MSP-EXP430F5438 Experimenter Board

User's Guide

Literature Number: SLAU263I
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Read This First

Related Documentation From Texas Instruments

MSP-EXP430F5438 Design Files (SLAC228)

MSP-EXP430F5438(A) Example Software (SLAC227)

If You Need Assistance

The primary sources of MSP430 information are the device-specific data sheets and user's guides. The most up-to-date versions of the user's guide documents can be found at www.ti.com/msp430.

Information specific to the MSP-EXP430F5438 Experimenter Board can be found at http://www.ti.com/tool/MSP-EXP430F5438.

Support for the MSP430 device and the MSP-EXP430F5438 Experimenter Board is provided by the Texas Instruments Product Information Center (PIC). Contact information for the PIC can be found on the TI web site at www.ti.com.

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Getting Started

1.1 MSP-EXP430F5438 Experimenter Board Introduction

The MSP-EXP430F5438 Experimenter Board is an evaluation board meant to evaluate the capabilities of the MSP430F5438A family of microcontrollers. Built to complement the MSP430's high degree of mixed-signal integration, the Experimenter Board showcases external peripherals such as a dot-matrix LCD, two-axis accelerometer, microphone, audio output, a serial USB connection, and RF add-ons. Delivered with an example software project to help firmware designers understand how to program the new peripherals of the MSP430F5xx family of devices, there is no better way to learn how to use the MSP430F5438A than with the MSP-EXP430F5438 Experimenter Board. This document details the hardware, its use, and the example software.

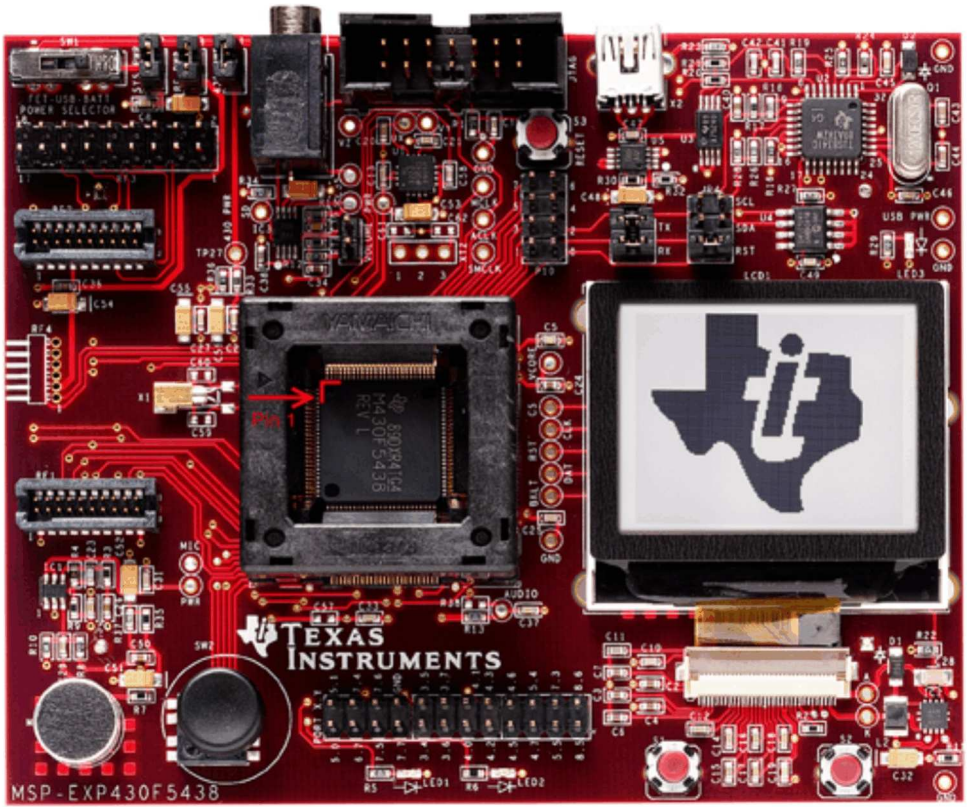

Figure 1-1. MSP-EXP430F5438 Experimenter Board

1.2 Kit Contents

- 1 x MSP-EXP430F5438 Experimenter Board + AA Batteries
- 1 x 100-pin MSP430F5438AIPZ microcontroller [1]

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1.3 Tools Requirements

1.3.1 Hardware

An MSP430 Flash Emulation Tool (MSP-FET430UIF) or an equivalent programming tool is required to download code and debug the MSP430F5438A. The JTAG programmer is connected to the MSP-EXP430F5438 Experimenter Board through the JTAG header located in the top center of the board. The MSP430F5438A utilizes the standard 4-wire JTAG connection. For more details on the installation and usage of the Flash Emulation Tool, see the *MSP430 Hardware Tools User's Guide* (SLAU278).

1.3.2 Software

Texas Instruments' Code Composer Studio (CCS) is an MSP430 integrated development environment (IDE) designed specifically to develop applications and program MSP430 devices. CCS, CCS Core Edition, and IAR Embedded Workbench can all be used to evaluate the example software for the Experimenter Board. The compiler limitation of 4 KB prevents IAR KickStart from being able to be used for the evaluation of the example software.

The example software, titled "User Experience," is available online as MSP-EXP430F5438(A) Example Software (SLAC227). The User Experience application must be loaded onto the MSP430F5438A that comes with the kit and is documented in Chapter 5. When compiled and run using an IDE, the APIs that have been included in the example software can be used to develop unique applications with the Experimenter Board. The APIs can serve as interfaces to the internal hardware modules of the MSP430F5438A (for example, ADC12 or UCS) as well as external peripherals and components (for example, buttons or an LCD). Chapter 3 describes the steps required to compile and run the example software using Code Composer Studio.

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Hardware Installation

2.1 USB Driver Installation

A serial communication driver is necessary for USB communication with the MSP-EXP430F5438 Experimenter Board. The driver intended to be used with a Windows PC running either a 32-bit or 64-bit operating system. To properly install the driver, follow these steps:

1. Download the driver from http://www.ti.com/lit/zip/swrc094 and extract the archive.
2. Run setup.exe and complete the "TUSB3410 Single Driver Wrapper – InstallShield Wizard." This extracts the driver files and installer into the Program Files directory.
3. Navigate to C:\Program Files\Texas Instruments Inc\TUSB3410 Single Driver Installer\DISK1 and run setup.exe. Complete the "TUSB3410 – Install Shield Wizard" to install the drivers.
4. Plug the mini-USB cable into the mini-USB port on the MSP-EXP430F5438 board. Plug the other end of the cable into a USB port on the host PC.
5. To make sure that the USB driver installation was successful, open Device Manager under Start > Control Panel > System > Hardware > Device Manager. An entry labeled as "MSP-EXP430F5438 USB – Serial Port (COMxx)" appear under "Ports (COM & LPT)" if installation was successful (the xx in COM identifies the enumeration of the COM port) (see Figure 2-1).

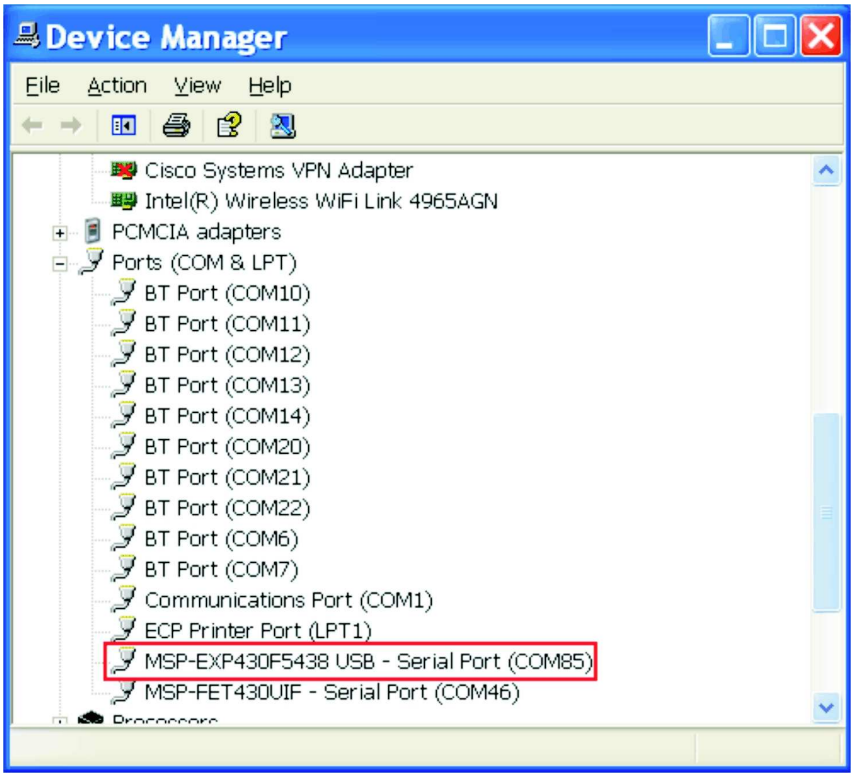

Figure 2-1. Installing the MSP-EXP430F5438 USB Driver

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Software Installation and Debugging

3.1 Code Composer Studio Install

To edit and download code to the MSP430, Code Composer Studio must be installed.

1. Download Code Composer Studio Core Edition from www.ti.com/ccs.
2. If necessary, extract the zip file and run the installation program.
3. Respond to the prompts to install the IDE.

NOTE: IDE Selection

The software example is provided for both Code Composer Studio and IAR Embedded Workbench, and the user has the option to select the IDE of their choice. However, the firmware is larger than IAR KickStart's 4KB limit, so a full license of IAR Workbench is required to compile the application using IAR. A 30-day evaluation version of IAR is also available from http://supp.iar.com/Download/SW/?item=EW430-EVAL.

This document describes working with Code Composer Studio.

3.2 Working With the Example Software

The MSP-EXP430F5438 example software is written in C and offers APIs to control the MSP430F5438A chip and external components on the MSP-EXP430F5438 Experimenter Board. New application development can use this library for guidance.

The example software can be downloaded from the MSP-EXP430F5438 tools page, MSP-EXP430F5438(A) Example Software (SLAC227). The zip package includes the MSP-EXP430F5438 example software and the USB driver required for communication with the Experimenter Board. The code is ready for compilation and execution.

To modify, compile, and debug the example code the following steps should be followed:

1. If you have not already done so, download the sample code from the MSP-EXP430F5438 tools page MSP-EXP430F5438(A) Example Software (SLAC227).
2. Connect the MSP-FET430UIF programmer to the computer. If you have not already done so, install the drivers for the programmer.
3. Connect one end of the 14-pin cable to JTAG programmer and another end to the JTAG header on the board.
4. Extract, move, or copy the example project (MSP-EXP430F5438 User Experience CCS) to the computer.
5. Open CCS and select a workspace directory (see Figure 3-1).

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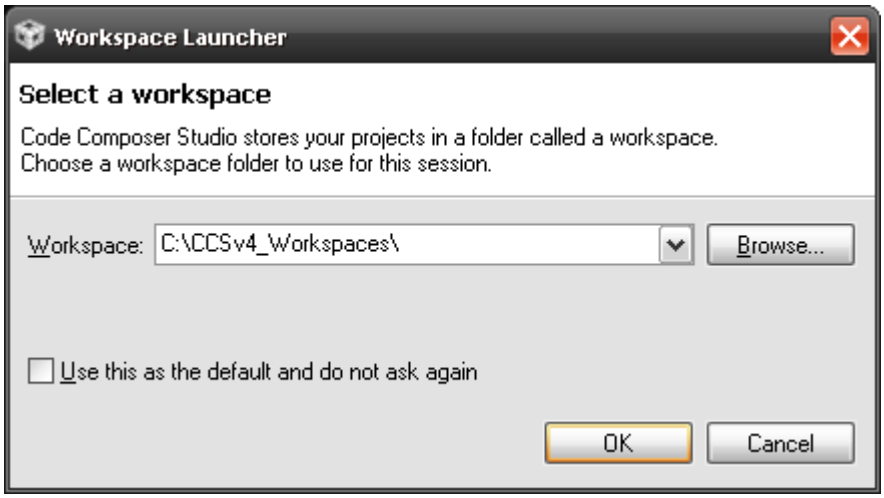

Figure 3-1. Selecting a CCS Workspace

6. Click Project > Import Existing CCS/CCE Eclipse Project.
7. Browse to the extracted project directory. The project should now show in the Projects list (see Figure 3-2).
8. Make sure that the project is selected and click Finish.

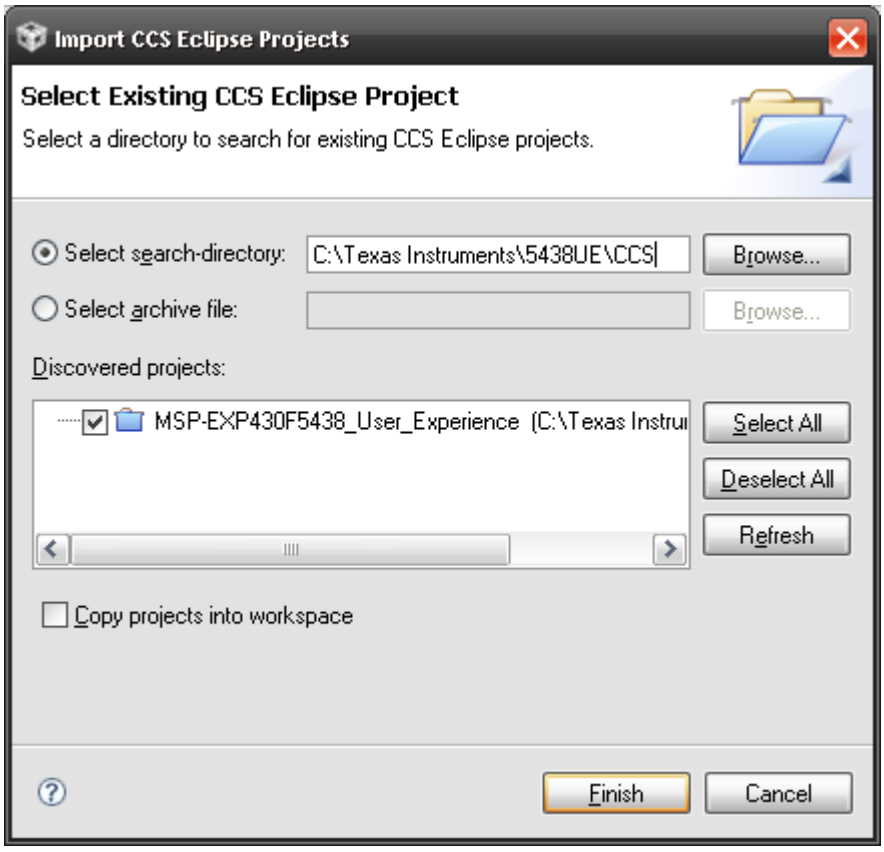

Figure 3-2. Opening Existing Project

The project is now open. To build, download, and debug the code to the device on the MSP-EXP430F5438 Experimenter Board, click Target > Debug Active Project or click the 'bug' button. Note that the silicon must be properly inserted into the socket before you click Target > Debug Active Project.

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You may be prompted to update the firmware on the MSP-FET430UIF programmer. Do not be concerned; click the button that says Update, and the program download should continue as expected.

3.2.1 Deprecated Devices

The example software does not support MSP430F5438 non-A devices or the MSP-EXP430F5438 Rev 0-02 boards. You should use MSP430F5438A devices and MSP-EXP430F5438 Rev 0-03 and newer boards to run the example software.

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Hardware Functional Overview

4.1 Hardware Overview

The MSP-EXP430F5438 Experimenter Board utilizes the MSP430F5438A peripherals connected to a number of external components that enable various functions as shown in Figure 4-1. The board provides a socket into which the MSP430F5438A should be loaded, with pin 1 located in the top left corner of the socket (look for a small arrow on the socket).

The interfaces to a 138x110 dot-matrix LCD, two-axis analog accelerometer, 5-directional joystick, two push buttons, and a complete analog signal chain from microphone to audio output jack enable the development of a variety of applications. The MSP-EXP430F5438 Experimenter Board also provides UART communication via the mini-USB connection, facilitating communication/data transfer with a PC host. In addition, wireless communication is also possible via TI wireless evaluation module headers or the EZ430-RF2500T headers.

Table 4-1. MSP-EXP430F5438 Jumper Settings and Functionality

Header	Functionality When Jumper Present	Functionality When Jumper Absent
JP1 – 430 PWR	Provides power to MSP430F5438. Also used to measure current consumption of the MSP430F5438.	MSP430F5438 is not powered.
JP2 – SYS PWR	Provides power to the entire MSP-EXP430F5438 board. Also used to measure current consumption of the entire board.	MSP-EXP430F5438 Experimenter Board is not powered. The USB circuitry including LED3 would still have power if USB cable is connected.
JP3 – RF PWR	Provides power to the RF headers: CC-EM header or the EZ430-RF2500T header	RF headers (CC-EM and EZ430-RF2500T) do not have power
JP4 – EEPROM Connection	Pins 1 to 4: Provides I2C connection between MSP430F5438 and TUSB EEPROM.	No connection between MSP430F5438 and TUSB EEPROM.
	Pins 5 to 6: Provides a RST enable to the TUSB3410.	No capability of holding the TUSB in RST NOTE: This functionality is not required for user applications.
JP5 – USB VCP Connection	Provides the serial connection to the TUSB3410 for communication with the PC. Jumpers should be connected horizontally.	No connection between MSP430F5438 and the computer

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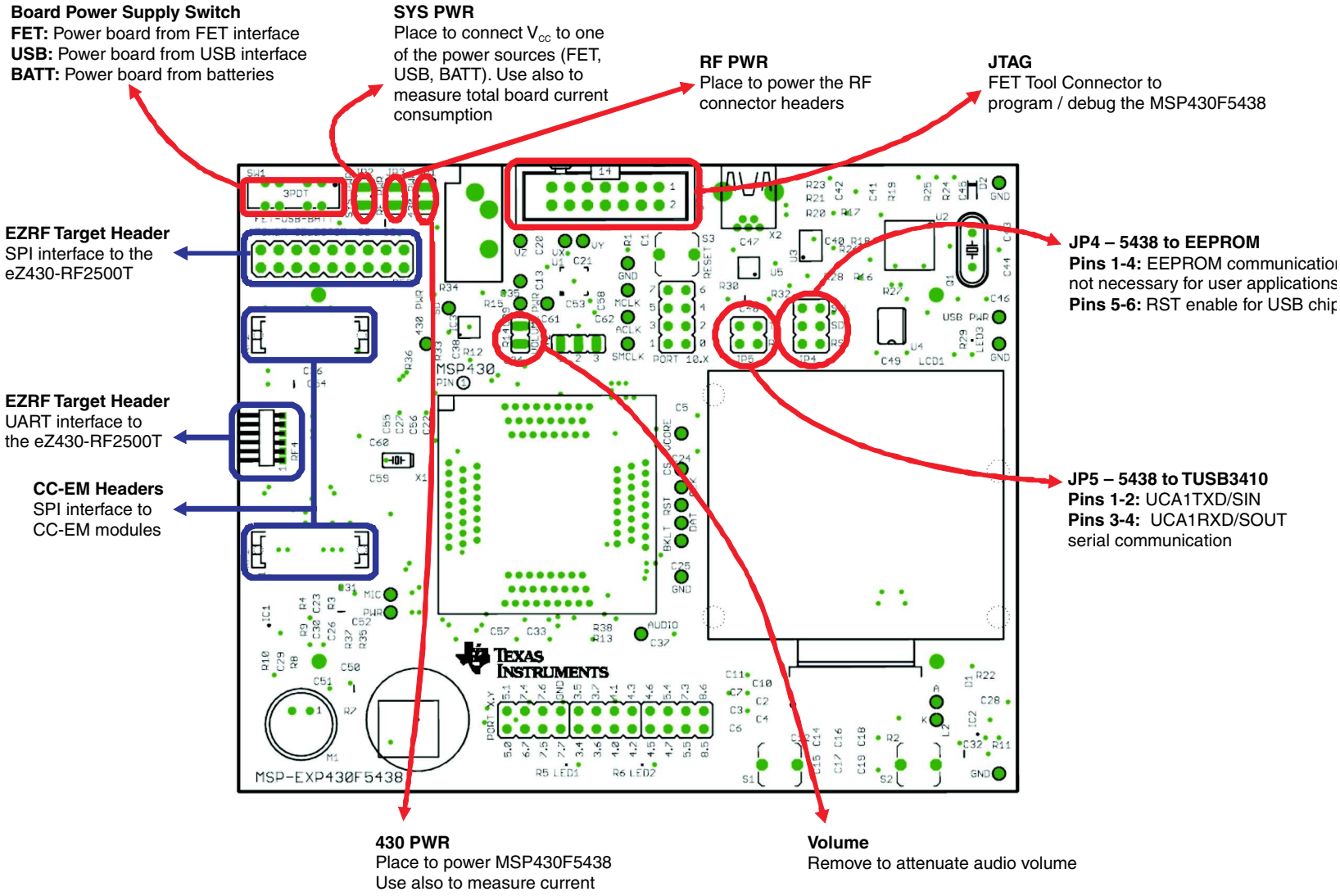

Figure 4-1. Functional Overview

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4.2 User Interfaces

4.2.1 Dot-Matrix LCD

The HD66753 is a Hitachi dot-matrix LCD with a resolution of 138 x 110, 4-level grayscale pixels. The LCD also has a built-in backlight driver that can be controlled by a PWM signal from the MSP430F5438A, pin P8.3. The MSP430F5438A communicates with the HD66753 via an SPI-like communication protocol. To supplement the limited set of instructions and functionalities provided by the on-chip LCD driver, an LCD driver has been developed for the MSP430F5438A to support additional functionalities such as font set and graphical utilities. More information on the LCD can be obtained from the manufacturer's data sheet.

4.2.2 Five-Directional Joystick, Push Buttons, and LEDs

The following table describes the pin connections for the 5-directional joystick switch, the push button switches, and the on-board LEDs.

The USB circuit on the board also sources an LED3, which indicates the presence of USB power from the mini-USB cable.

Table 4-2. Five-Directional Joystick, Push Button, and LED Pin Connections

Peripheral	Pin Connection
5-directional joystick (LEFT)	P2.1
5-directional joystick (RIGHT)	P2.2
5-directional joystick (CENTER)	P2.3
5-directional joystick (UP)	P2.4
Switch 1 (S1)	P2.6
Switch 2 (S2)	P2.7
RESET Switch (S3)	RST / NMI
LED1	P1.0
LED2	P1.1 / TA0 CCR0

4.3 Communication Peripherals

4.3.1 Wireless Evaluation Module Interface

Included in the communication peripherals are the headers that support the CC-EM boards from TI. The transceiver modules connect to the USCI of the MSP430F5438A configured in SPI mode using the UCB0 peripheral. Libraries that interface the MSP430 to these transceivers are available at www.ti.com/msp430 under Code Examples. The RF PWR jumper must be populated to provide power to the EM daughterboard. The following radio daughter cards are compatible with the MSP-EXP430F5438 Experimenter Board:

- CC1100EMK/CC1101EMK – Sub-1-GHz radio
- CC2500EMK – 2.4 GHz radio
- CC2420EMK/CC2430EMK – 2.4 GHz 802.15.4 [SoC] radio
- CC2520EMK/CC2530EMK – 2.4 GHz 802.15.4 [SoC] radio
- CC2520 + CC2591 EM (if R4 and R8 0-Ω resistors are connected)

NOTE: Future evaluation boards may also be compatible with the header connections.

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4.3.2 eZ430-RF2500T Interface

The eZ430-RF2500T module can be attached to the MSP-EXP430F5438 Experimenter Board in one of two ways – through an 18-pin connector (RF3) or a 6-pin connector (RF4). The pins on the eZ430-RF2500T headers are multiplexed with the pins on the CC-EM headers allowing the EZ430-RF2500T module to behave identically to a CC-EM daughterboard. Power must be provided to the EZ430-RF2500T module by setting the jumper RF PWR. The eZ430-RF2500T connection should always be made with the antenna facing off of the board. For more information on the connections to the required eZ430-RF2500T, see the *eZ430-RF2500 Development Tool User's Guide* (SLAU227), available through www.ti.com/ez430.

4.3.3 USB-UART

The USB interface on the MSP-EXP430F5438 Experimenter Board allows for UART communication with a PC host and also converts the USB power to 3.3-V power source for the entire board. The USCI module in the MSP430F5438A (UCA1) supports the UART protocol that is used to communicate with the TI TUSB chip for data transfer to the PC.

4.4 Two-Axis Accelerometer

The MSP-EXP430F5438 Experimenter Board supports a two-axis or three-axis accelerometer, ADXL322 or ADXL330. Three analog signals, one for each axis X, Y, and Z are connected to input channels one, two, and three of the MSP430F5438A ADC12 module, respectively. The board is currently populated with ADXL330. If the user would like to use a two-axis accelerometer, the ADXL330 would need to be removed and correctly replaced with the ADXL322. No further modifications to the board are required. The accelerometer is powered through pin P6.0. This interface, especially in conjunction with other on-board interfaces such as the LCD, enables several potential applications such as g-force measurement or tilt sensing. For more information on the accelerometer chip, see the manufacturer's data sheet. [6]

4.5 Analog Signal Chain

The MSP-EXP430F5438 Experimenter Board provides a complete analog signal chain enabling numerous audio applications such as speech recording, playback, or real-time audio signal analysis.

4.5.1 Audio Input Signal Chain

The MSP-EXP430F5438 audio input chain is based on a noninverting op-amp gain stage positioned between the microphone and the MSP430F5438A ADC12. The circuit utilizes a Texas Instruments TLV2760, optimized for low-power operation. The power for the TLV2760 is supplied directly from MSP430F5438A port pin P6.4, which can be turned off to remove power consumption when the TLV2760 is not in use. The op-amp has a cutoff frequency of approximately 4 kHz, which targets typical speech frequency range. See the MSP-EXP430F5438 schematic (Section 6.3) for the op-amp circuit.

The microphone is connected to the MSP430F5438A ADC12 input channel five via an analog filter circuit. The microphone is enabled or disabled via the same MSP430F5438A port pin as the TLV2760, P6.4.

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4.5.2 Audio Output Signal Chain

The MSP430F5438A generates a high-frequency PWM signal to emulate the functionality of a DAC. The duty cycle of the PWM is derived from the ratio between the emulated voltage and the rail of 3.3 V. This PWM output signal is filtered heavily to emulate a constant voltage value. This output is then connected to a Texas Instruments TPA301 audio amplifier.

The audio output circuit utilizes the audio amplifier to amplify the filtered output signal from the PWM and feed the amplified signal into the audio output jack. The amplification is sufficient to support non-amplified headphones as well as amplified speakers. For more information on the TPA301, see the device data sheet (SLOS208).

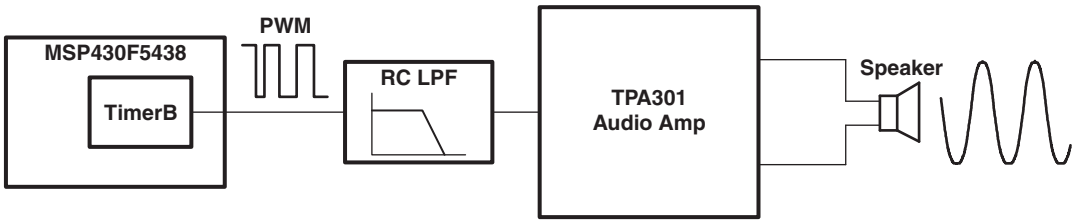

Figure 4-2. Audio Output Signal Chain

4.6 Headers Port X.Y, P10, and RF3

The MSP-EXP430F5438 Experimenter Boards includes three headers that can be used as additional connections to external hardware or for signal analysis during firmware development, Port x.y, P10, and RF3. All pins except the GND pin are internally selectable as either general purpose input/output pins or as described in the adjacent columns of Table 4-3 through Table 4-5.

Table 4-3. Pin Mapping for Header Port x.y

Pin Description	Port Pin	Port Pin	Pin Description
VREF+ out / VeREF+ in	P5.0	P5.1	VREF- / VeREF-
Analog Input (A7)	P6.7	P7.4	Analog Input (A12)
Analog Input (A13)	P7.5	P7.6	Analog Input (A14)
Analog Input (A15)	P7.7	GND	GND
UCA0TXD / UCA0SIMO	P3.4	P3.5	UCA0RXD / UCA0SOMI
UCB1STE / UCA1CLK	P3.6	P3.7	UCB1SIMO / UCB1SDA
Timer B0 CCR0 capture: CCI0A / CCI0B input; compare: Out0 output;	P4.0	P4.1	Timer B0 CCR1 capture: CCI1A/CCI1B input; compare: Out1 output; (PWM)
Timer B0 CCR2 capture: CCI2A/CCI2B input; compare: Out2 output; (PWM)	P4.2	P4.3	Timer B0 CCR3 capture: CCI3A/CCI3B input; compare: Out3 output; (PWM)
Timer B0 CCR5 capture: CCI5A/CCI5B input; compare: Out5 output; (PWM)	P4.5	P4.6	Timer B0 CCR6 capture: CCI6A/CCI6B input; compare: Out6 output; (PWM)
TB0 clock input / SMCLK output	P4.7	P5.4	UCB1SOMI / UCB1SCL
UCB1CLK / UCA1STE	P5.5	P7.3	Timer A1 CCR2 capture: CCI2B input; compare: Out2 output; (PWM)
Timer A1 CCR0 capture: CCI0B input; compare: Out0 output;	P8.5	P8.6	Timer A1 CCR1 capture: CCI1B input; compare: Out1 output; (PWM)

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Table 4-4. Pin Mapping for Header P10

Pin Description	Port Pin	Port Pin	Pin Description
GPIO only	P10.7	P10.6	GPIO only
UCA3RXD / UCA3SOMI	P10.5	P10.4	UCA3TXD / UCA3SIMO
UCB3CLK / UCA3STE	P10.3	P10.2	UCB3SOMI / UCB3SCL
UCB3SIMO / UCB3SDA	P10.1	P10.0	UCB3STE / UCA3CLK

Table 4-5. Pin Mapping for Header RF3

Pin Description	Port Pin	Port Pin	Pin Description
	VCC	GND	
Timer A0 CCR3 capture: CCI3A input compare: Out3 output (PWM)	P1.4	P11.0	ACLK output (divided by 1, 2, 4, 8, 16, or 32)
Timer A0 CCR1 capture: CCI1A input compare: Out1 output (PWM)	P1.2	P9.4	UCA2TXD / UCA2SIMO (EZRF_TXD)
Timer A0 CCR4 capture: CCI4A input compare: Out4 output (PWM)	P1.5	P9.5	UCA2RXD / UCA2SOMI (EZRF_RXD)
SMCLK output	P1.6	P8.2	Timer A0 CCR2 capture: CCI2B input compare: Out2 output (PWM)
	GND	P8.1	Timer A0 CCR1 capture: CCI1B input compare: Out1 output (PWM)
Timer A0 CCR2 capture: CCI2A input compare: Out2 output (PWM)	P1.3	P1.7	GPIO only
UCB0CLK / UCA0STE (RF_SPI_CLK)	P3.3	P3.2	UCB0SOMI / UCB0SCL (RF_MISO)
UCB0SIMO / UCB0SDA (RF_MOSI)	P3.1	P3.0	UCB0STE / UCA0CLK (RF_STE)

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Example Software – User Experience

5.1 User Experience

This section describes the example software that shows various functions of the MSP-EXP430F5438 Experimenter Board. To begin evaluation of the User Experience example software, make sure that the MSP430F5438A is correctly oriented in the socket before connecting power to the experimenter board. Pin 1 should be located at the top-left corner of the socket and aligned with the small arrow that is visible on the socket (see Figure 1-1).

After the device has been programmed with the example software and the board is supplied with power, the LCD should load the splash screen displaying the TI logo. Pressing the center direction on the joystick (push down) starts the normal operation of the board.

5.2 Main Menu

The main menu displays a list of applications and settings that users can choose from. Additionally, the menu also displays time and battery voltage on the LCD screen. Navigation in this menu can be done with the joystick (up, down, center to select) and/or the push buttons (S1 to exit, S2 to select/enter). Each application in the menu is described in the following sections.

In this screen, if there is no action from user within 10 seconds, the board goes into standby mode. By default, the board returns to active mode if any button is pressed or the board is tilted.

5.2.1 Clock

Select this option from the main menu to display an analog clock. After 10 seconds, the backlight is disabled to conserve power.

Press center on the joystick to return to the main menu.

5.2.2 UniBall

UniBall is an accelerometer demonstration in which the user can control the movements of a ball on the LCD screen by tilting the board. The LCD initially loads the TI logo as the background, and the ball appears as the dot on the TI logo. The user can tilt the board to move the ball and erase the TI logo in the process. The TI logo is reset periodically.

Press center on the joystick to return to the main menu.

5.2.3 USB-UART

This application displays a UART terminal to communicate with a host PC via USB cable at 57600 bps. Users can type in a terminal window to send characters to the LCD screen of the MSP-EXP430F5438 board. The board also sends characters to the PC if there are any actions on the joystick or the push buttons. Make sure jumpers JP5 (USB TX/RX) are set horizontally to properly communicate with the PC terminal.

Press center on the joystick to return to the main menu.

Advanced Debugging Tip: When jumpers J5 are connected vertically, the UART connections become an echo for both the MSP430 and the terminal window.

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5.2.4 Audio Apps

Selecting Audio Apps takes the user to a sub-menu containing two audio applications. Use the joystick to highlight either the Voice Recorder application or the FFT application, and press center on the joystick to select the application.

Select Quit to return to the main menu.

5.2.4.1 Voice Recorder

The voice recorder allows users to record speech into the MSP430F5438 flash memory. Due to the large size of the flash (256 KB), users can store up to approximately 20 seconds of speech audio.

- To record, press S1 and speak in normal voice into the microphone located in the bottom left of the Experimenter Board. The user can record for the entire length allowed by the flash size or stop the recording any time by pressing S2.
- To playback, press S2. Similarly to recording, the user can stop the playback anytime by pressing S1.

Press center on the joystick to return to the Audio Apps sub-menu.

5.2.4.2 FFT

This application allows users to see the results of a FFT performed on the received data from the microphone. As higher frequencies are received through the microphone, the spectrum moves towards the right side of the screen.

Press center on the joystick to return to the Audio Apps sub-menu.

5.2.5 Power Test

Selecting Power Test takes the user to a sub-menu containing two applications that allow the user to observe the current consumption of the MSP430F5438A in different operating modes. First, use the joystick to highlight Active or Low Power, then press center on the joystick to select the application.

Select Quit to return to the main menu.

5.2.5.1 Active

This application allows the user to experiment with the different DCO frequency settings that the MSP430F5438A supports. The MCLK options are listed on the right column and can be selected by pressing S2.

The V_{CORE} options are listed in the left column and can be selected by highlighting them with the joystick. The MCLK options are listed on the right column and can be selected by highlighting them with the joystick. MCLK options written in grey indicate clock rates requiring a higher V_{CORE} setting than the current selection. If the test equipment does not facilitate frequency measurement, the user can partially observe the frequency from the blinking of LED1.

For each setting, the user can measure V_{CORE} at the VCORE test point, the DCO frequency at the MCLK/SMCLK test points, and the active mode current via the MSP430 power jumper JP1. Pressing S1 turns off the LCD to give a more accurate active mode current measurement. LED2 blinks briefly every 2 seconds while the LCD is off to indicate the board is still active. Pressing any button turns the LCD back on.

Press center on the joystick to return to the Power Test sub-menu.

5.2.5.2 Low Power

This application allows the user to observe the current consumption of the different low-power modes supported by the MSP430F5438A. Select a low-power mode configuration using the joystick, then press center on the joystick to enter the low-power mode. The LCD shuts down to give a more accurate current reading. The current can be measured via the MSP430 power jumper JP1. Pressing any button turns the LCD back on and wakes the board from low-power mode.

Select Quit to return to the Power Test sub-menu.

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5.2.6 ADC Temp

The ADC Temp application demonstrates the use of the ADC with the temperature sensor to measure ambient temperature using two different methods. Users can observe the current consumption of the two modes via the MSP430 power jumper JP1. On entering the application, the LCD backlight is turned off so as not to affect current measurement. Use the joystick to highlight either Flag Poll Mode or Interrupt Mode. Flag Poll Mode uses software to trigger sampling and ADC conversions, whereas Interrupt Mode is a fully hardware driven implementation. The temperature in degrees Celsius and Fahrenheit is updated every 2 seconds, as well as the V_{CC}.

Press center on the joystick to return to the main menu.

5.3 Main Menu > Settings Menu

This option allows the user to modify various settings of digital components and calibrate analog sensors available on board. Select Quit or press S1 to return to the main menu. All settings are stored into the memory upon exiting the setting menu screen.

In this screen, if there is no action from user within 10 seconds, the board goes into sleep mode. By default, the board returns to active mode in the main menu if any button is pressed or the board is tilted.

5.3.1 Set Time

This option allows the user to modify the current time by moving up or down to modify the time values and moving left or right to select either Hour, Minute, or Second.

Press center on the joystick to return to the Settings menu.

5.3.2 LCD Contrast

This option allows the user to modify the contrast of the LCD by pressing S1 to reduce the contrast and pressing S2 to increase the contrast.

Press center on the joystick to return to the Settings menu.

5.3.3 LCD Backlight

This option allows the user to modify the backlight of the LCD by pressing S1 to dim the backlight and pressing S2 to brighten the backlight.

Press center on the joystick to return to the Settings menu.

5.3.4 Accelerometer Settings

The user can recalibrate the accelerometer sensor by pressing up while keeping the board flat and stationary. This screen also allows the user to specify whether or not the board returns from sleep mode if the board is tilted. This option can be selected with either S1 for No or S2 for Yes. To select different digits, press left or right.

Press center on the joystick to return to the Settings menu.

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Frequently Asked Questions, References, and Schematics

6.1 Frequently Asked Questions

1. **Which devices can be programmed with the Experimenter Board?**

   The MSP-EXP430F5438 board is designed specifically to demonstrate the MSP40F5438IPZ and the MSP430F5436IPZ silicon. Future MSP430 devices may be released which are also supported.

2. **The MSP430F5438A is no longer accessible via JTAG. is something wrong with the device?**

   Verify that the jumpers are configured correctly. See Chapter 4 for jumper configuration.

   Verify that the target device is powered properly.

   If the target is powered locally, verify that the supplied V_{CC} is sufficient to power the board. Check the device data sheet for the specification.

3. **I did every step in the previous question but still could not use or communicate with the device.**

   In the case that you are using the REV_02, check if you are using the test version of silicon, the XMS430F5438. Improper programming of the device could lead to a JTAG total lockup condition. The cause of this problem might be an incorrect device selection when creating a new project in CCS (selecting XMS430F5438 instead of MSP430F5438) or programming the device without a stable power source (low battery, switching the Power Selector while programming or absence of the MSP430 power jumper JP1 during programming).

   Regardless of the revision of silicon, completely reset the device, first unplug all power sources and connections (JTAG and USB cables). Set the Power Selector Switch to FET mode. Use a jumper cable to briefly short one of the GND test points with the 430 PWR test point. The device should now be released from the lockup state.

4. **Does the Experimenter Board protect against blowing the JTAG fuse of the target device?**

   No. Fuse blow capability is included in all Flash-based MSP430 devices to protect the user's intellectual property. Care must be taken to avoid enabling of the fuse blow option during programming, as that would prevent further access to the MSP430 device via JTAG.

5. **I am measuring system current in the range of 30 mA. Is this normal?**

   The LCD and the LCD backlight require a large amount of current (approximately 20 mA to 25 mA) to operate. This results in a total system current consumption in the range of 30 mA. If the LCD backlight is on, 30 mA is considered normal.

   To make sure that the board is operating as expected, disable the LCD and the LCD backlight and measure the current again. The entire board current consumption should not exceed 10 mA in this state. Note that the current consumption of the board could vary greatly depending on the optimization of the board configurations and the applications.

   The expected current consumption for the MSP430F5438A in standby mode (LPM3), for example, is approximately 2 µA. Operating at 1 MHz, the total current consumption should not exceed approximately 280 µA.

6. **The battery option for the Power Selector Switch does not seem to supply enough current for the Experimenter Board.**

   The LCD and the LCD backlight require large amount of current to operate. Prolonged operation with the LCD enabled could drain the batteries at a fast rate. Replace the batteries if the battery voltage measured drops significantly.

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7. **I have trouble reading the LCD clearly. Why is the LCD contrast setting so low?**

   The LCD contrast is highly dependent on the voltage of the system. Changing power source from USB (3.3 V) to batteries (approximately 3 V) can greatly reduce the contrast. Fortunately, the LCD driver supports adjustable contrast. The specific instruction can be found in the LCD user's guide. The MSP-EXP430F5438 software driver also provides the function call halLcdSetContrast() to adjust the contrast in software.

8. **When I run the example code, nothing happens on the LCD.**

   Possible sources of error include:

   - Make sure that the SYS PWR jumper (JP2) and the 14-pin JTAG cable are properly connected.
   - The contrast settings differ from board to board. Try switching between the different power connections (FET, USB, and BATT) to see if the contrast looks better. The example software also allows you to increase or decrease the contrast settings.
   - Revision 0-03 of the MSP-EXP430F5438 board is incompatible with revision 0-02 (distributed in limited quantities for the Advanced Technical Conference 2008). The revision number can be found on the back of the experimenter board. In Revision 0-03, P8.7 is grounded to differentiate this revision from previous revisions of the board, and the example software uses the internal pullup resistor on P8.7 to check this pin for compatibility with the software version. If the software and hardware do not match, the code never exits a while(1) loop at the beginning of the UserExperience() function of UserExperience.c.

9. **What is the correct orientation of the part in the socket?**

   Pin 1, denoted by a single small indented circle on the device package, must align with the arrow on the socket.

10. **When I compile the code, I get the following error: could not open source file ..\MSP-EXP430F5438 HAL\hal_MSP-EXP430F5438.h.**

    The length of the file path that Eclipse can accept is limited. Move the project higher in your directory structure (closer to the root directory of the drive) and the project should compile without error.

6.2 References

1. *MSP430x5xx and MSP430x6xx Family User's Guide* (SLAU208)
2. MSP430F543xA, MSP430F541xA Mixed Signal Microcontroller data sheet (SLAS655)
3. Code Composer Studio (CCStudio) Integrated Development Environment (IDE) (http://www.ti.com/tool/ccstudio)
4. *MSP430 Interface to CC1100/2500 Code Library* (PDF: SLAA325, associated files: (SLAA325.ZIP)
5. TPA301: 350-mW Mono Audio Power Amplifier data sheet (SLOS208)
6. ADXL322 data sheet (www.analog.com)
7. Hitachi HD66753 LCD data sheet
8. Hitachi HD66753 LCD user's guide

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6.3 Schematics

The original Eagle CAD schematics and Gerber files are available for download (SLAC228).

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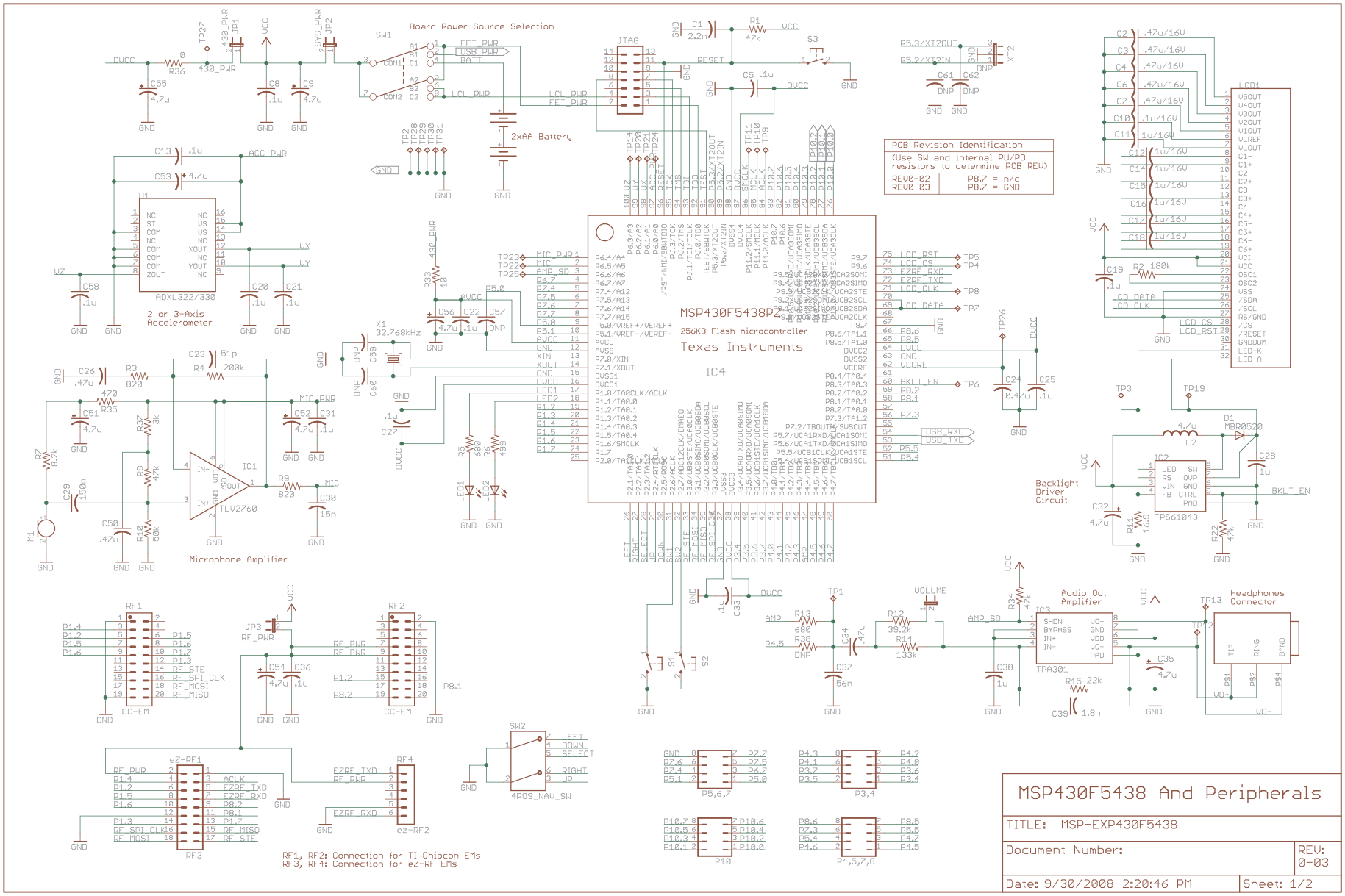

Figure 6-1. MSP430F5438A and Peripherals Schematic

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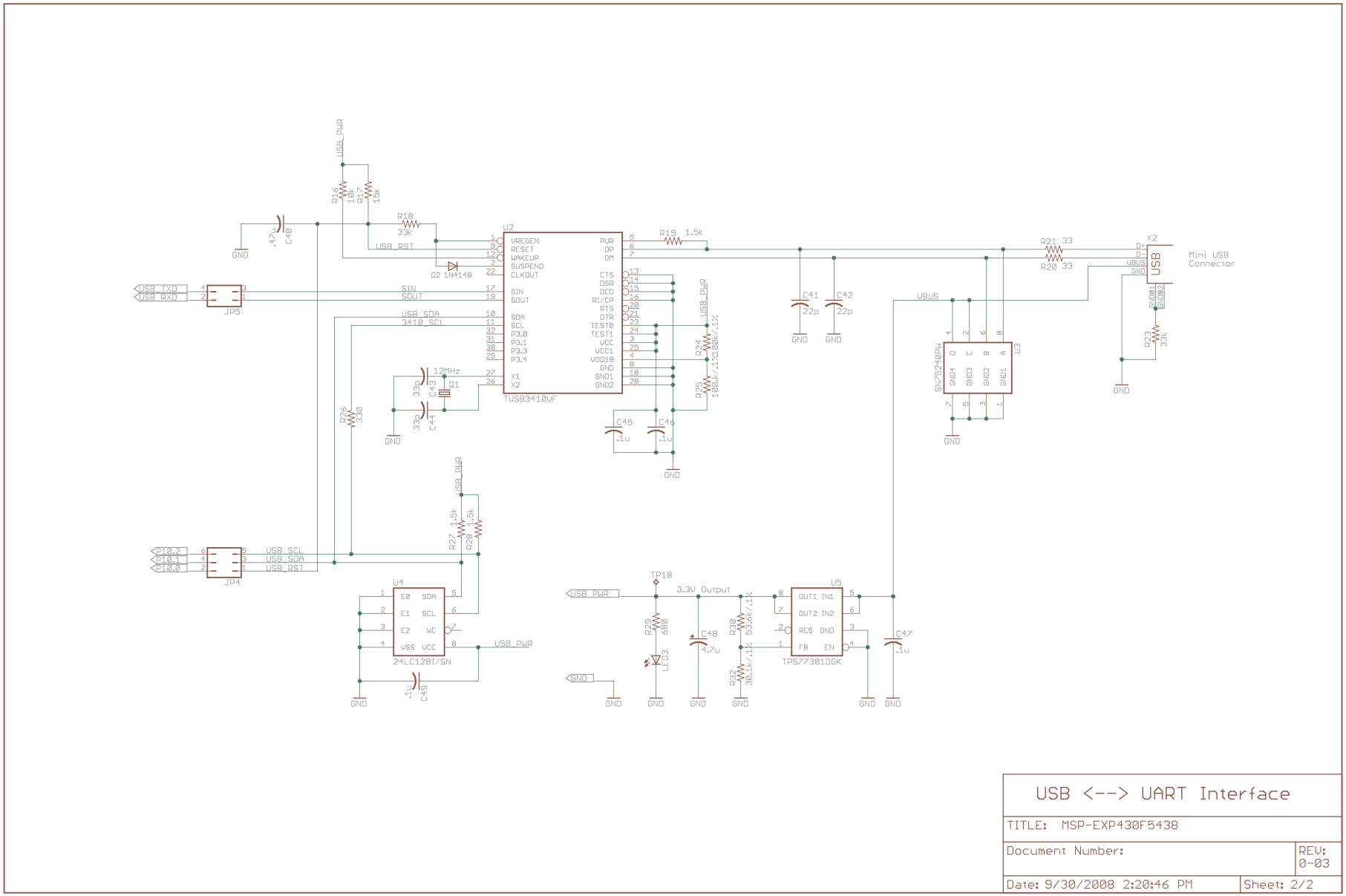

Figure 6-2. USB to UART Schematic

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Revision History

Changes from H Revision (July 2013) to I Revision	Page
• Changed Section 3.2.1 from "Example Software for Older Devices" to "Deprecated Devices", because the older devices are no longer supported	11

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

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