

# **9010A**

## **Micro-System Troubleshooter**

Service Manual



**NOTE**

**This manual documents the Model 9010A with Serial Numbers 4876000 and higher.**

# **9010A**

# **Micro-System Troubleshooter**

**Service Manual**

P/N 870147  
October 1989

© 1989, John Fluke Mfg. Co., Inc. All rights reserved. Litho in U.S.A.

**FLUKE**

# WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

**If any failure occurs, the following steps should be taken:**

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.
2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

## **SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT**

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way"\* prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

## **CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER**

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC., will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 2269, 5600 CG, Eindhoven, The Netherlands.

\*For European customers, Air Freight prepaid.

**John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206**

# Table of Contents

SECTION	TITLE	PAGE
<b>1</b>	<b>INTRODUCTION AND SPECIFICATIONS</b> .....	<b>1-1</b>
	1-1. THE 9010A INSTRUCTION MANUAL SET .....	1-1
	1-4. INSTRUMENT DESCRIPTION .....	1-1
	1-6. LIST OF RECOMMENDED TEST EQUIPMENT .....	1-2
	1-8. SPECIFICATIONS .....	1-2
<b>2</b>	<b>SHIPPING AND SERVICE INFORMATION</b> .....	<b>2-1</b>
	2-1. SHIPPING INFORMATION .....	2-1
	2-7. QUESTIONS/PROBLEMS .....	2-1
<b>3</b>	<b>THEORY OF OPERATION</b> .....	<b>3-1</b>
	3-1. INTRODUCTION .....	3-1
	3-3. OVERALL BLOCK DIAGRAM DESCRIPTION .....	3-1
	3-4. Interface Pod Function .....	3-1
	3-8. Troubleshooter Organization .....	3-1
	3-11. Immediate Mode Operation .....	3-4
	3-17. Programming Mode Operation .....	3-4
	3-19. Executing Mode Operation .....	3-4
	3-21. Probe Logic Function .....	3-4
	3-25. Signature Generator/Event Counter Function .....	3-5
	3-28. Magnetic Tape Controller Function .....	3-5
	3-30. RS-232 Interface Function (Option -001) .....	3-5
	3-32. DETAILED BLOCK DIAGRAM DESCRIPTION .....	3-5
	3-33. Introduction .....	3-5
	3-35. Control Section .....	3-5
	3-48. Display/Keyboard Assembly .....	3-7
	3-57. Pod/Probe PIA .....	3-9
	3-61. Pod Communication .....	3-10
	3-65. Probe Logic .....	3-10
	3-91. Signature Generator and Event Counter .....	3-15
	3-97. Magnetic Tape Controller .....	3-15
<b>4</b>	<b>MAINTENANCE</b> .....	<b>4-1</b>
	4-1. INTRODUCTION .....	4-1
	4-3. GENERAL INFORMATION .....	4-1
	4-4. Access Information .....	4-1
	4-6. Cleaning .....	4-1
	4-9. Line Voltage Switch Settings .....	4-1
	4-11. FUSE REPLACEMENT .....	4-1
	4-12. Line Fuse .....	4-1
	4-14. Probe Fuse .....	4-1
	4-16. PERFORMANCE TEST .....	4-3



TABLE OF CONTENTS, *continued*

SECTION	TITLE	PAGE
4-17.	Self Test .....	4-3
4-21.	Probe Level Detection/Verification .....	4-5
4-23.	Probe Pulser Checks .....	4-5
4-25.	Magnetic Tape Check .....	4-5
4-27.	Pod Connector Checks .....	4-5
4-29.	Display/Keyboard Check .....	4-5
4-31.	<b>CALIBRATION ADJUSTMENTS</b> .....	4-6
4-32.	Power Supply Adjustment .....	4-6
4-34.	Magnetic Tape Speed Adjustment .....	4-6
4-36.	Probe Input Compensation Adjustment .....	4-7
4-38.	<b>REPAIR PRECAUTIONS</b> .....	4-9
4-39.	<b>TROUBLESHOOTING</b> .....	4-9
4-40.	Introduction .....	4-9
4-42.	Power Supply Checks .....	4-9
4-46.	Bus/RAM/ROM Checks .....	4-9
4-48.	I/O Selector Checks .....	4-10
4-51.	Power-On Reset/Watchdog Timer Checks .....	4-10
4-53.	Pod/Probe PIA Checks .....	4-11
4-55.	Probe Related Circuit Checks .....	4-12
4-68.	Signature Register Checks .....	4-19
4-70.	Event Counter Checks .....	4-19
4-72.	Display/Keyboard Checks .....	4-19
4-86.	Magnetic Tape Controller Checks .....	4-25
<b>5</b>	<b>LIST OF REPLACEABLE PARTS</b> .....	<b>5-1</b>
	TABLE OF CONTENTS .....	5-1
5-1.	INTRODUCTION .....	5-2
5-4.	HOW TO OBTAIN PARTS .....	5-2
5-8.	MANUAL STATUS INFORMATION .....	5-2
5-10.	NEWER INSTRUMENTS .....	5-2
<b>6</b>	<b>OPTION AND ACCESSORY INFORMATION</b> .....	<b>6-1</b>
	TABLE OF CONTENTS .....	6-1
<b>8</b>	<b>SCHEMATIC DIAGRAMS</b> .....	<b>8-1</b>
	TABLE OF CONTENTS .....	8-1

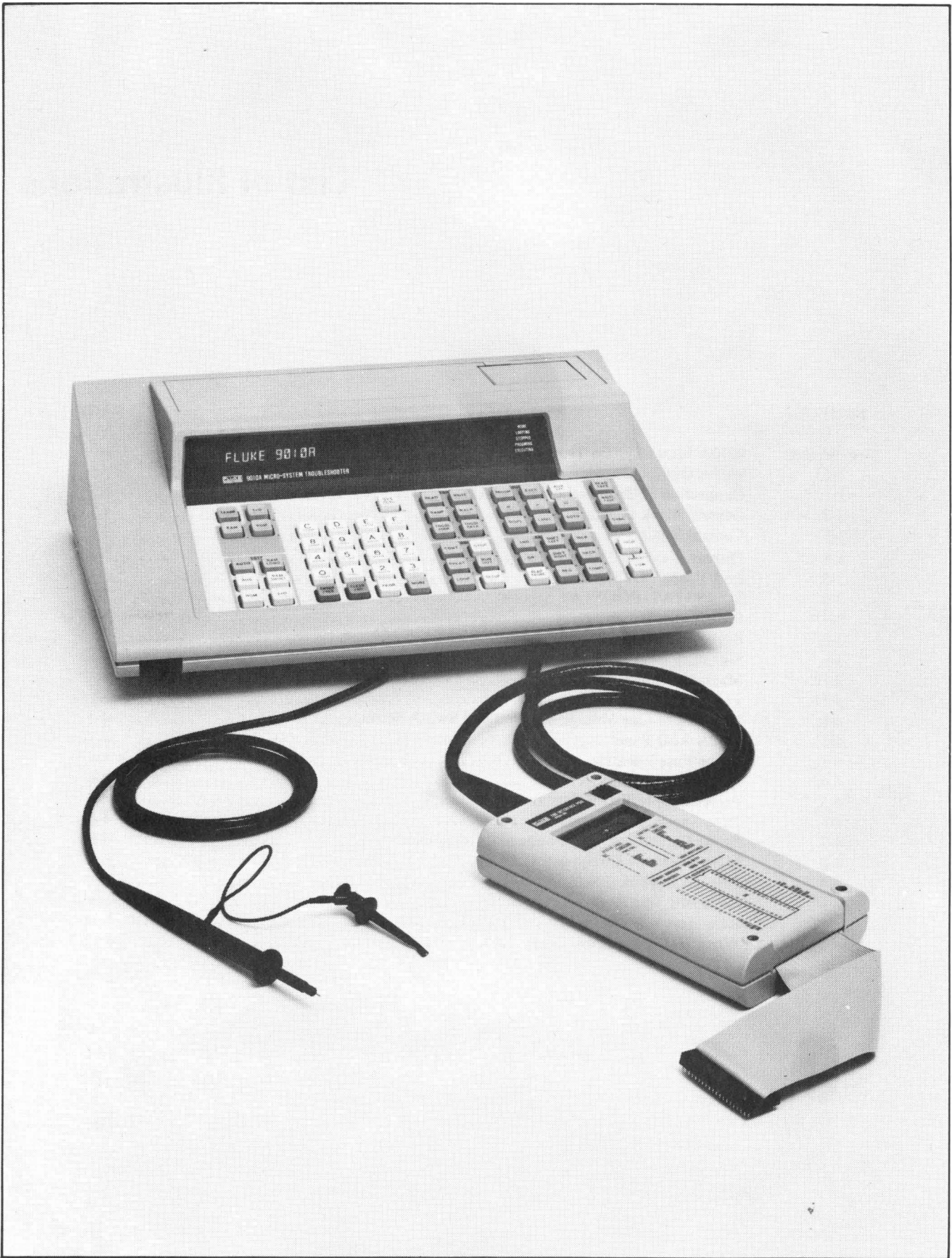
# List of Tables

TABLE	TITLE	PAGE
1-1.	Required Test Equipment .....	1-2
1-2.	9010A Specifications .....	1-2
4-1.	Self Test Failure Codes .....	4-4
4-2.	Display Performance Test .....	4-5
4-3.	Power Supply Test Points and Levels .....	4-9
4-4.	Memory Addresses and Signatures .....	4-10
4-5.	PIA (U22 Test) .....	4-13
4-6.	Free Running Probe Check .....	4-16
4-7.	Synchronized Probe Check .....	4-20
4-8.	Probe Pulse Output Check .....	4-21
4-9.	Signature Register Check .....	4-23
4-10.	Event Counter Test .....	4-24
4-11.	Keyboard Switch Identification .....	4-26
4-12.	Display/Keyboard Communication Check .....	4-29
4-13.	Memory and I/O Device Addressing and Commands .....	4-33
5-7.	Manual Status Information .....	5-20



## List of Illustrations

FIGURE	TITLE	PAGE
Frontispiece	9010A Micro-System Troubleshooter .....	vi
1-1.	9010A Outline Drawing .....	1-5
3-1.	Connection of Troubleshooter to UUT .....	3-2
3-2.	General Block Diagram .....	3-3
3-3.	Control Section .....	3-6
3-4.	Display/Keyboard Assemblies .....	3-8
3-5.	Pod/Probe PIA Signals .....	3-11
3-6.	MAINSTAT/PODSTAT Signals .....	3-11
3-7.	Probe Logic .....	3-12
3-8.	Probe Fuse Sensing Circuit .....	3-13
3-9.	Signature Register/Event Counter .....	3-14
3-10.	Magnetic Tape Controller .....	3-17
3-11.	Tape Data Ratio Coding .....	3-18
4-1.	Location of Line Voltage Switches and Switch Settings .....	4-2
4-2.	9010A Rear Panel .....	4-3
4-3.	Probe Fuse Location .....	4-4
4-4.	Asynchronous Input Values .....	4-6
4-5.	Power Supply Test Points and Adjustments .....	4-7
4-6.	Tape Speed Adjustments .....	4-8
4-7.	Probe Component Test Points and Adjustments .....	4-8
4-8.	Main Assembly Components .....	4-11
4-9.	Display/Keyboard Self-Test Points .....	4-25
4-10.	Keyboard Test Pattern .....	4-26
4-11.	Read Test Waveforms .....	4-31
4-12.	Write Test Waveforms .....	4-32



9010A Micro-System Troubleshooter

# Section 1

## Introduction and Specifications

### WARNING

**THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATOR MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.**

#### 1-1. THE 9010A INSTRUCTION MANUAL SET

1-2. The Fluke Model 9010A Micro System Troubleshooter is documented by a set of three manuals and a reference guide, all described below:

##### Operator Manual

Provides instrument description and specifications, operating instructions including troubleshooting and test techniques, probe useage, execution of programs, options and accessories, and routine operator maintenance.

##### Programming Manual

Provides description of instrument programming capabilities; writing, editing, and execution of programs. Little or no experience is required to program the 9010A.

##### Service Manual

Provides specifications, theory of operation, troubleshooting, repair/maintenance information, disassembly procedures, a list of replaceable parts, and schematic diagrams. Intended for use by qualified service personnel.

##### Reference Guide

Quick-reference operating and programming information.

1-3. In addition, an Interface Pod Manual is provided with each interface pod. The pod manual contains the following information:

##### Interface Pod Manual

Provides specifications, microprocessor data, status and control line identification information, interface pod operating characteristics, theory of operation, troubleshooting procedures, disassembly information, a list of replaceable parts, and schematic diagrams.

#### 1-4. INSTRUMENT DESCRIPTION

1-5. The 9010A Microsystem troubleshooter is a portable service instrument for testing and troubleshooting microprocessor-based equipment. The 9010A provides the following features:

- Keyboard selection of functions and operating modes.
- 32-character display for presentation of test results, operator messages, and prompts.
- Single-keystroke validation of electrical integrity of uP bus.
- Learn function for mapping UUT (unit under test) address space and identifying RAM, ROM, and I/O.
- Comprehensive, functional testing of RAM, ROM, and I/O.
- Nine troubleshooting functions for troubleshooting on or off the bus.



- On-line programming for development of system test and fault isolation programs.
- Consistent prompts and defaults for easy selection and specification of operations.
- Detailed error messages for locating UUT failures.
- Dual-function stimulus/response probe for generating bus-synchronized pulses or gathering signatures, counting events, and detecting logic levels.
- Hexadecimal keyboard for data entry.
- Sixteen 32-bit internal registers for storage and manipulation of data.
- Built-in cassette recorder for nonvolatile storage and transfer of test programs and data on minicassettes.
- Optional RS-232 port for remote communication.
- Optional interface pods for interfacing with most off-the-shelf microprocessors.
- UUT microprocessor emulation for execution of UUT program code.
- Rear-panel scope trigger output synchronized to UUT micoprocessor bus events.

**1-6. LIST OF RECOMMENDED TEST EQUIPMENT**

1-7. Table 1-1 lists the test equipment required to complete the adjustment and troubleshooting procedures described in Section 4 of this manual. Equivalent equipment, if available, may be used in place of the recommended models.

**1-8. SPECIFICATIONS**

1-9. Specifications for the 9010A are listed in Table 1-2. The dimensions of the 9010A are shown in Figure 1-1.

**Table 1-1. Required Test Equipment**

INSTRUMENT TYPE	RECOMMENDED MODEL
Micro System Troubleshooter	Fluke 9010A
Interface Pod	Fluke 9000A-Z80
Digital Multimeter	Fluke 8020, 0.1%
Oscilloscope	Tektronix 485 or equivalent
Storage Oscilloscope	Tektronix 7623A w/7A18 plug-in
Variable Dc Power Supply	Any 0-10V Model

**Table 1-2. 9010A Specifications**

<b>DISPLAY</b> .....	32 character, 14 segment alphanumeric with decimal points.
<b>KEYBOARD FUNCTIONS</b>	
<b>Data Entry</b> .....	16-Key hexadecimal keyboard (0 through 9, A through F) for entering data.
ENTER/YES .....	Used for terminating expressions, responding to questions.
CLEAR/NO .....	Used for terminating expressions, responding to questions, deleting unwanted input.
<b>Mapping UUT Memory</b>	
LEARN .....	Locates and identifies RAM, and I/O read-write registers. Computes ROM signatures and identifies read/writable I/O bits.
<b>Viewing UUT Memory</b>	
VIEW RAM, VIEW ROM, VIEW I/O .....	Allows viewing or editing of UUT address space information.

**Table 1-2. 9010A Specifications (cont)****Functional Tests**

BUS TEST .....	Checks electrical integrity of UUT microprocessor bus.
ROM TEST .....	Computes ROM signature and compares to specified ROM signature.
I/O TEST .....	Checks read-write capability of I/O registers.
RAM SHORT .....	Checks read-write capability and decoding of RAM locations.
RAM LONG .....	Checks bit pattern sensitive failures using an expanding checker-board pattern on RAM locations as well as those tests performed by RAM short test.
AUTO TEST .....	Performs in sequence BUS TEST, ROM TEST, RAM SHORT and I/O TEST.

**Troubleshooting Functions**

READ .....	Reads from UUT at an operator-specified address and reports value read.
WRITE .....	Writes operator-specified data to an operator-specified UUT address.
RAMP .....	Writes a binary incrementing pattern to an operator-specified UUT address.
WALK .....	Writes a rotating operator-specified bit pattern to the data lines at an operator-specified UUT address.
TOGGL DATA .....	Toggles an operator-specified data bit at a UUT address from one binary logic state to the other.
TOGGL ADDR .....	Toggles an operator-specified UUT address bit from one binary logic state to the other.
READ STS .....	Reads and displays the values of the UUT microprocessor status lines.
WRITE CTL .....	Writes operator-specified values to control lines on the UUT microprocessor bus.
TOGGL DATA CTL .....	Toggles an operator-specified control line from one binary logic state to another.

**Mode Controls**

CONT .....	Continues an interrupted operation (operations are typically interrupted to report errors).
STOP .....	Halts current 9010A operation.
RPEAT .....	Repeats the previously performed 9010A operation once.
LOOP .....	Continuously performs the previous operation.
RUN UUT .....	Executes UUT program code beginning at an operator-specified address.

**Editing**

MORE .....	Advances display to next line of information or next program step.
PRIOR .....	Scrolls display to previous line of information or prior program step.

**Test Sequencing** ..... Eight functions for entering or executing programs, and creating program messages, branches and loops.

**Arithmetic** ..... Eight functions for performing arithmetic on numeric quantities and manipulating data in registers.

Table 1-2. 9010A Specifications (cont)

<b>Selecting UUT-Specific Operations</b>	
SETUP .....	Allows the operator to select specific 9010A error detection and operating features to meet the requirements of a particular UUT.
<b>Cassette Tape Operations</b>	
READ TAPE .....	Reads information from cassette tape into 9010A memory.
WRITE TAPE .....	Writes information from 9010A memory onto cassette tape.
<b>Probe Controls</b>	
SYNC .....	Allows specification of probe synchronization to UUT bus events.
HIGH and LOW .....	Control generation of stimuli by the probe.
READ PROBE .....	Gathers response information at probe tip and displays signature, logic state history, and event count.
<b>RS-232 Interface Option Control</b>	
AUX I/F .....	Controls transfer of data over RS-232 Interface (if installed).
<b>CASSETTE TAPE</b> .....	Minicassettes store UUT memory map information, setup parameters, and program. Minicassette type: Verbatim.
<b>PROBE</b>	
<b>General</b> .....	Single-point stimulus and response probe.
STIMULUS .....	Pulse high, low, or toggle between high and low.
RESPONSE .....	Signature computation, logic states detected, event count.
<b>Stimulus Mode</b>	
<b>STIMULUS PULSE WIDTH</b>	
Address or data-valid sync .....	Equals address-valid or data-valid interval of the interface pod $\mu$ P.
Free-run .....	2 $\mu$ sec nominal.
<b>STIMULUS PULSE AMPLITUDE</b>	
High .....	>4V at +100 mA
Low .....	<0.2V at -100 mA
<b>Response Mode</b>	
<b>INDICATOR THRESHOLD</b>	
Logic High (Red) .....	>2.4V
Logic Low (Green) .....	<0.8V
Logic Tristate .....	<2.4V and >0.8V
INDICATOR THRESHOLD ACCURACY .	$\pm$ 0.2V
<b>INDICATOR MINIMUM PULSE WIDTH</b>	
Logic High .....	>75 ns
Logic Tristate .....	>100 ns
Logic Low .....	>75 ns
<b>Maximum Safe Input Voltage at Probe Tip</b> .	-30V dc to +30V dc
<b>Probe Fuse</b> .....	The ground clip used with the probe is protected by a series-connected fuse located adjacent to the probe connector. A blown fuse is sensed by the 9010A and reported by a message on the display.

Table 1-2. 9010A Specifications (cont)

<b>9010A OPERATOR-ACCESSIBLE MEMORY</b>	
<b>Tape-Transferable Memory</b> .....	Approximately 12k bytes for storage of UUT memory map information, Setup parameters, and programs. Contents may be transferred to and from cassette tape or transferred to and from a remote device via the RS-232 Interface Option.
<b>Registers</b> .....	Sixteen 32-bit registers.
<b>GENERAL</b>	
<b>Power Requirements</b> .....	100, 120, 220 or 240V ac $\pm 10\%$ 50 or 60 Hz $\pm 5\%$ 40 Watts maximum
<b>Size</b> .....	11.7x38.7x31.1cm. (HXWXL) (4.6x15.25x12.25in.) See Figure 1-2.
<b>Weight</b> .....	5 kg. (11 lb.)
<b>Environmental</b>	
STORAGE TEMPERATURE	
Without Cassette Tape .....	-40 to +70°C (RH <95%)
With Cassette Tape .....	+4 to 50°C (10% to 90% RH)
OPERATING TEMPERATURE	
Without Cassette Tape .....	0 to 25°C (RH <95%) 25 to 40°C (RH <75%) 40 to 50°C (RH <45%)
With Cassette Tape .....	10 to 25°C (20% to 80% RH) 25 to 30°C (20% to 73% RH) 30 to 35°C (20% to 49% RH) 35 to 40°C (20% to 32% RH)
<i>NOTE: All relative humidity (RH) conditions are non-condensing.</i>	

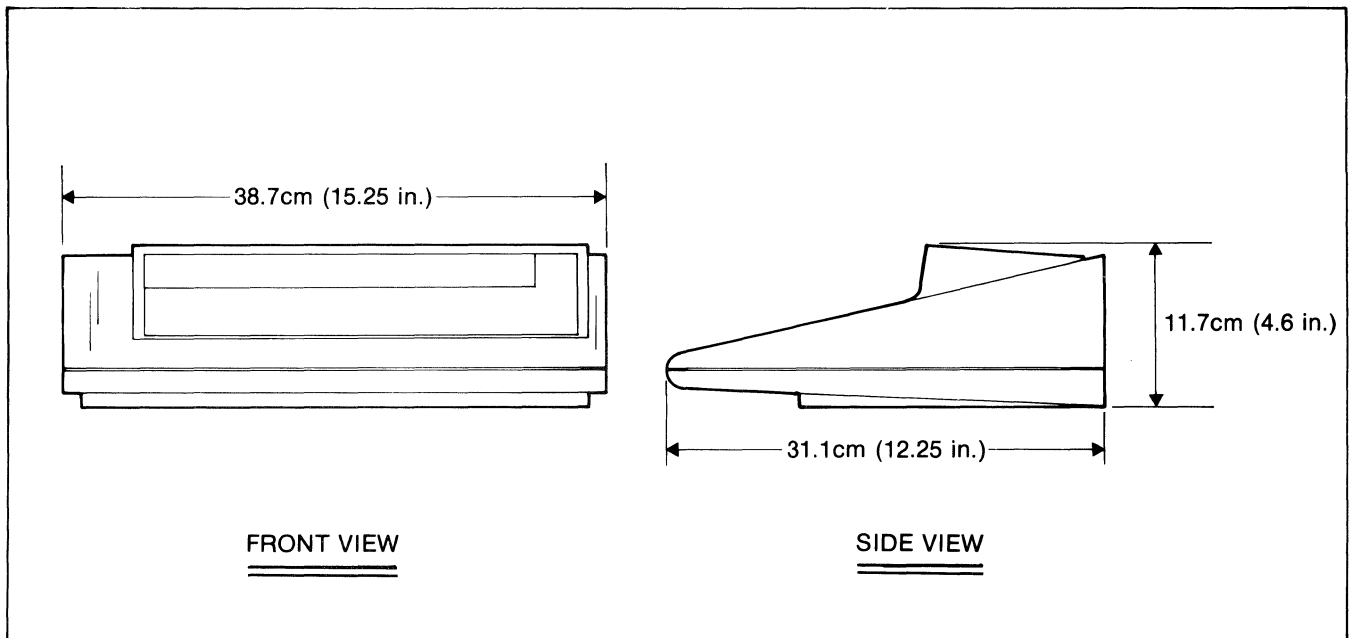


Figure 1-1. 9010A Outline Drawing



## Section 2

# Shipping and Service Information

### 2-1. SHIPPING INFORMATION

2-2. The 9010A is packed and shipped in a foam-packed container. When you receive the 9010A, inspect the instrument thoroughly for possible shipping damage. Special instructions for inspection and claims are included with the shipping container.

2-3. If reshipment is necessary, use the original container. If the original container is not available, order a new one from John Fluke Mfg. Co., Inc. P.O. Box C9090, Everett, WA 98206. Telephone (206) 347-6100.

### 2-4. SERVICE INFORMATION

2-5. Each Fluke Model 9010A Micro System Troubleshooter is warranted for a period of one year

upon delivery to the original purchaser. A copy of the WARRANTY is located at the front of this manual.

2-6. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. Section 6 contains a complete list of these service centers. If requested, the customer will be provided with an estimate before any work begins on instruments that are beyond the warranty period.

### 2-7. QUESTIONS/PROBLEMS

2-8. For additional information, contact the John Fluke Mfg. Co., Inc. at the address or telephone given in the Shipping Information.





## Section 3

# Theory of Operation

### 3-1. INTRODUCTION

3-2. This section presents the theory of operation for the 9010A on a general block diagram level, followed by more detailed block diagram descriptions of each portion of the instrument.

### 3-3. OVERALL BLOCK DIAGRAM DESCRIPTION

#### 3-4. Interface Pod Function

3-5. The main function of the troubleshooter is to diagnose problems within any bus-oriented microprocessor based equipment. As shown in Figure 3-1, the troubleshooter is connected to the unit under test (UUT) via its microprocessor socket and a matching interface pod. The interface pod is compatible with the pin layout, the status/control functions, interrupt handling, and timing for the particular microprocessor employed by the unit under test.

3-6. In order to perform tests on a UUT, the troubleshooter issues commands and address information to the interface pod. Each troubleshooter command causes the microprocessor within the pod to execute a corresponding routine contained in its ROM. The routine, when executed within the interface pod, performs the commanded functions, such as a read or a write to the UUT at the specified address.

3-7. In short, the troubleshooter issues a basic command, and the interface pod performs the actual operation in a manner compatible with the microprocessor type employed by the UUT. For a complete description of interface pod operation, refer to the particular Interface Pod Manual.

#### 3-8. Troubleshooter Organization

3-9. The troubleshooter is a microprocessor-based system, complete with 16K bytes of RAM and several I/O devices, including a magnetic tape unit and an optional communications interface. The general block diagram of

the instrument, presented in Figure 3-2, shows the internal organization of the instrument. The microprocessor initiates and controls all troubleshooter operations under the direction of firmware contained in ROM. The microprocessor views the RAM and ROM as memory devices, and views the following as I/O devices:

- Pod/Probe PIA (peripheral interface adapter)
- Display/Keyboard Assembly
- Signature Generator and Event Counter Circuit
- Magnetic Tape Controller
- RS-232 Interface (Option -001)

3-10. The microprocessor, in conjunction with the RAM, the ROM, the I/O selector, and the address and data buses, service each I/O device as required to:

- Issue commands and address data to the interface pod.
- Receive read data and status information from the interface pod.
- Receive keyboard data (operator commands) from the display/keyboard assembly.
- Send display data to the display assembly.
- Turn the probe pulse circuitry on or off.
- Receive signatures and/or event counts generated by the signature generator and event counter circuit from data at the probe tip.
- Write programs and test data stored in RAM to the magnetic tape unit for future use.

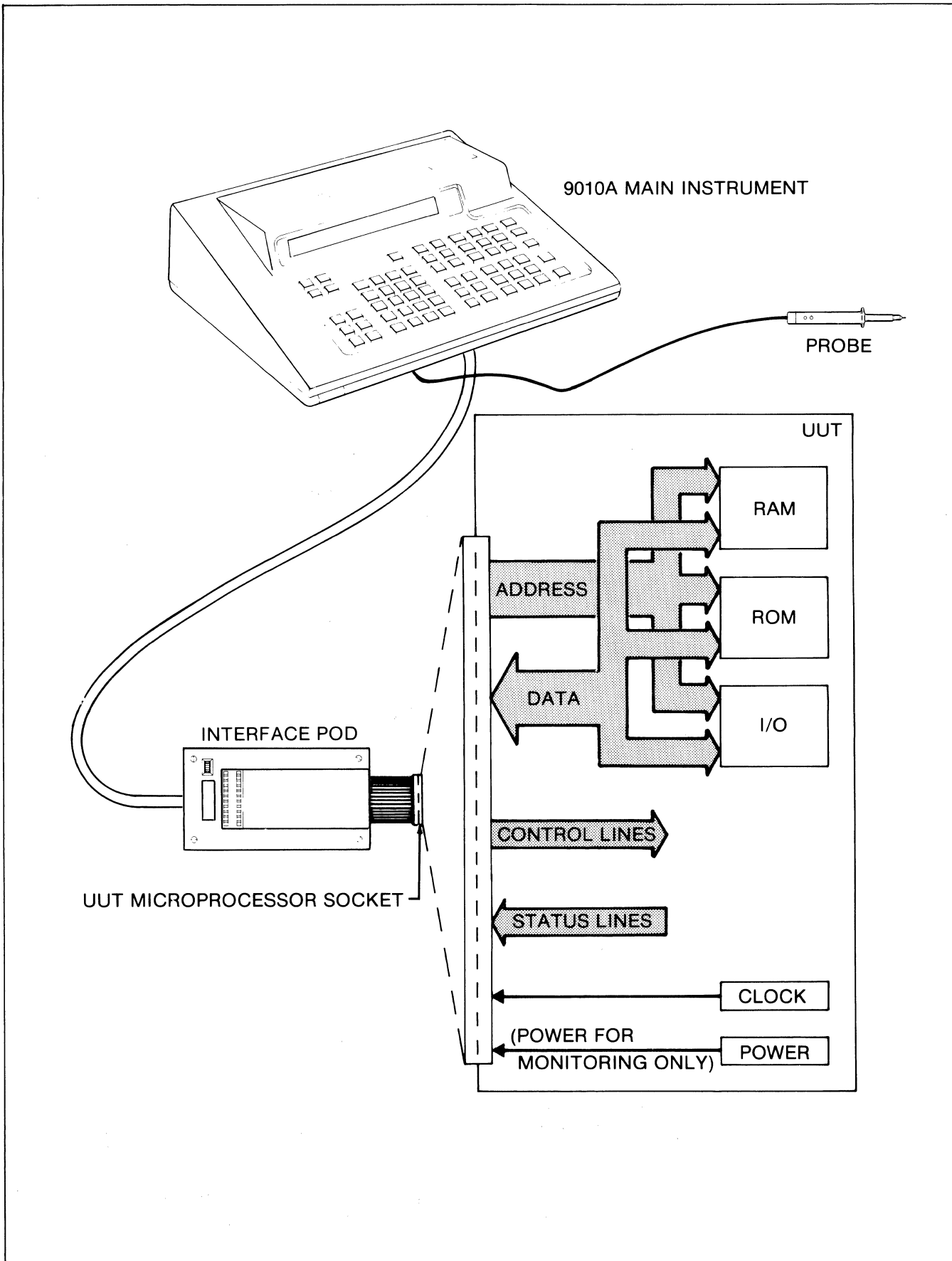


Figure 3-1. Connection of Troubleshooter to UUT

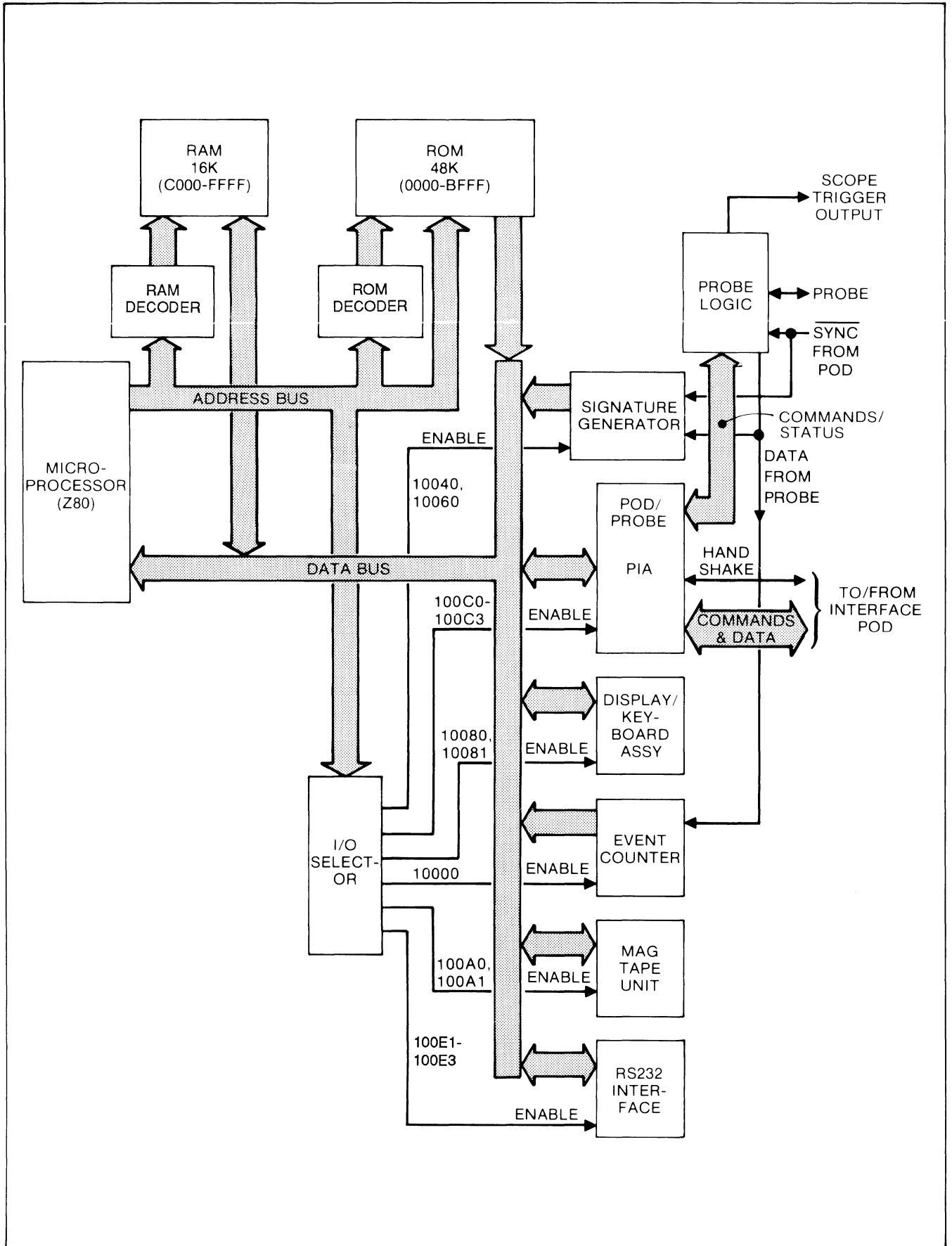


Figure 3-2. General Block Diagram

- Read programs and test data from the magnetic tape unit to RAM for immediate use.
- Send address space information, setup information, any or all programs, program numbers, or all information contained in tape-transferable memory to some remote device via the RS-232 interface.
- Receive data from a remote 9010A or computer via the RS-232 interface.

### 3-11. Immediate Mode Operation

3-12. When operating the troubleshooter in the immediate mode, the microprocessor routinely addresses (by means of the I/O selector) the Display/Keyboard Assembly for keyboard commands initiated by the operator. When the operator presses a key, the Display/Keyboard Assembly generates an 8-bit byte of keyboard data which corresponds to the key pressed. When addressed by the microprocessor, the Display/Keyboard Assembly places the byte of keyboard data on the data bus. The microprocessor reads the keyboard data and determines the key pressed. The microprocessor then takes appropriate action by sending a corresponding message to the Display/Keyboard Assemblies and prepares to receive subsequent keyboard data from the same.

3-13. For example, when the operator presses the READ key, and the microprocessor routinely addresses the Display/Keyboard Assembly, the Display/Keyboard assembly places the 8-bit data byte corresponding to the READ key on the data bus. The microprocessor reads the 8-bit byte and determines that the READ key is pressed: it then sends the message READ @ \_ to the display, prompting the operator for address information.

3-14. As the operator enters the read address, the microprocessor reads each byte of address data at the Display/Keyboard Assembly. The microprocessor then assembles the read address by writing each byte to a designated portion of RAM. When the operator completes the entry of the read address and presses the ENTER key, the microprocessor assumes completion of address entry. The microprocessor then addresses the pod/probe PIA and issues a read command to the pod, using the address assembled from the operator entry. The pod accepts the read command and address data then performs the actual read operation with the UUT.

3-15. Shortly after issuing the read command to the pod via the pod/probe PIA, the microprocessor routinely addresses the pod/probe PIA for the response data (the data read at the UUT location specified in the read command). As the pod sends each byte of data, read from the UUT, to the pod/probe PIA, the microprocessor reads each byte and writes it to a designated portion of RAM. When the microprocessor completes the reading

of UUT data and writing to RAM, it addresses the Display/Keyboard Assembly and writes the data for display.

3-16. The preceding example illustrates general operation of the troubleshooter in the immediate mode. Most operations in the immediate mode are performed in a manner similar to that described for a typical read operation. As the operator presses specific keys in order to select specific functions, the microprocessor performs corresponding tasks in order to complete the functions.

### 3-17. Programming Mode Operation

3-18. Operation of the troubleshooter in the programming mode is similar to that described for the immediate mode in that the operator presses specific function keys and enters data when prompted by the microprocessor display. Similarity of operation continues up to the point of pressing the ENTER key. When the operator presses the ENTER key to terminate entry of a command, the microprocessor stores the command in RAM as a step of a program instead of immediately issuing it to the interface pod. Execution of the stored step takes place when the program in which it resides is executed.

### 3-19. Executing Mode Operation

3-20. Operation of the troubleshooter in the executing mode is similar to that described for the immediate mode except for the lack of keyboard function. In the executing mode, the microprocessor obtains commands and data previously stored in RAM as part of a program (during operation in the programming mode) instead of reading commands and data from entries made at the keyboard. The microprocessor executes each command stored in RAM as a step of a stored program.

### 3-21. Probe Logic Function

3-22. The operator selects the mode of probe operation by pressing the appropriate keyboard keys (READ PROBE, HIGH, LOW, or SYNC). The microprocessor reads the key closures at the output of the display/keyboard assembly via the data bus in a manner similar to that described in Immediate Mode Operation. In response to the user selecting a probe function at the keyboard, the microprocessor addresses the appropriate port of the pod/probe PIA and writes the corresponding probe command to the probe logic. The probe logic decodes the probe command and causes the probe to produce high and/or low pulses, either synchronized or unsynchronized with pod operation.

3-23. In addition to generating pulses, the probe logic also receives input signals from the probe. It determines whether or not the voltages at the probe tip fall within certain valid limits (refer to the specifications for voltage detection threshold) and lights the probe lamps accordingly.

3-24. A data byte which indicates the logic level at the probe tip, or any invalid voltage condition, is sent by the probe logic to the appropriate port of the pod/probe PIA. The microprocessor reads the data byte applied to the pod/probe PIA port, after execution of a READ PROBE command, and determines the logic state at the probe tip (high, low, or invalid). The microprocessor then writes the appropriate message to the display/keyboard assembly for display to the operator.

### 3-25. Signature Generator/Event Counter Function

3-26. The signature generator receives the signal data read by the probe and, in conjunction with the SYNC pulse from the pod, applies these signals to the data and clock inputs of the signature shift register. As a result, the shift register generates a signature unique to the incoming probe signal. The event counter maintains a running total of high-to-invalid transitions (events) read by the probe.

3-27. Pressing the READ PROBE key causes the microprocessor to address (by means of the I/O selector) the signature generator and event counter circuit and reads their contents. The microprocessor then writes the current contents to a designated portion of RAM (register 0). With the signature and event count stored in RAM, the microprocessor resets the signature generator and event counter circuit permitting the next read probe operation to accumulate and yield new probe data. If the read probe operation was performed in the immediate mode, the microprocessor also sends new probe-tip state data, probe signature, and event count data to the Keyboard/Display Assembly for display to the operator.

### 3-28. Magnetic Tape Controller Function

3-29. The Magnetic Tape Controller controls the magnetic tape unit in response to commands from the microprocessor. The Magnetic Tape Controller contains a peripheral microcomputer which, under internal software control, performs the following functions:

- Reads to or writes from the tape.
- Controls tape direction and speed.
- Rewinds tape.
- Positions tape at load point.
- Formats write words.
- Decodes read words.
- Detects end of tape.
- Detects cassette present/not present.
- Detects write-protected cassette.

- Detects synchronization errors.
- Reports magnetic tape controller status to the main microprocessor.

### 3-30. RS-232 Interface Function (Option -001)

3-31. The RS-232 Interface provides an EIA RS-232-C compatible bidirectional interface to the troubleshooter with selectable baud rates of 110, 150, 300, 600, 1200, 4800, and 9600. The interface is isolated from the troubleshooter and meets all RS-232 requirements for bidirectional movement of serial data. The RS-232 Interface provides communications to and from other 9000 series troubleshooters or other RS-232 compatible devices. Refer to Section 6 for the description of the RS-232 Interface.

### 3-32. DETAILED BLOCK DIAGRAM DESCRIPTION

#### 3-33. Introduction

3-34. The following paragraphs describe operation of the troubleshooter at a detailed block diagram level. Each description includes a block diagram which can be related to the schematic diagrams contained in Section 8.

#### NOTE

*Memory and I/O devices are controlled by addresses and, in some cases, by data. Table 4-13 lists controlling addresses and data.*

### 3-35. Control Section

3-36. The control section of the troubleshooter, shown in block diagram Figure 3-3, contains the clock, the microprocessor, RAM, ROM, power-on reset circuit and watchdog timer, and an I/O selector. The control section operates as a small computer system to initiate and control, by means of software contained in ROM, all troubleshooter and interface pod functions.

#### 3-37. CLOCK CIRCUIT

3-38. The clock circuit, made up of G1, U34 and U30, provides timing control for the troubleshooter. The clock circuit contains a 6.5 MHz oscillator, the output of which is divided by two to produce a 3.25 MHz output. The 3.25 MHz is buffered and fed to the microprocessor, and flip-flop U32. (Flip-flop U32 produces a clock pulse to drive the pod/probe PIA each time an I/O operation takes place. Refer also to the pod/probe PIA description.)

#### 3-39. I/O SELECTOR

3-40. Several portions of the troubleshooter are viewed by the microprocessor as I/O devices, and are addressed and serviced accordingly. Portions of the troubleshooter which appear as I/O devices are:



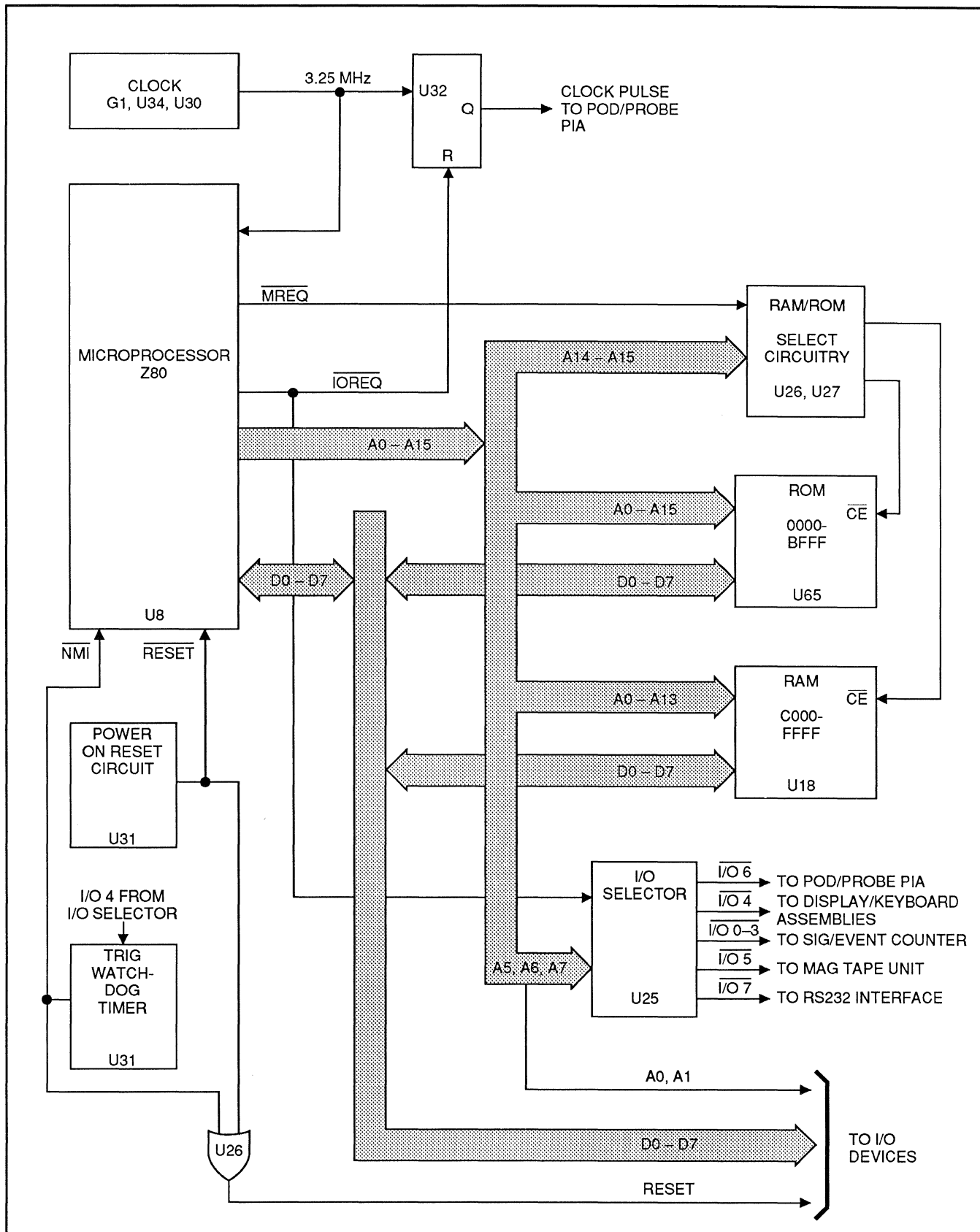


Figure 3-3. Control Section

- Display/Keyboard Assembly
- Pod/Probe PIA
- Signature Generator and Event Counter
- Magnetic Tape Unit
- RS-232 Interface (Option -001)

3-41. As indicated in the lower portion of Figure 3-3, each I/O device connects to the data bus (D0 - D7), address line A0, and also to the Reset line. In addition, each I/O device receives an enable signal from the I/O selector, U25, except the signature generator and event counter circuit which may receive any one of four enable signals. (Refer to Table 4-13 for specific I/O addresses.)

3-42. The I/O selector is a 3-to-8 line decoder which accepts address bus lines A5, A6, and A7 when enabled by the low  $\overline{\text{IOREQ}}$  (I/O request) output of the microprocessor. Whenever the microprocessor performs an I/O operation, it places the device address on the address bus and pulls the  $\overline{\text{IOREQ}}$  output low. The I/O selector produces an output to select the addressed I/O device. While selected, the I/O device can receive and/or send data over the data bus as directed by the microprocessor. Each I/O device also receives the  $\overline{\text{RESET}}$  signal from the power-on reset circuit and watchdog timer.

#### 3-43. POWER-ON RESET CIRCUIT

3-44. The power-on reset circuit controls the resetting (initializing) of the microprocessor and each I/O device when power is applied to the troubleshooter. The power-on reset circuit consists of a one-shot which, upon the application of instrument power, generates a  $\overline{\text{RESET}}$  and  $\overline{\text{RESET}}$  signal. The  $\overline{\text{RESET}}$  signal is fed to the  $\overline{\text{RESET}}$  input of the microprocessor, and is fed via U26 to each I/O device.

#### 3-45. WATCHDOG TIMER

3-46. The function of the watchdog timer is to detect any abnormal operation of the troubleshooter and, if abnormal operation occurs, interrupt the microprocessor and reset each I/O device. The watchdog timer, a re-triggerable one-shot, receives the  $\overline{\text{I/O4}}$  output from the I/O selector to the Display/Keyboard Assembly. As long as the troubleshooter is operating normally, addressing of the Display/Keyboard Assembly takes place at a frequency sufficient to keep the watchdog timer in the triggered state.

3-47. However, if a problem develops which prevents normal troubleshooter operation, addressing of the Display/Keyboard Assembly, and consequently the  $\overline{\text{I/O4}}$  signal, will typically cease or become infrequent. As a

result of the missing  $\overline{\text{I/O4}}$  signals, the watchdog timer times out before being retriggered, to produce a  $\overline{\text{RESET}}$  signal to each I/O device (via U26), and an  $\overline{\text{NMI}}$  (non-maskable interrupt) signal to interrupt the microprocessor. When interrupted, the microprocessor initiates a self test sequence to verify operation and writes the appropriate message to the Display/Keyboard Assembly.

#### 3-48. Display/Keyboard Assembly

3-49. The Display/Keyboard Assembly operates as a complete subsystem of the control section to:

- Receive display data from the control section.
- Decode ASCII characters into 14-segment character codes.
- Continually refresh the troubleshooter display including annunciators.
- Monitor the keyboard for switch closures.
- Translate key closures into appropriate ASCII codes.
- Place keyboard data on the data bus.

3-50. The microprocessor in the control section transmits display data to this subsystem as necessary to create the appropriate troubleshooter messages, and frequently polls for keyboard data. As shown in Figure 3-4, the main elements of the Display/Keyboard Assembly include:

- An 8-bit peripheral microcomputer, U1
- A 32-character display, V1
- A 32-bit character shift register, U3 - U6
- Segment shift registers, U13 and U14
- Segment drivers, U11 and U12
- A keyboard, A3
- An 8-bit row shift register, U2
- A set of annunciator latches, U15
- A set of annunciators, DS1 - DS5
- Filament drive circuit, U16, U17, Q1 and Q2

3-51. The troubleshooter display is a 14-segment, 32-character, vacuum fluorescent display having 14 commonly-connected segment and one decimal point enable lines and 32 individual character select lines. To

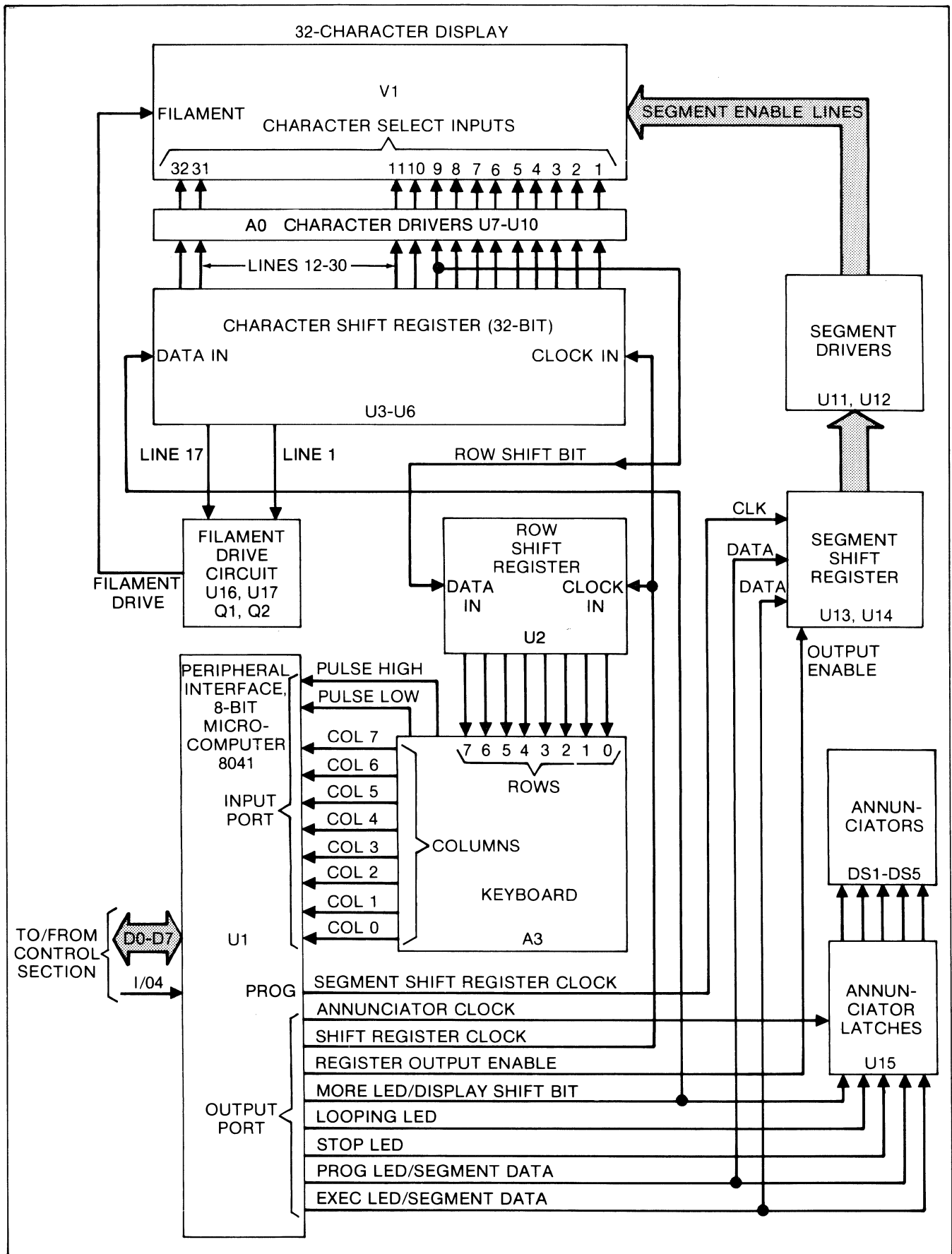


Figure 3-4. Display/Keyboard Assemblies

display a particular digit, letter, or symbol at a particular position on the 32-character display, the segment lines corresponding to the desired digit, letter or symbol are enabled and the desired display character selected. The individual characters of the display are sequentially selected by the outputs of a 32-bit shift register, referred to as the character shift register. The character shift register is driven by the peripheral microcomputer, which writes first to both the data input and clock input, and then 31 times to the clock input only, all via its output port. The 32 writes to the character shift register cause one bit to shift completely through the register, sequentially selecting each character position of the display.

3-52. Between each of the 32 writes to the character shift register, the peripheral microcomputer writes the segment and decimal point data (to the segment shift register) which is to be displayed at the next character position of the display. Once the segment shift register is loaded, the peripheral microcomputer writes an Output Enable signal to gate the segment data to the display segments.

3-53. The peripheral microcomputer refreshes the display at a 61.5 Hz rate while also controlling the annunciators (MORE, LOOPING, STOPPED, PROGRAMING, and EXECUTING) and polling the keyboard for operator commands. The peripheral microcomputer selectively turns each of the five annunciators on by writing a low to the corresponding input of annunciator latches, U15. The control section microprocessor provides the data which determines the particular latches written to, while the peripheral microcomputer U1 controls the flashing of the annunciators by writing and clocking high and low inputs to the latches.

3-54. The peripheral microcomputer receives keyboard commands by routinely polling its input port. The input port is connected to the columns of the 8-by-8 keyboard matrix. The rows of the keyboard matrix are connected to the outputs of the row shift register, U2. The row shift register is clocked by the same peripheral microcomputer output used to clock the character shift register. The row shift register receives a single bit of data at its input each time the character shift register selects character position 9 of the display. The result of this activity is that the keyboard rows are sequentially enabled once each time the character shift register cycles through the 32 display character position.

3-55. Whenever a particular row is enabled and a keyboard key is pressed, the column corresponding to that key produces an input to the input port of the peripheral microcomputer. Since the peripheral microcomputer controls which row is enabled and receives the column information directly from the keyboard, it determines the key pressed and places a

corresponding byte of keyboard data on the data bus. The control section microprocessor routinely polls the peripheral microcomputer for keyboard data and, from such data, determines the key pressed at the keyboard.

3-56. The display assembly also contains a filament drive circuit consisting of a set-reset flip-flop and drive transistors. The filament drive circuit alternates the polarity of the display V1 filament each time display characters 1 and 17 are selected by the character shift register. As a result, the polarity of the filament alternates twice per display refresh, to provide an average of six volts to the filament with no gradient across the tube. This is necessary to prevent a varying light output intensity over the length of the tube.

#### NOTE

*Refer to Table 4-13 for a list of display assembly protocol (address and command data).*

#### 3-57. Pod/Probe PIA

3-58. The pod/probe PIA (peripheral interface adapter) provides interface of the probe logic to the control section, and also of the interface pod to the control section. As shown in Figure 3-5, the PIA connects to the control section by means of the data bus and part of the address bus. The PIA also receives control signals from the  $\overline{RD}$  line of the microprocessor, the  $\overline{IOREQ}$  line of the microprocessor, and the I/O selector (via flip-flop U34).

3-59. The two I/O ports of the PIA are connected to the probe logic and to the interface pod. Each port is bidirectional and separately addressable by means of address lines A0 and A1. To command the probe logic, the microprocessor first addresses and writes to the I/O port A control register. (This is necessary in order to address either the I/O port A data direction register or I/O port A data buffer within the 6520 PIA, since both have the same address.) The microprocessor then writes to the I/O port A data direction register to set lines PA5, PA6, and PA7 as outputs. The microprocessor again addresses the I/O port A control register (this time to permit addressing of the I/O port A data buffer), followed by a write to the I/O port A data buffer to place data on lines PA5, PA6, and PA7 as required to control the probe logic. Refer to Table 4-13 for addresses and write data which perform pod/probe PIA functions.

3-60. To receive data from the probe logic, the microprocessor addresses and writes to the I/O port A control register (to permit addressing the I/O port A data direction register). A subsequent write to the I/O port A data direction register sets lines PA5, PA6, and PA7 as inputs. The microprocessor again addresses the I/O port A control register (to permit addressing the I/O port A data buffer) followed by a read to the I/O port A data

buffer to receive the data placed on lines PA5, PA6, and PA7 by the probe logic.

**NOTE**

*The function of the PA5, PA6, and PA7 lines is described in the subsequent probe logic description.*

**3-61. Pod Communication**

3-62. The control section communicates with the interface pod by sending commands, and receiving data in response to the commands. The transmission of commands and reception of data is mediated by two handshake lines labeled  $\overline{\text{MAINSTAT}}$  and  $\overline{\text{PODSTAT}}$ .

3-63. To command the interface pod, the microprocessor first addresses and writes to the I/O port A control and data direction registers to set line PA0 ( $\overline{\text{MAINSTAT}}$ ) as an output. The microprocessor then addresses and writes to the I/O port A control register and data buffer to set line PA0 low and create the  $\overline{\text{MAINSTAT}}$  signal. The interface pod responds to the  $\overline{\text{MAINSTAT}}$  signal by developing the  $\overline{\text{PODSTAT}}$  output signal. The microprocessor, after writing the  $\overline{\text{MAINSTAT}}$  signal, again writes to the I/O port A control and data direction registers to set the PA1 line as an input. With the PA1 line set as an input, the microprocessor writes to the I/O port A control register and then reads at the port A data buffer. When the  $\overline{\text{PODSTAT}}$  signal appears (PA1 goes low), the microprocessor proceeds to write data to the interface pod using the control register, data direction register, and the data buffer of I/O port B. Refer to Figure 3-6 for  $\overline{\text{MAINSTAT}}$  and  $\overline{\text{PODSTAT}}$  signal details, and to Table 4-13 for a list of pod/probe PIA addresses and commands.

3-64. During PIA operation, the PIA R/ $\overline{\text{W}}$  line controls data direction from the microprocessor, the data bus provides or receives the data, and lines A0 and A1 select control register or data direction register/data buffer of I/O ports A and B. The previously described control section provides clock pulses via U32, and the PIA is chip selected by the I/O selector, with some delay provided by flip-flop U34.

**3-65. Probe Logic**

3-66. The probe logic, shown in the block diagram Figure 3-8, provides the following functions:

- Receiving and interpreting logic pulses from the probe tip and reporting their condition to the microprocessor.
- Lighting the probe lamps in accordance with the logic signals appearing at the probe tip.
- Providing probe tip signals to the signature generator and event counter circuit.

- Providing high and/or low logic signals to the probe tip as directed by the microprocessor.
- Generating a differentiated pod Sync pulse for application to an oscilloscope as an external trigger signal.

**3-67. RECEIVING PROBE TIP SIGNALS**

3-68. High, low, and invalid signals applied to the probe tip are fed to an input of the probe logic as indicated in Figure 3-7. A network made up of R25, R26, C51 and C52 provides probe compensation, while Q1 provides high input and low output impedances. A pair of level detectors, one to detect logic high levels (U36/U41), and one to detect logic low levels (U49/U41), receive the incoming signals from the probe tip. The high level detector produces a output for the duration of logic high signals ( $>+2.4$  volts), while the low level detector produces a output for the duration of logic low signals ( $<+0.8$  volts). During signals of invalid levels ( $+0.8$  to  $2.4$  volts), neither level detector produces an output.

**3-69. SYNCHRONIZED/FREE-RUNNING OPERATION**

3-70. The sync select flip-flops, U37, and 2:1 multiplexer, U38, permit selection of synchronized or free-running probe operation. Synchronized operation allows the troubleshooter to detect only probe levels which exist at the time the interface pod terminates the SYNC signal (refer to the interface pod manual for Sync signal details). Free-running operation allows the troubleshooter to detect probe levels asynchronously with respect to pod operations.

3-71. Signals from the high and low level detectors are fed both through and around the sync select flip-flops to two sets of multiplexer, U38, inputs. The signals from the high level detector are also fed as SIG Data (signature data) over to the signature generator data input and event counter clock input. One set of multiplexer inputs receives the levels latched into the sync flip-flops at the termination of the interface pod SYNC signal. This set of multiplexer inputs is used during operation in the synchronized mode of probe operation.

3-72. The other set of multiplexer inputs receives signals produced by the high and low level detectors, and corresponds to the free-running mode of probe operation. Selection of either multiplexer input for connection to its output is made by the Sync Control signal fed from the input control latch, U45. The input control latch receives a synchronize or free-running command from the microprocessor via the pod/probe PIA and line PA7.

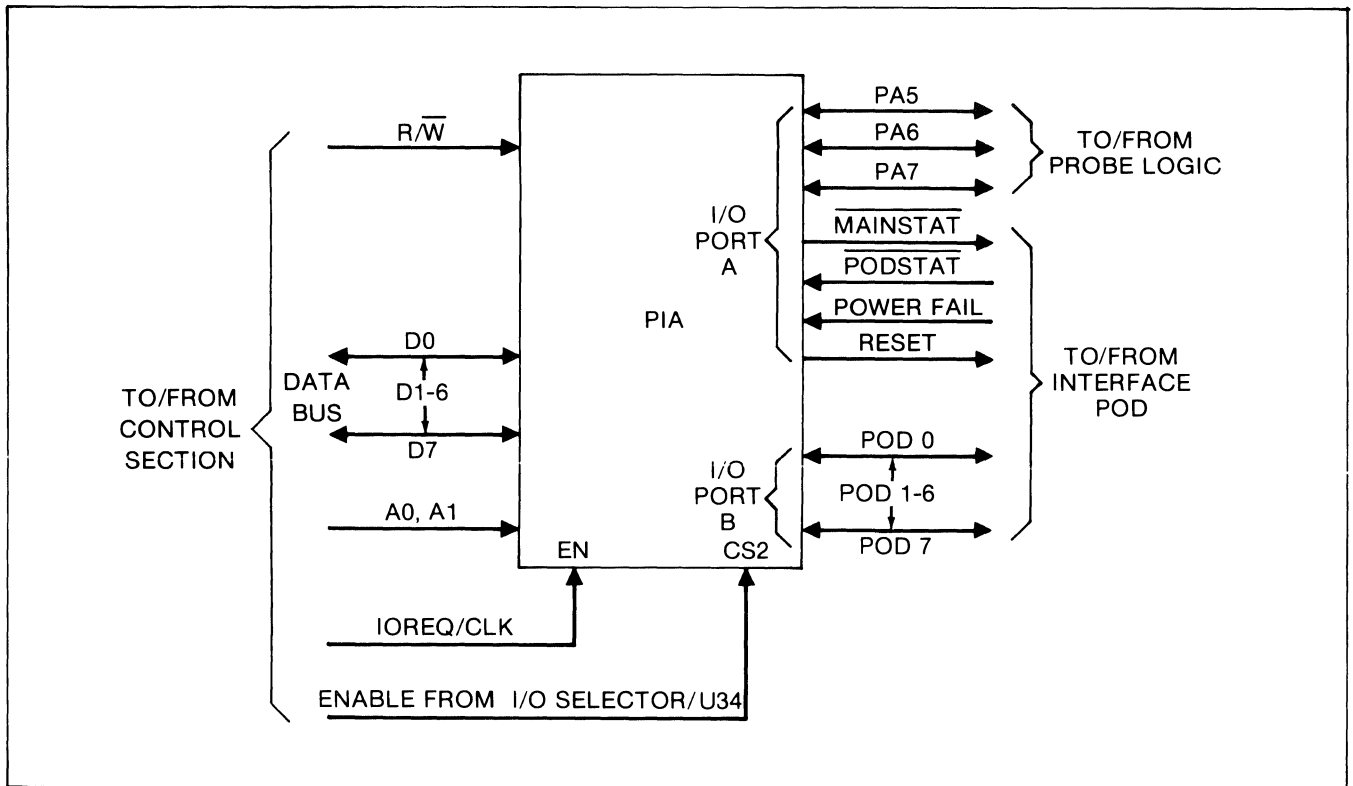


Figure 3-5. Pod/Probe PIA Signals

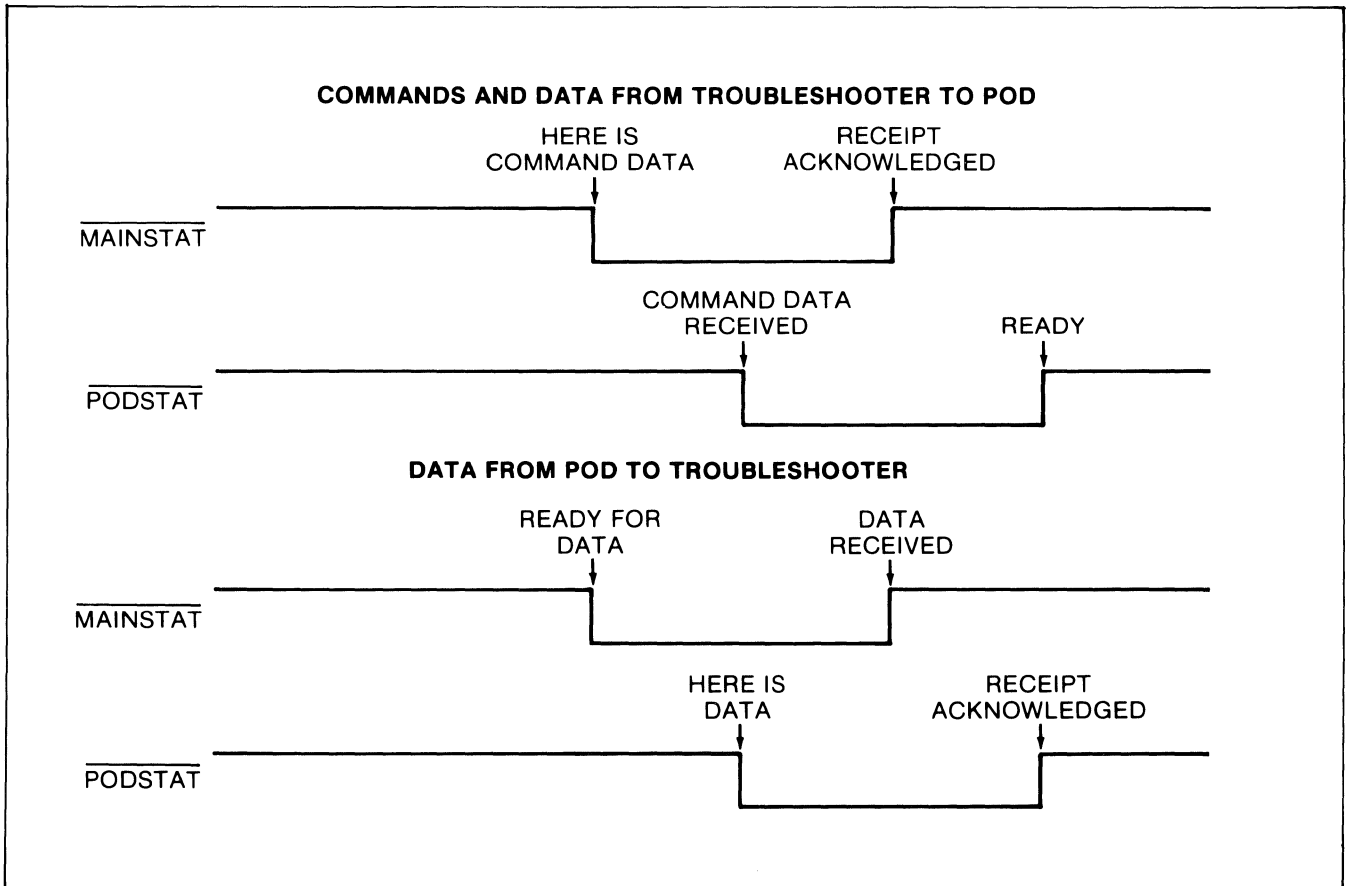


Figure 3-6. MAINSTAT/PODSTAT Signals



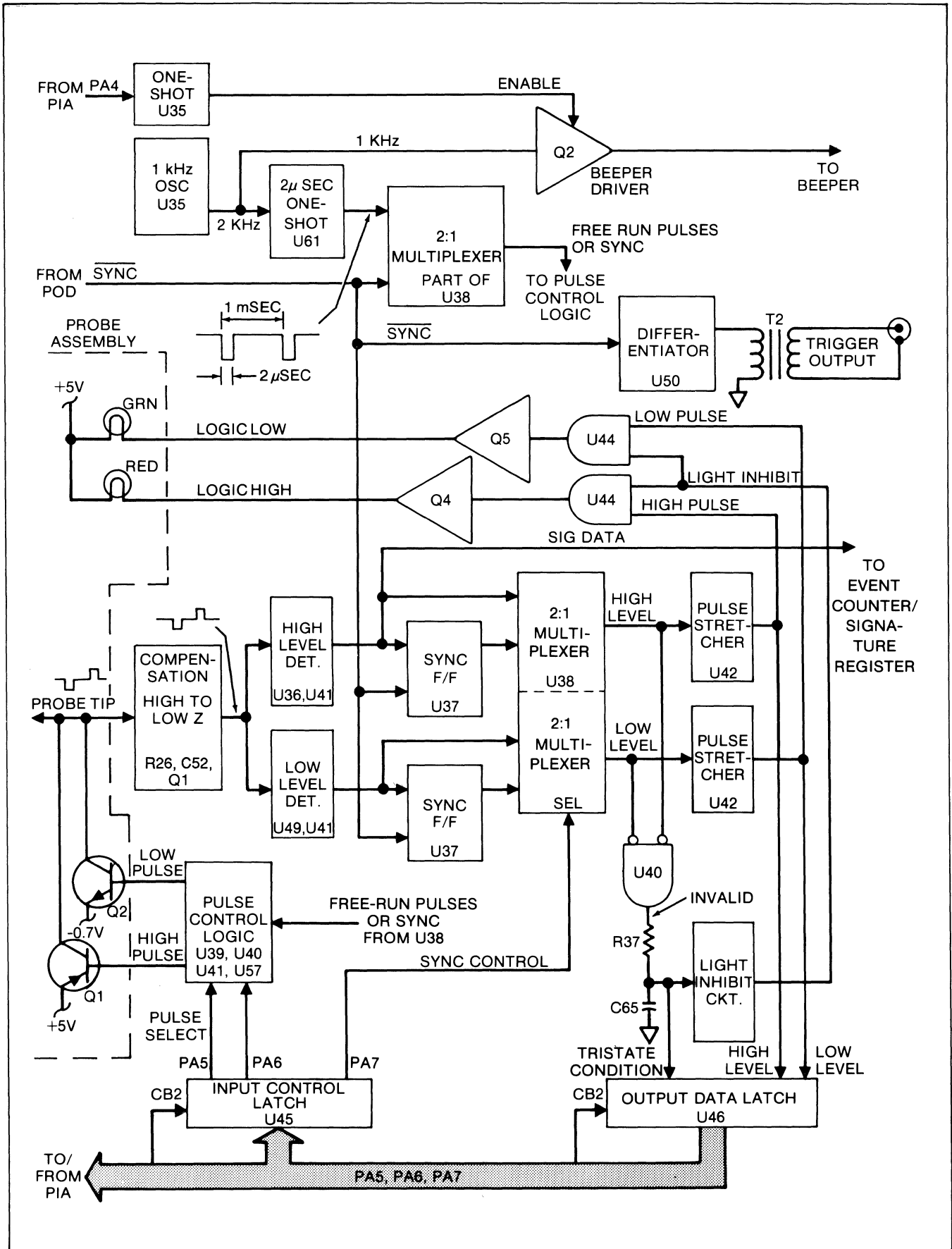


Figure 3-7. Probe Logic

### 3-73. PROBE LAMP CONTROL

3-74. The probe contains two lights, one green and one red, which are driven by Q5 and Q4 in conjunction with U44 and pulse stretchers (one-shots), U42. The pulse stretchers have a 200 millisecond duration and provide a means of making probe pulses of short duration visible on the probe indicator lights. Probe pulses of longer than 200 millisecond duration are fed around the one-shots and override their outputs. This arrangement allows pulses of short duration to be visible on the indicator lights for 200 milliseconds, and also allows pulses longer than 200 milliseconds to be visible for their entire duration. When the probe receives a logic high level, the red light glows, and when the probe receives a logic low level, the green light glows.

3-75. Signals, which are neither valid logic high nor valid logic low, cause the probe lights to go off. When an invalid level appears at the probe, neither the high level detector U36/U41 nor the low level detector U49/U41 provide an output. As a result, the outputs of the 2:1 multiplexer are both low. Gate U40 detects the lack of multiplexer outputs and produces a high output to the light inhibit circuit, U39/U43, via the integrator formed by R37 and C65. The integrator prevents the light inhibit circuit from responding to invalid signals having a duration of approximately 100 nanoseconds or less. Since a normal TTL edge can spend up to about 10 nanoseconds in the invalid region, the transitions will not cause the lights to flash.

3-76. The light inhibit circuit consists of two one-shots, each triggered at the occurrence of an invalid signal, the first having a duration equal to one-half (100 milliseconds) that of the second (200 milliseconds). The output of the second one-shot inhibits the input to the first so that an invalid signal triggers the first one-shot only as long as the second one-shot has returned to its stable state. As long as an invalid signal is present at the integrator, the first one-shot continues to be triggered, producing a 100 millisecond pulse every 200 milliseconds. The output of the first one-shot is the output of the light inhibit circuit.

3-77. The output of the light inhibit circuit enables gates U44 when invalid signals are less than about 100 nanoseconds in duration, but inhibits them for 100 milliseconds when invalid for longer than approximately 100 nanoseconds. Since U44 directs the outputs of the pulse stretchers to line drivers Q4 and Q5, the lights are turned off whenever the light inhibit circuit produces an output pulse, causing one or both lights to flash at a 5 Hz rate.

3-78. During a steady invalid signal, the light inhibit signal produces 100 millisecond pulses at the 5 Hz rate, but the lights stay off due to the lack of outputs at the pulse stretchers.

### 3-79. PROBE FUSE SENSING

3-80. The ground path for the probe contains a fuse, F2. A sensing circuit, shown in Figure 3-8, detects failure of the fuse and/or connection of the probe ground lead to any positive or negative supply. Normally, the probe ground lead ties to ground via fuse F2. However, when an overload condition causes failure of F2, the ground lead goes to +5 volts due to a pull-up resistor (R4) contained in the probe. The +5 volts turns Q3 on to produce the FB (fuse blown) signal fed to the event buffer shown in Figure 3-9. The microprocessor reads the contents of the event buffer during the read probe operation, and examines the FB (fuse blown) bit for a blown fuse condition. If the FB line is low, the blown probe fuse messages appears on the troubleshooter display.

3-81. If the probe ground lead is connected to a negative supply, the fuse blows, but Q3 remains off due to the negative voltage at its base. In this case, Q6 turns on to produce the low  $\overline{\text{FB}}$  signal and notify the microprocessor of the blown fuse condition.

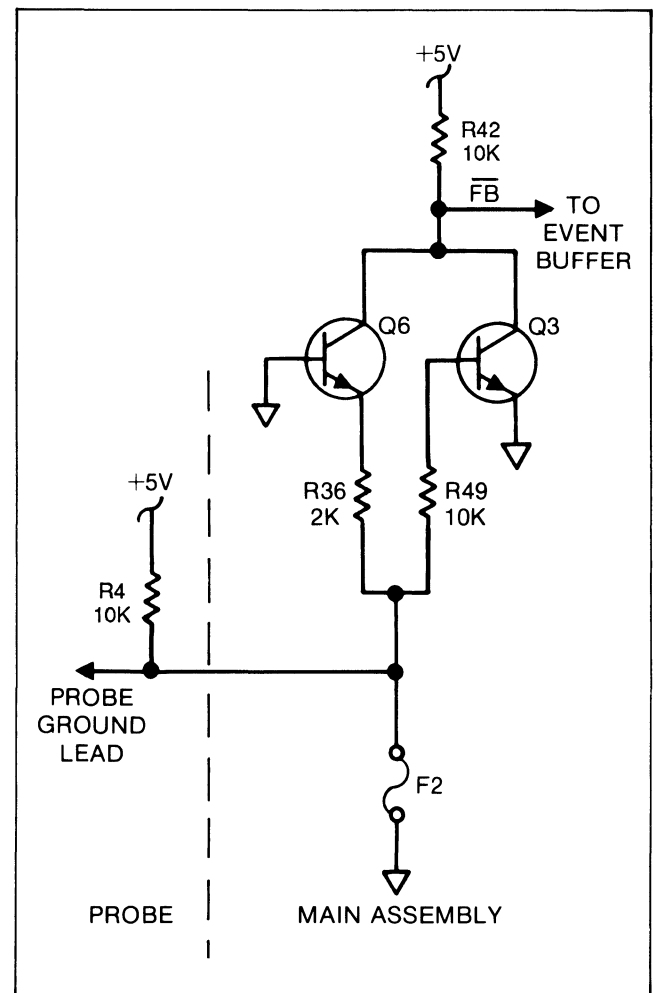


Figure 3-8. Probe Fuse Sensing Circuit

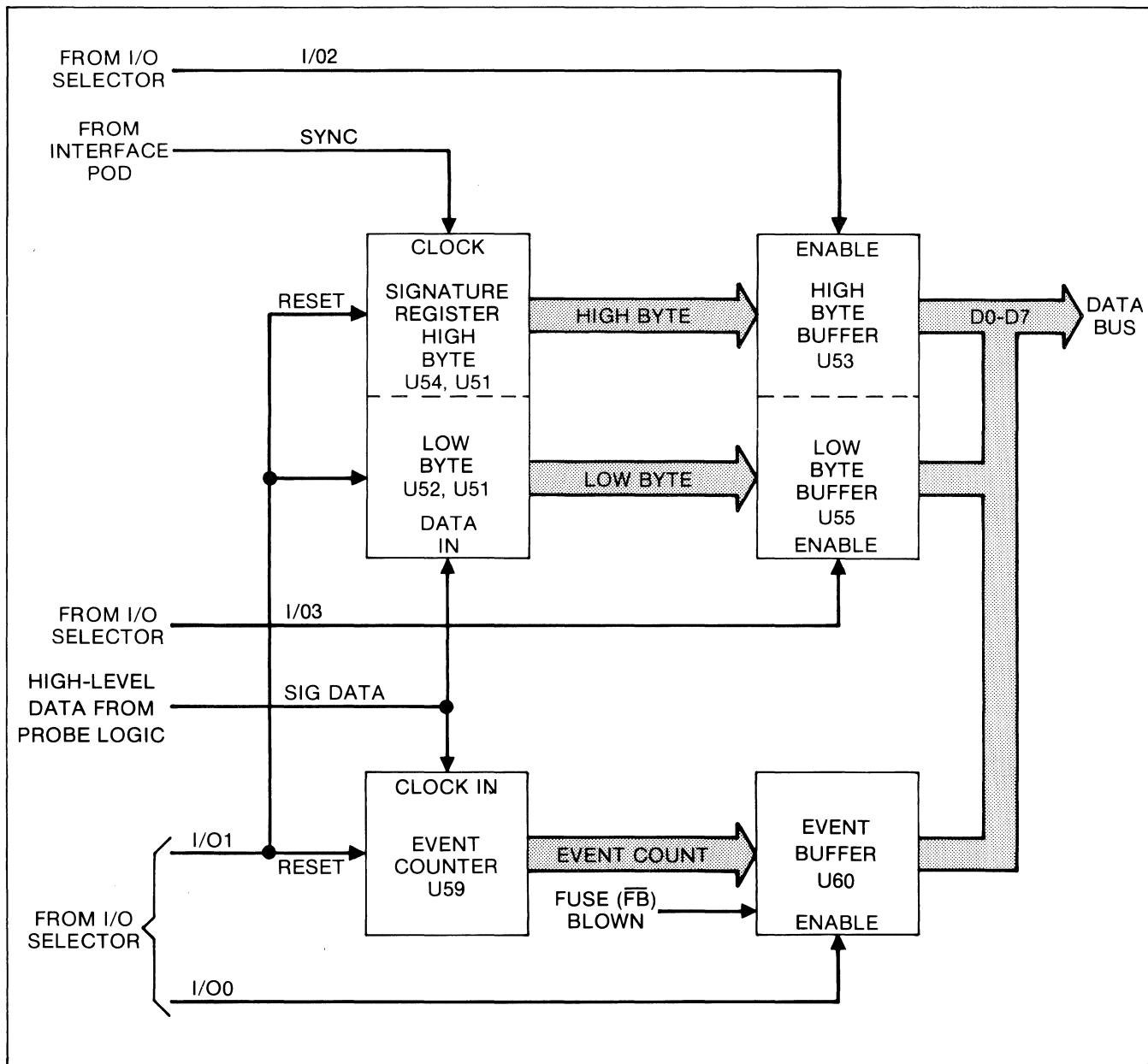


Figure 3-9. Signature Register/Event Counter

### 3-82. PROBE STATUS REPORTING

3-83. The probe logic reports the result of probe operations to the microprocessor by indicating the occurrence of logic high, logic low, and invalid signals. The occurrence of a logic high and/or logic low signal causes an output at one or both of the pulse stretchers. The pulse stretcher outputs are connected to respective inputs of the output data latch, U46. The occurrence of a 100 nanosecond or greater invalid signal causes an input to the light inhibit circuit, and also to an input of the output data latch. The output data latch stores its inputs and, when enabled by the CB2 signal from the pod/probe PIA, places the stored high, low, and/or invalid signal condition on PIA lines PA5, PA6, and PA7. The

pod/probe PIA operates under microprocessor control to place the probe signal condition data on the microprocessor data bus.

#### NOTE

*The invalid state goes unreported when operating in the synchronized mode. This is due to the controlling software and not the hardware.*

### 3-84. PROBE PULSE GENERATION/CONTROL

3-85. The probe logic generates pulses, either synchronized to the interface pod or free-running at 1 kHz, high or low, for application via the probe to a UUT.

Synchronized probe pulses are derived from the Sync signal (generated by the interface pod at valid address/data times), while free-running pulses are derived from a 1 kHz-oscillator/2-microsecond one-shot combination. Each probe pulse source connects to an input of a third section of the 2:1 multiplexer, U38 (described previously under Synchronized/Free-Running Operation). The Sync Control signal fed from input control latch, U45, makes selection of either multiplexer input for connection to the output. The input control latch receives a synchronize or free-running command from the microprocessor via the pod/probe PIA and line PA7.

3-86. For synchronized pulses, the multiplexer selects the  $\overline{\text{SYNC}}$  signal for application to the pulse control logic (U39, U40, U41, U57). For free-running pulses, the multiplexer selects the 1 kHz-oscillator/one-shot output for application to the pulse control logic. The 1 kHz oscillator output triggers a 2 microsecond one-shot to produce a continuous stream of 2 microsecond pulses at a 1 KHz rate.

3-87. The pulse control logic accepts either  $\overline{\text{SYNC}}$  pulses from the interface pod or 2 microsecond pulses from the 1 kHz-oscillator/one-shot, and accepts pulse select signals from input control latch, U45. Pulse select signals provided by U45 originate with the microprocessor and are written to the pod/probe PIA, and then to the input control latch via PIA lines PA5 and PA6.

3-88. Flip-flop U57, of the pulse control logic, in conjunction with the PA5 and PA6 signals from the PIA, allow the probe to pulse high, pulse low, or alternate between high and low by means of transistor switches Q1 and Q2, contained in the probe. The width of the output pulse is 2 microseconds for free-running mode, and equal to the pod SYNC pulse in the synchronized mode.

### 3-89. SCOPE TRIGGER OUTPUT

3-90. The probe logic includes a differentiator/amplifier circuit, U50, which provides negative-going and positive-going pulses at a rear panel-mounted BNC connector. These pulses, intended for application to the trigger input of an oscilloscope, result from the negative-going and positive-going edges of the interface pod  $\overline{\text{SYNC}}$  signal, and as a result, are coincident with the SYNC signal. A pulse transformer provides output coupling to the rear panel connector and isolates the scope ground (tied to earth ground) from the system ground.

### 3-91. Signature Generator and Event Counter

3-92. The signature generator consists of a pair of clocked shift registers (U52 and U54) equipped with exclusive-OR (U51) feedback to produce a unique four-digit (16-bit) hexadecimal signature. The signature

generator utilizes the high-level data provided by the probe logic for data input, and the  $\overline{\text{SYNC}}$  signal provided by the interface pod for the signature clock input. The traditional start and stop signature times are controlled from the execution of a read probe function within a 9010A user program.

3-93. As shown in Figure 3-9, the SIG Data signals provided by the high level detector of the probe logic are fed to the data input of the signature register. The Sync signal from the interface pod is applied to the clock input. As a result, any logic state appearing at the probe tip at the time of the  $\overline{\text{SYNC}}$  signal (trailing edge) affects the state of the signature register. The timing of the  $\overline{\text{SYNC}}$  and probe signals, in conjunction with the exclusive-OR feedback allows the signature register to produce unique signatures at different UUT test points. Since the signature register is clocked only by each interface pod-produced UUT event, the probe signature is always synchronized to interface pod/UUT activities regardless of the sync selected by the front panel  $\overline{\text{SYNC}}$  key.

3-94. The high byte and low byte buffers (U53 and U55) receive the signature from the register and gate it, one byte at a time, onto the data bus as commanded by the microprocessor. The I/O2 signal from the I/O selector gates the high byte of signature data onto the data bus; the  $\overline{\text{I/O3}}$  signal gates the low byte.

3-95. The event counter U59 produces a seven-bit count (0-127 with wrap-around) of logic high-to-invalid transitions appearing at the probe tip. The input to the event counter is provided by the SIG Data signal from the high level detector of the probe logic. The event buffer, U60, gates the seven-bit event count plus the one-bit fuse-blown ( $\overline{\text{FB}}$ ) indication onto the data bus in response to the  $\overline{\text{I/O0}}$  signal from the I/O selector as commanded by the microprocessor.

3-96. The microprocessor resets both the signature generator and the event counter by means of the  $\overline{\text{I/O1}}$  output of the I/O selector. Reset occurs at the beginning of all read probe operations.

### 3-97. Magnetic Tape Controller

#### 3-98. INTRODUCTION

3-99. The Magnetic Tape Controller provides control of the magnetic tape unit in response to commands from the microprocessor. The Magnetic Tape Controller contains a peripheral microcomputer which, under internal software control, performs the following functions:

- Reads to or writes from the tape.
- Controls tape direction and speed.

- Rewinds tape.
- Positions tape at load point.
- Formats write words.
- Decodes read words.
- Detects end of tape.
- Detects cassette present/not present.
- Detects write-protected cassette.
- Detect synchronization errors.
- Reports tape subsystem status to the microprocessor.

**NOTE**

*Refer to Table 4-13 for a list of addressing protocol for the magnetic tape controller.*

3-100. Selection (addressing) of the Magnetic Tape Controller by the microprocessor is done by means of the I/O5 output of the I/O selector described earlier in this section. In addition, address line A0 provides the controller with two addresses. When the microprocessor writes A0 low, the information placed on the data bus is for a read data or write data operation, as determined by the RD or WR lines. However, when A0 is written high, a write operation issues a command to the peripheral microcomputer to place controller status on the data bus. The peripheral microcomputer also receives the system RES signal generated by the power-on reset and watchdog timer circuits. Refer to Figure 3-10 for a block diagram of the magnetic tape controller.

### 3-101. TAPE DRIVE MOTOR CONTROL

3-102. A speed-regulated reel-drive motor moves the magnetic tape over the read/write head. To operate the motor in the forward direction, the peripheral microcomputer writes an output to the Forward line (and also an output to the  $\bar{E}$  line to enable all controller functions). The Forward signal operates the switch formed by U4B to connect the positive side of the tape drive motor to the +5 volt supply. As a result, motor current flows through U4B, through the motor, and out through back-EMF regulator, U6. The back-EMF regulator senses the voltage across the motor, which is proportional to motor speed, and provides the feedback necessary to maintain a constant motor speed. Potentiometer R14 provides a means of setting motor speed.

3-103. To operate the motor in the rewind direction, the peripheral microcomputer writes an output to the REWD line, and also to the  $\bar{E}$  line. The REWD signal turns on solenoid driver, U4A, to actuate the rewind solenoid, closes the switch formed by U4C, and closes the switch formed by U4D and Q1. As a result, motor current flows from the +5 volt supply through U4C, bypasses U6, flows through the motor and through Q1 to the ground. Since regulator U6 is bypassed, motor rewind speed is uncontrolled and is the maximum provided by five volts.

### 3-104. WRITE CONTROL

3-105. To avoid any possible errors which might result from tape jitter or speed variation, a method of ratio encoding is used to write all data on the tape. Figure 3-11 illustrates the method of ratio encoding employed by the magnetic tape controller. Any data bit is either 2/3 bit time high or low, with the other 1/3 bit time of the opposite polarity. A one bit begins low, and after 1/3 of the bit time makes a transition to high for the remaining 2/3 of the bit time. A zero bit also begins low, but stays low for 2/3 of the bit time, after which it makes a transition to high for the remaining 1/3 of the bit time. Under this coding scheme, the first 1/3 of a bit is always low, and the last 1/3 of a bit is always high. An extra 1/3 low provides a stop mark, and an inter-word high of 1-2/3 bit times is written for synchronization purposes. A high for ten word lengths indicates end-of-file.

3-106. To write to the tape, the peripheral microcomputer writes a WE (write enable) signal to current sources Q3 and Q4, and to current sinks U3A and U3B. The WE signal turns on the current sources and enables the current sinks. To write a high to the tape, the peripheral microcomputer writes to the WRITE 1 line to turn on current sink, U3A. When turned on, U3A directly sinks the current supplied by Q4, and also sinks the current supplied Q3 after passing through the read/write head in a negative-to-positive direction.

3-107. The read/write head records the transition as a flux change on the tape. To write a low to the tape, the peripheral microcomputer writes to the WRITE 0 line to turn on current sink, U3B. When turned on, U3B directly sinks the current supplied by Q3, and also sinks the current supplied by Q4 after passing through the read/write head in a positive-to-negative direction (opposite to the direction when writing a high level). The read/write head records the transition as a flux change on the tape, but of the opposite polarity of that recorded for the high portion of a data bit.

### 3-108. PLAYBACK AMPLIFIER

3-109. All signals appearing across the read/write head, including those written by the peripheral microcomputer,

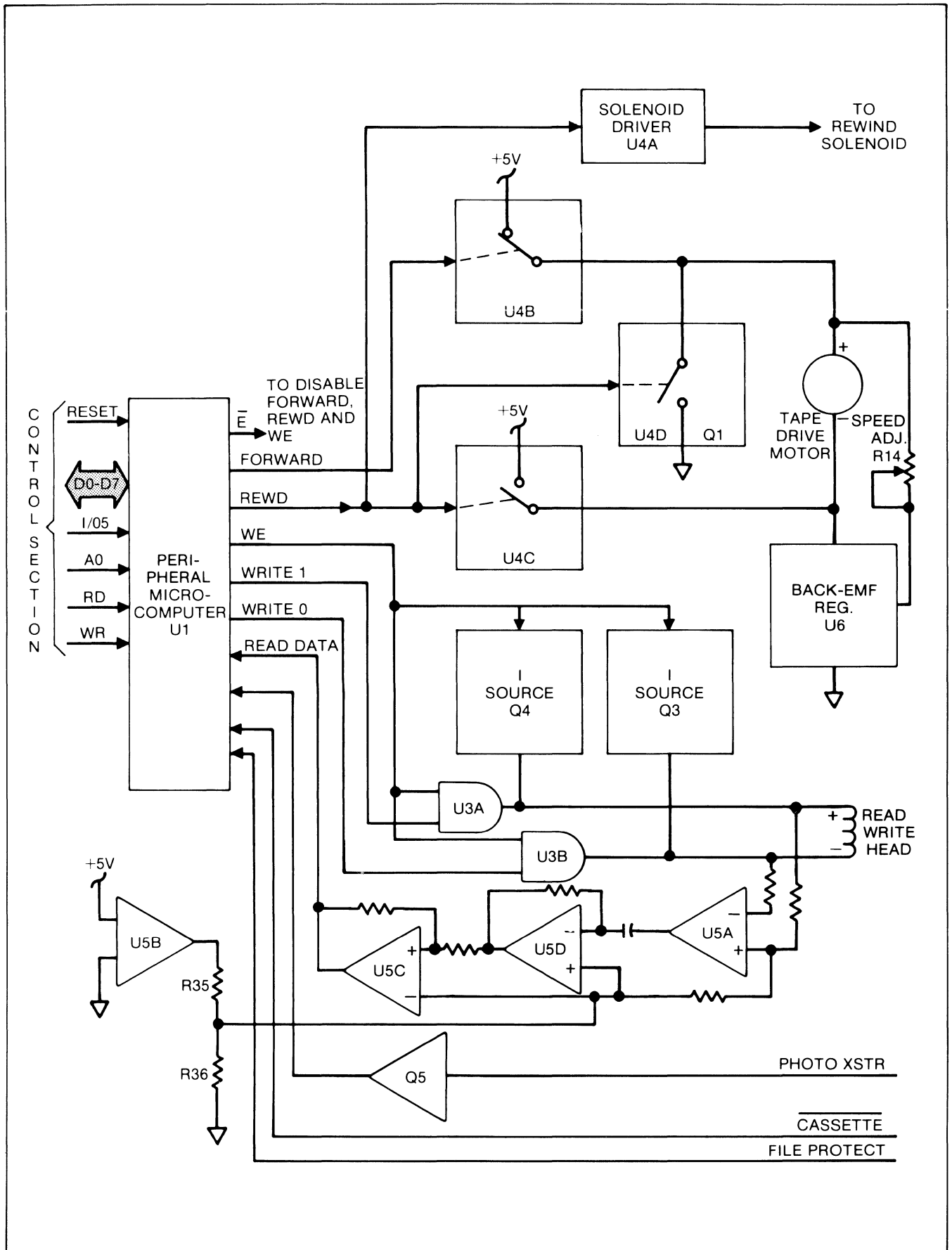


Figure 3-10. Magnetic Tape Controller



## Section 4 Maintenance

### 4-1. INTRODUCTION

4-2. This section of the manual contains routine maintenance and troubleshooting information for the 9010A. A list of recommended test equipment is given in Section 1, Table 1-1.

### 4-3. GENERAL INFORMATION

#### NOTE

*The 9010A is double-insulated from the power line. Although the rear panel is connected to earth (green wire), internal signal ground or logic common is floating. Consequently, ground connections for external test equipment must be made to logic common (TP2) on the main assembly.*

### 4-4. Access Information

4-5. To gain access to all the printed circuit assemblies (pca's) of the troubleshooter, proceed as follows:

1. Invert the instrument on a clean surface and remove the seven retaining screws from the bottom side.
2. Carefully return the instrument to the upright position while holding the top cover in place. Once in the upright position, remove the top cover and lay it to the right side of the instrument.
3. The top cover assembly includes the tape deck and the Magnetic Tape PCA. The display/keyboard is held in place by the top cover.

### 4-6. Cleaning

#### CAUTION

**Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions will react with the plastic materials used in the instrument.**

4-7. Clean the front panel, the display lens, and the case with a mild solution of detergent and water. Clean dust from the circuit board with low pressure (<20 psi) dry air. Contaminates can be removed from the circuit boards with demineralized water and a soft brush. Dry with clean dry air at low pressure, and then bake at 50 to 60 degrees C (124-140 degrees F) for 24 hours.

4-8. Cleaning of the magnetic tape drive is limited to occasional cleaning of the read/write head. The need for head cleaning is evidenced by the presence of iron oxide. Clean the head with cotton swabs moistened with isopropyl alcohol. Continue to clean the head until the swabs cease to be discolored.

### 4-9. Line Voltage Switch Settings

4-10. The 9010A can be set to operate from any of four different line voltages: 100V ac, 120V ac, 220V ac, or 240V ac. Two slide switches mounted near the left-front corner of the main assembly can be positioned to configure the 9010A to operate from any of the four input voltages. Refer to Figure 4-1. To select a specific input configuration, insert a flat-tipped screwdriver in switch slots and slide the switches to the required position as shown in Figure 4-1.

### 4-11. FUSE REPLACEMENT

#### 4-12. Line Fuse

4-13. The line fuse (F1) is located on the rear panel. Figure 4-2 illustrates line fuse location. Replace the fuse with a 1 ampere slow-blow, 250V (part no. 109272) for 100 and 120 volt operation; replace with a ½ ampere slow-blow, 250V (part no. 109322) for 220 and 240 operation.

### 4-14. Probe Fuse

4-15. The troubleshooter detects a probe fuse failure by halting operation and displaying the message REPLACE PROBE FUSE/UNPLUG PROBE. (Typically, the probe fuse is blown by inadvertently connecting the probe



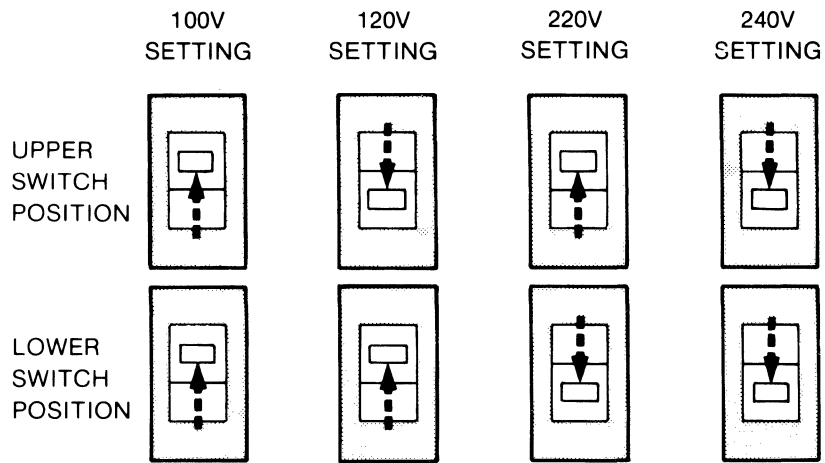
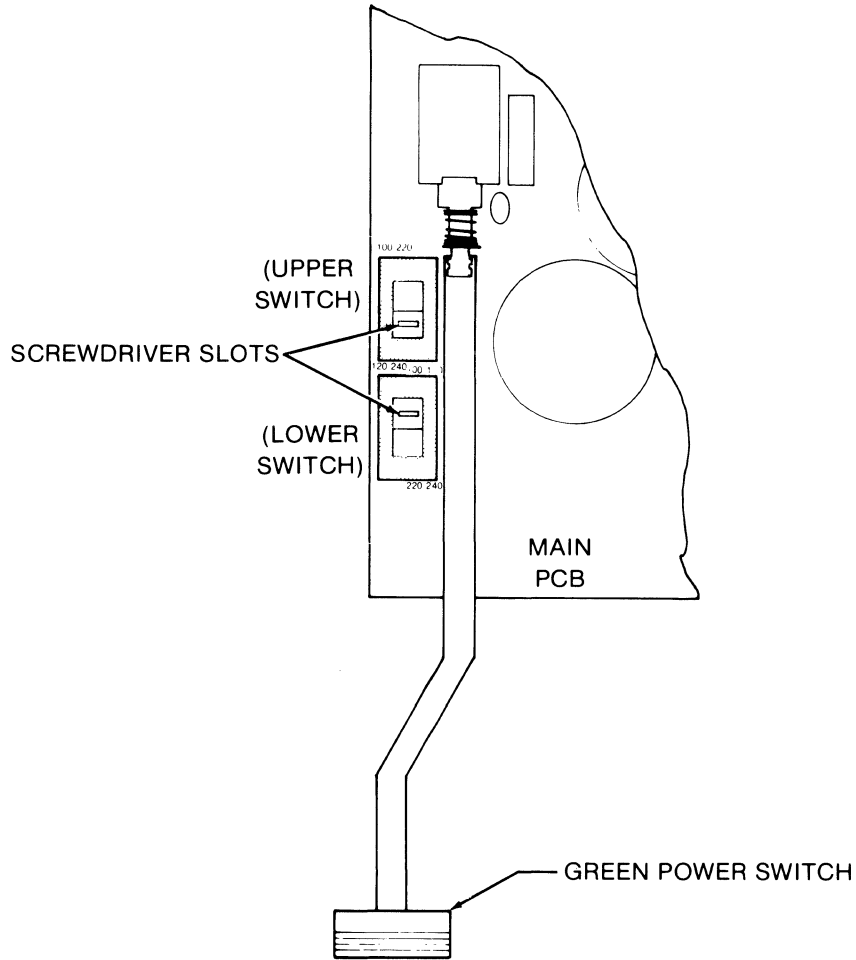


Figure 4-1. Location of Line Voltage Switches and Switch Settings

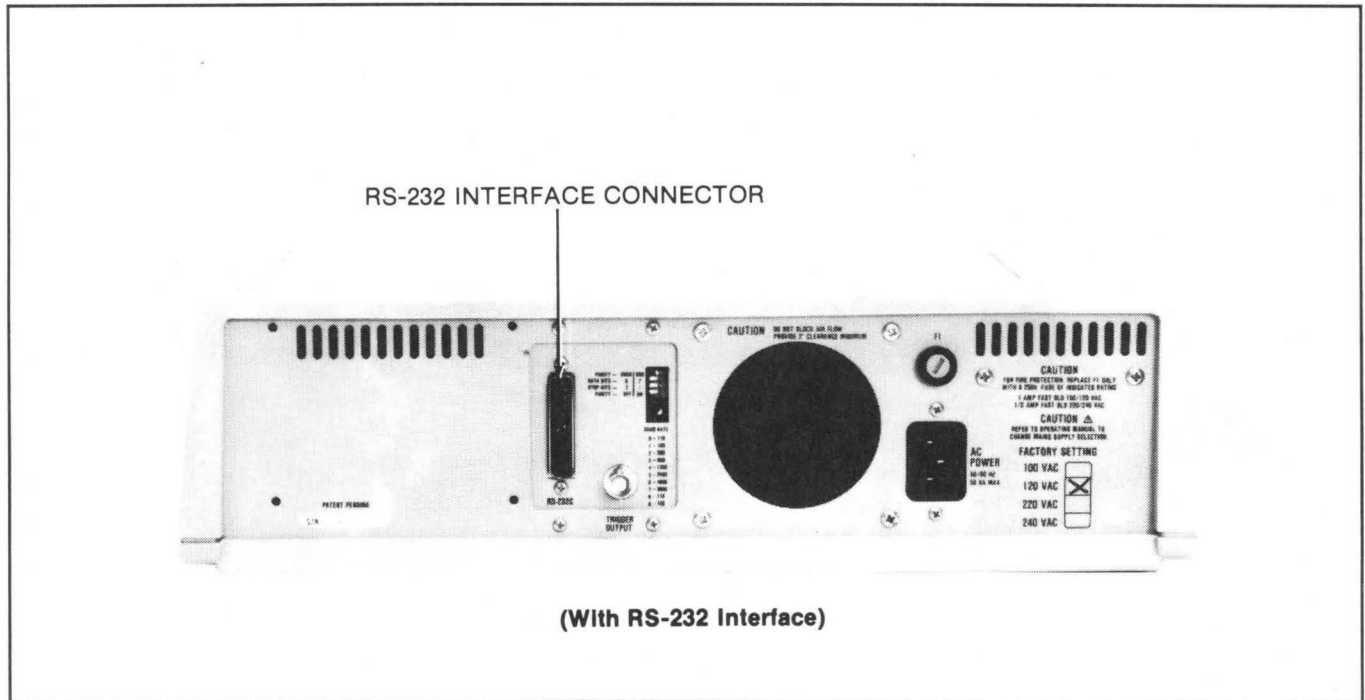


Figure 4-2. 9010A Rear Panel

ground clip to a power source.) To replace the probe fuse, proceed as follows:

1. Tilt up the front of the instrument and locate the probe fuse cap shown in Figure 4-3.
2. Remove the fuse cap by turning 1/8 turn counterclockwise with a screwdriver. Pull out the fuse with the fuse cap. Note the color of the fuse cap.
3. Replace the fuse with one having a 1/4 ampere, 250V rating. For black fuse caps use Fluke part number 543504 (5x20 mm), for grey fuse caps use Fluke part number 109314 (3AG).

**NOTE**

*If a spare fuse is not immediately available, remove the probe from the troubleshooter to continue operation without the probe.*

**4-16. PERFORMANCE TEST**

**4-17. Self Test**

4-18. Upon application of power, the troubleshooter performs a self test to verify proper operation of internal ROM and RAM. Upon successful completion of self test, the troubleshooter displays the message FLUKE 9000 POWER-UP OK VER-*nn*, where *nn* represents a number corresponding to the software version contained in the instrument.

4-19. If the self test routine detects a ROM or RAM problem, the troubleshooter displays the message FLUKE 9000 POWER-UP FAIL *mm*, where *mm* equals a two-digit hexadecimal failure code. Table 4-1 lists the failure codes and their meanings.

4-20. Troubleshooter self test may also occur at times other than power-on; referred to as restart. The troubleshooter contains a watchdog timer circuit which initiates self test whenever internal operation does not appear normal. In this case, the troubleshooter displays the message FLUKE 9000 RESTARTED SELF TEST followed by either FLUKE 9000 RESTARTED OK VER-*nn* (where *nn* equals the software version) or FLUKE 9000 RESTARTED FAIL *mm* (where *mm* equals a failure code listed in Table 4-1).

**4-21. Probe Level Detection/Verification**

4-22. Check for proper probe detection threshold levels as follows:

1. Connect the probe of the 9010A across the output of a variable dc power supply and the input of a 3-1/2 digit multimeter so that the probe tip connects to the positive terminals and the ground lead connects to the negative terminals. Select an output of zero volts on the power supply.
2. Select free-run synchronization by pressing SYNC followed by F.

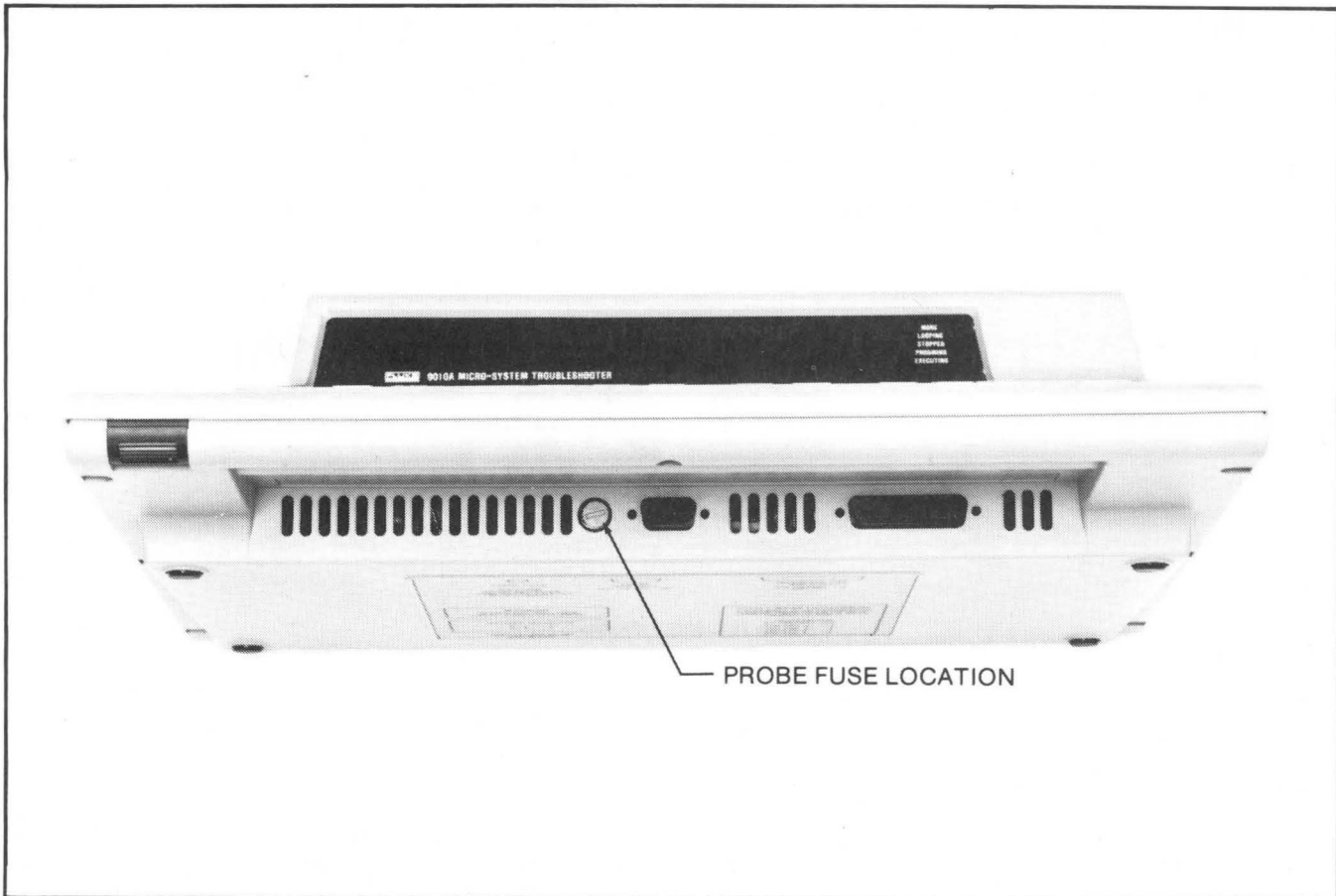


Figure 4-3. Probe Fuse Location

Table 4-1. Self Test Failure Codes

CODE	INDICATED FAILURE
02	RAM failed write FF during power-on
03	RAM failed write FF during restart
04	RAM failed write 00 during power-on
05	RAM failed write 00 during restart
06	RAM failed write FF/00 during power-on
07	RAM failed write FF/00 during restart
08	ROM check failed during power-on
09	ROM check failed during restart
0A	RAM failed write FF and ROM check during power-on
0B	RAM failed write FF and ROM check during restart
0C	RAM failed write 00 and ROM check during power-on
0D	RAM failed write 00 and ROM check during restart
0E	RAM failed write FF/00 and ROM check during power-on
0F	RAM failed write FF/00 and ROM check during restart



2. The display should read all "\*"s and the STOPPED annunciator should light.
3. Press CONT and the display reads all 8's. Press CONT and all decimal points are displayed. Press CONT.
4. The display reads KEY=. Press all keys except STOP, LOW or HIGH and verify the hexadecimal value is the same as shown in Figure 4-4. Press STOP to exit program.

**4-31. CALIBRATION ADJUSTMENTS**

**4-32. Power Supply Adjustment**

4-33. Adjustment (R2), shown in Figure 4-5, is provided for the +5-volt supply and should be adjusted to obtain a level of +5.1 volts  $\pm 10$  mV at TP10. For proper power supply loading, all assemblies should be connected to the Main Assembly.

**4-34. Magnetic Tape Speed Adjustment**

4-35. Tape speed can be checked and, if necessary, adjusted by means of the following procedure. Gain access to the Magnetic Tape Controller by removing the seven 9010A cover-retaining screws, removing the cover and to expose the Magnetic Tape Controller Assembly.

1. Open the cassette access door of the tape drive and place a strobe disk (part no. 609578 for 60 Hz operation, and part no. 609560 for 50 Hz operation) on the left spindle.
2. Power the 9010A off then on.
3. Select the read test by momentarily jumpering pins 20 and 22 of U1 on the magnetic tape controller assembly.

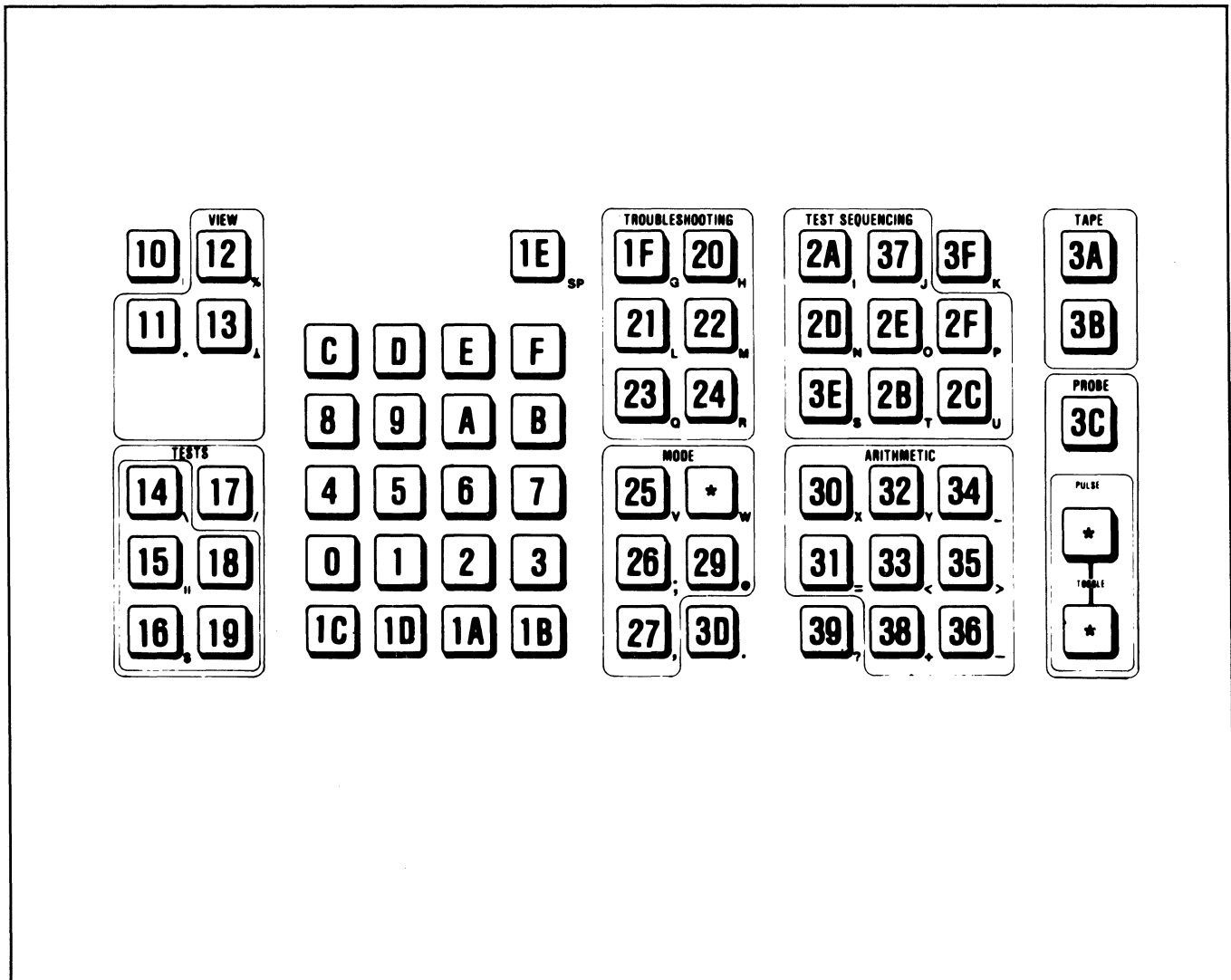


Figure 4-4. Asynchronous Input Values

- Observe the strobe disk while adjusting R14 (shown in Figure 4-6). The disk strobe lines appear motionless when proper speed is achieved.

**4-36. Probe Input Compensation Adjustment**

4-37. Adjust as follows:

- Gain access to the Main Assembly components as described under the heading Access Information.
- Connect the 9010A probe cable to the underside front connector of the troubleshooter, and leave the probe tip disconnected.
- Apply power to the troubleshooter.
- Measure the voltage at TP17 (+) with reference to TP1 (-). Voltage should be 0, ±5 mV. Adjust R64

if necessary. Refer to Figure 4-7 for test point locations.

- Connect an oscilloscope across TP8 (ground) and TP14 located on the Main Assembly.
- Adjust the oscilloscope to obtain a display of one or two full cycles of the signal at a vertical sensitivity of 2V/div.
- Remove the oscilloscope from TP14 and connect to TP1 changing the vertical sensitivity to 100 mV/div.
- Connect the 9020A probe tip to TP14 and probe GND to TP8.
- Adjust C52 (shown in Figure 4-7) to obtain best wave, i.e., square corners with minimum over or undershoot.

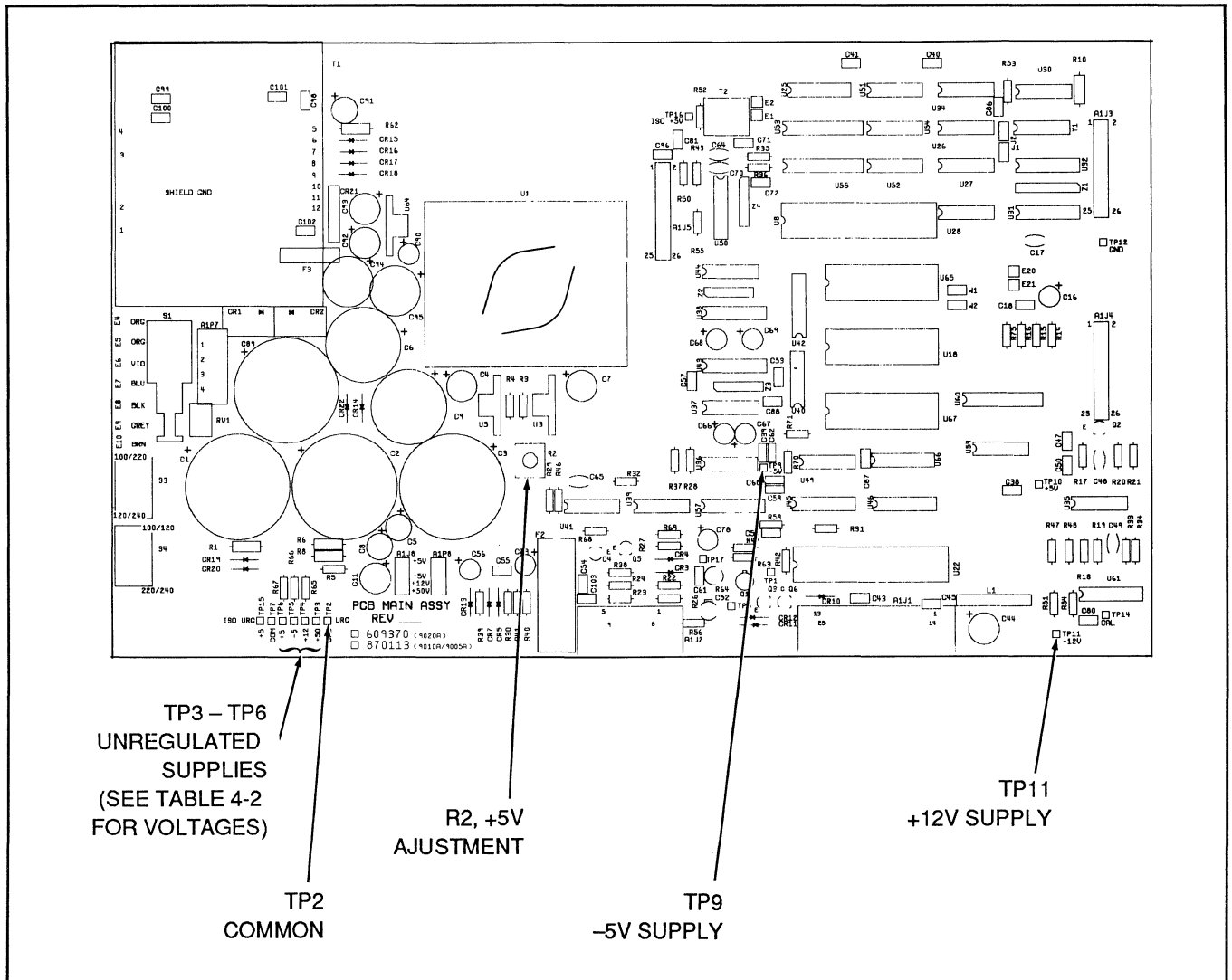


Figure 4-5. Power Supply Test Points and Adjustments

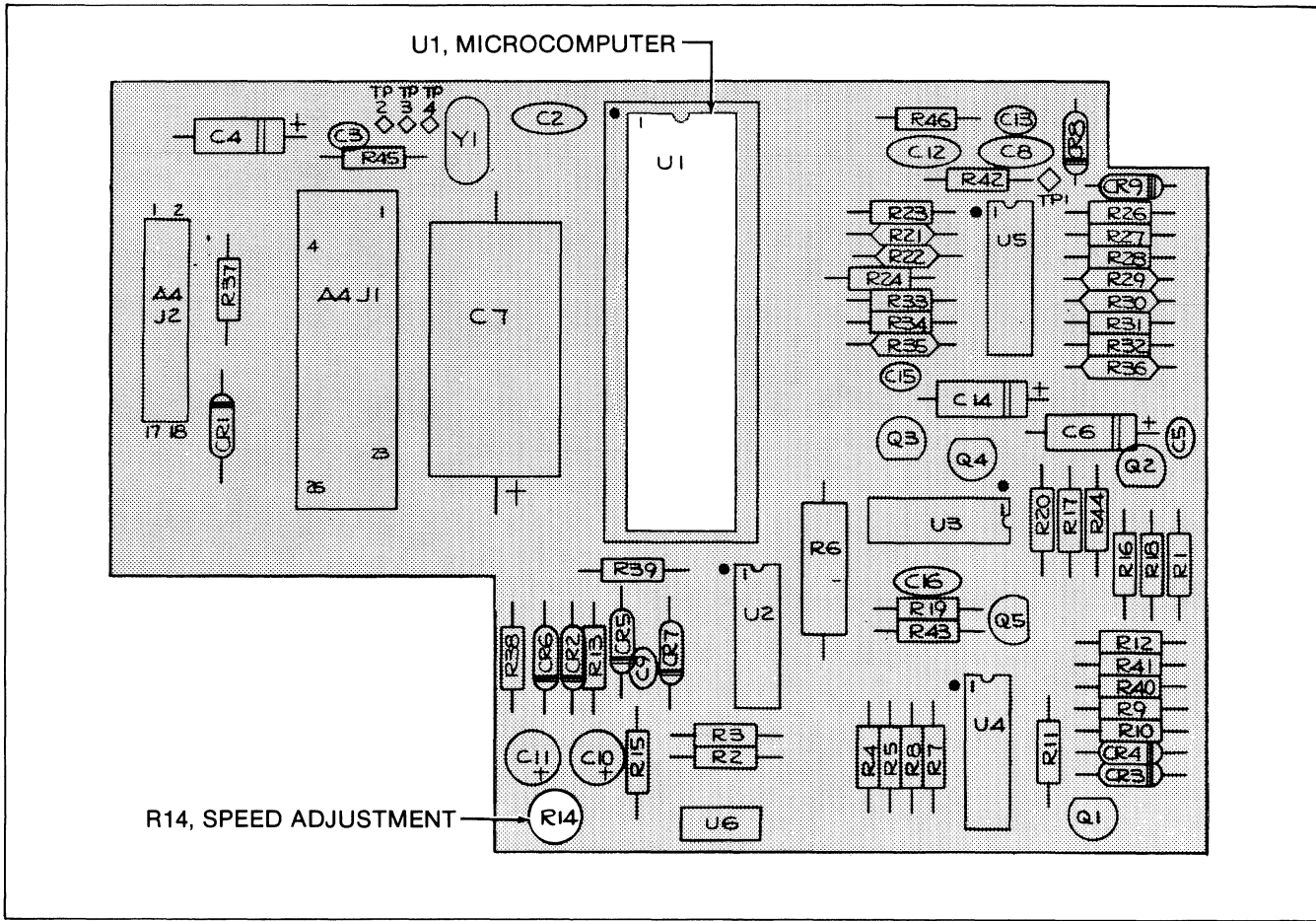


Figure 4-6. Tape Speed Adjustments

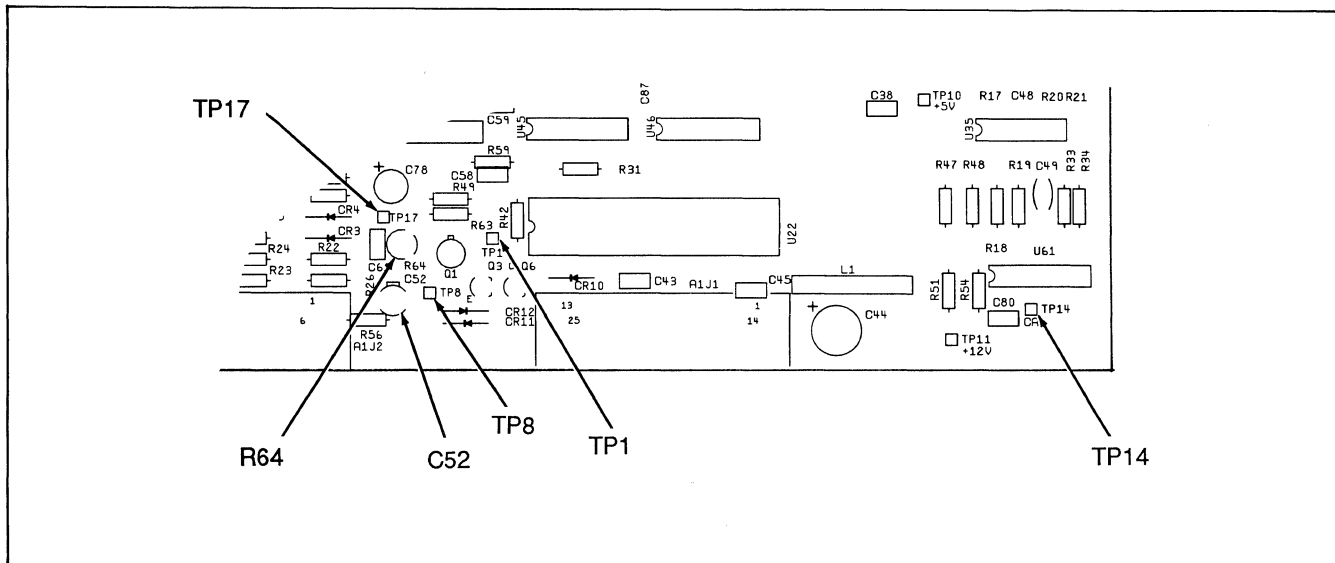


Figure 4-7. Probe Component Test Points and Adjustments

6. Adjust C51 and C52 (shown in Figure 4-7) to obtain best wave, i.e., square corners with minimum over or undershoot.

**4-38. REPAIR PRECAUTIONS**

**CAUTION**



**Static discharge can damage MOS components contained in the troubleshooter. To prevent this possibility,**

- Do not handle ICs or PCAs by their connectors.
- Attach static ground straps to repair personnel.
- Use conductive foam to store replacement or removed ICs.
- Remove all plastic, vinyl and styrofoam from the work area.
- Use a grounded soldering iron.

*NOTE*

*The soldering iron used for repair should have a rating of 25 watts or less to prevent overheating the PCB assembly.*

**4-39. TROUBLESHOOTING**

**4-40. Introduction**

4-41. Troubleshooting the 9010A is similar to troubleshooting any other microprocessor-based unit, and requires the equipment listed in Table 1-1. The troubleshooting information presented in the following paragraphs, plus the fault isolation diagram contained in Section 8 of this manual, provides a troubleshooting guide for use while employing normal fault isolation techniques. In addition, this section contains a series of test programs which can be run using a tester 9010A. These test programs are called out as required in the following troubleshooting procedures.

*NOTE*

*All programs listed in the following sections are included as a starting point for troubleshooting a faulty 9010A. These programs could be expanded as the user becomes more sophisticated in troubleshooting techniques. The programs could also be adapted to the particular style of testing the user desires.*

**4-42. Power Supply Checks**

4-43. Power supply levels should be checked whenever improper operation of the unit is suspected.

4-44. Using a digital multimeter, check the power supply voltages at the test points listed in Table 4-3 for the listed levels. The location of the power supply test points and adjustment is shown in Figure 4-5. In order to maintain proper power supply loading, do not disconnect the Display/Keyboard Assembly from the Main Assembly. Failure of the unregulated supplies could be caused by a defective transformer (T1), open or shorted rectifier diodes, or open or shorted filter capacitors. Failure of the regulated supplies could be caused by defective regulator devices or shorts at the regulator outputs.

4-45. Ac ripple on all regulated supplies (except the 50-volt supply) is 25 millivolts rms maximum. The 50-volt supply typically contains less than 100 millivolts of ac ripple.

**4-46. Bus/RAM/ROM Checks**

4-47. Use a second 9010A Troubleshooter, hereafter referred to as the tester 9010A, and a 9000A-Z80 Interface Pod to perform all Main Assembly checks. Gain access to the Z80 socket by removing the seven retaining screws and the top cover from the 9010A. Lift off the top cover assembly and set to the side leaving the two ribbon cables attached. Connect the tester 9010A and the 9000A-Z80 Interface Pod to the main Assembly as follows:

**Table 4-3. Power Supply Test Points and Levels**

POWER SUPPLY	UNREGULATED (Nominal Line Voltage)		REGULATED	
	TEST POINT	TYPICAL LEVEL	TEST POINT	NORMAL LEVEL V DC
+5V	TP3	+12.8V	TP10	+5.10 to 5.12
-5V	TP5	-14.7V	TP9	-4.75 to 5.25
+8V	TP7	+15.6V	TP13	+7.6 to 8.4
+12V	TP4	+23.1V	TP11	+11.4 to 12.6
+50V	TP6	+55V	---	---



1. With ac power off, remove the Z80 microprocessor (U8) from the A1 Main Assembly.
2. Connect the 9010A-Z80 interface pod to the vacant Z80 socket.
3. With power applied first to the tester 9010A, apply power to the UUT (9010A under repair).
4. Perform a Bus Test. If the test fails, examine the entire tester 9010A display diagnostic to determine the stuck line(s). Isolate any fault using the probe and schematic diagram contained in Section 8.
5. Perform a RAM Short test on address range C000 - FFFF; this test takes about 4 minutes and detects most types of RAM errors. A RAM Long test can also be performed, but allow approximately 67 minutes. RAM addresses are listed in Table 4-4.

**NOTE**

*If a RAM failure occurs, carefully examine the diagnostic message. The RAM Test is usually sufficient for deducing the failed component directly.*

6. Perform a ROM Test on the entire ROM. ROM addresses and signatures are listed in Table 4-4.

**4-48. I/O Selector Checks**

4-49. Failure of the I/O selector U25 can result in the failure of any or all I/O devices. The I/O devices within the 9010A include:

- The Signature Generator/Event Counter - Selector outputs 0, 1, 2 and 3
- The Display/Keyboard Assembly - Selector output 4
- The Magnetic Tape Controller - Selector output 5

- The Pod/Probe PIA - Selector output 6
- The RS-232 Interface - Selector output 7

4-50. With the tester 9010A connected to the 9010A under test, hereafter referred to as the UUT, as described for Bus/RAM/ROM Checks, check the individual outputs of the I/O selector as follows:

1. Synchronize the tester 9010A probe to the address sync mode.
2. Perform looping-reads at each I/O selector address listed below, and use the probe to verify low signals at the corresponding outputs. Only oneline should be selected low at any given time.

I/O Address	U25 PIN NO.
10000	15
10020	14
10040	13
10060	12
10080	11
100A0	10
100C0	9
100E0	7

**4-51. Power-On Reset/Watchdog Timer Checks**

4-52. Failure of the power-on reset circuit is indicated by failure of the troubleshooter to execute self test upon the application of ac power. Failure of the watchdog timer may not be obvious since it is normally triggered by some internal malfunction, and such an internal malfunction may not be known to be present. Gain access to the main assembly components as described under the heading Access Information and check these circuits as follows:

1. With the tester 9010A connected to the 9010A under test as described for Bus/RAM/ROM Checks, select the Run UUT mode on the tester 9010A.
2. Using the tester 9010A probe in the sync-free-run pulse-low mode, momentarily connect the

**Table 4-4. Memory Addresses and Signatures**

SOFTWARE VERSION 3.A			
ADDRESSABLE DEVICE	SIGNATURE	ADDRESS (HEX)	COMMENTS
ROM-U65	BF28	0000-BFFF	-1 PROM – JUMPERW2 INSTALLED; JUMPER W1 REMOVED
RAM-U18	N/A	C000-FFFF	

probe tip to U31-4 of the UUT. (Refer to Figure 4-8 for the location of U31.) The UUT should beep and display the power-up message FLUKE 9000 POWER-UP OK VER-xx (where xx indicates the current software version number) each time the probe is momentarily connected to U31.

3. Using the tester 9010A probe to read instead of pulse (pulse mode turned off), verify the presence of logic high levels at U31-4 and U31-7, and logic low at U31-6.

4. On the tester 9010A perform a looping-read or write to address 10080 while observing U31-10 of the UUT with the tester 9010A probe (free-

running). Press STOP on the tester 9010A and verify that the signal at U31-10 goes from high (red) to low (green) after approximately 4 seconds.

**4-53. Pod/Probe PIA Checks**

4-54. Failure of the pod/probe PIA typically causes communication problems with the pod and/or the probe since all commands and data move through the PIA. Follow the displayed instructions, setting the probe PULSE buttons both out or both in as instructed. Using the following procedure, verify proper operation of the pod/probe PIA. (Figure 4-8 shows the location of the pod/probe PIA U22, U31, U34, and U25.)

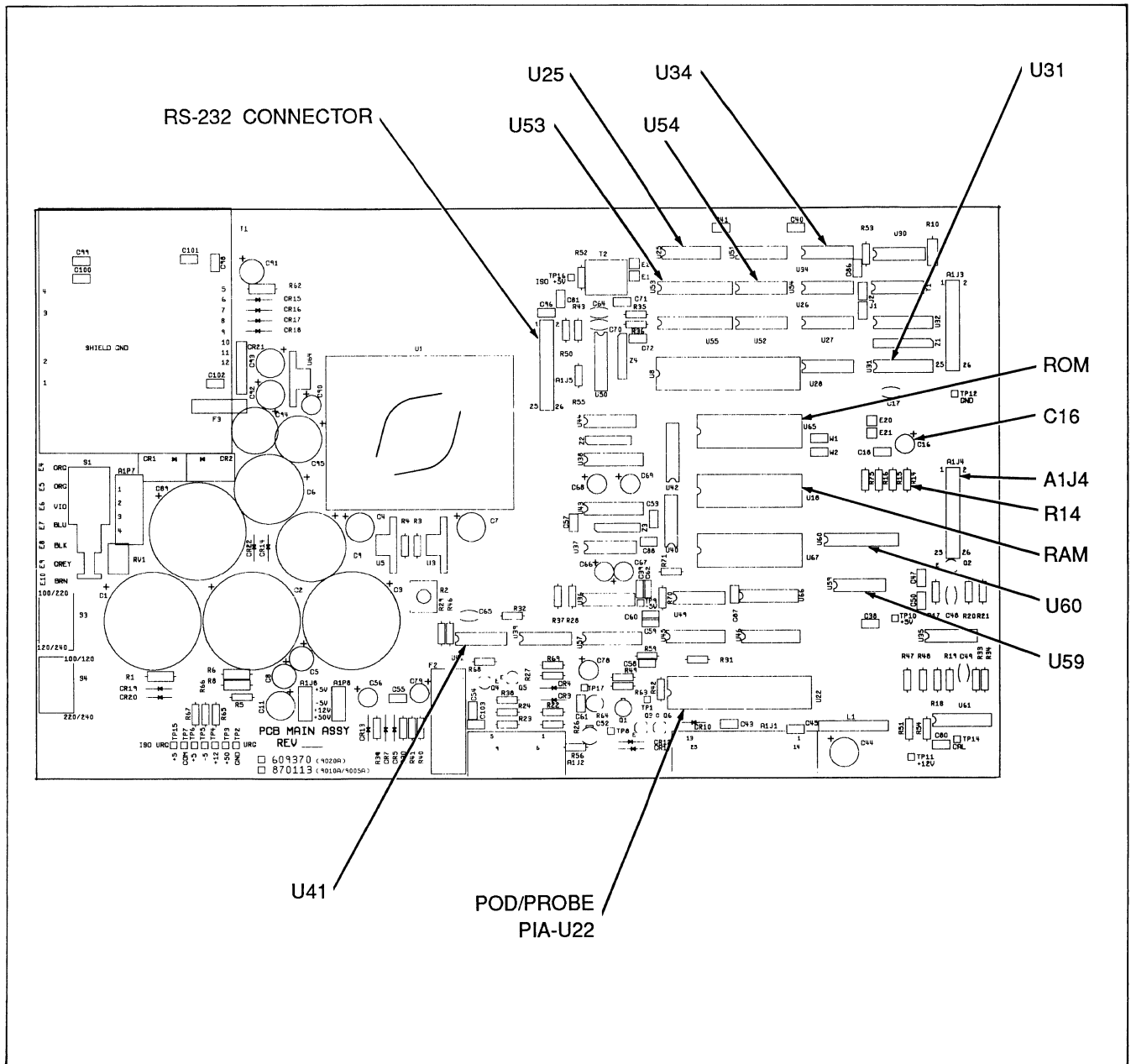


Figure 4-8. Main Assembly Components

1. Turn off the UUT and unplug the Display/Keyboard Assembly from the Main Assembly at A1J4.

2. Disable the watchdog timer U31 by jumpering R14 (the side adjacent to C16) to TP12 (ground). This removes the reset input from the pod/probe PIA and allows it to operate. Turn UUT power on.

3. Check the  $\overline{CS2}$  input of the pod/probe PIA as follows:

a. Synchronize the tester probe to the address sync mode.

b. Performing a looping-read at address 100C0.

c. Check the  $\overline{CS2}$  input at pin 23 of the PIA (U22), using the tester probe and if necessary at pin 10 of U34 and pin 9 of I/O selector U25. Verify that all are logic low.

d. Check the  $\overline{EN}$  input at U22 pin 25, CS0 at U22 pin 22, and CS1 at U22 pin 24. Verify that all are logic high.

4. Check the data transfer operation of the PIA (U23) by keying-in programs 11 and 12 listed in Table 4-5 and executing program 11. The program prompts the user for yes/no answers. If a fault occurs, the user has the option to recheck that test or continue with the next test. Any test can be skipped by answering NO in response to the test.

#### 4-55. Probe Related Circuit Checks

##### 4-56. CHECKING THE PROBE LOGIC

4-57. The probe logic is divided into four distinct functions:

- Probe Level Detectors
- Free-run Probe Logic
- Synchronized Probe Logic
- Pulse Output

4-58. Checking each function of the probe logic is accomplished by running a short program on the tester 9010A (connected to the faulty 9010A by means of a 9000A-Z80 interface pod and the vacant microprocessor socket as described under the heading Bus/RAM/ROM Checks) in conjunction with some manual checks. It is assumed that the Pod/Probe PIA Checks have been performed and all tests passed.

#### 4-59. Level Detector/Free-Run Checks

4-60. Perform level detectors/free-run checks as follows:

1. Turn off the UUT and remove the Display/Keyboard Assembly connector A1J4 (shown in Figure 4-8) to disable the beeper. Using a clip lead, disable the watchdog timer (U31) by jumping R14 (the end adjacent to C16) to TP12 (gnd). Turn on the tester 9010A and then the UUT.

2. Verify correct operation of the probe logic in the free-running mode by keying-in programs 2, 12 and 14 listed in Table 4-6 and executing program 2. The program sets up the pod/probe PIA U22 to control the probe logic, and also uses the tester 9010A to verify that the probe logic circuits are operating properly in the UUT.

a. Before running the program, remove the UUT probe and connect to the probe input (at A1J2-2 or at R22) of the UUT to the positive output of a variable dc supply via a 100k, 1%, resistor. (Be sure to install the 100k resistor at the 9010A end of the dc supply test lead in order to prevent noise pick-up.) The negative input should be tied to TP8 (gnd). Also connect the tester probe as directed during program execution.

#### CAUTION

**Do not allow the dc supply voltage to exceed 30 volts, or damage to the 9010A may result.**

b. If an incorrect condition occurs, use the probe of the tester 9010A to isolate the fault. The tester display shows the test that failed.

c. Disconnect the dc supply and 100k resistor.

4-61. In general, the signal should be traced through the FET buffer Q1, to HIGH and LOW comparators U36 and U49, through U41 buffers, through flip-flops U37, through selector U38, through one-shot U42, and finally to S/R latches in U46. The reference levels at U36-3 (318 mV) and U49-4 (106 mV) should also be checked using a DVM. If a fault occurs at J2-6 or J2-9, troubleshoot U40, U44, U43 and Q4/Q5.

#### 4-62. Synchronized Probe Check

4-63. Verify the probe input portion of the probe logic in the synchronized mode by keying-in the programs (3, 12, and 15) listed in Table 4-7 and executing program 3. This program sets up the pod/probe PIA U22 to control U45 and U38. To run the program, perform the following operations.

Table 4-5. PIA (U22) Test

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 11      865 BYTES  DPY-PIA TEST &lt;U22&gt;# SYNC ADDRESS EXECUTE PROGRAM 12 DPY-JUMP R14//C16 TO TP2 OR TP1 DPY-+2-CONT# STOP REG1 = 0 1: LABEL 1 INC REG1 REG3 = 0 IF REG1 = 6 GOTO F IF REG1 = 5 GOTO 7 IF REG1 = 4 GOTO 4 IF REG1 = 3 GOTO 3 IF REG1 = 2 GOTO 2 DPY-#TEST PORT A OUTPUT EXECUTE PROGRAM 12 DPY-TESTER PULSE HIGH, LOW OUT- DPY-+CONT# STOP WRITE @ 100C1 = 0 WRITE @ REGF DEC = FF WRITE @ REGF INC = 4 REG2 = 2 REG6 = A00 REGF = 100C0 GOTO 5 2: LABEL 2 DPY-#TEST PORT B OUTPUT EXECUTE PROGRAM 12 WRITE @ 100C3 = 0 WRITE @ REGF DEC = FF WRITE @ REGF INC = 4 REG2 = 10 REG6 = A00 REGF = 100C2 GOTO 5 3: LABEL 3 DPY-TEST PORT A INPUT# EXECUTE PROGRAM 12 WRITE @ 100C1 = 0 WRITE @ REGF DEC = 0 WRITE @ REGF INC = 4 DPY-TESTER PULSE HIGH, LOW IN- DPY-+CONT# STOP REG2 = 2 REG6 = 1 REGF = 100C0 GOTO 5 </pre>	<pre> delay disable watchdog  test number clear  increment test number clear bit number  which test is next?  delay  pia port a to output      Part of                           Test 1  1st pia pin number expected signature pia port a address  pia port b to output      Part of                           Test 2  enter 1st pia pin number expected signature pia port b address  pia port a to input      Part of                           Test 3  1st pia pin number expected signature port a address </pre>

Table 4-5. PIA (U22) Test (cont)

PROGRAM LISTING	COMMENTS
<pre> 4: LABEL 4   DPY-TEST PORT B INPUT#   EXECUTE PROGRAM 12   WRITE @ 100C3 = 0   WRITE @ REGF DEC = 0   WRITE @ REGF INC = 4   REG2 = 10   REG6 = 1   REGF = 100C2 5: LABEL 5   DPY-PROBE U22 PIN \$2    DPY-+, YES/NO #??   IF REG7 = 0 GOTO D   READ PROBE   IF REG1 = 5 GOTO 8   IF REG1 &gt; 2 GOTO 6    WRITE @ REGF = 0   DTOG @ REGF = FF BIT REG3    DTOG @ REGF = REGE BIT REGD    WRITE @ REGF = 0   READ PROBE   IF REG0 AND FFFF00 = REG6 GOTO C    GOTO E </pre>	<pre>           Part of pia port b to input      Test 4  1st pia pin number expected signature port b address  does oper wish to probe current pia pin?  no - increment pin and bit number yes - read probe if test 4 complete, check cb2 line if test 2 complete, continue with test 3, or 4  sets pia port to 0 toggle the bit no. in      Part of reg. 3                      Test 1 and 2  repeat toggle using default reg. pia to zero gather signature mask off all but sig and check against reg. 6 </pre>
<pre> 6: LABEL 6   READ @ REGF   REG8 = REGE   READ @ REGF   IF REG8 AND REG6 = REGE AND REG6 GOTO E    GOTO C </pre>	<pre> read pulse at pia port      Part save data                   of read pulse at pia port      Test if pulse present            3 and 4 at each read, error </pre>
<pre> 7: LABEL 7   DPY-#CB2 TEST   EXECUTE PROGRAM 12   DPY-TESTER PULSE HIGH, LOW OUT-   DPY-+CONT#   STOP   REG2 = 19   REG3 = 7   REG6 = 2   GOTO 5 </pre>	<pre> cb2 pin no. full count in bit counter expected event count </pre>

Table 4-5. PIA (U22) Test (cont)

PROGRAM LISTING	COMMENTS
<pre> 8: LABEL 8 WRITE @ 100C3 = 38 WRITE @ REGF = 30 WRITE @ REGF = 38 WRITE @ REGF = 30 READ PROBE IF REGO AND 7F = REG6 GOTO C GOTO E </pre>	<pre> stimulate cb2 line  gather event count verify event count - o.k. goto c not correct count - goto e </pre>
<pre> C: LABEL C DPY-+, GOOD EXECUTE PROGRAM 12 </pre>	<pre> sig o.k.  delay </pre>
<pre> D: LABEL D INC REG2 INC REG3 IF REG3 = 8 GOTO 1 IF 3 &gt; REG1 GOTO 5 SHL REG6 </pre>	<pre> increment pin increment bit  If tests 1 and 2, continue, move the test bit to next position for next pia pin check; tests 3 and 4 </pre>
<pre> GOTO 5 E: LABEL E DPY-#U22 PIN \$2 BIT \$3 FAILURE DPY-+ LOOP#?5 IF REG5 = 1 GOTO 5 DPY-TEST FAIL# STOP </pre>	<pre> sig. failure  repeat test yes </pre>
<pre> F: LABEL F DPY-PIA TEST PASSED# </pre>	
<pre> PROGRAM 12 21 BYTES </pre>	<pre> delay approx. 1 second </pre>
<pre> REG1 = 40 1: LABEL 1 DEC REG1 IF REG1 &gt; 0 GOTO 1 </pre>	

Table 4-6. Free-Running Probe Check

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 2  768 BYTES  DPY-FREE-RUN PROBE CHECK# SYNC FREE-RUN EXECUTE PROGRAM 12 DPY-JUMP R14//C16 TO TP2 OR TP1 DPY-+2-CONT# STOP 0: LABEL 0 DPY-SET INPUT &gt;.8V AND &lt;2.4V DPY-+ - CONT# STOP REG4 = 1 EXECUTE PROGRAM 14 IF REGE = 20 GOTO 1 DPY-INVALID STATUS GOTO E 1: LABEL 1 DPY-TESTER PROBE TO J2-6 - CONT DPY-+# STOP READ PROBE READ PROBE REG1 = 7000000 REG2 = 2000000 REG3 = 4000000 IF REG0 AND REG1 = REG2 GOTO 2 DPY-J2-6 INVALID GOTO E 2: LABEL 2 DPY-TESTER PROBE TO J2-9 - CONT DPY-+# STOP READ PROBE READ PROBE IF REG0 AND REG1 = REG2 GOTO 3 DPY-J2-9 INVALID GOTO E 3: LABEL 3 DPY-SET INPUT &lt;.8V - CONT# STOP REG4 = 2 EXECUTE PROGRAM 14 IF REGE = 40 GOTO 4 DPY-LOW STATUS GOTO E 4: LABEL 4 DPY-TESTER PROBE TO J2-9 - CONT DPY-+# STOP READ PROBE READ PROBE IF REG0 AND REG1 = REG2 GOTO 5 DPY-J2-9 LOW GOTO E </pre>	<pre> delay disable watchdog timer  invalid test pointer read uut probe level status check for invalid  clear tester probe read tester probe probe level mask invalid mask low mask check for invalid  clear tester probe read tester probe check for invalid  low test pointer read uut probe level status check for low  read tester probe, check for invalid </pre>

Table 4-6. Free-Running Probe Check (cont)

PROGRAM LISTING	COMMENTS
<pre> 5: LABEL 5 DPY-TESTER PROBE TO J2-6 - CONT DPY-+# STOP READ PROBE READ PROBE IF REG0 AND REG1 = REG3 GOTO 6 DPY-J2-6 LOW GOTO E 6: LABEL 6 DPY-SET INPUT &gt;2.4V - CONT# STOP REG4 = 3 EXECUTE PROGRAM 14 IF REGE = 80 GOTO 7 DPY-HI STATUS GOTO E 7: LABEL 7 DPY-TESTER PROBE TO J2-6 - CONT DPY-+# STOP READ PROBE READ PROBE IF REG0 AND REG1 = REG2 GOTO 8 DPY-J2-6 HI GOTO E 8: LABEL 8 DPY-TESTER PROBE TO J2-9 - CONT DPY-+# STOP READ PROBE READ PROBE IF REG0 AND REG1 = REG3 GOTO F DPY-J2-9 HI GOTO E E: LABEL E DPY-+ FAULT - CONT# STOP IF REG4 = 1 GOTO 0 IF REG4 = 2 GOTO 3 IF REG4 = 3 GOTO 6 GOTO 0 F: LABEL F DPY-FREE-RUN PROBE LOGIC OK DPY-+#  PROGRAM 12    21 BYTES </pre>	<pre> read tester probe, check for low  high test pointer read uut probe level status check for high status  read tester probe/check for invalid  read tester probe/check for low  append to test error message  delay approx. 1 second </pre>
<pre> REG1 = 40 1: LABEL 1 DEC REG1 IF REG1 &gt; 0 GOTO 1 </pre>	



Table 4-6. Free-Running Probe Check (cont)

PROGRAM LISTING	COMMENTS
PROGRAM 14    102 BYTES	
WRITE @ 100C3 = 30	cb2=0
WRITE @ 100C1 = 0	
WRITE @ 100C0 = FF	pia port a to out
WRITE @ 100C1 = 4	
WRITE @ 100C0 = 80	free-run - pulse off
WRITE @ 100C3 = 38	cb2=1
WRITE @ 100C1 = 0	
WRITE @ 100C0 = 0	pia port a to input
WRITE @ 100C1 = 4	
READ @ 100C0	read port a
REGE = REGE AND E0	mask off all except level status

1. Before proceeding make sure the dc supply is disconnected as instructed. Connect the probe tip of a tester 9010A (to be used as a source of sync pulses) to U41, pin 9 of the UUT; connect the ground lead to TP8 (shown in Figure 4-8).

2. Run the program and connect the probe input (A1J2-2 or at R22) of the UUT to logic low (TP8 or TP2); verify the tester display indicates - LOW. Connect the probe to +5V (TP10); verify the tester display indicates - HIGH.

#### 4-64. Probe Pulse Output Check

4-65. Verify the pulse output portion of the probe logic by keying-in programs 4, 12, and 13 listed in Table 4-8 and executing program 4. These programs set up the pod/probe PIA U22 to control U45, which enables U57, U37, U40, and U41. The program, an endless loop, also reads the output from the probe circuit and displays the pulse level on the tester 9010A. While running the program, observe that the lights of the UUT probe correspond to the tester 9010A display messages. Before running the check, remove all connections (except R14 to TP12) made for the previous tests and connect the UUT probe to its connector

#### 4-66. CHECKING THE PROBE FUNCTIONS

4-67. The probe can be checked by substituting with a known good unit from a tester 9010A. If the problem appears to still exist, fault may be in the probe circuitry on the Main Assembly of the 9010A. Proceed to the section titled Checking the Probe Logic to locate the fault. If the probe is determined to be defective, proceed as follows to isolate the fault:

1. Remove the R14 to TP12 jumper connected in previous checks.

2. Press RUN UUT, ENTER/YES on the tester 9010A. Verify the UUT powers up normally.

3. Verify the signal path from the probe tip to the 9010A as follows:

a. Connect the defective UUT probe to the UUT 9010A, and the probe tip to the points listed in the following table (UUT pulse should be off).

b. Using the good probe of the tester 9010A, check the levels at U36-11 and U49-11 located on the main assembly to be as follows. (Ground both probe leads to TP12.)

UUT		
PROBE INPUT	U36-11 LEVEL	U49-11 LEVEL
5V (TP10)	LOGIC LOW	LOGIC HIGH
GND (TP12)	LOGIC HIGH	LOGIC LOW
OPEN	LOGIC HIGH	LOGIC HIGH

4. Disassemble the probe by unscrewing and withdrawing the rear portion back along the cable. Lift off the probe case half to expose the lamps and printed circuit board assembly.

#### NOTE

*To further disassemble the probe for the purpose of repair, unscrew the ground lead and unsolder the circuit board from the tip.*

5. Verify proper operation of the probe lamps by connecting the UUT probe to the points listed in the following table and observing the lamps. If the lamps do not light in accordance with the table,

check that the lamp(s) are not burned out, and verify their connection to pins 6 and 9 of the probe connector. Also check that +5V appears in pin 4 of the connector located on the UUT.

PROBE INPUT	RED LAMP	GREEN LAMP
+5V (TP10)	ON	OFF
GND (TP12)	OFF	ON
OPEN	OFF	OFF

6. To verify operation of the output pulse circuit of the probe, select HIGH and LOW pulses on the UUT and observe the lamps. Both lamps should flash. If the lamps do not flash, connect the UUT probe to the probe of the tester 9010A. If the lamps of the tester 9010A probe do not flash, check the +5 volts supply to the probe; also check drivers Q1 and Q2 within the probe and their connections to pins 3 and 7 of the probe connector. If the lamps of the tester 9010A probe do flash, perform the Probe Level Detection/Verification.

#### 4-68. Signature Register Checks

4-69. A check of the signature register may be made if the UUT displays inconsistent or incorrect signatures for known-good UUTs. Connect the tester 9010A to the UUT as described under the heading Bus/RAM/ROM Checks. To check the signature counter, shown in sheet 4 of the Main Assembly schematic, key-in programs 5 and 12 listed in Table 4-9 and execute program 5. During program execution, follow the instructions on the tester 9010A display; press CONT after each messages.

#### NOTE

*The Signature Register Test program (listed in Table 4-9) uses the tester 9010A probe to generate sync pulses to the UUT signature register. The program also verifies the correct data after shifting a "1" bit through the register.*

#### 4-70. Event Counter Checks

4-71. A check of the event counter circuit should be made if the troubleshooter displays inconsistent or incorrect counts for known-good UUTs. Check the event counter, U59 and U60, shown in sheet 4 of the Main Assembly schematic and in Figure 4-8, as follows:

1. Be sure the UUT probe is connected.
2. Key-in programs 9 and 12 listed in Table 4-10 and execute program 9.
3. Repeat execution of the program by pressing the RPEAT key. If the counter test fails, note the bit in error and replace the appropriate device, U59 or U60.

#### 4-72. Display/Keyboard Checks

4-73. The Display/Keyboard Assemblies contain resident test programs which provide for complete testing of both assemblies. These tests can be performed at any time without the need for a tester 9010A by removing the 9010A Troubleshooter cover and lifting out the Display/Keyboard Assembly. Orient the Display/Keyboard Assembly so that the test points shown in Figure 4-9 are accessible and the display is visible. Apply power to the UUT, jumper R14/C16 to TP2 on the Main Assembly to disable watchdog timer and then perform the following tests as required.

#### 4-74. DISPLAY SEGMENT TEST

4-75. The display segment test causes each segment of each display character to sequentially light. The free-running probe of a tester 9010A can be used to verify segment data to the display via U11, U12, U13 and U14. To initiate the display segment test, momentarily jumper TP5 (ground) to TP0 (located on the Display Assembly); or, if the UUT is connected to a tester 9010A, perform WRITE @ 10081 = 00, followed by WRITE @ 10081 = 01.

#### 4-76. DISPLAY DIGIT DRIVERS TEST

4-77. The digit drivers test creates an all-segment character and walks the character across the entire display. The free-running probe of the tester 9010A can be used to verify digit driver signals at U3, U4, U5, U6, U7, U8, U9, and U10. To initiate the digit drivers test, momentarily jumper TP5 (ground) to TP1 (located on the Display Assembly) or, if the UUT is connected to a tester 9010A, perform WRITE @ 10081 = 00, followed by WRITE @ 10081 = 02.

#### 4-78. DISPLAY ANNUNCIATOR TEST

4-79. The annunciator test causes the MORE, STOPPED, and EXECUTING annunciators to flash when the PULSE HIGH switch is depressed and the LOOPING and PROGMINING annunciators to flash when the PULSE LOW switch is depressed. To initiate the annunciator test, momentarily jumper TP5 (ground) to TP2 (located on the Display Assembly) or, if the UUT is connected to a tester 9010A, perform WRITE @ 10081 = 00, followed by WRITE @ 10081 = 04.

#### 4-80. KEYBOARD TEST

4-81. The keyboard test, when initiated, writes the segment pattern shown in Figure 4-10 to the display. Initiate the keyboard test by momentarily jumpering TP5 (ground) to TP3 (located on the Display Assembly) or, if the UUT is connected to a tester 9010A, perform WRITE @ 10081 = 00, followed by WRITE @ 10081 = 08. Note the following:

- As each key (except HIGH and LOW) is pressed, the corresponding portion of the display goes out.

Table 4-7. Synchronized Probe Check

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 3   395 BYTES  DPY-SYNC PROBE CHECK# EXECUTE PROGRAM 12 DPY-JUMP R14//C16 TO TP2 OR TP1 DPY-+2-CONT# STOP SYNC FREE-RUN DPY-TESTER PROBE TO UUT U41-9  DPY-+ - CONT# STOP 0: LABEL 0 DPY-TESTER PULSER OFF - CONT# STOP REG1 = 1 EXECUTE PROGRAM 15 IF REGE = 0 GOTO 1 DPY-SYNC GOTO E 1: LABEL 1 DPY-TESTER TO PULSE LOW -CONT# STOP 2: LABEL 2 REG1 = 2 DPY-CONNECT INPUT TO LOW&lt;TP8&gt; DPY-+ - CONT# STOP EXECUTE PROGRAM 15 IF REGE = 40 GOTO 3 DPY-LOW GOTO E 3: LABEL 3 REG1 = 3 DPY-CONNECT INPUT TO HI&lt;TP10&gt; DPY-+ - CONT# STOP EXECUTE PROGRAM 15 IF REGE = 80 GOTO F DPY-HI GOTO E E: LABEL E DPY-+ FAULT# STOP IF REG1 = 1 GOTO 0 IF REG1 = 2 GOTO 2 IF REG1 = 3 GOTO 3 GOTO 0 F: LABEL F DPY-SYNC PROBE LOGIC OK# </pre>	<pre> delay disable watchdog  apply tester pulser to sync input of uut  test 1 pointer read uut probe level status check for no low or high  test 2 pointer  read uut probe level status check for low  test 3 pointer  read uut probe level status check for high  append to test message  return to test 1, 2, or 3 </pre>

Table 4-7. Synchronized Probe Check (cont)

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 12  21 BYTES    REG1 = 40 1: LABEL 1   DEC REG1   IF REG1 &gt; 0 GOTO 1  PROGRAM 15  101 BYTES    WRITE @ 100C3 = 30   WRITE @ 100C1 = 0   WRITE @ 100C0 = FF   WRITE @ 100C1 = 4   WRITE @ 100C0 = 0   WRITE @ 100C3 = 38   WRITE @ 100C1 = 0   WRITE @ 100C0 = 0   WRITE @ 100C1 = 4   READ @ 100C0   REGE = REGE AND C0   status </pre>	<pre> delay approx. 1 second  cb2=0  pia port a to out  sync mode/pulse off cb2=1  pia port a to input  read port a mask off all except high/low probe </pre>

Table 4-8. Probe Pulse Output Check

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 4  493 BYTES    DPY-#PULSE OUTPUT TEST   EXECUTE PROGRAM 12   DPY-JUMP R14//C16 TO TP2 OR TP1   DPY-+2-CONT#   STOP 0: LABEL 0   REG1 = 0   WRITE @ 100C3 = 30   WRITE @ 100C1 = 0   WRITE @ 100C0 = FF   WRITE @ 100C1 = 4   WRITE @ 100C0 = 10   WRITE @ 100C0 = A0   WRITE @ 100C3 = 38   GOTO 3 1: LABEL 1   WRITE @ 100C3 = 30   WRITE @ 100C1 = 0   WRITE @ 100C0 = FF   WRITE @ 100C1 = 4   WRITE @ 100C0 = C0   WRITE @ 100C3 = 38   GOTO 3 </pre>	<pre> delay disable watchdog  cb2=0  pia port a to out  beep pulse low/free-run cb2=1  free-run/high pulse </pre>

Table 4-8. Probe Pulse Output Check (cont)

PROGRAM LISTING	COMMENTS
<pre> 2: LABEL 2   WRITE @ 100C3 = 30   WRITE @ 100C1 = 0   WRITE @ 100C0 = FF   WRITE @ 100C1 = 4   WRITE @ 100C0 = E0   WRITE @ 100C3 = 38   GOTO 3 3: LABEL 3   WRITE @ 100C1 = 0   WRITE @ 100C0 = 0   WRITE @ 100C1 = 4   READ @ 100C0   INC REG1   REGE = REGE AND E0   IF REGE = 60 GOTO 4   IF REGE = A0 GOTO 5   IF REGE = E0 GOTO 6   GOTO 0 4: LABEL 4   DPY-#PULSE LOW &lt;GREEN&gt;   EXECUTE PROGRAM 13   IF REG1 = 1 GOTO 1   IF REG1 = 2 GOTO 2   GOTO 0 5: LABEL 5   DPY-PULSE HIGH &lt;RED&gt;#   EXECUTE PROGRAM 13   IF REG1 = 1 GOTO 1   IF REG1 = 2 GOTO 2   GOTO 0 6: LABEL 6   DPY-#PULSE HIGH AND LOW &lt;BOTH&gt;   EXECUTE PROGRAM 13   IF REG1 = 1 GOTO 1   IF REG1 = 2 GOTO 2   GOTO 0  PROGRAM 12    21 BYTES </pre>	<pre> free-run/high &amp; low pulse  pia port a to input  read port a  mask off all but probe level status check for low &amp; invalid check for high &amp; invalid check for low, invalid, high </pre>
<pre> REG1 = 40 1: LABEL 1   DEC REG1   IF REG1 &gt; 0 GOTO 1  PROGRAM 13    14 BYTES  EXECUTE PROGRAM 12 EXECUTE PROGRAM 12 EXECUTE PROGRAM 12 </pre>	<pre> delay approx. 1 second  delay approx. 3 seconds </pre>

Table 4-9. Signature Register Test

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 5    460 BYTES  DPY-SIGNATURE REGISTER TEST DPY-+# EXECUTE PROGRAM 12 SYNC DATA DPY-JUMP R14//C16 TO TP2 OR TP1 DPY-+2-CONT# STOP DPY-TESTER PROBE TO U41-9 DPY-+, CONT# STOP DPY-TESTER PULSE OFF - CONT# STOP DPY-UUT PROBE TO TP10&lt;+5V&gt; DPY-+, CONT# STOP WRITE @ 100C3 = 30 WRITE @ 100C1 = 0 WRITE @ 100C0 = FF WRITE @ 100C1 = 4 WRITE @ 100C0 = 80 WRITE @ 100C3 = 38 READ @ 10020 DPY-PRESS PULSE LOW ON TESTER DPY-+, CONT# STOP REG1 = 0 REGF = 10040 1: LABEL 1 READ @ REGF INC REG1 IF REG1 = 9 GOTO 2 GOTO 1 2: LABEL 2 IF REGE = FE GOTO 3 DPY-SIGNATURE ERROR-LO BYTE STOP GOTO F 3: LABEL 3 REG1 = 0 REGE = 0 REGF = 10060 4: LABEL 4 READ @ REGF INC REG1 IF REG1 = 8 GOTO 5 GOTO 4 5: LABEL 5 IF REGE = FE GOTO F DPY-SIGNATURE ERROR-HI BYTE STOP F: LABEL F DPY-SIGNATURE TEST COMPLETE </pre>	<pre> delay disable watchdog setup info cb2=0 port a to output free-run/pulse off cb2=1 reset signature/event counter sig. lo byte address 9 clks to sig. register check lo-byte sig. high byte address 8 clks to sig register check high-byte </pre>

Table 4-9. Signature Register Test (cont)

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 12  21 BYTES  REG1 = 40 1: LABEL 1 DEC REG1 IF REG1 &gt; 0 GOTO 1 </pre>	<p>delay approx. 1 second</p>

Table 4-10. Event Counter Test

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 9  347 BYTES  SYNC DATA DPY-#EVENT COUNTER TEST EXECUTE PROGRAM 12 DPY-JUMP R14//C16 TO TP2 OR TP1 DPY-+2-CONT# STOP DPY-UUT PROBE TO +5V&lt;TP10&gt;-CONT DPY-+# STOP DPY-TESTER PROBE TO U59-1-CONT# STOP DPY-TESTER TO PULSE OFF - CONT# STOP READ @ 10020 DPY-TESTER TO PULSE LOW-CONT# STOP REG2 = 0 0: LABEL 0 READ @ 10000 REGE = REGE AND 7F INC REG2 DPY-DATA READ = \$E IF REG2 = 80 GOTO 1 IF REGE = REG2 GOTO 0  DPY-DATA = \$E SHOULD BE = \$2 DPY-+ - CONT# STOP DPY-CHECK U59 AND U60 STOP 1: LABEL 1 DPY-END OF EVENT COUNTER CHECK  PROGRAM 12  21 BYTES  REG1 = 40 1: LABEL 1 DEC REG1 IF REG1 &gt; 0 GOTO 1 </pre>	<p>delay disable watchdog</p> <p>setup instructions</p> <p>reset event counter</p> <p>initialize count</p> <p>read event counter mask off fuse blown bit increment count</p> <p>count = 80 - done check - is hardware event count (rege) = soft count (reg2)</p> <p>delay approx. 1 second</p>

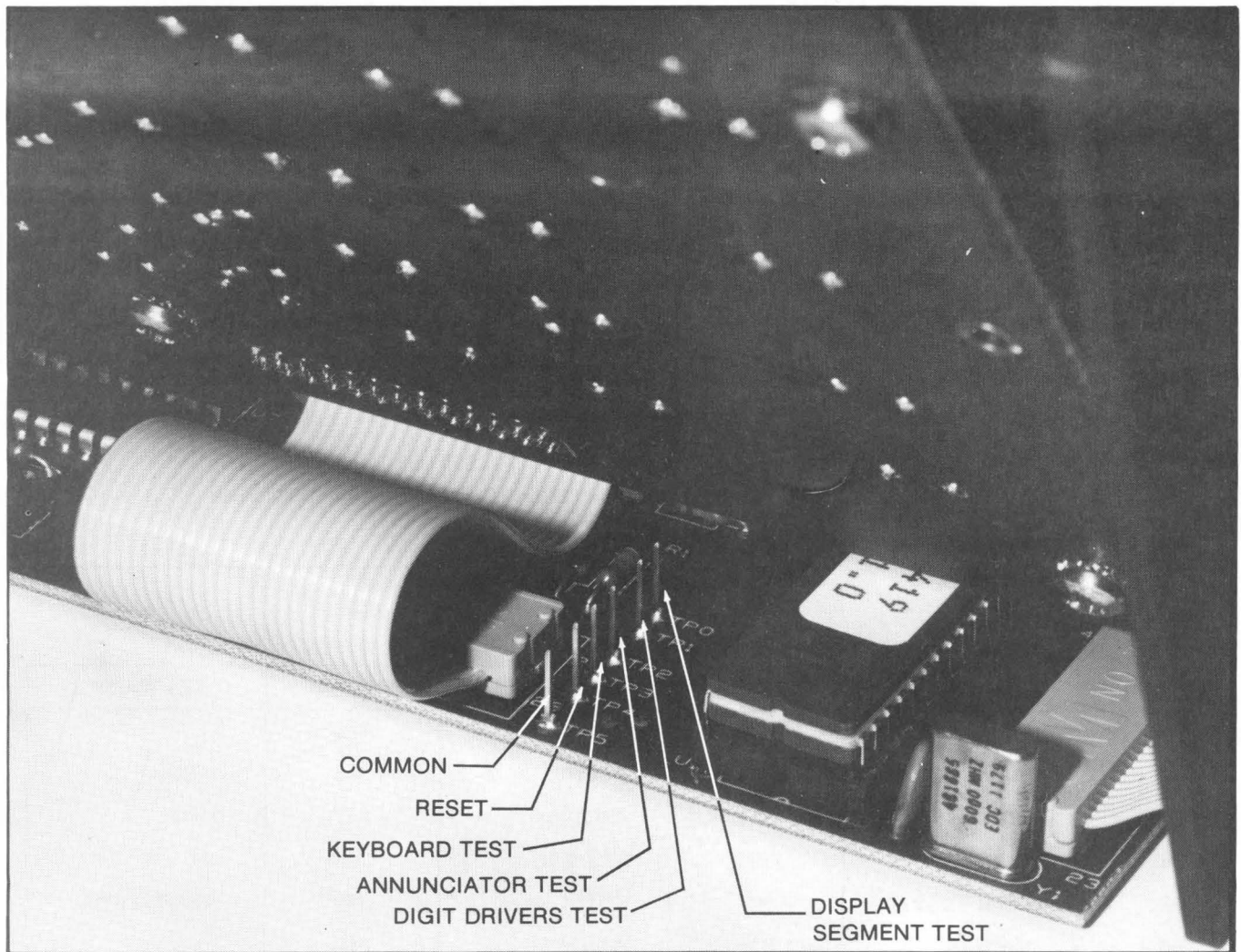


Figure 4-9. Display Keyboard Self-Test Points

Pressing all keys results in a blank display. Refer to Figure 4-10 and Table 4-11 for key/switch identification.

- A shorted key causes the corresponding portion of the display to remain blank when initiating the test.
- If two or more keys are shorted, two or more portions of the pattern go out when one of the keys is pressed.
- An open switch causes a portion of the pattern to remain.

#### 4-82. DISPLAY/KEYBOARD RESET

4-83. To reset the Display/Keyboard Assembly, momentarily jumper TP5 (ground) to TP4 (located on the Display Assembly) or, if the UUT is connected to a tester 9010A, perform WRITE @ 10081 = 00, followed by WRITE @ 10081 = 00.

#### 4-84. DISPLAY KEYBOARD COMMUNICATION CHECKS

4-85. Communication between the microprocessor and the display/keyboard peripheral microcomputer may be checked by keying-in programs 6, 12, and 13 listed in Table 4-12 and executing program 6. The program verifies that the main microprocessor is able to communicate with the peripheral microcomputer by attempting to write data to the display and read data from the keyboard. In addition, proper operation of the status registers are verified and also the self-test commands are checked for proper operation.

#### 4-86. Magnetic Tape Controller Checks

4-87. The Magnetic Tape Controller contains resident test programs which provide testing of the controller and tape drive. These tests can be performed at any time without the need for a tester 9010A by removing the troubleshooter cover and inserting it to expose the Magnetic Tape Controller shown in Figure 4-6. Apply power to the troubleshooter and perform any or all of the following tests.



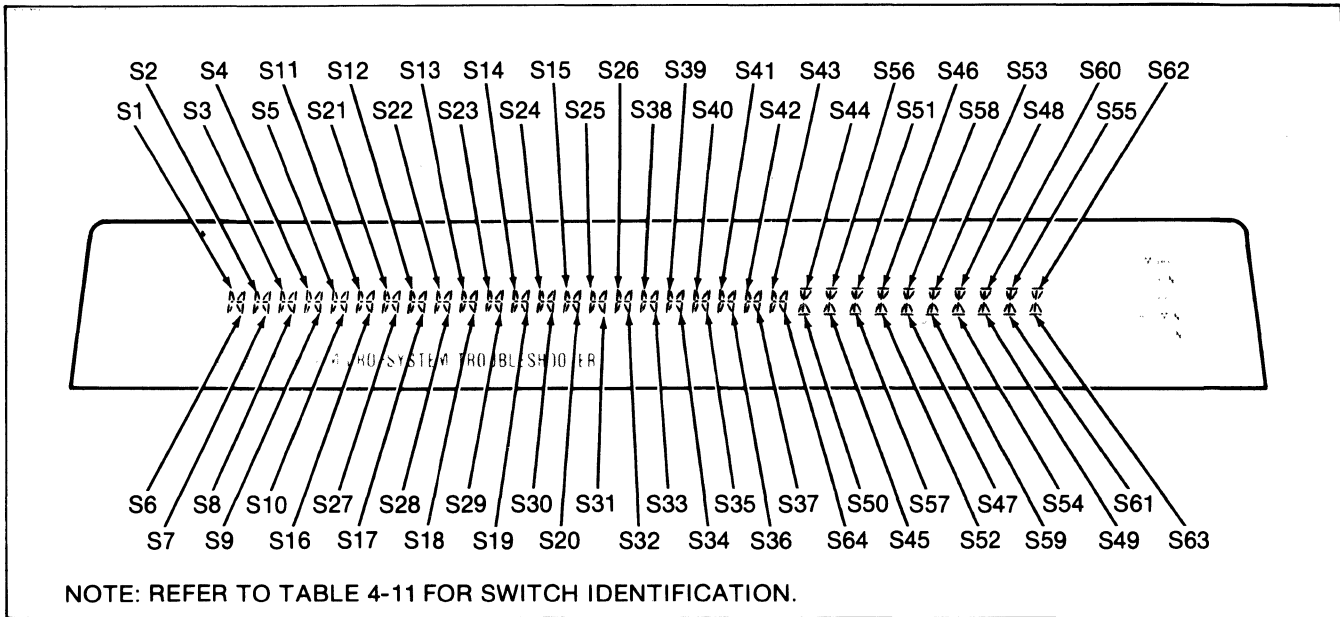


Figure 4-10. Keyboard Test Pattern

Table 4-11. Keyboard Switch Identification

SWITCH	KEY NAME	SWITCH	KEY NAME	SWITCH	KEY NAME
S1	LEARN	S23	6/0110	S45	IF
S2	VIEW RAM	S24	2/0010	S46	DISPL
S3	AUTO TEST	S25	PRIOR	S47	AND
S4	BUS TEST	S26	STS/CTL	S48	OR
S5	ROM TEST	S27	F/1111	S49	READ PROBE
S6	VIEW I/O	S28	B/1011	S50	EXEC
S7	VIEW ROM	S29	7/0111	S51	>
S8	RAM LONG	S30	3/0011	S52	LABEL
S9	RAM SHORT	S31	MORE	S53	SHIFT LEFT
S10	I/O TEST	S32	READ	S54	SHIFT RIGHT
S11	C/1100	S33	RAMP	S55	REG
S12	8/1000	S34	TOGGL ADDR	S56	AUX I/F
S13	4/0100	S35	CONT	S57	=
S14	0/0000	S36	REPEAT	S58	GOTO
S15	ENTER/YES	S37	LOOP	S59	INCR
S16	D/1101	S38	WRITE	S60	DECR
S17	9/1001	S39	WALK	S61	COMPL
S18	5/0101	S40	TOGGL DATA	S62	READ TAPE
S19	1/0001	S41	STOP	S63	WRITE TAPE
S20	CLEAR/NO	S42	RUN UUT	S64	PROBE SYNC
S21	E/1110	S43	SET UP	S65	PULSE HIGH
S22	A/1010	S44	PROGM	S66	PULSE LOW

Table 4-12. Display/Keyboard Communication Check

PROGRAM LISTING	COMMENTS
<pre> PROGRAM 6    1395 BYTES  WRITE @ 10081 = FF READ @ 10080 REPT DPY-DISPLAY/KYBD COMM. CHECK EXECUTE PROGRAM 12 DPY-JUMP R14//C16 TO TP2 OR TP1 DPY-+2-CONT# STOP 0: LABEL 0 READ @ 10080 DPY-HIT UUT 'WRITE' - CONT# STOP READ @ 10081 IF REGE AND 1 = 1 GOTO 1 DPY-#BAD STATUS BIT 0 &lt;NO KEY&gt; DPY-+-CONT STOP GOTO 0 1: LABEL 1 READ @ 10080 DPY-HIT UUT 'RAMP' - CONT# STOP READ @ 10080 IF REGE = 21 GOTO 2 DPY-READ DATA FAILURE - CONT# STOP GOTO 1 2: LABEL 2 DPY-#HIT UUT 'READ' TWICE, CONT STOP READ @ 10081 IF REGE AND 80 &gt; 0 GOTO 3 DPY-#BAD STATUS BIT 7, NO OVER DPY-+RUN STOP GOTO 2 3: LABEL 3 DPY-TEST STATUS BIT 3=0 &lt;CTRL&gt;# EXECUTE PROGRAM 13 WRITE @ 10081 = FF READ @ 10081 IF REGE AND 8 = 0 GOTO D DPY-#TEST STATUS BIT 3=1 &lt;DATA&gt; EXECUTE PROGRAM 13 WRITE @ 10080 = AA READ @ 10081 IF REGE AND 8 &gt; 0 GOTO D WRITE @ 10081 = C0 DPY-DISPLAY U'S LEFT-TO-RIGHT# REG2 = 0 WRITE @ 10081 = 20 </pre>	<pre> reset display/kybd clear out buffer  delay disable watchdog  clear buffer  read status check - buffer full - yes no - error  repeat status check buffer - full clear buffer  read kybd check for 'ramp' key - yes not correct data  repeat test read data passes  read status overrun bit set - yes overrun bit not set - fail  repeat test  delay reset read status last command "control"?- fail goto d  write data read status last command "data"?- fail goto d clear display  digit counter pointer to left most digit </pre>

Table 4-12. Display/Keyboard Communication Check (cont)

PROGRAM LISTING	COMMENTS
<pre> 4: LABEL 4   WRITE @ 10080 = 55    INC REG2   IF 20 &gt; REG2 GOTO 4   DPY-#ALL U'S - YES//NO?0   IF REGO = 0 GOTO E   DPY-DISPLAY *. RIGHT-TO-LEFT#   REG3 = 20 5: LABEL 5   REG2 = REG3 DEC   WRITE @ 10081 = 20 OR REG2    WRITE @ 10080 = AA    DEC REG3   IF REG3 &gt; 0 GOTO 5   DPY-#ALL *. 'S - YES//NO?0   IF REGO = 0 GOTO E    DPY-#FLASH EACH DIGIT   REG2 = 0 6: LABEL 6   WRITE @ 10081 = 60 OR REG2    INC REG2   IF 20 &gt; REG2 GOTO 6   WRITE @ 10081 = 80   DPY-+#-YES//NO?0   IF REGO = 0 GOTO C    DPY-BLANK DISPLAY TWICE#   WRITE @ 10081 = DF   EXECUTE PROGRAM 12   WRITE @ REGF = DF   DPY-+#-YES//NO?0   IF REGO = 0 GOTO C    DPY-#MASTER RESET TEST   EXECUTE PROGRAM 13   WRITE @ 10081 = FF   DPY-#   DPY-DISPLAY BLANK-YES//NO?0   IF REGO = 0 GOTO C    DPY-#LIGHT ALL LED'S   WRITE @ 10081 = 5F   DPY-+#-YES//NO?0   IF REGO = 0 GOTO C    DPY-#SINGLE SEGMENT TEST CMD   WRITE @ 10081 = 00   WRITE @ REGF = 1   DPY-+-OK?0   IF REGO = 0 GOTO C </pre>	<pre> write a "U" and increment (shift right) one digit increment digit counter &gt; than decimal 32 goto 4  user checks for all U's - if no goto e  digit counter to right most  set digit pointer = left most digit + dec. value of reg 2 to right write a ".*" to display; move pointer to right 1 digit decrement digit counter dme - go to 5  user checks for all ".*"'s - if not goto e  flash pointer  set flash mode - position = leftmost + dec. value of reg 2 inc. flash position flashed all characters turn off flash mode  user verifies all char flashed - if no goto c  blank display (31 scans) delay blank display (31 scans)  user verifies display blanked - if no goto c  master reset  user verifies display went blank - if no goto c  light all leds  user verifies all LED's are lit - if no goto c  reset test start seg. test  user verifies test started - if no goto c </pre>

Table 4-12. Display/Keyboard Communication Check (cont)

PROGRAM LISTING	COMMENTS
<pre> DPY-#WALKING CHARACTER TEST CMD WRITE @ 10081 = 0 WRITE @ REGF = 2 DPY-+-OK?0 IF REGO = 0 GOTO C  WRITE @ 10081 = 0 DPY-HIT UUT PULSE LOW AND HIGH- DPY-+CONT# STOP DPY-#LED TEST COMMAND WRITE @ REGF = 4 DPY-+#-ALL LEDS ON?0 IF REGO = 0 GOTO C  DPY-UUT PULSE HIGH AND LOW OFF- DPY-+CONT# STOP DPY-#KEY TEST CMND WRITE @ 10081 = 0 WRITE @ REGF = 8 DPY-+#-STARTED?0 IF REGO = 0 GOTO C  GOTO F C: LABEL C DPY-WRITE CMND FAIL-CONT# STOP GOTO 3 D: LABEL D DPY-#BAD STATUS BIT 3 &lt;\$E&gt; STOP GOTO 3 E: LABEL E DPY-WRITE DATA FAIL-CONT# STOP GOTO 3 F: LABEL F DPY-DISPLAY/KYBD TEST COMPLETE WRITE @ 10081 = FF </pre>	<pre> reset test start walk. char. test  user verifies test started - if no goto c reset test  start led test  user verifies test started - if no goto c  reset test start key test  user verifies test started - if no goto c </pre>
<pre> PROGRAM 12    21 BYTES  REG1 = 40 1: LABEL 1 DEC REG1 IF REG1 &gt; 0 GOTO 1 </pre>	<pre> delay approx. 1 second </pre>
<pre> PROGRAM 13    14 BYTES  EXECUTE PROGRAM 12 EXECUTE PROGRAM 12 EXECUTE PROGRAM 12 </pre>	<pre> delay approx. 3 seconds </pre>

## 4-88. SELF TEST

4-89. Initiate self test by removing and reapplying power to the 9010A and then momentarily jumpering pins 20 (ground) and 21 (SLFTST) of microcomputer U1 on the Magnetic Tape Assembly. (Be sure to use a blank tape, or one that contains old data and is not write-protected.) The self test causes the controller to perform the following functions:

- Rewind the tape
- Write one thousand words of known data
- Rewind the tape
- Read and check the written data
- Stops upon the detection of any read error
- Repeats the entire sequence until reset by jumpering pins 20 and 4 of microcomputer U1

4-90. If the magnetic tape drive stops during the self test, a failure is indicated. Perform the read and write tests in order to isolate the fault. If the magnetic tape drive passes the read and write tests, perform the checks presented under the heading Magnetic Tape Communications Checks.

## 4-91. MAGNETIC TAPE READ TEST

4-92. Initiate the read test by momentarily jumpering pins 20 and 22 (RDTST) of microcomputer U1. The read test causes the controller to perform the following functions:

- Rewind the tape
- Operate the tape drive in the read mode
- If a cassette is installed, rewinds at end-of-tape and repeats the read operation

4-93. During performance of the read test, make the following checks:

1. During the rewind portion of the read test, check for approximately +4.8V (solenoid voltage) at A4J2, pin 14; approximately +0.2V (+ motor voltage) at A4J2, pin 17; and approximately +4.8V (- motor voltage) at A4J2, pin 18. If any voltage is not correct, trace the signal from U1, pin 33, (REWD) through U2 and U4 to locate the fault. Also verify that the solenoid pulls in during rewind.

2. Using an oscilloscope, verify that U1, pin 27 (CLEAR LEADER) is high just as the tape starts forward and is still on clear leader, and then drops low. Also observe a low 20 ms pulse as the start-of-

tape hole passes over the optical sensing path. If these signals do not occur, check Q5; verify that the LED conducts by measuring voltage drop across R38; and check that A4J2, pin 8 (PHOTO XSTR) drops low when on clear leader. If all active devices appear normal, check alignment of the optical path.

3. During forward read, the Motor (+) voltage (A4J2-17) should be at approximately +4.8V dc. If not, check the Forward signal from U1-32 through U2-A and transistor U4B. The Motor(-) (A4J2-18) should measure approx 2.5V dc. If not check U6 and its related components.

4. Using a tape with data already recorded and a storage type oscilloscope, verify the waveforms at U5A-1, U5D-14, U5C-8 and U5B-7 against those shown in Figure 4-11. Be sure to note the voltage levels. Be sure the Head(+) (A4J2-3) and Head(-) (A4J2-4) wires are connected. If the proper signals are not present, a faulty U5 or an open resistor is indicated. Be sure to check that the signal at U5B-8 is also present at U1-39.

5. Verify that U1-27 is logic low with a cassette installed and logic high when the tape lid is open.

6. Verify that U1-38 is logic low with a cassette installed that has the file protect tab not removed, and logic high if the tab is removed.

## 4-94. MAGNETIC TAPE WRITE TEST

4-95. Initiate the write test by momentarily jumpering pins 20 (ground) and 23 (WTTST) of microcomputer U1. The write test causes the controller to perform the following functions:

- Rewind the tape.
- Operate the tape drive in the forward direction and write the hexadecimal word CA at all locations on the tape.
- Rewinds at end-of-tape and repeats the write operation.

4-96. During performance of the write test, verify that the Head+ signal at A4J2-3 and the Head- signal at A4J2-4 appear as shown in Figure 4-12. If the signals are not as shown, check gates U3-A, B, and D; transistors Q2, Q3, and Q4; and associated resistors.

*NOTE*

*If the read and write test fail to isolate and correct a fault that causes failure of self test, it is possible that the controller passes self test but does not communicate properly with the main microprocessor.*

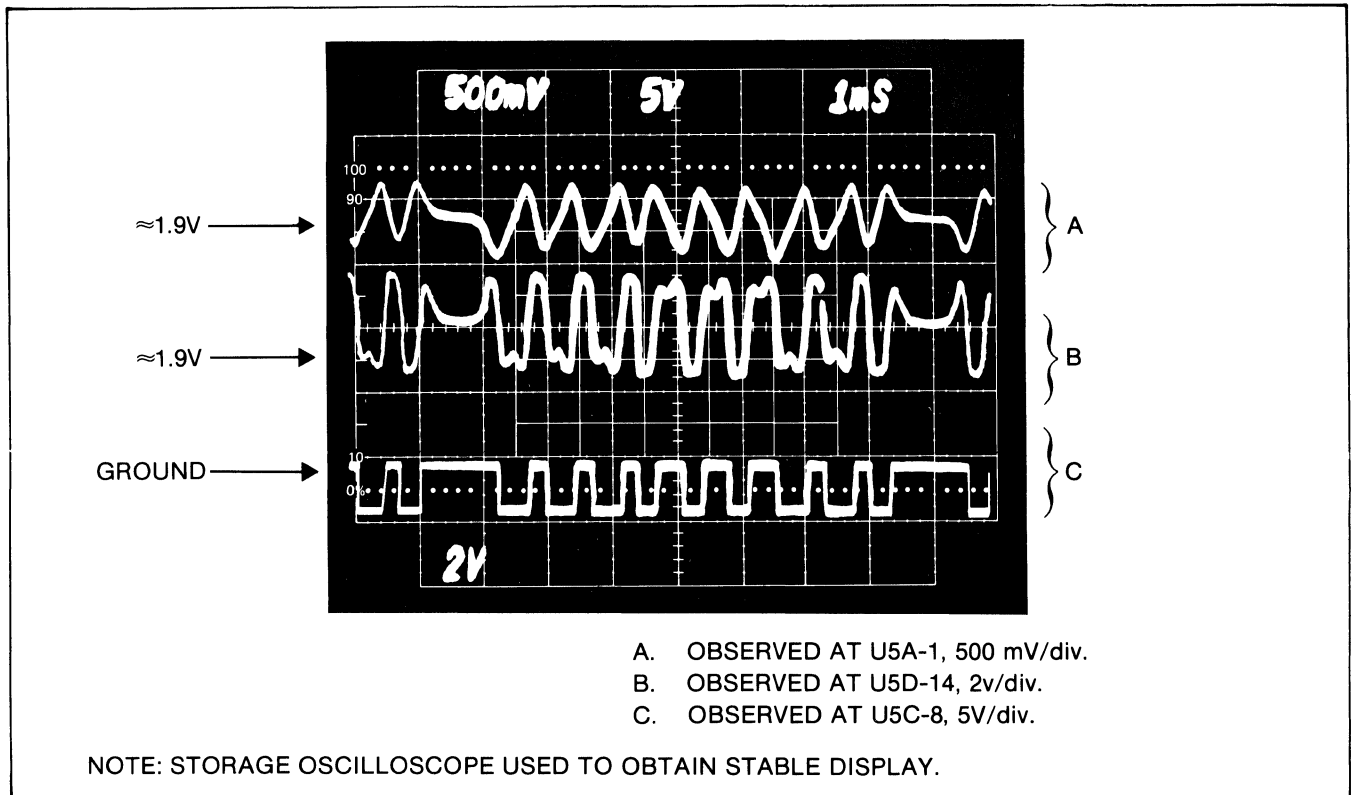


Figure 4-11. Read Test Waveforms

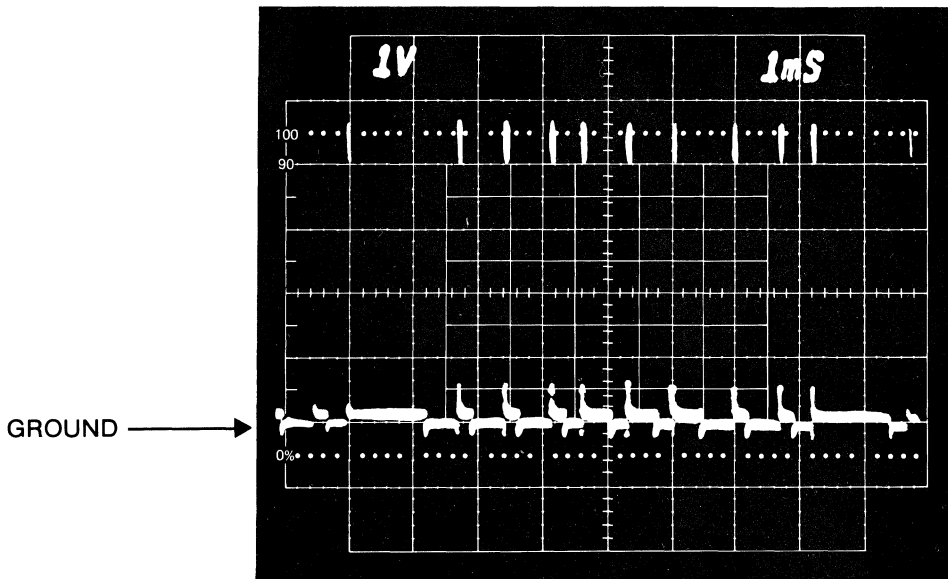
#### 4-97. MAGNETIC TAPE COMMUNICATION CHECKS

4-98. Communications between the microprocessor, via the address and data bus, can be checked by means of a tester 9010A connected as described for Bus/RAM/ROM Checks. Using the tester 9010A, check communication by performing the following operations:

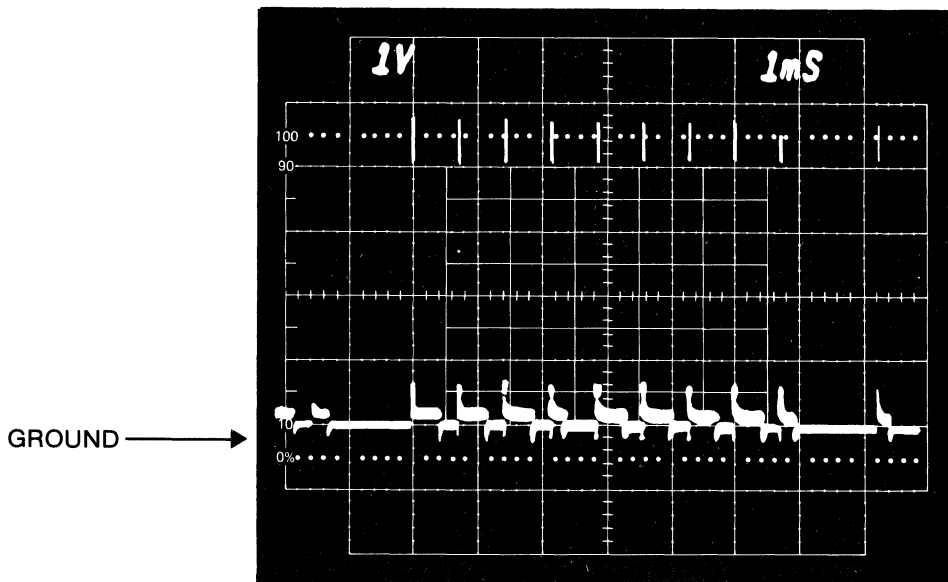
1. Disable the watchdog timer U31 by jumpering the C16 side of or R14 (located on the main assembly) to TP12 (ground).
2. Remove any tape cassette and leave the door open.
3. Turn UUT power off then on. Perform a looping read at location 100A1. The data read should be 14. Reach inside the tape deck cover press the cassette-present switch located at the right of the head at the rear of the unit. The data read should be 10. Press the write protect switch located at the front of the unit and verify data read is 04.
4. Install a blank cassette (or one with obsolete data), which is not write protected, into the tape drive with the full reel to the left. Write a 11 to location 100A1. This write causes the tape to rewind and then move forward stop, rewind, go forward slightly and stop.
5. Read at location 100A1 and verify data is 48.

6. If these tests fail, perform the following series of manual tests:

- a. With the tester 9010A probe in the free-run mode, verify that U1-4, 5, 26, and 40 are at logic high; U1-7 and 20 are at logic low; and that U1-2 alternates between high and low.
- b. With the tester 9010A probe synchronized to address, verify that U1-8 ( $\overline{RD}$ ) goes low when a read at location 100A0 is performed.
- c. With the tester 9010A probe in the free-run mode, verify that U1-10 ( $\overline{WR}$ ) goes low as a write at location 100A0 is repeated.
- d. With the tester 9010A probe synchronized to address, verify that U1-9 (A0) toggles when a toggle address at location 100A0, bit 0 is performed.
- e. With the tester 9010A probe synchronized to address, verify that U1-12 (D0) toggles as a toggle data at location 100A0, bit 0 is repeated. Repeat at pins 13 through 19 for bits 1 through 7 of location 100A0.
- f. If the above tests do not locate a faulty line of the microcomputer, replace U1 with a known-good device and recheck operation of the controller.



OBSERVED AT A4J2-3 (HEAD +)



OBSERVED AT A4J2-4 (HEAD -)

NOTE: STORAGE OSCILLOSCOPE USED TO OBTAIN STABLE DISPLAY.

Figure 4-12. Write Test Waveform

Table 4-13. Memory and I/O Device Addressing and Commands

MEMORY PAGE ADDRESSES			
MEMORY PAGE	ADDRESS	TYPE	REFERENCE DESIGNATOR
0	0000 - BFFF	ROM	U65
1	C000 - FFFF	RAM	U18
DISPLAY/KEYBOARD ASSEMBLY PROTOCOL			
ADDRESS	DATA	WRITE/READ	FUNCTION PERFORMED
10080	Any	Both	Used to write and read data between the main microprocessor and the display peripheral microcomputer. On a write, sends data to the current display character. On a read, gates keyboard data. (After a write, the position pointer is incremented by one to enable the next digit to the right on the display.)
10081	FF(hex)	Write	Master reset
10081	C0(hex)	Write	Clears the 32-character display.
10081	80(hex)	Write	Turns off flashing character mode.
10081	110xxxxx (binary)	Write	Turns off the display for xxxxx scans of the display, where xxxxx is the binary number of display scans; e.g. 00001 = one scan, 1000 = 16 scans, 11111 = 31 scans.
10081	011bbbb (binary)	Write	Sets flashing character in the display position represented by bbbbb, where bbbbb is a binary number; 00000 = leftmost position, 11111 = rightmost position.
10081	010bbbb (binary)	Write	Turns on annunciator LEDs as follows: bbbb 00001 = EXECUTING 00010 = PROGRAMMING 00100 = STOPPED 01000 = LOOPING 10000 = MORE
10081	001bbbb (binary)	Write	Moves the store pointer to the display position represented by bbbbb, where bbbbb is a binary number; 00000 = leftmost position, 11111 = rightmost position (usually followed by a write at address 10080 to place data in the selected display position).
10081	01(hex)	Write	Selects display segment (self) test.
10081	01(hex)	Write	Selects digit drivers (self) test.
10081	04(hex)	Write	Selects annunciator (self) test.
10081	08(hex)	Write	Selects keyboard (self) test.
10081	00(hex)	Write	Selects reset test mode (always precedes the above self tests).
10081	bbbbbbbb (binary)	Read	Causes peripheral microcomputer to respond with a bbbbbbb status byte as follows: bbbbbb xxxxxx1 = Output buffer and display full xxxxxx1x = Input buffer from keyboard full xxx1xxx = Last write was control xxx0xxx = Last write was data 1xxxxxx = Overrun error (more than one key pressed before data read)



**Table 4-13. Memory and I/O Device Addressing and Commands (cont)**

<b>POD/PROBE PIA (U22) INTERNAL REGISTER/BUFFER ADDRESSES</b>			
<b>ADDRESS</b>	<b>WRITE DATA</b>	<b>REGISTER/BUFFER ADDRESSED AND FUNCTION</b>	
100C1	00	Sets I/O Port A control register to allow addressing of I/O Port A data direction register.	
100C1	04	Sets I/O Port A control register to allow addressing of I/O Port A data buffer.	
100C0	As Required	Sets the I/O Port A data direction register in accordance with the write data, or addresses the I/O Port A data buffer; depending upon the previous setting of the I/O Port A control register.	
100C3	00	Sets I/O Port B control register to allow addressing of I/O port B data direction register.	
100C3	04	Sets I/O Port B control register to allow addressing of I/O Port B data buffer.	
100C2	As Required	Sets the I/O Port A data direction register in accordance with the write data, or addresses the I/O Port A data buffer; depending upon the previous setting of the I/O Port A control register.	
<b>POD/PROBE PIA (U22) PROTOCOL</b>			
<b>ADDRESS</b>	<b>DATA</b>	<b>WRITE/READ</b>	<b>FUNCTION PERFORMED</b>
100C1	00(hex)	Write	Refer to above table of addresses.
100C1	04(hex)	Write	Refer to above table of addresses.
100C3	00(hex)	Write	Refer to above table of addresses.
100C3	04(hex)	Write	Refer to above table of addresses.
100C0	FF(hex)	Write	Sets I/O port A data direction register so that all I/O port A data buffer lines are outputs (follows a WRITE @ 100C1 = 00).
100C0	00(hex)	Write	Sets I/O port A data direction register so that all I/O port A data buffer lines are inputs (follows a WRITE @ 100C1 = 00).
100C2	FF(hex)	Write	Sets I/O port B data direction register so that all I/O port B data buffer lines are outputs (follows a WRITE @ 100C3 = 00).
100C2	00(hex)	Write	Sets I/O port B data direction register so that all I/O port B data buffer lines are inputs (follows a WRITE @ 100C3 = 00).
100C3	30(hex)	Write	Sets PIA output CB2 to off.
100C3	38(hex)	Write	Sets PIA output CB2 to on.

Table 4-13. Memory and I/O Device Addressing and Commands (cont)

POD/PROBE PIA (U22) PROTOCOL (CONT)			
ADDRESS	DATA	WRITE/READ	FUNCTION PERFORMED
100C0	bbbbbbbb (binary)	Write	<p>Performs the following functions in accordance with the binary data represented by the bbbbbbbb write data as follows (Port A must be set to output).</p> <p>bbbbbbbb</p> <p>xxxxxxx1 = Set MAINSTAT output high                      xxxxxx0 = Set MAINSTAT output low                      xxxx1xxx = Set pod RESET output high                      xxx0xxx = Set pod RESET output low                      xxx0xxxx = Activate beeper                      x00xxxx = Turn probe pulse circuit off                      x01xxxx = Generate low probe pulses                      x10xxxx = Generate high probe pulses                      x11xxxx = Generate low and high probe pulses (toggle)                      0xxxxxxx = Select synchronized probe mode                      1xxxxxxx = Select free-running probe mode</p>
100C0	bbbbbbbb (binary)	Read	<p>Causes the display peripheral microcomputer to respond with a bbbbbbbb status byte as follows (Port A must be set to input):</p> <p>bbbbbbbb</p> <p>xxxxx1x = High PODSTAT signal from pod (see interface pod manual)                      xxxxxx0x = Low PODSTAT signal from pod (see interface pod manual)                      xxxxx1xx = High POWER FAIL signal from pod (indicates failure)                      xx1xxxx = Invalid signal detected during last READ PROBE operation                      x1xxxxx = Logic low signal detected during last READ PROBE operation                      1xxxxxxx = Logic high signal detected during last READ PROBE operation</p>

**Table 4-13. Memory and I/O Device Addressing and Commands (cont)**

<b>MAGNETIC TAPE CONTROLLER PROTOCOL</b>			
<b>ADDRESS</b>	<b>DATA</b>	<b>WRITE/READ</b>	<b>FUNCTION</b>
100A0	Any	Both	Used to write and read data between the main microprocessor and the magnetic tape peripheral microcomputer.
100A1	11(hex)	Write	Selects magnetic tape write mode; rewinds tape then starts in forward direction.
100A1	12(hex)	Write	Selects magnetic tape read mode; rewinds tape then starts in forward direction.
100A1	13(hex)	Write	Causes magnetic tape to stop.
100A1	bbbbbbbb (binary)	Read	Causes the magnetic tape peripheral microcomputer to respond with a bbbbbbbb status byte as follows:  bbbbbbbb xxxxxx1 = Output buffer full xxxxxx1x = Input buffer full xxxxx1xx = No cassette loaded xxxx1xxx = Last write was a command xxx1xxxx = Cassette write protected xx1xxxxx = End-of-tape/clear leader x1xxxxxx = Error 1xxxxxxx = End-of-file read
<b>SIGNATURE GENERATOR/EVENT COUNTER PROTOCOL</b>			
<b>ADDRESS</b>	<b>DATA</b>	<b>WRITE/READ</b>	<b>FUNCTION PERFORMED</b>
10000	bbbbbbbb	Read	Reads the contents of the event counter plus the probe fuse blown bit.
10020	Any	Write	Resets the signature generator and the event counter.
10040	bbbbbbbb	Read	Reads the low byte of the signature generator.
10060	bbbbbbbb	Read	Reads the high byte of the signature generator.

## Section 5

# List of Replaceable Parts

### TABLE OF CONTENTS

ASSEMBLY NAME	DRAWING NO.	TABLE NO. PAGE		FIGURE NO. PAGE	
Final Assembly .....	9010A-T&B	5-1	5-3	5-1	5-4
A1 Main PCA .....	9010A-4011T	5-2	5-8	5-2	5-11
A2 Display PCA .....	9000A-4002T	5-3	5-12	5-3	5-13
A3 Keyboard PCA .....	9010A-4033T	5-4	5-14	5-4	5-15
A4 Magnetic Tape PCA .....	9010A-4034T	5-5	5-16	5-5	5-17
A7 Data Probe PCA .....	9000A-4091T	5-6	5-18	5-6	5-19

**5-1. INTRODUCTION**

5-2. This section contains an illustrated parts breakdown of the instrument. A similar parts list is included in the Options and Accessories Section for each of the options. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed by reference designation. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation.
2. Description of Each Part.
3. FLUKE Stock Number.
4. Federal Supply Code for Manufacturers.
5. Manufacturer's Part Number.
6. Total Quantity of Components Per Assembly.

**5-4. HOW TO OBTAIN PARTS**

5-5. Components may be ordered directly from the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. or an authorized representative by using the **FLUKE STOCK NUMBER**. In the event the part ordered has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity.

2. FLUKE Stock Number.
3. Description.
4. Reference Designation.
5. Printed Circuit Assembly Part Number and Revision Letter.
6. Instrument Model and Serial Number.

5-7. Parts price information is available from the John Fluke Mfg. Co., Inc. or its representative. Prices are also available in a Fluke Replacement Parts Catalog, which is available upon request.

**5-8. MANUAL STATUS INFORMATION**

5-9. Table 5-7 defines the revision levels of the pca's documented in this manual. To identify the configuration of the pca's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pca.

**5-10. NEWER INSTRUMENTS**

5-11. As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pca. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

**CAUTION**

**\***

**Indicated devices are subject to damage by static discharge.**

Table 5-1. 9010A Final Assembly  
(See Figure 5-1.)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N 0 T -E			
-A>-NUMERICS-----> S-----DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----					
A 1		*	MAIN PCA	870113	89536	870113	1	
A 2		*	DISPLAY PCA	579250	89536	579250	1	
A 3		*	KEYBOARD PCA	579425	89536	579425	1	
A 4		*	MAG TAPE PCA	579441	89536	579441	1	
A 7		*	DATA PROBE PCA	580969	89536	580969	1	
B 1			FAN, 115VAC, 20CFM, 3.14	631929	89536	631929	1	
C 97			CAP, CER, 0.01UF, +80-20%, 250V, 25V	520254	40402	RX15-0.01UF250V	1	
F 1			FUSE, .25X1.25, 1A, 250V, SLOW	109272	71400	MDL-1	1	
F 1			FUSE, .25X1.25, 0.5A, 250V, SLOW	109322	71400	MDL-1/2	1	2
F 2			FUSE, .25X1.25, 0.25A, 250V, FAST	109314	71400	AGC-1/4	1	
F 2			FUSE, 5X20MM, 0.25A, 250V, FAST	543504	71400	GMA-1/4	1	2
FL 1			FILTER, 115V/3A, 230V/3A, PNL MNT	500405	89536	500405	1	
H 1			SCREW, MACH, PH, P, STL, 6-32X0.250	152140	73734	19042	1	
H 2, 19			SCREW, MACH, PH, P, SEMS, STL, 6-32X.375	177022		COMMERCIAL	3	
H 3			SCREW, MACH, PH, P, STL, 8-32X0.500	159749		COMMERCIAL	3	
H 4			WASHER, FLAT, STL, .170, .375, .031	110288		COMMERCIAL	3	
H 5			NUT, CAP, EXT. LOCK, STL, 8-32	195263		COMMERCIAL	3	
H 6			AIR FILTER	650598		COMMERCIAL	1	
H 7, 23			SCREW, MACH, PH, P, SS, 6-32X.375	334458		COMMERCIAL	7	
H 8			SCREW, MACH, PH, P, SS, 4-40X.250	256156		COMMERCIAL	4	
H 9			SCREW, MACH, PH, P, SS, 4-40X.375	256164		COMMERCIAL	3	
H 10, 21			WASHER, FLAT, STL, .149, .375, .031	110270	88044	AN960-6	1	
H 11			NUT, CAP EXT LW, STL, 6-32X.109	152819	78189	511-061800-00	6	
H 12			NUT, HEX, STL, 6-32	110551		COMMERCIAL	1	
H 13			NUT, CAP, EXT. LOCK, STL, 4-40	195255	78189	511-041800-00	2	
H 14			WASHER, FLAT, BRASS, #4, 0.025	110775		COMMERCIAL	1	
H 15			WASHER, LOCK, EXTRNL, STEEL, 0.500 ID	175943	89462	5005-75-PP	1	
H 16			SCREW, MACH, PH, P, SEMS, STL, 6-32X.313	530287		COMMERCIAL	10	
H 17			SCREW, MACH, PH, P, SEMS, STL 4-40X.750	756676		COMMERCIAL	4	
H 18			SCREW, MACH, PH, P, SEMS, STL, 4-40X.250	185918		COMMERCIAL	4	
H 20			CONN ACC, D-SUB, SLIDING LOCK, POST ASSY	353201	54492	D53018	2	
H 22			SCREW, MACH, RHP, BR, 4-40X5/16	149773		COMMERCIAL	2	
H 24			SCREW, MACH, PHP, STL, 6-32X0.750	114223		COMMERCIAL	4	
MP 1			BASE	583054	89536	583054	1	
MP 2			PUSH ROD, POWER SWITCH	577619	89536	577619	1	
MP 3			GROUND SHIELD ASSY	544866	89536	544866	1	
MP 4			RUBBER, URETHANE, FOAM, SHEET, 0.125 THK	574236	89536	574236	1	
MP 5			FOOT, ADHESIVE, RUBBER, BLACK, .50X.14	513820	28213	SJ5012	4	
MP 6, 13			HLDR PART, FUSE, CAP, 1/4X1-1/4	460238	61935	031.1666	1	
MP 7			LABEL 609370 (MAIN PCB T)	609396	89536	609396	1	
MP 8			PANEL, REAR	544874	89536	544874	1	
MP 9			SUB PANEL, BLANK	579334	89536	579334	1	
MP 10			SPACER, FAN	652610	89536	652610	1	
MP 11			BRKT, RS232 SUPPORT	652644	89536	652644	1	
MP 12			HLDR PART, FUSE, BODY 1/4X1-1/4, 5X20MM	460329	61935	031.1673	1	
MP 14			CABLE TIE, 4.0L, .100W, .75 DIA	172080	06383	SST 1M	2	
MP 16			CASE TOP	607127	89536	607127	1	
MP 17			FRONT PANEL	609156	89536	609156	1	
MP 18			DOOR, CASSETTE	577676	89536	577676	1	
MP 19			CASSETTE COVER BUTTON	608810	89536	608810	1	
MP 20			DECAL, FRONT PANEL, DISPLAY	536763	89536	536763	1	
MP 21			DECAL, FRONT PANEL, KEYBOARD	586503	89536	586503	1	
MP 22			NUT PLATE DB9	609214	89536	609214	1	
MP 23			NUT PLATE DB25	609222	89536	609222	1	
MP 24			PLUG, BASE	755785	89536	755785	1	
MP 25			DECAL, SPEC	755801	89536	755801	1	
MP 26			NAMEPLATE, SERIAL -REAR PANEL-	472795	89536	472795	2	
MP 27			DECAL, FLUKE-PHILIPS, BLACK, SMALL	835272	89536	835272	1	
MP 28			DECAL CSA	525527	89536	525527	1	
MP 29			LABEL, CALIBRATION NOTICE	642439	89536	642439	1	
MP 30			PROBE ACCESSORIES	613802	89536	613802	1	1
MP 31			CONN, COAX, BNC (F), PANEL	152033	52500	30355-1	1	
MP 32			CONN PART, MATE-N-LOK, HOUSG, REC, 4 POS	501692	89536	501692	1	
MP 33			CONN PART, MATE-N-LOK, SKT, 0.084D, 18-22	614826	89536	614826	4	
MP 34			TERM, RING, 3/8 & 7/64, SOLDR	441972	79963	761	1	
MP 35			TERM, RING #6, 3/32 - 2 PLACES, SOLDR	132399	71002	2104-06-00	1	
T 1			TRANSFORMER, POWER	540393	89536	540393	1	
TM 1			9010A OPERATOR MANUAL	609263	89536	609263	1	
TM 2			9010A SERVICE MANUAL	870147	89536	870147	1	
TM 3			9010A PROGRAMMING MANUAL	609289	89536	609289	1	
TM 4			9010A REFERENCE GUIDE	609271	89536	609271	1	
W 1			CORD, LINE, 5-15/IEC, 3-18AWG, SVT	343723	79093	17237	1	
W 4			CABLE, POWER SUPPLY	583237	89536	583237	1	

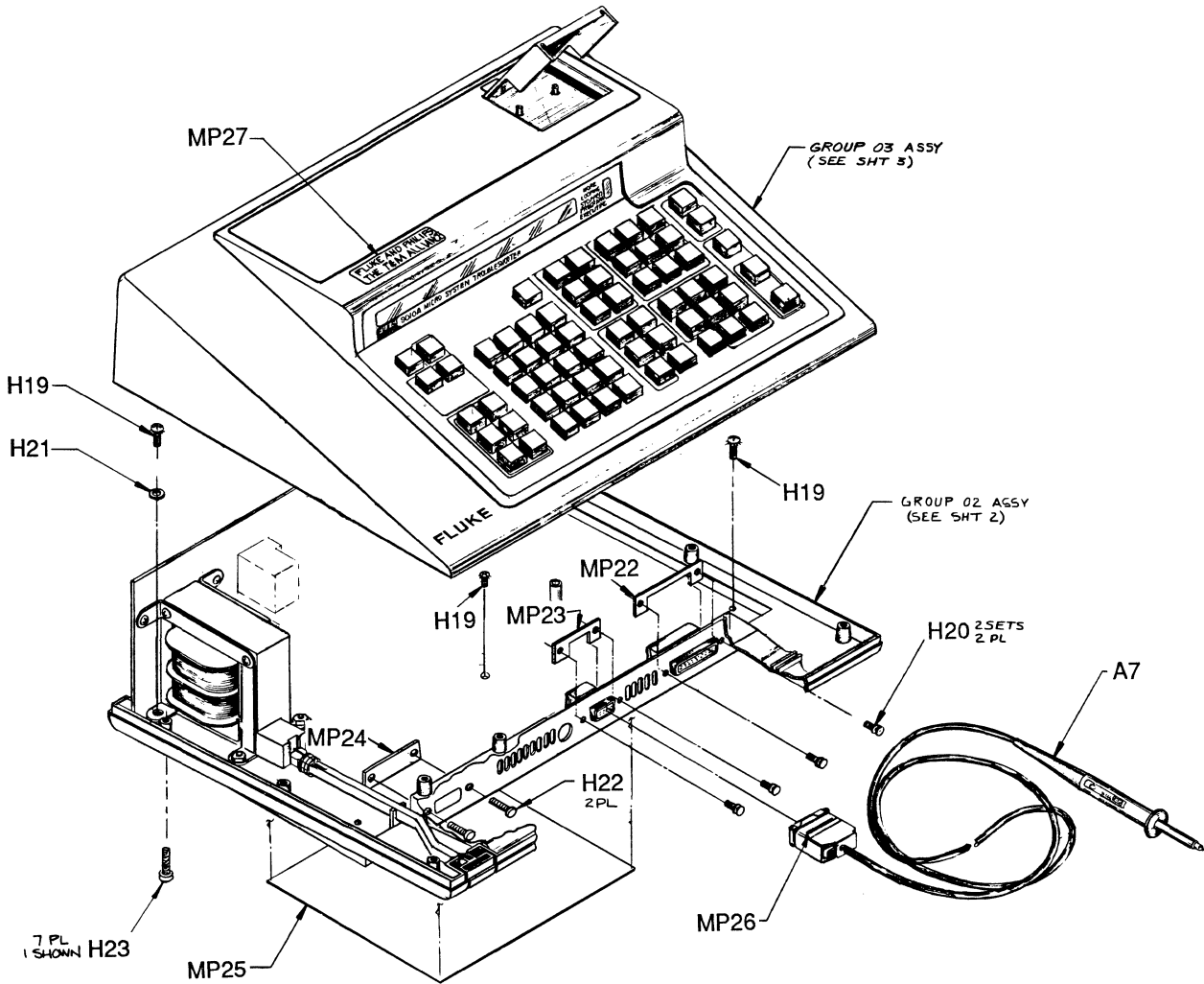
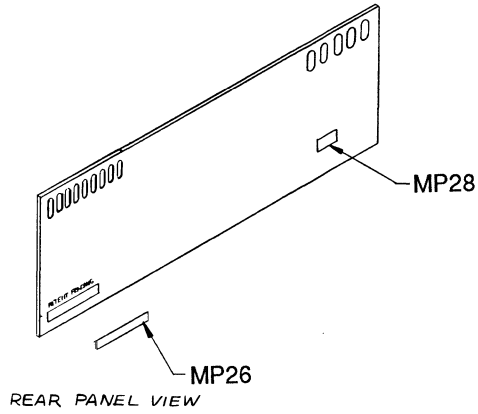
An \* in 'S' column indicates a static-sensitive part.

NOTE 1 = MP30 includes: 1 clip hook 602938, 1 alligator clip 602946, 1 ground lead 609115, 1 IC tip 583674.

NOTE 2 = Used on 230V configuration units only.

NOTES: UNLESS OTHERWISE SPECIFIED

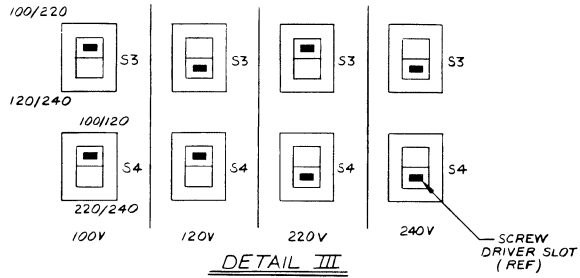
5 PROGRAM APPROPRIATE VOLTAGE SETTING AT POWER CONNECTOR SOCKET ON REAR PANEL.



9000A T&B  
(1 of 4)

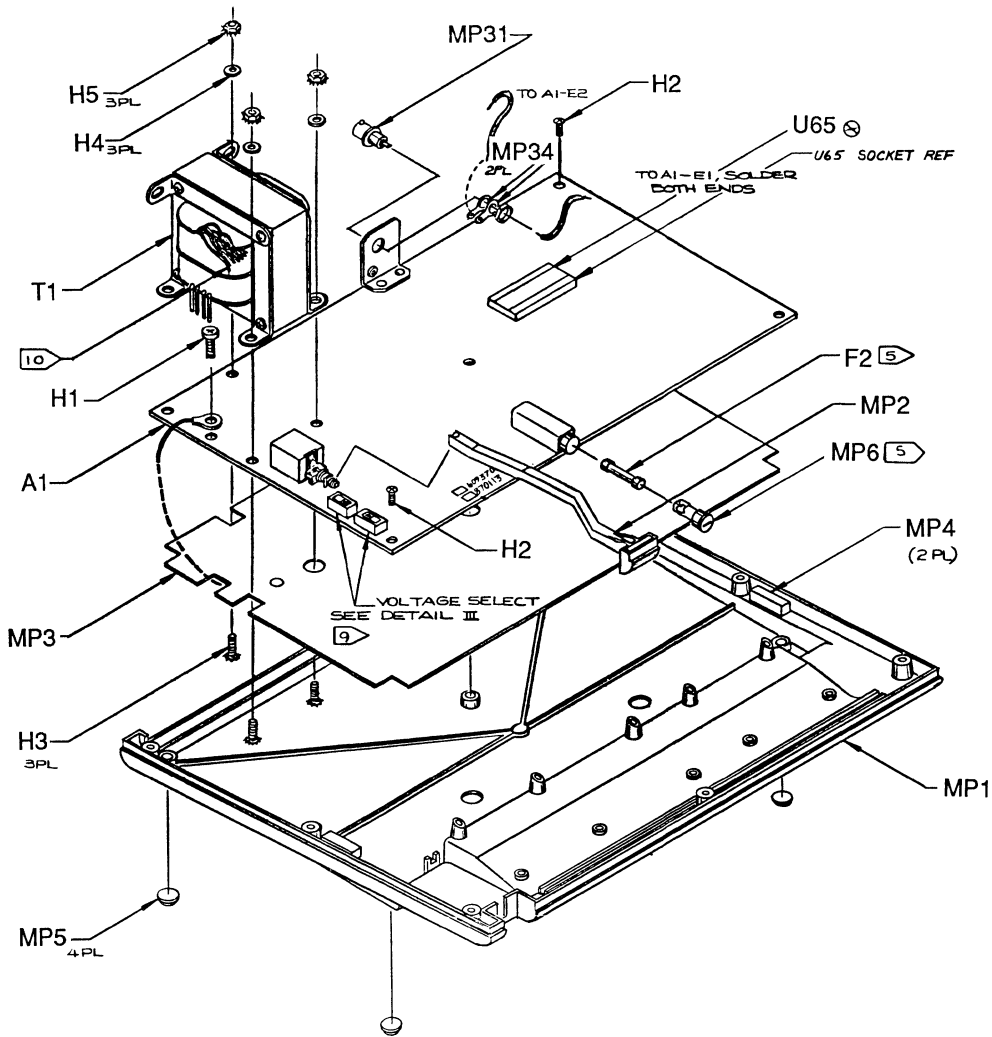
Figure 5-1. Final Assembly

**CAUTION**  
SUBJECT TO DAMAGE BY  
STATIC ELECTRICITY



NOTES : UNLESS OTHERWISE NOTED

- 5 FUSE & FUSE CAP VARY DEPENDING ON VOLTAGE UNIT IS PROGRAMMED FOR, SEE TABLE I FOR FUSE & CAP PART NUMBERS.
- 9 PROGRAM APPROPRIATE LINE VOLTAGE PER DETAIL III.
- 10 LOCATE & SOLDER TRANSFORMER (T1) PRIMARY LEADS TO PCB PER TABLE II BELOW.



VOLTAGE	ITEM MP6 FUSE CAP	ITEM F2 FUSE 1/4 A
100 / 120	440238	109314
220 / 240	441020	543504

XFMR PRIMARY LEAD COLOR	SOLDER TO MAIN PCB CONNECTION
ORN	E4
ORN	E5
VIO	E6
BLU	E7
BLK	E8
GREY	E9
BRN	E10

**WARNING:** Ⓢ INDICATES USAGE OF MOS DEVICE(S) WHICH MAY BE DAMAGED BY STATIC DISCHARGE. USE SPECIAL HANDLING PER S.O.P. 18.1

9000A T&B  
(2 of 4)

Figure 5-1. Final Assembly (cont)

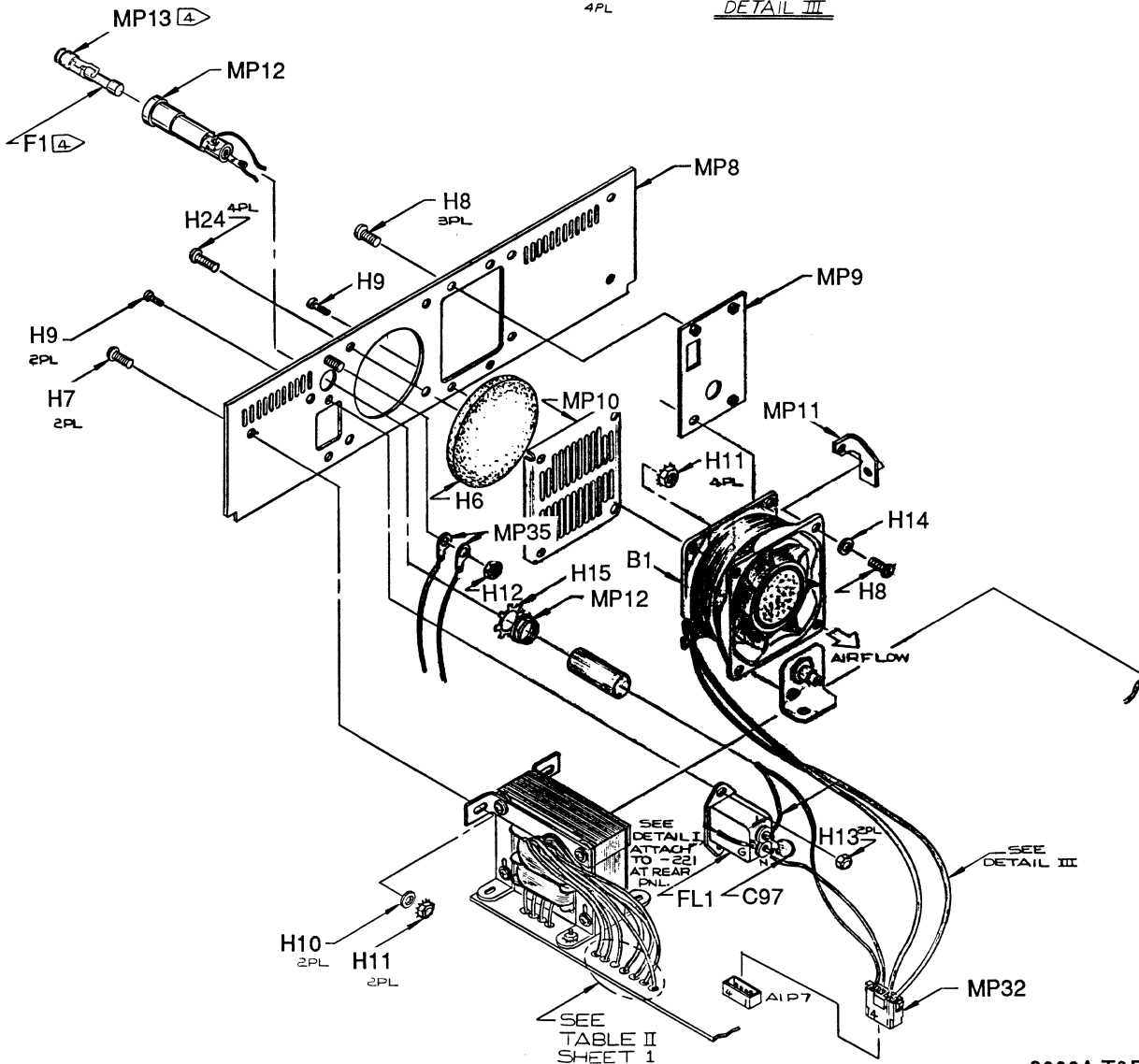
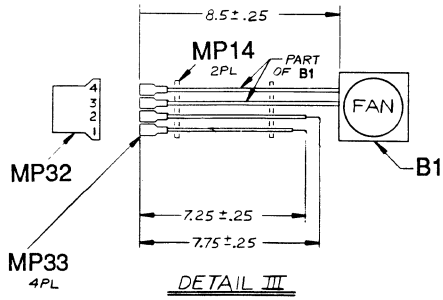


NOTES: UNLESS OTHERWISE SPECIFIED

1. SEE DRAWING 9000A-1201 FOR INTERCONNECT WIRING.

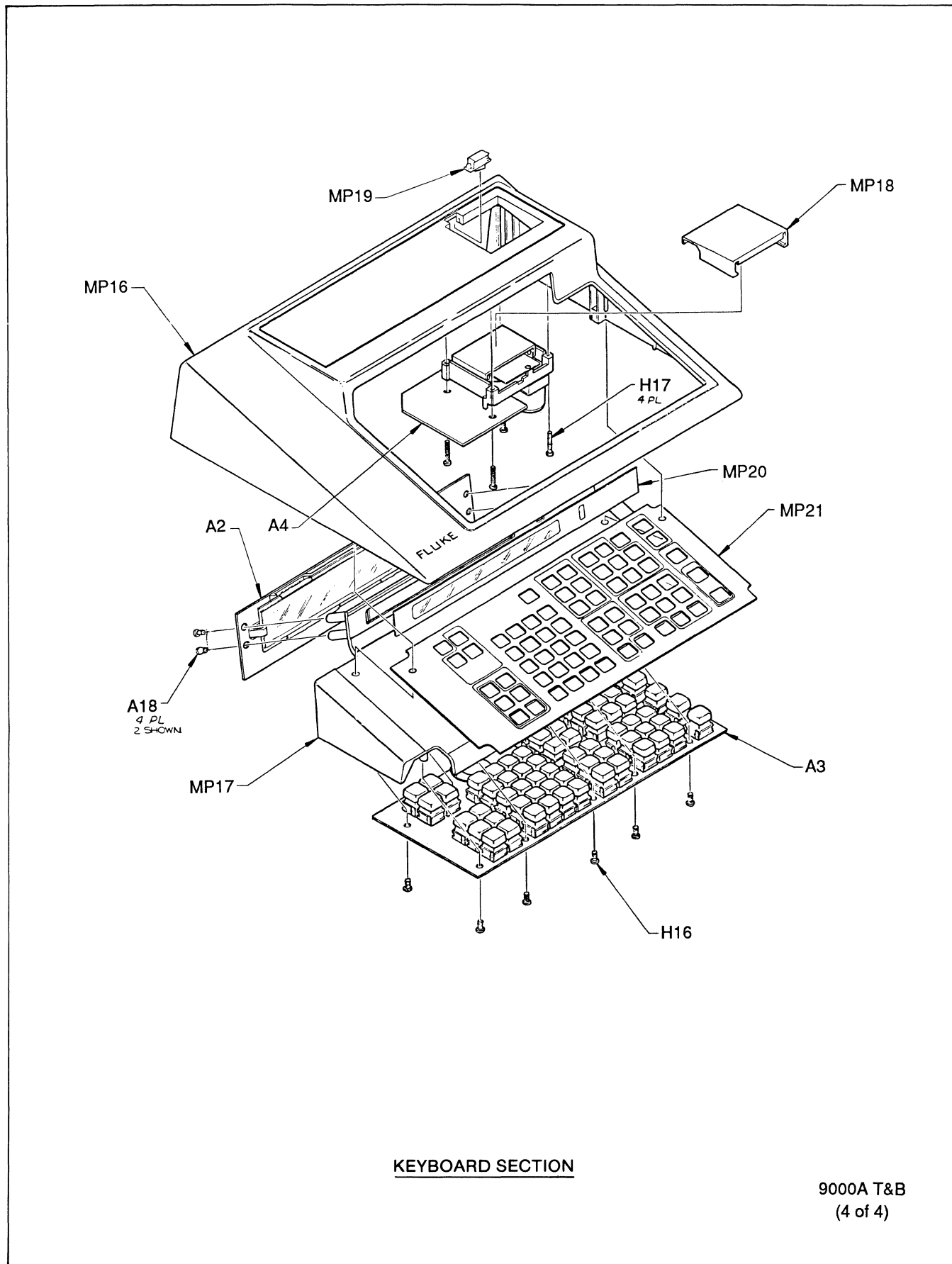
4 FUSE VARIES FOR VOLTAGE THE UNIT IS PROGRAMMED FOR. SEE TABLE I FOR FUSE & FUSE CAP SELECTION.

VOLTAGE	AGC	
	MP13 FUSE CAP 1/4" X 1-1/4"	F1 FUSE 1/4" X 1-1/4"
100/120	460238	1A
220/240	460238	2A



9000A T&B  
(3 of 4)

Figure 5-1. Final Assembly (cont)



KEYBOARD SECTION

9000A T&B  
(4 of 4)

Figure 5-1. Final Assembly (cont)

Table 5-2. A1 Main PCA  
(See Figure 5-2.)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT	N O T E
-A>-NUMERICS-----> S-----DESCRIPTION----- --NO--	-CODE-	-OR	GENERIC TYPE-----	QTY-	-E-
C 1- 3, 89	574186	62643	BK16VR153M35X30LLV	4	
C 4, 7, 11,	416982	62643	SM 35 VB 100	4	
C 44	416982				
C 5, 8, 91	519561	62643	SL16VB470K8X14LLE	3	
C 6, 9	574178	62643	BKVR332M25X25FMV	2	
C 16, 68	330662	56289	199D106X0020CA2	2	
C 17, 49	368647	04222	SR225E104ZAA	2	
C 18, 38- 41,	519157	04222	SR205E224MAT	24	
C 43, 45, 47,	519157				
C 50, 53, 57-	519157				
C 62, 71, 72,	519157				
C 81, 86- 88,	519157				
C 96, 103	519157				
C 48	368639	04222	SR225E103ZAA	1	
C 52	321117	43744	ECV-12W50X32	1	
C 54, 55, 80	402966	04222	SR251C102MAT	3	
C 56, 66, 67,	423012	56289	199D226X0015DA2	5	
C 69, 90	423012				
C 64, 70	105593	60705	561CR3LCK102EF101K	2	
C 65	105569	60705	562CZUCK102AE202P	1	
C 78, 79	363713	56289	199D685X0035DA2	2	
C 92, 93	631390	89536	631390	2	
C 94, 95	603381	89536	603381	2	
C 98-102	375857	89536	375857	5	
CR 1, 2	325746	04713	MR751	2	
CR 3- 5, 7,	203323	07910	1N4448	8	
CR 10- 13	203323				
CR 14- 20, 22	343491	04713	1N4002	8	
CR 21	296509	30800	KBP 02M	1	
E 3	447813	22526	65501-136	1	
F 3	460915	89536	460915	1	
H 1	574541	00779	207084-2	1	
H 2	461996	00779	206584-2	1	
H 3	559039	77900	5110061800-01	2	
H 4	424713	78189	511 041800 00	2	
H 5	110692	86928	5727-17	2	
H 6	542621	12014	R-4020	2	
H 7	745869	02768	231-080551-05-0108	3	
H 8	146225	86928	5710-31-30-P	3	
J 2	757294	00779	850108-1	1	1
J 1, 2	447813	22526	65501-136	2	1
J 3, 4	756866	00779	1-102977-3	2	
J 5	756841	00779	1-103240-3	1	
J 8	756858	00779	102977-5	1	
L 1	502138	89536	502138	1	
MP 1	441865	32559	814-060	1	
MP 2	475681	89536	475681	1	
MP 3	634386	89536	634386	1	
MP 4	334797	32559	TO-35-15-E	1	
MP 5	524934	13103	6025B-TT	3	
MP 6	193128	9W423		1	
MP 7	577635	89536	577635	1	
MP 8	435578	9W423	9531B-B-0632	5	
P 7	512269	00779	350211-1	1	
P 8	756858	00779	102977-5	1	
Q 1	654434	17856	DN1963	1	
Q 2	218396	04713	2N3904	1	
Q 3- 6	330803	04713	MPS6560	4	
R 1	108894	01121	EB7515	1	
R 2	275735	32997	3386R-OT1-101	1	
R 3	441519	80031	1-4-5P300E	1	
R 4	442293	89536	442293	1	
R 5	343418	80031	1-4-5P1K5	1	
R 6	109074	01121	EB2725	1	
R 8	187898	01121	EB1835	1	
R 10	188508	01121	EB1015	1	
R 14	348987	80031	1-4-5P1M	1	
R 15, 16, 40	348920	80031	1-4-5P100K	3	
R 17	348953	80031	5043C475224K0J	1	

An \* in 'S' column indicates a static-sensitive part.

Table 5-2. A1 Main PCA (cont)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T E
-A>-NUMERICS-----> S-----DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----	----	-E-
R 18, 19, 59	RES,CF,4.7K,+5%,0.25W	348821	59124 CF1-4 472 J B	3	
R 20, 42, 49,	RES,CF,10K,+5%,0.25W	348839	59124 CF1-4 102 J B	7	
R 65- 67, 75		348839			
R 21, 56	RES,CF,2K,+5%,0.25W	441469	59124 CF1-4 202 J B	2	
R 22	RES,CF,220,+5%,0.25W	342626	80031 1-4-5P220E	1	
R 23, 41	RES,CF,200,+5%,0.25W	441451	80031 1-4-5P200E	2	
R 24	RES,CF,330,+5%,0.25W	368720	80031 1-4-5P330E	1	
R 26	RES,MF,15K,+1%,0.125W,100PPM	285296	91637 CMF551502F T-1	1	
R 27	RES,MF,549,+1%,0.125W,100PPM	436469	91637 CMF555490F T-1	1	
R 28	RES,MF,24.3,+1%,0.125W,100PPM	281816	91637 CMF5524R3F T-1	1	
R 29, 63	RES,MF,10,+1%,0.125W,100PPM	268789	91637 CMF5510R0F T-1	2	
R 30	RES,CF,430,+5%,0.25W	441568	59124 CF1-4 431 J B	1	
R 31	RES,CF,3.9K,+5%,0.25W	342600	59124 CF1-4 392 J	1	
R 32, 47, 53,	RES,CF,2.2K,+5%,0.25W	343400	80031 1-4-5P2K2	4	
R 54		343400			
R 33	RES,CF,470,+5%,0.25W	343434	80031 1-4-5P470E	1	
R 34	RES,CF,390,+5%,0.25W	441543	80031 1-4-5P390E	1	
R 35- 37, 52	RES,CF,100,+5%,0.25W	348771	80031 1-4-5P100E	4	
R 38	RES,CF,510,+5%,0.25W	441600	80031 1-4-5P510E	1	
R 39, 46, 48	RES,CF,1K,+5%,0.25W	343426	59124 CF1-4 102 J B	3	
R 43	RES,CF,680,+5%,0.25W	368779	80031 1-4-5P680E	1	
R 50	RES,CF,2.7K,+5%,0.25W	386490	80031 1-4-5P2K7	1	
R 51	RES,CF,5.1K,+5%,0.25W	368712	80031 1-4-5P5K1	1	
R 55	RES,CF,10,+5%,0.25W	340075	59124 CF1-4 100 J B	1	
R 62	RES,CC,2K,+5%,0.5W	169854	01121 EB2025	1	
R 64	RES,VAR,CERM,100,+20%,0.5W	193052	72982 332/H-101	1	
R 68, 71	RES,CF,39K,+5%,0.25W	442400	59124 CF1-4 393 J B	2	
R 69, 70	RES,MF,301,+1%,0.125W,100PPM	267740	91637 CMF-55 3010 F T-1	2	
RV 1	VARISTOR,470V,+20%,1.0MA	443192	09214 V300LA4	1	
S 1	SWITCH, ON-OFF	453605	89536 453605	1	
S 3, 4	SWITCH,SLIDE,DPDT,POWER	234278	82389 11A1297A	2	
T 2	TRANSFORMER, PULSE	579219	89536 579219	1	
TP 2- 7, 15	HEADER,1 ROW,.150CTR,7 PIN	756916	22526 65566	7	
TP 8- 14, 17	HEADER,1 ROW,.100CTR,36 PIN	447813	22526 65501-136	8	
U 1	* IC,VOLT REG,ADJ,1.2 TO 32 V,5 AMP OUT	585497	27014 L M338K	1	
U 3	* IC,VOLT REG,FIXED,-5 VOLTS,1.5 AMPS	394551	04713 MC7905CT	1	
U 5	* IC,VOLT REG,FIXED,+12 VOLTS,1.5 AMPS	413195	04713 MC7812CT	1	
U 8	* IC,NMOS,8 BIT MICROCOMPUTER	478073	66958 MK3880P-4	1	
U 18	* IC,CMOS,32K X 8 STATIC RAM,120 NSEC	800250	33297 D43256C12L	1	
U 22	* IC,NMOS,PERIPHERAL INTERFACE ADAPTOR	536318	51284 MCS6520	1	
U 25	* IC,LSTTL,3-8 LINE DCDR W/ENABLE	407585	01295 SN74LS138N	1	
U 26	* IC,TTL,QUAD 2 INPUT AND GATE	393066	04713 SN74LS08N	1	
U 27	* IC,LSTTL,QUAD 2 INPUT OR GATE	393108	04713 SN74LS32N	1	
U 28	* IC,LSTTL,HEX INVERTER	393058	04713 SN74LS04N	1	
U 30	* IC,TTL,HEX INVERTER W/OPEN COLLECTOR	407593	01295 SN7406N	1	
U 31	* IC,CMOS,RETRIG/RESET MULTIVIBRATOR	393512	54590 CD4098BE	1	
U 32, 57	* IC,LSTTL,DUAL J-K F/F,+EDG TRIG	412999	04713 SN74LS109AN	2	
U 34, 37	* IC,LSTTL,DUAL D F/F,+EDG TRG,W/CLR	393124	04713 SN74LS74AN	2	
U 35	* IC,BPLR,DUAL TIMER,14 PIN DIP	387407	04713 MC3456P	1	
U 36, 49	* IC,COMPARATOR,HI-SPEED,14 PIN DIP	386920	18324 NES29A	2	
U 38	* IC,LSTTL,QUAD 2-1 LINE MUX W/STROBE	407833	04713 SN74LS157N	1	
U 39	* IC,LSTTL,TRIPLE 3 INPUT NAND GATE	393074	04713 SN74LS10N	1	
U 40	* IC,LSTTL,QUAD 2 INPUT NOR GATE	393041	04713 SN74LS02N	1	
U 41	DELAY LINE,60 NS,HEX INVERTER	655373	32440 SMTTLDL-140	1	
U 42, 43, 61	* IC,LSTTL,RETRG MONOSTAB MULTIVIB W/CLR	404186	01295 SN74LS123N	3	
U 44	* IC,LSTTL,QUAD 2 IN NOR GATE W/OPN COL	414037	04713 SN74LS33N	1	
U 45	* IC,LSTTL,QUAD D F/F,+EDG TRG,W/CLR	393215	01295 SN74LS175N	1	
U 46	* IC,CMOS,QUAD NOR R/S LTCH W/3-STATE	536607	04713 MC14043BCP	1	
U 50	* IC,ECL,QUAD LINE RECEIVER	584045	04713 MC10115P	1	
U 51	* IC,LSTTL,QUAD 2 INPUT XOR GATE	408237	04713 SN74LS86N	1	
U 52, 54	* IC,LSTTL,8BIT S-IN, P-OUT R-SHIFT RGS	408732	18324 74LS164NA	2	
U 53, 55, 60	* IC,LSTTL,OCTL LINE DRVR W/3-STATE OUT	429035	04713 SN74LS244N	3	
U 59	* IC,LSTTL,DUAL DIV BY 16 BINARY CNTR	483578	01295 SN74LS393N	1	
U 64	* IC,VOLT REG,FIXED,+5 VOLTS,1.5 AMPS	647073	89536 647073	1	
U 65	* EPROM,PROGRAMMED	870089	89536 870089	1	
U 66	* IC,LSTTL,HEX BUFFER W/NOR ENABLE	483800	01295 SN74LS367AN	1	
W 1	JUMPER,WIRE,TEFLON INSUL,0.200CTR	529776	60386 J 0.200X.0253 I 22	1	
W 4, 6	JUMPER,WIRE,NONINSUL,0.100CTR	529701	60386 J 0.275X0.250 B 22	2	
XF 2	HLDR PART,FUSE,BODY,PWB MT	602763	61935 FAU031.3573	1	
XU 8, 22	SOCKET,IC,40 PIN	429282	00779 2-640379-1	2	
XU 18, 65, 67	SOCKET,IC,28 PIN	448217	91506 228-AG39D	3	
XU 34, 41	SOCKET,IC,14 PIN	370304	89536 370304	2	

An \* in 'S' column indicates a static-sensitive part.

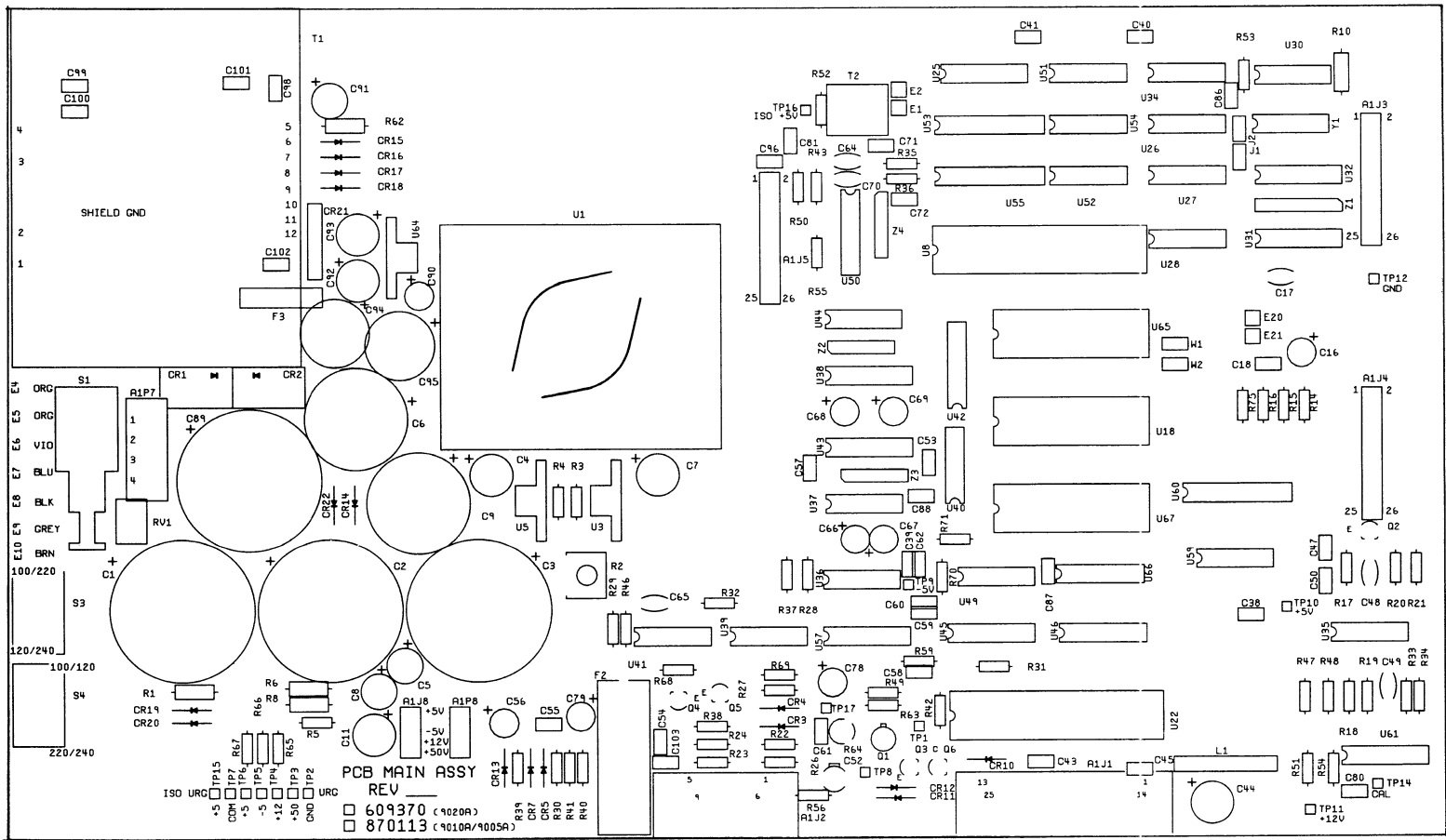
Table 5-2. A1 Main PCA (cont)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT	N O T
-A>-NUMERICS--> S-----DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----	QTY-	-E-
XU 53, 55, 60	SOCKET, IC, 20 PIN	454421	00779 2-640464-1	3	
Y 1	OSCILLATOR, 6.5MHZ, TTL CLOCK	586933	91637 X0-43B 6.5	1	
Z 1	RES, NET, SIP, 8 PIN, 7 RES, 10K, +-2%	412924	91637 CSC08A-01-103G	1	
Z 2	RES, NET, SIP, 6 PIN, 5 RES, 1K, +-2%	408310	91637 CSC06A-01-102G	1	
Z 3	RES, NET, SIP, 6 PIN, 5 RES, 22K, +-2%	520122	91637 CSC06A-01-223G	1	
Z 4	RES, NET, SIP, 6 PIN, 5 RES, 510, +-2%	459974	91637 CSC08A-01-511G	1	

An \* in 'S' column indicates a static-sensitive part.

NOTE 1 = J2 consists of 2 parts, 757294 and 447813.

Figure 5-2. A1 Main PCA



9000A-1611

**CAUTION**  
 SUBJECT TO DAMAGE BY  
 STATIC ELECTRICITY

Table 5-3. A2 Display PCA  
(See Figure 5-3.)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T E
-A>-NUMERICS-----> S-----	DESCRIPTION-----	--NO--	-OR GENERIC TYPE-----	QTY-	-E-
C 1		447573	89536 447573	1	
C 2, 3		170266	62643 SM25 T-100	2	
C 4		106369	89536 106369	1	
C 5, 6		519157	04222 SR205E224MAT	2	
DS 1- 5		504761	14936 MV57124	5	
H 1, 2		110775	COMMERCIAL	2	
H 3, 4		183574	COMMERCIAL	2	
J 1, 2		530154	89536 530154	2	
MP 1		577601	89536 577601	1	
MP 2		530162	89536 530162	2	
Q 1, 2	*	418707	07263 MPS6562	2	
R 1, 2		348896	80031 1-4-5P47J	2	
R 3, 9		348839	59124 CF1-4 102 J B	2	
R 4- 8		441436	59124 CF1-4 181 J B	5	
R 10, 13		348797	89536 348797	2	
R 11, 14		348946	80031 1-4-5P180K	2	
R 12, 15		109009	01121 EB5601	2	
TP 0- 5		447813	22526 65501-136	6	
U 1	*	535419	89536 535419	1	
U 2- 6	*	340125	04713 MC14015BCP	5	
U 7- 12	*	535799	56289 UDN-6118A	6	
U 13, 14	*	524520	89536 524520	2	
U 15	*	604264	89536 604264	1	
U 16	*	393041	04713 SN74LS02N	1	
U 17	*	288605	01295 SN7416N	1	
V 1		535401	89536 535401	1	
W 1		579235	89536 579235	1	
W 2		579227	89536 579227	1	
XU 1		429282	00779 2-640379-1	1	
Y 1		461665	89536 461665	1	

An \* in 'S' column indicates a static-sensitive part.

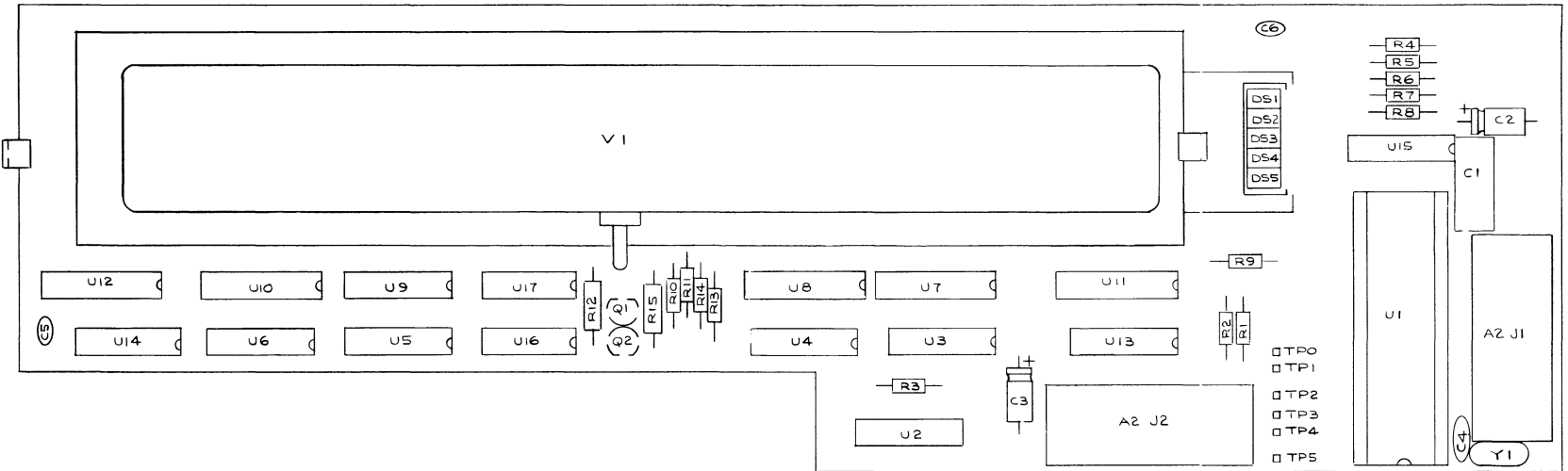


Figure 5-3. A2 Display PCA

9000A-1602

**CAUTION**  
SUBJECT TO DAMAGE BY  
STATIC ELECTRICITY

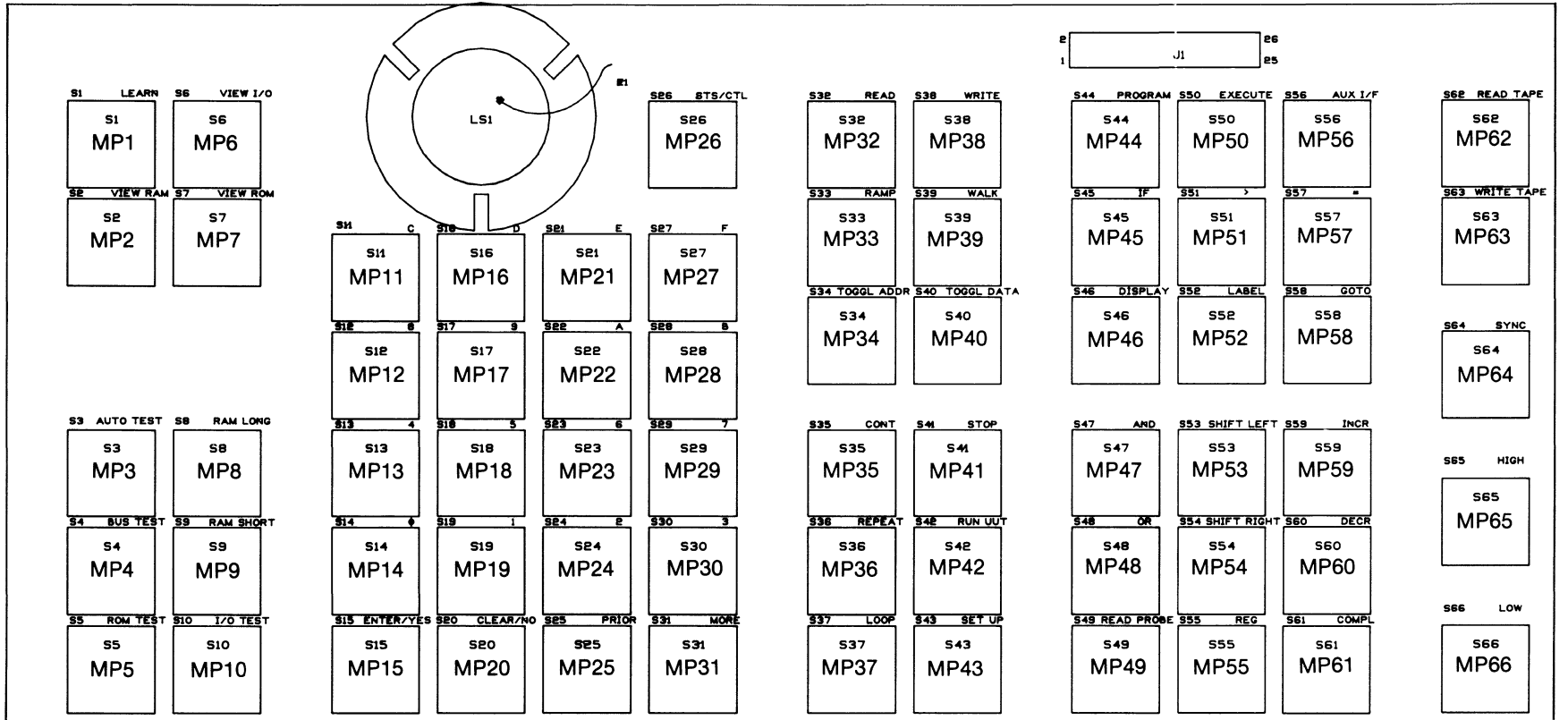


Table 5-4. A3 Keyboard PCA  
(See Figure 5-4.)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T E
-A>-NUMERICS-----> S-----DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----		-E-
J 1	512590	00779	1-87230-3	1	
LS 1	513101	89536	513101	1	
MP 1	584284	89536	584284	1	
MP 2	584300	89536	584300	1	
MP 3	584326	89536	584326	1	
MP 4	584359	89536	584359	1	
MP 5	584367	89536	584367	1	
MP 6	584292	89536	584292	1	
MP 7	584318	89536	584318	1	
MP 8	584334	89536	584334	1	
MP 9	584342	89536	584342	1	
MP 10	584375	89536	584375	1	
MP 11	584557	89536	584557	1	
MP 12	584516	89536	584516	1	
MP 13	584474	89536	584474	1	
MP 14	584433	89536	584433	1	
MP 15	584409	89536	584409	1	
MP 16	584565	89536	584565	1	
MP 17	584524	89536	584524	1	
MP 18	584482	89536	584482	1	
MP 19	584441	89536	584441	1	
MP 20	584417	89536	584417	1	
MP 21	584573	89536	584573	1	
MP 22	584532	89536	584532	1	
MP 23	584490	89536	584490	1	
MP 24	584458	89536	584458	1	
MP 25	584383	89536	584383	1	
MP 26	584425	89536	584425	1	
MP 27	584581	89536	584581	1	
MP 28	584540	89536	584540	1	
MP 29	584508	89536	584508	1	
MP 30	584466	89536	584466	1	
MP 31	584391	89536	584391	1	
MP 32	584607	89536	584607	1	
MP 33	584623	89536	584623	1	
MP 34	584649	89536	584649	1	
MP 35	584664	89536	584664	1	
MP 36	584680	89536	584680	1	
MP 37	584706	89536	584706	1	
MP 38	584615	89536	584615	1	
MP 39	584631	89536	584631	1	
MP 40	584656	89536	584656	1	
MP 41	584672	89536	584672	1	
MP 42	584698	89536	584698	1	
MP 43	584599	89536	584599	1	
MP 44	584714	89536	584714	1	
MP 45	584748	89536	584748	1	
MP 46	584789	89536	584789	1	
MP 47	584797	89536	584797	1	
MP 48	584805	89536	584805	1	
MP 49	584920	89536	584920	1	
MP 50	584771	89536	584771	1	
MP 51	584755	89536	584755	1	
MP 52	584722	89536	584722	1	
MP 53	584813	89536	584813	1	
MP 54	584821	89536	584821	1	
MP 55	584839	89536	584839	1	
MP 56	584938	89536	584938	1	
MP 57	584763	89536	584763	1	
MP 58	584730	89536	584730	1	
MP 59	584847	89536	584847	1	
MP 60	584854	89536	584854	1	
MP 61	584862	89536	584862	1	
MP 62	584870	89536	584870	1	
MP 63	584888	89536	584888	1	
MP 64	584896	89536	584896	1	
MP 65	584904	89536	584904	1	
MP 66	584912	89536	584912	1	
S 1- 64	513473	31918	DC-61-03	64	
S 65, 66	602219	89536	602219	2	

An \* in 'S' column indicates a static-sensitive part.

Figure 5-4. A3 Keyboard PCA

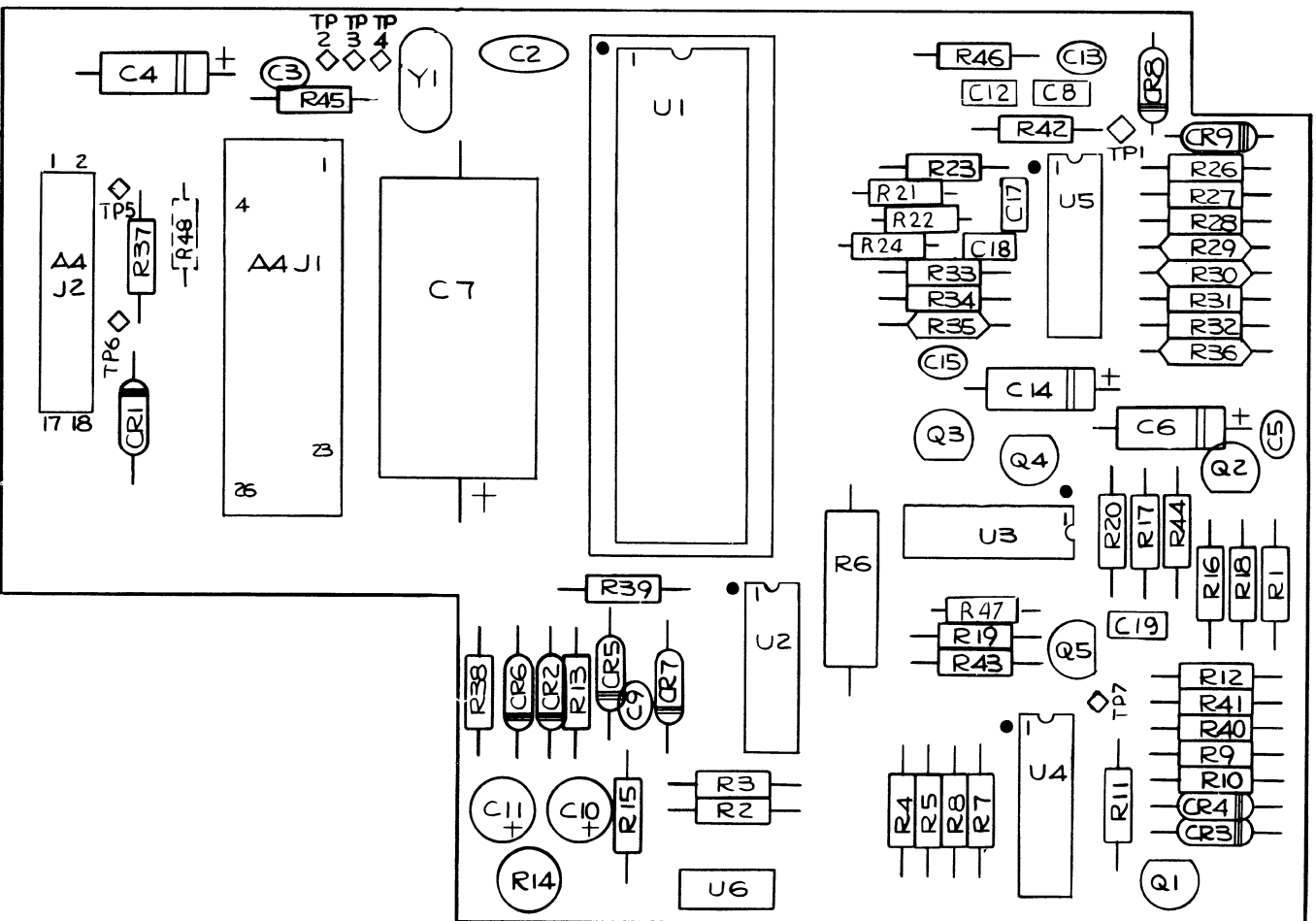


9010A-1633

Table 5-5. A4 Mag Tape PCA  
(See Figure 5-5.)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T E
-A>-NUMERICS-----S-----DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE----		-E-
C 2	106369	89536	106369	1	
C 3, 5, 9,	519157	04222	SR205E224MAT	4	
C 15	519157				
C 4, 6, 14	170266	62643	SM25 T-100	3	
C 7	572511	89536	572511	1	
C 8	603506	05397	C315C181J1G5EA	1	
C 10, 11	161943	56289	196D475X0025KA1	2	
C 12, 18	512962	05397	C315C390G1G5EA	2	
C 13	407361	04222	3419-1000-103M	1	
C 17, 19	512111	05397	C315C221J1G5EA	2	
CR 1- 7	203323	07910	1N4448	7	
CR 8, 9	375485	09214	STB804	2	
H 1	602128	COMMERCIAL		3	
J 1	530154	89536	530154	1	
J 2	806273	00779	1-103186-0	1	
MP 1	574459	89536	574459	1	
MP 2	530162	89536	530162	1	
Q 1	330803	04713	MPS6560	1	
Q 2- 4	195974	04713	2N3906	3	
Q 5	524140	89536	524140	1	
R 1	340075	59124	CF1-4 100 J B	1	
R 2, 10, 42,	348839	59124	CF1-4 102 J B	4	
R 46	348839				
R 3	348813	80031	1-4-5P3K3	1	
R 4	442285	80031	1-4-5P110E	1	
R 5, 8, 26,	441469	59124	CF1-4 202 J B	6	
R 32, 40, 47	441469				
R 6	218701	01121	EB1R25	1	
R 7	352286	80031	1-4-5P360E	1	
R 9, 11, 15	441451	80031	1-4-5P200E	3	
R 12, 17, 27,	348920	80031	1-4-5P100K	6	
R 28, 33, 34	348920				
R 13	441436	59124	CF1-4 181 J B	1	
R 14	226068	89536	226068	1	
R 16	368779	80031	1-4-5P680E	1	
R 18- 20, 38,	348771	80031	1-4-5P100E	6	
R 39, 45	348771				
R 21, 22	289256	89536	289256	2	
R 23, 24	248807	91637	MFF1-81003F	2	
R 29	235333	91637	MFF1-84022F	1	
R 30	261701	91637	MFF1-82003F	1	
R 31, 44	441501	80031	1-4-5P27K	2	
R 35, 36	168260	91637	MFF1-81002F	2	
R 41	441444	80031	1-4-5P1K8	1	
R 43	343426	59124	CF1-4 102 J B	1	
TP 1- 7	447813	22526	65501-136	7	
U 1	536094	89536	536094	1	
U 2, 3	524736	04713	SN74LS38N	2	
U 4	477828	89536	477828	1	
U 5	402669	27014	LM324N	1	
U 6	862644	89536	862644	1	
U 6	536383	89536	536383	1	
W 1	581801	89536	581801	1	
XU 1	429282	00779	2-640379-1	1	
Y 1	461665	89536	461665	1	

An \* in 'S' column indicates a static-sensitive part.



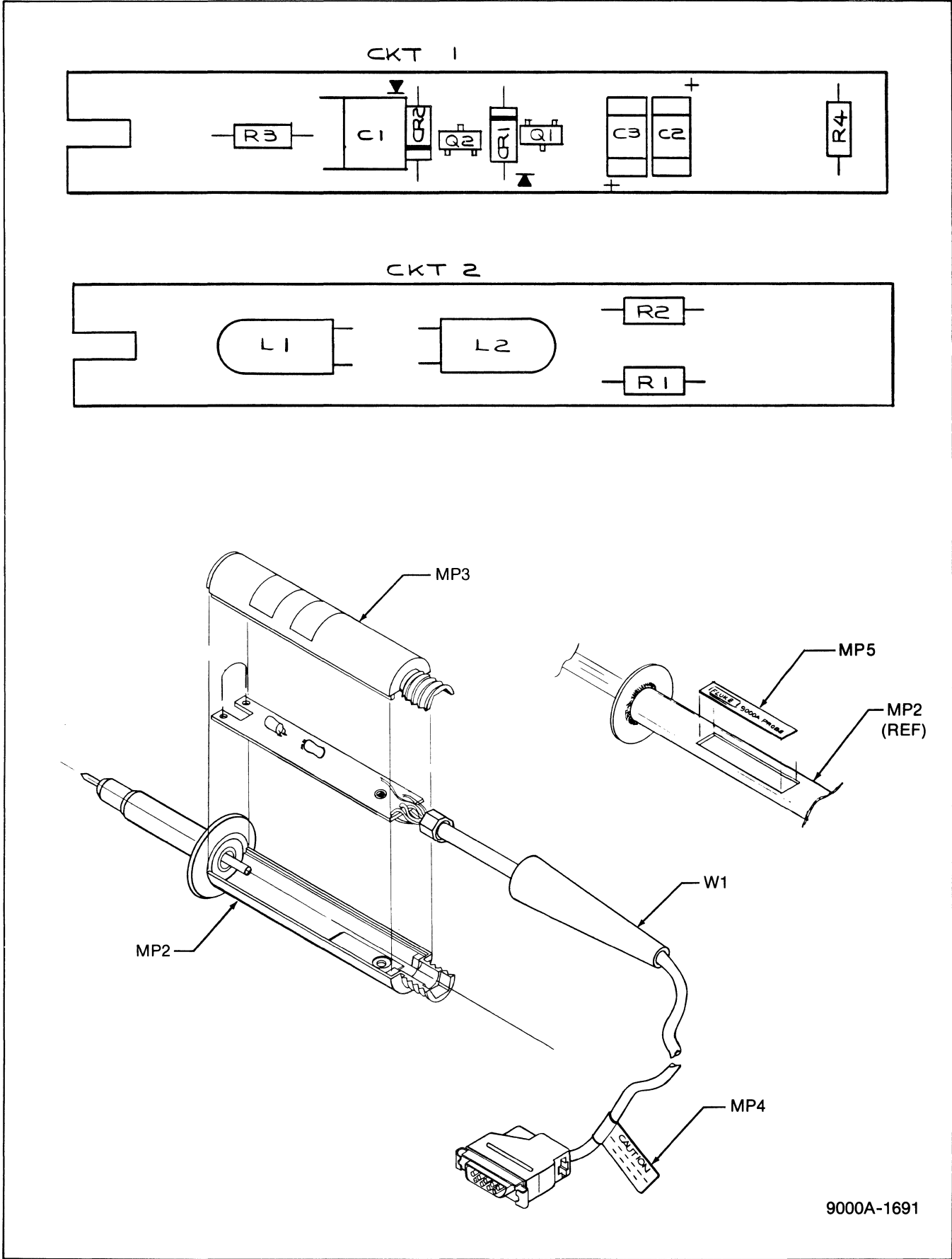
9010A-1634

Figure 5-5. A4 Magnetic Tape PCA

Table 5-6. A7 Data Probe Assembly  
(See Figure 5-6.)

REFERENCE DESIGNATOR			FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T E
-A>-NUMERICS----->	S-----	DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----		-E-
C	1	CAP,CER,33PF,+/-2%,50V,COG	354852	51406	RD8712NPO330G50V	1	
C	2, 3	CAP,CER,0.39UF,+80-20%,50V,X7R,1812	614552	89536	614552	2	
CR	1, 2	* DIODE,SI,BV=75V,IO=150MA,500MW	203323	07910	1N4448	2	
DS	1, 2	LAMP,SUB-MIN,5V,75MA	574475	89536	574475	2	
MP	1	PCB STANDOFF	584201	89536	584201	1	
MP	2	PROBE BODY	611814	89536	611814	1	
MP	3	PROBE, CANOPY	580910	89536	580910	1	
MP	4	DECAL	585307	89536	585307	1	
MP	5	LABEL, PROBE CAUTION	605816	89536	605816	1	
Q	1	* TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT23	483735	89536	483735	1	
Q	2	* TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT23	742031	73445	BCX19TRL	1	
R	1	RES,MF,205K,+/-1%,0.125W,100PPM	375931	89536	375931	1	
R	2	RES,CF,220,+/-5%,0.25W	342626	80031	1-4-5P220E	1	
R	3	RES,MF,100K,+/-1%,0.125W,100PPM	248807	91637	MFF1-81003F	1	
R	4	RES,CC,10K,+/-10%,0.125W	246975	01121	BB1031	1	
W	1	CABLE, PROBE	583344	89536	583344	1	

An \* in 'S' column indicates a static-sensitive part.



9000A-1691

Figure 5-6. A7 Data Probe Assembly

Table 5-7. Manual Status Information

REF OR OPTION NO.	ASSEMBLY NAME	FLUKE PART NO.	X = The PCA revision levels documented in this manual.																									
			-	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W		
A1	Main PCA	870113																									X	
A2	Display PCA	579250							X																			
A3	Keyboard PCA	579425			X																							
A4	Magnetic Tape PCA	579441								X																		
A7	Data Probe PCA	580969					X																					
-001	RS-232 PCA	716027								X																		

## MANUFACTURER'S FEDERAL SUPPLY CODES

00779 AMP, Inc. Harrisburg, PA	14936 General Instrument Co. Discrete Semi Conductor Div. Hicksville, NY	51284 Mos Technology Norristown, PA	72982 Erie Specialty Products, Inc. Erie, PA
01121 Allen Bradley Co. Milwaukee, WI	17856 Siliconix Inc. Santa Clara, CA	52500 Amphenol, RF Operations Burlington, MA	73445 Amperex Electronic Corp. Hicksville, NY
01295 TX Instruments, Inc. Semiconductor Group Dallas, TX	18324 Signetics Corp. Sacramento, CA	54492 Cinch Clamp Co., Inc. Santa Rosa, CA	73734 Federal Screw Products Inc. Chicago, IL
02768 ITW Fastex Division Des Plaines, IL	22526 Dupont, El DeNemours & Co. Dupont Connector Systems Advanced Products Division New Cumberland, PA	54590 RCA Corp. Electronic Components Div. Cherry Hill, NJ	77900 Shakeproof Lock Washer Co (Now 78189)
04222 AVX Corp. AVX Ceramics Div. Myrtle Beach, SC	27014 National Semiconductor Corp. Santa Clara, CA	56289 Sprague Electric Co. North Adams, MA	78189 IL Tool Works Inc. Shakeproof Division Elgin, IL
04713 Motorola Inc. Semiconductor Group Phoenix, AZ	28213 MN Mining & Mfg. Co. Consumer Products Div. 3M Center Saint Paul, MN	59124 KOA-Speer Electronics Inc. Bradford, PA	79963 Zierick Mfg. Corp. Mount Kisco, NY
05397 Union Carbide Corp. Materials Systems Div. Cleveland, OH	30800 General Instrument Corp. Capacitor Division Hicksville, NY	60386 Squires Electronics Inc. Cornelius, OR	80031 Mepco/Electra Inc. Morristown, NJ
06383 Panduit Corp. Tinley Park, IL	31918 ITT-Schadow Eden Prairie, MN	60705 Cera-Mite Corp. Grafton, WI	82389 Switchcraft Inc. Sub of Raytheon Co. Chicago, IL
07263 Fairchild Semiconductor North American Sales Ridgeview, CT	32440 Engineered Components Co. Huntington Beach, CA	61935 Schurter Inc. Petaluma, CA	86928 Seastrom Mfg. Co., Inc. Glendale, CA
07910 Teledyne Semiconductor Mountain View, CA	32559 Bivar Santa Ana, CA	62643 United Chemicon Rosemont, IL	88044 Aeronautical Standards Group Dept. of Navy & Air Force
09214 General Electric Co. Semiconductor Products Dept. Auburn, NY	32997 Bourns Inc. Trimpot Div. Riverside, CA	66958 SGS Semiconductor Corp. Phoenix, AZ	89462 Waldes Truarc, Inc. Long Island, NY
12014 Chicago Rivet & Machine Co. Naperville, IL	33297 NEC Electronics USA Inc. Electronic Arrays Inc. Div. Mountain View, CA	70903 Cooper-Belden Corp. Geneva, IL	9W423 Amatom El Mont, CA
13103 Thermalloy Co., Inc. Dallas, TX	43744 Panasonic Industrial Co. San Antonio, TX	71002 Birnback Co. Inc. Farmingdale, NY	91506 Augat Alcoswitch North Andover, MA
		71400 Bussman Manufacturing Div. McGraw-Edison Co. St. Louis, MO	91637 Dale Electronics, Inc. Columbus, NE



## TECHNICAL SERVICE CENTERS

### U.S. Service Locations

#### California

Fluke Technical Center  
16969 Von Karman Avenue  
Suite 100  
Irvine, CA 92714  
Tel: (714) 863-9031

Fluke Technical Center  
46610 Landing Parkway  
Fremont, CA 94538  
Tel: (415) 651-5112

#### Colorado

Fluke Technical Center  
14180 East Evans Avenue  
Aurora, CO 80014  
Tel: (303) 695-1171

#### Florida

Fluke Technical Center  
940 N. Fern Creek Avenue  
Orlando, FL 32803  
Tel: (407) 896-4881

#### Illinois

Fluke Technical Center  
1150 W. Euclid Ave.  
Palatine, IL 60067  
Tel: (312) 705-0500

#### Maryland

Fluke Technical Center  
5640 Fishers Lane  
Rockville, MD 20852  
Tel: (301) 770-1576

#### New Jersey

Fluke Technical Center  
East 66 Midland Avenue  
Paramus, NJ 07652-0930  
Tel: (201) 599-9500

#### Texas

Fluke Technical Center  
1801 Royal Lane, Suite 307  
Dallas, TX 75229  
Tel: (214) 869-2848

#### Washington

Fluke Technical Center  
John Fluke Mfg. Co., Inc.  
1420 75th St. S.W.  
M/S 6-30  
Everett, WA 98203  
Tel: (206) 356-5560

### International

#### Argentina

Coasin S.A.  
Virrey del Pino 4071 DPTO E-65  
1430 CAP FED  
Buenos Aires  
Tel: 54 1 522-5248

#### Australia

Philips Customer Support  
Scientific and Industrial  
23 Lakeside Drive  
Tally Ho Technology Park  
East Burwood  
Victoria 3151

#### Australia

Philips Customer Support  
Scientific & Industrial  
25-27 Paul St. North  
North Ryde N.S.W. 2113  
Tel: 61 02 888 8222

#### Austria

Oesterreichische Philips Industrie  
Unternehmensbereich Prof. Systeme  
Triesterstrasse 66  
Postfach 217  
A-1101 Wein  
Tel: 43 222-60101, x1388

#### Belgium

Philips & MBLE Associated S.A.  
Scientific & Industrial Equip. Div  
Service Department.  
80 Rue des deux Gares B-1070  
Brussels  
Tel: 32 2 525 6111

#### Brazil

Hi-Tek Electronica Ltda.  
Al. Amazonas 422, Alphaville  
CEP 06400 Barueri  
Sao Paulo  
Tel: 55 011 421-5477

#### Canada

Fluke Electronics Canada Inc.  
400 Britannia Rd. East, Unit #1  
Mississauga, Ontario  
L4Z 1X9  
Tel: 416-890-7600

#### Chile

Intronsa Inc.  
Casilla 16158  
Santiago 9  
Tel: 56 2 232-1886, 232-4308

#### China

Fluke International Corp.  
P.O. Box 9085  
Beijing  
Tel: 86 01 512-3436

#### Colombia

Sistemas E Instrumentacion, Ltda.  
Carrera 13, No. 37-43, Of. 401  
Ap. Aereo 29583  
Bogota  
Tel: 57 232-4532

#### Denmark

Philips A/S  
Technical Service I & E  
Strandlodsvej 1A  
PO Box 1919  
DK-2300  
Copenhagen S  
Tel: 45 1 572222

#### Ecuador

Proteco Coasin Cia., Ltda.  
P.O. Box 228-A  
Ave. 12 de Octubre  
2285 y Orellana  
Quito  
Tel: 593 2 529684

#### Egypt

Philips Egypt  
10, Abdel Rahman el Rafei st.  
el. Mohandessin  
P.O. Box 242  
Dokki Cairo  
Tel: 20-2-490922

#### England

Philips Scientific  
Test & Measuring Division  
Colonial Way  
Watford  
Hertfordshire WD2 4TT  
Tel: 44 923-240511

#### Finland

Oy Philips AB  
Central Service  
Sinikalliontie 1-3  
P.O. Box 11  
SF-02630 ESPOO  
Tel: 358-0-52572

#### France

S.A. Philips Industrielle  
et Commerciale,  
Science et Industry  
105 Rue de Paris BP 62  
93002 Bobigny, Cedex  
Tel: 33-1-4942-8040

#### Germany (F.R.G.)

Philips GmbH  
Service fuer FLUKE - Produkte  
Department VSF  
Oskar-Messter-Strasse 18  
D-8045 Ismaning/Munich,  
West Germany  
Tel: 49 089 9605-239

#### Greece

Philips S.A. Hellenique  
15, 25th March Street  
177 78 Tavros  
10210 Athens  
Tel: 30 1 4894911

#### Hong Kong

Schmidt & Co (H.K.) Ltd.  
18/FL., Great Eagle Centre  
23 Harbour Road  
Wanchai  
Tel: 852 5 8330222

#### India

Hinditron Services Pvt. Ltd  
1st Floor, 17-B,  
Mahal Industrial Estate  
Mahakali Road, Andheri East  
Bombay 400 093  
Tel: 91 22 6300043

Hinditron Services Pvt. Inc.  
33/44A Raj Mahal Villas Extn.  
8th Main Road  
Bangalore 560 080  
Tel: 91 812 363139

Hinditron Services Pvt. Ltd.  
Field Service Center  
Emerald Complex 1-7-264  
5th Floor  
114 Sarojini Devi Road  
Secunderabad 500 003  
Tel: 08 42-821117

Hinditron Services Pvt. Ltd.  
15 Community Centre  
Panchshila Park  
New Delhi 110 017  
Tel: 011-6433675

#### Indonesia

P.T. Lamda Triguna  
P.O. Box 6/JATJG  
Jakarta 13001  
Tel: (021) 8195365

#### Israel

R.D.T. Electronics Engineering, Ltd.  
P.O. Box 43137  
Tel Aviv 61430  
Tel: 972 3 483211

#### Italy

Philips S.p.A.  
Sezione I&E / T&M  
Viale Elvezia 2  
20052 Monza  
Tel: 39-39-363-5342

#### Japan

John Fluke Mfg. Co., Inc.  
Japan Branch  
Sumitomo Higashi Shinbashi Bldg.  
1-1-11 Hamamatsucho  
Minato-ku  
Tokyo 105  
Tel: 81 3 434-0181

#### Korea

Myoung Corporation  
Yeo Eui Do P.O. Box 14  
Seoul 150  
Tel: 82 2 784-9942

#### Malaysia

Mecomb Malaysia Sdn. Bhd.  
P.O. Box 24  
46700 Petaling Jaya  
Selangor  
Tel: 60 3 774-3422

#### Mexico

Mexel Servicios en Computacion  
Instrumentacion y Perifericos  
Blvd. Adolfo Lopez Mateos No. 163  
Col. Mixcoac  
Mexico D.F.  
Tel: 52-5-563-5411

#### Netherlands

Philips Nederland  
Test & Meetapparaten Div.  
Postbus 115  
5000 AC Tilburg  
Tel: 31-13-352445

#### New Zealand

Philips Customer Support  
Scientific & Industrial Division  
2 Wagener Place  
Mt. Albert  
Auckland  
Tel: 64 9 894-160

#### Norway

Morgenstjerne & Co. A/S  
Konghellegate 3  
P.O. Box 6688, Rodelokka  
Oslo 5  
Tel: 47 2 356110

## TECHNICAL SERVICE CENTERS

**Pakistan**

International Operations (PAK) Ltd.  
505 Muhammadi House  
I.I. Chundrigar Road  
P.O. Box 5323  
Karachi  
Tel: 92 21 221127, 239052

**Peru**

Importaciones & Representaciones  
Electronicas S.A.  
Avad Franklin D. Roosevelt 105  
Lima 1  
Tel: 51 14 288650

**Philippines**

Spark Radio & ElectronicS Inc.  
Greenhills, P.O. Box 610  
San Juan, Metro-Manila Zip 3113  
Tel: 63-2-775192

**Portugal**

Decada Espectral  
Equipmentos de Elec. e Cientificos  
Av. Bomberos Voluntarios  
Lote 102B, Miraflores/Alges  
1495 Lisboa  
Tel: 351 1 410-3420

**Singapore**

Rank O'Connor's Singapore Pte Ltd  
98 Pasir Panjang Road  
Singapore 0511  
Tel: 65 4737944

**South Africa**

South African Philips (Pty) Ltd.  
Service Department  
195 Main Rd  
Martindale, Johannesburg, 2092  
Tel: 27 11 470-5255

**Spain**

Philips Iberica Sae  
Depto. Tecnico Instrumentacion  
c/Martinez Villergas 2  
28027 Madrid  
Tel: 34 1 4042200

**Sweden**

Philips Kistaindustrier Ab  
I&E Technical Customer Support  
Borgarfjordsgatan 16  
S 164 93 Kista  
Tel: 46-8-703-1000

**Switzerland**

Philips A.G.  
Technischer Kundendienst  
Postfach 670  
Allmendstrasse 140  
CH-8027 Zurich  
Tel: 41 1 482211

**Taiwan, R.O.C.**

Schmidt Electronics Corp.  
5th Floor, Cathay Min Sheng  
Commercial Building,  
344 Min Sheng East Road  
Taipei  
Tel: 886 2 501-3468

**Thailand**

Measuretronix Ltd.  
2102/63 Ramkamhaeng Rd.  
Bangkok 10240  
Tel: 66 2 374-2516, 374-1632

**Turkey**

Turk Philips Ticaret A.S.  
Inonu Caddesi 78/80  
Posta Kutusu 504-Beyoglu  
Istanbul  
Tel: 90 1 1435891

**Uruguay**

Coasin Uruguay S.A  
Casilla de Correo 1400  
Libertad 2525  
Montevideo  
Tel: 598-2-789015

**Venezuela**

Coasin C.A.  
Calle 9 Con Calle 4, Edif. Edinurbi  
Apartado de Correos Nr-70-136  
Los Ruices  
Caracas 1070-A  
Tel: 58 2 241-0309, 241-1248

**West Germany**

Philips GmbH  
Service VSF  
Unternehmensbereich Elektrubj  
fur Wissenschaft und Industrie  
Oskar-Messter-Strasse 18  
8045 Ismaning  
Tel: 49-089-9605-260



# Section 6 Option & Accessory Information

## TABLE OF CONTENTS

OPTION/ MODEL NO.	DESCRIPTION	PAGE
-001	RS-232 Interface .....	001-1

### **6-1. INTRODUCTION**

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 9010A Micro System Troubleshooter. It consists of an introductory section, an accessory section, and an option subsection.

### **6-3. ACCESSORIES**

6-4. The accessories are fully documented in the Accessories subsection of the 9010A Operator Manual.

### **6-5. OPTIONS**

6-6. Each option is documented in an individual subsection of this manual section. Each option subsection includes all maintenance information for the specific

option: theory of operation, calibration, general maintenance, performance test, troubleshooting, parts list, and schematics.

6-7. Unique page and paragraph numbering, which corresponds to the option number, facilities subsection location. For example, a page numbered 001-1 is the first page of information for Option -001. A paragraph numbered 001-1 is the first paragraph concerning Option 001.

6-8. Subsections for options available at the time of this printing are included in this manual. Additional options will be available in the future. Contact your nearest Fluke sales representative for a current list of available options.

## Option -001 RS-232 Interface

### 001-1. INTRODUCTION

001-2. Option -001 is an RS-232 Interface which consists of a printed circuit board assembly mounted on the 9010A Main Assembly, and a standard RS-232 connector mounted on the 9010A rear panel. The RS-232 Interface allows the 9010A to communicate with remote devices, such as a printer, a computer, or another 9010A via the rear panel connector. Data transmission is asynchronous, with operator-selectable baud rates, seven or eight data bits, one or two stop bits, and selectable odd, even or no parity. Refer to the 9010A Operator Manual for connection and operating details.

### 001-3. THEORY OF OPERATION

#### 001-4. UART Control

001-5. The RS-232 Interface (Option -001) provides a standard communications interface port. The interface contains a UART (universal asynchronous receiver/transmitter) which performs the necessary parallel-to-serial and serial-to-parallel data conversion, and inserts stop bits and parity coding. Figure 001-1 shows that the data input lines (T0-T7) are connected via tri-state buffer U7 to the data bus. This buffer is constantly enabled. The status output lines: parity error (PE); framing error (FE); overrun error (DE); data received (DR); transmit buffer empty (TBE); and transmit register empty (TRE) are all buffered to the data bus via tri-state buffer U8. In addition to the six status lines, U8 always sends the upper bit (b7) low and the next bit (b6) high when a read status is performed. These two bits are used by the main microprocessor to detect the presence of the option card. The data output lines, and the status output lines of the UART, U1, are all connected to the microprocessor data bus, D0 - D7.

001-6. The microprocessor selects/addresses UART functions by means of the  $\overline{I/O7}$  output of the I/O selector (described in Section 3) in conjunction with address lines A0 and A1, and the  $\overline{WR}$  (write) line. To read the UART

status on six lines (D0-D5) of the data bus, the microprocessor makes address line A0 low, and  $\overline{I/O7}$  low, which enables U8 to place status on the bus. The UART reset line is tied to the mainframe Reset line via U4. In addition the DR (Data Received) line is tied via U4 to INT (interrupt) line for use in the 9020 mainframe only.

#### NOTE

*Refer to Table 001-1 for a list of addressing protocol for the RS-232 Interface Assembly.*

001-7. The TBRL (transit buffer register load) input of the UART is made low whenever the microprocessor issues a  $\overline{WR}$  (write) and the  $\overline{I/O7}$  line is low. A low TBRL input loads the data byte present on the data input lines T0-T7 into the transmit buffer of the UART. The UART then transmits the byte in serial fashion via the TRO (transmitter register output) output.

001-8. The RRD (receiver register disable) input of the UART is held high by a high A1 address line whenever the microprocessor performs a write to the UART, or when the  $\overline{I/O7}$  line is high. The high RRD input holds the UART data outputs (R0-R7) (to the data bus) in the high impedance state, allowing the UART data inputs (via U7) to accept write data placed on the data bus by the microprocessor or to be off when no UART transactions are taking place.

001-9. The  $\overline{DRR}$  (data register reset) input of the UART is made low by a low A1 address line and a low  $\overline{I/O7}$  whenever the microprocessor performs a read from the UART. The low DRR input notifies the UART that a read by the microprocessor has been performed. The UART resets its receive data register (connected to the data bus) and loads it with the next byte of serial data received via the RRI (receive register input) input.

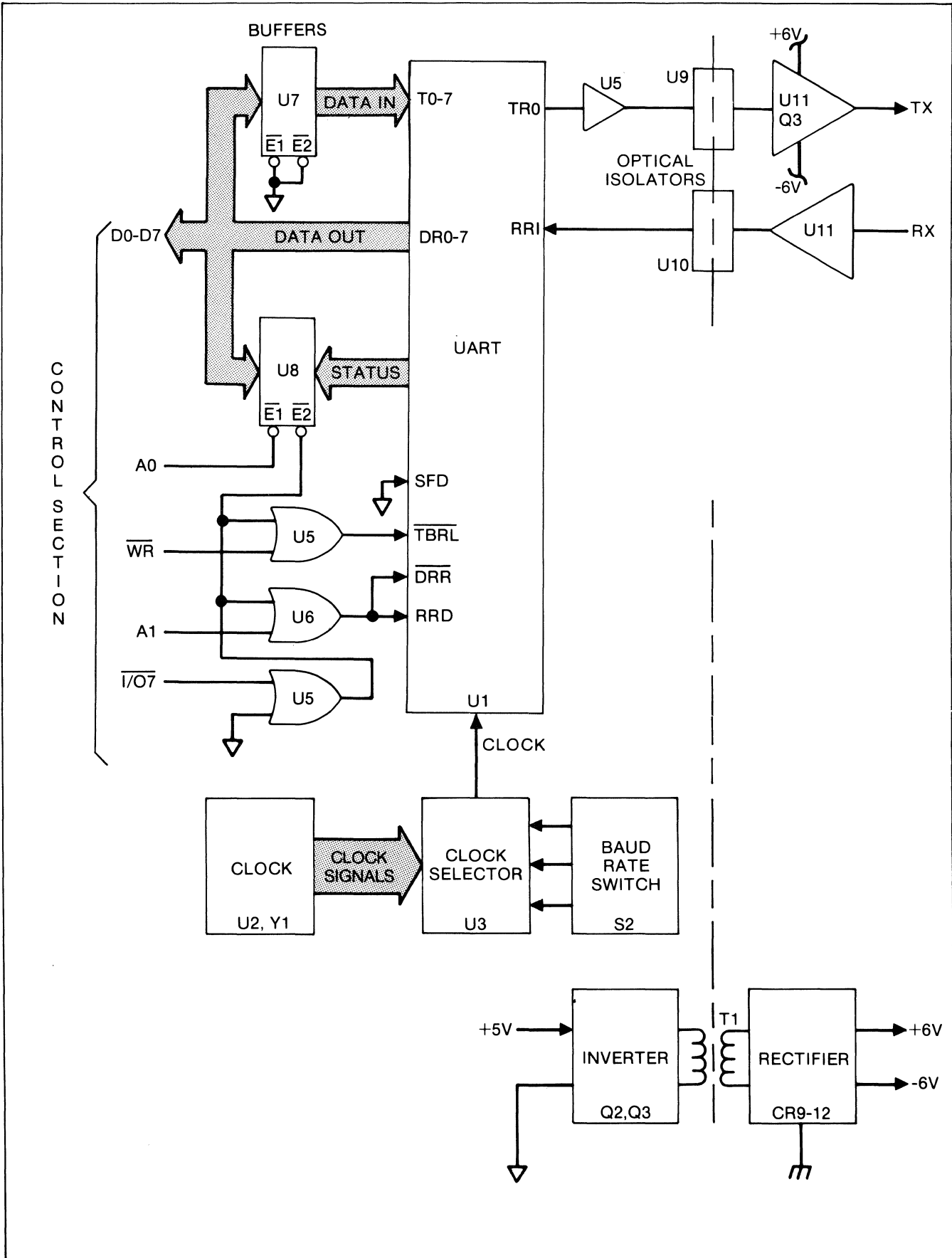


Figure 001-1. RS-232 Interface

**Table 001-1. RS-232 Interface Protocol**

ADDRESS	DATA	WRITE/READ	FUNCTION PERFORMED
100E1	Any	Read	Reads data received by the interface.
100E3	Any	Write	Writes data to be transmitted by the interface.
100E2	bbbbbbbb (binary)	Read	Causes the interface to respond with a bbbbbbbb status byte as follows:  bbbbbbbb xxxxxxx1 = Parity error xxxxxx1x = Framing error xxxxx1xx = Overrun error xxx1xxx = Data received xxx1xxxx = Transmit buffer empty

**001-10. UART Clock**

001-11. Clock generator U2, in conjunction with crystal Y1, provides an array of clock signals required for operation at baud rates of 110 to 9600. Clock selector U3 receives all clock signals and, under control of the baud rate switch S2, connects the required clock signal to the UART. The clock signal into the UART is 16 times the selected baud rate. Switch S1 is used to select parity (PI), 1 or 2 stop bits (SBS), 7 or 8 bit communication (CLS1), and even or odd parity (EPE).

**001-12. Line Driver/Receiver**

001-13. Driver U5 feeds the serial output of the UART to optical isolator U9. The optical isolator provides a guard crossing to the line driver made up of Q3, U11 and associated components. The line driver utilizes +6 volt and -6 volt supplies to provide +6V and -6V output levels to meet RS-232 signal requirements. The line driver output connects to the TX (transmit) line of the RS-232 connector.

001-14. The RX (receive) line of the RS-232 connector connects to the line receiver U11. The line receiver drives optical isolator U10 to cross the guard and apply received data to the RRI (receiver register in) input of the UART.

**001-15. Six-Volt Supply**

001-16. A +6 volt and -6 volt supply provides the power necessary for the line driver and line receiver to transmit and receive data under RS-232 requirements. The supply comprises an inverter, the output of which is transformer coupled across the guard to a full-wave rectifier. The rectifier provides filtered +6 volt and -6 volt outputs.

**001-17. Performance Checks**

001-18. To perform checks on the RS-232 interface, gain access to the PCB assembly by removing the seven cover-retaining screws, and removing the cover. The location of the RS-232 interface PCB assembly is shown in Figure 4-7. Proceed as follows:

1. Verify the correct signal period (and a 50% duty cycle) for each setting of the baud rate switch, S2, in accordance with Table 001-2. Use an oscilloscope with a X10 probe connected to the clock input of the UART (universal asynchronous receiver/transmitter), pin 40 of U1 on the RS-232 interface PCB assembly.

*NOTE*

*The frequency and period of the clock signal at pin 21 of U2 is 1.8432 MHz and 543 nanoseconds respectively.*

2. Verify the presence of +6 volts across filter capacitor C5 and -6 volts across filter capacitor C4, both on the RS-232 Interface PCB Assembly.

3. Verify the proper operation of the RS-232 Interface by performing the following:

a. Disable the watchdog timer (U31 on the main assembly) by jumpering C16/R14 to TP12 (ground). This removes the reset input from the RS-232 interface assembly and allows it to operate.

b. Jumper pins 2 and 3 of the RS-232 connector to loop the transmit line back to the receive line.

c. Key-in programs 8, 7, 12, 13, and 16 listed in Table 001-3 and execute program 8. The program writes and reads data while verifying accuracy and correct status reporting.

001-19. If any of the performance or program checks fail, proceed as follows:

1. Swap the UART (U1) with a known-good device and rerun the program.



Table 001-2. Clock Signal Frequencies and Periods

SWITCH (S2) SETTING	BAUD RATE	FREQUENCY	PERIOD (APPROX)
0,8	110	1760 Hz	568 $\mu$ s
1,9	150	2400 Hz	417 $\mu$ s
2	300	4800 Hz	208 $\mu$ s
3	600	9600 Hz	104 $\mu$ s
4	1200	19.2 kHz	52 $\mu$ s
5	2400	38.4 kHz	26 $\mu$ s
6	4800	76.8 kHz	13 $\mu$ s
7	9600	153.6 kHz	6.5 $\mu$ s

2. Remove the jumper from pins 2 and 3 of the RS-232 connector. Jumper pins 20 and 25 of the UART (U1) to bypass the output buffers, isolators, and line receiver. Rerun the program; if the program passes, a problem is indicated in the output buffers, isolators, or line receiver.

3. Verify closures of parameter switches (S1) at pins 35, 36, 38, and 39 of the UART, U1 using the

tester 9010A probe in the free-running mode. Switches in the left (as viewed from the rear of the UUT) or open position should produce a logic high indication at the associated U1 pin. Refer to the schematic diagram contained in Section 8 for switch and UART pin relationships.

4. When prompted by the program, examine the opto-isolator circuits with an oscilloscope to verify that transmit data reaches the RS-232 connector at  $\pm 6$ -volt levels, and that received data reaches the UART (U1). Use signal ground (A5J2-5) for the common lead of the oscilloscope when checking at the RS-232C connector, and the 9010A ground when checking the UART.

#### 001-19. LIST OF REPLACEABLE PARTS

001-20. A list of replaceable parts for the RS-232 Interface is given in Table 001-4. Refer to Section 5 of this manual for ordering information.

#### CAUTION

\*

Indicated devices are subject to damage by static discharge.

Table 001-3. RS-232 Test

PROGRAM LISTING	COMMENTS
PROGRAM 8    1352 BYTES  DPY-RS-232 TEST# EXECUTE PROGRAM 12 DPY-JUMP R14//C16 TO TP2 OR TP1 DPY-+2-CONT# STOP DPY-#SET PARITY ON, ODD; CONT STOP DPY-#SET 8 BITS, 1 STOP BIT; DPY-+CONT STOP DPY-#SET BAUD RATE = 9600, CONT STOP DPY-JUMPER RS232 PIN 2 TO 3#, DPY-+CONT STOP DPY-#MASTER CLEAR TEST EXECUTE PROGRAM 12 REG4 = 7000000 SYNC FREE-RUN DPY-POWER OFF UUT, PROBE U1-21, DPY-+ CONT STOP READ PROBE	delay disable watchdog timer  rs-232 setup  level mask - all states

Table 001-3. RS-232 Test (cont)

PROGRAM LISTING	COMMENTS
<pre> DPY-POWER ON UUT, CONT# STOP READ PROBE IF REG4 &gt; REG0 AND REG4 GOTO D 0: LABEL 0 DPY-XMIT BUFFER STATUS TEST# EXECUTE PROGRAM 13 READ @ 100E2 IF REGE AND 10 = 10 GOTO 1 DPY-XMIT BUFFER FULL GOTO E 1: LABEL 1 DPY-DATA RECV'D STATUS TEST# EXECUTE PROGRAM 13 READ @ 100E1  READ @ 100E2 IF REGE AND 8 = 0 GOTO 2 DPY-DATA RECV'D-NONE SENT- GOTO E 2: LABEL 2 DPY-OVERRUN STATUS TEST# EXECUTE PROGRAM 13 REGB = 10 REG1 = 55 EXECUTE PROGRAM 16 WRITE @ 100E3 = REG1 EXECUTE PROGRAM 16 WRITE @ 100E3 = REG1  EXECUTE PROGRAM 12 READ @ 100E2 IF REGE AND 4 = 4 GOTO 3 DPY-OVERRUN STATUS GOTO E 3: LABEL 3 DPY-DATA XMIT//REC'D TEST# EXECUTE PROGRAM 13 READ @ 100E1 IF REGE = REG1 GOTO 4 GOTO C 4: LABEL 4 REG1 = AA REGB = 10 EXECUTE PROGRAM 16 WRITE @ 100E3 = REG1 EXECUTE PROGRAM 12 READ @ 100E1 IF REGE = REG1 GOTO F GOTO C </pre>	<pre> check for low, invalid and high  delay read rs-232 status ready for character? not ready - should be - display error message  delay read data (clear any character in buffer) read status check for no character received  error - char. sent  ready for char. mask  wait until ready for char. write 55 to rs232 wait until ready for char. write 55 to rs232  delay read rs-232 status check for overrun status  no overrun error  delay read rs-232 data is data a 55? data error  wait till ready for character send an aa delay read rs-232 data if data = aa goto F data error </pre>

Table 001-3. RS-232 Test (cont)

PROGRAM LISTING	COMMENTS
<pre> 5: LABEL 5   SYNC FREE-RUN   DPY-PROBE U1-1,34,37-HIGH?0   IF REGO = 0 GOTO E   DPY-PROBE U1-3,16-ALL LOW?0   IF REGO = 0 GOTO E   DPY-PROBE U1-17,40-HI//LOW?0   IF REGO = 0 GOTO E   DPY-#UART CONTROL TEST   EXECUTE PROGRAM 12   SYNC ADDRESS   REGB = 1   DPY-#PROBE U1-23 - CONT   STOP   REGA = 300   EXECUTE PROGRAM 7   IF REGA = 0 GOTO E   REGB = 2   DPY-#PROBE U1-4 - CONT   STOP   REGA = 600   EXECUTE PROGRAM 7   IF REGA = 0 GOTO E   REGB = 3   DPY-#PROBE U1-18 - CONT   STOP   REGA = 600   EXECUTE PROGRAM 7   IF REGA = 0 GOTO E   DPY-#UART TRANSMIT TEST   EXECUTE PROGRAM 12   DPY-PROBE U1-25 - CONT   STOP   REGA = 4   EXECUTE PROGRAM 7   IF REGA = 0 GOTO 6   GOTO A </pre>	<pre> check pins for logic high error - goto e check pins for logic low error - goto e check pins for toggle error - goto e  delay  u1-23 test pointer probe - tbrl  expected sig = 300 gather sig error u1-4 test pointer  expected sig gather sig error u1-18 test pointer  expected sig. gather sig error  delay  expected event count = 4 gather count error </pre>
<pre> 6: LABEL 6   DPY-#U1-25 TRANSMIT ERROR - CON   DPY-+T   STOP   GOTO F </pre>	
<pre> A: LABEL A   SYNC FREE-RUN   DPY-#BAD ITEM NOT FOUND;   EXECUTE PROGRAM 13   DPY-#USE A SCOPE TO CHECK INPUT   DPY-+ AND   EXECUTE PROGRAM 13   DPY-#OUTPUT OPTO ISOLATORS.   EXECUTE PROGRAM 13   DPY-A 55 IS BEING SENT CONTINUO   DPY-+SLY# </pre>	<pre> no problem found - prompt user  to use a scope to check  opto - isolators. </pre>

Table 001-3. RS-232 Test (cont)

PROGRAM LISTING	COMMENTS
<pre> EXECUTE PROGRAM 13 REGO = 40 DPY-#HIT CLEAR//NO TO END TEST DPY-+%0 B: LABEL B IF REGO = 1D GOTO F WRITE @ 100E3 = 55 GOTO B C: LABEL C DPY-DATA ERROR-SENT \$1-REC'D \$E DPY-+-CONT# STOP GOTO 5 E: LABEL E DPY-+ ERROR-CONT# STOP GOTO 5 D: LABEL D DPY-#BAD MASTER CLEAR, CONT STOP GOTO F F: LABEL F DPY-#END RS-232-C TEST </pre>	<pre> look for clear/no key send a 55 to rs-232  error messages </pre>
<pre> PROGRAM 7    172 BYTES  READ PROBE WRITE @ 100E3 = AA READ @ 100E2 READ @ 100E1 READ PROBE REG1 = REGO AND 7000000 REG2 = REGO AND FFFF00 REG3 = REGO AND 7F IF REG1 = REGA GOTO A IF REG2 = REGA GOTO A IF REG3 = REGA GOTO A REGA = 0 GOTO B A: LABEL A REGA = 1 GOTO B B: LABEL B IF REGB = 1 GOTO C IF REGB = 2 GOTO D IF REGB = 3 GOTO E C: LABEL C DPY-U1-23 GOTO F D: LABEL D DPY-U1-4 GOTO F E: LABEL E DPY-U1-18 F: LABEL F </pre>	<pre> read probe for rs232 checks  clear sig, counter, logic level write aa to rs-232 uart read status read data  logic level = reg1 sig = reg 2 count = reg 3  look for expected data - rega = 1, 2, or 3 error flag - rega = 0  check for u1-23 flag check for u1-4 flag check for u1-18 flag </pre>

Table 001-3. RS-232 Test (cont)

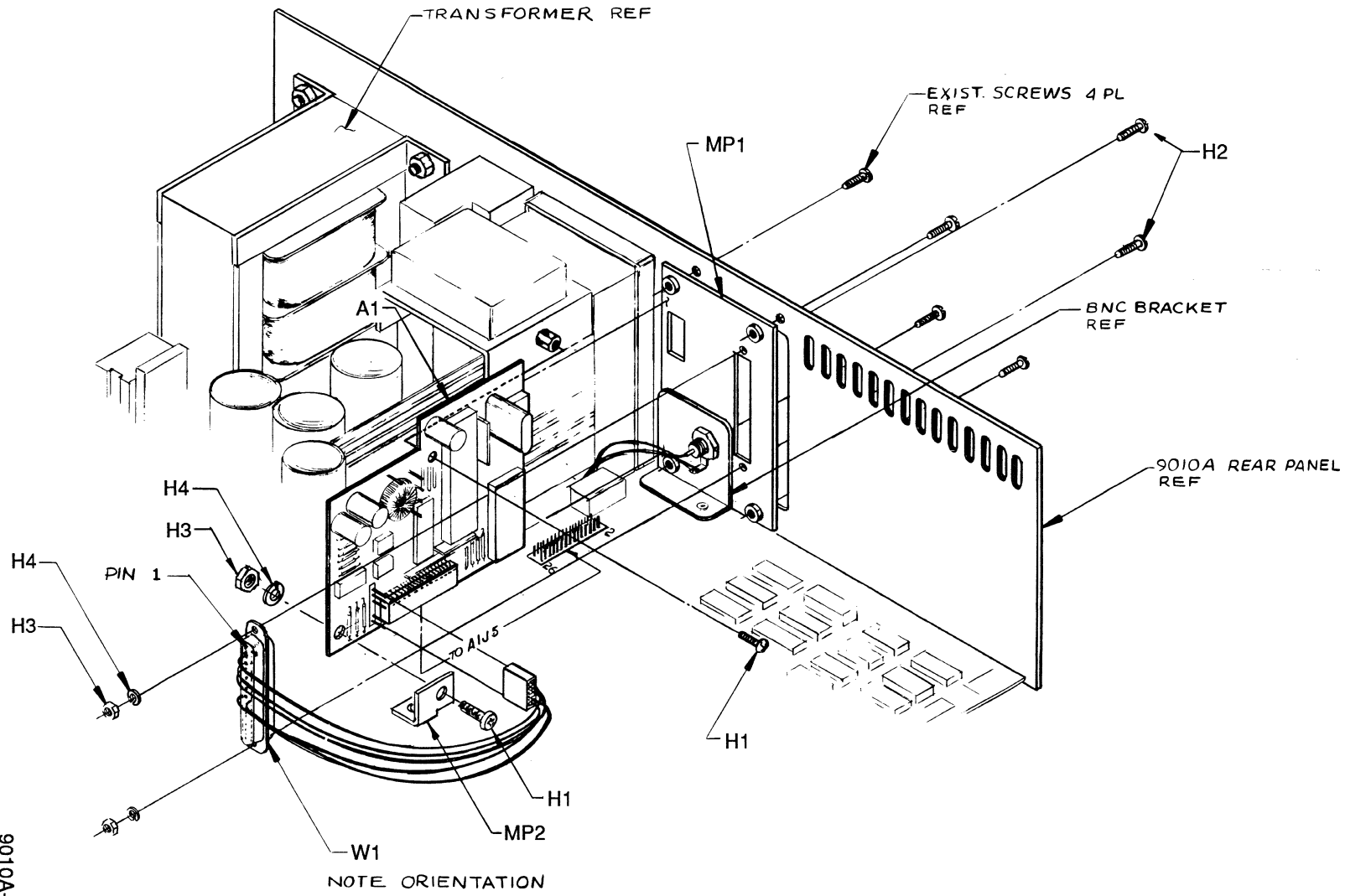
PROGRAM LISTING	COMMENTS
<pre> PROGRAM 12  21 BYTES    REG1 = 40 1: LABEL 1   DEC REG1   IF REG1 &gt; 0 GOTO 1 </pre>	<pre> delay approx. 1 second </pre>
<pre> PROGRAM 13  14 BYTES    EXECUTE PROGRAM 12   EXECUTE PROGRAM 12   EXECUTE PROGRAM 12 </pre>	<pre> delay approx. 3 seconds </pre>
<pre> PROGRAM 16  32 BYTES  0: LABEL 0   READ @ 100E2   IF REGE AND REGB = REGB GOTO F   GOTO 0 F: LABEL F </pre>	<pre> waits for status to match reg b  read status is status = reg b; wait if not </pre>

Table 001-4. Option -001, RS-232 Interface Final Assembly  
(See Figure 001-2.)

REFERENCE DESIGNATOR		FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT	N O T
-A>-NUMERICS----->	S-----DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----	QTY-	-E-
A	5					
		RS-232 INTERFACE PCA	716027	89536 716027		1
H	1	SCREW, MACH, PH, P, STL, 4-40X0.312	152116	73734 19023		2
H	2	SCREW, MACH, PH, P, SS, 4-40X.375	256164	COMMERCIAL		2
H	3	NUT, HEX, S. STL, 4-40	147611	COMMERCIAL		3
H	4	WASHER, LOCK, SPLIT, S STEEL, #4	147603	COMMERCIAL		3
H	5	SPACER, HEX, BR, MALE-FEMALE, 6-32, .625	757427	COMMERCIAL		1
H	6	WASHER, LOCK, SPLIT, STEEL, #6	110692	86928 5727-17		1
MP	1	SUB PANEL, RS232	607168	89536 607168		1
MP	2	BRKT, RS232 PCB MOUNTING	582163	89536 582163		1
W	1	CABLE, RS232	581835	89536 581835		1

An \* in 'S' column indicates a static-sensitive part.

Figure 001-2. Option -001 RS-232 Interface Final Assembly



9010A-001

Table 001-5. A5 RS-232 Interface PCA  
(See Figure 001-3.)

REFERENCE DESIGNATOR			FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T E
-A>-NUMERICS----->	S-----	DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----		-E-
C 1- 3, 8-		CAP, CER, 0.22UF, +-20%, 50V, Z5U	519157	04222	SR205E224MAT	6	
C 10			519157				
C 4, 6, 7		CAP, AL, 47UF, +75-10%, 16V	519561	62643	SL16VB470K8X14LLE	3	
C 5		CAP, CER, 0.01UF, +-20%, 100V, X7R	407361	04222	3419-1000-103M	1	
CR 1- 8	*	DIODE, SI, BV=75V, IO=150MA, 500MW	203323	07910	1N4448	8	
CR 9		DIODE, SI, RECT, BRIDGE, BV=50V, IO=1.0A	418582	14936	DF005M	1	
P 1		SOCKET, 2 ROW, PWB, 0.100C, RT ANG, 26 POS	543512	00779	86063-9	1	
Q 1, 2	*	TRANSISTOR, SI, NPN, SMALL SIGNAL	272237	89536	272237	2	
Q 3	*	TRANSISTOR, SI, PNP, SMALL SIGNAL	195974	04713	2N3906	1	
R 1, 10		RES, CF, 390, +-5%, 0.25W	441543	80031	1-4-5P390E	2	
R 2		RES, CF, 5.6K, +-5%, 0.25W	442350	80031	1-4-5P5K6	1	
R 3		RES, CF, 15K, +-5%, 0.25W	348854	80031	1-4-5P15K	1	
R 4		RES, CF, 47, +-5%, 0.25W	441592	80031	1-4-5P47E	1	
R 5		RES, CC, 15M, +-5%, 0.25W	643528	89536	643528	1	
R 6		RES, CF, 200, +-5%, 0.25W	441451	80031	1-4-5P200E	1	
R 7		RES, CF, 12K, +-5%, 0.25W	348847	80031	1-4-5P12K	1	
R 9, 11		RES, CF, 620, +-5%, 0.25W	442319	80031	1-4-5P620E	2	
R 12		RES, CF, 56K, +-5%, 0.25W	441626	80031	1-4-5P6K	1	
R 13		RES, CF, 3.3K, +-5%, 0.25W	348813	80031	1-4-5P3K3	1	
R 14		RES, CF, 1K, +-5%, 0.25W	343426	59124	CF1-4 102 J B	1	
S 1		SWITCH, DIP, DPST, PIANO, 4 POS	495218	89536	495218	1	
S 2		SWITCH, ROTARY, BCD, 10 POS	495614	89536	495614	1	
T 1		TRANSF, INV, 5VDC, 20KHZ, TOROID	461863	89536	461863	1	
TP 11- 14		TERM, FASTON, TAB, .110, SOLDER	512889	00779	62395-1	4	
U 1	*	IC, CMOS, UNIV ASYNC RECEIVR/TRANSMITER	453464	89536	453464	1	
U 2	*	IC, CMOS, BIT RATE GENERATOR	418921	04713	MC14411P	1	
U 3	*	IC, CMOS, 8-INPUT MUX W/3-STATE OUTPUT	504647	04713	MC14512BCP	1	
U 4	*	IC, LSTTL, QUAD 2 INPUT NAND GATE	393033	04713	SN74LS00N	1	
U 5	*	IC, LSTTL, QUAD 2 INPUT OR GATE	393108	04713	SN74LS32N	1	
U 7, 8	*	IC, LSTTL, OCTAL BUFFER/LINE DRIVER	634105	04713	SN74LS541N	2	
U 9, 10	*	ISOLATOR, OPTO, HI-SPEED, LED TO XSISTOR	407742	89536	407742	2	
U 11	*	IC, ARRAY, 5 TRANS, NPN, 3 ISO, 2 DIFF CON	248906	04713	MC3346P	1	
XU 1		SOCKET, IC, 40 PIN	429282	00779	2-640379-1	1	
XU 2		SOCKET, IC, 24 PIN	376236	91506	224-AG39D	1	
Y 1		CRYSTAL, 1.8432MHZ, +-0.01%, HC-6/U	424184	89536	424184	1	
Z 1		RES, NET, SIP, 10 PIN, 9 RES, 47K, +-2%	485193	89536	485193	1	

An \* in 'S' column indicates a static-sensitive part.



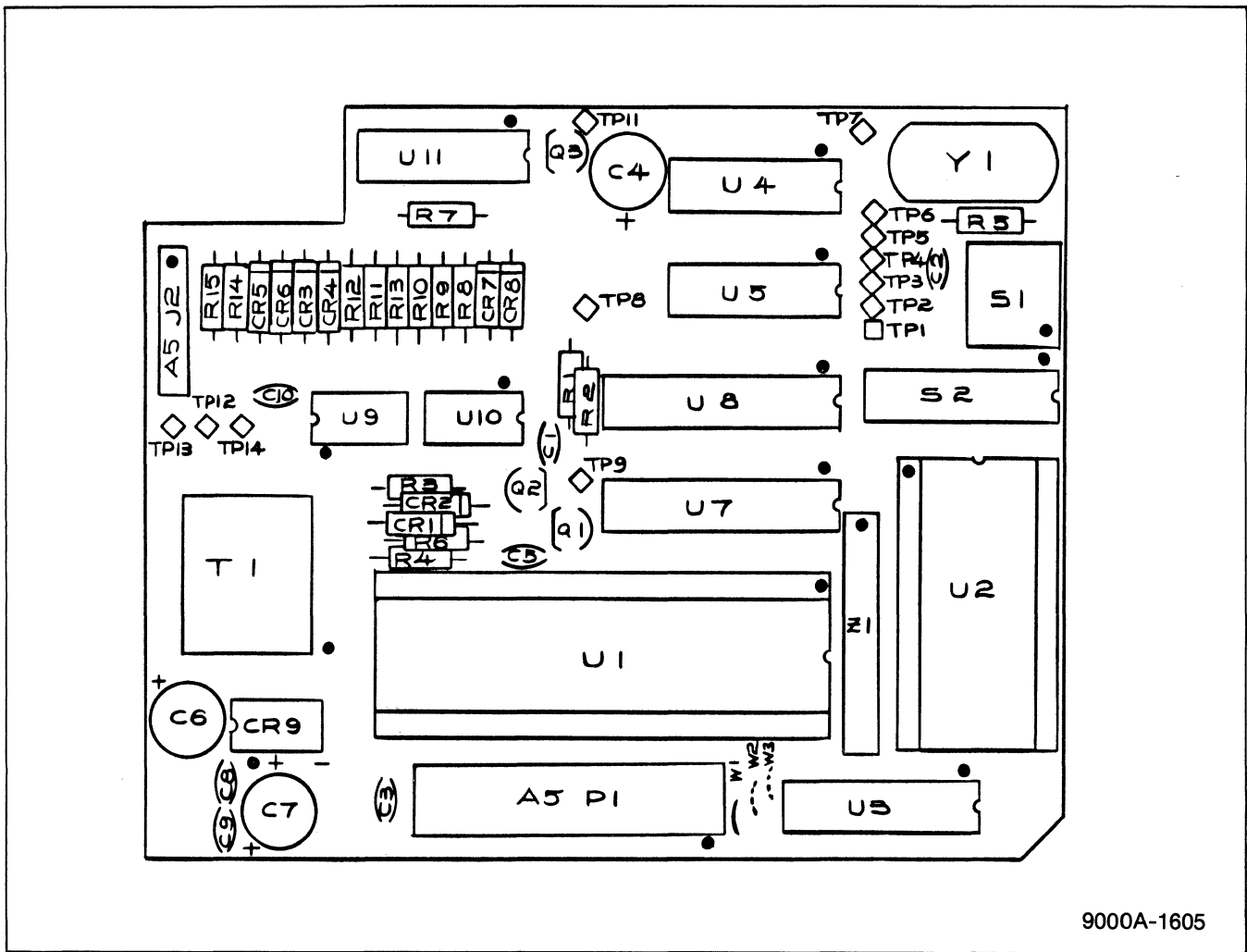


Figure 001-3. A5 RS-232 Interface PCA

## Section 7

# General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

## Federal Supply Codes for Manufacturers

D9816 Westermann Wilhelm Augusta-Anlage Mannheim-Nackarau Germany	01101 Wabash Inc (Formerly Wabash Magnetics) Wabash, IN	02697 Parker-Hannifin Corp. O-Ring Div Lexington, KY	04423 Telonic Berkley Inc. Laguna Beach, CA
S0482 Sony Corp. Tokyo, Japan	01121 Allen Bradley Co. Milwaukee, WI	02735 RCA-Solid State Div. Somerville, NJ	04713 Motorola Inc. Semiconductor Group Phoenix, AZ
S3774 Oshino Electric Lamp Works Tokoyo, Japan	01281 TRW Electronics & Defense Sector R F Devices Lawndale, CA	02768 ITW (IL Tool Works) Fastex Division Des Plaines, IL	04946 Standard Wire and Cable Rancho Dominguez, CA
0AD86 IN General El Paso, TX	01295 TX Instruments Inc. Semiconductor Group Dallas, TX	02799 Arco Electronics Inc. Chatsworth, CA	05173 General Radio NY,NY. Replaced by:
0AE89 Autosplice Inc. Woodside, NY	01526 Genicom Waynesboro, VA	03296 Nylon Molding Corp. Monrovia, CA	24655 Genrad,INC. Concord, MA
0BW21 Noritake Co. Inc. Burlington, MA	01537 Motorola Communications & Electronics Inc. Franklin Park, IL	03445 Leroon Electronics Inc Burbank, CA	05236 Jonathan Mfg. Co. Fullerton, CA
0ANF0 Topaz Semiconductor Inc San Jose, CA	01686 RCL Electronics/Shallcross Inc. Electro Components Div. Manchester, NH	03508 General Electric Co. Semiconductor Products & Batteries Auburn, NY	05245 Corcom Inc. Libertyville, IL
0DSM7 Conductive (Pkg) Containers Inc. Brookfield, WI	01884 Sprague Electric Co. (Now 56289)	03797 Genisco Technology Corp. Eltronics Div. Rancho Dominguez, CA	05276 ITT Pomona Electronics Div. Pomona, CA
0CLN7 Emhart Fastening Group Shelton, CT	01961 Varian Associates Inc. Pulse Engineering Div. Convoy, CT	03877 Gilbert Engineering Co.Inc Incon Sub of Transitron Electronic Corp. Glendale, AZ	05277 Westinghouse Elec. Corp. Semiconductor Div. Youngwood, PA
0FB81 S-Mos Systems Inc. San Jose, CA	01963 Cherry Electrical Products Corp Waukegan, IL	03888 KDI Electronics Inc. Pyrofilm Div. Whippany, NJ	05347 Ultronix Inc Grand Junction, CO
0FFP1 Eveready LTD Ever Ready Special Battery Div. Dawley Telford Salop UK	02111 Spectrol Electronics Corp. City of Industry, CA	03911 Clairex Corp. Clairex Electronics Div. Mount Vernon, NY	05397 Union Carbide Corp. Materials Systems Div. Cleveland. OH
00199 Marcon Electronics Corp Keamy, NJ	02114 Amperex Electronic Corp. Ferrox Cube Div. Saugerties, NY	03980 Muirhead Inc. Mountainside, NJ	05571 Sprague Electric Co. (Now 56289)
00213 Nytronics Comp. Group Inc. Darrington, NC	02131 General Instrument Corp. Government Systems Div. Westwood, MA	04009 Cooper Industries, Inc. Arrow Hart Div. Hartford, CT	05574 Viking Connectors Inc Sub of Ctron Corp. Chatsworth, CA
00327 Welwyn International Inc. Westlake, OH	02395 Sonar Radio Corp. Hollywood, FL	04217 Essex International Inc. Wire & Cable Div. Anaheim, CA	05791 LYN-TRON Burbank, CA
00656 Aerovox Corp. New Bedford, MA	02533 Leigh Instruments Ltd. Frequency Control Div. Don Mills, Ontario, Canada	04221 Midland-Ross Corp. Midtex Div. N. Mankato, MN	05820 EG & G Wakefield Engineering Wakefield, MA
00686 Film Capacitors Inc. Passaic, NJ	02606 Fenwal Labs Division of Travenal Labs Morton Grove, IL	04222 AVX Corp. AVX Ceramics Div. Myrtle Beach, SC	05839 Advance Electrical Chicago, IL
00779 AMP, Inc. Harrisburg, Pennsylvania	02660 Bunker Ramo-Eltra Corp. Amphenol NA Div. Broadview, IL		05972 Loctite Corp. Newington, CT
00853 Sangamo Weston Inc Components Div Pickens, NC			
01091 Allied Plastics Co. Los Angeles, CA			

## Federal Supply Codes for Manufacturers (cont)

06001 General Electric Co. Electric Capacitor Product Section Columbia, SC	07047 Ross Milton Co., The Southampton, PA	08111 MF Electronics New Rochelle, NY	1B715 (United Shoe & Nylock Corp) -Nylock Fastener Corp.- Paramus, NJ
06141 Fairchild Weston Systems Inc. Data Systems Div. Sarasota, FL	07138 Westinghouse Electric Corp. Industrial & Government Tube Div. Horseheads, NY	08235 Industro Transistor Corp. Long Island City, NY	10059 Barker Engineering Corp. Kenilworth, NJ
06192 La Deau Mfg. Co. Glendale, CA	07233 Benchmark Technology Inc. City of Industry, CA	08261 Spectra-Strip An Eltra Co. Garden Grove, CA	10389 IL Tool Works Inc. Licon Div. Chicago, IL
06229 Electrovert Inc. Elmsford, NY	07239 Biddle Instruments Blue Bell, PA	08445 Electri-Cord Mfg., Inc Westfield, PA	11236 CTS Corp. Resistor Products Div. Beme, IN
06383 Panduit Corp. Tinley Park, IL	07256 Silicon Transistor Corp. Sub of BBF Inc. Chelmsford, MA	08530 Reliance Mica Corp. Brooklyn, NY	11237 CTS Corp of CA Electro Mechanical Div. Paso Robles, CA
06473 Bunker Ramo Corp. Amphenol NA Div. SAMS Operation Chatsworth, CA	07261 Avnet Corp. Culver City, CA	08718 ITT Cannon Electric Phoenix Div. Phoenix, AZ	11295 ECM Motor Co. Schaumburg, IL
06540 Mite Corp Amatom-Electrical Div	07263 Fairchild Semiconductor North American Sales Ridgeview, CT	08806 General Electric Co. Miniature Lamp Products Cleveland, OH	11358 Columbia Broadcasting System CBS Electronic Div. Newburyport, MA
06555 Beede Electrical Instrument Penacook, NH	07344 Bircher Co. Inc., The Rochester, NY	08863 Nylomatic Fallsington, PA	11403 Vacuum Can Co. Best Coffee Maker Div. Chicago, IL
06665 Precision Monolithics Sub of Boums Inc. Santa Clara, CA	07374 Optron Corp Woodbridge, CT	08988 Skottie Electronics Inc. Archbald, PA	11502 (can also use 35009) TRW Inc. TRW Resistive Products Div. Boone, NC
06666 General Devices Co. Inc. INpolis, IN	07557 Campion Co. Inc. Philadelphia, PA	09021 Airco Inc. Airco Electronics Bradford, PA	11503 Keystone Columbia Inc. Freemont, IN
06739 Electron Corp. Littleton, CO	07597 Bumdy Corp. Tape/Cable Div. Rochester, NY	09023 Cornell-Dublier Electronics Fuquay-Varina, NC	11532 Teledyne Relays Teledyne Industries Inc. Hawthorne, CA
06743 Gould Inc. Foil Div. Eastlake, OH	07716 TRW Inc. (Can use 11502) IRC Fixed Resistors/ Burlington Burlington, VT	09214 General Electric Co. Semiconductor Products Dept. Auburn, NY	11711 General Instrument Corp. Rectifier Div. Hicksville, NY
06751 Components Inc. Semcor Div. Phoenix, AZ	07792 Lema Engineering Corp. Northampton, MA	09353 C and K Components Inc. Newton, MA	11726 Qualidyne Corp. Santa Clara, CA
06776 Robinson Nugent Inc. New Albany, IN	07810 Bock Corp. Madison, WI	09423 Scientific Components Inc. Santa Barbara, CA	12014 Chicago Rivet & Machine Co. Naperville, IL
06915 Richco Plastic Co. Chicago, IL	07910 Teledyne Semiconductor Mtn. View, CA	09922 Bumdy Corp. Norwalk, CT	12020 Ovensaire Div. of Electronic Technologies Charlottesville, VA
06961 Vernitron Corp. Piezo Electric Div. Bedford, OH	07933 Raytheon Co. Semiconductor Div. Mountain View, CA	09969 Dale Electronics Inc. Yankton, SD	12038 Simco (Div of Ransburg Corp) Hatfield, PA
06980 EIMAC (See Varian) San Carlos, CA	08FG6 Calmos Systems Inc. Kanata, Ont. Canada	09975 Burroughs Corp. Electronics Components Detroit, MI	12040 National Semiconductor Corp. Danbury, CT
	080A9 Dallas Semiconductor Dallas, TX	1A791 LFE Electronics Danvers, MA	

## Federal Supply Codes for Manufacturers (cont)

12060 Diodes Inc. Northridge, CA	13050 Potter Co. Wesson, MS	14704 Crydom Controls (Division of Int Rectifier) El Segundo, CA	16473 Cambridge Scientific Industries Div. of Chemed Corp. Cambridge, MD
12136 PHC Industries Inc. Formerly Philadelphia Handle Co. Camden, NJ	13103 Thermalloy Co., Inc. Dallas, TX	14752 Electro Cube Inc. San Gabriel, CA	16733 Cablewave Systems Inc. North Haven, CT
12300 AMF Canada Ltd. Potter-Brumfield Guelph, Ontario, Canada	13327 Solitron Devices Inc. Tappan, NY	14936 General Instrument Corp. Discrete Semi Conductor Div. Hicksville, NY	16742 Paramount Plastics Fabricators Inc. Downey, CA
12323 Practical Automation Inc. Shelton, CT	13511 Bunker-Ramo Corp. Amphenol Cadre Div. Los Gatos, CA	14949 Trompeter Electronics Chatsworth, CA	16758 General Motors Corp. Delco Electronics Div. Kokomo, IN
12327 Freeway Corp. Cleveland, OH	13606 Sprague Electric Co. (Use 56289)	15412 Amtron Midlothian, IL	17069 Circuit Structures Lab Burbank, CA
12406 Elpac Electronics Inc. Santa Ana, CA	13689 SPS Technologies Inc. Hatfield, NJ	15542 Scientific Components Corp. Mini-Circuits Laboratory Div. Brooklyn, NY	17117 Electronic Molding Corp. Woonsocket, RI
12443 Budd Co.,The Plastics Products Div. Phoenixville, PA	13764 Micro Plastics Flippin, AZ	15636 Elec-Trol Inc. Saugus, CA	17338 High Pressure Eng. Co. Inc. OK City, OK
12581 Hitachi Metals International Ltd. Hitachi Magna-Lock Div. Big Rapids, MO	13919 Burr-Brown Research Corp. Tucson, AZ	15782 Bausch & Lomb Inc. Graphics & Control Div. Austin, TX	17504 Aluminum Filter Co. Carpinteria, CA
12615 US Terminals Inc. Cincinnati, OH	14099 Semtech Corp. Newbury Park, CA	15801 Fenwal Electronics Inc. Div. of Kidde Inc. Framingham, MA	17545 Atlantic Semiconductors Inc. Asbury Park, NJ
12617 Hamlin Inc. LaKe Mills, WI	14140 McGray-Edison Co. Commercial Development Div. Manchester, NH	15818 Teledyne Inc. Co. Teledyne Semiconductor Div. Mountain View, CA	17745 Angstrom Precision, Inc. Hagerstown, MD
12673 Wesco Electrical Greenfield, MA	14189 Ortronics, Inc. Orlando, FL	15849 Useco Inc. (Now 88245)	17856 Siliconix Inc. Santa Clara, CA
12697 Clarostat Mfg. Co. Inc. Dover, NH	14193 Cal-R-Inc. Santa Monica, CA	15898 International Business Machines Corp. Essex Junction, VT	18178 E G & Gvactee Inc. St. Louis, MO
12749 James Electronic Inc. Chicago, IL	14301 Anderson Electronics Hollidaysburg, PA	16068 International Diode Div. Harrison, NJ	18235 KRL/Bantry Components Inc. Manchester, NH
12856 MicroMetals Inc. Anaheim, CA	14329 Wells Electronics Inc. South Bend, IN	16162 MMI Southfield, MI	18310 Concord Electronics New York, NY
12881 Metex Corp. Edison, NJ	14482 Watkins-Johnson Co. Palo Alto, CA	16245 Conap Inc. Olean, NY	18324 Signetics Corp. Sacramento, CA
12895 Cleveland Electric Motor Co. Cleveland, OH	14552 Microsemi Corp. (Formerly Micro-Semiconductor) Santa Ana, CA	16258 Space-Lok Inc. Burbank, CA	18377 Parflex Corp. Methuen, MA
12954 Microsemi Corp. Components Group Scottsdale, AZ	14604 Elmwood Sensors, Inc Pawtucket, RI	16352 Codi Corp. Linden, NJ	18520 Sharp Electronics Corp. Paramus, NJ
12969 Unitrode Corp. Lexington, MA	14655 Cornell-Dublier Electronics Div. of Federal Pacific Electric Co. Govt Cont Dept. Newark, NJ	16469 MCL Inc. LaGrange, IL	18542 Wabash Inc. Wabash Relay & Electronics Div. Wabash, IN

## Federal Supply Codes for Manufacturers (cont)

18565 Chomerics Inc. Woburn, MA	2Y384 North American Philips Lighting Corp. Van Wert, OH	23732 Tracor Applied Sciences Inc. Rockville, MD	26402 Lumex, Inc. Bayshore, NY
18612 Vishay Intertechnology Inc. Vishay Resistor Products Group Malvern, PA	20584 Enochs Mfg. Inc. INpolis, IN	23880 Stanford Applied Engineering Santa Clara, CA	26629 Frequency Sources Inc. Sources Div. Chelmsford, MA
18632 Norton-Chemplast Santa Monica, CA	20891 Cosar Corp. Dallas, TX	23936 William J. Purdy Co. Pamotor Div. Burlingame, CA	26806 American Zettler Inc. Irvine, CA
18677 Scanbe Mfg. Co. Div. of Zero Corp. El Monte, CA	21317 Electronics Applications Co. El Monte, CA	24347 Penn Engineering Co. S. El Monte, CA	27014 National Semiconductor Corp. Santa Clara, CA
18736 Voltronics Corp. East Hanover, NJ	21604 Buckeye Stamping Co. Columbus, OH	24355 Analog Devices Inc. Norwood, MA	27167 Corning Glass Works Corning Electronics Wilmington, NC
18786 Micro-Power Long Island City, NY	21845 Solitron Devices Inc. Semiconductor Group Rivera Beach, FL	24444 General Semiconductor Industries, Inc. Tempe, AZ	27264 Molex Inc. Lisle, IL
18927 GTE Products Corp. Precision Material Products Business Parts Div. Titusville, PA	21847 Aertech Now TRW Microwave Inc. Sunnyvale, CA	24546 Bradford Electronics Bradford, PA	27440 Industrial Screw Products Los Angeles, CA
19080 Robinson Electronics Inc. San Luis Obispo, CA	21962 Vectron Corp. Replaced by: S.W. Electronics	24618 Transcon Mfg. Now: D.J. Associates Inc.	27494 Staffall, Inc. Providence, RI
19112 Garry Corp. Langhorne, PA	22526 DuPont, EI DeNemours & Co. Inc. DuPont Connector Systems Advanced Products Div. New Cumberland, PA	24655 Genrad Inc. (Replaced General Radio 05173) Concord, MA	27745 Associated Spring Bames Group Inc. Syracuse, NY
19315 Bendix Corp., The Navigation & Control Group Terboro, NJ	22626 Micro Semiconductor (Now 14552)	24759 Lenox-Fugle Electronics Inc. South Plainfield, NJ	27918 Component Parts Corp. Bellmore, NY
19451 Perine Machine Tool Corp. Kent, WA	22670 GM Nameplate Seattle, WA	24796 AMF Inc. Potter & Brumfield Div. San Juan Capistrano, CA	27956 Relcom (Now 14482)
19482 Delta Electronics Alexandria, VA	22767 ITT Semiconductors Palo Alto, CA	24931 Specialty Connector Co. Greenwood, IN	28175 Alpha Metals Chicago, IL
19613 MN Mining & Mfg. Co. Textool Products Dept. Electronic Product Div. Irving, TX	22784 Palmer Inc. Cleveland, OH	24995 ECS Grants Pass, OR	28198 Positronic Industries Springfield, MO
19647 Caddock Electronics Inc. Riverside, CA	23050 Product Comp. Corp. Mount Vernon, NY	25088 Siemen Corp. Isilen, NJ	28213 MN Mining & Mfg. Co. Consumer Products Div. 3M Center Saint Paul, MN
19701 Mepco/Centralab Inc. A N. American Philips Co. Mineral Wells, TX	23223 CTS Microelectronics Lafayette, NY	25099 Cascade Gasket Kent, WA	28309 Kaiser Minette, AL
2B178 Wire Products Cleveland, OH	23237 I.R.C., Inc. Microcircuits Division Philadelphia, PA	25403 Amperex Electronic Corp. Semiconductor & Micro-Circuit Div. Slatersville, RI	28425 Serv-O-Link Eules, TX
2K262 Boyd Corporation Portland, OR	23302 S.W. Electronics & Mfg. Corp. Cherry Hill, NJ	25435 Moldtronics, Inc Downers Grove, IL	28478 Deltrol Corporation Deltrol Controls Div. Milwaukee, WI
	23730 Mark Eyelet and Stamping Inc. Wolcott, CT	25706 Daburn Electronic & Cable Corp. Norwood, NJ	28480 Hewlett Packard Co. Corporate HQ Palo Alto, CA

## Federal Supply Codes for Manufacturers (cont)

28484 Emerson Electric Co. Gearmaster Div. McHenry, IL	31433 Kemet Electronics Corp. Simpsonville, NC	33246 Epoxy Technology Inc. Billerica, MA	36701 Van Waters & Rogers Valley Field, Quebec, Canada
28520 Heyco Molded Products Kenilworth, NJ	31448 Army Safeguard Logistics Command Huntsville, AL	33292 Pioneer Sterilized Wiping Cloth Co. Portland, OR	37942 Mallory Capacitor Corp. Sub of Emhart Industries INpolis, IN
28932 Lumax Industrials, Inc Altoona, PA	31471 Gould Inc Semiconductor Div Santa Clara, CA	33297 NEC Electronics USA Inc. Electronic Arrays Inc. Div. Mountain View, CA	39003 Maxim Industries Middleboro, MA
29083 Monsanto Co. Santa Clara, CA	31522 Metal Masters Inc. Baldwin, MS	33919 Nortek Inc. Cranston, RI	4F434 Plastic Sales Los Angeles, CA
29604 Stackpole Components Co. Raleigh, NC	31746 Cannon Electric Woodbury, TN	34114 Oak Industries Rancho Bernardo, CA	40402 Roderstein Electronics Inc. Statesville, NC
29907 Omega Engineering Inc. Stamford, CT	31827 Budwig Ramona, CA	34263 CTS Electronics Corp. Brownsville, TX	42498 National Radio Melrose, MA
3D536 Aimco Inc. Seattle, WA	31918 ITT-Schadow Eden Prairie, MN	34333 Silicon General Inc. Garden Grove, CA	43543 Nytronics Inc.(Now 53342)
30035 Jolo Industries Inc. Garden Grove, CA	32293 Intersil Cupertino, CA	34335 Advanced Micro Devices (AMD) Sunnyvale, CA	43744 Panasonic Industrial Co. San Antonio, TX
30045 Solid Power Corp. Farmingdale, NY	32539 Mura Corp. Westbury, Long Island, N.Y.	34359 MN Mining & Mfg. Co. Commercial Office Supply Div. Saint Paul, MN	43791 Datron Systems Wilkes Barre, PA
30146 Symbex Corp. Painesville, OH	32559 Bivar Santa Ana, CA	34371 Harris Corp. Harris Semiconductor Products Group Melbourne, FL	44655 Ohmite Mfg. Co. Skokie, IL
30148 AB Enterprise Inc. Ahoskie, NC	32719 Siltronics Santa Ana, CA	34576 Rockwell International Corp. Newport Beach, CA	47001 Lumberg Inc. Richmond, VA
30161 Aavid Engineering Inc. Laconia, NH	32767 Griffith Plastics Corp. Burlingame, CA	34641 Instrument Specialties Euless, TX	47379 ISOCOM Campbell, CA
30315 Itron Corp. San Diego, CA	32879 Advanced Mechanical Components Northridge, CA	34649 Intel Corp. Santa Clara, CA	49569 IDT (International Development & Trade) Dallas, TX
30323 IL Tool Works Inc. Chicago, IL	32897 Murata Erie North America Inc. Carlisle Operations Carlisle, Pennsylvania	34802 Electromotive Inc. Kenilworth, NJ	49671 RCA Corp. New York, NY
30800 General Instrument Corp. Capacitor Div. Hicksville, NY	32997 Bourms Inc. Trimpot Div. Riverside, CA	34848 Hartwell Special Products Placentia, CA	49956 Raytheon Company Executive Offices Lexington, MA
30838 Fastec Chicago, ILL	33025 M/A ComOmni Spectra, Inc. (Replacing Omni Spectra) Microwave Subsystems Div. Tempe, AZ	35009 Renfrew Electric Co. Ltd. IRC Div. Toronto, Ontario, Canada	5D590 Mostek Corp. Replaced by: SGS Thompson Microelec- tronics
31019 Solid State Scientific Inc. Willow Grove, PA	33096 CO Crystal Corp. Loveland, CO	35986 Amrad Melrose Park, IL	5F520 Panel Components Corp. Santa Rosa, CA
31091 Alpha Industries Inc. Microelectronics Div. Hatfield, PA	33173 General Electric Co. Owensboro, KY	36665 Mitel Corp. Kanata, Ontario, Canada	5P575 Nobel Electronics Suffern, NY
31323 Metro Supply Company Sacramento, CA			5W664 NDK Div. of Nihon Dempa Kogyo LTD Lynchburg, VA

## Federal Supply Codes for Manufacturers (cont)

5U802 Dennison Mfg. Co. Framingham, MA	51499 Amtron Corp. Boston, MA	52840 Western Digital Corp. Costa Mesa, CA	54937 DeYoung Mfg. Bellevue, WA
50088 SGS - Thomson Microelectronics Inc. Carrollton, TX	51506 Accurate Screw Machine Co. (ASMCO) Nutley, NJ	53021 Sangamo Weston Inc. (See 06141)	54590 RCA Corp. Electronic Components Div. Cherry Hill, NJ
50120 Eagle-Picher Industries Inc. Electronics Div. CO Springs, CO	51605 CODI Semiconductor Inc. Kenilworth, NJ	53036 Textool Co. Houston, TX	55026 American Gage & Machine Co. Simpson Electric Co. Div. Elgin, IL
50157 Midwest Components Inc. Muskegon, MS	51642 Centre Engineering Inc. State College, PA	53184 Xciton Corp. Lathan, NY	55112 Plessey Capacitors Inc. (Now 60935)
50356 Teac Corp. of America Industrial Products Div Montebello, CA	51705 ICO/Rally Palo alto, CA	53217 Technical Wire Products Inc. Santa Barbara, CA	55261 LSI Computer Systems Inc. Melville, NY
50364 MMI, Inc.(Monolithic Memories Inc) Military Products Div. Santa Clara, CA	51791 Statek Corp. Orange, CA	53342 Opt Industries Inc. Phillipsburg, NJ	55285 Bercquist Co. Minneapolis, MN
50472 Metal Masters, Inc. City of Industry, CA	51984 NEC America Inc. Falls Church, VA	53673 Thompson CSF Components Corp. (Semiconductor Div) Conaga Park, CA	55322 Samtech Inc. New Albany, IN
50541 Hypertronics Corp. Hudson, MA	52063 Exar Integrated Systems Sunnyvale, CA	53718 Airmold/W. R. Grese & Co. Roanoke Rapids, NC	55408 STL-CO Industries Co Buffalo, NY
50558 Electronic Concepts, Inc. Eatontown, NJ	52072 Circuit Assembly Corp. Irvine, CA	53848 Standard Microsystems Hauppauge, NY	55464 Central Semiconductor Corp. Hauppauge, NY
50579 Litronix Inc. Cupertino, CA	52152 MN Mining & Mfg. Saint Paul, MN	53894 AHAM Inc. RanchoCA, CA	55557 Microwave Diode Corp. W.Stewartstown, NH
50891 Semiconductor Technology Stuart, FL	52333 API Electronics Haugpauge,Long Island,NY	53944 Glow-Lite Pauls Valley, OK	55566 R A F Electronic Hardware Inc. Seymour, CT
50934 Tran-Tec Corp Columbus, NE	52361 Communication Systems Piscataway, NJ	54178 Plasmetex Industries Inc. San Marcos, CA	55576 Synertek Santa Clara, CA
51167 Aries Electronics Inc. Frenchtown, NJ	52500 Amphenol, RF Operations Burlington, MA	54294 Shallcross Inc. Smithfield, NC	55680 Nichicon/America/Corp. Schaumburg, IL
51284 Mos Technology Norristown, PA	52525 Space-Lok Inc. Lerco Div. Burbank, CA	54453 Sullins Electronic Corp. San Marcos, CA	55943 D J Associates, Inc (Replaced Transcon Mfg.-24618) Fort Smith, AZ
51249 Heyman Mfg. Co. Cleveland, OH	52531 Hitachi Magnetics Edmore, MO	54473 Matsushita Electric Corp. (Panasonic) Secaucus, NJ	56282 Utek Systems Inc. Olathe, KS
51372 Verbatim Corp. Sunnyvale, CA	52745 Timco Los Angeles, CA	54492 Cinch Clamp Co., Inc. Santa Rosa, CA	56289 Sprague Electric Co. North Adams, MA
51398 MUPAC Corp. Brockton, MA	52763 Stettner-Electronics Inc. Chattanooga, TN	54583 TDK Garden City, NY	56365 Square D Co. Corporate Offices Palatine, IL
51406 Murata Erie, No. America Inc. (Also see 72982) Marietta, GA	52769 Sprague-Goodman Electronics Inc. Garden City Park, NY	54590 RCA Corp Distribution & Special Products Cherry Hill, NY	56375 WESCORP Div. Dal Industries Inc Mountain View, CA
	52771 Monitem Corp. Amatrom Div. Santa Clara, CA	54869 Piher International Corp. Arlington Heights, IL	



## Federal Supply Codes for Manufacturers (cont)

56481 Shugart Associates Sub of Xerox Corp. Sunnyvale, CA	59610 Souriau Inc Valencia, CA	60911 Inmos Corp. CO Springs, CO	64537 KDI Electronics Whippany, NJ
56637 RCD Components Inc. Manchester, NH	59635 HV Component Associates Howell, NJ	60935 Westlake Capacitor Inc. Tantalum Div. Greencastle, IN	64782 Precision Control Mfg. Inc. Bellevue, WA
56708 Zilog Inc. Campbell, CA	59640 Supertex Inc. Sunnyvale, CA	60958 ACIC Intercomp Wire & Cable Div. Hayesville, NC	64834 West M G Co. San Francisco, CA
56856 Varnistor Corp. of TN Sevierville, TN	59660 Tusonix Inc. Tucson, AZ	61271 Fujitsu Microelectronics Inc San Jose, CA	64961 Electronic Hardware LTD North Hollywood, CA
56880 Magnetics Inc. Baltimore, MD	59730 Thomas and Betts Corp. IA City, IA	61394 SEEQ Technology Inc. San Jose, CA	65092 Sangamo Weston Inc. Weston Instruments Div. Newark, NJ
57026 Endicott Coil Co. Inc. Binghamton, NY	59831 Semtronics Corp. Watchung, NJ	61429 Fox Electronics Cape Coral, FL	65786 Cypress Semi San Jose, CA
57053 Gates Energy Products Denver, CO	61053: American Components Inc. an Insilco Co. RPC Div. Hayesville, NC	61529 Aromat Corp. New Providence, NJ	65940 Rohm Corp & Whatney Irvine, CA
57170 Cambridge Thermionic Cambridge, MA Replaced by: 71279 Interconnection Products Inc.	6L611 Allen, Robert G. Inc. Van Nuys, CA	61752 IR-ONICS Inc Warwick, RI	65964 Evox Inc. Barnockbum, IL
57668 R-ohm Corp Irvine, CA	6U850 Burgess Switch Co., Inc Northbrook, IL	61772 Integrated Device Technology Santa Clara, CA	66150 Entron Inc. Winslow Teltronics Div. Glendale, NY
57962 SGS - Thomson Microelectronics Inc Montgomeryville, PA	6U095 AMD Enterprises, Inc. Roswell, GA	61802 Toshiba Houston, TX	66302 VLSI Technology Inc. San Jose, CA
58014 Hitachi Magnalock Corp. (Now 12581)	6X403 SGS/ATES Semiconductor Corp. INpolis, IN	61857 SAN-O Industrial Corp. Bohemia, Long Island, NY	66419 Exel San Jose, CA
58104 Simco Atlanta, GA	6Y440 Micron Technology Inc. Boise, ID	61935 Schurter Inc. Petaluma, CA	66450 Dyna-Tech Electronics, Inc Walled Lake, MI
58364 BYCAP Inc. Chicago, IL	60046 Power Dynamics Inc West Orange, NJ	62351 Apple Rubber Lancaster, NY	66608 Bering Industries Freemont, CA
58451 Precision Lamp Cotat, CA	60197 Precicontact Inc. Langhorne, PA	62643 United Chemicon Rosemont, IL	66891 BKC International Electronics Lawrence, MA
58474 Superior Electric Co. Bristol, CT	60386 Squires Electronics Inc Cornelius, OR	62712 Seiko Instruments Torrance, CA	66958 SGS Semiconductor Corp. Phoenix, AZ
58614 Communications Instruments Inc. Fairview, NC	60395 Xicor Inc. Milpitas, CA	62793 Lear Siegler Inc. Energy Products Div. Santa Ana, CA	66967 Powerex Inc Aubum, NY
59124 KOA-Speer Electronics Inc. Bradford, PA	60399 Torin Engineered Blowers Div. of Clevepak Corp. Torrington, CT	63743 Ward Leonard Electric Co.Inc. Mount Vernon, NY	67183 Altera Santa Clara, CA
59422 Holmberg Electronics Irvine, CA	60496 Micrel Inc. Sunnyvale, CA	64154 Lamb Industries Portland, OR	68919 WIMA % Harry Levinson Co. Seattle, WA
	60705 Cera-Mite Corp. (formerly Sprague) Grafton, WI	64155 Linear Technology Milpitas, CA	

### Federal Supply Codes for Manufacturers (cont)

7F361 Richmond-Division of Dixco % Zellerbach Paper Co. Seattle, WA	71468 ITT Cannon Div. of ITT Fountain Valley, CA	73138 Beckman Industrial corp. Helipot Div. Fullerton, CA	75042 TRW Inc. IRC Fixed Resistors Philadelphia, PA
7F844 Moore Business Forms, Inc Seattle, WA	71482 General Instrument Corp. Clare Div. Chicago, IL	73168 Fenwal Inc. Ashland, MA	75297 Kester Solder Div. Litton Systems, Inc Des Plaines, IL
7G902 Textron Inc. Camcar Div. Rockford, IL	71590 Mepco/Centralab A North American Philips Co. Fort Dodge, IA	73293 Hughes Aircraft Co. Electron Dynamics Div. Torrance, CA	75376 Kurz-Kasch Inc. Dayton, OH
7J395 Universal Plastics Welshpool, WA	71707 Coto Corp. Providence, RI	73445 Ampere Electronic Corp. Hicksville, NY	75378 CTS Knights Inc. Sandwich, IL
7J696 AMD Plastics East Lake, OH	71744 General Instrument Corp. Lamp Div/Worldwide Chicago, IL	73559 Carlingswitch Inc. Hartford, CT	75382 Kulka Electric Corp. (Now 83330) Mount Vernon, NY
7K354 Omni Spectra Inc Los Altos, CA	71785 TRW Inc. Cinch Connector Div. Elk Grove Village, IL	73586 Circle F Industries Trenton, NJ	75569 Performance Semiconductor Corp. Sunnyvale, CA
7Z884 ALPS Seattle, WA	71984 Dow Corning Corp. Midland, MI	73734 Federal Screw Products Inc. Chicago, IL	75915 Littelfuse Tracor (Formerly: Tracor-Littelfuse) Des Plaines, IL
7X634 Duracell USA Div. of Dart & Kraft Inc. Valdese, NC	72005 AMAX Specialty Metals Corp. Newark, NJ	73743 Fischer Special Mfg. Co. Cold Spring, KY	76854 Oak Switch Systems Inc. Crystal Lake, IL
70290 Almetal Universal Joint Co. Cleveland, OH	72136 Electro Motive Mfg. Corp. Florence, NC	73893 Microdot Mt. Clemens, MS	77122 TRW Assemblies & Fasteners Group Fastener Div. Moutainside, NJ
70485 Atlantic India Rubber Works Inc. Chicago, IL	72228 AMCA International Corp. Continental Screw Div. New Bedford, MA	73899 JFD Electronic Components Div. of Murata Erie Oceanside, NY	77342 AMF Inc. Potter & Brumfield Div. Princeton, IN
70563 Amperite Company Union City, NJ	72259 Nytronics Inc. New York, NY	73905 FL Industries Inc. San Jose, CA	77542 Ray-O-Vac Corp Madison, WI
70903 Cooper-Belden Corp. Geneva, IL	72619 Ampere Electronic Corp. Dialight Div. Brooklyn, NY	73949 Guardian Electric Mfg. Co. Chicago, IL	77638 General Instrument Corp. Rectifier Div. Brooklyn, NY
71002 Bimbach Co. Inc. Farmingdale, NY	72653 G C Electronics Co. Div. of Hydrometals Inc. Rockford, IL	74199 Quam Nichols Co. Chicago, IL	77900 Shakeproof Lock Washer Co. (Now 78189)
71034 Bliley Electric Co. Erie, PA	72794 Dzus Fastner Co. Inc. West Islip, NY	74217 Radio Switch Co. Marlboro, NJ	77969 Rubbercraft Corp. of CA Ltd. Torrance, CA
71183 Westinghouse Electric Corp. Bryant Div. Bridgeport, CT	72928 Gulton Industries Inc. Gudeman Div. Chicago, IL	74306 Piezo Crystal Co. Div. of PPA Industries Inc. Carlisle, PA	78189 IL Tool Works Inc. Shakeproof Div. Elgin, IL
71279 Interconnection Products Inc. Formerly Midland-Ross Cambion Div. Santa Ana, CA	72962 Elastic Stop Nut Div. of Harrard Industries Union, NJ	74445 Holo-Krome Co. Elmwood, CT	78277 Sigma Instruments Inc. South Braintree, MA
71400 Bussman Manufacturing Div. McGraw-Edison Co. St. Louis, MO	72982 Erie Specialty Products, Inc Formerly: Murata Erie Erie, PA	74542 Hoyt Elect.Instr. Works Inc. Penacook, NH	78290 Struthers Dunn Inc. Pitman, NJ
71450 CTS Corp. Elkhart, IN		74840 IL Capacitor Inc. Lincolnwood, IL	78553 Eaton Corp. Engineered Fastener Div. Cleveland, OH

**Federal Supply Codes for Manufacturers (cont)**

78592 Stoeger Industries South Hackensack, NJ	81439 Therm-O-Disc Inc. Mansfield, OH	83315 Hubbell Corp. Mundelein, IL	87034 Illuminated Products Inc. (Now 76854)
79497 Western Rubber Co. Goshen, IN	81483 International Rectifier Corp. Los Angeles, CA	83330 Kulka Smith Inc. A North American Philips Co. Manasquan, NJ	87516 Standard Crystal KS City, KS
79727 C - W Industries Southampton, PA	81590 Korry Electronics Inc. Seattle, WA	83478 Rubbercraft Corp. of America West Haven, CT	88044 Aeronautical Standards Group Dept. of Navy & Air Force
79963 Zierick Mfg. Corp. Mount Kisco, NY	81741 Chicago Lock Co. Chicago, IL	83553 Associated Spring Barnes Group Gardena, CA	88219 GNB Inc. Industrial Battery Div. Langhorne, PA
8C798 Ken-Tronics, Inc. Milan, IL	82227 Airpax Corp. Cheshire Div. Cheshire, CT	83740 Union Carbide Corp. Battery Products Div. Danbury, CT	88245 Winchester Electronics Litton Systems-Useco Div. Van Nuys, CA
8D528 Baumgartens Atlanta, GA	82240 Simmons Fastner Corp. Albany, NY	84171 Arco Electronics Commack, NY	88486 Triangle PWC Inc. Jewitt City, CT
8F330 Eaton Corp. Cutler Hammer Product Sales Office Mountain View, CA	82305 Palmer Electronics Corp. South Gate, CA	84411 American Shizuki TRW Capacitors Div. Ogallala, NE	88690 Essex Group Inc. Wire Assembly Div. Dearborn, MI
8T100 Tellabs Inc. Naperville, IL	82389 Switchcraft Inc. Sub of Raytheon Co. Chicago, IL	84613 FIC Corp. Rockville, MD	88786 Atlantic India Rubber Co. Goshen, IN
80009 Tektronix Beaverton, OR	82415 Airpax Corp. Frederick Div. Frederick, MD	84682 Essex Group Inc. Peabody, MA	88978 Philips (Now Fluke) Mahwah, NJ
80031 Mepco/Electra Inc. Morristown, NJ	82872 Roanwell Corp. New York, NY	84830 Lee Spring Co. Inc Brooklyn, NY	89020 Amerace Corp. Buchanan Crimptool Products Div. Union, NJ
80032 Ford Aerospace & Communications Corp. Western Development Laboratories Div. Palo Alto, CA	82877 Rotron Inc. Custom Div. Woodstock, NY	85367 Bearing Distributing Co. San Francisco, CA	89265 Potter-Brumfield (See 77342)
80145 LFE Corp. Process Control Div. Clinton, OH	82879 ITT Royal Electric Div. Pawtucket, RI	85372 Bearing Sales Co. Los Angeles, CA	89462 Waldes Truarc, Inc. Long Island, NY
80183 Sprague Products (Now 56289)	83003 Varo Inc. Garland, TX	85480 W. H. Brady Co. Industrial Product Milwaukee, WI	89536 John Fluke Mfg. Co., Inc. Everett, WA
80294 Boums Instruments Inc. Riverside, CA	83014 Hartwell Corp. Placentia, CA	85840 Brady WH Co Industrial Products Div Milwaukee, WI	89597 Fredericks Co. Huntingdon Valley, PA
80583 Hammerlund Mfg. Co. Inc. Paramus, NJ	83055 Signalite Fuse Co. (Now 71744)	85932 Electro Film Inc. Valencia, CA	89709 Bunker Ramo-Eltra Corp. Amphenol Div. Broadview, IL
80640 Computer Products Inc. Stevens-Arnold Div. South Boston, MA	83058 TRW Assemblies & Fasteners Group Fasteners Div. Cambridge, MA	86577 Precision Metal Products Co. Peabody, MA	89730 General Electric Lamp Div. Newark, NJ
81073 Grayhill Inc. La Grange, IL	83259 Parker-Hannifin Corp. O-Seal Div. Culver City, CA	86684 Radio Corp. of America (Now 54590)	9R216 Data Composition Svc, Inc Laurel, MD
81312 Litton Systems Inc. Winchester Electronics Div. Watertown, CT	83298 Bendix Corp. Electric & Fluid Power Div. Eatonville, NJ	86928 Seastrom Mfg. Co. Inc. Glendale, CA	9S171 Port Plastics Tukwila, WA

## Federal Supply Codes for Manufacturers (cont)

9W423 Amatom El Mont, CA	91934 Miller Electric Co. Woonsocket, RI	95573 Campion Laboratories Inc. Detroit, MI	98278 Malco A Microdot Co. South Pasadena, CA
90201 Mallory Capacitor Co. Sub of Emhart Industries Inc. Indianapolis, IN	91967 National Tel-Tronics Div. of electro Audio Dynamics Inc Meadville, PA	95712 Bendix Corp. Electrical Comp. Div. Franklin, IN	98291 Sealectro Corp. BICC Electronics Trumbull, CT
90215 Best Stamp & Mfg. Co. KS City, MO	91984 Maida Development Co. Hampton, VA	95987 Weckesser Co. Inc. (Now 85480)	98372 Royal Industries Inc. (Now 62793)
90303 Duracell Inc. Technical Sales & Marketing Bethel, CT	91985 Norwalk Valve Co. S. Norwalk, CT	96733 SFE Technologies San Fernando, CA	98388 Lear Siegler Inc. Accurate Products Div. San Deigo, CA
91094 Essex Group Inc. Suflex/IWP Div. Newmarket, NH	92218 Wakefield Corp., The Wakefield, ME	96853 Gulton Industries Inc. Measurement & Controls Div. Manchester, NH	98978 IERC (International Electronic Research Corp.) Burbank, CA
91247 IL Transformer Co. Chicago, IL	92527 VTC Inc. Bloomington, MN	96881 Thomson Industries Inc. Port WA, NY	99120 Plastic Capacitors Inc. Chicago, IL
91293 Johanson Mfg. Co. Boonton, NJ	92607 Tensolite Co. Div. of Carlisle Corp. Buchanan, NY	97464 Industrial Retainer Ring Irvington, NJ	99217 Bell Industries Inc. Elect. Distributor Div. Sunnyvale, CA
91462 Alpha Industries Inc. Logansport, IN	92914 Alpha Wire Corp. Elizabeth, NJ	97525 EECO Inc. Santa Ana, CA	99378 ATLEE of DE Inc. N. Andover, MA
91502 Associated Machine Santa Clara, CA	93332 Sylvania Electric Products Semiconductor Products Div. Woburn, MA	97540 Whitehall Electronics Corp. Master Mobile Mounts Div. Fort Meyers, FL	99392 Mepco/Electra Inc. Roxboro Div. Roxboro, NC
91506 Augat Alcoswitch N. Andover, MA	94144 Raytheon Co. Microwave & Power Tube Div. Quincy, MA	97913 Industrial Electronic Hardware Corp. NY, NY	99515 Electron Products Inc. Div. of American Capacitors Duarte, CA
91507 Froeliger Machine Tool Co. Stockton, CA	94222 Southco Inc. Concordville, PA	97945 Pennwalt Corp. SS White Industrial Products Piscataway, NJ	99779 Bunker Ramo- Eltra Corp. Barnes Div. Lansdown, PA
91637 Dale Electronics Inc. Columbus, NE	94988 Wagner Electric Corp. Sub of McGraw-Edison Co. Whippany, NJ	97966 CBS Electronic Div. Danvers, MA	99800 American Precision Industries Delevan Div. East Aurora, NY
91662 Elco Corp. A Gulf Western Mfg. Co. Connector Div. Huntingdon, PA	95146 Alco Electronic Products Inc. Switch Div. North Andover, MA	98094 Machlett Laboratories Inc. Santa Barbara, CA	99942 Mepco/Centralab A North American Philips Co. Milwaukee, WI
91737 ITT Cannon/Gremar (Now 08718)	95263 Leecraft Mfg. Co. Long Island City, NY	98159 Rubber-Teck Inc. Gardena, CA	
91802 Industrial Devices Inc. Edgewater, NJ	95275 Vitramon Inc. Bridgeport, CT		
91833 Keystone Electronics Corp. NY, NY	95303 RCA Corp. Receiving Tube Div. Cincinnati, OH		
91836 King's Electronics Co. Inc. Tuckahoe, NY	95348 Gordo's Corp. Bloomfield, NJ		
91929 Honeywell Inc. Micro Switch Div. Freeport, IL	95354 Methode Mfg. Corp. Rolling Meadows, IL		

## TECHNICAL SERVICE CENTERS

### U.S. Service Locations

#### California

Fluke Technical Center  
16969 Von Karman Avenue  
Suite 100  
Irvine, CA 92714  
Tel: (714) 863-9031

Fluke Technical Center  
46610 Landing Parkway  
Fremont, CA 94538  
Tel: (415) 651-5112

#### Colorado

Fluke Technical Center  
14180 East Evans Avenue  
Aurora, CO 80014  
Tel: (303) 695-1171

#### Florida

Fluke Technical Center  
940 N. Fern Creek Avenue  
Orlando, FL 32803  
Tel: (407) 896-4881

#### Illinois

Fluke Technical Center  
1150 W. Euclid Ave.  
Palatine, IL 60067  
Tel: (312) 705-0500

#### Maryland

Fluke Technical Center  
5640 Fishers Lane  
Rockville, MD 20852  
Tel: (301) 770-1576

#### New Jersey

Fluke Technical Center  
East 66 Midland Avenue  
Paramus, NJ 07652-0930  
Tel: (201) 599-9500

#### Texas

Fluke Technical Center  
1801 Royal Lane, Suite 307  
Dallas, TX 75229  
Tel: (214) 869-2848

#### Washington

Fluke Technical Center  
John Fluke Mfg. Co., Inc.  
1420 75th St. S.W.  
M/S 6-30  
Everett, WA 98203  
Tel: (206) 356-5560

### International

#### Argentina

Coasin S.A.  
Virrey del Pino 4071 DPTO E-65  
1430 CAP FED  
Buenos Aires  
Tel: 54 1 522-5248

#### Australia

Philips Customer Support  
Scientific and Industrial  
23 Lakeside Drive  
Tally Ho Technology Park  
East Burwood  
Victoria 3151

#### Australia

Philips Customer Support  
Scientific & Industrial  
25-27 Paul St. North  
North Ryde N.S.W. 2113  
Tel: 61 02 888 8222

#### Austria

Oesterreichische Philips Industrie  
Unternehmensbereich Prof. Systeme  
Triesterstrasse 66  
Postfach 217  
A-1101 Wein  
Tel: 43 222-60101, x1388

#### Belgium

Philips & MBLE Associated S.A.  
Scientific & Industrial Equip. Div  
Service Department.  
80 Rue des deux Gares B-1070  
Brussels  
Tel: 32 2 525 6111

#### Brazil

Hi-Tek Electronica Ltda.  
Al. Amazonas 422, Alphaville  
CEP 06400 Barueri  
Sao Paulo  
Tel: 55 11 421-5477

#### Canada

Fluke Electronics Canada Inc.  
400 Britannia Rd. East, Unit #1  
Mississauga  
Ontario L4Z 1X9  
Tel: 416-890-7600

#### Chile

Intronica Chile Ltda.  
Casilla 16228  
Santiago 9  
Tel: 56 2 2321886, 2324308

#### China

Fluke International Corp.  
P.O. Box 9085  
Beijing  
Tel: 86 01 512-3436

#### Colombia

Sistemas E Instrumentacion, Ltda.  
Carrera 13, No. 37-43, Of. 401  
Ap. Aereo 29583  
Bogota DE  
Tel: 57 232-4532

#### Denmark

Philips A/S  
Technical Service I & E  
Strandlodsvej 1A  
PO Box 1919  
DK-2300  
Copenhagen S  
Tel: 45 1 572222

#### Ecuador

Proteco Coasin Cia., Ltda.  
P.O. Box 228-A  
Ave. 12 de Octubre  
2285 y Orellana  
Quito  
Tel: 593 2 529684

#### Egypt

Philips Egypt  
10, Abdel Rahman el Rafei st.  
el. Mohandessin  
P.O. Box 242  
Dokki Cairo  
Tel: 20-2-490922

#### England

Philips Scientific  
Test & Measuring Division  
Colonial Way  
Watford  
Hertfordshire WD2 4TT  
Tel: 44 923-40511

#### Finland

Oy Philips AB  
Central Service  
Sinikalliontie 1-3  
P.O. Box 11  
SF-02630 ESPOO  
Tel: 358-0-52572

#### France

S.A. Philips Industrielle  
et Commerciale,  
Science et Industry  
105 Rue de Paris Bp 62  
93002 Bobigny, Cedex  
Tel: 33-1-4942-8040

#### Germany (F.R.G.)

Philips GmbH  
Service fuer FLUKE - Produkte  
Department VSF  
Oskar-Messter-Strasse 18  
D-8045 Ismaning/Munich,  
West Germany  
Tel: 49 089 9605-239

#### Greece

Philips S.A. Hellenique  
15, 25th March Street  
177 78 Tavros  
10210 Athens  
Tel: 30 1 4894911

#### Hong Kong

Schmidt & Co (H.K.) Ltd.  
18/FL., Great Eagle Centre  
23 Harbour Road  
Wanchai  
Tel: 852 5 8330222

#### India

Hinditron Services Pvt. Ltd  
1st Floor, 17-B,  
Mahal Industrial Estate  
Mahakali Road, Andheri East  
Bombay 400 093  
Tel: 91 22 6300043

Hinditron Services Pvt. Inc.  
33/44A Raj Mahal Villas Extn.  
8th Main Road  
Bangalore 560 080  
Tel: 91 812 363139

Hinditron Services Pvt. Ltd.  
Field Service Center  
Emerald Complex 1-7-264  
5th Floor  
114 Sarojini Devi Road  
Secunderabad 500 003  
Tel: 08 42-821117

Hinditron Services Pvt. Ltd.  
15 Community Centre  
Panchshila Park  
New Delhi 110 017  
Tel: 011-6433675

#### Indonesia

P.T. Lamda Triguna  
P.O. Box 6/JATJG  
Jakarta 13001  
Tel: (021) 8195365

#### Israel

R.D.T. Electronics Engineering, Ltd.  
P.O. Box 43137  
Tel Aviv 61430  
Tel: 972 3 483211

#### Italy

Philips S.p.A.  
Sezione I&E / T&M  
Viale Elvezia 2  
2005 Monza  
Tel: 39 39 3635342

#### Japan

John Fluke Mfg. Co., Inc.  
Japan Branch  
Sumitomo Higashi Shinbashi Bldg.  
1-1-11 Hamamatsucho  
Minato-ku  
Tokyo 105  
Tel: 81 3 434-0181

#### Korea

Myoung Corporation  
Yeo Eui Do P.O. Box 14  
Seoul 150  
Tel: 82 2 784-9942

#### Malaysia

Mecomb Malaysia Sdn. Bhd.  
P.O. Box 24  
46700 Petaling Jaya  
Selangor  
Tel: 60 3 774-3422

#### Mexico

Mexel Servicios en Computacion  
Instrumentacion y Perifericos  
Blvd. Adolfo Lopez Mateos No. 163  
Col. Mixcoac  
Mexico D.F.  
Tel: 52-5-563-5411

#### Netherlands

Philips Nederland  
Test & Meetapparaten Div.  
Postbus 115  
5000 AC Tilburg  
Tel: 31-13-352445

**New Zealand**

Philips Customer Support  
Scientific & Industrial Division  
2 Wagener Place  
Mt. Albert  
Auckland  
Tel: 64 9 894-160

**Norway**

Morgenstjerne & Co. A/S  
Konghellegate 3  
P.O. Box 6688, Rodelokka  
Oslo 5  
Tel: 47 2 356110

**Pakistan**

International Operations (PAK) Ltd.  
505 Muhammadi House  
I.I. Chundrigar Road  
P.O. Box 5323  
Karachi  
Tel: 92 21 221127, 239052

**Peru**

Importaciones & Representaciones  
Electronicas S.A.  
Avad Franklin D. Roosevelt 105  
Lima 1  
Tel: 51 14 288650

**Philippines**

Spark Radio & ElectronicS Inc.  
Greenhills, P.O. Box 610  
San Juan, Metro-Manila Zip 3113  
Tel: 63-2-775192

**Portugal**

Decada Espectral  
Equipmentos de Elec. e Cientificos  
Av. Bomberos Voluntarios  
Lote 102B, Miraflores/Alges  
1495 Lisboa  
Tel: 351 1 410-3420

**Singapore**

Rank O'Connor's Singapore (PTE) Ltd.  
98 Pasir Panjang Road  
Singapore 0511  
Tel: 65 4737944

**South Africa**

South African Philips (Pty) Ltd.  
Service Department  
195 Main Rd  
Martindale, Johannesburg, 2092  
Tel: 27 11 470-5255

**Spain**

Philips Iberica S.A.E.  
Depto. Tecnico Instrumentacion  
c/Martinez Villergas 2  
28027 Madrid  
Tel: 34 1 4042200

**Sweden**

Philips Kistaindustrier AB  
Customer Support  
Borgarfjordsgatan 16  
S-16493 Kista

**Switzerland**

Philips A.G.  
Technischer Kundendienst  
Postfach 670  
Allmendstrasse 140  
CH-8027 Zurich  
Tel: 41 1 482211

**Taiwan**

Schmidt Electronics Corp.  
5th Floor, Cathay Min Sheng  
Commercial Building,  
344 Min Sheng East Road  
Taipei  
Tel: 886 2501-3468

**Thailand**

Measuretronix Ltd.  
2102/63 Ramkamhaeng Rd.  
Bangkok 10240  
Tel: 66 2 374-2516, 374-1632

**Turkey**

Turk Philips Ticaret A.S.  
Inonu Caddesi 78/80  
Posta Kutusu 504-Beyoglu  
Istanbul  
Tel: 90 1 1435891

**Uruguay**

Coasin Uruguay S.A  
Casilla de Correo 1400  
Libertad 2525  
Montevideo  
Tel: 598-2-789015

**Venezuela**

Coasin C.A.  
Calle 9 Con Calle 4, Edif. Edinurbi  
Apartado de Correos Nr-70-136  
Los Ruices  
Caracas 1070-A  
Tel: 58 2 241-0309, 241-1248

**West Germany**

Philips GmbH  
Department VSF  
Service fuer FLUKE - Produkte  
Oskar - Messter - Strasse 18  
D-8045 Ismaning / Munich  
Tel: 49 089 9605-260



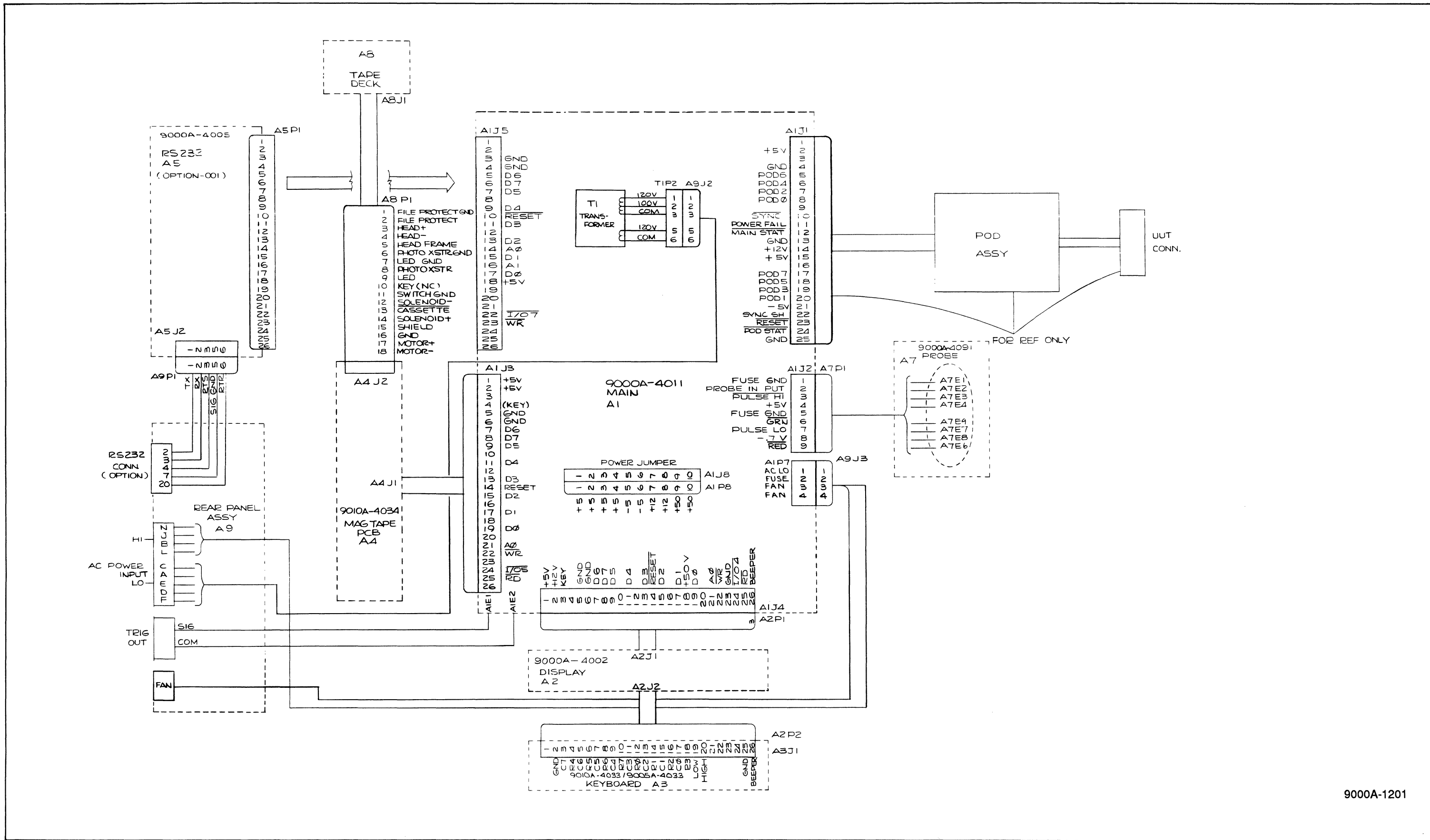
## Section 8

# Schematic Diagrams

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
8-1.	9010A Interconnect Diagram .....	8-3
8-2.	A1 Main PCA .....	8-4
8-3.	A2 Display PCA .....	8-12
8-4.	A3 Keyboard PCA .....	8-14
8-5.	A4 Magnetic Tape PCA .....	8-16
8-6.	A7 Data Probe PCA.....	8-18
8-7.	Option-001, RS-232 Interface PCA .....	8-20



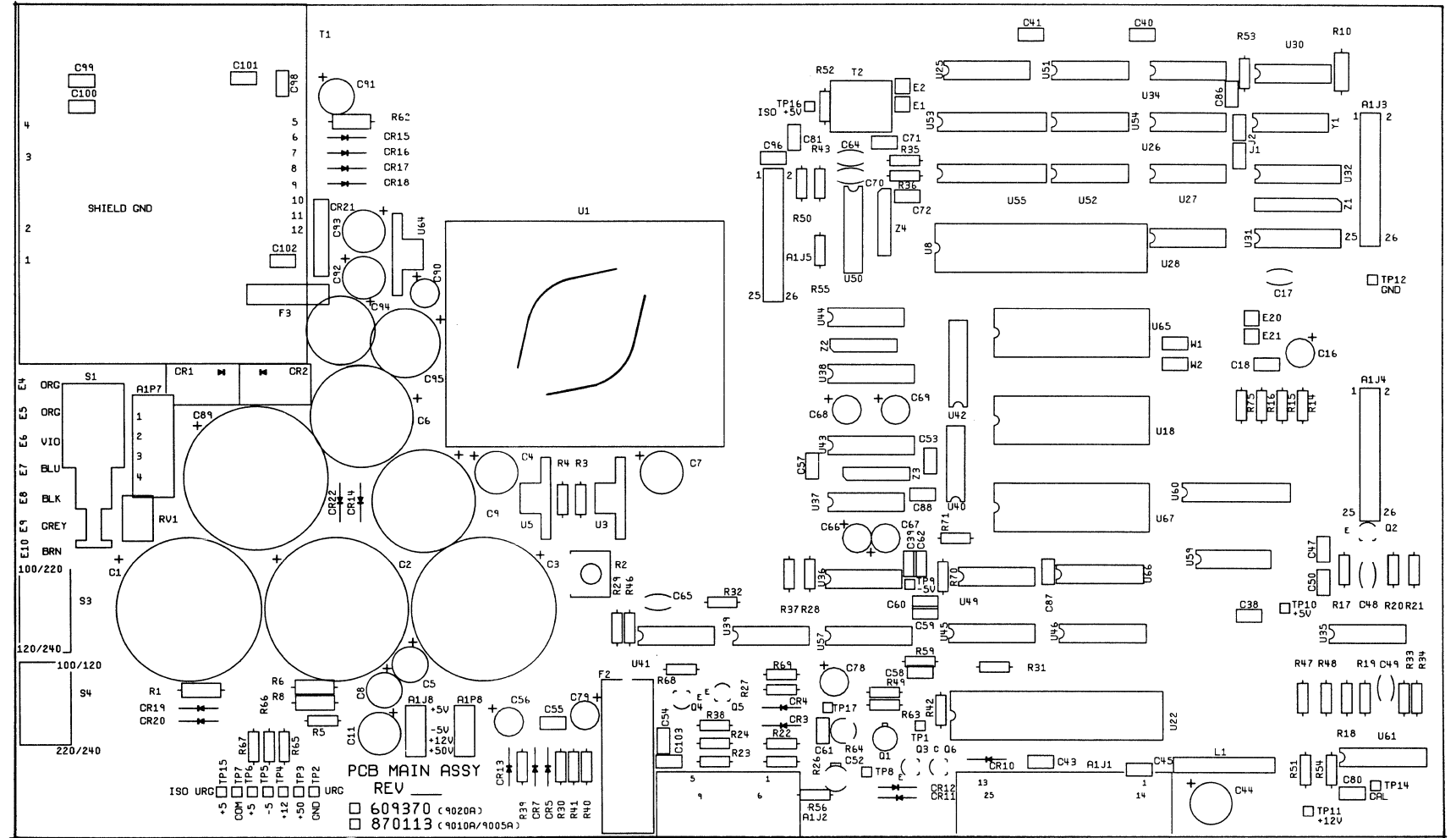




9000A-1201

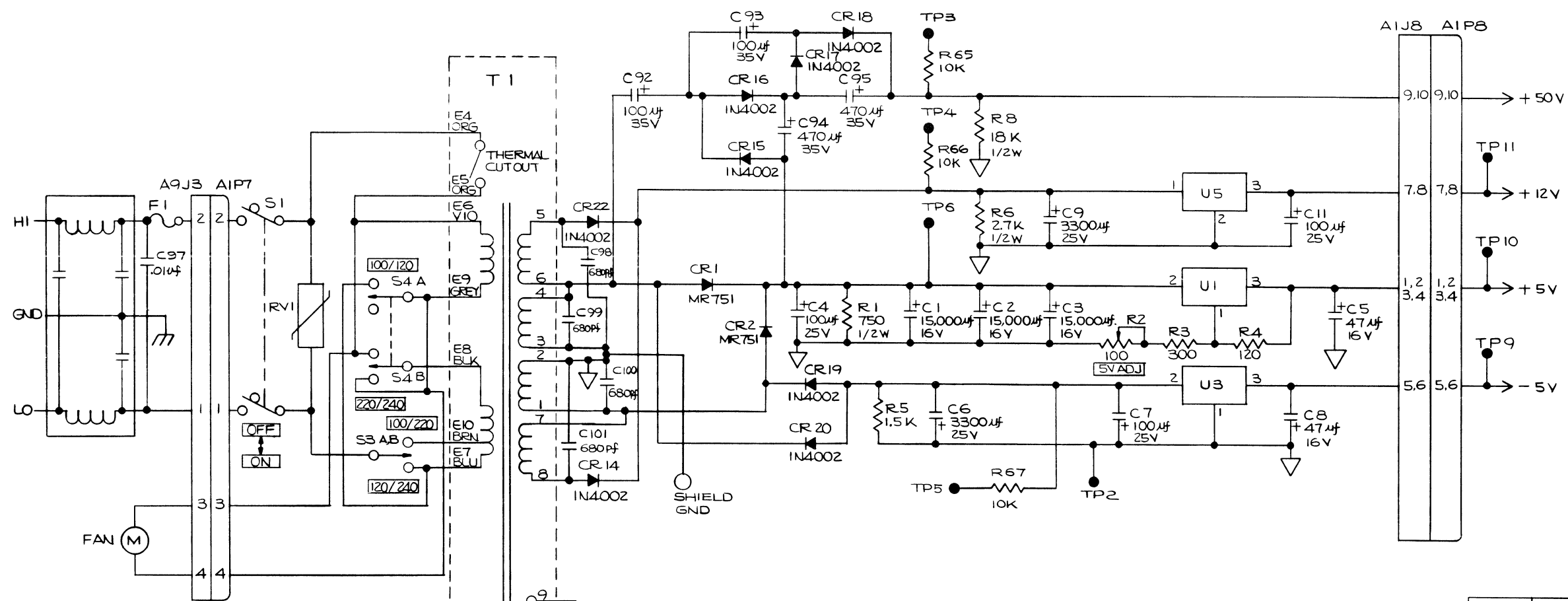
Figure 8-1. 9010A Interconnect Diagram

 **CAUTION**  
SUBJECT TO DAMAGE BY  
STATIC ELECTRICITY



9000A-1611

Figure 8-2. A1 Main PCA



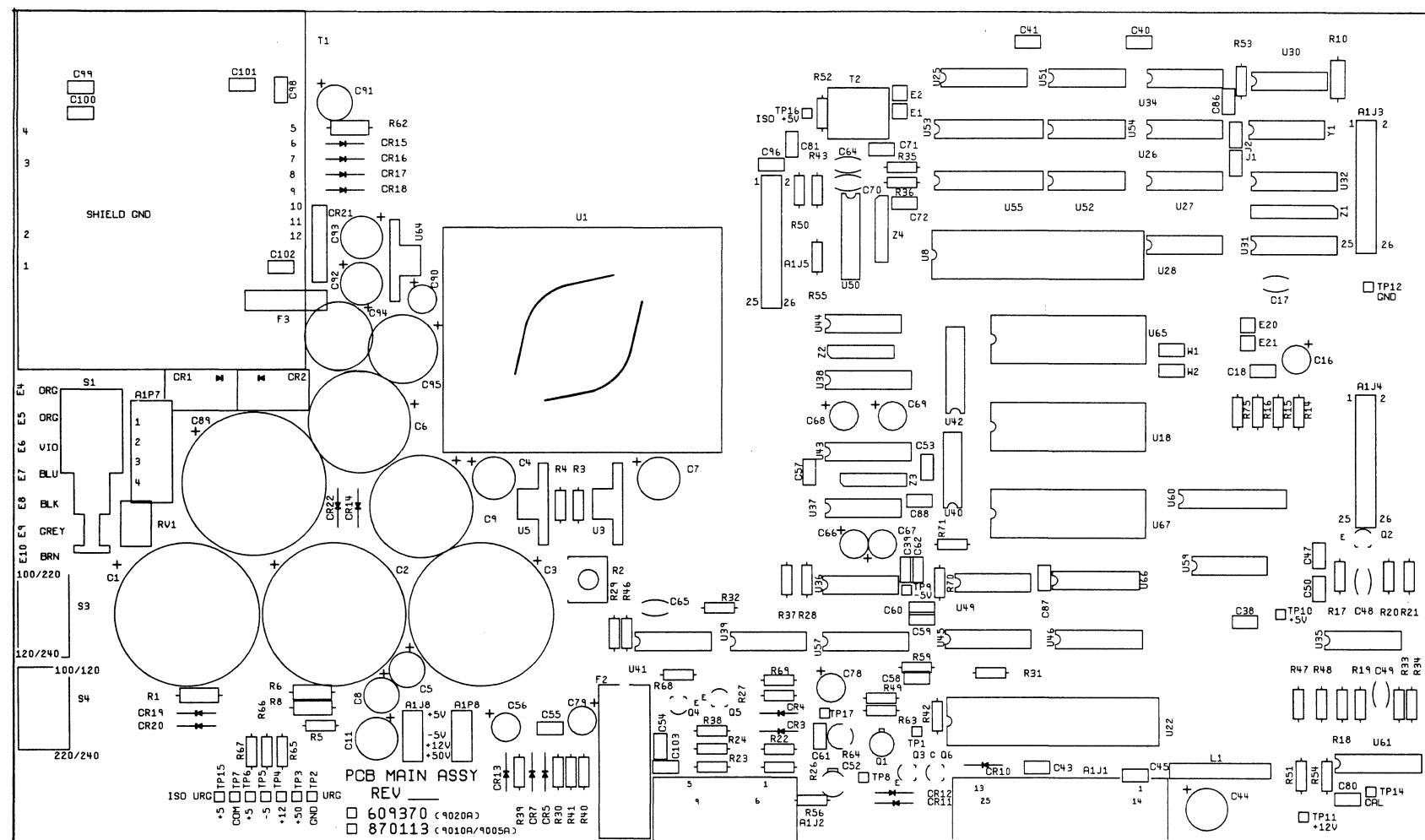
REF	DES
HIGHEST NO.	NOT USED NO.
R 71	R44,25, 7,9,11, 45
C 103	C10,12,13, 42, 76,77,82-85,14, 15, 63, 73, 74, 75, 46,51
CR 22	CR8,9,6
Q 6	-
TP17	TP13
E 10	-
W 8	-
Y 1	-
RV 1	-
S 4	S2
L 1	-
T 2	-
J 8	J6, J7
F 3	-
U 66	2, 4, 6, 7, 17, 33, 47, 48, 55, 58, 63
Z 5	-
P 8	P1 - P6

DES	DEVICE	+5V	+12V	+50V	-5V	GND	QTY
U 1	LM338K	3	-	-	-	-	1
U 5	LM7812	-	3	-	-	2	1
U 3	LM7905	-	-	-	3	1	1
U 64	TL780-05	2	-	-	-	3	1

NOTES: UNLESS OTHERWISE SPECIFIED.  
 1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.

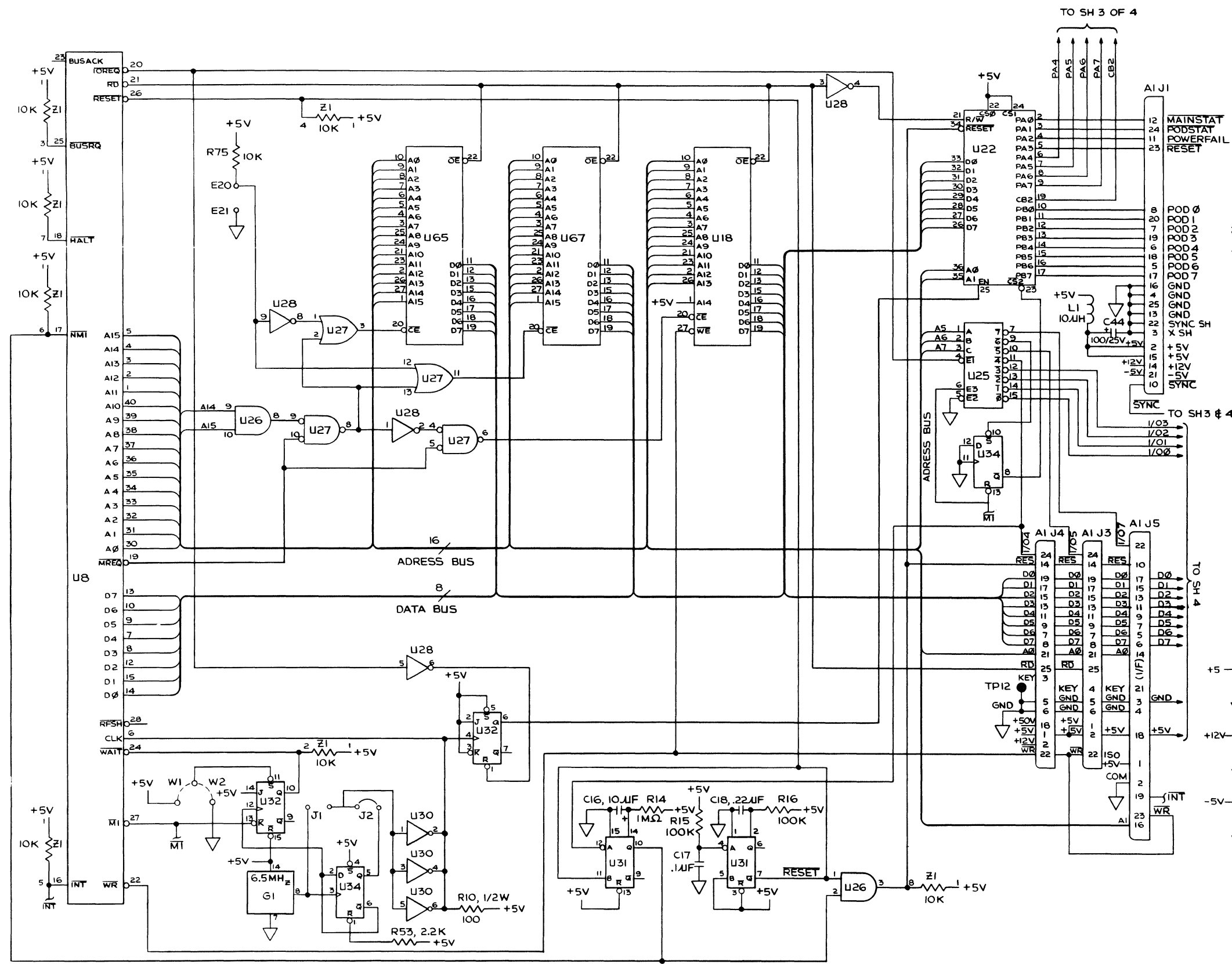
Figure 8-2. A1 Main PCA (cont)

 **CAUTION**  
SUBJECT TO DAMAGE BY  
STATIC ELECTRICITY



9000A-1611

Figure 8-2. A1 Main PCA (cont)



ROM CONFIGURATION	INSTALLATION:	U65	U67	W1	W2
I-27C512	P0-P5	—	—	OUT	IN

- NOTES: UNLESS OTHERWISE SPECIFIED
- ALL RESISTANCES ARE IN OHMS, 1/4W .5%.
  - ALL CAPACITANCES ARE IN MICROFARADS.
  - PAGE REFERENCES:
    - P0-0000-1FFF P3-6000-7FFF
    - P1-2000-3FFF P4-8000-9FFF
    - P2-4000-5FFF P5-A000-BFFF

DES	DEVICE	+5V	GND	-5V	+12V	QTY
U65, 67	SEE TABLE	28	14	—	—	SEE TABLE
U25	74LS138	16	8	—	—	1
U18	43256-12	28	14	—	—	1
U8	Z-80A	11	29	—	—	1
U22	6520	20	1	—	—	1
U31	4098	16	1,8,15	—	—	1
U27	74LS32	14	7	—	—	1
U26	74LS08	14	7	—	—	1
U28	74LS04	14	7	—	—	1
U30	7406	14	7	—	—	1
U32	74LS109	16	8	—	—	1
U34	74LS74	14	7	—	—	1
Z1	RES NET 10K	1	—	—	—	1
Z5	RES NET 1K	1	—	—	—	1

- +5V C40, 38, 41, 86, 87, 88
- .22 uF
- +12V C45
- .22 uF
- 5V C39, 43
- .22 uF

Figure 8-2. A1 Main PCA (cont)

 **CAUTION**  
SUBJECT TO DAMAGE BY  
STATIC ELECTRICITY

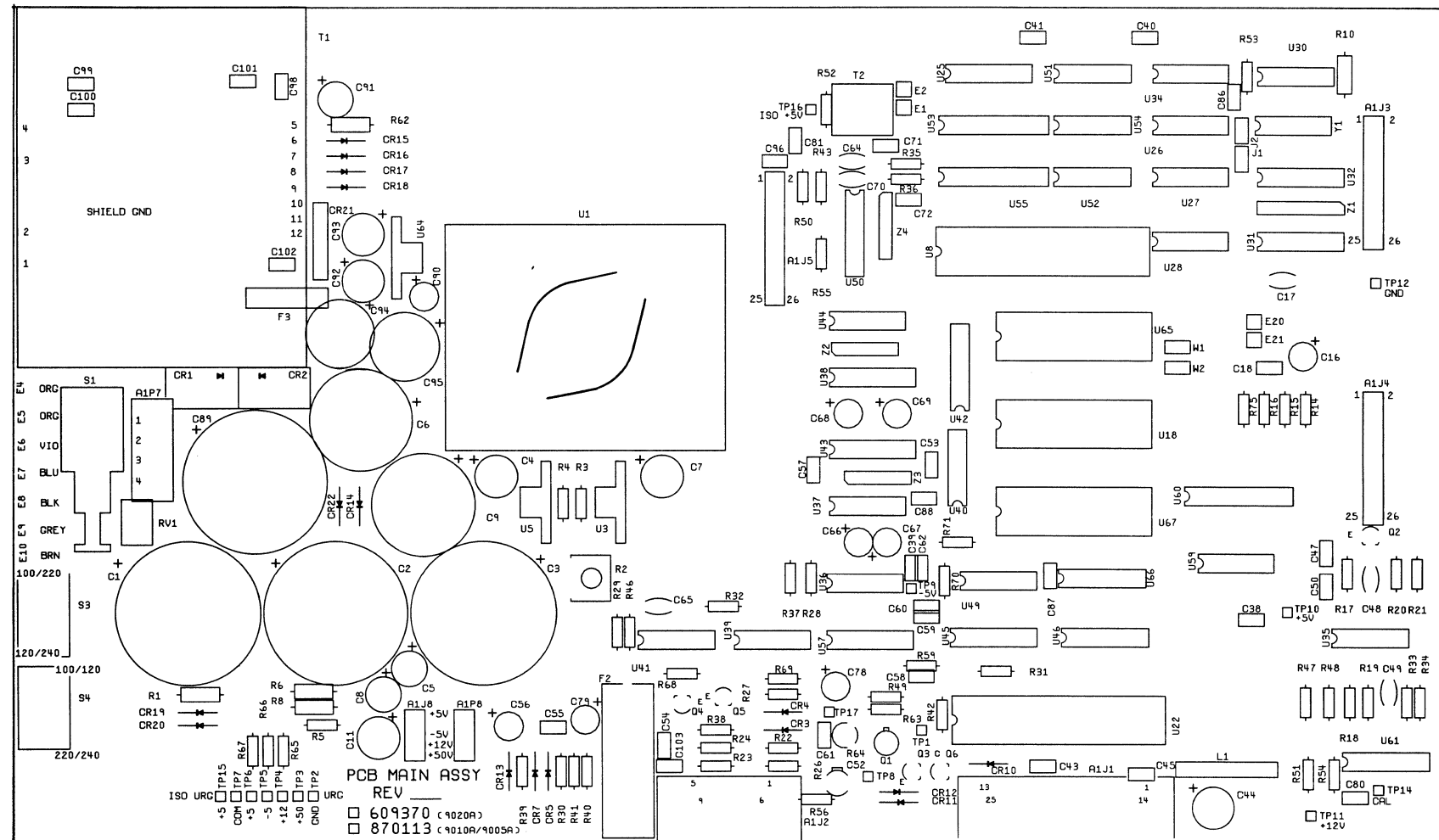
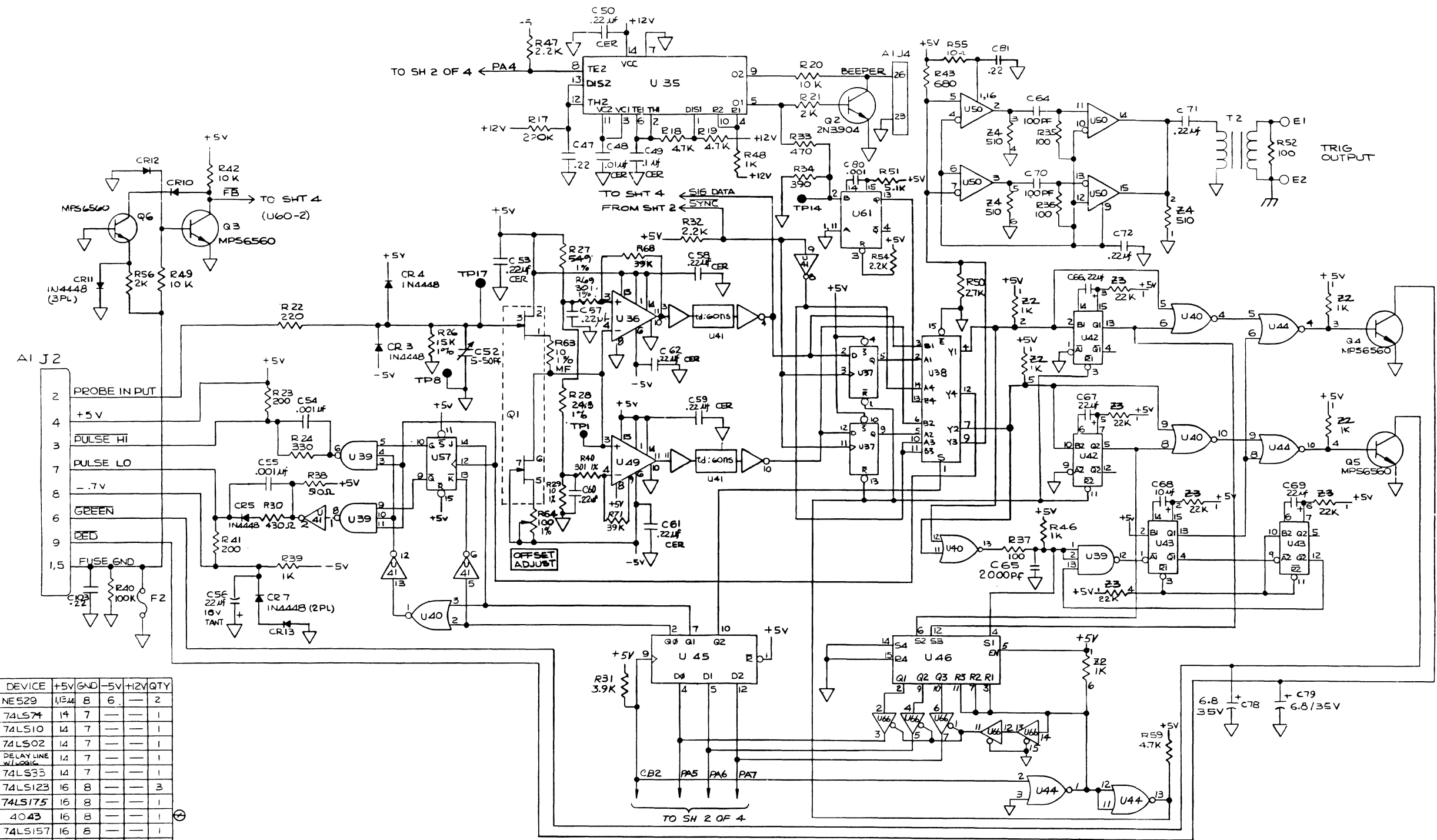


Figure 8-2. A1 Main PCA (cont)

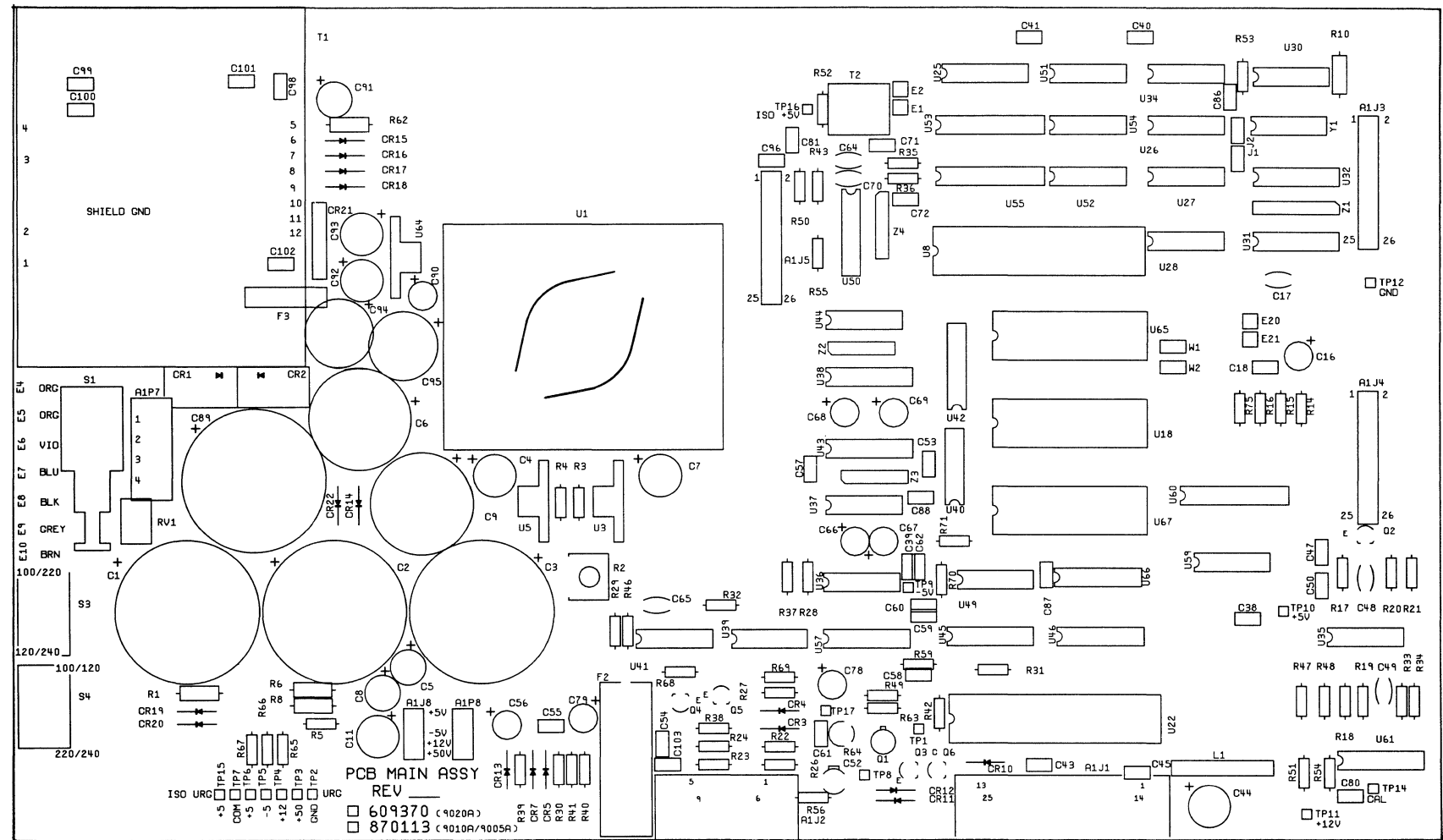


DES	DEVICE	+5V	GND	-5V	+12V	QTY
U 36,49	NE529	1,13,14	8	6	—	2
U 37	74LS74	14	7	—	—	1
U 39	74LS10	14	7	—	—	1
U 40	74LS02	14	7	—	—	1
U 41	DELAY LINE w/LOGIC	14	7	—	—	1
U 44	74LS33	14	7	—	—	1
U61,42,43	74LS123	16	8	—	—	3
U 45	74LS175	16	8	—	—	1
U 46	4043	16	8	—	—	1
U 38	74LS157	16	8	—	—	1
Z2	1K RES.NET.	1	—	—	—	1
Z3	22K RES.NET.	1	—	—	—	1
U 35	NE556	—	7	—	14	1
U 50	10115	—	8	—	—	1
U 57	74LS109	16	8	—	—	1
Z4	510ΩL RES.NET.	1	—	—	—	1
U66	74LS367	16	8	—	—	1

Figure 8-2. A1 Main PCA (cont)

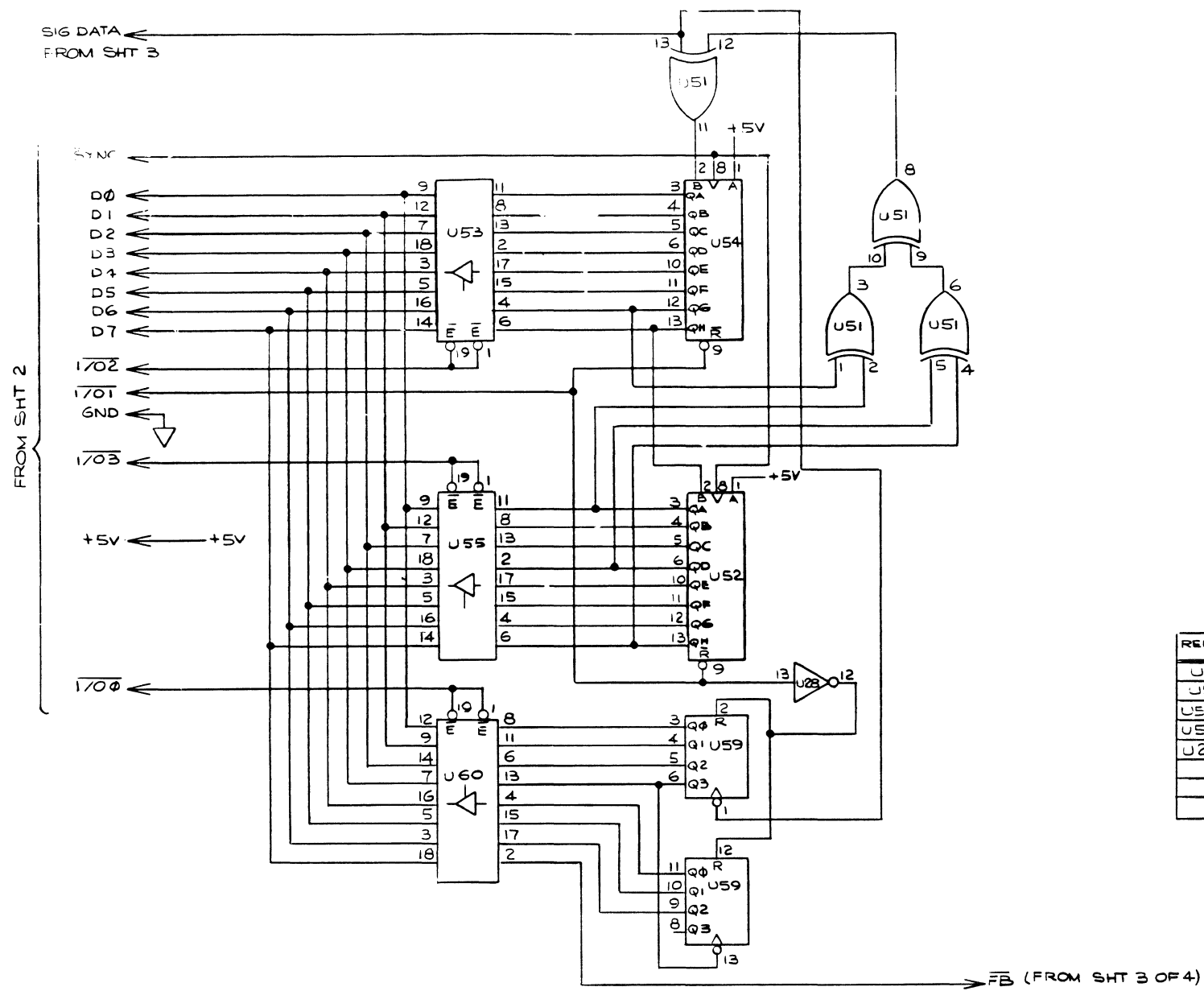


**CAUTION**  
SUBJECT TO DAMAGE BY  
STATIC ELECTRICITY



9000A-1611

Figure 8-2. A1 Main PCA (cont)



REF DES	TYPE	+5V	GND
U51	74LS06	14	7
U52,54	74LS164	14	7
U53,55,60	74LS244	20	10
U59	74LS393	14	7
U28	74LS04	14	7

Figure 8-2. A1 Main PCA (cont)

 **CAUTION**  
SUBJECT TO DAMAGE BY  
STATIC ELECTRICITY

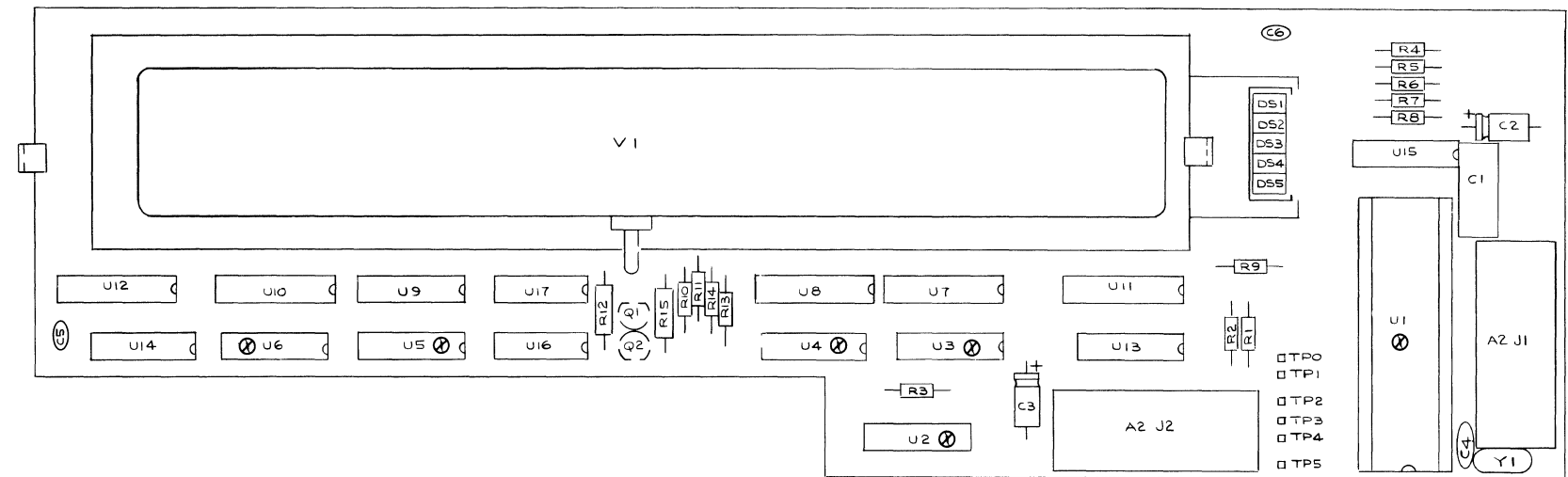
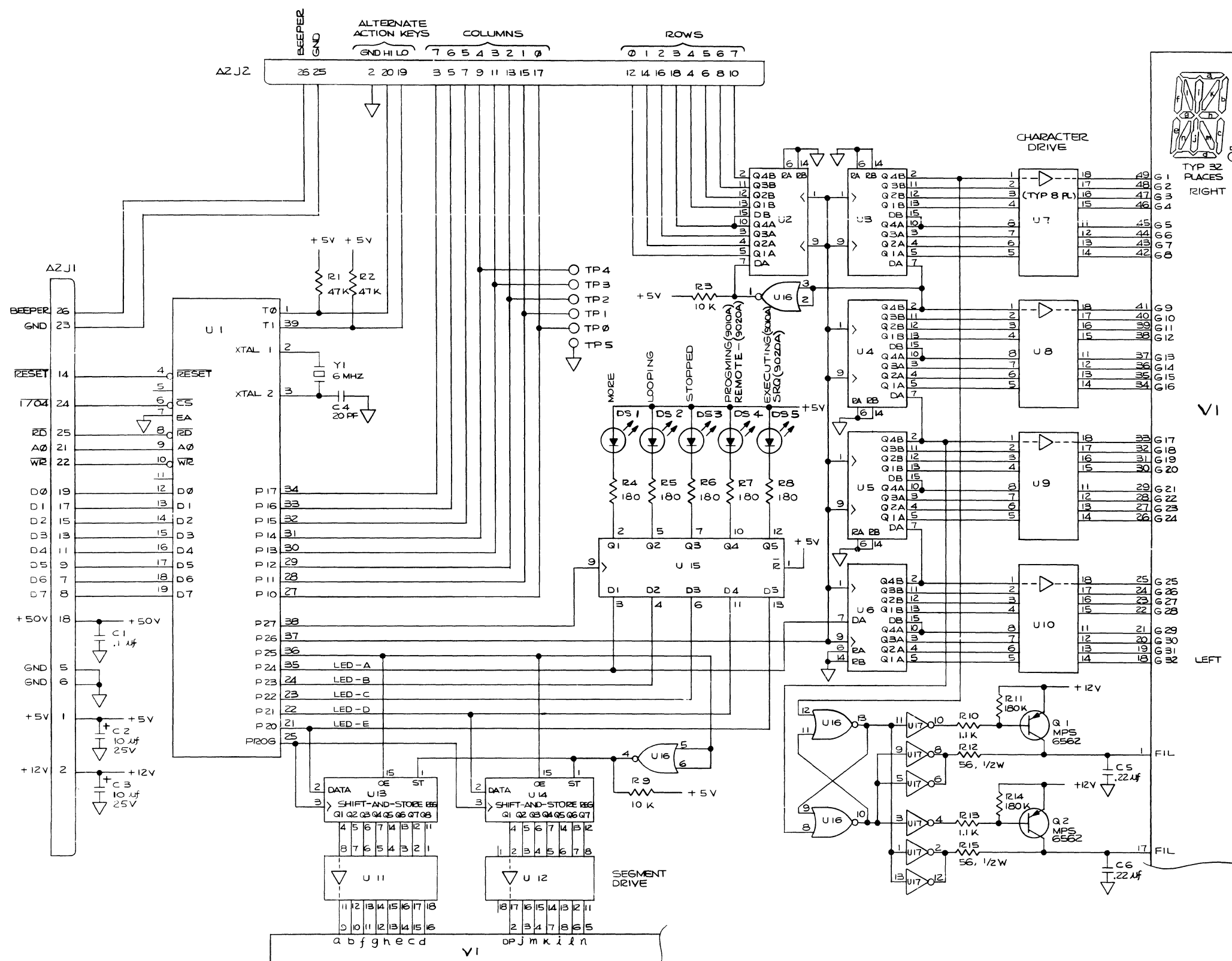


Figure 8-3. A2 Display PCA



NOTES  
 1 UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W. CARBONFILM AND 5%

REF	DES
HIGHEST	NOT USED
U 17	
R 15	
C 6	
Q 2	
DS 5	
Y 1	
J 2	
DSP 1	

REF	TYPE	+5V	GND	+12V	+50V	QTY
U 7,8,9 10,11,12	UDN-6118A	9		10	6	
U 2,3,4 5,6	4015	16	8			5
U 1	8741AH	26,40	20			1
U 13, 14	4094	16	8			2
U 15	74174	16	8			1
U 16	74LS02	14	7			1
U 17	7416	14	7			1

9000A-1002

Figure 8-3. A2 Display PCA (cont)

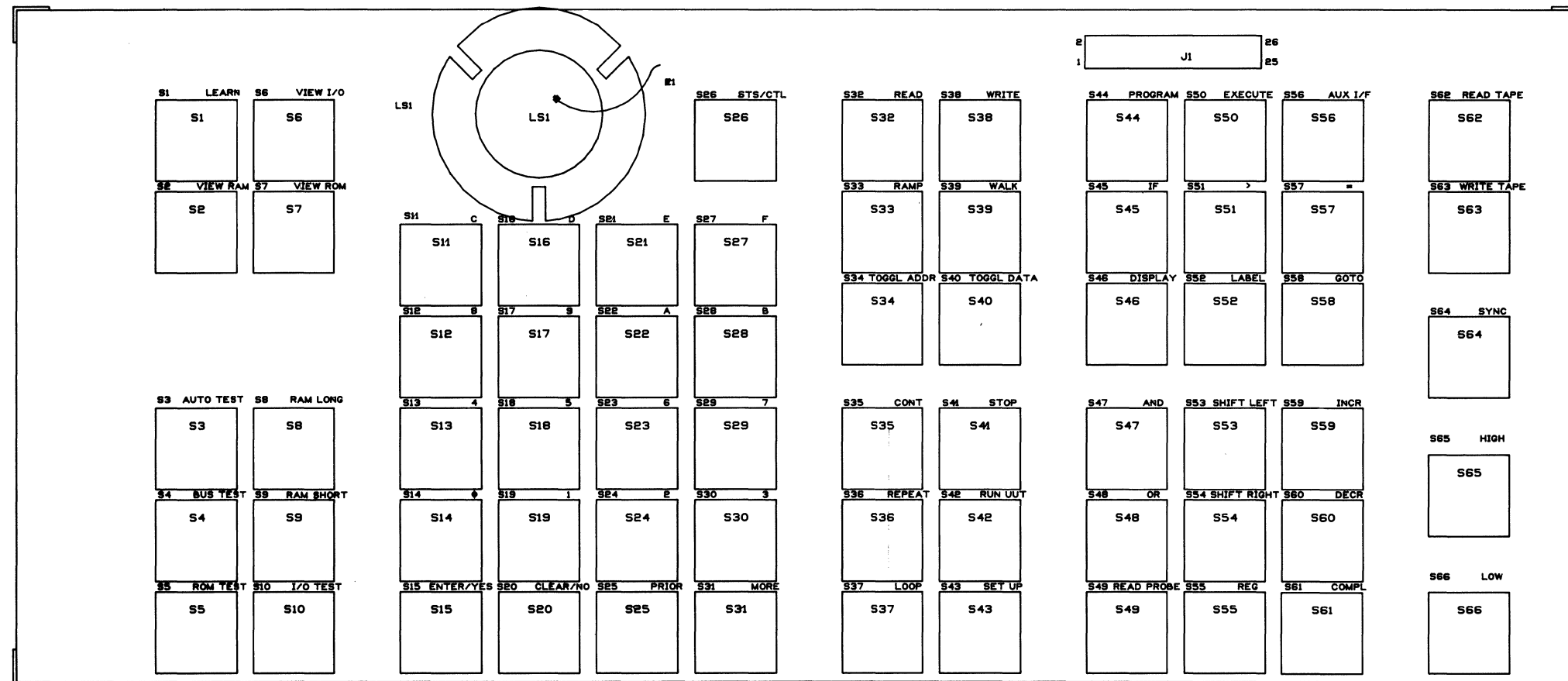
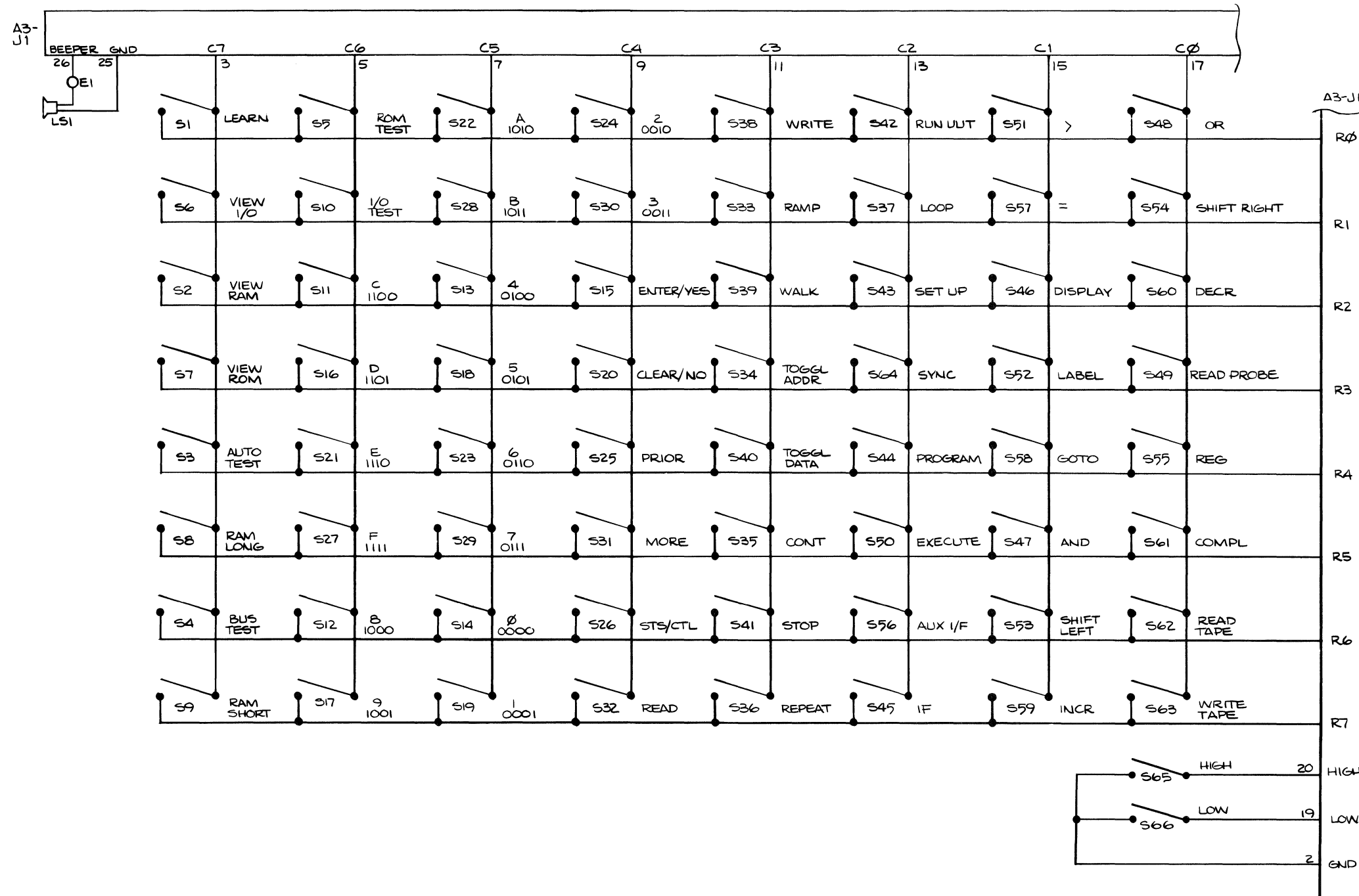


Figure 8-4. A3 Keyboard PCA



9010A-1033

Figure 8-4. A3 Keyboard PCA (cont)

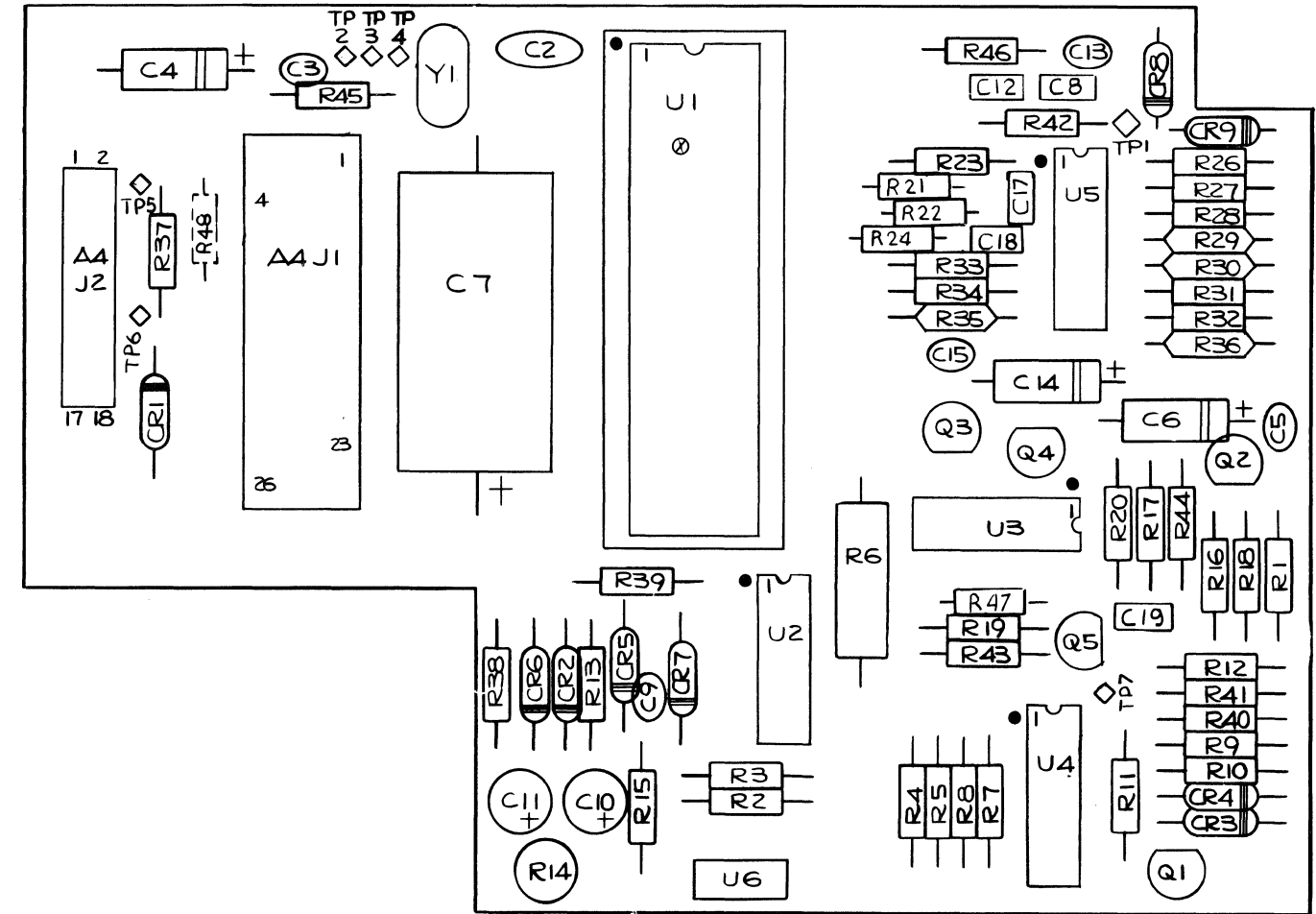
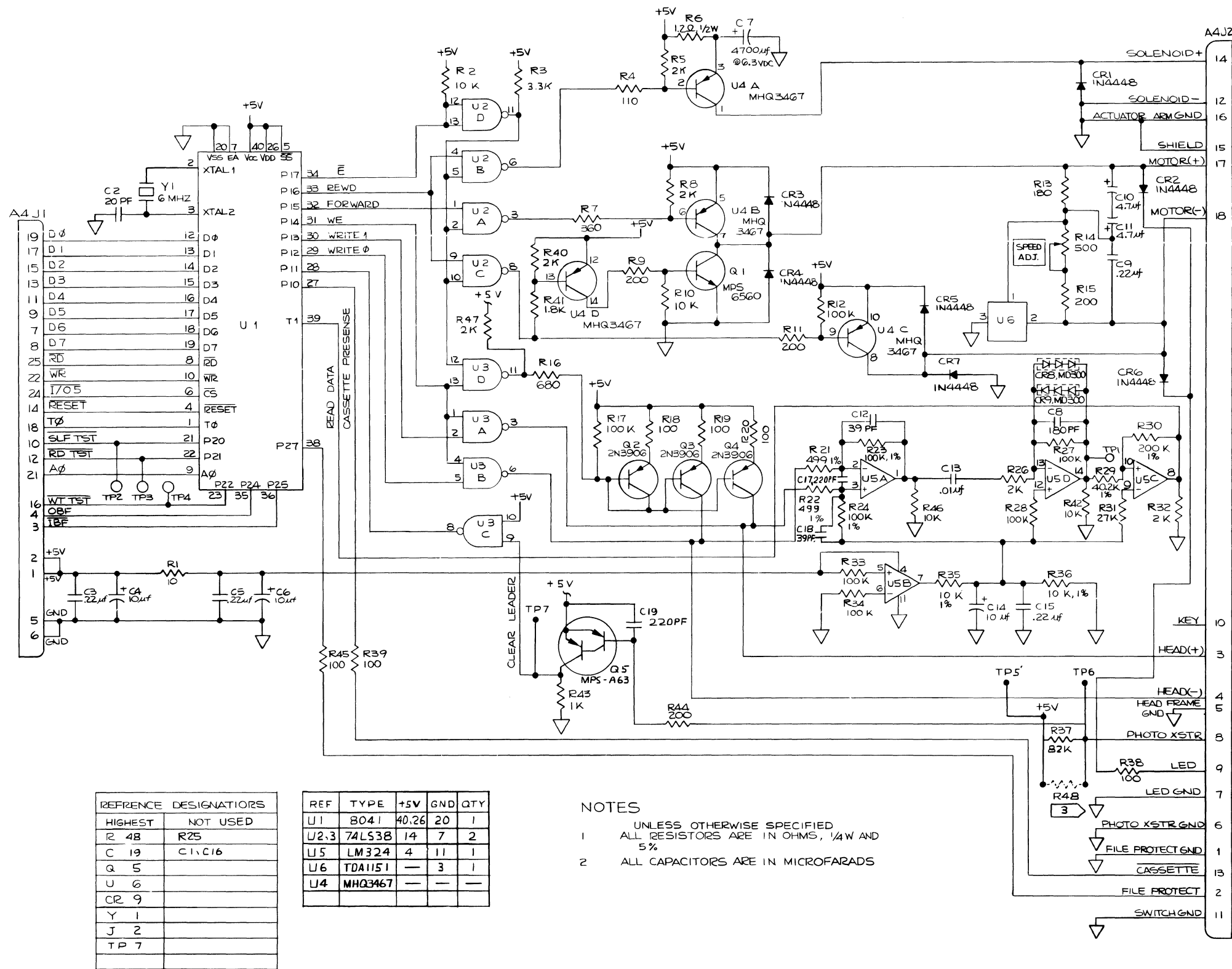


Figure 8-5. A4 Magnetic Tape PCA



REFERENCE DESIGNATORS	
HIGHEST	NOT USED
R 48	R25
C 19	C1, C16
Q 5	
U 6	
CR 9	
Y 1	
J 2	
TP 7	

REF	TYPE	+5V	GND	QTY
U1	8041	40.26	20	1
U2,3	74LS38	14	7	2
U5	LM324	4	11	1
U6	TDA1151	—	3	1
U4	MHQ3467	—	—	—

NOTES  
 1 UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W AND 5%  
 2 ALL CAPACITORS ARE IN MICROFARADS

Figure 8-5. A4 Magnetic Tape PCA (cont)



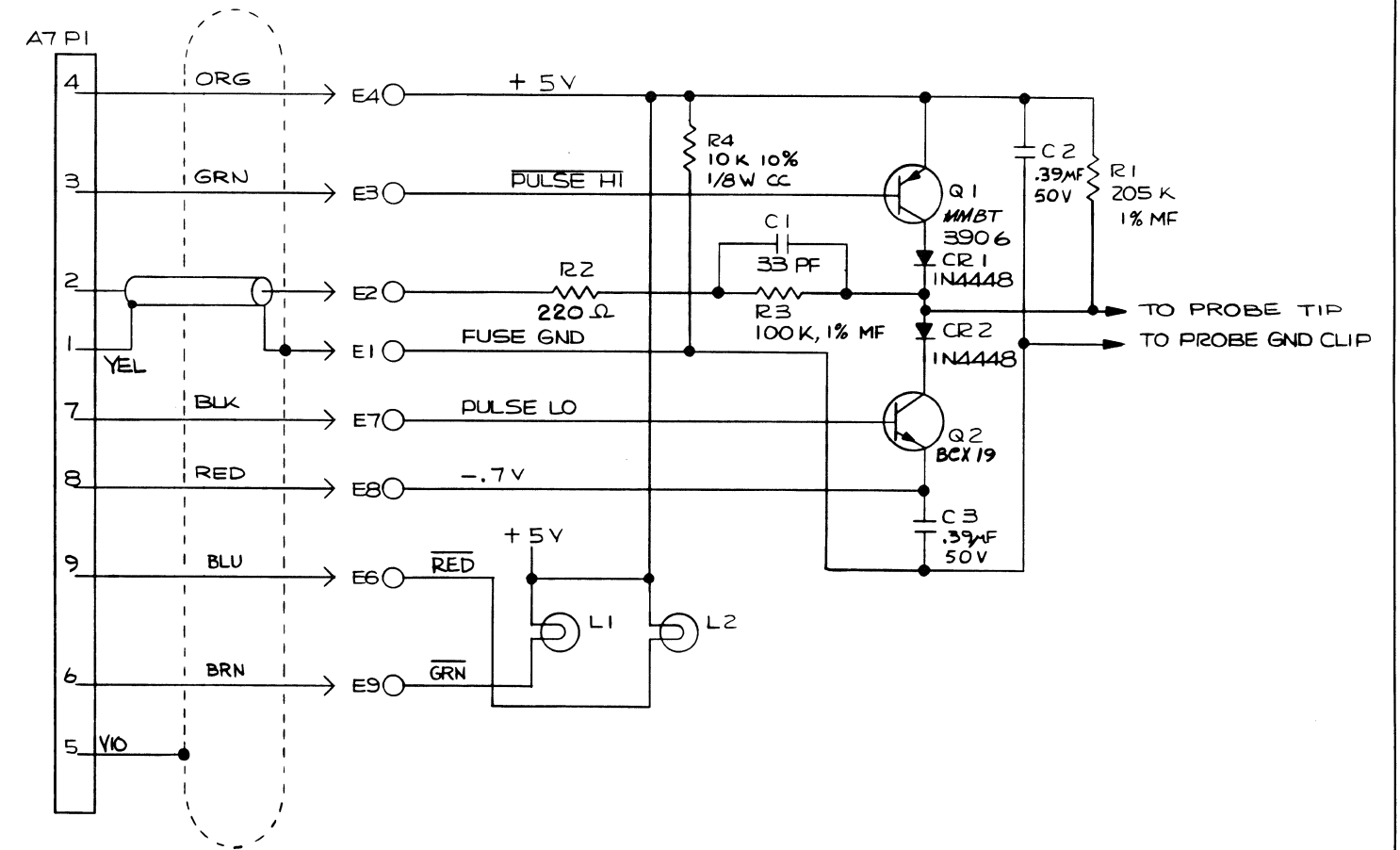
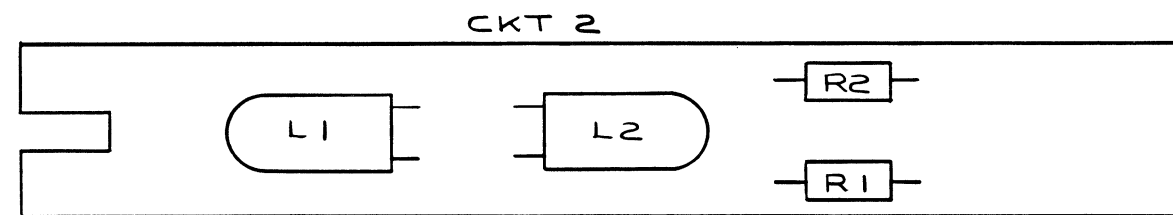
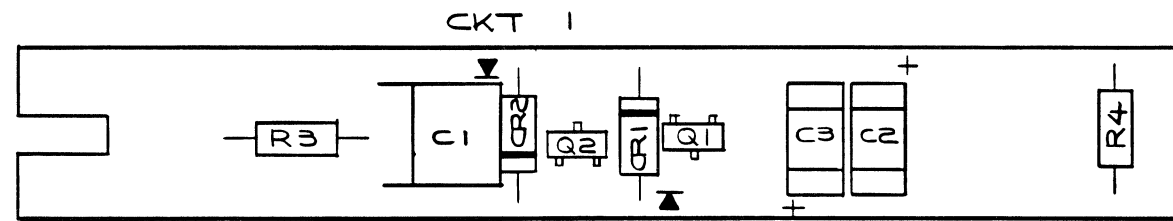
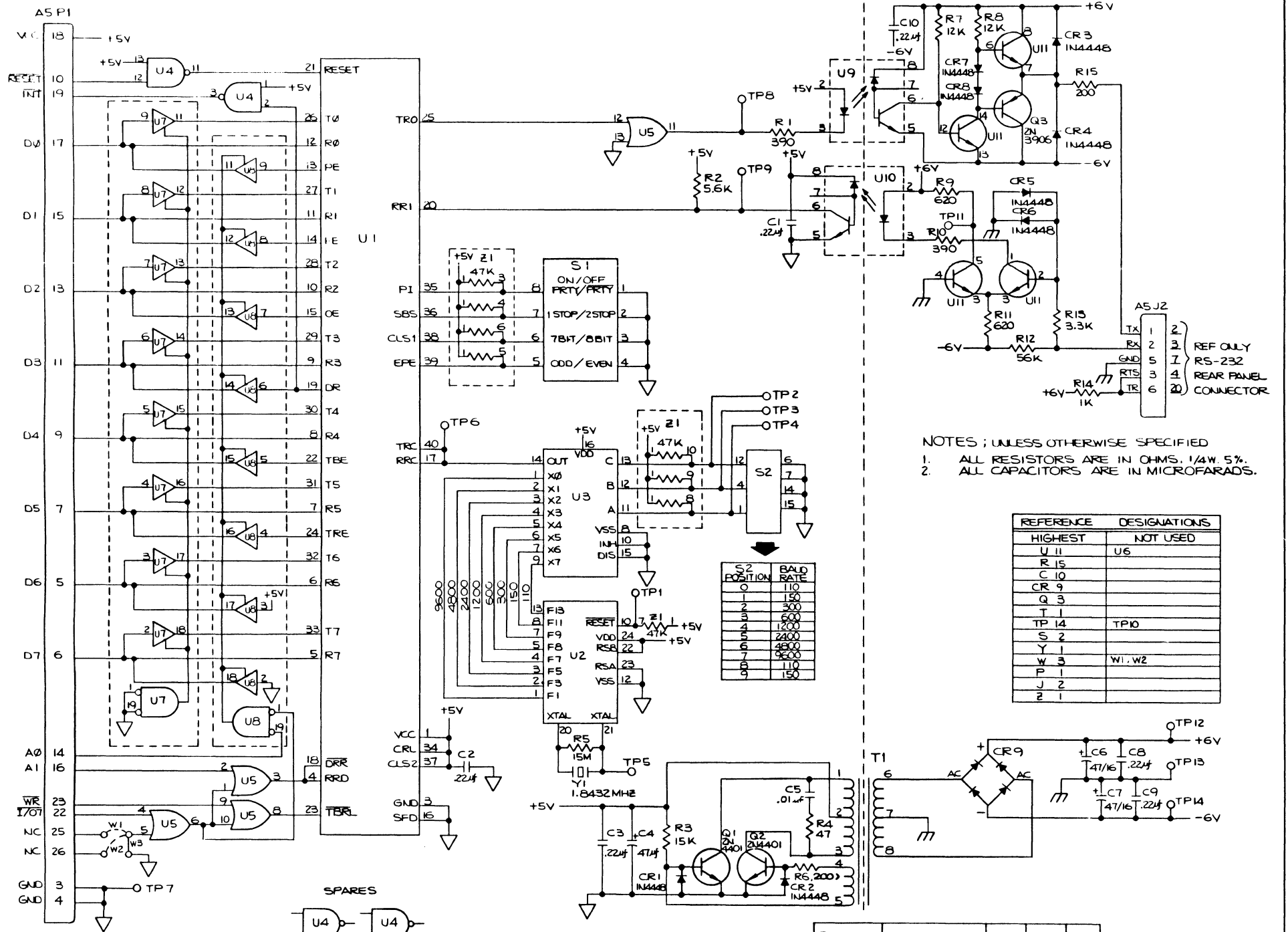
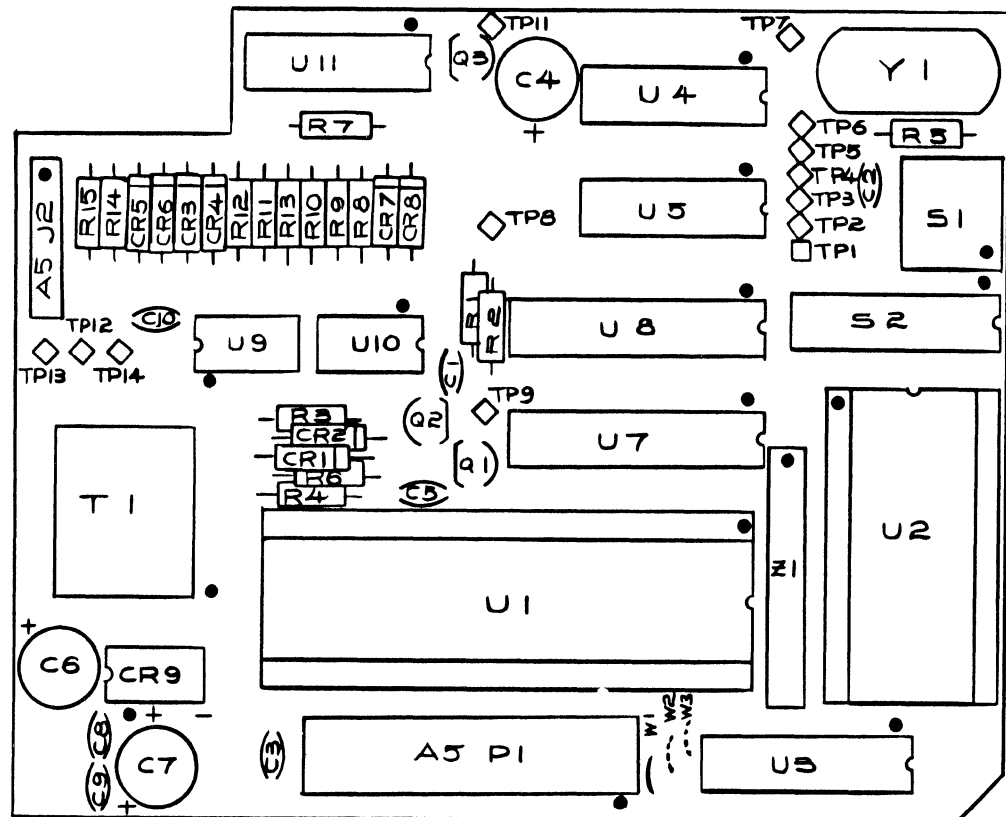


Figure 8-6. A7 Data Probe PCA



NOTES ; UNLESS OTHERWISE SPECIFIED  
 1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.  
 2. ALL CAPACITORS ARE IN MICROFARADS.

HIGHEST	NOT USED
U 11	U 6
R 15	
C 10	
CR 9	
Q 3	
T 1	
TP 14	TP10
S 2	
Y 1	
W 3	W1, W2
P 1	
J 2	
Z 1	

S2 POSITION	BALD RATE
0	110
1	150
2	300
3	600
4	1200
5	2400
6	4800
7	9600

REF DES	DEVICE	+5V	GND	QTY
U1	6402	1	3	1
U2	MC14411	24	12	1
U3	MC 4512 B	16	8	1
U4	74LS00	14	7	1
U5	74LS32	14	7	1
U7,8	74LS541	20	10	2
U9,10	HP 6N136			2
U11	CA 3046			1

9000A-1605

**CAUTION**  
 SUBJECT TO DAMAGE BY  
 STATIC ELECTRICITY

9000A-1005

Figure 8-7. Option -001, RS-232 Interface PCA

