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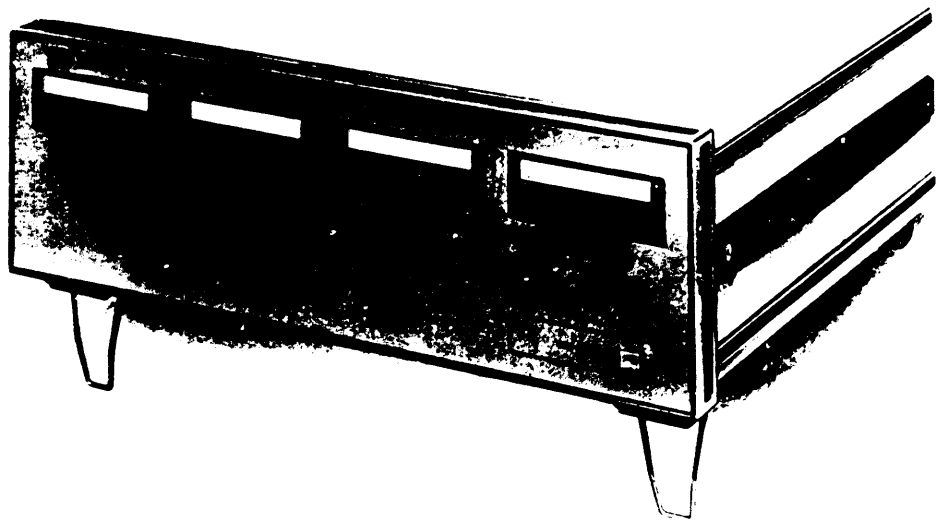
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HEWLETT - PACKARD 9877A EXTERNAL TAPE MEMORY SERVICE MANUAL



**HEWLETT - PACKARD 9877A
EXTERNAL TAPE MEMORY**



HP 9877A External Tape Memory and the HP 9825A Calculator

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CHAPTER 1

GENERAL INFORMATION

INTRODUCTION

This manual provides the information necessary to service the 9877A External Tape Memory. The chapters include theory of operation, troubleshooting and replaceable parts. This chapter provides general service and installation information.

For operating instructions on how to control the 9877A with a 9825A Calculator refer to both the following manuals.

9825A Operating Manual Part No. 09825-90000 9877A Operating Manual Part No. 09877-90000
--

SERVICE CONCEPT

The I/O Interface Card A1, I/O Controller A2, Power Supply A5 and Power Module A6 can be either repaired to a component level or exchanged with a new replacement assembly (See Block Diagram, Figure 4-1). All other electronic assemblies should be exchanged with the 9825 service kit assembly. The defective assembly should be returned (on the exchange program) to PCE (Europe) or Calculator Products Division Loveland.

ENVIRONMENTAL RANGE

Operating Temperature:	5°C to 40°C (ambient)
Storage Temperature:	-40°C to +65°C
Ambient Humidity:	20% to 80% (30°C max wet bulb temperature)

POWER CORDS

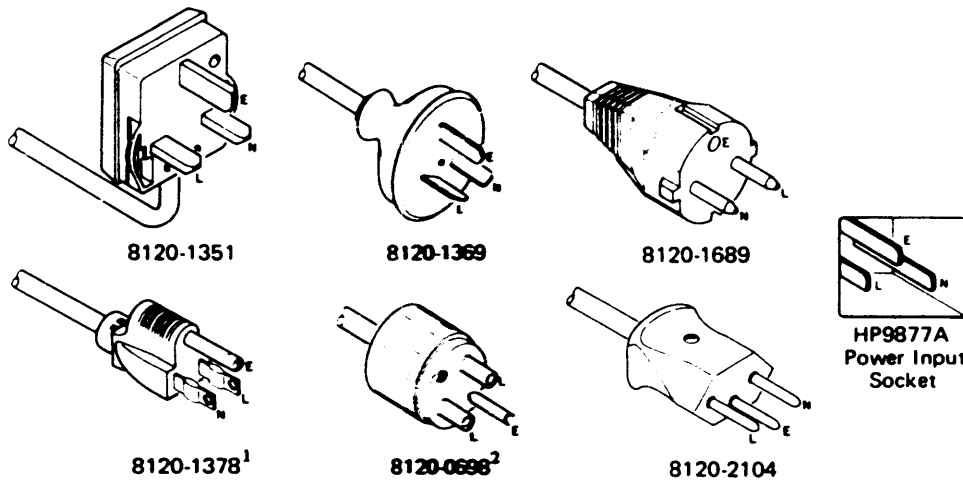
Power cords supplied by HP will have polarities matched to the power-input socket on the external tape memory, as shown below.

- 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 DEATH OR INJURY, MIGHT EXIST. IN ADDITION, THE EQUIPMENT COULD BE SEVERELY DAMAGED IF EVEN A RELATIVELY MINOR INTERNAL FAILURE OCCURED.

Power cords with different plugs are available for the external tape memory; the part number of each cord is shown below. Each plug has a ground connector. The cord packaged with each unit depends upon where it is to be delivered. If your unit has the wrong power cord for your area, please contact your local HP sales and service office.



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

²UL and CSA approved for use in the United States of America and Canada when set for either 220 or 240 Vac operation.

Figure 1-1 Power Cords

POWER REQUIREMENTS

The HP 9877A has the following power requirements:

- Line Voltage:

100 Vac + 5%, -10%	} Switch Selectable
120 Vac + 5%, -10%	
220 Vac + 5%, -10%	
240 Vac + 5%, -10%	
- Line Frequency: 48 to 66 Hertz
- Power Consumption (maximum):

	100/120 Volts	220/240 Volts
Standard	1.5A	700mA
Option 002	1.75A	800mA
3 tape drives	1.8A	860mA
Option 004	2.0A	920mA

GROUNDING REQUIREMENTS

To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the unit be properly grounded. The 9877A is equipped with a three-conductor power cable which, when connected to an appropriate power receptacle, grounds the unit. To preserve this protection feature, do not operate the unit from an ac power outlet which has no ground connection.

FUSES

The fuse installed in the external tape memory depends upon the unit type and the power supply voltage. Check that the fuse installed in your unit conforms to the table below.

	100/120 Volts	220/240 Volts
Standard	1.5AT	750mAT
Option 002	2.0AT	1.0AT
3 tape drives	2.0AT	1.0AT
Option 004	2.0AT	1.0AT

WARNING

TO AVOID THE POSSIBILITY OF SERIOUS INJURY, DISCONNECT THE AC POWER CORD BEFORE REMOVING OR INSTALLING A FUSE.

The fuse is located on the rear panel of the external tape memory to the left of the power socket. To change the fuse, disconnect the power cord to the unit. Remove the fuse cap by pressing inward while twisting it counterclockwise. Remove the fuse from the cap and insert the correct replacement fuse (either end) into the cap. Put the fuse and cap back into the fuse holder. Press on the cap and twist it clockwise until it locks in place.

EXTERNAL TAPE MEMORY/CALCULATOR CONFIGURATION

Place the external tape memory and calculator on a flat surface where they are to be used. Raise the two front tilt stands located underneath the front of the HP 9877A.

CAUTION

The interface connector must not be inserted or removed from the external tape memory or calculator with the power on. To do so will cause damage to the equipment.

Insert the interface card into any of the three slots located at the rear of the calculator (see Figure 1.2). Connect the other end of the interface into the socket on the rear of the external tape memory. Do not connect the power leads at this stage.

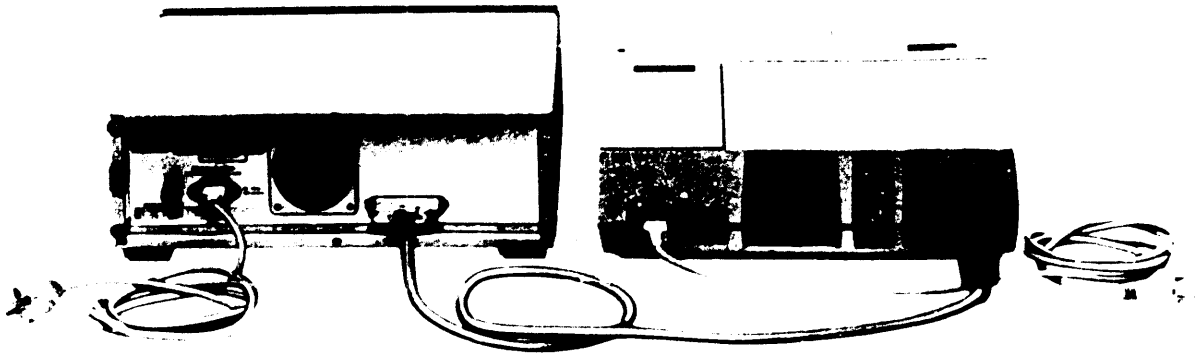
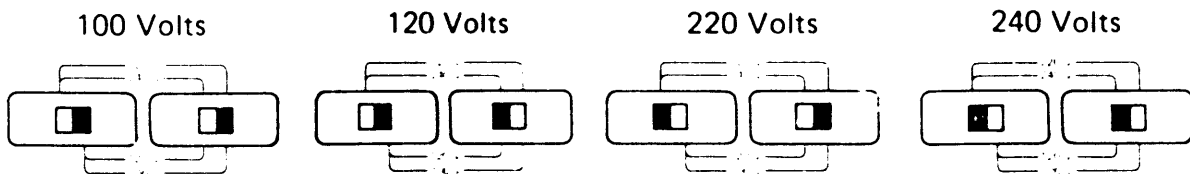


Figure 1-2. 9877A/9825A Configuration

INITIAL TURN-ON INSTRUCTIONS

1. Set the external tape memory voltage selector switches to the setting applicable to your a.c. mains supply. The voltage selector switches are located on the rear of the unit. Switch settings for the nominal line voltages are shown below.



2. Check that the calculator voltage selector is set to the correct position (see 9825A Calculator Operating and Programming Manual).
3. Connect both the external tape memory and calculator power leads into a.c. mains sockets.
4. Using the switches on the front panel of the external tape memory, and on the right hand side of the calculator, switch on the power.

EXTERNAL TAPE MEMORY CLEANING

Case

The external tape memory case can be cleaned by using a soft, moist cloth. Do not use harsh or abrasive detergents, and do not allow moisture to penetrate the external tape memory.

Fan Filter

The fan filter is on the back of the external tape memory. Just pull it out to remove it. Clean the filter in warm soapy water, rinse it in clean water and dry thoroughly before replacing it.

Magnetic Tape Head

To ensure the reliability of tape operation, it is recommended that the tape head be cleaned after every eight hours of tape operations. It's a good idea to clean the tape head before making important recordings.

The tape head is cleaned as follows:

1. Remove the tape cartridge if installed.
2. Clean the tape head with a cotton swab that has been dampened with head cleaning solution (HP part no. 8500-1251). Wipe the top of the tape head a few times with the cotton swab. Remove any other dust that has accumulated in the vicinity of the tape head.

CONDITIONING THE TAPE

Repeated operations over a short length of tape (usually less than 4000 bytes or 1.5 m (5 ft.)) can cause slack (extreme changes in temperature can also cause this). The outer layer of tape can slip and rub on the cartridge, causing damage to the tape. If operation continues, the tape may jam and be ruined.

NOTE

This problem is most likely to occur if exclusive use is made of one file or two adjacent files near the beginning or end of tape.

If a particular application requires such operation, this slack can be prevented by conditioning the tape periodically. For example, for a tape with 80 files where only files 0 and 1 are used, execute the following program segment after every 200 operations on file 0 or 1:

```
18: fdf80  
19: rew
```

TAPE CARTRIDGE CONSIDERATIONS

If the tape unwinds completely from one of the reels, refer to Figure 1-3 and use the procedure below to rethread the tape.

1. Remove the 4 screws holding the cartridge cover and remove the cover.
2. Thread the tape around the guides as shown in Figure 1-3, making sure it passes through the tape scraper.
3. With the tape extended almost to the drive belt, moisten the end of the tape so that it will stick to the take-up reel.
4. Use a pencil (or other sharp instrument) to guide the tape between the drive belt and the take-up reel. Keeping the tape taut, wind the tape onto the take-up reel using the pencil.
5. As you wind the tape onto the reel, ensure that there is no slack in the tape. If the tape is not tight, repeat the operation. Be sure the tape follows hub around for the first turn.
6. Wind at least 20 turns of tape onto the reel by turning the drive roller. If any rollers creep up away from the plate, press them back again.
7. Reassemble the cartridge.

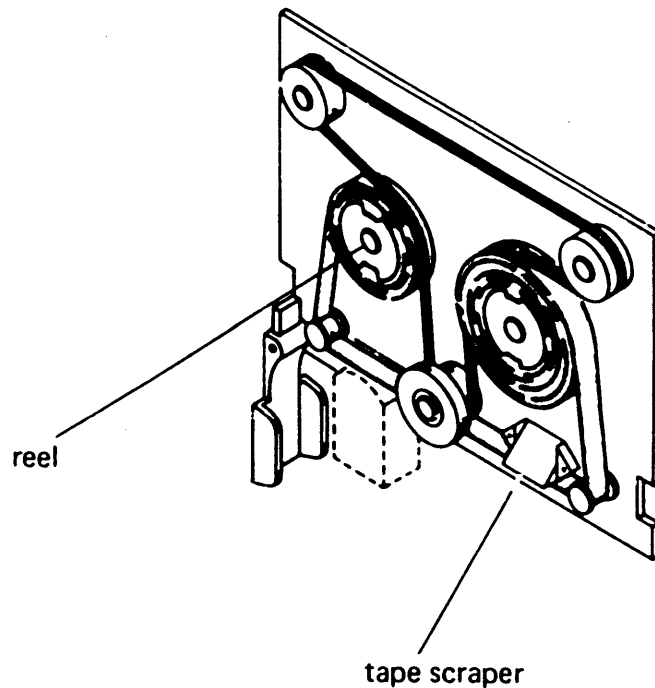


Figure 1-3. Tape Cartridge

CHAPTER 2

SETTING UP PROCEDURES

GENERAL

The external tape memory cartridge units are identical to the unit fitted in the calculator. Also, tape care, format and commands are identical. Therefore, before using the external tape memory the user should read Chapter 9 (tape cartridge operations) in the calculator operating and programming manual. The following chapter only provides the additional information required to use the HP 9877A.

SETTING THE SELECT CODE

The select code is a number by which the calculator identifies a peripheral device. When a select code is addressed in a program or through the calculator keyboard, a communication link is set up between the calculator and peripheral. Although the external tape memory is essentially one peripheral, each tape cartridge unit is considered by the calculator to be an individual peripheral. The reason for this is that the calculator can only service one tape cartridge unit at a time.

To provide the communication link between the 9825A calculator and a specific tape cartridge unit in the 9877A, there are two stages in setting up the select code. This is accomplished by setting a switch on the interface card and by a calculator keyboard entry or by specification in a peripheral control program.

The select code number set on the interface card (see Figure 2-1) identifies the HP 9877A as a whole. If you also have other peripherals or instruments connected to the calculator each of these will be allocated their own code number. You must therefore choose a select code whose combination does not include a number already allocated to another device (see select code combinations). This number, once set, does not normally need to be altered again.

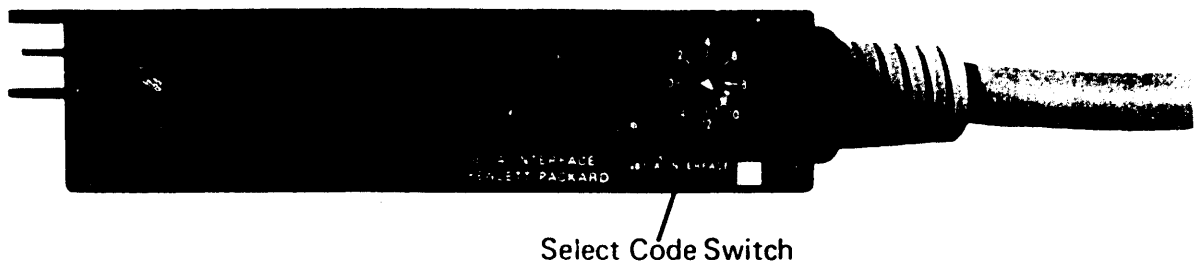


Figure 2-1 Interface Card Select Code Switch

The select code number entered through the calculator keyboard, or specified in a peripheral control program, identifies the individual tape cartridge units. When the 9877A is being used as an external memory, the user must identify the specific cartridge each time he wishes to use it by addressing it in the control program or through the keyboard with the appropriate select code. This includes the calculator built-in unit which is always identified by select code number 1 (ssc 1).

When the unit is being used to duplicate a master tape, the DUPLICATOR tape cartridge supplied with the HP 9877A is used. The program contained on this cartridge includes the cartridge select codes. Therefore the user only needs to set the interface card selector.

SELECT CODE COMBINATIONS

The select code numbers you choose to set on the 9877A interface card and through the calculator keyboard (or control program) are governed by various restrictions. It is important that you observe these restrictions in order that the 9825A/9877A configuration functions correctly.

Decribed below are the combinations of select codes applicable to each of the three versions of HP 9877A.

NOTE

After upgrading it is possible to have a 3 tape drive unit. See Chapter 3 for this special case.

For all versions select codes 0 and 1 must never be used as these are allocated to functions within the 9825A calculator (0 selects keyboard and display and 1 selects the built-in cartridge). In addition, select codes 2 and 3 must not be used with option 004. If either 2 or 3 is used a meaningless response will result. The select code combinations for each version is as follows:

Standard (1 cartridge unit)

Select codes 2 to 15 inclusive are available. The select code set on the interface card must also be addressed through the keyboard (or control program). Whichever number you select cannot be used to identify any other peripheral. Also you cannot use any number already allocated to another peripheral.

Option 002 (2 cartridge unit)

Select Code	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tape Cartridge	=1	=2	=1	=2	=1	=2	=1	=2	=1	=2	=1	=2	=1	=2

Select codes 2 to 15 inclusive are available. The code numbers are divided into pairs. To identify the 9877A as a whole either number of a pair may be set on the interface card (e.g. 2 or 3; 4 or 5; 6 or 7 etc.). However, if either number of a pair is being used to identify another peripheral then neither number is available for use with the 9877A. Also, whichever number you choose to set on the 9877A interface means that its partner number cannot be used to identify other peripherals.

To identify the individual tape cartridge units, select codes must also be addressed through the calculator keyboard (or by control program). The select codes used here must relate directly to the number set on the interface card. For example, if 6 is set on the interface only 6 or 7 may be used to identify the individual cartridge units. For each number pair the lower number always identifies tape cartridge = 1 and the higher number tape cartridge = 2.

Option 004 (4 cartridge unit)

Select Code	4	5	6	7	8	9	10	11	12	13	14	15
Tape Cartridge	=1	=2	=3	=4	=1	=2	=3	=4	=1	=2	=3	=4

Only select codes 4 to 15 inclusive are available and these are divided into groups of four as shown above. To identify the 9877A as a whole, any number of a group may be set on the interface card provided that this number, or any other number in it's group, is not being used to identify other peripherals. Similarly the number you choose to set on the interface, along with the other three numbers from its group, cannot be used to identify other peripherals.

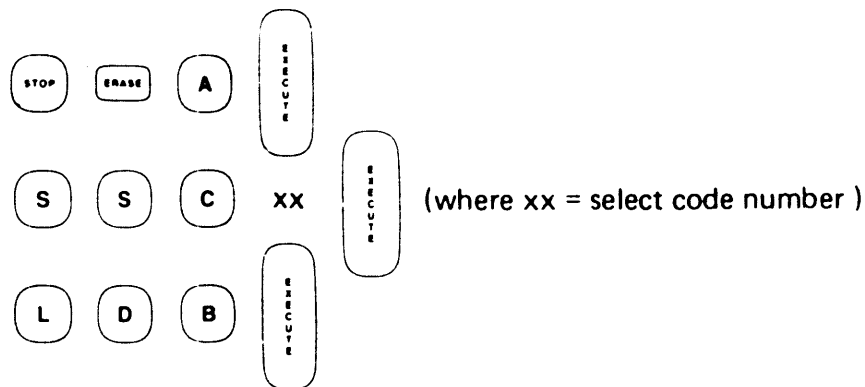
To identify the individual tape cartridge units, select codes must also be addressed through the calculator keyboard (or by control program). As with option 002 these codes must relate directly to the code number set on the interface card. For example, if 9 is set on the interface card, numbers 8, 9, 10 and 11 may be used. With each group the lower number always identifies tape cartridge # 1 and the higher number tape cartridge # 4.

9877A SYSTEM TEST

This description contains a test procedure to verify the performance of the 9877A. It is good practice to initially check the 9825 Tape Cartridge, to verify that the 9825 is working correctly.

Then run the test as follows:

1. Turn on the calculator and external tape memory.
2. Insert the System Test Cartridge into the tape cartridge unit to be tested.
3. Press:



4. The calculator display will show:

HIGH TEST 3

5. Press:



6. The following display and printout should be seen:

INSERT SCRATCH CARTRIDGE

CARTRIDGE TEST

7. Remove the System Test Cartridge and insert a scratch cartridge*, then press .

8. After about 45 seconds the following display and printout should be seen.

REPLACE TEST CARTRIDGE

CARTRIDGE TEST
COMPLETE

9. Remove the scratch cartridge.

*The scratch cartridge must be a good, unprotected tape cartridge which does not contain wanted information.

For full information on calculator tests refer to the HP 9825A System Test Booklet, Part No. 09825-90031.

CHAPTER 3

FIELD INSTALLATION

FITTING THE FIELD INSTALLATION KIT

The following procedure describes the field installation of the 11242A field installation extension. You should read 'Assembly Access' (Chapter 5 of this manual) before any kit installation to get familiar with the 9877A construction.

Proceed as follows:

- Remove the front panel assembly as described in 'Transport Assembly', Chapter 5.
- Remove the four screws from the left most panel filler (looking from front) in the sub-panel and the front panel.
- Install the tape cartridge unit and the tape drive.
- Replace the panel assembly.
- Remove the filler boards.
- Set the "Option" switches as described at the end of this Chapter.
- Connect the right most tape unit (looking from front) with the lowest transport logic board. Connect the board above with the next tape unit on the left and so on.
- Install the new transport logic board at the place of the lowest filler board and connect it to CARTRIDGE # 1.
- Upgrade the boards with filler boards if needed.
- Check and replace the fuse if necessary (see Chapter 1 for fuse ratings).

Three Tape Drive Unit

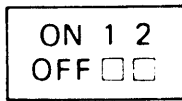
After upgrading, it is possible that a customer has a 9877A unit with three installed tape cartridges. As there is no description in the operating manual for you to cover this possibility, check the following points for a correctly working device.

- Set the "option" switches as described at the end of this Chapter.
- Use the select code combinations as for option 004. The select code numbers 4,8 and 12 of the three possible combinations are not used in this case, you can use them in the same manner as code numbers 2 and 3 for other peripherals connected to the calculator.
- The select code switch on the interface card must not be set to positions 4,8 or 12. If these codes are used the 9877A will not respond.

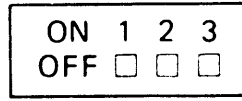
SETTING THE "OPTION" SWITCHES

Depending upon which option is installed in the External Tape Memory, the switches on the I/O Controller board and interface board must be positioned in the following way:

I/O Controller (S1)



Interface Board (S2)



Option	I/O Controller Switch S1		Interface Board Switch S2		
	1	2	1	2	3
Standard (single tape drive)	OFF	OFF	OFF	ON	ON
002 (two tape drives)	ON	OFF	OFF	OFF	ON
3 tape drives	ON	ON	ON	OFF	OFF
004 (four tape drives)	ON	ON	OFF	OFF	OFF

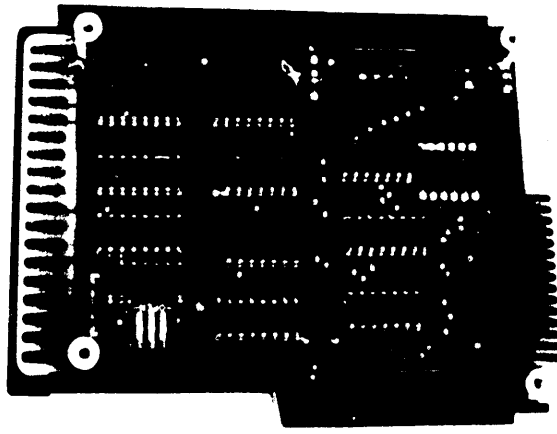
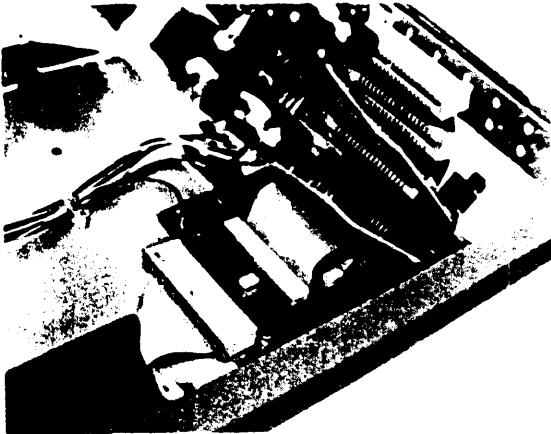


Figure 3-1 Location of "option" switches on I/O Controller-Board and Interface Board.

CHAPTER 4

THEORY OF OPERATION

INTRODUCTION

This chapter provides the principles of operation of the external tape memory. It includes a block diagram, a general description and a brief theory of operation for those boards which are on component level repair. Schematic diagrams of the PCB's are given in Chapter 6, Figures 6-4, 6-5 and 6-6.

LOGIC DEFINITIONS

The following logic conventions are used when describing the tape memory signals:

- Logic levels are nominally 0 volts and +5 volts; 0V is referred to as the "low" state and +5V as the "high" state.
- The mnemonics, which are given to the logic signals are of two types:
 1. Those with a bar over the characters are true when they are in "low" state.
 2. Signals without a bar over the characters are true when they are in "high" state.

BLOCK-DIAGRAM (OPTION 4)

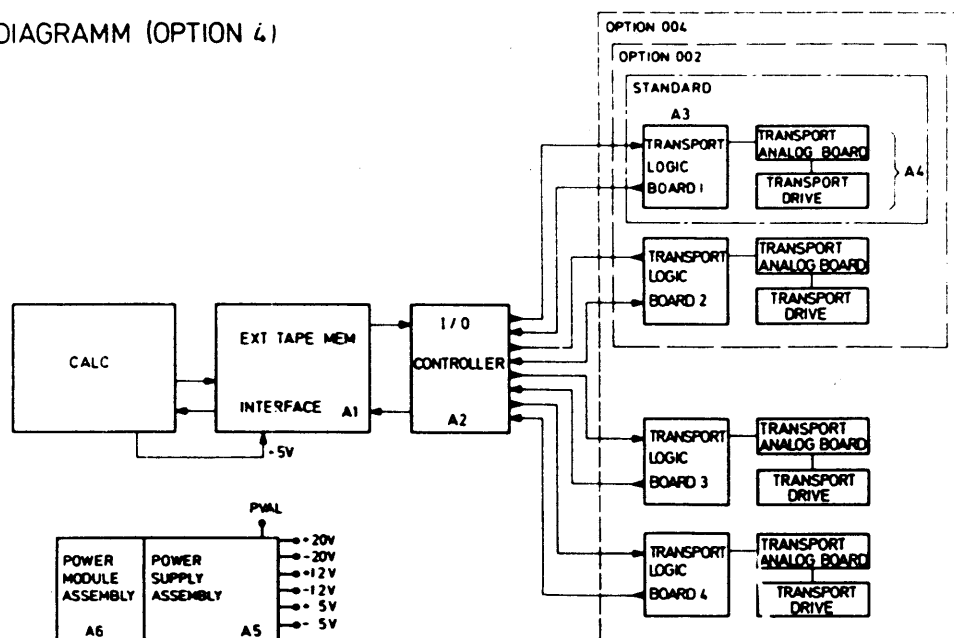


Figure 4-1. Overall Block Diagram (Option 004).

GENERAL DESCRIPTION

Interface Card (A1)

The 9877A External Tape Memory functions with the 9825A Calculator using the dedicated Interface 09877-67901 which is delivered with the External Tape Memory.

The I/O card plugs into any of the calculator I/O slots. The function of the I/O card is to provide the select code for the external tape memory and to co-ordinate and buffer the data exchange between the calculator and the external tape memory. When the sending device has data to be transferred, the I/O card accepts the data, performs any necessary buffering and logic operations, and outputs the data when the receiving device is ready. Power for the I/O card is provided by the +5V from the calculator.

Mnemonic list for the external tape memory	
PA (0-3)	Peripheral Address
INIT	Initialize
INT	Interrupt
DOUT	Data Out
IOSB	Input-Output-Strobe
CTL (1-2)	Control Line
DMAR	Direct Memory Access Request
FLG	Flag
STS	Status
IOD (0-7)	Input-Output Dataline
MYP A	My Peripheral-Address
SHLD	Shield

I/O Controller (A2)

The I/O Controller selects, with the select code it receives from the interface card, the tape unit with which it is to work. Its function depends upon the number of tape units installed in the external tape memory (see also Chapter 3, setting the "option" switches). It also sets the logic circuits on the Transport Logic Boards in a correct state during the power up and reset period.

Recording System

The recording system consists of two major assemblies.

- The tape transport logic board.
- The tape transport drive assembly.

These assemblies control the data transfer between the tape cartridge and the calculator.

Tape Transport Logic Board (A3)

The tape transport logic board contains the following circuits.

- Control and timing
- Command latch
- Status registers

Tape Transport Drive Assembly (A4)

The tape transport drive assembly consists of an analog board and the motor-tach assembly. The analog board supplies (or receives) serial data to-or-from the read/record head and contains the servo motor control circuits. The motor-tach assembly drives the tape cartridge as required by the analog board.

Power Supply (A5, A6)

The power module assembly and the power supply assembly provides $\pm 20V$, $\pm 12V$, and $\pm 5V$ to the external tape memory.

THEORY OF OPERATION

NOTE: The symbol • indicates the 'AND' function.

Interface Card (A1)

U1 (open collector outputs) compares the select code chosen by the select code switch on the Interface Card with the four peripheral address lines $\overline{PA0}$ – $\overline{PA3}$ during an operation. For each version of the 9877A this operates as follows:

- Standard (single cartridge) unit. $MYPA \bullet \overline{INT}$ goes high when $\overline{PA3}$, $\overline{PA2}$, $\overline{PA1}$ and $\overline{PA0}$ agree with bits 3, 2, 1 and 0 of the select code, and the \overline{INT} line is also high.
- 002 (two cartridge) unit. $MYPA \bullet \overline{INT}$ goes high when $\overline{PA3}$, $\overline{PA2}$ and $\overline{PA1}$ agree with bits 3, 2 and 1 of the select code, and the \overline{INT} line is also high.
- Three cartridge unit and 004 (four cartridge) unit. $MYPA \bullet \overline{INT}$ goes high when $\overline{PA3}$ and $\overline{PA2}$ agree with bits 3 and 2 of the select code, and the \overline{INT} line is also high (Note. For 3 cartridge unit only, $\overline{PA1}$ or $\overline{PA0}$ or both must also be low).

U2 and U5 are used as line drivers and tri-state buffers. During data-exchange U2 and U5 are enabled with a low DISAB signal. Only when the reset key is pressed, or when the 9877 is switched on, the DISAB line goes high for 1,4 μ s and disables these buffers forcing the output-lines high. U3, U4 and U8 are tri-state buffers, which allow input or output transfer with A2. With a low output at U7 pin 8, data can be transferred from the external tape memory to the calculator. With the inverted signal at U7 pin 12, data transfer is enabled in the other direction. The option switch S2 is used to select the addressed transport logic boards together with U1A, U1B, U1C and U1D. It's position depends upon the option (see Chapter 3, setting the "option" switches).

The external tape memory can pull down the \overline{FLG} and \overline{STS} lines when the calculator wants the 9877 to input or output data. These two lines are enabled with a high MYPA • \overline{INT} signal (which is inverted in U6 and enables the tri-state buffers U10).

The \overline{DMAR} line should only be enabled when in the search mode. \overline{Q} of the D-Flip-Flop U11 enables this line. The condition for the clock pulse of U11 is:

$$\text{Clock} = \text{D OUT} \cdot \text{IOSB} \cdot \text{CTL1} \cdot \overline{\text{INT}} \cdot \text{MYPA} \cdot \overline{\text{CTL2}}$$

I/O Controller (A2)

The I/O Controller selects one of the transport logic boards. This is addressed by its select-code via the interface-board. Every transport logic board has its internal select code. To address each of the transport logic boards, two of these lines are required:

The lines PA1 (transport logic boards 1 and 2),
 $\overline{PA1}$ (boards 3 and 4),
 PA0 (boards 1 and 3) and
 $\overline{PA0}$ (boards 2 and 4).

To address for example, board 3, $\overline{PA0}$ and PA1 must be high, and PA0 and $\overline{PA1}$ low.

Depending upon the option and the positions of the "option" switches (see Chapter 3), there are up to 4 transport logic boards addressable via the interface-board. The resistors R2, R3 and R4 are used to avoid line noise on the interface cable. U3B, CR1, Q1 and the resistors R5, R6, R7 and R2 are necessary for a correct \overline{INIT} signal. The \overline{INIT} line goes low when the reset-key is pressed or when the 9825 is switched off.

The PVAL signal is derived from the 9877A power supply and suppresses any command to the transport logic boards during a power failure (PVAL – low).

The other circuits on the I/O controller board set the logic circuits on the transport logic boards to a defined state when the 9877A/9825A configuration is switched on. To do so, it is necessary to set two different "states" on the lines CTL1, and DOUT while CTL2 and IOSB are "low" and the lines PA0, PA0, PA1, PA1, MYPA • \overline{INT} are disabled (their output is high during this period) with a high DISABLE signal at one-shot U4A output Q.

U4A is triggered with a high going collector output at Q1, and outputs a $1,4 \mu\text{s}$ pulse, refer to the timing diagram below (Figure 4-2).

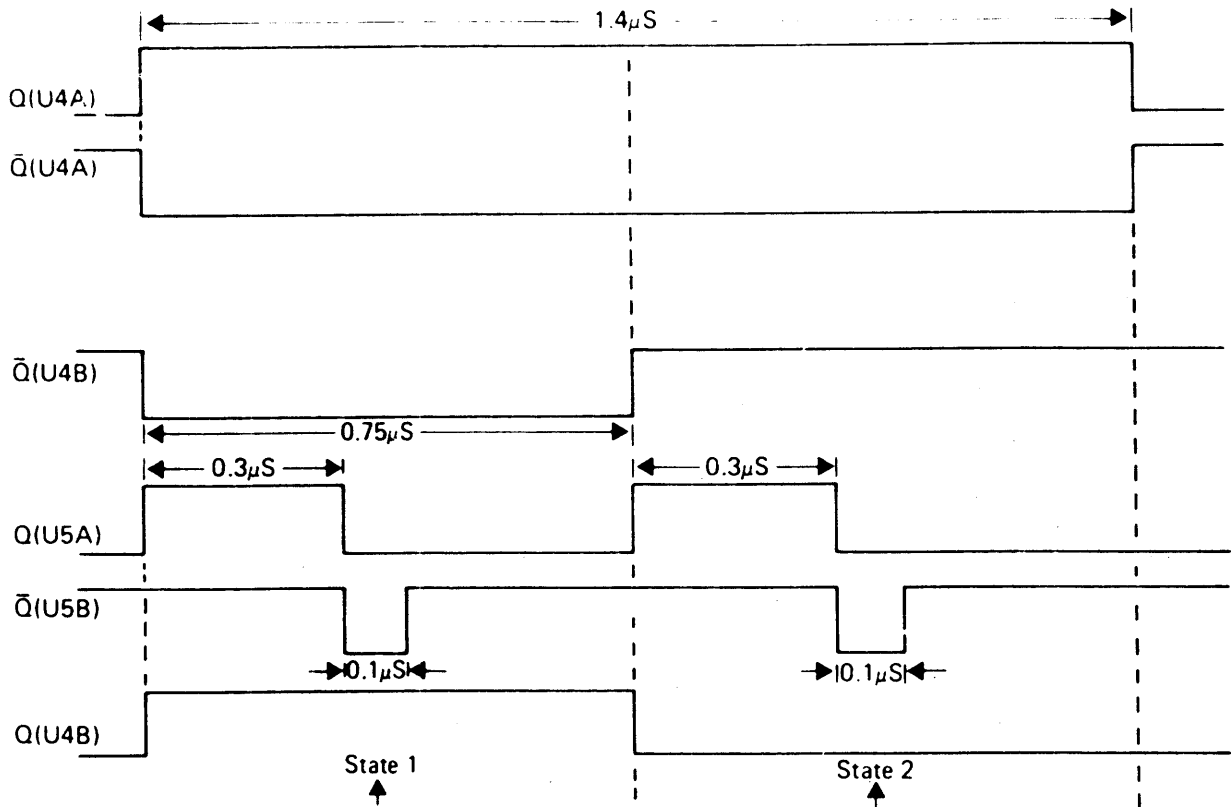


Figure 4.2. Timing Diagram

\bar{Q} of U4A forces $\overline{CTL2}$ low during this period. Q of U4A clocks U4B, which outputs a $0,75 \mu\text{s}$ pulse, and this holds the $\overline{CTL1}$ and \overline{DOUT} lines low for the period of the first word.

Q of U4A also triggers one-shot U5A. With the trailing edge of the $0,3 \mu\text{s}$ pulse at output Q of U5A, U5B is triggered and \bar{Q} of U5B goes low for $0,1 \mu\text{s}$, forcing the \overline{IOSB} line low.

With the low \overline{IOSB} signal, state 1 is latched in the transport logic boards.

	$\overline{CTL1}$	$\overline{CTL2}$	\overline{DOUT}	\overline{IOSB}
State 1	0	0	0	0
State 2	1	0	1	0

With the trailing edge of Q (U4B), U5A is triggered again and U5A Q goes high for a second $0,3 \mu\text{s}$ pulse. The trailing edge of this pulse forces U5B \bar{Q} low for $0,1 \mu\text{s}$ and this low \overline{IOSB} signal latches state 2 in the transport logic boards.

Power Supply

The power supply provides six different voltages and one status signal to the calculator. The voltage lines are used by the various circuits, as shown in Figure 4-3 for power distribution. PVAL is used to suppress any command to the transport logic boards when going low (power failure).

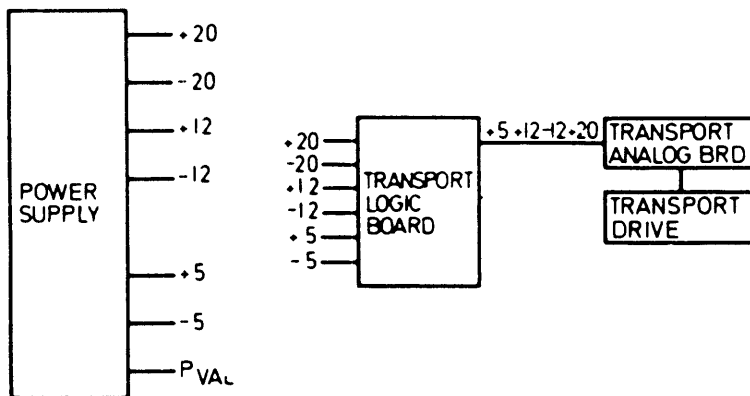


Figure 4-3. Power Supply Block Diagram

+5 Volt Supply

The +5V power supply utilizes a switching regulator technique to provide maximum output current with minimum heat dissipation by the series pass transistor. Since Q3 draws current only when saturated, power dissipation in Q3 is minimised.

Q2 is switched by a small voltage difference between U4 pin 2 and U4 pin 3 (inputs to the IC operational amplifier). A +5V reference is established on the amplifier non-inverting input (pin 3) by voltage divider R14 and R16. When the supply output is less than the reference voltage, U4 switches Q3 on. The +20V Q3 collector voltage, divided by R15 and R17, establishes a higher reference voltage. When the supply output increases to the higher reference voltage, U4 switches Q3 off and the previous reference decreases to the level originally established by R14 and R16. Q3 is switched on when the voltage output is again equal to the reference voltage.

The Q3 output is a 20V square wave, which is filtered by L2 and C10. The output of the filter (+5V) is the average of the Q3 collector signal. CR5 provides a continuous path for inductor (L2) current when Q3 is off. L1 isolates the capacitance of C10 from external filter capacitance, couples the ripple voltage to the +5V sense line and provides additional +5V filtering.

CAUTION

The +5V power supply is not current limited. A failure which results in excessive +5V current may cause damage to the instrument.

-5 Volt Supply

The source for the -5 volt supply is the -12 volt supply. CR8 and R7 establish the -5 volt supply. An additional resistor, R1 (82 Ω), is soldered to the edge connector between pins L and 17. This provides a higher current output at the -5V power supply.

+20 Volt and -20 Volt Supplies

The +20 volt and -20 volt supplies are unregulated and filtered only by C₁, C₂, and C₃. These voltages are used by the tape transport. They are also the source of power for the regulated supplies.

+12 Volt Supply

The U3 internal reference zener diode provides a +7.15V reference for the operational amplifier (U3). The +12V supply functions as a non-inverting amplifier which amplifies the zener reference voltage. The gain of the amplifier is determined by the voltage at the wiper-arm of the output voltage adjust, R11. The range of this adjustment on the output voltage is typically ± 0.5 volts of nominal.

R13 (in conjunction with U3) provides current limiting for Q4.

The +12V supply provides the reference voltage for the +5 volt supply, any changes or adjustments of the +12 volt supply will affect the +5 volt supply.

-12 Volt Supply

The source for the -12 volt supply is the -20 volt unregulated supply. U2 is a self-contained 12 volt regulator.

CHAPTER 5

TROUBLESHOOTING

INTRODUCTION

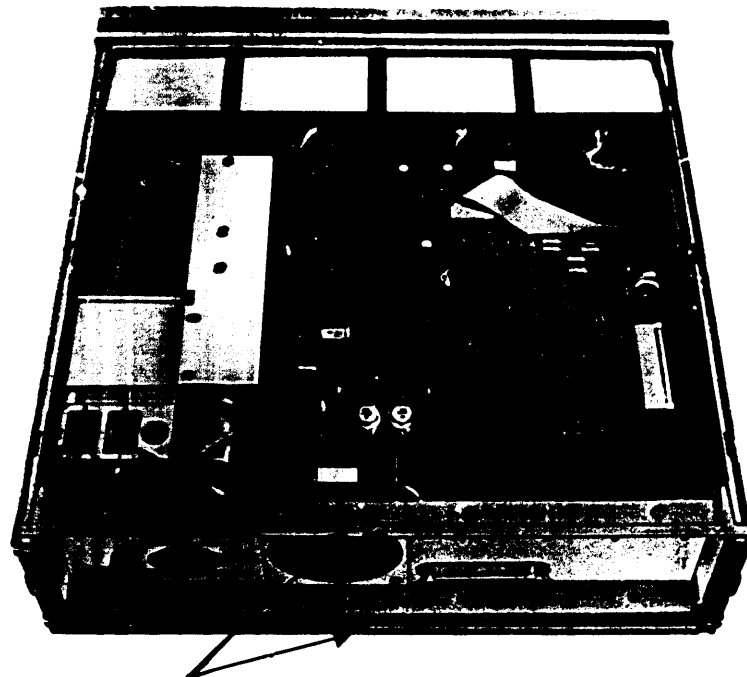
This chapter provides assembly access and troubleshooting procedures. In conjunction with the theory of operation and the schematic diagrams (see Chapter 6, Figures 6-4, 6-5 and 6-6) it will aid you in the repair of the 9877A External Tape Memory.

ASSEMBLY ACCESS

WARNING

Disconnect the AC-power cord, before removing any external tape memory assembly.

Most of the 9877A assemblies may be accessed by removing the screw located on the back of the top cover. Then slide the top cover backwards and remove it.



cover release screws

Figure 5-1. 9877 without top cover.

Transport Logic Board

To remove the transport logic board, press the removal tool (paper spindle from calculator) down over the white keepers, one at a time, while lifting that area of the PC board. To remove the board from the stack, remove the cable connectors, pivot the board and then disengage the hinge, by sliding it forward (about 1 cm).

The other transport logic boards are accessed in a similar manner. To remove the board, which is connected to the left most tape unit, remove the two screws at the handle on the left side of the case and slide the left side panel backwards.

Power Supply Board

To remove the power supply, remove the three screws from the heatsink shown in Figure 5-1 and remove the heatsink. The power supply board can now be lifted out of its edge connector and removed. Do not remove the heatsink from the power-supply board, if the 9877A is to be turned on.

I/O Controller

With the transport logic boards removed, the I/O Controller can also be removed. To do so, remove the screws at the corners of the board, remove the cable connector to the back panel and the +5V and PVAL single pin connectors.

Power Module

To remove the power module, remove the right side of the case and release the two screws which secure the power module to the case. Release the four corner screws in the base of the power module (note, one of these screws has a ground lug). Remove the screw holding the power cable to the power module case. Unsolder the wires to the voltage selector switches. Lift the power module from the chassis.

Transport Assembly

To remove the transport assembly,

1. Remove the top cover and the bottom cover of the 9877A. To do this, remove the two screws shown in Figure 5-1.
2. Disconnect the installed tape units and transport logic boards. To remove the plug from the left most tape unit it is necessary to remove the left side of the unit. This is possible when the two screws by the left handle are removed. Then slide the left side panel backwards and remove it.
3. Disconnect the power switch and the LED.
4. Remove the screws, which hold the tape units at the bottom of the case. The number of screws depends upon the number of installed units (two for each).

5. Remove the top trim as shown in Figure 5-2 and the side trim from the left and right side to gain access to the tape unit securing screws.
6. Remove the screws on the left and right side (two on each side) and on the top and bottom cover (three on each).
7. Slide all the tape units, together with the front panel, forward.
8. To remove a tape unit, remove the four screws and remove the unit, see Figure 5-3.

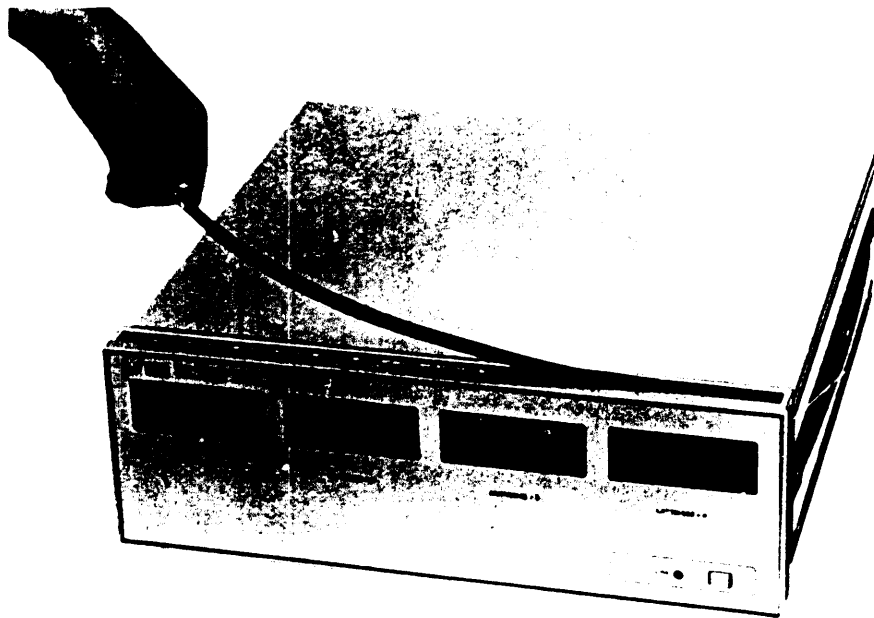


Figure 5-2. Location of front panel screws

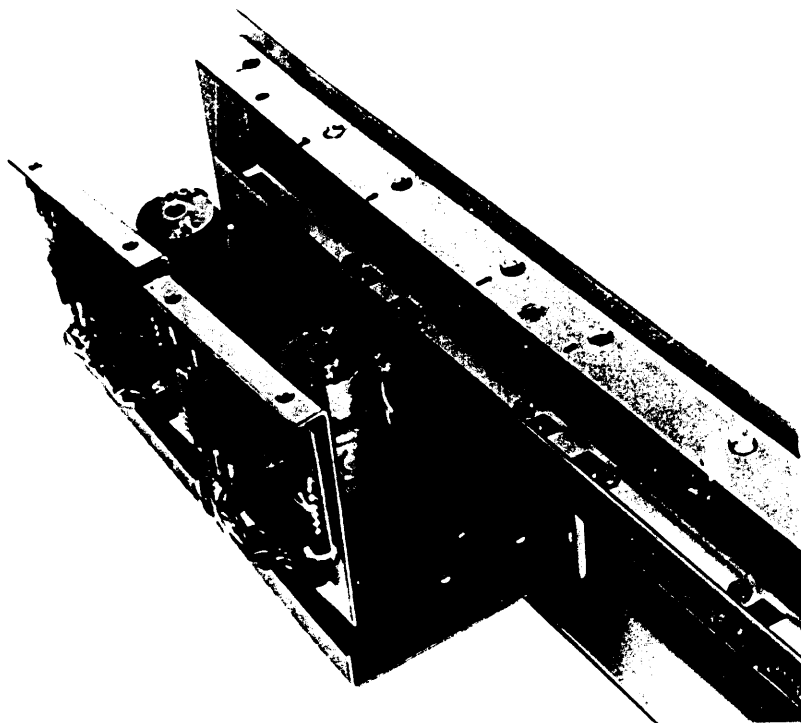


Figure 5-3. Front panel with tape unit

TROUBLESHOOTING

INTERFACE CARD (A1)

The following procedure assumes, that the problem has been isolated to the A1 assembly.

Visually inspect the board for damaged components or foreign conductive materials. If any defects are found, they should be corrected before proceeding further.

- If the external tape memory fails to work completely, check the address circuits U1, U2 A – C, U6A, U6B, U5B and the flag and status lines U9B, U9C.
- If the 9825 does not read or write data correctly or if the calculator does not accept 9877A status, check U4, U3, U8, U7A, U7B, U5E.
- If calculator commands are not accepted correctly, check the tri-state line drivers U2 D – F, U5 D – F.
- If the 9877 does not work correctly in search mode, check U9A, U10, U7C, U6 D – F,
- If the drives are not correctly addressed, check the position of the select code switches. Also check U1A, U1B, U1C and U1D and replace if defective.

I/O CONTROLLER (A2)

The following procedure assumes that the problem has been isolated to the A2 assembly:

- If the 9877A doesn't stop working when the reset key is pressed, or when the 9825 is switched off, check U1, CR1 and Q1 and replace if defective.
- If the 9877A does not start working check if Q1 collector is high. If not, check U1, CR1 and Q1 and replace if defective.
- If Q1 collector is high, check disable line at U4A pin 13, it must be low for a correct working device. If not replace U4.
- Check U6D, U6A, U6B, U6C and replace if defective.
- If with the first cassette operation Error 43 occurs in the calculator display, check U4 and U5 for correct output pulses (refer to the timing diagram, Figure 4-2) and replace if defective.
- If more than one cassette starts working at the same time, check U2B and U2C and replace if defective.

POWER SUPPLY ADJUSTMENTS AND CHECKS

+12 and +5 Volt Supplies

Use trim-pot R11 to adjust the +12 Volt supply to the nominal value, refer to the power supply schematic (Figure 6-4, Chapter 6), component locator and Table 6-1 in Chapter 6.

The reference voltage for the +5 Volt supply is provided by the +12 Volt supply, adjustments will affect the +5 Volt supply. Each of these voltages should be checked and rechecked after making an adjustment to the +12 Volt supply.

Other Supplies

The remaining supplies are non-adjustable but their output can be checked for proper operation. Refer to Table 5-1 and Figure 6-4 in Chapter 6.

	Nominal Voltage	Tolerance	Lower Limit (Absolute value)	Upper Limit (Absolute value)
Adjustable (R11)	+12	±2%	+11.76	+12.24
Non-Adjustable	+5	±3%	+4.85	+5.15
	-5	±5%	-4.75	-5.25
	-12	±5%	-11.4	-12.6

Table 5-1. Power Supply Voltage

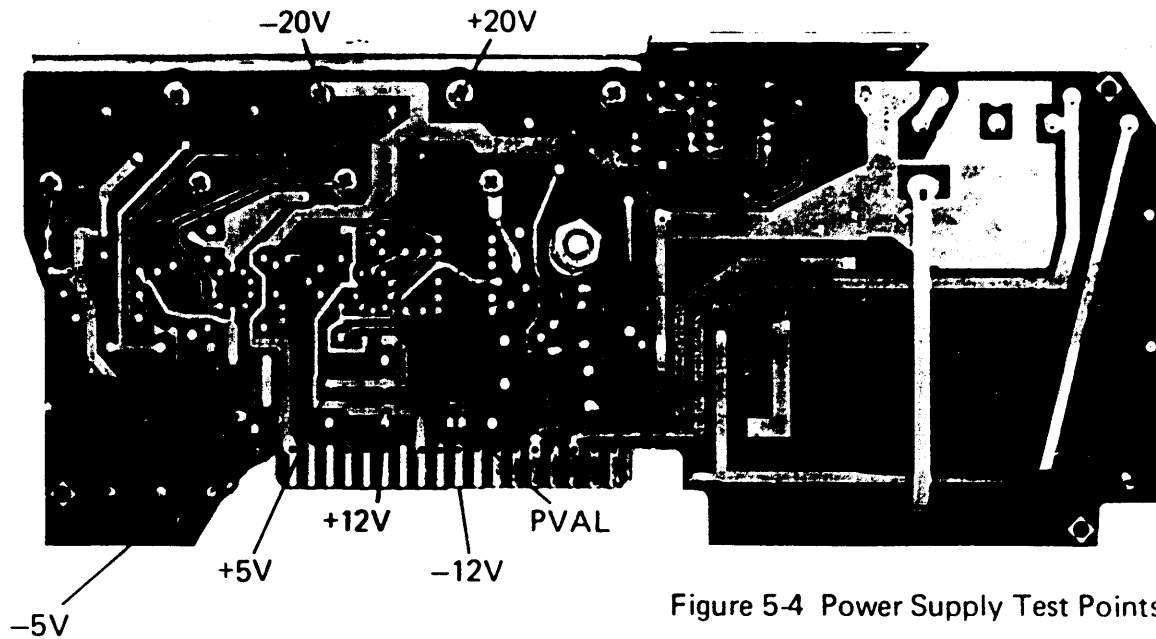


Figure 5-4 Power Supply Test Points.

POWER SUPPLY CHECKS

The following procedure assumes that the problem has been isolated to the A5 assembly.

Visually inspect the board for foreign, conductive material and loose or damaged components. If defects are found, perform any repairs that are necessary.

Check the supplies in the following sequence:

±20V Power Supplies

Before checking any of the other voltages, check the output of the full-wave bridge rectifier for ±20V (unregulated). If this output is satisfactory, check the other supplies.

–12V Power Supply

If the – 12V power supply is defective, change U2.

– 5V Power Supply

If the – 12V power supply output is satisfactory, but the – 5V output is incorrect, check CR8. Replace CR8 if it is suspect. If the current output is insufficient, check resistor R1 (82 Ω) at the edge connector.

+12V Power Supply

To troubleshoot the +12V power supply,

- If the power supply is not within the specifications, adjust trim-pot R11 to obtain the correct power supply output.
- Check, and replace if defective, fuse-resistor R13 and Q4.
- Replace voltage-regulator U3. Then adjust pot R11 for the required power supply output.

+5V Power Supply

As the +12V power supply provides the reference voltage for the +5V regulator U4, any changes in the +12V output will affect the +5V supply.

- Check Q3. The collector output of Q3 **must** be a 20V square wave.
- Check CR5, replace if defective.
- If the collector output of Q3 is still not **switching**, change U4.
- Check Q6, replace if defective.
- Check Q5 and CR7, replace if defective.
- Check L3, L2 and C10 and replace if **necessary**.

Power-Valid Circuit (PVAL)

- If the +20V and +5V supplies are within **range**, but the PVAL level is not within specifications (+5V), check CR6, replace if **defective**.
- Check Q1 and Q2 and replace if **necessary**.

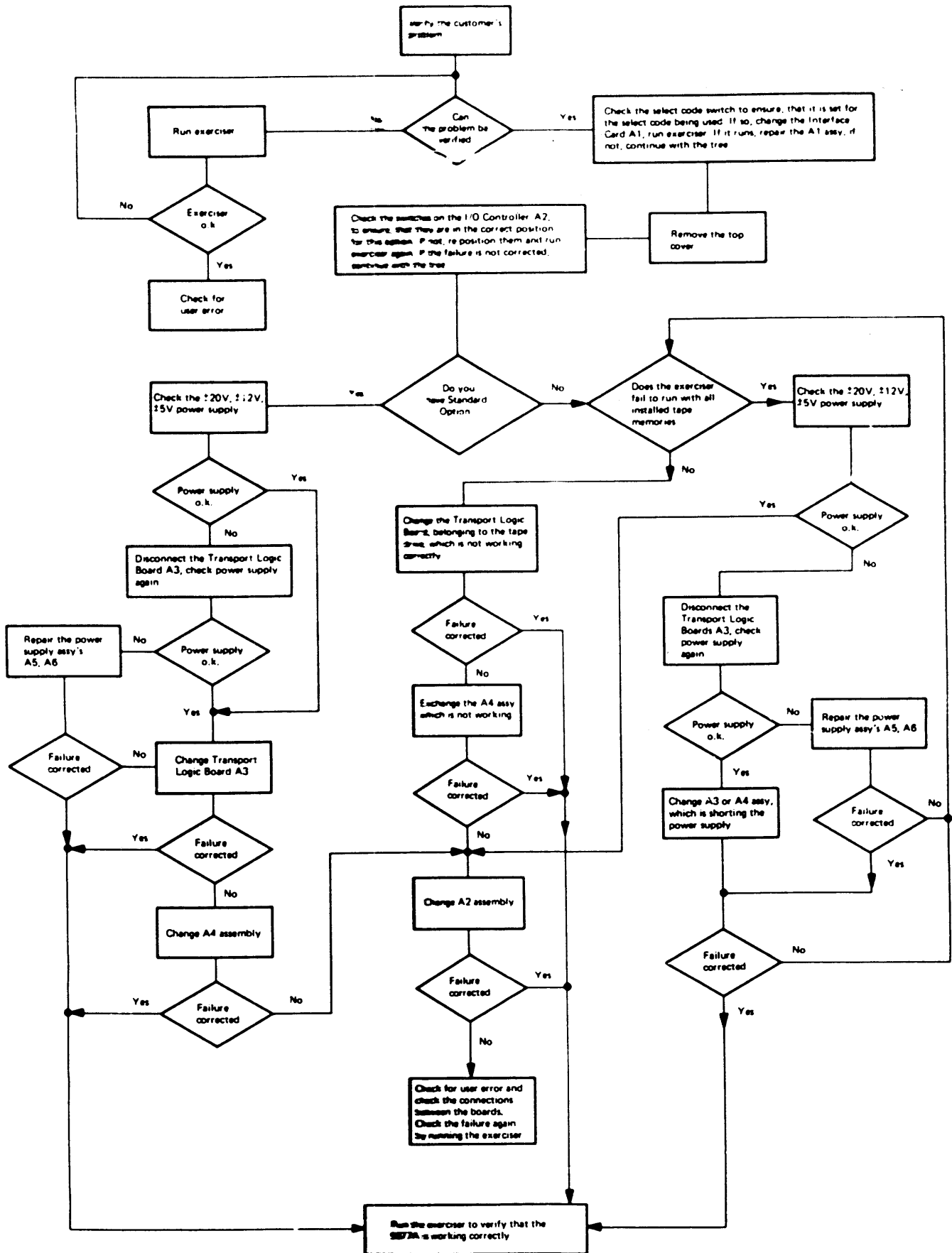


Figure 5-5 Troubleshooting Tree

CHAPTER 6

REPLACEABLE PARTS LIST

Table 6-1 Replaceable Parts List

REFERENCE DESIGNATOR	-hp- PART NO.	DESCRIPTION
A1	09877-66501	BD AY Interface
C1	0160-0174	C: 0.47 MF 25V
C2, C3	0160-2055	C: 0.01 MV 100V
R1	1810-0076	R-Network 1,8K
R2	1810-0125	R-Network 8 PIN
R3	1810-0142	R-Network 470 Ω
R4, R8, R9	0757-0283	R 2K 1% 0.125 W
R10, R11, R12	0757-0280	R 1K 1% 0.125 W
R13	0757-0437	R 4,75K 1%
U1	1820-1297	IC 74 LS 266 N
U2, U5	1820-1491	IC SN 7407
U3, U4, U8, U10		IC SN 74 LS 367 N
U6	1820-0471	IC SN 7406
U7	1820-1202	IC SN 74 LS 10
U9	1820-1201	IC SN 74 LS 03
U11	1820-1112	IC SN 74 LS 74
S2	3101-2096	Switch
A2	09877-66502	BD AY I/O Contr.
C1	0160-0174	C: 0,47 MF 25V
C2, C3, C4, C5	0140-0193	C: 82 PF 300V
-	0360-1705	Connector 40 PIN
R1	0757-0437	R 4,75K 1%
R2	1820-0142	R-Network 470 Ω
R3	1820-0076	R-Network 1,8K
R4	1820-0125	R-Network
R5	0757-0410	R: 301 Ω
R6, R7	0757-0430	R: 2,21 K
R9	0757-0427	R: 1,5 K
R10	0698-3359	R: 12,7 K
R11	0698-3258	R: 5,36 K
R12	0698-0084	R: 2,15 K
R14	0698-3159	R: 26,1 K
U2	1820-1255	IC: DM 8098
U3	1820-1197	IC: 74 LS 00
U4, U5	1820-0579	IC: 74123N
U6	1820-0668	IC: 7407
Q1	1854-0071	TR NPN
CR1	1901-0040	SI-DIO
S1	3101-2061	Switch
-	8120-2189	Cable Flat

Table 6-1 Replaceable Parts List (cont.)

REFERENCE DESIGNATOR	hp-PART NO.	DESCRIPTION
A5	09825-66551	Power Supply Assembly
C1, C2	0180-2405	C: Fxd 6400 μ f 25V
C3	0180-0408	C: Fxd 5400 μ f 25V
C4	0180-0229	C: Fxd 33 μ f 10V
C5, C6, C12	0180-0210	C: Fxd 3.3 μ f 15V
C7	0180-0106	C: Fxd 60 μ f 6V
C8	0180-2614	C: Fxd 100 μ f 30V
C9	0180-1701	C: Fxd 6.8 μ f 6V
C10	0180-2208	C: Fxd 200 μ f 10V
C11	0150-0071	C: Fxd 63 μ f 15V
C14, C15	0180-1714	C: Fxd 300 μ f 15V
CR1 thru CR4	1901-0662	D10: Power Rect.
CR5	1901-0511	D10: SI IN 3889R
CR6	1902-3190	D10: ZNR 13V
CR7	1901-0040	D10: SI .05A 30V
CR8	1902-0533	D10: ZNR 4.00V
L1, L3	9100-3462	Inductor
L2	9100-3488	Choke
Q1	1854-0094	XSTR: 2N3646
Q2, Q5	1845-0071	XSTR: 2N4398
Q4	1854-0063	XSTR: 2N3055
Q6	1853-0045	XSTR: 2N4036
R1, R2	0683-4725	R: Fxd 4.7KM 5%
R3,	0683-3325	R: Fxd 3.3KM 5%
R4, R18	0683-1025	R: Fxd 1K Ω 5%
R5	0757-0410	R: Fxd 301 Ω 5%
R6	0757-0399	R: Fxd 81.5 Ω 5%
R7	0686-1815	R: Fxd 108 Ω 5%
R8	0812-0037	R: Fxd 5 Ω 5W
R9	0698-4431	R: Fxd 3050 Ω 1%
R10	0698-3151	R: Fxd 2870 Ω 1%
R11	2100-2061	R: Var 200 Ω 10%
R12	0757-0274	R: Fxd 1210 Ω 1%
R13	0811-3414	R: Fxd 0.2 Ω
R14	0698-4461	R: Fxd 698 Ω 1%
R15	0698-3557	R: Fxd 806 Ω 1%
R16	0757-0416	R: Fxd 511 Ω 1%
R17	0757-0270	R: Fxd 249 K 1%
R19	0683-1005	R: Fxd 10 Ω 5%
R20	0683-2205	R: Fxd 22 Ω 5%
R21	0683-2215	R: Fxd 230 Ω 5%
R22	0811-3069	R: Fxd 1 Ω
R23, R24	0683-1045	R: Fxd 100K Ω 5%
U1	1820-0430	IC: LM300K
U2	1826-0123	IC: LM320K - 12
	09825-01101	Heat Sink - Fxd
	09852-01102	Heat Sink - Removable
	09825-64101	Insulator - Q3
	0340-0155	Insulator - Q4, U1, U2
	1200-0080	Insulator - CR5

Table 6-1 Replaceable Parts List (cont.)

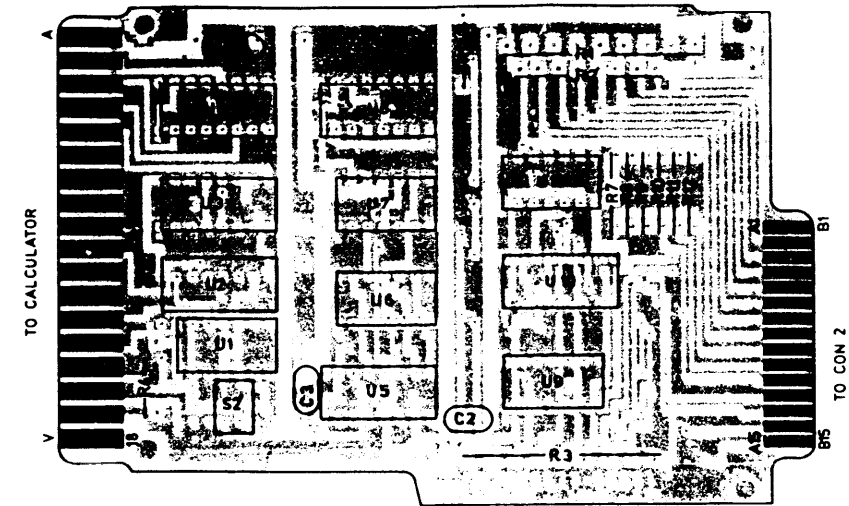
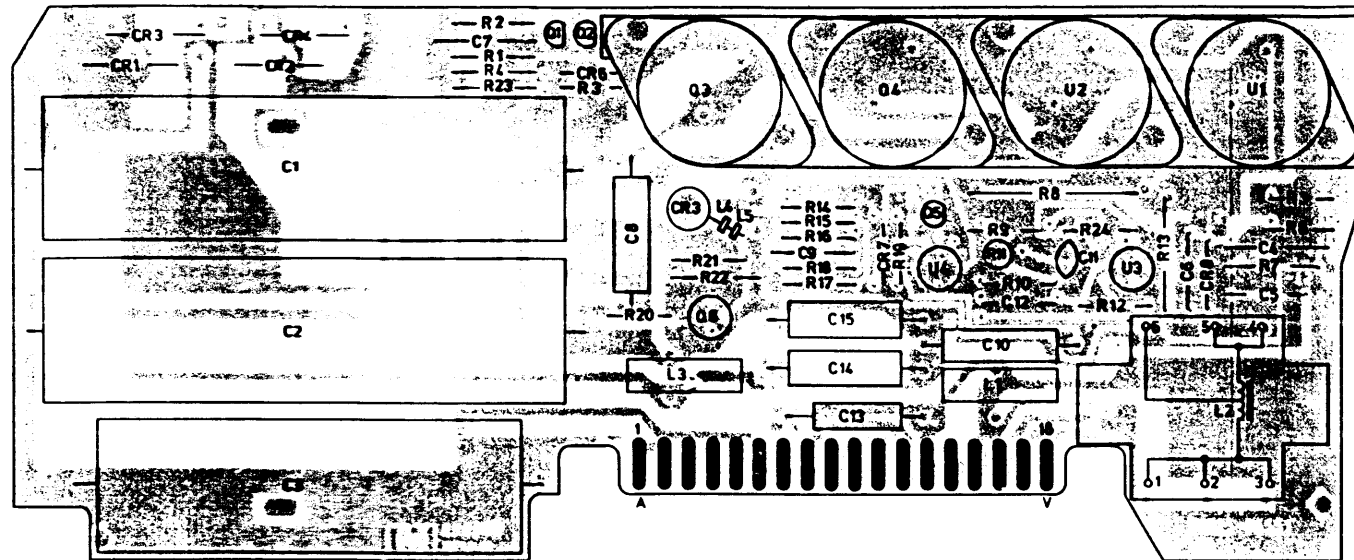
REFERENCE DESIGNATOR	-hp- PART NO.	DESCRIPTION
1	09877-00101	Chassis
2	9100-3455	XFMR
3	09877-66502	I/O-Controller Assy
4	3160-0209	Fan
5	09877-00202	Panel - Rear
6	09825-66561	Transport Logic Board
7	09825-66551	Power Supply Assy
8	09877-00603	Power Supply Shield
9	09877-04701	Connector SPRT
10	09877-02301	Holder Transport Assy
11	09877-00214	Panel Filler
12	09815-67902	Transport Assy
13	5040-7827	Cartridge Eject Bar
14	09877-00203	Sub-panel
15	09877-00211	Panel - Front
16	5040-8162	Rocker Switch
	3101-2080	
17	5082-4955	LED
18	09877-40002	Snap In
19	5040-7779	Door
20	2110-0467	Nut - Hex.
21	5040-7787	PC Hinge Half
22	5040-7721	PC Hinge
23	09877-01201	Fact Folder
24	1251-2500	Connector PC 12 Contacts
25	1251-0334	Connector PC 36 Contacts
26	2110-0470	Fuse Holder - Hex
	2110-0465	Cap Fuse
27	11201-24701	Support-Fan
28	5040-8248	Fan-Filler
29	09877-61602	Input Cable Assy
30	3150-0233	Filter - Foam
	09877-67902	Cable Assy - Rear
31	1251-0086	Connector 50 m Plug
32	5040-7860	Cable - moulded
33	98032-66502	Configuration Assy
34	5040-8173	Cover - Right
35	5040-8174	Cover - Left
	09877-67901	Interface 8 Bit (Complete)
36	09877-66501	Interface Assy
37	5040-8161	Case - Left
38	5040-8158	Spring Latch
39	5040-8153	Case - Right
40	0380-0632	Spacer Snap-in
41	1251-2357	Power Connector AC
42	3101-2042	Switch - Slide
43	0403-0150	Guide
44	09877-02303	Holder XFMR
45	09877-02304	Holder PC Board Front
46	09877-02305	Holder PC Board Rear
R1	0761-0044	R: 82 Ω 1W 5%

The following parts also have an exchange part number as they are in the blue stripe exchange program.

REFERENCE DESIGNATOR	hp EXCHANGE PART NO.	DESCRIPTION
6	09825-69561	Transport Logic Board
12	09815-69902	Transport Assy

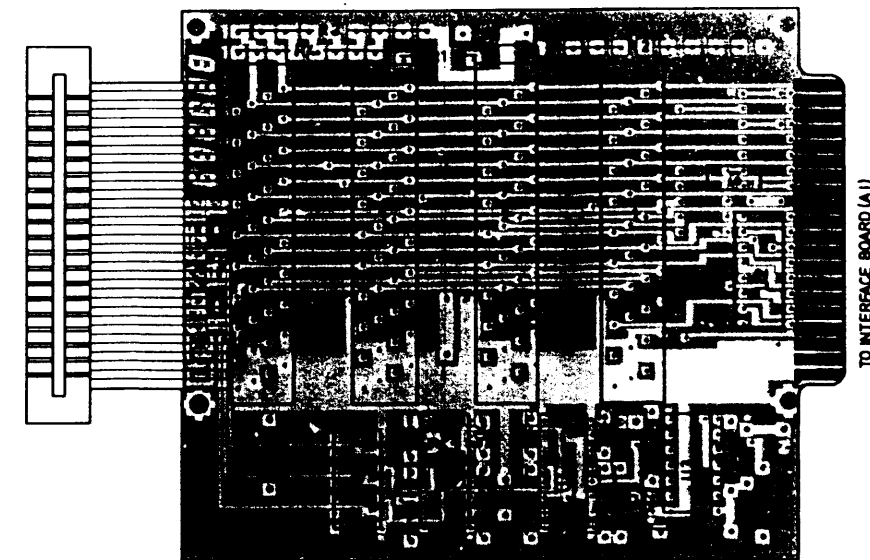
REFERENCE DESIGNATOR	hp PART NO.	DESCRIPTION
60	09877-04113	Cover - Bottom
61	09877-04112	Cover - Top
62	5020-8803	Frame - Front
63	5020-8804	Frame - Rear
64	5020-8836	Strut - Corner
65	09877-04111	Cover - Side
66	5001-0432	Gusset - Side
67	5040-7201	Foot
68	5001-0439	Trim - Side
69	5060-9803	Strap - Handle
70	5040-7207	Cap - Rear
71	09877-00001	Top - Trim
73	5040-7206	Cap - Front

COMPONENT SIDE A5 09825-6651



COMPONENT SIDE A1

HP Part No 09877-66501



COMPONENT SIDE A2

FIGURE 6-1 COMPONENT LOCATION

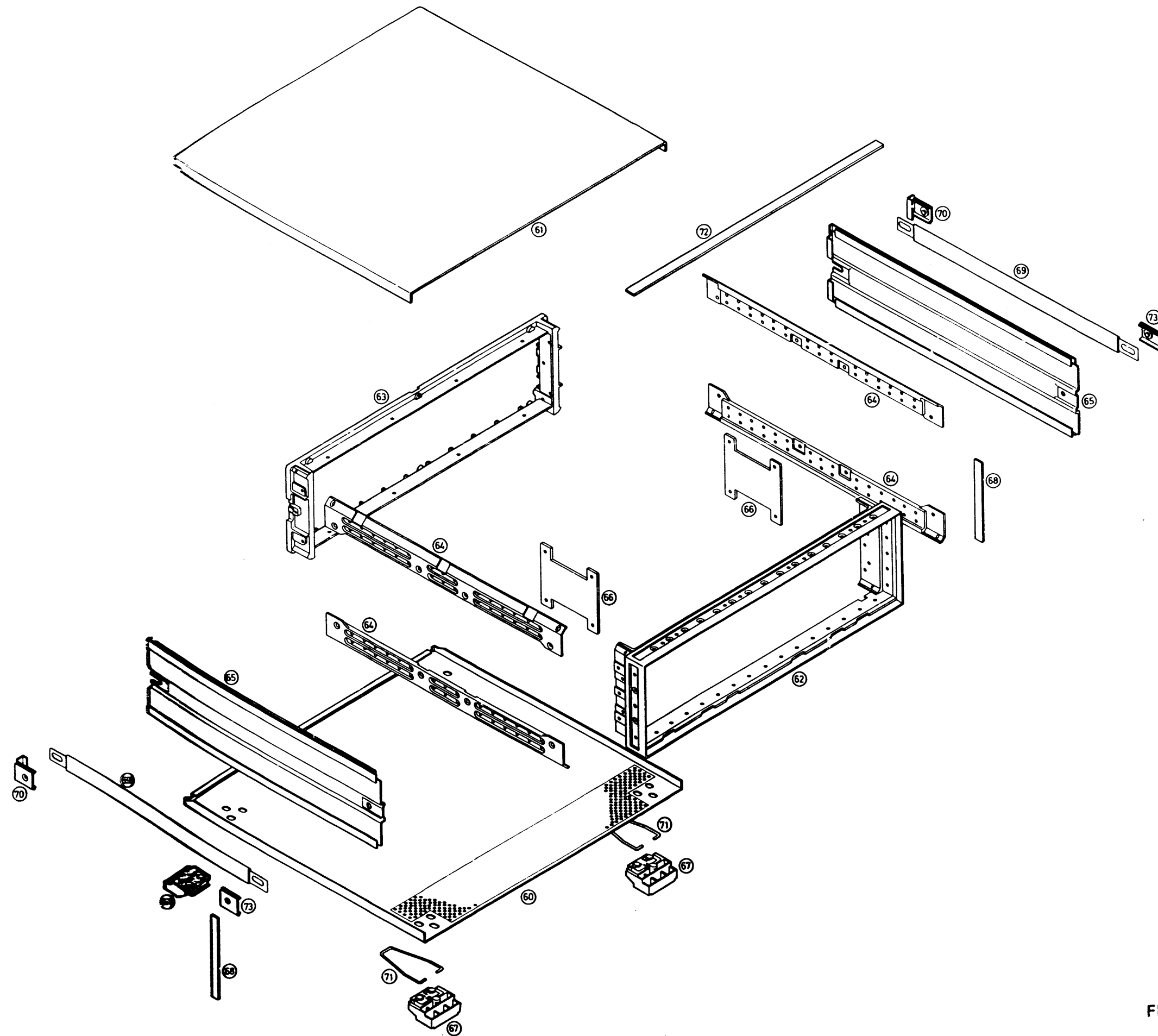


FIGURE 6-2 EXPLODED VIEW OF CASE

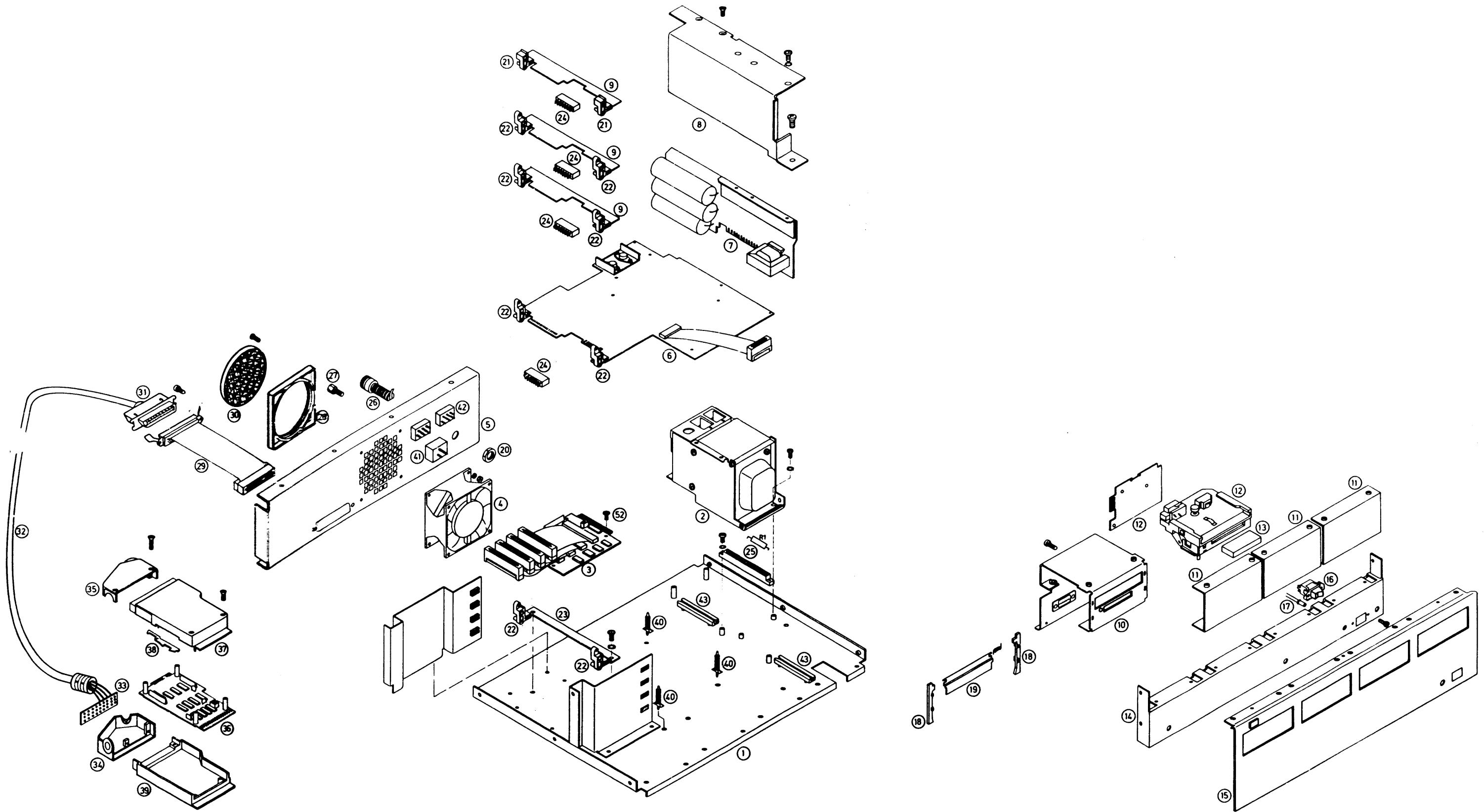


FIGURE 6-3 EXPLODED VIEW (Sub-assemblies)

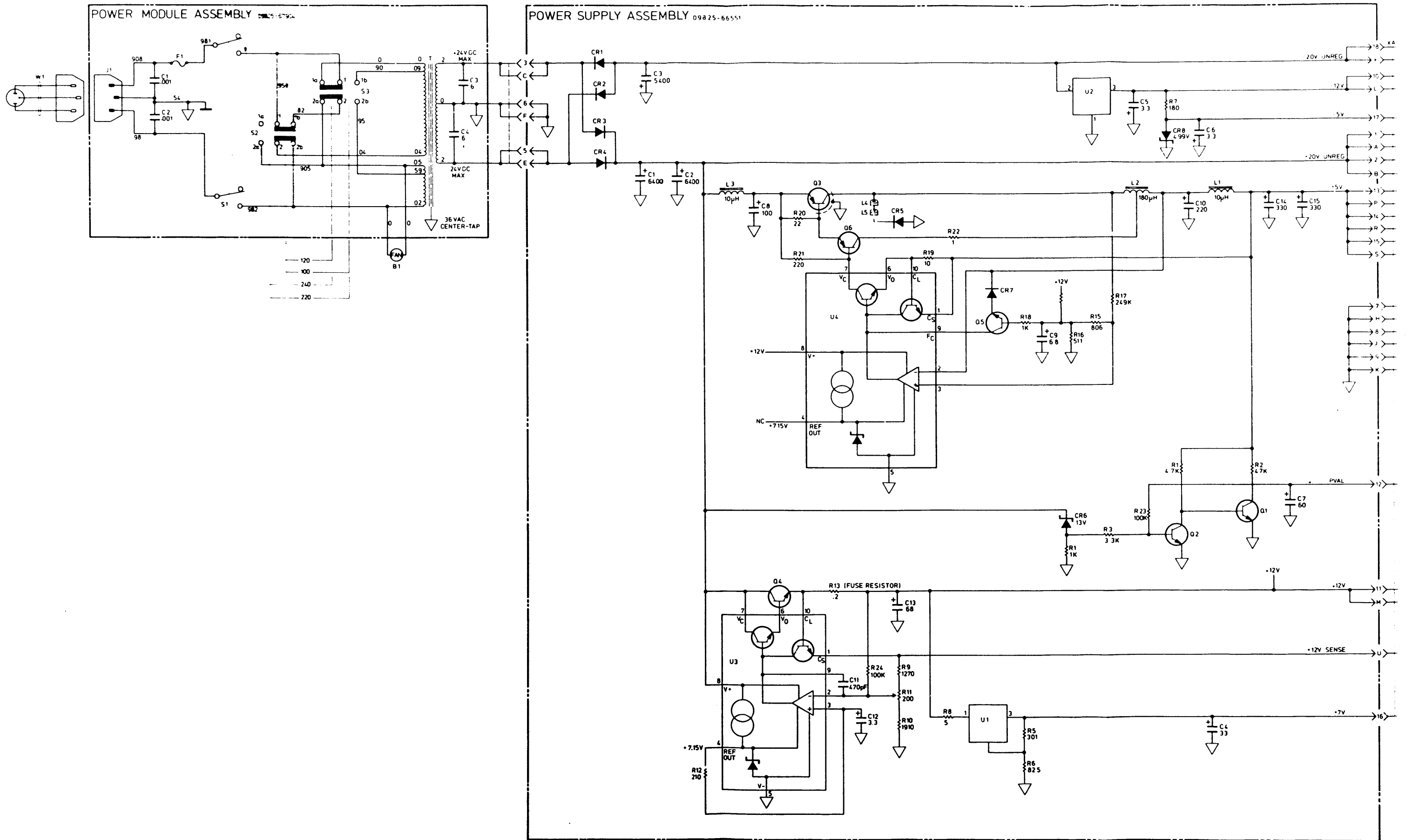


FIGURE 6-4 A5 Power Supply Assembly Schematic Diagram

A2 I/O CONTROLLER, 09877-66502

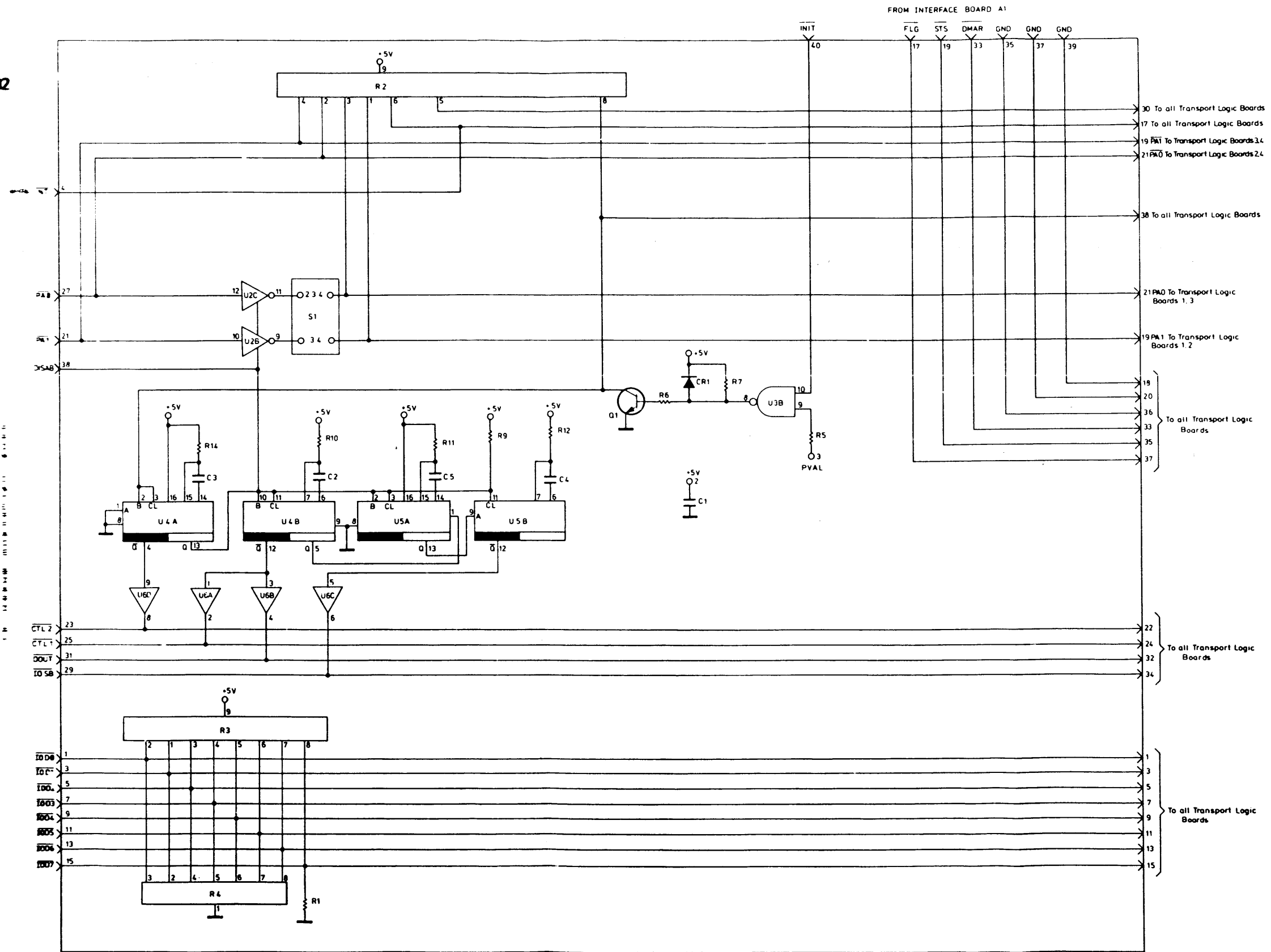


FIGURE 6-6 A2 I/O CONTROLLER Assembly Schematic Diagram

