Quick Start Guide
SLAU826–November 2019

MSP430 Replicator

This quick start guide explains how to set up the hardware and software of the Replicator for MSP430™ MCUs. After following the steps described in this document, you should be able to use the Replicator hardware as a stand-alone programmer for MSP430 devices (that is, you can use it without using a host PC and IDE software). Detailed information and suggestions on how to develop your own production programmer can be found in MSP430 Programming With the JTAG Interface or derived from the Replicator source code.

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1 Hardware Setup

NOTE: Before beginning to set up the Replicator for initial use, make sure that you have the following components available:

1. REP430F board
2. 9-V DC power supply
3. Flash Emulation Tool (MSP-FET430UIF or MSP-FET)
4. Target board (an MSP430 target socket board)
5. Code Composer Studio™ IDE or IAR Embedded Workbench® IDE installed on the host PC

To program other MSP430 devices with the Replicator, the host MCU on the REP430F target board itself has to be programmed first. Follow these steps to properly set up the Replicator hardware for programing the host firmware (also see Figure 1):

1. Power the REP430F board by connecting the 9-V DC power supply to the black DC socket using a standard 2.1-mm DC plug or to the blue DC connector using bare wires. The yellow LED labeled "+3V" should illuminate.
2. Connect the MSP430 Flash Emulation Tool (for example, MSP-FET430UIF) to the host PC.
3. Connect the Flash Emulation Tool to the JTAG connector on the REP430F board, labeled "HOST" using the provided 14-wire JTAG cable.

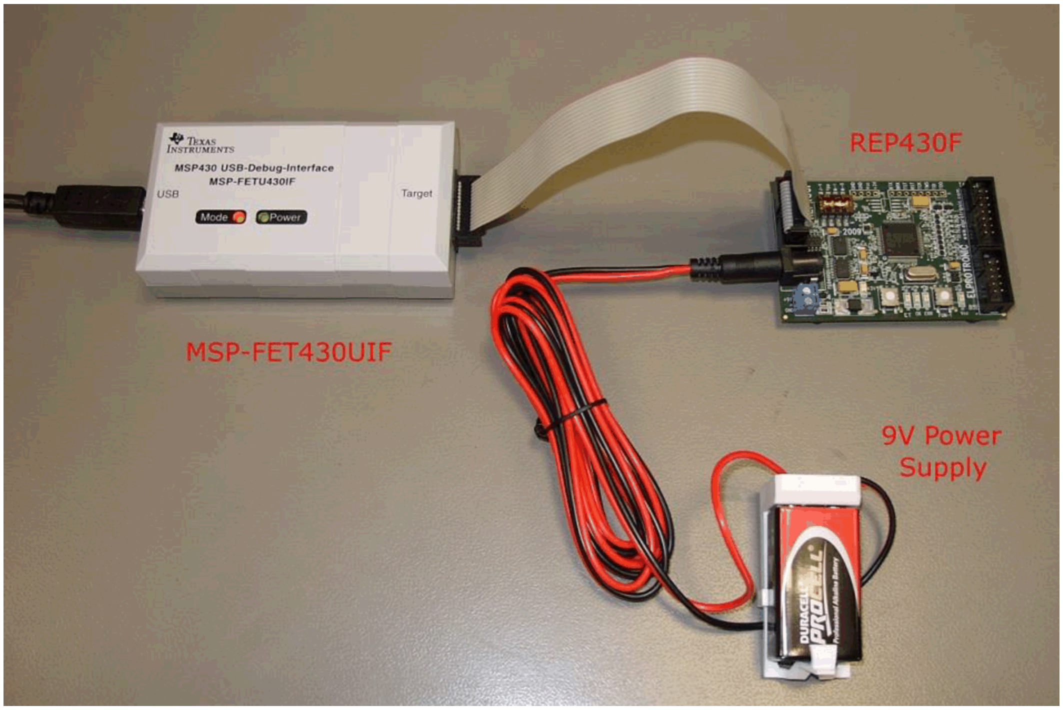

Figure 1. Hardware Setup for the MSP430 Replicator

2 Project Setup

The source code for the host controller firmware is included in the slau320.zip package. Project files are available for Code Composer Studio IDE (CCS) and IAR Embedded Workbench IDE (EW430).

Using CCS, you can import the Replicator projects to your CCS workspace using **Project** > **Import Existing CCS/CCE Eclipse Project** from this directory:

`<slau320>/CCS`

The path of the Replicator workspaces for EW430 is:

`<slau320>/IAR`

NOTE: The CCS and IAR projects use the same source code files, which are located in these directories:

`<slau320>\Replicator430`

`<slau320>\Replicator430X`

`<slau320>\Replicator430Xv2`

`<slau320>\Replicator430FR`

The Replicator software consists of four different projects:

Replicator430 for programming devices with the MSP430 architecture such as:

- Devices from the F1xx family (support for 4-wire JTAG)
- Older devices from the F2xx family (support for 4-wire JTAG and 2-wire Spy-Bi-Wire)
- Older devices from the F4xx family (support for 4-wire JTAG)

Replicator430X for programming devices with the MSP430X extended architecture such as:

- Newer devices from the F2xx family (support for 4-wire JTAG)
- Newer devices from the F4xx family (support for 4-wire JTAG)

Replicator430Xv2 for programming devices with the MSP430Xv2 extended architecture such as:

- Devices from the F5xx family (support for 4-wire JTAG and 2-wire Spy-Bi-Wire)
- Devices from the F6xx family (support for 4-wire JTAG and 2-wire Spy-Bi-Wire)

Replicator430FR for programming devices with FRAM memory:

- FRAM devices (support for 4-wire JTAG and 2-wire Spy-Bi-Wire)

1. Choose the project that corresponds to the architecture of your target device. If you are not sure which one to choose, refer to the *JTAG Features Across Device Families* section in MSP430 Programming With the JTAG Interface.
2. After you have chosen the correct Replicator project according to the architecture of the MSP430 target device, there are a few device-specific changes to the source code that must be done before programming the host MSP430 MCU on the Replicator board. To make these changes, open the appropriate configuration file in your IDE project browser:

   Config430.h, Config430X.h, Config430Xv2.h, or Config430FR.h

   This configuration file includes all high-level functionality for user interaction, including options that must be configured for an initial setup of the Replicator project. Figure 2 shows the "Quick Start Options" section in the configuration file.

```
/****************************************************************************/
/* QUICK START OPTIONS */
/****************************************************************************/
//! Select the interface to be used to communicate with the device
//! Options: JTAG_IF | SPYBIWIRE_IF | SPYBIWIREJTAG_IF
//! Select ONLY ONE interface below, comment-out remaining options
//#define INTERFACE JTAG_IF //MCU has 4 wire JTAG ONLY
//#define INTERFACE SPYBIWIRE_IF //2 wire Spy-Bi-Wire
#define INTERFACE SPYBIWIREJTAG_IF //4 wire JTAG in MCU with Spy-Bi-Wire
//! Set the target's Vcc level supplied by REP430F
//! data = 10*Vcc - range 2.1V to 3.6V or 0 (Vcc-OFF)
#define VCC_LEVEL 30
//! Set start address of the main memory
#define MAIN_START_ADDRESS 0xF000
//! Set length of main memory
//! Note that the memory length is counted in 16-bit WORDS!
#define MAIN_LENGTH 0x800
//! Set the start address of the device RAM
#define RAM_START_ADDRESS 0x1C00
/****************************************************************************/
```

Figure 2. Quick Start Options Section in the Replicator Configuration File

3. Change, activate, or deactivate these options according to the characteristics of the device by adding or removing comments of the respective #defines or by specifying different values. Table 1 lists the options and their possible parameters along with an explanation. If you are not sure which options apply to your device, refer to the device-specific data sheet or to MSP430 Programming With the JTAG Interface.

Table 1. Quick Start Options

Option	Values	Explanation
INTERFACE	SPYBIWIREJTAG_IF	Choose this for 4-wire JTAG communication with a device that also supports 2-wire Spy-Bi-Wire communication. (F2xx, F4xx with SBW, F5xx, F6xx, FRAM devices)
	JTAG_IF	Choose this if your device supports 4-wire JTAG interface only. (F1xx, old F4xx)
	SPYBIWIRE_IF	Choose this for 2-wire Spy-Bi-Wire communication. (F2xx, F4xx with SBW, F5xx, F6xx, FRAM devices)
VCC_LEVEL	30 (default)	Specifies the voltage level for the target supplied by the Replicator board. The desired voltage value must be multiplied by 10 (for example, 3.0 V = 30).
MAIN_START_ADDRESS (Replicator430Xv2 and Replicator430FR only)	0xF000	Specifies the start address of the main memory of the device. (0xF000 is correct for most MSP430 devices.)
MAIN_LENGTH (Replicator430Xv2 and Replicator430FR only)	0x800	Specifies the length of the main memory of the device. This value is in 16-bit words instead of bytes. Look up this value in the device-specific data sheet.
RAM_START_ADDRESS (Replicator430Xv2 and Replicator430FR only)	0x1C00	Specifies the start address of the RAM of the device. Certain MSP430 devices might have different RAM locations. Look up this value in the device data sheet.

4. Now that your Replicator project is properly configured, the Replicator firmware can be programmed into the host controller on the REP430F board. To program the board, open a debug session in your IDE.
5. After the IDE has finished loading the Replicator firmware, close the debug session and disconnect the Flash Emulation Tool from the REP430F board.

3 Start Programming

The Replicator hardware now functions as a stand-alone programmer for MSP430 devices that match the selected parameters (for example, JTAG or SBW interface and memory locations). The default target code is a simple program that toggles pin P1.0. For MSP430 target socket boards, this causes LED1 to blink.

The binary code is initially programmed into the host controller flash memory with the firmware. To load it into a target device, follow these steps:

1. Connect the target board to the JTAG connector on the REP430F board labeled "TARGET" using a 14-wire JTAG cable.
2. If a certain interface can be selected on the target board (for example, by using a set of jumpers for JTAG or SBW on MSP430 target socket boards), make sure that the settings on the target board match the interface specified in the Replicator configuration file.
3. Press the button labeled "S2" on the REP430F board to start the code download to the target device. When download is finished, the green LED labeled "OK" illuminates. If an LED is connected to P1.0 on the target board, it should start to blink.

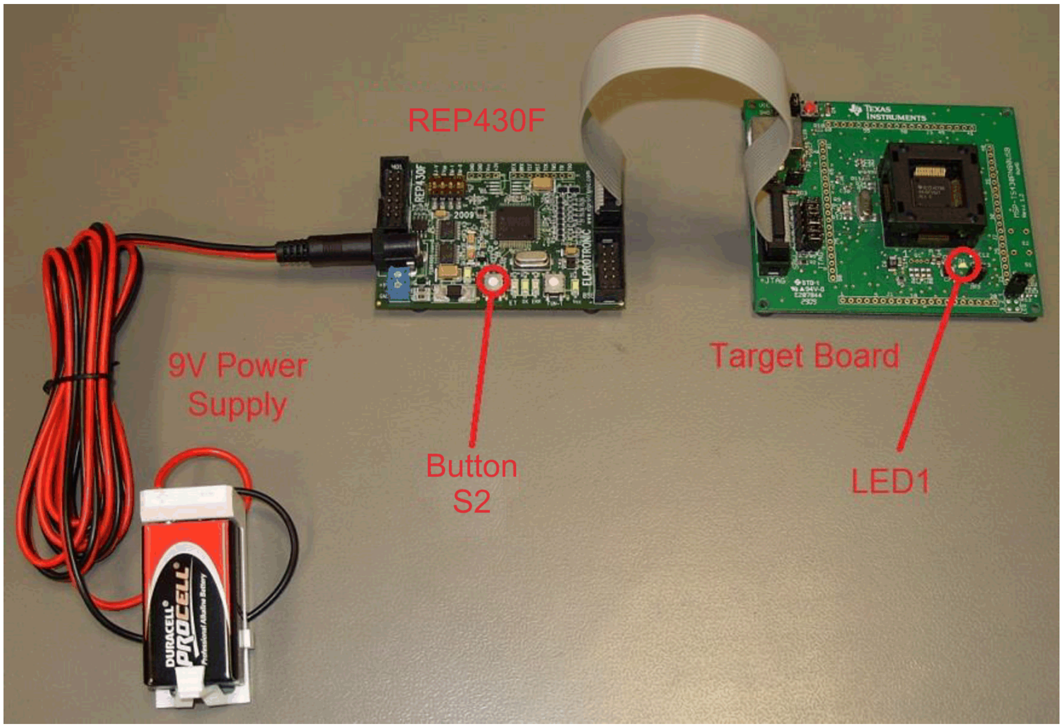

Figure 3. Using the REP430F as a Stand-Alone Programmer

4 Include Your Own Target Code

To use the Replicator to program MSP430 devices with your own target code, follow these steps to convert your code into a format which is accepted by the Replicator source code.

1. Create a binary output file in TI-txt format for your project. In CCS, select the following option from the project settings:

   Project properties > **Build** > **Build Steps** > **Post-Build-Steps** > **Apply predefined step** > **"Create flash image: TI-txt"**

   Using EW430 you can generate a TI-txt output file by specifying this option:

   Project options > **Linker** > **Output** > **Format** > **Other** > **Output Format: "msp430-txt"**

   This will generate a ".d43" file which you will have to change to ".txt".
2. Build your project and copy the generated binary files in TI-txt format in this directory:

   ```
   <slau320>\Targetcode\SRecord
   ```
3. Download the open source conversion tool SRecord from http://sourceforge.net/projects/srecord/files/ and place the included executables **srec_cat.exe** and **srec_info.exe** in **\Targetcode\SRecord** as well.
4. Run **srec.bat** from the command line and provide the file name (without the extension) as a parameter to start the conversion.

   ```
   >> srec.bat my_file
   ```
5. SRecord now converts your TI-txt file to several other formats. Choose either the ".h", ".asm" or the ".s43" file to include it in the Replicator project instead of the default blinking LED target code.

   When repeating the steps described in Section 3, the Replicator stand-alone programmer will now load your target code into the memory of MSP430 devices.

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