PDP-11/23 PLUS

Configuring Guide

digital

PDP-11/23-PLUS Configuring Guide

PREFACE

The purpose of this document, *The PDP-11/23 PLUS Configuring Guide*, is to provide Technical Volume Group (TVG) Sales Representatives and customers with the needed information to successfully configure the new PDP-11/23 PLUS microcomputer.

The Guide is organized in sections as follows:

- The **Introduction** provides a brief overview of Digital Equipment Corporation's microcomputer history, the PDP-11/23 PLUS's compatibility with existing systems, and the Extended LSI-11 architecture.
- Section 1, **The PLUS in the PDP-11/23 PLUS**, discusses some of the outstanding features and benefits of this new microcomputer.
- Section 2, **System Models**, presents the box-level models and packaged systems offered.
- Section 3, **Options**, presents the options available in configuring the PDP-11/23 PLUS; memory, floating point processors, communications options, etc.
- Secton 4, **Operating Systems and Software**, includes descriptions of the RT-11, RSX-11S, RSX-11M, RSX-11M-PLUS, and MicroPower/PASCAL operating systems and their supported software.
- Section 5 provides concise, step-by-step **Configuring Instructions.**
- **Appendix A** contains software instruction times for the PDP-11/23 PLUS.

LEGEND

This legend defines abbreviations and conventions used in this book. Descriptive explanations are provided.

Model
The system model number has two power variations. The 120V, 60Hz version appears first, while the 240V, 50Hz version is shown in parentheses.

Expansion Space
The amount of expansion space available within the CPU and/or expander boxes for additional backplanes or modules. It is important to remember that expansion space refers to physical space - for example: Quad slots - and not dc power consumption or electrical bus loads required by a particular option.

Extended LSI-11 Quad Slot
Space in prewired backplane for a 26.51 cm (10.44 in) high module for PDP-11/23-PLUS systems.
For further details, please consult your local Digital Sales representative.

CPU Cabinet Expansion
Expansion space within the CPU cabinet for expander boxes, distribution panels, and battery backup units. The Quad slots and dual-height slots available are shown in the matrix and in the backplane diagram for each system.

System Memory Expansion
Amount of memory that can be added to the system and maximum amount of memory the system can support.

System Disk Expansion
Number of like disks/disk subsystems that can be added to the system and maximum number of disks/disk subsystems the system can support.

Option Code
The option code designates voltage and cycle power requirements.

Mounting Code
Indicates type of mounting or layout required for a system component.

CAB
Cabinet mounted

DC Amps Available
Direct current available for system expansion @+5V and @+12V.

AC Amps Available
Alternating current available for system expansion @120V within a specific system cabinet for peripheral expansion.

AC Amps Drawn
Alternating current drawn by the option @120V or @240V.

AC Unit Load
An AC unit load is the unit of measure used to define the impedence that a bus element presents to the Extended LSI-11 Bus. This impedence is due to backplane wiring, etch runs, "receiver" chip inputs, and "driver" chip outputs.

DC Unit Load
A DC unit load is the unit of measure used to define the amount of leakage current that a bus element presents to the Extended LSI-11 Bus. This leakage is due to the electrical characteristics of the "receiver" and "driver" chips.

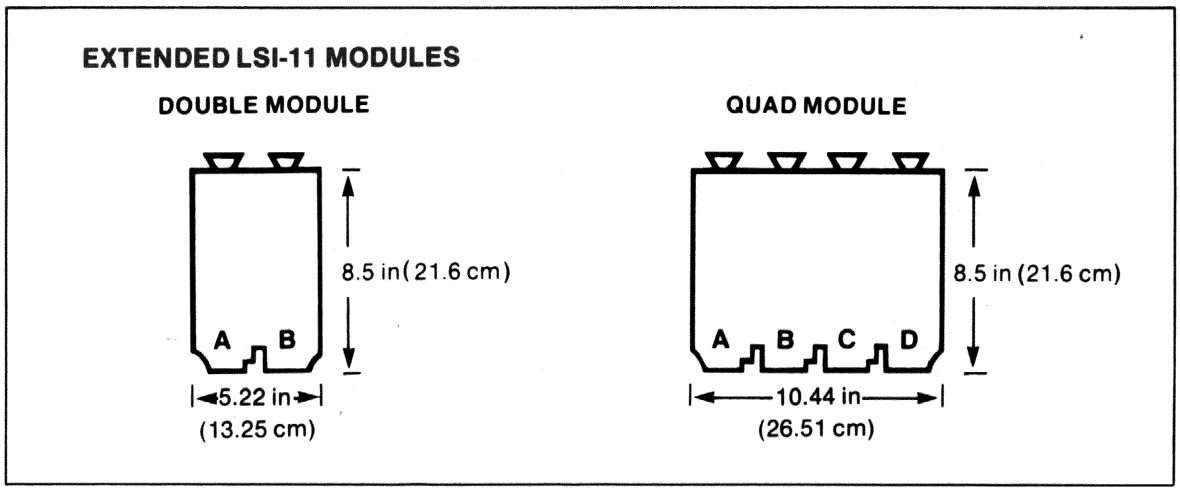
System Software
The operating system(s) which support the option.

Recommended Environment
The computer area environment (temperature and humidity) has a substantial effect on the overall reliability of a system and should be individually evaluated by a Digital Field Service Representative. For optimal system performance, Digital recommends the following environment.

Temperature:	21°±3°C (70°±5°F)
Temperature Rate of Change:	2°C/hr (5.5°F/hr)
Relative Humidity:	50% ±10% (non-condensing)
Humidity Rate of Change:	6%/hr

Units of Measurement

K = 1024
M = 1024^2
KB = Kbytes
MB = Mbytes
KB/s = Kbytes per second
MB/s = Mbytes per second



Modules

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Introduction

In 1975, Digital announced its first 16-bit microcomputer, which was followed by other complementary 16-bit systems. In December, 1981, Digital announced the PDP-11/23 PLUS, the latest 16-bit, microprocessor-based LSI-11 system.

For TVG OEMs and end-users, the PDP-11/23 PLUS is a full-functionality, multiuser product. It is supported by Digital's proven compatibility among operating systems and layered software products on other PDP-11 systems. The PDP-11/23 PLUS offers 22-bit addressing capability, new memories that utilize 64K chips, improved packaging (six available slots in packaged system configurations, seven in box-level products), and many other minicomputer features at a microcomputer price.

EXTENDED LSI-11 ARCHITECTURE

The new Extended LSI-11 architecture offers several major enhancements to the current Q-BUS, including full 22-bit addressing, extended memory space, and parity memory.

The original LSI-11 BUS was designed to accommodate Digital's quad-height as well as dual-height modules, and became known as the "Q-BUS" to reflect the quad board form factor. Earlier versions of the LSI-11 BUS included only 38 signal lines instead of the 42 signal lines currently included.

The LSI-11 BUS has been expanded to provide 22 address lines. This expanded Q-BUS is now called the "Extended LSI-11," (sometimes called the "Q-22 BUS"), allowing it to access up to four megabytes (4 MB) of physical address space. With current memory board densities and processor power, one megabyte is a practical limit yielding a balanced system.

The Extended LSI-11 BUS is a superset of the Q-BUS and can operate as a standard Q-BUS when the system memory is 256 KB or less. This means that the PDP-11/23 PLUS effectively is a Q-BUS for any application of 256 KB or less. Most current Q-BUS compatible options will operate, therefore, in 18-bit mode on the PDP-11/23 PLUS.

There is a very smooth evolution to systems larger than 256 KB. All that is required is additional memory.

PARITY MEMORIES

A significant addition to the Extended LSI-11 architecture and protocol is the implementation of MSV11-P parity memories. Two bus data and address lines (BDAL lines 16 and 17), are used to multiplex memory parity information with data and address information.

During the data transfer cycle, when data is being placed on the bus by the slave, bit 17 is asserted to inform the bus master that the parity error detection logic on the bus master should be enabled. Bit 16 is then asserted to indicate that a parity error has occurred.

The control and status register in the MSV11-P contains bits that are used to store the parity error address bits. By setting a bit in the Control Status Register (CSR), you can force wrong parity. This is a useful diagnostic tool for checking out the parity logic. The CSR has its own address in the top 4K of memory. Bus masters can read or write to the CSR.

The parity control circuitry in the MSV11-P generates parity bits based on the data being written into memory during a DATO or DATOB bus cycle. One parity bit is assigned to each data byte and is stored with the data in the MOS storage array. When the data is retrieved from memory during DATI or DATIO bus cycles, the parity of the data is determined. If the data is good, the data is assumed correct. If the parity bits do not correspond, the data is assumed unreliable, and memory initiates the following action:

- A red LED on the module illuminates. This provides a visual indication of a parity error and sets CSR bit 15.
- If bit 0 in the CSR is set, the memory asserts BDAL 16 and 17. This warns the processor that a parity error has occurred.
- Part of the address of the faulty data is recorded in the CSR.

There is a green LED on the module that stays illuminated as long as +5V power is supplied to the logic required for memory refresh, read/write requests, arbitration, and row and column addressing.

ASYNCHRONOUS

The Extended LSI-11 BUS handles all communication between the PDP-11/23 PLUS processor and other modules in the system. Since it operates asynchronously, each module is able to operate at its own speed, thus improving overall system performance. The processor, or device, places the addresses of main memory or an input/output (I/O) device on the bus, along with control information through a set of control signals. These signals are interpreted by the addressed module which then either sends or receives data as requested. This is essentially identical to the standard Q-BUS protocol.

EXTENDED LSI-11 AND Q-BUS SIMILARITIES

Program transfer devices are handled in the same fashion on the Extended LSI-11 BUS, as on the Q-BUS. This includes devices such as a DRV11 general-purpose, program-controlled parallel line interface unit, and DLV11 single line, asynchronous interface.

EXTENDED LSI-11 AND Q-BUS DIFFERENCES

The difference in the two buses comes in the area of DMA devices. The Extended LSI-11 BUS requires a DMA device to create a 22-bit wide address. Previous Q-BUS DMA devices have created 18-bit addresses.

The RLV12 controller has been redesigned to fit onto a single quad module and supports the 22-bit addressing capability. It also supports 18-bit addressability.

All future DMA devices will be designed with a 22-bit addressing capability, making them fully compatible with the Extended LSI-11 BUS.

PRIORITY INTERRUPT SCHEME

A fully vectored, priority interrupt scheme allows every device to have its own vector and interrupt service routine. This scheme eliminates the need to poll each device to determine which device wants to interrupt the Central Processing Unit (CPU).

The priority of a device is a combination of hardware interrupt priority level, of which there are four, (BIRQ4 through BIRQ7), and a device's electrical proximity to the CPU (physically closest in the backplane).

Priority is established by hardware and can be enabled or disabled through software access of a device's control and status registers.

EXTENDED LSI-11 VS. Q-BUS ADDRESS STRUCTURE COMPARISON

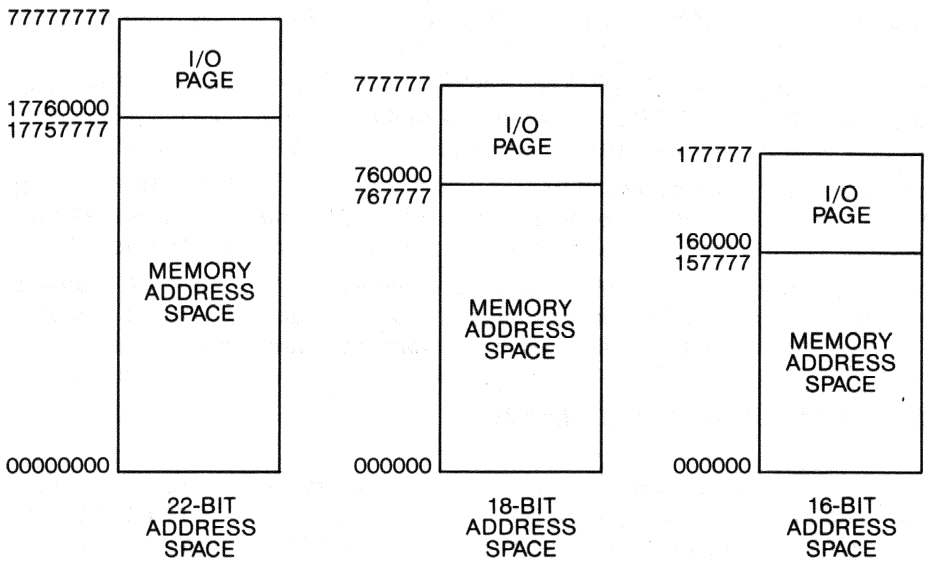
On the Extended LSI-11 BUS, devices are addressed in the same fashion as on the standard Q-BUS. If signals on the bus data and address lines have a valid device address, bus protocol causes the following sequence to occur.

A signal, BBS7, is asserted indicating that an address in the I/O page is requested. Control information is carried by the BWTBT signal indicating that either data will be written to the I/O device address by us to address lines, or that the transaction will be byte-oriented rather than word-oriented.

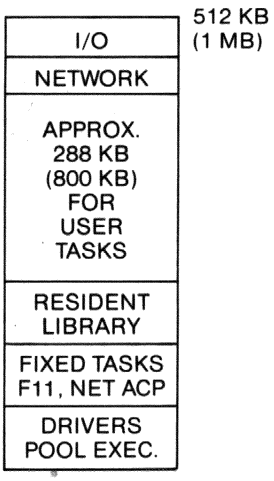
The handshake protocol used by the BYSNC signal indicates bus synchronization. This signal is asserted when one of the following conditions has occurred.

- Extended LSI-11 BUS data and address lines carry a valid device address in the I/O Page
- Signal BBS7 is asserted
- Control information for this transaction is valid and carried by the BWTBT signal

PHYSICAL ADDRESS SPACE, I/O SPACE, AND MEMORY ADDRESS SPACE



Memory and I/O Space



The entire range constitutes the physical address space. Physical address space is divided into memory space and I/O space as pictured above. The expanded memory address space available on the PDP-11/23 PLUS will permit higher performance due to less swapping and greater use of memory-resident overlays.

PHYSICAL ADDRESS SPACE

The Extended LSI-11 bus supports systems with 16-bit, 18-bit and 22-bit physical address space. In each case, the top 8 KB of physical address space is defined as the I/O Page address area.

The CPU and all other devices capable of becoming bus master assert BBS7 when they reference the I/O Page.

The 22-bit physical address covers addresses from 000 000 00 to 17 777 777. The 22-bit I/O Page is located from 177 600 00 to 17 777 777. A CPU with enabled 22-bit memory management addesses a device in the I/O Page range of addresses when BBS7 is asserted.

The original 16-bit physical address space covers addresses from 000 000 to 177 777. The 16-bit I/O Page is located from 160 000 to 177 777 for systems that support up to 64 KB of memory. And, a 16-bit CPU, or a CPU with memory management disabled, will use this range as the I/O Page when BBS7 is asserted.

In all systems, whether they are 22-bit, 18-bit, or 16-bit, virtual addresses in the 000 through 376 range are reserved for trap and interrupt vector addresses. For larger system configurations, additional virtual addresses in the 400 through 776 range are also reserved for interrupt vector addresses.

DEFINING EXTENDED LSI-11 MEMORY ADDRESS SPACE

On the Extended LSI-11 BUS, memory is addressed in the same fashion as on the Q-BUS. Logic determines that an address on the Data and Address (DAL) lines is not in the upper 8K or I/O Page, and therefore, BBS7 is not raised. Bus cycle control information carried by BWTBT indicates if this is a WRITE or BYTE operation, and memory responds to the CPU or device by raising BSYNC as part of the bus handshake protocol.

For 22-bit systems, the memory address space covers addresses 000 000 0 through 17 757 777. For 18-bit systems, the memory address space covers addresses 000 000 through 757 777. And for the 16-bit systems, the memory address range is 000 000 through 157 777.

Section 1
The PLUS In The PDP-11/23-PLUS

This section discusses the features and benefits of the PDP-11/23 PLUS, such as a new processor board and new high density parity memory for efficient backplane utilization.

KDF11-B PROCESSOR MODULE

The new KDF11-B multifunctioning processor module incorporates new functions such as:

Two Serial Line Units

The two asynchronous serial lines on the processor board provide half the functionality of a DLV11-J. They are full-duplex and provide EIA interfaces which are RS-232-C and RS-423 compatible.

Baud rates are switch-selectable, while the character formats, number of bits, and parity type are jumper selectable.

The first serial line unit (SLU1) is dedicated for the console terminal. The second serial line can be used for expansion.

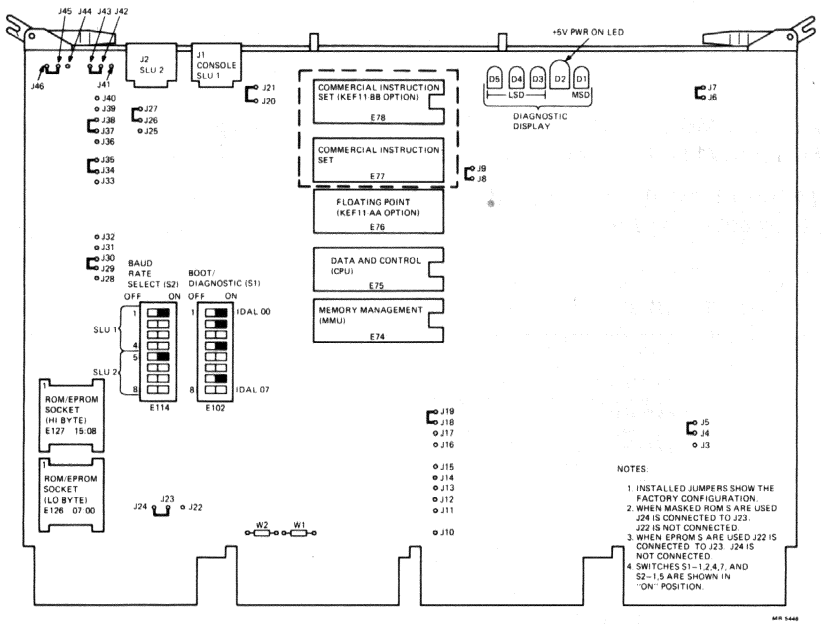
Line Frequency Clock

The Line Frequency Clock provides the system with timing information at fixed intervals, typically 16.7 milliseconds for a 60 Hz line, or 20.0 milliseconds for a 50 Hz line.

Boot/Diagnostic Capability

The KDF11-B Boot and Diagnostic features two ROMs in sockets. If the Digital-supplied ROMS are not used, either 2K, 4K, or 8K of 16-bit read-only memory can be used. The Digital-supplied ROMS contain bootstrap programs for standard load devices as well as diagnostic programs to verify the CPU and memory.

KDF11-B Module



The KDF11-B processor module is compatible with the KDF11-AA PDP-11/23 CPU. Some of the compatible features are:

- Full PDP-11/34A instruction set and Extended Instruction Set
- 16-bit word and 8-bit byte addressable locations
- Eight internal registers
- Stack processing
- Direct memory access (DMA)
- Power fail/auto restart hardware
- 18-bit Octal Debugging Tool (ODT) console emulator
- Memory management

The KDF11-B multifunction, quad processor module includes new functions in addition to the list below. These new features are: two serial line units, a line frequency realtime clock, and bootstrap and diagnostic ROMS. The KEF11-AA floating point chip is offered as an option.

MEMORY MANAGEMENT

With many programs running simultaneously on a system, the operating system must move programs out of memory temporarily so that other programs can be brought into memory to execute. This is called "swapping." When this occurs, CPU resources are required to manage the scheduling and movement of programs. Disk I/O is significantly increased as the programs are swapped. As a result, the swapping of programs negatively affects both system throughput and system response time, especially in I/O bound applications.

Such multifunctioning programs require total memory exceeding the amount of memory on the system. Memory management on the PDP-11/23 PLUS allows up to 4 MB of addressing space, giving the PDP-11/23 PLUS a significant increase in system performance for applications performing multiple functions simultaneously.

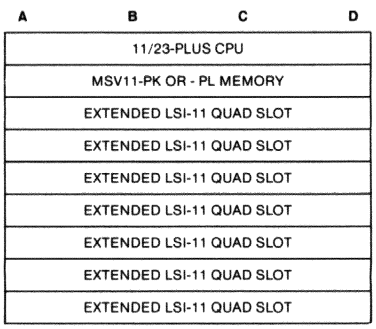
Using larger PDP-11/23 PLUS memory configurations and its 22-bit addressing capability minimizes program swapping. The CPU and disk resources required for swapping are freed for productive tasks. The programs can now become memory resident so they can respond to realtime interrupts more quickly, and more terminals can be supported by the system.

Note: Memory and DMA interface options that were designed for 18-bit (256 KB maximum) LSI-11 systems cannot be used in PDP-11/23 PLUS systems larger than 256 KB. Non-DMA interface options are not affected.

MEMORY

The PDP-11/23 PLUS supports up to 1 MB of parity memory. Memory is offered in new memory modules of 256 KB (MSV11-PK) and 512 KB (MSV11-PL). These new memory modules use 64K RAM chips.

The backplane drawing below shows where memory is located on the PDP-11/23 PLUS and where more memory, in 256 KB or 512 KB increments, may be added.



PDP-11/23-PLUS Backplane

MODES OF EXECUTION

The PDP-11 CPU family offers three (CPU model dependent) modes of execution: Kernel, Supervisor, and User. The PDP-11/23 PLUS offers the Kernel and User modes only. The modes are used to enhance the memory protection scheme and to increase the flexibility and functionality of timesharing and multiprograming environments.

Kernel mode is the most privileged of the three modes and allows execution of any instruction. In an operating system featuring multiprogramming, ultimate control is implemented in code that executes in Kernel mode.

User mode is the least privileged mode and prohibits the execution of instructions such as HALT and RESET. A multiprogramming operating system will typically restrict execution of user programs to User mode to prevent a single user from having a negative effect on the system as a whole. The user's virtual address space is set up such that the only areas of memory that can be written to are those belonging to the user. Areas shared among users are protected as read-only, execute-only, or for both read and execute access.

EXTENDED INSTRUCTION SET

The PDP-11/23 PLUS processor offers a standard instruction set of 91 instructions. This instruction set includes both single and double operand instructions that operate with bit, byte, 16-bit word, and multiple-word data types. A variety of addressing modes extends the standard instruction set to over 400 powerful instructions common to all PDP-11 processors. In addition to the standard instruction set, an optional microcoded floating point chip (KEF11-A) provides 46 instructions for single-precision (32-bit) and double-precision (64-bit) floating point data.

For applications requiring increased floating point performance, the optional FPF11 floating point processor provides faster execution of the same instructions offered by the KEF11-A microcoded chip. For a complete description and power specifications of the FPF11, see Section 3, Options.

THE RLV12 CONTROLLER

The RLV12 Controller interfaces the RL01 and RL02 disk drives to a 16-, 18-, or 22-bit LSI-11 bus. One RLV12 can support up to four RL01 and RL02 disk drives in any combination. The RLV12 module, the M8061, has the LSI-11 bus transceivers and decoders, programmable registers, the controller timing and sequence logic, and the data formatting circuits necessary to read and write on the disk.

The user can change the device address, interrupt vector, and memory parity error abort feature.

The RLV12 can be installed in any Quad LSI-11 slot. The controller's priority level is based on its electrical distance from the CPU module.

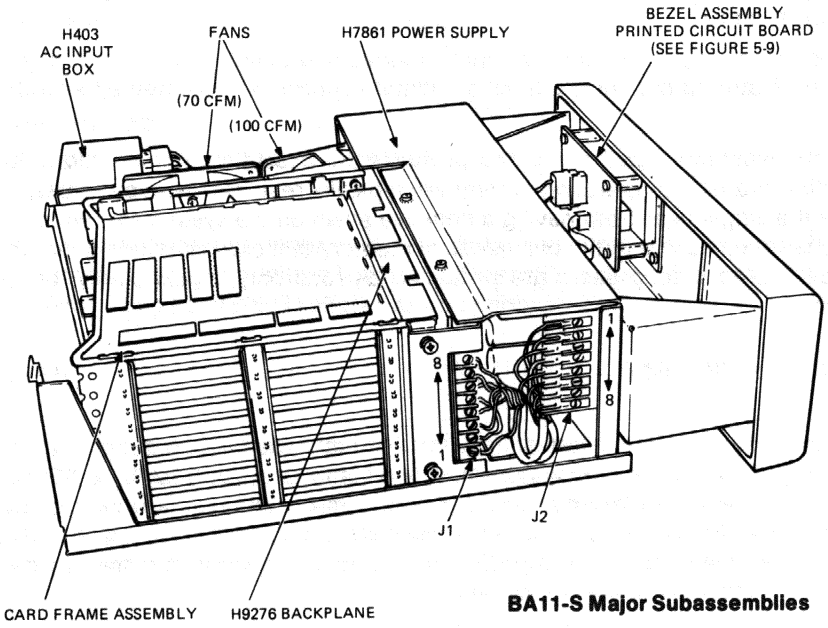
GREATER PACKAGING DENSITY - BA11-S

An important feature of the PDP-11/23 PLUS is that an OEM can add Digital options and his own value-added hardware in the BA11-S box. The BA11-S 13.3 cm (5.15 in) box contains a 4x9 H9276 backplane with the H7861 power supply. In adding options, there is no added expense for an expansion cabinet.

Packaged system configurations have space for six quad- or double-height modules; box-level-only configurations have space for seven. A packaged system can be configured with either 256 KB or 512 KB memory and still have six slots for expansion.

Although the BA11-S backplane is position-independent, the interrupt priority structure is etched into the backplane. Therefore, I/O options should be positioned in the backplane *according to speed and buffering capability.*

The BA11-S houses two cooling fans (a 70 cfm (cubic feet per minute) fan to cool the logic modules and a 100 cfm fan to cool the power supply), an H9276 backplane with a card frame assembly, an H7861 power supply, and an H403 ac input box. The BA11-S is available with a control panel or blank panel that operates at 120 Vac or 240 Vac. The major subassemblies of the BA11-S are shown in the drawing below.



BA11-S Major Subassemblies

The ac input box, power supply, and H9276 logic and assembly (which includes the fans and the backplane) are attached to the logic box base; the bezel is attached to the power supply. The power supply assembly is hinged to the base and can be swung open to expose the internal components; with little effort, the entire assembly can be removed from the base and replaced. Extended LSI-11 bus modules are inserted in the backplane from the rear of the box through the rear access door.

The BA11-S can be used as a mounting box for a PDP-11/23 PLUS system, which consists of a KDF11-B processor, MSV11-P memories, and other extended LSI-11 bus options compatible with the PDP-11/23 PLUS bus.

BA11-S Mounting Box Specifications

Electrical:

Phasing	Single
Input voltage	90 to 132 VRMS (120V nominal) 180 to 264 VRMS (240V nominal)
Frequency	47 to 63 Hz
Input current	6A @120V 3A @240V

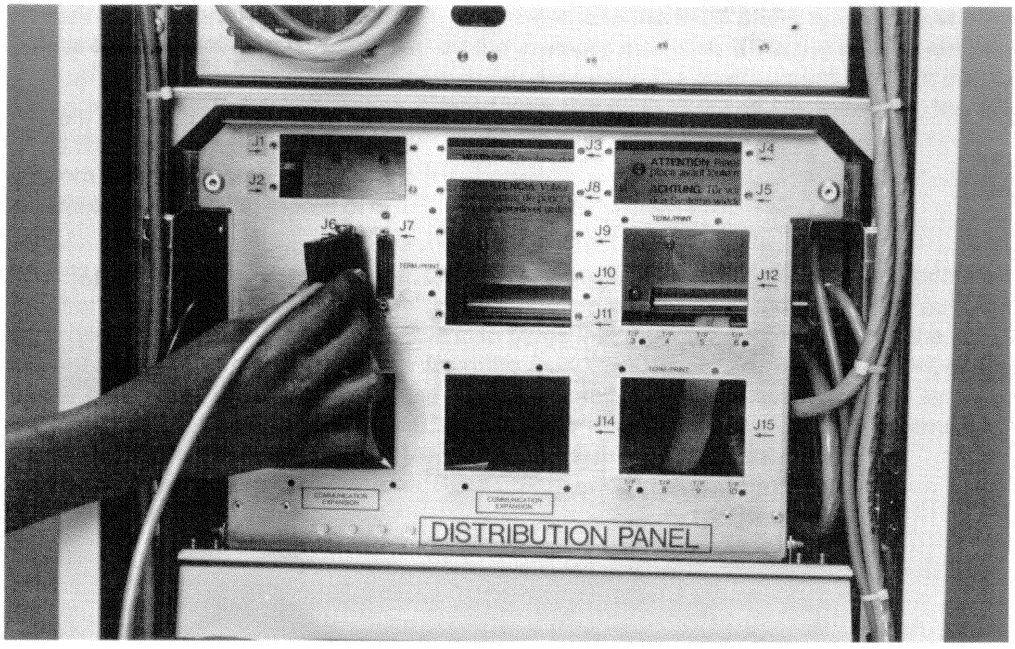
Output voltage	Maximum Output	Recommended Output (90% max)
	+5V 36A	32.4A
	+12 5A	4.5A

Maximum power consumption	540 W
Mechanical:	
Size	48.3 cm (W) x 13.3 cm (H) x 57.8 cm (D) (19 in x 5.19 in x 22.75 in)
Weight	20 kg (44 lb)
Environmental:	
Operating temperature	5 °C to 50 °C (41°F to 122°F)
Operating humidity	10% to 95% wet bulb 32°C (90°F) and minimum dew point 2°C (36°F)
Maximum wet bulb	32°C (90°F)
Maximum altitude	To 2.44 km (8,000 ft)
Non-operating temperature	-40°C to 66°C (-40°F to 151°F)
Non-Operating humidity	95% (non-condensing)
Non-Operating max. altitude	To 15.25 km (50,000 ft)

NEW DISTRIBUTION PANEL

Included with the PDP-11/23 PLUS packaged system is a new 21.28 cm x 22.86 cm (11.5 x 9 in) system distribution panel. Its purpose is to make the system easier to install. The OEM and/or customer can easily connect terminals, line printers, and other communications cables without having to access the backplane of the processor or modules.

The system distribution panel is mounted behind the processor box to the system cabinet. On the processor side of the system distibution panel, cables connect the modules to the panel. On the outer side of the panel are the appropriate EIA, 20mA and other panel connectors necessary to connect terminals, a line printer, etc., to the panel. (See the photograph and the drawing below.) Since the patch panel is mounted on the cabinet, the panel is included with packaged systems only. The distribution panel may be purchased separately. Only one distribution panel may be included with each system. The distribution panel cable assemblies to the PDP-11/23 PLUS are also listed below.



Distribution Panel

Option	Module	Ext Cable
DLV11-ED	M8017	BC05D-25 or BC03M-25 or BC22A-25
DLV11-J	M8043	BC22A-25 (4 required)
DMV11-AA	M8053	BC05D-25 (EIA)
DMV11-AC	M8054	BC55M-98 (Local) (2 required for full duplex)
DZV11-C	M7957	BC05D-25 or BC03M-25 or BC22A-25 (4 required)
DRV11-D	M7941	BC08R-25 (2 required)
DRV11-JA	M8049	BC05W-15

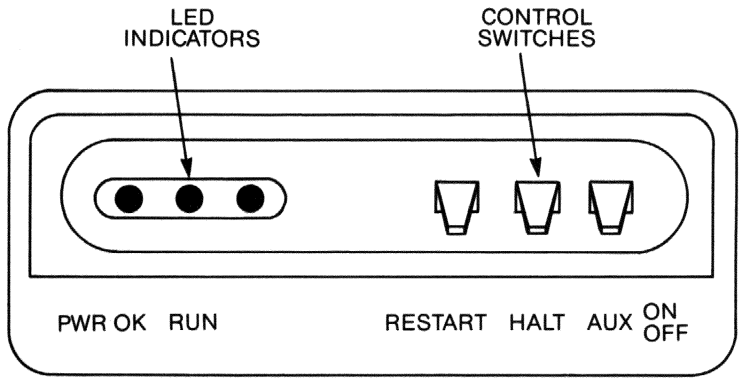
CONTROL PANEL

Power control switches provide power, on/off, and bootstrap communications between the user and the microcomputer system. The panel contains three switches: AUX ON/OFF, HALT, and RESTART. The switch panel contains three LED indicators; two of which are used: POWER and RUN. The third LED is not used by the system.

Control panel switches and indicators are listed and described below.

SWITCHES

Switch	Position	Function
AUX ON/OFF	**OFF**	Power is removed from the system.
	ON	The ac power is applied to the system. If the HALT switch is enabled, the default start-up mode is to automatically boot the system.
HALT	**Up (Enable)**	The processor is enabled to run.
	Down (Halt)	The processor is halted and will respond to console ODT commands.
RESTART	**RESTART (momentary switch)**	When the HALT switch is up, the processor carries out a power-up sequence and displays the bootstrap dialog.



Control Panel

INDICATORS

LED	Function
PWR OK	Illuminated when the processor is generating proper dc output voltages
RUN	Illuminated when the processor is operating; turned off when the processor is not executing instructions. Blinks when characters are typed.

FPF11 FLOATING POINT PROCESSOR

The FPF11 is a single- (32-bit) and double- (64-bit) precision floating point option. It is a hardware (quad board) implementation of the full PDP-11/34 floating point instruction set. It provides floating point processor performance for users requiring higher performance than is offered by the KEF11-AA. FPF11 includes two ribbon cables; one for connection to the PDP-11/23 PLUS, and one for connection to the PDP-11/24. On the PDP-11/23 PLUS, the FPF11 mounts adjacent to the CPU. Overall floating point performance is optimized for PDP-11 FORTRAN-77/RSX.

BATTERY BACKUP

Battery backup provides power for memory refresh to the MOS memory if the input power fails. Backup time is limited by the heat generated by the memory modules, since the ac fans are not powered by the backup unit. Backup time is also highly dependent upon the environment in which the computer is used. There is no battery backup option offered with the PDP-11/23 PLUS; however, the MSV11-P memory module has pins with which a user can configure his own battery backup.

874 POWER CONTROLLER

The 874 Power Controller, located on the rear base of the console cabinet, contains the main circuit breaker for the system. The system-component line cords are plugged into the outlets provided on the controller. The remote operation cable also plugs into a connector mounted on the controller and allows the operator to turn on the ac power from the AUX ON/OFF switch. There are three configurations for the power controller: 120 Vac systems use the 874-A rated at 12 A and have 4.0 amps available for expansion; the 874-C is rated at 16 A and has 8.0 amps available for expansion. The 874-B rated at 8 A is used on 240 Vac systems and has 4.0 amps available for expansion.

Section 2
System Models

The PDP-11/23 PLUS offers two box-level models, the 11/23-BC and the 11/23-BE. Both models include the following features:

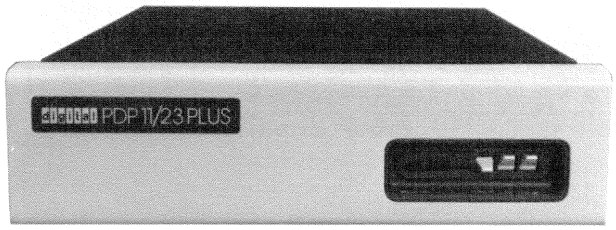
- KDF11-B CPU
- BA11-S Mounting Box
- 256 KB or 512 KB Memory

The KDF11-B CPU includes the following:

- KDF11-AA compatible CPU module
- KDF11-AA compatible memory management
- Two serial line units
- Optional floating point processor instruction set (KEF11-AA)
- Line frequency realtime clock
- Boot and diagnostic ROMS

ROW	SIZE	OPTION	AMPS		BUS LOADS	
			+5V	+12V	AC	DC
1	Q	KDF11-B	3.0	0.3	2	1
2	Q	MSV11-PK, -PL	4.0	—	2	1
3	Q					
4						
5						
6						
7						
8						
9						
		H9276	—	—	3	—
		TOTAL AMPS/LOADS	7.0	0.3	7	2
		AVAILABLE AMPS/LOADS	32.4	4.5	35	20
		REMAINING AMPS/LOADS	25.4	4.2	28	18

PDP-11/23-BC, -BE MODULE PLACEMENT



A	B	C	D
11/23-PLUS CPU			
MSV11-PK OR - PL MEMORY			
EXTENDED LSI-11 QUAD SLOT			
EXTENDED LSI-11 QUAD SLOT			
EXTENDED LSI-11 QUAD SLOT			
EXTENDED LSI-11 QUAD SLOT			
EXTENDED LSI-11 QUAD SLOT			
EXTENDED LSI-11 QUAD SLOT			
EXTENDED LSI-11 QUAD SLOT			

PDP-11/23-BC/BE

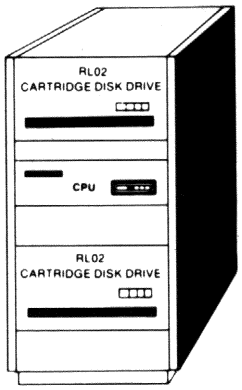
MODEL	MEMORY	EXPANSION SPACE	DC AMPS AVAILABLE @+5V	DC AMPS AVAILABLE @+12V	AC AMPS DRAWN @120V	BUS LOADS AVAILABLE
11/23-BC	256 KB	7 Quad or 7 Double	23.9	3.85	31	18
11/23-BE	512 KB	7 Quad or 7 Double	23.9	3.85	31	18

PDP-11/23 PLUS PACKAGED SYSTEMS

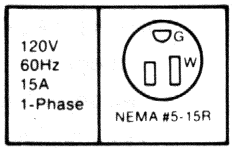
Packaged systems are offered running under RSX-11M and RSX-11M-PLUS operating systems. Each packaged system depicted here includes the features of the system, a photo, a backplane drawing, and electrical specifications needed to expand upon these configurations. The RL02 Disk drive and the microcomputer are housed in a 106 cm (41 in) high H9642 CPU cabinet. Physical specifications and receptacles used with the system are included at the end of this section. Options available for these systems are given in Section 3, Options.

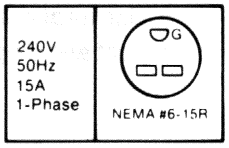
Height: 106 cm (41.75 in)
Width: 54 cm (21.25 in)
Depth: 76.2 cm (30 in)
Rear door clearance: 48.3 cm (19 in)
Weight: 170.3 kg (375 lb)
Watts: 840
Btu/hr: 2864

H9642 CPU CABINET



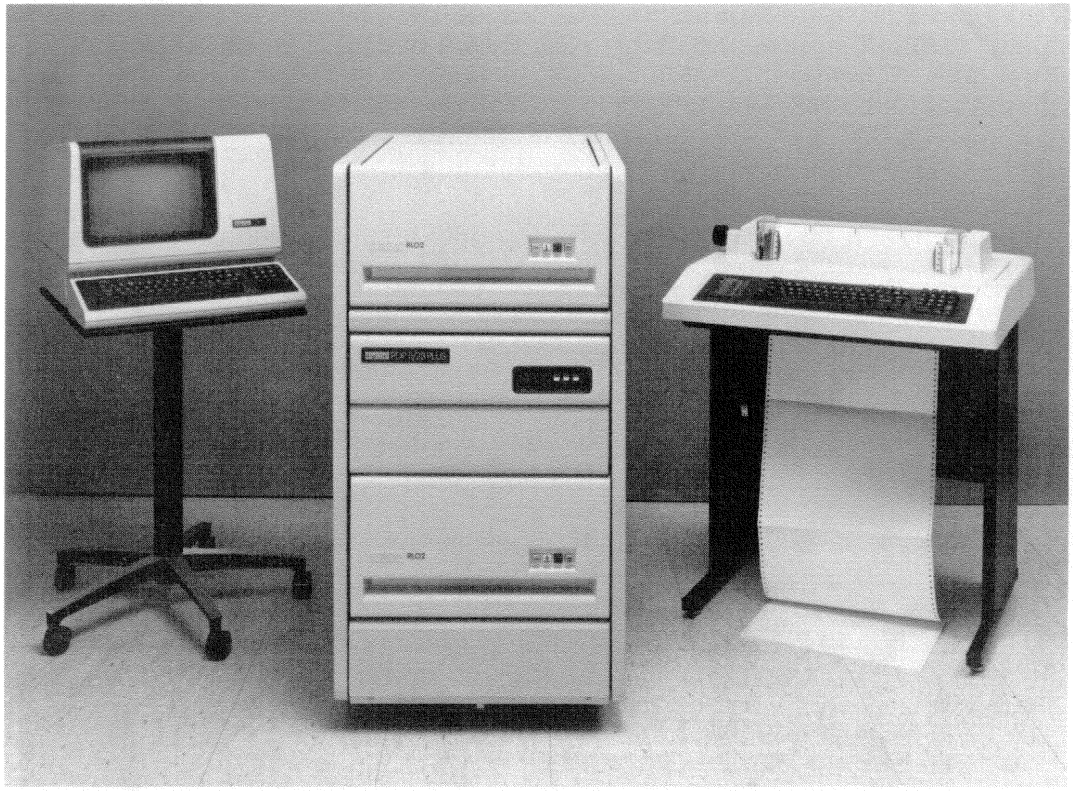
RECEPTACLES USED





PDP-11/23 PLUS

PDP-11/23 PLUS RL02-BASED SYSTEMS RUNNING UNDER RSX-11M



SM-RXMMB

These two PDP-11/23-PLUS RL02-based systems include:

- RSX-11M operating system
- 11/23-PLUS CPU, including bootstrap with diagnostics
- 256 KB MOS memory
- Memory management
- Two single line asynchronous EIA/CCITT interfaces: one for the console terminal and one available for expansion
- System distribution panel for serial line and options interconnect
- One RLV22 disk subsystem (one controller and one 10.4 MB RL02 removable cartridge disk drive) for use as the system device
- One 10.4 MB RL02 removable cartridge disk drive for use as the backup and load device
- Cabinetry: One 106 cm (41.75 in) high H9642 cabinet
- Console Terminal: LA120 DECwriter III or VT100 video display terminal with advanced video option

CPU CABINET EXPANSION: There is a 13.2 cm (5.25 in) by 68 cm (26.8 in) deep area of mounting space available below the CPU box for expansion.

SYSTEM MEMORY EXPANSION: This system has 768 KB of MOS memory expansion available in 256 KB or 512 KB increments for a maximum total of 1 MB.

SYSTEM DISK EXPANSION: Two more RL02 removable cartridge disk drives may be added to this system for a total of four.

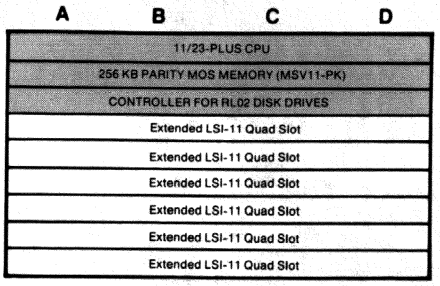
The diagram below shows the location of modules in the backplanes within the CPU box. The shaded areas indicate unusable space while the areas labeled Extended LSI-11 Quad indicate available expansion space.

PDP-11/23 PLUS PACKAGED SYSTEM BACKPLANE

H9276 POWER CONSUMPTION/LOADS

ROW	SIZE	OPTION	AMPS		BUS LOADS	
			+5V	+12V	AC	DC
1	Q	KDF11-B	3.0	0.3	2	1
2	Q	MSV11-PK, -PL	4.0	-	2	1
3	Q	RLV12	5.0	0.1	3	1
4						
5						
6						
7						
8						
9						
		H9276	-	-	3	-
		TOTAL AMPS/LOADS	12.0	0.4	10	3
		AVAIL. AMPS/LOADS	32.4	4.5	35	20
		REMAINING AMPS/LOADS	20.4	4.1	25	17

CPU BOX



SM-RXMMB-CA(CD)
SM-RXMMB-BA(BD)

MODEL	CONSOLE TERMINAL	MEMORY	MASS STORAGE	EXPANSION SPACE	DC AMPS AVAILABLE @+5V	DC AMPS AVAILABLE @+12V	AC AMPS AVAILABLE @120V	DC BUS LOADS AVAILABLE
SM-RXMMB-CA(CD)	LA120 DECwriter III	256 KB MOS	Dual RL02s	6 Extended LSI-11 Quad Slots	20.4	4.1	N/A*	17
SM-RXMMB-BA(BD)	VT100 Video Display							

* For 120 Volt systems, an 874-C power controller may be required for cabinet expansion.

PDP-11/23 PLUS RL02-BASED SYSTEMS RUNNING UNDER RSX-11M-PLUS

SN-RXMMC

These two PDP-11/23-PLUS RL02-based systems include:

- RSX-11M-PLUS operating system
- 11/23-PLUS CPU, including bootstrap with diagnostics
- 512 KB MOS memory
- Memory management
- Two single line asynchronous EIA/CCITT interfaces: one for console terminal and one available for expansion
- System distribution panel for serial line and options interconnect
- One RLV22 disk subsystem (one controller and one 10.4 MB RL02 removable cartridge disk drive) for use as the system device
- One 10.4 MB RL02 removable cartridge disk drive for use as the backup and load device
- Cabinetry: One 106 cm (41.75 in) high H9642 cabinet
- Console Terminal: LA120 DECwriter III or VT100 video display terminal with advanced video option

CPU CABINET EXPANSION: There is a 13.2 cm (5.25 in) by 68 cm (26.8 in) deep area of mounting space available below the CPU box for expansion.

SYSTEM MEMORY EXPANSION: This system has 512 KB of MOS memory expansion available in 256 KB or 512 KB increments for a maximum total of 1 MB.

SYSTEM DISK EXPANSION: Two more RL02 removable cartridge disk drives may be added to this system for a total of four.

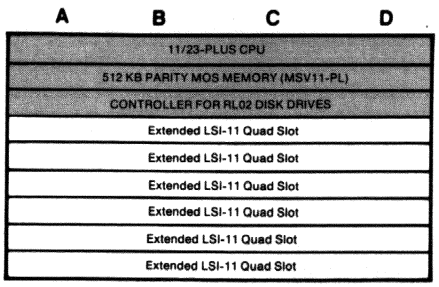
The diagram below shows the location of modules in the backplanes within the CPU box. The shaded areas indicate unusable space while the areas labeled Extended LSI-11 Quad indicate available expansion space.

PDP-11/23 PLUS PACKAGED SYSTEM BACKPLANE

H9276 POWER CONSUMPTION/LOADS

ROW	SIZE	OPTION	AMPS		BUS LOADS	
			+5V	+12V	AC	DC
1	Q	KDF11-B	3.0	0.3	2	1
2	Q	MSV11-PK, -PL	4.0	-	2	1
3	Q	RLV12	5.0	0.1	3	1
4						
5						
6						
7						
8						
9						
		H9276	-	-	3	-
		TOTAL AMPS/LOADS	12.0	0.4	10	3
		AVAIL. AMPS/LOADS	32.4	4.5	35	20
		REMAINING AMPS/LOADS	20.4	4.1	25	17

CPU BOX



SN-RXMMC-CA(CD)
SN-RXMMC-BA(BD)

MODEL	CONSOLE TERMINAL	MEMORY	MASS STORAGE	EXPANSION SPACE	DC AMPS AVAILABLE @+5V	DC AMPS AVAILABLE @+12V	AC AMPS AVAILABLE @120V	DC BUS LOADS AVAILABLE
SN-RXMMC-CA(CD)	LA120 DECwriter III	512 KB MOS	Dual RL02s	6 Extended LSI-11 Quad Slots	20.4	4.1	N/A*	17
SN-RXMMC-BA(BD)	VT100 Video Display							

* For 120 Volt systems, an 874-C power controller may be required for cabinet expansion.

Section 3
Options

PDP-11/23 PLUS Processor Options

KEF11-AA

Single and double precision floating point option for use with PDP-11/23 PLUS. The microcode to implement this option resides in two chips on one 40-pin package. Executes PDP-11/34 instruction set on 32-bit (single-precision) and 64-bit (double-precision) floating point numbers. Provides precision up to 17 decimal places, as well as integer-to-floating point conversions. Mounts on the CPU board.
PREREQUISITE: PDP-11/23 PLUS

FPF11

Microcoded hardware floating point option for use with PDP-11/23 PLUS. The microcode to implement this option resides on one quad module mounted adjacent to the CPU. Executes PDP-11/34 instruction set on 32-bit (single-precision) and 64-bit (double-precision) floating point numbers. Provides precision up to 17 decimal places, as well as integer-to-floating point conversions. Mounts on the CPU board. Executes instructions up to six times faster than the KEF11-AA.
PREREQUISITE: PDP-11/23 PLUS

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn AC	Bus Loads Drawn DC
1 Quad slot adjacent to CPU module	5.5	0.0	N/A	N/A

KEF11-BB

Commercial Instruction Set (CIS) for the PDP-11/23 PLUS. Microcode resides on six chips on one carrier the size of two 40-pin packages. Implements a set of 47 commercial instructions on a variety of data types, including character strings, packed decimal and numeric formats.
PREREQUISITE: PDP-11/23 PLUS CPU

PDP-11/23 PLUS Memory

MSV11-PK

256 KB dynamic Random Access Memory with parity.
PREREQUISITE: PDP-11/23 PLUS

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn AC	Bus Loads Drawn DC
1 Extended LSI-11 Quad slot	4.0	0.00	1	2

MSV11-PL

512 KB dynamic Random Access Memory with parity.
PREREQUISITE: PDP-11/23 PLUS

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn AC	Bus Loads Drawn DC
1 Extended LSI-11 Quad slot	4.0	0.00	1	2

MCV11-DA 8 KB non-volatile, non-parity, CMOS memory with on-board battery.
PREREQUISITE: PDP-11/23 PLUS

Mounting Code	DC Amps Drawn @+5V	@+12V	Bus Loads Drawn AC	DC
1 Extended LSI-11 Dual slot	1.2	0.00	1.4	1

MCV11-DC 32 KB non-volatile, non-parity CMOS memory with on-board battery.
PREREQUISITE: PDP-11/23 PLUS

Mounting Code	DC Amps Drawn @+5V	@+12V	Bus Loads Drawn AC	DC
1 Extended LSI-11 Dual slot	1.2	0.00	1.4	1.0

RLV22 Cartridge Disk Subsystems

The RLV22 single drive buffered subsystem combines reliability and maintainability in a low cost, medium capacity mass storage device. An embedded closed-loop servo positioning system improves data integrity by continuously sampling servo information with the same head that reads and writes the data. To further ensure data integrity, a Cyclic Redundancy Check (CRC) is performed on data transfers between the drive and controller. Also, a phase-locked-loop clock system and modified frequency modulation (MFM) recording provides reliable reading and recording techniques. Direct Memory Access (DMA) is used to provide rapid data transfer and efficient utilization of the host processor. DMA transfer is supported in 16-, 18-, and 22-bit addressing modes. This subsystem consists of an RL02 10.4 MB disk drive and RLV12 controller with disk to controller cabling and is packaged in a standard cabinet-mountable unit.

Expansion Specifications:

- Drives per controller: 4
- Maximum controllers per CPU: 2

Performance Specifications:

- Formatted capacity per drive: 10.4 MB
- Peak transfer rate: 512 KB/s
- Average access time: 67.5 msec
- Average seek time: 55 msec
- Average latency time: 12.5 msec
- Dual-port option: no
- Media surfaces: 2 data
- Tracks per surface: 512
- Sectors per track: 40
- Bytes per sector: 256
- Track-track seek: 15 msec
- Rotational speed: 2400 rpm

Subsystems

RLV22-AK Top-loading removable cartridge disk drive and RLV12 controller to interface to the Extended LSI-11 bus. Configurable to support 22-bit addressing. It is also software compatible with the existing RL01/RL02 (16-, 18-bit mode) controller.

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	AC Amps Drawn @120V	Bus Loads Drawn AC	Bus Loads Drawn DC	System Software
1 LSI-11 Quad slot PAN	5.0	0.1	3.0	3	1	RT-11, RSX-11M RSX-11M-PLUS

RL02 Cartridge Disk Drive Site Preparation Specifications:

- Height: 26.7 cm (10.5 in)
- Width: 48.3 cm (19 in)
- Depth: 63.5 cm (25 in)
- Weight: 33.75 kg (75 lb)
- Watts: 150
- Btu/hr: 600
- Receptacles required: NEMA #5-15R (120V); NEMA #6-15R (240V)

DISK CARTRIDGE

RL02-DC 10.4 MB disk cartridge for the RL02.

ADD-ON CARTRIDGE DISK DRIVE

RL02-AK Add-on cartridge disk
PREREQUISITE: RLV21-AK

Mounting Code	AC Amps Drawn @+120V
PAN	1.5

VIDEO TERMINALS

VT100 Video Terminal

The VT100 tabletop video display terminal features a sculptured typewriter-like detachable keyboard with 1.9 m (6 ft) coiled cord. The VT100 operates on full-duplex asynchronous communications lines, and is equipped with a standard EIA interface.**Note:** Communication cables are not provided with the VT100 terminal and must be ordered separately. The recommended cables are BC03M-xx or BC22A-xx for local connection of the VT100 to a line unit and BC05D-xx or BC22B-xx for connection of the VT100 to a modem.

Performance Specifications:

- Baud rate: 50 to 19,200 b/s
- Format: 24 lines x 80 characters or 14 lines x 132 characters (selectable)
- Characters: 94-character ASCII and 32 special graphic features
- Double-width/double-size characters
- Bi-directional smooth scrolling
- Split screen capability
- Normal or reversed screen image
- Parity: Even, odd, or none (keyboard selectable)

VT100-AA(AB) VT100 tabletop video display terminal.

Mounting Code	AC Amps Drawn @+120V
TT	3.0

Site Preparation Specifications:

- Height: 36.8 cm (14.5 in)
- Width: 45.7 cm (18 in)
- Depth (with keyboard): 51.6 cm (20.3 in)
- Weight: 15.6 kg (34.5 lb)
- Watts 150
- Btu/hr: 512
- Receptacles required: NEMA #L5-15R (120V); NEMA #L6-15R (240V)

VT101 Video Terminal

The tabletop VT101 video display terminal features a sculptured, typewriter-like keyboard that attaches to the video display unit by means of a 1.9 m (6 ft) cord. The VT101 offers basic VT100 functionality plus local echo. This local echo feature allows the user to attach the VT101 to non-Digital computer systems. The VT101 operates on full-duplex, asynchronous communications lines and is equipped.with a standard EIA interface. **Note:** Communications cables are not included and must be ordered separately. The recommended cables are BC03M-xx or BC22A-xx for local connection of the VT101 to a line unit and BC05D-xx or BC22B-xx for connection of the VT101 to a modem.

Performance Specifications:

- Baud rate: 50 to 19,200 b/s (operation at certain speeds requires XON-XOFF protocol or use of fill characters)
- Format: 24 lines x 80 characters, or 14 lines x 132 characters
- Character set: 94-character ASCII set, with 32 special graphic characters
- Keyboard: 83-key detachable unit
- Standard numeric/function keyboard
- Non-volatile memory holds feature settings
- Bi-directional smooth scrolling
- Split screen capability
- Underline or reverse video character emphasis
- Selectable double-width and double-size characters
- Adjustable tabs and line drawing graphic characters

VT101-AA(AB) VT101 tabletop video display terminal.
PREREQUISITE: EIA/CCITT serial line interface or equivalent.

Mounting Code	AC Amps Drawn @+120V
TT	0.80

Site Preparation Specifications:
Dimensions
Monitor:

- Height: 36.8 cm (14.5 in)
- Width: 45.7 cm (18 in)
- Depth: 36.2 cm (14.2 in)

Keyboard:

- Height: 8.9 cm (3.5 in)
- Width: 45.7 cm (18 in)
- Depth: 20.3 cm (8 in)

Combined Monitor and Keyboard:

- Depth: 51.4 cm (20.3 in)
- Weight: 18.6 kg (41 lb)
- Watts: 70
- Btu/hr: 240
- Receptacles required: NEMA #L5-15R (120V); NEMA #L6-15R (240V)

VT102 Video Terminal

The VT102 terminal is a fully optioned VT100 video terminal which offers a new level of functionality. VT100 advanced video and printer port features are built into the VT102 video display terminal to provide greater functionality at a lower cost. In addition, the VT102 terminal features U.S. and European half- and full-duplex communication and modem controls, as well as local echo. Advanced editing features allowing character and line insert and delete are standard. The VT102 video display terminal is an extremely versatile product. **Note:** *Communication cables not included with the VT102 terminal and must be ordered separately.* The recommended cables are BC03M-xx or BC22A-xx for local connection of the VT102 to a line unit and BC05D-xx or BC22B-xx for connection of the VT102 to a modem. **Note:** *Stand not included.*

Performance Specifications:

- Baud rate: 50 to 19,200 b/s
- Format: 24 lines x 80 characters or 132 characters
- Characters: 7 x 10 dot matrix with descenders
- Character set: 94-character ASCII set and 32-character special graphics set
- Double-width/double-size characters
- Standard numeric/function keypad
- Bidirectional smooth scrolling
- Split-screen capability
- Normal or reversed screen image
- Adjustable tabs and line drawing graphic characters
- Normal or reverse video, blinking, underline, and bold characters on a character-by-character basis.
- Local print functions without host intervention.
- Enhanced terminal editing features

VT102-AA(AB) VT102 tabletop video terminal.
PREREQUISITE: EIA/CCITT serial line interface or equivalent

Mounting Code	AC Amps Drawn @+120V
TT	0.80

Site Preparation Specifications:

Dimensions

Monitor:
- Height: 36.8 cm (14.5 in)
- Width: 45.7 cm (18 in)
- Depth: 36.2 cm (14.2 in)

Keyboard:
- Height: 8.9 cm (3.5 in)
- Width: 45.8 cm (18 in)
- Depth: 20.3 cm (8 in)

Combined Monitor and Keyboard:
- Depth: 51.4 cm (20.3 in)

Power:
- Watts: 70
- Btu/hr: 240
- Receptacles required: NEMA #L5-15R (120)
  NEMA #L6-15R (240)

VT125 GRAPHICS TERMINAL

The VT125 is an intelligent alphanumeric terminal with data plotting extensions which combine bit map graphics architecture, automatic vector and general curve generation, as well as the alphanumeric features. The VT125 is a microcprocessor-based terminal that directly executes Digital's general-purpose graphics descriptor ReGIS (Remote Graphics Instruction Set). ReGIS commands are easy-to-remember, single mnemonics and are easily inserted in programs written in any language such as BASIC, COBOL, FORTRAN or PASCAL. The VT125 operates on full-duplex, asynchronous serial communications lines with either an EIA or 20mA interface. **Note:** Communications cables are not included. The recommended cables are BC03M-xx or BC22A-xx for local connection of the VT125 to a line unit and BC05D-xx or BC22B-xx for connection of the VT125 to a modem.

Performance Specifications:

- Baud rates: 50 to 19,200 b/s
- Parity: Even, odd or none (keyboard selectable)

Text Features:

- Text format: 24 lines x 80 characters or 14 lines x 132 characters (keyboard- or host-selectable).
- Character: 7 x 10 dot matrix with descenders
- Character set: 96-ASCII characters set (upper/lower-case, numeric and punctuation) with 32-character special graphics set
- Split screen capability
- Normal or reverse video screen image
- Double-width/double-size characters
- Line drawing graphic characters for grids
- Bi-directional smooth scrolling
- Cursor type: Keyboard-selectable, blinking block character or blinking underline (in text mode), or flashing cross-shair (in graphics mode)

Graphics Features

- Graphics resolution: 768 x 240 pixels
- Two full graphics planes
- Firmware for direct execution of ReGIS commands
- Printer port for graphics mode (for use with LA34-VA)
- Visual attributes: Color output - 4 colors at a time, out of a possible 64 (on detached monitor)
  Black and white output - 4 gray levels

VT125-AA(AB) VT125 tabletop graphics terminal operating with EIA/CCITT interface. **Note:** Cables not included.
PREREQUISITE: EIA Interface

Mounting Code	AC Amps Drawn @+120V
TT	3.0

Site Preparation Specificatons:
Dimensions:
Monitor:

- Height: 36.8 cm (14.5 in)
- Width: 45.7 cm (18 in)
- Depth: 36.2 cm (14.2 in)
- Weight: 14.6 kg (32.2 lb)

Keyboard:

- Height: 8.9 cm (3.5 in)
- Width: 45.7 cm (18 in)
- Depth: 20.3 cm (8 in)
- Weight: 2.0 kg (4.5 lb)

Combined Monitor and Keyboard:

- Depth: 51.3 cm (20.2 in)
- Weight: 16.6 kg (36.7 lb)

Power:

- Watts: 150 watts, input (maximum)
- Btu/hr: 512
- Receptacles required: NEMA #L5-15R (120Vac)
  NEMA #L6-15R (240Vac)

VT1XX-AA	20mA adapter for the VT100. Allows VT100 terminal to convert from an EIA interface to a 20mA current loop interface. Includes BC05F-15 cable.
VT1XX-AB	Advanced video option for the VT100/VT125. Provides four additional character attributes (bold, blink, underline, and reverse video) in any combination; space and connections for an alternate character set memory; and extra screen memory (10 additional lines for a total of 24 lines x 132 columns).
VT1XX-AC	Printer port option. Allows connection of a VT100 to a hardcopy printer. **PREREQUISITE:** Advanced video option
VT1XX-CA	20mA interface adapter option for VT101/VT102/VT125. Allows for conversion from the EIA interface to a current loop interface for communications lengths exceeding 15.2 m (50 ft).
VT1XX-CB	Upgrade kit. Converts VT100 to VT125 graphics functionality.

HARDCOPY TERMINALS

LA120 DECwriter III Printing Terminal

The LA120 freestanding printing terminal features a contoured, typewriter-styled keyboard with N-key roll-over. Throughput is increased by combining bidirectional smart printing (seeks shortest path to next print position) with a 1K character buffer with fast horizontal and vertical skipping over white space. The LA120 operates on 5 half- and full-duplex asynchronous communications lines and standard EIA/CCITT interface. Includes universal power supply.**Note:** Communication cables are not provided with the LA120 terminal and must be ordered separately. The recommended cables are BC03M-25 or BC22A-25 for local connection of the LA120 to a line unit and BC05D-25 for connection of the LA120 to a modem.

Performance Specifications:

- Baud rate: 50 to 9600 b/s
- Print speed: 180 characters/s
- Lines per inch: 2/3/4/6/8/12
- Characters per inch: 5/6/6.6/8.25/10/12/13.2/16.5
- Characters: 7 x 7 dot matrix
- Character set: 7-bit ASCII plus ANSI-compatible escape sequences
- Tabs: 217 horizontal, 168 vertical
- Font sizes: 8
- Line spacings: 6
- Parity: Odd, even, or none

LA120-DA Free-standing DECwriter III hardcopy terminal.
PREREQUISITE: DLV11-JA or DZV11-C

Mounting Code	AC Amps Drawn @+120V
FS	3.0

LA120-RA Free-standing DECprinter III receive-only version of the LA120-DA hardcopy terminal.
PREREQUISITE: DLV11-JA or DZV11-C

Mounting Code	AC Amps Drawn @+120V
FS	3.0

Site Preparation Specifications:

- Height: 85.1 cm (33.5 in)
- Width: 69.9 cm (27.5 in)
- Depth: 61 cm (24 in)
- Weight: 46.4 kg (102 lb)
- Watts: 440 (maximum printing)
- Btu/hr: 1500
- Receptacles required: NEMA #5-15R (120V); NEMA #6-15R (240V)

COMMUNICATIONS OPTIONS

DLV11-ED

Asynchronous EIA line interface module with full modem control. Selectable stop and data bits. Even, odd or no parity. Full- or half-duplex. Data rates from 50 to 19,700 b/s. Compatible with Bell 103, 113, 202C, 202D, and 212. Includes cabling from the option module to a 25-pin "D" connector mounted on the H349 System Distribution Panel. The recommended external cable is the BC05D-25.
PREREQUISITE: PDP-11/23 PLUS with H349 Distribution Panel.

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn DC	Bus Loads Drawn AC	System Software
1 Extended LSI-11 Double Slot	1.0	0.15	1	1.6	RT-11, RSX-11M RSX-11M-PLUS

DLV11-JA

Four-line asynchronous EIA/CCITT serial line unit without modem control. Character formats: 7 or 8 data bits, 1 or 2 stop bits, even, odd or no parity. Data rates from 150 to 38,400 b/s. Includes cabling from the option module to a connector panel mounted on the H349 System Distribution Panel. The connector panel contains four 25-pin "D" connectors. The recommended external cables are four BC22A-25 cables.
PREREQUISITE: PDP-11/23 PLUS with H349 System Distribution Panel

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn DC	Bus Loads Drawn AC	System Software
1 Extended LSI-11 Double slot	1.0	0.15	1	1	RT-11, RSX-11M RSX-11M-PLUS

DMV11-AA

A high-speed, intelligent, synchronous communications interface for communication with EIA RS232-C, RS423-A, and CCITT V.24/V.28 modems. The maximum data rate for EIA RS423-A operation is 56,000 b/s. All other modes have a maximum data rate of 19,200 b/s. Controller microcode handles all DDCMP processing. Cabling from the option module to the H349 System Distribution Panel is included. The recommended external cable is the BC05D-25.
PREREQUISITE:PDP-11/23 PLUS with H349 System Distribution Panel.

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn AC	Bus Loads Drawn DC	System Software
1 Extended LSI-11 Quad slot	3.41	0.38	2	1	DECnet-RT, DECnet-M, DECnet-M+

DMV11-AC

A high-speed, intelligent, multipoint, synchronous interface with integral modem for local networks. Supports a fixed data rate of 56,000 b/s in full- or half-duplex operation. Controller microcode handles DDCMP processing for point-to-point or multi-point operation. Cabling from the option module to the H349 System Distribution Panel is included. The recommended external cable is the BC55M-98 (two such cables are required for full-duplex operation).
PREREQUISITE: PDP-11/23 PLUS System Distribution Panel.

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn AC	Bus Loads Drawn DC	System Software
1 Extended LSI-11 Quad slot	3.35	0.26	2	1	DECnet-RT

DZV11-C

Asynchronous four-line multiplexor for EIA/CCITT terminals or modems. Programmable speeds (up to 9600 b/s), and formats on a per-line basis. Includes data set control for use with Bell 103 or 113 or equivalent modems. Includes cabling from the option module to the connector panel located on the H349 System Distribution Panel. The connector panel contains four 25-pin "D" connectors. Four external cables are required. Recommended cables (depending upon application) are: BC05D-25, BC03M-25, BC22A-25.
PREREQUISITE: PDP-11/23 PLUS H349 System Distribution Panel

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn AC	Bus Loads Drawn DC	System Software
1 Extended LSI-11 Quad slot	1.2	0.39	4	1	RT-11, RSX-11M RSX-11M-PLUS

DRV11-D

General-purpose parallel line unit. Data transfers up to 40,000 words per second. Includes cabling from the optio module to two 40-pin connectors to be mounted on the H349 System Distribution Panel. recommended external cables are two BC08R-25 cables..

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn DC	Bus Loads Drawn AC	System Software
1 LSI-11 Dual slot	0.9	0.00	1	1.4	RSX-11M

DRV11-JA

General-purpose parallel line unit. Four 16-bit ports. Programmable interrupt vectors and bit-interruptability on 16 lines. Includes cabling from the option module to two 50-pin connectors to be mounted on the H349 System Distribution Panel. Recommended external cables are two BC05W-15 cables.

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn DC	Bus Loads Drawn AC	System Software
1 LSI-11 Dual slot	0.00	1.6	1	2	None

COMMUNICATIONS ACCESSORIES

BC03M-XX

Null modem cable allows local connection of asynchronous interfaces or terminals having EIA interfaces. The following standard lengths are available: 7.6 m (25 ft), 30.5 m (100 ft), 76.2 m (250 ft), 152.4 m (500 ft), 304.8 m (1000 ft) cables (three shielded twisted pair) with two DB25S sockets.

BC05D-XX

EIA extension cable for use with cinch DB25S socket and DB25P plug. The following standard lengths are available: 3.0 m (10 ft), 7.6 m (25 ft), and 15.2 m (50ft).

BC22A-XX

Null modem EIA cable RS-232C, three twisted pair shielded molded connectors allows local connection of asynchronous terminals having EIA interfaces. The following standard lengths are available: 3.0 m (10 ft), 7.6 m (25 ft).

BC55M-98

29.9 m (98 ft) triaxial cable with AMP connectors for local connection of MDR11-AC units. Two cables are needed for full-duplex operation. Used for speeds of 250K b/s and above.

H349 System Distribution Panel

Multifunction System Distribution Panel that is an integral part of each PDP-11/23 PLUS. H349 is offered to the CPU Box customer to facilitate integration of the PDP-11/23 PLUS options and improve cable management and EMI reduction. Eight cutouts of various sizes are provided for mounting connector assemblies of the PDP-11/23 PLUS options listed above. Includes cabling from the PDP-11/23 PLUS CPU Module to two 25-pin "D" connectors mounted in dedicated openings. The recommended external cable for each of the two serial lines is the BC22A-25.
PREREQUISITE: PDP-11/23 PLUS CPU Box, H9642 Cabinet.

Mounting Code	DC Amps Drawn @+5V	DC Amps Drawn @+12V	Bus Loads Drawn	System Software
13.3 cm (10.5 in) PANEL	N/A	N/A	N/A	N/A

*The options listed above in a PDP-11/23 PLUS system with the recommended external cables will result in a compliant system. Systems assembled by the customer that use options not listed above or that use non-Digital options may or may not be compliant.

PDP-11/23 PLUS OPTION SUPPORT MATRIX

	Options Fully Supported on PDP-11/23 PLUS	Options that are compatible with but not supported on PDP-11/23 PLUS	Options not compatible with PDP-11/23 PLUS
Memory	MCV11-DA, -DC MSV11-PK, -PL MSV11-LF, -LK	MRV11-C[1] MRV11-AA, -BA[2] MSV11-C, -D, -E[1] MXV11-AA, -AC[1]	MMV11-A[2,4] MSV11-B[2,3]
Communications	DLV11-ED DLV11-JA DMV11-AA, -AB, -AC DZV11-C DRV11-D DRV11-JA	DLV11-E, -F, -J DUV11 DPV11 DRV11-B[1] DZV11-B IBV11	
Mass Storage	RLV12	RXV11[1] RKV11-D[2] RXV21[1] TU58	RLV11[5]
Other	FPF11 H349 KEF11-AA KEF11-BB	TEV11[1] LPV11/LP25 AAV11-C[1] DV11-C[1] AXV11-C[1] KWV11-C[1]	AAV11-A[5] ADV11-A[5] KWV11-A[5] REV11[3]

[1]These modules have a 256 KB (18-bit) addressing limitation

[2]These modules have a 56 KB (16-bit) addressing limitation

[3]Not compatible with any PDP-11/23-class system

[4]Not compatible with any system utilizing a Q/CD backplane

[5]Not compatible due to Extended LSI-11 bus pin utilization

Section 4
Operating Systems And Software

OPERATING SYSTEMS/SOFTWARE MATRIX

	RSX-11M	RSX-11M -PLUS	RT-11	RSX-11S	Micro Power/ PASCAL
Languages					
FORTRAN IV	X	X	X	X	
FORTRAN 77	X	X		X	
PDP-11 BASIC PLUS-2	X	X			
BASIC-11	X		X		
MU BASIC-11			X		
Pascal					X
PDP-11 COBOL	X	X			
CORAL-66	X				
Communications					
DECnet	X	X	X	X	
RSX DLX-11	X			X	
Internet Software					
RSX-11 2780/ 3780	X	X			
RSX-11 3271	X	X			
MUX200/ RSX-IAS		X			
Data Management					
DATATRIEVE	X	X			
RMS-11	X	X			
SORT-11	X	X			
Applications Programs					
FMS-11	X	X	X	X	

OPERATING SYSTEMS

RSX-11M OPERATING SYSTEM

SPD. NO. 14.35.117

RSX-11M is a disk-based, realtime operating system that runs on the PDP-11/23 and the PDP-11/23 PLUS. It provides an environment for the development and execution of multiple realtime tasks (program images) using a priority structured, event driven scheduler. System generation allows the user to configure the software for systems ranging in size from small, 32 KB systems to large, 3408 KB systems.

Program development and realtime tasks can execute concurrently in systems with at least 48 KB of memory. The system's software priority levels enable the user to compile/assemble, debug, and install tasks without affecting realtime task response.

A multiuser, program development facility is available. LOGIN/LOGOUT, password protection, device access protection, a round-robin scheduler (running under the realtime executive), and concurrent execution of equal priority tasks via executive level swapping are provided. All systems have the traditional MCR command interface available. Mapped systems can select the easier-to-use Digital Command Language (DCL), with MCR or DCL selectable on a per terminal basis.

Tasks can be written in MACRO-11 assembly language, and optionally FORTRAN IV, FORTRAN-77, PDP-11 COBOL, CORAL 66, BASIC-11, and BASIC-PLUS-2. Shareable libraries and system support for user-created libraries are provided. The EDI and EDT editors, utilities, symbol cross-reference, interactive debugger, and task memory dump facilities are provided to assist task development and checkout.

The RSX-11M file system provides automatic space allocation and file structures for all block-structured devices. Features include file protection, device independence, and logical device assignment.

During system generation the user can select a minimum 4 KB version of the resident file system to conserve space. Multiheader file support is provided, which enables file size to be limited only by the capacity of the volume on which it resides.

In addition, two record mechanisms are provided (FCS and RMS). Sequential, random, and relative (RMS-11) file organizations are provided. The use of the File Control Services (FCS) will increase the user task size by approximately 2 KB to 8 KB, depending on the number of open files and the services desired. The Record Management System (RMS) requires at least 8 KB per task.

Indirect command file support provides extremely powerful batch-like facilities. A terminal user can create a file containing system commands. The system can then be instructed to execute the commands in the files without operator intervention. The indirect file processor can be executing command files concurrent with realtime task execution.

Memory is logically divided into partitions in which tasks are loaded and executed. Activity in a partition can either be user-controlled or system-controlled; the user determines the placement of tasks in the former, and the system controls the placement of tasks in the latter. Automatic memory compaction minimizes fragmentation of a system controlled partition. Unmapped systems support only user-controlled partitions. Mapped systems support both user-controlled and system-controlled partitions.

Realtime interrupt response is provided by the system's task scheduler that recognizes 250 software priority levels. The user-specified task priority determines the task's eligibility to execute. A task can be fixed in a partition to ensure immediate execution when it is activated, or it can reside while it is dormant to make memory available to other tasks. Task checkpointing enables tasks to be displaved from a partition to enable a higher priority, nonresident task to execute.

Software-supported reliability features:

- Disk error logging
- Power fail restart
- On-line device exercisor (IOX) to verify correct operation of disks and tapes

RSX-11M Features

- Logical device assignments
- Line printer spooling
- Loadable device drivers
- Post-mortem and snapshot dump facility
- Crash dump analyzer facility
- Host for RSX-11S systems
- Optional full-duplex terminal driver that supports DMA output with DLV11-E modem control
- RMS sequential and relative file access
- Direct connect of user task to hardware interrupts

RSX-11M-PLUS OPERATING SYSTEM

SPD. NO. 14.70.5

RSX-11M-PLUS is a disk-based, priority structured, event-driven, multiuser, multiprogramming operating system. It is an extension to the RSX-11M Operating System and is now available on the PDP-11/23-PLUS.

RSX-11M-PLUS offers complete program development facilities as well as realtime response, run-time system. Program development, realtime tasks, and batch streams can execute concurrently. The system's software priority levels enable the user to compile/assemble, debug, install and execute tasks, and run batch streams without significantly affecting realtime response.

A multiuser program development facility is provided. The traditional MCR command interface and the easy-to-use Digital Command Language (DCL) are supported, along with the capability of user-written command interpreters. In addition, accounting information is logged to a disk file, recording per user connect time, CPU time, and pages printed.

Tasks can be written in the supplied MACRO-11 assembly language or in optionally available languages, such as FORTRAN, COBOL, and BASIC.

An extensive set of utilities is provided to facilitate file and system maintenance, error analysis, and program debugging. Two editors, the traditional RSX EDI line editor, and EDT, the DEC Standard text editor, are supplied.

The file system provides automatic space allocation and file structures for block structured devices. The system provides multiuser file protection, device independence, and logical device assignment. Sequential, random, and relative (RMS-11) file organizations are supported.

The use of File Control Services (FCS) will increase the user-task size by approximately 2 KB to 8 KB, depending on the number of open files and services desired. The Record Management System (RMS) requires at least 8 KB per task.

A powerful, multistream BATCH facility is provided with RSX-11M-PLUS, in addition to the RSX-11M indirect command file processing capabilities. The batch commands are in DCL or MCR format, making this capability easy to use. Status is returned to the batch processor as each step is accomplished allowing for conditionalized branching. The batch processor collects all print files from a batch stream and spools them along with the log file. The queue manager provided gives the system manager control over the multiple batch streams and print queues.

Features of RSX-11M-PLUS:

- Request queue optimization, which reduces average seek time on disk up to 30%.
- Complete upward compatibility for nonprivileged tasks with RSX-11M, Version 3.2 and 4.0. Task rebuilding is not required.
- Shadowed disk support, which allows two disks of the same type to be designated as a shadowed backup of a mounted Files-11 volume. All writes to the primary drive are automatically written to the secondary. In the event of a read failure on the primary drive, the system will automatically read the data from the secondary drive.
- Powerfail restart, which allows the system to continue executing upon power restoration, restarting all interrupted I/O activities and notifying any active task through a powerfail asynchronous system trap entry point
- Host for RSX-11S program development and system building

RSX-11S OPERATING SYSTEM

SPD. NO. 9.21.10
QJ642

RSX-11S is a memory-based, realtime operating system designed to operate on a PDP-11 processor with a minimum of 16 KB of memory. It is a fully compatible subset of the RSX-11M disk-based operating system. RSX-11S is designed, however, for the run-time execution of memory-resident application programs and requires the support of a disk-based host system for system generation and program development.

The I/O driver interfaces are identical. Device drivers written for either system can execute on both systems. Any application program that executes under RSX-11S will execute under RSX-11M without change, following a relink of the object program.

As a memory-based system, RSX-11S does not support a file system, non/resident tasks, checkpointing (rollin/rollout), overlays (excluding memory resident overlays), or program development. It provides a runtime environment for execution of tasks on a memory-based processor.

RSX-11S has most of the features and generation capability of the RSX-11M system. RSX-11S supports all of the peripheral devices that are supported under RSX-11M, plus CPU options such as floating point processors, parity memory, and memory management.

Tasks written in MACRO, FORTRAN IV, or FORTRAN-77 must be assembled or compiled and subsequently linked on a host system and transported to a target RSX-11S system for execution. Tasks written in FORTRAN require a minimum of 32 KB of memory for the RSX-11S target system. Transportation of tasks between the host system and the RSX-11S target system for execution is provided via the File Exchange Utility (FLX) on the host system and the On-line Task Loader (OTL) on the target system.

Among the software components contained in the RSX-11S distribution kit are the following:

- Monitor Console Routine - RSX-11M Subset
- On-Line Task Loader
- System Image Preservation Program
- File Control Services (FCS) for record devices (does not include directory support)
- Task Termination and Device Not Ready Program
- System Status Display Programs

RT-11 OPERATING SYSTEM

SPD. NO. 12.1.18
QJ013

RT-11 is a compact, single-user, realtime operating system designed for interactive program development and/or on-line applications. Standard with all RT-11 systems are the MACRO-11 assembly language, the KED keypad editor, and the EDIT text editor. Optional software supported by RT-11 includes FORTRAN IV/RT-11, BASIC-11/RT-11, MU BASIC-11/RT-11, DECnet-RT, and FMS-11/RT-11, DIGITAL'S Forms Management System.

RT-11 supports both single-job and foreground/background processing modes. In foreground/background mode, memory for user programs is divided into two separate regions. Two independent programs, therefore, can reside in memory and effectively share the resources of the system. The foreground program is given priority and executes until it relinquishes control to the background program. The background program then executes until the foreground program again requires control.

RT-11 supports indirect command files which further simplify system interaction. Users can construct indirect command files that contain strings of commonly issued keyboard monitor commands. By executing only the indirect file, users can invoke the stream of commands. Indirect command files provide capabilities similar to batch processing, yet do not require users to learn the complicated job control language. RT-11 does include a batch facility.

RT-11 offers program development tools including a choice of three text editors, file and device maintenance utilities, an on-line debugger, and a number of patch utilities. With DECnet RT, DIGITAL'S advanced networking software, RT-11 systems can be linked with other DIGITAL operating systems for network operation. Using Internet protocol emulators, RT-11 can efficiently communicate with IBM mainframe systems or other systems that support Binary Synchronous Communication (BSC) protocols.

MICROPOWER/PASCAL

SPD. NO. 19.12.0
QJ029

MicroPower PASCAL is a software package for development of microcomputer applications. It includes all components needed to create concurrent, realtime application programs on a PDP-11 host system and to execute and debug the application on PDP-11 (Q-BUS) microcomputer target systems.

The application software developed through the use of MicroPower/PASCAL is selectively combined with a library of executive service modules, thus eliminating the need for a general-purpose operating system. PASCAL application programs execute stand-alone and do not run under any Digital operating system.

An extended version of PASCAL is provided as the implementation language suitable for most user applications, however, MACRO-11 can be also used as the implementation language.

Features

- PASCAL language with extensions that support concurrent realtime programming
- Modular run-time system with language interfaces for both MicroPower/PASCAL and MACRO-11
- RT-11 compatible file system
- Symbolic debugger to aid the debugging of application programs running on the target system
- Flexible set of utility programs to build and load the application software into target systems
- Host system support to produce ROM/RAM execution environments
- A set of device handlers for widely used I/O device interfaces

Transferring an application to the target system can be done by:

- Down-line loading via a serial line interface
- Programming PROM chips and transferring them to the target system (PROM programming hardware and software not included with this product)
- Mutually transferring a bootable application via a TU58 DECtape II cartridge or an RX02 diskette

Components

- MicroPower/PASCAL compiler - supports a superset of the PASCAL language plus realtime extensions
- Run-time system - composed of kernel and system processes included in the kit in the form of object libraries
- PASDBG - aids debugging applications programs and allows reference to PASCAL source-code names and system data structures
- MACRO-11 source libraries - MACRO-11 interface to the run-time system is included in the form of a macro library
- Microfiche listing of run-time system sources
- Subset of RT-11 (O/S) - for use on the host development system

LANGUAGES

FORTRAN IV

FORTRAN IV/IAS-RSX
SPD NO. 14.63.8
QP230

FORTRAN IV-RT-11
SPD. NO. 12.10.2
QJ813

FORTRAN IV is an extended superset of the ANSI FORTRAN X3.9-1966 standard. Systems with memory management directives provide support for virtual arrays. PDP-11 FORTRAN IV provides fast, one-pass compilation, and compiler optimizations include common subexpression elimination; local code tailoring; array vectoring; and optional in-line code generation for integer and logical operations. FORTRAN IV provides a set of object modules (Object Time System or OTS) that are selectively linked with compiler-produced object modules to produce an executable program. Other features include general expressions in all meaningful contexts; mixed-mode arithmetic; BYTE data type for character manipulation; commenting at the end of each source line; and list-directed input/output.

PDP-11 FORTRAN-77/RSX

SPD NO. 14.31.3
QJ668

PDP-11 FORTRAN-77 is an extended implementation of the ANSI subset FORTRAN-77 X3.9-1978 standard. Extensions to the ANSI standard include language elements for keyed and sequential access to RMS multikey ISAM files; DEFINE, FILE, FIND, DELETE, REWRITE, and UNLOCK statements; TYPE and ACCEPT input/output statements; BYTE data type; hexadecimal and octal consultants. Virtual memory array support for systems with memory management directives. Two Object Time Systems (a set of object modules selectively linked with compiler-produced object modules by the operating system's task builder to produce a task, or program, ready for execution) are available with FORTRAN-77: the File Control Services-based OTS or the RMS-based OTS. The FORTRAN-77 compiler produces direct PDP-11 machine code optimized for execution time efficiency on a PDP-11 with a floating point processor.

PDP-11 BASIC-PLUS-2

SPD NO. 14.14.2
QR514 (RSX-11M-PLUS)
QR526 (RSX-11M)

BASIC-PLUS-2 is a superset of the BASIC-PLUS and Dartmouth BASIC languages which use simple English language-like statements and familiar mathematical notations to perform operations. The language processor is composed of a compiler and an Object-Time System/Library that contains the following run-time routines: performing library and arithmetic functions; handling dynamic allocation of string storage and I/O buffers; handling I/O operations; and processing errors in arithmetic, I/O, and system operations. Other features include extensive string manipulation functions; terminal-format files; virtual arrays; matrix package handling operations; RMS I/O; and external subprograms such as SUB, CALL, CHAIN and COMMON; and other user-defined functions.

BASIC-11/IAS-RSX

SPD. NO. 14.67.9
QP240

BASIC is a conversational programming language that uses simple, English language-like statements and familiar mathematical notations to describe a procedure. BASIC-11/IAS-RSX is an incremental, interactive interpreter operating under RSX-11M or RSX-11M-PLUS operating systems.

BASIC-11/RT-11

SPD NO. 12.5.9
QJ913

BASIC-11/RT-11, based on Dartmouth College developed BASIC, is a conversational programming language utilizing simple English language-like statements and familiar mathematical notations to perform operations. It is an incremental, interactive, interpretive compiler and features support for real, integer, double precision and string data types; immediate mode statements for debugging and desk calculator usage; sequential data storage using the RT-11 file system; string capability, including string arrays and functions; disk virtual arrays for string, integer and real data types; chaining with COMMON to accommodate large programs; CALL facility for invoking assembly language subroutines using a PDP-11 FORTRAN-compatible call interface; formatted output using the PRINT USING statement.

MU BASIC-11/RT-11

SPD NO. 12.20.7
QJ921

MU BASIC/RT-11, based on Dartmouth College developed BASIC, is a conversational programming language utilizing simple English language-like statements and familiar mathematical notations to perform operations. It is an interpreter running under the RT-11 operating system Foreground/Background (FB) monitor with multiterminal (up to eight) capability and features a variety of program manipulation commands; support for real (single or double precision) integer and string data types; sequential data storage using the RT-11 file system; program chaining and overlaying with COMMON to accommodate large programs; ability to run in either the foreground or background under the RT-11 FB monitor concurrently with another job; immediate mode execution for desk calculator operation and program debugging; and virtual arrays on disk.

PDP-11 COBOL

SPD NO. 12.40.16
QP012 (RSX-11M and RSX-11M-PLUS)

PDP-11 COBOL is a precise, well-defined language for business data processing and is based on ANSI COBOL, X3.23-1974. PDP-11 COBOL language processor is composed of a compiler and an Object Time System/Library.

CORAL 66

SPD NO. 14.56.9
QP066 (RSX-11M)

CORAL 66 is a high-level block-structured programming language. It is the standard general purpose language prescribed by the British Government for realtime and process control applications. This language is designed to replace assembly level programming in modern industrial and commercial applications.

DATA MANAGEMENT

DATATRIEVE-11

SPD NO. 12.48.7
QP301 (RSX-11M and RSX-11M-PLUS)

DATATRIEVE-11 is an interactive query, report, and data maintenance system designed for the less sophisticated computer user. It uses a set of English language-like commands for data retrieval, modification, and display. It provides automatic prompting for both command and data entry. DATATRIEVE-11 utilizes the RMS-11K record management services to access data contained in files of sequential, indexed, or relative organization. It also provides facilities for selective data retrieval, sorting, formatting, updating, and report generation without the need for programming overhead. Data dictionaries, which are shared by DATATRIEVE-11 users, can be used to store frequently used sequences of commands to be recalled and processed later. DATATRIEVE-11 also provides the Application Design Tool (ADT) to assist novice users in creating domain and recording definitions.

RMS-11K

SPD NO. 12.50.5
QP901 (RSX-11M)

RMS-11K provides keyed access record management services for the RSX-11M operating system. RMS-11K comprises a set of run-time routines and utility programs that enable keyed access data files to be defined, populated, updated, and maintained on random access storage devices. Application programs retrieve, modify, or store logical data records by using key field reference values once established by interactive utility program functions. The RMS-11K run-time service routines provide an interface between PDP-11 multi-programmed operating systems and user developed applications programs and also provide all necessary access control, data buffering, record blocking/deblocking, and file structure maintainence. This language can be supported by any valid RSX-11M system with memory management that meets the minimum memory requirements for the operating system and language processors, plus an additional 8 KB.

SORT-11

SPD NO. 12.7.5
QP602 (RSX-11M and RSX-11M-PLUS)

SORT-11 is an optional utility that can accept as input any RMS-11 format file and output a reordered RMS-11 format file. Input files can contain data stored in binary, EBCDIC, or ASCII format, and the file organization can be sequential, relative, or indexed sequential. Records can be sequenced by key fields in ascending and descending order. SORT-11 cannot be used to merge two separate files. SORT-11 provides four different user-selectable, sorting processes: Record Sort (manipulates records in their entirety); Tag Sort (produces a reordered file by manipulating only the key position of each record); Address Routing Sort (produces a file for the date and multiple address files that are used to access the data in the desired sequences); and Index Sort (produces a separate index file that contains the record SORT key field and a pointer to the record's location in the data file).

APPLICATION PACKAGES

FMS-11/RSX

SPD NO. 12.27.3
QJ715 (RSX-11M and RSX-11M-PLUS)

FMS-11/RSX is a forms-oriented, video I/O management system which functions as an independent, software front-end that logically off-loads the complexities of interactive video I/O management from the application program. Forms defined using FMS-11/RSX utilize the following features of a VT100 Video Terminal: reverse video characters; bold characters; underline characters; blinking characters; 132-column lines; jump and smooth scrolling; split screen; and reverse screen. Software components include: Form Editor for creating and modifying video forms by typing them on a VT100 screen; Form Utility for manipulating FMS/RT-11 forms descriptions; Form Driver for controlling screen processing; and Video Keypad Editor for general purpose text editing of standard ASCII files.

FMS-11/RT-11

SPD. NO. 12.22.3
QJ713

FMS-11/RT-11 is a set of utilities and subroutines that provide a multiterminal video form capability for programs written in MACRO-11, BASIC-11, or FORTRAN IV under the RT-11 operating systems. Forms defined using FMS-11 can use the following features of Digital's VT100 terminal:

- Reverse video characters
- Bold characters
- Underlines characters
- Blinking characters
- 132-column lines
- Jump and smooth scrolling
- Split screen
- Reverse screen

COMMUNICATIONS

DECnet-11M

SPD NO. 10.75.7
QJ684

DECnet-11M allows a suitably configured RSX-11M system to participate as a routing or non-routing (end) node in DECnet computer networks. DECnet-11M offers task-to-task communications; utilities for network file transfer; homogeneous network command terminal support; and network resource-sharing capabilities, using the DIGITAL Network Architecture (DNA) protocols. DECnet-11M communicates with adjacent nodes over synchronous and asynchronous communications lines and parallel interfaces. Access to DECnet-11M is supported for RSX-11M user programs written in MACRO-11, FORTRAN IV, BASIC-PLUS-2, and COBOL. RSX-11M users should note that the functions available depend, in part, on the configuration of the rest of the network. Each DECnet product offers its own level of functionality and its own set of features.

DECnet-11M-PLUS

SPD NO. 10.66.0
QR580

DECnet-11M-PLUS allows a suitably configured RSX-11M-PLUS system to participate as a routing or non-routing (end) node in DECnet computer networks. DECnet-11M-PLUS offers task-to-task communications; utilities for network file transfer; homogeneous network command terminal support; and network resource-sharing capabilities, using the DIGITAL Network Architecture (DNA) protocols. DECnet-11M-PLUS communicates with adjacent nodes over synchronous and asynchronous communications lines and parallel interfaces. Access to DECnet-11M-PLUS is supported for RSX-11M-PLUS user programs written in MACRO-11, FORTRAN IV, BASIC-PLUS-2, and COBOL. RSX-11M-PLUS users should note that the functions available depend, in part, on the configuration of the rest of the network. Each DECnet product offers its own level of functionality and its own set of features.

DECnet-11S

SPD. NO. 10.74.7
QJ694

DECnet-11S allows a suitably configured RSX-11S system to participate as a routing or non-routing (end) node in DECnet computer networks.

DECnet-11S offers task-to-task communications, RSX network command terminnal support, and network resource-sharing capabilities using the Digital Network Architecture (DNA) protocols. DECnet-11S communicates with adjacent nodes over synchronous and asynchronous lines and parallel interfaces. Access to DECnet-11S is supported for RSX-11S user programs written in MACRO-11, FORTRAN IV, FORTRAN-77, and BASIC-PLUS-2.

RSX DLX-11

SPD NO. 10.6.0
QJ689

RSX DLX-11 is a low-overhead software communications line interface which provides users of DIGITAL microcomputers access to Phase III DECnet networks. The product is available on the RSX-11M system for interfacing with a DECnet-11M or DECnet-11M-PLUS Phase III node.

RSX DLX-11 supports a single physical line in a point-to-point or multi-point connection. A user-written MACRO-11 program at each end of the line controls the communication line directly. The integrity and sequentiality of data sent over the line are maintained by the use of DECnet Digital Data Communication Message Protocol (DDCMP).

DECnet-RT

SPD. NO. 10.72.7
QJ687

DECnet-RT is a Phase III network product that allows a suitably configured RT-11 Foreground/Background system to participate as a nonrouting (end) node in DECnet computer networks. DECnet-RT offers task-to-task communications, utilities for network file operations, and network resource-sharing capabilities using Digital Network Architecture (DNA) protocols. DECnet-RT communicates with adjacent nodes over synchronous communication lines. Access to DECnet-RT is supported for RT-11FB user programs written in MACRO-11 and FORTRAN IV.

INTERNET SOFTWARE

RSX-11 2780/3780 Emulator

SPD. NO. 10.1.0
QJD82

The RSX-11 2780/3780 software emulates the communications protocol of an IBM 2780 or 3780 device while running as a user task on a suitably configured RSX-11M or RSX-11M-PLUS disk based system. This product is not designed to run on RSX-11S systems.

The RSX-11 2780/3780 Emulator appears an an IBM 2780 or 3780 data transmission terminal on a point-to-point switched or non-switched synchronous data link operating with standard 2780/3780 protocol.

RSX-11/3271 Protocol Emulator

SPD. NO. 10.88.4
QJD76

The RSX-11/3271 Protocol Emulator (PE) permits user tasks running on a PDP-11 to communicate interactively with user jobs running on an IBM 360, 370, or 303x host system. User tasks must be written in MACRO or use MACRO level calls. This product will run with RSX-11M or RSX-11M-PLUS but not RSX-11S systems.
The user task in the RSX-11M or RSX-11M-PLUS system presents itself to the host IBM system as an IBM 3277 display unit attached to an IBM 3271 control unit operating in slave mode.

MUX200/RSX-IAS

SPD. NO. 10.77.6
QJ070

MUX200/RSX-IAS is a PDP-11 based software package that provides communication with a CDC 6000, CYBER series, or other host computer systems capable of using 200 UT Mode 4A communications protocol.

The software operates under an RSX-11M or IAS operating system through supported terminals. The user can communicate at command level with a host system. Using RSX-IAS supported devices, jobs for batch processing can be sent to and results received from the host.

MUX200/RSX-IAS communicates with the host using the Mode 4A communications protocol, as defined in CDC publication 82128000. The software package can be configured to support either ASCII or external BCD versions of the communications protocol.

Section 5
Configuring Instructions

This section contains the step-by-step instructions and notes needed to configure with the PDP-11/23 PLUS. Typical 256 KB and 512 KB system configurations are provided at the end of this section.

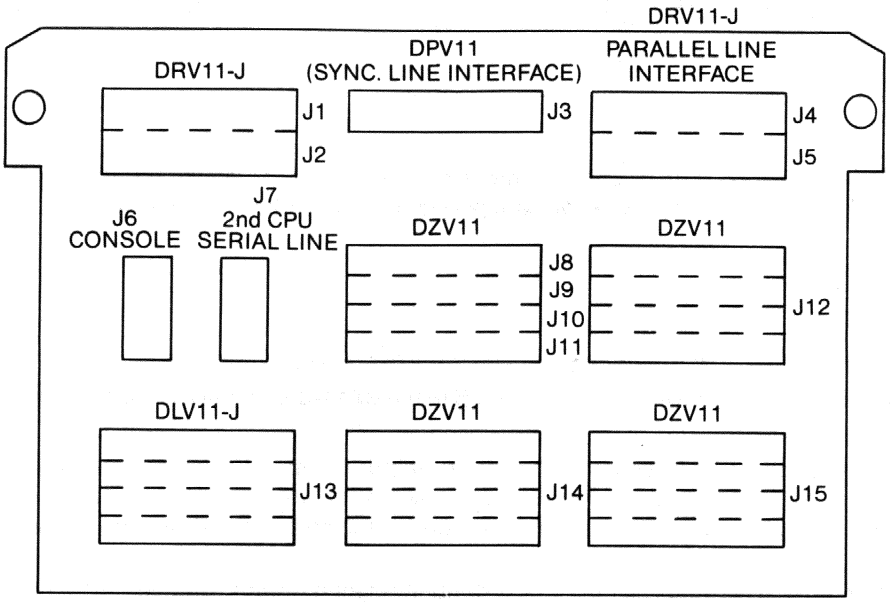
BA11-S Configuring Notes

- The BA11-S is a box containing a 4x9 H9276 backplane with the H7861 power supply.
- The Extended LSI-11 bus signals are present on slots A and B in the BA11-S box, but not slots C and D.
- The H9276 backplane uses **three** ac busloads.
- The BA11-S backplane is position-independent. The interrupt priority structure is etched into the backplane. Therefore, I/O options should be positioned in the backplane according to speed and buffering. The modules's backplane placement is based on preferred interrupt priority. See below for the proper order to install options in the backplane.
- The BA11-S can accommodate nine quad-height or nine double-height modules. Double-height modules can be placed in slots A and B only.

Order of Options in Backplane

The list below gives the proper order for inserting modules in the backplane of the PDP-11/23 PLUS.

1. KDF11-B
2. FPF11, if present
3. Memory Modules
   - MSV11-PK
   - MSV11-PL
   - MCV11-DA
   - MCV11-DC
   - MSV11-LF
   - MSV11-LK
4. Synchronous Communication Modules, without silo.
   - DPV11
5. General-purpose I/O ports.
   - DRV11-JA
   - DRV11-D
6. Asynchronous Communications Modules, without silo.
   - DLV11-ED
   - DLV11-JA
7. Asynchronous Communication Modules with silo.
   - DZV11-C
8. Synchronous DMA Communication Modules
   - DMV11
9. Disk Controller Interface
   - RLV12



Patch Panel

Notes:

- If there are two general-purpose I/O devices, (such as the DRV11-JA or the DRV11-D), the first device uses patch panel slots J4 and J5. The second one uses slots J8 through J11.
- A second and third DLV11-JA uses patch panel slots J14 and J13.
- A second DZV11-C would use slot J15.

Single Backplane Configuration Rules

- There can be no spaces between modules on the backplane.
- Dual-height modules can be mounted in slots A and B only.
- The Extended LSI-11 bus can support up to 35 ac loads; the processor has on-board termination for one end of the bus. After 35 ac loads, the other end of the bus must be terminated with 120 ohms.
- The un-terminated bus can support up to 35 ac loads. If additional ac loading is required, adding a 120 ohm terminator at the far end of the bus will boost the maximum to 45 ac loads.
- The bus can support up to 20 dc loads.
- The recommended current drawn from the power supply should be no greater than 90% of the maximum rated output of the supply.

Configuring with the BA11-S

When configuring a system starting with the BA11-S only, keep in mind that the BA11-S can support up to:

35 ac loads	20 dc loads	32.4 A @+15V	4.5 A @+12V

The BA11-S box itself uses 3.0 ac loads. To add to an empty BA11-S, do the following:

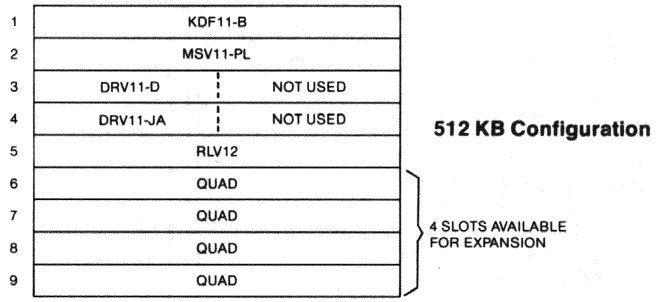
- Determine the options that are to be added to the box.
- Determine the amps and bus loads that each option requires (see Section 3, Options).
- Total the amps and bus loads of the processor, memory, and all the options and the BA11-S.
- Total the quad and double slots required by the modules.
- Subtract amps, busloads, and slots from those available to see if your configuration is viable. A valid configuration must not exceed the maximum amps and bus loads that the BA11-S mounting box can support.

EXAMPLE CONFIGURATIONS

A 512 KB System Configuration (Patch panel slot is indicated with diagram.)

BACKPLANE	MODULE TYPE	PATCH PANEL LOCATION
KDF11-B	CPU	J6, J7
MSV11-PL	Memory	No cable
DRV11-JA	General-purpose I/O	J1, J2 or J4, J5
DLV11-JA	4 Asynch Serial Lines	J13
RLV12	RL02 Disk Controller	Cable routed around panel, does not use patch panel

4 Slots available for expansion

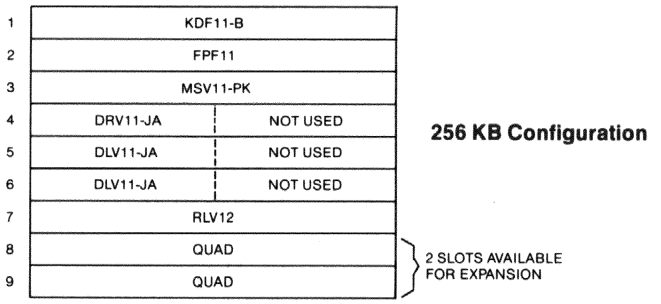


512 KB Configuration

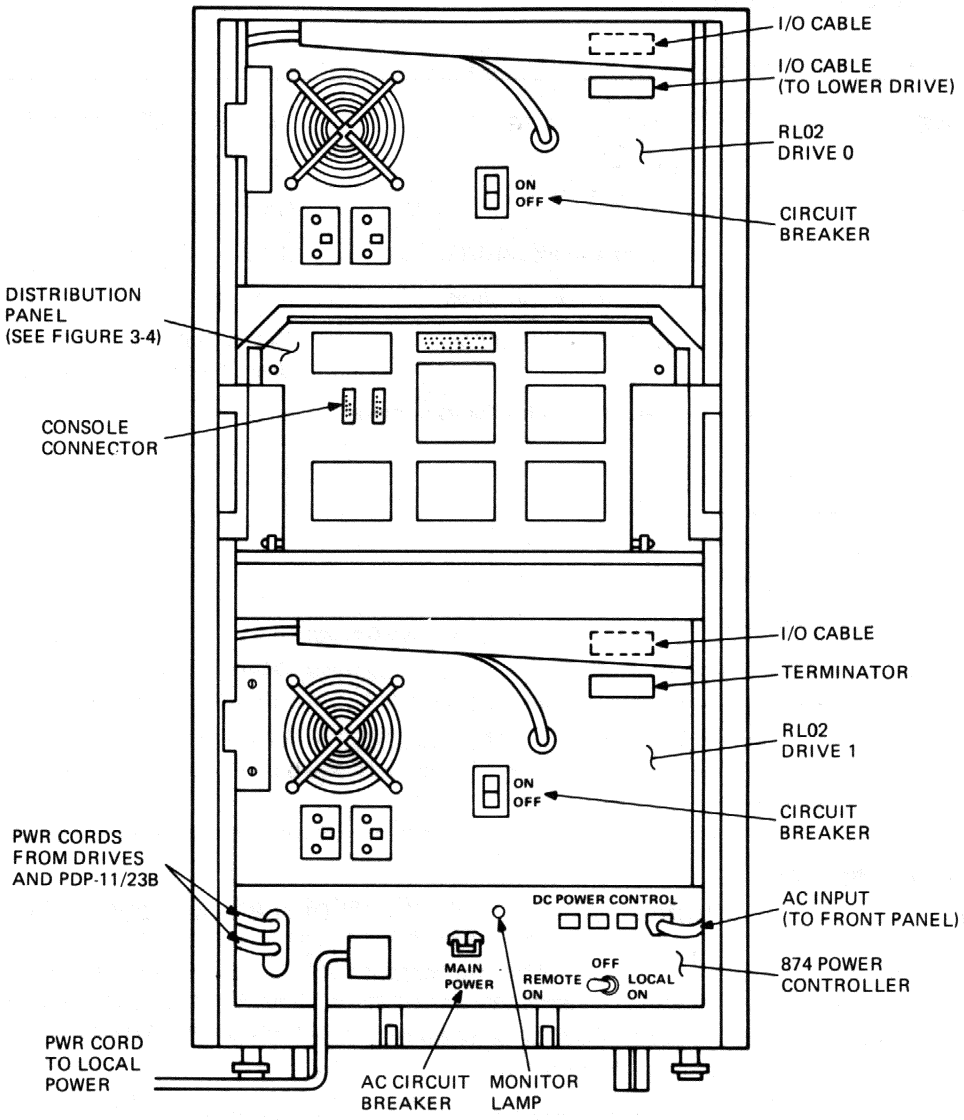
A 256 KB Box-Level Configuration

BACKPLANE	MODULE SLOT	PATCH PANEL LOCATION
KDF11-B	CPU	J6, J7
FPF11	Floating Point Processor	Cabled directly to CPU; doesn't connect to patch panel
MSV11-PK	Memory	No cable
DRV11-JA	General-purpose I/O	J1, J2 or J4, J5
DLV11-JA	4 Asynch Serial Lines	J14, J13
DLV11-JA	4 Asynch Serial Lines	J14
RLV12	RL02 Disk Controller	Cable routed around panel, does not use patch panel.

2 Slots available for expansion



256 KB Configuration



PDP-11/23-PLUS Rear View

Appendix

PDP-11/23-PLUS TIMING

The PDP-11/23-PLUS (KDF11-B) CPU executes PDP-11 instructions as a series of microcode cycles. A data fetch consists of an address cycle and a bus DIN cycle. A data write consists of an address cycle and a bus DOUT cycle. An instruction fetch consists of an address cycle, a bus DIN cycle, and a non-I/O cycle. The execution of an instruction typically consists of one or more non-I/O cycles. Floating Point instructions also include interchip DIN and DOUT cycles which move data between the DATA and MMU chips. The execution time for an instruction depends on the type of instruction, modes of addressing used, the type of memory referenced and whether the memory management unit is enabled or disabled.

Each microcode cycle consists of an integral number of clock pulses which occur at 75 ns intervals. The number of clock pulses and time required to complete the most common microcode cycles are listed in Table 1. The time required for bus DIN or DOUT microcode cycles which access either the memory management registers (MMU DIN or DOUT) or the KDF11-B on-board peripherals (IDAL bus DIN or DOUT) are listed in Table 2. The KDF11-B peripherals include the bootstrap and diagnostic ROMS, the line clock logic and the serial line units.

Table 1 KDF11-B Common Microcode Cycle Times

Type of Cycle	Clock Pulses	Time (ns)
Address (No Relocation)	5	375
Address (Relocation)	8	600
LSI-11 Bus DIN (1)	10	750
LSI-11 Bus DIN (2)	11	825
LSI-11 Bus DOUT (3)	11	825
INTERCHIP DIN	5	375
INTERCHIP DOUT	5	375
Non I/O (Micro-NOP)	4	300

The KDF11-B detects RRPLY assertion within 112.5 ns of the time it asserts TDIN. (Typical for peripherals which assert TRPLY as soon as they receive RDIN asserted.)

The KDF11-B detects RRPLY assertion within 337.5 ns of the time it asserts TSYNC. (Typical for the MSV11-P Parity Memory).

The KDF11-B detects RRPLY assertion within 150 ns of the time it asserts TDOUT. (Typical for peripherals and memories which assert TRPLY as soon as they receive RDOUT asserted. This includes the MSV11-P Parity Memory.)

Table 2 KDF11-B Peripheral Microcode Cycle Times

Type of Cycle	Clock Pulses	Time (ns)
IDAL Bus DIN	8	600
IDAL Bus DOUT	8	600
MMU DIN	7	525
MMU DOUT	7	525

BASIC INSTRUCTION TIMING

This system lists the source, destination and fetch/execute times for the KDF11-B Basic Instruction Set. KDF11-B instruction times are calculated using the following equation:

INSTRUCTION TIME = Basic Time + Source Time + Destination Time
(Basic Time = Fetch Time + Execute Time)

The basic, source and destination times were calculated from the microcode cycle times listed in Table 1. LSI-11 Bus DIN (2) and DOUT (3) times of 825 ns were used for the MSV11-P Parity Memory which has the specifications listed in Table 3.

Table 3 MSV11-P Parity Memory

Bus Cycles	Access Time (ns)		Cycle Time (ns)	
	Typ	Max	Typ	Max
DATI	240	260	560	590
DATO (B)	90	120	610	640
DATIO (B)	660	690	1175	1210

The instruction execution times for systems with memory management enabled or disabled are listed in Tables 4 through 7.

Table 4 Source Address Times

Instruction	Source Mode	Memory Cycles	Time (microseconds) with Memory Management Enabled	Disabled
	0	0	0	0
ADD, SUB	1	1	1.425	1.200
MOV(B), CMP(B)		2	1	1.425
1.200				
BIS(B), BIC(B)		3	2	2.850
2.400				
BIT(B)	4	1	1.725	1.500
	5	2	3.150	2.700
	6	2	3.150	2.700
	7	3	4.575	3.900
	0	0	1.275	1.275
MUL, DIV	1	1	1.725	1.450
ASH, ASHC	2	1	1.725	1.450
MFPI, MFPD	3	2	2.850	2.400
MTPS	4	1	1.725	1.500
	5	2	3.150	2.700
	6	2	3.150	2.700
	7	3	4.575	3.900

Table 5 Destination Address Times

Instruction	Source Mode	Memory Cycles	Time (microseconds) with Memory Management Enabled	Disabled
MOV(B), CLR(B)	0	0	0	0
SXT, MFPS	1	1	2.025	1.800
MTPI, MTPD	2	1	2.025	1.800
	3	2	3.150	2.700
	4	1	2.025	1.950
	5	2	3.450	3.000
	6	2	3.450	3.000
	7	3	4.875	4.500
CMP(B), BIT(B)	0	0	0	0
TST(B)	1	1	1.725	1.500
	2	1	1.725	1.500
	3	2	2.850	2.400
	4	1	1.725	1.500
	5	2	3.150	2.700
	6	2	3.150	2.700
	7	3	4.575	3.900
ADD, SUB	0	0	0	0
INC(B), DEC(B)		1	1	2.850
COM(B), NEG(B)		2	1	2.850
ROR(B), ROL(B)		3	2	4.275
ASR(B), ASL(B)		4	1	2.850
BIS(B), BIC(B)		5	2	4.575
ADC, SBC	6	2	4.575	4.125
XOR, SWAB	7	3	6.000	5.325

Table 6 Basic (Fetch & Execute) Time

Instruction	Memory Cycles	Time (microseconds) with Memory Management Enabled	Disabled
MOU, CMP, BIT BIC, BIS, ADD, SUB, SXT, CLR, TST, COM, INC, DEC, NEG, ADC, SBC, RCR, ROL, ASR, ASL, SWAB, MFPS	1	2.025	1.800
MTPS	1	3.600	3.375
MFPI, MFPD	2	4.050	3.600
MTPI, MTPD	2	4.725	4.275
SCB (NO BRANCH)	1	2.625	2.400
SOB (BRANCH)	1	2.925	2.700
ALL BRANCH	1	2.025	1.800
CLN, CLE, CLV, CLC, SEN, SEZ, SEV, SEC, CCC, SCC	1	2.925	2.700
RTS	2	3.750	3.300
MARK	2	5.325	4.875
RTI	3	6.225	5.550
RTT	3	7.500	6.825
IOT, BPT	5	10.500	9.375
EMT, TRAP	5	9.525	8.850
WAIT	1	3.375	3.150
MUL	1	33.300	33.075
DIV	1	49.650	49.425
ASH	1	24.825	24.600
ASHC	1	46.050	45.825

NOTE

1. The instruction times for MUL, DIV, ASH, and ASHC are operand dependent and could be less than the values given above.
2. The instruction times for the RESET and Halt instructions are Mode/Option Dependent.

Table 7 Jump Instruction Times

Instruction	Dest. Mode	Memory Cycles	Time (microseconds) with Memory Management Enabled	Disabled
	1	1	2.325	2.100
JMP	2	1	2.625	2.400
	3	2	3.450	3.000
	4	1	2.625	2.400
	5	2	3.750	3.300
	6	2	3.750	3.300
	7	3	5.175	4.500
	1	2	4.350	3.900
JSR	2	2	4.650	4.200
	3	3	5.475	4.800
	4	2	4.650	4.200
	5	3	5.775	5.100
	6	3	5.775	5.100
	7	4	7.200	6.300

DMA AND INTERRUPT LATENCIES

DMA latency is the time required for the first DMA device to obtain bus mastership after it asserts a direct memory access request (BDMR L). The DMA latency is 1.35 microseconds, maximum. The maximum DMA latency was calculated for a relocated address cycle followed by a DOUT cycle. The processor disables DMA grant (BDMGO L) from the end of the address cycle phase time until four 75 ns intervals after the DOUT cycle phase time.

Interrupts (BR requests) are acknowledged by the processor at the end of the current instruction. Interrupt latency is defined as the time required by the KDF11-B to assert an interrupt acknowledge (BIAKO L) after receiving an interrupt request. Interrupt service time is defined as the time required to fetch the first service routine instruction after asserting BIAKO L. The interrupt latency time and the interrupt service time must be added to obtain the total time from the reception of the interrupt request to the fetch of the first service routine instruction. The specifications for interrupt latency and interrupt service times are as follows.

Interrupt Latency	−5.475 s, typ [MOV X(R7),R0]
	12.600 −S, max (except EIS)
	54.225 −s, max (including EIS)
Interrupt Service	8.625 −s (Memory Management Off)
	9.750 −s (Memory Management On)

NOTE

1. Interrupt and DMA latencies assume a KDF11-B with memory management enabled and using MSV11-P memory.
2. The maximum interrupt latencies were calculated for ADD @X(R7), @Y(R7) and for DIV @X(R7).

SELECTED OPTIONS WORKSHEET

OPTION					
TYPE	NUMBER	QUANTITY SELECTED	MOUNTING CODE	AMPS REQUIRED?	BUS LOADS

REFERENCES

PDP-11/23 PLUS System Manual
EK-1T23B-OP-001

PDP-11/23B Mounting Box User's Guide
EK-23BMB-UG-001

PDP-11/23B Mounting Box Technical Manual
EK-23BMB-TM-001

RLV12 Disk Controller User's Guide
EK-RLV12-UG-001

RLV12 Disk Controller Technical Manual
EK-RLV12-TM-001

MSV11-P User's Guide
EK-MSV0P-UG-001

KDF11-B User's Guide
EK-KDFEB-UG

Microcomputers and Memories Handbook 1982
EB 20912-22

Microcomputers and Interfaces Handbook
EB-21075-20/80

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