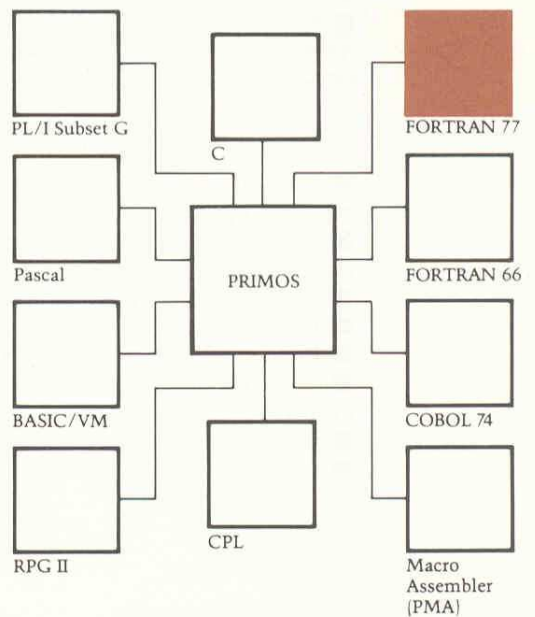


# PRIME

# FORTRAN 77

## Features

- Full ANSI 78 FORTRAN.
- Globally optimizing compiler.
- Exploits the Prime high-level instruction set and virtual memory architecture.
- Features extensions to enhance mainframe compatibility.
- Supports programs up to 32M bytes.
- Compatible with Prime FORTRAN 66.
- File compatibility with all Prime languages.
- Object compatible with other Prime languages.
- Full support for the Prime Source-Level Debugger.
- Comprehensive compiler diagnostics with a wide range of compiler options.
- Shared re-entrant code and compiler improve memory utilization in multiprogramming environments.
- Full support of Prime 50 Series systems with 32-bit architecture.



## Description

Prime FORTRAN 77 is a powerful language processor that fully exploits the unique hardware and software architecture of Prime processors and the PRIMOS® operating system. FORTRAN 77 is a full implementation of the latest ANSI standard, X3.9—1978. It also includes many extensions that enhance compatibility with mainframe FORTRAN dialects for easy program migration.

FORTRAN 77 uses extensive global and local code optimization techniques that increase program execution speed. In conjunction with the PRIMOS operating system, it supports many features typical of equipment several times more expensive than Prime systems. For example, FORTRAN 77 permits programs up to 32M bytes in size, and through a common calling convention, allows programs to access routines written in other languages.

## Program Execution

### *Global and Local Optimization*

The Prime FORTRAN 77 compiler performs extensive global and local optimization that significantly reduces execution time and space requirements of FORTRAN object programs.

In contrast to many FORTRAN compilers that optimize only within a single statement or contiguous block of statements, Prime FORTRAN 77 optimizes globally, across an entire program unit, as well as locally within individual statements or expressions. The compiler uses sophisticated flow analysis techniques to detect potentially optimizable FORTRAN expressions. Typical of the global optimizations performed are:

- Removal of invariant computations from DO-loops.
- Global elimination of common subexpressions using dominance relationships derived by global flow analysis.
- Near-optimal allocation of frequently referenced quantities to registers, both across DO-loops and within straight-line code.

### *Other Significant Optimizations*

- Compile-time evaluation of expressions with constant operands.
- Compile-time evaluation and absorption of constant subscript expressions.
- Compile-time conversion of constants.
- Partial evaluation of Boolean expressions.
- Relational branch optimization.
- Machine-dependent code selection optimizations.
- In-line generation of many intrinsic functions.
- Compilation of FORMAT statements.

## *Architectural Support for FORTRAN 77*

The execution speed of FORTRAN 77 programs is further increased by a high-level instruction set and processor architecture designed specifically to support high-level languages. The instruction repertoire of Prime systems includes: integral floating-point operations, character manipulation and editing functions, and decimal arithmetic operations—augmented by stack- and register-oriented addressing modes. Many such instructions correspond directly to FORTRAN 77 constructs such as arithmetic IF, computed GO TO and CALL with argument transfer.

## Interactive Program Development and Debugging

FORTRAN 77 offers features that simplify interactive program development and increase programmer productivity.

## *Power and Consistency*

The ANSI 78 FORTRAN language represents a significant improvement over previous FORTRAN implementations in terms of language power and consistency. Features such as CHARACTER datatype, IF-THEN-ELSE, automatic type conversions, generic function selection, generalized DO-loops, the PARAMETER statement, and list-directed I/O provide flexibility and ease-of-use. The compiler's optimization facilities further contribute to efficient, structured programming by allowing programmers to concentrate on program clarity rather than efficiency.

## *Flexible Compiler*

In program development, fast compilation is as important as fast program execution. Therefore, FORTRAN 77's optimization can be user-disabled to further enhance compile speed.

The compiler can produce a full range of program listings, including annotated source program listings, generated code listing, cross-reference and storage map listings, and summary compilation statistics. Optionally, it can emit code to perform array subscript checking at execution time. Other features include comprehensive compiler and run-time diagnostics produced in self-explanatory English phrases.



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### *Source-Level Debugger Support*

In conjunction with the Prime Source-Level Debugger and the interactive capabilities of the PRIMOS® operating system, FORTRAN 77 provides an interactive environment for program development. From a timesharing terminal, an interactive user can create and edit source files on-line using the Prime text editor. The user can then immediately compile, execute and test these programs interactively under the control of the Source-Level Debugger. Debugger commands allow users to dynamically set and clear breakpoints on source statements, examine and modify variables, step through a program, trace statement execution, restart or proceed from a breakpoint, display source statements, and trace back subroutine activation history. As a result, the test and debugging time associated with program development is dramatically reduced.

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### *Large Computer Features*

As a full implementation of the latest ANSI standard, Prime FORTRAN 77 includes many enhancements over the previous standard. In addition, it provides many common mainframe extensions beyond even the 1978 standard. For example, Prime FORTRAN 77 includes extensions such as NAMELIST, double-precision, quadruple floating point arithmetic, COMPLEX, ENCODE and DECODE, data initialization in specification statements, and IBM-style direct access I/O. These extensions simplify program development and allow easy migration and interchange of programs with computers of varying vendors. And since Prime FORTRAN 77 supports programs up to 32M bytes, the addressing limitations that typically encumber minicomputer FORTRAN implementations are eliminated, along with the need for program segmentation and overlays.

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### *Easy Program Migration*

FORTRAN 77 is upward compatible with the 1966 ANSI FORTRAN specifications. This allows standard-conforming programs written for other compilers to be compiled without modification by Prime FORTRAN 77. In particular, Prime FORTRAN 77 provides continued support for many features of the 1966 standard excised from the revised standard. For example, Hollerith data and DO-loops with extended range are still supported. Where the FORTRAN 77 language is incompatible with the previous standard or with common industry practice, the Prime FORTRAN 77 compiler provides alternative interpretations on a programmer-selectable basis.

FORTRAN 77 is supported on all Prime systems. Users never need to rewrite programs when upgrading from a small Prime system to a larger one. More important, programs developed on one Prime system can be run without modification on any other Prime system. This means that a large multiuser system can be used as a software development tool, creating programs that transfer directly to other Prime systems.

Through a variety of communications software products, FORTRAN 77 programs are directly transferable to other Prime systems as well as other vendor's systems within a distributed processing network. PRIMENET™ networking software allows communication of FORTRAN 77 programs over packet switched networks. Users can also interface Prime systems with a variety of terminals and communications lines with multiple protocols, for example X.25, and remote job entry options. The Prime Distributed Processing Terminal Executive (DPTX) software conforms to the protocols used by IBM 3271/3277 Display Systems.

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### *Total System/Language Integration*

As a result of Prime's software first philosophy, FORTRAN 77 is integrated into a synergistic language/operating system environment. FORTRAN 77 uses system facilities for virtual memory management, procedure sharing and protection. These facilities are the result of close interaction between the processors' ring protection, segmentation and demand paging hardware, and PRIMOS operating system software. For users it means enhanced performance and greater application flexibility.

FORTRAN 77 programs can include modules written in other languages, because the calling conventions and libraries used by other Prime software apply to FORTRAN 77. This means application packages developed in other languages are available to FORTRAN 77 programmers, minimizing program development efforts.

The PRIMOS operating system also uses the same calling mechanism to interface between user routines. This means FORTRAN 77 programs have direct access to the PRIMOS operating system and the Prime File Management System.

FORTRAN 77 also provides access to other Prime software such as MIDASPLUS™, the Multiple Index Data Access System; DBMS, Prime's CODASYL-compliant Database Management System; and FORMS, the Forms Management System.

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## FORTRAN 77 Standards And Extensions

The FORTRAN standard defines a number of significant extensions not available on FORTRAN 66:

- CHARACTER datatype
- IF-THEN-ELSE
- I/O enhancements
  - Direct Access I/O
  - List-directed I/O
  - Internal files
- FORMAT extensions
- END = and ERR = I/O specifiers
- OPEN, CLOSE and INQUIRE statements
- "Regularized" language
  - Automatic type conversions
  - Generic function selection
  - Generalized array subscripts
  - Generalized DO-loops
- Array enhancements
- Alternate returns
- PARAMETER statement
- SAVE statement
- INTRINSIC statement
- ENTRY statement
- IMPLICIT statement
- PROGRAM statement

Prime's implementation of FORTRAN 77 also includes several extensions over the X3.9-1978 ANSI standard which further enhances main-frame compatibility:

- NAMelist I/O
- Extended type specifications
  - LOGICAL\*1, LOGICAL\*2, LOGICAL\*4
  - INTEGER\*2, INTEGER\*4
  - REAL\*4, REAL\*8, REAL\*16
  - COMPLEX\*8, COMPLEX\*16
- Double-precision COMPLEX datatype
- ENCODE and DECODE statements
- Data initialization in specification statements
- IBM-style direct access
- I/O Hollerith data
- DO-loops with extended range
- Source file include capability
- Long symbolic names of up to 32 characters
- Extended character set
- Embedded comments

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