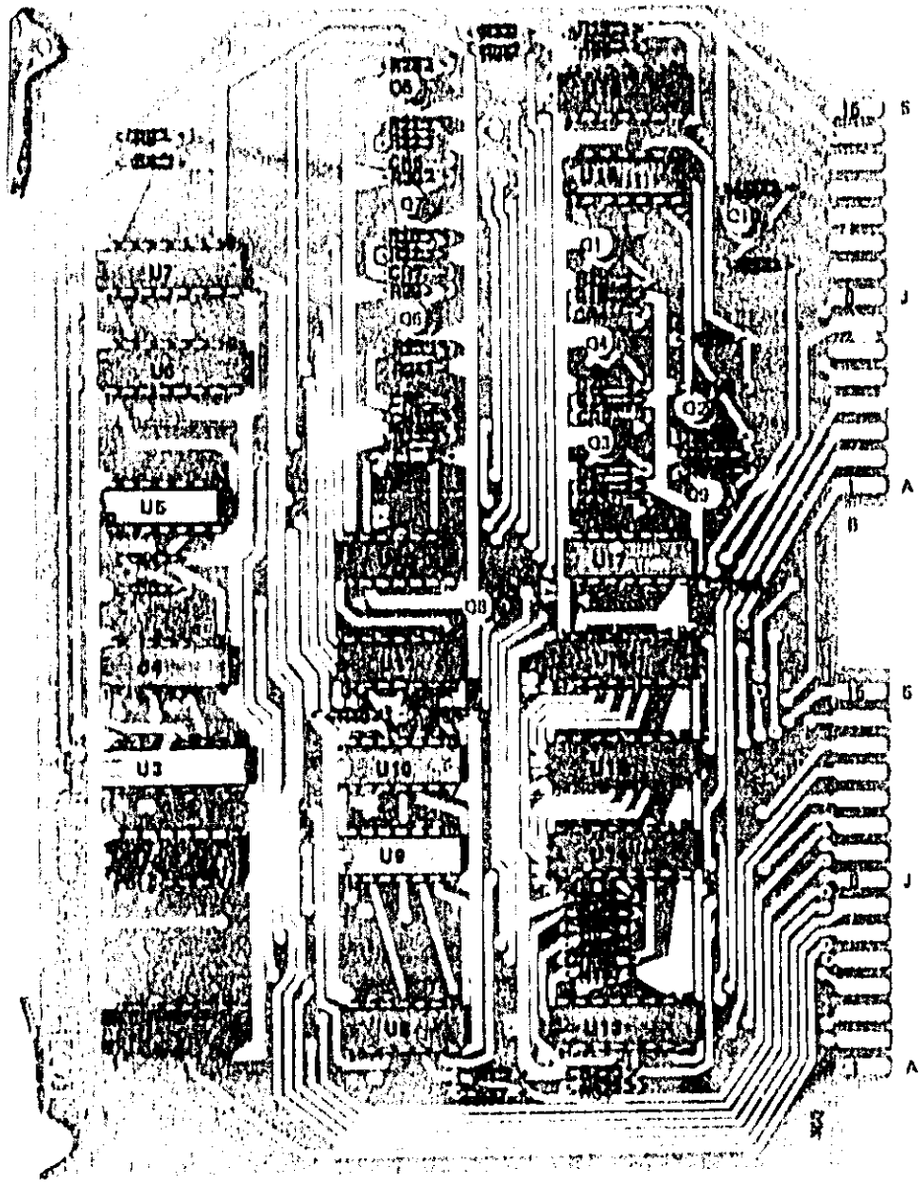


Figure 8-17. A11 Preset Counter Assembly



P/O Figure 8-18. A12 Interface Driver Assembly

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

REFERENCE DESIGNATIONS

A12
C1 CR1-7 Q1-9 R1-44 U1-18

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1	1901-0028
CR2-7	1901-0040
Q1-7,9	1854-0210 2N222
Q8	1854-0010
U1	1820-0586 DM74L04N
U2	1820-0627 93L01
U3	1820-0716 SN74161N
U4,8	1820-0583 DM74L00N
U5	1820-0068 SN7410N
U6,7	1820-0906 DM8214N
U9	1820-0511 SN7408N
U10	1820-0070 SN7430N
U11	1820-0269 SN7403N
U12,19	1820-0596 DM74L74N
U13,14,15,16	1820-0574 DM8551N
U17	1820-0054 SN7400N
U18	1820-0174 SN7404N

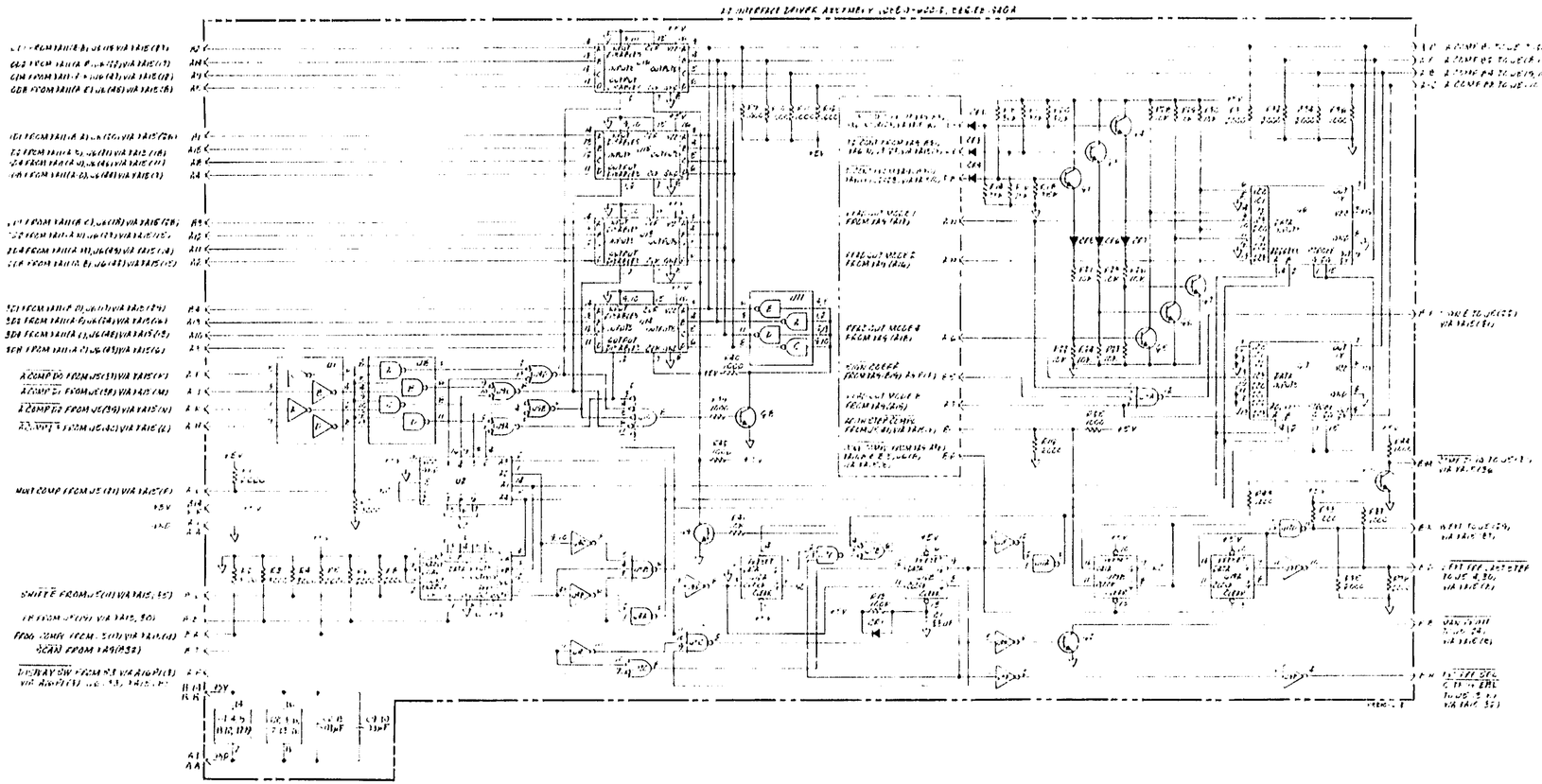
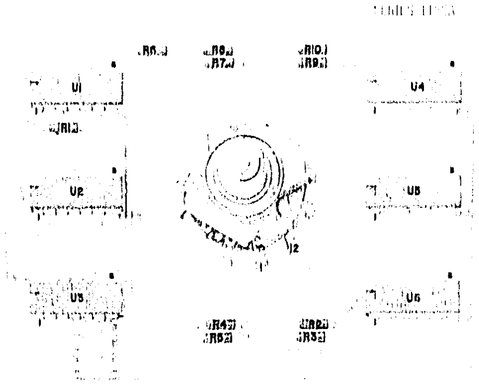


Figure 8-18. A12 Interface Driver Assembly



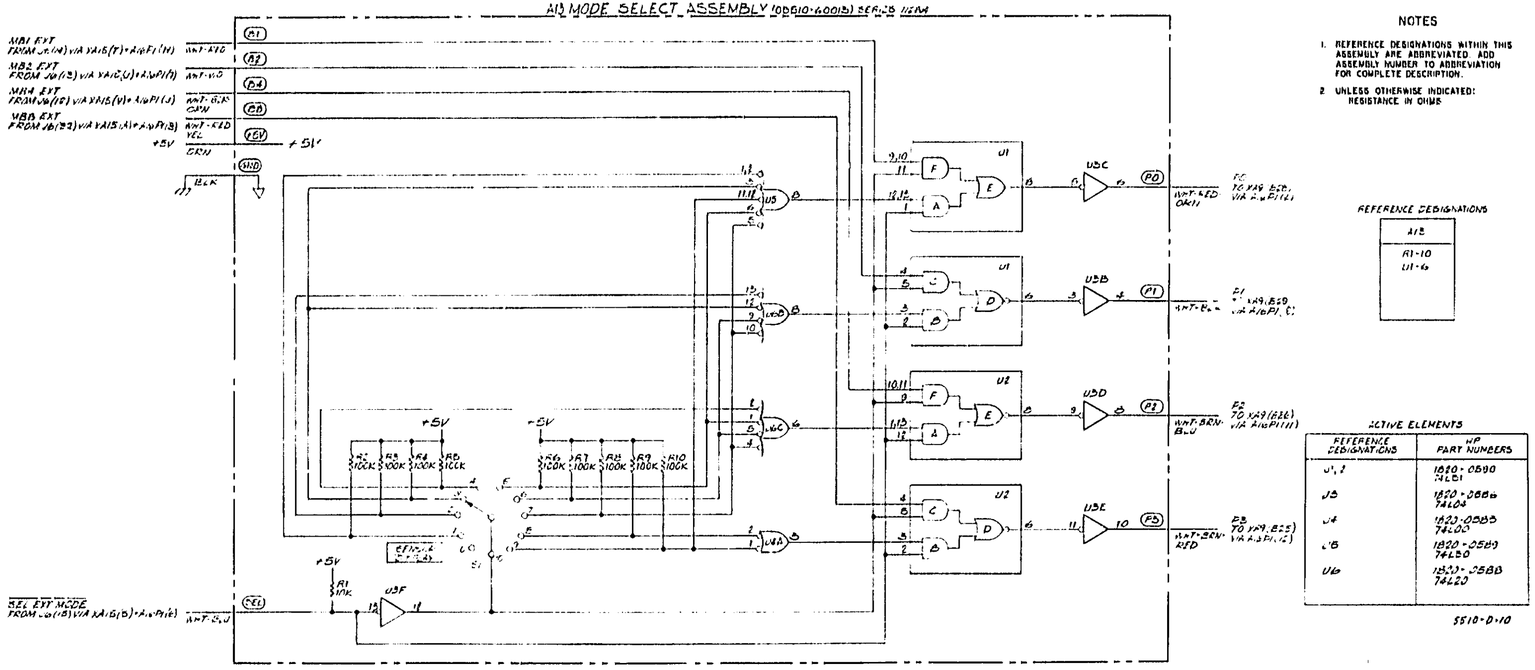
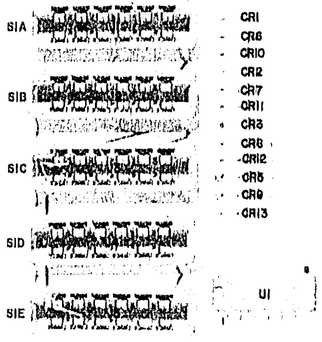
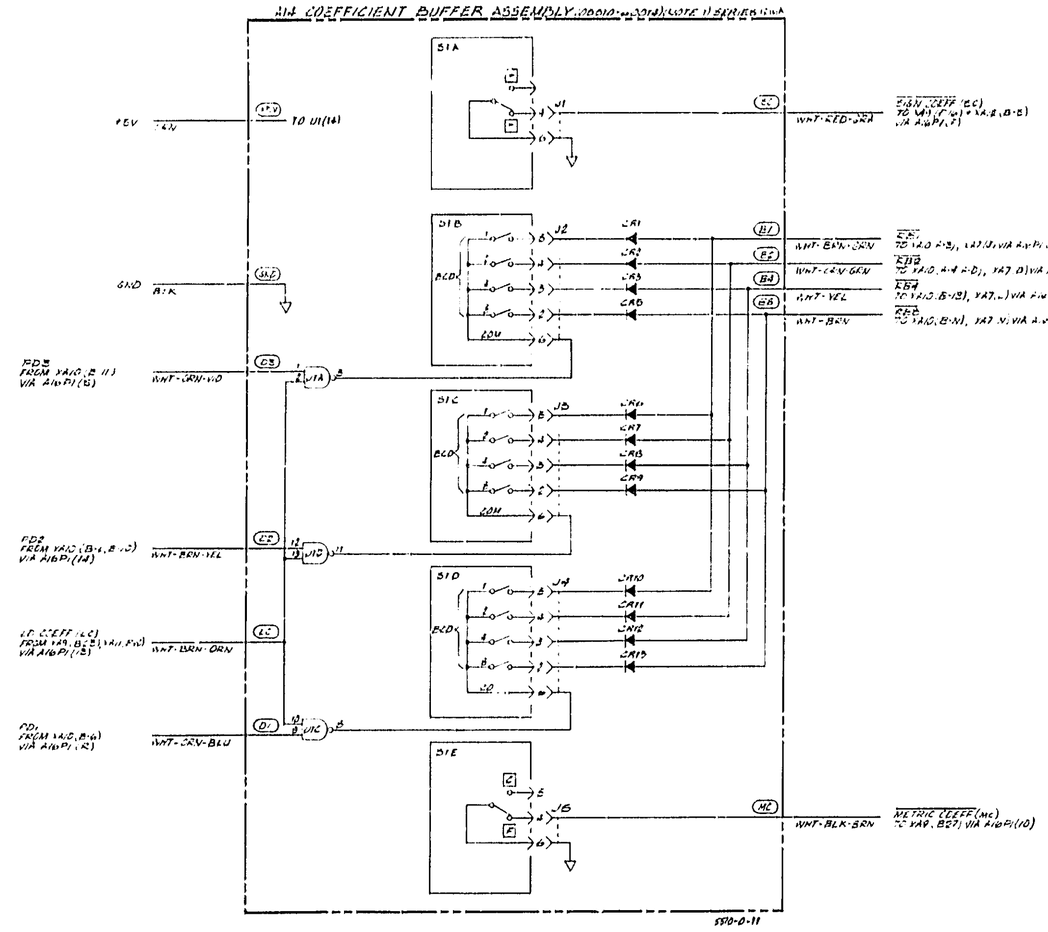


Figure 8-19. A13 Mode Select Assembly





NOTES

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.

S1 TRUTH TABLE
(OUTPUTS SHOWN WHEN THE COM PIN IS LOW)
(SWITCH IS SHOWN IN DECIMAL ZERO POSITION)

SWITCH DIGIT	BCD			
	8	4	2	1
0	H	H	H	H
1	H	H	H	L
2	H	H	L	H
3	H	H	L	L
4	H	L	H	H
5	H	L	H	L
6	H	L	L	H
7	H	L	L	L
8	L	H	H	H
9	L	H	H	L

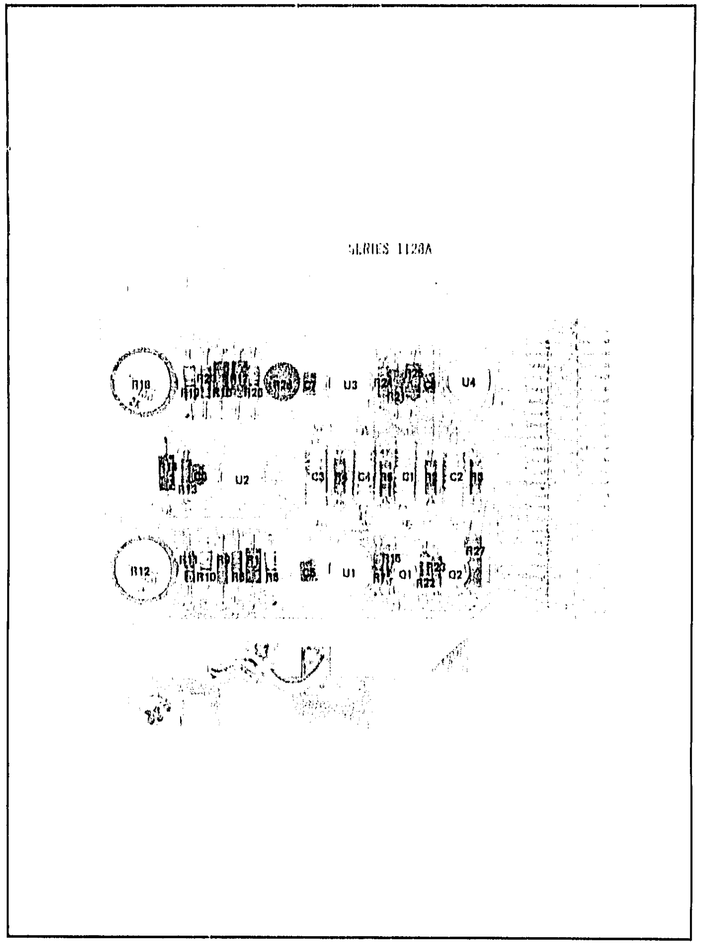
REFERENCE DESIGNATIONS

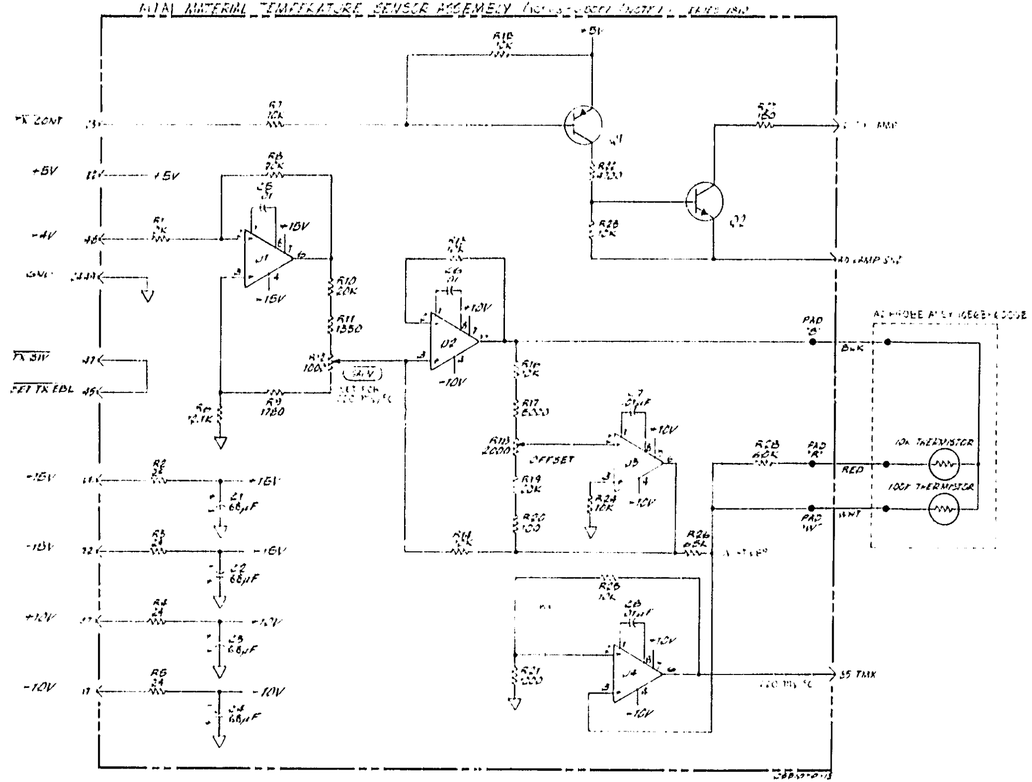
A14
S1
U1

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1-13	1901-0040
U1	P/O 08553-60109

Figure 8-20. A14 Coefficient Buffer Assembly





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 MICROFARADS
3. [illegible] DESIGNATIONS SHOWN AS [illegible] MAY REPRESENT TWO OR MORE [illegible] IDENTICAL REFERENCE DESIGNATIONS. THE NUMBER OF [illegible] IS INDICATED

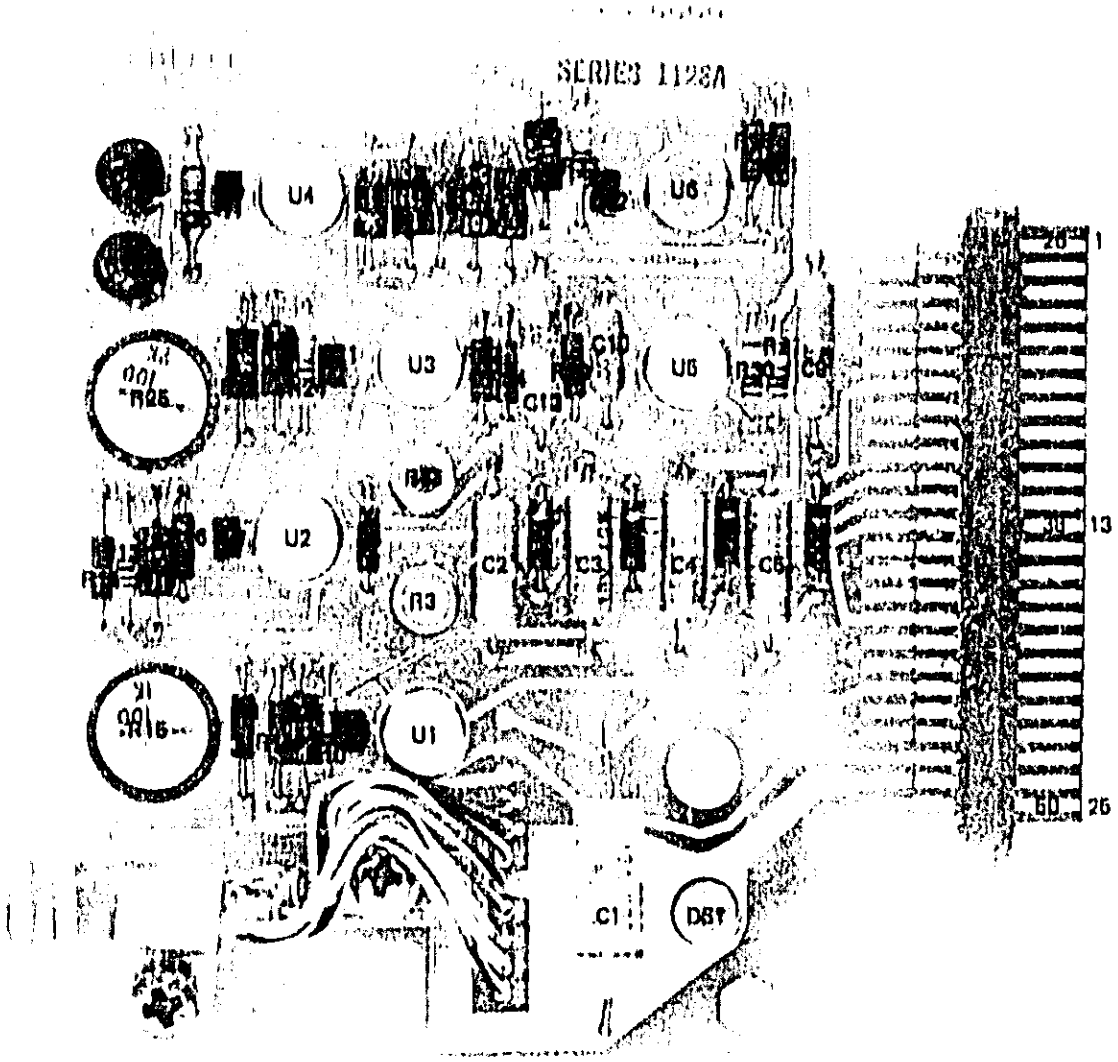
REFERENCE DESIGNATIONS

A1-A5	
A1, 2	
A1-3B	
U1-4	

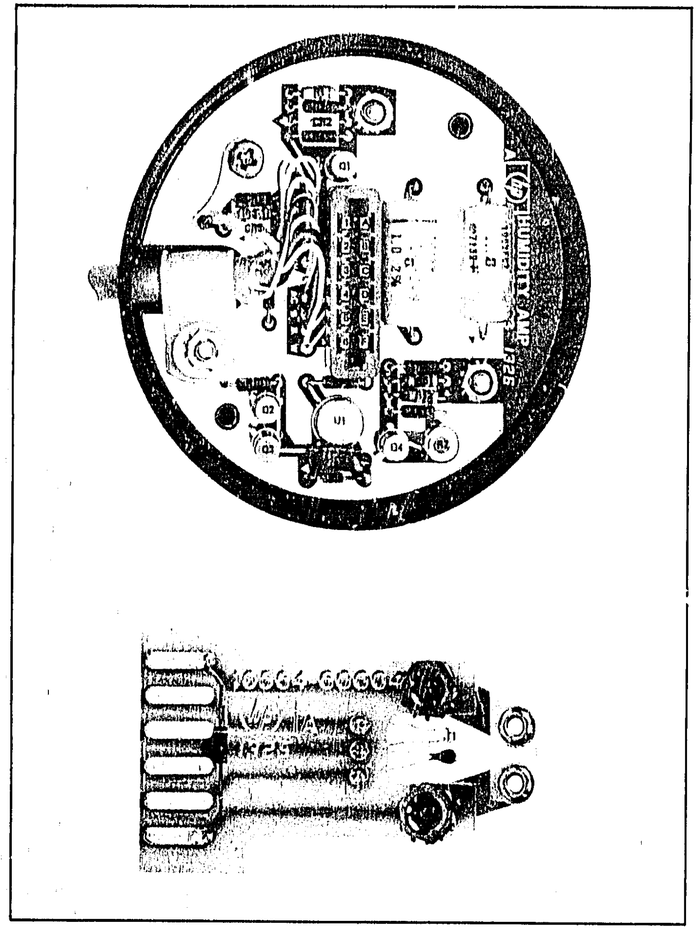
ACTIVE ELEMENTS

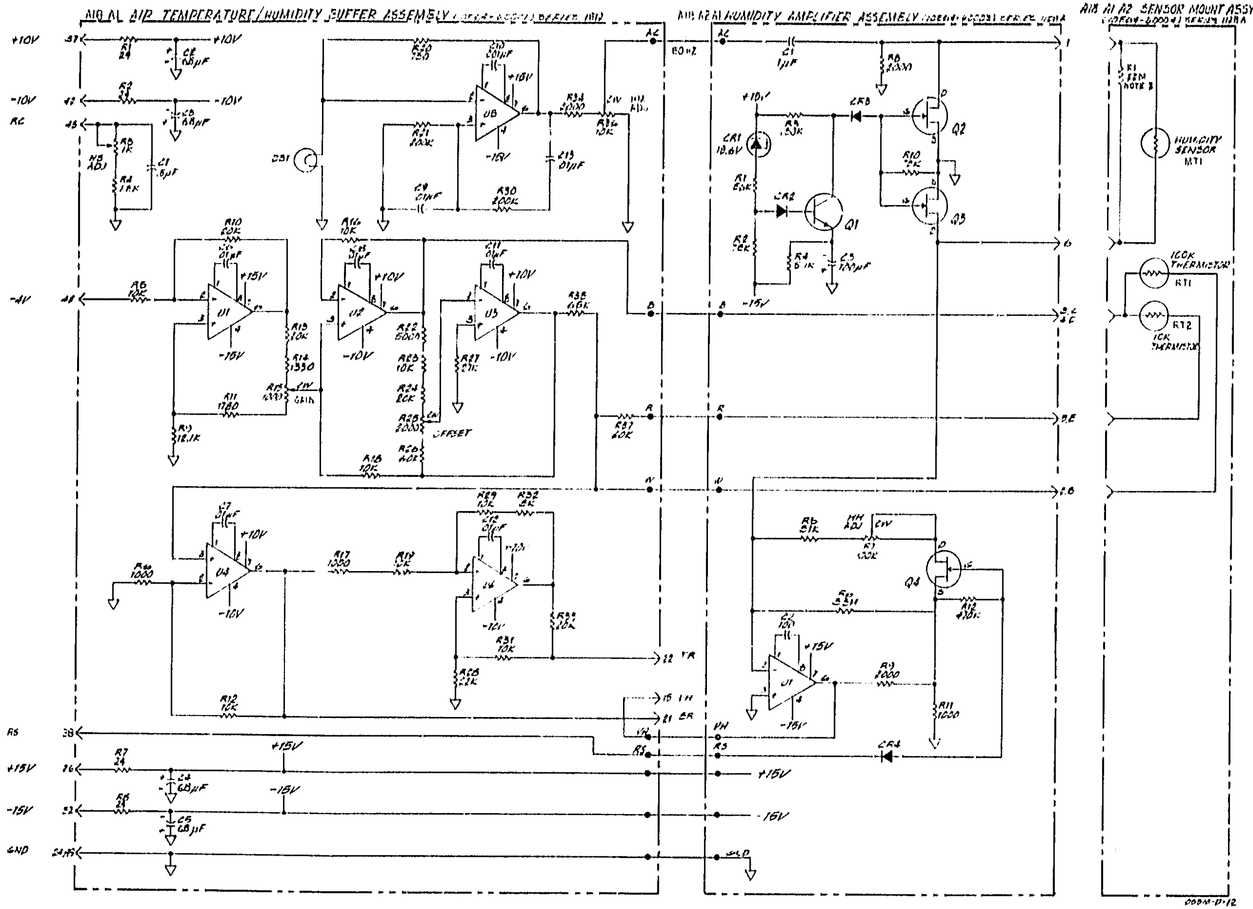
REFERENCE DESIGNATIONS	HP PART NUMBERS
U1	1855-0210
U2	1854-0210
U3-5	1826-0223 LM301A
U4	1826-0235 LM308AH

Figure 8-21. A17 Material Temperature Sensor Assembly



Part of Figure 8-22. A18 Air Temperature/Humidity Assembly





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 MICROFARADS.
3. RELOSTER A2 A2R1 HAS NOT INCLUDED AT EARLY PRODUCTION RUNS.

REFERENCE DESIGNATIONS

A1	A2 A1	A2 A2
C1-18	C1-3	RT1
D31	CR1-4	R1
J1	S1-4	RT1-2
R1-37	R1-12	
U1-6	U1	

ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
10864-60001	
D31	6140-0084
U1-3, 5, 6	1820-0220 LM301A
U4	1826-0088 LM308A
10864-60003	
CR1	1902-3234
CR2-4	1901-0040
Q1	1854-0210
S2-4	1885-0020
U1	1826-0058 LM308A

Figure 8-22. A18 Air Temperature/Humidity Assembly

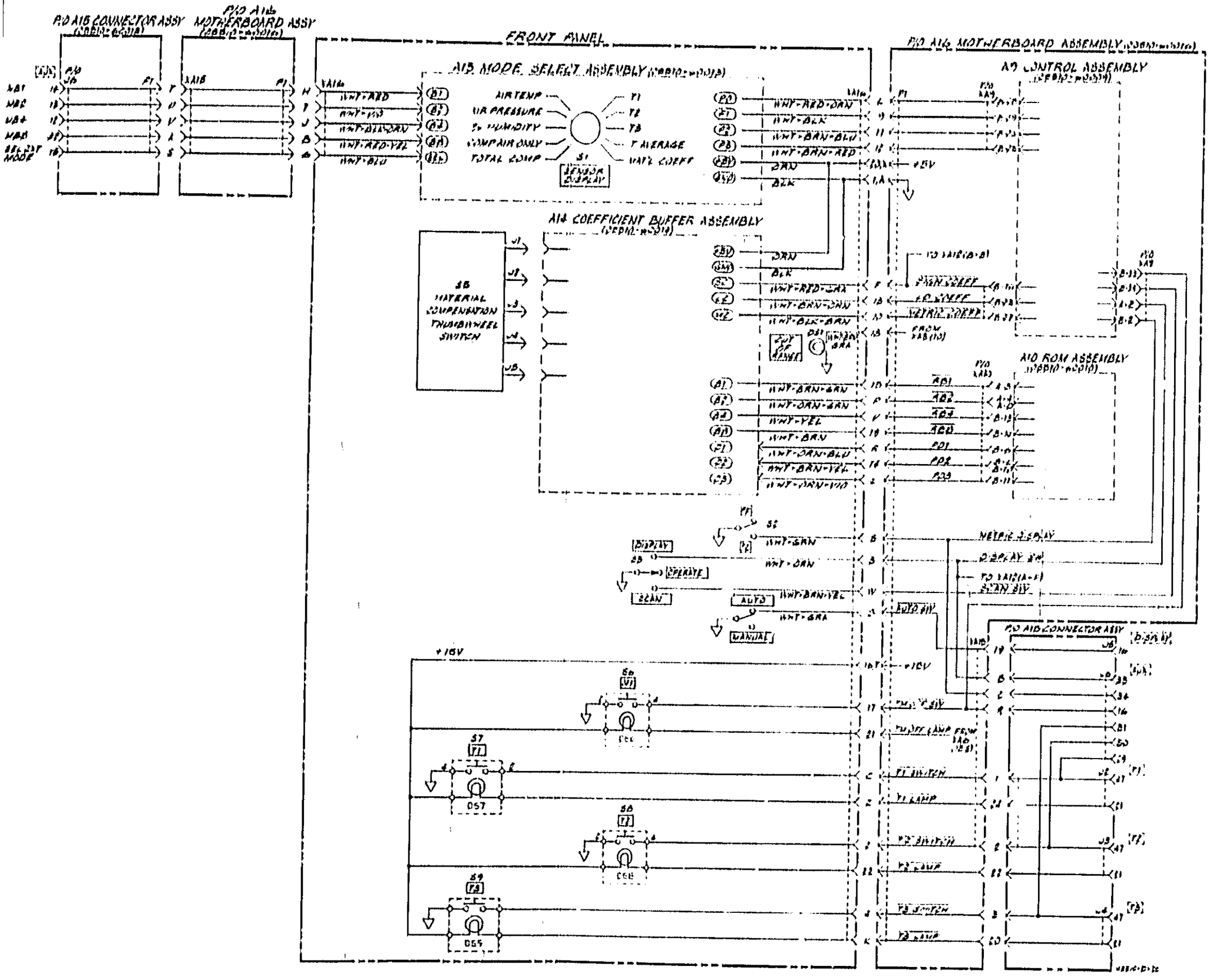


Figure 8-23. 5510A Wiring Diagram

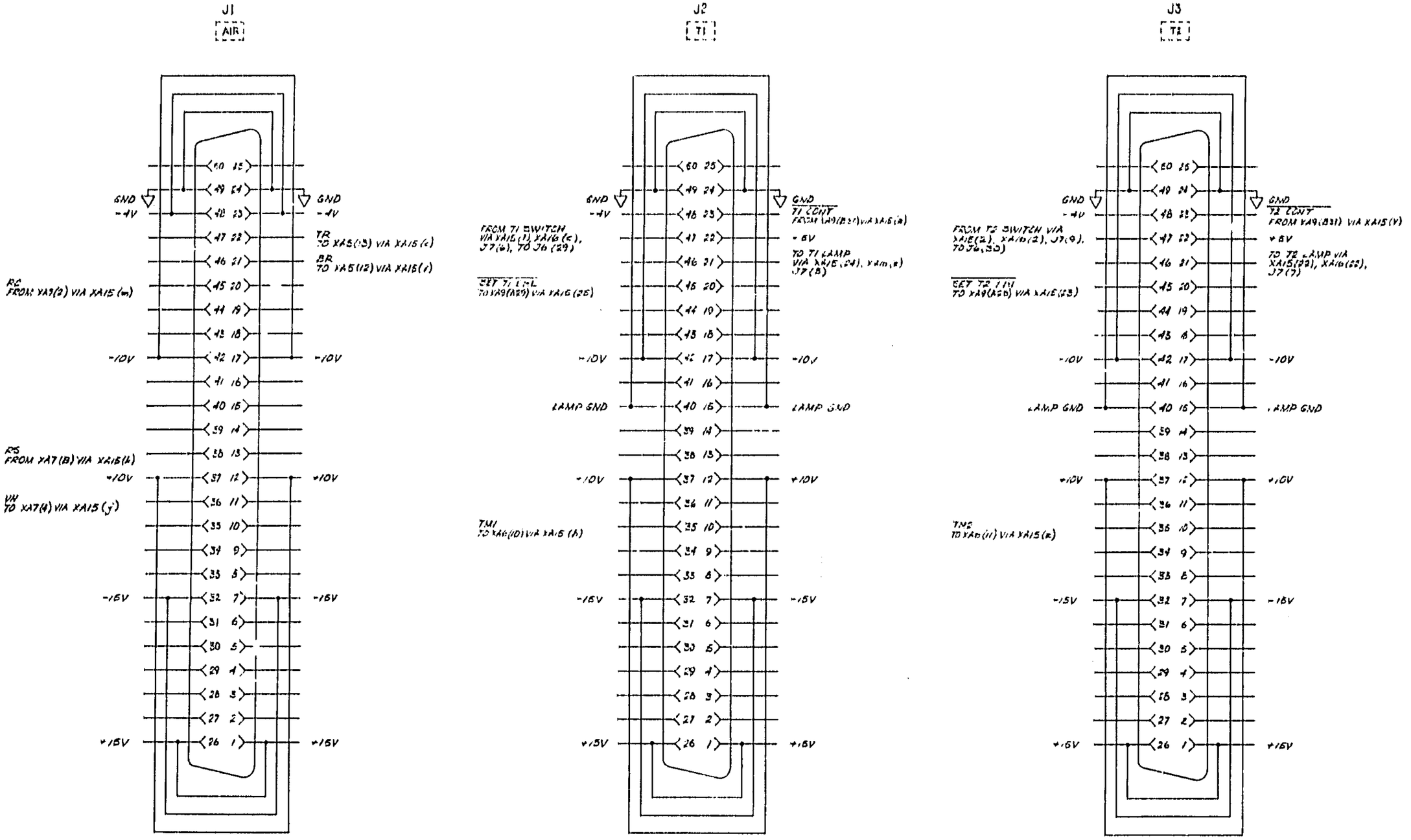
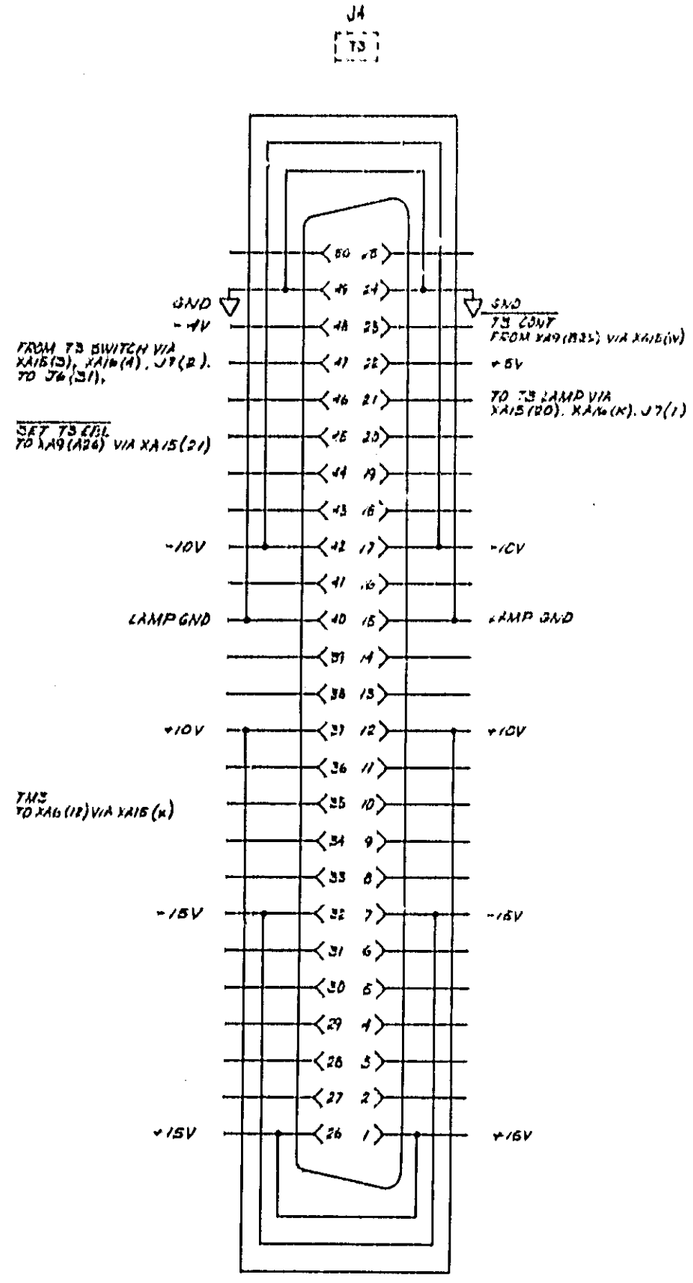
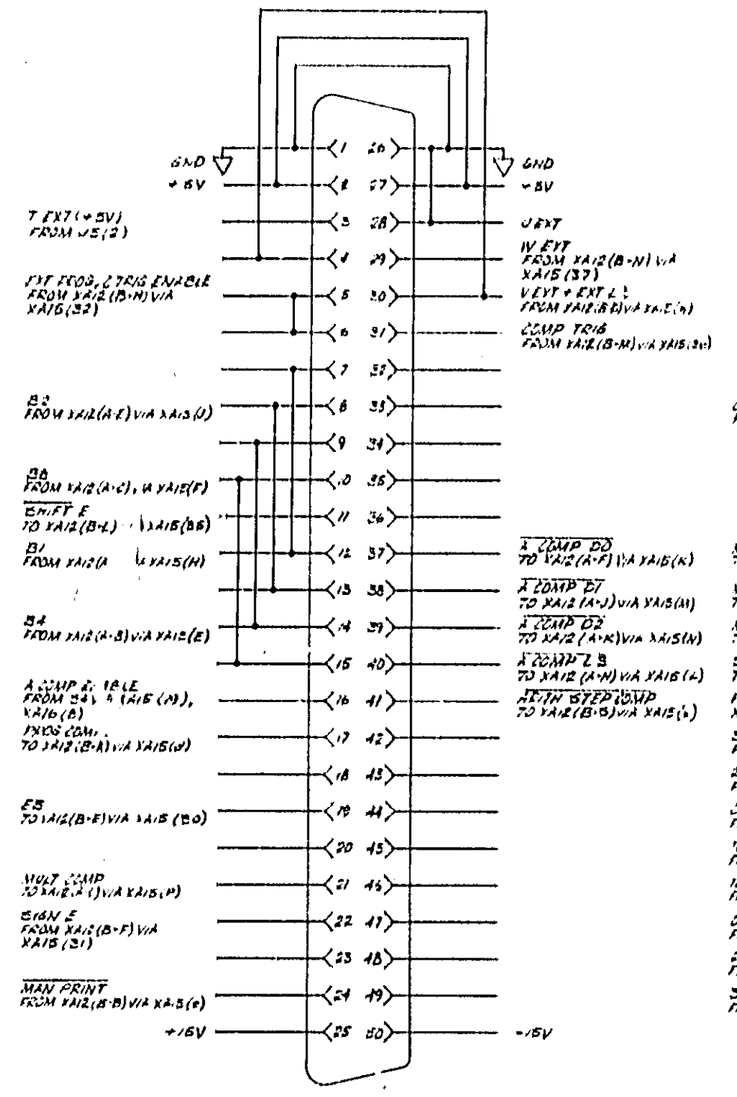


Figure 8-24. 5510A Rear Panel Connectors
(Sheet 1 of 2)





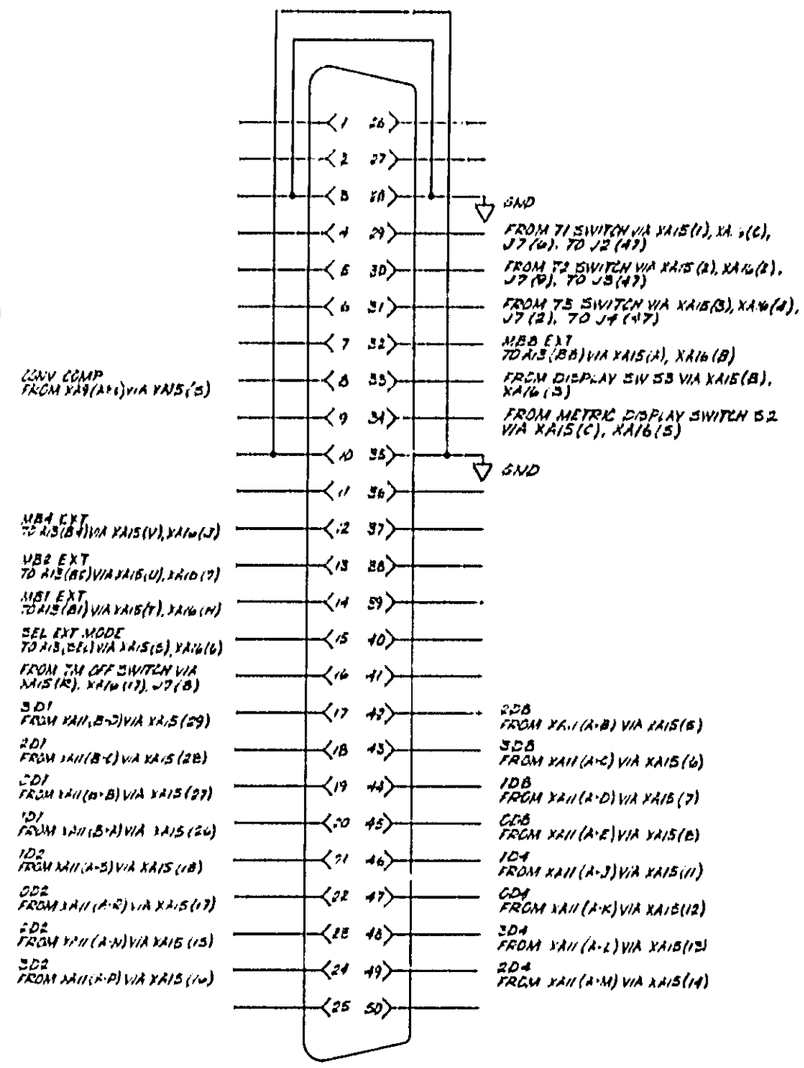


Figure 8-24. 5510A Rear Panel Connectors
(Sheet 2 of 2)

MANUAL CHANGES

MANUAL UPDATING CHANGES

CHANGE DATE: May 10, 1985

MANUAL UPDATING COVERAGE

This supplement adapts your manual to instruments with serial numbers prefixed through 2520.

MANUAL IDENTIFICATION

Instrument: Model 5510A Automatic Compensator Operating & Service Manual

Manual Part No: 05510-90016
Manual Microfiche: 05510-90017
Manual Print Date: Feb 1981

ABOUT THIS SUPPLEMENT

The information in this supplement is provided to correct manual errors and to update the manual to instruments containing changes after the manual print date.

Change and correction information in this supplement is itemized by page numbers corresponding to the original manual pages. The pages in this supplement are organized in numerical order by manual page number.

Manual updating supplements are revised as often as necessary to keep manuals as accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the model number, print date, and part number listed at the top of this page.

HOW TO USE THIS SUPPLEMENT

Insert this title page in front of the title page in your manual.

Perform all changes specified for "All Serials", and all changes through the Series Prefix of your instrument or board.

Insert any complete replacement pages provided into your manual in the proper location.

If your manual has been updated according to the last edition of this supplement, you need only perform those changes pertaining to the new series prefix. See List of Effective Pages on the reverse side of this page. New information affecting "All Serials" will be indicated by a "#" in the left margin.

HEWLETT PACKARD

LIST OF EFFECTIVE PAGES

SERIAL PREFIX OR SERIAL NUMBER	PAGES
All Serials	After vi, 1-1, 1-2, 5-2, 5-3, 5-9, 5-10, 5-11, 6-16
2252A	6-13, 6-15, 8-25, 8-31
2448A	6-5, 6-6, 6-7, 6-8, 6-9, 6-11 8-9, 8-11, 8-13, 8-15, 8-17, 8-19, 8-21
2520A	6-13, 8-25, 8-31

SERIAL PREFIX OR SERIES NUMBER	CHANGES

After page vi:

All Serials >Delete the FCC RFI statement.

Page 1-1, General Information:

All Serials Paragraph 1-9:
>Delete the last sentence, The High-Accuracy Temperature Sensor is no longer available.

Page 1-2, Table 1-1, 5510A Specifications:

All Serials **Air Temperature/Accuracy:**
>Change the specification to read: "+-0.65 deg C +-0.01 deg C/Month over the range of 13-40 deg C."

Pressure/Accuracy:
>Change the specification to read: "+-1.5 mm Hg +-0.25 mm Hg/Month over the range of 560-790 mm Hg."

Overall Wavelength Compensation Accuracy:
>Delete the Air Temperature, Air Pressure, and Humidity specifications.
>Change the specification for Total Wavelength Compensation Measurement Error (worst case) to read: "+-1.5 ppm +-0.1 ppm/Month over the range of 13-40 deg C."

Interferometer/Automatic Compensator System Accuracy:
>Change specification for English units to: "+-2.0 ppm +-1 count in least significant digit."
>Change specification for Metric units to: "+-2.0 ppm +-2 counts in least significant digit."

Accuracy, right-hand column:
>Delete all reference to the 10563 Option 001 High Accuracy Sensors.

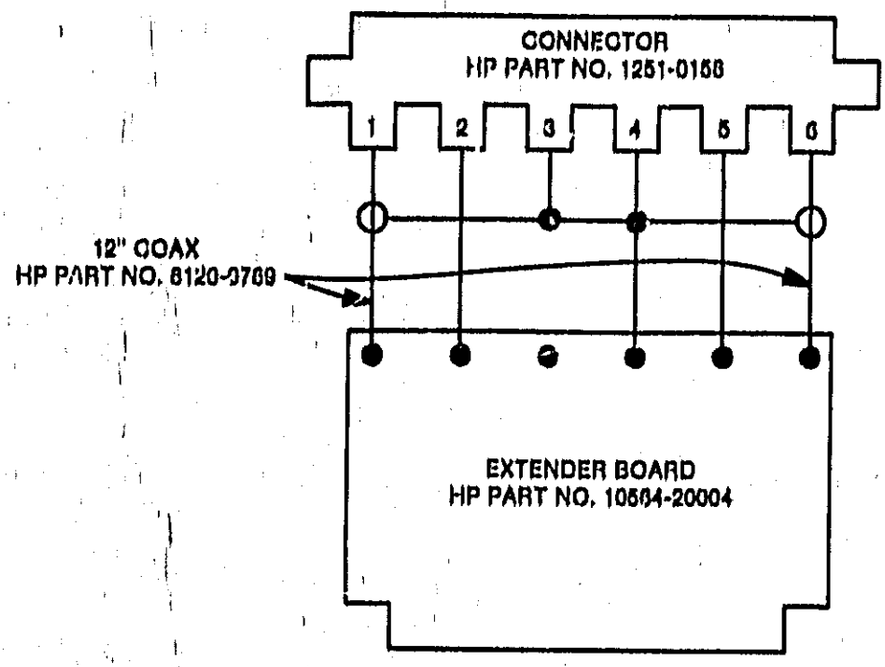
Accessories Available:
>Delete item 2. The High Accuracy Sensor is no longer available.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

Page 5-2, Table 5-2. Recommended Test Equipment:

All Serials

>Change 5th item "Recommended Type" from K12-5510A to "10694-60001" and "10694-60003".
>Change 6th item from "Cable" to Extender Cable.
>Change 6th item "Recommended Type" from K14-5510A to "Note A".
>Delete NOTE A and items 1 and 2.
>Add "NOTE A: Cable can be constructed as shown in following figure:"



Page 5-3. Maintenance:

All Serials

Paragraph 5-12:
>Change the second sentence to read: "The procedures require the use of a calibration kit, consisting of test controller board 10694-60003 and current-to-voltage converter board 10694-60001.

Step c, second sentence:
>Change 05510-92001 to 10694-60001.

Step d:
>Change 05510-91005 to 10694-60003.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

Page 5-9. Maintenance:

All Serials — Paragraph 5-19:
>Delete note just below step f.

Page 5-10. Maintenance:

All Serials — Paragraph 5-23, step h:
>Change special cable K14-5510A to "Extender Cable (see Note A under Table 5-2)".

Page 5-11. Maintenance:

All Serials
>Delete the note at the top of the page.

>Paragraph 5-24, step f:
>Change to read "Connect Extender Cable (see Note A under Table 5-2) between the 10564-60004 board and the socket on the 10564-60003".

Page 6-5, Table 6-2, A1 Voltage Reference Assembly Replaceable Parts:

2448
>Add "(SERIES 2448)" to A1 (05510-60001) description.
>Change C7 from 0180-0106 to 0180-2929 CAPACITOR-FXD 68uF +-10% 10VDC TA.

Pages 6-5/6-6, Table 6-2, A2 Current Reference Assembly Replaceable Parts:

2448
>Add "(SERIES 2448)" to A2 (05510-60002) description.
>Change C1, C2 from 0180-1746 to 0180-3074 CAPACITOR-FXD 68uF +-10% 10VDC TA.

Page 6-6, Table 6-2, A3 Integrator Assembly Replaceable Parts:

2448
>Add "(SERIES 2448)" to A3 (05510-60003) description.
>Change C3, C4, C6, C7, C9, C10 from 0180-1746 to 0180-3074 CAPACITOR-FXD 15uF +-20% 30VDC TA.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

Pages 6-7/6-8, Table 6-2. A4 Pressure Buffer Assembly Replaceable Parts:

2448 >Add "(SERIES 2448)" to A4 (05510-60004) description.
>Change C1, C2, C3, C4 from 0180-1746 to 0180-3074 CAPACITOR-FXD 15uF +-20% 30VDC TA.

Pages 6-8/6-9, Table 6-2. A5 Air Temperature Assembly Replaceable Parts:

2448 >Add "(SERIES 2448)" to A5 (05510-60005) description.
>Change C1, C2 from 0180-1746 to 0180-3074 CAPACITOR-FXD 15uF +-20% 30VDC TA.

Pages 6-9/6-10, Table 6-2. A6 Material Temperature Averager Replaceable Parts:

2448 >Add "(SERIES 2448)" to A6 (05510-60006) description.
>Change C1, C2 from 0180-1746 to 0180-3074 CAPACITOR-FXD 15uF +-20% 30VDC TA.

Pages 6-11/6-12, Table 6-2. A7 Humidity Assembly Replaceable Parts:

2448 >Add "(SERIES 2448)" to A7 (05510-60007) description.
>Change C2, C3, C4 from 0180-0210 to 0180-3574 CAPACITOR-FXD 3.3uF 30V TA.

Page 6-13, Table 6-2. A9 Control Board Assembly Replaceable Parts:

2252 >Change A9U7, U24, and U29 from 1820-0627 to 1820-0111, QTY 4, IC-DCDR TTL BCD-TO-DEC 4-TO-10-LINE, 04713; MC8301P.

2520 >Change A9 (05510-60009) SERIES to 2504.
>Change A9U16 from 1820-0875 to 1820-0704 IC-TTL 74122.

Page 6-15, Table 6-2. A12 Interface Driver Assembly Replaceable Parts:

2252 >Change A12U2 from 1820-0627 to 1820-0111 IC-DCDR TTL BCD-TO DEC 4-TO-10-LINE, 04713, MC8301P.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

Page 6-16, Table 6-2. A15 Connector Board Assembly:

All Serials >Add 05510-20026, Qty 6, CONNECTOR CLIPS; used with A15J1 thru A15J6.

Page 8-9, Figure 8-7. A1 Voltage Reference Assemble Schematic Diagram:

2448 >Change A1 (05510-60001) SERIES to 2448.
>Change C7 value from 60uF to 68uF.

Page 8-11, Figure 8-8. A2 Current Reference Assembly Schematic Diagram:

2448 >Change A2 (05510-60002) SERIES to 2448.

Page 8-13, Figure 8-9. A3 Integrator Assembly Schematic Diagram:

2448 >Change A3 (05510-60003) SERIES to 2448.

Page 8-15, Figure 8-10. A4 Pressure Buffer Assembly Schematic Diagram:

2448 >Change A4 (05510-60004) SERIES to 2448.

Page 8-17, Figure 8-11. A5 Air Temperature Assembly Schematic Diagram:

2448 >Change A5 (05510-60005) SERIES to 2448.

Page 8-19, Figure 8-12. A6 Material Temperature Averager Schematic Diagram:

2448 >Change A6 (05510-60006) SERIES to 2448.

Page 8-21, Figure 8-13. A7 Control Board Assembly Schematic Diagram:

2448 >Change A7 (05510-60007) SERIES to 2448.

SERIAL PREFIX OR SERIES NUMBER	CHANGES

Page 8-25, Figure 8-15, A9 Control Board Assembly:

2252

Table of Active Elements:
>Change U7, U24 and U29 from 1820-0627 to 1820-0111, MP8301P.

2520

>Replace A9 (05510-60009) schematic diagram with new schematic diagram (SERIES 2504).

Table of Active Elements:
>Change A9U16 from 1820-0875 (9600) to 1820-0704 (74122).

Page 8-31, Figure 8-18, A12 Interface Driver Assembly:

2252

Table of Active Elements:
>Change U2 from 1820-0627 to 1820-0111; MC8301P.

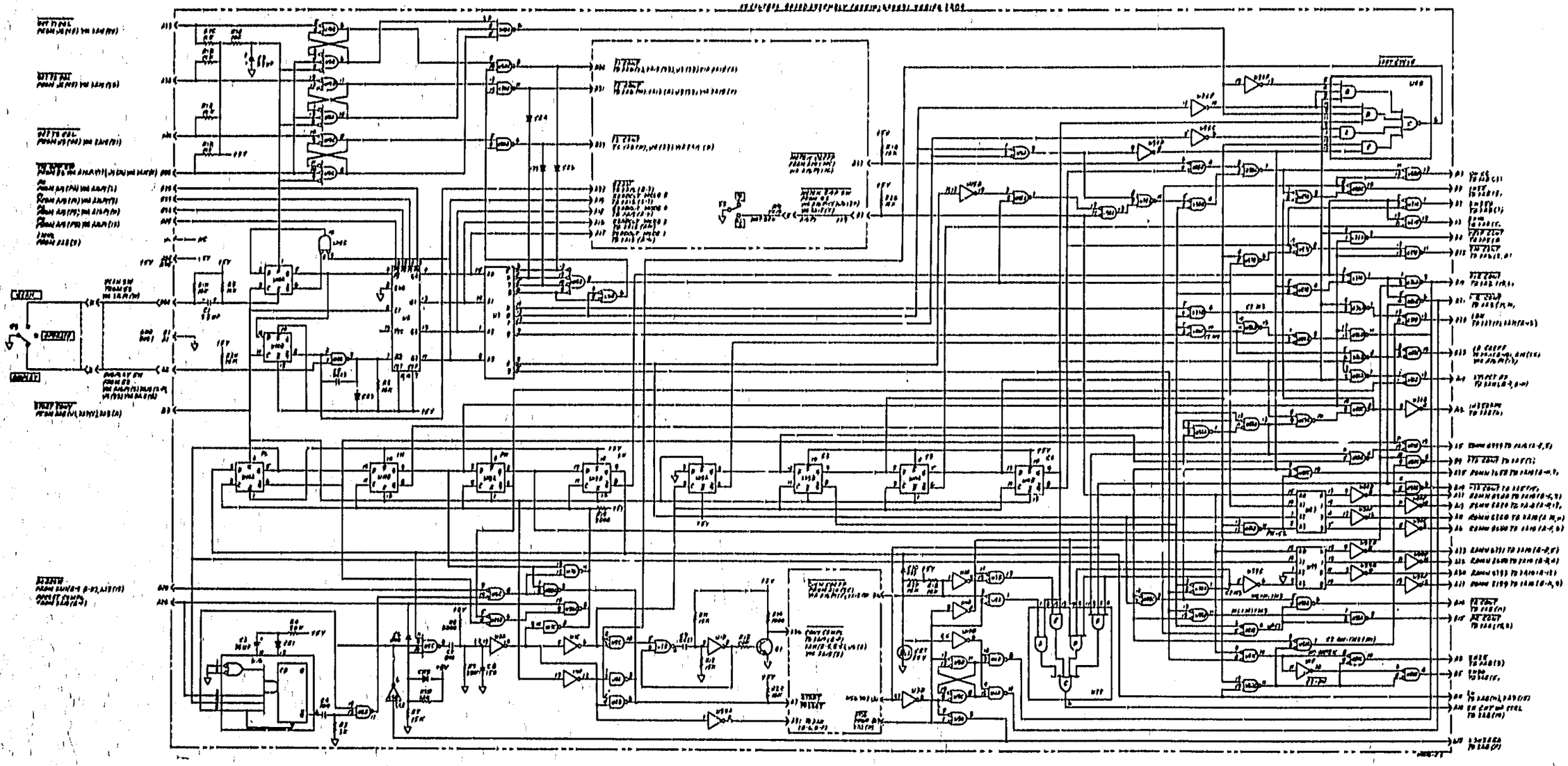


Figure 8-15
A9 Control Board Assembly
(05510-60009 SERIES 2504)

9