HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

MODEL 44421A
LOW THERMAL RELAY ASSEMBLY
(Option 010)

MODEL 44422A
LOW THERMAL RELAY ASSEMBLY
WITH THERMOCOUPLE COMPENSATION
(Option 020)

WARNING

Only personnel with knowledge of electronic circuitry should install, reconfigure, or make repairs to the instrument.

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HEWLETT PACKARD

CERTIFICATION

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

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment [,except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period] . During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by -hp-. Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

Hewlett-Packard warrants that its software and firmware designated by -hp- for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

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

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HEWLETT PACKARD

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

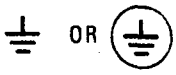
Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals.

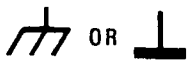
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

The DANGER sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which could result in injury or death to personnel even during normal operation.

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which,if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE:

The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual contains operating and service instructions for the following cards and assemblies:

Option 10	Low Thermal Relay
Option 20	Low Thermal Relay (with thermocouple compensation)

1-3. Applicability.

1-4. Option 10 and Option 20 are intended for use with the -hp- 3497A Data Acquisition/Control Unit and/or the 3498A Extender.

1-5. DESCRIPTION.

1-6. Card Structure.

1-7. The Low Thermal Relay card consists of reed actuated relays that switch High, Low, and Guard on each of twenty channels. Inputs to the relay card are provided by terminal connector cards, one of which has thermocouple compensation built in. The reed relays switch the inputs to a common on card bus which may be divided into two decades. The output of the common bus can be accessed through the terminal card or switched onto the mainframe common analog bus through a tree switching relay (see Figure 1-1).

1-8. Terminal Cards.

1-9. The terminal card without thermocouple compensation has straight through connections from the terminals to the edge connector. The compensated terminal card has electronic devices to measure the temperature of the terminal strips (through a plated layer on the circuit board) and to convert this temperature to an offset voltage that simulates an ice point reference. The reference is used to offset the thermocouple generated voltage and is matched to the thermocouple type through a selectable resistance network. The offset thermocouple voltage leaving the connector card can be directly compared to a lookup table for conversion to a temperature value.

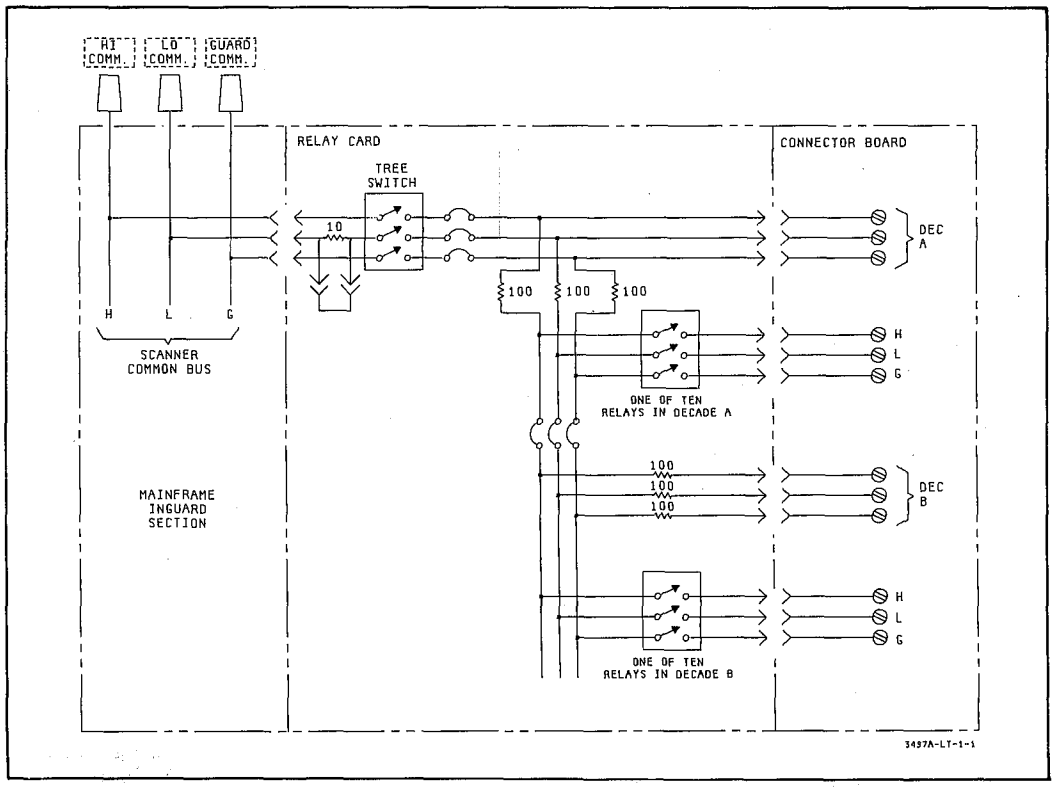


Figure 1-1. Low Thermal Relay Card.

1-10. Channel Determination.

1-11. The channel numbers which the relays assume are determined by the slot in which they are placed. Relay sequencing and selection is determined by instructions obtained via the remote control interface or manual inputs from the front panel. Operating instructions are given in Section III Operation.

1-12. SAFETY.

1-13. When connected to a power source or when installed in an instrument, voltage potentials of up to 170 volts peak may be present on the circuit board and circuit board devices. Only service trained personnel are permitted access to devices within the covers of the instrument.

WARNING

Never remove or replace the Low Thermal Relay assembly with power applied to the instrument or with power sources connected to the terminal cards.

1-14. MANUAL CHANGES.

1-15. Manual changes necessitated by circuit board revision or errata in documentation are given in a Manual Changes Supplement. To keep this manual as current as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes Supplement. The supplement is identified with the manual print date and part number.

1-16. WARRANTY.

1-17. The warranty information provided with this manual covers the Low Thermal Relay card options and does not extend to any other options used with the 3497A or 3498A.

1-18. ORDERING ADDITIONAL MANUALS.

1-19. A manual is shipped with each Model 44421A or 44422A order. Additional manuals may be purchased from your local Hewlett-Packard Sales and Service Office. Specify the card model number and the -hp- Part Number as shown on the title page.

1-20. SPECIFICATIONS.

1-21. Specifications for the Low Thermal Relay Assembly are give in Table 1-1.

Table 1-1. Specifications.

Low Thermal Relays:

Input Characteristics
- Maximum Input Voltage: < 170 V peak between any two terminals.
- Maximum Current: 50 mA per channel non-inductive
- Maximum Power: 1 VA per channel
- Thermal Offset:
  - Direct Switched: < 1 μV Differential
  - Tree Switched: < 2 μV Differential
- Closed Channel Resistance:
  - In Series: 100 ohms ± 10% in High, Low, and Guard
  - Relays only: < 1 ohm

Isolation (Relays)

	25°C, < 85% R.H. 40°C, < 60% R.H.	40°C, < 95% R.H.
HI To LO		
Relay Open	$>10^{10}$ Ohm	$>10^{9}$ Ohm
Relay Closed		
Option 010	$>10^{10}$ Ohm	$>10^{9}$ Ohm
Option 020	$>10^{8}$ Ohm	$>10^{7}$ Ohm
LO to GUARD	$>10^{10}$ Ohm	$>10^{7}$ Ohm
GUARD to CHASSIS	$>10^{10}$ Ohm	$>10^{9}$ Ohm

Operating Characteristics:
- Maximum Switch Rate: 475/second using hardware increment
- Rated Switch Life at 1 VA: 10^7 operations
- All relays are Break Before Make

AC Performance
- High to Low Capacitance:
  - Channel Open: < 10 pF/channel
  - Channel Closed: < 220 pF/channel
- Interchannel Capacitance: < 15 pF

Cross Talk	100 kHz	1 MHz
Channel to Common		
50 ohm termination	70 dB	50 dB
1 M ohm termination	50 dB	40 dB
Channel to Channel		
50 ohm termination	70 dB	32 dB
1 M ohm termination	50 dB	30 dB

Thermocouple Compensation:
- Reference Junction Compensation Accuracy (23°C ± 5°C): ± 0.1°C
- Temperature Coefficient: (0°C to 18°C, 28°C to 50°C): .009°C/°C
- Stability: 075°C/1000 hours
- Temperature across isothermal block < 2°C

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section provides installation instructions for the Low Thermal Relay circuit board. This section also includes information concerning initial inspection, damage claims, packaging, storage, and shipment.

2-3. INITIAL INSPECTION.

2-4. The relay circuit board and terminal boards were carefully inspected both mechanically and electrically before shipment. The assembly should be free from physical damage and be in perfect electrical order upon receipt. To confirm this, inspect the circuit boards and covers for physical damage. If any damage was incurred in transit, file a claim with the carrier. Test the electrical performance of the assembly as directed by the Performance Test (Section IV of this manual). If there is damage or deficiency, see the warranty in the front of the manual.

2-5. OPERATING ENVIRONMENT.

2-6. Because of the high impedance requirements for the circuit board and circuit board components, clean handling techniques must be used exclusively. Also be aware of the specifications changes due to the relative humidity in the operating environment and the specifications changes applicable when the circuit board is used in the 3498A Extender. The specifications are located in the General Information portion of the manual.

CAUTION

Use clean handling techniques when removing, replacing, or reconfiguring the circuit boards. Handle the circuit board by the edges and do not subject the components to static discharges or excessive voltages.

NOTE

Installation and hookup should be accomplished by service trained personnel who are aware of the hazards involved.

2-7. INSTALLATION.

2-8. The relay circuit board may be installed separately from the terminal board. Five slots are available for circuit board installation in the 3497A and ten slots are available for circuit board installation in the 3498A. Note however that to minimize low thermal offsets, the circuit board should be installed in the leftmost slots of the instrument with additional Low Thermal Relay boards installed in consecutive slots. Slot #4 in the 3497A and Slots #4 and #9 in the 3498A require that the temperature shield on the circuit board assembly be removed for installation. The relay card assumes the address of the slot in which it is placed. Consult the 3497A Mainframe functional area or the 3498A functional area for slot assigned addresses.

NOTE

Address configuration may not necessarily correspond to the slot location in the 3497A or the 3498A.

2-9. Hookup and installation of the terminal cards is given in Operation, Section III of this manual.

2-10. STORAGE AND SHIPMENT.

2-11. Environment.

2-12. The Low Thermal Relay assembly may be stored or shipped within the following limits:

Temperature ..... −40°C to +75°C
Humidity ..... Up to 95% R.H.

The assembly should also be protected from temperature extremes which may lead to condensation on the circuit board or circuit board components.

2-13. Packaging.

2-14. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the assembly is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and the serial number of the card. Also mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the assembly by model number, revision letter, and board serial number.

2-15. Other Packaging. The following general instructions should be used for repacking with commercially available materials:

a. Wrap the assembly in a material which will not subject the circuit board or circuit board components to static discharge.

b. Use a strong shipping container. A shipping container should be so constructed that the circuit board and circuit board components will not sustain damage in transit.

c. Seal the shipping container securely.

d. Mark the container as indicated in Original Packaging.

WARNING

The Model 44421A and the Model 44422A are not intended for outdoor use. Do not expose them to rain or other excessive moisture.

WARNING

Only personnel with knowledge of electronic circuitry should install, re-configure, or make repairs to this instrument.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. The Operation Section contains those instructions which correspond to the operation of the Low Thermal Relay assemblies. Also included are hookup, reconfiguration procedures, and information concerning the thermocouple compensation terminal card.

3-3. OPERATING COMMANDS.

3-4. The instructions which correspond to the Low Thermal Relay board are given in Table 3-1. Note that these instructions are also listed in the Command Quick Reference under the Analog grouping (see Interfacing, Commands and Syntax Structure).

Table 3-1. Analog Commands.

Mnemonic	Function	Definition
AFn	Analog First Channel	n=Ø to 999
ALn	Analog Last Channel	n=Ø to 999
AS	Analog Step	increments channel
AEn	Analog External Increment	n=Ø: OFF, n=1: ON, n=2: Fast Scan
AR	Analog Reset	Opens all analog channels
ACn1,n2,n3,n4	Analog Close	n=Ø to 999
AVn	Analog View	n=Ø to 999
AIn	Analog increment, close channel, and trigger VM	n=Ø to 999

3-5. Analog First Channel.

3-6. Sending "AFn" over the remote interface causes the sequence of channels to be scanned to begin at channel "n". The values of "n" may be an integer number from Ø to 999. The default value is Ø.

3-7. Analog Last Channel.

3-8. Sending "ALn" over the remote interface causes the sequence of channels to be scanned to terminate at channel "n". The value of "n" may be an integer number from Ø to 999. The default value is 999.

NOTE

If the channel designated by "AFn" is greater than the channel designated by "ALn", the scanning sequence will run in the order of decreasing channel numbers. These commands do not in themselves cause the closure of a channel, and therefore must be used in combination with other analog commands.

3-9. Analog Step.

3-10. Sending "AS" over the remote interface causes the next channel, in the sequence of channels being scanned, to close. If the sequence of channels has not been established, the next channel closed will be the next immediate channel in the order of increasing channel numbers between the default values of Ø and 999.

3-11. Analog External Increment.

3-12. Sending "AEn" over the remote interface enables or disables a control port on the rear panel of the Outguard Controller called EXT INCR. For n=1 or n=2 (fast scan), the negative going edge of a TTL pulse, input to the port, results in the next channel in the sequence of channels being scanned to close. See "Analog Step" for conditions concerning undefined sequences. For n=Ø, the port becomes disabled.

3-13. Special Considerations. When "AE2" (fast scan) is in effect, the 3497A controller is slaved to the scanning operation. Any control information (except AFn and ALn) will change the mode of EXT INCR to "AE1". In addition to this, BBM SYNC (break before make) is not monitored by the 3497A and the BBM SYNC output port may contain spurious data. As a general rule, use AE1 for closure rates to 350 channels/sec and AE2 for closure rates between 350 and 5000 channels/sec.

3-14. Analog Reset.

3-15. When "AR" is received, all analog channels are opened. In addition to this, the commands VF1,VR5, VWØ,VSØ,AEØ,AFØ,AL999 are in effect.

3-16. Analog Close.

3-17. Up to four channels may be closed simultaneously by using the "ACn1,n2,n3,n4" command. For example, to close channel 2 send "AC2"; to close channels 2,12,22,32 send "AC2,12,22,32". When this command is used, only one channel/decade may be closed at any one time.

NOTE

Up to ten channels may be closed simultaneously (one per decade) through reconfiguration of the Inguard Controller (see Mainframe Functional Area).

3-18. Analog View.

3-19. Analog view is initiated by the "AVn" command. This command causes the display (when the front panel option is present) to be locked onto the designated channel which is determined by the parameter "n" (Ø to 999). Analog view may be disabled by sending "AV" without a parameter. It is helpful to note that analog view is a real time function which may be initiated on the front panel during local lockout and during a scanning operation.

3-20. Analog Increment.

3-21. The command "AIn" causes the 3497A to go to the channel designated by the parameter "n" (Ø to 999), close the channel, and trigger the internal voltmeter (when VM option present).

WARNING

Verify that all power is disconnected from the 3497A before removing or replacing a terminal card.

3-22. USING THE UNCOMPENSATED TERMINAL CARD.

3-23. The uncompensated terminal card has High, Low, and Guard terminals for each channel. In addition to this, there are connector blocks for the Decade A bus as well as the Decade B bus. Each of the two connector blocks have High, Low, and Guard terminals with 100 ohms in series with each terminal (resistors are located on the relay board). When shipped from the factory, the Decade A bus is connected to the Decade B bus by jumper wires that are soldered into the relay circuit board.

3-24. For single channel readings, only the inputs to the appropriate channels need to be connected. Multiple channel readings require modification of the relay circuit board so that two input signals do not become shorted together. It is important to remember that only one channel per decade may be closed at any one time regardless of the addressing configuration.

3-25. To connect the inputs to the terminals remove four screws that retain the terminal card cover. Route the wires through the labyrinth in the card holder and out the port at the bottom; this provides strain relief for the terminals (see Figure 3-1). When finished replace the card cover.

3-26. Example Programs.

3-27. Closing a Channel. The following program in BASIC illustrates some of the steps which may be taken to close a single channel (1) via the remote interface.

```
1Ø CLEAR 7Ø9
2Ø OUTPUT 7Ø9; "AC1"
3Ø LOCAL 7Ø9
4Ø END
```

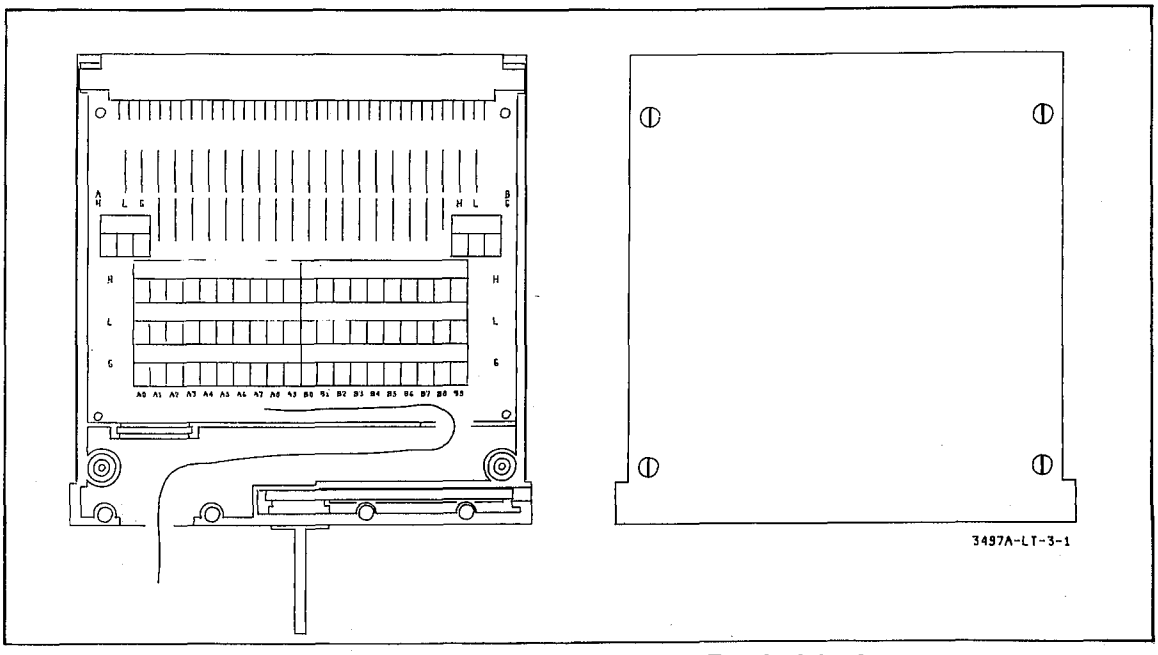


Figure 3-1. Wiring the Uncompensated Terminal Card.

3-28. Closing Multiple Channels. To close multiple channels (1 and 10), send "ACn1,n2" over the remote interface.

```
10 CLEAR 709
20 OUTPUT 709; "AC1,10"
30 LOCAL 709
40 END
```

3-29. Scanning Channels. To scan channels requires that the data be read after each channel is closed. The example program shows how channels 0 to 9 may be scanned. Either the internal voltmeter or a suitable remote controlled voltmeter may be used to convert the analog levels into digital data. The external voltmeter can be connected to HI COM, LO COM, and GUARD COM located on the rear panel of the 3497A.

```
10 CLEAR 709
20 OUTPUT 709; "AF0AL9"
30 FOR I=0 to 9
40 OUTPUT 709; "AS"
50 ! CONVERT ANALOG DATA HERE
60 NEXT I
70 LOCAL 709
80 END
```

3-30. Advanced Operating Information. For more complex procedures, such as using the external increment, see Advanced Operations in the main Operating and Service Manual.

3-31. USING THE COMPENSATED TERMINAL CARD.

3-32. The compensated terminal card is designed to accept several types of thermocouples and automatically compensate for the temperature error created in the thermocouple connector junction. The connector terminals are held in an isothermal block whose temperature is monitored by a solid state device.

3-33. Hardware Compensation.

3-34. Hardware compensation for the isothermal block region is available for J,K,T,E,R, and S type thermocouples. Specifically, two resistors on the thermocouple compensation connector board must be changed to accommodate each type of thermocouple. Remember also that only one type of thermocouple should be used per compensation connector board. Table 3-2 shows what values of compensation resistors to use for each type of thermocouple. Figure 3-2 shows where the two resistors are located.

3-35. A functional view of the thermocouple compensation terminal board is shown in Figure 3-3. This figure also shows the isothermal block and the proper connections for attaching the thermocouple wires. Note that the isothermal block does not enclose the GUARD terminals or the HIGH, LOW, and GUARD Decade Common I/O terminal blocks.

Table 3-2. Thermocouple Compensation Resistors.

Thermocouple Type	Resistor Value	-hp- Part No.
J	R120 3.650kΩ ±.1% R100 619Ω ±.1%	
K	R120 9.40kΩ ±.1% R100 357Ω ±.1%	
T	R120 8.210kΩ ±.1% R100 1.24kΩ ±.1%	
E	R120 435Ω ±.1% R100 909Ω ±.1%	
R	R120 149.625k ±.1% R100 2.55k ±.1%	
S	R120 149.625k ±.1% R100 2.1k ±.1%	

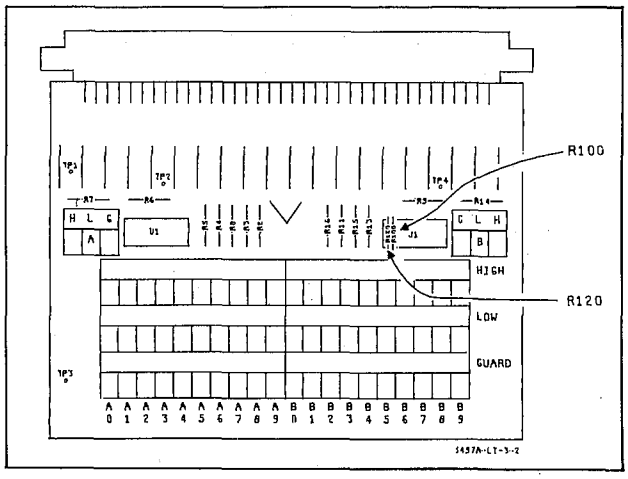


Figure 3-2. Compensation Resistor Location.

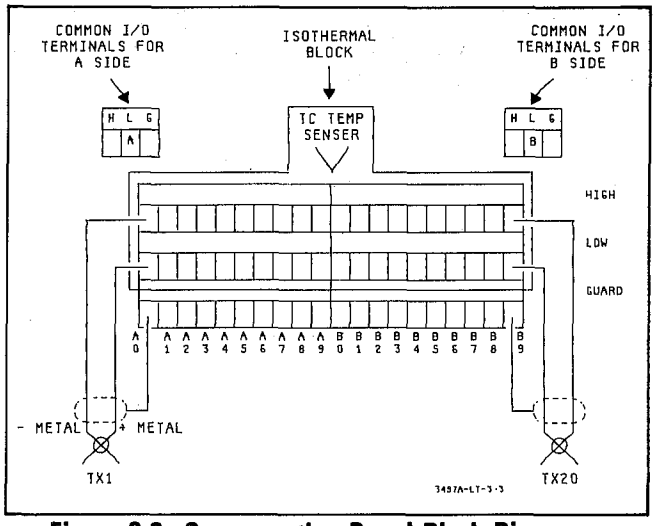


Figure 3-3. Compensation Board Block Diagram.

3-36. Software Compensation.

3-37. Often it is desirable to mix thermocouple types on a single terminal card. If this is necessary for your application, then software compensation must be used. Requirements for this mode of operation include modification of the terminal card in addition to having a controller program which compensates the thermocouple reading for terminal junction temperature variations. The relay board jumper must be set for "NO T/C COMP" (see Relay Board Modifications).

3-38. Modifying the Terminal Card. The terminal card must be modified such that the terminal junction temperature may be read on a dedicated input channel. Channel B9 is provided for this purpose and may be enabled for reading the temperature sensing device, in the iso-thermal block, after modification of a jumper block has taken place (see Figure 3-4).

3-39. Programming Considerations. Things to consider when setting up the software program are given as follows:

a. The terminal junction temperature sensing device is read on channel B9 and has the parameters of 2.5 V at 25°C with 100 mV/°C change.

b. Scan channel B9 often enough to reduce the possibility of measurement error due to terminal junction temperature drift.

3-40. Other Modifications.

3-41. Various portions of the terminal junction temperature reference circuit may be measured on designated channels by inserting wires into the jumper block. The jumper descriptions are illustrated in Figure 3-5.

3-42. Additional Information.

3-43. When using thermocouples, the following precautions should be considered:

a. Use the largest wire possible that will not shunt heat away from the measurement area.

b. Try to use thermocouple wire well within its rating.

c. Avoid mechanical stress and vibration which could strain the wires.

d. When making long runs, connect the shield to the GUARD terminal of the scanner and use twisted pair connector cables.

e. Avoid steep temperature gradients.

f. Use the proper sheathing material in hostile environments to reduce the effect on the thermocouple wires.

3-44. For further information concerning the use of thermocouples, refer to Hewlett-Packard Application Note AN290, Practical Temperature Measurements.

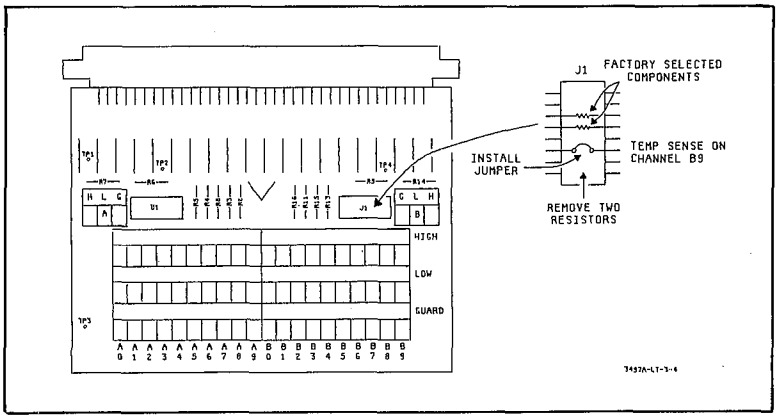


Figure 3-4. Modifications for Software Compensation.

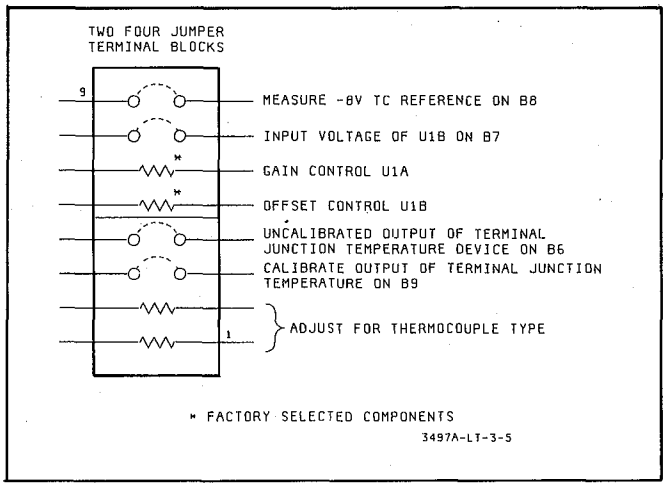


Figure 3-5. Jumper Configurations.

3-45. RELAY BOARD MODIFICATIONS.

3-46. The relay circuit board is shipped from the factory in a configuration that corresponds to the option ordered. However, further modifications may be made to the circuit board to enhance its utility for such tasks as performing a four wire ohms measurement. Figure 3-6 describes portions of the circuit board which are subject to reconfiguration. See Advanced Operations in the main Operating and Service Manual for procedures and setups to enable specific applications.

NOTE

Short out 100 Ohm resistors when making two wire ohms measurements or when using 3456A ohms function.

a. TC COMP Jumper. This jumper determines whether thermocouple compensation on the terminal card will be enabled. Set the jumper to "NO T/C COMP" for software compensation.

b. Decade A and Decade B to Tree Switch Jumpers. These jumpers enable Decade A and Decade B signals to pass through the tree switch (when energized) and onto the analog common bus.

c. Decade B to Decade A Jumpers. These jumpers enable Decade B to be connected to Decade A. Remove these for four wire ohms.

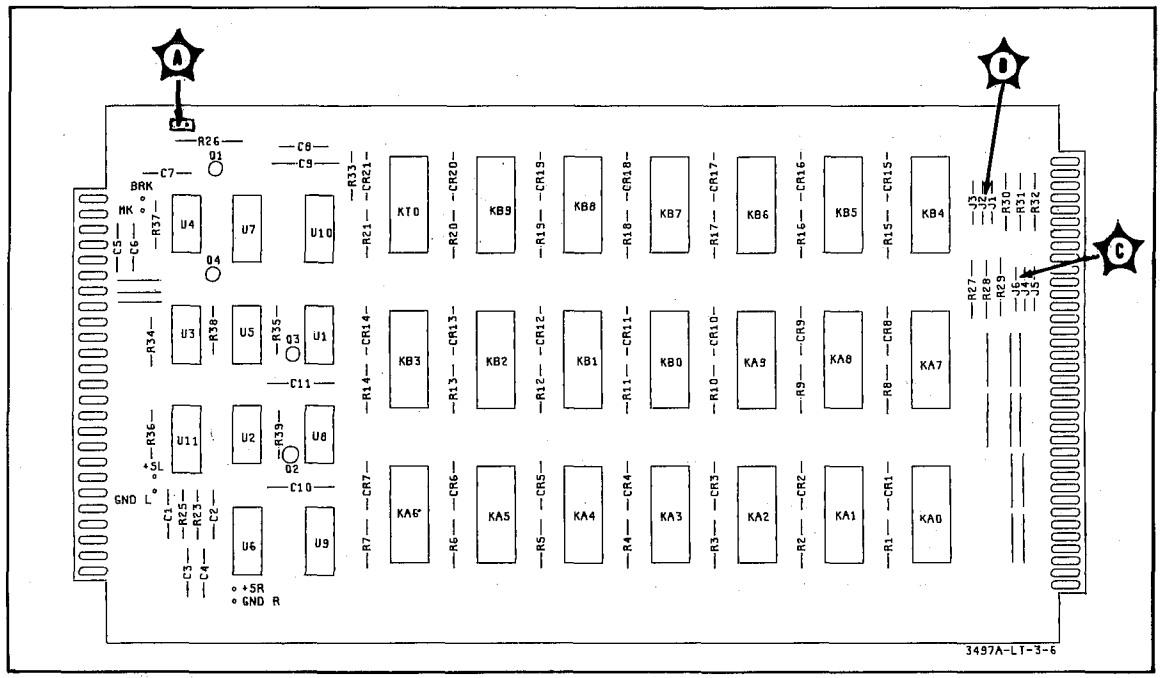


Figure 3-6. Relay Board Modifications.

3-47. PRECAUTIONS WHEN USING THE LOW THERMAL RELAY CARD IN THE 3498A.

3-48. When the Low Thermal Relay Assembly is used in the 3498A Extender, a possible hazard can exist when making measurements in a system containing a high voltage, high power source (100VA or above).

3-49. In the 3498A, the guard sheet metal might short to the chassis sheet metal because of close mechanical spacing. If this happens and if the 100 ohm resistor in the guard common line has been jumpered out (shorted), a current path to chassis ground can exist. See Figure 3-7.

3-50. If the guard common line is in contact with a high voltage, high power source (100VA or above) or could come in contact with such a source and the 100 ohm resistor in the guard common line has been jumpered, a possible fire or shock hazard could exist.

WARNING

Do NOT jumper the 100 ohm resistor in the guard common line. If this resistor must be jumpered, provide adequate external fusing shown in Figure 3-7.

After connecting wires to the terminal card outputs, replace the protective rear cover of the 3498A, since the sheet metal is at guard potential (as high as 170 volts).

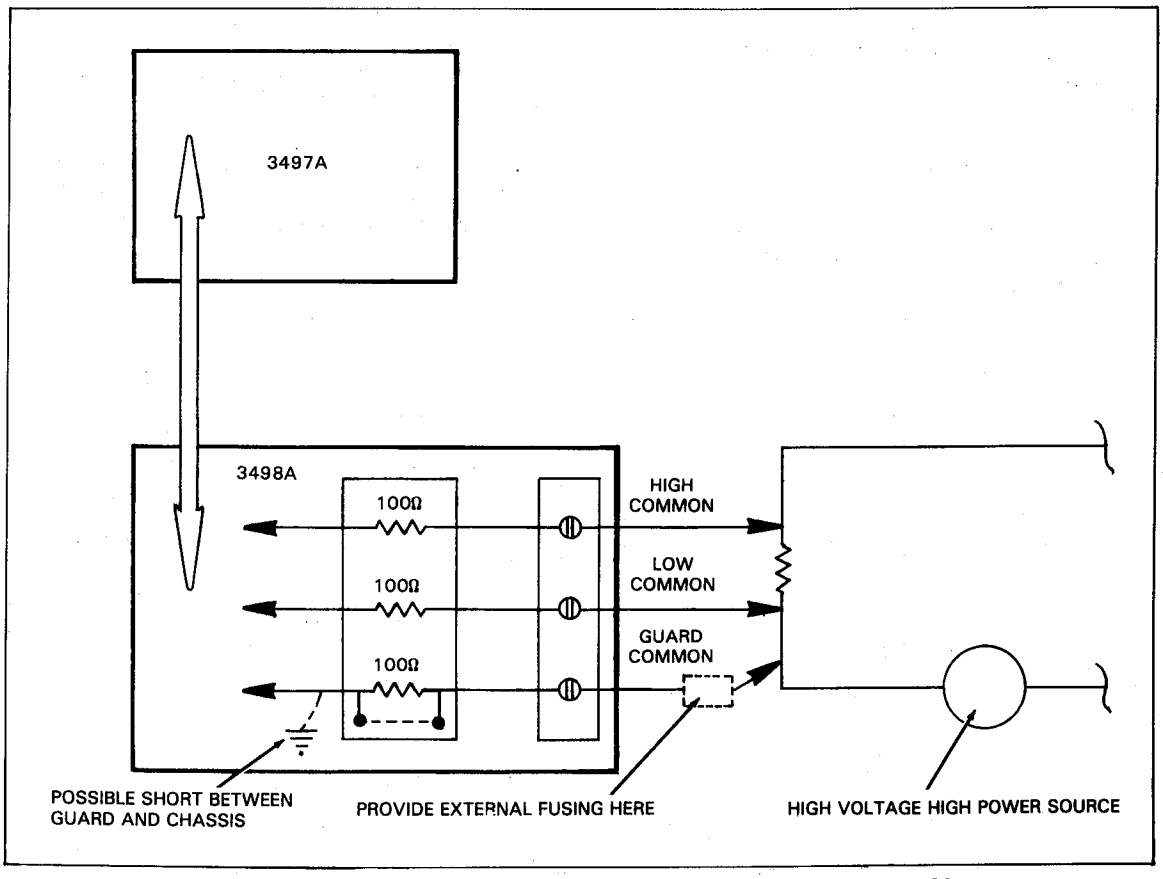


Figure 3-7. Fusing The Low Thermal Relay Card Guard Common Line.

SECTION IV
PERFORMANCE TEST

4-1. INTRODUCTION.

4-2. The performance test for the Low Thermal Relay assembly utilizes a 9825A Calculator and a 3455A Digital Voltmeter to measure the resistance between the terminal card and the analog common outputs (located on the rear panel of the 3497A).

4-3. RECOMMENDED TEST EQUIPMENT.

4-4. Test equipment required to check the Low Thermal Relay assembly is given in Table 4-1. Other equipment may be substituted if the specifications meet or exceed the specifications of the equipment given.

Table 4-1. Recommended Test Equipment.

Instrument	Important Characteristics	Required Model	Test
Calculator	N/A	-hp- 9825A (001)	All
Calculator ROMs	String Var/Adv Prog	-hp- 98210A	All
	Gen I/O-Extend Prog	-hp- 98214A	All
HP-IB Interface	N/A	-hp- 98034A	All
HP-IB Cable	One Required	-hp- 10631A	All
Digital VM	HP-IB compatible Resolution: 1 Ohm	-hp- 3455A	All

WARNING

Verify that all power is disconnected from the instrument before performing the Test Equipment Setup.

4-5. TEST EQUIPMENT SETUP.

4-6. Connect the calculator, DVM, and 3497A as indicated by the following procedure (use Figure 4-1 as a guide).

a. Verify that all equipment is turned OFF.

b. Install ROMs and HP-IB Interface in calculator.

c. Connect the HP-IB cable from the interface to the DVM and the additional cable from the DVM to the 3497A.

d. Verify that the DVM is set to address 22. The 3497A should be set to address 09 (factory set address).

4-7. Preparing a Terminal Card for Test Use.

4-8. The following procedure shows how a terminal card may be adapted for performance test use (see Figure 4-2):

a. Wire High, Low, and Guard together for Decade A. Then connect and mark a lead-out wire for test use to the same decade.

b. Wire High, Low, and Guard together for Decade B. Then connect and mark a lead-out wire for test use to the same decade.

c. If Decade B on the relay card is isolated from the tree switch (jumpers are removed), connect High, Low, and Guard between the common I/O terminal blocks of the connector card.

NOTE

The relay card must have the jumper for thermocouple compensation set to "NO T/C COMP".

4-9. PERFORMANCE TEST PROCEDURE.

4-10. The performance test is divided into three main parts:

a. Analog Common Bus Check.

b. Individual Relay Checks.

c. Multiple Closure Checks.

4-11. The controller will stop and prompt the operator to make connections to the DVM. After the connections are made, the operator should press "CONTINUE" to proceed with the test.

4-12. Analog Common Bus Check.

4-13. The analog common bus check measures the resistance of the bus from High Common to Low Common, from High Common to Guard Common, and from Low Common to Guard Common. The terminals that are connected to the DVM are located on the left rear panel (as viewed from the back) of the 3497A. The checks require the connections to be made as indicated in Figure 4-3.

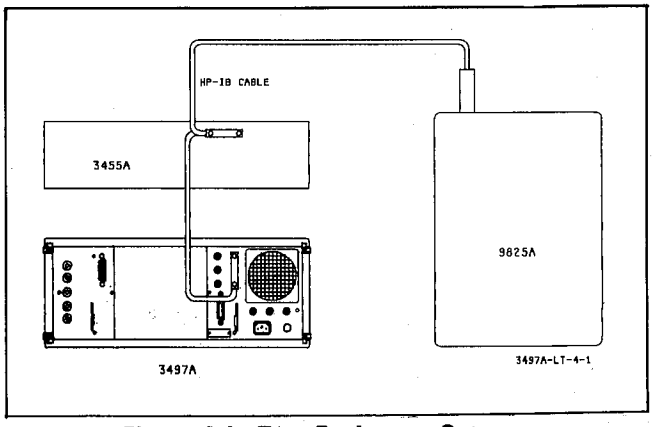


Figure 4-1. Test Equipment Setup.

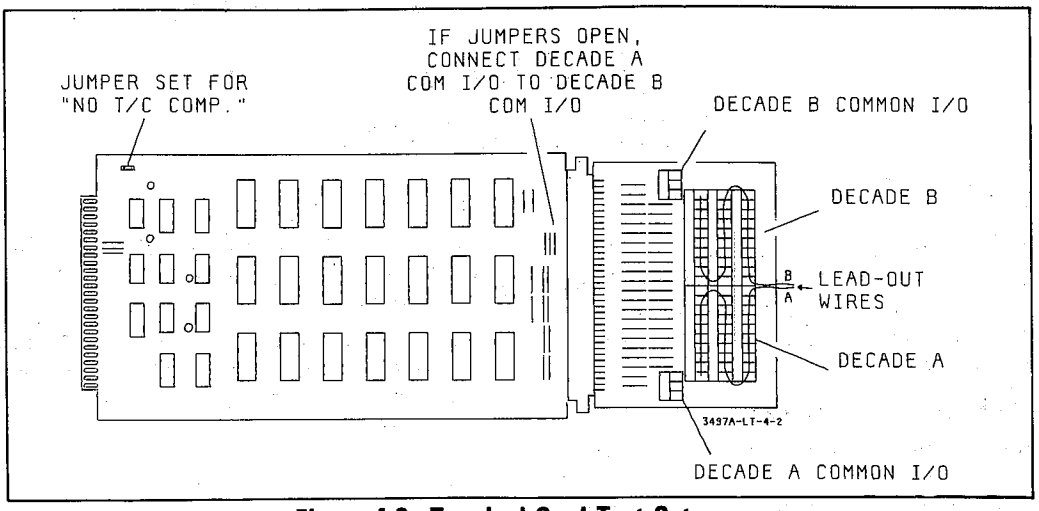


Figure 4-2. Terminal Card Test Setup.

4-14. Individual Relay Check.

4-15. The individual relay checks measure the resistance from the terminal card to one of the analog common bus terminals. This requires that the "LO" input to the DVM be connected to both the Decade A and Decade B lead-out wires (from the terminal card). The "HI" input to the DVM is then connected (as prompted by the controller) to "HI COM", then "LO COM", then "GUARD COM" (see Figure 4-4).

4-16. Multiple Closure Checks.

4-17. The multiple closure checks measure the resistance from relays on Decade A to relays on Decade B. The relays are closed in each of the possible combinations (one per decade). The "HI" input to the DVM is connected to the lead wire from Decade A and the "LO" input to the DVM is connected to the lead wire from Decade B (see Figure 4-5).

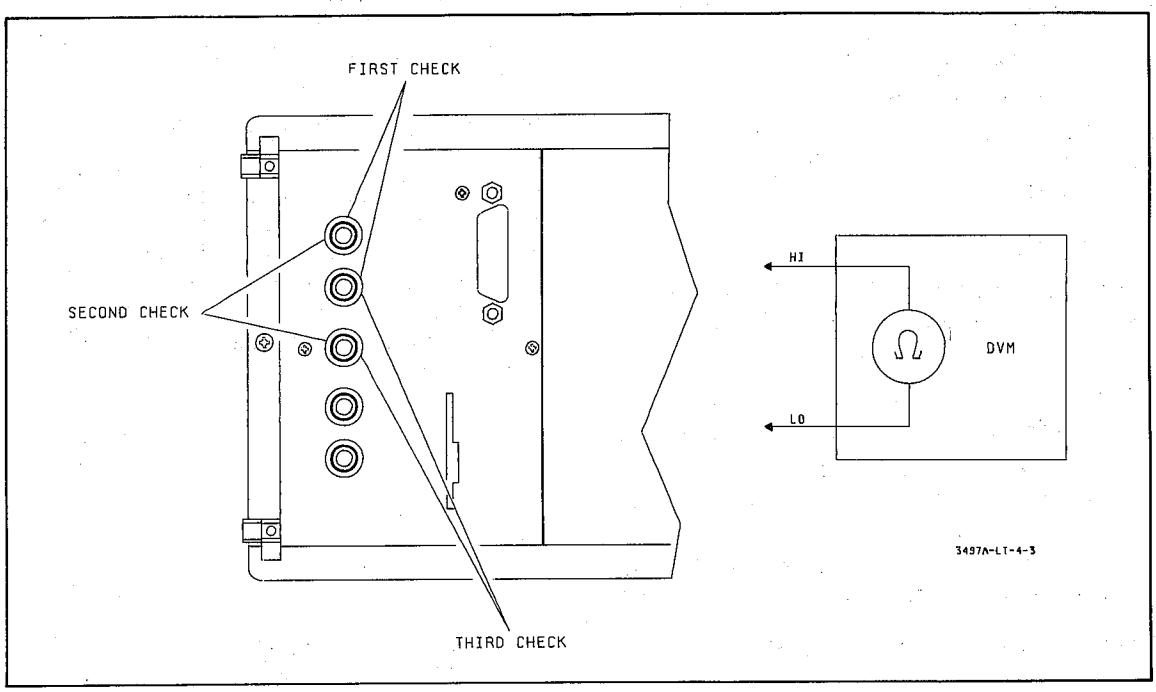


Figure 4-3. Analog Common Bus Checks.

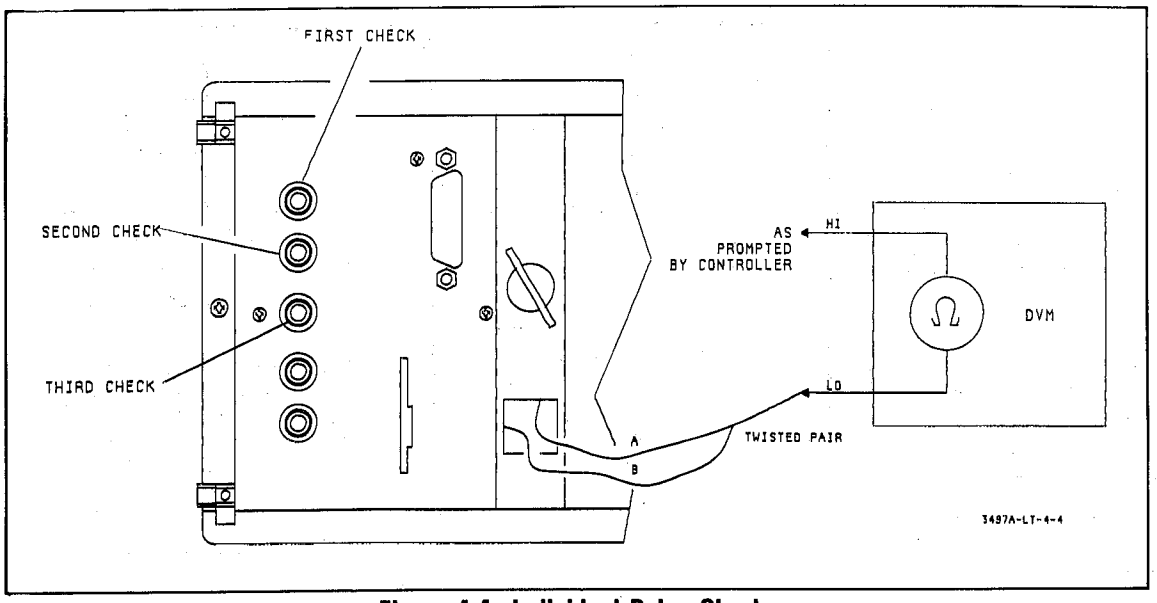


Figure 4-4. Individual Relay Checks.

4-18. Performing The Test.

4-19. Enter the program given in Figure 4-6 into the 9825A. If a different controller or DVM is used, see associated block diagram description of the test procedure.

4-20. Verify that all equipment has been operating long enough to meet specifications. The 3497A requires at least one hour of warm-up time. To initiate the test, press the RUN button on the 9825A. Operator interaction with the test will be prompted by the 9825A display.

NOTE

To save time, it may be useful to determine the channel numbers for Decade A and Decade B before running the checks. See Mainframe functional area for information on address reconfiguration of slots.

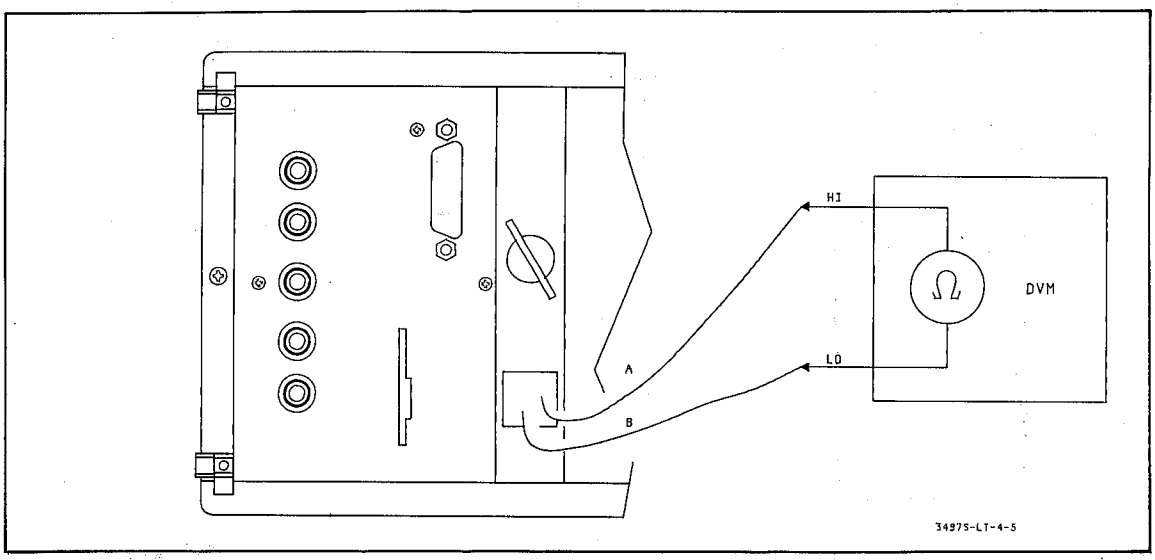
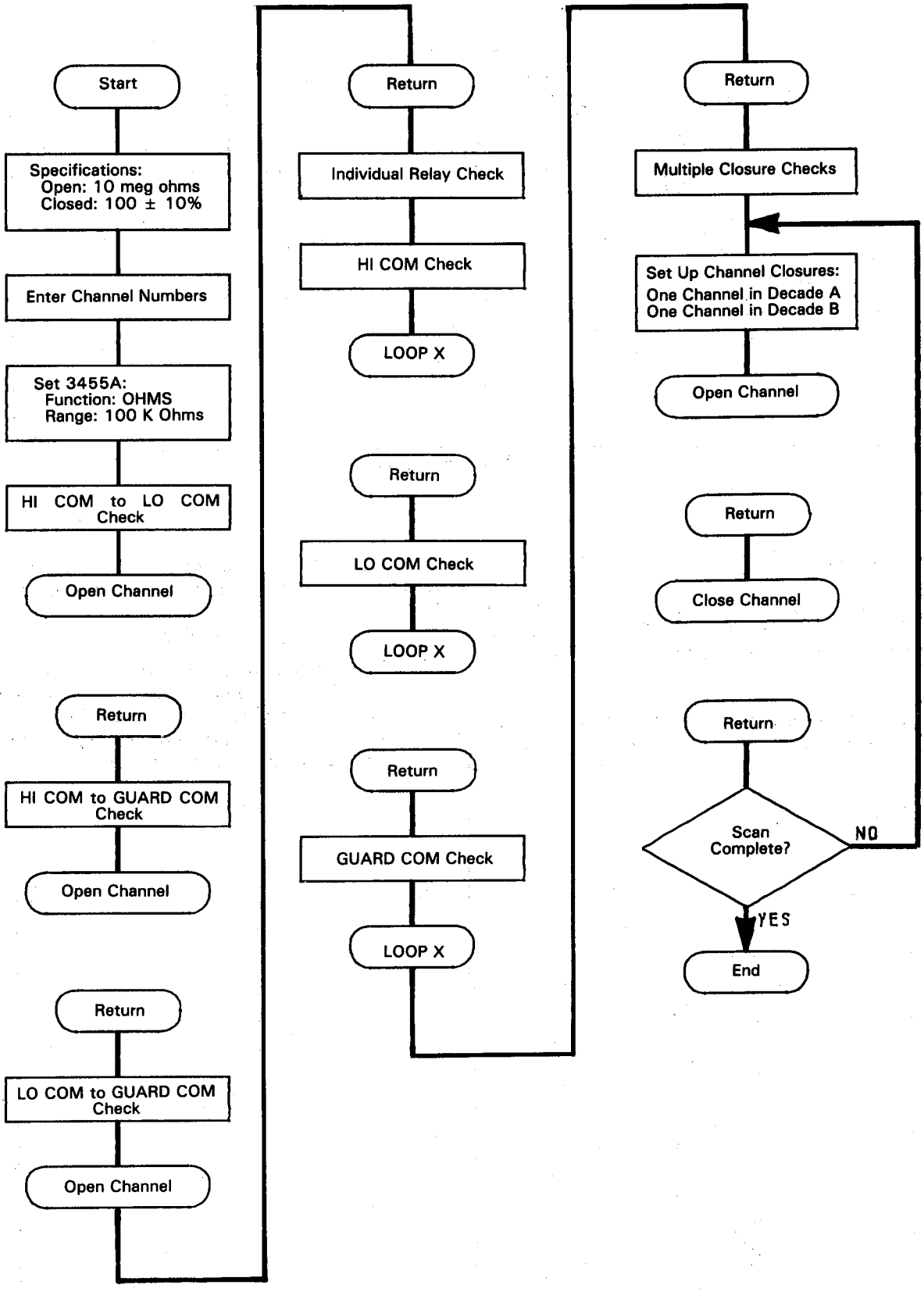
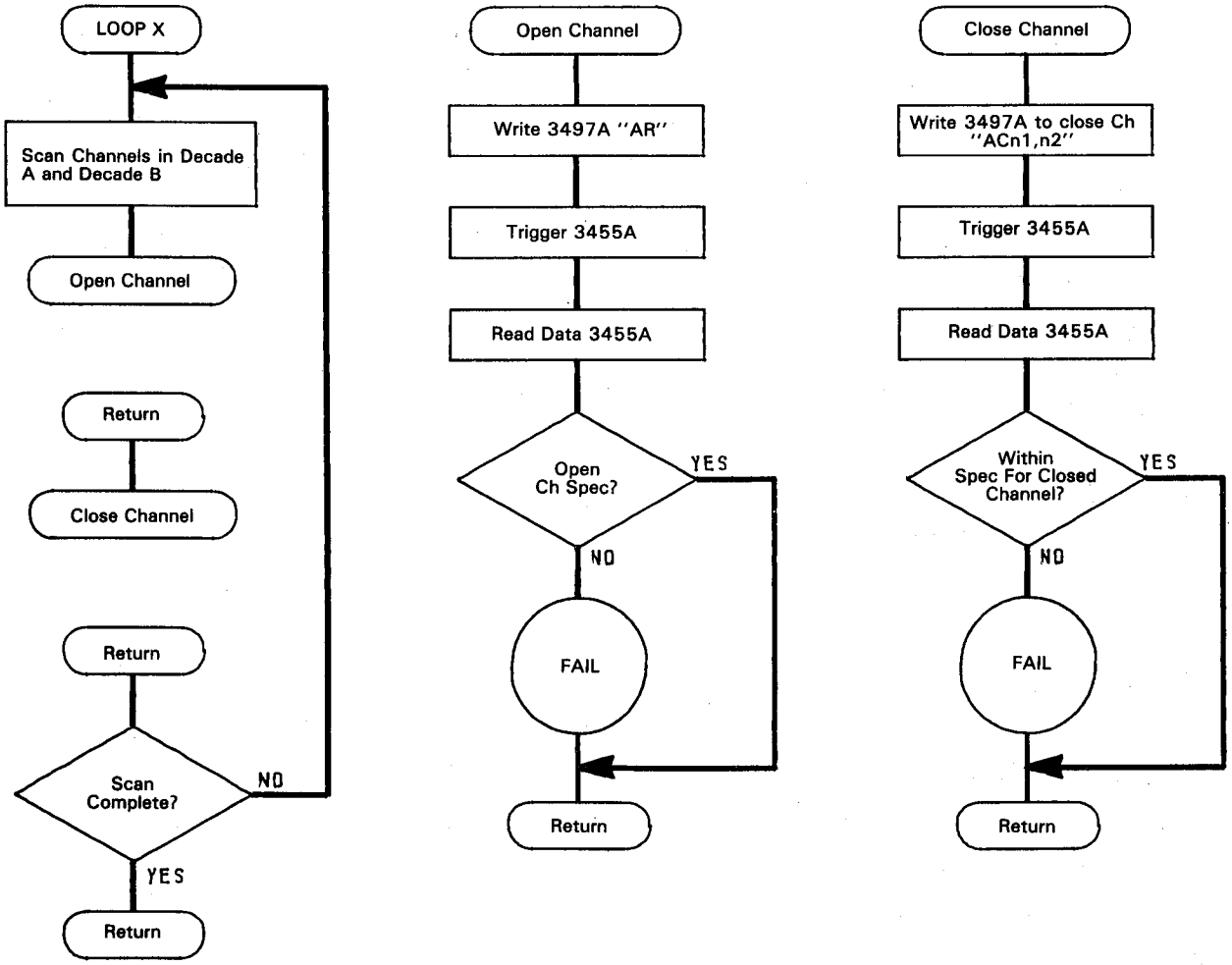


Figure 4-5. Multiple Closure Checks.


Start
Specifications:
Open: 10 meg ohms
Closed: 100 ± 10%
Enter Channel Numbers
Set 3455A:
Function: OHMS
Range: 100 K Ohms
HI COM to LO COM Check
Open Channel
Return
HI COM to GUARD COM Check
Open Channel
Return
LO COM to GUARD COM Check
Open Channel
Return
Individual Relay Check
HI COM Check
LOOP X
Return
LO COM Check
LOOP X
Return
GUARD COM Check
LOOP X
Return
Multiple Closure Checks
Set Up Channel Closures:
One Channel in Decade A
One Channel in Decade B
Open Channel
Return
Close Channel
Return
Scan Complete?
NO
YES
End

SUBROUTINES



3497A-LT-4-6

```
 0: "Open Channel Spec":10↑7→C
 1: "Close Channel Spec (high)":100+.1*100→D
 2: "Close Channel Spec (low)":100-.1*100→E
 3: " ":
 4: " ":
 5: ent "If T/C enter 1, then CONTINUE";U
 6: ent "Beginning Decade A Ch. #";A
 7: ent "Beginning Decade B Ch. #";B
 8: " ":
 9: " ":
10: prt "Press CONTINUE  only when RUN . light is OFF"⚡spc 4
11: prt "****************"
12: " ":
13: " ":
14: "Set up 3455A":
15: clr 722⚡wrt 722,"F4R4T3"
16: " ":
17: " ":
18: "************************************HI, LO, GUARD COM Resistance Check":
19: prt "****************"⚡spc 1
20: 1→P
21: dsp "VM: leads to HI COM and LOW COM"⚡stp
22: prt "*HI COM to LOW   COM Check**"
23: prt "****************"⚡spc 1
24: 1→P
25: gsb "Open Channel"
26: if P=0⚡gto 28
27: 1→P⚡prt "Check Passes"⚡spc 1
28: dsp "VM: leads to HI COM & GUARD COM"⚡stp
29: prt "****************"
30: prt "*HI COM to GUARD COM Check*"⚡spc 1
31: 1→P
32: gsb "Open Channel"
33: if P=0⚡gto 35
34: 1→P⚡prt "Check Passes"⚡spc 1
35: dsp "VM: leads to LO COM & GUARD COM"⚡stp
36: prt "****************"⚡spc 1
37: prt "*LO COM to       GUARD COM       Check*"⚡spc 1
38: 1→P
39: gsb "Open Channel"
40: if P=0⚡gto 43
41: 1→P⚡prt "Check Passes"
42: prt "****************"
43: " ":
44: " "⚡spc 3
45: prt "****************"
46: prt "****************"
47: "************************************************Individual Relay Check":
48: prt "Individual Relay     Checks"⚡spc 2
49: dsp "Decades A&B to LO VM INPUT"⚡stp
50: 1→S⚡1→P⚡0→Q
51: dsp "HI COM to HI VM INPUT"⚡stp
52: prt "****************"
53: prt "*HI Relay Checks"⚡spc 1
54: gsb "Loop X"
55: if Q=1⚡gto 57
56: prt "*HI Relay Checks Pass*"⚡spc 2
57: dsp "LO COM to HI VM INPUT"⚡stp
58: prt "****************"
59: prt "*LO Relay Checks"⚡spc 1
60: 0→Q⚡D→H⚡E→G
61: if U=1⚡D+10→D⚡E+10→E
62: gsb "Loop X"
63: if Q=1⚡gto 65
64: prt "*LO Relay Checks Pass*"⚡spc 2
65: dsp "GUARD COM to HI VM INPUT"⚡stp
66: H→D⚡G→E
67: prt "****************"
68: prt "*GUARD Relay     Checks"⚡spc 1
69: 0→Q
70: gsb "Loop X"
71: if Q=1⚡gto 73
72: prt "*GUARD Relay     Checks Pass*"⚡spc 2
73: " ":
74: " ":
75: prt "****************"
```

```
prt "****************"
"************************************Multiple Closure Functional Check":
dsp "Decade A to HI VM INPUT";stp
dsp "Decade B to LO VM INPUT";stp
prt "Multi-Closure       Checks";spc 1
prt "****************"
0→Q;0→S;1→P;10→D;-1→E
for I=1 to 2
for F=A to A+9
for L=B to B+9
dsp "Channels under test";F;L
gsb "Open Channel"
if P=1;gto 90
1→P;prt "Channels";F;L;spc 1;1→Q
gsb "Close Channel"
if P=1;gto 93
1→P;prt "Channels";F;L;spc 1;1→Q
next L
next F
A→X;B→A;X→B
next I
if Q=1;gto 99
prt "*Multi-Closure   Checks Pass*";spc 2
prt "****************"
prt "****************"
prt "**END OF TEST**";spc 6
end
" ":
" ":
"*****************************************************************Loop X":
"Loop X":A→X
for I=1 to 2
for F=X to X+9
dsp "Channel under test";F
gsb "Open Channel"
if P=1;gto 113
1→P;prt "Channel";F;spc 2;1→Q
gsb "Close Channel"
if P=1;gto 116
1→P;prt "Channel";F;spc 2;1→Q
next F
B→X
next I
ret
" ":
" ":
"*********************************************************Open Channel":
"Open Channel":fxd 0
wrt 709,"AR";wait 500
trg 722
red 722,O
if O>C;gto 132
prt "**Fail Open**"
prt "Spec =",C
prt "Ohms =",O
0→P
ret
" ":
" ":
"*********************************************************Close Channel":
"Close Channel":fxd 0
if S=1;gto 140
wrt 709,"AC",F,",",L;wait 500
gto 141
wrt 709,"AC",F;wait 250
trg 722
red 722,O
if O<D and O>E;gto 149
prt "**Fail Closed**"
prt "Spec (high)=",D
prt "Spec (low)=",E
prt "Ohms =",O
0→P
ret
*23407
```

SECTION V
ADJUSTMENTS

Not Applicable

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

This section contains information for ordering replacement parts for the Model 44421A and Model 44422A only. Table 6-3 lists parts in alphanumeric order of their reference designators and indicates the description, Hewlett-Packard part number of each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (Qty column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See List of Abbreviations in Table 6-1.)

c. Typical manufacturer of the part is a five-digit code. (See Table 6-2 for list of manufacturers.)

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed in Table 6-3 following their respective assemblies. General miscellaneous parts are listed at the conclusion of Table 6-3.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix A for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial number; board revision letter and serial number.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.
b. Instrument serial number.
c. Description of the part.
d. Function and location of the part.

6-8. PROPRIETARY PARTS.

6-9. Items marked by a dagger (†) in the reference designator column are available only for repair and service of Hewlett-Packard instruments.

Table 6-1. List of Abbreviations.

ABBREVIATIONS

Ag . . . silver	Hz . . . hertz (cycle(s) per second)	NPO . . . negative positive zero (zero temperature coefficient)	sl . . . slide
Al . . . aluminum	ID . . . inside diameter	ns . . . nanosecond(s) = 10^{-9} seconds	SPDT . . . single-pole double-throw
A . . . ampere(s)	impg . . . impregnated	nsr . . . not separately replaceable	SPST . . . single-pole single-throw
Au . . . gold	incd . . . incandescent		Ta . . . tantalum
C . . . capacitor	ins . . . insulation(ed)	Ω . . . ohm(s)	TC . . . temperature coefficient
cer . . . ceramic	kΩ . . . kilohm(s) = 10^{+3} ohms	obd . . . order by description	TiO_2 . . . titanium dioxide
coef . . . coefficient	kHz . . . kilohertz = 10^{+3} hertz	OD . . . outside diameter	tog . . . toggle
com . . . common			tol . . . tolerance
comp . . . composition	L . . . inductor	p . . . peak	trim . . . trimmer
conn . . . connection	lin . . . linear taper	pA . . . picoampere(s)	TSTR . . . transistor
dep . . . deposited	log . . . logarithmic taper	pc . . . printed circuit	V . . . volt(s)
DPDT . . . double-pole double-throw	mA . . . milliampere(s) = 10^{-3} amperes	pF . . . picofarad(s) 10^{-12} farads	vacw . . . alternating current working voltage
DPST . . . double-pole single-throw	MHZ . . . megahertz = 10^{+6} hertz	piv . . . peak inverse voltage	var . . . variable
elect . . . electrolytic	MΩ . . . megohm(s) = 10^{+6} ohms	p/o . . . part of	vdcw . . . direct current working voltage
encap . . . encapsulated	met flm . . . metal film	pos . . . position(s)	W . . . watt(s)
	mfr . . . manufacturer	poly . . . polystyrene	w/ . . . with
F . . . farad(s)	ms . . . millisecond	pot . . . potentiometer	wiv . . . working inverse voltage
FET . . . field effect transistor	mtg . . . mounting	p-p . . . peak-to-peak	w/o . . . without
fxd . . . fixed	mV . . . millivolt(s) = 10^{-3} volts	ppm . . . parts per million	ww . . . wirewound
GaAs . . . gallium arsenide	μF . . . microfarad(s)	prec . . . precision (temperature coefficient, long term stability and/or tolerance)	
GHz . . . gigahertz = 10^{+9} hertz	μs . . . microsecond(s)	R . . . resistor	
gd . . . guard(ed)	μV . . . microvolt(s) = 10^{-6} volts	Rh . . . rhodium	
Ge . . . germanium	my . . . Mylar ®	rms . . . root-mean-square	* . . . optimum value selected at factory, average value shown (part may be omitted)
gnd . . . ground(ed)	nA . . . nanoampere(s) = 10_{-9} amperes	rot . . . rotary	** . . . no standard type number assigned selected or special type
H . . . henry(ies)	NC . . . normally closed	Se . . . selenium	
Hg . . . mercury	Ne . . . neon	sect . . . section(s)	® Dupont de Nemours
	NO . . . normally open	Si . . . silicon	

DESIGNATORS

A . . . assembly	FL . . . filter	Q . . . transistor	TS . . . terminal strip
B . . . motor	HR . . . heater	QCR . . . transistor-diode	U . . . microcircuit
BT . . . battery	IC . . . integrated circuit	R(p) . . . resistor(pack)	V . . . vacuum tube, neon bulb, photocell, etc.
C . . . capacitor	J . . . jack	RT . . . thermistor	W . . . cable
CR . . . diode or thyristor	K . . . relay	S . . . switch	X . . . socket
DL . . . delay line	L . . . inductor	T . . . transformer	XDS . . . lampholder
DS . . . lamp	M . . . meter	TB . . . terminal board	XF . . . fuseholder
E . . . misc electronic part	MP . . . mechanical part	TC . . . thermocouple	Y . . . crystal
F . . . fuse	P . . . plug	TP . . . test point	Z . . . network

Table 6-2. Code List of Manufacturers.

Mfr No.	Manufacturer Name	Address
H9027	Schurter A G H	Luzern, SW
0049D	United Chemicon Inc.	
01121	Allen-Bradley Co.	Milwaukee, WI 53204
01295	Texas Instr. Inc. Semicond Compnt Div.	Dallas, TX 75222
0192B	RCA Corp. Solid State Div.	Somerville, NJ 08876
03508	GE Co. Semiconductor Prod. Dept.	Syracuse, NY 13201
04713	Motorola Semiconductor Products	Phoenix, AZ 85062
07263	Fairchild Semiconductor Div.	Mountain View, CA 94042
13606	Sprague Elect. Co. Semiconductor Div.	Concord, NH 03301
19701	Mepco/Electra Corp.	Mineral Wells, TX 76067
24546	Corning Glass Works (Bradford)	Bradford, PA 16701
27014	National Semiconductor Corp.	Santa Clara, CA 95051
27167	Corning Glass Works (Wilmington)	Wilmington, NC 28401
28480	Hewlett-Packard Co. Corporate Hq.	Palo Alto, CA 94304
32293	Intersil Inc.	Cupertino, CA 95014
34649	Intel Corp.	Mountain View, CA 95051
50522	Monsanto Co. Elek Special Prod.	Cupertino, CA 94304
56289	Sprague Electric Co.	North Adams, MA 01247
75915	Littelfuse Inc.	Des Plaines, IL 60016

Replaceable Parts

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9	03497-66509	3	1	LOW THERMAL RELAY ASSEMBLY	28480	03497-66509
A9C1	0180-2073	3	1	CAPACITOR-FXD .033UF+-10% 35VDC TA	28480	0180-2073
A9C2	0180-2127	8	1	CAPACITOR-FXD .15UF+-5% 35VDC TA	56289	150D154X5035A2
A9C3	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A9C4	0180-0309	4	5	CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A9C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9C6	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A9C7	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A9C8	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A9C9	0180-0229	7	3	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A9C10	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A9C11	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A9CR1	1901-0040	1	21	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR20	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9J1	8159-0005	0	38	WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J2	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J3	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J4	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J5	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J6	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J7	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J8	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J9	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J10	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J11	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J12	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J13	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J14	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J15	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J16	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J17	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J18	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9J19	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A9KA0	0490-1231	0	21	RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA1	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA2	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA3	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA4	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA5	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA6	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA7	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA8	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KA9	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB0	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB1	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB2	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB3	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB4	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB5	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB6	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB7	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB8	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9KB9	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9KT0	0490-1231	0		RELAY-REED 3A 250MA 200VDC 5VDC-COIL	28480	0490-1231
A9Q1	1853-0036	2	3	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A9Q2	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A9Q3	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A9Q4	1854-0009	1	1	TRANSISTOR NPN SI PD=300MW FT=600MHZ	04713	2N709
A9R1	0698-3445	2	21	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R2	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R3	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R4	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R5	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R6	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R7	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R8	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R9	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R10	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R11	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R12	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R13	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R14	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R15	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R16	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R17	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R18	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R19	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R20	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R21	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A9R23	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A9R25	0698-4478	3	1	RESISTOR 10.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1072-F
A9R26	0811-2123	3	1	RESISTOR 10 .1% .25W PWW TC=0+-10	28480	0811-2123
A9R27	0698-8768	2	6	RESISTOR 100 5% .25W CC TC=-400/+500	28480	0698-8768
A9R28	0698-8768	2		RESISTOR 100 5% .25W CC TC=-400/+500	28480	0698-8768
A9R29	0698-8768	2		RESISTOR 100 5% .25W CC TC=-400/+500	28480	0698-8768
A9R30	0698-8768	2		RESISTOR 100 5% .25W CC TC=-400/+500	28480	0698-8768
A9R31	0698-8768	2		RESISTOR 100 5% .25W CC TC=-400/+500	28480	0698-8768
A9R32	0698-8768	2		RESISTOR 100 5% .25W CC TC=-400/+500	28480	0698-8768
A9R33	0757-0401	0	3	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R34	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R35	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A9R36	0698-3558	8	3	RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A9R37	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A9R38	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A9R39	0698-4207	6	1	RESISTOR 44.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4422-F
A9R40	0683-1035	1	7	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9R41	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9R42	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9R43	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9R44	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9R45	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9R46	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A9U1	1820-1970	6	2	IC GATE CMOS OR QUAD 2-INP	04713	MC14071BCP
A9U2	1820-1970	6		IC GATE CMOS OR QUAD 2-INP	04713	MC14071BCP
A9U3	1820-1747	5	1	IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A9U4	1820-1209	4	1	IC BFR TTL LS NAND QUAD 2-INP	01295	SN74LS38N
A9U5	1820-0950	0	1	IC GATE CMOS NAND DUAL 4-INP	0192B	CD4012UBE
A9U6	1820-0958	8	2	IC LCH CMOS D-TYPE QUAD	0192B	CD4042AF
A9U7	1820-0958	8		IC LCH CMOS D-TYPE QUAD	0192B	CD4042AF
A9U8	1820-1963	7	1	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	0192B	CD4013BAE
A9U9	1820-1426	7	2	IC DCDR TTL LS BCD-TO-DEC 4-TO-10-LINE	01295	SN74LS145N
A9U10	1820-1426	7		IC DCDR TTL LS BCD-TO-DEC 4-TO-10-LINE	01295	SN74LS145N
A9U11	1820-4647	0	1	IC-MC14538BPC	28480	1820-4647
			8	MISCELLANEOUS PARTS		
	1251-4647	3	1	CONNECTOR 3 PIN	28480	1251-4647
	1258-0141	8	1	JUMPER REMOVABLE	28480	1258-0141
	0403-0408	8	1	FINGER ESTRACTOR: PC BOARD	28480	0403-0408
	5000-9043	6	1	PIN: FINGER EXTRACTOR	28480	5000-9043
	44421-90001			MANUAL*		
A10	03497-66510	6	1	TERMINAL ASSEMBLY T/C	28480	03497-66510
A10J1	1200-0473	8	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A10J10	1251-3323	0	2	CONNECTOR 8-PIN M RECTANGULAR	28480	1251-3323
A10J11	1251-3323	0		CONNECTOR 8-PIN M RECTANGULAR	28480	1251-3323
A10J12	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J13	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005

See introduction to this section for ordering information
*Indicates factory selected value

Replaceable Parts

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10J14	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J15	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J16	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J17	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J18	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J19	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J20	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J21	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J22	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J23	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J24	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J25	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J26	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J27	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J28	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J29	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10J30	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A10R1	0699-0122	8	1	RESISTOR 4.8K .1% .125W F TC=0+-25	28480	0699-0122
A10R2	0699-0192	2	1	RESISTOR 3.894K .1% .125W F TC=0+-25	28480	0699-0192
A10R3	0683-1025	9	2	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A10R4	0698-8190	4	1	RESISTOR 16.384K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-16384R-B
A10R5	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A10R6	0699-0107	9	1	RESISTOR 4.75K .1% .125W F TC=0+-25	28480	0699-0107
A10R7	0698-7670	3	1	RESISTOR 23.69K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-23691-B
A10R8	0698-6395	7	2	RESISTOR 7.5M 5% .25W FC TC=-900/+1100	01121	CB7555
A10R9	0698-6395	7		RESISTOR 7.5M 5% .25W FC TC=-900/+1100	01121	CB7555
A10R11	0698-4524	0	1	RESISTOR 174K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1743-F
A10R13	0699-0278	5	2	RESISTOR 15K .05% .1W F TC=0+-15	28480	0699-0278
A10R14	0698-6360	6	2	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A10R15	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A10R16	0699-0278	5		RESISTOR 15K .05% .1W F TC=0+-15	28480	0699-0278
A10R100				SELECTED RES. ACCORDING TO THERMOCOUPLE TYPE, SOLD AS AN ASSY IN 8 PIN DIP.		
A10R120				SELECTED RES. ACCORDING TO THERMOCOUPLE TYPE, SOLD AS AN ASSY IN 8 PIN DIP.		
	03497-67901	1	1	RESISTOR ASSEMBLY-A	28480	03497-67901
	03497-67902	2	1	RESISTOR ASSEMBLY-E	28480	03497-67902
	03497-67903	3	1	RESISTOR ASSEMBLY-J	28480	03497-67903
	03497-67904	4	1	RESISTOR ASSEMBLY-K	28480	03497-67904
	03497-67905	5	1	RESISTOR ASSEMBLY-R	28480	03497-67905
	03497-67906	6	1	RESISTOR ASSEMBLY-S	28480	03497-67906
	03497-67907	7	1	RESISTOR ASSEMBLY-T	28480	03497-67907
A10RS1				SELECTED RESISTOR, FACTORY REPAIR		
A10RS2				SELECTED RESISTOR, FACTORY REPAIR		
A10U1	1826-0719	1	1	IC OP AMP PRGMBL QUAD 16-DIP-C PKG	52063	XR346CJ
A10U2	1826-0661	2	1	IC TEMP XDCR TO-52 PKG	24355	AD590KH
				MISCELLANEOUS PARTS		
	0360-1995	8	1	BARRIER BLOCK-10	28480	0360-1995
	0360-1994	7	2	BARRIER BLOCK-30	28480	0360-1994
	1251-5944	5	1	CONNECTOR PC EDGE	28480	1251-5944
A11	03497-65511	5	1	TERMINAL ASSEMBLY	28480	03497-65511
	0360-1993	6	1	BARRIER BLOCK-10	28480	0360-1993
	0360-1994	7		BARRIER BLOCK-3	28480	0360-1994
	1251-5994	5	1	CONNECTOR PC EDGE	28480	1251-5994

See introduction to this section for ordering information
*Indicates factory selected value

SECTION VII
BACKDATING

Not Applicable

WARNING

Only personnel with a knowledge of electronic circuitry should install, reconfigure, or make repairs to this instrument.

SECTION VIII
SERVICE

8-1. INTRODUCTION.

8-2. This section contains the theory, procedures, schematics and component locators to aid in troubleshooting the 20 Channel Multiplexer assembly.

8-3. SAFETY CONSIDERATIONS.

8-4. Only service trained personnel are qualified to perform service on this assembly. Be aware of the following cautions and warnings:

WARNING

The 3497A or 3498A may contain voltages as high as 357 Volts within the cabinet enclosures. Always turn OFF and/or remove all sources of external power to the instrument BEFORE initiating any service procedures.

CAUTION

Do not subject this printed circuit assembly or any of the components to static electrical discharges. Also use clean handling techniques when any service operations are performed.

8-5. CIRCUIT DESCRIPTION.

8-6. General Operation.

8-7. All slots have the units data bus (UNØ-UN3) in common. The Decade A and Decade B signal lines, however, are unique to each slot. An analog card will respond only when one or both of its slot decade lines are activated. Each slot has in common a "BREAK" and a "MAKE" output. The inguard processor monitors these lines to assure that the break-before-make operation is carried out between successive relay closures. There are two major modes involving relay closures:

a. Single Relay Closures.
b. Multiple Relay Closures.

8-8. Single Relay Closures.

8-9. The following chronological events take place for a single relay closure:

a. Units bus lines UNØ-UN3 go high and decades A and B go high. For single closures, the (L) LATCH line is high causing a reset signal to be applied to U8A and U8B. The Q outputs of these flip-flops are held low and when subsequently applied to the CLK input of U6 and U7 causes them to be transparent (i.e. Q follows D). The transition of the decade and units data lines (to the high state) is sensed by "NAND" gate U5B, which has a low going output that triggers a single shot timer U11A. The pulse output from U11A (approximately 353 usec) is the "$\overline{\text{BREAK}}$" output from the relay board. Note that the break output is also applied to U2C and U2D (in this instance the signal is high true). This signal, along with a high on Decade A and Decade B, will cause the card to ignore any data on the units bus (thus helping to insure that all relays are open).

b. The next sequence of events occurs when "$\overline{\text{BREAK}}$" goes high and Decade A or Decade B goes low. The relay closure data is now placed on the units bus (UNØ-UN3). U5A, acting as a low true NOR, produces a high going signal (a pulse approximately 634 usec) which is inverted by U4A as the "MAKE" output. At the same time, U9 or U10 (depends upon whether Decade A or Decade B is selected) decodes the units data and closes an appropriate relay. Also U3C, acting as a low true NOR, outputs a signal to U4D causing closure of the tree switch relay "TØ". The activated relays will remain closed as long as UNØ-UN3 contains a valid relay address (BCD data for relays Ø to 9) or Decade A and Decade B do not both go high.

8-10. Multiple Relay Closure.

8-11. The same events for single closure are repeated for multiple closure. However, the process is repeated twice while the (L) LATCH signal line is held low. Now, the "MAKE" signal, in combination with the (L) LATCH signal and a low decade signal, will trigger the "D" flip-flop U8. The outputs from U8 will cause the latches U6 and/or U7 to retain the units data thereby resulting in the closure of the two selected channel relays. The relays will remain closed as long as the (L) LATCH line is held in a low logic state.

8-12. RECOMMENDED SERVICE EQUIPMENT.

8-13. The following equipment is recommended for troubleshooting the 20 Channel Multiplexer assembly.

Equipment/Aid	-hp- Model/Part No.
Logic Probe	-hp- Model 545A
Logic Pulser	-hp- Model 546A
Extender Cable	-hp- 03497-67913
Low Thermal Relay	

8-14. TROUBLESHOOTING INFORMATION.

8-15. Instrument Preparation.

8-16. To prepare the instrument and hence the Multiplexer card for troubleshooting, perform the following procedure:

WARNING

The 3497A or 3498A may contain voltages as high as 357 Volts within the cabinet enclosure.

a. Verify that the LINE switch is OFF.

b. Turn off other external sources of input power to the 3497A and/or 3498A and remove the safety cover from the rear of the instrument.

c. Remove all input terminal cards and/or verify that all sources of signal input power are within 40V of ground potential.

d. Unplug the multiplexer input board to be serviced and plug the extender cable in its place. Then plug the multiplexer board onto the extender cable.

e. Connect the Logic Probe to +5V and GND as indicated by designated pins on the printed circuit board.

f. Set the LINE switch to ON.

CAUTION

Use clean handling techniques when servicing this printed circuit assembly.

8-17. Troubleshooting Procedures.

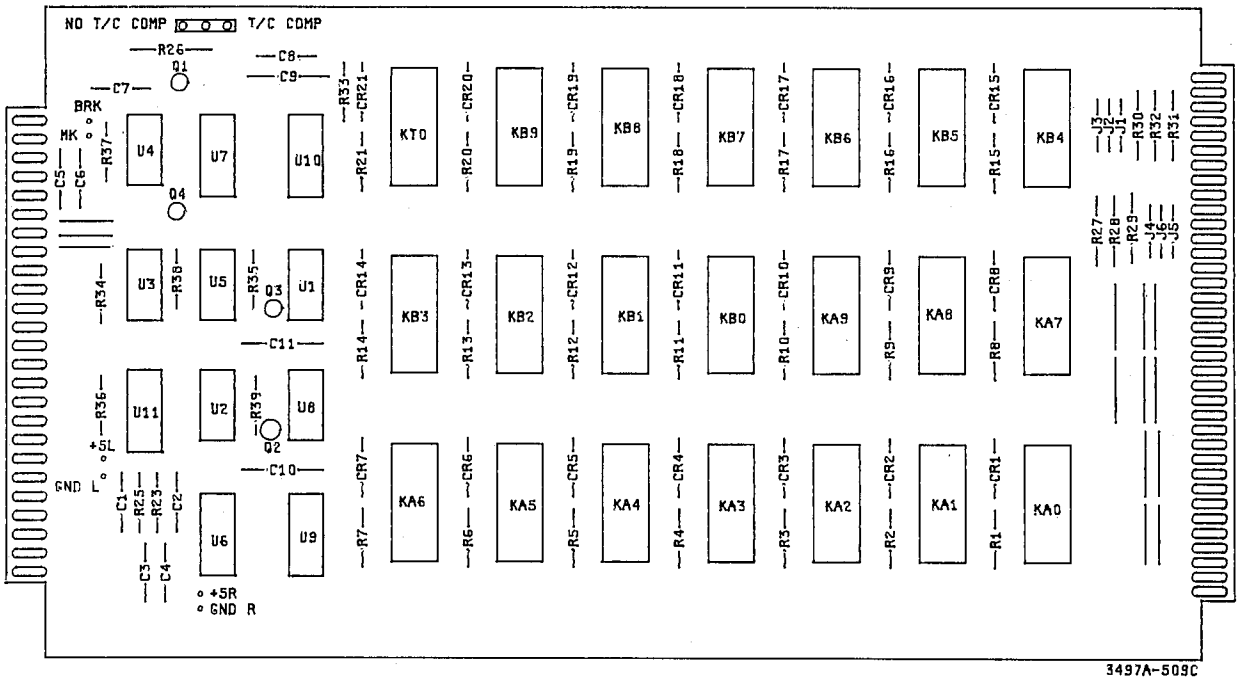
8-18. Relay Failures. When a malfunctioning relay is suspected, first, check the relay coil for an open circuit; then, check for a voltage developed across the coil when the relay is activated. If the coil is good and the driving voltage is present, then the contacts are probably broken and the relay should be replaced.

8-19. If a driving voltage is not present, work back toward the decoder drivers to check for logic transitions when that relay is activated. The following program may be used to set and clear a channel relay (see Figure 8-1).

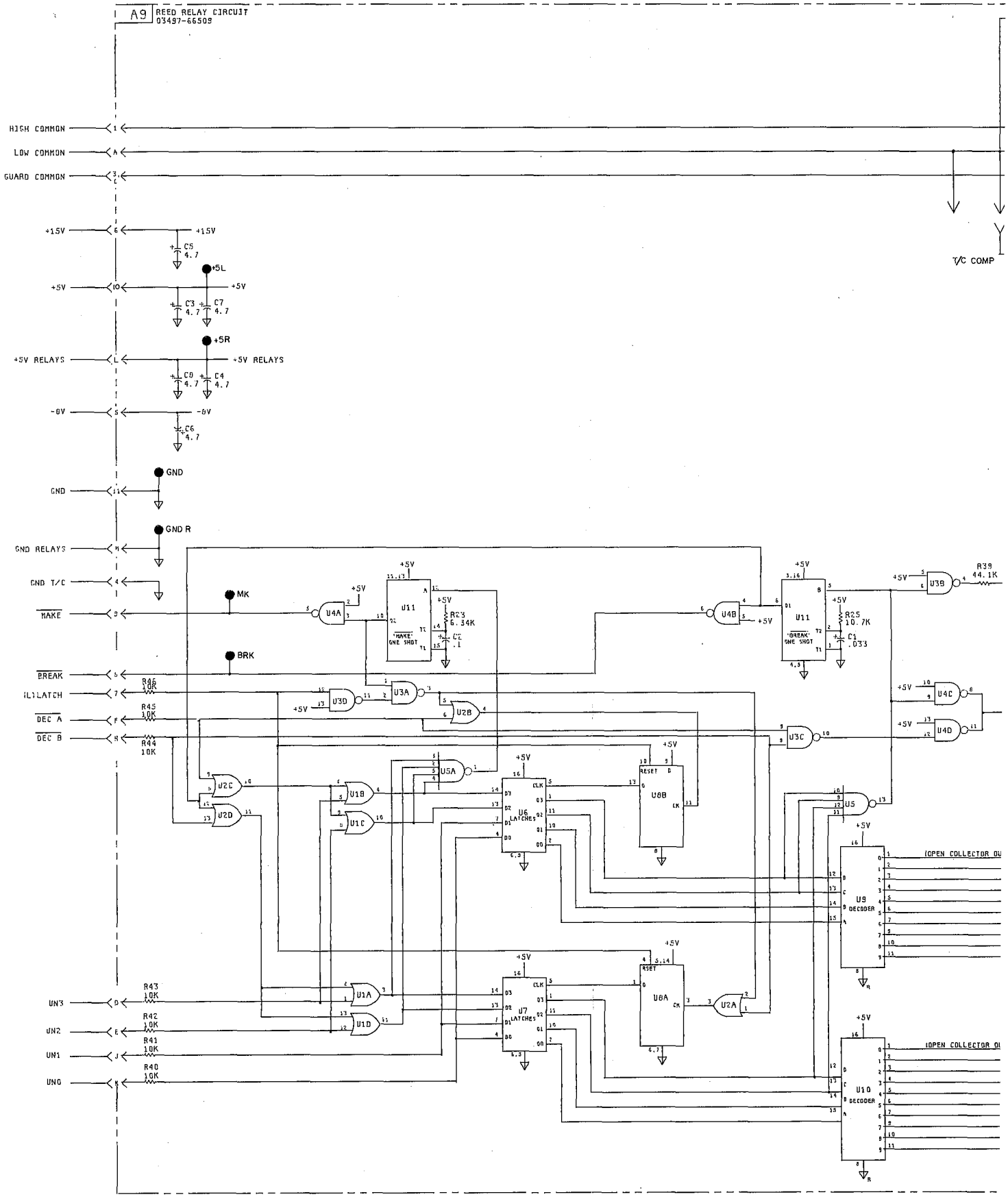
8-20. Control Circuit Failures. To check for BBM signals, run either portion of the program in Figure 8-1. Then use a logic probe to trace the signal paths through the "MAKE" timer and the "BREAK" timer. If multiclosure functions are inoperative, run the second portion of the program in Figure 8-1. Be aware that only one channel per decade may be closed at any one time. Use a logic probe to trace the (L) LATCH signal through the "D" flip-flops and into the data latches. Remember that a low clock level at the data latches will force the latches into the transparent mode.

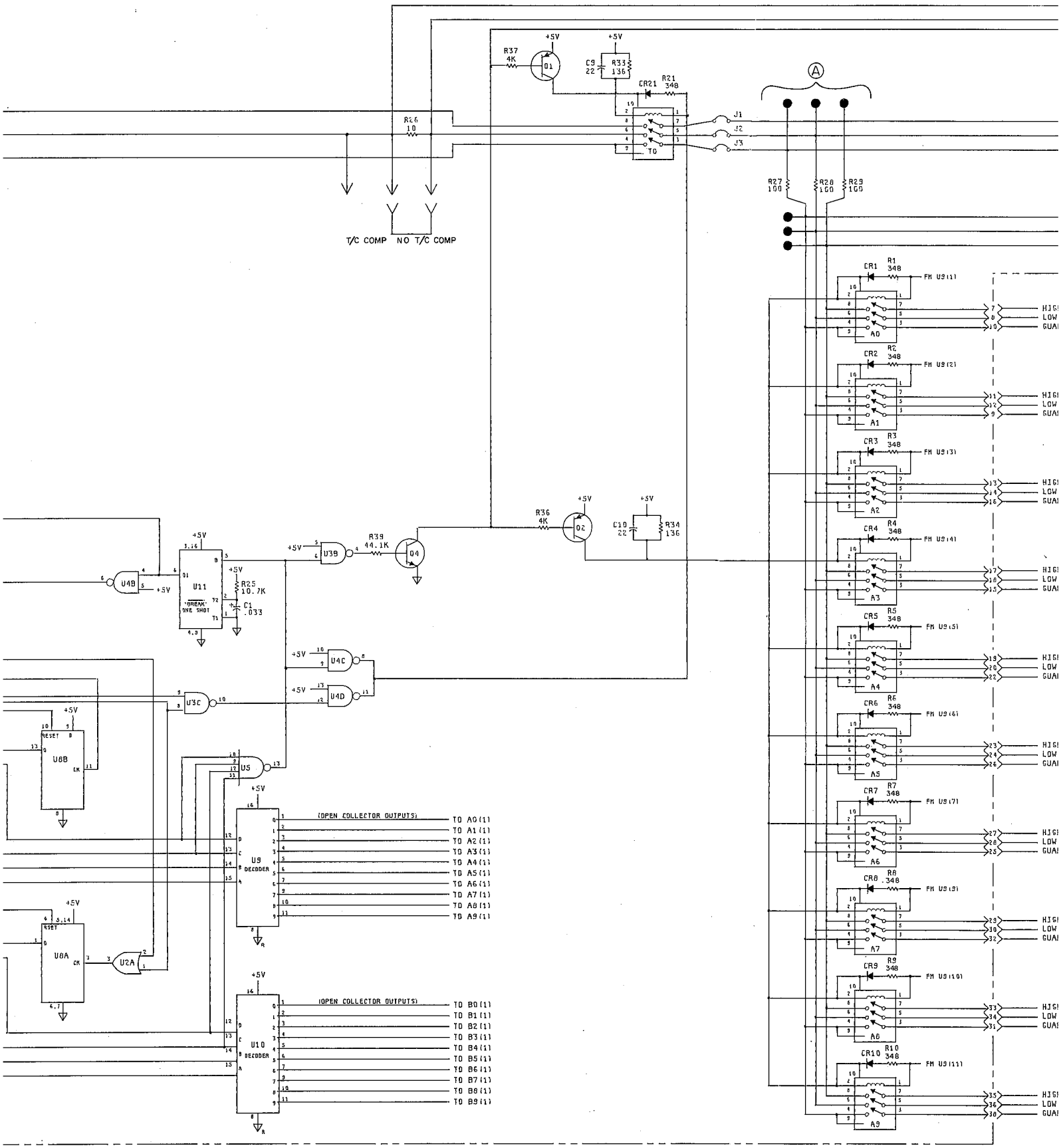
```
0: fxd 0
1: ent "Enter 0 for single, 1 for multi",A
2: if A=1;sto 8
3: ent "Enter channel # please?",C
4: wrt 709,"AR";wait 500
5: wrt 709,"AC",C
6: dsp "Test in progress"
7: sto 4
8: ent "Enter first channel # please",C
9: ent "Enter second channel # please",D
10: wrt 709,"AR";wait 500
11: wrt 709,"AC",C,",",D
12: dsp "Test in progress"
13: sto 10
14: end
*19837
```

Figure 8-1. Relay Exercise Program.



A9
03497-66509




+5V
R37 4K
Q1
C9 22
R33 136
CR21
R21 348
R26 10
J1
J2
J3
TO
R27 100
R28 100
R29 100
T/C COMP
NO T/C COMP
A
CR1
R1 348
FM U9(1)
A0
CR2
R2 348
FM U9(2)
A1
CR3
R3 348
FM U9(3)
A2
CR4
R4 348
FM U9(4)
A3
CR5
R5 348
FM U9(5)
A4
CR6
R6 348
FM U9(6)
A5
CR7
R7 348
FM U9(7)
A6
CR8
R8 348
FM U9(8)
A7
CR9
R9 348
FM U9(10)
A8
CR10
R10 348
FM U9(11)
A9
HIGH
LOW
GUARD
R36 4K
Q2
C10 22
R34 136
U4B
U11
ONE SHOT
R25 10.7K
C1 .033
U3B
R39 44.1K
Q4
U4C
U4D
U3C
U8B
RESET
CK
U5
U8A
U2A
U9
DECODER
(OPEN COLLECTOR OUTPUTS)
TO A0(1)
TO A1(1)
TO A2(1)
TO A3(1)
TO A4(1)
TO A5(1)
TO A6(1)
TO A7(1)
TO A8(1)
TO A9(1)
U10
DECODER
TO B0(1)
TO B1(1)
TO B2(1)
TO B3(1)
TO B4(1)
TO B5(1)
TO B6(1)
TO B7(1)
TO B8(1)
TO B9(1)

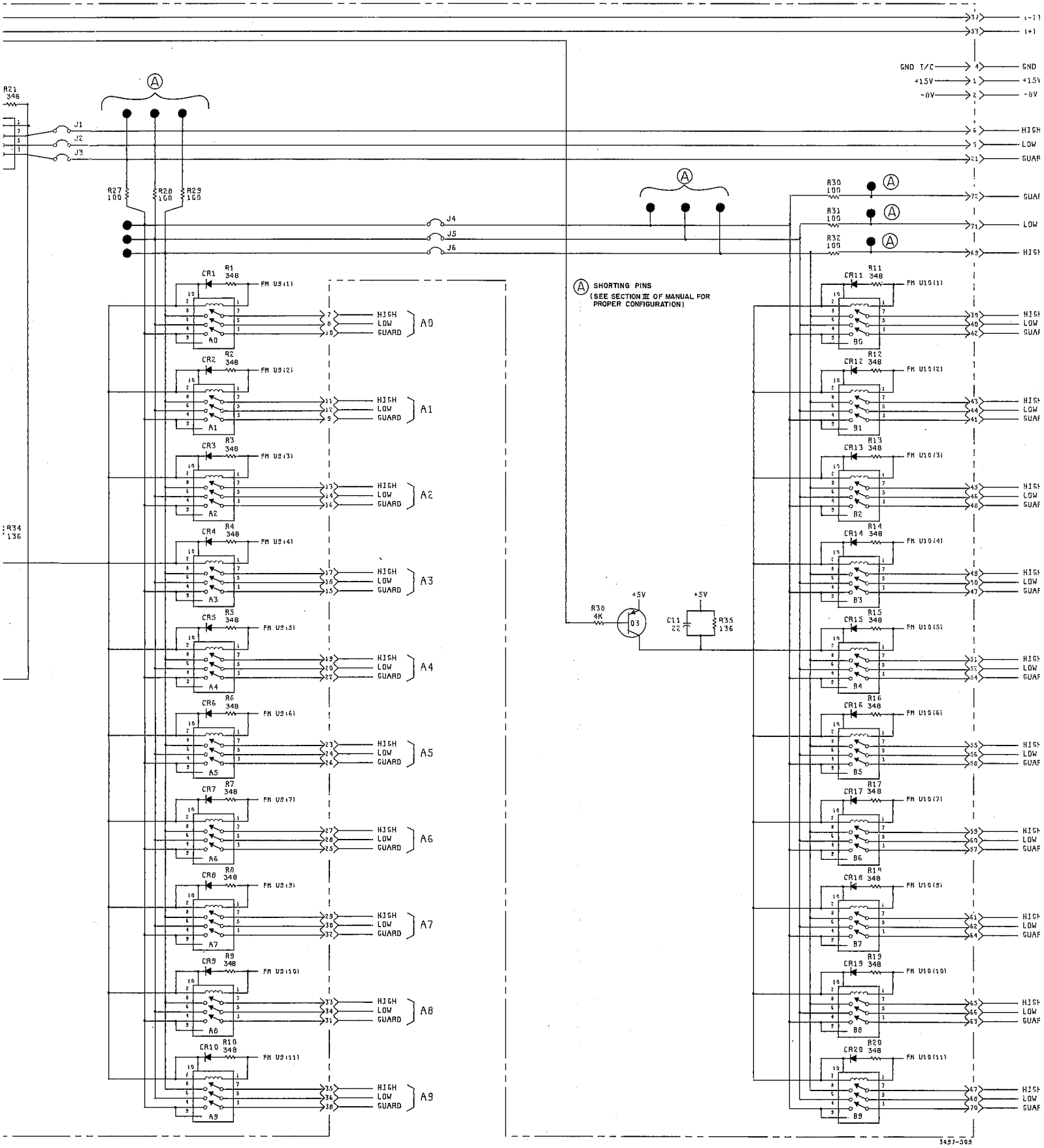
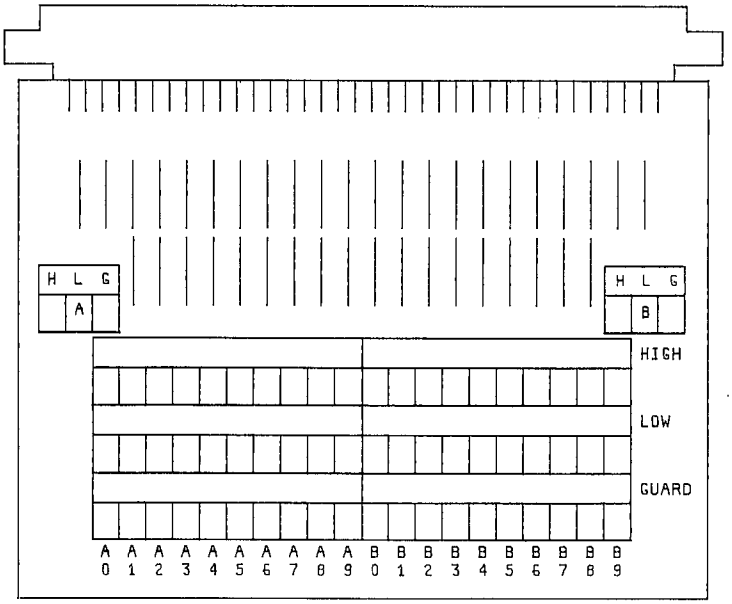


Figure 8-2. Relay Circuit
Low Thermal I
8-



A11
03497-66511

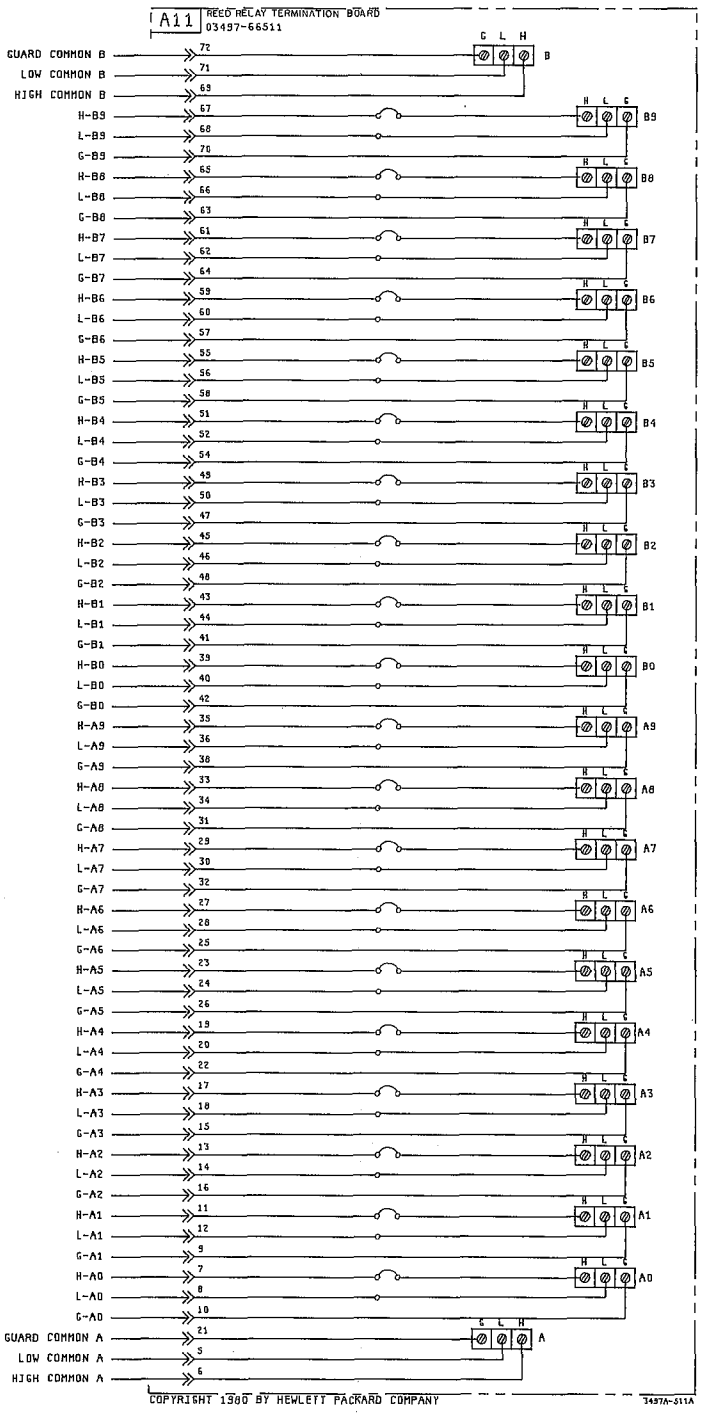
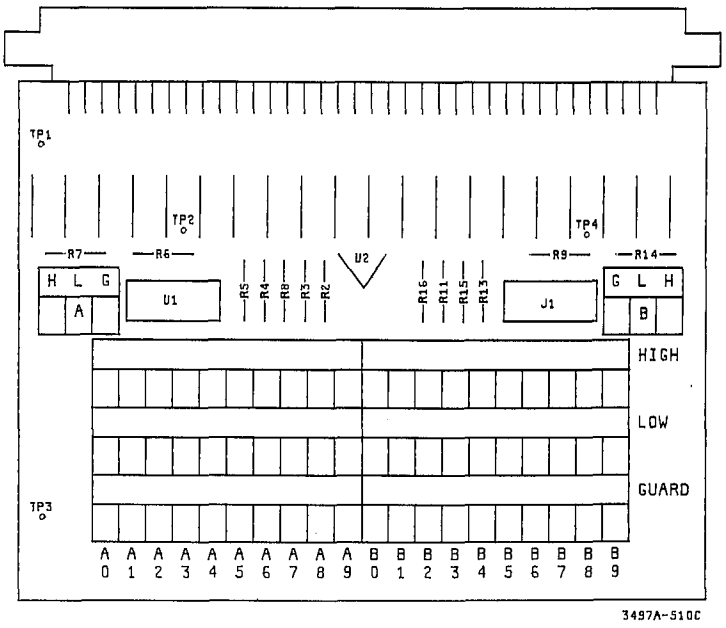
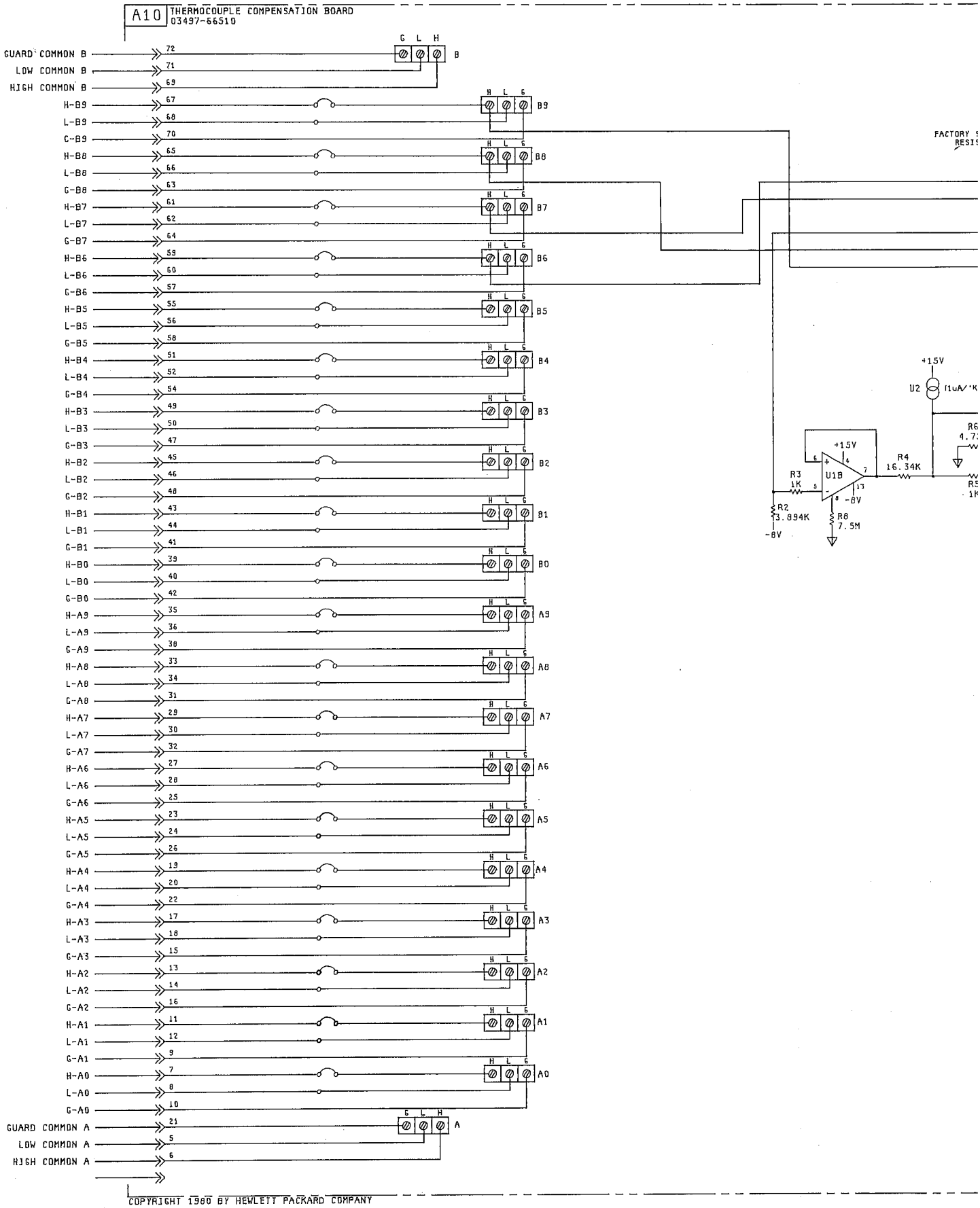


Figure 8-3. Non Compensated Low Thermal Relay



A10
03497-66510


A10 THERMOCOUPLE COMPENSATION BOARD
03497-66510
GUARD COMMON B
LOW COMMON B
HIGH COMMON B
H-B9
L-B9
G-B9
H-B8
L-B8
G-B8
H-B7
L-B7
G-B7
H-B6
L-B6
G-B6
H-B5
L-B5
G-B5
H-B4
L-B4
G-B4
H-B3
L-B3
G-B3
H-B2
L-B2
G-B2
H-B1
L-B1
G-B1
H-B0
L-B0
G-B0
H-A9
L-A9
G-A9
H-A8
L-A8
G-A8
H-A7
L-A7
G-A7
H-A6
L-A6
G-A6
H-A5
L-A5
G-A5
H-A4
L-A4
G-A4
H-A3
L-A3
G-A3
H-A2
L-A2
G-A2
H-A1
L-A1
G-A1
H-A0
L-A0
G-A0
GUARD COMMON A
LOW COMMON A
HIGH COMMON A
G L H
B
B9
B8
B7
B6
B5
B4
B3
B2
B1
B0
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
A
+15V
U2
R4
16.34K
R3
1K
U1B
R2
3.894K
R8
7.5M
-8V
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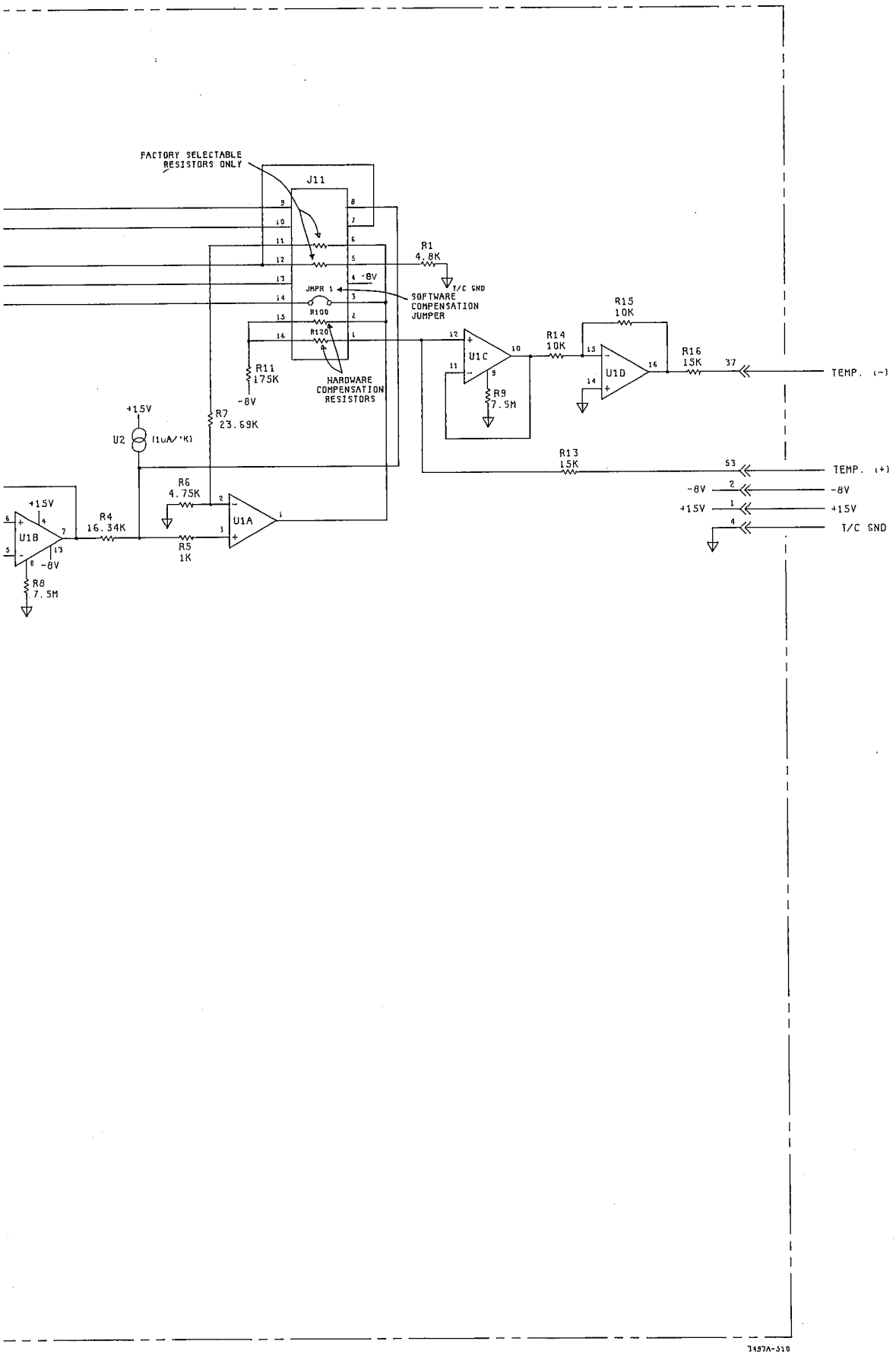

Figure 8-4. Thermocouple Assy
Low Thermal Relay
8-7/8-8