HEWLETT **hp** *PACKARD*

OPERATING AND SERVICE MANUAL

12584A

12584A-01

12584A-02

TELEPRINTER MULTIPLEXOR COMPUTER INTERFACE KITS

NOTE

This manual should be retained with Volume Three
of the HP Computer System Documentation.

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SECTION I
INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 12584A Teleprinter Multiplexor Interface Kit provides 16 input/output ports to interface up to 16 teleprinters or Bell System data sets to the HP 2000A Time-Shared BASIC System. This system uses the HP 2116B Computer. Each input/output port provides a path for bit-serial transfer of data and/or control information between the Computer and a remote terminal. Selection of ports for input and output operations is a function of the software system; all 16 ports can be used simultaneously for input and/or output operations. The Teleprinter Multiplexor permits the polling of each port in a fixed sequence, at a rate determined by system software, by providing interrupts to the computer at an 880 Hz rate. An 880 Hz oscillator is used to time the polling operation. The oscillator frequency is set at eight times that of the teleprinter transmission rate (110 bits per second) to enable sampling near the center of each bit period during input operations. This provides optimum sampling relative to noise. The interface input/output levels are compatible with Electronic Industry Association (EIA) RS-232 specifications.

1-3. DESCRIPTION.

1-4. DATA SET CHARACTERISTICS.

1-5. The data set is a device which transmits digital data over a common carrier (such as normal telephone lines) or a private communications system. Data sets are used in pairs of identical or compatible units, one at each end of the communications line. Data transmission in this case is accomplished by using the digital data to modulate a carrier frequency; the received signal must then be demodulated to recover the digital data. The data sets perform this modulation and demodulation and for this reason, are sometimes called Modems (Modulator/Demodulator). As far as data formats and conventions are concerned, data sets are completely transparent; all format characteristics are simply transferred from the terminal devices. It is important to remember that the data set itself is not a terminal device and only provides a means of connecting a terminal device for transmitting and receiving of data.

1-6. The Bell System Model 103A2 Data Set is used with the HP Teleprinter Multiplexor for connection to terminals via communications lines. Voltage levels and logic conventions are the same as the teleprinter since they both adhere to the EIA RS-232 interface specification. For direct wiring to the Teleprinter Multiplexor use the HP 2749A Teleprinter.

1-7. DATA SET CONTROL.

1-8. The data set has special requirements of its own, in addition to the controls required by the terminal device. For a more detailed understanding of the data set, refer to the Bell System Data Communications Technical Reference series entitled:

Data Set 103A
Interface Specifications
February, 1967

1-9. The Data Terminal Ready control signal from the Teleprinter Multiplexor card is controlled by Computer software when the 12584A-01 Interface Kit is used. The Data Terminal Ready signal must be set true for the Computer to transfer data through the Data Set 103A2.

1-10. In a time share application, the local data sets are capable of an automatic answering operation. This is controlled by a pushbutton switch located on the control unit of the data set or it can be wired in by the telephone company. With this option, an incoming call will automatically be answered and data transfer can proceed. However, there is no guarantee that the caller is a data-set originated call; it could be a normal telephone subscriber dialing a wrong number and then hanging up. In certain types of exchanges, notably FX lines, this will result in a line to the terminal kept busy indefinitely. This type of call is termed a "housewife call" and is controlled by Computer software when the 12584A-02 Interface Kit is used.

1-11. TELEPRINTER MULTIPLEXOR OPTIONS.

1-12. INTERFACE KIT 12584A. The standard 12584A Teleprinter Multiplexor Interface Kit provides only the basic multiplex function of 16 I/O ports for use with the HP 2000A Time-Shared BASIC System. In order to be useful with time-shared systems, the 12584A-01 Interface Kit must also be used. The 12584A Interface Kit consists of the following:

a. Teleprinter Multiplexor I/O card, HP Part No. 12584-6001.

b. I/O Multiplex Test Connector, HP Part No. 12584-6003.

c. Teleprinter Multiplexor Test - Binary Tape, HP Accessory No. 20439A.

Note

Each tape has a suffix letter after the HP Accessory Number. This suffix letter is subject to change depending on the supplied version of the tape.

1-13. INTERFACE KIT 12584A-01. This option is the basic Teleprinter Multiplexor Interface Kit for the HP 2000A Time-Shared BASIC System. This interface kit includes the I/O Multiplexor cable and I/O

Multiplexor Panel to connect the teleprinters or data sets to the Computer in the system. This option connects the Data Terminal Ready lines of all data sets together, resulting in single line control by the Computer. Status information from the data sets is not brought into the Computer. The 12584A-01 option is best suited for use in a multiple teleprinter situation where all the teleprinters are local (not connected by communication lines). The 12584A-01 Interface Kit consists of the following (the blank card secures connector XA1 to the Multiplexor Panel):

a. Teleprinter Multiplexor I/O card, HP Part No. 12584-6001.

b. Multiplexor Panel, HP Part No. 12584-6002.

c. Blank card, HP Part No. 12584-20001.

d. I/O Multiplex Test Connector, HP Part No. 12584-6003.

e. I/O Multiplexor Jumper Plug, HP Part No. 12584-6004.

f. I/O Multiplexor Cable, HP Part No. 12584-6005.

g. Teleprinter Multiplexor Test - Binary Tape, HP Accessory No. 20439A.

1-14. INTERFACE KIT 12584A-02. This option must be used with the 12584A-01 option and provides additional ports into and out of the Computer for data set control. This interface kit includes the Data Set Disconnect cable which connects another Teleprinter Multiplexor I/O card to the Multiplexor Panel. A Ring Carrier Interface card transfers either the CF Carrier signal or the CE Ringing Indicator signal to the Computer in the system as REC signals. When using this option, the status of each data set can be transferred into the Computer and tested. The Data Terminal Ready line for each data set is individually answered and disconnected. The 12584A-02 Interface Kit consists of the following:

a. Teleprinter Multiplexor I/O card, HP Part No. 12584-6001.

b. Ring Carrier Interface card, HP Part No. 12584-6011.

c. I/O Multiplex Test Connector, HP Part No. 12584-6003.

d. Data Set Disconnect Cable, HP Part No. 12584-6008.

e. Teleprinter Multiplexor Test - Binary Tape, HP Accessory No. 20439A.

1-15. SPECIFICATIONS

1-16. Input/Output characteristics for the Teleprinter Multiplexor Interface Kit are as follows:

Interface Current Supplied by the Computer

Voltage	Current
+4.5V	2.2A
+12.0V	100 ma
-12.0V	40 ma
-2.0V	125 ma

Input/Output Logic Levels

Data Logic Levels (Data Transmitted signal; Data Received signal)

"1" state = negative voltage but more than -5V
"0" state = positive voltage but more than +5V

Logic levels for communication control signals (refer to EIA RS232 specifications)

Signal	Logic Level	Voltage
CD Data Terminal Ready	"1"	positive
	"0"	negative
CF Carrier	"1"	positive
	"0"	negative
CE Ringing Indicator	"1"	positive
	"0"	negative

SECTION II

INSTALLATION AND PROGRAMMING

2-1.   INSTALLATION.

2-2.   Connection from the Teleprinter Multiplexor interface card to the teleprinters or data sets is made through a Multiplexor Panel. Refer to Figure 2-1 for a front view of this panel with options and accessories. The Multiplexor Panel is located in the back of the system cabinet, usually below the Computer and behind the high speed tape reader. Access to the tape reader connector is possible through an opening in the Multiplexor Panel. Located on the Multiplexor Panel are a Ring Carrier Interface card connector, 18 receptacle connectors, and connector cabling. Receptacle connectors J0 through J15 are connected to the
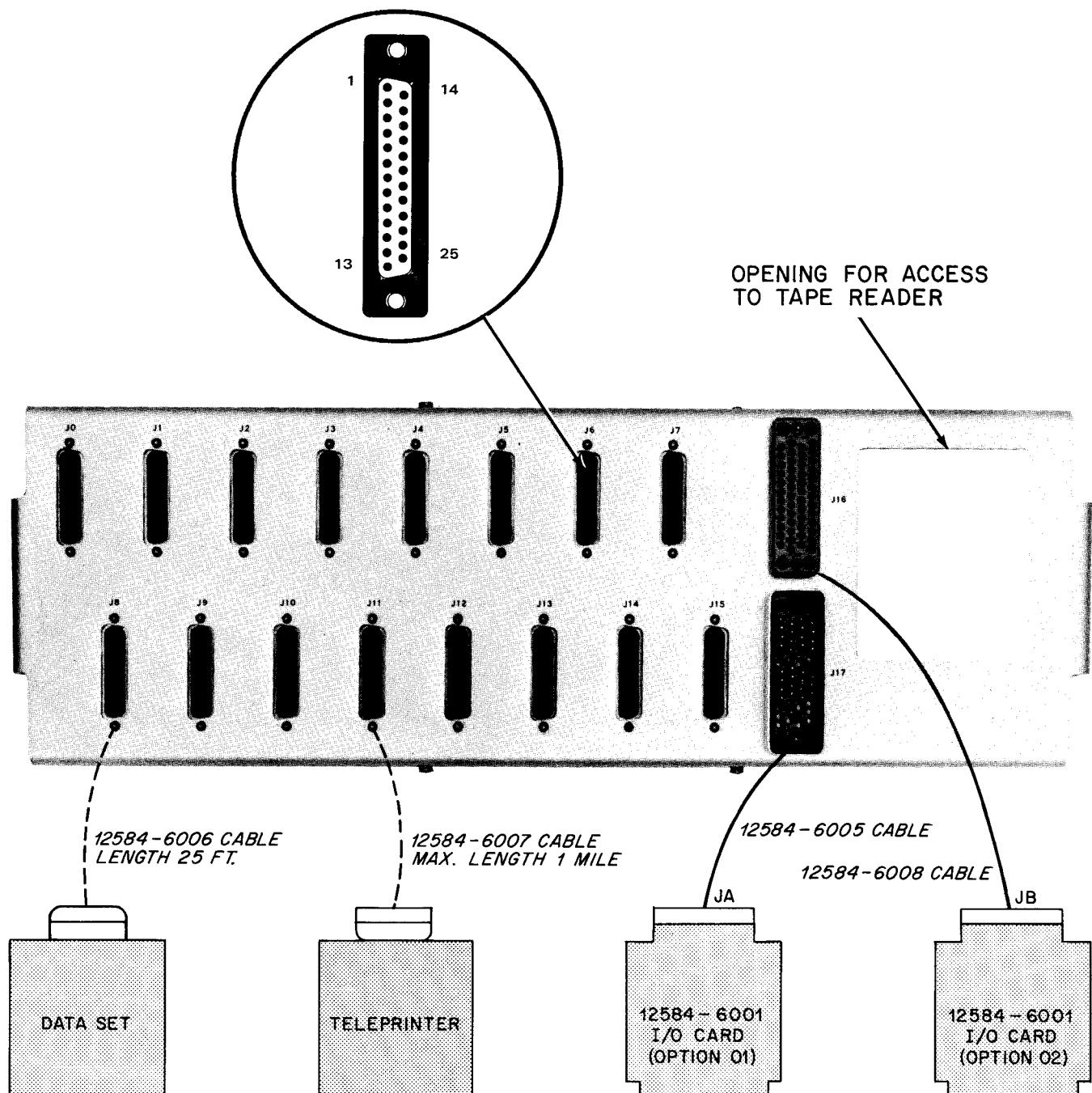
Figure 2-1. Multiplexor Panel, Options, and Accessories

Teleprinters or Data Sets, or any combination of each, with a maximum of 16. Connector J16 is used only with the 02 option of the interface kit. When option 02 is not used, an I/O Multiplexor Jumper Plug, Part No. 12584-6004, must be inserted in J16 at all times, and a blank card (Part No. 12584-20001) is inserted in the Ring Carrier Interface card connector to secure connector XA1 to the Multiplexor Panel. Connector J17 is used with the 01 and 02 options of the interface kit. The Ring Carrier Interface card is used only with the 02 option. Figure 2-2 illustrates the back view of the Multiplexor Panel; a wiring diagram of the panel is shown in Figure 2-3. Optional cables are available to connect the teleprinters or data sets to the Multiplexor Panel connectors as follows:

a.   Teleprinter cable for HP 2749A: 1 mile maximum length, Part No. 12584-6007; specify length when ordering. Refer to Table 2-1 for cable connector pin assignments.

Table 2-1. Teleprinter Cable (Part No. 12584-6007) Connector Pin Assignments

From Teleprinter, Pin	To Multiplexor Panel, Pin	Signal
1	1	AA Protective Ground
2	2	BA Transmitted Data
3	3	BB Received Data
7	7	AB Signal Ground
8	8	Spare
20	20	CD Data Terminal Ready

b.   Data Set cable for Bell System 103A2: 25 feet, Part No. 12584-6006. Refer to Table 2-2 for cable connector pin assignments.

Table 2-2. Data Set Cable (Part No. 12584-6006) Connector Pin Assignments

From Data Set Pin	To Multiplexor Pin	Signal
1	1	AA Protective Ground
2	3	BA Transmitted Data
3	2	BB Received Data
4	4	Spare
5	5	Spare
6	6	Spare
7	7	AB Signal Ground
8	20	CF Carrier
20	8	CD Data Terminal Ready
22	22	CE Ringing Indicator

2-3.   STANDARD INTERFACE KIT.

2-4.   The standard 12584A Teleprinter Multiplexor Interface Kit, in addition to providing the Teleprinter Multiplexor card, includes an I/O Multiplex Test Connector, and a Binary Test Tape required for diagnostic testing. To install this kit, open the Computer for access to the I/O section and insert the Teleprinter Multiplexor card in the appropriate I/O slot of the Computer. Refer to the Diagnostic Supplement to this manual for the 880 Hz oscillator adjustment procedures and for instructions on using the I/O Multiplexor Test Connector and the running of the diagnostic test. (Figure 2-4 illustrates the internal wiring of the test connector.)
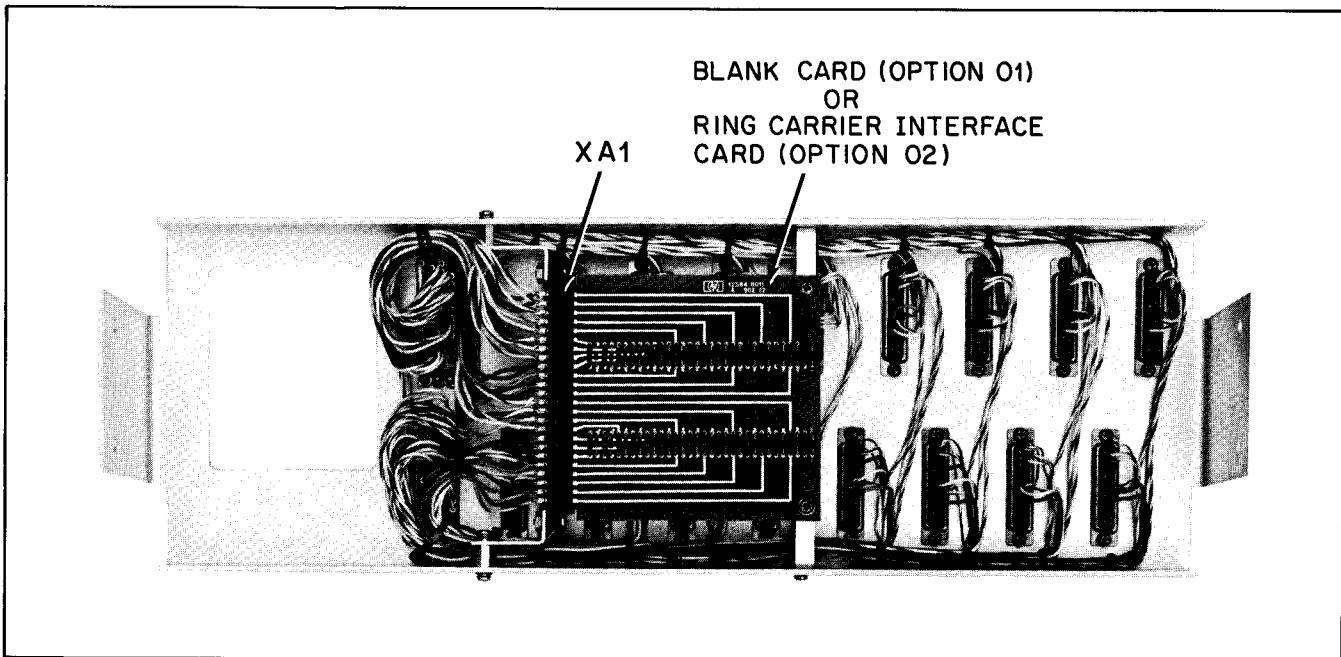
Figure 2-2. Multiplexor Panel, Back View

J8
20 XA1-U
22 XA1-17
8 J16-K
3 J17-K
2 J17-k
1
7

J9
20 XA1-V
22 XA1-18
8 J16-L
3 J17-L
2 J17-m
1
7

J10
20 XA1-W
22 XA1-19
8 J16-M
3 J17-M
2 J17-n
1
7

J11
20 XA1-X
22 XA1-20
8 J16-N
3 J17-N
2 J17-p
1
7

J12
20 XA1-Y
22 XA1-21
8 J16-P
3 J17-P
2 J17-r
1
7

J13
20 XA1-Z
22 XA1-22
8 J16-R
3 J17-R
2 J17-s
1
7

J14
20 XA1-AA
22 XA1-23
8 J16-S
3 J17-S
2 J17-t
1
7

J15
20 XA1-BB
22 XA1-24
8 J16-T
3 J17-T
2 J17-u
1 J17-BB
7

XA1

J15-22	24 BB	J15-20
J14-22	23 AA	J14-20
J13-22	22 Z	J13-20
J12-22	21 Y	J12-20
J11-22	20 X	J11-20
J10-22	19 W	J10-20
J9-22	18 V	J9-20
J8-22	17 U	J8-20
J16-m	16 T	J16-n
J16-p	15 S	J16-k
J16-s	14 R	J16-r
J16-u	13 P	J16-t
J16-j	12 N	J16-h
J16-f	11 M	J16-e
J16-d	10 L	J16-a
J16-b	9 K	J16-c
J0-22	8 J	J0-20
J1-22	7 H	J1-20
J2-22	6 F	J2-20
J3-22	5 E	J3-20
J4-22	4 D	J4-20
J5-22	3 C	J5-20
J6-22	2 B	J6-20
J7-22	1 A	J7-20

J0
1
7
2 J17-a
3 J17-A
8 J16-A
20 XA1-J
22 XA1-8

J1
1
7
2 J17-b
3 J17-B
8 J16-B
20 XA1-H
22 XA1-7

J2
1
7
2 J17-c
3 J17-C
8 J16-C
20 XA1-F
22 XA1-6

J3
1
7
2 J17-d
3 J17-D
8 J16-D
20 XA1-E
22 XA1-5

J4
1
7
2 J17-e
3 J17-E
8 J16-E
20 XA1-D
22 XA1-4

J5
1
7
2 J17-f
3 J17-F
8 J16-F
20 XA1-C
22 XA1-3

J6
1
7
2 J17-h
3 J17-H
8 J16-H
20 XA1-B
22 XA1-2

J7
1 J16-BB
7
2 J17-j
3 J17-J
8 J16-J
20 XA1-A
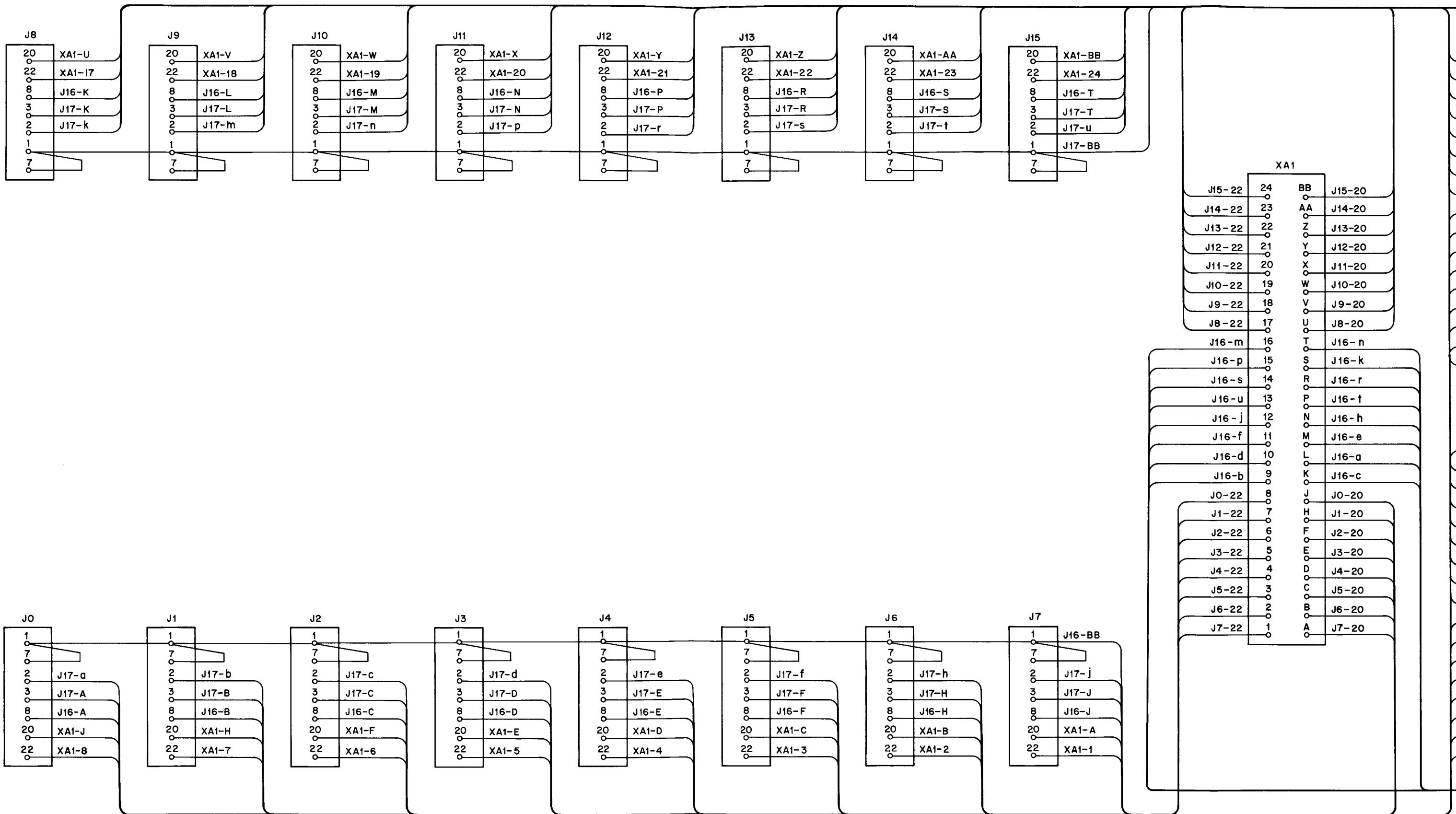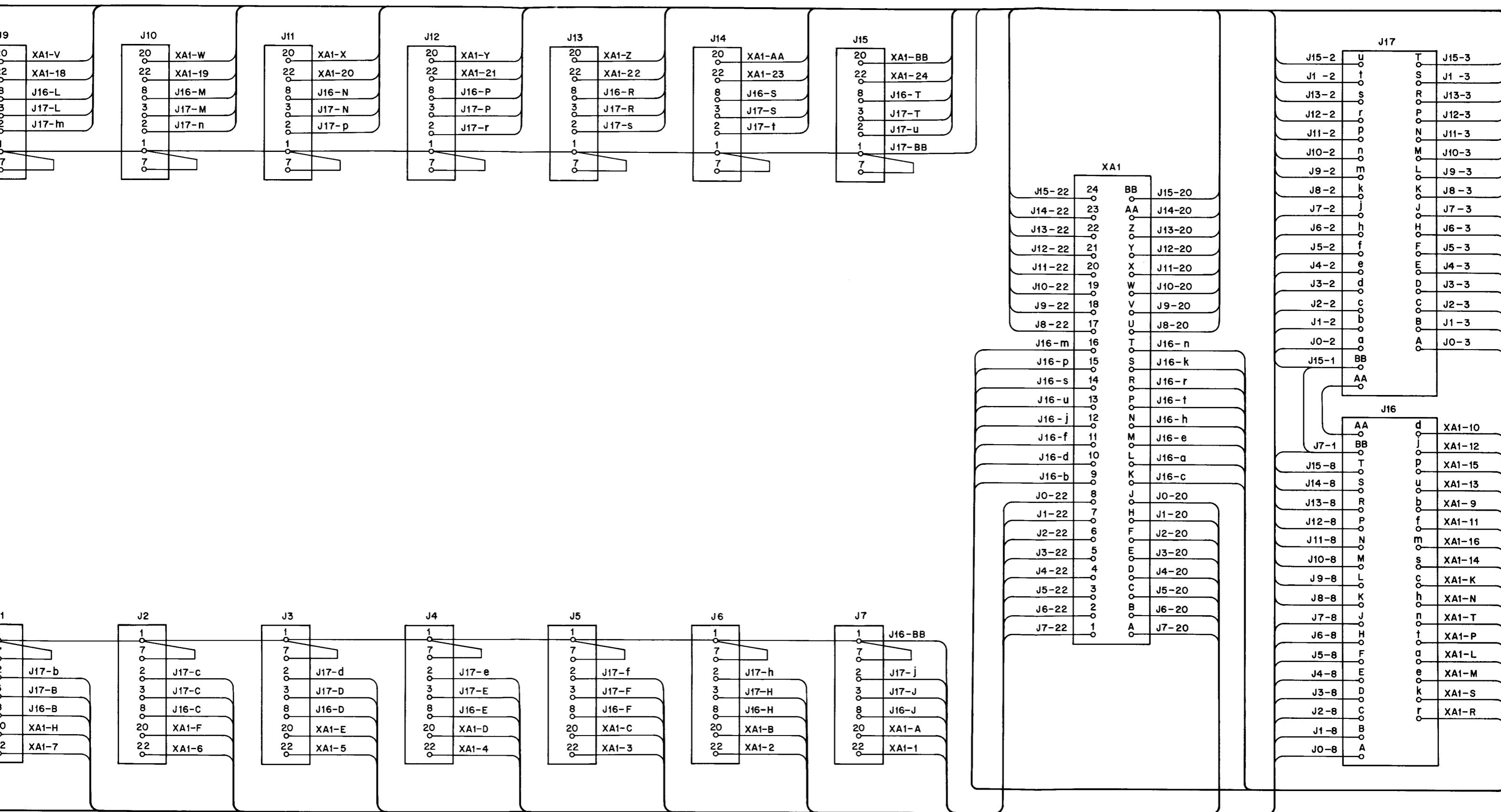22 XA1-1

Figure 2-3. M

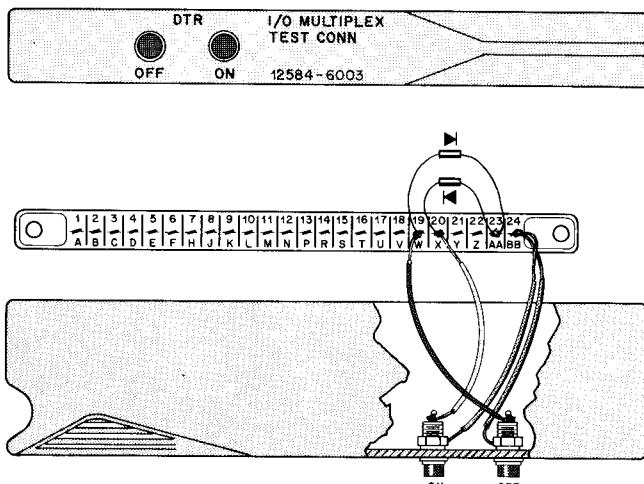Figure 2-3. Multiplexor Panel Wiring Diagram

Figure 2-4. I/O Multiplex Test Connector

2-5. OPTION 12584A-01 INTERFACE KIT.

2-6. This option provides the interface between the Computer and Teleprinters and/or data sets and contains the standard 12584A kit. Installation procedures for this kit are as follows:

a. Open the Computer for access to the I/O section and insert the Teleprinter Multiplexer card in the appropriate I/O slot of the Computer.

b. Although the blank card (HP Part No. 12584-20001) is located in Ring Carrier Interface card connector XA1 of the Multiplexor Panel, the blank card is not necessary for operation of the HP 2000A Time-Shared BASIC System.

c. The Multiplexor Panel (Part No. 12584-6002) is designed to mount on standard Retma rails and these rails are usually located in the back of the Computer cabinet, behind the high speed tape reader. Place the Multiplexor Panel into the rack and bolt the panel to the unistrut by means of four self-locking unistrut nuts. The unistrut nuts are furnished as part of the interface kit.

d. Connect the I/O Multiplexor Jumper Plug, P16 (Part No. 12584-6004), into connector J16 on the Multiplexor Panel. This plug connects all Data Terminal Ready signals (pin 8 of connectors J0 through J15) together to be controlled as a single line. The jumper plug must be used only with this option. Figure 2-5 is the wiring diagram for jumper plug P16.
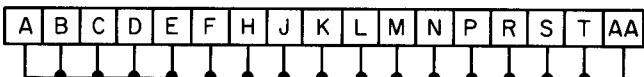
Figure 2-5. I/O Multiplexor Jumper Plug
Wiring Diagram

e. Connect the I/O Multiplexor Cable (Part No. 12584-6005) between connector JA (48-pin connector of the Teleprinter Multiplexor card) and connector J17 of the Multiplexor Panel. (Refer to Table 2-3 for the I/O Multiplexor Cable connector pin assignments.)

Table 2-3. Connector Pin Assignments for I/O Multiplexor Cable (Option 12584A-01)

FROM (48-PIN) CONN. JA, PIN	TO PANEL CONN. P17, PIN	*SIGNAL
1	a	REC 0
2	b	REC 1
3	c	REC 2
4	d	REC 3
5	e	REC 4
6	f	REC 5
7	h	REC 6
8	i	REC 7
9	k	REC 8
10	m	REC 9
11	n	REC 10
12	p	REC 11
13	r	REC 12
14	s	REC 13
15	t	REC 14
16	u	REC 15
22, Z	**	Internal Clock
A	A	TSM 0
B	B	TSM 1
C	C	TSM 2
D	D	TSM 3
E	E	TSM 4
F	F	TSM 5
H	H	TSM 6
J	J	TSM 7
K	K	TSM 8
L	L	TSM 9
M	M	TSM 10
N	N	TSM 11
P	P	TSM 12
R	R	TSM 13
S	S	TSM 14
T	T	TSM 15
AA, 23	AA	Data Terminal Ready
BB, 24	BB	Signal Ground

* REC denotes Data Receive Channel from the teleprinter or data set to the Computer.

TSM denotes Data Transmit Channel from the Computer to the teleprinter or data set.

**No connection to P17.

f. Connect the data set and/or teleprinter cable from the device to a "J" connector on the Multiplexor Panel.

g. Refer to the Diagnostic Supplement to this manual for the 880 Hz oscillator adjustment procedures and for instructions on running the diagnostic test.

2-7. OPTION 12584A-02 INTERFACE KIT.

2-8. This option must be used with the 12584A-01 option. Installation procedures for this kit are as follows:

a. Open the Computer for access to the I/O section and insert the Teleprinter Multiplexor card in the appropriate I/O slot of the Computer.

b. Insert the 12584-6011 Ring Carrier Interface card in connector XA1 located in the back of the Multiplexor Panel.

c. Remove the I/O Multiplexor Jumper Plug from connector J16 on the Multiplexor Panel.

d. Connect the Data Disconnect Cable (Part No. 12584-6008) between connector JB (the 48-pin connector of the other Teleprinter Multiplexor card) and Multiplexor Panel Connector J16. (Refer to Table 2-4 for the Data Set Disconnect Cable connector pin assignments.)

e. Refer to the Diagnostic Supplement to this manual for the 880 Hz oscillator adjustment procedures and for instruction on running the diagnostic test.

2-9. PROGRAMMING,

2-10. DATA INPUT PROGRAMMING.

2-11. The Teleprinter Multiplexor card causes interrupts to the Computer at a rate eight times faster than the rate of the input data from a teleprinter. When an interrupt occurs, software determines if data at any input port has changed from a "one" (mark) state to a "zero" (start) state, indicating that a character is being received. If this change in the input signal occurs, the software counts 12 interrupts and reads the first bit into the A- or B-Register of the Computer. Succeeding bits are input every eighth interrupt. (Refer to Figure 2-6.) This continues until all eight data bits are read into the A- or B-Register. The software monitors for a change from a mark condition to a start condition for the following characters.
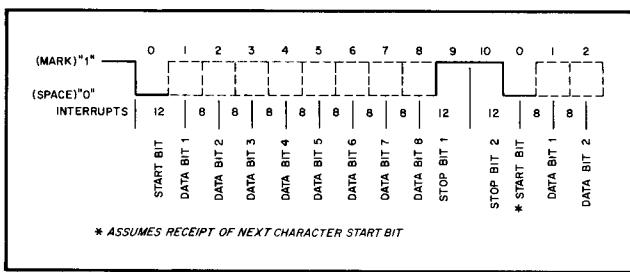
Figure 2-6. Teleprinter Multiplexor Interrupt Timing Diagram

2-12. DATA OUTPUT PROGRAMMING.

2-13. When the Computer is ready to transfer a character through the output port of the option, the character bit is made a "0" for eight interrupts which is interpreted by the teleprinter as a start bit. On the ninth interrupt and every eighth interrupt thereafter, a new bit is transferred through the port until a complete character (8 bits) and two stop bits have been transferred. The output port is then left in a "1" state, which is the quiescent state for the communications line, until the next character is to be sent.

Table 2-4. Connector Pin Assignments for Data Set Disconnect Cable (Option 12584A-02)

FROM (48-PIN) CONN. JB, PIN	TO PANEL CONN. P16, PIN	*SIGNAL
1	a	REC 0
2	b	REC 1
3	c	REC 2
4	d	REC 3
5	e	REC 4
6	f	REC 5
7	h	REC 6
8	j	REC 7
9	k	REC 8
10	m	REC 9
11	n	REC 10
12	p	REC 11
13	r	REC 12
14	s	REC 13
15	t	REC 14
16	u	REC 15
A	A	TSM 0
B	B	TSM 1
C	C	TSM 2
D	D	TSM 3
E	E	TSM 4
F	F	TSM 5
H	H	TSM 6
J	J	TSM 7
K	K	TSM 8
L	L	TSM 9
M	M	TSM 10
N	N	TSM 11
P	P	TSM 12
R	R	TSM 13
S	S	TSM 14
T	T	TSM 15
BB	BB	Signal Ground

*Either the CF Carrier signal or the CE Ringing Indicator signal is Received by the Computer in the system as an REC signal.

REC denotes Data Received Channel from the teleprinter or data set to the Computer.

TSM denotes Data Transmit Channel from the Computer to the teleprinter or data set.

2-14. CONTROL FUNCTIONS PROGRAMMING.

2-15. OPTION 12584A-01. This option offers only limited control over any data sets connected to it. If an input port is inactive, there is no way for the system to monitor for a disconnect; also, if the operator at the remote terminal has completed transmissions there is no way for the Computer to cause a disconnect. A Set Control (STC) instruction will make the Data Terminal Ready signal true for all data sets. A Clear Control (CLC) instruction will make the Data Terminal Ready signal false. Individual control for each data set is not available using only the 01 option.

2-5

2-16. OPTION 12584A-02. When this option is used, each data set c a n be controlled individually by the Computer. The Data Terminal Ready signal is made true for a given data set by placing a "1" in the output control port dedicated to that data set. Up to 16 data sets can be controlled in this manner since the 02 option has 16 output control ports. In addition to the output control ports, an input status port exists for each of the data sets being controlled. The information available on these status lines is the logical "or" function o f the Carrier Detect and Ringing signals. The Computer must sample these lines periodically and properly interpret the results. A logic "1" detected o n a status line indicates the presence o f a Ringing signal from a data set. The Computer res-

ponds by making the Data Terminal Ready signal true for that data set and thus, the data set is "answered". The Computer continues to sample the status line; if a "1" is still present after the data set has been answered, the data set is transmitting data to the Computer. If a "1" is not sensed after a time established by Computer software, the Computer responds by making the Data Terminal Ready signal false, disconnecting the data set. This provides protection against "housewife" calls. Also, if an input port is inactive for a time established by Computer software, the Computer causes a disconnect. The assumption here is that the operator at the remote terminal has completed transmissions but has not properly terminated the data set.

SECTION III
THEORY OF OPERATION

3-1. GENERAL THEORY OF OPERATION.

3-2. Refer to Figure 3-1 for the logic diagram of the Teleprinter Multiplexor Interface Card. For lead-wire connections between the interface card and the Connector Panel, refer to Figure 3-1 and Tables 2-1 through 2-4. Figure 3-2 illustrates the Teleprinter Multiplexor card parts locations.

3-3. Logic diagram reference designations preceded by MC are identified by part number in Section IV and the logic diagram for each Microcircuit Package is shown in Figure 3-3.

3-4. DATA INPUT OPERATIONS.

3-5. The Computer checks each data input line under program control and the input lines are not buffered. The 880 Hz oscillator is used by software to establish the sampling rate of the input lines. This timing is also used to determine the data transfer rate of 110 bits per second.

3-6. An input operation is initiated by a Set Control, Clear Flag (STC, CLF) instruction to the Teleprinter Multiplexor card. The STC portion of the instruction sets the Control Flip-Flop (FF) which enables the Flag circuit and makes the Data Terminal Ready signal true (option 01 only). The CLF portion of the instruction resets the Flag Buffer and Flag FF's to prevent false interrupt signals from being sent to the Computer.

3-7. A Flag signal is applied to the Teleprinter Multiplexor card every 1.14 milliseconds by the 880 Hz oscillator. The Flag signal sets up a request for service (Interrupt Request, or Skip Flag if the interrupt system is not being used). At time T2, the Enable Flag (ENF) signal and the set-side output of the Flag Buffer FF sets the Flag FF. If a device of higher priority has not requested an interrupt, the output from the Flag FF initiates an interrupt signal to the Computer, indicating that data is available at the input lines.

3-8. To accomplish an input operation, the Computer must accept the data from the Input Register. This is done by a Load Into A/B (LIA/B) or a Merge Into A/B (MIA/B) instruction. When one of these instructions is issued, the IOI (I/O IN) signal enables the data on the input "and" gates to the IOBI (I/O Bus In) lines. These lines transfer the data to the A- or B-Register.

3-9. The set or reset condition of the Flag FF may be checked by a Skip on Flag Set (SFS) or a Skip on Flag Clear (SFC) instruction to determine when an input operation should be performed. When using this method, the Interrupt System Enable FF on the I/O

Control card must be reset by a CLF instruction with a Select Code of 00.

3-10. DATA OUTPUT OPERATIONS.

3-11. Computer software determines which output lines will be used to output data to the teleprinters and/or data sets; all output lines are buffered. The 880 Hz oscillator determines the output data transfer rate of 110 bits per second.

3-12. If the interrupt system is to be used during the output operation, the Interrupt System Enable FF, on the I/O control card, must be set by a Set Flag (STF) instruction with a Select Code of 00. An Output from A/B (OTA/B) instruction must be issued by the Computer program to output data from the A- or B-Register to the Teleprinter Multiplexor card. The IOO (I/O out) signal to the card, which results from the OTA/B instruction, enables the bits from the A- or B-Register to set the Output Register FF's on the Teleprinter Multiplexor Card.

3-13. The Computer program initiates an output operation with a STC, CLF instruction and the address of the Teleprinter Multiplexor card. The STC portion of the instruction sets the Control FF. The output from the Control FF is "nanded" with the Run signal (from the STG card in the Computer) providing a true Data Terminal Ready signal to the Data Set or Teleprinter (option 01 only). If the Data Terminal Ready signal is false, an incoming call will not be answered; if true, it will be answered. If a call is answered and the Data Terminal Ready signal is then made false (by a CLC instruction), the connection will be broken. Therefore, setting the Data Terminal Ready signal true (by an STC, SC instruction) is equivalent to answering the phone. Normally the Computer sets the Data Terminal Ready signal to the true state and waits for calls to arrive. The calls are then automatically answered and data transfer can proceed. The STC portion of the instruction also provides an enable signal to the Interrupt Control logic. The CLF portion of the instruction resets the Flag Buffer and Flag FF's (which were set by the POPIO signal when power was initially applied) to prevent a false interrupt signal from being sent to the Computer before the I/O device has accepted data.

3-14. The Internal Clock signal (pin 22) is formed by the free-running 880 Hz oscillator. This signal causes interrupts every 1.14 milliseconds and is applied to pin 22 and then to pin Z through the jumper plug (option 01 only). The Internal Clock signal resets the Flag Storage FF, and is transferred through "nand" gate MC17B, setting the Flag Buffer FF. The Flag Storage FF stores one interrupt in case the first interrupt is not cleared by the Computer before a second interrupt occurs.

3-15. DETAILED THEORY OF OPERATION.

3-16. COMPUTER POWER ON.

3-17. When power is initially applied by the Computer POWER switch, the POPIO and CRS signals are received simultaneously by the interface card from the Computer. These signals establish initial conditions for operation of the interface card. The POPIO signal is applied through connector pin 17 to "nand" gate MC67D. All inputs to the "nand" gate are then true and its false output sets the Flag Buffer FF (the input to the FF is inverted). At time T2, the ENF signal is applied through connector pin 46 to "nand" gate MC37C. The output from gate MC37C resets the IRQ FF. The output from "nand" gate MC37C is also transferred through "nand" gate MC37D and with the output of the Flag Buffer FF, sets the Flag FF and Flag Storage FF. The POPIO signal is transferred through "nand" gate MC77D and applied to "nand" gates MC97A and MC97B. The output from these gates directly sets the 16 output Register FF's to a mark condition to prevent the teleprinters from running open.

Note

In teleprinter terminology, a logic "1" is a mark condition and a logic "0" is a space condition.

3-18. When power is first applied, the positive pulse of the Control Reset signal is received at pin 13 and inverted by "nand" gate MC67B. The output from this gate resets the Control FF. Therefore the card is always in the input state after power turn on or whenever the Computer PRESET switch is pressed.

3-19. FLAG AND CONTROL LOGIC.

3-20. A programmed STC instruction with the address of the Teleprinter Multiplexor card provides STC, LSCL, LSCM, and IOG signals to the Teleprinter Multiplexor card. The STC signal is applied to connector pin 22 and transferred as one true input to "nand" gate MC77A. The LSCL, LSCM, and IOG signals are applied to "nand" gate MC47A, transferred through "nand" gate MC57D providing the second true input to gate MC77A. The false output of "nand" gate MC77A sets the Control FF at Time T4. The set-side output of the Control FF is applied as one true input to "nand" gate MC36A. The other inputs to this gate are the true IEN signal (generated by the set-side of the Interrupt System Enable FF on the I/O Control card), and the true output from the set-side of the Flag FF. The output of "nand" gate MC36A is applied to "nand" gate MC26A and MC15A. Gate MC15A will have a true output after the Flag FF is reset and a device of higher priority has not requested an interrupt (PRH true). Gate MC16B will have a false output if at time T5 (SIR) the PRH signal is true, the Flag Buffer FF is set (true), and the output of "nand" gate MC26A is true. The false output of MC16B sets the Interrupt Request (IRQ) FF. This FF is reset at the next time T2 (ENF) to allow devices of higher priority to interrupt. If no higher priority device requested an interrupt, the IRQ FF sets again and interrupts the computer program. The set-side output of the

IRQ FF is applied to "nand" gate MC57B. The output of this "nand" gate or the output of "nand" gate MC77B resets the Flag Buffer FF to permit recognition of the next interrupt.

3-21. DATA TERMINAL READY.

3-22. A STC, CLF instruction with the address of the Teleprinter Multiplexor Card enables the Teleprinter Multiplexor card. The STC instruction sets the Control FF. The true output of the Control FF is applied to "nand" gate MC87A. The other true input to this gate is the Run signal, received from the Computer STG card. The Run signal is transferred through connector pin 50 and applied to MC87A. This gate is enabled, transferred through "nand" gate MC87B, where a positive voltage is applied to transistor Q52, turning the transistor on. With Q52 conducting, the Data Terminal Ready signal is in a true state indicating that the Computer is running and the Data Terminal Ready signal is present on pins AA and 23 (option 01). If the Data Terminal Ready signal is in a false state, incoming calls will not be answered. The Ring Carrier Interface card performs this function for option 02.

3-23. INPUT REGISTER.

3-24. Logic levels from the external I/O device are as follows:

Logic "1" = negative voltage but more than -5 volts

Logic "0" = positive voltage but more than +5 volts

3-25. When REC 0 through REC 15 signals are transferred from the I/O device to the Input Register, a negative voltage (external transistor off) is received at the input to the register. Since REC 0 through 15 circuits are identical, only REC 0 will be explained.

3-26. A negative voltage (logic "1"), from the I/O device is applied through connector pin 1 to the base of transistor Q1. Transistor Q1 is cut off which applies a positive voltage (logic "0") to pin 2 of "and" gate MC45A. The other true signal, applied to pin 14 of "and" gate MC45A, is the IOI· [LSCL·LSCM·IOG] signal. This enables "and" gate MC45A, and data (positive voltage) is transferred to the Computer through pin 26 of the 86-pin connector, as a true IOBI 0 signal.

3-27. A positive voltage (logic "0") from the I/O device, is applied through connector pin 1 to the base of transistor Q1. Transistor Q1 conducts, which applies a ground potential to pin 2 of "and" gate MC45A. With any ground input to "and" gate MC45A, the output (pin 13) is also ground and is transferred to the Computer through pin 26 of the 86-pin connector as a false IOBI 0 signal.

3-28. OUTPUT REGISTER.

3-29. Logic levels to the external I/O device are as follows:

TELEPRINTER MULTIPLEXER (12584-6001, REV 831)

DWG. REV C
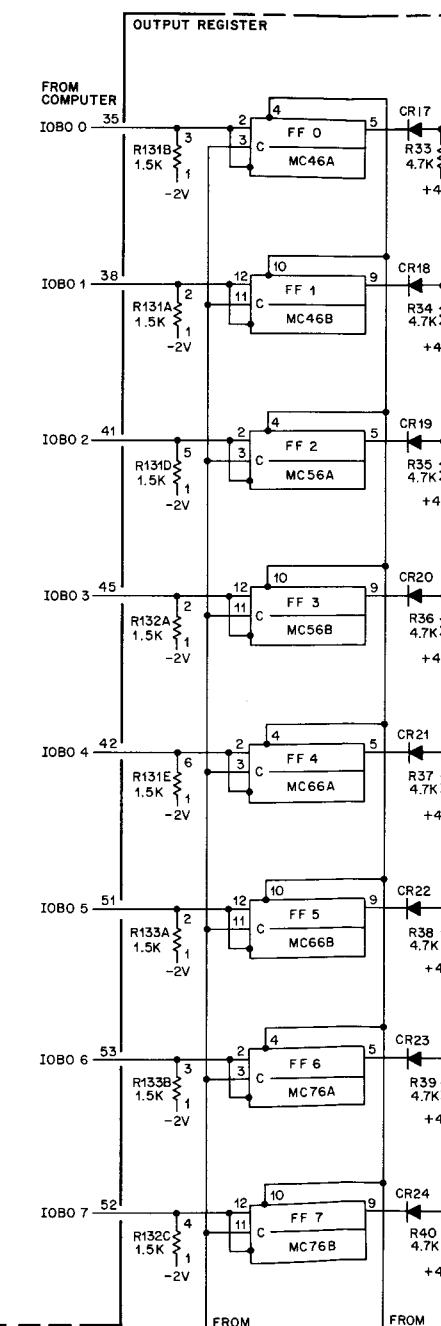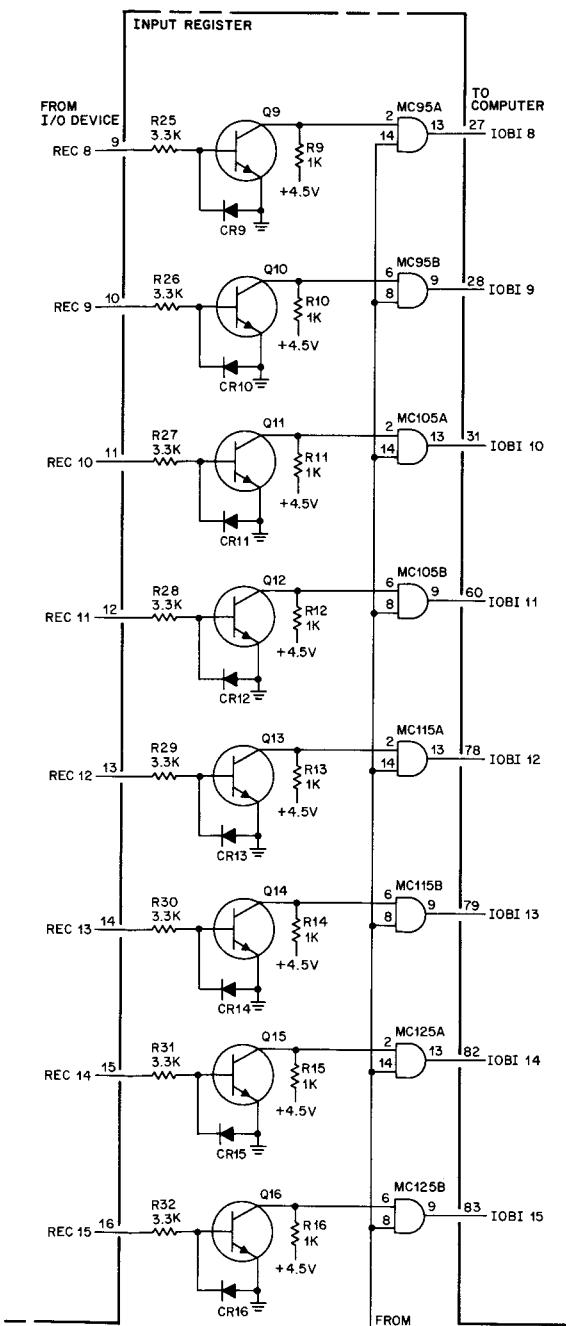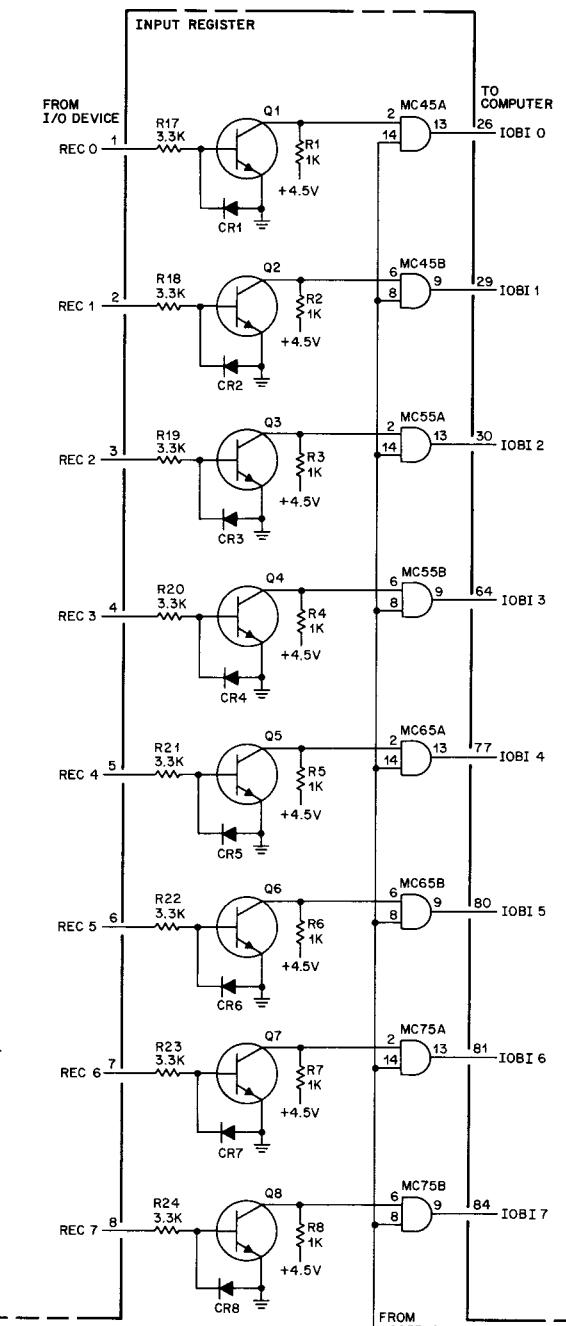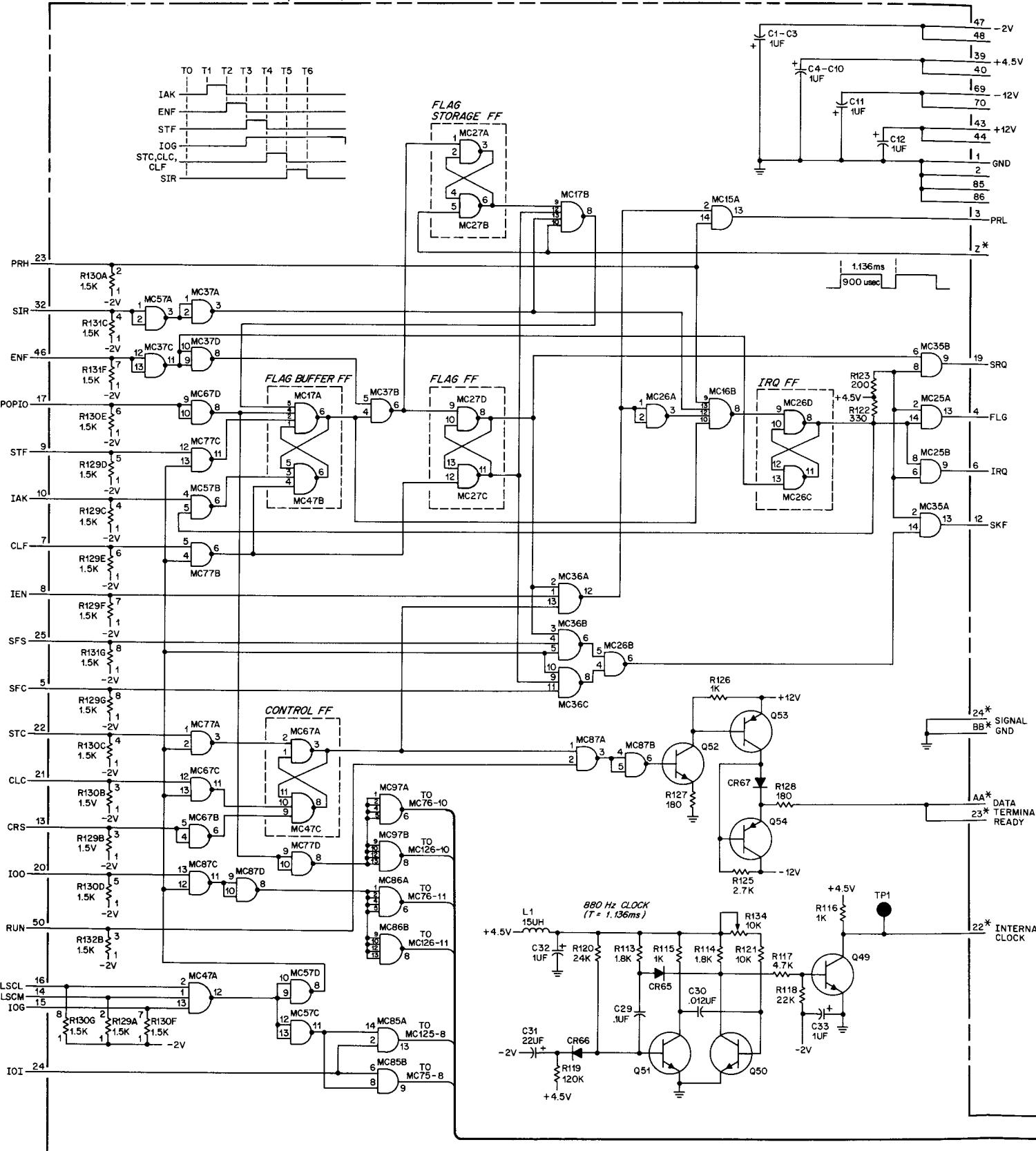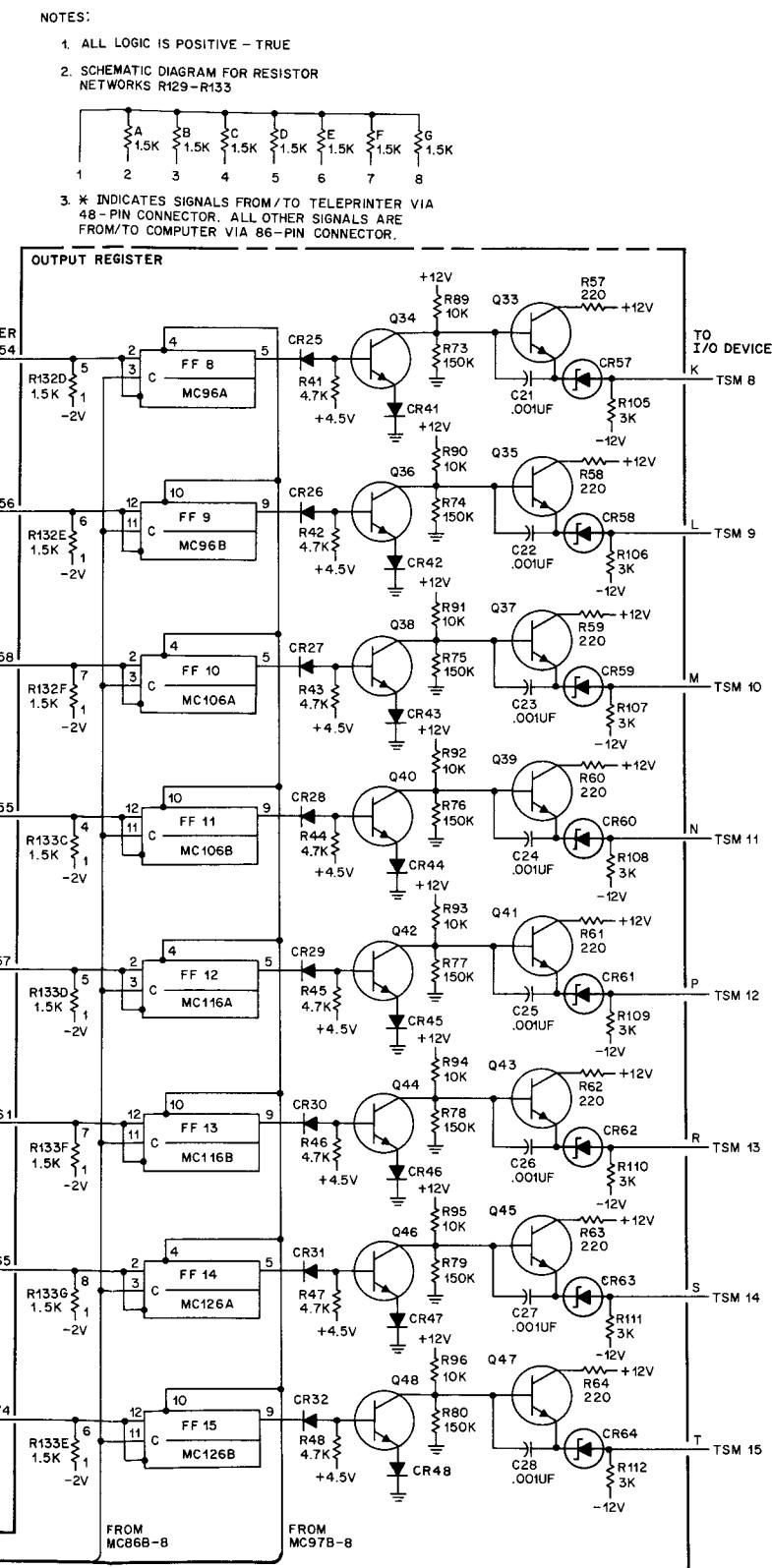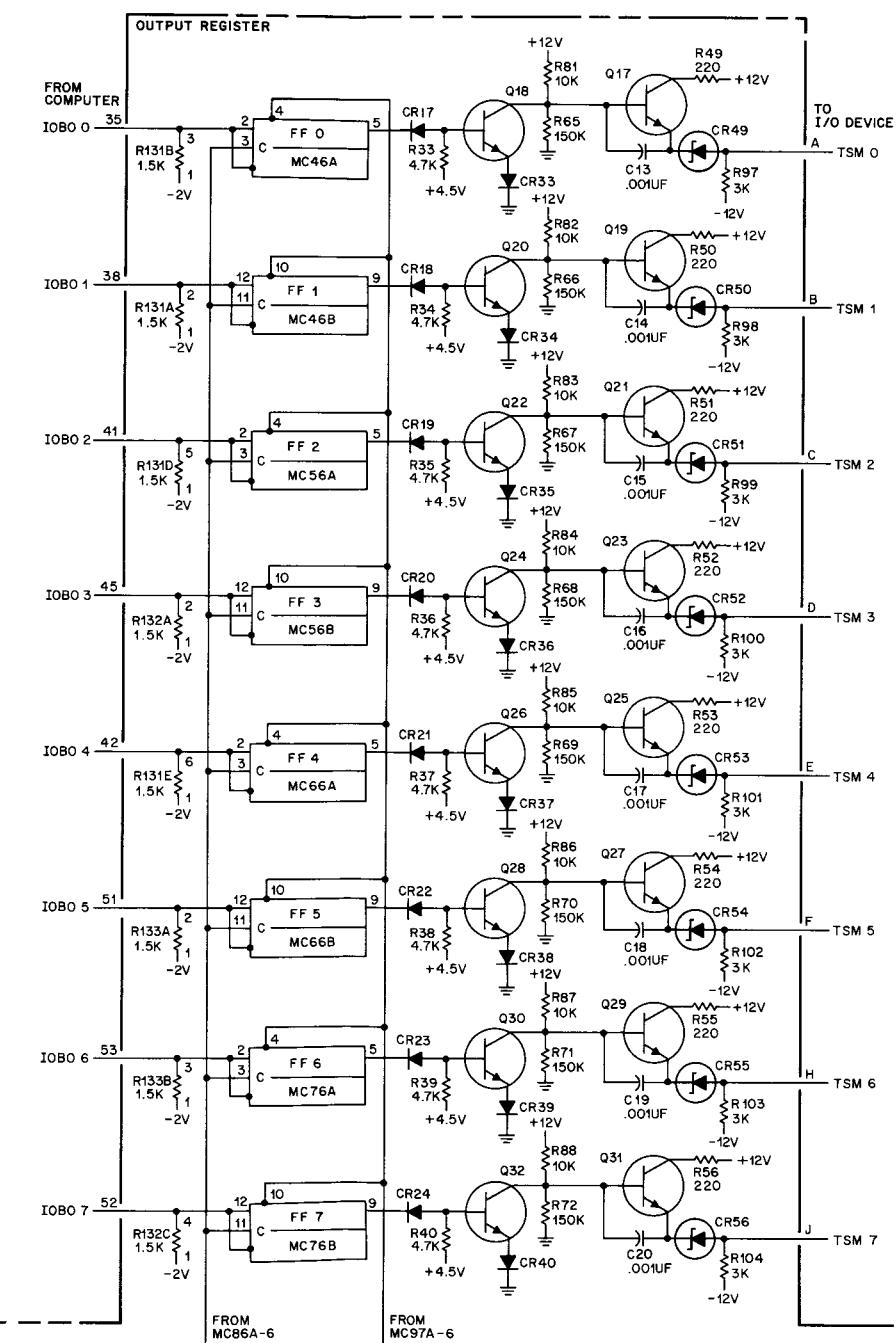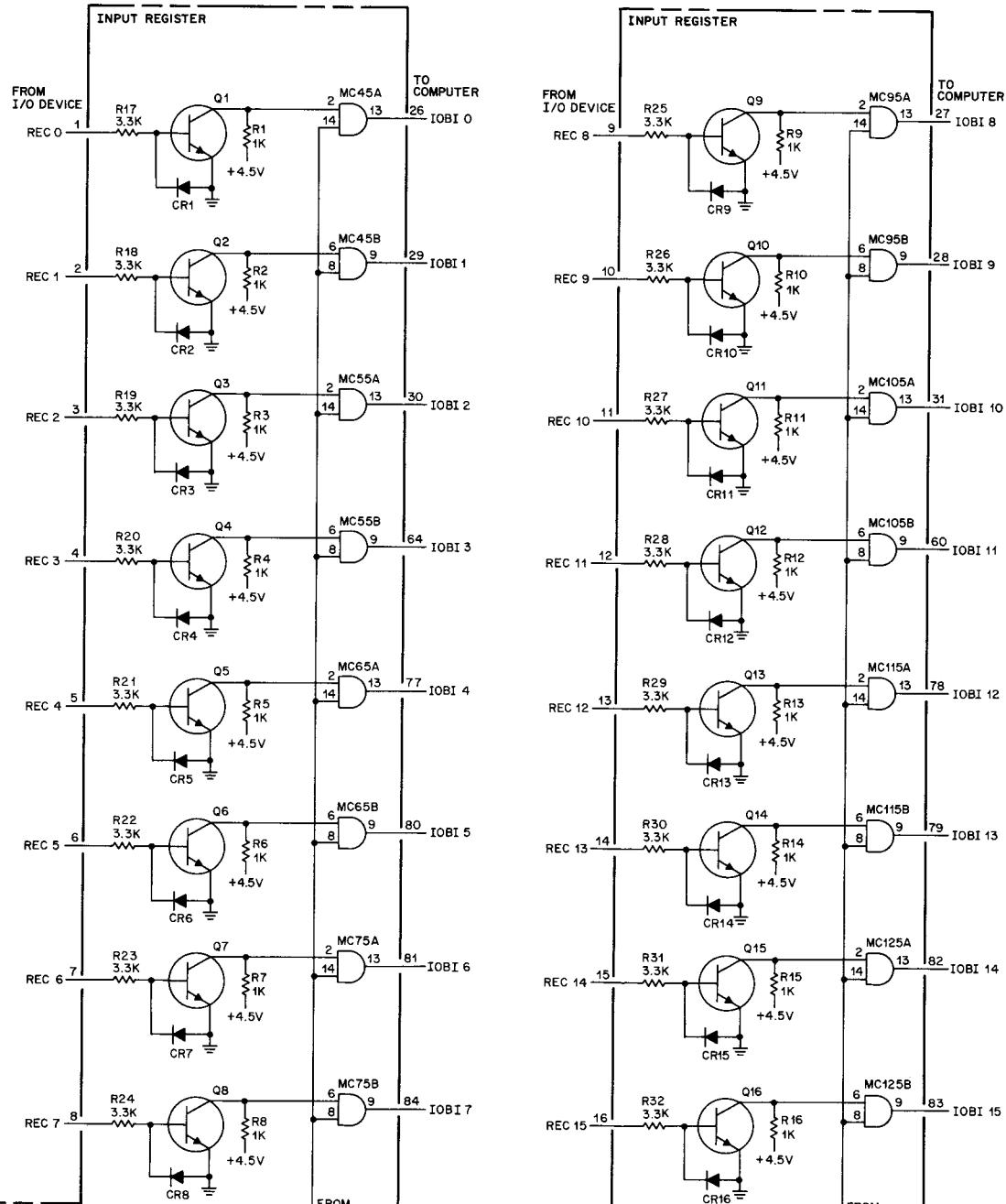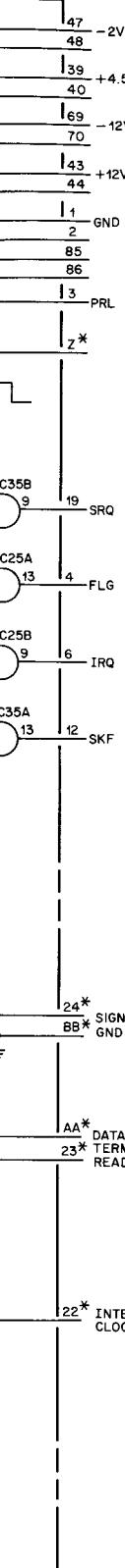
Figure 3-1. Teleprinter Multiplexor Logic Diagram
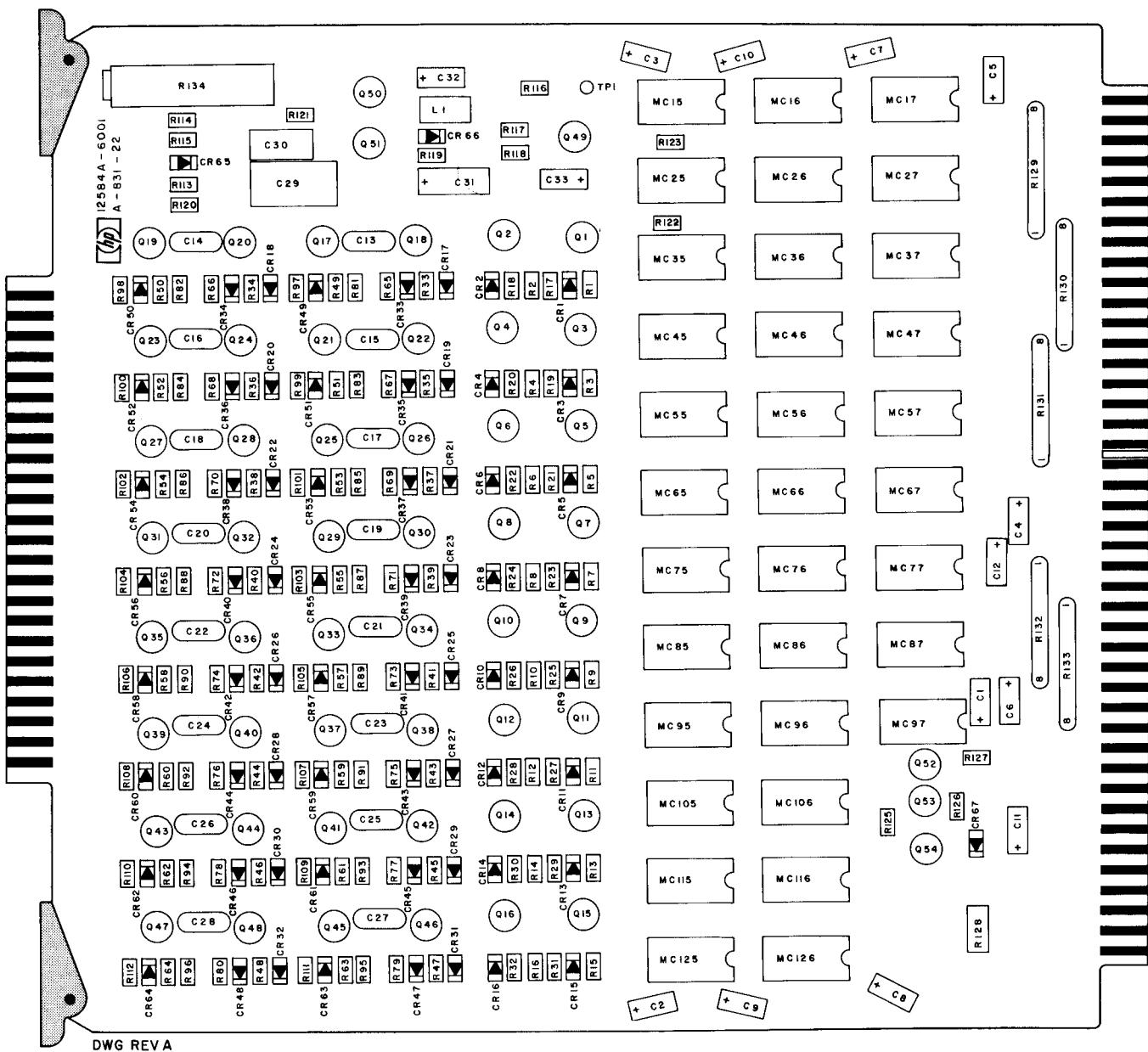
Figure 3-2. Teleprinter Multiplexor, Parts Location Diagram
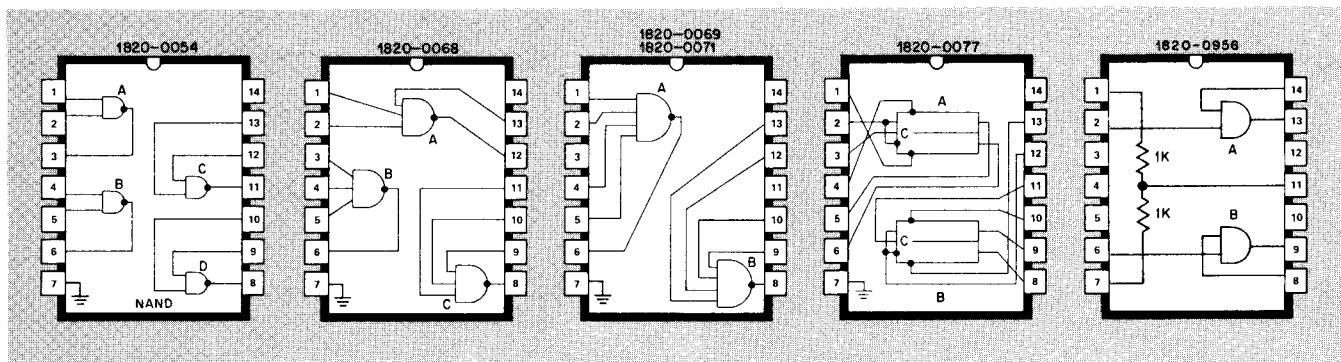
Figure 3-3. Microcircuit Packages, Top View

Logic "1" = negative voltage but more
than -5 volts

Logic "0" = positive voltage but more
than +5 volts

3-30. When IOBO signals are transferred from the Computer (via backplane wiring) to the Output Storage Register, -0.5 volts (logic "0") or +2.5 volts (logic "1") is received at the input to the storage register. Since all IOBO circuits are identical, only IOBO 0 will be explained.

3-31. A positive voltage (logic "1") from the Computer, received through connector pin 35, is applied to the set-side of flip-flop MC46A. An $\overline{IOO}$ · [LSCM · LSCL · IOG] signal is applied to pin 4 of MC46A. This strobes the data through the flip-flop where a positive potential is output on pin 5. When this occurs, transistor Q18 conducts and applies a ground potential on the base of emitter follower, Q17, which is always conducting. Zener diode CR49 is reversed biased, transferring -5.11 volts through connector pin A as a true (mark) data bit.

3-32. A ground potential (logic "0") from the Computer, received through connector pin 35, resets the flip-flop, MC46A, during $\overline{IOO}$ · [LSCM · LSCL · IOG]. The flip-flop is latched when $\overline{IOO}$ · [$\overline{LSCM}$ · $\overline{LSCL}$ · $\overline{IOG}$] goes false. The set-side output of this FF is at ground and is applied to the base of transistor Q18, turning the transistor off. With transistor Q18 in the off state, a positive voltage is applied to the base of emitter follower, transistor Q17. Zener diode CR49 is reversed biased, transferring +5.5 volts through connector pin A as a false (space) data bit.

3-33. I/O MULTIPLEX TEST CONNECTOR.

3-34. Figure 3-4 illustrates the schematic diagram of the I/O Multiplex Test Connector. When the Data Terminal Ready signal is true (-12V), the ON indicator lamp lights. When the Data Terminal Ready signal is false (+12V), the Off indicator lamp lights. This test connector is used with Option 01 only during the Preset Test (refer to diagnostic instructions at the back of this manual). The ON and OFF indicator lamps will oscillate on and off approximately every 10 seconds during the test.
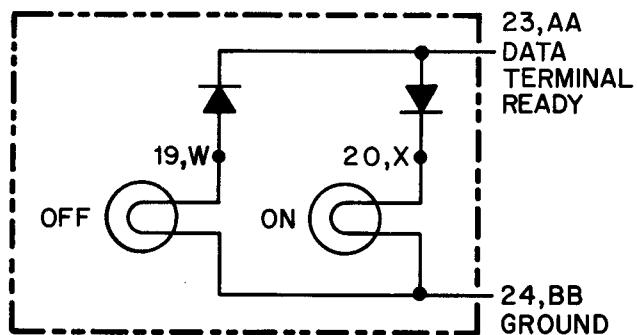
Figure 3-4. I/O Multiplex Test Connector
Schematic Diagram

3-35. RING CARRIER INTERFACE CARD.

3-36. The Ring Carrier Interface Card is a subassembly of the Multiplexor Panel and is used only with Option 02. Figure 3-5 illustrates the Parts Location Diagram, and the schematic diagram is shown in Figure 3-6. Located on this card are 16 identical circuits. Each circuit consists of two diodes and two resistors connected together to form an exclusive "or" gate. The input to each gate is the CF Carrier signal or the CE Ringing Indicator signal. Either of these signals are transferred to the Computer as an REC signal when -12 volts is applied to the input.
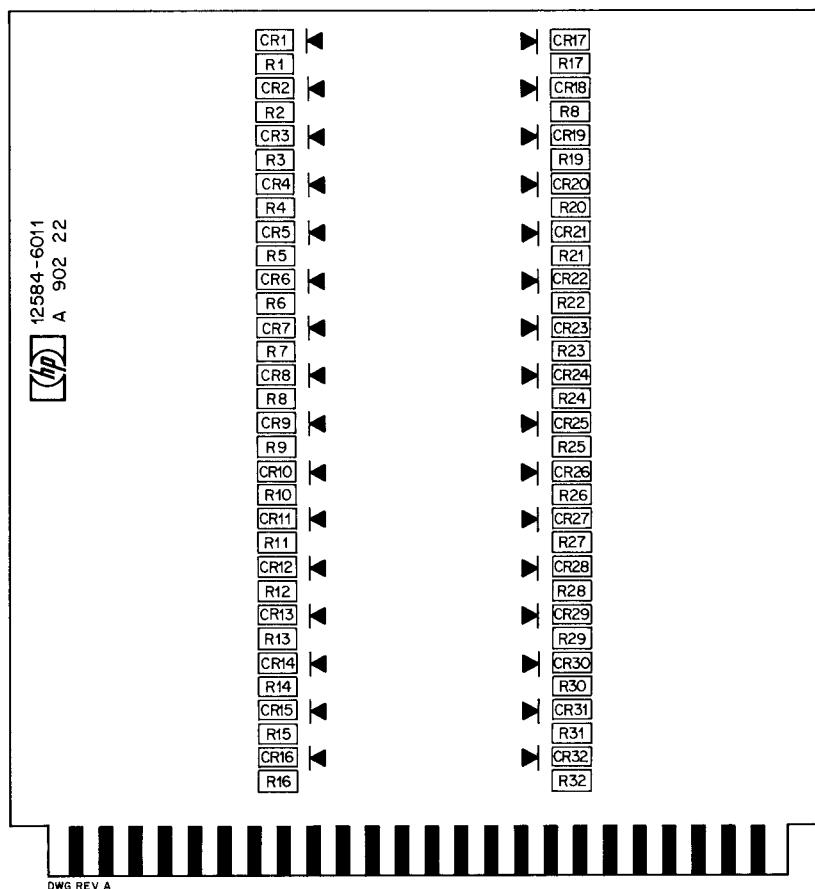
Figure 3-5.   Ring Carrier Interface Card, Parts Location Diagram
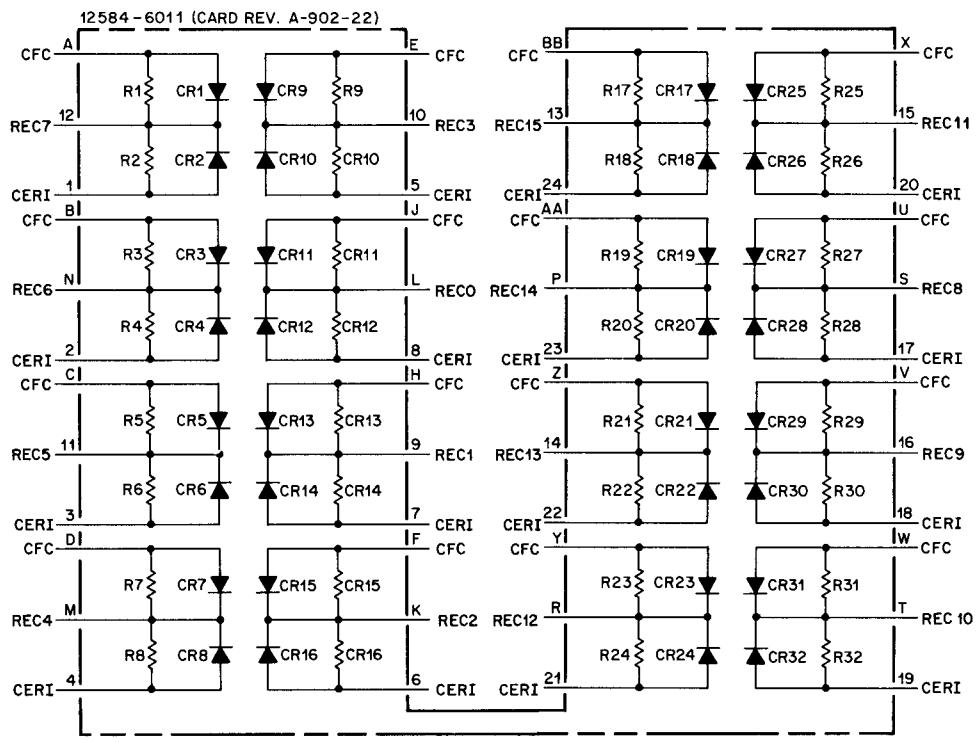
NOTES:
1. CFC DENOTES THE CF CARRIER SIGNAL.
2. CERI DENOTES THE CE RINGING INDICATOR SIGNAL.
3. REC DENOTES THE RECEIVED DATA SIGNAL

Figure 3-6.   Ring Carrier Interface Card, Schematic Diagram

SECTION IV
REPLACEABLE PARTS

4-1. INTRODUCTION.

4-2.   This section contains information for ordering replacement parts for the Teleprinter Multiplexor Interface Kit. Refer to Table 4-1 for a list of replaceable parts in alpha-numerical order of their reference designations, with a description and HP part number for each part. Table 4-2 lists parts alpha-numerically by their HP part numbers.

4-3. ORDERING INFORMATION.

4-4.   To order a replacement part, address the order or inquiry to your local Hewlett-Packard field office. See the list at the back of this manual for field office addresses.

4-5.   Specify the following information for each part when ordering:

  a. Hewlett-Packard part number.

  b. Circuit reference designation.

  c. Description.

4-6.   To order a part not listed in Tables 4-1 and 4-2, give a complete description of the part and include its function and location.

Table 4-1. Reference Designation Index

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION
	12584-6001	12584A I/O Multiplexor
C1-12,32,33	0180-0291	C:fxd, elect. 390 uf, 20%, 10 VDCW
C13-28	0150-0050	C:fxd, cer, 1000 pf, 600 VDCW
C29	0160-0169	C:fxd, mica, 2850 pf, 1%, 300 VDCW
C30	0160-0301	C:fxd, my, 0.012 uf, 10%, 200 VDCW
C31	0180-0028	C:fxd, elect, 22 uf, 10%, 15 VDCW
CR1-16,33-48,65,66	1901-0040	Diode: Silicon, 30 ma, 30 wv
CR17-32	1910-0016	Diode: Germanium, 1N55A
CR49-64	1902-0041	Diode: Breakdown, 5.11V, 5%, 400 mw
CR67	1901-0025	Diode: Silicon, 100 wv, 100 ma
L1	9140-0082	Coil: fxd, RF:15
MC15,25,35,45,55,65,75, 85,95,105,115,125	1820-0956	Integrated Circuit: CTL
MC16,17	1820-0069	Integrated Circuit: TTL
MC26,27,37,57,67,77,87	1820-0054	Integrated Circuit: TTL
MC36,47	1820-0068	Integrated Circuit: TTL
MC46,56,66,76,96,106, 116,126	1820-0077	Integrated Circuit: TTL
MC86,97	1820-0071	Integrated Circuit
Q1-51	1854-0094	Transistor: Silicon, NPN
Q53,54	1853-0058	Transistor: Silicon, PNP
Q52	1854-0215	Transistor: Silicon, NPN
R1-16,115,116,126	0698-4254	R:fxd, flm, 1K ohm, 5%, 1/8W
R17-32	0698-4266	R:fxd, flm, 3.3K ohm, 5%, 1/8W
R33-48,117	0698-4270	R:fxd, flm, 4.7K ohm, 5%, 1/8W
R49-64	0698-4239	R:fxd, flm, 220 ohm, 5%, 1/8W
R65-80	0698-4306	R:fxd, flm, 150 ohm, 5%, 1/8W
R81-96,121	0698-4278	R:fxd, flm, 10K ohm, 5%, 1/8W
R97-112	0698-4265	R:fxd, flm, 3K ohm, 5%, 1/8W
R113,114	0698-4260	R:fxd, flm, 1.8K ohm, 5%, 1/8W
R118	0698-4286	R:fxd, flm, 22K ohm, 5%, 1/8W
R119	0698-4304	R:fxd, flm, 120K ohm, 5%, 1/8W
R120	0698-4287	R:fxd, flm, 24K ohm, 5%, 1/8W
R122	0698-4243	R:fxd, flm, 330 ohm, 5%, 1/8W
R123	0698-4238	R:fxd, flm, 200 ohm, 5%, 1/8W
R125	0698-4264	R:fxd, flm, 2.7K ohm, 5%, 1/8W
R127	0698-4237	R:fxd, flm, 180 ohm, 5%, 1/8W

Table 4-1. Reference Designation Index (Cont'd)

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION
R128	0686-1815	R:fxd, comp 180 ohm, 5%, 1/2W
R129-133	1810-0020	Resistor Network: met flm (7 res)
R134	2100-0478	R:var, ww, 10K ohm, 10%, 1/4W
	12584-6003	I/O Multiplexor Test Connector
CR1,2	1901-0025	Diode: Silicon, 100 wv, 100 ma
DS1,2	2140-0259	Lamp: Incandescent, 12V, 0.06A
E1,2	1450-0152	LEN: Lamp Holder, Red Plastic
E3,4	1450-0153	Lamp Holder: For T-1 series
	1251-0332	Conn: PC 24 contacts
		Accessories
	1251-0063	Connector: Male Type D 25 contacts
	1251-0064	Connector: Female 25 contacts
		12584A-01
	12584-6002	Multiplexor Panel
	12584-6004	I/O Multiplexor Jumper Plug
	12584-6005	I/O Multiplexor Cable
XA1	12584-20001	Blank Card
	12584-6002	Multiplexor Panel
E1-16	1251-0064	Connector: Female 25 contacts
E17	1251-0335	Connector: 48 contact PC
E18	1251-0338	Connector: Female 50 pin
E19	1251-0341	Connector: Male 50 contacts
MP1-34	1251-0185	Contact-Connector: Female
MP35-68	1251-0190	Pin-Connector: Male
	12584-6004	I/O Multiplexor Jumper Plug
MP1-17	1251-0190	Pin-Connector: Male
E1	1251-337	Connector: 50 pin
	12584-6005	I/O Multiplexor Cable
MP1-34	1251-0185	Contact-Connector: Female
E1	1251-0335	Connector: 48 contact PC
	8120-0132	Cable: 37 conductor (7 ft.)
		12584-02
	12584-6001	I/O Multiplexor (Additional Card)
	12584-6008	Data Set Disconnect Cable
	12584-6011	Ring Carrier Interface (Subassembly of 12584-6002)
	12584-6008	Data Set Disconnect Cable
E1	1251-0335	Connector: 48 contact PC
E2	1251-0337	Connector: 50 pin
E3	8120-0803	Cable: (7 ft.)
MP1-33	1251-0190	Pin Connector: Male
	12584-6011	Ring Carrier Interface (Subassembly of 12584-6002)
R1-32	0683-1035	R:fxd, comp, 10K ohm, 5%, 1/4W
CR1-32	1901-0040	Diode: Silicon, 30 ma, 30 wv

Table 4-2. Replaceable Parts

HP PART NO.	DESCRIPTION	MFR.	MFR. PART NO.	TQ
0150-0050	C:fxd, cer, 1000 pf, 600 VDCW	77630	OBD	16
0160-0169	C:fxd, mica, 2850 pf, 1%, 300 VDCW	14655	RDM19 F(2850QF35)	1
0160-0301	C:fxd, my, 0.012 uf, 10%, 200 VDCW	28480	0160-0301	1
0180-0228	C:fxd, elect, 22 uf, 10%, 15 VDCW	28480	0180-0228	1
0180-0291	C:fxd, elect, 390 uf, 20%, 10 VDCW	56289	109D397X0010T2	14
0686-1815	R:fxd, comp, 180 ohm, 5%, 1/2W	28480	0686-1815	1
0698-4237	R:fxd, flm, 180 ohm, 5%, 1/8W	28480	0698-4237	1
0698-4238	R:fxd, flm, 200 ohm, 5%, 1/8W	28480	0698-4238	1
0698-4239	R:fxd, flm, 220 ohm, 5%, 1/8W	28480	0698-4239	16
0698-4243	R:fxd, flm, 330 ohm, 5%, 1/8W	28480	0698-4243	1
0698-4254	R:fxd, flm, 1K ohm, 5%, 1/8W	28480	0698-4254	19
0698-4260	R:fxd, flm, 1.8K ohm, 5%, 1/8W	28480	0698-4260	2
0698-4264	R:fxd, flm, 2.7K ohm, 5%, 1/8W	28480	0698-4264	1
0698-4265	R:fxd, flm, 3K ohm, 5%, 1/8W	28480	0698-4265	16
0698-4266	R:fxd, flm, 3.3K ohm, 5%, 1/8W	28480	0698-4266	16
0698-4270	R:fxd, flm, 4.7K ohm, 5%, 1/8W	28480	0698-4270	17
0698-4278	R:fxd, flm, 10K ohm, 5%, 1/8W	28480	0698-4278	17
0698-4286	R:fxd, flm, 22K ohm, 5%, 1/8W	28480	0698-4286	1
0698-4287	R:fxd, flm, 24K ohm, 5%, 1/8W	28480	0698-4287	1
0698-4304	R:fxd, flm, 120K ohm, 5%, 1/8W	28480	0698-4304	1
0698-4306	R:fxd, flm, 150K ohm, 5%, 1/8W	28480	0698-4306	16
1251-0063	Connector: Male Type D 25 contacts	71468	M-25P	3
1251-0064	Connector: Female, 25 contacts	71468	DBM-255	1
1251-0332	Connector: PC, 24 contacts	28480	1251-0332	1
1450-0152	LEN: Lampholder Red Plastic	08717	102XX-R	2
1450-0153	Lampholder: Fox T-1 series	08717	102SR	2
1810-0020	Resistor Network: met flm (7 res)	28480	1810-0020	5
1820-0054	Integrated Circuit: TTL	01295	SN4342	7
1820-0068	Integrated Circuit: TTL	56289	USN7410A	2
1820-0069	Integrated Circuit: TTL	56289	USN7420A	2
1820-0071	Integrated Circuit: TTL	01295	SN4346	2
1820-0077	Integrated Circuit: TTL	56289	USN7474A	8
1820-0956	Integrated Circuit: TTL	07263	SL3459	12
1853-0058	Transistor, Silicon, PNP	07263	2N3644	2
1854-0094	Transistor, Silicon, NPN	28480	1854-0094	51
1854-0215	Transistor, Silicon, NPN	28480	1854-0215	1
1901-0025	Diode: Silicon, 100 wv, 100 ma	28480	1901-0025	3
1901-0040	Diode: Silicon, 30 wv, 30 ma	28480	1901-0040	34
1902-0041	Diode: Breakdown, 5.11V, 5%, 400 mw	28480	1902-0041	16
1910-0016	Diode: Germanium, 1N55A	28480	1910-0016	16
9140-0082	Coil: fxd, RF:15	28480	9140-0082	1
2100-0478	R:var, WW, 10K ohm, 10%, 1/4W	80294	200 P-1-103	1
2140-0259	Lamp: Incandescent, 12V, 0.06A	71744	CM8-1099	2
12584-6001	I/O Multiplexor	28480	12584-6001	1
12584-6003	I/O Multiplexor Test Connector	28480	12584-6003	1
	12584A Option 01			
1251-0064	Connector: Female, 25 contacts	71468	DBM-25S	16
1251-0185	Contact - Connector, Female	95238	2506-S6A-22	68
1251-0190	Pin - Connector, Male	28480	1251-0190	51
1251-0335	Connector: PC 48 contacts	28480	1251-0335	2
1251-0337	Connector: 50 pin, Male	28480	1251-0337	1
1251-0338	Connector: 50 pin, Female	28480	1251-0338	1
1251-0341	Connector: Male 50 contacts	95238	2S-50PG-DSC	1
8120-0132	Cable: 37 conductor (7 ft.)	28480	8120-0132	1
12584-6002	Multiplexor Panel	28480	12584-6002	1
12584-6004	I/O Multiplexor Jumper Plug	28480	12584-6004	1
12584-6005	I/O Multiplexor Cable	28480	12584-6005	1
12584-20001	Blank Card	28480	12584-20001	1

Table 4-2. Replaceable Parts (Cont'd)

HP PART NO.	DESCRIPTION	MFR.	MFR. PART NO.	TQ
	12584A Option 02			
0683-1035	R:fxd, comp, 10K ohm, 5%, 1/4W	01121	CB1035	32
1251-0190	Pin Connector: Male	28480	1251-0190	33
1251-0335	Connector: 48 contact PC	28480	1251-0335	1
1251-0337	Connector: 50 pin	28480	1251-0337	1
1901-0040	Diode: Silicon, 30 ma, 30 wv	28480	1901-0040	21
8120-0803	Cable: (7 ft.)	28480	8120-0803	1
12584-6001	I/O Multiplexor (Additional Card)	28480	12584-6001	1
12584-6008	Data Set Disconnect Cable	28480	12584-6008	1
12584-6011	Ring Carrier Interface (Subassembly of the 12584-6002)	28480	12584-6011	1

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. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U. S. A. Common	Any supplier of U. S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N. Y.
00287	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microtron Co., Inc.	Valley Stream, N. Y.
00373	Garlock Inc.	Cherry Hill, N. J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N. J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S. C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N. J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N. Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N. Y.
02116	Wheelock Signals, Inc.	Long Branch, N. J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N. J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G. E. Semiconductor Prod. Dept.	Syracuse, N. Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.
03954	Singer Co., Diehl Div. Finderne Plant	Sumerville, N. J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N. J.
04062	Arco Electronic Inc.	Great Neck, N. Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S. C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P. M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.

Code No.	Manufacturer	Address
05397	Union Carbide Corp., Linde Div., Kemet Dept.	Cleveland, Ohio
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N. Y.
05729	Metro-Tel Corp.	Westbury, N. Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N. Y.
06402	E. T. A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N. Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N. H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Semcor Div. Components Inc.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N. Y.
07149	Filmohm Corp.	New York, N. Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N. J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N. J.
08145	U. S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Calif.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08792	CBS Electronics Semiconductor Operations, Div of C. B. S. Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N. Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.

Code No.	Manufacturer	Address
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N. J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N. J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N. M.
12697	Clarostat Mfg. Co.	Dover, N. H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N. J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13103	Thermolloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp.	Newark, N. J.
14674	Corning Glass Works	Corning, N. Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co.	New York, N. Y.
15287	Scionics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15558	Micron Electronics	Garden City, Long Island, N. Y.
15566	Amprobe Inst. Corp.	Lynbrook, N. Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mt. View, Calif.
16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N. J.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N. Y.
16758	Delco Radio Div. of G. M. Corp.	Kokoma, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
17870	McGraw-Edison Co.	Manchester, N. H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N. Y.
18873	E. I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N. J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N. J.
19589	Concoa	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N. Y.
19701	Electra Mfg. Co.	Independence, Kansas

Code No.	Manufacturer	Address
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.

Code No.	Manufacturer	Address
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littelfuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.

Code No.	Manufacturer	Address
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	. . . . . .
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.

Code No.	Manufacturer	Address
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
87034	Marco Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect, Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.

Code No.	Manufacturer	Address
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91886	Malco Mfg. Co., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Dania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.

Code No.	Manufacturer	Address
97464	Industrial Retaining Ring Co.	Irvington, N.J
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

Code No.	Manufacturer	Address
0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

I/O MULTIPLEXOR DIAGNOSTIC

BINARY TAPE   -HP20439A

SOURCE TAPE   -HP20550A

SOURCE LISTING   -HP20439AL

```
0001                        ASMB,A.B,L,T
ABLE0     000110
ABLEX     000116
FT01      000226
MA01      000231
FT02      000234
FTA2      000235
MA02      000240
FT03      000243
MA03      000246
FT04      000251
FTA4      000252
MA04      000255
PT01      000270
PTA1      000272
PT02      000277
PT04      000306
PT03      000307
GB01      000315
TSW2      000325
PT05      000333
AMOT      000335
LOOP      000336
AMOT1     000340
AMOT2     000343
IT01      000355
ITA1      000356
ITB1      000366
MA06      000374
ITC1      000377
IT02      000400
ITA2      000401
ITB3      000411
MA07      000417
ITC2      000422
OI01      000435
ECTR      000447
REPT      000451
REPTA     000452
REPTB     000453
MA08      000471
GBPT      000475
NEXT      000477
NEXTA     000500
NEXTB     000506
TSW       000522
MA09      000531
TTYA      000535
MPXA      000536
C1        000537
C2        000540
C3        000541
C4        000542
C5        000543
C6        000544
C7        000545
C8        000546
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D1        000547
D2        000550
D3        000551
D4        000552
D5        000553
D6        000554
D7        000555
MS00      000556
D10       000564
MS01      000565
D24       000602
MS02      000603
MS03      000620
MS04      000636
D26       000654
TIMER     000655
D60       000656
CON1      000657
AHLT      000660
AJMP      000661
BJMP      000662
MS06      000663
D16       000674
MS07      000675
D32       000716
EIN       000717
PATR      000720
C9        000721
MS08      000722
BPATR     000743
GPATR     000744
GOOD      000745
BAD       000746
MSG       000747
TEMP      000760
BCTR      000761
MSGAD     000762
TEMO      000763
ADR       000764
MS09      000765
D34       001007
AJSB      001010
SPTR      001011
MA00      001022
TIMR      001026
EINTR     001036
SWPT      001044
SWPA      001045
SWPB      001046
CONV      001050
REAG      001057
X         001104
**   NO ERRORS*
```

```
0001                    ASMB,A,B,L,T
0002    00110               ORG 110B
0003*
0004*        THIS IS SOURCE TAPE FOR THE TYPE NO. 12584A I/O MULTIPLEXOR
0005*        DIAGNOSTIC PROGRAM PREPARED 5-1-68.
0006*
0007*     OPERATING INSTRUCTIONS
0008*        1.   LOAD TTY SIO DRIVER WITH BINARY LOADER
0009*        2.   STARTING ADDRESS 2B
0010*        3.   SET SWITCH REGISTER = SC TTY
0011*        4.   LOAD DIAGNOSTIC WITH BINARY LOADER
0012*        5.   SELECT DESIRED TESTS BY THE FOLLOWING ADDRESSES.
0013*
0014*        THERE ARE 6 STARTING POINTS IN THE PROGRAM TO ALLOW OPERATOR
0015*        TO SELECT DESIRED TEST TO BE RUN. THESE POINTS ARE AS FOLLOWS:
0016*
0017*           ADDRESS:
0018*
0019*           110B   START--INITIALIZE I/O ADDRESS OF MPX.
0020*
0021*           111B   FLAG TESTS FOLLOWED BY OPTION ANALYSIS. PRESET
0022*                  BEFORE RUN.
0023*
0024*           112B   PRESET TEST. INSTALL I/O MPX. TEST CONNECTOR ON 48
0025*                  PIN EDGE CONN. OF MPX. BOARD. THIS CONNECTOR IS
0026*                  REQUIRED FOR THIS TEST AND ALL FOLLOWING TEST.(IT
0027*                  LOOPS OUTPUT TO INPUT AND CONNECTS INTERNAL OSC.)
0028*                  TEST FOLLOWED BY OPTION ANALYSIS. PRESET BEFORE RUN
0029*
0030*           113B   ADJUST MPX. OSCILLATOR FOLLOWED BY OPTION ANALYSIS.
0031*
0032*           114B   INTERRUPT TEST FOLLOWED BY OPTION ANALYSIS.
0033*
0034*           115B   OUTPUT/INPUT DATA ANALYSIS FOLLOWED BY OPTION
0035*                  ANALYSIS. END OF DIAGNOSTIC TEST
0036*
0037*     SWITCH OPTION ARE:
0038*
0039*           SWITCH REGISTER 14:IF ON PAUSES FOR MOMENTARY TEST INTER-
0040*                             RUPT; IF OFF, CONTINUES
0041*
0042*           SWITCH REGISTER 15:TERMINATES TEST
0043*
0044*     EACH TEST ROUTINE WILL LOOP TO THEIR STARTING POINT UNTIL EXIT
0045*     SWITCHED IS SENSED:
0046*
0047*           SW1=1, EXIT FLAG TEST
0048*
0049*           SW2=1, EXIT PRESET TEST
0050*
0051*           SW3=1, EXIT ADJ. MPX. OSC. TEST
0052*
0053*           SW4=1, EXIT INTERRUPT TEST
0054*
0055*           SW5=1, EXIT OUTPUT/INPUT DATA ANALYSIS
0056*
0057*        THE FIRST SECTION OF THIS PROGRAM ALLOWS ADDRESS NUMBER SELECT
```

```
0058*         FOR THE PERIPERAL INVOLVED.  BEFORE STARTING THE DIAGNOSTIC
0059*         PROGRAM INITIALIZE BY SETTING SW. REG. AS FOLLOWS:
0060*
0061*               MPX ADDR. IN A REG.
0062*                 STARTING ADDRESS (110B) IN P REG.
0063*                 DEPRESS PRESET AND RUN
0064*                 THE PROGRAM WILL HALT WITH A AND B CLEAR
0065*
0066    00110  024116    ABLE0  JMP ABLEX        START WITH I/O ADDRESS SET UP
0067    00111  024226           JMP FT01         START WITH FLAG TEST
0068    00112  024270           JMP PT01         START WITH PRESET TEST
0069    00113  024335           JMP AMOT         START WITH ADJ. MPX. OSC. TEST
0070    00114  024355           JMP IT01         START INTERRUPT TEST
0071    00115  024435           JMP OI01         START O/I DATA ANALYSIS TEST
0072    00116  070536    ABLEX  STA MPXA          STORE MPX ADDRESS
0073    00117  002400           CLA
0074    00120  060660           LDA AHLT         HALT INSTRUCTION - HALT 77B
0075    00121  070010           STA 10B
0076    00122  070011           STA 11B
0077    00123  070012           STA 12B
0078    00124  070013           STA 13B
0079    00125  070014           STA 14B
0080    00126  070015           STA 15B
0081    00127  070016           STA 16B
0082    00130  070017           STA 17B
0083    00131  070020           STA 20B
0084    00132  070021           STA 21B
0085    00133  070022           STA 22B
0086    00134  070023           STA 23B
0087    00135  070024           STA 24B
0088    00136  070025           STA 25B
0089    00137  070026           STA 26B
0090    00140  070027           STA 27B
0091    00141  002400           CLA
0092    00142  006400           CLB
0093    00143  103100           CLF 00           CLEAR FLAG ALL I/O DEVICES
0094    00144  106700           CLC 00           CLEAR CONTROL ALL I/O DEVICES
0095    00145  060537           LDA C1           SET UP STF0
0096    00146  030536           IOR MPXA         ADD I/O ADDRESS
0097    00147  070251           STA FT04
0098    00150  060540           LDA C2           SET UP CLF0
0099    00151  030536           IOR MPXA
0100    00152  070234           STA FT02
0101    00153  070343           STA AMOT2
0102    00154  070355           STA IT01
0103    00155  070400           STA IT02
0104    00156  060541           LDA C3           SET UP SFC0
0105    00157  030536           IOR MPXA
0106    00160  070243           STA FT03
0107    00161  060542           LDA C4           SET UP SFS0
0108    00162  030536           IOR MPXA
0109    00163  070226           STA FT01
0110    00164  070235           STA FTA2
0111    00165  070252           STA FTA4
0112    00166  070340           STA AMOT1
0113    00167  070356           STA ITA1
0114    00170  070401           STA ITA2
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0115    00171 060543        LDA C5          SET UP STC0
0116    00172 030536        IOR MPXA
0117    00173 070272        STA PTA1
0118    00174 070335        STA AMOT
0119    00175 070366        STA ITB1
0120    00176 070411        STA ITB3
0121    00177 060544        LDA C6          SET UP CLC0
0122    00200 030536        IOR MPXA
0123    00201 070270        STA PT01
0124    00202 070377        STA ITC1
0125    00203 070422        STA ITC2
0126    00204 060545        LDA C7          SET UP OTA0,C
0127    00205 030536        IOR MPXA
0128    00206 071045        STA SWPA
0129    00207 070452        STA REPTA
0130    00210 070477        STA NEXT
0131    00211 070306        STA PT04
0132    00212 070333        STA PT05
0133    00213 060546        LDA C8          SET UP LIB0,C
0134    00214 030536        IOR MPXA
0135    00215 070277        STA PT02
0136    00216 071046        STA SWPB
0137    00217 070307        STA PT03
0138    00220 070500        STA NEXTA
0139    00221 060721        LDA C9          SET UP LIA0,C
0140    00222 030536        IOR MPXA
0141    00223 070453        STA REPTB
0142    00224 002400        CLA
0143    00225 102000        HLT 00          END OF ADDRESS INITIALIZATION
0144*
0145*
0146*           FLAG TESTS--PRESET BEFORE RUN (PRESET SETS FLAG BUFFER FF AND
0147*           FLAG FF, RESETS CONTROL FF AND SETS OUTPUT REGISTER OF MPX. TO
0148*           MARK STATE).
0149*
0150*
0151    00226 102300  FT01  SFS 0           TEST PRESET TO SET FLAG
0152    00227 024231        JMP MA01        IF FLAG IS CLEAR PRINT ER.MESS.
0153    00230 024234        JMP *+4
0154    00231 060602  MA01  LDA D24
0155    00232 064565        LDB MS01
0156    00233 114102        JSB 1028,I
0157*
0158    00234 103100  FT02  CLF 0           CLEAR FLAG TEST
0159    00235 102300  FTA2  SFS 0           IF FLAG IS SET PRINT ER.MESS.
0160    00236 024243        JMP *+5
0161    00237 024240        JMP MA02
0162    00240 060602  MA02  LDA D24
0163    00241 064603        LDB MS02
0164    00242 114102        JSB 1028,I
0165*
0166    00243 102200  FT03  SFC 0           TEST SFC INSTRUCTION
0167    00244 024246        JMP MA03        IF FLAG IS SET PRINT ER.MESS.
0168    00245 024251        JMP *+4
0169    00246 060654  MA03  LDA D26
0170    00247 064620        LDB MS03
0171    00250 114102        JSB 1028,I
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0172*
0173    00251 102100    FT04    STF 0           TEST STF INSTRUCTION
0174    00252 102300    FTA4    SFS 0           IF FLAG IS CLEAR PRINT ER.MESS.
0175    00253 024255            JMP MA04
0176    00254 024260            JMP *+4
0177    00255 060654    MA04    LDA D26
0178    00256 064636            LDB MS04
0179    00257 114102            JSB 102B,I
0180    00260 102501            IIA 01          LOAD SW. REG.
0181    00261 001100            ARS             SHIFT RIGHT ONE BIT
0182    00262 000010            SLA             EXIT SW. 1 TEST
0183    00263 024266            JMP *+3         EXIT SW. IS ON
0184    00264 015011            JSB SPTR        EXIT SW. IS OFF,TEST FOR PAUSE,TR
0185    00265 024226            JMP FT01        LOOP TO REPEAT TEST
0186    00266 102001            HLT 01B
0187    00267 024270            JMP PT01
0188*
0189*
0190*          PRESET TEST--DISCONNECT I/O MPX. CABLE AND INSTALL I/O MPX.
0191*          TEST CONNECTOR ON 48 PIN EDGE CONN. THIS TEST CONN. CONNECTS
0192*          MPX. OSC. AND CONNECTS INPUT TO OUTPUT FOR BALANCE OF TESTS TO
0193*          FOLLOW. VISUAL INSPECTION OF LIGHTS ON MXP. TEST CONNECTOR
0194*          INDICATE DATASET 103 SIG-DATA TERMINAL READY- ON IF PROGRAM
0195*          RUNNING AND CONTROL FF SET. OTHERWISE OFF CONDITION IS INDIC.
0196*          DEPRESS PRESET THAN RUN. DATA TERMINAL READY LIGHT WILL REMAIN
0197*          OFF FOR APPROX. 10 SEC AND THAN COME ON FOR 10SEC.+.
0198*          OUTPUT REG. OF MPX. TESTED FOR ALL 1'S AND THAN ALL 0'S. IF
0199*          NOT EQUAL, GOOD AND BAD PATTERNS ARE TYPED.
0200*
0201*
0202    00270 106700    PT01    CLC 0
0203    00271 015026            JSB TIMR        DTR LIGHT OFF-ON FOR 10 SEC.
0204    00272 102700    PTA1    STC 0
0205    00273 015026            JSB TIMR        DTR LIGHT ON-ON FOR 10 SEC.+
0206    00274 002400            CLA
0207    00275 006400            CLB
0208    00276 060657            LDA CON1        LOAD A REG WITH ALL 1'S
0209    00277 107500    PT02    LIB 0,C         READ IN MDX OUTPUT REG.
0210    00300 074743            STB BPATR
0211    00301 070744            STA GPATR
0212    00302 054000            CPB 0           COMPARE MPX OUTPT FOR ALL 1'S
0213    00303 024305            JMP *+2         ALL 1'S
0214    00304 024315            JMP GB01
0215    00305 002400            CLA
0216    00306 103600    PT04    OTA 0,C
0217    00307 107500    PT03    LIB 0,C
0218    00310 074743            STB BPATR
0219    00311 070744            STA GPATR
0220    00312 054000            CPB 0           COMPARE MPX OUTPUT FOR ALL 0'S
0221    00313 024325            JMP TSW2
0222    00314 024315            JMP GB01
0223    00315 060745    GB01    LDA GOOD
0224    00316 070747            STA MSG
0225    00317 060744            LDA GPATR
0226    00320 015050            JSB CONV
0227    00321 060746            LDA BAD
0228    00322 070747            STA MSG
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0229    00323 060743           LDA  BPATR
0230    00324 015250           JSB  CONV
0231    00325 102501    TSW2   LIA  01
0232    00326 001121           ARS,ARS         SHIFT RIGHT TWO PLACES
0233    00327 000010           SLA             EXIT SW. 2 TEST
0234    00330 024335           JMP  AMOT        EXIT SW. IS ON
0235    00331 015011           JSB  SPTR        EXIT SW. OFF,TEST FOR PAUSE-TERM.
0236    00332 060657           LDA  CON1
0237    00333 103600    PT05   OTA  0,C
0238    00334 024270           JMP  PT01        LOOP TO REPEAT TEST
0239*
0240*
0241*           ADJUST MPX. OSCILLATOR TEST--ADJUST OSC. TRIMPOT R134 ON MPX.
0242*           UNTIL A REG. READS OCTAL 346
0243*
0244*
0245    00335 102700    AMOT   STC  0           ENABLE INTERRUPT
0246    00336 006400    LOOP   CLB
0247    00337 006004           INB             INCREMENT B
0248    00340 102300    AMOT1  SFS  0           SKIP IF FLAG SET
0249    00341 024337           JMP  *-2
0250    00342 060001           LDA  1
0251    00343 103100    AMOT2  CLF  0
0252    00344 070763           STA  TEMO
0253    00345 102501           LIA  01          LOAD SW. REG.
0254    00346 001121           ARS,ARS
0255    00347 001100           ARS             SHIFT RIGHT 3 PLACES
0256    00350 000010           SLA             EXIT SW.3 TEST
0257    00351 024355           JMP  IT01        EXIT SW. IS ON
0258    00352 015011           JSB  SPTR        EXIT SW. OFF, TEST FOR PAUSE-TERM
0259    00353 060763           LDA  TEMO
0260    00354 024336           JMP  LOOP
0261*
0262*
0263*           INTERRUPT TEST--THIS TEST ENABLES AN INTERRUPT BY STC MPX.
0264*           INSTRUCTION AND THAN TESTS FLAG STORAGE FF TO STORE ONE
0265*           INTERRUPT.
0266*
0267*
0268    00355 103100    IT01   CLF  0           CLEAR FLAG
0269    00356 102300    ITA1   SFS  0           TEST FOR FLAG SET BY MPX. OSC.
0270    00357 024356           JMP  *-1         WAIT FOR IT
0271    00360 064547           LDB  D1          INITALIZE TIMER FOR 800 MICROSEC
0272    00361 034001           ISZ  1
0273    00362 024361           JMP  *-1
0274    00363 060661           LDA  AJMP        SET UP INTERRUPT INSTR. JMP ITC1
0275    00364 170536           STA  MPXA,I      Store it in trap cell
0276    00365 102100           STF  00          ENABLE SYSTEM INTERRUPT
0277    00366 102700    ITB1   STC  0           ENABLE MPX. INTERRUPT
0278    00367 000000           NOP
0279    00370 000000           NOP
0280    00371 000000           NOP
0281    00372 000000           NOP
0282    00373 103100           CLF  00          DISABLE SYSTEM INTERRUPT
0283    00374 060674    MA06   LDA  D16         SHOULD SKIP THIS
0284    00375 064563           LDB  MS06
0285    00376 114102           JSB  102B,I      OUTPUT ERROR MESSAGE
```

```
0286   00377 106700   ITC1   CLC 0
0287*
0288   00400 103100   IT02   CLF 0
0289   00401 102300   ITA2   SFS 0
0290   00402 024401          JMP *-1
0291   00403 064550          LDB D2         INITALIZE TIMER FOR 1900 MICROSEC
0292   00404 034001          ISZ 1
0293   00405 024404          JMP *-1
0294   00406 060662          LDA BJMP
0295   00407 170536          STA MPXA,I
0296   00410 102100          STF 00         ENABLE SYSTEM INTERRUPT
0297   00411 102700   ITB3   STC 0
0298   00412 000000          NOP
0299   00413 000000          NOP
0300   00414 000000          NOP
0301   00415 000000          NOP
0302   00416 103100          CLF 00         DISABLE SYSTEM INTERRUPT
0303   00417 060716   MA07   LDA D32
0304   00420 064675          LDB MS07
0305   00421 114102          JSB 102B,I
0306   00422 106700   ITC2   CLC 0
0307   00423 061010          LDA AJSB        ERROR INTERRUPT INSTRUCTION
0308   00424 170536          STA MPXA,I
0309   00425 103100          CLF 00
0310   00426 102501          LIA 01          LOAD SW. REG.
0311   00427 001121          ARS,ARS
0312   00430 001121          ARS,ARS         SHIFT RIGHT 4 PLACES
0313   00431 000010          SLA             EXIT SW.4 TEST
0314   00432 024435          JMP OI01        EXIT SW IS ON
0315   00433 015011          JSB SPTR        EXIT SW OFF,TEST FOR PAUSE-TERM.
0316   00434 024355          JMP IT01        LOOP TO REPEAT TEST
0317*
0318*
0319*        OUTPUT/INPUT DATA ANALYSIS TEST--SWITCH OPTIONS FOR THIS TEST
0320*        ARE:SW6=1,OUTPUT DATA PATTERN FROM SWITCH REGISTERS TO MPX.,
0321*        A REG. WILL DISPLAY INPUT PATTERN TO MPX.
0322*        B REG. WILL DISPLAY PATTERN FROM MPX.
0323*        IF SW6=0, PROGRAM WILL PERMUTE OUTPUT/INPUT OF MPX.,COMPARE
0324*        AND TYPE GOOD PATTERN,BAD PATTERN
0325*        SW7=1,ERRORS MADE IN PATTERN COMPARISON WILL BE COUNTED IN
0326*        LIEU OF INDIVIDUAL ERROR PATTERNS TYPED. ERROR COUNT IN B REG.
0327*
0328*
0329   00435 102501   OI01   LIA 01          LOAD SW. REG.
0330   00436 001727          ALF,ALF
0331   00437 001200          RAL             SHIFT LEFT 9 PLACES
0332   00440 002020          SSA             TEST SW6
0333   00441 025044          JMP SWPT        SW6 ON, USE SW REG FOR PATTERN
0334   00442 102501          LIA 01
0335   00443 001727          ALF,ALF         SHIFT LEFT 8 PLACES
0336   00444 002020          SSA             TEST SW7
0337   00445 024447          JMP ECTR        SW7 ON, DISPLAY ERROR COUNT B REG
0338   00446 024475          JMP GBPT        SW7 OFF, OUTPUT G AND B PATTERN
0339   00447 006400   ECTR   CLB             INITIALIZE ERROR CNTR. TO 0
0340   00450 002400          CLA             A REG IS PATTERN
0341   00451 070720   REPT   STA PATR        TEMP STORAGE OF PATTERN
0342   00452 103600   REPTA  OTA 0,C         OUTPUT PATR TO MPX
```

```
0343    00453 103500    REPTB LIA 0,C      INPUT MPX
0344    00454 050720          CPA PATR     IS PATR OUTPUT=INPUT
0345    00455 024457          JMP *+2      YES
0346    00456 006004          INB          NO,ADD A ERROR COUNT TO B REG
0347    00457 060720          LDA PATR
0348    00460 034000          ISZ 0        INCREMENT PATR
0349    00461 024451          JMP REPT
0350    00462 102501          LIA 01       LOAD SW. REG.
0351    00463 001727          ALF,ALF
0352    00464 001222          RAL,RAL      SHIFT LEFT 10 PLACES
0353    00465 002020          SSA          EXIT SW.5 TEST
0354    00466 024471          JMP *+3      EXIT SW IS ON
0355    00467 015011          JSB SPTR     EXIT SW OFF, TEST FOR PAUSE-TERM.
0356    00470 024451          JMP REPT
0357    00471 060716    MA08  LDA D32
0358    00472 064722          LDB MS08
0359    00473 114102          JSB 102B,I
0360    00474 102005          HLT 05B
0361    00475 002400    GBPT  CLA          CLEAR GOOD PATTERN STORAGE POINT
0362    00476 006400          CLB          CLEAR BAD  PATTERN STORAGE POINT
0363    00477 103600    NEXT  OTA 0,C      OUTPUT TO MPX
0364    00500 107500    NEXTA LIB 0,C      INPUT FROM MPX
0365    00501 074743          STB BPATR
0366    00502 070744          STA GPATR
0367    00503 050001          CPA 1        TEST FOR =
0368    00504 024506          JMP *+2      =
0369    00505 024512          JMP *+5      NOT = , PRINT OUT GOOD AND BAD PT
0370    00506 060744    NEXTB LDA GPATR
0371    00507 034000          ISZ 0        INCREMENT TEST PATTERN
0372    00510 024477          JMP NEXT     REPEAT FOR NEXT PATTERN
0373    00511 024522          JMP TSW      TEST SW REG AFTER EACH PERMUTE
0374    00512 060745          LDA GOOD
0375    00513 070747          STA MSG
0376    00514 060744          LDA GPATR
0377    00515 015050          JSB CONV
0378    00516 060746          LDA BAD
0379    00517 070747          STA MSG
0380    00520 060743          LDA BPATR
0381    00521 015050          JSB CONV
0382    00522 102501    TSW   LIA 01
0383    00523 001727          ALF,ALF
0384    00524 001222          RAL,RAL
0385    00525 002020          SSA
0386    00526 024531          JMP *+3
0387    00527 015011          JSB SPTR
0388    00530 024506          JMP NEXTB
0389    00531 061007    MA09  LDA D34
0390    00532 064765          LDB MS09
0391    00533 114102          JSB 102B,I
0392    00534 102006          HLT 06
0393    00535 000000    TTYA  OCT 0        TTY ADDRESS
0394    00536 000000    MPXA  OCT 0        MPX ADDRESS
0395    00537 102100    C1    STF 0
0396    00540 103100    C2    CLF 0
0397    00541 102200    C3    SFC 0
0398    00542 102300    C4    SFS 0
0399    00543 102700    C5    STC 0
```

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0400    00544  106700   C6      CLC  0
0401    00545  103600   C7      OTA  0,C
0402    00546  107500   C8      LIB  0,C
0403    00547  177546   D1      DEC  -154
0404    00550  177214   D2      DEC  -372
0405    00551  177742   D3      DEC  -30
0406    00552  177770   D4      DEC  -8
0407    00553  000001   D5      OCT  1
0408    00554  000060   D6      OCT  60
0409    00555  000022   D7      DEC  18
0410    00556  000557   MS00    DEF  *+1
0411    00557  052105           ASC  5,TERMINATE
        00560  051115
        00561  044516
        00562  040524
        00563  042440
0412    00564  000012   D10     DEC  10
0413    00565  000566   MS01    DEF  *+1
0414    00566  050122           ASC  12,PRESET DID NOT SET FLAG
        00567  042523
        00570  042524
        00571  020104
        00572  044504
        00573  020116
        00574  047524
        00575  020123
        00576  042524
        00577  020106
        00600  046101
        00601  043440
0415    00602  000030   D24     DEC  24
0416    00603  000604   MS02    DEF  *+1
0417    00604  041514           ASC  12,CLF DID NOT CLEAR FLAG
        00605  043040
        00606  042111
        00607  042040
        00610  047117
        00611  052040
        00612  041514
        00613  042501
        00614  051040
        00615  043114
        00616  040507
        00617  020040
0418    00620  000621   MS03    DEF  *+1
0419    00621  051506           ASC  13,SFC LOGIC COMPONENT FAILED
        00622  041440
        00623  046117
        00624  043511
        00625  041440
        00626  041517
        00627  046520
        00630  047516
        00631  042516
        00632  052040
        00633  043101
        00634  044514
```

```
        00635 042504
0420    00636 000637   MS04   DEF *+1
0421    00637 051524          ASC 13,STF LOGIC COMPONENT FAILED
        00640 043040
        00641 046117
        00642 043511
        00643 041440
        00644 041517
        00645 046520
        00646 047516
        00647 042516
        00650 052040
        00651 043101
        00652 044514
        00653 042504
0422    00654 000032   D26    DEC 26
0423    00655 000000   TIMER  OCT 0
0424    00656 000074   D60    DEC 60
0425    00657 177777   CON1   OCT 177777
0426    00660 102077   AHLT   HLT 77B
0427    00661 024377   AJMP   JMP ITC1
0428    00662 024422   BJMP   JMP ITC2
0429    00663 000664   MS06   DEF *+1
0430    00664 044516          ASC 8,INTERRUPT FAILED
        00665 052105
        00666 051122
        00667 052520
        00670 052040
        00671 043101
        00672 044514
        00673 042504
0431    00674 000020   D16    DEC 16
0432    00675 000676   MS07   DEF *+1
0433    00676 043114          ASC 16,FLAG STORAGE FF FAILED TO STORE
        00677 040507
        00700 020123
        00701 052117
        00702 051101
        00703 043505
        00704 020106
        00705 043040
        00706 043101
        00707 044514
        00710 042504
        00711 020124
        00712 047440
        00713 051524
        00714 047522
        00715 042440
0434    00716 000040   D32    DEC 32
0435    00717 000000   EIN    NOP
0436    00720 000000   PATR   OCT 0
0437    00721 103500   C9     LIA 0,C
0438    00722 000723   MS08   DEF *+1
0439    00723 052117          ASC 16,TOTAL ERRORS DISPLAYED IN B REG.
        00724 052101
        00725 046040
```

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              00726 042522
              00727 051117
              00730 051123
              00731 020104
              00732 044523
              00733 050114
              00734 040531
              00735 042504
              00736 020111
              00737 047040
              00740 041740
              00741 051105
              00742 043456
0440          00743 000000   BPATR OCT 0
0441          00744 000000   GPATR OCT 0
0442          00745 043475   GOOD  ASC 1,G=
0443          00746 041075   BAD   ASC 1,R=
0444          00747 000000   MSG   BSS 9
0445          00760 000000   TEMP  BSS 1
0446          00761 000000   BCTR  BSS 1
0447          00762 000747   MSGAD DEF MSG
0448          00763 000000   TEMO  BSS 1
0449          00764 000000   ADR   BSS 1
0450          00765 000766   MS09  DEF *+1
0451          00766 042516         ASC 17,END OF OUTPUT/INPUT DATA ANALYSIS
              00767 042040
              00770 047506
              00771 020117
              00772 052524
              00773 050125
              00774 052057
              00775 044516
              00776 050125
              00777 052040
              01000 042101
              01001 052101
              01002 020101
              01003 047101
              01004 046131
              01005 051511
              01006 051440
0452          01007 000042   D34   DEC 34
0453          01010 015036   AJSB  JSB EINTR
0454*
0455*             THE FOLLOWING SUB-ROUTINE TEST FOR SWITCH OPTION 14,15
0456*
0457          01011 000000   SPTR  NOP
0458          01012 102501         LIA 01       LOAD SW REG
0459          01013 001200         RAL          ROTATE LEFT ONE BIT
0460          01014 002020         SSA          PAUSE SW. 14 OFF
0461          01015 025012         JMP *-3      PAUSE SW ON,LOOP
0462          01016 001300         RAR          ROTATE RIGHT ONE BIT
0463          01017 002020         SSA          TERMINATE SW.15 OFF
0464          01020 025022         JMP MA00     TERMINATE SW.ON
0465          01021 125011         JMP SPTR,I   NO TERMINATION
0466          01022 060564   MA00  LDA D10
0467          01023 064556         LDB MS00
```

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0468   01024 114102        JSB 1028,I
0469   01025 102015        HLT 15B          TERMINATE SW.15 ON
0470*
0471   01026 000000  TIMR  NOP              10 SEC TIMER SUBROUTINE
0472   01027 060551        LDA D3
0473   01030 006400        CLB
0474   01031 034001        ISZ 1
0475   01032 025031        JMP *-1
0476   01033 034000        ISZ 0
0477   01034 025030        JMP *-4
0478   01035 125026        JMP TIMR,I
0479*
0480*        ERROR INTERRUPT ROUTINE
0481*        A REG. IS SAVED
0482*        B REG. CONTAINES ADDRESS WHEN INTERRUPT OCCURS.
0483*
0484   01036 000000  EINTR NOP
0485   01037 074717        STB EIN
0486   01040 065036        LDB EINTR
0487   01041 102004        HLT 04B
0488   01042 064717        LDB EIN
0489   01043 125036        JMP EINTR,I
0490*
0491*        SW. REG. ROUTINE SELECTED BY SW6=1.TO EXIT THIS TEST
0492*        IT IS NECESSARY TO DEPRESS HALT SWITCH BUTTON AND
0493*        REINITIALIZE TO STARTING ADDRESS OF NEXT TEST TO BE
0494*        RUN.
0495*
0496   01044 102501  SWPT  LIA 01           LOAD PATTERN FROM SW REG
0497   01045 103600  SWPA  OTA 0,C
0498   01046 107500  SWPB  LIB 0,C
0499   01047 025044        JMP SWPT
0500*
0501*        SUBROUTINE TO CONVERT AND OUTPUT TEST PATTERNS
0502*
0503   01050 000000  CONV  NOP
0504   01051 070760        STA TEMP         STORE PATTERN
0505   01052 060552        LDA D4           INITALIZE COUNTER FOR 8 CONV.
0506   01053 070761        STA BCTR
0507   01054 060762        LDA MSGAD        STARTING ADDRESS OF STORAGE
0508   01055 002004        INA              FIRST CONV TO BE PLACED IN 2 WORD
0509   01056 070764        STA ADR
0510   01057 060760  REAG  LDA TEMP         LOAD PATTERN
0511   01060 001200        RAL              ROTATE BIT 15 TO BIT 0
0512   01061 070760        STA TEMP
0513   01062 010553        AND D5           MASK OFF ALL BITS BUT 0
0514   01063 030554        IOR D6           ADD ASC CODE FOR NUM
0515   01064 001727        ALF,ALF          SHIFT TO HIGH ORDER BITS
0516   01065 070001        STA 1            STORE TEMP IN B REG.
0517   01066 060760        LDA TEMP         LOAD PATTERN
0518   01067 001200        RAL              ROTATE NEXT BIT POS. TO BIT 0
0519   01070 070760        STA TEMP
0520   01071 010553        AND D5
0521   01072 030554        IOR D6
0522   01073 030001        IOR 1            MERGE INTO LOWER ORDER OF WORD
0523   01074 170764        STA ADR,I        STORE
0524   01075 034764        ISZ ADR
```

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0525   01076  034761        ISZ  BCTR
0526   01077  025357        JMP  REAG
0527   01100  060555        LDA  D7
0528   01101  064762        LDB  MSGAD
0529   01102  114102        JSB  1028,I
0530   01103  125050        JMP  CONV,I
0531   01104  001104    X   DEF  *
0532                        END
```
** NO ERRORS*

HEWLETT *hp* **PACKARD**

DIAGNOSTIC TEST
for
TELEPRINTER MULTIPLEXOR
COMPUTER INTERFACE KITS

model
12584A
12584A-01
12584A-02

Manual Supplement   MAY 1969

CONTENTS

DIAGNOSTIC OPERATING PROCEDURE

1.   TELEPRINTER MULTIPLEXOR OPERATING PROCEDURE.

2.   A diagnostic test tape and listing is furnished with each Teleprinter Multiplexor Interface Kit.   The HP part number of the tape is on a label attached to the tape and/or container.   Use this number for re-ordering purposes.   This diagnostic program checks the Teleprinter Multiplexor Interface card, HP 12584-6001.

3.   INITIALIZATION TEST.

   a.   Load the teleprinter driver, and configure.

   b.   Load the Teleprinter Multiplexor diagnostic test tape using the Basic Binary Loader.

   c.   Do not install the test connector (12584-6003).

   d.   Put 000110 into Switch Register.

   e.   Push LOAD ADDRESS switch.

   f.   Put address of Teleprinter Multiplexor card into Switch Register.

   g.   Push LOAD A switch.

   h.   Clear Switch Register.

   i.   Push RUN switch.

   j.   Correct execution of this test is indicated by a HLT 00, with the A- and B-Registers cleared.

4.   FLAG TEST.

   a.   Push PRESET switch.

   b.   Push RUN switch.

   c.   This test should loop continuously until Switch 1 of the Switch Register is placed up.

   d.   Correct execution is indicated by a HLT 01, with no errors printed out on the Teleprinter.

5.   PRESET TEST.

a.   Slide test connector (12584-6003) onto the 48-pin connector of the Teleprinter Multiplexor card under test.

b.   Push PRESET switch.

c.   Push RUN switch.

d.   This section of the program will loop continuously. Errors are printed out on the Teleprinter. The ON and OFF indicator lights (located on the test connector) will oscillate between ON and OFF approximately every 10 seconds.

e.   This test loops continuously until Switch 2 of the Switch Register is placed up.

6.   OSCILLATOR ADJUST TEST.

a.   Check the A-Register. If 000346 glows dimly in the A-Register, proceed to step "c" of this test, as the oscillator is within tolerance.

b.   While the card is under test, adjust variable resistor R134 until 000346 is in the A-Register. The oscillator is then set to 880 ± 2 Hz.

c.   To exit this test, put Switch 3 of the Switch Register up.

7.   INTERRUPT TEST.

a.   This test loops continuously. If an error occurs, it is printed out on the Teleprinter.

b.   To exit this test, put Switch 4 of the Switch Register up.

8.   INPUT/OUTPUT TEST.

a.   This test loops continuously. If an error occurs, it is printed out on the Teleprinter.

b.   To exit this test, put Switch 5 of the Switch Register up.

c.   A printed message will indicate that the I/O testing has ended.

d.   Errors are counted in the B-Register when Switch 7 of the Switch Register is up.

9. **TROUBLESHOOTING TEST.**

    a. If an error is typed out on the Teleprinter, put Switch 6 of the Switch Register up. This allows data to be input by the Switch Register. Any port may be tested via the Switch Register.

    b. The A-Register displays the input and the B-Register displays the output.

    c. To exit the troubleshooting test, push HALT switch.

10. **INTERRUPT OPTION.**

11. If at any time the operator would like to suspend the test and then go back to the test at a later time, put Switch 14 of the Switch Register up. To resume normal sequence put Switch 14 down.

12. **TERMINATION OPTION.**

13. If at any time the operator would like to completely suspend a test and start testing a new interface card, put Switch 15 of the Switch Register up. This terminates the current test and goes back to the Initialization Test. At the start of the Initialization Test put Switch 15 of the Switch Register down.