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**Sourcery G++ Lite**  
**Power GNU/Linux**  
**Sourcery G++ Lite 4.2-138**  
**Getting Started**



## **Sourcery G++ Lite: Power GNU/Linux: Sourcery G++ Lite 4.2-138: 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 Power GNU/Linux</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:

`> command arg ...` A command, typed by the user, and its output. The “>” character is the command prompt.

**command** The name of a program, when used in a sentence, rather than in literal input or output.

literal 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 Power GNU/Linux 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 Binary Utilities	GNU General Public License 3.0 <sup>1</sup>
GNU Compiler Collection	GNU General Public License 3.0 <sup>2</sup>
GNU Debugger	GNU General Public License 3.0 <sup>3</sup>
GNU C Library	GNU Lesser General Public License 2.1 <sup>4</sup>
Linux Kernel	GNU General Public License 2.0 <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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- Definitions.**

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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 Power GNU/Linux**

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 build a target application, Sourcery G++ automatically selects the multilib matching the build options you have selected.

Each multilib corresponds to a *sysroot* directory that contains the files that should be installed on the target system. The *sysroot* contains the dynamic linker used to run your applications on the target as well as the libraries. Refer to Section 3.4, “Using Sourcery G++ Lite on GNU/Linux Targets” for instructions on how to install and use these support files on your target GNU/Linux system. You can find the *sysroot* directories provided with Sourcery G++ in the `powerpc-linux-gnu/libc` directory of your installation. In the tables below, the dynamic linker pathname is given relative to the corresponding *sysroot*.

The following library configurations are available in Sourcery G++ Lite for Power GNU/Linux.

<b>603 - GLIBC, 32-bit</b>	
Command-line option(s):	
Sysroot subdirectory:	<code>./</code>
Dynamic linker:	<code>lib/ld.so.1</code>

<b>603 - Soft-Float, GLIBC, 32-bit</b>	
Command-line option(s):	<code>-msoft-float</code>
Sysroot subdirectory:	<code>nof/</code>
Dynamic linker:	<code>lib/ld.so.1</code>

<b>e600 (Altivec) - GLIBC, 32-bit</b>	
Command-line option(s):	<code>-te600</code>
Sysroot subdirectory:	<code>te600/</code>
Dynamic linker:	<code>lib/ld.so.1</code>

<b>e500v1 - GLIBC, 32-bit</b>	
Command-line option(s):	<code>-te500v1</code>
Sysroot subdirectory:	<code>te500v1/</code>
Dynamic linker:	<code>lib/ld.so.1</code>

<b>e500v2 - GLIBC, 32-bit</b>	
Command-line option(s):	<code>-te500v2</code>
Sysroot subdirectory:	<code>te500v2/</code>
Dynamic linker:	<code>lib/ld.so.1</code>

## 3.2. Library Selection

The compiler selects between libraries based on several compiler switches. These are:



<code>-mcpu=603e</code>	Libraries suitable for the PPC603e, e300 family, and compatible processors are selected. This is the default if no more specific option is selected. The compiler generates floating-point instructions, and the libraries may use them.
<code>-msoft-float</code>	Libraries using software floating-point routines for PPC603e and compatible processors are selected. These libraries run on most Power Architecture processors. They do not rely on hardware floating point, AltiVec, or SPE.
<code>-te500v1</code>	Libraries suitable for the E500V1 family and compatible processors are selected. The compiler generates SPE instructions, and the libraries may use them.
<code>-te500v2</code>	Libraries suitable for the E500V2 family and compatible processors are selected. The compiler generates SPE instructions, including double-precision floating point, and the libraries may use them.
<code>-te600</code>	Libraries suitable for the E600 family and compatible processors are selected. The compiler generates AltiVec instructions, and the libraries may use them.

### 3.3. Target Kernel Requirements

The GNU C library supplied with this version of Sourcery G++ Lite requires that Linux kernel version 2.6.10 or later be installed on the target in order to run applications.

### 3.4. Using Sourcery G++ Lite on GNU/Linux Targets

In order to run and debug programs produced by Sourcery G++ on a GNU/Linux target, you must install runtime support files on the target. You may also need to set appropriate build options so that your executables can find the correct dynamic linker and libraries at runtime.

The runtime support files, referred to as the *sysroot*, are found in the `powerpc-linux-gnu/libc` directory of your Sourcery G++ Lite installation. The *sysroot* consists of the contents of the `etc`, `lib`, `sbin`, and `usr` directories. There may be other directories in `powerpc-linux-gnu/libc` that contain additional *sysroots* customized for particular combinations of command-line compiler flags, or *multilibs*. Refer to Section 3.1, “Library Configurations” for a list of the included *multilibs* in this version of Sourcery G++ Lite.

There are three choices for installing the *sysroot* on the target:

- You can install the files in the filesystem root, replacing the system-provided files. All applications automatically use the Sourcery G++ libraries. This method is primarily useful when you are building a GNU/Linux system from scratch. Otherwise, overwriting your existing C library may break other applications on your system, or cause it to fail to boot.
- You can install the *sysroot* in an alternate location and build your application with the `-rpath` and `--dynamic-linker` linker options to specify the *sysroot* location.
- You can install the *sysroot* in an alternate location and explicitly invoke your application through the dynamic linker to specify the *sysroot* location. If you are just getting started with Sourcery G++ Lite, this may be the easiest way to get your application running, but this method does not support use of the debugger.

Setting the environment variable `LD_LIBRARY_PATH` on the target is not sufficient, since executables produced by Sourcery G++ depend on the Sourcery G++ dynamic linker included in the sysroot as well as the Sourcery G++ runtime libraries.

### 3.4.1. Installing the Sysroot

If you are modifying an existing system, rather than creating a new system from scratch, you should place the sysroot files in a new directory, rather than in the root directory of your target system.

If you choose to overwrite your existing C library, you may not be able to boot your system. You should back up your existing system before overwriting the C library and ensure that you can restore the backup even with your system offline.

When running Sourcery G++ on a GNU/Linux host, you have the alternative of installing the sysroot on the target at the same pathname where it is installed on the host system. One way to accomplish this is to NFS-mount the installation directory on both machines in the same location, rather than to copy files.

In many cases, you do not need to copy all of the files in the sysroot. For example, the `usr/include` subdirectory contains files that are only needed if you will actually be running the compiler on your target system. You do not need these files for non-native compilers. You also do not need any `.o` or `.a` files; these are used by the compiler when linking programs, but are not needed to run programs. You should definitely copy all `.so` files and the executable files in `usr/bin` and `sbin`.

You need to install the sysroot(s) corresponding to the compiler options you are using for your applications. The tables in Section 3.1, “Library Configurations” tell you which sysroot directories correspond to which compiler options. If you are unsure what sysroot is being referenced when you build your program, you can identify the sysroot by adding `-v` to your compiler command-line options, and looking at the `--sysroot=` pathname in the compiler output.

### 3.4.2. Using Linker Options to Specify the Sysroot Location

If you have installed the sysroot on the target in a location other than the file system root, you can use the `-rpath` and `--dynamic-linker` linker options to specify the sysroot location.

First find the correct sysroot directory and dynamic linker for your selected multilib. Refer to Section 3.1, “Library Configurations”. In the following steps, `sysroot` is the absolute path to the sysroot directory on the target corresponding to your selected multilib. For the default multilib, the dynamic linker path relative to the sysroot is `lib/ld.so.1`. This is used in the example below.

If you are using Sourcery G++ from the command line, follow these steps:

1. When invoking **powerpc-linux-gnu-gcc** to link your executable, include the command-line options:

```
-Wl,-rpath=sysroot/lib:sysroot/usr/lib \  
-Wl,--dynamic-linker=sysroot/lib/ld.so.1
```

where `sysroot` is the absolute path to the sysroot directory on the target corresponding to your selected multilib.

2. Copy the executable to the target and execute it normally.

Note that if you specify an incorrect path for `--dynamic-linker`, the common failure mode seen when running your application on the target is similar to

```
> ./hello
./hello: No such file or directory
```

or

```
> ./hello
./hello: bad ELF interpreter: No such file or directory
```

This can be quite confusing since it appears from the error message as if it is the `./hello` executable that is missing rather than the dynamic linker it references.

### 3.4.3. Specifying the Sysroot Location at Runtime

You can invoke the Sourcery G++ dynamic linker on the target to run your application without having to compile it with specific linker options. To do this, follow these steps:

1. Build your application on the host, without any additional linker options, and copy the executable to your target system.
2. Find the correct sysroot directory and dynamic linker for your selected multilib. Refer to Section 3.1, “Library Configurations”. In the following steps, *sysroot* is the absolute path to the sysroot directory on the target corresponding to your selected multilib. For the default multilib, the dynamic linker is `lib/ld.so.1`. This is used in the example below.
3. On the target system, invoke the dynamic linker with your executable as:

```
> sysroot/lib/ld.so.1 \
--library-path sysroot/lib:sysroot/usr/lib \
/path/to/your-executable
```

where *sysroot* is the absolute path to the sysroot directory on the target corresponding to your selected multilib.

Invoking the linker in this manner requires that you provide either an absolute pathname to your executable, or a relative pathname prefixed with `./`. Specifying only the name of a file in the current directory does not work.

## 3.5. Using GDB Server for Debugging

The GDB server utility provided with Sourcery G++ Lite can be used to debug a GNU/Linux application. While Sourcery G++ runs on your host system, **gdbserver** and the target application run on your target system. Even though Sourcery G++ and your application run on different systems, the debugging experience when using **gdbserver** is very similar to debugging a native application.

### 3.5.1. Running GDB Server

The GDB server executables are included in the sysroot in ABI-specific subdirectories of *sysroot/usr*. Use the executable from the sysroot that matches your program. See Section 3.1, “Library Configurations” for details.

You must copy the sysroot to your target system as described in Section 3.4.1, “Installing the Sysroot”. You must also copy the executable you want to debug to your target system.

If you have installed the sysroot in the root directory of the filesystem on the target, you can invoke **gdbserver** as:

```
> gdbserver :10000 program arg1 arg2 ...
```

where *program* is the path to the program you want to debug and *arg1 arg2 ...* are the arguments you want to pass to it. The `:10000` argument indicates that **gdbserver** should listen for connections from GDB on port 10000. You can use a different port, if you prefer.

If you have installed the sysroot in an alternate directory, invoking **gdbserver** becomes more complicated. You must build your application using the link-time options to specify the location of the sysroot, as described in Section 3.4.2, “Using Linker Options to Specify the Sysroot Location”. You must also invoke **gdbserver** itself using the dynamic linker provided in the Sourcery G++ sysroot, as described in Section 3.4.3, “Specifying the Sysroot Location at Runtime”. In other words, the command to invoke **gdbserver** in this case would be similar to:

```
> sysroot/lib/ld.so.1 \
  --library-path sysroot/lib:sysroot/usr/lib \
  sysroot/usr/lib/bin/gdbserver :10000 program arg1 arg2 ...
```

### 3.5.2. Connecting to GDB Server from the Debugger

You can connect to GDB server by using the following command from within GDB:

```
(gdb) target remote target:10000
```

where *target* is the host name or IP address of your target system.

When your program exits, **gdbserver** exits too. If you want to debug the program again, you must restart **gdbserver** on the target. Then, in GDB, reissue the `target` command shown above.

### 3.5.3. Setting the Sysroot in the Debugger

If you have installed the sysroot in the root filesystem on the target, as described in Section 3.4.1, “Installing the Sysroot”, you can enable debugging of shared libraries and support for multi-threaded debugging by using the **set sysroot** GDB command:

```
(gdb) set sysroot pathname
```

The *pathname* is the pathname to a copy of the sysroot on the host, or the unstripped original sysroot files included with your Sourcery G++ Lite distribution if you have installed a stripped copy on the target.

The *pathname* is used as a prefix for all file names GDB reads from your target. If you installed the sysroot in an alternate location on the target, use **set sysroot** to point to the root of your target's filesystem. For instance, if the Sourcery G++ libraries are located in `/opt/codesourcery` on your target and `/data/software/opt/codesourcery` on your host, use `set sysroot /data/software`. If the Sourcery G++ libraries are located at the same path on both host and target, you do not need **set sysroot**.

## 3.6. Sourcery G++ Lite Release Notes

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

### 3.6.1. Changes in Sourcery G++ Lite 4.2-138

**E500 large stack frame fix.** A bug that caused GCC to generate incorrect code for functions with large stack frames on E500 targets has been fixed.

**GDB info registers crash fix.** Executing **info registers** after executing **flushregs** no longer crashes GDB.

### 3.6.2. Changes in Sourcery G++ Lite 4.2-101

**GDB and Ctrl-C on Windows .** GDB no longer crashes when you press **Ctrl-C** twice during remote debugging to give up waiting for the target.

**E500 small data fix.** A bug that caused an internal compiler error when attempting to place float or vector variables into the small data section has been fixed.

**Improved argument-passing code.** The compiler can now generate more efficient code for certain functions whose arguments must be sign-extended to conform with language or ABI conventions. The required conversion was formerly being performed both in the called function and at all call sites; now the redundant conversion has been eliminated for functions that can only be called within the compilation unit where they are defined.

**Multi-process mode for gdbserver.** The **gdbserver** utility has a new command-line option, `--multi`, that allows you to use it to debug multiple program instances. Refer to the Debugger manual for more information.

**GDB qOffsets crash fix.** GDB no longer crashes when a remote stub provides load offsets for an unlinked object file.

**Function prologue and epilogue size improvements.** Calls to library routines are now used in function prologues and epilogues when compiling with `-Os`, which results in smaller functions. In addition, the necessary routines are only included when used, which leads to smaller binaries.

**GCC stack size limit increased.** On Windows hosts, the maximum stack size for the GCC executable has been increased. This means that more complex programs can be compiled.

**Stack overflows in printf.** Some stack overflows in `printf`-family functions have been fixed. These overflows occurred with format strings with very large precision values such as `%1.3000000000s`, and with some invalid format strings.

**Invalid object file after strip.** A bug in the assembler has been fixed that formerly caused `.set symbol expression` constructs to emit `symbol` in the wrong section. This in turn caused inconsistent behavior after stripping the symbol table.

**GCC update.** The GCC package has been updated to version 4.2.3. This version includes numerous bug fixes since GCC 4.2.

**License checking on Linux.** Sourcery G++'s license-checking logic now includes a workaround for a kernel bug present in some versions of Linux. This bug formerly caused failures with an error message from the `cs-license` component.

**C++ library ABI fix.** GCC 4.2.1's `std::type_info` was not fully compatible with earlier versions. The ordering of four virtual functions has been fixed in this update.

**Improved gdbserver thread support.** The GNU/Linux remote debug agent, **gdbserver**, no longer fails when two threads call `pthread_create` at the same time. It also supports limited thread debugging when symbols for `libpthread.so` are not available.

**GDB support for user-defined prefixed commands.** The GDB **define** and **document** commands, which allow you to add new commands to the GDB command-line interface, now support creating

commands within an existing prefix such as **target**. Hooks for prefixed commands are also supported. Refer to the Debugger manual for more information.

**GDB update.** The included version of GDB has been updated to 6.7.20080107. This update includes numerous bug fixes.

**UNC pathname bug fix.** A bug has been fixed that caused linker errors on Windows hosts when running a Sourcery G++ toolchain installed in a UNC path (`\\host\directory`).

**Linker crash on invalid input files.** Some older versions of GCC generated object files with invalid mergeable string sections when compiling with `-fmerge-all-constants`. This bug was fixed in Sourcery G++ as of version 4.1-43. However, since system libraries included with some GNU/Linux distributions were affected by this bug, the linker has now been changed to accept object files with such invalid sections, rather than crash or produce an error message.

**GDB search path bug fix.** A bug in GDB has been fixed that formerly resulted in an internal error when setting `solib-search-path` or `solib-absolute-prefix` after establishing a connection to a remote target.

**Binutils update.** The binutils package has been updated to version 2.18.50.20080215 from the FSF trunk. This update includes numerous bug fixes.

**String alignment changes when optimizing for size.** When compiling with `-Os`, strings are aligned to byte boundaries instead of word boundaries on non-E500 targets. This change results in smaller binaries.

**Race fixes in `setuid`.** Several bugs in multi-threaded `setuid` have been fixed. The bugs led to threads with incorrect privileges and hangs at thread exit. The `setgid`, `seteuid`, `setegid`, `setreuid`, `setregid`, `setresuid`, and `setresgid` functions were also affected.

**gdbserver support for execution wrappers.** `gdbserver` has a new command-line option, `--wrapper`, which specifies a wrapper for any programs run by `gdbserver`. The specified wrapper can prepare the system and environment for the new program.

**Read-only variables.** The C++ compiler now places variables whose types are instantiations of template classes in a read-only data section if they are declared `const` and initialized with a constant value. This change reduces the RAM usage of affected applications.

### 3.6.3. Changes in Sourcery G++ Lite 4.2-82

**No significant changes.** There are no significant changes for Power GNU/Linux in this release.

### 3.6.4. Changes in Sourcery G++ Lite 4.2-81

**E500 compiler crash.** A bug that caused the compiler to crash on some versions of Fedora Core when compiling for E500 targets has been fixed.

### 3.6.5. Changes in Sourcery G++ Lite 4.2-72

**Linker error allocating ELF segments.** A bug where the linker produces an incorrect error message with segments at the top of the address space has been fixed.

### 3.6.6. Changes in Sourcery G++ Lite 4.2-50

**Volatile postincrement and postdecrement bug fix.** A code generation bug that caused postincrement or postdecrement of a volatile object to reread the modified value from that object in some

contexts has been fixed. The bug affected code performing a comparison of the postincrement or postdecrement expression with a constant, or that was optimized to comparison with a constant.

**C++ class debug information.** The flag `-femit-class-debug-always` is now disabled by default. The flag produces duplicate C++ class debug information as a work-around for older debuggers.

**Optimized `memcpy` and `memmove`.** Optimized implementations of `memcpy` and `memmove` have been added for E500 targets.

**Improved breakpoints in constructors and template functions.** GDB now supports breakpoints on source code locations that have several code addresses associated with them. Setting a breakpoint on a constructor automatically associates the breakpoint with all constructor bodies generated by GCC. If you set a breakpoint on a line of a templated function, GDB breaks at the indicated line in all instantiations of the templated function.

**GDB `printf %p`.** GDB's `printf` command now supports the "`%p`" format specifier.

**GDB update.** The included version of GDB has been updated to 6.6.20070821. This update includes numerous bug fixes.

**Assembler code file name suffixes.** GCC now recognizes `.sx` as well as `.S` as a file name suffix indicating assembler code which must be preprocessed. The alternate suffix may be useful in conjunction with other program development tools on Windows that do not distinguish case on filenames and treat `.S` the same as `.s`, which GCC uses to indicate assembler code without preprocessing.

**E500 vectorization support.** When compiling for E500 targets, the `-ftree-vectorize` flag now enables automatic vectorization of loops.

**Large stack frame fix.** A bug that caused GCC to generate incorrect code for functions with large stack frames on E500 targets has been fixed.

**E500 interrupt safety fix.** A bug that caused GCC to generate function epilogues that were not interrupt safe on E500 targets has been fixed.

**Improved inline `memset`, `memcpy`, and `memmove` for E500.** GCC can now use E500 vector instructions when generating inline code for `memset`, `memcpy`, or `memmove` on E500 targets.

### 3.6.7. Changes in Sourcery G++ Lite 4.2-31

**Preprocessing assembly code.** The compiler driver passes `-I` options to the assembler, so that `#include` directives (processed by the preprocessor) and `.include` directives (processed by the assembler) use the same search path.

**Dynamically-initialized `const` variables.** Dynamically-initialized namespace-scope C++ variables are no longer placed in read-only data sections, even when marked `const`. These variables must be modified at startup, so they cannot be placed in ROM, even though their values cannot change once initialized.

**Register allocation bug fix.** A register allocation bug has been fixed. Under rare circumstances, the bug caused incorrect code generation.

**Disabling diagnostics for use of system header and library directories.** The warnings for use of options such as `-I/usr/include` when cross compiling can be disabled with a new option `-Wno-poison-system-directories`. This option is intended for use in chroot environments

when such directories contain the correct headers and libraries for the target system rather than the host.

**Debugging of statically-linked threaded programs.** GDB and EGLIBC now support thread debugging when using GCC's `-static` option. Existing statically-linked programs must be relinked after upgrading EGLIBC for this fix.

**Crash when generating vector code.** A bug that sometimes caused the compiler to crash when invoked with the `-ftree-vectorize` option has been fixed.

**Stricter check for anonymous unions.** G++ now issues an error about invalid code that uses the same name for a member of an anonymous union and an entity in the surrounding namespace. For example, you will now get an error about code like:

```
int i;
static union { int i; };
```

because both the global variable and the anonymous union member are named `i`. To make this code valid you must change one of the declarations to use a different name.

**GCC update.** The GCC package has been updated to version 4.2.1. This version includes numerous bug fixes since GCC 4.2.

**Smaller code for C++ destructors.** G++ now generates more compact code to handle the destruction of C++ objects declared at namespace scope or declared within a function scope using the `static` keyword.

**Robustness on Microsoft Windows.** Defects that sometimes caused GDB to become non-responsive on Microsoft Windows have been eliminated.

**Binutils update.** The binutils package has been updated to the 2007-08-19 version of the pre-2.18 FSF trunk. This contains many new improvements and bug fixes. For more information, refer to the manuals for the individual utilities, and to the binutils web site at <http://www.gnu.org/software/binutils/>.

**Debugging information fix.** GCC no longer generates invalid debugging information for sections with no contents. The invalid debugging information caused the GNU/Linux prelinker to crash.

**ABI markings for Power Architecture binaries.** GCC and Binutils now mark Power Architecture binaries according to their floating point and vector calling conventions. The linker reads this information and warns when mismatched object files are linked together. For example, the linker warns if `-msoft-float` objects are linked to a `-mhard-float` C library. GDB uses the same information to correctly call functions from the command line and display return values after **finish**.

**Inlined function debugging fix.** GDB now backtraces correctly when stopped at the first instruction of an inlined function. Earlier versions would sometimes encounter internal errors in this situation.

**Improved diagnostics for region overflow.** The linker will now give more helpful diagnostics when the object files being linked are too big for one of the memory regions defined in the linker script.

**Debugging of inlined functions.** GDB now supports inlined functions. GDB can include inlined functions in the stack trace; display inlined functions' arguments and local variables; and step into, over, and out of inlined functions.



**Debugger access to AltiVec and SPE registers.** GDB can display AltiVec and SPE registers when using gdbserver on configurations with these auxiliary processors.

**GCC version 4.2.** Sourcery G++ Lite for Power GNU/Linux is now based on GCC version 4.2. For more information about changes from GCC version 4.1 that was included in previous releases, see <http://gcc.gnu.org/gcc-4.2/changes.html>.

**Debugger access to out-of-bounds memory.** GDB turns on `inaccessible-by-default` by default, disallowing access to memory outside the regions specified in a board configuration.

**Binutils update.** The binutils package has been updated from version 2.17 to the pre-2.18 FSF trunk. This is a significant update with many improvements and bug fixes.

Changes to the assembler (`as`) include:

- On MIPS targets, support for additional processors and the SmartMIPS and DSP Release 2 extensions has been added.

New linker (`ld`) features include:

- A new command-line option `--default-script` has been added to give more precise control over linker script processing.
- There are new command-line options `-Bsymbolic-functions`, `--dynamic-list`, `--dynamic-list-cpp-new`, and `--dynamic-list-data` to control symbols that should be dynamically linked.
- The new `--print-gc-sections` option lists sections removed by garbage collection.

Other changes include:

- The `objcopy` utility has a new `--extract-symbol` option to extract only symbol table information from the input file.
- The `gprof` utility now allows input files to have histogram records for several memory ranges, provided those ranges are disjoint.

For more information, refer to the manuals for the individual utilities, and the binutils web site at <http://www.gnu.org/software/binutils/>.

**GDB update.** The included version of GDB has been updated to 6.6.50.20070620. This update includes numerous bug fixes.

### 3.6.8. Changes in Sourcery G++ Lite 4.1-69

**Segmentation fault in `memset`.** A segmentation fault in `memset` has been fixed. The problem occurs on some 8xx series PowerPC CPUs when executing a `dcbz` instruction, because 8xx processors are unable to report page faults correctly in this case. The problematic `dcbz` instruction is avoided on affected processors.

**Assembler skipping `\` characters.** A bug is fixed where the assembler would skip `\` characters when they appeared at certain positions in the input file. This bug primarily affected assembler macros.

**Spurious compiler warnings eliminated.** GCC no longer emits warnings when linker-specific command-line options are provided in combination with modes that do not perform linking, such as with the `-c` flag.

### 3.6.9. Changes in Sourcery G++ Lite 4.1-59

**Forced alignment of array variables.** A new option `-falign-arrays` has been added to the compiler. Specifying this option sets the minimum alignment for array variables to be the largest power of two less than or equal to their total storage size, or the biggest alignment used on the machine, whichever is smaller. This option may be helpful when compiling legacy code that uses type punning on arrays that does not strictly conform to the C standard.

**E500 floating-point bug fix.** Some bugs affecting comparisons of NaNs on E500 processors have been fixed.

**Software floating-point bug fix.** A bug affecting conversion of wider floating-point types to subnormal `float` values when using software floating point has been fixed.

### 3.6.10. Changes in Sourcery G++ Lite 4.1-56

**Linux Host Requirements.** The lowest version of Linux that is required for the Linux hosted toolchain is now RedHat 7.3. Previous versions required RedHat 8.0 or later.

**Installer hangs while refreshing environment.** The Sourcery G++ installer for Microsoft Windows now updates the `PATH` environment variable without waiting for open applications to acknowledge the update. This change prevents open applications from blocking the installer's progress.

**Less disk space required for installation.** Sourcery G++ Lite packages are smaller because multiple copies of files have been replaced with hard and/or symbolic links when possible. Both the size of the installer images and the amount of disk space required for an installed package have been reduced.

**Alignment bug fix.** A bug has been fixed that formerly caused incorrect code to be generated in some situations for copying structure arguments being passed by value. The incorrect code caused alignment errors on stack accesses on some targets.

### 3.6.11. Changes in Sourcery G++ Lite 4.1-51

**No significant changes.** There are no significant changes for Power GNU/Linux in this release.

### 3.6.12. Changes in Sourcery G++ Lite 4.1-47

**Improved handling of Windows paths in GDB.** GDB now properly recognizes the names of source files that were passed to the compiler using an absolute path on Windows. You may refer to the file either by its base name (without any leading directory components), by the exact path passed to the compiler, or by its absolute path.

### 3.6.13. Changes in Sourcery G++ Lite 4.1-46

**Initial release.** This is the initial release for Power GNU/Linux.

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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 "powerpc-linux-gnu".

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

Sourcery G++ supports the following host operating systems:

- 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).
- Solaris 2.8 (and later) systems using SPARC processors.

Not all combinations of host and target systems are available. Therefore, Sourcery G++ for your target system may not be available on all of the above host systems.

Sourcery G++ is built as a 32-bit application. Therefore, even when running on a 64-bit GNU/Linux 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 scratch space during the installation process.

### 4.2.3. Target System Requirements

See Chapter 3, *Sourcery G++ Lite for Power GNU/Linux* 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.

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 Solaris, and 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 and Solaris systems, save the download package in your home directory.

## 4.4. Installing Sourcery G++ Lite

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. This package comes with a bundled Java Runtime Environment; you do not have to download any additional software.

### 4.4.2. Installing Sourcery G++ Lite on GNU/Linux systems 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. This package comes with a bundled Java Runtime Environment; you do not have to download any additional software.

### 4.4.3. Installing Sourcery G++ Lite on Solaris or GNU/Linux systems 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++-4.1` or similar.

---

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

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

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
```

If you are installing a native toolchain, it is then necessary to run a post-install script found in the share directory:

```
> /bin/sh sourceryg++-4.1/share/postinst-*
```

The `.tar.bz2` package is not bundled with a Java Runtime Environment.

#### 4.4.4. Installing the Java Runtime Environment

Some versions of Sourcery G++ include the Eclipse Integrated Development Environment. Because Eclipse is an optional component, the installer allows you to choose whether or not to install it. Eclipse is a Java application and requires the Java Runtime Environment (JRE). The Java Runtime Environment is available at no charge from Sun Microsystems Java website<sup>3</sup>. You may download either the Java Runtime Environment (JRE) or the Java Development Kit (JDK). (The JDK includes the JRE.)

## 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 Power GNU/Linux`. 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 Power GNU/Linux`. Follow the on-screen dialogs to uninstall Sourcery G++ Lite.

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<sup>3</sup> <http://java.sun.com/j2se/>

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 `powerpc-linux-gnu` 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

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. The name of the Sourcery G++ commands all begin with **powerpc-linux-gnu** so that you can install Sourcery G++ for multiple target systems in the same directory.

### 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:

```
> powerpc-linux-gnu-g++ -v
```

and verifying that the last line of the output contains: `Sourcery G++ Lite 4.2-138`.

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%;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:

```
> powerpc-linux-gnu-g++ -v
```

Verify that the last line of the output contains: `Sourcery G++ Lite 4.2-138`.

#### 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 (`cs`h or `tc`sh), 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++-powerpc-linux-gnu/man`.

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

```
> powerpc-linux-gnu-g++
```

and verifying that you receive the message:

```
powerpc-linux-gnu-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 `powerpc-linux-gnu`, as indicated by the `powerpc-linux-gnu` 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:

```
> powerpc-linux-gnu-gcc -o hello hello.c
```

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

## 5.2. Running Applications on the Target System

You may need to install the Sourcery G++ runtime libraries and dynamic linker on the target system before you can run your application. Refer to Chapter 3, *Sourcery G++ Lite for Power GNU/Linux* for specific instructions.

To run your program on a GNU/Linux target system, use the command:

```
> ./hello
```

You should see:

```
Hello world!
```

## 5.3. 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.

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.

### 5.3.1. Connecting to an External GDB Server

On targets with UNIX-like operating systems (including GNU/Linux), Sourcery G++ Lite includes a program called **gdbserver** that can be used for remote debugging. Follow the instructions in Chapter 3, *Sourcery G++ Lite for Power GNU/Linux* to install and run **gdbserver** on your target system.

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.

---

# **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++-powerpc-linux-gnu/` 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++-powerpc-linux-gnu/man/man1
```

Then you can invoke **man** as:

```
> man ./powerpc-linux-gnu-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/>