

Sourcery G++ Lite

C6000 uClinux

Sourcery G++ Lite 4.5-109

Getting Started



Sourcery G++ Lite: C6000 uClinux: Sourcery G++ Lite 4.5-109: Getting Started

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Abstract

This guide explains how to install and build applications with Sourcery G++ Lite, CodeSourcery's customized and validated version of the GNU Toolchain. Sourcery G++ Lite includes everything you need for application development, including C and C++ compilers, assemblers, linkers, and libraries.

When you have finished reading this guide, you will know how to use Sourcery G++ from the command line.

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Preface

This preface introduces the Sourcery G++ Lite Getting Started guide. It explains the structure of this guide and describes the documentation conventions used.

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, “Quick Start”	This chapter includes a brief checklist to follow when installing and using Sourcery G++ Lite for the first time. You may use this chapter as an abbreviated guide to the rest of this manual.
Chapter 2, “Installation and Configuration”	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 3, “Sourcery G++ Lite for C6000 uClinux”	This chapter contains information about using Sourcery G++ Lite that is specific to C6000 uClinux targets. You should read this chapter to learn how to best use Sourcery G++ Lite on your target system.
Chapter 4, “Using Sourcery G++ from the Command Line”	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 5, “Next Steps with Sourcery G++”	This chapter describes where you can find additional documentation and information about using Sourcery G++ Lite and its components. It also provides information about Sourcery G++ subscriptions. CodeSourcery customers with Sourcery G++ subscriptions receive comprehensive support for Sourcery G++.
Appendix A, “Sourcery G++ Lite Release Notes”	This appendix contains information about changes in this release of Sourcery G++ Lite for C6000 uClinux. You should read through these notes to learn about new features and bug fixes.
Appendix B, “Sourcery G++ Lite Licenses”	This appendix provides information about the software licenses that apply to Sourcery G++ Lite. Read this appendix to understand your legal rights and obligations as a user of Sourcery G++ Lite.

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.

<code>command</code>	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.
<code>\</code>	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.

Chapter 1

Quick Start

This chapter includes a brief checklist to follow when installing and using Sourcery G++ Lite for the first time. You may use this chapter as an abbreviated guide to the rest of this manual.

Sourcery G++ Lite for C6000 uClinux is intended for developers working on embedded uClinux applications. It may also be used for uClinux kernel development and debugging, or to build a uClinux distribution.

Follow the steps given in this chapter to install Sourcery G++ Lite and build and run your first application program. The checklist given here is not a tutorial and does not include detailed instructions for each step; however, it will help guide you to find the instructions and reference information you need to accomplish each step. Note that this checklist is also oriented towards application debugging rather than kernel debugging.

You can find additional details about the components, libraries, and other features included in this version of Sourcery G++ Lite in Chapter 3, “Sourcery G++ Lite for C6000 uClinux”.

1.1. Installation and Set-Up

Install Sourcery G++ Lite on your host computer. You may download an installer package from the Sourcery G++ web site¹, or you may have received an installer on CD. The installer is an executable program that pops up a window on your computer and leads you through a series of dialogs to configure your installation. When the installation is complete, it offers to launch the Getting Started guide. For more information about installing Sourcery G++ Lite, including host system requirements and tips to set up your environment after installation, refer to Chapter 2, “Installation and Configuration”.

1.2. Configuring Sourcery G++ Lite for the Target System

Identify your target libraries. Sourcery G++ Lite supports libraries optimized for different targets. Libraries are selected automatically by the linker, depending on the processor and other options you have specified. Refer to Section 3.2, “Library Configurations” for details. You must identify the multilib appropriate for your target in order to find the correct `gdbserver` executable to use for debugging your applications, as described in Section 3.3, “GDB Server”.

1.3. Building Your Program

Build your program with Sourcery G++ command-line tools. Create a simple test program, and follow the directions in Chapter 4, “Using Sourcery G++ from the Command Line” to compile and link it using Sourcery G++ Lite.

1.4. Running and Debugging Your Program

The steps to run or debug your program depend on your target system and how it is configured. Choose the appropriate method for your target.

Run your program on the target system. Copy your program to the target system and run it from the command line.

Debug your program on the target using GDB server. You can debug a program on a remote C6000 uClinux target using GDB server. Copy your program to the target system. Follow the instructions in Section 3.3, “GDB Server” to install and run `gdbserver` on your target system. Then, you can connect to GDB server from the debugger running on your host system. Refer to Section 4.3,

¹ http://www.codesourcery.com/gnu_toolchains/

“Running Applications from GDB” for instructions on connecting to the target from command-line GDB.

Chapter 2

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.

2.1. 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 `c6x-uc.linux`.

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.

2.2. System Requirements

2.2.1. Host Operating System Requirements

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

- Microsoft Windows 2000, Windows XP, Windows Vista, and Windows 7 systems using IA32, AMD64, and Intel 64 processors.
- GNU/Linux systems using IA32, AMD64, or Intel 64 processors, including Debian 3.1 (and later), Red Hat Enterprise Linux 3 (and later), and SuSE Enterprise Linux 8 (and later).

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

Installing on Ubuntu and Debian GNU/Linux Hosts

The Sourcery G++ graphical installer is incompatible with the `dash` shell, which is the default `/bin/sh` for recent releases of the Ubuntu and Debian GNU/Linux distributions. To install Sourcery G++ Lite on these systems, you must make `/bin/sh` a symbolic link to one of the supported shells: `bash`, `csh`, `tcsh`, `zsh`, or `ksh`.

For example, on Ubuntu systems, the recommended way to do this is:

```
> sudo dpkg-reconfigure -plow dash
Install as /bin/sh? No
```

This is a limitation of the installer and uninstaller only, not of the installed Sourcery G++ Lite toolchain.

2.2.2. Host Hardware Requirements

In order to install and use Sourcery G++ Lite, you must have at least 512MB 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. When you start the graphical installer, it checks whether there is sufficient disk space before beginning to install. Note that the graphical installer also requires additional temporary disk space during the installation process. On Microsoft Windows hosts, the installer uses the location specified by the `TEMP` environment variable for these temporary files. If there is not enough free space on that volume, the installer

prompts for an alternate location. On Linux hosts, the installer puts temporary files in the directory specified by the `IATEMPDIR` environment variable, or `/tmp` if that is not set.

2.2.3. Target System Requirements

See Chapter 3, “Sourcery G++ Lite for C6000 uClinux” for requirements that apply to the target system.

2.3. 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 2.4, “Installing Sourcery G++ Lite”.

You can download Sourcery G++ Lite from the Sourcery G++ web site¹. This free version of Sourcery G++, which is made available to the general public, does not include all the functionality of CodeSourcery's product releases. If you prefer, you may instead purchase or register for an evaluation of CodeSourcery's product toolchains at the Sourcery G++ Portal².

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 Sourcery G++ Lite is provided as an executable installer package with the `.bin` extension. You may also install from a compressed archive with the `.tar.bz2` extension.

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

2.4. Installing Sourcery G++ Lite

The method used to install Sourcery G++ Lite depends on your host system and the kind of installation package you have downloaded.

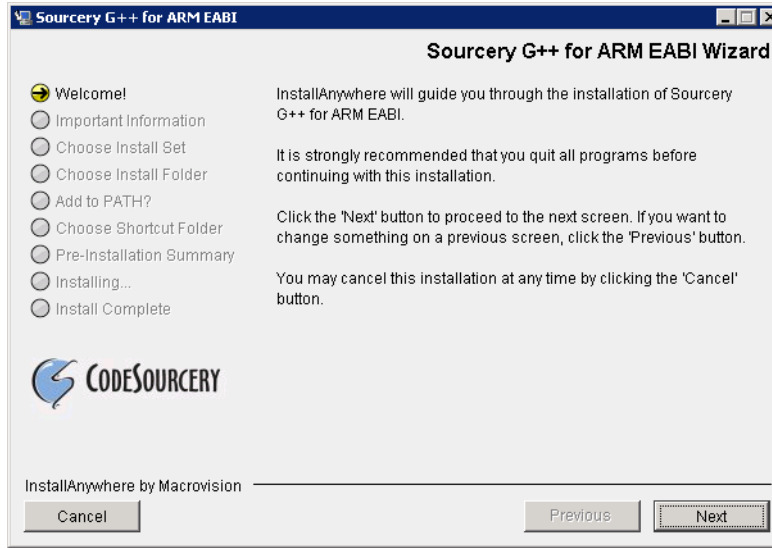
2.4.1. Using the Sourcery G++ Lite Installer on Microsoft Windows

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. The installer is intended to be self-explanatory and on most pages the defaults are appropriate.

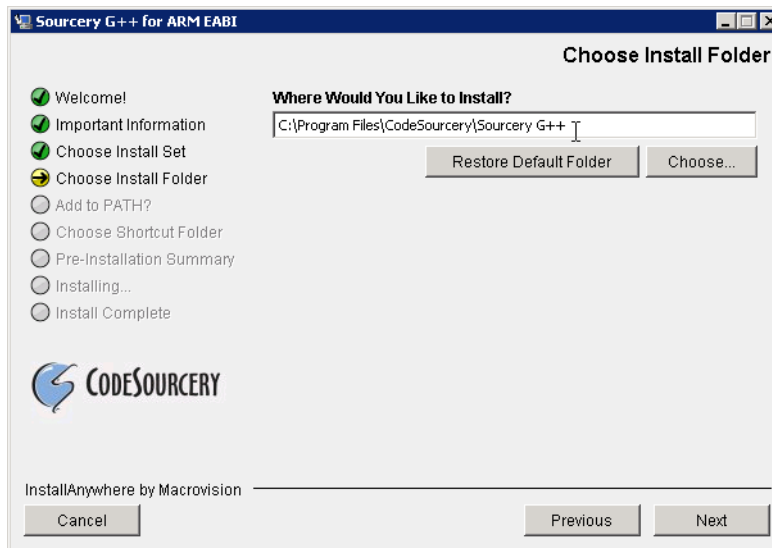
¹ http://www.codesourcery.com/gnu_toolchains/

² <https://support.codesourcery.com/GNUToolchain/>

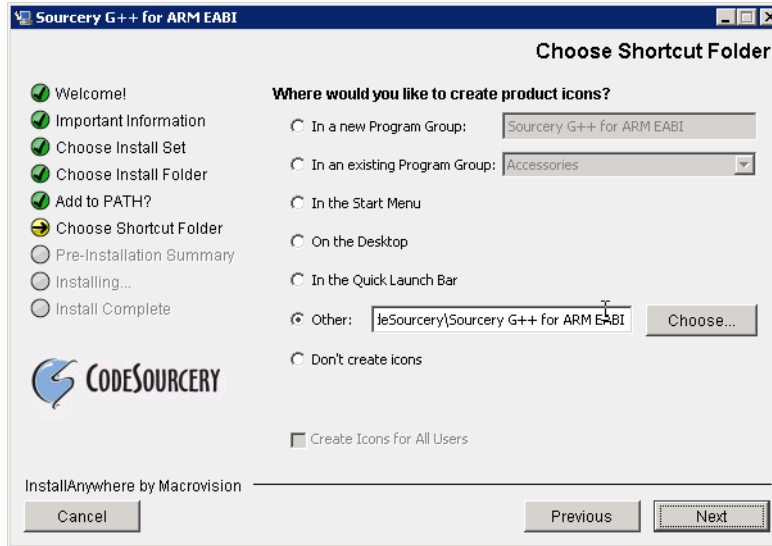


Running the Installer. The graphical installer guides you through the steps to install Sourcery G++ Lite.

You may want to change the install directory pathname and customize the shortcut installation.

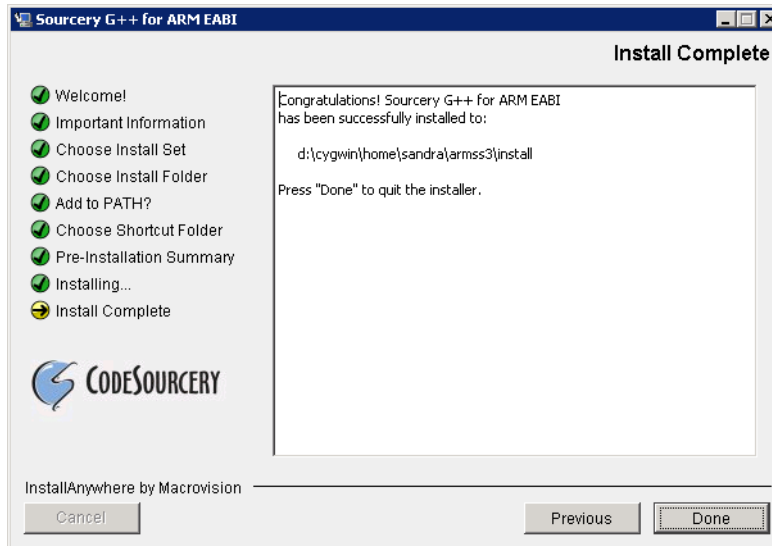


Choose Install Folder. Select the pathname to your install directory.



Choose Shortcut Folder. You can customize where the installer creates shortcuts for quick access to Sourcery G++ Lite.

When the installer has finished, it asks if you want to launch a viewer for the Getting Started guide. Finally, the installer displays a summary screen to confirm a successful install before it exits.



Install Complete. You should see a screen similar to this after a successful install.

If you prefer, you can run the installer in console mode rather than using the graphical interface. To do this, invoke the installer with the `-i console` command-line option. For example:

```
> /path/to/package.exe -i console
```

2.4.2. Using the Sourcery G++ Lite Installer on GNU/Linux Hosts

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. For additional details on running the installer, see the discussion and screen shots in the Microsoft Windows section above.

If you prefer, or if your host system does not run the X Window System, you can run the installer in console mode rather than using the graphical interface. To do this, invoke the installer with the `-i console` command-line option. For example:

```
> /bin/sh ./path/to/package.bin -i console
```

2.4.3. Installing Sourcery G++ Lite from a Compressed Archive

You do not need to be a system administrator to install Sourcery G++ Lite from a compressed archive. 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++-4.5`.

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
```

2.5. Installing Sourcery G++ Lite Updates

If you have already installed an earlier version of Sourcery G++ Lite for C6000 uClinux on your system, it is not necessary to uninstall it before using the installer to unpack a new version in the same location. The installer detects that it is performing an update in that case.

If you are installing an update from a compressed archive, it is recommended that you remove any previous installation in the same location, or install in a different directory.

Note that the names of the Sourcery G++ commands for the C6000 uClinux target all begin with `c6x-uclinux`. This means that you can install Sourcery G++ for multiple target systems in the same directory without conflicts.

2.6. Setting up the Environment

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

2.6.1. Setting up the Environment on Microsoft Windows Hosts

2.6.1.1. Setting the PATH

In order to use the Sourcery G++ tools from the command line, you should add them to your PATH. You may skip this step if you used the graphical installer, since the installer automatically adds Sourcery G++ to your PATH.

To set the PATH on a Microsoft Windows Vista system, use the following command in a `cmd.exe` shell:

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

where `C:\Program Files\Sourcery G++` should be changed to the path of your Sourcery G++ Lite installation.

To set the PATH on a system running Microsoft Windows 7, from the desktop bring up the Start menu and right click on Computer. Select Properties and click on Advanced system settings. Go to the Advanced tab, then click on the Environment Variables button. Select the PATH variable and click the Edit. Add the string `;C:\Program Files\Sourcery G++\bin` to the end, and click OK. Be sure to adjust the pathname to reflect your actual installation directory.

To set the PATH on older versions of Microsoft Windows, from the desktop bring up the Start menu and right click on My Computer. Select Properties, go to the Advanced tab, then click on the Environment Variables button. Select the PATH variable and click the Edit. Add the string `;C:\Program Files\Sourcery G++\bin` to the end, and click OK. Again, you must adjust the pathname to reflect your installation directory.

You can verify that your PATH is set up correctly by starting a new `cmd.exe` shell and running:

```
> c6x-uclinux-g++ -v
```

Verify that the last line of the output contains: `Sourcery G++ Lite 4.5-109`.

2.6.1.2. 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.

2.6.2. Setting up the Environment on GNU/Linux Hosts

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

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

```
> setenv PATH $HOME/CodeSourcery/Sourcery_G++/bin:$PATH
```

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

```
> PATH=$HOME/CodeSourcery/Sourcery_G++/bin:$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++-c6x-uclinux/man`.

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

```
> c6x-uclinux-g++ -v
```

Verify that the last line of the output contains: `Sourcery G++ Lite 4.5-109`.

2.7. Uninstalling Sourcery G++ Lite

The method used to uninstall Sourcery G++ Lite depends on the method you originally used to install it. 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. In particular, the `c6x-uclinux` directory located in the install directory will be removed entirely by the uninstaller.

2.7.1. Using the Sourcery G++ Lite Uninstaller on Microsoft Windows

You should use the provided uninstaller to remove a Sourcery G++ Lite installation originally created by the graphical installer. Start the graphical uninstaller by invoking the Uninstall executable located in your installation directory, or use the uninstall shortcut created during installation. After the uninstaller starts, follow the on-screen dialogs to uninstall Sourcery G++ Lite.

You can run the uninstaller in console mode, rather than using the graphical interface, by invoking the Uninstall executable found in your Sourcery G++ Lite installation directory with the `-i console` command-line option.

To uninstall third-party drivers bundled with Sourcery G++ Lite, first disconnect the associated hardware device. Then use `Uninstall a program` (Vista and newer) or `Add or Remove Programs` (older versions of Windows) to remove the drivers separately. Depending on the device, you may need to reboot your computer to complete the driver uninstall.

2.7.2. Using the Sourcery G++ Lite Uninstaller on GNU/Linux

You should use the provided uninstaller to remove a Sourcery G++ Lite installation originally created by the executable installer script. 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.

You can run the uninstaller in console mode, rather than using the graphical interface, by invoking the `Uninstall` script with the `-i console` command-line option.

2.7.3. Uninstalling a Compressed Archive Installation

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.

Chapter 3

Sourcery G++ Lite for C6000 uClinux

This chapter contains information about features of Sourcery G++ Lite that are specific to C6000 uClinux targets. You should read this chapter to learn how to best use Sourcery G++ Lite on your target system.

3.1. Included Components and Features

This section briefly lists the important components and features included in Sourcery G++ Lite for C6000 uClinux, and tells you where you may find further information about these features.

Component	Version	Notes
GNU programming tools		
GNU Compiler Collection	4.5.1	Separate manual included.
GNU Binary Utilities	2.20.51	Includes assembler, linker, and other utilities. Separate manuals included.
Debugging support and simulators		
GNU Debugger	7.2.50	Separate manual included.
GDB Server	N/A	Included with GDB. See Section 3.3, “GDB Server”.
Target libraries		
uClibc C Library	0.9.32-20110309	
Linux Kernel Headers	2.6.35.2	
Other utilities		
GNU Make	N/A	Build support on Windows hosts.
GNU Core Utilities	N/A	Build support on Windows hosts.

3.2. Library Configurations

Sourcery G++ Lite for C6000 uClinux includes the following library configuration.

C64x+ - Little-Endian	
Command-line option(s):	default
Sysroot subdirectory:	./

C64x+ - Big-Endian	
Command-line option(s):	-mbig-endian
Sysroot subdirectory:	be/

C674x - Little-Endian	
Command-line option(s):	-march=c674x
Sysroot subdirectory:	c674x/

C674x - Big-Endian	
Command-line option(s):	-mbig-endian -march=c674x
Sysroot subdirectory:	be/c674x/

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

Each multilib corresponds to a *sysroot* directory which contains the files that should be installed on the target system. You can find the *sysroot* directories provided with Sourcery G++ in the *c6x-uclinux/libc* directory of your installation.

3.3. GDB Server

Sourcery G++ Lite contains a *gdbserver* for running on the target. The server executable is located in the *sysroot/usr/bin* directory of your installation, where *sysroot* is the pathname to the *sysroot*, as documented in Section 3.2, “Library Configurations”. You need to copy the appropriate *gdbserver* executable to your target system and then invoke it as

```
# gdbserver :port program
```

port can be any available TCP port; 5000 is a common choice. *gdbserver* waits for a connection from *gdb* and then commences serving requests for it. To connect to *gdbserver* from your host system, start *gdb*, but specify the special *.gdb* version of your program.

```
> c6x-uclinux-gdb program.gdb
```

Then connect to the target system:

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

At this point you are able to debug as usual.

Chapter 4

Using Sourcery G++ from the Command Line

This chapter demonstrates the use of Sourcery G++ Lite from the command line.

4.1. 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 `c6x-uclinux`, as indicated by the `c6x-uclinux` command prefix.

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

```
#include <stdio.h>

int factorial(int n) {
    if (n == 0)
        return 1;
    return n * factorial (n - 1);
}

int main () {
    int i;
    int n;
    for (i = 0; i < 10; ++i) {
        n = factorial (i);
        printf ("factorial(%d) = %d\n", i, n);
    }
    return 0;
}
```

Compile and link this program using the command:

```
> c6x-uclinux-gcc -o factorial main.c
```

There should be no output from the compiler. (If you are building a C++ application, instead of a C application, replace `c6x-uclinux-gcc` with `c6x-uclinux-g++`.)

4.2. Running Applications on the Target System

To run your program on a uClinux target system, use the command:

```
> factorial
```

You should see:

```
factorial(0) = 1
factorial(1) = 1
factorial(2) = 2
factorial(3) = 6
factorial(4) = 24
factorial(5) = 120
factorial(6) = 720
factorial(7) = 5040
factorial(8) = 40320
factorial(9) = 362880
```

4.3. 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.

When starting GDB, give it the pathname to the program you want to debug as a command-line argument. For example, if you have built the factorial program as described in Section 4.1, “Building an Application”, enter:

```
> c6x-uclinux-gdb factorial.gdb
```

For uClinux you must specify the ELF binary, not the FLT binary that you load onto your target.

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.

4.3.1. Connecting to an External GDB Server

Sourcery G++ Lite includes a program called `gdbserver` that can be used to debug a program running on a remote C6000 uClinux target. Follow the instructions in Chapter 3, “Sourcery G++ Lite for C6000 uClinux” 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 5

Next Steps with Sourcery G++

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

5.1. Sourcery G++ Knowledge Base

The Sourcery G++ Knowledge Base is available to registered users at the Sourcery G++ Portal¹. 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.

5.2. Example Programs

Sourcery G++ Lite includes some bundled example programs. You can find the source code for these examples in the `share/sourceryg++-c6x-uclinux-examples` directory of your Sourcery G++ installation.

The subdirectories contain a number of small, target-independent test programs. You may find these programs useful as self-contained test cases when experimenting with configuring the correct compiler and debugger settings for your target, or when learning how to use the debugger or other features of the Sourcery G++ toolchain.

5.3. 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++-c6x-uclinux/` 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++-c6x-uclinux/man/man1
```

Then you can invoke `man` as:

```
> man ./c6x-uclinux-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 2.6, "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.

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

Appendix A

Sourcery G++ Lite Release Notes

This appendix contains information about changes in this release of Sourcery G++ Lite for C6000 uClinux. You should read through these notes to learn about new features and bug fixes.

A.1. Changes in Sourcery G++ Lite for C6000 uClinux

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

A.1.1. Changes in Sourcery G++ Lite 4.5-109

Alignment of `malloc` return values. A bug in uClibc has been fixed which caused `malloc` to return memory that was aligned to four bytes only, rather than eight.

A.1.2. Changes in Sourcery G++ Lite 4.5-108

Compiler crash with `-mlong-calls`. A bug that could cause the compiler to crash in certain situations with the `-mlong-calls` option has been fixed.

Incorrect code generation when scheduling. A compiler bug has been fixed which could cause incorrect code to be generated during scheduling.

Dynamic assignment of DSBT indices. The uClibc dynamic linker can now dynamically assign an index to a DSBT shared library that was compiled without a `--dsbt-index` option. This is not recommended in general as it generates private mappings of library text segments, requiring extra space and load time.

uClibc `clock_nanosleep` added. The function `clock_nanosleep` has been added to uClibc's `librt`. Due to lack of NPTL threading, it may not fully work in threaded cases.

A.1.3. Changes in Sourcery G++ Lite 4.5-106

Linker bug fix. A bug in the linker that caused incorrect output for C++ exception tables emitted by the TI compiler has been fixed.

New version of uClibc. A new version of uClibc, based on upstream git mainline, has been imported. This results in an ABI change; all programs and libraries built with earlier releases must be rebuilt.

Inferior calling support. The included version of GDB has been updated to provide inferior call support. A bug causing GDB to obtain the return address incorrectly has also been fixed.

A.1.4. Changes in Sourcery G++ Lite 4.5-104

C++ exception handling. Sourcery G++ Lite for C6000 uClinux now includes support for C++, including exception handling using the unwinding tables defined by the C6000 EABI.

Position independent code generation. The compiler no longer accepts the `-fpic` option without `-mdsbt`. Also, the code generator has been fixed not to emit `addkpc` instructions on C62X.

uClibc `ffs1` and `ffs11` functions. The uClibc library now includes implementations of the functions `ffs1` and `ffs11`.

Error reading FDPIC exec loadmap message. A bug has been fixed that caused `gdb` to fail with the error message "Error reading FDPIC exec loadmap" when the "set sysroot" command is used before connecting to the target.

Segmentation fault fixed. A bug causing gdb to segfault when the "set sysroot" command is used with no file to debug has been fixed.

A.1.5. Changes in Sourcery G++ Lite 4.5-97

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.6. Changes in Sourcery G++ Lite 4.5-96

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.7. Changes in Sourcery G++ Lite 4.5-94

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.8. Changes in Sourcery G++ Lite 4.5-92

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.9. Changes in Sourcery G++ Lite 4.5-88

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.10. Changes in Sourcery G++ Lite 4.5-86

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.11. Changes in Sourcery G++ Lite 4.5-78

GCC fix for reference to undefined label. A bug in the optimizer that caused GCC to emit references to undefined labels has been fixed.

Alignment attributes. A bug has been fixed that caused the compiler to ignore alignment attributes of C++ static member variables where the attribute was present on the definition, but not the declaration.

Compiler optimization improvements. The compiler has been enhanced with a number of optimization improvements, including:

- Smaller and faster code for compound conditionals.
- Improved filling of branch delay slots.
- Removal of superfluous sign and zero extensions.

New `-fstrict-volatile-bitfields` option. The compiler has a new option, `-fstrict-volatile-bitfields`, which forces access to a volatile structure member using the width that conforms to its type. Refer to the GCC manual for details.

Compiler optimization improvements. The compiler has been enhanced with a number of optimization improvements, including:

- More efficient assignment for structures containing bitfields.
- Better code for initializing C++ arrays with explicit element initializers.

- Improved logic for eliminating/combining redundant comparisons in code with nested conditionals.
- Better selection of loop variables, resulting in fewer temporaries and more efficient register usage.
- Better code when constant addresses are used as arguments to inline assembly statements.
- Better code for copying small constant strings.

GCC version 4.5.1. Sourcery G++ Lite for C6000 uClinux is now based on GCC version 4.5.1. For more information about changes from GCC version 4.4 that was included in previous releases, see <http://gcc.gnu.org/gcc-4.5/changes.html>.

A.1.12. Changes in Sourcery G++ Lite 4.4-326

GDB `finish` internal error. A bug has been fixed that caused a GDB internal error when using the `finish` command. The bug occurred when debugging optimized code.

GDB update. The included version of GDB has been updated to 7.0.50.20100218. This update adds numerous bug fixes and new features, including improved C++ language support, automatic caching of stack memory, and Position Independent Executable (PIE) support.

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.

Printing casted values in GDB. A GDB bug that caused incorrect output for expressions containing casts, such as in the `print *(Type *)ptr` command, has been fixed.

GDB update. The included version of GDB has been updated to 6.8.50.20090630. This update adds numerous bug fixes and new features, including support for multi-byte and wide character sets and improved C++ template support.

GDB update. The included version of GDB has been updated to 7.2.50.20100908. This update adds numerous bug fixes and new features, including improved C++ language support, a new command to save breakpoints to a file, a new convenience variable `$_thread` that holds the number of the current thread, among many other improvements.

GDB and third-party compilers. Some bugs that caused GDB to crash when debugging programs compiled with third-party tools have been fixed. These bugs did not affect programs built with Sourcery G++.

GDB asynchronous mode fix. GDB can now be used from the command line in asynchronous mode with remote targets. Previously, GDB did not accept user input while asynchronous commands (such as `continue &`) were running.

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.

Remote debugging hardware watchpoint bug fix. A GDB bug has been fixed that caused hardware watchpoint hits to be incorrectly reported in some cases.

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

GDB update. The included version of GDB has been updated to 6.8.50.20080821. This update adds numerous bug fixes and new features, including support for decimal floating point, the new

find command to search memory, the new /m (mixed source and assembly) option to the disassemble command, and the new macro define command to define C preprocessor macros interactively.

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 internal warning fix. A GDB bug has been fixed that caused warnings of the form warning: (Internal error: pc address in read in psymtab, but not in symtab.).

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

GDB crash fix. A bug has been fixed that caused GDB to crash on launch if the environment variable CYGPATH is set to a program that does not exist or cannot be executed.

GDB interrupt handling bug fix. A bug in GDB has been fixed that caused it to sometimes fail to indicate that the target had stopped after being interrupted. The bug affected clients using GDB's MI front end.

GDB display of source. A bug has been fixed that prevented GDB from locating debug information in some cases. The debugger failed to display source code for or step into the affected functions.

Printing global variables in GDB. A GDB bug that caused errors in printing values of global variables in the debugger has been fixed. GDB was formerly computing addresses of such variables incorrectly; in some cases, this resulted in incorrect values being printed, while in others, it resulted in memory access errors in the remote gdbserver.

Improved debugging for optimized code. GDB's ability to print and change variables' values in optimized code is improved. GDB now tracks variable scopes more accurately, making better use of the detailed debugging information produced by Sourcery G++ compilers.

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.

Connecting to the target using a pipe. A bug in GDB's target remote | program command has been fixed. When launching the specified program failed, the bug caused GDB to crash, hang, or give a message Error: No Error.

Remote debugging improvements. The gdbserver utility now supports a more efficient communications protocol that can reduce latency during remote debugging. The protocol optimizations are enabled automatically when gdbserver operates over a TCP connection. Refer to the GDB manual for more information.

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

Memory access errors when setting breakpoints. A GDB bug that caused spurious "Cannot access memory" errors has been fixed. The errors occurred when setting breakpoints after the program being debugged exited or was killed.

GDB support for Cygwin pathnames. A bug in GDB's translation of Cygwin pathnames has been fixed.

GDB update. The included version of GDB has been updated to 6.6.50.20070228. This update includes numerous bug fixes and improved support for C++ pointers to members.

GDB and programs linked with the `--gc-sections` linker option. GDB has been improved to better handle debug information found in programs and libraries linked with the `--gc-sections` option. GDB formerly selected the wrong debug information in some cases, resulting in incorrect behavior when stepping over a function or displaying local variables, for example.

Remote debugging connection auto-retry. The `target remote` command within GDB now uses a configurable auto-retry timeout when establishing TCP connections. This is useful in avoiding race conditions when the remote GDB stub or GDB server is launched simultaneously with GDB. The auto-retry behavior is enabled by default; refer to the GDB manual for details.

GDB segment warning. Some compilers produce binaries including uninitialized data regions, such as the stack and heap. GDB incorrectly displayed the warning `Loadable segment "name" outside of ELF segments` for such binaries; the warning has now been fixed.

GDB memory find bug fix. A bug in GDB's `find` command has been fixed. The bug caused searches on large memory areas to fail or report matches at incorrect addresses.

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.

Startup code debugging fixes. Two GDB bugs have been fixed that caused errors when debugging startup code. One bug caused an internal error message; the other caused the error `Cannot find bounds of current function`.

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.

Frame manipulation bug fix. A bug in GDB has been fixed that caused frame manipulation commands to report an internal error in some cases when used on arbitrary stack frames specified by an address.

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

Read watchpoints bug fix. A GDB bug has been fixed that caused watchpoints set to trigger on memory reads to be silently ignored in some cases.

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.

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.

GDB quit error. A bug in GDB has been fixed that caused quit to report `Quitting: You can't do that without a process to debug.` when debugging a core dump file.

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.

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.

Errors after loading the debugged program. An intermittent GDB bug has been fixed. The bug could cause a GDB internal error after the `load` command.

Persistent remote server connections. A GDB bug has been fixed that caused the `target extended-remote` command to fail to tell the remote server to make the connection persistent across program invocations.

GDB update. The included version of GDB has been updated to 6.8.50.20081022. This update includes numerous bug fixes.

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

Setting thread-specific breakpoints in GDB. A bug in GDB has been fixed that caused a syntax error for the `break *expression thread threadnum` command.

A.1.13. Changes in Sourcery G++ Lite 4.4-322

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.14. Changes in Sourcery G++ Lite 4.4-320

No significant changes. There are no significant changes for C6000 uClinux in this release.

A.1.15. Changes in Sourcery G++ Lite 4.4-319

Linker debug information fix. A bug in linker processing of debug information has been fixed. The bug sometimes prevented the Sourcery G++ debugger from displaying source code if the executable was linked with the `--gc-sections` option.

A.1.16. Changes in Sourcery G++ Lite 4.4-316

Initial release. This is the initial public release for C6000 uClinux.

Appendix B

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 appendix explains what licenses apply to your use of Sourcery G++ Lite. You should read this appendix to understand your legal rights and obligations as a user of Sourcery G++ Lite.

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17. **Severability.** If any provision of this Agreement is declared invalid or unenforceable, such provision shall be deemed modified to the extent necessary and possible to render it valid and enforceable. In any event, the unenforceability or invalidity of any provision shall not affect any other provision of this Agreement, and this Agreement shall continue in full force and effect, and be construed and enforced, as if such provision had not been included, or had been modified as above provided, as the case may be.
18. **Arbitration.** Except for actions to protect intellectual property rights and to enforce an arbitrator's decision hereunder, all disputes, controversies, or claims arising out of or relating to this Agreement or a breach thereof shall be submitted to and finally resolved by arbitration under the rules of the American Arbitration Association ("AAA") then in effect. There shall be one arbitrator, and such arbitrator shall be chosen by mutual agreement of the parties in accordance with AAA rules. The arbitration shall take place in Granite Bay, California, and may be conducted

by telephone or online. The arbitrator shall apply the laws of the State of California, USA to all issues in dispute. The controversy or claim shall be arbitrated on an individual basis, and shall not be consolidated in any arbitration with any claim or controversy of any other party. The findings of the arbitrator shall be final and binding on the parties, and may be entered in any court of competent jurisdiction for enforcement. Enforcements of any award or judgment shall be governed by the United Nations Convention on the Recognition and Enforcement of Foreign Arbitral Awards. Should either party file an action contrary to this provision, the other party may recover attorney's fees and costs up to \$1000.00.

19. **Jurisdiction And Venue.** The courts of Placer County in the State of California, USA and the nearest U.S. District Court shall be the exclusive jurisdiction and venue for all legal proceedings that are not arbitrated under this Agreement.
20. **Independent Contractors.** The relationship of the parties is that of independent contractor, and nothing herein shall be construed to create a partnership, joint venture, franchise, employment, or agency relationship between the parties. Licensee shall have no authority to enter into agreements of any kind on behalf of CodeSourcery and shall not have the power or authority to bind or obligate CodeSourcery in any manner to any third party.
21. **Force Majeure.** Neither CodeSourcery nor Licensee shall be liable for damages for any delay or failure of delivery arising out of causes beyond their reasonable control and without their fault or negligence, including, but not limited to, Acts of God, acts of civil or military authority, fires, riots, wars, embargoes, or communications failure.
22. **Miscellaneous.** This Agreement constitutes the entire understanding of the parties with respect to the subject matter of this Agreement and merges all prior communications, representations, and agreements. This Agreement may be modified only by a written agreement signed by the parties. If any provision of this Agreement is held to be unenforceable for any reason, such provision shall be reformed only to the extent necessary to make it enforceable. This Agreement shall be construed under the laws of the State of California, USA, excluding rules regarding conflicts of law. The application of the United Nations Convention of Contracts for the International Sale of Goods is expressly excluded. This license is written in English, and English is its controlling language.

B.3. Attribution

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B.3.1. Android Open Source Project

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