

Using GNU Fortran

For GCC version 4.2.2

The gfortran team

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Short Contents

1	Introduction	1
	Part I: Invoking GNU Fortran	5
2	GNU Fortran Command Options	7
3	Runtime: Influencing runtime behavior with environment variables	17
	Part II: Language Reference	19
4	Fortran 2003 Status	21
5	Extensions	23
6	Intrinsic Procedures	29
	Contributing	133
	GNU GENERAL PUBLIC LICENSE	137
	GNU Free Documentation License	143
	Funding Free Software	151
	Option Index	153
	Keyword Index	155

Table of Contents

1	Introduction	1
1.1	About GNU Fortran	1
1.2	GNU Fortran and GCC	2
1.3	GNU Fortran and G77	2
1.4	Project Status	2
1.5	Standards	3
	Part I: Invoking GNU Fortran	5
2	GNU Fortran Command Options	7
2.1	Option summary	7
2.2	Options controlling Fortran dialect	8
2.3	Options to request or suppress errors and warnings	9
2.4	Options for debugging your program or GNU Fortran	11
2.5	Options for directory search	11
2.6	Influencing runtime behavior	12
2.7	Options for code generation conventions	12
2.8	Environment variables affecting gfortran	15
3	Runtime: Influencing runtime behavior with environment variables	17
3.1	GFORTTRAN_STDIN_UNIT—Unit number for standard input	17
3.2	GFORTTRAN_STDOUT_UNIT—Unit number for standard output	17
3.3	GFORTTRAN_STDERR_UNIT—Unit number for standard error	17
3.4	GFORTTRAN_USE_STDERR—Send library output to standard error	17
3.5	GFORTTRAN_TMPDIR—Directory for scratch files	17
3.6	GFORTTRAN_UNBUFFERED_ALL—Don't buffer output	17
3.7	GFORTTRAN_SHOW_LOCUS—Show location for runtime errors	17
3.8	GFORTTRAN_OPTIONAL_PLUS—Print leading + where permitted	17
3.9	GFORTTRAN_DEFAULT_RECL—Default record length for new files	17
3.10	GFORTTRAN_LIST_SEPARATOR—Separator for list output	18
3.11	GFORTTRAN_CONVERT_UNIT—Set endianness for unformatted I/O	18
	Part II: Language Reference	19
4	Fortran 2003 Status	21
5	Extensions	23
5.1	Old-style kind specifications	23
5.2	Old-style variable initialization	23
5.3	Extensions to namelist	23
5.4	X format descriptor without count field	24
5.5	Commas in FORMAT specifications	24
5.6	Missing period in FORMAT specifications	24
5.7	I/O item lists	24

5.8	BOZ literal constants	25
5.9	Real array indices	25
5.10	Unary operators	25
5.11	Implicitly convert LOGICAL and INTEGER values	25
5.12	Hollerith constants support	25
5.13	Cray pointers	26
5.14	CONVERT specifier	27
5.15	OpenMP	28
6	Intrinsic Procedures	29
6.1	Introduction to intrinsic procedures	29
6.2	ABORT — Abort the program	29
6.3	ABS — Absolute value	30
6.4	ACCESS — Checks file access modes	30
6.5	ACHAR — Character in ASCII collating sequence	31
6.6	ACOS — Arccosine function	31
6.7	ACOSH — Hyperbolic arccosine function	32
6.8	ADJUSTL — Left adjust a string	32
6.9	ADJUSTR — Right adjust a string	33
6.10	AIMAG — Imaginary part of complex number	33
6.11	AINT — Truncate to a whole number	34
6.12	ALARM — Execute a routine after a given delay	34
6.13	ALL — All values in MASK along DIM are true	35
6.14	ALLOCATED — Status of an allocatable entity	36
6.15	AND — Bitwise logical AND	36
6.16	ANINT — Nearest whole number	37
6.17	ANY — Any value in MASK along DIM is true	37
6.18	ASIN — Arcsine function	38
6.19	ASINH — Hyperbolic arcsine function	38
6.20	ASSOCIATED — Status of a pointer or pointer/target pair	39
6.21	ATAN — Arctangent function	40
6.22	ATAN2 — Arctangent function	40
6.23	ATANH — Hyperbolic arctangent function	41
6.24	BESJ0 — Bessel function of the first kind of order 0	41
6.25	BESJ1 — Bessel function of the first kind of order 1	42
6.26	BESJN — Bessel function of the first kind	42
6.27	BESY0 — Bessel function of the second kind of order 0	43
6.28	BESY1 — Bessel function of the second kind of order 1	43
6.29	BESYN — Bessel function of the second kind	44
6.30	BIT_SIZE — Bit size inquiry function	44
6.31	BTEST — Bit test function	44
6.32	CEILING — Integer ceiling function	45
6.33	CHAR — Character conversion function	45
6.34	CHDIR — Change working directory	46
6.35	CHMOD — Change access permissions of files	46
6.36	CMPLX — Complex conversion function	47
6.37	COMMAND_ARGUMENT_COUNT — Get number of command line arguments	48
6.38	COMPLEX — Complex conversion function	48
6.39	CONJG — Complex conjugate function	49
6.40	COS — Cosine function	49
6.41	COSH — Hyperbolic cosine function	50
6.42	COUNT — Count function	50
6.43	CPU_TIME — CPU elapsed time in seconds	51
6.44	CSHIFT — Circular shift elements of an array	51

6.45	CTIME — Convert a time into a string	52
6.46	DATE_AND_TIME — Date and time subroutine	53
6.47	DBLE — Double conversion function	53
6.48	DCMPLX — Double complex conversion function	54
6.49	DFLOAT — Double conversion function	54
6.50	DIGITS — Significant digits function	55
6.51	DIM — Positive difference	55
6.52	DOT_PRODUCT — Dot product function	56
6.53	DPROD — Double product function	56
6.54	DREAL — Double real part function	57
6.55	DTIME — Execution time subroutine (or function)	57
6.56	EOSHIFT — End-off shift elements of an array	58
6.57	EPSILON — Epsilon function	59
6.58	ERF — Error function	59
6.59	ERFC — Error function	60
6.60	ETIME — Execution time subroutine (or function)	60
6.61	EXIT — Exit the program with status	61
6.62	EXP — Exponential function	61
6.63	EXPONENT — Exponent function	62
6.64	FDATE — Get the current time as a string	62
6.65	FLOAT — Convert integer to default real	63
6.66	FGET — Read a single character in stream mode from stdin	63
6.67	FGETC — Read a single character in stream mode	64
6.68	FLOOR — Integer floor function	65
6.69	FLUSH — Flush I/O unit(s)	65
6.70	FNUM — File number function	65
6.71	FPUT — Write a single character in stream mode to stdout	66
6.72	FPUTC — Write a single character in stream mode	66
6.73	FRACTION — Fractional part of the model representation	67
6.74	FREE — Frees memory	68
6.75	FSEEK — Low level file positioning subroutine	68
6.76	FSTAT — Get file status	68
6.77	FTELL — Current stream position	69
6.78	GERROR — Get last system error message	69
6.79	GETARG — Get command line arguments	70
6.80	GET_COMMAND — Get the entire command line	70
6.81	GET_COMMAND_ARGUMENT — Get command line arguments	71
6.82	GETCWD — Get current working directory	71
6.83	GETENV — Get an environmental variable	72
6.84	GET_ENVIRONMENT_VARIABLE — Get an environmental variable	72
6.85	GETGID — Group ID function	73
6.86	GETLOG — Get login name	73
6.87	GETPID — Process ID function	73
6.88	GETUID — User ID function	74
6.89	GMTIME — Convert time to GMT info	74
6.90	HOSTNM — Get system host name	75
6.91	HUGE — Largest number of a kind	75
6.92	IACHAR — Code in ASCII collating sequence	76
6.93	IAND — Bitwise logical and	76
6.94	IARGC — Get the number of command line arguments	77
6.95	IBCLR — Clear bit	77
6.96	IBITS — Bit extraction	77
6.97	IBSET — Set bit	78
6.98	ICHAR — Character-to-integer conversion function	78

6.99	IDATE	— Get current local time subroutine (day/month/year)	79
6.100	IEOR	— Bitwise logical exclusive or	79
6.101	IERRNO	— Get the last system error number	80
6.102	INDEX	— Position of a substring within a string	80
6.103	INT	— Convert to integer type	81
6.104	INT2	— Convert to 16-bit integer type	81
6.105	INT8	— Convert to 64-bit integer type	82
6.106	IOR	— Bitwise logical or	82
6.107	IRAND	— Integer pseudo-random number	82
6.108	ISATTY	— Whether a unit is a terminal device	83
6.109	ISHFT	— Shift bits	83
6.110	ISHFTC	— Shift bits circularly	84
6.111	ITIME	— Get current local time subroutine (hour/minutes/seconds)	84
6.112	KILL	— Send a signal to a process	85
6.113	KIND	— Kind of an entity	85
6.114	LBOUND	— Lower dimension bounds of an array	85
6.115	LEN	— Length of a character entity	86
6.116	LEN_TRIM	— Length of a character entity without trailing blank characters	86
6.117	LGE	— Lexical greater than or equal	87
6.118	LGT	— Lexical greater than	87
6.119	LINK	— Create a hard link	88
6.120	LLE	— Lexical less than or equal	88
6.121	LLT	— Lexical less than	89
6.122	LNBLNK	— Index of the last non-blank character in a string	89
6.123	LOC	— Returns the address of a variable	89
6.124	LOG	— Logarithm function	90
6.125	LOG10	— Base 10 logarithm function	90
6.126	LOGICAL	— Convert to logical type	91
6.127	LONG	— Convert to integer type	91
6.128	LSHIFT	— Left shift bits	92
6.129	LSTAT	— Get file status	92
6.130	LTIME	— Convert time to local time info	92
6.131	MALLOC	— Allocate dynamic memory	93
6.132	MATMUL	— matrix multiplication	94
6.133	MAX	— Maximum value of an argument list	94
6.134	MAXEXPONENT	— Maximum exponent of a real kind	95
6.135	MAXLOC	— Location of the maximum value within an array	95
6.136	MAXVAL	— Maximum value of an array	96
6.137	MCLOCK	— Time function	96
6.138	MCLOCK8	— Time function (64-bit)	97
6.139	MERGE	— Merge variables	97
6.140	MIN	— Minimum value of an argument list	98
6.141	MINEXPONENT	— Minimum exponent of a real kind	98
6.142	MINLOC	— Location of the minimum value within an array	98
6.143	MINVAL	— Minimum value of an array	99
6.144	MOD	— Remainder function	100
6.145	MODULO	— Modulo function	100
6.146	MOVE_ALLOC	— Move allocation from one object to another	101
6.147	MVBITS	— Move bits from one integer to another	102
6.148	NEAREST	— Nearest representable number	102
6.149	NEW_LINE	— New line character	103
6.150	NINT	— Nearest whole number	103
6.151	NOT	— Logical negation	104
6.152	NULL	— Function that returns an disassociated pointer	104

6.153	OR — Bitwise logical OR	104
6.154	PACK — Pack an array into an array of rank one	105
6.155	PERROR — Print system error message	106
6.156	PRECISION — Decimal precision of a real kind	106
6.157	PRESENT — Determine whether an optional dummy argument is specified	106
6.158	PRODUCT — Product of array elements	107
6.159	RADIX — Base of a model number	107
6.160	RAN — Real pseudo-random number	108
6.161	RAND — Real pseudo-random number	108
6.162	RANDOM_NUMBER — Pseudo-random number	108
6.163	RANDOM_SEED — Initialize a pseudo-random number sequence	109
6.164	RANGE — Decimal exponent range of a real kind	110
6.165	REAL — Convert to real type	110
6.166	RENAME — Rename a file	111
6.167	REPEAT — Repeated string concatenation	111
6.168	RESHAPE — Function to reshape an array	112
6.169	RRSPACING — Reciprocal of the relative spacing	112
6.170	RSHIFT — Right shift bits	112
6.171	SCALE — Scale a real value	113
6.172	SCAN — Scan a string for the presence of a set of characters	113
6.173	SECNDS — Time function	114
6.174	SECOND — CPU time function	114
6.175	SELECTED_INT_KIND — Choose integer kind	115
6.176	SELECTED_REAL_KIND — Choose real kind	115
6.177	SET_EXPONENT — Set the exponent of the model	116
6.178	SHAPE — Determine the shape of an array	116
6.179	SIGN — Sign copying function	117
6.180	SIGNAL — Signal handling subroutine (or function)	117
6.181	SIN — Sine function	118
6.182	SINH — Hyperbolic sine function	119
6.183	SIZE — Determine the size of an array	119
6.184	SLEEP — Sleep for the specified number of seconds	120
6.185	SNGL — Convert double precision real to default real	120
6.186	SPACING — Smallest distance between two numbers of a given type	120
6.187	SPREAD — Add a dimension to an array	121
6.188	SQRT — Square-root function	121
6.189	SRAND — Reinitialize the random number generator	122
6.190	STAT — Get file status	122
6.191	SUM — Sum of array elements	123
6.192	SYMLNK — Create a symbolic link	124
6.193	SYSTEM — Execute a shell command	124
6.194	SYSTEM_CLOCK — Time function	125
6.195	TAN — Tangent function	125
6.196	TANH — Hyperbolic tangent function	126
6.197	TIME — Time function	126
6.198	TIME8 — Time function (64-bit)	127
6.199	TINY — Smallest positive number of a real kind	127
6.200	TRANSFER — Transfer bit patterns	127
6.201	TRANSPOSE — Transpose an array of rank two	128
6.202	TRIM — Remove trailing blank characters of a string	128
6.203	TTYNAM — Get the name of a terminal device.	129
6.204	UBOUND — Upper dimension bounds of an array	129
6.205	UMASK — Set the file creation mask	130
6.206	UNLINK — Remove a file from the file system	130

6.207	UNPACK — Unpack an array of rank one into an array	130
6.208	VERIFY — Scan a string for the absence of a set of characters	131
6.209	XOR — Bitwise logical exclusive OR	131
Contributing		133
	Contributors to GNU Fortran	133
	Projects	134
	Proposed Extensions	134
	Compiler extensions:	134
	Environment Options	134
GNU GENERAL PUBLIC LICENSE		137
	Preamble	137
	TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION	137
	Appendix: How to Apply These Terms to Your New Programs	141
GNU Free Documentation License		143
	ADDENDUM: How to use this License for your documents	149
Funding Free Software		151
Option Index		153
Keyword Index		155

1 Introduction

This manual documents the use of **gfortran**, the GNU Fortran compiler. You can find in this manual how to invoke **gfortran**, as well as its features and incompatibilities.

The GNU Fortran compiler front end was designed initially as a free replacement for, or alternative to, the unix **f95** command; **gfortran** is the command you'll use to invoke the compiler.

1.1 About GNU Fortran

The GNU Fortran compiler is still in an early state of development. It can generate code for most constructs and expressions, but much work remains to be done.

When the GNU Fortran compiler is finished, it will do everything you expect from any decent compiler:

- Read a user's program, stored in a file and containing instructions written in Fortran 77, Fortran 90, Fortran 95 or Fortran 2003. This file contains *source code*.
- Translate the user's program into instructions a computer can carry out more quickly than it takes to translate the instructions in the first place. The result after compilation of a program is *machine code*, code designed to be efficiently translated and processed by a machine such as your computer. Humans usually aren't as good writing machine code as they are at writing Fortran (or C++, Ada, or Java), because it is easy to make tiny mistakes writing machine code.
- Provide the user with information about the reasons why the compiler is unable to create a binary from the source code. Usually this will be the case if the source code is flawed. When writing Fortran, it is easy to make big mistakes. The Fortran 90 requires that the compiler can point out mistakes to the user. An incorrect usage of the language causes an *error message*.

The compiler will also attempt to diagnose cases where the user's program contains a correct usage of the language, but instructs the computer to do something questionable. This kind of diagnostics message is called a *warning message*.

- Provide optional information about the translation passes from the source code to machine code. This can help a user of the compiler to find the cause of certain bugs which may not be obvious in the source code, but may be more easily found at a lower level compiler output. It also helps developers to find bugs in the compiler itself.
- Provide information in the generated machine code that can make it easier to find bugs in the program (using a debugging tool, called a *debugger*, such as the GNU Debugger **gdb**).
- Locate and gather machine code already generated to perform actions requested by statements in the user's program. This machine code is organized into *modules* and is located and *linked* to the user program.

The GNU Fortran compiler consists of several components:

- A version of the **gcc** command (which also might be installed as the system's **cc** command) that also understands and accepts Fortran source code. The **gcc** command is the *driver* program for all the languages in the GNU Compiler Collection (GCC); With **gcc**, you can compile the source code of any language for which a front end is available in GCC.
- The **gfortran** command itself, which also might be installed as the system's **f95** command. **gfortran** is just another driver program, but specifically for the Fortran compiler only. The difference with **gcc** is that **gfortran** will automatically link the correct libraries to your program.

- A collection of run-time libraries. These libraries contain the machine code needed to support capabilities of the Fortran language that are not directly provided by the machine code generated by the `gfortran` compilation phase, such as intrinsic functions and subroutines, and routines for interaction with files and the operating system.
- The Fortran compiler itself, (`f951`). This is the GNU Fortran parser and code generator, linked to and interfaced with the GCC backend library. `f951` “translates” the source code to assembler code. You would typically not use this program directly; instead, the `gcc` or `gfortran` driver programs will call it for you.

1.2 GNU Fortran and GCC

GNU Fortran is a part of GCC, the *GNU Compiler Collection*. GCC consists of a collection of front ends for various languages, which translate the source code into a language-independent form called *GENERIC*. This is then processed by a common middle end which provides optimization, and then passed to one of a collection of back ends which generate code for different computer architectures and operating systems.

Functionally, this is implemented with a driver program (`gcc`) which provides the command-line interface for the compiler. It calls the relevant compiler front-end program (e.g., `f951` for Fortran) for each file in the source code, and then calls the assembler and linker as appropriate to produce the compiled output. In a copy of GCC which has been compiled with Fortran language support enabled, `gcc` will recognize files with `.f`, `.f90`, `.f95`, and `.f03` extensions as Fortran source code, and compile it accordingly. A `gfortran` driver program is also provided, which is identical to `gcc` except that it automatically links the Fortran runtime libraries into the compiled program.

This manual specifically documents the Fortran front end, which handles the programming language’s syntax and semantics. The aspects of GCC which relate to the optimization passes and the back-end code generation are documented in the GCC manual; see [section “Introduction” in *Using the GNU Compiler Collection \(GCC\)*](#). The two manuals together provide a complete reference for the GNU Fortran compiler.

1.3 GNU Fortran and G77

The GNU Fortran compiler is the successor to `g77`, the Fortran 77 front end included in GCC prior to version 4. It is an entirely new program that has been designed to provide Fortran 95 support and extensibility for future Fortran language standards, as well as providing backwards compatibility for Fortran 77 and nearly all of the GNU language extensions supported by `g77`.

1.4 Project Status

As soon as `gfortran` can parse all of the statements correctly, it will be in the “larva” state. When we generate code, the “puppa” state. When `gfortran` is done, we’ll see if it will be a beautiful butterfly, or just a big bug....

—Andy Vaught, April 2000

The start of the GNU Fortran 95 project was announced on the GCC homepage in March 18, 2000 (even though Andy had already been working on it for a while, of course).

The GNU Fortran compiler is able to compile nearly all standard-compliant Fortran 95, Fortran 90, and Fortran 77 programs, including a number of standard and non-standard extensions, and can be used on real-world programs. In particular, the supported extensions include OpenMP, Cray-style pointers, and several Fortran 2003 features such as enumeration, stream I/O, and some of the enhancements to allocatable array support from TR 15581. However, it is still under development and has a few remaining rough edges.

At present, the GNU Fortran compiler passes the [NIST Fortran 77 Test Suite](#), and produces acceptable results on the [LAPACK Test Suite](#). It also provides respectable performance on the [Polyhedron Fortran compiler benchmarks](#) and the [Livermore Fortran Kernels test](#). It has been used to compile a number of large real-world programs, including the [HIRLAM weather-forecasting code](#) and the [Tonto quantum chemistry package](#); see <http://gcc.gnu.org/wiki/GfortranApps> for an extended list.

Among other things, the GNU Fortran compiler is intended as a replacement for G77. At this point, nearly all programs that could be compiled with G77 can be compiled with GNU Fortran, although there are a few minor known regressions.

The primary work remaining to be done on GNU Fortran falls into three categories: bug fixing (primarily regarding the treatment of invalid code and providing useful error messages), improving the compiler optimizations and the performance of compiled code, and extending the compiler to support future standards—in particular, Fortran 2003.

1.5 Standards

The GNU Fortran compiler implements ISO/IEC 1539:1997 (Fortran 95). As such, it can also compile essentially all standard-compliant Fortran 90 and Fortran 77 programs. It also supports the ISO/IEC TR-15581 enhancements to allocatable arrays, and the [OpenMP Application Program Interface v2.5](#) specification.

In the future, the GNU Fortran compiler may also support other standard variants of and extensions to the Fortran language. These include ISO/IEC 1539-1:2004 (Fortran 2003).

Part I: Invoking GNU Fortran

2 GNU Fortran Command Options

The `gfortran` command supports all the options supported by the `gcc` command. Only options specific to GNU Fortran are documented here.

See [section “GCC Command Options” in *Using the GNU Compiler Collection \(GCC\)*](#), for information on the non-Fortran-specific aspects of the `gcc` command (and, therefore, the `gfortran` command).

All GCC and GNU Fortran options are accepted both by `gfortran` and by `gcc` (as well as any other drivers built at the same time, such as `g++`), since adding GNU Fortran to the GCC distribution enables acceptance of GNU Fortran options by all of the relevant drivers.

In some cases, options have positive and negative forms; the negative form of ‘`-ffoo`’ would be ‘`-fno-foo`’. This manual documents only one of these two forms, whichever one is not the default.

2.1 Option summary

Here is a summary of all the options specific to GNU Fortran, grouped by type. Explanations are in the following sections.

Fortran Language Options

See [Section 2.2 \[Options controlling Fortran dialect\]](#), page 8.

```
-fall-intrinsics -ffree-form -fno-fixed-form
-fdollar-ok -fimplicit-none -fmax-identifier-length
-std=std -fd-lines-as-code -fd-lines-as-comments
-ffixed-line-length-n -ffixed-line-length-none
-ffree-line-length-n -ffree-line-length-none
-fdefault-double-8 -fdefault-integer-8 -fdefault-real-8
-fcray-pointer -fopenmp -frange-check -fno-backslash
```

Error and Warning Options

See [Section 2.3 \[Options to request or suppress errors and warnings\]](#), page 9.

```
-fmax-errors=n
-fsyntax-only -pedantic -pedantic-errors
-Wall -Waliasing -Wampersand -Wcharacter-truncation -Wconversion
-Wimplicit-interface -Wline-truncation -Wnonstd-intrinsics -Wsurprising
-Wno-tabs -Wunderflow
```

Debugging Options

See [Section 2.4 \[Options for debugging your program or GNU Fortran\]](#), page 11.

```
-fdump-parse-tree -ffpe-trap=list
```

Directory Options

See [Section 2.5 \[Options for directory search\]](#), page 11.

```
-Idir -Jdir -Mdir
```

Runtime Options

See [Section 2.6 \[Options for influencing runtime behavior\]](#), page 12.

```
-fconvert=conversion -frecord-marker=length
-fmax-subrecord-length=length
```

Code Generation Options

See [Section 2.7 \[Options for code generation conventions\]](#), page 12.

```
-fno-automatic -ff2c -fno-underscoring -fsecond-underscore
-fbounds-check -fmax-stack-var-size=n
-fpack-derived -fpack-arrays -fshort-enums
```

2.2 Options controlling Fortran dialect

The following options control the details of the Fortran dialect accepted by the compiler:

-ffree-form

-ffixed-form

Specify the layout used by the source file. The free form layout was introduced in Fortran 90. Fixed form was traditionally used in older Fortran programs. When neither option is specified, the source form is determined by the file extension.

-fall-intrinsics

Accept all of the intrinsic procedures provided in libgfortran without regard to the setting of `'-std'`. In particular, this option can be quite useful with `'-std=f95'`. Additionally, gfortran will ignore `'-Wnonstd-intrinsics'`.

-fd-lines-as-code

-fd-lines-as-comments

Enable special treatment for lines beginning with `d` or `D` in fixed form sources. If the `'-fd-lines-as-code'` option is given they are treated as if the first column contained a blank. If the `'-fd-lines-as-comments'` option is given, they are treated as comment lines.

-fdefault-double-8

Set the DOUBLE PRECISION type to an 8 byte wide type.

-fdefault-integer-8

Set the default integer and logical types to an 8 byte wide type. Do nothing if this is already the default.

-fdefault-real-8

Set the default real type to an 8 byte wide type. Do nothing if this is already the default.

-fdollar-ok

Allow `'$'` as a valid character in a symbol name.

-fno-backslash

Change the interpretation of backslashes in string literals from “C-style” escape characters to a single backslash character.

-ffixed-line-length-n

Set column after which characters are ignored in typical fixed-form lines in the source file, and through which spaces are assumed (as if padded to that length) after the ends of short fixed-form lines.

Popular values for `n` include 72 (the standard and the default), 80 (card image), and 132 (corresponding to “extended-source” options in some popular compilers). `n` may also be `'none'`, meaning that the entire line is meaningful and that continued character constants never have implicit spaces appended to them to fill out the line. `'-ffixed-line-length-0'` means the same thing as `'-ffixed-line-length-none'`.

-ffree-line-length-n

Set column after which characters are ignored in typical free-form lines in the source file. The default value is 132. `n` may be `'none'`, meaning that the entire line is meaningful. `'-ffree-line-length-0'` means the same thing as `'-ffree-line-length-none'`.

-fmax-identifier-length=n

Specify the maximum allowed identifier length. Typical values are 31 (Fortran 95) and 63 (Fortran 2003).

-fimplicit-none

Specify that no implicit typing is allowed, unless overridden by explicit `IMPLICIT` statements. This is the equivalent of adding `implicit none` to the start of every procedure.

-fcray-pointer

Enable the Cray pointer extension, which provides C-like pointer functionality.

-fopenmp Enable the OpenMP extensions. This includes OpenMP `!$omp` directives in free form and `c$omp`, `*$omp` and `!$omp` directives in fixed form, `!$` conditional compilation sentinels in free form and `c$`, `*$` and `!$` sentinels in fixed form, and when linking arranges for the OpenMP runtime library to be linked in.

-frange-check

Enable range checking on results of simplification of constant expressions during compilation. For example, by default, GNU Fortran will give an overflow error at compile time when simplifying `a = EXP(1000)`. With `'-fno-range-check'`, no error will be given and the variable `a` will be assigned the value `+Infinity`. Similarly, `DATA i/Z'FFFFFFFF'/` will result in an integer overflow on most systems, but with `'-fno-range-check'` the value will “wrap around” and `i` will be initialized to `-1` instead.

-std=std Specify the standard to which the program is expected to conform, which may be one of `'f95'`, `'f2003'`, `'gnu'`, or `'legacy'`. The default value for `std` is `'gnu'`, which specifies a superset of the Fortran 95 standard that includes all of the extensions supported by GNU Fortran, although warnings will be given for obsolete extensions not recommended for use in new code. The `'legacy'` value is equivalent but without the warnings for obsolete extensions, and may be useful for old non-standard programs. The `'f95'` and `'f2003'` values specify strict conformance to the Fortran 95 and Fortran 2003 standards, respectively; errors are given for all extensions beyond the relevant language standard, and warnings are given for the Fortran 77 features that are permitted but obsolescent in later standards.

2.3 Options to request or suppress errors and warnings

Errors are diagnostic messages that report that the GNU Fortran compiler cannot compile the relevant piece of source code. The compiler will continue to process the program in an attempt to report further errors to aid in debugging, but will not produce any compiled output.

Warnings are diagnostic messages that report constructions which are not inherently erroneous but which are risky or suggest there is likely to be a bug in the program. Unless `'-Werror'` is specified, they do not prevent compilation of the program.

You can request many specific warnings with options beginning `'-W'`, for example `'-Wimplicit'` to request warnings on implicit declarations. Each of these specific warning options also has a negative form beginning `'-Wno-'` to turn off warnings; for example, `'-Wno-implicit'`. This manual lists only one of the two forms, whichever is not the default.

These options control the amount and kinds of errors and warnings produced by GNU Fortran:

-fmax-errors=n

Limits the maximum number of error messages to `n`, at which point GNU Fortran bails out rather than attempting to continue processing the source code. If `n` is 0, there is no limit on the number of error messages produced.

-fsyntax-only

Check the code for syntax errors, but don't do anything beyond that.

-pedantic

Issue warnings for uses of extensions to Fortran 95. ‘-pedantic’ also applies to C-language constructs where they occur in GNU Fortran source files, such as use of ‘\e’ in a character constant within a directive like `#include`.

Valid Fortran 95 programs should compile properly with or without this option. However, without this option, certain GNU extensions and traditional Fortran features are supported as well. With this option, many of them are rejected.

Some users try to use ‘-pedantic’ to check programs for conformance. They soon find that it does not do quite what they want—it finds some nonstandard practices, but not all. However, improvements to GNU Fortran in this area are welcome.

This should be used in conjunction with ‘-std=f95’ or ‘-std=f2003’.

-pedantic-errors

Like ‘-pedantic’, except that errors are produced rather than warnings.

-Wall Enables commonly used warning options pertaining to usage that we recommend avoiding and that we believe are easy to avoid. This currently includes ‘-Waliasing’, ‘-Wampersand’, ‘-Wsurprising’, ‘-Wnonstd-intrinsics’, ‘-Wno-tabs’, and ‘-Wline-truncation’.

-Waliasing

Warn about possible aliasing of dummy arguments. Specifically, it warns if the same actual argument is associated with a dummy argument with `INTENT(IN)` and a dummy argument with `INTENT(OUT)` in a call with an explicit interface.

The following example will trigger the warning.

```
interface
  subroutine bar(a,b)
    integer, intent(in) :: a
    integer, intent(out) :: b
  end subroutine
end interface
integer :: a

call bar(a,a)
```

-Wampersand

Warn about missing ampersand in continued character constants. The warning is given with ‘-Wampersand’, ‘-pedantic’, ‘-std=f95’, and ‘-std=f2003’. Note: With no ampersand given in a continued character constant, GNU Fortran assumes continuation at the first non-comment, non-whitespace character after the ampersand that initiated the continuation.

-Wcharacter-truncation

Warn when a character assignment will truncate the assigned string.

-Wconversion

Warn about implicit conversions between different types.

-Wimplicit-interface

Warn if a procedure is called without an explicit interface. Note this only checks that an explicit interface is present. It does not check that the declared interfaces are consistent across program units.

-Wnonstd-intrinsics

Warn if the user tries to use an intrinsic that does not belong to the standard the user has chosen via the ‘-std’ option.

-Wsurprising

Produce a warning when “suspicious” code constructs are encountered. While technically legal these usually indicate that an error has been made.

This currently produces a warning under the following circumstances:

- An INTEGER SELECT construct has a CASE that can never be matched as its lower value is greater than its upper value.
- A LOGICAL SELECT construct has three CASE statements.

-Wtabs

By default, tabs are accepted as whitespace, but tabs are not members of the Fortran Character Set. ‘-Wno-tabs’ will cause a warning to be issued if a tab is encountered. Note, ‘-Wno-tabs’ is active for ‘-pedantic’, ‘-std=f95’, ‘-std=f2003’, and ‘-Wall’.

-Wunderflow

Produce a warning when numerical constant expressions are encountered, which yield an UNDERFLOW during compilation.

-Werror Turns all warnings into errors.

See [section “Options to Request or Suppress Errors and Warnings”](#) in *Using the GNU Compiler Collection (GCC)*, for information on more options offered by the GBE shared by **gfortran**, **gcc** and other GNU compilers.

Some of these have no effect when compiling programs written in Fortran.

2.4 Options for debugging your program or GNU Fortran

GNU Fortran has various special options that are used for debugging either your program or the GNU Fortran compiler.

-fdump-parse-tree

Output the internal parse tree before starting code generation. Only really useful for debugging the GNU Fortran compiler itself.

-ffpe-trap=list

Specify a list of IEEE exceptions when a Floating Point Exception (FPE) should be raised. On most systems, this will result in a SIGFPE signal being sent and the program being interrupted, producing a core file useful for debugging. *list* is a (possibly empty) comma-separated list of the following IEEE exceptions: ‘invalid’ (invalid floating point operation, such as `SQRT(-1.0)`), ‘zero’ (division by zero), ‘overflow’ (overflow in a floating point operation), ‘underflow’ (underflow in a floating point operation), ‘precision’ (loss of precision during operation) and ‘denormal’ (operation produced a denormal value).

See [section “Options for Debugging Your Program or GCC”](#) in *Using the GNU Compiler Collection (GCC)*, for more information on debugging options.

2.5 Options for directory search

These options affect how GNU Fortran searches for files specified by the INCLUDE directive and where it searches for previously compiled modules.

It also affects the search paths used by **cpp** when used to preprocess Fortran source.

-Idir

These affect interpretation of the INCLUDE directive (as well as of the `#include` directive of the **cpp** preprocessor).

Also note that the general behavior of ‘-I’ and INCLUDE is pretty much the same as of ‘-I’ with `#include` in the **cpp** preprocessor, with regard to looking for ‘`header.gcc`’ files and other such things.

This path is also used to search for ‘.mod’ files when previously compiled modules are required by a `USE` statement.

See section “Options for Directory Search” in *Using the GNU Compiler Collection (GCC)*, for information on the ‘-I’ option.

-Mdir

-Jdir This option specifies where to put ‘.mod’ files for compiled modules. It is also added to the list of directories to searched by an `USE` statement.

The default is the current directory.

‘-J’ is an alias for ‘-M’ to avoid conflicts with existing GCC options.

2.6 Influencing runtime behavior

These options affect the runtime behavior of programs compiled with GNU Fortran.

-fconvert=conversion

Specify the representation of data for unformatted files. Valid values for *conversion* are: ‘native’, the default; ‘swap’, swap between big- and little-endian; ‘big-endian’, use big-endian representation for unformatted files; ‘little-endian’, use little-endian representation for unformatted files.

This option has an effect only when used in the main program. The `CONVERT` specifier and the `GFORTRAN_CONVERT_UNIT` environment variable override the default specified by ‘-fconvert’.

-frecord-marker=length

Specify the length of record markers for unformatted files. Valid values for *length* are 4 and 8. Default is 4. *This is different from previous versions of gfortran*, which specified a default record marker length of 8 on most systems. If you want to read or write files compatible with earlier versions of `gfortran`, use ‘-frecord-marker=8’.

-fmax-subrecord-length=length

Specify the maximum length for a subrecord. The maximum permitted value for *length* is 2147483639, which is also the default. Only really useful for use by the `gfortran` testsuite.

2.7 Options for code generation conventions

These machine-independent options control the interface conventions used in code generation.

Most of them have both positive and negative forms; the negative form of ‘-ffoo’ would be ‘-fno-foo’. In the table below, only one of the forms is listed—the one which is not the default. You can figure out the other form by either removing ‘no-’ or adding it.

-fno-automatic

Treat each program unit as if the `SAVE` statement was specified for every local variable and array referenced in it. Does not affect common blocks. (Some Fortran compilers provide this option under the name ‘-static’.)

-ff2c Generate code designed to be compatible with code generated by `g77` and `f2c`.

The calling conventions used by `g77` (originally implemented in `f2c`) require functions that return type default `REAL` to actually return the C type `double`, and functions that return type `COMPLEX` to return the values via an extra argument in the calling sequence that points to where to store the return value. Under the default GNU calling conventions, such functions simply return their results as they would in GNU C—default `REAL` functions return the C type `float`, and `COMPLEX`

functions return the GNU C type `complex`. Additionally, this option implies the `'-fsecond-underscore'` option, unless `'-fno-second-underscore'` is explicitly requested.

This does not affect the generation of code that interfaces with the `libgfortran` library.

Caution: It is not a good idea to mix Fortran code compiled with `'-ff2c'` with code compiled with the default `'-fno-f2c'` calling conventions as, calling `COMPLEX` or default `REAL` functions between program parts which were compiled with different calling conventions will break at execution time.

Caution: This will break code which passes intrinsic functions of type default `REAL` or `COMPLEX` as actual arguments, as the library implementations use the `'-fno-f2c'` calling conventions.

`-fno-underscoring`

Do not transform names of entities specified in the Fortran source file by appending underscores to them.

With `'-funderscoring'` in effect, GNU Fortran appends one underscore to external names with no underscores. This is done to ensure compatibility with code produced by many UNIX Fortran compilers.

Caution: The default behavior of GNU Fortran is incompatible with `f2c` and `g77`, please use the `'-ff2c'` option if you want object files compiled with GNU Fortran to be compatible with object code created with these tools.

Use of `'-fno-underscoring'` is not recommended unless you are experimenting with issues such as integration of GNU Fortran into existing system environments (vis-a-vis existing libraries, tools, and so on).

For example, with `'-funderscoring'`, and assuming other defaults like `'-fcase-lower'` and that `j()` and `max_count()` are external functions while `my_var` and `lvar` are local variables, a statement like

```
I = J() + MAX_COUNT (MY_VAR, LVAR)
```

is implemented as something akin to:

```
i = j_() + max_count__(&my_var__, &lvar);
```

With `'-fno-underscoring'`, the same statement is implemented as:

```
i = j() + max_count(&my_var, &lvar);
```

Use of `'-fno-underscoring'` allows direct specification of user-defined names while debugging and when interfacing GNU Fortran code with other languages.

Note that just because the names match does *not* mean that the interface implemented by GNU Fortran for an external name matches the interface implemented by some other language for that same name. That is, getting code produced by GNU Fortran to link to code produced by some other compiler using this or any other method can be only a small part of the overall solution—getting the code generated by both compilers to agree on issues other than naming can require significant effort, and, unlike naming disagreements, linkers normally cannot detect disagreements in these other areas.

Also, note that with `'-fno-underscoring'`, the lack of appended underscores introduces the very real possibility that a user-defined external name will conflict with a name in a system library, which could make finding unresolved-reference bugs quite difficult in some cases—they might occur at program run time, and show up only as buggy behavior at run time.

In future versions of GNU Fortran we hope to improve naming and linking issues so that debugging always involves using the names as they appear in the source, even

if the names as seen by the linker are mangled to prevent accidental linking between procedures with incompatible interfaces.

-fsecond-underscore

By default, GNU Fortran appends an underscore to external names. If this option is used GNU Fortran appends two underscores to names with underscores and one underscore to external names with no underscores. GNU Fortran also appends two underscores to internal names with underscores to avoid naming collisions with external names.

This option has no effect if ‘**-fno-underscoring**’ is in effect. It is implied by the ‘**-ff2c**’ option.

Otherwise, with this option, an external name such as `MAX_COUNT` is implemented as a reference to the link-time external symbol `max_count__`, instead of `max_count_`. This is required for compatibility with `g77` and `f2c`, and is implied by use of the ‘**-ff2c**’ option.

-fbounds-check

Enable generation of run-time checks for array subscripts and against the declared minimum and maximum values. It also checks array indices for assumed and deferred shape arrays against the actual allocated bounds.

In the future this may also include other forms of checking, e.g., checking substring references.

-fmax-stack-var-size=n

This option specifies the size in bytes of the largest array that will be put on the stack.

This option currently only affects local arrays declared with constant bounds, and may not apply to all character variables. Future versions of GNU Fortran may improve this behavior.

The default value for *n* is 32768.

-fpack-derived

This option tells GNU Fortran to pack derived type members as closely as possible. Code compiled with this option is likely to be incompatible with code compiled without this option, and may execute slower.

-frepack-arrays

In some circumstances GNU Fortran may pass assumed shape array sections via a descriptor describing a noncontiguous area of memory. This option adds code to the function prologue to repack the data into a contiguous block at runtime.

This should result in faster accesses to the array. However it can introduce significant overhead to the function call, especially when the passed data is noncontiguous.

-fshort-enums

This option is provided for interoperability with C code that was compiled with the ‘**-fshort-enums**’ option. It will make GNU Fortran choose the smallest `INTEGER` kind a given enumerator set will fit in, and give all its enumerators this kind.

See [section “Options for Code Generation Conventions”](#) in *Using the GNU Compiler Collection (GCC)*, for information on more options offered by the GBE shared by `gfortran`, `gcc`, and other GNU compilers.

2.8 Environment variables affecting gfortran

The `gfortran` compiler currently does not make use of any environment variables to control its operation above and beyond those that affect the operation of `gcc`.

See [section “Environment Variables Affecting GCC”](#) in *Using the GNU Compiler Collection (GCC)*, for information on environment variables.

See [Chapter 3 \[Runtime\]](#), page 17, for environment variables that affect the run-time behavior of programs compiled with GNU Fortran.

3 Runtime: Influencing runtime behavior with environment variables

The behavior of the `gfortran` can be influenced by environment variables.

Malformed environment variables are silently ignored.

3.1 `GFORTRAN_STDIN_UNIT`—Unit number for standard input

This environment variable can be used to select the unit number preconnected to standard input. This must be a positive integer. The default value is 5.

3.2 `GFORTRAN_STDOUT_UNIT`—Unit number for standard output

This environment variable can be used to select the unit number preconnected to standard output. This must be a positive integer. The default value is 6.

3.3 `GFORTRAN_STDERR_UNIT`—Unit number for standard error

This environment variable can be used to select the unit number preconnected to standard error. This must be a positive integer. The default value is 0.

3.4 `GFORTRAN_USE_STDERR`—Send library output to standard error

This environment variable controls where library output is sent. If the first letter is ‘y’, ‘Y’ or ‘1’, standard error is used. If the first letter is ‘n’, ‘N’ or ‘0’, standard output is used.

3.5 `GFORTRAN_TMPDIR`—Directory for scratch files

This environment variable controls where scratch files are created. If this environment variable is missing, GNU Fortran searches for the environment variable `TMP`. If this is also missing, the default is ‘/tmp’.

3.6 `GFORTRAN_UNBUFFERED_ALL`—Don’t buffer output

This environment variable controls whether all output is unbuffered. If the first letter is ‘y’, ‘Y’ or ‘1’, all output is unbuffered. This will slow down large writes. If the first letter is ‘n’, ‘N’ or ‘0’, output is buffered. This is the default.

3.7 `GFORTRAN_SHOW_LOCUS`—Show location for runtime errors

If the first letter is ‘y’, ‘Y’ or ‘1’, filename and line numbers for runtime errors are printed. If the first letter is ‘n’, ‘N’ or ‘0’, don’t print filename and line numbers for runtime errors. The default is to print the location.

3.8 `GFORTRAN_OPTIONAL_PLUS`—Print leading + where permitted

If the first letter is ‘y’, ‘Y’ or ‘1’, a plus sign is printed where permitted by the Fortran standard. If the first letter is ‘n’, ‘N’ or ‘0’, a plus sign is not printed in most cases. Default is not to print plus signs.

3.9 `GFORTRAN_DEFAULT_RECL`—Default record length for new files

This environment variable specifies the default record length, in bytes, for files which are opened without a `RECL` tag in the `OPEN` statement. This must be a positive integer. The default value is 1073741824 bytes (1 GB).

3.10 GFORTRAN_LIST_SEPARATOR—Separator for list output

This environment variable specifies the separator when writing list-directed output. It may contain any number of spaces and at most one comma. If you specify this on the command line, be sure to quote spaces, as in

```
$ GFORTRAN_LIST_SEPARATOR=' , ' ./a.out
```

when `a.out` is the compiled Fortran program that you want to run. Default is a single space.

3.11 GFORTRAN_CONVERT_UNIT—Set endianness for unformatted I/O

By setting the `GFORTRAN_CONVERT_UNIT` variable, it is possible to change the representation of data for unformatted files. The syntax for the `GFORTRAN_CONVERT_UNIT` variable is:

```
GFORTRAN_CONVERT_UNIT: mode | mode ';' exception | exception ;
mode: 'native' | 'swap' | 'big_endian' | 'little_endian' ;
exception: mode ':' unit_list | unit_list ;
unit_list: unit_spec | unit_list unit_spec ;
unit_spec: INTEGER | INTEGER '-' INTEGER ;
```

The variable consists of an optional default mode, followed by a list of optional exceptions, which are separated by semicolons from the preceding default and each other. Each exception consists of a format and a comma-separated list of units. Valid values for the modes are the same as for the `CONVERT` specifier:

NATIVE Use the native format. This is the default.

SWAP Swap between little- and big-endian.

LITTLE_ENDIAN Use the little-endian format for unformatted files.

BIG_ENDIAN Use the big-endian format for unformatted files.

A missing mode for an exception is taken to mean **BIG_ENDIAN**. Examples of values for `GFORTRAN_CONVERT_UNIT` are:

`'big_endian'` Do all unformatted I/O in big-endian mode.

`'little_endian;native:10-20,25'` Do all unformatted I/O in little-endian mode, except for units 10 to 20 and 25, which are in native format.

`'10-20'` Units 10 to 20 are big-endian, the rest is native.

Setting the environment variables should be done on the command line or via the `export` command for `sh`-compatible shells and via `setenv` for `csh`-compatible shells.

Example for `sh`:

```
$ gfortran foo.f90
$ GFORTRAN_CONVERT_UNIT='big_endian;native:10-20' ./a.out
```

Example code for `csh`:

```
% gfortran foo.f90
% setenv GFORTRAN_CONVERT_UNIT 'big_endian;native:10-20'
% ./a.out
```

Using anything but the native representation for unformatted data carries a significant speed overhead. If speed in this area matters to you, it is best if you use this only for data that needs to be portable.

See [Section 5.14 \[CONVERT specifier\]](#), page 27, for an alternative way to specify the data representation for unformatted files. See [Section 2.6 \[Runtime Options\]](#), page 12, for setting a default data representation for the whole program. The `CONVERT` specifier overrides the `'-fconvert'` compile options.

Note that the values specified via the `GFORTRAN_CONVERT_UNIT` environment variable will override the `CONVERT` specifier in the open statement. This is to give control over data formats to users who do not have the source code of their program available.

Part II: Language Reference

4 Fortran 2003 Status

Although GNU Fortran focuses on implementing the Fortran 95 standard for the time being, a few Fortran 2003 features are currently available.

- Intrinsic `command_argument_count`, `get_command`, `get_command_argument`, `get_environment_variable`, and `move_alloc`.
- Array constructors using square brackets. That is, `[...]` rather than `(/.../)`.
- `FLUSH` statement.
- `IOMSG=` specifier for I/O statements.
- Support for the declaration of enumeration constants via the `ENUM` and `ENUMERATOR` statements. Interoperability with `gcc` is guaranteed also for the case where the `-fshort-enums` command line option is given.
- TR 15581:
 - `ALLOCATABLE` dummy arguments.
 - `ALLOCATABLE` function results
 - `ALLOCATABLE` components of derived types
- The `OPEN` statement supports the `ACCESS='STREAM'` specifier, allowing I/O without any record structure.

5 Extensions

GNU Fortran implements a number of extensions over standard Fortran. This chapter contains information on their syntax and meaning. There are currently two categories of GNU Fortran extensions, those that provide functionality beyond that provided by any standard, and those that are supported by GNU Fortran purely for backward compatibility with legacy compilers. By default, `-std=gnu` allows the compiler to accept both types of extensions, but to warn about the use of the latter. Specifying either `-std=f95` or `-std=f2003` disables both types of extensions, and `-std=legacy` allows both without warning.

5.1 Old-style kind specifications

GNU Fortran allows old-style kind specifications in declarations. These look like:

```
TYPESPEC*size x,y,z
```

where `TYPESPEC` is a basic type (`INTEGER`, `REAL`, etc.), and where `size` is a byte count corresponding to the storage size of a valid kind for that type. (For `COMPLEX` variables, `size` is the total size of the real and imaginary parts.) The statement then declares `x`, `y` and `z` to be of type `TYPESPEC` with the appropriate kind. This is equivalent to the standard-conforming declaration

```
TYPESPEC(k) x,y,z
```

where `k` is equal to `size` for most types, but is equal to `size/2` for the `COMPLEX` type.

5.2 Old-style variable initialization

GNU Fortran allows old-style initialization of variables of the form:

```
INTEGER i/1/,j/2/
REAL x(2,2) /3*0.,1./
```

The syntax for the initializers is as for the `DATA` statement, but unlike in a `DATA` statement, an initializer only applies to the variable immediately preceding the initialization. In other words, something like `INTEGER I,J/2,3/` is not valid. This style of initialization is only allowed in declarations without double colons (`::`); the double colons were introduced in Fortran 90, which also introduced a standard syntax for initializing variables in type declarations.

Examples of standard-conforming code equivalent to the above example are:

```
! Fortran 90
  INTEGER :: i = 1, j = 2
  REAL :: x(2,2) = RESHAPE((/0.,0.,0.,1./),SHAPE(x))
! Fortran 77
  INTEGER i, j
  REAL x(2,2)
  DATA i/1/, j/2/, x/3*0.,1./
```

Note that variables which are explicitly initialized in declarations or in `DATA` statements automatically acquire the `SAVE` attribute.

5.3 Extensions to namelist

GNU Fortran fully supports the Fortran 95 standard for namelist I/O including array qualifiers, substrings and fully qualified derived types. The output from a namelist write is compatible with namelist read. The output has all names in upper case and indentation to column 1 after the namelist name. Two extensions are permitted:

Old-style use of `'$'` instead of `'&'`

```
$MYNML
  X(:)%Y(2) = 1.0 2.0 3.0
  CH(1:4) = "abcd"
$END
```

It should be noted that the default terminator is `'/'` rather than `'&END'`.

Querying of the namelist when inputting from stdin. After at least one space, entering `'?'` sends to stdout the namelist name and the names of the variables in the namelist:

```

?

&mynml
  x
  x%y
  ch
&end

```

Entering ‘=?’ outputs the namelist to stdout, as if `WRITE(*,NML = mynml)` had been called:

```

&MYNML
  X(1)%Y=  0.000000      ,  1.000000      ,  0.000000      ,
  X(2)%Y=  0.000000      ,  2.000000      ,  0.000000      ,
  X(3)%Y=  0.000000      ,  3.000000      ,  0.000000      ,
  CH=abcd,  /

```

To aid this dialog, when input is from stdin, errors send their messages to stderr and execution continues, even if `IOSTAT` is set.

`PRINT` namelist is permitted. This causes an error if ‘`-std=f95`’ is used.

```

PROGRAM test_print
  REAL, dimension (4)  :: x = (/1.0, 2.0, 3.0, 4.0/)
  NAMELIST /mynml/ x
  PRINT mynml
END PROGRAM test_print

```

Expanded namelist reads are permitted. This causes an error if ‘`-std=f95`’ is used. In the following example, the first element of the array will be given the value 0.00 and the two succeeding elements will be given the values 1.00 and 2.00.

```

&MYNML
  X(1,1) = 0.00 , 1.00 , 2.00
/

```

5.4 X format descriptor without count field

To support legacy codes, GNU Fortran permits the count field of the `X` edit descriptor in `FORMAT` statements to be omitted. When omitted, the count is implicitly assumed to be one.

```

      PRINT 10, 2, 3
10     FORMAT (I1, X, I1)

```

5.5 Commas in FORMAT specifications

To support legacy codes, GNU Fortran allows the comma separator to be omitted immediately before and after character string edit descriptors in `FORMAT` statements.

```

      PRINT 10, 2, 3
10     FORMAT ('F00='I1' BAR='I2)

```

5.6 Missing period in FORMAT specifications

To support legacy codes, GNU Fortran allows missing periods in format specifications if and only if ‘`-std=legacy`’ is given on the command line. This is considered non-conforming code and is discouraged.

```

      REAL :: value
      READ(*,10) value
10     FORMAT ('F4')

```

5.7 I/O item lists

To support legacy codes, GNU Fortran allows the input item list of the `READ` statement, and the output item lists of the `WRITE` and `PRINT` statements, to start with a comma.

5.8 BOZ literal constants

As an extension, GNU Fortran allows hexadecimal BOZ literal constants to be specified using the X prefix, in addition to the standard Z prefix. BOZ literal constants can also be specified by adding a suffix to the string. For example, Z'ABC' and 'ABC'Z are equivalent.

The Fortran standard restricts the appearance of a BOZ literal constant to the DATA statement, and it is expected to be assigned to an INTEGER variable. GNU Fortran permits a BOZ literal to appear in any initialization expression as well as assignment statements.

Attempts to use a BOZ literal constant to do a bitwise initialization of a variable can lead to confusion. A BOZ literal constant is converted to an INTEGER value with the kind type with the largest decimal representation, and this value is then converted numerically to the type and kind of the variable in question. Thus, one should not expect a bitwise copy of the BOZ literal constant to be assigned to a REAL variable.

Similarly, initializing an INTEGER variable with a statement such as DATA i/Z'FFFFFFFF'/ will produce an integer overflow rather than the desired result of -1 when i is a 32-bit integer on a system that supports 64-bit integers. The '-fno-range-check' option can be used as a workaround for legacy code that initializes integers in this manner.

5.9 Real array indices

As an extension, GNU Fortran allows the use of REAL expressions or variables as array indices.

5.10 Unary operators

As an extension, GNU Fortran allows unary plus and unary minus operators to appear as the second operand of binary arithmetic operators without the need for parenthesis.

```
X = Y * -Z
```

5.11 Implicitly convert LOGICAL and INTEGER values

As an extension for backwards compatibility with other compilers, GNU Fortran allows the implicit conversion of LOGICAL values to INTEGER values and vice versa. When converting from a LOGICAL to an INTEGER, .FALSE. is interpreted as zero, and .TRUE. is interpreted as one. When converting from INTEGER to LOGICAL, the value zero is interpreted as .FALSE. and any nonzero value is interpreted as .TRUE..

```
INTEGER :: i = 1
IF (i) PRINT *, 'True'
```

5.12 Hollerith constants support

GNU Fortran supports Hollerith constants in assignments, function arguments, and DATA and ASSIGN statements. A Hollerith constant is written as a string of characters preceded by an integer constant indicating the character count, and the letter H or h, and stored in bytewise fashion in a numeric (INTEGER, REAL, or complex) or LOGICAL variable. The constant will be padded or truncated to fit the size of the variable in which it is stored.

Examples of valid uses of Hollerith constants:

```
complex*16 x(2)
data x /16Habcdefghijklmnop, 16Hqrstuvwxyz012345/
x(1) = 16HABCDEFGHJKLMNOP
call foo (4h abc)
```

Invalid Hollerith constants examples:

```
integer*4 a
a = 8H12345678 ! Valid, but the Hollerith constant will be truncated.
a = 0H          ! At least one character is needed.
```

In general, Hollerith constants were used to provide a rudimentary facility for handling character strings in early Fortran compilers, prior to the introduction of `CHARACTER` variables in Fortran 77; in those cases, the standard-compliant equivalent is to convert the program to use proper character strings. On occasion, there may be a case where the intent is specifically to initialize a numeric variable with a given byte sequence. In these cases, the same result can be obtained by using the `TRANSFER` statement, as in this example.

```
INTEGER(KIND=4) :: a
a = TRANSFER ("abcd", a)      ! equivalent to: a = 4Habcd
```

5.13 Cray pointers

Cray pointers are part of a non-standard extension that provides a C-like pointer in Fortran. This is accomplished through a pair of variables: an integer "pointer" that holds a memory address, and a "pointee" that is used to dereference the pointer.

Pointer/pointee pairs are declared in statements of the form:

```
pointer ( <pointer> , <pointee> )
```

or,

```
pointer ( <pointer1> , <pointee1> ), ( <pointer2> , <pointee2> ), ...
```

The pointer is an integer that is intended to hold a memory address. The pointee may be an array or scalar. A pointee can be an assumed size array—that is, the last dimension may be left unspecified by using a `*` in place of a value—but a pointee cannot be an assumed shape array. No space is allocated for the pointee.

The pointee may have its type declared before or after the pointer statement, and its array specification (if any) may be declared before, during, or after the pointer statement. The pointer may be declared as an integer prior to the pointer statement. However, some machines have default integer sizes that are different than the size of a pointer, and so the following code is not portable:

```
integer ipt
pointer (ipt, iarr)
```

If a pointer is declared with a kind that is too small, the compiler will issue a warning; the resulting binary will probably not work correctly, because the memory addresses stored in the pointers may be truncated. It is safer to omit the first line of the above example; if explicit declaration of `ipt`'s type is omitted, then the compiler will ensure that `ipt` is an integer variable large enough to hold a pointer.

Pointer arithmetic is valid with Cray pointers, but it is not the same as C pointer arithmetic. Cray pointers are just ordinary integers, so the user is responsible for determining how many bytes to add to a pointer in order to increment it. Consider the following example:

```
real target(10)
real pointee(10)
pointer (ipt, pointee)
ipt = loc (target)
ipt = ipt + 1
```

The last statement does not set `ipt` to the address of `target(1)`, as it would in C pointer arithmetic. Adding 1 to `ipt` just adds one byte to the address stored in `ipt`.

Any expression involving the pointee will be translated to use the value stored in the pointer as the base address.

To get the address of elements, this extension provides an intrinsic function `LOC()`. The `LOC()` function is equivalent to the `&` operator in C, except the address is cast to an integer type:

```
real ar(10)
pointer(ipt, arpte(10))
real arpte
ipt = loc(ar) ! Makes arpte is an alias for ar
arpte(1) = 1.0 ! Sets ar(1) to 1.0
```

The pointer can also be set by a call to the `MALLOC` intrinsic (see [Section 6.131 \[MALLOC\]](#), [page 93](#)).

Cray pointees often are used to alias an existing variable. For example:

```

integer target(10)
integer iarr(10)
pointer (ipt, iarr)
ipt = loc(target)

```

As long as `ipt` remains unchanged, `iarr` is now an alias for `target`. The optimizer, however, will not detect this aliasing, so it is unsafe to use `iarr` and `target` simultaneously. Using a pointee in any way that violates the Fortran aliasing rules or assumptions is illegal. It is the user's responsibility to avoid doing this; the compiler works under the assumption that no such aliasing occurs.

Cray pointers will work correctly when there is no aliasing (i.e., when they are used to access a dynamically allocated block of memory), and also in any routine where a pointee is used, but any variable with which it shares storage is not used. Code that violates these rules may not run as the user intends. This is not a bug in the optimizer; any code that violates the aliasing rules is illegal. (Note that this is not unique to GNU Fortran; any Fortran compiler that supports Cray pointers will “incorrectly” optimize code with illegal aliasing.)

There are a number of restrictions on the attributes that can be applied to Cray pointers and pointees. Pointees may not have the `ALLOCATABLE`, `INTENT`, `OPTIONAL`, `DUMMY`, `TARGET`, `INTRINSIC`, or `POINTER` attributes. Pointers may not have the `DIMENSION`, `POINTER`, `TARGET`, `ALLOCATABLE`, `EXTERNAL`, or `INTRINSIC` attributes. Pointees may not occur in more than one pointer statement. A pointee cannot be a pointer. Pointees cannot occur in equivalence, common, or data statements.

A Cray pointer may also point to a function or a subroutine. For example, the following excerpt is valid:

```

implicit none
external sub
pointer (subptr,subpte)
external subpte
subptr = loc(sub)
call subpte()
[...]
subroutine sub
[...]
end subroutine sub

```

A pointer may be modified during the course of a program, and this will change the location to which the pointee refers. However, when pointees are passed as arguments, they are treated as ordinary variables in the invoked function. Subsequent changes to the pointer will not change the base address of the array that was passed.

5.14 CONVERT specifier

GNU Fortran allows the conversion of unformatted data between little- and big-endian representation to facilitate moving of data between different systems. The conversion can be indicated with the `CONVERT` specifier on the `OPEN` statement. See [Section 3.11 \[GFORTRAN-CONVERT-UNIT\]](#), [page 18](#), for an alternative way of specifying the data format via an environment variable.

Valid values for `CONVERT` are:

`CONVERT='NATIVE'` Use the native format. This is the default.

`CONVERT='SWAP'` Swap between little- and big-endian.

`CONVERT='LITTLE_ENDIAN'` Use the little-endian representation for unformatted files.

`CONVERT='BIG_ENDIAN'` Use the big-endian representation for unformatted files.

Using the option could look like this:

```

open(file='big.dat',form='unformatted',access='sequential', &
      convert='big_endian')

```

The value of the conversion can be queried by using `INQUIRE(CONVERT=ch)`. The values returned are `'BIG_ENDIAN'` and `'LITTLE_ENDIAN'`.

`CONVERT` works between big- and little-endian for `INTEGER` values of all supported kinds and for `REAL` on IEEE systems of kinds 4 and 8. Conversion between different “extended double” types on different architectures such as m68k and x86_64, which GNU Fortran supports as `REAL(KIND=10)` and `REAL(KIND=16)`, will probably not work.

Note that the values specified via the `GFORTRAN_CONVERT_UNIT` environment variable will override the `CONVERT` specifier in the open statement. This is to give control over data formats to users who do not have the source code of their program available.

Using anything but the native representation for unformatted data carries a significant speed overhead. If speed in this area matters to you, it is best if you use this only for data that needs to be portable.

5.15 OpenMP

GNU Fortran attempts to be OpenMP Application Program Interface v2.5 compatible when invoked with the `-fopenmp` option. GNU Fortran then generates parallelized code according to the OpenMP directives used in the source. The OpenMP Fortran runtime library routines are provided both in a form of a Fortran 90 module named `omp_lib` and in a form of a Fortran `include` file named `'omp_lib.h'`.

For details refer to the actual [OpenMP Application Program Interface v2.5](#) specification.

6 Intrinsic Procedures

6.1 Introduction to intrinsic procedures

The intrinsic procedures provided by GNU Fortran include all of the intrinsic procedures required by the Fortran 95 standard, a set of intrinsic procedures for backwards compatibility with G77, and a small selection of intrinsic procedures from the Fortran 2003 standard. Any conflict between a description here and a description in either the Fortran 95 standard or the Fortran 2003 standard is unintentional, and the standard(s) should be considered authoritative.

The enumeration of the `KIND` type parameter is processor defined in the Fortran 95 standard. GNU Fortran defines the default integer type and default real type by `INTEGER(KIND=4)` and `REAL(KIND=4)`, respectively. The standard mandates that both data types shall have another kind, which have more precision. On typical target architectures supported by `gfortran`, this kind type parameter is `KIND=8`. Hence, `REAL(KIND=8)` and `DOUBLE PRECISION` are equivalent. In the description of generic intrinsic procedures, the kind type parameter will be specified by `KIND=*`, and in the description of specific names for an intrinsic procedure the kind type parameter will be explicitly given (e.g., `REAL(KIND=4)` or `REAL(KIND=8)`). Finally, for brevity the optional `KIND=` syntax will be omitted.

Many of the intrinsic procedures take one or more optional arguments. This document follows the convention used in the Fortran 95 standard, and denotes such arguments by square brackets.

GNU Fortran offers the `‘-std=f95’` and `‘-std=gnu’` options, which can be used to restrict the set of intrinsic procedures to a given standard. By default, `gfortran` sets the `‘-std=gnu’` option, and so all intrinsic procedures described here are accepted. There is one caveat. For a select group of intrinsic procedures, `g77` implemented both a function and a subroutine. Both classes have been implemented in `gfortran` for backwards compatibility with `g77`. It is noted here that these functions and subroutines cannot be intermixed in a given subprogram. In the descriptions that follow, the applicable standard for each intrinsic procedure is noted.

6.2 ABORT — Abort the program

Description:

`ABORT` causes immediate termination of the program. On operating systems that support a core dump, `ABORT` will produce a core dump, which is suitable for debugging purposes.

Standard: GNU extension

Class: Subroutine

Syntax: `CALL ABORT`

Return value:

Does not return.

Example:

```
program test_abort
  integer :: i = 1, j = 2
  if (i /= j) call abort
end program test_abort
```

See also: [Section 6.61 \[EXIT\]](#), page 61, [Section 6.112 \[KILL\]](#), page 85

6.3 ABS — Absolute value

Description:

ABS(X) computes the absolute value of X.

Standard: F77 and later, has overloads that are GNU extensions

Class: Elemental function

Syntax: RESULT = ABS(X)

Arguments:

X The type of the argument shall be an INTEGER(*), REAL(*), or COMPLEX(*) .

Return value:

The return value is of the same type and kind as the argument except the return value is REAL(*) for a COMPLEX(*) argument.

Example:

```
program test_abs
  integer :: i = -1
  real :: x = -1.e0
  complex :: z = (-1.e0,0.e0)
  i = abs(i)
  x = abs(x)
  z = abs(z)
end program test_abs
```

Specific names:

Name	Argument	Return type	Standard
CABS(Z)	COMPLEX(4) Z	REAL(4)	F77 and later
DABS(X)	REAL(8) X	REAL(8)	F77 and later
IABS(I)	INTEGER(4) I	INTEGER(4)	F77 and later
ZABS(Z)	COMPLEX(8) Z	COMPLEX(8)	GNU extension
CDABS(Z)	COMPLEX(8) Z	COMPLEX(8)	GNU extension

6.4 ACCESS — Checks file access modes

Description:

ACCESS(NAME, MODE) checks whether the file NAME exists, is readable, writable or executable. Except for the executable check, ACCESS can be replaced by Fortran 95's INQUIRE.

Standard: GNU extension

Class: Inquiry function

Syntax: RESULT = ACCESS(NAME, MODE)

Arguments:

NAME Scalar CHARACTER with the file name. Tailing blank are ignored unless the character achar(0) is present, then all characters up to and excluding achar(0) are used as file name.

MODE Scalar CHARACTER with the file access mode, may be any concatenation of "r" (readable), "w" (writable) and "x" (executable), or " " to check for existence.

Return value:

Returns a scalar INTEGER, which is 0 if the file is accessible in the given mode; otherwise or if an invalid argument has been given for MODE the value 1 is returned.

Example:

```

program access_test
  implicit none
  character(len=*), parameter :: file = 'test.dat'
  character(len=*), parameter :: file2 = 'test.dat' // achar(0)
  if(access(file,'r') == 0) print *, trim(file), ' is exists'
  if(access(file,'r') == 0) print *, trim(file), ' is readable'
  if(access(file,'w') == 0) print *, trim(file), ' is writable'
  if(access(file,'x') == 0) print *, trim(file), ' is executable'
  if(access(file2,'rwx') == 0) &
    print *, trim(file2), ' is readable, writable and executable'
end program access_test

```

Specific names:

See also:

6.5 ACHAR — Character in ASCII collating sequence

Description:

ACHAR(I) returns the character located at position I in the ASCII collating sequence.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = ACHAR(I)

Arguments:

I The type shall be INTEGER(*).

Return value:

The return value is of type CHARACTER with a length of one. The kind type parameter is the same as KIND('A').

Example:

```

program test_achar
  character c
  c = achar(32)
end program test_achar

```

Note: See [Section 6.98 \[ICHAR\]](#), page 78 for a discussion of converting between numerical values and formatted string representations.

See also: [Section 6.33 \[CHAR\]](#), page 45, [Section 6.92 \[IACHAR\]](#), page 76, [Section 6.98 \[ICHAR\]](#), page 78

6.6 ACOS — Arccosine function

Description:

ACOS(X) computes the arccosine of X (inverse of COS(X)).

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = ACOS(X)

Arguments:

X The type shall be REAL(*) with a magnitude that is less than one.

Return value:

The return value is of type REAL(*) and it lies in the range $0 \leq \text{acos}(x) \leq \pi$. The kind type parameter is the same as X.

Example:

```
program test_acos
  real(8) :: x = 0.866_8
  x = acos(x)
end program test_acos
```

Specific names:

Name	Argument	Return type	Standard
DACOS(X)	REAL(8) X	REAL(8)	F77 and later

See also: Inverse function: [Section 6.40 \[COS\]](#), page 49

6.7 ACOSH — Hyperbolic arccosine function

Description:

ACOSH(X) computes the hyperbolic arccosine of X (inverse of COSH(X)).

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = ACOSH(X)

Arguments:

X The type shall be REAL(*) with a magnitude that is greater or equal to one.

Return value:

The return value is of type REAL(*) and it lies in the range $0 \leq \operatorname{acosh}(x) \leq \infty$.

Example:

```
PROGRAM test_acosh
  REAL(8), DIMENSION(3) :: x = (/ 1.0, 2.0, 3.0 /)
  WRITE (*,*) ACOSH(x)
END PROGRAM
```

Specific names:

Name	Argument	Return type	Standard
DACOSH(X)	REAL(8) X	REAL(8)	GNU extension

See also: Inverse function: [Section 6.41 \[COSH\]](#), page 50

6.8 ADJUSTL — Left adjust a string

Description:

ADJUSTL(STR) will left adjust a string by removing leading spaces. Spaces are inserted at the end of the string as needed.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = ADJUSTL(STR)

Arguments:

STR The type shall be CHARACTER.

Return value:

The return value is of type CHARACTER where leading spaces are removed and the same number of spaces are inserted on the end of STR .

Example:

```

program test_adjustl
  character(len=20) :: str = '  gfortran'
  str = adjustl(str)
  print *, str
end program test_adjustl

```

See also: [Section 6.9 \[ADJUSTR\], page 33](#), [Section 6.202 \[TRIM\], page 128](#)

6.9 ADJUSTR — Right adjust a string

Description:

ADJUSTR(STR) will right adjust a string by removing trailing spaces. Spaces are inserted at the start of the string as needed.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = ADJUSTR(STR)

Arguments:

STR The type shall be CHARACTER.

Return value:

The return value is of type CHARACTER where trailing spaces are removed and the same number of spaces are inserted at the start of STR.

Example:

```

program test_adjustr
  character(len=20) :: str = 'gfortran'
  str = adjustr(str)
  print *, str
end program test_adjustr

```

See also: [Section 6.8 \[ADJUSTL\], page 32](#), [Section 6.202 \[TRIM\], page 128](#)

6.10 AIMAG — Imaginary part of complex number

Description:

AIMAG(Z) yields the imaginary part of complex argument Z. The IMAG(Z) and IMAGPART(Z) intrinsic functions are provided for compatibility with g77, and their use in new code is strongly discouraged.

Standard: F77 and later, has overloads that are GNU extensions

Class: Elemental function

Syntax: RESULT = AIMAG(Z)

Arguments:

Z The type of the argument shall be COMPLEX(*).

Return value:

The return value is of type real with the kind type parameter of the argument.

Example:

```

program test_aimag
  complex(4) z4
  complex(8) z8
  z4 = cmplx(1.e0_4, 0.e0_4)
  z8 = cmplx(0.e0_8, 1.e0_8)
  print *, aimag(z4), dimag(z8)
end program test_aimag

```

Specific names:

Name	Argument	Return type	Standard
DIMAG(Z)	COMPLEX(8) Z	REAL(8)	GNU extension
IMAG(Z)	COMPLEX(*) Z	REAL(*)	GNU extension
IMAGPART(Z)	COMPLEX(*) Z	REAL(*)	GNU extension

6.11 AINT — Truncate to a whole number

Description:

AINT(X [, KIND]) truncates its argument to a whole number.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = AINT(X [, KIND])

Arguments:

X The type of the argument shall be REAL(*).
KIND (Optional) An INTEGER(*) initialization expression indicating the kind parameter of the result.

Return value:

The return value is of type real with the kind type parameter of the argument if the optional *KIND* is absent; otherwise, the kind type parameter will be given by *KIND*. If the magnitude of *X* is less than one, then AINT(*X*) returns zero. If the magnitude is equal to or greater than one, then it returns the largest whole number that does not exceed its magnitude. The sign is the same as the sign of *X*.

Example:

```

program test_aint
  real(4) x4
  real(8) x8
  x4 = 1.234E0_4
  x8 = 4.321_8
  print *, aint(x4), dint(x8)
  x8 = aint(x4,8)
end program test_aint

```

Specific names:

Name	Argument	Return type	Standard
DINT(X)	REAL(8) X	REAL(8)	F77 and later

6.12 ALARM — Execute a routine after a given delay

Description:

ALARM(SECONDS, HANDLER [, STATUS]) causes external subroutine *HANDLER* to be executed after a delay of *SECONDS* by using `alarm(2)` to set up a signal and `signal(2)` to catch it. If *STATUS* is supplied, it will be returned with the number of seconds remaining until any previously scheduled alarm was due to be delivered, or zero if there was no previously scheduled alarm.

Standard: GNU extension

Class: Subroutine

Syntax: CALL ALARM(SECONDS, HANDLER [, STATUS])

Arguments:

SECONDS The type of the argument shall be a scalar INTEGER. It is INTENT(IN).

HANDLER Signal handler (INTEGER FUNCTION or SUBROUTINE) or dummy/global INTEGER scalar. The scalar values may be either SIG_IGN=1 to ignore the alarm generated or SIG_DFL=0 to set the default action. It is INTENT(IN).

STATUS (Optional) *STATUS* shall be a scalar variable of the default INTEGER kind. It is INTENT(OUT).

Example:

```

program test_alarm
  external handler_print
  integer i
  call alarm (3, handler_print, i)
  print *, i
  call sleep(10)
end program test_alarm

```

This will cause the external routine *handler_print* to be called after 3 seconds.

6.13 ALL — All values in *MASK* along *DIM* are true

Description:

ALL(*MASK* [, *DIM*]) determines if all the values are true in *MASK* in the array along dimension *DIM*.

Standard: F95 and later

Class: Transformational function

Syntax: RESULT = ALL(*MASK* [, *DIM*])

Arguments:

MASK The type of the argument shall be LOGICAL(*) and it shall not be scalar.

DIM (Optional) *DIM* shall be a scalar integer with a value that lies between one and the rank of *MASK*.

Return value:

ALL(*MASK*) returns a scalar value of type LOGICAL(*) where the kind type parameter is the same as the kind type parameter of *MASK*. If *DIM* is present, then ALL(*MASK*, *DIM*) returns an array with the rank of *MASK* minus 1. The shape is determined from the shape of *MASK* where the *DIM* dimension is elided.

- (A) ALL(*MASK*) is true if all elements of *MASK* are true. It also is true if *MASK* has zero size; otherwise, it is false.
- (B) If the rank of *MASK* is one, then ALL(*MASK*,*DIM*) is equivalent to ALL(*MASK*). If the rank is greater than one, then ALL(*MASK*,*DIM*) is determined by applying ALL to the array sections.

Example:

```

program test_all
  logical l
  l = all(/.true., .true., .true./)
  print *, l
  call section
contains
  subroutine section
    integer a(2,3), b(2,3)
    a = 1
    b = 1
    b(2,2) = 2
  end subroutine section
end program test_all

```

```

        print *, all(a .eq. b, 1)
        print *, all(a .eq. b, 2)
    end subroutine section
end program test_all

```

6.14 ALLOCATED — Status of an allocatable entity

Description:

ALLOCATED(X) checks the status of whether X is allocated.

Standard: F95 and later

Class: Inquiry function

Syntax: RESULT = ALLOCATED(X)

Arguments:

X The argument shall be an ALLOCATABLE array.

Return value:

The return value is a scalar LOGICAL with the default logical kind type parameter. If X is allocated, ALLOCATED(X) is .TRUE.; otherwise, it returns the .TRUE.

Example:

```

program test_allocated
  integer :: i = 4
  real(4), allocatable :: x(:)
  if (allocated(x) .eqv. .false.) allocate(x(i))
end program test_allocated

```

6.15 AND — Bitwise logical AND

Description:

Bitwise logical AND.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. For integer arguments, programmers should consider the use of the [Section 6.93 \[IAND\]](#), page 76 intrinsic defined by the Fortran standard.

Standard: GNU extension

Class: Function

Syntax: RESULT = AND(I, J)

Arguments:

I The type shall be either INTEGER(*) or LOGICAL.

J The type shall be either INTEGER(*) or LOGICAL.

Return value:

The return type is either INTEGER(*) or LOGICAL after cross-promotion of the arguments.

Example:

```

PROGRAM test_and
  LOGICAL :: T = .TRUE., F = .FALSE.
  INTEGER :: a, b
  DATA a / Z'F' /, b / Z'3' /

  WRITE (*,*) AND(T, T), AND(T, F), AND(F, T), AND(F, F)
  WRITE (*,*) AND(a, b)
END PROGRAM

```

See also: F95 elemental function: [Section 6.93 \[IAND\]](#), page 76

6.16 ANINT — Nearest whole number

Description:

ANINT(X [, KIND]) rounds its argument to the nearest whole number.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = ANINT(X [, KIND])

Arguments:

X The type of the argument shall be REAL(*).
KIND (Optional) An INTEGER(*) initialization expression indicating the kind parameter of the result.

Return value:

The return value is of type real with the kind type parameter of the argument if the optional *KIND* is absent; otherwise, the kind type parameter will be given by *KIND*. If *X* is greater than zero, then ANINT(*X*) returns AINT(*X*+0.5). If *X* is less than or equal to zero, then it returns AINT(*X*-0.5).

Example:

```
program test_anint
  real(4) x4
  real(8) x8
  x4 = 1.234E0_4
  x8 = 4.321_8
  print *, anint(x4), dnint(x8)
  x8 = anint(x4,8)
end program test_anint
```

Specific names:

Name	Argument	Return type	Standard
DNINT(X)	REAL(8) X	REAL(8)	F77 and later

6.17 ANY — Any value in MASK along DIM is true

Description:

ANY(MASK [, DIM]) determines if any of the values in the logical array *MASK* along dimension *DIM* are .TRUE..

Standard: F95 and later

Class: Transformational function

Syntax: RESULT = ANY(MASK [, DIM])

Arguments:

MASK The type of the argument shall be LOGICAL(*) and it shall not be scalar.
DIM (Optional) *DIM* shall be a scalar integer with a value that lies between one and the rank of *MASK*.

Return value:

ANY(MASK) returns a scalar value of type LOGICAL(*) where the kind type parameter is the same as the kind type parameter of *MASK*. If *DIM* is present, then ANY(MASK, DIM) returns an array with the rank of *MASK* minus 1. The shape is determined from the shape of *MASK* where the *DIM* dimension is elided.

(A) ANY(MASK) is true if any element of *MASK* is true; otherwise, it is false. It also is false if *MASK* has zero size.

- (B) If the rank of *MASK* is one, then `ANY(MASK,DIM)` is equivalent to `ANY(MASK)`. If the rank is greater than one, then `ANY(MASK,DIM)` is determined by applying `ANY` to the array sections.

Example:

```

program test_any
  logical l
  l = any(/.true., .true., .true./)
  print *, l
  call section
contains
  subroutine section
    integer a(2,3), b(2,3)
    a = 1
    b = 1
    b(2,2) = 2
    print *, any(a .eq. b, 1)
    print *, any(a .eq. b, 2)
  end subroutine section
end program test_any

```

6.18 ASIN — Arcsine function

Description:

`ASIN(X)` computes the arcsine of its *X* (inverse of `SIN(X)`).

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = ASIN(X)`

Arguments:

X The type shall be `REAL(*)`, and a magnitude that is less than one.

Return value:

The return value is of type `REAL(*)` and it lies in the range $-\pi/2 \leq \text{asin}(x) \leq \pi/2$. The kind type parameter is the same as *X*.

Example:

```

program test_asin
  real(8) :: x = 0.866_8
  x = asin(x)
end program test_asin

```

Specific names:

Name	Argument	Return type	Standard
<code>DASIN(X)</code>	<code>REAL(8) X</code>	<code>REAL(8)</code>	F77 and later

See also: Inverse function: [Section 6.181 \[SIN\]](#), page 118

6.19 ASINH — Hyperbolic arcsine function

Description:

`ASINH(X)` computes the hyperbolic arcsine of *X* (inverse of `SINH(X)`).

Standard: GNU extension

Class: Elemental function

Syntax: `RESULT = ASINH(X)`

Arguments:

X The type shall be `REAL(*)`, with X a real number.

Return value:

The return value is of type `REAL(*)` and it lies in the range $-\infty \leq \operatorname{asinh}(x) \leq \infty$.

Example:

```
PROGRAM test_asinh
  REAL(8), DIMENSION(3) :: x = (/ -1.0, 0.0, 1.0 /)
  WRITE (*,*) ASINH(x)
END PROGRAM
```

Specific names:

Name	Argument	Return type	Standard
<code>DASINH(X)</code>	<code>REAL(8) X</code>	<code>REAL(8)</code>	GNU extension.

See also: Inverse function: [Section 6.182 \[SINH\]](#), page 119

6.20 ASSOCIATED — Status of a pointer or pointer/target pair

Description:

`ASSOCIATED(PTR [, TGT])` determines the status of the pointer PTR or if PTR is associated with the target TGT .

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = ASSOCIATED(PTR [, TGT])`

Arguments:

PTR PTR shall have the `POINTER` attribute and it can be of any type.
 TGT (Optional) TGT shall be a `POINTER` or a `TARGET`. It must have the same type, kind type parameter, and array rank as PTR .

The status of neither PTR nor TGT can be undefined.

Return value:

`ASSOCIATED(PTR)` returns a scalar value of type `LOGICAL(4)`. There are several cases:

- (A) If the optional TGT is not present, then `ASSOCIATED(PTR)` is true if PTR is associated with a target; otherwise, it returns false.
- (B) If TGT is present and a scalar target, the result is true if TGT is not a 0 sized storage sequence and the target associated with PTR occupies the same storage units. If PTR is disassociated, then the result is false.
- (C) If TGT is present and an array target, the result is true if TGT and PTR have the same shape, are not 0 sized arrays, are arrays whose elements are not 0 sized storage sequences, and TGT and PTR occupy the same storage units in array element order. As in case(B), the result is false, if PTR is disassociated.
- (D) If TGT is present and an scalar pointer, the result is true if target associated with PTR and the target associated with TGT are not 0 sized storage sequences and occupy the same storage units. The result is false, if either TGT or PTR is disassociated.

- (E) If *TGT* is present and an array pointer, the result is true if target associated with *PTR* and the target associated with *TGT* have the same shape, are not 0 sized arrays, are arrays whose elements are not 0 sized storage sequences, and *TGT* and *PTR* occupy the same storage units in array element order. The result is false, if either *TGT* or *PTR* is disassociated.

Example:

```

program test_associated
  implicit none
  real, target :: tgt(2) = (/1., 2./)
  real, pointer :: ptr(:)
  ptr => tgt
  if (associated(ptr) .eqv. .false.) call abort
  if (associated(ptr,tgt) .eqv. .false.) call abort
end program test_associated

```

See also: [Section 6.152 \[NULL\]](#), page 104

6.21 ATAN — Arctangent function

Description:

ATAN(*X*) computes the arctangent of *X*.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = ATAN(*X*)

Arguments:

X The type shall be REAL(*).

Return value:

The return value is of type REAL(*) and it lies in the range $-\pi/2 \leq \text{atan}(x) \leq \pi/2$.

Example:

```

program test_atan
  real(8) :: x = 2.866_8
  x = atan(x)
end program test_atan

```

Specific names:

Name	Argument	Return type	Standard
DATAN(<i>X</i>)	REAL(8) <i>X</i>	REAL(8)	F77 and later

See also: Inverse function: [Section 6.195 \[TAN\]](#), page 125

6.22 ATAN2 — Arctangent function

Description:

ATAN2(*Y*,*X*) computes the arctangent of the complex number $X + iY$.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = ATAN2(*Y*,*X*)

Arguments:

Y The type shall be REAL(*).
X The type and kind type parameter shall be the same as *Y*. If *Y* is zero, then *X* must be nonzero.

Return value:

The return value has the same type and kind type parameter as Y . It is the principal value of the complex number $X + iY$. If X is nonzero, then it lies in the range $-\pi \leq \text{atan}(x) \leq \pi$. The sign is positive if Y is positive. If Y is zero, then the return value is zero if X is positive and π if X is negative. Finally, if X is zero, then the magnitude of the result is $\pi/2$.

Example:

```
program test_atan2
  real(4) :: x = 1.e0_4, y = 0.5e0_4
  x = atan2(y,x)
end program test_atan2
```

Specific names:

Name	Argument	Return type	Standard
DATAN2(X)	REAL(8) X	REAL(8)	F77 and later

6.23 ATANH — Hyperbolic arctangent function

Description:

ATANH(X) computes the hyperbolic arctangent of X (inverse of TANH(X)).

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = ATANH(X)

Arguments:

X The type shall be REAL(*) with a magnitude that is less than or equal to one.

Return value:

The return value is of type REAL(*) and it lies in the range $-\infty \leq \text{atanh}(x) \leq \infty$.

Example:

```
PROGRAM test_atanh
  REAL, DIMENSION(3) :: x = (/ -1.0, 0.0, 1.0 /)
  WRITE (*,*) ATANH(x)
END PROGRAM
```

Specific names:

Name	Argument	Return type	Standard
DATANH(X)	REAL(8) X	REAL(8)	GNU extension

See also: Inverse function: [Section 6.196 \[TANH\]](#), page 126

6.24 BESJ0 — Bessel function of the first kind of order 0

Description:

BESJ0(X) computes the Bessel function of the first kind of order 0 of X .

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = BESJ0(X)

Arguments:

X The type shall be REAL(*), and it shall be scalar.

Return value:

The return value is of type `REAL(*)` and it lies in the range $-0.4027... \leq Bessel(0, x) \leq 1$.

Example:

```
program test_besj0
  real(8) :: x = 0.0_8
  x = besj0(x)
end program test_besj0
```

Specific names:

Name	Argument	Return type	Standard
DBESJ0(X)	REAL(8) X	REAL(8)	GNU extension

6.25 BESJ1 — Bessel function of the first kind of order 1

Description:

BESJ1(X) computes the Bessel function of the first kind of order 1 of X.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = BESJ1(X)

Arguments:

X The type shall be `REAL(*)`, and it shall be scalar.

Return value:

The return value is of type `REAL(*)` and it lies in the range $-0.5818... \leq Bessel(0, x) \leq 0.5818$.

Example:

```
program test_besj1
  real(8) :: x = 1.0_8
  x = besj1(x)
end program test_besj1
```

Specific names:

Name	Argument	Return type	Standard
DBESJ1(X)	REAL(8) X	REAL(8)	GNU extension

6.26 BESJN — Bessel function of the first kind

Description:

BESJN(N, X) computes the Bessel function of the first kind of order N of X.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = BESJN(N, X)

Arguments:

N The type shall be `INTEGER(*)`, and it shall be scalar.
 X The type shall be `REAL(*)`, and it shall be scalar.

Return value:

The return value is a scalar of type `REAL(*)`.

Example:

```

program test_besjn
  real(8) :: x = 1.0_8
  x = besjn(5,x)
end program test_besjn

```

Specific names:

Name	Argument	Return type	Standard
DBESJN(X)	INTEGER(*) N REAL(8) X	REAL(8)	GNU extension

6.27 BESY0 — Bessel function of the second kind of order 0

Description:

BESY0(X) computes the Bessel function of the second kind of order 0 of X.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = BESY0(X)

Arguments:

X The type shall be REAL(*), and it shall be scalar.

Return value:

The return value is a scalar of type REAL(*) .

Example:

```

program test_besy0
  real(8) :: x = 0.0_8
  x = besy0(x)
end program test_besy0

```

Specific names:

Name	Argument	Return type	Standard
DBESY0(X)	REAL(8) X	REAL(8)	GNU extension

6.28 BESY1 — Bessel function of the second kind of order 1

Description:

BESY1(X) computes the Bessel function of the second kind of order 1 of X.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = BESY1(X)

Arguments:

X The type shall be REAL(*), and it shall be scalar.

Return value:

The return value is a scalar of type REAL(*) .

Example:

```

program test_besy1
  real(8) :: x = 1.0_8
  x = besy1(x)
end program test_besy1

```

Specific names:

Name	Argument	Return type	Standard
DBESY1(X)	REAL(8) X	REAL(8)	GNU extension

6.29 BESYN — Bessel function of the second kind

Description:

BESYN(*N*, *X*) computes the Bessel function of the second kind of order *N* of *X*.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = BESYN(*N*, *X*)

Arguments:

N The type shall be INTEGER(*), and it shall be scalar.
X The type shall be REAL(*), and it shall be scalar.

Return value:

The return value is a scalar of type REAL(*).

Example:

```
program test_besyn
  real(8) :: x = 1.0_8
  x = besyn(5,x)
end program test_besyn
```

Specific names:

Name	Argument	Return type	Standard
DBESYN(<i>N</i> , <i>X</i>)	INTEGER(*) <i>N</i> REAL(8) <i>X</i>	REAL(8)	GNU extension

6.30 BIT_SIZE — Bit size inquiry function

Description:

BIT_SIZE(*I*) returns the number of bits (integer precision plus sign bit) represented by the type of *I*.

Standard: F95 and later

Class: Inquiry function

Syntax: RESULT = BIT_SIZE(*I*)

Arguments:

I The type shall be INTEGER(*).

Return value:

The return value is of type INTEGER(*)

Example:

```
program test_bit_size
  integer :: i = 123
  integer :: size
  size = bit_size(i)
  print *, size
end program test_bit_size
```

6.31 BTEST — Bit test function

Description:

BTEST(*I*,*POS*) returns logical .TRUE. if the bit at *POS* in *I* is set.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = BTEST(I, POS)

Arguments:

I The type shall be INTEGER(*).
POS The type shall be INTEGER(*).

Return value:

The return value is of type LOGICAL

Example:

```
program test_btest
  integer :: i = 32768 + 1024 + 64
  integer :: pos
  logical :: bool
  do pos=0,16
    bool = btest(i, pos)
    print *, pos, bool
  end do
end program test_btest
```

6.32 CEILING — Integer ceiling function

Description:

CEILING(X) returns the least integer greater than or equal to X.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = CEILING(X [, KIND])

Arguments:

X The type shall be REAL(*).
KIND (Optional) An INTEGER(*) initialization expression indicating the kind parameter of the result.

Return value:

The return value is of type INTEGER(KIND)

Example:

```
program test_ceiling
  real :: x = 63.29
  real :: y = -63.59
  print *, ceiling(x) ! returns 64
  print *, ceiling(y) ! returns -63
end program test_ceiling
```

See also: [Section 6.68 \[FLOOR\]](#), [page 65](#), [Section 6.150 \[NINT\]](#), [page 103](#)

6.33 CHAR — Character conversion function

Description:

CHAR(I [, KIND]) returns the character represented by the integer I.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = CHAR(I [, KIND])

Arguments:

I The type shall be INTEGER(*).
KIND (Optional) An INTEGER(*) initialization expression indicating the kind parameter of the result.

Return value:

The return value is of type CHARACTER(1)

Example:

```
program test_char
  integer :: i = 74
  character(1) :: c
  c = char(i)
  print *, i, c ! returns 'J'
end program test_char
```

Note: See [Section 6.98 \[ICHAR\]](#), page 78 for a discussion of converting between numerical values and formatted string representations.

See also: [Section 6.5 \[ACHAR\]](#), page 31, [Section 6.92 \[IACHAR\]](#), page 76, [Section 6.98 \[ICHAR\]](#), page 78

6.34 CHDIR — Change working directory

Description:

Change current working directory to a specified path.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL CHDIR(NAME [, STATUS])
STATUS = CHDIR(NAME)
```

Arguments:

<i>NAME</i>	The type shall be CHARACTER(*) and shall specify a valid path within the file system.
<i>STATUS</i>	(Optional) INTEGER status flag of the default kind. Returns 0 on success, and a system specific and non-zero error code otherwise.

Example:

```
PROGRAM test_chdir
  CHARACTER(len=255) :: path
  CALL getcwd(path)
  WRITE(*,*) TRIM(path)
  CALL chdir("/tmp")
  CALL getcwd(path)
  WRITE(*,*) TRIM(path)
END PROGRAM
```

See also: [Section 6.82 \[GETCWD\]](#), page 71

6.35 CHMOD — Change access permissions of files

Description:

CHMOD changes the permissions of a file. This function invokes `/bin/chmod` and might therefore not work on all platforms.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL CHMOD(NAME, MODE[, STATUS])
STATUS = CHMOD(NAME, MODE)
```

Arguments:

<i>NAME</i>	Scalar CHARACTER with the file name. Trailing blanks are ignored unless the character <code>achar(0)</code> is present, then all characters up to and excluding <code>achar(0)</code> are used as the file name.
<i>MODE</i>	Scalar CHARACTER giving the file permission. <i>MODE</i> uses the same syntax as the <i>MODE</i> argument of <code>/bin/chmod</code> .
<i>STATUS</i>	(optional) scalar INTEGER, which is 0 on success and non-zero otherwise.

Return value:

In either syntax, *STATUS* is set to 0 on success and non-zero otherwise.

Example: CHMOD as subroutine

```
program chmod_test
  implicit none
  integer :: status
  call chmod('test.dat','u+x',status)
  print *, 'Status: ', status
end program chmod_test
```

CHMOD as function:

```
program chmod_test
  implicit none
  integer :: status
  status = chmod('test.dat','u+x')
  print *, 'Status: ', status
end program chmod_test
```

6.36 CMPLX — Complex conversion function

Description:

`CMPLX(X [, Y [, KIND]])` returns a complex number where *X* is converted to the real component. If *Y* is present it is converted to the imaginary component. If *Y* is not present then the imaginary component is set to 0.0. If *X* is complex then *Y* must not be present.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = CMPLX(X [, Y [, KIND]])`

Arguments:

<i>X</i>	The type may be <code>INTEGER(*)</code> , <code>REAL(*)</code> , or <code>COMPLEX(*)</code> .
<i>Y</i>	(Optional; only allowed if <i>X</i> is not <code>COMPLEX(*)</code> .) May be <code>INTEGER(*)</code> or <code>REAL(*)</code> .
<i>KIND</i>	(Optional) An <code>INTEGER(*)</code> initialization expression indicating the kind parameter of the result.

Return value:

The return value is of `COMPLEX` type, with a kind equal to *KIND* if it is specified. If *KIND* is not specified, the result is of the default `COMPLEX` kind, regardless of the kinds of *X* and *Y*.

Example:

```

program test_cmplx
  integer :: i = 42
  real :: x = 3.14
  complex :: z
  z = cmplx(i, x)
  print *, z, cmplx(x)
end program test_cmplx

```

See also: [Section 6.38 \[COMPLEX\]](#), page 48

6.37 COMMAND_ARGUMENT_COUNT — Get number of command line arguments

Description:

COMMAND_ARGUMENT_COUNT() returns the number of arguments passed on the command line when the containing program was invoked.

Standard: F2003

Class: Inquiry function

Syntax: RESULT = COMMAND_ARGUMENT_COUNT()

Arguments:

None

Return value:

The return value is of type INTEGER(4)

Example:

```

program test_command_argument_count
  integer :: count
  count = command_argument_count()
  print *, count
end program test_command_argument_count

```

See also: [Section 6.80 \[GET_COMMAND\]](#), page 70, [Section 6.81 \[GET_COMMAND_ARGUMENT\]](#), page 71

6.38 COMPLEX — Complex conversion function

Description:

COMPLEX(X, Y) returns a complex number where X is converted to the real component and Y is converted to the imaginary component.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = COMPLEX(X, Y)

Arguments:

X	The type may be INTEGER(*) or REAL(*).
Y	The type may be INTEGER(*) or REAL(*).

Return value:

If X and Y are both of INTEGER type, then the return value is of default COMPLEX type.

If X and Y are of REAL type, or one is of REAL type and one is of INTEGER type, then the return value is of COMPLEX type with a kind equal to that of the REAL argument with the highest precision.

Example:

```
program test_complex
  integer :: i = 42
  real :: x = 3.14
  print *, complex(i, x)
end program test_complex
```

See also: [Section 6.36 \[CMPLX\]](#), page 47

6.39 CONJG — Complex conjugate function

Description:

CONJG(Z) returns the conjugate of Z. If Z is (x, y) then the result is (x, -y)

Standard: F77 and later, has overloads that are GNU extensions

Class: Elemental function

Syntax: Z = CONJG(Z)

Arguments:

Z The type shall be COMPLEX(*).

Return value:

The return value is of type COMPLEX(*) .

Example:

```
program test_conjg
  complex :: z = (2.0, 3.0)
  complex(8) :: dz = (2.71_8, -3.14_8)
  z= conjg(z)
  print *, z
  dz = dconjg(dz)
  print *, dz
end program test_conjg
```

Specific names:

Name	Argument	Return type	Standard
DCONJG(Z)	COMPLEX(8) Z	COMPLEX(8)	GNU extension

6.40 COS — Cosine function

Description:

COS(X) computes the cosine of X.

Standard: F77 and later, has overloads that are GNU extensions

Class: Elemental function

Syntax: RESULT = COS(X)

Arguments:

X The type shall be REAL(*) or COMPLEX(*) .

Return value:

The return value is of type REAL(*) and it lies in the range $-1 \leq \cos(x) \leq 1$. The kind type parameter is the same as X.

Example:

```
program test_cos
  real :: x = 0.0
  x = cos(x)
end program test_cos
```

Specific names:

Name	Argument	Return type	Standard
DCOS(X)	REAL(8) X	REAL(8)	F77 and later
CCOS(X)	COMPLEX(4) X	COMPLEX(4)	F77 and later
ZCOS(X)	COMPLEX(8) X	COMPLEX(8)	GNU extension
CDCOS(X)	COMPLEX(8) X	COMPLEX(8)	GNU extension

See also: Inverse function: [Section 6.6 \[ACOS\]](#), page 31

6.41 COSH — Hyperbolic cosine function

Description:

COSH(X) computes the hyperbolic cosine of X.

Standard: F77 and later

Class: Elemental function

Syntax: X = COSH(X)

Arguments:

X The type shall be REAL(*).

Return value:

The return value is of type REAL(*) and it is positive ($\cosh(x) \geq 0$).

Example:

```
program test_cosh
  real(8) :: x = 1.0_8
  x = cosh(x)
end program test_cosh
```

Specific names:

Name	Argument	Return type	Standard
DCOSH(X)	REAL(8) X	REAL(8)	F77 and later

See also: Inverse function: [Section 6.7 \[ACOSH\]](#), page 32

6.42 COUNT — Count function

Description:

COUNT(MASK [, DIM]) counts the number of .TRUE. elements of MASK along the dimension of DIM. If DIM is omitted it is taken to be 1. DIM is a scalar of type INTEGER in the range of 1/leqDIM/leqn) where n is the rank of MASK.

Standard: F95 and later

Class: Transformational function

Syntax: RESULT = COUNT(MASK [, DIM])

Arguments:

MASK The type shall be LOGICAL.
 DIM The type shall be INTEGER.

Return value:

The return value is of type INTEGER with rank equal to that of MASK.

Example:

```
program test_count
  integer, dimension(2,3) :: a, b
  logical, dimension(2,3) :: mask
```

```

a = reshape( (/ 1, 2, 3, 4, 5, 6 /), (/ 2, 3 /))
b = reshape( (/ 0, 7, 3, 4, 5, 8 /), (/ 2, 3 /))
print '(3i3)', a(1,:)
print '(3i3)', a(2,:)
print *
print '(3i3)', b(1,:)
print '(3i3)', b(2,:)
print *
mask = a.ne.b
print '(3l3)', mask(1,:)
print '(3l3)', mask(2,:)
print *
print '(3i3)', count(mask)
print *
print '(3i3)', count(mask, 1)
print *
print '(3i3)', count(mask, 2)
end program test_count

```

6.43 CPU_TIME — CPU elapsed time in seconds

Description:

Returns a `REAL(*)` value representing the elapsed CPU time in seconds. This is useful for testing segments of code to determine execution time.

Standard: F95 and later

Class: Subroutine

Syntax: `CALL CPU_TIME(TIME)`

Arguments:

`TIME` The type shall be `REAL(*)` with `INTENT(OUT)`.

Return value:

None

Example:

```

program test_cpu_time
  real :: start, finish
  call cpu_time(start)
  ! put code to test here
  call cpu_time(finish)
  print '("Time = ",f6.3," seconds.")',finish-start
end program test_cpu_time

```

See also: [Section 6.194 \[SYSTEM_CLOCK\]](#), page 125, [Section 6.46 \[DATE_AND_TIME\]](#), page 53

6.44 CSHIFT — Circular shift elements of an array

Description:

`CSHIFT(ARRAY, SHIFT [, DIM])` performs a circular shift on elements of `ARRAY` along the dimension of `DIM`. If `DIM` is omitted it is taken to be 1. `DIM` is a scalar of type `INTEGER` in the range of $1/leq DIM/leqn$ where n is the rank of `ARRAY`. If the rank of `ARRAY` is one, then all elements of `ARRAY` are shifted by `SHIFT` places. If rank is greater than one, then all complete rank one sections of `ARRAY` along the given dimension are shifted. Elements shifted out one end of each rank one section are shifted back in the other end.

Standard: F95 and later

Class: transformational function

Syntax: `RESULT = CSHIFT(A, SHIFT [, DIM])`

Arguments:

<i>ARRAY</i>	May be any type, not scalar.
<i>SHIFT</i>	The type shall be <code>INTEGER</code> .
<i>DIM</i>	The type shall be <code>INTEGER</code> .

Return value:

Returns an array of same type and rank as the *ARRAY* argument.

Example:

```

program test_cshift
  integer, dimension(3,3) :: a
  a = reshape( (/ 1, 2, 3, 4, 5, 6, 7, 8, 9 /), (/ 3, 3 /))
  print '(3i3)', a(1,:)
  print '(3i3)', a(2,:)
  print '(3i3)', a(3,:)
  a = cshift(a, SHIFT=(/1, 2, -1/), DIM=2)
  print *
  print '(3i3)', a(1,:)
  print '(3i3)', a(2,:)
  print '(3i3)', a(3,:)
end program test_cshift

```

6.45 CTIME — Convert a time into a string

Description:

`CTIME` converts a system time value, such as returned by `TIME8()`, to a string of the form 'Sat Aug 19 18:13:14 1995'.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

`CALL CTIME(TIME, RESULT).`
`RESULT = CTIME(TIME),` (not recommended).

Arguments:

<i>TIME</i>	The type shall be of type <code>INTEGER(KIND=8)</code> .
<i>RESULT</i>	The type shall be of type <code>CHARACTER</code> .

Return value:

The converted date and time as a string.

Example:

```

program test_ctime
  integer(8) :: i
  character(len=30) :: date
  i = time8()

  ! Do something, main part of the program

  call ctime(i,date)
  print *, 'Program was started on ', date
end program test_ctime

```

See Also: [Section 6.89 \[GMTIME\]](#), page 74, [Section 6.130 \[LTIME\]](#), page 92, [Section 6.197 \[TIME\]](#), page 126, [Section 6.198 \[TIME8\]](#), page 127

6.46 DATE_AND_TIME — Date and time subroutine

Description:

DATE_AND_TIME(DATE, TIME, ZONE, VALUES) gets the corresponding date and time information from the real-time system clock. *DATE* is INTENT(OUT) and has form ccyymmdd. *TIME* is INTENT(OUT) and has form hhmmss.sss. *ZONE* is INTENT(OUT) and has form (+-)hhmm, representing the difference with respect to Coordinated Universal Time (UTC). Unavailable time and date parameters return blanks.

VALUES is INTENT(OUT) and provides the following:

VALUE(1):	The year
VALUE(2):	The month
VALUE(3):	The day of the month
VALUE(4):	Time difference with UTC in minutes
VALUE(5):	The hour of the day
VALUE(6):	The minutes of the hour
VALUE(7):	The seconds of the minute
VALUE(8):	The milliseconds of the second

Standard: F95 and later

Class: Subroutine

Syntax: CALL DATE_AND_TIME([DATE, TIME, ZONE, VALUES])

Arguments:

DATE	(Optional) The type shall be CHARACTER(8) or larger.
TIME	(Optional) The type shall be CHARACTER(10) or larger.
ZONE	(Optional) The type shall be CHARACTER(5) or larger.
VALUES	(Optional) The type shall be INTEGER(8).

Return value:

None

Example:

```

program test_time_and_date
  character(8)  :: date
  character(10) :: time
  character(5)  :: zone
  integer,dimension(8) :: values
  ! using keyword arguments
  call date_and_time(date,time,zone,values)
  call date_and_time(DATE=date,ZONE=zone)
  call date_and_time(TIME=time)
  call date_and_time(VALUES=values)
  print '(a,2x,a,2x,a)', date, time, zone
  print '(8i5))', values
end program test_time_and_date

```

See also: [Section 6.43 \[CPU_TIME\], page 51](#), [Section 6.194 \[SYSTEM_CLOCK\], page 125](#)

6.47 DBLE — Double conversion function

Description:

DBLE(X) Converts X to double precision real type.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = DBLE(X)

Arguments:

X The type shall be INTEGER(*), REAL(*), or COMPLEX(*) .

Return value:

The return value is of type double precision real.

Example:

```
program test_dble
  real    :: x = 2.18
  integer :: i = 5
  complex :: z = (2.3,1.14)
  print *, dble(x), dble(i), dble(z)
end program test_dble
```

See also: Section 6.49 [DFLOAT], page 54, Section 6.65 [FLOAT], page 63, Section 6.165 [REAL], page 110

6.48 DCMPLX — Double complex conversion function

Description:

DCMPLX(X [,Y]) returns a double complex number where X is converted to the real component. If Y is present it is converted to the imaginary component. If Y is not present then the imaginary component is set to 0.0. If X is complex then Y must not be present.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = DCMPLX(X [, Y])

Arguments:

X The type may be INTEGER(*), REAL(*), or COMPLEX(*) .
Y (Optional if X is not COMPLEX(*).) May be INTEGER(*) or REAL(*) .

Return value:

The return value is of type COMPLEX(8)

Example:

```
program test_dcmlpx
  integer :: i = 42
  real    :: x = 3.14
  complex :: z
  z = cmplx(i, x)
  print *, dcmlpx(i)
  print *, dcmlpx(x)
  print *, dcmlpx(z)
  print *, dcmlpx(x,i)
end program test_dcmlpx
```

6.49 DFLOAT — Double conversion function

Description:

DFLOAT(X) Converts X to double precision real type.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = DFLOAT(X)

Arguments:

X The type shall be `INTEGER(*)`.

Return value:

The return value is of type double precision real.

Example:

```

program test_dfloat
  integer :: i = 5
  print *, dfloat(i)
end program test_dfloat

```

See also: [Section 6.47 \[DBLE\], page 53](#), [Section 6.65 \[FLOAT\], page 63](#), [Section 6.165 \[REAL\], page 110](#)

6.50 DIGITS — Significant digits function

Description:

`DIGITS(X)` returns the number of significant digits of the internal model representation of *X*. For example, on a system using a 32-bit floating point representation, a default real number would likely return 24.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = DIGITS(X)`

Arguments:

X The type may be `INTEGER(*)` or `REAL(*)`.

Return value:

The return value is of type `INTEGER`.

Example:

```

program test_digits
  integer :: i = 12345
  real :: x = 3.143
  real(8) :: y = 2.33
  print *, digits(i)
  print *, digits(x)
  print *, digits(y)
end program test_digits

```

6.51 DIM — Positive difference

Description:

`DIM(X,Y)` returns the difference *X*-*Y* if the result is positive; otherwise returns zero.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = DIM(X, Y)`

Arguments:

X The type shall be `INTEGER(*)` or `REAL(*)`

Y The type shall be the same type and kind as *X*.

Return value:

The return value is of type `INTEGER(*)` or `REAL(*)`.

Example:

```

program test_dim
  integer :: i
  real(8) :: x
  i = dim(4, 15)
  x = dim(4.345_8, 2.111_8)
  print *, i
  print *, x
end program test_dim

```

Specific names:

Name	Argument	Return type	Standard
IDIM(X,Y)	INTEGER(4) X,Y	INTEGER(4)	F77 and later
DDIM(X,Y)	REAL(8) X,Y	REAL(8)	F77 and later

6.52 DOT_PRODUCT — Dot product function

Description:

DOT_PRODUCT(X,Y) computes the dot product multiplication of two vectors *X* and *Y*. The two vectors may be either numeric or logical and must be arrays of rank one and of equal size. If the vectors are INTEGER(*) or REAL(*), the result is SUM(X*Y). If the vectors are COMPLEX(*), the result is SUM(CONJG(X)*Y). If the vectors are LOGICAL, the result is ANY(X.AND.Y).

Standard: F95 and later

Class: Transformational function

Syntax: RESULT = DOT_PRODUCT(X, Y)

Arguments:

<i>X</i>	The type shall be numeric or LOGICAL, rank 1.
<i>Y</i>	The type shall be numeric or LOGICAL, rank 1.

Return value:

If the arguments are numeric, the return value is a scalar of numeric type, INTEGER(*), REAL(*), or COMPLEX(*). If the arguments are LOGICAL, the return value is .TRUE. or .FALSE..

Example:

```

program test_dot_prod
  integer, dimension(3) :: a, b
  a = (/ 1, 2, 3 /)
  b = (/ 4, 5, 6 /)
  print '(3i3)', a
  print *
  print '(3i3)', b
  print *
  print *, dot_product(a,b)
end program test_dot_prod

```

6.53 DPROD — Double product function

Description:

DPROD(X,Y) returns the product X*Y.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = DPROD(X, Y)

Arguments:

X The type shall be `REAL`.
 Y The type shall be `REAL`.

Return value:

The return value is of type `REAL(8)`.

Example:

```
program test_dprod
  real :: x = 5.2
  real :: y = 2.3
  real(8) :: d
  d = dprod(x,y)
  print *, d
end program test_dprod
```

6.54 DREAL — Double real part function

Description:

`DREAL(Z)` returns the real part of complex variable `Z`.

Standard: GNU extension

Class: Elemental function

Syntax: `RESULT = DREAL(Z)`

Arguments:

Z The type shall be `COMPLEX(8)`.

Return value:

The return value is of type `REAL(8)`.

Example:

```
program test_dreal
  complex(8) :: z = (1.3_8,7.2_8)
  print *, dreal(z)
end program test_dreal
```

See also: [Section 6.10 \[AIMAG\], page 33](#)

6.55 DTIME — Execution time subroutine (or function)

Description:

`DTIME(TARRAY, RESULT)` initially returns the number of seconds of runtime since the start of the process's execution in `RESULT`. `TARRAY` returns the user and system components of this time in `TARRAY(1)` and `TARRAY(2)` respectively. `RESULT` is equal to `TARRAY(1) + TARRAY(2)`.

Subsequent invocations of `DTIME` return values accumulated since the previous invocation.

On some systems, the underlying timings are represented using types with sufficiently small limits that overflows (wrap around) are possible, such as 32-bit types. Therefore, the values returned by this intrinsic might be, or become, negative, or numerically less than previous values, during a single run of the compiled program. This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

`TARRAY` and `RESULT` are `INTENT(OUT)` and provide the following:

<code>TARRAY(1):</code>	User time in seconds.
<code>TARRAY(2):</code>	System time in seconds.
<code>RESULT:</code>	Run time since start in seconds.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL DTIME(TARRAY, RESULT).
RESULT = DTIME(TARRAY), (not recommended).
```

Arguments:

TARRAY The type shall be REAL, DIMENSION(2).
RESULT The type shall be REAL.

Return value:

Elapsed time in seconds since the start of program execution.

Example:

```
program test_dtime
  integer(8) :: i, j
  real, dimension(2) :: tarray
  real :: result
  call dtime(tarray, result)
  print *, result
  print *, tarray(1)
  print *, tarray(2)
  do i=1,1000000000    ! Just a delay
    j = i * i - i
  end do
  call dtime(tarray, result)
  print *, result
  print *, tarray(1)
  print *, tarray(2)
end program test_dtime
```

6.56 EOSHIFT — End-off shift elements of an array

Description:

EOSHIFT(*ARRAY*, *SHIFT* [, *BOUNDARY*, *DIM*]) performs an end-off shift on elements of *ARRAY* along the dimension of *DIM*. If *DIM* is omitted it is taken to be 1. *DIM* is a scalar of type **INTEGER** in the range of $1/\text{leq}DIM/\text{leqn}$ where n is the rank of *ARRAY*. If the rank of *ARRAY* is one, then all elements of *ARRAY* are shifted by *SHIFT* places. If rank is greater than one, then all complete rank one sections of *ARRAY* along the given dimension are shifted. Elements shifted out one end of each rank one section are dropped. If *BOUNDARY* is present then the corresponding value of from *BOUNDARY* is copied back in the other end. If *BOUNDARY* is not present then the following are copied in depending on the type of *ARRAY*.

<i>Array Type</i>	<i>Boundary Value</i>
Numeric	0 of the type and kind of <i>ARRAY</i> .
Logical	.FALSE..
Character(<i>len</i>)	<i>len</i> blanks.

Standard: F95 and later

Class: transformational function

Syntax: **RESULT** = **EOSHIFT**(*A*, *SHIFT* [, *BOUNDARY*, *DIM*])

Arguments:

ARRAY May be any type, not scalar.
SHIFT The type shall be **INTEGER**.
BOUNDARY Same type as *ARRAY*.
DIM The type shall be **INTEGER**.

Return value:

Returns an array of same type and rank as the *ARRAY* argument.

Example:

```
program test_eoshift
  integer, dimension(3,3) :: a
  a = reshape( (/ 1, 2, 3, 4, 5, 6, 7, 8, 9 /), (/ 3, 3 /))
  print '(3i3)', a(1,:)
  print '(3i3)', a(2,:)
  print '(3i3)', a(3,:)
  a = EOSHIFT(a, SHIFT=(/1, 2, 1/), BOUNDARY=-5, DIM=2)
  print *
  print '(3i3)', a(1,:)
  print '(3i3)', a(2,:)
  print '(3i3)', a(3,:)
end program test_eoshift
```

6.57 EPSILON — Epsilon function

Description:

EPSILON(X) returns a nearly negligible number relative to 1.

Standard: F95 and later

Class: Inquiry function

Syntax: RESULT = EPSILON(X)

Arguments:

X The type shall be REAL(*).

Return value:

The return value is of same type as the argument.

Example:

```
program test_epsilon
  real :: x = 3.143
  real(8) :: y = 2.33
  print *, EPSILON(x)
  print *, EPSILON(y)
end program test_epsilon
```

6.58 ERF — Error function

Description:

ERF(X) computes the error function of X.

Standard: GNU Extension

Class: Elemental function

Syntax: RESULT = ERF(X)

Arguments:

X The type shall be REAL(*), and it shall be scalar.

Return value:

The return value is a scalar of type REAL(*) and it is positive ($-1 \leq \text{erf}(x) \leq 1$).

Example:

```
program test_erf
  real(8) :: x = 0.17_8
  x = erf(x)
end program test_erf
```

Specific names:

Name	Argument	Return type	Standard
DERF(X)	REAL(8) X	REAL(8)	GNU extension

6.59 ERFC — Error function

Description:

ERFC(X) computes the complementary error function of X.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = ERFC(X)

Arguments:

X The type shall be REAL(*), and it shall be scalar.

Return value:

The return value is a scalar of type REAL(*) and it is positive ($0 \leq \text{erfc}(x) \leq 2$).

Example:

```
program test_erfc
  real(8) :: x = 0.17_8
  x = erfc(x)
end program test_erfc
```

Specific names:

Name	Argument	Return type	Standard
DERFC(X)	REAL(8) X	REAL(8)	GNU extension

6.60 ETIME — Execution time subroutine (or function)

Description:

ETIME(TARRAY, RESULT) returns the number of seconds of runtime since the start of the process's execution in *RESULT*. *TARRAY* returns the user and system components of this time in TARRAY(1) and TARRAY(2) respectively. *RESULT* is equal to TARRAY(1) + TARRAY(2).

On some systems, the underlying timings are represented using types with sufficiently small limits that overflows (wrap around) are possible, such as 32-bit types. Therefore, the values returned by this intrinsic might be, or become, negative, or numerically less than previous values, during a single run of the compiled program.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

TARRAY and *RESULT* are INTENT(OUT) and provide the following:

TARRAY(1):	User time in seconds.
TARRAY(2):	System time in seconds.
RESULT:	Run time since start in seconds.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL ETIME(TARRAY, RESULT).
RESULT = ETIME(TARRAY), (not recommended).
```

Arguments:

TARRAY The type shall be `REAL`, `DIMENSION(2)`.
RESULT The type shall be `REAL`.

Return value:

Elapsed time in seconds since the start of program execution.

Example:

```

program test_etime
  integer(8) :: i, j
  real, dimension(2) :: tarray
  real :: result
  call ETIME(tarray, result)
  print *, result
  print *, tarray(1)
  print *, tarray(2)
  do i=1,1000000000    ! Just a delay
    j = i * i - i
  end do
  call ETIME(tarray, result)
  print *, result
  print *, tarray(1)
  print *, tarray(2)
end program test_etime

```

See also: [Section 6.43 \[CPU_TIME\], page 51](#)

6.61 EXIT — Exit the program with status.

Description:

EXIT causes immediate termination of the program with status. If status is omitted it returns the canonical *success* for the system. All Fortran I/O units are closed.

Standard: GNU extension

Class: Subroutine

Syntax: `CALL EXIT([STATUS])`

Arguments:

STATUS Shall be an `INTEGER` of the default kind.

Return value:

STATUS is passed to the parent process on exit.

Example:

```

program test_exit
  integer :: STATUS = 0
  print *, 'This program is going to exit.'
  call EXIT(STATUS)
end program test_exit

```

See also: [Section 6.2 \[ABORT\], page 29](#), [Section 6.112 \[KILL\], page 85](#)

6.62 EXP — Exponential function

Description:

EXP(*X*) computes the base *e* exponential of *X*.

Standard: F77 and later, has overloads that are GNU extensions

Class: Elemental function

Syntax: `RESULT = EXP(X)`

Arguments:

X The type shall be `REAL(*)` or `COMPLEX(*)`.

Return value:

The return value has same type and kind as *X*.

Example:

```
program test_exp
  real :: x = 1.0
  x = exp(x)
end program test_exp
```

Specific names:

Name	Argument	Return type	Standard
<code>DEXP(X)</code>	<code>REAL(8) X</code>	<code>REAL(8)</code>	F77 and later
<code>CEXP(X)</code>	<code>COMPLEX(4) X</code>	<code>COMPLEX(4)</code>	F77 and later
<code>ZEXP(X)</code>	<code>COMPLEX(8) X</code>	<code>COMPLEX(8)</code>	GNU extension
<code>CDEXP(X)</code>	<code>COMPLEX(8) X</code>	<code>COMPLEX(8)</code>	GNU extension

6.63 EXPONENT — Exponent function

Description:

`EXPONENT(X)` returns the value of the exponent part of *X*. If *X* is zero the value returned is zero.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = EXPONENT(X)`

Arguments:

X The type shall be `REAL(*)`.

Return value:

The return value is of type default `INTEGER`.

Example:

```
program test_exponent
  real :: x = 1.0
  integer :: i
  i = exponent(x)
  print *, i
  print *, exponent(0.0)
end program test_exponent
```

6.64 FDATE — Get the current time as a string

Description:

`FDATE(DATE)` returns the current date (using the same format as `CTIME`) in *DATE*. It is equivalent to `CALL CTIME(DATE, TIME())`.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

DATE is an `INTENT(OUT) CHARACTER` variable.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL FDATE(DATE).
DATE = FDATE(), (not recommended).
```


Arguments:

DATE The type shall be of type CHARACTER.

Return value:

The current date as a string.

Example:

```

program test_fdate
  integer(8) :: i, j
  character(len=30) :: date
  call fdate(date)
  print *, 'Program started on ', date
  do i = 1, 100000000 ! Just a delay
    j = i * i - i
  end do
  call fdate(date)
  print *, 'Program ended on ', date
end program test_fdate

```

6.65 FLOAT — Convert integer to default real

Description:

FLOAT(*I*) converts the integer *I* to a default real value.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = FLOAT(*I*)

Arguments:

I The type shall be INTEGER(*).

Return value:

The return value is of type default REAL.

Example:

```

program test_float
  integer :: i = 1
  if (float(i) /= 1.) call abort
end program test_float

```

See also: [Section 6.47 \[DBLE\]](#), page 53, [Section 6.49 \[DFLOAT\]](#), page 54, [Section 6.165 \[REAL\]](#), page 110

6.66 FGET — Read a single character in stream mode from stdin

Description:

Read a single character in stream mode from stdin by bypassing normal formatted output. Stream I/O should not be mixed with normal record-oriented (formatted or unformatted) I/O on the same unit; the results are unpredictable.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Note that the FGET intrinsic is provided for backwards compatibility with g77. GNU Fortran provides the Fortran 2003 Stream facility. Programmers should consider the use of new stream IO feature in new code for future portability. See also [Chapter 4 \[Fortran 2003 status\]](#), page 21.

Standard: GNU extension

Class: Subroutine, function

Syntax: CALL FGET(C [, STATUS])

Arguments:

<i>C</i>	The type shall be CHARACTER.
<i>STATUS</i>	(Optional) status flag of type INTEGER. Returns 0 on success, -1 on end-of-file, and a system specific positive error code otherwise.

Example:

```
PROGRAM test_fget
  INTEGER, PARAMETER :: strlen = 100
  INTEGER :: status, i = 1
  CHARACTER(len=strlen) :: str = ""

  WRITE (*,*) 'Enter text:'
  DO
    CALL fget(str(i:i), status)
    if (status /= 0 .OR. i > strlen) exit
    i = i + 1
  END DO
  WRITE (*,*) TRIM(str)
END PROGRAM
```

See also: [Section 6.67 \[FGETC\], page 64](#), [Section 6.71 \[FPUT\], page 66](#), [Section 6.72 \[FPUTC\], page 66](#)

6.67 FGETC — Read a single character in stream mode

Description:

Read a single character in stream mode by bypassing normal formatted output. Stream I/O should not be mixed with normal record-oriented (formatted or unformatted) I/O on the same unit; the results are unpredictable.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Note that the FGET intrinsic is provided for backwards compatibility with g77. GNU Fortran provides the Fortran 2003 Stream facility. Programmers should consider the use of new stream IO feature in new code for future portability. See also [Chapter 4 \[Fortran 2003 status\], page 21](#).

Standard: GNU extension

Class: Subroutine, function

Syntax: CALL FGETC(UNIT, C [, STATUS])

Arguments:

<i>UNIT</i>	The type shall be INTEGER.
<i>C</i>	The type shall be CHARACTER.
<i>STATUS</i>	(Optional) status flag of type INTEGER. Returns 0 on success, -1 on end-of-file and a system specific positive error code otherwise.

Example:

```
PROGRAM test_fgetc
  INTEGER :: fd = 42, status
  CHARACTER :: c

  OPEN(UNIT=fd, FILE="/etc/passwd", ACTION="READ", STATUS = "OLD")
  DO
    CALL fgetc(fd, c, status)
    IF (status /= 0) EXIT
    call fputc(c)
  END DO
```

```

        END DO
        CLOSE(UNIT=fd)
    END PROGRAM

```

See also: [Section 6.66 \[FGET\]](#), page 63, [Section 6.71 \[FPUT\]](#), page 66, [Section 6.72 \[FPUTC\]](#), page 66

6.68 FLOOR — Integer floor function

Description:

FLOOR(X) returns the greatest integer less than or equal to X.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = FLOOR(X [, KIND])

Arguments:

X	The type shall be REAL(*).
KIND	(Optional) An INTEGER(*) initialization expression indicating the kind parameter of the result.

Return value:

The return value is of type INTEGER(KIND)

Example:

```

program test_floor
    real :: x = 63.29
    real :: y = -63.59
    print *, floor(x) ! returns 63
    print *, floor(y) ! returns -64
end program test_floor

```

See also: [Section 6.32 \[CEILING\]](#), page 45, [Section 6.150 \[NINT\]](#), page 103

6.69 FLUSH — Flush I/O unit(s)

Description:

Flushes Fortran unit(s) currently open for output. Without the optional argument, all units are flushed, otherwise just the unit specified.

Standard: GNU extension

Class: Subroutine

Syntax: CALL FLUSH(UNIT)

Arguments:

UNIT	(Optional) The type shall be INTEGER.
------	---------------------------------------

Note: Beginning with the Fortran 2003 standard, there is a FLUSH statement that should be preferred over the FLUSH intrinsic.

6.70 FNUM — File number function

Description:

FNUM(UNIT) returns the POSIX file descriptor number corresponding to the open Fortran I/O unit UNIT.

Standard: GNU extension

Class: Function

Syntax: **RESULT = FNUM(UNIT)**

Arguments:
 UNIT The type shall be **INTEGER**.

Return value:
 The return value is of type **INTEGER**

Example:

```
program test_fnum
  integer :: i
  open (unit=10, status = "scratch")
  i = fnum(10)
  print *, i
  close (10)
end program test_fnum
```

6.71 FPUT — Write a single character in stream mode to stdout

Description:

Write a single character in stream mode to stdout by bypassing normal formatted output. Stream I/O should not be mixed with normal record-oriented (formatted or unformatted) I/O on the same unit; the results are unpredictable.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Note that the **FGET** intrinsic is provided for backwards compatibility with g77. GNU Fortran provides the Fortran 2003 Stream facility. Programmers should consider the use of new stream IO feature in new code for future portability. See also [Chapter 4 \[Fortran 2003 status\]](#), page 21.

Standard: GNU extension

Class: Subroutine, function

Syntax: **CALL FPUT(C [, STATUS])**

Arguments:
 C The type shall be **CHARACTER**.
 STATUS (Optional) status flag of type **INTEGER**. Returns 0 on success, -1 on end-of-file and a system specific positive error code otherwise.

Example:

```
PROGRAM test_fput
  CHARACTER(len=10) :: str = "gfortran"
  INTEGER :: i
  DO i = 1, len_trim(str)
    CALL fput(str(i:i))
  END DO
END PROGRAM
```

See also: [Section 6.72 \[FPUTC\]](#), page 66, [Section 6.66 \[FGET\]](#), page 63, [Section 6.67 \[FGETC\]](#), page 64

6.72 FPUTC — Write a single character in stream mode

Description:

Write a single character in stream mode by bypassing normal formatted output. Stream I/O should not be mixed with normal record-oriented (formatted or unformatted) I/O on the same unit; the results are unpredictable.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Note that the **FGET** intrinsic is provided for backwards compatibility with **g77**. GNU Fortran provides the Fortran 2003 Stream facility. Programmers should consider the use of new stream IO feature in new code for future portability. See also [Chapter 4 \[Fortran 2003 status\]](#), page 21.

Standard: GNU extension

Class: Subroutine, function

Syntax: `CALL FPUTC(UNIT, C [, STATUS])`

Arguments:

<i>UNIT</i>	The type shall be INTEGER .
<i>C</i>	The type shall be CHARACTER .
<i>STATUS</i>	(Optional) status flag of type INTEGER . Returns 0 on success, -1 on end-of-file and a system specific positive error code otherwise.

Example:

```
PROGRAM test_fputc
  CHARACTER(len=10) :: str = "gfortran"
  INTEGER :: fd = 42, i

  OPEN(UNIT = fd, FILE = "out", ACTION = "WRITE", STATUS="NEW")
  DO i = 1, len_trim(str)
    CALL fputc(fd, str(i:i))
  END DO
  CLOSE(fd)
END PROGRAM
```

See also: [Section 6.71 \[FPUT\]](#), page 66, [Section 6.66 \[FGET\]](#), page 63, [Section 6.67 \[FGETC\]](#), page 64

6.73 FRACTION — Fractional part of the model representation

Description:

FRACTION(X) returns the fractional part of the model representation of **X**.

Standard: F95 and later

Class: Elemental function

Syntax: `Y = FRACTION(X)`

Arguments:

<i>X</i>	The type of the argument shall be a REAL .
----------	---

Return value:

The return value is of the same type and kind as the argument. The fractional part of the model representation of **X** is returned; it is $X * \text{RADIX}(X) ** (-\text{EXPONENT}(X))$.

Example:

```
program test_fraction
  real :: x
  x = 178.1387e-4
  print *, fraction(x), x * radix(x)**(-exponent(x))
end program test_fraction
```

6.74 FREE — Frees memory

Description:

Frees memory previously allocated by `MALLOC()`. The `FREE` intrinsic is an extension intended to be used with Cray pointers, and is provided in GNU Fortran to allow user to compile legacy code. For new code using Fortran 95 pointers, the memory de-allocation intrinsic is `DEALLOCATE`.

Standard: GNU extension

Class: Subroutine

Syntax: `CALL FREE(PTR)`

Arguments:

<i>PTR</i>	The type shall be <code>INTEGER</code> . It represents the location of the memory that should be de-allocated.
------------	--

Return value:

None

Example: See `MALLOC` for an example.

See also: [Section 6.131 \[MALLOC\]](#), page 93

6.75 FSEEK — Low level file positioning subroutine

Not yet implemented in GNU Fortran.

Description:

Standard: GNU extension

Class: Subroutine

Syntax:

Arguments:

Return value:

Example:

Specific names:

See also: [g77 features lacking in gfortran](#)

6.76 FSTAT — Get file status

Description:

`FSTAT` is identical to [Section 6.190 \[STAT\]](#), page 122, except that information about an already opened file is obtained.

The elements in `BUFF` are the same as described by [Section 6.190 \[STAT\]](#), page 122.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax: `CALL FSTAT(UNIT, BUFF [, STATUS])`

Arguments:

<i>UNIT</i>	An open I/O unit number of type <code>INTEGER</code> .
<i>BUFF</i>	The type shall be <code>INTEGER(4)</code> , <code>DIMENSION(13)</code> .
<i>STATUS</i>	(Optional) status flag of type <code>INTEGER(4)</code> . Returns 0 on success and a system specific error code otherwise.

Example: See [Section 6.190 \[STAT\]](#), page 122 for an example.

See also: To stat a link: [Section 6.129 \[LSTAT\]](#), page 92, to stat a file: [Section 6.190 \[STAT\]](#), page 122

6.77 FTELL — Current stream position

Description:

Retrieves the current position within an open file.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL FTELL(UNIT, OFFSET)
OFFSET = FTELL(UNIT)
```

Arguments:

<i>OFFSET</i>	Shall of type INTEGER.
<i>UNIT</i>	Shall of type INTEGER.

Return value:

In either syntax, *OFFSET* is set to the current offset of unit number *UNIT*, or to -1 if the unit is not currently open.

Example:

```
PROGRAM test_ftell
  INTEGER :: i
  OPEN(10, FILE="temp.dat")
  CALL ftell(10,i)
  WRITE(*,*) i
END PROGRAM
```

See also: [Section 6.75 \[FSEEK\]](#), page 68

6.78 GERROR — Get last system error message

Description:

Returns the system error message corresponding to the last system error. This resembles the functionality of `strerror(3)` in C.

Standard: GNU extension

Class: Subroutine

Syntax: CALL GERROR(RESULT)

Arguments:

<i>RESULT</i>	Shall of type CHARACTER(*).
---------------	-----------------------------

Example:

```
PROGRAM test_gerror
  CHARACTER(len=100) :: msg
  CALL gerror(msg)
  WRITE(*,*) msg
END PROGRAM
```

See also: [Section 6.101 \[IERRNO\]](#), page 80, [Section 6.155 \[PERROR\]](#), page 106

6.79 GETARG — Get command line arguments

Description:

Retrieve the *N*th argument that was passed on the command line when the containing program was invoked.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. In new code, programmers should consider the use of the [Section 6.81 \[GET_COMMAND_ARGUMENT\]](#), page 71 intrinsic defined by the Fortran 2003 standard.

Standard: GNU extension

Class: Subroutine

Syntax: CALL GETARG(*N*, *ARG*)

Arguments:

<i>N</i>	Shall be of type INTEGER(4), $N \geq 0$
<i>ARG</i>	Shall be of type CHARACTER(*).

Return value:

After GETARG returns, the *ARG* argument holds the *N*th command line argument. If *ARG* can not hold the argument, it is truncated to fit the length of *ARG*. If there are less than *N* arguments specified at the command line, *ARG* will be filled with blanks. If $N = 0$, *ARG* is set to the name of the program (on systems that support this feature).

Example:

```
PROGRAM test_getarg
  INTEGER :: i
  CHARACTER(len=32) :: arg

  DO i = 1, iargc()
    CALL getarg(i, arg)
    WRITE (*,*) arg
  END DO
END PROGRAM
```

See also: GNU Fortran 77 compatibility function: [Section 6.94 \[IARGC\]](#), page 77
 F2003 functions and subroutines: [Section 6.80 \[GET_COMMAND\]](#), page 70,
[Section 6.81 \[GET_COMMAND_ARGUMENT\]](#), page 71, [Section 6.37 \[COMMAND_ARGUMENT_COUNT\]](#), page 48

6.80 GET_COMMAND — Get the entire command line

Description:

Retrieve the entire command line that was used to invoke the program.

Standard: F2003

Class: Subroutine

Syntax: CALL GET_COMMAND(*CMD*)

Arguments:

<i>CMD</i>	Shall be of type CHARACTER(*).
------------	--------------------------------

Return value:

Stores the entire command line that was used to invoke the program in *ARG*. If *ARG* is not large enough, the command will be truncated.

Example:

```
PROGRAM test_get_command
  CHARACTER(len=255) :: cmd
  CALL get_command(cmd)
  WRITE (*,*) TRIM(cmd)
END PROGRAM
```

See also: [Section 6.81 \[GET_COMMAND_ARGUMENT\]](#), page 71, [Section 6.37 \[COMMAND_ARGUMENT_COUNT\]](#), page 48

6.81 GET_COMMAND_ARGUMENT — Get command line arguments

Description:

Retrieve the *N*th argument that was passed on the command line when the containing program was invoked.

Standard: F2003

Class: Subroutine

Syntax: CALL GET_COMMAND_ARGUMENT(*N*, *ARG*)

Arguments:

<i>N</i>	Shall be of type INTEGER(4), $N \geq 0$
<i>ARG</i>	Shall be of type CHARACTER(*).

Return value:

After GET_COMMAND_ARGUMENT returns, the *ARG* argument holds the *N*th command line argument. If *ARG* can not hold the argument, it is truncated to fit the length of *ARG*. If there are less than *N* arguments specified at the command line, *ARG* will be filled with blanks. If $N = 0$, *ARG* is set to the name of the program (on systems that support this feature).

Example:

```
PROGRAM test_get_command_argument
  INTEGER :: i
  CHARACTER(len=32) :: arg

  i = 0
  DO
    CALL get_command_argument(i, arg)
    IF (LEN_TRIM(arg) == 0) EXIT

    WRITE (*,*) TRIM(arg)
    i = i+1
  END DO
END PROGRAM
```

See also: [Section 6.80 \[GET_COMMAND\]](#), page 70, [Section 6.37 \[COMMAND_ARGUMENT_COUNT\]](#), page 48

6.82 GETCWD — Get current working directory

Description:

Get current working directory.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax: CALL GETCWD(CWD [, STATUS])

Arguments:

CWD The type shall be CHARACTER(*).
STATUS (Optional) status flag. Returns 0 on success, a system specific and non-zero error code otherwise.

Example:

```
PROGRAM test_getcwd
  CHARACTER(len=255) :: cwd
  CALL getcwd(cwd)
  WRITE(*,*) TRIM(cwd)
END PROGRAM
```

See also: [Section 6.34 \[CHDIR\], page 46](#)

6.83 GETENV — Get an environmental variable

Description:

Get the *VALUE* of the environmental variable *ENVVAR*.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. In new code, programmers should consider the use of the [Section 6.84 \[GET_ENVIRONMENT_VARIABLE\], page 72](#) intrinsic defined by the Fortran 2003 standard.

Standard: GNU extension

Class: Subroutine

Syntax: CALL GETENV(ENVVAR, VALUE)

Arguments:

ENVVAR Shall be of type CHARACTER(*).
VALUE Shall be of type CHARACTER(*).

Return value:

Stores the value of *ENVVAR* in *VALUE*. If *VALUE* is not large enough to hold the data, it is truncated. If *ENVVAR* is not set, *VALUE* will be filled with blanks.

Example:

```
PROGRAM test_getenv
  CHARACTER(len=255) :: homedir
  CALL getenv("HOME", homedir)
  WRITE (*,*) TRIM(homedir)
END PROGRAM
```

See also: [Section 6.84 \[GET_ENVIRONMENT_VARIABLE\], page 72](#)

6.84 GET_ENVIRONMENT_VARIABLE — Get an environmental variable

Description:

Get the *VALUE* of the environmental variable *ENVVAR*.

Standard: F2003

Class: Subroutine

Syntax: CALL GET_ENVIRONMENT_VARIABLE(ENVVAR, VALUE)

Arguments:

ENVVAR Shall be of type CHARACTER(*).
VALUE Shall be of type CHARACTER(*).

Return value:

Stores the value of *ENVVAR* in *VALUE*. If *VALUE* is not large enough to hold the data, it is truncated. If *ENVVAR* is not set, *VALUE* will be filled with blanks.

Example:

```
PROGRAM test_getenv
  CHARACTER(len=255) :: homedir
  CALL get_environment_variable("HOME", homedir)
  WRITE (*,*) TRIM(homedir)
END PROGRAM
```

6.85 GETGID — Group ID function*Description:*

Returns the numerical group ID of the current process.

Standard: GNU extension

Class: Function

Syntax: `RESULT = GETGID()`

Return value:

The return value of GETGID is an INTEGER of the default kind.

Example: See GETPID for an example.

See also: [Section 6.87 \[GETPID\], page 73](#), [Section 6.88 \[GETUID\], page 74](#)

6.86 GETLOG — Get login name*Description:*

Gets the username under which the program is running.

Standard: GNU extension

Class: Subroutine

Syntax: `CALL GETLOG(LOGIN)`

Arguments:

LOGIN Shall be of type CHARACTER(*).

Return value:

Stores the current user name in *LOGIN*. (On systems where the `getlogin(3)` function is not implemented, this will return a blank string.)

Example:

```
PROGRAM TEST_GETLOG
  CHARACTER(32) :: login
  CALL GETLOG(login)
  WRITE(*,*) login
END PROGRAM
```

See also: [Section 6.88 \[GETUID\], page 74](#)

6.87 GETPID — Process ID function*Description:*

Returns the numerical process identifier of the current process.

Standard: GNU extension

Class: Function

Syntax: **RESULT = GETPID()**

Return value:

The return value of **GETPID** is an **INTEGER** of the default kind.

Example:

```

program info
  print *, "The current process ID is ", getpid()
  print *, "Your numerical user ID is ", getuid()
  print *, "Your numerical group ID is ", getgid()
end program info

```

See also: [Section 6.85 \[GETGID\], page 73](#), [Section 6.88 \[GETUID\], page 74](#)

6.88 GETUID — User ID function

Description:

Returns the numerical user ID of the current process.

Standard: GNU extension

Class: Function

Syntax: **RESULT = GETUID()**

Return value:

The return value of **GETUID** is an **INTEGER** of the default kind.

Example: See **GETPID** for an example.

See also: [Section 6.87 \[GETPID\], page 73](#), [Section 6.86 \[GETLOG\], page 73](#)

6.89 GMTIME — Convert time to GMT info

Description:

Given a system time value *STIME* (as provided by the **TIME8()** intrinsic), fills *TARRAY* with values extracted from it appropriate to the UTC time zone (Universal Coordinated Time, also known in some countries as GMT, Greenwich Mean Time), using **gmtime(3)**.

Standard: GNU extension

Class: Subroutine

Syntax: **CALL GMTIME(STIME, TARRAY)**

Arguments:

<i>STIME</i>	An INTEGER(*) scalar expression corresponding to a system time, with INTENT(IN) .
<i>TARRAY</i>	A default INTEGER array with 9 elements, with INTENT(OUT) .

Return value:

The elements of *TARRAY* are assigned as follows:

1. Seconds after the minute, range 0–59 or 0–61 to allow for leap seconds
2. Minutes after the hour, range 0–59
3. Hours past midnight, range 0–23
4. Day of month, range 0–31
5. Number of months since January, range 0–12
6. Years since 1900
7. Number of days since Sunday, range 0–6

8. Days since January 1
9. Daylight savings indicator: positive if daylight savings is in effect, zero if not, and negative if the information is not available.

See also: [Section 6.45 \[CTIME\], page 52](#), [Section 6.130 \[LTIME\], page 92](#), [Section 6.197 \[TIME\], page 126](#), [Section 6.198 \[TIME8\], page 127](#)

6.90 HOSTNM — Get system host name

Description:

Retrieves the host name of the system on which the program is running.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL HOSTNM(NAME[, STATUS])
STATUS = HOSTNM(NAME)
```

Arguments:

<i>NAME</i>	Shall of type CHARACTER(*).
<i>STATUS</i>	(Optional) status flag of type INTEGER. Returns 0 on success, or a system specific error code otherwise.

Return value:

In either syntax, *NAME* is set to the current hostname if it can be obtained, or to a blank string otherwise.

6.91 HUGE — Largest number of a kind

Description:

HUGE(*X*) returns the largest number that is not an infinity in the model of the type of *X*.

Standard: F95 and later

Class: Inquiry function

Syntax: RESULT = HUGE(*X*)

Arguments:

<i>X</i>	Shall be of type REAL or INTEGER.
----------	-----------------------------------

Return value:

The return value is of the same type and kind as *X*

Example:

```
program test_huge_tiny
  print *, huge(0), huge(0.0), huge(0.0d0)
  print *, tiny(0.0), tiny(0.0d0)
end program test_huge_tiny
```

6.92 IACHAR — Code in ASCII collating sequence

Description:

IACHAR(C) returns the code for the ASCII character in the first character position of C.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = IACHAR(C)

Arguments:

C Shall be a scalar CHARACTER, with INTENT(IN)

Return value:

The return value is of type INTEGER and of the default integer kind.

Example:

```
program test_iachar
  integer i
  i = iachar(' ')
end program test_iachar
```

Note: See [Section 6.98 \[ICHAR\]](#), [page 78](#) for a discussion of converting between numerical values and formatted string representations.

See also: [Section 6.5 \[ACHAR\]](#), [page 31](#), [Section 6.33 \[CHAR\]](#), [page 45](#), [Section 6.98 \[ICHAR\]](#), [page 78](#)

6.93 IAND — Bitwise logical and

Description:

Bitwise logical AND.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = IAND(I, J)

Arguments:

I The type shall be INTEGER(*).
 J The type shall be INTEGER(*), of the same kind as I. (As a GNU extension, different kinds are also permitted.)

Return value:

The return type is INTEGER(*), of the same kind as the arguments. (If the argument kinds differ, it is of the same kind as the larger argument.)

Example:

```
PROGRAM test_iand
  INTEGER :: a, b
  DATA a / Z'F' /, b / Z'3' /
  WRITE (*,*) IAND(a, b)
END PROGRAM
```

See also: [Section 6.106 \[IOR\]](#), [page 82](#), [Section 6.100 \[IEOR\]](#), [page 79](#), [Section 6.96 \[IBITS\]](#), [page 77](#), [Section 6.97 \[IBSET\]](#), [page 78](#), [Section 6.95 \[IBCLR\]](#), [page 77](#), [Section 6.151 \[NOT\]](#), [page 104](#)

6.94 IARGC — Get the number of command line arguments

Description:

IARGC() returns the number of arguments passed on the command line when the containing program was invoked.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. In new code, programmers should consider the use of the [Section 6.37 \[COMMAND_ARGUMENT_COUNT\]](#), page 48 intrinsic defined by the Fortran 2003 standard.

Standard: GNU extension

Class: Function

Syntax: RESULT = IARGC()

Arguments:

None.

Return value:

The number of command line arguments, type INTEGER(4).

Example: See [Section 6.79 \[GETARG\]](#), page 70

See also: GNU Fortran 77 compatibility subroutine: [Section 6.79 \[GETARG\]](#), page 70
F2003 functions and subroutines: [Section 6.80 \[GET_COMMAND\]](#), page 70, [Section 6.81 \[GET_COMMAND_ARGUMENT\]](#), page 71, [Section 6.37 \[COMMAND_ARGUMENT_COUNT\]](#), page 48

6.95 IBCLR — Clear bit

Description:

IBCLR returns the value of *I* with the bit at position *POS* set to zero.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = IBCLR(*I*, *POS*)

Arguments:

<i>I</i>	The type shall be INTEGER(*).
<i>POS</i>	The type shall be INTEGER(*).

Return value:

The return value is of type INTEGER(*) and of the same kind as *I*.

See also: [Section 6.96 \[IBITS\]](#), page 77, [Section 6.97 \[IBSET\]](#), page 78, [Section 6.93 \[IAND\]](#), page 76, [Section 6.106 \[IOR\]](#), page 82, [Section 6.100 \[IEOR\]](#), page 79, [Section 6.147 \[MVBITS\]](#), page 102

6.96 IBITS — Bit extraction

Description:

IBITS extracts a field of length *LEN* from *I*, starting from bit position *POS* and extending left for *LEN* bits. The result is right-justified and the remaining bits are zeroed. The value of *POS*+*LEN* must be less than or equal to the value BIT_SIZE(*I*).

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = IBITS(I, POS, LEN)`

Arguments:

<i>I</i>	The type shall be <code>INTEGER(*)</code> .
<i>POS</i>	The type shall be <code>INTEGER(*)</code> .
<i>LEN</i>	The type shall be <code>INTEGER(*)</code> .

Return value:

The return value is of type `INTEGER(*)` and of the same kind as *I*.

See also: [Section 6.30 \[BIT.SIZE\], page 44](#), [Section 6.95 \[IBCLR\], page 77](#), [Section 6.97 \[IBSET\], page 78](#), [Section 6.93 \[IAND\], page 76](#), [Section 6.106 \[IOR\], page 82](#), [Section 6.100 \[IEOR\], page 79](#)

6.97 IBSET — Set bit

Description:

IBSET returns the value of *I* with the bit at position *POS* set to one.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = IBSET(I, POS)`

Arguments:

<i>I</i>	The type shall be <code>INTEGER(*)</code> .
<i>POS</i>	The type shall be <code>INTEGER(*)</code> .

Return value:

The return value is of type `INTEGER(*)` and of the same kind as *I*.

See also: [Section 6.95 \[IBCLR\], page 77](#), [Section 6.96 \[IBITS\], page 77](#), [Section 6.93 \[IAND\], page 76](#), [Section 6.106 \[IOR\], page 82](#), [Section 6.100 \[IEOR\], page 79](#), [Section 6.147 \[MVBITS\], page 102](#)

6.98 ICHAR — Character-to-integer conversion function

Description:

ICHAR(*C*) returns the code for the character in the first character position of *C* in the system's native character set. The correspondence between characters and their codes is not necessarily the same across different GNU Fortran implementations.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = ICHAR(C)`

Arguments:

<i>C</i>	Shall be a scalar <code>CHARACTER</code> , with <code>INTENT(IN)</code>
----------	---

Return value:

The return value is of type `INTEGER` and of the default integer kind.

Example:

```
program test_ichar
  integer i
  i = ichar(' ')
end program test_ichar
```


Note: No intrinsic exists to convert between a numeric value and a formatted character string representation – for instance, given the CHARACTER value '154', obtaining an INTEGER or REAL value with the value 154, or vice versa. Instead, this functionality is provided by internal-file I/O, as in the following example:

```

program read_val
  integer value
  character(len=10) string, string2
  string = '154'

  ! Convert a string to a numeric value
  read (string, '(I10)') value
  print *, value

  ! Convert a value to a formatted string
  write (string2, '(I10)') value
  print *, string2
end program read_val

```

See also: [Section 6.5 \[ACHAR\], page 31](#), [Section 6.33 \[CHAR\], page 45](#), [Section 6.92 \[IACHAR\], page 76](#)

6.99 IDATE — Get current local time subroutine (day/month/year)

Description:

IDATE(TARRAY) Fills *TARRAY* with the numerical values at the current local time. The day (in the range 1-31), month (in the range 1-12), and year appear in elements 1, 2, and 3 of *TARRAY*, respectively. The year has four significant digits.

Standard: GNU extension

Class: Subroutine

Syntax: CALL IDATE(TARRAY)

Arguments:

TARRAY The type shall be INTEGER, DIMENSION(3) and the kind shall be the default integer kind.

Return value:

Does not return.

Example:

```

program test_idate
  integer, dimension(3) :: tarray
  call idate(tarray)
  print *, tarray(1)
  print *, tarray(2)
  print *, tarray(3)
end program test_idate

```

6.100 IEOR — Bitwise logical exclusive or

Description:

IEOR returns the bitwise boolean exclusive-OR of *I* and *J*.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = IEOR(I, J)

Arguments:

I The type shall be `INTEGER(*)`.
J The type shall be `INTEGER(*)`, of the same kind as *I*. (As a GNU extension, different kinds are also permitted.)

Return value:

The return type is `INTEGER(*)`, of the same kind as the arguments. (If the argument kinds differ, it is of the same kind as the larger argument.)

See also: [Section 6.106 \[IOR\]](#), page 82, [Section 6.93 \[IAND\]](#), page 76, [Section 6.96 \[IBITS\]](#), page 77, [Section 6.97 \[IBSET\]](#), page 78, [Section 6.95 \[IBCLR\]](#), page 77, [Section 6.151 \[NOT\]](#), page 104

6.101 IERRNO — Get the last system error number

Description:

Returns the last system error number, as given by the C `errno()` function.

Standard: GNU extension

Class: Function

Syntax: `RESULT = IERRNO()`

Arguments:

None.

Return value:

The return value is of type `INTEGER` and of the default integer kind.

See also: [Section 6.155 \[PERROR\]](#), page 106

6.102 INDEX — Position of a substring within a string

Description:

Returns the position of the start of the first occurrence of string *SUBSTRING* as a substring in *STRING*, counting from one. If *SUBSTRING* is not present in *STRING*, zero is returned. If the *BACK* argument is present and true, the return value is the start of the last occurrence rather than the first.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = INDEX(STRING, SUBSTRING [, BACK])`

Arguments:

STRING Shall be a scalar `CHARACTER(*)`, with `INTENT(IN)`
SUBSTRING Shall be a scalar `CHARACTER(*)`, with `INTENT(IN)`
BACK (Optional) Shall be a scalar `LOGICAL(*)`, with `INTENT(IN)`

Return value:

The return value is of type `INTEGER` and of the default integer kind.

See also: [Section 6.172 \[SCAN\]](#), page 113, [Section 6.208 \[VERIFY\]](#), page 131

6.103 INT — Convert to integer type

Description:

Convert to integer type

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = INT(A [, KIND])`

Arguments:

A Shall be of type `INTEGER(*)`, `REAL(*)`, or `COMPLEX(*)`.
KIND (Optional) An `INTEGER(*)` initialization expression indicating the kind parameter of the result.

Return value:

These functions return a `INTEGER(*)` variable or array under the following rules:

- (A) If *A* is of type `INTEGER(*)`, `INT(A) = A`
- (B) If *A* is of type `REAL(*)` and $|A| < 1$, `INT(A)` equals 0. If $|A| \geq 1$, then `INT(A)` equals the largest integer that does not exceed the range of *A* and whose sign is the same as the sign of *A*.
- (C) If *A* is of type `COMPLEX(*)`, rule B is applied to the real part of *A*.

Example:

```
program test_int
  integer :: i = 42
  complex :: z = (-3.7, 1.0)
  print *, int(i)
  print *, int(z), int(z,8)
end program
```

Specific names:

Name	Argument	Return type	Standard
<code>IFIX(A)</code>	<code>REAL(4) A</code>	<code>INTEGER</code>	F77 and later
<code>IDINT(A)</code>	<code>REAL(8) A</code>	<code>INTEGER</code>	F77 and later

6.104 INT2 — Convert to 16-bit integer type

Description:

Convert to a `KIND=2` integer type. This is equivalent to the standard `INT` intrinsic with an optional argument of `KIND=2`, and is only included for backwards compatibility.

The `SHORT` intrinsic is equivalent to `INT2`.

Standard: GNU extension.

Class: Elemental function

Syntax: `RESULT = INT2(A)`

Arguments:

A Shall be of type `INTEGER(*)`, `REAL(*)`, or `COMPLEX(*)`.

Return value:

The return value is a `INTEGER(2)` variable.

See also: [Section 6.103 \[INT\], page 81](#), [Section 6.105 \[INT8\], page 82](#), [Section 6.127 \[LONG\], page 91](#)

6.105 INT8 — Convert to 64-bit integer type

Description:

Convert to a `KIND=8` integer type. This is equivalent to the standard `INT` intrinsic with an optional argument of `KIND=8`, and is only included for backwards compatibility.

Standard: GNU extension.

Class: Elemental function

Syntax: `RESULT = INT8(A)`

Arguments:

A Shall be of type `INTEGER(*)`, `REAL(*)`, or `COMPLEX(*)`.

Return value:

The return value is a `INTEGER(8)` variable.

See also: [Section 6.103 \[INT\], page 81](#), [Section 6.104 \[INT2\], page 81](#), [Section 6.127 \[LONG\], page 91](#)

6.106 IOR — Bitwise logical or

Description:

`IEOR` returns the bitwise boolean OR of *I* and *J*.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = IOR(I, J)`

Arguments:

I The type shall be `INTEGER(*)`.

J The type shall be `INTEGER(*)`, of the same kind as *I*. (As a GNU extension, different kinds are also permitted.)

Return value:

The return type is `INTEGER(*)`, of the same kind as the arguments. (If the argument kinds differ, it is of the same kind as the larger argument.)

See also: [Section 6.100 \[IEOR\], page 79](#), [Section 6.93 \[IAND\], page 76](#), [Section 6.96 \[IBITS\], page 77](#), [Section 6.97 \[IBSET\], page 78](#), [Section 6.95 \[IBCLR\], page 77](#), [Section 6.151 \[NOT\], page 104](#)

6.107 IRAND — Integer pseudo-random number

Description:

`IRAND(FLAG)` returns a pseudo-random number from a uniform distribution between 0 and a system-dependent limit (which is in most cases 2147483647). If *FLAG* is 0, the next number in the current sequence is returned; if *FLAG* is 1, the generator is restarted by `CALL SRAND(0)`; if *FLAG* has any other value, it is used as a new seed with `SRAND`.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. It implements a simple modulo generator as provided by `g77`. For new code, one should consider the use of [Section 6.162 \[RANDOM_NUMBER\], page 108](#) as it implements a superior algorithm.

Standard: GNU extension

Class: Function

Syntax: RESULT = IRAND(FLAG)

Arguments:
 FLAG Shall be a scalar INTEGER of kind 4.

Return value:
 The return value is of INTEGER(kind=4) type.

Example:

```
program test_irand
  integer,parameter :: seed = 86456

  call srand(seed)
  print *, irand(), irand(), irand(), irand()
  print *, irand(seed), irand(), irand(), irand()
end program test_irand
```

6.108 ISATTY — Whether a unit is a terminal device.

Description:
 Determine whether a unit is connected to a terminal device.

Standard: GNU extension.

Class: Function

Syntax: RESULT = ISATTY(UNIT)

Arguments:
 UNIT Shall be a scalar INTEGER(*).

Return value:
 Returns .TRUE. if the *UNIT* is connected to a terminal device, .FALSE. otherwise.

Example:

```
PROGRAM test_isatty
  INTEGER(kind=1) :: unit
  DO unit = 1, 10
    write(*,*) isatty(unit=unit)
  END DO
END PROGRAM
```

See also: [Section 6.203 \[TTYNAM\]](#), page 129

6.109 ISHFT — Shift bits

Description:
 ISHFT returns a value corresponding to *I* with all of the bits shifted *SHIFT* places. A value of *SHIFT* greater than zero corresponds to a left shift, a value of zero corresponds to no shift, and a value less than zero corresponds to a right shift. If the absolute value of *SHIFT* is greater than BIT_SIZE(*I*), the value is undefined. Bits shifted out from the left end or right end are lost; zeros are shifted in from the opposite end.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = ISHFT(*I*, *SHIFT*)

Arguments:

<i>I</i>	The type shall be <code>INTEGER(*)</code> .
<i>SHIFT</i>	The type shall be <code>INTEGER(*)</code> .

Return value:

The return value is of type `INTEGER(*)` and of the same kind as *I*.

See also: [Section 6.110 \[ISHFTC\], page 84](#)

6.110 ISHFTC — Shift bits circularly

Description:

ISHFTC returns a value corresponding to *I* with the rightmost *SIZE* bits shifted circularly *SHIFT* places; that is, bits shifted out one end are shifted into the opposite end. A value of *SHIFT* greater than zero corresponds to a left shift, a value of zero corresponds to no shift, and a value less than zero corresponds to a right shift. The absolute value of *SHIFT* must be less than *SIZE*. If the *SIZE* argument is omitted, it is taken to be equivalent to `BIT_SIZE(I)`.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = ISHFTC(I, SHIFT [, SIZE])`

Arguments:

<i>I</i>	The type shall be <code>INTEGER(*)</code> .
<i>SHIFT</i>	The type shall be <code>INTEGER(*)</code> .
<i>SIZE</i>	(Optional) The type shall be <code>INTEGER(*)</code> ; the value must be greater than zero and less than or equal to <code>BIT_SIZE(I)</code> .

Return value:

The return value is of type `INTEGER(*)` and of the same kind as *I*.

See also: [Section 6.109 \[ISHFT\], page 83](#)

6.111 ITIME — Get current local time subroutine (hour/minutes/seconds)

Description:

IDATE(TARRAY) Fills *TARRAY* with the numerical values at the current local time. The hour (in the range 1-24), minute (in the range 1-60), and seconds (in the range 1-60) appear in elements 1, 2, and 3 of *TARRAY*, respectively.

Standard: GNU extension

Class: Subroutine

Syntax: `CALL ITIME(TARRAY)`

Arguments:

<i>TARRAY</i>	The type shall be <code>INTEGER</code> , <code>DIMENSION(3)</code> and the kind shall be the default integer kind.
---------------	--

Return value:

Does not return.

Example:

```
program test_itime
  integer, dimension(3) :: tarray
  call itime(tarray)
```

```

      print *, tarray(1)
      print *, tarray(2)
      print *, tarray(3)
end program test_itime

```

6.112 KILL — Send a signal to a process

Description:

Standard: Sends the signal specified by *SIGNAL* to the process *PID*. See `kill(2)`.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Class: Subroutine, function

Syntax: `CALL KILL(PID, SIGNAL [, STATUS])`

Arguments:

<i>PID</i>	Shall be a scalar <code>INTEGER</code> , with <code>INTENT(IN)</code>
<i>SIGNAL</i>	Shall be a scalar <code>INTEGER</code> , with <code>INTENT(IN)</code>
<i>STATUS</i>	(Optional) status flag of type <code>INTEGER(4)</code> or <code>INTEGER(8)</code> . Returns 0 on success, or a system-specific error code otherwise.

See also: [Section 6.2 \[ABORT\], page 29](#), [Section 6.61 \[EXIT\], page 61](#)

6.113 KIND — Kind of an entity

Description:

`KIND(X)` returns the kind value of the entity *X*.

Standard: F95 and later

Class: Inquiry function

Syntax: `K = KIND(X)`

Arguments:

<i>X</i>	Shall be of type <code>LOGICAL</code> , <code>INTEGER</code> , <code>REAL</code> , <code>COMPLEX</code> or <code>CHARACTER</code> .
----------	---

Return value:

The return value is a scalar of type `INTEGER` and of the default integer kind.

Example:

```

program test_kind
  integer,parameter :: kc = kind(' ')
  integer,parameter :: kl = kind(.true.)

  print *, "The default character kind is ", kc
  print *, "The default logical kind is ", kl
end program test_kind

```

6.114 LBOUND — Lower dimension bounds of an array

Description:

Returns the lower bounds of an array, or a single lower bound along the *DIM* dimension.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = LBOUND(ARRAY [, DIM])`

Arguments:

ARRAY Shall be an array, of any type.
DIM (Optional) Shall be a scalar `INTEGER(*)`.

Return value:

If *DIM* is absent, the result is an array of the lower bounds of *ARRAY*. If *DIM* is present, the result is a scalar corresponding to the lower bound of the array along that dimension. If *ARRAY* is an expression rather than a whole array or array structure component, or if it has a zero extent along the relevant dimension, the lower bound is taken to be 1.

See also: [Section 6.204 \[UBOUND\], page 129](#)

6.115 LEN — Length of a character entity

Description:

Returns the length of a character string. If *STRING* is an array, the length of an element of *STRING* is returned. Note that *STRING* need not be defined when this intrinsic is invoked, since only the length, not the content, of *STRING* is needed.

Standard: F77 and later

Class: Inquiry function

Syntax: `L = LEN(STRING)`

Arguments:

STRING Shall be a scalar or array of type `CHARACTER(*)`, with `INTENT(IN)`

Return value:

The return value is an `INTEGER` of the default kind.

See also: [Section 6.116 \[LEN_TRIM\], page 86](#), [Section 6.8 \[ADJUSTL\], page 32](#), [Section 6.9 \[ADJUSTR\], page 33](#)

6.116 LEN_TRIM — Length of a character entity without trailing blank characters

Description:

Returns the length of a character string, ignoring any trailing blanks.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = LEN_TRIM(STRING)`

Arguments:

STRING Shall be a scalar of type `CHARACTER(*)`, with `INTENT(IN)`

Return value:

The return value is an `INTEGER` of the default kind.

See also: [Section 6.115 \[LEN\], page 86](#), [Section 6.8 \[ADJUSTL\], page 32](#), [Section 6.9 \[ADJUSTR\], page 33](#)

6.117 LGE — Lexical greater than or equal

Description:

Determines whether one string is lexically greater than or equal to another string, where the two strings are interpreted as containing ASCII character codes. If the String A and String B are not the same length, the shorter is compared as if spaces were appended to it to form a value that has the same length as the longer.

In general, the lexical comparison intrinsics LGE, LGT, LLE, and LLT differ from the corresponding intrinsic operators .GE., .GT., .LE., and .LT., in that the latter use the processor's character ordering (which is not ASCII on some targets), whereas the former always use the ASCII ordering.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = LGE(String_A, String_B)`

Arguments:

String_A Shall be of default CHARACTER type.

String_B Shall be of default CHARACTER type.

Return value:

Returns .TRUE. if `String_A >= String_B`, and .FALSE. otherwise, based on the ASCII ordering.

See also: [Section 6.118 \[LGT\], page 87](#), [Section 6.120 \[LLE\], page 88](#), [Section 6.121 \[LLT\], page 89](#)

6.118 LGT — Lexical greater than

Description:

Determines whether one string is lexically greater than another string, where the two strings are interpreted as containing ASCII character codes. If the String A and String B are not the same length, the shorter is compared as if spaces were appended to it to form a value that has the same length as the longer.

In general, the lexical comparison intrinsics LGE, LGT, LLE, and LLT differ from the corresponding intrinsic operators .GE., .GT., .LE., and .LT., in that the latter use the processor's character ordering (which is not ASCII on some targets), whereas the former always use the ASCII ordering.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = LGT(String_A, String_B)`

Arguments:

String_A Shall be of default CHARACTER type.

String_B Shall be of default CHARACTER type.

Return value:

Returns .TRUE. if `String_A > String_B`, and .FALSE. otherwise, based on the ASCII ordering.

See also: [Section 6.117 \[LGE\], page 87](#), [Section 6.120 \[LLE\], page 88](#), [Section 6.121 \[LLT\], page 89](#)

6.119 LINK — Create a hard link

Description:

Makes a (hard) link from file *PATH1* to *PATH2*. A null character (`CHAR(0)`) can be used to mark the end of the names in *PATH1* and *PATH2*; otherwise, trailing blanks in the file names are ignored. If the *STATUS* argument is supplied, it contains 0 on success or a nonzero error code upon return; see `link(2)`.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL LINK(PATH1, PATH2 [, STATUS])
STATUS = LINK(PATH1, PATH2)
```

Arguments:

<i>PATH1</i>	Shall be of default CHARACTER type.
<i>PATH2</i>	Shall be of default CHARACTER type.
<i>STATUS</i>	(Optional) Shall be of default INTEGER type.

See also: [Section 6.192 \[SYMLNK\], page 124](#), [Section 6.206 \[UNLINK\], page 130](#)

6.120 LLE — Lexical less than or equal

Description:

Determines whether one string is lexically less than or equal to another string, where the two strings are interpreted as containing ASCII character codes. If the String A and String B are not the same length, the shorter is compared as if spaces were appended to it to form a value that has the same length as the longer.

In general, the lexical comparison intrinsics LGE, LGT, LLE, and LLT differ from the corresponding intrinsic operators `.GE.`, `.GT.`, `.LE.`, and `.LT.`, in that the latter use the processor's character ordering (which is not ASCII on some targets), whereas the former always use the ASCII ordering.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = LLE(String_A, String_B)`

Arguments:

<i>STRING_A</i>	Shall be of default CHARACTER type.
<i>STRING_B</i>	Shall be of default CHARACTER type.

Return value:

Returns `.TRUE.` if `STRING_A <= STRING_B`, and `.FALSE.` otherwise, based on the ASCII ordering.

See also: [Section 6.117 \[LGE\], page 87](#), [Section 6.118 \[LGT\], page 87](#), [Section 6.121 \[LLT\], page 89](#)

6.121 LLT — Lexical less than

Description:

Determines whether one string is lexically less than another string, where the two strings are interpreted as containing ASCII character codes. If the String A and String B are not the same length, the shorter is compared as if spaces were appended to it to form a value that has the same length as the longer.

In general, the lexical comparison intrinsics LGE, LGT, LLE, and LLT differ from the corresponding intrinsic operators .GE., .GT., .LE., and .LT., in that the latter use the processor's character ordering (which is not ASCII on some targets), whereas the former always use the ASCII ordering.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = LLT(STRING_A, STRING_B)

Arguments:

STRING_A Shall be of default CHARACTER type.
STRING_B Shall be of default CHARACTER type.

Return value:

Returns .TRUE. if STRING_A < STRING_B, and .FALSE. otherwise, based on the ASCII ordering.

See also: [Section 6.117 \[LGE\], page 87](#), [Section 6.118 \[LGT\], page 87](#), [Section 6.120 \[LLE\], page 88](#)

6.122 LNBLNK — Index of the last non-blank character in a string

Description:

Returns the length of a character string, ignoring any trailing blanks. This is identical to the standard LEN_TRIM intrinsic, and is only included for backwards compatibility.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = LNBLNK(STRING)

Arguments:

STRING Shall be a scalar of type CHARACTER(*), with INTENT(IN)

Return value:

The return value is of INTEGER(kind=4) type.

See also: [Section 6.102 \[INDEX\], page 80](#), [Section 6.116 \[LEN_TRIM\], page 86](#)

6.123 LOC — Returns the address of a variable

Description:

LOC(X) returns the address of X as an integer.

Standard: GNU extension

Class: Inquiry function

Syntax: RESULT = LOC(X)

Arguments:

X Variable of any type.

Return value:

The return value is of type `INTEGER`, with a `KIND` corresponding to the size (in bytes) of a memory address on the target machine.

Example:

```

program test_loc
  integer :: i
  real :: r
  i = loc(r)
  print *, i
end program test_loc

```

6.124 LOG — Logarithm function

Description:

`LOG(X)` computes the logarithm of *X*.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = LOG(X)`

Arguments:

X The type shall be `REAL(*)` or `COMPLEX(*)`.

Return value:

The return value is of type `REAL(*)` or `COMPLEX(*)`. The kind type parameter is the same as *X*.

Example:

```

program test_log
  real(8) :: x = 1.0_8
  complex :: z = (1.0, 2.0)
  x = log(x)
  z = log(z)
end program test_log

```

Specific names:

Name	Argument	Return type	Standard
<code>ALOG(X)</code>	<code>REAL(4) X</code>	<code>REAL(4)</code>	f95, gnu
<code>DLOG(X)</code>	<code>REAL(8) X</code>	<code>REAL(8)</code>	f95, gnu
<code>CLOG(X)</code>	<code>COMPLEX(4) X</code>	<code>COMPLEX(4)</code>	f95, gnu
<code>ZLOG(X)</code>	<code>COMPLEX(8) X</code>	<code>COMPLEX(8)</code>	f95, gnu
<code>CDLOG(X)</code>	<code>COMPLEX(8) X</code>	<code>COMPLEX(8)</code>	f95, gnu

6.125 LOG10 — Base 10 logarithm function

Description:

`LOG10(X)` computes the base 10 logarithm of *X*.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = LOG10(X)`

Arguments:

X The type shall be `REAL(*)`.

Return value:

The return value is of type `REAL(*)` or `COMPLEX(*)`. The kind type parameter is the same as `X`.

Example:

```
program test_log10
  real(8) :: x = 10.0_8
  x = log10(x)
end program test_log10
```

Specific names:

Name	Argument	Return type	Standard
<code>ALOG10(X)</code>	<code>REAL(4) X</code>	<code>REAL(4)</code>	F95 and later
<code>DLOG10(X)</code>	<code>REAL(8) X</code>	<code>REAL(8)</code>	F95 and later

6.126 LOGICAL — Convert to logical type*Description:*

Converts one kind of `LOGICAL` variable to another.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = LOGICAL(L [, KIND])`

Arguments:

`L` The type shall be `LOGICAL(*)`.
`KIND` (Optional) An `INTEGER(*)` initialization expression indicating the kind parameter of the result.

Return value:

The return value is a `LOGICAL` value equal to `L`, with a kind corresponding to `KIND`, or of the default logical kind if `KIND` is not given.

See also: [Section 6.103 \[INT\], page 81](#), [Section 6.165 \[REAL\], page 110](#), [Section 6.36 \[CM-PLX\], page 47](#)

6.127 LONG — Convert to integer type*Description:*

Convert to a `KIND=4` integer type, which is the same size as a C long integer. This is equivalent to the standard `INT` intrinsic with an optional argument of `KIND=4`, and is only included for backwards compatibility.

Standard: GNU extension.

Class: Elemental function

Syntax: `RESULT = LONG(A)`

Arguments:

`A` Shall be of type `INTEGER(*)`, `REAL(*)`, or `COMPLEX(*)`.

Return value:

The return value is a `INTEGER(4)` variable.

See also: [Section 6.103 \[INT\], page 81](#), [Section 6.104 \[INT2\], page 81](#), [Section 6.105 \[INT8\], page 82](#)

6.128 LSHIFT — Left shift bits

Description:

LSHIFT returns a value corresponding to *I* with all of the bits shifted left by *SHIFT* places. If the absolute value of *SHIFT* is greater than `BIT_SIZE(I)`, the value is undefined. Bits shifted out from the left end are lost; zeros are shifted in from the opposite end.

This function has been superseded by the `ISHFT` intrinsic, which is standard in Fortran 95 and later.

Standard: GNU extension

Class: Elemental function

Syntax: `RESULT = LSHIFT(I, SHIFT)`

Arguments:

<i>I</i>	The type shall be <code>INTEGER(*)</code> .
<i>SHIFT</i>	The type shall be <code>INTEGER(*)</code> .

Return value:

The return value is of type `INTEGER(*)` and of the same kind as *I*.

See also: [Section 6.109 \[ISHFT\], page 83](#), [Section 6.110 \[ISHFTC\], page 84](#), [Section 6.170 \[RSHIFT\], page 112](#)

6.129 LSTAT — Get file status

Description:

LSTAT is identical to [Section 6.190 \[STAT\], page 122](#), except that if path is a symbolic link, then the link itself is stattd, not the file that it refers to.

The elements in `BUFF` are the same as described by [Section 6.190 \[STAT\], page 122](#).

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax: `CALL LSTAT(FILE, BUFF [, STATUS])`

Arguments:

<i>FILE</i>	The type shall be <code>CHARACTER(*)</code> , a valid path within the file system.
<i>BUFF</i>	The type shall be <code>INTEGER(4), DIMENSION(13)</code> .
<i>STATUS</i>	(Optional) status flag of type <code>INTEGER(4)</code> . Returns 0 on success and a system specific error code otherwise.

Example: See [Section 6.190 \[STAT\], page 122](#) for an example.

See also: To stat an open file: [Section 6.76 \[FSTAT\], page 68](#), to stat a file: [Section 6.190 \[STAT\], page 122](#)

6.130 LTIME — Convert time to local time info

Description:

Given a system time value *STIME* (as provided by the `TIME8()` intrinsic), fills *TARRAY* with values extracted from it appropriate to the local time zone using `localtime(3)`.

Standard: GNU extension

Class: Subroutine

Syntax: CALL LTIME(STIME, TARRAY)

Arguments:

<i>STIME</i>	An INTEGER(*) scalar expression corresponding to a system time, with INTENT(IN).
<i>TARRAY</i>	A default INTEGER array with 9 elements, with INTENT(OUT).

Return value:

The elements of *TARRAY* are assigned as follows:

1. Seconds after the minute, range 0–59 or 0–61 to allow for leap seconds
2. Minutes after the hour, range 0–59
3. Hours past midnight, range 0–23
4. Day of month, range 0–31
5. Number of months since January, range 0–12
6. Years since 1900
7. Number of days since Sunday, range 0–6
8. Days since January 1
9. Daylight savings indicator: positive if daylight savings is in effect, zero if not, and negative if the information is not available.

See also: [Section 6.45 \[CTIME\], page 52](#), [Section 6.89 \[GMTIME\], page 74](#), [Section 6.197 \[TIME\], page 126](#), [Section 6.198 \[TIME8\], page 127](#)

6.131 MALLOC — Allocate dynamic memory

Description:

MALLOC(SIZE) allocates *SIZE* bytes of dynamic memory and returns the address of the allocated memory. The MALLOC intrinsic is an extension intended to be used with Cray pointers, and is provided in GNU Fortran to allow the user to compile legacy code. For new code using Fortran 95 pointers, the memory allocation intrinsic is ALLOCATE.

Standard: GNU extension

Class: Function

Syntax: PTR = MALLOC(SIZE)

Arguments:

<i>SIZE</i>	The type shall be INTEGER(*).
-------------	-------------------------------

Return value:

The return value is of type INTEGER(K), with *K* such that variables of type INTEGER(K) have the same size as C pointers (sizeof(void *)).

Example: The following example demonstrates the use of MALLOC and FREE with Cray pointers. This example is intended to run on 32-bit systems, where the default integer kind is suitable to store pointers; on 64-bit systems, ptr_x would need to be declared as integer(kind=8).

```

program test_malloc
  integer i
  integer ptr_x
  real*8 x(*), z

```

```

pointer(ptr_x,x)

ptr_x = malloc(20*8)
do i = 1, 20
  x(i) = sqrt(1.0d0 / i)
end do
z = 0
do i = 1, 20
  z = z + x(i)
  print *, z
end do
call free(ptr_x)
end program test_malloc

```

See also: [Section 6.74 \[FREE\]](#), page 68

6.132 MATMUL — matrix multiplication

Description:

Performs a matrix multiplication on numeric or logical arguments.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = MATMUL(MATRIX_A, MATRIX_B)`

Arguments:

<i>MATRIX_A</i>	An array of <code>INTEGER(*)</code> , <code>REAL(*)</code> , <code>COMPLEX(*)</code> , or <code>LOGICAL(*)</code> type, with a rank of one or two.
<i>MATRIX_B</i>	An array of <code>INTEGER(*)</code> , <code>REAL(*)</code> , or <code>COMPLEX(*)</code> type if <i>MATRIX_A</i> is of a numeric type; otherwise, an array of <code>LOGICAL(*)</code> type. The rank shall be one or two, and the first (or only) dimension of <i>MATRIX_B</i> shall be equal to the last (or only) dimension of <i>MATRIX_A</i> .

Return value:

The matrix product of *MATRIX_A* and *MATRIX_B*. The type and kind of the result follow the usual type and kind promotion rules, as for the `*` or `.AND.` operators.

See also:

6.133 MAX — Maximum value of an argument list

Description:

Returns the argument with the largest (most positive) value.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = MAX(A1, A2 [, A3 [, ...]])`

Arguments:

<i>A1</i>	The type shall be <code>INTEGER(*)</code> or <code>REAL(*)</code> .
<i>A2, A3, ...</i>	An expression of the same type and kind as <i>A1</i> . (As a GNU extension, arguments of different kinds are permitted.)

Return value:

The return value corresponds to the maximum value among the arguments, and has the same type and kind as the first argument.

Specific names:

Name	Argument	Return type	Standard
MAXO(I)	INTEGER(4) I	INTEGER(4)	F77 and later
AMAXO(I)	INTEGER(4) I	REAL(MAX(X))	F77 and later
MAX1(X)	REAL(*) X	INT(MAX(X))	F77 and later
AMAX1(X)	REAL(4) X	REAL(4)	F77 and later
DMAX1(X)	REAL(8) X	REAL(8)	F77 and later

See also: [Section 6.135 \[MAXLOC\], page 95](#) [Section 6.136 \[MAXVAL\], page 96](#), [Section 6.140 \[MIN\], page 98](#)

6.134 MAXEXPONENT — Maximum exponent of a real kind

Description:

MAXEXPONENT(X) returns the maximum exponent in the model of the type of X.

Standard: F95 and later

Class: Inquiry function

Syntax: RESULT = MAXEXPONENT(X)

Arguments:

X Shall be of type REAL.

Return value:

The return value is of type INTEGER and of the default integer kind.

Example:

```

program exponents
  real(kind=4) :: x
  real(kind=8) :: y

  print *, minexponent(x), maxexponent(x)
  print *, minexponent(y), maxexponent(y)
end program exponents

```

6.135 MAXLOC — Location of the maximum value within an array

Description:

Determines the location of the element in the array with the maximum value, or, if the *DIM* argument is supplied, determines the locations of the maximum element along each row of the array in the *DIM* direction. If *MASK* is present, only the elements for which *MASK* is *.TRUE.* are considered. If more than one element in the array has the maximum value, the location returned is that of the first such element in array element order. If the array has zero size, or all of the elements of *MASK* are *.FALSE.*, then the result is an array of zeroes. Similarly, if *DIM* is supplied and all of the elements of *MASK* along a given row are zero, the result value for that row is zero.

Standard: F95 and later

Class: Transformational function

Syntax:

```

RESULT = MAXLOC(ARRAY, DIM [, MASK])
RESULT = MAXLOC(ARRAY [, MASK])

```

Arguments:

<i>ARRAY</i>	Shall be an array of type <code>INTEGER(*)</code> , <code>REAL(*)</code> , or <code>CHARACTER(*)</code> .
<i>DIM</i>	(Optional) Shall be a scalar of type <code>INTEGER(*)</code> , with a value between one and the rank of <i>ARRAY</i> , inclusive. It may not be an optional dummy argument.
<i>MASK</i>	Shall be an array of type <code>LOGICAL(*)</code> , and conformable with <i>ARRAY</i> .

Return value:

If *DIM* is absent, the result is a rank-one array with a length equal to the rank of *ARRAY*. If *DIM* is present, the result is an array with a rank one less than the rank of *ARRAY*, and a size corresponding to the size of *ARRAY* with the *DIM* dimension removed. If *DIM* is present and *ARRAY* has a rank of one, the result is a scalar. In all cases, the result is of default `INTEGER` type.

See also: [Section 6.133 \[MAX\]](#), page 94, [Section 6.136 \[MAXVAL\]](#), page 96

6.136 MAXVAL — Maximum value of an array

Description:

Determines the maximum value of the elements in an array value, or, if the *DIM* argument is supplied, determines the maximum value along each row of the array in the *DIM* direction. If *MASK* is present, only the elements for which *MASK* is `.TRUE.` are considered. If the array has zero size, or all of the elements of *MASK* are `.FALSE.`, then the result is the most negative number of the type and kind of *ARRAY* if *ARRAY* is numeric, or a string of nulls if *ARRAY* is of character type.

Standard: F95 and later

Class: Transformational function

Syntax:

```
RESULT = MAXVAL(ARRAY, DIM [, MASK])
RESULT = MAXVAL(ARRAY [, MASK])
```

Arguments:

<i>ARRAY</i>	Shall be an array of type <code>INTEGER(*)</code> , <code>REAL(*)</code> , or <code>CHARACTER(*)</code> .
<i>DIM</i>	(Optional) Shall be a scalar of type <code>INTEGER(*)</code> , with a value between one and the rank of <i>ARRAY</i> , inclusive. It may not be an optional dummy argument.
<i>MASK</i>	Shall be an array of type <code>LOGICAL(*)</code> , and conformable with <i>ARRAY</i> .

Return value:

If *DIM* is absent, or if *ARRAY* has a rank of one, the result is a scalar. If *DIM* is present, the result is an array with a rank one less than the rank of *ARRAY*, and a size corresponding to the size of *ARRAY* with the *DIM* dimension removed. In all cases, the result is of the same type and kind as *ARRAY*.

See also: [Section 6.133 \[MAX\]](#), page 94, [Section 6.135 \[MAXLOC\]](#), page 95

6.137 MCLOCK — Time function

Description:

Returns the number of clock ticks since the start of the process, based on the UNIX function `clock(3)`.

This intrinsic is not fully portable, such as to systems with 32-bit `INTEGER` types but supporting times wider than 32 bits. Therefore, the values returned by this intrinsic might be, or become, negative, or numerically less than previous values, during a single run of the compiled program.

Standard: GNU extension

Class: Function

Syntax: `RESULT = MCLOCK()`

Return value:

The return value is a scalar of type `INTEGER(4)`, equal to the number of clock ticks since the start of the process, or `-1` if the system does not support `clock(3)`.

See also: [Section 6.45 \[CTIME\]](#), page 52, [Section 6.89 \[GMTIME\]](#), page 74, [Section 6.130 \[LTIME\]](#), page 92, [Section 6.137 \[MCLOCK\]](#), page 96, [Section 6.197 \[TIME\]](#), page 126

6.138 MCLOCK8 — Time function (64-bit)

Description:

Returns the number of clock ticks since the start of the process, based on the UNIX function `clock(3)`.

Warning: this intrinsic does not increase the range of the timing values over that returned by `clock(3)`. On a system with a 32-bit `clock(3)`, `MCLOCK8()` will return a 32-bit value, even though it is converted to a 64-bit `INTEGER(8)` value. That means overflows of the 32-bit value can still occur. Therefore, the values returned by this intrinsic might be or become negative or numerically less than previous values during a single run of the compiled program.

Standard: GNU extension

Class: Function

Syntax: `RESULT = MCLOCK8()`

Return value:

The return value is a scalar of type `INTEGER(8)`, equal to the number of clock ticks since the start of the process, or `-1` if the system does not support `clock(3)`.

See also: [Section 6.45 \[CTIME\]](#), page 52, [Section 6.89 \[GMTIME\]](#), page 74, [Section 6.130 \[LTIME\]](#), page 92, [Section 6.137 \[MCLOCK\]](#), page 96, [Section 6.198 \[TIME8\]](#), page 127

6.139 MERGE — Merge variables

Description:

Select values from two arrays according to a logical mask. The result is equal to *TSOURCE* if *MASK* is `.TRUE.`, or equal to *FSOURCE* if it is `.FALSE.`.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = MERGE(TSOURCE, FSOURCE, MASK)`

Arguments:

<i>TSOURCE</i>	May be of any type.
<i>FSOURCE</i>	Shall be of the same type and type parameters as <i>TSOURCE</i> .
<i>MASK</i>	Shall be of type <code>LOGICAL(*)</code> .

Return value:

The result is of the same type and type parameters as *TSOURCE*.

6.140 MIN — Minimum value of an argument list

Description:

Returns the argument with the smallest (most negative) value.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = MIN(A1, A2 [, A3, ...])`

Arguments:

A1 The type shall be `INTEGER(*)` or `REAL(*)`.
A2, A3, ... An expression of the same type and kind as *A1*. (As a GNU extension, arguments of different kinds are permitted.)

Return value:

The return value corresponds to the maximum value among the arguments, and has the same type and kind as the first argument.

Specific names:

Name	Argument	Return type	Standard
<code>MINO(I)</code>	<code>INTEGER(4) I</code>	<code>INTEGER(4)</code>	F77 and later
<code>AMINO(I)</code>	<code>INTEGER(4) I</code>	<code>REAL(MIN(X))</code>	F77 and later
<code>MIN1(X)</code>	<code>REAL(*) X</code>	<code>INT(MIN(X))</code>	F77 and later
<code>AMIN1(X)</code>	<code>REAL(4) X</code>	<code>REAL(4)</code>	F77 and later
<code>DMIN1(X)</code>	<code>REAL(8) X</code>	<code>REAL(8)</code>	F77 and later

See also: [Section 6.133 \[MAX\], page 94](#), [Section 6.142 \[MINLOC\], page 98](#), [Section 6.143 \[MINVAL\], page 99](#)

6.141 MINEXPONENT — Minimum exponent of a real kind

Description:

`MINEXPONENT(X)` returns the minimum exponent in the model of the type of *X*.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = MINEXPONENT(X)`

Arguments:

X Shall be of type `REAL`.

Return value:

The return value is of type `INTEGER` and of the default integer kind.

Example: See `MAXEXPONENT` for an example.

6.142 MINLOC — Location of the minimum value within an array

Description:

Determines the location of the element in the array with the minimum value, or, if the *DIM* argument is supplied, determines the locations of the minimum element along each row of the array in the *DIM* direction. If *MASK* is present, only the elements for which *MASK* is `.TRUE.` are considered. If more than one element in the

array has the minimum value, the location returned is that of the first such element in array element order. If the array has zero size, or all of the elements of *MASK* are *.FALSE.*, then the result is an array of zeroes. Similarly, if *DIM* is supplied and all of the elements of *MASK* along a given row are zero, the result value for that row is zero.

Standard: F95 and later

Class: Transformational function

Syntax:

```
RESULT = MINLOC(ARRAY, DIM [, MASK])
```

```
RESULT = MINLOC(ARRAY [, MASK])
```

Arguments:

ARRAY Shall be an array of type *INTEGER(*)*, *REAL(*)*, or *CHARACTER(*)*.

DIM (Optional) Shall be a scalar of type *INTEGER(*)*, with a value between one and the rank of *ARRAY*, inclusive. It may not be an optional dummy argument.

MASK Shall be an array of type *LOGICAL(*)*, and conformable with *ARRAY*.

Return value:

If *DIM* is absent, the result is a rank-one array with a length equal to the rank of *ARRAY*. If *DIM* is present, the result is an array with a rank one less than the rank of *ARRAY*, and a size corresponding to the size of *ARRAY* with the *DIM* dimension removed. If *DIM* is present and *ARRAY* has a rank of one, the result is a scalar. In all cases, the result is of default *INTEGER* type.

See also: [Section 6.140 \[MIN\], page 98](#), [Section 6.143 \[MINVAL\], page 99](#)

6.143 MINVAL — Minimum value of an array

Description:

Determines the minimum value of the elements in an array value, or, if the *DIM* argument is supplied, determines the minimum value along each row of the array in the *DIM* direction. If *MASK* is present, only the elements for which *MASK* is *.TRUE.* are considered. If the array has zero size, or all of the elements of *MASK* are *.FALSE.*, then the result is *HUGE(ARRAY)* if *ARRAY* is numeric, or a string of *CHAR(255)* characters if *ARRAY* is of character type.

Standard: F95 and later

Class: Transformational function

Syntax:

```
RESULT = MINVAL(ARRAY, DIM [, MASK])
```

```
RESULT = MINVAL(ARRAY [, MASK])
```

Arguments:

ARRAY Shall be an array of type *INTEGER(*)*, *REAL(*)*, or *CHARACTER(*)*.

DIM (Optional) Shall be a scalar of type *INTEGER(*)*, with a value between one and the rank of *ARRAY*, inclusive. It may not be an optional dummy argument.

MASK Shall be an array of type *LOGICAL(*)*, and conformable with *ARRAY*.

Return value:

If *DIM* is absent, or if *ARRAY* has a rank of one, the result is a scalar. If *DIM* is present, the result is an array with a rank one less than the rank of *ARRAY*, and a size corresponding to the size of *ARRAY* with the *DIM* dimension removed. In all cases, the result is of the same type and kind as *ARRAY*.

See also: [Section 6.140 \[MIN\]](#), page 98, [Section 6.142 \[MINLOC\]](#), page 98

6.144 MOD — Remainder function

Description:

MOD(*A*,*P*) computes the remainder of the division of *A* by *P*. It is calculated as $A - (\text{INT}(A/P) * P)$.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = MOD(*A*, *P*)

Arguments:

<i>A</i>	Shall be a scalar of type INTEGER or REAL
<i>P</i>	Shall be a scalar of the same type as <i>A</i> and not equal to zero

Return value:

The kind of the return value is the result of cross-promoting the kinds of the arguments.

Example:

```

program test_mod
  print *, mod(17,3)
  print *, mod(17.5,5.5)
  print *, mod(17.5d0,5.5)
  print *, mod(17.5,5.5d0)

  print *, mod(-17,3)
  print *, mod(-17.5,5.5)
  print *, mod(-17.5d0,5.5)
  print *, mod(-17.5,5.5d0)

  print *, mod(17,-3)
  print *, mod(17.5,-5.5)
  print *, mod(17.5d0,-5.5)
  print *, mod(17.5,-5.5d0)
end program test_mod

```

Specific names:

Name	Arguments	Return type	Standard
AMOD(<i>A</i> , <i>P</i>)	REAL(4)	REAL(4)	F95 and later
DMOD(<i>A</i> , <i>P</i>)	REAL(8)	REAL(8)	F95 and later

6.145 MODULO — Modulo function

Description:

MODULO(*A*,*P*) computes the *A* modulo *P*.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = MODULO(*A*, *P*)

Arguments:

A Shall be a scalar of type `INTEGER` or `REAL`
P Shall be a scalar of the same type and kind as *A*

Return value:

The type and kind of the result are those of the arguments.

If *A* and *P* are of type `INTEGER`:

`MODULO(A,P)` has the value *R* such that $A=Q \cdot P+R$, where *Q* is an integer and *R* is between 0 (inclusive) and *P* (exclusive).

If *A* and *P* are of type `REAL`:

`MODULO(A,P)` has the value of $A - \text{FLOOR}(A / P) * P$.

In all cases, if *P* is zero the result is processor-dependent.

Example:

```
program test_modulo
  print *, modulo(17,3)
  print *, modulo(17.5,5.5)

  print *, modulo(-17,3)
  print *, modulo(-17.5,5.5)

  print *, modulo(17,-3)
  print *, modulo(17.5,-5.5)
end program
```

6.146 `MOVE_ALLOC` — Move allocation from one object to another

Description:

`MOVE_ALLOC(SRC, DEST)` moves the allocation from *SRC* to *DEST*. *SRC* will become deallocated in the process.

Standard: F2003 and later

Class: Subroutine

Syntax: `CALL MOVE_ALLOC(SRC, DEST)`

Arguments:

SRC `ALLOCATABLE`, `INTENT(INOUT)`, may be of any type and kind.
DEST `ALLOCATABLE`, `INTENT(OUT)`, shall be of the same type, kind and rank as *SRC*

Return value:

None

Example:

```
program test_move_alloc
  integer, allocatable :: a(:), b(:)

  allocate(a(3))
  a = [ 1, 2, 3 ]
  call move_alloc(a, b)
  print *, allocated(a), allocated(b)
  print *, b
end program test_move_alloc
```

6.147 MVBITS — Move bits from one integer to another

Description:

Moves *LEN* bits from positions *FROMPOS* through *FROMPOS*+*LEN*-1 of *FROM* to positions *TOPOS* through *TOPOS*+*LEN*-1 of *TO*. The portion of argument *TO* not affected by the movement of bits is unchanged. The values of *FROMPOS*+*LEN*-1 and *TOPOS*+*LEN*-1 must be less than *BIT_SIZE*(*FROM*).

Standard: F95 and later

Class: Elemental subroutine

Syntax: CALL MVBITS(*FROM*, *FROMPOS*, *LEN*, *TO*, *TOPOS*)

Arguments:

<i>FROM</i>	The type shall be <i>INTEGER</i> (<i>*</i>).
<i>FROMPOS</i>	The type shall be <i>INTEGER</i> (<i>*</i>).
<i>LEN</i>	The type shall be <i>INTEGER</i> (<i>*</i>).
<i>TO</i>	The type shall be <i>INTEGER</i> (<i>*</i>), of the same kind as <i>FROM</i> .
<i>TOPOS</i>	The type shall be <i>INTEGER</i> (<i>*</i>).

Return value:

The return value is of type *INTEGER*(***) and of the same kind as *FROM*.

See also: [Section 6.95 \[IBCLR\], page 77](#), [Section 6.97 \[IBSET\], page 78](#), [Section 6.96 \[IBITS\], page 77](#), [Section 6.93 \[IAND\], page 76](#), [Section 6.106 \[IOR\], page 82](#), [Section 6.100 \[IEOR\], page 79](#)

6.148 NEAREST — Nearest representable number

Description:

NEAREST(*X*, *S*) returns the processor-representable number nearest to *X* in the direction indicated by the sign of *S*.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = *NEAREST*(*X*, *S*)

Arguments:

<i>X</i>	Shall be of type <i>REAL</i> .
<i>S</i>	(Optional) shall be of type <i>REAL</i> and not equal to zero.

Return value:

The return value is of the same type as *X*. If *S* is positive, *NEAREST* returns the processor-representable number greater than *X* and nearest to it. If *S* is negative, *NEAREST* returns the processor-representable number smaller than *X* and nearest to it.

Example:

```
program test_nearest
  real :: x, y
  x = nearest(42.0, 1.0)
  y = nearest(42.0, -1.0)
  write (*,"(3(G20.15))") x, y, x - y
end program test_nearest
```


6.149 NEW_LINE — New line character

Description:

NEW_LINE(*C*) returns the new-line character.

Standard: F2003 and later

Class: Inquiry function

Syntax: RESULT = NEW_LINE(*C*)

Arguments:

C The argument shall be a scalar or array of the type CHARACTER.

Return value:

Returns a CHARACTER scalar of length one with the new-line character of the same kind as parameter *C*.

Example:

```
program newline
  implicit none
  write(*,'(A)') 'This is record 1.'//NEW_LINE('A')// 'This is record 2.'
end program newline
```

6.150 NINT — Nearest whole number

Description:

NINT(*X*) rounds its argument to the nearest whole number.

Standard: F77 and later

Class: Elemental function

Syntax: RESULT = NINT(*X*)

Arguments:

X The type of the argument shall be REAL.

Return value:

Returns *A* with the fractional portion of its magnitude eliminated by rounding to the nearest whole number and with its sign preserved, converted to an INTEGER of the default kind.

Example:

```
program test_nint
  real(4) x4
  real(8) x8
  x4 = 1.234E0_4
  x8 = 4.321_8
  print *, nint(x4), idnint(x8)
end program test_nint
```

Specific names:

Name	Argument	Standard
IDNINT(<i>X</i>)	REAL(8)	F95 and later

See also: [Section 6.32 \[CEILING\]](#), page 45, [Section 6.68 \[FLOOR\]](#), page 65

6.151 NOT — Logical negation

Description:

NOT returns the bitwise boolean inverse of *I*.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = NOT(I)`

Arguments:

I The type shall be `INTEGER(*)`.

Return value:

The return type is `INTEGER(*)`, of the same kind as the argument.

See also: [Section 6.93 \[IAND\], page 76](#), [Section 6.100 \[IEOR\], page 79](#), [Section 6.106 \[IOR\], page 82](#), [Section 6.96 \[IBITS\], page 77](#), [Section 6.97 \[IBSET\], page 78](#), [Section 6.95 \[IBCLR\], page 77](#)

6.152 NULL — Function that returns an disassociated pointer

Description:

Returns a disassociated pointer.

If *MOLD* is present, a disassociated pointer of the same type is returned, otherwise the type is determined by context.

In Fortran 95, *MOLD* is optional. Please note that F2003 includes cases where it is required.

Standard: F95 and later

Class: Transformational function

Syntax: `PTR => NULL ([MOLD])`

Arguments:

MOLD (Optional) shall be a pointer of any association status and of any type.

Return value:

A disassociated pointer.

Example:

```
REAL, POINTER, DIMENSION(:) :: VEC => NULL ()
```

See also: [Section 6.20 \[ASSOCIATED\], page 39](#)

6.153 OR — Bitwise logical OR

Description:

Bitwise logical OR.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. For integer arguments, programmers should consider the use of the [Section 6.106 \[IOR\], page 82](#) intrinsic defined by the Fortran standard.

Standard: GNU extension

Class: Function

Syntax: `RESULT = OR(X, Y)`

Arguments:

<i>X</i>	The type shall be either <code>INTEGER(*)</code> or <code>LOGICAL</code> .
<i>Y</i>	The type shall be either <code>INTEGER(*)</code> or <code>LOGICAL</code> .

Return value:

The return type is either `INTEGER(*)` or `LOGICAL` after cross-promotion of the arguments.

Example:

```

PROGRAM test_or
  LOGICAL :: T = .TRUE., F = .FALSE.
  INTEGER :: a, b
  DATA a / Z'F' /, b / Z'3' /

  WRITE (*,*) OR(T, T), OR(T, F), OR(F, T), OR(F, F)
  WRITE (*,*) OR(a, b)
END PROGRAM

```

See also: F95 elemental function: [Section 6.106 \[IOR\]](#), page 82

6.154 PACK — Pack an array into an array of rank one

Description:

Stores the elements of *ARRAY* in an array of rank one.

The beginning of the resulting array is made up of elements whose *MASK* equals `TRUE`. Afterwards, positions are filled with elements taken from *VECTOR*.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = PACK(ARRAY, MASK[, VECTOR])`

Arguments:

<i>ARRAY</i>	Shall be an array of any type.
<i>MASK</i>	Shall be an array of type <code>LOGICAL</code> and of the same size as <i>ARRAY</i> . Alternatively, it may be a <code>LOGICAL</code> scalar.
<i>VECTOR</i>	(Optional) shall be an array of the same type as <i>ARRAY</i> and of rank one. If present, the number of elements in <i>VECTOR</i> shall be equal to or greater than the number of true elements in <i>MASK</i> . If <i>MASK</i> is scalar, the number of elements in <i>VECTOR</i> shall be equal to or greater than the number of elements in <i>ARRAY</i> .

Return value:

The result is an array of rank one and the same type as that of *ARRAY*. If *VECTOR* is present, the result size is that of *VECTOR*, the number of `TRUE` values in *MASK* otherwise.

Example: Gathering non-zero elements from an array:

```

PROGRAM test_pack_1
  INTEGER :: m(6)
  m = (/ 1, 0, 0, 0, 5, 0 /)
  WRITE(*, FMT="(6(I0, ' '))") pack(m, m /= 0) ! "1 5"
END PROGRAM

```

Gathering non-zero elements from an array and appending elements from *VECTOR*:

```

PROGRAM test_pack_2
  INTEGER :: m(4)
  m = (/ 1, 0, 0, 2 /)
  WRITE(*, FMT="(4(I0, ' '))") pack(m, m /= 0, (/ 0, 0, 3, 4 /)) ! "1 2 3 4"
END PROGRAM

```

See also: [Section 6.207 \[UNPACK\]](#), page 130

6.155 `PERROR` — Print system error message

Description:

Prints (on the C `stderr` stream) a newline-terminated error message corresponding to the last system error. This is prefixed by *STRING*, a colon and a space. See `perror(3)`.

Standard: GNU extension

Class: Subroutine

Syntax: `CALL PERROR(STRING)`

Arguments:

STRING A scalar of default `CHARACTER` type.

See also: [Section 6.101 \[IERRNO\]](#), page 80

6.156 `PRECISION` — Decimal precision of a real kind

Description:

`PRECISION(X)` returns the decimal precision in the model of the type of *X*.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = PRECISION(X)`

Arguments:

X Shall be of type `REAL` or `COMPLEX`.

Return value:

The return value is of type `INTEGER` and of the default integer kind.

Example:

```
program prec_and_range
  real(kind=4) :: x(2)
  complex(kind=8) :: y

  print *, precision(x), range(x)
  print *, precision(y), range(y)
end program prec_and_range
```

6.157 `PRESENT` — Determine whether an optional dummy argument is specified

Description:

Determines whether an optional dummy argument is present.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = PRESENT(A)`

Arguments:

A May be of any type and may be a pointer, scalar or array value, or a dummy procedure. It shall be the name of an optional dummy argument accessible within the current subroutine or function.

Return value:

Returns either `TRUE` if the optional argument *A* is present, or `FALSE` otherwise.

Example:

```
PROGRAM test_present
  WRITE(*,*) f(), f(42)      ! "F T"
CONTAINS
  LOGICAL FUNCTION f(x)
    INTEGER, INTENT(IN), OPTIONAL :: x
    f = PRESENT(x)
  END FUNCTION
END PROGRAM
```

6.158 PRODUCT — Product of array elements

Description:

Multiplies the elements of *ARRAY* along dimension *DIM* if the corresponding element in *MASK* is *TRUE*.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = PRODUCT(ARRAY[, MASK])` `RESULT = PRODUCT(ARRAY, DIM[, MASK])`

Arguments:

<i>ARRAY</i>	Shall be an array of type <code>INTEGER(*)</code> , <code>REAL(*)</code> or <code>COMPLEX(*)</code> .
<i>DIM</i>	(Optional) shall be a scalar of type <code>INTEGER</code> with a value in the range from 1 to <i>n</i> , where <i>n</i> equals the rank of <i>ARRAY</i> .
<i>MASK</i>	(Optional) shall be of type <code>LOGICAL</code> and either be a scalar or an array of the same shape as <i>ARRAY</i> .

Return value:

The result is of the same type as *ARRAY*.

If *DIM* is absent, a scalar with the product of all elements in *ARRAY* is returned. Otherwise, an array of rank *n*-1, where *n* equals the rank of *ARRAY*, and a shape similar to that of *ARRAY* with dimension *DIM* dropped is returned.

Example:

```
PROGRAM test_product
  INTEGER :: x(5) = (/ 1, 2, 3, 4, 5 /)
  print *, PRODUCT(x)           ! all elements, product = 120
  print *, PRODUCT(x, MASK=MOD(x, 2)==1) ! odd elements, product = 15
END PROGRAM
```

See also: [Section 6.191 \[SUM\]](#), [page 123](#)

6.159 RADIX — Base of a model number

Description:

`RADIX(X)` returns the base of the model representing the entity *X*.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = RADIX(X)`

Arguments:

<i>X</i>	Shall be of type <code>INTEGER</code> or <code>REAL</code>
----------	--

Return value:

The return value is a scalar of type `INTEGER` and of the default integer kind.

Example:

```

program test_radix
  print *, "The radix for the default integer kind is", radix(0)
  print *, "The radix for the default real kind is", radix(0.0)
end program test_radix

```

6.160 RAN — Real pseudo-random number

Description:

For compatibility with HP FORTRAN 77/iX, the `RAN` intrinsic is provided as an alias for `RAND`. See [Section 6.161 \[RAND\], page 108](#) for complete documentation.

Standard: GNU extension

Class: Function

See also: [Section 6.161 \[RAND\], page 108](#), [Section 6.162 \[RANDOM_NUMBER\], page 108](#)

6.161 RAND — Real pseudo-random number

Description:

`RAND(FLAG)` returns a pseudo-random number from a uniform distribution between 0 and 1. If *FLAG* is 0, the next number in the current sequence is returned; if *FLAG* is 1, the generator is restarted by `CALL SRAND(0)`; if *FLAG* has any other value, it is used as a new seed with `SRAND`.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. It implements a simple modulo generator as provided by `g77`. For new code, one should consider the use of [Section 6.162 \[RANDOM_NUMBER\], page 108](#) as it implements a superior algorithm.

Standard: GNU extension

Class: Function

Syntax: `RESULT = RAND(FLAG)`

Arguments:

FLAG Shall be a scalar `INTEGER` of kind 4.

Return value:

The return value is of `REAL` type and the default kind.

Example:

```

program test_rand
  integer,parameter :: seed = 86456

  call srand(seed)
  print *, rand(), rand(), rand(), rand()
  print *, rand(seed), rand(), rand(), rand()
end program test_rand

```

See also: [Section 6.189 \[SRAND\], page 122](#), [Section 6.162 \[RANDOM_NUMBER\], page 108](#)

6.162 RANDOM_NUMBER — Pseudo-random number

Description:

Returns a single pseudorandom number or an array of pseudorandom numbers from the uniform distribution over the range $0 \leq x < 1$.

The runtime-library implements George Marsaglia's KISS (Keep It Simple Stupid) random number generator (RNG). This RNG combines:

1. The congruential generator $x(n) = 69069 \cdot x(n-1) + 1327217885$ with a period of 2^{32} ,
2. A 3-shift shift-register generator with a period of $2^{32} - 1$,
3. Two 16-bit multiply-with-carry generators with a period of $597273182964842497 > 2^{59}$.

The overall period exceeds 2^{123} .

Please note, this RNG is thread safe if used within OpenMP directives, i. e. its state will be consistent while called from multiple threads. However, the KISS generator does not create random numbers in parallel from multiple sources, but in sequence from a single source. If an OpenMP-enabled application heavily relies on random numbers, one should consider employing a dedicated parallel random number generator instead.

Standard: F95 and later

Class: Subroutine

Syntax: `RANDOM_NUMBER(HARVEST)`

Arguments:

HARVEST Shall be a scalar or an array of type `REAL(*)`.

Example:

```
program test_random_number
  REAL :: r(5,5)
  CALL init_random_seed()      ! see example of RANDOM_SEED
  CALL RANDOM_NUMBER(r)
end program
```

See also: [Section 6.163 \[RANDOM_SEED\]](#), page 109

6.163 RANDOM_SEED — Initialize a pseudo-random number sequence

Description:

Restarts or queries the state of the pseudorandom number generator used by `RANDOM_NUMBER`.

If `RANDOM_SEED` is called without arguments, it is initialized to a default state. The example below shows how to initialize the random seed based on the system's time.

Standard: F95 and later

Class: Subroutine

Syntax: `CALL RANDOM_SEED(SIZE, PUT, GET)`

Arguments:

<i>SIZE</i>	(Optional) Shall be a scalar and of type default <code>INTEGER</code> , with <code>INTENT(OUT)</code> . It specifies the minimum size of the arrays used with the <i>PUT</i> and <i>GET</i> arguments.
<i>PUT</i>	(Optional) Shall be an array of type default <code>INTEGER</code> and rank one. It is <code>INTENT(IN)</code> and the size of the array must be larger than or equal to the number returned by the <i>SIZE</i> argument.
<i>GET</i>	(Optional) Shall be an array of type default <code>INTEGER</code> and rank one. It is <code>INTENT(OUT)</code> and the size of the array must be larger than or equal to the number returned by the <i>SIZE</i> argument.

Example:

```

SUBROUTINE init_random_seed()
  INTEGER :: i, n, clock
  INTEGER, DIMENSION(:), ALLOCATABLE :: seed

  CALL RANDOM_SEED(size = n)
  ALLOCATE(seed(n))

  CALL SYSTEM_CLOCK(COUNT=clock)

  seed = clock + 37 * (/ (i - 1, i = 1, n) /)
  CALL RANDOM_SEED(PUT = seed)

  DEALLOCATE(seed)
END SUBROUTINE

```

See also: [Section 6.162 \[RANDOM_NUMBER\]](#), page 108

6.164 RANGE — Decimal exponent range of a real kind

Description:

RANGE(X) returns the decimal exponent range in the model of the type of X.

Standard: F95 and later

Class: Inquiry function

Syntax: RESULT = RANGE(X)

Arguments:

X Shall be of type REAL or COMPLEX.

Return value:

The return value is of type INTEGER and of the default integer kind.

Example: See PRECISION for an example.

6.165 REAL — Convert to real type

Description:

REAL(X [, KIND]) converts its argument X to a real type. The REALPART(X) function is provided for compatibility with g77, and its use is strongly discouraged.

Standard: F77 and later

Class: Elemental function

Syntax:

```

RESULT = REAL(X [, KIND])
RESULT = REALPART(Z)

```

Arguments:

X Shall be INTEGER(*), REAL(*), or COMPLEX(*).
 KIND (Optional) An INTEGER(*) initialization expression indicating the kind parameter of the result.

Return value:

These functions return a REAL(*) variable or array under the following rules:

- (A) REAL(X) is converted to a default real type if X is an integer or real variable.
- (B) REAL(X) is converted to a real type with the kind type parameter of X if X is a complex variable.

- (C) `REAL(X, KIND)` is converted to a real type with kind type parameter *KIND* if *X* is a complex, integer, or real variable.

Example:

```
program test_real
  complex :: x = (1.0, 2.0)
  print *, real(x), real(x,8), realpart(x)
end program test_real
```

See also: [Section 6.47 \[DBLE\]](#), page 53, [Section 6.49 \[DFLOAT\]](#), page 54, [Section 6.65 \[FLOAT\]](#), page 63

6.166 RENAME — Rename a file

Description:

Renames a file from file *PATH1* to *PATH2*. A null character (`CHAR(0)`) can be used to mark the end of the names in *PATH1* and *PATH2*; otherwise, trailing blanks in the file names are ignored. If the *STATUS* argument is supplied, it contains 0 on success or a nonzero error code upon return; see `rename(2)`.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL RENAME(PATH1, PATH2 [, STATUS])
STATUS = RENAME(PATH1, PATH2)
```

Arguments:

<i>PATH1</i>	Shall be of default CHARACTER type.
<i>PATH2</i>	Shall be of default CHARACTER type.
<i>STATUS</i>	(Optional) Shall be of default INTEGER type.

See also: [Section 6.119 \[LINK\]](#), page 88

6.167 REPEAT — Repeated string concatenation

Description:

Concatenates *NCOPIES* copies of a string.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = REPEAT(STRING, NCOPIES)`

Arguments:

<i>STRING</i>	Shall be scalar and of type CHARACTER(*).
<i>NCOPIES</i>	Shall be scalar and of type INTEGER(*).

Return value:

A new scalar of type CHARACTER built up from *NCOPIES* copies of *STRING*.

Example:

```
program test_repeat
  write(*,*) repeat("x", 5)    ! "xxxxx"
end program
```

6.168 RESHAPE — Function to reshape an array

Description:

Reshapes *SOURCE* to correspond to *SHAPE*. If necessary, the new array may be padded with elements from *PAD* or permuted as defined by *ORDER*.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = RESHAPE(SOURCE, SHAPE[, PAD, ORDER])`

Arguments:

<i>SOURCE</i>	Shall be an array of any type.
<i>SHAPE</i>	Shall be of type <code>INTEGER</code> and an array of rank one. Its values must be positive or zero.
<i>PAD</i>	(Optional) shall be an array of the same type as <i>SOURCE</i> .
<i>ORDER</i>	(Optional) shall be of type <code>INTEGER</code> and an array of the same shape as <i>SHAPE</i> . Its values shall be a permutation of the numbers from 1 to n, where n is the size of <i>SHAPE</i> . If <i>ORDER</i> is absent, the natural ordering shall be assumed.

Return value:

The result is an array of shape *SHAPE* with the same type as *SOURCE*.

Example:

```
PROGRAM test_reshape
  INTEGER, DIMENSION(4) :: x
  WRITE(*,*) SHAPE(x)           ! prints "4"
  WRITE(*,*) SHAPE(RESHAPE(x, (/2, 2/))) ! prints "2 2"
END PROGRAM
```

See also: [Section 6.178 \[SHAPE\], page 116](#)

6.169 RRSPACING — Reciprocal of the relative spacing

Description:

`RRSPACING(X)` returns the reciprocal of the relative spacing of model numbers near *X*.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = RRSPACING(X)`

Arguments:

<i>X</i>	Shall be of type <code>REAL</code> .
----------	--------------------------------------

Return value:

The return value is of the same type and kind as *X*. The value returned is equal to `ABS(FRACTION(X)) * FLOAT(RADIX(X))**DIGITS(X)`.

See also: [Section 6.186 \[SPACING\], page 120](#)

6.170 RSHIFT — Right shift bits

Description:

`RSHIFT` returns a value corresponding to *I* with all of the bits shifted right by *SHIFT* places. If the absolute value of *SHIFT* is greater than `BIT_SIZE(I)`, the value is

undefined. Bits shifted out from the left end are lost; zeros are shifted in from the opposite end.

This function has been superseded by the `ISHFT` intrinsic, which is standard in Fortran 95 and later.

Standard: GNU extension

Class: Elemental function

Syntax: `RESULT = RSHIFT(I, SHIFT)`

Arguments:

<i>I</i>	The type shall be <code>INTEGER(*)</code> .
<i>SHIFT</i>	The type shall be <code>INTEGER(*)</code> .

Return value:

The return value is of type `INTEGER(*)` and of the same kind as *I*.

See also: [Section 6.109 \[ISHFT\], page 83](#), [Section 6.110 \[ISHFTC\], page 84](#), [Section 6.128 \[LSHIFT\], page 92](#)

6.171 SCALE — Scale a real value

Description:

`SCALE(X, I)` returns $X * \text{RADIX}(X)^{**}I$.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = SCALE(X, I)`

Arguments:

<i>X</i>	The type of the argument shall be a <code>REAL</code> .
<i>I</i>	The type of the argument shall be a <code>INTEGER</code> .

Return value:

The return value is of the same type and kind as *X*. Its value is $X * \text{RADIX}(X)^{**}I$.

Example:

```
program test_scale
  real :: x = 178.1387e-4
  integer :: i = 5
  print *, scale(x,i), x*radix(x)**i
end program test_scale
```

6.172 SCAN — Scan a string for the presence of a set of characters

Description:

Scans a *STRING* for any of the characters in a *SET* of characters.

If *BACK* is either absent or equals `FALSE`, this function returns the position of the leftmost character of *STRING* that is in *SET*. If *BACK* equals `TRUE`, the rightmost position is returned. If no character of *SET* is found in *STRING*, the result is zero.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = SCAN(STRING, SET[, BACK])`

Arguments:

STRING Shall be of type CHARACTER(*).
SET Shall be of type CHARACTER(*).
BACK (Optional) shall be of type LOGICAL.

Return value:

The return value is of type INTEGER and of the default integer kind.

Example:

```
PROGRAM test_scan
  WRITE(*,*) SCAN("FORTRAN", "AO")           ! 2, found 'O'
  WRITE(*,*) SCAN("FORTRAN", "AO", .TRUE.)    ! 6, found 'A'
  WRITE(*,*) SCAN("FORTRAN", "C++")          ! 0, found none
END PROGRAM
```

See also: [Section 6.102 \[INDEX\], page 80](#), [Section 6.208 \[VERIFY\], page 131](#)

6.173 SECNDS — Time function

Description:

SECNDS(*X*) gets the time in seconds from the real-time system clock. *X* is a reference time, also in seconds. If this is zero, the time in seconds from midnight is returned. This function is non-standard and its use is discouraged.

Standard: GNU extension

Class: Function

Syntax: RESULT = SECNDS (*X*)

Arguments:

T Shall be of type REAL(4).
X Shall be of type REAL(4).

Return value:

None

Example:

```
program test_secnds
  integer :: i
  real(4) :: t1, t2
  print *, secnds (0.0)    ! seconds since midnight
  t1 = secnds (0.0)        ! reference time
  do i = 1, 10000000       ! do something
  end do
  t2 = secnds (t1)         ! elapsed time
  print *, "Something took ", t2, " seconds."
end program test_secnds
```

6.174 SECOND — CPU time function

Description:

Returns a REAL(4) value representing the elapsed CPU time in seconds. This provides the same functionality as the standard CPU_TIME intrinsic, and is only included for backwards compatibility.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL SECOND(TIME)
TIME = SECOND()
```

Arguments:

TIME Shall be of type REAL(4).

Return value:

In either syntax, *TIME* is set to the process's current runtime in seconds.

See also: [Section 6.43 \[CPU-TIME\]](#), page 51

6.175 SELECTED_INT_KIND — Choose integer kind

Description:

SELECTED_INT_KIND(I) return the kind value of the smallest integer type that can represent all values ranging from -10^I (exclusive) to 10^I (exclusive). If there is no integer kind that accommodates this range, SELECTED_INT_KIND returns -1 .

Standard: F95 and later

Class: Transformational function

Syntax: RESULT = SELECTED_INT_KIND(I)

Arguments:

I Shall be a scalar and of type INTEGER.

Example:

```
program large_integers
  integer,parameter :: k5 = selected_int_kind(5)
  integer,parameter :: k15 = selected_int_kind(15)
  integer(kind=k5) :: i5
  integer(kind=k15) :: i15

  print *, huge(i5), huge(i15)

  ! The following inequalities are always true
  print *, huge(i5) >= 10_k5**5-1
  print *, huge(i15) >= 10_k15**15-1
end program large_integers
```

6.176 SELECTED_REAL_KIND — Choose real kind

Description:

SELECTED_REAL_KIND(P,R) return the kind value of a real data type with decimal precision greater of at least P digits and exponent range greater at least R.

Standard: F95 and later

Class: Transformational function

Syntax: RESULT = SELECTED_REAL_KIND(P, R)

Arguments:

P (Optional) shall be a scalar and of type INTEGER.

R (Optional) shall be a scalar and of type INTEGER.

At least one argument shall be present.

Return value:

SELECTED_REAL_KIND returns the value of the kind type parameter of a real data type with decimal precision of at least P digits and a decimal exponent range of at

least *R*. If more than one real data type meet the criteria, the kind of the data type with the smallest decimal precision is returned. If no real data type matches the criteria, the result is

- 1 if the processor does not support a real data type with a precision greater than or equal to *P*
- 2 if the processor does not support a real type with an exponent range greater than or equal to *R*
- 3 if neither is supported.

Example:

```

program real_kinds
  integer,parameter :: p6 = selected_real_kind(6)
  integer,parameter :: p10r100 = selected_real_kind(10,100)
  integer,parameter :: r400 = selected_real_kind(r=400)
  real(kind=p6) :: x
  real(kind=p10r100) :: y
  real(kind=r400) :: z

  print *, precision(x), range(x)
  print *, precision(y), range(y)
  print *, precision(z), range(z)
end program real_kinds

```

6.177 SET_EXPONENT — Set the exponent of the model

Description:

SET_EXPONENT(*X*, *I*) returns the real number whose fractional part is that of *X* and whose exponent part is *I*.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = SET_EXPONENT(*X*, *I*)

Arguments:

<i>X</i>	Shall be of type REAL.
<i>I</i>	Shall be of type INTEGER.

Return value:

The return value is of the same type and kind as *X*. The real number whose fractional part is that of *X* and whose exponent part if *I* is returned; it is FRACTION(*X*) * RADIX(*X*)***I*.

Example:

```

PROGRAM test_setexp
  REAL :: x = 178.1387e-4
  INTEGER :: i = 17
  PRINT *, SET_EXPONENT(x, i), FRACTION(x) * RADIX(x)**i
END PROGRAM

```

6.178 SHAPE — Determine the shape of an array

Description:

Determines the shape of an array.

Standard: F95 and later

Class: Inquiry function

Syntax: **RESULT = SHAPE(SOURCE)**

Arguments:

SOURCE Shall be an array or scalar of any type. If **SOURCE** is a pointer it must be associated and allocatable arrays must be allocated.

Return value:

An **INTEGER** array of rank one with as many elements as **SOURCE** has dimensions. The elements of the resulting array correspond to the extent of **SOURCE** along the respective dimensions. If **SOURCE** is a scalar, the result is the rank one array of size zero.

Example:

```
PROGRAM test_shape
  INTEGER, DIMENSION(-1:1, -1:2) :: A
  WRITE(*,*) SHAPE(A)           ! (/ 3, 4 /)
  WRITE(*,*) SIZE(SHAPE(42))    ! (/ /)
END PROGRAM
```

See also: [Section 6.168 \[RESHAPE\], page 112](#), [Section 6.183 \[SIZE\], page 119](#)

6.179 SIGN — Sign copying function

Description:

SIGN(A,B) returns the value of **A** with the sign of **B**.

Standard: F77 and later

Class: Elemental function

Syntax: **RESULT = SIGN(A, B)**

Arguments:

A Shall be of type **INTEGER** or **REAL**
B Shall be of the same type and kind as **A**

Return value:

The kind of the return value is that of **A** and **B**. If $B \geq 0$ then the result is **ABS(A)**, else it is **-ABS(A)**.

Example:

```
program test_sign
  print *, sign(-12,1)
  print *, sign(-12,0)
  print *, sign(-12,-1)

  print *, sign(-12.,1.)
  print *, sign(-12.,0.)
  print *, sign(-12.,-1.)
end program test_sign
```

Specific names:

Name	Arguments	Return type	Standard
ISIGN(A,P)	INTEGER(4)	INTEGER(4)	f95, gnu
DSIGN(A,P)	REAL(8)	REAL(8)	f95, gnu

6.180 SIGNAL — Signal handling subroutine (or function)

Description:

SIGNAL(NUMBER, HANDLER [, STATUS]) causes external subroutine **HANDLER** to be executed with a single integer argument when signal **NUMBER** occurs. If **HANDLER** is an integer, it can be used to turn off handling of signal **NUMBER** or revert to its default action. See **signal(2)**.

If **SIGNAL** is called as a subroutine and the *STATUS* argument is supplied, it is set to the value returned by **signal(2)**.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL SIGNAL(NUMBER, HANDLER [, STATUS])
STATUS = SIGNAL(NUMBER, HANDLER)
```

Arguments:

NUMBER Shall be a scalar integer, with INTENT(IN)
HANDLER Signal handler (INTEGER FUNCTION or SUBROUTINE) or dummy/global INTEGER scalar. INTEGER. It is INTENT(IN).
STATUS (Optional) *STATUS* shall be a scalar integer. It has INTENT(OUT).

Return value:

The **SIGNAL** function returns the value returned by **signal(2)**.

Example:

```
program test_signal
  intrinsic signal
  external handler_print

  call signal (12, handler_print)
  call signal (10, 1)

  call sleep (30)
end program test_signal
```

6.181 SIN — Sine function

Description:

SIN(X) computes the sine of *X*.

Standard: F77 and later

Class: Elemental function

Syntax: **RESULT = SIN(X)**

Arguments:

X The type shall be **REAL(*)** or **COMPLEX(*)**.

Return value:

The return value has same type and kind as *X*.

Example:

```
program test_sin
  real :: x = 0.0
  x = sin(x)
end program test_sin
```

Specific names:

Name	Argument	Return type	Standard
DSIN(X)	REAL(8) X	REAL(8)	f95, gnu
CSIN(X)	COMPLEX(4) X	COMPLEX(4)	f95, gnu
ZSIN(X)	COMPLEX(8) X	COMPLEX(8)	f95, gnu
CDSIN(X)	COMPLEX(8) X	COMPLEX(8)	f95, gnu

See also: [Section 6.18 \[ASIN\], page 38](#)

6.182 SINH — Hyperbolic sine function

Description:

SINH(*X*) computes the hyperbolic sine of *X*.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = SINH(*X*)

Arguments:

X The type shall be REAL(*).

Return value:

The return value is of type REAL(*).

Example:

```
program test_sinh
  real(8) :: x = - 1.0_8
  x = sinh(x)
end program test_sinh
```

Specific names:

Name	Argument	Return type	Standard
DSINH(<i>X</i>)	REAL(8) <i>X</i>	REAL(8)	F95 and later

See also: [Section 6.19 \[ASINH\], page 38](#)

6.183 SIZE — Determine the size of an array

Description:

Determine the extent of *ARRAY* along a specified dimension *DIM*, or the total number of elements in *ARRAY* if *DIM* is absent.

Standard: F95 and later

Class: Inquiry function

Syntax: RESULT = SIZE(*ARRAY*[, *DIM*])

Arguments:

ARRAY Shall be an array of any type. If *ARRAY* is a pointer it must be associated and allocatable arrays must be allocated.

DIM (Optional) shall be a scalar of type INTEGER and its value shall be in the range from 1 to *n*, where *n* equals the rank of *ARRAY*.

Return value:

The return value is of type INTEGER and of the default integer kind.

Example:

```
PROGRAM test_size
  WRITE(*,*) SIZE((/ 1, 2 /))    ! 2
END PROGRAM
```

See also: [Section 6.178 \[SHAPE\], page 116](#), [Section 6.168 \[RESHAPE\], page 112](#)

6.184 SLEEP — Sleep for the specified number of seconds

Description:

Calling this subroutine causes the process to pause for *SECONDS* seconds.

Standard: GNU extension

Class: Subroutine

Syntax: CALL SLEEP(SECONDS)

Arguments:

SECONDS The type shall be of default INTEGER.

Example:

```
program test_sleep
  call sleep(5)
end
```

6.185 SNGL — Convert double precision real to default real

Description:

SNGL(*A*) converts the double precision real *A* to a default real value. This is an archaic form of REAL that is specific to one type for *A*.

Standard: GNU extension

Class: Elemental function

Syntax: RESULT = SNGL(*A*)

Arguments:

A The type shall be a double precision REAL.

Return value:

The return value is of type default REAL.

See also: [Section 6.47 \[DBLE\]](#), page 53

6.186 SPACING — Smallest distance between two numbers of a given type

Description:

Determines the distance between the argument *X* and the nearest adjacent number of the same type.

Standard: F95 and later

Class: Elemental function

Syntax: RESULT = SPACING(*X*)

Arguments:

X Shall be of type REAL(*).

Return value:

The result is of the same type as the input argument *X*.

Example:

```
PROGRAM test_spacing
  INTEGER, PARAMETER :: SGL = SELECTED_REAL_KIND(p=6, r=37)
  INTEGER, PARAMETER :: DBL = SELECTED_REAL_KIND(p=13, r=200)

  WRITE(*,*) spacing(1.0_SGL)      ! "1.1920929E-07"          on i686
  WRITE(*,*) spacing(1.0_DBL)      ! "2.220446049250313E-016" on i686
END PROGRAM
```

See also: [Section 6.169 \[RRSPACING\]](#), page 112

6.187 SPREAD — Add a dimension to an array

Description:

Replicates a *SOURCE* array *NCOPIES* times along a specified dimension *DIM*.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = SPREAD(SOURCE, DIM, NCOPIES)`

Arguments:

SOURCE Shall be a scalar or an array of any type and a rank less than seven.

DIM Shall be a scalar of type `INTEGER` with a value in the range from 1 to *n*+1, where *n* equals the rank of *SOURCE*.

NCOPIES Shall be a scalar of type `INTEGER`.

Return value:

The result is an array of the same type as *SOURCE* and has rank *n*+1 where *n* equals the rank of *SOURCE*.

Example:

```
PROGRAM test_spread
  INTEGER :: a = 1, b(2) = (/ 1, 2 /)
  WRITE(*,*) SPREAD(A, 1, 2)      ! "1 1"
  WRITE(*,*) SPREAD(B, 1, 2)      ! "1 1 2 2"
END PROGRAM
```

See also: [Section 6.207 \[UNPACK\]](#), page 130

6.188 SQRT — Square-root function

Description:

`SQRT(X)` computes the square root of *X*.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = SQRT(X)`

Arguments:

X The type shall be `REAL(*)` or `COMPLEX(*)`.

Return value:

The return value is of type `REAL(*)` or `COMPLEX(*)`. The kind type parameter is the same as *X*.

Example:

```
program test_sqrt
  real(8) :: x = 2.0_8
  complex :: z = (1.0, 2.0)
  x = sqrt(x)
  z = sqrt(z)
end program test_sqrt
```

Specific names:

Name	Argument	Return type	Standard
<code>DSQRT(X)</code>	<code>REAL(8) X</code>	<code>REAL(8)</code>	F95 and later

CSQRT(X)	COMPLEX(4) X	COMPLEX(4)	F95 and later
ZSQRT(X)	COMPLEX(8) X	COMPLEX(8)	GNU extension
CDSQRT(X)	COMPLEX(8) X	COMPLEX(8)	GNU extension

6.189 SRAND — Reinitialize the random number generator

Description:

SRAND reinitializes the pseudo-random number generator called by RAND and IRAND. The new seed used by the generator is specified by the required argument *SEED*.

Standard: GNU extension

Class: Subroutine

Syntax: CALL SRAND(SEED)

Arguments:

SEED Shall be a scalar INTEGER(kind=4).

Return value:

Does not return.

Example: See RAND and IRAND for examples.

Notes: The Fortran 2003 standard specifies the intrinsic RANDOM_SEED to initialize the pseudo-random numbers generator and RANDOM_NUMBER to generate pseudo-random numbers. Please note that in GNU Fortran, these two sets of intrinsics (RAND, IRAND and SRAND on the one hand, RANDOM_NUMBER and RANDOM_SEED on the other hand) access two independent pseudo-random number generators.

See also: [Section 6.161 \[RAND\]](#), page 108, [Section 6.163 \[RANDOM_SEED\]](#), page 109, [Section 6.162 \[RANDOM_NUMBER\]](#), page 108

6.190 STAT — Get file status

Description:

This function returns information about a file. No permissions are required on the file itself, but execute (search) permission is required on all of the directories in path that lead to the file.

The elements that are obtained and stored in the array BUFF:

buff(1)	Device ID
buff(2)	Inode number
buff(3)	File mode
buff(4)	Number of links
buff(5)	Owner's uid
buff(6)	Owner's gid
buff(7)	ID of device containing directory entry for file (0 if not available)
buff(8)	File size (bytes)
buff(9)	Last access time
buff(10)	Last modification time
buff(11)	Last file status change time
buff(12)	Preferred I/O block size (-1 if not available)
buff(13)	Number of blocks allocated (-1 if not available)

Not all these elements are relevant on all systems. If an element is not relevant, it is returned as 0.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax: `CALL STAT(FILE,BUFF[,STATUS])`

Arguments:

<i>FILE</i>	The type shall be <code>CHARACTER(*)</code> , a valid path within the file system.
<i>BUFF</i>	The type shall be <code>INTEGER(4)</code> , <code>DIMENSION(13)</code> .
<i>STATUS</i>	(Optional) status flag of type <code>INTEGER(4)</code> . Returns 0 on success and a system specific error code otherwise.

Example:

```

PROGRAM test_stat
  INTEGER, DIMENSION(13) :: buff
  INTEGER :: status

  CALL STAT("/etc/passwd", buff, status)

  IF (status == 0) THEN
    WRITE (*, FMT="(Device ID:', T30, I19)") buff(1)
    WRITE (*, FMT="(Inode number:', T30, I19)") buff(2)
    WRITE (*, FMT="(File mode (octal):', T30, I19)") buff(3)
    WRITE (*, FMT="(Number of links:', T30, I19)") buff(4)
    WRITE (*, FMT="(Owner's uid:', T30, I19)") buff(5)
    WRITE (*, FMT="(Owner's gid:', T30, I19)") buff(6)
    WRITE (*, FMT="(Device where located:', T30, I19)") buff(7)
    WRITE (*, FMT="(File size:', T30, I19)") buff(8)
    WRITE (*, FMT="(Last access time:', T30, A19)") CTIME(buff(9))
    WRITE (*, FMT="(Last modification time', T30, A19)") CTIME(buff(10))
    WRITE (*, FMT="(Last status change time:', T30, A19)") CTIME(buff(11))
    WRITE (*, FMT="(Preferred block size:', T30, I19)") buff(12)
    WRITE (*, FMT="(No. of blocks allocated:', T30, I19)") buff(13)
  END IF
END PROGRAM

```

See also: To stat an open file: [Section 6.76 \[FSTAT\]](#), page 68, to stat a link: [Section 6.129 \[LSTAT\]](#), page 92

6.191 SUM — Sum of array elements

Description:

Adds the elements of *ARRAY* along dimension *DIM* if the corresponding element in *MASK* is `TRUE`.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = SUM(ARRAY[, MASK])` `RESULT = SUM(ARRAY, DIM[, MASK])`

Arguments:

<i>ARRAY</i>	Shall be an array of type <code>INTEGER(*)</code> , <code>REAL(*)</code> or <code>COMPLEX(*)</code> .
<i>DIM</i>	(Optional) shall be a scalar of type <code>INTEGER</code> with a value in the range from 1 to <i>n</i> , where <i>n</i> equals the rank of <i>ARRAY</i> .
<i>MASK</i>	(Optional) shall be of type <code>LOGICAL</code> and either be a scalar or an array of the same shape as <i>ARRAY</i> .

Return value:

The result is of the same type as *ARRAY*.

If *DIM* is absent, a scalar with the sum of all elements in *ARRAY* is returned. Otherwise, an array of rank *n*-1, where *n* equals the rank of *ARRAY*, and a shape similar to that of *ARRAY* with dimension *DIM* dropped is returned.

Example:

```
PROGRAM test_sum
  INTEGER :: x(5) = (/ 1, 2, 3, 4, 5 /)
  print *, SUM(x)                ! all elements, sum = 15
  print *, SUM(x, MASK=MOD(x, 2)==1) ! odd elements, sum = 9
END PROGRAM
```

See also: [Section 6.158 \[PRODUCT\], page 107](#)

6.192 SYMLNK — Create a symbolic link

Description:

Makes a symbolic link from file *PATH1* to *PATH2*. A null character (CHAR(0)) can be used to mark the end of the names in *PATH1* and *PATH2*; otherwise, trailing blanks in the file names are ignored. If the *STATUS* argument is supplied, it contains 0 on success or a nonzero error code upon return; see `symlink(2)`. If the system does not supply `symlink(2)`, ENOSYS is returned.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL SYMLNK(PATH1, PATH2 [, STATUS])
STATUS = SYMLNK(PATH1, PATH2)
```

Arguments:

<i>PATH1</i>	Shall be of default CHARACTER type.
<i>PATH2</i>	Shall be of default CHARACTER type.
<i>STATUS</i>	(Optional) Shall be of default INTEGER type.

See also: [Section 6.119 \[LINK\], page 88](#), [Section 6.206 \[UNLINK\], page 130](#)

6.193 SYSTEM — Execute a shell command

Description:

Passes the command *COMMAND* to a shell (see `system(3)`). If argument *STATUS* is present, it contains the value returned by `system(3)`, which is presumably 0 if the shell command succeeded. Note that which shell is used to invoke the command is system-dependent and environment-dependent.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL SYSTEM(COMMAND [, STATUS])
STATUS = SYSTEM(COMMAND)
```

Arguments:

<i>COMMAND</i>	Shall be of default CHARACTER type.
<i>STATUS</i>	(Optional) Shall be of default INTEGER type.

See also:

6.194 SYSTEM_CLOCK — Time function

Description:

Determines the *COUNT* of milliseconds of wall clock time since the Epoch (00:00:00 UTC, January 1, 1970) modulo *COUNT_MAX*, *COUNT_RATE* determines the number of clock ticks per second. *COUNT_RATE* and *COUNT_MAX* are constant and specific to **gfortran**.

If there is no clock, *COUNT* is set to `-HUGE(COUNT)`, and *COUNT_RATE* and *COUNT_MAX* are set to zero

Standard: F95 and later

Class: Subroutine

Syntax: `CALL SYSTEM_CLOCK([COUNT, COUNT_RATE, COUNT_MAX])`

Arguments:

Arguments:

COUNT (Optional) shall be a scalar of type default **INTEGER** with **INTENT(OUT)**.

COUNT_RATE (Optional) shall be a scalar of type default **INTEGER** with **INTENT(OUT)**.

COUNT_MAX (Optional) shall be a scalar of type default **INTEGER** with **INTENT(OUT)**.

Example:

```
PROGRAM test_system_clock
  INTEGER :: count, count_rate, count_max
  CALL SYSTEM_CLOCK(count, count_rate, count_max)
  WRITE(*,*) count, count_rate, count_max
END PROGRAM
```

See also: [Section 6.46 \[DATE_AND_TIME\]](#), page 53, [Section 6.43 \[CPU_TIME\]](#), page 51

6.195 TAN — Tangent function

Description:

TAN(X) computes the tangent of *X*.

Standard: F77 and later

Class: Elemental function

Syntax: `RESULT = TAN(X)`

Arguments:

X The type shall be **REAL(*)**.

Return value:

The return value is of type **REAL(*)**. The kind type parameter is the same as *X*.

Example:

```
program test_tan
  real(8) :: x = 0.165_8
  x = tan(x)
end program test_tan
```

Specific names:

Name	Argument	Return type	Standard
DTAN(X)	REAL(8) X	REAL(8)	F95 and later

See also: [Section 6.21 \[ATAN\], page 40](#)

6.196 TANH — Hyperbolic tangent function

Description:

TANH(X) computes the hyperbolic tangent of X.

Standard: F77 and later

Class: Elemental function

Syntax: X = TANH(X)

Arguments:

X The type shall be REAL(*).

Return value:

The return value is of type REAL(*) and lies in the range $-1 \leq \tanh(x) \leq 1$.

Example:

```
program test_tanh
  real(8) :: x = 2.1_8
  x = tanh(x)
end program test_tanh
```

Specific names:

Name	Argument	Return type	Standard
DTANH(X)	REAL(8) X	REAL(8)	F95 and later

See also: [Section 6.23 \[ATANH\], page 41](#)

6.197 TIME — Time function

Description:

Returns the current time encoded as an integer (in the manner of the UNIX function `time(3)`). This value is suitable for passing to `CTIME()`, `GMTIME()`, and `LTIME()`.

This intrinsic is not fully portable, such as to systems with 32-bit `INTEGER` types but supporting times wider than 32 bits. Therefore, the values returned by this intrinsic might be, or become, negative, or numerically less than previous values, during a single run of the compiled program.

See [Section 6.198 \[TIME8\], page 127](#), for information on a similar intrinsic that might be portable to more GNU Fortran implementations, though to fewer Fortran compilers.

Standard: GNU extension

Class: Function

Syntax: RESULT = TIME()

Return value:

The return value is a scalar of type `INTEGER(4)`.

See also: [Section 6.45 \[CTIME\], page 52](#), [Section 6.89 \[GMTIME\], page 74](#), [Section 6.130 \[LTIME\], page 92](#), [Section 6.137 \[MCLOCK\], page 96](#), [Section 6.198 \[TIME8\], page 127](#)

6.198 TIME8 — Time function (64-bit)

Description:

Returns the current time encoded as an integer (in the manner of the UNIX function `time(3)`). This value is suitable for passing to `CTIME()`, `GMTIME()`, and `LTIME()`.

Warning: this intrinsic does not increase the range of the timing values over that returned by `time(3)`. On a system with a 32-bit `time(3)`, `TIME8()` will return a 32-bit value, even though it is converted to a 64-bit `INTEGER(8)` value. That means overflows of the 32-bit value can still occur. Therefore, the values returned by this intrinsic might be or become negative or numerically less than previous values during a single run of the compiled program.

Standard: GNU extension

Class: Function

Syntax: `RESULT = TIME8()`

Return value:

The return value is a scalar of type `INTEGER(8)`.

See also: [Section 6.45 \[CTIME\], page 52](#), [Section 6.89 \[GMTIME\], page 74](#), [Section 6.130 \[LTIME\], page 92](#), [Section 6.138 \[MCLOCK8\], page 97](#), [Section 6.197 \[TIME\], page 126](#)

6.199 TINY — Smallest positive number of a real kind

Description:

`TINY(X)` returns the smallest positive (non zero) number in the model of the type of `X`.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = TINY(X)`

Arguments:

`X` Shall be of type `REAL`.

Return value:

The return value is of the same type and kind as `X`

Example: See `HUGE` for an example.

6.200 TRANSFER — Transfer bit patterns

Description:

Interprets the bitwise representation of `SOURCE` in memory as if it is the representation of a variable or array of the same type and type parameters as `MOLD`.

This is approximately equivalent to the C concept of *casting* one type to another.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = TRANSFER(SOURCE, MOLD[, SIZE])`

Arguments:

`SOURCE` Shall be a scalar or an array of any type.
`MOLD` Shall be a scalar or an array of any type.
`SIZE` (Optional) shall be a scalar of type `INTEGER`.

Return value:

The result has the same type as *MOLD*, with the bit level representation of *SOURCE*. If *SIZE* is present, the result is a one-dimensional array of length *SIZE*. If *SIZE* is absent but *MOLD* is an array (of any size or shape), the result is a one-dimensional array of the minimum length needed to contain the entirety of the bit-wise representation of *SOURCE*. If *SIZE* is absent and *MOLD* is a scalar, the result is a scalar.

If the bitwise representation of the result is longer than that of *SOURCE*, then the leading bits of the result correspond to those of *SOURCE* and any trailing bits are filled arbitrarily.

When the resulting bit representation does not correspond to a valid representation of a variable of the same type as *MOLD*, the results are undefined, and subsequent operations on the result cannot be guaranteed to produce sensible behavior. For example, it is possible to create LOGICAL variables for which *VAR* and *.NOT.VAR* both appear to be true.

Example:

```
PROGRAM test_transfer
  integer :: x = 2143289344
  print *, transfer(x, 1.0)    ! prints "NaN" on i686
END PROGRAM
```

6.201 TRANSPOSE — Transpose an array of rank two*Description:*

Transpose an array of rank two. Element (i, j) of the result has the value *MATRIX*(j, i), for all i, j.

Standard: F95 and later

Class: Transformational function

Syntax: **RESULT = TRANSPOSE(MATRIX)**

Arguments:

MATRIX Shall be an array of any type and have a rank of two.

Return value:

The result has the the same type as *MATRIX*, and has shape (/ m, n /) if *MATRIX* has shape (/ n, m /).

6.202 TRIM — Remove trailing blank characters of a string*Description:*

Removes trailing blank characters of a string.

Standard: F95 and later

Class: Transformational function

Syntax: **RESULT = TRIM(STRING)**

Arguments:

STRING Shall be a scalar of type CHARACTER(*).

Return value:

A scalar of type CHARACTER(*) which length is that of *STRING* less the number of trailing blanks.

Example:

```

PROGRAM test_trim
  CHARACTER(len=10), PARAMETER :: s = "GFORTRAN "
  WRITE(*,*) LEN(s), LEN(TRIM(s)) ! "10 8", with/without trailing blanks
END PROGRAM

```

See also: [Section 6.8 \[ADJUSTL\], page 32](#), [Section 6.9 \[ADJUSTR\], page 33](#)

6.203 TTYNAM — Get the name of a terminal device.

Description:

Get the name of a terminal device. For more information, see `ttynam(3)`.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```

CALL TTYNAM(UNIT, NAME)
NAME = TTYNAM(UNIT)

```

Arguments:

<i>UNIT</i>	Shall be a scalar <code>INTEGER(*)</code> .
<i>NAME</i>	Shall be of type <code>CHARACTER(*)</code> .

Example:

```

PROGRAM test_ttynam
  INTEGER :: unit
  DO unit = 1, 10
    IF (isatty(unit=unit)) write(*,*) ttynam(unit)
  END DO
END PROGRAM

```

See also: [Section 6.108 \[ISATTY\], page 83](#)

6.204 UBOUND — Upper dimension bounds of an array

Description:

Returns the upper bounds of an array, or a single upper bound along the *DIM* dimension.

Standard: F95 and later

Class: Inquiry function

Syntax: `RESULT = UBOUND(ARRAY [, DIM])`

Arguments:

<i>ARRAY</i>	Shall be an array, of any type.
<i>DIM</i>	(Optional) Shall be a scalar <code>INTEGER(*)</code> .

Return value:

If *DIM* is absent, the result is an array of the upper bounds of *ARRAY*. If *DIM* is present, the result is a scalar corresponding to the upper bound of the array along that dimension. If *ARRAY* is an expression rather than a whole array or array structure component, or if it has a zero extent along the relevant dimension, the upper bound is taken to be the number of elements along the relevant dimension.

See also: [Section 6.114 \[LBOUND\], page 85](#)

6.205 UMASK — Set the file creation mask

Description:

Sets the file creation mask to *MASK* and returns the old value in argument *OLD* if it is supplied. See `umask(2)`.

Standard: GNU extension

Class: Subroutine

Syntax: `CALL UMASK(MASK [, OLD])`

Arguments:

<i>MASK</i>	Shall be a scalar of type <code>INTEGER(*)</code> .
<i>MASK</i>	(Optional) Shall be a scalar of type <code>INTEGER(*)</code> .

6.206 UNLINK — Remove a file from the file system

Description:

Unlinks the file *PATH*. A null character (`CHAR(0)`) can be used to mark the end of the name in *PATH*; otherwise, trailing blanks in the file name are ignored. If the *STATUS* argument is supplied, it contains 0 on success or a nonzero error code upon return; see `unlink(2)`.

This intrinsic is provided in both subroutine and function forms; however, only one form can be used in any given program unit.

Standard: GNU extension

Class: Subroutine, function

Syntax:

```
CALL UNLINK(PATH [, STATUS])
STATUS = UNLINK(PATH)
```

Arguments:

<i>PATH</i>	Shall be of default <code>CHARACTER</code> type.
<i>STATUS</i>	(Optional) Shall be of default <code>INTEGER</code> type.

See also: [Section 6.119 \[LINK\], page 88](#), [Section 6.192 \[SYMLNK\], page 124](#)

6.207 UNPACK — Unpack an array of rank one into an array

Description:

Store the elements of *VECTOR* in an array of higher rank.

Standard: F95 and later

Class: Transformational function

Syntax: `RESULT = UNPACK(VECTOR, MASK, FIELD)`

Arguments:

<i>VECTOR</i>	Shall be an array of any type and rank one. It shall have at least as many elements as <i>MASK</i> has <code>TRUE</code> values.
<i>MASK</i>	Shall be an array of type <code>LOGICAL</code> .
<i>FIELD</i>	Shall be of the same type as <i>VECTOR</i> and have the same shape as <i>MASK</i> .

Return value:

The resulting array corresponds to *FIELD* with `TRUE` elements of *MASK* replaced by values from *VECTOR* in array element order.

Example:

```
PROGRAM test_unpack
  integer :: vector(2) = (/1,1/)
  logical :: mask(4) = (/ .TRUE., .FALSE., .FALSE., .TRUE. /)
  integer :: field(2,2) = 0, unity(2,2)

  ! result: unity matrix
  unity = unpack(vector, reshape(mask, (/2,2/)), field)
END PROGRAM
```

See also: [Section 6.154 \[PACK\], page 105](#), [Section 6.187 \[SPREAD\], page 121](#)

6.208 VERIFY — Scan a string for the absence of a set of characters

Description:

Verifies that all the characters in a *SET* are present in a *STRING*.

If *BACK* is either absent or equals **FALSE**, this function returns the position of the leftmost character of *STRING* that is not in *SET*. If *BACK* equals **TRUE**, the rightmost position is returned. If all characters of *SET* are found in *STRING*, the result is zero.

Standard: F95 and later

Class: Elemental function

Syntax: `RESULT = VERIFY(String, SET[, BACK])`

Arguments:

<i>STRING</i>	Shall be of type CHARACTER(*) .
<i>SET</i>	Shall be of type CHARACTER(*) .
<i>BACK</i>	(Optional) shall be of type LOGICAL .

Return value:

The return value is of type **INTEGER** and of the default integer kind.

Example:

```
PROGRAM test_verify
  WRITE(*,*) VERIFY("FORTRAN", "AO")           ! 1, found 'F'
  WRITE(*,*) VERIFY("FORTRAN", "FOO")          ! 3, found 'R'
  WRITE(*,*) VERIFY("FORTRAN", "C++")          ! 1, found 'F'
  WRITE(*,*) VERIFY("FORTRAN", "C++", .TRUE.) ! 7, found 'N'
  WRITE(*,*) VERIFY("FORTRAN", "FORTRAN")      ! 0' found none
END PROGRAM
```

See also: [Section 6.172 \[SCAN\], page 113](#), [Section 6.102 \[INDEX\], page 80](#)

6.209 XOR — Bitwise logical exclusive OR

Description:

Bitwise logical exclusive or.

This intrinsic routine is provided for backwards compatibility with GNU Fortran 77. For integer arguments, programmers should consider the use of the [Section 6.100 \[IEOR\], page 79](#) intrinsic defined by the Fortran standard.

Standard: GNU extension

Class: Function

Syntax: `RESULT = XOR(X, Y)`

Arguments:

X	The type shall be either <code>INTEGER(*)</code> or <code>LOGICAL</code> .
Y	The type shall be either <code>INTEGER(*)</code> or <code>LOGICAL</code> .

Return value:

The return type is either `INTEGER(*)` or `LOGICAL` after cross-promotion of the arguments.

Example:

```
PROGRAM test_xor
  LOGICAL :: T = .TRUE., F = .FALSE.
  INTEGER :: a, b
  DATA a / Z'F' /, b / Z'3' /

  WRITE (*,*) XOR(T, T), XOR(T, F), XOR(F, T), XOR(F, F)
  WRITE (*,*) XOR(a, b)
END PROGRAM
```

See also: F95 elemental function: [Section 6.100 \[IEOR\]](#), page 79

Contributing

Free software is only possible if people contribute to efforts to create it. We're always in need of more people helping out with ideas and comments, writing documentation and contributing code.

If you want to contribute to GNU Fortran, have a look at the long lists of projects you can take on. Some of these projects are small, some of them are large; some are completely orthogonal to the rest of what is happening on GNU Fortran, but others are “mainstream” projects in need of enthusiastic hackers. All of these projects are important! We'll eventually get around to the things here, but they are also things doable by someone who is willing and able.

Contributors to GNU Fortran

Most of the parser was hand-crafted by *Andy Vaught*, who is also the initiator of the whole project. Thanks Andy! Most of the interface with GCC was written by *Paul Brook*.

The following individuals have contributed code and/or ideas and significant help to the GNU Fortran project (in no particular order):

- Andy Vaught
- Katherine Holcomb
- Tobias Schlüter
- Steven Bosscher
- Toon Moene
- Tim Prince
- Niels Kristian Bech Jensen
- Steven Johnson
- Paul Brook
- Feng Wang
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- Paul Thomas
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- Steven G. Kargl
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- Janne Blomqvist
- Erik Edelmann
- Thomas Koenig
- Asher Langton
- Jakub Jelinek
- Roger Sayle
- H.J. Lu
- Richard Henderson
- Richard Sandiford
- Richard Guenther
- Bernhard Fischer

The following people have contributed bug reports, smaller or larger patches, and much needed feedback and encouragement for the GNU Fortran project:

- Erik Schnetter
- Bill Clodius
- Kate Hedstrom

Many other individuals have helped debug, test and improve the GNU Fortran compiler over the past few years, and we welcome you to do the same! If you already have done so, and you would like to see your name listed in the list above, please contact us.

Projects

Help build the test suite

Solicit more code for donation to the test suite. We can keep code private on request.

Bug hunting/squishing

Find bugs and write more test cases! Test cases are especially very welcome, because it allows us to concentrate on fixing bugs instead of isolating them.

Smaller projects (“bug” fixes):

- Allow init exprs to be numbers raised to integer powers.
- Implement correct rounding.
- Implement F restrictions on Fortran 95 syntax.
- See about making Emacs-parsable error messages.

If you wish to work on the runtime libraries, please contact a project maintainer.

Proposed Extensions

Here’s a list of proposed extensions for the GNU Fortran compiler, in no particular order. Most of these are necessary to be fully compatible with existing Fortran compilers, but they are not part of the official J3 Fortran 95 standard.

Compiler extensions:

- User-specified alignment rules for structures.
- Flag to generate `Makefile` info.
- Automatically extend single precision constants to double.
- Compile code that conserves memory by dynamically allocating common and module storage either on stack or heap.
- Compile flag to generate code for array conformance checking (suggest `-CC`).
- User control of symbol names (underscores, etc).
- Compile setting for maximum size of stack frame size before spilling parts to static or heap.
- Flag to force local variables into static space.
- Flag to force local variables onto stack.
- Flag for maximum errors before ending compile.
- Option to initialize otherwise uninitialized integer and floating point variables.

Environment Options

- Pluggable library modules for random numbers, linear algebra. LA should use BLAS calling conventions.
- Environment variables controlling actions on arithmetic exceptions like overflow, underflow, precision loss—Generate NaN, abort, default. action.
- Set precision for fp units that support it (i387).

- Variable for setting fp rounding mode.
- Variable to fill uninitialized variables with a user-defined bit pattern.
- Environment variable controlling filename that is opened for that unit number.
- Environment variable to clear/trash memory being freed.
- Environment variable to control tracing of allocations and frees.
- Environment variable to display allocated memory at normal program end.
- Environment variable for filename for * IO-unit.
- Environment variable for temporary file directory.
- Environment variable forcing standard output to be line buffered (unix).

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```
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gfortran's command line options are indexed here without any initial '-' or '--'. Where an option has both positive and negative forms (such as -foption and -fno-option), relevant entries in the manual are indexed under the most appropriate form; it may sometimes be useful to look up both forms.

F

fall-intrinsics	8
fbounds-check	14
fconvert=conversion	12
fcray-pointer	9
fd-lines-as-code	8
fd-lines-as-comments	8
fdefault-double-8	8
fdefault-integer-8	8
fdefault-real-8	8
fdollar-ok	8
fdump-parse-tree	11
ff2c	12
ffixed-line-length-n	8
ffpe-trap=list	11
ffree-form	8
ffree-line-length-n	8
fimplicit-none	9
fmax-errors-n	9
fmax-identifier-length=n	8
fmax-stack-var-size	14
fmax-subrecord-length=length	12
fno-automatic	12
fno-backslash	8
fno-fixed-form	8
fno-underscoring	13
fopenmp	9
fpack-derived	14
frange-check	9
frecord-marker=length	12
frepack-arrays	14
fsecond-underscore	14
fshort-enums	14, 21
fsyntax-only	9

I

Idir	11
------	----

J

Jdir	12
------	----

M

Mdir	12
------	----

P

pedantic	10
pedantic-errors	10

S

std=std option	9
----------------	---

W

Waliasing	10
Wall	10
Wampersand	10
Wcharacter-truncation	10
Wconversion	10
Werror	11
Wimplicit-interface	10
Wnonstd-intrinsics	10
Wsurprising	11
Wtabs	11
Wunderflow	11

Keyword Index

\$

\$ 8

&

& 10

[

[...] 21

A

ABORT 29
 ABS 30
 absolute value 30
 ACCESS 30
 ACCESS='STREAM' I/O 21
 ACHAR 31
 ACOS 31
 ACOSH 32
 adjust string 32, 33
 ADJUSTL 32
 ADJUSTR 33
 AIMAG 33
 AINT 34
 ALARM 34
 aliasing 10
 ALL 35
 all warnings 10
 ALLOCATABLE components of derived types 21
 ALLOCATABLE dummy arguments 21
 ALLOCATABLE function results 21
 ALLOCATED 36
 allocation, moving 101
 allocation, status 36
 ALOG 90
 ALOG10 90
 AMAX0 94
 AMAX1 94
 AMINO 98
 AMIN1 98
 AMOD 100
 AND 36
 ANINT 37
 ANY 37
 area hyperbolic cosine 32
 area hyperbolic sine 38
 area hyperbolic tangent 41
 arguments, to program 48, 70, 71, 77
 array, add elements 123
 array, apply condition 35, 37
 array, bounds checking 14
 array, change dimensions 112
 array, combine arrays 97
 array, condition testing 35, 37
 array, conditionally add elements 123
 array, conditionally count elements 50
 array, conditionally multiply elements 107
 array, constructors 21

array, count elements 119
 array, duplicate dimensions 121
 array, duplicate elements 121
 array, element counting 50
 array, gather elements 105
 array, increase dimension 121, 130
 array, indices of type real 25
 array, location of maximum element 95
 array, location of minimum element 98
 array, lower bound 85
 array, maximum value 96
 array, merge arrays 97
 array, minimum value 99
 array, multiply elements 107
 array, number of elements 50, 119
 array, packing 105
 array, permutation 51
 array, product 107
 array, reduce dimension 105
 array, rotate 51
 array, scatter elements 130
 array, shape 116
 array, shift 58
 array, shift circularly 51
 array, size 119
 array, sum 123
 array, transmogrify 112
 array, transpose 128
 array, unpacking 130
 array, upper bound 129
 ASCII collating sequence 31, 76
 ASIN 38
 ASINH 38, 41
 ASSOCIATED 39
 association status 39
 ATAN 40
 ATAN2 40
 Authors 133

B

backslash 8
 BESJ0 41
 BESJ1 42
 BESJN 42
 Bessel function, first kind 41, 42
 Bessel function, second kind 43, 44
 BESY0 43
 BESY1 43
 BESYN 44
 BIT_SIZE 44
 bits, clear 77
 bits, extract 77
 bits, get 77
 bits, move 102, 127
 bits, negate 104
 bits, number of 44
 bits, set 78
 bits, shift 83
 bits, shift circular 84
 bits, shift left 92

bits, shift right	112
bits, testing	44
bits, unset	77
bitwise logical and	36, 76
bitwise logical exclusive or	79, 131
bitwise logical not	104
bitwise logical or	82, 104
bounds checking	14
BOZ literal constants	25
BTEST	44

C

CABS	30
calling convention	12
CCOS	49
CDABS	30
CDCOS	49
CDEXP	61
CDLOG	90
CDSIN	118
CDSQRT	121
ceiling	37, 45
CEILING	45
CEXP	61
CHAR	45
character set	8
CHDIR	46
checking subscripts	14
CHMOD	46
clock ticks	96, 97, 125
CLOG	90
CMPLX	47
code generation, conventions	12
collating sequence, ASCII	31, 76
command options	7
command-line arguments	48, 70, 71, 77
command-line arguments, number of	48, 77
COMMAND_ARGUMENT_COUNT	48
COMPLEX	48
complex conjugate	49
complex numbers, conversion to	47, 48, 54
complex numbers, imaginary part	33
complex numbers, real part	57, 110
CONJG	49
Contributing	133
Contributors	133
conversion	10
conversion, to character	45
conversion, to complex	47, 48, 54
conversion, to integer	25, 76, 78, 81, 82, 91
conversion, to logical	25, 91
conversion, to real	53, 54, 63, 110, 120
conversion, to string	52
CONVERT specifier	27
core, dump	29
COS	49
COSH	50
cosine	49
cosine, hyperbolic	50
cosine, hyperbolic, inverse	32
cosine, inverse	31
COUNT	50
CPU_TIME	51
Credits	133

CSHIFT	51
CSIN	118
CSQRT	121
CTIME	52
current date	53, 62, 79
current time	53, 62, 84, 126, 127

D

DABS	30
DACOS	31
DACOSH	32
DASIN	38
DASINH	38, 41
DATAN	40
DATAN2	40
date, current	53, 62, 79
DATE_AND_TIME	53
DBESJO	41
DBESJ1	42
DBESJN	42
DBESYO	43
DBESY1	43
DBESYN	44
DBLE	53
DCMPLX	54
DCONJG	49
DCOS	49
DCOSH	50
DDIM	55
debugging information options	11
delayed execution	34, 120
DEXP	61
DFLOAT	54
dialect options	8
DIGITS	55
DIM	55
DIMAG	33
DINT	34
directive, INCLUDE	11
directory, options	11
directory, search paths for inclusion	11
division, modulo	100
division, remainder	100
DLOG	90
DLOG10	90
DMAX1	94
DMIN1	98
DMOD	100
DNINT	37
dot product	56
DOT_PRODUCT	56
DPROD	56
DREAL	57
DSIGN	117
DSIN	118
DSINH	119
DSQRT	121
DTAN	125
DTANH	126
DTIME	57

E

elapsed time.....	57, 114
ENUM statement	21
ENUMERATOR statement	21
environment variable	15, 17, 72
EOSHIFT	58
EPSILON	59
ERF	59
ERFC	60
error function.....	59
error function, complementary	60
errors, limiting.....	9
escape characters.....	8
ETIME	60
EXIT	61
EXP	61
EXPONENT	62
exponential function.....	61
exponential function, inverse	90
Extension	23

F

f2c calling convention.....	12, 14
FDATE	62
FDL, GNU Free Documentation License	143
FGET	63
FGETC	64
file format, fixed	8
file format, free	8
file operation, file number.....	65
file operation, flush.....	65
file operation, position	68, 69
file operation, read character	63, 64
file operation, seek	68
file operation, write character	66
file system, access mode	30
file system, change access mode	46
file system, create link	88, 124
file system, file creation mask	130
file system, file status	68, 92, 122
file system, hard link	88
file system, remove file.....	130
file system, rename file	111
file system, soft link	124
FLOAT	63
floating point, exponent	62
floating point, fraction.....	67
floating point, nearest different	102
floating point, relative spacing	112, 120
floating point, scale	113
floating point, set exponent	116
floor	34, 65
FLOOR	65
FLUSH	65
FLUSH statement	21
FNUM	65
Fortran 77.....	2
FPUT	66
FPUTC	66
FRACTION	67
FREE	68
FSEEK	68
FSTAT	68

FTELL	69
-------------	----

G

g77	2
g77 calling convention.....	12, 14
GCC	2
GERROR	69
GET_COMMAND.....	70
GET_COMMAND_ARGUMENT	71
GET_ENVIRONMENT_VARIABLE.....	72
GETARG	70
GETCWD	71
GETENV	72
GETGID	73
GETLOG	73
GETPID	73
GETUID	74
GMTIME	74
GNU Compiler Collection.....	2
GNU Fortran command options	7

H

Hollerith constants	25
HOSTNM	75
HUGE	75
hyperbolic arccosine.....	32
hyperbolic arcsine.....	38
hyperbolic arctangent	41
hyperbolic cosine.....	50
hyperbolic function, cosine	50
hyperbolic function, cosine, inverse	32
hyperbolic function, sine.....	119
hyperbolic function, sine, inverse	38
hyperbolic function, tangent	126
hyperbolic function, tangent, inverse	41
hyperbolic sine.....	119
hyperbolic tangent	126

I

I/O item lists	24
IABS	30
IACHAR	76
IAND	76
IARGC	77
IBCLR	77
IBITS	77
IBSET	78
ICHAR	78
IDATE	79
IDIM	55
IDINT	81
IDNINT	103
IEOR	79
IERRNO	80
IFIX	81
IMAG	33
IMAGPART	33
INCLUDE directive	11
inclusion, directory search paths for	11
INDEX	80
INT	81

INT2	81
INT8	82
integer kind	115
intrinsic procedures	29
IOMSG= specifier	21
IOR	82
IRAND	82
ISATTY	83
ISHFT	83
ISHFTC	84
ISIGN	117
ITIME	84

K

KILL	85
kind	85
KIND	85
kind, integer	115
kind, old-style	23
kind, real	115

L

language, dialect options	8
LBOUND	85
LEN	86
LEN_TRIM	86
lexical comparison of strings	87, 88, 89
LGE	87
LGT	87
libf2c calling convention	12, 14
limits, largest number	75
limits, smallest number	127
LINK	88
LLE	88
LLT	89
LNBLNK	89
LOC	89
location of a variable in memory	89
LOG	90
LOG10	90
logarithmic function	90
logarithmic function, inverse	61
LOGICAL	91
logical and, bitwise	36, 76
logical exclusive or, bitwise	79, 131
logical not, bitwise	104
logical or, bitwise	82, 104
login name	73
LONG	91
LSHIFT	92
LSTAT	92
LTIME	92

M

MALLOC	93
MATMUL	94
matrix multiplication	94
matrix, transpose	128
MAX	94
MAXO	94
MAX1	94

MAXEXPONENT	95
maximum value	94, 96
MAXLOC	95
MAXVAL	96
MCLOCK	96
MCLOCK8	97
MERGE	97
messages, error	9
messages, warning	9
MIN	98
MINO	98
MIN1	98
MINEXPONENT	98
minimum value	98, 99
MINLOC	98
MINVAL	99
MOD	100
model representation, base	107
model representation, epsilon	59
model representation, largest number	75
model representation, maximum exponent	95
model representation, minimum exponent	98
model representation, precision	106
model representation, radix	107
model representation, range	110
model representation, significant digits	55
model representation, smallest number	127
module search path	11, 12
modulo	100
MODULO	100
MOVE_ALLOC	101
moving allocation	101
multiply array elements	107
MVBITS	102

N

Namelist	23
NEAREST	102
NEW_LINE	103
newline	103
NINT	103
NOT	104
NULL	104

O

OpenMP	9, 28
operators, unary	25
options, code generation	12
options, debugging	11
options, dialect	8
options, directory search	11
options, errors	9
options, fortran dialect	8
options, gfortran command	7
options, negative forms	7
options, run-time	12
options, runtime	12
options, warnings	9
OR	104
output, newline	103

P

PACK	105
paths, search	11, 12
PERROR	106
pointer, cray	26, 68, 93
pointer, disassociated	104
pointer, status	39, 104
positive difference	55
PRECISION	106
PRESENT	106
process id	73
PRODUCT	107
product, double-precision	56
product, matrix	94
product, vector	56
program termination	61
program termination, with core dump	29

R

RADIX	107
RAN	108
RAND	108
random number generation	82, 108
random number generation, seeding	109, 122
RANDOM_NUMBER	108
RANDOM_SEED	109
RANGE	110
range checking	14
read character, stream mode	63, 64
REAL	110
real kind	115
real number, exponent	62
real number, fraction	67
real number, nearest different	102
real number, relative spacing	112, 120
real number, scale	113
real number, set exponent	116
REALPART	110
remainder	100
RENAME	111
repacking arrays	14
REPEAT	111
RESHAPE	112
root	121
rounding, ceiling	37, 45
rounding, floor	34, 65
rounding, nearest whole number	103
RRSPACING	112
RSHIFT	112

S

SAVE statement	12
SCALE	113
SCAN	113
search path	11
search paths, for included files	11
SECNDS	114
SECOND	114
seeding a random number generator	109, 122
SELECTED_INT_KIND	115
SELECTED_REAL_KIND	115
SET_EXPONENT	116

SHAPE	116
SHORT	81
SIGN	117
sign copying	117
SIGNAL	117
SIN	118
sine	118
sine, hyperbolic	119
sine, hyperbolic, inverse	38
sine, inverse	38
SINH	119
SIZE	119
size of a variable, in bits	44
SLEEP	120
SNGL	120
SPACING	120
SPREAD	121
SQRT	121
square-root	121
SRAND	122
Standards	3
STAT	122
statement, ENUM	21
statement, ENUMERATOR	21
statement, FLUSH	21
statement, SAVE	12
STREAM I/O	21
stream mode, read character	63, 64
stream mode, write character	66
string, adjust left	32
string, adjust right	33
string, comparison	87, 88, 89
string, concatenate	111
string, find missing set	131
string, find non-blank character	89
string, find subset	113
string, find substring	80
string, length	86
string, length, without trailing whitespace	86
string, remove trailing whitespace	128
string, repeat	111
structure packing	14
subscript checking	14
substring position	80
SUM	123
sum array elements	123
suppressing warnings	9
symbol names	8
symbol names, transforming	13, 14
symbol names, underscores	13, 14
SYMLNK	124
syntax checking	9
SYSTEM	124
system, error handling	69, 80, 106
system, group id	73
system, host name	75
system, login name	73
system, process id	73
system, signal handling	117
system, system call	124
system, terminal	83, 129
system, user id	74
system, working directory	46, 71
SYSTEM_CLOCK	125

T

tabulators	11
TAN	125
tangent	125
tangent, hyperbolic	126
tangent, hyperbolic, inverse	41
tangent, inverse	40
TANH	126
terminate program	61
terminate program, with core dump	29
TIME	126
time, clock ticks	96, 97, 125
time, conversion to GMT info	74
time, conversion to string	52
time, conversion to local time info	92
time, current	53, 62, 84, 126, 127
time, elapsed	51, 57, 60, 114
TIME8	127
TINY	127
TR 15581	21
TRANSFER	127
transforming symbol names	13, 14
transpose	128
TRANSPOSE	128
trigonometric function, cosine	49
trigonometric function, cosine, inverse	31
trigonometric function, sine	118
trigonometric function, sine, inverse	38
trigonometric function, tangent	125
trigonometric function, tangent, inverse	40
TRIM	128
TTYNAM	129
type cast	127

U

UBOUND	129
UMASK	130

underflow	11
underscore	13, 14
UNLINK	130
UNPACK	130
user id	74

V

vector product	56
VERIFY	131

W

warnings, aliasing	10
warnings, all	10
warnings, ampersand	10
warnings, character truncation	10
warnings, conversion	10
warnings, implicit interface	10
warnings, non-standard intrinsics	10
warnings, suppressing	9
warnings, suspicious code	11
warnings, tabs	11
warnings, to errors	11
warnings, underflow	11
write character, stream mode	66

X

XOR	131
------------------	-----

Z

ZABS	30
ZCOS	49
ZEXP	61
ZLOG	90
ZSIN	118
ZSQRT	121