HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

12595A

MULTIPLEXED INPUT/OUTPUT ACCESSORY KIT

(FOR 2114 COMPUTERS)

Card Assemblies

12595-6001, Rev. 903
12595-6002, Rev. 944

Note

This manual is a supplement to Volume Three, Input/Output System Operation, of the 2114 Computer system documentation.

12595-9001

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides general information, installation instructions, theory of operation, maintenance, and replaceable parts information for the Hewlett-Packard (HP) 12595A Multiplexed Input/Output Accessory Kit for HP 2114 series computers (see figure 1-1).

1-3. DESCRIPTION.

1-4. The multiplexed input/output accessory kit expands the number of I/O devices that can be used with a 2114 Computer. As many as 56 peripheral I/O devices can be connected to a single user-designed controller that is interfaced to the computer by a plug-in multiplexer data card and a modified I/O control card. These cards provide all required address, control, and data signals to the user's controller.

1-5. ACCESSORY KIT CONTENTS.

1-6. The multiplexed input/output accessory kit consists of the following:

a. Multiplexer data card, part no. 12595-6001.

b. Eight integrated circuits, part no. 1820-0071 (for modification of the existing computer I/O control card).

c. Two 48-pin connector kits, part no. 02116-6178.

d. Decal, part no. 12595-8003 (for modified I/O control card).

e. Operating and Service Manual, part no. 12595-9001.

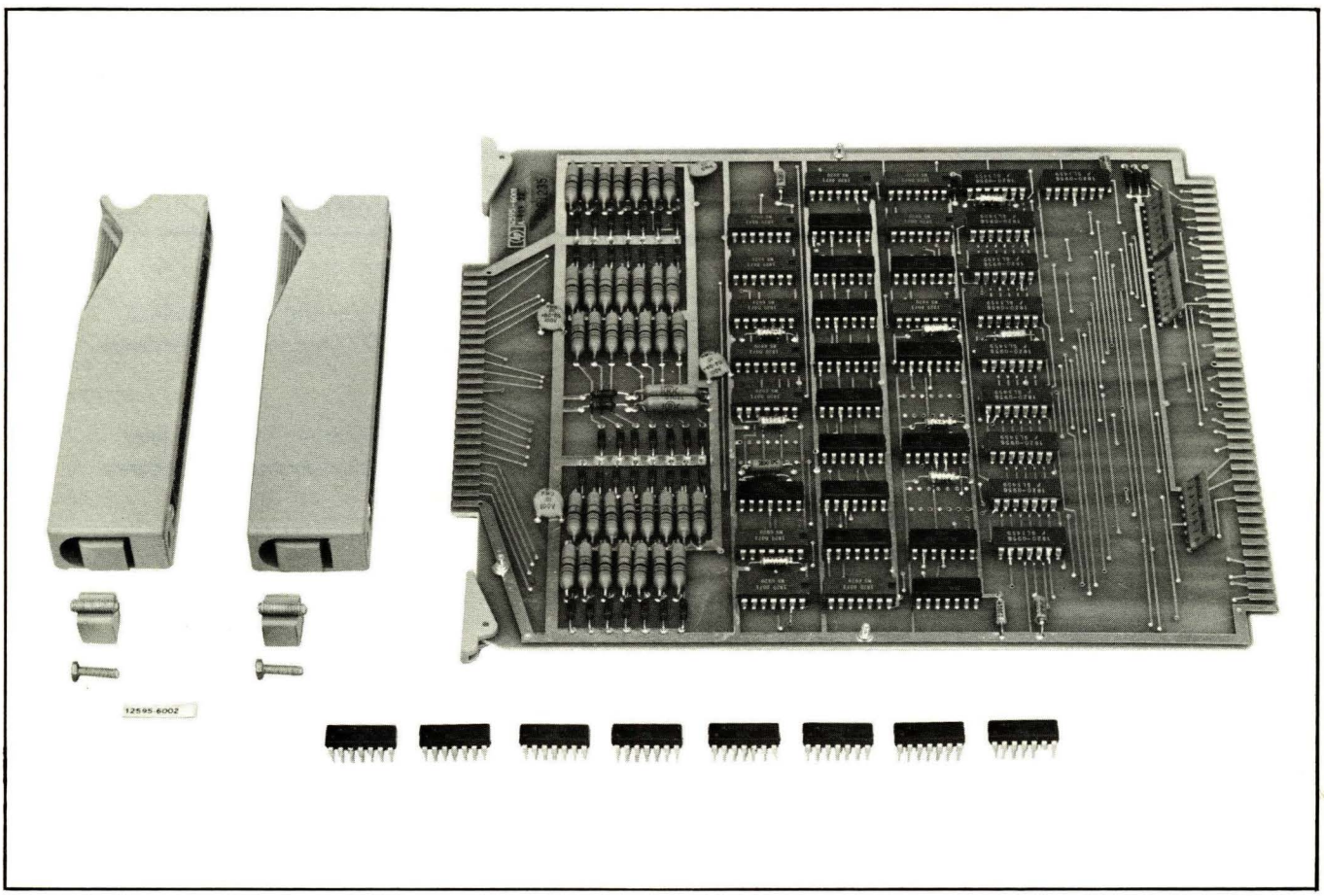


Figure 1-1. HP 12595A Multiplexed Input/Output Accessory Kit

1-7. IDENTIFICATION.

1-8. This operating and service manual is identified on the title page by interface kit designation and nomenclature, card assembly part number and revision code, manual part number, and publication date. Refer to the information in the following paragraphs and ensure that this manual applies to the equipment being serviced.

1-9. Hewlett-Packard uses five digits and a letter (00000A) for standard interface kit designations. If the designation of your kit does not agree with that on the title page of this manual, there are differences between your kit and the kit described in this manual. The appropriate manual or manual supplement is available at the nearest HP Sales and Service Office listed at the back of this manual.

1-10. Printed-circuit cards used as plug-in card assemblies or fixed wired assemblies are identified by a letter, a revision code, and a division code stamped on the card (e.g., A-832-22). The letter identifies the version of the etched trace pattern on the unloaded card. The revision code (three or four middle digits) refers to the electrical characteristics of the loaded card. The division code (last two digits) identifies the Hewlett-Packard division which manufactured the card. If the revision code on the printed-circuit card does not agree with the revision code shown on the title page of this manual, there are differences between your card and the card described in this manual. These differences are described in manual supplements available at the nearest HP Sales and Service Office.

1-11. ADDITIONAL ITEMS REQUIRED.

1-12. Because of application differences, the interconnecting cables must be supplied by the user. Two cables are required: one from the I/O control card to the user's controller, and one from the multiplexer data card to the user's controller. For minimum signal loss and propagation delay, Hewlett-Packard recommends that these cables be of the twisted-pair type and be kept as short as possible. To fit the 48-pin connectors supplied with the accessory kit, the outside diameter of the cables must not exceed 0.4 inch. Hewlett-Packard cables that meet these requirements are: part no. 8120-1167, a 48-pair cable suitable for connection to the multiplexer data card; and part no. 8120-1283, a 36-pair cable suitable for connection to the I/O control card. These cables are sold by the foot and can be ordered through any Hewlett-Packard Sales and Service Office listed at the back of this manual.

1-13. Paragraph 3-29 provides important timing information that must be considered before determining the allowable length of the interconnecting cables. Both cables should be nearly the same length and under no circumstances can these cables exceed a length of 60 feet.

1-14. SPECIFICATIONS.

1-15. Table 1-1 lists specifications of the 12595A Multiplexed Input/Output Accessory Kit.

Table 1-1. Accessory Kit Specifications

CHARACTERISTICS	SPECIFICATIONS
Input Levels:	
Logic 1	+0.5V maximum, 16 mA to load
Logic 0	+3.5V, 222 ohm source impedance
Output Levels:	
Logic 1	+0.5V maximum, 16 mA to load
Logic 0	+3.5V, 222 ohm source impedance
Current Required By Accessory Kit:	
+12V dc	0.0A
-12V dc	0.0A
+4.5V dc	1.0A
-2V dc	0.05A
Multiplexer Data Card Dimensions:	
Width	7-3/4 inches (196,8 mm)
Height	8-11/16 inches (220,7 mm)

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section provides information for unpacking and inspection, reshipment, preparation for installation, and installation of the kit.

2-3. UNPACKING AND INSPECTION.

2-4. If the shipping carton is damaged upon receipt, request that the carrier's agent be present when the interface kit is unpacked. Inspect the contents of the kit for damage (cracks, broken components, etc.). If the card is damaged and fails to meet specifications, notify the carrier and the nearest HP Sales and Service Office immediately. (Sales and Service Offices are listed at the back of this manual.) Retain the shipping container and packing material for the carrier's inspection. The HP Sales and Service Office will arrange for repair or replacement of the damaged card without waiting for claims against the carrier to be settled.

2-5. RESHIPMENT.

2-6. If an item of the kit is to be shipped to Hewlett-Packard for service or repair, attach a tag to the item identifying the owner and indicating the service or repair to be accomplished. Include the model number of the kit and the sales order number if available.

2-7. Pack the item in the original factory packing material if available. If the original material is not available, standard factory packing material can be obtained from the nearest HP Sales and Service Office.

2-8. If standard packing material is not used, wrap the item in Air Cap TH-240 cushioning (manufactured by Sealed Air Corporation, Hawthorn, N.J.), or equivalent, and place in a corrugated carton (200 pound test material). Seal the shipping carton securely and mark it "FRAGILE" to ensure careful handling.

Note: In any correspondence, identify the kit by number. Refer any questions to the nearest Hewlett-Packard Sales and Service Office.

2-9. PREPARATION FOR INSTALLATION.

2-10. Prior to installing the accessory kit, modify the computer I/O control card, fabricate interconnecting cables, and determine availability of operating currents as described in the following paragraphs.

2-11. I/O CONTROL CARD MODIFICATION.

2-12. To provide the necessary signals from the computer to the user's controller, modify the I/O control card as follows:

a. Ensure that the computer POWER switch is set to OFF.

b. Remove the I/O control card (02114-6007) from slot A15 of the computer.

c. Insert the eight integrated circuits into the sockets provided on the I/O control card. All eight circuits are identical and must be installed with the keyed ends of the circuits facing the 86-pin connector side of the card.

d. Remove jumpers W1 through W11 from the I/O control card. Figure 4-2 shows jumper locations.

e. Add the decal, included in the accessory kit, to show that the I/O control card has been modified and bears a new part number (12595-6002).

2-13. CABLE ASSEMBLY FABRICATION.

2-14. The user must fabricate the cables used between the I/O control and multiplexer data cards in the computer and the user's controller. Cable selection details are given in paragraphs 1-11 through 1-13 of this manual. The two 48-pin connectors included in the accessory kit connect to the two cards in the computer; the cable connectors required for the user's controller are supplied by the user.

2-15. Tables 4-3 and 4-5 list pin connections and the corresponding signals on the 48-pin connectors of the modified I/O control card and the multiplexer data card. Using tables 4-3 and 4-5 and figures 2-1 and 2-2, fabricate the interconnecting cable assemblies as follows:

a. Insert approximately 10 inches of cable into the connector hood.

b. Strip the outer jacket of the cable back 5 inches.

c. Prepare a bus wire from 22-gauge bare-copper wire and solder it to pins BB and 24 of the connector as shown in figure 2-1.

d. Divide the twisted-pairs into groups of six pairs each.

e. Starting at the end of the 48-pin connector nearest pins BB and 24, connect the first six pairs as follows:

(1) Solder the six signal wires to their respective pins on the connector and insulate each pin with tubing as shown in figure 2-2.

(2) Solder the six ground wires to the bus wire and insulate with shrink tubing as shown in figure 2-2.

f. Repeat substeps (1) and (2) with the remaining groups of wires until all wires are soldered to the connector and insulated.

g. Trim excess bus wire and install the 48-pin connector in the connector hood using the two self-tapping screws.

h. Install the cable clamp and tighten it in place with the setscrew.

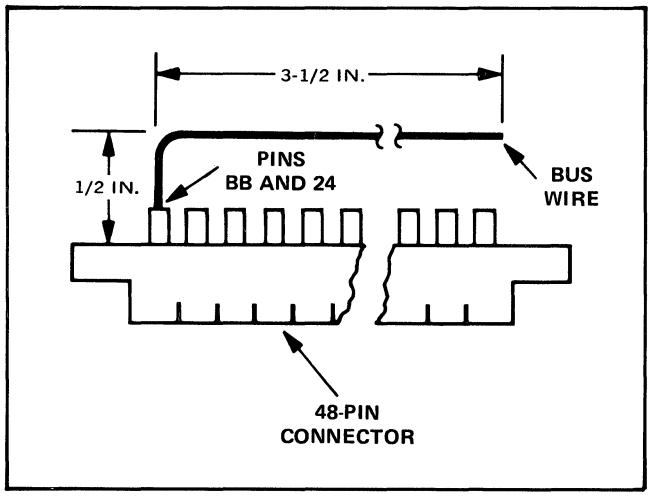


Figure 2-1. Bus-Wire Details

2-16. CURRENT REQUIREMENTS.

2-17. The interface card in the kit obtains its operating currents from the computer power supply. Before installing the interface card, determine the current requirements of the card in combination with all other interface or accessory kits already installed in the computer. Volume Three of the computer system documentation defines the currents available from the computer power supply and describes the procedure for calculating the total current requirements. If the total current requirements exceed the limitations of the computer power supply, a Hewlett-Packard power supply extender or input/output extender must be used. See table 1-1 for the current requirements of the multiplexer data card.

2-18. INSTALLATION.

2-19. Install the multiplexed input/output accessory kit as follows:

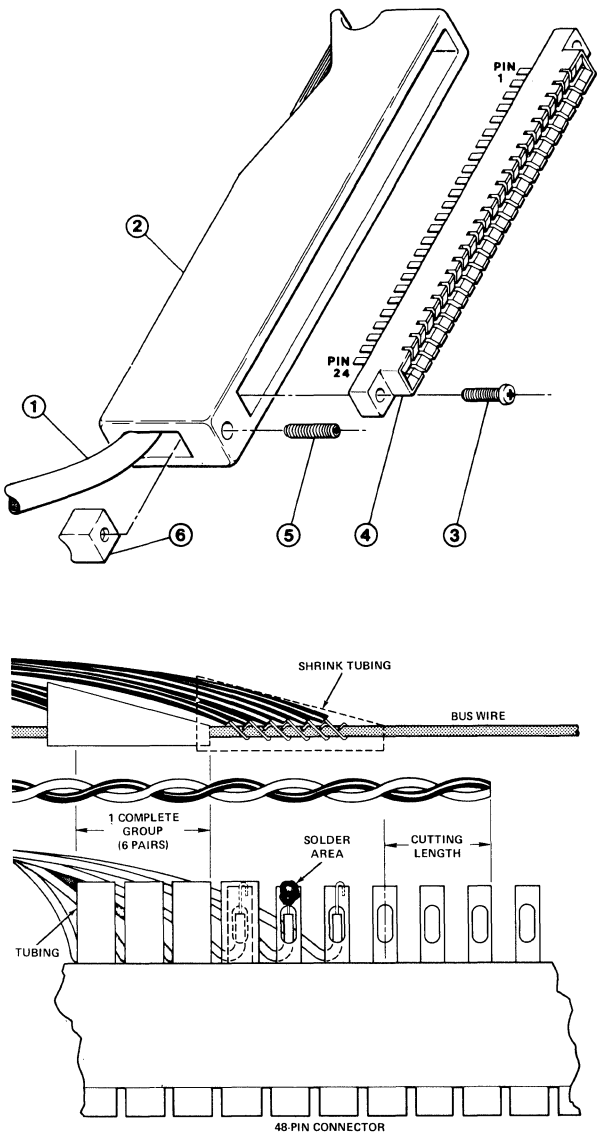
a. Ensure that power is removed from the computer and the input/output system.

b. Insert modified I/O control card into computer slot A15.

c. Insert multiplexer data card into a vacant I/O card slot. Priority considerations are given in paragraph 3-15.

d. Interconnect the I/O control card, the multiplexer data card, and the user's controller with the cables fabricated in paragraph 2-13.

e. Power can now be applied to the computer and the user's multiplexed I/O system to verify proper operation.



ITEM	DESCRIPTION	PART NO.
*1	Cable	
2	Connector hood	02116-4001
3	Self-tapping screw	0624-0098
4	Connector, 48-pin	1251-0335
5	Setscrew	3030-0143
6	Cable clamp	02116-4003

*Not supplied with this kit. See paragraph 1-12 for suitable cables available from Hewlett-Packard.

Figure 2-2. Cable Fabrication Diagram and Parts List

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION.

3-2. This section provides the theory of operation for the circuits directly associated with the multiplexed I/O accessory kit. For detailed theory of operation for the computer I/O section, refer to Volume Three of the computer system documentation.

3-3. Logic diagrams for the multiplexed I/O accessory kit are located in the maintenance section (Section IV) of this manual. Figure 4-3 is the modified I/O control card logic diagram, and figure 4-5 is the multiplexer data card logic diagram.

3-4. Operation of the multiplexed I/O accessory kit is automatic under normal conditions. All necessary I/O address, control, the data lines are available to the user's controller. Multiplexed I/O devices have access to the computer priority and interrupt system. Interrupt requests from multiplexed devices are serviced in the same manner as interrupts from devices using the I/O slots in the computer mainframe.

3-5. As an aid to designing the user's controller, this section also contains critical timing information and descriptions of the device addressing methods available to the user.

3-6. MODIFIED I/O CONTROL CARD

3-7. The addition of eight integrated circuits to the I/O control card makes the complete set of select code addresses 10 through 77 (octal) available to the user through the 48-pin connector on the card. Table 4-3 lists the signal lines available from the modified I/O control card. These signal lines allow any multiplexed device to be addressed under program control and allow an interrupt address to be returned to the computer. Select codes 10 through 17 (octal) can be used to address either an interface card in the mainframe or multiplexed device, but not both.

3-8. Control signals used by the I/O control card include the External Interrupt ($\overline{\text{XINT}}$), Interrupt Address (IA), and External Power Fail (XPF) signal. The $\overline{\text{XINT}}$ signal and the IA signals provide the necessary interrupt information. The XPF signal allows the user to have access to the computer power fail circuitry.

3-9. The $\overline{\text{XINT}}$ signal together with a true Enable Service Request (ESR) signal generates a true Interrupt (INT) signal causing the computer to enter the interrupt phase. The computer strobes the 6-bit interrupt address into the central interrupt register which then places the address of the interrupting device onto the T-bus. Multiplexed interrupts are processed the same as other I/O interrupts.

3-10. The interrupt causes the computer to read the location in memory that contains the address of the subroutine used to service the interrupting device. The interrupt address is sent with the $\overline{\text{XINT}}$ signal to the I/O control card, and is applied to the input of the central interrupt register. The presence of signals on the IA lines will not, by themselves, cause an interrupt.

3-11. MULTIPLEXER DATA CARD.

3-12. The multiplexer data card provides a buffered path for data and control signals to and from the computer (see figure 3-1). The buffer elements invert the signal levels causing the complement of each input signal to be provided at the output. All input and output signal levels are compatible with DTL/TTL current-sinking logic as listed in table 1-1. Table 4-5 lists the signal lines available from the multiplexer data card.

3-13. The multiplexer data card provides 16 bidirectional, buffered data lines that link the multiplexed devices with the computer Input/Output Bus (IOB) lines. The driver and receiver gates on these lines are "OR-tieable" permitting the user to have several input or output devices on each data line (subject to the specification in table 1-1).

3-14. Data transfer from the computer to a multiplexed device via the multiplexer data card is enabled by an I/O Output (IOO) signal which is generated by a programmed output instruction. This signal enables the data output gates. The delay network made up of MC83, MC93 and MC105B maintains the IOO enabling signal from T3 through T5 of a machine timing cycle to provide a longer data transfer period. Data transfer to the computer is enabled by an I/O Input (IOI) signal to the data input gates. The IOI signal is a result of a programmed input instruction.

3-15. PRIORITY NETWORK OPERATION.

3-16. The multiplexer data card receives a Priority High (PRH) signal from the I/O slot in which it is placed. For example, if the data card is placed in slot A20, it will receive the PRH13 priority signal (see figure 3-2). All devices used in the multiplexed system will then have an interrupt priority higher than devices plugged into slots A19, A18, A17, or A16 and lower priority than devices using I/O slots A21, A22, or A23. The user can use the priority signal from the multiplexer data card to produce his own priority string and maintain an orderly interrupt system for the multiplexed devices.

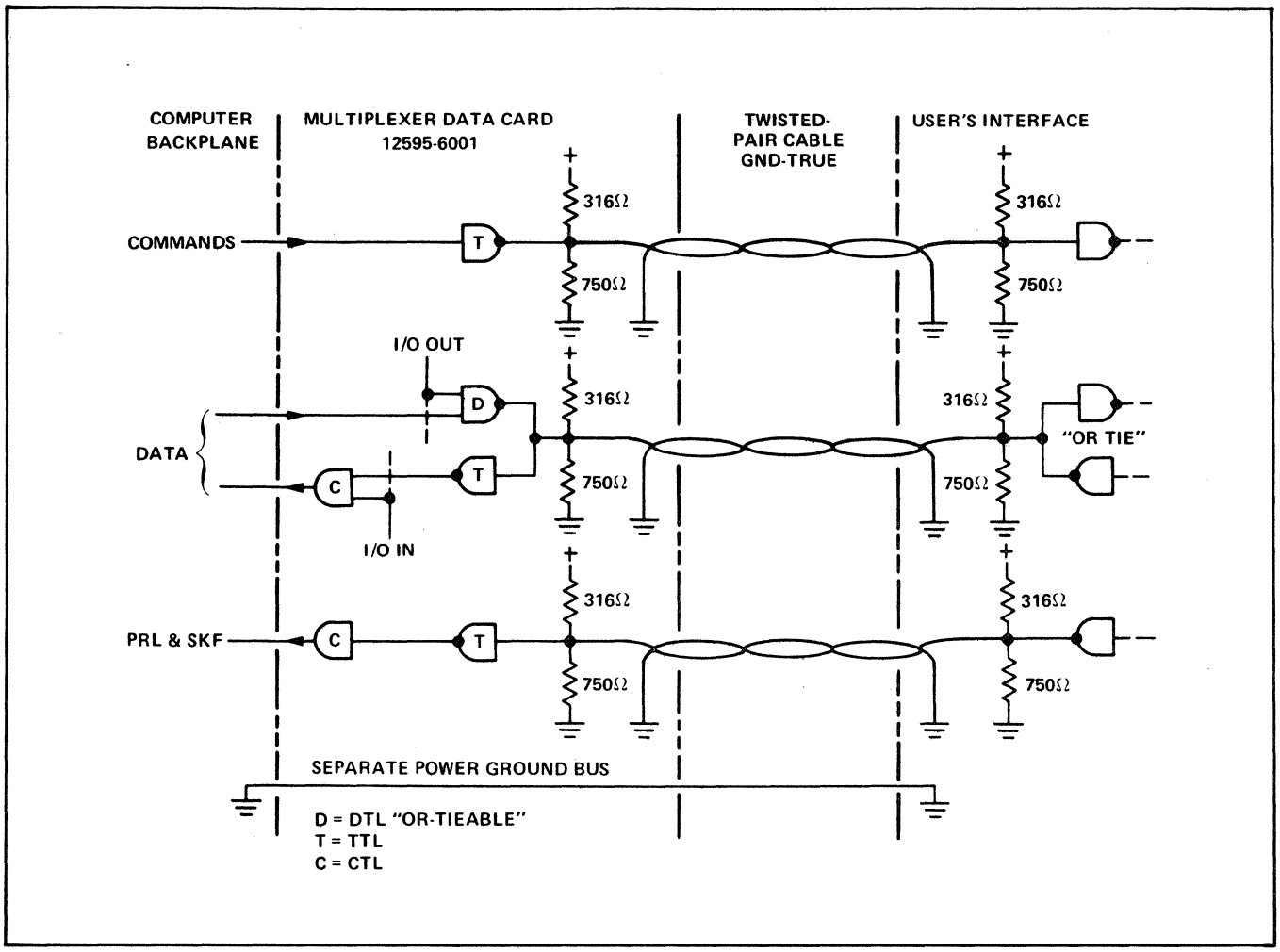


Figure 3-1. Multiplexed I/O Interface Connections

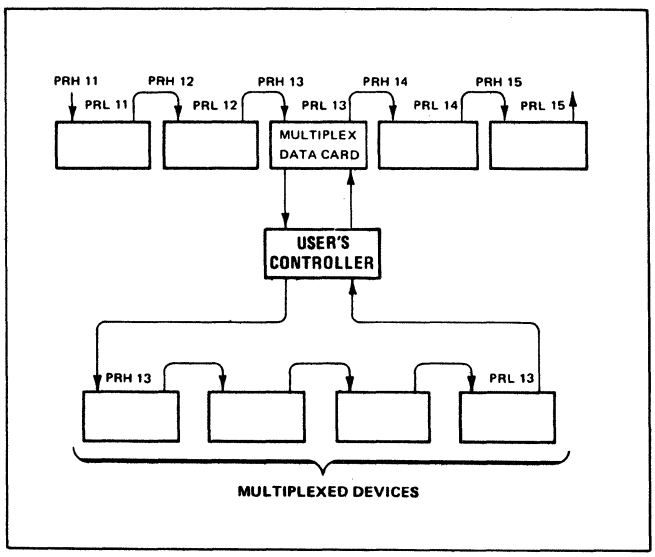


Figure 3-2. Priority Continuity

3-17. The Priority Low (PRL) signal from the user's controller must be returned to the computer before T5 time to complete the computer priority network. If the multiplexer data card is inserted in the lowest priority I/O slot (A16), the PRL signal need not be returned, but must settle before T5 time (see paragraph 3-29).

3-18. USER'S CONTROLLER.

3-19. Data interchanges between the computer and the external I/O devices must occur at the proper time, and the correct I/O device must be selected. The user must design a controller to satisfy these requirements.

3-20. The following paragraphs describe general controller requirements, methods to address multiplexed devices, and critical timing information. For more detailed information about controller design, refer to A Pocket Guide to Interfacing HP Computers, part no. 5950-8718, available from any HP Sales and Service Offices.

3-21. GENERAL REQUIREMENTS.

3-22. Controller design is simplified by the availability of all I/O address and control signals. All signal lines are compatible with TTL or DTL logic; controller design must provide for proper termination of these lines.

3-23. The interrupt address must be supplied to the computer only when the Interrupt Enable (IEN) and PRH signals from the computer are true. This prevents simultaneous arrival of address information from devices on the multiplexed I/O string and devices using I/O slots in the computer mainframe. The interrupt address lines must be true between the leading edge of T5 Set Interrupt Request (SIR) of a machine cycle and the leading edge of T2 Enable Flag (ENF) of the following machine cycle. The I/O priority chain determines which device is allowed to interrupt computer operation.

3-24. The multiplexed device may send a Skip on Flag (SKF) signal to the computer where it causes the computer program counter to be incremented by one, skipping the next sequential program instruction. Figure 3-3 shows the logic necessary to generate a SKF signal.

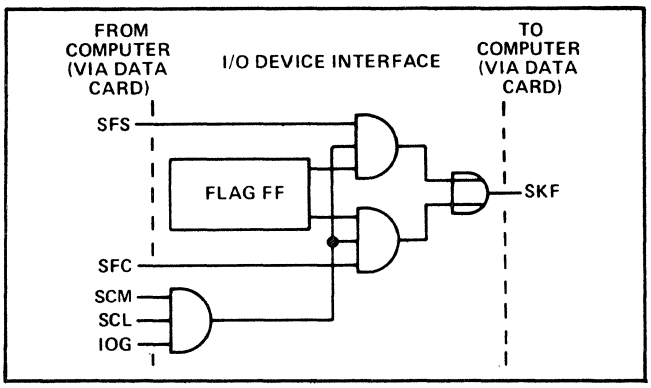


Figure 3-3. SKF Signal Generation

3-25. The SKF signal is initiated by a programmed Skip if Flag Set (SFS) or Skip if Flag Clear (SFC) instruction with the select code of the desired device. These instructions test device status. If the Flag flip-flop of the addressed device is set, indicating that the device is ready to send or receive data, and an SFS instruction is being executed by the computer, then a SKF is sent to the computer from the device. If a SFC instruction has been decoded and the Flag FF is not set, then a SKF signal is sent to the computer.

3-26. The XPF signal provides the user with the ability to turn off the computer in the event of a power failure in the multiplexing controller or in one of the multiplexed I/O devices. The use of the XPF signal to actuate the computer power fail circuitry is optional. When the power level drops, the XPF signal must go low, causing the computer power fail circuitry to halt the computer. The power-fail with automatic-restart option is accessed by the XPF signal in the same manner. When the XPF line is not used, the XPF input is held high by resistor R10 on the I/O control card; no holdoff level is required.

3-27. INTERRUPT PROCESSING.

3-28. A multiplexed I/O device can request an interrupt by sending the $\overline{\text{XINT}}$ signal and the device IA signals to the computer. The computer then goes to the memory location specified by the interrupt address, and performs the program steps necessary to handle the interrupt for that specific device. If transfer speed is not a prime consideration, however, the interrupt address lines can be connected to provide the same fixed address regardless of which device requests the interrupt. This reduces the amount of logic circuits required to service interrupts. When an interrupt occurs, the computer reads the same memory location containing the address of a subroutine to test each device. This subroutine determines which device generated the interrupt.

3-29. TIMING CONSIDERATIONS.

3-30. Timing is an important consideration when designing the controller circuits and fabricating the cables required for interconnection. Particular attention must be given to the settling times of the SKF, PRH, PRL, and input data signals. Timing details are illustrated in figure 3-4. The

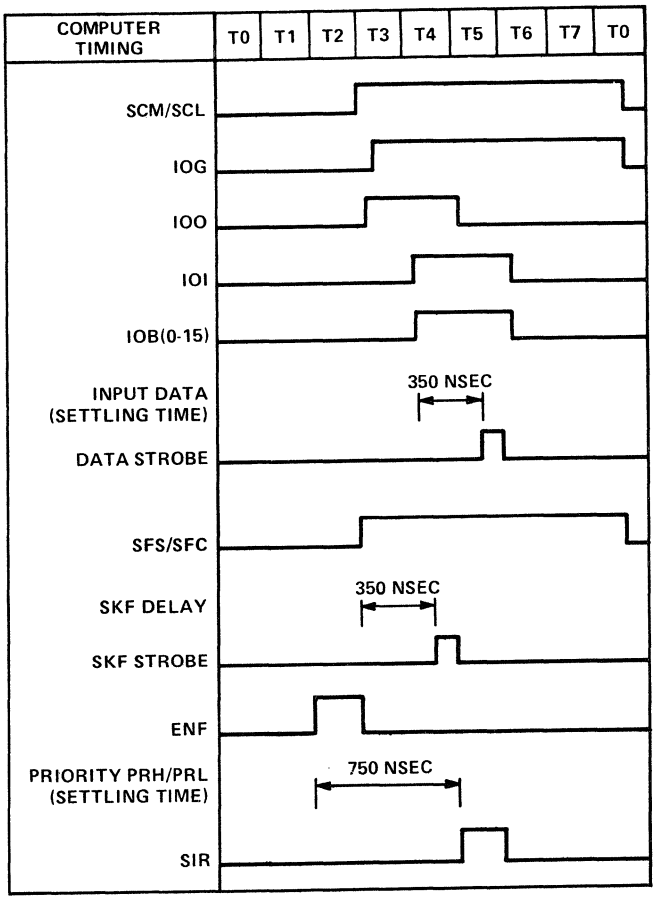


Figure 3-4. Critical Signal Timing Diagram

settling times shown in figure 3-4 are absolute maximums, and the signals must be settled prior to the end of these times.

3-31. A system with a large number of multiplexed I/O devices may cause problems with the priority settling time. Each gate in the priority chain has a propagation delay which, when added to the cable delay, could exceed the 750-nanosecond maximum. It may be necessary to construct the priority chain to disable groups of devices for faster propagation as shown in figure 3-5.

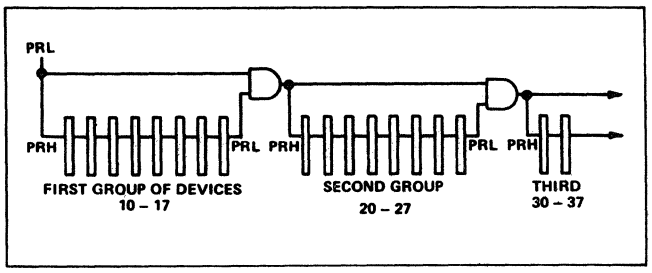


Figure 3-5. High Speed Priority Propagation

SECTION IV

MAINTENANCE

4-1. INTRODUCTION.

4-2. This section provides maintenance information for the accessory kit. Preventive maintenance instructions, corrective maintenance instructions, and maintenance data consisting of signal indexes, integrated circuit characteristics and pin connections, reference designation indexes, parts location diagrams, and logic diagrams are included.

4-3. PREVENTIVE MAINTENANCE.

4-4. Include maintenance for the accessory kit in the preventive maintenance routines in Volume Two for the computer. Also, visually inspect the printed circuit cards, cables, and cable connectors for cracked, broken, or burned insulation, wiring, and components; repair if necessary.

4-5. CORRECTIVE MAINTENANCE.

4-6. When performing corrective maintenance, refer to figures 4-1 through 4-5 and tables 4-1 through 4-5 in this section and figure 3-4 in Section III.

4-7. PIN CONNECTIONS.

4-8. For connections to the 86-pin edge of the modified I/O control card and the multiplexer data card, refer to the computer backplane wire list in Volume II of the computer system documentation. For connection to the 48-pin edge of these cards, refer to table 4-3 (modified I/O control card) and table 4-5 (multiplexer data card).

4-9. SIGNAL VOLTAGES.

4-10. To determine the input and output voltage characteristics of the integrated circuits on the modified I/O control card and the multiplexer data card, locate the integrated circuit in figure 4-1, and refer to the listed characteristics in table 4-1.

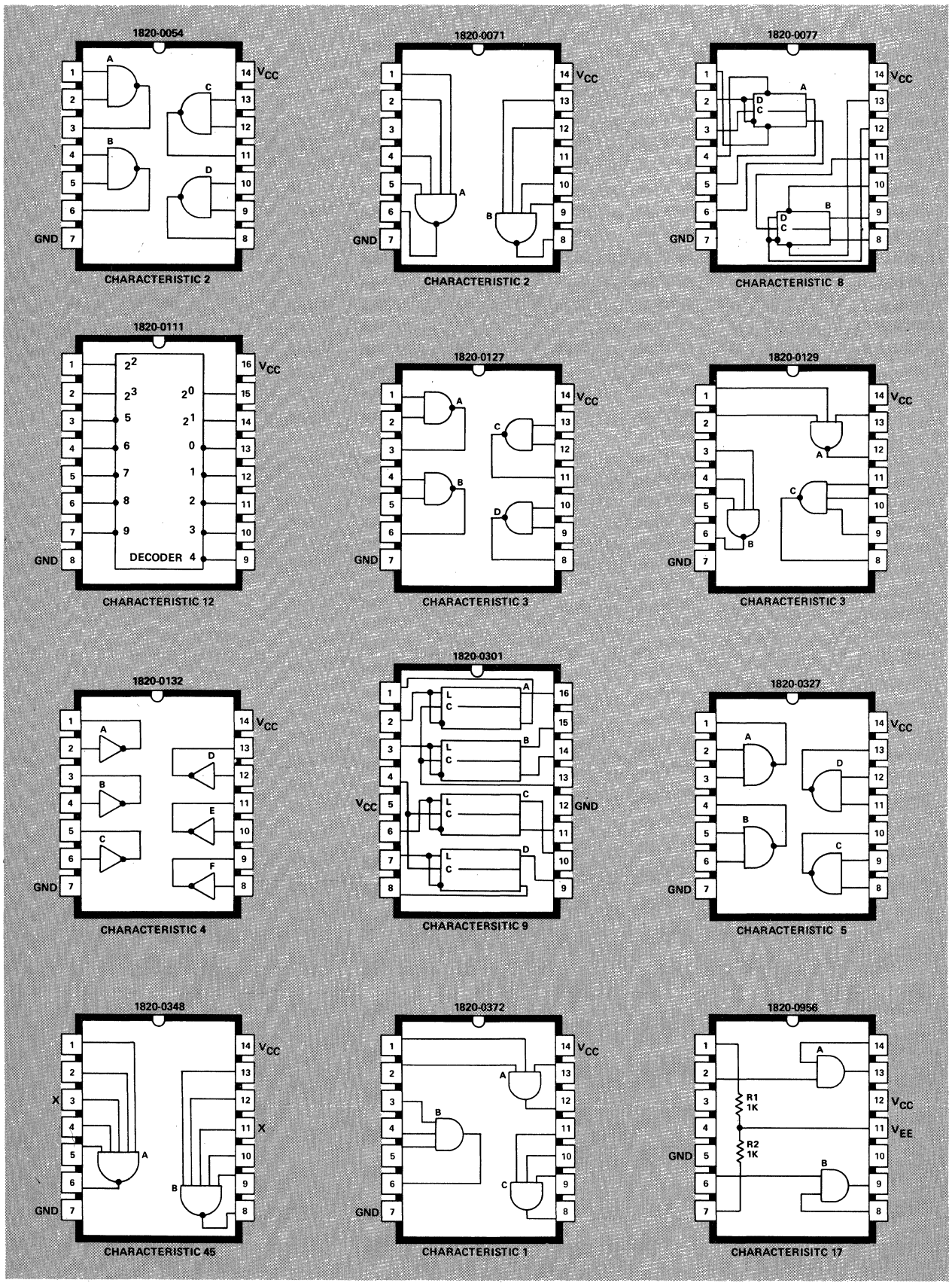


Figure 4-1. Integrated Circuit Pin Connections

Table 4-1. Integrated Circuit Characteristics

CHARACTERISTIC	INPUT LEVEL (VOLTS)		OUTPUT LEVEL (VOLTS)		OPEN INPUT ACTS AS:	MAXIMUM PROPAGATION DELAY (NANOSECONDS)	
	LOGIC 1 MIN.	LOGIC 0 MAX.	LOGIC 1 MIN.	LOGIC 0 MAX.		TO LOGIC 1	TO LOGIC 0
1	+2.0	+0.8	+2.4	+0.4	Logic 1	15	15
2	+2.0	+0.8	+2.4	+0.1	Logic 1	29	15
3	+2.0	+0.8	+2.4	+0.4	Logic 1	12	10
4	+1.9	+0.8	+2.4	+0.45	Logic 1	15	13
5	+2.0	+0.8	(12)	+0.4	Logic 1	45	15
8	+2.0*	+0.8	+2.4	+0.4	Logic 1	35	50
9	+2.0**	+0.8	+2.4	+0.4	Logic 1	40	25
12	+2.0	+0.8	+0.4	+2.4	Logic 1	35	30
17	+1.25	+0.5	+2.25	-0.36	Logic 0	18	18
45	+2.0	+1.1	(12)	+0.5	Logic 1	50	35

NOTES:

* Required Pulse Width 30 ns minimum

** Required Pulse Widths; clock 30 ns minimum, data 75 ns minimum

(12) Level depends on external load

Table 4-2. Modified I/O Control Card, Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
	12595-6002	I/O Control Card	28480	12595-6002
C3 thru C42,51,53	0160-2065	Capacitor, Fxd, Cer, 0.01 uF, -20 +80%, 100 VDCW	56289	C023F101F103ZS22-CDH
C52	0180-0100	Capacitor, Fxd, Elect, 4.7uF, 10%, 35 VDCW	56289	150D475X9035B2
CR1	1902-3043	Diode, Breakdown, 3.32V, 2%, 400mW	28480	1902-3043
CR2	1910-0022	Diode, Ge, 5 WIV	28480	1910-0022
MC13, 23, 33, 53, 54, 55, 63, 64, 65, 84	1820-0327	Integrated Circuit, TTL	01295	SN7401N
MC14, 15, 45, 46, 85	1820-0127	Integrated Circuit, TTL	07263	U6A900259X
MC16	1820-0129	Integrated Circuit, TTL	07263	U6A900359X
MC24, 25, 26, 56, 66, 76, 86, 96, 106	1820-0956	Integrated Circuit, CTL	07263	U6A995679X
MC34, 35	1820-0077	Integrated Circuit, TTL	01295	SN7474N
MC36, 43, 95	1820-0372	Integrated Circuit, TTL	01295	SN74H11N
MC44, 74, 94, 104	1820-0132	Integrated Circuit, TTL	07263	U6A901659X
MC52, 62, 72, 82, 92, 93, 102, 103	1820-0071	Integrated Circuit, TTL	01295	SN7440N
MC73, 83	1820-0301	Integrated Circuit, TTL	01295	SN7475N
MC75, 105	1820-0111	Integrated Circuit, TTL	07263	U6B930159X
Q1 thru Q6	1854-0215	Transistor, Si, NPN	04713	SPS 3611
R1, 10, 11, 13, 14, 17, 30, 31, 40, 41, 44, 50, R65 thru R77, 80	0683-4715	Resistor, Fxd, Comp, 470 ohms, 5%, 1/4W	28480	0683-4715
R2 thru R5, R85 thru R96	0683-3315	Resistor, Fxd, Comp, 330 ohms, 5%, 1/4W	28480	0683-3315
R6, 18, 20, 21, 29, 32, 36, R51 thru R61, 78, 79, 97, 98	0683-1025	Resistor, Fxd, Comp, 1k, 5%, 1/4W	28480	0683-1025
R7, 19, 34, 42, 43	0683-1015	Resistor, Fxd, Comp, 100 ohms, 5%, 1/4W	28480	0683-1015
R16, 46	0683-3915	Resistor, Fxd, Comp, 390 ohms, 5%, 1/4W	28480	0683-3915
R33	0683-1005	Resistor, Fxd, Comp, 10 ohms, 5%, 1/4W	28480	0683-1005
R35	0683-1525	Resistor, Fxd, Comp, 1.5k, 5%, 1/4W	28480	0683-1525
R45	0757-0198	Resistor, Fxd, Flm, 100 ohms, 1%, 1/2W	28480	0757-0198
R47	0698-3394	Resistor, Fxd, Flm, 31.6 ohms, 1%, 1/2W	28480	0698-3394
R48	0683-1825	Resistor, Fxd, Comp, 1.8k, 5%, 1/4W	28480	0683-1825

Table 4-3. Modified I/O Control Card, 48-Pin Connector Signal Index

PIN NO.	DESCRIPTION	PIN NO.	DESCRIPTION
1	GND	A	Not Used
2	(FLG1) Do Not Use	B	$\overline{SCL7}$: Select Code Least significant digit 7
3	(FLG2) Do Not Use	C	$\overline{XINT}$*: External Interrupt
4	(SCM1) No Connection; Jumper Removed	D	$\overline{IA1}$*: Interrupt Address 1
5	$\overline{IA2}$*: Interrupt Address 2	E	$\overline{IA0}$*: Interrupt Address 0
6	$\overline{IA5}$*: Interrupt Address 5	F	$\overline{IA4}$*: Interrupt Address 4
7	$\overline{IA3}$*: Interrupt Address 3	H	$\overline{SCL1}$: Select Code Least significant digit 1
8	$\overline{SCL6}$: Select Code Least significant digit 6	J	$\overline{SCM2}$: Select Code Most significant digit 2
9	$\overline{SCM7}$: Select Code Most significant digit 7	K	$\overline{SCL3}$: Select Code Least significant digit 3
10	$\overline{SCM6}$: Select Code Most significant digit 6	L	$\overline{SCM1}$: Select Code Most significant digit 1
11	$\overline{SCL0}$: Select Code Least significant digit 0	M	(SCM2) No Connection; Jumper Removed
12	$\overline{SCM0}$: Select Code Most significant digit 0	N	(SCM3) No Connection; Jumper Removed
13	$\overline{SCM5}$: Select Code Most significant digit 5	P	SCM4: Select Code Most significant digit 4
14	(IRQ1) Do Not Use	R	$\overline{SCL2}$: Select Code Least significant digit 2
15	(IRQ2) Do Not Use	S	$\overline{SCM3}$: Select Code Most significant digit 3
16	(IRQ3) Do Not Use	T	$\overline{SCL4}$: Select Code Least significant digit 4
17	(IRQ4) Do Not Use	U	(SCL0) No Connection; Jumper Removed
18	(IRQ5) Do Not Use	V	(SCL1) No Connection; Jumper Removed
19	(IRQ6) Do Not Use	W	(SCL2) No Connection; Jumper Removed
20	(IRQ7) Do Not Use	X	(SCL3) No Connection; Jumper Removed
21	Not Used	Y	(SCL4) No Connection; Jumper Removed
22	XPF*: External Power Fail	Z	(SCL5) No Connection; Jumper Removed
23	$\overline{SCL5}$: Select Code Least significant digit 5	AA	(SCL6) No Connection; Jumper Removed
24	GND	BB	(SCL7) No Connection; Jumper Removed

Notes: All signals in this table are ground-true.
*Denotes user-supplied control signals.

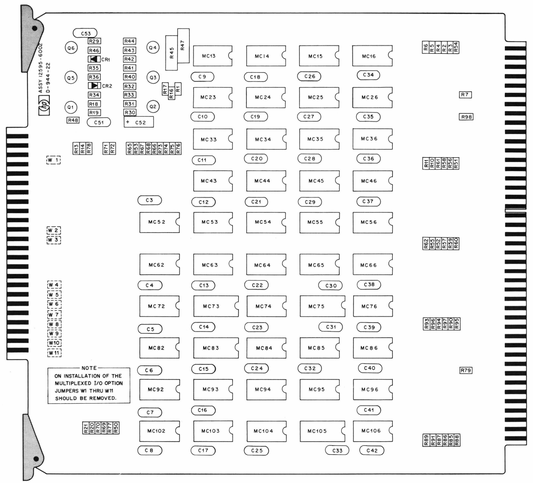


Figure 4-2. Modified I/O Control Card, Parts Location Diagram

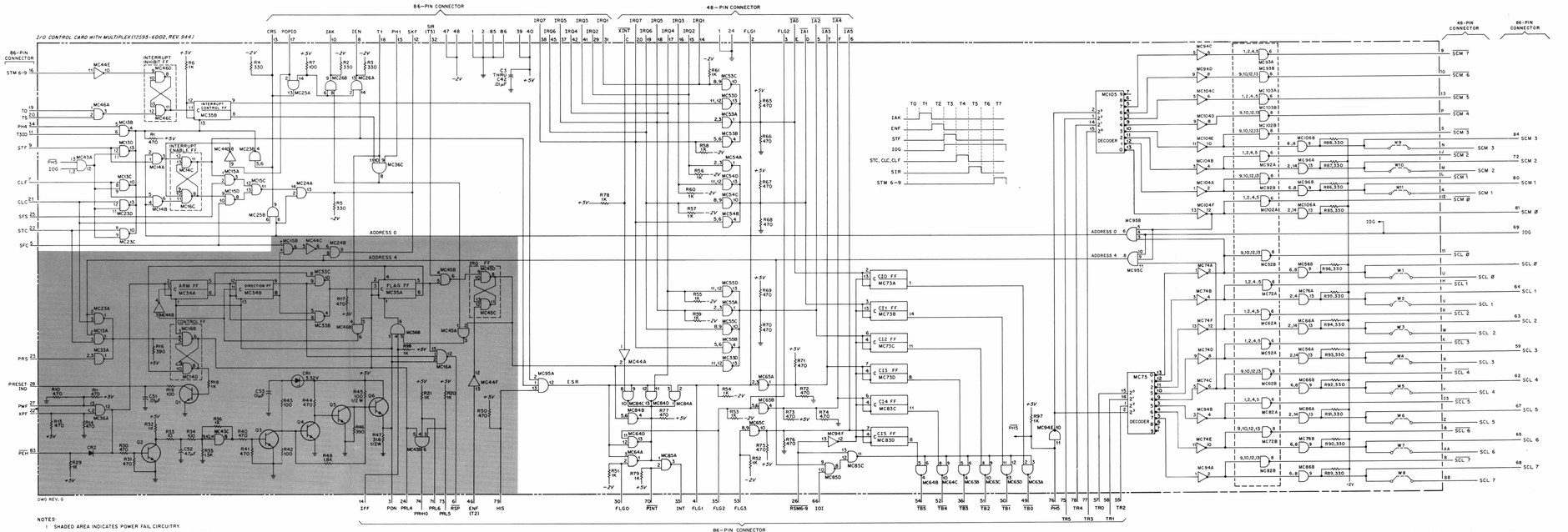


Figure 4-3. Modified I/O Control Card, Logic Diagram

Table 4-4. Multiplexer Data Card, Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
	12595-6001	Multiplexer Data Card	28480	12595-6001
C1	0160-0153	Capacitor, Fxd, My, 0.001uF, 10%, 200 VDCW	56289	192P10292-PTS
C2 thru C10, 15, 16, 17	0180-0197	Capacitor, Fxd, Elect, 2.2uF, 10%, 20 VDCW	56289	150D225X9020-A2-DYS
C11 thru C14	0160-2055	Capacitor, Fxd, Cer, 0.01uF, -20 +80%, 100 VDCW	56289	C023F101F103ZS22-CDH
MC14, 15, 23, 25, 33, 43, 45, 53, 63, 93, 103, 104	1820-0071	Integrated Circuit, TTL	01295	SN7440N
MC16, 17, 26, 36, 46, 56, 66, 76 86, 96	1820-0956	Integrated Circuit, CTL	07263	U6A995679X
MC24, 34, 44, 54, 64, 74, 84, 94	1820-0348	Integrated Circuit, DTL	07263	U6A994459X
MC35, 55, 75, 83, 95, 105	1820-0054	Integrated Circuit, TTL	01295	SN7400N
R1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 65, 67, 69, 71, 73, 75	0757-0420	Resistor, Fxd, Flm, 750 ohms, 1%, 1/8W	28480	0757-0420
R2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76	0698-3402	Resistor, Fxd, Flm, 316 ohms, 1%, 1/2W	28480	0698-3402
R77	0757-0401	Resistor, Fxd, Flm, 100 ohms, 1%, 1/8W	28480	0757-0401
R78	0698-3441	Resistor, Fxd, Flm, 215 ohms, 1%, 1/8W	28480	0698-3441
R79, 80	0757-0427	Resistor, Fxd, Flm, 1.50k, 1%, 1/8W	28480	0757-0427
R81 thru R83	1810-0020	Resistor Network (7 fxd flm resistors)	28480	1810-0020
R84	0698-3444	Resistor, Fxd, Flm, 316 ohms, 1%, 1/8W	28480	0698-3444

Table 4-5. Multiplexer Data Card, 48-Pin Connector Signal Index

PIN NO.	DESCRIPTION		PIN NO.	DESCRIPTION
1	GND		A	GND
2	Not Used		B	PRL*: Priority Low
3	PRH: Priority High		C	STF: Set Flag
4	Not Used		D	SFC: Skip if Flag is Clear
5	SKF*: Skip on Flag		E	T3: Time period 3
6	IOB0: I/O Bus bit 0		F	CLF: Clear Flag
7	IOB1: I/O Bus bit 1		H	IEN: Interrupt Enable
8	IOB2: I/O Bus bit 2		J	IOI: I/O Input Instruction
9	IOB3: I/O Bus bit 3		K	IOO: I/O Output Instruction
10	IOB4: I/O Bus bit 4		L	POPIO: Power On Pulse to I/O
11	IOB5: I/O Bus bit 5		M	T5: (SIR): Set Interrupt Request
12	IOB6: I/O Bus bit 6		N	SFS: Skip if Flag is Set
13	IOB7: I/O Bus bit 7		P	IAK: Interrupt Acknowledge
14	IOB8: I/O Bus bit 8		R	T2: (ENF): Enable Flag
15	IOB9: I/O Bus bit 9		S	Not Used
16	IOB10: I/O Bus bit 10		T	Not Used
17	IOB11: I/O Bus bit 11		U	Not Used
18	IOB12: I/O Bus bit 12		V	CRS: Control Reset to I/O
19	IOB13: I/O Bus bit 13		W	SPARE
20	IOB14: I/O Bus bit 14		X	IOG: I/O Group Instruction
21	IOB15: I/O Bus bit 15		Y	Not Used
22	STC: Set Control		Z	RUN
23	PON: Power On		AA	CLC: Clear Control
24	GND		BB	GND

Notes: All signals in this table are ground-true.
*Denotes user-supplied control signals.

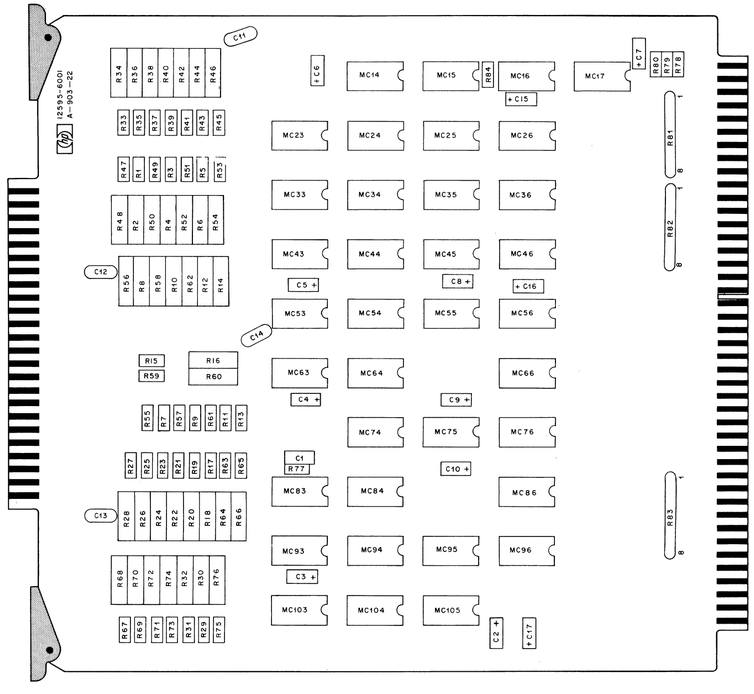


Figure 4-4. Multiplexer Data Card Part Location Diagram

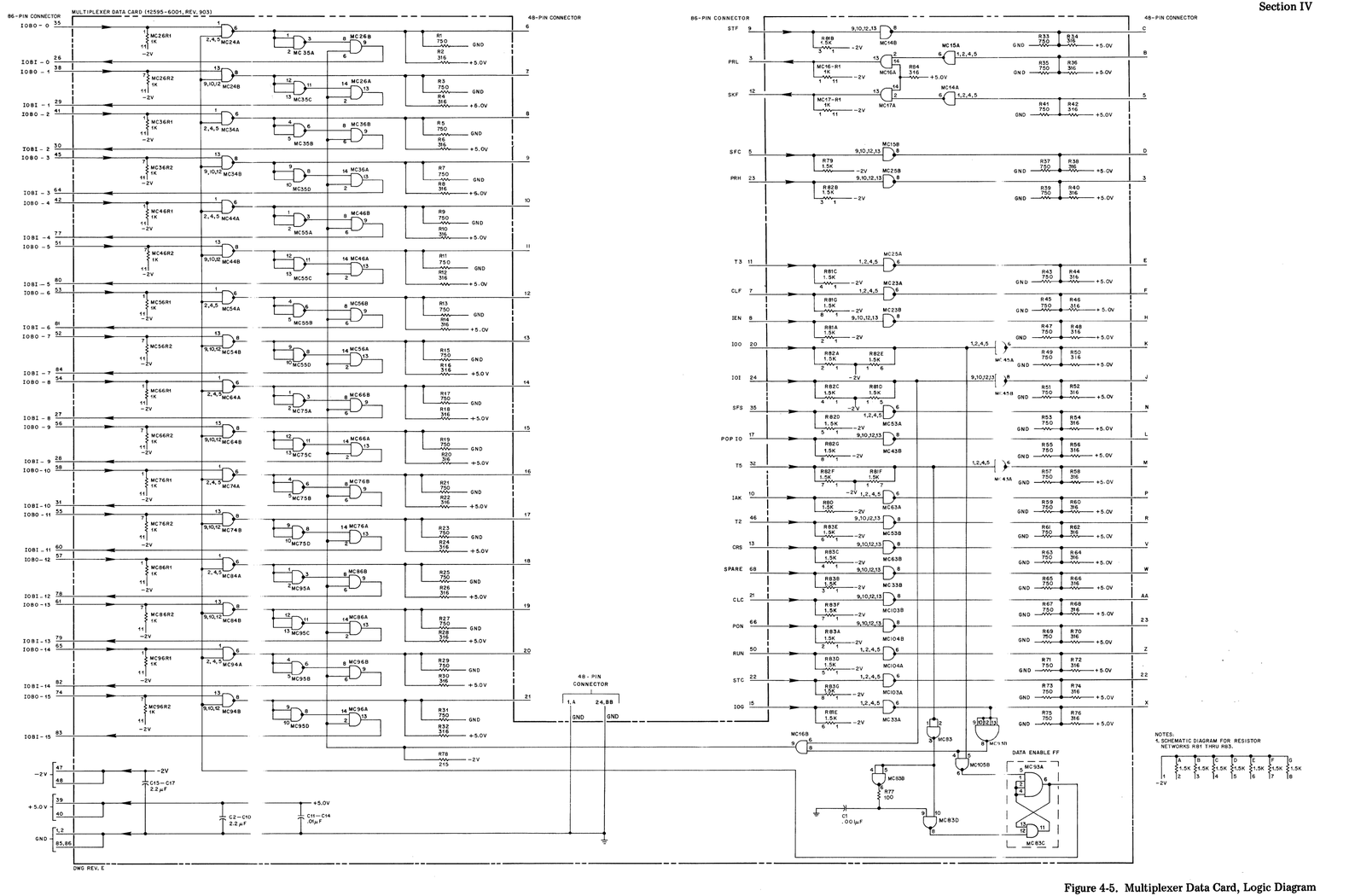


Figure 4-5. Multiplexer Data Card, Logic Diagram

SECTION V

REPLACEABLE PARTS

5-1. INTRODUCTION.

5-2. This section provides information for ordering replacement parts for the accessory kit.

5-3. Table 5-1 is a numerical listing of all replaceable parts in the accessory kit and also includes those parts for the I/O control card added by this kit. Card replaceable parts (tables 4-2 and 4-4) and parts location diagrams (figure 4-2 and 4-4) are located in Section IV of this manual. Table 5-2 lists and defines the reference designations and abbreviations used in these tables. Table 5-3 is a list of manufacturers' code numbers.

5-4. Tables 4-2, 4-4, and 5-1 list the following information for each replaceable part:

a. Reference designation of the part (tables 4-2 and 4-4 only).

b. Hewlett-Packard part number.

c. Description of the part.

d. A five digit manufacturer's code number.

e. Manufacturer's part number.

f. Total quantity (TQ) of each part used in the kit (table 5-1 only).

5-5. ORDERING INFORMATION.

5-6. To order replaceable parts, address the order or inquiry to the nearest Hewlett-Packard Sales and Service Office. (Refer to the list at the back of this manual for addresses.) Specify the following information for each part ordered:

a. Identification of the kit assembly containing the part (refer to paragraph 1-7).

b. Hewlett-Packard part number for each part.

c. Description of each part.

d. Reference designation (if applicable).

Table 5-1. Multiplexed Input/Output Accessory Kit, Replaceable Parts

HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	TQ
0160-0153	Capacitor, Fxd, My, 0.001uF, 10%, 200 VDCW	56289	192P10292-PTS	1
0160-2055	Capacitor, Fxd, Cer, 0.01uF, +80 -20%, 100 VDCW	56289	C023F101F103ZS22-CDH	4
0180-0197	Capacitor, Fxd, Elect, 2.2uF, 10%, 20 VDCW	56289	150D225X9020A2-DYS	12
0698-3402	Resistor, Fxd, Flm, 316 ohms, 1%, 1/2W	28480	0698-3402	38
0698-3441	Resistor, Fxd, Flm, 215 ohms, 1%, 1/8W	28480	0698-3441	1
0698-3444	Resistor, Fxd, Flm, 316 ohms, 1%, 1/8W	28480	0698-3444	1
0757-0401	Resistor, Fxd, Flm, 100 ohms, 1%, 1/8W	28480	0757-0401	1
0757-0420	Resistor, Fxd, Flm, 750 ohms, 1%, 1/8W	28480	0757-0420	38
0757-0427	Resistor, Fxd, Flm, 1.50k, 1%, 1/8W	28480	0757-0427	2
1480-0116	Extractor Pin, PC Card	28480	1480-0116	2
1540-0027	Box, Plastic	28480	1540-0027	1
1810-0020	Resistor Network (7 fxd flm resistor)	28480	1810-0020	3
1820-0054	Integrated Circuit, TTL	01295	SN7400N	6
1820-0071	Integrated Circuit, TTL	01295	SN7440N	20
1820-0348	Integrated Circuit, DTL	07263	U6A994459X	8
1820-0956	Integrated Circuit, CTL	07263	U6A995679X	10
5040-1464	Extractor, PC Card	28480	5040-1464	2
02116-6178	Connector Kit	28480	02116-6178	2
12595-6001	Multiplexer Data Card	28480	12595-6001	1
12595-8003	Decal	28480	12595-8003	1
12595-9001	Operating and Service Manual	28480	12595-9001	1

Table 5-2. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly	K = relay	TB = terminal board
B = motor, synchro	L = inductor	TP = test point
BT = battery	M = meter	U = integrated circuit, non-repairable assembly
C = capacitor	MC = microcircuit	V = vacuum tube, photocell, etc.
CB = circuit breaker	P = plug connector	VR = voltage regulator
CR = diode	Q = semiconductor device other than diode or microcircuit	W = cable, jumper
DL = delay line	R = resistor	X = socket
DS = indicator	RT = thermistor	Y = crystal
E = Misc electrical parts	S = switch	Z = tuned cavity, network
F = fuse	T = transformer	
FL = filter		
J = receptacle connector		

ABBREVIATIONS

A = amperes	gra = gray	ph = Phillips head
ac = alternating current	grn = green	pk = peak
ad = anode		p-p = peak-to-peak
Al = aluminum	H = henries	pt = point
AR = as required	Hg = mercury	PIV = peak inverse voltage
adj = adjust	hr = hour(s)	PNP = positive-negative-positive
assy = assembly	Hz = hertz	PWV = peak working voltage
	hdw = hardware	porc = porcelain
B = base	hex = hexagon, hexagonal	posn = position(s)
bp = bandpass		pozi = pozidrive
blk = black	ID = inside diameter	
blu = blue	IF = intermediate frequency	
brn = brown	in. = inch, inches	rf = radio frequency
brs = brass	I/O = input/output	rdh = round head
Btu = British thermal unit	int = internal	rmo = rack mount only
Be Cu = beryllium copper	incl = include(s)	rms = root-mean-square
	insul = insulation, insulated	RWV = reverse working voltage
C = collector	impgrg = impregnated	rect = rectifier
cw = clockwise	incand = incandescent	r/min = revolutions per minute
ccw = counterclockwise		RTL = resistor-transistor logic
cer = ceramic	k = kilo (10^3), kilohm	
cmo = cabinet mount only		s = second
com = common	lp = low pass	SB = slow blow
crt = cathode-ray tube		Se = selenium
CTL = complementary-transistor logic	m = milli (10^{-3})	Si = silicon
	M = mega (10^6), megohm	scr = silicon controlled rectifier
cath = cathode	My = Mylar	sil = silver
cd pl = cadmium plate	mfr = manufacturer	sst = stainless steel
Comp = composition	mom = momentary	stl = steel
conn = connector	mtg = mounting	spcl = special
compl = complete	misc = miscellaneous	spdt = single-pole, double-throw
	Met Ox = metal oxide	spst = single-pole, single-throw
dc = direct current	mintr = miniature	semicond = semiconductor
dr = drive		
DTL = diode-transistor logic	n = nano (10^{-9})	Ta = tantalum
depc = deposited carbon	n.c. = normally closed or no connection	td = time delay
dpdt = double-pole, double-throw		Ti = titanium
dpst = double-pole, single-throw	Ne = neon	tgl = toggle
	no. = number	thd = thread
E = emitter	n.o. = normally open	tol = tolerance
ECL = emitter-coupled logic	np. = nickel plated	TTL = transistor transistor logic
ext = external	NPN = negative-positive-negative	
encap = encapsulated	NPO = negative-positive zero (zero temperature coefficient)	U(μ) = micro (10^{-6})
elctlt = electrolytic	NSR = not separately replaceable	
F = farads	NRFR = not recommended for field replacement	V = volt(s)
FF = flip-flop		var = variable
flh = flat head		vio = violet
Flm = film	OD = outside diameter	VDCW = direct current working volts
Fxd = fixed	OBD = order by description	
filh = fillister head	orn = orange	W = watts
	ovh = oval head	WW = wirewound
G = giga (10^9)	oxd = oxide	wht = white
Ge = germanium		WIV = working inverse voltage
gl = glass	p = pico (10^{-12})	
gnd = ground(ed)	PC = printed circuit	yel = yellow

Table 5-3. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements.

Code No.	Manufacturer	Address
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
04713	Motorola, Inc., Semiconductor Prod., Div.	Phoenix, Arizona
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
56289	Sprague Electric Co.	North Adams, Mass.

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TWX: 710-425-3416

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Norwalk 06851
Tel: (203) 853-1251
TWX: 710-468-3750

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Ft. Lauderdale 33307
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TWX: 510-955-4099

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621 Commonwealth Avenue
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TWX: 810-850-0113

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TWX: 810-766-4890

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Tel: (312) 677-0400
TWX: 910-223-3613

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TWX: 810-341-3263

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TWX: 810-955-5524

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