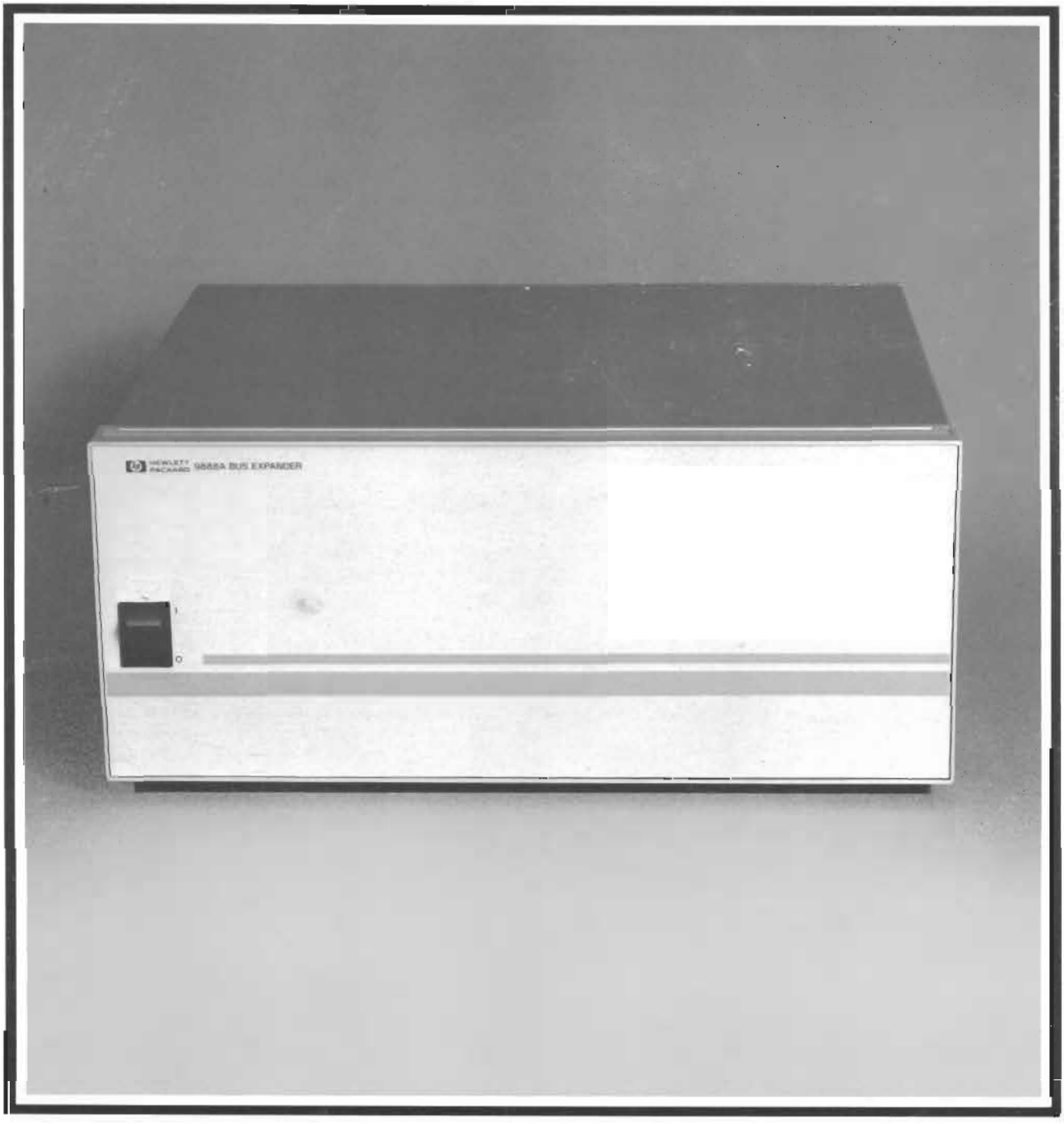
HP Series 200 Computers

HEWLETT PACKARD

9888A Bus Expander
Installation and Service



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9888A Bus Expander Installation and Service

Part No. 09888-90000
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Printing History

New editions of this manual will incorporate all material updated since the previous edition. Update packages may be issued between editions and contain replacement and additional pages to be merged into the manual by the user. Each updated page will be indicated by a revision date at the bottom of the page. A vertical bar in the margin indicates the changes on each page. Note that pages which are rearranged due to changes on a previous page are not considered revised.

The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

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FEDERAL COMMUNICATIONS COMMISSION
RADIO FREQUENCY INTERFERENCE
STATEMENT

The Federal Communications Commission (in Subpart J of Part 15, Docket 20780) has specified that the following notice be brought to the attention of the users of this product.

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Table of Contents

Chapter 1
General Information

Introduction

The HP 9888 Bus Expander allows for connecting up to eight interface cards and eight memory cards or up to 16 memory cards to HP Series 200 Personal Technical Computers, using one I/O slot in the computer.

The bus expander is supplied with an interface cable which permits it to be located up to 1.57 metres (5.15 feet) from the computer.

Equipment Supplied

Table 1-1 lists the equipment furnished with the bus expander.

Table 1-1

Description	Quantity	Part No.
Installation and Service Manual	1	09888-90000
Power Cord	1	see figure 2-2
Spare Fuses		
5A 250V Normal Blow (90 thru 125Vac)	2	2110-0010
2.5A 250V Normal Blow (195 thru 250Vac)	2	2110-0083
Fuse Holder Cap	1	2110-0565
Fuse Holder	2	2110-0622

Rack Mount Kit

A rack mount kit, part number 5061-0078, is available to convert the standard bus expander to an option 908. Refer to Rack Mount Kit Installation in chapter 2.

Initial Inspection

The bus expander and its accessories were carefully inspected before they were shipped to you. Please verify that the correct accessories are present. Then inspect for shipping damage and report any to the carrier. If any item is missing contact the nearest HP Sales and Service office.

Specifications

Power Requirements:

Power line frequency	48 thru 66 Hertz
Switch selected power line voltages	90 thru 125 Vac 195 thru 250 Vac
Power consumption	250 Watts maximum
Power output capability + 5 volt supply	22 A maximum
± 12 volt supply	3 A maximum

Physical:

Size	Height..190.5 mm (7.5 inches) Width...426 mm (16.8 inches) Depth...377 mm (14.8 inches)
Weight	10 Kg (22 pounds)
Cooling Space Requirements	44.5 mm (1.8 inches) clearance

Environmental:

Operating Temperature	0° thru 55°C(32° thru 131°F).
Humidity	5 thru 95% Relative humidity, noncondensing
Maximum Altitude	4572 metres (15000 feet)
Storage Temperature	−40° thru +75°C (−40° thru +167°F).
Meets E.M.I. Conducted and Radiated Interference	VDE 0871/0875 CISPR publication 11 FCC Class A
Meets safety requirements	UL 114, 478 CSA 22.2 Nu. 154 IEC 380, 435

Chapter 2
Installation

Power Requirements

The bus expander operates from power line voltages of 90 thru 125 volts ac or 195 thru 250 volts ac. One switch on the back of the instrument allows the selection of the two voltage ranges. (See figure 2-1). The line frequency must be in the range of 48 thru 66 Hz. Typical power requirment for an expander loaded with eight 98256A RAM boards, four 98622A GPIO boards, and four 98628A Data Comm. boards (a fully loaded expander) is 100 watts.

CAUTION

THE BUS EXPANDER MAY BE DAMAGED IF THE LINE SELECT SWITCH SETTING IS INCORRECT. CHECK THE SWITCH AND THE FUSE BEFORE APPLYING POWER.

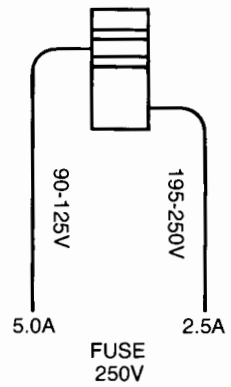


Figure 2-1. Line Voltage Switch

Fuses

WARNING

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

The bus expander must have a 5A, normal blow fuse, for 90 thru 125V operation and a 2.5A, normal blow fuse, for 195 thru 250V operation. Fuse part numbers are listed in table 1-1. Please verify that your expander has the correct fuse for your operation.

Grounding Requirements

To protect operating personnel, the National Electrical Manufacturers Association (NEMA) recommends that the bus expander case be grounded. The power cord supplied with the expander has a three wire cable which when connected to an appropriate receptacle, grounds the cabinet of the expander.

Power Cords

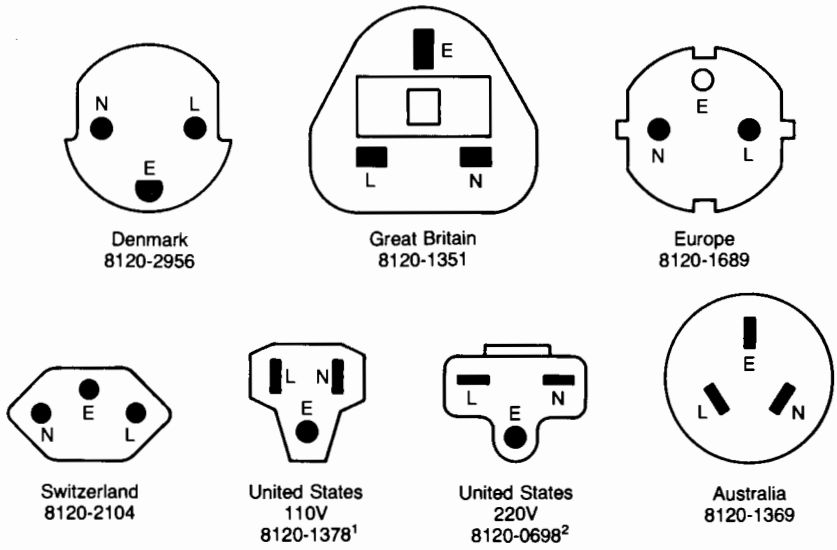
Power cords supplied by HP will have polarities matched to the power input socket on the equipment as shown below:

- L = Load 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 MIGHT EXIST, WHICH COULD RESULT IN INJURY OR DEATH.

Power cords with different connectors are available for the expander. Part numbers are shown in figure 2-2. Each cord has a ground connector. The cord packaged with the expander depends upon where the expander is to be delivered. If your expander has the wrong power cord for your area, please contact the nearest HP Sales and Service Office.



[1]UL and CSA approved for 100/120 Vac operation.
[2]UL and CSA approved for 220/240 Vac operation.

Power cords supplied by HP have polarities matched to the power-input socket on the computer:

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

Figure 2-2. Available Power Cords

Installing the Bus Expander

The expander is installed between an HP Series 200 Computer and the external I/O and memory cards. The expander is connected to the computer via its own cable and buffer cards. The expander is shipped with the cable already attached to the expander. Assure that the expander and the computer are off and install the small printed circuit card on the other end of the cable in one of the I/O slots in the computer, and tighten the thumb screws.

Multiple Bus Expanders

Up to four expanders may be attached to a computer using a different I/O slot for each. An expander may not be attached to an expander.

I/O Configuration:

This table lists the cards supported by the HP 9888 expander.

Table 2-1.Supported Cards

98254A	64K byte RAM memory board
98256A	256K byte RAM memory board
98622A	GPIO Interface card
98623A	BCD Interface card
98624A	HP-IB Interface board
98625A	Disc Interface card
98626A	Serial Interface card
98627A	Color Video Interface card
98628A	Data Communications Interface card
98629A	Resource Management Interface card

Cards that are not supported include the 98620A DMA controller card and any ROM based language card. These cards must be plugged into the computer and not the expander.

Maximum I/O and Memory Cards

A system composed of four expanders and a computer can contain up to:

- 24 I/O cards and either
- 30 98254 (64K bytes) RAM memory boards or
- 29 98256 (256K bytes) RAM memory boards.

A system comprised of a combination of 98254 and 98256 RAM boards should not exceed more than 2 megabytes of total memory. This includes the RAM resident on the computer processor board. When the combination of 98254 and 98256 RAM boards is used, the 98256 (256K bytes) boards must be installed in the top memory locations before the 98254 (64K bytes) boards. Memory in this configuration in excess of 2 megabytes may cause memory errors.

Performance

The signal passes through two buffers and a cable from the computer to the expander. Due to the time required for a round trip, there is a one state time (125 ns) delay imposed on any transaction between the computer and the expander. For example, memory cards placed in the computer operate in five state times (625 ns). A memory card placed in the expander requires six state times (750 ns), or one state time more than it would if placed in the computer. Because of the increased time delay, optimum RAM performance is obtained by locating all program RAM in the computer. Any programed timing loops will be affected if they are set up in the computer and later run through the expander and vice versa.

Bus masters, such as the HP 98620 Direct Memory Access (DMA) controller, must not be installed in the expander. They are required to reside in the computer. ROM-based language systems such as ROM-BASIC, operate in the synchronous address space of the bus and must reside in the computer. Because of the added delay of the expander, such ROM-based boards may not operate correctly if located in the expander.

Rack Mount Kit Installation

The rack mount kit, part number 5061-0078, provides the hardware needed to install the expander in a standard 19 inch equipment rack.

CAUTION

THE RACK MOUNT BRACKETS MAY NOT BE ABLE TO SUPPORT THE ENTIRE WEIGHT OF THE BUS EXPANDER AND THE I/O CABLES. A SHELF OR BRACKET SHOULD BE PROVIDED BY THE EQUIPMENT RACK OR CABINET TO SUPPORT THE WEIGHT OF THE EXPANDER.

System Turn On

The expander must be turned on before the computer is powered up.

When an HP Series 200 computer is powered up, the processor determines the amount of memory available, and then assigns its internal memory to the next available memory block. If the computer is reset, it again searches for all memory but does not reassign the internal memory. If the expander is powered up after the computer, the reset circuits in the expander will reset the computer and the memory that is in the expander may overwrite the internal memory causing memory failures.

OVERWRITTEN MEMORY

When the internal memory is overwritten by the expander, the computer will not function as it should or will not function at all until this condition is remedied.

To remedy this condition, turn both the computer and the expander off and then turn the expander on BEFORE turning on the computer.

Powerfail Option

If the computer is either a 9826 or a 9836 with the powerfail option and a power line failure occurs, the expander will reset the computer when the expander powers down and again when the power returns. When this occurs, memory locations will be correctly retained but any data or program stored in memory will be destroyed. Powerfail is not supported.

Chapter 3
Service

Introduction

This chapter contains the Theory of Operation, a Block Diagram and Description, and Troubleshooting Information. This information will assist you in servicing the HP 9888 Bus Expander.

Recommended Equipment

The following is a list of equipment that will aid in troubleshooting the expander.

- Voltmeter, accuracy ±1% on +5 volts and ±12 volts.
- Logic Probe, HP 547A or equivalent
- HP 98624A HP-IB Card.
- HP 9826/9836 System Test Pack part number 09836-10034.
- Antistatic Workstation, HP part number 9300-0933

Theory of Operation

The HP 9888 Bus Expander consists of a box with bus connections, two interface card assemblies, and a cable interconnecting them. The small interface card assembly (09888-66501) inserts into the computer while the larger interface card assembly (09888-66502) inserts into the lowest card slot in the expander. Figure 3-1 is the block diagram of each assembly. The primary purpose of the interface cards is to reduce the loading on the bus in the computer and the expander. Each assembly has buffered address, data, and control lines. Each has buffer control circuits and reset circuits. The expander interface card has latch circuits in the address lines.

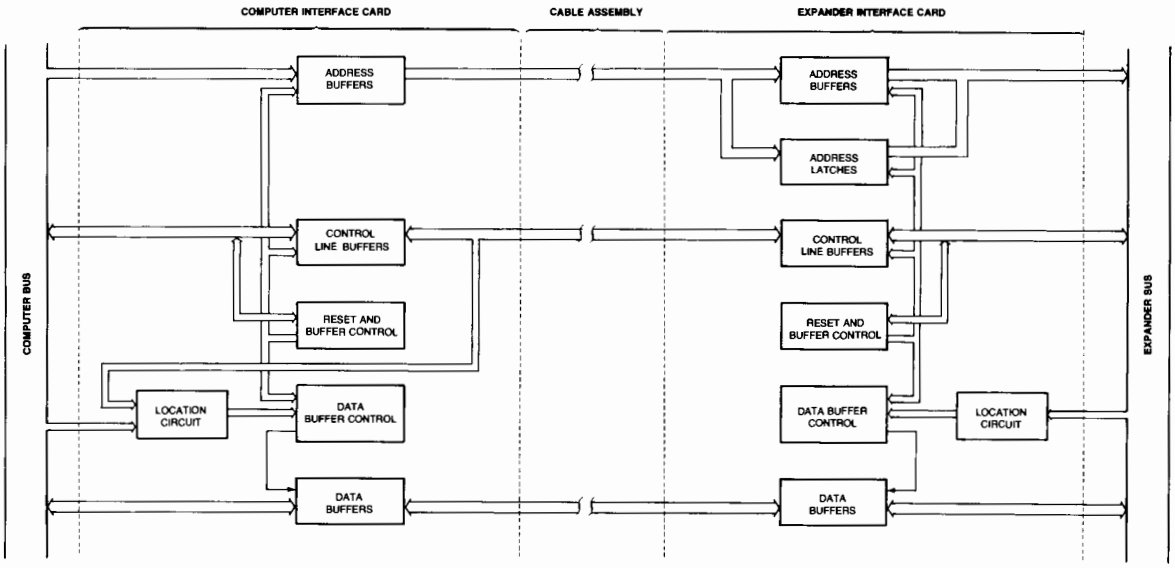


Figure 3-1. Block Diagram

Performance

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See schematics for the following discussion.

Address Buffers:
The address buffers on the computer buffer board (09888-66501) are U13, U19, U25, and U31. They are enabled whenever the expander is on and is asserting its expander on (EXON) signal (U 12 pin 3). They point from the computer toward the expander.

The address buffers on the expander buffer board (09888-66502) are U27, U28, U44, and U43. Because of the need, discussed later, to delay buffered address strobe (BAS) there is the possibility that the address may go away before BAS. Since the address is valid for 15 ns after BAS, the address needs to be latched. U19, U20, U35,and U36 are used to latch the address and assure the address remains valid a sufficient amount of time. They are turned on while BAS is high and before the new addresses become valid. They are latched on BAS going low. The output enables on the latches are made valid after BAS occurs, through delay line U9. 35 ns later, the buffers are turned off and only the latches are holding the addresses valid. The latch outputs remain enabled untill 35 ns after BAS has gone away. This provides the hold time on the addresses that is needed.

Control Buffers:
While buffering reduces the loading on the bus, it has the disadvantage of introducing skew on the bus. The bus is a synchronous bus which implies that the presence of valid information on the address or data lines is indicated by the associated control lines. Due to differences in loading and gate delays of the buffers, the possibility exists that the control lines may declare the data valid before it actually is or, at the other end of the cycle, the data may become invalid before the control lines so indicate. However BAS, buffered upper data strobe (BUDS), and buffered lower data strobe (BLDS) are delayed by 30 ns to account for the potential skews that can occur.

The Enable DTACK (ENDT) signal also has a delay. In this case it is 55 ns. ENDT is used to allow the RAM cards to respond with data transfer acknowledge (DTACK) prior to placing data on the bus.This allows the RAM cards to operate two states faster than would be obtained by waiting to assert DTACK after data has been placed on the bus. ENDT must be delayed long enough to ensure that DTACK will not be seen in the computer too early since the data delay caused by the expander is an additional state time. Likewise, it must not be delayed so long that DTACK comes late, causing a two state delay. The 55 ns delay is required to make the path length for ENDT out, and DTACK return at least 125 ns.

DTACK in the computer and DTACK and DMARDY in the expander have delay lines in series with their paths for the same reason that the delay lines are in the path for BAS above.

The delay lines in the paths for the enables for the DMARDY and DTACK buffers are used to ensure that the control buffers turn on after the data buffers are turned on. This ensures that the proper set up time for DATA with respect to DTACK or DMARDY is maintained.

Data Buffers and Control:
Data buffers, U26, U27, U32, and U33 on the 66501 board and U21, U22, U29, U30, U38, and U46 on the 66502 board are required to turn on or off as appropriate to get the data to and from the source to the destination. The important parameter in all transactions is the location of the source of the data. The location of the recipient need never be known. For standard cycles initiated by the processor, if a write is in process, the source is known to be in the computer. Therefore the buffers turn on pointing toward the expander. If a read is in progress and the memory card (for example) is in the expander, then the expander buffers point toward the computer. If the card is in the computer, then the buffers should either be off or pointing toward the expander. The four 74S151s (U14, U15, U20, and U21 on the 66501 board or U31, U38, U40, and U45 on the 66502 board) on each board select from the proper input parameters to enable the correct buffers for the right directions.

Location of cards being accessed with a normal $\overline{\text{BAS}}$ cycle may be determined by monitoring the $\overline{\text{IMA}}$ line in the expander. All cards are required to assert $\overline{\text{IMA}}$ after they have decoded their address on the bus. Since this is known to be valid within 80ns after $\overline{\text{BAS}}$ occurs, then $\overline{\text{IMA}}$ can be checked at that time, and can be used to generate Valid IMA (VIMA), or Valid Not IMA (VNIMA), to control the data buffer direction correctly.

If a DMA operation is in progress and a read from memory, write to I/O is occuring, then the buffers need to be set up to point away from wherever the memory is. If a read from I/O, write to memory is occuring, then the location of the I/O is needed and the buffers are pointing away from the I/O card.

The location of an I/O card during a DMA input operation must be determined in an indirect way. By monitoring the $\overline{\text{DMAR}}$ lines on the expander side of the buffers and the $\overline{\text{BGACK}}$ lines, it is possible to determine where the I/O card is located. If the $\overline{\text{BGACK}}$ is asserted and the $\overline{\text{DMAR}}$ lines on the expander side of the buffers have not been asserted then the I/O device must be in the computer. A location signal is thus generated along with a signal (U7 pin 6 on the 66501 board and U24 pin 12 on the 66502 board)indicating that a DMA cycle is in progress. Location circuits (LOC) on the 66501 board are U1 and U4, LOC on the 66502 board are U2 and U10.

Reset:
Currently, if the expander is turned on after the computer is on, the computer is reset. The circuits including U13 and 1/2 of U4 generate a power on $\overline{\text{RESET}}$ in the expander which is transmitted to the computer by asserting both $\overline{\text{HALT}}$ and $\overline{\text{RESET}}$. This circuit generates a reset signal that is roughly 230msec long after the 5 volt supply reaches 90% of its nominal value.

When the expander is turned off, the buffers in the computer are turned off. The other half of U4 and Q1 generate the $\overline{\text{EXON}}$ signal. As soon as the 5 volt supply begins to decay, U4 senses this and turns $\overline{\text{EXON}}$ off. 1/4 of U4 delays the turn on of $\overline{\text{EXON}}$ until after the supply and logic has stabilized (Approximately 20msec).

In the computer buffer card, after $\overline{\text{EXON}}$ goes invalid, R4, C26, U12, U22, and U16 generate a system $\overline{\text{RESET}}$ which resets the processor.

Troubleshooting

Host Computer Test

Assure that the computer will function as a stand-alone computer.

Remove the expander I/O cable from the computer and test the computer by itself. If the computer does not function, refer to the service manual for the computer. If the computer functions as it should, then go on to the power-up tests.

Power-up Tests

1. Turn the expander on and check that the fan is running. If the fan is not running, turn off the expander, remove the power cord from the expander and check the backpanel fuse. If the fuse is open, replace with proper value.
2. Reconnect the power cord and turn on the expander. If the fan still does not run, turn the expander off. Go to power supply tests.
3. If the fan is running, the expander primary circuits, the secondary circuits, the +5 volt power supply, and the +12 volt supply are working. Proceed to I/O Function Tests.

Note

There are internal fuses inside the expander that may be open. If they are open the fan will run but the backplane will not have one or more voltages present. You may want to check out the power supply before going to the I/O Function Tests.

Power Supply Tests

WARNING

THE HEATSINK AREA OF THE POWER SUPPLY HAS HAZARDOUS VOLTAGES PRESENT. ELECTRICAL SHOCK OR PERSONAL INJURY IS POSSIBLE.

If you have replaced the fuse and the fan still is not running, you have been led here. Welcome.

1. Turn the expander off and remove the power cord. Remove the top cover of the expander. This will expose the power supply and all of the needed test points.

WARNING

THE POWER SUPPLY PRESENTS A HAZARD TO PERSONNEL. EXTREME CARE MUST BE TAKEN WHEN CONNECTING THE VOLTMETER PROBES TO THE TEST POINTS. ACCIDENTAL BRIDGING OF THE +5 VOLT SUPPLY TO GROUND BY RINGS OR WATCH BANDS CAN CAUSE SEVERE PERSONAL INJURY. DE-ENERGIZE THE EXPANDER BY REMOVING THE POWER CORD FROM THE EXPANDER BEFORE CONNECTING OR REMOVING TEST PROBES.

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2. With an ohmmeter, check the internal fuses on the power supply board for continuity. Replace any that are open with the proper value fuse. Fuse F1 is a 5A/250V fuse and fuse F2 is a 3A/250V fuse.
3. Install the power cord and turn the expander on. If the fan still does not run, check the backplane test points located at the top of the backplane board (see figure 3-2). If the voltages are present, suspect the fan to be defective.

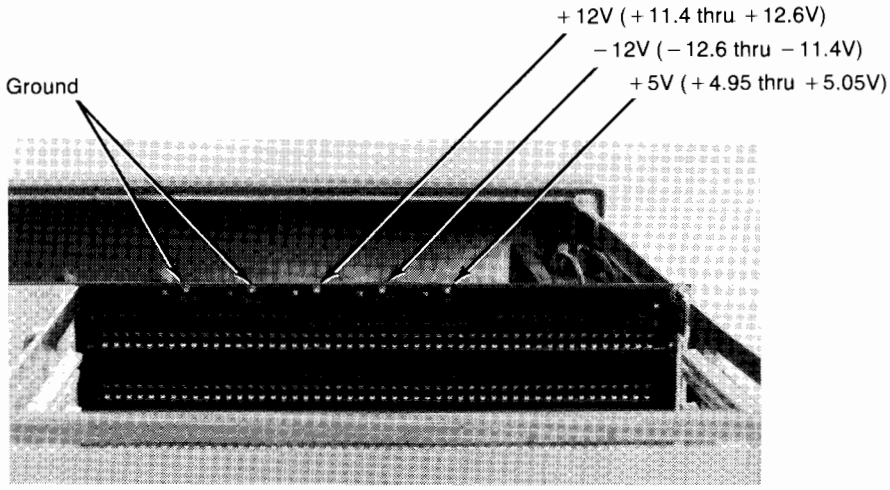


Figure 3-2. Backplane Test Points

4. Turn the expander off. If any voltage is not present, check the associated fuse located in the fuse block on the rear surface of the front panel (see figure 3-3). Replace open fuses with the proper value fuses.

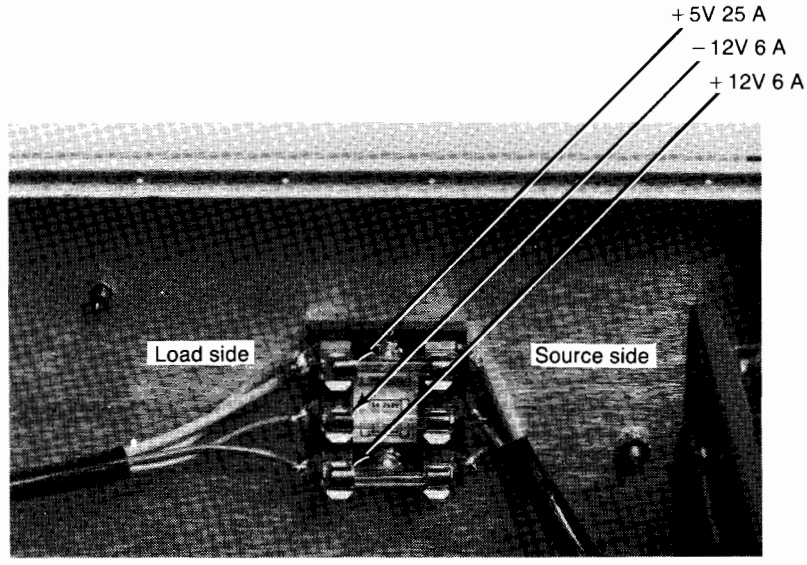


Figure 3-3. Fuse Block

5. Before turning the expander on, remove all I/O and memory cards in the backplane of the expander to remove any possible external short circuits.

6. Turn on the expander. Check the voltage test points on the backplane board. If any voltage is not present, that voltage is short-circuited to ground. Turn the expander off and remove the power cord.
7. Disconnect the backplane connector located in the lower left corner of the backplane board. Replace open fuses. Connect the voltmeter probe to the +5 fuse load connection (see figure 3-4). Reconnect the power cord and turn the expander on. Note the voltmeter reading. Repeat for the +12 V and the −12 V. If the proper voltages are present, the backplane board has a short circuit. Replace the backplane board.
8. If in step 7 the voltages were not present, the trouble is in the power supply and it should be replaced. See Power Supply Removal.

I/O Function Tests

1. Make tests such as:

   - Read I/O
   - Write I/O

2. Are problems limited to a single I/O card? If not, go to Interface Cable Assembly Tests.

Single I/O Card Tests

1. If the problem is limited to a single I/O card in the expander, then the possible failure causes or broken assemblies can include:

   - The I/O card is defective.
   - The I/O card is not properly seated.
   - The expander backplane board has failed (broken trace or connector).

2. If you suspect one I/O card is defective, remove it from the expander and install the card in the computer. Run the I/O tests again. If the I/O card now works, the problem is in the expander. If the I/O card still does not function, the card is defective. Replace it and you are done.
3. If the card worked in the computer, replace it in the expander and assure that it is properly seated. If it still does not work in the expander, the problem is in either the backplane board or the interface cable assembly. Visually inspect the backplane board for obvious broken connectors and replace. If none is visible, go to the Interface Cable Assembly Tests.

Interface Cable Assembly Tests

The interface cable assembly consists of two 50-conductor flat ribbon cables and two printed circuit boards. The printed circuit boards are a 09888-66501 which makes connection to the computer, and a 09888-66502 which connects to the expander.

CAUTION

EXTREME CARE MUST BE TAKEN TO PREVENT ELECTRO-STATIC DISCHARGE DAMAGE TO THE BUFFER CARDS. THE CARDS SHOULD BE HANDLED IN A STATIC-CONTROLLED ENVIRONMENT SUCH AS PROVIDED BY THE ANTISTATIC WORKSTATION.

Board Swap Procedure

If it is not possible to determine which of the parts of the interface assembly is at fault, follow these steps:

1. Replace the 66502 board and retry the system. If the problem goes away you are finished.
2. Replace the 66501 board and retry the system. If the problem goes away you are finished.
3. Replace the 1.5 metre (5 feet) cables and retry the system. If the problem goes away you are finished.
4. Replace the backplane board and retry the system.

09888-66501 Board Test

With a voltmeter test the output side of the "$\overline{\text{MFON}}$" signal on the 66501 board by probing U3 pin 5. If the voltage is low, then the "$\overline{\text{MFON}}$" line is enabled and the board is likely to be okay. Go to board swap procedure. If the voltage is high, check the voltage at U3 pin 15. If this voltage is low, then the 66501 board is probably bad. Replace the 66501 board. Return to I/O function checks.

09888-66502 Board Test

With a voltmeter test the output side of the "$\overline{\text{EXON}}$" signal on the 66502 board by probing U28 pin 19. If the voltage is low, then the "$\overline{\text{EXON}}$" line is enabled and the 66502 board is likely to be okay. Go to board swap procedure. If the voltage is high, check the voltage at U3 pin 13. If this voltage is high, then the 66502 board is probably bad. Replace the 66502 board. Return to I/O function checks.

Power Supply Removal

WARNING

THE HEATSINK AREA OF THE POWER SUPPLY HAS HAZARDOUS VOLTAGES PRESENT. ELECTRICAL SHOCK OR PERSONAL INJURY IS POSSIBLE.

The expander incorporates a power supply subassembly that can be removed and replaced as a unit by accomplishing the following steps:

1. Remove power cord from the rear of the expander.
2. Tag and disconnect the fan wires (red wire goes to the positive terminal) and remove the four screws that hold the fan in place. Save the hardware.
3. Tag and remove the cable harness from the large terminal strip. Save the screws.
4. Tag and remove the wires from the small terminal strip. Save the screws.
5. Cut and remove the two tie wraps that hold the cable harness to the power supply.
6. Position the expander on its left side. Loosen and remove all the screws holding the power supply to the bottom (See figure 3-4).

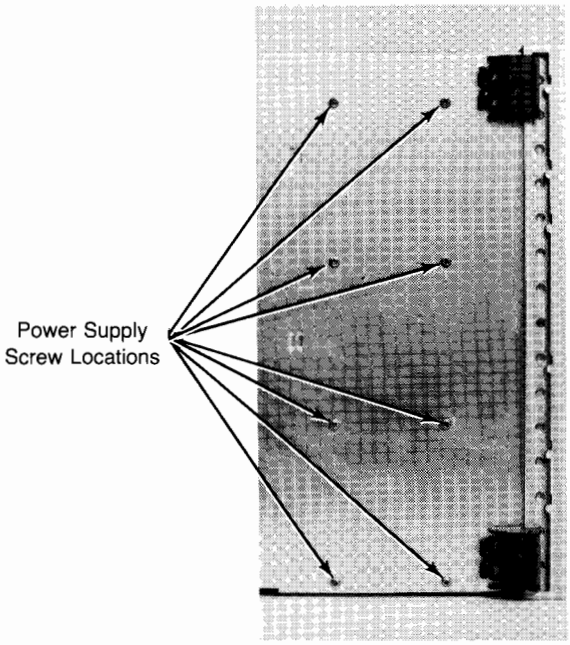


Figure 3-4. Power Supply Mounting Screws

7. The power supply may now be slid toward the front of the expander and lifted from the expander.
8. Reverse these steps to reinstall the power supply.

Chapter 4
Replaceable Parts

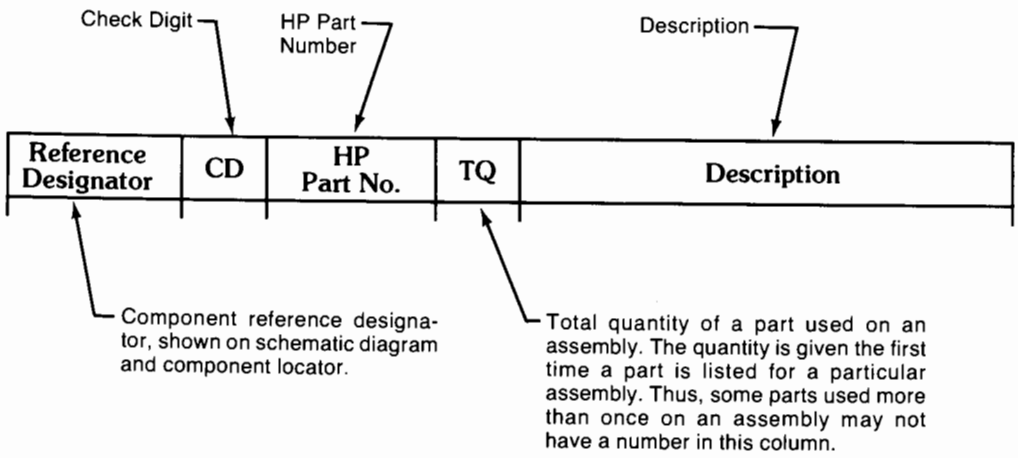
Introduction

This chapter contains part number information for the 9888 Bus Expander. This information is listed in the following manner:

1. Assemblies
2. Electronic parts by assembly
3. Keyboard and case parts
4. Support package contents
5. Miscellaneous items

The part number information is presented in this manner:

Table 1 lists the replaceable parts. Here is a description of each table column.



Parts may be ordered from Corporate Parts Center. The address is:

Corporate Parts Center
333 Logue Avenue
Mountain View, California 94042

The telephone number is: (415) 968-9200

Table 4-1. 9888 Chassis Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	09888-61603	3		SECONDARY HARNESS	28480	09888-61603
	9888A	2		CHPMK I/O EXP	28480	9888A
	09888-61601	1		PRIMARY HARNESS	28480	09888-61601
	09888-61602	2		CABLE ASSEMBLY-EXT	28480	09888-61602
	09888-61603	3		SECONDARY HARNESS	28480	09888-61603
	09888-66501	0		PC ASSEMBLY-I/O EXP	28480	09888-66501
	09888-66502	1		PC ASSEMBLY-I/O EXP	28480	09888-66502
	09888-87901	8		MISCELLANEOUS KIT	28480	09888-87901
	09888-90000	5		INSTALLATION/SERVICE MANUAL	28480	09888-90000
	9888A-#900	3		CABLE-OPTION POWER	28480	9888A-#900
	9888A-#901	5		CABLE-OPTION POWER	28480	9888A-#901
	9888A-#902	7		CABLE-OPTION POWER	28480	9888A-#902
	9888A-#903	9		CABLE-OPTION POWER	28480	9888A-#903
				MISCELLANEOUS PARTS		
	0362-0608	2	10	TERMINAL-CRIMP	00779	2-31882-3
	0362-0616	2	2	CONTACT-CRIMP-ON	28480	0362-0616
	0698-3601	2	1	RESISTOR 10 5% 2W MO TC=0+-200	27167	FP42-2-T00-10R0-J
	1251-3911	2	8	CONTACT-CONNECTOR FEMALE	28480	1251-3911
	1251-4752	1	1	CONNECTOR-FEMALE 9 PIN	28480	1251-4752
	2110-0056	3	2	FUSE 6A 250V NTD 1.25X.25 UL IEC	75915	312006
	2110-0250	9	1	FUSE 25A 32V NTD 1.25X.25	28480	2110-0250
	2110-0010	9	2	FUSE 5A 250V NTD 1.25X.25 UL	75915	312005
	2110-0083	6	2	FUSE 2.5A 250V NTD 1.25X.25 UL	28480	2110-0003
	2110-0565	9	1	FUSEHOLDER CAP 12A MAX FOR UL	28480	2110-0565
	2110-0622	9	2	FUSEHOLDER-EXTR POST 16A 250 V BAY CAP	28480	2110-0622
	0950-1633	2	1	POWER SUPPLY BOARD	28480	0950-1633
	09920-66501	1	1	BACKPLANE PC ASSEMBLY	28480	09920-66501
	1251-4442	6	4	CONNECTOR-FEMALE, 50 PIN	28480	1251-4442
	3101-2299	2	1	SWITCH-SLIDE DPDT	28480	3101-2299
	3101-2615	6	1	SWITCH-ON/OFF	28480	3101-2615
	3160-0377	7	1	FAN- 9.5VDC	28480	3160-0377
	1251-5339	2	1	CONNECTOR-MALE, 9 PIN	28480	1251-5339
	1251-5378	9	18	CONNECTOR-P.C. 2 X 50 CONTACTS	28480	1251-5378
	7120-3428	5	1	LABEL-IDENT	28480	7120-3428
	7120-3694	7	1	LABEL	28480	7120-3694
	7120-4930	6	1	LABEL-SERIAL PLATE	28480	7120-4930
	7121-1076	7	1	LABEL-INFO	28480	7121-1076
	7121-3353	7	1	LABEL-IDENT	28480	7121-3353
	7124-2083	4	1	LABEL-INFO	28480	7124-2083
	8120-1369	0	1	CABLE	28480	8120-1369
	8120-1689	7	1	CABLE	28480	8120-1689
	8120-1378	1	1	CABLE-AC POWER	28480	8120-1378
	8120-3651	7	1	CABLE-RIBBON	28480	8120-3651
	5061-0078	7	1	RACK FLANGE MOUNTING KIT	28480	5061-0078
		8	2	RACK FLANGE MOUNTING KIT	28480	

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

Table 4-2. A1 Board Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	09888-66501	0		I/O EX PC ASSEMBLY	28480	09888-66501
C1	0160-3847	9	28	CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C2	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C3	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C4	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C5	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C6	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C7	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C8	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C9	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C10	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C11	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C12	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C13	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C14	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C15	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C16	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C17	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C18	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C19	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C20	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C21	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C22	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C23	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C24	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C25	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C27	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C28	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C29	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
R2	0683-1035	1	2	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R3	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R4	0683-1835	9	1	RESISTOR 18K 5% .25W FC TC=-400/+800	01121	CB1835
U1	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U2	1820-1199	1	2	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U4	1820-0682	5	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S03N
U5	1810-0083	9	1	NETWORK-RES 14-DIP1.0K OHM X 13	11236	760-1-R1K
U7	1820-0683	6	1	IC INV TTL S HEX 1-INP	01295	SN74S04N
U8	1820-0606	9	1	IC GATE TTL S AND TPL 3-INP	01295	SN74S11N
U10	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U12	1820-2024	3	12	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U13	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U14	1820-1319	7	4	IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U15	1820-1319	7		IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U16	1820-0621	2	1	IC BFR TTL NAND QUAD 2-INP	01295	SN7438N
U18	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U19	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U20	1820-1319	7		IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U21	1820-1319	7		IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U22	1820-2967	3	2	IC-74LS621	28480	1820-2967
U24	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U25	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U26	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U27	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U28	1820-2967	3		IC-74LS621	28480	1820-2967
U30	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U31	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U32	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U33	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
	1251-5653	3	2	CONNECTOR-POST TYPE-HDR	28480	1251-5653
		6	1	1/2 STRAIN RELIEF (FAB)	28480	
		0	1	1/2 STRAIN RELIEF (3-M)	28480	
		8	1	LPSLDL-55	28480	
		4	1	MLPSLDL-35	28480	
		6	1	MAIN FRAME INTERFACE	28480	
		7	2	MLPSLDL-30	28480	

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

Table 4-2. A1 Board Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
C26	0180-0228	6	2	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C30	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
R1	0683-1035	1	1	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R2	1251-5653	3	2	CONNECTOR-POST-TP-HDR	28480	1251-5653
R3	1251-5653	3		CONNECTOR-POST-TP-HDR	28480	1251-5653
U1	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U3	1810-0083	9	1	NETWORK-RES 14-DIP1.0K OHM X 13	11236	760-1-R1K
U11		4	1	IC	28480	
U17		7	2	IC	28480	
U23		8	1	IC	28480	
U29		7		IC	28480	

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

Table 4-3. A2 Board Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	09888-66502	1	1	I/O EX PC ASSEMBLY	28480	09888-66502
C1	0160-5246	6	33	CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C2	0160-4574	1	4	CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
C3	0160-4574	1		CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
C4	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C5	0160-4574	1		CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
C6	0160-4574	1		CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-4574
C7	0180-0291	3	2	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
C8	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C9	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C10	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C11	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
C12	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C13	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C14	0180-1746	5	1	CAPACITOR-FXD 150UF+-10% 20VDC TA	56289	150D156X9020B2
C15	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C16	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C17	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C18	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C19	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C20	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C21	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C22	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C23	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C24	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C25	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C26	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C27	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C28	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C29	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C30	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C31	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C32	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C33	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C34	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C35	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C36	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C37	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C38	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C39	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C40	0160-5246	6		CAPACITOR-FXD 0.1UF 80% 50VDC	28480	0160-5246
C41	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
CR1	1826-0910	4	1	IC-LIN LM336BZ	28480	1826-0910
F1	2110-0592	2	1	FUSE 4A 125V NTD .281X.093	28480	2110-0592
Q1	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
R1	0683-1045	3	2	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
R2	0683-5135	0	1	RESISTOR 51K 5% .25W FC TC=-400/+000	01121	CB5135
R3	0757-0442	9	4	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R4	0698-0064	5	2	RESISTOR 9.31K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-9311-F
R5	0698-4481	8	1	RESISTOR 16.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1652-F
R6	0757-0445	2	1	RESISTOR 13K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1302-F
R7	0683-1025	9	3	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R8	0683-4745	6	2	RESISTOR 470K 5% .25W FC TC=-800/+900	01121	CB4745
R9	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R10	0683-4325	8	1	RESISTOR 4.3K 5% .25W FC TC=-400/+700	01121	CB4325
R11	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
R12	0683-4745	6		RESISTOR 470K 5% .25W FC TC=-800/+900	01121	CB4745
R13	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R14	0698-3558	8	1	RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
R15	0698-0064	5		RESISTOR 9.31K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-9311-F
R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R17	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R19	0698-4506	8	1	RESISTOR 73.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7322-F
R20	0698-3497	4	1	RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
U1	1010-0083	9	2	NETWORK-RES 14-DIP1.3K OHM X 13	11236	760-1-R1K
U2	1820-0682	5	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S03N
U3	1820-2024	3	15	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U4	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
U5	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N

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

Table 4-3. A2 Board Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U10	1820-1197	9	2	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U11	1820-1449	4	1	IC GATE TTL S OR QUAD 2-INP	01295	SN74S32N
U12	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U13	1820-0668	7	1	IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
U17	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U18	1820-1997	7	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
U19	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
U20	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U21	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U23	1820-0683	6	1	IC INV TTL S HEX 1-INP	01295	SN74S04N
U24	1820-1568	8	1	IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
U25	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U26	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U27	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U28	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U29	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U30	1820-1319	7	4	IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U31	1820-0686	9	1	IC GATE TTL S AND TPL 3-INP	01295	SN74S11N
U32	1810-0481	1	1	NETWORK-RES 16-DIP MULTI-VALUE	28480	1810-0481
U33	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U34	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
U35	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
U36	1820-1319	7		IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U37	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U38	1820-0681	4	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
U39	1820-1319	7		IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U40	1810-0083	9		NETWORK-RES 14-DIP1.0K OHM X 13	11236	760-1-R1K
U41	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U42	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U43	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
U44	1820-1319	7		IC MUXR/DATA-SEL TTL S 8-TO-1-LINE 8-INP	01295	SN74S151N
U45	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
P2	1251-5653	3	2	CONNECTOR-POST-TP-HDR	28480	1251-5653
P3	1251-5653	3		CONNECTOR-POST-TP-HDR	28480	1251-5653
U9		4		IC	28480	
U16		7		IC	28480	
U22		3		IC	28480	
	0380-1324	9	4	STANDOFF-THREADED	28480	0380-1324
		0	1	EXPR INTERFACE	28480	
		3	2	MLPSLDL-60	28480	
		4	2	MLPSLDL-35	28480	
		7	2	MLPSLDL-30	28480	

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

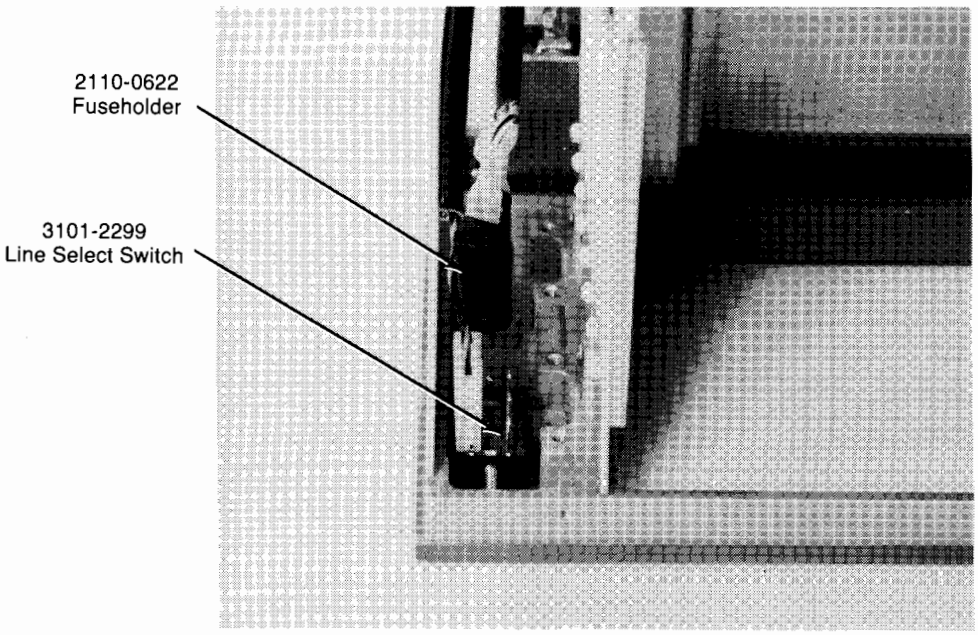


Figure 4-1. Line Select Switch and Fuse Holder

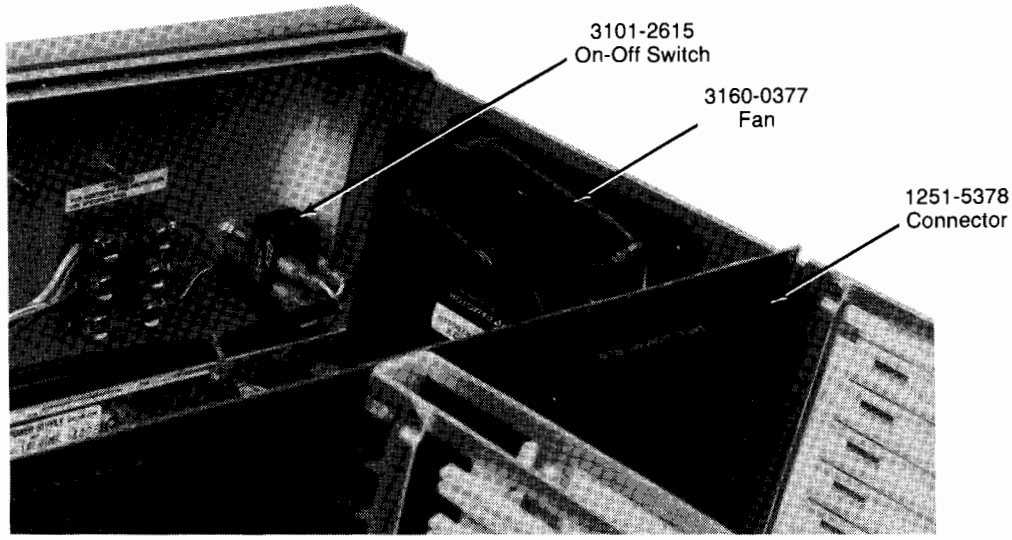


Figure 4-2. Miscellaneous Chassis Parts

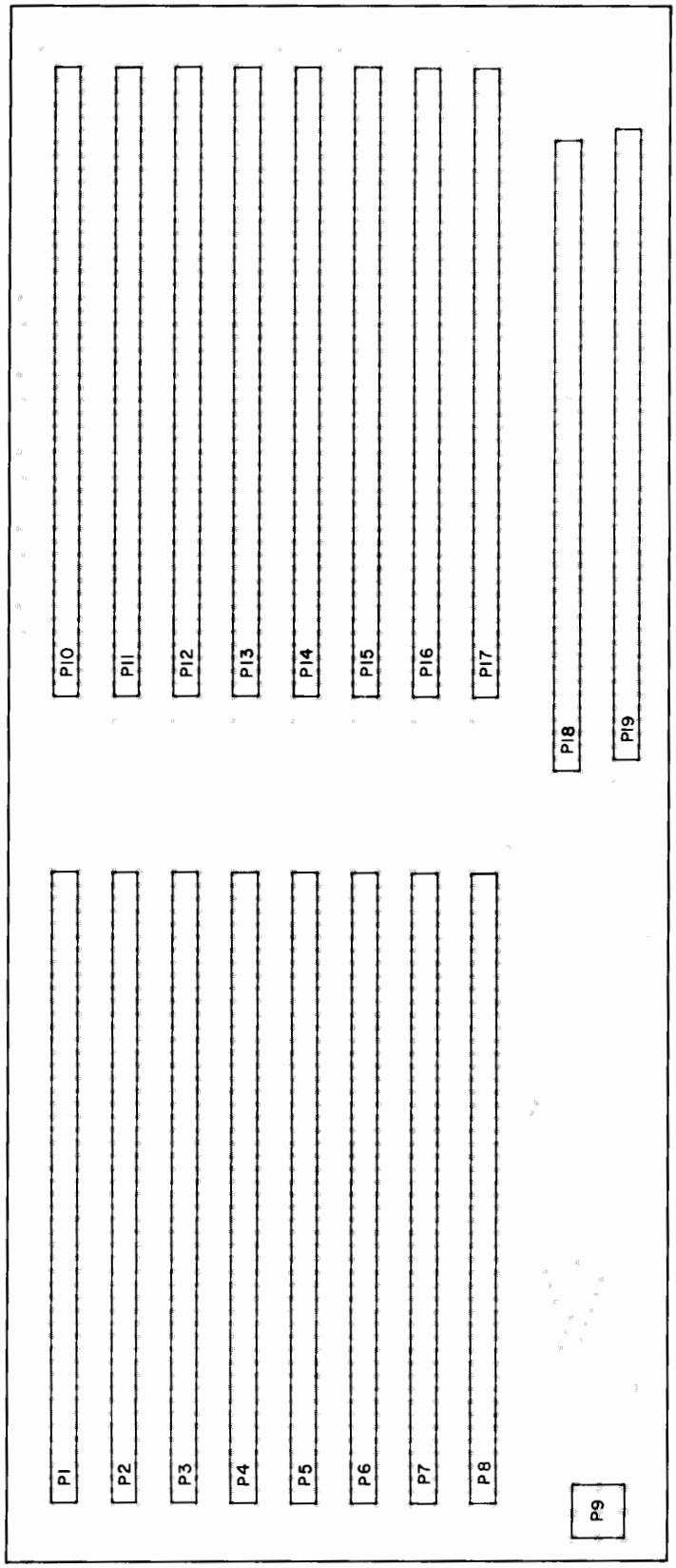


Figure 4-3. Back Plane

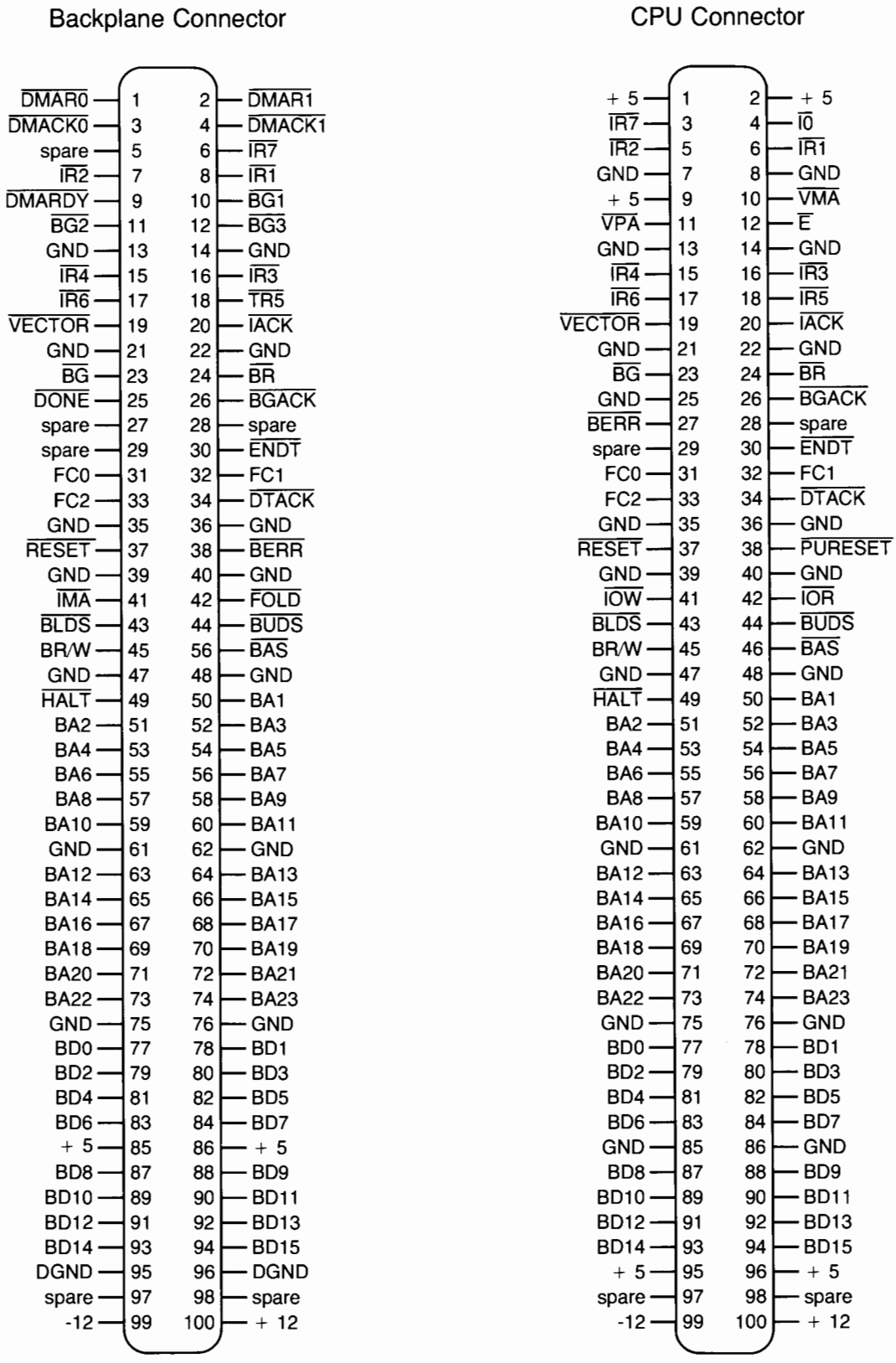


Figure 4-4. Back Plane Connectors

Appendix A

Table A-1. Backplane Signal Lines and Mnemonics

BA1-23	Buffered Address Lines 1-23—these 23 lines form a unidirectional, three-state bus for addressing during all cycles except interrupt cycles. During interrupt cycles, BA1-3 indicate what level of interrupt is being serviced and all other lines are tied high.
BAS	Buffered Address Strobe—indicates that there is a valid address on the address bus.
BD0-15	Buffered Data lines 0-15—these 16 lines form a bi-directional, three-state bus for data transfer.
BERR	Bus Error—informs the processor that there is a problem with the cycle being executed.
BG	Bus Grant—indicates to all potential bus master devices that the processor will release bus control at the end of the current bus cycle.
BG1-3	Bus Grant 1-3
BGACK	Bus Grant Acknowledge—indicates that some device other than the processor has become the bus master.
BLDS	Buffered Lower Data Strobe—controls the data on the lower byte of the data bus in conjunction with BR/W.
BR	Bus Request—indicates to the processor that some other device desires to become the bus master.
BR/W	Buffered Read/Write—defines the data bus transfer to be either a read or write cycle.
BUDS	Buffered Upper Data Strobe—controls the data on the upper byte of the data bus in conjunction with BR/W.
C0-15	Keyboard Columns 0-15
CSCRT	CRT Controller Chip and RAM Select
CSDISC	Disc Drive Controller Chip Select
CSGRAPH	Graphics RAM Chip Select
DGND1-3	Noisy ground 1-3
DMACK0-1	Direct Memory Access Acknowledge 0-1
DMAR0-1	Direct Memory Access Request 0-1
DMARDY	Direct Memory Access Ready (to/from I/O card)
DONE	Direct Memory Access Transfer Done

DTACK	Data Transfer Acknowledge—indicates to the processor that a data transfer is completed.
E	E (6800 cycle)—this is the standard enable signal for external devices.
ENDT	Enable DTACK (for 5 state access)
FC0-2	Function Code 0-2 (from 68000)—indicates the mode and cycle type currently being executed.
FOLD	Fold lower byte to upper byte (DMA)
FULL	Full-Bright Video
GND	Ground
HALF	Half-bright video
HALT	Halt—when driven by the processor, HALT indicates to external devices that the processor has stopped. When driven by an external device, HALT causes the processor to stop at the completion of the current bus cycle.
HRTC	Horizontal Retrace
IACK	Interrupt acknowledge
IMA	I'm Addressed (accessory backplane only)
INT1-7	Interrupt 1-7
IO	I/O Address Space Accessed
IOR	I/O read
IOW	I/O Write
PFAIL	Input power failed
PURESET	Power-up reset
R1-7	Keyboard rows 1-7
RESET	Reset—When driven by the processor, RESET causes all external devices to be reset without affecting the internal state of the processor. When driven by an external device, RESET resets the processor.
RPGA-B	Rotary Control Knob Lines
S0	Shift Key
S1	Control Key
SHUTDOWN	Shutdown
SP	Speaker
VECTOR	Vectored Interrupt Active
VERT1-2	CRT Vertical Deflection Current
VMA	Valid Memory Address (6800 cycle)—indicates to M6800 peripheral devices that there is a valid address on the address bus and the processor is synchronized to enable. This signal only responds to a VPA input.
VPA	Valid peripheral address (6800 cycle)—indicates that the device or region addressed is an M6800 family device and data transfer should coincide with the enable signal (E), and that the processor should use automatic vectoring for an interrupt.