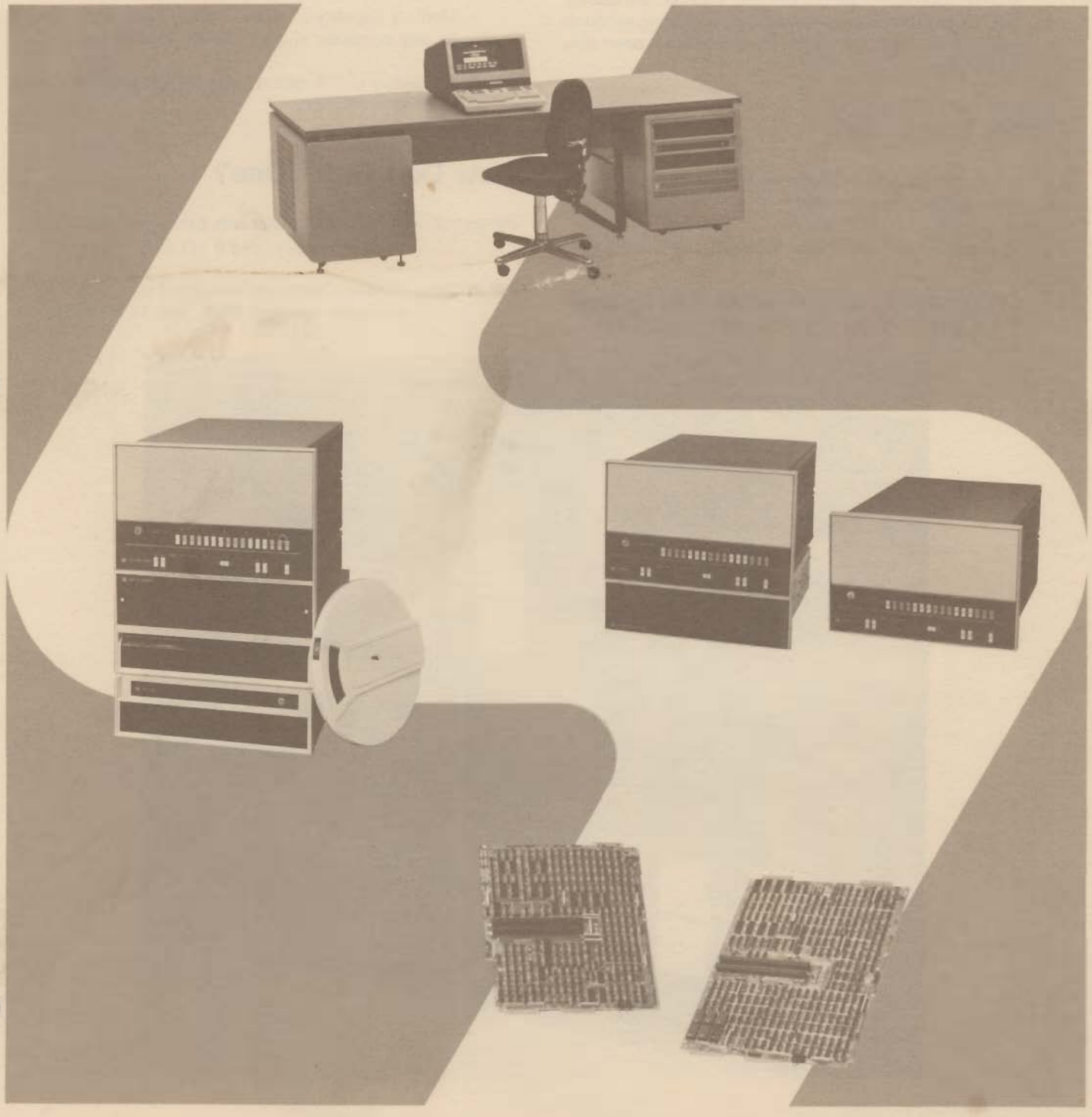
HP 1000 F-SERIES

HEWLETT hp PACKARD

Sales Training Manual



For Internal Use Only

HP 1000 F-SERIES

F-Series At A Glance

What is it?

- A new high performance, fully microprogrammable computer with a floating point processor and extended instruction set capabilities. Representing the high end of the HP 1000 computer product line, the **F-Series allows you to go after new business,** both in existing accounts and in new ones, that we have previously not been able to address.

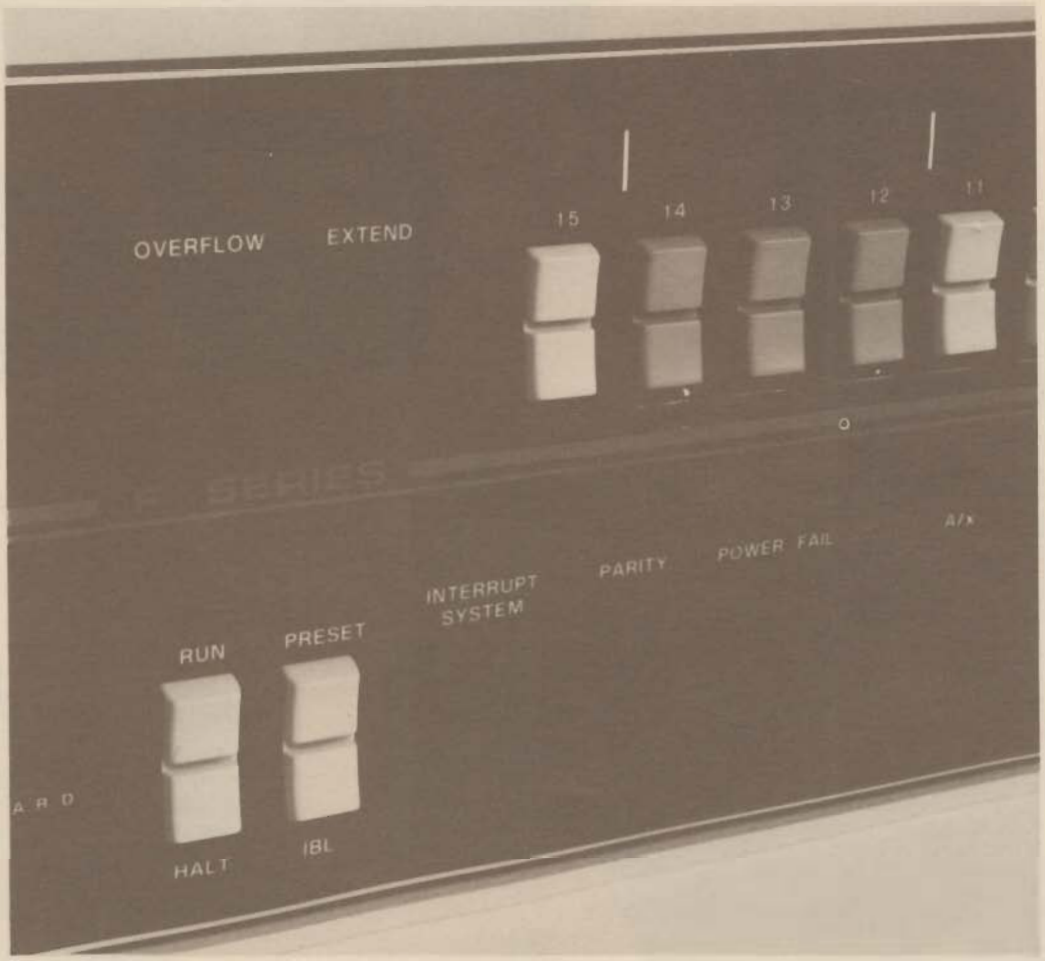
What can it do?

- It can perform a floating point multiply **four times faster** than the E-Series computer.
- It provides you with unique **lock-out** specs such as:
  - — Trigonometric and logarithmic instructions with speed unequalled by any of the popular minicomputers.
  - — 350 nanosecond main memory performance.
  - — FORTRAN accelerator routines (from the Fast FORTRAN Processor) unavailable on any DEC/DG/IBM minicomputer.
  - — Memory capacity of up to 2 million bytes unequalled by any computer in the F-Series price range.
- It can hold up to one million bytes of **high performance fault control memory.**

How Do I Order One?

HP 2111F — F-Series computer with 64K bytes high performance memory, and 9 I/O slots.

HP 2117F — F-Series computer with 128K bytes high performance memory, DMS, and 14 I/O slots.



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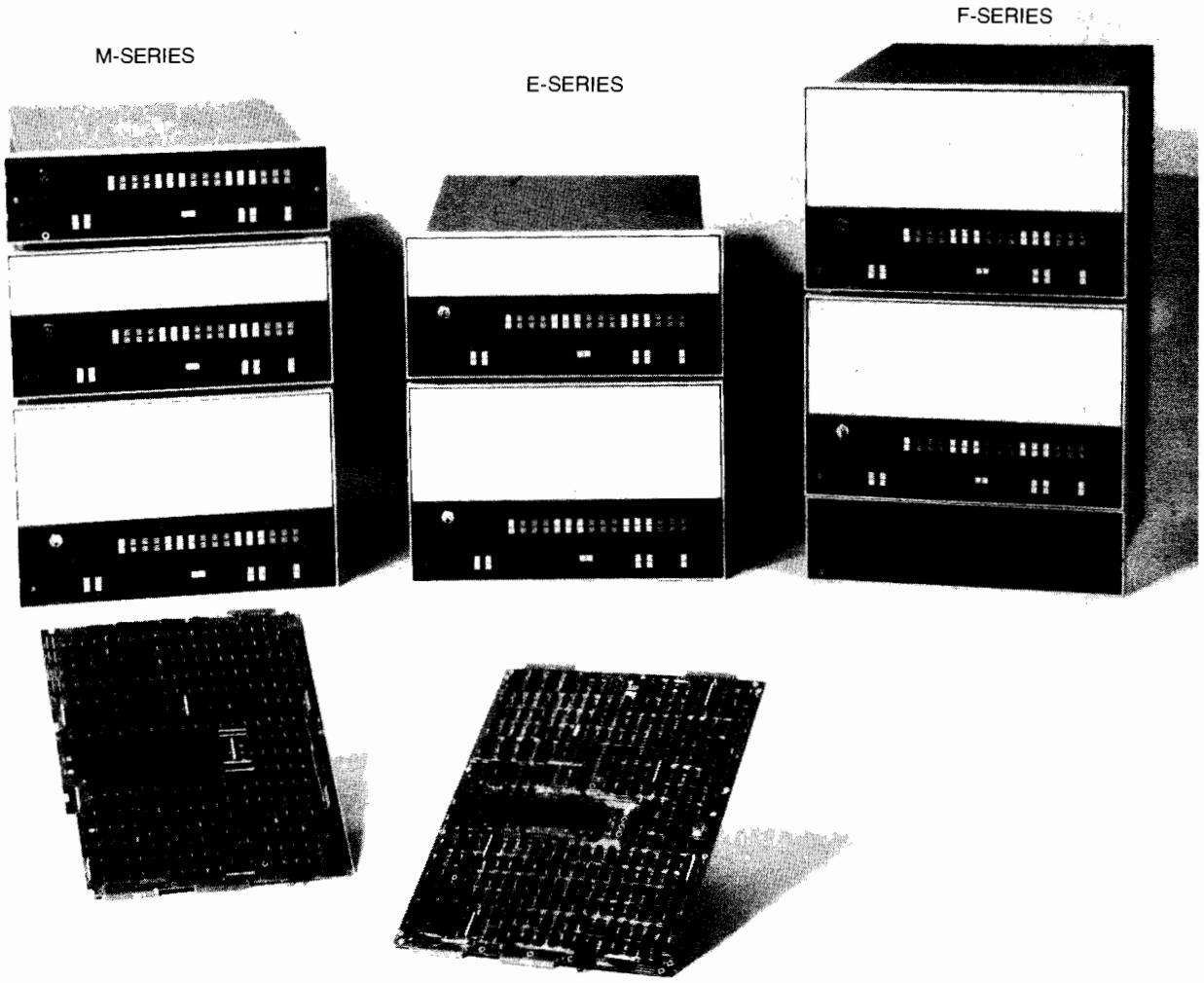
HP 1000 Family Overview

The introduction of the F-Series computer brings with it a new way of describing the HP Technical Computer Family. The term "HP 1000," formerly used to denote HP computer systems, has been expanded to be associated with the entire product line. Thus, the 21MX M-Series and 21MX E-Series become the HP 1000 M-Series and HP 1000 E-Series, respectively. The HP 1000 computer product line now consists of M-Series, E-Series, and F-Series computers. All three are available in a variety of rack-mountable chassis sizes. HP 1000 M-Series and E-Series are available as board computers for high volume applications where it is useful to integrate the central processing unit into a product to achieve space and power economies. HP 1000 E-Series and F-Series computers also form the basis for complete HP 1000 Computer Systems, which combine computer, mass storage, CRT terminal, operating software, and cabinetry into fully integrated, packaged systems.



Pro Forma Press Release

Hewlett-Packard today introduced a new computer, which the company called a high performance addition to its HP 1000 family of small computers. The new computer is called the HP 1000 F-Series, and is aimed at real-time applications in instrumentation, computation, and operations management, as well as the OEM marketplace.

The new F-Series computer is compatible with the HP 1000 E-Series computer, and in fact has the same basic instruction set. The F-Series also features a separate hardware processor for fast execution of floating point instructions, a new Scientific Instruction Set for hardware execution of trigonometric and logarithmic functions, and a set of microprogrammed routines that accelerate FORTRAN performance.

The Floating Point Processor is a separate hardware processor that improves floating point execution speeds by a factor of five to seven over previously available firmware routines. The F-Series computer executes a floating multiply, for example, in 6.3 microseconds.

The company expects the F-Series to be especially well received by users in computation-oriented areas such as computer aided design and drafting, scientific problem solving, simulation, and graphics.

"Our HP 1000 E-Series computer has proven to be a very good solution in industrial and scientific applications where customers are able to critically judge what the best price/performance combination is," said Bob Puette, Marketing Manager of **Hewlett-Packard's** Data System Division. "The addition of the F-Series as the top of the line gives us fast floating point capability and with the Scientific Instruction Set and Fast FORTRAN Processor, the HP 1000 family will now be able to address truly high performance applications.

Scientific Instruction Set —

The Scientific Instruction Set, to which Puette referred is a group of new instructions that calculate trigonometric and logarithmic functions of floating point numbers at extremely hgh speeds. Taking the sine of a number, for example, is done in only 47.6 microseconds.

The Scientific Instruction Set gives the F-Series a unique capability among small computers, as the instructions are executed between six and twenty-four times faster than commonly used software routines. This dramatic speed improvement is achieved primarily because the instructions use the floating point processor as a computing resource. Many scientific and engineering applications, such as computer aided design, simulation, and modeling, make extensive use of trigonometric and logarithmic calculations.

"Combining the microprogrammability of the HP 1000 family with the new floating point processor has resulted in the unique power of the Scientific Instruction Set", noted Puette. "And, I expect many of our customers to implement more specialized functions in the same way. The F-Series provides the microprogrammer with an extremely powerful computing resource that can be used as a separate, parallel arithmetic processor."

Fast FORTRAN Processor —

Another instruction set extension standard in the F-Series is called the Fast FORTRAN Processor. These instructions accelerate several commonly used FORTRAN operations such as parameter passing between subroutines and array address calculations. "Because a great deal of the applications programming for the F-Series will be done in FORTRAN, we think the combination of the Fast FORTRAN routines, the Scientific Instruction Set, and the high speed floating point capability represents a great deal of value for our scientific and industrial customers," added Puette.

RTE-IV —

The F-Series computer is supported by HP's full range of Real Time Executive (RTE) operating system software. The latest version, introduced simultaneously with the F-Series, is RTE-IV, which features the ability to address data segments of up to 1.8 million bytes. The HP 1000 F-Series together with RTE-IV are ideal for FORTRAN applications that demand high speed and the ability to work with large data arrays.

Configuration —

The HP 1000 F-Series will be marketed both as a desktop or rack mountable computer, and as a completely integrated HP 1000 Computer System. The two computer models are 2111F and 2117F. The 2111F contains 64K bytes of high performance memory, room for up to 512K Bytes of memory and nine fully powered I/O slots, all in a 12¼ inch high mainframe. The larger 2117B contains 128K bytes of high performance memory, fourteen I/O slots, and can house up to one million bytes of memory in a 17¼ inch frame. Extender boxes are available with each model, to allow expansion to 1.8 million bytes of memory and 46 I/O slots.

HP 1000 F-SERIES

The New High Performance Member . . .

The HP 1000 F-Series computer, the latest addition to the HP 1000 product line, is a high performance machine aimed at those OEM and end user customers who require a high level of computation capability from their computers. Designed for both performance and accuracy in applications that involve floating point arithmetic, trigonometric, logarithmic, and other scientific calculations, the F-Series will be very attractive to customers looking for a cost effective solution.

Powerful HP 1000 Instruction Set

The HP 1000 F-Series utilizes the same powerful control processor as the E-Series computer, with an enhanced instruction set that is an extension of the HP 1000 base set common to M-Series and E-Series computers. Execution times for single precision floating point instructions have been improved by a factor of 2.5 to six, while remaining completely compatible with software executed on M-Series or E-Series computers.

New Floating Point Processor

All this is possible because of a new Floating Point Processor, that is dedicated to performing floating point arithmetic. Implemented in hardware and connected directly to the computer's control processor through the Microprogrammable Processor Port (MPP), the floating point processor executes floating point instructions much faster than was previously possible. The new processor executes both single precision (32-bit) and extended precision (48-bit) floating point instructions at hardware speed to give the F-Series greater number crunching ability. Accurate to at least eleven decimal places, these 48-bit floating point instructions typically execute 3 to 6 times faster than equivalent firmware and software routines on the E-Series computer.

New Scientific Instructions

In addition to the floating point processor, the F-Series offers as standard nine new instructions that perform trigonometric and logarithmic operations. Called the Scientific Instruction Set (SIS), the new instructions utilize the computational resources of the floating point processor to give the F-Series the ability to execute these instructions with incredible speed and accuracy. SIS instructions execute up to 24 times faster (and several orders of magnitude more accurately) than the software routines they replace.

Accelerated FORTRAN Performance

Offered as a standard in the F-Series computer are firmware routines designed to improve FORTRAN performance. The FORTRAN accelerator routines of the Fast FORTRAN Processor consist of 15 instructions that perform frequently used FORTRAN operations, such as parameter passing, array address calculations, floating point conversion, packing and normalization functions. This results in an increase in performance by a factor of two to twenty over that of equivalent software routines, and a 50-70% performance improvement for a typical FORTRAN applications program.

A Powerful New Microprogramming Resource

As with all members of the HP 1000 family, the F-Series computer is fully user microprogrammable, thus allowing the user to create his own tailored, high performance microprogrammed subroutines. Microprograms communicating with the floating point processor can utilize processor overlap and instruction chaining capabilities to achieve extremely high performance.

High Performance Fault Control Memory

High Performance 350 nanosecond memory is the standard memory system offered with the F-Series. Based on state of the art 4K and 16K RAM technology, memory is available in modules of 32K and 128K bytes. For fault secure operation, 420 nsec high performance fault control memory is also available. Fault control provides for correction of all single bit errors and detection of all double bit errors.

High Speed Input/Output

The variety of high speed I/O capabilities available on the E-Series computer are also available on the F-Series computer. The Dual Channel Port Controller (DCPC) offers transfer rates of up to 2.2 million bytes second on a cycle stealing basis. Microprogrammed Block I/O provides an intelligent I/O channel with transfer rates of up to 3 million bytes per second.

. . . Of the HP 1000 Family

In addition to the high performance characteristics of the F-Series, there are other equally important features — those associated with membership in the HP 1000 product line.

Two Models to Choose From

The F-Series computer is available in two models, the 2111F and the 2117F.

The 2111F includes CPU, Floating Point Processor, 64K bytes of high performance memory, F-Series instruction set, SIS, FORTRAN accelerator routines, power supply, 9 I/O slots, and room for 640K bytes of memory, all in a single 12¼" rack mountable unit. The 2117F is similar to the 2111F, except that the floating point processor is housed in a separate 5¼" unit. The 2117F includes 128K bytes of high performance memory, Dynamic Mapping System, 14 I/O slots and room for 1280K bytes of memory.

Powerful Real Time Operating Systems

Memory- and disc-based operating systems that are compatible with the entire HP 1000 family are available. In particular, the new RTE-IV real-time operating system is a perfect complement for the F-Series computer. With RTE-IV's ability to process large arrays of data, it will be ideal for use in many computation intensive applications.

Automatic Boot Up

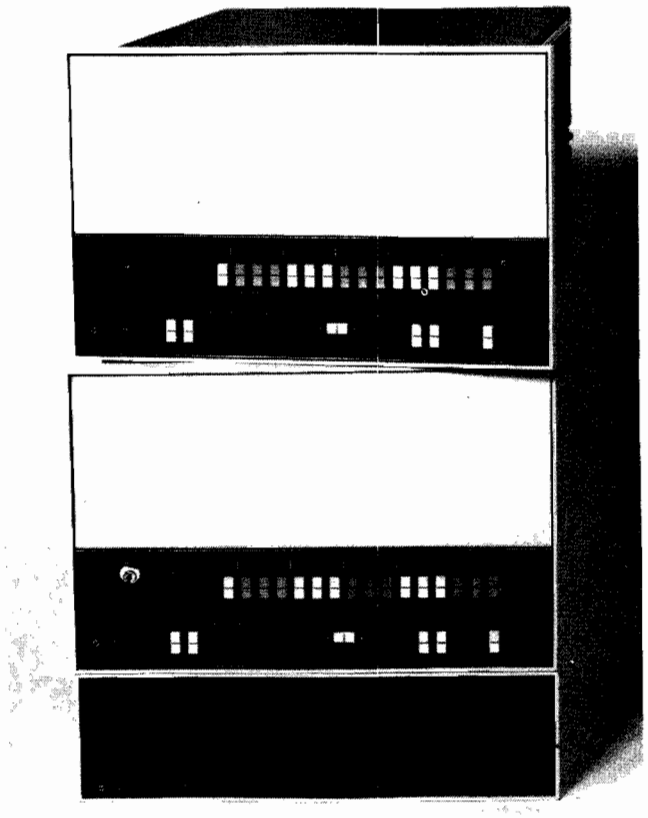
The Remote Program Load (RPL) feature of the F-Series allows the operating system to be booted up without operator assistance. Just turn it on and up it comes! RPL also allows the computer to boot up on a signal from a remote site, or to re-boot itself on execution of certain instructions.

Tough, Reliable Design

Designed, built, tested, and specified to operate under harsh environmental conditions, the F-Series continues the line of sturdy construction and reliable memory systems, for which the HP 1000 product line is known. These tough specifications mean that the F-Series will be able to perform its tasks longer, better, and more reliably than many other small computers.

2111F

2117F



HP 1000 F-SERIES

New Sales Opportunities for Computation Intensive Applications

In the area of computation intensive applications, the addition of the F-Series to the HP 1000 product line will open many new sales opportunities with its high speed floating point computation ability. These new high performance capabilities, coupled with features such as microprogramming, high performance memory, and high speed I/O will provide both the OEM and end user with excellent tools for developing his particular application.

Scientific Problem Solving

Any application where scientific number crunching ability is a major requirement will be an opportunity for the F-Series. Scientific applications such as Fourier Transforms, series expansion, curve fitting, partial differential equations, and complex integration will benefit greatly from the speed and accuracy of the F-Series' floating point instructions and Scientific Instruction Set.

Graphics

Graphics is becoming an increasingly popular method for implementing the computer-human interface in many applications. The F-Series' ability to perform many of the trigonometric and floating point functions required in a graphics application make it an excellent choice where high performance graphics capability is desired. Possible graphics applications include all types of computer aided design applications, and information displays for process control, simulation and modeling.

Computer Aided Design

The F-Series should greatly enhance HP's offering in the broad computer aided design (CAD) market. HP 1000 computers are being used today in such applications as integrated circuit design, and textile products design. The speed of the F-Series will allow us to address many more CAD applications. Examples include electronic circuit design, antenna design, microwave equipment design, structural design, automotive parts design, other mechanical design.

Simulation and Modeling

The simulation and modeling of complex systems usually requires both high performance processing and number crunching ability. F-Series opportunities for simulation and modeling applications can be found in the chemical, aerospace, electronics, and petroleum industries. Modeling and simulation of process control systems, electronic circuits, mechanical designs, power distribution networks, and transportation systems are all candidates for the F-Series computer.

Linear Programming

Many linear programming applications require the processing of both large arrays and the ability to reduce large amounts of data. HP's new RTE-IV operating system allows for large data arrays and the F-Series provides high performance computational capability . . . a winning combination.

Don't Forget Instrumentation

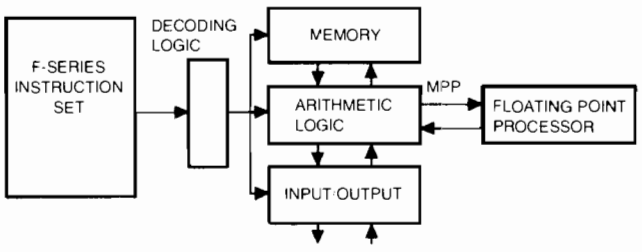
While a major focus of the F-Series computer will be on many of the "computation" applications outlined above, there are many applications involving instrumentation that require high speed floating point arithmetic. The F-Series, with its high speed I/O capability, strong instrumentation interfacing, and real time operating systems provide an excellent solution for process control, monitoring, and automatic testing applications where number crunching is also a requirement. The introduction of the F-Series will create many new opportunities in computation intensive instrumentation applications.

Features and Benefits

Feature

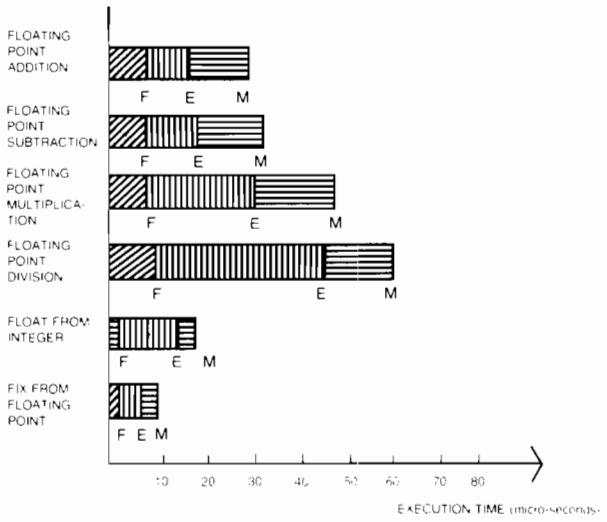
Powerful HP 1000 instruction set offers greatly enhanced floating point instruction performance. The base instruction set is completely compatible with existing M-Series and E-Series computers, yet single precision (32 bit) floating point instructions are executed 2.5 to six times faster. All this is possible because of a new FLOATING POINT PROCESSOR which is an integral part of the F-Series computer. The floating point processor contains data and control logic dedicated to floating point operations, so the control processor no longer needs to perform these calculations in lengthy firmware or software routines. Since the floating point processor is optimized for floating point arithmetic, it can perform these operations extremely rapidly. The F-Series computer uses the same powerful control processor as the E-Series computer with the floating point processor hooked directly to the main data bus via the Microprogrammable Processor Port (MPP). Instruction set enhancements provide the ability to communicate with the floating point processor through standard and new assembly language instructions. There are basically eight single precision floating point instructions standard in the F-Series — add, subtract, multiply, divide, and four instructions to convert between integer and single precision floating point numbers. Two of the conversion instructions, (conversion of single precision floating point to double integer, and vice-versa) are new instructions. The other six instructions are identical to floating point instructions on M-Series and E-Series computers, except that the calculation is actually performed in the floating point processor instead of in firmware.

Instruction times for the F-Series single precision instructions are shown in the following table. The actual performance increase for a given program depends on the floating point mix (i.e., of total instructions that are floating point instructions), but an increase of two to three times is not unusual.



Benefit

The F-Series offers the performance of a hardware floating point instruction processor for the first time in the HP 1000 family. This tremendous increase in floating point performance translates directly into cost savings for many applications. Floating point performance means increased throughput and more efficient use of computing resources. For applications where floating point computation must be accomplished in real-time, the F-Series provides a powerful, cost effective solution. Compatibility with the HP 1000 instruction set insures that the customer's software investment is protected with the F-Series.

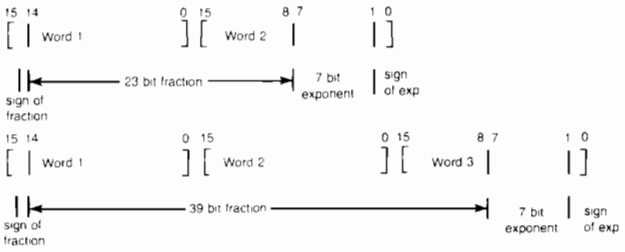


F-SERIES SINGLE PRECISION FLOATING POINT INSTRUCTION EXECUTION TIME

Feature

Eight new extended precision (48-bit) floating point instructions have been added to the F-Series instruction set. These instructions perform extended precision add, subtract, multiply, divide, and conversion functions 3 to 6 times faster than the E-Series computer.

An extended precision floating number requires 48-bits, or three computer words. The actual formats of single and extended precision formats appear as follows:



While a single precision (32-bit) floating point number provides at least six decimal places of precision, an extended precision number provides at least eleven decimal places of precision.

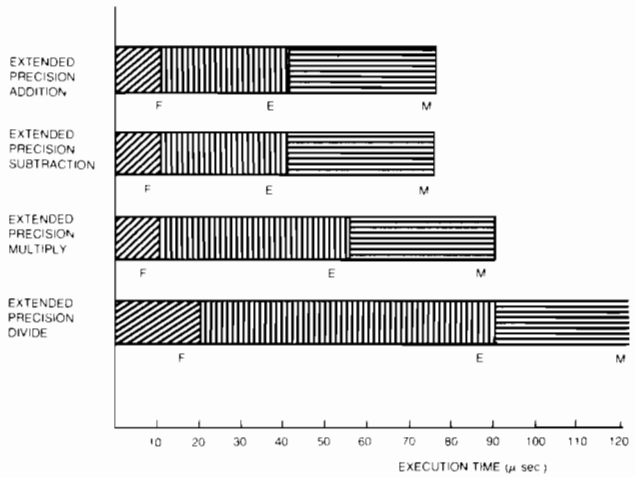
Single precision	π	= 3.14159
Extended precision	π	= 3.1415926536

The eight extended precision floating point instructions perform add, subtract, multiply, and divide functions as well as conversion between extended pressure floating point numbers. While the four arithmetic operations are available on M-Series and E-Series computers as software routines, or as part of the Fast FORTRAN Processor, the conversion routines are completely new. All eight extended precision instructions utilize the capabilities of the Floating Point Processor.

The following chart shows relative execution times for several extended precision floating point instructions.

Benefit

The F-Series provides extended precision accuracy at a speed faster than most previously available single precision operations. This makes the F-Series an outstanding candidate for applications demanding both floating point performance and accuracy.



SELECTED EXTENDED PRECISION FLOATING POINT EXECUTION TIMES

Feature

Nine new trignometric and logarithmic instructions execute six to 24 times faster than equivalent software routines. Called the Scientific Instruction Set (SIS), these instructions have been previously available only as software library routines that executed more slowly and with less accuracy. The new Scientific Instruction Set instructions include: sine, cosine, tangent, arc tangent, square root, exponential, natural logarithm, base ten logarithm, and hyperbolic tangent. Execution times and improvement factors are listed below (all times are in μseconds).

Benefit

This unique capability is of direct benefit to the engineer solving graphics, simulation, data analysis and other engineering applications, because it provides speed, accuracy, and convenience.

	E-Series	F-Series	Improvement Factor
SIN	290	47.6	6.1
COS	314	47.9	6.6
TAN	979	48.4	20.2
ATAN	1045	42.4	24.7
SQRT	197	30.9	6.4
EXP	362	44.7	8.1
LOG	301	43.3	7.0
LOGT	335	79.4	6.8
TANH	472	57.2	8.3

The use of the new SIS instructions are completely transparent to the FORTRAN user. He still codes "Y = SIN (x)" as always. The only difference is that, when this program is run on an F-Series computer, the sine function is computed at hardware speed instead of in a lengthy software algorithm. How can SIS be so fast? HP has used the microprogrammable capabilities of the F-Series to optimize these functions by eliminating much memory overhead and overlapping CPU and floating point processor execution. In addition to high speed, accuracy is another strong suit of the Scientific Instruction Set. Trigometric and logarithmic functions may have no exact answers, since they are transcendental functions. (For example, $\sqrt{2}$ = 1.41421356 . . .) The algorithms used to calculate these functions are typically interactive calculations that **approximate** the desired functions. Because of this, there is usually a tradeoff between the function's accuracy and its execution time. (To achieve greater accuracy, more iterations are required, hence longer execution times.) Because of the exceptional processing speed of the floating point processor, the Scientific Instruction Set has been able to achieve **both** speed and accuracy. Shown below is a table giving a measure of SIS accuracy.

RMS Relative Error

	E-Series	F-Series	Improvement Ratio E/F
SIN	1.7×10^{-4}	8.8×10^{-8}	1930
COS	5.5×10^{-6}	8.8×10^{-8}	62
TAN	6.6×10^{-4}	2.0×10^{-7}	3200
ATAN	1.0×10^{-7}	1.3×10^{-7}	0.74
SQRT	6.7×10^{-8}	6.7×10^{-8}	1.01
EXP	2.8×10^{-7}	1.9×10^{-7}	2.0
LOG	2.6×10^{-5}	1.3×10^{-7}	202
LOGT	1.7×10^{-5}	1.4×10^{-7}	1.2
TANH	2.3×10^{-7}	1.3×10^{-7}	1.7

RMS error is calculated by $\sqrt{\frac{\sum (\text{error})^2}{N}}$ for N values calculated over a relevant range for that function. Note that the accuracy of a single precision floating point number can be no greater than about 1.2×10^{-7}.

Feature

FORTRAN accelerator instructions, which increase FORTRAN performance by a factor of two to twenty, are standard in the F-Series. The FORTRAN accelerator instructions of the Fast FORTRAN Processor consist of 15 frequently used routines, such as parameter passing, array address calculation, packing, unpacking, complementing, and conversion of floating of single and extended precision floating point numbers. Use of the Fast FORTRAN Processor routines is transparent to the FORTRAN user. For example, when an array address calculation is required in a FORTRAN statement like "Y = ARRAY (40,15)", the FORTRAN compiler will generate a subroutine call to . . MAP, a library subroutine. In an F-Series computer, this calculation would automatically take place at high speed in the Fast FORTRAN . . MAP instruction.

Benefit

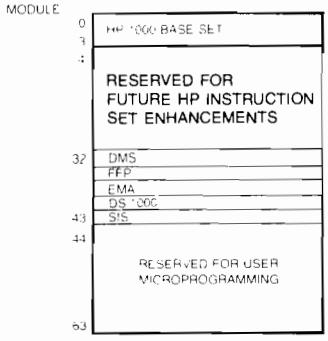
By performing operations that are frequently utilized in FORTRAN, these accelerator routines are a major contribution to the F-Series excellent price/performance ratio.

Feature

The F-Series provides a powerful new microprogramming resource in addition to complete microprogramming support for the user. As with the M-Series and E-Series computers, user microprogramming is fully supported and encouraged on the F-Series. A complete software support package is available, inlcuding a micro-assembler, micro-debug editor, cross reference generator, PROM tape generator and microprogramming utility programs.

Microprograms are written in an easy to learn, assembly-like microprogramming language. Development is done in Writeable Control Score (WCS) which facilitates debugging and updating of microprograms by being dynamically alterable.

There are 16K words of available control memory in the F-Series computer, with up to 6.5K words available to the user for microprogramming without infringing upon HP reserved areas. A map of control memory appears as follows, showing HP base set, instruction set enhancements, and user microprogramming areas.



Benefit

Microprogramming allows for specialized and/or high performance capabilities to be added to the F-Series computers. Specialized products can be created at minimal additional cost to the customer in the areas of development, manufacturing cost, training and support. Additionally, firmware provides a much higher degree of security than does a software product.

Very efficient use can be made of the floating point processor through user microprogramming. Floating point instructions executed from assembly language will incur memory overhead both in fetching the operand from memory and then storing the result after the operation has completed. Memory overhead can be as much as 70% of the total instruction time, and much of this overhead can be eliminated under microprogram control by overlapping memory accesses with floating point processor operations. In addition, the floating processor has an accumulator in which intermediate results may be stored for chain calculations. (Example: Begin a floating point multiply; while it is executing, fetch the next operand from memory. As soon as the FPP is finished, immediately begin the next operation, using the intermediate result left in the floating point accumulator. This has effectively eliminated the memory overhead of storing the intermediate results, refetching it, and fetching the second operand.)

An important aid for you in selling microprogramming is to demonstrate to your prospect the advantages HP has gained by using this capability for standard projects. The power we've been able to add to the HP 1000 architecture via microprogramming is quite impressive.

- Dynamic Mapping instructions were written to allow addressing of up to 2 million bytes of main memory, including a rich instruction set for manipulating memory management hardware.

- The accelerator routines of the Fast FORTRAN Processor in the F-Series enhance FORTRAN performance by a factor of two to twenty.

- Much of the success of DS/1000, in particular the error checking and multi-line handling capabilities, is due to the microcoded communications driver.

- RTE-IV's Extended Memory Array instructions use microprogramming to provide the industry the most capable large memory operating system.

- Finally, the new microprogramming resource of the floating point processor has been utilized in the Scientific Instruction Set.

HP not only supports user microprogramming, but has also created the instruction set enhancements that prove its value.

Feature	Benefit
Maximum interrupt latency time has been reduced by almost a factor of three, from 48 to 18 microseconds. Since interrupt latency is one measure of the response time associated with an interrupt, the F-Series can potentially respond more quickly to an interrupt that an E-Series or M-Series computer.	For the OEM with a real time application where response time is important, the reduced interrupt latency may result in a more cost effective solution with the F-Series.

Feature	Benefit
The F-Series computer offers extensive software compatibility with all current HP operating systems and other active software products. The currently available memory and disc based real time operating systems are completely compatible with the F-Series. In fact, the powerful array processing capabilities of the new RTE-IV operating system are a perfect complement to the F-Series floating point capabilities. Extensive software compatibility also exists between the F-Series and programs written on HP 1000 M-Series and E-Series computers. Except for timing dependencies in the software, and a few cautions concerning floating point software (See "Questions and Answers"), all programs written and executed on older HP machines will also execute on the F-Series.	By preserving HP software investment, the customer can bring a new system up quickly and at low cost. This benefit is a powerful one, both for current customers and new prospects. The F-Series is yet another piece of evidence that HP is committed to long term relationship. With customers, and the continually enhancing their ability to solve problems without unnecessary changes.

Feature	Benefit
Built in self test features for CPU, Memory, and Floating Point Processor provide the user with a level of confidence in the hardware integrity without running extensive diagnostics. The CPU and memory are verified in two different tests. One test is executed whenever the IBL/Test button is pressed on the front panel. It performs a check of the CPU functions and a non-destructive check of the first 64K bytes of memory. A second more thorough test is executed either on power-up or from the front panel and verifies most CPU functions and performs an extensive check of all memory. The floating point processor self-test is run from the front panel, and varifies data and control paths and the ability of the floating point processor to perform floating point operations. A similar test will verify proper operation of the Scientific Instruction Set.	Reduction of failures and down time results in cost savings to the customer and increased efficiency. The verification test of the floating point processor and the Scientific Instruction Set will be useful in isolating problems, especially in complex systems.

Feature	Benefit
The Remote Program Load (RPL) feature of the F-Series computer allows for automatic system boot up and cold loading of systems from a remote node. To enable RPL, one need only to code boot up information into a set of switches on the CPU board. This information specifies which loader ROM, the select code of the loading	Ease of designing turn-key OEM products. Cost effective since RPL can reduce or eliminate the need for a trained computer operator.

device, and subchannel or disc platter number. Then, when power is turned on with the front panel in the "LOCK" position, the CPU will wait for the input device to be ready, then boot itself up. This is ideal for applications where unskilled personnel may be required to reboot the system. (Note: When the power fail recovery system is installed, you must also turn off the battery when rebooting, or else the computer will auto-restart.)

Another application of RPL is to boot up a remote station. A specially designed interface card in the I/O section may have the capability to force a boot up. This feature would be successful to "wake-up" a remote station or to attempt to recover from some kind of communication link failure. (This feature is not supported by DS/1000 or any other HP software at this time, but has been implemented for specialized applications by several of our OEM customers.)

A third RPL feature is the ability for the computer to cause itself to reboot by executing certain HALT instructions. This capability would be useful in a situation where it was desired to programmatically recover from a catastrophic error by rebooting.

RPL is currently compatible with loader ROMS for 7900, 7905, 7906, 7920 discs, Floppy disc and Data Communications. Also, many users write specialized loader ROMS for their own applications.

HP 1000 F-SERIES

Ordering Information

Complete ordering information for all HP 1000 F-Series computers and accessories can be found in the current version of the **HP 1000 Computers Selection and Configuration Guide.**

Sales Aid Summary

Sales Tool	Description	Target Audience	Ordering Information
HP 1000 Family Brochure	A new 40-page full color brochure designed to be the lead-in piece for all HP 1000 computer products. This brochure has been updated to include the F-Series and an overview of the entire HP 1000 product line — systems, computers, and board computers.	Top Management, Director of MIS, Division Manufacturing Manager.	Part No. 5953-3005
HP 1000 Computation Brochure	A 16 page full color brochure designed to highlight the computation capabilities of the HP 1000 product line. Applications for the F-Series computer, RTE-IV, and Graphics are covered in the fields of environmental research, cost analysis, vibration analysis, simulation, electronic testing, computer-aided design, and product testing.	Same as above, but also aimed at project leaders, first and second level management.	Part No. 5953-3001
HP 1000 Computer Announcement Flyer	This four page, full color flyer features the new F-Series computer and its high performance capabilities. Also featured is the HP 1000 Computer Product line, including M-Series, E-Series, and F-Series computers.	Same as above. Ideal for direct mail campaigns.	Part No. 5953-3006
HP 1000 System Announcement Flyer	This 4 page full color flyer is designed to highlight the new HP 1000 systems. Featured are the new models 25, 40, and 45 along with the F-Series computer and RTE IV.	Same as above. Ideal for direct mail campaigns	Part No. 5953-3007
HP 1000 F-Series Demonstration Software	This super 10 minute demonstration actually shows the customer the power of the F-Series floating point capabilities. Programs containing floating point intensive routines are run at E-Series speed and at F-Series speed, demonstrating the actual performance improvement contributed by the floating point processor, Scientific Instruction Set, and FORTRAN accelerator routines.	Same as above, but also including programmers and others involved in the actual project implementation.	
Data Sheets	HP 1000 Computer Technical Data Book contains all relevant technical information on the F-Series computers and accessories. Also included is information concerning upgrade of E-Series computers to F-Series capability.	All customers who need technical data.	Part No. 5953-0894
Selection and Configuration Guide	This new 32-page manual contains easily understood pricing and configuration information for the HP 1000 product line, including F-Series computers.	HP personnel and customers who need price and/or configuration information.	Part No. 5953-0896

Competition

The introduction of the F-Series computer brings true floating point performance to the HP 1000 product line. We are now very strong in areas in which we were formerly the most vulnerable. The performance of the F-Series relative to the competition has been quantified with a series of benchmark programs, discussed below. Following a discussion of the benchmark results is a comparison of competitors' prices, and a summary of the F-Series strengths and weaknesses.

The Benchmark Game

HP 1000 computers have already been applied to many computation applications, but the introduction of the F-Series, with its ability to perform high speed floating point arithmetic, greatly broadens our offering in this area. Previously, if a floating point benchmark was involved in a computational sales bid, we were many times outperformed, resulting in a weakened selling position. The F-Series computer dramatically strengthens our offering in this area, and while we don't recommend selling only on benchmark results, the F-Series will certainly let us qualify for a lot more sales. For most computation intensive programs, the F-Series has shown a 2 to 3 times performance increase over the E-Series. We will outperform an 11/70 or an Eclipse S/230 in some applications, and will almost always be in the same ballpark.

Thus, if a bid involves a FORTRAN benchmark, expect the F-Series to be competitive. The F-Series should perform well, giving HP a good foundation from which we can sell our strengths. Finally, we will run the above benchmarks on other machines also. Times for a PDP 11/60, Eclipse S/130, and PRIME 300 should be out shortly. The following table summarizes the benchmark results for HP, the DEC PDP 11/70 and Eclipse S/230.

SYSTEMS / BENCHMARKS	HP M Series Standard Memory Fast FORTRAN Processor RTE-III	HP E Series Standard Memory RTE-III	HP E Series Standard Memory Fast FORTRAN Processor RTE-III	HP E Series High Speed Memory Fast FORTRAN Processor RTE-III	HP F Series High Speed Memory RTE-III	Digital PDP 11/70 FORTRAN 4+ Hardware Floating Point (FP II-C) RSX II/M	Data General Eclipse S230 FORTRAN 5 Hardware Floating Point (8413) AOS	HP 3000 Series II MPE
WHETSP	2.02	2.01	1.2	1.03	.40	.33	.397	.83
WHETDP	3.13	29.8	2.06	1.81	.86	.41	.47	2.03
TRANS SP	5.75	3.56	3.36	3.0	.40	.67	.81	2.45
TRANS DP	12.12	110.88	7.39	6.86	2.64	.95	1.11	7.92
FLOAT SP		1.76	1.75	1.63	.58	.24	.37	1.08
FLOAT DP		71.2	3.20	2.91	.93	.33	.47	2.83
OPT 1	3.1	1.96	1.96	1.6	.9167	.42	.715	1.26
OPT 2	3.0	1.88	1.88	1.3	1.28	.95	.77	1.54

Benchmarks

All of the above benchmarks are compute bound FORTRAN programs which require only a small amount of memory. They were designed to measure CPU performance only, although some do reveal strengths and weaknesses of the various compilers.

The WHETSTONE benchmark was designed to represent a typical FORTRAN program with an average floating point mix. It was coded in FORTRAN using the WHETSTONE algorithm created by the National Physical Laboratory in England. The algorithm represents an instruction mix derived form analysis of about 1000 Algol 60 programs. (The universality of this algorithm has been substantiated by subsequent analysis of FORTRAN programs.) The WHETSTONE benchmark is also the closest thing available to an industry standard benchmark. WHETSP and WHETDP are single and double precision versions of this benchmark.*

The TRANSSP and TRANSDP benchmarks perform transcendental calculations, TRANSSP being single precision and TRANSDP being double precision. They make extensive use of the square root, sine, cosine, arctangent, and exponential function in the F-Series Scientific Instruction Set. They do not use tangent, hyperbolic tangent, natural logarithm, or base ten logarithm, all of which run very fast on the F-Series. FLOATSP and FLOATDP perform FORTRAN floating point calculations. FLOADTP is the double precision version, but does the same number of calculations. OPT1 and OPT2 were designed to be easily optimized by an optimizing compiler. OPT1 is a combination of single precision floating point and single dimension array accesses. OPT2 is a FORTRAN DO loop around a series of 24 IF statements (e.g., IF (I)201,199,199). TRANSSP, TRANSDP, OPT1, and OPT2 were also written by the National Physical Laboratory in England.

*Note that "double precision" as used here means extended precision (48-bit) on the HP 1000, but means true double precision (64-bit) on all other machines benchmarked. HP FORTRAN programs that specify "double precision" actually do calculations in extended precision, so the double precision benchmark results are not really an "apples to apples" comparison. The benchmarks still provide lots of useful information, but don't get burned trying to compare their double precision performance to our extended precision performance.

How We Compare to Ourselves

The table above shows how different HP 1000 configurations compare to each other with regard to computational FORTRAN programs. The most pronounced difference involves the addition of the Fast FORTRAN Processor (FFP) to an E-Series CPU. For the three double precision benchmarks (WHETDP, TRANSDP & FLOATDP) FFP gave a 14:1, 15:1 & 22:1 improvement, respectively. The other firmware routines in FFP accounted for over a 50% improvement in WHETSP, a program that has no double precision calculations.

The addition of high speed memory will give between 15–20% improvement depending on the program. FLOATSP got only a 7% speed improvement as compared to a 45% improvement for OPT 2, because IF statements are loaded with memory references and single precision floating point calculations are not. Generally, the less time a program spends crunching numbers, the better performance increase due to the addition of high speed memory. Even for programs with a low percentage of floating point calculations, the contribution of FFP is significant. Together, FFP & high speed memory can easily give a 25–75% performance increase, not including the 15:1 improvement occurring when using double precision.

The new F-Series adds even greater price-performance for computation intensive applications, where the F-Series has consistently shown a 2–3 times performance increase over the fastest E-Series configuration. For the single precision floating point benchmark, the F-Series is 2.8 times faster and for double precision floating point benchmark it is over 3 times faster than an E-Series with FFP & high speed memory. Programs using single precision transcendentals (i.e., sin, tan, exp, log, etc.) can achieve as much as 7:1 improvement. Thus, for computation, the F-Series easily out performs any other computer Hewlett-Packard has offered to date.

Note that the F-Series is superior to the HP 3000 Series II at running floating point benchmarks. The HP 3000 comparison has been included here to clarify the fact that, for technical applications, the HP 1000 is Hewlett-Packard's **best** solution. True performance measures for the 3000 would be in more commercial areas, where 3000 product developments are aimed. Judge the HP 1000 for technical work, and the HP 3000 for commercial applications.

How Do We Compare To Our Competition

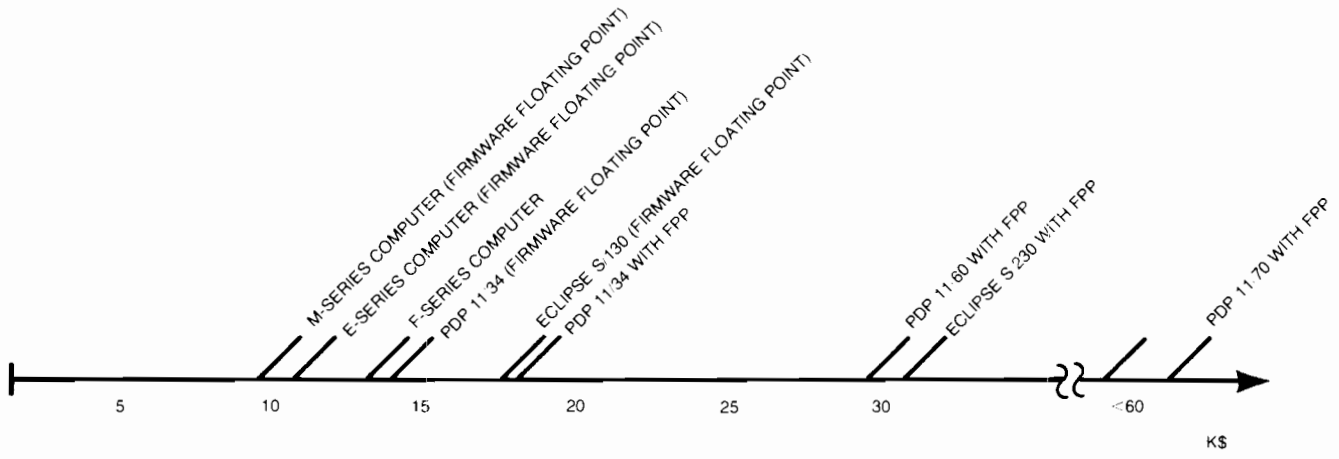
The PDP 11/70 and Eclipse S/230 represent high performance 16 bit machines offered by DEC and Data General respectively. For the single precision floating point benchmark, the 11/70 is 59% faster and the S/230 is 36% faster than the F-Series. For the double precision floating point benchmark, the 11/70 is 65% faster and the S/230 is 50% faster than the F-Series. But few programs are entirely floating point number crunchers. With a smaller floating point mix, the performance gap gets smaller.

The Whetstone single precision benchmark (WHETSP) is significant because the F-Series runs as fast as the Eclipse S/230 and the 11/70 runs only 18% faster than that. This means that we pick up ground on both of them in areas other than floating point. Benchmark OPT 1 does single precision floating point but manipulates single dimension arrays to do it. For this benchmark DG runs only 22% faster than us as compared to 36% faster for single precision floating point (FLOATSP). This indicates that DG's FORTRAN 5 compiler is inefficient with respect to single dimension arrays.

Obviously, these benchmarks don't compare everything that has to do with CPU performance, but the significance of the F-Series can not be overlooked, especially when one compares the 11/70 and the Eclipse S/230 to the E-Series. For computational programs the F-Series is a significant achievement.

Where do we really shine? SINGLE PRECISION TRANSCENDENTALS!!!! For TRANSSP the Eclipse S/230 is over 100% slower and the 11/70 is 67% slower than the F-Series. One would be hard pressed to find any computer that outperformed the F-Series for single precision transcendentals. For applications which use transcendental functions (i.e. Fourier transforms, microwave analysis, etc.) the F-Series is an excellent solution.

RELATIVE PRICES FOR HP 1000 COMPUTERS & COMPETITION
(Configurations include 64KB memory, parity TBG, powerfail, serial I/F, Front Panel)



F-Series vs. DEC 11/34

HP Strengths

- Overall performance, especially in floating point.
- Scientific Instruction Set
- High performance 350 nsec memory.
- Memory Expansion to 2M bytes.
- Fully user microprogrammable
- Memory parity standard, fault control optional
- RTE-IV
- DS/1000

HP Weaknesses

DEC Strengths

DEC Weaknesses

- Limited memory expansion
- No user microprogramming
- Overall performance

F-Series vs. DEC 11/60

HP Strengths

- PRICE – 2/3's the price of 11/60
- Price/Performance
- Scientific Instruction Set
- Low memory prices
- Memory expansion to 2 Mbytes
- User microprogramming — DEC finally has it, but still not up to par with HP
- 350 nsec memory
- DS/1000
- RTE-IV

HP Weaknesses

- No error logging
- No soft fail of floating point processor

DEC Strengths

- Slight Performance Edge
- ECC, error logging standard
- Soft fail of cache
- Floating point processor accumulator operations
- Flexible floating point instructions
- Floating point processor soft fail capability

DEC Weaknesses

- Price
- Limited memory expansion to 256 Kbytes
- Microprogramming difficult to implement

F-Series vs. DEC 11/70

HP Strengths

- PRICE – less than 1/3 the price of an 11/70
- Price/performance
- Scientific Instruction Set faster than 11/70
- Fully user microprogrammable
- Microprogramming the floating point processor can result in 11/70 performance.
- Low memory prices
- DS/1000
- RTE-IV

HP Weaknesses

- Doesn't have the 11/70's horsepower — although not that far off.

DEC Strengths

- Performance
- Floating point accumulator operations

DEC Weaknesses

- Price
- No user microprogramming
- Memory expandable to 2 Mbytes, but expensive

F-Series vs. DG Eclipse S/130

HP Strengths

- Slight price advantage
- Overall Performance
- Floating point performance
- Fully user microprogrammable
- Memory expansion to 2 Mbytes
- DS/1000
- RTE-IV

HP Weaknesses

- Floating point accumulator accessable only at micro-code level
- No 64 bit operations

DG Strengths

- Floating point accumulator operations

DG Weaknesses

- No floating point processor, floating point implemented in microcode
- User microprogrammable, but harder to implement and less software support than HP

F-Series vs. DG Eclipse S/230

HP Strengths

- PRICE – Less than 2/3 the price of an S-230
- Price/Performance
- Scientific Instruction Set
- 350 nsec memory
- Fully user microprogrammable
- Memory Expansion to 2 Mbytes
- DS/1000
- RTE-IV
- Low hardware maintenance costs

DG Strengths

- Slight performance advantage
- Floating point speed
- Four floating point accumulators
- Flexible floating point instruction set

HP Weaknesses

- Floating Point accumulator accessible only through microcode
- No 64 bit operations

DG Weaknesses

- High Price
- Memory expansion limited to 512K bytes

Questions and Answers

When should I propose an M-Series or E-Series Computer?

The F-Series is a high performance computer with very high performance floating point capabilities. For applications where high performance floating point capability is not a requirement, the F-Series may not be the most appropriate solution. Since both the E-Series and F-Series have the same control processor, programs without floating point operations will not run any faster on an F-Series. The price differential between the two computers will make the E-Series the best proposal in these situations.

The M-Series computer is still the best solution in situations where a low cost solution is desired and the higher performance of the E-Series and F-Series computers is not a major requirement. If low cost is the issue, propose the 2108M or 2112M.

Both the M-Series and E-Series computers are considered to be important contributors to the broad HP 1000 product line and as such will continue to be fully supported by HP. In addition, the clear upgrade path seen by the customer when purchasing an M-Series or E-Series computer further enhances the position of these computers.

What about compatibility problems (hardware)?

All hardware compatible with current E-Series computers is completely compatible with F-Series computers, with the exception of the base set microcode. This includes memory systems, memory accessories, I/O cards, I/O extenders, and other subsystems.

What about compatibility problems (software)?

Extensive software compatibility exists between the F-Series and programs written on other HP computers. For programs written in FORTRAN, a program need only be reloaded (not recompiled) to be executed on an F-Series computer. The purpose of the relocation is to link all calls to floating point subroutines to the new instructions used with the floating point processor. Similarly, assembly language programs that do floating point calculations need only be reloaded, not reassembled, in order to execute on the F-Series.

Several areas of caution should be noted:

1. Because of the extensive normalizing and rounding logic contained in the floating point processor, many answers will be more accurate when run on an F-Series computer. While this is certainly not a problem, it is possible that some applications programs written for other HP computers may utilize the less accurate firmware floating point result for comparison purposes. The solution to any problems caused by this increase in accuracy is to use the more accurate value for comparison purposes.

2. The opcodes of several extended precision instructions have been changed to insure future compatibility and expandability of the F-Series floating point capabilities. Specifically, the opcodes of the four extended precision arithmetic operations, formerly located in FFP, have been changed to move these instructions to the F-Series base set. In the Fast FORTRAN Processor, each of these operations had two alternate opcodes, each with a different calling sequence. The preferred routines, denoted by operations .XADD, .XSUB, .XMPY, and .XDIV, are those which utilize the floating point processor on the F-Series. The alternative operations, XADD, XSUB, XMPY, and XDIV, differ only by the calling sequence, but do not communicate with the floating point processor, and are not utilized by any HP software.

   Thus, for any use of the alternate extended precision operations, the calculations will not take place in the floating point processor. Some examples of correct and incorrect use of these operations are shown below. Because all HP software and most user written software use the desired routines, this should not be a problem to the vast majority of users.

FORTRAN Example:

A = B*C	CALL XMPY (RETURN,A,B,C)
correct	incompatible with F-Series

Assembly language example:

JSB .XMPY	JSB XMPY	OCT 105621
DEF RESULT	DEF RETURN	DEF RESULT
DEF A	DEF A	DEF A
DEF B	DEF B	DEF B
	DEF RESULT	
correct —	incorrect — uses alternate floating point routine	incorrect — uses old opcode for extended precision multiply

3. An illegal FORTRAN programming technique, which is nonetheless used by some programmers, is to store or reference ASCII characters as floating point numbers. Floating point comparisons of ASCII characters in FORTRAN will usually work on M-Series and E-Series computers, but will fail quite often on the F-Series computer. This is due to the normalization and rounding done by the floating point processor. For example, if the ASCII strings "1119" and "bbb7" are compared using this technique, they will be compared as being equal. The solution for a user having this problem is to specify all ASCII characters as being integer variables.

What about compatibility problems (firmware)?

Although the microprogramming language for E-Series and F-Series computers is identical, several changes to the F-Series base set and HP reserved entry points have been made. User written microcode developed on an E-Series computer may have to be relocated for use on an F-Series computer. Since these changes affect only HP reserved entry points, most customers should not be affected.

Can the customer attach another device to the microprogrammable processor port (MPP)?

The capability for more than one device (i.e., the floating point processor and one or more user defined devices) to operate on the MPP is not currently supported on the F-Series computer. Users requiring both high speed floating point capability and high speed I/O should choose either the DCPC or microprogrammed block I/O methods of high speed input/output.

With all these new firmware products, isn't the firmware accessory board (FAB) getting full?

It certainly is. If one has all possible firmware options now offered by HP, his FAB board is completely full.

If the user has Dynamic Mapping, Fast FORTRAN Processor, Scientific Instruction Set, DS/1000, and RTE-IV EMA, **and** he wants to burn some ROM's for his own use, he will have to put them on a 13047A 2K User Control Store (UCS) Board. Up to three UCS boards may be plugged into the I/O backplane of the F-Series computer, providing the user with 6K of microcode area. If the user has not filled up his FAB board, and does not plan to use all the HP instruction set enhancements, he may, of course, put his ROM's on the FAB with the knowledge that it may limit his ability to upgrade in the future.

What about double precision (64-bit) arithmetic?

HP software does not currently support double precision arithmetic. The advantage of double precision arithmetic is that 64-bit floating point numbers contain 16 bits of decimal accuracy, while extended precision (48-bit) numbers are accurate to at least 11 decimal places. The 11 decimal places of accuracy should be sufficient for most customers' needs.

What happens when the floating point processor fails?

When the floating point processor fails during a floating point operation under RTE, a Memory Protect Violation occurs. This violation will be reported on the system console. RTE-IV reports the failing instruction, the value of the program counter, A, B, X, Y, E, and O. If the failing instruction is a floating point operation, and the overflow register is set, a floating point processor failure is indicated. The user need only recognize this condition and call his local Customer Engineer.

For those users not operating under RTE-IV, a floating point processor failure will cause a memory protect violation, set the overflow bit, and store all one's (an invalid floating point number) into the 1st word of the floating point result.

It is then the responsibility of the user to manually or programmatically check to see if a floating point processor failure has occurred.

If the floating point processor fails, programs not utilitizing floating point instructions may still be run. For programs containing floating point instructions, a simple reloading of each program referencing the equivalent software floating point routines will allow the user to continue operation with degraded performance.

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