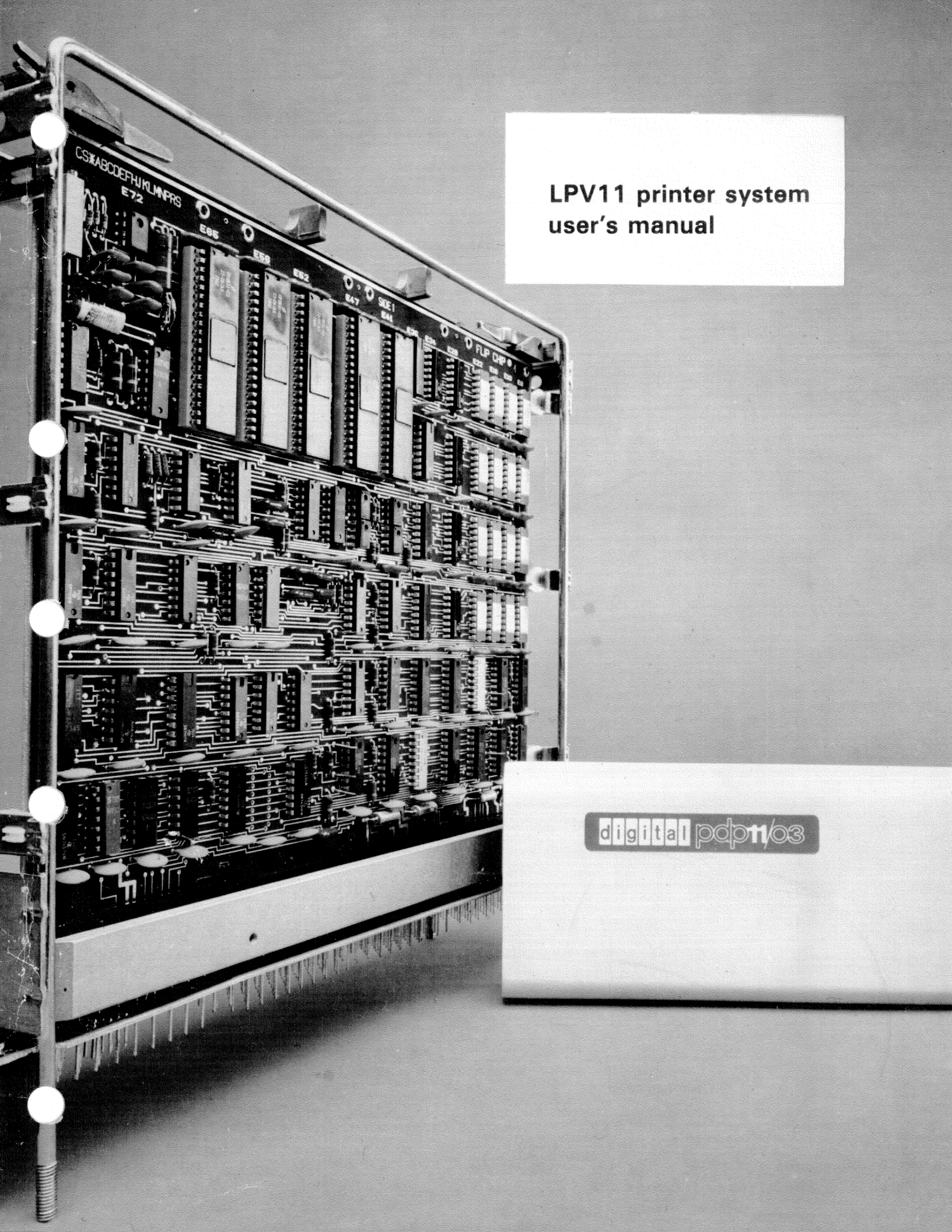

LPV11 printer system user's manual

digital pdp11/03

LPV11 printer system user's manual

EK-LPV11-OP-001

digital equipment corporation • marlborough, massachusetts

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CHAPTER 1
INTRODUCTION

1.1 GENERAL

The LPV11 is a high speed/line printer system option for the LSI-11 family of microcomputers. Twelve LPV11 models define the type of printer supplied and primary power (line) voltage. Printer types include the LA180 DECprinter, and two LP05 line printer models (uppercase letters only, and both upper- and lowercase letters). Each LP05 printer system includes an LSI-11 bus-compatible interface module (M8027) that plugs into any LSI-11 bus-structured backplane, a printer, and an interface cable. Printers are shown in Figures 1-1 (LP05 line printer) and 1-2 (LA180 DECprinter).

This manual includes information for installing and programming the LPV11. Detailed information is provided for the LPV11 interface only; refer to the appropriate printer manual (LA180 or LP05) supplied with the LPV11 option for detailed information on the printer.

1.2 OPTIONS

1.2.1 General

LPV11 printer systems are available in twelve models. A list of LPV11 models is provided in Table 1-1.

Table 1-1 LPV11 Option Summary

Option No. (Model)	Interface Cable*	Primary Power	Model	Printer Description
LPV11-PA	BC11S-25	115 V, 60 Hz	LA180-PA	180 char/s
LPV11-PB	BC11S-25	230 V, 60 Hz	LA180-PB	printer, 132
LPV11-PC	BC11S-25	115 V, 50 Hz	LA180-PC	column, upper- and
LPV11-PD	BC11S-25	230 V, 50 Hz	LA180-PD	lowercase letters
LPV11-VA	70-11212-25	115 V, 60 Hz	LP05-VA	300 line/min
LPV11-VB	70-11212-25	230 V, 60 Hz	LP05-VB	printer, 132
LPV11-VC	70-11212-25	115 V, 50 Hz	LP05-VC	column, uppercase
LPV11-VD	70-11212-25	230 V, 50 Hz	LP05-VD	letters
LPV11-WA	70-11212-25	115 V, 60 Hz	LP05-WA	240 line/min
LPV11-WB	70-11212-25	230 V, 60 Hz	LP05-WB	printer, 132 column
LPV11-WC	70-11212-25	115 V, 50 Hz	LP05-WC	upper- and lower
LPV11-WD	70-11212-25	230 V, 50 Hz	LP05-WD	case letters

*7.62 m (25 ft) interface cable is supplied with each option.

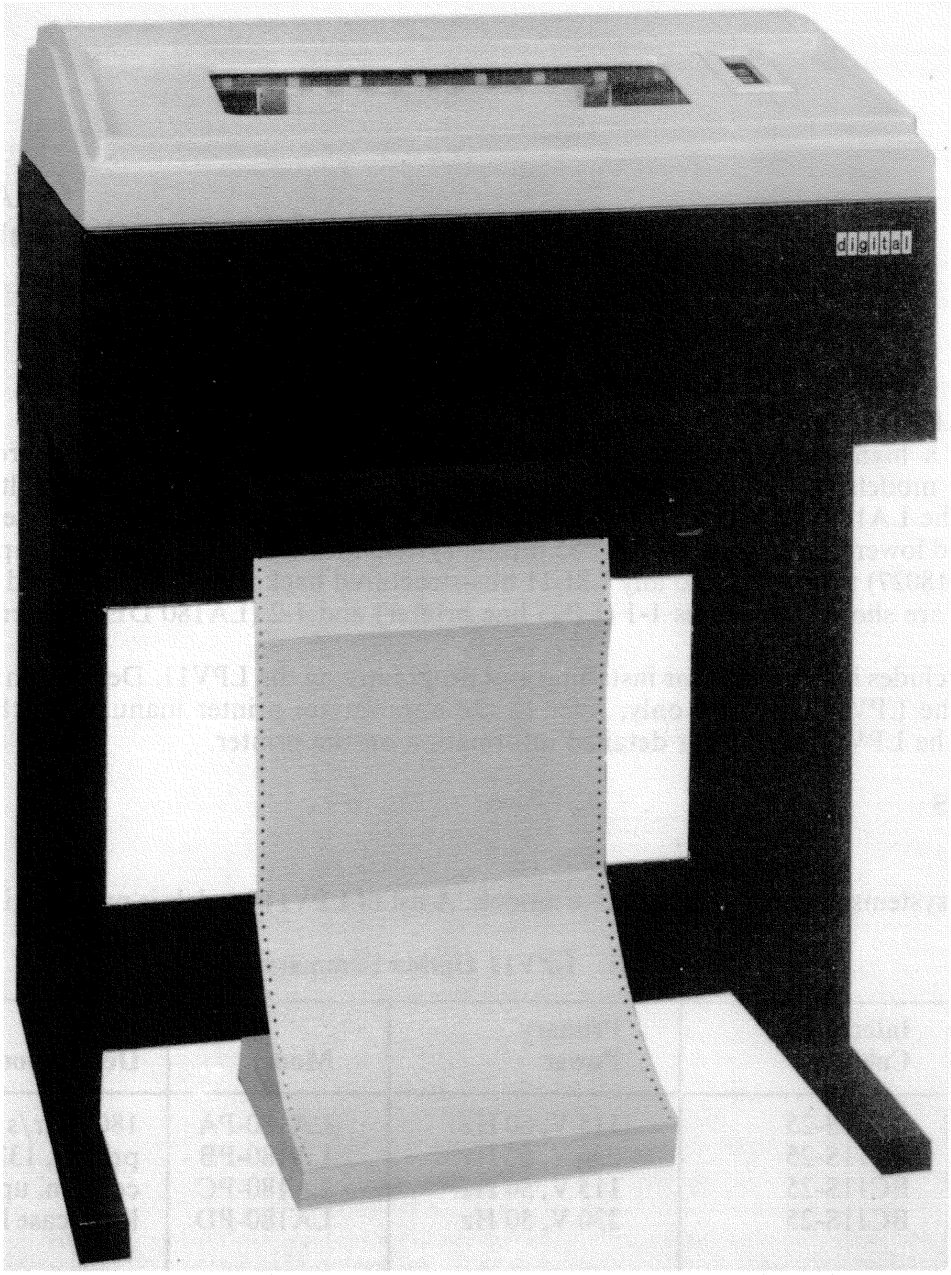
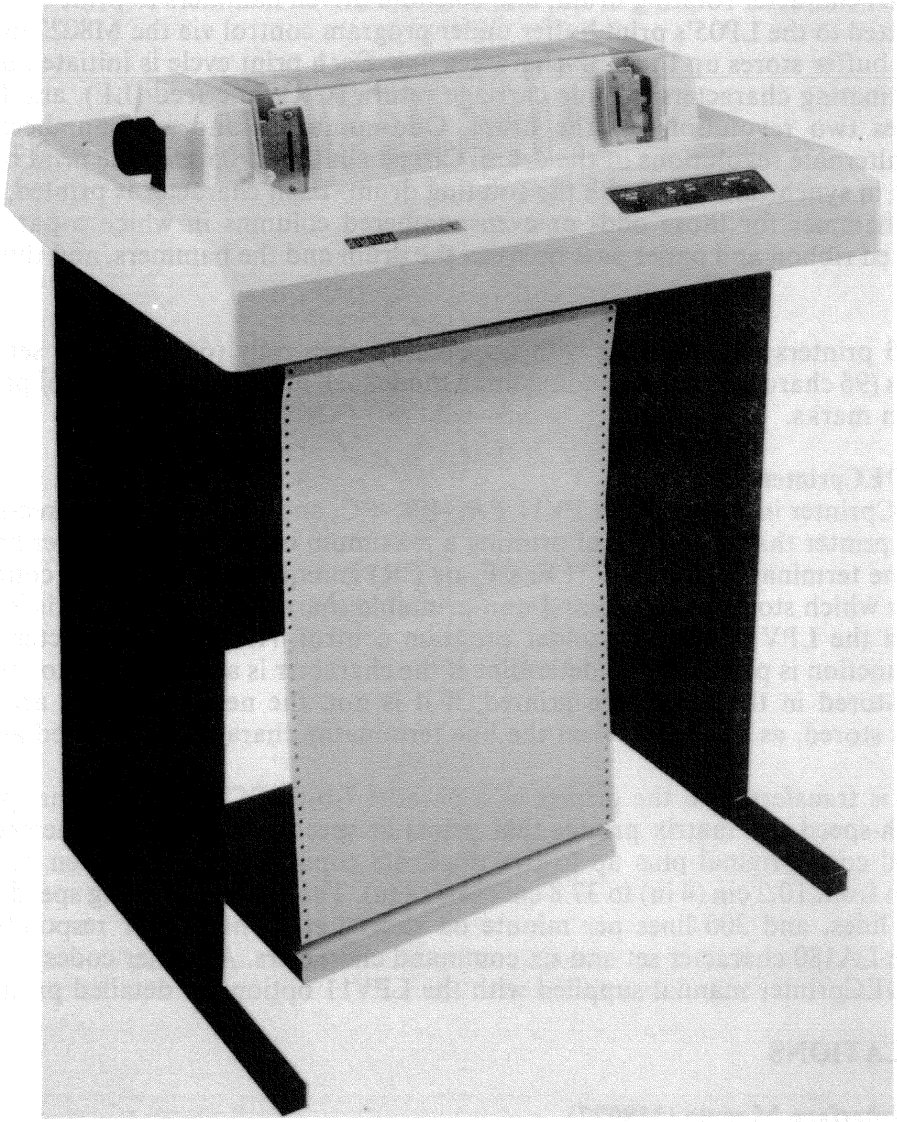


Figure 1-1 LP05 Line Printer



7595-5

Figure 1-2 LA180 DECprinter

1.2.2 LP05 Line Printers

LP05 printers (Figure 1-1) use a 132-column, 64- (LPV11-VA, -VB, -VC, -VD) or 96- (LPV11-WA, -WB, -WC, -WD) character rotating drum, and solenoid driven hammers to print characters. Characters are transmitted to the LP05's print buffer under program control via the M8027 interface module. The LP05 print buffer stores up to a 132-character line. Each print cycle is initiated by a terminating character. Terminating characters include carriage return (CR), line feed (LF), and form feed (FF). Printing requires two revolutions of the drum. Odd-numbered and even-numbered columns are printed during alternate revolutions of the drum. Circuits in the LP05 scan the print buffer characters stored for a line in synchronization with the rotating drum. Each character is printed, as appropriate, by driving the hammer for those odd- or even-numbered columns in which a particular character appears. An inked ribbon and paper pass between the drum and the hammers, and thus the characters are printed.

Note that LP05 printers are available with uppercase letters only (64 character set) or upper- and lowercase letters (96 character set) depending upon model. All models are capable of printing numerals and punctuation marks.

1.2.3 LA180 DECprinter

The LA180 DECprinter included with LPV11-PA, -PB, -PC, and -PD models is a free-standing, pedestal-type impact printer that is capable of printing a maximum of 132 characters per line. To initiate a print cycle, a line terminator character (LF, FF, or CR) is required. The printer contains a 256 by 8 character buffer which stores printable and non-printable characters. This buffer is loaded character-by-character via the LPV11 interface under program control. After each character is stored in the buffer, a read function is performed to determine if the character is a line terminator character. If it is, the characters stored in the buffer are printed; if it is not, the next characters are input until the complete line is stored, as indicated when the line terminator character is received and stored.

Each character is transferred to the printer as a parallel 7-bit ASCII plus optional parity code. The printer is a high-speed dot matrix printer that prints at speeds up to 180 characters per second. It produces a hard copy original plus up to five duplicate copies on tractor-driven continuous forms, varying in width from 10.2 cm (4 in) to 37.8 cm (14-7/8 in). The average printing speeds are 70 lines per minute on full lines, and 300 lines per minute on short lines. The printer responds only to codes representing the LA180 character set and six command characters. All other codes are ignored. Refer to the LA180 DECprinter manual supplied with the LPV11 option for detailed printer information.

1.3 SPECIFICATIONS

1.3.1 LPV11 Interface Module (M8027)

The LPV11 interface module can be installed in any LSI-11 bus structured backplane. Standard device and interrupt vector addresses are factory configured. Non-standard addresses can be configured by the user by removing and/or installing jumpers on the module. A 40-pin connector (J1) allows the user to connect the module to the printer via an appropriate cable supplied with the LPV11 option (defined in Table 1-1).

Size	
Height	13.2 cm (5.2 in)
Length	22.8 cm (8.9 in)
Width	1.27 cm (0.5 in)
Environmental Operating Temperature	5 to 50° C (40 to 122° F) with a relative humidity of 10% to 95% (no condensation), and adequate airflow across the module. When operating at the maximum temperature (50° C or 122° F), airflow must maintain the inlet-to-outlet air temperature rise across the module to 7° C (12.5° F) maximum.

Storage Temperature Range	–40 to 66° C (–40 to 150° F)
Bus Backplane Pinning	Refer to Table 1-2.
Power Requirements	+5 V ± 5%, 0.8 A (1.4 A maximum)

Table 1-2 LPV11 Backplane Pin Utilization

Module Side 1 (Component Side)		Module Side 2 (Solder Side)	
Backplane Pin	**Signal Mnemonic**	**Backplane Pin**	**Signal Mnemonic**
AA1		AA2	+5 V
AB1		AB2	
AC1		AC2	GND
AD1		AD2	+12 V
AE1		AE2	BDOUT L
AF1		AF2	BRPLY L
AH1		AH2	BDIN L
AJ1	GND	AJ2	BSYNC L
AK1	CLK OUT	AK2	BWTBT L
AL1	CLK IN	AL2	BIRQ L
AM1	GND	AM2	BIAKI L
AN1		AN2	BIAKO L
AP1		AP2	BBS7 L
AR1		AR2	BCMGI L
AS1		AS2	BDMGO L
AT1	GND	AT2	BINIT L
AU1		AU2	BDAL0 L
AV1		AV2	BDAL1 L
BA1		BA2	+5 V
BB1		BB2	
BC1		BC2	GND
BD1		BD2	
BE1		BE2	BDAL2 L
BF1		BF2	BDAL3 L
BH1		BH2	BDAL4 L
BJ1	GND	BJ2	BDAL5 L
BK1		BK2	BDAL6 L
BL1		BL2	BDAL7 L
BM1	GND	BM2	BDAL8 L
BN1		BN2	BDAL9 L
BP1		BP2	BDAL10 L
BR1		BR2	BDAL11 L
BS1		BS2	BDAL12 L
BT1	GND	BT2	
BU1		BU2	
BV1	+5 V	BV2	BDAL15 L

NOTE

AK1 and AL1 are connected together by the LSI-11 backplane when the module is plugged into the backplane.

1.3.2 Interface Cable

Type	BC11S-25 or 70-11212-25, depending on LPV11 model (Table 1-1)
Length	7.62 m (25 ft) maximum

1.3.3 LP05 Line Printer

Power	115 Vac ± 10%, 50/60 Hz ± 3 Hz or 230 Vac ± 10%, 50/60 Hz ± 3 Hz 700 W
Printable Characters	!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJ KLMNOPQRSTUVWXYZ[\]^_
96-character set	All of the above plus a through z : ~
Type	Open Gothic print
Size	Typically 0.024 cm (0.095 in) high; 0.065 cm (0.065 in) wide
Code Format	ASCII
Characters Per Line	132
Character Drum Speed	64-Character Drum 1200 r/min 96-Character Drum 800 r/min
Printer Characteristics	
Format	Top-of-form control; single line advance with automatic perforation step-over, and carriage return. Automatic vertical format control is optional.
Paper-Feed	One pair of pin-feed tractors for 1.27 cm (1/2 in) hole center, edge-punched paper.
Paper Slew Speed	50.8 cm (20 in) per second
Print Area	33.53 cm (13.2 in) wide, left justified
Character Spacing (horizontal)	0.254 ± 0.0127 cm (0.1 ± 0.005 in) between centers; maximum possible accumulative error for normal spacing is 0.0254 cm (0.01 in) per 80- or 132-character line.
Line Spacing	0.424 ± 0.025 cm (0.167 ± 0.01 in) at 6 lines per inch; 0.3175 cm (0.125 in) at 8 lines per inch. Each character within ± 0.254 cm (0.1 in) from mean line through character.
Line Advance Time	50 ms maximum
Character Synchronization	Variable reluctance pick-off senses drum position.

Physical Characteristics	
Height	1.14 m (45 in)
Width	0.81 m (32 in)
Depth	0.56 m (22 in)
Weight	150 kg (330 lb)
Ribbon Characteristics	
Type	Inked roll
Width	38.1 cm (15 in)
Length	18.288 m (20 yd)
Thickness	0.01 cm (0.004 in)
Paper Characteristics	
Type	Standard fanfold, edge punched, 27.94 cm (11 inches) between folds.
Width	10.16 cm to 42.55 cm (4 in to 16-3/4 in) 15 lb bond minimum (single copy) 12 lb bond with single-sheet carbon for up to six parts (multiple copy)
Weight	15 lb bond minimum (single copy) 12 lb bond with single-sheet carbon for up to six parts (multiple copy)
Environmental	
Operating Temperature	10 to 32° C (50 to 90° F).
Humidity	30% to 90% (no condensation)
Print Rates	
LP05-VA, -VB, -VC, -VD (64-character drum)	300 line/min
LP05-WA, -WB, -WC, -WD (96-character drum)	240 lines/min

1.3.4 LA180 DECprinter

Power	90–132 Vac or 180–264 Vac 50 or 60 Hz ± 1 Hz 400 W max (printing) 200 W max (idle)
Printable Characters	96 upper- and lowercase character set (7 × 7 dot matrix):

```
+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRST
UVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~
 !"#$%&'()*
```

Code Format	ASCII
Non-Printable Characters	Six commands: BEL, BS, LF, FF, CR, DEL

Number of Characters Per Line	132 max
Type of Character Transfer	Parallel (7-bit plus parity)

Printer Characteristics

Print Cycle Speed	Up to 180 characters per second
Line Printing Speeds	70 lines per minute on full line 300 lines per minute on short lines
Print Size	0.254 cm (10 characters per inch) horizontal 0.233 cm (6 lines per inch) vertical

1.4 RELATED HARDWARE MANUALS

Title	Document No.
1977-78 Microcomputer Handbook*	EB 07948 53/77
PDP-11V03 System Manual*	EK-11V03-TM-002
PDP-11T03 System Manual*	EK-11T03-OP-001
LA180 DECprinter I User's Manual* (for LPV11-PA, -PB, -PC, or -PD Users)	EK-LA180-OP-002

Dataproducts Corporation
Technical Manual, Model 2230 Line Printer, Volume 1 and Volume 2 (for LPV11-VA, -VB, -VC, -VD, -WA, -WB -WC, or -WD users).

*These documents can be ordered from:
DIGITAL EQUIPMENT CORPORATION
444 Whitney Street
Northboro, MA 01532

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CHAPTER 2
INSTALLATION

2.1 GENERAL

The LPV11 printer option can be installed in any system in the LSI-11 family, including LSI-11 component systems, PDP-11/03, PDP-11V03, and PDP-11T03 systems.

Installation involves:

1. Installing the LPV11 interface module in the LSI-11 backplane
2. Installing the printer (connecting ac power and connecting to the LSI-11 system via an interface cable).

Each interface module is shipped from the factory with jumpers configured for standard (DEC software-compatible) device and interrupt vector assignments. It is normally not necessary for the user to configure address or vector jumpers unless special device and/or interrupt vectors are desired. They can be configured as directed in Paragraph 2.2. The factory (or user) configured module can be installed as directed in Paragraph 2.3.

CAUTION

Modules must be installed or removed only when dc power is removed from the backplane.

The remainder of this chapter contains specific instructions for configuring and installing the LPV11 interface module (check jumper configuration before installing module), and installing the printer (LP05 or LA180). Use only those procedures applicable to the specific option model (type of printer).

2.2 CONFIGURING INTERFACE MODULE JUMPERS

2.2.1 General

LPV11 interface module jumpers are located as shown in Figure 2-1. Factory-installed jumpers can be removed by carefully cutting each end close to the printed circuit board. Note that factory-installed jumpers have W numbers assigned. Adjacent to each factory-installed jumper location are wire-wrap pins allowing a user to reinstall a jumper previously removed. The remaining jumpers (not factory installed) can be installed using the designated wire-wrap pins. Dots in Figure 2-1 represent wire-wrap pins; a line connecting a pair of pins shows the electrical connection that must be wire-wrapped to insert that jumper.

Note

Jumper F+ (factory installed W6) and F– do not have associated wire-wrap pins. These jumpers must be installed by soldering and removed by cutting or unsoldering.

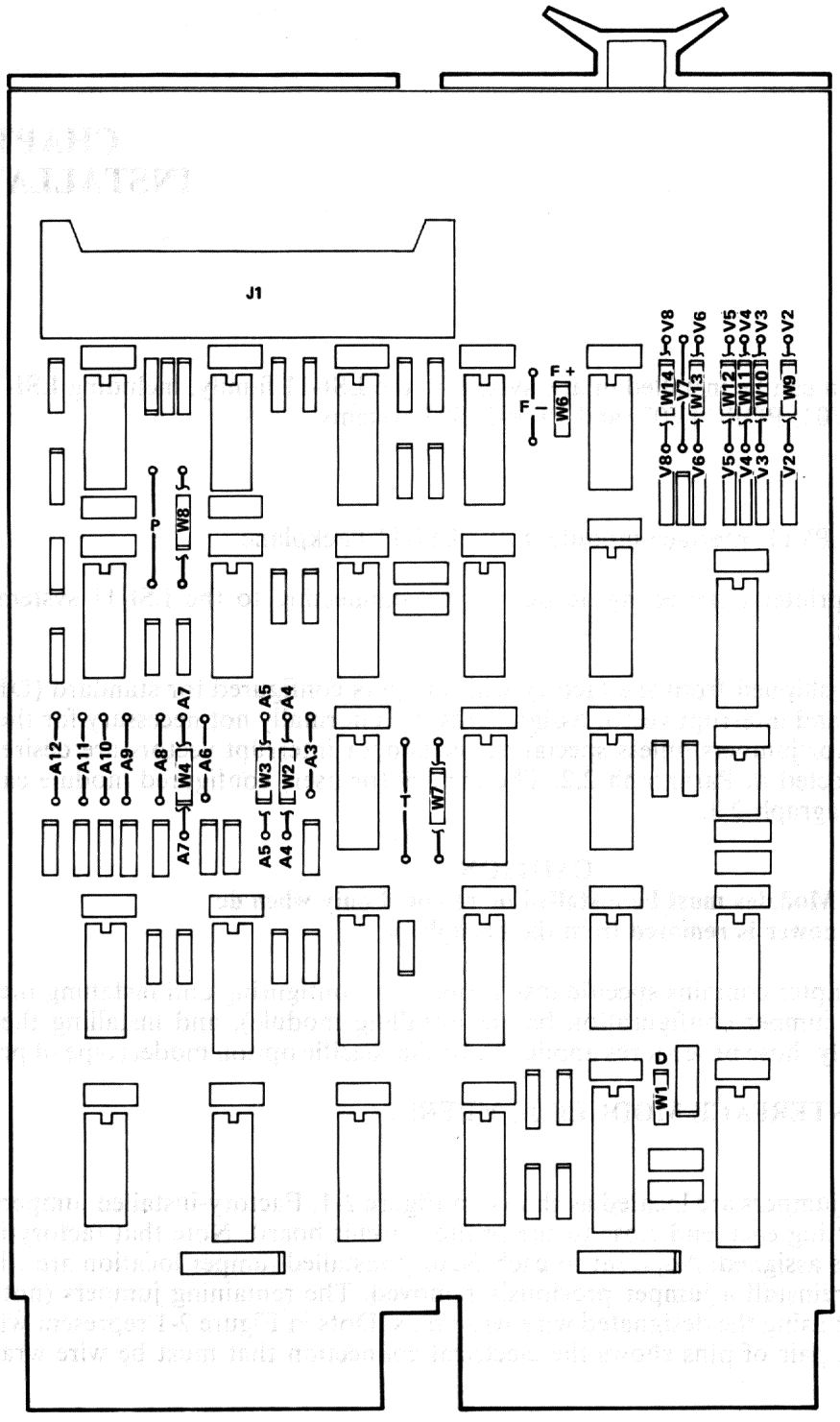


Figure 2-1 LPV11 Interface Module

2.2.2 Device Address

The LPV11 is factory-configured for device control/status register (CSR) address equal to 177514. The data buffer register (DBR) is always the configured CSR address +2; thus, the standard DBR address is 177516. If more than one LPV11 option is installed in the system, or if special device addresses are desired, remove and/or install jumpers (one for each CSR address bit) as directed in Figure 2-2.

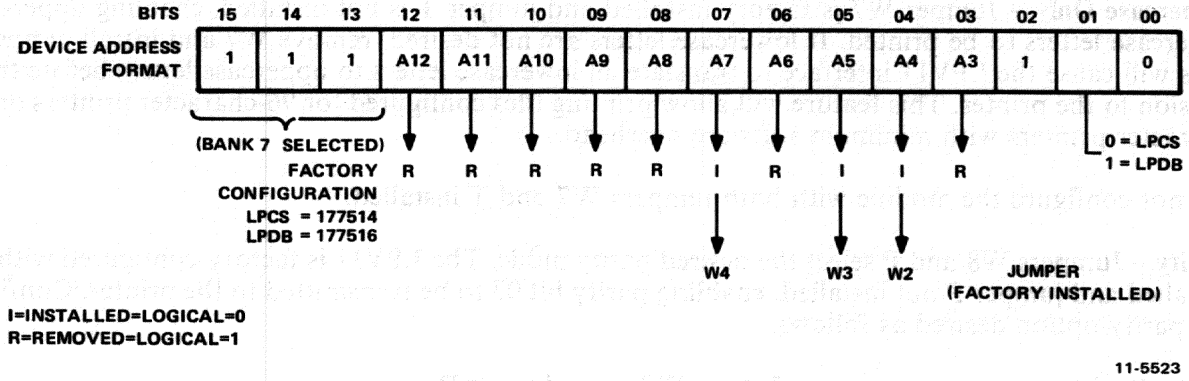


Figure 2-2 LPV11 Device Address Format and Jumpers

2.2.3 Interrupt Vector Address

The LPV11 is factory-configured for an interrupt vector address equal to 200. If more than one LPV11 option is installed in the system, or if a special interrupt vector address is desired, remove and/or install jumpers (one for each vector address bit) as directed in Figure 2-3.

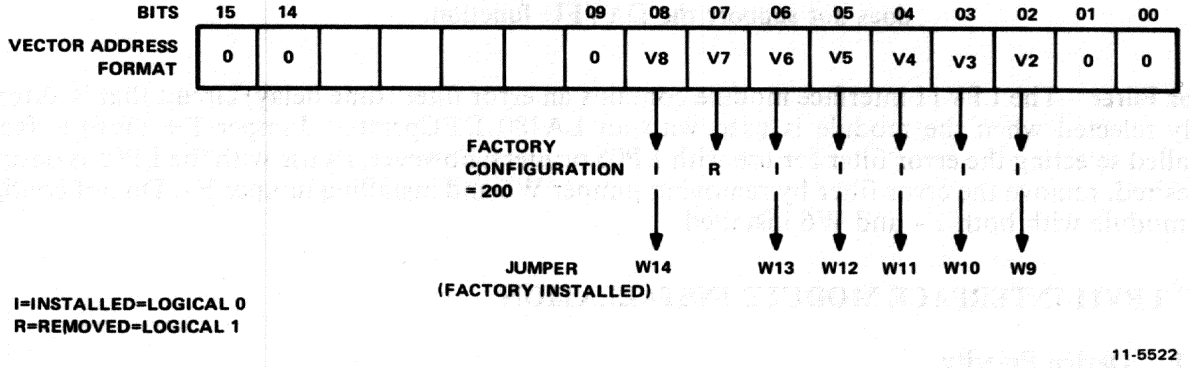


Figure 2-3 LPV11 Interrupt Vector Address Format and Jumpers

2.2.4 Optional Features

Optional jumpers alter LPV11 operation for specific functional purposes. These functions, and their associated jumpers are described as follows.

Bus Reply Timing – Jumper D (W1) is factory-installed to delay the BRPLY L bus signal timing for LPV11 use with LA180 printers. If desired, this jumper can be removed for use with future printers; however, the LP05 will function if it is left installed.

Uppercase Only – Jumper W7 is factory installed and jumper T is not installed, enabling upper- and lowercase letters to be printed. If lowercase letters are not desired, remove W7 and install jumper T. This will cause the LPV11 interface to translate all lowercase letters to uppercase letters before transmission to the printer. This feature will allow printing files configured for 96-character printers on 64-character printers with minimum software overhead.

Do not configure the module with both jumpers W7 and T installed.

Parity – Jumpers W8 and P select the desired parity mode. The LPV11 is factory-configured with W8 installed and jumper P not installed, enabling parity bit 07 to be transmitted to the printer. Configure the parity option desired as follows.

Parity Option	Jumper W8	Jumper P
Normal parity bit	Installed	Removed
No parity, bit 07 low	Removed	Removed
No parity, bit 07 high	Removed	Installed

Do not configure the module with both jumpers W8 and P installed.

NOTE

If the LPV11 interface module is used with an LP05 printer equipped with the Direct Access Vertical Form Unit (DAVFU), it is recommended that the user remove jumper W8. The LP05 interface module does not support the DAVFU function.

Error Filter – The LPV11 interface module contains an error filter (time delay) circuit that is automatically selected when the module is used with an LA180 DECprinter. Jumper F+ (W6) is factory installed selecting the error filter for use with LP05 printers; however, its use with the LP05 is optional. If desired, remove the error filter by removing jumper W6 and installing jumper F–. Do not configure the module with both F– and W6 installed.

2.3 LPV11 INTERFACE MODULE INSTALLATION

2.3.1 Device Priority

LPV11 device priority must be first considered to determine which backplane slot in which the LPV11 module will be installed. In all LSI-11 systems, device priority is established by the relative electrical position of device interface modules along the I/O bus. H9270 and DRV11-B backplanes are structured to allow the user to configure device priority by installing modules in appropriate positions. The PDP-11/03 includes one factory-installed H9270 backplane.

Figure 2-4 is a front view of the H9270 backplane, showing typical module locations. The processor module should be installed in backplane slots A1-D1.

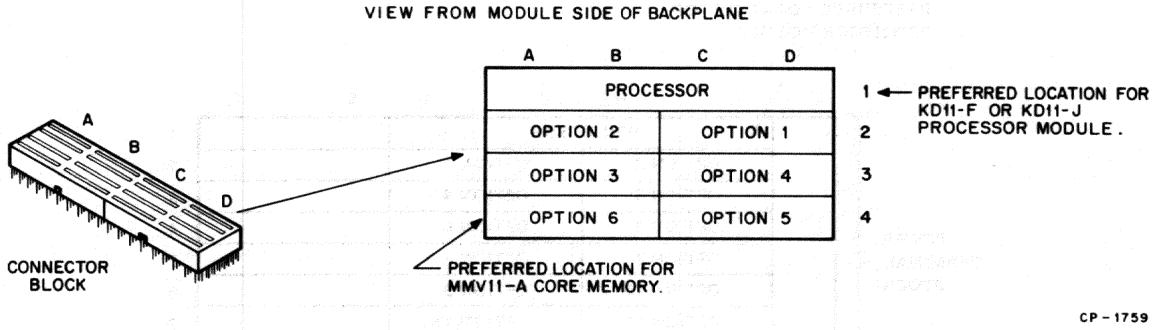


Figure 2-4 Typical H9270 Backplane Processor and Option Locations

The LSI-11 bus structure includes two daisy-chained signals: BIAKO L/BIAKI L (for interrupts) and BDMGO L/BDMGI L (for DMA grant). These signals normally propagate through option modules until they reach the requesting device. Option 1, as shown in Figure 2-4, is the first device location to receive the daisy-chained signals when the processor module is installed in slots A1-D1. Hence, six options can be installed in the backplane. The PDP-11/03 is shipped with the processor module installed in the backplane as shown in the figure. Do not relocate the processor module to another location; a separate non-bused (jumper) connection is provided on the backplane to this location for proper RUN indicator operation.

CAUTION

Do not configure the system with unused option locations in the backplane between the processor module and I/O devices that require either of the two daisy-chained signals; an unused location will break the daisy-chain signal continuity, and devices in higher numbered locations will not receive interrupt or DMA grant signals. Unused locations should occur only in the highest numbered option locations.

Note that the daisy-chained BIAK and BDMG signals always follow in increasing numbered option locations, as shown in the figure.

Device priority on the DDV11-B backplane is established in the same manner as described for the H9270 backplane. However, larger physical size allows up to 16 options (including a bus terminator module) to be installed on the backplane. Device (option) locations are shown in Figure 2-5. This highest priority location is option 1; the lowest priority location is option 16.

Since the LPV11 printer system only functions as an output device, and if it is interrupted by higher priority devices there is no danger of losing data, it can be located on the backplane as a low priority device. Install input devices as the higher priority devices.

Refer to the Microcomputer Handbook for system installation and bus termination details when the system contains MMV11-A core memory or more than six memory or peripheral device options.

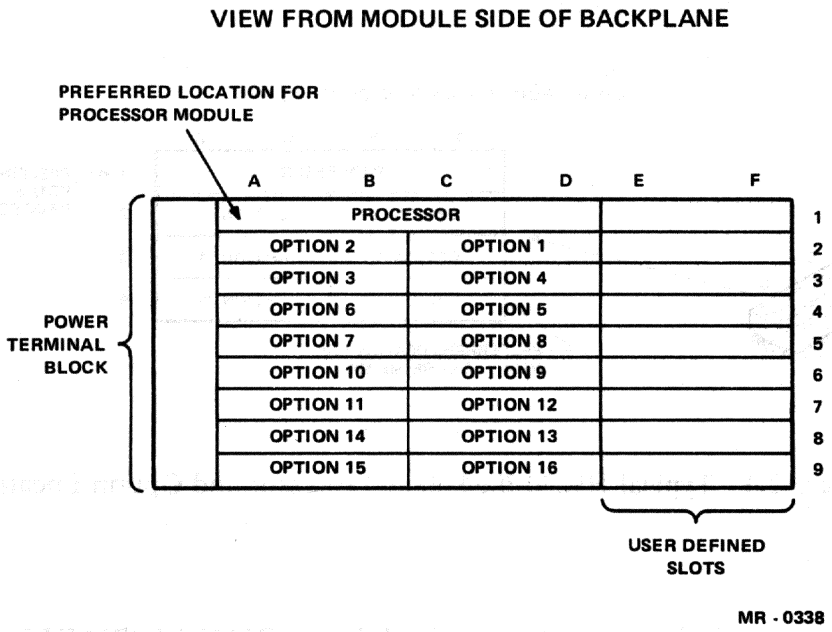


Figure 2-5 Typical DDV11-B Backplane

2.3.2 Module Installation

Modules must be installed or removed only when dc power is removed from the backplane. The PDP-11/03 contains a control/indicator panel on the front of the power supply; the DC ON/OFF switch allows the user to turn off dc power for safe module insertion and removal.

Modules must be installed in the backplane with components facing row 1, as shown in Figure 2-6.

CAUTION

The LSI-11 modules and the backplane assembly mounting blocks may be damaged if the modules are plugged in backward.

DC power must be removed from the backplane during module insertion or removal.

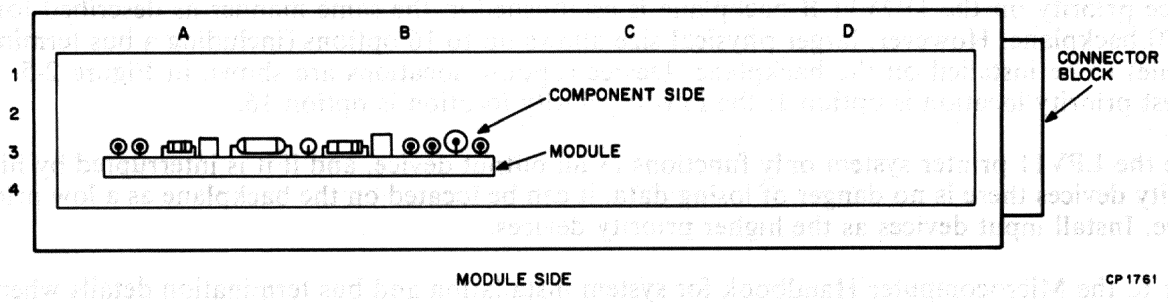


Figure 2-6 Module Installation

2.4 PRINTER INSTALLATION

Connect the LA180 or LP05 printer to the LPV11 interface module as directed in the following paragraphs. Connector J1 is located on the LPV11 interface module as shown in Figure 2-1.

CAUTION

Turn off LSI-11 system power and the printer power whenever installing or removing the printer's interface cable or interface module.

2.4.1 LA180 Installation

LPV11 printer systems equipped with the LA180 printer include the *LA180 DECprinter I User's Manual.* Refer to this manual for detailed installation procedures for the LA180 printer.

Connect the printer to the LPV11 interface module using the BC11S-25 cable supplied with the option. (Cable pinning is described in the printer manual.) Connect one end (P2) to the printer (J3) as directed in the printer manual. Connect the free end (P1) to the LP05 interface module connector (J1).

2.4.2 LP05 Installation

LPV11 printer systems equipped with the LP05 printer include the *Dataproducts Corporation Model 2230 Line Printer Technical Manual,* Volume 1. Refer to this manual for detailed installation procedures for the LP05 line printer.

Connect the printer to the LPV11 interface module using the 70-11212-25 cable supplied with the option. (Cable pinning is described in Table 2-1.) Connect one end of the cable (P1) to the interface connector on the rear of the LP05 line printer. Connect the free end (P2) to the LP05 interface connector (J1).

2.5 PRINTER SYSTEM CHECKOUT

After the printer system is installed, the system can be checked for proper operation by executing ZJ178-RB LP11/LP05 diagnostic software included with the LPV11 option. The diagnostic software kit includes a diagnostic program paper tape and documentation. Operating instructions and program listings for the diagnostic program are included in the documentation.

Table 2-1 LP05 Interface Cable (70-11212) Pin Assignments

From P1 (LP05)	To P2 (M8027)	Signal Name
B	JJ	P DATA 1 (LSB)
C	W	P DEMAND RET
D	HH	P DATA 1 RET
E	X	P DEMAND
F	LL	P DATA 2
J	XX	P DATA 2 RET
L	BB	P DATA 3
N	AA	P DATA 3 RET
R	FF	P DATA 4
T	EE	P DATA 4 RET
V	TT	P DATA 5
X	SS	P DATA 5 RET
Y	U	VERIFY RET
Z	RR	P DATA 6

Table 2-1 LP05 Interface Cable (70-11212) Pin Assignments (Cont)

From P1 (LP05)	To P2 (M8027)	Signal Name
AA	P	P FAULT RET
BB		
CC		
DD		
EE	V	CONNECTOR VERIFY
FF		
a		
b	PP	P DATA 6 RET
c		
f		
h		
j	VV	P STROBE
k	CC	P DATA 7 RET
m	UU	P STROBE RET
n	DD	P DATA 7 (MSB)
p	D	P DATA 8 (Parity)
r		
s	C	P DATA 8 RET
t		
u		
w		SELECT (no connection)
y	R	P FAULT
z		

Blank = not connected

CHAPTER 3
PROGRAMMING

3.1 PROGRAMMING SPECIFICATIONS

3.1.1 Printer Commands

Programs (except diagnostics) written for a specific LPV11 can generally be used for any LPV11 (models including either the LP05 or LA180 printers). Therefore, separate LP05 device handlers are not required for different LPV11 models. However, LP05 and LA180 printers do respond differently to certain non-printing characters (commands). A summary of commands for both printers is provided in Table 3-1. The programmer must use the proper command to produce the desired result with a specific printer. All characters (printing and non-printing) are 7-bit ASCII plus optional parity.

Table 3-1 LPV11 Command Character Summary

Command Character	Code	Printer's Response to Command	
		LP05	LA180
BEL	007	Prints a space	*BEL – Bell Activates alarm bell
BS	010	Prints a space	BS – Backspace Backspace one position
PF or LF	012	PF – Paper Feed Print cycle Carriage return Advances paper one line	LF – Line Feed Print cycle Carriage return Advances paper one line
VT	013	Vertical Tab Prints a space	None
FF	014	Form Feed Print cycle Carriage return Advances paper to the third line of the next form	Form Feed Print cycle Carriage return Advances paper to the first line of next form

*The LA180 produces three different audible alarm signals:

1. Continuous tone – indicates a carriage jam or failure.
2. Repetitive beeping – indicates an out of paper condition or a series of bell codes.
3. Single beep – indicates a bell code.

Table 3-1 LPV11 Command Character Summary (Cont)

Command Character	Code	LP05	Printer's Response to Command LA180
CR	015	Carriage Return Print cycle Carriage return No line feed	Carriage Return Causes all characters in LA180 memory to be printed Carriage return
ELONG	016	Elongated Character Prints a space	None
SEL	021	Select Prints a space	None
DSEL	023	Deselect Prints a space	None
DEL	177	Delete Prints a space	Delete Clears printer buffer of all data

3.1.2 LPV11 Device Registers

All programmed communication with the LPV11 option is via two device registers in the LPV11 interface module. These registers include the Line Printer Control and Status (LPCS) and Line Printer Data Buffer (LPDB). These registers are factory configured with LSI-11 bus addresses 177514 and 177516, respectively, and are software-compatible with DEC software. However, if additional LPV11 options are added to the system, or if the user requires addresses other than those factory configured, it will be necessary to alter interface module jumpers as directed in Paragraph 2.2 and provide an LPV11 program using these special device addresses. Each register is subsequently described in Tables 3-2 and 3-3 and both are shown in Figure 3-1.

Table 3-2 LPCS Register Bit Functions

Bit	Name	Function
15	ERROR	Asserted (1) whenever an error condition exists in the line printer. Error conditions include: LP05 Errors: 1. Power off 2. No paper 3. Printer drum gate open 4. Over-temperature alarm 5. PRINT INHIBIT switch off 6. Printer off-line 7. Torn paper

Table 3-2 LPCS Register Bit Functions (Cont)

Bit	Name	Function
		LA180 Errors: 1. Fault (paper fault) 2. On-line switch (in off position) Reset by manual correction of error condition if LPCS bit 06 is not set. If bit 06 is set, bit 15 is reset by manual correction of the error and (1) reading the interrupt vector if the interface is "ready," or (2) after reading the LPCS if the interface is "not ready." Read only.
<14:08>	Not used	(Read as 0s)
07	DONE	LP05 – Asserted (1) whenever printer is ready for next character to be loaded. Indicates that previous function is either complete or has been started and continued to a point where the printer can accept the next command. This bit is set by the LSI-11 processor asserting BINIT L; if bit 06 is also set, an interrupt sequence is initiated. Also set by the printer when on-line and ready to accept a character. Cleared by loading (writing into) the LPDB register. Inhibited when bit 15 is set. Read only. LA180 – Asserted (1) when the printer is ready to accept another character. DONE is set by the LSI-11 processor asserting BINIT L and is cleared by loading (output transfer to) the LPDB register. If the INTERRUPT ENABLE bit is set, setting DONE will initiate an interrupt request.
06	INTERRUPT ENABLE	Set or cleared by the program. Also cleared by the LSI-11 processor asserting BINIT L. When set, an interrupt sequence is initiated if either the ERROR or DONE bit is set.
<05:02>	Not Used	(Read as 0s)
01	ON LINE	Not supported and not required by DEC software. The following information is provided for reference only. LA180 – Set when the LA180 is on-line. Read only. LP05 – Not used. (Read as 0.)
00	BUSY	Not supported and not required by DEC software. Information is provided below for reference only. LA180 – Set when the LA180 is printing a line or advancing paper. LP05 – Not used. (Read as 0.)

Table 3-3 LPDB Register Bit Functions

Bit	Name	Function
<15:08>	Not used	(Read as 0s. Data written into these bits is lost.)
07	PARITY or D8	Optional use. (Read as 0.) LA180 – Optional parity bit. LP05 – Optional paper instruction bit. Not supported by the LPV11. (Read as 0.)
<06:00>	DATA	7-bit ASCII character register. Characters are sequentially output to the printer buffer via this register. (Read as 0s.)

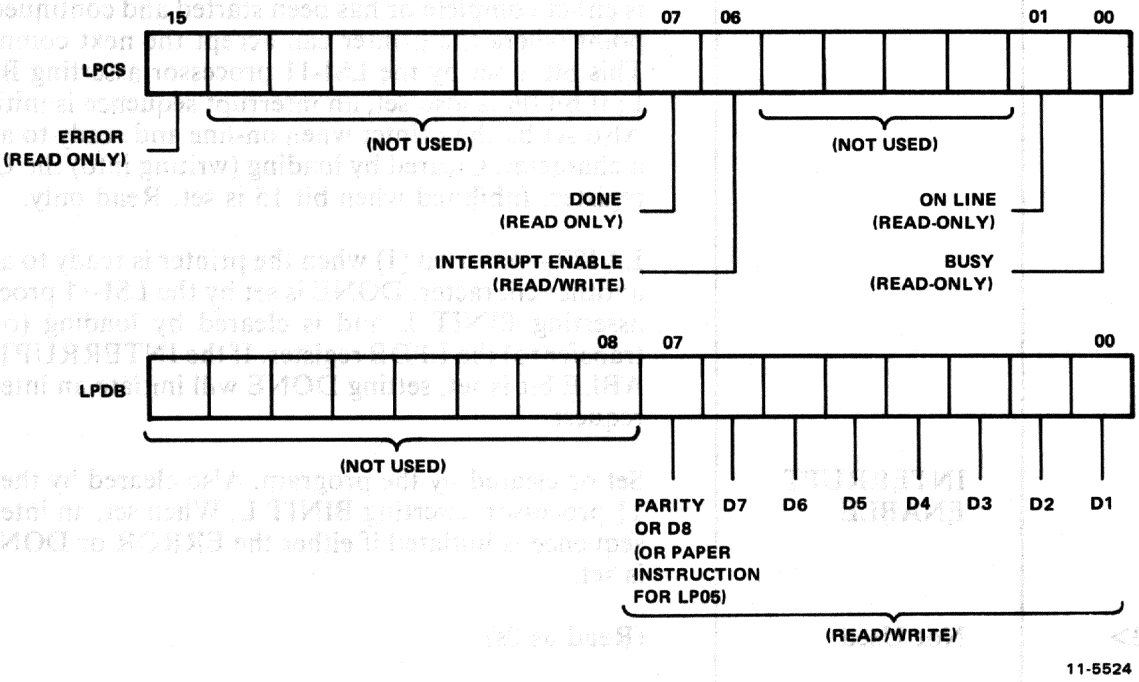


Figure 3-1 LPV11 Word Formats

3.1.3 Interrupts

Programs written for use with the LPV11 are generally composed of an interrupt-driven routine. When the LPCS register INTERRUPT ENABLE bit is set and either the DONE or ERROR bit is set, an interrupt request is initiated. Entry to the LPV11 service routine is normally via the factory-configured vector addresses 200 (PC) and 202 (PS). When servicing an interrupt and a second interrupt occurs, the second (and subsequent) interrupt may not be recognized. This condition can be avoided by checking for both interrupt conditions (DONE and ERROR) in the interrupt service routine.

3.1.4 Printer Operation

LP05 – Characters are sequentially output to the printer one character at a time, under program control. All characters are output via the LPV11 interface module LPDB register. Characters are stored in the LP05 print buffer until one of three special non-printing characters (CR, PF, or FF) is recognized. When a special character is recognized, the print cycle starts and the complete line is printed.

LA180 – Characters are sequentially output to the printer and stored in the same manner as for the LP05 printer. When a special character [CR, LF (same ASCII code as the LP05 PF character), or FF] is recognized, all characters comprising the line are sequentially printed.

3.2 PROGRAMMING EXAMPLE

A programming example for use with any LPV11 model is as shown. Portions shown include the LPV11 vector locations (200 and 202), one instruction in the main program that enables LPV11 interrupts, and the LPV11 interrupt service routine. Not shown are addresses for the buffer in system memory (BUFADR and BUFEND), the error routine (ERROR) and the printer complete routine, which are user-defined.

```
200:        LPSERV          ;VECTOR TO SERVICE ROUTINE
202:        200             ;SERVICE AT PRIORITY 4
            .
            .
            .
MAIN:       BIS #100,LPCS   ;ENABLE INTERRUPT
            .
            .
            .
LPSERV:     TST LPCS        ;CHECK FOR ERROR
            BMI ERROR       ;BRANCH IF ERROR
            MOV R0,-(SP)    ;SAVE R0
            MOV BUFADR,R0   ;GET BUFFER POINTER
LOAD:       MOVB (R0)+,LPDB ;LOAD PRINTER BUFFER
            CMP R0,BUFEND   ;END OF DATA?
            BHI PRCOMP      ;YES, GO TO PRINT COMPLETE
            TSTB LPCS       ;NO, CHECK DONE
            BMI LOAD        ;NOT FULL, GET ANOTHER CHAR.
EXIT:       MOV R0,BUFADR   ;SAVE BUFFER POINTER
            MOV (SP)+,R0    ;RESTORE R0
            RTI             ;RETURN TO MAIN PROGRAM
BUFADR:                     ;BUFFER DATA POINTER
BUFEND:                     ;BUFFER END ADDRESS
ERROR:                      ;ERROR ROUTINE START ADDRESS
```

```
PRCOMP:                 ;PRINTER COMPLETE ROUTINE
                        ;START ADDRESS

LPCS=177514             ;LPV11 STATUS REGISTER
LPDB=177516             ;LPV11 DATA BUFFER
```

CHAPTER 4
TECHNICAL DESCRIPTION

4.1 GENERAL

Logic functions that comprise the LPV11 interface are shown in Figure 4-1. Each logic function is briefly described in the following paragraphs. Detailed information can be obtained by referring to drawing CS-M8027 (included in the print set supplied with the option) and the LA180 and LP05 strobe timing diagrams (Figures 4-2 and 4-3, respectively).

4.2 LPV11 INTERFACE FUNCTIONS

4.2.1 General

LPV11 interface functions for use with LP05 or LA180 printers are similar; however, printer strobe signals required by the printer in use are different. By using the specified interface cable for the printer in use, the interface module produces the appropriate printer strobe.

The major part of the LSI-11 bus I/O and interrupt protocol is performed by two special integrated circuits (DC004 and DC003, respectively). These integrated circuit functions are described in the *1977-78 Microcomputer Handbook (Second Edition)*, Appendix F. Refer to drawing CS-M8027 to obtain correct signal names. LPV11 programmed I/O and interrupt transactions are as described in the *Microcomputer Handbook*, Section 1, Chapter 3.

4.2.2 Bus Transceivers and Drivers

Bus transceivers (DEC 8641) receive the LSI-11 bus BDAL<0:7> L signals and distribute the bits on DAL<0:7> H lines. In addition, they transmit LPCS bits or interrupt vector address bits during a DATI bus cycle, or interrupt sequence. Bus drivers (DEC 8881) transmit LPCS bits 8 and 15 during a DATI bus cycle in which the LPCS is addressed.

4.2.3 Device Address Decoding

Device address decoding logic receives DAL<2:7> H, BDAL<8:12> L, and BBS7 signals and compares the address to the device address jumpers (Paragraph 2.2.1); when the LSI-11 bus address bits 2 through 15 equal the jumper-configured address for the LPV11, ENB H goes active. Note that address bits 13, 14, and 15 are not decoded by the LPV11; the LSI-11 processor asserts BBS7 when these bits are all logical 1s, indicating an address is present in bank 7. In addition, address bits <0:2> are decoded for the device register (and byte) in the bus control logic. Bus control logic programmed transfer functions are enabled by the active ENB H signal.

4.2.4 Print Data Transmission

Print data is transmitted to the printer from the LSI-11 bus under program control. The print character buffer functions as the LPDB register. It is an 8-bit register, including the optional Parity/D8 bit. The bus control logic produces WRITE DB H during a DATO or DATOB bus cycle in which the LPDB is addressed. Jumper W8 can be removed to disable program transfer of LPDB bit 07 to the printer. When W8 is removed, P DATA 8 is forced low; if desired, jumper P can be installed to force P DATA 8 high.

Uppercase translation logic gives the user the option to print upper/lowercase data files on an uppercase letters-only printer (LP05-VA, VB, VC, or VD). Software overhead is reduced by performing the lowercase to uppercase translation in hardware, rather than in software. Jumper W7 normally applies unmodified upper/lowercase ASCII characters to the print character buffer. When the lowercase to uppercase letters translation is desired, jumper W7 is removed and jumper T is installed. The result is that ASCII codes 140 through 177 are translated to 100 through 137 (bit 5 = 0), as shown in Table 4-1.

4.2.5 Read Data Select Logic

Read data select logic functions enable the LSI-11 processor to read the LPCS register under program control or the LPV11s interrupt vector during an interrupt transaction. Control signals READ CS H and VECTOR H select the bits. LPCS bits are produced by various LPV11 interface functions as shown on Figure 4-1. Vector address bits are jumper-selected as described in Paragraph 2.2.2.

4.2.6 Ready Flag and LP Strobe Logic

Ready flag (LPCS bit 7) and line printer (LP) strobe logic provides the proper control signal interface to the printer. The LP strobe function is used only for LP05 printers; the LA180 uses the DATA STROBE H signal generated by the bus control logic. Selection of the appropriate strobe source is automatically produced by the LA/LP select logic function. Connecting the proper interface cable for the LA180 grounds the SELECT line, causing the LA/LP select logic to select LA180 (data selector port B) functions. When the LP05 is used, the interface cable does not ground the line and LP05 (data selector port A) functions are selected. The LA180 strobe is a negative-going pulse. The LP05 strobe is a positive-going pulse initiated by the leading edge of P DEMAND H and cleared by the trailing edge of P DEMAND H.

The ready flag is produced by the logic function when the printer is requesting a character (P DEMAND H goes active) and no error is present. In addition to setting the LPCS ready flag, the RQST A signal input to the interrupt logic goes active; if interrupts are enabled (LPCS bit 6 is set), an interrupt request is initiated (BIRQ L goes active). The ready flag is cleared by an active DATA STROBE L signal when writing a new character into the print character buffer.

When an error condition occurs in the printer, the printer asserts P FAULT L. The fault is applied to the error flip-flop logic (via the M FAULT H signal), producing an active ERROR L signal and an active ERROR H signal (LPCS bit 15). The ready flag logic function responds by not producing a ready flag, although P DEMAND H may be active, and by producing an active RQST A H signal. Thus, an error condition will initiate an interrupt request (if LPCS bit 6 is set) and set LPCS bit 15. The error flag is cleared by the processor reading the LPCS register if the ready flag is not set, or when the LPV11s interrupt vector is read.

4.2.7 Error Filter

The error filter is always used (automatically selected) for use with the LA180 printer and jumper selected for optional use with the LP05 printer. This function is produced by a clock pulse generator/counter circuit that requires an active P FAULT L signal for 8 ms before the M FAULT H signal is produced. The minimum time requirement for the fault signal presence prevents false errors due to noise.

4.2.8 BRPLY Delay

Bus control logic generation of BRPLY L signals is delayed 400 ns (approximately) by factory-installed jumper W1. W1 connects C3 to the DC004 RxCx input pin, delaying the BRPLY L signal for proper operation with LA180 printers. When LP05 printers are used, the jumper may be either left installed or removed to reduce the BRPLY delay, as desired.

4.2.9 Initialization

The LSI-11 processor initializes devices on the LSI-11 bus by asserting BINIT L. BINIT L is received by the interrupt logic and distributed as the INIT L signal. INIT L clears the print character buffer, error flip-flop logic, interrupt enable bit (LPCS bit 6), and sets the ready flag.

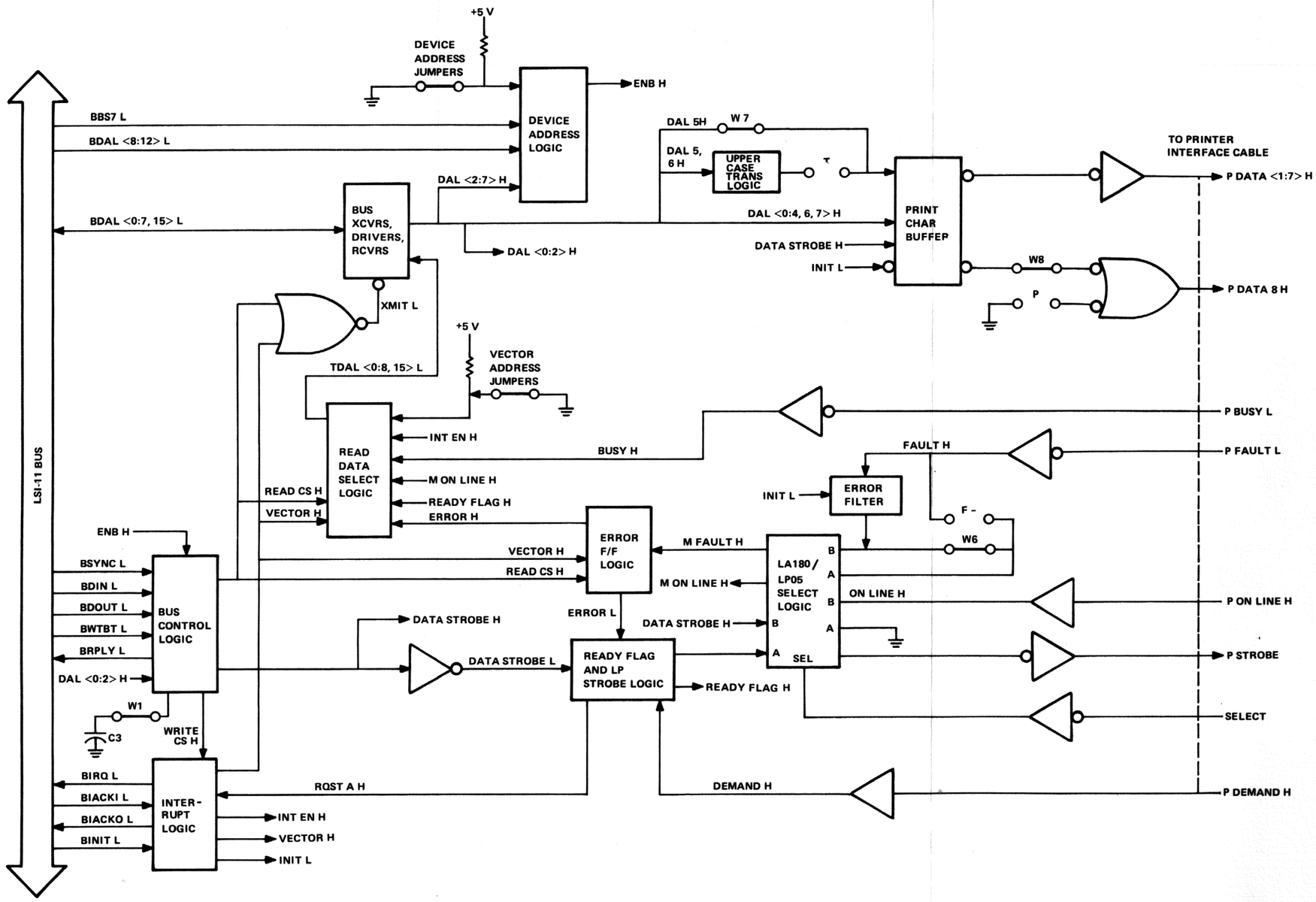
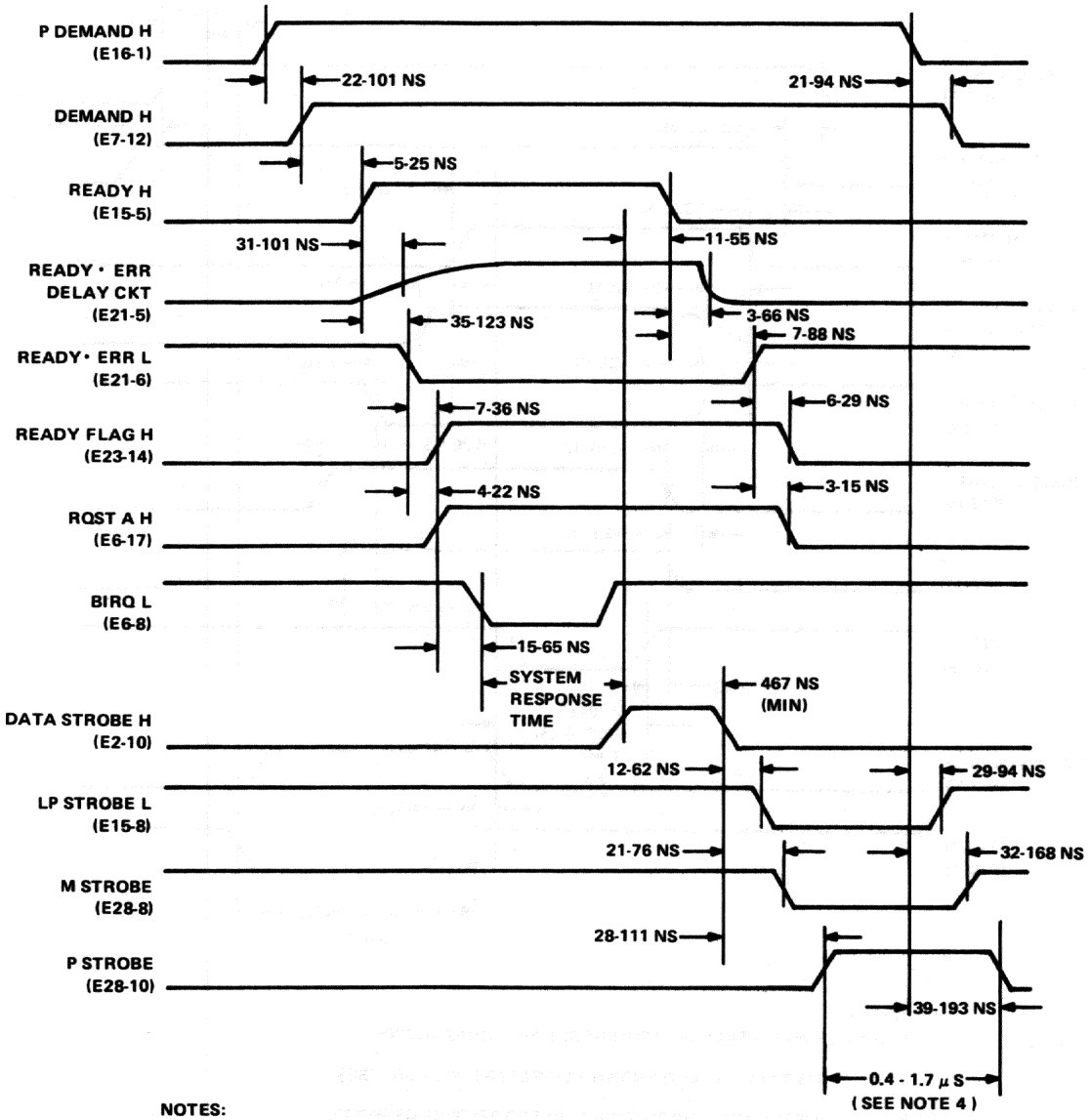


Figure 4-1 LPV11 Interface Logic Functions

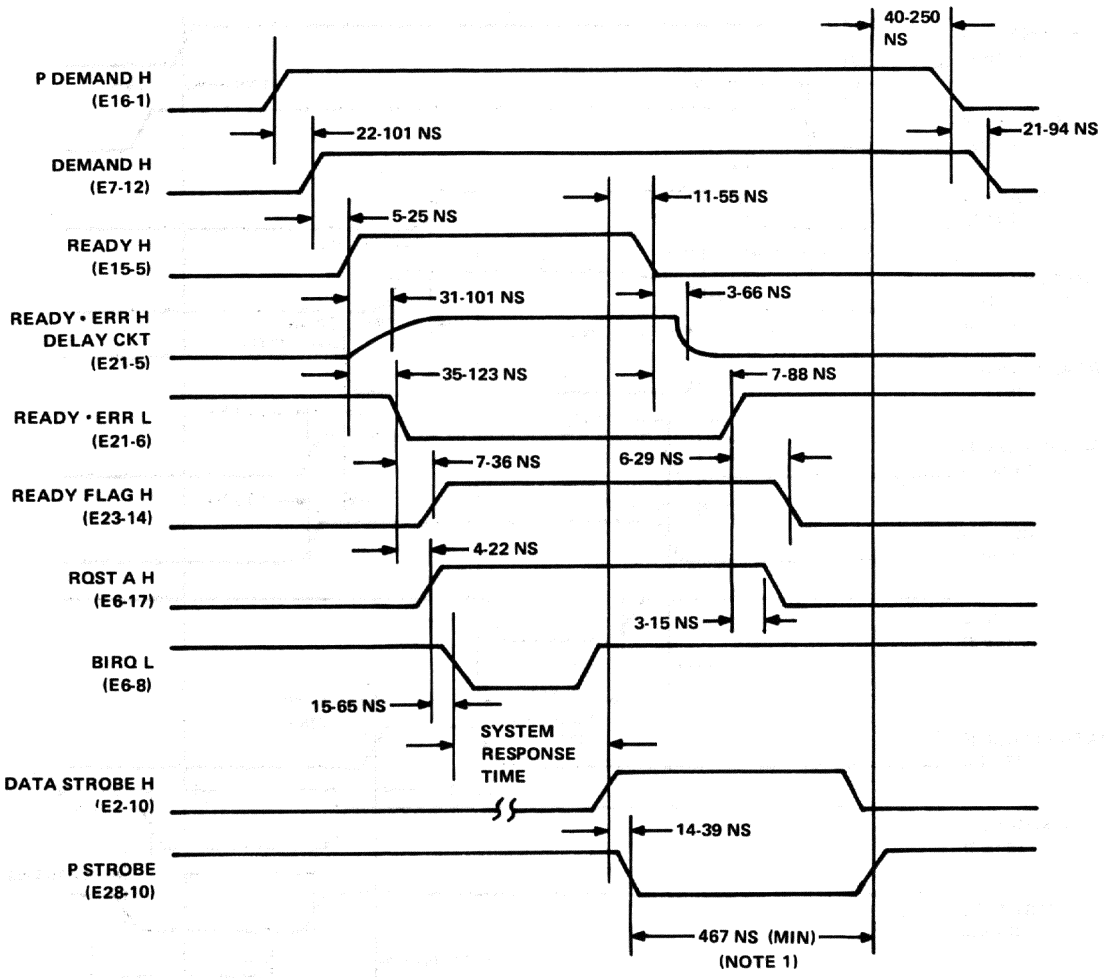


NOTES:

1. TIMING SHOWN IS TYPICAL, AND SHOWN FOR REFERENCE PURPOSES ONLY'
2. TIMING SHOWN WITH JUMPER W1 INSTALLED
3. ( ) = INTEGRATED CIRCUIT PINS. REFER TO DWG. CS - M8027
4. TIME IS DETERMINED BY LP05 PRINTER LOGIC.

11-5638

Figure 4-2 LP05 Strobe Timing



NOTES:

1. JUMPER W1 INSTALLED (REQUIRED) FOR TIMING SHOWN.
2. TIMING IS TYPICAL, AND SHOWN FOR REFERENCE PURPOSES ONLY.
3. ( ) = INTEGRATED CIRCUIT PINS. REFER TO DWG. CS M8027.

11-5637

Figure 4-3 LA180 Strobe Timing

Table 4-1 Uppercase-Only Code Translation

ASCII INPUT		ASCII OUTPUT	
Code	**Character**	**Code**	**Character**
140		100	@
141	a	101	A
142	b	102	B
143	c	103	C
144	d	104	D
145	e	105	E
146	f	106	F
147	g	107	G
150	h	110	H
151	i	111	I
152	j	112	J
153	k	113	K
154	l	114	L
155	m	115	M
156	n	116	N
157	o	117	O
160	p	120	P
161	q	121	Q
162	r	122	R
163	s	123	S
164	t	124	T
165	u	125	U
166	v	126	V
167	w	127	W
170	x	130	X
171	y	131	Y
172	z	132	Z
173	{	133	[
174	¦	134	\
175	}	135	]
176	~	136	^
177	DEL	137	-

CHAPTER 5
MAINTENANCE

5.1 GENERAL

Maintenance for the LPV11 involves executing a diagnostic program that tests the printer system and, if required, repairing the interface module or the printer. Maintenance procedures for the printers (LP05 or LA180) are covered in the appropriate printer manuals supplied with the option and are not repeated in this manual.

As a general rule, the user should first check that the LPV11 interface module is properly installed as described in Chapter 2 and that printer controls are properly set for operation. If the module appears to be properly installed (jumpers are properly configured, interface cable is properly installed, no unused option locations in the backplane between the LPV11 and the LSI-11 processor module), confirm the operational status of the interface module by executing the diagnostic software supplied with the option. Printer controls are described in printer documents supplied with the LPV11 option.

5.2 DIAGNOSTIC SOFTWARE

The LPV11 option includes diagnostic software in the ZJ178-RB LP11/LP05 Documentation/Paper Tape Kit. Documentation includes diagnostic program listings and detailed operating instructions. The diagnostic program can be input using the binary paper tape included in the kit. Running the program will effectively test the LPV11 printer system, including interface module functions and printer functions.

Minimum hardware requirements for running this diagnostic include the basic LSI-11 system, including 4K read/write memory in Bank 0, a console terminal, and a paper tape reader. Refer to the *Microcomputer Handbook,* Section 1, Paragraph 9.3 for general instructions for using paper tape diagnostics.

5.3 DIGITAL SERVICES

Maintenance services can be performed by the user or by DIGITAL, as desired. DIGITAL's services are described in the *Microcomputer Handbook,* Section 5, Chapter 3.

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