HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

12653A

LINE PRINTER INTERFACE KIT

(FOR 2114, 2115, AND 2116 COMPUTERS)

Card Assembly

12653-60002, Rev. 1024

Note

This manual should be retained with Volume Three of the Hewlett-Packard computer documentation.

12653-90002

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This operating and service manual covers general information, installation, programming, theory of operation, maintenance, and replaceable parts for the Hewlett-Packard 12653A Line Printer Interface Kit (see figure 1-1).

1-3. GENERAL DESCRIPTION.

1-4. The HP 12653A Line Printer Interface Kit provides the necessary equipment to enable using the HP 2767A Line Printer with an HP 2114, 2115, or 2116 Computer. The kit contains the following items:

a. 12653-60002 Line Printer Interface Card.

b. 12653-60001 Cable Assembly.

c. 12653-90002 Operating and Service Manual.

1-5. The line printer interface kit uses a printed-circuit card with integrated circuits (positive-true logic) to transfer data and status information between the computer and the line printer. The interface card contains two 16-bit registers; one for output from the computer and one for input to the computer. Seven data bits are transferred from the computer through the output register to the line printer, and two status bits are transferred from the line printer through the input register to the computer. In addition to the two registers, the interface card contains control and interrupt logic circuits that permit programming of the I/O functions.

1-6. The following information is transferred from the interface card to the line printer:

a. The Device Command signal (called Data Strobe at the line printer) indicates when data is available for transfer to the line printer.

b. Output register bits 0 through 6 (called Data signals 1 through 7 at the line printer) represent an ASCII (American Standard Code for Information Interchange) character for printout or one of the following control words: line feed, form feed, or carriage return.

1-7. The following information is transferred from the line printer, to the interface card:

a. Input register bit 0 (called Demand Line signal at the line printer) indicates the line printer busy status.

b. Input register bit 15 (called Ready signal at the line printer) indicates the line printer ready status.

c. The Device Flag signal (called Demand Line signal at the line printer) indicates when the line printer is unconditionally able to accept new data.

1-8. IDENTIFICATION.

1-9. Printed-circuit card revisions are identified by a letter, a date code, and a division code stamped on the card (e.g., A-1024-22). The letter code identifies the version of

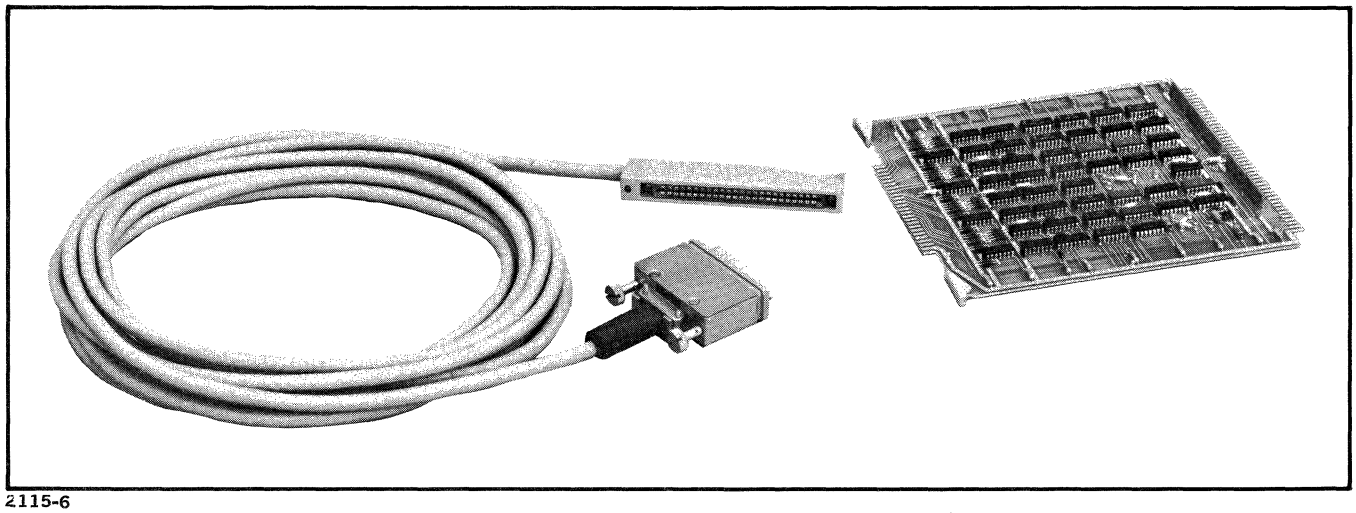

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Figure 1-1. 12653A Line Printer Interface Kit

the etched trace pattern on the unloaded card. The date code (four middle digits) refers to the electrical characteristics of the loaded card. The division code (last two digits) identifies the Hewlett-Packard division that manufactured the card. If the date code stamped on the printed-circuit card does not agree with the date code shown on the title page of this manual, there are differences between your card and the card described in this manual. These differences are described in manual supplements available at the nearest HP Sales and Service Office.

1-10. SPECIFICATIONS.

1-11. Specifications for the line printer interface kit are given in table 1-1.

Table 1-1. Interface Kit Specifications

CURRENT REQUIRED FROM COMPUTER:	
+4.5 Volt Supply:	1.10 amperes
-2 Volt Supply:	0.05 ampere
DATA TRANSFER RATE:	2.5 microseconds per character (average)
TYPE OF CODE USED:	ASCII (7-bits per character)
LOGIC VOLTAGE LEVELS:	
Logic 1:	+2.4 volts dc (minimum)
Logic 0:	+0.4 volts dc (maximum)

SECTION II

INSTALLATION AND PROGRAMMING

2-1. INTRODUCTION.

2-2. This section provides information on unpacking, inspection, installation, reshipment, and programming for the HP 12653A Line Printer Interface Kit.

2-3. UNPACKING AND INSPECTION.

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

2-5. INSTALLATION.

2-6. JUMPER WIRES.

2-7. Table 2-1 lists the appropriate positions of the jumper wires on the interface card. Inspect the card and verify that the jumper wires are in the required positions. See the parts location view in figure 4-1 to determine the physical location of the jumpers.

Table 2-1. Interface Card Jumper Wire Positions

JUMPER WIRE	POSITION
W1	B
W2	A
W3	B
W4	B
W5	Out
W6	In
W7	In
W8	Out
W9	A

2-8. CARD INSTALLATION.

2-9. Install the interface card and cable assembly as follows:

a. Determine if the computer power supplies will provide the additional current required for operation of the interface card. Refer to Volume Three of the Hewlett-Packard computer documentation for a listing of current available from the computer power supplies.

b. Turn off computer and line printer power.

CAUTION

Determine that computer power is off before installing the interface kit, or damage to the computer may result.

c. Open computer for access to I/O card slots.

d. Plug interface card into I/O slot assigned for the particular computer system. Make certain that all higher priority slots have either another I/O card or a priority jumper card installed.

e. Pass the interface card connector of the cable assembly through opening at rear of computer. Slide connector onto interface card and close computer.

f. Connect other end of cable assembly to the mating connector at the rear of line printer.

g. Run diagnostic test as described in the Diagnostic Operating Procedure, part number 12653-90003, contained in the Manual of Diagnostics to verify that the interface card is functioning properly.

2-10. RESHIPMENT.

2-11. If an item of the kit is to be shipped to Hewlett-Packard for service or repair, attach a tag to the item identifying the owner and indicating the service or repair to be accomplished. Include the number of the kit.

2-12. Package the item in the original factory packaging material, if available. If the original material is not available, standard factory packaging material can be obtained from a local Hewlett-Packard Sales and Service Office.

2-13. If standard factory packaging material is not used, wrap the item in Air Cap TH-240 cushioning (or equivalent) manufactured by Sealed Air Corp., Hawthorne, N.J., and place in a corrugated carton (200 pound test material). Seal the shipping carton securely and mark it "FRAGILE" to assure careful handling.

Note

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

2-14. PROGRAMMING.

2-15. The following paragraphs provide information for programming the line printer interface card and line printer. This information consists of the line printer characteristics, status and timing considerations, and a sample assembly language program. Additional programming information is available in the software manuals supplied with the computer.

2-16. LINE PRINTER CHARACTERISTICS.

2-17. The line printer prints up to 475 characters per second depending upon the message length and pattern. Each character requires 7-bits of data (ASCII code) and when each twentieth character is loaded in the line printer input buffers, a print cycle is automatically initiated. Print cycles require from 0.57 to 34.2 milliseconds to complete depending on the distance around the print drum to the last printed character. During the print cycle, characters cannot be loaded into the input buffers.

2-18. Characters are printed in 1 to 4 fields across the print drum with up to 20 characters being printed in each field and a maximum of 80 characters per line. Printing fewer characters per line increases the number of lines printed per minute and decreases the average number of characters printed per second due to the increased time used to feed paper. The minimum printing rates using the four fields are shown in table 2-2.

2-19. The line printer accepts ASCII coded data over seven data lines from the interface card. This data is converted into 64 printed characters and 3 format control words by the line printer input buffers. Printed characters include the 36 standard alphanumeric characters, 27 punctuation marks, and a space. The format control words are: single line, top-of-form, and carriage return. Each of these control words causes the printer to finish printing any characters remaining in the input buffers and then to perform the control word action as follows:

a. The single line control word is programmed by an octal 012 and causes the paper to advance one line. A request for new data is initiated before the paper stops. If the first input data for the next line is also a single line control word, the request for new data is cancelled and the printer advances paper to the next line. To avoid printing on perforations, an Automatic Perforation Stepover signal is initiated by the line printer. When a page boundary (perforation) is sensed, the Automatic Perforation Stepover signal causes the next single line control word to advance the paper six lines, three above and three below the perforation.

b. The top-of-form control word is programmed by an octal 014 and causes the paper to advance to the top of the next form. The paper automatically stops at the third line following the next perforation. A request for new data is initiated before the paper stops.

c. The carriage return control word is programmed by an octal 015 and clears the control registers so that the next character is printed at the left margin.

2-20. STATUS SIGNALS.

2-21. The line printer supplies two status signals that are sent to the interface card. These signals appear as bits 0 and 15 of the input register. Conditions indicated by the status bits are as follows:

BIT	CONDITION
0	Busy signal. Logic 0 indicates that the line printer is unconditionally able to accept new data (on line and ready). Logic 1 indicates that the line printer is storing a character, a print cycle is in progress, or the printer is not on-line and ready.
15	$\overline{\text{Ready}}$ signal. Logic 0 indicates that the line printer is ready to be put on-line and that the following five conditions are true: (1) line printer power is on, (2) paper is loaded, (3) drum gate is closed, (4) motor is running up to speed, and (5) paper feed motor is not over heated. Logic 1 indicates that a fault condition exists in the line printer.

Table 2-2. Line Printer Printing Rates

FIELD NO.	CHARACTER POSITIONS IN FIELD	MAXIMUM CHARACTERS PER LINE	MINIMUM PRINTING RATE (LINES PER MINUTE)
1	0 thru 20	20	1110
2	21 thru 40	40	650
3	41 thru 60	60	460
4	61 thru 80	80	356

2-22. TIMING.

Note

In the following discussion, high refers to the more positive signal and low refers to the less positive signal.

2-23. Line printer operation is synchronized through Device Flag and Device Command signals. (These signals are called Demand Line and Data Strobe, respectively, on the line printer diagrams.) The Device Flag signal is initiated by the line printer when it is able to accept an input from the interface card. The Device Command signal is initiated on the interface card by a programmed instruction. Device Command signals are sent to the line printer to indicate when interface card outputs are ready to be transferred to the line printer. Figure 2-1 shows the interface card signal timing.

2-24. DEVICE FLAG SIGNAL. To initiate a Device Flag signal the line printer must be in ready status, placed in the on-line mode by the operator, and not busy processing a previous input. The line printer is in ready status when the power is on, drum gate is closed, paper is loaded, and no fault conditions exist. When the line printer is ready, the ready status signal goes low and remains low. The operator selects the on-line mode by setting a switch on the line printer. With these two conditions met, the line printer can receive and process inputs from the interface card. Inputs from the interface card consist of characters and control words (containing seven bits each) that are transferred serially to the line printer. Each character or control word received by the line printer is stored in the input buffers. The input is then decoded and the control word action performed. The line printer is busy when it is transferring data to storage or performing one of the control word operations. While the line printer is busy, the Device Flag signal is high. The Device Flag signal is low only when operations are complete and the line printer is not busy.

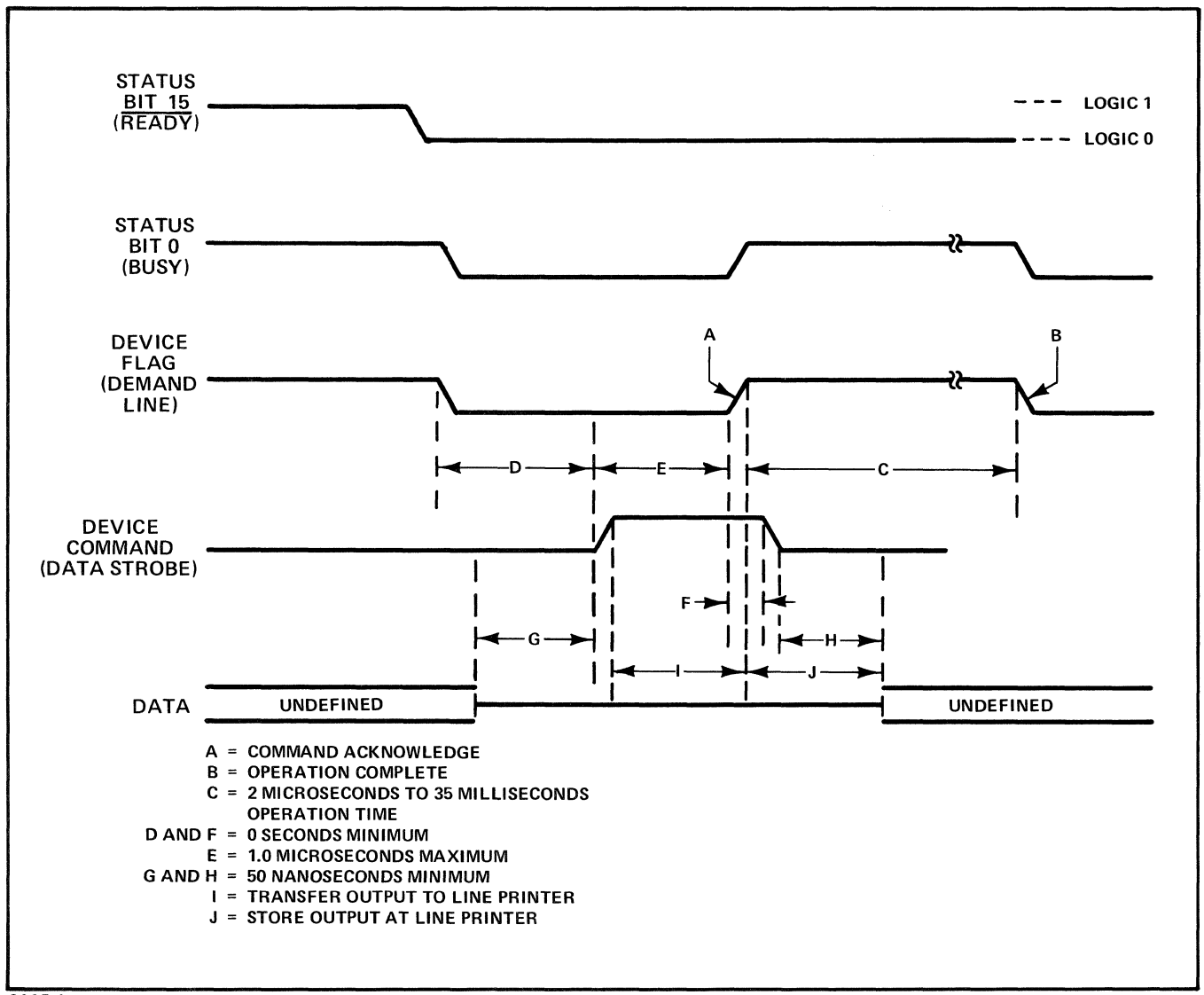

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Figure 2-1. Interface Signal Timing Diagram

2-25. The Device Flag signal is used by the interface card to indicate busy status, to acknowledge the transfer of data to the line printer, and to indicate to the computer when the line printer is ready to accept new data. To indicate busy status, the Device Flag signal line is connected to the input register Bit 0 FF. When the flip-flop output is a logic 0, the line printer is not busy (figure 2-1). To acknowledge data transfer, the Device Flag signal transition from low-to-high is used to clear the Device Command FF. The Device Flag signal goes from low-to-high when the line printer receives and is processing new data. As soon as the data processing is complete, the line printer is again not busy and the Device Flag signal goes from high-to-low. This transition from high-to-low causes the Flag FF to be set. Setting the Flag FF indicates that the data processing is complete and the line printer is ready to accept new data.

2-26. DEVICE COMMAND SIGNAL. The Device Command signal is initiated by programming a set control, clear flag (STC,C) instruction with the line printer select code. First, a character or control word is transferred from the computer to the interface card output register by an OTA or OTB instruction. Then, the set control portion of the STC,C instruction initiates the Device Command signal. The Device Command signal enables the transfer of data from the interface card to the line printer. The clear flag portion of the instruction causes the computer to hold any additional data until the transferred data is stored. When the character or control word is transferred to the line printer, the line printer causes the Device Flag signal to go high. During the low-to-high transition, the Device Flag signal acknowledges the data transfer by causing the Device Command signal to go low. The Device Command signal remains low until the computer is again programmed to transfer data.

2-27. The line printer accepts and stores 20 consecutive characters and then automatically initiates a print cycle. A print cycle is also initiated by any of the three control words. When the line printer receives any control word, it first prints the characters that are stored in the line printer input buffers and then performs the control word function. The control word functions are: single line paper advance, top-of-form paper advance, and carriage return.

2-28. ASSEMBLY LANGUAGE PROGRAM.

2-29. Table 2-3 provides an assembly language program that indicates the operations and instructions required to transfer data from the computer memory to the line printer for print out. This program, when assembled on an object tape, will perform a print out using the skip-if-flag-set (SFS) method. The interrupt method is also available; however, the program is more complex because of subroutine requirements.

Table 2-3. Assembly Language Program for the Line Printer Interface Card

```
0001                    ASMB,A,L,B,T
NEXT     001012
NEWD     001020
OUT      001022
N        001036
BFCTR    001037
BFADD    001040
BUFAD    001041
BUFF     001042
LF       001107
LP       000014
CHRCT    001110
**  NO ERRORS*
0001                    ASMB,A,L,B,T
0002*  THIS IS A SAMPLE PROGRAM FOR THE HP 80-COLUMN
0003*  LINE PRINTER
0004*
0005*
0006  01000                 ORG 1000B
0007  01000 065110          LDB CHRCT     INITIALIZE SWITCH TO KEEP TRACK
0008*                                      OF THE LEFT OR RIGHT CHARACTER
0009*                                       WITHIN WORD
0010  01001 061036          LDA N         INITIALIZE PRINT LINE
0011  01002 071037          STA BFCTR      COUNTER
0012  01003 061041          LDA BUFAD     INITIALIZE PRINT LINE BUFFER
0013  01004 071040          STA BFADD      ADDRESS POINTER
0014  01005 102514          LIA LP        GET LINE-PRINTER STATUS. B15=0
0015  01006 002020          SSA            INDICATES: PAPER LOADED, GATE
0016*                                       CLOSED, SPEED OKAY, POWER ON,
0017*                                        TEMPERATURE OKAY
0018  01007 102010          HLT 10B       B15=1
0019  01010 000010          SLA           B0=0 INDICATES LINE PRINTER
0020*                                      READY, ON-LINE AND NOT BUSY
0021  01011 102011          HLT 11B       B0=1 LINE PRINTER BUSY
0022  01012 161040  NEXT    LDA BFADD,I   PICK-UP CHARS AND DETERMINE WHICH
0023  01013 006011          SLB,RSS        CHAR WITHIN WORD IS TO BE OUTPUT
0024  01014 025020          JMP NEWD      GO TO OUTPUT LEFT CHARACTER
0025  01015 035040          ISZ BFADD      UPDATE POINTER TO NEXT WORD
0026  01016 005200          RBL             INDICATE LEFT CHAR TO BE
0027*                                        OUTPUT NEXT
0028  01017 025022          JMP OUT       OUTPUT CHARACTER
0029  01020 001727  NEWD    ALF,ALF       POSITION SO LEFT CHARACTER
0030*                                      CAN BE OUTPUT NEXT
0031  01021 005200          RBL             INDICATE RIGHT CHAR TO BE
0032*                                        OUTPUT NEXT
0033  01022 102614  OUT     OTA LP        OUTPUT CHARACTER
0034  01023 103714          STC LP,C      STROBE INTO LINE PRINTER BUFFER
0035*                                      AND CLEAR INTERFACE BUFFER
0036  01024 102314          SFS LP        WAIT FOR COMPLETION OF CHARACTER
0037  01025 025024          JMP *-1        TRANSFER
0038  01026 035037          ISZ BFCTR     INCREMENT LINE OUTPUT COUNTER
0039  01027 025012          JMP NEXT      OUTPUT MORE CHARACTERS
0040  01030 061107          LDA LF        OUTPUT LINE-FEED
0041  01031 102614          OTA LP         CHARACTER
0042  01032 103714          STC LP,C        AND STROBE INTO LINE
0043*                                        PRINTER BUFFER
0044  01033 102314          SFS LP        WAIT FOR LINE-FEED OPERATION
0045  01034 025033          JMP *-1       COMPLETION
0046  01035 102012          HLT 12B       OPERATION COMPLETE HALT
```

Table 2-3. Assembly Language Program for the Line Printer Interface Card (Continued)

```
0047  01036 177667  N      DEC -73
0048  01037 000000  BFCTR  BSS 1
0049  01040 000000  BFADD  BSS 1
0050  01041 001042  BUFAD  DEF BUFF
0051  01042 052110  BUFF   ASC 17,THIS IS A SAMPLE PROGRAM USING THE
      01043 044523
      01044 020111
      01045 051440
      01046 040440
      01047 051501
      01050 046520
      01051 046105
      01052 020120
      01053 051117
      01054 043522
      01055 040515
      01056 020125
      01057 051511
      01060 047107
      01061 020124
      01062 044105
0052  01063 020110          ASC 13, HEWLETT-PACKARD 80-COLUMN
      01064 042527
      01065 046105
      01066 052124
      01067 026520
      01070 040503
      01071 045501
      01072 051104
      01073 020070
      01074 030055
      01075 041517
      01076 046125
      01077 046516
0053  01100 020114          ASC  7, LINE PRINTER
      01101 044516
      01102 042440
      01103 050122
      01104 044516
      01105 052105
      01106 051040
0054  01107 000012  LF     OCT 12
0055  00014         LP     EQU 14B       LINE PRINTER SELECT CODE
0056  01110 125252  CHRCT  OCT 125252
0057                       END
**  NO ERRORS*
```

SECTION III
THEORY OF OPERATION

3-1. INTRODUCTION.

3-2. This section contains a functional description and a detailed circuit description of the line printer interface card. Also included at the back of this section is an operational flow diagram (figure 3-2) of the interface card.

3-3. FUNCTIONAL DESCRIPTION.

3-4. The line printer interface card contains an output register and the necessary control circuits to transfer data from the computer to the line printer. The interface card also contains an input register used to transfer status information from the line printer to the computer. All functions are performed under programmed instructions and result in characters being printed by the line printer. Programmed instructions initiate the control signals that are sent from the computer to the interface card (figure 3-1). These control signals enable the interface card output register so that data is transferred from the computer to the register. Control signals then initiate a Device Command signal that is sent from the interface card to the line printer. When the line printer is on-line and ready to receive data, it responds to the Device Command signal by printing.

3-5. Data is transferred from the computer to the interface card and then to the line printer in 7-bit parallel ASCII. Each data transfer represents one character for printing or one of three control words. As the character or control word is received by the line printer, the line printer stores or processes the data as required and then returns a Device Flag signal to the interface card. The Device Flag signal indicates when the line printer is ready to receive more data.

3-6. On the interface card, the Device Flag signal initiates either a Skip Flag or Interrupt Request signal depending on the method programmed for data transfer. The initiated signal is then sent to the computer to start the next data transfer. Data transfer continues as long as the computer is programmed to transfer data to the line printer and the line printer remains on-line and ready.

3-7. Line printer status is indicated by two status signals that are sent from the line printer to the interface card input register. To read status indications, Control signals are used to enable the input register and send the information to the computer. The signals indicate the line printer ready and busy status and both signals are false when the line printer is ready, on-line, and not busy processing data.

3-8. DETAILED CIRCUIT DESCRIPTION.

3-9. The line printer interface card uses integrated circuits with positive-true logic. There are nine jumper wires

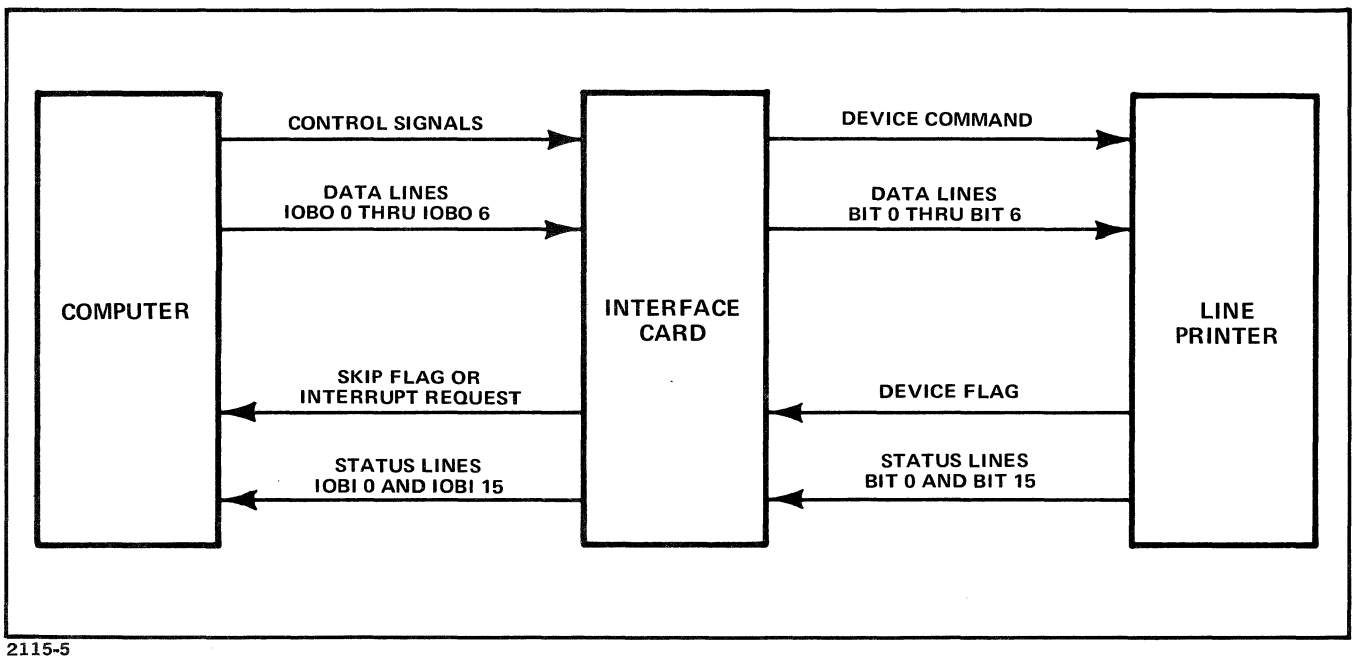


Figure 3-1. Line Printer Interface Signal Flow, Block Diagram

used to establish operating conditions for the integrated circuits. These jumper wires must be installed or removed as shown in table 2-1. The jumper wire configuration is also shown on the line printer interface card schematic diagram and parts location view, figure 4-1. In this configuration, some components are not used and are not described in the following paragraphs. Circuits that are described are divided into eight circuit groups as follows:

a. Turn-on and preset circuit.
b. Select code detector circuit.
c. Flag circuit.
d. Control circuit.
e. Interrupt circuit.
f. Skip-flag circuit.
g. Output register.
h. Input register.

3-10. TURN-ON AND PRESET CIRCUIT.

3-11. The turn-on and preset circuit establishes initial conditions for the interface card logic circuits. At computer power turn-on or when computer preset is enabled, the computer sends true POPIO(B) and CRS signals to the interface card. The true POPIO(B) signal is inverted to set the Flag Buffer FF which then enables the Flag FF at the next time T2. This inverted POPIO(B) signal is inverted again to provide a true Latch signal to the output register. Computer inputs to the output register are false during turn-on and preset so that a true Latch signal clears the register. The true CRS signal is inverted to clear both the Control and Device Command FFs.

3-12. SELECT CODE DETECTOR CIRCUIT.

3-13. The select code detector circuit enables the line printer interface card to accept and perform the instructions intended for the line printer. When the line printer is addressed by programmed instructions, the SCM and SCL signals are both true at the interface card. The IOG signal goes true when any instruction is programmed for an I/O device. These three signals are combined and inverted, and then inverted again and distributed to the programmed instruction signal input gates. Therefore, all three signals must be true before the interface card will accept a programmed instruction.

3-14. FLAG CIRCUIT.

3-15. The flag circuit provides initial conditions that allow the computer to send data to the line printer by either the interrupt or skip flag method. This circuit contains the Flag and Flag Buffer FFs and the device flag pulse shaping network. One condition that is required to transfer data is that the Flag FF be set. The Flag FF is always set at T2 (ENF signal true) of the following machine cycle after the Flag Buffer FF is set. Setting the Flag Buffer FF is done by any of three methods; during power turn-on and preset by the POPIO(B) signal, by programming an STF instruction, and by the Operation Complete signal from the device flag pulse shaping network. The Flag and Flag Buffer FFs are both cleared by a CLF instruction and the Flag Buffer FF can also be cleared by an IAK signal from the computer.

3-16. The line printer sends a Device Flag signal to a pulse shaping network on the interface card. During the time that the line printer is busy storing or printing data, the Device Flag signal is held true. When the line printer is ready, on-line, and not busy storing or printing data, the Device Flag signal goes false and is held false until new data is accepted. These changes in signal levels are used by the pulse shaping network to develop Command Acknowledge and Operation Complete signals as follows: When the Device Flag signal is false (line printer not busy) the input to gate U86C is false at pin 13 and true at pin 12. During the transistion of the Device Flag signal from false to true, pin 13 to gate U86C goes true and pin 12 remains true providing a false output until capacitor C5 discharges. This false output is the Command Acknowledge signal that is used to clear the Device Command FF. The Operation Complete signal is developed in the same manner except that the output is inverted through gate U85B. This inversion provides a true Operation Complete signal when the Device Flag signal goes from true to false. The true Operation Complete signal is used to set the Flag Buffer FF when the line printer is ready to accept data.

3-17. CONTROL CIRCUIT.

3-18. The control circuit is enabled to signal the line printer that data is available at the interface card output register. This circuit contains the Control and Device Command FFs. Both flip-flops are set by an STC instruction and cleared by a CRS signal or CLC instruction. The Device Command FF is also cleared by a Command Acknowledge signal from the device-flag pulse-shaping network. (Refer to paragraph 3-16.) Normally, the Control FF is set by the first STC instruction to the interface card and remains set until a CRS signal or CLC instruction is received. When set, the Control FF provides one condition for enabling the interrupt circuit. When the Device Command FF is set, the false clear-side output is sent to gate U75A. This gate inverts the false signal and sends a true Device Command signal to the line printer.

3-19. INTERRUPT CIRCUIT.

3-20. The interrupt circuit interrupts computer operation on a priority basis. During the interrupt, data is transferred from computer memory to the line printer. The interrupt circuit contains the IRQ FF. Initial conditions are established when the Flag and Control FFs are set and an IEN signal is received to enable gate U46B. An IEN signal is received when an STF instruction is programmed with select code 00. The false output from gate U46B is sent to gate U25A and inverted and sent to gate U35A. If gate U25A also receives a true PRH signal, indicating that there are no higher priority cards requesting an interrupt, the gate output goes false, sending a PRL signal to all lower priority cards. The PRL signal inhibits all lower priority cards from interrupting line printer operation. Gate U35A also receives a PRH signal, a signal from the set-side output of the Flag Buffer FF, and an SIR (T5) signal. If all the inputs to gate

U35A are true, the output goes false and sets the IRQ FF. Setting the IRQ FF provides FLG and IRQ output signals. When the IRQ FF is first set, the true FLG and IRQ signals are sent to the computer to initiate an interrupt phase (phase 4) during the next machine cycle.

3-21. During the interrupt phase, at time T2, the ENF signal is true and the SIR (time T5) signal is false. The ENF signal then clears the IRQ FF to allow any higher priority cards to use the requested interrupt phase. If a higher priority card does not use the requested interrupt phase, the PRH signal remains true, as do the other inputs to gate U35A, and the IRQ FF is set a second time at time T5 (SIR goes true). When the IRQ FF is set the second time, the true FLG and IRQ signals are used to decode the interrupt address.

3-22. The next machine cycle is then controlled by the instruction located at the interrupt address in the computer memory. During this machine cycle, the computer sends an IAK signal to the interface card that clears the Flag Buffer FF at time T1, and the ENF signal clears the IRQ FF at time T2. Clearing the Flag Buffer FF prevents the IRQ FF from being set again after the requested interrupt is enabled. However, the Flag FF remains set to provide a false PRL signal and inhibit lower priority cards from interrupting until the requested interrupt is complete. To clear the Flag FF and enable lower priority cards to interrupt, a CLF instruction must be programmed.

3-23. SKIP FLAG CIRCUIT.

3-24. The skip flag circuit is used to transfer data from computer memory to the line printer using a non-interrupt method. Before using the non-interrupt method, a CLF instruction is usually issued to select code 00 to disable the IEN signal and ensure that interrupt cannot occur. To enable the skip flag circuit, an SFS or SFC instruction is issued with the line printer select code. With the SFS instruction, the Flag FF must be set to provide a true SKF output signal to the computer. For the SFC instruction, the Flag FF must be cleared to provide a true SKF output signal. The true SKF signal tells the computer that the line printer is ready to receive data. With this method of transferring data, the computer is programmed to wait in a recycling loop before each data transfer until the SKF signal is true.

3-25. OUTPUT REGISTER.

3-26. The output register provides a buffer between computer memory and the line printer. Data to be transferred is first stored in the output register and then read by the line printer. The output register contains 16 latching flip-flops. However, only seven (bits 0 through 6) are used for line printer data transfer. Latching flip-flops can change states only if the latch input is true. Each signal input is applied to both the set- and clear-side input pins. When the latch input is true, a true input signal causes the flip-flop to set, and a false input signal causes the flip-flop to clear. Input signals to the flip-flops are applied directly from the computer on the IOBO lines and are applied to the lines by an OTA or OTB instruction. The same instruction causes an IOO signal to be applied to gate U45C. Gate U45C is enabled if the OTA or OTB instruction was addressed with the line printer select code and the IOO Delay FF is set. The IOO Delay FF inhibits gate U45C until computer time T4. This allows time for the data on the IOBO lines to stabilize. At time T4, gate U45C is enabled and its output inverted by gate U85A. The resulting true IOO (delayed) signal is applied to the output register latch inputs, and data on the IOBO lines is loaded into the output register. Output gates of the output register are continuously enabled through gate U75B. To read data from the output register, the line printer must receive a Device Command signal from the interface card. Data sent to the line printer is in seven-bit parallel ASCII code with each seven-bit word representing one character for printing or one control word.

3-27. INPUT REGISTER.

3-28. The input register provides a buffer for transferring status information from the line printer to the computer. Status information is always available at the input register and can be read by the computer by an LIA or LIB instruction. The input register contains 16 latching flip-flops. However, only the Bit 0 and Bit 15 flip-flops are used. The latch input to the Bit 0 FF is tied to +4.5V dc through resistor R67, and the latch input to the Bit 15 FF is tied to +4.5V dc through resistor R75. This keeps both latch inputs at a true level so that true inputs will set the flip-flops and false inputs will clear the flip-flops. Input to the Bit 15 FF is provided from the line printer Ready output. The signal is false when the line printer is ready. Input to the Bit 0 FF is provided from the line printer Device Flag signal line. The Device Flag signal is false when the line printer is on-line and not busy storing or printing data. To prevent erroneous indications, the input pins to the Bit 1 through Bit 14 FFs are tied to ground at the interface card connector. Output gates of the input register are enabled by an LIA or LIB instruction with the line printer select code. This instruction develops an IOI signal that is sent through gate U25B to enable the output gates.

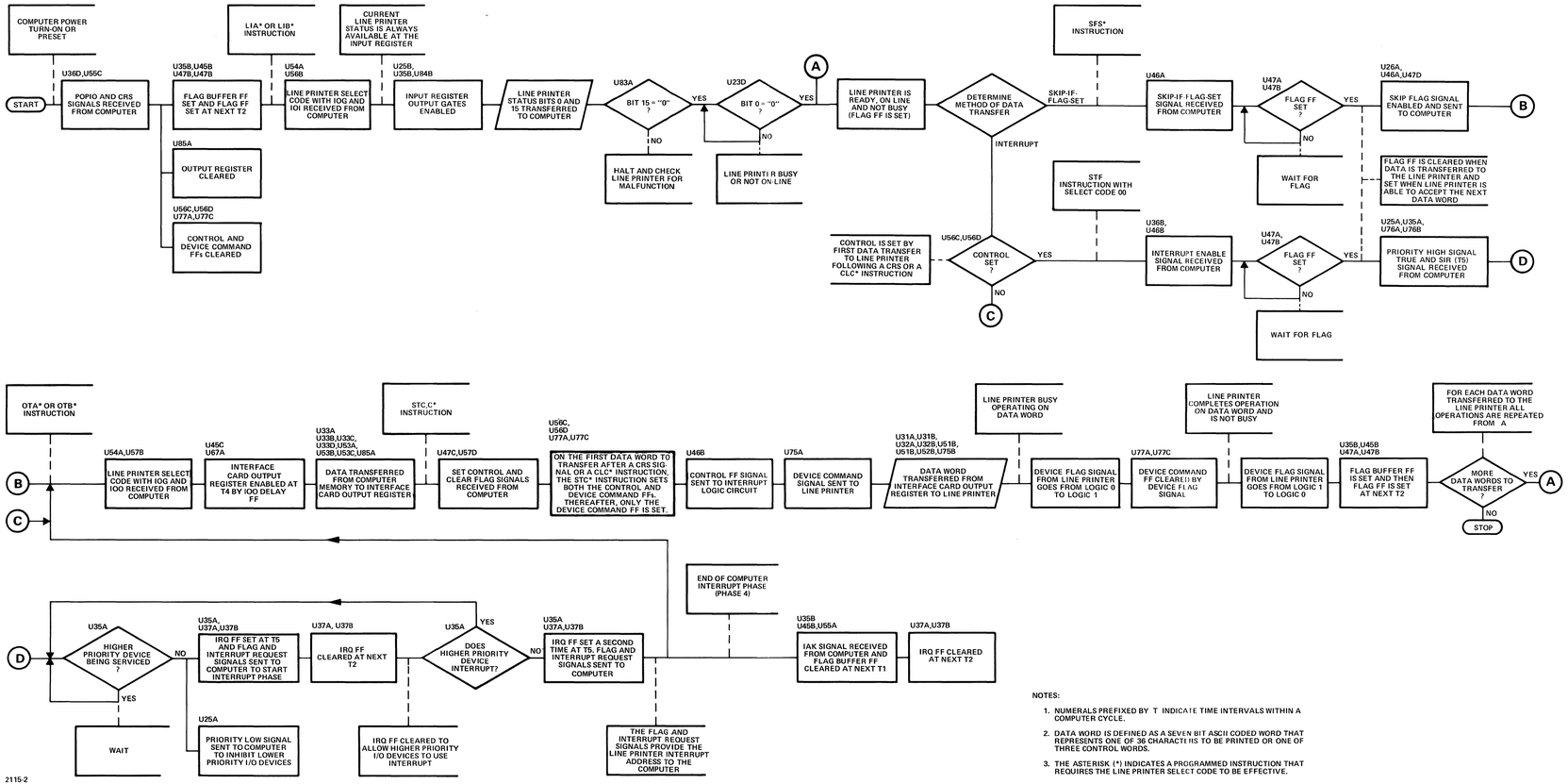


Figure 3-2. Operational Flow Diagram

SECTION IV
MAINTENANCE

4-1. INTRODUCTION.

4-2. This section contains information on diagnostics and troubleshooting for the line printer interface kit.

4-3. PREVENTIVE MAINTENANCE.

4-4. Detailed preventive maintenance procedures and schedules are provided in Volume Two for the computer. There are no separate preventive maintenance procedures to be performed on the interface kit.

4-5. DIAGNOSTICS.

4-6. The interface card may be checked using the Diagnostic Operating Procedures, part no. 12653-90003, contained in the Manual of Diagnostics. The diagnostic will check the flag, control, and interrupt circuits, and the input and output buffer registers on the interface card.

4-7. TROUBLESHOOTING.

4-8. Troubleshooting for the interface card is accomplished by performing the tests in the diagnostic program and analyzing any error halts that occur as the test is being run. Continuity checks of the interconnecting cable may be performed by using table 4-1. To further isolate the trouble, refer to the schematic diagram and parts location view in figure 4-1. Table 4-2 contains a parts list for the interface card with the parts listed in alphanumeric order by reference designation. Logic and pin location diagrams for the integrated circuits used on the interface card are contained in figure 4-2. Table 4-3 gives the integrated circuit input levels, output levels, and delay times which correspond to the integrated circuit characteristic number shown below each diagram in figure 4-2.

4-9. CABLE ASSEMBLY CONNECTOR PIN FUNCTIONS.

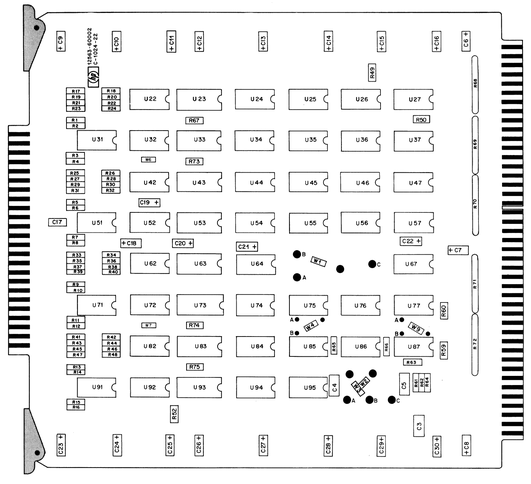
4-10. Table 4-1 contains a list of cable assembly pin assignments for the interface card connector and the line printer connector. The cable assembly contains 12 twisted-pair conductors. Each twisted pair consists of a signal conductor and a signal ground conductor. The entries in table 2-2 are organized with the signal conductor of a twisted pair listed first and the corresponding signal ground conductor immediately following. The signal ground conductors are connected together at pins BB and 24. In the cable connector that connects to the interface card, pins 2 through 15 are also connected to signal ground through pins BB and 24.

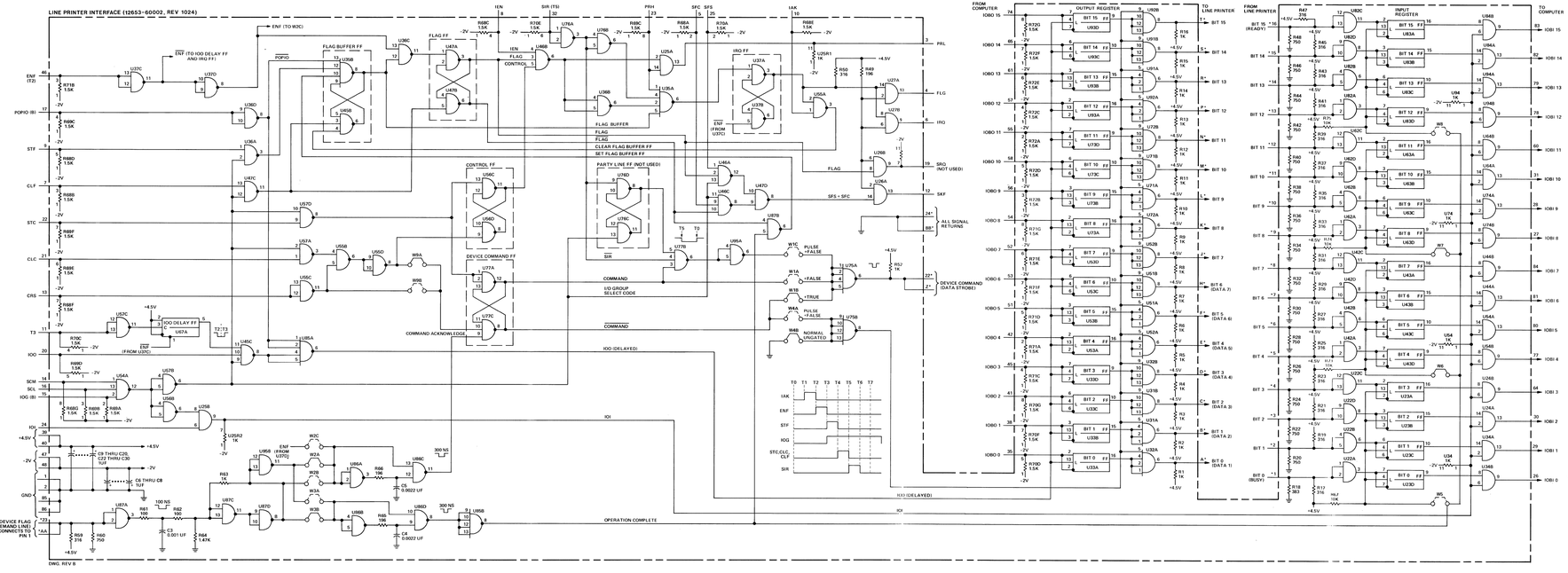
Table 4-1. Cable Assembly, Connector Pin Functions

INTERFACE CARD CONNECTOR PINS	LINE PRINTER CONNECTOR PINS	WIRE COLOR	SIGNAL NAME	
			INTERFACE CARD	LINE PRINTER
A BB,24	B D	BRN WHT	Output Bit 0 Sig Gnd	Data 1
B BB,24	F J	RED WHT	Output Bit 1 Sig Gnd	Data 2
C BB,24	L N	ORN WHT	Output Bit 2 Sig Gnd	Data 3
D BB,24	R T	YEL WHT	Output Bit 3 Sig Gnd	Data 4
E BB,24	V X	GRN WHT	Output Bit 4 Sig Gnd	Data 5
F BB,24	Z b	BLU WHT	Output Bit 5 Sig Gnd	Data 6
H BB,24	n k	VIO WHT	Output Bit 6 Sig Gnd	Data 7
Z,22 BB,24	j m	WHT/BLK WHT	Device Command Sig Gnd	Data Strobe
AA,23,1 BB,24	E C	WHT/RED WHT	Device Flag/Input Bit 0 Sig Gnd	Demand Line
16 BB,24	CC EE	GRA WHT	Input Bit 15 Sig Gnd	$\overline{\text{Ready}}$
2 thru 15	–	–	Sig Gnd	

Table 4-2. Line Printer Interface Card Replaceable Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
C3	0160-0153	Capacitor, Fxd, My, 1000 pF, 10%, 200 VDCW	28480	0160-0152
C4,5	0160-0154	Capacitor, Fxd, My, 2200 pF, 10%, 200 VDCW	28480	0160-0154
C6 thru C20, C22 thru C30	0180-0291	Capacitor, Fxd, Elect, 1uF, 10%, 35 VDCW	56289	150D105X 9035A2
R1 thru R16,52,63	0757-0280	Resistor, Fxd, Flm, 1k, 1%, 1/8W	14674	MF4CD1001F
R17,19,21,23,25,27,29,31,33, 35,37,39,41,43,45,47,50,59	0698-3444	Resistor, Fxd, Flm, 316 ohms, 1%, 1/8W	19701	MF4CD3160F
R18,20,22,24,26,28,30,32,34, 36,38,40,42,44,46,48,60	0757-0420	Resistor, Fxd, Flm, 750 ohms, 1%, 1/8W	28480	0757-0420
R49,65,66	0698-3440	Resistor, Fxd, Flm, 196 ohms, 1%, 1/8W	28480	0698-3440
R61,62	0757-0401	Resistor, Fxd, Flm, 100 ohms, 1%, 1/8W	28480	0757-0401
R64	0757-1094	Resistor, Fxd, Flm, 1.47k, 1%, 1/8W	28480	0757-1094
R67, R73 thru R75	0757-0442	Resistor, Fxd, Flm, 10k, 1%, 1/8W	14674	MF4CD1002F
R68 thru R72	1810-0020	Resistor Network (7 fxd flm resistors)	28480	1810-0020
U22,42,62,82	1820-0141	Integrated Circuit, TTL	04713	SC7514PK
U23,33,43,53,63,73,83,93	1820-0301	Integrated Circuit, TTL	01295	SN4463
U24 thru U27,34,44,54,64,74 84,94	1820-0956	Integrated Circuit, CTL	07263	SL3459
U31,32,51,52,71,72,91,92	1820-0140	Integrated Circuit, TTL	04713	SC7513PK
U35	1820-0069	Integrated Circuit, TTL	56289	USN7420A
U36,37,47,55,56,57,76,86, 87,95	1820-0054	Integrated Circuit, TTL	01295	SN4343
U45,46,77	1820-0068	Integrated Circuit, TTL	12040	SN7410N
U67	1820-0077	Integrated Circuit, TTL	01295	SN43354
U75,85	1820-0071	Integrated Circuit, TTL	01295	SN7440N
W1 thru W4,6,7,9	8159-0005	Jumper Wire	28480	8159-0005





NOTES:

1. ALL LOGIC IS POSITIVE TRUE.
2. PINS 23* AND AA* ARE EXTERNALLY JUMPERED TO PIN 1*.
3. SCHEMATIC DIAGRAM FOR RESISTOR NETWORKS R68 THRU R72

4. AN ASTERISK (*) DENOTES PINS ON THE 48-PIN CONNECTOR. ALL OTHER PINS ARE ON THE 86-PIN CONNECTOR.
5. PINS 2* THROUGH 15* ARE EXTERNALLY JUMPERED TO PINS BB* AND 24*.

Figure 4-1. Line Printer Interface Card Schematic Diagram and Parts Location View

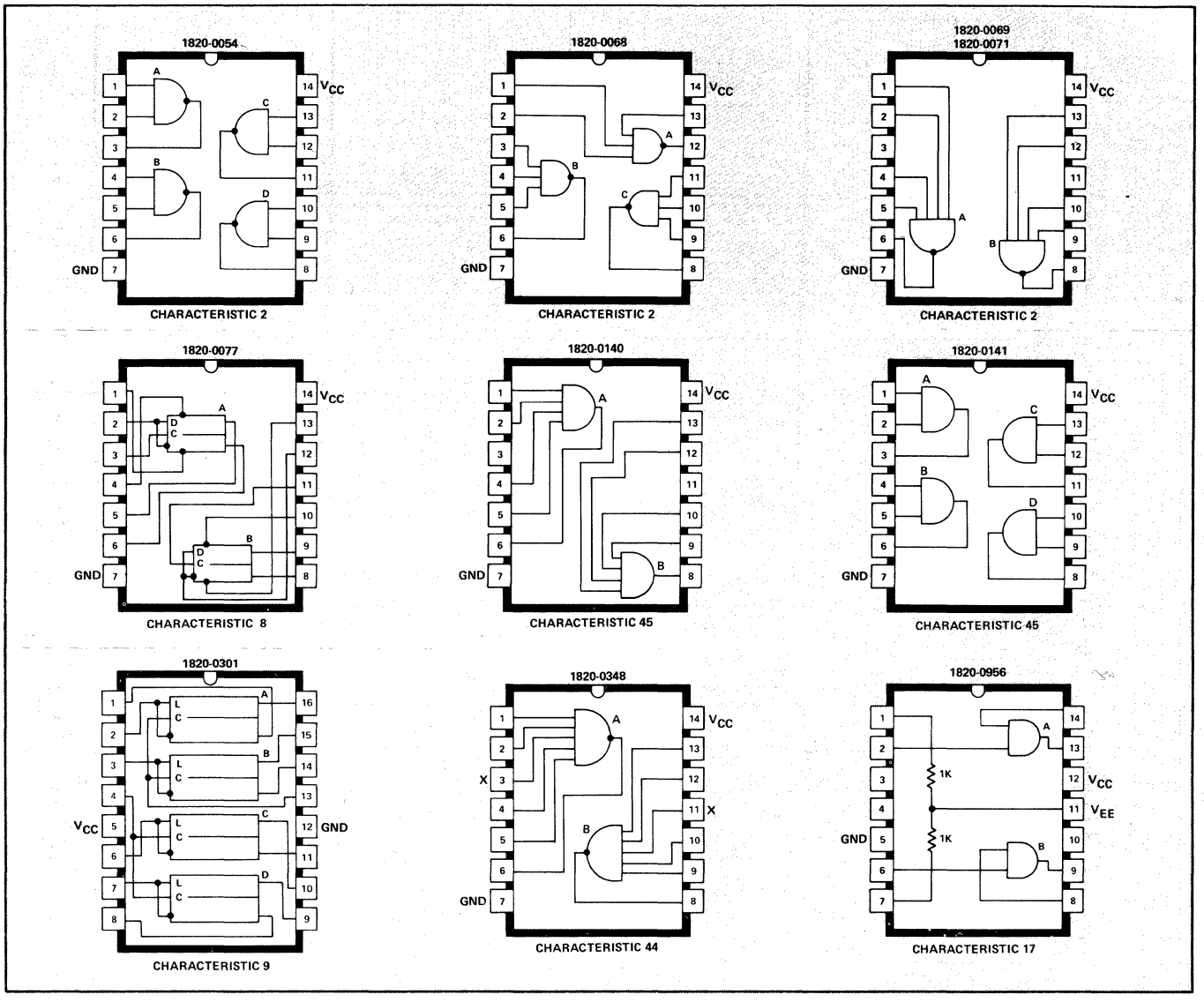


Figure 4-2. Integrated Circuit Diagrams

Table 4-3. Integrated Circuit Characteristics

CHARACTERISTIC	INPUT LEVEL		OUTPUT LEVEL		OPEN INPUT ACTS AS:	PROPAGATION DELAY (MAX)	
	LOGIC 1 (VOLTS, MIN)	LOGIC 0 (VOLTS, MAX)	LOGIC 1 (VOLTS, MIN)	LOGIC 0 (VOLTS, MAX)		TO LOGIC 1 (NANOSECONDS)	TO LOGIC 0 (NANOSECONDS)
2	+2.0	+0.8	+2.4	+0.4	Logic 1	29	15
8	+2.0	+0.8	+2.4	+0.4	Logic 1	35	50
9	+2.0	+0.8	+2.4	+0.4	Logic 1	40	25
17	+1.25	+0.5	+2.25	-0.36	Logic 0	18	18
44	+1.8	+1.1	+2.5	+0.4	Logic 1	15	15
45	+2.0	+1.1	Note 1	+0.5	Logic 1	50	35

NOTE:

1. Depends on load.

SECTION V
REPLACEABLE PARTS

5-1. INTRODUCTION.

5-2. This section contains information for ordering replacement parts for the HP 12653A Line Printer Interface Kit. Table 5-1 lists parts in alphanumeric order by HP part number and lists the following information for each part.

a. Description of the part. (Refer to table 5-2 for an explanation of abbreviations and reference designations used in the DESCRIPTION column.)

b. Typical manufacturer of the part in a five-digit code; refer to the list of manufacturers in table 5-3.

c. Manufacturer's part number.

d. Total quantity of each part used in the interface kit.

5-3. A separate parts list is provided along with the parts location view for the interface card in section IV of this manual. This parts list presents the parts in alphanumeric order by reference designation.

5-4. ORDERING INFORMATION.

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

a. Instrument model and serial number.
b. Hewlett-Packard part number for each part.
c. Description of each part.
d. Circuit reference designation.

Table 5-1. Line Printer Interface Kit Replaceable Parts

HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	TQ
0160-0153	Capacitor, Fxd, My, 1000 pF, 10%, 200 VDCW	28480	0160-0152	1
0160-0154	Capacitor, Fxd, My, 2200 pF, 10%, 200 VDCW	28480	0160-0154	2
0180-0291	Capacitor, Fxd, Elect, 1 uF, 10%, 35 VDCW	56289	150D105X 9035A2	24
0698-3440	Resistor, Fxd, Flm, 196 ohms, 1%, 1/8W	28480	0698-3440	3
0698-3444	Resistor, Fxd, Flm, 316 ohms, 1%, 1/8W	19701	MF4CD3160F	18
0757-0280	Resistor, Fxd, Flm, 1k, 1%, 1/8W	14674	MF4CD1001F	18
0757-0401	Resistor, Fxd, Flm, 100 ohms, 1%, 1/8W	28480	0757-0401	2
0757-0420	Resistor, Fxd, Flm, 750 ohms, 1%, 1/8W	28480	0757-0420	17
0757-0442	Resistor, Fxd, Flm, 10k, 1%, 1/8W	14674	MF4CD1002F	4
0757-1094	Resistor, Fxd, Flm, 1.47k, 1%, 1/8W	28480	0757-1094	1
1810-0020	Resistor Network (7 fxd flm resistors)	78480	1810-0020	5
1820-0054	Integrated Circuit, TTL	01295	SN4343	10
1820-0068	Integrated Circuit, TTL	12040	SN7410N	3
1820-0069	Integrated Circuit, TTL	56289	USN7420A	1
1820-0071	Integrated Circuit, TTL	01295	SN7440N	2
1820-0077	Integrated Circuit, TTL	01295	SN43354	1
1820-0140	Integrated Circuit, TTL	04713	SC7513PK	8
1820-0141	Integrated Circuit, TTL	04713	SC7514PK	4
1820-0301	Integrated Circuit, TTL	01295	SN4463	8
1820-0956	Integrated Circuit, CTL	07263	SL3459	11
8159-0005	Jumper Wire	28480	8159-0005	7
12566-8001	Printed Circuit Board	28480	8159-8001	1
12653-60001	Cable Assembly	28480	12653-60001	1
12653-60002	Line Printer Interface Card Assembly	28480	12653-60002	1
12653-90002	Line Printer Interface Kit Operating and Service Manual	28480	12653-90002	1

Table 5-2. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly	K = relay	TB = terminal board
B = motor	L = inductor	TP = test point
BT = battery	M = meter	U = integrated circuit
C = capacitor	MC = microcircuit	V = vacuum tube, neon bulb, photocell, etc.
CR = diode	P = plug connector	
DL = delay line	Q = transistor	VR = voltage regulator
DS = indicator (lamp)	R = resistor	W = cable, jumper
E = misc hardware	RT = thermistor	X = socket
F = fuse	S = switch	Y = crystal
FL = filter	T = transformer	Z = tuned cavity, network
J = receptacle connector		

ABBREVIATIONS

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

Table 5-3. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. 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	Mictron, 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.
00809	Croven, Ltd.	Whitby, Ontario, Canada
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, Cal.
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, Cal.
01281	TRW Semiconductors, Inc.	Lawndale, Cal.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co	Alliance, Ohio
01538	Small Parts Inc.	Los Angeles, Cal.
01589	Pacific Relays, Inc.	Van Nuys, Cal.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01960	Pulse Engineering Co	Santa Clara, Cal.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc	Sunnyvale, Cal.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins EngineeringCo.	San Fernando, Cal.
02875	Hudson Tool & Die	Newark, N.J.
03296	Nylon Molding Corp.	Springfield, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Cal.
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	Taruus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex Wire	Los Angeles, Cal.
04222	Hi-Q Division of Aerovox.	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Cal.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Cal.
04811	Precision Coil Spring Co.	El Monte, Cal.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Cal.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Cal.
05397	Union Carbine Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Cal.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Cal.
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, Cal.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Cal.
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	Components Inc., Ariz. Div.	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.
06980	Varian Assoc. Etmac Div.	San Carlos, Cal.
07088	Kelvin Electric Co.	Van Nuys, Cal.
07126	Digitran Co.	Pasadena, Cal.
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, Cal.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Cal.
07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp, The	Monterey Park, Cal.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Cal.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.
07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Cal.
08289	Blinn, Delbert Co.	Pomona, Cal.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Cal.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Cal.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc	Lowell, Mass.
08806	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Cal.
09097	Electronic Enclosures Inc.	Los Angeles, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Cal.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09795	Pennsylvania Florocarbon.	Clifton Heights, Penn.
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Cal.
10411	Ti-Tal, Inc.	Berkeley, Cal.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
11314	National Seal	Downey, Cal.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Cal.
11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Cal.
11870	Melabs, Inc.	Palo Alto, Cal.
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, Cal.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13061	Wilco Products	Detroit, Mich.
13103	Thermolloy	Dallas, Texas
13327	Solitron Devices Inc.	Tappan, N.Y.
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Cal.
14193	Calif. Resistor Corp	Santa Monica, Cal.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation	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, Cal.
14960	Williams Mfg. Co.	San Jose, Cal.
15106	The Sphere Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Cal.
15291	Adjustable Bushing Co.	N. Hollywood, Cal.
15558	Micron Electronics.	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Cal.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Cal.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mountain View, Cal.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N.J.
16554	Electroid Co.	Union, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
16688	Ideal Prec. Meter Co., Inc., De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Cal.
17474	Tranex Company	Mountain View, Cal.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Cal.
17856	Siliconix Inc.	Sunnyvale, Cal.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Cal.
18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
18324	Signetics Corp.	Sunnyvale, Cal.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18565	Chomerics	Plainville, Mass.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
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	West Orange, N.J.
19589	Concoa	Baldwin Park, Cal.

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Table 5-3. Code List of Manufacturers (Continued)

Code No.	Manufacturer	Address
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21355	Fafnir Bearing Co., The	New Britian, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23020	General Reed Co.	Metuchen, N.J.
23042	Texscan Corp.	Indianapolis, Ind.
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	Grobert File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac Hollister Co.	Hollister, Cal.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Cal.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products, Istd.	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.
40931	Honeywell Inc.	Minneapolis, Minn.
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	HP Co. Med. Elec. Div.	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 & System Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
58474	Superior Elect. Co.	Bristol, Conn.
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.
70417	Amplex. Div. of Chrysler Corp.	Detroit, Mich.
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 Electric Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincey, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
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.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Cal.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Cal.
71471	Cinema, Div. Aerovox Corp.	Burbank, Cal.
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 Division	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Cal.
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, Cal.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal.
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, Cal.
73957	Groove-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 Electronic Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights, Inc.	Sandwich, Ill.
75382	Kulka Electric Corp.	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Cal.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Cal.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Cal.
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, Cal.
77075	Pacific Metals Co.	San Francisco, Cal.
77221	Phaostran Instrument and Electronic Co.	So. Pasadena, Cal.
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 Division	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Cal.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
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, Cal.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Cal.
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.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Standard tube or semi-conductor device, any manufacturer.	
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, Cal.
80411	Arco Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Cal.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Inst. Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Cal.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	
81483	International Rectifier Corp.	El Segundo, Cal.
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.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N.J.
82209	Magurie 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	Rolton Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Cal.
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, Cal.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Cal.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisades 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, Cal.
84411	TRW Capacitor Div.	Ogallala, Neb.

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Table 5-3. Code List of Manufacturers (Continued)

Code No.	Manufacturer	Address
94870	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Cal.
85474	R.M. Bracamonte & Co.	San Francisco, Cal.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Cal.
87034	Marco Industries	Anaheim, Cal.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Cal.
87664	Van Waters & Rogers Inc.	San Francisco, Cal.
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, Cal.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89479	Security Co.	Detroit, Mich.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90365	Belleville Speciality Tool Mfg., Inc.	Belleville, Ill.
90763	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Cal.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Cal.
91345	Miller Dial & Nameplate Co.	El Monte, Cal.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91673	Epiphone Inc.	New York, N.Y.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Cal.
91886	Malco Mfg., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Division	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Cal.
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.	Westbury, L.I., N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Pallisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Cal.
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 Patterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95146	Alco Elect. Mfg. Co.	Lawrence, Mass.
95236	Allies Products Corp.	Diania, 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	Microwave Assoc., West, Inc.	Sunnyvale, Cal.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Mfg. Co.	Los Angeles, Cal.
96396	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Cal.
96508	Xcelite, Inc.	Orchard Park, N.Y.
96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
96881	Thomson Ind. Inc.	Long Island, N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
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98278	Microdot, Inc.	So. Pasadena, Cal.
98291	Sealectro Corp.	Mamaronech, N.Y.
98376	Zero Mfg. Co.	Burbank, Cal.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Division of Hewlett-Packard Co.	Palo Alto, Cal.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Cal.
99109	Columbia Technical Corp.	New York, N.Y.
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99378	Atlee Corp.	Winchester, Mass.
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99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Rembrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
99957	Technology-Instrument Corp. of California	Newbury Park, Cal.

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000AB	ETA	England
000BB	Precision Instrument Comp. Co.	Van Nuys, Cal.
000CS	Hewlett-Packard Co., Colorado Springs Div.	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Cal.
000NN	A "N" D Mfg. Co.	San Jose, Cal.
000QQ	Cooltron	Oakland, Cal.
000WW	California Eastern Lab	Burlington, Cal.
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12653A

LINE PRINTER INTERFACE KIT

(FOR 2100, 2114, 2115, AND 2116 COMPUTERS)

UPDATING SUPPLEMENT FOR OPERATING AND SERVICE MANUAL

14 OCT 1971

MANUAL IDENTIFICATION

Manual Serial No. Prefix: N/A

Manual Printed: OCT 1970

Manual Part Number: 12653-90002

SUPPLEMENT DESCRIPTION

The purpose of this supplement is to adapt the manual to instruments containing production improvements made subsequent to the printing of the manual and to correct manual errors. Enter the new information (or the Change Number, if more convenient) into the appropriate places in the manual, identified at left.

INSTRUMENT CHANGES

Serial No. Prefix	Change

ASSEMBLY CHANGES

Ref Des	Description	HP Part No.	Rev	Changes

Changes 1 through 13 dated 14 October 1971.

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CHANGE	DESCRIPTION
1	Title page. Change the computer model numbers to read, "(FOR 2100, 2114, 2115, AND 2116 COMPUTERS)".
2	Title page. Change the note to read as follows: Note This manual should be retained with the applicable computer system documentation.
3	Page 1-1, paragraph 1-4. Change line three to read, ". . . HP 2767A Line Printer with an HP 2100, 2114, 2115, or 2116 . . . ".
4	Page 2-1, paragraph 9, step "a". Change line three to read, ". . . interface card. Refer to the applicable Hewlett- . . . ".
5	Page 2-1, paragraph 9, step "g". Change the paragraph to read, "Run diagnostic test as described in the Diagnostic Program Procedures, part number 12653-90003 (for 2114, 2115, and 2116 Computers) or part number 12653-90008 (for 2100 Computers), in the Manual of Diagnostics to verify that the interface card is functioning properly."
6	Page 3-3, paragraph 3-20. Delete the word "phase" in the next to last line of the paragraph. Also, delete "(phase 4)" in the last line of the paragraph.
7	Page 3-3, paragraph 3-21. Delete the word "phase" in three places.
8	Page 3-3, paragraph 3-22. Change the second sentence by deleting the words "at time T1".
9	Page 3-3, figure 3-2. Make two deletions in the figure text as follows: a. At the lower-left of the figure, delete the word PHASE from the annotation symbol. The remaining text reads "IRQ FF SET AT T5 AND FLAG AND INTERRUPT REQUEST SIGNALS SENT TO COMPUTER TO START INTERRUPT". b. At the lower center of the figure, delete the words PHASE (PHASE 4) from the annotation symbol. The remaining text reads "END OF COMPUTER INTERRUPT".
10	Page 4-1, paragraph 4-4. Change the first sentence to read "Detailed preventive maintenance procedures and schedules are provided in the applicable documentation for the computer."
11	Page 4-1, paragraph 4-6. Change the first sentence to read "The interface card may be checked using the Diagnostic Program Procedures, part no. 12653-90003 (for 2114, 2115, and 2116 Computers) or part no. 12653-90008 (for 2100 Computers), in the Manual of Diagnostics."
12	Page 4-3, figure 4-1. At the lower-center of the figure, delete the waveform diagram and add the following reference: "Refer to updating supplement change 12".
13	Figure US-1 of this updating supplement. A quick reference timing diagram is provided in figure US-1.

CHANGE	DESCRIPTION
13 (Cont)	

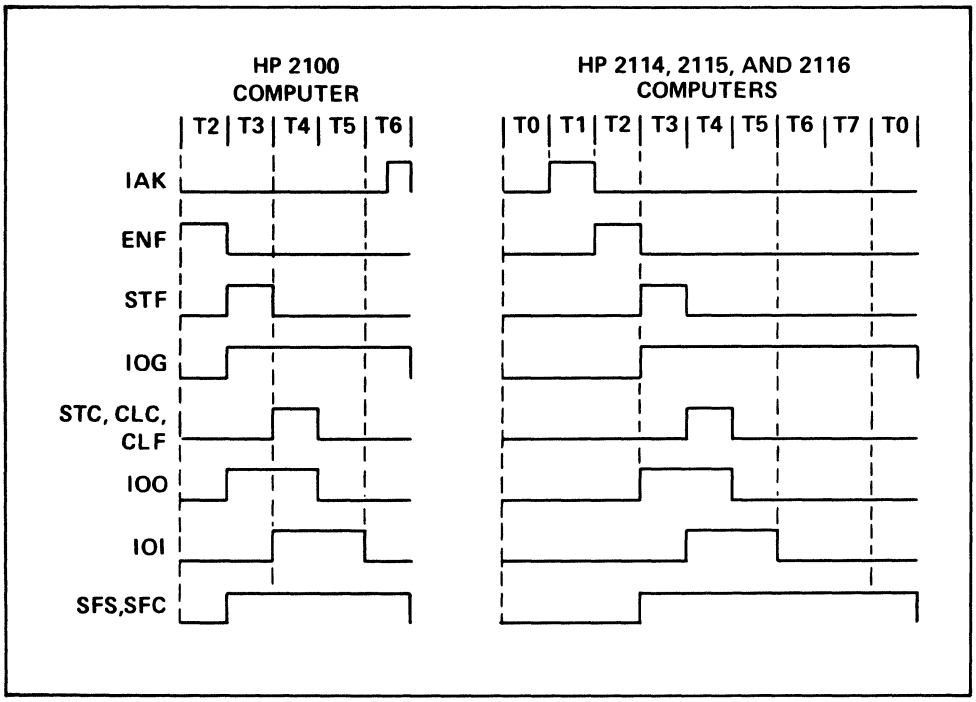

Figure US-1. Quick Reference Timing Diagram