
Sourcery G++ Lite

ARM EABI

2006q3-27

Getting Started



Sourcery G++ Lite: ARM EABI: 2006q3-27: 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. If you are an administrator installing Sourcery G++ Lite on a UNIX-like system for all of your users to use, you should also be familiar with the package-management software (such as the Red Hat Package Manager) for your system.

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++ Lite subscriptions. CodeSourcery customers with Sourcery G++ Lite subscriptions receive comprehensive support for Sourcery G++ Lite. Read this chapter to find out how to obtain and use a Sourcery G++ Lite subscription.
Chapter 3, <i>Sourcery G++ Lite for ARM EABI</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++ Lite with Eclipse</i>	This chapter explains how to install the Sourcery G++ Lite Eclipse plugin so that you can use Sourcery G++ Lite with the Eclipse integrated development environment.
Chapter 6, <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.
Appendix A, <i>GNU General Public License</i>	This appendix contains the full text of the GNU General Public License, the license that applies to certain components of Sourcery G++ Lite.

3 Typographical Conventions

The following typographical conventions are used in this guide:

<code>> command arg ...</code>	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.
<code>literal</code>	Text provided to or received from a computer program.
<i>placeholder</i>	Text that should be replaced with an appropriate value when typing a command.

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.

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The CodeSourcery License is available in Section 1.2, "Sourcery G++(TM) (Lite Edition) Software License 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!

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, including an evaluation subscription, you can access your support account by visiting the Sourcery G++ support site¹. If you have a support account, but are unable to log in, send email to <support@codesourcery.com>.

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

Chapter 3

Sourcery G++ Lite for ARM EABI

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 Using Sourcery G++ Lite for ARM EABI

3.1.1 ARMv7M Interrupt handlers

Because of a discrepancy between the ARMv7M Architecture and the ARM EABI it is not safe to use normal C functions directly as interrupt handlers. The EABI requires the stack be 8-byte aligned, whereas ARMv7M only guarantees 4-byte alignment when calling an interrupt vector. This can cause subtle runtime failures, usually when 8-byte types are used.

Functions that are used directly as interrupt handlers should be annotated with `__attribute__((__interrupt__))`. This tells the compiler to add special stack alignment code to the function prologue.

3.1.2 Building ARMv7M Applications

Sourcery G++ Lite includes support for building applications to run on ARMv7M hardware (eg. Cortex-M3 based devices). Configurations are provided for Generic ARMv7M and some specific devices.

When building an application for a specific board the linker will put the stack at the top of RAM. When using the generic ARMv7M configurations the memory size is not known, so the location of the stack must be specified manually. To specify the stack location add `-Wl,--defsym,__stack=address` to the gcc linker commandline. For example, a Cortex-M3 device with 64k of RAM starting at address 0x20000000 would use `-Wl,--defsym,__stack=0x20010000`.

Configurations are provided for both ROM and RAM based image. ROM based images are intended to be burned into flash, and will run when the device is reset. RAM based images are often useful during development and are typically loaded by the debugger via JTAG or similar interfaces.

Note that many Cortex-M3 based devices have very small amounts of memory. Using some large library functions (eg. `malloc` or semihosted file IO) may overflow available memory.

3.1.2.1 Choosing a Board Configuration from the IDE

If you are using the Sourcery G++ IDE, choose `Properties` from the `Project` menu. Select `C/C++ Build` followed by `Tool Settings`. Select `Target` to specify the appropriate board configuration.

3.1.2.2 Choosing a Board Configuration from the Command-Line

Specific board configurations are selected by means of a linker script. The following table shows which linker scripts are available:

Board	Script (ROM)	Script (RAM)
Generic ARMv7M	armv7m-rom.ld	armv7m-ram.ld
LM3S101/LM3S102	lm3s10x-rom.ld	lm3s10x-ram.ld
LM3S301	lm3s301-rom.ld	lm3s301-ram.ld
LM3S310/LM3S315/LM3S316	lm3s31x-rom.ld	lm3s31x-ram.ld
LM3S6xx	lm3s6xx-rom.ld	lm3s6xx-ram.ld
LM3S8xx	lm3s8xx-rom.ld	lm3s8xx-ram.ld

From the command-line, you must add `-T script` to your linker command, where `script` is the appropriate linker script. For example, if you are using an LM3S101 board, you should link with `-T lm3s10x.ld`.

3.1.3 NEON SIMD Code

Sourcery G++ Lite contains preliminary support for automatic generation of NEON SIMD vector code. Autovectorization is a compiler optimization where loops involving normal integer or floating point code are transformed into loops that use NEON SIMD instruction to process several data elements at once.

To enable generation of NEON vector code specify `-ftree-vectorize -mfpu=neon -mfloat-abi=softfp`. `-mfpu=neon` also enables generations of VFPv3 scalar floating point code.

Sourcery G++ Lite also contains preliminary support for manual generation of NEON SIMD code using C intrinsic functions. These intrinsics, the same as those supported by the ARM RVCT compiler, are defined in the `arm_neon.h` header and are documented in the 'ARM NEON Intrinsics' section of the GCC manual. The options `-mfpu=neon -mfloat-abi=softfp` must be specified to use these intrinsics; `-ftree-vectorize` is not required.

NEON support is still under active development. It has not been subject to extensive testing, and may not yet take full advantage of all the features provided by the NEON architecture.

3.2 Sourcery G++ Lite Release Notes

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

3.2.1 Changes in Sourcery G++ Lite 4.1-27

Rename Windows executables. The Windows host tools "make.exe" and "rm.exe" are now named "cs-make.exe" and "cs-rm.exe." This change avoids conflicts with tools provided by other distributors.

3.2.2 Changes in Sourcery G++ Lite 4.1-23

Windows Debugging Fix. In recent releases of Sourcery G++ Lite, the GDB **target remote** | command would hang on Windows. This affected both command line and Eclipse debugging when using the Sourcery G++ Lite Debug Sprite.

3.2.3 Changes in Sourcery G++ Lite 4.1-18

Binutils Update. The binutils in this release is based on the final binutils 2.17 release.

GDB Update. The included version of GDB has been upgraded to 6.5.50.20060822. This includes numerous bug fixes from the previous version.

GDB support for flash memory. The GDB **load** command can now write to flash memory, if the remote debugging stub contains appropriate support.

3.2.4 Changes in Sourcery G++ Lite 4.1-16

GCC Update. This release is based on GCC 4.1.1.

Fully relocatable compiler. The compiler now searches for its components only in the directory where it has been installed, and no longer also searches pathnames matching the directory where it was configured. This speeds up the compiler and prevents problems with unintentionally finding unrelated files or directories on the machine where it has been installed.

3.2.5 Changes in Sourcery G++ Lite 4.1-1

Initial release. This release is based on GCC 4.1.0.

3.3 ARM Release Notes

This section documents ARM related changes for each released revision.

3.3.1 Changes in Sourcery G++ Lite 4.1-27

iWMMXt Bug Fixes. Some bugs involving incorrect code generation and internal compiler errors when generating iWMMXt code have been fixed.

Cortex-M3 startup code. The ARMv7M startup code (`armv7m-crt0.o`) incorrectly contained ARM code. This has been replaced with Thumb-2 code.

3.3.2 Changes in Sourcery G++ Lite 4.1-23

Stellaris USB Debug Sprite Improvements. The former USB Debug Stub, **armswd**, is now known as the USB Debug Sprite, and has been renamed to **arm-stellaris-eabi-sprite**. In addition, its initialization sequence has been updated to recognize the r1p1 release of the Cortex-M3 processor.

Incompatible Changes to Stellaris Linker Scripts. Sourcery G++ Lite now supports linking executables to run from RAM as well as ROM. As part of this change, there are now separate RAM and ROM versions of the linker scripts for each supported board, and the former ROM-based versions have been renamed. For example, if you were formerly linking with `-T lm3s10x.ld`, you should now use `-T lm3s10x-rom.ld` to get the same behavior.

3.3.3 Changes in Sourcery G++ Lite 4.1-21

Eclipse Debuggers. Eclipse configurations for debugging arm-none-eabi applications using the GDB simulator and remote debug stubs have been added.

iWMMXt2 Support. The assembler and disassembler now support iWMMXt2 instructions.

NEON Intrinsics Support. GCC now supports NEON intrinsics defined in the `arm_neon.h` header. These are the same intrinsics supported by the ARM RVCT compiler and are documented in the 'ARM NEON Intrinsics' section of the GCC manual.

3.3.4 Changes in Sourcery G++ Lite 4.1-19

ARMv4t linux multilib. Linux configurations now support ARMv4t CPUs.

Linker scripts. Several problems with the linker scripts for bare-metal targets have been fixed.

3.3.5 Changes in Sourcery G++ Lite 4.1-18

NEON Compiler Support. Initial GCC support for autovectorization and generation of NEON SIMD instructions has been added.

Bare Metal Cortex-M3 Configurations. Bare metal configurations now support generating images for use on ARMv7M devices (eg. Cortex-M3).

iWMMXt support in GLIBC. GLIBC's `setjmp` and `longjmp` now support saving and restoring iWMMXt registers on hardware with those registers. This requires a kernel reporting `iwmmxt` in the `Features` entry in `/proc/cpuinfo`.

iWMMXt exception handling support. Exception handling now restores the values of iWMMXt registers correctly.

Corrected IPC functions. A bug in GLIBC's `msgctl`, `semctl`, and `shmctl` functions has been corrected.

3.3.6 Changes in Sourcery G++ Lite 4.1-16

Stack permission marking for ARM GNU/Linux. Non-executable stacks can provide increased security against some forms of "buffer overflow" attacks. The tools involved must coordinate the annotation of required stack permissions, either executable, or non-executable. For ARM GNU/Linux targets the compiler now outputs annotations indicating the required stack permissions.

3.3.7 Changes in Sourcery G++ Lite 4.1-15

Stabs Debugging Information Support. Using the Stabs debugging format (available with `-gstabs` or `-gstabs+`) now works in conjunction with `-mthumb`. CodeSourcery recommends the default DWARF debugging format (available with `-g`) as DWARF is a more comprehensive debugging format.

3.3.8 Changes in Sourcery G++ Lite 4.1-13

Stellaris Linker Scripts in IDE. Linker scripts may now be selected via a drop-down menu in Eclipse.

Stellaris Linker Scripts for 3xx Series CPUs. The linker scripts for 3xx Series CPUs now place the ISR vector at address zero, as required by all Cortex-M3 cores.

Stellaris USB Debug Stub Improvements. Bug fixes and new features include:

- A bug that caused the stub not to correctly update the program counter and other register values was fixed. As a result of this fix, it is now possible to run programs residing in SRAM using the `continue` command from GDB.
- The stub no longer prints status messages via GDB console output when invoked with the `-q` command-line option.
- The stub's initialization sequence was updated to recognize revision C Cortex-M3 hardware.

3.3.9 Changes in Sourcery G++ Lite 4.1-9

Stellaris USB Debug Stub Improvements. Program images exceeding 4K can now be uploaded to flash memory.

Additional Stellaris Boards Supported. The Stellaris 301, 310, 315, and 316 CPUs are now supported. Linker scripts have been added for these boards.

3.3.10 Changes in Sourcery G++ Lite 4.1-8

Stellaris USB Debug Stub Improvements. Several bug fixes and enhancements were made to the USB Debug Stub. In particular:

- Bugs in the implementation of `open`, `read`, and `lseek` were fixed.
- Support was added for `isatty`, `rename`, `unlink`, and `system`.
- Memory reads that span 4K block boundaries now work correctly.

3.3.11 Changes in Sourcery G++ Lite 4.1-4

Runtime Libraries. Support for ARMv7 including Cortex-M3 and pure Thumb-2.

Assembler. Support for NEON and VFPv3, including unified NEON/VFP syntax.

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++ Lite while the term *target system* refers to the system on which the code produced by Sourcery G++ Lite runs. The target system for this version of Sourcery G++ Lite is "arm-none-eabi".

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

4.2 System Requirements

4.2.1 Host Operating System Requirements

Sourcery G++ Lite supports the following host operating systems:

- Microsoft Windows NT 4, Windows 2000, and Windows XP 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++ Lite for your target system may not be available on all of the above host systems.

4.2.2 Host Hardware Requirements

In order to install and use Sourcery G++ Lite, you must have:

- At least 200MB of free disk space.
- At least 64MB of available memory.

4.2.3 Target System Requirements

See Chapter 3, *Sourcery G++ Lite for ARM EABI* 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++ Lite subscription (or evaluation), then you can log into the Sourcery G++ support site¹ to download your Sourcery G++ Lite toolchain(s). CodeSourcery also makes some toolchains available to the general public from Sourcery G++ web site². These publicly available toolchains do not include all the functionality of CodeSourcery's product releases.

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

² 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++ Lite installer is provided as an executable, with the `.exe` extension. For GNU/Linux Solaris systems, Sourcery G++ Lite is provided as a compressed tape archive file, with the `.tar.bz2` extension.

On Microsoft Windows systems, save the installer to the desktop. On GNU/Linux and Solaris systems, save the download package in any location that is convenient.

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 will start 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.

Some versions of Sourcery G++ Lite include the Eclipse Integrated Development Environment. Because Eclipse is an optional component, the installer will allow you to choose whether or not to install it. Eclipse is a Java application, so it requires the Java Runtime Environment (JRE). The Java Runtime Environment is available at no charge from Sun Microsystems Java website³. You may download either the Java Runtime Environment (JRE) or the Java Development Kit (JDK). (The JDK includes the JRE.)

Caution

You should install the JRE before you install Sourcery G++ Lite so that Sourcery G++ Lite can automatically determine the location of your JRE. If you do not install the JRE first, Eclipse may not be able to find the JRE. In this case, you may reinstall Sourcery G++ Lite, or you may manually modify your installation as follows. Navigate the *Start* until you find the *Sourcery G++ Lite IDE*. Right click on *Sourcery G++ Lite IDE* and select *Properties*. Click the *Shortcut* tab and click in the *Target* field. Press the **End** key to move to the end of the field and adjust the path for *javaw* to contain the full path to the directory in which your JRE was installed. If you accepted the default installation directory, the correct value will be similar to `C:\Program Files\Java\jre1.5.0_06\bin\javaw`. The entire path name should be enclosed in quotation marks.

4.4.2 Installing Sourcery G++ Lite on GNU/Linux or Solaris

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 `codesourcery` subdirectory of your home directory and that the filename of the package you have downloaded is `/path/to/package.tar.bz2`.

First, uncompress the package file:

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

³ <http://java.sun.com/j2se/>

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
```

This will have created a subdirectory called `sourceryg++-4.1` or similar. If you are installing a native toolchain, it is then necessary to run a post-install script found in the `share` directory:

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

4.5 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++ Lite commands all begin with **arm-none-eabi** so that you can install Sourcery G++ Lite for multiple target systems in the same directory.

4.5.1 Setting up the Environment on Microsoft Windows

The installer automatically adds Sourcery G++ Lite to your `PATH`. You can test that your `PATH` is set up correctly by using the following command:

```
> arm-none-eabi-g++
```

and verifying that you receive the message:

```
arm-none-eabi-g++.exe: no input files
```

4.5.1.1 Working with Cygwin

Sourcery G++ Lite does not require Cygwin or any other UNIX emulation environment. You can use Sourcery G++ Lite directly from the Eclipse IDE or from the Windows command shell. You can also use Sourcery G++ Lite 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++ Lite is not a Cygwin application, it does not, by default, recognize Cygwin paths.

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

```
> export CYGPATH=
```

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

```
> export CYGPATH=/path/to/cygpath
```

will direct Sourcery G++ Lite to use `/path/to/cygpath` as the path conversion utility.

4.5.2 Setting up the Environment on GNU/Linux or Solaris

Before using Sourcery G++ Lite you should add Sourcery G++ Lite 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 $HOME/CodeSourcery/Sourcery_G++/bin:$PATH
```

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

```
> export PATH=$HOME/CodeSourcery/Sourcery_G++/bin:$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++ Lite manual pages, which provide additional information about using Sourcery G++ Lite. To set the `MANPATH` environment variable, follow the same steps shown above, replacing `PATH` with `MANPATH`, and `bin` with `man`.

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

```
> arm-none-eabi-g++
```

and verifying that you receive the message:

```
arm-none-eabi-g++: no input files
```

Chapter 5

Using Sourcery G++ Lite with Eclipse

This chapter explains how to use the Eclipse IDE to build a C or C++ application with Sourcery G++ Lite. This chapter assumes you have installed Sourcery G++ Lite as described in Chapter 4, *Installation and Configuration*. If you would prefer to use the command line to build your applications, you may refer to Chapter 6, *Using Sourcery G++ from the Command Line* instead.

The Eclipse IDE is not included in Sourcery G++ Lite. If you are using Sourcery G++ Lite, you can skip this chapter.

5.1 Overview

If you have installed the Eclipse IDE, you can use it to build and debug your applications. Semi-hosting is required for the following examples. Semi-hosting may not be available on all boards; please see Chapter 3, *Sourcery G++ Lite for ARM EABI* for more details.

5.2 Building Applications

Eclipse supports two modes: the "Managed Make" and "Standard Make" modes. In general, if you are intending to do all of your development from within Eclipse, you should use the Managed Make mode. In this mode, Eclipse will automatically handle building your project for you. However, if you are working with code that has previously been built with **make**, you may wish to use the "Standard Make" mode instead.

5.2.1 Using Managed Make Mode

Start Eclipse and create a Sourcery G++ Lite project by selecting `File → New → Project`. Expand the `C++` label and select `Managed Make C++ Project`. (To build a C application, expand the `C` label instead.) Click the `Next` button. Give the project the name "hello" and click the `Next` button. From the `Project Type` menu select `Executable (Sourcery G++ Lite for ARM EABI)` and click `Finish`. If you are asked whether or not to open a new perspective, click the `Yes` button.

Next, select `File → New → Source File` to add a C++ source file to your project. Name the source file `hello.cc` and click `Finish`. Paste the following code into the file:

```
#include <iostream>

int main () {
    std::cout << "Hello, world!" << std::endl;
}
```

As soon as you save the file, Eclipse will build the program. The executable itself will be located in a subdirectory of the Eclipse workspace directory named `hello`. Of course, the executable will run on the target system, so if you are targeting an embedded system, you will have to upload the executable to the target system before running the application.

5.2.2 Using Standard Make Mode

Caution

Using Standard Make Mode requires that you manually maintain information about how your program is built. If you use this mode, you will need to be familiar with the **make** utility.

If you want to import an existing project for use with Eclipse, and that project uses **make**, or some similar command-line tool to manage the build process, you should use a Standard Make project, instead of a Managed Make project. In Standard Make mode, Eclipse will invoke **make** (or an alternative program that you specify) to build your program. If you add new files to your project, you will have to manually update the `Makefile` for your project.

To set up the Standard Make mode to work with Sourcery G++ Lite, you will have to make a few changes to the default Eclipse project settings. When you are creating the project, you will be presented with a window that permits you to define the project settings.

Select the `Discovery Options` tab and set the `Compiler invocation command` to **arm-none-eabi-gcc** instead of the default **gcc**. That change will tell Eclipse to use Sourcery G++ Lite when scanning your program code to determine cross-reference information. You may also have to adjust your `Makefile` to use Sourcery G++ Lite. For example, you might need to set the `cc` variable in your `Makefile` to **arm-none-eabi-gcc**.

5.3 Debugging Applications

5.3.1 Choosing a Debugging Mode

Before you can use Eclipse to debug your application, you must decide which debugging mode to use. The debugging mode to use depends on your choice of target system, and, in some cases, on the way that you have built your application.

Sourcery G++ Lite supports several debugging modes, as described below. Some modes are available only in certain versions of Sourcery G++ Lite, so there may be modes listed in this section that are not available to you.

External Embedded Server (RAM) The External Embedded Server (RAM) mode is designed for use with target systems that have no operating system support for debugging. In the Embedded mode, Sourcery G++ Lite connects to a "GDB stub" running on either the target system or on a host system. You must start the stub manually.

When you debug your application in the Embedded mode, Eclipse will load the application on your target system, set the program counter to the address of the `_start` function, and then begin execution.

External Embedded Server (ROM) The External Embedded Server (ROM) mode is like the External Embedded Server (RAM) mode, but should be used for applications that are stored in ROM (or flash memory) on the target system. In this mode, Sourcery G++ Lite will use hardware breakpoints, since the program image cannot be modified. Therefore, there will probably be a limit on the total number of breakpoints you can create.

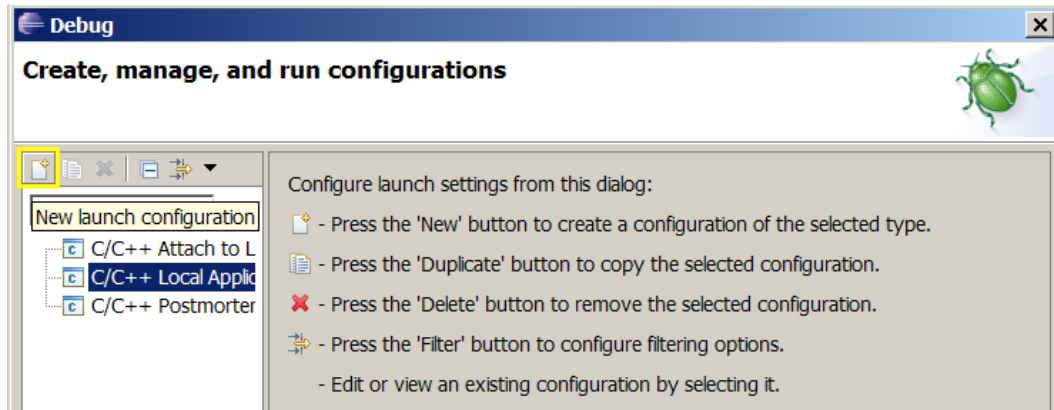
Some debugger operations (such as stepping over a function call) will not work correctly in the ROM mode because the debugger is unable to set software breakpoints.

External Server On UNIX-like operating systems (including GNU/Linux) Sourcery G++ Lite includes a program called **gdbserver** which can be used for remote debugging. The Server mode allows you to connect to an already-executing **gdbserver**.

Simulator In the Simulator mode, Sourcery G++ Lite will use the instruction-set simulator provided with Sourcery G++ Lite. You do not need target hardware in order to use this mode.

5.3.2 Starting the Debugger

After you build your application, choose `Debug...` from the `Run` menu. Select the `C/C++ Local Application` label in the `Configurations` pane. Take a moment to read through icons and their meanings. Click the left-most icon described as the `New launch configuration` or `New` button. The following figure shows the icon highlighted in yellow.



On the `Main` tab, use the `Browse` button to select your project, if it is not already selected. Use the `Search Project...` button to select your application. Then, switch to the `Debugger` tab. Select the `Sourcery G++ Lite` debugger appropriate for your target, and adjust the settings as required.

Some debuggers offer a `Connection` tab, accessible from the `Debugger` tab. The `Connection` tab controls how the debugger connects to the target. The default connection is set to the first serial port. Adjust this setting to suit your environment; options include `TCP/IP` and `Serial`.

To start debugging, click the `Debug` button.

You do not need to repeat this process the next time you launch the debugger. Instead, you can select `Debug Last Launched` from the `Run` menu to start the debugger.

5.4 Learning More About Eclipse

Eclipse has many features and capabilities. For more information about Eclipse in general visit the Eclipse web site¹. For more information about the C and C++ application development with Eclipse, visit the CDT web site².

¹ <http://www.eclipse.org>

² <http://www.eclipse.org/cdt/>

Chapter 6

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*. If you would prefer to use an integrated development environment to build your applications, you may refer to Chapter 5, *Using Sourcery G++ Lite with Eclipse* instead.

6.1 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 **arm-none-eabi**. If you are using a different target system, you will have to replace commands that begin with **arm-none-eabi** with the name of your target system.

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:

```
> arm-none-eabi-gcc -o hello hello.c
```

There will be no output from the compiler. (If you were building a C++ application, instead of a C application, you would replace **arm-none-eabi-gcc** with **arm-none-eabi-g++**.)

6.2 Running an Application

If the target system is the same as the host system (e.g., if you are running Sourcery G++ Lite on IA32 GNU/Linux to build an application for IA32 GNU/Linux), then you can just run the resulting application. On a Microsoft Windows system, you may use the command:

```
> hello
```

On a GNU/Linux or Solaris system, use the slightly more complex:

```
> ./hello
```

command. In either case, you should see:

```
Hello world!
```

If the target system is not the same as the host system, then you cannot run the application directly. Instead, you will have to run the application on the target system. You should consult the manuals for your target system to determine the exact procedures required to run the application.

On some systems, Sourcery G++ Lite includes a simulator that can be used to run the program. To use the simulator run:

```
> arm-none-eabi-run hello
```

The simulator is available if you see the expected output:

```
Hello, world!
```

There is no simulator for your target system if you see a message like:

```
'arm-none-eabi-run' is not recognized as an internal or external command
```

or:

```
arm-none-eabi-run: command not found
```

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Version 2, June 1991

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