CPE 325: Embedded Systems Laboratory
Laboratory #3 Reference
TI MSP430FG4618/2013 Experimenter's Board

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Table of Contents

This document gives a brief description of the TI MSP430FG4618/F2013 Experimenter's board. Specifically, it describes the following:

Available components in MSP430FG4618/F2013 Experimenter Board

Locating different components on the board

Schematic of MSP430FG4618/F2013

WARNING! IMPORTANT NOTE: Before handling any hardware development boards or components, one should note that they can be damaged by electrostatic discharge (ESD). This is typically solved by grounding oneself using an anti-static wrist wrap, but these may not be readily available in the lab. One should try to discharge any static electricity that might have been generated by touching the case of your lab computer or a grounded metal object for a second before handling the board.

1 Board Overview

Figure 1 shows a photo of the TI's Experimenter's board used in the Embedded Systems Laboratory. Figure 2 shows its block diagram illustrating main components on the board. We can identify the following board components.

Microcontrollers. The board has two separate MSP430 microcontrollers and a number of interfaces for use in a variety of applications. The two onboard microcontrollers are the MSP430FG4618 and MSP430F2013. The main microcontroller used in this lab is MSP430FG4618.

4-MUX LCD. The Softbaugh SBLCDA4 LCD display supports 4-MUX operation and is interfaced to the MSP430FG4618 LCD driver peripheral. More information is available in the manufacturer LCD datasheet.

Push-on Buttons. The two buttons, S1 and S2 are connected to pins on Port 1 (P1) of the MSP430FG4618.

Light Emitting Diodes (LEDs). There are four onboard LEDs, three of which are connected to the MSP430FG4618, and one connected to the F2013. LED3 and LED4 can be disabled using jumpers JP2 and JP3, respectively. Although not shown on the functional diagram, LED1 and LED2 are located between headers H4 and H2; LED3 is to the left of the F2013 CPU; and LED4 is located directly beneath jumper JP3.

Buzzer. A buzzer is connected to one of the MSP430FG4618 port pins and can be disabled using jumper JP1.

Single-Touch Capacitive Sensing Interface. A 16-segment touch pad in the shape of a number "4" is connected to the data pins of the MSP430F2013, which then relays the data to the MSP430FG4618 using the inter-processor communications peripherals on each CPU.

RS232 Serial Communication Port. A standard 9-pin serial communications port is connected to the MSP430FG4618 USCI peripheral and can be used when the USCI is configured in UART mode.

Microphone & Analog Out. A microphone is connected to a port pin of the MSP430FG4618, and the input to the 3.5mm analog out can be connected to the output from the MSP430FG4618's 12-bit digital to and analog (DAC12) convertor. More details can be found on pages 5-6 of [7].

Wireless Communication Module Interface. This board supports an additional wireless communication expansion module. Several different radio frequency expansion modules are available, but will not be used in this lab.

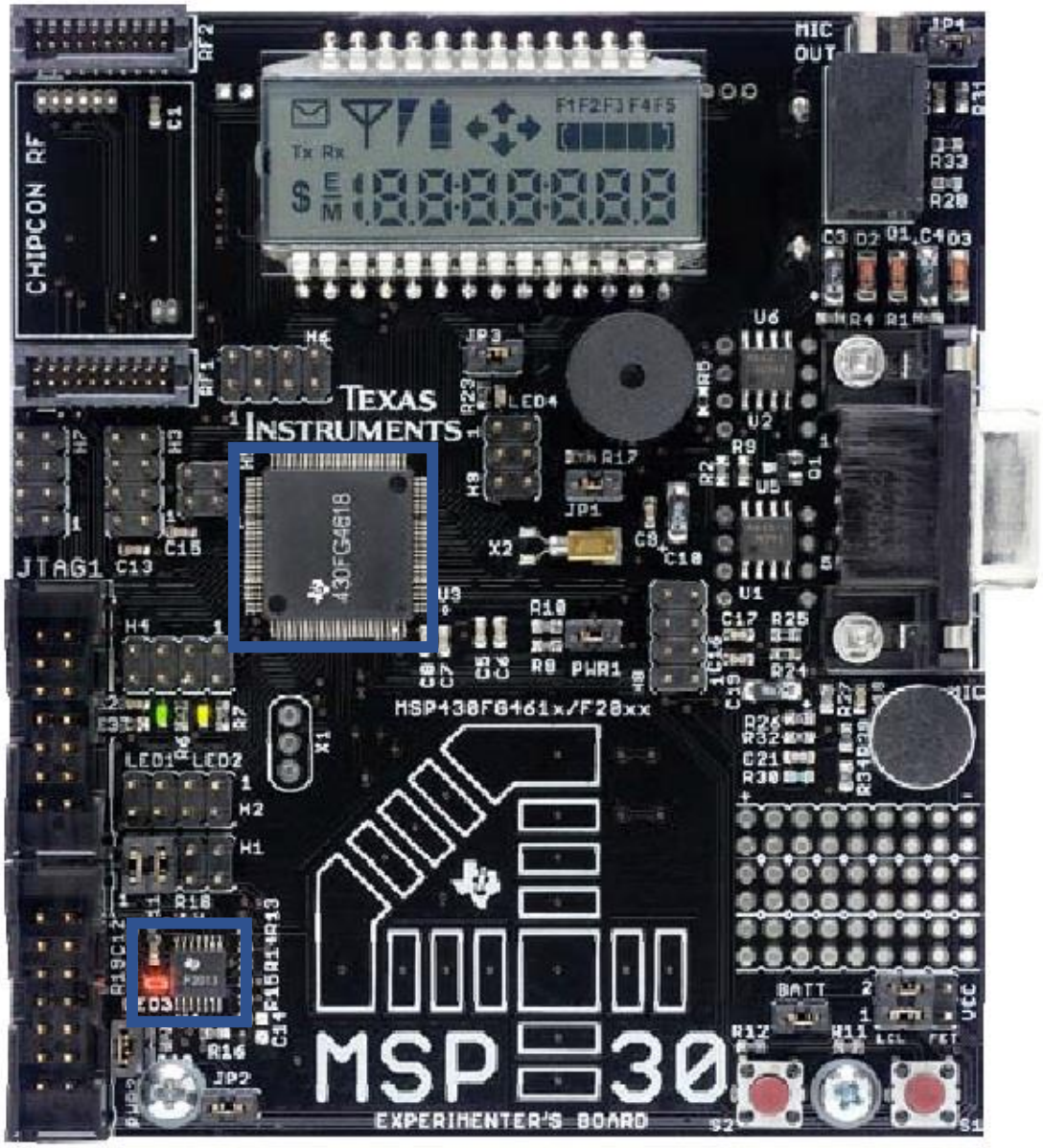

Figure 1. MSP430 Experimenter's Board.

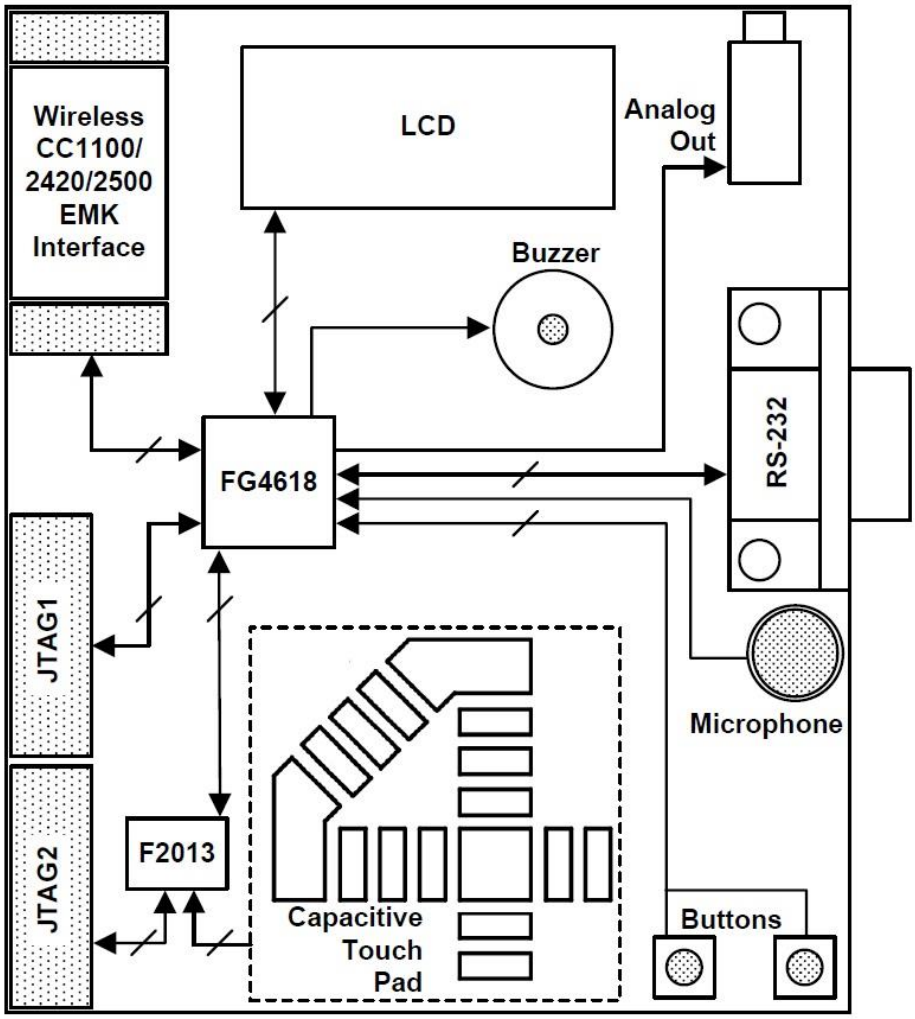

Figure 2. Block Diagram of the Experimenter's Board.

2 Board Power Setup

The board can be powered by battery or through the TI USB JTAG programmer. For the purposes of this lab, the JTAG will be used to power the board. The jumpers PWR1 and PWR2 determine whether or not the MSP430FG4618 and MSP430F2013 are respectively powered. The jumpers VCC_1, VCC_2, and BATT determine the power source for this board. A jumper diagram for the board power is shown in **Figure 3**.

The jumpers VCC_1 and VCC_2 will need to be set to FET for all assignments in this lab (In other words, the jumper will need to be placed on the rightmost two pins of the each header). The BATT jumper will need to be placed on one of the pins so that it does not connect the two pins, since we will not be using the batteries for these projects but don't want to lose the jumpers themselves. The jumpers are set properly and students typically do not need to change power settings.

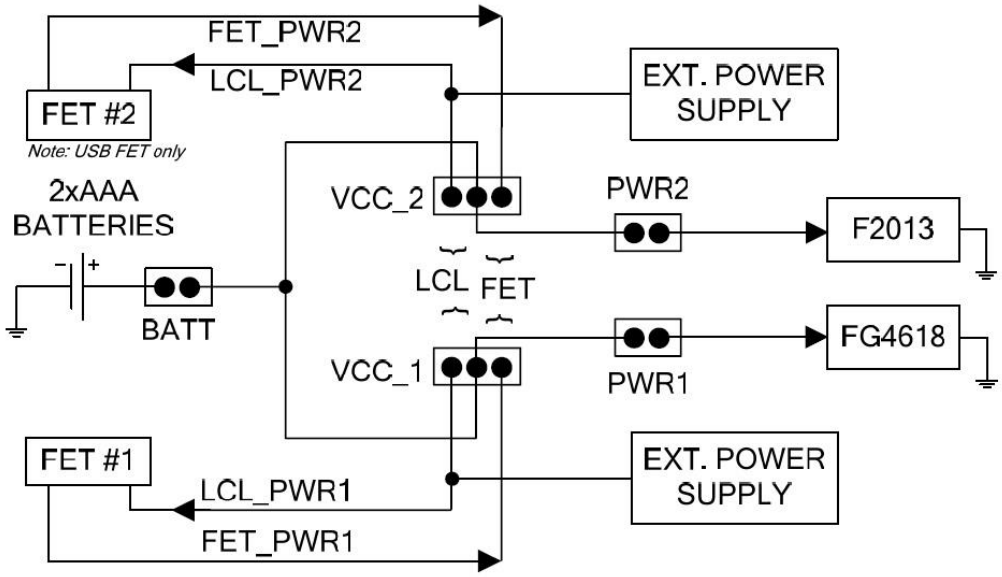

Figure 3. Board Power Supply Configuration.

2.1 Required Jumper Settings for Lab Assignments

One should note that the boards in the lab should already be configured according to the configuration table below. There should be no need to change the jumper settings, but if a board is not correctly configured, these settings should be used to reset the jumpers. If one should need to change a jumper setting for any reason, one should make sure to disconnect board power by either disconnecting the JTAG, batteries, or external power supply before doing so. The table below shows the default jumper configuration.

Default Jumper Assignments											
Header	PWR1	PWR2	BATT	VCC_1	VCC_2	JP1	JP2	JP3	JP4	H1 (1-2,3-4)	H1 (1-2,3-4,5-6,7-8)
Jumper Connected	YES	YES	NO	FET	FET	YES	YES	YES	YES	YES	YES*
Pins Connected	1&2	1&2	NA	2&3	2&3	1&2	1&2	1&2	1&2	1-2,3-4	1-2,3-4

2.2 Jumper Locations

Figure 4 shows the names and locations of each board jumper. One should take care to check the jumper settings listed above before applying power to the board. As mentioned previously, one should never change jumpers while the board is powered. The following diagram can also be found in Appendix B of [7].

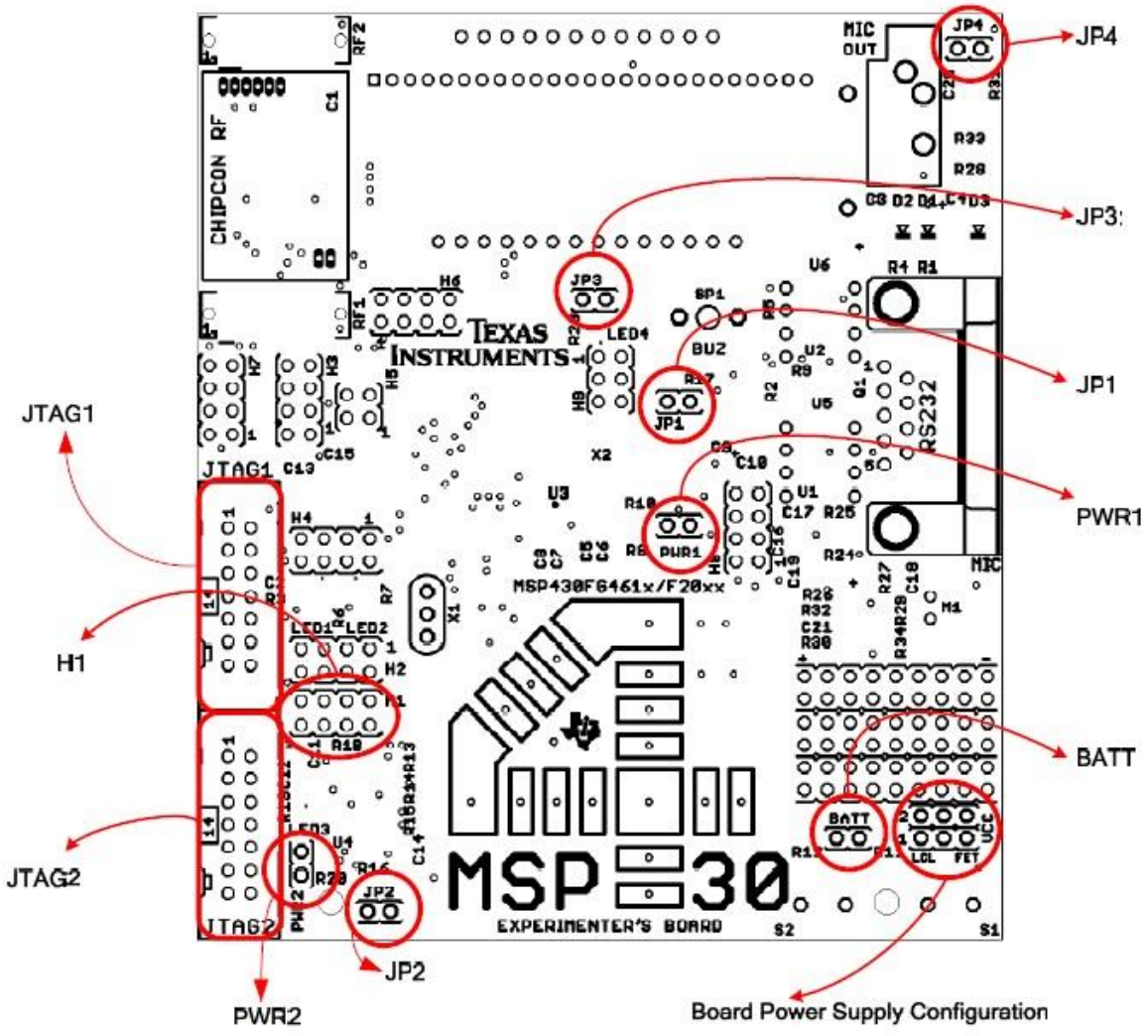

Figure 4. Jumper locations.

2.3 Jumper Functionality

The following table in Figure 5 outlines the functions of each jumper on the board. One should note that the "Required" column of the table refers to whether or not the jumper is required for board operation, but does not necessarily refer to the jumper configuration utilized for programming in this lab.

Header	Functionality when jumper present	Functionality when jumper absent	Requirement
PWR1	Provides power to MSP430FG4618 Also used to measure current consumption of the MSP430FG4618	MSP430FG4618 is not powered	Required for MSP430FG4618 use
PWR2	Provides power to MSP430F2013 Also used to measure current consumption of the MSP430F2013	MSP430F2013 is not powered	Required for MSP430F2013 use
BATT	On-board batteries provide power Also used to measure current consumption	Batteries will not provide power to either MSP430	Required for use with AAA batteries
JP1	Buzzer enabled and connected to P3.5 of the MSP430FG4618	Buzzer muted	Optional
JP2	LED3 enabled and connected to P1.0 of the MSP430F2013	LED3 connection disabled	Optional / Required for LED3 use
JP3	LED4 enabled and connected to P5.1 of MSP430FG4618	LED4 connection disabled	Optional / Required for LED4 use
JP4	Attenuation set to approximately 69% of the DAC12 audio output	98% attenuation of the DAC12 audio output	Optional
Header H1 (Pins 1-2, 3-4)	**I2C Configuration** 1-2: SDA – UCB0SDA 3-4: SCL – UCB0SCL	No communication possible via I2C	Required for inter-processor communication
Header H1 (Pins 1-2, 3-4, 5-6, 7-8)	**SPI Configuration** 1-2: SDI – UCB0SIMO 3-4: SDO – UCB0SOMI 5-6: P1.4 – P3.0 (CS) 7-8: SCLK – UCB0CLK	No communication possible via SPI	Required for inter-processor communication

Figure 5. Jumper and header functionality.

3 Connecting and Programming the MSP430FG4618

3.1 Connecting the Texas Instruments (TI) USB JTAG Programmer

The JTAG should be connected to the host PC via the USB cable. The small 14-pin ribbon cable should first be connected to the JTAG itself, and then the other end of the cable should be attached to the JTAG1 port on the board to program the MSP430FG4618. To program the MSP430F2013, the other end of the ribbon cable should be attached to the JTAG2 port of the board.

3.2 IAR Embedded Workbench Software Setup

The following assumes that a project is setup in IAR Embedded Workbench. To begin, one should bring up the project options by selecting **Options** from the **Project** drop down menu. Under the **General Options** tab, **Target** should be selected, and the **MSP430FG4618** should be selected as seen below.

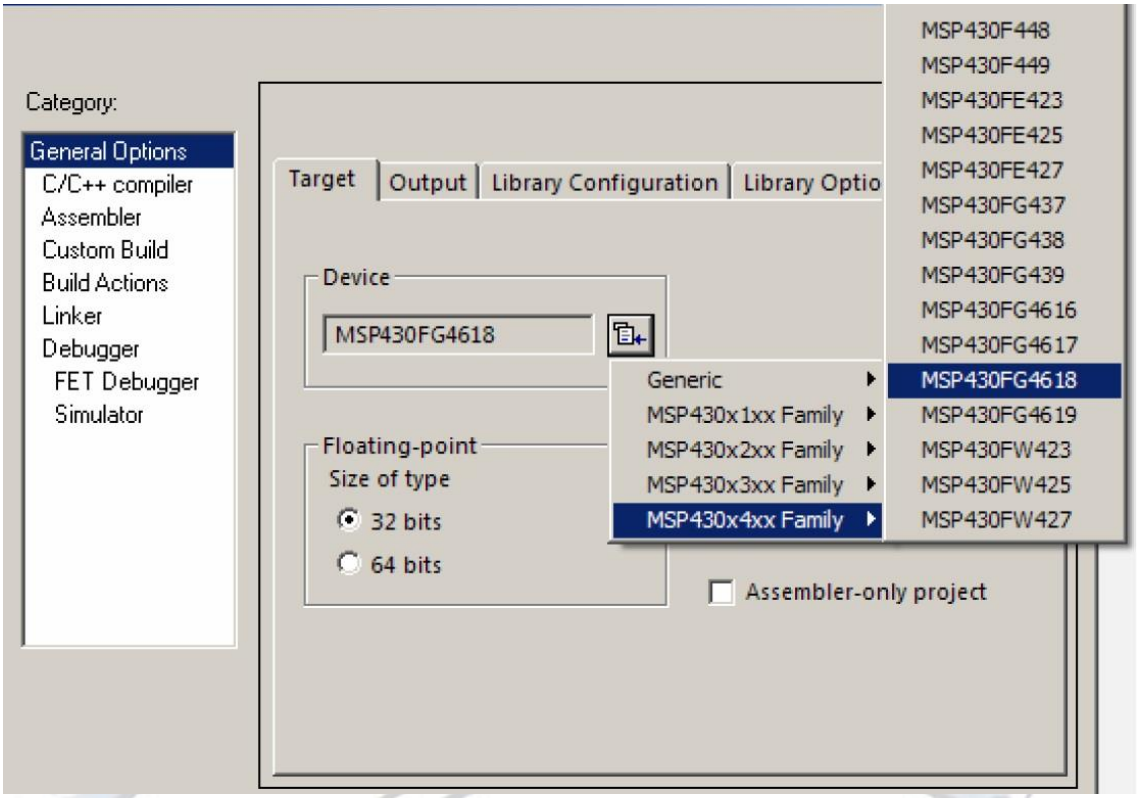

Figure 6. Specifying device (MSP430FG4618) in IAR Workbench.

3.3 Code Composer Studio Software Setup

When creating a new project the Target field should be properly set by selecting MSP430FG4618 as shown in Figure 7.

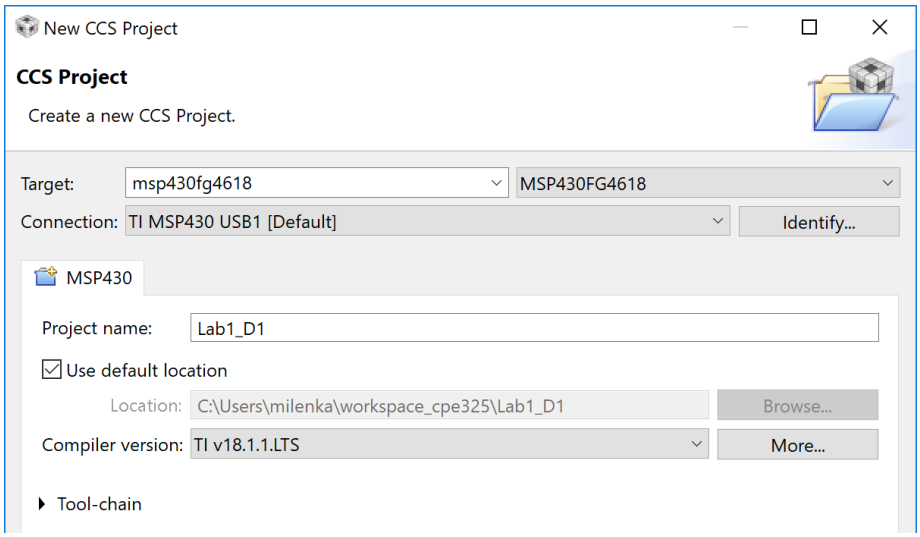

Figure 7. Specifying device (MSP430FG4618) in CCStudio.

4 Official Board Schematic

The official board schematic from [7] is shown in Figure 8.

5 References

1. *MSP430x4xx Family* User's Guide, Texas Instruments literature number SLAU056
2. *MSP430x2xx Family* User's Guide, Texas Instruments literature number SLAU144
3. *MSP430xG461x device data sheet*, Texas Instruments literature number SLAS508
4. *MSP430x20x3 Device datasheet*, Texas Instruments literature number SLAS491
5. *MSP-FET430 Flash Emulation Tool (FET) (for use with IAR v3.x) User's Guide, Texas Instruments literature number SLAU138*
6. *MSP430 Interface to CC100/2500 Code Library, Texas Instruments literature number SLAA325*
7. *MSP430FG4618/F2013 Experimenter's Board User's Guide, Texas Instruments literature number SLAU213A*

Reference Documentation can be downloaded from the Texas Instruments website (www.ti.com). It is suggested to use the document literature number when searching for quick access.

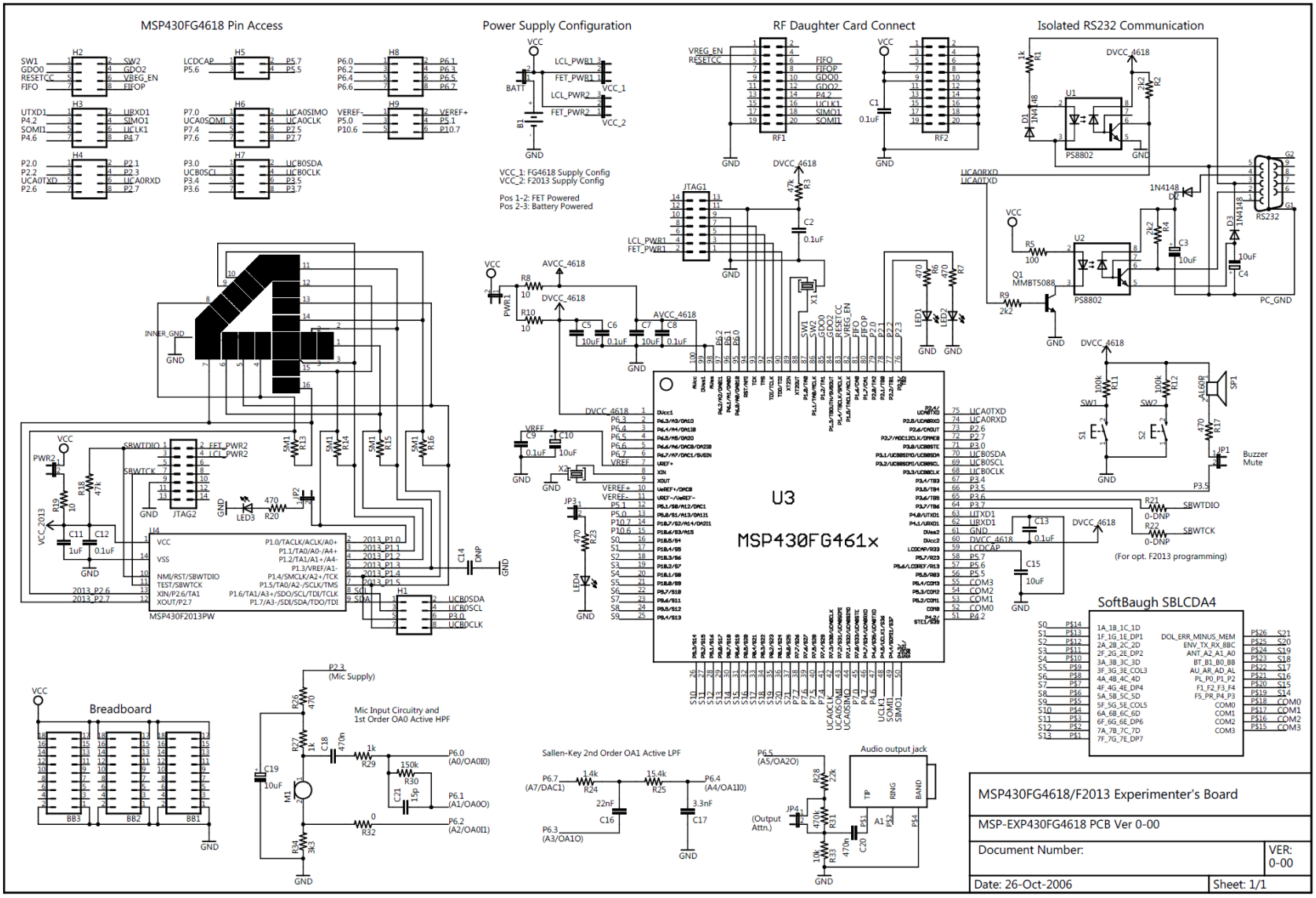

Figure 8. Experimenter's Board Schematic

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