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# **Sourcery G++ Lite**

**MIPS ELF**

**Sourcery G++ Lite 4.2-199**

**Getting Started**



## **Sourcery G++ Lite: MIPS ELF: Sourcery G++ Lite 4.2-199: Getting Started**

CodeSourcery, Inc.

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# Preface

This preface introduces *Getting Started With Sourcery G++ Lite*. It explains the structure of this guide and lists other sources of information that relate to Sourcery G++ Lite.

## 1. Intended Audience

This guide is written for people who will install and/or use Sourcery G++ Lite. This guide provides a step-by-step guide to installing Sourcery G++ Lite and to building simple applications. Parts of this document assume that you have some familiarity with using the command-line interface.

## 2. Organization

This document is organized into the following chapters and appendices:

Chapter 1, <i>Sourcery G++ Lite Licenses</i>	This chapter provides information about the software licenses that apply to Sourcery G++ Lite. Read this chapter to understand your legal rights and obligations as a user of Sourcery G++ Lite.
Chapter 2, <i>Sourcery G++ Subscriptions</i>	This chapter provides information about Sourcery G++ subscriptions. CodeSourcery customers with Sourcery G++ subscriptions receive comprehensive support for Sourcery G++. Read this chapter to find out how to obtain and use a Sourcery G++ subscription.
Chapter 3, <i>Sourcery G++ Lite for MIPS ELF</i>	This chapter provides information about this release of Sourcery G++ Lite including any special installation instructions, recent improvements, or other similar information. You should read this chapter before building applications with Sourcery G++ Lite.
Chapter 4, <i>Installation and Configuration</i>	This chapter describes how to download, install and configure Sourcery G++ Lite. This section describes the available installation options and explains how to set up your environment so that you can build applications.
Chapter 5, <i>Using Sourcery G++ from the Command Line</i>	This chapter explains how to build applications with Sourcery G++ Lite using the command line. In the process of reading this chapter, you will build a simple application that you can use as a model for your own programs.
Chapter 6, <i>Next Steps with Sourcery G++</i>	This chapter describes where you can find additional documentation and information about using Sourcery G++ Lite and its components.

## 3. Typographical Conventions

The following typographical conventions are used in this guide:

<code>&gt; command arg ...</code>	A command, typed by the user, and its output. The “>” character is the command prompt.
<b>command</b>	The name of a program, when used in a sentence, rather than in literal input or output.
<code>literal</code>	Text provided to or received from a computer program.

*placeholder*

Text that should be replaced with an appropriate value when typing a command.

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At the end of a line in command or program examples, indicates that a long line of literal input or output continues onto the next line in the document.

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# Chapter 1

## Sourcery G++ Lite Licenses

Sourcery G++ Lite contains software provided under a variety of licenses. Some components are "free" or "open source" software, while other components are proprietary. This chapter explains what licenses apply to your use of Sourcery G++ Lite. You should read this chapter to understand your legal rights and obligations as a user of Sourcery G++ Lite.

## 1.1. Licenses for Sourcery G++ Lite Components

The table below lists the major components of Sourcery G++ Lite for MIPS ELF and the license terms which apply to each of these components.

Some free or open-source components provide documentation or other files under terms different from those shown below. For definitive information about the license that applies to each component, consult the source package corresponding to this release of Sourcery G++ Lite. Sourcery G++ Lite may contain free or open-source components not included in the list below; for a definitive list, consult the source package corresponding to this release of Sourcery G++ Lite.

Component	License
GNU Compiler Collection	GNU General Public License 3.0 <sup>1</sup>
GNU Binary Utilities	GNU General Public License 3.0 <sup>2</sup>
GNU Debugger	GNU General Public License 3.0 <sup>3</sup>
SDE C Library	BSD License <sup>4</sup>
SDE MDI Library	BSD License <sup>5</sup>
GNU Make	GNU General Public License 2.0 <sup>6</sup>
GNU Core Utilities	GNU General Public License 2.0 <sup>7</sup>

The CodeSourcery License is available in Section 1.2, "Sourcery G++™ Software License Agreement".

### Important

Although some of the licenses that apply to Sourcery G++ Lite are "free software" or "open source software" licenses, none of these licenses impose any obligation on you to reveal the source code of applications you build with Sourcery G++ Lite. You can develop proprietary applications and libraries with Sourcery G++ Lite.

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- Parties.** The parties to this Agreement are you, the licensee ("You" or "Licensee") and CodeSourcery. If You are not acting on behalf of Yourself as an individual, then "You" means Your company or organization.
- The Software.** The Software licensed under this Agreement consists of computer programs and documentation referred to as Sourcery G++™ Lite Edition (the "Software").
- Definitions.**

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<sup>1</sup> <http://www.gnu.org/licenses/gpl.html>

<sup>2</sup> <http://www.gnu.org/licenses/gpl.html>

<sup>3</sup> <http://www.gnu.org/licenses/gpl.html>

<sup>4</sup> [http://en.wikipedia.org/wiki/BSD\\_license](http://en.wikipedia.org/wiki/BSD_license)

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<sup>6</sup> <http://www.gnu.org/licenses/old-licenses/gpl-2.0.html>

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19. **Jurisdiction And Venue.** The courts of Placer County in the State of California, USA and the nearest U.S. District Court shall be the exclusive jurisdiction and venue for all legal proceedings that are not arbitrated under this Agreement.
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# Chapter 2

## Sourcery G++ Subscriptions

CodeSourcery provides support contracts for Sourcery G++. This chapter describes these contracts and explains how CodeSourcery customers can access their support accounts.

## 2.1. About Sourcery G++ Subscriptions

CodeSourcery offers Sourcery G++ subscriptions. Professional Edition subscriptions provide unlimited support, with no per-incident fees. CodeSourcery's support covers questions about installing and using Sourcery G++, the C and C++ programming languages, and all other topics relating to Sourcery G++. CodeSourcery provides updated versions of Sourcery G++ to resolve critical problems. Personal Edition subscriptions do not include support, but do include free upgrades as long as the subscription remains active.

CodeSourcery's support is provided by the same engineers who build Sourcery G++. A Sourcery G++ subscription is like having a team of compiler engineers and programming language experts available as consultants!

Subscription editions of Sourcery G++ also include many additional features not included in the free Lite editions:

- **Sourcery G++ IDE.** The Sourcery G++ IDE, based on Eclipse, provides a fully visual environment for developing applications, including an automated project builder, syntax-highlighting editor, and a graphical debugging interface. The debugger provides features especially useful to embedded systems programmers, including the ability to step through code at both the source and assembly level, view registers, and examine stack traces. CodeSourcery's enhancements to Eclipse include improved support for hardware debugging via JTAG or ICE units and complete integration with the rest of Sourcery G++.
- **Debug Sprites.** Sourcery G++ Debug Sprites provide hardware debugging support using JTAG and ICE devices. On some systems, Sourcery G++ Sprites can automatically program flash memory and display control registers. And the board initialization performed by each Sprite can be customized with simple XML-based configuration files to insert delays and write to particular memory addresses. Debug Sprites included in Lite editions of Sourcery G++ include only a subset of the functionality of the Sprites in the subscription editions.
- **QEMU Instruction Set Simulator.** The QEMU instruction set simulator can be used to run — and debug — programs even without target hardware. Most bare-metal configurations of Sourcery G++ include QEMU and linker scripts targeting the simulator. Configurations of Sourcery G++ for GNU/Linux targets include a user-space QEMU emulator that runs on Linux hosts.
- **Sysroot Utilities.** Subscription editions of Sourcery G++ include a set of sysroot utilities for GNU/Linux targets. These utilities simplify use of the Sourcery G++ dynamic linker and shared libraries on the target and also support remote debugging with **gdbserver**.
- **CS3.** CS3 provides a uniform, cross-platform approach to board initialization and interrupt handling on ARM EABI, ColdFire ELF, fido ELF, and Stellaris EABI platforms.
- **GNU/Linux Prelinker.** For select GNU/Linux target systems, Sourcery G++ includes the GNU/Linux prelinker. The prelinker is a postprocessor for GNU/Linux applications which can dramatically reduce application launch time. CodeSourcery has modified the prelinker to operate on non-GNU/Linux host systems, including Microsoft Windows.
- **Library Reduction Utility.** Sourcery G++ also includes a Library Reduction Utility for GNU/Linux targets. This utility allows the GNU C Library to be relinked to include only those functions used by a given collection of binaries.

- **Additional Libraries.** For some platforms, additional run-time libraries optimized for particular CPUs are available. Pre-built binary versions of the libraries with debug information are also available to subscribers.

If you would like more information about Sourcery G++ subscriptions, including a price quote or information about evaluating Sourcery G++, please send email to <sales@codesourcery.com>.

## 2.2. Accessing your Sourcery G++ Subscription Account

If you have a Sourcery G++ subscription, you may access your account by visiting the Sourcery G++ Portal<sup>1</sup>. If you have a support account, but are unable to log in, send email to <support@codesourcery.com>.

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<sup>1</sup> <https://support.codesourcery.com/GNUToolchain/>

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## **Chapter 3**

# **Sourcery G++ Lite for MIPS ELF**

This chapter contains information about using Sourcery G++ Lite on your target system. This chapter also contains information about changes in this release of Sourcery G++ Lite. You should read this chapter to learn how to best use Sourcery G++ Lite on your target system.

## 3.1. Library Configurations

Sourcery G++ includes copies of run-time libraries that have been built with optimizations for different target architecture variants or other sets of build options. Each such set of libraries is referred to as a *multilib*. When you link a target application, Sourcery G++ selects the multilib matching the build options you have selected.

Sourcery G++ Lite includes linker scripts as well as runtime libraries for each multilib. You can find these files in multilib-specific subdirectories of the `mips-sde-elf/lib` directory of your Sourcery G++ install.

### 3.1.1. Included Libraries

The following library configurations are available in Sourcery G++ Lite for MIPS ELF.

<b>MIPS32 revision 2 - Big-Endian, O32</b>	
Command-line option(s):	default
Library subdirectory:	./

<b>MIPS32 revision 2 - Little-Endian, O32</b>	
Command-line option(s):	-EL
Library subdirectory:	el/

<b>MIPS32 revision 2 - Big-Endian, O32, mips16</b>	
Command-line option(s):	-mips16
Library subdirectory:	mips16/

<b>MIPS32 revision 2 - Big-Endian, O32, fp64</b>	
Command-line option(s):	-mfp64
Library subdirectory:	fp64/

<b>MIPS32 revision 2 - Soft-Float, O32</b>	
Command-line option(s):	-msoft-float
Library subdirectory:	sof/

<b>MIPS32 revision 2 - No-Float, O32</b>	
Command-line option(s):	-mno-float
Library subdirectory:	nof/

<b>MIPS32 revision 2 - Big-Endian, O32, mips16, fp64</b>	
Command-line option(s):	-mips16 -mfp64
Library subdirectory:	mips16/fp64/

<b>MIPS32 revision 2 - Big-Endian, O32, mips16, Soft-Float</b>	
Command-line option(s):	-mips16 -msoft-float
Library subdirectory:	mips16/sof/



<b>MIPS32 revision 2 - Big-Endian, O32, mips16, No-Float</b>	
Command-line option(s):	<code>-mips16 -mno-float</code>
Library subdirectory:	<code>mips16/nof/</code>

<b>MIPS32 revision 2 - Big-Endian, O32, mips16, code-readable=no</b>	
Command-line option(s):	<code>-mips16 -mcode-readable=no</code>
Library subdirectory:	<code>mips16/spram/</code>

<b>MIPS32 revision 2 - Big-Endian, O32, mips16, fp64, code-readable=no</b>	
Command-line option(s):	<code>-mips16 -mfp64 -mcode-readable=no</code>
Library subdirectory:	<code>mips16/fp64/spram/</code>

<b>MIPS32 revision 2 - Big-Endian, O32, mips16, Soft-Float, code-readable=no</b>	
Command-line option(s):	<code>-mips16 -msoft-float -mcode-readable=no</code>
Library subdirectory:	<code>mips16/sof/spram/</code>

<b>MIPS32 revision 2 - Big-Endian, O32, mips16, No-Float, code-readable=no</b>	
Command-line option(s):	<code>-mips16 -mno-float -mcode-readable=no</code>
Library subdirectory:	<code>mips16/nof/spram/</code>

<b>MIPS32 revision 2 - Little-Endian, O32, mips16</b>	
Command-line option(s):	<code>-EL -mips16</code>
Library subdirectory:	<code>el/mips16/</code>

<b>MIPS32 revision 2 - Little-Endian, O32, fp64</b>	
Command-line option(s):	<code>-EL -mfp64</code>
Library subdirectory:	<code>el/fp64/</code>

<b>MIPS32 revision 2 - Little-Endian, O32, Soft-Float</b>	
Command-line option(s):	<code>-EL -msoft-float</code>
Library subdirectory:	<code>el/sof/</code>

<b>MIPS32 revision 2 - Little-Endian, O32, No-Float</b>	
Command-line option(s):	<code>-EL -mno-float</code>
Library subdirectory:	<code>el/nof/</code>

<b>MIPS32 revision 2 - Little-Endian, O32, mips16, fp64</b>	
Command-line option(s):	<code>-EL -mips16 -mfp64</code>
Library subdirectory:	<code>el/mips16/fp64/</code>

<b>MIPS32 revision 2 - Little-Endian, O32, mips16, Soft-Float</b>	
Command-line option(s):	<code>-EL -mips16 -msoft-float</code>
Library subdirectory:	<code>el/mips16/sof/</code>

<b>MIPS32 revision 2 - Little-Endian, O32, mips16, No-Float</b>	
Command-line option(s):	-EL -mips16 -mno-float
Library subdirectory:	el/mips16/nof/

<b>MIPS32 revision 2 - Little-Endian, O32, mips16, code-readable=no</b>	
Command-line option(s):	-EL -mips16 -mcode-readable=no
Library subdirectory:	el/mips16/spram/

<b>MIPS32 revision 2 - Little-Endian, O32, mips16, fp64, code-readable=no</b>	
Command-line option(s):	-EL -mips16 -mfp64 -mcode-readable=no
Library subdirectory:	el/mips16/fp64/spram/

<b>MIPS32 revision 2 - Little-Endian, O32, mips16, Soft-Float, code-readable=no</b>	
Command-line option(s):	-EL -mips16 -msoft-float -mcode-readable=no
Library subdirectory:	el/mips16/sof/spram/

<b>MIPS32 revision 2 - Little-Endian, O32, mips16, No-Float, code-readable=no</b>	
Command-line option(s):	-EL -mips16 -mno-float -mcode-readable=no
Library subdirectory:	el/mips16/nof/spram/

### 3.1.2. Library Selection

A given multilib may be compatible with additional processors and build options beyond those listed above. However, even if a particular set of command-line options produces code compatible with one of the provided multilibs, those options may not be sufficient to identify the intended library to the linker. For example, on some targets, specifying only a processor option on the command line may imply architecture features or floating-point support for compilation, but not for library selection. The details of the mapping from command-line options to multilibs are target-specific and quite complex. Therefore, it is recommended that your link command line include exactly the options listed in the tables above for your intended target multilib. In some cases, you may need to supply different options for linking than for compilation.

If you are uncertain which multilib is selected by a particular set of command-line options, GCC can tell you if you invoke it with the `-print-multi-directory` option in addition to your other build options. For example:

```
> mips-sde-elf-gcc -print-multi-directory options...
```

The output of this command is a directory name for the multilib, which you can look up in the tables given previously.

## 3.2. Sourcery G++ Lite Additional Documentation

Two additional documents can be found in the `share/doc/sourceryg++-mips-sde-elf/` subdirectory of your installation directory. `MIPS-SDE-LIBRARY.pdf` documents the MIPS SDE Library. `MIPS-TOOLCHAIN.pdf` documents the toolchain.

## 3.3. Sourcery G++ Lite Release Notes

This section documents Sourcery G++ Lite changes for each released revision.

### 3.3.1. Changes in Sourcery G++ Lite 4.2-199

**Debugging programs built by Green Hills compilers.** GDB has been further extended to accommodate non-standard debug information produced by some Green Hills toolchains.

### 3.3.2. Changes in Sourcery G++ Lite 4.2-198

**No significant changes.** There are no significant changes for MIPS ELF in this release.

### 3.3.3. Changes in Sourcery G++ Lite 4.2-196

**Debugging programs built by Green Hills compilers.** GDB has been extended to accommodate non-standard debug information produced by some Green Hills toolchains.

### 3.3.4. Changes in Sourcery G++ Lite 4.2-195

**Setting breakpoints on Windows.** A bug in GDB on Microsoft Windows hosts has been fixed. The bug caused setting breakpoints on a source line by using the file's full path to fail with No source file named *filename*.

**GDB support for YAMON.** GDB now supports debugging via the YAMON boot loader GDB stub. Consult YAMON documentation for details on enabling the GDB stub.

**GDB Support for MIPSsim on Windows.** A bug in the GDB support for MIPSsim on Microsoft Windows hosts has been fixed. The bug caused the `target mdi` command to fail with the error Cannot find MIPSsim config file template: `mipssim.cfg`.

**MIPS SDE linker script.** The `rel.dyn` and `.rel.dyn` sections have been added to the linker scripts for the MIPS SDE kit.

**FPU defaults.** The `-ffast-math` option now causes subnormal numbers to be immediately flushed to zero. It also sets the rounding mode to round-to-nearest.

**Output files removed on error.** When GCC encounters an error, it now consistently removes any incomplete output files that it may have created.

**MIPS SDE Kit.** The `net`, `netexampl`, `rtpx`, `rtpxlite` and `rtpxtest` directories have been removed from the MIPS SDE kit.

**Installer fails during upgrade.** The Sourcery G++ installer for Microsoft Windows hosts could fail during an upgrade while waiting for the previous version to be uninstalled. This bug has been fixed.

**Placing bss-like regions in load regions.** The linker no longer issues an incorrect error message when a bss-like section is placed at specific load region. The linker formerly incorrectly considered the section as taking up space in the load region.

**-mwarn-framesize=size option.** GCC has a new command-line option, `-mwarn-framesize=size`, which causes warnings if any function's stack frame exceeds the given *size*. This option is useful when generating code for environments with limited or absent stack, e.g., BIOS.

**Uninstaller removed by upgrade.** The uninstaller could be incorrectly deleted during an upgrade on Microsoft Windows hosts. This bug has been fixed.

**Spurious GDB error message fixed.** A spurious `Current thread went away!?` message is no longer generated when using GDB to debug programs running on cores that do not support hardware multi-threading. This problem was specific to the MDI target support in GDB.

**Unnecessary section removed.** A linker bug that caused an unnecessary `.rel.dyn` section to be placed in the executable has been fixed.

**Install directory pathnames.** Bugs in the install and uninstall scripts for Linux hosts that caused errors or incorrect behavior when the Sourcery G++ install directory pathname contains whitespace characters have been fixed.

**Debugging with no program loaded.** A bug in GDB on Microsoft Windows hosts has been fixed. The bug caused GDB to crash if execution was attempted with no program loaded on cores that do not support hardware multi-threading. This problem was specific to the MDI target support in GDB.

**Linker bug fix for `--gc-sections`.** A linker bug that caused certain linker-generated sections to be incorrectly omitted from the executable when the `--gc-sections` option is used has been fixed.

### 3.3.5. Changes in Sourcery G++ Lite 4.2-166

**No significant changes.** There are no significant changes for MIPS ELF in this release.

### 3.3.6. Changes in Sourcery G++ Lite 4.2-162

**No significant changes.** There are no significant changes for MIPS ELF in this release.

### 3.3.7. Changes in Sourcery G++ Lite 4.2-160

**MIPS SDE Kit.** The SDE kit directory now includes all subdirectories. The SDE kit is in the `mips-sde-elf/kit` subdirectory of your installation.

**Architecture level inference fix.** The `-march=4kp` and `-march=4ksc` options now imply `-mips32` and the `-march=4ksd` option implies `-mips32r2`. The erroneous option `-march=4kf` has been removed.

**Flags fix.** The `-mips3d` and `-mpaired-single` options can now be used with `-mips32r2` as well as `-mips64`.

**Program exit cleanup actions.** A bug causing programs to fail to flush their buffers on exit has been fixed.

**"Can't find matching LO16" linker error fixed.** An assembler bug that caused errors when linking files containing mixed MIPS16 and non-MIPS16 code has been fixed.

**Multilib matching fix.** The `-mips16e` option now causes the same multilibs to be used as the `-mips16` option.

**Misaligned accesses to packed structures fix.** A bug that caused GCC to generate misaligned accesses to packed structures has been fixed.

### 3.3.8. Changes in Sourcery G++ Lite 4.2-157

**MIPS SDE Examples.** Sourcery G++ Lite now includes examples showing how to use the MIPS SDE Library. You can find these examples in the `mips-sde-elf/examples/` subdirectory of your installation.

**jalx instruction.** The assembler no longer reports an error if the `jalx` instruction is used outside of MIPS16 mode.

### 3.3.9. Changes in Sourcery G++ Lite 4.2-127

**Initial release.** This is the initial release for MIPS ELF.

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# Chapter 4

## Installation and Configuration

This chapter explains how to install Sourcery G++ Lite. You will learn how to:

1. Verify that you can install Sourcery G++ Lite on your system.
2. Download the appropriate Sourcery G++ Lite installer.
3. Install Sourcery G++ Lite.
4. Configure your environment so that you can use Sourcery G++ Lite.

## 4.1. Terminology

Throughout this document, the term *host system* refers to the system on which you run Sourcery G++ while the term *target system* refers to the system on which the code produced by Sourcery G++ runs. The target system for this version of Sourcery G++ is `mips-sde-elf`.

If you are developing a workstation or server application to run on the same system that you are using to run Sourcery G++, then the host and target systems are the same. On the other hand, if you are developing an application for an embedded system, then the host and target systems are probably different.

## 4.2. System Requirements

### 4.2.1. Host Operating System Requirements

This version of Sourcery G++ supports the following host operating systems and architectures:

- Microsoft Windows NT 4, Windows 2000, Windows XP, and Windows Vista systems using IA32, AMD64, and EM64T processors.
- GNU/Linux systems using the IA32, AMD64, or EM64T processors, including Debian 3.0 (and later), Red Hat Enterprise Linux 3 (and later), SuSE Enterprise Linux 8 (and later).

Sourcery G++ is built as a 32-bit application. Therefore, even when running on a 64-bit host system, Sourcery G++ requires 32-bit host libraries. If these libraries are not already installed on your system, you must install them before installing and using Sourcery G++ Lite. Consult your operating system documentation for more information about obtaining these libraries.

### 4.2.2. Host Hardware Requirements

In order to install and use Sourcery G++ Lite, you must have at least 128MB of available memory.

The amount of disk space required for a complete Sourcery G++ Lite installation directory depends on the host operating system and the number of target libraries included. Typically, you should plan on at least 400MB. In addition, the graphical installer requires a similar amount of temporary space during the installation process.

### 4.2.3. Target System Requirements

See Chapter 3, *Sourcery G++ Lite for MIPS ELF* for requirements that apply to the target system.

## 4.3. Downloading an Installer

If you have received Sourcery G++ Lite on a CD, or other physical media, then you do not need to download an installer. You may skip ahead to Section 4.4, “Installing Sourcery G++ Lite”.

If you have a Sourcery G++ subscription (or evaluation), then you can log into the Sourcery G++ Portal<sup>1</sup> to download your Sourcery G++ toolchain(s). CodeSourcery also makes some toolchains available to the general public from the Sourcery G++ web site<sup>2</sup>. These publicly available toolchains do not include all the functionality of CodeSourcery's product releases.

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<sup>1</sup> <https://support.codesourcery.com/GNUToolchain/>

<sup>2</sup> [http://www.codesourcery.com/gnu\\_toolchains/](http://www.codesourcery.com/gnu_toolchains/)

Once you have navigated to the appropriate web site, download the installer that corresponds to your host operating system. For Microsoft Windows systems, the Sourcery G++ installer is provided as an executable, with the `.exe` extension. For GNU/Linux systems with an X Window System, Sourcery G++ Lite is provided as a graphical installer with the `.bin` extension. For GNU/Linux systems without an X Window System, Sourcery G++ Lite is provided as a compressed archive `.tar.bz2`.

On Microsoft Windows systems, save the installer to the desktop. On GNU/Linux systems, save the download package in your home directory.

## 4.4. Installing Sourcery G++ Lite

Note that the names of the Sourcery G++ commands for the MIPS ELF target all begin with `mips-sde-elf`. This means that you can install Sourcery G++ for multiple target systems in the same directory without conflicts.

The method used to install Sourcery G++ Lite depends on your host system.

### 4.4.1. Installing Sourcery G++ Lite on Microsoft Windows

If you have received Sourcery G++ Lite on CD, insert the CD in your computer. On most computers, the installer then starts automatically. If your computer has been configured not to automatically run CDs, open `My Computer`, and double click on the CD. If you downloaded Sourcery G++ Lite, double-click on the installer.

After the installer starts, follow the on-screen dialogs to install Sourcery G++ Lite.

### 4.4.2. Installing Sourcery G++ Lite on GNU/Linux Hosts with an X Window System

Start the graphical installer by invoking the executable shell script:

```
> /bin/sh ./path/to/package.bin
```

After the installer starts, follow the on-screen dialogs to install Sourcery G++ Lite.

### 4.4.3. Installing Sourcery G++ Lite on Solaris or GNU/Linux Hosts without an X Window System

You do not need to be a system administrator to install Sourcery G++ Lite on a GNU/Linux or Solaris system. You may install Sourcery G++ Lite using any user account and in any directory to which you have write access. This guide assumes that you have decided to install Sourcery G++ Lite in the `$HOME/CodeSourcery` subdirectory of your home directory and that the filename of the package you have downloaded is `/path/to/package.tar.bz2`. After installation the toolchain will be in `$HOME/CodeSourcery/sourceryg++-4.2`.

First, uncompress the package file:

```
> bunzip2 /path/to/package.tar.bz2
```

Next, create the directory in which you wish to install the package:

```
> mkdir -p $HOME/CodeSourcery
```

Change to the installation directory:



```
> cd $HOME/CodeSourcery
```

Unpack the package:

```
> tar xf /path/to/package.tar
```

## 4.5. Uninstalling Sourcery G++ Lite

The method used to uninstall Sourcery G++ Lite depends on your host system. If you have modified any files in the installation it is recommended that you back up these changes. The uninstall procedure may remove the files you have altered.

### 4.5.1. Uninstalling Sourcery G++ Lite on Microsoft Windows

Select `Start`, then `Control Panel`. Select `Add or Remove Programs`. Scroll down and click on `Sourcery G++ for MIPS ELF`. Select `Change/Remove` and follow the on-screen dialogs to uninstall Sourcery G++ Lite.

To uninstall third-party drivers bundled with Sourcery G++ Lite, first disconnect the associated hardware device. Then use `Add or Remove Programs` to remove the drivers separately. Depending on the device, you may need to reboot your computer to complete the driver uninstall.

### 4.5.2. Uninstalling Sourcery G++ Lite on Microsoft Windows Vista

Select `Start`, then `Settings` and finally `Control Panel`. Select the `Uninstall a program` task. Scroll down and double click on `Sourcery G++ for MIPS ELF`. Follow the on-screen dialogs to uninstall Sourcery G++ Lite.

To uninstall third-party drivers bundled with Sourcery G++ Lite, first disconnect the associated hardware device. Then use `Uninstall a program` to remove the drivers separately. Depending on the device, you may need to reboot your computer to complete the driver uninstall.

### 4.5.3. Uninstalling Sourcery G++ Lite on GNU/Linux using the Graphical Uninstaller

If you installed on GNU/Linux using the graphical installer, then you must use the graphical uninstaller to remove Sourcery G++ Lite. The `mips-sde-elf` directory located in the install directory will be removed entirely by the uninstaller. Please back up any changes you have made to this directory, such as modified linker scripts.

Start the graphical uninstaller by invoking the executable `Uninstall` shell script located in your installation directory. After the uninstaller starts, follow the on-screen dialogs to uninstall Sourcery G++ Lite.

### 4.5.4. Uninstalling Sourcery G++ Lite on GNU/Linux or Solaris

If you installed Sourcery G++ Lite from a `.tar.bz2` file, you can uninstall it by manually deleting the installation directory created in the install procedure.

## 4.6. Setting up the Environment

As with the installation process itself, the steps required to set up your environment depend on your host operating system.

### 4.6.1. Setting up the Environment on Microsoft Windows

On a non-Vista Microsoft Windows system, the installer automatically adds Sourcery G++ to your PATH. You can test that your PATH is set up correctly by using the following command:

```
> mips-sde-elf-g++ -v
```

and verifying that the last line of the output contains: Sourcery G++ Lite 4.2-199.

On a Microsoft Windows Vista system, the installer does not automatically add Sourcery G++ to your PATH. To set up your PATH on Microsoft Windows Vista, use the following command in a `cmd.exe` shell:

```
> setx PATH "%PATH%;C:\Program Files\Sourcery G++\bin"
```

where `C:\Program Files\Sourcery G++` should be changed to the path of your Sourcery G++ Lite installation. You can verify that the command worked by starting a second `cmd.exe` shell and running:

```
> mips-sde-elf-g++ -v
```

Verify that the last line of the output contains: Sourcery G++ Lite 4.2-199.

#### 4.6.1.1. Working with Cygwin

Sourcery G++ Lite does not require Cygwin or any other UNIX emulation environment. You can use Sourcery G++ directly from the Windows command shell. You can also use Sourcery G++ from within the Cygwin environment, if you prefer.

The Cygwin emulation environment translates Windows path names into UNIX path names. For example, the Cygwin path `/home/user/hello.c` corresponds to the Windows path `c:\cygwin\home\user\hello.c`. Because Sourcery G++ is not a Cygwin application, it does not, by default, recognize Cygwin paths.

If you are using Sourcery G++ from Cygwin, you should set the `CYGPATH` environment variable. If this environment variable is set, Sourcery G++ Lite automatically translates Cygwin path names into Windows path names. To set this environment variable, type the following command in a Cygwin shell:

```
> export CYGPATH=cygpath
```

To resolve Cygwin path names, Sourcery G++ relies on the **cygpath** utility provided with Cygwin. You must provide Sourcery G++ with the full path to **cygpath** if **cygpath** is not in your PATH. For example:

```
> export CYGPATH=c:/cygwin/bin/cygpath
```

directs Sourcery G++ Lite to use `c:/cygwin/bin/cygpath` as the path conversion utility. The value of `CYGPATH` must be an ordinary Windows path, not a Cygwin path.

### 4.6.2. Setting up the Environment on GNU/Linux or Solaris

If you installed Sourcery G++ Lite using the `.bin` graphical installer then you may skip this step. The graphical installer does this setup for you.

Before using Sourcery G++ Lite you should add it to your `PATH`. The command you must use varies with the particular command shell that you are using. If you are using the C Shell (**csh** or **tcsh**), use the command:

```
> setenv PATH $HOME/CodeSourcery/sourceryg++-4.1/bin:$PATH
```

If you are using Bourne Shell (**sh**), the Korn Shell (**ksh**), or another shell, use:

```
> PATH=$HOME/CodeSourcery/sourceryg++-4.1/bin:$PATH
> export PATH
```

If you are not sure which shell you are using, try both commands. In both cases, if you have installed Sourcery G++ Lite in an alternate location, you must replace the directory above with `bin` subdirectory of the directory in which you installed Sourcery G++ Lite.

You may also wish to set the `MANPATH` environment variable so that you can access the Sourcery G++ manual pages, which provide additional information about using Sourcery G++. To set the `MANPATH` environment variable, follow the same steps shown above, replacing `PATH` with `MANPATH`, and `bin` with `share/doc/sourceryg++-mips-sde-elf/man`.

You can test that your `PATH` is set up correctly by using the following command:

```
> mips-sde-elf-g++
```

and verifying that you receive the message:

```
mips-sde-elf-g++: no input files
```

---

# Chapter 5

## Using Sourcery G++ from the Command Line

This chapter demonstrates the use of Sourcery G++ Lite from the command line. This chapter assumes you have installed Sourcery G++ Lite as described in Chapter 4, *Installation and Configuration*.

## 5.1. Building an Application

This chapter explains how to build an application with Sourcery G++ Lite using the command line. As elsewhere in this manual, this section assumes that your target system is `mips-sde-elf`, as indicated by the **`mips-sde-elf`** command prefix.

Using an editor (such as **notepad** on Microsoft Windows or **vi** on UNIX-like systems), create a file named `hello.c` containing the following simple program:

```
#include <stdio.h>

int
main (void)
{
    printf("Hello World!\n");
    return 0;
}
```

Compile and link this program using the command:

```
> mips-sde-elf-gcc -o hello hello.c -T script
```

Sourcery G++ requires that you specify a linker script with the `-T` option to build applications for bare-board targets. Linker errors like `undefined reference to `read'` are a symptom of failing to use an appropriate linker script. Default linker scripts are provided in `mips-sde-elf/lib`.

There should be no output from the compiler. (If you are building a C++ application, instead of a C application, replace **`mips-sde-elf-gcc`** with **`mips-sde-elf-g++`**.)

## 5.2. Running Applications on the Target System

Consult your target board documentation for instructions on loading programs onto the target, and running them.

## 5.3. Running Applications in the Simulator

Sourcery G++ Lite includes a simulator that you can use on the host system to run programs compiled for the target system. Since you do not need target hardware, this is the easiest way to try out Sourcery G++.

To use the simulator run:

```
> mips-sde-elf-run hello
```

You should see the expected output:

```
Hello, world!
```

You can also use the simulator to execute target programs when debugging with GDB. See Section 5.4, “Running Applications from GDB” for more information.

## 5.4. Running Applications from GDB

You can run GDB, the GNU Debugger, on your host system to debug programs running remotely on a target board or system. You can also run and debug programs using the GDB simulator.

While this section explains the alternatives for using GDB to run and debug application programs, explaining the use of the GDB command-line interface is beyond the scope of this document. Please refer to the GDB manual for further instructions.

### 5.4.1. Connecting to the GDB Simulator

GDB includes a simulator that allows you to debug MIPS ELF applications without target hardware. To start and connect to the simulator from within GDB, use this command:

```
(gdb) target sim
```

### 5.4.2. Connecting to an External GDB Server

From within GDB, you can connect to a running **gdbserver** or other debugging stub that uses the GDB remote protocol using:

```
(gdb) target remote host:port
```

where *host* is the host name or IP address of the machine the stub is running on, and *port* is the port number it is listening on for TCP connections.

### 5.4.3. Connecting with MDI

Sourcery G++ Lite for MIPS ELF supports debugging with third-party simulators and hardware debug devices that implement the MDI (Microprocessor Debug Interface) API.

Before you can connect to a target using the MDI API, you must tell GDB which shared library or DLL to load for your simulator or device, and set up parameters to select your MDI target. This can be done either by means of environment variables or GDB commands. For example, you may want to put the GDB configuration commands in your `.gdbinit` file, which is loaded automatically when you start GDB.

This section describes the basic MDI usage; refer to the documentation for your MDI simulator or debug device for details specific to that target. Note, in particular, that some MDI targets may require you to set up a configuration file and/or license in addition to the steps given here.

In order to tell GDB which MDI library to load, on Linux hosts you should add the directory containing the shared library files to your `LD_LIBRARY_PATH` environment variable. On Windows hosts, add the directory containing the DLLs to your `PATH` environment variable. Then, either set the environment variable `GDBMDILIB` to the base name of the MDI library before starting GDB, or select the library within GDB using the command:

```
(gdb) set mdi library name
```

To verify that your shared library configuration is correct, you can query it from GDB for the devices it supports:

```
(gdb) show mdi devices
```

Each device is identified by a target number and device number. You can select the values you want to use with the following GDB commands:

```
(gdb) set mdi target targetnum
(gdb) set mdi device devicenum
```

Alternatively, you can set the environment variables GDBMDITARGET and GDBMDIDEVICE.

At this point, you can establish a connection to the selected MDI device using:

```
(gdb) target mdi
```

Then you can load and run your program on the target.

---

# Chapter 6

## Next Steps with Sourcery G++

This chapter describes where you can find additional documentation and information about using Sourcery G++ Lite and its components.



## 6.1. Sourcery G++ Knowledge Base

The Sourcery G++ Knowledge Base is available to registered users at the Sourcery G++ Portal<sup>1</sup>. Here you can find solutions to common problems including installing Sourcery G++, making it work with specific targets, and interoperability with third-party libraries. There are also additional example programs and tips for making the most effective use of the toolchain and for solving problems commonly encountered during debugging. The Knowledge Base is updated frequently with additional entries based on inquiries and feedback from customers.

For more information on CodeSourcery support, see Chapter 2, *Sourcery G++ Subscriptions*.

## 6.2. Manuals for GNU Toolchain Components

Sourcery G++ Lite includes the full user manuals for each of the GNU toolchain components, such as the compiler, linker, assembler, and debugger. Most of the manuals include tutorial material for new users as well as serving as a complete reference for command-line options, supported extensions, and the like.

When you install Sourcery G++ Lite, links to both the PDF and HTML versions of the manuals are created in the shortcuts folder you select. If you elected not to create shortcuts when installing Sourcery G++ Lite, the documentation can be found in the `share/doc/sourceryg++-mips-sde-elf/` subdirectory of your installation directory.

In addition to the detailed reference manuals, Sourcery G++ Lite includes a Unix-style manual page for each toolchain component. You can view these by invoking the **man** command with the pathname of the file you want to view. For example, you can first go to the directory containing the man pages:

```
> cd $INSTALL/share/doc/sourceryg++-mips-sde-elf/man/man1
```

Then you can invoke **man** as:

```
> man ./mips-sde-elf-gcc.1
```

Alternatively, if you use **man** regularly, you'll probably find it more convenient to add the directory containing the Sourcery G++ man pages to your `MANPATH` environment variable. This should go in your `.profile` or equivalent shell startup file; see Section 4.6, "Setting up the Environment" for instructions. Then you can invoke **man** with just the command name rather than a pathname.

Finally, note that every command-line utility program included with Sourcery G++ Lite can be invoked with a `--help` option. This prints a brief description of the arguments and options to the program and exits without doing further processing.

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<sup>1</sup> <https://support.codesourcery.com/GNUToolchain/>