

## 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.

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## 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.

### 2.3 Debugging

#### 2.3.1 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.

##### 2.3.1.1 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.

##### 2.3.1.2 Using the Command Line

Open a command shell, change to **INSTALL\_DIR** and enter:

Linux:

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

Windows:

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

## 2.3.2 Debugging With GDB

### 2.3.2.1 Running a Program in the Debugger

1. In the command terminal, you can now enter the command `make debug`.
2. The GDB process is now started and waits for commands. This is indicated by the prompt `<gdb>`.
3. To connect GDB to the agent process, enter 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 downloaded program.
6. The LED on the target board should blink.

### 2.3.2.2 Setting a Breakpoint

1. Connect the GNU debugger to the GDB Agent and load a program to the device.
2. To set a breakpoint on a function, type: `break function`.
3. To set a breakpoint on a source line, type: `break filename:line`.
4. When you run the program, the program execution stops in the given function.

### 2.3.2.3 Single Stepping

1. Connect the GNU debugger to the GDB Agent and load a program to the device.
2. If you have set a breakpoint and the debugger stopped the program execution:
  - To execute the source line, type `next`.  
`next` does not step into functions, it executes them and stops after they have been executed.
  - 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`.

### 2.3.2.4 Stopping or Interrupting a Running Program

1. Connect the GNU debugger to the GDB Agent 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 example project's makefiles into your project directory.
3. 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.

## 4 Using the GDB Agent

### 4.1 Introduction

The GDB Agent is a tool to connect the GNU Debugger 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 debugger program.

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

### 4.2 Console Application

If you use the console application, invoke it from a console window 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 open the TCP/IP port on the local machine. This port number is displayed in the console. By default, this port number is 55000.

### 4.3 GUI Application

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

1. Click the <Configure> button and select the msp430.dat file. If successfully configured, an MSP430 device displayed in the <Targets> list. The TCP/IP port for the GDB server 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.

### 4.4 Attaching the Debugger

To attach to the GDB server, use the *target remote* [*<host ip address>*]:*<port>* command, where <port> is the TCP/IP port from above. If the GDB Agent runs locally, you can omit the host IP address.

### 4.5 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.

## 5 Troubleshooting

### 5.1 Missing libexpat

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
```

## 5.2 Could Not Initialize MSP430 (TIUSB)

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 has probably not the necessary privileges to access the UIF hardware. Try starting GDB Agent with root privileges:

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

## 5.3 GDB Timeout

To avoid timeout errors in GDB, use the command `set remotetimeout 120` to increase the default timeout threshold for remote commands to complete. Timeouts are most common when connecting, particularly when connecting to an MSP430 device that requires a firmware upgrade of the debug probe.

## 6 References

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

## Revision History

Changes from Original (August 2014) to A Revision	Page
• Added <a href="#">Section 4.5</a> .....	<a href="#">4</a>

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

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