The GNU D Compiler

For GCC version 12.3.0

(GCC)

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Introduction

This manual describes how to use `gdc`, the GNU compiler for the D programming language. This manual is specifically about `gdc`. For more information about the D programming language in general, including language specifications and standard package documentation, see `https://dlang.org/`.

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1 Invoking gdc

The `gdc` command is the GNU compiler for the D language and supports many of the same options as `gcc`. See Section "Option Summary" in *Using the GNU Compiler Collection (GCC)*. This manual only documents the options specific to `gdc`.

1.1 Input and Output files

For any given input file, the file name suffix determines what kind of compilation is done. The following kinds of input file names are supported:

file`.d` D source files.

file`.dd` Ddoc source files.

file`.di` D interface files.

You can specify more than one input file on the `gdc` command line, each being compiled separately in the compilation process. If you specify a `-o` *file* option, all the input files are compiled together, producing a single output file, named *file*. This is allowed even when using `-S` or `-c`.

A D interface file contains only what an import of the module needs, rather than the whole implementation of that module. They can be created by `gdc` from a D source file by using the `-H` option. When the compiler resolves an import declaration, it searches for matching '`.di`' files first, then for '`.d`'.

A Ddoc source file contains code in the D macro processor language. It is primarily designed for use in producing user documentation from embedded comments, with a slight affinity towards HTML generation. If a '`.d`' source file starts with the string `Ddoc` then it is treated as general purpose documentation, not as a D source file.

1.2 Runtime Options

These options affect the runtime behavior of programs compiled with `gdc`.

`-fall-instantiations`
: Generate code for all template instantiations. The default template emission strategy is to not generate code for declarations that were either instantiated speculatively, such as from `__traits(compiles, ...)`, or that come from an imported module not being compiled.

`-fno-assert`
: Turn off code generation for `assert` contracts.

`-fno-bounds-check`
: Turns off array bounds checking for all functions, which can improve performance for code that uses arrays extensively. Note that this can result in unpredictable behavior if the code in question actually does violate array bounds constraints. It is safe to use this option if you are sure that your code never throws a `RangeError`.

`-fbounds-check=`*value*
: An alternative to '`-fbounds-check`' that allows more control as to where bounds checking is turned on or off. The following values are supported:

'on' Turns on array bounds checking for all functions.

'safeonly'
Turns on array bounds checking only for `@safe` functions.

'off' Turns off array bounds checking completely.

`-fno-builtin`
Don't recognize built-in functions unless they begin with the prefix '`__builtin_`'. By default, the compiler will recognize when a function in the `core.stdc` package is a built-in function.

`-fcheckaction=value`
This option controls what code is generated on an assertion, bounds check, or final switch failure. The following values are supported:

'context' Throw an `AssertError` with extra context information.

'halt' Halt the program execution.

'throw' Throw an `AssertError` (the default).

`-fdebug`

`-fdebug=value`
Turn on compilation of conditional `debug` code into the program. The '`-fdebug`' option itself sets the debug level to `1`, while '`-fdebug=`' enables `debug` code that are identified by any of the following values:

'level' Sets the debug level to *level*, any `debug` code <= *level* is compiled into the program.

'ident' Turns on compilation of any `debug` code identified by *ident*.

`-fno-druntime`
Implements `https://dlang.org/spec/betterc.html`. Assumes that compilation targets an environment without a D runtime library.

This is equivalent to compiling with the following options:

```
gdc -nophoboslib -fno-exceptions -fno-moduleinfo -fno-rtti
```

`-fextern-std=standard`
Sets the C++ name mangling compatibility to the version identified by *standard*. The following values are supported:

'c++98'

'c++03' Sets `__traits(getTargetInfo, "cppStd")` to `199711`.

'c++11' Sets `__traits(getTargetInfo, "cppStd")` to `201103`.

'c++14' Sets `__traits(getTargetInfo, "cppStd")` to `201402`.

'c++17' Sets `__traits(getTargetInfo, "cppStd")` to `201703`. This is the default.

'c++20' Sets `__traits(getTargetInfo, "cppStd")` to `202002`.

`-fno-invariants`
: Turns off code generation for class `invariant` contracts.

`-fmain`
: Generates a default `main()` function when compiling. This is useful when unittesting a library, as it enables running the unittests in a library without having to manually define an entry-point function. This option does nothing when `main` is already defined in user code.

`-fno-moduleinfo`
: Turns off generation of the `ModuleInfo` and related functions that would become unreferenced without it, which may allow linking to programs not written in D. Functions that are not be generated include module constructors and destructors (`static this` and `static ~this`), `unittest` code, and `DSO` registry functions for dynamically linked code.

`-fonly=`*`filename`*
: Tells the compiler to parse and run semantic analysis on all modules on the command line, but only generate code for the module specified by *filename*.

`-fno-postconditions`
: Turns off code generation for postcondition `out` contracts.

`-fno-preconditions`
: Turns off code generation for precondition `in` contracts.

`-fpreview=`*`id`*
: Turns on an upcoming D language change identified by *id*. The following values are supported:

  ‘`all`’ Turns on all upcoming D language features.

  ‘`dip1000`’ Implements `https://github.com/dlang/DIPs/blob/master/DIPs/other/DIP1000.md` (Scoped pointers).

  ‘`dip1008`’ Implements `https://github.com/dlang/DIPs/blob/master/DIPs/other/DIP1008.md` (Allow exceptions in `@nogc` code).

  ‘`dip1021`’ Implements `https://github.com/dlang/DIPs/blob/master/DIPs/accepted/DIP1021.md` (Mutable function arguments).

  ‘`dip25`’ Implements `https://github.com/dlang/DIPs/blob/master/DIPs/archive/DIP25.md` (Sealed references).

  ‘`dtorfields`’
  : Turns on generation for destructing fields of partially constructed objects.

  ‘`fieldwise`’
  : Turns on generation of struct equality to use field-wise comparisons.

  ‘`fixaliasthis`’
  : Implements new lookup rules that check the current scope for `alias this` before searching in upper scopes.

  ‘`in`’ Implements `in` parameters to mean `scope const [ref]` and accepts rvalues.

'`inclusiveincontracts`'
: Implements `in` contracts of overridden methods to be a superset of parent contract.

'`intpromote`'
: Implements C-style integral promotion for unary `+`, `-` and `~` expressions.

'`nosharedaccess`'
: Turns off and disallows all access to shared memory objects.

'`rvaluerefparam`'
: Implements rvalue arguments to `ref` parameters.

'`shortenedmethods`'
: Implements use of `=>` for methods and top-level functions in addition to lambdas.

`-frelease`
: Turns on compiling in release mode, which means not emitting runtime checks for contracts and asserts. Array bounds checking is not done for `@system` and `@trusted` functions, and assertion failures are undefined behavior.

  This is equivalent to compiling with the following options:

```
gdc -fno-assert -fbounds-check=safe -fno-invariants \
    -fno-postconditions -fno-preconditions -fno-switch-errors
```

`-frevert=`
: Turns off a D language feature identified by *id*. The following values are supported:

  '`all`' Turns off all revertable D language features.

  '`dip25`' Reverts `https://github.com/dlang/DIPs/blob/master/DIPs/archive/DIP25.md` (Sealed references).

  '`dtorfields`'
  : Turns off generation for destructing fields of partially constructed objects.

  '`markdown`'
  : Turns off Markdown replacements in Ddoc comments.

`-fno-rtti`
: Turns off generation of run-time type information for all user defined types. Any code that uses features of the language that require access to this information will result in an error.

`-fno-switch-errors`
: This option controls what code is generated when no case is matched in a `final switch` statement. The default run time behavior is to throw a `SwitchError`. Turning off '`-fswitch-errors`' means that instead the execution of the program is immediately halted.

`-funittest`
: Turns on compilation of `unittest` code, and turns on the `version(unittest)` identifier. This implies '`-fassert`'.

`-fversion=`*`value`*
: Turns on compilation of conditional `version` code into the program identified by any of the following values:

  '`level`' Sets the version level to *level*, any `version` code >= *level* is compiled into the program.

  '`ident`' Turns on compilation of `version` code identified by *ident*.

`-fno-weak-templates`
: Turns off emission of declarations that can be defined in multiple objects as weak symbols. The default is to emit all public symbols as weak, unless the target lacks support for weak symbols. Disabling this option means that common symbols are instead put in COMDAT or become private.

1.3 Options for Directory Search

These options specify directories to search for files, libraries, and other parts of the compiler:

`-I`*`dir`*
: Specify a directory to use when searching for imported modules at compile time. Multiple '`-I`' options can be used, and the paths are searched in the same order.

`-J`*`dir`*
: Specify a directory to use when searching for files in string imports at compile time. This switch is required in order to use `import(file)` expressions. Multiple '`-J`' options can be used, and the paths are searched in the same order.

`-L`*`dir`*
: When linking, specify a library search directory, as with `gcc`.

`-B`*`dir`*
: This option specifies where to find the executables, libraries, source files, and data files of the compiler itself, as with `gcc`.

`-fmodule-file=`*`module=spec`*
: This option manipulates file paths of imported modules, such that if an imported module matches all or the leftmost part of *module*, the file path in *spec* is used as the location to search for D sources. This is used when the source file path and names are not the same as the package and module hierarchy. Consider the following examples:

```
gdc test.d -fmodule-file=A.B=foo.d -fmodule-file=C=bar
```

  This will tell the compiler to search in all import paths for the source file *foo.d* when importing *A.B*, and the directory *bar/* when importing *C*, as annotated in the following D code:

```
module test;
import A.B;     // Matches A.B, searches for foo.d
import C.D.E;   // Matches C, searches for bar/D/E.d
import A.B.C;   // No match, searches for A/B/C.d
```

`-imultilib` *`dir`*
: Use *dir* as a subdirectory of the gcc directory containing target-specific D sources and interfaces.

`-iprefix` *prefix*
: Specify *prefix* as the prefix for the gcc directory containing target-specific D sources and interfaces. If the *prefix* represents a directory, you should include the final `'/'`.

`-nostdinc`
: Do not search the standard system directories for D source and interface files. Only the directories that have been specified with '`-I`' options (and the directory of the current file, if appropriate) are searched.

1.4 Code Generation

In addition to the many `gcc` options controlling code generation, `gdc` has several options specific to itself.

`-H`
: Generates D interface files for all modules being compiled. The compiler determines the output file based on the name of the input file, removes any directory components and suffix, and applies the '`.di`' suffix.

`-Hd` *dir*
: Same as '`-H`', but writes interface files to directory *dir*. This option can be used with '`-Hf` *file*' to independently set the output file and directory path.

`-Hf` *file*
: Same as '`-H`' but writes interface files to *file*. This option can be used with '`-Hd` *dir*' to independently set the output file and directory path.

`-M`
: Output the module dependencies of all source files being compiled in a format suitable for `make`. The compiler outputs one `make` rule containing the object file name for that source file, a colon, and the names of all imported files.

`-MM`
: Like '`-M`' but does not mention imported modules from the D standard library package directories.

`-MF` *file*
: When used with '`-M`' or '`-MM`', specifies a *file* to write the dependencies to. When used with the driver options '`-MD`' or '`-MMD`', '`-MF`' overrides the default dependency output file.

`-MG`
: This option is for compatibility with `gcc`, and is ignored by the compiler.

`-MP`
: Outputs a phony target for each dependency other than the modules being compiled, causing each to depend on nothing.

`-MT` *target*
: Change the *target* of the rule emitted by dependency generation to be exactly the string you specify. If you want multiple targets, you can specify them as a single argument to '`-MT`', or use multiple '`-MT`' options.

`-MQ` *target*
: Same as '`-MT`', but it quotes any characters which are special to `make`.

`-MD`
: This option is equivalent to '`-M -MF` *file*'. The driver determines *file* by removing any directory components and suffix from the input file, and then adding a '`.deps`' suffix.

`-MMD`
: Like '`-MD`' but does not mention imported modules from the D standard library package directories.

`-X` Output information describing the contents of all source files being compiled in JSON format to a file. The driver determines *file* by removing any directory components and suffix from the input file, and then adding a '`.json`' suffix.

`-Xf file` Same as '`-X`', but writes all JSON contents to the specified *file*.

`-fdoc` Generates `Ddoc` documentation and writes it to a file. The compiler determines *file* by removing any directory components and suffix from the input file, and then adding a '`.html`' suffix.

`-fdoc-dir=dir`
Same as '`-fdoc`', but writes documentation to directory *dir*. This option can be used with '`-fdoc-file=file`' to independently set the output file and directory path.

`-fdoc-file=file`
Same as '`-fdoc`', but writes documentation to *file*. This option can be used with '`-fdoc-dir=dir`' to independently set the output file and directory path.

`-fdoc-inc=file`
Specify *file* as a *Ddoc* macro file to be read. Multiple '`-fdoc-inc`' options can be used, and files are read and processed in the same order.

`-fdump-c++-spec=file`
For D source files, generate corresponding C++ declarations in *file*.

`-fdump-c++-spec-verbose`
In conjunction with '`-fdump-c++-spec=`' above, add comments for ignored declarations in the generated C++ header.

`-fsave-mixins=file`
Generates code expanded from D `mixin` statements and writes the processed sources to *file*. This is useful to debug errors in compilation and provides source for debuggers to show when requested.

1.5 Warnings

Warnings are diagnostic messages that report constructions that are not inherently erroneous but that 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.

`-Wall` Turns on all warnings messages. Warnings are not a defined part of the D language, and all constructs for which this may generate a warning message are valid code.

`-Walloca` This option warns on all uses of "alloca" in the source.

`-Walloca-larger-than=n`
Warn on unbounded uses of alloca, and on bounded uses of alloca whose bound can be larger than *n* bytes. '`-Wno-alloca-larger-than`' disables '`-Walloca-larger-than`' warning and is equivalent to '`-Walloca-larger-than=SIZE_MAX`' or larger.

`-Wcast-result`
: Warn about casts that will produce a null or zero result. Currently this is only done for casting between an imaginary and non-imaginary data type, or casting between a D and C++ class.

`-Wno-deprecated`
: Do not warn about usage of deprecated features and symbols with `deprecated` attributes.

`-Werror`
: Turns all warnings into errors.

`-Wspeculative`
: List all error messages from speculative compiles, such as `__traits(compiles, ...)`. This option does not report messages as warnings, and these messages therefore never become errors when the '`-Werror`' option is also used.

`-Wtemplates`
: Warn when a template instantiation is encountered. Some coding rules disallow templates, and this may be used to enforce that rule.

`-Wunknown-pragmas`
: Warn when a `pragma()` is encountered that is not understood by `gdc`. This differs from '`-fignore-unknown-pragmas`' where a pragma that is part of the D language, but not implemented by the compiler, won't get reported.

`-Wno-varargs`
: Do not warn upon questionable usage of the macros used to handle variable arguments like `va_start`.

`-fignore-unknown-pragmas`
: Turns off errors for unsupported pragmas.

`-fmax-errors=`*n*
: Limits the maximum number of error messages to *n*, at which point `gdc` bails out rather than attempting to continue processing the source code. If *n* is 0 (the default), there is no limit on the number of error messages produced.

`-fsyntax-only`
: Check the code for syntax errors, but do not actually compile it. This can be used in conjunction with '`-fdoc`' or '`-H`' to generate files for each module present on the command-line, but no other output file.

`-ftransition=`*id*
: Report additional information about D language changes identified by *id*. The following values are supported:

  '`all`' List information on all D language transitions.

  '`complex`' List all usages of complex or imaginary types.

  '`field`' List all non-mutable fields which occupy an object instance.

  '`in`' List all usages of `in` on parameter.

  '`nogc`' List all hidden GC allocations.

'`templates`'
List statistics on template instantiations.

'`tls`' List all variables going into thread local storage.

'`vmarkdown`'
List instances of Markdown replacements in Ddoc.

1.6 Options for Linking

These options come into play when the compiler links object files into an executable output file. They are meaningless if the compiler is not doing a link step.

`-defaultlib=`*`libname`*
Specify the library to use instead of libphobos when linking. Options specifying the linkage of libphobos, such as '`-static-libphobos`' or '`-shared-libphobos`', are ignored.

`-debuglib=`*`libname`*
Specify the debug library to use instead of libphobos when linking. This option has no effect unless the '`-g`' option was also given on the command line. Options specifying the linkage of libphobos, such as '`-static-libphobos`' or '`-shared-libphobos`', are ignored.

`-nophoboslib`
Do not use the Phobos or D runtime library when linking. Options specifying the linkage of libphobos, such as '`-static-libphobos`' or '`-shared-libphobos`', are ignored. The standard system libraries are used normally, unless '`-nostdlib`' or '`-nodefaultlibs`' is used.

`-shared-libphobos`
On systems that provide '`libgphobos`' and '`libgdruntime`' as a shared and a static library, this option forces the use of the shared version. If no shared version was built when the compiler was configured, this option has no effect.

`-static-libphobos`
On systems that provide '`libgphobos`' and '`libgdruntime`' as a shared and a static library, this option forces the use of the static version. If no static version was built when the compiler was configured, this option has no effect.

1.7 Developer Options

This section describes command-line options that are primarily of interest to developers or language tooling.

`-fdump-d-original`
Output the internal front-end AST after the `semantic3` stage. This option is only useful for debugging the GNU D compiler itself.

`-v` Dump information about the compiler language processing stages as the source program is being compiled. This includes listing all modules that are processed through the `parse`, `semantic`, `semantic2`, and `semantic3` stages; all `import` modules and their file paths; and all `function` bodies that are being compiled.

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