

HP 3000 Series I Configuration Guide

Features

- 128-kilobyte core memory
- Multiprogrammed operating system
- Concurrent CPU and I/O operation
- Integrated terminal access
- 50 megabytes of disc storage
- Software compatible with other HP 3000 models

Series I is a general purpose computer system designed for educational, commercial, and scientific applications. The system features concurrent batch and terminal access, and can be adapted to a dedicated application, yet retains its flexibility and performance for adaptation to a variety of tasks.

Hardware supplied

The HP 3000 Series I hardware includes:

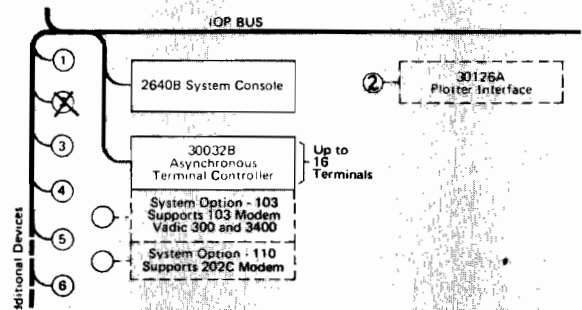
- Central processing unit (CPU)
- 128-kilobyte core memory
- 192 firmware instructions
- System clock
- 16-port asynchronous terminal controller
- System I/O Multiplexer
- System desk, two cabinet bays, card cages, and power supplies
- 30030A high-speed selector channel
- 2640B CRT console with the HP 13234A additional 4-kilobyte memory
- 30229A Disc controller with 7920A 50-megabyte disc unit
- 30215A Magnetic tape controller with 7970E 1600 bpi magnetic tape unit
- 5 spare I/O slots
- 60 Hz, 12.6 KVA Isolation transformer

Software supplied

- Multiprogramming Executive operating system (MPE-C)
- HP 3000 Series I Fundamental Operating Software, including:
 - System Programming Language (SPL)
 - Text editor (EDIT)
 - Program debugging aids (DEBUG and TRACE)
 - File-copying utilities (FCOPY)
 - Sort and merge package (SORT)
 - Compiler library

How to configure a system

When choosing options denoted by "circles", be certain to write the number of the interface slot which the option will occupy in the open circle beside the selected option; then, cross out the numbered circle connected to the IOP Bus to show that the interface slot is no longer available. For example:



As a result, the options that have been chosen and the interface slots they occupy will be evident at a glance. DO NOT EXCEED THE TOTAL NUMBER OF AVAILABLE INTERFACE SLOTS ON THE IOP BUS. If more than five interface slots for additional devices are selected, then the expanded I/O option 300 or product number 30413A must be ordered. This option provides ten additional I/O slots on the IOP bus.

Site preparation data

	HP 7920A 50 Mb DISC DRIVE		TWO SYSTEM BAYS		HP 2640B CRT CONSOLE AND DESK	
	USA (60 Hz)	NON-USA (50 Hz)	USA (60 Hz)	NON-USA (50 Hz)	USA (60 Hz)	NON-USA (50 Hz)
VOLTAGE	115	230	208 phase/phase	230	115	230
PHASES	1	1	3	1	1	1
CURRENT PER PHASE	4.5A	2.3A	* †	* 12A	1.3	0.7
CONNECTION CODE	C	E	M	M	F	F
HEAT OUTPUT (per hour)	2200 btu	554 kcal	14000 btu	3500 kcal	483 btu	129 kcal
WEIGHT	240 lb	109 kg	790lb	358 kg	139 lb	64 kg
SIGNAL CABLE LENGTH	**	**	—	—	25 ft	7.6 m

* Plan for 300% overcurrent turn-on surge. † A = 9.5A; B = 11A; C = 2A.

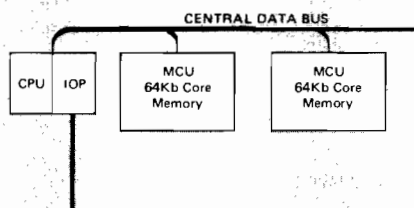
** Up to eight disc drives may be daisy-chained to a controller. The cable length from the controller to the first drive is 18 ft. (5.5 m). The cable length between disc drives is 8 ft. (2.4 m).

In addition, each drive also has a cable back to the controller. The length of this cable for each drive is 50 ft. (15.2 m).

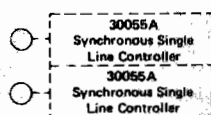
The maximum cumulative length of daisy-chained cable is 74 ft. (22.5 m).

Devices identified with triangles or squares will function only in the positions designated by matching geometric shapes.

Equipment Supplied (Standard Configuration). Products in "clear white" outlined by "solid lines".



Optional Equipment. Products in "gray screen" outlined by "interrupted lines".



The "Pricing Guide" at the rear of this publication may offer additional specific qualifications for selecting options.

Connecting Additional Terminals. One asynchronous terminal controller (ATC) is supplied. It permits the connection of up to 16 terminals. The system console does not count as one of these terminals.

Disc Drive. One 50 Mb Disc Subsystem with controller is supplied, connected directly to the Central Data Bus through a Selector Channel. The controller can handle a total of 8 drives, 400 Mb maximum capacity.

Magnetic Tape Units. One 1600 bpi magnetic tape drive is supplied and is connected through a controller to the system. An 800 bpi drive may be selected as an alternative. The supplied controller can also handle up to three extra drives of mixed densities (up to a total of four).

Additionally, a second controller may be ordered which can also support up to four drives of mixed densities. A maximum of two controllers and four drives can be attached to a system.

Each additional tape drive ordered will be supplied in a cabinet attached to the system bays. See the 7970 data sheet for further configuration details on extra drives.

Line Printers. Eight options are available; as many as two printers may be connected to any Series I System.

Modem Support. Modems supported for the HP 3000 Series I are:

Type	Half/Full Duplex	Speed (cps)
Bell 103A	Full	30
Bell 113A	Full	30
Bell 202C	Half	120
Vadic 300	Full	30
Vadic 3400	Full	120

Environmental specifications

The following specifications apply to any HP 3000 Series I configured with any combination of the peripheral devices listed in this data book. It is not necessary to consider each device separately.

Temperature (operating)

60° – 82°F (16° – 28°C)

Relative humidity

50 - 80% non-condensing. Maximum wet bulb temperature 78°F.

Line voltage

115V +5%, -10%. (For 3-phase inputs this is the neutral-to-phase specification for each phase).
230V +5%, -10%.

Line frequency

50 or 60 Hz, ±0.5 Hz.

Maximum rate of temperature change

10°F/Hr. (5.5°C/Hr.)



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Features

- Hardware-implemented stack
- 192 unique instructions
- 33 registers, 16 accessible to user programs
- 175-nanosecond microinstruction time
- 16- and 32-bit integer arithmetic
- 32- and 48-bit floating point arithmetic
- 28-digit packed decimal arithmetic

The basic hardware of the HP 3000 Series I System consists of a Central Processing Unit (CPU), Input-Output Processor (IOP) and Core Memory, interconnected via a high speed central data bus. A separate Input-Output Processor bus connects external devices to the system. Additionally, the multiplexer channel contains a processor capable of simultaneous execution of up to 16 I/O programs. Terminals are interfaced to the IOP bus through an asynchronous terminal controller capable of connecting 16 terminals to the system. A selector channel provides high speed peripheral devices with a direct link to the central data bus.

Central processing unit (CPU)

The three major components of the CPU are instruction decoder, firmware storage and control, and hardware processor.

The Instruction Decoder unit converts an instruction in the Current Instruction Register (CIR) into a starting address for the microcode contained in a Read-Only Memory (ROM), and determines various initial conditions required for executing the instruction. As the current instruction is being executed, the next instruction is fetched and placed into the Next Instruction Register (NIR). Upon completion of the current instruction, the contents of NIR are loaded into CIR and the cycle is repeated. This "pipelining" of the current instruction execution with the next instruction-fetch improves throughput by overlapping operations.

The Hardware Processor consists of an arithmetic-logic unit, shifting network, 33 specific purpose registers and related data manipulating and testing logic. Table I lists the 33 registers and their associated functions.

The four top-of-stack registers are of special interest. In order to improve execution speed, up to four elements from the top of a user's data stack may be contained in these registers. This allows many functions to be treated as register-to-register operations rather than the slower-speed memory-to-register or register-to-memory type operations. These registers are manipulated by the CPU, and their use is fully transparent to the user.

Firmware Storage and Control consists of microcode, stored in read-only memory (ROM), and associated control logic. Microcode routines control the operation of the

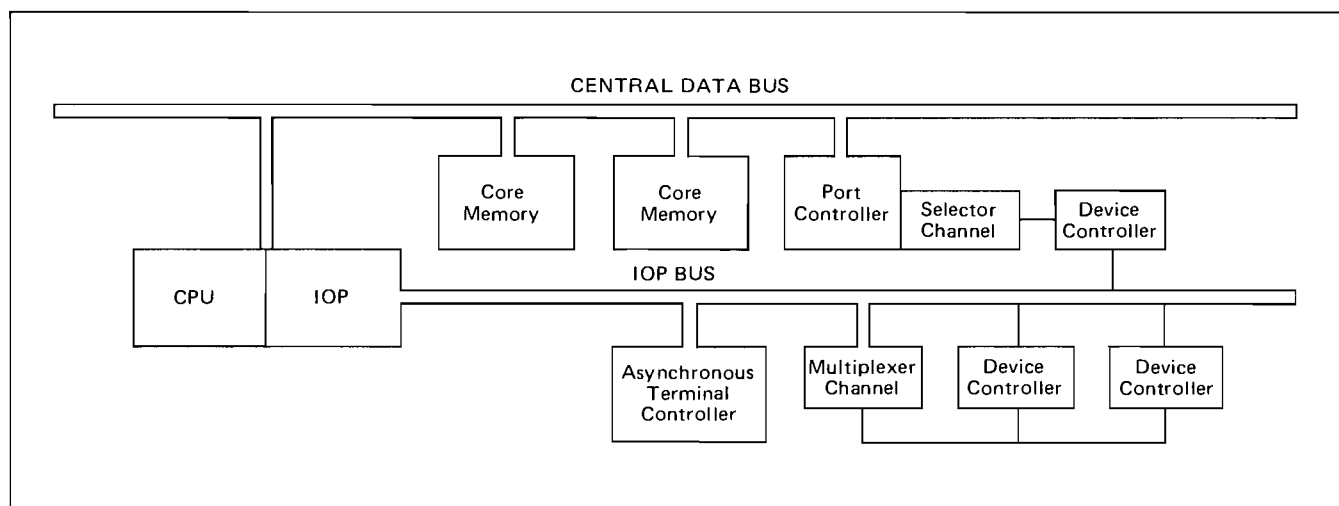


TABLE I

REGISTERS ACCESSIBLE TO THE PROGRAMMER	
REGISTER	FUNCTION
PB P PL	Code Segment Pointers
DL DB Q SM SR Z	
RA RB RC RD	Stack Pointers
X	Top of Stack Registers
STA	Index Register
SWCH	Status Register
	Switch Register
REGISTERS DEDICATED FOR SYSTEM USE	
CIR	Current Instruction Register
NIR	Next Instruction Register
SP0 SP1 SP2 SP3 CTR CPX1 CPX2 MOD	Scratch Pad, Flag, and Interrupt Registers
IOA IOD	I/O Registers
PCOR UCOR OPND	Memory Address and Data Registers
RAR SAVE	Firmware Address Registers

Instruction Decoder and the Hardware Processor, in order to create the 3000 Series I operating environment — including the 192 instructions available to the programmer.

All instructions are 16 bits in length except stack operations, which are 8-bit instructions. These include a variety of memory reference, branch, arithmetic and data manipulation instructions that operate on integer, real, logical, packed decimal, character and string data. Floating point arithmetic can be performed in single precision (32 bits) or extended precision (48 bits), integer arithmetic in 16-bit and 32-bit lengths, and packed decimal instructions extend to 28 digits of precision. In addition, there are a number of instructions designed to aid in creating the multi-programming environment of the Series I. These include procedure call and exit instructions and others which implement various operating system functions previously done in software.

Input output processor (IOP)

The Input/Output Processor controls the IOP bus and interrupt lines, providing the communications and data path between the CPU and I/O devices for direct I/O operations and interrupt processing, and also provides a data path between memory and I/O devices for programmed I/O operations.

I/O operations are divided into three categories, Direct I/O, Programmed I/O, and Interrupt Processing. Direct I/O operations take place as a result of I/O instructions executed by the CPU; they result in transfer of a word of information between the CPU and an I/O device through the IOP or cause a control function to take place in the I/O system. Devices connected to a Multiplexer (see Peripheral I/O Hardware) may use programmed I/O, with the Fundamental Series I hardware. Once started, programmed I/O operations can (through the execution of I/O programs stored in memory) transfer block(s) of data between I/O devices and memory, and perform other device control functions without further CPU intervention or attention. The IOP also accepts interrupt requests from the device controllers, interrogates them by means of a poll line to find the highest priority request, sends an interrupt signal to the CPU and supplies it with the number of the interrupting device.

Peripheral I/O hardware

Features

- Peripheral interfacing to the HP 3000 Series I
- 16 port terminal-controller
- 880 kilobyte/second IOP bus transfer rate
- Support for 14 device controllers on the multiplexer channel
- Options for Bell 103A, 113B and 202C and Vadic 300 and 3400 modem support
- System console

The peripheral I/O hardware consists of the IOP bus, interrupt lines, and a multiplexer; these provide the basic peripheral interfacing capabilities. Additionally, an asynchronous terminal controller provides for the interfacing of log-on terminals.

IOP Bus

All devices are connected to the IOP bus, (some are also connected via a multiplexer). The maximum transmission rate of the IOP bus is 880 kilobytes per second.

30032B Asynchronous terminal controller

The Asynchronous Terminal Controller (ATC) is designed to interface user terminals to the HP 3000 Series I via the IOP bus. Up to 16 terminals can be interfaced. Terminals can be hardwired or connected through Bell 103A, 113B, and 202C and Vadic 300 and 3400 modems. The modems listed are for dial-up use. Hewlett-Packard does not support the use of leased lines with the Series I HP 3000 computers. The system console does not occupy a terminal port. Sixteen terminal ports are available.

Multiplexer

The multiplexer performs programmed I/O operations for up to 14 device controllers concurrently. All device controllers may be involved in programmed I/O operations simultaneously. The multiplexer is connected to the IOP bus, through which I/O program words are fetched from memory. A solid state memory in the multiplexer is divided into sections, one for each device controller. Typically, this memory contains the current I/O program word and related information for each device. When a device is selected for service, the multiplexer executes the indicated operation

(or portion thereof) in conjunction with the device controller.

Selector channel

The Selector Channel interfaces high speed peripheral devices to the HP 3000 Series I, and connects to the central data bus through a port controller. High-speed peripherals access the selector channel through their device controllers; the selector channel is used in interfacing the 30229A disc controller which is supplied as part of the standard HP 3000 Series I.

System physical characteristics

UNIT	Height		Width		Depth		Ship. Weight	
	Inches	cm	Inches	cm	Inches	cm	lbs	kg
CPU BAY	64.5	163.2	21	53.3	33	83.8	559	254
PIO BAY	64.5	163.2	21	53.3	33	83.8	539	245
7920A DISC	32.5	82.5	19.65	50	32	81.3	345	157
TABLE	28.5	72.4	48	122	31	78.7	124	56.4
HP 2640B	13.5	34.3	17.5	44.5	25.5	64.8	44.1	17

Features

- **Concurrent multi-lingual capability, FORTRAN, COBOL, RPG, BASIC, and SPL**
- **Multiprogramming**
- **Virtual memory**
- **Stack architecture**
- **Simple and powerful command language**
- **Complete accounting of resources**
- **File backup and security**
- **Relocatable program modules**
- **Recursivity/reentrancy**
- **Dynamic resource allocation**
- **Remote processing via terminals**
- **Spooling — input and output**
- **Power fail/manual restart**

MPE-C is a general purpose, disc-based software operating system that makes possible concurrent execution of many programs in a multi-lingual environment. When a user program enters execution, the instructions within it are executed on a multiprogramming basis. Should one job be temporarily suspended, perhaps to await the completion of an I/O operation, another can immediately employ the central processor. Thus, when many users are active in the system, uninterrupted processing and high user throughput can be maintained.

User programs are independent of the mode through which they are input; the user can run the same code from either traditional batch input devices or interactive terminals. In fact, the same system code is used to accomplish particular functions in either mode, resulting in storage economy and reduced overhead.

Stack architecture and virtual memory

The employment of stack architecture by MPE-C automatically provides the separation of code from a user's data. This separation of data from code provides for both recursivity and reentrancy of user programs. That is, one copy of a program can be shared by many users while each still operates in his own environment free from interference by the other users.

Storage for local data is allocated only as needed and is automatically freed when no longer required, allowing reuse of that area of memory by other parts of the program. Consequently, programs require less storage than conventional systems.

MPE-C virtual memory provides a total memory space that far exceeds the main memory of 128k bytes. Programs are logically divided into variable length segments of code and data which reside in disc memory. Only those code and data segments required at a particular time are required to be in main memory; when a code segment is no longer needed it can be overwritten by a new segment. Segments can contain the operating system, users' code and data areas. The management of the segments is automatically handled by MPE-C, transparent to the user.

Storage economy

MPE-C provides economized use of main memory and secondary mass storage, freeing the maximum storage possible for user programs and data. Priorities are used to control main-memory resources, eliminating the need for fixed or variable memory partitions to support MPE's unified multi-lingual, multiprogramming environment. Main memory is allocated for temporary and local variables only when needed, and is de-allocated when a procedure exits. Disc storage is automatically allocated as needed, and files on disc can be accessed simultaneously by many users, or protected by means of a flexible set of security measures.

Command language

The simplicity of the command language greatly enhances the MPE-C System's usability. The user interfaces with MPE-C through commands (for general functions external to his programs) and intrinsic calls (for specific functions invoked during program execution). Common system commands are used to initiate and terminate jobs and sessions, re-specify file characteristics, compile and execute programs, and call various utility subsystems. The programmer need learn only one set of conventions for using these facilities because they all use the same command formats, special characters, and error-diagnostic methods. Intrinsic calls implement such functions as reading, writing on, and updating files, skipping forward or backward on a file, or returning system table information to the user's program. These intrinsic calls are available not only to the SPL (Systems Programming Language) but also to the higher level languages, BASIC, FORTRAN, RPG, and COBOL.

File management capabilities

MPE file system provides user program interaction with I/O devices in a manner that is device independent. Thus, for example, any program can read data from either a card reader, tape, or disc without changing the program.

File commands allow programs to reference files without specific knowledge of their actual names or characteristics, and allow file specifications to be altered at runtime.

The file system simplifies I/O programming and provides a straightforward method to access data. Files can be accessed in any language. All I/O is handled by the file system; therefore programs become device independent.

The file system security and account/group/user structure provides many classes of security for user files. Access to files may be controlled at several levels which range from unrestricted access by anyone to controlled access available only to the creator of the file. For example, a user could make his data file available to any other user in a 'read-only' mode, while only members of his immediate account can append data to the file. The file and account/group/user structure provides the user with security and integrity.

Spooling

Jobs and job input/output are automatically buffered, if desired, thus removing the contention that would normally be encountered with non-shareable devices.

This spooling capability requires no modification to programs or data to implement, thus it is "transparent" to the HP 3000 user. For example, a simple STREAM command can be used to initiate a spooled job. After a spooled job is started a SHOWJOB Command will inter-actively display the status of the job.

Accounting

Accounting capability enables the HP 3000 system manager to set CPU time, connect time and disc space limits on individual accounts, and to obtain reports of the usage of these resources broken down by individual group. It also enables an account manager to set limits and obtain reports on groups within his account. Job/session data is also provided to individual users to enable the placement of limits on jobs.

Through the logging capability, the system supervisor can collect a record of system activity at the user level on a disc

file. The collected data enables the writing of a billing program which takes into account use of significant system resources, or to analyze the manner in which the system is used. Examples of statistics collected are amounts of virtual memory used by a process, number of I/O transactions to a file, number of processes created, use of files by name, etc.

Debugging facilities

Extensive system tools are provided for indepth debugging of System Programming Language (SPL) programs. These capabilities are especially useful when machine dependent routines are being developed.

System generation and maintenance

MPE-C consists of a single operating system which can be specifically tailored to the installation needs within minutes. Through the system generation facilities, file directories and files modified as of a specified date can be dumped to tape. This capability, along with the standard system reload procedure, provides for complete file backup. System generation is a simple, straightforward process.

Supporting software

Standard programming languages and software subsystems greatly enhance and complement the capabilities of MPE-C. These systems include the languages COBOL, RPG, FORTRAN, BASIC, and SPL, plus a text editor, file copier, sort/merge package, scientific library, utility functions, and system diagnostic software.

Diagnostics

Two levels of diagnostic software help identify and diagnose hardware problems in the HP 3000 system. The levels of diagnostics are:

- Stand-alone diagnostics
- Interactive diagnostics generator (SLEUTH)