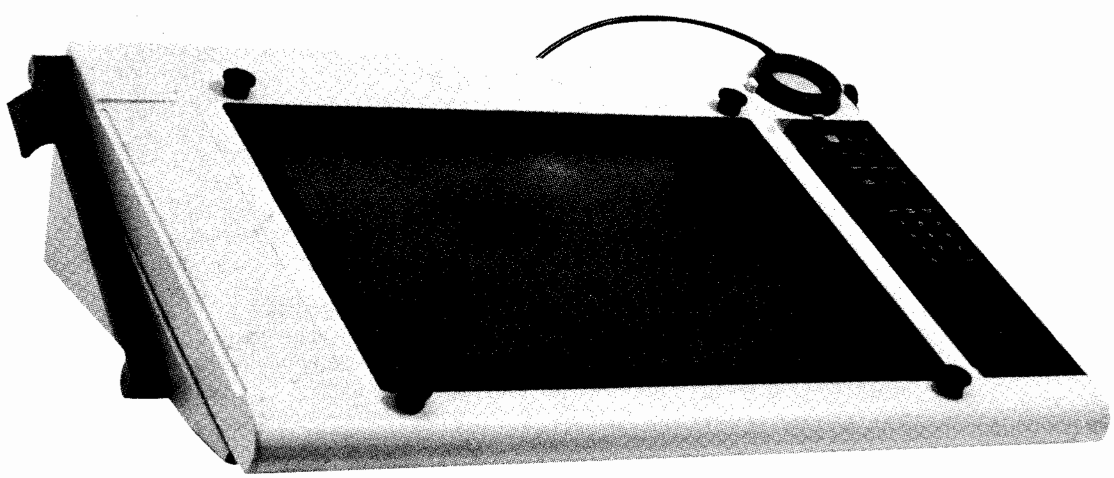
Hewlett-Packard 9874A Documentation



9874A Digitizer

August 1, 1978

Hewlett-Packard Desktop Computer Division
3404 East Harmony Road, Fort Collins, Colorado 80525
(For World-wide Sales and Service Offices see back of manual.)

Manual Introduction

This manual contains the installation, operating and service information for your HP 9874A Digitizer. Periodically, this manual is updated and reprinted. The reprint date is listed on the title page. This date shows the month and year of the last reprint and the current revision number according to the following format:

Month and year of printing

July 1, 1978

Revision number

To keep the information in this manual current between printings, additional pages with updated information on them are provided. These pages should be inserted at the appropriate place in the manual and the original page (where possible) should be removed. When the original page cannot be removed, the new page should be taped or stapled to the old page.

The portion of each new page that has been updated is identified by a vertical line in the left margin. The portions of the page that have not been changed do not have a line in the left margin. The date of the update is printed in the bottom margin of each new page.

Whenever the manual is reprinted, the current updates are incorporated into the manual which eliminates the need for those update pages. You can identify the pages in the manual that have been updated at a reprint by the following items on the pages:

- A vertical line in the left margin next to the updated information.
- The reprint date that shows when the update was done in the bottom margin.

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Chapter 1: General Information

General Information

Introduction

This manual contains installation, operation and service information for the HP 9874A Digitizer. The organization of this manual is as follows:

- General Information
- Installation
- Operation
- Adjustments and Self Test
- Theory of Operation
- Assembly Access
- Circuit Diagrams
- Replaceable Parts
- Appendix
- Notes
- Index

This chapter contains general information. Here are the topics discussed in this chapter.

- Specifications
- Equipment Supplied
- Accessories
- Repair Philosophy

9874A Specifications

Size/Weight:

Height: platen lowered −203.2 mm (8.00 inches)

platen extended −546.1 mm (21.50 inches)

Width: 850.9 mm (33.50 inches)

Depth: 520.7 mm (20.50 inches)

Weight: 27.kg (60.5 lbs.)

Power Requirements:

Nominal voltage settings: 100, 120, 240 Vac; +5% −10% of each setting; 180 voltamp max.

Frequency: 48 to 66Hz (inclusive)

Active Digitizing Area:

315 x 435 mm (12.40 x 17.13 inches)
Ability to digitize drawings as large as 53 kilometres in either deminsion using the Axis Extend mode.

Resolution: (The distance corresponding to a change of one in the least significant digit.)

25 micrometres (.000984 inches)

Accuracy: (The difference between the indicated position and the actual position of any digitized point, including the origin, will be within the rated limits.)

10° C to 40° C
Cursor ± 125 micrometres (.00492 inches)
Stylus ± 500 micrometres (.01969 inches)
See environmental limits

Repeatability: (For a given environmental condition the indicated position will not have a maximum spread of more than the indicated limits.)

Cursor ± 25 micrometres (.00984 inches)
Stylus ± 300 micrometres (.01181 inches)
See environmental limits

Environmental Limits

Storage:

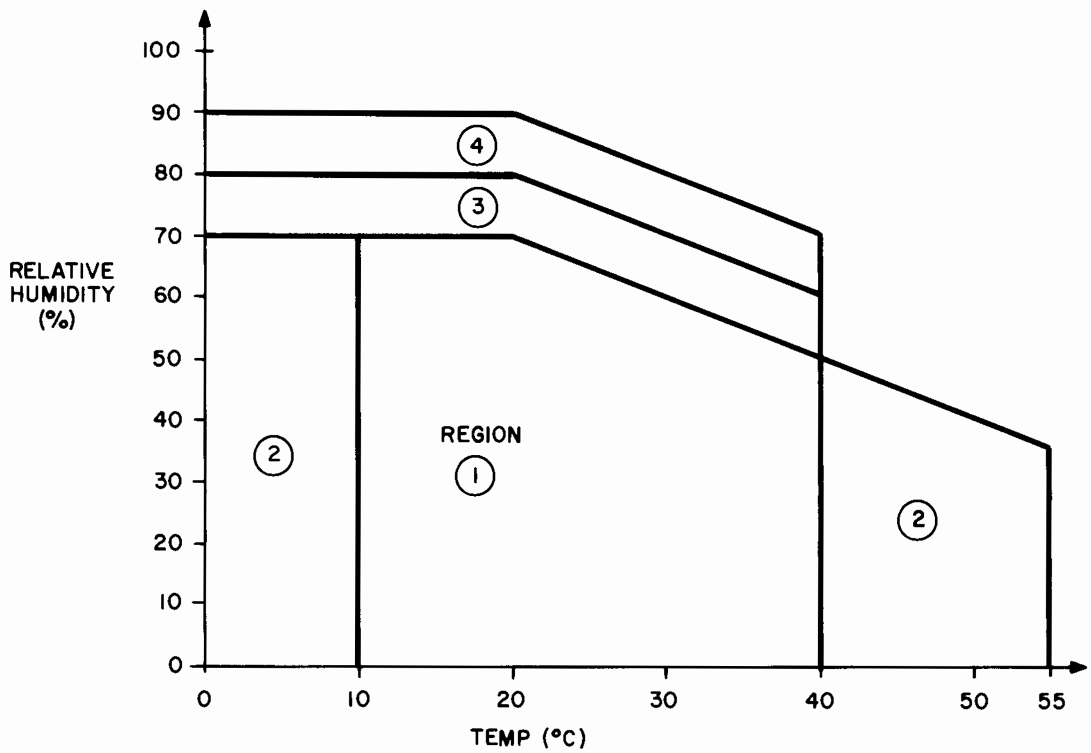
Temperature: −40° to +75°C

Humidity: 95% relative, 40°C and below

Operating:

Temperature: 0° to 55°C

Humidity: Non-condensing. See the following humidity/temperature graph.



Region	Document Thickness Millimetres (inches)	Cursor Accuracy ± millimetres (inches)	Cursor Repeatibility ± millimetres (inches)	Stylus Accuracy ± millimetres (inches)	Stylus Repeatibility ± millimetres (inches)
1	2.0 (0.078)	.125 (.0049)	.025 (.00098)	.500 (.0197)	.250 (.0098)
	4.0 (0.157)	.200 (.0079)	.075 (.00295)	.500 (.0197)	.250 (.0098)
2	2.0 (0.078)	.200 (.0079)	.025 (.00098)	.550 (.0216)	.250 (.0098)
	4.0 (0.157)	.275 (.0108)	.075 (.00295)	.550 (.0216)	.250 (.0098)
3	2.0 (0.078)	.250 (.0098)	.050 (.00197)	.750 (.0295)	.325 (.0128)
	4.0 (0.157)	.375 (.0157)	.100 (.00394)	.750 (.0295)	.325 (.0128)
4	2.0 (0.078)	.625 (.0246)	.125 (.00492)	1.00 (.0394)	.450 (.0177)
	4.0 (0.157)	.700 (.0276)	.175 (.00689)	1.00 (.0394)	.450 (.0177)

Cursor Velocity:

Maximum cursor velocity, that allows the Y to X correction calculations, is 762.0 millimetres/sec (30 inches/sec).

Document Material:

Nonconductive
Full accuracy digitizing through 2 millimetres (.078 inches) thick paper. Reduced accuracy digitizing through 4 millimetres (.158 inches) thick paper. See environmental limits.

In situations where extreme accuracy is required, the deminsional stability of the document being digitized should be considered. Also the document should be uniform and homogeneous for best results. Varying document thickness or material types across the platen may cause slight errors (typically .125 millimetres).

Interface:

HP-IB (IEEE 488-1975)

Coordinate System:

Absolute with respect to the origin established by the user; reference is unaffected if the cursor is removed and replaced.

Cursor:

Vacuum hold-down
Vacuum Control Switch and Control Switch for Digitizing
Integral Digitize Indicator Light
Crosshairs and Viewing Area Illuminated

Stylus:

Single control for digitizing, activated by pressing stylus on platen
Ball Point Cartridge for Writing

Data Rate:

Maximum 30 points/second.

This is the maximum data rate at which the digitizer can transfer data. Depending on your controller and controller program, your data rate may vary.

NOTE

For highest accuracy the front and back surfaces of the platen should be kept clean. Contaminates that are conductive are best removed with isopropal alcohol.

Digitizing pencil drawings which are made with lead containing graphite is not recommended. Graphite is electrically conductive and causes some loss of accuracy. The amount of error depends on the line width, length and the lead hardness. A typical mechanical drawing made with graphite lead may have as much as .5 millimetres (.020 inches) of error.

Digitizing under conditions where condensation is present (any moisture on the platen or document) can also affect accuracy.

This note refers to digitizing using the cursor. The stylus should not be used under the above conditions.

Equipment Supplied

Table 1-1 lists the equipment supplied with each 9874A Digitizer.

Table 1-1: Equipment Supplied

Item	HP Part Number
Miscellaneous Kit	09874-87901
Stylus Assembly	09874-61600
(4) Hold-Down Magnets	09874-67924
Cursor Assembly	09874-67950
Mylar Package Assembly	09874-87000
(5) Information Labels	7120-7105
Ball Point Cartridge	9282-0680
9874 Documentation Manual	09874-90000
Spare Fuse	
2.5amp (100-120 Vac)	2110-0083
1.5amp (220-240 Vac)	2110-0043
Proper Operating Note[1]	
Proper Utility Pack[1]	

Power cord – the appropriate power cord is supplied based on the origin code of the sales order.

1 These items pertain to your HP system. The operating note is designed to get you started with your HP Desktop Computer and 9874A Digitizer. The utility cartridge verifies proper operation of your HP system.

Accessories

Table 1-2 is a list of accessories available for the 9874A.

Table 1-2: Accessories Available

Accessories	HP Part Number
Carrying Case	1540-0555
Strip Chart Box	98741A
Foot Switch	98743A

The installation procedures for accessories which require installation are located in the Appendix.

Maintenance Agreements

When you buy Hewlett-Packard equipment, service is an important factor. If you are to get maximum use from your equipment, it must be in good working order. An HP Maintenance Agreement is the best way to keep your equipment in optimum running condition.

Consider these important advantages:

- **Fixed Cost** – The cost is the same regardless of the number of calls, so it is a figure that you can budget.
- **Priority Service** – Your Maintenance Agreement assures that you receive priority treatment, within an agreed upon response time.
- **On-Site Service** – There is no need to package your equipment and return it to HP. Fast and efficient modular replacement at your location saves you both time and money.
- **A Complete Package** – A single charge covers labor, parts, and transportation.
- **Regular Maintenance** – Periodic visits are included, per factory recommendations, to keep your equipment in optimum operating condition.
- **Individualized Agreements** – Each Maintenance Agreement is tailored to support your equipment configuration and your requirements.

After considering these advantages, we are sure you will agree that a Maintenance Agreement is an important and cost-effective investment.

For more information, please contact your local HP Sales and Service Office.

Repair Philosophy

The 9874A electronic assemblies are divided into those that can be exchanged and those that can be repaired in the field. Table 1-3 lists the 9874A electronic and electro-mechanical assemblies and whether they are to be exchanged on the Green Stripe Exchange Program or repaired in the field. Component repair items not repairable in the field should be ordered at list price but not returned.

Table 1-3: Repair Philosophy

Assembly Part Number	Description	Assembly Exchange	Component Repair
09874-66500	Motherboard (A1)		X
09874-66505	Interface Assembly (A2)	X	
09874-66571	ROM Assembly (A3)		X
09874-66512	Processor Assembly (A4)	X	
09874-66551	Regulator Assembly (A5)		X
09874-66511	Phase Counter Assembly (A6)		X
09874-66502	Clock/Audio Assembly (A7)		X
09874-66501	Filter Assembly (A8)	X	
09874-68001	Bridge Assembly		X
09874-66561	Keyboard Assembly (A9)		
09874-66593	Display/Indicator Assembly (A10)		
09874-66531	Keyboard/Display Drivers Assembly (A11)		X
09874-66503	48 Stage Shift Register Assemblies (A12,A13,A14)		X
09874-66504	24 Stage Shift Register Assembly (A15)		X
09874-67902	Platen (A16)		X
09874-67904	Power Supply Module		X
09874-66541	Rectifier/Capacitor Assembly (A17)		X
09874-67906	Vacuum Pump Module		X
09874-66542	Filter Assembly (A18)		X

Chapter 2: Installation

Installation

Introduction

This chapter contains the installation and initial power-on procedues for your HP 9874A Digitizer. Here are the topics discussed in this chapter.

- Power Requirements
- Fuses
- Grounding Requirements
- Power Cords
- The Interface
- Cursor/Stylus Installation
- Digitizer Controls
- Power-On
- Platen Adjustment

Power Requirements

The 9874A Digitizer operates from nominal line voltages of 100, 120, 220 or 240 volts ac. The range of operation is within +5% and −10% of each voltage. Two switches on the digitizer's back panel allow selection of any one of the four nominal voltages (see Figure 2-1).

The line frequency must be within 48 to 66Hz. The digitizer requires a maximum of 180 voltamps.

CAUTION

THE DIGITIZER MAY BE DAMAGED IF THE VOLTAGE SWITCH SETTINGS ARE INCORRECT. CHECK THE SWITCH SETTINGS BEFORE APPLYING POWER.

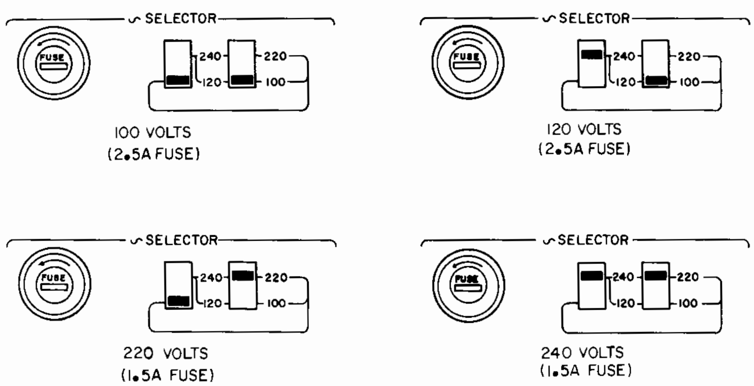


Figure 2-1: Nominal Line Voltage Settings

Fuses

The digitizer must be fitted with a 2.5amp fuse for 100V/120V operation and a 1.5amp fuse for 220V/240V operation. Fuse part numbers are listed in Table 1-1.

WARNING

BEFORE CHANGING THE FUSE, BE SURE THAT THE DIGITIZER IS DISCONNECTED FROM ANY POWER SOURCE.

Always be sure that the correct fuse is used, since failure to follow this precaution may result in needless damage to the digitizer if a malfunction or an unusual line voltage occurs.

To remove the fuse, place a screwdriver into the slot in the fuse holder and twist the cap in a counterclockwise direction. Pull the cap free and remove the fuse. To install a fuse, place either end of the fuse into the pocket in the cap, and install the cap by pushing in on the cap with the screwdriver and twisting in a clockwise direction until the cap locks into place.

Grounding Requirements

To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the digitizer's chassis be grounded. The Digitizer is equipped with a three-conductor power cord which, when connected to an appropriate receptacle, grounds the chassis of the digitizer.

Power Cords

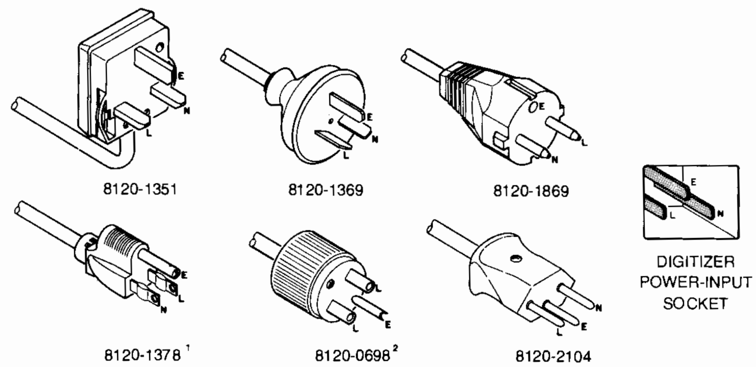
Power cords supplied by HP have polarities matched to the power-input socket on the equipment, as shown below:

- L = Line or Active Conductor (also called "live" or "hot")
- N = Neutral or Identified Conductor
- E = Earth or Safety Ground

WARNING

IF IT IS NECESSARY TO REPLACE THE POWER CORD, THE REPLACEMENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL. OTHERWISE A SAFETY HAZARD FROM ELECTRICAL SHOCK TO PERSONNEL, WHICH COULD RESULT IN INJURY OR DEATH, MIGHT EXIST. IN ADDITION, THE EQUIPMENT COULD BE SEVERELY DAMAGED IF EVEN A RELATIVELY MINOR INTERNAL FAILURE OCCURRED.

Power cords with different plugs are available for the equipment; the part number of each cord is shown in Figure 2-2. Each plug has a ground connector. The cord packaged with the equipment depends upon where the equipment is to be delivered. If your equipment has the wrong power cord for your area, please contact your local HP Sales and Service Office for a replacement.



[1] UL and CSA approved for use in the United States of America and Canada with equipment set for either 100 or 120 Vac operation.

[2] UL and CSA approved for use in the United States of America and Canada with equipment set for either 220 for 240 Vac operation.

Figure 2-2: Power Cords

The Interface

The HP 9874A is connected to its controller via the Hewlett-Packard Interface Bus (HP-IB). If you are using an HP controller, a two-metre cable is supplied with the bus card. Other devices are connected to the bus using the standard bus cables in Figure 2-3.

Length	Accessory Number
1 metre	10631A
2 metres	10631B
4 metres	10631C

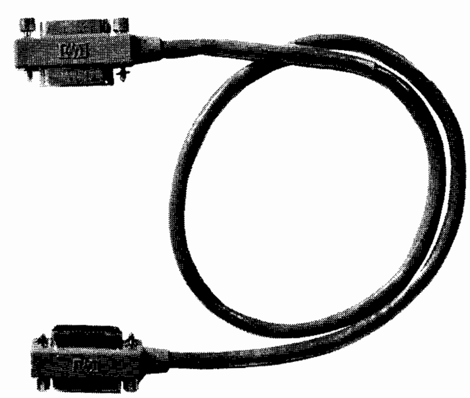


Figure 2-3: Standard HP-IB Cables

Cabling Length Restrictions

In order to ensure proper operation of the bus, two rules must be observed regarding the total length of bus cables when they are connected together:

- The total length of cable permitted in one bus system must be less than or equal to two metres times the number of devices connected together (the interface card is counted as one device).
- The total length of cable must not exceed 20 metres.

For example, a system containing 6 devices can be connected together with cables that have a total length less than or equal to 12 metres (6 devices x 2m/device = 12m). The individual lengths of cable can be distrubuted in any manner desired as long as the total length does not exceed the allowed maximum. If more than 10 devices are to be connected together, cables shorter than 2 metres must be used between some of the devices to keep the total cable length less than 20 metres.

The maximum number of devices that can be connected together in one bus system is 15.

There are no restrictions to the ways cables may be connected together; however, it is recommended that no more than four piggy-back connectors be stacked together on one device. The resulting structure could exert enough force on the connector mounting to damage it.

Interface Connection

Observing the cabling restrictions, the HP 9874A is connected into your system as shown in Figure 2-4.

CAUTION

ALL THE POWER SWITCHES MUST BE SET TO THE OFF POSITION WHEN CONNECTING DEVICES TO YOUR SYSTEM.

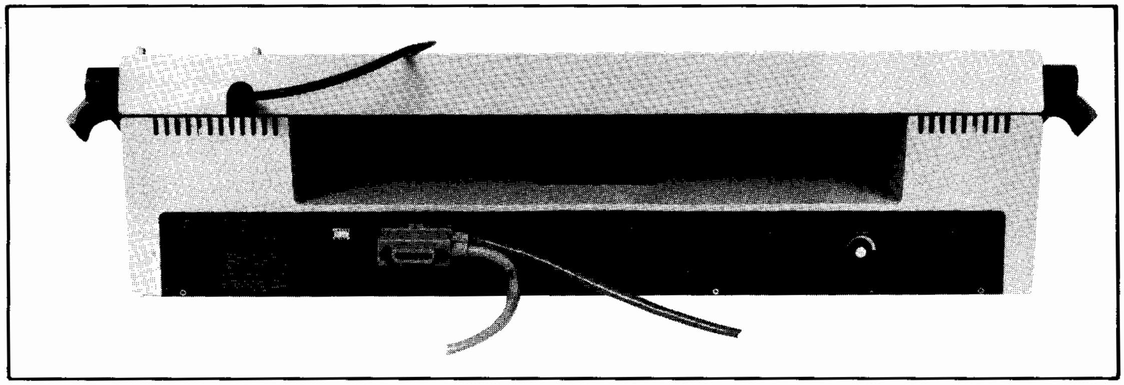


Figure 2-4: Interface Connection

The Digitizer Address Code

Each HP-IB System can have up to 15 devices connected to it and each device must be set to a specific address code.

The digitizer can be set to any one of 31 HP-IB addresses ranging from 0 through 30. Each address can be selected by setting the switches on the digitizer rear panel (see Figure 2-5). The switches are set to the appropriate binary bit positions they represent for the desired address.

The digitizer is set to an address code of 00110 (6) at the factory. Check your digitizer for the proper switch positions.

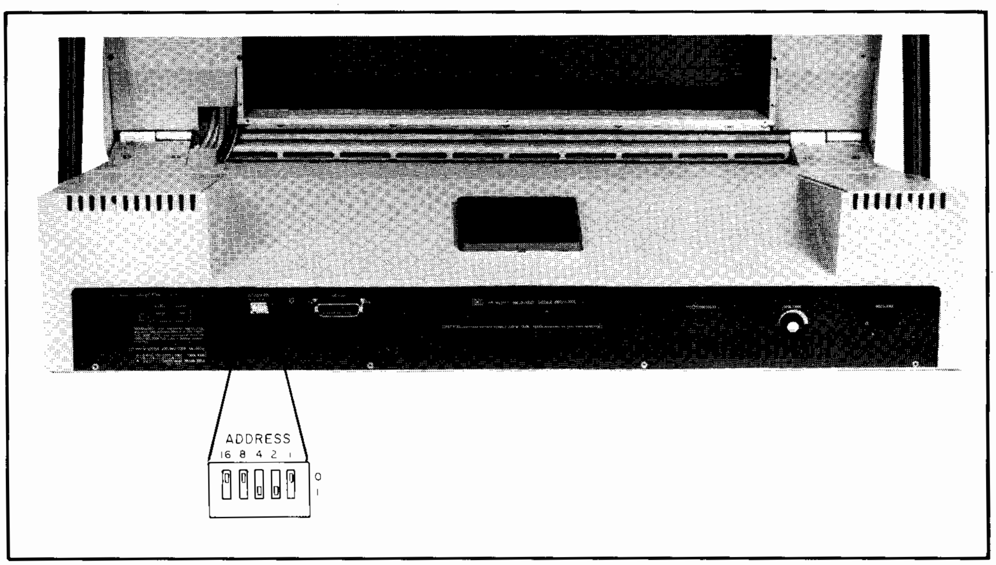


Figure 2-5: Digitizer Address Switches

Table 2-1 lists the switch positions for each address value.

Table 2-1: Address Switch Positions

Address Characters		Address Switch Settings					Address Codes	
Listen	Talk	(5)	(4)	(3)	(2)	(1)	decimal	octal
SP	@	0	0	0	0	0	0	0
!	A	0	0	0	0	1	1	1
"	B	0	0	0	1	0	2	2
#	C	0	0	0	1	1	3	3
$	D	0	0	1	0	0	4	4
%	E	0	0	1	0	1	5	5
&	F	0	0	1	1	0	6	6 ← preset
'	G	0	0	1	1	1	7	7
(	H	0	1	0	0	0	8	10
)	I	0	1	0	0	1	9	11
*	J	0	1	0	1	0	10	12
+	K	0	1	0	1	1	11	13
,	L	0	1	1	0	0	12	14
–	M	0	1	1	0	1	13	15
.	N	0	1	1	1	0	14	16
/	O	0	1	1	1	1	15	17
0	P	1	0	0	0	0	16	20
1	Q	1	0	0	0	1	17	21
2	R	1	0	0	1	0	18	22
3	S	1	0	0	1	1	19	23
4	T	1	0	1	0	0	20	24
5	U	1	0	1	0	1	21	25
6	V	1	0	1	1	0	22	26
7	W	1	0	1	1	1	23	27
8	X	1	1	0	0	0	24	30
9	Y	1	1	0	0	1	25	31
:	Z	1	1	0	1	0	26	32
;	[	1	1	0	1	1	27	33
<	/	1	1	1	0	0	28	34
=	]	1	1	1	0	1	29	35
>	^	1	1	1	1	0	30	36

Cursor / Stylus Installation

The cursor or stylus installation is the same for the digitizer. The cursor cable has a keyed connector which attaches to the digitizer. The receiving connector is also keyed. These keys must be aligned to assure proper cursor connection. After the connector is aligned push the connector in until it is firmly seated into the receiving connector (see Figure 2-6).

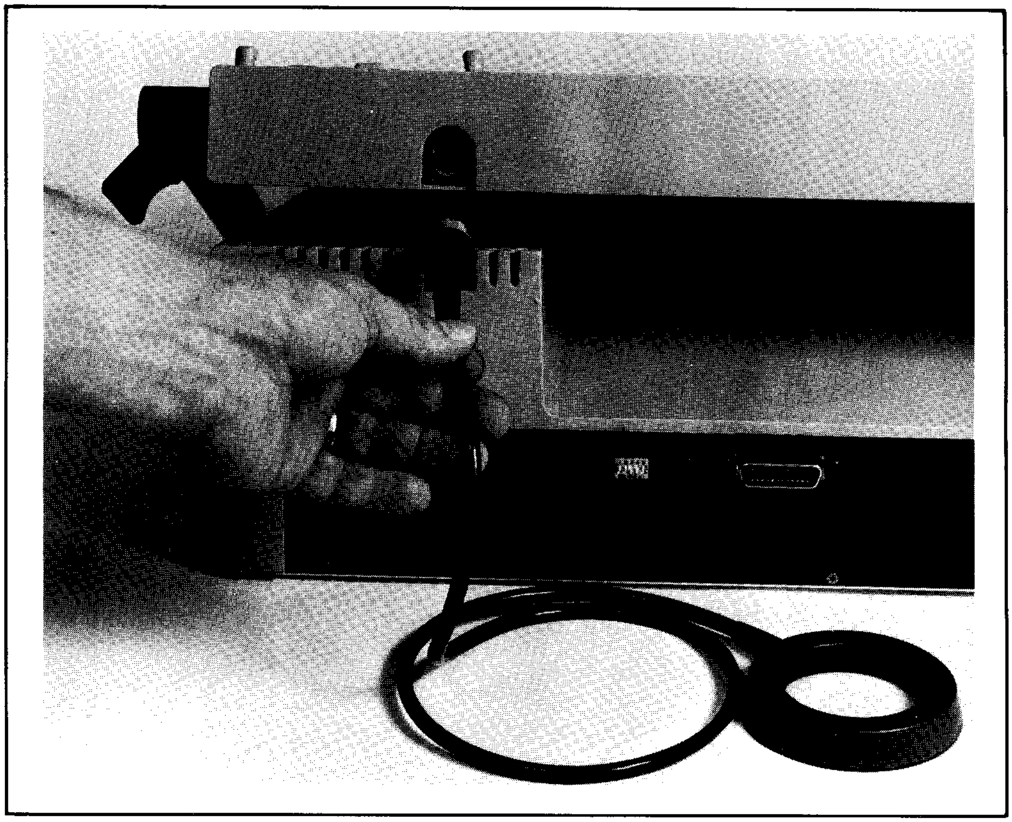


Figure 2-6: Cursor/Stylus Installation

Digitizer Controls

The following text and figures describe the digitizer's controls. The keypad is explained separately in Chapter 3.

Referring to Figure 2-7 the following controls are located on the rear panel:

- **Vacuum Switch** – This switch is the main on/off power switch for the vacuum system.
- **Volume Control** – This variable potentiometer controls the volume of the internal tone.
- **Address Switches** – This is explained in the previous section titled "The Digitizer Address Code".

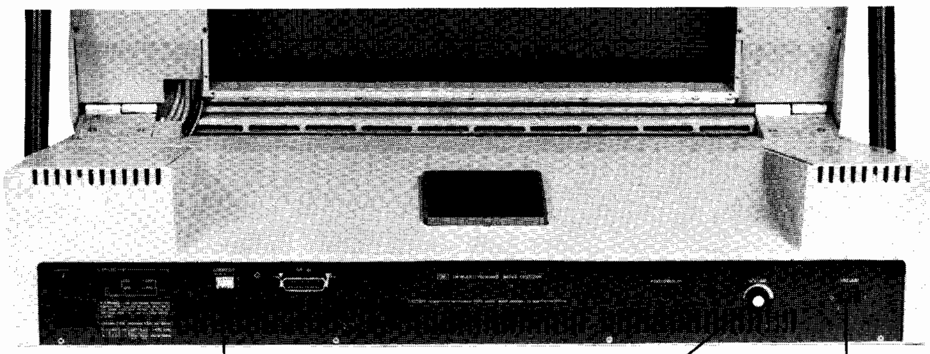


Figure 2-7: Rear Panel View

The following digitzer controls are operated from the front of the digitizer. See Figure 2-8.

- **On/Off Switch** – This is the master power switch for the digitizer.
- **Telescoping Supports** – These adjustable supports attach the upper portion of the platen assembly to the chassis. Pulling the locking mechanism at the top of both supports, the platen can be raised or lowered to any position desired.
- **Bail** – The bail allows the front of the digitizer to be raised approximately six centimetres (2½ inches). Raising the front of the digitizer with one hand, the bail is pulled down and forward with the other hand. Be sure the bail is in its most forward position before resting the digitizer on this support.
- **Hold-Down Magnets** – These four magnets are used to hold the plastic mylar in position. A document placed between the mylar and platen is kept secure on the platen surface.
- **Cursor Home Position** – Molded plastic protrusions form the home position for the cursor and keep the cursor secure in all platen positions.

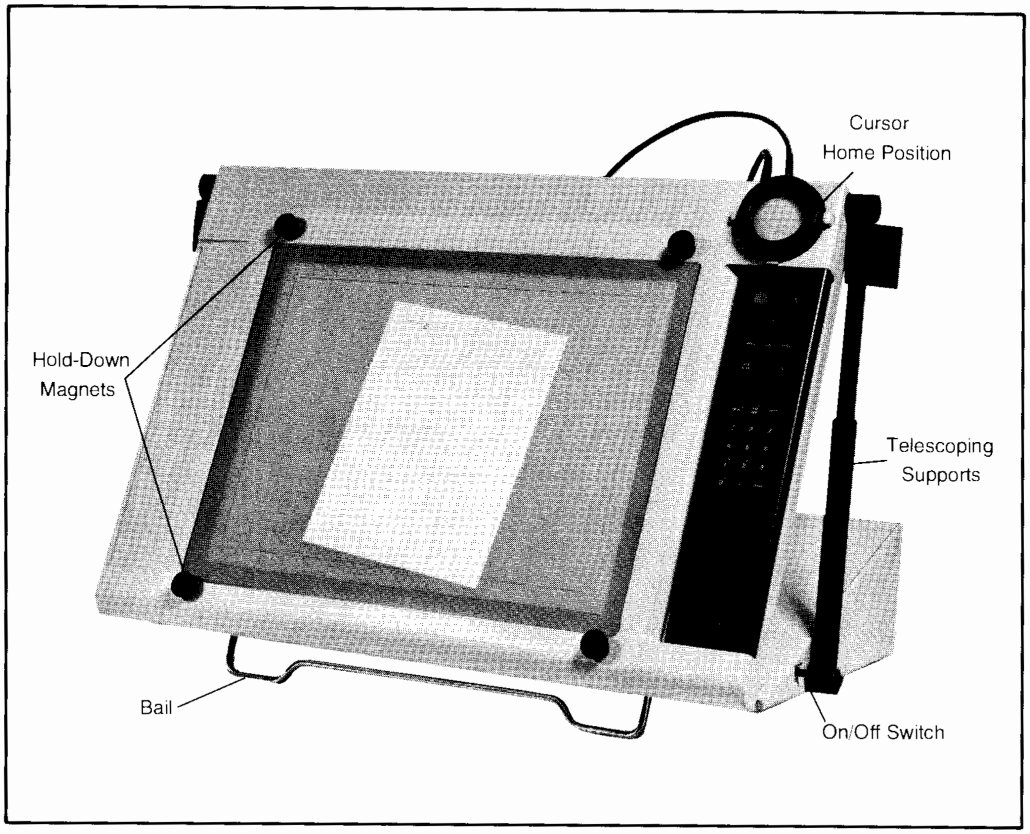


Figure 2-8: Digitizer's Front View

Power-On

After observing the proper power and grounding requirements specified in the previous sections, the power cord may be connected and the digitizer switched on.

The power switch is located on the right-hand side of the chassis. The label on the power switch is marked with a 0 indicating the off position and a 1 indicating power is on.

After power-on, the display remains blank for approximately 2 seconds while self test is in operation. At the completion of the self test, the ⊢ appears in the display.

Platen Adjustment

The platen can be adjusted to any desired working angle. This is done by pulling both strut locks (located on each side of the platen) and raising the entire platen assembly (see Figure 2-9).

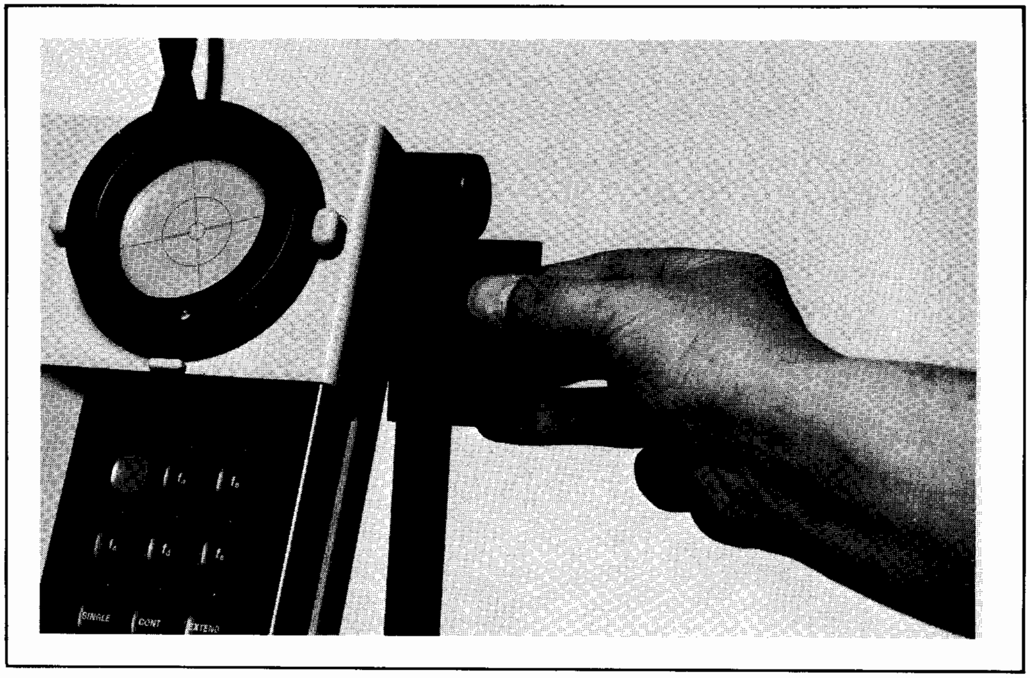


Figure 2-9: Raising The Platen

Chapter 3: Operation

Operation

Introduction

This chapter includes operating instructions for an interface device. Specific examples for controlling the HP 9874A Digitizer via the Hewlett-Packard Interface Bus are given rather than for a particular controller. You should be thoroughly familiar with the appropriate Input/Output (I/O) operations of your controller before using the HP 9874A Digitizer.

Here are the topics discussed in this chapter.

- Overview of the HP-Interface Bus
- HP-IB with the 9874A Digitizer
- 9874A Instruction Set
- Basic Controller/Digitizer Operations
- Keypad Functions and Controller Functions

Overview of the HP-Interface Bus

The following is a definition of the terms and concepts used to describe HP-IB (bus) system operations.

HP-IB System Terms

1. Byte – A unit of information consisting of 8 binary digits (bits).
2. Device – Any unit that is compatible with the IEEE Standard 488-1975.
3. Device Dependent – A response to information sent on the HP-IB that is characteristic of an individual device's design and may vary from device to device.
4. Operator – The person that operates either the system or any device in the system.
5. Addressing – The characters sent by a controlling device to specify which device will send information on the bus and which device(s) will receive that information.

6. Polling – The process typically used by a controller to locate a device that needs to interact with the controller. There are two types of polling:

   - Serial Poll – This method obtains one byte of operational information about an individual device in the system. The process must be repeated for each device from which information is desired.
   - Parallel Poll – This method obtains information about a group of devices simultaneously.

Interface Bus Concepts

Devices which communicate along the interface bus can be classified into three basic categories:

1. Talkers – Devices which send information on the bus when they have been addressed.
2. Listeners – Devices which receive information sent on the bus when they have been addressed.
3. Controllers – Devices that can specify the talker and listeners for an information transfer. Controllers can be categorized as one of two types:

   - Active Controller – The current controlling device on the bus.
   - System Controller – The controller that can take priority control of the bus even if it is not the current active controller. Although each bus system can have only one system controller, the system can have any number of devices capable of being the active controller.

Message Concepts

Devices which communicate along the interface bus are transferring quantities of information. The transfer of information can be from one device to another device, or from one device to more than one device. These quantities of information can easily be thought of as "messages". Typically, each message consists of two basic parts; the address portion specified by the controller and the information that comprises the message.

In turn, the messages can be classified into twelve types. The twelve types of messages are defined as follows:

1. The Data Message. This is the actual information (binary bytes) which are sent from one talker to one or more listeners along the interface bus. Data can be either in numeric form, or it can be a string of characters.

2. The Trigger Message. This message causes the listening device(s) to perform a device-dependent action.
3. The Clear Message. This message causes either the listening device(s) or all of the devices on the bus to return to their predefined device-dependent states.
4. The Remote Message. This message causes listening devices to switch from local front-panel control to remote program control.
5. The Local Message. This message clears the Remote Message from the listening device(s) and returns the device(s) to local front-panel control.
6. The Local Lockout Message. This message prevents a device operator from manually inhibiting remote program control.
7. The Clear Lockout and Set Local Message. This message causes all devices on the bus to be removed from Local Lockout and revert to Local. This message also clears the Remote Message for all devices on the bus.
8. The Require Service Message. A device can send this message at any time to signifiy that the device needs some type of interaction with the controller. This message is cleared by the device's Status Byte Message if the device no longer requires service.
9. The Status Byte Message. A byte that represents the status of a single device on the bus. One bit indicates whether the device sent a Require Service Message and the remaining bits indicate operational conditions defined by the device. This byte is sent from a talking device in response to a serial poll operation performed by a controller.
10. The Status Bit Message. A byte that represents the operational conditions of a group of devices on the bus. Each device responds on a particular bit of the byte thus identifying a device-dependent condition. This bit is typically sent by devices in response to a parallel poll operation.

    The Status Bit Message can also be used by a controller to specify the particular bit and logic level that a device will respond with when a parallel poll operation is performed. Thus more than one device can respond to the same bit.
11. The Pass Control Message. This transfers the bus management responsibilities from the active controller to another controller.
12. The Abort Message. The system controller sends this message to unconditionally assume control of the bus from the active controller. This message terminates all bus communications but does not implement a Clear Message.

These messages represent the full implementation of all HP-IB system capabilities. Each device in a system, however, may be designed to use only the messages that are applicable to its purpose in the system. It is important for you to be aware of the HP-IB functions implemented on each device connected to your HP-IB system to ensure the operational compatibility of the system.

The HP 9874A is capable of implementing five of the twelve interface messages. These messages are shown in Table 3-1.

Table 3-1: Interface Messages

Message	Implemented
Data	Send and Receive
Trigger	Not Implemented
Clear	Receive Only
Remote	Not Implemented
Local	Not Implemented
Local Lockout	Not Implemented
Clear Lockout and Set Local	Not Implemented
Require Service	Send Only
Status Byte	Send Only
Status Bit	Send Only
Pass Control	Not Implemented
Abort	Not Implemented

HP-IB With The 9874A Digitizer

Data messages are transmitted along the interface in the following form.

<Addressing Sequence> <Data Characters> <Terminator>

The addressing sequence, which originates from the controller, specifies each message origin (talker) and destination (listener) on the bus. This addressing sequence must contain the following information.

<Unlisten Command> <Talk Address> <Listen Addresses>

- The unlisten command is the universal bus command with a character code of "?". It unaddresses all listeners. After the unlisten command is transmitted, no active listeners remain on the bus.
- The talk address designates the device that is to talk. A new talk address automatically unaddresses the previous talker.
- The listen address designates one or more devices that are to listen. A listen address adds the designated device as a listener along with other addressed listeners.

This addressing sequence simply states who is to talk to whom. The unlisten command "?" plays a vital roll in this sequence. It is important that a device receives only the data that is intended for it.

When a new talk address is transmitted in the addressing sequence, the previous talker is unaddressed. Therefore, only the new talker can send data on the bus and there is no need to use an untalk command in the same manner as the unlisten command.

The 9874A Digitizer talk/listen address is set via 5 switches on the rear panel. The factory setting of these switches is 00110 which corresponds to a listen address of "&" and talk address of "F". These switches can be changed to any one of the settings in Table 2-4; however, each device on the bus must have its own talk/listen address.

If your system controller is an HP controller which uses the 98034A Interface Card, the proper talk/listen address is automatically sent. The 98034A Card has a preset factory setting of 7 for the bus address. The factory setting for the digitizer address is 00110 (6). If these factory settings are compatible to your system, your controller/9874A address using the 98034A Interface is (706).

The data characters consist of information in numeric or character form. X and Y coordinate values for the 9874A Digitizer are in numeric form. The two-letter mnemonic (instruction set which is described later) and their allowable parameters are in character and numeric form.

The terminator (end of command character) terminates the data or command. The digitizer accepts the ASCII code for the CR/LF (carriage return/linefeed), LF (linefeed) or (semicolon) characters as its command terminators. The digitizer outputs the CR/LF code after placing its data on the bus lines. Refer to the appropriate controller manual for information on end of command characters.

Cursor Controls

Located on the cursor ring are two switches and one LED (light emitting diode). The cursor also contains four internal lights which illuminate the area being digitized. Referring to Figure 3-1, the left-hand switch (labeled A) controls the vacuum applied to the cursor. If the master vacuum switch (rear panel location) is on, vacuum is applied to the cursor when the digitizer is switched on. Depressing the air switch terminates the vacuum supplied to the cursor (this is for cursor movement). As the switch is released, vacuum is again supplied and the cursor is fixed to the platen. The air switch has a toggle mode which is set by pressing the prefix key then the key labeled "Vacuum Mode". With this mode set, depressing and releasing the air switch terminates the vacuum. Depressing and releasing the air switch again applies vacuum. Pressing the prefix key followed by the Vacuum Mode key a second time places the air switch in its original mode.

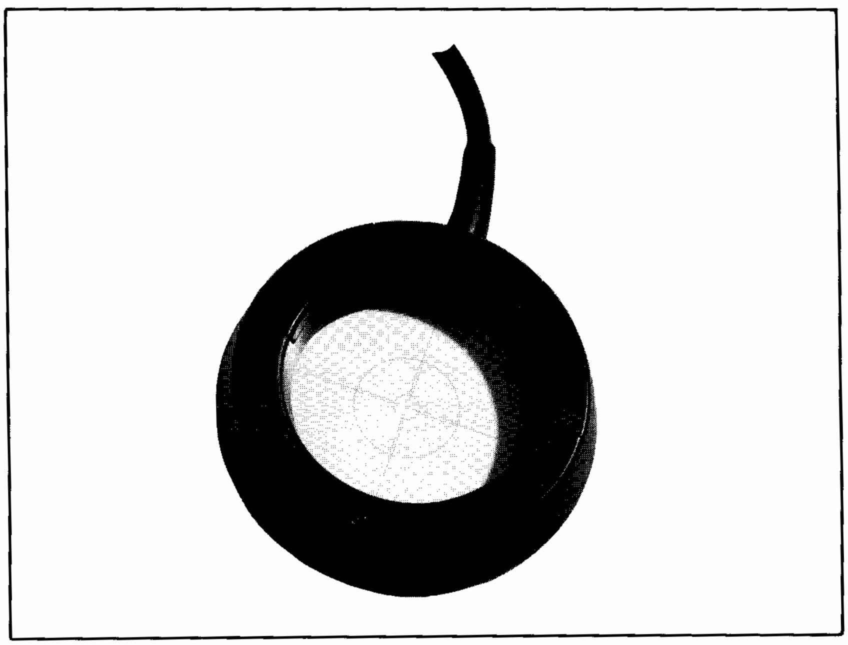


Figure 3-1: Cursor

The digitize switch (labeled D) is used to enter data points into the digitizer. By pressing and releasing this switch, the coordinate values of the center dot on the glass section of the cursor are recorded in the digitizer. The digitize switch also has a follow mode. See the SF (Set Follow) instruction in the instruction set. In the SF mode, holding the digitize switch depressed data samples are taken. Releasing the digitize switch stops the data sampling.

The LED is illuminated when the digitizer is ready to accept a digitized point. The LED is out after a point is taken (pressing the digitize switch). After the data is sent to the controller, the LED is illuminated again.

Hardware Considerations

Since the vacuum pump is a mechanical device, it is subject to wear. To increase the operating lifetime of the vacuum pump, you should always switch the master vacuum switch OFF when the cursor vacuum is not being used.

Stylus Control

Internal to the stylus is the digitize switch. This switch is activated by applying a slight pressure on the ball point tip. The stylus contains a metalic ink cartridge used for tracing documents.

Platen

The platen is a sheet of laminated glass with the X, Y conductors placed between the layers of glass. The top surface of the glass is lapped to provide uniform smoothness for the cursor vacuum feature. Lapping the top surface also eliminatesparallax error when the digitizer is used with rear projected images.

When the platen is in its highest upright position, slides can be projected onto the rear of the platen. The projected image appears on the front of the platen area.

The platen boundaries are indicated with etched circles in each of the four corners. These circles are connected with etched lines which form a complete boundary around the active digitizing area.

The active digitizing area is divided into 25 micrometre units. One digitizer unit is equal to 25 micrometres. The platen default condition places P1 within the lower left etched circle. The upper right P2 point has a value of (17400,13500) digitizer units. Refer to Figure 3-2.

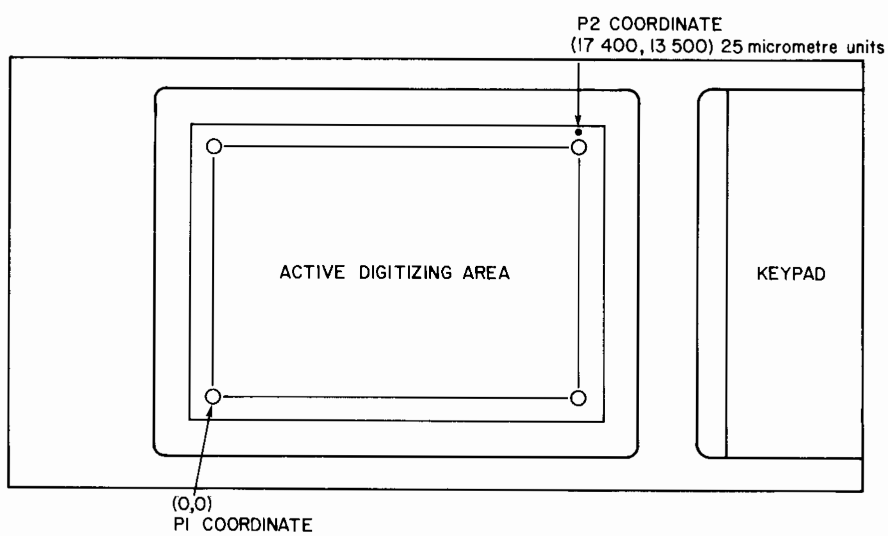


Figure 3-2: Platen Boundaries

Digitizing outside the active digitizing area generates an "out of bound" error which is indicated on the digitizer's display; the error tone is also generated. Upon receiving the out of bound error the digitized point is still taken by the digitizer. At this point no information is lost, but digitizing further in this direction results in loss of data.

Another error signal "low signal" is available. This low signal error is not accessible at power-on, but is available with the IM (Input Masks) instruction. The "low signal" error is explained with the IM instruction.

Keypad

The keypad consists of 27 individual keys and a 15 digit display. See Figure 3-3.

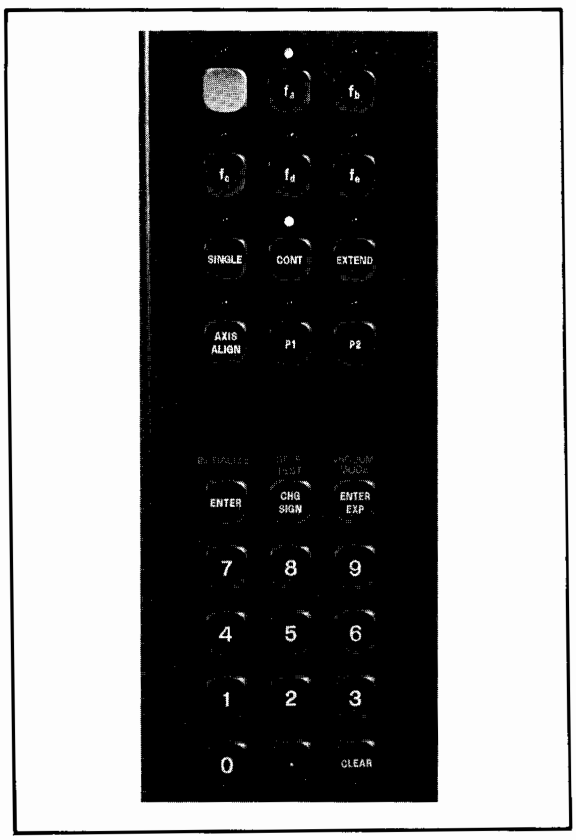


Figure 3-3: Keypad

The top twelve keys have an indicator LED above each key which illuminates when the key is pressed. These twelve keys toggle, thus pressing the key again clears the function or mode. The LED also goes out as the key is cleared. The twelve keys are divided into two sections: five special function keys and six mode keys. When a special function key or mode key is set, pressing another key of that section clears any previously set key.

The prefix (tan key top left of the keypad) is used to obtain a secondary function for certain keys. The secondary functions are explained with the appropriate key.

Special Function Keys

There are eleven special function keys: fa through fe, prefix fa through prefix fe and the foot switch.

The special function keys are used to trigger controller routines. As the key is pressed, bit seven of the status byte is set. Using a program routine to detect when this bit is set, the OK (Output Key) instruction (instruction set) is sent to the digitizer. The OK instruction if followed with a read or enter command reads the key value into your controller. This value is used to access a controller routine.

Table 3-2 is a list of the keys and the value returned using the OK instruction.

Table 3-2: Special Function Key Values

Key	Value Returned
f_a	1
f_b	2
f_c	4
f_d	8
f_e	16
Prefix f_a	32
Prefix f_b	64
Prefix f_c	128
Prefix f_d	256
Prefix f_e	512
Foot Switch (accessory)	1024

The following flow chart is a simplified use for the special function key (f_e).

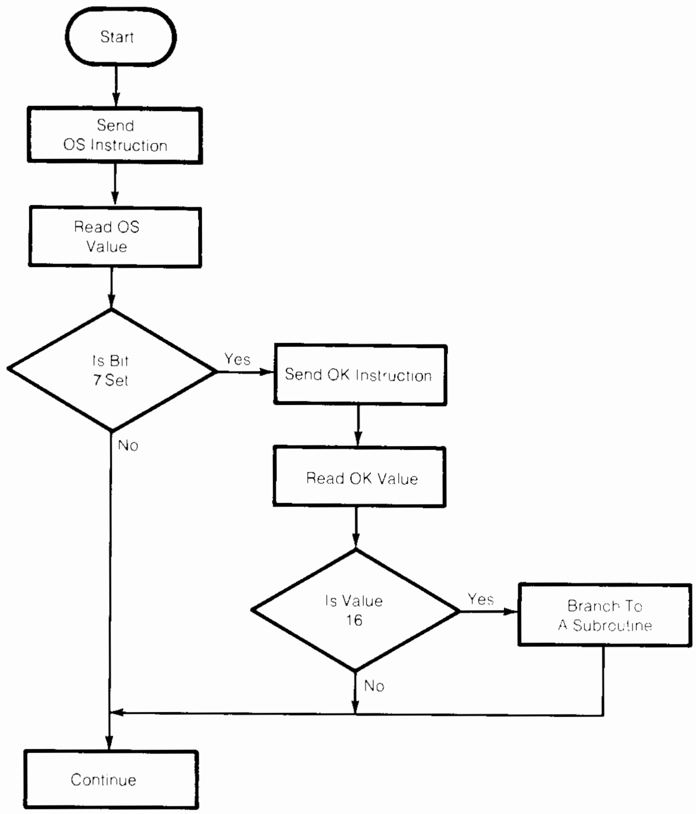


Figure 3-4: Special Function Key (f_e)

Mode Keys

The six keys just above the display are the mode keys. Each of these keys, when set, places the digitizer in a certain mode. Only one mode can be set at a time. In some cases, you are required to digitize specific points to complete the mode. This is explained with the description of the key mode.

Single and Continuous Keys

The two keys labeled "SINGLE" and "CONT" control the sampling modes of the digitizer. You can change modes whenever the digitizing of a document requires the other mode be set. Pressing either key illuminates the LED located on the cursor indicating the digitizer is ready to accept a point. When the digitize switch on the cursor is pressed, the X, Y coordinate of the cursor/stylus (if on the platen) is stored in the digitizer. The LED on the cursor also goes out.

Bit 2 of the status byte is set at this time. Using the OS (Output Status) instruction and checking for bit 2 to be set, the controller can branch to a routine which would read the digitizer's information. Another point cannot be taken until this digitized point is sent to the controller via the OD (Output Digitized Point) instruction.

Using the OD instruction followed with a read or enter command, four parameters are read into the controller: X-and Y-axis information, pen position and annotation (label numbers). Annotation is explained later. Once these parameters are output to the controller the LED on the cursor again illuminates indicating the digitizer is ready to accept another point. If the single sample mode is set, the digitize switch must be pressed again to take another point. If the continuous mode is set, sampling continues until the digitize switch is pressed again to stop digitizing. See the CN (Continuous Sampling) instruction in the instruction set for parameters available in this mode.

The following flow chart is a summary of the preceding paragraph.

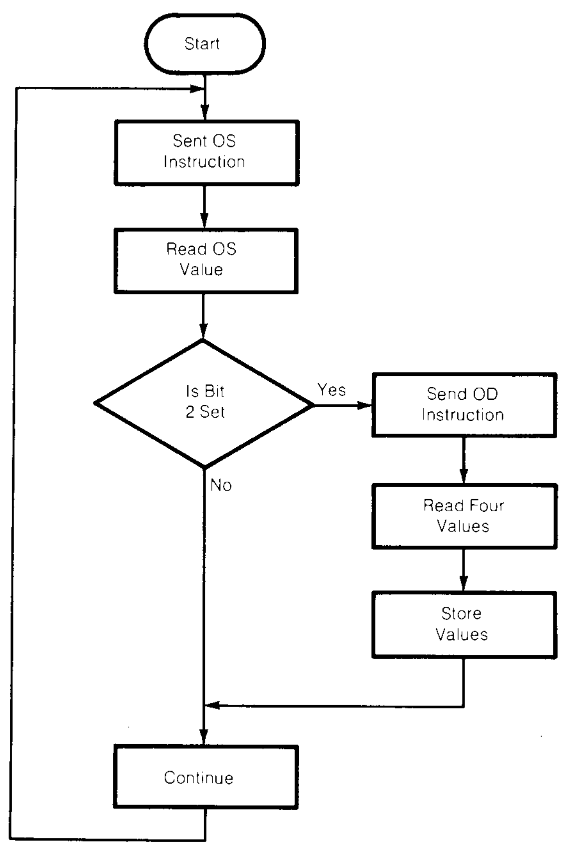


Figure 3-5: The OS and OD Instruction

Axis Align and Extend Keys

The "AXIS ALIGN" and "EXTEND" keys set the modes used to align the document to the platen. Both modes require you to digitize specific points to complete the modes. The Axis Align mode is explained first because this mode should be used each time a document is placed on the platen.

The Axis Align mode is used to align the platen coordinates to that of the document placed upon it. When the AXIS ALIGN key is pressed, the digitizer requires two points be digitized. The first point digitized becomes the (0,0) coordinate. The line formed by the first point digitized and the second point digitized becomes the X-axis. The Y-axis is a line perpendicular to the X-axis at point (0,0) the first point. P1 and P2 do not change values; although their locations are moved using the Axis Align. See Figure 3-6.

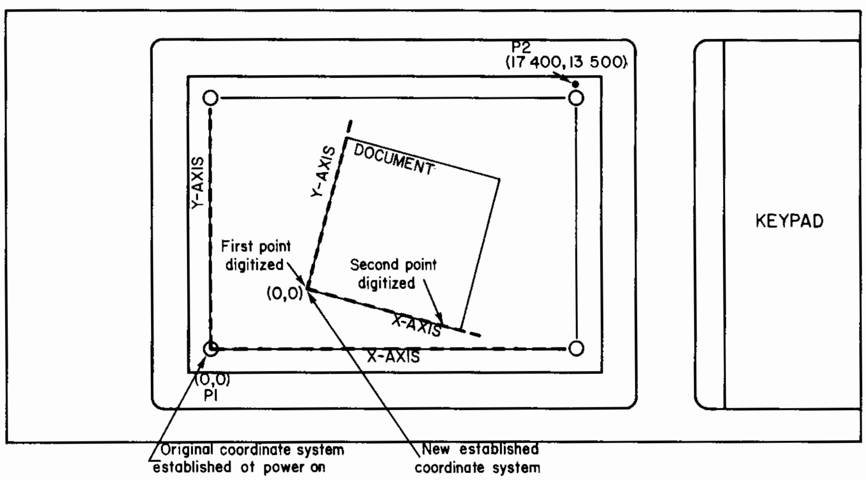


Figure 3-6: Axis Align Mode

As the AXIS ALIGN key is pressed, the LED above the key and on the cursor illuminates. As the first point is digitized, the LED on the cursor blinks and the digitizer's internal tone sounds. The digitizer is then ready for the second point. After the second point is digitized the LEDs on the cursor and above the AXIS ALIGN key go out. The Axis Align mode is completed with the digitizing of the second point. The new coordinate system is established and the digitizer returns to the idle state. A digitizing mode (Cont. or Single) can now be selected and the document digitized.

The EXTEND key is used to digitize documents which are larger than the active digitizing surface. When the EXTEND key is pressed the LEDs above the EXTEND key and on the cursor illuminate. The digitizer in the Axis Extend mode requires that four points be digitized. Two of these points are digitized prior to the movement of the document and the last two points are digitized after the document has been moved.

The order of the points digitized is important because in this mode axis translation and rotation are calculated. As each of the points is digitized, the LED on the cursor blinks and the internal digitizer tone sounds. After the first point is digitized, the next point to be digitized appears in the display. The order the points are digitized is as follows:

- Axis Extend One (AE1) first point
- Axis Extend Two (AE2) second point

} (Before document is moved)

- AE1′ third point
- AE2′ fourth point

} (After document is moved)

The AE1 and AE1′ points digitized are the exact same point marked on the document. This is for calculation of axis transformation.

The AE2 and AE2′ points are also the exact same point.

NOTE

Referring to the fourth point AE2′, this point does not need to be the exact AE2 point. It is necessary, however, that AE2′ be located on the line formed by AE1 and AE2. This allows you greater flexibility in the movement of the document.

Greater accuracy can be obtained by using the same point for AE2 and AE2′ due to the uncertainty in the exact position of the line on document.

The information for the rotation calculations is obtained by comparing the line formed by AE1 and AE2 (before document movement) and the line formed by AE1′ and AE2′ (after movement) with an internal reference line.

The following example is given to further explain the Axis Extend mode. See Figure 3-7. In this example, the document is moved across the platen from left to right, but the document could be moved in any direction or simply rotated by selecting a different position for AE1 and AE2.

The AE1 and AE2 points are selected to achieve the greatest amount of physical document movement.

The AE1 and AE2 points are marked or easily recognized as they are to be digitized again.

The linear distance between AE1 and AE2 should be as great as the document will allow.

AE1 and AE2 must not be located on the existing X-axis.

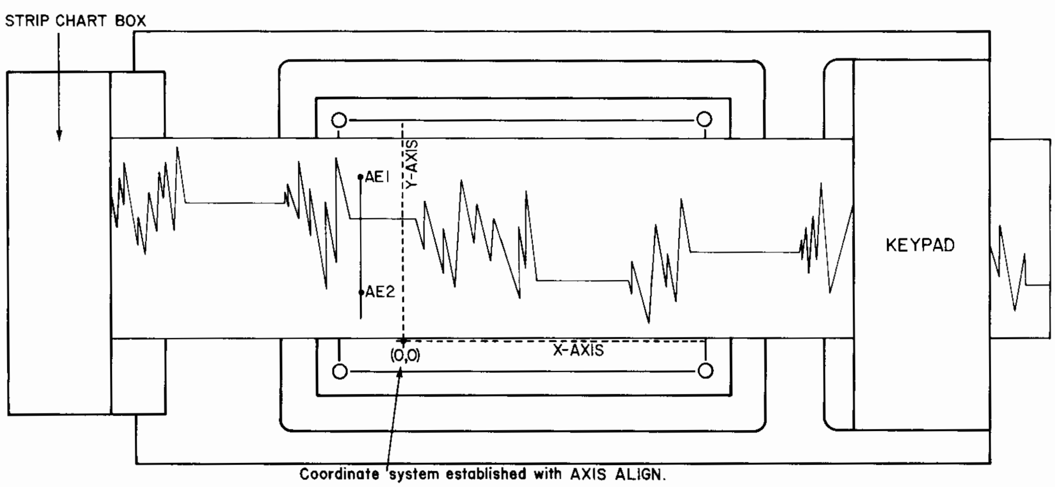


Figure 3-7: Extend Mode

The AE1 and AE2 points are digitized and the cursor is placed in its home position. The document is then moved so that the AE1 and AE2 points are located on the apposite side of the active digitizing surface. The AE1 and AE2 points are now the prime value points AE1′ and AE2′. These points are then digitized, AE1′ first. Refer to Figure 3-8.

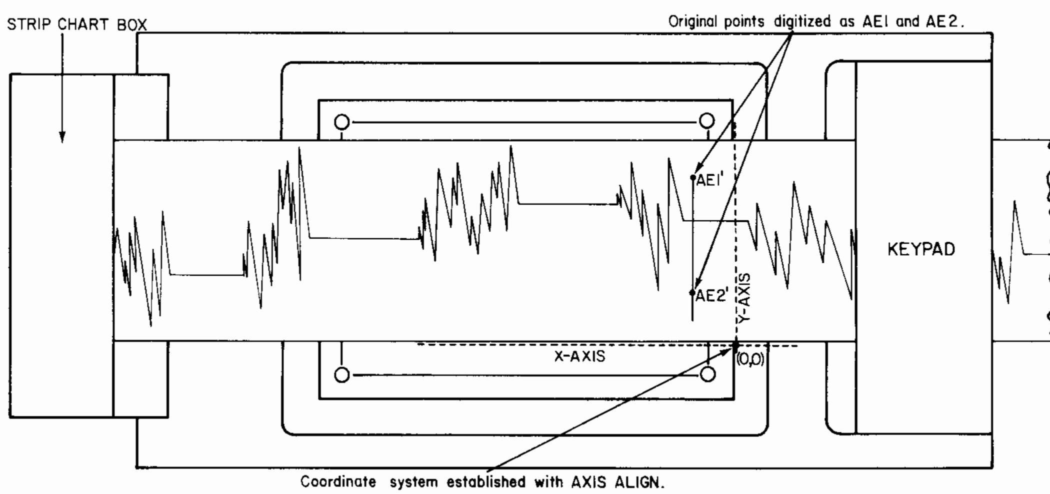


Figure 3-8: Completing the Extend Mode

NOTE

If for some reason there is some doubt as to the accuracy that AE1′ was digitized or the document movement proved unsatisfactory, pressing the prefix (tan key) followed by pressing the zero key clears the AE1′ just digitized. AE1′ again appears in the display. The document can be repositioned as desired and AE1′ can be digitized again.

The digitizing of the fourth point AE2′ completes the Axis Extend mode and returns the digitizer to an idle state. The new coordinate system is established.

For all practical applications, there is no limit to the number of Axis Extends the digitizer is capable of completing. Remember with every Axis Extend a certain amount of human error is introduced into the translation and rotation of the document. This error continues to grow with each additional Axis Extend completed. It should be stressed, that when digitizing all four axis extend points, great care be taken to minimize induced error.

P1 and P2 Keys

The P1 and P2 modes are used to send specific points (in digitizer units) to other plotting and graphic devices. Each mode when set requires one point be digitized: P1 being the lower left and P2 being the upper right with respect to the coordinate system. The coordinates of these points are then stored in the digitizer. Bit one of the status byte is set when you change these scaling points. Using the OS (Output Status) instruction, your controller can check bit one and then output these coordinates from the digitizer with the OP (Output Points) instruction followed with a read or enter statement.

The Display

The digitizer display is a fifteen character display. Using the annotation function, characters are entered from left to right. The first and thirteenth characters are used for the + or − sign of the number and exponent entered from the keypad. For other features which are allowed using the display, see the LB and DD instruction in the instruction set.

The Display Keys

The fifteen keys below the display are used to enter annotational identification numbers into the display. The keys are 0 through 9 with a decimal point, change sign key and exponential key. The keys are entered into the display from left to right. Pressing the enter key stores the displayed value into the annotation buffer. The value stored in the annotation buffer is output to the controller using the OD (Output Digitized Point) instruction followed by a read or enter statement. The annotation is used as an identification or label number when digitizing. Each of the coordinates digitized can have a different annotation number or one annotation number can be used for a group of digitized points.

The annotation is designed to give you a third dimension parameter for the coordinate system. This third dimension can be elevation, chart or graph quadrant information or any label number.

When an annotation number is stored in the buffer, bit 0 of the status byte is set. The value stored in the annotation buffer does not change until another value is entered from the keypad. Pressing the CLEAR key clears the present value appearing in the display, bit 0 of the status byte and also the value stored in the annotation buffer. If an error appears in the display, the clear key clears the error and returns any value which appeared in the display before the error appeared. The clear key does not clear the error bit.

The decimal point is used to enter decimal values. Two decimal points are not allowed in the same number; the error tone is sounded.

The three keys immediately below the display have a prefix key function. The lettering above the key explains its function. Pressing the prefix key followed by the ENTER key initializes the digitizer. This places the digitizer in its power-on state. See the IN (Initialize) instruction in the instruction set. Pressing prefix CHANGE SIGN activates the user interaction self test. This self test is explained in Chapter 4.

Pressing prefix ENTER EXP. changes the mode of the air switch. At power-on vacuum is applied to the cursor. Depressing the air switch on the cursor stops the vacuum to the cursor. The release of the air switch applies vacuum. The change mode key sequence places the air switch into a toggle mode. Depressing and releasing the air switch turns off the vacuum. Depressing and releasing the air switch again applies vacuum. Pressing the change mode key sequence again places the air switch into its power-on state.

9874A Instruction Set

The instruction set for the 9874A Digitizer consists of 40 Hewlett-Packard Graphics Language (HPGL) instructions. Each instruction is a two-letter mnemonic which can be either upper or lower case. Depending on the instruction, some of the mnemonics have numeric parameters. If more than one parameter is allowed with an instruction, the parameters must be separated with commas. **Optional parameters used with instructions (in this manual) are enclosed within brackets.** Table 3-3 is a list and brief explanation of the instruction set. A detailed explanation follows the table and is presented in the same order as the table.

The transfer of data to the digitizer is in 8-bit ASCII code. Instructions received by the digitizer must be terminated with a carriage return/linefeed (CR/LF), linefeed (LF) or semicolon (;). Parameters included with some instructions must be separated with commas. Spaces are ignored by the digitizer except when using the LB (Label) instruction.

Data placed on the bus by the digitizer is terminated with a CR/LF. Parameters within the data are separated by commas.

Note

All output instructions, from your controller that require the digitizer to place data on the bus, must be followed with an appropriate ASCII input operation.

Table 3-3: The 9874A Instruction Set

Instruction	Definition
Digitize Modes	
SG	Sets the Single Sample Mode.
CN[Δt,Δd]	Sets the Continuous Sample Mode.
OD	Output Digitized Point.
	Four parameters returned (X position, Y position, pen position and annotation).
OC	Output Current Cursor Position.
	Four parameters returned (X position, Y position, pen position and annotation).
OA	Output Actual Cursor Position.
	Four parameters returned (X position, Y position, pen position and annotation).
RC	Read Cursor Position.
	Four parameters returned (X position, Y position, pen position and annotation).
ON	Output Current Annotation Number.
	(Annotation) Single parameter returned.
AA	Sets the Axis Align Mode.
AE	Sets the Axis Extend Mode.
PO	Point One (sets P1 mode).
PT	Point Two (sets P2 mode).
IP[P1x,P1y,P2x,P2y]	Input Points (sets P1 and P2 values from the controller).
OP	Output Points (P1 and P2) Four parameters returned P1x, P1y, P2x and P2y.
WO	Sets Window One Mode. The next point digitized becomes the lower left corner of the window.

Instruction	Definition
WT	Sets Window Two Mode. The next point digitized becomes the upper right corner of the window.
IW[P1x,P1y,P2x,P2y]	Input the Window coordinates.
OW	Output the Window coordinates. Four parameters returned P1x, P1y, P2x, P2y.

Digitize Switch Modes

Instruction	Definition
SN	Switch Normal (toggle mode for digitize switch). This instruction returns the digitize switch to power-on condition.
SF	Switch Follow. This instruction places the digitize switch in phase with the pen information using the continuous sampling mode. The digitize switch must be depressed to digitize data points.
TP	Take Point. This instruction is the programmable counterpart of pressing the digitize switch.

Air Switch Modes

Instruction	Definition
AN	Sets the Air Normal Mode. Returns the air switch to power-on condition.
AT	Sets Air Toggle Mode. Depressing and releasing the air switch applies vacuum or terminate vacuum.
AV	Activate Vacuum. Vacuum is applied to the cursor. The air switch is disabled.
RV	Remove Vacuum. The vacuum to the cursor is terminated and the air switch is disabled.

Special Function Keys

Instruction	Definition
SK key value	Set Special Function Key. Parameter allowed is the key address (0,1,2,4,8,16, through 1024).
OK	Output Special Function Key. One parameter (the key value) is returned.

Instruction	Definition
Additional	
BP[frequency,duration]	Beep. The internal digitizer tone is sounded.
DD position, segment	Display Driver. Digit positions 1 through 15 can be specified and any combination of individual segments within the digit position can be illuminated on the display.
LB string	Label the display. String must not exceed 15 characters.
OR	Output Resolution. Two parameters are returned.
OI	Output Identification. One parameter is returned.
OF	Output Factor. Two parameters are returned.
CC[9872]	Compatibility Command. **CC** normal 9874A operation. CC9872-digitizer operation is restricted to outputting three parameters using the OD instruction.
Self Test	
TD value[,1]	Test Digitizer. Parameter allowed is 1 (user interaction test) or 2 (continuous cycling self test).
Configuration Status	
DF	Default.
DC	Digitizer Clear.
IN	Initialize.
OS	Output Status. One parameter is returned.
OE	Output Error. One parameter is returned.
IM[E-mask[,S-mask[,P-mask]]]	Input Masks. Parameters allowed for Error mask, Status mask and Parallel Poll response mask.

Instruction	Definition
Accepted Mnemonics	These instructions are included to allow compatibility with other graphic and plotting devices. The mnemonics are accepted by the digitizer, although no action is taken.
DP	Digitize Point.
PC	Position Cursor.
LT	Line Type.
PD	Pen Down.
PU	Pen Up.
Factory Testing Mnemonics	
RM	These instructions are for factory use only. If your digitizer accidentally receives one of these instructions, control can be lost. To regain control, turn the digitizer off and then back on.
WM	
EX	
OM	

Digitize Modes

Single Sample Mode

Instruction: **SG**

The **SG** instruction sets the digitizer's single sample mode. The LED above the (SINGLE) key and on the cursor illuminate. Each time the digitize switch is pressed (labeled D on the cursor), the coordinate values of the cursor are stored in the digitizer. The **OD** instruction outputs these coordinate values when followed by a read statement from your controller.

Continuous Sample Mode

Instruction: **CN[Δt,Δd]**

The **CN** instruction sets the digitizer's continuous sample mode. The LED above the (CONT) key and on the cursor illuminate. Each time the digitize switch is pressed and released, sample taking begins. Pressing the digitize switch again terminates sample taking. The **SF** instruction is used to place the digitize switch in phase with pen information. In this mode, the digitize switch must be depressed to digitize points. The **OD** instruction outputs the coordinate when followed by a read or enter statement.

The **CN** instruction has two allowable parameters (Δt and Δd). Δt can be specified without Δd. Δt (the elapsed time between samples) can be a value from 20 to 32767 milliseconds. The Δd (distance the cursor is moved between samples) can be a value from 1 to 5148 (.1 to 514.8 millimetres in steps of .1 millimetre which equals 100 micrometres). Upon completion of the first condition placed by Δt or Δd the sample is taken. Sending the **CN** instruction without parameters sets the mode to the last specified values.

The default parameters for the **CN** instruction are Δt equals 20 milliseconds and Δd equals 514.8 millimetres.

Output Digitized Point
Instruction: **OD**

The **OD** instruction outputs four parameters: the X position, Y position, the pen position and annotation. These parameters are from the last point that was digitized.

Output Current Cursor Position
Instruction: **OC**

Output Actual Cursor Position
Instruction: **OA**

Read Cursor Position
Instruction: **RC**

The preceding three instructions output four parameters: X position, Y position of the cursor, pen position and annotation. The position values output are of the present cursor position if located on the platen. If the cursor is not on the platen, the values from the last known position are output.

These instructions do not require a digitize mode be set or that the digitize switch be pressed. They do not interact with bit 2 of the status byte.

These instructions are extremely useful in outputting data for plotting and graphic devices.

1. Data sampling is independent of the digitize switch.
2. The digitize switch controls the pen parameter (switch depressed =1, switch released =0).
3. The data output with an OC, OA or RC instruction follow the coordinate systems established with Axis Align and Extend modes.

4. The window area and platen errors are not sensed unless the Single or Cont. mode is set. Digitizing with an OC, OA or RC instruction having the Single or Cont. mode set does not affect the data output, but does generate and display the platen boundary and window errors.

CAUTION

TRANSIENTS ARE CREATED WITHIN THE STYLUS AS THE STYLUS STRIKES THE PLATEN. IF THE OC, OA OR RC INSTRUCTION IS USED TO OUTPUT DATA, THESE TRANSIENTS CAUSE DATA TO BE INCORRECT FOR APPROXIMATELY 100 MILLISECONDS.

THE TRANSIENT CONDITION IS MINIMIZED BY GENTLY TOUCHING THE STYLUS TO THE PLATEN.

THIS CONDITION IS CORRECTED WHEN A SAMPLE MODE IS SET (SINGLE OR CONT.) AND THE OD INSTRUCTION IS USED TO OUTPUT DATA.

Output Current Annotation Number
Instruction: **ON**

One parameter is output. This is the value (annotation) entered from the keypad. This instruction resets bit 0 of the status byte.

Axis Align Mode
Instruction: **AA**

This instruction sets the Axis Align mode. With this mode set, the next two points digitized become the new established X-axis. See the preceding section titled "AXIS ALIGN and EXTEND KEYS".

Axis Extend Mode
Instruction: **AE**

The instruction sets the Extend mode. The next four points digitized are used to translate and rotate the current platen coordinate system. See the previous explanation of the (EXTEND) key.

NOTE

With the Axis Align and Extend modes after the last point is digitized, the digitizer performs internal calculations. These internal calculations establish the new coordinate system. During these calculations bit 4 (the digitize ready bit) is cleared indicating the digitizer is busy.

Point One
Instruction: **PO**

This instruction sets the P1 mode. The next point digitized becomes the new P1 coordinate value.

Point Two
Instruction: **PT**

This instruction sets the P2 mode. The next point digitized becomes the new P2 coordinate value.

NOTE

Bit 1 of the status byte is set when you digitize a point after sending the PO or PT instruction.

Input Points
Instruction: **IP** [P1x, P1y, P2x, P2y]

This instruction sets the scaling points from the controller. Four parameters are required with this instruction and the values must be in digitizer units. Sending the **IP** instruction without parameters sets the default condition. The lower left edge of the active digitizing area is the coordinate value (0,0); whereas, the upper right (P2 point) is the value (17400, 13500).

Output Points
Instruction: **OP**

The values for P1 and P2 are output to your controller. Four parameters are returned; P1x, P1y, P2x and P2y.

Window One

Instruction: **WO**

This instruction sets the window one mode. The next point digitized becomes the lower left corner of the digitizing window.

Window Two

Instruction: **WT**

This instruction sets the window two mode. The next point digitized becomes the upper right corner of the digitizing window.

Input Window Coordinates

Instruction: **IW** [P1x, P1y, P2x, P2y]

This instruction can contain four optional parameters. These parameters establish the digitizing window on the platen. They must be in digitizer units. Digitizing outside the established window generates the "out of bounds" error. The **IW** instruction without parameters sets the lower left and upper right values of the window to infinity.

NOTE

The lower left and upper right points which establish the window area are relative to the existing platen coordinate system.

The window area follows the rotation and translation of the Axis Align and Extend modes and may be inverted or relocated off the platen area.

Output Window

Instruction: **OW**

The four parameters which represent the window coordinate values are output: P1x, P1y, P2x and P2y.

Digitize Switch Modes

Switch Normal

Instruction: **SN**

The digitize switch is reset to the power-on condition. In the single sample mode, the digitize switch is pressed to take a sample. In the continuous sample mode, the digitize switch is pressed and released to begin sampling, pressed and released again to stop sampling.

Switch Follow

Instruction: **SF**

This instruction places the digitize switch in phase with the pen information while digitizing in the continuous sampling mode. The digitize switch must be held down for sampling to begin. Having the digitize switch pressed also generates the pen down, equal to one, parameter. Releasing the digitize switch discontinues sample taking. The pen parameter for each data point is always a one. Due to the timing sequence between the digitzer and your controller, the last data point taken may have a pen parameter of 0.

NOTE

The SN and SF instructions only affect the digitize switch operation while in the Cont. sampling mode. These instructions have no affect while digitizing in the Single sample mode.

Take Point

Instruction: **TP**

This instruction is the programmable counterpart of pressing the digitize switch. The **TP** instruction must have one of the digitizing modes set (single or continuous) before a point is taken. This instruction is especially useful when used in conjunction with the foot switch.

The following table is provided to show you how the various modes affect the pen, window sensing, and annotation parameters.

Instruction	Sampling Mode	Digitize Switch Mode	Pen Parameter Returned	Window Limits Sensed	Annotation Entered by: Digitize Switch	Annotation Entered by: Enter Button	Annotation Entered by: Next Point Entered	Coordinate Data Entered by: Digitize Switch	Coordinate Data Entered by: Program Control
OD	SG	SN	[illegible]	Yes	X	X		X	
OD	SG	SF	1	Yes	X	X		X	
OD	CN	SN	1	Yes	X	X		X	
OD	CN	SF	1*	Yes	X	X		X	
OC	**	N/A	Follows Switch	**	X	X			X
RC	**	N/A	Follows Switch	**	X	X			X
OA	**	N/A	Follows Switch	**	X	X			X
TP	SG	SN	1	Yes			X***		X
TP	SG	SF	1	Yes			X***		X
TP	CN	SN	1	Yes			X***		X
TP	CN	SF	****	****	****	****	****	****	****

* Due to timing considerations the pen parameter may be a zero for the last point that was digitized.

** Single or continuous sample mode must be set in order to sense the "out of bound" error if a window has been set on the platen.

*** The program should be stopped to enter the annotation if more than one digit is to be entered.

**** This configuration is not valid.

Air Switch Modes

Air Normal

Instruction: **AN**

This instruction returns the air switch on the cursor to its power-on condition. Depressing the switch releases the vacuum. Releasing the switch applies vacuum to the cursor.

Air Toggle

Instruction: **AT**

This instruction places the air switch into a toggle mode. Depressing and releasing the air switch terminates vacuum or applies vacuum.

Activate Vacuum

Instruction: **AV**

This instruction applies vacuum to the cursor. The air switch located on the cursor is disabled.

Remove Vacuum

Instruction: **RV**

This instruction removes vacuum from the cursor. The air switch located on the cursor is disabled.

NOTE

The master vacuum switch should be switched OFF when the cursor vacuum is not being used.

Special Function Keys

Set Special Function Key

Instruction: **SK** value

This instruction sets the specified key value or foot switch. The LED above the key which is set illuminates. The key values are listed in Table 3-4.

Table 3-4: Special Function Key Values

Key	Value
f_a	1
f_b	2
f_c	4
f_d	8
f_e	16
Prefix f_a	32
Prefix f_b	64
Prefix f_c	128
Prefix f_d	256
Prefix f_e	512
Foot Switch (accessory)	1024
Clear all keys (all LEDs are off)	0

Setting any key with the SK instruction clears any other key which is on except the foot switch. This allows the footswitch and one other key to be used at the same time.

Output Special Function Key

Instruction: **OK**

This instruction returns one parameter. The parameter returned is the key value of the key which is set.

Additional

Beep

Instruction: **BP** [frequency, duration]

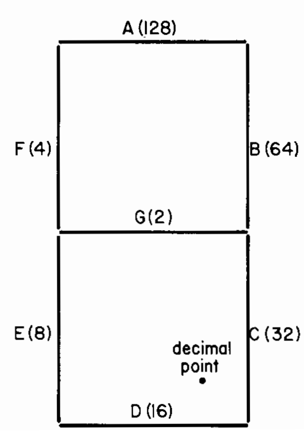
This instruction sounds the digitizer's internal tone. Frequency and duration parameters are allowed with this instruction. Frequency values range from 0 to 255 corresponding from 240 Hz to 2600 Hz in steps of approximately 9 Hz. The length of the tone (duration) can be set from 0 to 32767 milliseconds. If the BP instruction is received without parameters, the digitizer beeps using the last specified values of frequency and duration.

Display Driver

Instruction: **DD** position, segment

This instruction illuminates the position and segments described in the parameters. The parameters are required for the instruction. The position value is from 1 through 15 with 1 being the left most 7 segment display. The segment to be illuminated is specified by the value or summed values shown below.

Value	128	64	32	16	8	4	2	1
Segment	A	B	C	D	E	F	G	dp



Label
Instruction: **LB** string

The label instruction is used to write to the digitizer's display. The character string must not exceed 15 digits. Characters are displayed as follows:

Characters	Action
Digits 0 through 9	Displayed
Decimal point	Displayed
E (exponent)	Displayed
Space (within quote field)	Displayed as space
Comma (within quote field)	Displayed as space
− (sign)	Displayed
+ (sign)	Displayed as space

Output Resolution
Instruction: **OR**

The output resolution instruction returns two parameters. The values returned .025 and .025 correspond to the X and Y resolution in millimetres.

Output Identification
Instruction: **OI**

This instruction outputs one parameter. The parameter is 9874. This instruction can be used to identify this device on a large bus system.

Output Factor
Instruction: **OF**

The output factor instruction returns two parameters. These values are the inverse of the resolution (40 and 40 counts per millimetre for the X-and Y-axis).

Self Test

Test Digitizer
Instruction: **TD** value [,1]

This instruction initiates self test. The value allowed pertains to the test initiated (1 user interaction test or 2 continuous cycling self test).

TD1 is the user interaction self test. You are required to press the keys which appear on the digitizer's display. At the end of the test, the word "pass" appears on the display. A complete explanation of the user intraction self test is in Chapter 4. This explanation includes the optional parameters available at the end of each test, the test routines and a list of the error numbers.

TD2 is a continuous cycling self test. This self test is designed to locate intermittent malfunctions. Refer to the "Continuous Cycling Self Test" section in Chapter 4 for a complete explanation of this test routine.

The optional parameter (,1) is allowed with either self test. This parameter generates an interface interrupt (via interface line SRQ) upon error detection or test cycle completion.

Configuration Status

Default

Instruction: **DF**

The default instruction resets the digitizer to its power-on condition. The following existing conditions established on the platen are not affected: P1, P2, Axis Align and Axis Extend, W1 and W2.

Table 3-5 is a list of the default conditions.

Table 3-5: Default Conditions

Function	Condition
Continuous Sample Parameters	Δt 20 milliseconds
	Δd 514.8 millimetres
Beep Parameters	Reset to 100 frequency, 200 duration
Display/Annotation	Clear
Input Mask Parameters	E-mask 191, S-mask 0, P-mask 0
Status byte	16
Vacuum Switch	SN (Set Normal mode)

All digitizing modes and special function keys are cleared. All bits of the status byte are set to 0 except bit 4 which is set to 1.

Digitize Clear
Instruction: **DC**

The digitizer clear instruction clears the digitizing mode and bit 2 of the status byte. The condition of the platen coordinates, however, are not affected. The coordinates and coordinate systems established with AA, AE, P1, P2, W1 and W2 are not affected.

Initialize
Instruction: **IN**

The initialize instruction sets the digitizer to its power-on condition except for the returned value of Device Specified Jump. This instruction is the same as pressing the prefix-ENTER key sequence (which initializes the digitizer). Table 3-6 is a list of the conditions after the digitizer is initialized.

Table 3-6: Initialize Conditions

Function	Condition
P1	Set to lower left of platen, value (0,0)
P2	Set to (17400, 13500)
Digitizing Window	Coordinates set to infinity
Platen Coordinate System	Systems set with Axis Align and Axis Extend are cleared
Continuous Sample Parameters	Δt equals 20 milliseconds Δd equals 514.8 millimetres
Beep Parameters	Reset to 100 frequency and 200 duration
Display and Annotation	Clear
Input Mask Parameters	E-mask 191, S-mask 0, P-mask 0
Status byte	16
Vacuum Switch	SN (Set Normal mode)

All digitizing modes and special function key are cleared.

Output Status
Instruction: **OS**

This instruction causes the digitizer to output the decimal sum of its status-byte bits. The status byte consists of eight bits (0 through 7). Different bits are set corresponding to the digitizer's internal condition. The summed total of the weighted value of the set bits is output. Table 3-7 shows the weighted values and conditions represented by the bits of the status byte.

Table 3-7: The Status Byte

Weighted Value	Bit	Set Bit	Clear Bit
1	0	Annotation bit – annotation entry sets this bit	ON,IN,DF or pressing the clear key
2	1	Scaling points bit – this bit is set when the user adjusts P1 or P2 from the keypad	OP,IN or DF
4	2	Digitized point bit – This is set when a point is digitized	OD,IN,DC,DF or changing the digitize mode
8	3	Initialized bit – This bit is set on power-on or initialization	OS,DF or Device Specified Jump
16	4	Ready for Input set(digitizer ready)clear (digitizer busy)	Axis Align or Axis Extend Computation
32	5	Error bit – The occurrence of an error sets this bit	OE,IN or DF
64	6	Service request bit – This is set when the digitizer required service. Power-on sends a service request and sets this bit	Serial Poll, IN, OS or DF
128	7	Special function keys – This bit is set when a special function key is pressed	OK,IN or DF

When an instruction is used to clear a bit of the status byte that requires the digitizer to output data, that bit is cleared only when your controller reads the data from the digitizer.

Output Error

Instruction: **OE**

The output error instruction causes the digitizer to output the decimal value of the current error. The error numbers are listed in Table 3-8.

Table 3-8: Digitizer Errors

0	No error
1	Instruction not recognized or instruction exceeded 60 characters
2	Wrong number of parameters
3	Bad parameters received
4	Label instruction too long, greater than 15 characters
5	Not used
6	Out-of-bounds
7	Low signal
8	Not used

Input Mask

Instruction: **IM** [E-mask value [,S-mask value [,P-mask value]]]

The three parameters used by the mask instruction specify the conditions under which an error message, require service message and parallel poll response occurs. The S-mask and P-mask also can change the digitizer's response to the OS (output status) instruction.

The E-mask value specifies the decimal equivalent of the bit values of the digitizer error numbers that set the error bit (bit 5) of the digitizer status byte and display the error number in the display. See Table 3-9.

Table 3-9: E-Mask Values

E-Mask Bit Value	Error Number	Meaning
1	1	Instruction not recognized or instruction exceeded 60 characters
2	2	Wrong number of parameters
4	3	Bad parameters received
8	4	Label instruction too long, greater than 15 characters
16	5	Not used
32	6	Out of bounds
64	7	Low signal
128	8	Not used

For example an E-mask value 191 which is the default value (1+2+4+8+16+32+128) specifies that error numbers 1 through 6 and 8 can set the error bit in the status byte and display the error whenever it occurs. Error 7, however, will not set the error bit or display an error when it occurs since it is not included in the E-mask value.

At power-on, the E-mask value is set to 191. The low signal error (value 64) is masked out. The digitizer is designed to assure you data points are being taken. Using the out-of-bounds error to control the active digitizing surface of the platen, you are assured that all the data points are being taken. The out-of-bounds error signal does not stop sample taking.

To obtain the low signal error, the E-mask value must include bit 7 (value 64). When the low signal error is generated, data is invalid. Data sampling at this time is discontinued and the last known data points are retained in the digitizer. Moving the cursor back to the active digitizing surface and pressing the digitize switch resumes data sampling. The error displayed can be cleared by pressing (CLEAR). Bit 5 of the status byte (the error bit) is only cleared with the **OE** or **DF** instruction or initialization.

The S-mask value specifies the status-byte conditions that can send the required service message (interface line SRQ). The S-mask is the decimal equivalent sum of the bit values of the selected status-byte bits. See Table 3-10.

Table 3-10: S-Mask Values

S-Mask Bit Values	Status Bit	Meaning
1	0	Annotation entered
2	1	Pl or P2 changed from default
4	2	Digitized point available
8	3	Initialized
16	4	Ready(this remains set except during AA and AE calculations)
32	5	Error
64	6	Require service sent (SRQ)
128	7	Key changed

Combinations of the 7 bits can be specified to send the require service message. Bit 6 is the state of the SRQ (interface line) on the interface bus. Bit 6 is set indirectly during a required service operation. Bit 7 is set when the special function key information has changed.

For example, an S-mask value of 16 specifies that the ready bit (bit 4) of the status byte sends the service request message. The other 6 bits (bits 0 through 3 and bits 5 and 7) do not send the require service message.

The P-mask value specifies which of the status-byte conditions results in a logical l response to a parallel poll operation. See Table 3-11.

Table 3-11: P-Mask Values

P-Mask Bit Value	Status Bit Number	Meaning
1	0	Annotation entered
2	1	P1 or P2 changed
4	2	Digitized point available
8	3	Initialized
16	4	Ready
32	5	Error
64	6	Require service sent (SRQ)
128	7	Key changed

For example, a P-mask value of 48 specifies that only bits 4 and 5 (16+32) of the status byte can cause the digitizer to respond to a parallel poll with a logical l on the appropriate data line.

Device Specified Jump

Instruction Sequence:

1. Address the digitizer to talk with its primary address.
2. Send the secondary command 16 (decimal value).

The device specified jump (DSJ) is an action which returns a status condition from the digitizer. This is the only HP-IB secondary address recognized by the digitizer. The following values are returned:

Value	Meaning
0	Digitizer is ready
1	Digitizer has an error
2	Digitizer is in power-on condition

Serial and Parallel Polling

The digitizer responds to a serial poll by sending the set bits of the status byte.

Table 3-12: The Status Byte

Weighted Value	Bit	Set Bit	Clear Bit
1	0	Annotation bit – annotation entry sets this bit	ON,IN,DF or pressing the clear key
2	1	Scaling points bit – this bit is set when the user adjusts P1 or P2 from the keypad	OP,IN or DF
4	2	Digitized point bit – This is set when a point is digitized	OD,IN,DC,DF or changing the digitize mode
8	3	Initialized bit – This bit is set on power-on or initialization	OS,DF or Device Specified Jump
16	4	Ready for Input set (digitizer ready) clear (digitizer busy)	Axis Align or Axis Extend computation

32	5	Error bit – The occurence of an error sets this bit	OE,IN or DF
64	6	Service request bit – This is set when the digitizer required service Power-on sends a service request and sets this bit.	Serial Poll, DF,IN or OS
128	7	Special function keys – This bit is set when a special function key is pressed	OK,IN or DF

The value returned in a serial poll operation differs from the OS (output status) instruction in the following cases:

- The initialize bit (bit 3) is cleared with the OS instruction, but it is never cleared with a serial poll operation.
- The serial poll and OS instruction each address a different location in the digitizer. The service request bit (bit 6) remains set in each location until that location receives the instruction which clears bit 6.

The digitizer can also respond to a parallel poll by sending a logical 1 on one of the 8 data lines.

The line used is determined by the digitizer address value as shown in the Table 3-13.

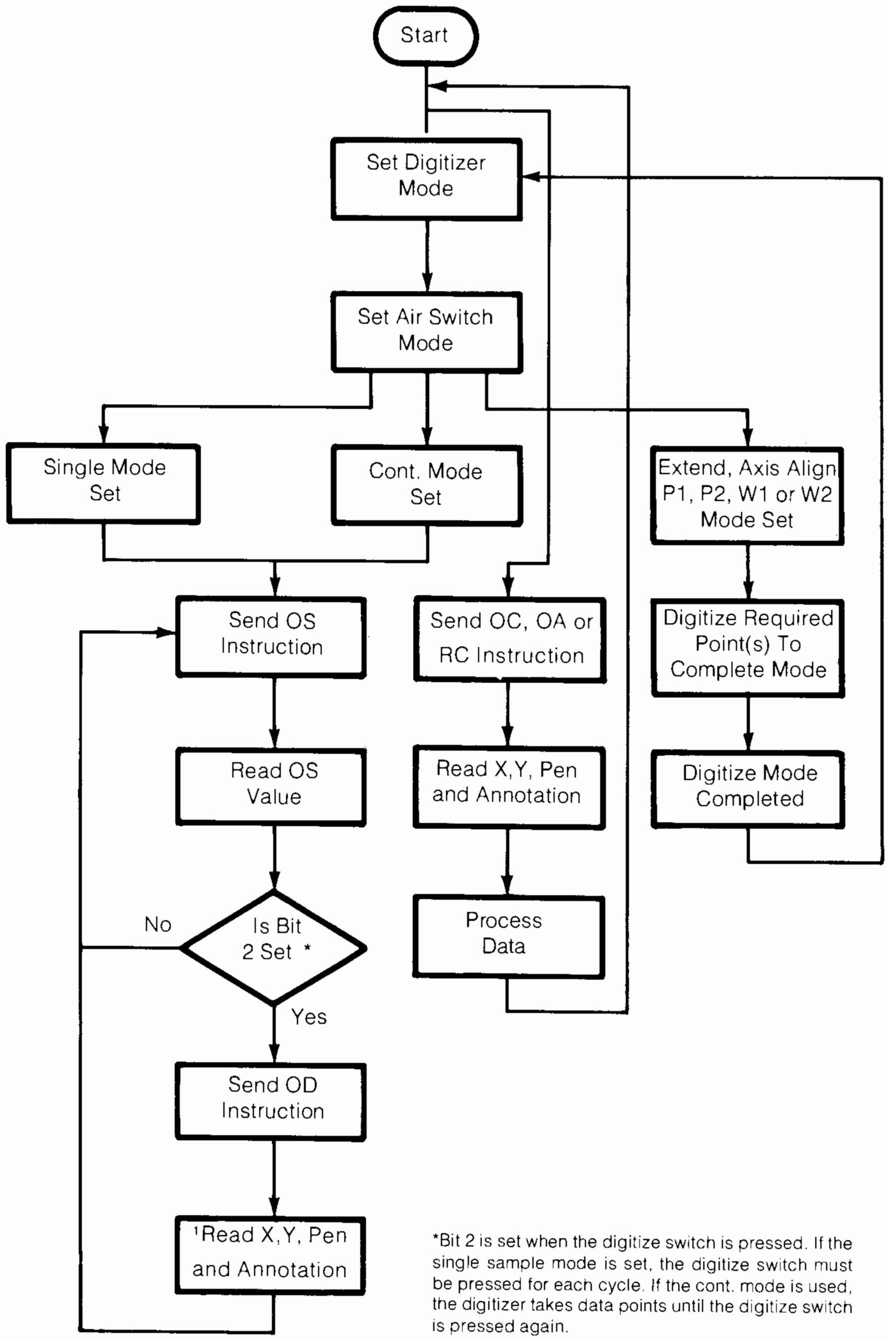
Table 3-13: Parallel Poll Response

Digitizer Address	Parallel Poll Bit Position	HP-IB Data Line Number	Value Returned
0	7	8	128
1	6	7	64
2	5	6	32
3	4	5	16
4	3	4	8
5	2	3	4
6	1	2	2
7	0	1	1
8 or above	Does not respond unless configured.		

The address settings from 8 through 30 do not respond to a parallel poll at power-on. If the digitizer's address is 8 or above, the digitizer must be configured by an IEEE parallel poll configure message.

Basic Controller/Digitizer Operations

The flow chart Figure 3-9 are the basic controller/digitizer operations.



*Bit 2 is set when the digitize switch is pressed. If the single sample mode is set, the digitize switch must be pressed for each cycle. If the cont. mode is used, the digitizer takes data points until the digitize switch is pressed again.

[1]The four parameters must be read to obtain proper cursor LED response.

Figure 3-9: Basic Controller /Digitizer Operations

Keypad Functions and Controller Functions

Table 3-14 summarizes sharing of control between the digitizer keypad and the controller.

Table 3-14: Keypad Functions and Controller Functions

Instruction or Mode	Digitizer Keypad	Controller
Initialize	x	x
Set Digitizer Modes	x	x
Single sample	x	x
Continuous sample	x	x
Axis Extend	x	x
Axis Align	x	x
P1 and P2 Mode	x	x
Window P1 and P2	x	x
Annotation	x	
Digitizer Clear	x	x
Default		x
Input Masks		x
Digitize Point	x	x
Check Status		x
Check Error		x
Operate Beep		x
Operate Air Switch	x	x
Set / Clear Keys	x	x
Control Display		x
Self Test	x	x

The Prefix Key

The following is a summary of the additional functions obtained pressing the prefix (tan key) followed by a second key. Many key do not have a prefix function, but those that do are listed below.

Prefix	f_a	32 } Value Returned
Prefix	f_b	64 } Value Returned
Prefix	f_c	128 } Value Returned
Prefix	f_d	256 } Value Returned
Prefix	f_e	512 } Value Returned
Prefix	P1	Window One Mode
Prefix	P2	Window Two Mode
Prefix	ENTER	Initialize
Prefix	CHG SIGN	User Interaction Self Test
Prefix	ENTER EXP	Change Mode for the Air Switch
Prefix	0	Resets AE1′ when in the Extend Mode

Stylus Considerations

The stylus is sensitive to moisture, graphite and vibrations due to its limited sensing area. While digitizing with the stylus the following precautions should be applied to reduce or eliminate the possibility of obtaining erratic data:

- Some printing inks contain graphite which cause erratic data when digitized. If problems are encountered, the mylar overlay (shiny side up) should be used over the document. Ink may be removed from the overlay with isopropyl alcohol.

- Avoid digitizing over one line repeatedly, as an accumulation of ink deposited by the stylus can cause erratic data to be taken.

- Vibrations appear in the stylus while digitizing at velocities in excess of 25.4 centimetres/second (10 inches/second). These vibrations are more easily generated when digitizing directly on the glass platen (via rear projection). If your application requires stylus digitizing of a rear projection in CN (Continuous Sampling) mode, the mylar overlay should be used between the stylus and platen. See the caution following the explanation of the RC instruction.

Chapter 4: Adjustments and Self Test

Adjustments and Self Test

Introduction

This chapter contains problem isolation information and will help you maintain and keep your digitizer in proper operating condition. Here are the topics discussed in this chapter.

- Safety
- Digitizer Adjustments
- Troubleshooting and Self Test
- Digitizer Cleaning

Safety

WARNING

LETHAL VOLTAGES ARE PRESENT INSIDE THE DIGITIZER.

Procedure For All Personnel Trained In Electrical or Electronic Installation Maintenance and / or Repair

- Do all possible operations with the power source deactivated.
- If the installation, maintenance or repair has to be done while energized, the following precautions should be taken:

  a. Never work alone in high voltage areas. In case of accidental shock, a life may depend on rapid removal from the energized source and appropriate first-aid action.

  b. Employees working in high voltage areas should know where to obtain respiratory resuscitation and/or cardiac pulmonary resuscitation (CPR), in case a fellow worker needs assistance.

  c. In case of burns, treat only after the person is breathing and has a normal heartbeat.

These simple precautions can save a life.

General Safety Guidelines For High Voltage Testing

Here is a list of safety guidelines to be followed when working with voltages in excess of 50vdc or 50vac RMS.

1. Know each step of the test procedure. Check the test setup to be sure the instruments are connected properly and that all control settings are correct.
2. Never defeat interlocks.
3. Never have one hand on chassis or other ground while measuring high voltages with a probe held in the other hand. Use the one hand method, i.e., probe in one hand, the other hand behind the back or in a pocket.
4. Make sure the probe being used has voltage insulation higher than the voltage being measured. Check wires and probes for cracked insulation and defects. If any defects are noted do not use until repairs are made.
5. Make certain that the instrument being worked on is turned off and all capacitors and high voltage circuits are discharged before any component or hardware is removed or touched. Remember that a circuit can be lethally charged if a component is open, missing, or if a wire is disconnected or open even with the ac power switch off. Isolated heat sinks will also be statically charged.
6. Make certain that instruments used for testing are used within their rated specification. Never use instruments floated above their specified rating.
7. Never reach around energized high voltage circuits. Always turn equipment off and discharge the high voltage before reaching.
8. NEVER WORK ALONE. Be familiar with location of power switches in your area and what they control. Know how to free a fellow worker from high voltage without energizing yourself.
9. Keep work area neat, free of any interfacing conductive material, and free of any sharp objects. Remember a reaction to a shock can cause one to strike nearby objects which can result in a serious injury.
10. Always leave safety shields in place unless work must be done on circuits behind the shields. Replace the shields after work is completed.
11. Never leave work area with high voltage equipment energized and high voltage circuits exposed.
12. Have available and use approved warning signs and tags in areas where high voltage testing is in process.

13. Do not make measurements in a circuit where corona is present. Corona can be identified by a pale-blue color, or from a buzzing sound emanating from sharp metal points in the circuit, or from the odor of ozone.
14. Hands, shoes, floor, and workbench must be dry. Avoid making measurements under humid, damp or other environmental conditions that could affect the dielectric withstanding voltage of the test leads or instruments.
15. All test procedures and safety procedures should be strictly followed at all times.

Digitizer Adjustments

There are four adjustments internal to the digitizer. Referring to Figure 4-1 the adjustments are as follows:

- Two +5 Volt adjustments on the regulator assembly.
- A 6mHz clock adjustment on the processor assembly.
- The skew register switches on the processor assembly.

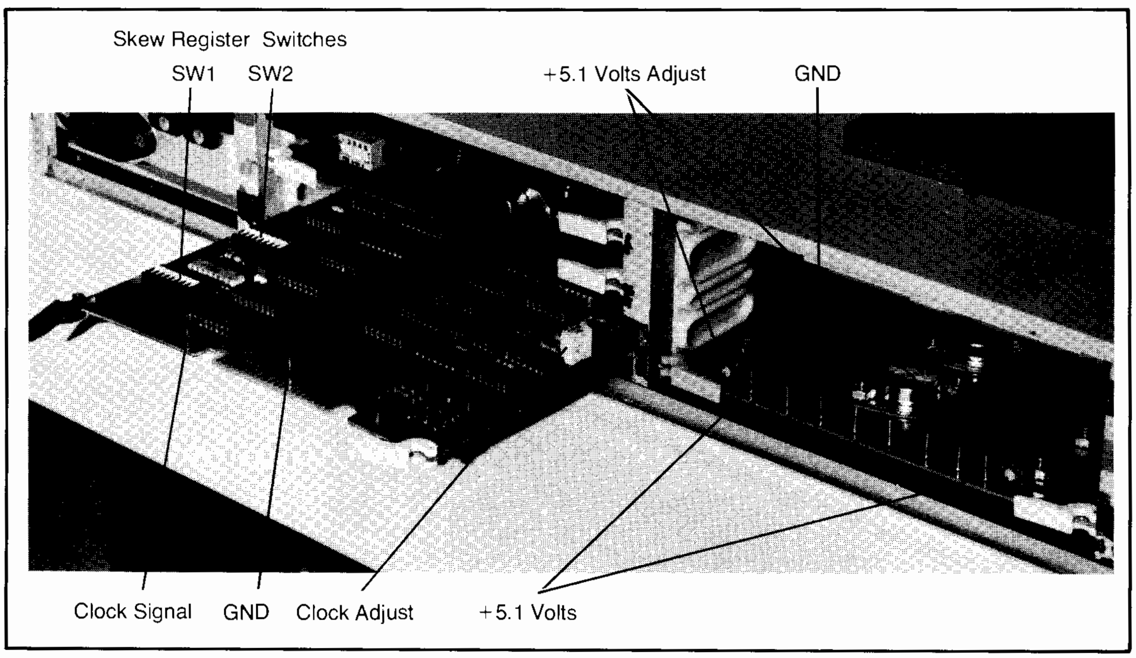


Figure 4-1: Internal Adjustments

Regulator Assembly Adjustments

The regulator assembly contains two +5 volt adjustments which are accessed from the rear of the A5 assembly. Referring to Figure 4-1, the variable potentiometer is adjusted so that the adjacent pin is set to 5.1 volts + or −.1 volt.

Processor Clock Adjustments

The processor assembly contains its own 6mHz timing clock. Refer to Figure 4-1 for the location of the adjustment and signal pins.

The processor clock is adjusted to 6mHz (166.67 nanoseconds). The adjustment spec for the clock is .1mHz, 5.9mHz (169.49 nanoseconds) to 6.1mHz (163.93 nanoseconds). Figure 4-2 is a typical oscilloscope wave form of the timing clock. The oscilloscope settings are as follows:

- Amplitude 2v/div.
- Sweep 100 μsec/div.

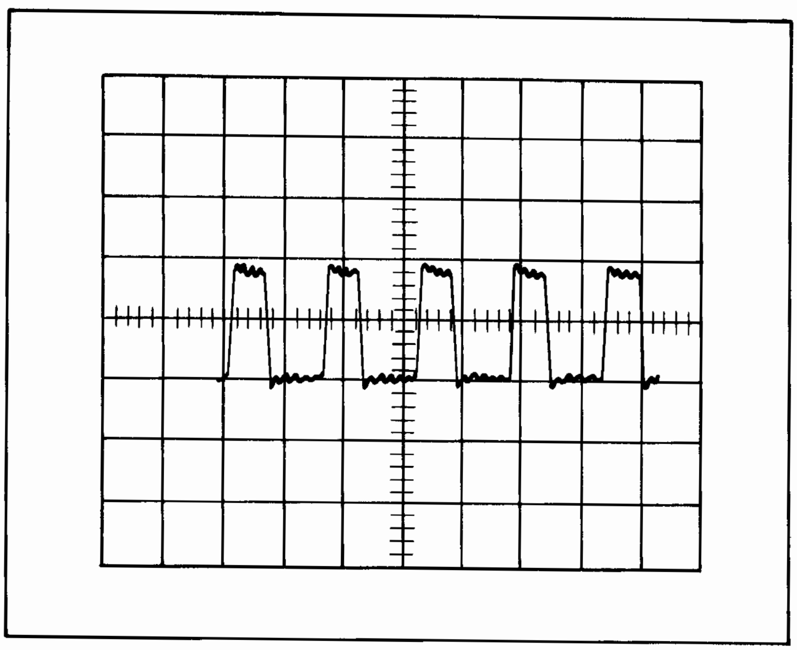


Figure 4-2: 6mHz Clock

The Skew Register Switches

The skew register switches are located on the processor board. Refer to Figure 4-1 for their location.

The skew register switches must be set to the skew value of the platen. The platen skew value is located on the upper left-hand ribbon cable of the platen assembly (see Figure 6-1B in Chapter 6).

Referring to Figure 4-3, all the switches in the figure are set to a 1. A zero setting places the rocker down next to the bit position number.

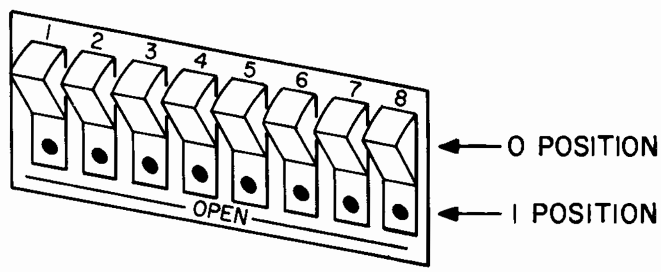


Figure 4-3: Rocker Switches

NOTE

The skew register switches are set at the factory. If the processor assembly or the platen is replaced, the skew register switches must be set to the platen skew value. If this is not done, the accuracy of the digitizer can be affected.

Troubleshooting and Self Test

At power-on, two indications are immediately available: the cooling fan should be operating, the vacuum system (if the vacuum power switch is set to on) should supply vacuum to the cursor. If these two indications are not present and assuming that the power cord is connected, the following items should be checked.

- Line voltage selector switches
- Fuse

Self Test

The digitizer contains the following three self test routines:

- Power-on self test.
- User interaction self test (TD1).
- Continuous cycling self test (TD2).

The user interaction self test is the complete digitizer test and requires you to press the keys on the keypad in the order the keys appear in the display. The other two self tests are subsets of the user interaction test routine; the power-on self test being the least significant of the three.

NOTE

During any self test routine as an error is generated and displayed, the test routine is halted at that point. Pressing any key on the keypad exits the test routine and initializes the digitizer. Depending on the severity of the error (see Table 4-4), the digitizer may be operational and can be used after initialization.

Power-On Self Test

The power-on self test is initiated each time the digitizer is switched on or initialized. This test routine takes approximately 2 seconds after which the digitizer is initialized and the ⊢ appears in the display.

The power-on self test performs the tests in Table 4-1.

Table 4-1: Power-On Self Test

Test	Assembly Under Test
ROM checksum test	ROM Assembly A3
Clock tests	Clock/Audio Assembly A7
Interrupt Tests	See Processor Interrupt Test Error Numbers
Key scanner tests	Indicator and Display Assembly A11
Phase counter test	Phase Counter Assembly A6
Filter board test	Filter Assembly A8

User Interaction Self Test

The user interaction self test can be initiated from the keypad (pressing the prefix key followed by the CHG SIGN key) or from a controller (the digitizer receives a TD1). This test routine uses the display to indicate the test in progress.In some cases, the speed of the test is fast enough that the test number is not seen. Table 4-2 is a list of the test and test number which appears in the display.

NOTE

Throughout this manual the tan colored key on the keypad is referred to as the prefix key. The keyswitch test displays the next key to be pressed. The test displays "shift" when the prefix key is to be pressed.

Table 4-2: User Interaction Self Test

Test	Display Indication	Approximate Test Time
ROM Checksum Test	Pass 1	−0−
Read/Write Memory Test	Test 2	45 sec
Clock Test	Test 3	−0−
Interrupt Test	Test 4	−0−
Display and LED Test	Each Display Segment and LED is tested (Test 5)	70 sec
Keyboard Scanner Test	Test 6	−0−
Keyswitch Test	Displays Key to be Pressed	User Interaction
Audio Test	Test 7	6 sec
Phase Counter Test	Test 8	−0−
Filter Test	Test 9	−0−
	Pass	Successful completion of self test. Pressing any key on the keypad initializes the digitizer.

Upon test completion or error detection, the user interaction test has available two optional parameters. These parameters can be read into the controller and displayed or printed. The parameters are the pass number (always 1 using this test routine) and the error number (zero if the test is completed with no errors).

The optional parameter may be used when this self test is initiated from the controller. When the digitizer receives the TD1,1 instruction, the digitizer sets the HP-IB SRQ line false on completion of the self test or error detection. This function is the HP-IB device interupt.

Continuous Cycling Self Test

The continuous cycling self test is designed to locate intermittent failures. This self test is only accessable through your controller. When the digitizer receives a TD2, the continuous cycling self test is initiated. After a complete cycle, two result parameters are available from the self test. These are the test cycle and the error number. These parameters must be read into the controller before the self test recycles. Once the parameters are read the next test cycle is initiated. If an error is detected, the cycle number and error number are output with the next read from the controller. Once an error is detected the test is stopped and the digitizer must receive another TD2 instruction to continue the cycling self test.

TD2,1 can be used with the continuous cycling self test to interrupt the controller when the test cycle is complete or an error is found. The order of tests performed with the continuous cycling routine is listed in Table 4-3.

Table 4-3: Continuous Cycling Self Test

Test	Display Indication
ROM Checksum Test	Pass (cycle number)
Read/Write Memory Test	Test 2
Clock Test	Test 3
Interrupt Test	Test 4
LED Indicator Test	Test 5
Keyboard Scanner Test	Test 6
Audio Test	Test 7
Phase Counter Test	Test 8
Filter Test	Test 9

Self Test Error Numbers

On detection of an error, the error number represents a particular section of the assembly under test. Table 4-4 is a list of the error numbers and corresponding failures.

Table 4-4: Error Numbers

Error Numbers	Failure	Test
100	System error	Read/Write Memory Test (A4 Assembly)
101	U5	
102	U6	
103	U7	
104	U8	
105	1818 2833 ROM	ROM Checksum Test (A3 Assembly)
106	1818 2819 ROM	
110	Stuck key on keypad Hardware failure on A11 assembly.	Keypad Scanner Test (A9,A10,A11 Assemblies)
111	Keyswitch scanner inoperative	
112	Bad key, wrong key pressed	(only during TD1)

Error Numbers	Failure	Test
115	No interrupt (A4 Assembly)	Processor Interrupt Test
116	Clock interupt time exceeded 2 millisconds (A4 or A7 Assemblies)	
117	Interrupt from wrong device (A4 Assembly)	
118	No platen interrupt occurred (A6 Assembly)	
119	Platen interrupt occured, but wrong measurement received (A6 Assembly)	
120	18M Hz, 1.8M Hz	Clock Test (A7 Assembly)
121	18M Hz, 225K Hz	
122	18M Hz, 40K Hz	
123	18M Hz, 5.0K Hz	
124	1.8M Hz, 2.5K Hz	
125	1.8M Hz, 1.0K Hz	
126	1.8M Hz, 225 Hz	
127 128 129 130 131 132 133 134 135 136 137 138	These tests check the X/Y and coarse/ fine signals	Phase Counter Test (A6 assembly)
141 142 143	These tests check the AVE2, AVE4 and I REF signals as they affect real counts on the A6 Assembly.	Phase Counter Test (A6 Assembly)

Error Numbers	Failure	Test
144 145 146	A measurement cycle is completed through the state machine for each signal	
152 153	U26, U42 tested Timing too long (data sampling is slow but valid) Timing too fast (possible data errors)	Phase Counter Test (A6 Assembly)
160 161 162 163 164 165	Low signal injected, but not detected Overload condition on filter board under low signal condition Overload signal injected, but not detected Overload signal injected, but low signal condition indicated Normal signal injected, but low signal condition indicated Normal signal injected, but overload condition indicated	Filter Board Test (A8 Assembly)
166 167	Measurement not completed in required time Low signal condition detected	Filter Board Driving Phase Counter (A8, A6 Assemblies)
180 181 182	00 U21, U36 10 The four states 01 of the clear and	Phase Counter Test (A8 Assembly)

Error Numbers	Failure	Test
183	11 serial/parallel signals to the shift registers are checked	
200	Vacuum switch pressed (or down) when digitize switch is checked	Cursor Test (Only during TD1)
201	Digitize switch pressed (or down) when vacuum switch is checked	

Digitizer Cleaning

Case

The digitizer case and keypad can be cleaned using a soft, moist cloth. Do not use harsh or abrasive detergents and do not allow moisture to enter the digitizer.

Platen

The digitizer platen can be cleaned using any good quality household glass cleaner. Do not use a cleaner containing wax as it can reduce the effectiveness of the glass surface for rear projection. After cleaning the platen and before using the digitizer, make sure the platen is completely dry. Digitizing with moisture on the platen can affect the accuracy of the digitizer.

Air Filter

The air filter is located on the top of the chassis assembly. The platen is raised to access the fan filter. To remove the filter, first switch the digitize off. Insert a small screwdriver or other tool into one of the slots on either side of the filter frame and pry the filter out. See Figure 4-4. Clean the filter by washing it in warm soapy water and rinsing in clean water. Dry the filter thoroughly and reinstall it in the digitizer.

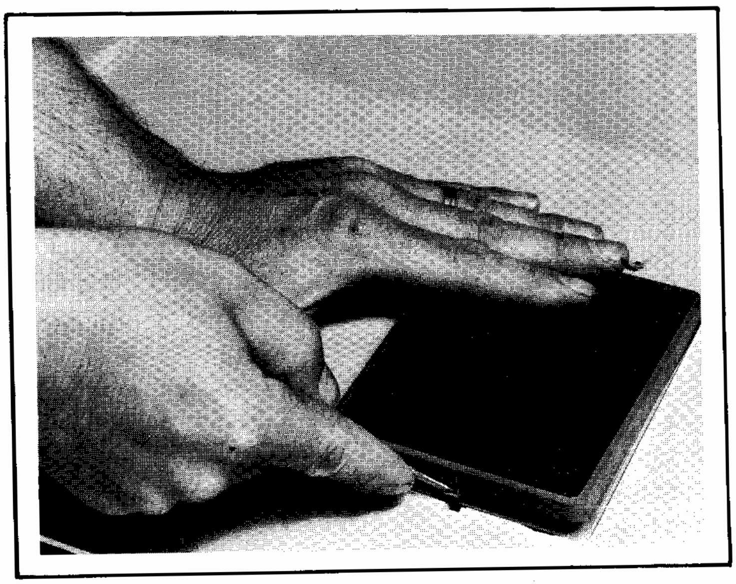


Figure 4-4: Fan Filter Removal

Chapter 5: Theory of Operation

Theory of Operation

Introduction

This chapter begins with a general theory of operation and overall block diagram. This is followed by a detailed theory of operation of the more complex assemblies.

General Theory of Operation

Here is an explanation of the basic digitizer operations. Refer to the Digitizer Block Diagram (Figure 5-1).

The processor assembly (A4) is the heart of the digitizer. This assembly contains the Processor, Read/Write Memory and a 6mHz timing clock. The processor assembly controls incoming commands and data, compares the commands and data with ROM information, and outputs the appropriate internal signals to the rest of the digitizer circuits via the IOD lines. The processor can be compared to a controller which is interfaced to several peripheral devices. Each assembly (peripheral) is connected to the processor via the 16 IOD lines. The processor controls the assemblies through subroutines which read or write one 16 bit word over the IOD lines.

The processor functions can be divided into two distinct groups: the idle loop with its subroutines and the interrupt service routines. At power-on, the processor initiates both the self-test and initialize routines. This is followed by the processor going into an idle routine.

Processor Idle Routine

The processor idle routine performs four checks in the following order:

- Keypad – Bit O of the 16 bit word is checked. This bit is set true if a key has been pressed. If bit O is true, the processor branches to a subroutine which reads the 16 IOD lines. This data is then processed, and the processor writes to the keypad setting a mode indicator, a special function key, or displays a digit depending upon which key was pressed. The A and D switches located on the cursor are also checked in a separate portion of this routine.

- Input – The processor checks the FLG and STS lines from the interface assembly (A2). If the STS line is false, the interface assembly has information for the processor. The processor then branches to the appropriate subroutine which reads the information and stores it into read/write memory until a delimiter is seen (CR/LF, LF or ;). The processor then returns to its idle loop. Later, the processor compares the information to ROM information and processes the data using the appropriate subroutine.

- Point Processing – During this routine, the processor performs calculations on the values stored in the platen communication buffer. This buffer is part of the processor assembly. This process continually updates this buffer with the valid X, Y coordinate of the cursor/stylus. The values stored in the platen communication buffer arrive via the interrupt service routines. This is a separate processor function and is explained immediately following the idle routine explanation.

- Output – The interface chip on the A2 interface assembly is controlled via the HP-IB lines. As the controller requests information, the interface chip sets the FLG line. The processor reads this line as the final function of its idle loop. If this line is set true, the processor branches to a subroutine and writes the required information to the bi-directional buffers on the A2 interface assembly.

Platen Interrupt Routine

The interrupt service routine provides the software for the platen control and digitizing sequence. This portion of the processor assembly controls the platen control section of the A6 assembly and on interrupt reads the platen information.

The platen is driven in six different modes: X-course, X-reference, X-fine, clear, Y-fine, Y-reference, Y-coarse and clear. Each mode generates a signal which is filtered, phase compared, averaged and stored in the platen buffer on the A6 assembly. The A6 assembly (phase counter) also generates the platen interrupt which informs the processor of data in the platen buffer. The processor interrupts and reads the data which is then stored in the platen communications buffer which completes the loop. This process is continued for each of the six platen modes and is repeated continuously.

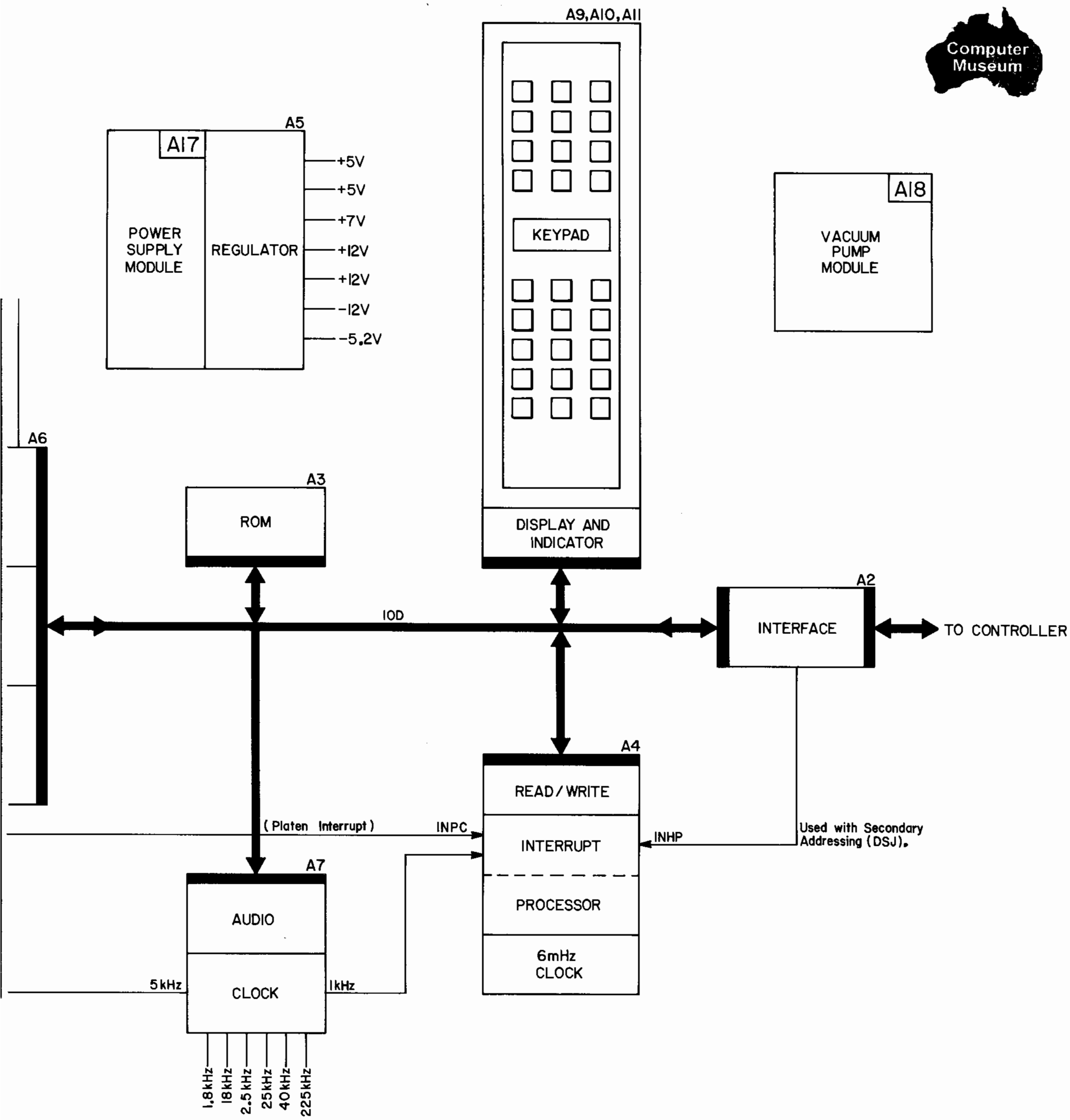
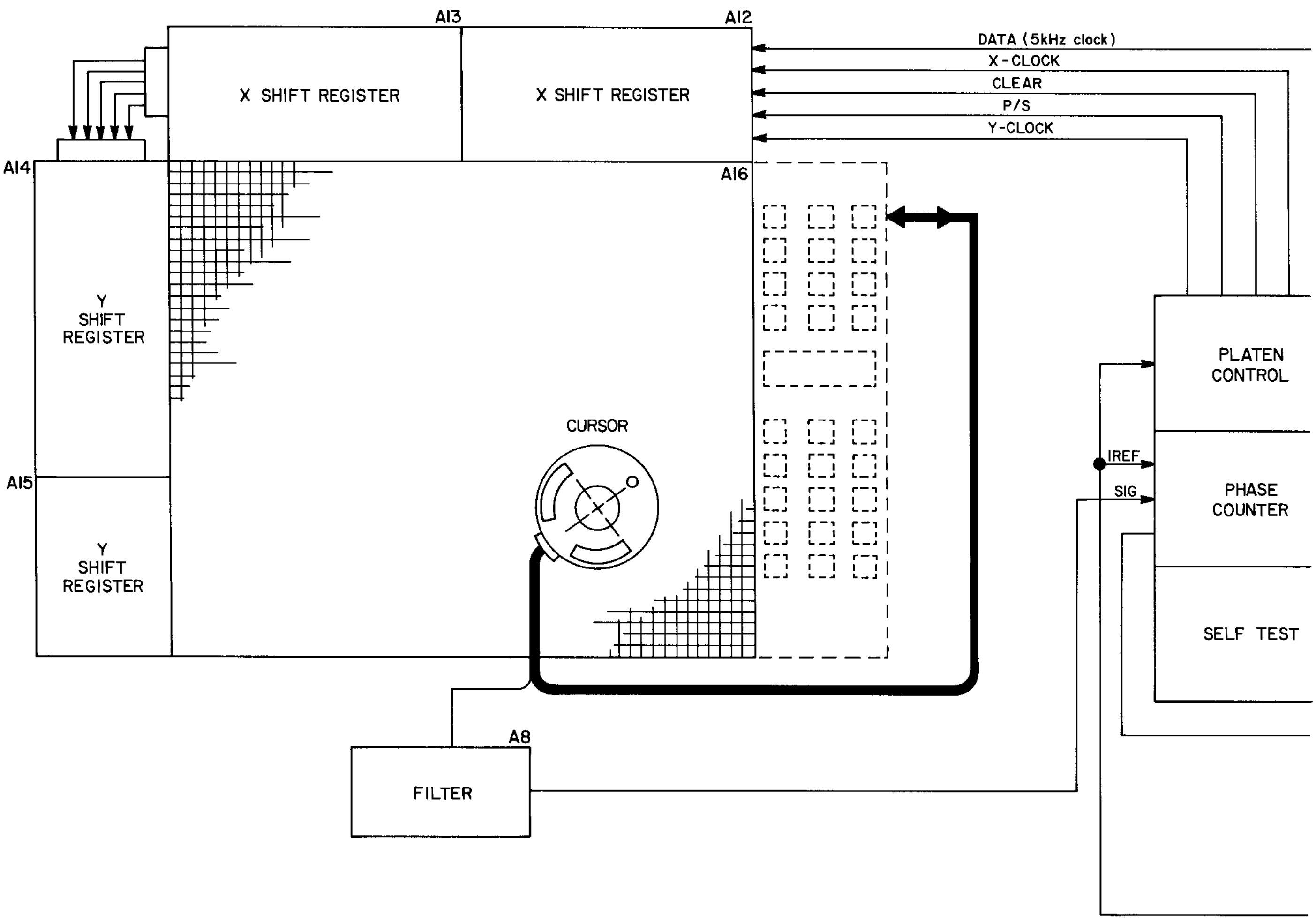


Figure 5-1: Digitizer Block Diagram


A13
A12
X SHIFT REGISTER
X SHIFT REGISTER
DATA (5kHz clock)
X-CLOCK
CLEAR
P/S
Y-CLOCK
A14
A16
Y
SHIFT
REGISTER
A15
Y
SHIFT
REGISTER
CURSOR
PLATEN
CONTROL
IREF
SIG
PHASE
COUNTER
SELF TEST
A8
FILTER

The platen control section of the A6 assembly drives each set of axis shift registers in three distinct modes: coarse, fine and reference. In the coarse mode, the data waveform and clock waveform to the shift registers are chosen so that a single square wave appears across the entire set of axis conductors. The rise and fall points of the square wave are continuously shifted across the platen at the clock rate.

The fine mode is similar to the coarse mode except that multiple square waves are set up on the platen and shifted across at a different clock rate.

The reference mode is set up such that all of the axis conductors are driven high and low at the same time. Thus, providing a uniform signal over the entire set of platen axis conductors.

In all three modes, the cursor/stylus detects the high to low and low to high transition of each wave as it passes beneath the probe pickup area. Each conductor has an effect which is related to its distance from the center of the cursor/stylus. The cursor circuits create a capacitive divider between the platen to cursor capacitance and a known large capacitor. Thus, the signal from the cursor appears as a summation of weighted square waves with the largest weight given to the closest conductor.

The filter assembly (A8) receives the weighted square wave cursor signal. Here all the signals are removed except the fundamental signal. The fundamental signal feeds into a zero crossover detector which generates a logic level square wave with zero crossing at the same point as the fundamental sine wave. This square wave is fed into the phase counter which measures the time delay between the square wave and an internal reference (I ref.). The output of the phase counter is a binary number which is read into the processor via the 16 IOD lines and reduced to positional information relative to the cursor.

Detailed Theory of Operation

Interface Assembly (A2) Theory

The interface assembly allows communication between the digitizer's processor and the interface cable. The interface cable control lines (refer to the IEEE Standard 488-1975) are continually monitored by the interface chip on the A2 assembly. The interface chip responds to the interface control lines with the proper handshake cycles and input/output data cycles.

Refer to Figure 5-2, the Interface Assembly Block Diagram and the interface assembly circuit diagram, while reading the following basic discription of the assembly operation.

The heart of the assembly is the interface chip which is controlled by the HP-IB control lines. All handshake and control lines pass through the control transceivers, whereas all interface instructions and data pass through the data transceivers.

The ATN signal separates the digitizer's talk and listen address from the instructions and data sequences (ATN true = address or bus message, ATN false = instruction or data). The address code determines the direction of the following data transfer. When ATN is false, the data transfer occurs.

The bus address received when ATN is true determines how the interface chip responds to the read/write control hardware. This hardware informs the processor of the operation via the FLG and STS lines. The processor then interacts with the read/write control hardware using the four control lines ADV7, WRT, DVL, PDR. The data byte stored in the data latch is then directed in the proper direction.

The processor may request service from your controller by setting the SRQ bit true of the status latch. This automatically asserts service request on the HP-IB lines. Your controller can then conduct a serial (or parallel) poll to determine which device or devices on the bus are requesting service. The interface chip responds to a serial poll operation by immediately outputting the byte stored in the status latch. This byte includes useful digitizer status information in addition to the state of the SRQ bit. This routine does not require processor interaction as does the Output Status (OS) instruction.

The Device Specified Jump secondary command is handled through a processor interrupt routine. The interface chip processes the command and triggers the secondary command hardware, which in turn interrupts the processor. The digitizer's condition is immediately returned through the data latch to the interface cable. See the section titled "Device Specified Jump".

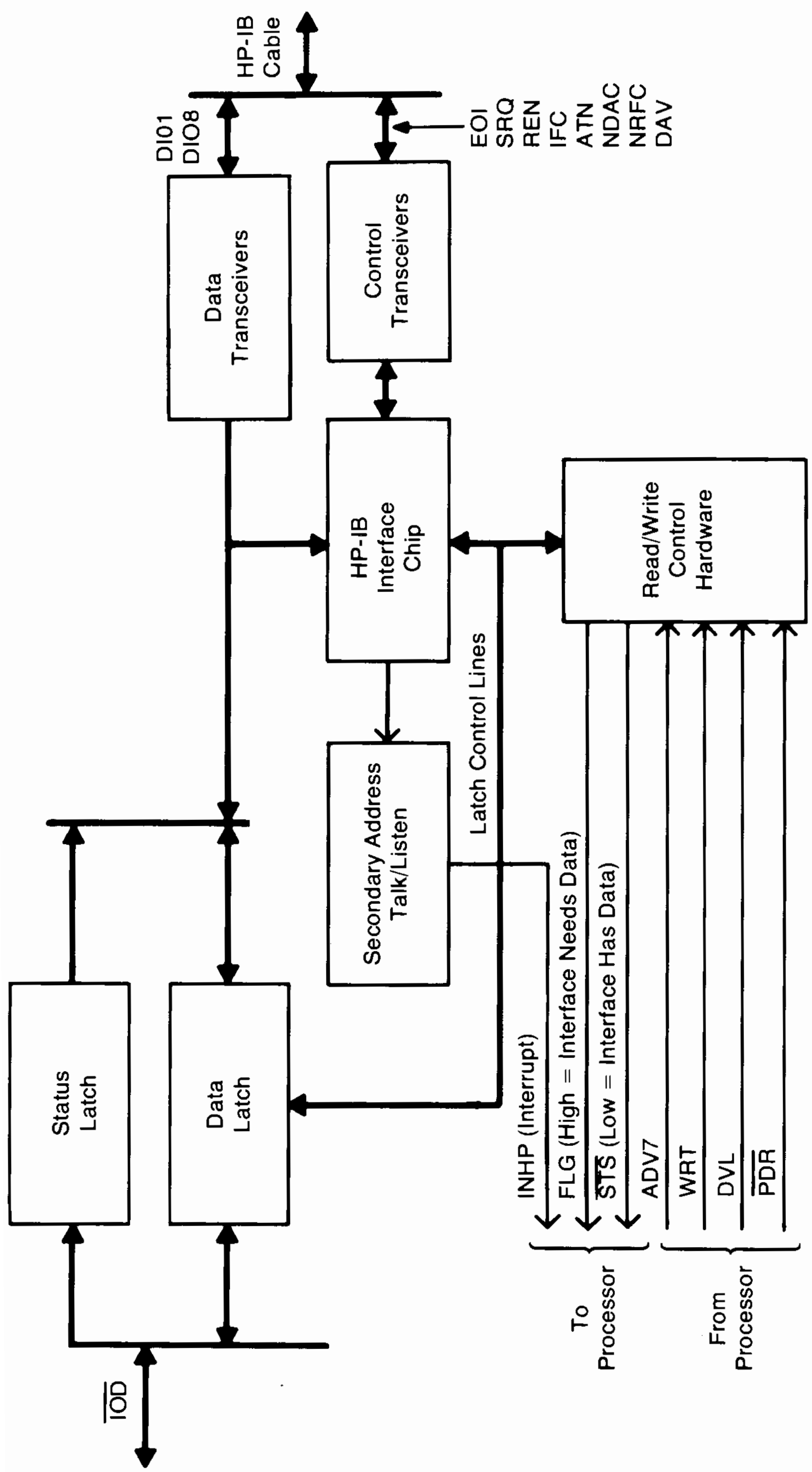


Figure 5-2: Interface Assembly Block Diagram

ROM Assembly (A3) Theory

The ROM (Read Only Memory) assembly contains 8K words of memory and two bi-directional buffers.

Referring to the ROM assembly circuit diagram, here is the basic description of the assembly operation. The processor directly controls the ROM assembly via the STM ROM (Start Memory ROM) and the PDR (Processor Driving) signals.

The ROMs are in a power-off state until the processor drives the STM ROM signal true while addressing one of the ROMs. The PDR signal controls the direction of data flow through the bi-directional buffers.

The addressing sequence differs with this assembly in that the processor directly addresses the section of ROM indicated by the processor routine. There is no ADV (address valid) signal to this assembly. Each ROM decodes its own address and outputs that addressed information. All address and data lines are parallel to both ROMs.

To initiate a read cycle from the ROM assembly the processor first gains control of the IOD lines by driving the PDR signal false. This signal also sets the proper direction for the bi-directional buffers. The STM ROM signal goes true and the processor outputs the proper ROM address. The PDR signal is then pulled low; the bi-directional buffers switch direction and ROM information is read into the processor.

Incidently, each ROM is a plug in ROM and may be interchanged. The self test section in this manual gives an error code for each ROM which relates to the number on the ROM.

Processor Assembly (A4) Theory

The processor assembly controls all the digitizer's internal data communications. This is accomplished with four signals which originate from the processor assembly. These four signal (explained below) control data communication via a 16 bit word on the 0 thru 15 IOD lines.

The processor assembly contains its own 6MHz timing clock which is only used on the processor assembly. Information for proper clock adjustment is found in Chapter 4 "Adjustments".

Referring to the processor block and timing diagrams Figures 5-3 and 5-4 and the processor assembly circuit diagram, here is a basic description of the assembly operation.

Each of the data registers located on the assemblies connected to the IOD lines are controlled with four signal lines: PDR (processor driving), ADV (address valid) signals 2 thru 7 (ADVO and ADV1 are used by the processor itself), DVL (data valid) and WRT (write). The PDR signal is low when the processor is driving the IOD lines with an address. The ADV line specifies which register is being addressed. The DVL line in a write operation signals when the data is valid. The WRT signal determines if the memory or registers are being read or written to by the processor.

At power-on the processor receives a signal via POP (power on preset) and initiates an instruction fetch from address 40 of the ROM assembly. The returned information is processed and the digitizer power-on routine begins. This routine is followed with the power-on self test which, if performed successfully, leaves the digitizer in the initialized state.

The processor communicates with the bus through the bi-directional buffers. Each communication cycle begins with an address which is latched and held in the address buffer until the entire cycle is completed. The decoder decodes the address and drives the proper ADV line informing the register that it is being addressed. Table 5-1 is a list of the ADV lines and the register which it addresses.

Table 5-1: Register Address Lines

Signal Line	Register	Assembly Location
ADV0	R10 Interrupt Register	Processor Assembly (A4)
ADV1	R11 Skew Register	Processor Assembly (A4)
ADV2	R12 Phase Counter Register	Phase Counter (A6)
ADV3	R13 Self Test Register	Phase Counter (A6)
ADV4	R14 Variable Audio Register	Clock/Audio (A7)
ADV5	R15 Display Register	Keypad and Indicator (A10)
ADV6	R16 Scanner Register	Indicator and Display (A11)
ADV7	R17 HP-IB Register	Interface Assembly (A2)

The interrupt hardware (R10) contains an address value in which the lower 3 bits are supplied by each of the interrupt lines. the 1kHz clock sets bit 0 to 1, the platen sets bit 1 to 1 and the HP-IB clears bit 2 (0 is interrupt). When an interupt occurs, R10 provides the address of the routine used to service the interrupt. Interrupt requests are responded to only during instruction fetch (sync high) and additionally, can be disabled by the software.

The 1kHz clock increments or decrements timing counters used by the interrupt software routines.

The platen interrupt routine addresses and reads the value stored in the counter register on the phase counter assembly. The data read from the counter is the raw cursor location and is combined with the data from R11 (the skew register). These two values are processed to obtain the true value of the cursor location.

R11 in a series of switches which contain the skew value (angular deviation from 90° in the X and Y platen conductors). This skew value is read into the processor and stored as part of the power-on procedure.

The interface assembly interrupt routine only occurs with a secondary command. See the section titled "Device Specified Jump".

The memory timing hardware serves four basic functions:

- Generates the PDR (processor driving) signal and STM ROM (Start Memory ROM) signal.
- Returns a UMC (memory cycle complete) signal to the processor. The UMC signal is automatically sent to the processor after 825 nanoseconds or 5 cycles of the 6mHz clock to terminate a memory cycle.
- Converts SMC into the proper DVL (data valid) signal.

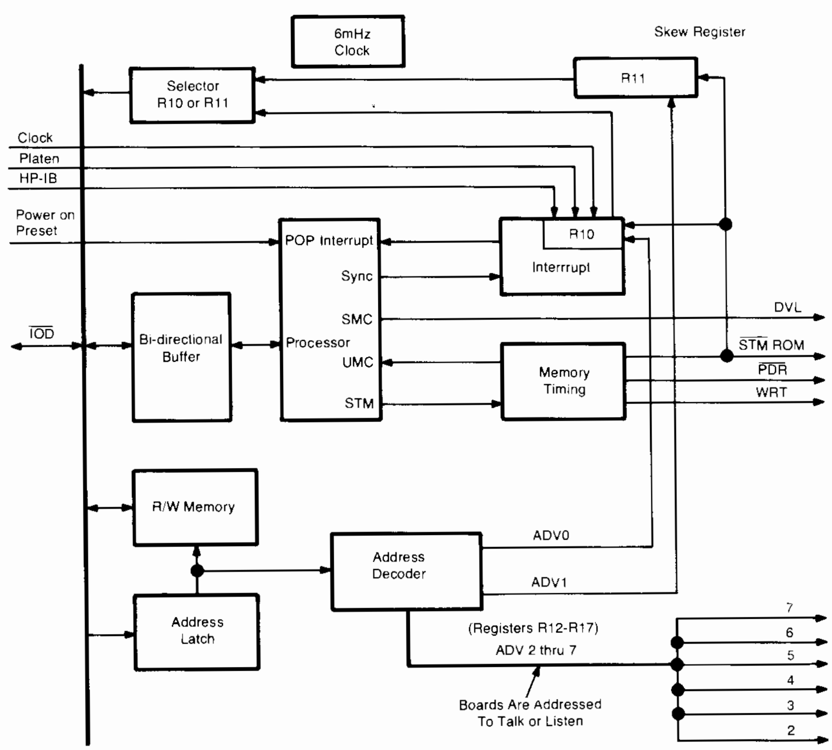


Figure 5-3: Processor Assembly Block Diagram

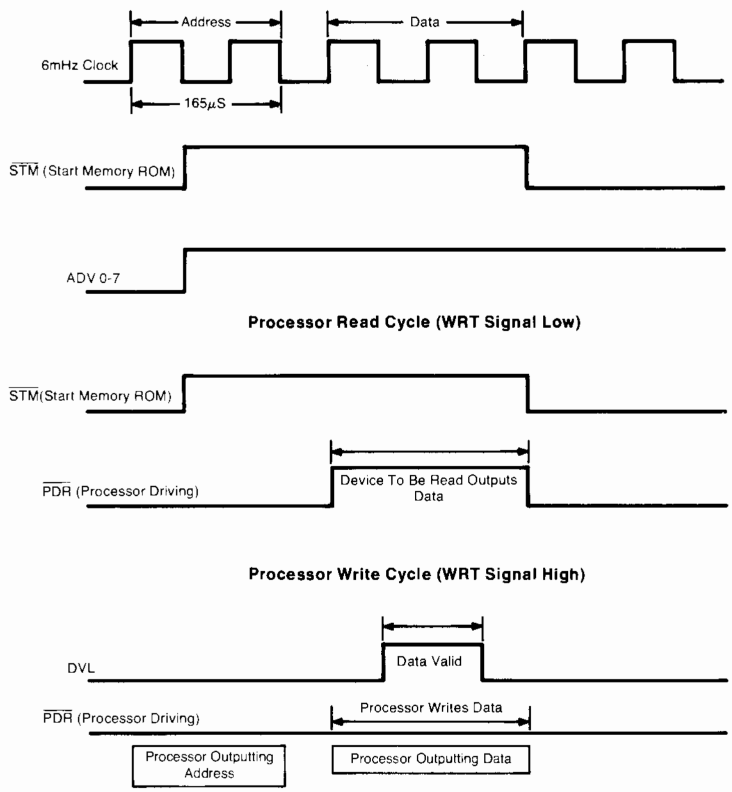


Figure 5-4: Processor Assembly Timing Diagram

Regulator Assembly (A5) Theory

The regulator assembly receives raw voltages from the motherboard and converts them to a number of regulated voltages used throughout the digitizer. The regulated voltages leave the regulator assembly via the motherboard. The POP (power on preset) signal in also generated by the regulator assembly.

The regulator assembly has two +5 volt adjustments which are adjusted with the assembly installed in the digitizer. Refer to Chapter 4 "Adjustments" for the adjustment procedure.

Referring to the power module and regulator assembly circuit diagram, here is a basic description of the regulator assembly (A5).

U1 and U7 are intergrated regulator circuits. Referring to U7, the output voltage is sensed at pin 2. Pin 3 senses the reference voltage established by the resistor network R15, R16 and R21 from the internal IC reference at pin 4. The base drive to Q7 is adjusted by the IC such that the voltage of pin 2 equals that of pin 3.

Q7 provides additional base drive to Q4 because of the higher output current needed from this regulator. Q4 is the series pass regulator transistor.

R14, R19, R17 and Q6 form a current foldback limit circuit. As the output current exceeds the limit value, both the voltage and current are reduced to protect the following circuitry. The foldback circuit also reduces the power dissipation of Q4 in the event of a malfunction.

SCR2, CR6, R23 and C25 form a crowbar circuit. When the output voltage exceeds approximately 7 volts the SCR fires pulling the output voltage down to approximately 1 volt. This protects the following circuitry from excessive voltage.

The circuitry associated with U1 operates in the same manner. The current requirements are lower; thus, the IC drives Q5 (the series pass transistor) directly. The crowbar circuitry of this regulator triggers at approximately 6 volts. Q2, Q3 and associated components generate the POP (power on preset) signal. This signal remains low for approximately 10 to 20 milliseconds after which it has a +5.0 volt value.

The other voltages are generated via fixed voltage IC regulators.

Phase Counter Assembly (A6) Theory

The phase counter drives the platen registers in the six sampling modes. The state machine on the A6 assembly reads the cursor signal and counts the phase difference between the cursor signal and the I Ref signal. At the end of each count cycle the state machine interupts the processor and the processor reads the count stored in the phase counter.

Referring to Figure 5-5 (phase counter block diagram), Figure 5-6 (state machine block diagram) and Table 5-2 (phase counter cycles), here is a basic description of the assembly operation.

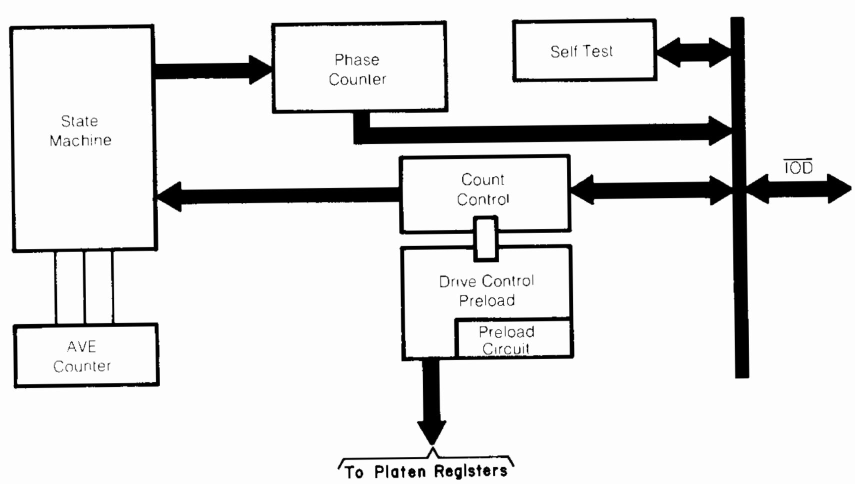


Figure 5-5: Phase Counter Block Diagram

The processor interrupt routine writes to the phase counter and the control signals are loaded into the count control (U36). The clear and P/S (parallel/serial) signals pass through U21 and directly to the shift registers. The X/Y signal line selects the clock line which is used to drive the shift registers (X or Y axis registers). The coarse/fine signal from the processor selects the 1.8MHz or 40kHz clock which drives the platen in the coarse or fine mode (1.8MHz drives the coarse mode and 40kHz drives the fine mode).

The preload circuitry within the platen drive control is used only during the coarse to fine mode transition. The preload circuit shifts the frequency of the clock and data up to 225kHz (data) and 1.8MHz (clock) to preload the shift registers. The preload condition is held for 40 cycles of the 225kHz data and then synchrously resumes the normal mode of 5kHz (data) and 40kHz (clock). Preloading the fine mode increases the data sampling by approximately 1/3.

The AVE2, AVE4, I Ref., Delta and Start signals (count control) are inputs used to set and control the cycling of the state machine.

The state machine is controlled by the processor with 5 signal lines: Start, Delta, AVE2, AVE4, and I Ref. Referring to the state machine block diagram, here is a brief explanation of the states and cycles of the state machine.

State "a"	This is the idle state.
State "b"	If Delta is true, the flip flops stay in state 1 until the one shot (U26) has timed out.
State "c"	The state machine pulls reset true which resets the phase counter (U48, U49, U37 and U24) and resets the AVE counter (U20).
States "d""e""m"	These states determine the condition of the AVE counter. If AVE4 is set true via the processor, the state machine goes to state d. If AVE4 is false and AVE2 is true, the state machine goes to state e. If both are false the state machine goes to state m.
State "d"	The STC1 (set counter 1) is set true. This sets the AVE counter to 1.
State "e"	The STC3 (set counter 3) is set true. This sets the AVE counter to 3.
State "m"	This state leaves the AVE counter set to false.

State "f"	This state waits for the I Ref wave form to go to a 1. On the 0 to 1 transition of the I Ref phase the state machine goes to state "g".
State "g"	This state waits for the I Ref wave form to go to a 0. On the 1 to 0 transition of the I Ref phase the state machine goes to state "h".
State "h"	The counter enable line is immediately pulled true allowing the phase counter to start counting at the 18MHz clock rate. The state machine remains in state "h" until the cursor signal (SIG) line is detected low.
State "i"	The count enable (CE) remains true in state "i". The state machine remains in state "i" until the SIG line makes a 0 to 1 transition.
State "j"	The state machine enters state "j" on the 0 to 1 transition of the SIG line. The count enable is pulled false at this time stopping the phase counter. See the timing diagram in Figure 3-9.
	State "k" is only entered if the AVE counter count is zero. During states "e" or "d" if AVE2 or AVE4 was true the AVE counter contains a 1 or 3.
State "k"	The increment counter line is immediately set true which increments the AVE counter one count. The state machine reenters state "f" and counts another cycle thru state "j". If AVE2 was true (AVE counter contains count 3), the AVE counter was incremented from a 3 to 0 the last time through state "k". If AVE4 was set via the processor the state machine continues through state "k" two more times.
State "l"	In this state the state machine signals completion of its cycle routine via the platen interrupt to the procesor (INPC).
State "a"	The state machine continues to provide an interrupt to the processor until the processor supplies a new command.

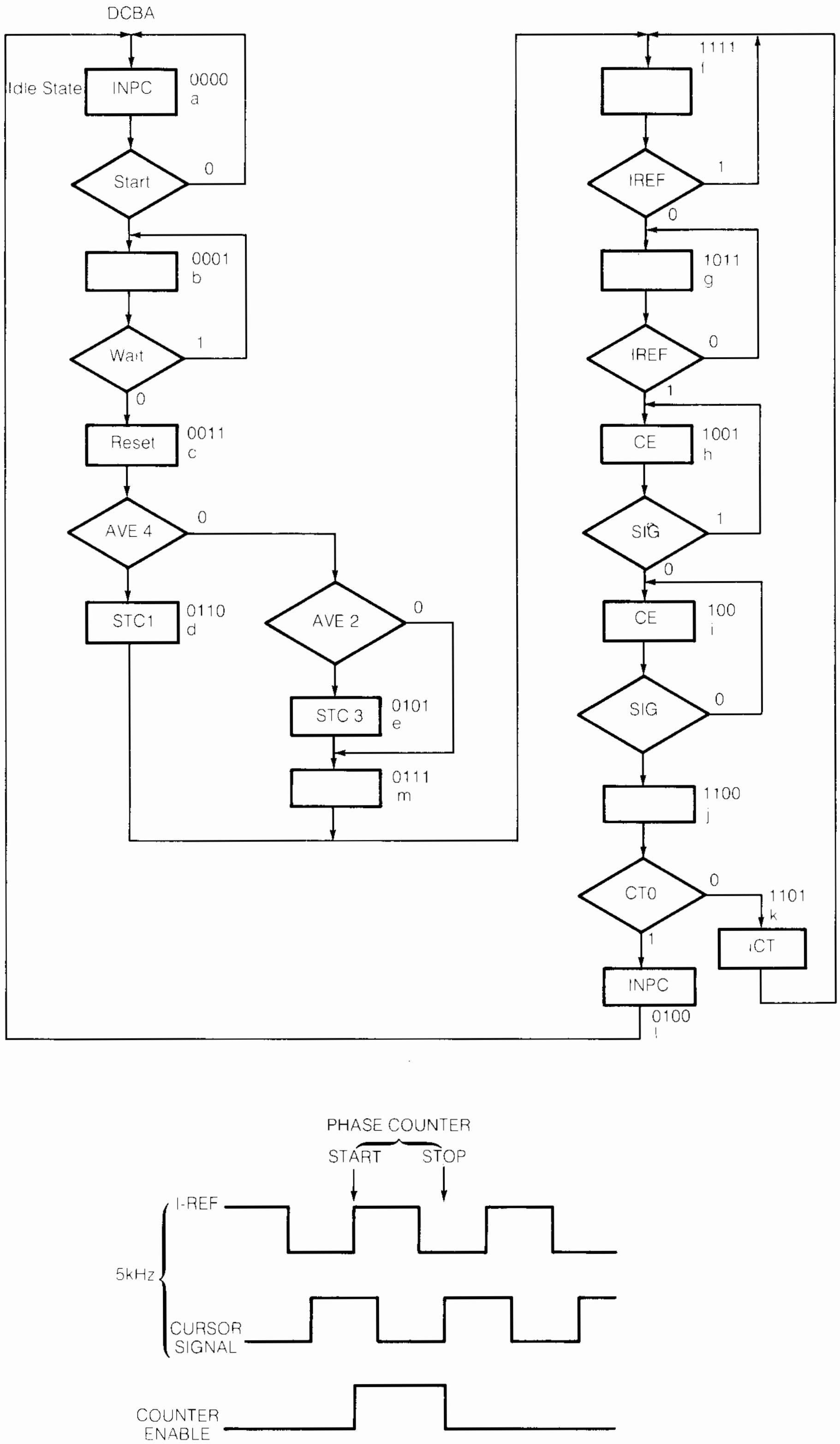


Figure 5-6: State Machine Block Diagram

Table 5-2 is a list of the platen drive modes and the cycling sequence of the state machine. The state machine cycle sequence determins the value stored in the phase counter. On interrupt the phase counter is read by the processor.

Table 5-2: Phase Counter Cycle

Platen Drive Mode	Counter Output to Processor
Clear	Clear
X-coarse	AVE1
	AVE4
X-ref	AVE1
	AVE4
	AVE4
	AVE4
	AVE4
	AVE4
X-fine	AVE1
	AVE4
	AVE4
	AVE4
	AVE4
	AVE4
Clear	Clear
Y-fine	AVE1
	AVE4
	AVE4
	AVE4
	AVE4
	AVE4
Y-ref	AVE1
	AVE4
	AVE4
	AVE4
	AVE4
	AVE4
Y-coarse	AVE1
	AVE4

During the processor idle loop the processor is updating the buffer in which these values are stored (platen communication buffer). These values are summed and divided by the total number of averages (5 or 21). In addition to the averaging, the processor performs calculations on the X-fine values to determine the velocity of the cursor. Knowing the velocity, the Y-fine values are then corrected for the time difference between the X-fine and Y-fine platen modes. The maximum cursor velocity, that allows the Y to X correction calculations, is 762.0mm/sec (30 inches/sec).

Clock/Audio Assembly (A7) Theory

Referring to the clock/audio assembly circuit diagram, here is the basic operation of the A7 assembly.

Audio Theory

The footswitch (accessory) is plugged into this assembly and is read with the keypad word (IOD 15) ADV6. The remaining IOD lines are write only by the processor. The processor write information is latched into U16 and U17. The electronic switches (U12 and U13) are controlled with this information via the drivers (U14 and U15).

U11 generates a triangle wave (1 volt peak to peak) which rides on a 2 volt dc level. The frequency of the triangle wave is controlled by switching in paralleled resistors via the electronic switches.

IOD0 is the off/on processor control to the speaker driver. The speaker driver consists of U8, Q1, Q2 and associated components.

Clock Theory

All the clocks begin with the 18MHz crystal oscillator. Each clock is divided by the appropriate counters to obtain the proper frequency.

Filter Assembly (A8) Theory

The filter assembly transforms the weighted square wave input cursor signal to a 5 volt (5kHz) peak to peak square wave output signal. The square wave output signal contains cursor position data in the form of a phase shift which is used to start and stop a counter in the following assembly circuitry.

Referring to the filter assembly block diagram (Figure 5-7) and the filter assembly circuit diagram, here is the basic A8 theory of operation.

The input buffer (Q2 and U15) is a high impedence low noise buffer amplifier. The signal voltage gain through this amplifier is approximatly 700. The output signal from this buffer is shown as the upper signal in Figure 5-7. The large portion of the signal cycle is approximately 80 millivolts peak to peak. The level differences of this signal are reduced by the attenuator network.

The attenuator network is a group of electronic processor controlled switches. As the different cursor signals pass through the attenuator, they are attenuated at different levels. Thus, the attenuator output remains the same for each platen drive mode. The attenuator output signal varies from 3 to 30 millivolts peak to peak depending upon the thickness of the document being digitized.

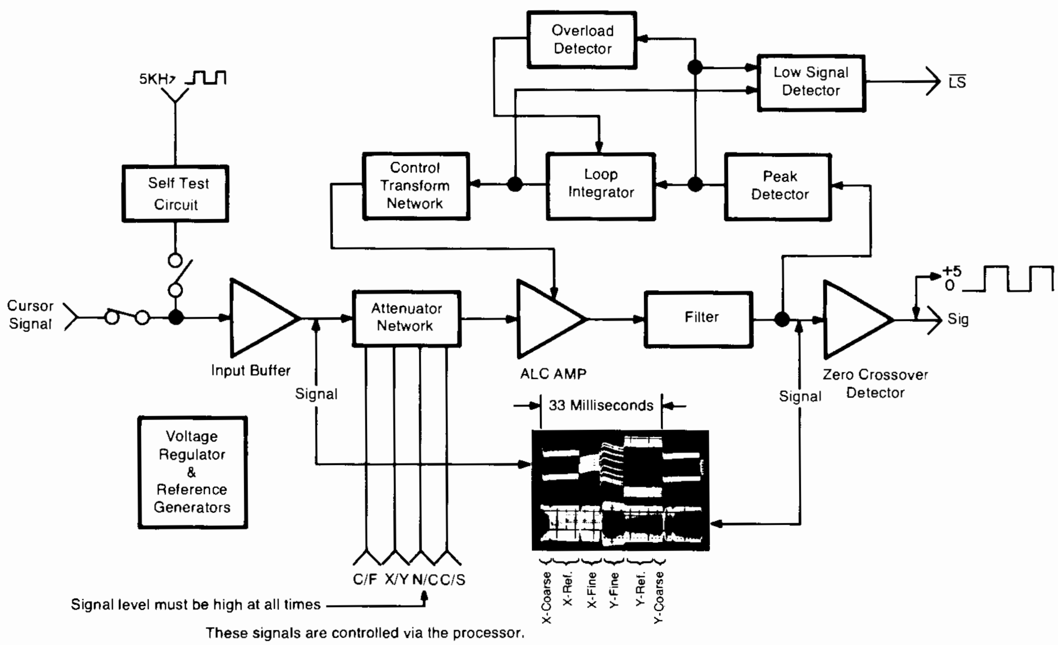


Figure 5-7: Filter Assembly Block Diagram

The automatic level control (ALC) amplifier (U18 and U19) is the input to the feedback loop. Through feedback from the loop integrator and the control transform network, the voltage level on the output side of the filter is maintained at a level of 10 volts peak to peak. This signal is shown as the lower signal in Figure 5-7.

The filter block consists of U14, U13, U17, U16, U12 and U8. The band width of this 5.0kHz filter is 1kHz. The approximate gain of the filter is 700.

The zero crossover detector (U4) converts the 10 volt peak to peak sine wave to a TTL level square wave based on the zero crossing of the sine wave.

The peak detector (U8) converts the 10 volt sine wave to a + DC level proportional to the peak value of the sine wave. The gain of the peak detector is approximately .7. The output is approximately 3.5 volts.

The loop integrator (U7) establishes an average DC output level such that the total forward gain makes the peak detector output equal to 3.5 volts.

The control transform network converts the voltage source (output of the loop integrator) into a current source. This current establishes the gain of the ALC amplifier.

The low signal detector (U5, U10) generates the low signal error signal when the input signal is too low to obtain valid data.

The overload detector (U9, U11, Q1) insures that the filter does not saturate during the digitizing process (such as removing the cursor from the platen then replacing it and immediately digitizing a point).

The self test circuit switches in the 5kHz signal (which is previously checked) to test the filter and phase counter assemblies.

Referring to the signal sequence (X-coarse thru Y-coarse), let's assume that the X-fine signal develops a malfunction and is not present at the input to the zero crossover detector. This condition interrupts the cycle routine and begins the routine again at the X-coarse position. Due to the malfunction of the X-fine signal, the remaining signals (Y-fine, Y-ref. and Y-coarse) are not present.

Bridge and Keyboard/Display Driver Assemblies (A9, A10, A11) Theory

The bridge assembly contains two assemblies: the keyswitch assembly (A9) and the keypad and indicator assembly (A10). These assemblies are connected with a ribbon cable to the indicator and display driver assembly (A11) located inside the platen housing.

Referring to the block diagram Figure 5-8 and the circuit diagram for the A9, A10 and A11 assemblies, here is a basic explanation of these assemblies.

The processor writes to the indicator/vacuum control section. The information is latched into the data latches (U16 and U26). The outputs QA thru QF from the latch (U16) individually control the LEDs of the special function keys. QH and the following circuitry controls the vacuum value. Three inputs to the decoder (U18) from the data latch U26 are decoded to set one of the six LEDs which are the mode indicators. QH of U26 controls the cursor LED.

The display driver section controls the digitizer's display. The cathodes for each segment of the seven segment displays are paralled and controlled by the cathode buffers (U13 and U21). The anodes of each segment of the 15 display characters are paralled and controlled by the anode buffers (U14, U22 and U24). A +5V output from these drivers, in conjunction with a low from U13 and U21, illuminates the individual segments.

The memory data is loaded from the IOD lines into memory (U8, U15 and U23) when a write is initiated to the display. IOD lines 0 thru 3 contain the address information (U8). During a write operation U8 is set to select the memory address from IOD lines 0 thru 3. This occurs during the normal display mode. U8 is set to select the data from the position counter (U7) to drive the memory address lines. U7 counts through the character positions in a binary sequence. The character position is decoded via the 4 to 16 line decoder (U1). The decoder drives the cathode buffers used to sink the proper amount of current to illuminate the LEDs.

IOD lines 4 thru 11 contain anode information for one individual character segment (seven segment display). Thus, the memory receives the anode information for one character position and the character address location in one write cycle.

The keyboard scanner reads the keypad. If a key is pressed, bit 0 of the IOD lines is set true. During the processor's idle routine the keypad-scanner IOD lines are continually read into the processor. Bit 0 is checked and if this bit is true, the data is processed.

The scan counter (U4 and U12) is a 5 bit binary counter clocked at a 2.5kHz rate. The two most significant bits drive the column driver. The column driver selects one column and pulls it low. The 3 least significant bits individually gate the row outputs through the row scanner. When a key is closed at the intersection of the column/row being acessed, the status sensor (U11) is toggled thus stopping the scan counter at that position. The status sensor also sets the IOD0 line true which indicates to the processor that a key is depressed. The status sensor and scan counter outputs are provided to the processor through the tri-state buffers. During the processor read cycle, the debounce one shot is triggered. After the one shot has timed out the status sensor is reset and scanning is resumed.

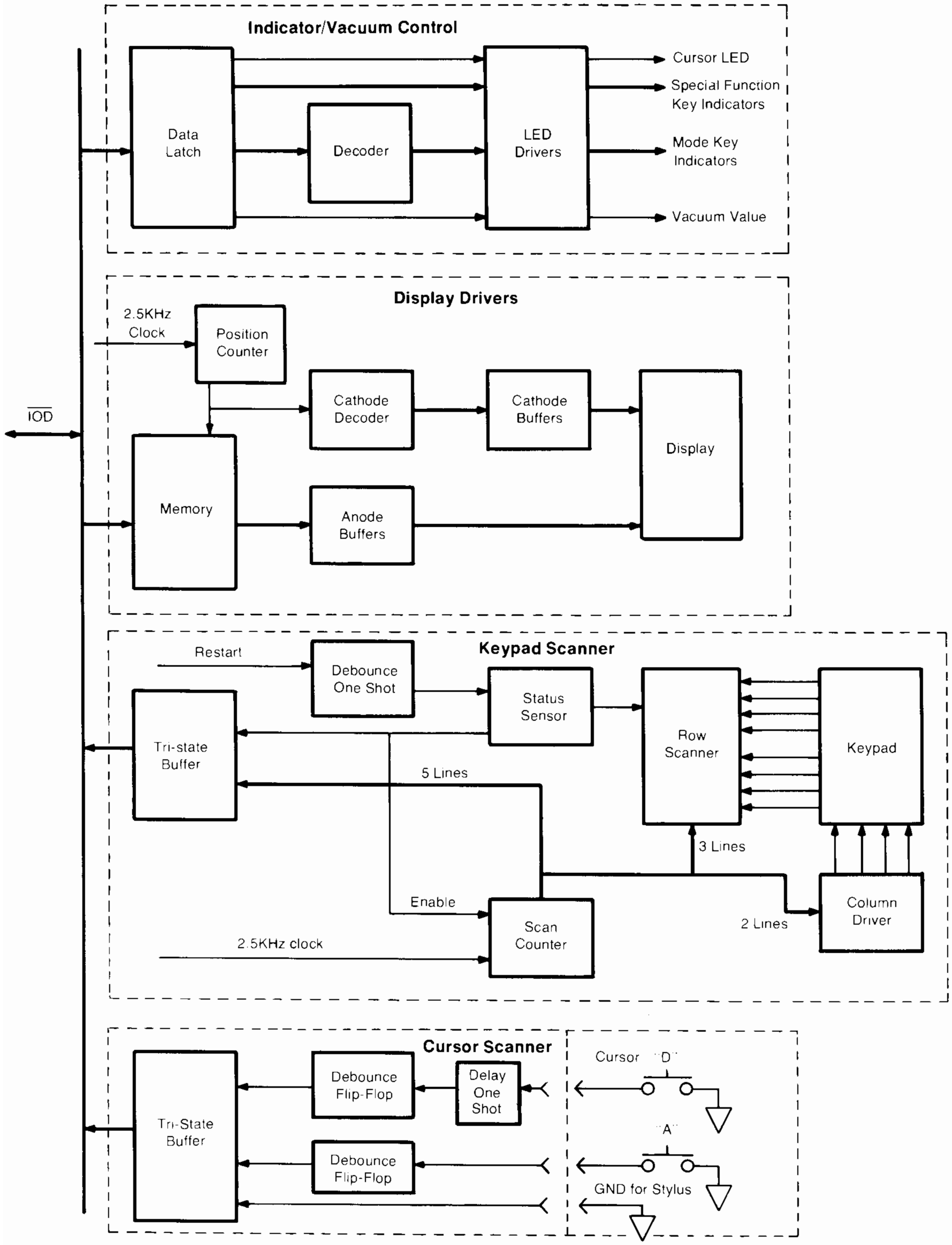


Figure 5-8: Bridge and Keyboard/Display Driver Block Diagram

The cursor scanner is also read with the keypad scanner. Pressing either the digitize or the air switch toggles its flip-flop which is output to the processor through the tri-state buffers. The delay one shot on the "D" switch line delays the acceptance of the "D" switch closure by 90 milliseconds. This prevents noise on the switch line from causing erroneous data to be recorded.

Shift Register Assemblies (A12, A13, A14, A15) Theory

There are three 48 stage shift registers and a 24 stage shift register which drive the platen conductors. The 48 stage shift registers are completely interchangeable. The wire harness which connects the Y-axis registers to the X-axis registers crosses the clock signals making each 48 stage shift register interchangeable.

Referring to the assembly A12, A13, A14 and A15 circuit diagram, here is a basic description of the operation of these assemblies.

The shift registers are driven via 5 signal lines: Data (5kHz clock), P/S (parallel/serial), Clear and two clocks. Clock 2 drives the X-axis assemblies and Clock 1 crossed to the clock 2 pin in the wire harness drives the Y-axis assemblies.

The data signal provides parallel data to all the shift register stages.

The harness connecting the first assembly in each axis shorts pin 12 to pin 13. This causes the data signal to become the S data signal only on the first assembly. The S data is the serial input which is sequentially shifted from stage to stage and to the next assembly.

During the serial shifting of the shift registers the clock changes from 1.8MHz to 40kHz. The resulting cursor signals develop:

5kHz Signal	Shift Rate
Coarse	1.8MHz
Fine	40kHz

A combination of the parallel and 1.8MHz clock creates the cursor reference signal and the clear line clears the registers.

The 24 stage shift register components differ from the other shift registers only in the addition of a resistor pack as a noise reducer due to transient coupling over the length of the signal lines.

Chapter 6: Assembly Access

Assembly Access

Introduction

This chapter describes how to access the various 9874A assemblies.

The following is a disassembly procedure. The following tools are required:

- Small Pozi-drive screwdriver
- Pozi-drive screwdriver
- Flat-blade screwdriver
- Small Flat-blade screwdriver

WARNING

REMOVE ANY AC POWER FROM THE DIGITIZER BEFORE REMOVING ANY ASSEMBLY.

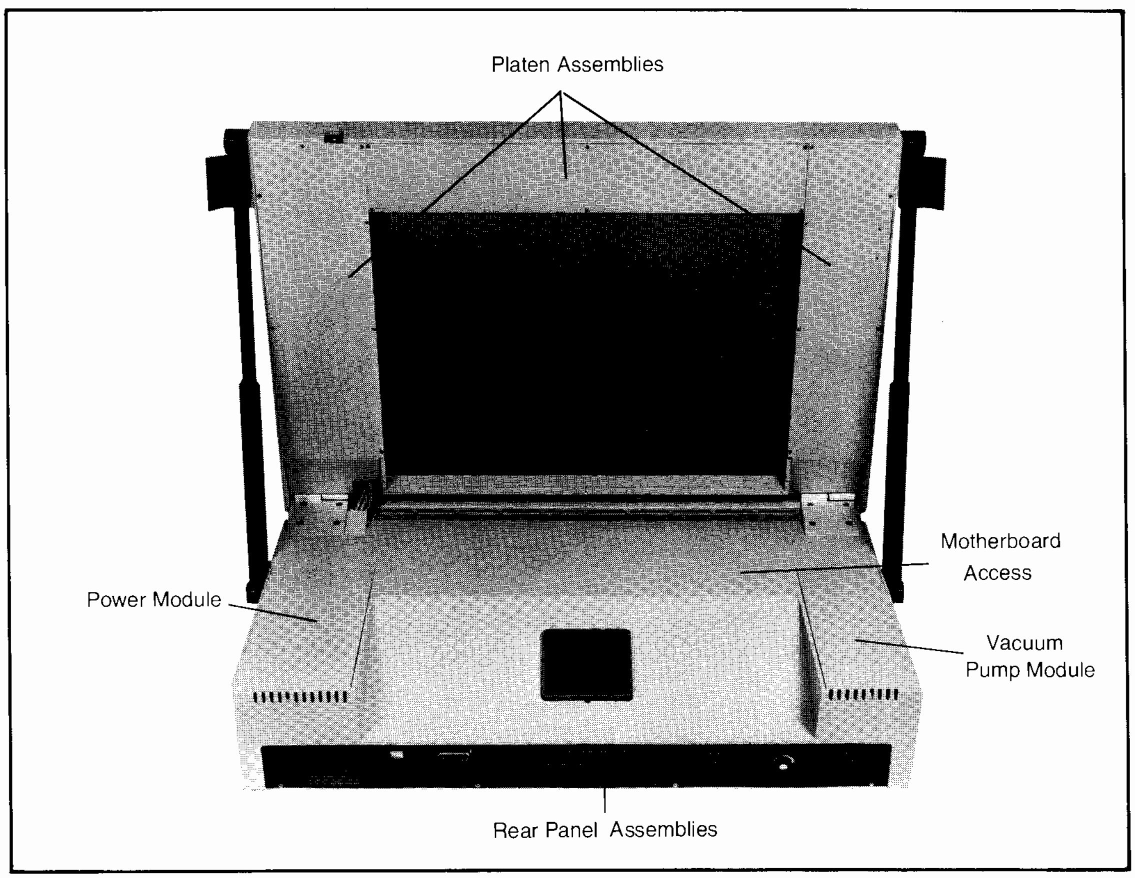
Access to the various assemblies is described in five sections:

- Power Supply Rmoval
- Vacuum Pump Removal
- Rear Panel Assemblies
- Motherboard Removal
    1. Fan Removal
    2. Power Switch Removal
- Platen Assemblies

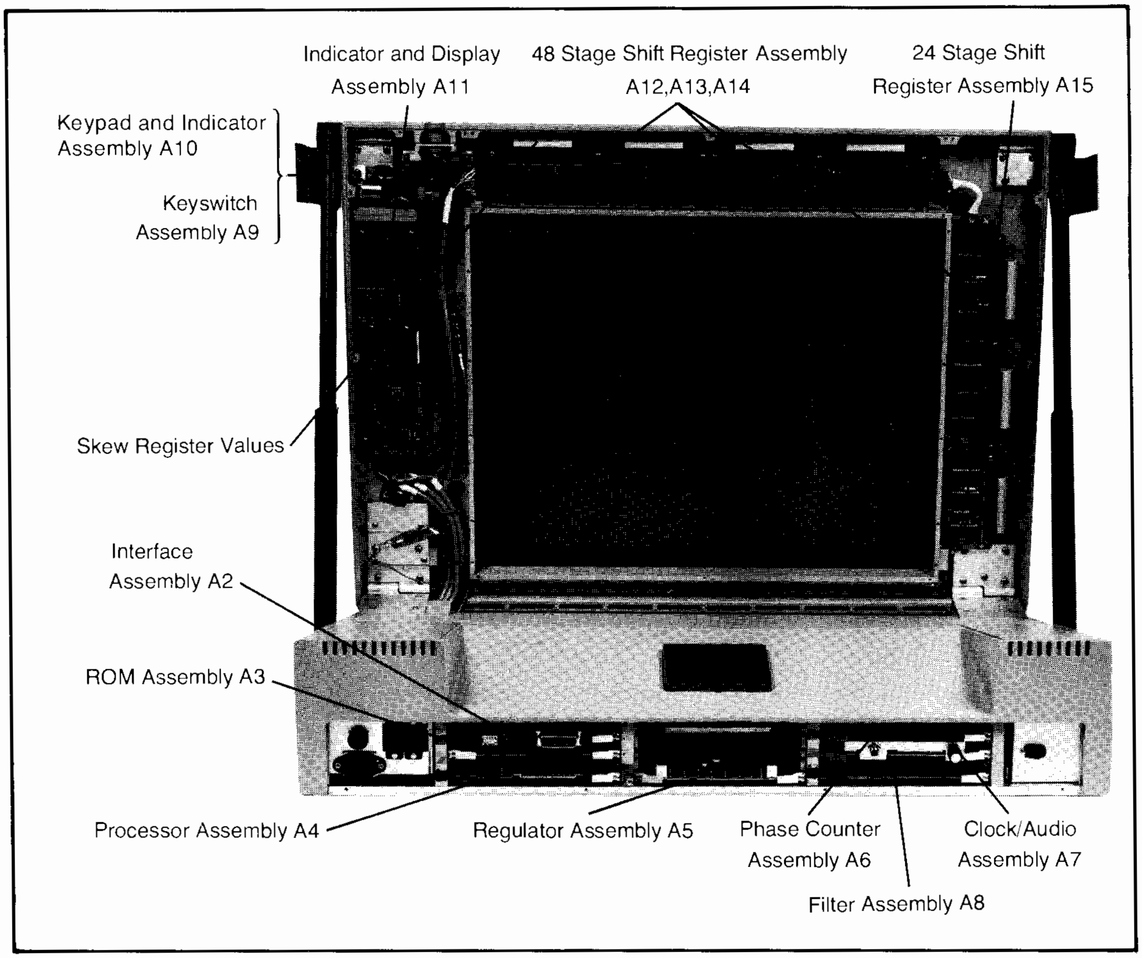
NOTE

The fan removal requires screws be removed from both sides of the chassis. See Figure 6-9. If the fan is to be removed, remove the screws on the upper chassis before inverting the digitizer.

Figure 6-1 shows PC assembly locations and refferance to the sections which describe access to the assemblies.



A. Digitizer Sections



B. Digitizer Assemblies

Figure 6-1: PC Assembly Location

NOTE

Unless noted in the procedures, the digitizer assemblies are installed by reversing the procedure given for their removal.

Power Supply Removal

To access the power supply module, the cover plate above the module must be removed. This is done using a small flat-blade screwdriver to pry up the rear section of the cover plate (see Figure 6-2).

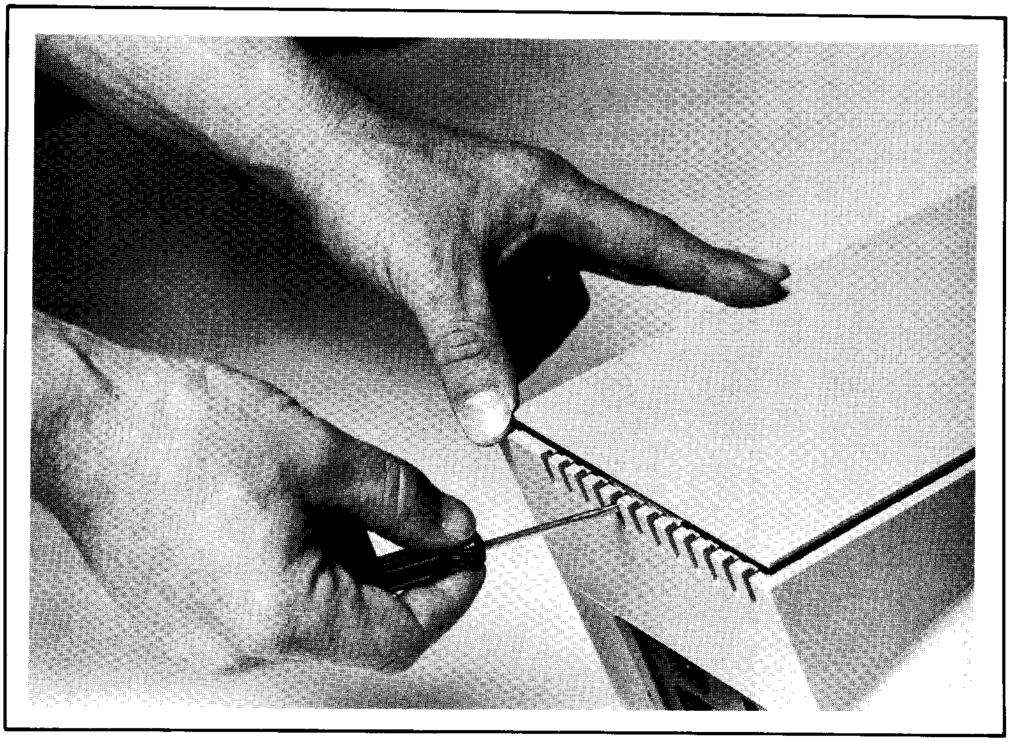


Figure 6-2. Removing Power Supply Cover Plate

Disconnect the three cable connectors shown in Figure 6-3. Remove the five screws that hold the power module to the digitizer's base plate. The power module can then be lifted from the chassis.

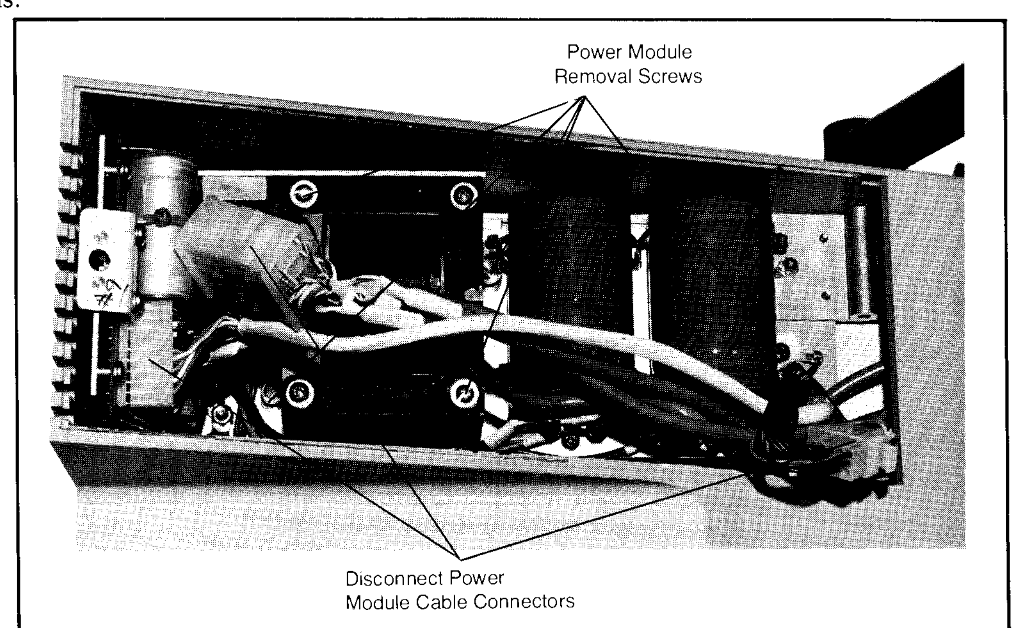


Figure 6-3. Power Module Removal

Vacuum Pump Module

The vacuum pump is accessed by removing the cover plate. This plate is removed in the same manner as the cover plate of the power module (see Figure 6-2).

The following procedure is used to remove the vacuum pump module.

- Remove the four screws that hold the vacuum pump module to the base plate (see Figure 6-4).
- Disconnect the power cable connector and vacuum line.
- The module can be tipped on end to access the vacuum line.
- Remove the vacuum pump from the chassis.

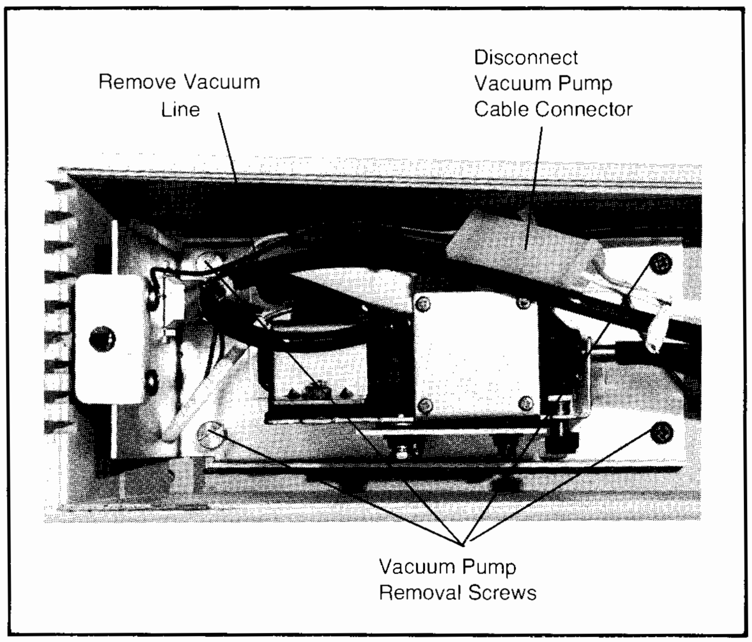


Figure 6-4. Vacuum Pump Module Removal

Rear Panel Assemblies

Seven assemblies (A2 through A8) are accessible with the rear panel removed. Removal of the screws shown in Figure 6-5 allows the rear panel to be removed.

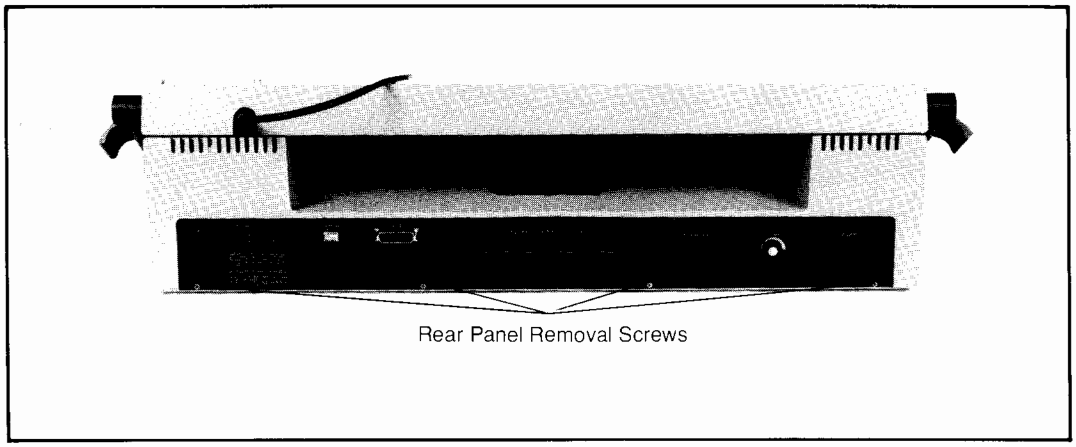


Figure 6-5. Rear Panel Removal

The pc assemblies shown in Figure 6-6 can be removed by pressing outwards on their colored extractors and then pulling the assemblies from the chassis. The isolation shield can then be pulled from its motherboard connector.

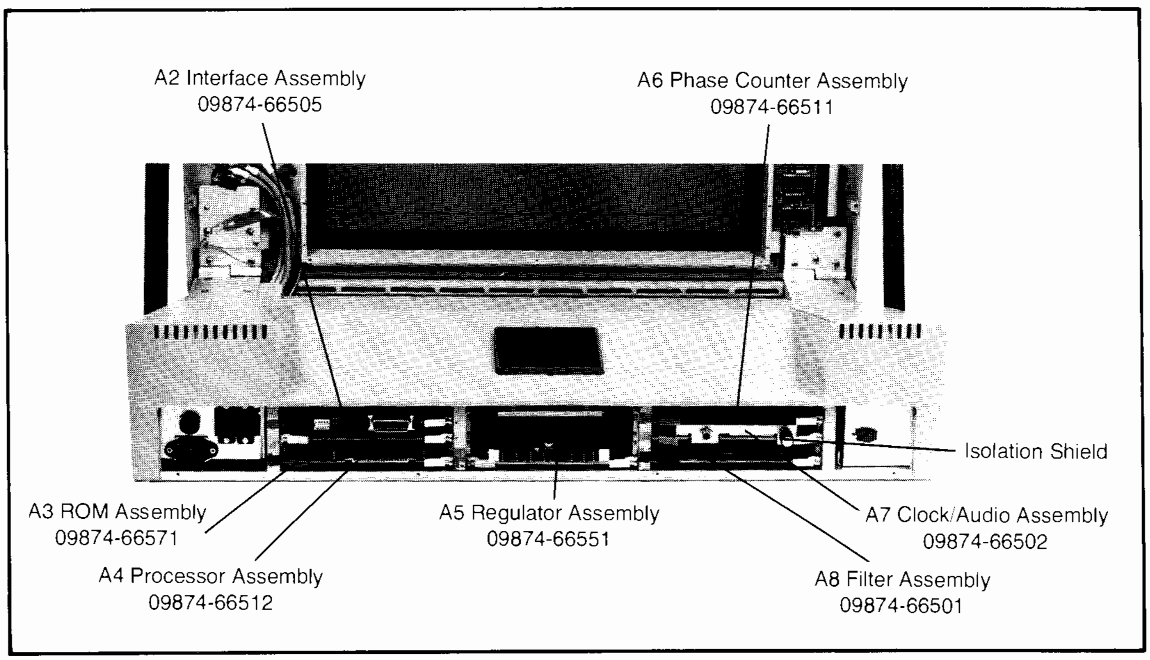


Figure 6-6. Rear Chassis Assemblies

Motherboard Removal

To remove the motherboard, the following assemblies must be removed.

- Power Module
- Vacuum Pump Module
- Rear Panel and Assemblies (A2 through A8 and the isolation shield)

All of these assemblies in some manner restrict the removal of the motherboard. These assemblies are more easily removed while the digitizer rests on its base grommets (feet).

Once these assemblies are removed, the digiter is inverted (placed face down on the platen). See the following caution.

CAUTION

CARE MUST BE TAKEN SO AS NOT TO DAMAGE THE DIGITIZER. THE PLATEN SHOULD BE PLACED FACE DOWN ON A SOFT, NON-ABRASIVE SURFACE OR MATERIAL. THE PLATEN SHOULD BE SUPPORTED IN SUCH A MANNER THAT THE WEIGHT OF THE DIGITIZER DOES NOT REST ON THE PLASTIC PROTRUSIONS WHICH FORM THE HOME POSITION FOR THE CURSOR. THE TELESCOPING STRUTS WHICH SUPPORT THE PLATEN (IN ITS NORMAL POSITION) MUST BE FULLY CLOSED OR OPEN TO A DEGREE GREATER THAN 60% BUT LESS THAN 90%. FIXING THE STRUTS IN THIS MANNER ALLOWS EASE OF ACCESS TO THE BASE PLATE WITHOUT PLACING UNDUE STRESS AT THE STRUT PIVOT POINTS WHILE GIVING THE DIGITIZER SOME DEGREE OF STABILITY.

Removal of the screws (indicated with arrows) in Figure 6-7 allows the base plate to be removed.

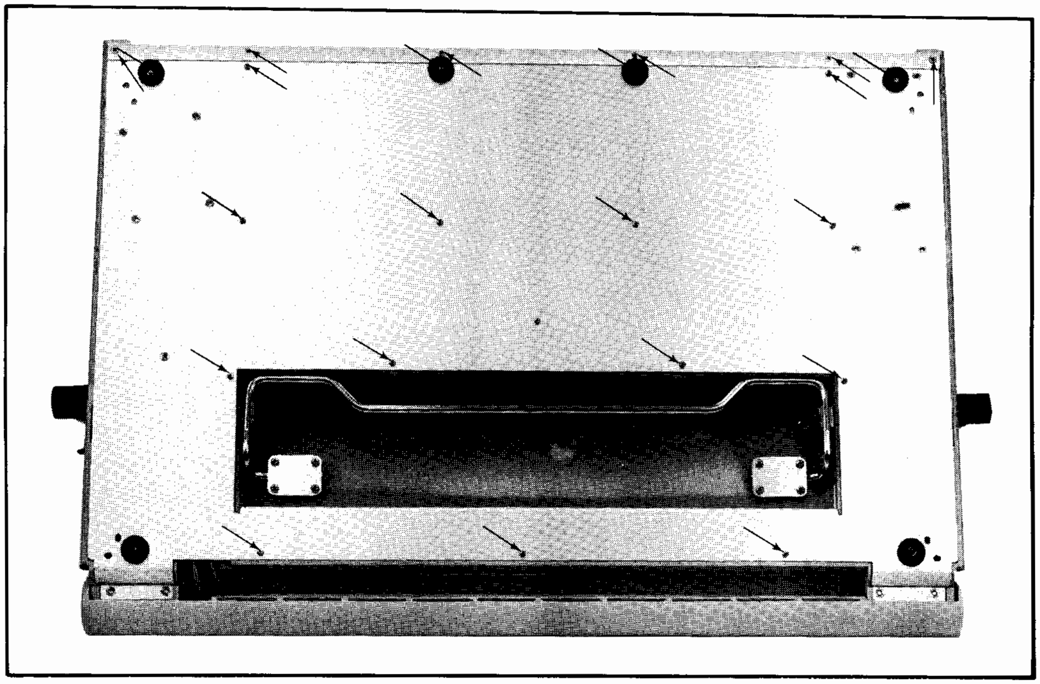


Figure 6-7: Base Plate Removal

The motherboard and its associated sheet metal bracket are removed together as one unit. Removal of the screws in Figure 6-8 allows the motherboard to be pulled away from the chassis. Disconnect the four cable connectors and remove the motherboard.

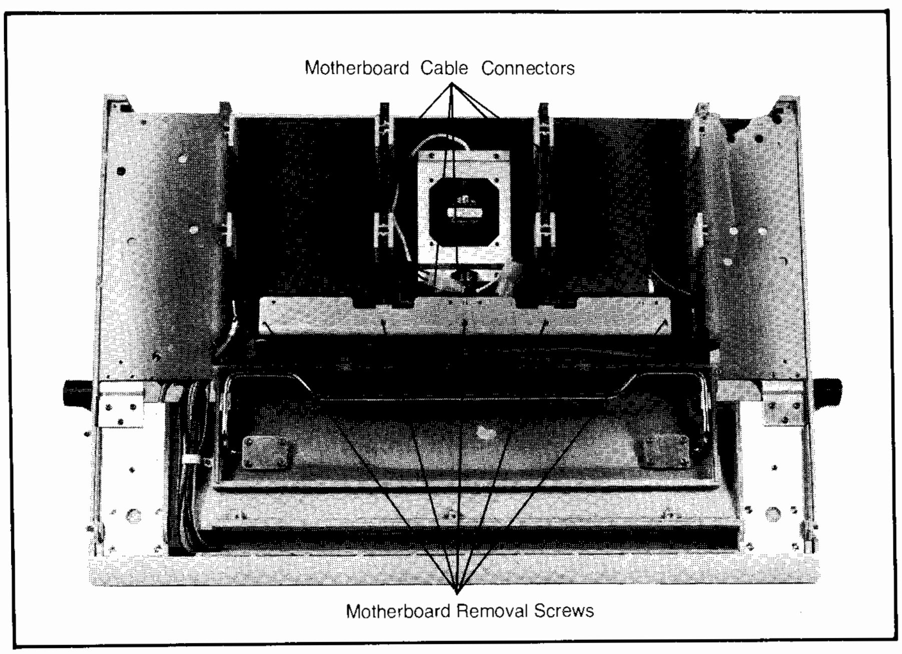
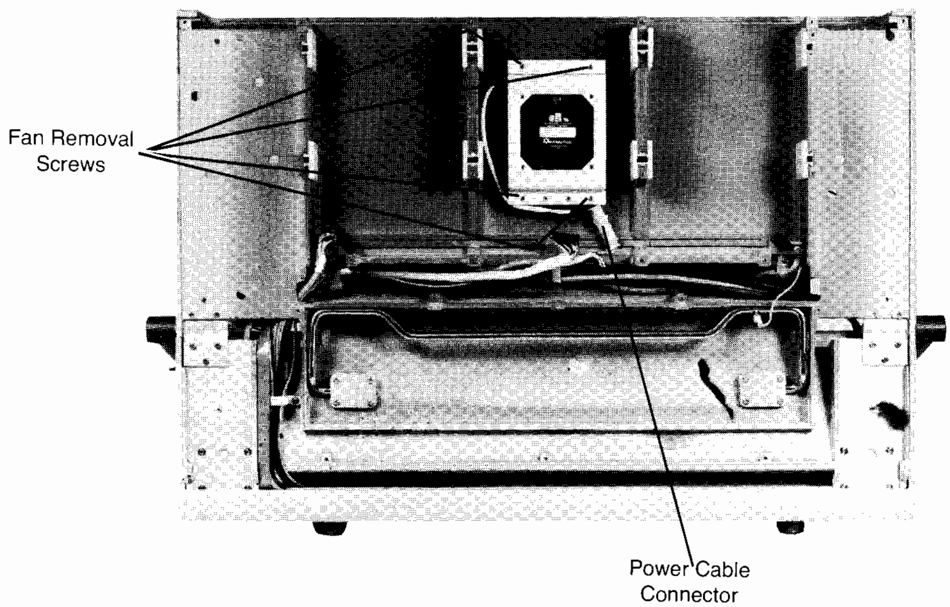


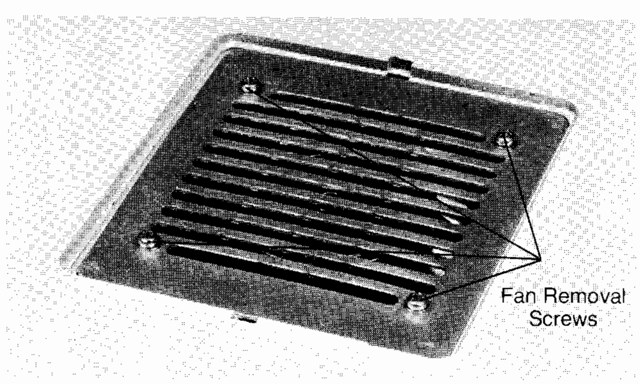
Figure 6-8: Motherboard Removal

Fan Removal

Disconnect the power cable connector from the fan (see Figure 6-9). Remove the screws securing the fan to its sheet metal brackets. These screws must be removed from both sides of the chasis.



A. Bottom View

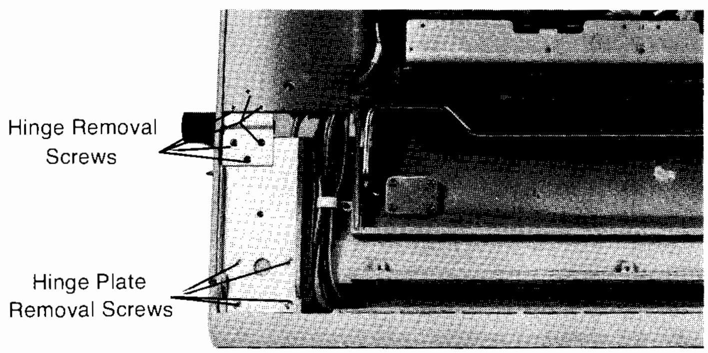


B. Top View

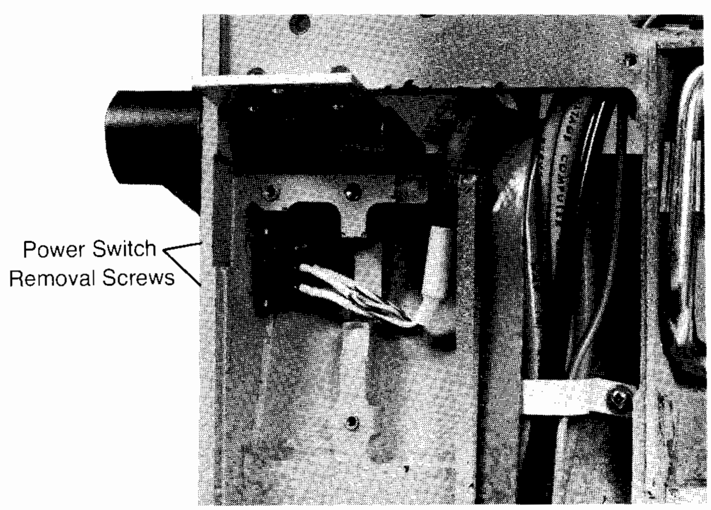
Figure 6-9: Fan Removal

Power Switch Removal

The hinge and hinge plate must be removed prior to removing the power switch (see Figure 6-10). The screws securing the hinge plate must be removed from the other side of the chassis. Remove the hinge screws, hinge plate and the two screws securing the power switch.



A. Hinge and Hinge Plate Removal



B. Power Switch

Figure 6-10: Power Switch Removal

Platen Assemblies

Access to the platen assemblies is gained by removing the access plates located on the back of the platen assembly. Place the platen in its highest upright position to access these plates. The access plates are removed by removing the screws shown in Figure 6-11.

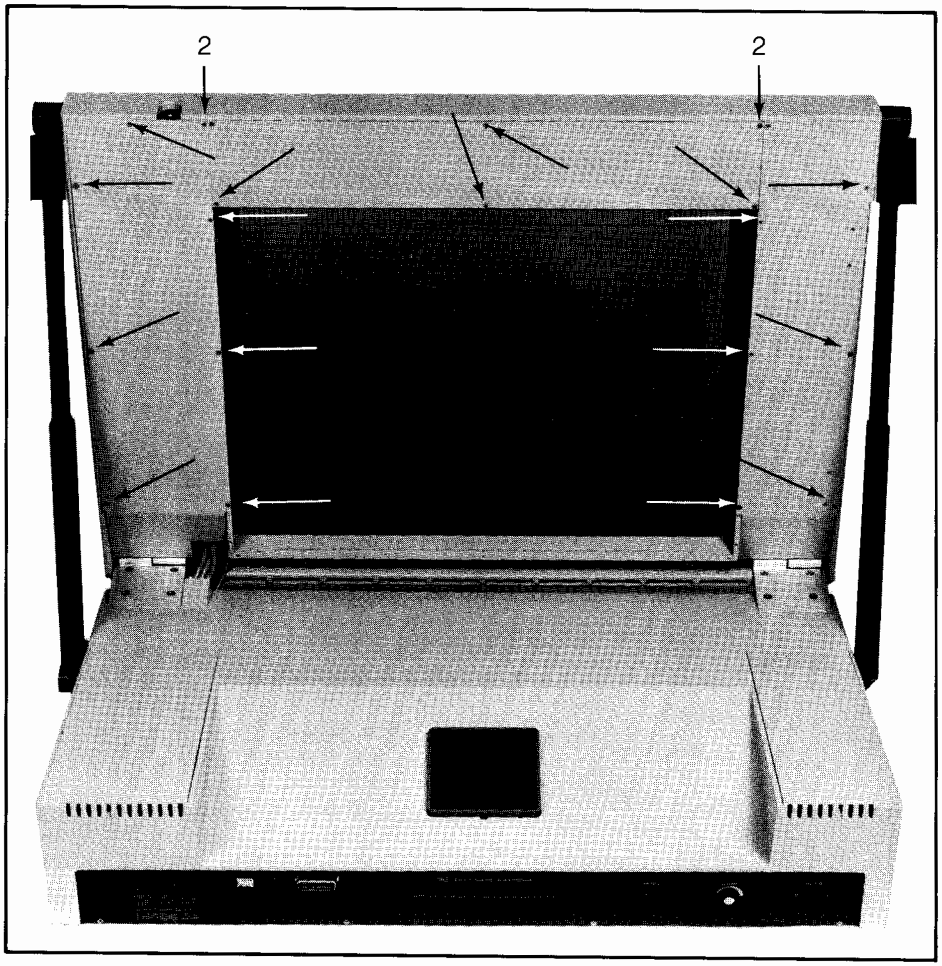


Figure 6-11: Platen Assembly Access Plates

Five assemblies are readily accessible with the access plates removed. These are shown in Figure 6-12 with the screw locations which secure the assemblies. The cable connectors can be removed at this time, but the screws securing the assemblies should be left in place until the ribbon cables are unfastened see Figure 6-13.

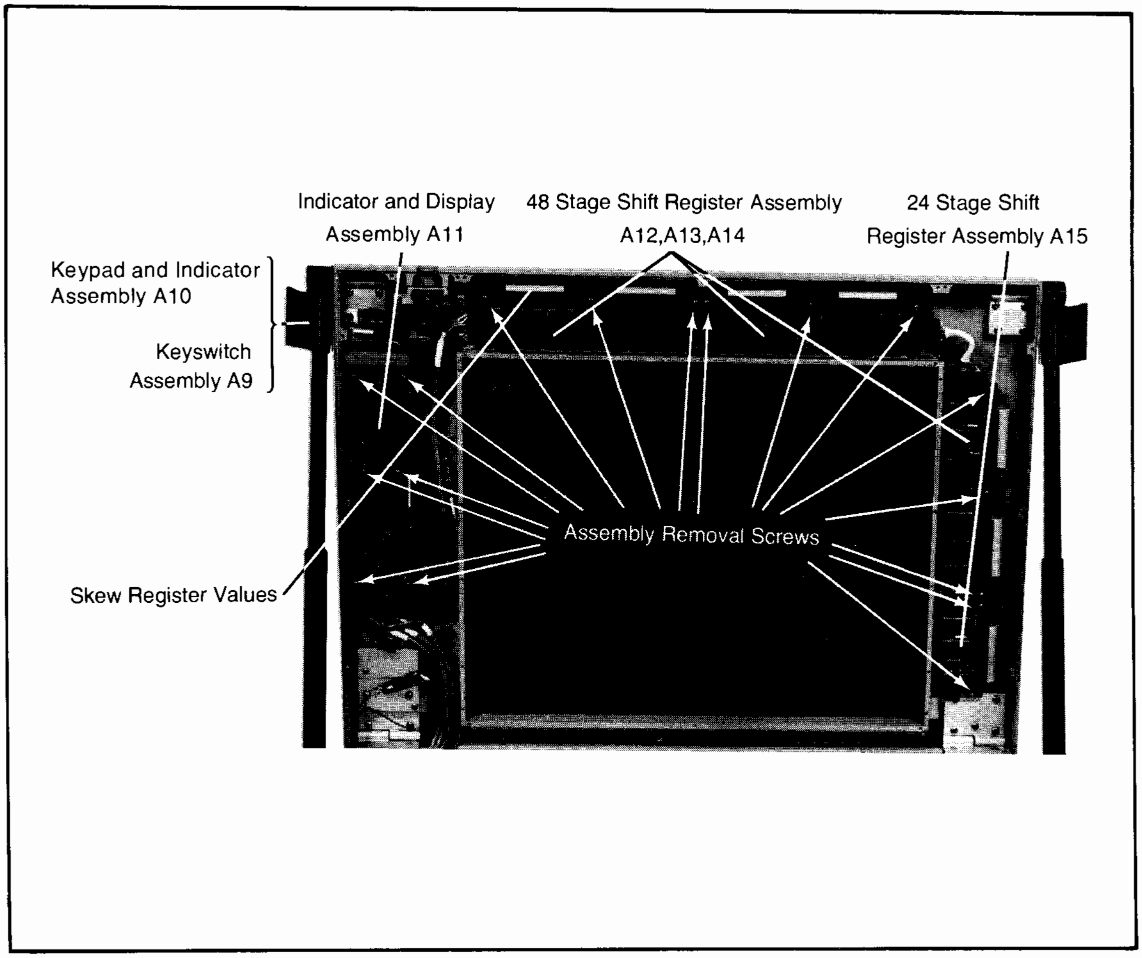


Figure 6-12: Platen Assemblies

The X-and Y-axis shift register assemblies (A12 through A15) are attached to the platen by seven ribbon cables. The ribbon cables are connected to the register assemblies with a locking plastic connector. The connectors are released by applying an outward pressure to the side opposite the hinge. The ribbon cable then slides out from the pin section of the connector (see Figure 6-13).

Referring to Figure 6-12, the screws and assemblies can be removed.

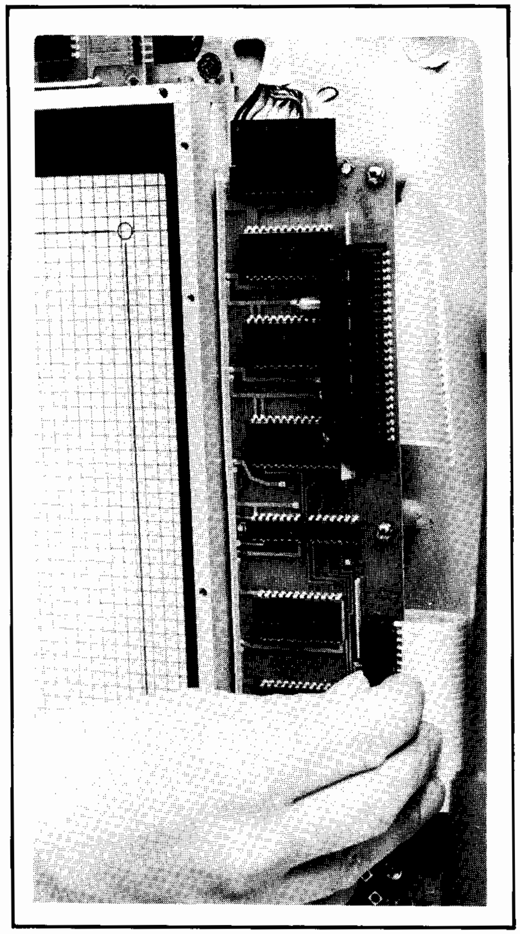


Figure 6-13: Ribbon Cable Removal

After the removal of the assemblies shown in Figure 6-12, two other assemblies remain (platen and bridge assemblies). Removing the bridge screws shown in Figure 6-14 allows the bridge assembly to be removed from the front of the platen assembly. Care should be taken to avoid damaging the ribbon cable that is attached to the bridge assembly. This cable must be guided through the slot in the platen housing.

The vacuum solenoid, cursor/stylus connector and speaker are connected together by a wire harness. The removal of the solenoid bracket, cursor connector bracket and harness clamps allows these three items to be removed.

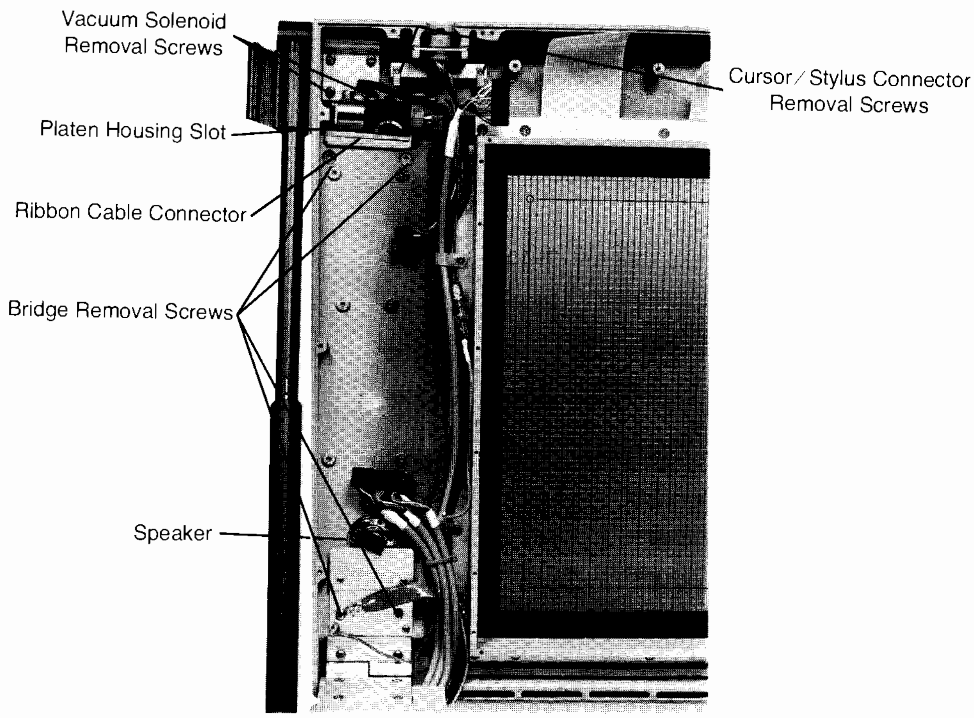


Figure 6-14: Bridge Assembly Removal

The bridge assembly is composed of the A9 and A10 assemblies. The exploded view in Figure 6-15 shows the bridge assembly.

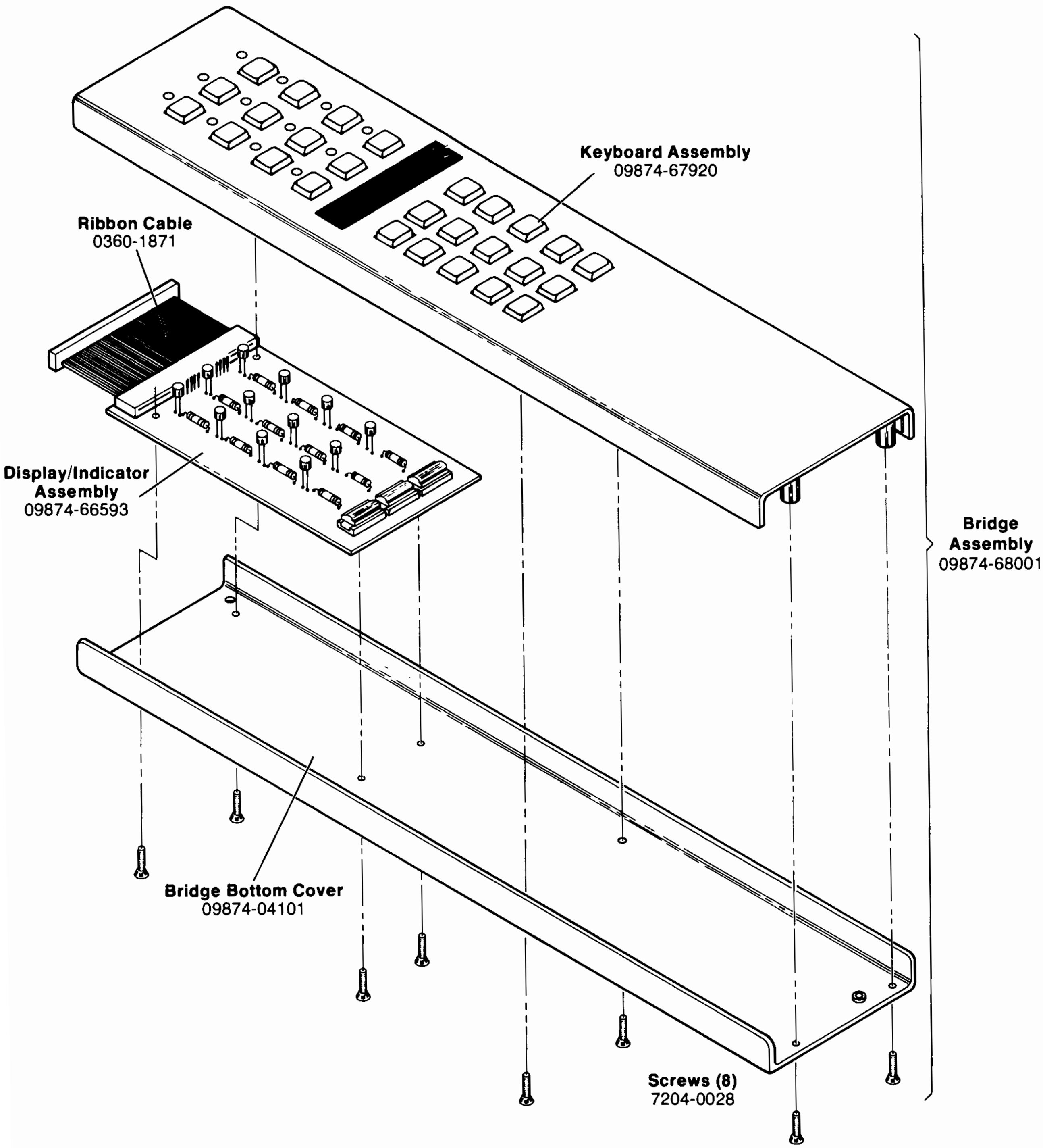


Figure 6-15: Exploded View of Bridge Assembly

The digitizer's glass platen is a relatively heavy item. Therefore, it is recommended that the digitizer be placed face down on the platen with the struts fully extended.

CAUTION

CARE MUST BE TAKEN SO AS NOT TO DAMAGE THE DIGITIZER WHILE IN THIS POSITION. THE PLATEN SHOULD BE PLACED FACE DOWN ON A SOFT, NON-ABRASIVE SURFACE OR MATERIAL. THE PLATEN SHOULD BE SUPPORTED IN SUCH A MANNER THAT THE WEIGHT OF THE DIGITIZER DOES NOT REST ON THE PLASTIC PROTRUSIONS WHICH FORM THE HOME POSITION FOR THE CURSOR. WITH THE TELESCOPING STRUTS FULLY EXTENDED (NECESSARY IN THIS REMOVAL), THE DIGITIZER IS TOP HEAVY. IT IS RECOMMENDED THAT THE BASE PLATE BE SUPPORTED (PLACED AGAINST A WALL OR OTHER UPRIGHT STATIONARY STRUCTURE).

Removal of the screws shown in Figure 6-16 allows the extruded metal brackets retaining the platen to be removed. The platen can then be lifted from its position.

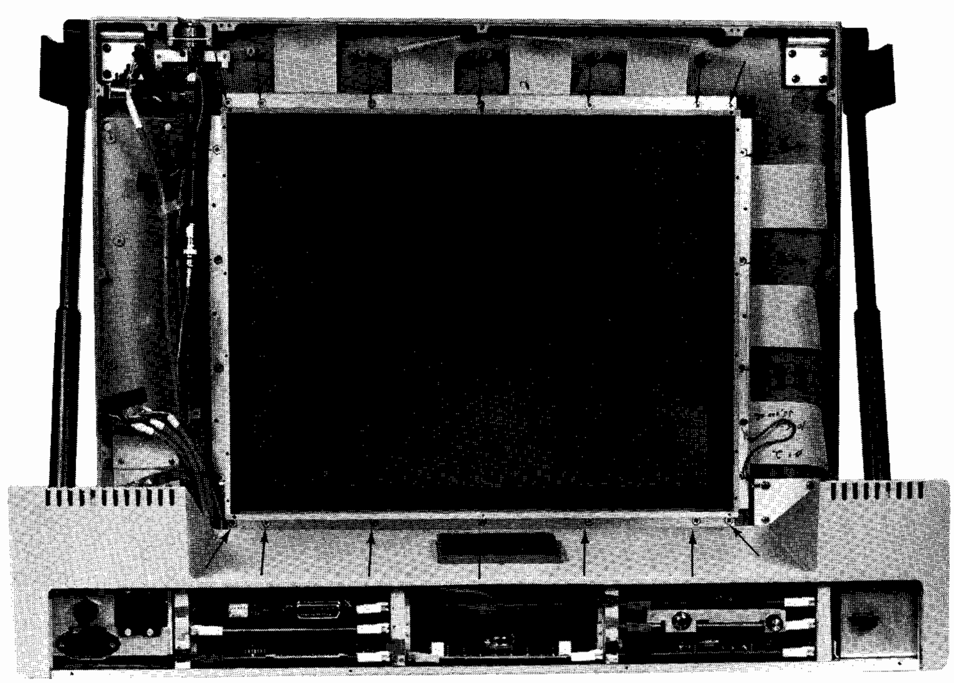


Figure 6-16: Platen Removal

NOTE

To insure accuracy of the digitizer whenever a platen or processor assembly is replaced, the platen skew value must be transferred to the skew register switches on the processor assembly.

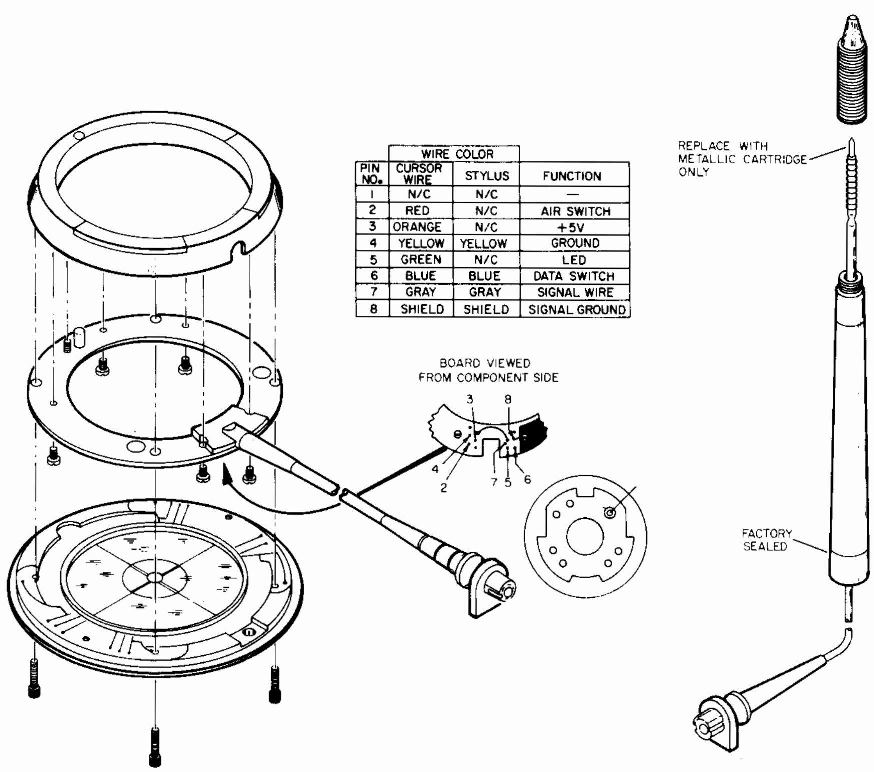
Cursor/Stylus Assemblies

The cursor and stylus assemblies are presented together in Figure 6-17. Refer to this figure for disassembly and wire diagram information.

The Stylus Cartridge

The ink cartridge contained in the stylus may be purchased in your local area. The following replacement cartridge must be used.

- HP part number 9282-0680
- Paper Mate Division part number NI-448-01
- Paper Mate – **Fine Point** refill **STANDARD**



PIN NO.	WIRE COLOR CURSOR WIRE	WIRE COLOR STYLUS	FUNCTION
1	N/C	N/C	—
2	RED	N/C	AIR SWITCH
3	ORANGE	N/C	+5V
4	YELLOW	YELLOW	GROUND
5	GREEN	N/C	LED
6	BLUE	BLUE	DATA SWITCH
7	GRAY	GRAY	SIGNAL WIRE
8	SHIELD	SHIELD	SIGNAL GROUND

Figure 6-17: Cursor/Stylus Assemblies

Chapter 7: Circuit Diagram

Circuit Diagrams

Introduction

This chapter contains the circuit diagrams for the 9874A Digitizer. The circuit diagrams are presented in assembly order (A1 assembly being first). The circuit diagrams for the A17 and A18 assemblies are shown with the regulator assembly A5 circuit diagram.

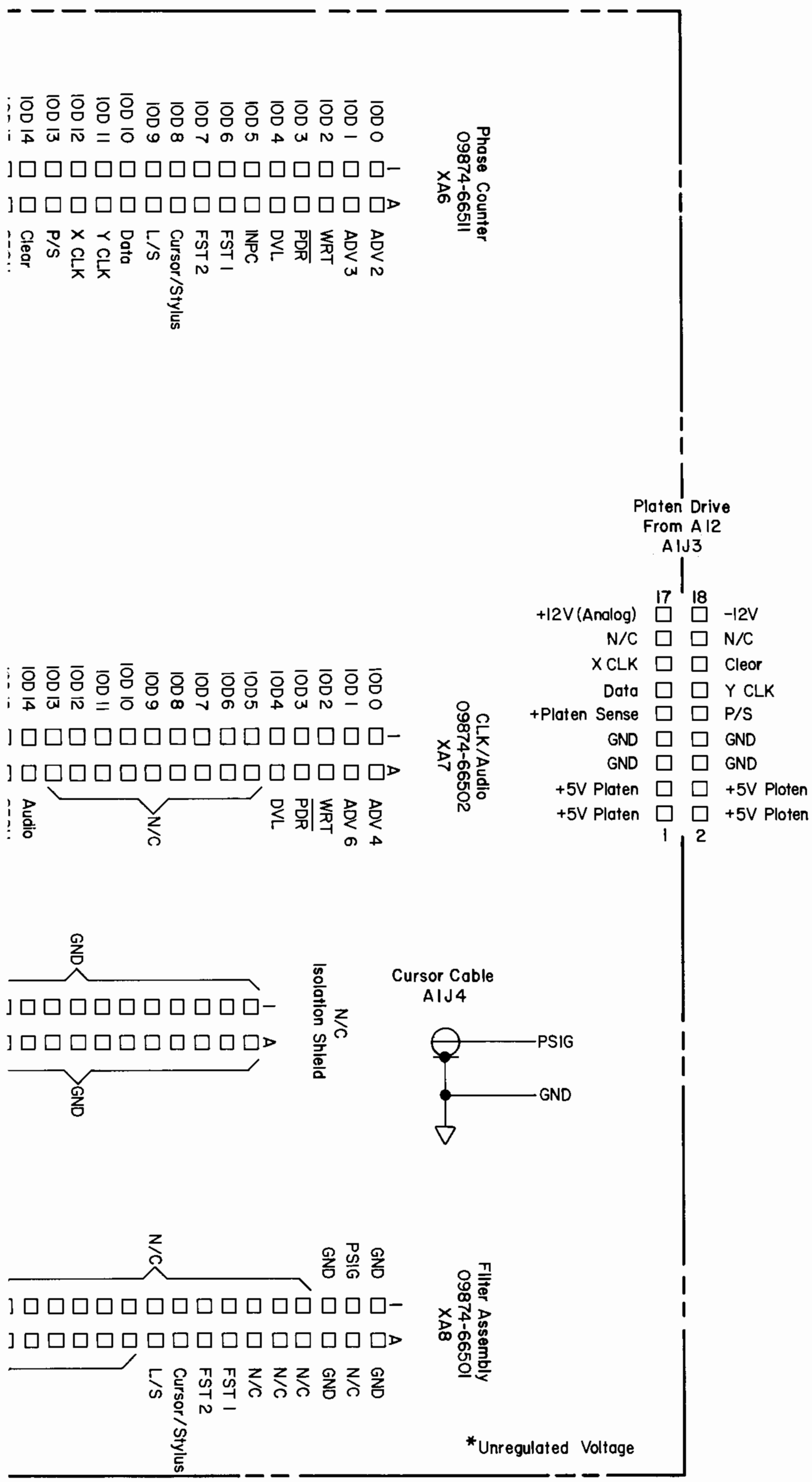
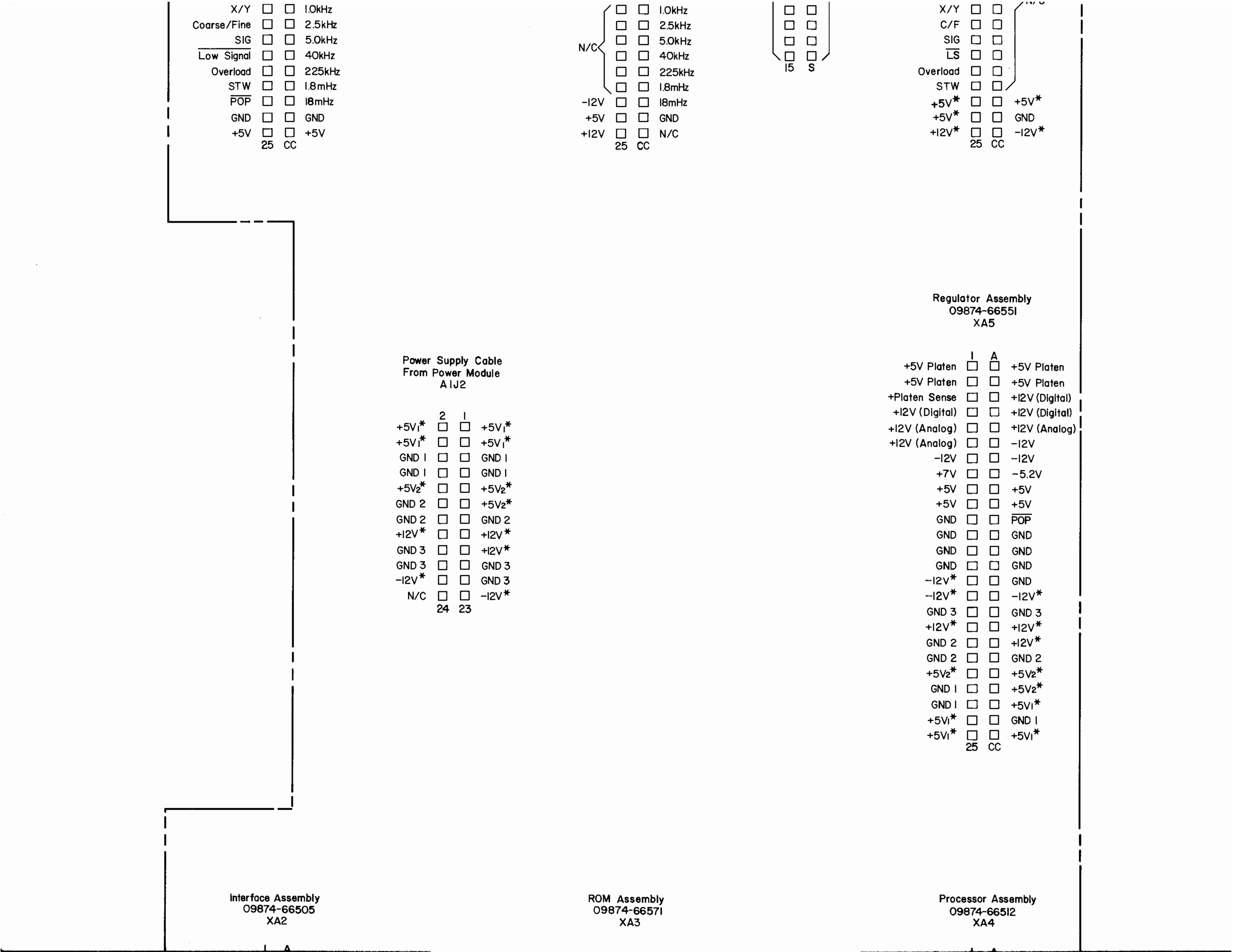
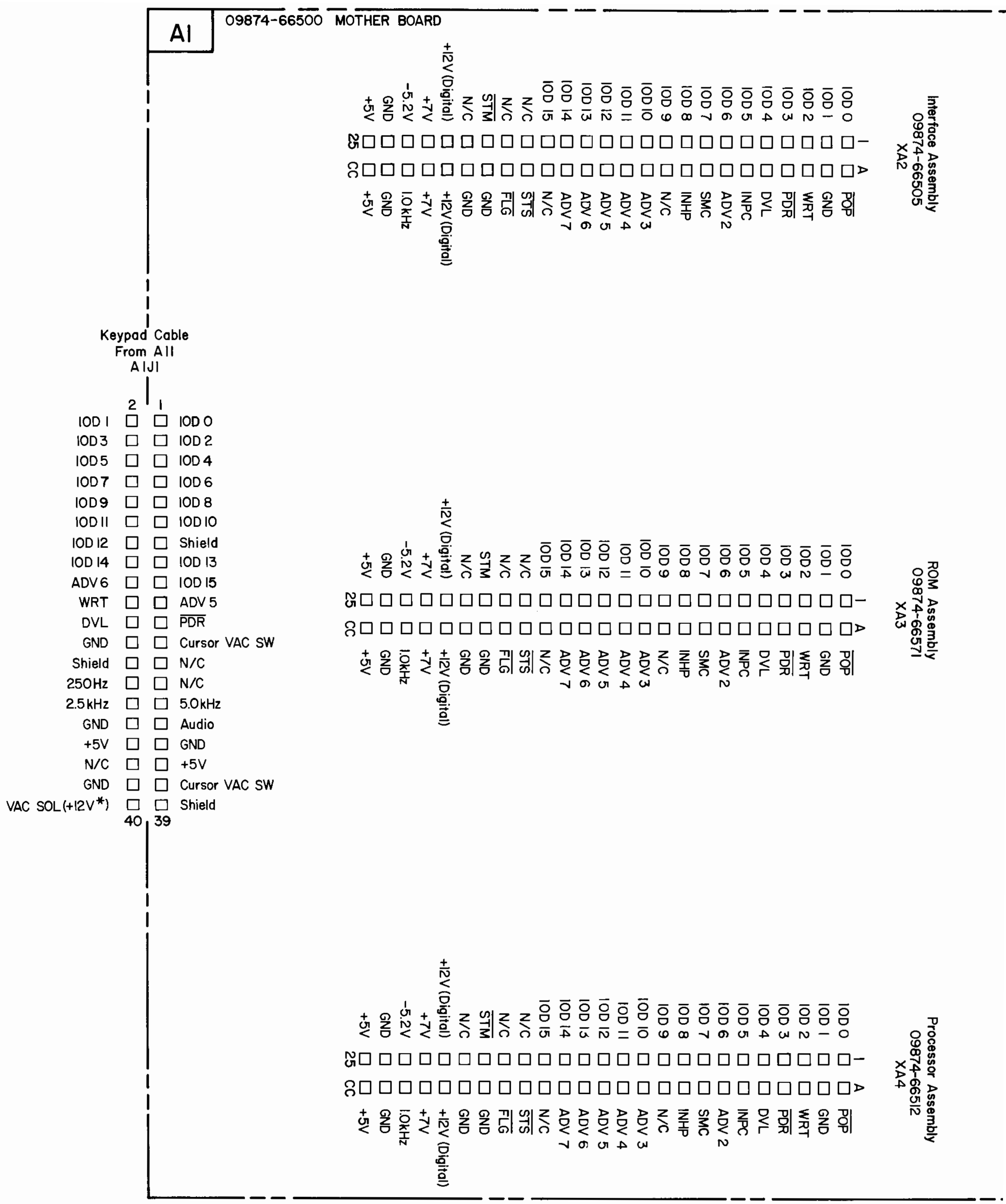


Figure 7-1: A1 Motherboard Assembly



X/Y 1.0kHz
Coarse/Fine 2.5kHz
SIG 5.0kHz
Low Signal 40kHz
Overload 225kHz
STW 1.8mHz
POP 18mHz
GND GND
+5V +5V
25 CC
N/C 1.0kHz
2.5kHz
5.0kHz
40kHz
225kHz
1.8mHz
-12V 18mHz
+5V GND
+12V N/C
25 CC
15 S
X/Y
C/F
SIG
LS
Overload
STW
+5V* +5V*
+5V* GND
+12V* -12V*
25 CC
Power Supply Cable
From Power Module
A1J2
2 1
+5V1* +5V1*
+5V1* +5V1*
GND 1 GND 1
GND 1 GND 1
+5V2* +5V2*
GND 2 +5V2*
GND 2 GND 2
+12V* +12V*
GND 3 +12V*
GND 3 GND 3
-12V* GND 3
N/C -12V*
24 23
Regulator Assembly
09874-66551
XA5
1 A
+5V Platen +5V Platen
+5V Platen +5V Platen
+Platen Sense +12V (Digital)
+12V (Digital) +12V (Digital)
+12V (Analog) +12V (Analog)
+12V (Analog) -12V
-12V -12V
+7V -5.2V
+5V +5V
+5V +5V
GND POP
GND GND
GND GND
GND GND
-12V* GND
-12V* -12V*
GND 3 GND 3
+12V* +12V*
GND 2 +12V*
GND 2 GND 2
+5V2* +5V2*
GND 1 +5V2*
GND 1 +5V1*
+5V1* GND 1
+5V1* +5V1*
25 CC
Interface Assembly
09874-66505
XA2
ROM Assembly
09874-66571
XA3
Processor Assembly
09874-66512
XA4


A1
09874-66500 MOTHER BOARD
Interface Assembly
09874-66505
XA2
ROM Assembly
09874-66571
XA3
Processor Assembly
09874-66512
XA4
1 A
25 CC
IOD 0 POP
IOD 1 GND
IOD 2 WRT
IOD 3 PDR
IOD 4 DVL
IOD 5 INPC
IOD 6 ADV 2
IOD 7 SMC
IOD 8 INHP
IOD 9 N/C
IOD 10 ADV 3
IOD 11 ADV 4
IOD 12 ADV 5
IOD 13 ADV 6
IOD 14 ADV 7
IOD 15 N/C
N/C STS
N/C FLG
STM GND
N/C GND
+12V (Digital) +12V (Digital)
+7V +7V
-5.2V 1.0kHz
GND GND
+5V +5V
Keypad Cable
From A11
A1J1
2 1
IOD 1 IOD 0
IOD 3 IOD 2
IOD 5 IOD 4
IOD 7 IOD 6
IOD 9 IOD 8
IOD 11 IOD 10
IOD 12 Shield
IOD 14 IOD 13
ADV 6 IOD 15
WRT ADV 5
DVL PDR
GND Cursor VAC SW
Shield N/C
250Hz N/C
2.5kHz 5.0kHz
GND Audio
+5V GND
N/C +5V
GND Cursor VAC SW
VAC SOL (+12V*) Shield
40 39

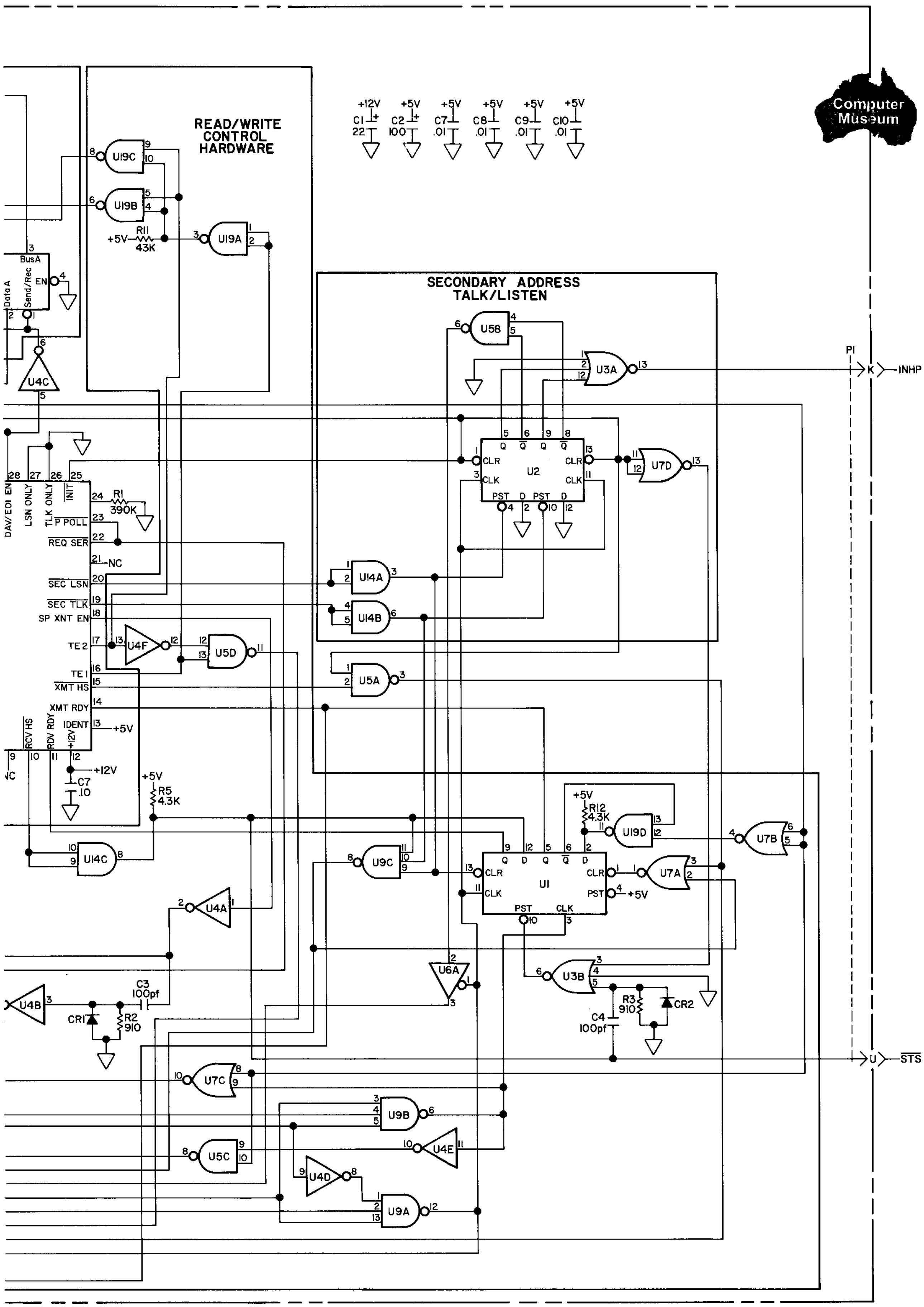
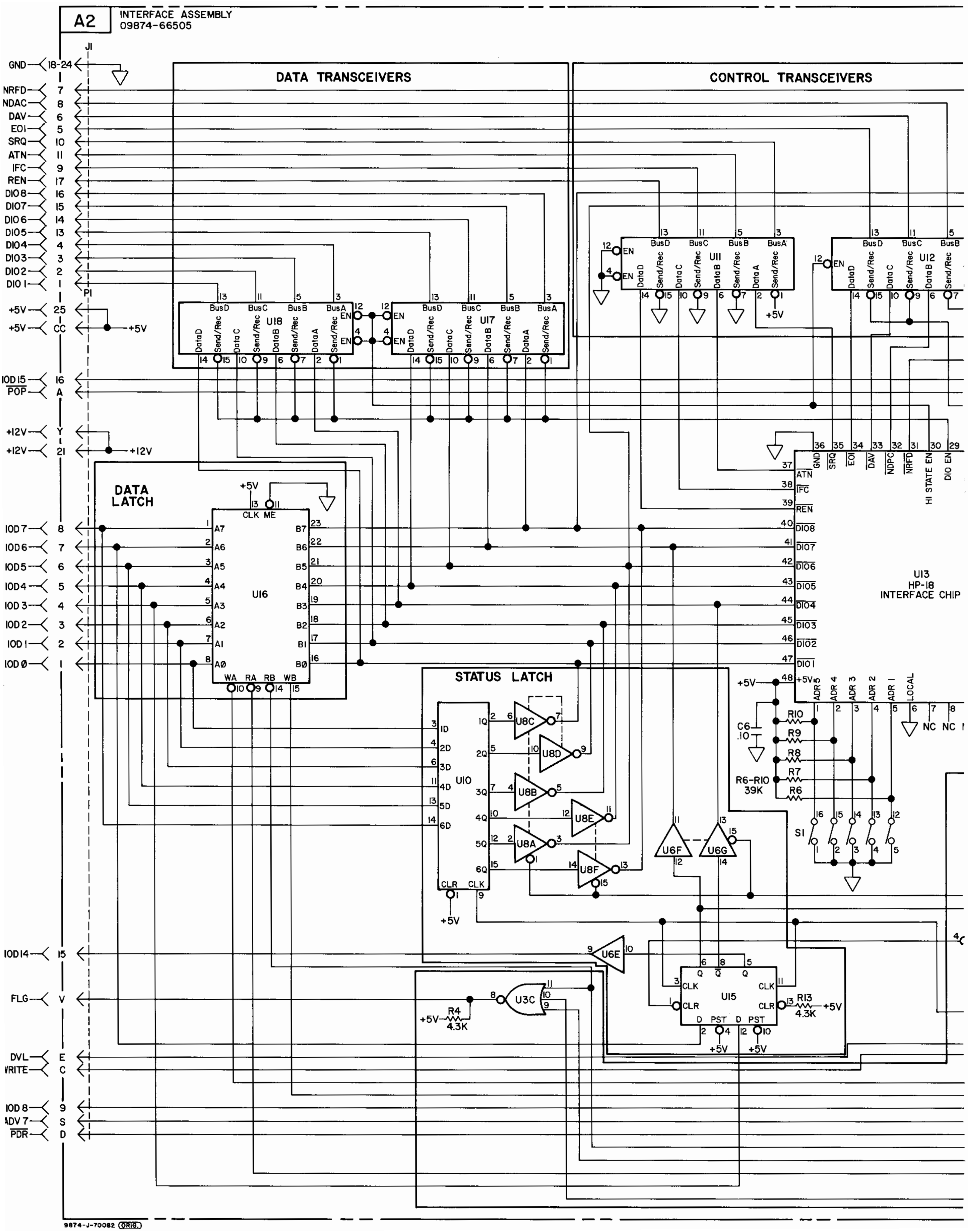
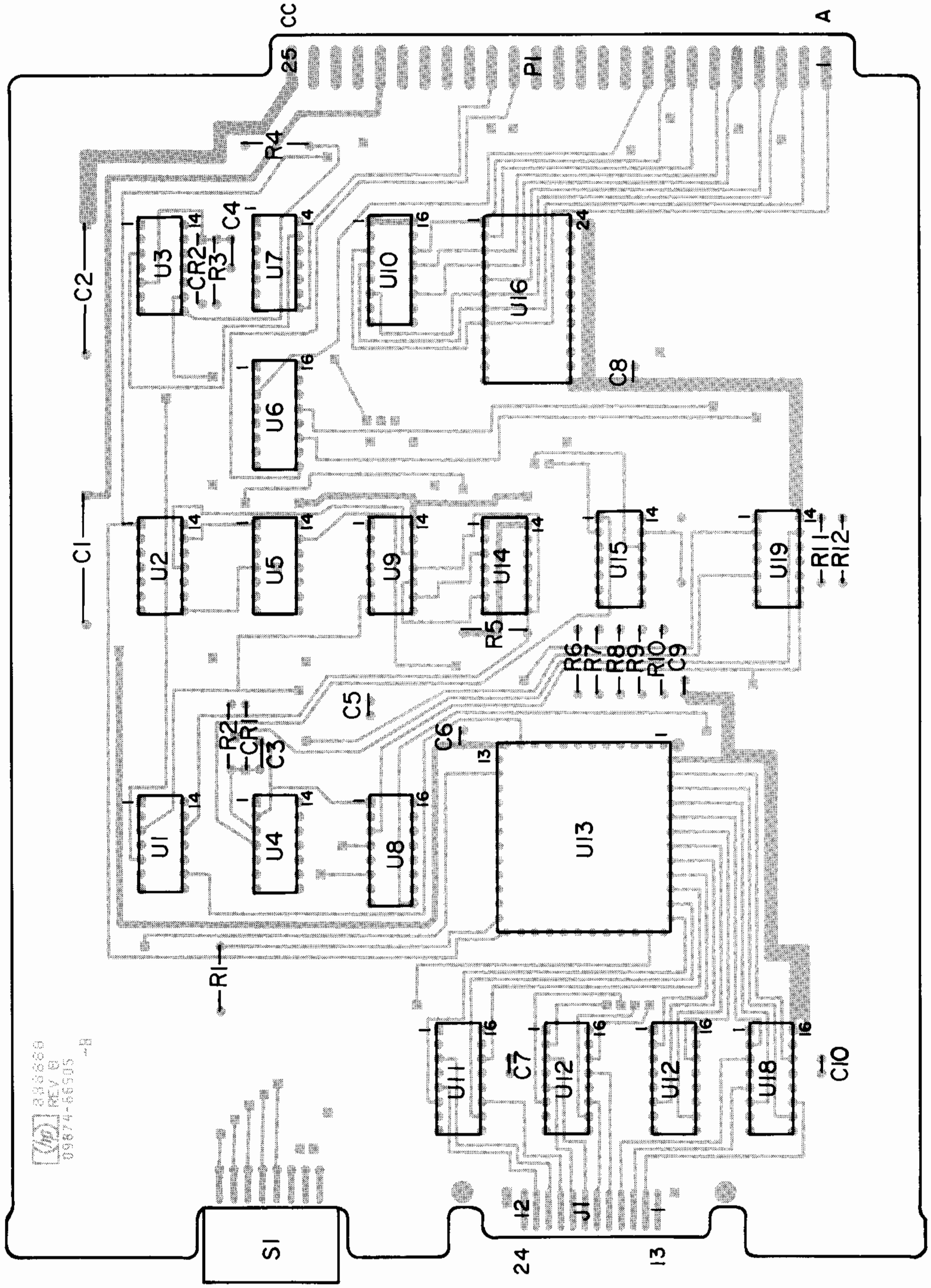


Figure 7-2: A2 Interface Assembly Circuit Diagram


A2
INTERFACE ASSEMBLY
09874-66505
DATA TRANSCEIVERS
CONTROL TRANSCEIVERS
DATA LATCH
STATUS LATCH
U13
HP-IB
INTERFACE CHIP
U18
U17
U11
U12
U16
U10
U15
R6-R10
39K
R4
4.3K
R13
4.3K
C6
.10
S1
GND
NRFD
NDAC
DAV
EOI
SRQ
ATN
IFC
REN
DIO8
DIO7
DIO6
DIO5
DIO4
DIO3
DIO2
DIO1
+5V
IOD15
POP
+12V
IOD7
IOD6
IOD5
IOD4
IOD3
IOD2
IOD1
IOD0
IOD14
FLG
DVL
WRITE
IOD8
ADV7
PDR
HI STATE EN
DIO EN
LOCAL
9874-J-70082 (ORIG.)



COMPONENT SIDE
A2

-hp- Part No. 09874-66505 Rev B

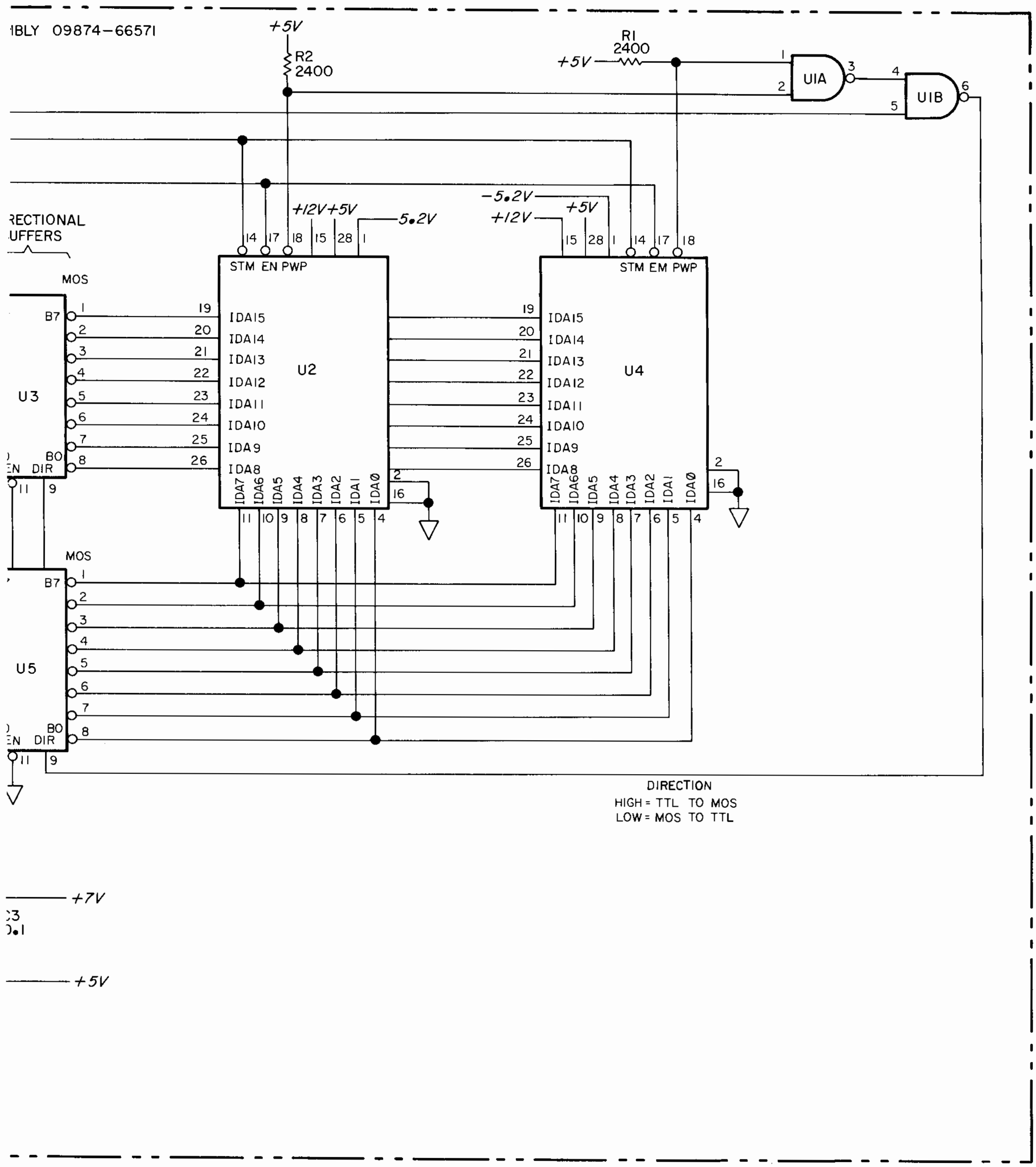
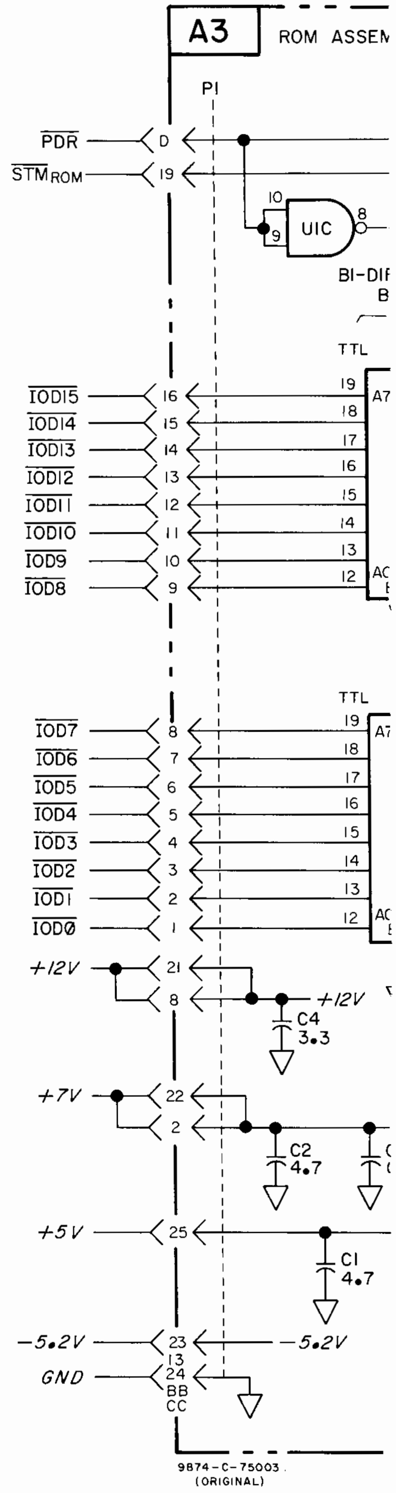
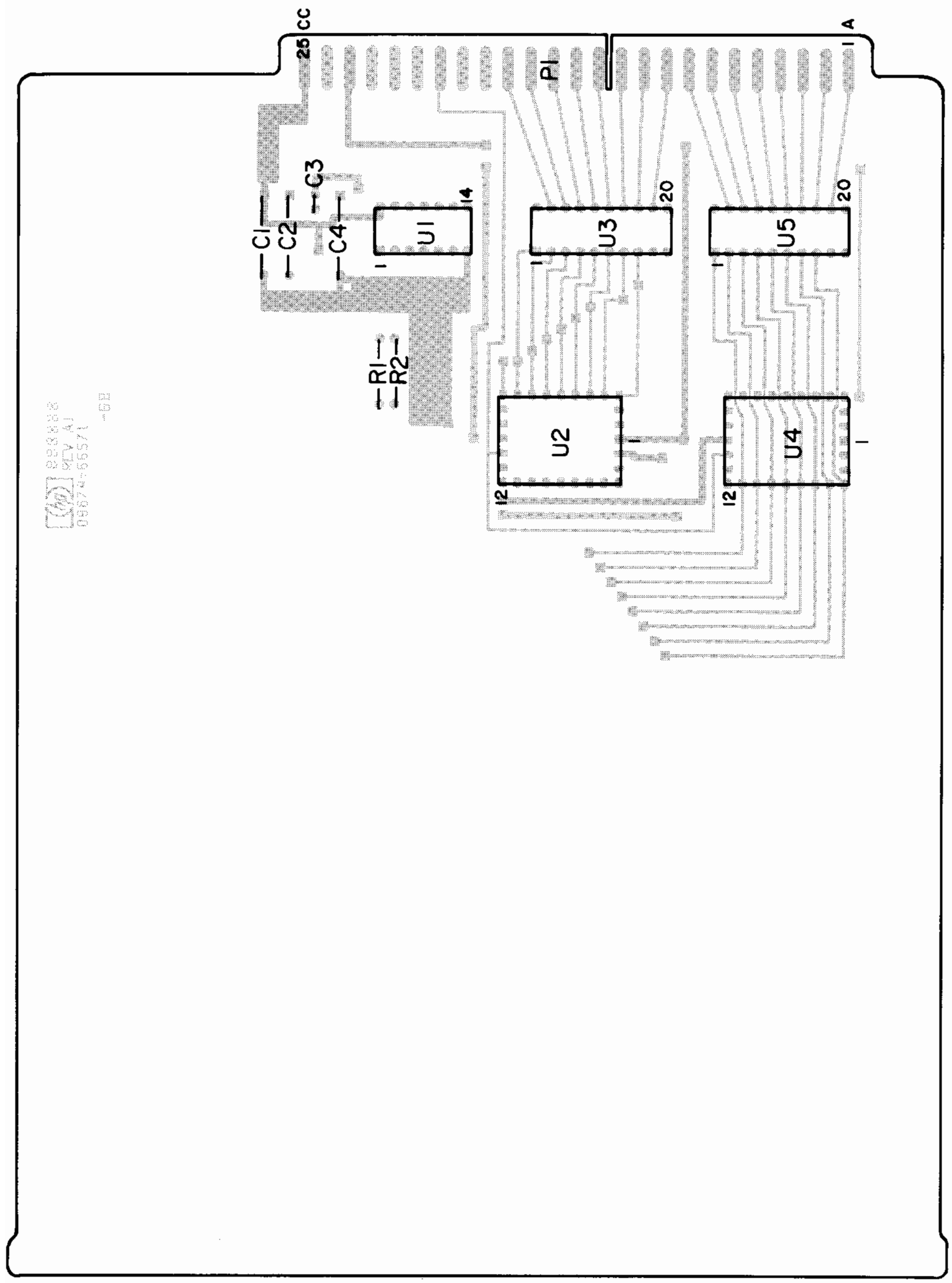


Figure 7-3: A3 ROM Assembly Circuit Diagram


A3
ROM ASSEM
P1
PDR
STMROM
U1C
BI-DIR
TTL
IOD15
IOD14
IOD13
IOD12
IOD11
IOD10
IOD9
IOD8
IOD7
IOD6
IOD5
IOD4
IOD3
IOD2
IOD1
IOD0
+12V
C4
3.3
+7V
C2
4.7
+5V
C1
4.7
−5.2V
GND
9874-C-75003
(ORIGINAL)



COMPONENT SIDE
A3

-hp- Part No. 09874-66571 Rev A

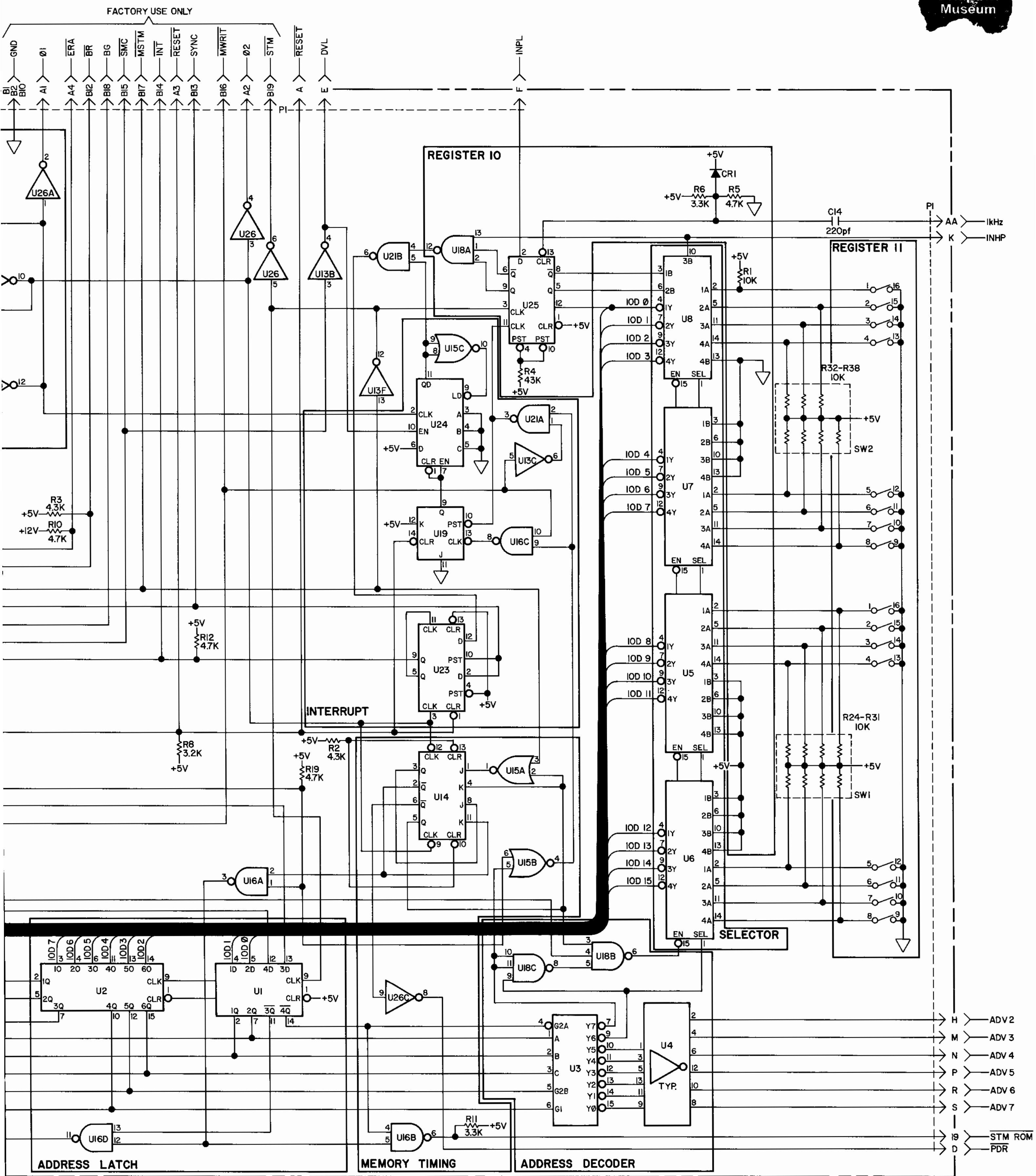
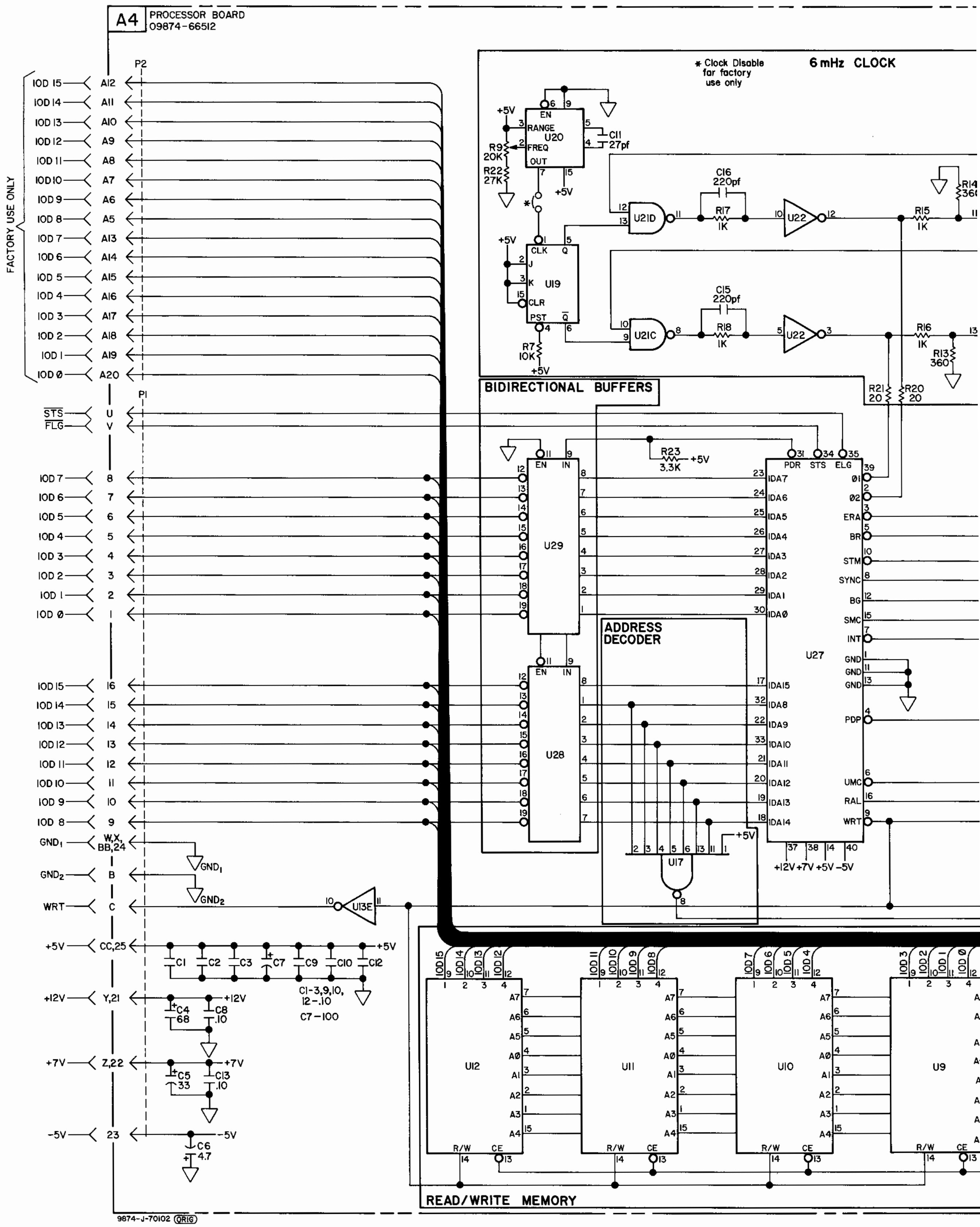
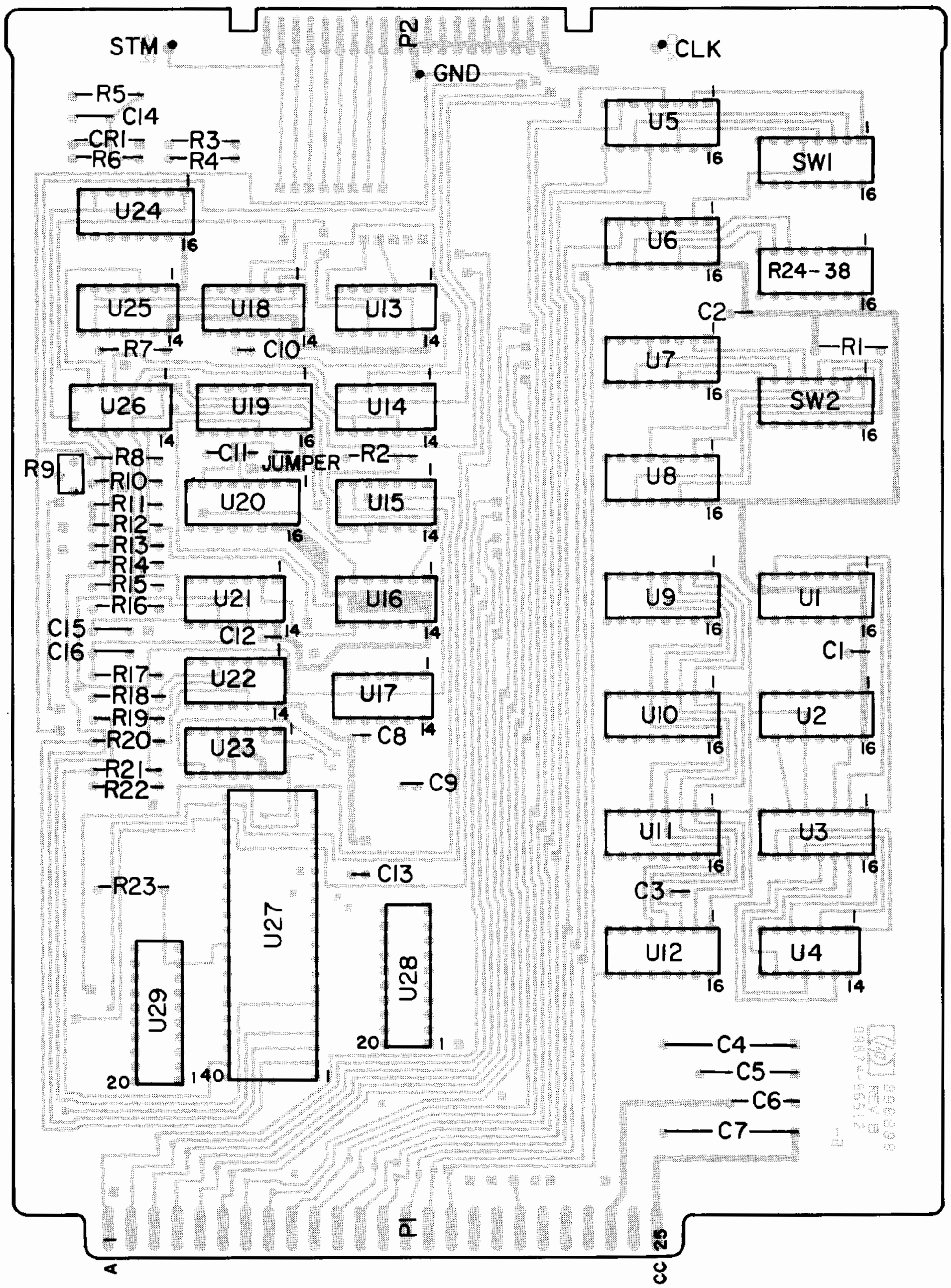


Figure 7-4: A4 Processor Assembly Circuit Diagram



A4 PROCESSOR BOARD 09874-66512
6 mHz CLOCK
* Clock Disable for factory use only
BIDIRECTIONAL BUFFERS
ADDRESS DECODER
READ/WRITE MEMORY
FACTORY USE ONLY
U20
U19
U21D
U21C
U22
U29
U28
U27
U17
U13E
U12
U11
U10
U9
C1-3,9,10, 12-.10
C7-100
9874-J-70102 (ORIG)



COMPONENT SIDE
A4

-hp- Part No. 09874-66512 Rev B

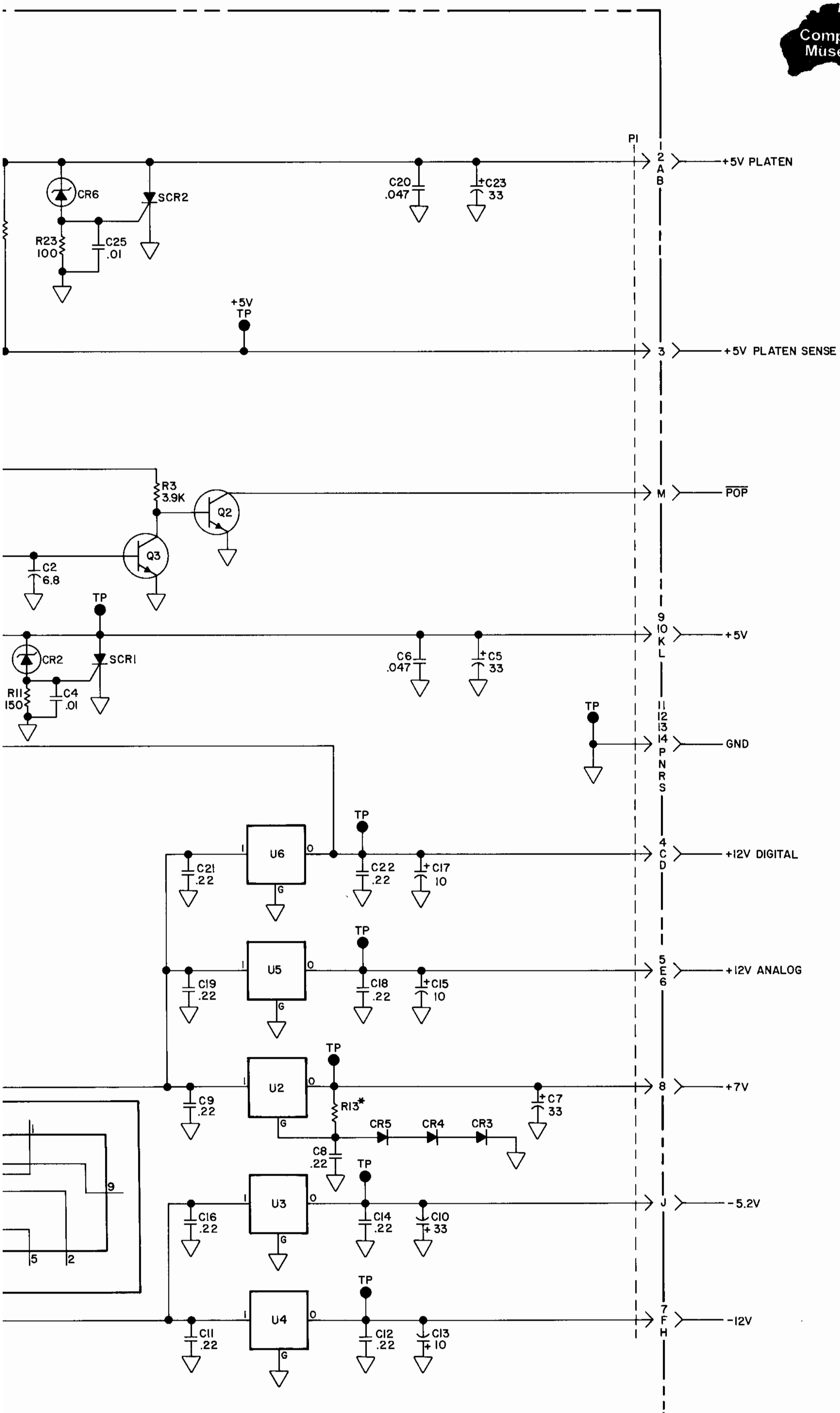
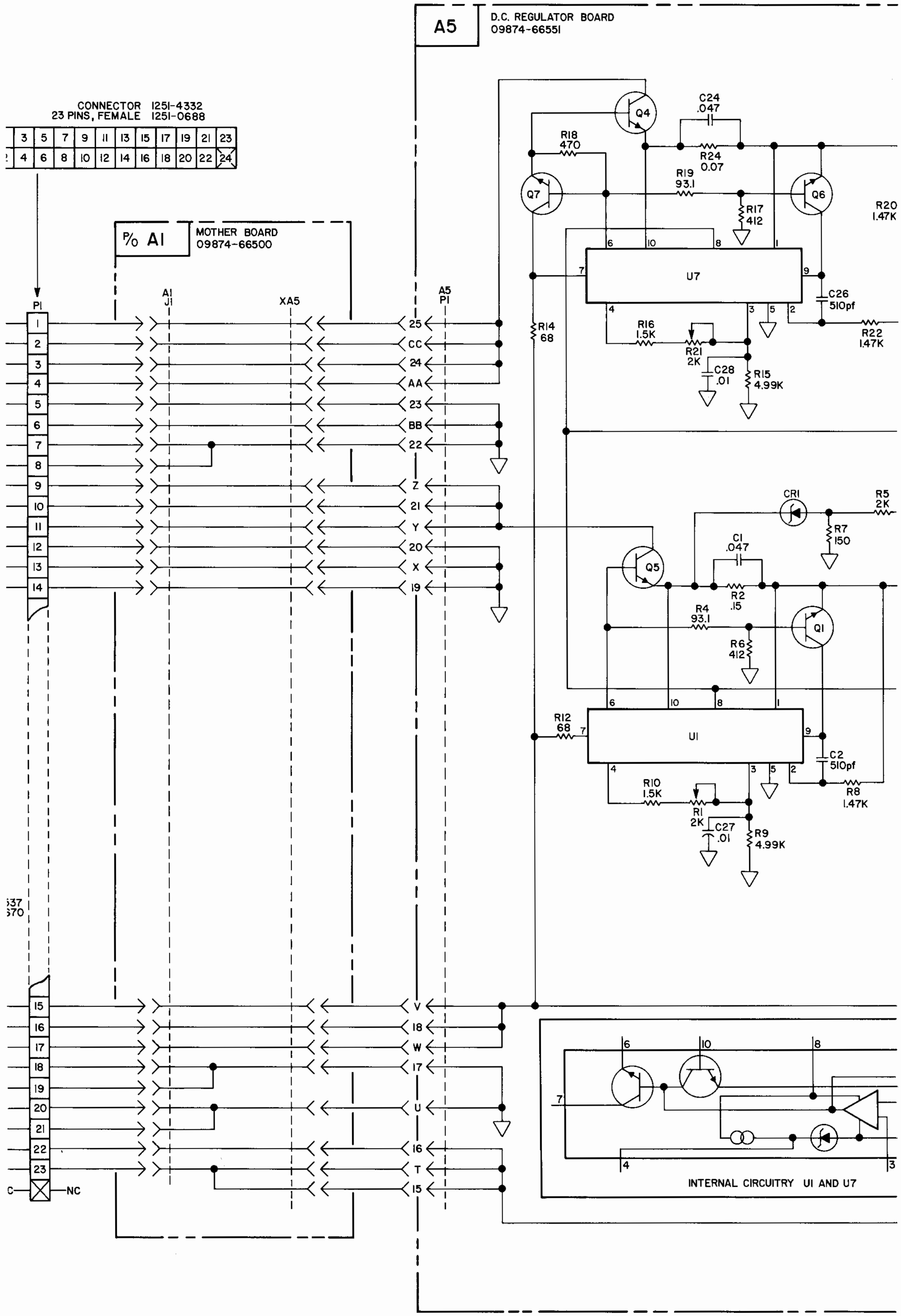
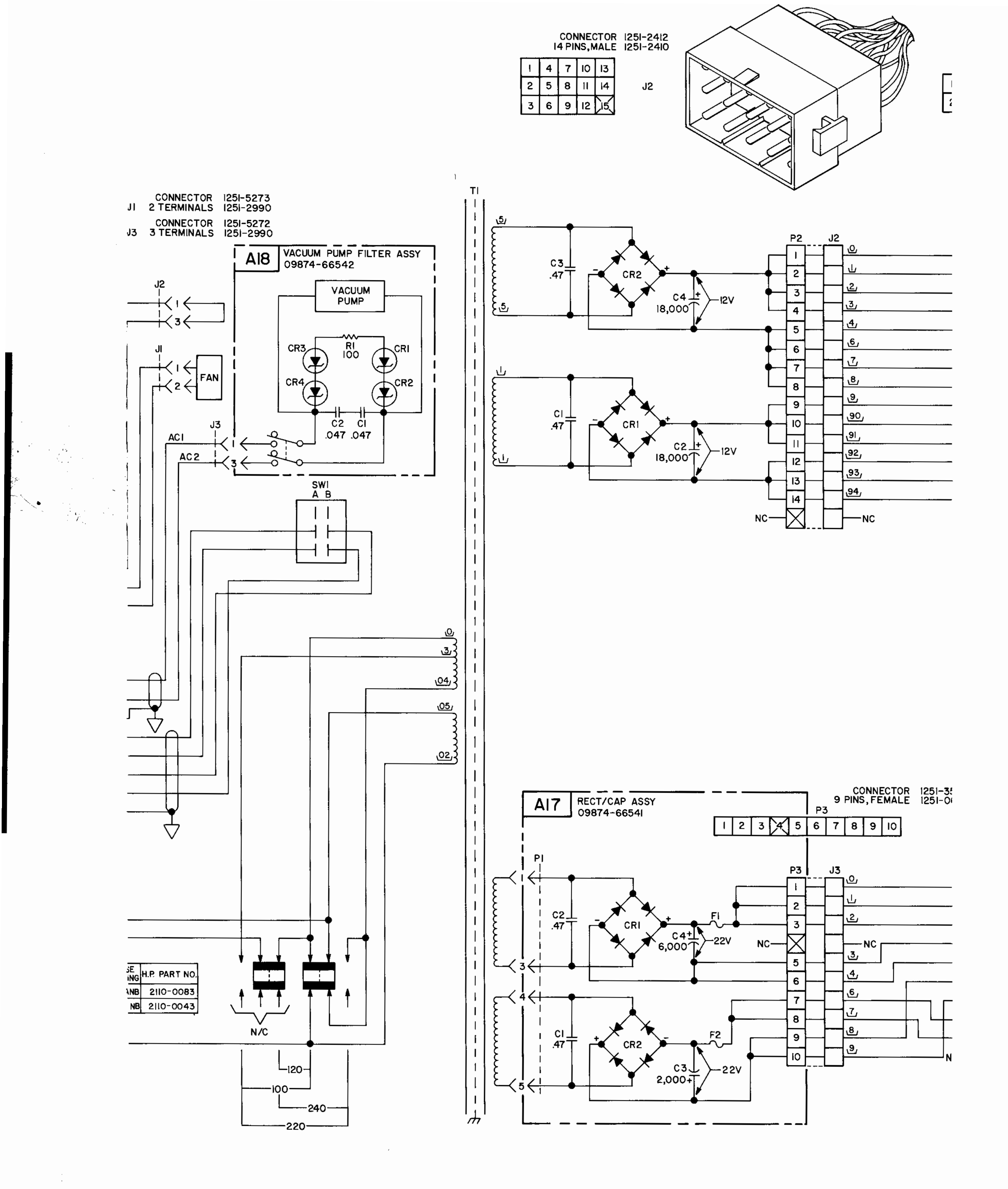


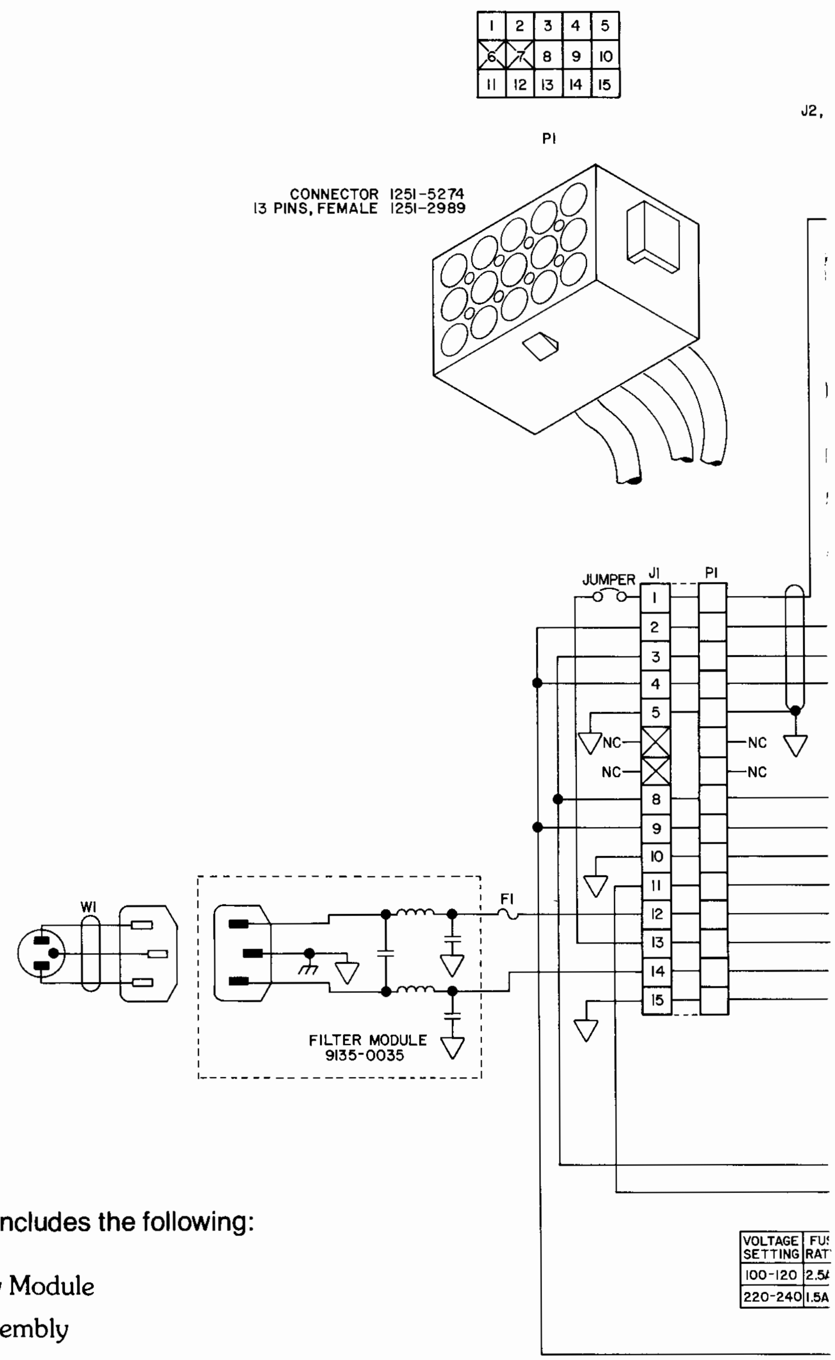
Figure 7-5: A5 Regulator Assembly Circuit Diagram



A5
D.C. REGULATOR BOARD
09874-66551
CONNECTOR 1251-4332
23 PINS, FEMALE 1251-0688
P/O A1
MOTHER BOARD
09874-66500
P1
A1 J1
XA5
A5 P1
C24 .047
R24 0.07
R18 470
R19 93.1
R17 412
R20 1.47K
Q4
Q7
Q6
U7
C26 510pf
R14 68
R16 1.5K
R21 2K
C28 .01
R15 4.99K
R22 1.47K
CR1
R5 2K
R7 150
C1 .047
R2 .15
R4 93.1
R6 412
Q5
Q1
U1
R12 68
C2 510pf
R8 1.47K
R10 1.5K
R1 2K
C27 .01
R9 4.99K
NC
INTERNAL CIRCUITRY U1 AND U7

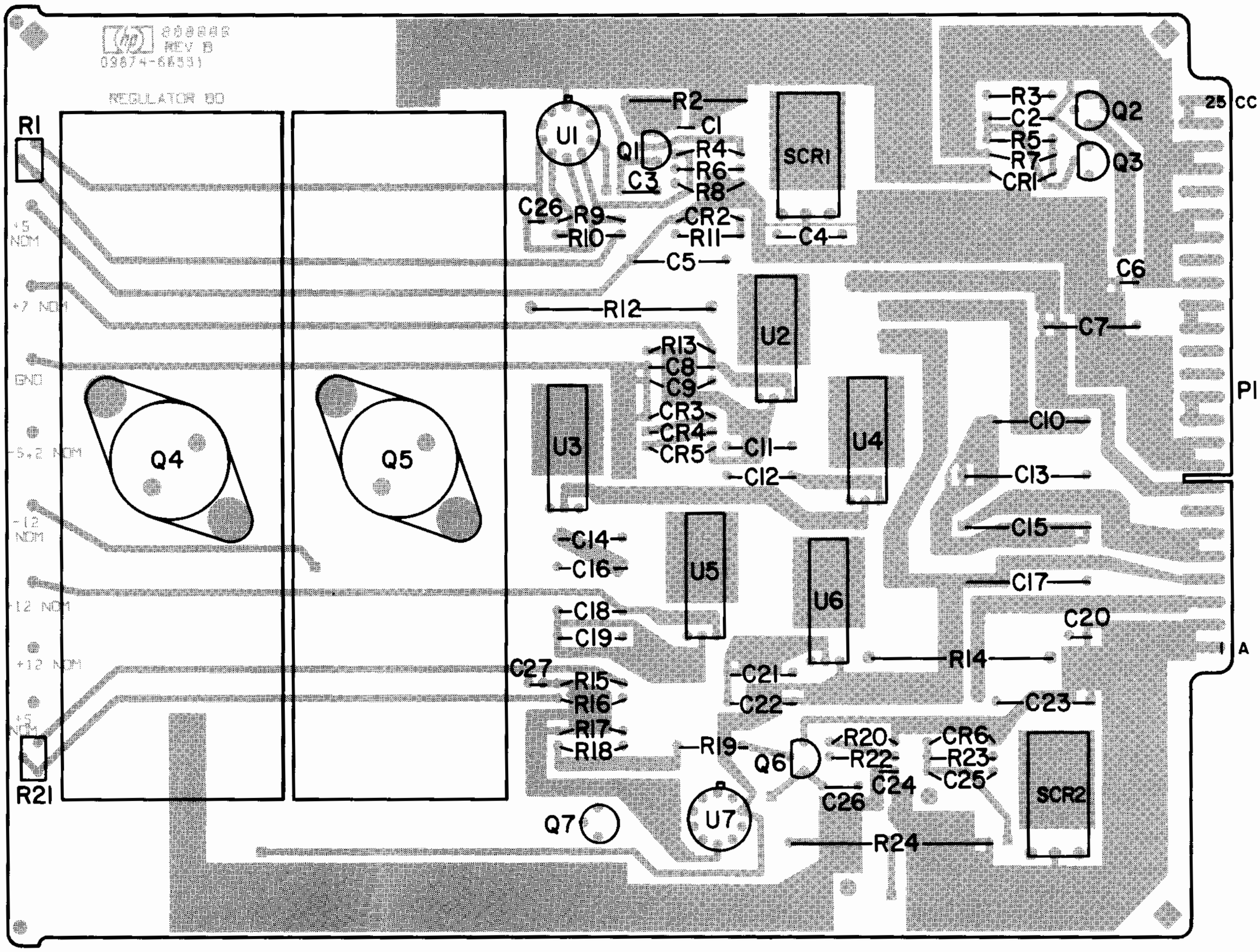


CONNECTOR 1251-2412
14 PINS, MALE 1251-2410
J2
CONNECTOR 1251-5273
J1 2 TERMINALS 1251-2990
CONNECTOR 1251-5272
J3 3 TERMINALS 1251-2990
A18 VACUUM PUMP FILTER ASSY 09874-66542
VACUUM PUMP
R1 100
CR1 CR2 CR3 CR4
C2 .047 C1 .047
FAN
AC1
AC2
SW1 A B
T1
C3 .47
CR2
C4 18,000
12V
C1 .47
CR1
C2 18,000
12V
P2
J2
NC
N/C
120
100
240
220
H.P. PART NO.
2110-0083
2110-0043
A17 RECT/CAP ASSY 09874-66541
CONNECTOR 1251-3
9 PINS, FEMALE 1251-0
P3
J3
P1
C2 .47
CR1
F1
C4 6,000
22V
C1 .47
CR2
F2
C3 2,000
22V



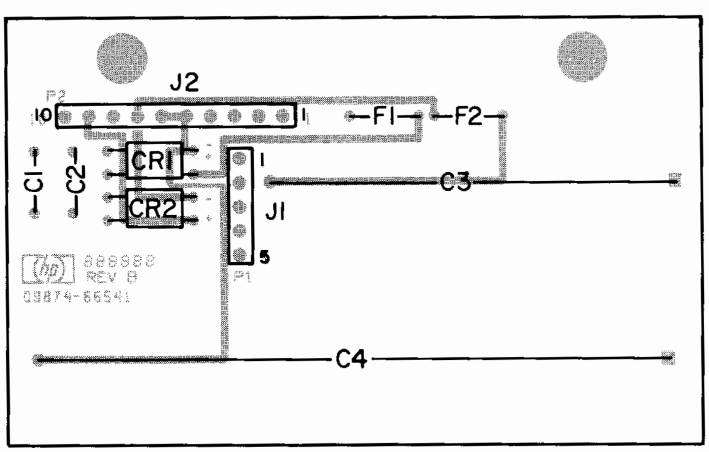
This circuit diagram includes the following:

- Power Supply Module
- AC Cable Assembly
- DC Cable Assembly
- A17 Rectifier / Capacitor Assembly
- Vacuum Pump Module
- A18 Filter Assembly



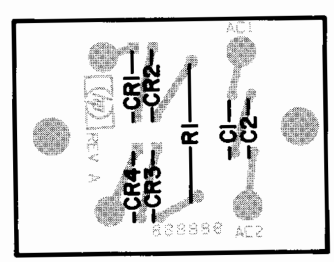
COMPONENT SIDE A5

-hp- Part No. 09874-66551 Rev B



COMPONENT SIDE A17

-hp- Part No. 09874-66541 Rev B



COMPONENT SIDE A18

-hp- Part No. 09874-66542 Rev A

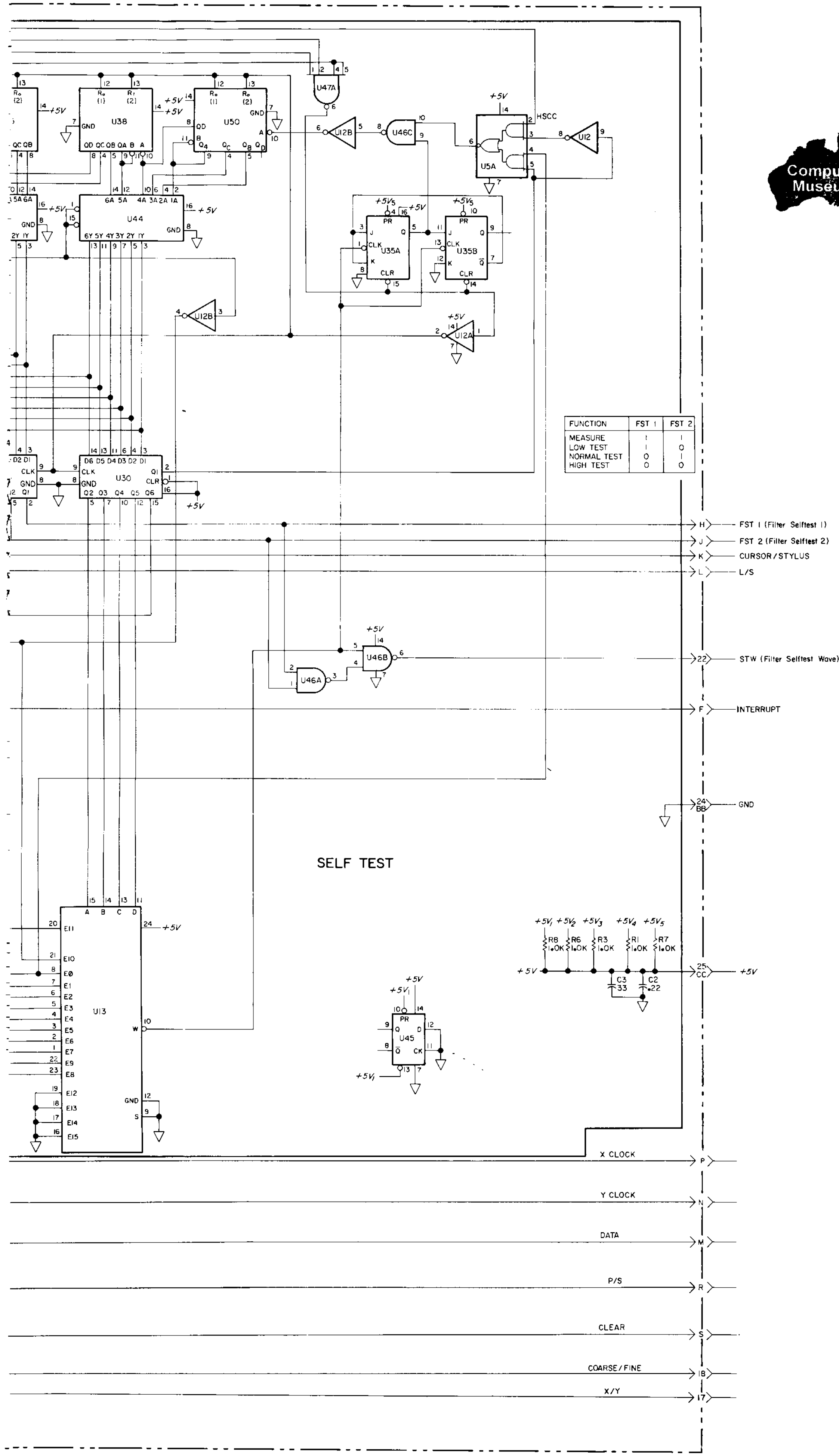
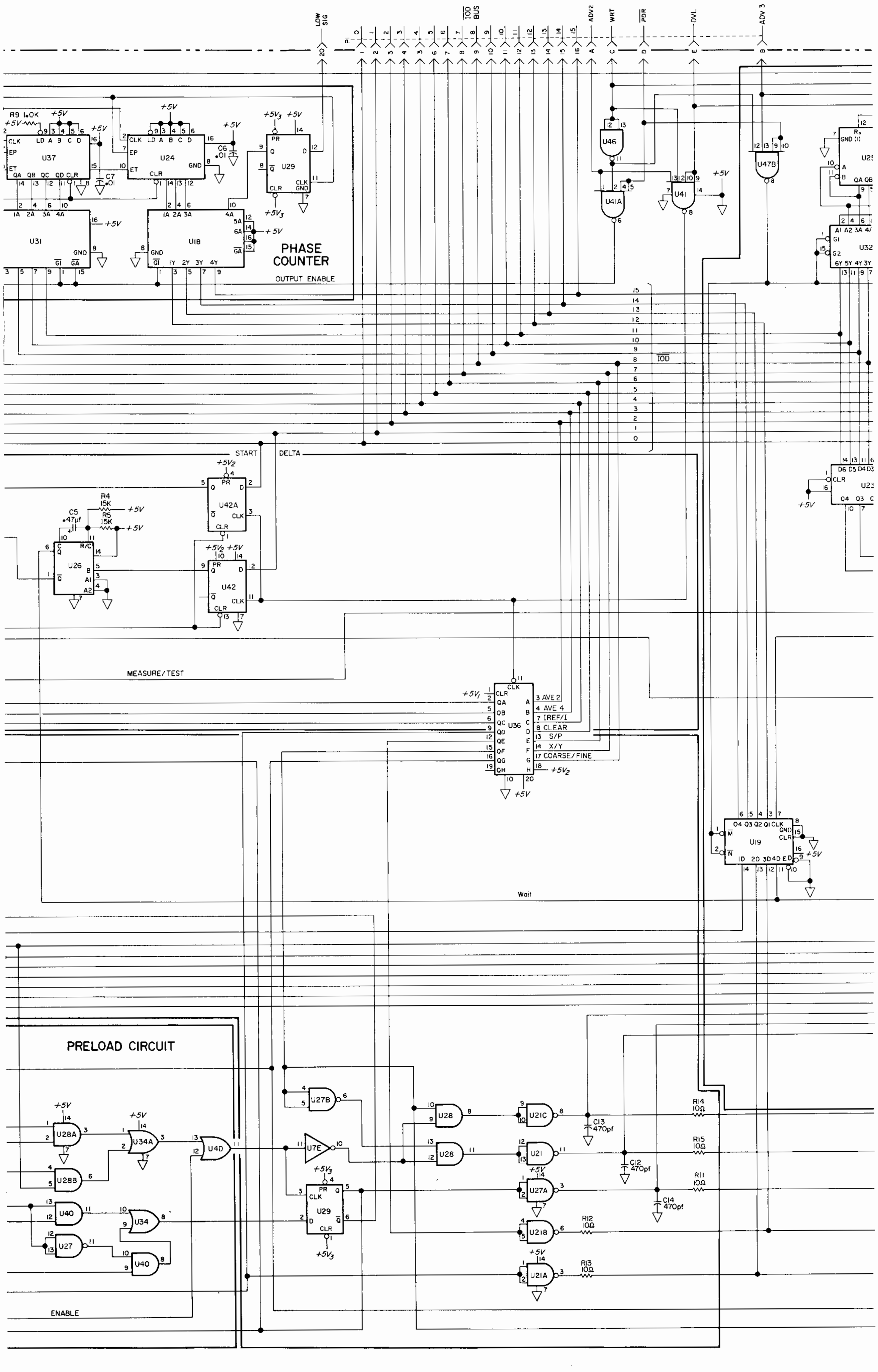
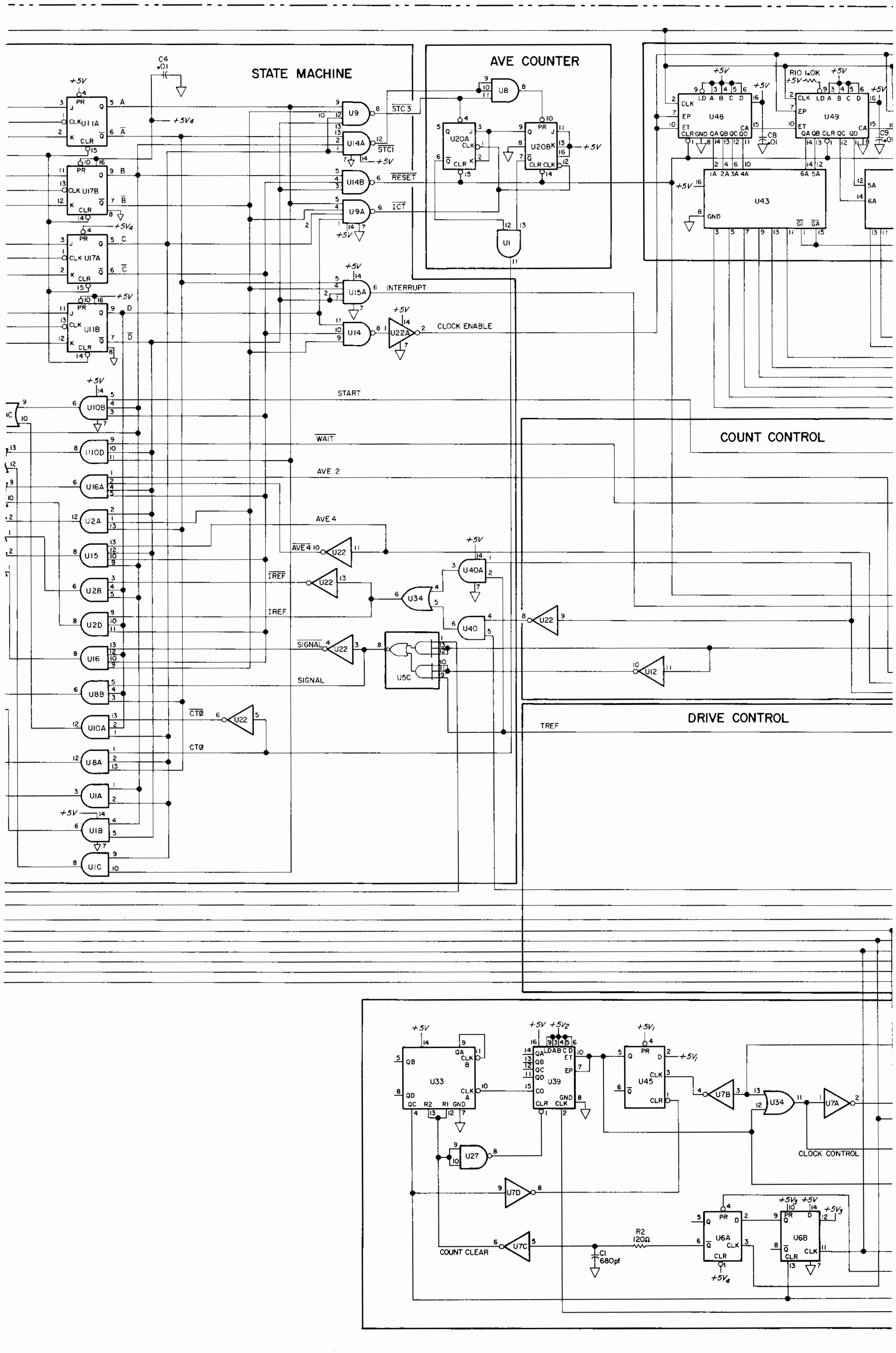
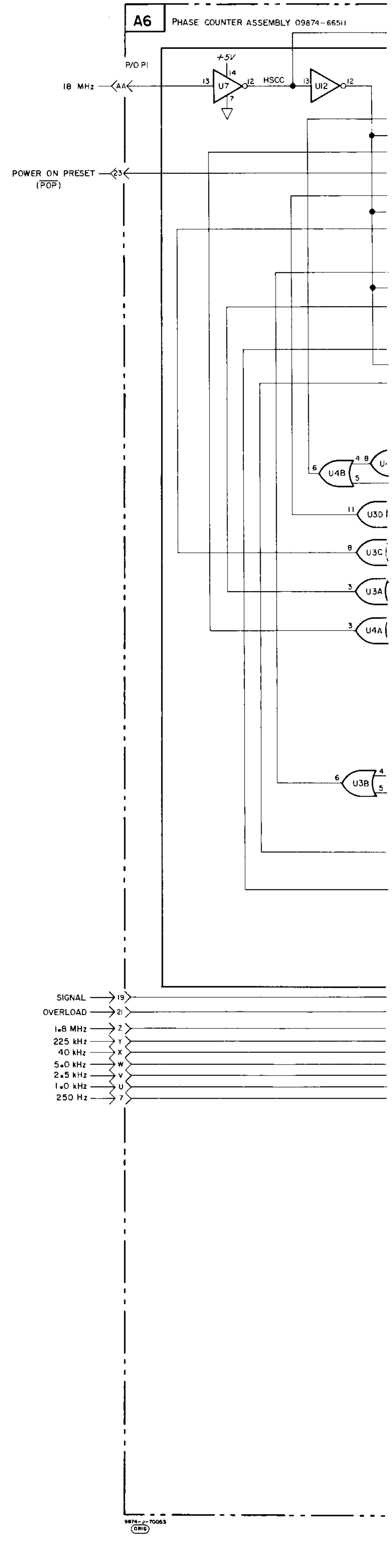
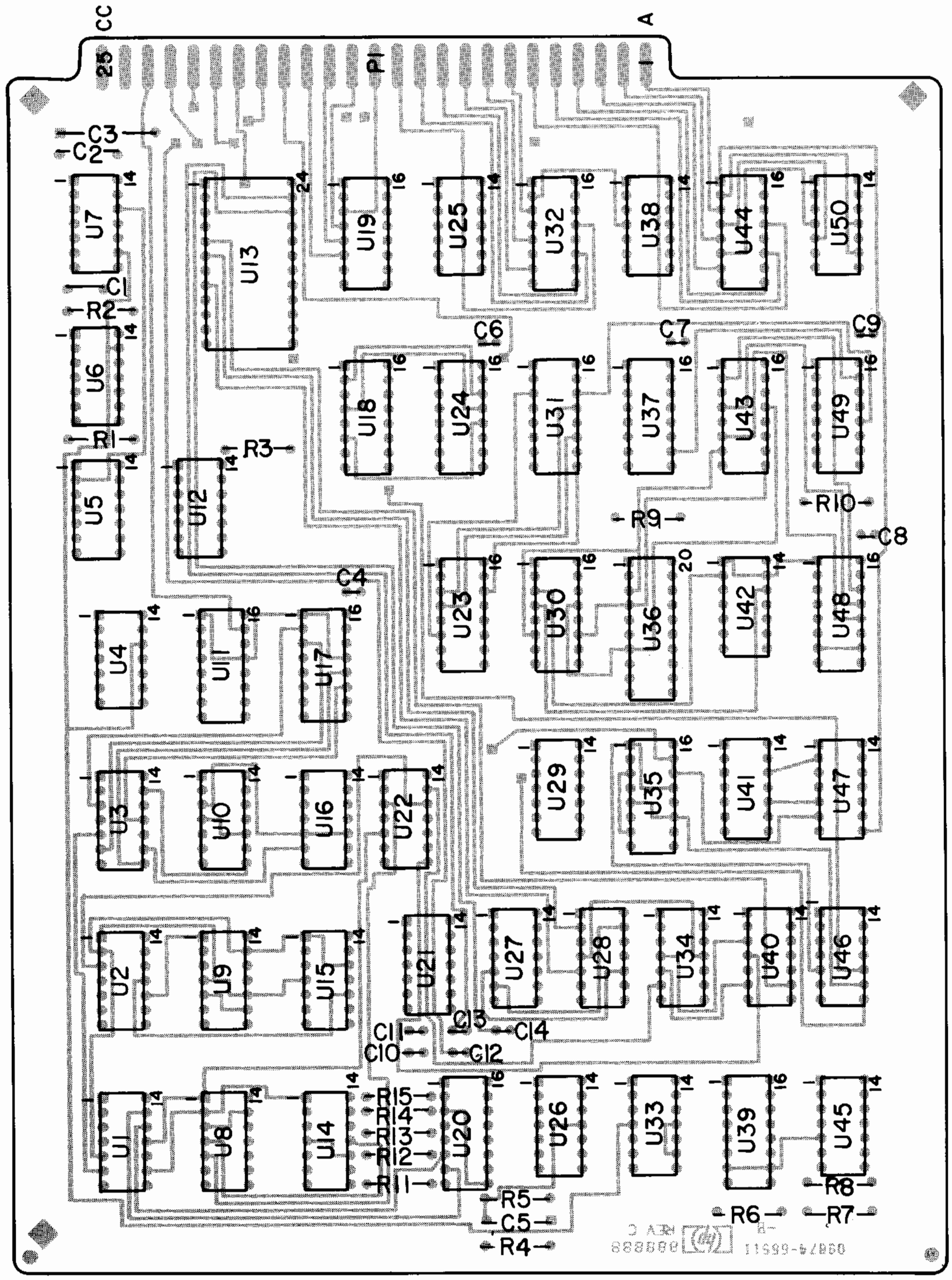


Figure 7-6: A6 Phase Counter Assembly Circuit Diagram


PHASE COUNTER
OUTPUT ENABLE
PRELOAD CIRCUIT
START
DELTA
MEASURE/TEST
ENABLE
Wait
IOD BUS
LOW SIG
ADV2
WRT
PDR
DVL
ADV 3
AVE 2
AVE 4
IREF/I
CLEAR
S/P
X/Y
COARSE/FINE


STATE MACHINE
AVE COUNTER
COUNT CONTROL
DRIVE CONTROL
STC 3
STC1
RESET
ICT
INTERRUPT
CLOCK ENABLE
START
WAIT
AVE 2
AVE 4
AVE 4
IREF
IREF
SIGNAL
SIGNAL
CTØ
CTØ
TREF
COUNT CLEAR
CLOCK CONTROL
U43
U48
U49
U33
U39
U45
U34
U5C
R10 1.0K
R2 120Ω
C1 680pf
C4 .01
C8 .01
C9 .01


A6
PHASE COUNTER ASSEMBLY 09874-66511
P/O P1
+5V
18 MHz
AA
U7
HSCC
U12
POWER ON PRESET
(POP)
23
U4B
U3D
U3C
U3A
U4A
U3B
SIGNAL
19
OVERLOAD
21
1.8 MHz
Z
225 kHz
Y
40 kHz
X
5.0 kHz
W
2.5 kHz
V
1.0 kHz
U
250 Hz
T
9874-J-70063



COMPONENT SIDE
A6

-hp- Part No. 09874-66511 Rev C

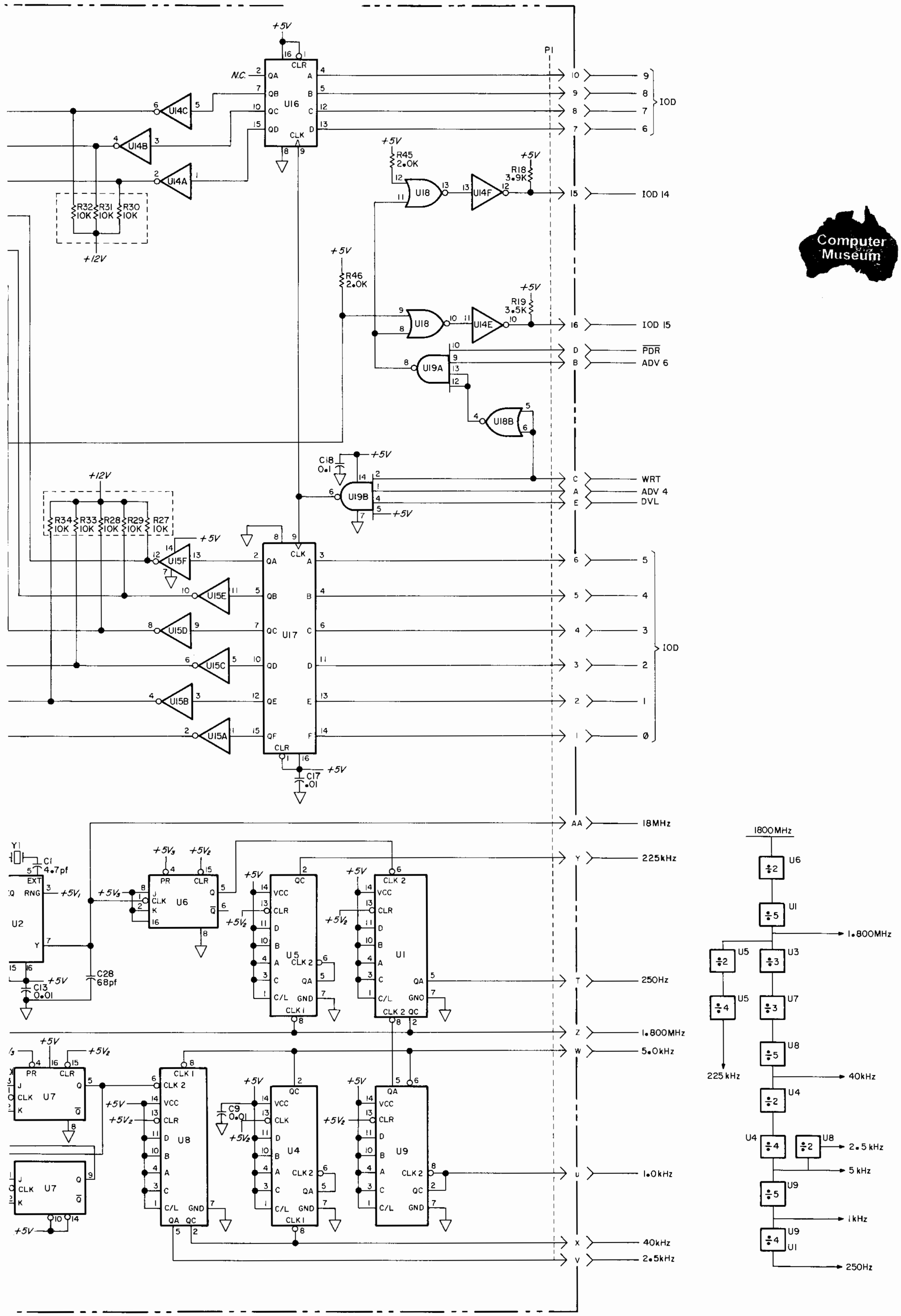
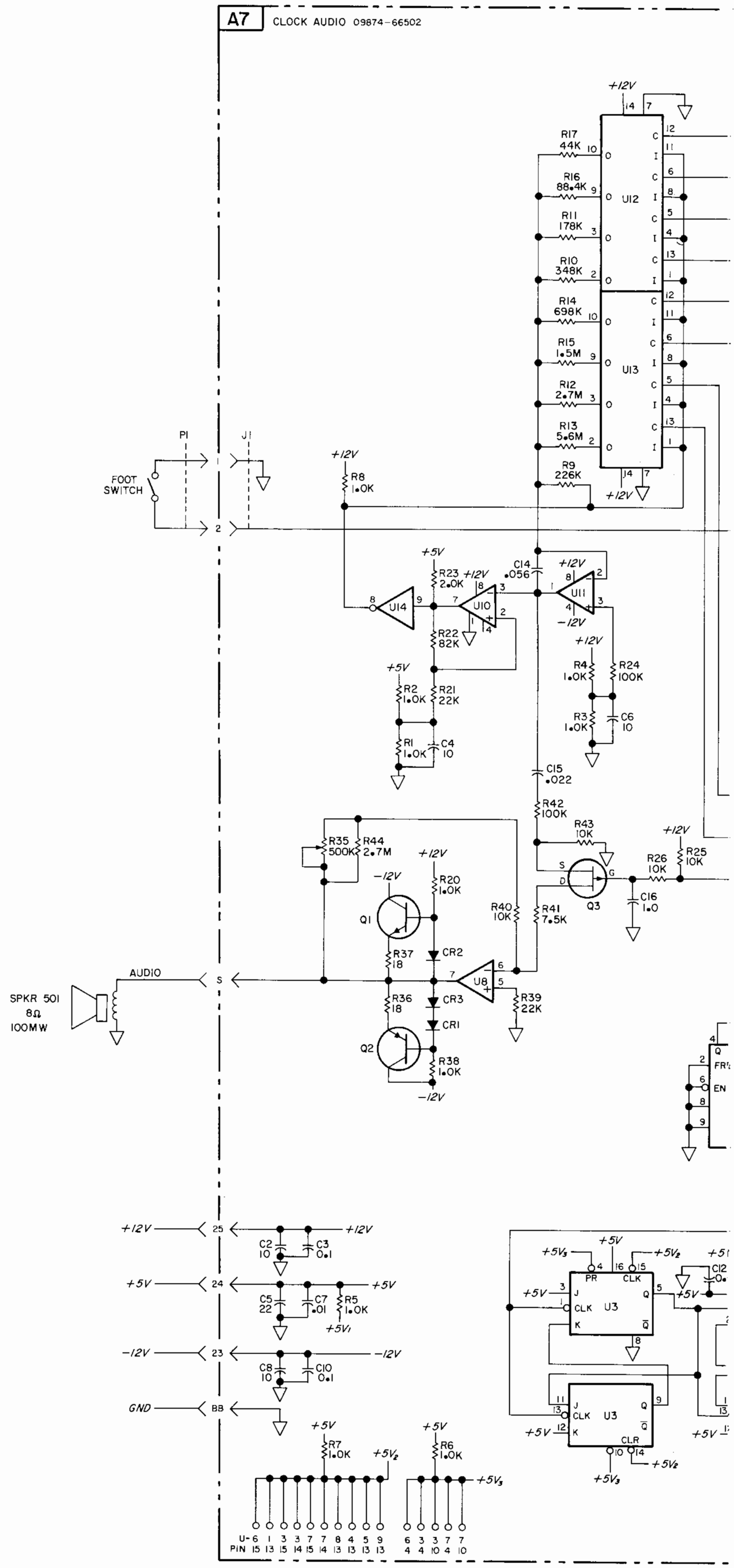
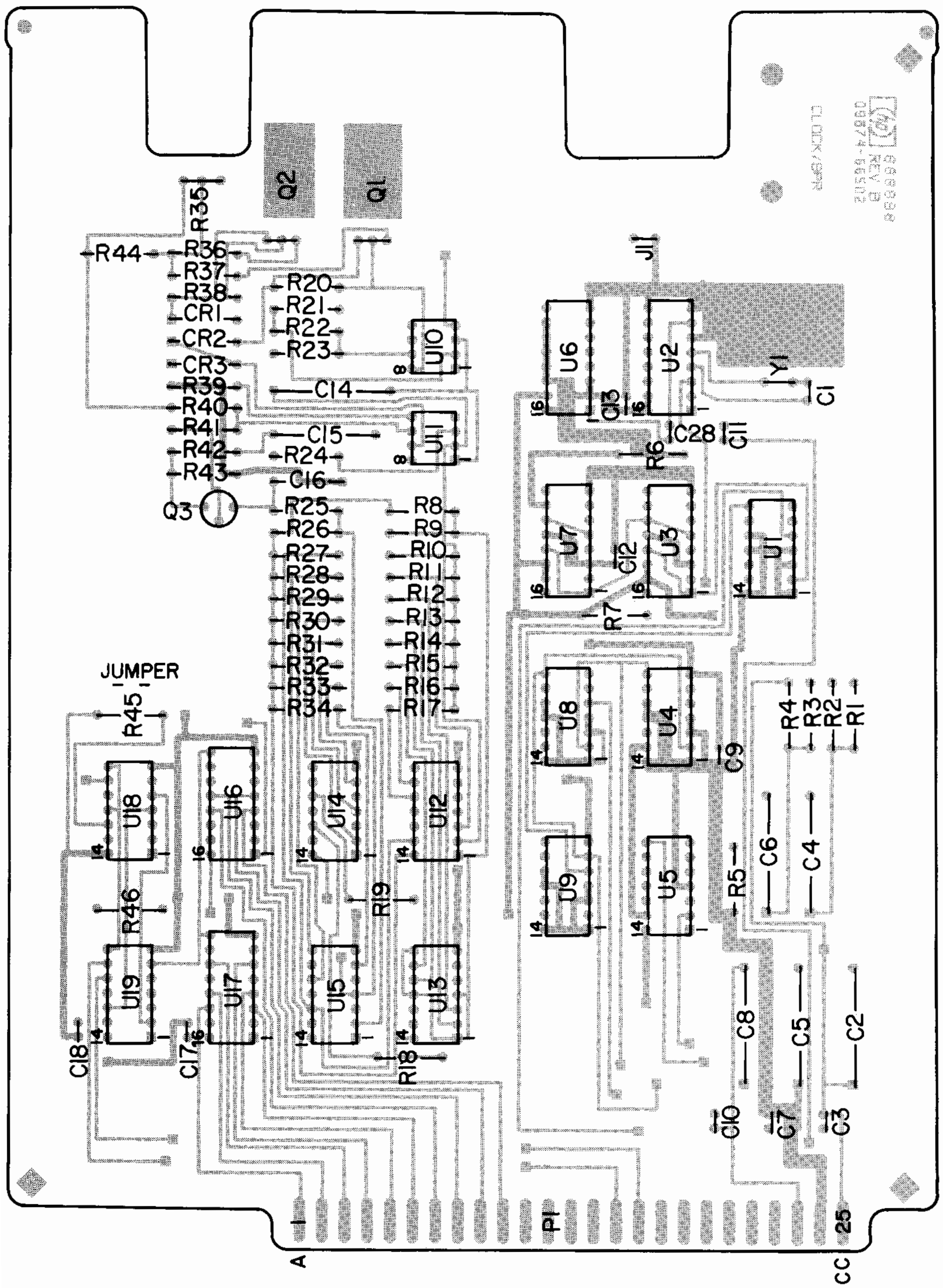


Figure 7-7: A7 Clock/Audio Assembly Circuit Diagram


A7
CLOCK AUDIO 09874-66502
U12
U13
U14
U10
U11
U8
U3
Q1
Q2
Q3
FOOT SWITCH
P1
J1
SPKR 501
8Ω
100MW
AUDIO
+12V
+5V
-12V
GND
R17 44K
R16 88.4K
R11 178K
R10 348K
R14 698K
R15 1.5M
R12 2.7M
R13 5.6M
R9 226K
R8 1.0K
C14 .056
R23 2.0K
R22 82K
R21 22K
R2 1.0K
R1 1.0K
C4 10
R4 1.0K
R24 100K
R3 1.0K
C6 10
C15 .022
R42 100K
R43 10K
R35 500K
R44 2.7M
R20 1.0K
R37 18
R36 18
R38 1.0K
R40 10K
R41 7.5K
R39 22K
CR1
CR2
CR3
R26 10K
R25 10K
C16 1.0
C2 10
C3 0.1
C5 22
C7 .01
R5 1.0K
C8 10
C10 0.1
R7 1.0K
R6 1.0K
C12
U-6
PIN



COMPONENT SIDE
A7

-hp- Part No. 09874-66502 Rev B

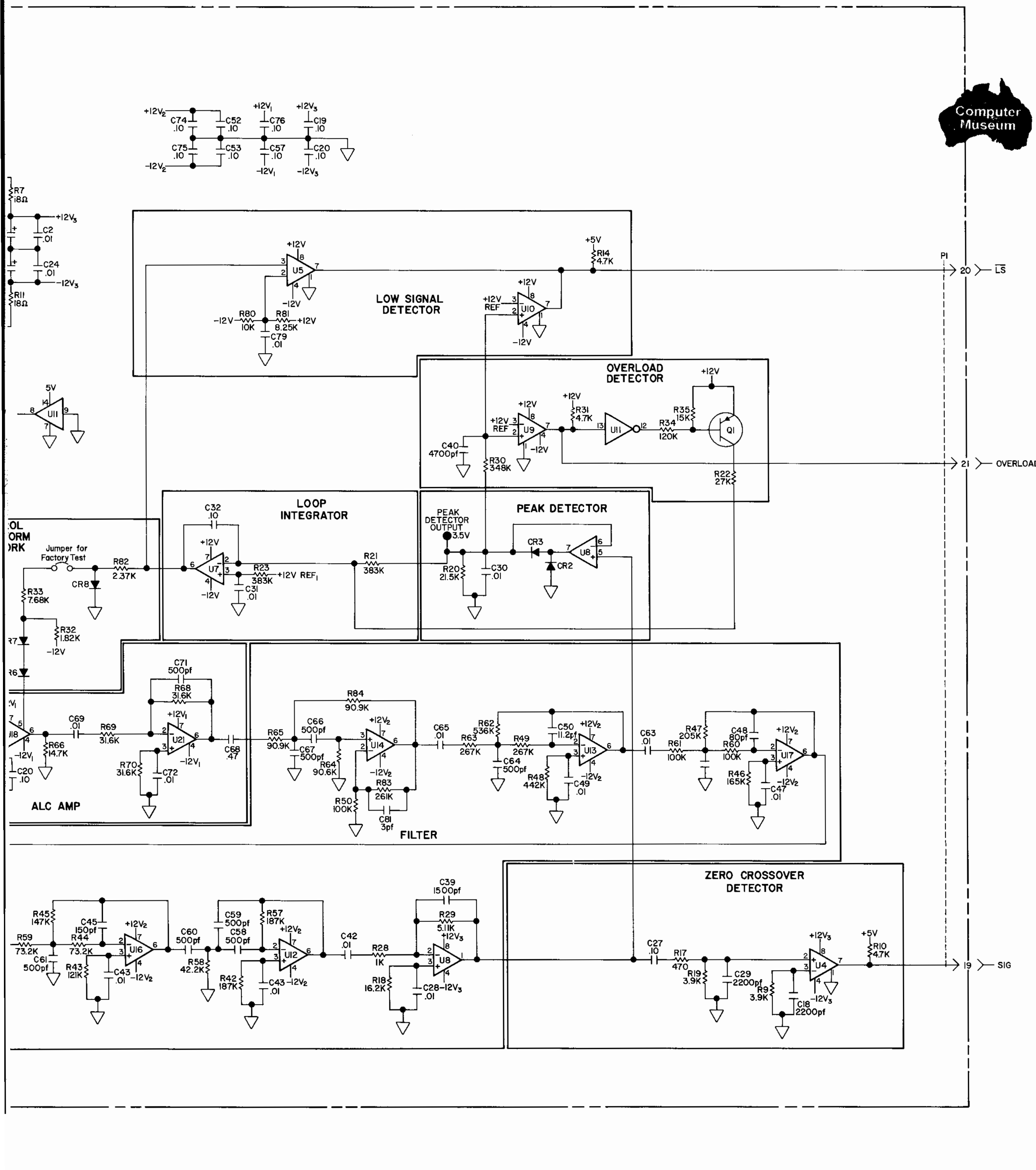
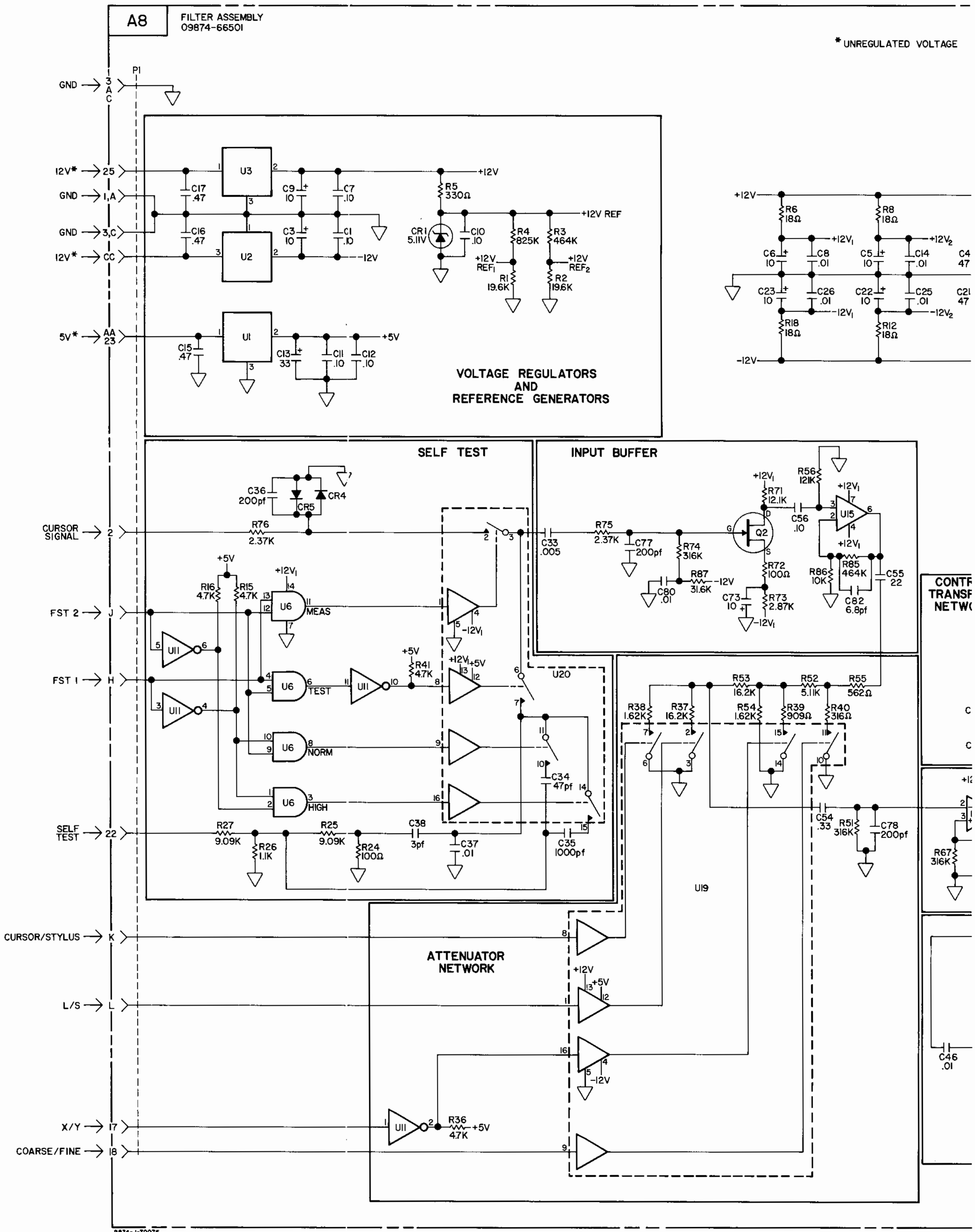
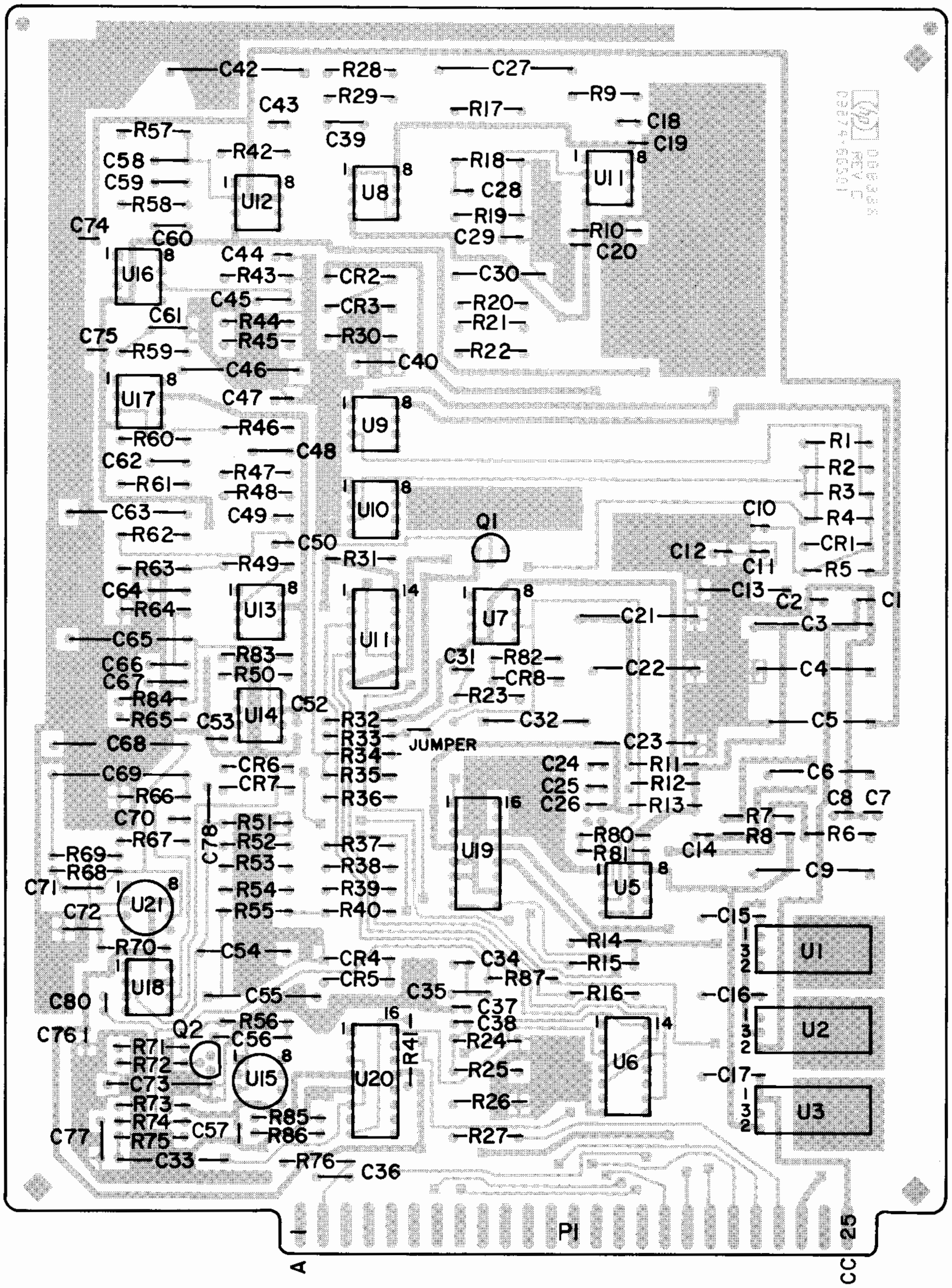


Figure 7-8: A8 Filter Assembly Circuit Diagram


A8
FILTER ASSEMBLY
09874-66501
* UNREGULATED VOLTAGE
GND
12V*
5V*
CURSOR SIGNAL
FST 2
FST 1
SELF TEST
CURSOR/STYLUS
L/S
X/Y
COARSE/FINE
P1
VOLTAGE REGULATORS
AND
REFERENCE GENERATORS
+12V REF
SELF TEST
INPUT BUFFER
ATTENUATOR NETWORK
U19
U20
MEAS
TEST
NORM
HIGH
9874-J-T0076



COMPONENT SIDE
A8

-hp- Part No. 09874-66501 Rev C

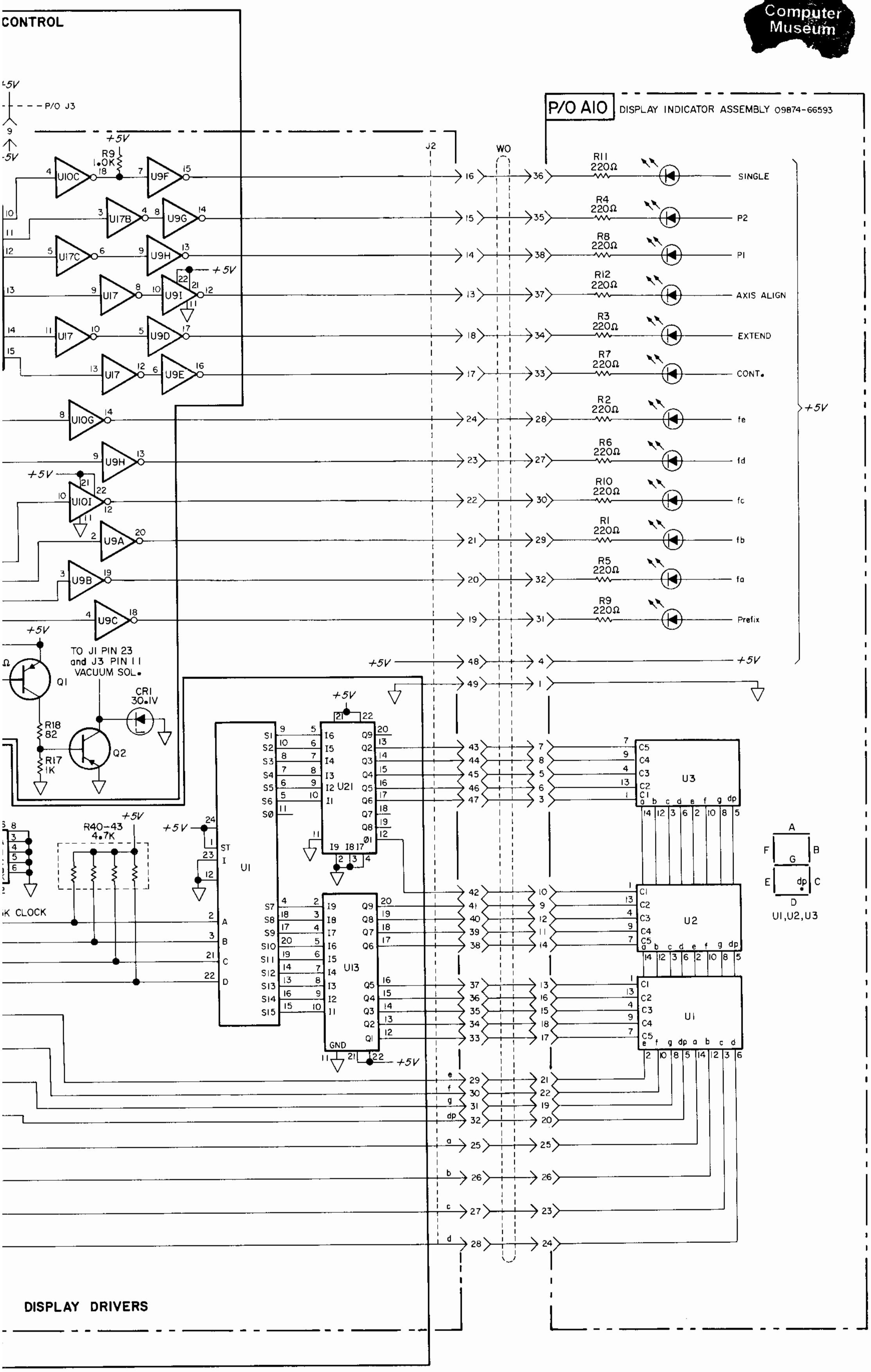
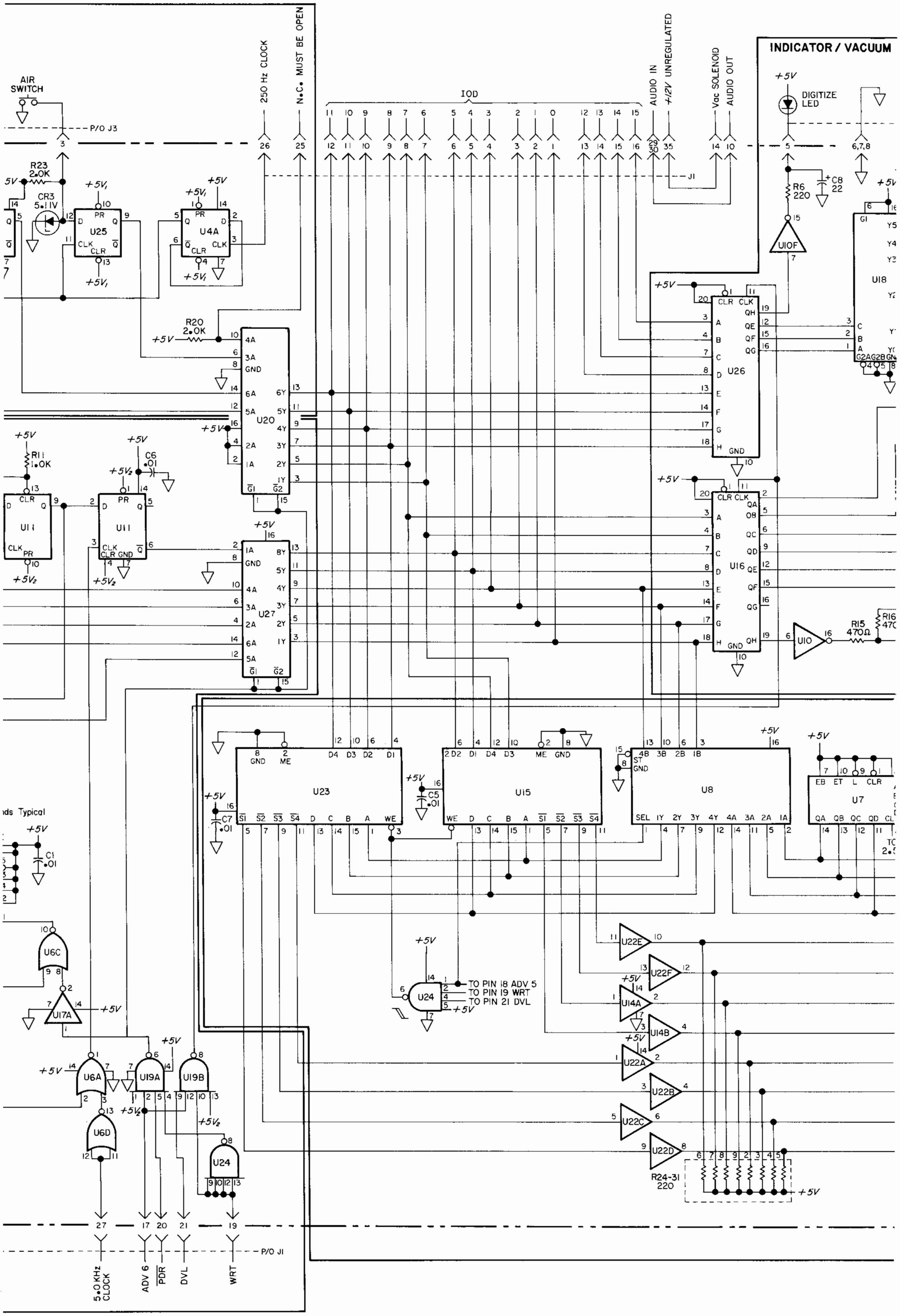
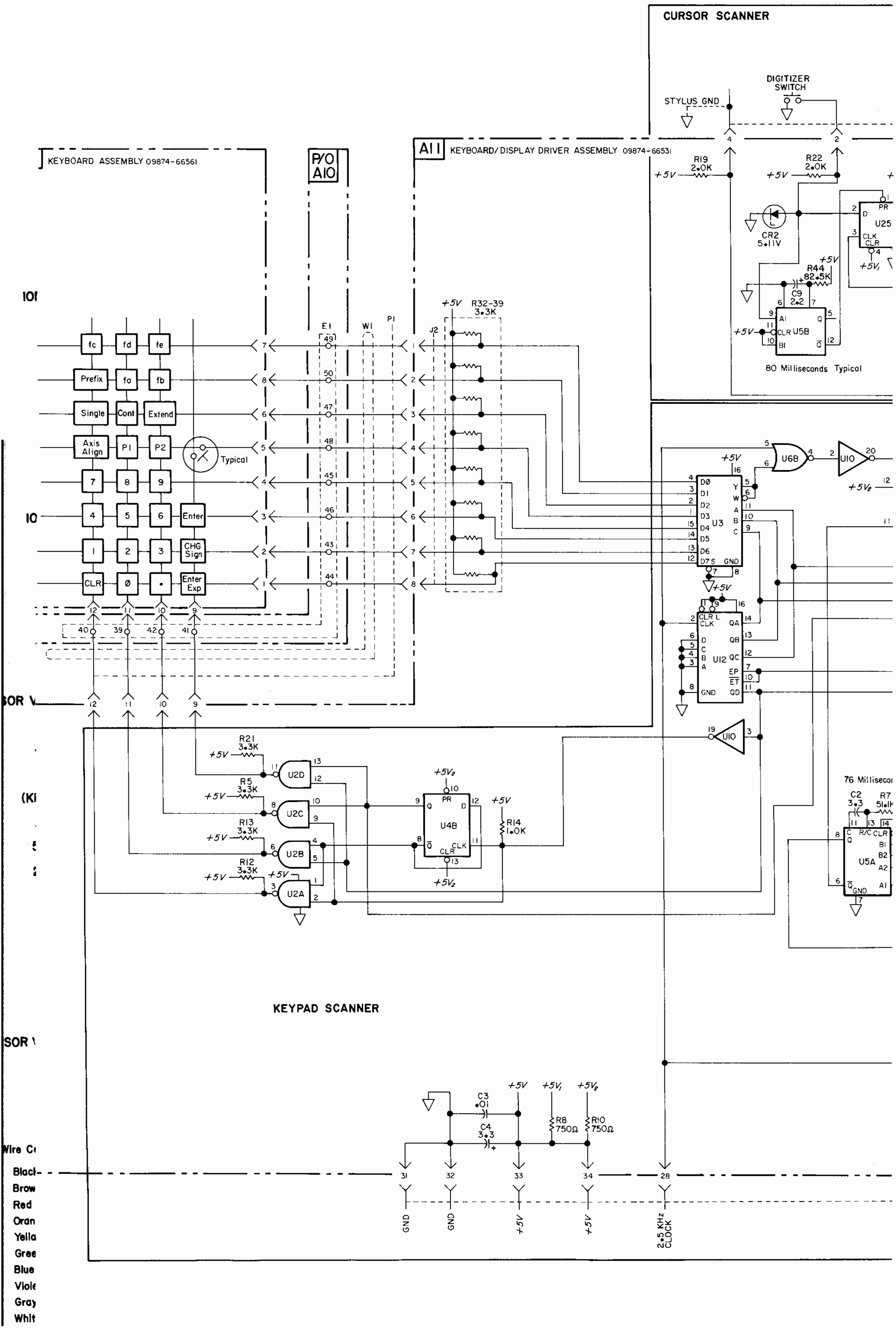


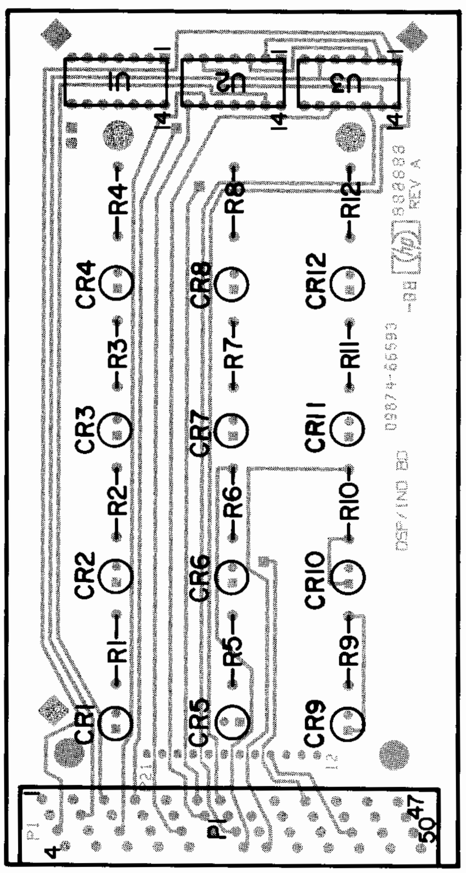
Figure 7-9: A9 Keyboard Assembly Circuit Diagram
A10 Display Indicator Assembly Circuit Diagram
A11 Keyboard/Display Driver Assembly Circuit Diagram



INDICATOR / VACUUM
AIR SWITCH
P/O J3
250 Hz CLOCK
N.C. MUST BE OPEN
IOD
AUDIO IN
+12V UNREGULATED
Vac SOLENOID
AUDIO OUT
DIGITIZE LED
J1
R23 2.0K
CR3 5.1 V
U25
U4A
R20 2.0K
U20
U26
U18
R6 220
C8 22
U10F
U16
U10
R15 470Ω
R16 470
R11 1.0K
C6 .01
U11
U27
U23
U15
U8
U7
C5 .01
C7 .01
C1 .01
U6C
U17A
U6A
U19A
U19B
U6D
U24
TO PIN 18 ADV 5
TO PIN 19 WRT
TO PIN 21 DVL
U22E
U22F
U14A
U14B
U22A
U22B
U22C
U22D
R24-31 220
P/O J1
5.0 KHz CLOCK
ADV 6
PDR
DVL
WRT

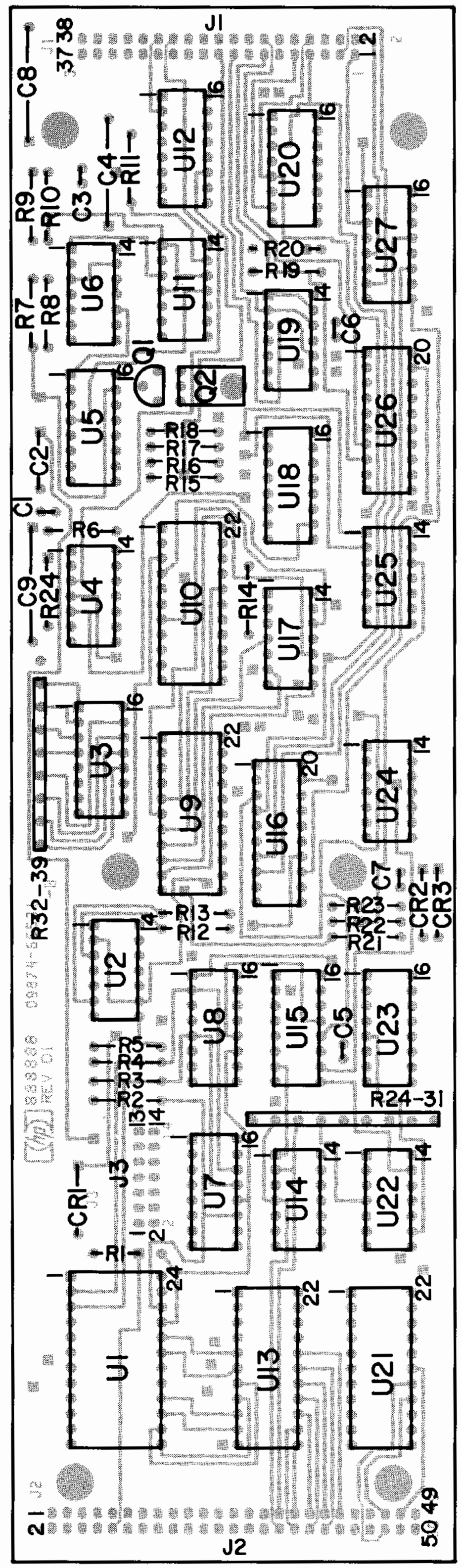


CURSOR SCANNER
DIGITIZER SWITCH
STYLUS GND
KEYBOARD ASSEMBLY 09874-66561
P/O A10
A11
KEYBOARD/DISPLAY DRIVER ASSEMBLY 09874-66531
R19 2.0K
R22 2.0K
CR2 5.11V
U25
R44 82.5K
C9 2.2
U5B
80 Milliseconds Typical
R32-39 3.3K
fc
fd
fe
Prefix
fa
fb
Single
Cont
Extend
Axis Align
P1
P2
Typical
Enter
CHG Sign
CLR
Enter Exp
E1
W1
P1
J2
U6B
U10
U3
U12
R21 3.3K
R5 3.3K
R13 3.3K
R12 3.3K
U2D
U2C
U2B
U2A
U4B
R14 1.0K
76 Millisecon
C2 3.3
R7 51.1K
U5A
KEYPAD SCANNER
C3 .01
C4 3.3
R8 750Ω
R10 750Ω
GND
GND
+5V
+5V
2.5 KHz CLOCK
Black
Brow
Red
Oran
Yello
Gree
Blue
Viole
Gray
Whit



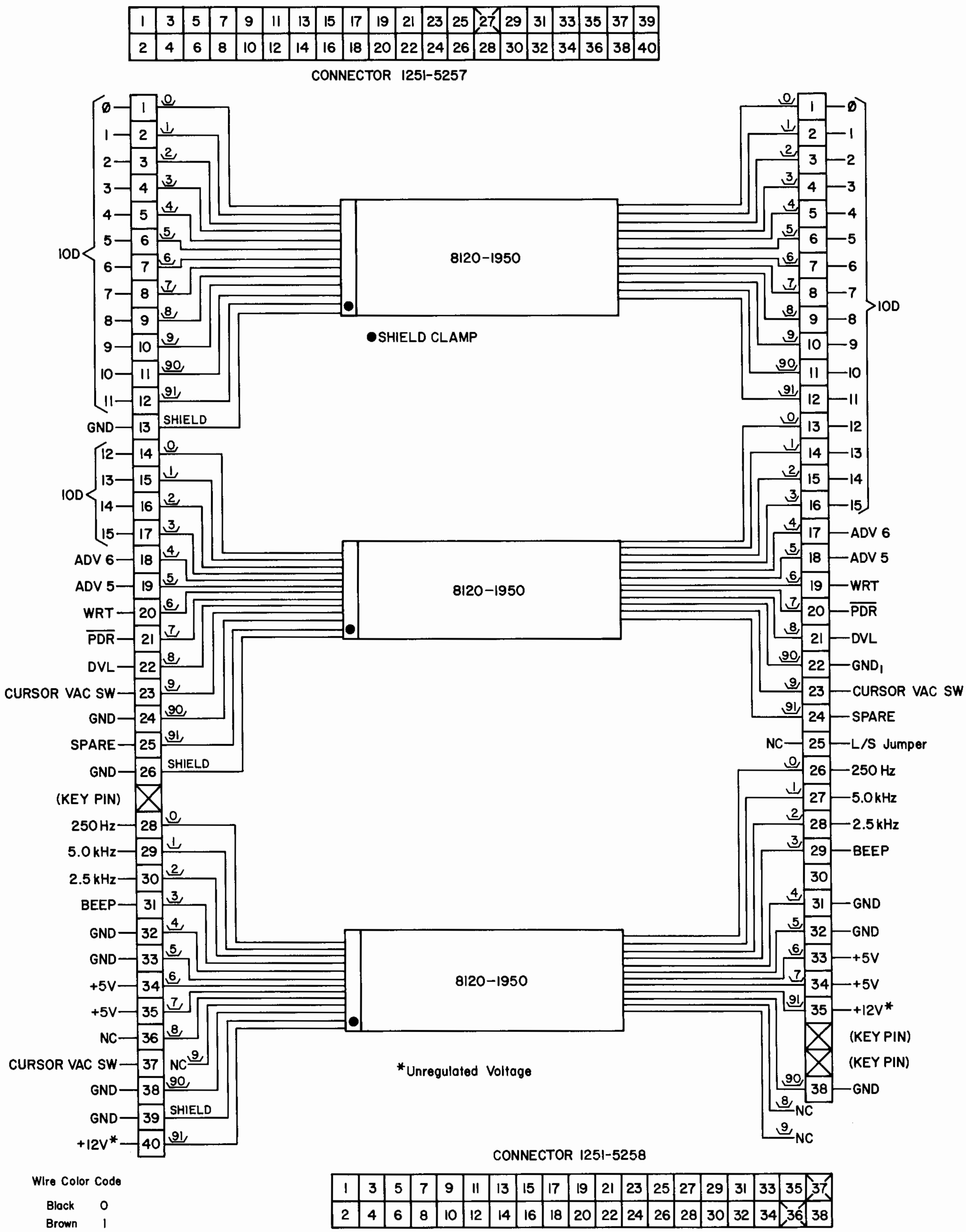
COMPONENT SIDE A10

-hp- Part No. 09874-66593 Rev A



COMPONENT SIDE A11

-hp- Part No. 09874-66531 Rev D



Wire Color Code

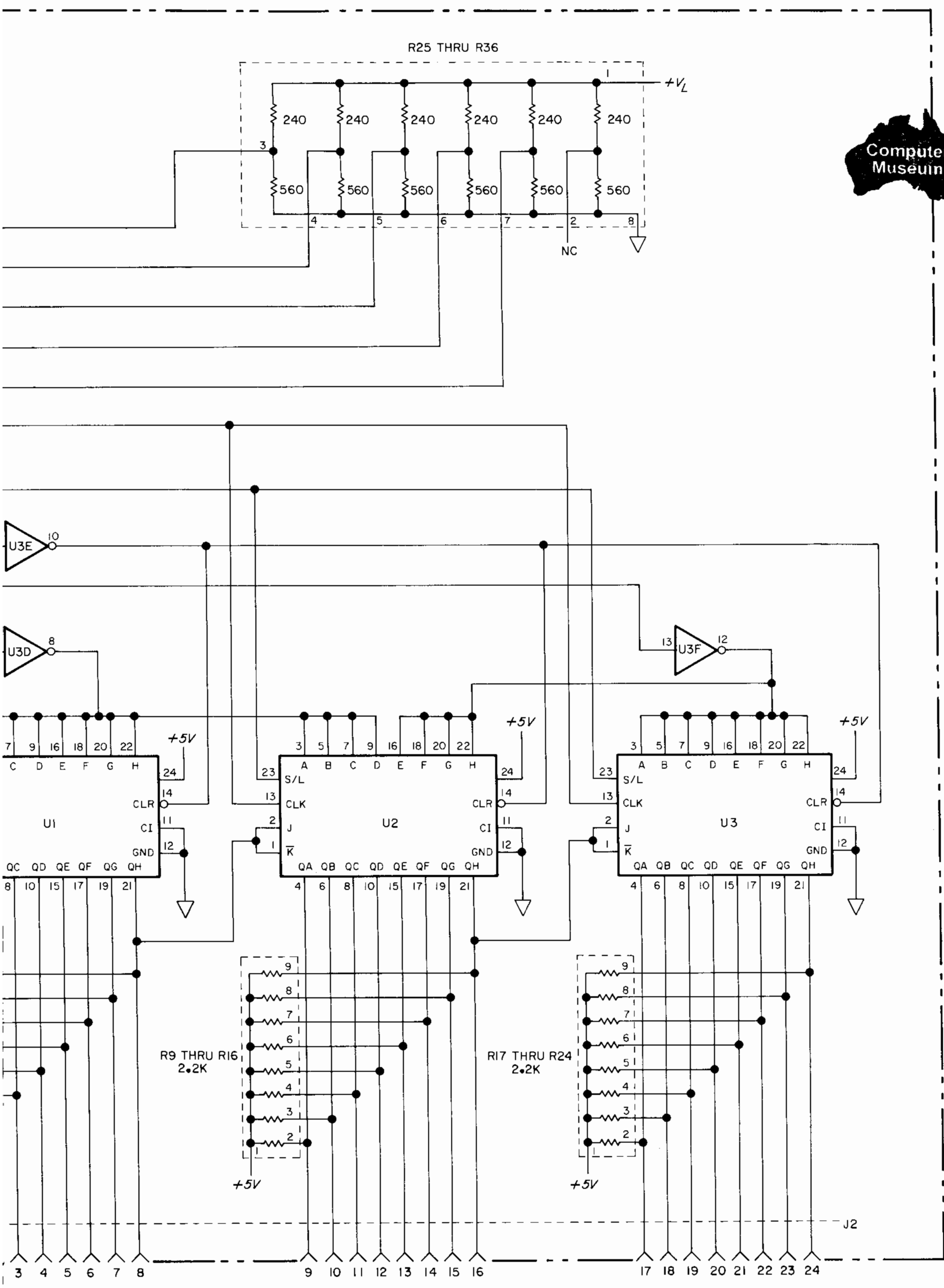
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

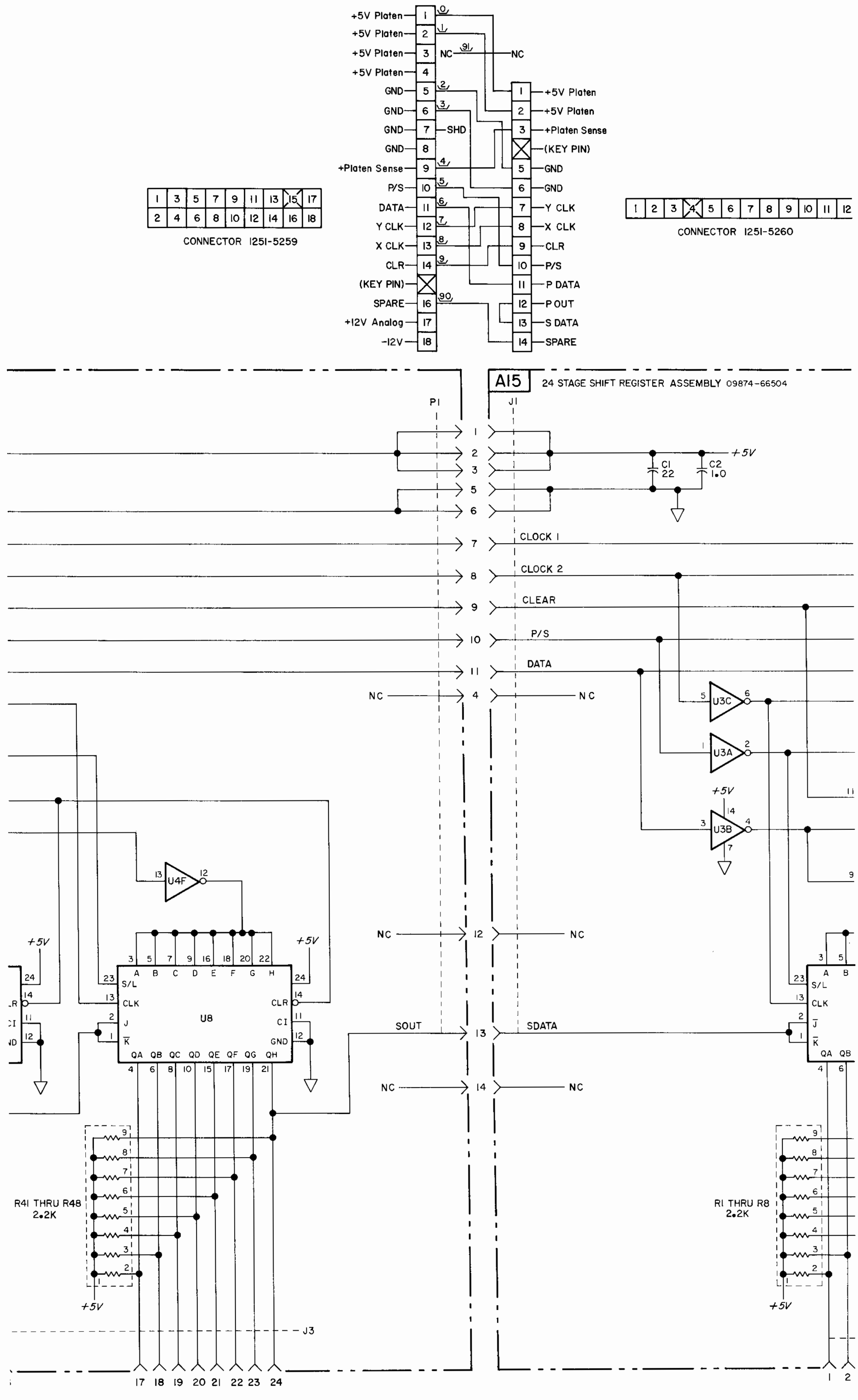
Keypad Cable

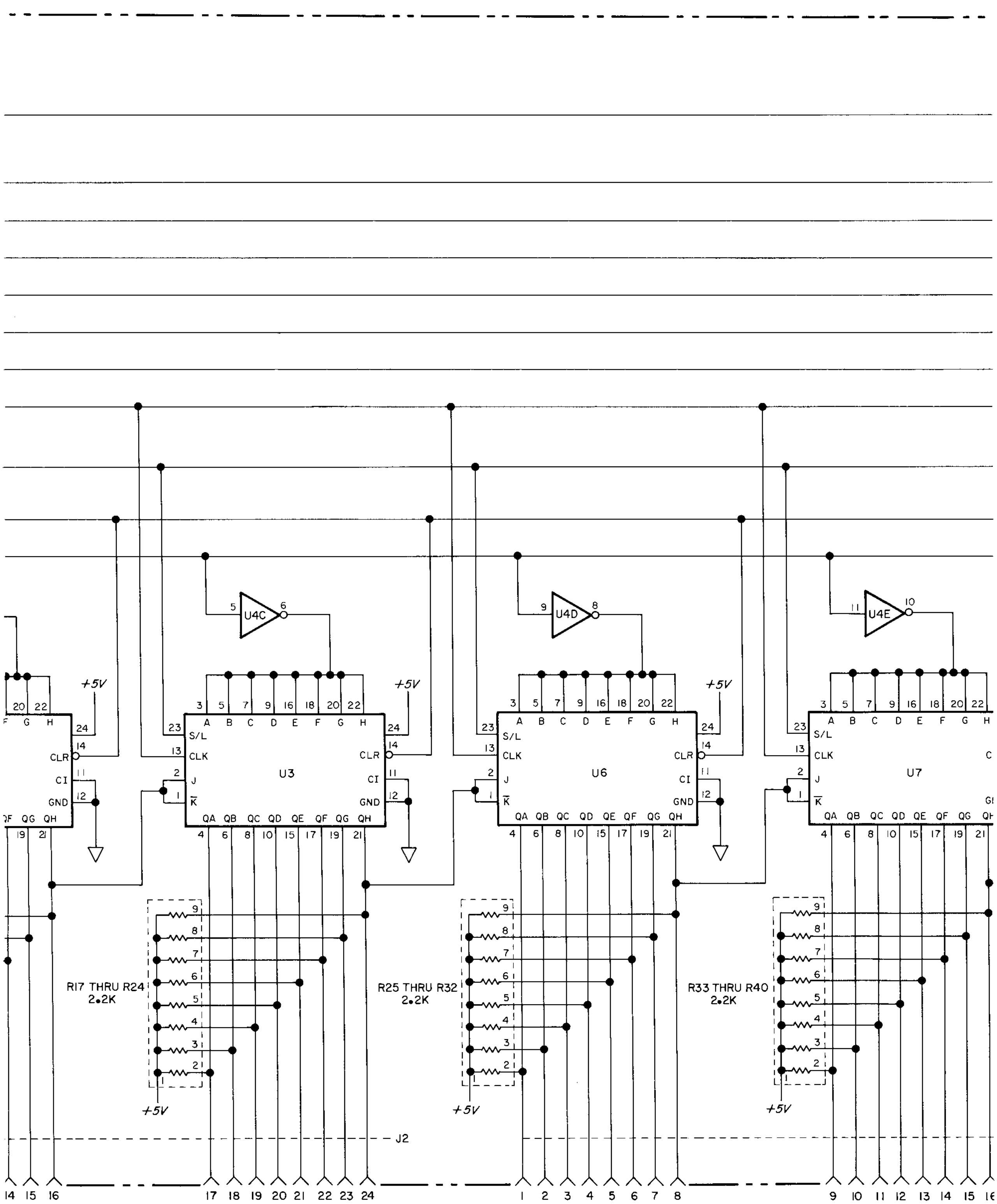
13 14

Figure 7-10: A12, A13, A14 48 Stage Shift Register Assemblies Circuit Diagram

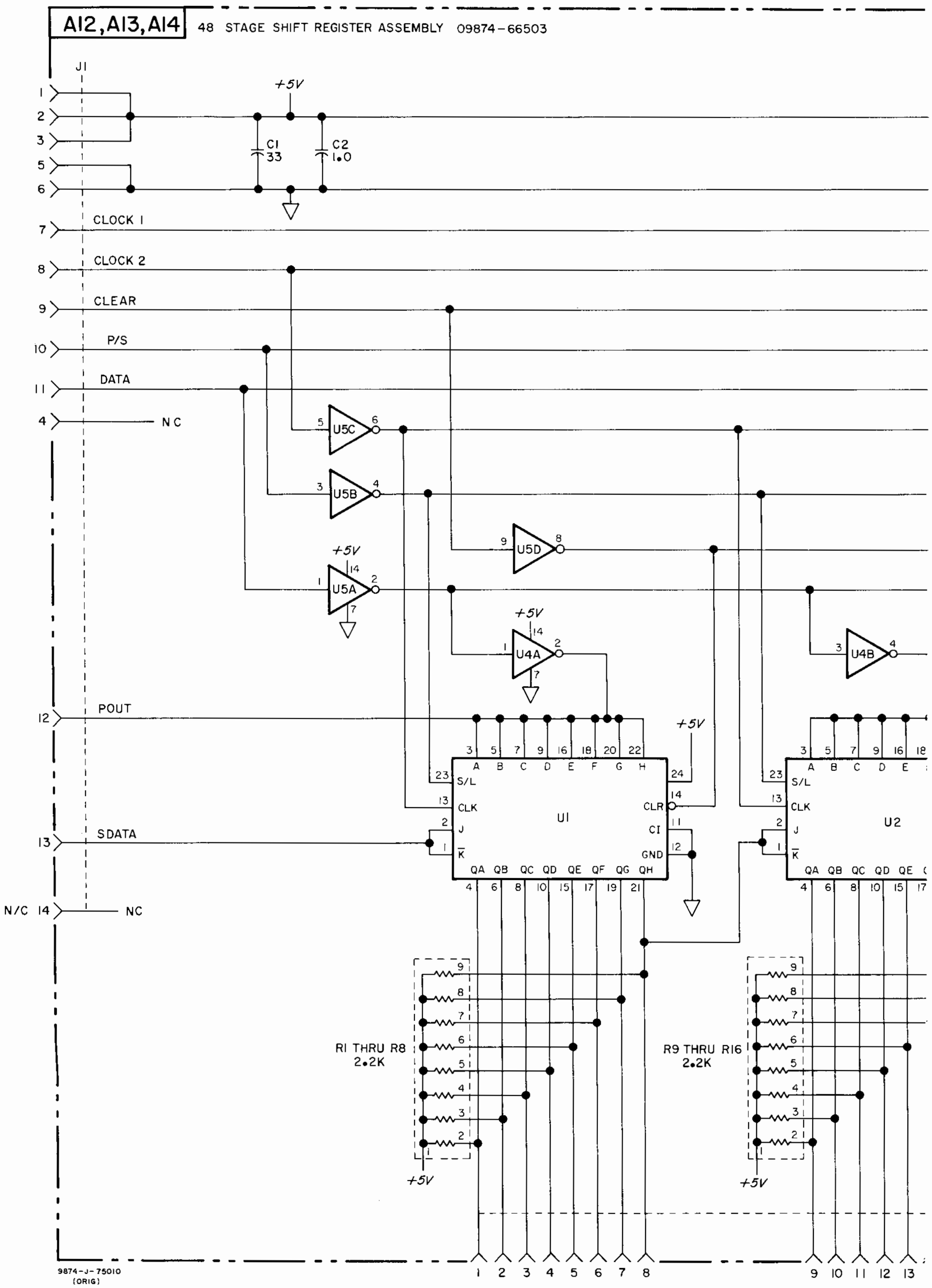
A15 24 Stage Shift Register Assembly Circuit Diagram



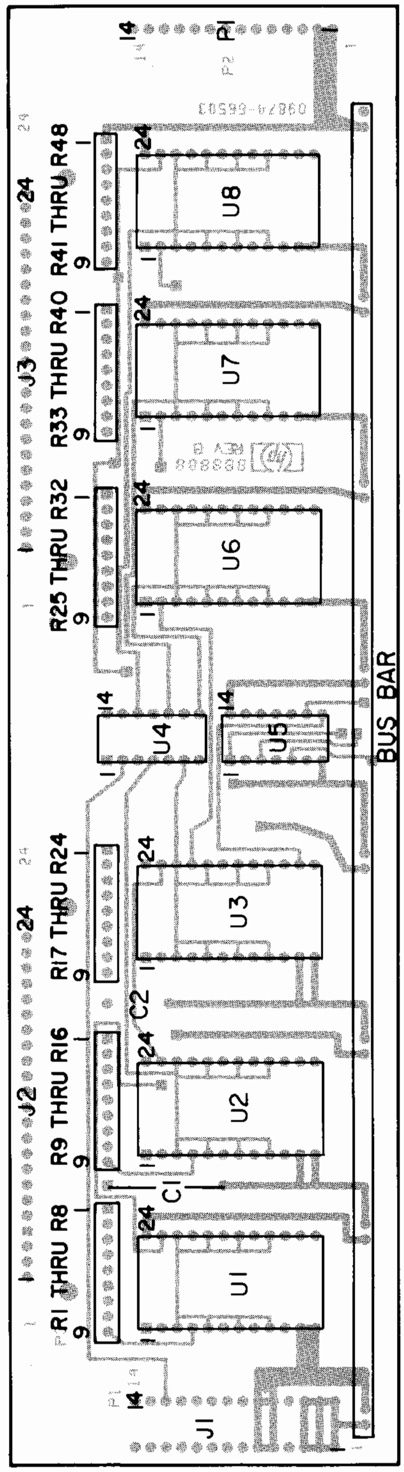

+5V Platen
+5V Platen
+5V Platen
+5V Platen
GND
GND
GND
GND
+Platen Sense
P/S
DATA
Y CLK
X CLK
CLR
(KEY PIN)
SPARE
+12V Analog
-12V
NC
NC
SHD
+5V Platen
+5V Platen
+Platen Sense
(KEY PIN)
GND
GND
Y CLK
X CLK
CLR
P/S
P DATA
P OUT
S DATA
SPARE
CONNECTOR 1251-5259
CONNECTOR 1251-5260
A15
24 STAGE SHIFT REGISTER ASSEMBLY 09874-66504
P1
J1
+5V
C1 22
C2 1.0
CLOCK 1
CLOCK 2
CLEAR
P/S
DATA
NC
NC
U3C
U3A
U3B
U4F
U8
SOUT
SDATA
R41 THRU R48 2.2K
R1 THRU R8 2.2K
J3



U4C
U4D
U4E
U3
U6
U7
+5V
R17 THRU R24
2.2K
R25 THRU R32
2.2K
R33 THRU R40
2.2K
J2

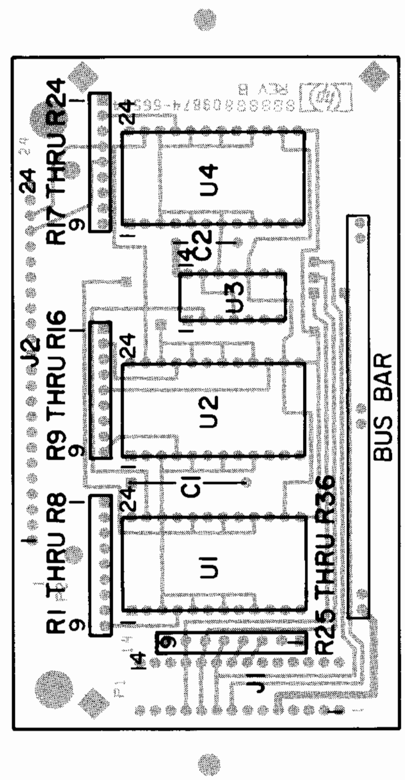


A12,A13,A14
48 STAGE SHIFT REGISTER ASSEMBLY 09874-66503
J1
+5V
C1 33
C2 1.0
CLOCK 1
CLOCK 2
CLEAR
P/S
DATA
NC
U5C
U5B
U5D
U5A
U4A
U4B
POUT
SDATA
N/C
U1
U2
S/L
CLK
CLR
CI
GND
R1 THRU R8 2.2K
R9 THRU R16 2.2K
9874-J-75010 (ORIG)



COMPONENT SIDE
A12, A13, A14

-hp- part No. 09874-66503 Rev B



COMPONENT SIDE
A15

-hp- Part No. 09874-66504 Rev B

Chapter 8: Replaceable Parts

Replaceable Parts

Introduction

Table 8-1 lists the 9874A replaceable parts. Each part listed is given a level number in the first column. The levels indicate which items are part of a particular sub-assembly and which sub-assemblies are part of major assemblies.

A "1" level item is a major assembly. The major assembly may have sub-assemblies and other parts listed as "2" and "3" levels after the "1" level part number. This gives you a choice as to which level of assembly you wish to order and also tells you what you get with a major assembly. Remember, all parts listed after a "1" level are associated with the "1" level part until the next "1" level part appears. Likewise with "2" an "3" level parts. Electrical components on a particular pc assembly are listed in the order of their component designators.

The total quantity of a part is listed only the first time it is used on a particular assembly.

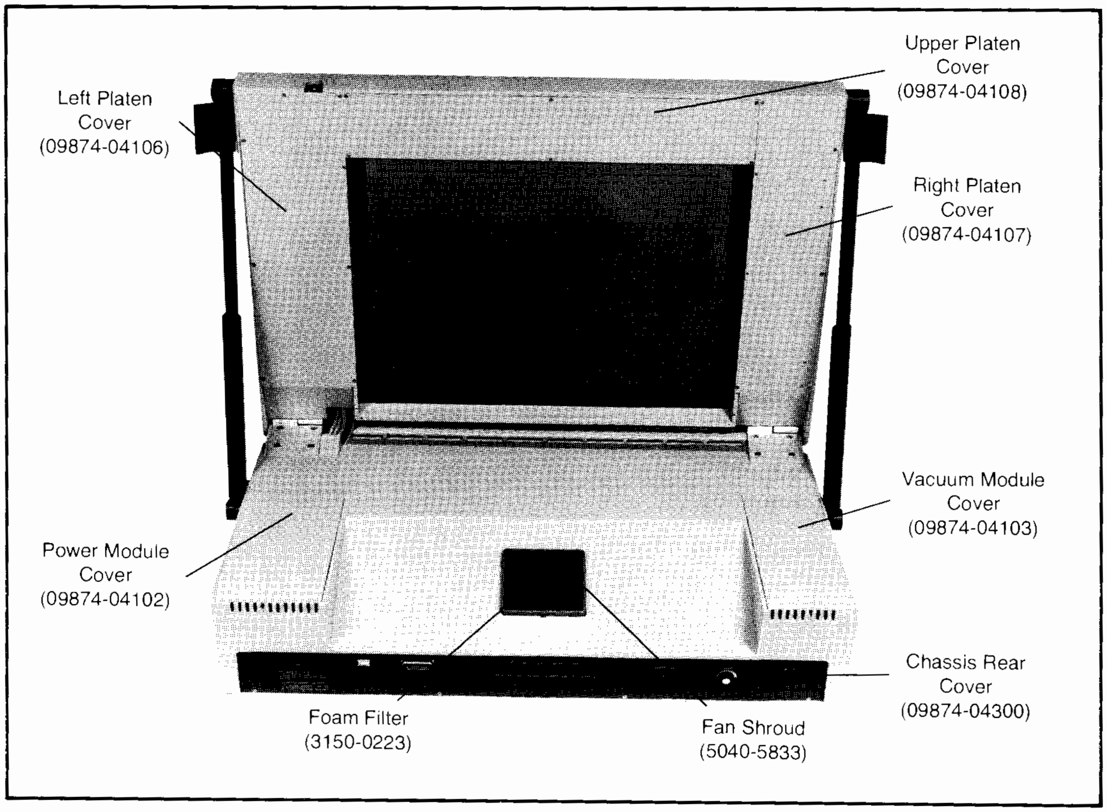


Figure 8-1: 9874A Rear View

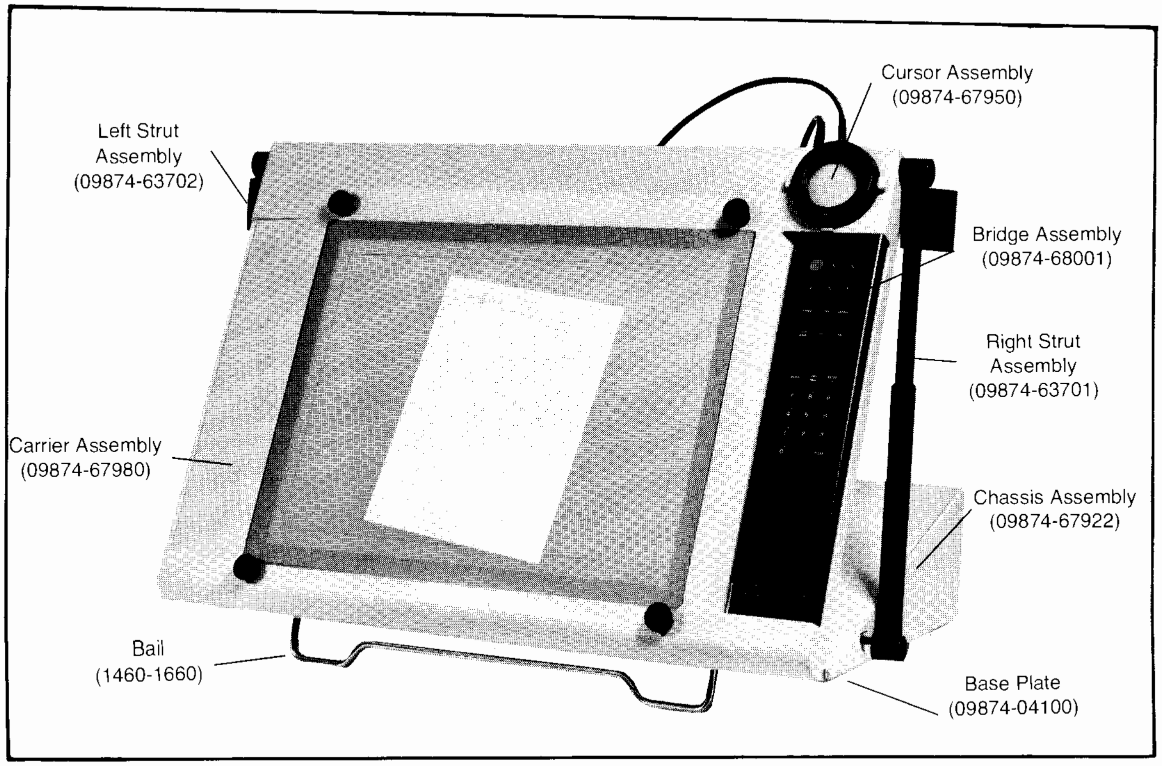
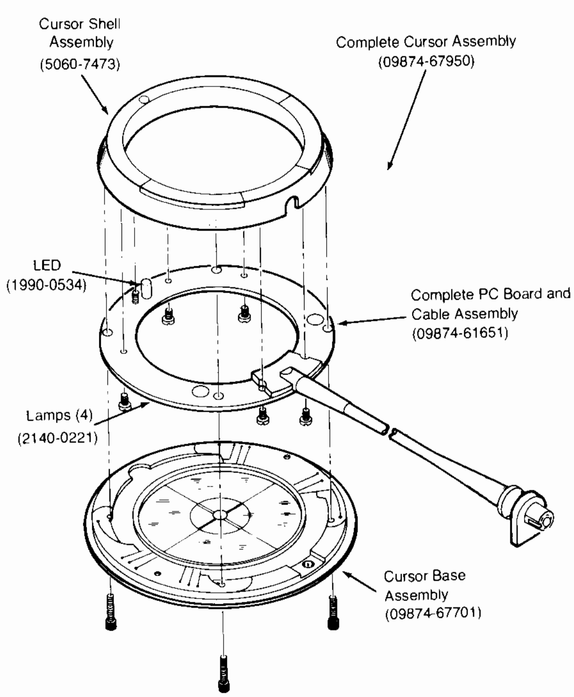


Figure 8-2: 9874A Front View



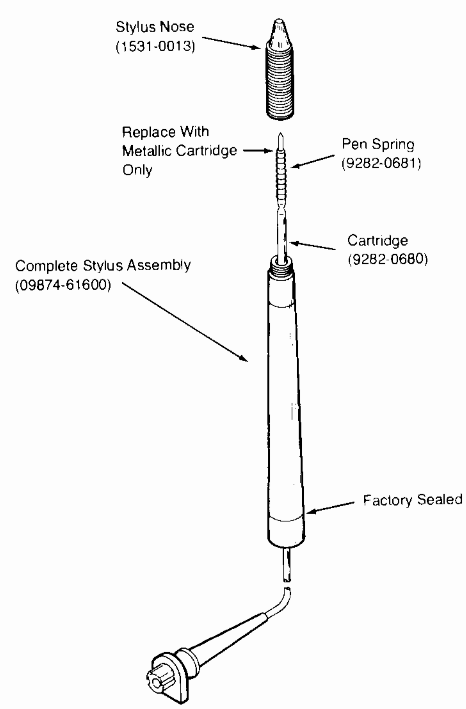


Figure 8-3: Cursor / Stylus

Table 8-1: Replaceable Parts

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
1	**A1**	**09874-66500**	**1**	**MOTHERBOARD ASSEMBLY**
2		1251-1626	1	CONNECTOR 24PIN
2		1251-2915	7	CONNECTOR 50PIN
2		1251-2969	1	PHONE CONNECTOR
2		1251-5265	1	CONNECTOR
2		1251-5266	1	CONNECTOR
2		1251-5267	1	CONNECTOR
1	**A2**	**09874-66505**	**1**	**HP-IB INTERFACE ASSEMBLY**
2	C1	0180-0228	1	C-F: 22UF 15V
2	C2	0180-0317	1	C-F: 100UF 10V
2	C3,C4	0140-0196	2	C-F: 150PF 300V
2	C5 thru C10	0160-0575	6	C-F: .047UF 20V
2	CR1,CR2	1901-0025	2	DIO-Si
2	R1	0683-3945	1	R-F: 390K 5%
2	R2,R3	0683-9115	2	R-F: 910Ω 5%
2	R4,R5	0683-4325	5	R-F: 4300Ω 5%
2	R6 thru R10	0683-3935	5	R-F: 39K 5%
2	R11 thru R13	0683-4325		R-F: 4300Ω 5%
2	U1,U2	1820-1112	3	TTL 74LS74
2	U3	1820-1206	1	IC: SN74LS27
2	U4	1820-1199	1	TTL INV 74LS04N
2	U5	1820-1197	1	IC: SN74LS00
2	U6	1820-1491		IC: SN74LS367N
2	U7	1820-1144	1	IC: SN74LS502N
2	U8	1820-1492	1	IC: SN74LS368N
2	U9	1820-1202	1	TTL GATE 74LS10N
2	U10	1820-1196	1	IC: SN74LS174N
2	U11,U12	1820-2058	2	IC: MC 3448
2	U13	1AA7-6001	1	IC: INTERFACE CHIP
2	U13	1200-0650	1	SOCKET
2	U14	1820-1201	1	IC: SN74LS08N
2	U15	1820-1112		TTL 74LS74
2	U16	1820-2108	1	SIGNETICS 8T31
2	U17,U18	1820-2058		IC: MC 3448
2	U19	1820-1198	1	IC: SN74LS03N
2	J1	1251-4040	1	HP-IB 24 PIN-CONNECTOR
2		1200-0797	1	S1 SOCKET
2	S1	3101-2159	1	ADDRESS SWITCH
1	**A3**	**09874-66571**	**1**	**ROM ASSEMBLY**
2	C1,C2	0180-0309	2	C-F:4.7UF 10V
2	C3	0160-0576	1	C-F: .1UF 50V
2	C4	0180-0210	1	C-F:3.3UF 15V
2	R1,R2	0683-2425	2	R-F: 2400Ω 5%
2	U1	1820-1197	1	IC: SN74LS00
2	U2	1818-2819	1	ROM
2	U3	1820-1584	2	IC: BIB
2	U4	1818-2833	1	ROM
2	U5	1820-1584		IC: BIB
1	**A4**	**09874-66512**	**1**	**PROCESSOR ASSEMBLY**
2	C1 thru C3	0160-0576	8	C-F: .1UF 50V
2	C4	0180-1835	1	C-F: 68UF 15V
2	C5	0180-0229	1	C-F: 33U 10V
2	C6	0180-0309	1	C-F: 4.7UF 10V
2	C7	0180-0137	1	C-F: 100UF 10V
2	C8 thru C10	0160-0576		C-F: .1UF 50V
2	C11	0160-2306	1	C-F: 27PF 300V

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2	C12,C13	0160-0576		C-F: .1UF 50V
2	C14 thru C16	0160-0134	3	C-F: 220PF 300V
2	CR1	1901-0025	1	DIO-Si
2	R1	0683-1035	2	R-F: 10K 5%
2	R2 thru R4	0683-4325	3	R-F: 4300Ω 5%
2	R5	0683-4725	4	R-F: 4700Ω 5%
2	R6	0683-3325	4	R-F: 3300Ω 5%
2	R7	0683-1035		R-F: 10K 5%
2	R8	0683-3325		R-F 3300Ω 5%
2	R9	2100-3353	1	R-F: 20KΩ 10%
2	R10	0683-4725		R-F: 4700Ω 5%
2	R11	0683-3325		R-F: 3300Ω 5%
2	R12	0683-4725		R-F: 4700Ω 5%
2	R13,R14	0683-3615	2	R-F: 360Ω 5%
2	R15 thru R18	0683-1025	4	R-F: 1000Ω 5%
2	R19	0683-4725		R-F: 4700Ω 5%
2	R20,21	0683-2005	2	R-F: 20Ω 5%
2	R22	0683-3325	1	R-F: 27K 5%
2	R23	0683-3325		R-F: 3300Ω 5%
2	R24 thru R38	1810-0287	1	RESISTOR NETWORK
2	U1	1820-1195	1	IC: 74LS175
2	U2	1820-1196	1	IC: SN74LS174N
2	U2	1820-1324	1	TTL 74S124
2	U3	1820-1216	1	IC: SN74LS138
2	U4	1820-1199	2	TTL INV 74LS04N
2	U5 thru U8	1820-1439	4	IC: SN74LS258
2	U9 thru U12	1818-0553	4	IC: INTEL 2112A
2	U13	1820-1199		TTL INV 74LS04N
2	U14	1820-1469	1	IC: SN74LS107
2	U15	1820-1144	1	IC: SN74LS02N
2	U16	1820-1197	2	IC: SN74LS00
2	U17	1820-1207	1	IC: DGTL SN74LS30
2	U18	1820-1202	1	IC: TTL GATE 74LS10N
2	U19	1820-1212	1	IC: SN74LS112N
2	U21	1820-1197		IC: SN74LS00
2	U22	1820-1288	1	IC: DGTL MMH0026CL
2	U23	1820-1112	1	TTL 74LS74
2	U24	1820-1432	1	TTL CNTR 74LS163
2	U25	1820-1112		TTL 74LS74
2	U26	1820-0683	1	IC: SN74S04N
2	U27	1818-2500	1	IC: BPC
2	U28,U29	1820-1584	2	IC: BIB
2	SW1,SW2	3101-1983	2	SW: TGL 8-I A NS
1	**A5**	**09874-66551**	**1**	**REGULATOR ASSEMBLY**
2	C1	010-0575	4	C-F: .047UF 20V
2	C2	0180-1701	1	C-F: 6.8UF 6V
2	C3	0160-0362	2	C-F: 510PF 300V
2	C4	0160-3874	2	C-F: .01UF 50V
2	C5	0180-0229	4	C-F: 33UF 10V
2	C6	0160-0575		C-F: .047UF 20V
2	C7	0180-0229		C-F: 33UF 10V
2	C8,C9	0160-0170	10	C-F: .22UF 25V
2	C10	0180-0229		C-F: 33UF 10V
2	C11,C12	0160-0170		C-F: .22UF 25V
2	C13	0180-0374	3	C-F: 10UF 20V
2	C14	0160-0170		C-F: .22UF 25V
2	C15	0180-0374		C-F: 10UF 20V
2	C16	0190-0170		C-F: .22UF 25V
2	C17	0180-0374		C-F: 10UF 20V
2	C18,C19	0160-0170		C-F: .22UF 25V
2	C20	0160-0575		C-F: .047UF 20V
2	C21,C22	0160-0170		C-F: .22UF 25V
2	C23	0180-0229		C-F: 33UF 10V

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2	C24	0160-0575		C-F: .047UF 20V
2	C25	0160-3879		C-F: .01UF 100V
2	C26	0160-0362		C-F: 510PF 300V
2	C27,C28	0160-3879	2	C-F: .01UF 100V
2	CR1	1902-3073	1	DIO: BKDN 4.32V
2	CR2	1902-0041	1	DIO: BKDN 5.11V
2	CR3 thru CR5	1901-1098	2	DIO: IN4150
2	CR6	1902-0057	1	DIO: BKDN 6.49V
2	Q1 thru Q3	1854-0071	3	XSTR: NPN SPS5103
2	Q4,Q5	1854-0566	2	XSTR: NPN SI
2	Q6	1854-0071		XSTR: NPN SPS5103
2	Q7	1854-0090	1	XSTR: NPN SM8158
2	R1	2100-3273	2	R-F: 2K 10%
2	R2	0812-0045	1	R-F: .15Ω
2	R3	0683-3925	1	R-F: 3900Ω 5%
2	R4	0698-4400	2	R-F: 93.1Ω 1%
2	R5	0683-2025	1	R-F: 2000Ω 5%
2	R6	0698-3122	2	R-F: 412Ω 1%
2	R7	0683-1515	3	R-F: 150Ω 5%
2	R8	0757-1094	3	R-F: 1.4K 1%
2	R9	0698-3279	2	R-F: 4.99K
2	R10	0683-1525	2	R-F: 1500Ω 5%
2	R11	0683-1515		R-F: 150Ω 5%
2	R12,R14	0811-3531	2	R-F: 68Ω 5%
2	R15	0698-3279		R-F: 4.99K
2	R16	0683-1525		R-F: 1500Ω 5%
2	R17	0698-3122		R-F: 412Ω 1%
2	R18	0683-4715	1	R-F: 470Ω 5%
2	R19	0698-4400		R-F: 93.1Ω 1%
2	R20	0757-1094		R-F: 1.47K 1%
2	R21	2100-3273		R-F: 2K 10%
2	R22	0757-1094		R-F: 1.47K 1%
2	R23	0683-1515		R-F: 150Ω 5%
2	R24	0811-2864	1	R-F: .07Ω
2	U1	1820-0196	2	IC: U5R7723393
2	U2	1826-0144	1	IC: 7805C
2	U3	1826-0215	1	IC: 7905.2
2	U4	1826-0221	1	IC: 7912C
2	U5,U6	1826-0147	2	IC: RGTR 7812CP
2	U7	1820-0196		IC: U5R7723393
2	SCR1,SCR2	1884-0066	2	THYR-2N4443
2		0403-0219	1	BOARD EXTRACTOR WHITE
1	**A6**	**09874-66511**	**1**	**PHASE COUNTER ASSEMBLY**
2	C1	0140-0208	1	C-F: 680PF 300V
2	C2	0160-0170	1	C-F: 74LS293N
2	C3	0180-0229	1	C-F: 33UF 10V
2	C4	0160-3879	5	C-F: .01UF 100V
2	C5	0180-0376	1	C-F: .47UF 35V
2	C6 thru C9	0160-3879		C-F: 470PF .20V
2	R1	0757-0280	5	R-F:1000Ω1%
2	R2	0683-1215	1	R-F: 120Ω5%
2	R3	0757-0280		R-F: 1000Ω1%
2	R5	0757-0446	1	R-F: 15K 1%
2	R6 thru R8	0757-0280		R-F: 1000Ω1%
2	R11 thru R15	0683-1005	5	R-F: 10Ω5%
2	U1	1820-1201	3	IC: SN74LS08N
2	U2	1820-1203	3	IC: SN74LS11N
2	U3,U4	1820-1208	3	IC: SN74LS32
2	U6	1820-1112	4	TTL 74LS74
2	U7	1820-0683	3	IC: SN74S04N
2	U8	1820-1203		IC: SN74LS11N
2	U9	1820-1204		IC: SN74LS20N
2	U10	1820-1203		IC: SN74LS11N
2	U11	1820-0629	3	TTL FF 74S112N

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2	U12	1820-0683		IC: SN74S04N
2	U13	1820-0640	1	IC: SN74150N
2	U14	1820-0685	1	IC: SN74S10
2	U15,U16	1820-1205	2	IC: DGTL SN74LS21
2	U17	1820-0629	1	TTL FF 74S112N
2	U18	1820-1491	5	IC: SN74LS367N
2	U19	1820-1192	1	IC: DGTL SN74173
2	U20	1820-0629		TTL FF 74S112N
2	U21	1820-1450	2	IC: SN74S37N
2	U22	1820-0683		IC: SN74S04N
2	U23	1820-1196	2	IC: SN74LS174N
2	U24	1820-1453	4	IC: SN74S163N
2	U25	1820-1443	4	TTL CTR 74LS293N
2	U26	1820-0261		IC: 74121N
2	U27	1820-1450		IC: SN74S37N
2	U28	1820-1201		IC: SN74LS08N
2	U29	1820-1112		TTL 74S74
2	U30	1820-1196		IC: SN74LS174N
2	U31,U32	1820-1491		IC: SN74LS367N
2	U33	1820-1443		TTL CTR 74LS293N
2	U34	1820-1208		IC: SN74LS532
2	U35	1820-0629		TTL FF 74S112N
2	U36	1820-1730	1	TTL OCTFF74LS273
2	U37	1820-1453		IC: SN74S163N
2	U38	1820-1443		TTL CTR 74LS293N
2	U39	1820-1429	1	IC: SN74LS160N
2	U40	1820-1201		IC: SN74LS08N
2	U41	1820-1415	2	IC: 74LS13N
2	U42	1820-1112		TTL 74LS74
2	U43,U44	1820-1491		IC: SN74LS367N
2	U45	1820-1112		TTL 74LS74
2	U46	1820-1425	1	IC: SN74LS132N
2	U47	1820-1415		IC: 74LS13N
2	U48,U49	1820-1453		IC: SN74S163N
2	U50	1820-1443		TTL CTR 74LS293N
2		0403-0212	1	BOARD EXTRACTOR RED
2		0403-0219	1	BOARD EXTRACOR WHITE
1	**A7**	**09874-66502**	**1**	**CLOCK/AUDIO ASSEMBLY**
2	C1	0610-3873	1	C-F: 4.7PF
2	C2	0180-0374	4	C-F: 10UF 20V
2	C3	0160-0576	2	C-F: .1UF 50V
2	C4,C5	0180-0374		C-F: 10UF 20V
2	C6	0180-0228		C-F: 22UF 15V
2	C7	0130-3879	6	C-F: .01UF 100V
2	C8	0180-0374		C-F: 10UF 20V
2	C9	0160-3879		C-F: .01UF 100V
2	C10	0160-0576		C-F: .1UF 50V
2	C11	0160-4350	1	C-F: 68PF
2	C12,C13	0160-3879		C-F: .01UF 100V
2	C14	0160-0165	1	C-F: .056UF 200V
2	C15	0170-0024	1	C-F:.022UF 200V
2	C16	0180-0291	1	C-F: 1UF 35V
2	C17,C18	0160-3879		C-F: .01UF 100V
2	CR1 thru CR3	1901-0044	3	DIO: SI
2	Q1	1854-0456	1	XSTR: SI NPN
2	Q2	1853-0234	1	XSTR: SI PNP
2	Q3	1855-0082	1	JFET: SS3723
2	R1 thru R4	0757-0280	4	R-F: 1000Ω 1%
2	R5 thru R8	0683-1025	6	R-F: 1000Ω 5%
2	R9	0698-4529	1	R-F:226K 1%
2	R10	0698-3458	1	R-F: 348K 1%
2	R11	0698-3243	1	R-F: 178K 1%
2	R12	0683-2755	2	R-F: 2.7M 5%
2	R13	0683-5655	1	R-F: 5.6M 5%

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2	R14	0698-8348	1	R-F: 698K 1%
2	R15	0683-1555	1	R-F: 1.5M 5%
2	R16	0698-6752	1	R-F: 88.4K
2	R17	0698-8416	1	R-F: 44K
2	R18,R19	0683-3925	2	R-F: 3900Ω 5%
2	R20	0683-1025		R-F: 1000Ω 5%
2	R21	0683-2235	2	R-F: 22K 5%
2	R22	0683-8235	1	R-F: 82K 5%
2	R23	0683-2025	3	R-F: 2000Ω 5%
2	R24	0683-1045	2	R-F: 100K 5%
2	R25 thru 34	0683-1035	12	R-F: 10K 5%
2	R35	2100-2651	1	R-F: 500K 20% VAR
2	R36,R37	0683-1805	2	R-F: 18Ω 5%
2	R38	0683-1025		R-F: 1000Ω 5%
2	R39	0683-2235		R-F: 22K 5%
2	R40	0683-1035		R-F: 10K 5%
2	R41	0757-0440	1	R-F: 7500Ω 1%
2	R42	0683-1045		R-F: 100K 5%
2	R43	0683-1035		R-F: 10K 5%
2	R44	0683-2755		R-F: 2.7M 5%
2	R45,R46	0683-2025		R-F: 2000Ω 5%
2	U1	1820-1251	3	IC: SN74LS196N
2	U2	1820-1324	1	TTL 74S124
2	U3	1820-0629	3	TTL FF 74LS112N
2	U4,U5	1812-1193	2	IC: SN74LS197
2	U6,U7	1820-1212		IC: SN74LS112N
2	U8,U9	1820-1251		IC: SN74LS196N
2	U10	1826-0065	1	IC: SGTL LM311N
2	U11	1826-0139	1	OP AMPL MC145P1
2	U12,U13	1826-0502	2	IC
2	U14,U15	1820-0577	2	IC: SN746N
2	U16	1820-1195	1	IC: 74LS175
2	U17	1820-1196	1	IC: SN74LS174N
2	U18	1820-1144	1	IC: SN74LS02N
2	U19	1820-1415	1	IC: 74LS13N
2	Y1	0410-1178	1	18mHz CRYSTAL
2	J1	1251-3552	1	PHONE PLUG
2		0370-2585	1	VOL CTL KNOB
2		0340-0564	2	INSULATOR
2		0403-0211	1	BOARD EXTRACTOR BROWN
2		0403-0219	1	BOARD EXTRACTOR WHITE
1	**A8**	**09874-66501**	**1**	**FILTER ASSEMBLY**
2	C1	0160-0576	14	C-F: .1UF 50V
2	C2	0160-3879	16	C-F: .01UF 100V
2	C3	0180-0374	7	C-F: 10UF 20V
2	C4	0180-0387	2	C-F: 47UF 20V
2	C5,C6	0180-0374		C-F: 10UF 20V
2	C7	0160-0576		C-F: .1UF 50V
2	C8	0160-3879		C-F: .01UF 100V
2	C9	0180-0374		C-F: 10UF 20V
2	C10 thru C12	0160-0576		C-F: .1UF 50V
2	C13	0180-0229	1	C-F: 33UF 10V
2	C14	0160-3879		C-F: .01UF 100V
2	C15 thru C17	0160-0174	3	C-F: .47UF 25V
2	C18	0160-0572	2	C-F: 2200PF
2	C19,C20	0160-0576		C-F: .01UF 50V
2	C21	0180-0387		C-F: 47UF 20V
2	C22,C23	0180-0374		C-F: 10UF 20V
2	C24 thru C26	0160-3879		C-F: .01UF 100V
2	C27	0160-0168	3	C-F: .1UF 200V
2	C28	0160-3879		C-F: .01UF 100V
2	C29	0160-0572		C-F: 2200PF
2	C30	0160-0161	5	C-F: .01UF 200V

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2	C31	0160-3879		C-F: .01UF 100V
2	C32	0160-0168		C-F: .1UF 200V
2	C33	0160-0157	1	C-F: .0047UF 200V
2	C34	0160-3876	1	C-F: 47PF 300V
2	C35	0160-0938	1	C-F: 1000PF 100V
2	C36	0140-0198	3	C-F: 200PF 300V
2	C37	0160-3879		C-F: .01UF 100V
2	C38	0160-4382	2	C-F: 3.3PF
2	C39	0160-2222	1	C-F: .0015UF 300V
2	C40	0160-4298	1	C-F: 4700PF
2	C42	0160-0168		C-F: .1UF 200V
2	C43,C44	0160-3879		C-F: .01UF 100V
2	C45	0160-0203	1	C-F: 150PF 300V
2	C46	0160-0161		C-F: .01UF 200V
2	C47	0160-3879		C-F: .01UF 100V
2	C48	0160-3919	1	C-F: 80PF
2	C49	0160-3879		C-F: .01UF 100V
2	C50	0160-3147	1	C-F: 11.2PF
2	C52,C53	0160-0576		C-F: .1UF 50V
2	C54	0180-0195	1	C-F: .33UF 35V
2	C55	0180-0228	1	C-F: 22UF 15V
2	C56	0160-2099	1	C-F: .0018UF 35V
2	C57	0160-0576		C-F: .1UF 50V
2	C58 thru C62	0160-2543	9	C-F: 500PF
2	C63	0160-0161		C-F: .01UF 200V
2	C64	0160-2543		C-F: 500PF
2	C65	0160-0161		C-F: .01UF 200V
2	C66,C67	0160-2543		C-F: 500PF
2	C68	0160-3183	1	C-F: .47UF 50V
2	C69	0160-0161		C-F: .01UF 200V
2	C70	0160-0576		C-F: .1UF 50V
2	C71	0160-2543		C-F: 500PF
2	C72	0160-3879		C-F: .01UF 100V
2	C73	0180-0374		C-F: 10UF 20V
2	C74 thru C76	0160-0576		C-F: .1UF 50V
2	C77,C78	0140-0198		C-F: 200PF 300V
2	C79,C80	0160-3879		C-F: .01UF 100V
2	C81	0160-4382		C-F: 3.3PF
2	C82	0160-4383	1	C-F: 6.8PF
2	CR1	1902-0041	1	DIO: BKDN 5.11V
2	CR2 thru CR8	1901-0044	7	DIO:SI
2	Q1	1853-0036	1	XSTR: 2N3906
2	Q2	1855-0081	1	JFET: NCHAN 2N5245
2	R1,R2	0698-3157	2	R-F: 19.6K 1%
2	R3	0698-3159	1	R-F: 26.1K 1%
2	R4	0757-0441	2	R-F: 8250Ω 1%
2	R5	0683-3315	1	R-F: 330Ω 5%
2	R6 thru R8	0683-1805	6	R-F: 18Ω 5%
2	R9	0683-3925	2	R-F: 3900Ω 5%
2	R10	0683-4725	7	R-F: 4700Ω 5%
2	R11 thru R13	0683-1805		R-F: 18Ω 5%
2	R14 thru R16	0683-4125		R-F: 4700Ω 5%
2	R17	0683-4715	1	R-F: 470Ω 5%
2	R18	0757-0447	3	R-F: 16.2K 1%
2	R19	0683-3925		R-F: 3900Ω 5%
2	R20	0757-0199	1	R-F: 21.5K 1%
2	R21	0698-3459	2	R-F: 383K 1%
2	R22	0683-1045	1	R-F: 100K 5%
2	R23	0698-3459		R-F: 383K 1%
2	R24	0683-1015	1	R-F: 100Ω 5%
2	R25	0757-0288	2	R-F: 9090Ω 1%
2	R26	0683-1125	1	R-F: 1100Ω 5%
2	R27	0757-0288		R-F: 9090Ω 1%
2	R28	0757-0280	1	R-F: 1000Ω 1%
2	R29	0757-0438	2	R-F: 5110Ω 1%
2	R30	0698-3458	1	R-F: 348K 1%

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2	R31	0683-4725		R-F: 4700Ω 5%
2	R32	0757-0429	1	R-F: 1820Ω 1%
2	R33	0698-4472	1	R-F: 7680Ω 1%
2	R34	0683-1245	1	R-F: 120K 5%
2	R35	0683-1245	1	R-F: 20K 5%
2	R35	0683-1535	1	R-F: 15K 5%
2	R36	0683-4725		R-F: 4700Ω 5%
2	R37	0757-0447		R-F: 16.2K 1%
2	R38	0698-0085	1	R-F: 2610Ω 1%
2	R39	0757-0422	1	R-F: 909Ω 1%
2	R40	0698-3444	1	R-F: 316Ω 1%
2	R41	0683-4725		R-F: 4700Ω 5%
2	R42	0698-4525	2	R-F: 187K 1%
2	R43	0757-0467	2	R-F: 121K 1%
2	R44	0698-4506	2	R-F: 73.2K 1%
2	R45	0698-3452	1	R-F: 147K 1%
2	R46	0698-4522	1	R-F: 165K 1%
2	R47	0698-4527	1	R-F: 205K 1%
2	R48	0698-4541	1	R-F: 442K 1%
2	R49	0698-4531	1	R-F: 267K 1
2	R50	0757-0465	3	R-F: 100K 1%
2	R51	0698-3457	3	R-F: 316K 1%
2	R52	0757-0438		R-F: 5110Ω 1%
2	R53	0757-0447		R-F: 16.2K 1%
2	R54	0757-0428	1	R-F: 1610Ω 1%
2	R55	0757-0417	1	R-F: 562Ω 1%
2	R56	0757-0467		R-F: 121K 1%
2	R57	0698-4525		R-F: 187K 1%
2	R58	0698-3450	1	R-F: 42.2K 1%
2	R59	0698-4506		R-F: 73.2K 1%
2	R60,R61	0757-0465		R-F: 100K 1%
2	R62	0698-8342	1	R-F: 536K 1%
2	R63	0698-4531		R-F: 267K 1%
2	R64,R65	0757-0464	3	R-F: 90.9K 1%
2	R66	0698-3156	1	R-F: 14.7K 1%
2	R67	0698-3557		R-F: 316K 1%
2	R68 thru R70	0698-3160	4	R-F: 31.6K 1%
2	R71	0757-0444	1	R-F: 12.1K 1%
2	R72	0757-0401	1	R-F: 100Ω 1%
2	R73	0698-3151	1	R-F: 2870Ω 1%
2	R74	0698-3457		R-F: 316K 1%
2	R75,R76	0698-3150	3	R-F: 2370Ω 1%
2	R77	0698-3160		R-F: 31.6K 1%
2	R80	0757-0442		R-F: 10K 1% %W
2	R81	0757-0441		R-F: 8250Ω 1%
2	R82	0698-3150		R-F: 2370Ω 1%
2	R83	0698-3455	1	R-F: 261K 1%
2	R84	0757-0464		R-F: 90.9K 1%
2	R85	0698-3260	1	R-F: 464K 1%
2	R87	0757-0442		R-F: 10K 1%
2	U1	1826-0144	1	IC: 7805C
2	U2	1826-0221	1	IC: 7912C
2	U3	1826-0147	1	REGULATOR 7812CP
2	U5	1826-0065	4	IC: LM311N
2	U6	1820-1201	1	IC: SN74LS08N
2	U7	1826-0271	1	IC: UA 741C
2	U8	1826-0139	1	OP AMPL MC1458P1
2	U9,U10	1826.0065		IC: LM311N
2	U11	1820-0577	1	IC: SN7416N
2	U12 thru U14	1826-0207	5	IC: LM318N
2	U15	1826-0357		IC: LF357H
2	U16,U17	1826-0207		IC: LM318N
2	U18	1826-0534	1	IC: CA3080E
2	U19,U20	1820-1986	2	IC: ANALOG SWITCH
2	U21	1826-0319	1	IC: LF356
2		0403-0219	1	BOARD EXTRACTOR WHITE
2		0403-0189	1	BOARD EXTRACTOR BLACK

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
1	**A9**	**09874-66531**	**1**	**KEYBOARD ASSEMBLY**
2		5041-1413	1	WINDOW DISPLAY
1	**A10**	**09874-66593**	**1**	**DISPLAY INDICATOR ASSEMBLY**
2	R1 thru R12	0683-2215	12	R-F: 220Ω 5%
2	U1 thru U3	1990-0335	3	LED DISPLAY
2	LED1 thru LED12	1990-0487	12	VISIBLE YELLOW LED
1	**A11**	**09874-66531**	**1**	**KEYBOARD/DISPLAY DRIVERS ASSEMBIY**
2	C1	0160-3879	4	C-F: .01UF 100V
2	C2	0180-0161	1	C-F: 3.3UF 35V
2	C3	0160-0576	1	C-F: .1UF 50V
2	C4	0180-0229	1	C-F: 33UF 10V
2	C5 thru C7	0160-3879		C-F: .01UF 100V
2	C8	0180-0228	1	C-F: 22UF 15V
2	C9	0180-0197	1	C-F: 2.2UF 20V
3	CR1	1902-0243	1	DIO BKDN 30.1V
2	CR2	1902-3104	1	DIO BKDN 5.62V
2	CR3,CR4	1902-0041	2	DIO BKDN 5.11V
2	Q1	1854-0036	1	XSTR 2N3906
2	Q2	1854-0699	1	XSTR
2	R1 thru R4	0683-4725	4	R-F: 4700Ω 5%
2	R5	0757-0443	4	R-F: 3320Ω 1%
2	R6	0683-2215	1	R-F: 220Ω 5%
2	R7	0757-0458	1	R-F: 51.1K 1%
2	R8	0757-0420	2	R-F: 750Ω 1%
2	R9	0757-0230	4	R-F: 100Ω 1%
2	R10	0757-0420		R-F: 750Ω 1%
2	R11	0757-0280		R-F: 1000Ω 1%
2	R12,R13	0757-0433		R-F: 3320Ω 1%
2	R14	0757-0280		R-F: 1000Ω 1%
2	R15,R16	0683-4715	2	R-F: 470Ω 5%
2	R17	0757-0280		R-F: 1000Ω 1%
2	R18	0757-0399	1	R-F: 82.5Ω 1%
2	R19,R20	0757-0283	4	R-F: 2000Ω 1%
2	R21	0757-0433		R-F: 3320Ω 1%
2	R22,R23	0757-0283		R-F: 2000Ω 1%
2	R24 thru R31	1810-0041	1	RESISTER NETWORK 202Ω
2	R32 thru R39	0683-1035	1	RESISTER NETWORK 3.3K
2	R40 thru R43	1810-0163	1	RESISTER NETWORK 4.7K
2	R44	0757-0463	1	R-F: 82.5K 1%
2	U1	1820-1683	1	LATCH MC14514
2	U2	1820-1198	1	IC: SN74LSO3N
2	U3	1820-1217	1	IC: SN74LS151
2	U4	1820-1112	3	TTL 74LS74
3	U5	1820-1423	1	TTL MLVB 74LS123
2	U6	1820-1144	1	IC: SN74LS02N
2	U7	1820-1432	1	TTL CNTR 74LS163
2	U8	1820-1470	1	IC: SB74LS157
2	U9,U10	1820-2136	4	IC: DS8973
2	U11	1820-1112		TTL 74LS74
2	U12	1820-1430	1	IC: SN74LS161
2	U13	1820-2136		IC: DS8973
2	U14	1820-0618	2	IC: DGTL SN7417N
2	U15	1816-0724	2	IC: SN74S189N
2	U16	1820-1730	2	TT; OCTFF74LS273
2	U17	1820-1199	1	TTL INV 74LS04N
2	U18	1820-1216	1	IC: SN74LS138
2	U19	1820-1415	2	IC: 74LS13N
2	U20	1820-1491	2	IC: SN74LS367N
2	U21	1820-2136		IC: DS8973
2	U22	1820-0618		IC: DGTL SN7417N
2	U23	1816-0724		IC: SN74S189N

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2	U24	1820-1415		IC: 74LS13N
2	U25	1820-1112		TTL 74LS74
2	U26	1820-1730		TTL OCTFF74LS273
2	U27	1820-1491		IC: SN74LS367N
2	P1	1251-5270	1	CONNECTOR
2	P2	1251-5269	1	CONNECTOR
2	P3	1251-5268	1	CONNECTOR
1	**A12 thru A14**	**09874-66503**	**3**	**48STAGE SHIFT REGISTER ASSEMBLY**
2	C1	0180-0229	1	C-F: 33UF 10V
2	C2	0160-0127	1	C-F: 1UF 25V
2	R1 thru R48	1810-0376	6	RESISTER NETWORK 2.2K
2	U1 thru U3	1820-0726	6	TTL RGST 74199N
2	U4	1820-0683	1	IC: SN74S04N
2	U6 thru U8	1820-0726		TLT RGST 74199N
2	U5	1820-1053	1	TLT SCHMT 7414N
2	J2,J3	1251-5278	2	CONNECTOR
2	J1	1251-5261	1	CONNECTOR
2	P1	1251-5326	1	CONNECTOR 14PIN
1	**A15**	**09874-66504**	**1**	**24STAGE SHIFT REGISTER ASSEMBLY**
2	C1	0180-0228	1	C-F: 22UF 15V
2	C2	0160-0127	1	C-F:1UF 25V
2	R1 thur R24	1810-0376	3	RESISTER NETORK 2.2K
2	R25 thru R36	1810-0127	1	RESISTER NETWORK 6(24Ω) 6(560Ω)
2	U1,U2	1820-0726	3	TLT RGST 74199N
2	U3	1820-1053	1	TLT SCHMT 7414N
2	U4	1820-0726		TTL RGST 74199N
2	J2	1251-5278	1	CONNECOR
2	J1	1251-5261	1	CONNECTOR
2		0360-1908	1	CONNECTOR
1		**09874-67904**	**1**	**POWER SUPPLY ASSEMBLY**
2		0160-0174	2	C-F: .47UF 25V
2		0180-2397	2	C-F: .018F 25V
2		0360-0269	2	TERMINAL LUG
2		0360-1262	1	TERMINAL
2		0390-0006	2	NYLON SPACER
2		09874-01201	1	MT-LINE MODULE
2		09874-01203	1	MT-AC COVER CLIP
2	**A17**	**09874-66541**	**1**	**RECTIFIRER CAPACITOR**
3	C1,C2	0160-4300	2	C-F:.47UF
3	C3	0180-2351	1	C-F: 2000UF 50V
3	C4	0180-0583	1	C-F: 6000UF 30V
3	CR1,CR2	1901-0364	2	DIODE ASSEMBLY SI
3	F1,F2	2110-00447	2	FUSE 3A 125V
3		1251-4495	1	CONNECTOR
2		1251-0512	1	CONNECTOR
2		1251-2412	1	CONNECTOR 15PIN
2		1251-5276	1	CONNECTOR
2		1901-0525	2	DIODE ASSEMBLY 50V
2		2110-0083	1	FUSE 2.5A
2		2110-0543	1	FUSE HOLDER
2		2110-0545	1	FUSE HOLDER CAP
2		2200-0778	4	MACHINE SCREW
2		2510-0138	2	SCREW
2		3050-0810	1	WASHER
2		9100-4061	1	TANSFORMER
2		9135-0035	1	LINE FILTER

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
1		**09874-67906**	**1**	**PUMP ASSEMBLY**
2		0360-0269	1	LUG TERMINAL
2		0380-0599	7	SPACER
2		0400-0193	7	SHOCK GROMMET
2		09874-01203	1	COVER CLIP
2		09874-01900	1	SWITCH PUMP
2		09874-01901	1	INSOLATION BRACKET
2	**A18**	**09874-66542**	**1**	**PUMP FILTER ASSEMBLY**
3	C1,C2	0160-4300	2	C-F: .047UF
3	R1	0698-3620	1	R-F: 100Ω
3		1902-0666	4	DIODE BKDN
2		09874-67291	1	PUMP
3		0100-1100	1	T CONNECTOR
3		0100-1103	2	VACUUMN PORT
2		3101-2080	1	ROCKER SWITCH
2		5040-8290	1	SWITCH ROCKER
1		09874-67925	1	MOLDED BASE
1		1251-5271	1	CONNECTOR
1		1251-5275	1	CONNECTOR
1		1400-0583	2	CLIP
1		1460-1660	1	BAIL
1		1531-0008	1	BASE STRUT MOUNT RIGHT HAND
1		1531-0009	1	BASE STRUT MOUNT LEFT HAND
1		1531-0012	1	BASE TIE BAR
1		2520-0038	2	SCREW
1		3160-0209	1	FAN
1		5041-1414	12	PC BOARD GUIDESET
1		8120-2697	1	COAX CABLE ASSEMBLY
1		09874-27707	1	PLATEN LAMINATED
1		09874-61604	1	CABLE ASSEMBLY X-Y
2		1251-0688	11	CONNECTOR TERMINAL
2		1251-3808	2	POLARIZING PLUG
2		1251-4431	13	MALE PIN
2		1251-5260	2	CONNECTOR
1		09874-67914	1	PLATEN/CURSOR CONNECTOR AND BRACKET
1		09874-67917	1	VACUUM VALVE ASSEMBLY
2		0100-0792	2	CONNECTOR
2		0100-1099	1	ELBOW CONNECTOR
2		0101-0431	1	VALVE
2		09874-01213	1	MOUNTING BRACKET
2		1251-0688	2	TERMINAL CONNECTOR
1		09874-67918	1	SPEAKER ASSEMBLY
1		09874-67927	1	MOLDED CARRIER
1		09874-68001	1	BRIDGE ASSEMBLY
2		09874-04101	1	BOTTOM COVER BRIDGE
1		09874-01208	2	BAIL SUPPORT BRACKET
1		09874-01218	1	MOTHERBOARD
1		09874-04100	1	CHASSIS BASE PLATE
1		09874-04703	1	LEFT HINGE SUPPORT
1		09874-04704	1	RIGHT HINGE SUPPORT
1		09874-04705	1	LOWER FAN SUPPORT
1		09874-04706	1	UPPER FAN SUPPORT
1		09874-61601	1	GROUND STRAP CABLE
1		09874-61607	1	AC HARNESS ASSEMBLY
2		1251-5272	2	CONNECTOR

LEVEL	REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
2		1251-5273	1	CONNECTOR
2		1251-5274	1	CONNECTOR
2		3101-2080	1	ROCKER SWITCH
2		5040-7943	1	ACTUATOR SWITCH
1		09874-61609	1	DC HARNESS ASSEMBLY
2		1251-0688	23	CONNECTOR TERMINAL
2		1251-2412	1	CONNECTOR 15PIN FEMALE
2		1251-3537	1	CONNECTOR 10PIN FEMALE
2		1251-4332	1	CONNECTOR HOUSING
1		09874-61611	1	KEYPAD-ASSEMBLY CABLE
2		1251-0688	74	CONNECTOR TERMINAL
2		1251-3808	3	POLARIZING PLUG
2		1251-5257	1	CONNECTOR
2		1251-5258	1	CONNECTOR
1		09874-61612	1	PLATEN DRIVE CABLE
2		1251-0688	12	CONNECTOR TERMINAL
2		1251-3808	2	POLARIZING PLUG
2		1251-5259	1	CONNECTOR
2		1251-5260	1	CONNECTOR
1		1531-0002	2	LEFT HAND PLATEN SUPPORT
1		1531-0004	2	RIGHT HAND PLATEN SUPPORT
1		1531-0015	1	LEFT HAND CARRIER STRUT
1		1531-0016	1	RIGHT HAND CARRIER STRUT
1		3110-0130	1	LEFT HAND BASE HINGE
1		3110-0131	1	RIGHT HAND BASE HINGE
1		3110-0132	1	LEFT HAND CARRIER HINGE
1		3110-0133	1	RIGHT HAND CARRIER HINGE
1		09874-04102	1	COVER POWER MODULE
1		09874-04103	1	COVER VACUUM MODULE
1		09874-04106	1	LEFT PLATEN COVER
1		09874-04107	1	RIGHT PLATEN COVER
1		09874-04108	1	UPPER PLATEN COVER
1		09874-04300	1	CHASSIS REAR COVER
1		09874-04714	1	FILTER ASSEMBLY SHIELD
1		09874-63701	1	RIGHT STRUT ASSEMBLY
1		09874-63702	1	LEFT STRUT ASSEMBLY
1		**09874-87901**	**1**	**MISC KIT**
2		09874-61600	1	STYLUS ASSEMBLY
3		1531-0013	1	STYLUS NOSE
3		9282-0680	1	PEN CARTRIDGE
3		9282-0681	1	PEN SPRING
2		09874-67924	4	HOLD DOWN MAGNETS
2		09874-67950	1	CURSOR ASSEMBLY
3		0624-0340	4	TAPPING SCREW
3		09874-61651	1	PC CABLE ASSEMBLY
4		1990-0534	1	YELLOW LED
4		2140-0221	4	INCAND LAMP
3		09874-67701	1	CURSOR BASE ASSEMBLY
3		3030-0404	4	SCREW
3		5060-7473	1	SHELL ASSEMBLY
2		09874-87000	1	MYLAR PKG ASSEMBLY
2		09874-90000	1	DOCUMENTATION MANUAL
2		2110-0043	2	FUSE 1.5A
2		2110-0083	1	FUSE 2.5A
2		7120-7105	5	INFORMATION LABEL
2		9282-0680	1	PEN CARTRIDGE
1		3150-0223	1	FOAM FILTER
1		5040-5833	1	FAN SHROUD
1		7120-6892	1	LINE LABEL

Appendix

Appendix

Accessory Installation

This appendix shows the installation of the following accesories:

- Foot Switch
- Strip Chart Box

Foot Switch

The foot switch cable contains a plug which is plugged into the receiving jack located on the rear panel of the digitizer. See Figure A-1.

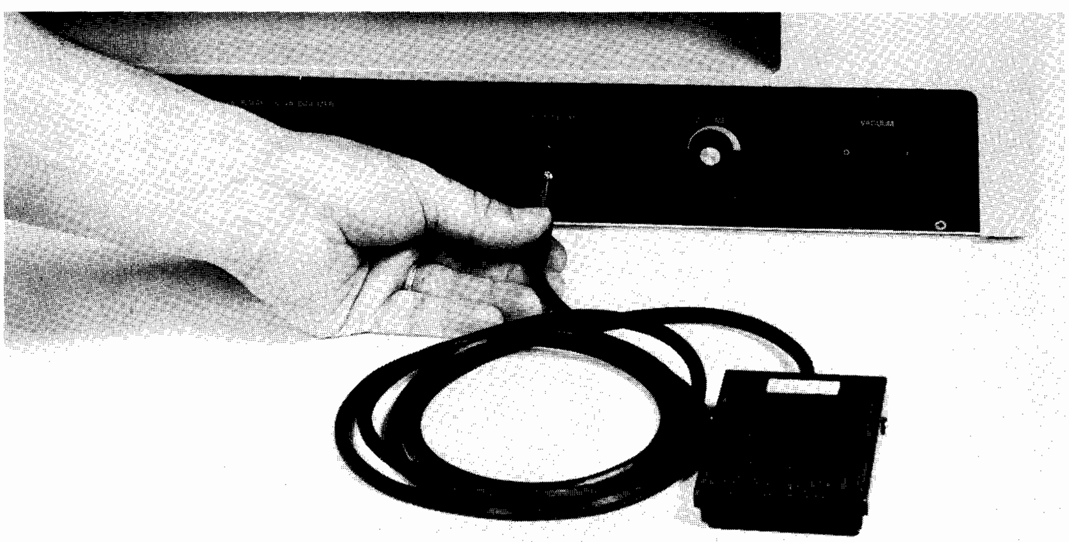


Figure A-1: Foot Switch Installation

Strip Chart Box

The strip chart box mounting bracket is connected with four screws to the rear access panel of the digitizer (refer to Figure A-2).

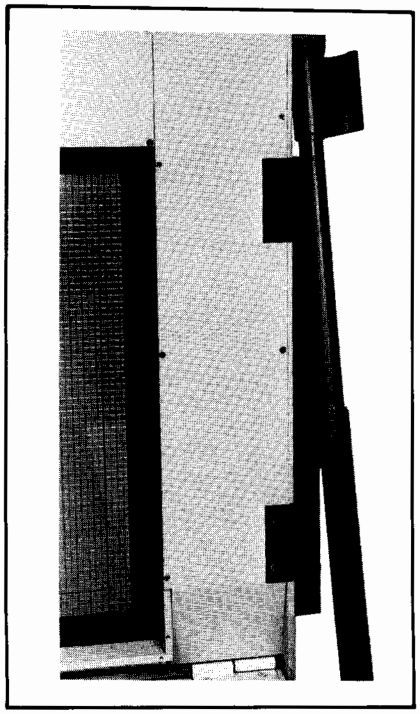


Figure A-2: Strip Chart Bracket Installation

The strip chart box is placed into the retaining slot on its bracket (see Figure A-3). The outer edge of the strip chart box is pushed toward the rear of the digitizer until it locks into place.

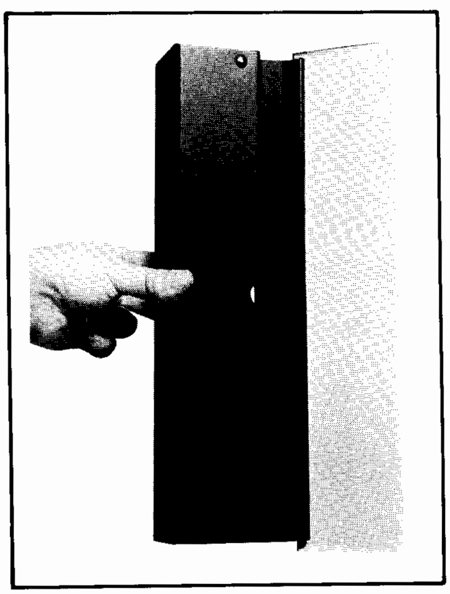


Figure A-3: Strip Chart Box Installation

The strip chart is placed between the plastic mylar and the platen and guided beneath the keypad bridge assembly. See Figure A-4.

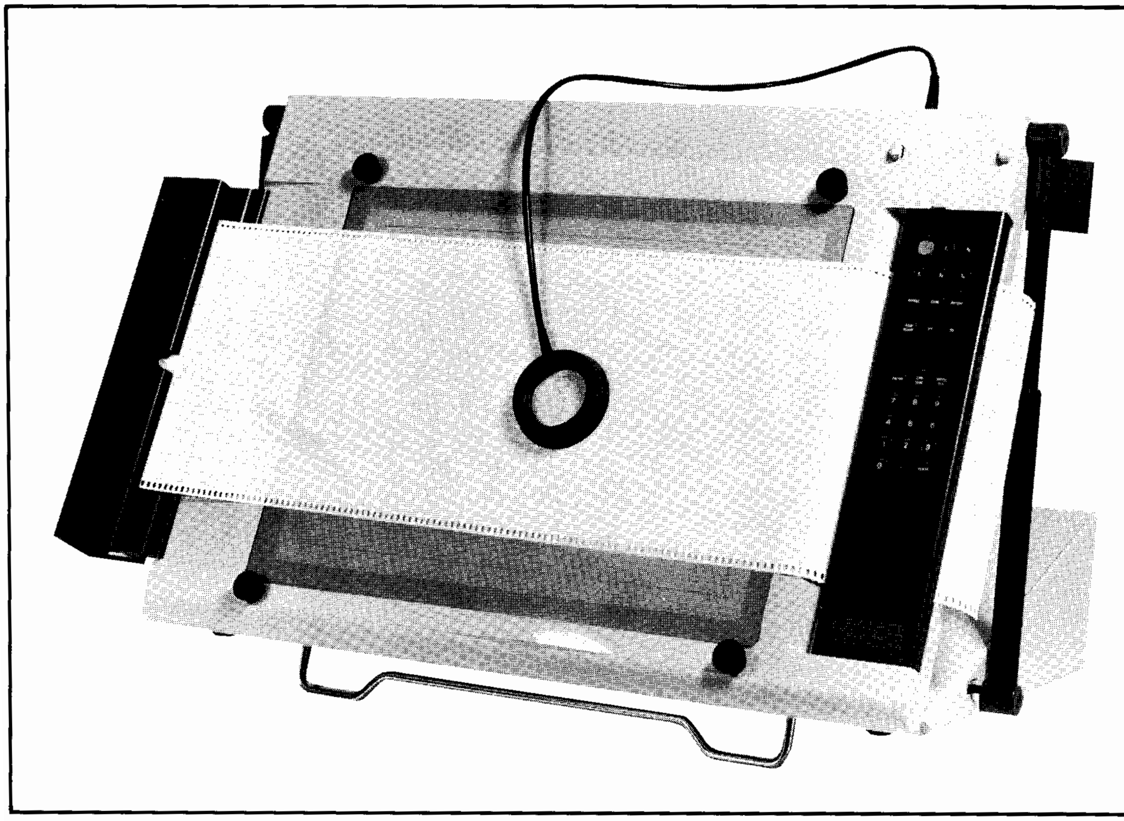


Figure A-4: Installing the Strip Chart

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