HEWLETT PACKARD

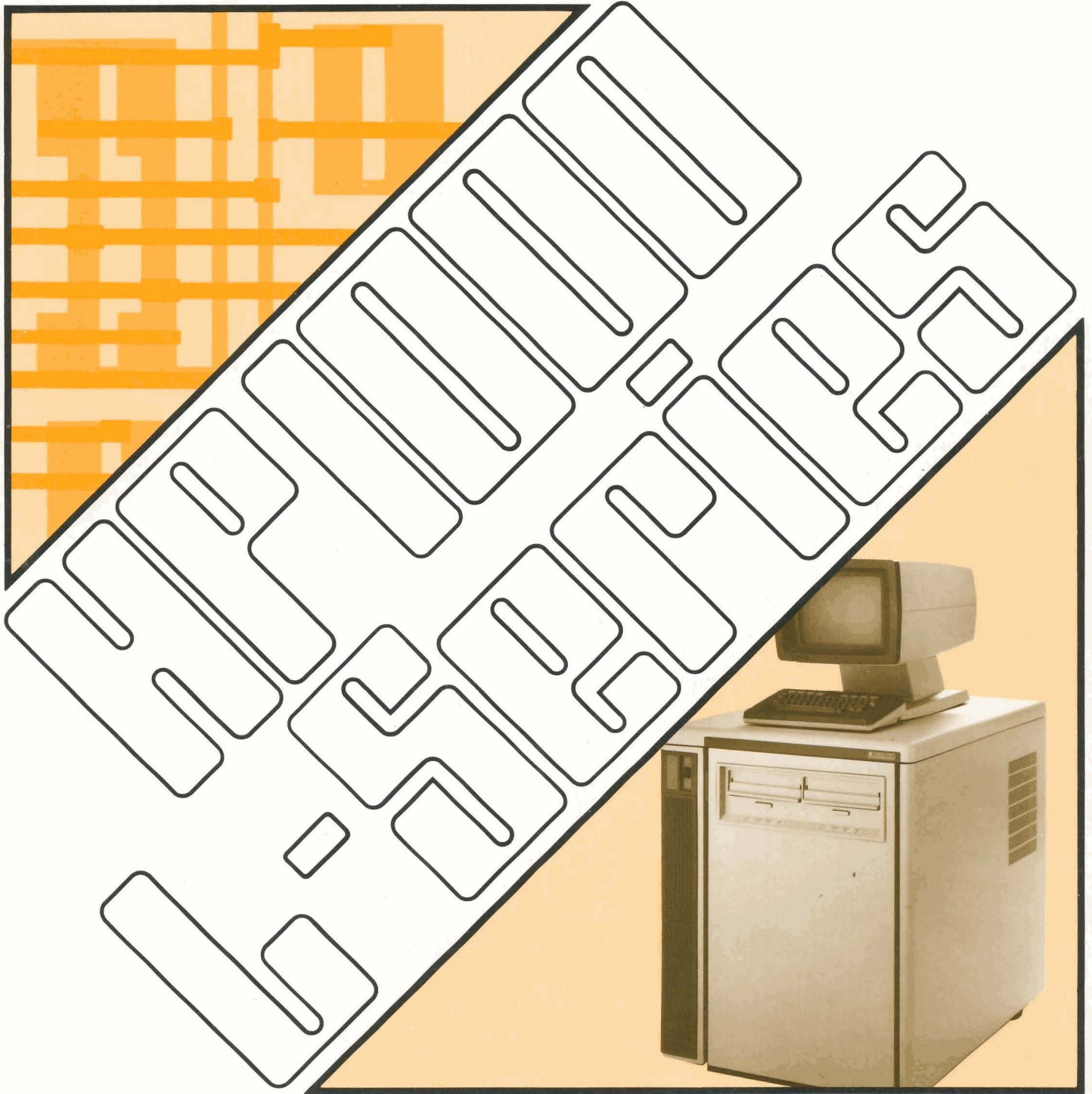# HP 1000 Computers and Systems

HP 1000 L-Series Product Data

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HP 1000 L-Series Information Locator

HP 1000 L-Series overview

Computers and accessories

Computer systems

Interface modules and interconnection hardware

Standard peripherals and table for HP 1000 L-Series Systems

Software and diagnostics for HP 1000 L-Series Systems

Product support information

## Power specifications for HP 1000 L-Series computers and accessories

HP 1000 L-Series identifies a new series of LSI-based computation products from Hewlett-Packard. Based on Hewlett-Packard's proprietary Silicon-On-Sapphire (SOS) technology, these new products provide OEMs and end users with a high degree of flexibility for dedicated applications while maintaining instruction and program compatibility with the other members of Hewlett-Packard's HP 1000 family of technical computer products. This data sheet describes the overall systems design and its capabilities and provides specifications common to all L-Series products.

Features

- Distributed intelligence I/O design that simplifies programming and includes many powerful features for high I/O throughput, such as DMA per channel
- High reliability and maintainability through the use of SOS LSI, reduced circuit area, and simple packaging
- Modular design with choice of three levels of integration — boards, boxes, and systems — to fit your application needs
- Broad range of interfaces and peripherals
- 80 powerful instructions, including:
  - Integer arithmetic
  - Memory and register reference
  - I/O group
- Instruction and program compatibility with other members of the HP 1000 family protects software investment of current OEMs and gives user access to a broad base of proven software
- Built-in memory protect, time base generator, and self-test
- Standard memory parity generation and checking that protects programs against bit loss, reducing software development and maintenance costs
- Power fail detection and auto restart (battery backup is optional)
- Boot loaders included for boot-up from:
  - Disc drive
  - PROM module
  - HP Mini cartridge tape unit on terminal
- Virtual Control Panel program that provides for use of a local or remote terminal to access processor registers, alter or examine memory, run programs, or initiate boot loading
- 64k bytes of main memory
- Power supply designed for wide tolerance of power line fluctuations and interruptions
- Excellent noise immunity achieved through extensive use of ground planes and steel enclosed power supply
- Software support with 92070A RTE-L real-time executive operating system
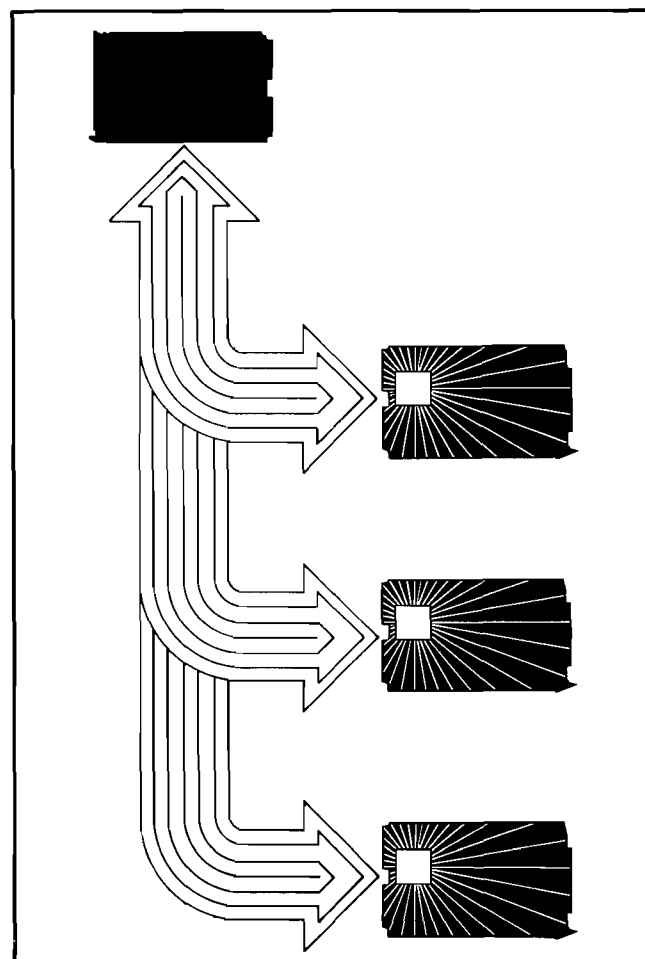
Flexibility to satisfy a wide variety of OEM and end user requirements

HP 1000 L-Series computational products are offered at three levels of integration (Figure 1) to satisfy a variety of user's configuration needs.

Board computers

In board (or component) form, the central processor card and a 64k byte memory card are available as the model 2103LK Board Computer to OEMs and end users that require its processing capabilities without packaging by Hewlett-Packard. An extensive selection of I/O boards is available for a wide variety of applications. As shown in Figure 1, five and ten slot card cages and the L-Series power supply are accessories available to assist in packaging and powering the 2103LK board computer and I/O boards.

2103L (box) Computer

64k byte Memory Card

Central Processor Card
(underneath memory)

10-Slot Card Cage

Power Module

Front Panel

Computer Cabinet

2103LK Board Computer and Integration Accessories

2103LK Board Computer

64k byte Memory Card

12030A 10-Slot Card Cage

Central Processor Card

12035A Power Module

12032A 5-Slot Card Cage

I/O Interfaces and other plug-in accessories

12005A Async Serial (terminal) Interface
12006A Parallel Interface
12008A PROM Storage Module
12009A HP-IB Interface

12010A Breadboard Interface
12012A Priority Jumper Card
12013A Battery Backup Card

12011A Extender Board

Figure 1. HP 1000 Products

HP 1000 L-Series Computer Systems, Models 9 and 10

(2145B/2146B System Processing Unit (SPU) shown; 2145A/2146A
SPU is housed in taller 62.2 inch cabinet)

System Terminal
(either of two
different terminal
choices is required
in Model 9 and 10
Systems)

16-Slot Card Cage with:
- Battery Backup Card
- Memory Card
- Central Processor Card
- HP-IB Interface for Discs
- Async Serial (terminal)
  Interface

Single/dual 1.2M
byte Flexible
Disc; Dual flexible
disc is included
in 2145A/B SPU
Single flexible disc
is included in
2146A/B SPU

Power
Distribution
Module

7910HR Fixed Disc
(7910HR or other hard
disc choice is pre-
requisite for Model 10
System)

Power Supply

System Cabinet

Figure 1. HP 1000 Products, continued

Box computers

In box form, the 2103LK board computer is packaged as the 2103L Computer with the ten-slot card cage and L-Series power module for users designing their own rack-mountable systems.

Systems

The HP 1000 Model 9 and 10 Computer Systems are the third level of integration. These systems use the 2103LK board computer in a sixteen-slot card cage with battery backup, terminal and disc interfaces, the RTE-L real-time operating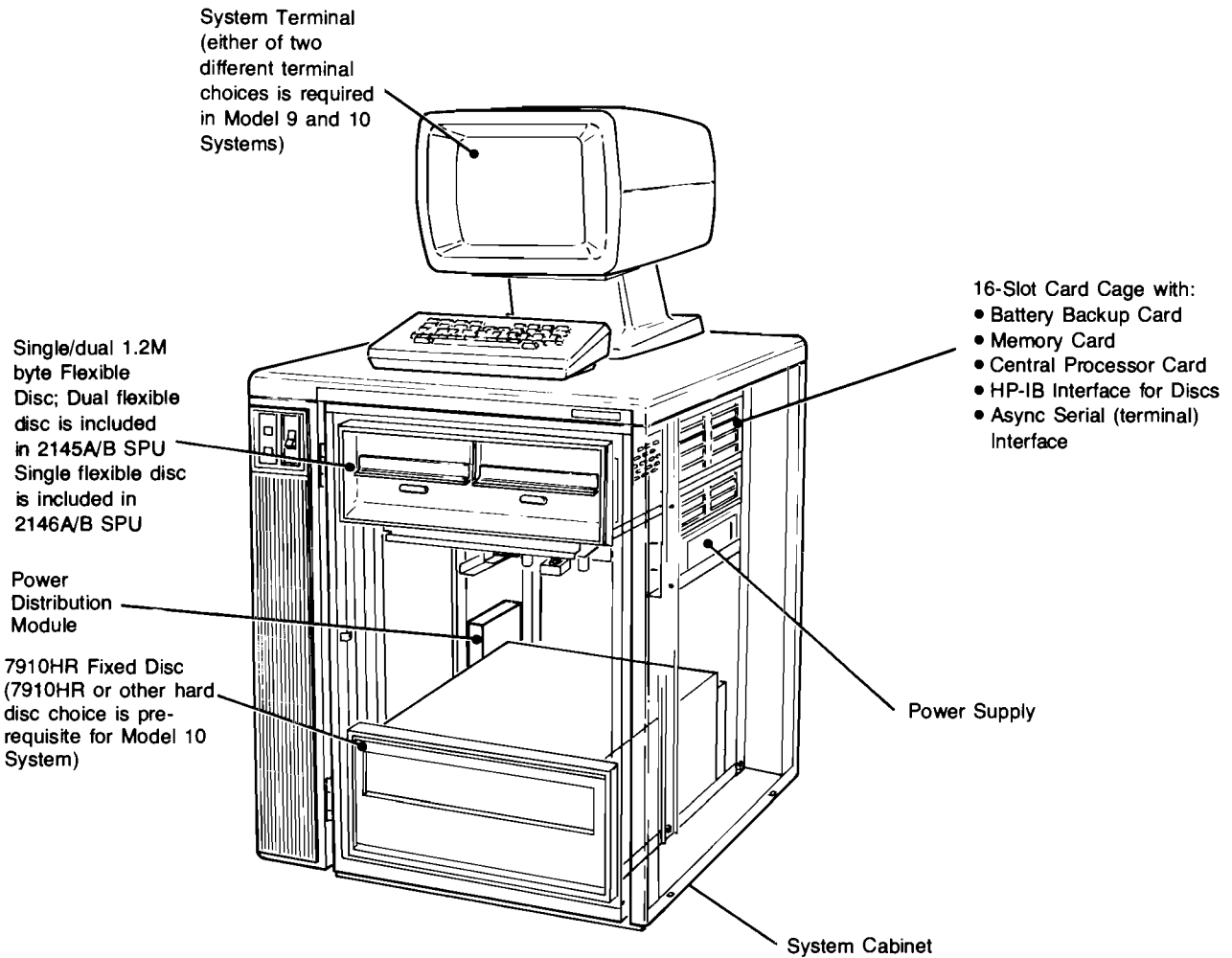 system, single or dual flexible disc, hard disc (with Model 10), and the user's choice of terminals. This configuration is for anyone not requiring the physical flexibility of boxes or boards.

Interfaces and accessories

A broad choice of interfaces and other plug-ins is available to HP 1000 L-Series users at all levels of integration. These include:

- 12005A Asynchronous RS232 and current loop serial interface for connection of terminals or other serial devices to L-Series computers or systems
- 12006A Parallel interface. a 16-bit general-purpose duplex interface for connection of external instruments or other devices to L-Series computers or systems
- 12008A PROM Storage Module with up to 64k bytes of PROM capacity for non-volatile storage of user's programs or complete operational software systems used in L-Series computers or systems
- 12009A HP-IB Interface for connection of multiple disc memory units, printers, instruments, and other HP-IB devices to L-Series computers or systems
- 12010A Breadboard Interface for user development of specialized interfaces for use in L-Series computers or systems (includes I/O Master circuitry common to all L-Series interfaces)
- 12011A Extender Board
- 12012A Priority Jumper Card for continuation of hardware priority chain through card cage bus position not occupied by an I/O interface or other plug-in accessory board
- 12013A Battery Backup Card provides power to sustain 64k bytes of memory for at least 1 hour in the event of power failure

CMOS/SOS LSI technology promotes reliability and maintainability

The HP 1000 L-Series computational products are based on processors manufactured using Hewlett-Packard's proprietary CMOS/SOS (Silicon on Sapphire) Large-Scale Integration (LSI) integrated circuit process. The SOS process makes possible high circuit densities, so that much of the logic of a processor resides on a single chip. The chip and auxiliary circuits for the central processor, memory, I/O interfaces, and other L-Series components occupy single circuit boards, each only 29 cm long by 17.2 cm wide (11.4 in by 6.8 in) The low parts count made possible by LSI using CMOS/SOS promotes reliability. Providing all active L-Series components on plug-in boards simplifies packaging and fault isolation, and speeds repair.

Distributed intelligence architecture boosts I/O efficiency and simplifies programming

Of the principal functions of a computer, computation and input/output are usually both controlled by the central processor. In the HP 1000 L-Series system design, the high circuit density and cost savings realized by using CMOS/SOS LSI circuits have made it practical to change that. The central processor has been relieved of I/O processing. That function has instead been assigned to an individual, custom-designed I/O Processor on each interface card. Thus, the CPU is free to do its real job of processing data. The central processor, the I/O Processors on each interface, and memory all communicate with each other via a common bus, as shown in Figure 2.
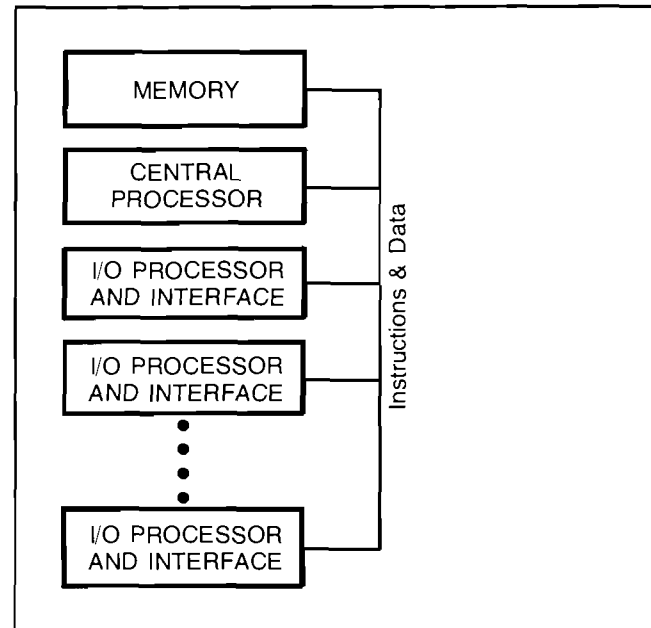

Figure 2. L-Series Functional diagram

Low-overhead I/O

I/O Processor-managed DMA. Their built-in intelligence equips L-Series I/O interfaces to manage their own I/O operations autonomously. This includes Direct Memory Access (DMA), and can even include chained multiple DMA transfers without interruption of the central processor until all transfers have been completed.

DMA-per-channel I/O. The same master I/O Processor intelligence is provided on all L-Series I/O interfaces. For that reason, any I/O interface can access memory in the efficient, low-overhead DMA mode, even interfaces serving slow devices, such as terminals. There is no restriction on the number or type of interfaces or devices using DMA.

Automatic end of transfer termination. For variable-length transfers to/from terminals or other devices, the I/O Processor provides for termination of DMA upon receipt of an end of transfer signal. For instance, when the asynchronous serial interface receives a carriage return, that can be recognized as an end of record character which terminates the DMA transfer automatically.

I/O access priority

Priority of I/O interrupts and access to memory is controlled simply, by interface card position on the card cage bus with respect to the central processor. The interface closest to the processor has highest priority, those farther down the bus have successively lower priority according to their position, as shown in Figure 3. The central processor is granted access to memory when memory cycles are not being used by I/O interfaces. However, in a situation of I/O monopolization of the backplane, the central processor is granted access to the 33rd memory cycle after requesting access.

12032A 5-SLOT CARD CAGE (Viewed from the open end)	Memory*	XA01†*
	Processor	XA02
	I/O Priority 1	XA03
	I/O Priority 2	XA04
	I/O Priority 3	XA05

12030A OR 2103L
10-SLOT CARD CAGE
(Viewed from the open end)

XA06*	I/O Priority 4*	Memory*	XA01†*
XA07	I/O Priority 5	Processor	XA02
XA08	I/O Priority 6	I/O Priority 1	XA03
XA09	I/O Priority 7	I/O Priority 2	XA04
XA10	I/O Priority 8	I/O Priority 3	XA05

16-SLOT CARD CAGE
USED IN L-SERIES SYSTEMS
(Viewed from the open end)

XA09*	I/O Priority 6*	Battery Backup	XA01†*
XA10	I/O Priority 7	Memory	XA02
XA11	I/O Priority 8	Processor	XA03
XA12	I/O Priority 9	I/O Priority 1	XA04
XA13	I/O Priority 10	I/O Priority 2	XA05
XA14	I/O Priority 11	I/O Priority 3	XA06
XA15	I/O Priority 12	I/O Priority 4	XA07
XA16	I/O Priority 13	I/O Priority 5	XA08

† *XA01, XA02, XA03, etc. designations identify receptacle connectors on the card cage backplane.*

* *When the 12013A Battery Backup Card is used in the 5-Slot Card Cage it must be plugged into receptacle XA01 and the Memory and Processor boards should move down to XA02 and XA03, respectively. The I/O priority 1 and 2 receptacle are then XA04 and XA05, respectively. In the 10-Slot Card Cage, the Battery Backup Card can occupy receptacle XA01 or XA06, which shifts the physical positions of I/O priorities down accordingly. Two Battery Backup Cards can be used in the 10-Slot and 16-Slot Card Cages; the second Battery Backup Card would occupy slot XA09 in the 16-Slot Card Cage. The Battery Backup Card includes priority jumpering so that its insertion between interfaces does not break the priority chain.*

Figure 3. I/O Access Priority by I/O interface card position in HP 1000 L-Series card cages.

Simplified I/O programming

The same level of intelligence that makes possible DMA-per-channel input/output also simplifies I/O programming. The master I/O Processor logic provides for recognition of interface I/O addressing independently of card position on the card cage bus. This makes it possible to standardize I/O

addresses used for particular devices or functions without requiring any particular arrangement of I/O cards in the card cage.

Two modes of I/O interface addressing

Compatibility mode. The I/O Processor supports the mode of input/output addressing currently used by other HP 1000 (M-, E-, and F-Series) Computers. In this mode, each I/O instruction contains the select code of the interface to which it is directed. Use of this mode minimizes changes needed to convert programs that now run on HP 1000 M-, E-, or F-Series Computers for use on HP 1000 L-Series Computers.

Auto-addressing mode. The I/O Processor also supports a new auto-addressing mode. In this mode, a single program instruction addresses an I/O interface once before sending instructions to it. Thereafter, the I/O select codes in I/O instructions are not needed. This eliminates the need to prepare a separate configuration section in input/output drivers, reducing programming workload for OEMs or other users preparing their own drivers. It also shortens I/O driver execution time and reduces overhead because there is no configuration section to be executed prior to an I/O transfer.

Since an I/O interface is addressed in auto addressing mode only prior to receiving I/O instructions, six of the bits in I/O instructions that were formerly used for I/O select codes are freed for other uses. For example, these bits can be used to address registers on the interface itself. Or they can be used to exchange additional data or control bits with interfaced devices.

HP 1000-compatible central processor provides built-in real-time capabilities

The HP 1000 L-Series CMOS/SOS LSI central processor chip executes the same HP 1000 base instruction set (arithmetic and extended arithmetic, memory reference, and register reference instructions) as other HP 1000 (M-, E-, and F-Series) Computers. In addition to making possible a compact central processor, the LSI CPU chip includes memory protect, and a time base generator. Other standard features include integer arithmetic, self-test, bootstrap loaders, power fail/auto restart, and virtual control panel.

Program compatibility

While there is a compatibility mode that minimizes differences, certain aspects of the HP 1000 L-Series I/O design will require minor changes in a user's existing I/O drivers. Otherwise, HP 1000 programs that use the same instructions as the L-Series are directly program compatible. Of course, to realize the significantly greater efficency of DMA-per-channel I/O will require more extensive revision of existing programs.

Auto boot-up

As noted previously, the L-Series central processor includes bootstrap loaders. Two of these can be used for automatic boot-up at power on, from the following devices:

- A disc memory via the 12009A HP-IB interface.
- A 12008A PROM storage module.

Virtual Control Panel

The conventional front panel has been replaced by a ROM-based Virtual Control Panel (VCP) program. The VCP program enables an operator to perform control panel functions via a locally or remotely connected terminal. Only one I/O

card can have this capability, which can connect to a terminal accessible only to the system manager or the maintenance department, an important system integrity safeguard. The operator at the VCP terminal can examine and change the contents of registers and memory locations, control program execution, and select a bootstrap loader and initiate the boot-up of a system.

Because of its remote potential, the VCP can be used for remote isolation of L-Series system faults, which can help to minimize support costs for OEM products that use L-Series components. When not being used as a Virtual Control Panel, the VCP-assigned terminal can be used in the same way as any other terminal connected to the L-Series system.

Software support

Software support available for L-Series computation products starts with RTE-L, a true foreground-background real-time executive system, which is configurable for either memory-based or disc-based operation. In disc-based configuration, RTE-L supports program development in FORTRAN IV, Assembly language, and (optionally) in real-time BASIC/1000L. These software products are described in separate data sheets.

Diagnostic support

A diagnostic package is available for stand-alone testing of the L-Series central processor, memory, and L-Series interface cards. In addition, a BASIC-like Diagnostic Design Language interpreter is provided to assist the preparation of diagnostics for user-designed interfaces. The diagnostic package is described in a separate data sheet.

L-Series common specifications

Architecture

Type: Distributed intelligence with separate CPU and I/O Processors. communicating with each other and with memory via a single bus, as shown in Figure 2.

Implementation: Hardwired with SOS/LSI and MSI hardware.

Data path width: 16 bits.

Bus structure: Single backplane bus for memory, processor, and I/O.

Bus speed: Up to 2.8M bytes/sec.

Interrupt system: Vectored priority interrupt structure with the following priority assignments and select codes. Note that select codes need not match priorities.

Priority	Select Code	Function
1	00005	Memory parity interrupt
2	00010	Illegal instruction interrupt
3	00007	Memory protect interrupt
4	00004	Power fail interrupt
5	00017	Special interrupts
6	00006	Time base generator interrupt
	00011-00016	Reserved functions
7-21	00020-00077	I/O device interrupts

Central Processor Board

Accumulators: 2 (A and B), 16 bits each. Implicitly addressable, also explicitly addressable as memory locations.

Memory registers: 3 (T,P), 16 bits each, and (M), 15 bits.

Supplementary registers: 2 (overflow and extend), one bit each.

Instruction types:
Memory-to-accumulator
Direct register modification

Instruction formats:

Combined single word	Double word
Single word	

Addressing modes:

Direct	Double word
Multilevel-indirect	Single word
Register implicit	Bit

Instruction execution times:

Instruction	Execute time (μsec)*
Memory Reference Group (14 total)	
ADA/B, AND, IOR, XOR	4.5
LDA/B, STA/B	4.1
CPA/B without skip	4.5
CPA/B with skip	5.0
ISZ without skip	5.9
ISZ with skip	6.4
JMP	2.7
JSB	4.1
Indirect addressing (per level)	1.8
Shift-Rotate Group (20 total)	3.2
Alter-Skip Group (19 total)	3.6
Overflow bit manipulation (4 total)	
STO, CLO, SOS, SOC	3.6
HaLT (HLT)	15.2
Extended Arithmetic Memory Reference Instructions (6 total)	
DLD, DST	7.7
MPY	28.1
DIV	8.6-33.1
Extended Arithmetic Register Reference Shifting Instructions (6 total)	
ASL, ASR, LSL, LSR, RRL, RRR, Basic w/1 shift	2.3
Per additional shift	0.45

This figure assumes no DMA intervention; concurrent DMA intervention may increase execution time.

Power fail provisions: When primary line power falls below a predetermined level while the computer is running, a power fail warning signal from the 12035A Power Module or user-supplied power module causes an interrupt to memory location 00004. Memory location 00004 is intended to contain a Jump-to-subroutine (JSB) instruction to a user-written power fail subroutine. A minimum of 5 milliseconds is available to execute the power fail subroutine.

Memory protect: Memory protect logic on the central processor:

1. Protects a selected block of memory of any size, from a settable "fence" address downward, against alteration or entry by programmed instructions, except those involving the A and B registers.

2. Prohibits execution of I/O instructions, except those referencing select code 01 (the CPU status register and the overflow register). This limits control of I/O operations to interrupt control only, which can be used to give exclusive control of the I/O system to an executive program.

3. In response to a memory protect violation, interrupts the computer and saves the address of the violating instruction in memory location 00007, from which it can be made accessible in the A or B register by a single Assembly language instruction.

Time base generator interrupt: A time base generator interrupt is provided for maintaining a real time clock. The interrupt request is made when the CPU signals, at 10-millisecond intervals, that its internal clock is ready to roll over. Timing accuracy of the time base generator is ±4.32 seconds per (24 hour) day.

Illegal instruction interrupt: An illegal instruction interrupt is requested when the CPU chip signals that the last instruction fetched was not recognized by it. This interrupt provides a straightforward entry to software routines for the execution of instruction codes not recognized by the L-Series system hardware.

Memory board

Memory structure: 32 pages of 2048 bytes, with direct access to current and base (page 0) pages, indirect access to all pages.

Memory size: 64k bytes is included with all HP 1000 L-Series computation products.

Memory cycle time: 680 nanoseconds.

Memory parity checking: Parity logic on the Memory board continuously generates correct parity for all words written into memory and monitors the parity of all words read out of memory. Either odd or even parity can be selected. A parity error will generate an interrupt to memory location 00005, which can contain a JSB to a user written parity error handling subroutine or a halt instruction.

I/O Master Processor

Purpose: To maintain the high performance of the L-Series I/O structure, HP uses the I/O Master as the standard interface circuitry to the L-Series backplane. It includes the I/O Processor chip, which executes I/O instructions, and other circuits that make high speed transfers possible. Every HP 1000 L-Series I/O interface card, including the 12008A PROM Storage Module and the 12010A Breadboard Interface, has the I/O Master circuitry.

Determination of I/O address: I/O address select code is set for each interface by select code switches on the interface and is therefore independent of interface card position along the backplane bus.

I/O addressing: An I/O interface may be pre-addressed by pre-setting its select code into the Global Register (GR), which leaves the six select code bits of I/O instructions available for addressing registers or other functions on the interface. Alternatively, the GR can be turned off and the select code bits in each I/O instruction can be used to address the I/O interface.

I/O processor instruction and select codes recognition summary:

Instruction	Select codes recognized	
	GR off	GR on
CLear Control (CLC)	SC	20-23 & 30
CLear Flag (CLF)	02 & SC	02, 20-23, & 30
Load In A or B (LIA/B)	00,02,03, & SC	00,02,03, & XX
Merge In A or B (MIA/B)	00,02,03, & SC	00,02,03, & XX
Output from A or B (OTA/B)	00,02,03, & SC	00,02,03, & XX
Skip if Flag Clear (SFC)	SC	20-24 & 30
Skip if Flag Set (SFS)	SC	20-24 & 30
SeT Flag (STF)	02 & SC	02, 20-22, & 30
SeT Control (STC)	SC	02, 20-22, & 30

SC = The Select Code of the interface: 20 <=SC <=77.

XX = Other use of the interface select code bits for addressing of registers or functions on the interface itself: 20 <=XX <=77.

Instructions executed by interface enabled to perform the "Virtual Control Panel slave cycle" regardless of GR status: LIA/B 3,C; OTA/B 3,C; CLC 3; HLT XX (0<=XX<=77).

Instruction execution times:

Instruction	Execute time (μsec)
STC, CLC, STF, CLF	3.6
LIA/B, MIA/B, OTA/B	6.4
SFC, SFS without skip	3.6
SFC, SFS with skip	5.0

I/O device interrupt priority: Depends upon I/O interface position along the card cage bus, with respect to the processor board, as illustrated in Figure 3.

I/O interrupt procedure:
1. One or more I/O interfaces requests an interrupt.
2. When the central processor acknowledges the interrupt request of the highest priority interface, it executes the instruction in a memory location that corresponds to the select code of the interface.

Interrupt masking: The I/O Master logic includes an interrupt mask register which provides for selective inhibition of interrupts from specific interfaces under program control. This capability can be programmed to temporarily cut off undesirable interrupts from any combination of interfaces when they could interfere with crucial transfers.

Interrupt latency when there is no DMA interference: 0.88 to 33.1 microseconds, 1.6 microseconds typical. (Interrupts cannot be serviced until a DMA cycle or an instruction in progress has completed execution. The worst-case latency of 33.1 microseconds is based upon time to complete an integer divide, the longest instruction.)

Interrupt latency when DMA is completely monopolizing the backplane: 95 to 828 microseconds, depending upon the instruction mix.

Direct Memory Access (DMA): The IOP chip supports DMA capability on each I/O interface, which reduces the number of interrupts from one per data item (byte or word) to one per complete DMA block transfer, greatly reducing overhead and increasing throughput.

DMA Latency: Time interval from Service Request by an I/O device through completion of the I/O data transfer to/from the I/O interface is 0.908 μsec for input, 1.135 μsec for output for the interface with highest hardware priority.

Self-configured, chained DMA: The IOP chip also supports a self-configuring mode of operation. In this mode, instead of interrupting after a block transfer, the IOP fetches a new set of control words for the next transfer, reconfigures itself, and initiates another block transfer. This process continues for as long as additional control word sets are available.

Data packing under DMA: When byte mode is specified in control word instructions, the IOP automatically manages byte packing or unpacking.

Maximum achievable DMA rate: 1.35 million words/sec (2.7 megabytes/sec).

Self-configured mode DMA timing: 7 microseconds, maximum, between successive transfers of a chained series.

I/O Master signals and timing: Refer to the HP 1000 L-Series I/O interfacing guide 02103-90005.

Electrical specifications

Electrical specifications are given in the 2103L, 2103LK, 2145A/B, 2146A/B, and 12035A data sheets and summarized on page 8-1.

Environmental specifications

Except for the HP 1000 Model 9 and 10 Computer Systems, which are specified separately in the 2145B data sheet, the following environmental specifications apply to all HP 1000 L-Series hardware products.

Temperature

Operating: 0° to 55°C (32° to 131°F).

Storage: −40° to 75°C (−40° to 167°F).

Relative humidity

5% to 95% at 40°C (104°F), without condensation.

Altitude

Operating: To 4.6 km (15,000 ft).

Non-operating: To 15.3 km (50,000 ft).

Vibration and shock

HP 1000 L-Series products are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Vibration: 0.38 mm (0.15 in) p-p deflection over 5-55 Hz frequency range, 3 axis.

Shock, 1/2 sine, 3 axis:

Component Weight, kg (and lb)	Magnitude (g's)	Duration (millisec)
<0.454 (1)	500	1
0.454-4.54 (1-10)	100	4
>4.54 (10)	30	11

Safety and RFI qualification

See individual data sheets on the 2103L, 2145B, and 12035A in Sections 2 and 3.

Physical Characteristics

See individual data sheets for 2103L, 2103LK, 2145B, and 12035A in Sections 2 and 3.

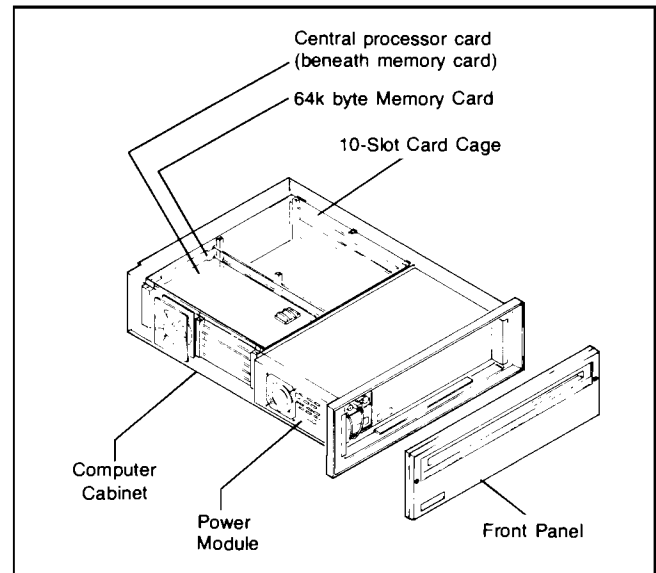# Ordering Information

See individual product data sheets.

HEWLETT PACKARD	**L-Series Computer**

The 2103L is a packaged L-Series computer for users designing their own rack-mounted systems. In a rack-mountable cabinet 13.3 cm (5.25 in) high by 59.7 cm (23.5 in) deep, the 2103L provides a CPU board and a 64k byte memory module in a 10-slot card cage along with the 12035A L-Series power supply. Since the CPU and memory boards each use one card cage slot, eight slots remain available for I/O interfaces, the 12013A Battery Backup Module, and/or the 12008A PROM Storage Module. At least one I/O interface and associated terminal or other peripheral is required in addition to the 2103L Computer for a usable system.

Features

- Distributed intelligence I/O design that simplifies programming and includes many powerful features for high I/O throughput, such as DMA per channel
- High reliability and maintainability through the use of SOS LSI, reduced circuit area, and simple packaging
- 80 powerful instructions, including:
  — Integer arithmetic
  — Memory and register reference
  — I/O group (with I/O interface)
- Instruction and program compatibility with other members of the HP 1000 family protects software investment of current OEMs and gives user access to a broad base of proven software
- Built-in memory protect, time base generator, and self-test
- Standard memory parity generation and checking that protects programs against bit loss, reducing software development and maintenance costs
- Power fail detection and auto restart (battery backup is optional)
- Boot loaders included for boot-up from:
  — Disc drive
  — PROM card
  — HP Mini cartridge tape unit on terminal
- Virtual Control Panel program that provides for use of a local or remote terminal to access processor registers, alter or examine memory, run programs, or initiate boot loading
- 64k bytes of main memory
- Modular packaging for easy maintenance
- Power supply designed for great tolerance of power line variations and power interruptions
- Excellent noise immunity achieved through extensive use of ground planes and steel enclosed power supply
- Broad range of interfaces and peripherals
- Software support with 92070A RTE-L real-time executive operating system

Central processor card (beneath memory card)
64k byte Memory Card
10-Slot Card Cage
Computer Cabinet
Power Module
Front Panel

CMOS/SOS LSI technology promotes reliability and maintainability

The 2103L Computer and L-Series I/O interfaces are based on processors manufactured using Hewlett-Packard's proprietary CMOS/SOS (Silicon on Sapphire) Large-Scale Integration (LSI) integrated circuit process. The SOS process makes possible high circuit densities, so that all of the logic of a processor can fit on a single chip. The chip and auxiliary circuits for the central processor, memory, I/O interfaces, and other L-Series components comfortably occupy single circuit boards, each only 29 cm long by 17.2 cm wide (11.4 in by 6.8 in) The low parts count made possible by LSI using CMOS/SOS promotes reliability. Providing all active L-Series components on plug-in boards simplifies fault isolation and speeds repair.

2103L central processor description

The 2103L CMOS/SOS LSI central processor chip executes the same HP 1000 base instruction set (arithmetic and extended arithmetic, memory reference, and register reference instructions) as other HP 1000 (M-, E-, and F-Series) Computers. In addition to making possible a compact central processor, the LSI CPU chip includes memory protect, and a time base generator. Other standard features include integer arithmetic, automatic parity generation and checking, self-test, bootstrap loaders, power fail/auto restart, and virtual control panel.

2-1

Auto boot-up

As noted previously, the L-Series central processor includes bootstrap loaders. Two of these can be used for automatic boot-up at power on, from the following sources:

- A disc memory via the 12009A HP-IB interface.
- A 12008A PROM storage module.

Virtual Control Panel

In the 2103L, a ROM-based Virtual Control Panel (VCP) program replaces the usual conventional front panel. The VCP program enables an operator to perform control panel functions via a locally or remotely connected terminal. The operator can examine and change the contents of registers and memory locations, control program execution, and select a bootstrap loader and initiate the boot-up of a system.

Because of its remote potential, the VCP can be used for remote isolation of L-Series system faults, which can help to minimize support costs for OEM products that use the 2103L.

Only one I/O card can have VCP capability. Connecting that I/O card to a terminal that is accessible only to a system manager or a maintenance department controls VCP access to the L-Series system, providing an important system integrity safeguard.

Distributed intelligence architecture boosts I/O efficiency and simplifies programming

Of the principal functions of a computer, computation and input/output are usually both controlled by the central processor. In the 2103L Computer, the high circuit density and cost savings realized by using CMOS/SOS LSI circuits have made it practical to change that. The central processor has been relieved of the burden of I/O processing. That function has instead been assigned to individual, custom-designed SOS LSI I/O Processors (IOPs) on each interface card. Thus, the central processor is free to do its real job of processing data. The central processor, the IOPs on each interface, and memory all communicate with each other via a common bus, as shown in Figure 1.

NOTE: For description of the advantages of the HP 1000 L-Series I/O design, see the HP 1000 L-Series system design data sheet, page 1-4.

Program compatibility

HP 2103L CPU instructions and L-Series I/O instructions are identical to the same instructions in other HP 1000 (M-, E-, and F-Series) Computers. This makes the 2103L Computer largely program compatible with other HP 1000 Computers. However, certain aspects of the I/O design, will require minor changes in user's application programs. Of course, to realize the significantly greater I/O efficiencies of DMA-per-channel I/O will require more extensive revision of existing programs.
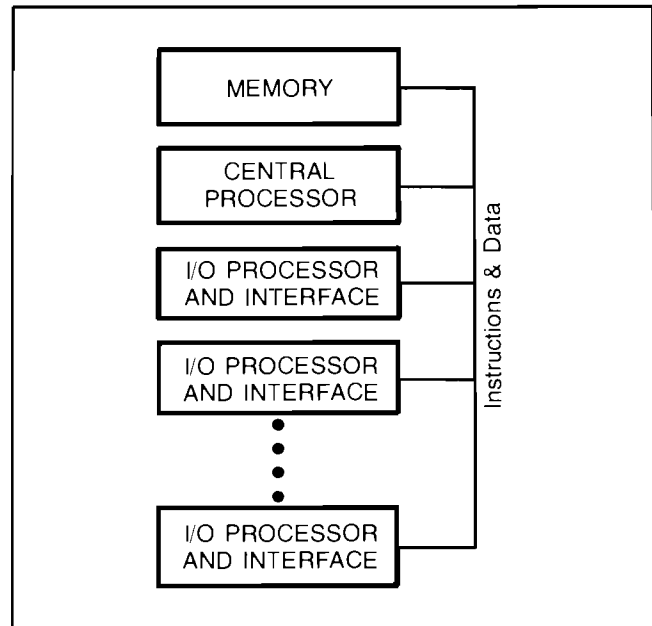

Figure 1. L-Series Functional diagram

Software support

Software support available for the 2103L Computer starts with RTE-L, a true foreground-background real-time executive system, which is configurable for either memory-based or disc-based operation. In disc-based configuration, RTE-L supports program development in FORTRAN IV, Assembly language, and (optionally) in BASIC/1000L real-time BASIC. RTE-L and BASIC/1000L are described in separate data sheets.

Diagnostic support

A diagnostic package is available for stand-alone testing of the L-Series central processor, memory, and L-Series interface cards. In addition, a BASIC-like Diagnostic Design Language interpreter is provided to assist the preparation of diagnostics for user-designed interfaces. The diagnostic package is described in a separate data sheet.

Functional specifications

Architecture
See L-Series common specifications, page 1-6.

Central Processor Board
See L-Series common specifications, page 1-6.

Memory board
See L-Series common specifications, page 1-7.

Available card cage slots
Eight slots are available for I/O interfaces and other plug-in accessories.

Controls
Rear panel power switch.

Electrical specifications

AC power required

Line voltage: 86-127V (115V −25%/+10%) or 195-253V (230V −15%/+10%). Input line voltage is easily changed in the field by removing the 2103L front panel and using a screwdriver to reset the line selector switch in the power module.

Line frequency: 47-66 Hz.

Maximum power required: 500W, fused at 6A on 86-127V range.

Power factor: Approximately 0.65 at full load.

Direct current available (+) and required (−) for I/O interfaces and accessories.

See table on page 8-1.

Power supply protection, regulation, and other specifications:

See the 12035A Power Module data sheet, page 2-8.

Safety qualification

The 2103L has been designed to meet Underwriter's Laboratory (UL) and Canadian Standards Association (CSA) safety standards. UL and CSA approvals are pending.

Physical characteristics

Dimensions

Height: 13.3 cm (5.25 in).

Width: 48.3 cm (19 in) panel.

Depth: 59.7 cm (23.5 in) overall; 56.4 cm (22.5 in) behind panel.

Weight

14.1 kg (31 lb).

Ventilation

Air intake is on the left side, exhaust is on the right.

Maximum heat dissipation

258 Kilogram-Calories/hr (1024 BTU/hr).

Air flow (power supply and card cage fans)

Velocity: 61 metres/min (200 ft/min) at exit with atmospheric pressure at 1016 millibars (30 inches of mercury).

Volume: 1 cubic metre/min (35.3 cfm).

Ordering information

2103L Computer

The 2103L Computer includes:
1. Computer with power module, 1.5m (5 ft) power cable, and central processor card and 64k byte memory card in 10-slot card cage, all inside rack-mountable cabinet.
2. L-Series Computers Installation and Service manual (02103-90003).
3. L-Series Reference manual (02103-90007).
4. L-Series I/O Interfacing guide (02103-90005).

2103L Hardware accessories

12005A Asynchronous Serial Interface for connection of terminal or other serial device to the 2103L.

12006A Parallel interface for 16-bit duplex I/O from/to external devices.

12008A PROM Storage Module for mounting up to 64k bytes of PROMs for non-volatile program storage.

12009A HP-IB Interface for connection of disc memories, printers, graphics peripherals, instruments, and other HP-IB devices to the 2103L.

12010A Breadboard Interface for user-implemented special-purpose interfaces (includes the I/O Master circuitry common to all L-Series interfaces).

12011A Extender Card

12012A Priority Jumper Card for continuation of hardware priority chain through card cage bus position not occupied by an I/O interface or other plug-in accessory board.

12013A Battery Backup Card provides power to sustain 64k bytes of memory for up to 1 hour in event of power failure.

Software available for 2103L Computer

24397A L-Series Diagnostic Package.

92070A RTE-L Operating System (includes program development software for FORTRAN IV and Assembly language programs).
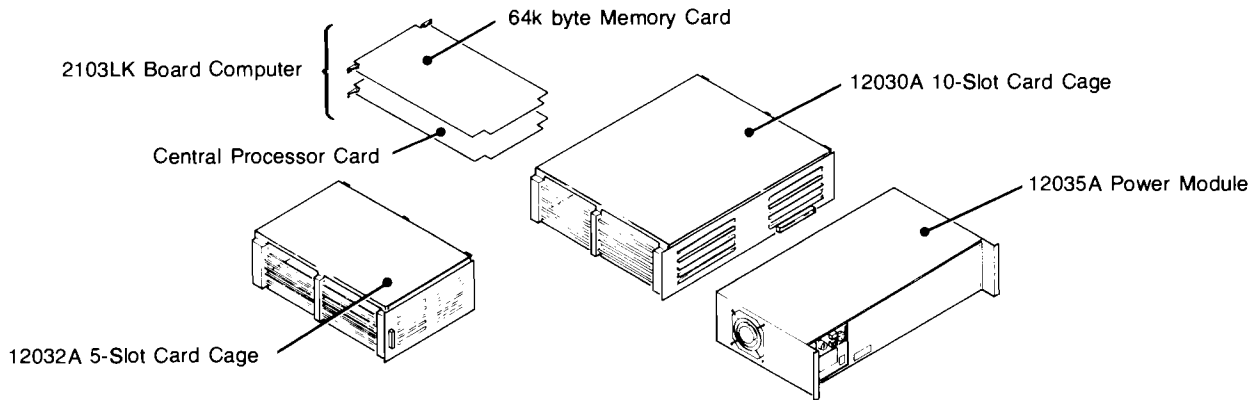
92076A BASIC/1000L Real-time BASIC language program development and execution subsystem.

product numbers 2103LK, 12030A, and 12032A

2103LK Board Computer and Integration Accessories

The 2103LK consists of the HP 1000 L-Series Central Processor Board and a 64k byte Memory Module, which offer maximum packaging flexibility to OEMs and End Users designing their own computer systems. Optional accessories include 5- and 10-slot card cages, product numbers 12032A and 12030A, respectively, which facilitate packaging of the 2103LK with I/O interfaces, the 12013A Battery Backup Module, and/or the 12008A PROM Module. Also available to facilitate L-Series system development is the 12035A Power Module, covered in a separate data sheet.

Features

- Maximum packaging flexibility for OEMs and End Users designing their own L-Series computer systems
- Choice of 10-slot and 5-slot card cages and power module to assist development of OEM assembled systems
- High reliability and maintainability through the use of SOS LSI, reduced circuit area, and simple packaging
- Distributed intelligence I/O design that simplifies programming and includes many powerful features for high I/O throughput, such as DMA per channel
- 80 powerful instructions, including:
  — Integer arithmetic
  — Memory and register reference
  — I/O group (with I/O interface)

- Instruction and program compatibility with other members of the HP 1000 family protects software investment of current OEMs and gives user access to a broad base of proven software
- Built-in memory protect, time base generator, and self test
- Standard memory parity generation and checking that protects programs against bit loss, reducing software development and maintenance costs
- Power fail detection and auto restart (battery backup is optional)
- Boot loaders included for boot-up from:
  — Disc drive
  — PROM module
  — HP Mini cartridge tape unit on terminal
- Virtual Control Panel program that provides for use of a local or remote terminal to access processor registers, alter or examine memory, run programs, break program execution, or initiate boot loading
- 64k bytes of main memory
- Modular packaging for easy maintenance
- Excellent noise immunity achieved through extensive use of ground planes and steel enclosed power supply
- Broad range of interfaces and peripherals
- Software support with 92070A RTE-L real-time executive operating system

CMOS/SOS LSI technology promotes reliability and maintainability

The 2103LK Board Computer and L-Series I/O interfaces are based on processors manufactured using Hewlett-Packard's proprietary CMOS/SOS (Silicon-On-Sapphire) Large-Scale Integration (LSI) integrated circuit process. The SOS process makes possible high circuit densities, so that much of the logic of a processor resides on a single chip. The chip and auxiliary circuits for the central processor, memory, I/O interfaces, and other L-Series components occupy single circuit boards, each only 29 cm long by 17.2 cm wide (11.4 in by 6.8 in) The low parts count made possible by LSI using CMOS/SOS promotes reliability. Providing all active L-Series components on plug-in boards simplifies fault isolation and speeds repair.

2103LK central processor description

The 2103LK CMOS/SOS LSI central processor chip executes the same HP 1000 base instruction set (arithmetic and extended arithmetic, memory reference, and register reference instructions) as other HP 1000 (M-, E-, and F-Series) Computers. In addition to making possible a compact central processor, the LSI CPU chip includes memory protect, and a time base generator. Other standard features include integer arithmetic, self-test, bootstrap loaders. power fail/auto restart, and virtual control panel.

Auto boot-up

As noted previously, the L-Series central processor includes bootstrap loaders. Two of these can be used for automatic boot-up at power on, from the following sources:

- A disc memory via the 12009A HP-IB interface.
- A 12008A PROM storage module.

Virtual Control Panel

In the 2103LK, a ROM-based Virtual Control Panel (VCP) program enables an operator to perform control panel functions via a locally or remotely connected terminal. The operator can examine and change the contents of registers and memory locations. control program execution, and select a bootstrap loader and initiate the boot-up of a system. Making control panel functions available on a terminal eliminates the need for a control panel on OEM and End User designed systems, minimizing system cost.

Because of its remote potential, the VCP can be used for remote isolation of L-Series system faults, which can help to minimize support costs for OEM products that use the 2103LK.

Only one I/O card can have VCP capability. Connection of that I/O card to a terminal that is accessible only to a system manager or a maintenance department controls VCP access to the L-Series system, providing an important system integrity safeguard.

Distributed intelligence architecture boosts I/O efficiency and simplifies programming

Of the principal functions of a computer, computation and input/output are usually both controlled by the central processor. In the 2103LK Board Computer, the high circuit density and cost savings realized by using CMOS/SOS LSI circuits have made it practical to change that. The central processor has been relieved of I/O processing. That function has instead been assigned to individual, custom-designed SOS LSI I/O Processors (IOPs) on each interface card. The central processor, the IOPs on each interface, and memory all communicate with each other via a common bus. as shown in Figure 1.

NOTE: For description of the advantages of the HP 1000 L-Series I/O design, see the HP 1000 L-Series system design data sheet, page 1-4.
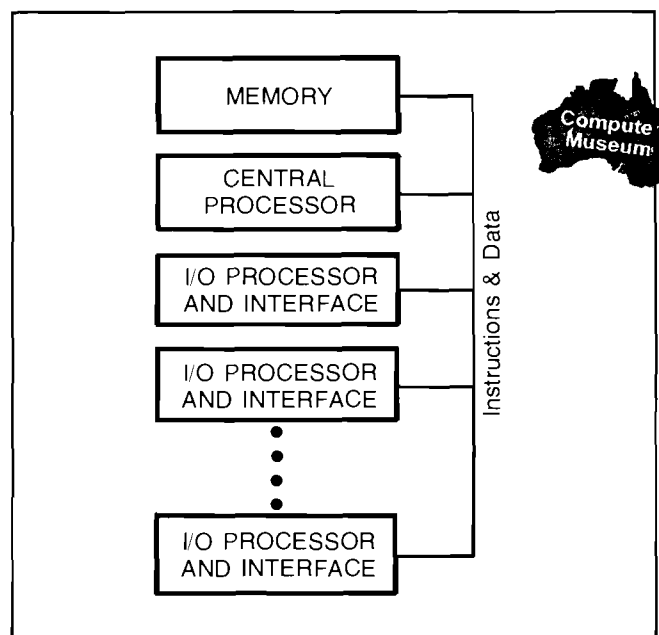
Figure 1. L-Series Functional diagram

Program compatibility

HP 2103LK CPU instructions and L-Series I/O instructions are identical to the same instructions in other HP 1000 (M-, E-, and F-Series) Computers. This makes the 2103LK Board Computer largely program compatible with other HP 1000 Computers. However, certain aspects of the I/O design, such as interface pre-addressing will require minor changes in user's application programs. More extensive revision of existing programs will realize the significantly greater efficiencies of DMA-per-channel I/O

Software support

Software support available for the 2103LK Board Computer starts with RTE-L, a true foreground-background real-time executive system, which is configurable for either memory-based or disc-based operation. In disc-based configuration,

RTE-L supports program development in FORTRAN IV, Assembly language, and (optionally) in BASIC/1000L real-time BASIC. RTE-L and BASIC/I000L are described in separate data sheets.

Diagnostic support

A diagnostic package is available for stand-alone testing of the L-Series central processor, memory, and L-Series interface cards. In addition, a BASIC-like Diagnostic Design Language interpreter is provided to assist the preparation of diagnostics for user-designed interfaces. The diagnostic package is described in a separate data sheet.

2103LK Integration accessories

Integration accessories for the 2103LK Board Computer include 10-slot and 5-slot card cages, product numbers 12030A and 12032A, respectively, and the 12035A Power Module. The 12030A 10-Slot Card Cage and the 12035A Power Module are designed to plug together without external power cabling, which simplifies assembly and connection of all required L-Series power supply voltages to the 2103LK and other L-Series printed circuit boards housed in the card cage.

Power supply voltages (+5V, +12V, and −12V) are connected to the 5-slot card cage via a miniature screw-terminal block on the rear of the backplane.

Functional specifications

Architecture

See L-Series common specifications, page 1-6.

Central Processor Board

See L-Series common specifications, page 1-6.

Memory board

See L-Series common specifications, page 1-7.

Available card cage slots

12030A Card Cage: Eight slots are available for I/O interfaces and other plug-in accessories.

12032A Card Cage: Three slots are available for I/O interfaces and other plug-in accessories.

Electrical specifications

Direct current required (−) for 2103LK central processor and memory boards, I/O interfaces, and accessories:

See table on page 8-1.

Recommended power supply:

12035A Power Module (see data sheet on page 2-8.

Physical characteristics

L-Series circuit board dimensions

Card cage dimensions, millimeters (and inches)
12030A 10-Slot Card Cage:

* including 11.1 (0.43) for power module connector
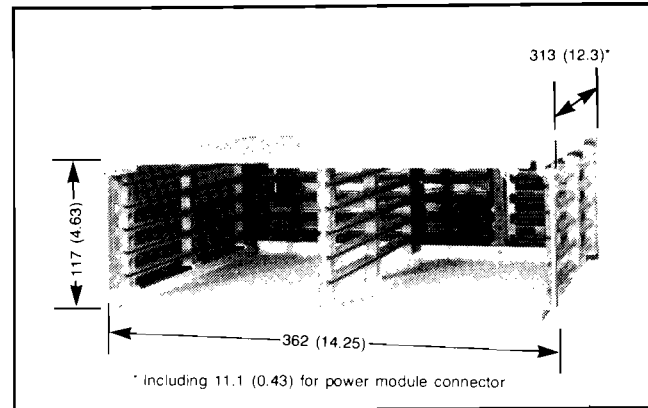
12032A 5-Slot Card Cage:
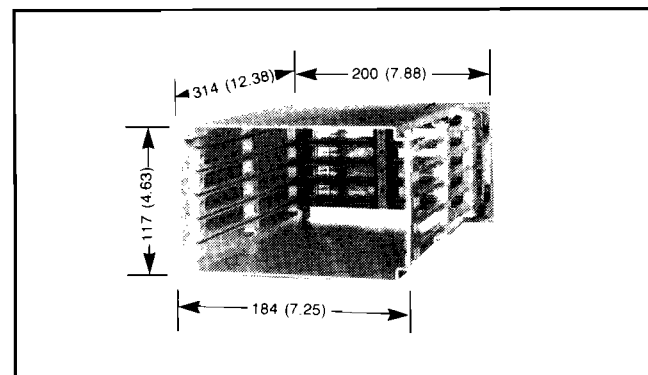
Weight
2103LK (two circuit boards):	0.682 kg (1.5 lb).
12030A 10-Slot Card Cage:	2.0 kg (4.4 lb).
12032A 5-Slot Card Cage:	1.09 kg (2.4 lb).

Maximum heat dissipation of 2103LK (two boards)
26 Kilogram-Calories/hr (102 BTU/hr).

Ventilation
Air flow on the order of 1.13 cubic metres/min (40 cfm) across the central processor board and the memory board is required for cooling the 2103LK Board Computer.

Ordering information

2103LK Board Computer

The 2103LK Board Computer includes:
1. HP 1000 L-Series central processor card.
2. 64k byte memory card.

2103LK Hardware accessories

12030A 10-Slot Card Cage.

12032A 5-Slot Card Cage.

12035A Power Module.

12005A Asynchronous serial interface for connection of terminals or other serial devices to the 2103LK*.

12006A Parallel interface for 16-bit duplex I/O from/to external devices*.

12008A PROM Storage module for mounting up to 64k bytes of PROMs for non-volatile program storage*.

12009A HP-IB interface for connection of disc memories, printers, graphics peripherals, instruments, and other HP-IB devices to the 2103LK*.

12010A Breadboard interface for user-implemented special-purpose interfaces (includes the I/O Master circuitry common to all L-Series interfaces)*.

12011A Extender Card*.

12012A Priority jumper card for continuation of hardware priority chain through card cage bus position not occupied by an I/O interface or other plug-in accessory board†.

12013A Battery backup card provides power to sustain 64k bytes of memory for up to 1 hour in event of power failure*.

* *The 12030A or 12032A Card Cage is strongly recommended for HP 1000 L-Series systems based on the 2103LK that use additional L-Series plug-in cards.*

† *The priority jumper card has no application outside of a 12030A/ 32A Card Cage or OEM's card cage that supports the hardware priority scheme of the HP 1000 L-Series system design.*

Software available for 2103LK Board Computer

24397A L-Series Diagnostic Package.

92070A RTE-L Operating System (includes program development software for FORTRAN IV and Assembly language programs).

92076A BASIC/1000L Real-time BASIC language program development and execution subsystem.

HP 1000 L-Series Power Module

product number 12035A

The HP 1000 L-Series Power Module, product number 12035A, provides +5V, +12V, and −12V dc supply voltages and 39V rms split-phase and 27V rms single-phase 25 kHz ac power for L-Series computers and systems. The power module is integrated into the 2103L Computer and the 2145A/B L-Series System Core. The 12035A is also separately available as an integration accessory component for the 2103LK Board Computer, along with the 12030A 10-Slot Card Cage.

The 25 kHz ac output of the power module provides a conveniently-used ac power source for on-interface and other power supplies developed by OEMs and End Users with unique power supply needs.
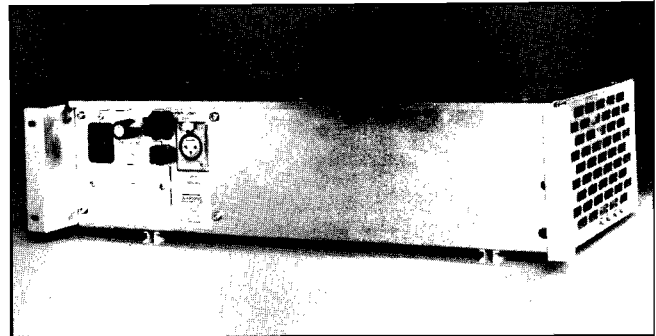
Features

- Slide-out design for easy servicing
- Plug-in connection to 12030A 10-Slot Card Cage for convenient assembly of L-Series systems from components
- 25 kHz ac for powering special purpose dc supplies on interfaces or for external logic or signal conditioning
- Wide tolerance of power line fluctuations and power interruptions
- Designed to meet VDE RFI specifications and UL, CSA, and VDE safety specifications

Functional specifications

Type of power supply

Switching regulator from the 50/60 Hz power line input to a regulated 25 kHz sine wave, which is rectified, filtered, and regulated to produce the +5V, +12V, and −12V dc outputs of the power module.

Input

Input voltage ranges: Two, 115V and 230V, front panel selectable using a screwdriver-set switch.

115V input voltage range: 86 to 127V rms (−25% +10% tolerance).

230V input voltage range: 195 to 253V rms (−25% +10% tolerance).

Line frequency range: 47 to 66 Hz.

No-load power input: < 40 Watts, including internal fan.

Maximum input power: Up to 525W; input power depends upon output loading.

Surge current: Less than 15 Amps from cold start; less than 20 Amps for restart after one minute.

Input current fusing: 3AG normal blow 7A fuse for 115V range, 3A fuse for 230V range.

Power factor: 0.65, maximum, at full load.

Input line overvoltage protection: Misapplication or line transients 1.5 times nominal line voltage for more than one second will blow the input fuse.

Conducted RFI back to power line input

Less than Level A VDE specification.

Power interruption detection

A line voltage detector monitors the peak-to-peak value of line voltage. The times required to generate the Power Fail Warning signal after an instantaneous dropout of power from various line voltages are listed below.

Line voltage	Min. Dropout Time
86V ac	> 5 ms
115V ac	> 20 ms
195V ac	> 10 ms
230V ac	> 25 ms

Line voltage sag

An instantaneous drop in line voltage that exceeds 30%, but remains within the allowable range, may generate a Power Fail Warning, but will not make the Power On signal go false.

Line voltage surge

Surge voltages from nominal up to 1.25 times nominal for 1/2 cycle every 5 seconds will not disturb normal operation and will not generate Power Fail Warning.

Output

DC voltages, tolerances, & Periodic and Random Dev, no load-to full load:

+5V	±2%	50mV, nom., 300mV, max.
+12V	±3%	100mV, max.
−12V	±6%	100mV, max.

AC voltages and tolerances: 39V rms ±8% split phase from three pins on backplane-mating rear connector and 27V rms ±8% single phase from two pins of front panel connector.

NOTE: The 27V rms front panel connector is not usable in the 2103L Computer because of insufficient clearance between the front panel of the power supply and the front panel of the 2103L.

Maximum dc output only current ratings:*

+5V	+12V	−12V
25A	4.0A	2.0A

Maximum ac power and dc current ratings:*†

25 kHz AC Power	DC Power Supply Current		
	+5V	+12V	−12V
70 Watts	25A	4.0A	2.0A
140 Watts	25A	3.0A	1.5A
180 Watts	21A	2.0A	0.5A

When operated in ambient temperatures to 55 °C (131 °F) and at altitudes to 4.6 km (15,000 ft).

†NOTE: Alternate ac power and dc current output combinations are possible within the 250W to 319W maximum total power output, provided that no more than the highest power or current listed above is drawn from any output. However, because of complex thermal interactions within the power module you cannot rely upon directly trading all of the power not used in one or more dc outputs for additional ac power.

Short circuit protection: All dc and ac power outputs are fault protected for short circuits. The power module will shut down, lighting the fault indicator, if any of the outputs are short circuited.

+5V output overvoltage protection: The +5V output is sensed for overvoltage and the +5V supply will shut down if its output voltage exceeds 6.5V. The ac power switch must be cycled to reset the +5V output.

External fan power: Up to 15W at 86 to 127V rms is available from a receptacle on the front of the power module.

Power control logic inputs

Line Power Up and Power Supply Up inputs provide a means of inhibiting power output from the power module for applications in which other power supplies in a system must be operational before the computer served by the 12035A power module is turned on. These inputs, which have +5V logic level, must both be true (high) to enable operation of the power module. If these inputs are left open, they have no effect on the operation of the power module.

Synchronization input

A pulse train of 1 to 12V p-p, 100 ns min pulse width at 100 kHz ±1% may be used to synchronize the internal power module inverter switching frequency to an external clock for minimization of power supply interference with system functions.
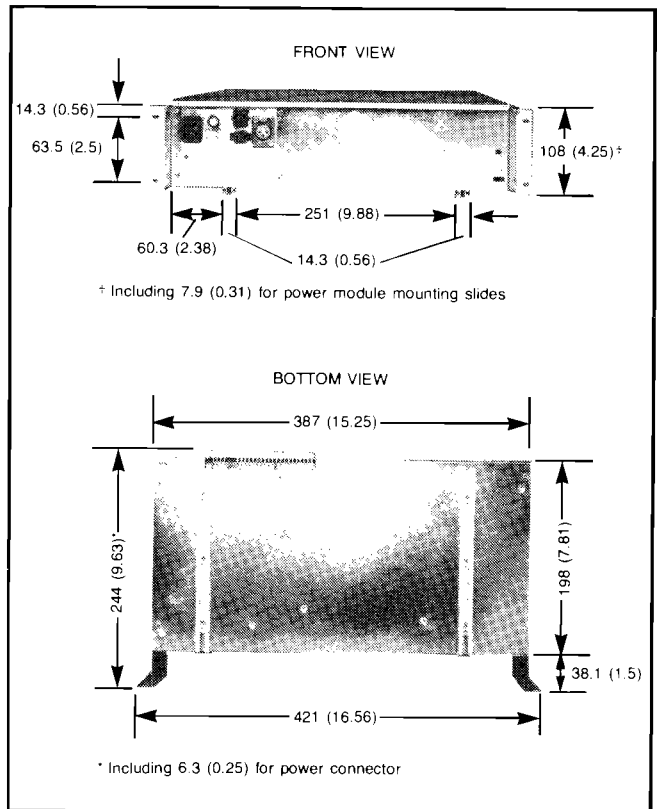
Logic outputs for use by the computer

Power Fail Warning: When true (in low state) warns the computer of failing power. All voltages are held within specified tolerance for 5 ms after this signal goes low. This signal can never be low for less than 5 ms; at the low line limit, this signal can cycle at a line frequency rate while the Power On signal remains true.

Power On: Is released to be high (true) after all dc voltages are up and within their regulation tolerances. It remains high for 5 ms after the Power Fail Warning signal goes true (low), during which time all output voltages remain within their regulation tolerances.

Electrical characteristics: Both signals have 100mA sink from an open collector, with rise and fall times less than 50 ns.

Physical characteristics

Dimensions, mm (and inches)

FRONT VIEW

14.3 (0.56)
63.5 (2.5)
108 (4.25)†
60.3 (2.38)
251 (9.88)
14.3 (0.56)

† Including 7.9 (0.31) for power module mounting slides

BOTTOM VIEW

387 (15.25)
244 (9.63)*
198 (7.81)
38.1 (1.5)
421 (16.56)

* Including 6.3 (0.25) for power connector

Weight
6.1 kg (13.5 lb)

Maximum power module heat dissipation
150 kilogram-calories/hr (597 BTU/hr).

Air flow requirements

The air inlet and exit of the power module must not be restricted. A flow rate of 20 cfm (velocity approximately 200 ft/min) at the exit must be present to provide adequate cooling at the maximum air inlet temperatures listed in the power and current ratings specification, above.

Ordering information

12035A Power Module

The 12035A Power Module includes a 1.5 metre (5 foot) power cable.

Related 2103LK accessory

12030A 10-Slot Card Cage.

HEWLETT PACKARD

L-Series PROM Module

The 12008A PROM Storage Module provides mounting for up to 64k bytes of off-line PROM storage for HP 1000 L-Series Computers and Systems. For applications in which operating system and user software can be stored in PROMs, the use of the 12008A PROM Storage Module offers the following advantages:

1. Non-volatile storage, unaffected by loss of power regardless of duration.
2. Rugged storage medium that is usable in environments too harsh for flexible or hard discs or other mechanical storage devices.
3. For minimal storage requirements, the PROM module is more compact and less costly than disc storage.

I/O Master Processor and PROM interface logic on the PROM module can load software into main memory at up to 2.1M bytes/sec in blocks that can range in size from 2 bytes up to 64k bytes. This can include automatic bootup of PROM-resident programs at power on. The size and destination of the transfer into main memory is dynamically determined under software control. Multiple PROM modules can be used to keep several different software systems resident inside the L-Series Computer. Any of these systems can be loaded at extremely fast rates under program control or under Direct Memory Access. However, it is important to note that programs may not be executed directly from PROM, but must be loaded into main memory for execution.

Features

- Capacity for 64k bytes of PROM storage
- Automatic program load on power-up capability
- Multi-system storage with multiple PROM modules
- Dynamic controllability of transfer size and destination
- 2.1M byte/sec transfer rate into main memory
- Direct memory access capability

Functional specifications

Organization

Capacity: 32 sockets for 16k PROMs; 64k bytes, maximum.

Minimum block size: 4k bytes.

PROMs per block: 2.

PROM selection and programming

Recommended PROMs: Intel 2716 or equivalent UV-erasable 16k PROMs.

PROM burners: PROMs may be programmed using any commercially available PROM burner.
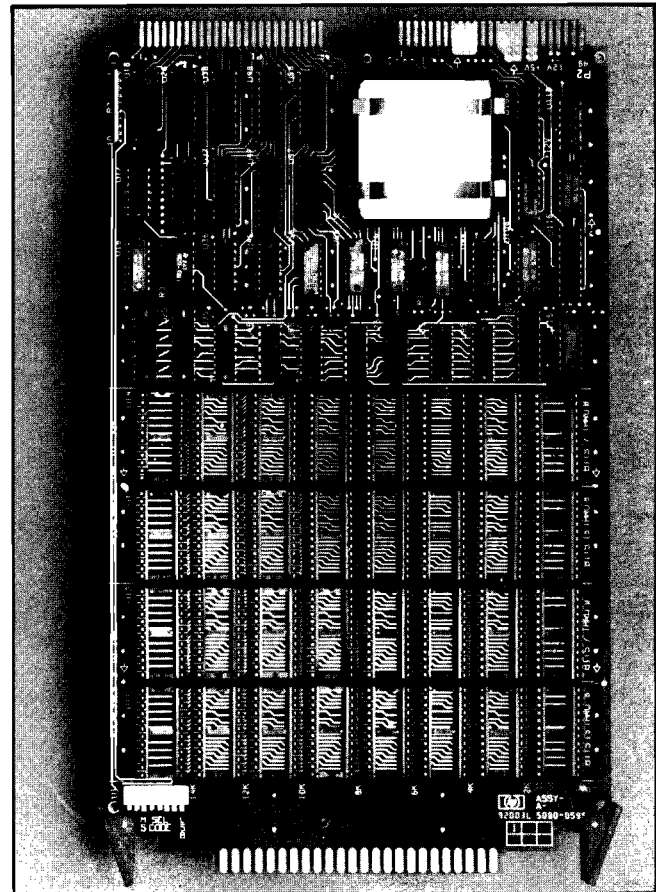
Software-supported PROM burner: The Data I/O System 19 PROM Burner interfaced to an L-Series Computer or System via the 12005A +003 Asynchronous Serial Interface or to an E- or F-Series Computer or System operating under RTE-IVB via the 12880A CRT Terminal Interface is compatible with the PFORM and PBURN PROM programming utilities that are provided with the RTE-L operating system.

Transfer characteristics

Minimum transfer: 2 bytes under program control, 10 bytes under DMA control.

Maximum transfer: 64k bytes under DMA or program control.

Maximum transfer rate: 2.1M bytes/sec under DMA control.

Configuration information

Computer and system compatibility: The 12008A PROM Storage Module is compatible with all HP 1000 L-Series Computers and Systems.

Software support: Programming of PROMs for the 12008A PROM Storage Module is supported by PFORM and PBURN utilities and program loading from the PROM module into main memory is supported by drivers ID.36 and DD.36. These utilities and drivers are all included in the RTE-L operating system.

Card cage slots required: One per 12008A PROM Module.

Installation: Set the select code switches on the PROM module to the appropriate select code I/O address and plug the PROM module into an I/O slot in the L-Series Computer or System card cage.

Electrical specifications

Direct current requirements

2A(+5V) and 0.05A(+12V).

Physical characteristics

Dimensions, mm (and inches)

289 (11.38) long

172 (6.75) wide

10.2 (0.4) Parts clearance

Board thickness 1.6 (0.063)

5.1 (0.2) Beneath board clearance
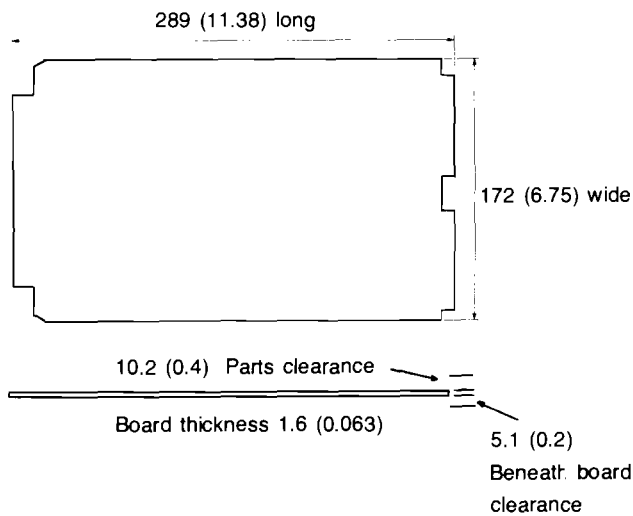
Weight

340 grams (12 oz).

Ordering information

12008A PROM Storage Module

The 12008A PROM Storage Module includes:
1. PROM Storage Module (12008-60001).
2. PROM Storage Module Reference Manual (12008-90001).

The 12013A Battery Backup Card provides battery power for sustaining HP 1000 L-Series computer memory during power line outages. The batteries, charging circuit, and battery condition signalling circuit are all mounted on the 12013A card, which plugs into a single slot on the L-Series backplane.

For a power outage of an hour or less, a fully charged battery backup card will sustain 64k bytes of memory so that the power fail/auto restart capability of the L-Series processor may be used to resume processing. Except in the 12032A 5-Slot Card Cage, two 12013A Battery Backup Cards can be used to provide 2 hours of battery sustaining power. Sustaining time can be further extended by connecting external batteries.

If a long power outage fully depletes the battery charge, the power fail recovery routine will automatically clear memory and will either reboot the operating system or transfer control to the Virtual Control Panel device. The 12013A Battery Backup Module can be used with the 12035A Power Module or a power supply designed and built by the user.

Features

- 1 hour of sustaining power for 64k bytes of memory on a single L-Series plug-in card
- Up to two battery backup cards can be used in 2103L Computer, 12030A 10-slot Card Cage, or HP 1000 L-Series Model 9 or 10 Computer System
- Audible alarm signals operator when a power failure has occurred and indicates if memory has not been sustained
- Built-in battery charging circuit
- Automatic clearing of memory when power failure outlasts the battery charge
- Connector for external battery pack and remote control of battery backup

Functional specifications

Operational characteristics

Memory sustaining time: At least one hour for 64k bytes of memory when battery is fully charged. Two fully-charged 12013A Battery Backup Cards will sustain memory for two hours.

Power restart: Detects resumption of power and generates an interrupt to a trap cell for a user-written restart program that has been protected in memory by the sustaining battery.

Power control and charging: On-board circuits provide slow charge.
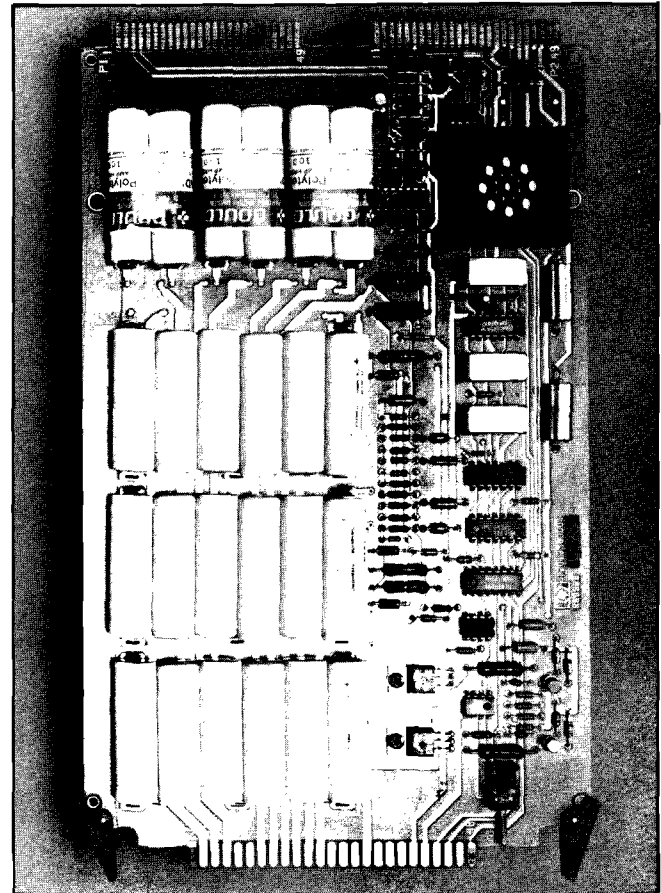
Power fail signalling: A power outage initiates an audible power fail signal that consists of a 1-second beep every 9 seconds while the battery backup module is sustaining memory. Resumption of line power or depletion of the battery charge terminates this power failure signal.

Reboot signalling: If the batteries fully discharge, so that memory has not been sustained, the restoration of line power is accompanied by a single two-second beep which signals the operator that the system is being, or must be, rebooted.

Remote enable: A remote contact closure input on the front printed circuit connector can control whether memory is sustained when power is turned off. This can be used to avoid unnecessary depletion of battery charge when it is not necessary to sustain memory.

Remote/off/on: A toggle switch provides the following functions:

1. Remote, which connects the remote input to the battery backup card control circuits.

2. Off, which disconnects battery sustaining power but permits charging of the backup card batteries while line power is on. This position can be used to prevent unnecessary depletion of battery charge when the computer is intentionally turned off or for battery charging when the computer is not being used.

3. On, which disconnects the remote input from the battery backup control circuits, so the battery backup module always works to sustain memory.

Battery

Type: 1.2 Volt nickel-cadmium cells.

Charging rate: 0.1 of cell capacity rate.

Charge time: Approximately 14 times the total previous discharge time to full charge (14 hours, maximum).

Overload protection: Controlled width traces on the battery backup card function as fusible links which open if 2 to 4 times normal current is drawn from the batteries. Pad eyes are provided on the card for replacement of these links with wire jumpers after correction of an overload condition that causes them to open.

Configuration information

Installation: Because it requires more top-of-card component clearance than other L-Series plug-ins, the 12013A Battery Backup Card should be installed in backplane slot XA1 in the 12032A 5-slot card cage, slot XA1 or XA6 in the 12030A or 2103L 10-slot card cage, or slot XA1 or XA9 in the HP 1000 L-Series Model 9 or 10 System 16-slot card cage.

Number of battery backup cards per computer/system: Maximum of one in 12032A 5-Slot Card Cage: maximum of two in 2103L Computer, 12030A 10-Slot Card Cage, or HP 1000 Model 9 or 10 Computer System. One battery backup card is included in the HP 1000 Model 9 and 10 Computer Systems.

External battery connection: In addition to the remote enable signal traces, front connector traces are provided for connection of external battery power to extend the memory sustaining time of the battery backup card.

One battery backup card and a mating connector that can be used for connection of an external battery to the battery backup card is included with HP 1000 Model 9 and 10 Computer Systems, but such connection will require additional wiring to that mating connector. For use with 2103L and 2103LK Computers, a 48-pin connector kit, HP Part Number 5061-3426, provides the required mating connector.

Electrical characteristics

Direct current requirements

170mA(+12V), 10mA(−12V).

Physical characteristics

Dimensions, mm (and inches)

289 (11.38) long

172 (6.75) wide

17.8 (0.7) Parts clearance

Board thickness 1.6 (0.063)

5.1 (0.2)
Beneath board
clearance
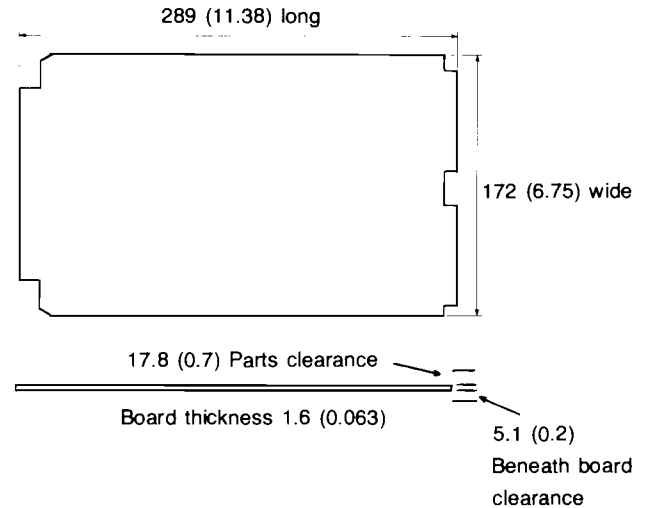
Weight

909 grams (2 lb).

Ordering information

12013A Battery Backup Card

NOTE: One 12013A Battery Backup Card is included in HP 1000 L-Series Computer Systems, Models 9 and 10.

HEWLETT PACKARD

HP 1000 L-Series Computer Systems, Models 9 and 10

based on system processing unit, product numbers 2145A/B and 2146A/B

HP 1000 Models 9 and 10 are low-cost Computer Systems that are configured around a group of basic system elements, called the System Processing Unit (SPU), product numbers 2145A/B and 2146A/B. These systems are managed by the RTE-L real-time executive operating system. To the SPU, OEMs and end users add an operator terminal, one or more hard discs to the 2146A/B, and other peripheral devices as needed for their applications.

The Model 9 is a flexible disc based Computer System with two 1.2 megabyte flexible disc drives (2.4 megabytes total). It is intended primarily for dedicated applications.

The Model 10 is a hard disc based Computer System with one 1.2 megabyte flexible disc drive and a choice of 12 megabyte fixed disc or 19.6 megabyte cartridge disc. The faster access and greater capacity provided by hard discs makes the Model 10 more suitable than the Model 9 System for program development and for applications that involve extensive use of disc storage. Program development is supported in FORTRAN IV or Assembly language (real-time BASIC/1000L is optional).

The SPU hardware consists of the L-Series central processor board, 64k bytes of memory, and battery backup, HP-IB disc interface, and serial terminal interface cards in a 16-slot card cage. The card cage is housed in a 62-inch cabinet (2145A/46A) or 36-inch cabinet (2145B/46B). Because it embodies the exceptional I/O efficiency of the L-Series distributed intelligence architecture and has 11 card cage slots available, the SPU is a powerful building block for OEM and End User applications in data acquisition, automatic testing, process monitoring and control, and operations management.

Features

- Integrated system building block for OEMs and End Users designing their own L-Series-based application products
- Eleven I/O slots available for interfacing application-dependent instruments or peripheral devices
- System operation managed by RTE-L real-time executive operating system
- High reliability and maintainability through the use of SOS LSI, reduced circuit area, and simple packaging
- Distributed intelligence I/O design that simplifies programming and includes many powerful features for high I/O throughput, such as DMA per channel
- 80 powerful instructions, including:
  — Integer arithmetic
  — Memory and register reference
  — I/O group (with I/O interface)
- Instruction and program compatibility with other members of the HP 1000 family protects software investment of current OEMs and gives user access to a broad base of proven software

- Built-in memory protect, time base generator, and self test
- Standard memory parity generation and checking that protects programs against bit loss, reducing software development and maintenance costs
- Power fail detection and auto restart; battery backup is included
- Boot loaders included for boot-up from:
  — Disc drive
  — PROM card
  — HP Mini cartridge tape unit on terminal
- Virtual Control Panel program that provides for use of a local or remote terminal to access processor registers, alter or examine memory, run programs, or initiate boot loading
- 64k bytes of main memory
- Modular packaging for easy maintenance
- Excellent noise immunity achieved through extensive use of ground planes, steel enclosed power supply, and steel system cabinet
- HP-IB disc interface, serial terminal interface and dual/single flexible discs are included; a broad range of other interfaces and peripherals is available
- Design for compliance with UL, CSA, and VDE safety and RFI specifications
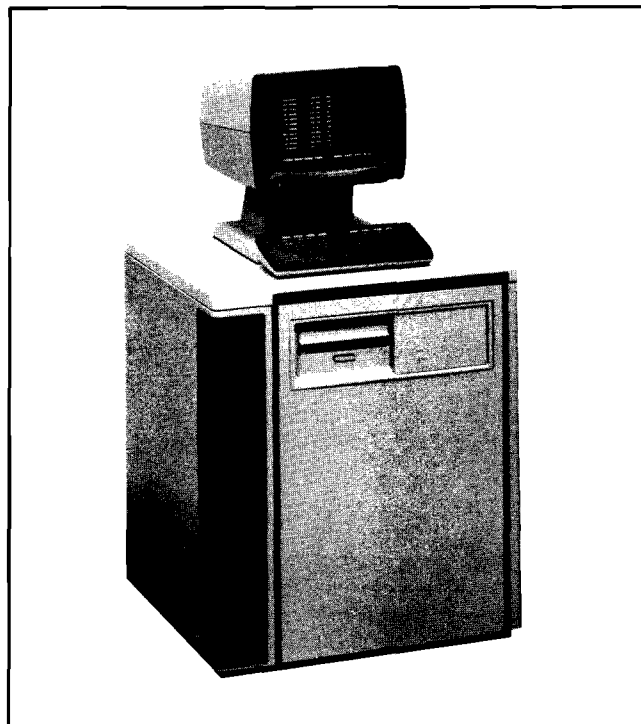
CMOS/SOS LSI technology promotes reliability and maintainability

The HP 1000 L-Series Systems and L-Series I/O interfaces are based on processors manufactured using Hewlett-Packard's proprietary CMOS/SOS (Silicon-On-Sapphire) Large-Scale Integration (LSI) integrated circuit process. The SOS process makes possible high circuit densities, so that most of the logic of a processor can fit on a single chip. The chip and auxiliary circuits for the central processor, memory, I/O interfaces, and other L-Series components occupy single circuit boards, each only 29 cm long by 17.2 cm wide (11.4 in by 6.8 in) The low parts count made possible by LSI using CMOS/SOS promotes reliability. Providing all active L-Series processor, memory, and I/O interface components on plug-in boards simplifies fault isolation and speeds repair.

Central processor description

The CMOS/SOS LSI central processor chip used in L-Series Systems executes the same HP 1000 base instruction set (arithmetic and extended arithmetic, memory reference, and register reference instructions) as other HP 1000 (M-, E-, and F-Series) Computers. In addition to making possible a compact central processor, the LSI CPU chip includes memory protect, and a time base generator. Other standard features include integer arithmetic, self-test, bootstrap loaders, power fail/auto restart, and virtual control panel.

Auto boot-up

As noted previously, the L-Series central processor includes bootstrap loaders. Two of these can be used for automatic boot-up at power on, from the following sources:

- A disc memory via the 12009A HP-IB interface.
- A 12008A PROM storage module.

Virtual Control Panel

In the L-Series Systems, a ROM-based Virtual Control Panel (VCP) program enables an operator to perform control panel functions via a locally or remotely connected terminal. The operator can examine and change the contents of registers and memory locations. control program execution, and select a bootstrap loader and initiate the boot-up of a system. Making control panel functions available on a terminal eliminates the need for a control panel on OEM and End User designed application products based on the HP 1000 L-Series Systems, minimizing cost. Because of its remote potential, the VCP can be used for remote isolation of L-Series system faults, which can help to minimize support costs for OEM products based on HP 1000 L-Series Systems.

Only one I/O card can have VCP capability. Connection of that I/O card to a terminal that is accessible only to a system manager or the maintenance department controls VCP access to the L-Series system, providing an important system integrity safeguard.

Distributed intelligence architecture boosts I/O efficiency and simplifies programming

Of the principal functions of a computer, computation and input/output are usually both controlled by the central processor. In the L-Series Systems, the high circuit density and cost savings realized by using CMOS/SOS LSI circuits have made it practical to change that. The central processor has been relieved of the burden of I/O processing. That function has instead been assigned to an individual, custom-designed SOS LSI I/O Processor (IOP) on each interface card. The central processor, the IOP on each interface, and memory all communicate with each other via a common bus, as shown in Figure 1.

Low-overhead I/O

I/O Processor-managed DMA. Their built-in intelligence equips L-Series I/O interfaces to manage their own operations autonomously. This includes Direct Memory Access (DMA). and can even include chained multiple DMA transfers without interruption of the central processor until all transfers of a chain have been completed.

DMA per channel I/O. The same master I/O processor intelligence is provided on all L-Series I/O interfaces, so any I/O interface can access memory in the efficient, low-overhead DMA mode, even interfaces serving slow devices, such as terminals. There is no restriction on the number or type of interfaces or devices using DMA.

Automatic end of transfer termination. For variable-length transfers to/from terminals or other devices, the I/O processor provides for termination of DMA upon receipt of an end of transfer signal. For instance, when the asynchronous serial interface receives a carriage return, it is recognized as an end of record character which terminates the DMA transfer automatically.
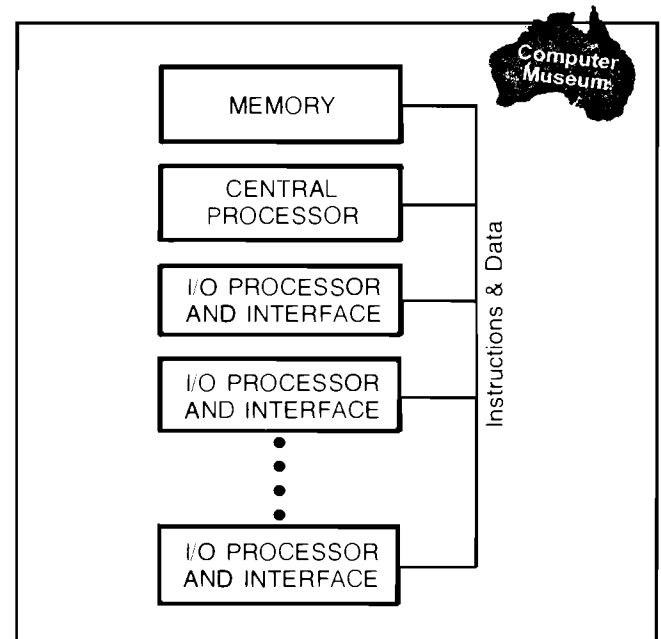

Figure 1. L-Series Functional diagram

3-1

I/O access priority

Priority of I/O interrupts and access to memory is controlled simply, by interface card position on the card cage bus with respect to the central processor. The interface closest to the processor, which is the 12009A HP-IB disc interface in the HP 1000 L-Series Systems, has highest priority. The 12005A Async serial interface has next highest priority. The remaining available I/O slots have successively lower relative priorities following the 12009A and 12005A interfaces. The central processor is granted access to memory only when memory cycles are not being used by I/O interfaces.

Simplified I/O programming

The same level of intelligence that makes possible DMA-per-channel input/output also simplifies I/O programming. The master I/O Processor logic provides for recognition of interface I/O addressing independent of card position on the card cage bus. This makes it possible to standardize I/O addresses used for particular devices or functions without requiring any particular arrangement of I/O cards in the card cage.

Two modes of I/O interface addressing

Compatibility mode. The I/O Processor supports the mode of input/output addressing currently used by other HP 1000 (M-, E-, and F-Series) Computers. In this mode, each I/O instruction contains the select code of the interface to which it is directed. Use of this mode minimizes changes needed to convert programs that now run on HP 1000 M-, E-, and F-Series Computers for use on the L-Series Computer Systems.

Auto addressing mode. The I/O Processor also supports a new auto addressing mode. In this mode, a single program instruction addresses an I/O interface **once** before sending instructions to it. Thereafter, the I/O select codes in I/O instructions are not needed. This eliminates the need to prepare a separate configuration section in input/output drivers, reducing programming workload for OEMs or other users preparing their own drivers. It also shortens I/O driver execution time and reduces overhead because there is no configuration section to be executed prior to an I/O transfer.

Since an I/O interface is addressed in auto addressing mode only prior to receiving I/O instructions, six of the bits in I/O instructions that were formerly used for I/O select codes are freed for other uses. These bits can be used to exchange additional data or control information with interfaced devices.

Program compatibility

HP 1000 Model 9 and 10 CPU instructions and I/O instructions are identical to the same instructions in other HP 1000 (M-, E-, and F-Series) Computers. This makes the L-Series Computer Systems largely program compatible with other HP 1000 Computer Systems. However, certain aspects of the I/O design, such as interface pre-addressing will require minor changes in user's application programs. Of course, to realize the significantly greater efficiencies of DMA-per-channel I/O will require more extensive revision of existing programs.

Software support

The System Processing Unit (SPU) includes the RTE-L real-time executive operating system relocatable modules on a flexible disc. The RTE-L system is configurable for flexible disc based (Model 9) or hard disc based (Model 10) operation. Each HP 1000 Model 9 or 10 Computer System also includes a configured, ready-to-use RTE-L primary system on a separate flexible disc that is appropriate to its configuration (Model 9 or 10), which gives users a head start on applications development.

Program development is supported in FORTRAN IV, Assembly language, and (optionally) in real-time BASIC/1000L. However, because of faster access speeds and greater capacity of the hard disc, the HP 1000 Model 10 System is more appropriate than the Model 9 System for program development. RTE-L and BASIC/1000L are described in separate 92070A and 92076A data sheets.

The SPU also includes the L-Series Diagnostic Package on a flexible disc to assist checkout of the system and its required peripherals as well as other compatible peripherals and interfaces that may be added. The diagnostic package is described in a separate 24397A data sheet.

Functional specifications

Architecture

See L-Series common specifications, page 1-6.

Central Processor Board

See L-Series common specifications, page 1-6.

Memory board

See L-Series common specifications, page 1-7.

Available card cage slots

Eleven slots are available for additional I/O interfaces and other plug-in accessories.

Flexible disc memory specifications (Models 9 and 10)

SPU Product Number	No. of Drives	Capacity (M bytes)	Average Transfer Rate*	Average Access Time
2145A/B	2	2.36	179 kb/s	174 ms
2146A/B	1	1.18	179 kb/s	174 ms

* Average transfer rate is based on the minimum time required to transfer one sector without overrun.

Hard disc memory specifications (Model 10)

Specifications depend upon choice of hard disc, as summarized below.

Hard Disc Product Number	Capacity (M bytes)	Average Transfer Rate*	Average Access Time
7910HR	12.1	493kb/s	80 ms
7906H	19.6	885.5kb/s	33.3 ms

* Average transfer rate is based on the minimum time required to transfer one sector without overrun.

Electrical specifications

Line voltage*

The system's power distribution module can be easily configured at the factory or in the field for the following line voltages:

100V +5%/-10%	(90-100V)
120V +5%/-10%	(108-126V)
220V +5%/-10%	198-231V)
240V +5%/-10%	(216-252V)

Line frequency*

Standard: 60 Hz ± 3.5% (57.9-62.1 Hz).

Option 015: 50 Hz ± 3.5% (48.25-51.75 Hz).

*A System Processing Unit ordered with option 015 will be configured for 50 Hz operation and the line voltage will be configured as appropriate to the country where it is to be shipped.

Power requirements

2145A/2146A System Processing Unit: 20A grounded receptacle at 100/120V (10A at 220/240V).

2145B/2146B System Processing Unit: 15A grounded receptacle at 100/120V (7.5A at 220/240V).

System console: 15A grounded receptacle at 100/120V (7.5A at 220/240V).

7906H Hard disc: 15A grounded receptacle at 100/120V (7.5A at 220/240V).

Direct current available (+) required (−) for additional I/O interfaces, and accessories: See table on page 8-1.

Power supply protection, regulation, and other specifications

See the 12035A Power Module data sheet, page 2-8.

Power cable

The standard System Processing Unit (SPU) includes a 3 metre (10 ft) power cable with either NEMA 5-20P power plug (with 2145A/2146A SPU) or 5-15P power plug (with 2145B/2146B SPU). No power cable is provided with 2145A/B or 2146A/B SPU ordered with option 015.

Physical characteristics

Dimensions in cm (and in)

	2145A/2146A	2145B/2146B
Height:	157.9 (62.2)	92.7 (36.5)
Width:	73.4 (29)	73.4 (29)
Depth:	81.3 (32)	81.3 (32)

External clearances at operating site

91.4 cm (36 in) should be left at the front and rear of the system cabinet for service access.

Weight kg (and lb)

SPU Product Number	System Model	Hard Disc Product Number	Weight
2145A	9	None	133.6 (294)
2145B	9	None	124.4 (274)
2146A	10	7910HR	159.5 (331)
2146B	10	7910HR	150.3 (331)

Maximum heat dissipation

SPU Product Number	Hard Disc	System Model	Kg-calories per hour	BTU/hr
2145A/B	none	9	567	2252
2146A/B	7910HR	10	738	2928
2145A/B	7906H	10	987*	3918*

* These heat dissipation figures represent the total of heat dissipation of the SPU and the separate stand-alone 7906H hard Disc drive.

Environmental specifications

Temperature

Operating: 10° to 40°C (50° to 104°F).

Storage: −40° to 60°C (−40° to 140°F).

Relative humidity

10% to 80% with maximum wet bulb temperature not to exceed 25.5°C (77.9°F), excluding all conditions which cause condensation.

Altitude

Operating: To 4.6 km (15,000 ft).

Non-operating: To 15.3 km (50,000 ft).

Vibration and shock

HP 1000 L-Series products are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Safety and RFI qualification

The 2145A/B and 2146A/B have been designed to meet Underwriters Laboratory (UL), Canadian Standards Association (CSA) and Verband Deutches Electrotechnikes (VDE) standards for safety and RFI. UL, CSA, and VDE approvals are pending.

Ordering information

2145A System Processing Unit

The 2145A System Processing Unit includes:
1. 64k byte Memory Card.
2. HP 1000 L-Series central processor card.
3. 12005A Asynchronous Serial (terminal) Interface.
4. 12009A HP-IB disc Interface.
5. 12013A Battery backup card.
6. 16-Slot card cage.
7. 12035A Power Module.
8. Dual 1.2 Megabyte flexible disc (2.4 Megabytes total).
9. 62.2-inch system cabinet with power distribution module and power cord (power cord not supplied with 2145A option 015).

10. RTE-L system relocatable modules on flexible disc and related manuals (see the 92070A data sheet for list).

11. Diagnostic software on flexible disc and related manuals (see the 24397A data sheet for list).

12. Primary system (preconfigured RTE-L operating system on flexible disc).

13. HP 1000 L-Series Computer Reference Manual (02103-90007).

14. HP 1000 L-Series Computer System Operator's Manual (02145-90001).

15. HP 1000 L-Series Computer Installation and Service Manual (02103-90003).

16. HP 1000 L-Series Computer System Installation and Service Manual (02145-90003).

17. HP 1000 L-Series Computer I/O Interfacing Guide (02103-90005).

18. HP 12005A Asynchronous Interface Reference Manual (12005-90001).

19. HP 12006A Parallel Interface Reference Manual (12006-90001).

20. HP 12008A PROM Storage Module Reference Manual (12008-90001).

21. HP 12009A HP-IB Interface Reference Manual (12009-90001).

2145B System Processing Unit

The 2145B System Processing Unit (SPU) is similar to the 2145A SPU, but provides 36-inch cabinet instead of 62.2 inch cabinet.

2146A System Processing Unit

The 2146A System Processing Unit (SPU) is similar to the 2145A SPU, but provides single 1.2M byte flexible disc instead of dual 1.2M byte flexible disc.

2146B System Processing Unit

The 2146B System Processing Unit (SPU) is similar to the 2145A SPU, but provides single 1.2M byte flexible disc instead of dual 1.2M byte flexible disc, and 36-inch cabinet instead of 62.2 inch cabinet.

2145A/B and 2146A/B Option 015

Configures SPU to operate from 50 Hz ±3.5% power line input with voltage configured per targeted shipping location. Power cord must be furnished by the user when system is configured for 220/240V.

2145B Accessories

12005A Asynchronous serial interface for connection of an additional terminal or other serial device to the 2145B.

12006A Parallel interface for 16-bit duplex I/O from/to an external device.

12008A PROM Storage module for mounting up to 64k bytes of PROMs for non-volatile program storage.

12009A HP-IB interface for connection of printers, graphics peripherals, instruments, and other HP-IB devices to the system.

12010A Breadboard interface for user-implemented special-purpose interfaces (includes the I/O Master circuitry common to all L-Series interfaces).

12011A Extender Card.

12012A Priority jumper card for continuation of hardware priority chain through card cage bus position not occupied by an I/O interface or other plug-in accessory board.

12013A Battery Backup Card. Additional card can be used to increase memory sustaining time to two hours.

Additional documentation available

HP 1000 L-Series Computer Engineering and Reference Documentation (02103-90009).

Additional requirements for HP 1000 Model 9 and Model 10 Computer Systems

CARD CAGE OF 2145A/B or 2146A/B SYSTEM PROCESSING UNIT PRODUCT	
Available I/O Slot 4	Battery Backup Card
Available I/O Slot 5	64k byte Memory Card
Available I/O Slot 6	Central Processor Card
Available I/O Slot 7	12009A HP-IB Interface
Available I/O Slot 8	12005A Async Serial I/F
Available I/O Slot 9	Available I/O Slot 1
Available I/O Slot 10	Available I/O Slot 2
Available I/O Slot 11	Available I/O Slot 3

REQUIRED ADDITIONS FOR
HP 1000 MODEL 9 COMPUTER SYSTEM

ONE OF THESE OPERATOR TERMINAL CHOICES

1. HP 2621A Interactive Terminal, keyboard-display only, 80 col, 960 char/sec.

2. HP 2621P Interactive Terminal with printer, keyboard-display to 960 char/sec, printer to 120 char/sec, 80 col.

REQUIRED ADDITIONS FOR
HP 1000 MODEL 10 COMPUTER SYSTEM

AN OPERATOR TERMINAL

Same choices as for the HP 1000 Model 9 Computer System, as listed above.

ONE OF THESE HARD DISC CHOICES

1. HP 7910HR Fixed Disc Drive, 12 megabytes.

2. HP 7906H Cartridge Disc Drive in separate low-profile cabinet, 19.6 megabytes divided between removable cartridge disc and fixed disc.

HEWLETT PACKARD

HP 1000 L-Series
Asynchronous Serial Interface

product number 12005A

The 12005A Asynchronous Serial Interface provides for connection of EIA Standard RS-232-C, RS-422/423, or RS-449 compatible devices to HP 1000 L-Series Computers or Systems. The connection can be either local via an optional hardwire cable, or remote, via Bell 103 Data Set or equivalent modem. Optional cables are available for hardwire connection to HP 2621A/P Interactive Terminals, HP 2635A Printing Terminals, or HP 2645A Display Stations. The 12005A and associated drivers provided with the 92070A RTE-L operating system support all aspects of functioning of the aforementioned terminals in a terminal-per-interface mode. This includes support of optional Mini cartridge I/O on the 2645A terminal.

Features

- EIA RS-232-C, RS-422, RS-423, and RS-449 compatibility
- Fifteen selectable data transfer rates from 50 to 9600 baud, plus externally-clocked rates to 56,000 baud
- Choice of half-duplex or full-duplex operation, or echoplex operation with secondary data channel
- Built-in DMA capability for optimum I/O efficiency
- Selectable special character recognition capability for termination of indeterminate length DMA transfers by an End of Transmission character
- Virtual control panel support
- Built-in framing error, overrun error, and parity error checking
- Hardware break detection
- Voltage level and current loop outputs
- I/O driver support with 92070A RTE-L operating system
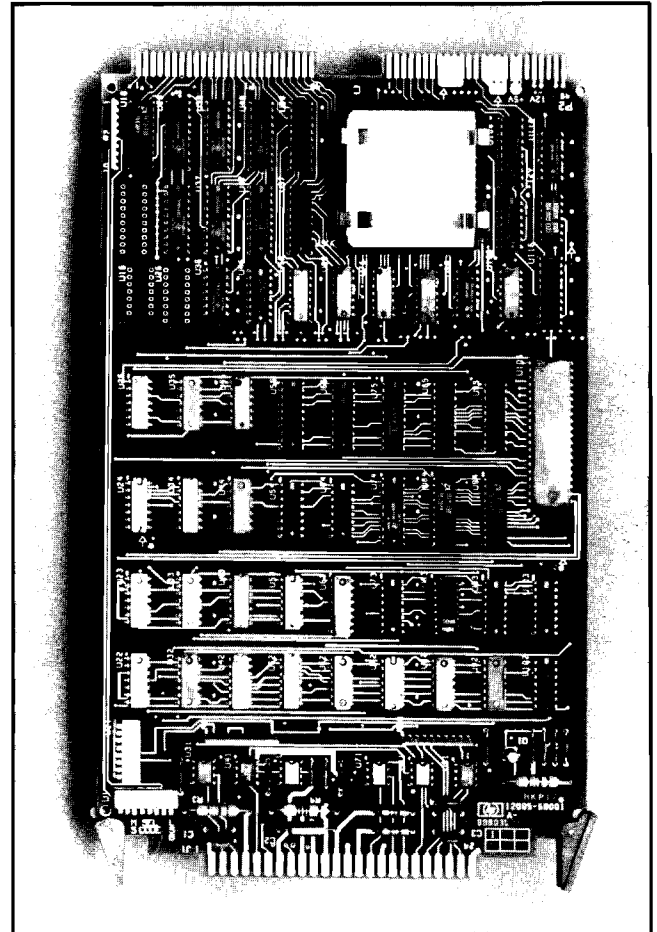
Functional specifications

Formats, parity, and format control

Data codes: 7-bit ASCII or 8-bit binary.

Serial data transfer format: Each 7-bit or 8-bit data code is preceded by a start bit, accompanied by an odd or even parity bit, and followed by one or two stop bits.

Parity selection: Odd or even parity is selected by a switch on the interface.

Stop bit selection: A switch on the interface selects either one or two stop bits.

EIA compliance

The 12005A interface complies with EIA Standards RS-232-C, RS-422, RS-423, and RS-449, and equivalent international standards, as summarized in Tables 1 and 2.

Table 1. Maximum cable lengths and data rates by EIA standard

EIA Std	RS-232-C	RS-422	RS-423	RS-449
Driver-Receiver Type	Single-Ended	Differential	Single-Ended	Both
Max. Cable Length	15 24 metres (50 ft)	12.19 metres (40 ft) at 10M baud 1219 metres (4000 ft) at 100k baud	12.19 metres (40 ft) at 100k baud 1219 metres (4000 ft) at 1k baud	60.96 metres (200 ft) at 2M baud
Max. Data Rate	20k baud	10M baud at 12.19 metres (40 ft)	100k baud at 12.19 metres (40 ft)	2M baud

4-1

Table 2. RS-449/RS-232 Data signal equivalency

Ext. Dir. from I/O	RS- 449	Signals	RS- 232-C	Signals
			AA	Protective Ground
	SG	Signal Ground	SB	Signal Ground
	SC	Send Common		
	RC	Receive Common		
Out	RS*	Request to Send	CA	Request to Send
In	CS*	Clear to Send	CB	Clear to Send
In	DM*	Data Mode	CC	Data Set Ready
Out	TR	Terminal Ready	CD	Data Terminal Ready
In	IC*	Incoming Call	CE	Ring Indicator
In	RR*	Receiver Ready	CF	Detector Line Signal
Out	SD*	Send Data	BA	Transmitted Data
In	RD*	Receive Data	BB	Received Data
Out	SSD	Secondary Send Data	SBA	Secondary Transmitted Data
In	SRD*	Secondary Receive Data	SBB	Secondary Received Data

* Differential driver or receiver is used on this signal, which is available as a balanced or unbalanced signal. NOTE, however, that all 12005A cable options are wired to use the unbalanced signals for compatibility with the HP 26xx terminals that are used with this interface.

Transfer rates

Interface-clocked rates: 50, 75, 110, 134.5, 150, 300, 600, 900, 1200, 1800, 2400, 3600, 4800, 7200, and 9600 baud (bits/second), selected by four switches on the interface.

Externally-clocked rate: Up to 56,000 baud (bits/second), as determined by the terminal or other serial device interfaced by the 12005A.

Character buffering

Two characters.

Teleprinter interface

A 20mA current loop interface, designed to run at 9600 baud (bits/second) is provided for interfacing to teleprinters; connection to this interface requires a user-fabricated cable.

Virtual control panel support

The 12005A interface can be set to support a terminal which will function as the Virtual Control Panel of the computer. For information on Virtual Control Panel functions and capabilities, see the L-Series System Design and Common Specifications data sheet, page 1-6.

Direct Memory Access (DMA) operation

DMA accessibility: The 12005A can access memory under control of its I/O master processor, regardless of how many other interfaces in the system are also accessing memory via DMA.

Termination of indeterminate length transfers: A special character recognition capability can be set up under program control so that a DMA transfer terminates automatically when a specified character is encountered. In this way, the receipt of a carriage return, for example, can be used to terminate block transfers from terminals regardless of the length of the block being transferred.

Break detection

Hardware break detection.

Configuration information

Computer and system compatibility: The 12005A Asynchronous Serial Interface is compatible with all HP 1000 L-Series Computers and Systems.

Connector compatibility: The 12005A printed circuit cable connector is pin-compatible with the 12531C/D interface used in HP 1000 M/E/F-Series Computers, but not with the 12966A interface used in those computers.

Software support: The 12005A interface is supported by RTE-L interface driver ID.00. Use of Hewlett-Packard 26xxA terminals with the 12005A interface is supported by RTE-L device drivers DD.00 (keyboard-display I/O) and D.20, (mini cartridge I/O) which work with interface driver ID.00.

Modem capability: The 12005A interface with supporting RTE-L driver ID.00 is compatible with Bell Type 103 Data Sets and equivalent modems.

Diagnostic support: A diagnostic and a test connector for the 12005A interface are provided in the 24397A Diagnostic Package.

Installation: Set baud rate switches; set Virtual Control Panel switch if used with a Virtual Control Panel terminal; select even or odd parity and desired number of stop bits; set I/O address on select code switches; turn off the computer; plug the interface into the computer backplane; connect the data cable to the terminal or modem; and integrate the interface driver into the operating system if that has not been accomplished previously.

NOTE: The select code switch I/O address setting is independent of the interface card's position in the computer backplane.

Electrical specifications

Direct current requirements

1.6A(+5V), 0.145A(+12V), 0.11A(−12V).

Physical characteristics

Dimensions

289 mm (11.38 in) long by 172 mm (6.75 in) wide by 1.6 mm (0.063 in) board thickness, with 10.2 mm (0.4 in) top-of-board parts clearance and 5.1 mm (0.2 in) beneath-board clearance.

Weight

795 grams (28 oz) with option 001, 002, or 003 cable.

Ordering information

12005A Asynchronous Serial Interface

The 12005A Asynchronous Serial Interface includes:
1. Asynchronous serial interface card (12005-60001).
2. Reference manual (12005-90001).

12005A connection Options

001: 15.2m (50 ft) cable (12005-60002) for connection to 2621A/P Interactive Terminal.

002: 15.2m (50 ft) cable (12005-60003) for connection to 2635A Printing Terminal, or to 2645A Display Station via an additional 13232C cable, or to another RS-232 terminal.

003: 7.6m (25 ft) cable (12005-60004) for connection to U.S. modem.

| HEWLETT PACKARD | HP 1000 L-Series Parallel Interface | Computer Museum |

The 12006A is a multi-purpose parallel interface for 8 or 16 bit bidirectional data transfers between external devices and HP 1000 L-Series Computers and Systems.

Features

- TTL (+5V) and +12V interface compatibility
- Separate 16-bit input and output storage registers
- Separate 4-bit control and status registers
- Built-in DMA capability offering data rates to 2.1 megabytes per second for optimum I/O efficiency
- Wide choice of programmable operating modes for easy use with instrumentation
- 8 or 16-bit operation with hardware packing of bytes into or from words
- I/O driver support with 92070A RTE-L operating system
- Pin compatibility with 12566B interface used in other HP 1000 Computers and Systems.

Functional specifications

Data transfer

Protocol: Transfers either 8 or 16 parallel bits at a time.

Maximum rate: Up to 1.05 million words/sec (2.1M bytes/sec) via Direct Memory Access (DMA).

High logic level choices: TTL (+5V) is standard; removal of six resistor packages converts the interface to +12V level.

Logic levels and circuits: See Figure 1, next page.

Byte packing: For use with 8-bit devices, such as tape readers, tape punches, and some line printers, the interface may be programmed to automatically pack/unpack bytes into/from 16-bit computer words.

Clocked mode: The parallel interface supports a clocked mode in which data transfers to/from external devices are synchronized by a flag-to-device handshake that is clocked by the external device.

Device command sense selection: The interface can be set to respond to either high-true or low-true device command from the interfaced device.

Transparent mode: The parallel interface can also be used to send data to or receive data from one or several devices, such as indicators or switches, that do not provide or use any type of clocking signal. Information is output to the destination device(s) exclusively under program control and input information may be read at any time.
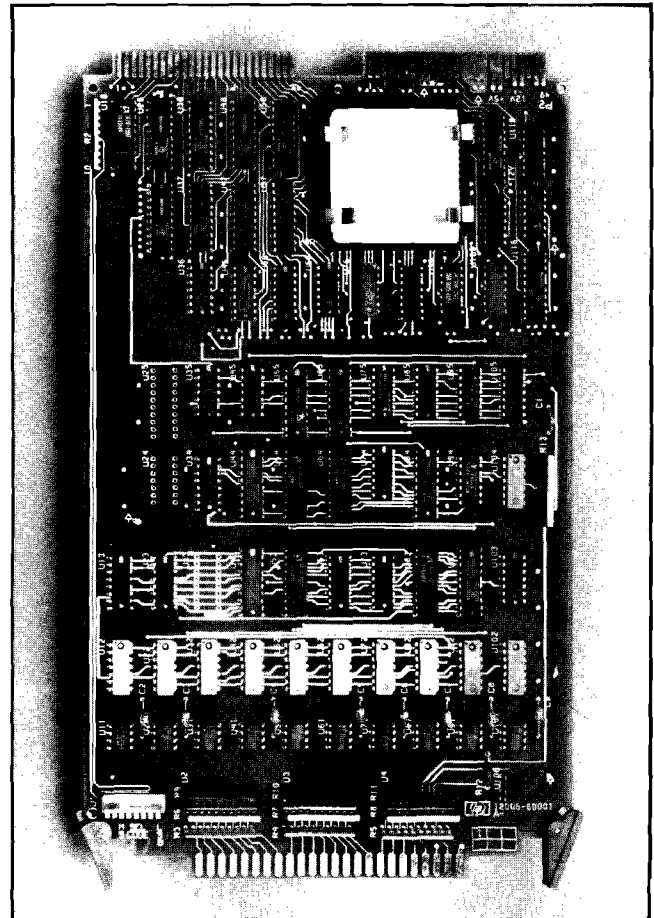
Control and status bit communication

Control output: Four control bits may be sent to the interfaced device via an output control word for use as control, command, or address bits. For instance, they can be decoded to address any of 16 device registers or actions, or to address any of 16 devices connected to the same parallel interface.

Status input: Four status bits may be received from the interfaced device via an input control word.

Prerequisite to control bit-status bit communication: The global register must be enabled, which precludes the use of compatibility mode.

Direct Memory Access (DMA) operation

DMA accessibility: The 12006A can access memory under control of its I/O master processor, regardless of how many other interfaces in the system are also accessing memory via DMA.
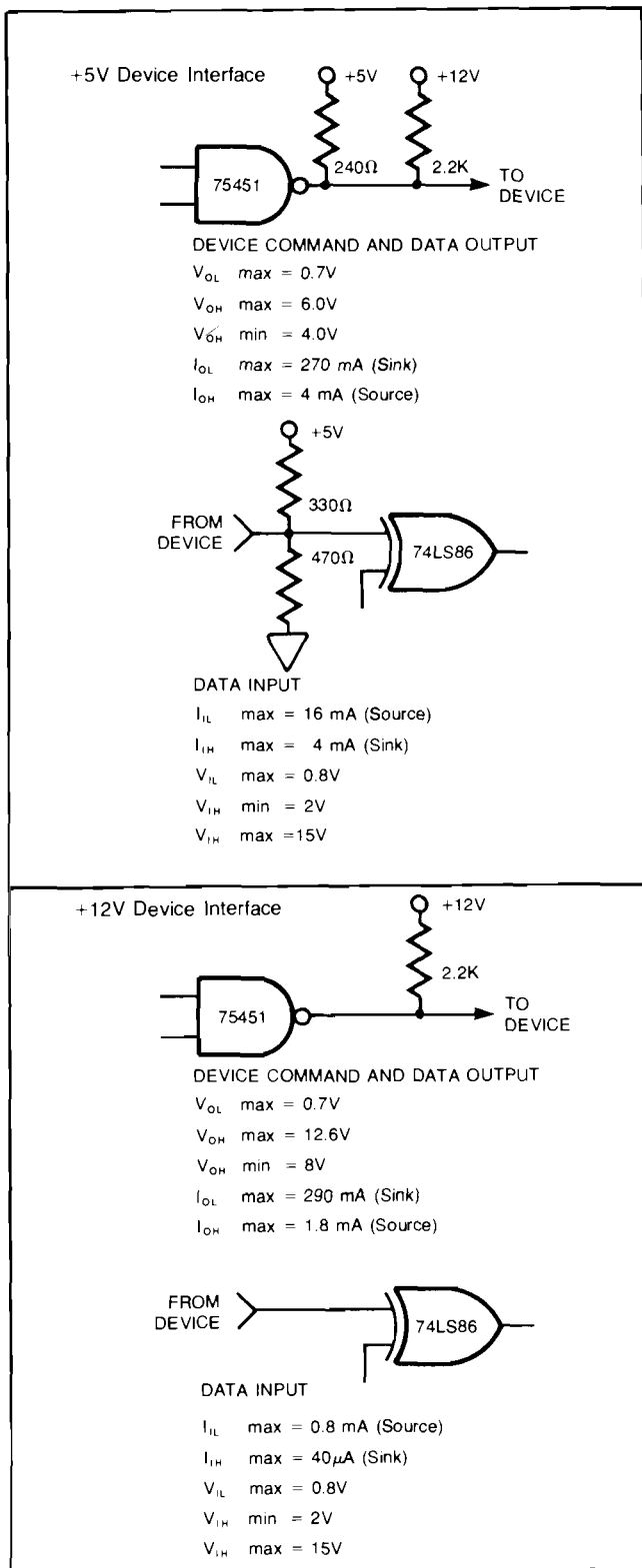
Figure 1. 12006A Logic levels and circuits

The figure contains the following labels and values:

+5V Device Interface

75451, 240Ω, 2.2K, +5V, +12V, TO DEVICE

DEVICE COMMAND AND DATA OUTPUT

V_{OL} max = 0.7V
V_{OH} max = 6.0V
V_{OH} min = 4.0V
I_{OL} max = 270 mA (Sink)
I_{OH} max = 4 mA (Source)

FROM DEVICE, +5V, 330Ω, 470Ω, 74LS86

DATA INPUT

I_{IL} max = 16 mA (Source)
I_{IH} max = 4 mA (Sink)
V_{IL} max = 0.8V
V_{IH} min = 2V
V_{IH} max = 15V

+12V Device Interface

75451, 2.2K, +12V, TO DEVICE

DEVICE COMMAND AND DATA OUTPUT

V_{OL} max = 0.7V
V_{OH} max = 12.6V
V_{OH} min = 8V
I_{OL} max = 290 mA (Sink)
I_{OH} max = 1.8 mA (Source)

FROM DEVICE, 74LS86

DATA INPUT

I_{IL} max = 0.8 mA (Source)
I_{IH} max = 40 μA (Sink)
V_{IL} max = 0.8V
V_{IH} min = 2V
V_{IH} max = 15V

Self configured, chained DMA mode: The I/O master processor on the 12006A interface supports a self configuring mode of operation. In this mode, instead of interrupting the central processor after a block transfer, the I/O processor fetches a new set of control words for the next transfer, reconfigures itself, and initiates another block transfer. This process continues as long as additional sets of control words are available. Chained DMA transfer is particularly useful for storing several sequential scans of measurement channels from an instrumentation subsystem into memory, which can be accomplished without interrupting computations or other processing by the central processor.

Configuration information

Computer and system compatibility: The 12006A Parallel Interface is compatible with all HP 1000 L-Series Computers and Systems.

Connector compatibility: The 12006A interface printed circuit cable connector is pin-compatible with the 12566B Microcircuit Interface, permitting direct substitution of an HP 1000 L-Series Computer or System with the 12006A interface for an HP 1000 M/E/F Series Computer System with 12566B interface.

Software support: The 12006A interface is supported by RTE-L interface driver ID.50.

Diagnostic support: A diagnostic and a test hood for the 12006A interface are provided in the 24397A Diagnostic Package.

Installation: Set device command sense switch to appropriate level; set the interface's I/O address on the select code switches; turn off power to the computer and interfaced device; plug the interface into the computer backplane; connect an appropriate cable from the interface to the device; and integrate the interface driver into the operating system if that has not been accomplished previously.

NOTE: The I/O address setting of the interface select code switches is independent of the interface card's position in the computer backplane.

Electrical specifications

Direct current requirements

For +5V logic level: 1.94A(+5V), 0.179A(+12V).

For +12V logic level: 1.61A(+5V), 0.175A(+12V).

Physical characteristics

Dimensions

289 mm (11.38 in) long by 172 mm (6.75 in) wide by 1.6 mm (0.063 in) board thickness, with 10.2 mm (0.4 in) top-of-board parts clearance and 5.1 mm (0.2 in) beneath-board clearance.

Weight

369 grams (13 oz) with mating connector.

Ordering information

12006A Parallel Interface

The 12006A Parallel Interface includes:

1. Parallel interface card (12006-60001).
2. 48-pin connector kit (5061-3426).
3. Reference manual (12006-90001).

HEWLETT PACKARD

HP 1000 L-Series
HP-IB* Interface

The 12009A HP-IB* Interface provides for connection of up to 14 Hewlett-Packard Interface Bus compatible devices to HP 1000 L-Series Computers or Systems. HP-IB interface-able devices include flexible and hard discs, printers, magnetic tape drives, plotters, graphics digitizers, and an extensive list of measurement instruments.

Features

- Interface to low cost peripherals
- Capacity of up to 14 instruments
- Simple software control of HP-IB based instrumentation systems
- Built-in DMA capability for optimum I/O efficiency
- Burst transfer rates to 940k bytes/sec
- Concurrent operation of multiple HP-IB buses under control of the RTE-L operating system
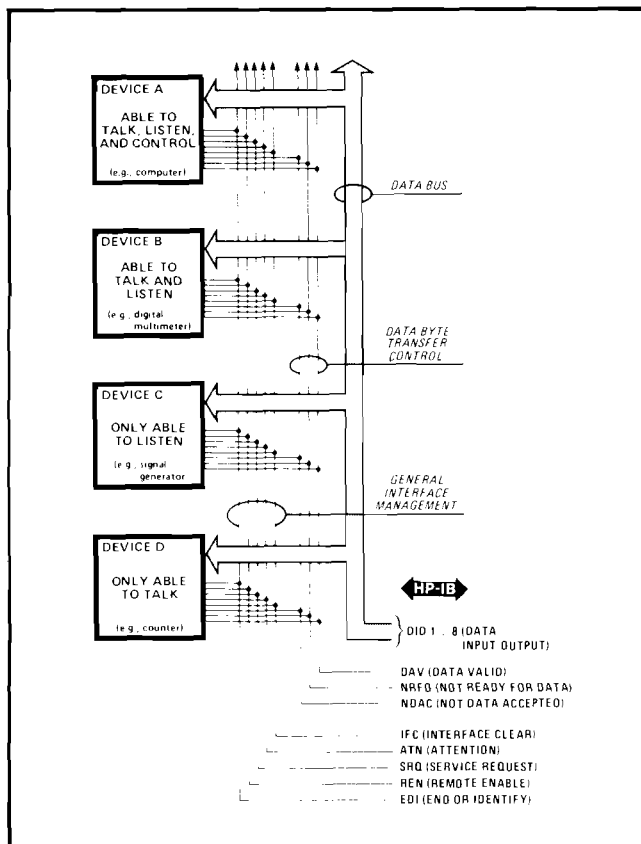- I/O driver support with 92070A RTE-L operating system
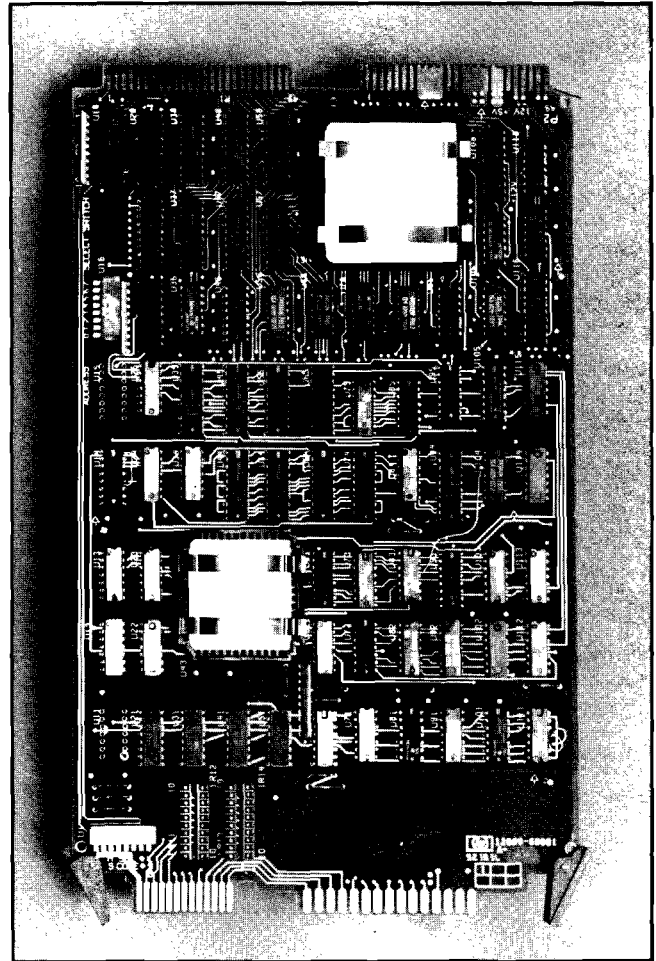
Figure 1. HP Interface Bus Concept

HP-IB capabilities

The 12009A HP-IB Interface connects to the signal lines shown in Figure 1, acting as DEVICE A. Eight bidirectional data bus lines carry coded messages in bit-parallel-byte-serial form to/from other devices on the bus, with each byte transferred from one "talker" to one or more "listeners". Data is exchanged asynchronously using interface messages to

The Hewlett-Packard Interface Bus (HP-IB) is HP's implementation of IEEE Standard 488-1978: "Digital Interface for programmable instrumentation" and identical ANSI Standard MC1.1. The term "HP-IB" is also used to identify Hewlett-Packard instruments conforming with this standard.

set up, maintain, and terminate an orderly flow of device-dependent messages. Three data byte transfer control lines control the transfer of each byte of coded data on the eight data lines. The five general interface management lines ensure an orderly flow of information within the HP-IB. The HP-IB functions of the 12009A interface are largely embodied in a CMOS/SOS LSI integrated circuit chip that works with the I/O master processor LSI chip and circuits to manage HP-IB control and communications.

Functional specifications

Capacity

7906H/7910HR discs per 12009A interface: Up to two, maximum, in addition to single or dual flexible disc.

Other HP-IB devices/interface: Up to 14.

Switch-selectable operating modes

High speed mode: Selects operation at data rates to 940k bytes/sec, maximum.

Normal mode: Selects operation at data rates to 500k bytes/sec, maximum.

Matching requirement: All devices connected to the same bus must be compatible with the selected mode. For that reason, separate 12009A interfaces will be required to interface both high speed mode and normal mode devices to the same L-Series Computer or System.

System controller mode: A two position switch enables 12009A operation as system controller (supported by RTE-L) or disables such operation (not supported by RTE-L).

Direct Memory Access (DMA) operation

The 12009A can directly access memory under control of its I/O master processor regardless of how many other interfaces in the system are also accessing memory via DMA.

Transfer rates

High speed mode: Up to 940k bytes per second via Direct Memory Access when HP-IB interface is plugged into the highest priority I/O slot (next to the central processor board) in the card cage.

Normal mode: Up to 500k bytes per second via Direct Memory Access.

Bus characteristics

Bus signal lines:

DIO	1-8	Data I/O lines 1 through 8
DAV		Data valid
NRFD		Not Ready For Data
NDAC		Not Data Accepted
IFC		Interface Clear
ATN		Attention
SRQ		Service Request
REN		Remote Enable
EOI		End or Identify

Logic levels, line terminations, line drivers, and line receivers: All characteristics conform to IEEE Standard 488-1978.

Maximum cable length for normal mode operation: 2 metres (6.5 ft) per device connected, with a 20 metre (65 ft) total length. The maximum number of devices is accommodated by interconnection using shorter than maximum cable length.

Maximum cable length for high speed operation: 2 metres (6.5 ft) per device connected, with a 15 metre (48.75 ft) total length. Additional load resistors may be required.

Configuration information

Computer and system compatibility: The 12009A HP-IB Interface is compatible with all HP 1000 L-Series Computers and Systems.

Software support: The 12009A interface is supported by RTE-L interface driver ID.37. Use of Hewlett-Packard disc memories and printers with the 12009A interface is supported by RTE-L device drivers DD.30 and DD.12 respectively, which work with interface driver ID.37.

Diagnostic support: A diagnostic for the 12009A interface is provided in the 24397A Diagnostic Package.

Installation: Set interface card switches to select (or unselect) operation as bus controller, normal or fast settling time, appropriate HP-IB bus address and control functions, and appropriate I/O address select code; turn off power to the computer; plug the interface into the computer backplane*; connect the bus cable from the interface to HP-IB devices; and integrate the interface driver into the operating system if that has not been accomplished previously.

NOTE: To achieve maximum data rate in high speed mode, the HP-IB interface must be plugged into the card cage slot next to the central processor; I/O address setting of the interface select code switches is independent of the interface card's position in the computer backplane.

Electrical specifications

Direct current requirements

2.1 A(+5V), 0.084A(+12V).

Physical characteristics

Dimensions

289 mm (11.38 in) long by 172 mm (6.75 in) wide by 1.6 mm (0.063 in) board thickness, with 10.2 mm (0.4 in) top-of-board parts clearance and 5.1 mm (0.2 in) beneath-board clearance.

Weight

710 grams (25 oz), with HP-IB cable.

Ordering information

12009A HP-IB Interface

The 12009A HP-IB Interface includes:
1. HP-IB interface card (12009-60001).
2. HP-IB cable (12009-60002).
3. Reference manual (12009-90001).

product number 12010A

The 12010A Breadboard Interface provides the standard L-Series I/O master circuit along with space for sixty 16-pin wire wrap sockets for user-designed custom interfaces. The printed circuit layout is based on a 2.5 mm (0.1 in) by 7.6 mm (0.3 in) matrix, which accommodates any mix of dual or single in-line integrated circuits. All signals needed by the user are brought, along with dc power supply voltages, to convenient, labelled connection pads along the edge of the I/O master circuit area.

Features

- Standard L-Series I/O master interface to computer or system backplane
- Built-in DMA capability for optimum I/O efficiency
- 60-socket space for user's circuits
- TTL-compatible signals

Functional specifications

I/O master

Purpose: To assure compatibility of user-designed interfaces with the high performance I/O design of L-Series Computers and Systems, the Breadboard Interface includes the same I/O master circuit as other L-Series interfaces. This includes the CMOS/SOS LSI I/O Processor chip, which executes I/O instructions, and other circuits that make high speed transfers possible.

Determination of I/O address: I/O address select code is set by select code switches and is independent of interface card position along the L-Series backplane bus.

I/O addressing: The Breadboard Interface may be pre-addressed by presetting its select code into its Global Register (GR), which leaves the six select code bits of I/O instructions available for addressing registers or other functions on the interface. Alternatively, the GR can be turned off and the select code bits in each instruction can be used to address the user-designed custom interface.

I/O instruction and select codes recognition, instructions executed by the interface enabled to perform the Virtual Control Panel slave cycle, and instruction execution times: See the L-Series system design and common specifications data sheet, page 1-7.

I/O device interrupt priority: Depends upon I/O interface position along the card cage bus with respect to the processor board, as shown in Figure 3, page 1-5.

Interrupt masking: An interrupt mask register provides for selective inhibition of interrupts from specific interfaces under program control. This capability can be programmed to temporarily cut off undesirable interrupts from any combination of interfaces when they could interfere with crucial transfers.
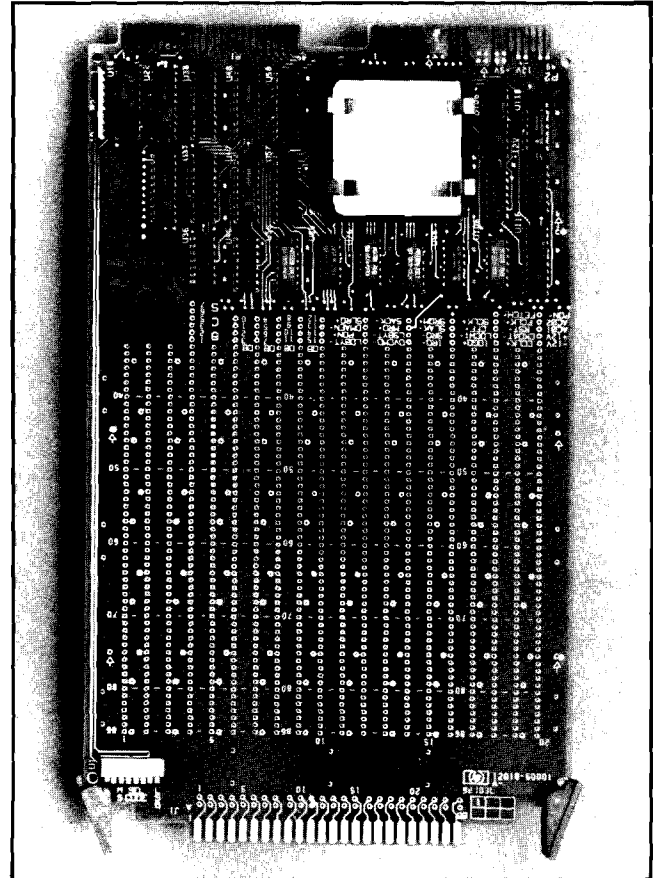
Direct Memory Access (DMA): The I/O master supports DMA capability for user's circuits on the Breadboard Interface, which reduces the number of interrupts from one per data item (byte or word) to one per complete DMA block transfer, greatly reducing overhead and increasing throughput.

Self-configured, chained DMA: A self-configuring mode of DMA operation is available for when groups of DMA transfers must be performed. In this mode, instead of interrupting after a block transfer, the I/O master fetches a new set of DMA control words for the next transfer, reconfigures itself, and initiates another block transfer. This chained process continues as long as additional control word sets are available.

Data packing under DMA: When byte mode is specified in control word instructions, the I/O master automatically manages byte packing or unpacking.

Maximum achievable DMA rate: 700,000 words/sec (1.4M bytes/ sec).

Virtual control panel support: The I/O master supports the provision of virtual control panel interface capability on user-designed custom interfaces based on the Breadboard Interface.

I/O Master signals and timing: Refer to the HP 1000 L-Series I/O interfacing guide 02103-90005.

User's circuit space

Area: 133 mm (5.25 in) by 146 mm (5.75 in).

Organization: The user's circuit area is organized into ten column pairs of 53 circuit pads each for mounting up to 60 16-pin wire wrap integrated circuit sockets or any other combination of dual in-line integrated circuit sockets with different numbers of pins.

Maximum component height above board surface: 10 mm (0.4 in) for an interface capable of being installed in any circuit card position in the 12030A or 2103L 10-slot card cage, 12032A 5-slot card cage, or 2145B 16-slot card cage. Height can be up to 18 mm (0.7 in) for an interface to be used only in 10-slot card cage slot XA6 or 16-slot card cage slot XA9.

Maximum permissible depth below board for leads or attaching hardware: 5 mm (0.2 in).

Power dissipation

Maximum per L-Series interface card: 17W, determined by air flow provided through the card cages in 2103L Computers and 2145B System Core.

I/O master dissipation: 5.3W.

Power dissipation capacity available for user's circuits: 11.7W.

Configuration information

Computer and system compatibility: The I/O master on the 12010A Breadboard Interface is compatible with all HP 1000 L-Series Computers and Systems.

Software support: User's custom-designed interfaces based on the 12010A Breadboard Interface will require user-written RTE-L driver software, which can be modelled on the general purpose RTE-L driver ID.50.

Diagnostic support: Diagnostic support for user's custom-designed interfaces must be user-written. A kernel diagnostic, supplemented by a BASIC-like interactive diagnostic test and design language is provided in the 24397A Diagnostic Package to assist the user's diagnostic development efforts.

Installation: Build user's custom interface on the Breadboard Interface; establish control settings as required for the user's custom application; set select code switches to the appropriate I/O address; turn off power to the computer and the interfaced device; plug the custom interface into the computer backplane; connect an appropriate cable from the interface to the external device; and integrate the interface and its user-written driver into the RTE-L operating system if that has not been accomplished previously.

NOTE: The I/O address setting of the interface select code switches is independent of the interface card's position in the computer backplane.

Electrical specifications

Direct current requirements

The I/O master requires 0.748A(+5V), and 0.034A(+12V).

Power sources available

DC/AC Voltage	Interface Card P2 Pin(s)
+5V dc	35-37
+12V dc	41,42
−12V dc	43,44
19.5V rms, 25kHz*	47,48
Common	2,15,17,19,21,27,34
19.5V rms, 25kHz*	49,50

*The 19.5V rms, 25kHz power is available for meeting unique power supply requirements. For more information see Hewlett-Packard Application Note 404-3, which is available from your Hewlett-Packard representative.

Physical characteristics

Dimensions, mm (and inches)

289 (11.38) long

172 (6.75) wide

10.2 (0.4) Parts clearance

Board thickness 1.6 (0.063)

5.1 (0.2)
Beneath board
clearance
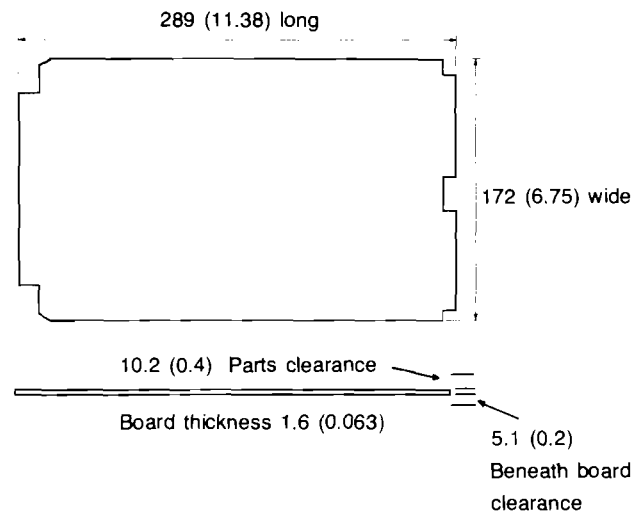
Weight

313 grams (11 oz), with mating connector.

Ordering information

12010A Breadboard Interface

The 12010A Breadboard Interface includes:
1. Breadboard interface card (12010-60001).
2. 48-pin connector kit (5061-3426).
3. L-Series I/O Interfacing Guide (02103-90005).

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HP 1000 L-Series Extender and Priority Jumper Cards

product numbers 12011A and 12012A

The 12011A and 12012A are, respectively, the Extender Card for out-of-card-cage access to system-connected L-Series plug-in cards and the Priority Jumper card for continuation of the HP 1000 L-Series hardware priority chain through an otherwise unoccupied card cage slot.

Functional specifications

Computer and system compatibility

The 12011A Extender Card and the 12012A Priority Jumper Card are compatible with all HP 1000 L-Series Computers, Systems, and card cages.

Installation

Extender Card: Remove the plug-in card to be accessed, plug the extender card into the card cage in its place, and plug the card into the extender board.

Priority jumper card: Plug the priority jumper card into the vacant card cage slot through which the priority chain is to be continued.

Physical characteristics
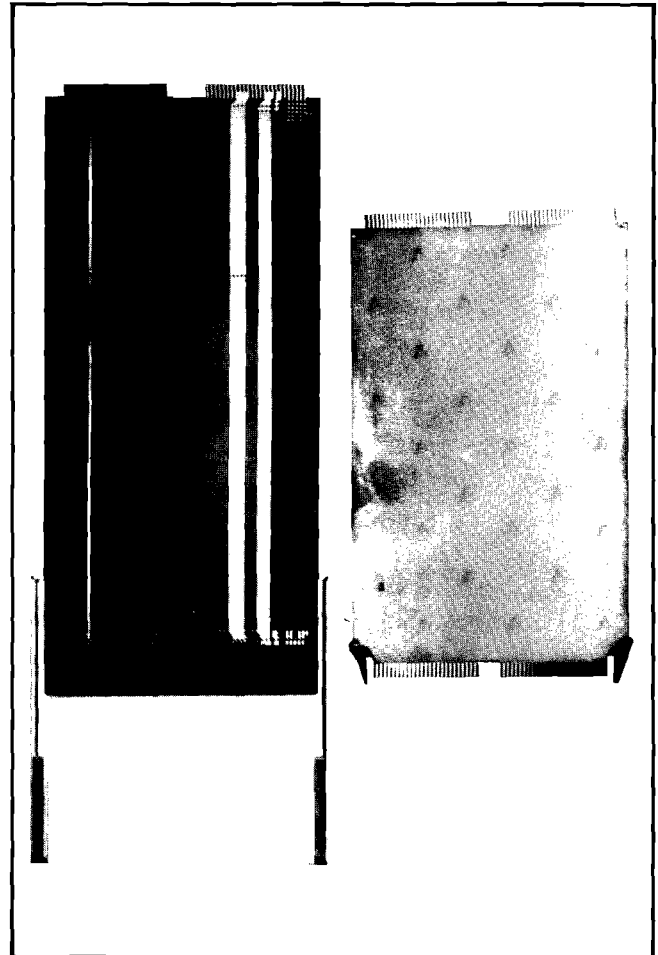
Weight

Extender Card: 426 grams (15 oz).

Priority jumper card: 170 grams (6 oz).

Ordering information

12011A Extender Card

12012A Priority Jumper Card

12011A Extender Card (left) & 12012A Priority Jumper Card (right)

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HP 1000 L-Series
System Terminals selection guide

product numbers 2621A, 2621P, 2635A, and 2645A
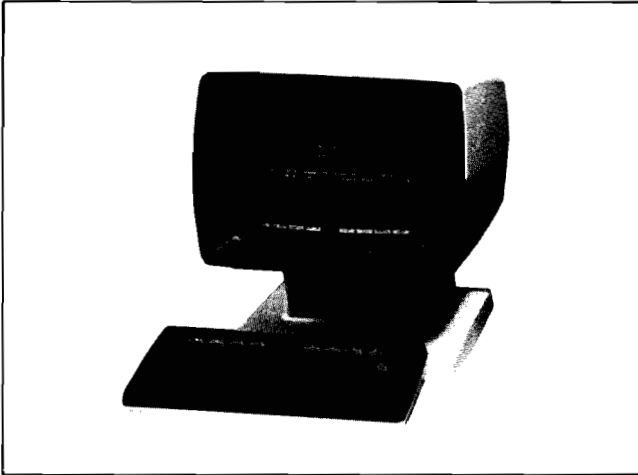
2621A Interactive Terminal
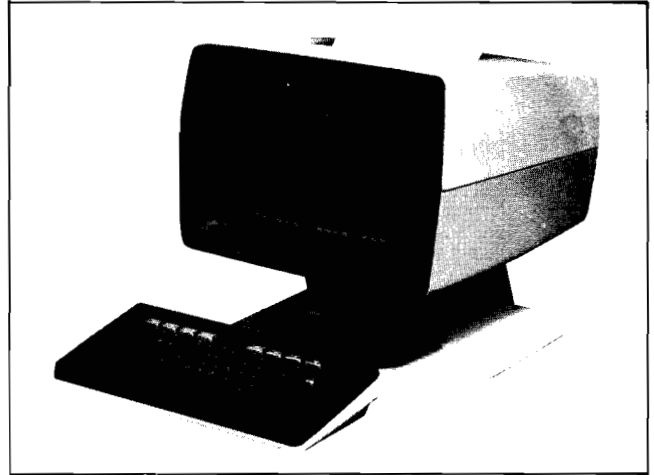
2621P Interactive Terminal

2645A Display station
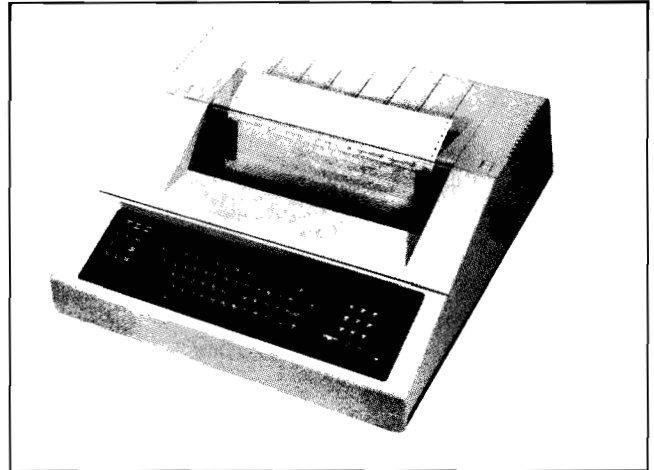
2635A Printing Terminal

HP 1000 L-Series Computers and Systems can be equipped with 2621A and/or 2621P Interactive Terminals where lowest cost is important or the 2635A (dot matrix) Printing Terminal where hard copy with up to 136 characters per line is desired or the 2645A Display Station where alternate character sets or local tape storage is needed. The principal performance characteristics and configuration requirements of these terminals as used in HP 1000 L-Series Computers and Systems are compared in Table 1 on the next page. All of the terminals listed provide the common features listed at right. For more detailed information on any of the terminals, ask your Hewlett-Packard representative.

Features

- Full upper/lower case ASCII character set
- Built-in self test
- I/O driver support with 92070A RTE-L real-time executive operating system

Table 1. HP 1000 L-Series operator terminals comparison

Terminal Choices	2621A Interactive Terminal	2621P Interactive Terminal	2635A Printing Terminal	2645A Display Station
Characters/line	80	80	136	80
Lines/page	24	24		24
Alpha memory	2 pages	2 pages		2 pages
Graphics memory				
Maximum Data Rates				
— Keyboard-display	960 char/sec†	960 char/sec†		960 char/sec†
— Print output		120 char/sec	180 char/sec†	
— Mini cartridge				120 char/sec*
— Graphics output				
Configuration Requirements for hardwire connection				
— Asynchronous Serial Interface	12005A +001	12005A +001	12005A +002	12005A +002
— Additional Cable	not req'd	not req'd	not req'd	13232C
Configuration Requirements for modem connection				
— Async Serial Interface	12005A +003	12005A +003	12005A +003	12005A +003
— Additional Cable	13222N/M**	13222M/N*		13232N/M**
92070A RTE-L Software Support				
— Interface driver	ID.00	ID.00	ID.00	ID.00
— Terminal driver	DD.00	DD.00	DD.00	DD.00
— Cartridge tape driver				DD.20
Electrical Specifications				
— AC Line voltage	90-126V‡ or 198-252V	90-126V‡ or 198-252V	88-132V‡ or 194-264V	92-126V or 177-253V
— Line frequency	57-63 Hz or 47.5-52.5 Hz	57-63 Hz or 47.5-52.5 Hz	48-62 Hz	59.8-60.1 Hz or 49.9-50.1 Hz
— Maximum AC power	50W	100W	220VA	140W
Physical characteristics				
— Height, cm (and in)	44 (17.3)	44 (17.3)	21.5 (8.5)	34.3 (13.5)
— Width, cm (and in)	38 (15)	38 (15)	64 (25.2)	44.5 (17.5)
— Depth, cm (and in)	66.5 (26.2)	66.5 (26.2)	59.5 (23.1)	64.8 (25.5)
— Weight, kg (and lb)	16.1 (35.5)	18 (39.5)	25.5 (56)	22.7 (50)
Optional additions				
— Mini cartridge input/output				2645A Options 007 and 032
— Terminal stand			26097A	
— Display enhancements				13231A (blinking, half bright, underline and line drawing set)
— Add'l memory				13234A (4 kb memory)

* Mini cartridge I/O is an optional capability that requires 2645A options 007 and 032 with hardwire connections to the system, option 007 with modem connection.

† Maximum rate with modem connection is 120 char/sec; actual rate depends upon the modem.

** 13222N/M and 13232N/M are modem cables; the suffix N cable is for connection to U.S. modems, the suffix N cable is for connection to European modems.

‡ Range shown here includes user-selectable choice of 100V or 120V input; there is a gap between 105V and 108V.

HP 1000 L-Series
Hard disc drives
selection guide

product numbers 7910HR and 7906H
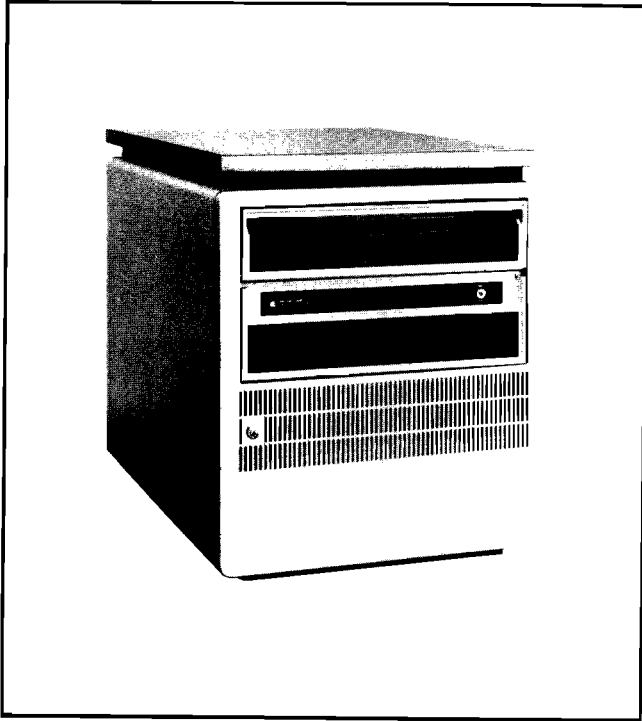
7906H Disc drive

HP 1000 L-Series Computers and Systems can be equipped with the user's choice of two different hard disc drives. The lowest priced unit is the 7910HR Fixed Disc, an integrated controller disc that provides 12 megabytes capacity, using Winchester technology. The 7910HR Fixed Disc is rack mounted in the HP 1000 Model 10 System cabinet.

Users who need interchangeable media and/or more capacity can choose the 7906H free-standing, integrated controller disc drive instead of or in addition to, the 7910HR. The 7906H provides 19.6 megabyte capacity, divided between an interchangeable disc cartridge and a fixed disc. The principal performance characteristics and configuration requirements of these 7906H and 7910HR discs are compared in Table 1 on the next page. All of these discs provide the common features listed below. For more detailed information on any of these discs, ask your Hewlett-Packard representative.

Features

- Low cost integrated controller
- Up to two hard discs and one flexible single/dual disc can use one HP-IB interface
- Usability as system boot-up device
- I/O driver support with 92070A RTE-L real-time executive operating system

Table 1. HP 1000 L-Series hard disc drive comparison

Hard Disc Drive Choices	7910HR Integrated Controller Fixed Disc Drive	7906H Integrated Controller Disc Drive
Capacity per Disc Drive — Fixed — Changeable	12,091,392 bytes	9,830,400 bytes 9,830,400 bytes
Disc Drives per interface	Two, in addition to L-Series single/dual flexible disc	
Total Average Access Time	80 milliseconds	33.3 milliseconds
Average Data Transfer Rate†	493 kilobytes/sec	885 kilobytes/sec
Mounting	Rack mounting	Mounted in own low-profile cabinet
Configuration Requirements	12009A HP-IB Interface (included in 2145B System Core)	
HP-IB Interface Mode	Must use fast mode	
92070A RTE-L Software Support	HP-IB Interface driver ID.37 and Disc Driver DD.30	
Electrical Specifications — AC line voltage — Line freq. — Maximum AC power	◆ ◆ ◆	90-126V‡ or 47-66 Hz 510W
Dimensions, cm (and in) — Height — Width — Depth	◆ ◆ ◆	71.8(28.3) 55.2(21.8) 79(31.1)
Weight, kg (and lb)	◆	138.8(303)
Media Product Nos.	Not separately available	12940A Formatted 10M byte Disc Cartridge

◆ These specifications are omitted, since the 7910HR becomes an integral part of the HP 1000 Model 10 Computer System.

† Average transfer rate is based on the minimum time required to transfer one track without overrun.

‡ This range includes user-selectable choice of 100V or 120V input; there is a gap between 105V and 108V.

HEWLETT PACKARD

Printer for HP 1000 L-Series Systems

product number 2631A

The 2631A is a 136-column, 180 char/sec printer suitable for service as a low-to-medium speed line printer with HP 1000 L-Series Computers and Systems.

Features

- 128 character USASCII character set
- Bi-directional printing at 180 char/sec with leading and trailing blanks skipped for high throughput
- Conveniently replaced cartridge ribbon
- Low cost HP-IB interfacing
- Single or multi-part forms (up to 6 copies)
- 8-channel ROM-based vertical forms control
- Manual or programmable horizontal tabs for report formatting
- Normal, expanded, or compressed printing
- Manual or programmable control of line-to-line spacing
- Bi-lingual character sets optional
- I/O driver support with 92070A RTE-L operating system

Functional specifications

Printer

Printing technique: 7 x 9 dot matrix, impact, cartridge ribbon.

Speed: 180 characters/second, bi-directional.

Pitch: 10 characters/inch, normal; 5 characters/inch, expanded; 16.7 characters/inch, compressed.

Characters/line: 136 (normal), 68 (expanded), 227 (compressed) on standard 37.8 cm (14-3/8 in) wide computer paper.

Character set: 128 USASCII characters, all printable (control codes are printable through a display functions capability).

Additional character sets: Optional secondary character sets can be used to give the 2631A bi-lingual capability. Two complete 128 character sets can reside in the 2631A simultaneously, both selectable under program control.

Paper advance: Tractor feed.

Configuration information

Computer and system compatibility: The 2631A Printer with option 046 interfaced via the 12009A HP-IB interface is compatible with all HP 1000 L-Series Computers and Systems

Software support: The 2631A+046 Printer is supported by RTE-L HP-IB interface driver ID.37 and RTE-L printer device driver DD.12, which works with interface driver ID.37.
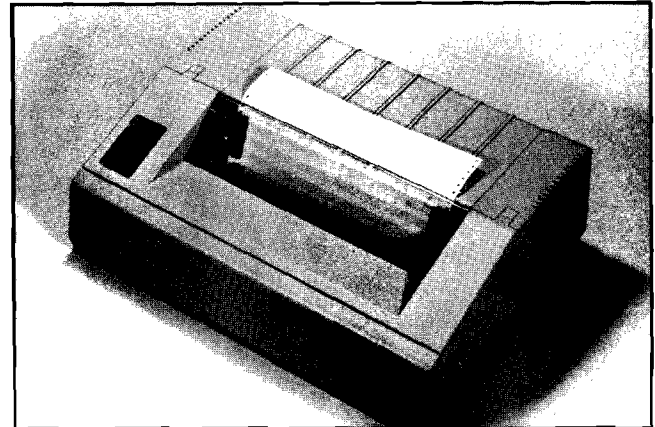
Installation: With computer and printer power off, connect the 2631A+046 Printer to the 12009A HP-IB Interface in the L-Series Computer or System card cage and integrate the interface and printer drivers into the RTE-L operating system if that has not been accomplished previously. This device requires that the 12009A HP-IB interface be configured for fast mode.

Electrical specifications

AC line voltage

Choice of 88-110V (100V +10%), 105.6-132V (120V +10%/-12%), 193.6-242V (220V +10%/-12%), or 211.2-264V (240V +10%/-12%) input ranges.

AC line frequency

48-66 Hz

Maximum ac power

140 VA when not printing, 265 VA when printing.

Environmental specifications

See page 1-5.

Physical characteristics

Dimensions

Height: 21.5 cm (8.5 in) without optional 26098A stand.

Width: 64 cm (25.2 in)

Depth: 46.9 cm (18.5 in)

Weight

23.5 kg (51 lb) without optional 26098A stand.

Ordering information

2631A +046 Printer

The 2631A +046 Printer includes:
1. 2631A Printer with internal HP-IB interface, cartridge ribbon, cleaning brush, and hex key for print-head replacement.
2. 02631-90901 Operator's manual.
3. 02635-90905 Reference manual.
4. 5952-9427 Pocket Guide.

2631A options*

001: Adds Swedish/Finnish character set.

002: Adds Norwegian/Danish character set.

003: Adds French character set.

004: Adds German character set.

007: Adds Cyrillic character set.

008: Replaces std character set with USASCII/Katakana character set.

009: Adds extended Roman character set.

010: Adds math character set.

*Only one of character set options 001 through 010 may be ordered per 2631A.

005: Adds United Kingdom character set (with English pound currency symbol).

006: Adds Spanish character set.

015: 220V operation.

016: 100V operation.

017: 240V operation.

26098A Stand for 2631A

26098A options

001: Adds casters.

002: Adds paper catcher.

product number 29434A

The 29434A System Table provides a convenient facility for mounting operator terminals or small desktop peripherals used with HP 1000 L-Series Computers and Systems. Its styling matches that of the L-Series system cabinets with safety-enhancing rounded edges and corners and a 99 x 80 cm (39 x 31 in) top that provides enough space for a terminal and working papers.

Physical characteristics

Dimensions

Width: 99.7 cm (39.25 in).
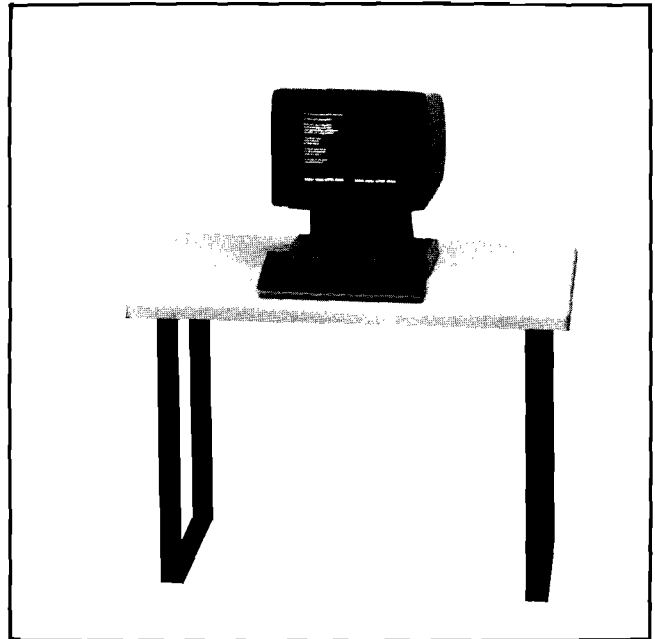
Depth: 80.6 cm (31.75 in).

Height: Adjustable from 73 to 75.2 cm (28.75 to 29.63 in) using screw-in levelling feet.

Weight

23.6 kg (52 lb).

Shipping method

The 29434A System Table is shipped disassembled to minimize shipping costs; it is easily assembled by the user at the installation site.

Ordering information

29434A System Table

HEWLETT-PACKARD COMPANY
HP 1000 Software Rights and Privileges Statement

November, 1979

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License to use software and software updates

The purchase of any HP 1000 software or software-firmware product (see Table I), grants the buyer a license to use the software product originally delivered on **one** Computer with no time limit. No title to, or ownership of, the software is transferred to the buyer. The buyer's right to use is at all times subject to the copyright restrictions listed below.

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Hewlett-Packard defines two "Types" of HP 1000 software and software-firmware products in the **HP Software Terms** document. (HP Literature stock number 5953-2107) The "Type" of a software or software-firmware product governs how and when the software may be copied, as follows:

License to copy Type I Software and Software-Firmware Products

Type I products are those products over which HP exercises complete copyright control via the HP Software Terms document.

A customer obtains the right to copy Type I software by purchasing the associated "Right to Copy" product (see Table I). Each purchase of a "Right to Copy" product provides the buyer with an additional set of firmware (if any), manuals, and a license to make one copy of the Type I software for use on a single additional computer.

The "Right to Copy" product is sold subject to the following conditions:
1. The customer must have already purchased or be concurrently purchasing a license to use the Type I product at full list price less appropriate discounts. Reduced price software upgrade products or options and software bundled with HP 1000 computer systems do **not** satisfy this prerequisite.
2. The customer must agree to label each copy of the original software with the following notice: "© Copyright Hewlett-Packard Company, 19XX. Copy made by permission of Hewlett-Packard."

License to use execute-only portion of a Type I Software Product

For a limited number of Type I software products, a customer can obtain the right to use the execute-only portion of that software on an additional computer by purchasing the associated "Execute-Only" product (see Table I). Each purchase of an "Execute-Only" product provides the buyer with an additional set of firmware (if any) and a license to use the Execute-Only subset of that product on a single additional computer. Definition of the subset of the modules which are included in the execute only license can be found in the data sheet for the appropriate software product.

The "Execute-Only" product also includes a license to use updated versions of the execute-only software modules (obtained via the appropriate software support service) on the additional system. This right is limited to use of updated versions of the specific modules included in the execute-only license as defined in the data sheet for the appropriate product.

The "Execute-Only" product is sold subject to the same conditions as the "Right to Copy" product described above.

License to copy Type I Software Updates Provided by Support Services

A customer can obtain a license to copy the Type I software updates provided by a particular software support service by purchasing the additional system support extension product for the appropriate service once for each computer to which the updates will be copied. Each purchase of the support extension product provides the buyer with a set of firmware updates (if applicable) and a license to make one copy of the software updates for use on a single additional computer.

The additional system support extension product is sold subject to the following conditions:
1. The customer must have in force a valid HP support agreement that includes the appropriate Type I software support service.

6-0

Table I. HP 1000 L-Series Active Software Products

SOFTWARE PRODUCT	RIGHT TO COPY PRODUCT	EXECUTE ONLY PRODUCT
92070A RTE-L Operating System Software	92070R "Right to Copy" RTE-L software once	92070E Right to execute RTE-L software on one additional computer.
92070X RTE-L Software Sources	92070Y "Right to Copy" binary object code derived from the 92070X product once	Not available
92076A BASIC/1000L Software	Not available	Not available
24397A L-Series Diagnostic Package Software	Not available	Not available

2. The customer must have previously purchased or be concurrently purchasing a license to use the original Type I software on each computer to which the updates are being copied. This license can be obtained either by purchasing an HP 1000 Computer System, a separate copy of the Type I product, or a Type I "Right to Copy" product.
3. The customer must agree to label each copy of the updated software in accordance with the procedures outlined above.

License to copy a Type I Software Update for customers without support services

Customers without support services on computers with copied software can obtain a license to copy a single Type I software update to such a computer by purchasing the associated "Right to Copy" product with option 001. Each purchase of a "Right to Copy" product with option 001 provides the buyer with a set of firmware (if any), manuals, and a license to make one copy of a Type I software update for use in updating the copied software previously installed on a single additional computer.

Option 001 of the "Right to Copy" product is sold subject to the following conditions:
1. The customer must have previously purchased the appropriate Type I software "Right to Copy" product without option 001 for the computer to which the update is being copied.
2. The customer must agree to label each copy of the updated software in accordance with the procedures outlined above

Type II Software Products and Updates

After a customer purchases a license to use a Type II product once at full list price, less appropriate discounts, HP grants that customer an additional license to copy and use that software on any other HP 1000 computers owned by the customer. The customer is required to label each copy of the Type II software in accordance with the procedures outlined above.

In addition, customers who have in force a valid HP support agreement that includes one of the Type II software support services are granted a license to copy and use those updates on any other HP 1000 computers owned by the customer. Each copy of the updated software must be labeled in accordance with the procedures outlined above.

Ordering/Acknowledgement Procedure

When a valid order for one or more of the license to copy Type I software or software updates products described above is received at an HP factory, one of the following acknowledgements will be sent:

"SPECIFIC RIGHTS TO REPRODUCE S/W GRANTED"

"SPECIFIC RIGHTS TO REPRODUCE S/W UPDATES GRANTED"

At that point, Hewlett-Packard specifically grants the right to copy the Type I software or software updates in accordance with the prerequisites and conditions described above.

The right to copy Type II software is granted only after a customer meets all of the prerequisites described above. No formal acknowledgement of the right to copy is sent in this case.

HEWLETT PACKARD

RTE-L real-time executive operating system

product number 92070A

RTE-L is a real-time operating system for management of the operations and resources of HP 1000 L-Series (2103L/LK) computers and HP 1000 Model 9 and 10 Computer Systems. RTE-L provides true multiprogramming capability and may be configured as a memory-based or disc-based system.

DISC-RESIDENT PROGRAM SWAPPING AREA	31,000 to 53,500 bytes for user's programs and common
MEMORY-RESIDENT PROGRAM #N	
•	
•	
MEMORY-RESIDENT PROGRAM #2	
MEMORY-RESIDENT PROGRAM #1	
SYSTEM COMMON	
RTE-L SYSTEM, I/O DRIVERS, TABLES, SYSTEM AVAILABLE MEMORY, AND RESIDENT LIBRARY	— 12,030 to 33,860 bytes

64k byte RTE-L System

Features

- Modular design that supports a range of configurations from small, operator-less, execute-only stations to full disc-based systems with program preparation capability
- True multiprogramming with concurrent program execution
- Time, event, program-to-program, and operator scheduling of program execution
- Complete file management capabilities for creation, maintenance, and manipulation of files on peripheral discs
- Language support that includes HP 1000 Assembler and FORTRAN IV for source program compilation and execution
- Optional real-time BASIC/1000L for on-line BASIC language program development and execution
- Program request and operator command functional compatibility with the HP 1000 RTE family of operating systems
- Program development tools that include an interactive source editor (EDITR), program debugger (DBUGR), relocating loader (LOADR) and system generator (RTLGN). (EDITR, LOADR and RTLGN can be executed on RTE-IVB systems as well as RTE-L systems.)
- Transportability that can be designed into user programs for the HP 1000 family of RTE operating systems
- Simplified on-line system generation and update procedure for fast, easy system generation and changeover
- All drivers are designed to take advantage of the L-Series advanced I/O architecture, minimizing I/O processing overhead
- Modular device and interface drivers that work together to provide efficient I/O with minimal use of memory
- Support for HP-IB instruments or peripheral subsystems is included
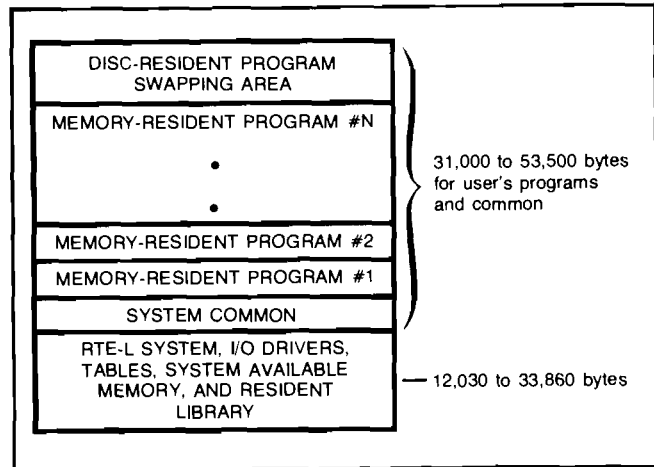
RTE-L — Configuration flexibility and efficient input/output for a wide variety of applications

Modular configurability

The RTE-L operating system is highly modular. RTE-L is usable for small, operator-less, memory-based configurations or in versatile disc-based configurations which support file management and program development concurrent with real-time operations, or for any configuration between these extremes.

In operator-less, memory-based configurations, the system can operate in less than 12k bytes of memory, leaving over 52k bytes for user's dedicated applications. From this base, capabilities can be added modularly. Potential additions include time and program-to-program scheduling, mailbox I/O, interactive operator communication with the system, program segmentation, program swapping, etc. A big advantage of the RTE-L design is that the user includes only needed capabilities.

Simplified remote or on-line local system generation and loading

RTE-L systems are generated by the RTLGN utility program. This program can be executed on RTE-L systems with a flexible disc or hard disc at the same time that real-time programs are also running. The RTLGN program can also be executed on RTE-IVB host systems to generate RTE-L systems for dedicated applications. System generation is done

in a semi-automatic mode from a file which the user pre-pares in advance to provide commands to RTLGN. Extensive use of default options simplifies command file preparation. Further user assistance is provided by command file examples in the RTE-L Generation Planning Guide manual. I/O configuration, often the most complex part of system generation, is simplified by built-in equipment identifiers in the software drivers.

After the command file has been prepared, system generation is typically accomplished in only six to ten minutes. The generator provides a generation list file of all messages and descriptions during the generation process, a generated system file from which the new operating system can be booted up, and a snapshot file that contains all the values of the entry points used by the new system. The snapshot file is used by the relocating loader to produce memory image program files.

Input/output efficiency

The RTE-L operating system fully exploits the built-in input/output efficiency of HP l000 L-Series hardware. Direct memory access per I/O channel involves the system only at the beginning and end of an input/output operation, minimizing overhead and maximizing the CPU time available for other processing.

Another aspect of the hardware design contributing to I/O efficiency is the independence of select codes with respect to hardware priority. Hardware priority is determined by the position of interface cards in the computer or system card cage and select codes are set by switches on the interface cards. It is thus possible to fine-tune the response of the system by changing interface card positions without having to change the select codes in programs or the system configuration.

Human engineered for easy use

At Hewlett-Packard, an important part of any design effort is directed toward maximizing the usability of our products. This is particularly true of the RTE-L operating system. The top-down structural design of RTE-L and its documentation set inherently extend it towards good human engineering, making it not only easy to use, but also easy to understand.

Disc access by name

RTE-L has a unified file structure for all disc space allocations in the system. This includes files for containing the swapped-out images of disc-resident programs; scratch files for temporary working storage by the interactive editor, assembler, and compiler; files occupied by the memory image of an RTE-L operating system; and user files for source, relocatable, or executable programs and data. Regardless of how it is used, every disc space allocation can be identified and accessed by a file name because its location is registered in a file directory. This is especially helpful in a system recovery situation. For example, suppose a user has been interactively editing a source file and before the new edits are saved into a file, the system halts with a memory parity error. Upon rebooting the operating system, instead of losing all of the edited information, which may have taken hours to enter, the editor's work file containing most of the new edits can be retrieved by name and used as the input source for continued editing.

Single-command to switch over from one generated operating system to another

An RTE-L operating system is generated and saved on disc as a named file manager file. The process of loading an operating system into memory and starting execution is called boot-up. In RTE-L, a disc initialized by the file manager (FMGR) contains a section of program code which, when loaded into memory by the disc loader ROM, will locate the operating system file on disc by searching through the file directory for its name. This program code will then load the new system into memory to complete the boot-up process. With the aid of the Virtual Control Panel built into the L-Series central processor and the boot-up program codes, a user may boot-up an RTE-L operating system by name from anywhere on a disc instead of some fixed and reserved physical disc location.

Single-command switchover facilitates switching to an updated RTE-L system with the latest revision of software modules generated into it. This same capability also makes it easy to generate and use multiple RTE-L operating systems, each optimized for a specific application. As the time or need arises to use one of these operating systems for a specific application, it can easily be booted up in less than a minute without requiring an operator to do extensive preparatory work, such as backing up a disc, prior to the switchover.

User-designable terminal control

Up to three levels of prompting response can be specified for an unexpected keystroke to prompt the interrupting operator with a message. The first two prompt response levels are optional and are assignable by a user during system generation or on-line after system boot-up. The bottom level, when neither of the first two levels is available, is the response of RTE-L itself.

The provision of these optional response levels helps a user to develop a controlled sequence of operator input. An unexpected keystroke on a terminal can cause either of two user programs (designated as primary and secondary programs) to be scheduled and executed to screen, control, and guide an operator's use of the system. This is especially useful in applications to be used by operators with little or no computer experience.

Easily accessed modular documentation

System documentation matches the exceptionally modular organization of RTE-L so the user can access needed information easily. More than twenty different manuals are provided, starting with tutorial step-by-step guides and extending to programming reference documentation. This includes a general information manual, a quick reference guide, and individual reference manuals on system generation, utilities, program development software, the software drivers included with the system, and the supporting libraries. The software manuals are divided into three main sets according to types of usage: operator's guide set, program development set, and system designer set.

Family compatibility

RTE-L is a member of Hewlett-Packard's compatible family of real-time executive operating systems. RTE-L program requests and operator commands are functionally compatible with the RTE-IVB system. There are some differences in certain programming calls to the RTE-L executive vs RTE-IVB, which are documented in the RTE-L General Information Manual and which an experienced RTE-IVB user should be aware of.

Real-time multiprogramming

RTE-L supervises the execution of multiple programs which can be used to perform several different functions concurrently. For example, under RTE-L, a program can send data to and receive data from peripheral equipment, another program can display information to an operator, and a third program can be used for program development. All these programs can run concurrently and independently.

Program Scheduling

RTE-L schedules programs on a priority basis by placing them in the order of their program priorities in a list known as the scheduled list. RTE-L provides these methods of scheduling programs:

- External events recognized by the system as interrupts may cause their respective programs to be scheduled.
- A program can be scheduled by another program through an EXEC call when program-to-program scheduling is configured into the system.
- Programs can be scheduled to execute once or continuously at an absolute pre-specified time of day or at a specified time interval. Time count is derived from the internal CPU time base which updates a system clock maintained as part of the operating system functions when the time scheduling capability is configured into the system.
- A program may be scheduled to execute by an operator command at a terminal when the required modules for interactive access are configured into the system.

PROGRAM SCHEDULING
AND EXECUTION

A calling program or an operator may either wait or not wait for the completion of execution of a scheduled program. Request choices allow either the program or the operator to schedule a program and then go on to other operations without waiting.

Priority Management

RTE-L provides 32767 levels of priority, giving a user close control over the priority execution of tasks. When a higher priority program is added to the scheduled list, a lower priority program currently executing will be suspended, and the higher priority program will begin execution.

# Memory utilization

User Program Areas

Within its maximum capacity of 64k bytes of memory, RTE-L can accommodate two user program areas, the memory-resident area and the disc-resident area. Either one of these areas is optional in an RTE-L system.

The memory-resident program area may contain several programs whose run-times are critical to the performance of the system. For example, they may be programs that respond to external interrupts, or may be programs that control the data flow from other programs. All programs in the memory-resident area are non-swappable, but may be replaced on-line by an operator. The last program in the memory-resident area may also be segmented. The number of programs in the memory-resident area is limited by the memory space allocated to that area during system generation.

The disc-resident area contains only one executing program at a time, which may be swapped to a disc when necessary to make room for another disc-resident program. Because of this swapping feature, it is recommended that only programs whose run-time is not critical to the performance of the system should be relocated as disc-resident programs. For example, the interactive editor, the FORTRAN IV compiler and other program development tools may be placed in this area. A segmented program can also be relocated for the disc-resident area.

Program segmentation

In spite of the wide range of user program space offered by the configuration flexibility of RTE-L, an unstructured, straight-line coding and add-on approach of a user program may eventually exhaust the memory space available on even a stripped down system. To solve this problem, the user program can be divided according to the logic of the program into multiple segments of code, each of which will overlay another, sharing the same physical memory space when called upon to execute. A segmented program must have a main (or root) segment which is not overlaid by other segments. The main segment contains the data area common to the other segments through which information can be passed from one overlaying segment to another. This common data area is known as a local common because it is common only within the segmented program and not with other programs in the system. The main segment also controls the program execution flow from segment to segment by invoking the appropriate segment load and execute service provided by RTE-L.
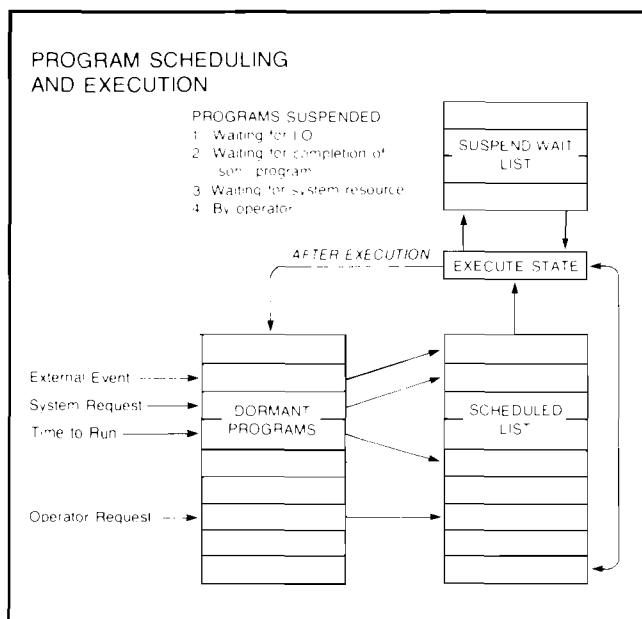
Interrupts

RTE-L uses the multi-priority level, vectored hardware interrupt system of the HP 1000 L-Series computer for detection of power failure, memory protect violation, parity error, illegal instructions, and time base ticks, as well as all device I/O interrupts. Interrupts are handled by priority according to the rules of the I/O backplane of the computer. As noted previously, the hardware design of the L-Series computer facilitates rearrangement of hardware priorities through interchange of interfaces without requiring any change of programs or the system's software configuration.

The feature of Direct Memory Access (DMA) capability per I/O interface card minimizes the number of interrupts to be processed. Even for the slowest input device connected to an interface, DMA can be used to load input data directly into memory, minimizing CPU overhead. Only after a full block of data has been transferred will an interrupt be generated.

System Integrity

The integrity of the RTE-L system is protected by the following features:

- Optional auto restart after power failure
- Memory "fence" protection of the operating system from the two user program areas, and of the memory-resident area from the disc-resident area
- Illegal instructions are trapped as interrupts to the operating system
- Optionally "downing" an I/O device with a message to the operator when its failure is detected or programmatically returning the error status to the calling program
- Optionally allowing user programs to lock certain system resources for their exclusive use
- Optional security code protection of disc files from unauthorized access

Input/Output

Driver Support

The following RTE-L drivers are provided for the support of interfaces and peripherals:

Driver	Supported Interface Cards	Supported Devices
ID.00 DD.00 DD.20	12005A Asynchronous Serial Interface	26xx Terminals Cartridge Tape Units
ID.37 DD.12 DD.30	12009A HP-IB Interface	2631A+046 Printer System flexible discs, and 7910HR/7906H Discs
ID.50	12006A General Purpose Interface	General purpose parallel interfaced devices
ID.36 DD.36	12008A PROM Storage Module	
ID.43	12013A Battery Backup Module	

Driver Structure

RTE-L driver structure consists of two parts, the interface drivers and the device drivers. The interface drivers, whose naming convention is ID.xx, are programmed according to the specifications of the interface cards as far as flag signals and command/status controls are concerned. These drivers perform actual I/O instructions. The device drivers, whose naming convention is DD.xx, generally are programmed according to the particular characteristics of the devices they address. Such characteristics include the device address data sequence which may precede every data transfer to a device (e.g. CTU unit number), or formatting of data (e.g. line spacing control in column 1 for printers). Many simple devices, such as HP-IB instruments, do not require device drivers.

RTE-L drivers are organized in such manner to optimize I/O processing for multiple device interfaces, i.e. several types of intelligent peripheral devices or instruments connected to a single interface card plugged into a computer. The following features are provided:

- High flexibility, ease and low development cost in adding another device to a system because only a device driver needs to be designed.
- More efficient usage of memory because one interface driver can serve multiple interface cards of the same kind.
- Interleaving of requests to devices on a multi-device interface may increase the system's aggregate throughput.

For example, HP-IB is a multiple device interface supported by RTE-L. Under RTE-L, adding a printer to a configured HP-IB would require only the addition of a new printer device driver; the HP-IB interface driver would remain unchanged.

Other I/O Features

- Timeout on I/O requests to prevent an inoperative I/O device from halting the entire system.
- Suspending a program which has initiated I/O and automatically re-scheduling that program at I/O completion in order to allow other non-I/O bound programs to execute.
- Slow output devices may be buffered, allowing a program to continue executing without having to wait for I/O completion.
- Input may also be buffered through the use of class I/O.
- Multiple programs within a system may pass data to one another through the use of mailbox I/O which frees them from having to rely on the integrity of a common data area shared and maintained by all interacting programs. Mailbox I/O helps to reduce the complexity and the development costs of user programs.
- Write/read request on an interactive device allows two successive I/O operations initiated by only one system call, eliminating 50% of the system call processing overhead. This is especially useful in an operator-prompting scheme where the prompting message is first written out before waiting for a reply.
- Fail-soft feature allows standard or user defined I/O error recovery.

On-line Program Development

When RTE-L is configured with a disc, program development can be done concurrently with real-time processes.

Language Support

- HP 1000 Assembler and cross reference generator
- FORTRAN IV
- BASIC (with 92076A BASIC/1000L).
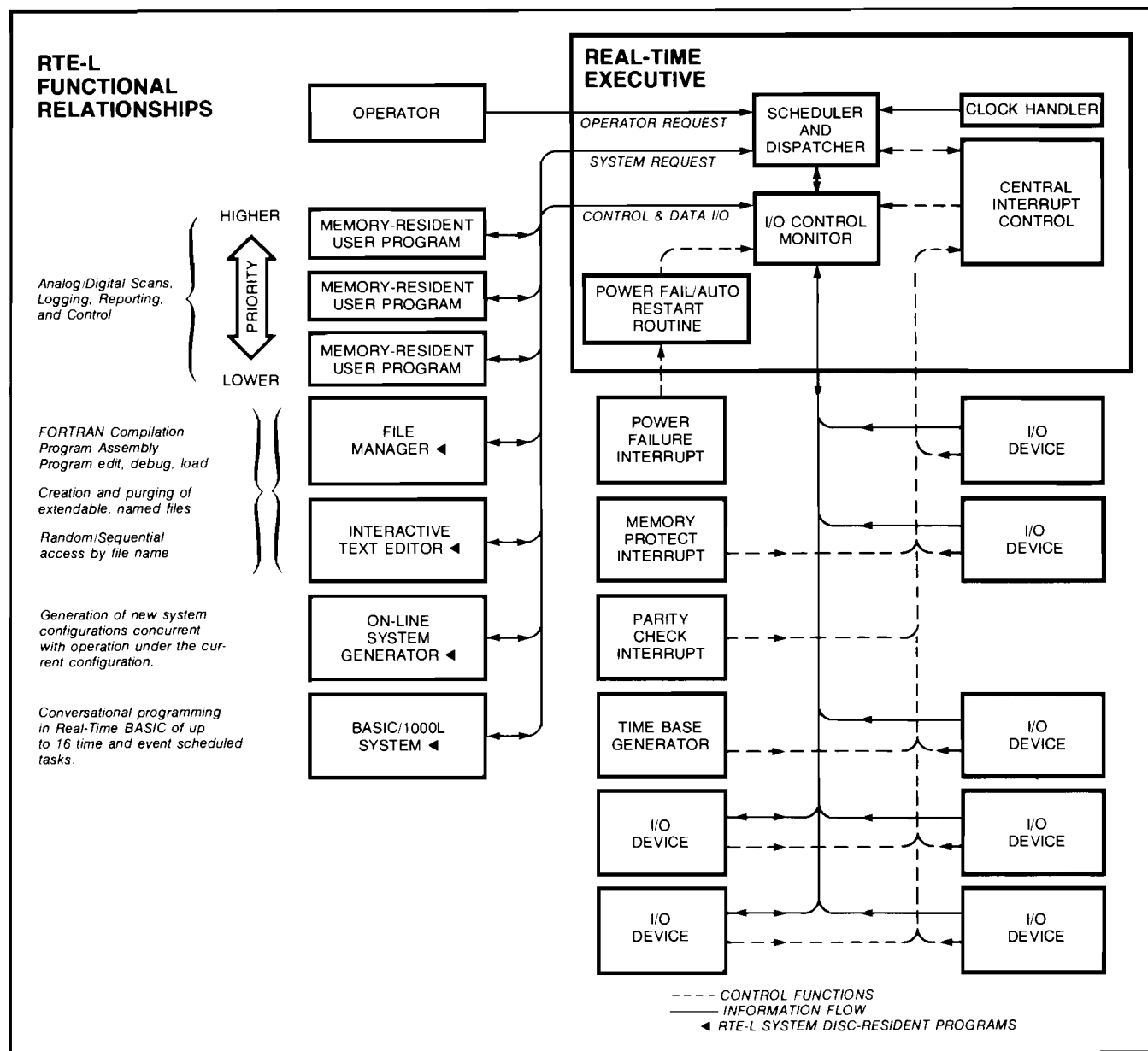
Development Tools

- Interactive file manager program, FMGR, and file management package FMP
- Interactive editor of source files
- On-line relocating loader
- On-line debug utility to aid user program development

File Manager and File Management Package. The File Manager, FMGR, allows the creation, deletion, storing, copying, packing, and listing of disc files from operator command level. The file management package FMP consists of a set of subroutines to be called by user's programs to programmatically access disc files for such operations as creating files, opening files, writing to and reading from files, closing files to inhibit further access, deleting files, etc. All disc files are referenced by name. Except for fixed-length record files oriented towards random access, disc files can be automatically extended to additional storage space when an attempt is made to write beyond the current end of file. The maximum number of times a file can be extended is 255. The maximum number of records in a file is 32,767.

The Interactive Editor provides a simple tool for a user to create and modify source files. It has the capabilities of searching for and correcting character strings in a file, in addition to the line-by-line editing features of inserting, deleting, copying, and replacing lines or characters.

On-line relocating loader. When a program has been compiled or assembled and is ready to be installed into the system for execution, RTE-L's loader can relocate it on-line into the appropriate program area (memory-resident or disc-resident) according to the program type or to the operator's command. The output is a memory image of the program fitted according to the snapshot of the particular operating system. This loader can be executed on an RTE-IVB system as well as on RTE-L, allowing a user to do RTE-L

RTE-L FUNCTIONAL RELATIONSHIPS

REAL-TIME EXECUTIVE

OPERATOR

OPERATOR REQUEST

SYSTEM REQUEST

CONTROL & DATA I/O

SCHEDULER AND DISPATCHER

CLOCK HANDLER

CENTRAL INTERRUPT CONTROL

I/O CONTROL MONITOR

POWER FAIL/AUTO RESTART ROUTINE

HIGHER

PRIORITY

LOWER

Analog/Digital Scans, Logging, Reporting, and Control

MEMORY-RESIDENT USER PROGRAM

MEMORY-RESIDENT USER PROGRAM

MEMORY-RESIDENT USER PROGRAM

FORTRAN Compilation Program Assembly Program edit, debug, load

FILE MANAGER ◄

POWER FAILURE INTERRUPT

I/O DEVICE

Creation and purging of extendable, named files

Random/Sequential access by file name

INTERACTIVE TEXT EDITOR ◄

MEMORY PROTECT INTERRUPT

I/O DEVICE

Generation of new system configurations concurrent with operation under the current configuration.

ON-LINE SYSTEM GENERATOR ◄

PARITY CHECK INTERRUPT

Conversational programming in Real-Time BASIC of up to 16 time and event scheduled tasks.

BASIC/1000L SYSTEM ◄

TIME BASE GENERATOR

I/O DEVICE

I/O DEVICE

I/O DEVICE

I/O DEVICE

I/O DEVICE

---- *CONTROL FUNCTIONS*
—— *INFORMATION FLOW*
◄ *RTE-L SYSTEM DISC-RESIDENT PROGRAMS*

program preparation on the service-oriented high end system. The loader can be operated interactively or by commands included in a file, by which a large number of programs can be relocated in one "full sweep" operation. This is especially attractive to a user updating RTE-L under Software Subscription Service or Customer Support Service and refitting user programs into the latest version of RTE-L.

Interactive Program Debugger. DBUGR, a program-callable or loader-appendable utility subroutine, provides users with the interactive capability of examining and modifying memory and registers when the program is in execution, setting of a breakpoint within the program and tracing program execution. To facilitate visual interpretation by a user, DBUGR translates machine codes in binary numbers back to assembly language mnemonics and octal numbers.

PROM Programming Utilities

Two utility programs are provided for programming PROMs to be installed on the 12008A PROM Storage Module. The first of these utilities, PFORM, formats software object code and/or data files into disc images of PROMs and records these images on flexible disc or hard disc. The second utility, PBURN, outputs the PFORMed disc images to a Data I/O System 19 PROM Burner via a 12005A +003 Asynchronous Serial Interface and I/O drivers ID.00 and DD.00. Together, these two utilities and the supporting drivers provide a convenient means of implementing user's software in non-volatile PROMs to be mounted on the 12008A PROM Storage Module.

The PFORM and PBURN utilities can also be executed on an RTE-IVB system as well as RTE-L, allowing OEMs to program PROMs for use in HP 1000 L-Series Computers and Systems on the same system they use for program development. Interface to the PROM burner from an RTE-IVB based system must be via the 12880A CRT Terminal Interface.

HP-IB Library

In addition to relocatable libraries of commonly-used mathematical and utility subroutines, RTE-L includes an HP-IB Library. The routines in the HP-IB library provide a consistent access method for all HP-IB instruments. The HP-IB library routines provide tools with which a user can read, write, clear, and exercise other control functions via high-level program calls without concern for the details of HP-IB bus protocol with an instrument.

System Utilities

RTE-L also includes a set of utility programs for the following purposes:
- Disc backup from one flexible disc to another or from one hard disc to another.
- Installing the boot-up file, BOOTEX, onto the beginning of a disc.
- Converting an absolute binary program file into a memory image file
- Converting a memory image file into an absolute binary file.
- Concatenating relocatable subroutines into one relocatable file for use as a library file during system generation or on-line program relocation.

Optional software

BASIC/1000L

BASIC/1000L can be added to the RTE-L system to provide the ease and convenience of conversational programming and execution from HP's real-time BASIC language.

Functional Specifications

Operating system basic specifications

Type: Disc or memory based real-time multiprogramming with a maximum address space of 64k bytes.

Basis of program scheduling for execution: By operator, time, event, or another program in the order of program priority. The caller (either the operator or another program) has the option of waiting or not waiting for the completion of execution of the requested program.

Program priority levels: 1 through 32767, the lowest number designating the highest priority.

User program areas: RTE-L can be configured with a memory-resident program area containing multiple user programs and/or a disc-resident area that can contain a single, swappable disc- resident user program.

Maximum program space available to the user: The difference between 64k bytes and the size of the operating system, including optional modules, I/O device and interface drivers, and table space. To predetermine approximate space that will be available for your application, use the Configuration Capabilities and Requirements Summary table for information on memory space used by the various modules available in RTE-L.

System requirements

Memory supported: 64k bytes.

Configuration requirements: An overview of memory and hardware-software requirements is given in the Configuration Capabilities and Requirements Summary table.

On-line operator requests
1. Turn program on and wait for completion
2. Turn program on without wait for completion
3. Terminate the execution of a program
4. Suspend user program, either executing or scheduled
5. Activate user program from operator suspension
6. List programs currently executing in the system
7. List status of all programs
8. List I/O configuration in terms of table description and drivers
9. Change priority of programs
10. Examine I/O device or I/O controller status
11. Alter I/O device timeout parameters
12. Alter device logical unit assignments
13. Control I/O device availability to programs
14. Set the real time clock
15. Display time (time-of-day, day, month, year, and day of the week)
16. Request program execution at a specified time or at a specified time interval
17. Alter device buffering assignments

Program development requests

1. Compile FORTRAN IV programs or assemble ASMB programs
2. Enter, test, debug, edit and run real-time BASIC programs (with optional BASIC/1000L subsystem)
3. Trace program execution, examine and modify memory and/or register contents with the DBUGR utility
4. Edit program and data files
5. Load relocatable programs and subroutines into a generated system

File Manager and File Management Package

1. Create files
2. Dump contents of a file to another file, or to a peripheral device
3. Copy files from one disc logical unit to another
4. List contents of a disc file directory
5. List contents of a cartridge directory of the disc logical units that have been mounted on the system
6. Purge disc files
7. Pack a disc logical unit
8. Rename disc files
9. Open files for access with mode options
10. Write on a random or a sequential file
11. Read from a random or a sequential file
12. Position a file according to an absolute or a relative record number
13. Close a file from further access

Configuration capabilities and requirements summary

Configuration capability	Req'd. Module	Approximate Memory Req'd. (bytes)		Hardware and/or additional software requirements
		Main Memory	Disc-Res.*	

1. Minimum system (includes):
a. Base page
b. System executive
c. Input/output control
	
	EXEC
	RTIOL
		
		2,048
		1,700
		3,620
				1. 2103L LK Computer or HP 1000 Model 9 or 10 Computer System with any of the following supported boot-up sources:
				  a. 12008A PROM Storage Module† (requires user-supplied PROM burner and user-written driver)
				  b. Any supported disc (see items 11 and 13. below)†
				  c. Any supported terminal with Mini cartridge I/O (see items 6 and 8. below)

2. Time scheduling	TIME	640		
3. System available memory management a. Allocation module b. System available memory c. String passing to programs (requires items a and b, above) d. Class I/O (requires items a and b)	 SAM STRNG CLASS	 260 1k-4k△ 270 1,140		
4. Program-to-program scheduling	SCHED	270		
5. LU and Resource Locking	LOCK	140		
6. Interface to terminal a. Async serial interface driver b. Table space for each interface	 ID.00	 690 50		6. 12005A Asynchronous serial interface per terminal

7. Terminal(s) providing keyboard and display or printout (requires item 6. above)
a. Terminal driver
b. Table space for each terminal
	
	DD.00
		
		1,500
		100
				7. Item 6. above, and any of the following terminals:
				  a. 2621A (display) Interactive terminal with 12005A interface cable option 001
				  b. 2621P (display and printing) Interactive terminal with 12005A cable option 001
				  c. 2635A Printing terminal with 12005A interface cable option 002
				  d. 2645A Display station with 12005A interface cable option 002 and 13232C cable

8. Terminal(s) providing Mini cartridge I/O as well as keyboard and display or printout (requires item 6. above) a. Terminal driver b. Mini cartridge driver c. Base table space per terminal d. Additional table space for each Mini cartridge tape unit used	 DD.00 DD.20	 1,500 1,100 100		8. Item 6. above, and any of the following terminals: a. 2645A+007, 032 Display station with 12005A interface cable option 002 and 13232C cable
9. Interactive use and error logging (requires items 6 and 7. above; item 8 is optional instead of item 7) a. Operator commands module b. Error logging module c. Operator error messages d. Status commands e. System commands	 SYCOM ERLOG OPMSG STAT XCMND	 900 230 100 900 160		9. Items 6 and 7. above; item 8 is optional instead of 7

Configuration capabilities and requirements summary, continued

Configuration capability	Req'd. Module	Approximate Memory Req'd. (bytes)		Hardware and/or additional software requirements
		Main Memory	Disc-Res.*	
10. Power fail/auto restart	ID.43	450		10. 12013A Battery backup module
11. HP-IB interface (used as disc, printer, and/or instrumentation interface) a. HP-IB interface driver b. Table space for each interface	ID.37	2,410 260		11. 12009A HP-IB interface
12. Disc storage (required for program development, storage, swapping, and on-line sys. generation) (Requires item 11, above) a. Disc driver b. Base table space per disc drive c. Table space per logical unit (LU); usually each recording surface is treated as a logical unit	DD.30	1,000 50 60		12. Item 11, above, and any of the following discs (up to four per 12009A interface) a. Single/Dual System Flexible disc drives with 1.2 Megabytes of storage per drive■ b. 7906H Cartridge disc drive with 10 Megabyte removable cartridge and 9.6 Megabyte fixed disc c. 7910HR Fixed disc with 12 Megabytes of storage on a single non-removable disc platter
13. Program and segment loading (requires items 11 and 12, above)	LOAD	380		13. items 11 and 12, above
14. Program swapping (requires items 11, 12, and 13, above)	SWAP	410		14. Items 11 and 12, above
15. File directory handler (requires items 11 and 12, above)	D.RTR	2,320		15. Items 11 and 12, above
16. Interactive file manager programs (requires items 2-6, 7 or 8, 9-13, and 15, above)	FMGR		18k	16. Items 6, 7 or 8, 11, and 12, above
17. Program development software (requires items 2-6, 7 or 8, 9-13, 15, and 16, above) a. FORTRAN IV Compiler b. Assembler and Cross-Reference Symbol Table c. Debug routine d. Interactive Editor e. Relocating Loader	FTN4 ASMB DBUGR EDITR LOADR		18k 20k 4k 14k 24k♦	17. Items 6, 7 or 8, 11, and 12, above
18. PROM Programming (requires items 2-6, 7 or 8, 9-13, 15, and 16, above) a. Software formatting into PROM images b. Burning PROM images onto PROMs	PFORM PBURN		26k 14k	18. Items 6, 7 or 8, 11, and 12, above, and Data I/O System 19 PROM Burner interfaced to computer via 12005A+003 Asynchronous Serial Interface
19. On-line System Generator (requires items 2-6, 7 or 8, 9-13, and 15, above)	RTLGN		24k♦	19. Items 6, 7 or 8, 11, and 12, above
20. Printer support (requires item 11, above) a. Printer driver b. Table space for each printer	DD.12	1,360 60		20. 2631A Printer with option 046 and item 11, above.
21. General-purpose parallel interface a. Parallel interface driver b. Table space for each interface	ID.50	890 10		21. 12006A Parallel interface
22. Access to software in PROM storage a. PROM Storage Module Driver b. Table space per PROM Storage Module	ID.36	220 88		22. 12008A PROM Storage Module

* Since disc-resident programs are swappable, this area must be allocated enough memory at system generation to hold the largest disc-resident program to be used.

† Bootup sources a and b may be used for automatic boot-up at power on. Virtual Control Panel (VCP) command can be used to boot-up from a, b, or c. Use of VCP command for boot-up will also require items 6 and 7 or 8, listed in the hardware column, above.

Δ System available memory requirements are application-dependent and, for some uses may even exceed the sample 4k byte upper limit listed here.

■ The system flexible discs are single and dual 7902A disc drives that are integrated into HP 1000 Model 9 and 10 Computer Systems.

♦ Relocating Loader and On-Line Generator memory requirements include approximately 8k bytes used for symbol table space.

System requests from programs

For Input/Output functions:

1. Read from or write to any non-disc input/output device with or without wait
2. Write to and then read from the same interactive device in the same call
3. Get status of queued read requests, or the resulting input data
4. Check I/O device or controller status
5. Control functions on CTU or other peripheral devices
6. Determine the type of a device (such as a terminal, a cartridge tape unit, a disc, or a printer, etc.) given the device number
7. Determine the device number of the terminal on which the command to run the program has been entered
8. Allocate/release I/O devices or other system resources for own exclusive use
9. Request device lock/unlock

For program scheduling functions:

10. Schedule programs for execution with or without wait for completion
11. Terminate own execution or other programs
12. Suspend self into a wait state
13. Load a program code segment from a disc (applicable to a segmented program only)
14. Change time scheduling of self or other programs

For other functions:

15. Obtain current year, date and time of day
16. Request resource lock/unlock
17. Reserve buffer space outside the program space
18. Convert integers from binary to ASCII
19. Pass message or data buffers between programs
20. Get a parameter string entered by the operator who runs the program
21. Execute some system requests as if they had been entered by an operator
22. Parse a command buffer into ASCII and integer fields

Ordering information

Products for the first-time single user

NOTE: The RTE-L system on media option 041 is automatically included in HP 1000 Model 9 and 10 Computer Systems. RTE-L as a product by itself is intended for user-assembled L-Series computer systems.

92070A RTE-L Real-Time Executive Operating System

RTE-L consists of:

1. The following software on one of media options 041, 050, or 051, which must be ordered:
   - A catalog file describing the set of software on the medium by part numbers and revision date codes
   - RTE-L operating system
   - On-line system generator
   - RTE FORTRAN IV compiler, HP1000 Assembler, Cross Reference generator, interactive DBUGR utility, interactive editor, and relocating loader
   - HP-IB, relocatable, and decimal string arithmetic libraries

- File manager and file management package
- PROM programming utilities
- System utilities

2. Getting started with RTE-L (92070-90001).
3. RTE-L General Information Manual (92070-90006).
4. RTE-L Operator's Guide (92070-90002).
5. RTE-L Interactive Editor Reference Manual (92070-90003).
6. RTE-L Utilities Manual (92070-90004).
7. RTE-L Programmer's Reference manual (92070-90007).
8. RTE-L File Management Reference manual (92070-90008).
9. RTE-L Relocating Loader Reference Manual (92070-90009).
10. RTE-L DEBUG Reference Manual (92070-90010).
11. RTE-L Driver Reference Manual (92070-90011).
12. RTE-L System Design Manual (92070-90013).
13. RTE-L Generation Planning Guide (92070-90014).
14. RTE-L Generator Reference Manual (92070-90016).
15. RTE-L Software Installation Guide (92070-90018).
16. RTE-L Driver Designer's Manual (92070-90019).
17. RTE-L Quick Reference Guide (92070-90020).
18. RTE-L Generation Requirements for Drivers Manual (92070-90042).
19. RTE-L PROM Card User's Guide (92070-90030).
20. Decimal String Arithmetic Routines Manual (02100-90140).
21. Relocatable Library Manual (24998-90001).
22. HP-IB User's Manual (59310-90064).
23. RTE FORTRAN IV Reference Manual (92060-90023).
24. RTE-IV Assembler Reference Manual (92067-90003).

92070A RTE-L options

041: Provides all RTE-L system software on flexible disc for L-Series System Flexible Discs.

The following options are valid only for current RTE-IVB users with the 7970 mag tape subsystem and a hard disc cartridge subsystem who intend to develop RTE-L systems on an RTE-IVB operating system with revision code 2001 or later.

050: Provides all RTE-L system software on an 800 bpi, 9-track mag tape.

051: Similar to 050, above, but with RTE-L system software on a 1600 bpi, 9-track mag tape.

Source product

92070X RTE-L Software Sources Product

The 92070X Software Sources Product is a set of computer source code used to construct an RTE-L (92070A) real-time executive operating system, driver software, file manager, loader, and generator. It also includes supporting technical specifications manuals.

Products for additional use of RTE-L on multiple systems

92070R Right to copy RTE-L for program development and execution on an additional computer system

The 92070R Right to copy product is available only to customers who have purchased a license to use 92070A. 92070R consists of:

1. The right to make one copy of software purchased with the 92070A RTE-L system for use on an additional system.
2. All manuals supplied with 92070A, items 2 through 24, listed previously.

NOTE: To assure proper support, we recommend that a user who intends to use copies ("R" products) of other HP software products, such as BASIC/1000L with copies of RTE-L, purchase the 92070R product (above) rather than the 92070E execute-only product (below).

92070E Right to execute RTE-L on one additional L-Series computer system

This is a low cost license for an OEM to use the RTE-L software as part of its product. (Excludes capabilities 17, 18, and 19 of the Configuration Capabilities Summary on page 6-9.) No manual or software is supplied and no program preparation is allowed on this product. This product is simply a license to execute RTE-L and user programs developed to run under RTE-L on a dedicated L-Series application system. 92070E includes the right to copy 92070S/T updates.

92070M RTE-L Manuals Package

The 92070M RTE-L Manuals package includes manual items 2 through 24 supplied with 92070A, listed previously. This is intended for an RTE-L user wanting an additional set of manuals.

RTE-L Software Support Services

NOTE: Software support services are priced in monthly units and are billable quarterly, or annually in advance.

RTE-L Customer Support Service Products

92070T Customer Support Service for 92070A software

Provides on-going Systems Engineering assistance for 92070A RTE-L software, consisting of assignment of an HP Systems Engineer to your account, a phone-in consulting service for discussion of questions on 92070A software, and on-site resolution of 92070A software problems, if required. Includes the 92070S Software Subscription Service described below, with 2103L firmware updates as applicable. Media option 041, 050, or 051, similar to those listed under 92070A, must be selected.

92070T options

041-051: Media options similar to those listed under 92070A.

92070P Additional phone-in consulting caller

Adds one authorized caller to the phone-in consulting service provided under 92070T, which is a prerequisite to 92070P.

92070V Central support for an additional copy of 92070A

Extends Customer Support Service to an additional copy of 92070A through the same system manager as the 92070T service, which is prerequisite to 92070V. Includes 2103L firmware updates.

RTE-L Software Subscription Service Products

92070S Software Subscription Service for 92070A software

Provides software and manual updates as required to keep your 92070A product current with respect to enhancements and other changes as they are released by Hewlett-Packard. Includes 2103L firmware updates and 92830A HP 1000 Software Notification Service described below. Media option 041, 050, or 051, similar to those listed under 92070A, must be selected.

92070S options

041-051: Media options similar to those listed under 92070A.

92070W Right to copy 92070S updates

Provides the right to copy 92070S updates once for use on an additional computer. 92070S is prerequisite to 92070W. Includes 2103L firmware updates.

RTE-L Documentation Distribution Services

NOTE: Documentation Distribution Services are priced in monthly units and are billable quarterly with other quarterly billable services, or annually in advance. (Annual prepayment is required if no other support service is ordered.)

92070Q Manual Update Service for 92070A software manuals

Provides manual updates as required to keep software manuals furnished with your 92070A or 92070M product current with respect to enhancements and other changes as they are released by Hewlett-Packard. The 92070Q service should be ordered for the manual set obtained in the 92070A RTE-L System if 92070T/S is not ordered and/or each manual set obtained via a 92070M RTE-L Manuals Package.

92830A HP 1000 Software Notification Service

Provides periodic notification of software status for all HP 1000 software via the Communicator/1000 (6 issues/year), the HP 1000 Software Status Bulletins (24/year), and the HP 1000 Software Update Notices (4/year).

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RTE-L Software Sources

The 92070X Software Sources Product is a set of computer source code used to construct an RTE-L (92070A) real-time executive operating system and supporting subsystems, such as the driver software, file manager, loader, and generator. Purchasing the 92070X product gives the customer the right to use the object code derived from RTE-L sources on **one** HP 1000 L-Series Computer. RTE-L hardware requirements are defined in the 92070A data sheet.

Ordering information

Prerequisites

The 92070X product is available to customers who have a current HP Purchase Agreement and who have previously acquired the 92070A product separately or in an HP 1000 Computer System. Purchase of the 92070X product requires the signing of a Software License Agreement and payment of the license fee listed in the Hewlett-Packard Corporate Price List. The License Agreement defines the appropriate use of the Software Sources and any derived object code.

92070X RTE-L Software Sources Product

The 92070X product consists of:

1. Source language program code on one of media options 041, 050, or 051, which must be selected, for the following software:
   a. All modules in the operating system, including RTE-L System Libraries.
   b. All standard RTE-L interface and device drivers.
   c. FMGR and FMP*.
   d. RTE-L Relocating Loader.
   e. RTE-L Generator.

2. The following manuals:
   a. RTE-L Executive Control Technical Specifications Manual (92070-90021).
   b. RTE-L I/O Control Technical Specifications Manual (92070-90022).
   c. RTE-L File Management Technical Specifications Manual (92070-90023).
   d. RTE-L Drivers Technical Specifications Manual (92070-90024).
   e. RTE-L Loader/Generator Technical Specifications Manual (92070-90025).

92070X Options

041: Provides all RTE-L Source Software on flexible disc for L-Series System Flexible Discs.

The following options are valid only for current RTE-IVB users with the 7970 mag tape subsystem who intend to develop RTE-L systems on an RTE-IVB operating system with revision code 2001 or later.

050: Provides all RTE-L Source Software on an 800 bpi, 9-track mag tape.

051: Similar to 050, above, but with RTE-L Source Software on a 1600 bpi, 9-track mag tape.

92070Y Right to copy binary object code derived from the 92070X RTE-L Software Sources Product

92070Y, which is available only to purchasers of the 92070X product, consists of:

1. The right to make **one** copy of object code derived from the 92070X RTE-L Software Sources Product.

2. All manuals furnished with the 92070A RTE-L Real-Time Executive Operating System.

Software Support Services

NOTE: Software support services are priced in monthly units and are billable quarterly, or annually in advance.

92070Z Software Subscription Service for 92070X

The 92070Z Software Subscription Service, which is available only to purchasers of the 92070X product, provides updates as required to keep your RTE-L source code current with respect to design changes as they are released by Hewlett-Packard. Includes 2103L firmware updates. Media option 041, 050, or 051, similar to those listed under 92070X, must be selected.

Support

Hewlett-Packard will not support any binary object code derived from the RTE-L source code modified by the user.

Warranty

Hewlett-Packard will warrant only the media on which the source code is delivered.

* NOTE: Portions of the file manager have been written in SPL/2100 for which a compiler is available from the International HP 1000 Users Group Contributed Library. You can obtain the library by writing to:

International HP 1000 Users Group
P.O. Box 1000
Norwood, MA 02062

NOTE, however, that this compiler has not been tested by Hewlett-Packard in either the RTE-L or RTE-IVB operating system and, like other HP 1000 Users Group contributed software, is not warranted or supported by Hewlett-Packard in any way.

Hewlett-Packard's BASIC/1000L is a single-user subsystem for conversational development, testing, and execution of Real-Time BASIC programs in computer systems managed by a disc-based configuration of HP's RTE-L real-time executive operating system.

Features

- Development and execution of Real-Time BASIC programs in RTE-L systems by a single-user.
- Conversational programming.
- Time and event scheduled operation of up to 16 tasks.
- High-level subroutine calls for instrumentation, including multi-instrument clusters bus-connected via HP-IB*.
- Character string manipulation with string variables.
- Support of bit manipulation.
- Access to subroutines or functions written in FORTRAN or Assembly language.
- Print with format control.

Functional description

Conversational program development.

Real-Time BASIC programs can be entered directly into the system via the system console or another keyboard terminal. The BASIC interpreter checks each statement as it is entered. If a statement contains an error, BASIC immediately returns a message that helps the user re-enter that statement correctly, in a conversational process. Errors encountered during program execution are flagged and corrected with similar ease.

Character string manipulation.

Strings up to 255 characters long can be represented by variables. This provides a shorthand representation of frequently-used strings that can save programming time and effort. It also makes possible the extraction of string segments using subscripts and character-by-character comparison of two strings.

Real-time multi-tasking.

User's BASIC program code can be subdivided into as many as 16 tasks that are BASIC subroutines. This subdivision gives the user the ability to match the frequency, timing, and basis for execution of programmed task actions to the diverse needs of real-time applications in research and manufacturing. Task executions may be scheduled as a function of time or event interrupt (such as contact closure).
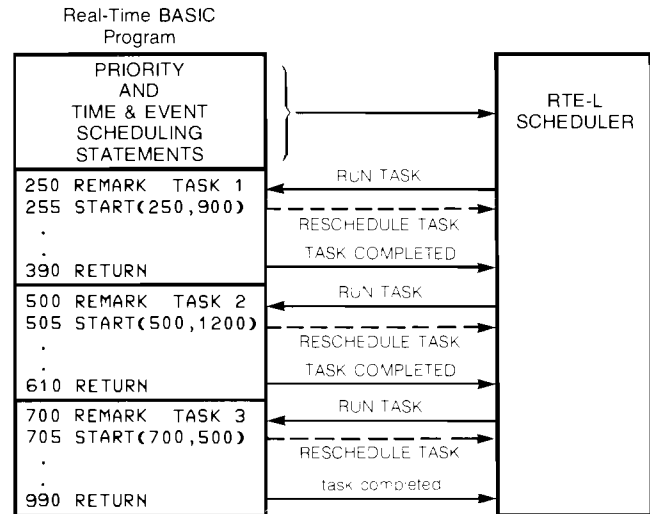
BASIC/1000L Real-Time Task Scheduling

(This requires the provision of time scheduling, which is optional in RTE-L). BASIC/1000L recognizes priority levels from 1 through 99.

Print with formatting.

A PRINT USING statement provides a means for specifying the format in which the variables specified in the statement are to be printed. This format can be in a literal string, a string variable, or in a special statement called the IMAGE statement. With PRINT USING:

- Numbers can be printed in integer, fixed point, and floating point representations.
- The exact position of the plus or minus sign can be specified.
- String values can be printed in specified fields and literal strings and blanks can be inserted wherever needed.
- Full control of carriage returns and line feeds is possible.
- Arbitrary long lines can be printed without the carriage returns and line feeds normally provided by the PRINT statement.

Program testing.

BASIC/1000L provides user requests for tracing program execution, inserting up to four breakpoints, and for simulating execution of subroutine calls. These capabilities are very convenient for testing programs on a system different from the target system in which they will be used.

*HP-IB (Hewlett-Packard Interface Bus) is Hewlett-Packard's implementation of IEEE Standard 488-1975/1978, "Digital Interface for programmable instrumentation."

Program editing.

Using the BASIC editor, the user can edit characters within a statement line, leaving some characters unchanged, inserting characters, and replacing or deleting characters as desired. This is in addition to the complete line replacement and insertion capabilities characteristic of most BASIC systems.

Program statement renumbering.

The BASIC/1000L, user can systematically change program statement numbering with a simple command, without retyping statements, a capability that greatly facilitates insertion of additional program statements where needed.

Disc storage of programs and data.

BASIC/1000L programs are easily saved in named disc files, in either source or faster-executing semi-compiled form. The user can also create files on the disc for data storage and retrieval access with serial PRINT# and READ# program statements. Files are easily renamed or purged to accommodate changing needs.

Program linking.

BASIC/1000L includes two statements for automatically linking two programs together so they run as one long program. These are the CHAIN statement and the INVOKE statement. Either of these statements in the current program retrieves a named program from the disc and starts it running from the first statement or any later statement number that is specified in the CHAIN or INVOKE statement. These statements can call either BASIC or non-BASIC programs, which can access previously-opened BASIC data files and use any previously-enabled TRAPs. A CHAINed or INVOKEd program may also call another program. The difference between these statements is that when the current executing INVOKEd program terminates or suspends itself, control is returned to the program that called it. The CHAIN statement does not include return of control.

Functional specifications

Configuration information

Compatibility: BASIC/1000L runs only under RTE-L. The BASIC/1000L table generator (BATBL) can be run in RTE-IVB with revision code 2001 or later to prepare tables of subroutines for BASIC/1000L for use in target L-Series systems operating under RTE-L.

Operating environment: Any disc-based L-Series hardware configuration that also includes a terminal.

Memory required: 32k byte background area, of which 12k bytes is available for the user's real-time BASIC program.

Basis of BASIC task scheduling for execution

By operator, another task, time, or event, in order of task priority.

BASIC task priority levels

1 through 99, the lowest number designating highest priority.

Program data types

- REAL data — a 32-bit quantity with sign, exponent, and mantissa, ranging from $\pm2^{-127}$ to $\pm2^{+127}$, with 6 to 7 decimal digit accuracy.
- STRING data — ASCII strings up to 255 characters long represented and manipulated by variables.

- OCTAL data — a 16-bit quantity including sign that can be entered into programs, manipulated, and output using the bit manipulation statements provided in HP Real-Time BASIC.

Program character set

- The 26 upper case letters A through Z.
- The ten digits 0 through 9.
- Special characters: blank; equals, greater than, less than, plus, minus, up arrow, and # signs; asterisk; slash; left and right parentheses and left and right brackets; quotation, apostrophe, and question marks; comma; colon; semi-colon; decimal and exclamation points; ampersand; and currency symbol.

Operator requests

1. Load program into memory.
2. Merge additional tasks or statements into program already in memory.
3. Run program that is in memory or stored on an off-line media.
4. List program that is in memory.
5. Save program that is in memory on flexible disc, cartridge disc, or fixed hard disc file or on Mini cartridge.
6. Delete current program from memory.
7. Enter individual program statements, operator requests, or data inputs into system.
8. Delete a line(s) of program.
9. Interrupt or abort a running program.
10. Create a data file on disc.
11. Purge program or data file from disc.
12. Rename program or data file on disc.
13. Trace program execution for correcting program faults.
14. Set up program breakpoints for correcting program faults.
15. Display and/or set subroutine call variables for simulation of subsystems not in the host computer system.
16. Renumber program statements.

System requests from programs

1. Read from any non-disc input device.
2. Print on any non-disc output device.
3. Schedule task to be run at specified time, at specified intervals, and/or in response to specific event, including terminal keystroke.
4. Enable or disable self or other task.
5. Access files on disc or flexible disc.
6. Read from or write on disc.
7. Link from current program to another named program on disc.

Supported capabilities

1. Real-time operation program statements are provided for specifying task priority and time scheduling, and for linking event interrupts to tasks.
2. Disc file access.
3. High-level calls to devices on the Hewlett-Packard Interface Bus (HP-IB).
4. Bit manipulation program statements are provided for examination, logical addition and multiplication, shifting and selective setting and clearing of digital word bit patterns.
5. Character string definition and manipulation: ASCII strings up to 255 characters long may be represented and manipulated through the use of string variables.
6. Chaining or linking together of program segments so they run as one long program.

7. Computation: real-time BASIC can call on 23 different standard functions and operators, including square root, exponentiation, logarithmic, logical, and trigonometric functions, as well as the base capabilities of addition, subtraction, multiplication, and division.
8. Formatted printing of numbers and character strings.

Program vocabulary

PROGRAM VOCABULARY ITEMS	USES
General program Statements	
COM P(8),T(18)	Allocates common program storage.
DIM A(3),B(3),K(5)	Allocates program storage.
REM TASK 1	Inserts remarks in program listing.
LET R=R1*100+R2	Assigns value ("LET" is optional).
DEF FN(A)=A↑3	Sets up user-defined function.
FOR I=1 TO 50 STEP 7	Sets up repetitive operations loop.
NEXT I	Returns to start of loop for next repetition, or terminates loop if NEXT I would exceed limit.
INPUT X,Y,Z	Receives data from user terminal.
READ #N,M;A(1), A(2), A(3)	Reads record M of disc file N or from unit N.
READ D(1),I(1),I(2),J(1)	Reads values from DATA statement.
DATA 1,27.5,10,35.79	Provides values to READ statement.
RESTORE	Resets READ pointer for next reading of DATA.
RESTORE 120	Resets READ pointer for specific DATA statement for next reading of data.
IF M1=24 THEN 590	Sets up conditional action.
GOTO 2480	Unconditional transfer to specified statement.
GOTO X+3 OF 200,300,400	Multibranch transfer.
PRINT "UNIT GOOD"	Prints on system console.
PRINT #Z,Y;A,"STRING",A(1)	Writes record Y on disc file Z or unit Z.
IMAGE "ENTER CLOCK NO"	Specifies format or content for PRINT USING statement.
PRINT USING 200:A$	Prints in format specified by IMAGE statement (statement no. 200) on system console.
PRINT USING #X 200:A$	Prints on, or outputs to, unit number X in format specified by IMAGE statement (statement no. 200).
WAIT (1000)	Inserts specified delay in program.
GOSUB 980	Transfers to specified subprogram statement.
GOSUB A+8 OF 120,340,710	Multi-branch transfer to subprogram statement.
RETURN	Returns from subprogram to statement following GOSUB that caused most recent transfer.
PAUSE	Interrupts program execution.
PAUSE (10)	Interrupts program execution and prints an identifying number (10 in this example).
STOP or END	Terminates program execution, returning system to conversational mode.
CHAIN "PROG2",S	Retrieves named program from disc and starts it running, from statement number S.
INVOKE "PROG2",S	Retrieves named program from disc and starts it running, from statement number S. Leaves BASIC data files open and TRAPs enabled and returns control to calling program upon completion.
CALL DCODE(P1, . . . PN)	Identifies and executes an external subroutine that has been established in an overlay. ("CALL" is optional.)

PROGRAM VOCABULARY ITEMS	USES
12009A HP-IB Interface Program Statements	
TRIGR(I)	Sends Group Execute Trigger (GET) to one or more devices.
CLEAR(I,C)	Initializes one or more devices to the dependent reset state.
RMOTE(I)	Sets the REN bus line high, causing one or more devices to go to remote.
GTL(I)	Sends a GTL command allowing one or more devices to go to local control mode.
LLO(I)	Sends Local LockOut (LLO) to all devices to prevent local panel control.
LOCL(I)	Returns devices to local mode from either remote or local lockout mode.
ABRT(I,C)	Clears all bus/device activities.
CNFG(I,C,W)	Configures LU to allow system or program handling of errors.
CMDR(I,C,D)	Issues bus I/O request to write command C and/or read input data D via HP-IB interface I.
SECR(I,S,D,L)	Issues secondary address S to device I and/or reads integer data D of length L.
SECRR(I,S,D,L)	Issues secondary address S to device I and/or reads real data D of length L.
CMDW(I,C,D)	Issues bus I/O request to write command C and/or output data D via HP-IB interface I.
SECW(I,S,D,L)	Issues secondary address S to device I and/or outputs integer data D of length L.
SECWR(I,S,D,L)	Issues secondary address S to device I and/or outputs real data of length L.
SRQ(I,V,P)	Enables or disables a Service ReQuest (SRQ) program P with arbitrary value V.
B.SET(I,N,V,T)	Sets up link between Service ReQuest (SRQ) from HP-IB device I to Trap number N with the ability to pass an arbitrary value V and (optionally) designate type of polling T, which can be parallel (default) or serial.
BSTAT(I,V,S)	Retrieves device I status S at last interrupt along with arbitrary value V.
SRQSN(I,N)	Sets up link between Service ReQuest (SRQ) from HP-IB device I and Trap number N (B.SET, above, is preferred over SRQSN for new uses; SRQSN is provided for compatibility with old programs).
STATS(I,S)	Retrieves device status S from device I.
PPOLL(I,C,D)	Controls parallel poll activity on the bus.
PPSCH(I,V,P)	Enables or disables parallel poll program P scheduling with arbitrary value V.
PPSN(I,N)	Sets up link between parallel poll program and Trap number N.
PSTAT(I,S)	Retrieves bus status S from devices that have been previously parallel poll enabled.
E = IBERR(I)	Retrieves device or interface I error code and stores it in E.
L = IOCNT(I)	Retrieves actual length of transfer from device I and stores it in L.
Formatted I/O Data Conversion Program Statements	
DCODE (A$,V,F$)	Converts character string A$ to value V as specified by format string F$.
DCODE (V,A$,F$)	Encodes value V into character string A$ as specified by format string F$.
CHRS (V,A$(2,2)	Assigns decimal value V to character 2 in character string A$.
V=NUM (A$(2,2))	Equates variable V to decimal value of character 2 in character string A$.

Program vocabulary

PROGRAM VOCABULARY ITEMS	USES
Event, Time, and Priority Scheduling and Control Program Statements	
TRAP N GOSUB 250	Links event interrupt N to execution of task subroutine starting at statement number 250.
TIME(T)	Gets time of day for program.
SETP (250,1)	Sets task priority level (1-99).
TRNON (250,1200)	Turns on task execution at specified time.
START (250,95)	Starts timing to next execution of task.
DSABL (250)	Disables task (prevents scheduling).
ENABL (250)	Enables task (permits scheduling).
Bit Manipulation Program Statements (can also be used as functions)	
OR (M,N,R)	Adds M and N, bit-by-bit, giving result R.
NOT (M,N)	Returns complement N of M.
EOR (M,N,R)	Adds M and N exclusively, giving result R.
AND (M,N,R)	Logically multiplies M by N, giving result R.
ISHFT (M,N,R)	Shifts M by ±N bit positions, giving result R.
IBTST (V,B,S)	Returns state S of bit B in value V.
IBSET (V,B,R)	Sets bit B in value V, giving result R.
IBCLR (V,B,R)	Clears bit B in value V, giving result R.
ISETC ("177077",K)	Sets variable K equal to an octal constant.
Disc File Program Statements	
FILES DATA, RESULTS	Designates and opens up to 16 files simultaneously to a program.
READ #1,M:A$,A,B,C,D	Reads character string A$ and variables A through D from record M of first file listed in FILES statement.
PRINT #3,X;R,W(1),R$,END	Prints variables R through R$ in record X of third file listed in FILES statement; END (End-of-File) is optional).
ASSIGN "NEWFL",4,S	Opens new file and associates it with specified file number.
IF END #2 THEN 800	Defines exit procedure at End of File on specified file.
Character String Program Statements	
COM A$(10),U$(3,8),A(16)	Allocates common storage for string variables as well as other variables.
DIM G$(12),X$(6,3),W(24)	Allocates program storage for string variables as well as other variables.
LET A$= "CHAR. STRING"	Assigns character string to variable, or adds or subtracts character string variables.
IF A$<=B$ THEN 230	Conditional action based on character string comparison.
INPUT A$,B$,C$	Character string entry from system console.
READ U$,P$	Reads character strings from DATA statement.
DATA "UNIT", "PASSES"	Provides character strings to READ statement.
PRINT U$,P$	Prints characters represented by string variables.

PROGRAM VOCABULARY ITEMS	USES
Functions (shown in program statements)	
LET X=ABS (W+V−Z)	Calculates absolute value of variable or expression.
LET Z=EXP (X)	Calculates base e exponential value of variable or expression.
IF Y<INT(X) THEN 240	Gives integer part of variable or expression.
LET R=R+LOG (S+T+Y*Z)	Gives base 10 logarithm of variable or expression.
LET B=C*LN (D−G)	Gives base e logarithm of variable or expression.
LET Y=RND(X)	Generates random numbers (0 through 1).
LET S=SGN (X+Y−Z*Q)	Returns sign (+·−) of variable or expression.
LET H=SQR (Y*Z)	Calculates square root of variable or expression
PRINT A,TAB(20),B,TAB(36),C	Controls column spacing in PRINT statements.
LET T=SIN(A)*3.25	Calculates sine of variable or expression.
LET U=COS(T)+21.575	Calculates cosine of variable or expression.
IF TAN(X)>5.347 THEN 420	Calculates tangent of variable or expression.
LET V=ATAN(Y+Z)	Calculates arctangent of variable or expression.
PRINT OCT(K),J.M	Provides for printing of octal values.
IF LEN(B$)>=21 THEN 1000	Determines length (no. of characters) in string (B$).
IF TYP(N)=2 THEN 1500	Determines type (number, character string, or end-of-file) of the next item in file N.
Operators (shown in program statements)	
LET X=Y+Z	Addition.
LET X=Y−Z	Subtraction.
LET X=Y*Z	Multiplication
LET X=Y/Z	Division.
LET X=Y↑Z	Exponentiation.
IF X AND Y>Z THEN 500	Logical AND.
IF X OR Y<Z THEN 670	Logical OR.
IF NOT X THEN 330	Logical NOT.
Relators (shown in program statements)	
IF X # THEN 130	Not equal to.
IF X < Y THEN 490	Less than.
IF X > Y THEN 520	Greater than.
IF X <= Y THEN 420	Less than or equal to.
IF X >= Y THEN 310	Greater than or equal to.
LET C = A+B−Q	Equal to.

Ordering information

Products for the first-time single user

92076A BASIC/1000L System
(for use in RTE-L System)

BASIC/1000L consists of:

1. BASIC/1000L resident library, subroutine library, including table generator, task scheduler, decimal string arithmetic interface, BASIC interpreter, and software numbering file on one of options 041 through 051, which must be ordered.
2. BASIC/1000L Real-Time BASIC Reference Manual (92076-90001).
3. RTE-L BASIC/1000L Software Installation Manual (92076-90002).

92076A BASIC/1000L options

041: Provides BASIC/1000L software on flexible disc for L-Series System Flexible Discs.

The following options are valid only for current RTE-IVB users with the 7970B/E mag tape subsystem who have 92070A (RTE-L relocatables) on the RTE-IVB system and intend to also configure the BASIC/1000L subsystem for an L-Series operating system.

050: Provides BASIC/1000L software on an 800 bpi, 9-track mag tape in exact disc image format of a FMGR disc space.

051: Similar to option 050, above, but with BASIC/1000L on 1600 bpi, 9-track mag tape.

BASIC/1000L Software Support Services

NOTE: Software Support Services are priced in monthly units and are billable quarterly, or annually in advance.

BASIC/1000L Customer Support Service Products

92076T Customer Support Service for 92076A software

Provides on-going Systems Engineering assistance for 92076A BASIC/1000L software, consisting of extension of your Account S.E. coverage to BASIC/1000L, a phone-in consulting service for discussion of questions on 92076A software, and on-site resolution of 92076A software problems, if required. Media option 041, 050, or 051, similar to those listed under 92076A, must be selected.

92076V Central support for an additional copy of 92076A

Extends Customer Support Service to an additional copy of 92076A through the same system manager as the 92076T service, which is prerequisite to 92076V.

BASIC/1000L Software Subscription Service Products

92076S Software Subscription Service for 92076A software

Provides one set of software and manual updates as required to keep your 92076A product current with respect to enhancements and other changes as they are released by Hewlett-Packard. Media option 041, 050, or 051, similar to those listed under 92076A, must be selected.

BASIC/1000L Documentation Distribution Service

NOTE: Documentation distribution services are priced in monthly units and are billable quarterly with other quarterly billing services or annually in advance. Annual prepayment is required if no other support service is ordered.)

92076Q Manual Update Service for 92076A software manuals

Provides updates as required to keep software manuals furnished with your 92076A product current with respect to enhancements and other changes as they are released by Hewlett-Packard if 92076T/S is not ordered.

product number 24397A

The HP 24397A Diagnostic Package provides stand alone testing of the L-Series CPU, memory, and its set of interface cards. Diagnostic software can be loaded into memory from a 2645A Terminal with cartridge tape unit (CTU) or from a 12023A/12024A Flexible Disc Subsystem.

Features

- Verification by the kernel diagnostic of all CPU instructions, memory, I/O logic and processor functions such as interrupt handling, timebase generator, memory protect, parity checking and direct memory access (DMA)
- An interface diagnostic written in Diagnostic Design Language for each of the following L-Series interface cards:

  12005A — Asynchronous Serial Interface
  12006A — Parallel Interface
  12008A — PROM Card
  12009A — HP-IB Interface

- Test hoods for complete verification of interface cards
- "BASIC-like" Diagnostic Design Language interpreter for easier user diagnostic design for user-designed interfaces and specialist level diagnosis
- All diagnostic software on a single medium of user's choice
- Remote diagnosis capability via phone lines using Bell 103 modem and the virtual control panel (VCP)

Configuration requirements

L-Series processor: 2103L/LK Computer or HP 1000 Model 9 or 10 System.

Memory: 32k bytes, minimum.

Loading devices: Cartridge tape unit on a 2645A +007 Terminal, or a 12023A/12024A Flexible Disc Subsystem.

Console device (needed only for running the Diagnostic Design Language and optional for running any of the interface diagnostics): Any HP 1000 L-Series compatible 26xxA terminal connected to the computer via a 12005A Asynchronous Serial Interface.

Ordering information

24397A Diagnostic Package, consisting of:

1. The following modules on one of media options 020 or 041, which must be ordered:
   a. Kernel Diagnostic for CPU functions
   b. Diagnostic Design Language
   c. 24397A Software numbering file
   d. 12005A Async Serial Interface Diagnostic
   e. 12006A Parallel Interface Diagnostic
   f. 12008A PROM Storage Module Diagnostic
   g. 12009A HP-IB Interface Diagnostic

2. A binder containing the following manuals:
   a. Hardware Troubleshooting for HP 1000 L-Series Computers Manual (24397-90001).
   b. Kernel Diagnostic Operating Manual (24397-90002).
   c. Diagnostic Design Language (DDL) Operating and Programming Manual (24397-90003).
   d. HP 12005A Async Serial Interface Diagnostic Operating Manual (24397-90005).
   e. HP 12006A Parallel Interface Diagnostic Operating Manual (24397-90006).
   f. HP 12008A PROM Storage Module Diagnostic Operating Manual (24397-90008).
   g. HP 12009A HP-IB Interface Diagnostic Operating Manual (24397-90009).

3. Test hoods 24397-60001 for verification of 12005A Asynchronous Serial Interface and 24397-60002 for verification of 12006A Parallel Interface.

24397A options

020: Diagnostic software on phase-encoded Mini cartridges for 2645A Terminal with option 007.

041: Diagnostic software on flexible disc for L-Series System Flexible Discs.

24397A in HP 1000 L-Series Systems

The 24397A L-Series Diagnostic Package is included in HP 1000 L-Series Systems, Models 9 and 10.

24397S Diagnostic Subscription Service

Provides all diagnostic routines, operating manuals, and test hoods included in the 24397A Diagnostic Package that have been added or updated in the last quarter as well as all manual updating supplements. The same media option used in ordering the 24397A Diagnostic Package must be specified when ordering 24397S. The 24397S service is priced in monthly units and is billable quarterly.

Support offered for HP 1000 L-Series Computers and Systems includes:

1. User training services.
2. Site planning service.
3. Installation.
4. Warranty.
5. Hardware history library.
6. Hardware notification subscription service.
7. Maintenance agreement service.
8. Software support services.

User training services

Regularly-scheduled training is available on HP 1000 L-Series software. The courses offered are listed in the training data sheet on page 7-2 and in the HP Computer Systems Group Course Schedule, along with registration information and course locations. The course schedule is available from your Hewlett-Packard Sales Representative.

Site planning consultation

To assist in planning your HP 1000 L-Series Computer System installation, Hewlett-Packard offers a Site Planning Service. After you've ordered your system and the site planning service, an HP Customer Engineer will send you the HP Site Planning Manual accompanied by a letter requesting that you review the manual and then contact the Customer Engineer to schedule an on-site planning visit. During that visit, the HP Customer Engineer will discuss with the person designated as your Site Coordinator the site preparation steps given in the manual and will assist your people in determining what electrical and environmental preparation should be accomplished at the system's operating site prior to installation.

Installation assistance

Hewlett-Packard also offers an installation service. With this service, after your System Manager or Site Coordinator has confirmed that the necessary hardware and software has been delivered and moved to the operating site, an HP Customer Engineer will:

1. Supervise unpacking, assembly, and installation of the system components and peripheral hardware.
2. Test the primary system.
3. Test the primary system peripherals and subsystems.
4. Run off-line diagnostic tests on non-configured peripherals.
5. Demonstrate the software backup procedure.
6. Provide advice on customer maintenance procedures.

Warranty

All Hewlett-Packard computers, components, and systems are covered by warranty. For specific information, contact your Hewlett-Packard Sales Representative.

Hardware history library

The 92851A HP 1000 Hardware history library is intended for OEMs and other users who desire in-depth information on HP 1000 Computer hardware and engineering changes to that hardware. The 92851A product includes:

Engineering Reference Documentation, which contains the theory of operation, timing information, and schematics of many of the HP 1000 Computer products.

The HP 1000 Hardware and manual index log, which provides a current index to all hardware manuals. It also includes engineering descriptions and documentation for many of the HP 1000 hardware products and their respective update and enhancement histories. This coverage is further supplemented by instructions on how to perform the actual modifications.

The current Service Notes fiche, which contains information on important product changes and status regarding warranty behind each change.

Hardware notification service

The 92851Q HP 1000 Hardware notification service provides updates to the 92851A Hardware history library that reflect HP 1000 hardware changes as they are released by Hewlett-Packard. These updates include:

- Updates to the HP 1000 Hardware and manual index log and the Engineering Reference Documentation as required to reflect hardware changes.

- The latest printed Service Notes to provide users with the most up-to-date information available.

- The latest Service Notes fiche when it is issued (every 6 months); this fiche will incorporate all previously issued printed Service Notes.

Hardware service agreements

Service agreements are available for HP installed Computer Systems and accessories. The Basic Monthly Maintenance Charge (BMMC) covering all necessary parts, labor, and travel within the normal service zone for preventive maintenance, remedial maintenance, and engineering updates will be quoted on request by your Hewlett-Packard Sales Representative. The BMMC provides coverage from 8 A.M. to 5 P.M., five days per week, excluding Hewlett-Packard holidays. Extended coverage is available at additional cost.

Software Support Services

Software support services are covered in a separate data sheet starting on page 7-3.

Catalog of RTE-L and related training courses

22953B RTE-L Course

Description: This course is intended for users who have no previous experience with Hewlett-Packard RTE systems. It covers the use of an RTE-L system in the HP 1000 L-Series system environment and includes program preparation using the standard program development software and RTE-L system generation and installation.

Length: 5 days.

Lab: Provides hands-on experience in putting the course content into actual practice on HP 1000 L-Series hardware.

Prerequisites: FORTRAN programming experience.

22954B RTE-L for RTE users

Description: This course is intended to provide current RTE users with a working understanding of RTE-L. Because of the student's previous training and experience, this shorter course can substitute for the 22953B course listed above. At the end of the first day, the student will be using the RTE-L system for program development and at the end of the second day, the student will be generating RTE-L systems.

Length: Two days.

Lab: Provides hands-on experience in putting the course content into actual practice on HP 1000 L-Series hardware.

Prerequisites: Previous training in, or experience on, other Hewlett-Packard RTE operating systems and FORTRAN programming experience.

22955B Advanced RTE-L Course

Description: This course explores the RTE-L system in sufficient depth to give a basis for making intelligent decisions about system performance and to provide instruction in the preparation of input/output drivers for use in the RTE-L operating system.

Length: Three days, which will normally be scheduled to follow the 22954B course.

Lab: Provides hands-on experience in development of I/O driver routines for operation under RTE-L.

Prerequisites: Completion of the 22953B or 22954B RTE-L course and the 22952B HP 1000 Assembler Programming course or equivalent Assembly language programming experience in an RTE system.

22952B HP 1000 Assembler Programming Course

Description: This course covers the operation of the RTE assembler in an HP 1000 Computer System environment. Major emphasis is placed on the development of assembly language programs for use in an RTE operating system.

Length: 5 days.

Lab: Provides extensive hands-on experience in the coding, editing, assembly, and debugging of RTE assembler programs using an HP 1000 Computer System (not necessarily an HP 1000 L-Series System).

Prerequisites: Completion of the 22953B or 22954B RTE-L course.

22980C HP-IB in HP 1000 Computers

Description: This course provides an introduction to HP-IB concepts and theory as they apply to use in HP 1000 Computer System controlled measurement systems as well as training in the programming of HP-IB on an RTE system. Information on HP-IB message subroutines and device subroutine writing techniques is also presented. NOTE: The course discussion centers mainly on HP-IB as it is used in HP 1000 Computer Systems based on HP 1000 M-, E-, and F-Series Computers and operating systems other than RTE-L; however, most of the basic principles apply equally to HP 1000 L-Series Computers and Systems and to operation under RTE-L.

Length: 4 days.

Lab: Provides hands-on experience with a typical HP 1000 computer controlled HP-IB instrument system.

Prerequisite: Completion of the 22953B or 22954B RTE-L course or equivalent RTE experience.

Ordering, registration, and scheduling information

Information on tuition for scheduled courses is provided in the HP 1000 L-Series Computers and Systems Price List and course scheduling information is provided in the current HP Computer Systems Group Course Schedule. Both of these documents are available from your Hewlett-Packard representative.

Introduction

It is important for you to know in advance the types and categories of Hewlett-Packard software and support that are available for your HP 1000 Computers and Systems. These are summarized briefly in the table below and further explained in this data sheet.

Software categories

Hewlett-Packard defines six categories of software: Active, Mature, Copied, Special, Contributed, and Obsolete. The availability of HP support services and training depends upon the category of a software product, as follows:

Active software.

Active HP 1000 software and firmware receives regular software maintenance and may also receive periodic enhancements that add capabilities or improve performance. HP's software services are available for all active software products. Training for most active software is scheduled on a regular basis at Hewlett-Packard training centers around the world.

Mature software.

Mature HP 1000 software receives regular software maintenance. HP's support services are available for many mature products. Training is usually available on request.

Copied software

Customers with multiple computer systems may find it economical to purchase a license to copy from HP in order to duplicate a given software product for use on an additional computer. HP's normal software support services are available for such copied software. Training availability is the same as that for the software copied.

Special software.

Certain software items are available from the factory Special Software Development Group to accomplish special jobs or achieve higher performance under specialized conditions. Support and training for special software is negotiated at time of purchase. For more information about software in this category check with your HP Sales Representative.

HP 1000 software support summary

SOFTWARE CATEGORIES AND DEFINITIONS	CATEGORY A: ACTIVE SOFTWARE Active software receives regular software maintenance and may also receive periodic enhancements that add capabilities or improve performance.	CATEGORY B: MATURE SOFTWARE Mature software receives regular software maintenance.	CATEGORY C: COPIED SOFTWARE Copied software includes active or mature HP software that has been duplicated by permission of HP. This usually involves the purchase of a right to copy product.
PRODUCT CONTENT	Provides a license to use software on one computer and delivery of software and manuals (and firmware if part of the product).		Provides a license to copy software once and delivery of manuals and firmware (if part of a right to copy product).
CUSTOMER TRAINING AVAILABILITY	Regularly-scheduled courses are available on most active software products.	Most training for mature products is scheduled on request.	Availability is the same as that for software being copied.
SOFTWARE SUPPORT SERVICES	Available for all active software products.	Available for many mature software products.	Availability is the same as that for software being copied.
Software Subscription Service content	Provides a license to use updates on one computer and delivery of software, firmware (if applicable) and manual updates plus periodic notification of software status. Customers may submit software maintenance requests via mail.		Provides firmware updates (if applicable) and license to copy software updates once for use on an additional system.
Customer Support Service content	Provides everything in the Software Subscription Service, plus a phone-in consulting service, on-site resolution of HP software problems (if required) and assigns an HP Systems Engineer to your account.		Provides firmware updates (if applicable) and license to copy software updates once for use on an additional system. Extends Customer Support Service to the copied software through the same System Manager.
DOCUMENTATION DISTRIBUTION SERVICES	Available for all active software products.	Available for many mature software products.	Availability is the same as that for software being copied.
Software Notification Service content	Provides information on software updates, outstanding software problems and resolutions, and new programming techniques.		Information provided is the same as that for software being copied.
Manual Update Service content	Provides periodic manual updates to keep additional manual sets for active software up to date. software up to date.		Provides periodic manual updates to keep manual sets associated with copied software up to date.
SOFTWARE CONSULTING	On-site consultation with a trained Hewlett-Packard Systems Engineer can be ordered for all categories of software.		

Contributed software.

Many programs written for HP 1000 Computers have been contributed to the International HP 1000 User's Group's Contributed Library. Such contributed softrware can provide you with many useful routines to help you further apply your system. You can obtain the library by writing to:

> International HP 1000 Users Group
> P.O. Box 1000
> Norwood, MA 02062

Obsolete software.

Assistance for obsolete software is available on a time and materials basis. Hewlett-Packard will provide software parts and documentation for at least 5 years after the start of the obsolescence period.

Implementation planning

Putting HP software to work for you

Prior to purchasing your HP 1000 system, a complete implementation plan should be developed with the assistance of your local Hewlett-Packard Sales Representative. This document will help you to plan in advance to make the best use of HP's wide range of support services and training. Such a plan would normally include the following items relating to software:
- Selecting a System Manager
- Training
- Keeping Your Software Current
- Software and Firmware Support
- Software Support for Multiple Computer Sites
- Documentation Distribution Services
- Software Consulting

Choosing the proper level of support in each of these areas can be a key factor in ensuring the success of your operation. Each area involving software and firmware is discussed in detail below. Hardware support is discussed elsewhere in this data book.

You'll want a competent system manager

Hewlett-Packard computer systems and software products are powerful and sophisticated computer tools that require a professional level of user knowledge for proper utilization. To realize the full potential benefits of your HP computer system and HP software, we recommend that you establish a position of System Manager in your organization and fill that position with a computer-knowledgeable person who has a degree in Computer Science, Electrical Engineering, or an equally-strong background. You should do this for the following reasons:

Reason one:

Your System Manager has the responsibility of putting your HP 1000 Computer System to work. This requires specific application and software knowledge to do the job.

Reason two:

HP can support your system and software most effectively when the person calling for assistance is familiar enough with your system to effectively communicate with our Customer Engineers and System Engineers. This same, knowledgeable person is also best-equipped to receive, understand, and successfully apply the suggestions of our technical field people. As with reason one, most effective HP support ultimately adds up to the most cost-effecitve implementation.

When your HP 1000 Computer Systems are linked together in a network, one System Manager should be appointed the Network Manager. By having this one person make all contacts with our Customer Engineers and Systems Engineers, a valuable base of network experience is built up that helps assure successful implementation of your network while minimizing your support costs.

HP's user training will prepare you you in advance

After you've purchased your software, your System Manager should attend the appropriate HP customer training courses to learn the use of the operating systems and software subsystems. Most of these courses include extensive hands-on experience and all of them will help your System Manager to implement your system. You may also want to send other members of your programming staff to the training courses to equip them to be most productive. At a minimum, your System Manager should attend one of the following courses:
- 22953B RTE-L Course
  or
- 22954B RTE-L for RTE Users

For more information on these and other courses, see the User Training Services Data Sheet on page 7-2.

Keeping your software and firmware current

It is important for you to realize that any new software added to your computer system will be guaranteed to be compatible only with the latest revision of the operating system and any other subsystems or firmware with which it interacts. This emphasizes the desirability of keeping your software and firmware current.

HP's support services are the recommended way to keep your software up to date and obtain enhancements that are made to the software products you have purchased. Customers who are on HP's software support services program for Type I software products will be provided with the most recent version of each software product covered at no additional charge (except in some cases, for media), provided that the new version will execute on the current hardware configuration.

Software updates for Type II software products will generally be limited to correction of software discrepancies. (See the HP 1000 Software Rights and Privileges Statement in this data book for a list of Type I and Type II active software products.)

Customers without support services must repurchase the product (in some cases an update discount is available) in order to obtain an enhancement to (or the latest version of) that software product.

HP's software support — a choice of services for keeping you current and helping you apply your system

Hewlett-Packard offers two levels of software support: Customer Support Service and Software Subscription Service.

Customer Support Service

Customer Support Service is Hewlett-Packard's standard software support product. This service provides the highest level of ongoing support available from HP, and is designed to assist your System Manager in using, updating, and maintaining HP 1000 software products. This service assures that a trained HP Systems Engineer will be in contact with your System Manager on a regular basis for assistance with HP products. This service features:

- Assignment of a Hewlett-Packard Systems Engineer to your account.
- Phone-in consulting service.
- On-site resolution of HP software problems.
- Right to use software updates and firmware updates on one computer.
- Software updates.
- Firmware updates.
- Reference manual updates.
- Periodic notification of software status.
- Software problem reporting.

Account responsible systems engineer. A Hewlett-Packard Systems Engineer (SE) will be assigned to be technically responsible for your account. This SE will be expected to spend several hours per quarter in direct personal support of your System Manager. Typically this will involve reviewing your application on a regular basis and previewing upcoming software releases for potential use of new features and explanation of any changes that may impact your operation.

Phone-in consulting service. Consulting by Hewlett-Packard Systems Engineers is available, over the phone, to assist the HP 1000 System Manager in resolving difficulties associated with HP 1000 software products. This service is provided within four working hours after the System Manager requests it.

On-site systems engineering assistance. The assistance of Hewlett-Packard Systems Engineers is available, at your System Manager's site, to help resolve HP 1000 software difficulties that cannot be resolved using phone-in consulting. On-site assistance is provided within eight working hours after the System Manager requests it.

Phone-in consulting service and on-site engineering assistance are not intended to be used for customer training or for any reason other than to resolve difficulties associated with HP 1000 software products. Consulting or assistance provided to resolve difficulties not associated with HP 1000 software products is subject to additional charge. Support for non-Hewlett-Packard devices and system modifications is the customer's responsibility.

Right to use software updates and firmware updates. Purchase of HP's Customer Support Service grants you a license to use the software updates (and firmware updates if any) provided by the service on **one** computer.

Software updates. Every quarter, one copy of newly released software updates and enhancements is mailed directly to your HP 1000 System Manager. Enhancements, which are made only to active Type I software products, add capabilities or improve performance. Updates correct discrepancies that have been identified in the Software Status Bulletin. Typically, three months or more are required to develop, code, test, manufacture, and distribute updates and enhancements. Consequently all Software Status Bulletin problems may not be resolved by a given update. Also, updates may not be available for every quarter.

Firmware updates. For certain products, changes in software may require simultaneous changes in an associated firmware program. For that reason, the Customer Support Service includes firmware updates (if applicable) along with the software updates as they are released by the factory. Installation of firmware updates is discussed later in this data sheet.

Some firmware products are not directly associated with any software product. Separate, independently orderable subscription services can be ordered to keep those firmware products up to date.

Reference manual updates. Every quarter, one set of updates to HP 1000 software reference manuals is mailed directly to your HP 1000 System Manager. The updates provide documentation on how to use all the features of newly released HP 1000 software updates and enhancements. Updates may also remedy documentation problems of omission, clarity, or errors that have been identified in Software Status Bulletins. Manual updates may be in the form of manual change information, manual page inserts, or entire manual replacements.

Periodic notification of software status. HP periodically distributes the following items to System Managers on the Customer Support Service:

- **HP 1000 Communicator.** (6 issues/year) contains useful software application data, abstracts, and ordering information for new and contributed software.
- **HP 1000 Software Status Bulletin.** (24 issues/year) lists newly discovered HP 1000 software problems and, when available, their interim programming solutions.
- **Software Update Notice.** (4 issues/year) contains thorough documentation of newly released HP 1000 software updates. It tells what software and manuals have changed, the effects of the changes, the current software revision codes and required firmware/hardware changes, if any. In addition, the Notice instructs the System Manager on how to incorporate new software into operating systems.

Software problem reporting. HP is continually working to improve its software by correcting known software problems. Customers who have purchased the Customer Support Service can help HP in this task by submitting Software Maintenance Reports to the local SE organization by mail. If the SE determines the problem to be a valid problem with HP software, it is forwarded to the factory for inclusion in the Software Status Bulletin. A written indication of the status of the problem is returned to the System Manager who has submitted the report.

Additional Phone-In Consulting callers for customers with Customer Support Service

Phone-In Consulting can be extended to an additional user by adding an authorized caller to the telephone number

used by the customer's System Manager. A separate product, which adds one caller, is provided for this purpose. Note, however, that on-site resolution of HP software problems can be arranged only by the System Manager.

Software Subscription Service

For those customers who do not require any Systems Engineering assistance, HP's Software Subscription Service is available. This service does not provide the assignment of an account-responsible Systems Engineer, Phone-In Consulting, or the on-site System Engineering assistance services of Customer Support Service, as described previously. The Software Subscription Service provides the following features as described under Customer Support Service:

- Right to use software updates and firmware updates (if any) on one computer.
- Software updates.
- Firmware updates.
- Reference manual updates.
- Software problem reporting by mail.
- Periodic notification of software status.

Software support for multiple computer sites.

When you establish the System Manager as our single point of contact for a group of HP 1000 computer systems, support for the software in each additional system can be purchased at a reduced rate. Separate support products are provided for this purpose. These products are sold on the following basis:

1. Each unique software product must be covered at least once at the full Customer Support Service or Software Subscription Service rate for that product.
2. All of the software in all of the computers connected in a network must be covered if any of the computers is to be covered.
3. Stand-alone systems or networks need not be included, but support services for systems not covered will be provided only at prevailing service rates.

Additional system support for both Customer Support Service and Software Subscription Service provides your System Manager with:
1. Firmware updates if applicable.
2. A license to copy software updates once for use on the additional system.
3. The right to copy, modify, and distribute one copy of the appropriate reference manual(s) for use with the additional system.

In addition, for Customer Support Service, the Phone-in Consulting Service is extended to include questions regarding the additional system. Note, however, that on-site resolution of HP problems is included for the additional system only if that system is located at the same facility address as the main system supported by your System Manager.

Buying software support along with your system

When you place an order for 12 months of either Customer Support Service or Software Subscription Service along with your order for an HP 1000 Computer System, HP will provide an additional 3 months of that service free of additional charge during the 90-day period immediately following installation of your system.

Firmware installation

Customers with Customer Support Service and a hardware service contract (and the 12791A Firmware Expansion Module on HP 1000 E- and F-Series Computers) will have firmware updates installed by the account Customer Engineer during the normal Preventive Maintenance visit. Under all other circumstances, the customer is responsible for installation of firmware updates. (Purchase of the 12791A Firmware Expansion Module for HP 1000 E- and F-Series Computers is strongly recommended as it greatly simplifies installation.) If desired, customers can purchase the services of an HP Customer Engineer to install firmware for a fixed fee.

HP's documentation distribution services

In addition to the two Software Support Services described earlier, Hewlett-Packard offers two types of Documentation Distribution Services. These services are appropriate for individual programmers who wish to be informed of software status and/or keep their own documentation up to date.

Software Notification Service

HP's Software Notification Service provides the recipient with the following publications on an annual basis:
- 6 issues of the Communicator/1000
- 24 issues of the Software Status Bulletins
- 4 issues of the Software Update Notice

You'll note that these are the same publications sent to your System Manager as part of the Customer Support Service or Software Subscription Service.

Manual Update Service

HP's Manual Update Service is available on a per-product basis. This service provides the recipient with one copy of all updates made to the reference manuals for a particular product. Changes are made quarterly as needed and may be in the form of manual change information, page inserts, or entire manual replacements.

Software Consulting

Assistance by a Hewlett-Packard System Engineer can be ordered as product number 22976B. This assistance is intended to provide a one-day on-site visit by a qualified HP System Engineer. Although this service does not include coding of software for your particular application, the insight gained through this service can help you better understand how to use the full potential of your HP 1000 Computer System and software. Multiple days of this service are ordered as a quantity multiplier of the 22976B product number.

Conditions for obtaining support services

- A System Manager must be designated by the customer as the recipient of the service. In addition, for Customer Support Service, the System Manager must be adequately trained in order to deal effectively with the HP System Engineer responsible for the account. Training requirements for HP 1000 System Managers are described earlier in this section.

- All system software and firmware must be at the current revision level before beginning software support and must not be modified by the customer. This ensures compatibility with software and firmware updates. *Customers with out of date software or firmware must purchase an upgrade product to obtain the latest versions before beginning software support.*

- All associated system hardware must be maintained at the latest required revision code level. This may be done through HP's Customer Engineering organization via a hardware service contract or on a time and materials basis. (To reproduce and analyze software problems the system must be compatible with those in HP Service Centers.)

- The same level of support must be purchased for all of the HP 1000 software and firmware products which make up the system. Due to the interaction among software and firmware products, service cannot be given to one product while omitting others.

Ordering information

HP 1000 Customer Support Service and Software Subscription Service

- Minimum subscription is 3 months.
- Service is billable quarterly, or annually in advance.
- One of the available media options **must be specified.**
- To assure prompt processing and timely start of coverage, order **must** include System Manager's name, complete mailing address, and telephone number.

HP 1000 Manual Update Service and Software Notification Service

- Minimum subscription is 12 months.
- These services are billable quarterly with other quarterly billable services or annually in advance (annual prepayment is required if no other support service is ordered).
- To assure prompt processing and timely start of coverage, order **must** include receipient's name and complete mailing address.

9xxxxT/9xxxxS Media options

020: Software updates on 26xxA phase-encoded Mini cartridges.

041: Software updates on flexible discs for L-Series System Flexible Disc Drives.

050: Software updates via 800 bpi magnetic tape.

051: Software updates via 1600 bpi magnetic tape.

HP 1000 L-Series Support and documentation services product summary

Supported software, software-firmware, or firmware-only product	Customer Support Service Products			Software Subscription Service Products		9xxxxT and 9xxxxS Media options			Manual Update Service Product
	For first system	For central support of additional system	For add'l. Phone-in Consulting caller	For first system	For central support of additional system	020	041	050-051	
92070A RTE-L software	92070T	92070V	92070P	92070S	92070W		•	•	92070Q
92076A BASIC/1000L software	92076T	92076V	†	92076S	92076W		•	•	92076Q
24397A L-Series Diagnostics	*	*	*	24397S	**	•	•		*
92070X RTE-L Sources	*	*	*	92070Z	*		•	•	*

92830A Software Notification Service: Covers all HP 1000 software products.

† *Included in 92070P.*
* *Not available.*
** *Not required because 24397A is a type II software product.*