

## Red Hat GCC for MSP430™ Microcontrollers

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The document shows:

- How to use the compiler to build an example for an MSP430™ target device
- How to debug software with the GDB Agent and the GNU Debugger tools

Experience with a command terminal on either the Microsoft® Windows® operating system or the GNU Linux® operating system is necessary.

### Contents

1	Prerequisites.....	1
2	Quick Start: Blink the LED.....	2
3	Creating a New Project .....	4
4	Troubleshooting .....	5
5	References .....	5

## 1 Prerequisites

This document assumes that a version of the GNU Make utility is installed on the system and that it is available on the system path.

The placeholder **INSTALL\_DIR** refers to the directory where you installed the GCC MSP430 package. The directory **INSTALL\_DIR/bin** should be on the system path.

As this document cannot go into much detail on how to use the GNU Compiler and Debugger, see *GDB: The GNU Project Debugger* [1] and *Using the GNU Compiler Collection* [2].

## 2 Quick Start: Blink the LED

### 2.1 Building With a Makefile

1. In the command terminal, go to the `INSTALL_DIR\examples` directory.
2. There are examples for Windows and Linux. They are located in the corresponding sub-directories. Choose one of the examples suitable for your Operating System and MSP430 target device.
3. Change to the directory and type `make`.
4. The binary can now be downloaded and debugged on the target hardware.

### 2.2 Building Manually With gcc

To build one of the examples manually, open a terminal and change to the example suitable for your target device and operating system. The compiler executable **msp430-elf-gcc** must be available on your system path.

```
msp430-elf-gcc -I <Path to MSP430 Support Files> -L <Path to MSP430 Support Files>  
-T DEVICE.ld -mmcu=DEVICE -O2 -g blink.c -o blink.o
```

The placeholder **<Path to MSP430 Support Files>** is the directory that contains the MSP430 Support Files (header files and linker scripts to support the different MSP430 devices).

The placeholder **DEVICE** tells the compiler and linker to create code for your target device. The command line argument `-T DEVICE.ld` is optional, as the compiler automatically selects the correct linker script from the `-mmcu=DEVICE` argument.

Example:

```
msp430-elf-gcc -I=../../include -L=../../include -T msp430fr5969.ld -  
mmcu=msp430fr5969 -O2 -g blink.c -o blink.o"
```

### 2.3 Debugging

#### 2.3.1 Using the GDB Agent

##### 2.3.1.1 Introduction

The GDB Agent is a tool to connect the GDB with the target hardware to debug your software. The GDB Agent uses the [MSP430 debug stack](#) to connect to the hardware and provides an interface to the GDB.

On Windows, both a console and a GUI application version of the GDB agent is provided. Only the console application is supported on Linux.

##### 2.3.1.2 Console Application

If you use the console application, invoke it from a command terminal using following syntax:

Linux:

```
INSTALL_DIR/bin/gdb_agent_console INSTALL_DIR/msp430.dat
```

Windows:

```
INSTALL_DIR\bin\gdb_agent_console INSTALL_DIR\msp430.dat
```

The console application opens a TCP/IP port on the local machine. It displays the port number in the console. By default, this port number is 55000.

### 2.3.1.3 GUI Application

After you start the GUI application, configure the GUI and then start the GDB server.

1. Click the *Configure* button and, in the Select board configuration file window, select the `msp430.dat` file. If successfully configured, an MSP430 device is displayed in the <Targets> list. The TCP/IP port for the GDB Agent is displayed when the MSP430 device is selected from the list.
2. To start the GDB server, click the <Start> button when the MSP430 device is selected.

### 2.3.1.4 Attaching the Debugger

After starting the debugger and to attach to the GDB server, use the *target remote [<host ip address>]:<port>* command, where <port> is the TCP/IP port from [Section 2.3.1.3](#). If the GDB Agent runs locally, you can omit the host IP address.

### 2.3.1.5 Configuring the Target Voltage

To configure the target voltage for your device, open the file `msp430.dat` in a text editor. To change the voltage, modify the key `msp430_vcc`. By default, this value is set to 3.3 volts.

## 2.3.2 Starting GDB Agent

On Microsoft Windows, you can start the GDB Agent either as a small GUI application or on the command line. On GNU Linux, only the command line version is available.

### 2.3.2.1 Using the GUI

Open the **INSTALL\_DIR/bin** directory and double-click `gdb_agent_gui`.

1. After the program is started, click the button *Configure*, select *msp430.dat*, and click *Open*.
2. Click on the button *Start* under the Panel Controls.
3. The "Log" window now contains the status message *Waiting for client*.
4. Leave the window open until the end of the debugging process.

### 2.3.2.2 Using the Command Line

Open a command terminal, change to **INSTALL\_DIR** and type:

Linux:

```
./bin/gdb_agent_console msp430.dat
```

Windows:

```
.\bin\gdb_agent_console msp430.dat
```

### 2.3.3 Debugging With GDB

#### 2.3.3.1 Running a Program in the Debugger

1. In the command terminal, go to the `INSTALL_DIR\examples\[Selected example]`, and type the command `make debug`.
2. This command starts the GDB, and it waits for commands. This is indicated by the prompt `<gdb>`.
3. To connect GDB to the GDB Agent, type the command `target remote :55000` and press enter.
4. To load a program binary to the MSP430 target device, type `load`.
5. Typing the command `continue` (short version: `c`) tells GDB to run the loaded program.
6. The LED on the target board will blink.

#### 2.3.3.2 Setting a Breakpoint

1. Connect the GDB to the GDB Agent as previously described, and load a program to the device.
2. To set a breakpoint on a function, type: `break function name`.
3. To set a breakpoint on a source line, type: `break filename:line`.
4. When you run the program, the program execution stops at the entry to the specified function or stops at the specified line.

#### 2.3.3.3 Single Stepping

1. Connect the GDB to the GDB Agent as previously described, and load a program to the device.
2. After the debugger has stopped the program at a breakpoint, you can step through the code:
  - To execute the source line, type `next`.  
`next` does not step into functions, it executes the complete function and stops on the line following the function call.
  - To execute the next source line and step into functions, type `step`.
  - To execute the next instruction, type `nexti`.
  - To execute the next instruction and step into functions, type `stepi`.

#### 2.3.3.4 Stopping or Interrupting a Running Program

1. Connect the GDB to the GDB Agent as previously described, and load a program to the device.
2. To stop a running program and get back to the GDB command prompt, type `Ctrl+C`. This currently applies only on Linux.

## 3 Creating a New Project

1. Create a directory for your project.
2. Copy one of the makefiles from the example project into your project directory.
3. Open the copied makefile, and set the variable `DEVICE` to the target device you are using.
4. Set the variable `GCC_DIR` to point to the directory where you installed the GCC MSP430 package.
5. Include all of your project source files (that is, the `*.c` files) as a dependency for the first target of the makefile.
6. You can now go to the project directory in a terminal and type `make` to build the project or `make debug` to start debugging the project.

```

OBJECTS=blink.o

GCC_DIR = ../../../../bin
SUPPORT_FILE_DIRECTORY = ../../../../include

# Please set your device here
DEVICE = msp430X
CC      = $(GCC_DIR)/msp430-elf-gcc
GDB     = $(GCC_DIR)/msp430-elf-gdb

CFLAGS = -I $(SUPPORT_FILE_DIRECTORY) -mmcu=$(DEVICE) -O2 -g
LFLAGS = -L $(SUPPORT_FILE_DIRECTORY) -T $(DEVICE).ld

all: ${OBJECTS}
    $(CC) $(CFLAGS) $(LFLAGS) $? -o $(DEVICE).out

debug: all
    $(GDB) $(DEVICE).out

```

## 4 Troubleshooting

### 4.1 Missing libexpat

If msp430-elf-gdb displays the following error message when trying to debug under Linux, even though libexpat is installed:

```

../../../../i686-msp430-gcc/bin/msp430-elf-gdb: error while loading shared libraries:
libexpat.so.0: cannot open shared object file: No such file or directory
make: *** [debug] Error 127

```

Go to the directory where libexpat\*.so is installed (probably /usr/lib/i386-linux-gnu) and create a link with the name that msp430-elf-gdb expects:

```
sudo ln -s libexpatw.so.1 libexpat.so.0
```

### 4.2 Could Not Initialize MSP430 (TIUSB)

If GDB Agent exits with the following error message after msp430-elf-gdb tries to connect under Linux:

```

Could not initialize MSP430 (TIUSB)
MSP430 Error :Could not find MSP-FET430UIF on specified COM port
Looking for MSP430 devices:1 devices detected.
Device ttyACM0: status is Available
Failed to connect to target...exiting

```

The current user probably does not have the necessary privileges to access the UIF hardware. Try starting GDB Agent with root privileges:

```
sudo ./gdb_agent_console msp430.dat
```

### 4.3 GDB Time-out

To avoid time-out errors in GDB, use the command `set remotetimeout 120` to increase the default time-out (2 s) threshold for remote commands to complete. Time-outs are most common when connecting, particularly when connecting to an MSP430 device that requires a firmware upgrade of the debug probe.

## 5 References

1. *GDB: The GNU Project Debugger*, Free Software Foundation, Inc. (<https://sourceware.org/gdb/current/online/docs/>)
2. *Using the GNU Compiler Collection*, Richard M. Stallman (<http://gcc.gnu.org/onlinedocs/gcc.pdf>)

## Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from September 5, 2015 to March 25, 2016	Page
• Added example in <a href="#">Section 2.2</a> , <i>Building Manually With gcc</i> .....	2
• Moved <a href="#">Section 2.3.1</a> , <i>Using the GDB Agent</i> (was Section 4) .....	2
• Added "After starting the debugger and" to <a href="#">Section 2.3.1.4</a> , <i>Attaching the Debugger</i> .....	3
• In step (1) of <a href="#">Section 2.3.3.1</a> , <i>Running a Program in the Debugger</i> , added "go to the INSTALL_DIR\examples\[Selected example]" .....	4
• In step (4) of <a href="#">Section 2.3.3.2</a> , <i>Setting a Breakpoint</i> , added "at the entry to the specified function or stops at the specified line" .....	4
• Changed step (2) of <a href="#">Section 2.3.3.3</a> , <i>Single Stepping</i> .....	4
• In step (3) of <a href="#">Section 3</a> , <i>Creating a New Project</i> , added "Open the copied makefile and" .....	4
• Added code example in <a href="#">Section 3</a> , <i>Creating a New Project</i> .....	5

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