9010A

Micro-System Troubleshooter

Service Manual

NOTE

This manual documents the Model 9010A and its assemblies at the revision levels shown in Section 7A.

9010A

Micro-System Troubleshooter

Service Manual

P/N 609297
APRIL 1982 Rev. 1 8/86

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 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

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

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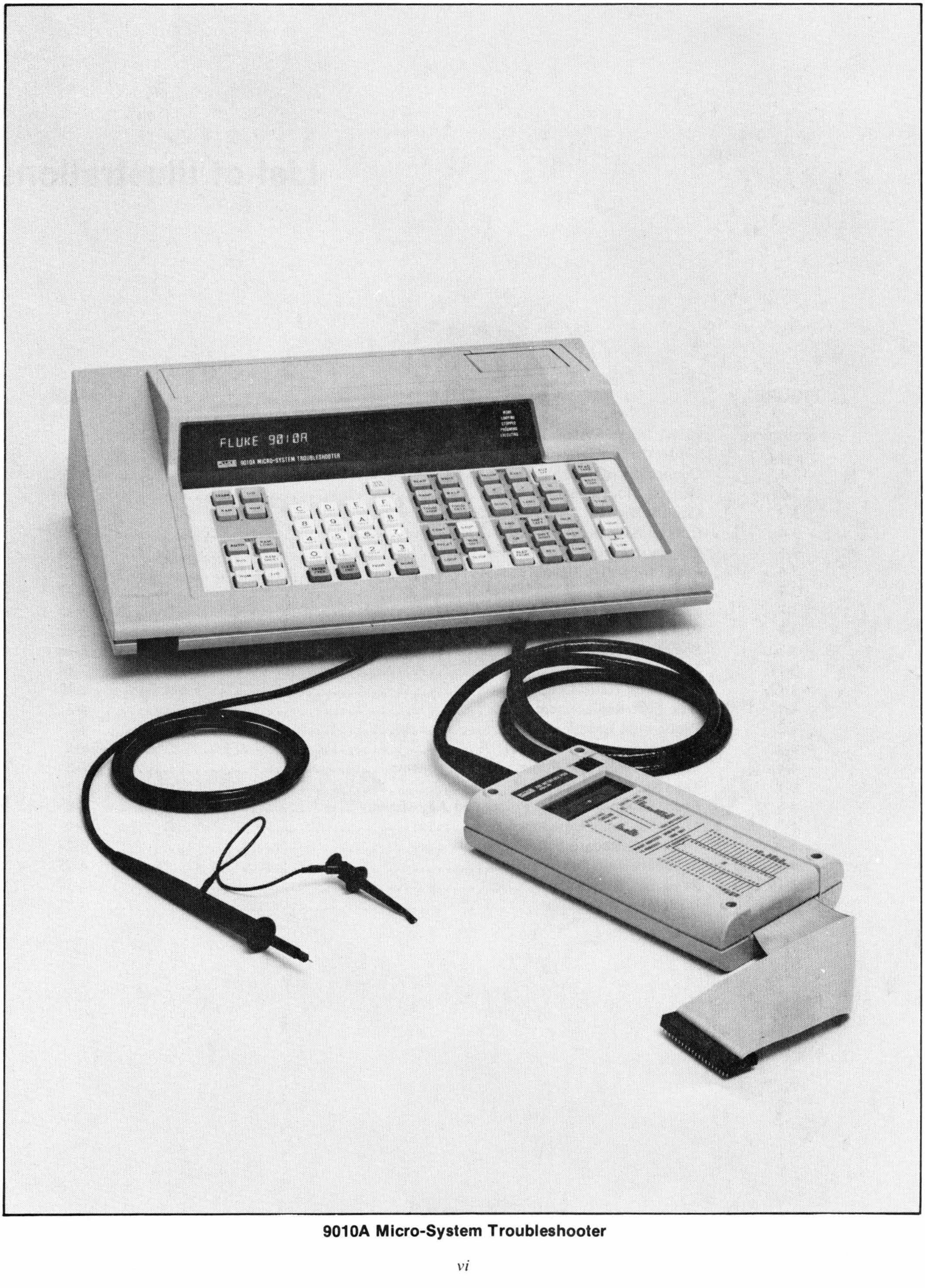


9010A Micro-System Troubleshooter

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

DISPLAY	32 character, 14 segment alphanumeric with decimal points.
KEYBOARD FUNCTIONS	
Data Entry	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.
Mapping UUT Memory	
LEARN	Locates and identifies RAM, and I/O read-write registers. Computes ROM signatures and identifies read/writable I/O bits.
Viewing UUT Memory	
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 checkerboard 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)

Selecting UUT-Specific Operations	
SETUP	Allows the operator to select specific 9010A error detection and operating features to meet the requirements of a particular UUT.
Cassette Tape Operations	
READ TAPE	Reads information from cassette tape into 9010A memory.
WRITE TAPE	Writes information from 9010A memory onto cassette tape.
Probe Controls	
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.
RS-232 Interface Option Control	
AUX I/F	Controls transfer of data over RS-232 Interface (if installed).
CASSETTE TAPE	Minicassettes store UUT memory map information, setup parameters, and program. Minicassette type: Verbatim.
PROBE	
General	Single-point stimulus and response probe.
STIMULUS	Pulse high, low, or toggle between high and low.
RESPONSE	Signature computation, logic states detected, event count.
Stimulus Mode	
STIMULUS PULSE WIDTH	
Address or data-valid sync	Equals address-valid or data-valid interval of the interface pod μP.
Free-run	2 μsec nominal.
STIMULUS PULSE AMPLITUDE	
High	>4V at +100 mA
Low	<0.2V at -100 mA
Response Mode	
INDICATOR THRESHOLD	
Logic High (Red)	>2.4V
Logic Low (Green)	<0.8V
Logic Tristate	<2.4V and >0.8V
INDICATOR THRESHOLD ACCURACY	±0.2V
INDICATOR MINIMUM PULSE WIDTH	
Logic High	>75 ns
Logic Tristate	>100 ns
Logic Low	>75 ns
Maximum Safe Input Voltage at Probe Tip	-30V dc to +30V dc
Probe Fuse	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)

9010A OPERATOR-ACCESSIBLE MEMORY	
Tape-Transferable Memory	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.
Registers	Sixteen 32-bit registers.
GENERAL	
Power Requirements	100, 120, 220 or 240V ac ±10% 50 or 60 Hz ± 5% 40 Watts maximum
Size	11.7x38.7x31.1cm. (HXWXL) (4.6x15.25x12.25in.) See Figure 1-2.
Weight	5 kg. (11 lb.)
Environmental	
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)
	NOTE: All relative humidity (RH) conditions are non-condensing.

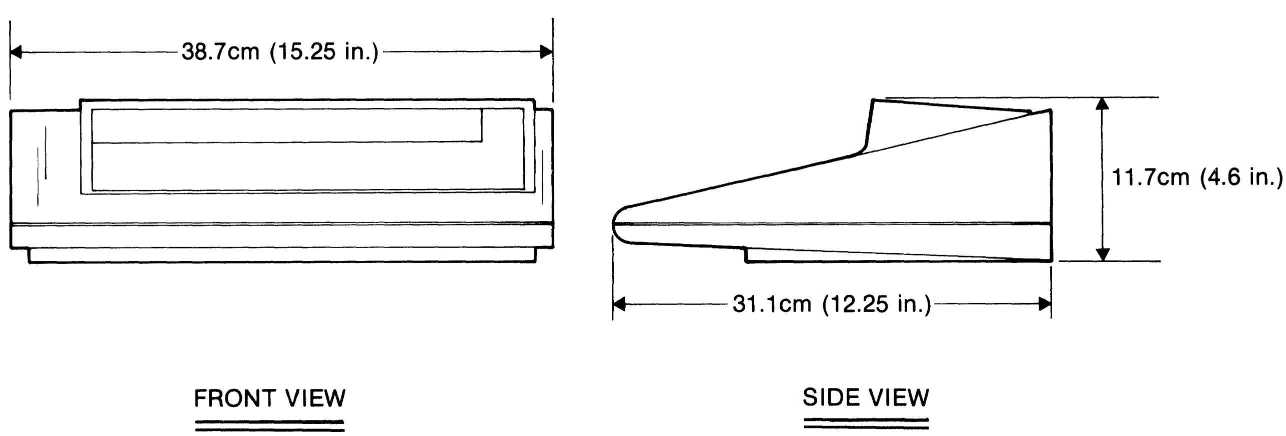


Figure 1-1. 9010A Outline Drawing

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 7 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 your nearest Fluke Sales Representatives (see Section 7) or 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.

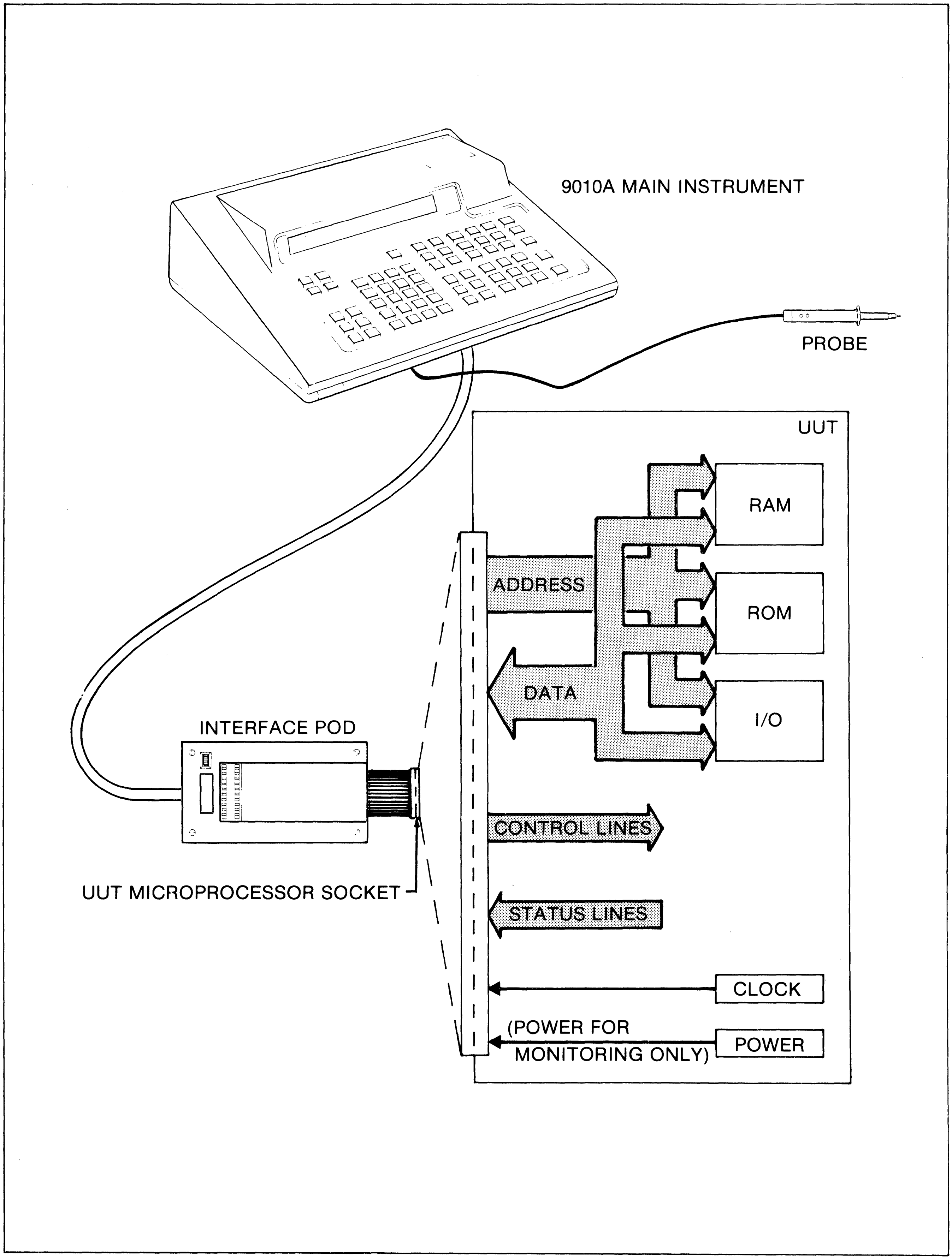


Figure 3-1. Connection of Troubleshooter to UUT

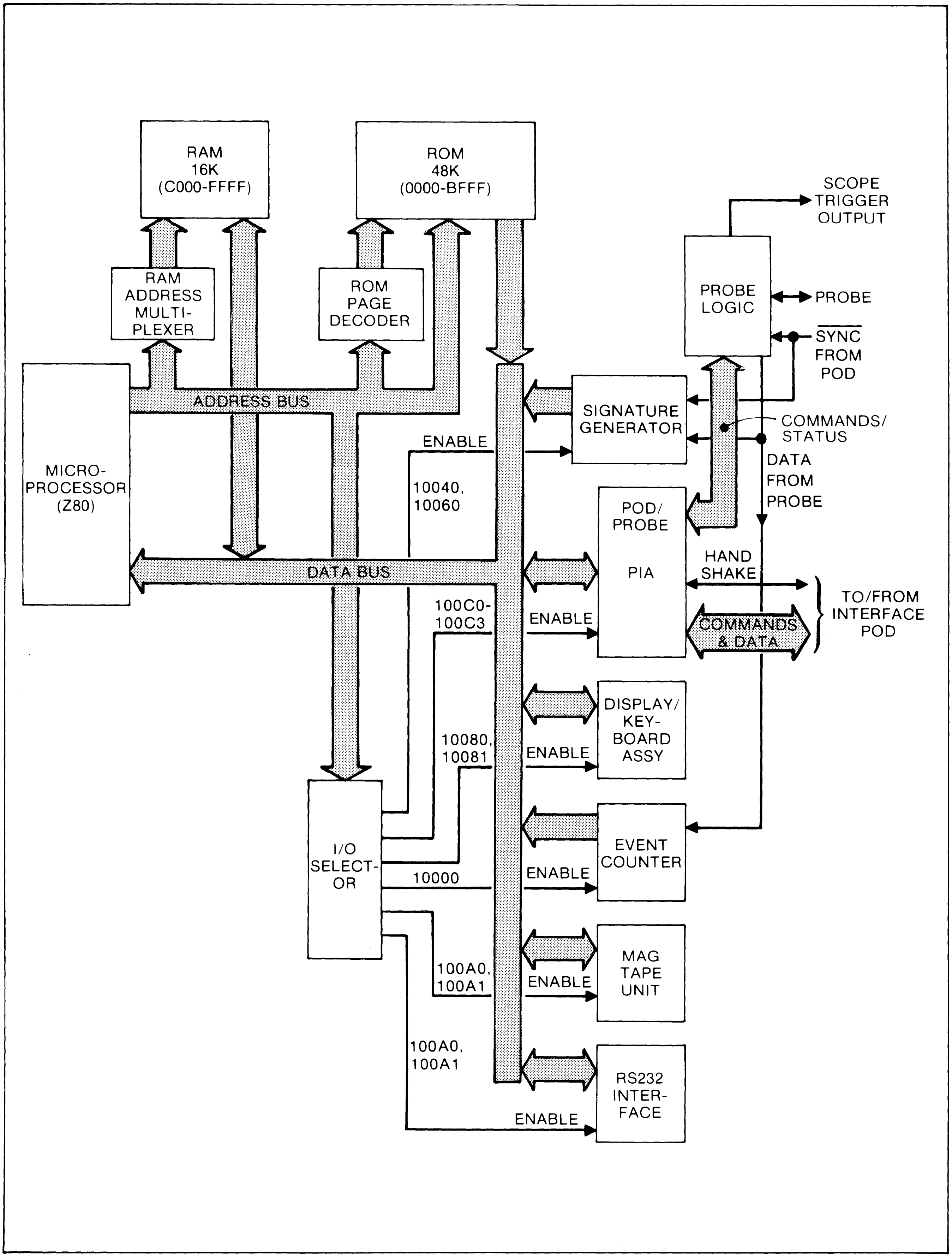


Figure 3-2. General Block Diagram

- 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, RFSH/RAM control, memory page selector, RAM address 2:1 multiplexer, 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, the RFSH/RAM control circuit, 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. MEMORY PAGE SELECTOR

3-40. When enabled by the logic signal RFSH•MREQ the memory page selector, U62, produces an enable signal to an addressed memory device while inhibiting all other memories. The memory page selector, a ROM, decodes address lines A13, A14, and A15 to produce corresponding outputs and enable the memory devices in 8K byte pages. (See Table 4-13). In addition to enabling ROM devices located on the Main PCB Assembly, the memory page selector enables devices located on the Piggy-Back ROM Assembly when addressed by the microprocessor.

3-41. Address bus lines A0 - A13 connect to all memory devices. As a result, all memory devices receive the same address information. However, only the device enabled by the output of the memory page selector outputs data onto the data bus, D0 - D7. (The memory page selector also produces a valid RAM address, VRA, signal to the RFSH/RAM control circuit when the microprocessor addresses page 6 or 7, C000-FFFF, of memory.)

3-42. REFRESH/RAM CONTROL CIRCUIT

3-43. The function of the RFSH/RAM control circuit is to furnish the control signals required for proper operation of the dynamic RAM, U9 - U16. In addition to the clock signal, the RFSH/RAM control circuit, made up of U26, U28 and U29, also receives the $\overline{\text{RFSH}}$ (refresh) and $\overline{\text{MREQ}}$ (memory request) signals from the microprocessor.

3-44. The control signals required by the RAM allow the application of two different addresses (row and column) at the same RAM inputs, but at different times. The RAM (addresses COOO through FFFF) requires a row address followed by a column address in order to perform a read or write at a specific address. Before the microprocessor initiates a read or write operation, the $\overline{\text{RAS}}$ (row address strobe) and $\overline{\text{CAS}}$ (column address strobe) lines to the RAM are high, and the RE (row enable) line to the 2:1 multiplexer, U23 and U24, is low.

3-45. When the microprocessor initiates a RAM read or write operation, the memory page selector, U62, accepts the RAM address placed on lines A13, A14, and A15 and produces a memory page $\overline{6}$ or page $\overline{7}$ output. The page $\overline{6}$ or $\overline{7}$ outputs produce the VRA (valid RAM address) signal which enables the RFSH/RAM control circuit to produce a low-going $\overline{\text{RAS}}$ signal. The $\overline{\text{RAS}}$ signal causes the RAM to accept the output (A0' - A6') of the 2:1 multiplexer as the row address. Figure 3-4 shows the relationship of microprocessor signals used during RAM operations.

3-46. The 2:1 multiplexer accepts address lines A0 - A13 and selects either A0 - A6 or A7 - A13 for connection to the address inputs of the RAM, depending upon the state of the RE signal. A low RE signal causes the 2:1 multiplexer to connect address bus lines A0 - A6 to the RAM. A high RE signal causes the 2:1 multiplexer to connect address bus lines A7 - A13 to the RAM. With the RE signal initially low, address bus lines A0 - A6, which contain the RAM row address, are connected to the address inputs of the RAM at the time of the $\overline{\text{RAS}}$ signal.

3-47. One-half a clock cycle after a $\overline{\text{RAS}}$ pulse, the RFSH/RAM control circuit produces a high RE signal. The high RE signal causes the 2:1multiplexer to connect address bus lines A7 - A13, which contain the RAM column address, to the address inputs of the RAM. One-half cycle after the RE signal goes high, the low-going $\overline{\text{CAS}}$ signal causes the RAM to accept the multiplexer output (A0 - A6) as the column address.

3-48. During the refresh portion of the microprocessor fetch cycle, the microprocessor applies a refresh address to the lowest seven address lines. These address lines are in-turn applied to the RAM devices via 2:1 multiplexer since the RE signal is low during the refresh cycle. The microprocessor changes this address each fetch cycle until all 128 rows are addressed and then repeats the cycle. During refresh, the RFSH/RAM control circuit produces only the $\overline{\text{RAS}}$ and RE signals, with the $\overline{\text{CAS}}$ signal inhibited as a result of the $\overline{\text{RFSH}}$ signal from the microprocessor.

3-49. I/O SELECTOR

3-50. 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:

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

3-51. 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.)

3-52. 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.

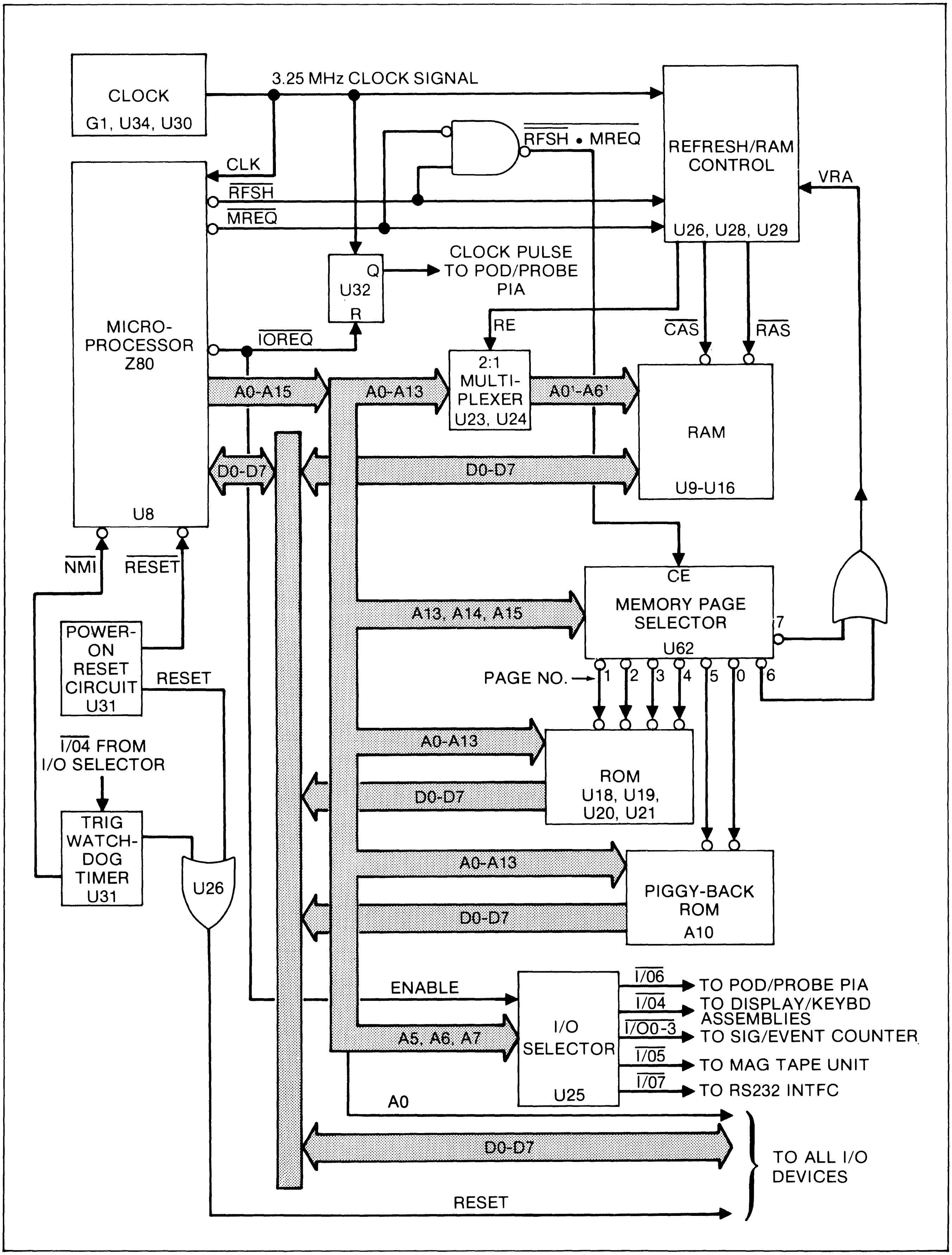


Figure 3-3. Control Section

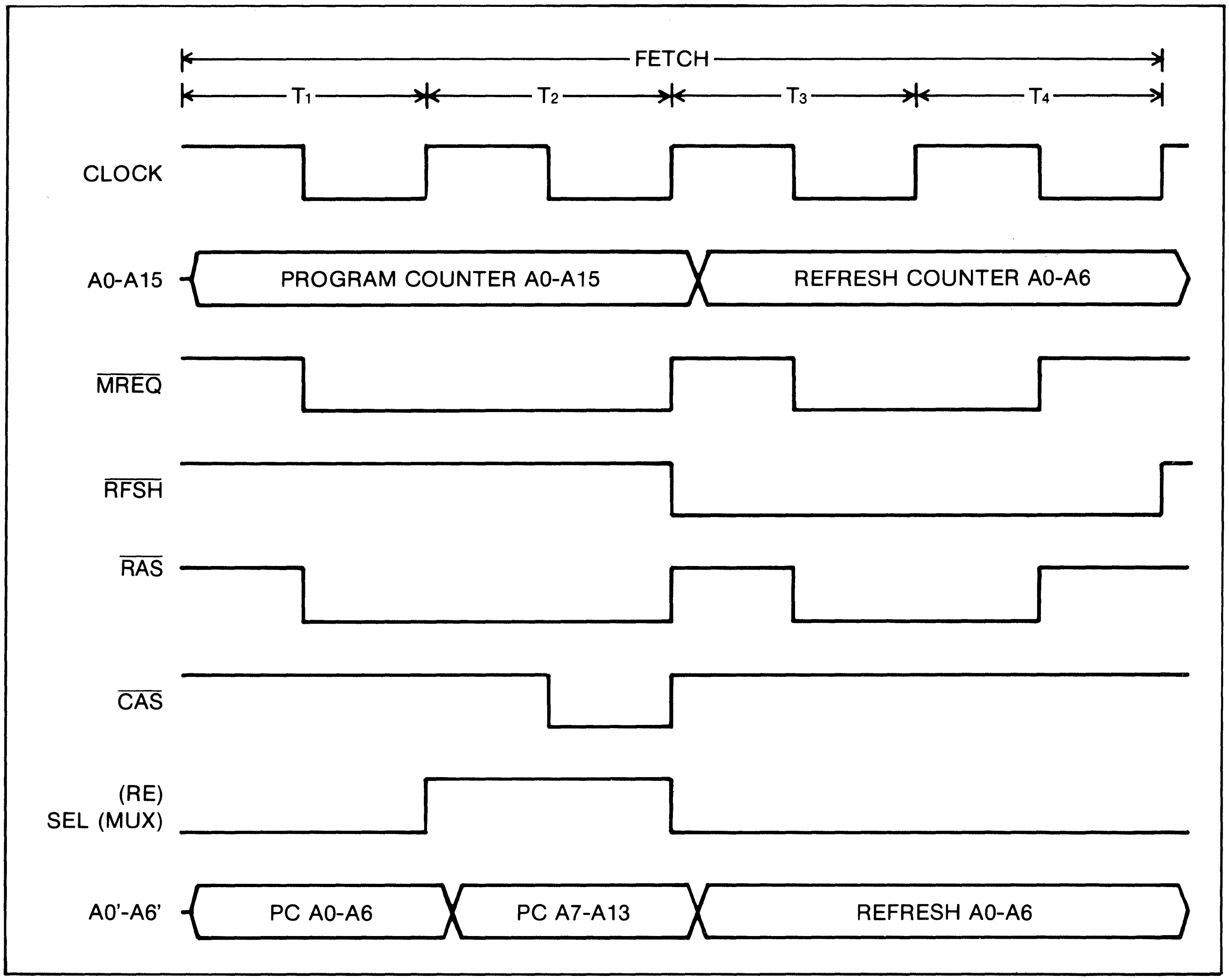


Figure 3-4. Control Section Signals

3-53. POWER-ON RESET CIRCUIT

3-54. 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 RESET and $\overline{\text{RESET}}$ signal. The $\overline{\text{RESET}}$ signal is fed to the $\overline{\text{RESET}}$ input of the microprocessor, while the RESET signal is fed via U26 to each I/O device.

3-55. WATCHDOG TIMER

3-56. 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.

3-57. 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 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.

3-58. Display/Keyboard Assembly

3-59. 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.

3-60. 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 3-5, 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

3-61. The troubleshooter display is a 14-segment, 32-character, vacuum flourescent display having 14 commonly-connected segment and one decimal point enable lines and 32 individual character select lines. To 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.

3-62. 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.

3-63. The peripheral microcomputer refreshes the display at a 61.5 Hz rate while also controlling the annunciators (MORE, LOOPING, STOPPED, PROGMING, 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 annuciators by writing and clocking high and low inputs to the latches.

3-64. 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.

3-65. 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.

3-66. 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 varing 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).

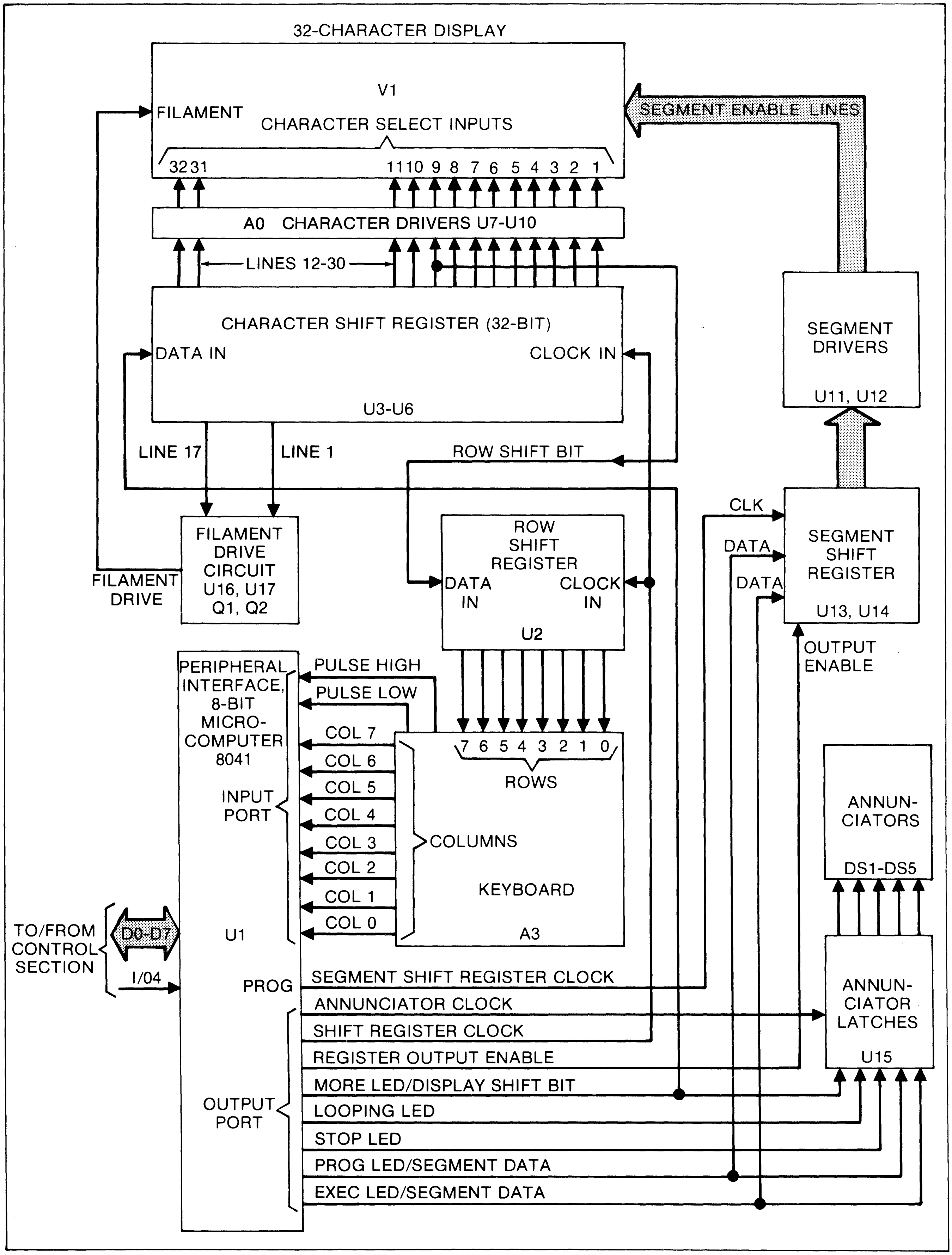


Figure 3-5. Display/Keyboard Assemblies

3-67. Pod/Probe PIA

3-68. 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 3-6, 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 $\overline{\text{RD}}$ line of the microprocessor, the $\overline{\text{IOREQ}}$ line of the microprocessor, and the I/O selector (via flip-flop U34).

3-69. 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.

3-70. 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.

3-71. Pod Communication

3-72. 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 $\overline{\text{PODSTAT}}$.

3-73. 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 3-7 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.

3-74. 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 linesA0 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.

3-75. Probe Logic

3-76. 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.

3-77. RECEIVING PROBE TIP SIGNALS

3-78. High, low, and invalid signals applied to the probe tip are fed to an input of the probe logic as indicated in Figure 3-8. 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.

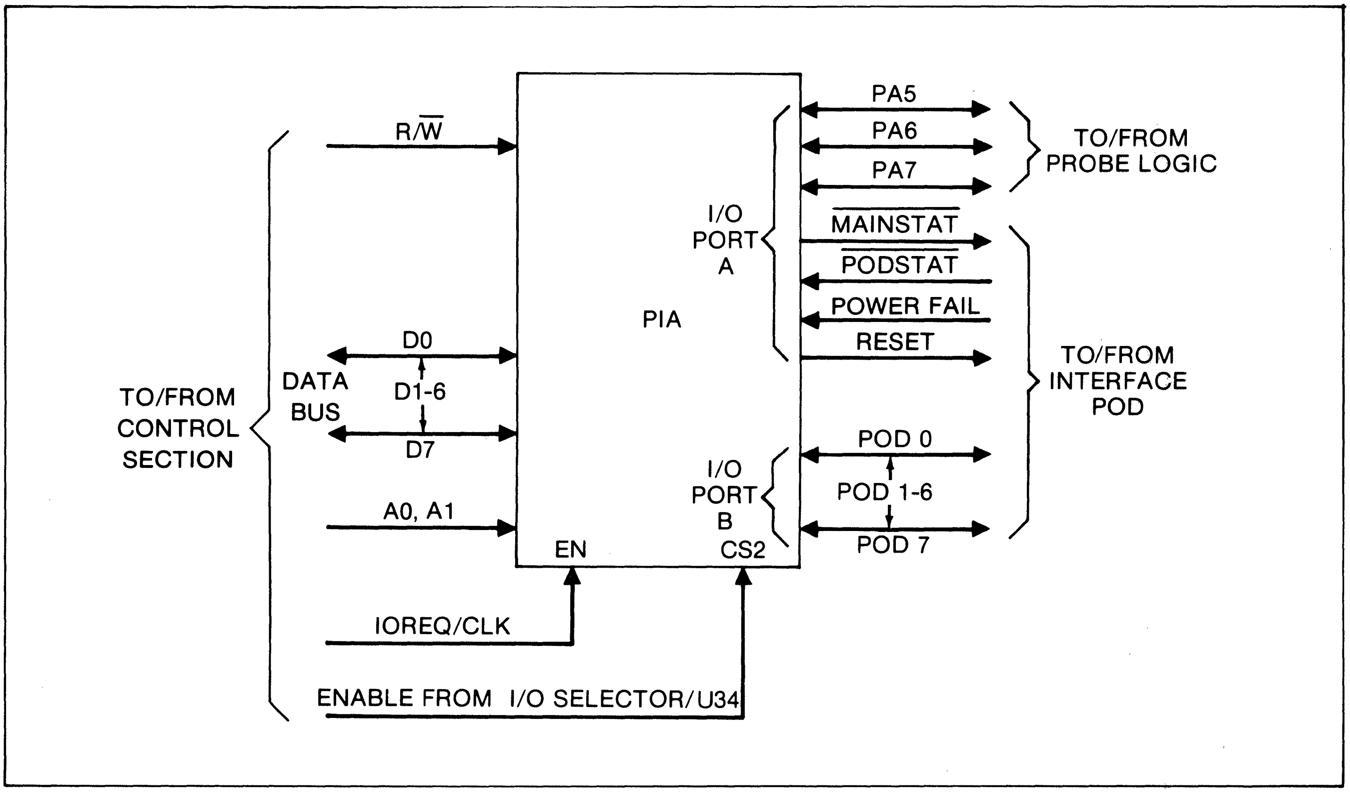


Figure 3-6. Pod/Probe PIA Signals

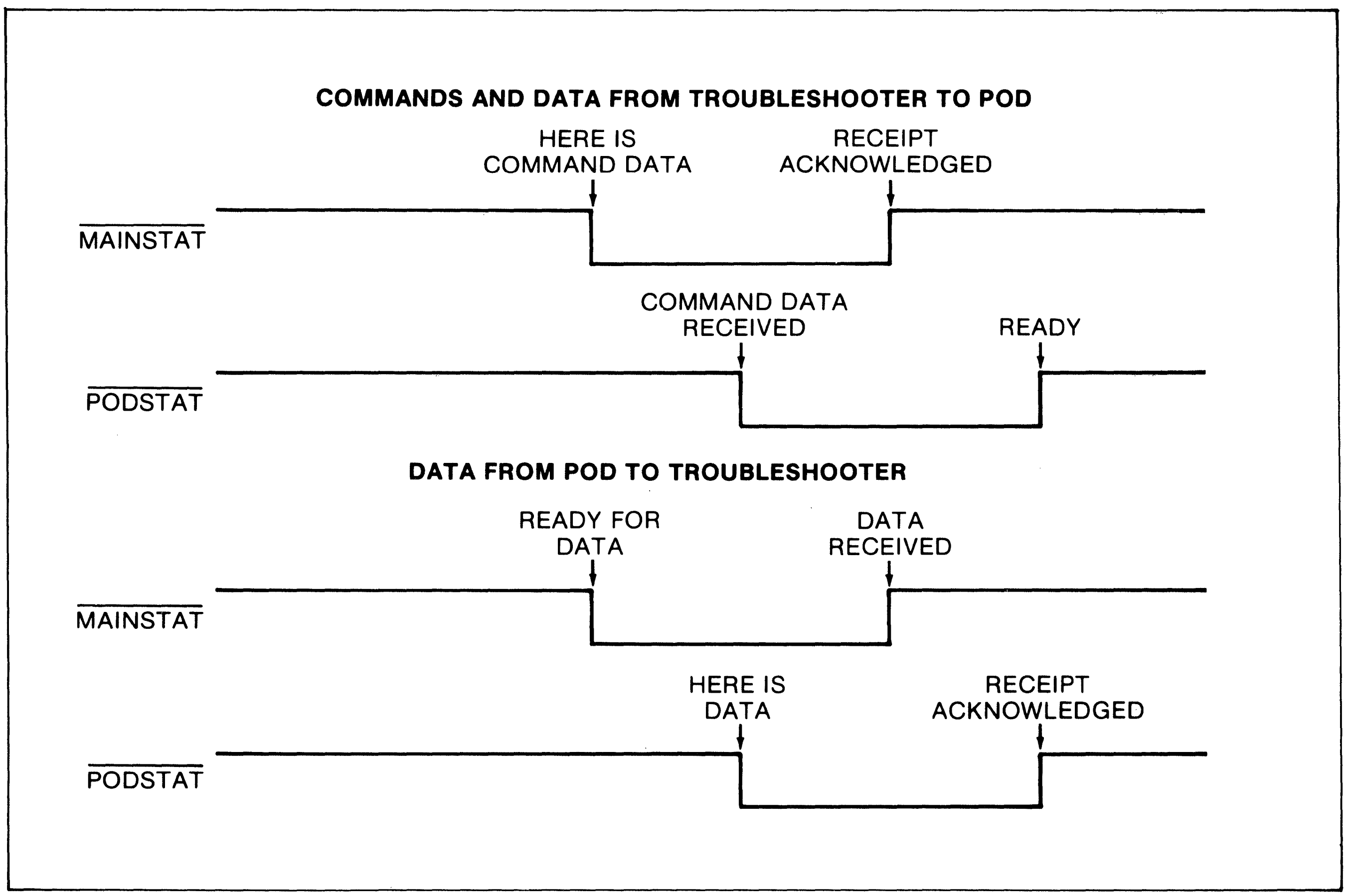


Figure 3-7. MAINSTAT/PODSTAT Signals

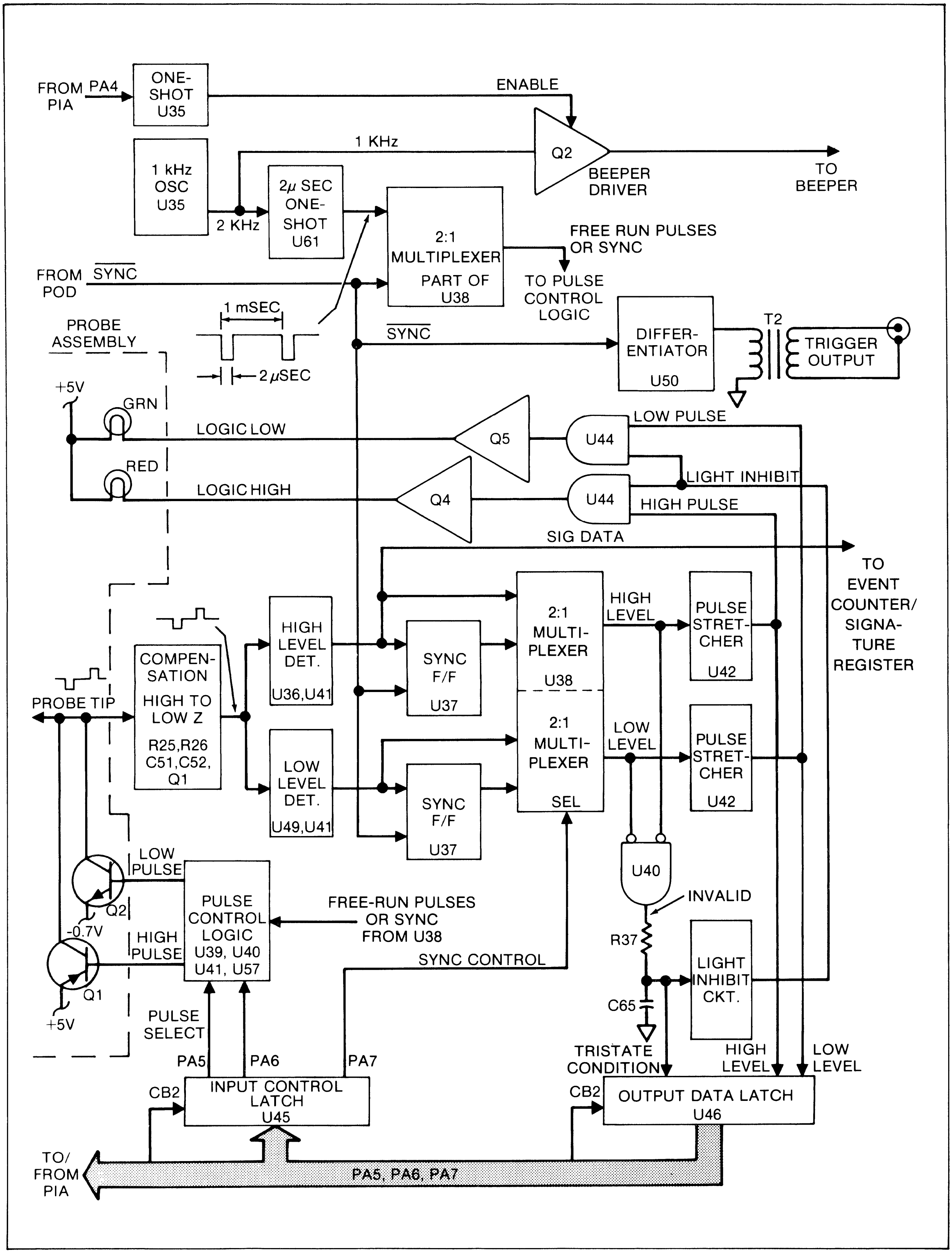


Figure 3-8. Probe Logic

3-79. SYNCHRONIZED/FREE-RUNNING OPERATION

3-80. 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.

3-81. 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 $\overline{\text{SYNC}}$ signal. This set of multiplexer inputs is used during operation in the synchronized mode of probe operation.

3-82. 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.

3-83. PROBE LAMP CONTROL

3-84. 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.

3-85. 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 transistions will not cause the lights to flash.

3-86. The light inhibit circuit consists of two one-shots, each triggered at the occurence 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 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.

3-87. 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.

3-88. 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.

3-89. PROBE FUSE SENSING

3-90. The ground path for the probe contains a fuse, F2. A sensing circuit, shown in Figure 3-9, 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 resister (R4) contained in the probe. The +5 volts turns Q3 on to produce the $\overline{\text{FB}}$ (fuse blown) signal fed to the event buffer shown in Figure 3-10. The microprocessor reads the contents of the event buffer during the read probe operation, and examines the $\overline{\text{FB}}$ (fuse blown) bit for a blown fuse condition. If the $\overline{\text{FB}}$ line is low, the blown probe fuse messages appears on the troubleshooter display.

3-91. 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.

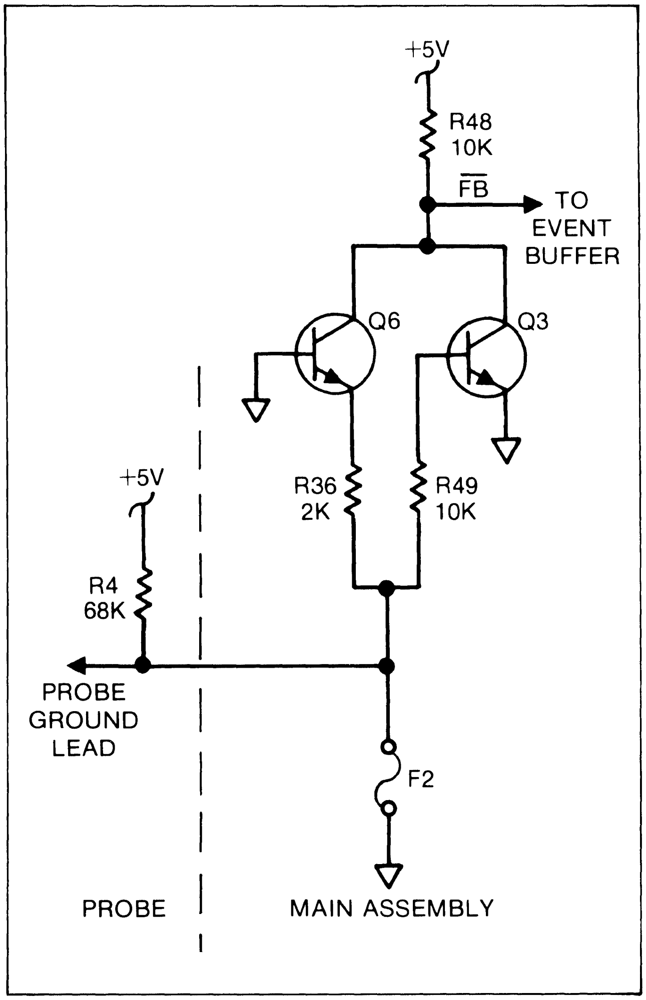


Figure 3-9. Probe Fuse Sensing Circuit

3-92. PROBE STATUS REPORTING

3-93. 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 occurence 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.

3-94. PROBE PULSE GENERATION/CONTROL

3-95. 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.

3-96. 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.

3-97. 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.

3-98. 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.

3-99. SCOPE TRIGGER OUTPUT

3-100. The probe logic includes a differentiator/amplier 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 $\overline{\text{SYNC}}$ 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.

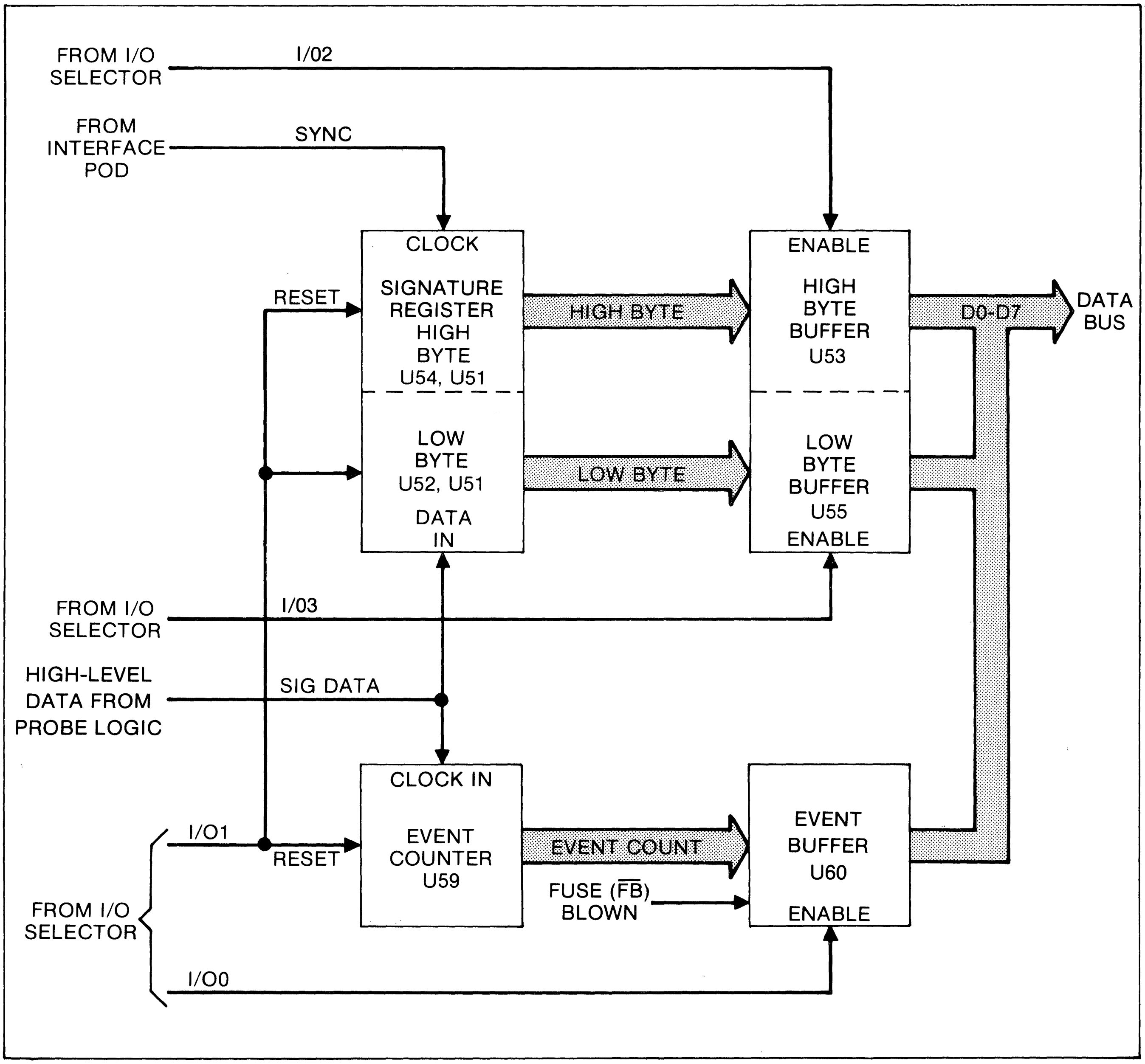


Figure 3-10. Signature Register/Event Counter

3-101. Signature Generator and Event Counter

3-102. 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.

3-103. As shown in Figure 3-10, 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.

3-104. 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 $\overline{I/O3}$ signal gates the low byte.

3-105. 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 ($\overline{FB}$) indication onto the data bus in response to the $\overline{I/O0}$ signal from the I/O selector as commanded by the microprocessor.

3-106. The microprocessor resets both the signature generator and the event counter by means of the $\overline{I/O1}$ output of the I/O selector. Reset occurs at the beginning of all read probe operations.

3-107. Magnetic Tape Controller

3-108. INTRODUCTION

3-109. 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, underinternal 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.

3-110. Selection (addressing) of the Magnetic Tape Controller by the microprocessor is done by means of the $\overline{I/O5}$ 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 $\overline{RD}$ or $\overline{WR}$ 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 $\overline{RES}$ signal generated by the power-on reset and watchdog timer cirucits. Refer to Figure 3-11 for a block diagram of the magnetic tape controller.

3-111. TAPE DRIVE MOTOR CONTROL

3-112. 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 $\overline{E}$ 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.

3-113. To operate the motor in the rewind direction, the peripheral microcomputer writes an output to the REWD line, and also to the $\overline{E}$ 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.

3-114. WRITE CONTROL

3-115. 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 3-12 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.

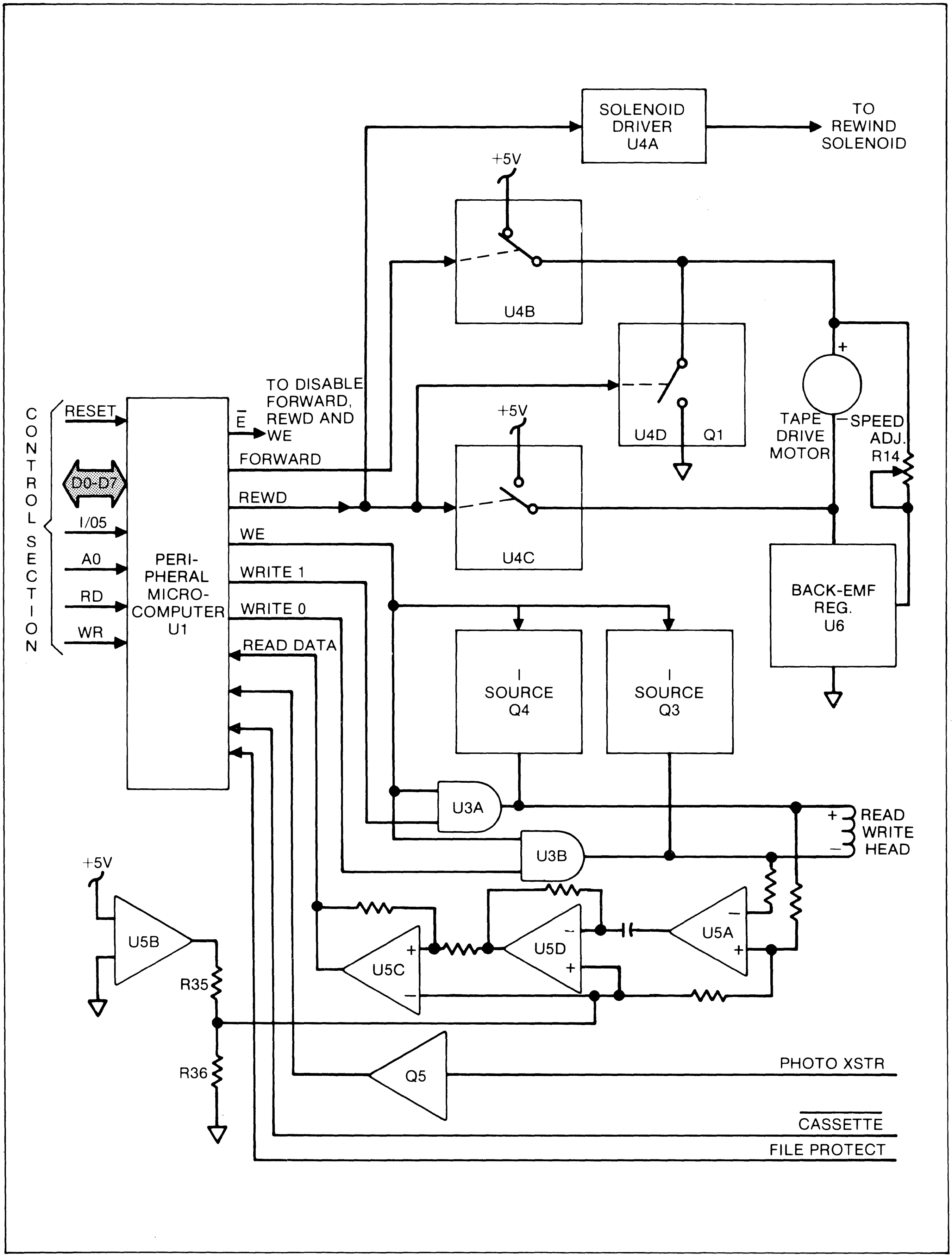


Figure 3-11. Magnetic Tape Controller

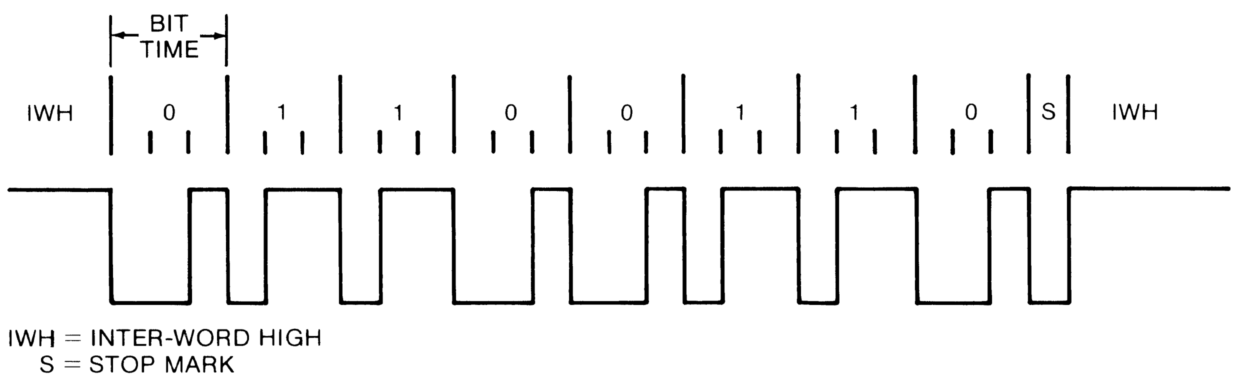


Figure 3-12. Tape Data Ratio Coding

3-116. 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 thecurrent sinks. To write a high to the tape, the peripheral microcomupter 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.

3-117. 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.

3-118. PLAYBACK AMPLIFIER

3-119. All signals appearing across the read/write head, including those written by the peripheral microcomputer, are applied to the input of the playback amplifier made up of U5A, U5B, U5C, and U5D (shown in Figure 3-11). The purpose of U5B is to establish a reference voltage which is halfway between the upper and lower output limits of the other three stages. Since the output characteristics of U5B are similar to the other three stages, and R35 and R36 are equal, applying +5 volts across the input of U5B produces a level equal to half its saturated output across R36.

3-120. Section U5A of the amplifier provides a gain of 200 and forms the first stage of the playback amplifier. The output of U5A is applied to differentiator stage U5D. CR8 and CR9 are provided to prevent this stage from going into saturation. The final stage is a center-crossing detector with a 25% (approx. ±0.4V) hysteresis. The three stages combined are used to detect the points of flux reversal on the tape. The output of the playback amplifier connects via the Read Data line to an input of the peripheral microcomputer. The peripheral microcomputer continuously reads this input during a read operation and decodes the incoming data into logic highs and logic lows.

3-121. OTHER FUNCTIONS

3-122. The Magnetic Tape Controller includes three other functions required for proper tape handling, each of which is reported to the peripheral microcomputer. An LED and phototransistor mounted on the tape path provide an indication of end-of-tape when the clear section of tape allows the passage of LED output to reach the phototransistor. Transistor Q5 amplifies the phototransistor output for application to the peripheral microcompter. In addition, a low $\overline{\text{Cassette}}$ signal indicates the presence of a cassette in the tape drive to the peripheral microcomputer; and a high File Protect signal indicates a write protected (the tab broken out) cassette. Both the File Protect and $\overline{\text{Cassette}}$ signals are produced by microswitches.

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 the all PCB assemblies 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 display/keyboard. The display/keyboard is held to the top cover by 2 clips, which must be removed if this assembly needs service.

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. FUSE REPLACEMENT

4-10. Line Fuse

4-11. The line fuse (F1) is located in a recessed compartment in the rear panel. Figure 4-1 illustrates line fuse replacement. To replace the fuse, proceed as follows:

1. Remove the power cord from the instrument.

2. Slide the clear plastic panel up to expose the fuse compartment.

3. Pull up the plastic lever (as shown in Figure 4-1) to slide the fuse out of the compartment.

4. Replace the fuse with a 1 ampere fast-blow, 250V (part no. 369819) for 100 and 120 volt operation; and with a 1/2 ampere fast-blow, 250V (part no. 153858) for 220 and 240 operation.

4-12. Probe Fuse

4-13. 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 ground clip to a power source.) To replace the probe fuse, proceed as follows:

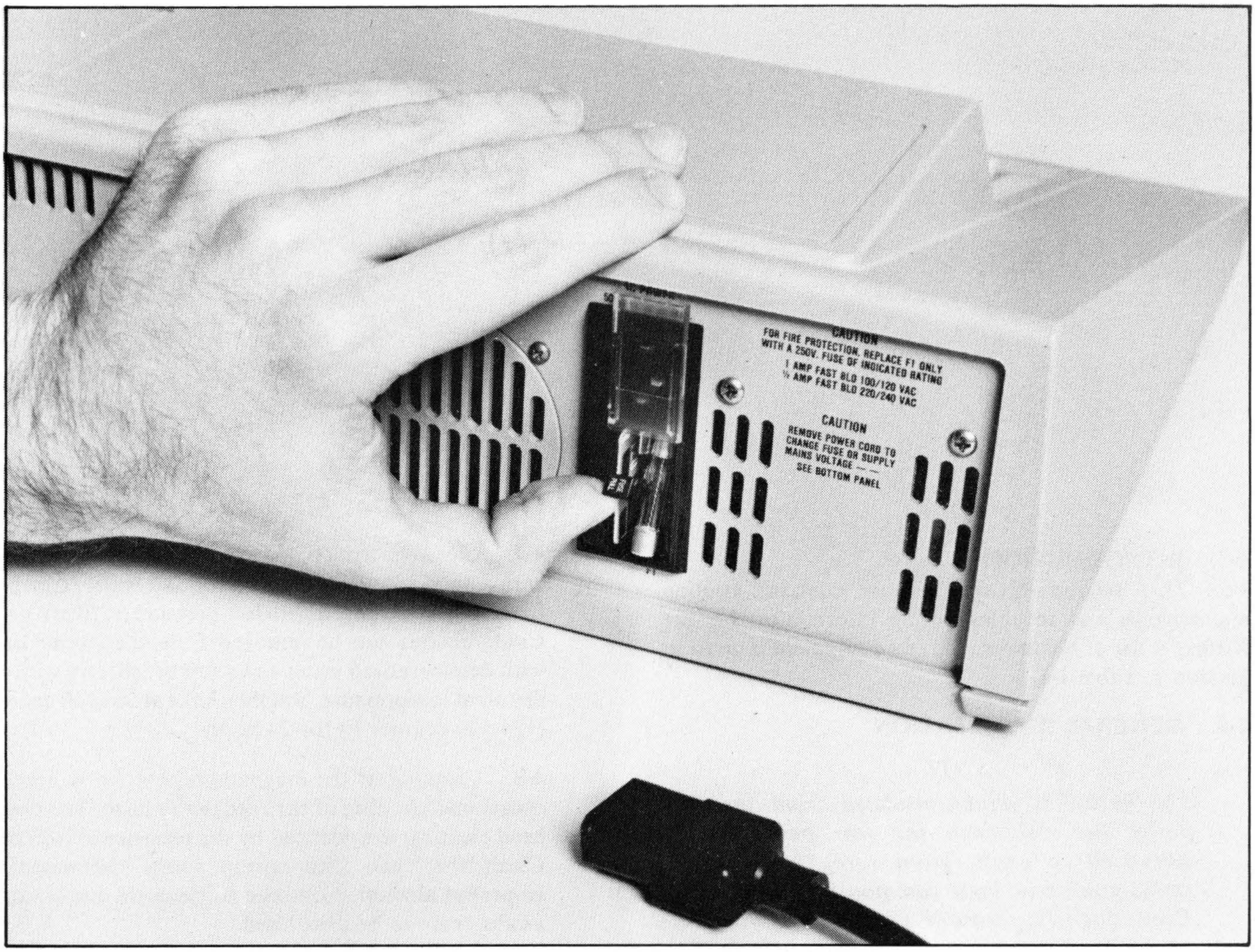


Figure 4-1. Line Fuse Replacement

1. Tilt up the front of the instrument and locate the probe fuse cap shown in Figure 4-2.

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.

4-14. PERFORMANCE TEST

4-15. Self Test

4-16. 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.

4-17. 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.

4-18. 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).

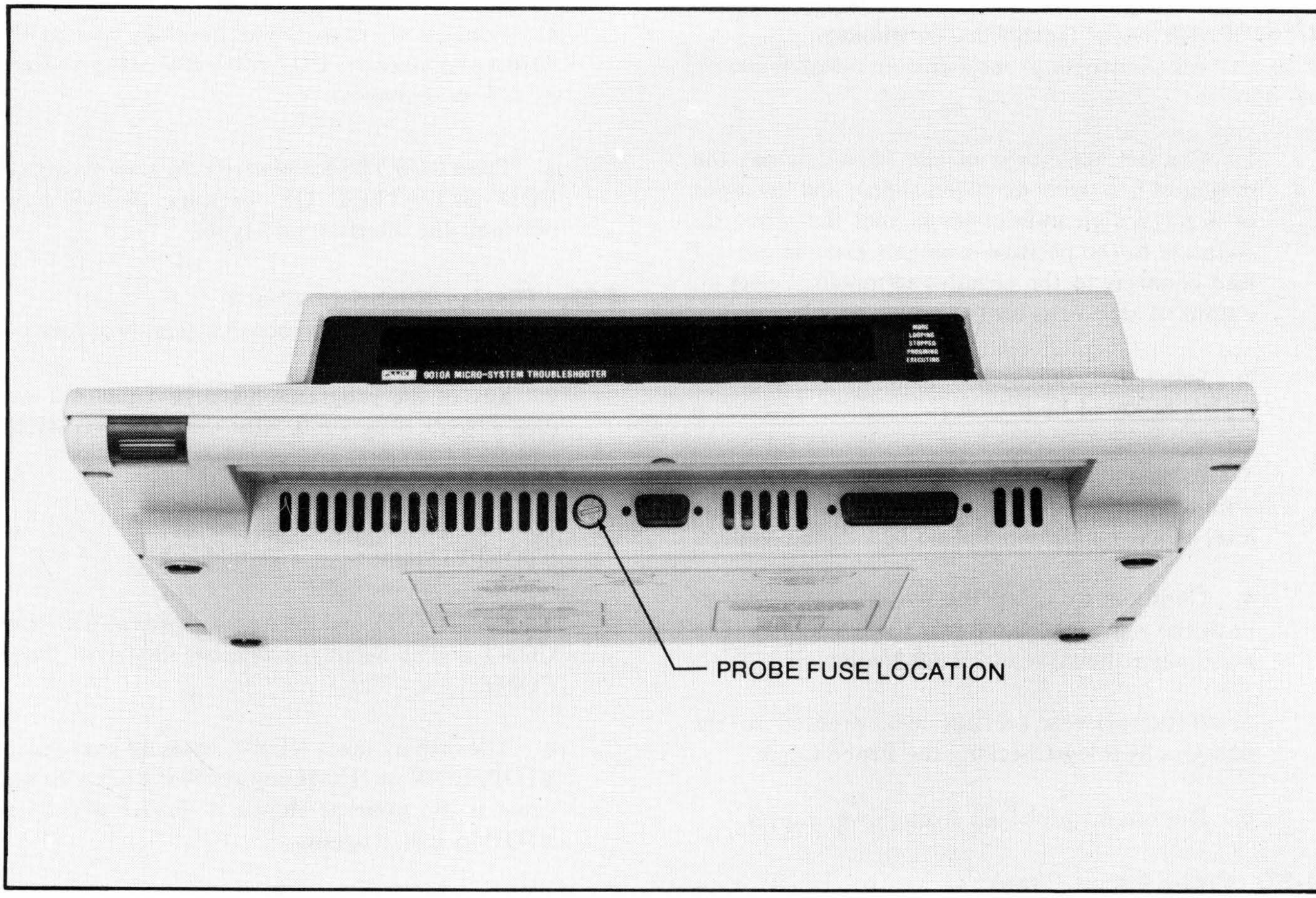


Figure 4-2. Probe Fuse Location

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 duringpower-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

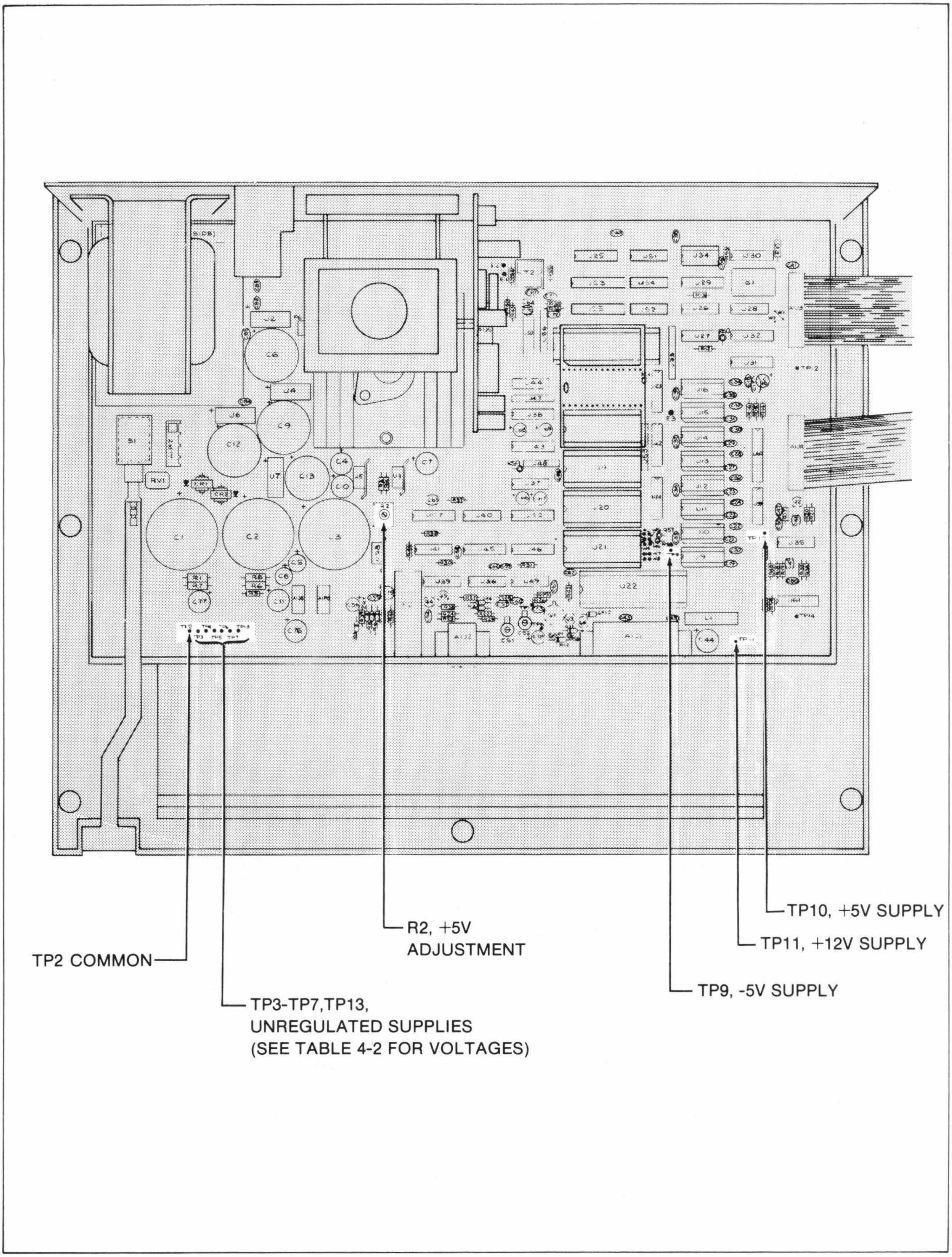


Figure 4-4. Power Supply Test Points and Adjustments

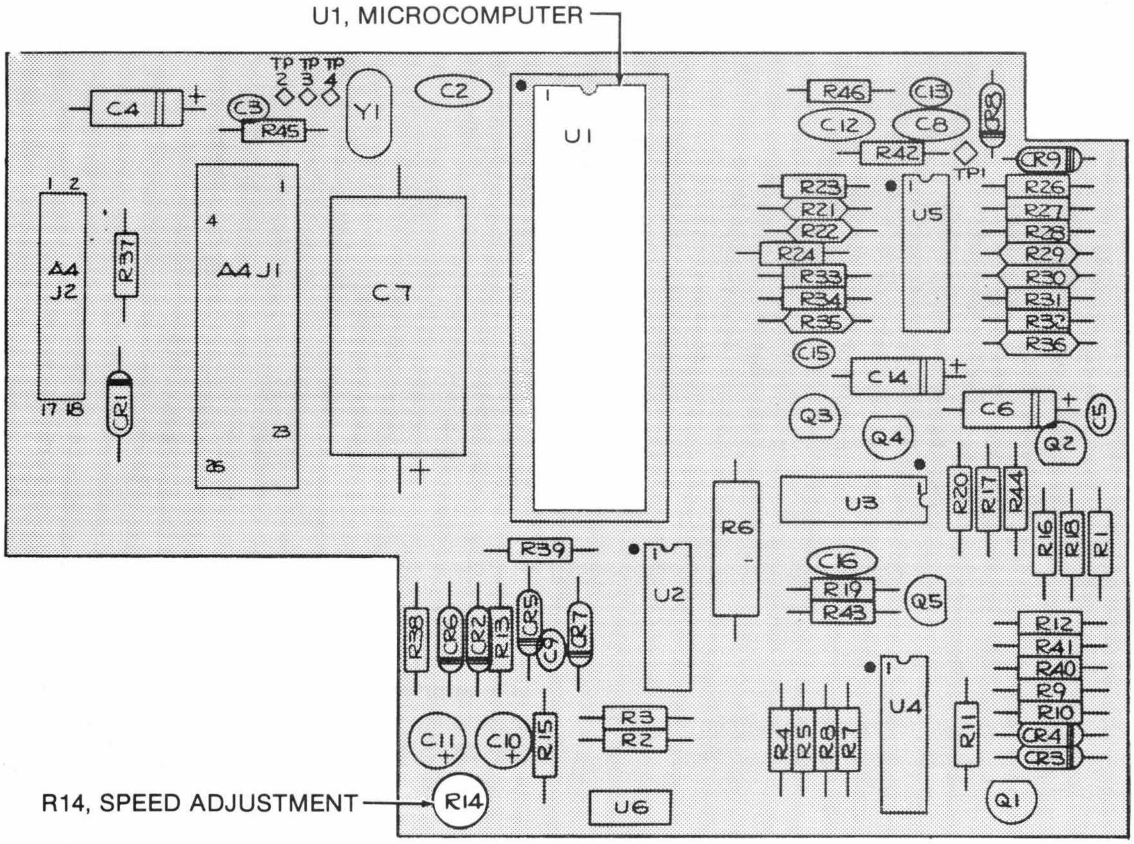


Figure 4-5. Tape Speed Adjustments

4-34. Probe Input Compensation Adjustment

4-35. Adjust probe input compensation as follows:

1. Gain access to the Main Assembly components as described under the heading Access Information.

2. Apply power to the troubleshooter and connect an oscilloscope across TP8 (ground) and TP14 located on the Main Assembly. Refer to Figure 4-6 for test point locations.

3. Adjust the oscilloscope to obtain a display of one or two full cycles of the signal at a vertical sensitivity of 2V/div.

4. Remove the oscilloscope from TP14 and connect to TP1 changing the vertical sensitivity to 100 mV/div.

5. Connect the probe cable to the underside front connector of the troubleshooter and connect the probe tip to TP14 and probe GND to TP8.

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

4-36. REPAIR PRECAUTIONS

CAUTION

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

- **Do not handle ICs or PCB assemblies by their connectors.**
- **Attatch 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.**

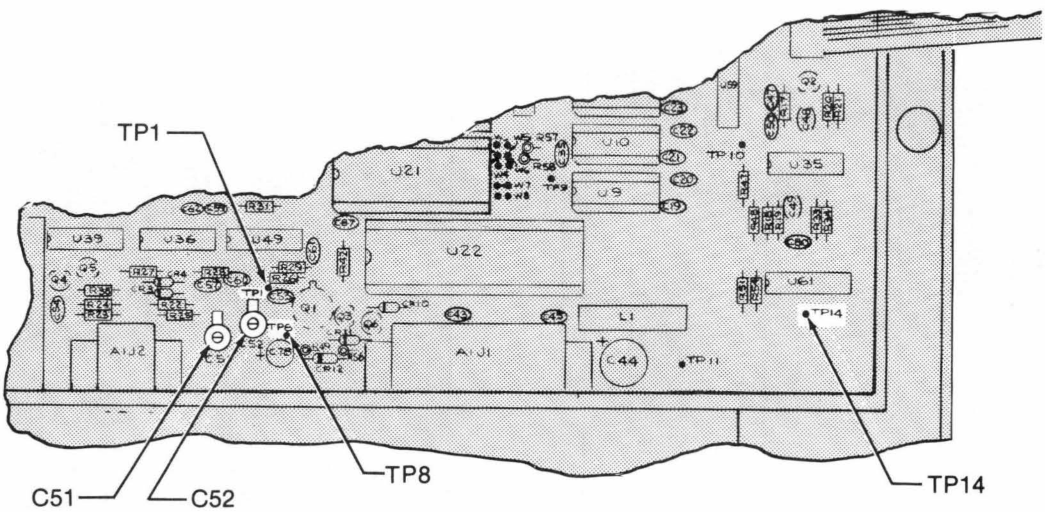


Figure 4-6. Probe Component Test Points and Adjustments

NOTE

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

4-37. TROUBLESHOOTING

4-38. Introduction

4-39. 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 trouble-shooting techniques. The programs could also be adapted to the particular style of testing the user desires.

4-40. Power Supply Checks

4-41. Power supply levels should be checked whenever improper operation of the unit is suspected.

4-42. 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 4-4. 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.

4-43. 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.

4-44. Bus/RAM/ROM Checks

4-45. 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:

1. With ac power off, and with reference to Figure 4-7, remove the ROM piggy-back bracket (not illustrated) and PCB assembly and the Z80 microprocessor (U8) from the Main Assembly.

2. Connect the 9010A-Z80 interface pod to the vacant Z80 socket and replace the ROM Piggy-Back Assembly, less the bracket.

3. With power applied first to the tester 9010A, apply power to the UUT (9010A under repair).

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	+4.99 to 5.01
-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	—	—

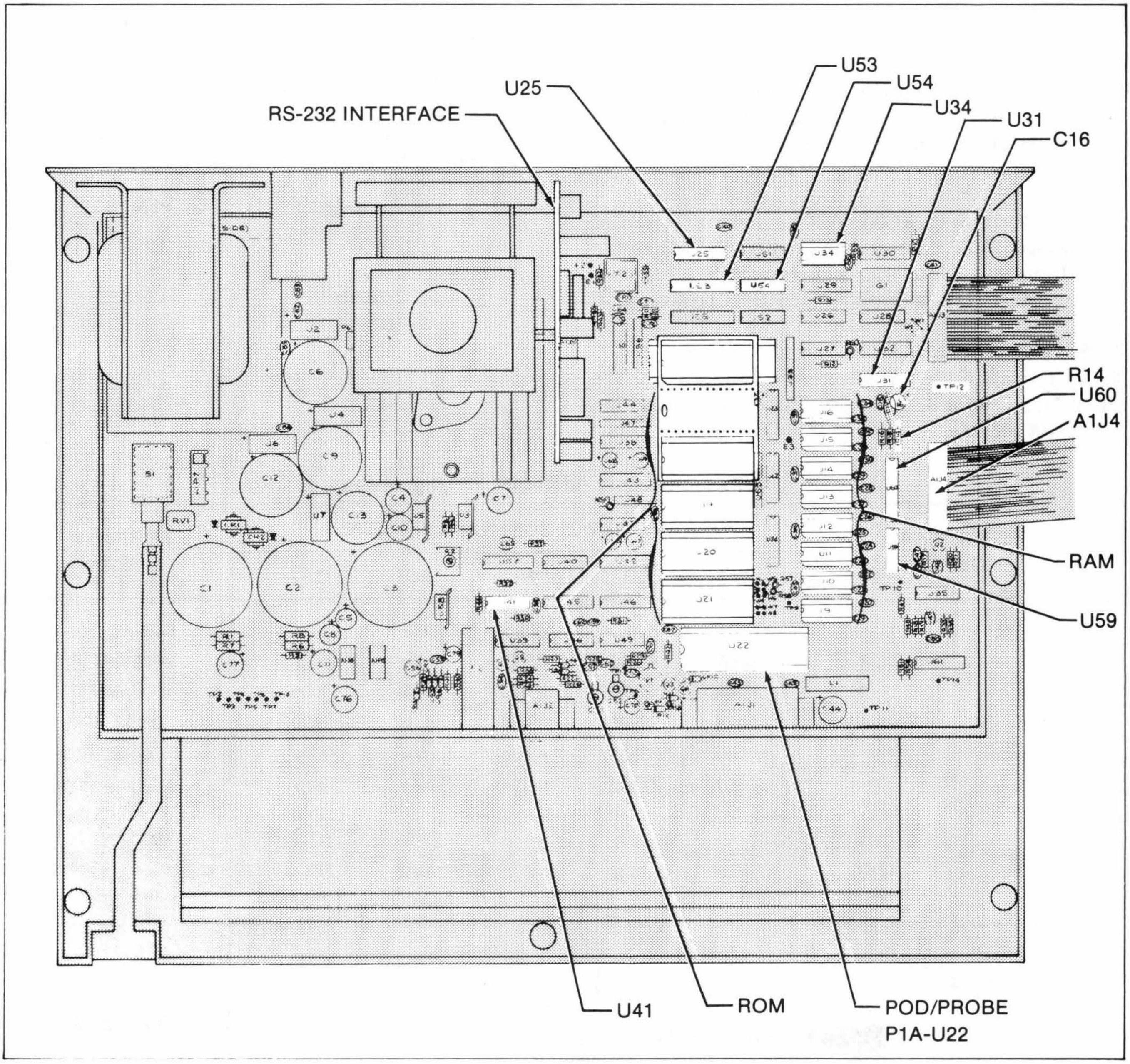


Figure 4-7. Main Assembly Components

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. To check the $\overline{RAS}$ and $\overline{CAS}$ signals of the RAM, use the probe synchronized to the address to trace the signals back through U29, U26, and U27 while performing a looping write to any RAM location.

7. Perform a ROM Test on the six blocks of ROM. ROM addresses and signatures are listed in Table 4-4. Note that signatures differ for each software version displayed at 9010A power-on.

4-46. I/O Selector Checks

4-47. 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

4-48. 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

Table 4-4. Memory Addresses and Signatures

ADDRESSABLE DEVICE		SIGNATURE PER SOFTWARE VERSION*					ADDRESS (HEX)†
		1A	2A	2B	2C	3A	
ROM	U1**	8345	651D	0295	n/a	n/a	0000-1FFF
	U18	895A	F906	C262	n/a	n/a	2000-3FFF
	U19	F3AA	4CC2	72BC	n/a	n/a	4000-5FFF
	U20	9BE4	1B90	0BA4	n/a	n/a	6000-7FFF
	U21	2140	9967	AF68	n/a	n/a	8000-9FFF
	U2**	CFCA	0D0A	90C4	n/a	n/a	A000-BFFF
	U64	n/a			8F19	1D1F	0000-3FFF
	U19				00A7	2BC4	4000-7FFF
	U21				4A6A	270E	8000-BFFF
RAM		n/a					C000-FFFF

*The software version installed in the 9010A is indicated on the display at power-on.
**Located on the Piggy Back ROM PCB Assembly.
†Size of ROM device depends on PCB revision level.

4-49. Power-On Reset/Watchdog Timer Checks

4-50. 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 probe tip to U31-4 of the UUT. (Refer to Figure 4-7 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.

4-51. Pod/Probe PIA Checks

4-52. 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. Using the following procedure, verify properoperation of the pod/probe PIA. (Figure 4-7 shows the location of the pod/probe PIA U22, U31, U34, and U25.)

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 $\overline{\text{CS2}}$ 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 $\overline{\text{CS2}}$ 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 $\overline{\text{EN}}$ 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.

4-53. Probe Related Circuit Checks

4-54. CHECKING THE PROBE LOGIC

4-55. The probe logic is divided into four distinct functions:

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

4-56. 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.

4-57. Level Detector/Free-Run Checks

4-58. Perform level detectors/free-run checks as follows:

1. Turn off the UUT and remove the Display/Keyboard Assembly connector A1J4 (shown in Figure 4-7) 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.

Table 4-5. PIA (U22) Test

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

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

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

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

PROGRAM LISTING	COMMENTS
8: LABEL 8	
WRITE @ 100C3 = 38	
WRITE @ REGF = 30	stimulate cb2 line
WRITE @ REGF = 38	
WRITE @ REGF = 30	
READ PROBE	gather event count
IF REG0 AND 7F = REG6 GOTO C	verify event count - o.k. goto a
GOTO E	not correct count - goto e
C: LABEL C	sig o.k.
DPY-+, GOOD	
EXECUTE PROGRAM 12	delay
D: LABEL D	
INC REG2	increment pin
INC REG3	increment bit
IF REG3 = 8 GOTO 1	
GOTO 5	
E: LABEL E	sig. failure
DPY-#U22 PIN $2 BIT $3 FAILURE	
DPY-+ LOOP#?5	repeat test
IF REG5 = 1 GOTO 5	yes
DPY-TEST FAIL#	
STOP	
F: LABEL F	
DPY-PIA TEST PASSED#	
PROGRAM 12 21 BYTES	delay approx. 1 second
REG1 = 40	
1: LABEL 1	
DEC REG1	
IF REG1 > 0 GOTO 1	

Table 4-6. Free-Running Probe Check

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

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

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

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

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.

4-59. 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.

4-60. Synchronized Probe Check

4-61. 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.

1. Before preceeding 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 4-7).

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.

4-62. Probe Pulse Output Check

4-63. 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, and 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

4-64. CHECKING THE PROBE FUNCTIONS

4-65. 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.

Table 4-7. Synchronized Probe Check

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

Table 4-7. Synchronized Probe Check (cont)

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

Table 4-8. Probe Pulse Output Check

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

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

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

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 cirucit 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.

4-66. Signature Register Checks

4-67. 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.

4-68. Event Counter Checks

4-69. 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 4-7, 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.

4-70. Display/Keyboard Checks

4-71. 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 4-8 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.

4-72. DISPLAY SEGMENT TEST

4-73. 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.

Table 4-9. Signature Register Test

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

Table 4-9. Signature Register Test (cont)

PROGRAM LISTING	COMMENTS
PROGRAM 12 21 BYTES	delay approx. 1 second
REG1 = 40	
1: LABEL 1	
DEC REG1	
IF REG1 > 0 GOTO 1	

Table 4-10. Event Counter Test

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

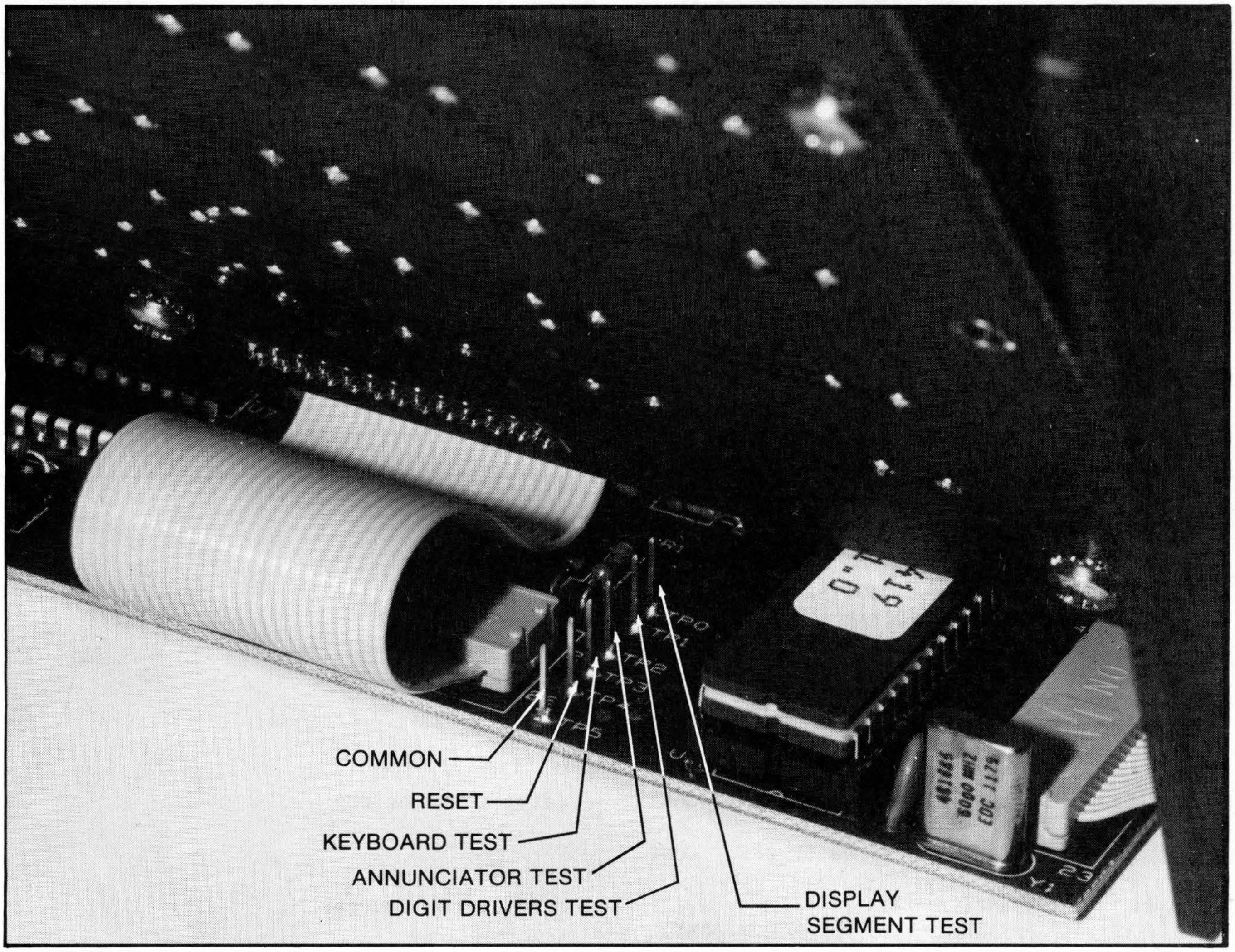


Figure 4-8. Display/Keyboard Self-Test Points

4-74. DISPLAY DIGIT DRIVERS TEST

4-75. 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.

4-76. DISPLAY ANNUNCIATOR TEST

4-77. The annunciator test causes the MORE, STOPPED, and EXECUTING annunciators to flash when the PULSE HIGH switch is depressed and the LOOPING and PROGMING 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.

4-78. KEYBOARD TEST

4-79. The keyboard test, when initiated, writes the segment pattern shown in Figure 4-9 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. Pressing all keys results in a blank display. Refer to Figure 4-9 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.

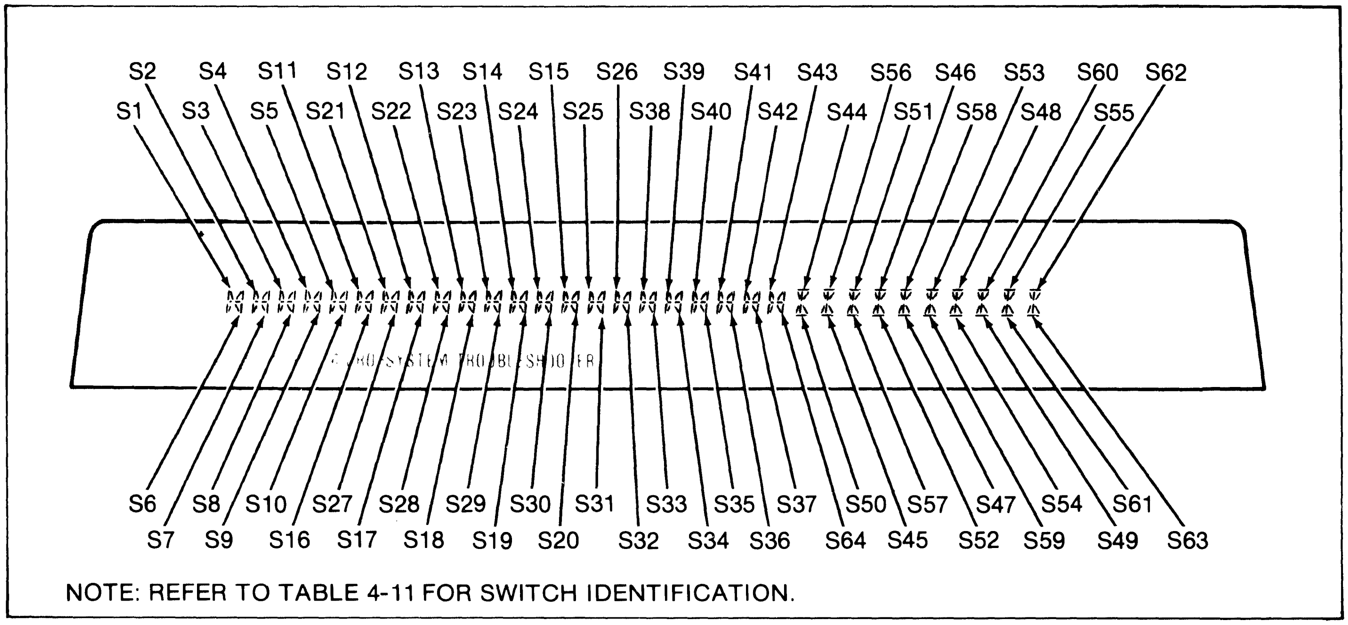


Figure 4-9. Keyboard Test Pattern

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

- An open switch causes a portion of the pattern to remain.

4-80. DISPLAY/KEYBOARD RESET

4-81. 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.

4-82. DISPLAY KEYBOARD COMMUNICATION CHECKS

4-83. 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.

4-84. Magnetic Tape Controller

4-85. 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 inverting it to expose the Magnetic Tape Controller shown in Figure 4-5. Apply power to the troubleshooter and perform any or all of the following tests.

4-86. SELF TEST

4-87. Initiate self test by removing and reapplying power to the 9010A and then momentarily jumpering pins 20 (ground) and 21 ($\overline{\text{SLFTST}}$) 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

4-88. 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.

4-89. MAGNETIC TAPE READ TEST

4-90. Initiate the read test by momentarily jumpering pins 20 and 22 ($\overline{\text{RDTST}}$) 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

4-91. 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 4-10. 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.

Table 4-12. Display/Keyboard Communication Check

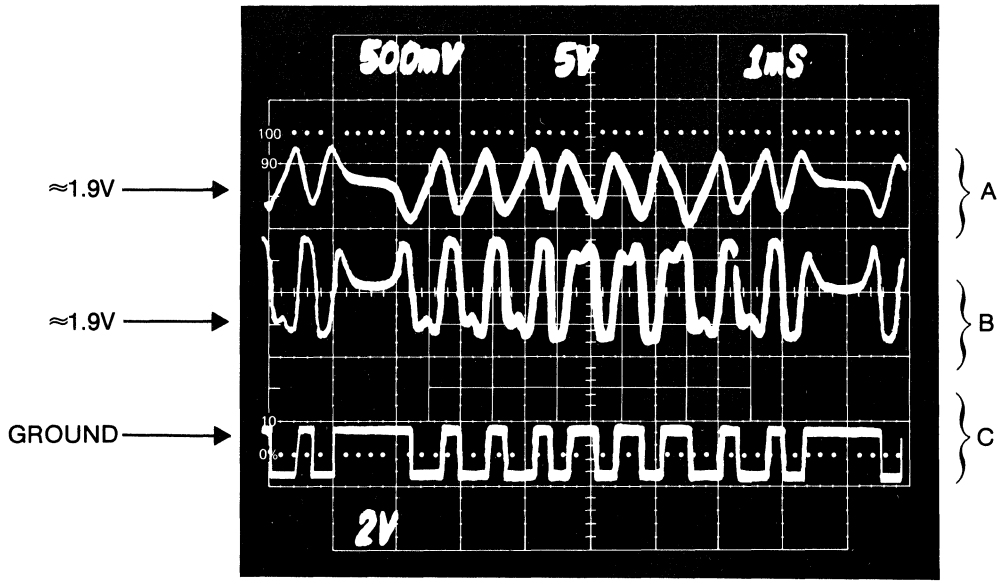
PROGRAM LISTING	COMMENTS
PROGRAM 6 1395 BYTES	
WRITE @ 10081 = FF	reset display/kybd
READ @ 10080 REPT	clear out buffer
DPY-DISPLAY/KYBD COMM. CHECK	
EXECUTE PROGRAM 12	delay
DPY-JUMP R14//C16 TO TP2 OR TP1	disable watchdog
DPY-+2-CONT#	
STOP	
0: LABEL 0	
READ @ 10080	clear buffer
DPY-HIT UUT 'WRITE'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

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

PROGRAM LISTING	COMMENTS
4: LABEL 4	
WRITE @ 10080 = 55	write a "u" and increment (shift right) one digit
INC REG2	increment digit counter
IF 20 > REG2 GOTO 4	> than decimal 32 goto 4
DPY-#ALL U'S - YES//NO?0	
IF REG0 = 0 GOTO E	user checks for all u's - if no goto e
DPY-DISPLAY *. RIGHT-TO-LEFT#	
REG3 = 20	digit counter to right most
5: LABEL 5	
REG2 = REG3 DEC	
WRITE @ 10081 = 20 OR REG2	set digit pointer = let most digit + dec. value of reg 2 to right
WRITE @ 10080 = AA	write a "*." to display; move pointer to right 1 digit
DEC REG3	decrement digit counter
IF REG3 > 0 GOTO 5	dme - go to 5
DPY-#ALL *.'S - YES//NO?0	
IF REG0 = 0 GOTO E	user checks for all "*."'s - if not goto e
DPY-#FLASH EACH DIGIT	
REG2 = 0	flash pointer
6: LABEL 6	
WRITE @ 10081 = 60 OR REG2	set flash mode - position = leftmost + dec. value of reg 2
INC REG2	inc. flash position
IF 20 > REG2 GOTO 6	flashed all characters
WRITE @ 10081 = 80	turn off flash mode
DPY-+#-YES//NO?0	
IF REG0 = 0 GOTO C	user verifies all char flashed - if no goto c
DPY-BLANK DISPLAY TWICE#	
WRITE @ 10081 = DF	blank display (31 scans)
EXECUTE PROGRAM 12	delay
WRITE @ REGF = DF	blank display (31 scans)
DPY-+#-YES//NO?0	
IF REG0 = 0 GOTO C	user verifies display blanked - if no goto c
DPY-#MASTER RESET TEST	
EXECUTE PROGRAM 13	
WRITE @ 10081 = FF	master reset
DPY-#	
DPY-DISPLAY BLANK-YES//NO?0	
IF REG0 = 0 GOTO C	user verifies display went blank - if no goto c
DPY-#LIGHT ALL LED'S	
WRITE @ 10081 = 5F	light all leds
DPY-+#-YES//NO?0	
IF REG0 = 0 GOTO C	user verifies display went blank - if no goto c
DPY-#SINGLE SEGMENT TEST CMD	
WRITE @ 10081 = 00	reset test
WRITE @ REGF = 1	start seg. test
DPY-+-OK?0	
IF REG0 = 0 GOTO C	user verifies test started - if no goto c

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

PROGRAM LISTING	COMMENTS
DPY-#WALKING CHARACTER TEST CMD	
WRITE @ 10081 = 0	reset test
WRITE @ REGF = 2	start walk. char. test
DPY-+-OK?0	
IF REG0 = 0 GOTO C	user verifies test started - if no goto c
WRITE @ 10081 = 0	reset test
DPY-HIT UUT PULSE LOW AND HIGH-	
DPY-+CONT#	
STOP	
DPY-#LED TEST COMMAND	
WRITE @ REGF = 4	start led test
DPY-+#-ALL LEDS ON?0	
IF REG0 = 0 GOTO C	user verifies test started - if no goto c
DPY-UUT PULSE HIGH AND LOW OFF-	
DPY-+CONT#	
STOP	
DPY-#KEY TEST CMND	
WRITE @ 10081 = 0	reset test
WRITE @ REGF = 8	start key test
DPY-+#-STARTED?0	
IF REG0 = 0 GOTO C	user verifies test started - if no goto c
GOTO F	
C: LABEL C	
DPY-WRITE CMND FAIL-CONT#	
STOP	
GOTO 3	
D: LABEL D	
DPY-#BAD STATUS BIT 3 <$E>	fail messages
STOP	
GOTO 3	
E: LABEL E	
DPY-WRITE DATA FAIL-CONT#	
STOP	
GOTO 3	
F: LABEL F	
DPY-DISPLAY/KYBD TEST COMPLETE	test complete
WRITE @ 10081 = FF	reset display
PROGRAM 12 21 BYTES	delay approx. 1 second
REG1 = 40	
1: LABEL 1	
DEC REG1	
IF REG1 > 0 GOTO 1	
PROGRAM 13 14 BYTES	delay approx. 3 seconds
EXECUTE PROGRAM 12	
EXECUTE PROGRAM 12	
EXECUTE PROGRAM 12	



A. OBSERVED AT U5A-1, 500 mV/div.
B. OBSERVED AT U5D-14, 2v/div.
C. OBSERVED AT U5C-8, 5V/div.

NOTE: STORAGE OSCILLOSCOPE USED TO OBTAIN STABLE DISPLAY.

Figure 4-10. Read Test Waveforms

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.

4-92. MAGNETIC TAPE WRITE TEST

4-93. Initiate the write test by momentarily jumpering pins 20 (ground) and 23 ($\overline{\text{WTTST}}$) 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.

4-94. 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 4-11. 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.

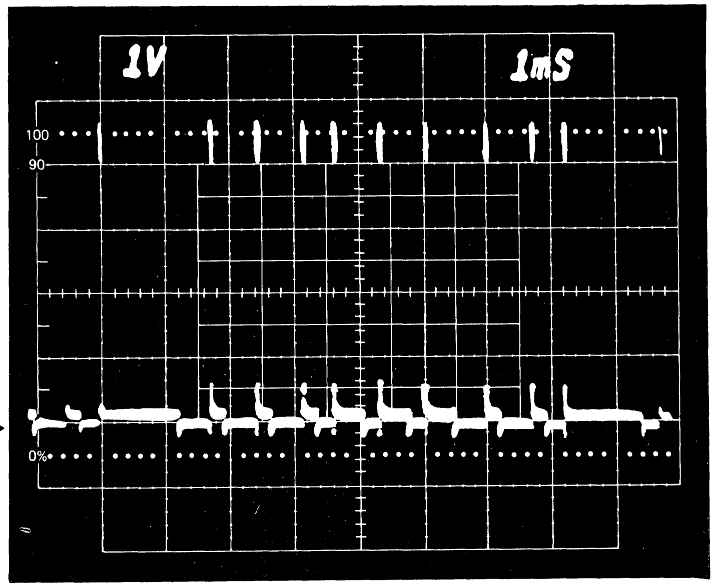
4-95. MAGNETIC TAPE COMMUNICATION CHECKS

4-96. Communications bwtween 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).

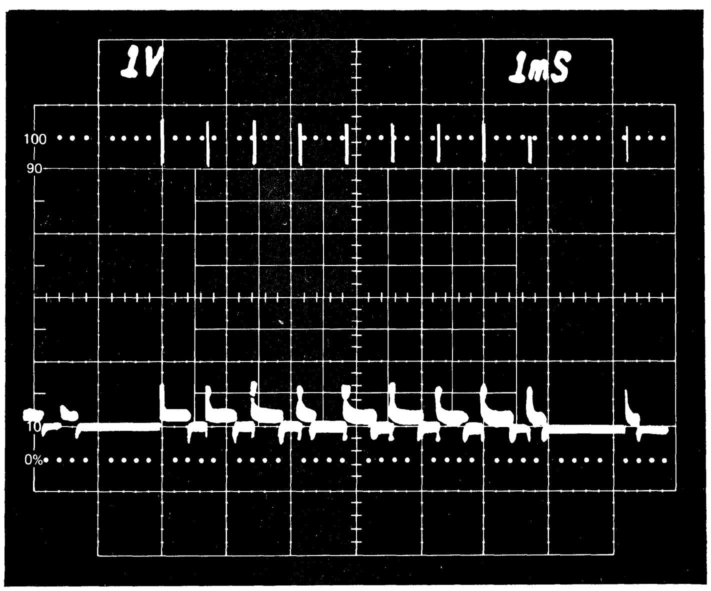
2. Remove any tape cassette and leave the door open.

GROUND



OBSERVED AT A4J2-3 (HEAD +)

GROUND



OBSERVED AT A4J2-4 (HEAD —)

NOTE: STORAGE OSCILLOSCOPE USED TO OBTAIN STABLE DISPLAY.

Figure 4-11. Write Test Wafeform

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.

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

MEMORY PAGE ADDRESSES			
MEMORY PAGE	**ADDRESS**	**TYPE**	**REFERENCE DESIGNATOR**
0	0000 - 1FFF	ROM	U1*
1	2000 - 3FFF	ROM	U18
2	4000 - 5FFF	ROM	U19
3	6000 - 7FFF	ROM	U20
4	8000 - 9FFF	ROM	U21
5	A000 - BFFF	ROM	U2*
6,7	C000 - FFFF	RAM	U9-U13
*Located on piggy-back ROM pcb			

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.

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

DISPLAY/KEYBOARD ASSEMBLY PROTOCOL (CONT)			
ADDRESS	**DATA**	**WRITE/READ**	**FUNCTION PERFORMED**
10081	011bbbbb (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: bbbbb 00001 = EXECUTING 00010 = PROGRAMMING 00100 = STOPPED 01000 = LOOPING 10000 = MORE
10081	001bbbbb (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 bbbbbbbb status byte as follows: bbbbbbbb xxxxxxx1 = Output buffer and display full xxxxxx1x = Input buffer from keyboard full xxxx1xxx = Last write was control xxxx0xxx = Last write was data 1xxxxxxx = Overrun error (more than one key pressed before data read)

POD/PROBE PIA (U22) INTERNAL REGISTER/BUFFER ADDRESSES		
ADDRESS	**WRITE DATA**	**REGISTER/BUFFER ADDRESSED AND FUNCTION**
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 dta, 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.

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

POD/PROBE PIA (U22) PROTOCOL			
ADDRESS	**DATA**	**WRITE/READ**	**FUNCTION PERFORMED**
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.
100C0	bbbbbbbb (binary)	Write	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). bbbbbbbb xxxxxxx1 = Set MAINSTAT output high xxxxxxx0 = Set MAINSTAT output low xxxx1xxx = Set pod RESET output high xxxx0xxx = Set pod RESET output low xxx0xxxx = Activate beeper x00xxxxx = Turn probe pulse circuit off x01xxxxx = Generate low probe pulses x10xxxxx = Generate high probe pulses x11xxxxx = Generate low and high probe pulses (toggle) 0xxxxxxx = Select synchronized probe mode 1xxxxxxx = Select free-running probe mode
100C0	bbbbbbbb (binary)	Read	Causes the display peripheral microcomputer to respond with a bbbbbbbb status byte as follows (Port A must be set to input): bbbbbbbb xxxxxx1x = 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) xx1xxxxx = Invalid signal detected during last READ PROBE operation x1xxxxxx = Logic low signal detected during last READ PROBE operation 1xxxxxxx = Logic high signal detected during last READ PROBE operation

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

MAGNETIC TAPE CONTROLLER PROTOCOL			
ADDRESS	**DATA**	**WRITE/READ**	**FUNCTION**
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 xxxxxxx1 = 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

SIGNATURE GENERATOR/EVENT COUNTER PROTOCOL			
ADDRESS	**DATA**	**WRITE/READ**	**FUNCTION PERFORMED**
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

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similiar 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.
7. Recommended quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of 2 years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for 1 year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument or are deviations from the basic instrument model, the REC QTY column lists the recommended spares quantity for the items in that particular 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 replaces 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 Board Part Number and Revision Letter.
6. Instrument Model and Serial Number.

5-7. A Recommended Spare Parts Kit for your basic instrument is available from the factory. This kit contains those items listed in the REC QTY column for the parts lists in the quantities recommended.

5-8. 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.

CAUTION

Indicated devices are subject to damage by static discharge.

TABLE 5-1. 9010A FINAL ASSEMBLY
(SEE FIGURE 5-1.)

REFERENCE DESIGNATOR A->NUMERICS--->		S	----------DESCRIPTION----------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
A	1	*	MAIN PCB ASSEMBLY	579268	89536	579268	1		
A	2	*	DISPLAY PCB ASSEMBLY	579250	89536	579250	1		
A	3		KEYBOARD PCB ASSEMBLY	579425	89536	579425	1		
A	4	*	MAG TAPE PCB ASSEMBLY	579441	89536	579441	1		
A	7	*	DATA PROBE PCB ASSEMBLY	580969	89536	580969	1		
B	1		FAN,12VDC,37CFM,62MM	501312	89536	501312	1	5	
F	1		FUSE,1/4 X 1-1/4,FAST,0.5A,250V	153858	71400	AGC1-2			
F	1		FUSE,1/4 X 1-1/4,FAST,1.0A,250V	369819	71400	AGC1	1	5	
F	2		FUSE,1/4 X 1-1/4,FAST,0.25A,250V	109314	71400	AGC1-4	1	5	
F	2		FUSE,5 X 20MM,FAST,0.25A,250V	543504	71400	GMA1-4			
FL	1		FILTER,LINE,240V/6A	446328	05245	6J4	1		
H	1		SCREW,MACH,PHP SEMS,STL,6-32X3/8	177022	89536	177022	2		
H	2		SCREW,MACH,PHP,STL,8-32X1/2	159749	89536	159749	3		
H	3		WASHER,FLAT,STEEL,#8,0.031 THK	110288	89536	110288	3		
H	4		NUT,CAP,EXT.LOCK,STL,8-32	195263	89536	195263	3		
H	5		NUT,MACH,HEX,STL,6-32	110551	89536	110551	1		
H	6		SCREW,MACH,PHP,S.STL,4-40X3/8	256164	89536	256164	1		
H	7		SCREW,MACH,PHP,S.STL,4-40X1/4	256156	89536	256156	3		
H	8		SCREW,MACH,PHP,S STL,4-40X1-3/8	614511	89536	614511	4		
H	9		SCREW,MACH,PHP,S.STL,6-32X3/8	334458	89536	334458	2		
H	10		NUT,STL,CAP EXT LW,6-32X7/64	152819	89536	152819	2		
H	11		WASHER,FLAT,STEEL,#6,0.031 THK	110270	89536	110270	2		
H	12		NUT,CAP,EXT.LOCK,STL,4-40	195255	89536	195255	2		
H	13		SCREW,MACH,PHP,STL,4-40X3/4	115063	89536	115063	2		
H	14		WASHER,LOCK,SPLIT,STEEL,#4	110395	89536	110395	2		
H	15		SCREW,MACH,PHP SEMS,STL,6-32X5/16	530287	89536	530287	10		
H	16		SCREW,MACH,PHP SEMS,STL 4-40X3/4	756676	89536	756676	4		
H	17		SCREW,MACH,PHP SEMS,STL,4-40X1/4	185918	89536	185918	4		
H	18		SCREW,MACH,PHP SEMS,STL,6-32X3/8	177022	89536	177022	3		
H	19		CONN ACC,D-SUB,SLIDING LOCK,POST ASSY	353201	89536	353201	4		
H	20		WASHER,FLAT,STEEL,#6,0.031 THK	110270	89536	110270	1		
H	21		SCREW,MACH,RHP,BR,4-40X5/16	149773	89536	149773	2		
H	22		SCREW,MACH,PHP,S.STL,6-32X3/8	334458	89536	334458	7		
MP	1		BASE	583054	89536	583054	1		
MP	2		PUSH ROD, POWER SWITCH	577619	89536	577619	1		
MP	3		ASSY, GROUND SHIELD	544882	89536	544882	1		
MP	4		TAPE,FOAM,ADHSV,1"W,1/4 THK	186122	89536	186122	2		
MP	5		HLDR PART,CAP,5MM X 20MM,BLACK	461020	89536	461020		1	
MP	6		HLDR PART,FUSE,CAP,1/4 X 1-1/4,GREY	460238	61935	031.1666	1		
MP	7		FOOT,RUBBER,SELF-ADHESIVE,BLACK	513820	89536	513820	4		
MP	8		PANEL, REAR	577593	89536	577593	1		
MP	9		SUB PANEL, BLANK	579334	89536	579334			
MP	10		BRACKET, FAN	607192	89536	607192	1		
MP	11		SPACER, FAN	607143	89536	607143	1		
MP	12		CABLE TIE,4"L,0.100"W,0.75 DIA	172080	89536	172080	1		
MP	13		SLEEV,POLYOL,SHRINK,.125-.062ID,BLACK	149450	89536	149450			
MP	14		CASE TOP	607127	89536	607127	1		
MP	15		FRONT PANEL	609156	89536	609156	1		
MP	16		DOOR, CASSETTE	577676	89536	577676	1		
MP	17		CASSETTE COVER BUTTON	608810	89536	608810	1		
MP	18		DECAL, FRONT PANEL,DISPLAY	536763	89536	536763	1		
MP	19		DECAL,FRONT PANEL, KEYBOARD	586503	89536	586503	1		
MP	20		NUT PLATE DB9	609214	89536	609214	1		
MP	21		NUT PLATE DB25	609222	89536	609222	1		
MP	22		PLUG, BASE	755785	89536	755785	1		
MP	23		DECAL, SPEC	755801	89536	755801	1		
MP	24		NAMEPLATE, SERIAL -REAR PANEL-	472795	89536	472795	2		
MP	25		TAPE, CASSETTE	446997	51372	MI-50-3066	2		
MP	26		ACCESSORY PLASTIC BAG 4 1/2X10	586057	89536	586057	1		
MP	27		SHIPPING CARTON, MAIN FRAME	605337	89536	605337	1		
MP	28		MOLDED PADS LEFT HAND	605345	89536	605345	1		
MP	29		MOLDED PADS RIGHT HAND	605352	89536	605352	1		
MP	30		ACCESSORY BOX	605360	89536	605360	1		
MP	31		PROBE ACCESSORIES	613802	89536	613802	1		
MP	32		LABEL, CALIBRATION NOTICE	642439	89536	642439	1		
#MP	33		CONN,COAX,BNC(F),PANEL	152033	95712	30355-1	1	5	
MP	34		SOLDER LUG	441972	89536	441972	1		
MP	35		CONNECTOR, 2 POS	602706	89536	602706	1		
T	1		TRANSFORMER, POWER	579185	89536	579185	1		
TM	1		9010A OPERATOR MANUAL	609263	89536	609263	1		
TM	2		9010A REFERENCE CARD	609271	89536	609271	1		
TM	3		9010A PROGRAMMING MANUAL	609289	89536	609289	1		
TM	4		9010A SERVICE MANUAL	609297	89536	609297	1		
W	2		CABLE, AC	581843	89536	581843	1		
W	3		CABLE,POWER SWITCH	609123	89536	609123	1		
W	4		CABLE, POWER SUPPLY	583237	89536	583237	1		
			RECOMMENDED SPARE PARTS KIT	638619					

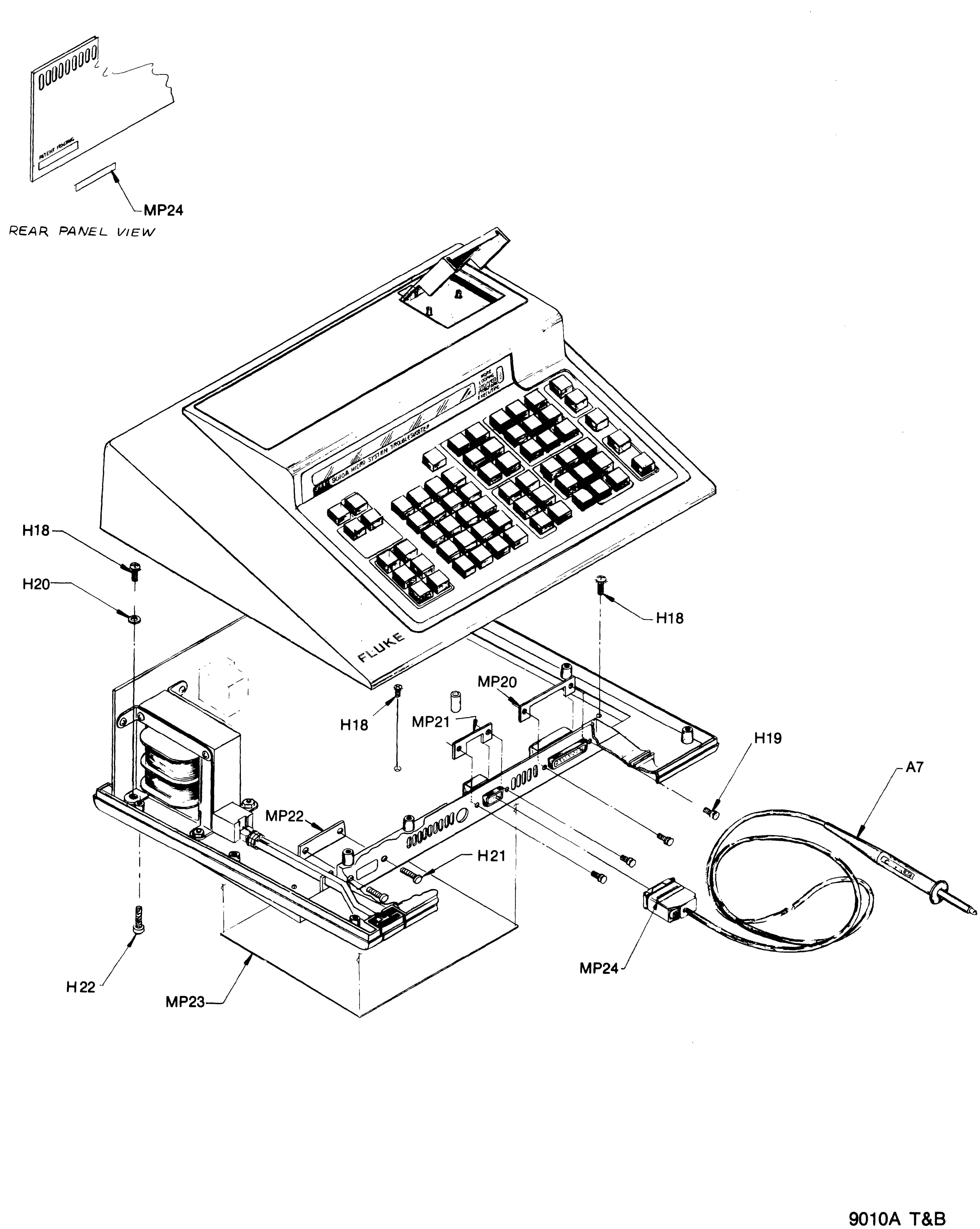


Figure 5-1. Final Assembly

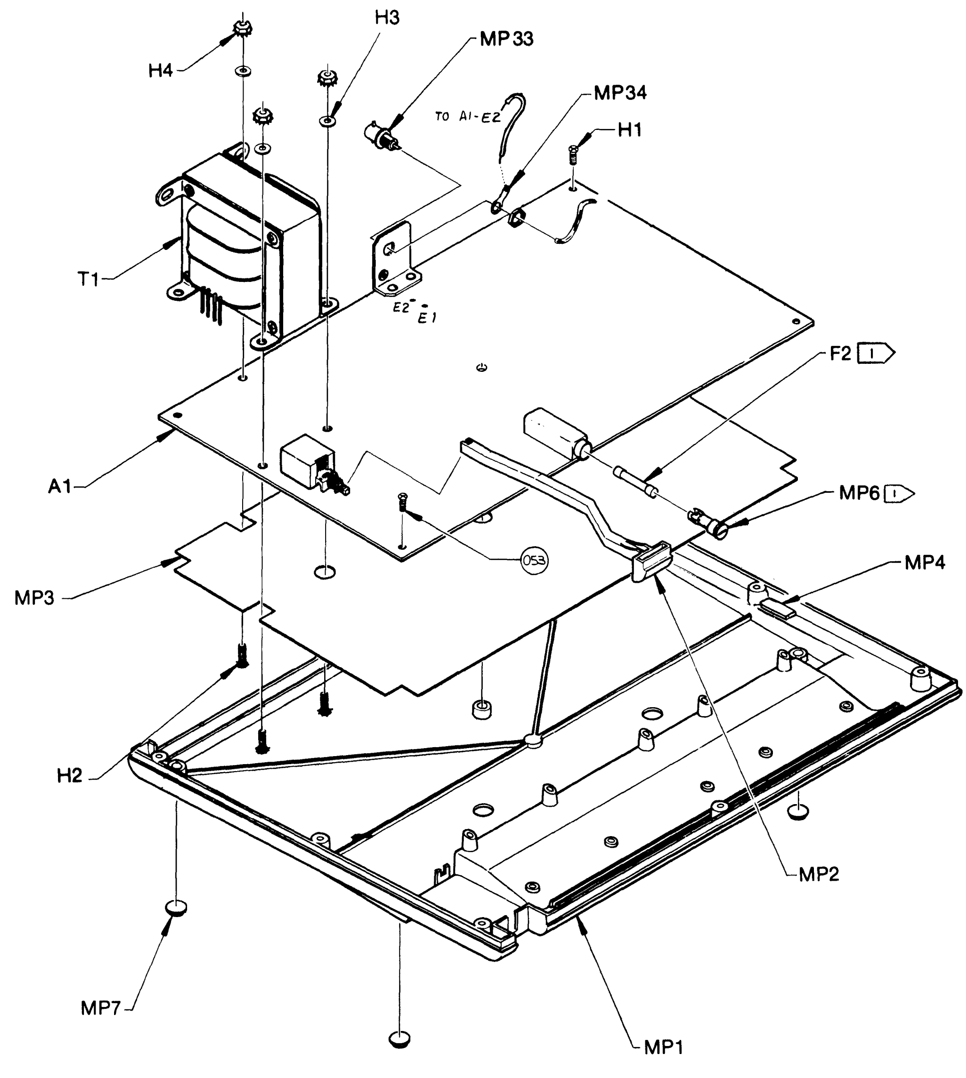


TABLE I

VOLTAGE	FUSEHOLDER	FUSE
100/120V	460238 (ITEM 048)	109314 (ITEM 050)
220/240V	461020 (ITEM 047)	543504 (ITEM 049)

1 FUSE & FUSE HOLDER VARY DEPENDING ON VOLTAGE UNIT IS PROGRAMMED FOR; SEE TABLE I FOR FUSE & CAP PART NUMBERS.

LOWER CHASSIS SECTION

9010A-5031
1 of 3

Figure 5-1. Final Assembly (cont)

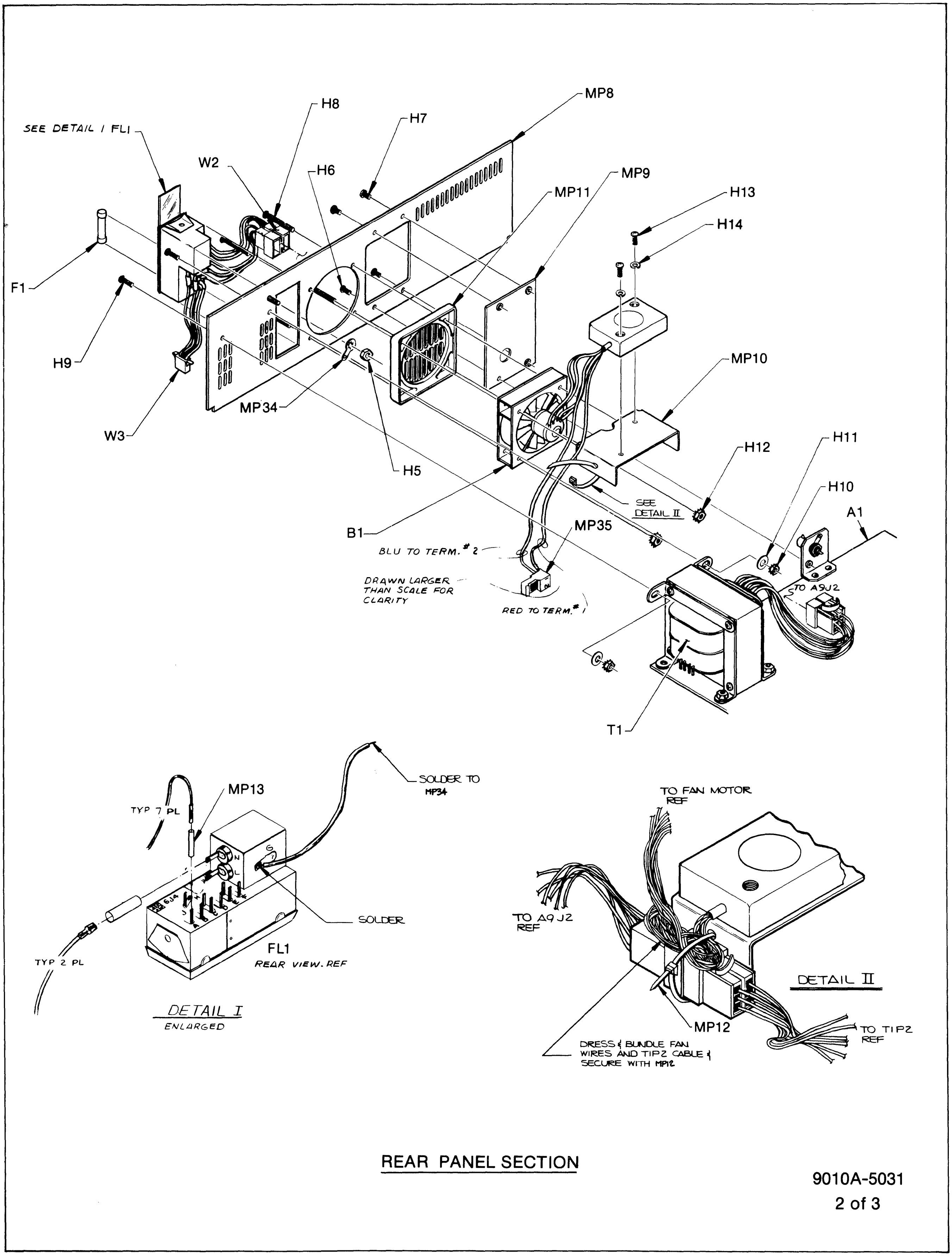


Figure 5-1. Final Assembly (cont)

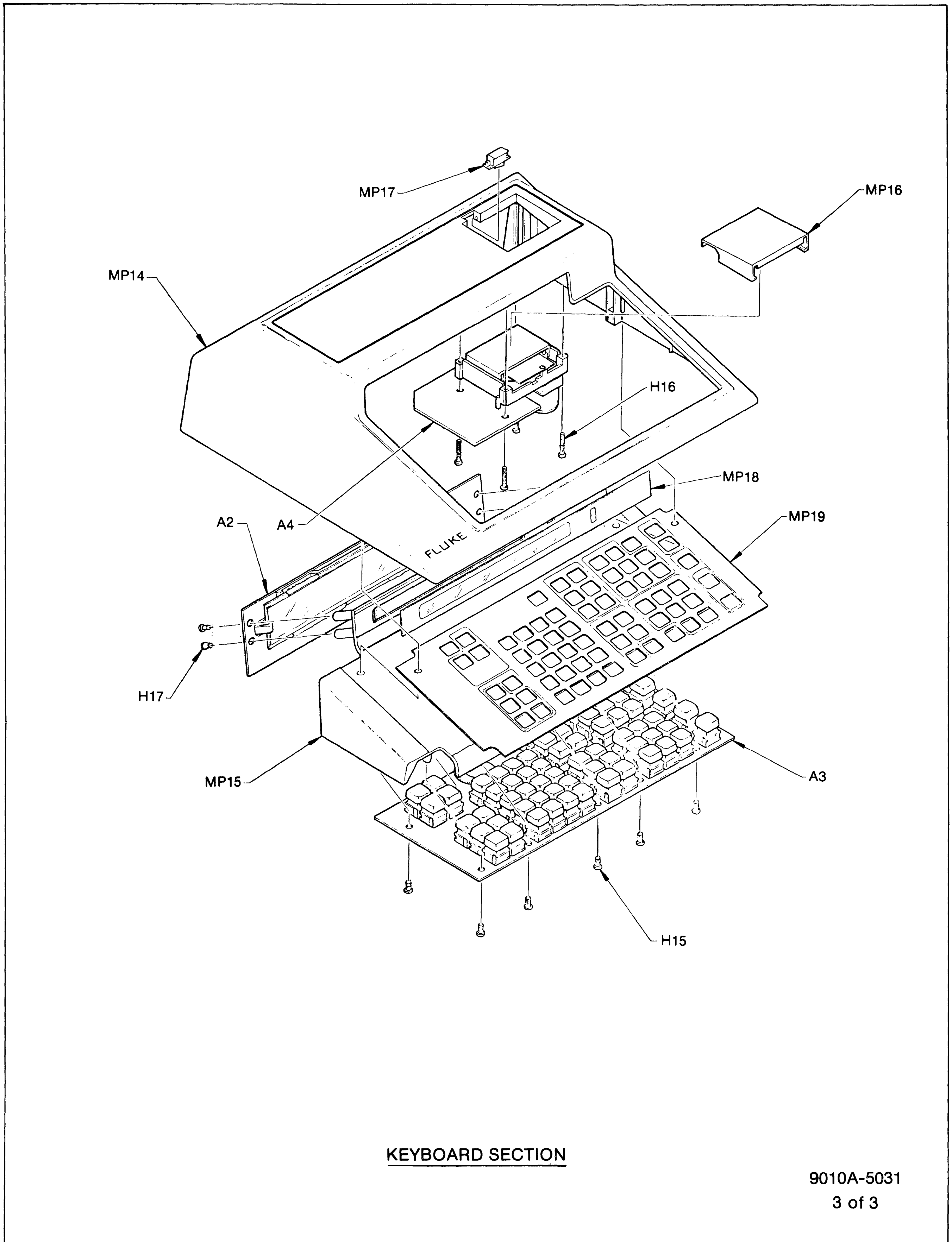


Figure 5-1. Final Assembly (cont)

TABLE 5-2. A1 MAIN PCB ASSEMBLY
(SEE FIGURE 5-2.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1- 3		CAP,AL,15000UF,+30-20%,16V	574186	89536	574186	3	1	
C 4, 7, 10,		CAP,AL,100UF,+50-20%,35V	416982	62643	SM/VB	7	1	
C 11, 76, 77,			416982					
C 44			416982					
C 5, 8		CAP,AL,47UF,+75-10%,16V	519561	89536	519561	2		
C 6, 9, 12		CAP,AL,3300UF,+30-20%,25V	574178	89536	574178	3		
C 13		CAP,AL,470UF,+30-20%,80V	574160	62643	NM	1		
C 16, 68		CAP,TA,10UF,+-20%,20V	330662	56289	196D106X0020KA1	2		
C 17, 49		CAP,CER,0.1UF,+80-20%,10V,Y5R	368647	71590	UK10-104	2		
C 18- 41, 43,		CAP,CER,0.22UF,+-20%,50V,Z5U	519157	51406	RPE111Z5U224M50V	41		
C 45, 47, 50,			519157					
C 53, 57- 62,			519157					
C 71, 72, 81,			519157					
C 86- 89			519157					
C 48		CAP,CER,0.01UF,+80-20%,16V,Y5R	368639	14655	HCC16103P	1		
C 52		CAP,VAR,6-50PF,250V,CER	321117	73899	DVJ305A	1		
C 54, 55, 80		CAP,CER,0.001UF,+-20%,100V,X7R	402966	72982	8121-A100-W5R-102M	3		
C 56, 66, 67,		CAP,TA,22UF,+-20%,15V	423012	56289	196D226X0015KA1	4		
C 69			423012					
C 64, 70		CAP,CER,100PF,+-10%,1000V,S3N	105593	71590	DD-101	2		
C 65		CAP,CER,2000PF,+100-0%,1000V,Z5U	105569	71590	DA140-139CB	1		
C 78, 79		CAP,TA,6.8UF,+-20%,35V	363713	56289	196D685X0035KA1	2		
C 82- 84		CAP,CER,470PF,+-20%,100V,X7R	358275	72982	8111-A100-W5R-471M	3		
C 85		CAP,CER,500PF,+-10%,1000V,X5R	105692	71590	2DDH60N501K	1		
CR 1, 2	*	DIODE,SI, 100 PIV, 22.0 AMP	325746	04713	MR751	2	1	
CR 3- 5, 7,	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	8		
CR 10- 13	*		203323					
G 1		OSCILLATOR,6.5MHZ,TTL CLOCK	586933	89536	586933	1	1	
H 1		ALUM OVAL HEAD SEMI TUBULAR	542621	89536	542621	2		
H 2		NYLON PUSH-RIVET W/PRE-DRIVEN PIN BLK	745869	89536	745869	3		
H 3		WASHER,FLAT S STEEL,#4,0.032 THK	146225	89536	146225	3		
H 4		SCREW,MACH,PHP,S.STL,6-32X5/16	424713	89536	424713	2		
H 5		WASHER,LOCK,SPLIT,STEEL,#6	110692	89536	110692	2		
H 6		NUT,HEX,LOCK,S.STL,6-32	329722	89536	329722	2		
J 1		CONN,D-SUB,PWB,RT ANGL,25 SCKT,.590	461996	00779	206584-1	1		
J 2		CONN,D-SUB,PWB,RT ANGL,9 SCKT,.590	574541	00779	207084-2	1		
J 3, 4		HEADER,2 ROW,0.100CTR,26 PIN	756866	89536	756866	2		
J 5		HEADER,2 ROW,0.100CTR,26 P/N	756841	89536	756841	1		
J 8		HEADER,2 ROW,0.100CTR,10 P/N	756858	89536	756858	2		1
L 1		CHOKE	502138	89536	502138	1		
MP 1		SPACER,DIP SOCKET,14 PIN,PLASTIC	441865	32559	814-060	1		
MP 2		COVER, AC SWITCH	475681	89536	475681	1		
MP 3		HEAT SINK	536797	89536	536797	1		
MP 4		SPACER,RND,SOLUBLE	334797	32559	TO-35-15-E	1		
MP 5		HLDR PART,FUSE,BODY,PWB MT	602763	89536	602763	1		
MP 6		SPACER,SWAGED,HEX,BRASS,6-32X1.000	193128	89536	193128	1		
MP 7		BRACKET, BNC MOUNTING	577635	89536	577635	1		
MP 8		HEATSINK, TO-220	524934	13103	6025B-TT	3	1	
MP 9		SPACER,SWAGED,RND,BRASS,6-32X0.125	435578	89536	435578	4		
P 6		HEADER,1 ROW,0.100CTR,2 PIN	602698	00779	640456-1	1		
P 7		CONN,MATE-N-LOK,PWB,4 PIN	512269	00779	350211-1	1		
Q 1	*	TRANSISTOR,SI,N-JFET,DUAL,SELECTED	654434	17856	DN1963	1	1	
Q 2	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	218396	04713	2N3904	1	1	
Q 3- 6	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	330803	07263	MPS6560	4	1	
R 1		RES,CC,750,+-5%,0.5W	108894	01121	EB7515	1		
R 2		RES,VAR,CERM,100,+-10%,0.5W	275735	11236	360T-101A	1		
R 3		RES,CF,300,+-5%,0.25W	643502	80031	CR251-4-5P300E	1	1	
R 4		RES,CF,120,+-5%,0.25W	643494	80031	CR251-4-5P120E	1		
R 5		RES,CF,1.5K,+-5%,0.25W	573212	80031	CR251-4-5P1K5	1		
R 6		RES,CC,2.7K,+-5%,0.5W	109074	01121	EB2725	1		
R 7		RES,CC,1.5K,+-5%,0.5W	266353	01121	EB1525	1		
R 8		RES,CC,18K,+-5%,0.5W	187898	01121	EB1835	1		
R 10		RES,CC,100,+-5%,0.5W	188508	01121	EB1015	1		
R 12, 13		RES,CF,20,+-5%,0.25W	572958	80031	CR251-4-5P20E	2		
R 14		RES,CF,1M,+-5%,0.25W	573691	80031	CR251-4-5P1M	1		
R 15, 16, 40		RES,CF,100K,+-5%,0.25W	573584	80031	CR251-4-5P100K	3		
R 17		RES,CF,220K,+-5%,0.25W	573642	80031	CR251-4-5P220K	1		
R 18, 19		RES,CF,4.7K,+-5%,0.25W	573311	80031	CR251-4-5P4K7	2		
R 20, 42		RES,CF,10K,+-5%,0.25W	573394	80031	CR251-4-5P10K	2		
R 21		RES,CF,2K,+-5%,0.25W	573238	80031	CR251-4-5P2K	1		
R 22		RES,CF,220,+-5%,0.25W	574244	80031	CR251-4-5P220E	1		
R 23, 41		RES,CF,200,+-5%,0.25W	573055	80031	CR251-4-5P200E	2		
R 24		RES,CF,330,+-5%,0.25W	573089	80031	CR251-4-5P330E	1		
R 26		RES,MF,15K,+-1%,0.125W,100PPM	285296	91637	CMF551502F	1		
R 27		RES,MF,549,+-1%,0.125W,100PPM	436469	91637	CMF555490F	1		
R 28		RES,MF,24.3,+-1%,0.125W,100PPM	281816	91637	CMF5524R2F	1		
R 29		RES,MF,10,+-1%,0.125W,100PPM	268789	91637	CMF5510R0F	1		
R 30		RES,CF,430,+-5%,0.25W	441568	80031	CR251-4-5P430E	1	1	
R 31		RES,CF,3.9K,+-5%,0.25W	342600	80031	CR251-4-5P3K9	1		

TABLE 5-2. A1 MAIN PCB ASSEMBLY
(SEE FIGURE 5-2.)

REFERENCE DESIGNATOR A->NUMERICS--->		S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
R	27		RES,MF,549,+-1%,0.125W,100PPM	436469	91637	CMF555490F	1		
R	28		RES,MF,24.3,+-1%,0.125W,100PPM	281816	91637	CMF5524R2F	1		
R	29		RES,MF,10,+-1%,0.125W,100PPM	268789	91637	CMF5510R0F	1		
R	30		RES,CF,430,+-5%,0.25W	441568	80031	CR251-4-5P430E	1	1	
R	31		RES,CF,3.9K,+-5%,0.25W	342600	80031	CR251-4-5P3K9	1		
R	32, 47, 53,		RES,CF,2.2K,+-5%,0.25W	573246	80031	CR251-4-5P2K2	4		
R	54			573246					
R	33		RES,CF,470,+-5%,0.25W	573121	80031	CR251-4-5P470E	1		
R	34		RES,CF,390,+-5%,0.25W	573105	80031	CR251-4-5P390E	1		
R	35- 37, 52		RES,CF,100,+-5%,0.25W	573014	80031	CR251-4-5P100E	4		
R	38		RES,CF,510,+-5%,0.25W	573139	89536	573139	1		
R	39, 43, 46,		RES,CF,1K,+-5%,0.25W	343426	80031	CR251-4-5P1K	5		
R	60, 61			343426					
R	39, 46, 48		RES,CF,1K,+-5%,0.25W	573170	80031	CR251-4-5P1K	3		
R	43		RES,CF,680,+-5%,0.25W	573154	80031	CR251-4-5P680E	1		
R	49, 57, 58		RES,CF,10K,+-5%,0.25W	348839	80031	CR251-4-5P10K	3		
R	50		RES,CF,2.7K,+-5%,0.25W	573261	80031	CR251-4-5P2K7	1		
R	51		RES,CF,5.1K,+-5%,0.25W	573329	80031	CR251-4-5P5K1	1		
R	55		RES,CF,10,+-5%,0.25W	572941	80031	CR251-4-5P10E	1		
R	56		RES,CF,2K,+-5%,0.25W	441469	80031	CR251-4-5P2K	1		
R	59		RES,CF,4.7K,+-5%,0.25W	348821	01121	CB4725	1		
R	62, 65		RES,CF,39K,+-5%,0.25W	442400	80031	CR251-4-5P39K	2		
R	63, 64		RES,MF,301,+-1%,0.125W,100PPM	267740	91637	CMF553010F	2		
RV	1		VARISTOR,470V,+-20%,1.0MA	443192	09214	V300LA2	1		
S	1		SWITCH, ON-OFF	453605	89536	453605	1		
T	2		TRANSFORMER, PULSE	579219	89536	579219	1		
TP	1, 8- 12,		PIN,SINGLE,PWB,0.025 SQ	267500	00779	87022-1	8	1	2
TP	14			267500					2
TP	2- 7, 13		HEADER,1 ROW,0.150CTR,7 P/N	756916	89536	756916	1		
U	1	*	IC,VOLT REG,ADJ,1.2 TO 32 V,5 AMP OUT	585497	12040	LM338K	1		
U	2, 4, 6	*	DIODE,SI,RECT,BRIDGE,BV=200V,IO=1.0A	296509	09423	FB200	3		
U	3	*	IC,VOLT REG,FIXED,-5 VOLTS,1.5 AMPS	394551	04713	MC7905CT	1	1	
U	5	*	IC,VOLT REG,FIXED,+12 VOLTS,1.5 AMPS	413195	04713	MC7812TP	1		
U	7	*	DIODE,SI,RECT,BRIDGE,BV=600V,IO=1.0A	341008	11711	KBP06	1	1	
U	8	*	IC,NMOS,8 BIT MICROCOMPUTER	478073	50088	MK3880-4CPU	1		
U	9- 16	*	IC,16K X 1 DYN RAM	483487	01295	TMS4116-25JL	8	1	
U	19	*	IC, 16K X 8 ROM 9000A-9051 R1	707174	89536	707174	1	1	
U	21	*	IC, 16K X 8 ROM 9000A-9052 R1	707182	89536	707182	1	1	
U	22	*	IC,NMOS,PERPHERAL INTERFACE ADAPTOR	536318	55576	SYP6520	1	1	
U	23, 24, 38	*	IC,LSTTL,QUAD 2-1 LINE MUX W/STROBE	407833	01295	SN74LS157N	3	1	
U	25	*	IC,LSTTL,3-8 LINE DCDR W/ENABLE	407585	01295	SN74LS138N	1		
U	27	*	IC,LSTTL,QUAD 2 INPUT NAND GATE	393033	01295	SN74LS00N	1	1	
U	28	*	IC,LSTTL,HEX INVERTER	393058	01295	SN74LS04N	1	1	
U	29	*	IC,LSTTL,DUAL JK F/F,-EDG TRIG	414029	01295	SN74LS112N	1	1	
U	30	*	IC,TTL,HEX INVERTER W/OPEN COLLECTOR	407593	01295	SN7406N	1	1	
U	31	*	IC,CMOS,RETRIG/RESET MULTIVIBRATOR	393512	02735	CD4098AE	1	1	
U	32, 57	*	IC,LSTTL,DUAL J-K F/F,+EDG TRIG	412999	01295	SN74LS109N	2	1	
U	33		RES,NET,SIP,8 PIN,7 RES,10K,+-2%	412924	80031	95081002CL	1		
U	34, 37	*	IC,LSTTL,DUAL D F/F,+EDG TRG,W/CLR	393124	01295	SN74LS74N	2	1	
U	35	*	IC,BPLR,DUAL TIMER,14 PIN DIP	387407	18324	NE556A	1	1	
U	36, 49	*	IC,COMPARATOR,HI-SPEED,14 PIN DIP	386920	18324	NE529A	2	1	
U	39	*	IC,LSTTL,TRIPLE 3 INPUT NAND GATE	393074	01295	SN74LS10N	1	1	
U	40, 26	*	IC,LSTTL,QUAD 2 INPUT NOR GATE	393041	01295	SN74LS02N	2	1	
U	41	*	DELAY LINE,60 NS,HEX INVERTER	655373	89536	655373	1		
U	42, 43, 61	*	IC,LSTTL,RETRG MONOSTAB MULTIVB W/CLR	404186	01295	SN74LS123N	3	1	
U	44	*	IC,LSTTL,QUAD 2 IN NOR GATE W/OPN COL	414037	01295	SN74LS33N	1	1	
U	45	*	IC,CMOS,QUAD D F/F,+EDG TRG	536292	04713	MC14175B	1	1	
U	46	*	IC,CMOS,QUAD NOR R/S LTCH W/3-STATE	536607	04713	MC14043BCP	1	1	
U	47		RES,NET,SIP,6 PIN,5 RES,1K,+-2%	408310	89536	408310	1		
U	48		RES,NET,SIP,6 PIN,5 RES,22K,+-2%	520122	89536	520122	1		
U	50	*	IC,ECL,QUAD LINE RECEIVER	584045	04713	MC10115P	1	1	
U	51	*	IC,TTL,QUAD 2 INPUT XOR GATE	408237	01295	SN74LS86N	1	1	
U	52, 54	*	IC,LSTTL,8BIT S-IN, P-OUT R-SHIFT RGS	408732	01295	SN74LS164N	2	1	
U	53, 55, 60	*	IC,LSTTL,OCTL LINE DRVR W/3-STATE OUT	429035	01295	SN74LS244N	3		
U	56		RES,NET,SIP,6 PIN,5 RES,510,+-2%	459974	89536	459974	1		
U	58	*	IC,VOLT REG,FIXED,+8 VOLTS,1.5 AMPS	407627	04713	MC7808CT	1	1	
U	59	*	IC,DUAL DIV BY 16 BINARY COUNTER	483578	01295	SN74LS393N	1	1	
U	62	*	IC, 32 X 8 PROM ,PROGRAMMED	605055	89536	605055	1	1	
U	63		RES,NEG,SIP,8 PIN,7 RES,1K,+-2%	414557	80031	95081002CL	1		
U	64	*	IC,16K X 8 ROM, 9000A-9050-R1	707166	89536	707166	1		
W	1		JUMPER,WIRE,TEFLON INSUL,0.200CTR	529776	89536	529776	1		
W	4, 6		JUMPER,WIRE,NONINSUL,0.100CTR	529701	89536	529701	2		
XU	8, 22		SOCKET,IC,40 PIN	429282	09922	DILB40P-108	2		
XU	9- 16		SOCKET,IC,16 PIN	276535	91506	316-AG39D	8	1	

TABLE 5-2. A1 MAIN PCB ASSEMBLY
(SEE FIGURE 5-2.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
XU 19, 21, 64		SOCKET,IC,28 PIN	448217	91506	328-AG39D	3		
XU 34, 41		SOCKET,IC,14 PIN	276527	09922	DILB8P-108	2		
XU 53, 55, 60		SOCKET,IC,20 PIN	454421	09922	DILB20P-108	3		

NOTE 1 = ALSO INCLUDES P8.
NOTE 2 = ALSO INCLUDES E3.

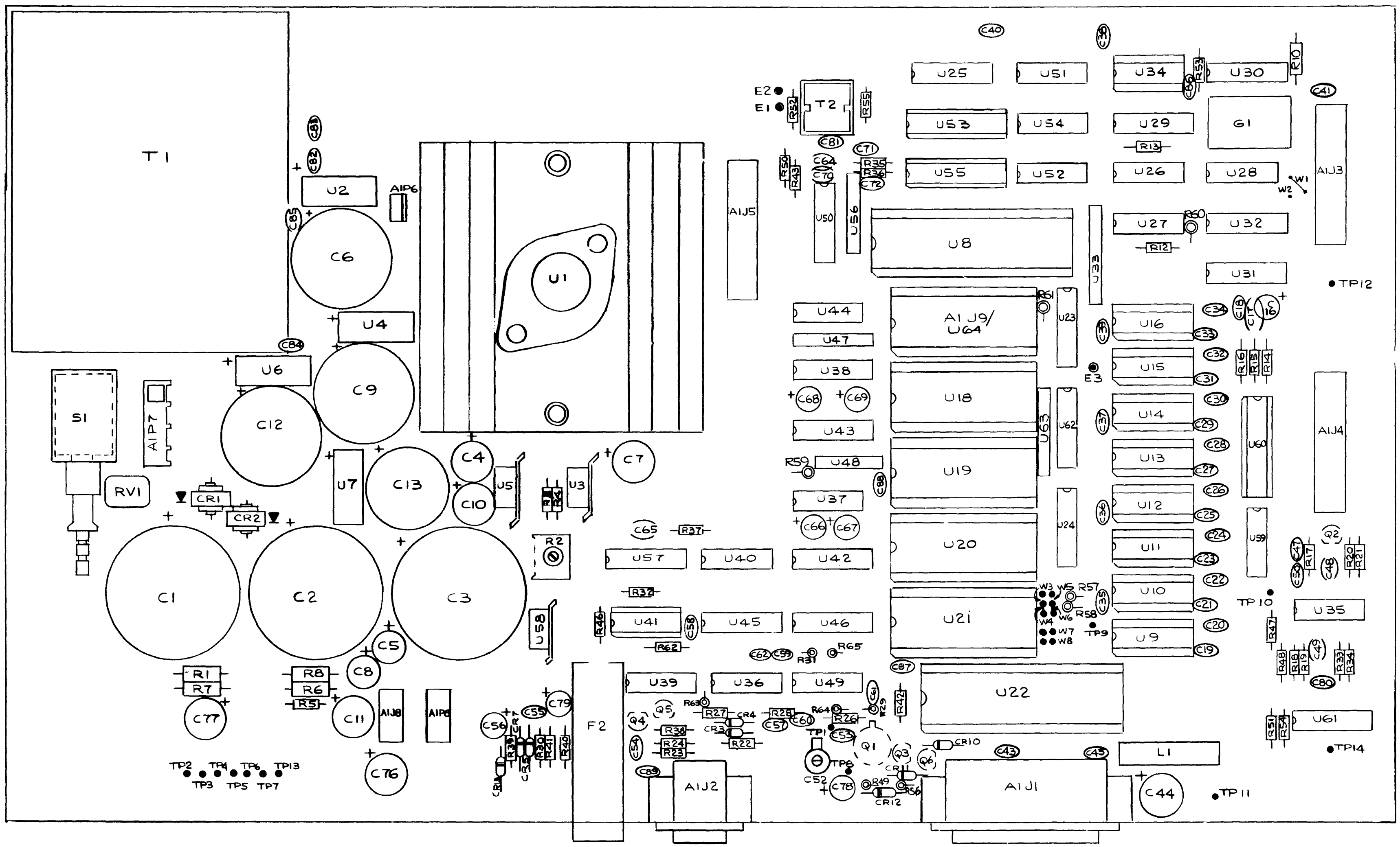


Figure 5-2. A1 Main PCB Assembly

9000A-1601

CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY

TABLE 5-3. A2 DISPLAY PCB ASSEMBLY
(SEE FIGURE 5-3.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1		CAP,POLYES,0.1UF,+-10%,400V	447573	73445	C280MA F/A100K	1		
C 2, 3		CAP,AL,10UF,+50-10%,25V	170266	73445	ET100X025A2	2		
C 4		CAP,CER,20PF,+-10%,500V,T2H	106369	56289	561CT2HBA102AE200K	1	1	
C 5, 6		CAP,CER,0.22UF,+-20%,50V,Z5U	519157	51406	RPE111Z5U224M50V	2		
DS 1- 5	*	LED,RED,RECTANGLE,PCB MOUNT	504761	14936	MV57124	5		
H 1		WASHER,FLAT,BRASS,#4,0.025	110775	89536	110775	2		
H 2		SCREW,THD CUT,PHP,S.STL,4-24X3/8	183574	89536	183574	2		
J 1, 2		CONN PART, FLAT CABLE, BODY,26 POS	530154	89536	530154	2		
MP 1		SPACER, DISPLAY	577601	89536	577601	1		
MP 2		CONN PART,FLAT CABLE,COVER,26 POS	530162	89536	530162	2		
Q 1, 2	*	TRANSISTOR,SI,PNP,SMALL SIGNAL	418707	04713	MPS56562	2	1	
R 1, 2		RES,CF,47K,+-5%,0.25W	348896	80031	CR251-4-5P47K	2		
R 3, 9		RES,CF,10K,+-5%,0.25W	348839	80031	CR251-4-5P10K	2		
R 4- 8		RES,CF,180,+-5%,0.25W	441436	80031	CR251-4-5P180E	5	1	
R 10, 13		RES,CF,1.1K,+-5%,0.25W	348797	89536	348797	2		
R 11, 14		RES,CF,180K,+-5%,0.25W	348946	80031	CR251-4-5P180K	2		
R 12, 15		RES,CC,56,+-10%,0.5W	109009	01121	RC20GF560KS	2		
TP 10- 5		PIN,SINGLE,PWB,0.025 SQ	267500	00779	87022-1	6		
U 1		IC,NMOS,UNV PERPHL INTRFCE,9000A-9001	535419	89536	535419	1		
U 2- 6	*	IC,CMOS,DUAL 4BIT SER-IN,PAR-OUT SHFT	340125	04713	MC14015CP	5		
U 7- 12	*	IC,BIPLR,8CHNL FLOURESCNT DISPLY DRVR	535799	56289	UDN6118A	6	1	
U 13, 14	*	IC,CMOS,8BIT SHFT RGS W/3-ST&I/O LTCH	524520	04713	MC14094BCP	2	1	
U 15	*	IC,TTL,HEX D F/F,+EDG TRG,W/CLR	604264	01295	SN74174N	1	2	
U 16	*	IC,LSTTL,QUAD 2 INPUT NOR GATE	393041	01295	SN74LS02N	1	1	
U 17	*	IC,TTL,HEX INVERTER W/OPEN COLLECTOR	288605	01295	SN7416N	1	1	
V 1		TUBE,DISPLAY,VAC FLUORSCENT,32 CHARCT	535401	30315	FG326A2	1	1	
W 1		CABLE, KEYBOARD	579235	89536	579235	1		
W 2		CABLE, DISPLAY	579227	89536	579227	1		
XU 1		SOCKET,IC,40 PIN	429282	09922	DILB40P-108	1		
Y 1	*	CRYSTAL,6MHZ,+-0.01%,HC-18/U	461665	89536	461665	1		

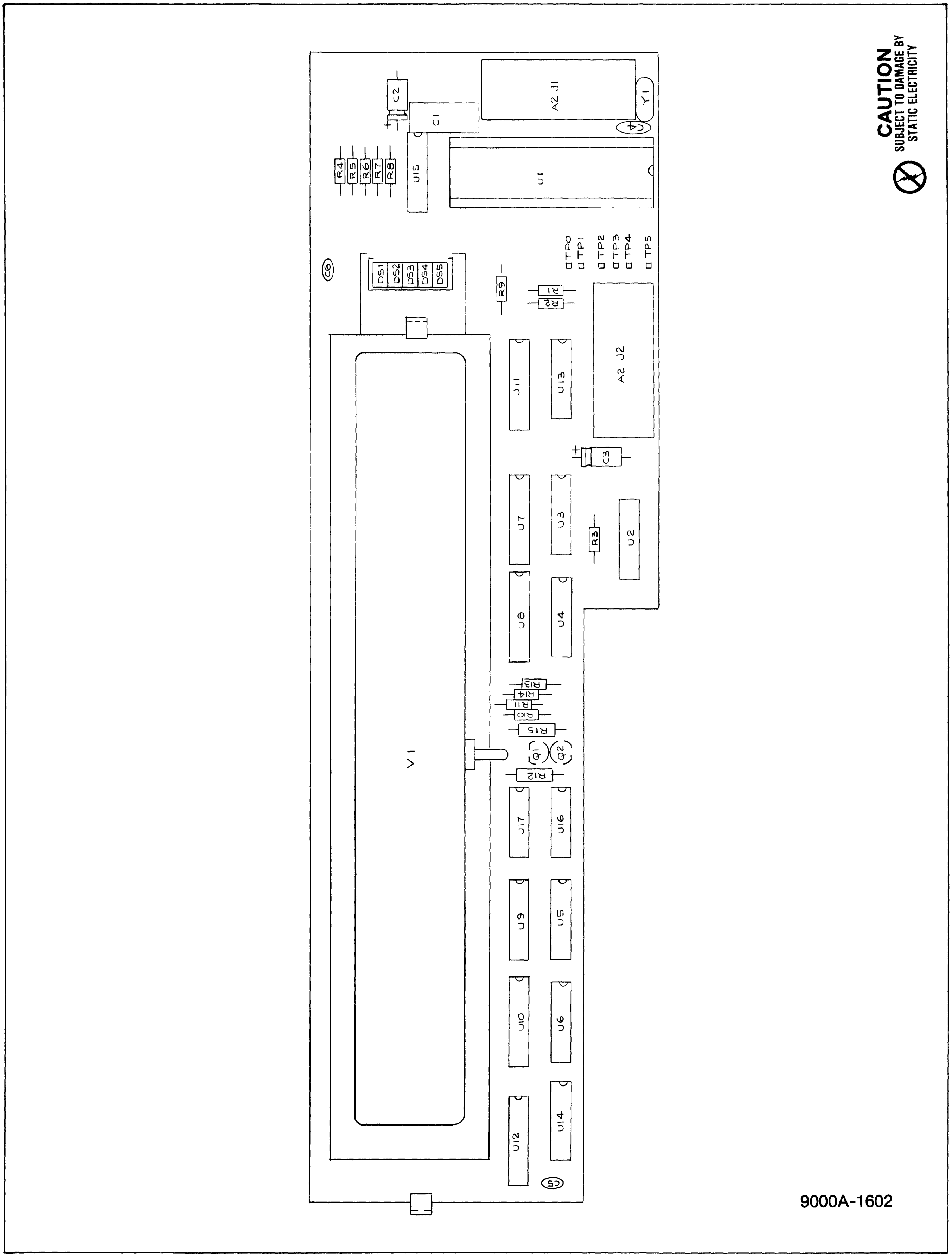
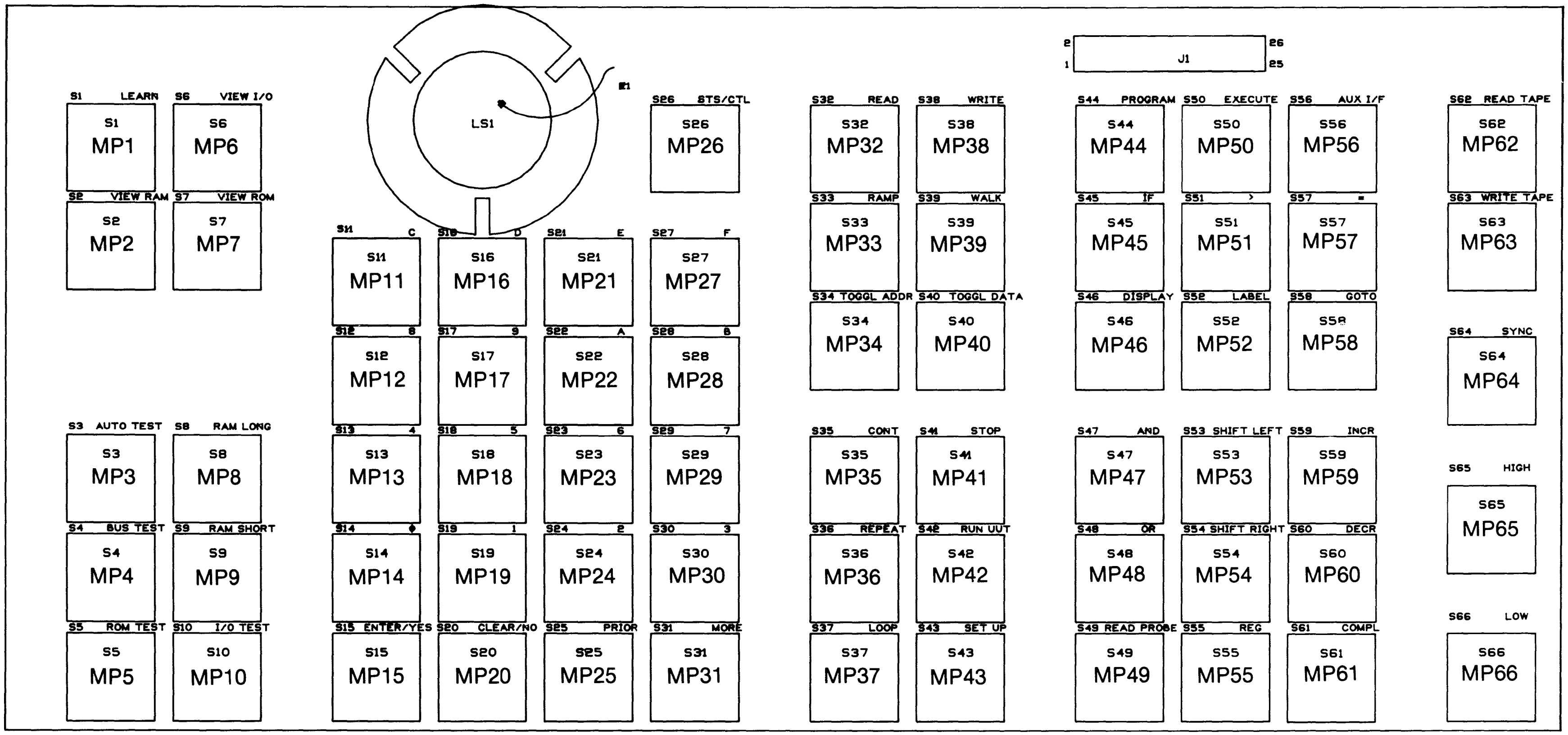


Figure 5-3. A2 Display PCB Assembly

TABLE 5-4. A3 KEYBOARD ASSEMBLY
(SEE FIGURE 5-4.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	-----------DESCRIPTION-----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
J 1		HEADER,2 ROW,0.100CTR,RT ANG,26 PIN	512590	89536	512590	1		
LS 1		AF TRANSD,PIEZO,41.3 MM,PCB MOUNT	513101	89536	513101	1	1	
MP 1		KEYTOP-LEARN	584284	89536	584284	1	13	
MP 2		KEYTOP-I/O	584292	89536	584292	1		
MP 3		KEYTOP-RAM	584300	89536	584300	1		
MP 4		KEYTOP-ROM	584318	89536	584318	1		
MP 5		KEYTOP-AUTO	584326	89536	584326	1		
MP 6		KEYTOP-RAM LONG	584334	89536	584334	1		
MP 7		KEYTOP-RAM SHORT	584342	89536	584342	1		
MP 8		KEYTOP-BUS	584359	89536	584359	1		
MP 9		KEYTOP-ROM	584367	89536	584367	1		
MP 10		KEYTOP-I/O	584375	89536	584375	1		
MP 11		KEYTOP - PRIOR	584383	89536	584383	1		
MP 12		KEYTOP-MORE	584391	89536	584391	1		
MP 13		KEYTOP-ENTER/YES	584409	89536	584409	1		
MP 14		KEYTOP-CLEAR/NO	584417	89536	584417	1		
MP 15		KEYTOP-STS/CTL	584425	89536	584425	1		
MP 16		KEYTOP-0 0000	584433	89536	584433	1		
MP 17		KEYTOP-1 0001	584441	89536	584441	1		
MP 18		KEYTOP-2 0010	584458	89536	584458	1		
MP 19		KEYTOP-3 0011	584466	89536	584466	1		
MP 20		KEYTOP-4 0100	584474	89536	584474	1		
MP 21		KEYTOP-5 0101	584482	89536	584482	1		
MP 22		KEYTOP - 6 0110	584490	89536	584490	1		
MP 23		KEYTOP-7 0111	584508	89536	584508	1		
MP 24		KEYTOP-8 1000	584516	89536	584516	1		
MP 25		KEYTOP-9 1001	584524	89536	584524	1		
MP 26		KEYTOP-A 1010	584532	89536	584532	1		
MP 27		KEYTOP-B 1011	584540	89536	584540	1		
MP 28		KEYTOP-C 1100	584557	89536	584557	1		
MP 29		KEYTOP-D 1101	584565	89536	584565	1		
MP 30		KEYTOP - E 1110	584573	89536	584573	1		
MP 31		KEYTOP-F 1111	584581	89536	584581	1		
MP 32		KEYTOP-SETUP	584599	89536	584599	1		
MP 33		KEYTOP-READ	584607	89536	584607	1		
MP 34		KEYTOP-WRITE	584615	89536	584615	1		
MP 35		KEYTOP-RAMP	584623	89536	584623	1		
MP 36		KEYTOP - WALK	584631	89536	584631	1		
MP 37		KEYTOP - TOGGL ADDR	584649	89536	584649	1		
MP 38		KEYTOP - TOGGL DATA	584656	89536	584656	1		
MP 39		KEYTOP-CONT	584664	89536	584664	1		
MP 40		KEYTOP-STOP	584672	89536	584672	1		
MP 41		KEYTOP-REPEAT	584680	89536	584680	1		
MP 42		KEYTOP-RUN UUT	584698	89536	584698	1		
MP 43		KEYTOP-LOOP	584706	89536	584706	1		
MP 44		KEYTOP-AND	584797	89536	584797	1		
MP 45		KEYTOP-OR	584805	89536	584805	1		
MP 46		KEYTOP-SHIFT LEFT	584813	89536	584813	1		
MP 47		KEYTOP-SHIFT RIGHT	584821	89536	584821	1		
MP 48		KEYTOP-REG	584839	89536	584839	1		
MP 49		KEYTOP-INCR	584847	89536	584847	1		
MP 50		KEYTOP-DECR	584854	89536	584854	1		
MP 51		KEYTOP-COMPL	584862	89536	584862	1		
MP 52		KEYTOP-SYNC	584896	89536	584896	1		
MP 53		KEYTOP-HIGH	584904	89536	584904	1		
MP 54		KEYTOP-LOW	584912	89536	584912	1		
MP 55		KEYTOP-READ PROBE	584920	89536	584920	1		
MP 56		KEYTOP-AUX I/F	584938	89536	584938	1		
MP 57		KEYTOP - PROGRAM	584714	89536	584714	1		
MP 58		KEYTOP-LABEL	584722	89536	584722	1		
MP 59		KEYTOP-GO TO	584730	89536	584730	1		
MP 60		KEYTOP-IF	584748	89536	584748	1		
MP 61		KEYTOP-GREATER THAN	584755	89536	584755	1		
MP 62		KEYTOP-=	584763	89536	584763	1		
MP 63		KEYTOP-EXECUTE	584771	89536	584771	1		
MP 64		KEYTOP-DISPLAY	584789	89536	584789	1		
MP 65		KEYTOP-READ TAPE	584870	89536	584870	1		
MP 66		KEYTOP-WRITE TAPE	584888	89536	584888	1		
S 1- 64		SWITCH,PUSHBUTTON,SPST KEYBOARD	513473	89536	513473	64		
S 65, 66		SWITCH,PUSHBUTTON,SPST ALT ACTION	602219	89536	602219	2		



9010A-1633

Figure 5-4. A3 Keyboard Assembly

TABLE 5-5. A4 MAGNETIC TAPE PCB ASSEMBLY
(SEE FIGURE 5-5.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 2		CAP,CER,20PF,+-10%,500V,T2H	106369	56289	561CT2HBA102AE200K	1	1	
C 3, 5, 9,		CAP,CER,0.22UF,+-20%,50V,Z5U	519157	51406	RPE111Z5U224M50V	4		
C 15			519157					
C 4, 6, 16		CAP,AL,10UF,+50-10%,25V	170266	73445	ET100X025A2	3		
C 7		CAP,AL,4700UF,+50-10%,5V	572511	89536	572511	1		
C 8		CAP,CER,180PF,+-5%,100V,COG	603506	56289	C023B501E181M	1		
C 10, 11		CAP,TA,4.7UF,+-20%,25V	161943	56289	196D475X0025KA1	2		
C 12, 18		CAP,CER,39PF,+-2%,100V,COG	512962	89536	512962	2		
C 13		CAP,CER,0.01UF,+-20%,100V,X7R	407361	72982	8121-A100-W5R-103M	1		
C 17, 19		CAP,CER,220PF,+-2%,100V,COG	512111	51406	RPE121	2		
CR 1- 7	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	7	1	
CR 8, 9	*	DIODE,SI,MULTI-PELLET	375485	09214	MPD300	2	1	
H 1		SCREW,THD FORM,PHP,S STL,2-32X1/4	602128	89536	602128	3		
J 1		CONN PART, FLAT CABLE, BODY,26 POS	530154	89536	530154	1		
MP 1		TAPE, MIN SIZE, CASSETTE, DIGITAL	574459	89536	574459	1		
MP 2		CONN PART,FLAT CABLE,COVER,26 POS	530162	89536	530162	1		2
Q 1	*	TRANSISTOR,SI,NPN,SMALL SIGNAL	330803	07263	MPS6560	1	1	
Q 2- 4	*	TRANSISTOR,SI,PNP,SMALL SIGNAL	195974	64713	2N3906	3	1	
Q 5	*	TRANSISTOR,SI,PNP,SM SIG,DARLINGTON	524140	04713	MPS-A63	1	1	
R 1		RES,CF,10,+-5%,0.25W	572941	80031	CR251-4-5P10E	1		
R 2, 10, 42,		RES,CF,10K,+-5%,0.25W	348839	80031	CR251-4-5P10K	4		
R 46			348839					
R 3		RES,CF,3.3K,+-5%,0.25W	573287	80031	CR251-4-5P3K3	1		
R 4		RES,CF,110,+-5%,0.25W	643486	80031	CR251-45P110E	1		
R 5, 8, 26,		RES,CF,2K,+-5%,0.25W	573238	80031	CR251-4-5P2K	6		
R 32, 40, 47			573238					
R 6		RES,CC,1.2,+-5%,0.5W	218701	01121	EB1R25	1		
R 7		RES,CF,360,+-5%,0.25W	573097	80031	CR251-4-5P360E	1		
R 9, 11, 15,		RES,CF,200,+-5%,0.25W	573055	80031	CR251-4-5P200E	4		
R 44			573055					
R 12, 17, 27,		RES,CF,100K,+-5%,0.25W	573584	80031	CR251-4-5P100K	6		
R 28, 33, 34			573584					
R 13		RES,CF,180,+-5%,0.25W	573048	80031	CR251-4-5P180E	1		
R 14		RES,VAR,CERM,500,+-20%,0.5W	226068	02111	62-1-1-501	1		
R 16		RES,CF,680,+-5%,0.25W	573154	80031	CR251-4-5P680E	1		
R 18- 20, 38,		RES,CF,100,+-5%,0.25W	573014	80031	CR251-4-5P100E	6		
R 39, 45			573014					
R 21, 22		RES,MF,499,+-1%,0.125W,50PPM	289256	91637	CMF554990F	2		
R 23, 24		RES,MF,100K,+-1%,0.125W,100PPM	248807	91637	CMF551003F	2	1	
R 29		RES,MF,40.2K,+-1%,0.125W,100PPM	235333	91637	CMF554022F	1	2	
R 30		RES,MF,200K,+-1%,0.125W,100PPM	261701	91637	CMF552003F	1		
R 31		RES,CF,27K,+-5%,0.25W	573477	80031	CR251-4-5P27K	1		
R 35, 36		RES,MF,10K,+-1%,0.125W,100PPM	168260	91637	CMF551002F	2		
R 37		RES,CF,82K,+-5%,0.25W	573568	80031	CR251-4-2P82K	1		
R 41		RES,CF,1.8K,+-5%,0.25W	573220	80031	CR251-4-5P1K8	1		
R 43		RES,CF,1K,+-5%,0.25W	573170	80031	CR251-4-5P1K	1		
‡TP 1- 7		PIN,SINGLE,PWB,0.025 SQ	267500	00779	87022-1	24		1
U 1	*	IC,NMOS,UNV PRPHRL INTRFCE,9000A-9002	536094	89536	536094	1		
U 2, 3	*	IC,LSTTL,QUAD 2 IN NAND W/OPEN COLLCT	524736	01295	SN74LS38N	2		
U 4	*	IC,ARRAY,4 TRANS,PNP,MEMORY DRIVER	477828	12040	DH3467CN	1	1	
U 5	*	IC,OP AMP,QUAD,14 PIN DIP	402669	12040	LM324N	1		
U 6	*	IC,BPLR,DC MOTOR SPEED REGULATOR	536383	89536	536383	1		
W 1		CABLE,MAG TAPE	581801	89536	581801	1		
XU 1		SOCKET,IC,40 PIN	429282	09922	DILB40P-108	1		
Y 1	*	CRYSTAL,6MHZ,+-0.01%,HC-18/U	461665	89536	461665	1		

NOTE 1 = ALSO INCLUDES J2.
NOTE 2 = WITH J1.

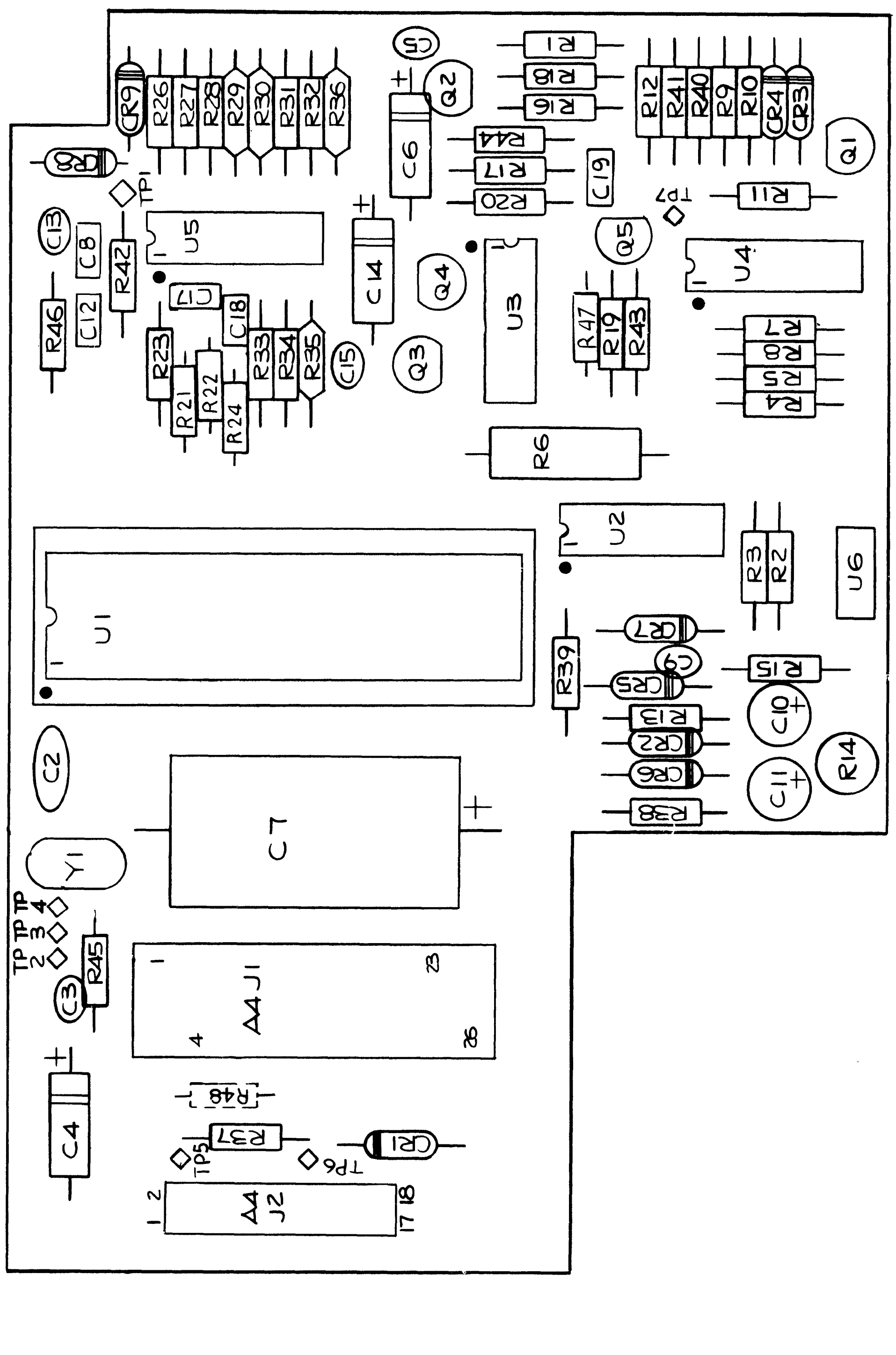


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Figure 5-5. A4 Magnetic Tape PCB Assembly

TABLE 5-6. A7 DATA PROBE PCB ASSEMBLY
(SEE FIGURE 5-6.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1		CAP,CER,33PF,+-2%,50V,COG	354852	72982	8121-A100-COG-330G	1	1	
C 2, 3		CAP,CER,0.39UF,+80-20%,50V,X7R	614552	89536	614552	2	1	
CR 1, 2	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	2		
L 1, 2		LAMP,SUB-MIN,5V,75MA	574475	76854	14AS15	2		
MP 1		PCB STANDOFF	584201	89536	584201	1	2	
MP 2		PROBE BODY	611814	89536	611814	1		
MP 3		PROBE, CANOPY	580910	89536	580910	1		
MP 4		LABEL, PROBE CAUTION	605816	89536	605816	1		
MP 5		DECAL	585307	89536	585307	1		
Q 1	*	TRANSISTOR,SI,PNP,USED ON HYBRIDS	483735	04713	MMBT3906	1		
Q 2	*	TRANSISTOR,SI,NPN,HYBRID USE,SM SIGNL	483743	04713	MMBT3904	1	1	
R 1		RES,MF,205K,+-1%,0.125W,100PPM	375931	91537	CMF552053F	1		
R 2		RES,CF,220,+-5%,0.25W	342626	80031	CR251-4-5P220E	1		
R 3		RES,MF,100K,+-1%,0.125W,100PPM	248807	91637	CMF551003F	1		
R 4		RES,CC,10K,+-10%,0.125W	246975	01121	BB1031	1		
W 1		CABLE, PROBE	583344	89536	583344	1		

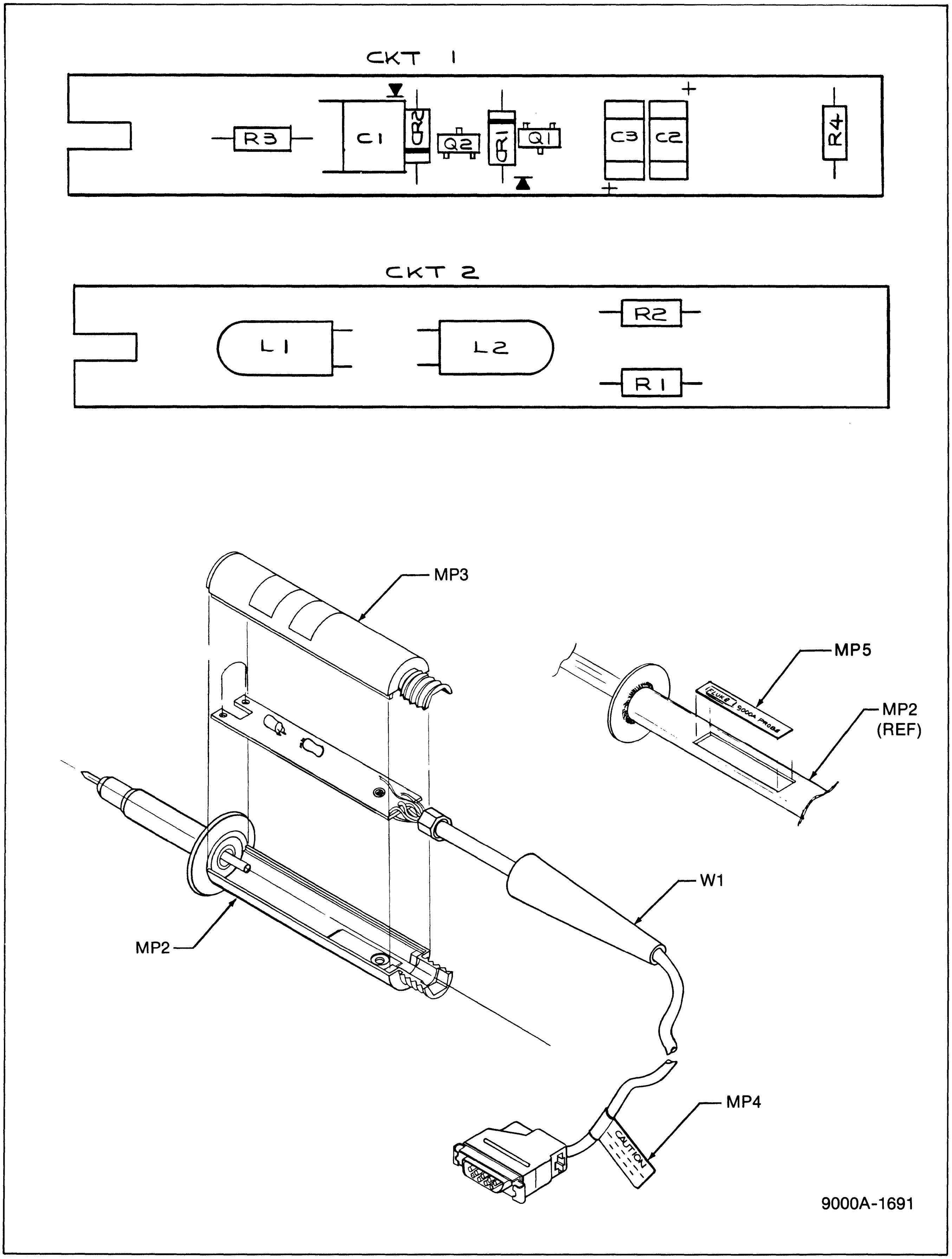

Figure 5-6. A7 Data Probe PCB Assembly

Section 6
Option & Accessory Information

TABLE OF CONTENTS

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 $\overline{\text{I/O7}}$ output of the I/O selector (described in Section 3) in conjunction with address lines A0 and A1, and the $\overline{\text{WR}}$ (write) line. To read the UART status on six lines (D0-D5) of the data bus, the microprocessor makes address line A0 low, and 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 $\overline{\text{WR}}$ (write) and the $\overline{\text{I/O7}}$ 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 transmitsthe 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 $\overline{\text{I/O7}}$ line is high. The high RDD 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 $\overline{\text{DRR}}$ (data register reset) input of the UART is made low by a low A1 address line and a low $\overline{\text{I/O7}}$ 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.

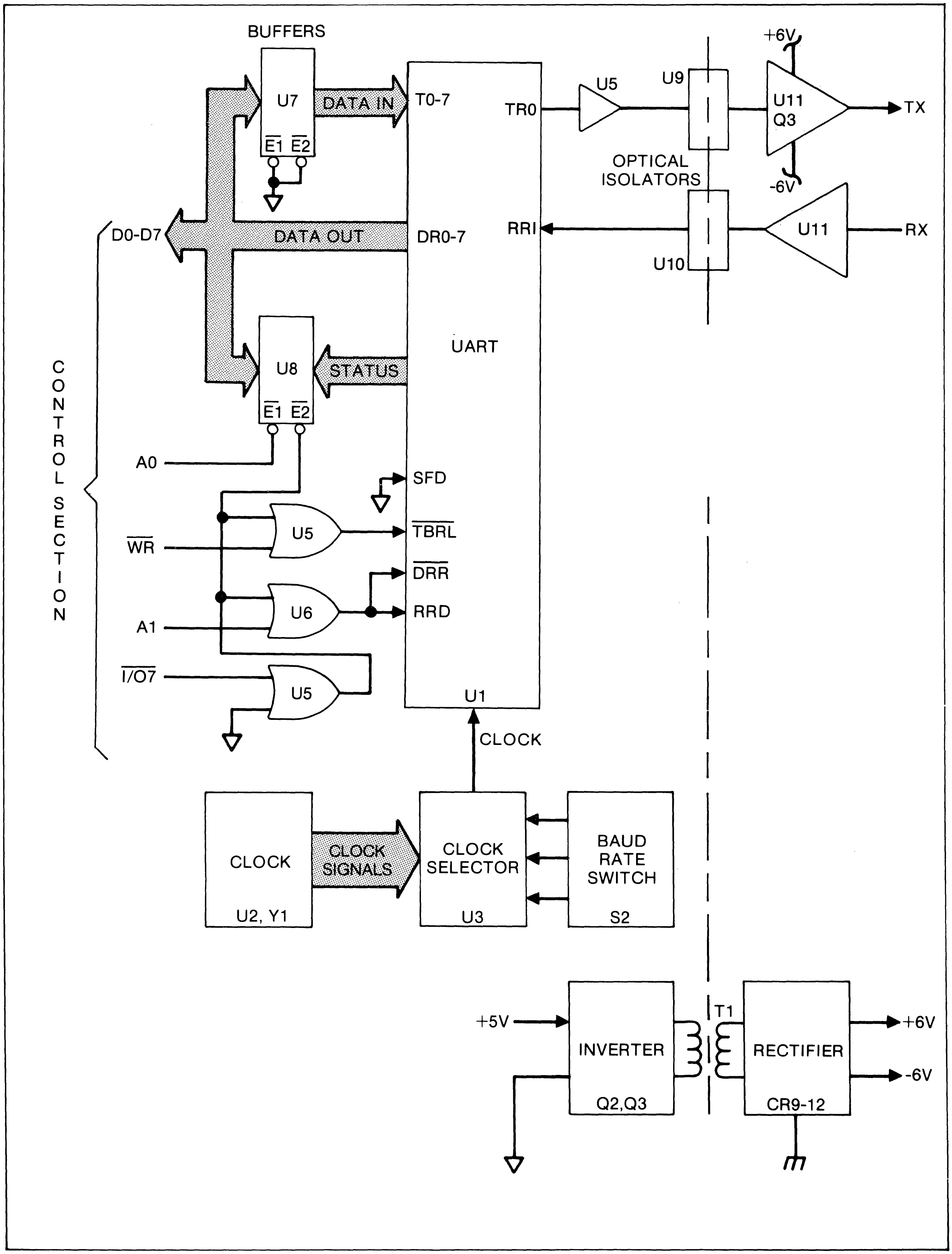

Figure 001-1. RS-232 Interface

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 xxxx1xxx = 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 isshown 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 programs 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 μs
1,9	150	2400 Hz	417 μs
2	300	4800 Hz	208 μs
3	600	9600 Hz	104 μs
4	1200	19.2 kHz	52 μs
5	2400	38.4 kHz	26 μs
6	4800	76.8 kHz	13 μs
7	9600	153.6 kHz	6.5 μs

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 ±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 (cont)

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

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

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

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

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

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

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

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

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

TABLE 001-4. RS232 FINAL ASSEMBLY
(SEE FIGURE 001-2.)

REFERENCE DESIGNATOR A->NUMERICS--->		S	---------DESCRIPTION---------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
A	1		RS232 PCB ASSEMBLY	609339	89536	609339	1		
H	1		SCREW,MACH,PHP,STL,4-40X5/16	152116	89536	152116	2		
H	2		SCREW,MACH,PHP,S.STL,4-40X3/8	256164	89536	256164	2		
H	3		NUT,HEX,S.STL,4-40	147611	89536	147611	3		
H	4		WASHER,LOCK,SPLIT,S STEEL,#4	147603	89536	147603	3		
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		

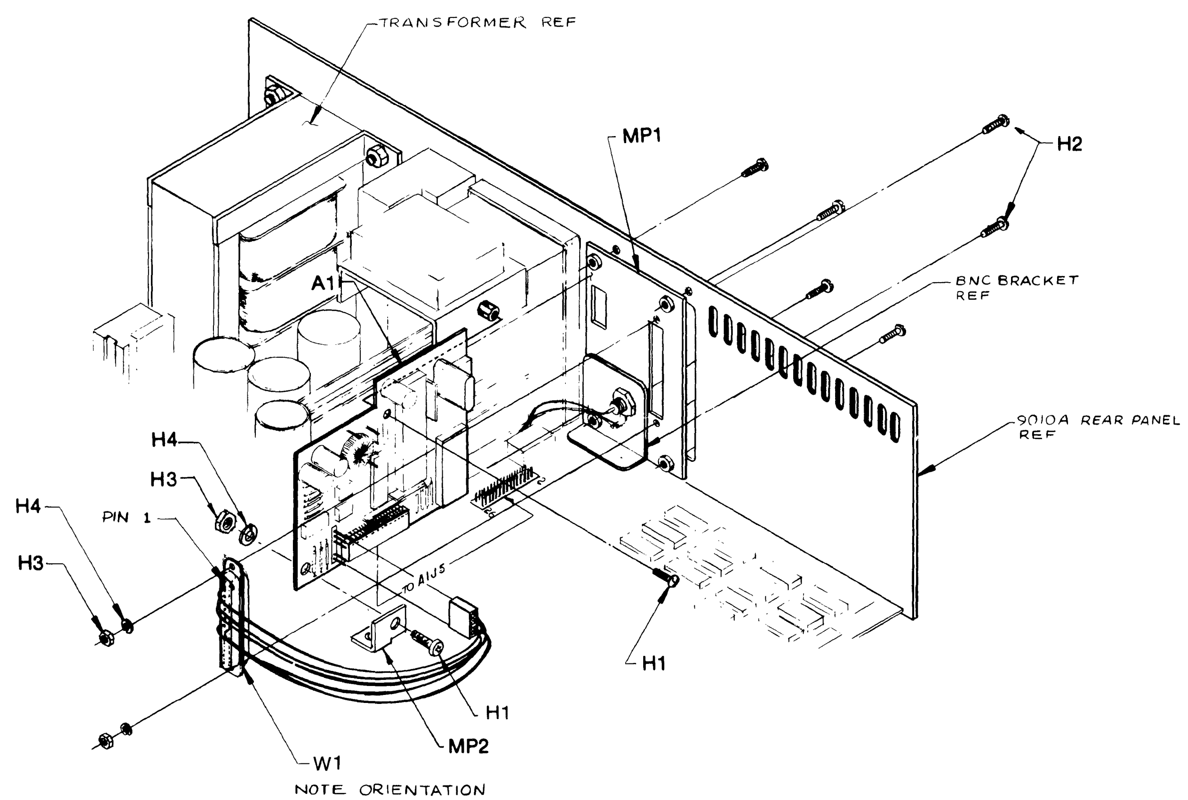

Figure 001-2. RS-232 Final Assembly

TABLE 001-5. RS232 PCB ASSEMBLY
(SEE FIGURE 001-3.)

REFERENCE DESIGNATOR A->NUMERICS--->	S	----------DESCRIPTION----------	FLUKE STOCK --NO--	MFRS SPLY CODE-	MANUFACTURERS PART NUMBER --OR GENERIC TYPE--	TOT QTY	R S -Q	N O T -E
C 1- 3, 8-		CAP,CER,0.22UF,+-20%,50V,Z5U	519157	51406	RPE111Z5U224M50V	6		
C 10			519157					
C 4, 6, 7		CAP,AL,47UF,+75-10%,16V	519561	89536	519561	3	1	
C 5		CAP,CER,0.01UF,+-20%,100V,X7R	407361	72982	8121-A100-W5R-103M	1		
CR 1- 3- 8	*	DIODE,SI,BV= 75.0V,IO=150MA,500 MW	203323	07910	1N4448	8		
CR 9	*	DIODE,SI,RECT,BRIDGE,BV= 50V,IO=1.0A	418582	83003	VM08	1	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	1	
Q 3	*	TRANSISTOR,SI,PNP,SMALL SIGNAL	195974	64713	2N3906	1	1	
R 1, 10		RES,CF,390,+-5%,0.25W	573105	80031	CR251-4-5P390E	2		
R 2		RES,CF,5.6K,+-5%,0.25W	442350	80031	CR251-4-5P5K6	1		
R 3		RES,CF,15K,+-5%,0.25W	573428	80031	CR251-4-5P15K	1		
R 4		RES,CF,47,+-5%,0.25W	572982	80031	CR251-4-5P47E	1		
R 5		RES,CC,15M,+-5%,0.25W	643528	89536	643528	1		
R 6		RES,CF,200,+-5%,0.25W	441451	80031	CR251-4-5P200E	1		
R 7		RES,CF,12K,+-5%,0.25W	348847	80031	CR251-4-5P12K	1		
R 8		RES,CF,12K,+-5%,0.25W	573402	80031	CR251-4-5P12K	1		
R 9, 11		RES,CF,620,+-5%,0.25W	641092	89536	641092	2		
R 12		RES,CF,56K,+-5%,0.25W	641126	89536	641126	1		
R 13		RES,CF,3.3K,+-5%,0.25W	573287	80031	CR251-4-5P3K3	1		
R 14		RES,CF,1K,+-5%,0.25W	573170	80031	CR251-4-5P1K	1		
R 15		RES,CF,200,+-5%,0.25W	573055	80031	CR251-4-5P200E	1		
S 1		SWITCH,MODULE,DPST,DIP,4 POS	495218	00779	435802-3	1		
S 2		SWITCH,ROTARY,BCD,10 POS	495614	00779	53919-2	1		
T 1		TRANSF,INV,5VDC,20KHZ,TOROID	461863	89536	461863	1	1	
TP 1- 9		PIN,SINGLE,PWB,0.025 SQ	267500	00779	87022-1	14		1
TP 11- 14		TERM,FASTON,TAB,SOLDR,0.110 WIDE	512889	02660	62395	4		
U 1	*	IC,CMOS,UNIV ASYNC RECEIVR/TRANSMITER	453464	32293	1M6402CPL	1		
U 1	*	IC,CMOS,UNIV ASYNC RECEIVER/TRANSMITR	658856	89536	658856			2
U 2	*	IC,CMOS,BIT RATE GENERATOR	418921	04713	MC14411P	1		
U 3	*	IC,CMOS,8-INPUT MUX W/3-STATE OUTPUT	504647	04713	MC4512BCP	1	1	
U 4	*	IC,LSTTL,QUAD 2 INPUT NAND GATE	393033	01295	SN74LS00N	1	2	
U 5	*	IC,LSTTL,QUAD 2 INPUT OR GATE	393108	01295	SN74LS32N	1	1	
U 7, 8	*	IC,LSTTL,OCTAL BUFFER/LINE DRIVER	634105	04713	SN74LS541N	2	1	
U 9, 10	*	ISOLATOR,OPTO,HI-SPEED,LED TO XSISTOR	407742	28480	HP5082-4351	2	1	
U 11	*	IC,ARRAY,5 TRANS,NPN,3 ISO,2 DIFF CON	248906	12040	LM3046N	1	1	
XU 1		SOCKET,IC,40 PIN	429282	09922	DILB40P-108	1		
XU 2		SOCKET,IC,24 PIN	376236	91506	324-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	80031	95081002CL	1	1	

NOTE 1 = ALSO INCLUDES J2.
NOTE 2 = CAN BE USED AS A SUBSTITUTE PART FOR 453464.

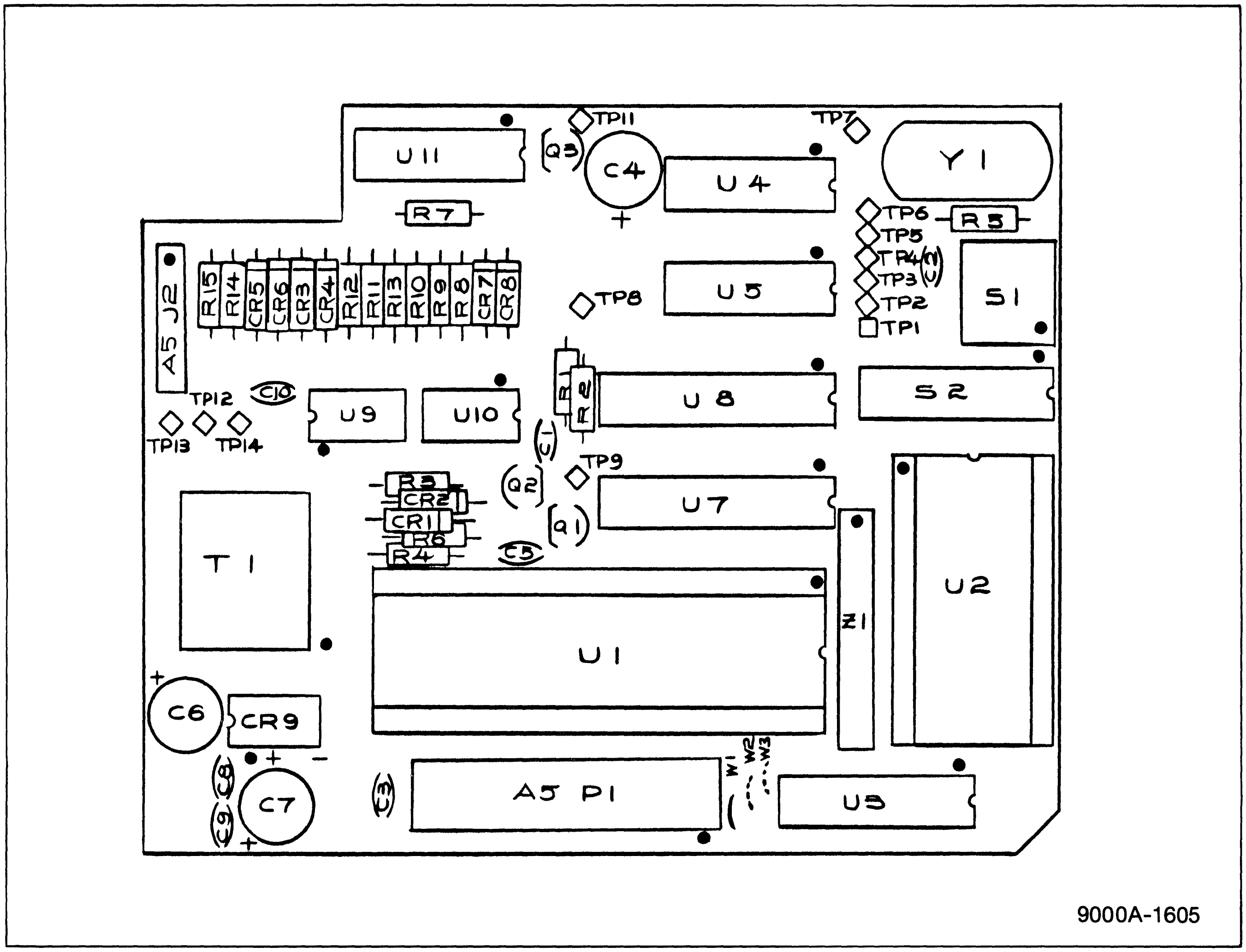

Figure 001-3. RS-232 PCB Assembly

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.

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(-) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmablle read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
The Ross Milton Co.
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div.
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp.
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div.
AMF Canada LTD.
Guelph, Ontario, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div.
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606
Use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

Federal Supply Codes for Manufacturers (cont)

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Bucheye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical
Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
P.R. Mallory & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp. formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, California

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnback Radio Co., Inc.
Freeport, New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village
Chicago, Illinois

72005
Wilber B. Driver Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Bechman Instrument Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp.
Mepco Div.
A North American Phillips Co.
Norristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183
Use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Arnold Stevens, Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81483
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
The Carr Co., United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Div.
Eatontown, New Jersey

83330
Herman H. Smith, Inc.
Brooklyn, New York

83478
Rubbercraft Corp.
of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
John Fluke Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co.
Div. of P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211
Use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737
Use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div. of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154
Use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts, Div. of
Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect.
Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779
Use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

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(312) 392-9510

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John Fluke Mfg. Co., Inc.
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(206) 881-6966

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Gerate GmbH & Co.
Vertrieb KG
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Tel: (222) 235555, TLX: (847) 134759

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Basma
P.O. Box 5701
Manama, Bahrain
Tel: 251-364; TLX: (955) 9003

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Motherland Corporation
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Dacca-3, Bangladesh
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TLX: (950) 642022

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Coasin Bolivia S.R.L.
Casilla 7295
La Paz, Bolivia
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Brazil •
Hi-Tek Eletronica Ltda.
Al. Amazonas 422,
Alphaville, Barueri,
CEP 06400, Sao Paulo, Brazil
Tel: (11) 421-5477, TLX: (391) 01135589

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Rank O'Connor's Berhad
No. 8 Blk D
Sufri Shophouse Complex
Mile 1 Jalan Tutong
Bandar Seri Begawan
Negara Brunei Darussalam
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TLX: (799) 2265 RANKOC

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Manuel Montt 024-Of. D
Casilla 16228
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Tel: (2) 44940, TLX: (332) 240301

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Sistemas E Instrumentacion, Ltda.
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Tel: (21) 66121, TLX: (826) 2395

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Mersin 10, Turkey
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TLX: (821) 57267

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Tel: (784) 63555, TLX: (851) 928855

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Tage Olsen A/S
Ballerup Byvej 222
2750 Ballerup
Denmark
Tel: (2) 658111, TLX: (855) 35293

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Ave. 12 de Octubre 2285
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Tel: (2) 529684, TLX: (393) 2865

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Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

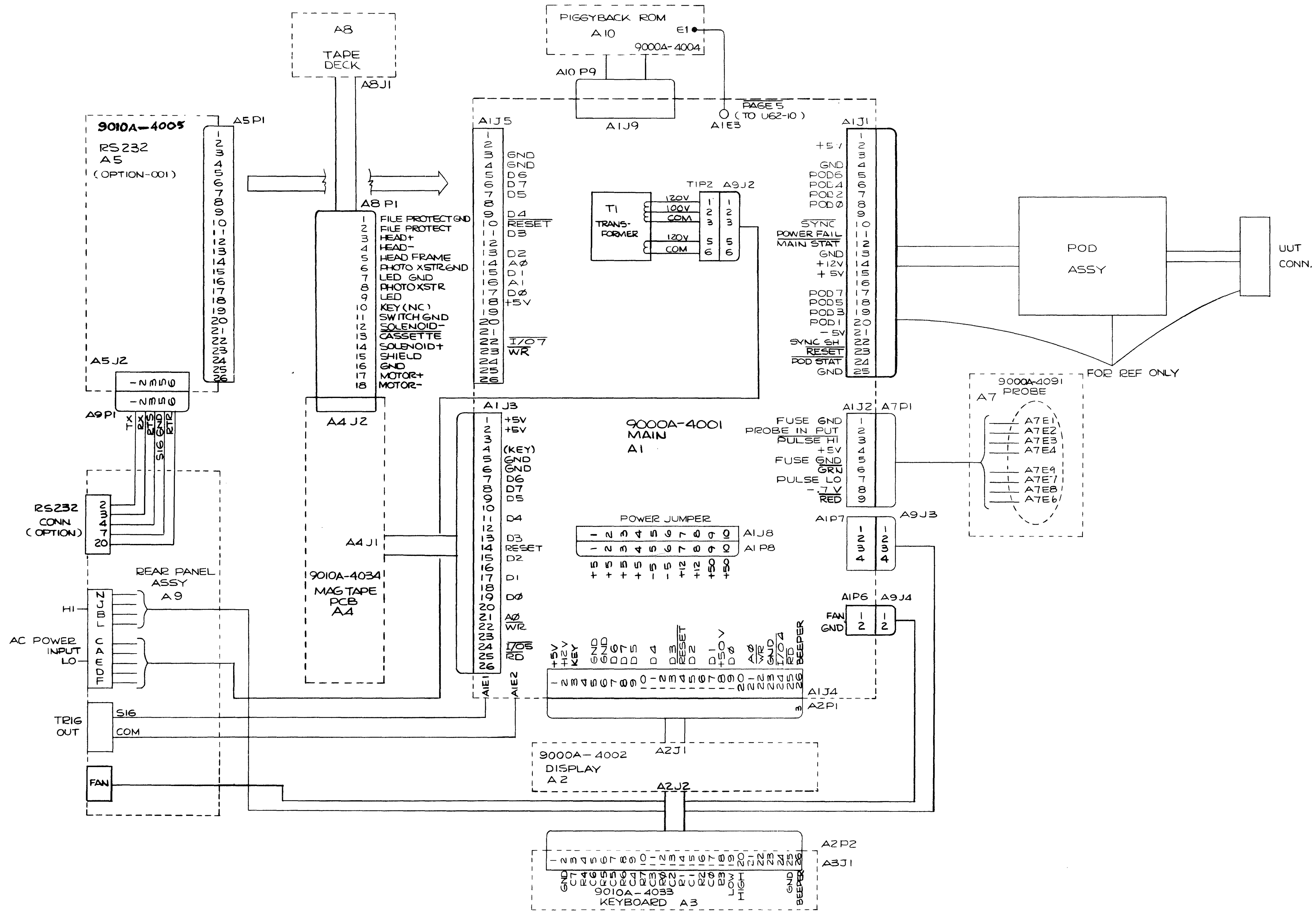
As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

Table 7A-1. Manual Status Information

Ref Or Option No.	Assembly Name	Fluke Part No.	X = The PCB revision levels documented in this manual.																					
			—	A	B	C	D	E	F	G	H	J	K	L	M	N	P							
A1	Main PCB Assembly	579268																X						
A2	Display PCB Assembly	579250							X															
A3	Keyboard PCB Assembly	579425			X																			
A4	Magnetic Tape PCB Assembly	579441									X													
A7	Data Probe Assembly	580969						X																
-001	RS-232 PCB Assembly	716027						X																

Section 8
Schematic Diagrams

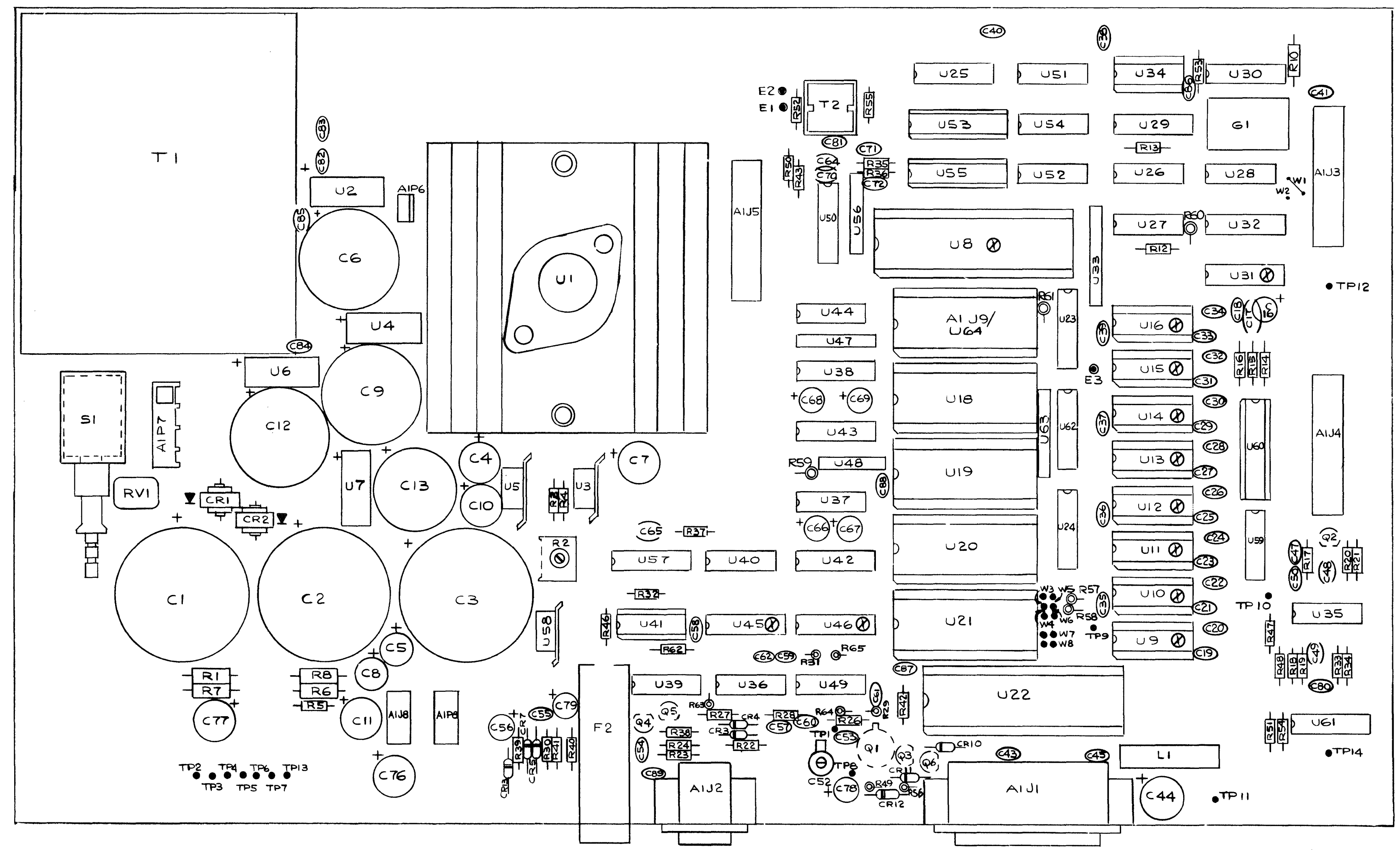
NOTES



9010A-1201

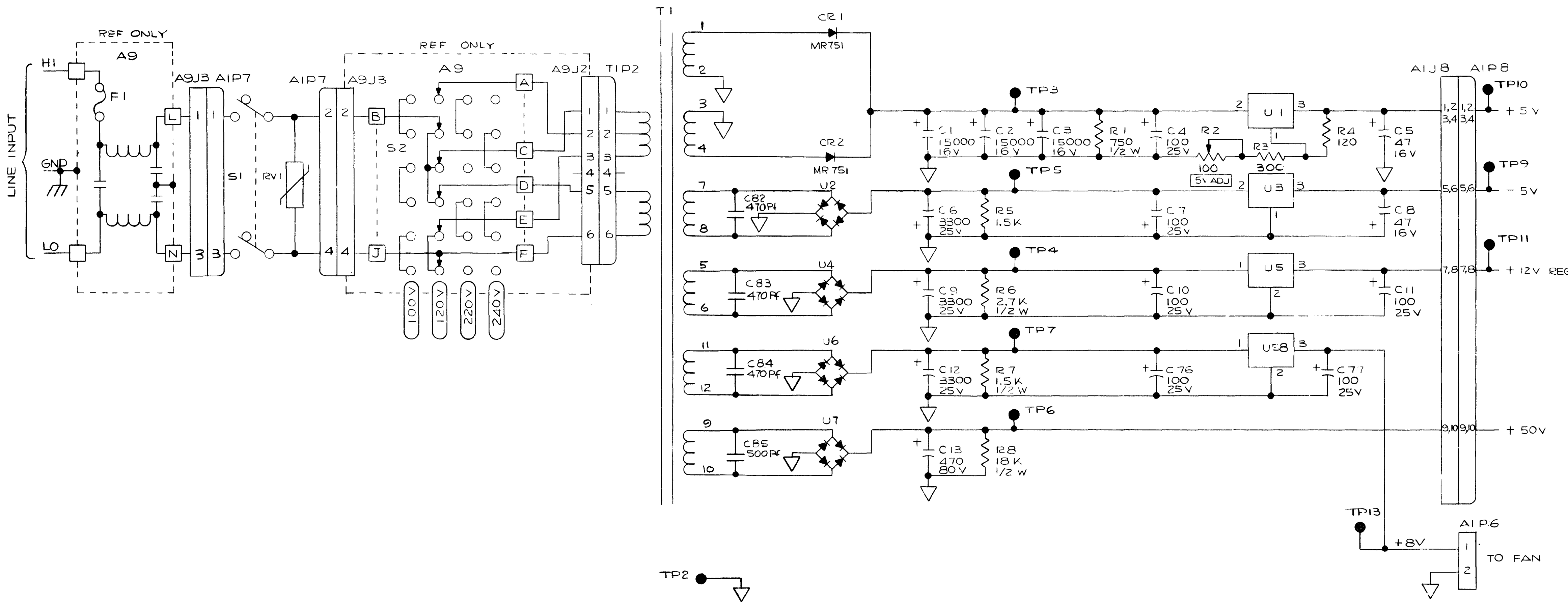
Figure 8-1. 9010A Interconnect Diagram

CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY



9000A-1601

Figure 8-2. A1 Main PCB Assembly



DES	DEVICE	+ 5V	− 5V	+ 12V	+ 12V UN	+ 50V	GND	QTY
U 1	LM338K	3	—	—	—	—	--	1
U 3	LM7905	—	3	—	—	—	1	1
U 5	LM7812	—	—	3	—	—	2	1
U 2,4	KBP02	—	—	—	—	—		2
U6	KBP02	—	—	—		—		1
U7	KBP06	—	—	—	—			1
U58	LM7808	---	—	—	—	---	2	1

REF	DES
HIGHEST NO.	NOT USED NO.
TP 14	
E 3	
W 8	
R 65	R25, R44
C 89	C42, C51
CR 12	CR6
U 64	
Q 6	
G 1	
RV 1	
S 2	
L1	
T 2	
J 10	
F 2	

NOTES:

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

9000A-1001
1 of 4

Figure 8-2. A1 Main PCB Assembly (cont)

CAUTION
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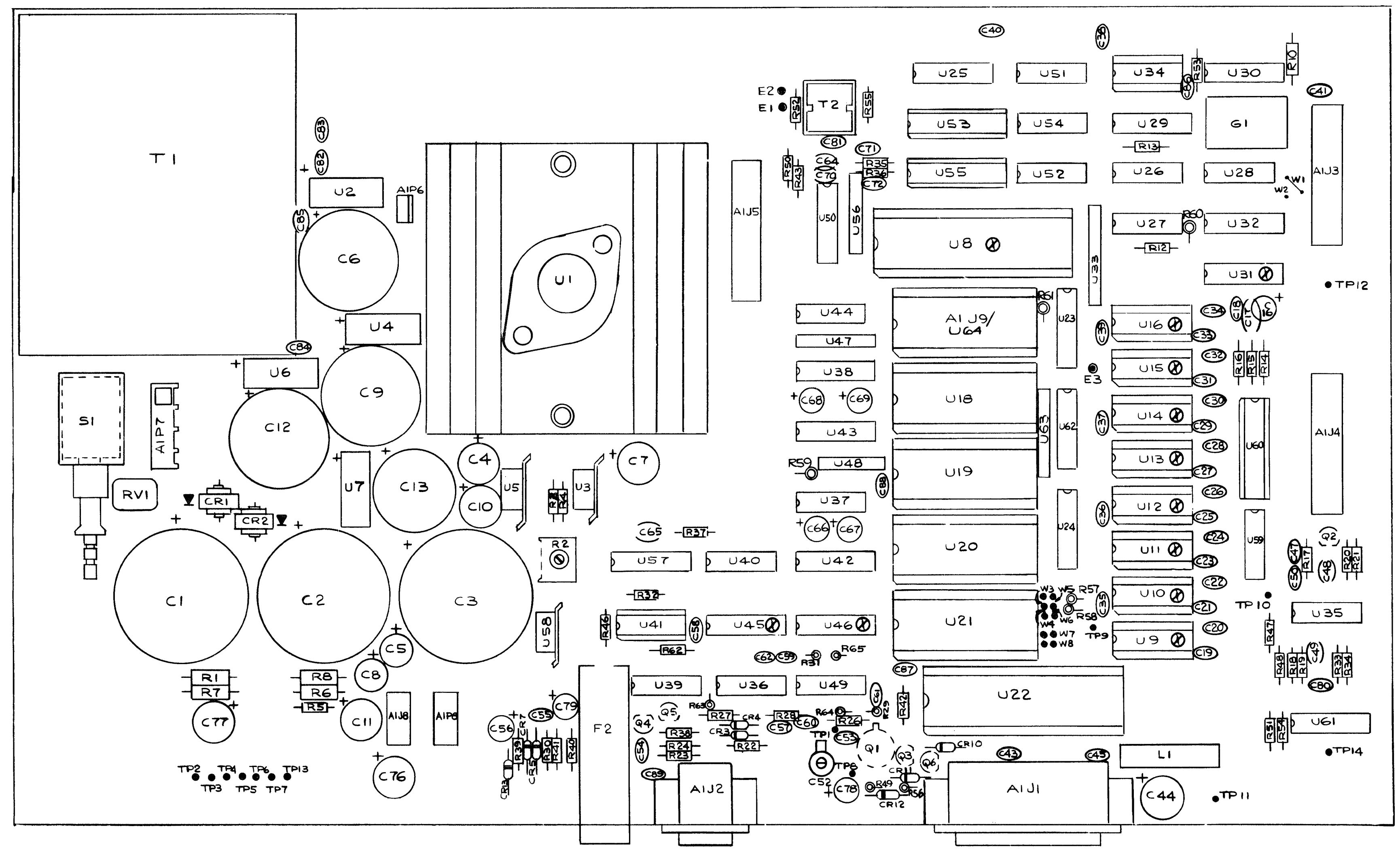
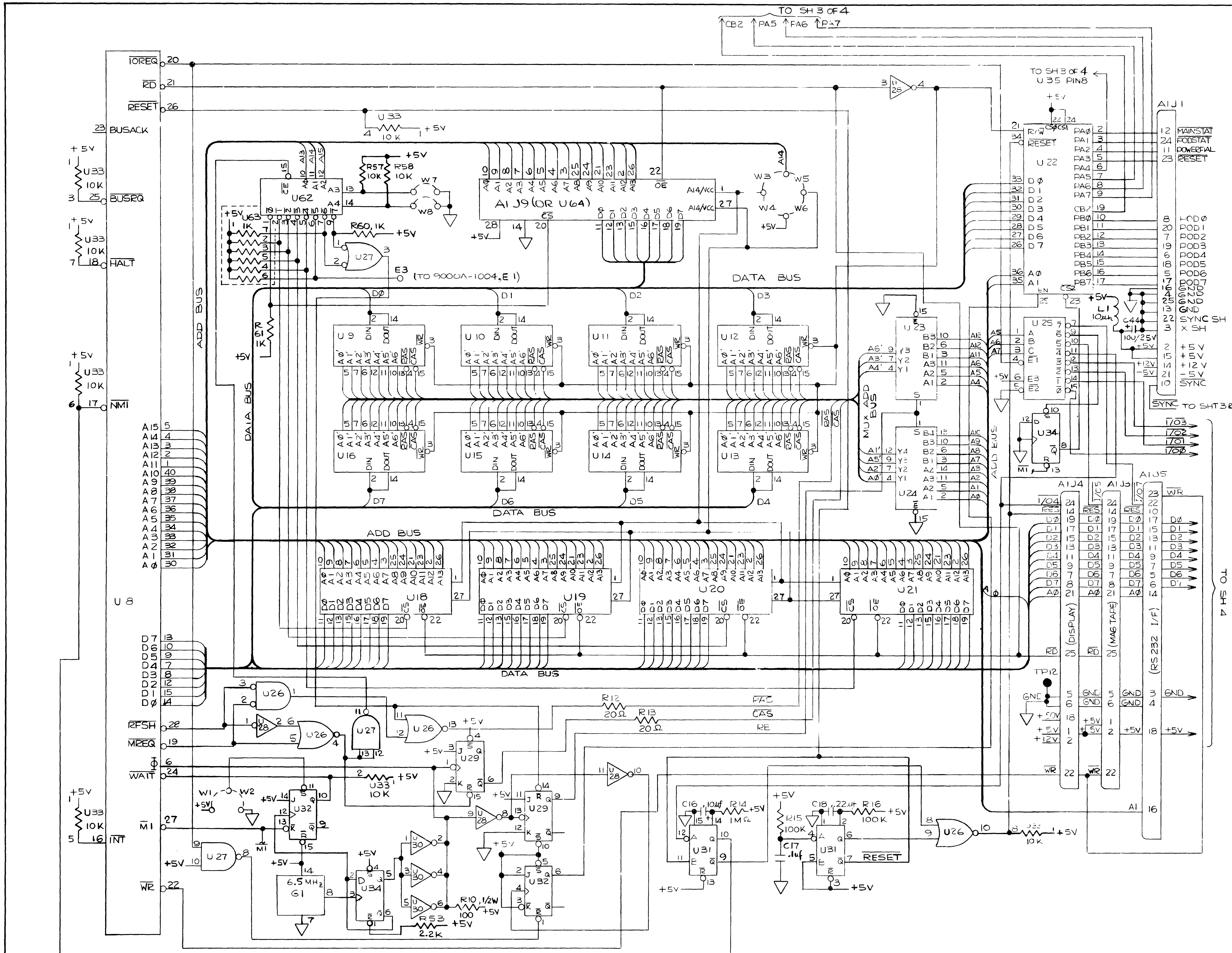


9000A-1601

Figure 8-2. A1 Main PCB Assembly (cont)



ROM CONFIGURATION	INSTALLATION												
	J9/U64	U18	U19	U20	U21	W3	W4	W5	W6	W7	W8	W1	W2
1 - 256K 2 - 64 K's	PΦ-P3	P4	P5	—	—	IN	OUT	OUT	OUT	IN	IN	IN	OUT
2 - 256 K's	PΦ-P3	—	—	—	P4,P5	IN	OUT	OUT	OUT	OUT	IN	IN	OUT
6 - 2764'S	PIGGY-BACK 613869 PΦ, P5	605089 P1	605097 P2	605105 P3	605113 P4	OUT	IN	OUT	IN	IN	OUT	IN	OUT
3 - 23128'S	PΦ, P1	—	P2, P3	—	P4,P5	OUT	IN	OUT	IN	OUT	OUT	IN	OUT

NOTES:

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

DES	DEVICE	+5V	GND	-5V	+12V	QTY
U 9,10,11,12,13, 14,15,16	4116	9	16	1	8	8
U 18, 21, 19, 20, 64	SEE TABLE	28	14	—	—	SEE TABLE
U 25	74LS138	16	8	—	—	1
U 23,24	74LS157	16	8	—	—	2
U 8	Z-80A	11	29	—	—	1
U 22	6520	20	1	—	—	1
U 31	4098	16	1, 8 15	—	—	1
U 27	74LS00	14	7	—	—	1
U 26	74LS02	14	7	—	—	1
U 28	74LS04	14	7	—	—	1
U 29	74LS112	16	8	—	—	1
U 30	7406	14	7	—	—	1
U 33	RES NET 10K	1	—	—	—	1
U 32	74LS109	16	8	—	—	1
U 34	74LS74	14	7	—	—	1
U 62	82S123	16	8	—	—	1
U 63	RES NET 1K	1				1

C20, 22, 24, 26, 28, 30, 32, 40, 34, 38, 41, 86, 87, 88 .22 μf

+12V C19, 21, 23, 25, 27, 29, 31, 45, 33 .22 μf

-5V C35, 36, 37, 39, 43 .22 μf

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Figure 8-2. A1 Main PCB Assembly (cont)

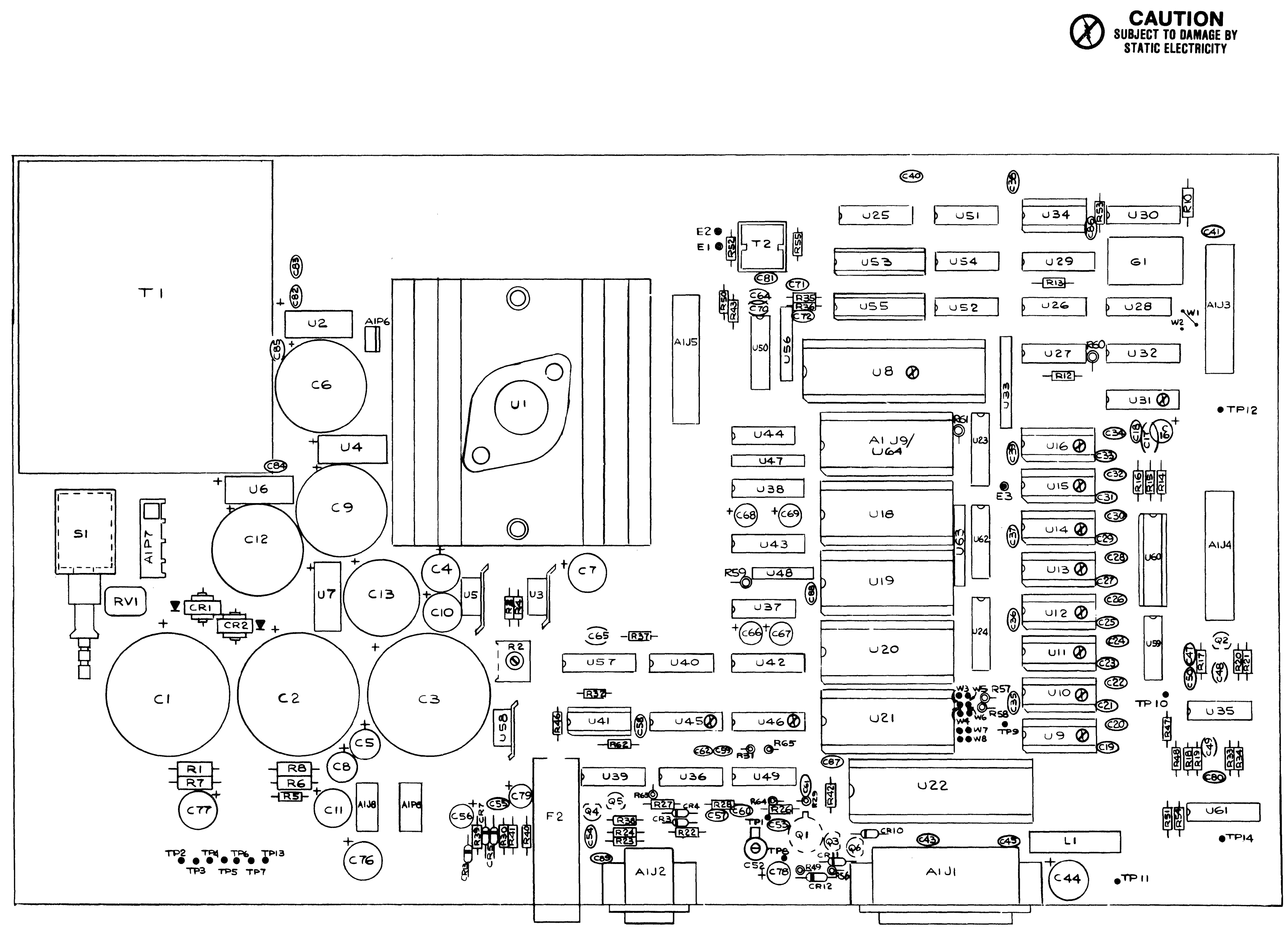
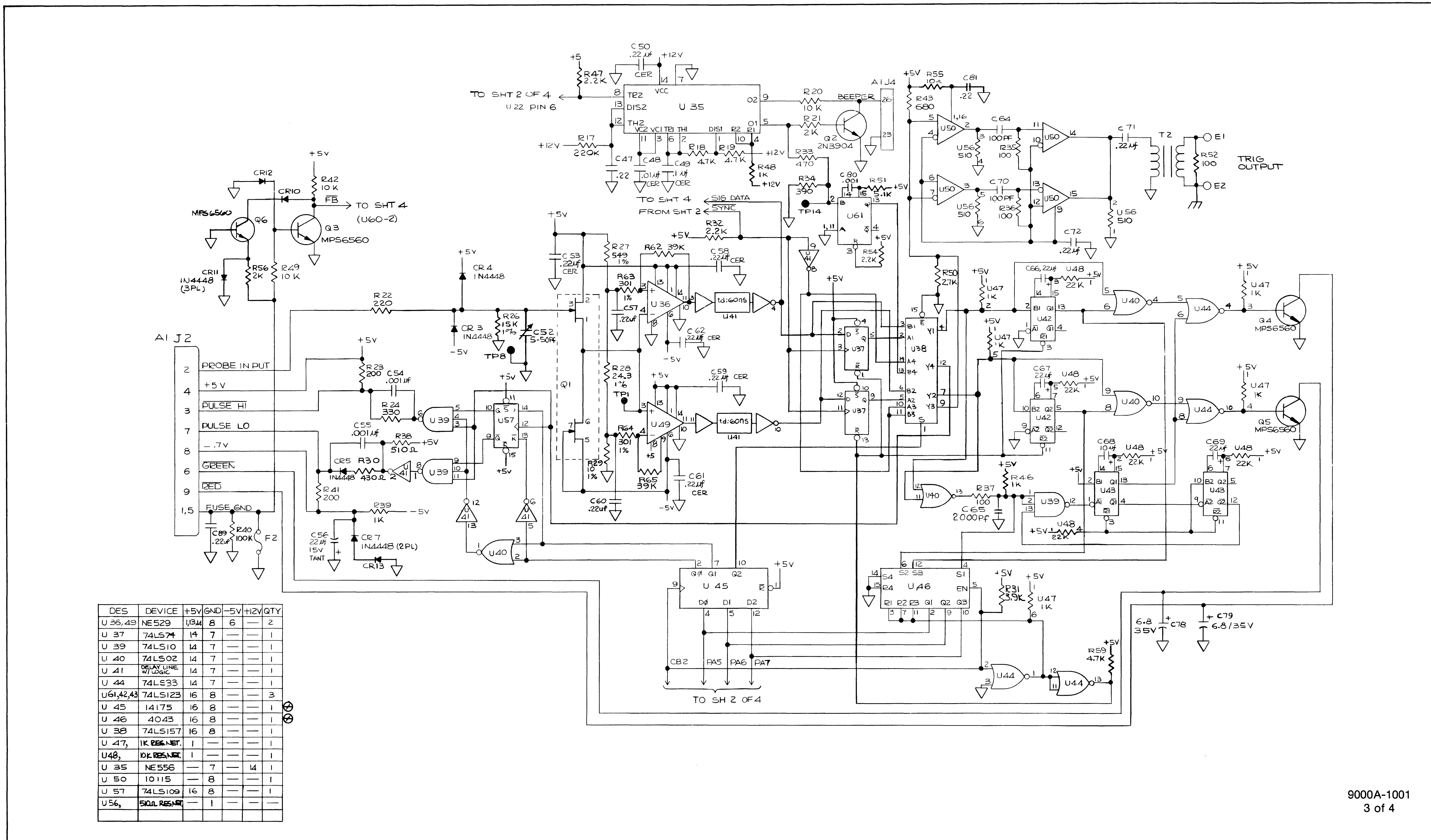


Figure 8-2. A1 Main PCB Assembly (cont)



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	14175	16	8	—	—	1
U 46	4043	16	8	—	—	1
U 38	74LS157	16	8	—	—	1
U 47,	1K RES.NET.	1	—	—	—	1
U48,	10K RES.NET.	1	—	—	—	1
U 35	NE556	—	7	—	14	1
U 50	10115	—	8	—	—	1
U 57	74LS109	16	8	—	—	1
U56,	510Ω RES.NET.	—	1	—	—	—

Figure 8-2. A1 Main PCB Assembly (cont)

CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY

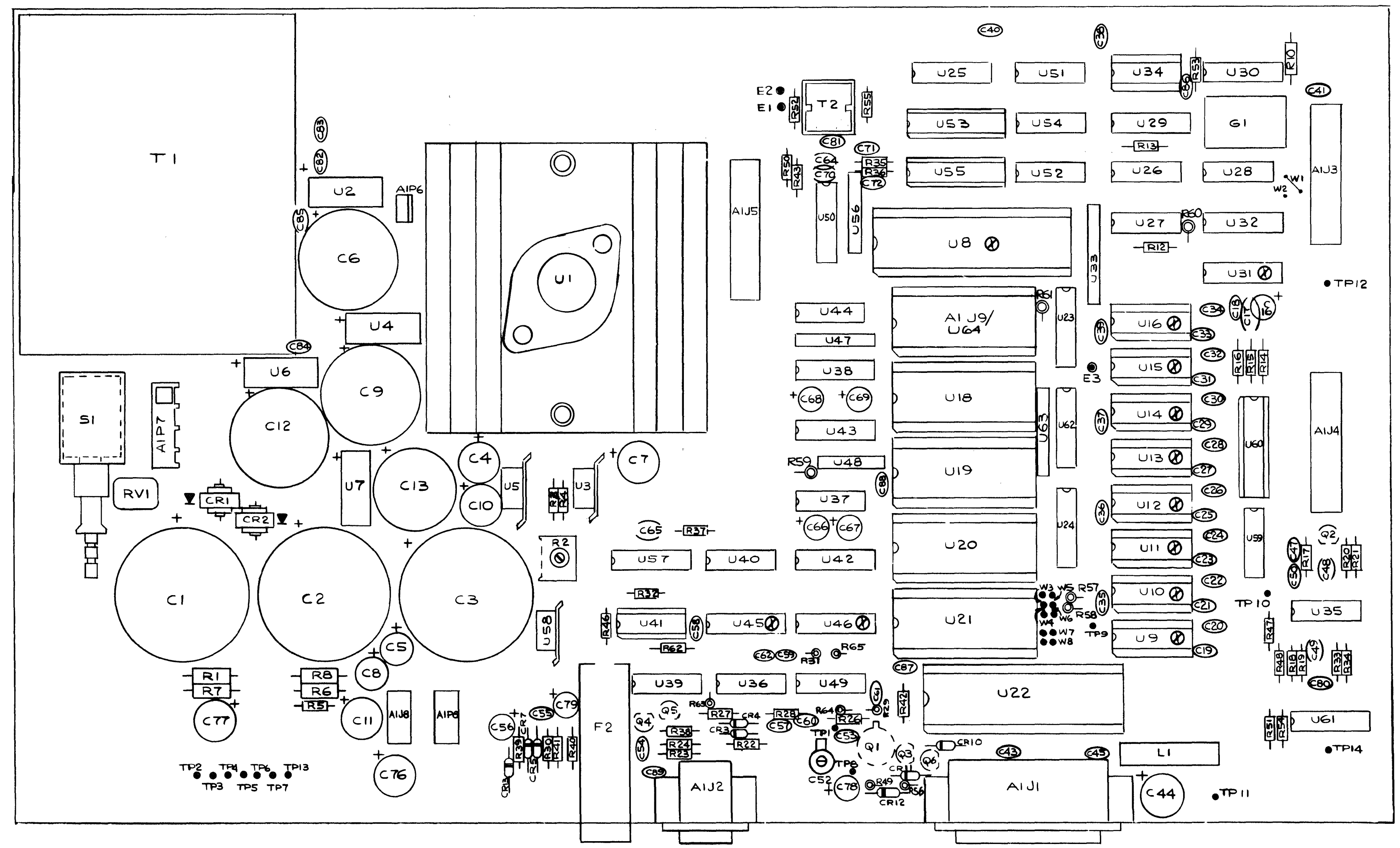


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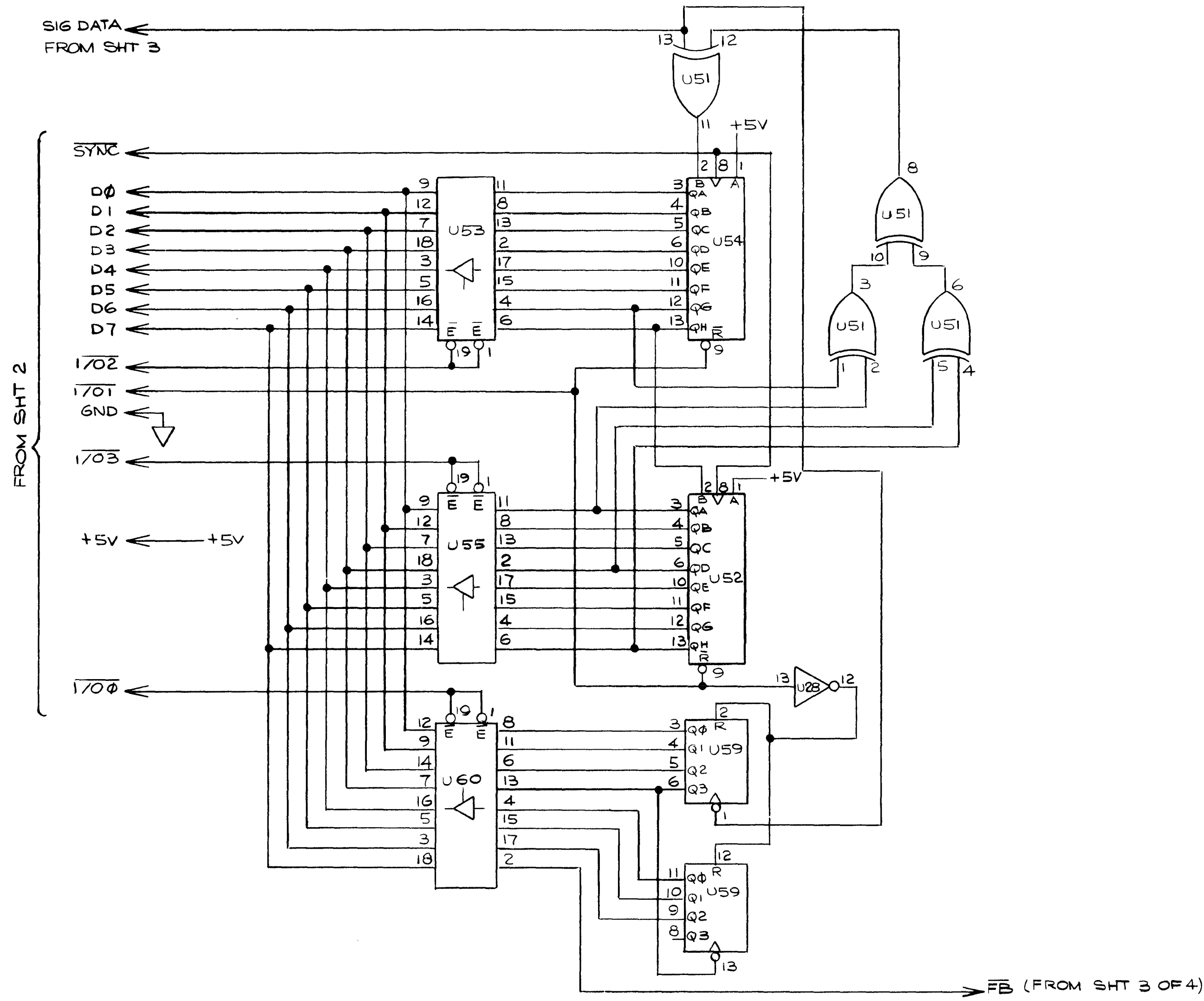
Figure 8-2. A1 Main PCB Assembly (cont)



REF DES	TYPE	+5V	GND
U51	74LS86	14	7
U52,54	74LS164	14	7
U53,55,60	74LS244	20	10
U59	74LS393	14	7
U28	74LS04	14	7

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Figure 8-2. A1 Main PCB Assembly (cont)

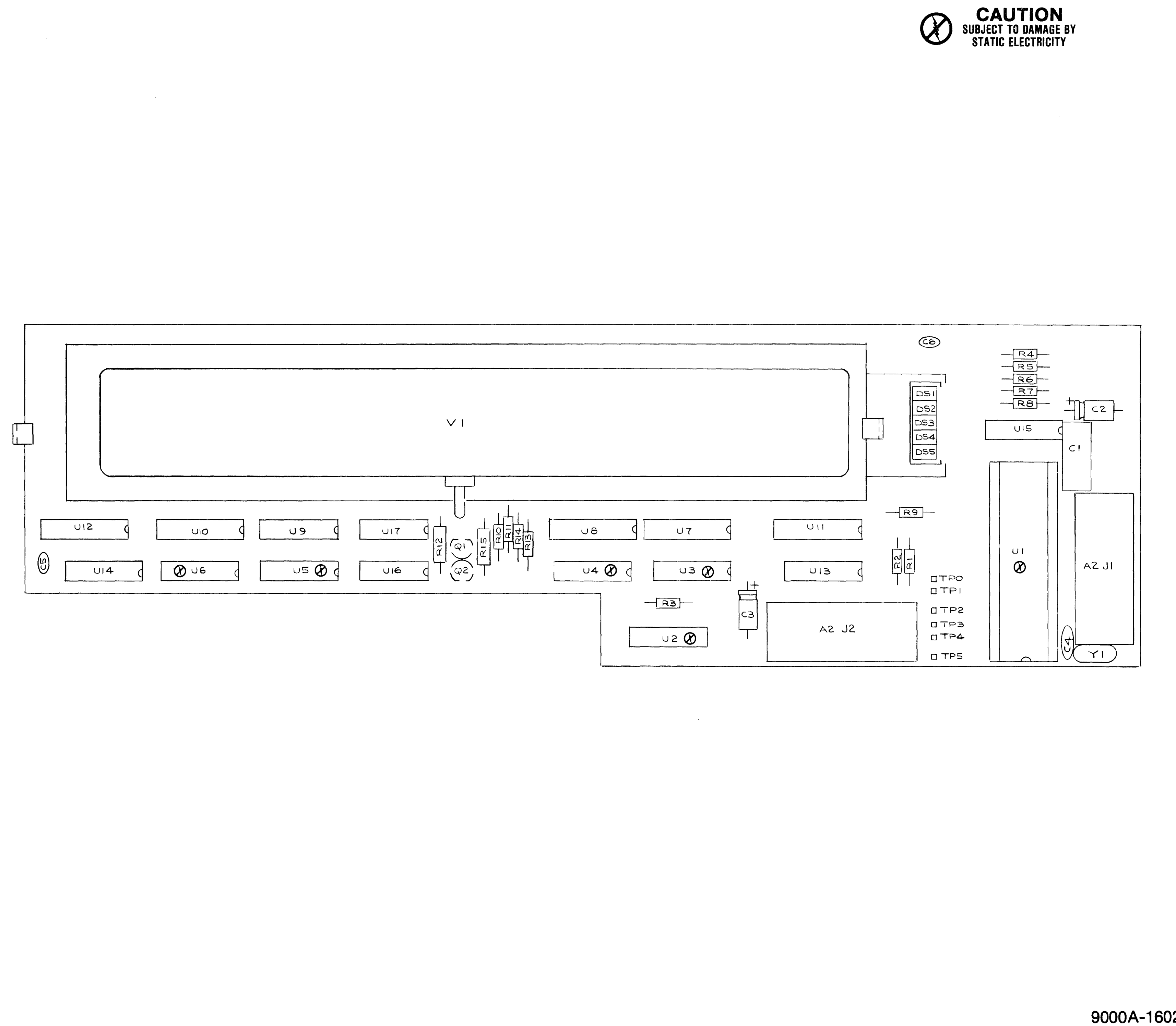
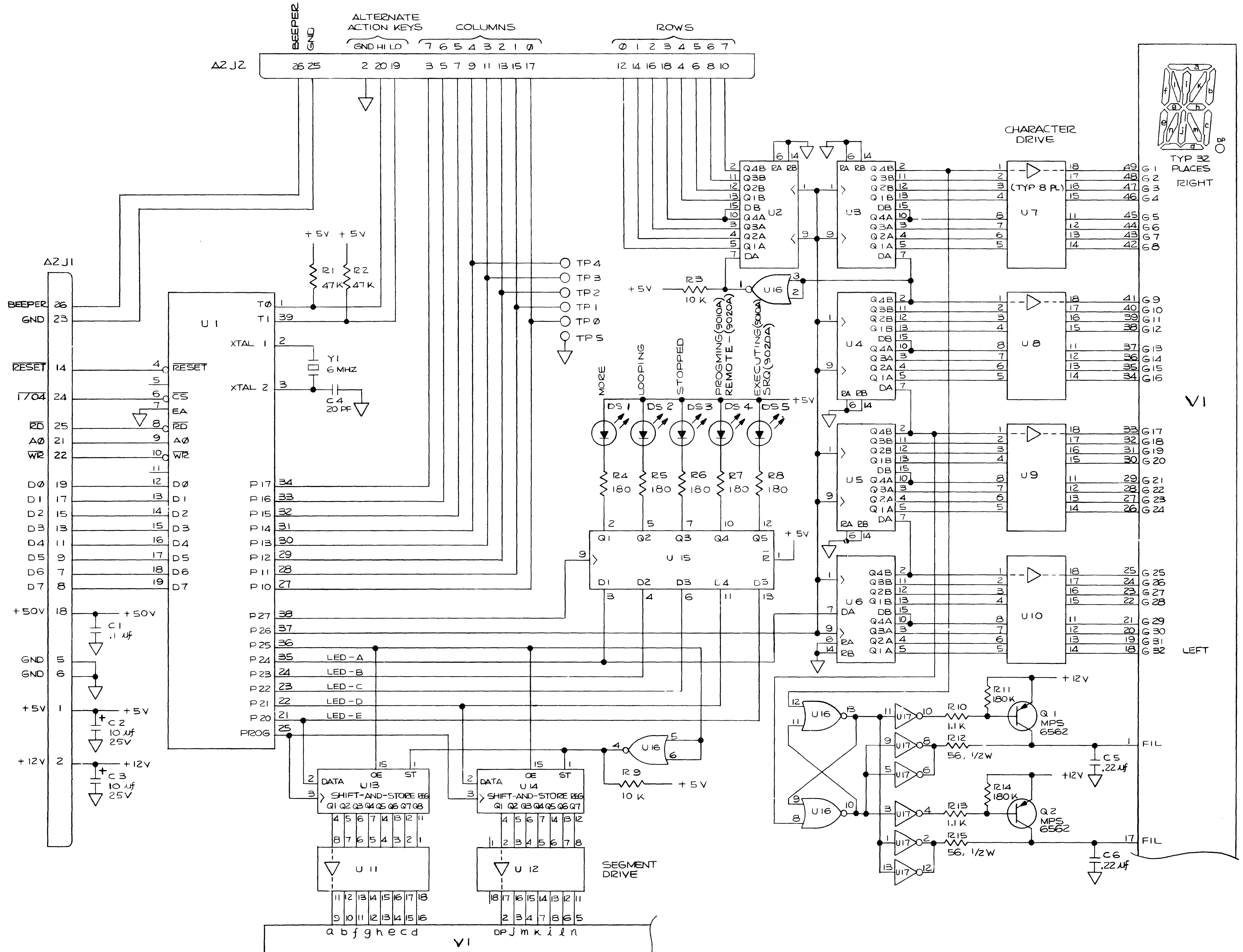


Figure 8-3. A2 Display PCB Assembly



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	8041	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 PCB Assembly (cont)

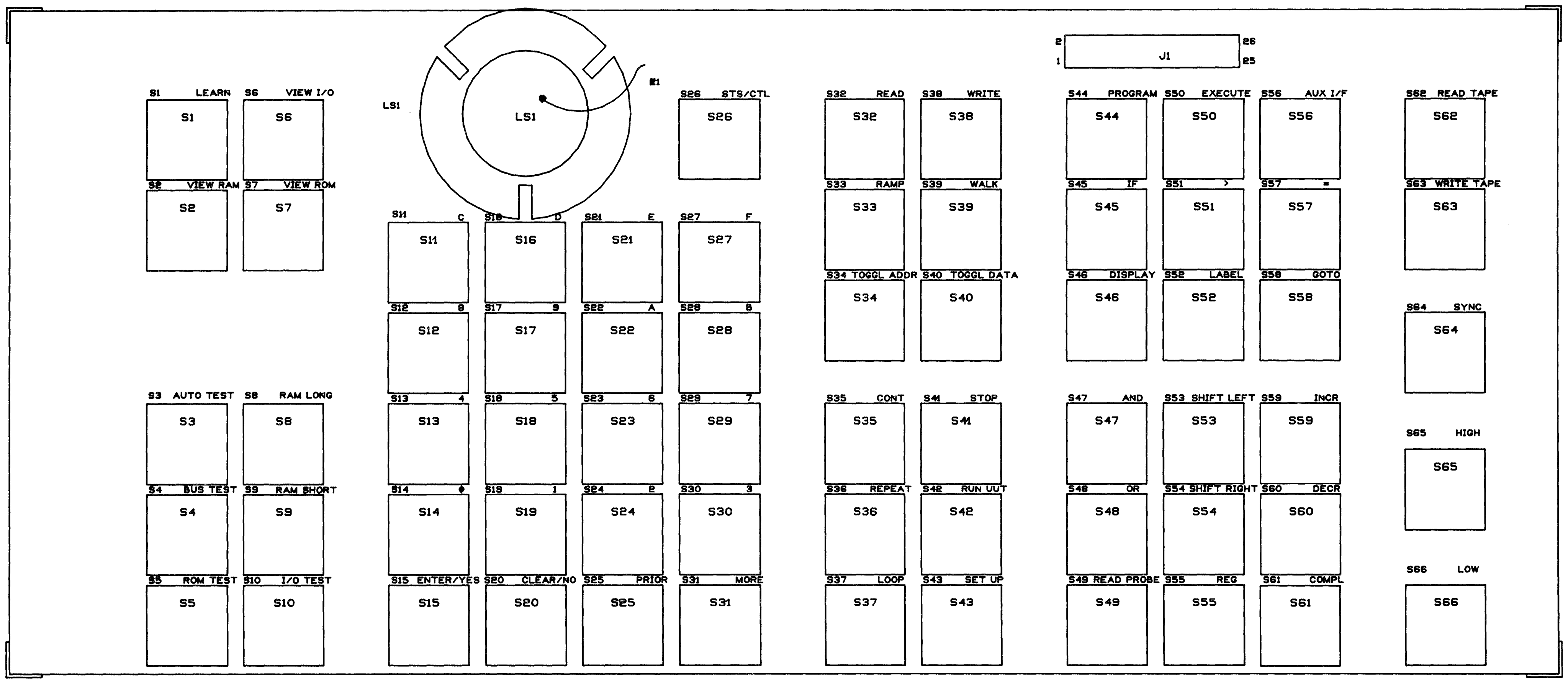


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Figure 8-4. A3 Keyboard PCB Assembly

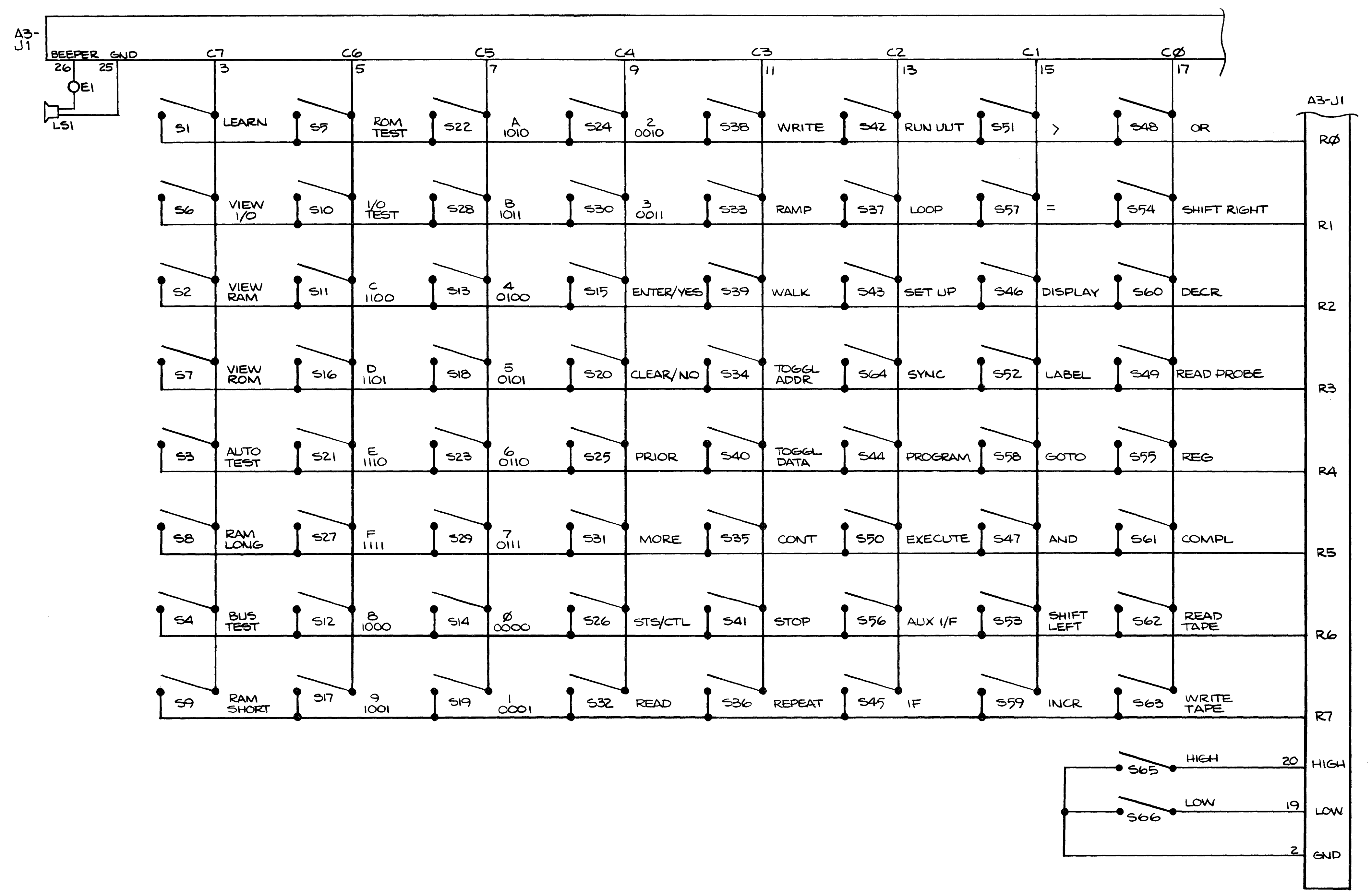

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Figure 8-4. A3 Keyboard PCB Assembly (cont)

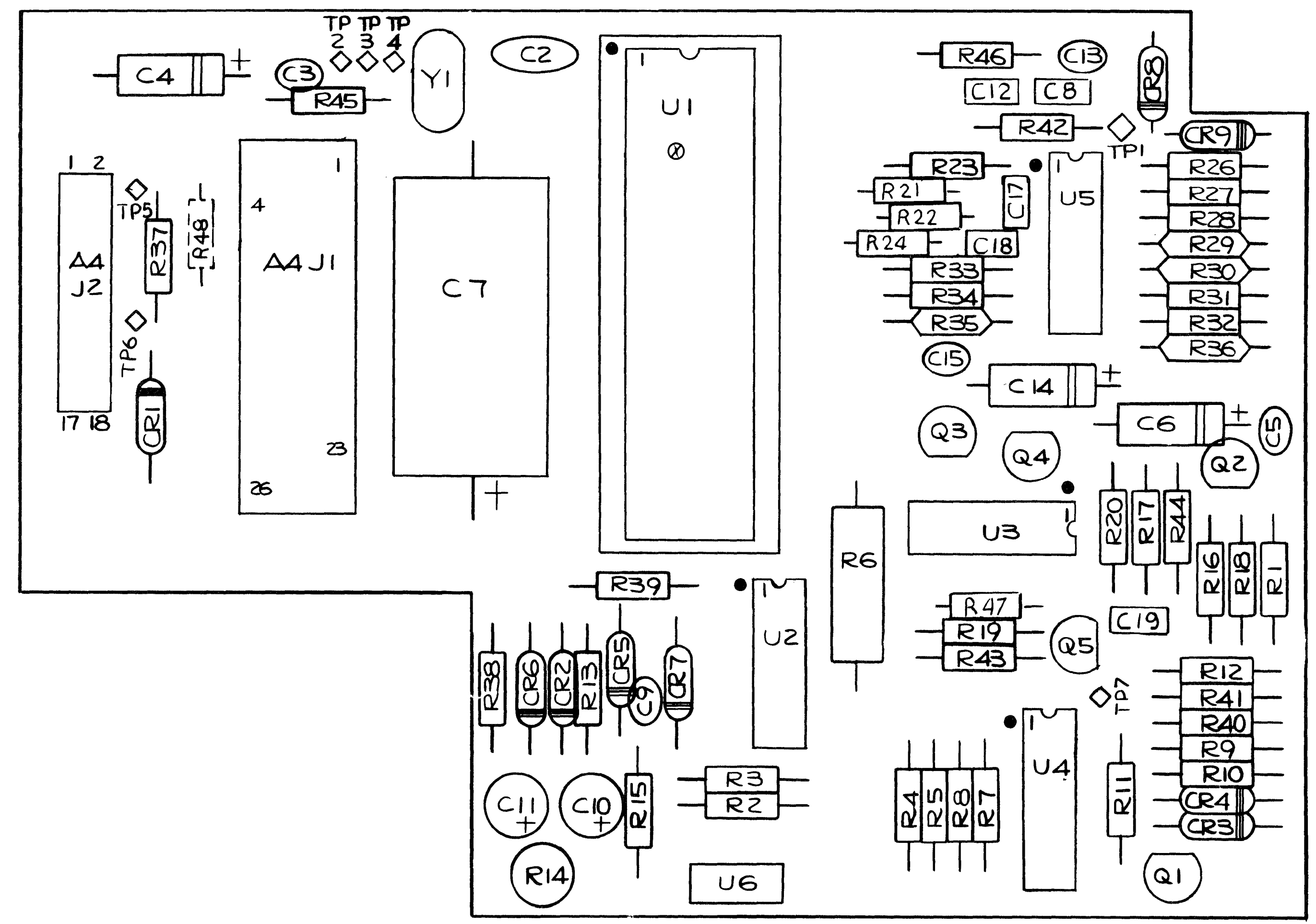
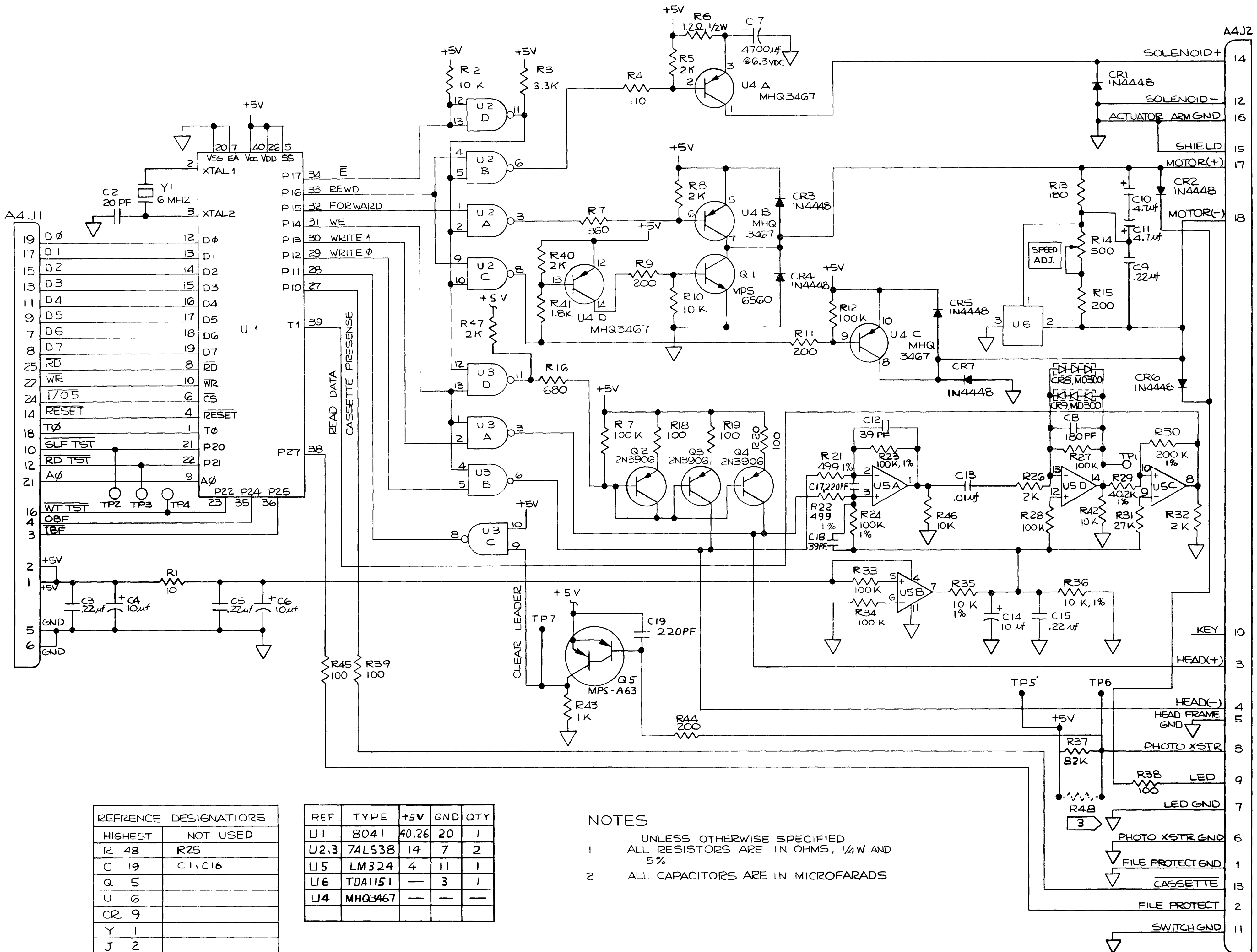


Figure 8-5. A4 Magnetic Tape PCB Assembly



REFRENCE DESIGNATIORS	
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

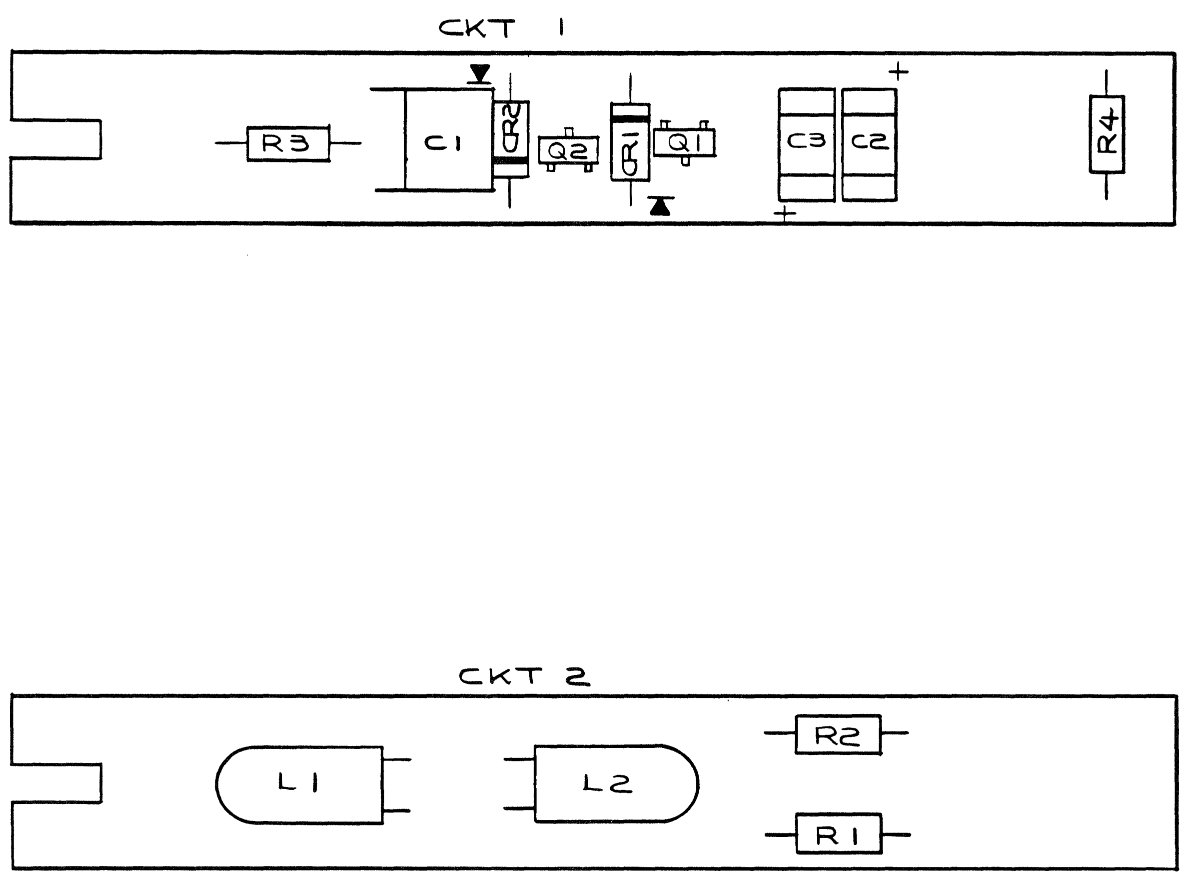
UNLESS OTHERWISE SPECIFIED

1 ALL RESISTORS ARE IN OHMS, 1/4W AND 5%

2 ALL CAPACITORS ARE IN MICROFARADS

9010A-1034

Figure 8-5. A4 Magnetic Tape PCB Assembly (cont)



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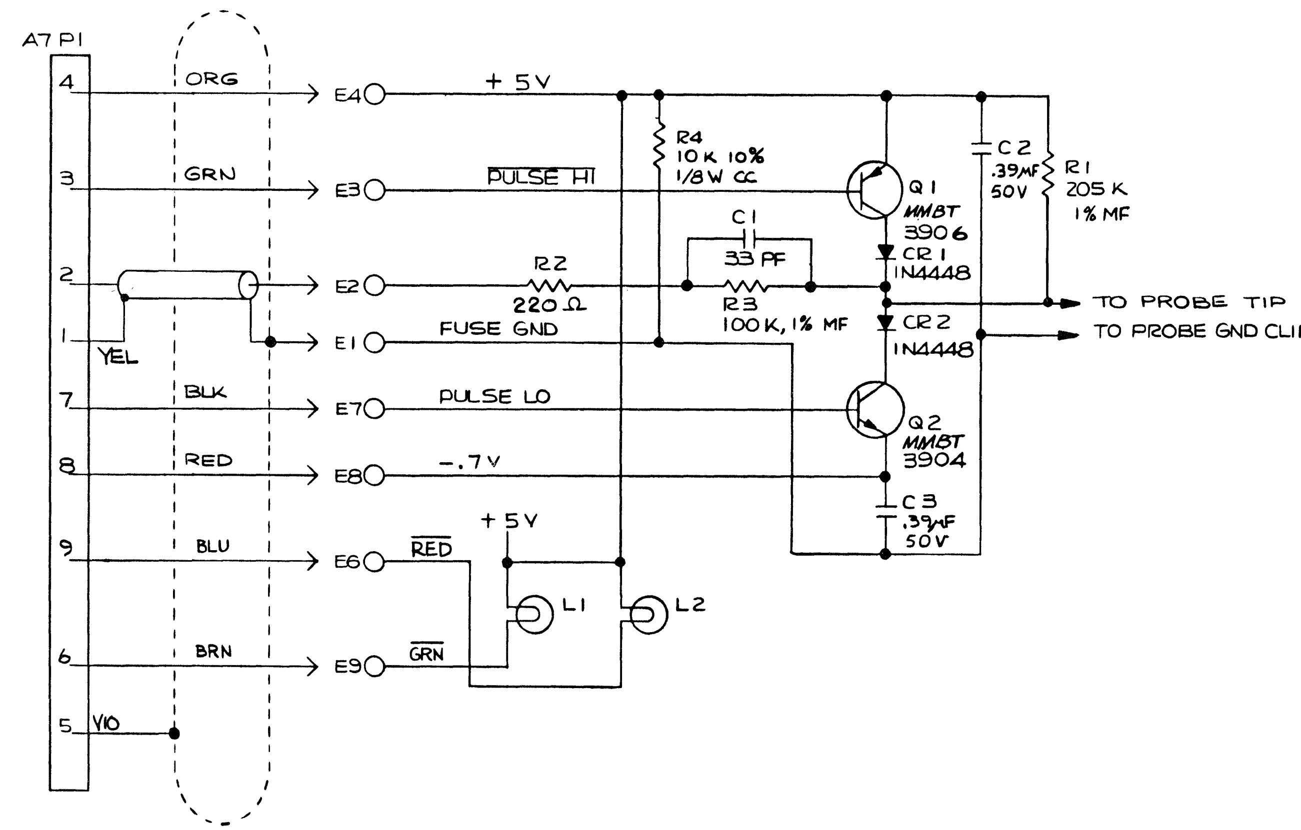
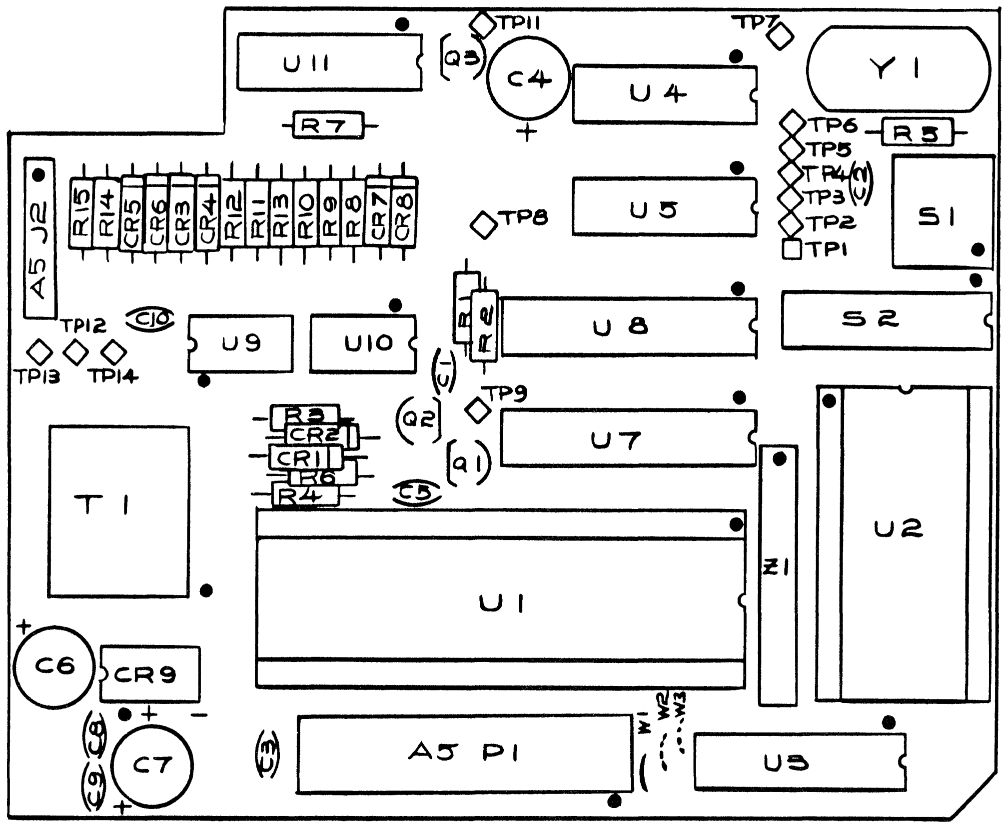
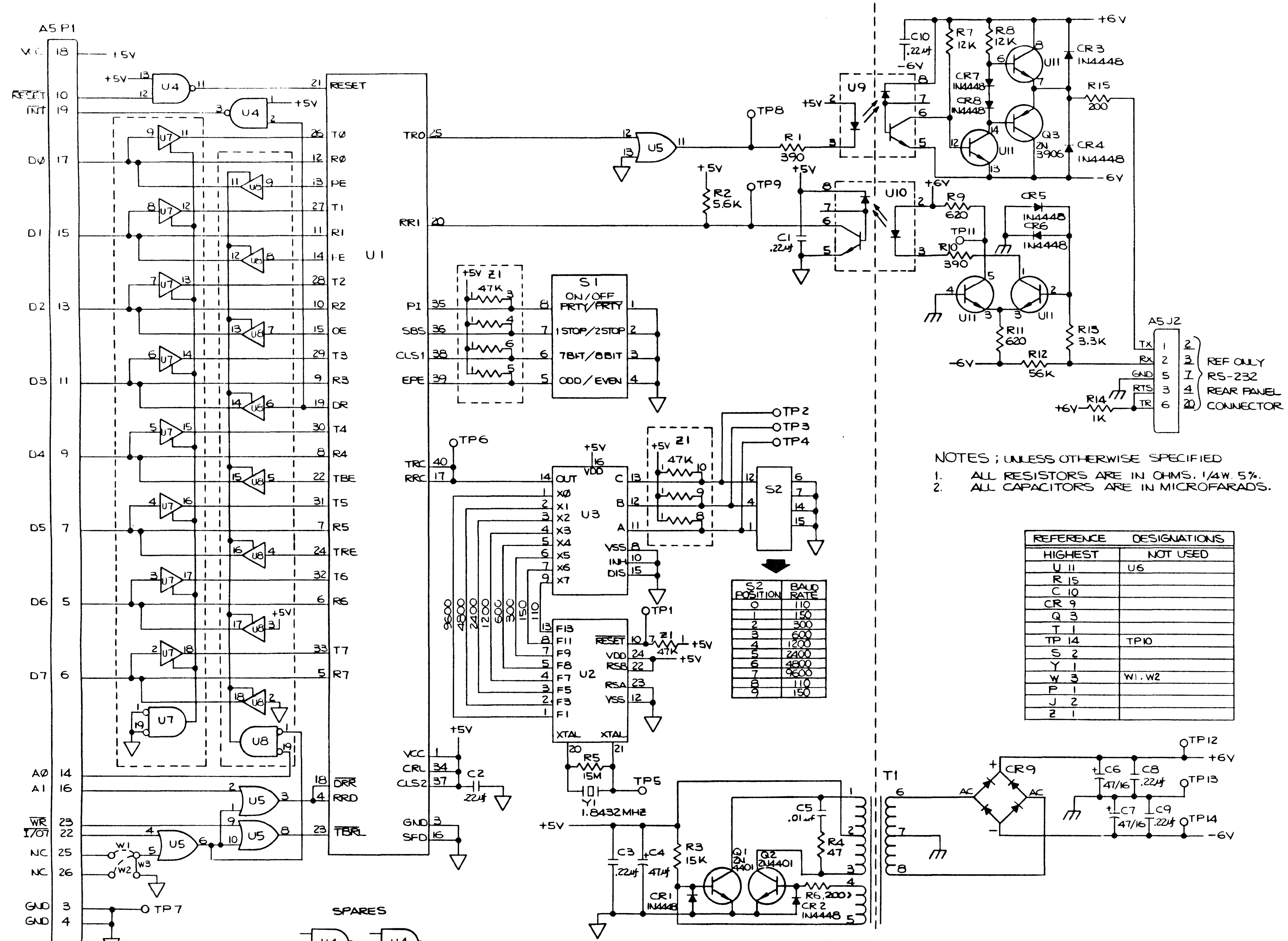


9000A-1091

Figure 8-6. A7 Data Probe PCB Assembly



9000A-1605



S2 POSITION	BAUD RATE
0	110
1	150
2	300
3	600
4	1200
5	2400
6	4800
7	9600
8	110
9	150

NOTES ; UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
2. ALL CAPACITORS ARE IN MICROFARADS.

REFERENCE DESIGNATIONS	
HIGHEST	NOT USED
U 11	U6
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	

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	CA3046			1

9000A-1005

Ⓧ **CAUTION**
SUBJECT TO DAMAGE BY STATIC ELECTRICITY

Figure 8-8. Option-001, RS-232 Interface PCB Assembly