

LaunchPad-Based MSP430 UART BSL Interface

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ABSTRACT

This application report describes the implementation of the low cost, LaunchPad™-based MSP430 UART bootstrap loader (BSL) interface. The goal of the implementation is to deploy the MSP430 Value Line devices that have less than two serial interface modules as the bridge between the BSL Scripser software tool and the MSP430 target device.

Project collateral and source code associated with this application report can be downloaded from the following URL: <http://www.ti.com/lit/zip/slaa535>.

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1 Introduction

1.1 MSP430 Bootstrap Loader (BSL)

The MSP430 BSL is a program that is built into the MSP430 devices for reading and modifying the MSP430 memory content, which can be used for firmware update purposes. Most MSP430 devices are delivered with UART BSL accessibility through the UART interface. The exception is for MSP430 devices with USB interface that have built-in USB BSL. More detailed information regarding the MSP430 BSL can be found in the following wiki: [BSL \(MSP430\)](#).

1.1.1 UART BSL

The UART BSL can be invoked by applying a specific BSL entry sequence signaling at RST and TEST (for devices with shared JTAG pins) and TCK (for device with dedicated JTAG pins). The BSL entry sequence is different between MSP430 devices that have shared JTAG pins and the ones with dedicated JTAG pins. The differences of the BSL entry sequences for both device types can be seen in [Figure 1](#) and [Figure 2](#).

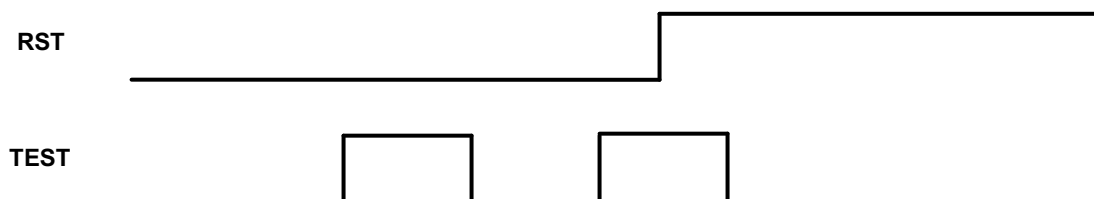


Figure 1. BSL Entry Sequence for Devices With Shared JTAG Pins

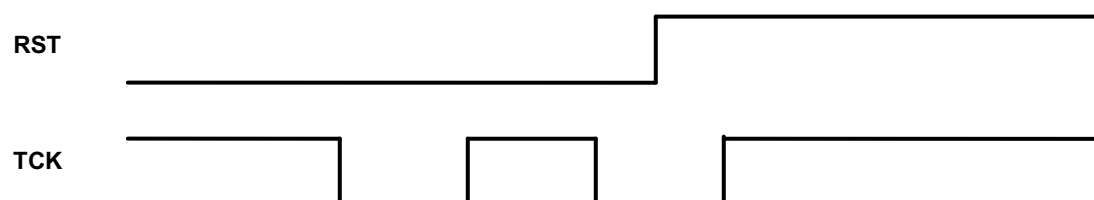


Figure 2. BSL Entry Sequence for Devices With Dedicated JTAG Pins

The protocol data frame of the UART BSL is basically different between the ROM-based BSL and the Flash-based BSL. The ROM-based BSL is available on the 1xx, 2xx, and 4xx devices, while the Flash-based BSL can be found in the 5xx and 6xx devices. For more information regarding the BSL protocol on both BSL types, see the *MSP430 Programming Via the Bootstrap Loader User's Guide* ([SLAU319](#)).

1.2 Universal Asynchronous Receiver/Transmitter (UART)

The universal asynchronous receiver/transmitter (UART) is a standard for serial communication, which is commonly deployed in embedded systems. Because the data is transferred serially and asynchronously (without any clock signal), both the transmitter and receiver sides have to use the same setting for data transfer speed (usually defined as baud rate), number of data bits, and usage of parity bit. The basic UART frame is shown in [Figure 3](#).

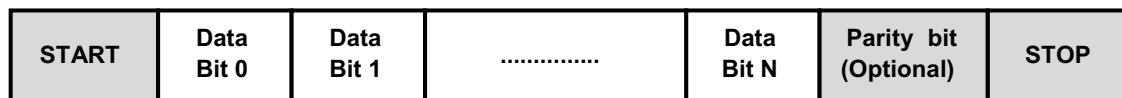


Figure 3. UART Frame

Per default, the UART line is idle at logical "HIGH" level. The START bit signal is basically marked as a transition of first logical change from "HIGH" level to "LOW" level. After the START bit, the data bits are transferred. In most systems, the data is sent in little endian format (LSB first), and the data bits can usually be adjusted as 7 or 8 data bits. Before the STOP bit, an optional parity bit can be sent, if necessary, for frame checking. Finally, the STOP bit signal marks the end of a UART frame by a transition from logical "LOW" level to "HIGH" level.

1.3 MSP-EXP430G2 Launchpad Experimenter Kit

The MSP-EXP430G2 development kit, commonly known as Launchpad, is a low-cost experimenter kit for the MSP430G2xxx Value Line devices. The experimenter kit has an on-board emulator with USB interface that can also be used as a UART (COM PORT) interface with 9600 baud rate. More detailed information regarding the Launchpad experimenter kit can be found in the following wiki: [MSP430 LaunchPad \(MSP-EXP430G2\)](#).

2 Implementation

This application report uses the MSP430G2231 on the MSP-EXP430G2 Launchpad board and the MSP430F5438A Rev E, which has the SYS10 bug (time between pulses of TEST and TCK pin should be less than 15 μ s) as the target MSP430 device on the MSP-TS430PZ5x100 development kit. [Figure 4](#) shows the test setup between the Launchpad and the MSP-TS430PZ5x100 board.

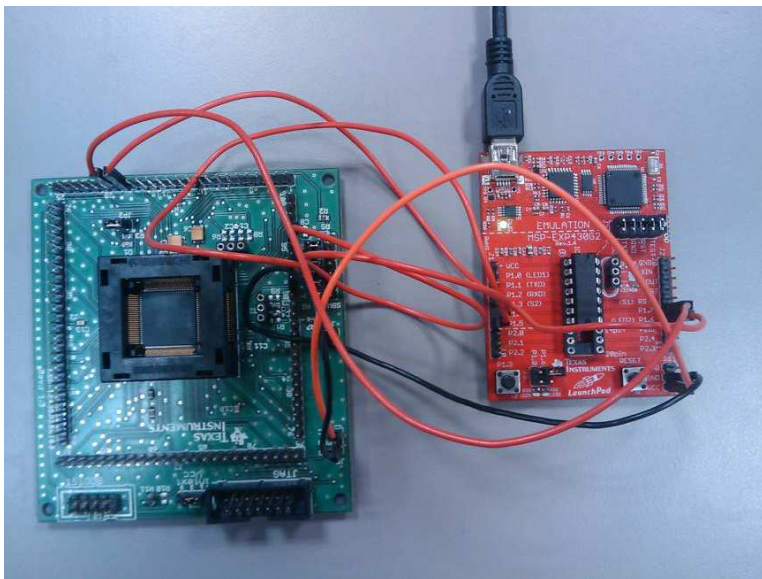


Figure 4. Test Setup of Launchpad UART BSL Interface

2.1 Hardware Implementation

2.1.1 Hardware Connection

[Figure 5](#) shows the basic hardware connection between the PC running the BSL Scriptor, the MSP-EXP430G2 Launchpad and the MSP430 target device; in this case, the MSP430F5438A on the MSP-TS430PZ5x100.

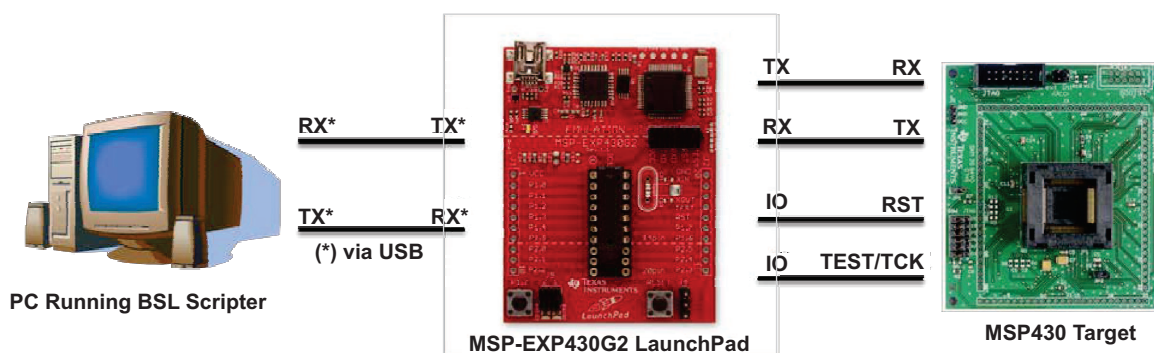


Figure 5. Basic Hardware Connection of Launchpad-Based BSL Interface

2.1.2 Pin Assignment

This implementation requires all pins of the MSP430G2231's Port 1 (P1). Besides the six pins shown in [Figure 5](#), there are two other pins on the Launchpad that are required for the BSL interface implementation. One pin is used to determine the MSP430 device target type whether it is a device with shared JTAG pins or a device with dedicated JTAG pins. The other pin that is connected to the on-board push-button switch is used as input to generate the BSL entry sequence. The BSL Scriptor originally used DTR and RTS pins to generate the BSL entry sequence on the MSP430 target device. However, these pins are not available on the UART connection of the MSP-EXP430G2 Launchpad experimenter kit, so it is necessary to use an alternative input to make the MSP430G2231 on the Launchpad generating the BSL entry sequence to the MSP430 target device. [Table 1](#) shows a list of the MSP430G2231 general-purpose input/output (GPIO) pin assignments:

Table 1. MSP430G2231 Pin Assignments

GPIO Pin	Description
P1.0	Input pin for BSL entry sequence type. High input means shared JTAGs pin target device, Low input means dedicated JTAG pins target device.
P1.1	UART transmit pin to PC (connected to PC's UART RX pin)
P1.2	UART receive pin from PC (connected to PC's UART TX pin)
P1.3	Push button input to generate BSL entry sequence.
P1.4	RST pin connection to MSP430 target for generating BSL entry sequence
P1.5	TEST and TCK pin connection to MSP430 target for generating BSL entry sequence
P1.6	UART receive pin from MSP430 target (connected to MSP430 target BSL TX pin)
P1.7	UART transmit pin to MSP430 target (connected to MSP430 target BSL RX pin)

2.2 Software

2.2.1 Bridging Technique

As described in the abstract of this document, the goal of this application report is to implement the BSL interface that bridges the UART interface of the PC, running the BSL Scriptor software tool and the MSP430 target device, with the MSP430 devices that have less than two serial interfaces.

Therefore, this implementation does not use the store and forward mechanism, where the MSP430 on the Launchpad receives byte by byte then forwards it to the opposite side. Instead it uses the GPIO interrupt mechanism where the RX pins are set as input with interrupt to control the corresponding TX pins that are set as output according to the input pin logical state.

In order to understand this mechanism clearly, see [Section 2.2.2](#), which shows the software implementation flowchart.

2.2.2 Flowchart

The software implementation of the Launchpad BSL interface is illustrated in [Figure 6](#).

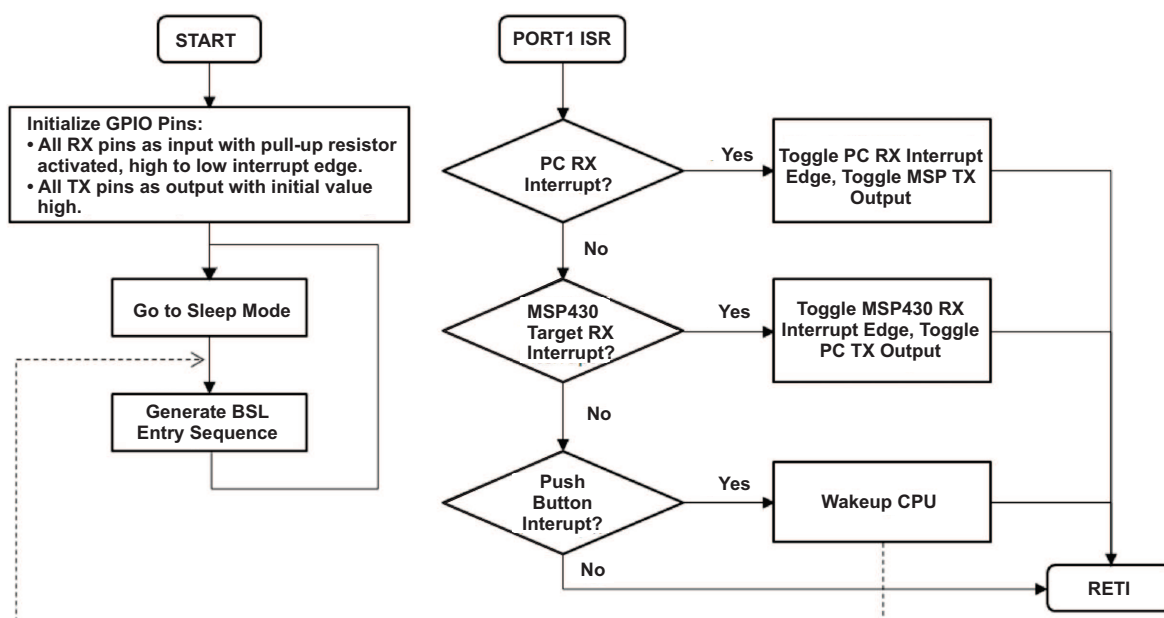


Figure 6. Software Implementation Flowchart of Launchpad BSL Interface

2.3 Using the Launchpad BSL Interface

There are few things to be considered when using the Launchpad BSL interface:

- For proper operation, the J5 jumpers connecting the P1.0 and P1.6 to the on-board LEDs need to be removed.
- Per default the BSL Scripter tool uses DTR and RTS lines to generate BSL entry sequence. These lines are not available on the MSP-EXP430G2 UART connection, so it is necessary to push the S2 switch before running the BSL Scripter software to generate the BSL entry sequence.
- The UART connection of MSP-EXP430G2 only works with 9600 baud. Therefore, it is not possible to run the BSL Scripter with different baud rates other than the 9600 baud.

3 References

- BSL (MSP430) wiki: [BSL \(MSP430\) wiki](#)
- *MSP430 Programming Via the Bootstrap Loader User's Guide* ([SLAU319](#))
- *MSP430x5xx/MSP430x6xx Family User's Guide* ([SLAU208](#))

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