CHAPTER 4
LE8-E LINE PRINTER

SECTION 1 INTRODUCTION

The LE8-E Line Printer Control interfaces an 80- or 132-column line printer to the PDP-8/E. All logic is contained on a single quad module that plugs into the OMNIBUS. The LE8-E connects to the line printer via a signal cable that is supplied with the system.

The LE8-E Line Printer is discussed here only to the extent necessary to both fully describe LE8-E operation and present supplementary information concerning installation and checkout. Details concerning the installation, operation, troubleshooting, and maintenance of the printer itself can be found in Data Products Corporation Technical Manual DPC-214163A (80-column printer) or DPC-215656A (132-column printer). Other publications and documents relevant to the LE8-E are:

a. *PDP-8/E & PDP-8/M Small Computer Handbook* — DEC, 1972
b. *PDP-8/E Maintenance Manual, Volume 1*
c. LE8-E Line Printer Diagnostic, MAINDEC-8E-D2BA
d. DEC Engineering Drawing, Line Printer Control, E-CS-M841-0-1.

SECTION 2 INSTALLATION

The LE8-E Line Printer and Control are installed on site by DEC Field Service personnel. The customer should *not* attempt to unpack, inspect, install, checkout, or service the equipment.

4.1 UNPACKING

Place the LE8-E Line Printer close to the ac power source and proceed as follows:

Step	Procedure
1	Cut the two steel straps that secure the telescoping cap and stitched sleeve to the shipping skid.
2	Remove the Tri-wall clips from all four sides of the stitched sleeve.
3	Remove the four bolts, washers, and nuts securing the line printer to the shipping skid, then remove the printer from the skid and install on the site.

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Step	Procedure
4	Unpack the LE8-E Control and the signal cable. Plug the LE8-E into the PDP-8/E OMNIBUS and connect it to the line printer with the cable (refer to Table 2-3, Volume 1, for information concerning module installation order). The cable connects to the control via a Berg Connector and to J1 of the line printer via a Winchester MRAC-50 Connector (refer to Section 1 of the Data Products Corporation technical manual for the location of J1).
5	Inspect both printer and control as outlined below and report any damage to the local DEC sales office. a. Inspect external surfaces of the printer and control for surface, bezel, switch, and light damage. b. Open the printer doors and inspect for internal damage. c. Inspect the wiring side of the printer logic mounting panels and the control module for bent pins, cut wire, loose external components, and foreign matter. Also inspect the signal cable for damage. d. Check equipment received against the packing list to be certain that all equipment has been unpacked.

4.2 CHECKOUT

Use the following procedure to check out the LE8-E Line Printer and Control.

Step	Procedure
1	Insert the ribbon in the printer, following the ribbon installation procedure detailed in Section 3 of the Data Products Corporation technical manual (referred to hereafter as the technical manual).
2	Load the printer with continuous-form paper, following the paper loading procedure detailed in Section 3 of the technical manual. **NOTE** **The READY indicator on the printer control panel should light 10–15 seconds after the last step of the procedure (close and latch drum gate, etc.) has been completed.**
3	See the paper positioning (vertical) procedure in Section 3 of the technical manual.
4	Check that the TOP OF FORM and PAPER STEP switches operate as in Table 3-1 of the technical manual.
5	Set the ON LINE/OFF LINE switch to the ON LINE position and check that the TOP OF FORM and PAPER STEP switches do not operate.
6	Hold the MASTER CLEAR switch in the "up" position and check that the READY and ON LINE indicators go out. Release the switch; the READY indicator should light.
7	Check the right tractor for correct adjustment and make sure that the COPIES CONTROL switch is set to the 1–2 position.
8	Set the ON LINE/OFF LINE switch to the ON LINE position and run the MAINDEC diagnostic program, starting at Part 1 of Test 1. While the program is running, adjust the vertical paper adjustment vernier.

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Step	Procedure
9	Stop the program and set the PRINT INHIBIT switch to the "up" position; set the ON LINE/OFF LINE switch to the ON LINE position and restart the program from Part 1 of Test 1. The PRINT INHIBIT indicator should light and the program should run as in Step 8. Run the program for one minute.
10	Set the PRINT INHIBIT switch to the "down" position and check for printout errors.
11	Replace the continuous-form paper with single-part paper. Run all parts of the program (except Part 1 of Test 1) for one hour.
12	Inspect all printouts for errors and print quality and compare to the enclosed factory-printed samples.

SECTION 3 BLOCK DIAGRAM DESCRIPTION

Figure 4-1 is a block diagram of the LE8-E Control. OMNIBUS pin numbers and pin assignments for both ends of the signal cable can be found on engineering drawing E-CS-M841-0-1. Connector receptacle J1 on the line printer is a 20-pin connector with a return pin for each of the 10 signal pins. Figure 4-2 is a timing diagram of the control; Table 4-1 presents the LE8-E IOT instructions. Refer to the figures while reading this description.

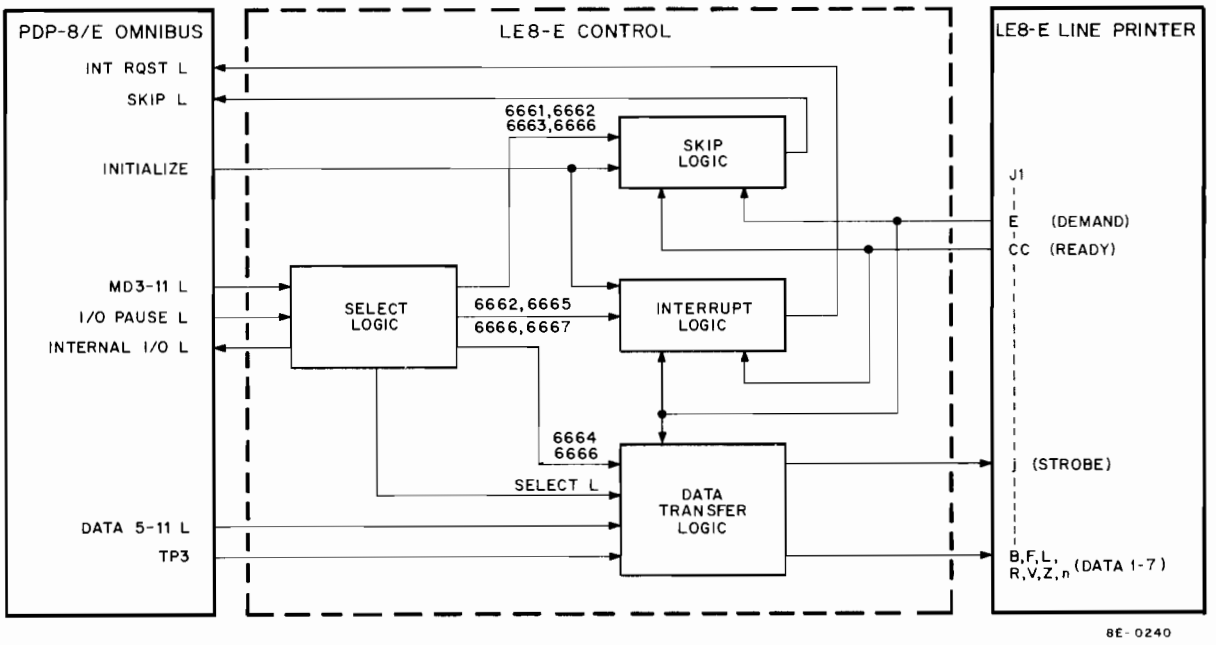

Figure 4-1 LE8-E Line Printer Control Block Diagram

When the line printer is ready to be placed on-line, a READY indicator on the line printer lights. At the same time, the READY signal is asserted. After the line printer has been placed on-line, it asserts the DEMAND signal when it is able to accept a character. The DEMAND signal sets the FLAG flip-flop in the interrupt logic. If the INT ENA flip-flop is set, the FLAG flip-flop asserts the OMNIBUS INT RQST L signal. The computer then begins to execute the interrupt servicing routine to determine the identity of the requesting device.

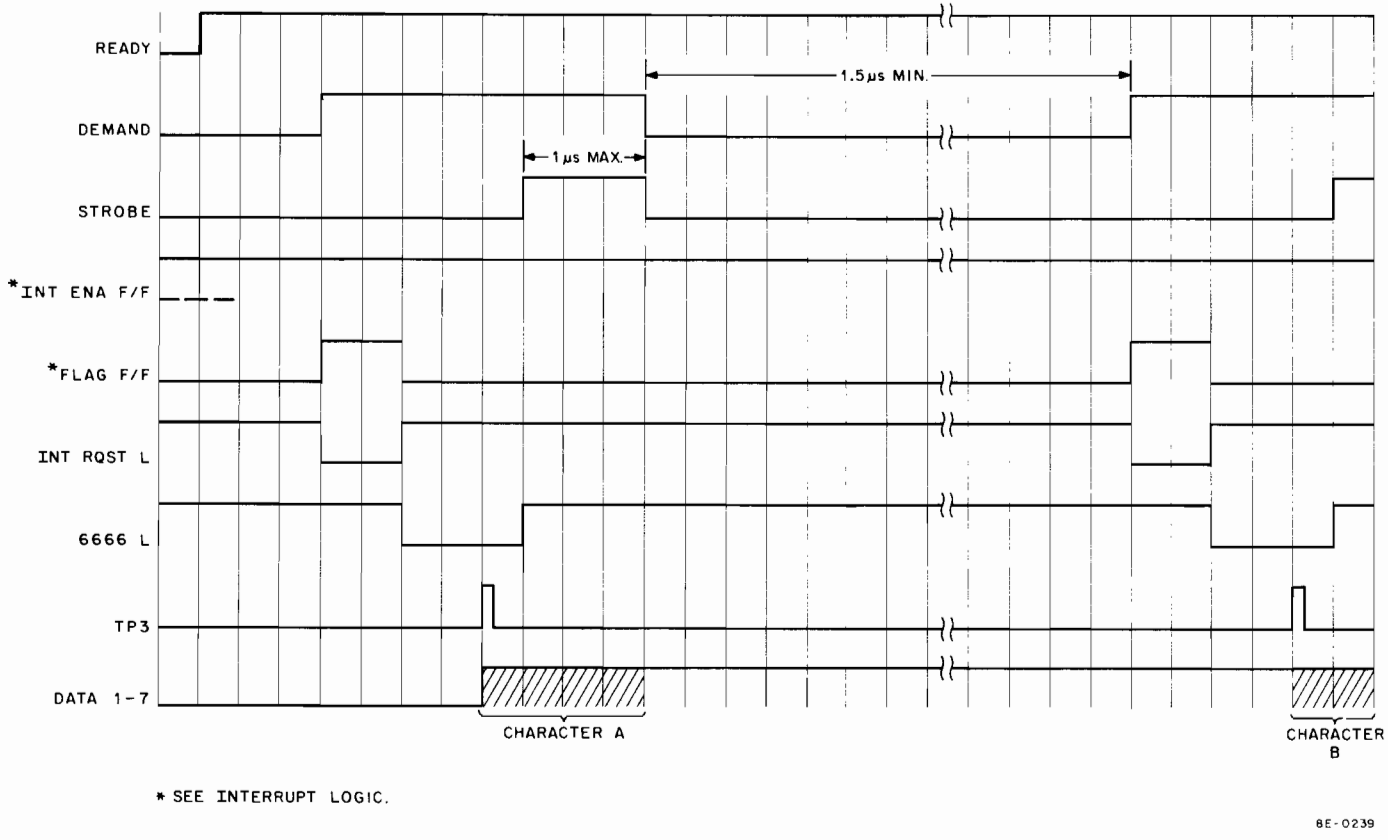

Figure 4-2 LE8-E Control Timing

Table 4-1
LE8-E IOT Instruction List

Octal Code	Mnemonic	Function
6661	PSKF	Skip on the Flag. Senses the state of the FLAG flip-flop. If it is set, the program counter is incremented so that the next sequential instruction is skipped.
6662	PCLF	Clear the Flag. Clears the FLAG flip-flop.
6663	PSKE	Skip on an Error. Senses the state of the READY signal. If it is low, indicating an error condition in the line printer, the program counter is incremented so that the next sequential instruction is skipped.
6664	PSTB	Load Line Printer Buffer Register. A character is transferred from the CPU AC Register, via the OMNIBUS DATA 5–11 lines and the Line Printer DATA 1–7 lines, to the Printer Buffer Register.
6665	PSIE	Set INT ENA flip-flop. The LE8-E is logically connected to the computer interrupt system. Both the READY signal and the DEMAND signal can cause a program interrupt.
6666	PCLF, PSTB	Clear the Flag, Load Line Printer Buffer Register. Microprogram of 6662 and 6664.
6667	PCIE	Clear INT ENA flip-flop.

When the 6661 instruction in the servicing routine is decoded, the skip logic asserts the OMNIBUS SKIP L signal. The computer then proceeds to the subroutine associated with the LE8-E. When the 6666 instruction (as an example) in the subroutine is decoded, the FLAG flip-flop is cleared and the information in the AC Register is placed on the OMNIBUS DATA 5–11 lines; at TP3 time the information is clocked into the Buffer Register of the data transfer logic. At the trailing edge of the 6666 instruction signal, the STROBE signal is generated and the information is clocked from the DATA 1–7 lines of the line printer into the 20-character Shift Register within the line printer. The DEMAND signal is then negated and, in turn, negates the STROBE signal.

SECTION 4 DETAILED LOGIC

4.3 SELECT LOGIC

The select logic is shown in Figure 4-3. Both the SELECT L and INTERNAL I/O L signals are asserted when a 666X instruction is decoded. The INTERNAL I/O L signal causes the positive I/O bus interface to ignore the IOT instruction; the SELECT L signal is gated with bits MD9–11 to provide inputs for the BCD-to-decimal decoder, E17 (refer to Appendix A, Volume 1, for details about the DEC 8251 IC). The decoder supplies the signals that represent IOT instructions 6661 through 6667.

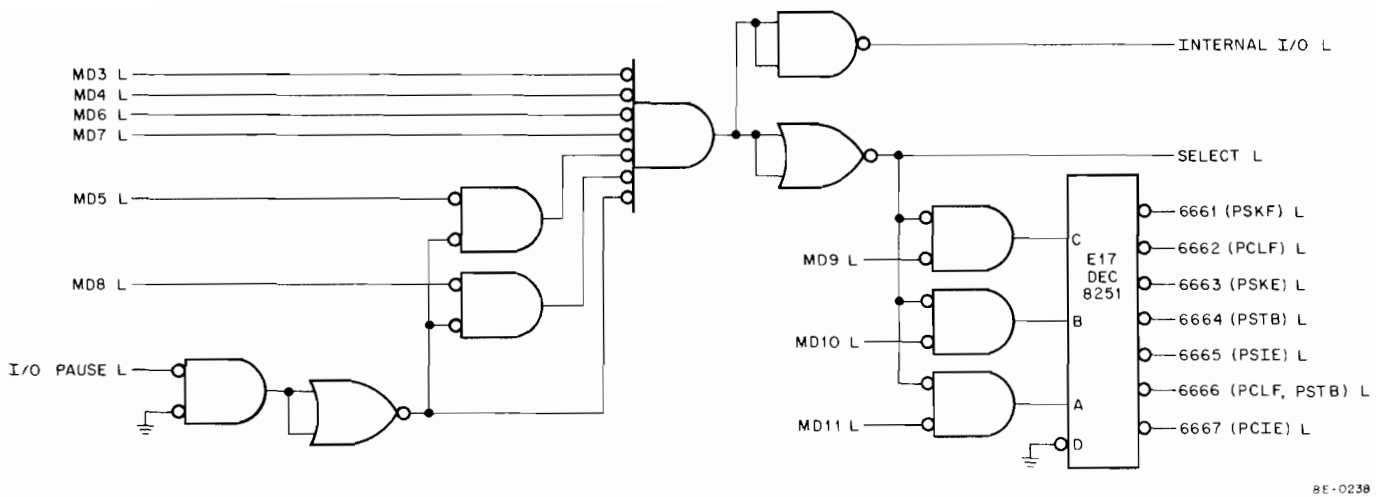

Figure 4-3 Select Logic

4.4 INTERRUPT LOGIC

The interrupt logic is shown in Figure 4-4. When the INT ENA flip-flop is set, the control is logically connected to the computer interrupt system. This flip-flop is cleared at computer power turn-on by the OMNIBUS INITIALIZE signal and can be cleared and set under program control by instructions 6667 (or 6007, CAF) and 6665, respectively.

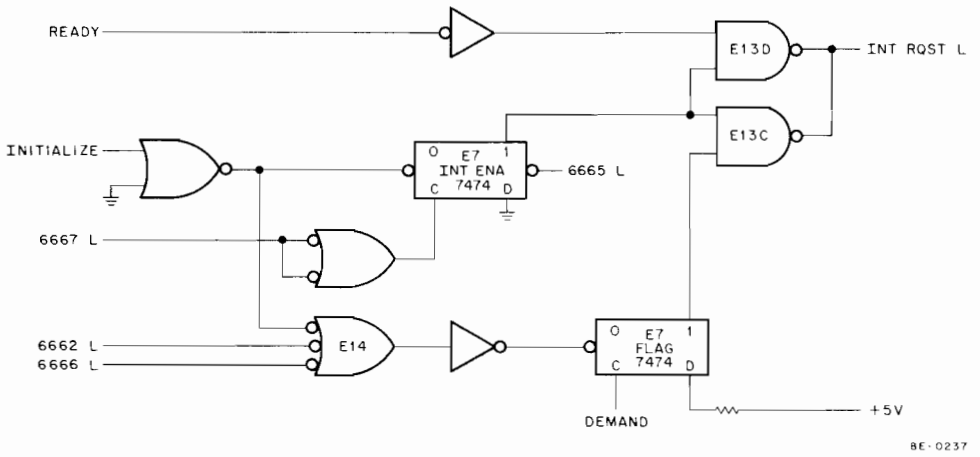

Figure 4-4 Interrupt Logic

When the INT ENA flip-flop is set, both the READY signal and the DEMAND signal can cause a program interrupt. If the READY signal is low, indicating an error condition in the line printer (drum gate open, excessive temperature in paper drive motor, insufficient drum motor speed, or printer out of paper) NAND gate E13 asserts the INT RQST L signal and the computer begins the interrupt servicing routine. Instruction 6663 senses the state of the READY line and causes a skip in the CPU program counter if READY is low (Figure 4-5).

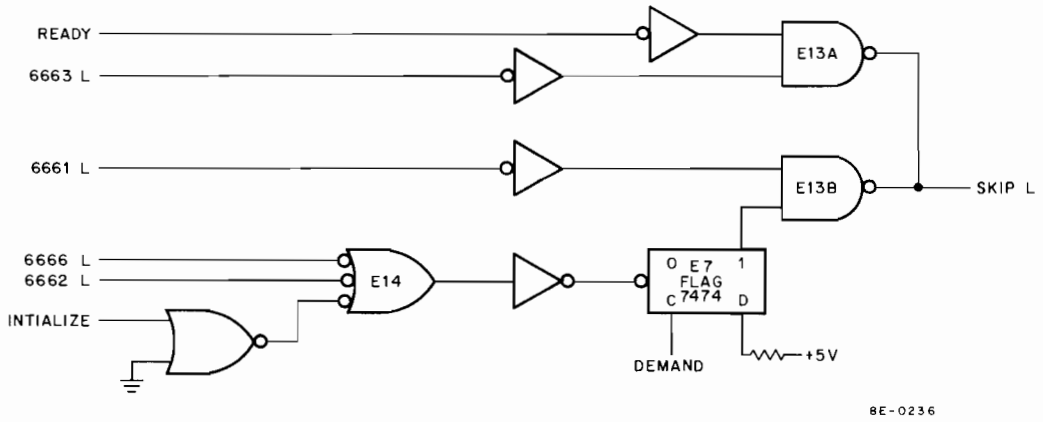

Figure 4-5 Skip Logic

The DEMAND signal causes a program interrupt by setting the FLAG flip-flop, as outlined in Section 3. Instruction 6661 senses the state of the FLAG flip-flop and causes a program skip when the FLAG is set (Figure 4-5). The FLAG flip-flop is cleared by the INITIALIZE signal and by program instructions 6662 and 6666.

4.5 DATA TRANSFER LOGIC

The data transfer logic is shown in Figure 4-6. The 7-bit code transmitted from the CPU AC Register to the printer 20-character Shift Register represents characters that appear on the 64- or 96-character printer drum (refer to the table of code/character relationship in Volume 1, Section 4). The coded information is gated from the AC Register to the OMNIBUS DATA 5–11 lines when the 6666 or 6664 instruction is decoded in the CPU. The SELECT L signal enables the DATA lines to condition the D-inputs of the 7-stage Buffer Register. When the control decodes the 6666 or 6664 instruction, the buffer is loaded at TP3 time and the coded character is placed on the printer DATA 1–7 lines.

Each character is followed by the STROBE signal that is generated when the STROBE flip-flop is set by the trailing edge of the instruction. The printer samples the DATA 1–7 lines and negates the DEMAND signal, clearing the STROBE flip-flop.

SECTION 5 MAINTENANCE

Refer to Volume 1 and the Data Products Corporation technical manual for maintenance information that pertains to both the control and the printer. The LE8-E Diagnostic, MAINDEC-8E-D2BA, should be run when an error in the LE8-E is suspected.

SECTION 6 SPARE PARTS

Table 4-2 lists recommended spare parts for the LE8-E. These parts can be obtained from any local DEC office or from DEC, Maynard, Massachusetts.

Table 4-2
LE8-E Recommended Spare Parts

DEC Part Number	Description	Quantity
19-05547	IC DEC 7474	1
19-05576	IC DEC 7410	1
19-05590	IC DEC 7401	1
19-09485	IC DEC 380	1
19-09594	IC DEC 8251	1
19-09686	IC DEC 7404	1
19-09704	IC DEC 314	1
19-09705	IC DEC 8881	1

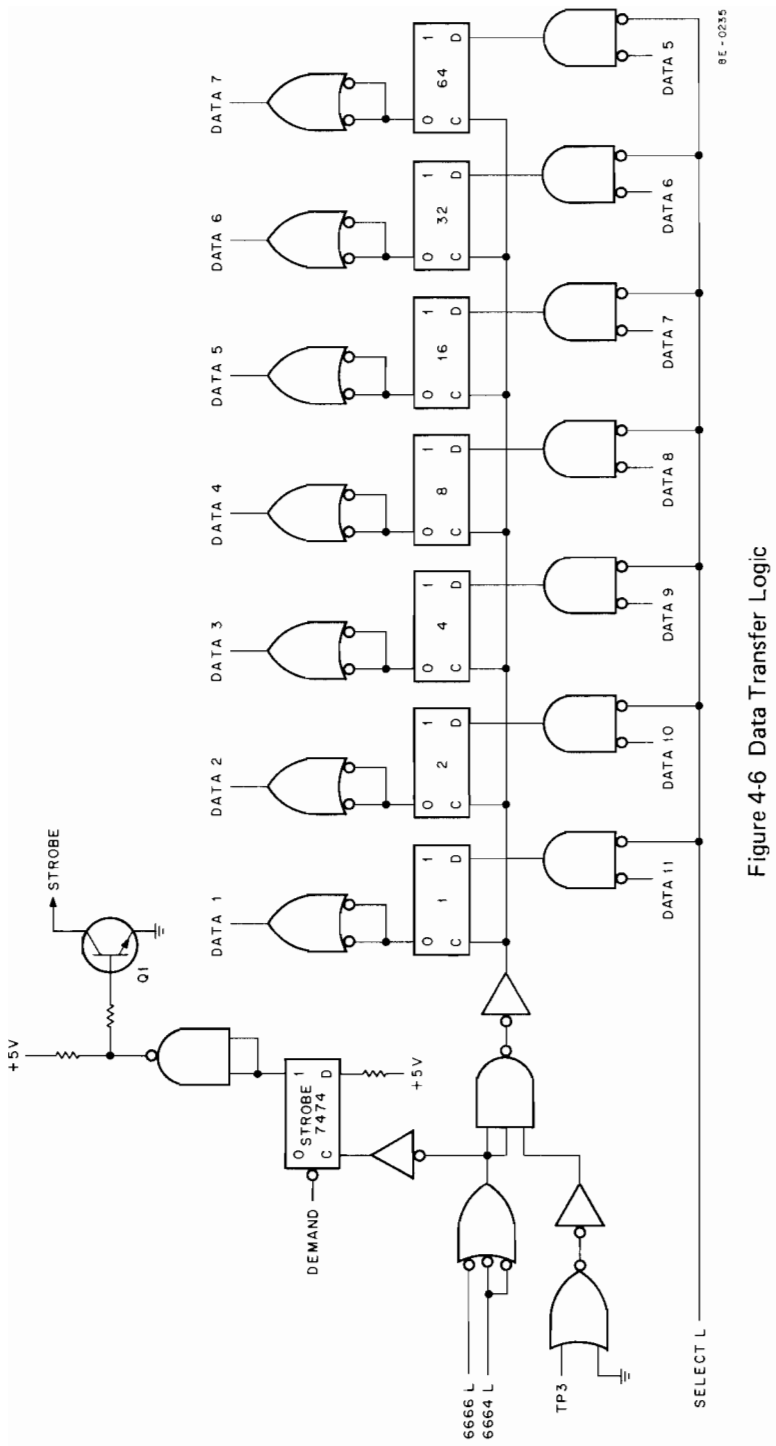

Figure 4-6 Data Transfer Logic