Developer's Guide
SLAU656B–October 2015–Revised June 2016

MSPDebugStack

The MSPDebugStack is a dynamic library that provides functions for controlling and debugging TI MSP430™ ultra-low-power microcontrollers during the software development phase. The MSPDebugStack controls the MSP430 microcontroller through the JTAG interface. The MSPDebugStack provides device control (for example, run and stop), memory programming, and debugging functionality (for example, breakpoints).

The MSPDebugStack supports the standard 4-wire JTAG and the low-pin-count debug interface called Spy-Bi-Wire (2-wire JTAG). All MSP430 debuggers can be used with the MSPDebugStack.

The MSPDebugStack simplifies control of the MSP430 microcontroller by isolating the user from the complexities of the JTAG protocol.

This document provides an overview of the MSPDebugStack and how to use it to control MSP430 microcontrollers. Additional information is provided in the C header files that are installed with the library. Several sample programs and flow charts show the practical use of the MSPDebugStack.

NOTE: This document assumes knowledge of C/C++, the dynamic link library mechanism, the MSP430 MCUs, and the MSP430 JTAG mechanism.

NOTE: Refer to the *MSP430 Hardware Tools User's Guide* for information on hardware connection to the JTAG pins of the MCUs. Refer to *MSP430 Programming With the JTAG Interface* for details on the MSP430-specific JTAG implementation in silicon.

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1 Abbreviations

- **MSP-FET430UIF**: The TI MSP430 USB Debugging Interface (USB FET)
- **MSP-FET**: The TI MSP MCU Programmer and Debugger
- **MSP-EXP430F5529LP**: The TI MSP430F5529 USB LaunchPad™ Evaluation Kit (includes an eZ-FET lite debugger)
- **eZ430-RF2500**: The TI MSP430 Wireless Development Tool (includes an eZ430™ debugger)
- **SBW**: The Spy-Bi-Wire JTAG debug interface, which is used on low-pin-count MSP430 MCUs.
- **CDC**: Communication Device Class
- **MSPDebugStack**: Official name of the software stack
- **MSPDS**: MSPDebugStack
- **USB-FET**: Synonym for different debuggers including MSP-FET430UIF, MSP-FET, eZ-FET, and eZ-FET lite

2 Developer's Package Folder and File Structure

The MSPDebugStack developer package is composed of the following folders and files. Installing the developer package creates the following folders and files in the selected installation destination directory.

- **ApplicationExamples**: This folder contains a set of application examples on how to apply the MSPDebugStack functionality. See Section 6 for specific details on each code example.
- **Doc**: This folder contains the complete API documentation of the MSPDebugStack in HTML and compressed HTML formats. This developer's guide is also in the Doc folder.
- **Driver**: This folder contains driver setup and files:
  - **CDC**: TI's CDC driver (DLL V3 only). Supports the MSP-FET430UIF, MSP-FET, and eZ-FET JTAG interfaces.
  - **VCP**: Deprecated. TI's VCP driver (DLL V2 only). Supports the MSP-FET430UIF JTAG interfaces.
  - **INF**: MS-Windows driver information file for the MSP430 Application UART that is available with the eZ430-RF2500 (eZ430 debuggers) emulator dongles (see Section 5 for details). Also see the *eZ430-RF2500 Development User's Guide* for more information. This folder also contains the PreinstallCDC folder, which contains example source code that shows how to install the driver INF file on a MS-Windows PC.
- **Inc**: This folder contains all of the C header files that are needed to use the MSPDebugStack in an application. These header files document all API functions, function prototypes, function parameters and function return values. The header files also include all required typedefs, #defines, enumerations, and data.
  - **MSP430.h**: This file is the main header file for the MSPDebugStack, and it provides the function prototypes, typedefs, #defines, enumerations, and data structures for the functions of the library. MSP430.h is normally located in the same directory as the application source file, and it should be #included by the application source file. MSP430.h is used during compile-time (see Section 3.1).
  - **MSP430_Debug.h**: This file is a header file for the MSPDebugStack, and it provides the function prototypes, typedefs, #defines, enumerations, and data structures for the debugging functions of the library. MSP430_Debug.h is normally located in the same directory as the application source file, and should be #included by the application source file. This file is used during compile-time (see Section 3.6).
  - **MSP430_EEM.h**: This file is a header file for the MSPDebugStack, and provides the function prototypes, typedefs, #defines, enumerations, and data structures for the **enhanced** debugging functions of the library. MSP430_EEM.h is normally located in the same directory as the application source file, and should be #included by the application source file. This file is used during compile-time (see Section 3.7).
  - **MSP430_FET.h**: This file is a header file for the MSPDebugStack, and provides the function prototypes, typedefs, #defines, enumerations, and data structures for MSP-FET430UIF maintenance functions of the library. MSP430_FET.h is normally located in the same directory as the application source file, and should be #included by the application source file. This file is used during compile-time (see Section 4).

- **Lib**: This folder contains library files.
  - **MSP430.lib**: This file is the library file for the MSPDebugStack and is required to access functions of the library. MSP430.lib is normally located in the same directory as the application source file and should be added to the Linker Object/Library Modules list of the application. This file is used during link-time.
- **MSP430.dll**: This file is the dynamic link library and contains the device control functions. This file is normally located in the same directory as the application's executable file, or in your computer system's default DLL folder. This file is used during run-time.
- **libmsp430.so**: This file is the dynamic library for Linux 32 bit and contains the device control functions. This file is normally located in the same directory as your application's executable file, or in your computer system's default library search path. This file is used during run-time.
- **libmsp430_64.so**: This file is the dynamic library for Linux 64 bit and contains the device control functions. This file is normally located in the same directory as your application's executable file, or in your computer system's default library search path. This file is used during run-time.
- **libmsp430.dylib**: This file is the dynamic library for Mac OS X and contains the device control functions. This file is normally located in the same directory as your application's executable file, or in your computer system's default library search path. This file is used during run-time.
- **revisions.txt**: This file provides information about added features of dedicated versions of the MSPDebugStack.
- **Objects**
  - **Libusb**: This folder contains the source files of the libusb version that is used for the Linux binary of the MSPDebugSyack.
  - **Linux32**: This folder contains static libraries for Linux 32 bit for recompiling the MSPDebugStack with a custom libusb.
  - **Linux64**: This folder contains static libraries for Linux 64 bit for recompiling the MSPDebugStack with a custom libusb.
  - **Makefile**: This is the Makefile for recompiling the MSPDebugStack with a custom libusb.
  - **README.txt**: This text file contains instructions on how to recompile the MSPDebugStack with a custom libusb.

3 Using the MSPDebugStack

3.1 General Application and Device Handling

The functions of the library are sequenced as follows:

1. Initialize the interface: MSP430_Initialize()
2. Choose the target architecture (MSP430 or MSP432): MSP430_SetTargetArchitecture()
3. Set the device VCC: MSP430_GetExtVoltage(), MSP430_VCC(), MSP430_GetCurVCCT()
4. Configure the JTAG protocol (Spy-Bi-Wire 2-Wire JTAG, 4-wire JTAG) is optional. By default the protocol is selected automatically: MSP430_Configure()
5. Connect and identify target device: MSP430_OpenDevice()
6. Return the identified device: MSP430_GetFoundDevice()
7. Manipulate the device memory:
   - Execute erase operation: MSP430_Erase()
   - Read or write device memory: MSP430_Memory(), MSP430_ReadOutFile(), MSP430_ProgramFile()
   - Execute verify operation: MSP430_VerifyFile(), MSP430_VerifyMem(), MSP430_EraseCheck()
8. Manipulate device functionality:
   - Secure device (disable JTAG access): MSP430_Secure()
   - Execute device reset: MSP430_Reset()
   - Start device code execution: MSP430_Run()

- Stop device code execution: MSP430_State()

9. Close device connection and CDC port: MSP430_Close()
10. Handle errors: MSP430_Error_Number(), MSP430_Error_String()

Figure 1 shows the start-up flow of an MSP430 debug session using the MSPDebugStack.

Figure 2 shows the example flow for starting a debug session including all needed error handling executed by the MSP430_Error_Number() and MSP430_Error_String() functions. The MSP430_DLL.chm help file offers detailed information on all library functions, their parameters, and return values.

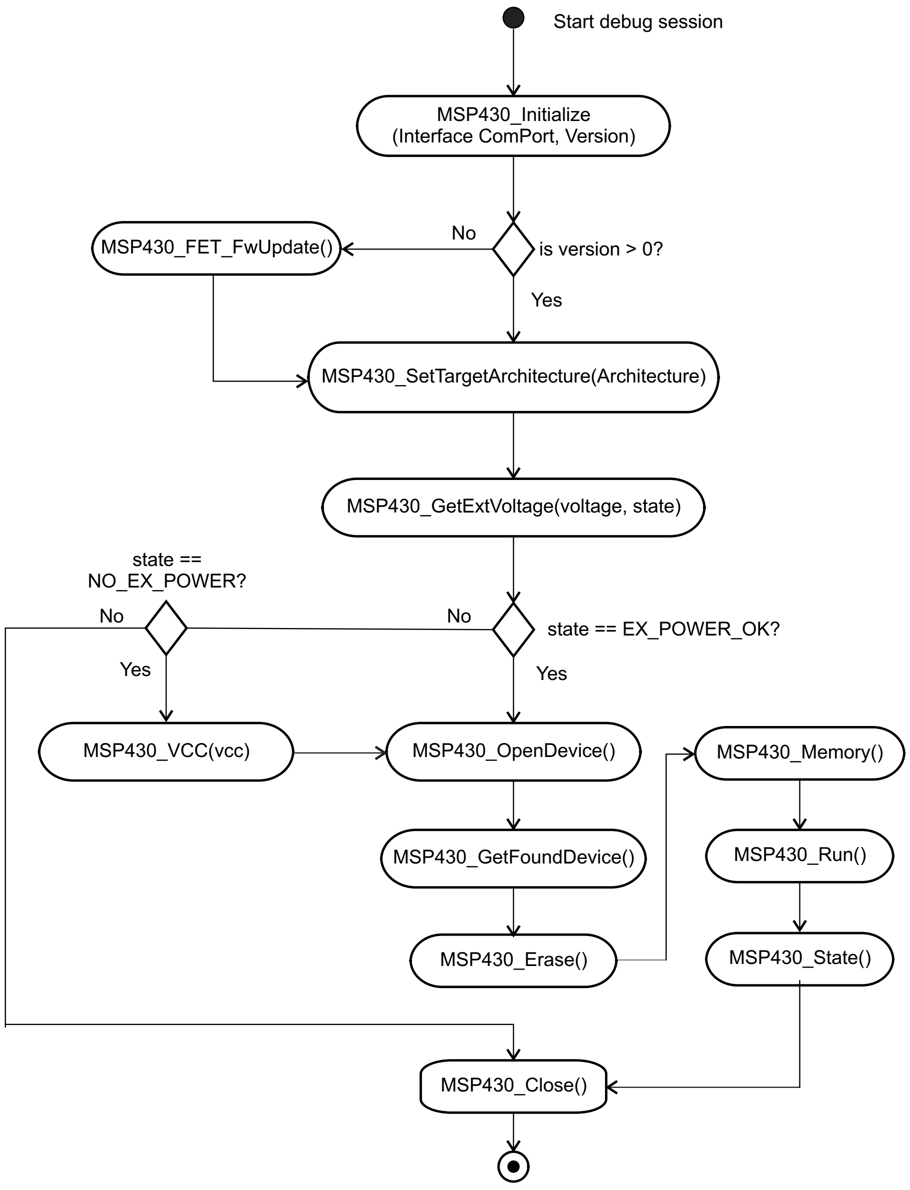


Figure 1. Recommended Flow to Start an MSP430 Debug Session

```
#include "stdio.h"
#include "MSP430_FET.h"
#include "MSP430_Debug.h"
#include "MSP430.h"

int32_t lVersion;          // MSPDebugStack version
long verify = 0;  // verify the filetransfer?
int32_t passwordLen = 8;
char password[] = “0x34127856”; // password is sent to device in following order: 0x12 0x34 0x56 0x78

// init JTAG interface – TIUSB will use first connected debugger
printf("MSP430_Initialize()\n");
if(MSP430_Initialize("TIUSB", &lVersion) == STATUS_ERROR)
{
   printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));      // print error string
   MSP430_Close(1);  // close the debug session
}

// Set target architecture
if (MSP430_SetTargetArchitecture(MSP430) == STATUS_ERROR)
{
         printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));          // print error string
         MSP430_Close(1);  // close the debug session and turn VCC off
}

// Check firmware compatibility
if(lVersion < 0)           // firmware outdated?
{
   // perform firmware update
   printf("MSP430_FET_FwUpdate()\n");
   if(MSP430_FET_FwUpdate(NULL, NULL, NULL) == STATUS_ERROR)
   {
         printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));          // print error string
         MSP430_Close(1);  // close the debug session and turn VCC off
   }
}
// power up the target device
printf("MSP430_VCC()\n");
if(MSP430_VCC(3000) == STATUS_ERROR)      // target VCC in millivolts
{
   printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));      // print error string
   MSP430_Close(1);  // close the debug session and turn VCC off
}
// configure interface - this is optional! automatic interface selection is the default
printf("MSP430_Configure()\n");
if(MSP430_Configure(INTERFACE_MODE, AUTOMATIC_IF) == STATUS_ERROR)
{
   printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));      // print error string
   MSP430_Close(1);  // close the debug session and turn VCC off
}
// open the device
printf("MSP430_OpenDevice()\n");
// If the device is password protected, use MSP430_OpenDevice with appropriate password
if(passwordLen > 0)
{
   if(MSP430_OpenDevice("DEVICE_UNKNOWN",password,passwordLen,0,DEVICE_UNKNOWN) == STATUS_ERROR)
   {
         printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));          // print error string
         MSP430_Close(1);  // close the debug session and turn VCC off
   }
}
else
{
   if(MSP430_OpenDevice("DEVICE_UNKNOWN","",0,0,DEVICE_UNKNOWN) == STATUS_ERROR)
   {
         printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));          // print error string
         MSP430_Close(1);  // close the debug session and turn VCC off
   }
}
// program .txt file into device memory (optional)
printf("MSP430_ProgramFile()\n");
if(MSP430_ProgramFile("C:\file.txt", ERASE_ALL, verify) == STATUS_ERROR)
{
   printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));      // print error string
   MSP430_Close(1);  // close the debug session and turn VCC off
}
/**************************** debug session is started ****************************/
```

Figure 2. Code Example to Start a Debug Session

3.2 Attach to a Running Device

The MSPDebugStack can connect to a running MSP430 target device without stopping or changing the target program execution. This feature can be used for debugging an application that is already running on the target device. During this special start-up sequence, only the JTAG interface must be initialized. No reset of the target device is performed, because a reset could change the application context of the target device. The running application could contain various information of interest for the debug session (for example, error states of long run-time errors such as a stack overflow).

Establishing the physical JTAG connection to the target device is not trivial, especially when the RST signal of the target processor is connected to the JTAG header. A successful connection is subject to stable signals on the JTAG connector (a bouncing signal on the RST pin will perform a reset of the connected microcontroller).

NOTE: Attach to running target is only available with external power supply. Using the internal power supply that is generated by the USB-FET would reset the device during V_{CC} supply start-up sequence.

Figure 3 shows the flow with the highest probability for successfully attaching to a running target. Figure 4 shows a code example that follows this flow.

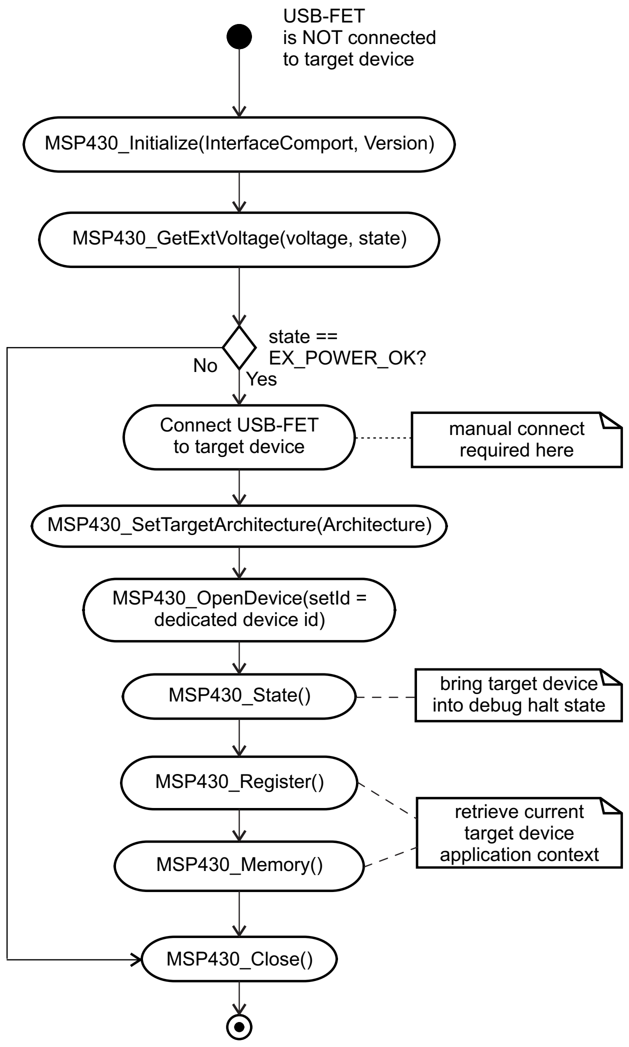

USB-FET is NOT connected to target device
MSP430_Initialize(InterfaceComport, Version)
MSP430_GetExtVoltage(voltage, state)
state == EX_POWER_OK?
No
Yes
Connect USB-FET to target device
manual connect required here
MSP430_SetTargetArchitecture(Architecture)
MSP430_OpenDevice(setId = dedicated device id)
MSP430_State()
bring target device into debug halt state
MSP430_Register()
MSP430_Memory()
retrieve current target device application context
MSP430_Close()

Figure 3. Attach to Running Target

```
int32_t lVersion, state, pCpuCycles;
DEVICE_T TargetDevice;
// get device information - determine device id
printf("MSP430_GetFoundDevice()\n");
if(MSP430_GetFoundDevice((char*)&TargetDevice, sizeof(TargetDevice.buffer)) == STATUS_ERROR)
{
   printf("%s\n", MSP430_Error_String(MSP430_Error_Number()));
   MSP430_Close(1);
}

// release the target from JTAG control
printf("MSP430_Run(FREE_RUN, release from JTAG)\n");
if(MSP430_Run(FREE_RUN, TRUE) == STATUS_ERROR)
{
   printf("%s\n", MSP430_Error_String(MSP430_Error_Number()));
   MSP430_Close(1);
}

printf("MSP430_Close(VccOff = false)\n");  // close the interface connection
if(MSP430_Close(FALSE) == STATUS_ERROR) // do NOT turn off Vcc power supply
{
   printf("%s\n", MSP430_Error_String(MSP430_Error_Number()));
   MSP430_Close(1);
}

Sleep(100);       // wait a few milliseconds
// initialize the interface again
printf("MSP430_Initialize()\n");
if(MSP430_Initialize("TIUSB", &lVersion) == STATUS_ERROR)
{
   printf("%s\n", MSP430_Error_String(MSP430_Error_Number()));
   MSP430_Close(1);
}

// Set target architecture
if (MSP430_SetTargetArchitecture(MSP430) == STATUS_ERROR)
{
            printf("Error: %s\n", MSP430_Error_String(MSP430_Error_Number()));              // print error string
            MSP430_Close(1);  // close the debug session
}

// attach to the running target with correct device string and/or device id
printf("MSP430_OpenDevice(DeviceNameString,…,…, TargetDevice.id)\n”);
if(MSP430_OpenDevice((char*)TargetDevice.string,””, 0, 0, TargetDevice.id) == STATUS_ERROR)
{
   printf("%s\n", MSP430_Error_String(MSP430_Error_Number()));
   MSP430_Close(1);
}

// check CPU state - state should be "RUNNING"
printf("MSP430_State(...,stop = FALSE,...) -> check CPU state\n");
if(MSP430_State(&state, FALSE, &pCpuCycles) == STATUS_ERROR)
{
   printf("%s\n", MSP430_Error_String(MSP430_Error_Number()));
   MSP430_Close(1);
}
```

NOTE: Open a debug session before using this code (see Figure 2).

Figure 4. Code Example for Attach to Running Target

3.3 Supporting Multiple USB-FET Debuggers

The MSPDebugStack can support multiple USB-FET debuggers connected to the computer. For this purpose, two MSP430 USB-FET support functions are available inside the MSP430.h file:

- MSP430_GetNumberOfUsbIfs()
- MSP430_GetNameOfUsbIf()

Before calling MSP430_Initialize() (to open the COM port where the USB-FET is attached) the two functions above must be executed in the correct order.

- MSP430_GetNumberOfUsbIfs()
  - First find how many USB-FETs are connected to the PC system
- MSP430_GetNameOfUsbIf()
  - Get the name (for example, COM5, or COM19) and status of the CDC COM port that is assigned to a certain USB-FET debugger.

After all information about how many and which CDC ports are available on the PC system has been retrieved, a dedicated USB-FET tool can be employed directly by passing the CDC port name to MSP430_Initialize() function [for example, MSP430_Initialize("COM5",…)].

Figure 5 shows the typical flow, which is executed to retrieve all needed information about connected USB-FET tools/debuggers.

Figure 6 shows example code for initializing multiple USB-FET debuggers one by one.

Also see Section 6.4 for information on the MultipleUifs example project, which is an application implementation proposal.

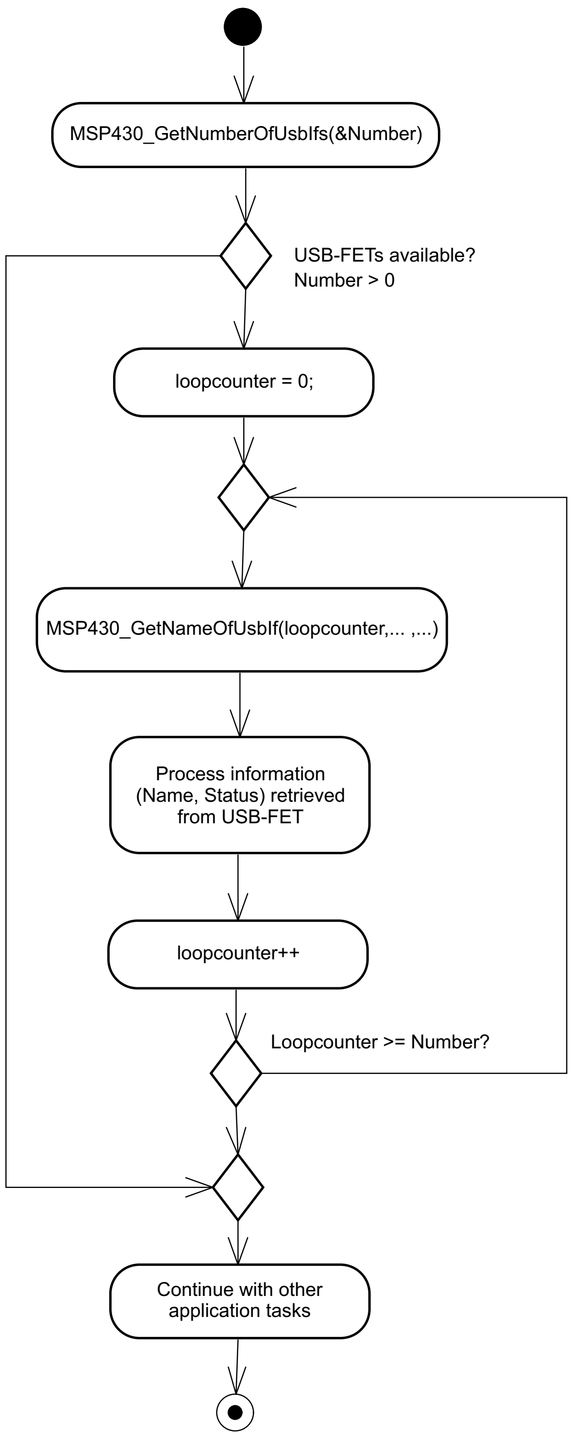

MSP430_GetNumberOfUsbIfs(&Number)
USB-FETs available?
Number > 0
loopcounter = 0;
MSP430_GetNameOfUsbIf(loopcounter,... ,...)
Process information (Name, Status) retrieved from USB-FET
loopcounter++
Loopcounter >= Number?
Continue with other application tasks

Figure 5. Retrieve Information About Available USB-FETs or Debuggers

```
#include "stdio.h"
#include "MSP430.h"

Int32_t number, count, status, lVersion, lErrorNumber;
char * name;

// determine the number of connected UIFs
printf("MSP430_GetNumberOfUsbIfs()\n");
if(MSP430_GetNumberOfUsbIfs(&number) == STATUS_ERROR)
{
    printf("Error: Could not determine number of UIFs!\n");
    lErrorNumber = MSP430_Error_Number();
    printf("Reason: %s\n", MSP430_Error_String(lErrorNumber));
}
else
{
    printf("Found %d UIF(s).\n", number);
    for(count = 0; count < number; count++)
    {
    // get the com port name
        printf("MSP430_GetNameOfUsbIf()\n");
        if(MSP430_GetNameOfUsbIf(count, &name, &status) == STATUS_ERROR)
        {
            printf("Error: Could not obtain com port name for UIF %d.\n", count+1);
            lErrorNumber = MSP430_Error_Number();
            printf("Reason: %s\n", MSP430_Error_String(lErrorNumber));
        }
        else
        {
            // initialize the interface
            printf("Initializing UIF @ %s.\n", name);
            printf("MSP430_Initialize(UIF %d)\n", count+1);
            if(MSP430_Initialize(name, &lVersion) == STATUS_ERROR)
            {
               lErrorNumber = MSP430_Error_Number();
               printf("Error: %s\n", MSP430_Error_String(lErrorNumber));
            }
            else
            {
               printf("Success!\n");

               // commence with debug session start here...

               // close the interface
               printf("MSP430_Close()\n");
               MSP430_Close(1);
            }
        }
    }
}
```

Figure 6. Code Example for Communication With Multiple USB-FETs or Debuggers

3.4 Configuring the JTAG Protocol

By default, the MSPDebugStack is configured to perform an automatic protocol scan before starting communication with MSP430 devices. This default configuration can be overwritten manually by using the INTERFACE_MODE configuration (see MSP430.h file for details). Four different interface modes are available and can be used for debugging the connected MSP430 device.

- **JTAG_IF**: The normal standard 4-wire JTAG communication (not supported by eZ debuggers).
- **SPYBIWIRE_IF**: Spy-Bi-Wire (2-wire) JTAG protocol.
- **SPYBIWIREJTAG_IF**: Standard 4-wire JTAG communication for MSP430 devices that also support Spy-Bi-Wire (a special entry sequence is needed to switch these MSP430 derivatives into 4-wire mode which cannot be applied to any MSP430 devices) (not supported by eZ debuggers).
- **AUTOMATIC_IF**: JTAG communication protocol is selected automatically by the MSPDebugStack (default).

If MSP430_Configure() is used to manually configure the JTAG protocol, it must be called before MSP430_OpenDevice() is called.

3.5 Speed up Flash Programming

The API routines MSP430_Erase() and MSP430_Memory() enable manipulation of the target devices Flash, RAM, and FRAM.

If flash memory is programmed by the MSPDebugStack, the target device RAM is used by the flash programming routines. Therefore, the RAM content of the target devices must be preserved before programming flash memory. After successfully programming, the original RAM content must be restored.

This RAM preservation mechanism allows flash memory manipulation during an active debug session without corrupting or changing any RAM content. However, the process requires noticeable time to preserve and restore RAM contents. Thus, this mechanism might not be useful under some circumstances; for example, during an initial flash programming at the beginning of a debug session.

Therefore, the RAM preserve and restore mechanism can be disabled by an additional MSP430_Configure() function call. This additional configuration mode is called RAM_PRESERVE_MODE.

The following sequence might be used, for example, for an initial flash programming sequence:

(1) MSP430_Configure(RAM_PRESERVE_MODE, DISABLE);

(2) MSP430_Erase(ERASE_ALL,..,..);

(3) MSP430_Memory(..., ..., ..., WRITE);

(4) MSP430_Memory(..., ..., ..., READ);

..... Flash programming or download finished

(n) MSP430_Configure(RAM_PRESERVE_MODE, ENABLE);

3.6 Controlling Device Program Execution

The MSPDebugStack provides additional debugging functions to developers of third-party tools for the MSP430. The debugging functions include execution control (free run, run to breakpoints, single step, state, stop, set breakpoint), device control (read or write registers, reset, clock configuration, device configuration), and low-level access to the advanced features of the Enhanced Emulation Module (EEM) that provides such features as complex breakpoints and trace buffers. The low-level access to EEM registers (namely the read/write EEM register) is in the library for compatibility with the EEM API.

3.7 Enhanced Emulation Module (EEM) Access – EEM API

The MSPDebugStack provides an enhanced debug API that allows access to the MSP430 Enhanced Emulation Module functionality. Refer to the source code of the application examples for details on how to use the EEM API.

NOTE: Some deprecated API functions are no longer allowed to be called when the EEM API is used. These functions are:

- MSP430_Configure() with parameter 'mode' set to CLK_CNTRL_MODE
- MSP430_Configure() with parameter 'mode' set to MCLK_CNTRL_MODE
- MSP430_State() with parameter 'stop' set to FALSE
- MSP430_EEM_Open()
- MSP430_EEM_Read_Register()
- MSP430_EEM_Read_Register_Test()
- MSP430_EEM_Write_Register()
- MSP430_EEM_Close()

Refer to the detailed documentation in MSP430_EEM.h.

3.8 Error Handling

All functions of the MSPDebugStack return an indication of success (STATUS_OK) or failure (STATUS_ERROR). If STATUS_ERROR is returned, MSP430_Error_Number() can be used to obtain a detailed error code. MSP430.h contains an enumeration of all error codes, and lists the error codes returned by each API function. MSP430_Error_String() returns the string corresponding to the error code parameter.

STATUS_ERROR is returned at the first error condition. The library typically does not attempt to retry or recover from the error condition. It is the responsibility of the application to retry the failed operation and possibly to implement a recovery mechanism.

3.9 Miscellaneous

The MSPDebugStack is a partially intrusive tool–accessing the device through JTAG can affect the device (for example, the clocking of the watchdog mechanism). However, steps are taken within the MSPDebugStack to minimize the effects upon the device caused by JTAG.

CAUTION

Do not unplug the JTAG cable during an active debug session. This can cause unknown device behavior.

4 MSP-FET430UIF Firmware Update Support

With every new version of MSPDebugStack, the firmware of the connected USB JTAG interface might need to be updated. The library includes a binary image of the corresponding USB-FET debugger firmware. Calling MSP430_FET_FwUpdate() as described in Figure 7 assures consistency between USB-FET firmware and MSPDebugStack.

With this release of version 3 of the MSPDebugStack (formerly named DLLv3), the firmware has changed and now consists of different independent parts (USB communication core, JTAG stack, low-level debugger hardware access, V_{CC} generation, and UART backchannel) that can be updated independently. Therefore, it was necessary to extend the firmware update mechanism to execute DLLv2 to DLLv3 updates. Figure 7 shows that MSP430_Initialize() returns either -3, -2 , -1 or the actual MSPDebugStack firmware version.

If MSP430_Initialize() returns -3, a major firmware version update (DLLv2 to DLLv3) is required. Afterward this update is complete, call MSP430_FET_FwUpdate() again to update the firmware with the MSPDebugStack internal binary image. In this special update case, a given update file is ignored.

If MSP430_Initialize() returns -1, the USB-FET firmware has been already updated to DLLv3 firmware. In this case, the communication core, JTAG stack, or HIL module does not match the MSPDebugStack version. By calling the MSP430_FET_FwUpdate() function, the internal library binary images are used for the USB-FET update.

If MSP430_Initialize() returns -2, the USB-FET firmware needs recovery because of major system corruption. A corrupted USB-FET always enumerates as HID-FET. The MSPDebugStack detects the HID-FET and raises a message that a connected USB-FET needs recovery. See Figure 8 for details on the USB-FET HID recovery flow.

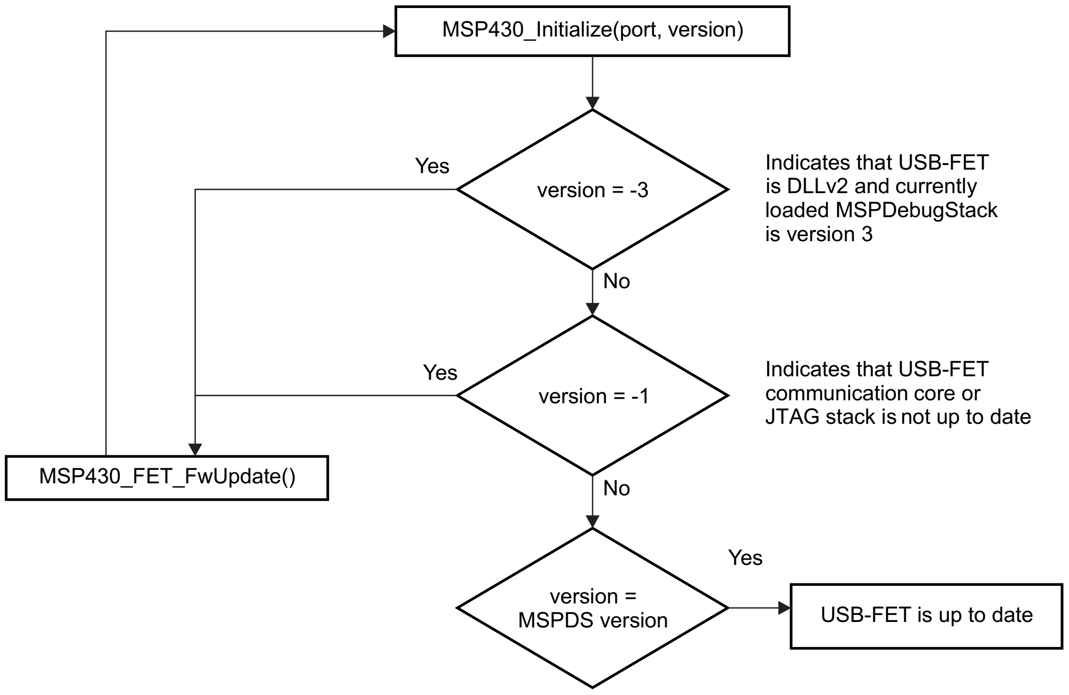

MSP430_Initialize(port, version)
Yes
version = -3
Indicates that USB-FET is DLLv2 and currently loaded MSPDebugStack is version 3
No
Yes
version = -1
Indicates that USB-FET communication core or JTAG stack is not up to date
MSP430_FET_FwUpdate()
No
Yes
version = MSPDS version
USB-FET is up to date

Figure 7. General Firmware Update Flow

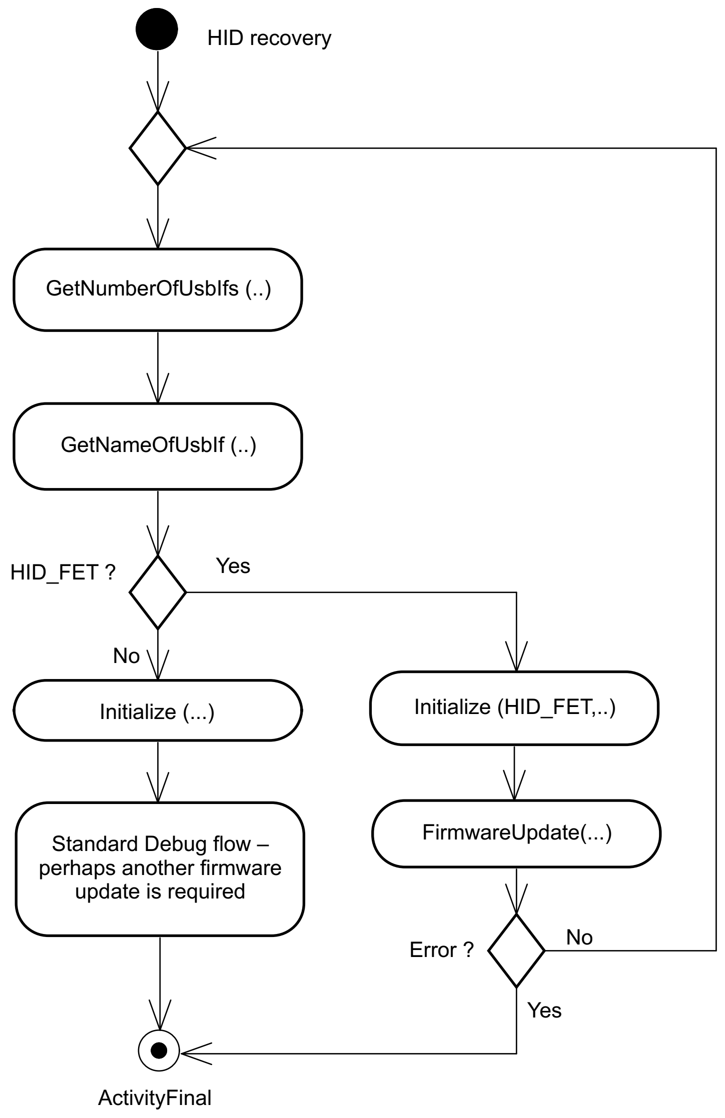


Figure 8. USB-FET HID Recovery Flow

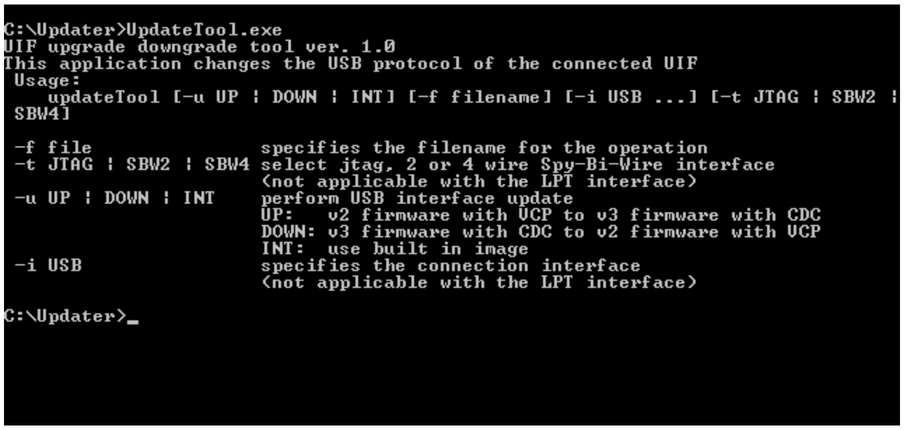
4.1 Firmware Update With Update Tool

An update of the MSP-FET430UIF firmware without an IDE can be executed using the command line based Update Tool. This tool can be used only with the MSP-FET430UIF.

The Update Tool can also upgrade or downgrade the firmware between major firmware versions.

For detailed information how to update the MSP-FET430UIF, refer to http://processors.wiki.ti.com/index.php/MSPDS_Debugger_Up-_and_Downgrade

NOTE: See Section 8 for details on how to determine if you are using MSP-FET430UIF revision 1.3, because it requires additional update steps (see Section 4.2).



```
C:\Updater>UpdateTool.exe
UIF upgrade downgrade tool ver. 1.0
This application changes the USB protocol of the connected UIF
 Usage:
    updateTool [-u UP | DOWN | INT] [-f filename] [-i USB ...] [-t JTAG | SBW2 |
 SBW4]

 -f file                specifies the filename for the operation
 -t JTAG | SBW2 | SBW4  select jtag, 2 or 4 wire Spy-Bi-Wire interface
                        (not applicable with the LPT interface)
 -u UP | DOWN | INT     perform USB interface update
                        UP:   v2 firmware with VCP to v3 firmware with CDC
                        DOWN: v3 firmware with CDC to v2 firmware with VCP
                        INT:  use built in image
 -i USB                 specifies the connection interface
                        (not applicable with the LPT interface)

C:\Updater>_
```

Figure 9. Update Tool

Available Commands

updateTool –u **UP**: Updates the UIF major firmware version (for example, version 2 to 3).

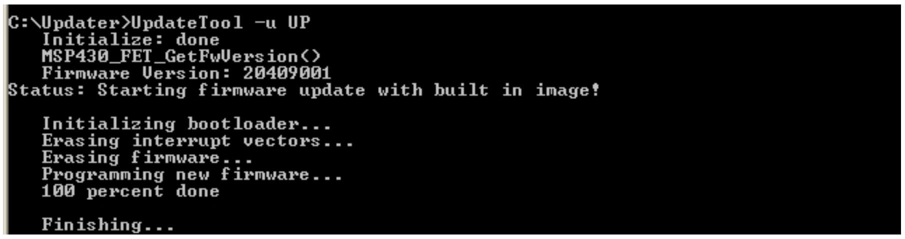
updateTool –u **DOWN**: Downgrades the UIF major firmware version through the binary image stored in Uifv3Downgrader.txt.

updateTool –u **INT**: Updates the UIF with the MSPDebugStack internal firmware image.

NOTE: Make sure that the CDC driver is already installed before performing a major firmware update. Also, a file named CDC.log with the content "True" must be in the same folder as the MSPDebugStack library to indicate that the CDC driver was installed successfully. If this file is not found or does not contain this content, the update process returns an update error.

4.2 Additional Update Step for MSP-FET430UIF Hardware Revision 1.3

After calling updateTool –u UP, the update process starts. Figure 10 shows the command line window that is displayed.



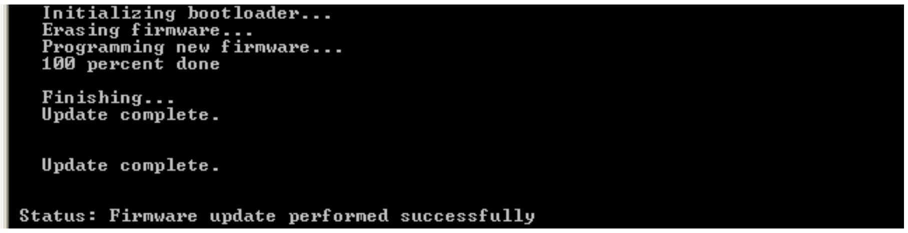
```
C:\Updater>UpdateTool -u UP
   Initialize: done
   MSP430_FET_GetFwVersion()
   Firmware Version: 20409001
Status: Starting firmware update with built in image!

   Initializing bootloader...
   Erasing interrupt vectors...
   Erasing firmware...
   Programming new firmware...
   100 percent done

   Finishing...
```

Figure 10. Start Firmware Update

When update is complete, the TUSB3410 is typically reset, and the UIF shows as a CDC device. However, as described in Section 8, the TUSB3410 cannot be reset in MSP-FET430UIF revision 1.3, so it is necessary to disconnect the MSP-FET430UIF and reconnect it. After doing so, the update process continues (see Figure 11).



```
   Initializing bootloader...
   Erasing firmware...
   Programming new firmware...
   100 percent done

   Finishing...
   Update complete.


   Update complete.


 Status: Firmware update performed successfully
```

Figure 11. Firmware Update Successful

5 Supporting eZ430 Emulator Dongles

Several different versions of the eZ430 emulator are available.

- eZ430-RF2500: The dongle enumerates as a Human Interface Device (HID). The HID class driver is part of the Windows operation system, thus the enumeration does not require any user interaction. The HID interface is used for the JTAG communication to the target device.

  In addition to the HID channel, the dongle also tries to enumerate a Virtual COM Port (which is called MSP430 Application UART). This driver is based on the Communication Device Class (CDC) interface. This CDC driver class is also part of the Windows operating system but it requires an INF file for installation. The provided INF file (430CDC.inf, can be found in folder Driver/Inf) is certified for MS-Windows operating systems XP32, XP64, Vista32, Vista64, Win7-32, and Win7-64.

  The folder Driver/Inf contains a subfolder PreinstallCDC. This subfolder contains an example source code that shows how to install the INF file on a MS-Windows PC. TI recommends installing the INF file as described in the example. If the install is not done, the Windows Hardware Wizard opens as soon as the user connects the tools to the PC. The user must manually point the Wizard to the correct location of the INF file when using the wizard.
- Other supported eZ430 tools that make use of the HID interface are the eZ430 Chronos™ Wireless development tool in a watch, the MSP430 LaunchPad Value Line Development Kit, and the MSP-EXP430FR5739 FRAM experimenter board.

6 Application Examples

The MSPDebugStack developer's package features a series of example projects that demonstrate the use of different DLL functions. TI recommends using Windows and Visual Studio 2013 for building these examples projects. After the rebuild, the executables can be found in the folder ApplicationExample/Executables. See the source code for details on how to call API functions and correctly pass parameters to those functions.

6.1 Example

Example is a simple example project that demonstrates how the basic functions of the MSPDebugStack are called to initialize the interface, identify and configure the device, manipulate the device memory (erase, program, verify, read), secure the device, reset the device, close the interface, and handle error conditions. Refer to the source file Example.c.

6.2 ExampleDebug

ExampleDebug is an example project that demonstrates how the functions of the MSPDebugStack are called to initialize the interface, identify and configure the device, manipulate the device memory (erase, program, verify, read), read the device registers, set device breakpoints, run the device (free, with breakpoints, single step), reset the device, close the interface, and handle error conditions. Refer to the source file Example Debug.c.

6.3 UifUpdate

UifUpdate is an example project that demonstrates how to perform an USB-FET firmware update by calling MSP430_FET_FwUpdate() including handling of the notify callback mechanism during the update process. Refer to the MSPDebugStack API documentation of MSP430_FET_FwUpdate() for details.

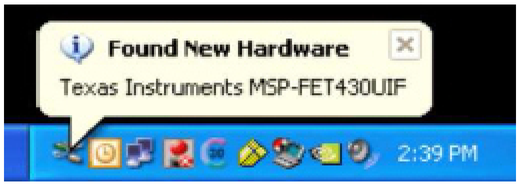
6.4 MultipleUifs

MultipleUifs is an example project that demonstrates how to support multiple MSP-FET430UIF tools connected to one PC system. The example project comes with a GUI that shows a possible support implementation.

7 Installation of CDC for USB-FET Debuggers

The UIF tries to enumerate a Virtual COM Port, which is based on Communication Device Class (CDC) driver. This CDC driver class is part of the Windows operating system, but it requires an INF file for installation.

After plugging in the USB-FET, Windows recognizes a new hardware called MSP-FET430UIF or MSP Debug interface (see Figure 12).



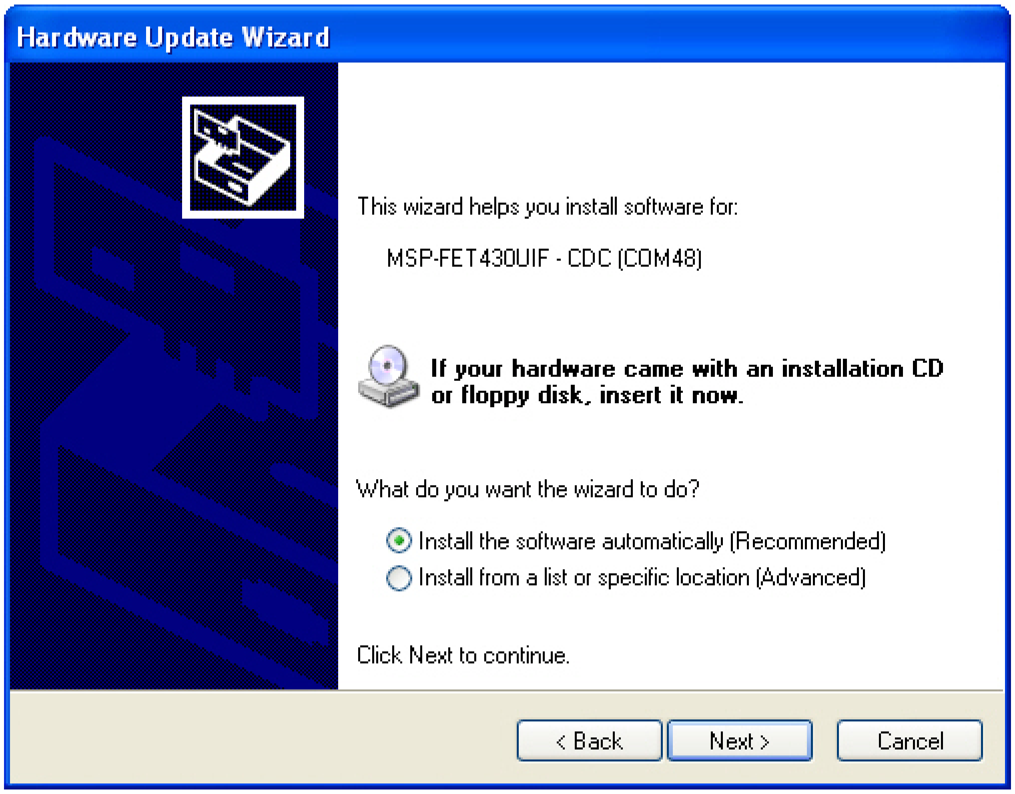
Found New Hardware

Texas Instruments MSP-FET430UIF

Figure 12. New Hardware

Next, the hardware wizard opens a new dialog (see Figure 13).

- If Code Composer Studio™ (CCS) IDE version 5 or 6 or IAR Embedded Workbench™ IDE is already installed, select "Install the software automatically".
- If no IDE has been installed, select the msp430tools.inf, which is part of the developer's package (MSP430_DLL_Developer_Package_Rev_x_x_x_x\Driver\CDC) and install the driver manually.


Hardware Update Wizard

This wizard helps you install software for:

MSP-FET430UIF - CDC (COM48)

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

● Install the software automatically (Recommended)

○ Install from a list or specific location (Advanced)

Click Next to continue.

Figure 13. Update Wizard

8 Update MSP-FET430UIF With Hardware Revision 1.3

If you are using a MSP-FET430UIF with hardware revision 1.3, the update process includes one additional step, because it is not possible to reset the TUSB3410 USB port controller during firmware update.

Without a reset, the TUSB3410 cannot change the VCP protocol to CDC and then install the new communication core and JTAG stack. Therefore, it is necessary to reset the device manually by disconnecting the MSP-FET430UIF and connect it to the PC again.

For IDE-specific information on how to update an MSP-FET430UIF revision 1.3, See the MSP-FET430UIF Debug FAQ (CCS v5.1 or later and IAR EW v5.40 or later).

See Figure 14 and Figure 15 to determine if you are using MSP-FET430UIF with hardware revision 1.3. Figure 14 shows that revision 1.3 has a CE logo on the front and no label with a revision number on the back. Figure 15 shows that revision 1.4 does not have the CE logo on the front and does have a label with the version number on the back.

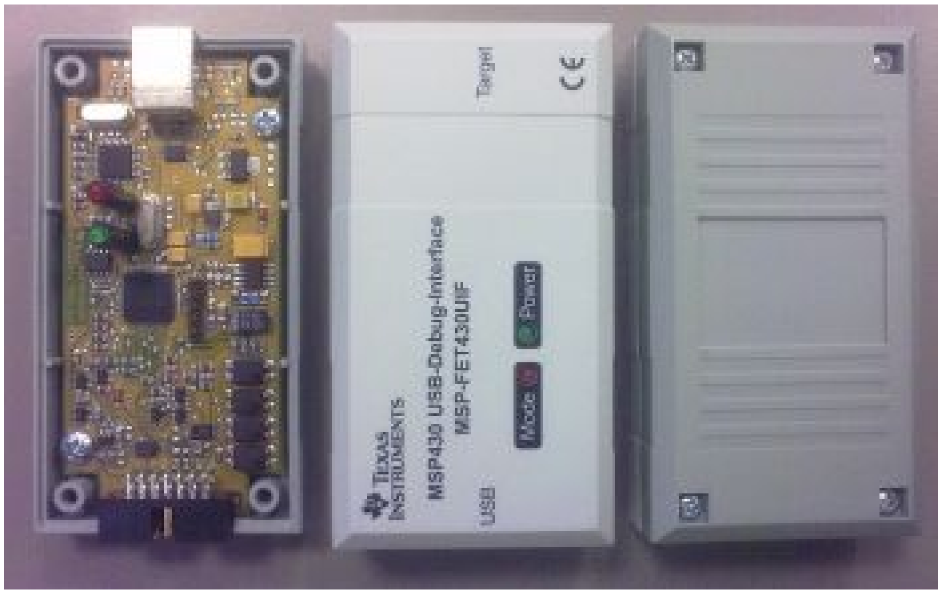


Figure 14. UIF Revision 1.3

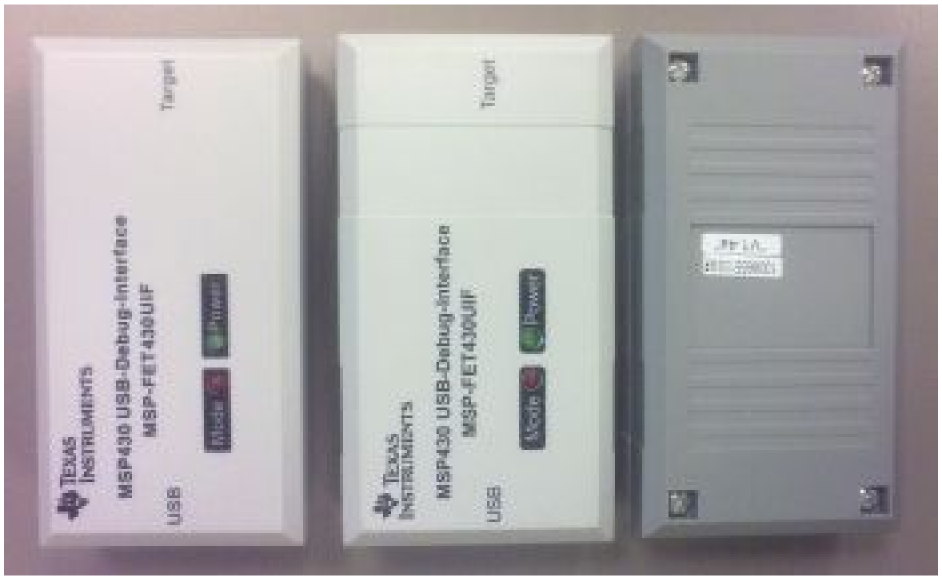


Figure 15. UIF Revision 1.4

9 References

1. TUSB3410 RS232/IrDA Serial-to-USB Converter
2. MSPDebugStack Software Tools

Revision History

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

Changes from February 18, 2016 to June 13, 2016 **Page**

- Throughout document, changed references to MSP430.DLL and the DLL to MSPDebugStack or the library 1
- Deleted the "wtypes.h:" list item in Section 2, *Developer's Package Folder and File Structure* 3
- Added the libmsp430.so, libmsp430_64.so, and libmsp430.dylib list items in Section 2, *Developer's Package Folder and File Structure* 4
- Added the Objects list item in Section 2, *Developer's Package Folder and File Structure* 4
- Updated Figure 2, *Code Example to Start a Debug Session* 6
- Updated Figure 4, *Code Example for Attach to Running Target* 8
- Updated Figure 6, *Code Example for Communication With Multiple USB-FETs or Debuggers* 11
- Updated Figure 7, *General Firmware Update Flow* 14
- Added "This tool can be used only with the MSP-FET430UIF" to the first paragraph in Section 4.1, *Firmware Update With Update Tool* 16
- Added "TI recommends using Windows and Visual Studio 2013 for building these examples projects" to the first paragraph in Section 6, *Application Examples* 18

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