

HP 1000 Computer Systems



HP 1000 M/E/F-Series Hardware Technical Data



Documentation Map for HP 1000 Data Books

I/O Architecture	Centralized Intelligence	Distributed Intelligence
Series	M/E/F	A/L
Systems and Computers	HP 1000 M/E/F-Series Hardware Technical Data Book	HP 1000 A/L-Series Hardware Technical Data Book*
Interfaces	HP 1000 M/E/F-Series Interfaces Summary	HP 1000 A/L-Series Interfaces Summary*
Software	HP 1000 Computers Systems Software Technical Data Book	
Communications	HP 1000 Computer Systems Communications Products Technical Data Book	
Peripherals	HP 1000 Peripherals Selection Guide	
Measurement and Control	HP 2250 Measurement and Control Processor Technical Data	
	HP 2240 Measurement and Control Processor Technical Data	

* Until about Mid-August 1982, there will be separate A- and L-Series data books, each containing information on interfaces.

NOTE: Data Book Supplements containing new or revised information are sometimes printed between data book revisions. Ask your Hewlett-Packard representative for the current data book or supplement in your area of interest.

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2108MK	M-Series Board Computer	2111F	Computer
2109EK	E-Series Board Computer	12990B	Memory Extender

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The HP 1000 Computers comprise a powerful, modular family of general-purpose small computers that are especially well suited for real-time applications that demand high performance. The HP 1000 family includes a broad range of processors which feature fast, reliable semiconductor memory systems, and multi-user, multiprogramming, Real-Time Executive (RTE) operating systems. The family also includes processors which meet your user-microprogramming needs.

The five members of the HP 1000 family are the A-Series, E-Series, F-Series, L-Series, and M-Series. This data book describes the M-, E-, and F-Series, which are a proven line of Centralized Intelligence I/O Architecture computers. The A- and L-Series contain Hewlett-Packard's unique Distributed Intelligence I/O Architecture, and are described in separate data books. See Table 1 for a summary of the HP 1000 computer family.

Table 1. HP 1000 Computer Family Summary

HP 1000 Series	I/O Architecture	HP 1000 Base Instruction Set	Supported Operating Systems	Implementation
M	Centralized Intelligence	Yes	RTE-II, -IVE, -IVB, and RTE-6/VM	Microprogrammed in STTL/MSI and SSI hardware
E	Centralized Intelligence	Yes	RTE-II, -IVE, -IVB, and RTE-6/VM	Microprogrammed in STTL/MSI and SSI hardware
F	Centralized Intelligence	Yes	RTE-IVE, -IVB, -IVB, and RTE-6/VM	Microprogrammed in STTL/MSI and SSI hardware*
A	Distributed Intelligence	Yes	RTE-A.1	Horizontally Microprogrammed Schottky bipolar LSI
L	Distributed Intelligence	Yes	RTE-L, -XL	Hardwired with SOS/LSI and MSI hardware

*Supplemented by the Floating Point Processor.

The Centralized Intelligence HP 1000 computers provide three classes of computing power within a tightly knit, well-integrated family. The M-Series Computers provide the lowest cost Centralized Intelligence power. E-Series Computers provide roughly twice the computing power of M-Series models at a moderate price premium. The F-Series Computers combine the basic processing speed of the E-Series with dedicated hardware for executing floating point instructions, along with instruction set extensions for extremely fast execution of FORTRAN operations

such as array address calculations. Because HP 1000 family members have upward-compatible instruction sets and use many of the same memory systems, I/O interfaces, and power systems, changing from one system to another can be done with minimal reinvestment in software training and spares provisioning.

HP 1000 M/E/F-Series Computers are available in a wide variety of packages to provide the most cost effective solution for your computing need. The basic computers are available in a variety of stand-alone or rack-mountable chassis sizes, complete with power system and many features, such as hardware multiply/divide, that are optional on other computers of the same size. M-Series and E-Series Computers are also available in board versions for high-volume applications where it is useful to integrate the central processor unit into a product to achieve space and power economies.

HP 1000 E- and F-Series Computers also form the basis for complete HP 1000 Computer systems, which combine computer, mass storage, display terminal, operating software, and cabinetry into an integrated, packaged system. See Table 2 for a performance comparison of M-Series, E-Series and F-Series Computers.

Table 2. HP 1000 Computers Performance Comparison

SERIES	M-Series	E & F Series
CONTROL PROCESSOR		
Address space (instr. words)	4,096	16,384
Micro-instruction execution time	325 ns	175/280 ns
MEMORY CYCLE TIME		
Standard performance memory	650 ns	595 ns*
High performance memory		350 ns*
DCPC (Direct Memory Access)		
INPUT RATES TO		
Standard performance memory	1.23Mb/s	1.95Mb/s
Fault control memory	1.23Mb/s	1.88Mb/s
High performance memory		2.28Mb/s
NON-DMS OUTPUT RATES FROM		
Standard performance memory	1.23Mb/s	1.77Mb/s
Fault control memory	1.23Mb/s	1.67Mb/s
High performance memory		2.28Mb/s
DMS OUTPUT RATES FROM		
Standard performance memory	1.23Mb/s	1.67Mb/s
Fault control memory	1.23Mb/s	1.62Mb/s
High performance memory		2.10Mb/s

*All memory cycle times quoted for the E and F Series Computers are subject to ± 35 ns variation because memory accesses are asynchronous with respect to the CPU in those machines. Dynamic mapping system (DMS) for addressing greater than 64k bytes of memory adds 70 ns (read only) to these cycle times.

The HP 1000 Model 65 System is Hewlett-Packard's highest performance technical computer system, which is configured around a set of basic system elements called the System Processor Unit (SPU). The SPU, product numbers 2179A (upright cabinet) and 2179B (desk cabinet), is based on the F-Series Computer. With 256k bytes of high speed memory and the large program and virtual memory-for-data capabilities of the RTE-6/VM Real-Time Executive operating system, the Model 65 combines computational power with the large capacity often needed for computer-aided design, computer-aided engineering, and other applications that require fast floating point, transcendental and vector/matrix calculations.

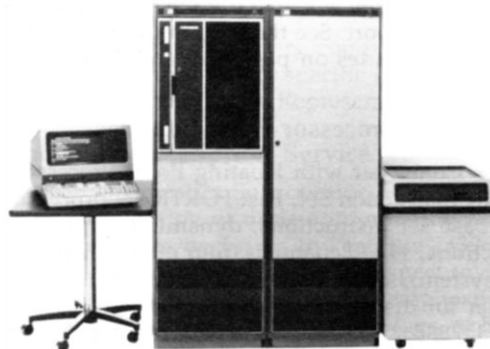
To the Model 65 SPU, users add an operator terminal as system console, one or more hard discs, and other peripheral devices as required for the application. The Model 65 can support up to 255 physical devices (terminals, discs, printers, mag tape units, plotters, digitizers, and instruments) in a real-time environment. Its 256k byte main memory is expandable to 2M bytes and the choice of disc memories offers capacities from 16M bytes to as much as 2400 bytes.

The Model 65 also provides a session monitor that supports multiple users in a protected environment with security for user-assigned disc storage space and time-slicing of compute-bound programs for equitable sharing of program execution time.

Real-time responsiveness and multiterminal accessibility to its powerful resources make the Model 65 the perfect system for industrial, scientific, and engineering applications that require fast computational capability.

Features

- **F-Series Computer with Hardware Floating Point Processor**
- **256k bytes of High-Performance Parity Memory, expandable to 2M bytes**
- **Scientific Instruction Set**
- **Vector Instruction Set**
- **Fast FORTRAN Processor**
- **RTE-6/VM Operating System**
 - Real-time response to interrupts
 - Time-slice scheduling of compute-bound programs
 - Secure multi-user access to system resources
 - Powerful screen editor
 - Load and execute large programs without segmentation commands in the code
 - Demand-paged virtual memory for data
 - Data arrays up to 128 million bytes
- **Multilingual programming: FORTRAN 77, Pascal, and BASIC (optional) and Macro assembly language**
- **Microprogramming support package (optional)**
- **Upright or Desk Configuration**



- **Automatic Boot-Up during Power-On Sequence**
- **Power Fail Recovery and Battery Backup**
- **16M byte Disc, expandable to 2400M bytes**
- **System Console with Minicartridge Tapes**
- **Site Preparation Consultation and System Installation**
- **On-Site Warranty for 90 days**
- **Optional Hardware includes:**
 - Fault Control Memory
 - Additional Cabinet Bay
 - HP's Broad Line of Peripherals
- **Optional Computer Networking with HP Distributed Systems Network**
- **Optional software includes:**
 - Image/1000 Data Base Management System
 - DATACAP/1000 Data Capture Software
 - Graphics/1000-II graphics software
 - Signal/1000 Signal processing software
 - HPSPICE Circuit Simulation Program

Functional specifications

Computer memory

256k bytes of high performance memory, optionally replaceable with up to 2.048M bytes (1.536M bytes with fault control) of high performance memory.

Disc memory

CS/80 Discs: 16.5, 28.1, or 65.6M byte fixed disc with built-in cartridge tape backup or 404M byte fixed disc that requires separate backup by a magnetic tape unit. Up to four drives per interface.

Multi-Access Controller Discs: 19.6, 50, or 120M byte removable media discs, up to eight drives per interface.

Disc interfaces per system: Maximum of two.

Available I/O channels

10 in computer mainframe, expandable to 26 in 2179A System Processor Unit with 12979B Dual-Port I/O Extender.

Ordering information

Note: A compatible terminal (not included) is required for local operator communication with the 2179A/B SPU and a 79xx disc is required for operating system and program development support. See the System Console and System Disc Selection Guides on pages 2-9 and 2-11 for more information.

2179A System Processor Unit, includes:

1. 2117F Computer with Floating Point Processor, Scientific Instruction Set, Fast FORTRAN processor, plus 128 base set instructions, dynamic mapping instructions, 14 I/O channels (four of which are used by the system), space for ten memory modules, and ROM loader for disc, and also equipped with:
 - a. 12788B 256k byte high performance memory package including 12731A Memory Expansion Module and 12892B Memory Protect Module.
 - b. 12991B Power Fail Recovery System.
 - c. 12992C CRT Terminal Loader ROM.
 - d. 12539C Time Base Generator.
 - e. 12829A Vector Instruction Set.
 - f. 12791A Firmware Expansion Module.
 - g. 12897B Dual Channel Port Controller.
 - h. 12966A+001 Buffered Asynchronous Communications Controller with cable to 264x terminal.
2. 29402C+200 System Cabinet with 56-inch rack space, front door, and Power Control Unit.
3. 92084A RTE-6/VM Operating System including system software and manuals.
4. Diagnostic package (24998-14002) on minicartridge tapes.
5. 91711B System Verification Package on minicartridge tapes.
6. System Installation and Service Manual.
7. Integration and test with primary system. Includes 6 each HP 93825A Engineering Units.
8. On-site installation and diagnostic checkout of all peripherals.
9. Site preparation consultation.

2179B System Processor Unit, includes:

Same components as a 2179A SPU, with computer and accessories mounted in a desk cabinet instead of upright cabinet.

System processor unit options

- 002:** Additional 56-inch cabinet bay (for mag tape, instruments, or accessories); 2179A only
- 005:** Substitute cable for 2621A/P, 2622, 2623, 2624, 2626, and 2629D/E/F/G terminals
- 006:** Substitute cable for 2621B and 2629L terminals
- 014:** Delete 256k byte high performance parity memory package (other high performance memory packages must be ordered separately — 256k bytes minimum)
- 015:** 220V/50 Hz power
- 022:** System software on tape cartridge for 7908, 7911, or 7912 disc drive*
- 031:** System software on 7906M disc pack**
- 032:** System software on 7920M disc pack**
- 033:** System software on 7925M disc pack**
- 101:** Value pack with 1M byte memory instead of 256k byte and FORTRAN 77 and Pascal compilers, Graphics/1000-II DGL and AGP software, and Image/1000 Data Base Management System on 7908/11/12 compatible cartridge tape. Prerequisite is media option 022 and no option 014.
- 102:** Option 101 Value pack with 2M byte memory instead of 256k byte. Same prerequisite as option 101.
- 111:** Value pack with 1M byte memory instead of 256k byte and FORTRAN 77 and Pascal compilers, Graphics/1000-II DGL and AGP software, and Image/1000 Data Base Management System on 264x Minicartridges. Prerequisite is media option 031, 032, or 033 and no option 014.
- 112:** Option 111 Value pack with 2M byte memory instead of 256k byte. Same prerequisite as option 111.

*Also includes 12821A disc interface, and 12992J loader ROM. 40017B Cabinet Stabilizer included in 2179A system where required for safety considerations.

**Also includes 13175B disc interface and 12992B loader ROM. 40017B Cabinet Stabilizer included in 2179A systems where required for safety considerations.

Model 60 Computer System



HP 1000 Computer Systems

product numbers 2178A and 2178B

The HP 1000 Model 60 System is a high-capacity technical computer system, which is configured around a set of basic system elements called the System Processor Unit (SPU). The SPU, product numbers 2178A (upright cabinet) and 2178B (desk cabinet), is based on the E-Series Computer. With 256k bytes of high speed memory and the large program and virtual memory-for-data capabilities of the RTE-6/VM Real-Time Executive operating system, the Model 60 offers good computational power and large capacity for computer-aided manufacturing applications that are satisfied with good all around performance.

To the Model 60 SPU, users add an operator terminal as system console, one or more hard discs, and other peripheral devices as required for the application. The Model 60 can support up to 255 physical devices (terminals, discs, printers, mag tape units, plotters, digitizers, and instruments) in a real-time environment. Its 256k byte main memory is expandable to 2M bytes and the choice of disc memories offers capacities from 16M bytes to as much as 2400M bytes.

The Model 60 also provides a session monitor that supports multiple users in a protected environment with security for user-assigned disc storage space and time-slicing of compute-bound programs for equitable sharing of program execution time.

Real-time responsiveness and multiterminal accessibility to its powerful resources make the Model 60 the perfect system for industrial applications that require large capacity.

Features

- E-Series Computer
- 256k bytes Parity Memory, Expandable to 2M bytes
- RTE-6/VM Operating System
 - Real-time response to interrupts
 - Time-slice scheduling of compute bound programs
 - Secure multi-user access to system resources
 - Powerful screen editor
 - Load and execute large programs without segmentation commands in the code
 - Demand-paged virtual memory for data
 - Data arrays to 128 million bytes
- Multilingual programming: FORTRAN 77, Pascal, and BASIC (optional) and Macro assembly language
- Microprogramming support package (optional)
- Upright or Desk Configuration
- Automatic Boot-Up during Power-On Sequence
- Power Fail Recovery and Battery Backup
- 16M bytes disc, expandable to 2400M bytes
- System Console with Minicartridges Tapes
- Site Preparation Consultation and System Installation
- On-Site Warranty Service for 90 days



- **Optional hardware includes:**
 - Fault Control memory
 - Additional cabinet bay
 - Fast FORTRAN Processor
 - HP's broad line of peripherals
- **Optional computer networking with HP Distributed Systems Network**
- **Optional software includes:**
 - Image/1000 Data Base Management System
 - DATACAP/1000 Data Capture Software
 - Graphics/1000-II graphics software

Functional specifications

Computer memory

256k bytes of standard performance memory, optionally replaceable with up to 2.048M bytes (1.536M bytes with fault control) of standard or high performance memory.

Disc memory

CS/80 Discs: 16.5, 28.1, or 65.6M byte fixed disc with built-in cartridge tape backup or 404M byte fixed disc that requires separate backup by a magnetic tape unit. Up to four drives per interface.

Multi-Access Controller Discs: 19.6, 50, or 120M byte removable media discs, up to eight drives per interface.

Disc interfaces per system: Maximum of two.

Available I/O channels

11 in computer mainframe, expandable to 27 in 2178A System Processor Unit with 12979B Dual-Port I/O Extender.

Ordering information

Note: A compatible terminal (not included) is required for local operator communication with the 2178A/B SPU and a 79xx disc is required for operating system and program development support. See the System Console and System Disc Selection Guides on pages 2-9 and 2-11 for more information.

2178A System Processor Unit, includes:

1. 2113E Computer with 128 base set instructions, 14 I/O channels (three of which are used by the system), space for ten memory modules, ROM loader for disc, and also equipped with:
 - a. 12786B 256k byte Standard Performance memory package, including 12731A Memory Expansion Module, and 12892B Memory Protect module.
 - b. 12991B Power Fail Recovery System
 - c. 12992C CRT Terminal Loader ROM
 - d. 12539C Time Base generator
 - e. 12897B Dual-Channel Port Controller
 - f. 12966A+001 Buffered Asynchronous Communications Interface with cable to 264x terminal.
2. 29402C+200 System cabinet with 56-inch rack space, front door, and Power Control Unit.
3. 92084A RTE-6/VM Operating System including system software and manuals.
4. Diagnostic package (24998-14002) on minicartridge tapes.

5. 91711B System Verification Package on minicartridge tapes.
6. System Installation and Service Manual.
7. Integration and test with primary system. Includes 6 each HP 93825A Engineering Units.
8. On-Site installation and diagnostic checkout of all peripherals.
9. Site Preparation Consultation.

A 2178B Computer System includes:

Same components as a 2178A SPU, with computer and accessories mounted in a desk cabinet instead of upright cabinet.

System processor unit options

- 002:** Additional 56-inch cabinet bay (for mag, tape instruments, or accessories); 2179A only
- 005:** Substitute cable for 2621A/P, 2622, 2623, 2624, 2626 and 2629D/E/F/G terminals
- 006:** Substitute cable for 2621B and 2629L terminals
- 014:** Delete 256k byte high performance parity memory package (other high performance memory packages must be ordered separately — 256k bytes minimum)
- 015:** 220V/50 Hz power
- 022:** System software on tape cartridge for 7908, 7911, or 7912 disc drive*
- 031:** System software on 7906M disc pack**
- 032:** System software on 7920M disc pack**
- 033:** System software on 7925M disc pack**

*Also includes 12821A disc interface, and 12992J loader ROM. 40017B Cabinet Stabilizer included in 2178A system where required for safety considerations.

**Also includes 13175B disc interface and 12992B loader ROM. 40017B Cabinet Stabilizer included in 2178A systems where required for safety considerations.

The HP Model 45 System is a high-performance technical computer system, which is configured around a set of basic system elements called the System Processor Unit (SPU). The SPU, product numbers 2177C (upright cabinet) and 2177D (desk cabinet), is based on the F-Series Computer. With 128k bytes of high speed memory and the ability to support up to 1.8M byte data arrays, the Model 45 combines excellent computational power and good capacity for computer-aided design, computer-aided engineering, and other applications that require fast floating point, transcendental, and vector/matrix calculations.

To the Model 45 SPU, users add an operator terminal as system console, one or more hard discs, and other peripheral devices as required for the application. The Model 45 can support up to 56 physical devices (terminals, discs, printers, mag tape units, plotters, digitizers, and instruments) in a real-time environment. Its 128k byte main memory is expandable to 2M bytes and the choice of disc memories offers capacities from 19.6M bytes to as much as 1920M bytes.

The Model 45 also provides a session monitor that supports multiple users in a protected environment with security for user-assigned disc storage space and time-slicing of compute-bound programs for equitable sharing of program execution time.

Real-time responsiveness and multiterminal accessibility to its powerful resources make the Model 45 a very good system for industrial, scientific, and engineering applications that require fast computational capability.

Features

- **128k bytes of High-Performance Parity Memory, expandable to 2M bytes**
- **Scientific Instruction Set**
- **Vector Instruction Set**
- **Fast FORTRAN Processor**
- **RTE-IVB Operating System**
 - Real-time response to interrupts
 - Time-slice scheduling of compute-bound programs
 - Secure multi-user access to system resources
 - Powerful screen editor
 - Extended memory areas for data arrays up to 1.8 Megabytes
- **Multilingual programming: FORTRAN 4X, Pascal, and BASIC (optional) and Assembly language**
- **Microprogramming support package (optional)**
- **Upright or desk cabinet configuration**
- **Automatic boot-up during Power-On Sequence**
- **Power Fail Recovery and Battery Backup**
- **Choice of 19.6, 50, or 120M bytes of disc storage, the latter expandable to 960M bytes (1920M bytes with two interfaces)**
- **System console with Minicartridge tapes**



2177D System (chair not included); 2177C upright cabinet version is similar to 2176C System, which is shown in the HP 1000 Model 40 data sheet.

- **Site Preparation Consultation and System Installation**
- **On-Site Warranty for 90 days**
- **Optional Hardware includes:**
 - Fault Control Memory
 - Additional Cabinet Bay
 - HP's Broad Line of Peripherals
- **Optional Computer Networking with HP Distributed Systems Network**
- **Optional Software includes:**
 - Image/1000 Data Base Management System
 - DATACAP/1000 Data Capture Software
 - Graphics/1000/II graphics software
 - Signal/1000 Signal processing software

Functional specifications

Computer memory

128k bytes of high performance memory, which is optionally replaceable with up to 2.048M bytes (1.536M bytes with fault control) of high performance memory.

Disc memory

User can choose from 19.6, 50, and 120M byte disc memories, the latter expandable to a total of 960M bytes with the addition of seven 120M byte slave disc drives, to a total of 1920M bytes with 16 drives connected via two interfaces.

Available I/O channels

10 in computer mainframe, expandable to 26 in 2177C System with 12979B Dual-Port I/O Extender.

Ordering information

Note: A compatible terminal (not included) is required for local operator communication with the 2177C/D SPU and a 79xx disc is required for operating system and program development support. See the System Console and System Disc Selection Guides on pages 2-9 and 2-11 for more information.

2177C Computer System includes:

1. 2117 Computer with Floating Point Processor, Scientific Instruction Set, and Fast FORTRAN Processor, plus 128 base set instructions, dynamic mapping instructions, 14 I/O channels (four of which are required by the system), space for ten memory modules, and ROM loader for disc, and also equipped with:
 - a. 12788A 128k byte High performance memory package, including 12731A Memory Expansion Module and 12892B Memory Protect Module.
 - b. 12991B Power Fail Recovery System.
 - c. 12992B RPL-compatible Disc Loader ROM.
 - d. 12992C CRT Terminal Loader ROM.
 - e. 12539C Time Base Generator.
 - f. 12824A Vector Instruction Set.
 - g. 12791A Firmware Expansion Module.
 - h. 12897B Dual-Channel Port Controller.
 - i. Auto boot-up capability.
2. 29402C+200 Cabinet with 56-inch rack space, front door, and power control unit.
3. 12966A system console interface with appropriate cable.
4. 92068A RTE-IVB real-time executive operating system on appropriate disc media.
5. On-line and off-line diagnostics on Minicartridge tapes.

6. System hardware and software manuals.
7. Integration and test with primary system on appropriate disc media. Includes 6 ea. HP 93285A Engineering Units.
8. On-site installation and diagnostic checkout of all peripherals and checkout of primary system.
9. Site prep consultation.

2177D Computer System includes:

1. Same as item 1 for 2177C System.
2. Desk cabinet.
- 3-9. Same as items 3 through 9 for the 2177C Computer System.

2177C/D Options

- 002:** Upright cabinet to house magnetic tape drive and system disc or additional disc. In 2177C, provides additional 29402C+400 cabinet bay with front door. In 2177D, provides 29402C+200 master upright cabinet (rack-mounting disc is prerequisite).
- 014:** Deletes 12788A memory package to permit replacement with an equal or larger-capacity high performance memory package, with or without fault control, which must be ordered separately.

The HP 1000 Model 40 System is a technical computer system configured around a set of basic system elements called the System Processor Unit (SPU). The SPU, product numbers 2176C (upright cabinet) and 2176D (desk cabinet), is based on the E-Series Computer. With 128k bytes of memory and the ability to support up to 1.8M byte data arrays, the Model 40 combines good computational power and capacity for computer-aided manufacturing applications that need good all around performance.

To the Model 40 SPU, users add an operator terminal as system console, one or more hard discs, and other peripheral devices as required for the application. The Model 40 can support up to 56 physical devices (terminals, discs, printers, mag tape units, plotters, digitizers, and instruments) in a real-time environment. Its 128k byte main memory is expandable to 2M bytes and the choice of disc memories offers from 19.6M bytes to as much as 1920M bytes.

The Model 40 also provides a session monitor that supports multiple users in a protected environment with security for user-assigned disc storage space and time-slicing of compute-bound programs for equitable sharing of program execution time.

Real-time responsiveness and multiterminal accessibility to its powerful resources make the Model 40 a good system for industrial applications.



*2176C System (chair and system console table not included).
2176D Desk cabinet version is similar to 2177D System, which is shown in the HP 1000 Model 45 data sheet.*

Features

- **128k bytes of Parity Memory, expandable to 2M bytes**
- **RTE-IVB Operating System**
 - Real-time response to interrupts
 - Time-slice scheduling of compute-bound programs
 - Secure multi-user access to system resources
 - Powerful screen editor
 - Extended memory areas for data arrays up to 1.8 Megabytes
- **Multilingual programming: FORTRAN 4X, Pascal, and BASIC (optional) and Assembly language**
- **Microprogramming support package (optional)**
- **Upright or desk cabinet configuration**
- **Automatic boot-up during Power-On Sequence**
- **Power Fail Recovery and Battery Backup**
- **Choice of 19.6, 50, or 120M bytes of disc storage, the latter expandable to 960M bytes with two interfaces)**
- **System console with Minicartridge tapes**
- **Site Preparation Consultation and System Installation**
- **On-Site Warranty for 90 days**
- **Optional Hardware includes:**
 - Fault Control Memory
 - Additional Cabinet Bay
 - HP's Broad Line of Peripherals

- **Optional Computer Networking with HP Distributed Systems Network**
- **Optional Software includes:**
 - Image/1000 Data Base Management System
 - DATACAP/1000 Data Capture Software
 - Graphics/1000-II graphics software

Functional specifications

Computer memory

128k bytes of standard performance memory, which is optionally replaceable with up to 2.048M bytes (1.536M bytes with fault control) of standard performance or high performance memory.

Disc memory

User can choose from 19.6, 50, and 120M byte disc memories, the latter expandable to a total of 960M bytes with the addition of seven 120M byte slave disc drives.

Available I/O channels

11 in computer mainframe, expandable to 27 in 2176C System with 12979B Dual-Port I/O Extender.

Ordering information

Note: A compatible terminal (not included) is required for local operator communication with the 2176C/D SPU and a 79xx disc is required for operating system and program development support. See the System Console and System Disc Selection Guides on pages 2-9 and 2-11 for more information.

2176C Computer System includes:

1. 2113 Computer with 128 base set instructions, dynamic mapping instructions, 14 I/O channels, space for ten memory modules, and ROM loader for disc, and also equipped with:
 - a. 12786A 128k byte Standard performance memory package, including 12731A Memory Expansion Module and 12892B Memory Protect Module.
 - b. 12991B Power Fail Recovery System.
 - c. 12992B RPL-compatible Disc Loader ROM.
 - d. 12992C CRT Terminal Loader ROM.
 - e. 12539C Time Base Generator.
 - f. 12897B Dual-Channel Port Controller.
 - g. 13304A Firmware Accessory Board.
 - h. Auto boot-up capability.
2. 29402C+200 Cabinet with 56-inch rack space, front door, and power control unit.
3. 12966A system console interface with appropriate cable.
4. 92068A RTE-IVB real-time executive operating system on appropriate disc media.
5. On-line and off-line diagnostics on Minicartridge tapes.
6. System hardware and software manuals.
7. Integration and test with primary system on appropriate disc media. Includes 6 ea. HP 93285A Engineering Units.
8. On-site installation and diagnostic checkout of all peripherals and checkout of primary system.
9. Site prep consultation.

2176D Computer System includes:

1. Same as item 1 for 2176C System.
2. Desk cabinet.
- 3-9. Same as items 3 through 9 for the 2176C Computer System.

2176C/D Options

- 002: Upright cabinet to house magnetic tape drive and system disc or additional disc. In 2176C, provides additional 29402C+400 cabinet bay with front door. In 2176D, 29402C+200 master upright cabinet (rack-mounting disc is prerequisite).
- 014: Deletes 12786A memory package to permit replacement with an equal or larger-capacity standard or high performance memory package, with or without fault control, which must be ordered separately.

For Model 40, 45, 60 and 65 Systems

Required System Console Configurations for HP 1000 Model 40, 45, 60 and 65 Computer Systems

The following terminal configurations provide Mini cartridge I/O capability that satisfies software, software update, and diagnostic loading requirements of HP 1000 Model 40, 45, 60 and 65 Computer Systems. The first HP

1000 Model 40, 45, 60 or 65 System at a site MUST use one of these terminal configurations for its system console to assure proper support. Additional systems may use one of the other system console configurations listed in the next table, provided that a terminal with Mini cartridge I/O will be readily available at the system site to HP Customer Engineers and System Engineers to assist their support of the system with the "other" system console. All the terminals listed here support the convenient soft-key utilities provided in the Model 40, 45, 60 and 65 systems.

Terminal Product Number and Name	Required Terminal Options and Description	Comments
2645A (or 2649B OEM) Display Station	007: Mini cartridge I/O 032: Extended Async comm.	Lowest-priced required System Console configuration
2648A (or 2649C OEM) Graphics Terminal	007: Mini cartridge I/O 032: Extended Async comm.	Graphics capability is supported by HP 1000 graphics software
2647A (or 2649G OEM) Intelligent Graphics Terminal	032: Extended Async comm.	Supported as a virtual 2648A (or 2649C OEM) Graphics Terminal. Graphics capability is supported by HP 1000 graphics software. Includes Mini cartridge I/O
2642A Enhanced Display Station	032: Extended Async comm. 070: Mini cartridge I/O instead of Minifloppy I/O	HP 1000 software and updates are not available on 2642A Minifloppy discs

NOTE: A box of five Mini cartridges, product number 98200A, is also strongly recommended with all of the above configurations.

Other System Console Configurations for HP 1000 Model 40, 45, 60 and 65 Computer Systems

The terminal configurations listed below may be used for HP 1000 Model 40, 45, 60 or 65 Computer Systems at

multi-system sites which also have a 264x terminal with Mini cartridge I/O that will be readily available at the system site to HP Customer Engineers and System Engineers to assist their support of the system with the "other" System Console.

Terminal Product Number and Name	Configuration Requirements	Comments
2621B (or 2629L OEM) Interactive Terminal	Must order 2178/9A/B System option 006 for Model 60 or 65 System.	Lowest priced terminal available; does not support RTE soft-key utilities.
2621A (or 2629A OEM) Interactive Terminal	Must order 2178/9A/B System option 005 for Model 60 or 65 System.	Previous model of 2621B (2629L OEM) terminal without printer. Does not support RTE soft-key utilities.

System Console Selection Guide

Terminal Product Number and Name	Configuration Requirements	Comments
2621P (or 2629B OEM) Interactive Terminal	Same as 2621A (or 2629A OEM) terminal, above.	2621A with built-in printer; does not support RTE soft-key utilities.
2622A (or 2629E OEM) Display Terminal	Must order 2178/9A/B System option 005 for Model 60 or 65 System.	Low-priced block mode terminal. Line drawing set and built-in printer optional. Use with RTE soft-key utilities not tested.
2623A (or 2629G OEM) Graphics Terminal	Same as 2622A (or 2629E OEM) terminal, above.	Low-priced graphics capability with block mode. Line drawing set and built-in printer are optional. Use with RTE soft-key utilities not tested.
2624B (or 2629F OEM) Display Terminal	Same as 2622A (or 2629E OEM) terminal, above.	Supports RTE soft-key utilities, forms capability, and advanced format editing. Built-in printer is optional.
2626A (or 2629D OEM) Display Station	Same as 2621A (or 2629A OEM) terminal, above.	Supports RTE soft-key utilities and interactive forms design. Multiple workspaces and split-screen capabilities are available to the applications programmer. Built-in printer is optional.
2635B Printing Terminal	2635B option 051: 264x Edge connector.	Dot-matrix impact serial printer; does not support RTE soft-key utilities.
2642A Enhanced Display Station	2642A option 032: Extended Async Comm.	Minifloppy disc can be used for system-accessible local mass storage only.
2645A (or 2649B OEM) Display Station	None	Supports RTE soft-key utilities.
2648A (or 2649C OEM) Graphics Terminal	None	Graphics capability is supported by HP 1000 graphics software. Supports RTE soft-key utilities.

System Disc Selection Guide



For Model 40, 45, 60 and 65 Systems

All systems	
Capacity per Drive	Multi-Access Controller (MAC) disc memories offer expandability to a total of eight discs by adding up to seven 79xxS Slave discs (also available in 19.6, 50, and 120M byte capacities) to the 79xxM Master disc. In addition, up to eight computers can be connected to the 79xxM Master disc for shared access to the storage capacity connected to it†. MAC discs require a 13175B interface , which is included with 2178/9A/B media option 031, 032, or 033, but must be ordered separately for 2176/7C/D System Processor Unit.
19.6M bytes, Half removable	7906M MAC Master Cartridge Disc Memory (standalone) 7906M+020 MAC Master Cartridge Disc Memory (rack mounting) Slaves are 7906S (standalone) and 7906SR+020 (rack mounting)
50M bytes, all removable	7920M MAC Master Disc Memory* (standalone) Slave is 7920S (standalone)
120M bytes, all removable	7925M MAC Master Disc Memory* (standalone) Slave is 7925S (standalone)

† Although more than one M/E/F-Series computer can be connected to the MAC Master disc in multi-computer installations, shared access to the same file spaces by one or more M/E/F-Series computers is not supported by the RTE system; provision of that capability requires additional programming effort by the user.

* With 50M byte or 120M byte disc, an additional disc drive or 7971A+260/262 Magnetic Tape Subsystem should be ordered to provide backup and copy capability for the system disc.

Model 60 and 65 systems only	
Capacity per Drive	Command Set 80 (CS/80) disc memories offer expandability to four discs per interface and the best price/performance of any Hewlett-Packard disc. (Up to 3200 Mb with 7933H discs connected via two interfaces.)
16.5M bytes	7908P Fixed Disc with internal cartridge tape backup.
28.1M bytes	7911P Fixed Disc with internal cartridge tape backup.
65.6M bytes	7912P Fixed Disc with internal cartridge tape drive
404M bytes	7933H Fixed Disc*

*With 404M byte disc, a 7971+260/262 Magnetic Tape Subsystem should be ordered to provide backup and copy capability for the system disc.

Definition of the Primary Operating System

HP 1000 Computer Systems

The primary operating system provided with HP 1000 Computer Systems is an operating system that is configured with the essential software required in most systems. This primary is a ready-to-use system that provides programming access to the major system features (languages, utilities, common I/O devices). It can also be used as the basis for generation of a custom-configured operating system. In addition to providing a common starting point, the primary can be used at any time to verify that the HP 1000 Computer System will function as it did when it was installed.

Objective of the primary system

The major objective behind the primary concept is to provide the HP 1000 Computer System user with a "getting started" software generation, recognizing that most users may regenerate their system several times to optimize it for their particular application. This getting started primary is included in the price of the HP 1000 Computer System. However, regeneration of the system software is not included in the system price and, therefore, must be quoted separately for users not wishing to do it themselves.

Model 40 and 45 primary systems

Model 40 and 45 primaries are supplied with the configuration that is appropriate for the disc that is ordered for the system. The primary includes the components that are common to most HP 1000 Model 40 and 45 Systems. It is intended to demonstrate to the user the functionality of those hardware and software components that are common to most Model 40 and 45 systems.

Only the primary system (hardware and software components) is system tested at the factory. Add-on I/O cards and peripherals ordered with the system are not installed at the factory. They remain packaged separately and are shipped separately (from other divisions).

The user will receive three 7906 disc cartridges or two 7920 or 7925 disc packs, depending upon the disc drive selected for the system. The first disc is the "grandfather" disc. The second disc is the primary system disc generated and tested at the factory. The third disc cartridge is blank.

Model 60 and 65 primary systems

Model 60 and 65 primary systems are similar to Model 40 and 45 primary systems as described above, but the primary is part of the RTE-6/VM operating system and not just part of the computer system as with the Models 40 and 45. Also, there is a further choice of media for CS/80 fixed discs. If the CS/80 disc option is selected for a Model 60 or 65 system, a single 7908/11/12 compatible cartridge tape of the primary system is supplied. At installation, the primary system is loaded into the 7908/11/12 system disc.

Devices and programs supported in the primary systems

Models		Supported Devices and Programs
40 & 45	60 & 65	
X	X	Time Base Generator
A	A	System disc driver (one of the following)
A	A	– 7906M/20M/25M MAC disc driver DVR32 or
	A	– 7906H/20H/25H ICD driver DVA32 or
	A	– 7908/11/12/33 CS/80 disc driver DVM33
X	X	System console (264x/262x/2635/2382) driver DVA05
X	X	Eight-channel multiplexer (12792A) drivers DVM00, PVM00, DDV05, DDV12, and &DVTB
X	X	HP-IB interface (59310B) driver DVA37
X	X	Line printer (2617A, 2619A & 2631A/B) driver DVA12
X	X	Line printer (2608A) driver DVB12
X	X	Printer (9876A) driver DVR37
X	X	Mag Tape (7970B/7970E/7971A) driver DVR23
X	X	Terminals and punched tape I/O driver DVR00
X	X	Multipoint terminal (2645A, 2648A, 2624B, and 2626A) driver DVR07
X	X	File manager
X	X	Relocating loader
X	X	Multi-level segmentation loader
X	X	Edit/1000
X	X	Interactive editor
X		FORTRAN-IV compiler
X		RTE-IVB Assembler
	X	Macro/1000 Assembler
X		Cross-Reference Table Generator
X	X	System Switch Program (SWTCH)
X	X	On-line system generator
X	X	Softkey programs
X	X	RTE Utilities
X	X	System Test Programs
X		BASIC/1000D*
X		Image/1000*
X	X	DS/1000-IV*

A = Alternate item; only the selected system disc has an assigned LU and track map table on its primary disc.

*These items are located in file manager type 6 files on the primary system and are purged during system integration if not ordered with the HP 1000 Computer System.

This data sheet provides specifications for the 2109E, 2113E, and 2117F computers. All specifications apply to each of these computers, unless otherwise noted. Product descriptions and ordering information can be found in the individual product data sheets.

M-Series data sheets are located in the Mature Products section of this data book. The 2111F computer will not be available after mid-1982, and its data sheet has been omitted from this data book. For information concerning the 2111F, please retain your previous HP 1000 Hardware data book.

Functional specifications

Processor architecture

Implementation: Microprogrammed in MSI and SSI hardware

Data path width: 16 bits

Standard registers:

Accumulators: 2 (A and B), 16 bits each, addressable as registers or memory locations

Index: 2 (X and Y), 16 bits each

Memory control: 3 (T,P) 16 bits each; (M), 15 bits

Supplementary: 2 (overflow and extend), 1 bit each

Manual data: 16-bit (display)

Instruction types:

Memory-to-accumulator Accumulator-to-I/O

Memory-to-memory Device control

Direct register modification

Instruction expansion: 176 instruction codes are available to the microprogrammer for instruction set additions.

Addressing modes:

Direct Double word

Multi-level indirect Single word

Indexed Byte

Indirect indexed Bit

Register implicit

Bus structure: Separate memory data, memory address, and I/O buses tied to the unified internal S Bus

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

Memory expansion: Paged memory address space expandable to 1024 pages of 2048 bytes using the Dynamic Mapping System

Input/Output: Vectored priority interrupt structure for up to four system devices and 46 I/O devices, such as DCPC, power fail, parity, and memory protect.

Control processor

Implementation: Hardwired MSI and SSI TTL

Instruction execution time: Variable, 175 or 280 nsec

Control path: 24 bits

Data path: 16 bits

Registers:

Standard registers: 6 (A,B,X,Y,P,S)

Scratch registers: 12 16-bit registers accessible to the microprogrammer

Iteration counter: 8 bits

Instruction register: 16 bits

Latch register: 16 bits

Status flag: 1 bit

Subroutine levels stack: 3 - 14 bits each

Instruction formats:

TYPE 1 Data transfer and modification

TYPE 2 Constant formation

TYPE 3 Conditional branch

TYPE 4 Unconditional branch

Bus structure: Unified single bus with program access to memory data, memory address, and I/O buses.

Bus speed: 11.4M bytes/sec.

Control memory structure:

Type: Bipolar LSI semiconductor R/W or ROM

Address space: 16,384 words; 64 modules of 256-words each

Word size: 24 bits

Cycle time: Variable, 175 or 280 nsec

Module assignments

F-Series:

(1 module = 256 words of control memory)

0 - 3 assigned to F-Series base instruction set, including Floating Point Processor instructions.

4 - 11 Reserved for HP enhancements.

12 - 15 Reserved for Vector Instruction Set.

16 - 17 Reserved for HP enhancements.

18 - 27 RTE-6/VM Operating System instructions.

28 - 31 Available for user microroutines.

32 Reserved for Dynamic Mapping Instructions.

33 - 35 Reserved for Fast FORTRAN Processor.

36 & 37 Reserved for RTE-IVB Extended Memory Area (EMA) or RTE-6/VM EMA/VMA mapping instructions.

38 & 39 Reserved for DS/1000 firmware.

40 - 43 Reserved for Scientific Instruction Set.

44 & 45 Reserved for HP enhancements.

46 - 63 Available for user microroutines.

E-Series:

- (1 module = 256 words of control memory)
- 0 - 3 Assigned to E-Series base instruction set
- 4 - 31 Available for user microroutines
- 32 Reserved for DMS instructions
- 33 - 35 Reserved for Fast FORTRAN Processor
- 36 & 37 Reserved for RTE-IVB Extended Memory Area (EMA) or RTE-6/VM EMA/VMA mapping instructions
- 38 & 39 Reserved for DS/1000 firmware
- 40 - 43 Reserved for future HP instruction set enhancements
- 44 & 45 RTE-6/VM Operating System instructions
- 46 - 63 Reserved for user microroutines

Control processor instructions: 211 total; up to 5 may be combined in 1 instruction.

E/F-Series:

- Operations: 15 total.
- Special: 32 total.
- ALU and conditional: 68 total.
- Store (destination): 32 total.
- S-bus (source): 32 total.
- Reverse Sense: 32 total.

Loader protection

All loaders reside in special ROM's on the CPU board. The loader routines are assembly code routines which are loaded into the last 64 words of main memory by activating front panel switches. Four switch-selectable loader spaces are provided to accommodate four different loader routines. User-generated loaders may be written in assembly language, written into PROMS, and mounted in any of the four available sockets on the CPU board.

Volatility protection

AC standby mode and sustaining power for line loss of 8 milliseconds before entering power fail routine. Power fail recovery system provides a minimum of 1.6 hours of battery-supplied memory standby power.

Memory parity check

Monitors all words read from memory. Utilizes 17th bit in memory. Switch programmable to halt, interrupt, or ignore parity error when detected. Interrupt on error requires memory protect option. Indication of a parity error is displayed by a light on the front panel.

Approximate instruction execution times for E/F-Series Computers

Instruction	Execution Time (μsec) in F-Series
Single-precision Floating Point (32 bit) Instructions (8 total)	
Add/Subtract	7.7
Multiply	6.4
Divide	9.3
Conversion to single integer	5.3
Conversion to double integer	6.3
Conversion from single integer	4.6
Conversion from double integer	5.7
Extended-precision Floating Point (48 bit) Instructions (8 total)	
Add/Subtract	13.8
Multiply	13.0
Divide	17.4
Conversion to single integer	6.8
Conversion to double integer	8.7
Conversion from single integer	6.6
Conversion from double integer	8.1
Double-precision Floating Point (64 bit) Instructions (8 total)	
Add/subtract	14.9
Multiply	13.7
Divide	19.7
Conversion to single integer	7.3
Conversion to double integer	9.2
Conversion from single integer	7.0
Conversion from double integer	8.5
Single-Precision (32 bit) Scientific Instruction Set Instructions (9 total)	
SIN (Sine) function	51.8
COS (Cosine) function	52.0
TAN (Tangent) function	53.7
ATAN (Arc Tangent) function	52.6
TANH (Hyperbolic Tangent) function	66.5
SQRT (Square Root) function	37.8
EXP (e _x) function	51.9
ALOG (Natural Logarithm) function	46.3
ALOGT (Base 10 Logarithm) function	52.6
Double-Precision (64 bit) Scientific Instruction Set Functions♦	
SIN (Sine) function	217.0
COS (Cosine) function	217.0
TAN (Tangent) function	212.0
ATAN (Arc Tangent) function	189.0
TANH (Hyperbolic Tangent) function	211.0
EXP (e _x) function	219.0
SQRT (Square Root) function	135.0
ALOG (Natural Logarithm) function	179.0
ALOGT (Base 10 Logarithm) function	214.0

♦The double-precision Scientific Instruction Set functions are a combination of firmware (approximately 90%) and software (approximately 10%); the software is included in the relocatable libraries of all compatible RTE operating systems.

Fault control memory and dynamic mapping system may each add 0 to 0.2 microsecond to these instruction execution times.

Asynchronous memory may cause variations of ±0.035 microseconds per memory reference.

More detailed instruction times are supplied in the HP 1000 F-Series reference manual (02111-90001).

The maximum non-interruptible time for any instruction is 12.2 milliseconds.

All execution times are worst case figures.

Approximate instruction execution times for E/F-Series Computers (Continued)

Instruction	Execution Time (μ sec) in F-Series
Double Integer (32 bit) Instructions	
Add	4.9
Subtract	5.7
Multiply	19.2
Divide	24.4
Reverse-order subtract	6.5
Reverse-order divide	24.4
Negate	2.3
Increment (A, B)	2.0
Decrement (A, B)	2.5
Increment and skip if zero	5.3
Decrement and skip if zero	5.1
Compare	4.4
Polynomial Evaluation Instruction	
Set-up time	19.0+
Additional time (base on M+N, when M = degree of numerator, N = degree of denominator)	9x(M+N)
Fast FORTRAN Processor Instructions (12 total)	
Moves to new locations:	
– Extended precision variable	12.81
– Address of parameters from calling sequence into subroutine list	13.9
Calculate X*2N for real X and integer N	+3.7*NP
Unpacking of real variable	8.4
Normalization, rounding, and packing of mantissa of extended precision variable	3.1
Complementing of extended precision variable	29.5
Complementing and normalization of extended precision variable	12.1
Complementing and normalization of extended precision variable	33.4
Transfer of control to destination of FORTRAN computed GOTO statement	10.6
Computes address of specified element of 2 or 3-dimensional array	27.2
Complementing and normalization of single precision variable	5.1
Complementing and normalization of double precision variable	9.8
Computation of $(1-x)/(1+x)$	28
Four-word transfer	10.3

Approximate instruction execution times for E/F-Series computers (Continued)

Instruction	Execution Time (μ sec)	
	with High Perf Memory E/F-Series	with Std Perf Memory E-Series
Memory reference group (14 total)		
Add/load/AND/IOR/XOR	0.91	1.19
Store	1.26	1.85
Jump	0.74	0.74
Jump to subroutine	1.61	1.85
Compare (normal/skip)	1.09/1.43	1.23/1.72
Increment, skip if zero	1.54/1.61	2.03
Indirect address, per level	0.46	0.575
Register reference group (43 total)		
Normal/skip	0.91/1.26	1.19/1.29
Input/Output group (13 total)		
SFS/SFC/SOS/SOC (normal)	2.28	2.28
SFS/SFC/SOS/SOC (skip)	2.66	2.73
All others	2.28	2.28
Floating point instructions (6 total); (E-Series only)		
Add	27.44	27.65
Subtract	29.22	29.44
Multiply	34.90	35.11
Divide	47.11	47.32
Fix	7.35	7.6
Float	10.82	10.82
Extended instruction group (10 total)		
Integer multiply	6.0	6.72
Integer divide	9.1	9.63
Double load	2.07	3.185
Double store	2.7	3.71
Shift/rotate (basic)	1.47	2.065
Additional per shift	0.175	0.175
Indirect addressing/level	0.81	1.19
Index instructions (32 total)		
Copy	1.29	1.435
Exchange	1.92	2.065
Decrement/increment (normal/skip)	1.75/2.0	2.03/2.52
Load or add index	2.66	3.05
Store index	2.94	3.43
Load indexed	3.19	3.745
Store indexed	3.46	3.815
Jump and load Y	2.67	2.8
Jump and index X	2.28	2.625
Data communications (10 total)		
Load byte	3.36	3.5/3.78
Store byte	3.89	4.45/4.83
Move bytes or words (basic)	3.75	4.27
Additional per byte	4.05	4.235
Additional per word	1.68	1.75
Compare bytes or words (basic)	3.75	4.27
Additional per byte	3.78	3.5/3.78
Additional per word	2.38	2.87
Scan for byte (basic)	1.92	2.17
Additional per byte	2.735	2.735
Set or clear bits	4.48	5.215
Test bits (normal/skip)	4.73/4.94	5.36/5.67

Microprogrammable processor port (E-Series only)

Addressable devices: 2
I/O lines: 16
Control lines: 9
Maximum burst transfer rate: 11.4M bytes/sec for 32 bytes
Maximum continuous transfer rate: 3.18M bytes/sec*
Maximum cable length: 1.2M (4ft), properly terminated
 *User-microprogram dependent.

Microprogrammable block I/O

I/O control lines: 3 special lines on I/O backplane
 NOTE: Requires user-designed I/O cards
Maximum synchronous transfer rate: 2.28M bytes/sec (input); 3.17M bytes/sec (output).
 *User-microprogram dependent.

Remote program load

Load device selection: 1 of 9 devices in a 2109E, 1 of 14 devices in a 2113E and 2117F
Loader selection: Choice of RPL-compatible optional loader ROMs.
Operating modes: a) Automatically on power-up; b) Remote forced load with 12966A or 12968A interface (Hardwired); c) Load after certain halts under program control.

Configuration information

	2109E	2113E	2117F
Input/output capacity:			
I/O channels in mainframe	9	14	14
With first I/O extender	25	30	30
With two I/O extenders	41	46	46
Standard memory:	64 kb	128 kb	128 kb
Memory capacity:			
Memory module spaces			
In computer only	5	10	10
In computer and extender	14	19	19
Max. non-fault control memory*			
In computer only	2.048 Mb	2.048 Mb	2.048 Mb
In computer and extender	2.048 Mb	2.048 Mb	2.048 Mb
Max. fault control memory*			
In computer only	1.024 Mb	2.048 Mb	2.048 Mb
In computer and extender	1.024 Mb	2.048 Mb	2.048 Mb

*Based on use of 512k byte memory modules.

Compatibility

Instruction set: The HP 1000 E/F-Series instruction set is backwards compatible with other HP 1000 computers.

Program: Most programs written for HP 1000 Centralized Intelligence Architecture computers are compatible among the M-, E-, and F-Series computers, except those with timing loop dependence.

Control processor address space

Total address space: 16k 24-bit words.
F-Series:
 Net address space available to the user: 5.5k words
 WCS overlay address space using 1k WCS boards: 3k**
 User PROMs address space using 8k FEM board: 5.5k**
E-Series:
 Net address space available to the user: 11.5k words
 PROM address space available on option 003 FAB board: 3.5k
 WCS overlay space using 1k WCS boards: 3k**
 User PROMs address space using 8k FEM boards: 11.5k**
 **Mounted on board(s) in I/O backplane, using I/O slots; total cannot exceed net address space available to the user. One 12791A FEM board is standard in E- and F-Series computers.

Scientific instruction set (F-Series only)

Data Formats: Single and double precision.
Execution times and function definitions: See approximate instruction execution times table.
Accuracy: RMS relative error for the various Scientific Instruction Set functions is as follows for single precision (sp) and double precision (dp)

Function	RMS Rel. Error (sp)	RMS Rel. Error (dp)	Function	RMS Rel. Error (sp)	RMS Rel. Error (dp)
SIN	9.2E-8	1.2E-16	SQRT	6.7E-8	1.6E-17
COS	7.7E-8	1.3E-16	EXP	3.2E-7	8.8E-17
TAN	1.5E-7	1.9E-16	ALOG	1.2E-7	1.3E-16
ATAN	1.5E-7	2.3E-16	ALOGT	1.6E-7	1.3E-16
TANH	2.2E-7	5.5E-17			

Floating Point Processor (F-Series only)

Floating point data formats:
 Single-precision: 32 bits (4 bytes), providing at least 6 significant decimal digits in mantissa
 Extended precision: 48 bits (6 bytes), providing at least 11 significant decimal digits in mantissa
 Double precision: 64 bits (8 bytes), providing at least 16 significant decimal digits in mantissa.
Exponent range: Exponent range: 2^{-128} to 2^{+127} in all floating point data formats; decimal equivalent is approximately 10^{-38} .
Fixed point data formats:
 Single-precision: 16 bits (2 bytes), twos complement integer
 Double-precision: 32 bits (4 bytes), twos complement integer
Execution times: See Approximate instruction execution times table

Computation times applicable to direct, chained micro-programming use of the Floating Point Processor: The following computation times apply to directly microprogrammed use of the Floating Point Processor for chained floating point calculations in which intermediate results are not transferred to and from the F-Series Computer memory.

Instruction	Computation Time (μ sec)		
	Min.	Typ.	Max.
Single-precision Floating Point Operations (8 total)			
Add/Subtract	0.680	0.860	3.440
Multiply	1.960	2.210	2.460
Divide	2.120	3.010	5.175
Conversion to single integer	0.680	1.380	2.000
Conversion to double integer	0.670	2.450	3.270
Conversion from single integer	0.630	1.250	1.780
Conversion from double integer	0.500	2.330	2.930
Extended-precision Floating Point Operations (8 total)			
Add/Subtract	0.800	1.200	4.480
Multiply	2.750	3.130	3.520
Divide	2.940	4.780	7.900
Conversion to single integer	0.680	1.380	1.850
Conversion to double integer	0.670	2.450	3.270
Conversion from single integer	0.630	1.250	1.780
Conversion from double integer	0.500	2.330	2.930
Double-precision Floating Point Operations (8 total)			
Add/subtract	0.800	1.200	5.580
Multiply	3.550	4.100	4.620
Divide	3.680	7.200	10.70
Conversion to/from single or double integer	Same as for extended precision, listed above.		

Electrical specifications

AC power required

Line voltage: 88-132V (110V \pm 20%); 176-264V (220V \pm 20%) with option 015. Input line voltage range is easily changed in the field by moving jumper connections.

Note that the 2117F Floating Point Processor voltage selector offers choice of 90-110V (100V \pm 10%), 108-132V (120V \pm 10%), 198-242V (220V \pm 10%), and 216-264V (240V \pm 10%) input line voltage ranges.

Line frequency: 47.5-66 Hz.

Maximum power required:

2109E and 2113E: 625W

2117F: 825W

Current available (+) required (-) for memory, I/O interfaces and accessories

See power specifications and applicability summary tables, page 8-3.

Power supply

Storage after line failure: Sustains computer through a line loss of 8 milliseconds when operating at the nominal ac line voltage

Input line overvoltage protection: Circuit breaker protects against surge caused by connecting computer to twice nominal line voltage

Input line transients: Withstands power line transients up to \pm 500V for 50 μ sec wide pulse, up to \pm 1000V for 100 nsec wide pulse, without damage

Output voltage regulation: \pm 5%, except -2V is \pm 10%

Output protection: All voltages are protected for over-voltage and over-current

Thermal sensing: Monitors internal temperature and automatically shuts down computer if temperature exceeds specified level.

Safety

Models 2109E, 2113E, and 2117F are recognized by Underwriters Laboratories, Inc., and certified by the Canadian Standards Association (with the exception of option 015).

Physical characteristics

	2117F	2109E	2113E
Panel width, cm (in.)		48.3 (19)	
Behind-panel width, cm (in.)		42.6 (16.75)	
Overall depth, cm (in.)		62.2 (24.5)	
Depth behind panel, cm (in.)		58.4 (23)	
Height, cm (in.)	44.5 (17.50)	22.2 (8.75)	(12.25)
Weight, kg (lb)	50 (110)	20.4 (45)	29.5 (65)
Heat dissipation $\frac{\text{kg-cal}}{\text{hr}}$ $\frac{\text{BTU}}{\text{hr}}$	752 (2986)	580 (2303)	580 (2302)
Air flow $\frac{\text{cubic meters}}{\text{minute}}$ $\frac{\text{cubic ft}}{\text{minute}}$	11 (390)*	5.7 (200)	7.9 (280)
Ventilation	Air intake is on the left side, facing the computer. Exhaust is on the right hand side.		

*2117F air flow includes flow through the computer mainframe and through the floating point processor, which is a separate package.

HP 1000 Computers

product numbers 2109E and 2113E

The HP 1000 E-Series computers are intermediate-performance members of the HP 1000 Computer Family. Combining successful HP 1000 architecture with a unique design philosophy, the E-Series has the power to meet tough computing demands.

A comprehensive range of software is available for both models, including compilers, and operating systems. In addition, a full line of HP-manufactured peripherals and data communications interface kits is offered, enabling complete systems to be tailored around these members of the HP 1000 Family.

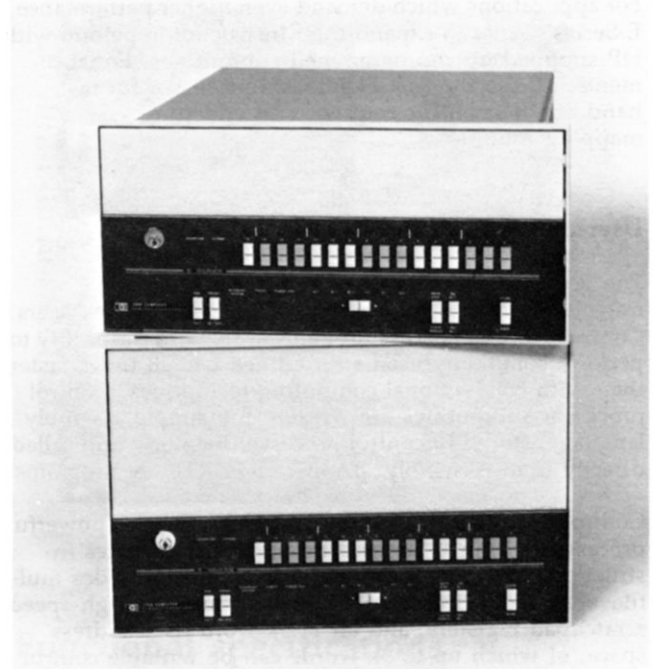
Features

- Proven HP 1000 architecture, providing extensive compatibility with HP 1000 Series processor options, peripherals, operating systems, and software
- Variable microcycle timing (VMT) for improved processor speed
- Powerful instruction set with 128 instructions
- 2.28 million byte/second direct memory access transfer rate available with Dual Channel Port Controller (DCPC)
- User microprogrammable, with complete user-microcode support
- Two models to choose from:
 - 2109E, with space for up to 2M bytes of memory and nine I/O channels in 8-3/4 inch mainframe
 - 2113E, with space for up to 2M bytes of memory and fourteen I/O channels in 12-1/4 inch mainframe
- Standard performance main memory is standard: 64k bytes in 2109E, 128k bytes in 2113E. 350 nanosecond High performance memory and/or fault control capability is optional
- Dynamic mapping system, optional in 2109E, standard in 2113E, provides for accessing up to two megabytes of memory
- Remote program load capability
- Self test for CPU and memory
- Microprogrammable processor port, permitting external processors to be interfaced directly to the E-Series control processor
- Microprogrammable block I/O for intelligent microprogrammed I/O channels
- Disc loader ROM is standard

Description

Architecture

HP 1000 E-Series architecture features a fully microprogrammed processor, which includes all arithmetic



functions, I/O, and full operator control panel. Four general-purpose registers are available, two of which may be used as index registers.

Standard E-Series instructions include indexed instructions, integer and floating point arithmetic, data communications, I/O, and a full complement of instructions for logical operations and bit/byte manipulation.

The E-Series offers extensive software program and I/O compatibility with other HP 1000 computers. E-Series processors have been optimized for performance with a microprogrammed control processor that directs operations of the other functional units. The control processor speed has been increased for certain operations by a sophisticated technique that varies microinstruction cycle time, depending on the complexity of the operation.

Efficiency of the microprogrammed routines that determine the machine language operation has also been increased through the mechanisms of instruction and operand prefetch. The CPU-memory interface is totally asynchronous in the E-Series, adding flexibility to the powerful memory structure.

All I/O channels are fully-powered, buffered, and bidirectional. Because of modular design, mainframe memory capacity is completely independent of I/O capacity, so that either memory or I/O modules may be added without taking valuable mainframe space from the other. Mainframe memory capacity is 2M bytes in the 2109E and 2113E.

E-Series Computers

A full line of I/O interface controllers is available to interface HP-manufactured peripherals, instrumentation, communications devices, or specialized devices.

For applications which demand even higher performance, E-Series users can expand their instruction repertoire with HP-supplied microprogrammed subroutines. Enhancements include the Fast FORTRAN processor for fast handling of scientific routines and operating system mapping routines.

User-microprogramming

The power and flexibility of control processor microprogramming is readily available to E-Series users. Control processor access provides users with the ability to perform commonly-used subroutines 2-to-20 times faster than with conventional computing techniques. Control processor subroutines are written in a simple assembly language, stored in control processor memory, and called directly from Assembly, BASIC, or FORTRAN programs.

Control processor programmers have access to a powerful processor within E-Series computers that executes instructions in 175-to-280 nanoseconds, and provides multilevel nested subroutines, 211 instructions, 12 high-speed scratchpad registers, and an 11.5k word user address space, of which up to 3k words can be writable control store implementing a control processor program overlay arrangement. Control program overlays provide a flexible system able to react to dynamic changes in speed requirements dictated by user program mix.

Control processor program development is aided by HP's complete software development tools, which include an assembler, debug editor, program overlay utility, and PROM tape generator, as well as a complete documentation package.

Memory system

The E-Series includes a standard performance memory system that utilizes the same field-proven semiconductor memory modules as the HP 1000 M-Series. Based on 16k or 64k bit MOS/RAM semiconductor chips, this system combines speed, reliability, and economy. High-speed, 420 ns cycle time memory (without Fault Control) is available to increase performance by up to 30%. For data integrity, memory parity check is standard and fault control capability may be added to improve the MTBF of memory systems. Memory is easily expandable by plug-in 64k, 128k, and 512k byte modules.

For efficient handling of large memory systems, the dynamic mapping system (DMS) is standard. A combination of hardware and control processor programs, DMS is a powerful memory manager that allows E-Series users to address up to 2048k bytes of memory, and provides read and/or write protection of each individual 2,048 byte page.

Four independent memory maps are provided — one for the system, one for the user, and two port controller maps for direct memory access operations. DMS adds 38 powerful memory management instructions to the standard E-Series instruction set. This capability is fully supported by HP's RTE-6/VM and RTE-IVB real-time executive operating systems which offer multi-user access to as many as 64 multi-user program partitions. In RTE-6/VM, support of large-memory systems also gives the user access to data arrays up to 128 megabytes in Virtual Memory.

Input/output

The E-Series I/O system features a multilevel vectored priority interrupt structure. There are 50 distinct interrupt levels, each with a unique priority assignment. Any I/O device can be selectively enabled or disabled or the entire interrupt system (except power fail and parity error interrupts) can be enabled or disabled under program control.

Data transfer between the computer and I/O devices may take place under program control, dual channel port controller (DCPC) control, or microprogram control. The DCPC provides two direct links between memory and I/O devices, and is program-assignable to any two devices. DCPC transfers occur on an I/O cycle-stealing basis, not subject to the I/O priority interrupt structure.

For applications where higher transfer rates are desirable, the E-Series has a special Microprogrammable Block I/O capability that allows transfer rates up to 3.1 million bytes/second. This capability can be implemented through user-designed I/O cards and block I/O control microprograms.

Remote and local program load

The initial binary-loading (IBL) function is easily performed on E-Series computers. For local bootstrap loading, a 64-word ROM-resident IBL program is called by a push-button switch on the front panel. Disc loader ROM is standard. Up to two additional HP or user-supplied loader ROMs may be added to any E-Series computer. The user can plug in up to four different loader ROMs if the standard loader ROMs are removed.

Computers at remote sites can be force-loaded from a central location through the use of a remote program load (RPL) capability. Information normally keyed into the front panel is set in switches on the CPU board, so the bootstrapping sequence may be initiated from a remote site, or automatically initiated on power-up from a local peripheral.

Self test

A comprehensive set of diagnostic routines permanently stored in read-only memory (ROM) is standard in the E-Series. Two of these routines, executed each time the IBL/TEST function is executed, provide quick tests of the processor and first 64k bytes of physical memory for verification of operating condition. A third test, executed whenever the machine is powered up, thoroughly tests the processor and all installed memory. This test may also be run manually.

Microprogrammable processor port (MPP)

The microprogrammable processor port provides a direct interface to the CPU for user-designed hardware processors. The MPP provides address, data, and control capability, so external processors can be controlled and can transfer data at burst rates up to 11.4M bytes/second.

Power system

HP 1000 E-Series power systems will operate normally in environments where power fluctuates widely. Input line voltages and frequencies may vary considerably without affecting computer operations. The optional power fail recovery system provides a minimum of 1.6 hours of memory sustaining power for the largest memory configuration, in the event of complete power failure.

Software

The HP 1000 E-Series maintains extensive program compatibility with earlier members of the HP 1000 Family, so users can take advantage of many man-years of software development.

A wide range of operating system software is available. Real-time executive (RTE) systems, available in disc and main memory-resident versions, are multi-programming systems that permit priority scheduling of several real-time programs while concurrent background processing takes place.

The memory-based RTE-M and disc-based RTE-IVB and RTE-6/VM operating systems can support up to 2.048M bytes of memory, managed by DMS. Comprehensive software systems are also available for computer networking.

Languages supported by HP operating systems include FORTRAN 4X, FORTRAN 77, Pascal, HP BASIC, Assembler, and user microprogramming. Utility software includes a debugging routine, a powerful screen editor, and an extensive library of commonly-used computational routines.

E-Series users may also take advantage of a wide variety of thoroughly-tested and documented programs that have been contributed to the HP User Library, PLUS/1000.

Specifications

All E-Series specifications can be found in the E/F-Series Specifications data sheet located at the beginning of this section.

Ordering information

2109E computer

The 2109E includes:

1. 2109B computer
2. 2102B standard performance memory controller and one 12746A 64k byte standard performance memory module
3. 12791A Firmware Expansion Module
4. 02109-90001 HP 1000 E-Series reference manual
5. 02109-90002 HP 1000 E-Series installation and service manual
6. 02109-90014 Microprogramming manual
7. DMI ROMs (13307B) and 79xxM Disc Memory and 2645A Minicartridge Loader ROMs

2113 computer

The 2113E Computer includes:

1. 2113 computer
2. 12786A 128k byte Standard performance memory package, including 2102B Memory controller, 12747A 128k byte memory module and 12731A Memory Expansion Module and 12892B Memory Protect Module
- 3-7. Same as items 3 through 7 of 2109E Computer, above.

2109E and 2113E options

003: 13304A Firmware Accessory Board instead of 12791A Firmware Expansion Module

2109E opt. 012: Replaces 64k bytes of standard performance memory with 64k bytes of high performance memory.

2113E opt.012: Replaces 128k bytes of standard performance memory with 64k bytes of high performance memory (deletes 12731A Memory Expansion Module and 12892B Memory Protect Module).

2113E opt. 013: Deletes 64k bytes of memory and Dynamic Mapping System, leaving 64k bytes of memory in computer.

014: Deletes standard memory, item 2, above, from 2109E or 2113E, to permit its replacement with another HP 1000 E-Series compatible standard performance or high performance memory system, with or without fault control, which must be ordered separately.

015: 220V (176-264V) operation

2109E and 2113E accessories

See power specifications and applicability summary on page 8-3, referring to the E-Series applicability column.

The F-Series are the most powerful of the Centralized Intelligence HP 1000 Computers. These machines combine the basic speed of the E-Series Computers with a high-performance Floating Point Processor, Scientific Instruction Set, a polynomial evaluation instruction, double-precision integer instructions, and the FORTRAN accelerator routines of the Fast FORTRAN Processor to provide a high level of processing speed in a compact, economical package. The F-Series Computers are suitable for real-time applications that require exceptional processing speed and extended arithmetic precision. Even more power can be provided for very fast vector and matrix arithmetic by adding the optional Vector Instruction Set.

A comprehensive range of software is available for the F-Series, including program development support software and operating systems. Particularly noteworthy for computational applications involving large data arrays is HP's disc-based RTE-6/VM operating system in which data arrays can be defined up to 128 million bytes in size. For complete information of HP 1000 software, see the HP 1000 Software Technical Data book.

In addition, a full line of HP-manufactured peripherals and data communications interface kits is offered, enabling complete systems to be tailored around this powerful member of the HP 1000 family of computers.



2117F Computer

Features

- **Instruction set extensions, and high speed central and floating point processors provide high performance for computation intensive applications**
- **Scientific Instruction Set for extremely fast computation of trigonometric, logarithmic functions.**
- **Polynomial evaluation instruction**
- **Double integer instructions.**
- **Fast FORTRAN Processor greatly accelerates FORTRAN operations by performing commonly used operations, such as array address calculations at hardware speed**
- **Dynamic mapping system provides for accessing up to 2 megabytes of memory computer plus extender.**
- **High speed direct memory access available via the Dual Channel Port Controller, with transfer rates up to 2.3 million bytes per second**
- **Fully user microprogrammable**
 - Complete microprogramming support software available
 - Floating point processor is available as a computing resource to the microprogrammer
- **Auto bootup and remote program load capability**
- **Self test for CPU and memory**
- **Disc loader ROM is standard**

The HP 1000 F-Series — more processing speed and precision for your computational applications

A hardware-implemented Floating Point Processor, included with the F-Series, slashes processing times for single, extended, and double-precision operations. Single-precision add/subtract takes as little as 4.8 microseconds; multiply/divide as little as 6.1 microseconds. Extended and double precision add/subtract takes 15 microseconds or less, multiply/divide as little as 12.9 microseconds. This provides the high level of floating point computational performance required for many real-time applications.

A Scientific Instruction Set consisting of nine instructions for single precision operations also supports the same operations in double precision format. It works with the Floating Point Processor to achieve execution speeds for trigonometric, logarithmic and other transcendental functions that are 6 to 24 times faster for single precision, 6 to 42 times faster for double precision than comparable software routines. Execution time for square root is under 38 microseconds for single precision, under 136 microseconds for double precision. Sine and cosine average less than 48 microseconds for single precision, less than 175 microseconds for double precision.

F-Series Computer

A **polynomial evaluation instruction** is provided for evaluation, at hardware speed, of polynomials of the form:

$$Z(x) = \frac{a_0 + a_1x + a_2x^2 \dots + a_nx^n}{b_0 + b_1x + b_2x^2 \dots + b_nx^n}$$

This capability is useful in function approximation, such as in curve fitting or correction of non-linearity in a sensor such as a strain gage or thermocouple.

In addition, the polynomial instruction can also be used to calculate the quotient of two polynomials (M/N), each having the same general form noted above.

A **Fast-FORTRAN Processor**, a set of routines that accelerate the performance of FORTRAN programs, is also standard in the F-Series computers. Parameter passing, array address calculation floating point conversion operations, and other commonly-used FORTRAN routines are speeded up by a factor of 2 to 20.

Double integer instructions provide for addition, subtraction, multiplication, division, reverse-order subtraction and division, incrementing and decrementing with or without skipping, and comparisons.

Architecture

The HP 1000 F-Series architecture features a fully-microprogrammable control processor, which includes all arithmetic functions in addition to the calculation capabilities described above, as well as I/O, self test, and full operator control panel. Four general-purpose registers are available to the assembly code programmer, two of which may be used as index registers.

Standard F-Series instructions provide for indexing; single and double integer calculations and conversions; single, extended, and double precision floating point arithmetic; single and double precision trigonometric and logarithmic functions; a powerful polynomial evaluation instruction; double integer instructions; and a full complement of instructions for logical operations and bit/byte manipulation.

The F-Series offers extensive software program and I/O compatibility with HP 1000 M- and E-Series Computers. F-Series processors have been optimized for performance with a microprogrammed control processor that directs operations of the other functional units. The control processor speed has been increased by a sophisticated technique that varies microinstruction cycle time, depending on the complexity of the operation.

Efficiency of the microprogrammed routines that determine the machine language operation has also been increased through the mechanism of instruction and operand pre-fetch. The CPU-memory interface is totally asynchronous in the F-Series, adding flexibility to the powerful memory structure.

All I/O channels are fully-powered, buffered, and bi-directional. Because of modular design, mainframe memory capacity is completely independent of I/O capacity, so that either memory or I/O modules may be added without taking valuable mainframe space from the other. Mainframe memory capacity is 2M bytes in the 2117F.

A full line of interface controllers is available to interface HP-manufactured peripherals, instrumentation, communications devices, or specialized devices.

For applications which demand even higher performance, F-Series users can expand their instruction repertoire with HP-supplied microprogrammed subroutines. For exceptionally fast vector and matrix arithmetic, there is the Vector Instruction Set. Other optional enhancements include the RTE-IVB Extended Memory Area (EMA) firmware, and RTE-6/VM Virtual Memory Area (VMA) Operating System firmware.

User microprogramming

The advantage of microprogramming. The power and flexibility of control processor microprogramming is readily available to F-Series users. Control processor access provides users with the ability to perform commonly-used software routines 2 to 20 times faster in microcode. Control processor routines are written in an assembly-like language, stored in control processor memory, and called directly from Assembly, FORTRAN, or BASIC programs.

The control processor and control store capacity. Control processor programmers have access to a powerful processor within F-Series computers that executes instructions in 175-to-280 nanoseconds, and provides three-level nested subroutines, 211 instructions, 16 high-speed scratchpad registers, 2 accumulators, and a 5.5k word address space available to the user. Up to 3k words of user microprograms may be implemented in Writable Control Store for microprogram development and dynamic loading of microprograms. Fully-developed microprograms may be stored in Programmable Read-Only Memory (PROM), a more permanent and secure storage medium for microprograms.

Microprogrammed use of the Floating Point Processor. Microprogrammers can use the Floating Point Processor (FPP) as a control processor computing resource to obtain significant performance increases over normal microprogramming. To the microprogrammer, the FPP provides a very high speed processor for floating point and extended precision integer operations. An example of the combined power of the Floating Point Processor and direct microprogramming is given by execution of a Sine(X) library function. With FPP, the execution time is 127.5 microseconds. With FPP and direct microprogramming, the execution time is 51.8 microseconds, more than 2.5 times faster.

Software support for microprogram development. Control processor program development is aided by HP's complete

software development tools, which include a micro-assembler, microdebug editor, program overlay load utility, and PROM tape generator, as well as a complete documentation package.

Memory system

Much of the speed of the F-Series Computer is due to the high speed of its primary memory systems. The F-Series Computer includes a memory system that cycles in 420 nanoseconds (without Fault Control Memory) and with a capacity up to 2 million bytes. Parity checking is standard in all HP 1000 memory systems. Fault control memory systems, which are capable of detecting and correcting all single-bit memory errors, and detecting all double bit errors, are optionally available.

For efficient handling of large memory systems, the dynamic mapping system (DMS) is standard. A combination of hardware and control processor programs, DMS is a powerful memory manager that allows F-Series users to address up to 2048k bytes of memory and provides read and/or write protection of each individual 2048-byte page. Four independent memory maps are provided — one for the operating system, one for the user, and two port controller maps for direct memory access operations. DMS adds 38 powerful memory management instructions to the standard F-Series instruction set. This capability is fully supported by HP's RTE-IVB and RTE-6/VM real-time executive operating systems which offer multi-user access to as many as 64 multi-user program partitions. In RTE-6/VM support of large-memory systems also gives the user access to data arrays up to 128 megabytes in Virtual Memory.

Input/output

The F-Series I/O system features a multi-level, vectored priority interrupt structure. There are 50 distinct interrupt levels, each with a unique priority assignment. Any I/O device can be selectively enabled or disabled, or the entire interrupt system (except power fail and parity error interrupts) can be enabled or disabled under program control.

Data transfer between the computer and I/O devices may take place under program control, dual channel port controller (DCPC) control, or microprogram control. The DCPC provides two direct links between memory and I/O devices, and is program assignable to any two devices. DCPC transfers occur on an I/O cycle-stealing basis, not subject to the I/O priority interrupt structure.

For applications where higher transfer rates are desirable, The F-Series has a special Microprogrammable Block I/O capability that allows transfer rates up to 3.1 million bytes/second. This capability can be implemented through user-designed I/O cards and block I/O control microprograms.

Remote and local program load

The initial binary loading (IBL) function is easily performed on F-Series Computers. For local bootstrap loading, a 64-word ROM-resident IBL program is called by a push-button switch on the front panel. Disc loader ROM is standard. Up to two additional HP or user-supplied loader ROMs may be added to any F-Series Computer. The user can plug in up to four different loader ROMs if the standard loader ROMs are removed.

Computers at remote sites can be force-loaded from a central location through the use of a remote program load (RPL) capability. Information normally keyed into the front panel is set in switches on the CPU board, so the bootstrapping sequence may be initiated from a remote site, or automatically initiated on power-up from a local peripheral.

Self test

A comprehensive set of diagnostic routines permanently stored in read-only memory (ROM) is standard in the F-Series. Two of these routines, executed each time the IBL/TEST function is executed, provide quick tests of the processor and first 64k bytes of physical memory for verification of operating condition. A third test, executed whenever the machine is powered up, thoroughly tests the processor and all installed memory. This test may also be run manually. Other tests, executed from the front panel, provide quick verification checks of the Floating Point Processor and all firmware.

Power fail recovery system

The optional power fail recovery system provides a minimum of 1.6 hours of memory sustaining power for the largest memory configuration in the event of complete power failure.

Software

The HP 1000 F-Series maintains extensive program compatibility with earlier members of the HP 1000 family, so users can take advantage of many man-years of software development.

A wide range of operating system software is available. Real-time executive (RTE) systems, available in disc and main memory-resident versions, are multiprogramming systems that permit priority scheduling of several real-time programs while concurrent background processing also takes place.

Languages supported by HP operating systems include FORTRAN 77, FORTRAN 4X, Pascal, HP real-time BASIC, Assembly language, and micro-assembly language. Utility software includes a debugging routine, interactive editors,

F-Series Computer

and an extensive library of commonly-used computational routines. The F-Series also supports the full range of HP 1000 applications software, including data base management, graphics, and distributed networking.

F-Series users may also take advantage of a wide variety of thoroughly-tested and documented programs that have been contributed to the HP User Library PLUS/1000.

Specifications

All F-Series specifications can be found in the E/F-Series Specifications data sheet, located at the beginning of this section.

Ordering information

2117F computer

The 2117F Computer consists of:

1. Computer with separate mainframe, including disc loader ROM, and 02117-60001 Floating Point Processor.
2. 12791A Firmware Expansion Module.
3. 12788A 128k byte High Performance Memory package, including 2102E Memory Controller, 12747H 128k byte High Performance Memory Module, 12731A Memory Expansion Module, and 12892B Memory Protect Module.
4. 02109-90014 Microprogramming manual.
5. 2111-90002 HP 1000 F-Series installation and service manual.
6. DMI ROMs (13307B)

2117F options

- 014: Deletes standard memory to permit its replacement, with another HP high performance memory system, with or without fault control, which must be ordered separately.
- 015: 220V operation

2117F accessories

For list of accessories that are compatible with the 2117F computer, see the power specifications and applicability summary on page 8-3, referring to the Series F applicability column.

12823S Firmware Subscription Service

Provides firmware updates of Dynamic Mapping Instructions, Scientific Instruction Set, and Fast FORTRAN Processor firmware in HP 1000 F-Series Computers as required to keep those firmware items up to date with respect to changes as they are released by Hewlett-Packard. The 12823S service is priced in monthly units and is billable quarterly.

Dual-Port I/O Extender and Dual CPU Kit

HP 1000 M/E/F-Series Computers

product numbers 12979B and 12781A

The 12979B Dual-Port I/O Extender expands the I/O capacity of HP 1000 computers by offering additional channels to house standard interface cards. Integral to the 12979B is a programmable I/O bus switch that provides the capability to develop configurations for peripheral sharing between two computers.

Features

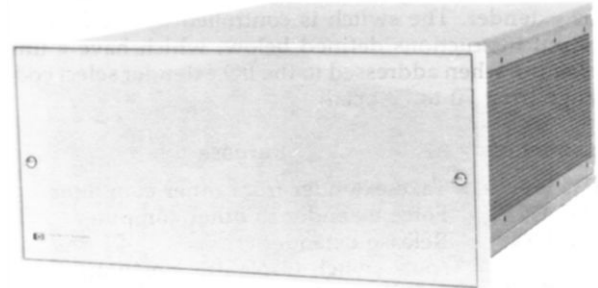
- Provides 16 additional I/O slots per extender, with up to two extenders per computer
- Integral I/O bus switch provides capability for peripheral sharing
- Solid state switching logic for speed and high reliability
- Optional direct memory access with dual-channel port controller accessory
- Full continuity of interrupt locations

Functional description

I/O expansion

The 12979B extender provides 17 I/O slots for standard interface cards. Adding the 12979B to any HP 1000 computer provides a net addition of 16 slots, since one mainframe slot is required for the extender buffer card. Space is also provided in the extender for mounting the 12898A Dual-Channel Port Controller accessory, which provides direct memory access capability for any peripheral connected via the I/O extender.

The I/O extender, when used in the single port mode, is transparent to the programmer. Any select code (I/O device address) may be programmed into it, and I/O cards will operate with the same speed and flexibility as those in the computer mainframe.



The first I/O slot in the extender can be programmed to any select code, so devices can be moved from the computer to the extender to balance power consumption or to share with another CPU without losing select codes.

I/O bus switch

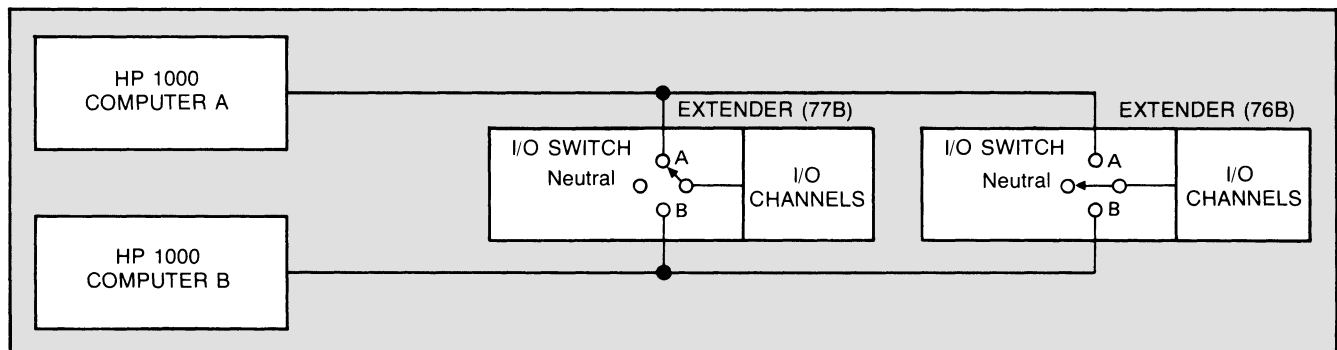
Integral to the extender is a programmable I/O bus switch that can transfer control of I/O devices connected to the extender between two HP 1000 M-Series, E-Series, or F-Series computers. This capability makes it easy to set up a variety of configurations for peripheral sharing.

The switch is operable under either manual or program control, and has three positions, defined as follows:

Connected to CPU port A: In this position, the I/O extender is connected to the computer associated with port A, and all devices interfaced via the extender are available to that computer. When connected, operations are totally transparent to the computer program.

Connected to CPU port B: Operation is the same as described for port A, above, except that the computer connected to port B has exclusive access to the extender and the devices connected to it.

Neutral: Neither computer is connected.



Two-computer connection to two dual-port I/O extenders

I/O bus switch programming

Switch programming is addressed to a select code (I/O device address), which can be any number from 70 to 77 octal, that is set by selector switches beneath the deck of the extender. The switch is controlled by the four input/output instructions defined below, which have a unique meaning when addressed to the I/O extender select code (in range from 70 to 77 octal).

Instruction	Purpose
STC EXT*	Take extender from other computer
CLC EXT*	Force extender to other computer
CLF EXT*	Release extender (puts switch in Neutral position)
SFC EXT*	Take extender if released. Skip indicates switch was in neutral position and has been connected to the computer issuing the instruction

*EXT = select code in range from 70 to 77 octal.

Functional specifications

Capacity

- Extender:** 17 I/O channels (16 additional).
- Extenders per computer:** Two, maximum.
- Computer I/O channels used:** One per extender.

I/O switch characteristics

- Number of computer ports:** Two.
- Switching time:** One I/O instruction.

Configuration information

- Maximum separation between computer and extender:** 1.8m (6 ft), cable length limited.
- Minimum clearances;** 7.6 cm (3 in) for rear cable; 5.7 cm (2-1/4 in) air intake inside clearance.
- Power fail communication:** Status of the power supplies in HP 1000 computers and I/O extenders is communicated via power control cables. A power failure or power shut-down in a computer or extender causes a power down signal to be transmitted over the power control cable(s) to any other computer or extender that is connected. When a computer receives the signal, a power fail interrupt is generated in that computer. Connection of the power control cables is required for orderly shutdown because a power failure or power down in an extender will cause unpredictable control and data signals that may cause loss of control over the computer's operation. Therefore, although use of the power control cables prohibits redundant operation, their installation is required, as shown in the 12979B installation manual.

Installation: To install, mount the 12979B in a rack less than 1.8m (6 ft) from the HP 1000 computer(s). Connect the power control cable between the extender and computer. Install an I/O buffer card in the first unused I/O slot in the computer(s). Configure the I/O extender control card to the first select code desired in the extender, the desired select code for the I/O switch, and the source of the priority chain for both computer ports (if both are used). Connect the I/O control signal flat cable(s) between the extender and the cpu board(s) in the computer(s) and connect the I/O data cable(s) between the I/O buffer card(s) in the computer(s) and the I/O extender control card. If only one computer is connected to the extender, the extender configuration switches can be set to lock the switch to that machine, avoiding the necessity of issuing STC EXT each time the system is powered up.

Electrical specifications

AC power required

88-132V, 47.5-66 Hz, 625W, maximum; 176-264V, 47.5-66 Hz with option 015. Input line voltage range is easily changed in the field by moving jumper connections.

Current required from computer

2A(+5V) and 1.35A(-2V) for I/O buffer card.

Current available to I/O slots

4.5A(+12V), 4.7A(+5V), 5A(-2V), 2.5A(-12V), 0.25A(+28V)

Power supply

- Storage after line failure:** I/O extender continues normal operation through temporary power interruptions of up to 8 milliseconds when operating at the minimum ac line voltage.
- Output protection:** All voltages are protected for over voltage and over current.
- Thermal sensing:** Monitors internal temperature and automatically shuts down I/O extender if temperature exceeds specified level.

Safety

The 12979B is recognized by Underwriters Laboratories, Inc., and certified by the Canadian Standard Association (with the exception of option 015).

Physical characteristics

Dimensions

Width: 48.3 cm (19 in) panel; 42.6 cm (16-3/4 in) behind panel casting.

Depth: 62.2 cm (24-1/2 in) overall; 58.4 cm (23 in) behind panel casting.

Height: 22.2 cm (8-3/4 in).

Weight

16 kg (35 lb)

Heat dissipation

538 kilogram-calories/hr (2138 BTU/hr).

Ventilation

Air flow is 5.7 cubic meters/min (200 cubic feet/min), intake on left side, exhaust on right side.

Ordering information

12979B Dual port I/O extender

The 12979B includes:

1. 12979B Dual port I/O Extender.
2. 12979-60029 I/O buffer card.
3. 12979-60028 I/O data cable, 2.1m (7 ft) long.
4. 12979-60008 I/O control cable.
5. 12979-60025 power control cable.
6. 12979-90016 installation and service manual.
7. 12979-90014 operating and reference manual.
8. 12979-60026 power control cable adaptor.

12781A dual cpu kit

The 12781A dual cpu kit includes:

1. 12979-60029 I/O buffer card.
2. 12979-60028 I/O data cable 2.1m (7 ft) long.
3. 12979-60008 I/O control cable.
4. 12979-60025 power control cable.
5. 12979-60026 power control cable adapter.

12898A dual channel port controller for 12979B

The 12898A dual channel port controller for the 12979B includes:

1. 12898-60001 dual channel port controller assembly.
2. 12898-90001 installation manual.

I/O extender option

015: 220V (176-264V) operation.

The 12944B and 12991B power fail recovery systems provide battery sustaining power for memory during line power outages, as well as battery charging circuitry, and battery charge state testing. If a line power outage does not last long enough to deplete available battery charge, the power fail/auto restart feature of HP 1000 computers may be used to resume processing. If, on the other hand, a line power outage lasts long enough to deplete available battery charge, the power fail recovery system prevents automatic power up and signals the operator that this condition exists.

Features

- Sustains memory through power failures
- Tests battery charge state and provides a low battery warning indicator
- Provides automatic memory clear on power failures lasting longer than available battery charge
- Operates throughout the entire range of HP 1000 environmental specifications

Functional specifications

Application

12944B is used for battery backup of 2108M and 2109E Computers. It contains one 14-volt sealed lead-acid battery with a rating of 5 ampere-hours.

12991B is used for battery backup of 2112M, 2113E, and 2117F Computers and Memory extenders. It contains two 14-volt sealed lead-acid batteries, each with a rating of 5 ampere-hours.

Memory sustaining time

No. of mem. modules:	1	2	3	4	5	6	7	8	9	10
Hours with 12944B:	4.1	3.3	2.5	1.9	1.6					
Hours with 12991B:	4.4	3.8	3.4	3.0	2.6	2.3	2.2	2.1	2.0	1.8

Power restart

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

Power control and charge unit

Monitors battery charge status and provides slow charge.

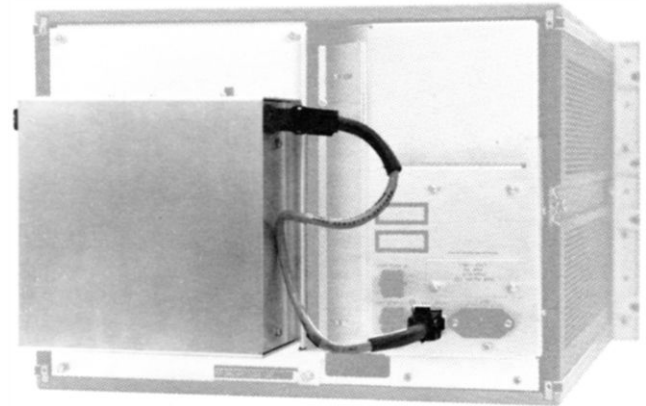
Sustaining battery

Type: 14 volt, 5 amp-hr (12944B) or 10 amp-hr (12991B) sealed lead acid.

Charging rate: 2A, maximum.

Battery charge time

Approximately 16 hours to fully-charge.



12991B power pack mounted on rear of 2113 computer

Installation

To install, secure the battery pack to the back of the computer or memory extender, plug the printed circuit cards into the power supply, and connect the battery cable to the extender's input battery connector.

Environmental specifications

All environmental specifications coincide with those of the M-, E-, and F-Series CPUs except for non-operating temperature, which is as follows:

Non-operating: -40° to 60°C (-40° to 140°F).

Physical characteristics

12944B: Adds 11.1 cm (4-3/8 in) to overall depth, 4.3 kg (9.5 lb) to weight of the Computer.

12991B: Adds 11.1 cm (4-3/8 in) to overall depth, 7.3 kg (16 lb) to weight of the Computer or Memory extender.

Ordering information

12944B power fail recovery system

The 12944B power fail recovery system includes:

1. 12944-60001 battery pack.
2. 5061-1348 battery charging assembly.
3. 5061-1349 battery backup assembly.
4. 12944-60002 cable.
5. 12944-90005 installation manual.

12991B power fail recovery system

The 12991B power fail recovery system includes:

1. 12991-60001 battery pack and mounting hardware.
- 2-4. Same as 2 through 4 of 12944B, above.
5. 12991-90004 installation manual.

Parity and Fault Control Memory Systems

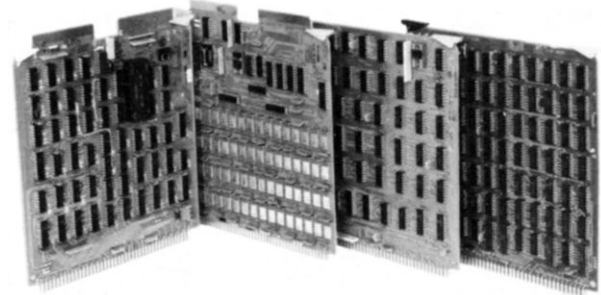
product numbers
 HP 2102B/C/E/H, 12699H, 12746H, 12747H, 12749H,
 12779H, 12780H, 12666H, 12784A-D, 12785A-D,
 12786A-D, 12787A-D, 12788A-H, and 12789A-M

For HP 1000 M/E/F-Series Systems

Parity and fault control memory systems for HP 1000 M/E/F-Series computers encompass standard performance memory for M/E-Series Computers and high performance memory for E/F-Series Computers. HP 1278x Memory Packages (Table 1, next page) provide convenient means of obtaining complete memory systems in memory sizes from 128k bytes to 2048k bytes.

Features

- Choice of parity or fault control memory
- Up to 2 Megabytes of high-density memory in computer mainframe using 512kb memory modules and 1Mb fault control check bit array boards
- Automatic correction of single-bit errors with fault control memory
- Convenient, economical large memory packages



12788E 512kb High performance memory package, including, left to right: 2102E Memory controller, 12749H 512kb Memory Module, 12892B Memory protect module, and 12731A Memory expansion module.

Functional specifications

Maximum Mainframe Memory Capacity

Computer	2108M, 2109E, or 2111F	2112M, 2113E, or 2117F
Memory Module Slots	5	10
Max. Parity Memory	2048kb*	2048kb*
Max. Fault Control Memory	1536kb*	2048kb*

* With 12749H 512kb Memory Modules, and 12666H 1Mb Fault Control Check Bit Array Boards. Use of other memory modules or fault control check bit boards reduces total memory capacity.

Memory Organization

Parity memory organization and cycle time:

Computer (System Model)	Memory Control	One or More Memory Modules	Capacity	Cycle Time
2108M or 2112M	2102B	12746A*/H 12747A*/H 12699H 12749H	64kb 128kb 256kb 512kb	650ns
2109E or 2113E (40 or 60)	2102B	12746A*/H 12747A*/H 12699H 12749H	64kb 128kb 256kb 512kb	665ns±35ns
2109E, 2111F, 2113E (40 or 60) or 2117F (45 or 65)	2102E	12746H 12747H 12699H 12749H	64kb 128kb 256kb 512kb	420ns±35ns

NOTE: Dynamic mapping system is required for >64kb memory.

* Identifies product to be obsoleted listed here for reference only.

Fault control memory organization and cycle time:

Computer (System Model)	Memory Control	One or More		Capacity	Cycle Time
		Memory Modules	Check Bit Boards		
2108M or 2112M	2102C	12746A*/H 12747A*/H 12699H 12749H	12779A*/H 12780A*/H 12666H	64kb 128kb 256kb 512kb 1024kb	650ns
2109E or 2113E (40 or 60)	2102C	12746A*/H 12747A*/H 12699H 12749H	12779A*/H 12788A*/H 12666H	64kb 128kb 256kb 512kb 1024kb	735ns ±35ns
2109E, 2111F, 2113E (40 or 60) or 2117F (45 or 65)	2102H	12746H 12747H 12699H 12749H	12779H 12788H 12666H	64kb 128kb 256kb 512kb 1024kb	490ns ±35ns

NOTE: Dynamic mapping system is required for >64kb memory.

* Identifies product to be obsoleted listed here for reference only.

Basic Word Size: 17 bits (2 bytes plus parity bit provided in memory modules).

Fault Control Memory Word Size: Check bit array cards add 5 check bits to basic word size.

Intermixing of Memory Modules: Memory modules of differing capacities can be intermixed on the same controller. Also, 1274xH and 12699H memory modules may be used with 1274xA memory modules on the same 2102B or 2102C controller, but 1274xA memory modules are not usable on the 2102E or 2102H controller.

Table 1. Summary of 12784/5/6/7/8/9x Memory Packages

NOTE: The preferred memory packages for each memory size are listed first.

		High Performance Memory Packages		Standard Performance Memory Packages				Memory Modules and FC Check Bit Boards Included (NOTE A)									
Computers Supported		2109E, 2111F, 2113E, and 2117F		2109E and 2113E		2108M and 2112M		Memory Modules			FC Check Bit Bds*						
Type of Memory		Parity	FC	Parity	FC	Parity	FC	12747H	12699H	12749H	12779H	12780H	12666H				
Memory Controller		2102E	2102H	2102B	2102C	2102B	2102C										
Memory Size	128kb	12788A	12789A	12786A	12787A	12784A	12785A	1	0	0	1	0	0				
	256kb 256kb	12788BB 12788B	12789B	12786B	12787B	12784B	12785B	0 2	1 0	0 0	0 1	0 0	0 0				
	512kb	12788E	12789J					0	0	1	0	0	1				
	512kb	12788C	12789E					12786C	12787C	12784C	12785C	0	0	1	0	1	0
	512kb		12789C									12785C	4	0	0	0	1
	1024kb	12788F	12789K					0	0	2	0	0	1				
	1024kb	12788D†‡	12789F					12786D†‡	12787D†‡	12784D†‡	12785D†‡	0	0	2	0	2	0
	1024kb		12789D†‡									12785D†‡	8	0	0	0	2
	1536kb	12788G	12789L					0	0	3	0	0	2				
	1536kb	12788H	12789G†					12789G†	0	0	3	0	3	0			
	2048kb		12788H	12789M†					0	0	4	0	0	2			
	2048kb	12789H†‡		12789H†‡					0	0	4	0	4	0			

NOTE A: The memory packages also include the 12731A Memory Expansion Module and 12892B Memory Protect Module for dynamic mapping of memory above the lowest 64k bytes. In addition, the 12784x and 12785x Memory Packages include the 12778B Dynamic Mapping Instructions for M-Series Computers. Dynamic Mapping Instructions for the E/F-Series Computers are now included with the computer.

* = Item included with fault control memory package only.

† = 12990B Memory Extender is required to furnish additional memory module slots for this package used in a 2108M, 2109E, or 2111F Computer.

‡ = 12990B Memory Extender is required to provide additional +5V memory current for 12785D, 12787D, 12789D, or 12789H Memory Package used in a 2112M, 2113E, or 2117F Computer with 12991B Power Fail Recovery System.

Fault Control Check Bit Array Board Configurability:

Within their maximum capacity, the check bit boards can be configured to support 64kb, 128kb, 256kb, and 512kb of fault control memory.

Intermixing of Fault Control Check Bit Array Boards:

12779H, 12780H, and 12699H Fault Control Check Bit Array Boards can be used with 12779A and 12780A Check Bit Boards on the same 2102C Controller, but 12779A and 12780A Check bit boards are not usable on the 2102H controller.

Refresh: Each memory location is refreshed automatically every 2 milliseconds.

Memory Data Integrity Provisions

Standard memory power supply: Provides power during line failure that does not exceed 8 milliseconds.

Battery backup: The optional 12944B (for 2108M or 2109E) or 12991B (for 2111F, 2112M, 2113E, or 2117F) Power Fail Recovery System provides memory power in case of total line failure exceeding 8 milliseconds. However, use of the

Power Fail Recovery System restricts the memory module and fault control check bit board configurations that can be used. (See 'Configuration Restrictions for Computers with Power Fail Recovery System' below.)

Parity memory: The 2102B or 2102E Memory Controller monitors all words read from memory, utilizing the 17th bit in each word for parity checking. Switch selectable response to parity error can be to halt, interrupt the RTE operating system, or ignore a detected parity error. The 12892B Memory Protect Module (part of the dynamic mapping system required to address more than 64kb memory) is required for parity error address detection for the RTE operating system.

Fault control memory error detection and correction: The 2102C or 2102H Fault Control Memory Controller in conjunction with the fault control check bit array boards executes a Hamming error correction code. Using this code, all single-bit errors are detected and automatically corrected so that processing is not interrupted. All double-bit and most multiple-bit errors are detected and flagged to the RTE operating system.

Configuration Restrictions for Computers with Power Fail Recovery System

In HP 1000 M/E/F-Series Computers with 12944B or 12991B Power Fail Recovery System (PFRS), the +5M memory supply has a maximum available current of 6A, which cannot be exceeded by the combined +5M current requirements of the memory controller, memory modules, and fault control check bit array boards installed in the computer. The maximum parity and fault control memory configurations that are supportable in the mainframe of 2112M, 2113E, 2117F computers within this current limitation are summarized below. The +5M current limitation is not important in 2108M, 2109E, or 2111F Computers because they have only five memory module slots. The memory capacity of HP 1000 M/E/F-Series computers without a power fail recovery system is not subject to the +5M 6A current limitation, since both +5V and +5M current requirements are taken from the +5V CPU supply.

Large memory configurations that are supportable in 2112M, 2113E, or 2117F Computer Mainframe with 12991B Power Fail Recovery System (NOTE A).

Memory Size	Parity Memory		Fault Control Memory			
	Mem. Modules		Mem. Modules		FC Check Bit Bds	
	12747H	12749H	12747H	12749H	12780H	12666H
1024kb	8	0	4	1	2	0
1024kb	4	1	4	1	0	1
1408kb	7	1	n/s	n/s	n/s	n/s
1536kb	4	2	0	3	3	0
1536kb	0	3	0	3	0	2
1792kb	6	2	n/s	n/s	n/s	n/s
2048kb	4	3	0	4	0	2
2048kb	0	4				

NOTE A: Other configurations this size or larger require 12990B Memory Extender with 12991B Power Fail Recovery System, which provides +5M current to memory modules and check bit boards installed in it.

n/s = Fault Control Memory size Not Supported in Computer mainframe; will require 12990B Memory Extender.

Ordering information

NOTE: For the hardware supplied in 12784A-D, 12785A-D, 12786A-D, 12787A-D, 12788A-H and 12789A-M Memory Packages and the memory sizes of each package, see Table 1. For installation manuals provided, see Table 2.

12784x Standard Performance Memory Packages for M-Series Computers

12785x Standard Performance Fault Control Memory Packages for M-Series Computers

12786x Standard Performance Memory Packages for E-Series Computers

12787x Standard Performance Fault Control Memory Packages for E-Series Computers

12788x High Performance Memory Packages for E/F-Series Computers

12789x High Performance Fault Control Memory Packages for E/F-Series Computers

2102B Standard Performance Memory Controller

2102C Standard Performance Fault Control Memory Controller

2102E High Performance Memory Controller

2102H High Performance Fault Control Memory Controller

12746H 64kb Memory Module

12747H 128kb Memory Module

12699H 256kb Memory Module

12749H 512kb Memory Module

12779H 256kb Fault Control Check Bit Array Board

12780H 512kb Fault Control Check Bit Array Board

12666H 1024kb Fault Control Check Bit Array Board

Table 2. Installation Manuals (by HP Part Number) Supplied with HP 1000 M/E/F-Series Memory Packages and Components

Components		Memory Packages		
Name	Product Numbers	12784A-D 12785A-D	12786A-D 12787A-D	12788A-H 12789A-M
Memory Control	2102B and 2102C 2102E and 2102H	5955-4310	5955-4310	Not Appl.
Memory Modules	12746H, 12747H, 12699H, & 12749H	5955-4311	5955-4311	5955-4311
FC Check Bit Bds	12779H, 12780H, & 12666H	5955-4311	5955-4311	5955-4311
Mem Exp Module	12731A	12731-90001	12731-90001	12731-90001
Memory Protect	12892B	12892-90007	12892-90007	12892-90007
Dyn Map Instr.	12778B	12976-90005	Not Appl.	Not Appl.

Time Base Generator

HP 1000 M/E/F-Series Computers

product number 12539C

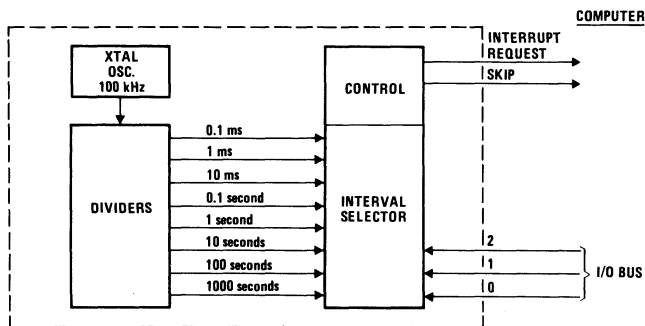
The 12539C Time Base Generator provides a system software clock for interfacing time-dependent equipment. All time base generator functions are contained on a single, plug-in card that has its own select code. The card provides command and interrupt logic, a 100k Hz oscillator, eight decade frequency dividers, and output selection logic.

Features

- Multiple time bases
- Built-in error detection
- Easy assembly-language programming
- Operates with interrupt or skip routines
- Plugs into I/O slot of any HP 1000 computer

Description

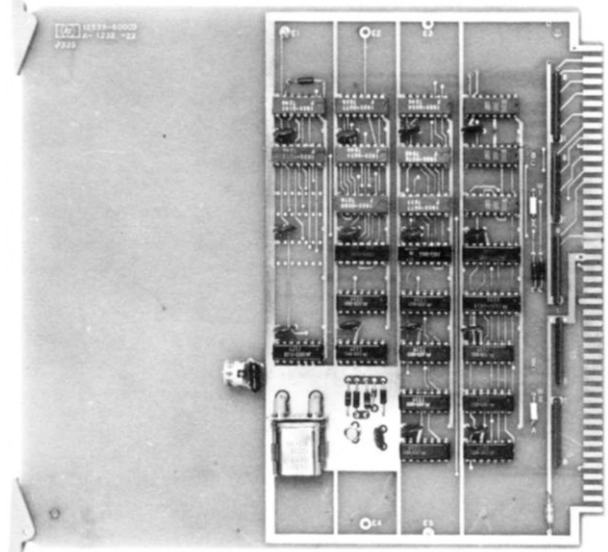
The time intervals are generated in decade steps from 100 microseconds to 1000 seconds (16.67 minutes) and are derived from the crystal oscillator. Any interval (in 100 microsecond increments) may be selected by use of a simple, assembly-language program loop. Built-in error detection provides an error status bit to the computer when a time interval is not acknowledged.



A signal from the computer enables the generator. The 100k Hz oscillator signal is formed into eight time base intervals by the divider circuit. The appropriate time base is selected by using one of the following interval codes:

Binary code	000	001	010	011
Interval (millisec)	0.1	1.0	10	100
Binary code	100	101	110	111
Interval (seconds)	1.0	10	100	1000

When the selected interval is elapsed, the control logic requests an interrupt or enables a skip signal to the counter.



Functional specifications

Base intervals

0.1, 1, 10, and 100 milliseconds and 1, 10, 100, and 1000 seconds.

Accuracy

Stability: 2 parts in 10^6 /week.

Temperature effects: 20 parts in 10^6 over temperature range of 15° to 35°C (59° to 95°F).

Total stability: 1/2 second/24-hour day

Electrical specifications

Current required from computer power supply

0.75A (+5V), 0.016A (-2V)

Ordering information

12539C Time base generator

The 12539C Time base generator includes:

1. 12539-60005 Time base generator.
2. 12539-90008 Operating and service manual.

The 12892B Memory Protect, when installed in the memory section, provides an operating system with the capability to protect itself from alteration, and preserve system control of I/O functions. It also offers capability to detect parity error operations by generating a parity interrupt, prevents infinite indirect addressing loops from holding off interrupt servicing, and identifies user violations when operating with DMS.

Features

- Memory protect logic prevents memory alteration below a programmable fence address
- I/O protect logic provides vectored interrupt on attempted execution of I/O instructions and prevents I/O operation until interrupt is serviced, thus giving system exclusive control of I/O and DMS operations
- Parity error interrupt logic provides an interrupt on occurrence of a parity error in memory and saves the parity error address
- Parity and memory protect features separately enabled/disabled by standard I/O instructions
- Computer may be switch-selected to interrupt or halt on parity error
- Operates in conjunction with dynamic mapping to provide interrupts for paged memory violations, privileged instruction violations, or parity errors
- Indirect level counter enables interruption of long indirect address loops

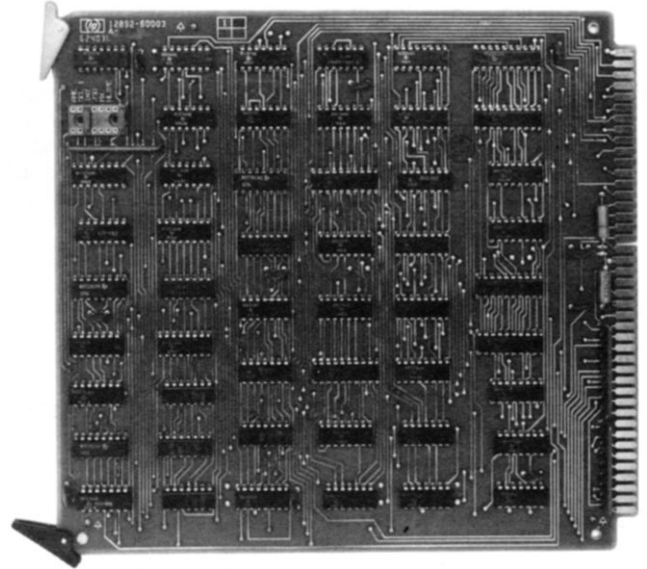
Functional description

Memory protect fence

Memory protect provides capability to protect a selected block of memory from a programmable fence downward, against alteration by programmed instructions (EXCEPT those directly involving the A and B registers.) Any programmed instruction except JMP may freely address the A and B registers as locations 00000 and 00001, respectively. By removing the appropriate jumper, it is possible to prevent a JSB to A or B.

I/O control

With an STC 05 instruction, memory protect logic prohibits the execution of all I/O instructions except those involving the operator panel SC01. This feature limits I/O operations to interrupt on DCPC only. Programming the system to direct all I/O interrupts to an executive program provides exclusive control of the I/O system. Memory protect logic is disabled automatically by any interrupt and must be reenabled by an STC 05 instruction at the end of each interrupt subroutine.



Programming

The following programming rules pertain to the use of memory protect, assuming an STC 05 instruction has been given:

- A. Location 00002 is the lower boundary of protected memory. Locations 00000 and 00001 are the A and B register addresses.
- B. JMP instructions may not reference the A or B register; however, a JSB instruction may do so. By removing the appropriate jumper, it is possible to prevent a JSB to A or B.
- C. The upper boundary, memory address, is loaded into the fence register from A or B register by an OTA 05 or OTB 05 instruction, respectively. Memory locations below but not including this address are protected.
- D. Execution will be inhibited and an interrupt to location 00005 will occur if a JMP, JSB, ISZ, STA, STB or DST instruction (also CBT, JLY, JPY, MVB, MVW, SAX, SAY, SBX, SBY, STX, and STY of the extended instruction group) directly addresses a location in protected memory. Execution will also be inhibited if any instruction is attempted, including HLT but excluding those addressing select code 01, the S register, and the overflow register.

Memory Protect

After three successive levels of indirect addressing, the memory protect logic will allow a pending I/O interrupt. The 12892B can be jumper-configured to permit I/O instructions to any select code. HLT is still inhibited and all other protection features remain unchanged.

- E. Any instruction not mentioned in step D is legal, even if the instruction directly references a protected memory address. Indirect addressing through protected memory by those instructions listed in step D is also legal provided that the ultimate effective address is outside the protected memory area.

Functional specifications

Compatibility

The 12892B is compatible with 2108, 2109, 2111, 2112, 2113, and 2117 Computers.

Configuration information

Slots required: 1 dedicated slot in computer mainframe.

Software recommended: 24396F diagnostic package on mini-cartridge.

Installation: To install, insert the 12892B board directly into dedicated slot in memory backplane. No cables required.

Electrical specifications

Current required from computer power supply

Model	+5V	-2V	+12V	-12V
12892B	1.25A	.05A	—	—

Ordering information

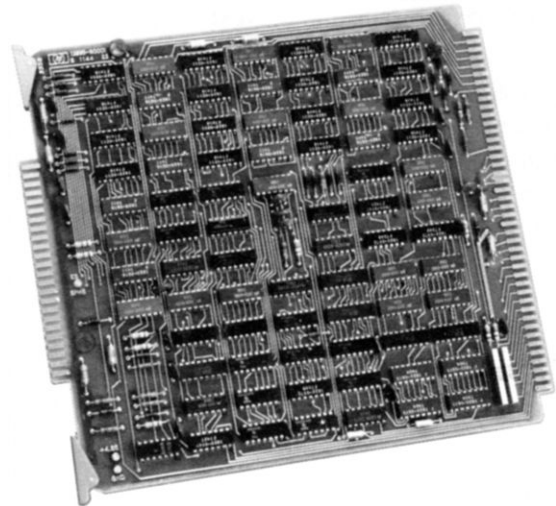
12892B Memory protect includes:

1. 12892-60003 Memory protect card.
2. 12892-90007 Installation manual.

The 12897B Dual Channel Port Controller (DCPC) provides a direct port between computer interfaces and memory. Two programmable channels can connect any I/O device to memory; these channels are program-assignable and reassignable, operating on a cycle-stealing basis with the processor.

When operating with the Dynamic Mapping System (DMS), each channel is allocated a separate, automatically-enabled memory map to provide logical-to-physical memory translation.

DCPC operation in the 12979B Dual-port I/O extender requires the 12898A extender DCPC. Operation and software are identical for devices in the extender and computer.



Features

- Program-assignable to any I/O channel
- Independent word count and address register for each channel
- Common DMA controller for lower interfacing costs
- Direct data transfers to and from memory
- Operating system can interrogate word count registers to monitor transfer progress

Functional specifications

DCPC transfer rates (megabytes/second)

	Computer Models	
	2108	2112
		2109
		2111
Transfer Operations and Memory Controller Models		2113
		2117
Input		
2102B (Std performance memory)	1.23	1.95
2102C (Std perf fault ctrl memory)	1.23	1.88
2102E (High performance memory)		2.28
Output, non-Dynamic mapping		
2102B (Std performance memory)	1.23	1.77
2102C (Std perf fault ctrl memory)	1.23	1.67
2102E (High performance memory)		2.28
Output with Dynamic mapping		
2102B (Std performance memory)	1.23	1.67
2102C (Std perf fault ctrl memory)	1.23	1.62
2102E (High performance memory)		2.1

Capacity

Number of channels: 2

Number of memory ports: 1

Registers: 2 word count registers; 2 address registers; 2 select code registers

Word size: 16 bits (2 bytes)

Maximum block size: 65,536 bytes

Program-assignable: To any I/O channel

Configuration information

Slots required: 1, dedicated

Software recommended: Diagnostic package on paper tape (24396A), or minicartridges (24396F).

Installation; To install the 12897B, insert it directly into slot 110 of the memory backplane. For the 12898A, insert it directly into a dedicated slot in the 12979B I/O extender.

Electrical specifications

Current required from computer/extender power supply

Model	+5V	-2V
12897B	2.4A	.08A
12898A	.5A	.04A

Ordering information

12897B Dual channel port controller includes:

1. 12897-60004 Dual channel port controller assembly.
2. 12897-60002 Cable
3. 12897-90005 Installation manual

12898A Dual channel port controller for 12979B Dual-port I/O extender includes:

1. 12898-60001 Dual channel port controller assembly.
2. 12898-90001 Installation manual.

The 13304A Firmware Accessory Board (FAB) is optional in HP 1000 E/F-Series Computers (except E-Series Board Computer) to provide space for 3.5k words of non-volatile control store. This space is used for HP-supplied enhancements, such as the 13307B Dynamic Mapping Instruction ROMs, the Scientific Instruction Set in the F-Series, DS/1000 firmware, RTE-6/VM or RTE-IVB firmware, and the 13306B Fast FORTRAN Processor ROMs. It accommodates both 4k (512 x 8) and 1k (256 x 4) bipolar ROMs or PROMs and is configured into four different address spaces.

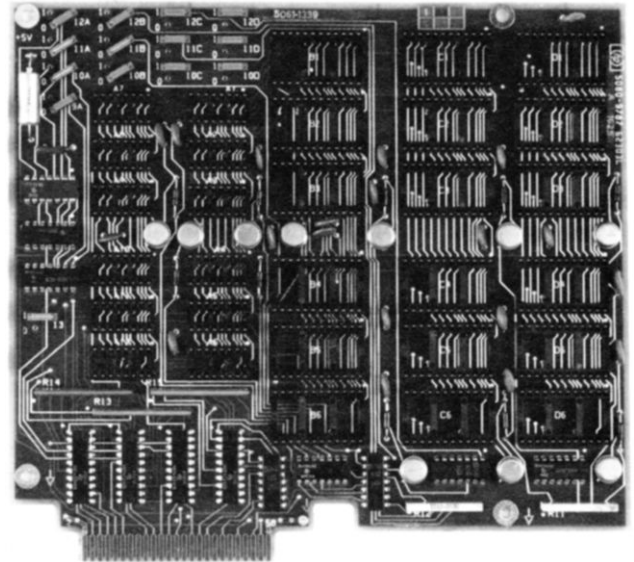
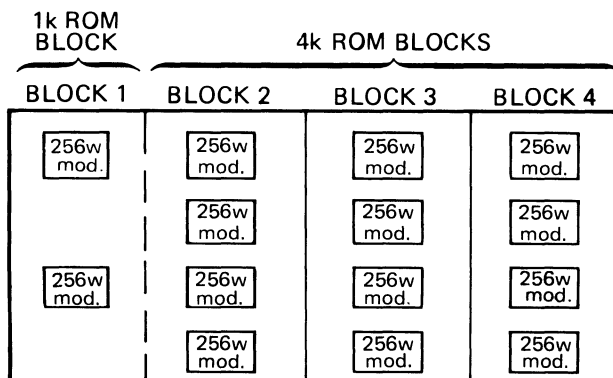
Features

- Four individually-configurable blocks (3.5k words) of non-volatile address space provided for HP 1000 E- and F-Series computers
- Utilizes 4k and 1k ROM's or PROM's
- Routines execute with no performance degradation from standard processor cycle times
- Compatible with HP microprogramming support software
- Easy configuration with plug-in jumpers
- ROM's current switched for low standby power

Functional description

The 13304A Firmware Accessory Board is arranged in four configurable address spaces (blocks) as shown in the diagram. Three of these blocks are 1k words (four each of 256 word modules) and use six 4k ROM's/block. These blocks can also be loaded with three 4k ROM's if only two modules are needed. The remaining block contains up to 512 words (two each of 256 word modules) and uses 12 1k ROM's. This block can also be loaded with six 1k ROM's if only one module is needed.

One jumper determines whether the FAB will be used in the upper or lower 8k of the E-Series 16k control store address space (Modules 0-31 vs. 32-63).



Once the upper or lower 8k address space is selected, each block can be jumpered to independently configure it to any address space within that 8k.

Functional specifications

Organization

Word size: 24 bits

Module size: 256 words

Board capacity: Three 1k word blocks of 4 modules each (4k ROM's), and one 512 word block of 2 modules (1k ROM's), each block individually configurable

Processor capacity: One 13304A Board

Cycle time: 175 nsec

ROM's or PROM's/module: 12 for 1k ROM block, 6 for each 4k ROM block

Reserved modules: HP 13306B, fast FORTRAN processor and dynamic mapping system instructions use 2 modules of 4k ROM's; Scientific Instruction Set uses four modules of 4k ROMs; DS/1000 and RTE-IVB or RTE-6/VM firmware each use 2 modules of 4k ROMs.

Recommended PROM's

4k: HP 1816-1142, Signetics 82S141, or Harris HM7641

1k: HP 1816-0782, or Harris 7611-5

Firmware Accessory Board

Configuration information

The 13304A Firmware Accessory Board is configured as described in installation and reference manual. Check CPU +5V power supply current capacity prior to installation.

Installation: After the ROM's or PROM's are correctly installed and configured on the FAB board, it is secured beneath the E-Series CPU by four screws. Electrical connection is made by attaching the flat cable from the FAB connector to connector J2 on the CPU (and UCS or WCS if installed).

Software recommended:

92061A RTE microprogramming software package.

Electrical specifications

Current required from +5V computer power supply

Power saver circuit limits current to 1.8A, maximum, regardless of the number of ROMs installed.

Ordering information

The 13304A is optional in the 2109E, 2113E, and 2117F Computers. The 12791A Firmware Expansion Module (FEM) is now standard.

13304A Firmware accessory board

The 13304A Firmware accessory board includes:

1. 5061-1339 Firmware accessory board.
2. 5061-3419 Cable assembly.
3. Four 2360-0113 screws.
4. 12791-90001 Installation and reference manual.

The Dynamic Mapping System (DMS) for HP 1000 E/F-Series computers provides for expansion of memory beyond the 64k bytes that is normally the maximum addressable by 16-bit computers.

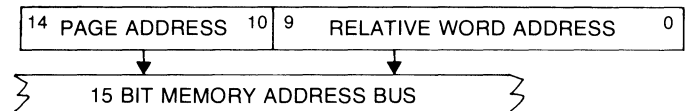
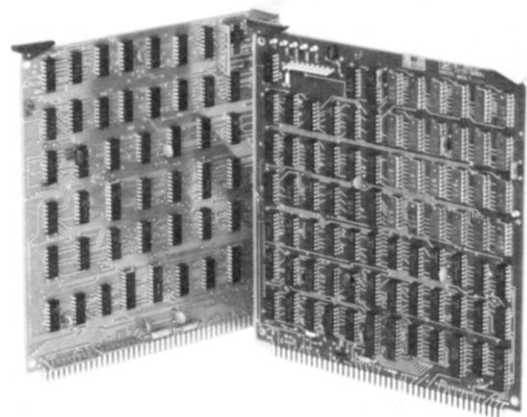
Features

- Two million byte address space
- Read and/or write protection for each page
- Four dynamically alterable memory maps; two for program execution and two for the dual channel port controller
- Program execution from non-contiguous page locations
- DCPC communication with a memory area separate from program space concurrently with program execution
- DCPC transfers to/from non-contiguous segments of memory
- Compatibility with previous software for HP 1000 family computers
- 38 instructions for memory management
- Provision of independent and shared base page segments using programmable fence
- Parity error interrupt logic that permits removal of erring memory pages from active use under program control
- Provision for sharing of programs and data between concurrent users
- Installation in dedicated slots in computer mainframe, so additional rack space is not needed
- Field or factory installability

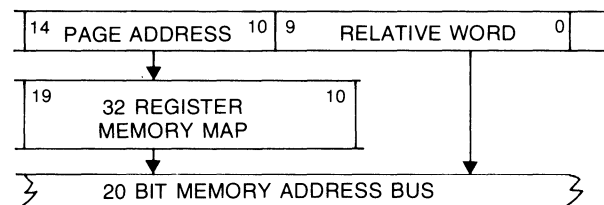
Dynamic mapping description

The basic addressing space of the HP 1000 E/F-Series is 65,536 bytes, called the "logical" memory. The amount of semiconductor memory actually installed in the computer is called the "physical" memory. An HP 1000 E/F-Series computer with Dynamic Mapping System (DMS) has an address space of two million bytes for physical memory. Dynamic mapping allows physical memory to be mapped into logical memory via four dynamically alterable memory maps, a capability that is fully software supported by HP's RTE-6/VM and RTE-IVB operating systems.

The basic memory addressing scheme of the HP 1000 provides for addressing of 32 pages of memory, each page being 2048 bytes. This memory is addressed through a 15 bit memory address bus. The upper five bits of this bus provide the page address, and lower ten bits provide the relative word address within the page.



The Memory expansion module of the dynamic mapping system converts the 5-bit page address into a 10-bit page address and thereby allows 2^{10} or 1024 pages to be addressed. The conversion is accomplished by allowing the original 5-bit page address to identify one of 32 registers within a "memory map". Each of these memory map registers contains the new, user specified 10-bit page address. This new page address is then joined with the original 10-bit relative word address to form a 20-bit memory address.



All registers within the memory map are dynamically alterable. To maximize system performance capability, there are four separate memory maps in the memory expansion module, selectable under program control: user map, system map, and two dual channel port controller (DCPC) maps.

Functional specifications

Memory address space provided

2048k bytes (2,097, 152 bytes)

Dynamic mapping instructions

All 38 DMS instructions are microprogrammed and assigned to control store module 32.

MNEM	Description	Typical Execute Times (μsec)‡	OP CODES
MBI	Move Bytes Into	4.94+1.82/wd	105702
MBF	Move Bytes From	+2.66 for	105703
MBW	Move Bytes Within	odd byte	105704
MWI	Move Words Into	2.59 +	105705
MWF	Move Words From	1.82/word	105706
MWW	Move Words Within		105707
SYA/B	Load/Store System	46-50.5-	101710/105710
USA/B	Load/Store User	46-50.5	101711/105711
PAA/B	Load/Store Port A	46-50.5	101712/105712
PBA/B	Load/Store Port B	46-50.5	101713/105713
SSM	Store Status in Memory	3.71*	105714
JRS	Jump and Restore Status	5.32-6.06*	105715
XMM	Transfer Map or Memory	4.27†	105720
XMS	Transfer Map Sequentially	4.10†	105721
XMA/B	Transfer Maps Internally	29.35	101722/105722
XLA/B	Cross Load	3.57*	101724/105724
XSA/B	Cross Store	4.17*	101725/105725
XCA/B	Cross Compare	3.57-4.24	101726/105726
LFA/B	Load Fence	2.17	101727/105727
RSA/B	Read Status	2.17	101730/105730
RVA/B	Read Violation	2.17	101731/105731
DJP	Disable and JMP	3.75*	105732
DJS	Disable and JSB	4.41*	105733
SJP	Enable System and JMP	3.75*	105734
SJS	Enable System and JSB	4.41*	105735
UJP	Enable User and JMP	4.17*	105736
UJS	Enable User and JSB	4.17*	105737

†Add 1.26 μsec for each level of indirect addressing.

‡Add 1.62 μsec for each map loaded.

§Using std performance memory, without fault control.

Dynamic mapping power fail characteristics

Power failure automatically enables the system map, and a minimum execution time of 500 μsec is assured the programmer. A power fail routine should include routines to save as many maps as desired.

Upon restoration of power, all maps are disabled and none are considered valid. It is the responsibility of the power fail recovery software to restore the maps as desired.

Violation register

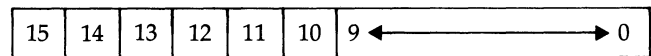
The memory expansion module violation register contains information so the programmer can detect where a fault occurred in hardware or software and what steps must be taken to correct it:



- 15 Read violation
- 14 Write violation
- 13 Base page violation
- 12 DMS privileged instruction
- 7 ME-bus enabled at violation
- 6 Maps enabled at violation
- 5 System user enabled at violation
- 0 - 4 Map register

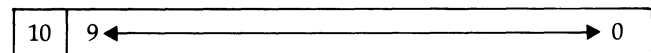
Status register

The memory expansion module status register allows the programmer to determine whether the MEM is on or off currently, and at time of the last interrupt, as well as indicates the address for the base page fence.



- 15 MEM enabled at last interrupt
- 14 System/user map selected at last interrupt
- 13 MEM currently enabled
- 12 System/user map currently selected
- 11 DMS protected mode
- 10 Portion mapped
- 0 - 9 Base page fence

Base page fence register



- 0 - 9 Fence address
- 10 Portion of base page mapped
- Bit 10 = 0: Fence ≤ M < 2000₈ is mapped
- Bit 10 = 1: 1 < M < Fence is mapped

Memory protect

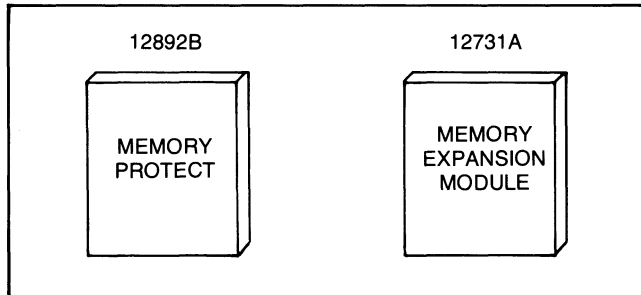
The memory protect feature of DMS provides all the capability of HP's 12892B memory protect plus the capability to read and/or write protect each individual page of physical memory.

Memory protect allows a block of logical memory of any size, from a selectable fence downward, to be protected against alteration by programmed instructions except those directly involving the A and B registers. This is in addition to the page-by-page protection provided within DMS.

Memory protect logic, when enabled, prohibits the execution of all I/O instructions except those referencing the switch register and the overflow register. This feature allows I/O to be controlled by interrupt only.

Although the memory expansion module performs its mapping function without the memory protect board installed, memory protect is required if the protection features are to be used.

Configuration information



Compatibility: This Dynamic Mapping System is compatible with 2109, 2113, and 2117 computers.

Computer locations used: One dedicated slot each for the 12892B memory protect module and the 12731A memory expansion module in 2109, 2113, or 2117 Computer.

Software recommended: RTE-6/VM or RTE-IVB Real-Time Executive operating system (92084A or 92068A).

Installation: Plug the 12892B and 12731A modules into the memory section of the computer to complete installation.

Electrical specifications

Current required from +5V computer power supply

Model	12731A	12892B	13307A
+5V current	3.9A	1.25A	(A)

(A) Current used by 13307B is included in current used by the 12791A Firmware Expansion Module or the 13304A Firmware Accessory Board and is not included in the current requirement for the E/F-Series Dynamic Mapping System.

Ordering information

NOTE: The 12892B and 12731A are included with 12786-94 memory packages. The 13307B Dynamic Mapping Instructions are included in 2109E/13E and 2117F and need not be ordered separately.

12731A Memory expansion module includes:

1. 12731-60001 Memory expansion module.
2. 12791-90001 M/E/F-Series Firmware Installation and Reference Manual.

12892B Memory protect

The 12892B Memory protect, also available separately (see separate data sheet), includes:

1. 12892-60003 Memory protect module.
2. 12892-90007 Installation manual.

13307S Firmware Subscription Service

Provides firmware updates of the 13307B Dynamic Mapping Instructions as they are released by Hewlett-Packard. The 13307S service is priced in monthly units and is billable quarterly.

Priority Jumper Card

HP 1000 M/E/F-Series Computers

product number 12777A

The HP 12777A provides a means of completing the I/O priority chain when blank I/O slots are configured into a system. This card passes the interrupt priority chain through to I/O cards which follow the blank space, thus making it possible for them to cause an interrupt.

Features

- Completes I/O priority chain
- Allows blanks to be configured into I/O backplane
- Saves moving I/O cards and reconfiguration to complete interrupt priority chain

Functional specifications

Application

This card provides a direct short between RPL (Pin 3) and PRH (Pin 23). It may also be used to tie +5V to PRL (Pin 3).

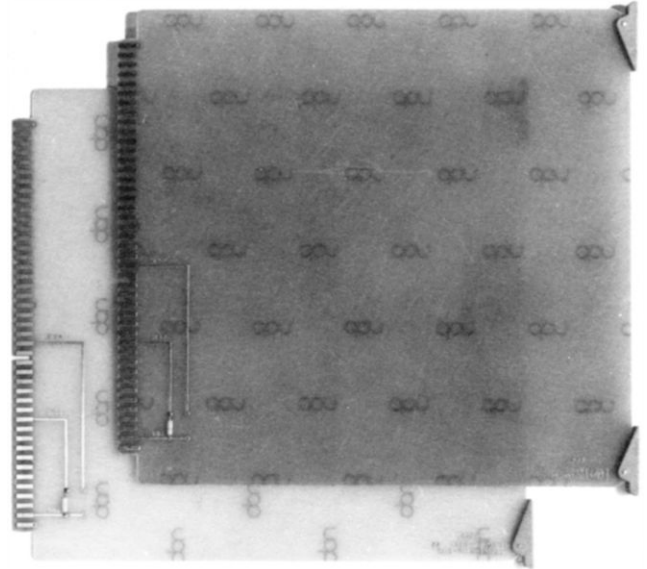
Installation

To install, plug into HP 1000 computer I/O slot where needed to complete the I/O priority chain.

Ordering information

12777A Priority Jumper Card

The 12777A priority jumper card provides the 02116-6110 priority jumper card.



Two 12777A priority jumper cards

The HP 1000 optional loader ROMs each consist of one 256 x 4 bit PROM. Two of the ROMs allow absolute binary programs to be loaded into HP 1000 memory from a 264x cartridge tape or a 797x 9-track magnetic tape unit. The remaining ROMs are used to load programs in disc boot format from 7908/11/12/35 CS/80 discs, 7900/7901/2883 discs, 7906/7920/7925 cartridge/top-loading disc, or a 9885 Flexible disc.

Features

- Provides a choice of program loading from disc, magnetic tape, or tape cassette
- Each of the installed loader ROMs can be selected using the switch register
- Up to three optional loader ROMs may be used in an HP 1000 Computer

Functional specifications

Application

12992A: Bootstrap loader for 7900/7901/2883 disc.

12992B: Bootstrap loader for 7906/7920/7925 disc.¹

12992C: Minicartridge loader for 264x CRT Terminals.

12992D: Loader for 9-track 7970B/E Magnetic Tape Unit (must be unit 0).*

12992E: 9885 Flexible disc loader ROM.¹

12992F: Bootstrap loader for 7900A disc.¹

12992J: Bootstrap loader for 7908/11/12/33 CS/80 discs.¹

¹ Identifies RPL-compatible ROM.

* 7970E tape speed with HP 1000 M-Series must be 37.5 ips or less when used with 12992D loader ROM.

NOTE: 12992 loader ROM's ordered with an HP 1000 computer are installed at the factory.

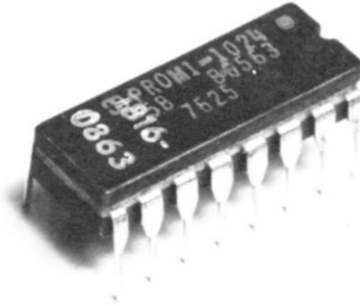
Configuration information

Optional loader CPU sockets required: 1 per loader

Prerequisites: HP 1000 with 16k bytes or more memory

3HP 1000 M-Series installation: To install, remove CPU board from mainframe, insert 12992 loader ROM in one of three optional loader ROM sockets, and reinstall CPU board.

HP 1000 E/F-Series installation: To install loader ROMs in the two unoccupied sockets, unplug modules from the lower half of the memory card cage, plug in the ROMs, and reinstall the removed modules in the memory card cage. Access to replace the standard disc bootstrap loader ROM with other ROMs requires removal and reinstallation of the CPU board.



Typical loader ROM

Electrical specifications

Current required from +5V computer power supply
130 mA per loader ROM

Ordering information

12992A 7900A disc loader ROM

12992B 7906M/7920M/7925M disc loader ROM

12992C 264x cartridge loader ROM

12992D 7970B/E 9 track mag tape loader ROM

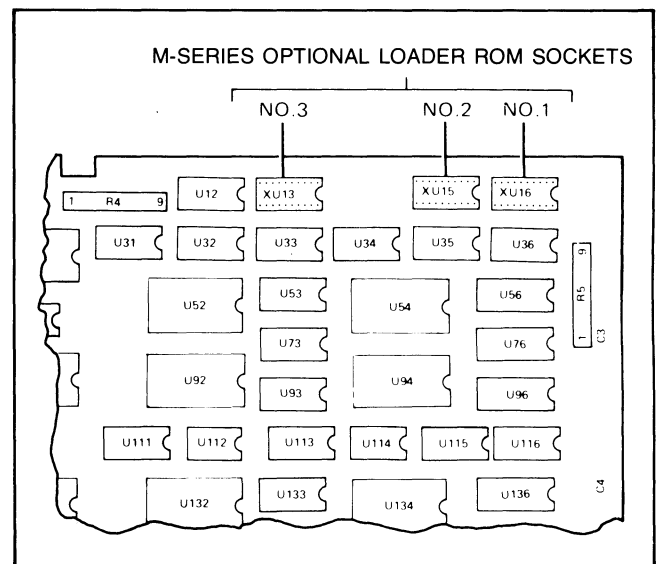
12992E 9885 Flexible disc loader ROM

12992F 7900A disc loader ROM

12992H 7906H/20H/25H disc loader ROM¹

12992J CS/80 disc loader ROM

Each loader ROM includes an installation manual (12992-90001).



The HP 13306B Fast FORTRAN Processor consists of 20 microcoded subroutines which enhance performance of FORTRAN programs, assembly language programs, and scientific application programs. These routines are stored in bipolar ROMs mounted on the 12791A Firmware Expansion Module or the 13304A Firmware Accessory Board and executed by the HP 1000 E-Series control processor. The Fast FORTRAN Processor is standard in HP 1000 F-Series computers.

Features

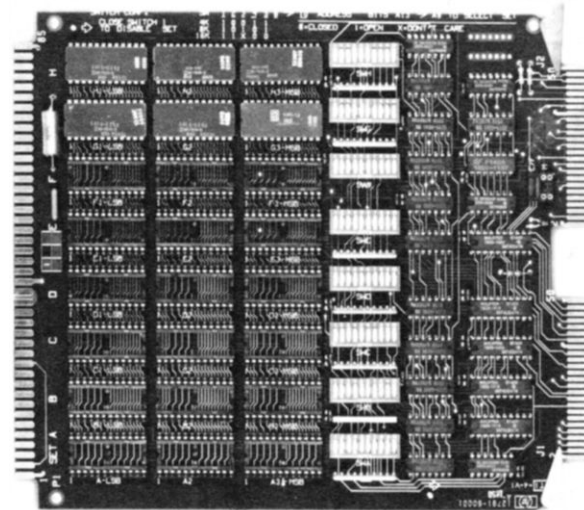
- Firmware microcode for 20 instructions and subroutines:
 - Extended precision floating point addition, subtraction, multiplication, and division
 - Single precision to extended floating point conversion
 - Extended precision to single precision conversion
 - Extended precision move
 - Extended precision normalization and pack
 - Two and three dimensional array mapping
 - Subroutine parameter transfer
 - Conditional control transfer
- Can be used with FORTRAN and assembly language
- Provides 2 to 20-fold faster program execution

Functional description

Each fast FORTRAN subroutine has a unique instruction code associated with it. When a high-level language program is compiled, a subroutine call to the program library is generated by the compiler. The loader then replaces the subroutine call with the appropriate fast FORTRAN machine code. Execution of the fast FORTRAN code calls a firmware routine, allowing the control processor to execute the instruction.

In assembly language, the machine opcodes of the fast FORTRAN processor and the appropriate parameter lists are used instead of the overlay library, to execute fast FORTRAN instructions (refer to the manual "Relocatable Subroutine," HP part number 24998-90001). For example, when the extended precision divide routine, XDIV, is to be executed in FFP microcode, a programmer simply replaces the assembly language statement JSB XDIV by the corresponding opcode 105204 as follows:

Assembly language	Assembly language
JSB.XDIV (Call subroutine)	OCT 105204 (Call FFP microcode subroutine)
DEF X (Result)	DEF X (Result)
DEF Y (1st operand)	DEF Y (1st operand)
DEF Z (2nd operand)	DEF Z (2nd operand)



13306B Fast FORTRAN Processor mounted on 12791A Firmware Expansion Module

Functional specifications

Microcoded routines

See next page

Control store locations required: One 256 word module in 1k section and 512 words in the 4k section of the Firmware Expansion Module or the Firmware Accessory Board.

Accessory required: 12791A Firmware Expansion Module or 13304A Firmware Accessory Board

Software recommended: 24396F/A Diagnostic package on Minicartridges/paper tapes

Installation: The 13306B ROM IC's are inserted into sockets on the 12791A FEM (Firmware Expansion Module — see photo) or the 13304A FAB (Firmware Accessory Board); then, the board is installed in the E-Series CPU.

Electrical specifications

Current required from +5V computer power supply

Included in electrical specifications of the 12791A Firmware Expansion Module or 13304A Firmware Accessory Board.

Ordering information

13306B Fast FORTRAN processor includes:

1. 5090-0589 through 0591, three 4k ROM instruction ICs.
2. 12791-90001 M/E/F-Series Firmware Installation and Reference Manual

Microcoded routines

Microcoded routines	Description	Execution time in μsec^\dagger			Opcode
		Min	Max	Max Non-interruptible	
DBLE	Converts single to extended precision	13.02	13.02		105201
SNGL	Converts extended to single precision	18.2	18.2		105202
¹ .XMPY and .XMPY	Extended multiply	56.0 56.7	64.8 65.5	36.4 μs max	105203 and 105211
¹ .XDIV and XDIV	Extended divide	80.0 80.7	92.4 93.1	37.8 μs max	105204 and 105212
¹ .XADD and XADD	Extended add	37.5 38.0	50.2 50.7	25.7 μs max	105213 and 105207
¹ .XSUB and XSUB	Extended subtract	37.5	50.2	25.7 μs max	105214 and 105210
² .DFER and XFER	Transfers an extended precision variable to another location	12.810 8.96	12.8 12.7		105205 and 105220
.CFER	Four word move	14.9	14.9		
.PWR2	Calculates $X*2^N$ for real X and integer N	8.4	8.4		105225
.FLUN	Unpacks a real variable	3.1	3.1		105226
.XPAK	Normalizes, rounds and packs mantissa of an extended precision number	18.9	29.5	11.6 μs max	105206
.PACK	Normalizes a real variable	19.2	27.2		105230
.XCOM	Complements an extended precision number	11.7	12.1		105215
..DCM	Complements and normalizes an extended precision number	22.1	33.4	12.2 μs max	105216
DDINT	Converts extended precision real to extended integer	23.9	58.6	30.6 μs max	105217
.GOTO	Transfers control to location indicated by FORTRAN computed GOTO statement	10.6	10.6		105221
..MAP	Computes the address of a specified element of 2 or 3 dimensional array	17.7	27.2		105222
³ .ENTR	Transfers address of parameters from a calling sequence into a subroutine list	13.9 + 3.7 *NP'			105223
.ENTP		13.6 + 3.7 *NP'			105224
.SETP	Sets a table of increasing values for DOS-III	6.4 + 1.2 *count			105227
		Interruptible for count > 30			

[†]Using standard performance memory

¹The difference between .AA and AA is a return address as follows:

```

JSB AA      JSB AA
DEF X      DEF *+N (return address)
DEF Y      DEF X
Etc.      DEF Y
:
:
Etc. (Nth arguments)
    
```

²The difference between .DFER and .XFER is as follows:

```

LDA (address of N) JSB .DFER
LDB (address of Y) DEF Y
JSB .XFER          DEF X
    
```

³The difference between .ENTR and .ENTP is:

```

.ENTR          .ENTP
For all BCS subrou- .For all privileged routines and
tines, all DOS/RTE re-entrant routines
utility routines
    
```

13306B opt. 100 Fast FORTRAN processor includes:

1. 13307-80033 through 80035, three 4k ROM instruction ICs

Additional equipment required for installation

1. 12791A Firmware Expansion Module or 13304A Firmware Accessory Board
2. If the Fast FORTRAN Processor is ordered for a machine which does not have the 13307B Dynamic Mapping Instructions, 13306B option 100 must be ordered; the 13307B contains part of the FFP.

13306S Firmware Subscription Service

Provides firmware updates of the 13306B Fast FORTRAN Processor as required to keep it up to date with respect to changes as they are released by Hewlett-Packard. The 13306S service is priced in monthly units and is billable quarterly.

The 12829A and 12824A are powerful Vector Instruction Sets, each containing 38 firmware instructions that work with the hardware floating point processor in HP 1000 F-Series Computers to provide extremely fast processing of data arrays. The 12829A VIS is used with the RTE-6/VM operating system and the 12824A VIS is used in an RTE-IVB environment. Software equivalent routines are also provided for use on HP 1000 M/E-Series Computers.

Features

- Four to ten times faster processing than software
- Easy interface to Virtual Memory for data and to Extended Memory Area for processing of megabyte-sized data arrays
- Simplified programming of vector/matrix operations
- Single or double precision floating point arithmetic
- Software equivalent routines provide program compatibility with HP 1000 M/E-Series Computers

Applications

- Image processing
- Process optimization
- 3-dimensional graphics
- Simulations of physical and chemical systems
- Linear programming
- Signal and vibration analysis

Functional description

VIS Firmware

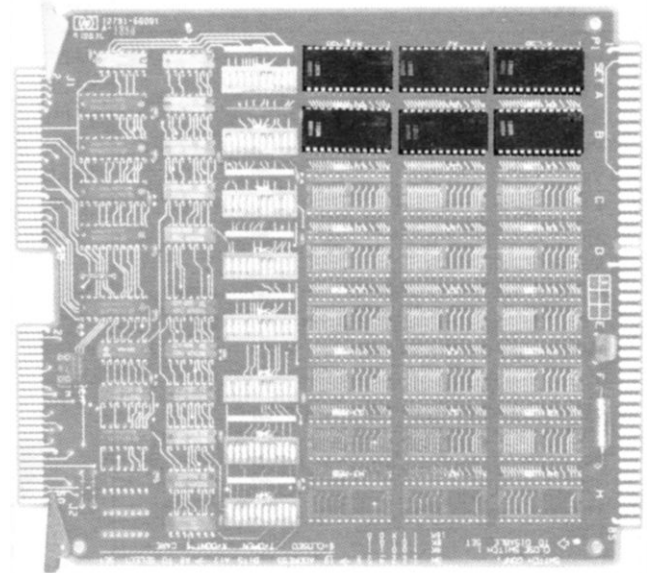
The vector instructions of the Vector Instruction Set (VIS) are used to replace FORTRAN DO loops performing iterative scalar operations. The VIS instructions are functionally equivalent, but execute much faster because they run pipelined floating point operations under fast microcode control and eliminate FORTRAN DO loop overhead. For example, the FORTRAN DO loop:

```
DO 999 I = 1, 100
999 V3(I) = V1(I) + V2(I)
```

is replaced with VIS by the single statement:

```
CALL VADD (V1,1,V2,1,V3,1,100)
```

Where VADD is a vector addition instruction that executes much faster than the DO loop it replaces.



12824A Vector Instruction Set mounted on
12791A Firmware Expansion Module

Matrix addition provides another example. To process $V3 = V1 + V2$, where $V1$, $V2$, and $V3$ are all 50×50 matrices the respective codings are:

FORTRAN DO Loop (Execution time = 230 milliseconds)

```
DO 100 J = 1, 50
DO 100 I = 1, 50
100 V3(I, J) = V1(I, J) + V2(I, J)
```

VIS Instruction (Execution time = 20 milliseconds)

```
100 CALL VADD(V1,1,V2,1,V3,1,2500)
```

VIS software equivalents

VIS software equivalents are FORTRAN subroutines that perform the same computational functions as the VIS firmware instructions, thus making it possible to develop and execute programs which call VIS routines on HP 1000 M- and E-Series Computers as well as F-Series Computers. This program compatibility is especially useful in DS/1000 networks. The VIS software equivalents require at least four times as long to execute as the firmware instructions. They are Type II software.

Functional specifications

Data types

Single-precision and double precision floating point.

VIS instructions, execution times, and interrupts

See table on next page.

VIS instructions and typical execution times for VIS firmware

OPERATION	SINGLE PRECISION				DOUBLE PRECISION			
	MNEM	Execution Times (μsec)			MNEM	Execution Times (μsec)		
		Fixed	Loop*	MNI†		Fixed	Loop*	MNI†
Vector ADDition	VADD	14.6	7.7	21	DVADD	15.8	11.1	24
Vector SUBtraction	VSUB	14.6	7.7	21	DVSUB	15.8	11.1	24
Vector Multiplication	VMPY	14.8	7.7	21	DVMPY	18.0	11.1	24
Vector DiVision	VDIV	16.0	7.7	21	DVDIV	20.5	12.7	24
Vector Scalar Addition	VSAD	13.6	7.7	21	DVSSAD	15.6	12.2	24
Vector Scalar SuBtraction	VSSB	13.6	7.7	21	DVSSB	15.6	12.2	24
Vector Scalar Multiplication	VSMY	13.9	7.7	21	DVSMY	17.6	12.6	24
Vector Scalar DiVide	VSDV	14.0	7.7	21	DVSDV	18.8	11.1	24
Vector PIVot (basic operation for matrix inversion)	VPIV	16.6	10.2	26	DVPIV	18.5	14.6	31
Vector ABSolute value (of each vector element)	VABS	12.4	6.9	19	DVABS	13.3	9.4	23
Vector SUM (sum of all vector elements)	VSUM	19.7	5.9	23	DVSUM	21.1	6.1	23
Vector NoRM (sum of element absolute values)	VNRM	20.0	5.9	23	DVNRM	21.2	6.1	23
Vector DOT product (basic operation for matrix multiplication)	VDOT	19.7	10.5	29	DVDOT	21.2	12.5	31
Vector MAXimum (to find maximum element in vector)	VMAX	8.5	7.9	17	DVMAX	8.4	9.8	18
Vector MAXimum aBSolute value	VMAB	7.6	8.4	17	DVMAB	7.4	10.6	18
Vector MINimum (to find minimum element in vector)	VMIN	8.5	7.9	17	DVMIN	8.4	9.9	18
Vector MINimum aBSolute value	VMIB	7.6	8.4	17	DVMIB	7.4	10.5	18
Vector MOVE (basic operation for matrix transposition)	VMOV	11.7	4.4	17	DVMOV	12.5	6.4	19
Vector SWaP	VSWP	11.8	7.5	20	DVSWP	13.0	11.3	25

* Fixed time is the basic instruction start-up time; loop time is the processing time per vector element. Total time = fixed time + the number of elements times loop time.

† MNI = the maximum period of non-interruptible instruction execution. When a VIS instruction is interrupted, the current state of execution is saved. Following the interrupt, VIS instruction execution resumes from the point of suspension.

Configuration information

Control store locations required: Four 256 word modules (12 through 15) in 2117F Computer.

Accessory required: 12791A Firmware Expansion Module.

Software recommended: 12829A is used with the 92084A RTE-6/VM operating system, which provides Virtual Memory for data and Extended Memory Area capability for processing megabyte-sized data arrays. 12824A is used with the 92068A RTE-IVB operating system, which provides Extended Memory Area capability for processing megabyte-sized data arrays.

Installation: Insert the VIS firmware ROMs into the appropriate sockets on the 12791A Firmware Expansion Module (FEM) as shown in the photo, configure address switches on the FEM, then install the FEM in the F-Series computer.

Electrical specifications

Current required from +5V computer power supply

2.36A, including 1.2A base requirement for the 12791A Firmware Expansion Module and 1.06A for the 1k words of ROM storage represented by the Vector Instruction Set.

Ordering information

12829A Vector Instruction Set for use with RTE-6/VM

The 12829A Vector Instruction Set includes:

1. 12824-80001 through 80006 six VIS instruction ROMs.
2. 12791-90001 M/E/F-Series Firmware Installation and Reference Manual.
3. 12824-90001 VIS User's Manual.
4. Firmware interface library, software equivalents library, and VIS on-line diagnostic on one of media options 020 through 051, **which must be ordered.**

12829A Options

- 001:** Provides discount for upgrade from 12824A VIS software equivalents to 12829A VIS software equivalents for customer not on 12824T/S. Deletes VIS firmware.
- 002:** Provides discount for upgrade from 12824A VIS software equivalents to 12829A VIS software equivalents for customer supported under 12824T/S. Deletes VIS firmware.
- 020:** Provides 12829A software equivalents on 264x Mini cartridge.
- 022:** Provides 12829A software equivalents on 7908/11/12 compatible tape cartridge.
- 050:** Provides 12829A software equivalents on 800 bpi mag tape.
- 051:** Provides 12829A software equivalents on 1600 bpi mag tape.

12824A Vector Instruction Set for use with RTE-IVB

12824A Vector Instruction Set includes:

1. 12824-80007 through 80009, three VIS instruction ROMs.
2. 12791-90001 M/E/F-Series Firmware Installation and Reference Manual.
3. 12824-90001 VIS User's Manual.
4. 12824-13301 Firmware interface library, software equivalents library, and VIS on-line diagnostic on Mini cartridge.

12824A options

- 001:** Provides discount for upgrade to latest version of VIS software equivalents for customer not enrolled in 12824T/S. Prerequisite is 12824A option 002.
- 002:** Deletes VIS firmware and firmware installation manual. Provides VIS software equivalents and VIS User's manual only.

Firmware and software support products available

12829T Customer Support Service for 12829A firmware and software, including S.E. support and firmware, software and manual updates. Same software equivalent media option as 12829A.

12829V Central Support Service for additional VIS package, including one set of firmware updates and extension of 12829T S.E. consulting to an additional 12829A VIS package.

12829S Software Subscription Service for 12829A firmware and software, including firmware, software, and manual updates. Same software equivalent media option as 12829A.

12829W Additional set of 12829A firmware updates.

12829Q Manual update service for 12829A manuals.

12824T Customer Support Service for 12824A firmware and software, including S.E. support and firmware, software, and manual updates. (Software updates are on Mini cartridges.)

12824V Central Support Service for an additional VIS package, including one set of firmware updates and extension of S.E. consulting service to an additional 12824A VIS package. (Prerequisite is 12824T service for first 12824A package supported.)

12824S Software Subscription Service for 12824A firmware and software, including firmware, software, and manual updates. (Software updates are on Mini cartridges.)

12824W Additional set of 12824A firmware updates.

12824Q Manual update service for 12824A manuals.

12824T/V/S options

- 002:** Deletes firmware updates, so only software and manual updates are provided with the 12824T/S product and only extension of S.E. consultation service is included with the 12824V product.
- 020:** Software equivalent updates on 264x Mini cartridges (12824T/S only).

Writable Control Store and Firmware Expansion Modules

HP 1000 M/E/F-Series Computer Systems

product numbers 13197A and 12791A

Two control store boards offer comprehensive support for user microprograms in HP 1000 M/E/F computer systems. One of these is the 13197A 1k word Writable Control Store (WCS) board, which supports development, testing, dynamic overlaying, and output of user's microprograms to the HP 1000 Control Processor. The other is the 12791A 8k Firmware Expansion Module (FEM) board, which provides mounting for PROMs containing user's microcode. In addition to hardware support provided by these control store boards, development of user's microprograms and dynamic loading and overlaying of WCS is software supported by the 92061A RTE Microprogramming Package.

Features

- Software support with 92061A RTE Microprogramming Package
- Writable Control Store (WCS) support for microcode development, testing, dynamic overlaying, and output, 1024 words of WCS per card
- Up to 3 WCS's or 2 FEM's per HP 1000 computer (except 1 FEM per M-Series)
- WCS can override installed PROM-based microcode
- Control processor programs sharable among multiple users

Functional specifications

Capacity

13197A WCS Board: 1k word, 2 modules of 512 words each

12791A FEM Board: Mounting for 8k words, eight modules of 1024 words, three PROMs per module

Word size

24 bits

Microinstruction cycle time

175-280 ns in 2109/2113/2117, 325 ns in 2108/2112

Recommended PROMs for 12791A FEM Board

4k PROMs: HP Part No. 1816-1163, MMI 6341, Signetics 82S141, and Harris HM 7681

8k PROMs: HP Part No. 1816-1160, MMI 6381, Signetics 82S181, and Harris HM 7681

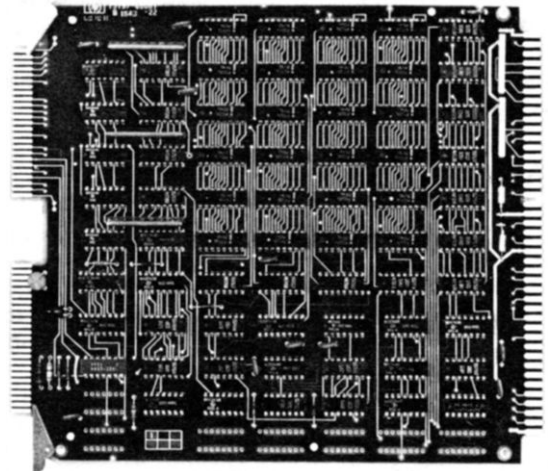
Priority

E/F-Series priority (1 is highest priority):

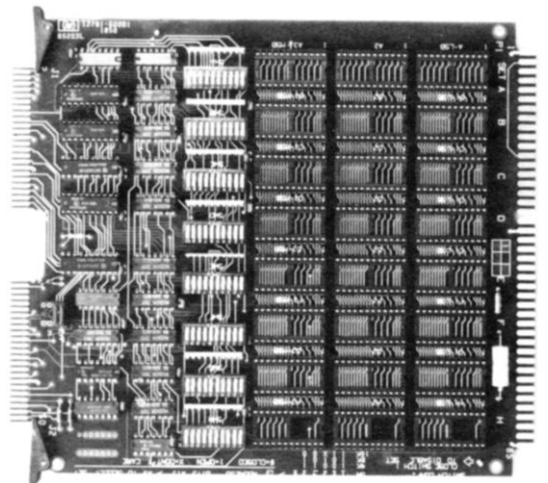
1. 1k WCS
2. 8k FEM
3. FAB
4. E/F-Series

M-Series priority (1 is highest priority):

1. 1k WCS/8k FEM
2. Base Set and 12945A UCS



13197A Writable Control Store



12791A Firmware Expansion Module

Configuration information

I/O slots required: One for each control store board

Software recommended: 92061A Microprogramming Package

WCS description

The 13197A WCS board is a dual-port memory. One port connects to the control processor's control store interface and the other to the computer backplane. Control processor instructions can be loaded into the WCS using either programmed I/O or DCPC transfers at full bandwidth via the I/O backplane memory port. Standard I/O instructions are then used to configure control store module addresses

and enable the control processor's memory port, thereby granting access to the loaded subroutines by the control processor.

If the WCS is configured with the same control store module address as a FEM module address, the WCS microcode is executed, taking priority over the FEM microcode. In this manner, the effective number of available control processor entry points is significantly increased.

FEM description

The 12791A FEM board provides up to 8k words of non-volatile control memory storage capacity for user-written instruction set enhancements. Module addresses are switch selectable, with a given module configurable to any address within control store address space. Users can supply recommended vendors with necessary information for generating PROM chips that are compatible with the 12791A, or can "burn" their own. The microprograms in PROMs are mounted on the FEM board, which is conveniently installed in the card cage of the HP 1000 computer system.

Electrical specifications

Current required from computer power supply

WCS: 2.2A (+5V), 0.007A (-2V)

FEM: 1.2A plus 0.525A (+5V) for each block of ROM control store installed on the module, 5.4A maximum, when fully loaded

Ordering information

13197A WCS Board

The 13197A WCS Board includes:

1. 13197-60001 Writable Control Store Board
2. 5061-3419 Flat Cable Assembly
3. 13197-90001 WCS Driver Manual
4. 12791-90001 Installation and Reference Manual

12791A Firmware Expansion Module

12791A Firmware Expansion Module includes:

1. 12791-60001 Firmware Expansion Module
2. 5061-3419 Flat Cable Assembly
3. 12791-90001 HP 1000 M/E/F-Series Firmware Installation and Reference Manual

NOTE: One 12791A FEM is included in the standard 2109/13E and 2117 computers.

HP 1000 Computers

product numbers 2108M and 2112M

The HP 1000 M-Series computers are a flexible and economical implementation of Hewlett-Packard's HP 1000 architecture. Standard features include a powerful instruction set with floating point and data communications instructions, integer arithmetic, automatic parity generation and checking, and fully-independent memory and I/O sections in the computer mainframe. Plug-in instructions are available to increase M-Series performance.

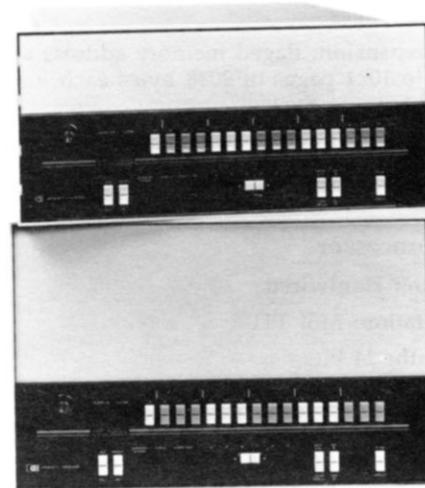
Utilizing 16k and 64k RAM semiconductor memory, memory modules offer a choice of 128k and 512k byte capacities. Fault control (error detection and correction) is available for important reliability improvements in large-memory systems or systems that require fault secure operation.

Microprogramming power and speed is readily available in the form of writable control store modules; it may also be permanently fused into Programmable Read-Only Memory (PROM) and plugged into processor control store.

Comprehensive HP 1000 software includes assemblers, compilers, and operating systems. A full line of HP-manufactured peripherals and data communications interface kits is available for tailoring complete systems around HP 1000 computers.

Features

- **128 powerful standard instructions including:**
 - Floating point
 - Integer arithmetic
 - Data communications
 - Index instructions
 - Memory and register reference
 - I/O group
- **Fully user-microprogrammable with complete software support**
- **650 nanosecond main memory is standard in M-Series computers: 64k bytes in 2108M, 128k bytes in 2112M. Fault control capability is optional**
- **Dynamic mapping system, optional in 2108M, standard in 2112M, provides for accessing up to two megabytes of memory in computer**
- **Optional power fail recovery system for automatic restart capability and for providing a minimum of 1.6 hours of memory sustaining power in the event of complete power failure**
- **Modular design and packaging for easy expandability and maintenance**
- **Large memory capacity in compact mainframe providing:**
 - 2M bytes in the 8-3/4-inch 2108M
 - 2M bytes in the 12-1/4-inch 2112M



- **Standard memory parity generation and checking that protects programs against bit loss, resulting in reduced software development and maintenance costs**

Functional specifications

Processor architecture

Implementation: Microprogrammed with MSI and SSI hardware.

Data path width: 16 bits

Standard registers:

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

Index: 2 (X and Y), 16 bits each

Memory control: 3 (T,P), 16 bits each; (M), 15 bits

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

Manual data: 1 16-bit (display)

Instruction types:

Memory-to-accumulator Accumulator-to-I/O

Memory-to-memory Device control

Direct register modification

Instruction formats:

Combined single-word Double-word

Single-word Triple-word

Instruction expansion: 256 instruction codes are available for instruction additions.

Addressing modes:

Direct Double-word

Multilevel-indirect Single-word

Indexed Byte

Indirect indexed Bit

Register implicit

M-Series Computers

Bus structure: Separate memory data, memory address, and I/O buses tied to the unified internal processor's S-bus.

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

Memory expansion: Paged memory address space expandable to 1024 pages of 2048 bytes each, using the Dynamic Mapping System

Input/output: Vectored priority interrupt structure for up to four system devices and 46 I/O devices

Control processor

Architecture: Hardwired

Implementation: MSI TTL

Control path: 24 bits

Data path: 16 bits

Registers:

Standard registers: 4 (A,B,X,Y)

Scratch registers: 12 16 bit registers accessible to the microprogrammer

Iteration counter: 8 bits

Latch register: 16 bits

Status flag: 1 bit

Instruction formats:

TYPE 1 Data transfer and modification

TYPE 2 Constant formation

TYPE 3 Conditional branch

TYPE 4 Unconditional branch

Bus structure: Unified single bus with program access to memory data, memory address, and I/O buses

Control Memory structure:

Type: Bipolar LSI semiconductor R/W or ROM

Address space: 4096 words; 16 modules of 256 words each

Word width: 24 bits

Cycle time: 325 nsec

Module assignments:

0, 14, and 15 assigned to base instruction set

Module 1 used for front panel control

Module 2 used for DMS instructions

Modules 3-5 used for fast FORTRAN

Modules 6-9 for microroutines

Modules 12 and 13 reserved for user microroutines

Microinstructions: 211 total; up to 5 may be combined in 1 instruction cycle

Operations: 15 Immediate modifier: 4

Special: 32 Store-destination: 32

ALU arithmetic: 32 Reverse jump sense: 32

Conditional branch: 32 S bus-source: 32

Execution time: 325 nsec

Memory parity check

Monitors all words read from memory. Utilizes 17th bit in memory. Switch-programmable to halt or ignore parity error when detected. Interrupt on error requires memory protect option. Parity error indication is displayed on the front panel.

Power fail interrupt

Priority: Highest priority interrupt

Power failure: Detects power failure and generates an interrupt to memory location 4 for user-written power failure routine. A minimum of 500 microseconds is provided for execution of the user-written system state save routine.

Loader protection

All loaders reside in special ROM's separate from the control ROM, and are loaded into the last 64 words of main memory by activating front panel switches. A paper tape loader is standard and disc, terminal, or mag tape loader ROM's are optional. Four switch-selectable loader spaces are provided to accommodate other modes of operation as a user option. User-generated loaders may be written in assembly language, written into PROMS, and mounted in sockets on the CPU board.

Volatility protection

AC standby mode and sustaining power for line loss of 8 milliseconds before entering power fail routine. Power fail recovery system provides a minimum of 1.6 hours of battery-supplied memory standby power.

Instruction execution times (microseconds)

Reference and I/O instructions (70 total)	Min.	Max.
Memory reference group (14 total)	1.9	2.9
Register reference group (43 total)	2.6	2.9
I/O group (13 total)	2.6	3.9
Extended arithmetic instructions (10 total)	Min.	Max.
Multiply	12.3	13.0
Divide	13.6	17.5
Double load		4.9
Double store		4.9
Shift/rotate	3.6	8.4
Indirect-addressing		1.3
Index instructions (32 total)		Max.
Copy A/B to X/Y		2.3
Copy X/Y to A/B		2.3
Exchange registers A/B-X/Y		3.3
Increment/decrement Index registers		3.3
Load index		*4.9
Store index		*5.2
Load A/B registers, indexed		*4.9
Store A/B registers, indexed		*5.2
Add memory-to-index registers		*4.9
Jump and load Y		*5.5
Jump and index Y		4.6
<i>*Plus 1.3 μsec/level of indirect addressing</i>		
Data communications instructions (10 total)	Setup	Execute
Load byte	4.6	5.2
Store byte	5.8	6.2
Move bytes	8.8	7.3
Move words	7.8	3.3
Compare bytes	8.8	8.1
Compare words	6.8	4.2
Scan for byte	2.3	4.9
Set bits	7.8	
Clear bits	7.8	
Test bits	7.1	

NOTE: Multiple execute steps may take place for each instruction set-up.

Floating point instructions (6 total)	Min.	Max.
Add	23.7	67.6
Subtract	29.7	70.5
Multiply	47.8	56.1
Divide	61.4	77.7
Fix	6.5	12.7

Configuration information	2108M	2112M
Input/output capacity		
I/O channels in mainframe	9	14
With first I/O extender	25	30
With two I/O extenders	41	46
Standard memory:	64kb	128kb
Memory module spaces		
In computer only	5	10
In computer & extender	14	19
Memory capacity using 12749A/H modules:		
Max. parity memory		
In computer only	0.640Mb	1.280Mb
In computer & extender	1.792M	2.048Mb
Max. fault control memory		
In computer only	0.512Mb	1.024Mb
In computer & extender	1.280Mb	1.792Mb
Memory capacity using 12749H modules:		
Max. parity memory in computer:		
	2.048Mb	2.048Mb
Max. fault control memory:		
In computer	1.024Mb	1.536Mb
In computer and extender	2.048Mb	2.048Mb

Compatibility

Instruction set: The HP 1000 M-Series is backward compatible with other HP 1000 computers.

Program: Most programs written for HP 1000 M-Series computers are compatible with other HP 1000 computers, except those with timing loop dependence.

Electrical specifications

AC power required

Line voltage: 88-132V (110V $\pm 20\%$); 176-264V (220V $\pm 20\%$) with option 015. Input line voltage is easily changed in the field by moving jumper connections.

Line frequency: 47.5 to 66 Hz

Maximum power required: 625W

Current available (+) required (-) for memory, I/O interfaces and accessories

See power specifications and applicability summary tables, page 8-3.

Power supply

Storage after line failure: Sustains processor through a line loss of 8 msec when operating at the normal 110/220 VAC.

Input line overvoltage protection: An input circuit breaker protects against surge caused by connecting computer to twice nominal line voltage.

Input line transients: Withstands power line transients up to $\pm 500V$ for 50 μ sec wide pulse, up to $\pm 1000V$ for 100 nsec wide pulse, without damage.

Output voltage regulation: $\pm 5\%$, except $-2V$ is $\pm 10\%$.

Output protection: All voltages are protected for over-voltage and overcurrent.

Thermal sensing: Monitors internal temperature and automatically shuts down the computer if temperature exceeds specified level.

Safety

HP 1000 M-Series computers are recognized by Underwriters Laboratories, Inc., and certified by the Canadian Standards Association (with the exception of Option 015).

Physical characteristics

Dimensions

Width: 48.3 cm (19 in) panel; 42.6 cm (16-3/4 in) behind panel casting.

Depth: 62.2 cm (24-1/2 in) overall; 58.4 cm (23 in) behind panel casting.

2108M Height: 22.2 cm (8-3/4 in).

2112M Height: 31.1 cm (12-1/4 in).

Weight

2108M: 20.4 kg (45 lb).

2112M: 29.5 kg (65 lb).

Ventilation

Air intake is on the left side (facing the computer), exhaust is on the right side.

Heat dissipation	2108M	2112M
K-Cal/hr, max.	580	580
BTU/hr, max.	2303	2303
Air flow	2108M	2112M
Cubic meters/min	5.7	7.9
Cubic ft/min	200	280

Ordering information

2108M Computer

The 2108M Computer includes:

1. 2108B Computer.
2. 2102B Standard performance memory controller and one 12746A 64k byte Standard performance memory module.
3. 02108-90037 Operation & reference manual.
4. 02108-90035 Installation & service manual.
5. 02108-90008 Microprogramming manual.
6. 02108-90014 Microprogramming pocket guide.
7. 05951-9162 Microcoding form.

2112M Computer

The 2112M Computer includes:

1. 2112B Computer.
2. 12784A 128k byte Standard performance memory package, including 2102B Memory controller, 12747A 128k byte Memory module, and 12976B Dynamic mapping system.
- 3-7. Same as items 3 through 7 of 2108M, above.

M-Series options

2112M Opt. 013: Deletes 64k bytes of memory and Dynamic Mapping System, leaving 64k bytes of memory in computer.

014: Deletes standard memory, item 2, above, from 2108M or 2113M, to permit its replacement with another HP 1000 M-Series compatible standard performance memory system, with or without fault control, which must be ordered separately.

015: 220V (176-264V) operation.

Accessories and field upgrades

For list of accessories that are compatible with the 2108M, and 2112M Computers, see the power specifications and applicability summary on page 8-3, referring to the series M applicability column.

The 12976B Dynamic Mapping System (DMS) for HP 1000 M-Series computers provides for expansion of memory beyond the 64k bytes that is normally the maximum addressable by 16-bit computers.

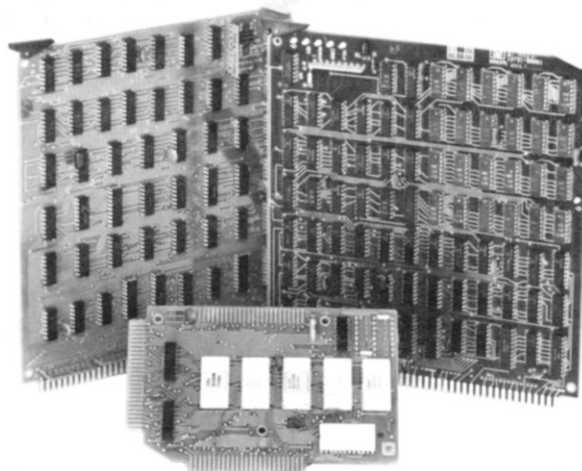
The Hewlett-Packard Fast Fortran processor (FFP) instructions may be added to the 12976B Dynamic Mapping System as an option (12976B-003).

Features

- Two million byte address space
- Read and/or write protection for each page
- Four dynamically alterable memory maps; two for program execution and two for the dual channel port controller
- Program execution from non-contiguous page locations
- DCPC communication with a memory area separate from program space concurrently with program execution
- DCPC transfers to/from non-contiguous segments of memory
- Compatibility with previous software for HP 1000 family computers
- 38 instructions for memory management
- Provision of independent and shared base page segments using programmable fence
- Parity error interrupt logic that permits removal of erasing memory pages from active use under program control
- Provision for sharing of programs and data between concurrent users
- Installation in dedicated slots in computer mainframe, so additional rack space is not needed
- Choice of convenient, economical packages for expansion of standard performance or fault control memory
- Field or factory installability

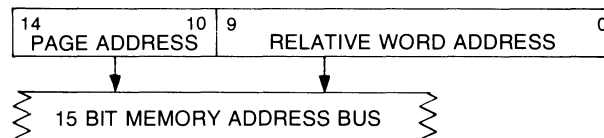
Dynamic mapping description

The basic addressing space of the HP 1000 M-Series is 65,536 bytes, called the "logical" memory. The amount of semiconductor memory actually installed in the computer is called the "physical" memory. An HP 1000 M-Series computer with Dynamic Mapping System (DMS) has an address space of two million bytes for physical memory. Dynamic mapping allows physical memory to be mapped into logical memory via four dynamically alterable memory maps, a capability that is fully software supported by HP's RTE-6/VM and RTE-IVB operating systems.

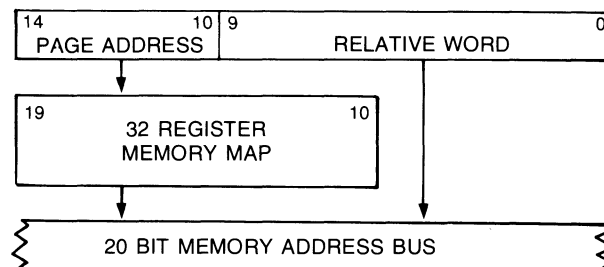


12976B and 003 Dynamic mapping system; firmware board (foreground) includes Fast FORTRAN processor instructions as well as dynamic mapping instructions.

The basic memory addressing scheme of the HP 1000 provides for addressing of 32 pages of memory, each page being 2048 bytes. This memory is addressed through a 15-bit memory address bus. The upper five bits of this bus provide the page address, and lower ten bits provide the relative word address within the page.



The memory expansion module of the dynamic mapping system converts the 5-bit page address into a 10-bit page address and thereby allows 2^{10} or 1024 pages to be addressed. The conversion is accomplished by allowing the original 5-bit page address to identify one of 32 registers within a "memory map". Each of these memory map registers contains the new, user specified 10-bit page address. This new page address is then joined with the original 10-bit relative word address to form a 20-bit memory address.



All registers within the memory map are dynamically alterable. To maximize system performance capability, there are four separate memory maps in the memory expansion module, selectable under program control: user map, system map, and two dual channel port controller (DCPC) maps.

Functional specifications

Memory address space provided

2048k bytes (2,097, 152 bytes)

Dynamic mapping instructions

All 38 DMS instructions are microprogrammed and assigned to control store module 32.

MNEM	Description	Typical Execute Times (μsec)	OP CODES
MBI	Move Bytes Into	6.49+2.92/wd	105702
MBF	Move Bytes From	+3.89 for	105703
MBW	Move Bytes Within	odd byte	105704
MWI	Move Words Into	3.24 +	105705
MWF	Move Words From	2.92/word	105706
MWW	Move Words Within		105707
SYA/B	Load/Store System	47.125-47.8	101710/105710
USA/B	Load/Store User	47.125-47.8	101711/105711
PAA/B	Load/Store Port A	47.125-47.8	101712/105712
PBA/B	Load/Store Port B	47.125-47.8	101713/105713
SSM	Store Status in Memory	5.84	105714
JRS	Jump and Restore Status	9.1-10.4*	105715
XMM	Transfer Map or Memory	9.75†	105720
XMS	Transfer Map Sequentially	8.45†	105721
XMA/B	Transfer Maps Internally	15.26-16.56	101722/105722
XLA/B	Cross Load	5.53*	101724/105724
XSA/B	Cross Store	5.53*	101725/105725
XCA/B	Cross Compare	6.18*	101726/105726
LFA/B	Load Fence	3.57	101727/105727
RSA/B	Read Status	2.59	101730/105730
RVA/B	Read Violation	2.27	101731/105731
DJP	Disable and JMP	5.85*	105732
DJS	Disable and JSB	6.5*	105733
SJP	Enable System and JMP	5.85*	105734
SJS	Enable System and JSB	6.5*	105735
UJP	Enable User and JMP	5.85*	105736
UJS	Enable User and JSB	6.5*	105737

*Add 1.3 μsec for each level of indirect addressing.

†Add 1.3 μsec for each map loaded.

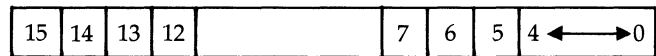
Dynamic mapping power fail characteristics

Power failure automatically enables the system map, and a minimum execution time of 500 μsec is assured the programmer. A power fail routine should include routines to save as many maps as desired.

Upon restoration of power, all maps are disabled and none are considered valid. It is the responsibility of the power fail recovery software to restore the maps as desired.

Violation register

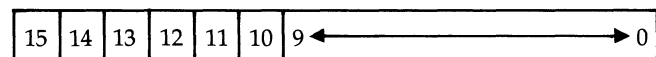
The memory expansion module violation register contains information so the programmer can detect where a fault occurred in hardware or software and what steps must be taken to correct it:



- 15 Read violation
- 14 Write violation
- 13 Base page violation
- 12 DMS privileged instruction
- 7 ME-bus enabled
- 6 Maps enabled
- 5 System/user map selected
- 0 - 4 Map register

Status register

The memory expansion module status register allows the programmer to determine whether the MEM is on or off currently, and at time of the last interrupt, as well as indicates the address for the base page fence.



- 15 MEM enabled at last interrupt
- 14 System/user map selected at last interrupt
- 13 MEM currently enabled
- 12 System/user map currently selected
- 11 DMS protected mode
- 10 Portion mapped
- 0 - 9 Base page fence

Memory protect

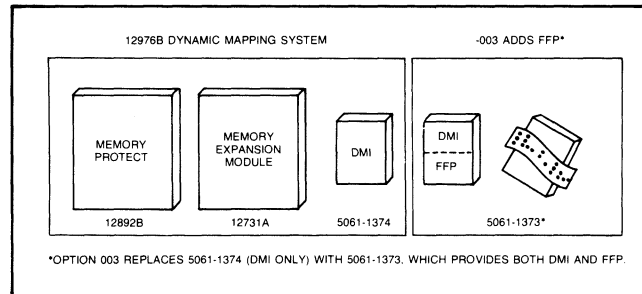
The memory protect feature of DMS provides all the capability of HP's 12892B memory protect plus the capability to read and/or write protect each individual page of physical memory.

Memory protect allows a block of logical memory of any size, from a selectable fence downward, to be protected against alteration by programmed instructions except those directly involving the A and B registers. This is in addition to the page-by-page protection provided within DMS.

Memory protect logic, when enabled, prohibits the execution of all I/O instructions except those referencing the switch register and the overflow register. This feature allows I/O to be controlled by interrupt only.

Although the memory expansion module performs its mapping function without the memory protect board installed, memory protect is required if the protection features are to be used.

Configuration information



Compatibility: 12976B is compatible with 2108 and 2112 Computers.

Control store locations required: One for DMI instruction board supplied with standard 12976B; Fast FORTRAN processor and DMI instructions (12976B-003) also fit on this board.

Other locations used: One dedicated slot each for the 12892B memory protect module and the 12731A memory expansion module in 2108 or 2112 Computer.

Software recommended: RTE-6/VM or RTE-IVB Real-Time Executive operating system (92084A or 92068A).

Installation: Connect the DMI board to the processor board. Then plug the 12892B and 12731A modules into their dedicated slots in the memory section of the computer to complete installation.

Electrical specifications

Model	12976B	12976B+003	12731A	12892B
+5V Current	6.35A	6.35A	3.9A	1.25A

Ordering information

NOTE: The 12976B Dynamic mapping system is furnished with the 12784A-D and 12785A-D Memory packages, which thus afford an economical alternative means of obtaining the dynamic mapping system

12976B Dynamic mapping system includes:

1. 12731A Memory expansion module.
2. 12892B Memory protect.
3. 5061-1374 Dynamic mapping instruction board.
4. 12976-90005 DMS installation manual.
5. 02108-90002 M-Series reference manual.

12976B option 003

12976B option 003 replaces the 5061-1374 Dynamic mapping instructions board with the 12977B Fast FORTRAN processor board, which includes both Dynamic mapping and Fast FORTRAN instructions (see 12977B data sheet for items included).

12731A Memory expansion module includes:

1. 12731-60001 Memory expansion module.
2. 12791-90001 M/E/K-Series Firmware Installation and Reference Manual.

12892B Memory protect

The 12892B Memory protect, also available separately (see separate data sheet), includes:

1. 12892-60003 Memory protect module.
2. 12892-90007 Installation manual.

The 12977B Fast FORTRAN Processor consists of 20 microcoded subroutines which enhance performance of FORTRAN programs, assembly language programs, and scientific application programs. These routines are stored in bipolar read-only memory and executed by HP 1000 M-Series processors. The 12977B also includes dynamic mapping instructions on the same board. The 12977B is a prerequisite to upgrading HP 1000 M-Series computers with FFP and DMI on two boards to be compatible with DS/1000 firmware supplied with the 91740A DS/1000 software-firmware (91740A is now an inactive product).

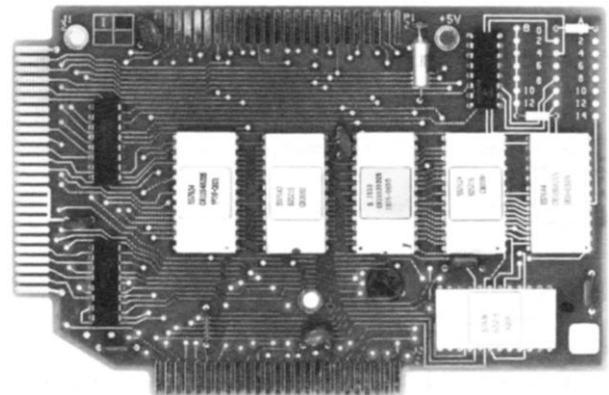
Features

- **Firmware microcode for 20 new instructions and subroutines:**
 - Extended precision floating point addition, subtraction, multiplication, division
 - Single precision to extended floating point conversion
 - Extended precision to single precision conversion
 - Extended precision move
 - Extended precision normalization and pack
 - Two and three dimensional array mapping
 - Subroutine parameter transfer
 - Conditional control transfer
- Includes library for use with FORTRAN IV, and assembly language
- Provides 2 to 20-fold faster program execution
- Includes dynamic mapping instructions

Functional description

Each fast FORTRAN subroutine has a unique instruction code associated with it. When a high level language program is compiled, a subroutine call to the program library is generated by the compiler. The library then replaces the subroutine call with the appropriate fast FORTRAN machine code. Execution of the fast FORTRAN code calls a firmware routine allowing the microprocessor to execute the instruction.

In assembly language, the machine opcodes of the fast FORTRAN processor and the appropriate parameter lists are used instead of the overlay library, to execute fast FORTRAN instructions (refer to the manual "Relocatable Subroutines", HP part number 24998-90001). For example, when the extended precision divide routine, .XDIV, is to



be executed in FFP microcode, a programmer simply replaces the assembly language statement JSB .XDIV by the corresponding opcode 105204 as follows:

Assembly language	Assembly language
JSB .XDIV (Call subroutine)	OCT 105204 (Call FFP Microcode)
DEF X (Result)	DEF X (Result)
DEF Y (1st operand)	DEF Y (1st operand)
DEF Z (2nd operand)	DEF Z (2nd operand)

Functional specifications

Microcoded routines

See next page.

Configuration information

CPU control store module locations required: 1

Software recommended: 24396F/A Diagnostic package on Minicartridges/paper tapes.

Installation: To install, remove bottom cover from the computer; using screws, install the FFP module on control store standoffs on the CPU board. Replace the cover.

Electrical specifications

Current required from +5V computer power supply

1.2A, total for both Fast FORTRAN and Dynamic mapping instructions, both of which are included on this board.

Microcoded routines

Microcoded routines	Description	Execution time in μ sec			Opcode
		Min	Max	Max Non-interruptible	
DBLE	Converts single to extended precision	15.28	15.28		105201
SNGL	Converts extended to single precision	20.15	65.00		105202
¹ .XMPY and .XMPY	Extended multiply	80.28	105.3	75.08 μ s	105203 and 105211
¹ .XDIV and .XDIV	Extended divide	107.9	163.15	75.08 μ s	105204 and 105212
¹ .XADD and .XADD	Extended add	42.25	130.98	75.08 μ s	105213 and 105207
¹ .XSUB and .XSUB	Extended subtract	42.25	130.98	75.08 μ s	105214 and 105210
² .DFER and .XFER	Transfers an extended precision variable to another location	9.75	13.33		105205 and 105220
.PWR2	Calculates X^{*2N} for real X and integer N	12.35	12.35		105225
.FLUN	Unpacks a real variable	4.23	4.23		105226
.XPAK	Normalizes, rounds and packs mantissa of an extended precision number	19.5	99.13	75.08 μ s	105206
.PACK	Normalizes a real variable	13.33	52.33		105230
.XCOM	Complements an extended precision number	12.68	15.28		105215
..DCM	Complements and normalizes an extended precision number	25.35	104.33	75.08 μ s	105216
DDINT	Converts extended precision real to extended integer	31.53	183.3	75.08 μ s	105217
.GOTO	Transfers control to location indicated by FORTRAN computed GOTO statement	13.0	13.0		105221
..MAP	Computes the address of a specified element of 2 or 3 dimensional array	26.98	43.88		105222
³ .ENTR	Transfers address of parameters from a calling sequence into a subroutine list	16.25 + 3.9 *NP'			105223
.ENTP		15.93 + 3.9 *NP'			105224
.SETP	Sets a table of increasing values for DOS-III	7.8 + 1.95 *count			105227
				Interruptible count > 30	

¹The difference between .AA and AA is a return address as follows:

```

JSB AA      JSB AA
DEF X      DEF *+N (return address)
DEF Y      DEF X
Etc.      DEF Y
.
.
.
Etc. (Nth arguments)
    
```

²The difference between .DFER and .XFER is as follows:

```

LDA (address of N) JSB .DFER
LDB (address of Y) DEF Y
JSB .XFER          DEF X
    
```

³The difference between .ENTR and .ENTP is:

```

.ENTR          .ENTP
For all BCS subrou- .For all privileged routines and
tines, all DOS/RTE re-entrant routines
utility routines
    
```

Ordering information

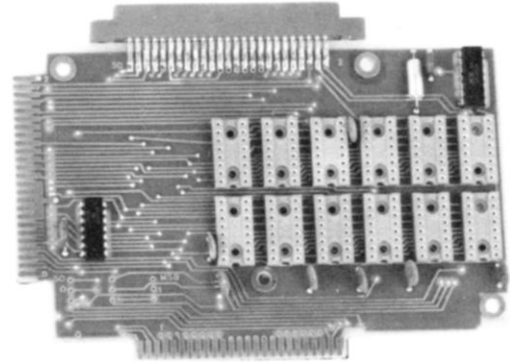
12977B Fast FORTRAN processor includes:

- 5061-1373 Fast FORTRAN processor board (includes Dynamic mapping instructions).
- 12791-90001 M/E/F-Series Firmware Installation and Reference Manual.

Ordered as part of 12976B Dynamic Mapping System

The HP 1000 M-Series Fast FORTRAN processor can also be ordered with the 12976B Dynamic Mapping System, as 12976B option 003.

The 12945A User Control Store Board provides HP 1000 M-Series microprogrammers with two consecutive 256-word modules of non-volatile memory address space. Using a PROM writer, programmers can write their programs into programmable read-only memory chips (PROMs) and verify that their contents match the expected data pattern. They can also supply recommended vendors with necessary information for generating masked or programmed read-only memory chips compatible with the 12945A. In either case, microprograms stored in read-only memory chips are mounted on the UCS board which, in turn, is conveniently mounted beneath the HP 1000 M-Series CPU board.



Features

- 512 words of non-volatile memory space provided for HP 1000 M-Series computers
- Very cost-effective means of adding microprograms
- Compatibility with HP microprogramming support software

Functional specifications

Organization

Word size: 24 bits
Module size: 256 words
Module capacity: 2 modules (must be consecutive)
Cycle time: 325 nsec
PROMs/module: 6
Recommended PROMs: HP 1816-0872, Harris 7611-5.

Configuration information

Each 12945A board uses one of the available processor control store board positions.

Control store board availability:	In 2108/12
Base capacity:	2 boards
Used for 12976B DMS:	-1 board
Used for 12977B FFP, with DMS	-1 board

NOTE: Use appropriate HP 1000 computer series manuals when selecting control store module addresses for the 12945A to avoid conflict with HP microcode products.

Software recommended: 92061A RTE microprogramming software package on paper tape (std), or 264x Minicartridge (Option 020), or 7908/11/12 comparable cartridge tape (Option 022).

Installation: To install loaded 12945A board, attach it to the control processor board with either a side jumper connector to an adjacent UCS board or a jumper connector directly to the processor board.

Electrical specifications

Current required from +5V computer power supply

Configuration	+5V
Logic only	0.1A maximum
1 module loaded	0.88A maximum
2 modules fully loaded	1.76A maximum

Ordering information

12945A User control store includes:

1. 5060-8391 User control store board.
2. Three 8159-0005 Jumper wires.
3. Mounting hardware.
4. 12945-90001 Installation manual.

5060-1336 Jumper cable assembly

This cable is needed only for 2108K control processor configuration.

1816-0872 PROMs

Environmental Specifications and Product Support Information



HP 1000 M/E/F-Series Computers

Environmental specifications

Except where otherwise specified in the individual data sheets, all products in this data book meet Hewlett-Packard Environmental Specifications, as follows:

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), non-condensing

Altitude

Operating: to 4500 metres (15,000 ft)

Non-operating: to 15300 metres (50,000 ft)

Vibration and shock

Type tested to qualify 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 (0.015 in) p-p, 10-55 Hz, 3 axis.

Shock: 30g, 11 Ms, 1/2 sine, 3 axis.

Product support

Support offered for HP 1000 Computers and accessories includes:

1. User training services.
2. Installation assistance.
3. Warranty.
4. Diagnostics subscription service.
5. Hardware history library.
6. Hardware notification subscription service.
7. Hardware service agreements.
8. Software notification service.
9. Manual Update Service.
10. Software subscription service.
11. Customer Support Service.
12. Software consulting service.

User training services

Regularly-scheduled training is available on HP 1000 software and on hardware maintenance. The courses offered are listed 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.

Installation assistance

All items in this data book are customer-installed products when ordered as components (not in an HP 1000 Computer System). Installation assistance is available on request at prevailing service rates.

Warranty

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

Diagnostics Subscription Service

The 24396S Diagnostics Subscription Service provides quarterly distribution of update information and revised diagnostic routines necessary to keep the 24396A/D/E/F Diagnostics Library up to date with respect to diagnostic improvements by the factory. Updated diagnostic routines are available on paper tape, Mini cartridges, or 800 bpi or 1600 bpi magnetic tape. Documentation is updated by providing revised diagnostic manuals or updating supplements to affected manuals. The 24396S service is ordered in monthly units for a minimum of six months, billable quarterly, or it can be prepaid for an entire year.

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 change 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 historical information on important product changes and status regarding warranty behind each change.

Hardware notification subscription service

The 92851Q HP 1000 Hardware notification subscription 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.

Environmental Specifications and Product Support Information

Hardware service agreements

Service agreements are available for coverage of HP 1000 Computers and accessories. Because Hewlett-Packard treats support as a product, you buy only the level that you need. Support levels range from on-call support seven days a week, 24 hours a day, to a service where support is provided through a network of HP field repair centers, located regionally throughout the world. See your HP sales person for a complete description of hardware service agreements.

Software support services

HP 1000 Software, described in the HP 1000 Computers and Systems Active Software and Mature Software data books, is supported by the following services:

Software Notification Service. Gives periodic information on software changes.

Manual Update Service. Provides updates as required to keep software manuals current with respect to changes by Hewlett-Packard.

Software Subscription Service. Provides software updates on user-specified media as well as update to documentation. Includes Software Notification Service when ordered for a software operating system.

Customer Support Service. Combines Software Subscription Service with a Phone-In Consulting Service that provides for answering customer's questions on HP 1000 software covered by this service and on-site resolution of problems with covered software if required.

Software Consulting service. Provides the on-site services of a trained HP System Engineer in daily units for helping customers better understand how to apply their software.

Ordering information

Product numbers and prices for all HP 1000 Systems Computer interfaces, peripherals, and hardware and software support services are given in the HP 1000 Ordering Information, which is available from your Hewlett-Packard Sales Representative.

Power Specifications and Applicability Summary



HP 1000 M/E/F-Series Computers

Product Number and Name	Applies To Series			Max. AC Power Req'd*	Computer power supply current available (+)/required (-) for memory, accessories, and I/O interfaces				
	M	E	F		+5V(A)	+5V(B)	+12V	-12V	-2V
Systems									
2176C Model 40 (upright) System		X		800W	+26.1A	+25.0A	+2.3A	+1.94A	+5.91A
2176D Model 40 (desk) System		X		750W	+26.1A	+25.0A	+2.3A	+1.94A	+5.91A
-014 Deletes 128k byte Memory		X		n/a	+6.9A	+8.0A	—	—	+0.06A
2178A Model 60 (upright) System		X		800W	+25.7A	+24.0A	+2.3A	+1.94A	+5.91A
2178B Model 60 (desk) System		X		750W	+25.7A	+24.0A	+2.3A	+1.94A	+5.91A
-014 Deletes 256k byte Memory		X		n/a	+7.3A	+9.0A	—	—	+0.06A
-022 CS/80 Media & Interface		X		n/a	-3.5A	-3.5A	—	—	-0.1A
-031/2/3 MAC Disc Media & Interface		X		n/a	-2.3A	-2.3A	—	—	-0.1A
2177C Model 45 (upright) System**			X	1000W	+19.4A	+18.1A	+2.3A	+1.94A	+5.91A
2177D Model 45 (desk) System**			X	950W	+19.4A	+18.1A	+2.3A	+1.94A	+5.91A
-014 Deletes 128k bytes Memory		X		n/a	+8.2A	+9.5A	—	—	+0.06A
2179A Model 65 (upright) System**		X		1000W	+18.9A	+17.0A	+2.3A	+1.94A	+5.91A
2179B Model 65 (desk) System**		X		950W	+18.9A	+17.0A	+2.3A	+1.94A	+5.91A
-014 Deletes 256k bytes Memory		X		n/a	+8.7A	+10.6A	—	—	+0.06A
-022 CS/80 Media & Interface		X		n/a	-3.5A	-3.5A	—	—	-0.05A
-031/2/3 MAC Disc Media & Interface		X		n/a	-2.3A	-2.3A	—	—	-0.05A
-101/111 1M byte value pack		X		n/a	-0.48A	-1.5A	—	—	-0.05A
-102/112 2M byte value pack		X		n/a	-1.44A	-3.74A	—	—	-0.05A
Computers									
2108M Computer	X			625W	+37.1A‡	+35.4A‡	+2.5A	+2.0A	+6.0A
2112M Computer	X			625W	+30.7A‡	+29.6A‡	+2.5A	+2.0A	+6.0A
2109E Computer (incl. 12791A**)		X		625W	+29.9A	+28.2A‡	+2.5A	+2.0A	+6.0A
2113E Computer (incl. 12791A**)		X		625W	+24.7A	+23.6A‡	+2.5A	+2.0A	+6.0A
2117F Computer, 12791A*, & Floating Point Proc.**			X	825W	+23.4A‡	+22.1A‡	+2.5A	+2.0A	+6.0A
Standard Performance Parity Memory Products									
2102B Memory Controller	X	X		n/a	-1.2A	-1.7A	—	—	-0.01A
12746A 64k byte Memory Module	X	X		n/a	-0.475A	-1.075A	—	—	—
12747A 128k byte Memory Module	X	X		n/a	-0.475A	-1.075A	—	—	—
12784A 128k byte Memory Package (C)	X			n/a	-8.1A	-9.2A	—	—	-0.06A
12784B 256k byte Memory Package (C)	X			n/a	-8.5A	-10.3A	—	—	-0.06A
12784C 512k byte Memory Package (C)	X			n/a	-9.5A	-12.4A	—	—	-0.06A
12784D 1024k byte Memory Package (C)	X			n/a	-11.4A	-16.7A	—	—	-0.06A
12786A 128k byte Memory Package (C)		X		n/a	-6.9A	-8.0A	—	—	-0.06A
12786B 256k byte Memory Package (C)		X		n/a	-7.3A	-9.0A	—	—	-0.06A
12786C 512k byte Memory Package (C)		X		n/a	-8.3A	-11.2A	—	—	-0.06A
12786D 1024k byte Memory Package (C)		X		n/a	-10.2A	-15.5A	—	—	-0.06A
Standard Performance Fault Control Memory Products									
2102C Memory Controller	X	X		n/a	-3.3A	-4.1A	—	—	—
12779A 256k byte Check Bit Array Board	X	X		n/a	-0.25A	-0.9A	—	—	—
12780A 512k byte Check Bit Array Board	X	X		n/a	-0.3A	-1.1A	—	—	—
12785A 128k byte Memory Package (C)	X			n/a	-10.4A	-12.5A	—	—	-0.05A
12785B 256k byte Memory Package (C)	X			n/a	-10.9A	-13.6A	—	—	-0.05A
12785C 512k byte Memory Package (C)	X			n/a	-11.9A	-16.0A	—	—	-0.05A
12785D 1024k byte Memory Package (C)	X			n/a	-14.1A	-21.5A	—	—	-0.05A
12787A 128k byte Memory Package (C)		X		n/a	-9.2A	-10.7A	—	—	-0.05A
12787B 256k byte Memory Package (C)		X		n/a	-9.7A	-12.4A	—	—	-0.05A
12787C 512k byte Memory Package (C)		X		n/a	-10.7A	-14.7A	—	—	-0.05A
12787D 1024k byte Memory Package (C)		X		n/a	-12.9A	-20.1A	—	—	-0.05A

*Line voltages are 88-132V (110V ±20%—standard) or 176-264V (220V ±20%—Option 015) for all HP 1000 Computers and Extenders, except for the Floating Point Processor included with the 2117 Computer, which offers switch-selectable 90-110V (100V ±10%), 108-132V (120V ±10%), 198-242V (220V ±10%), and 216-264V (240V ±10%) line voltage ranges.

- (A) +5V current requirements for HP 1000 Computer with 12944B or 12991B Power Fail Recovery System (strongly recommended).
- (B) +5V current requirements for HP 1000 Computer without 12944B or 12991B Power Fail Recovery System (+5V current requirements are higher for memory controllers, memory modules, and fault control check bit array boards).
- (C) All memory packages include the appropriate memory controller, one or more 128k byte memory modules, and the 12892B Memory Protect and 12731A Memory Expansion Modules, and fault control check bit array boards in fault control memory packages. The M-Series Dynamic Mapping Instructions board is also included in 12784/5A/B/C/D Memory Packages.

** Available +5V current specified here is that available after provision of 5.4A for fully-loaded 12791A Firmware Expansion Module.

‡ Available +5V current is 5A less at low line voltage (88-95 Vac).

Power specifications and applicability summary (continued)

Product Number and name	Applies To Series			Max. AC Power Req'd*	Computer power supply current available (+)/required (-) for memory, accessories, and I/O interfaces				
	M	E	F		+5V(A)	+5V(B)	+12V	-12V	-2V
High Performance Parity Memory Products									
2102E Memory Controller		X	X	n/a	-2.56A	-3.2A	—	—	—
12746H 64k byte Memory Module	X	X	X	n/a	-0.475A	-1.075A	—	—	—
12747H 128k byte Memory Module	X	X	X	n/a	-0.475A	-1.075A	—	—	—
12749H 512k byte Memory Module	X	X	X	n/a	-0.5A	-1.55	—	—	-0.05A
12788A 128k byte Memory Package (C)		X	X	n/a	-8.2A	-9.5A	—	—	-0.05A
12788B 256k byte Memory Package (C)		X	X	n/a	-8.7A	-10.6A	—	—	-0.05A
12788C 512k byte Memory Package (C)		X	X	n/a	-9.7A	-12.7A	—	—	-0.05A
12788D 1024k byte Memory Package (C)		X	X	n/a	-11.6A	-17.0A	—	—	-0.05A
12788E 512k byte Memory Package (C)		X	X	n/a	-8.2A	-9.9A	—	—	-0.05A
12788F 1024k byte Memory Package (C)		X	X	n/a	-8.7A	-11.0A	—	—	-0.05A
12788G 1536k byte Memory Package (C)		X	X	n/a	-9.2A	-12.1A	—	—	-0.05A
12788H 2048k byte Memory Package (C)		X	X	n/a	-9.6A	-13.3A	—	—	-0.05A
High Performance Fault Control Memory Products									
2102H Memory Controller		X	X	n/a	-3.3A	-4.1A	—	—	—
12779H 256k byte Check Bit Array Board	X	X	X	n/a	-0.25A	-0.9A	—	—	—
12780H 512k byte Check Bit Array Board	X	X	X	n/a	-0.3A	-1.1A	—	—	—
12789A 128k byte Memory Package (C)		X	X	n/a	-9.2A	-10.7A	—	—	-0.05A
12789B 256k byte Memory Package (C)		X	X	n/a	-9.7A	-12.4A	—	—	-0.05A
12789C 512k byte Memory Package (C)		X	X	n/a	-10.7A	-14.7A	—	—	-0.05A
12789D 1024k byte Memory Package (C)		X	X	n/a	-12.9A	-20.1A	—	—	-0.05A
12789E 512k byte Memory Package (C)		X	X	n/a	-9.5A	-12.02A	—	—	-0.05A
12789F 1024k byte Memory Package (C)		X	X	n/a	-10.55A	-14.38A	—	—	-0.05A
12789G 1536k byte Memory Package (C)		X	X	n/a	-11.6A	-16.74A	—	—	-0.05A
12789H 2048k byte Memory Package (C)		X	X	n/a	R/E	-19.1A	—	—	-0.05
Memory-Related Accessories									
12892B Memory Protect (D)	X	X	X	n/a	-1.3A	-1.3A	—	—	-0.05A
12731A Memory Expansion Module (D)	X	X	X	n/a	-3.9A	-3.9A	—	—	—
12976B Dynamic Mapping System	X			n/a	-6.4A	-6.4A	—	—	-0.05A
12897B Dual Channel Port Controller	X	X	X	n/a	-2.4A	-2.4A	—	—	-0.05A
Extenders									
12979B Dual-Port I/O Extender	X	X	X	625W	-2.0A	-2.0A	—	—	-1.35A
Firmware Products									
12977B Fast FORTRAN Processor	X			n/a	-1.2A†	-1.2A†	—	—	—
13306B Fast FORTRAN Processor Scientific Instruction Set		X	H	n/a	(E)	(E)	—	—	—
12824A/12829A Vector Instruction Set			X	n/a	(E)	(E)	—	—	—
92084A/R or 92068A/R RTE-6/VM or RTE-IVB Firmware		X	X	n/a	-2.25A(E)	-2.25A(E)	—	—	—
User Microprogramming Products									
13304A Firmware Accessory Board (3.5k)		X		n/a	-1.8A	-1.8A	—	—	—
12945A User Control Store Board (0.25k)	X			n/a	-2.2A	-2.2A	—	—	—
12978A Writable Control Store (0.25k)	X			n/a	-4.6A	-4.6A	—	—	—
12791A Firmware Expansion Module (8k)	X	X	H	n/a	(G)	(G)	—	—	—
13197A Writable Control Store (1k)	X	X	X	n/a	-2.2A	-2.2A	—	—	—
Other Mainframe Accessories									
12992 Loader ROMs (each)	X	X	X	n/a	-0.13A	-0.13A	—	—	—
12539C Time Base Generator	X	X	X	n/a	-0.76A	-0.76A	—	—	-0.02A
12620A Breadboard Interface for priv. int. control	X	X	X	n/a	-0.32A	-0.32A	—	—	—

*Line voltages are 88-132V (110V ±20%—standard) or 176-264V (220V ±20%—Option 015) for all HP 1000 Computers and Extenders, except for the Floating Point Processor included with the 2117 Computer, which offers switch-selectable 90-110V (100V ±10%), 108-132V (120V ±10%), 198-242V (220V ±10%), and 216-264V (240V ±10%) line voltage ranges.

- (A) +5V current requirements for HP 1000 Computer with 12944B or 12991B Power Fail Recovery System (strongly recommended).
- (B) +5V current requirements for HP 1000 Computer without 12944B or 12991B Power Fail Recovery System (+5V current requirements are higher for memory controllers, memory modules, and fault control check bit array boards).
- (C) All high performance memory packages include the appropriate memory controller, one or more 128k byte memory modules, and the 12892B Memory Protect and 12731A Memory Expansion Modules, and fault control check bit array boards in fault control memory packages.
- (D) 12892B Memory Protect and 12731A Memory Expansion Module are both included in Dynamic Mapping Systems.
- (E) This current requirement is included in the requirement of the 12791A Firmware Expansion Module or the 13304A Firmware Accessory Board.
- (G) 12791A uses 1.2A plus 0.525A for each of 8 blocks of instruction words; -5.4A when fully loaded.
- (H) This product capability is included in the 2117 F-Series Computers.
- ‡ Available +5V current is 5A less at low line voltage (88-95 Vac).
- R/E Requires 12990B Memory Extender; maximum Fault Control Memory supportable in 2113F/2117F Mainframe is 1536k byte.
- † The 12977B Fast FORTRAN Processor -1.2A current requirement is included in the requirements listed for the 12976B Dynamic Mapping System and the 12784/5A-D Memory packages and should not be added to the current requirements of a computer containing any of those products.

Power specifications and applicability summary (continued)

Product Number and name	Applies To Series			Max. AC Power Req'd*	Computer power supply current available (+)/required (-) for memory, accessories, and I/O interfaces				
	M	E	F		+5V(A)	+5V(B)	+12V	-12V	-2V
Data Communications Interfaces									
12250A DSN/X.25 Network Interface	X	X	X	n/a	-1.93A	-1.93A	-0.32A	-0.18A	—
12531C Teleprinter Interface	X	X	X	n/a	-0.76A	-0.76A	-0.05A	-0.1A	-0.05A
12531D Terminal Interface	X	X	X	n/a	-0.76A	-0.76A	-0.24A	-0.01A	-0.05A
12587B Asynchronous Comm. Interface	X			n/a	-1.6A	-1.6A	-0.08A	-0.05A	-0.07A
12589A Auto Calling Unit Interface	X			n/a	-0.65A	-0.65A	-0.05A	-0.06A	-0.05A
12618A Sync Comm. Interface (2 cards)	X	X	X	n/a	-2.18A	-2.18A	-0.1A	-0.07A	-0.23A
12771A Computer Serial Interface	X	X	X	n/a	-1.6A	-1.6A	-0.09A	-0.1A	-0.07A
12773A Computer Modem Interface	X	X	X	n/a	-1.6A	-1.6A	-0.04A	-0.04A	-0.07A
12790A Multipoint Terminal Interface	X	X	X	n/a	-3.0A	-3.0A	-0.018A	-0.1A	-0.06A
12792A 8-Channel Async Multiplexer	X	X	X	n/a	-2.0A	-2.0A	-0.3A	-0.4A	—
12793B DS/1000-IV Modem I/F to HP 3000	X	X	X	n/a	-1.93A	-1.93A	-0.32A	-0.18A	—
12794B DS/1000-IV Modem I/F to HP 1000	X	X	X	n/a	-1.93A	-1.93A	-0.32A	-0.18A	—
12825A DS/1000-IV Direct Conn I/F to HP 1000	X	X	X	n/a	-1.81A	-1.81A	-0.27A	-0.4A	—
12826B Programmable Serial Modem I/F	X	X	X	n/a	-1.93A	-1.93A	-0.32A	-0.18A	—
12830A Data Link Slave I/F to HP 1000	X	X	X	n/a	-1.3A	-1.3A	-0.16A	-0.07A	—
12834A DS/1000-IV Direct Conn I/F to HP 3000	X	X	X	n/a	-1.81A	-1.81A	-0.27A	-0.4A	—
12889A Hardwired Serial Interface	X	X	X	n/a	-2.25A	-2.25A	-0.13A	-0.05A	-0.01A
12920B Async Comm. Multiplexer (3 cards)	X	X	X	n/a	-5.53A	-5.53A	-0.24A	-0.48A	-0.26A
12920B Opt. 001 (Adds 1 card)	X	X	X	n/a	-1.44A	-1.44A	-0.16A	-0.24A	-0.10A
12966A Buffered Async Comm. Interface	X	X	X	n/a	-3.0A	-3.0A	-0.02A	-0.06A	-0.07A
12967A Synchronous Comm. Interface	X	X	X	n/a	-1.75A	-1.75A	-0.01A	-0.02A	-0.06A
12968A Asynchronous Comm. Interface	X	X	X	n/a	-1.3A	-1.3A	-0.01A	-0.04A	-0.05A
Disc Interfaces									
12821A CS/80 Disc Interface	X	X	X	n/a	-3.3A	-3.3A	—	—	-0.1A
13175B MAC Disc Interface	X	X	X	n/a	-2.3A	-2.3A	—	—	—
13178C Multi-CPU I/F to MAC Disc	X	X	X	n/a	-2.3A	-2.3A	—	—	—
Printer Interfaces									
12845B Printer Interface	X	X	X	n/a	-1.2A	-1.2A	—	—	—
26099A Printer Interface	X	X	X	n/a	-0.8A	-0.8A	—	—	—
General-Purpose Interfaces									
12551B 16-Bit Relay Output Register	X	X	X	n/a	-0.6A	-0.6A	-0.24A	—	-0.39A
12551B+001 Relay Register	X	X	X	n/a	-1.1A	-1.1A	-0.24A	—	-0.59A
12554A 16-Bit Duplex Register	X	X	X	n/a	-1.11A	-1.11A	-0.25A	-0.25A	-0.06A
12566C Microcircuit interface	X	X	X	n/a	-0.7A	-0.7A	—	—	-0.05A
12597A 8-Bit Duplex Register	X	X	X	n/a	-0.75A	-0.75A	-0.05A	-0.05A	-0.05A
12930A Universal Interface	X	X	X	n/a	-1.8A	-1.8A	—	—	-0.1A
12930A+001 or 002 Universal Interface	X	X	X	n/a	-2.2A	-2.2A	—	—	-0.1A
Measurement and Control Interfaces									
12555A Digital-to-Analog Converter	X			n/a	-2.4A	-2.4A	-0.5A	-0.36A	-1.08A
12556B 40-Bit Register	X	X		n/a	-0.9A	-0.9A	-0.15A	-0.01A	-0.08A
12604B Data Source Interface Card (I)	X			n/a	-1.1A	-1.1A	-0.01A	-0.02A	-0.35A
59310B HP-IB Interface Kit	X	X	X	n/a	-3.0A	-3.0A	—	—	-0.1A
91000A Plug-In 20kHz A-to-D Interface	X	X	X	n/a	-2.4A	-2.4A	—	—	-0.07A
Graphics Interfaces									
91200B TV Interface (3 cards required for color)	X	X	X	n/a	-1.2A	-1.2A	-0.32A	-0.05A	-0.05A

(A) +5V current requirements for HP 1000 Computer with 12944B or 12991B Power Fail Recovery System (strongly recommended).

(B) +5V current requirements for HP 1000 Computer without 12944B or 12991B Power Fail Recovery System (+5V current requirements are higher for memory controllers, memory modules, and fault control check bit array boards).

(I) 12604B also uses 0.037A from +30V computer power supply.



For more information call the HP Sales Office listed in the White Pages. Or write or phone Hewlett-Packard, Data Systems Division, 11000 Wolfe Rd., Cupertino, CA 95014, (408) 257-7000.

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