EVAL-ADUCM410QSPZ/EVAL-ADUCM410QSP1Z User Guide
UG-1541

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ADuCM410 Development System: Getting Started Tutorial

FEATURES

Interface through mIDAS-Link emulator
Power supply options: 9 V wall wart adapter, 5 V external supply terminal block, or USB supply
ADuCM410 development system facilitates performance evaluation of the ADuCM410 with a minimum of external components

DEVELOPMENT SYSTEM KIT CONTENTS

EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z evaluation board
An Analog Devices, Inc., J-Link OB emulator (USB-SWD/UART-EMUZ)
mIDAS-Link emulator
1 USB cable

DOCUMENTS NEEDED

ADuCM410 data sheet
ADuCM410 hardware reference manual

SOFTWARE NEEDED

ADuCM410 installer
MDIOWSD
Keil µVision5
IAR installer
IAR IDE software

GENERAL DESCRIPTION

The ADuCM410 is a fully integrated, single package device that incorporates high performance analog peripherals together with digital peripherals. The ADuCM410 features 16-bit, 2 MSPS data acquisition on up to 16 input pins, an Arm® Cortex®-M33 processor, 12 voltage digital-to-analog converters (DACs), and 2 × 512 kB Flash/EE memory, packaged in a 5 mm × 5 mm, 81-ball chip scale package ball grid array (CSP_BGA) and a 64-ball wafer level chip scale package (WLCSP).

The ADuCM410 development system (EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z) is fully packaged to evaluate all features of the ADuCM410, a high precision analog microcontroller. The ADuCM410 includes 16 external AINx channels, voltage output DACs (VDACs), four programmable gain amplifiers (PGAs), measurement of the PGA current channels, and various shared functions with the general-purpose input/outputs (GPIOs) that are configurable through registers. The VDAC channels generate an output range up to 2.5 V or 3.3 V full scale.

The EVAL-ADUCM410QSPZ and EVAL-ADUCM410QSP1Z board uses a low noise, low dropout (LDO) linear regulator to power up the device. The ADuCM410 is powered up using the following three options: a 9 V wall wart adapter, a 5 V external supply terminal block, and a USB supply.

This user guide describes how to configure the CSP_BGA version (EVAL-ADUCM410QSPZ) and WLCSP version (EVAL-ADUCM410QSP1Z) evaluation boards by providing step by step procedures about the connections on the evaluation boards. This user guide also contains information regarding which evaluation versions of the third-party software tools to download. Additionally, this user guide provides instructions on how to load the supplied code examples. See Figure 1 for a photograph of the EVAL-ADUCM410QSPZ board.

Following this guide allows users to generate and download their own user code to use in their own unique end system requirements.

Complete specifications for the ADucM410 are available in the ADuCM410 data sheet, which must be consulted in conjunction with this user guide when using the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board.

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REVISION HISTORY

9/2020—Revision 0: Initial Version

EVAL-ADUCM410QSPZ PHOTOGRAPH

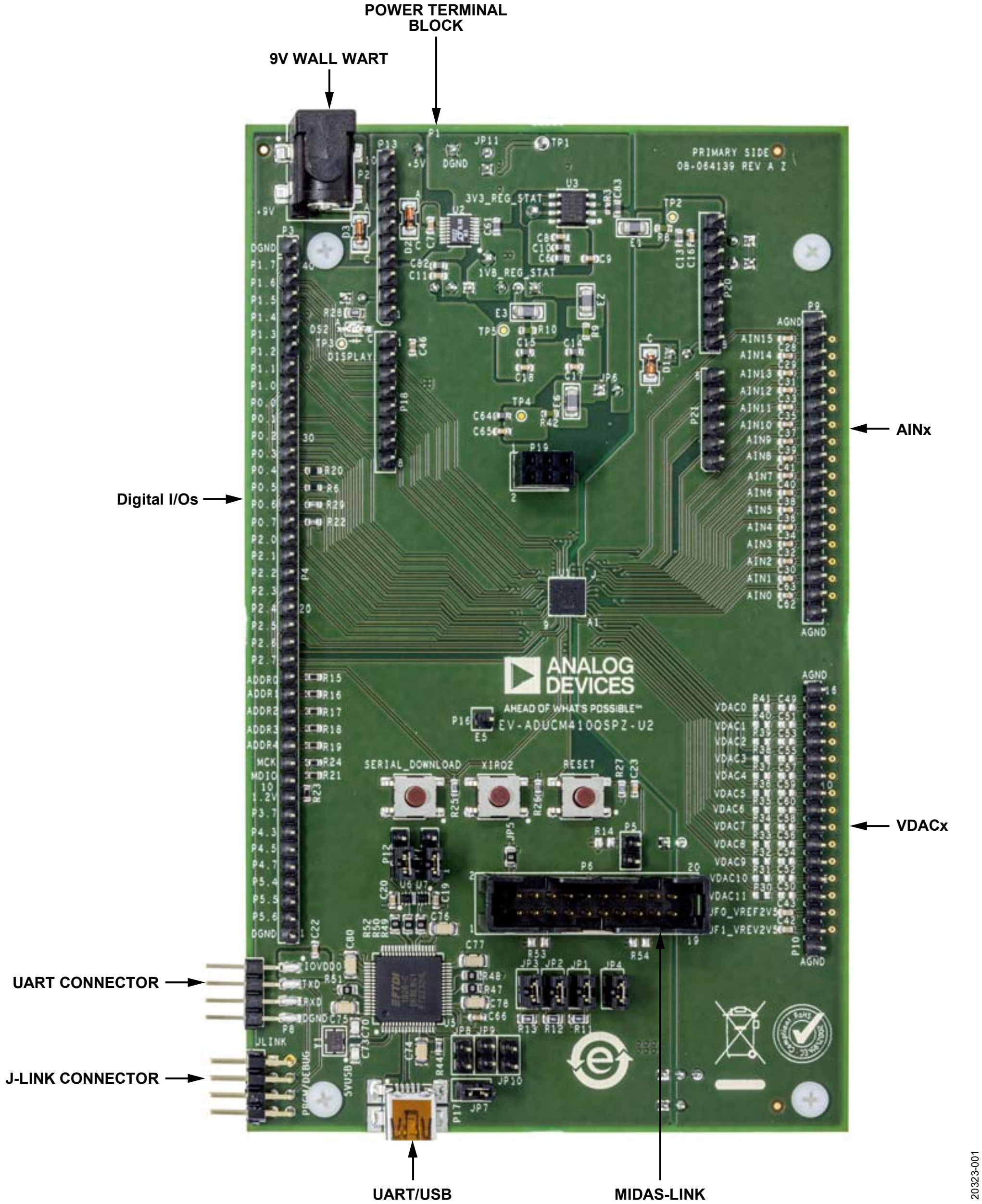

Figure 1.

EVALUATION BOARD HARDWARE

POWER SUPPLIES AND DEFAULT LINK OPTIONS

The EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z development system can be powered with the following options: a 5 V terminal block from bench supplies, a 9 V wall mounted adapter, or a USB supply. See Table 1 for the on-board jumper configurations for each power supply option and other optional connectors. Locate Pin 1 for each header pin for the supply.

For any of the power supply options, place the jumpers shown in Table 1 in the required operating setup before supplying power to the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z (see Figure 2).

Each power supply is decoupled to the relevant ground plane with 10 μF and 0.1 μF capacitors. Each device supply pin is also decoupled with a 10 μF and 0.1 μF capacitor pair to the relevant ground plane.

EVAL-ADUCM410QSPZ/EVAL-ADUCM410QSP1Z Board Interface

The ADuCM410 has on-chip digital peripheral interfaces, such as a universal asynchronous receiver/transmitter (UART), serial peripheral interface (SPI), management data input/output (MDIO), and I²C. See Figure 1 for the on-board component locations.

Bench Power Supply Option

The ADuCM410 requires 5 V for normal operation. Replicating the jumper configuration in Table 1, the 5 V terminal block supply passes through LDO regulators to regulate the power supply. The ADuCM410 can also configure the IOVDD1 and DVDD power supplies to be 1.2 V or 1.8 V, and 1.8 V or 3.3 V, respectively. To configure these supply options, select the required position on Jumper P11 for IOVDD1 and Jumper P15 for DVDD. P11 and P15 are on the solder side (bottom side of the evaluation board.)

Table 1. Jumper Configurations for the EVAL-ADUCM410QSPZ and EVAL-ADUCM410QSP1Z

Jumper No.	Optional	Jumper Configuration	Bench Supply or 9 V Wall Wart
JP6—Future Technology Devices International (FTDI) Supply	No	Short.	Yes
JP7—USB	Yes	Short.	Yes
P11—IOVDD1	No	Pin 1 and Pin 2 = 1.8 V, Pin 2 and Pin 3 = 1.2 V.	Yes
P15—DVDD	No	Pin 1 and Pin 2 = 3.3 V, Pin 2 and Pin 3 = 1.8 V.	Yes
P7—SIN1 Level Shifter	Yes	Pin 1 and Pin 2 = IOVDD0, Pin 2 and Pin 3 = IOVDD1.	Yes
P12—SOUT1 Level Shifter	Yes	Pin 1 and Pin 2 = IOVDD0, Pin 2 and Pin 3 = IOVDD1.	Yes
P14—LED Display	Yes	Short.	Yes
P5—IOVDD0 Pull-Up	Yes	Short.	Yes
JP1—SWCLK Pull-Up	Yes	JP3, JP4, and JP5 are optional pull-ups. The R14 resistor (see Figure 1) must be populated with values that are at least 100 kΩ to use these optional pull-ups.	Yes
JP2—SWDIO Pull-Up	Yes	Short.	Yes
JP3—P2.2 or SWO Pull-Up	Yes	Short.	Yes
JP8 to JP10	Yes	These pins use the on-board FTDI chip that can be used on the I²C downloader.	Yes

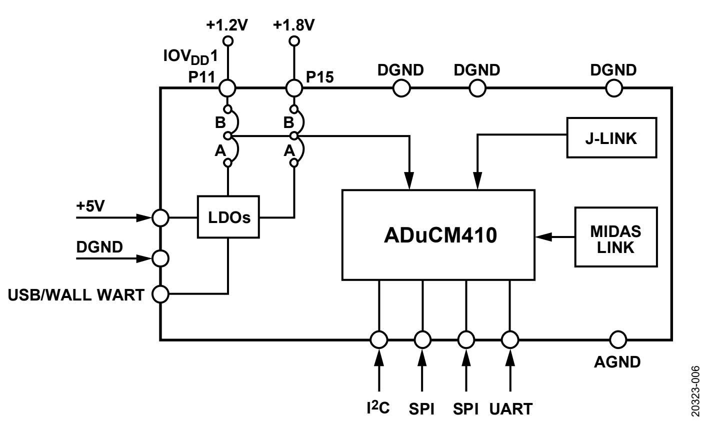

Figure 2. On-Board Jumper Configuration Diagram

HARDWARE MODULE

ADUCM410 AND ARDUINO POWER

Customers may want to connect their own custom circuits to the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z evaluation board.

Four connectors of the EVAL-ADUCM410QSPZ and EVAL-ADUCM410QSP1Z evaluation boards support an Arduino® Uno or Arduino Zero connection interface to external PCBs.

The EVAL-ADUCM410QSPZ/EVAL-ADUCM410QSP1Z evaluation boards can power the external Arduino-based board. Inversely, the Arduino is also capable of powering up the whole module, including the ADuCM410. Table 2 shows the jumper connections for the power configurations of the EVAL-ADUCM410QSPZ/EVAL-ADUCM410QSP1Z and the Arduino.

Table 2. Power Configurations for the EVAL-ADUCM410QSPZ (BGA) and EVAL-ADUCM410QSP1Z (WLCSP)

EVAL-ADUCM410QSPZ	EVAL-ADUCM410QSP1Z	Optional	Jumper Information	Jumper Configuration
P22	P20	Yes	Power selection either via USB power or via Arduino power	Pin 1 and Pin 2 = USB powered. Pin 2 and Pin 3 = Arduino powered. Do not use USB power for the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board if the Arduino and the evaluation board are powered up together.
JP16	JP16	Yes	Power from Arduino via the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board	If this jumper is shorted, the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z also power up the Arduino.
JP11[1]	JP11[1]	Yes	3.3 V LDO output	Short.
JP12[1]	JP12[1]	Yes	3.3 V power to Arduino IOREF pin	Short.
JP13[1]	JP13[1]	Yes	ADuCM410 reset to Arduino reset	Short.
JP14[1]	JP14[1]	Yes	3.3 V power to Arduino	Short.
JP15[1]	JP15[1]	Yes	5 V power to Arduino	Short.

[1] The JP11 to JP15 connectors are used if the Arduino is powered up via the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board.

ARDUINO CONNECTOR

The EVAL-ADUCM410QSPZ and EVAL-ADUCM410QSP1Z have Arduino R3 headers directly compatible with Arduino Uno and Arduino Zero. Using the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board with Arduino Uno or equivalent is recommended. The Arduino pins used by the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board are given in Table 3.

For more information on the ADuCM410 pins, refer to the ADuCM410 data sheet and ADuCM410 hardware reference manual (UG-1807).

Table 3. EVAL-ADUCM410QSPZ/EVAL-ADUCM410QSP1Z Pin Connections to Arduino Pins

EVAL-ADUCM410QSPZ (CSP_BGA)/ EVAL-ADUCM410QSP1Z (WLCSP) R3 Header Pins	Arduino Pin
Digital	
P13 (Both EVAL-ADUCM410QSPZ and EVAL-ADUCM410QSP1Z)	
P1.2/SCL1	SCL
P1.3/SDA1	SDA
AREF	AREF
DGND	GND
P0.0/SCLK0	SCK
P0.1/MISO0	MISO
P0.2/MOSI0	MOSI
P2.0	SS
P0.3/CS0	GPIO
P2.1/IRQ2	GPIO
P18 (EVAL-ADUCM410QSPZ) and P16 (EVAL-ADUCM410QSP1Z)	
P1.0/SIN1	RXD
P1.1/SOUT1	TXD
P0.6/SCL2	GPIO
P0.7/SDA2	GPIO
P1.4/SCLK1	GPIO
P1.5/MISO1	GPIO
P1.6/MOSI1	GPIO
P1.7/CS1	GPIO
P19 (EVAL-ADUCM410QSPZ) and P18 (EVAL-ADUCM410QSP1Z)	
P0.1/MISO0	MISO
IOVDD0	3.3V
P0.0/SCLK0	SCK
P0.2/MOSI0	MOSI
RESET	RESET
DGND	GND
Power	
P20 (EVAL-ADUCM410QSPZ) and P19 (EVAL-ADUCM410QSP1Z)	
Arduino or ADuCM410 Power	7V VIN
AGND	GND
AGND	GND
Arduino or ADuCM410 Power	5V
Arduino or ADuCM410 Power	3V3
Arduino or ADuCM410 Reset	RESET
Arduino or ADuCM410 Power	IOREF
No Connect	No connect
Analog	
P21 (Both EVAL-ADUCM410QSPZ and EVAL-ADUCM410QSP1Z)	
AIN0	ADC5
AIN1	ADC4
AIN2	ADC3
AIN3	ADC2
AIN4	ADC1
AIN14	ADC0

GETTING STARTED

SOFTWARE INSTALLATION PROCEDURES

Perform the following steps before plugging any of the USB devices into the PC:

1. Close all open applications on the PC.
2. After downloading the ADuCM410 installer from ftp://ftp.analog.com/pub/microconverter/ADucM410, double click **ADuCM410Installer-V0.1.0.0.exe** and follow the instructions shown in Figure 3. The **ADuCM410-Installer Setup** window displays the installation method and component selection as shown in Figure 3. The end user license agreement (EULA) is displayed after proceeding through the **ADuCM410Installer Setup** window. Accepting the EULA extracts the installer, and rejecting the EULA cancels the installer.

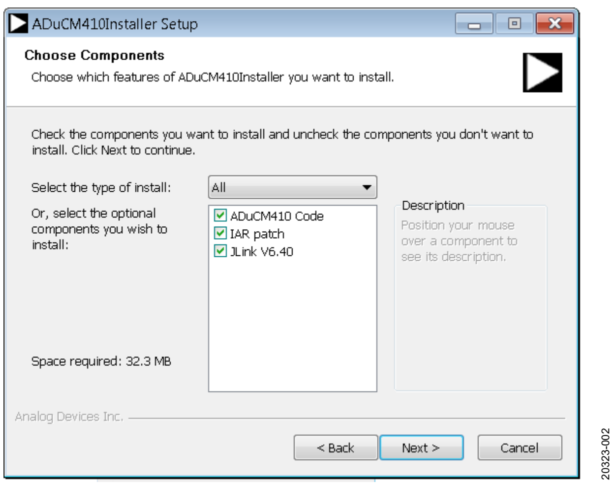

Figure 3. Installation Options

3. After installation, the **\AnalogDevices\ADuCM410** folder opens. This location contains the **examples** folder that stores the example codes for the ADuCM410 (see Figure 4).

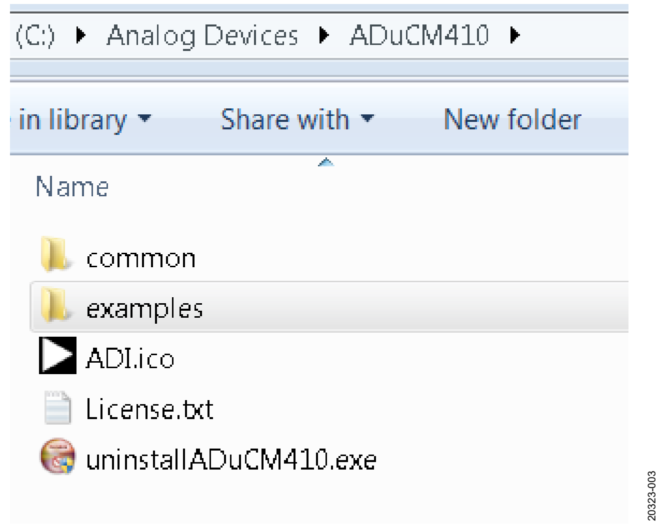

*Figure 4. ADuCM410 **examples** Folder with Projects*

KEIL µVISION5

The Keil µVision5® integrated development environment (IDE) integrates all the tools necessary to edit, assemble, and debug code. The fastest way to begin running the Keil IDE is to open an existing project by using the following steps:

1. In Keil, click **Project** > **Open Project**.
2. Browse to the folder where the ADuCM410 software is installed (**C:\AnalogDevices\ADuCM410...**).
3. Open the **M410_GPIO.uvprojx** file, located in the **ADuCM410\examples\M410_GPIO\ARM** folder. Opening the file launches an example project.
4. Set up the Cortex microcontroller software interface standard (CMSIS) pack before proceeding through the source. See the CMSIS Pack in Keil µVision5 section for details on how to import the CMSIS pack.
5. Compile and download the source code to the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board through the menu bar on the IDE.
6. To run the source code, press **RESET** on the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board and then press **RUN**.
7. When running the code, the green LED on the board marked **DISPLAY** flashes.

CMSIS PACK IN KEIL µVISION5

After the Keil µVision5® IDE is installed, open the application and use the following steps to properly set up the ADuCM410 device from the IDE:

1. Open the CMSIS pack installer as shown in Figure 5. When the pack installer is opened for the first time, it may take a few minutes to update the pack installer.

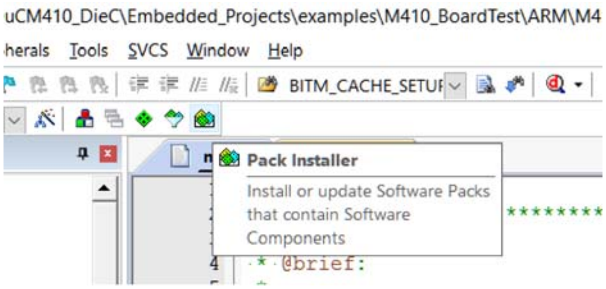

Figure 5. Pack Installer

2. After the CMSIS pack installer has opened, click **File** > **Import**. Select and import the ADuCM410 pack that is included in the installation setup (see Figure 6).
3. With the ADuCM410 CMSIS pack installed, the ADuCM410 device is supported by the Keil µVision5 IDE. The **ADuCM410** appears in the **Device** tab of the Keil window, as shown in Figure 7.

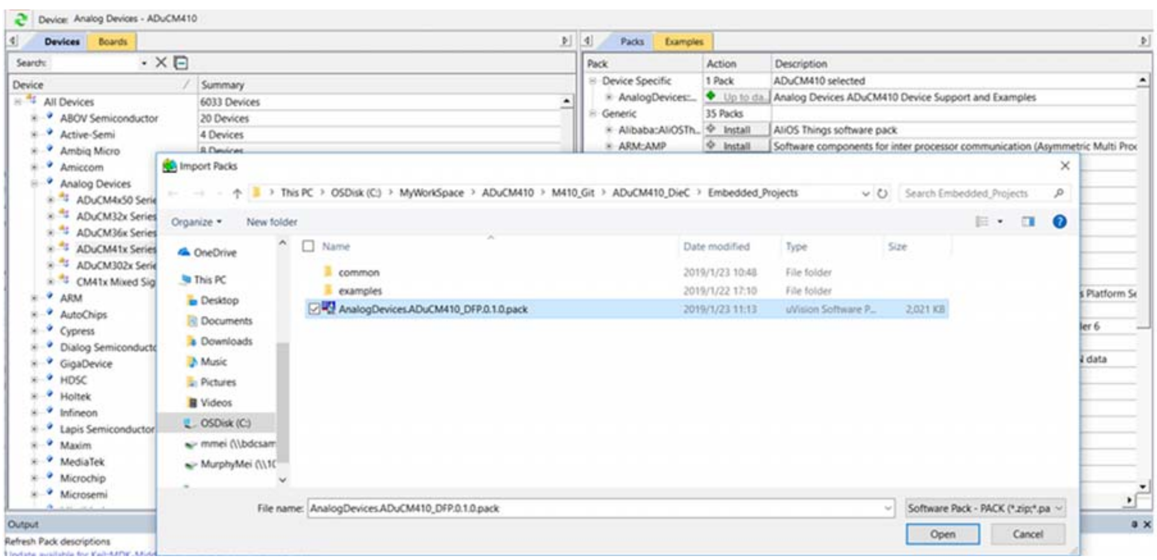

Figure 6. Pack Installer

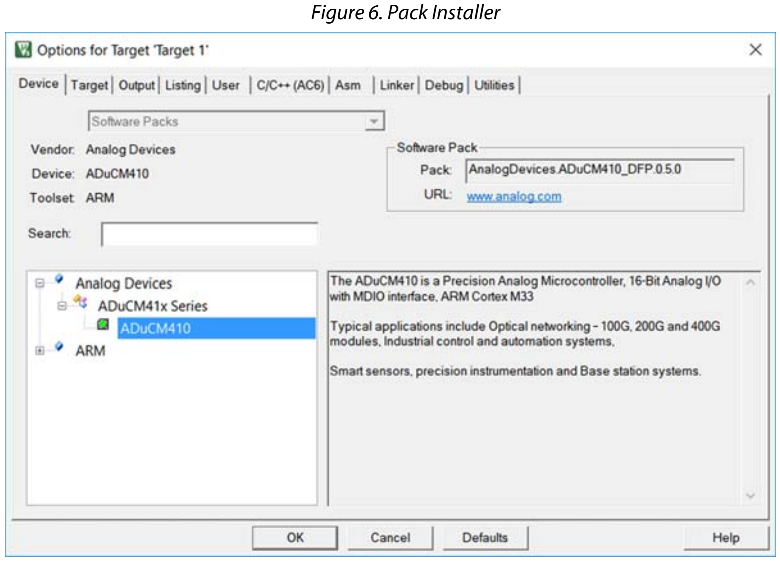

*Figure 7. **ADuCM410** Device in Keil µVision5*

LIBRARY AND PROJECT OPTIONS FOR ADUCM410 IN KEIL µVISION5

The Keil µVision5 project files are placed in the Arm folder for each example program. For example, **C:\Analog Devices\ ADuCM410\examples\M410_Adc\ARM\M410_Adc.uvporjx** is the file that is opened by Keil. By clicking the **Manage Run-Time Environment** icon from the Keil settings menu (see Figure 8), users can select the components needed from **Peripheral Libraries** in their project, as shown in Figure 10.

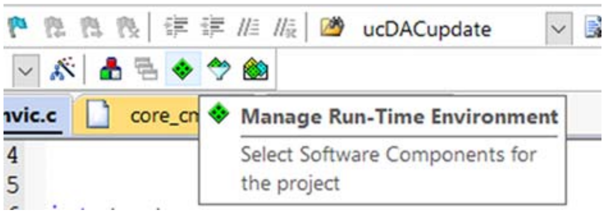

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*Figure 8. **Manage Run-Time Environment** Icon*

IAR IDE PROJECT SETTINGS

It is recommended for first time users to open an example project from the examples folder. For instance, the **M410_Adc.eww** file is the IAR Embedded Workbench® project file for the ADC example, and it can be opened from the **C:\Analog Devices\ ADuCM410\examples\M410_Adc\IAR** folder.

Opening an example file allows compilation, programming, and debugging without any configuration changes from the user.

If creating a new IAR-based project, the following steps must be completed to run the ADuCM410 example programs properly:

1. From the **Project** menu, select **Options**.
2. Click the **General Options** category, and ensure the selected device is **Analog Devices ADuCM410** under the **Target** tab.

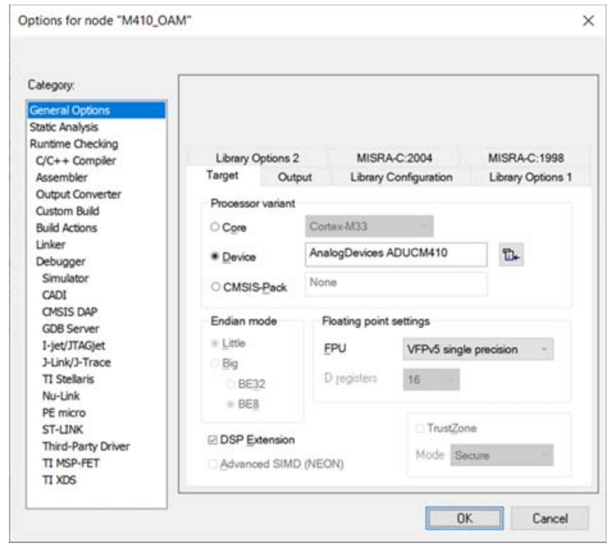

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Figure 9. IAR Project Setting

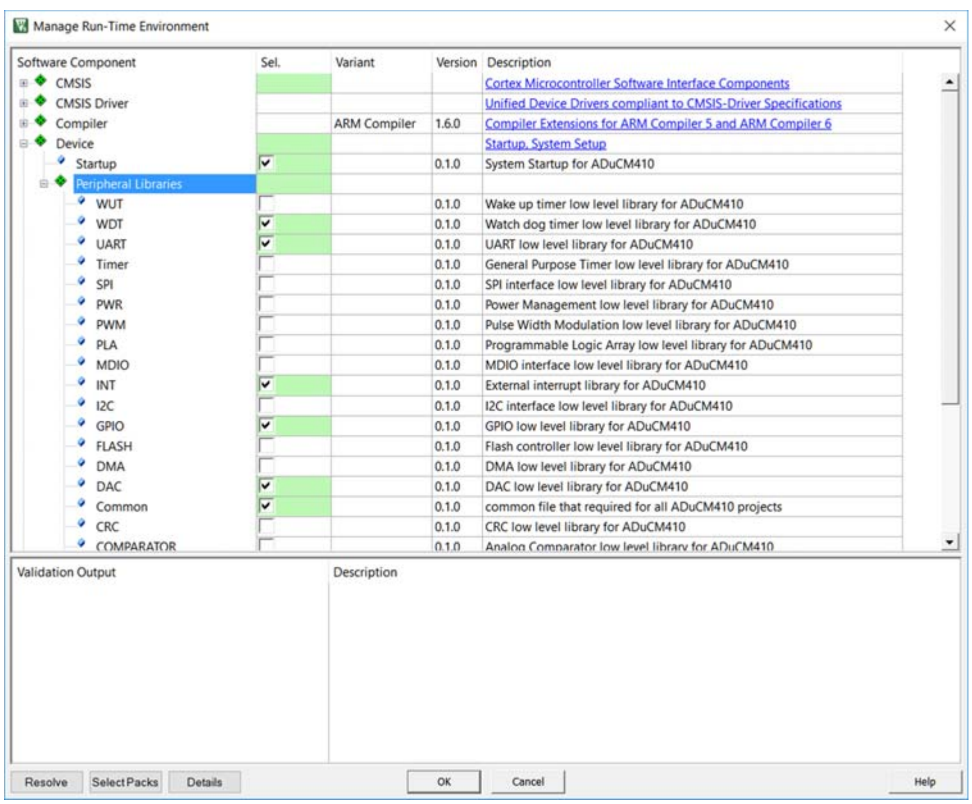

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Figure 10. Peripheral Libraries

3. After the ADuCM410 device is selected, click the **Library Configuration** tab. Ensure that all settings match those shown in Figure 11.

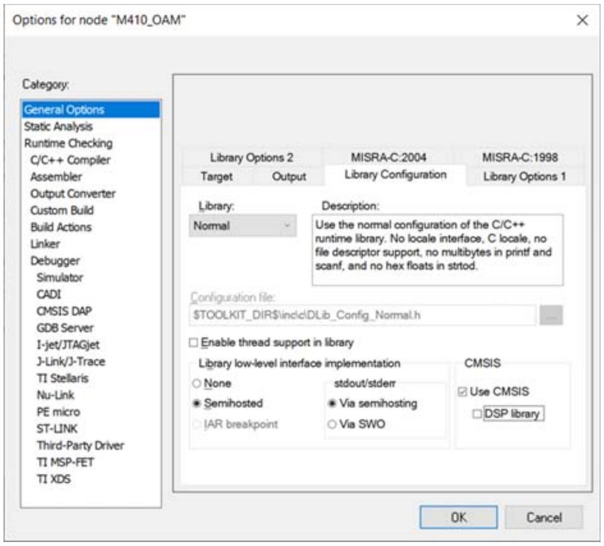


Figure 11. IAR Library Configuration

4. Next, click **C/C++ Compiler**, and check that the directories match those shown in the **Additional include directories** box (see Figure 12).

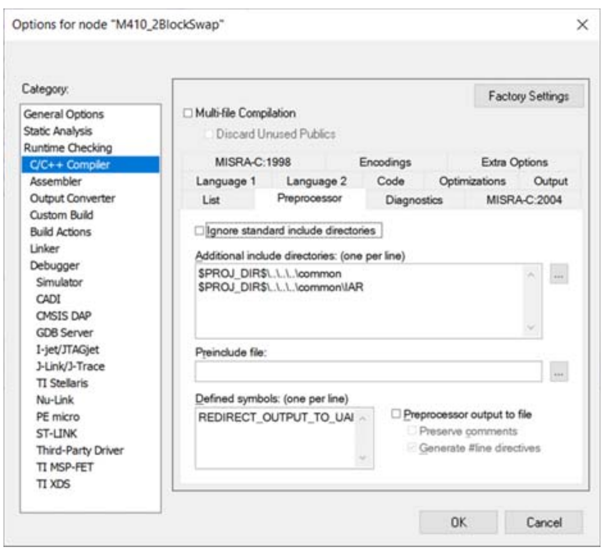


*Figure 12. **C/C++ Compiler** Setting*

5. Next, click the **Linker** category, check the **Override default** box in the **Config** tab, and browse for the linker file under the **Linker configuration file** section, as shown in Figure 13.

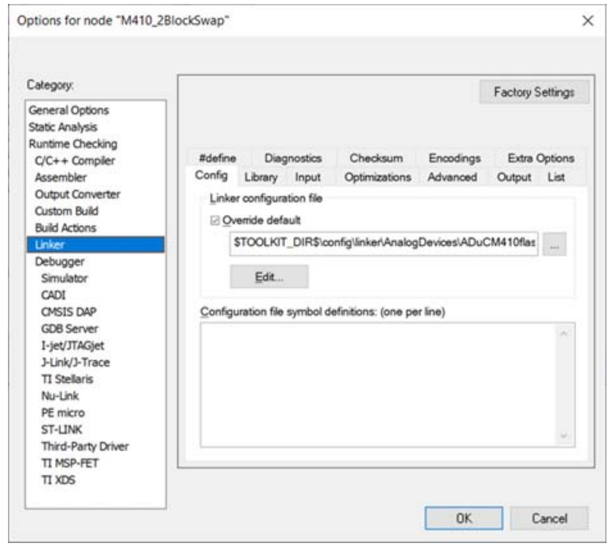


*Figure 13. **Linker** Setting*

6. Check the **Debugger** settings and ensure that all settings match those shown in Figure 14 and Figure 15 in the **Download** and **Setup** tabs.

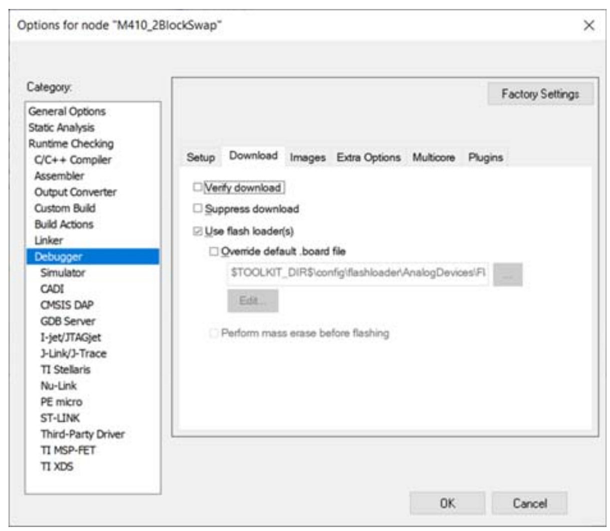


*Figure 14. **Debugger** Configuration*

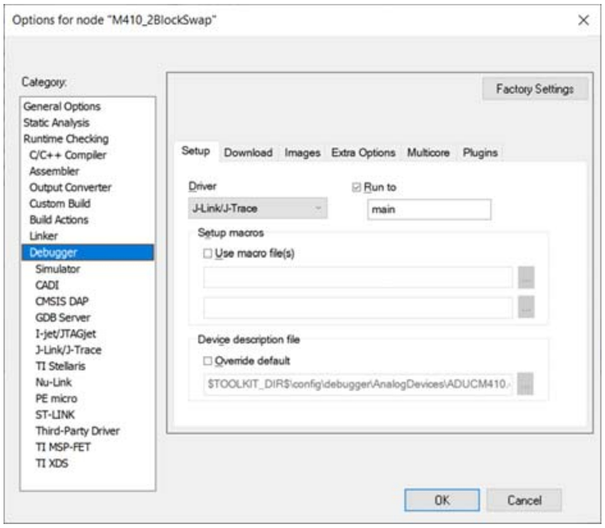


*Figure 15. **J-Link/J-Trace** Selected in **Setup** Tab*

5. Check that the **J-Link/J-Trace** settings in the **Setup** tab match those as shown in Figure 16.

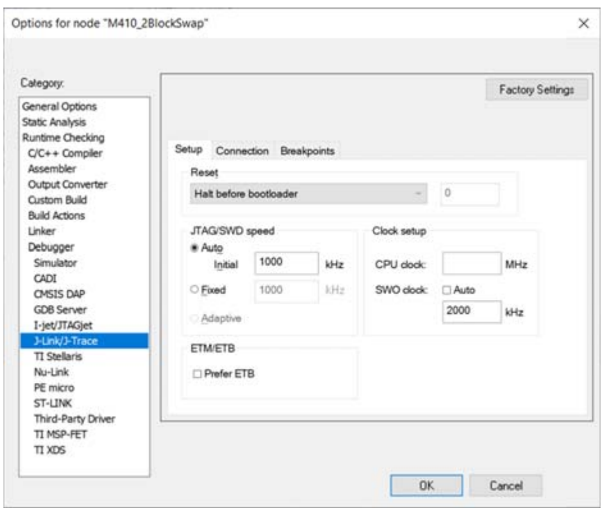


*Figure 16. **J-Link/J-Trace** Settings*

6. Click **OK,** and the user can start configuring the example program for the ADuCM410 in the IAR IDE.

mIDAS-LINK CONNECTOR—CONNECTING THE HARDWARE

Use the following steps to connect the mIDAS-Link to the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z:

1. Connect the provided USB cable between the PC and the mIDAS-Link connector.
2. The yellow LED lights up on the mIDAS-Link to indicate the connection to the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z is initializing.
3. Install the driver for the ADuCM410. Driver installation details are included in a **.exe** file in the ADuCM410 installer.

After connecting the mIDAS-link hardware to the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z, the mIDAS-Link can be used in Keil µVision5 and IAR Embedded Workbench development.

Table 4 shows the mIDAS-Link pin configuration.

Table 4. mIDAS-Link Pin Labels

EVAL-ADUCM410QSPZ/EVAL-ADUCM410QSP1Z Header Pin No.	mIDAS-Link Pin Labels
1, 2	DVDD
3, 11, 19	NC
4, 6, 8,10, 12, 14, 16, 18	DGND
5	P1.0/SIN0
7	SWDIO
9	SWCLK
13	P2.2/SWO option via JP4
15	$\overline{\text{RESET}}$
17	P1.1/SOUT

EVALUATING THE MDIO DOWNLOAD MODE

The MDIO downloader can be extracted from the installer on the ftp://ftp.analog.com/pub/microconverter/ADucM410 website. Use the MDIO downloader with the **MDIOWSD** software to download the hexadecimal files. Use the SUB-20 multiple interface USB adapter (not included) to connect the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z to the PC via the **MDIOWSD** software tool. The Windows 10 Operating System section outlines the procedure to download code and the example programs from the installer to the ADuCM410 device using the MDIO interface.

Windows 10 Operating System

After connecting the SUB-20 multiple interface USB adapter to the PC, the USB adapter automatically installs the needed SUB-20 software. To ensure the software properly installs and connects to the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z, follow these steps:

1. Double click the **SUB-20 firmware updater.exe** file installed on the PC after the SUB-20 adapter is connected to open the graphical user interface (GUI) shown in Figure 17.

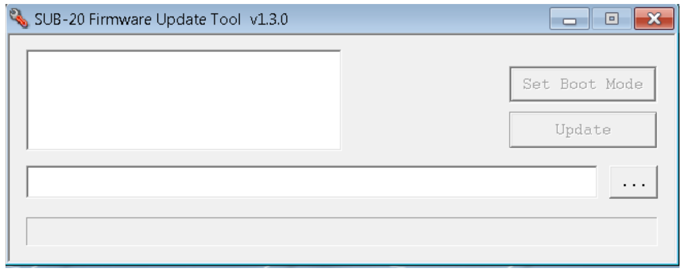


Figure 17. GUI for Updating the SUB-20 Firmware

2. For Windows® 10, Figure 17 may open automatically to update the SUB-20 adapter without having to double click the **SUB-20 firmware updater.exe** file. Click the **Update** button. For Windows 7 and earlier versions, users may not need to update the SUB-20 adapter.
3. After the adapter finishes updating, connect the pins on the SUB-20 board to the pins on the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z as described in Table 5.
4. On the SUB-20 board, ensure that Pin J7 is set to 3.3 V, Pin JP1 to Pin JP4 and Pin JP5 are set to connect Header Pin 1 to Header Pin 2, and Pin JP6 is set to connect Header Pin 2 to Header Pin 3.
5. Connect the USB cable from the PC to the SUB-20 board and run **C:\ADuCM410…\SoftwareTools\MDIOWSD\MDIOWSD.exe**. The GUI window then opens, as shown in Figure 18.
6. Click the **Browse** button (see Figure 18), and navigate to the desired code to download.

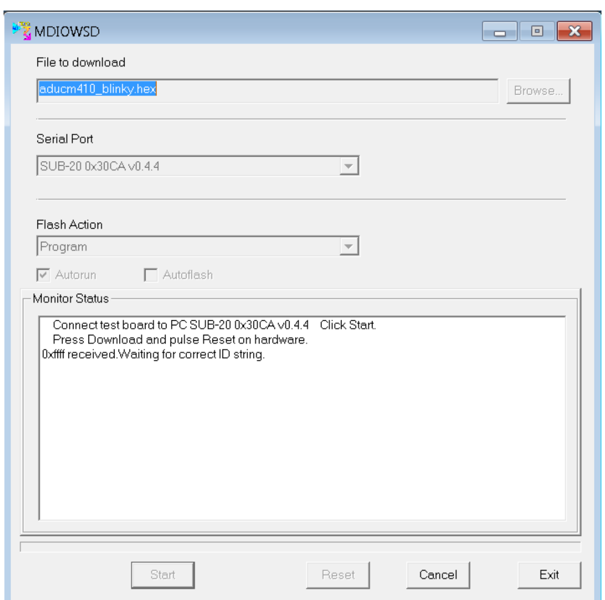


*Figure 18. **MDIOWSD** GUI*

4. To download the code, select **Program and Verify** from **the Flash Action** box, click **Start**, and follow the instructions listed on the GUI.

Table 5. SUB-20 to EVAL-ADUCM410QSPZ/ EVAL-ADUCM410QSP1Z Pin Connection Guide

EVAL-ADUCM410QSPZ/ EVAL-ADUCM410QSP1Z Pins on P3	SUB-20 Pins
DGND	J6-10
1.2V	J6-9
MDIO	J6-7
MCK	J6-1

For more information about flash block switching and the MDIO, refer to the ADuCM410 hardware reference manual (UG-1807).

EVALUATING THE I²C DOWNLOAD MODE

The I²C downloader can be extracted from the installer on the ftp://ftp.analog.com/pub/microconverter/ADucM410 website. Use the I²C downloader with the **M12CFTWSD** software to download the hexadecimal files. Use the on-board FTDI chip to interface with the device. The FTDI chip allows connectivity between the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board and the PC via the **MI2CFTWSD** software tool. When the downloader is extracted, follow these steps:

1. On the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z, ensure JP7, JP8, JP9, and JP10 are shorted to use the on-board FTDI chip.
2. Open the **MI2CFTWSD** folder, and double click **MI2CFTWSD.exe**.
3. The GUI opens, as shown in Figure 19.

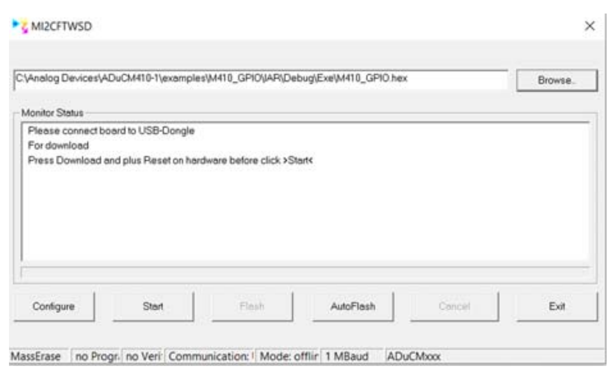
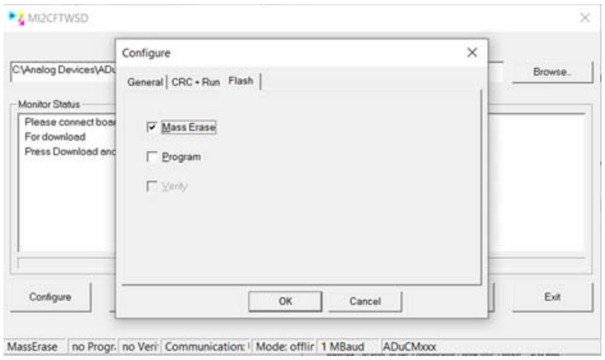


*Figure 19. **MI2CFTWSD** GUI*

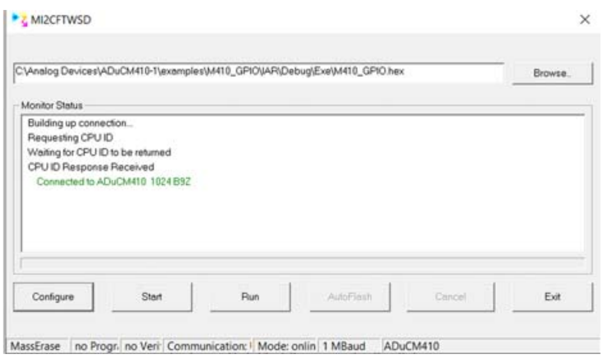
4. Settings such as **Mass Erase** and **Program** can be found by clicking **Configure**, then the **Flash** tab. Select **Mass Erase** or **Program** as needed, and click **OK**.



20323-118

Figure 20. ***Mass Erase*** *and* ***Program*** *Options in* ***MI2CFTWSD***

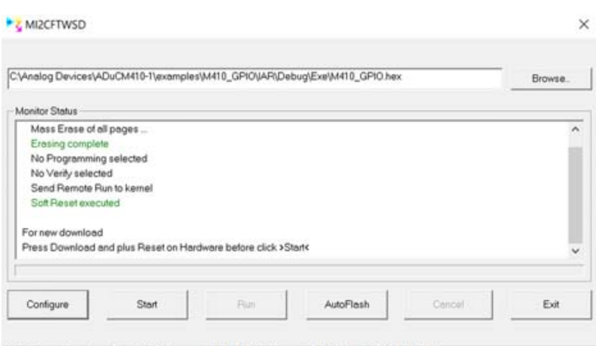
5. On the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board, press the **SERIAL_DOWNLOAD** button and pulse the **RESET** button to set up the device in I^2C download mode.
6. Click the **Start** button in the **MI2CFTWSD** window. If the I^2C connection is established, the status shows the ADuCM410 is connected, as shown in Figure 21.



20323-119

Figure 21. I^2C Connection Established

7. After I^2C connection is established. Click the **Run** button and it automatically flashes the device and either mass erases or downloads the program, depending on the configuration that the user selected in Step 4. Figure 22 shows an example of a complete mass erase on the device.



20323-120

Figure 22. Complete Mass Erase

8. Repeat Step 4 through Step 7 to select another option from the software tool.

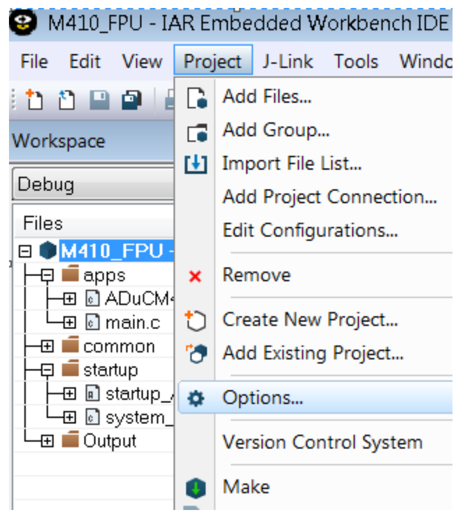
FLOATING-POINT UNIT ENABLE PROCEDURE

The settings shown in the **Project** dropdown menu (see Figure 23) are available on the Keil and IAR software tool environment. By default, the floating-point unit (FPU) is disabled after the settings are disabled. Code to enable and output the floating-point value is added in the **SystemInit** function in the **system_ADuCM410.c** file. This file is located in the example program in the ADuCM410 installer folder named **M410_FPU** (under the **Files** list in Figure 23).

Running the IAR FPU Program

Perform the following steps before running the FPU example program in the IAR IDE software (downloaded from the provided IAR installer).

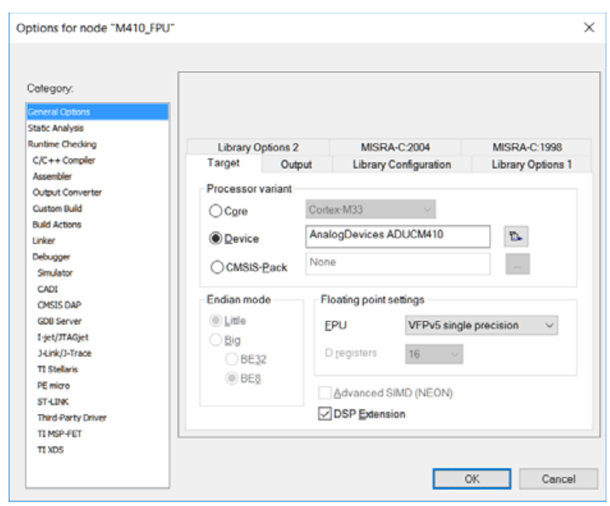
1. After opening the IAR IDE, click the **Project** dropdown menu and select **Options** (see Figure 23).



20323-010

Figure 23. Selecting ***Options*** *in the IAR IDE*

2. From the **Category** section, click **General Options**. Then click the **Target** tab, and ensure the **FPU** box in the **Floating point settings** section is set to **VFPv5 single precision**, as shown in Figure 24.



20323-011

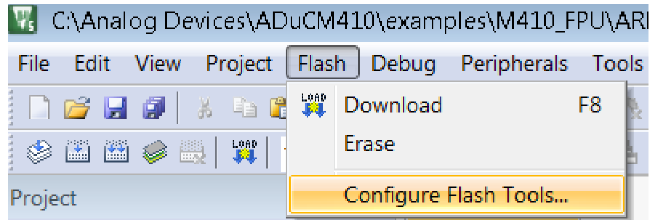
Figure 24. IAR IDE ***General Options***

3. After setting the **Floating point settings** options, run the FPU example program. Running the debug mode causes the **Output** section in the **Terminal I/O** window to display fractional values of the variables, as shown in Figure 26.

Running the Keil FPU Program

Perform the following steps before running the FPU example program from the Keil IDE (included on the ADuCM410 installer).

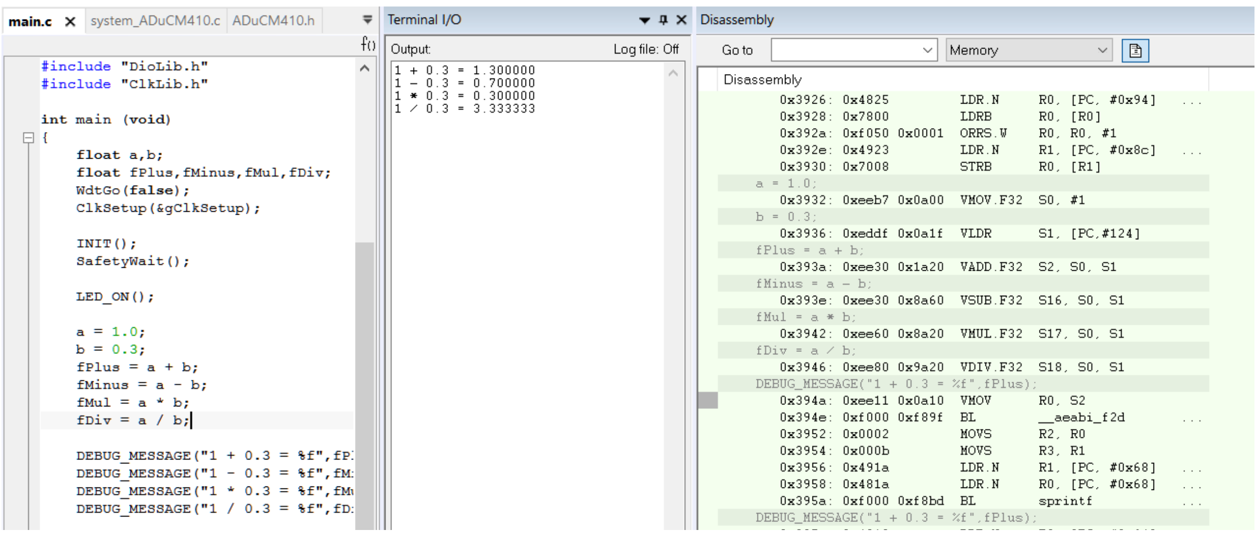
1. After opening the Keil IDE, click the **Flash** dropdown menu and select the **Configure Flash Tools** option (see Figure 25).



20323-013

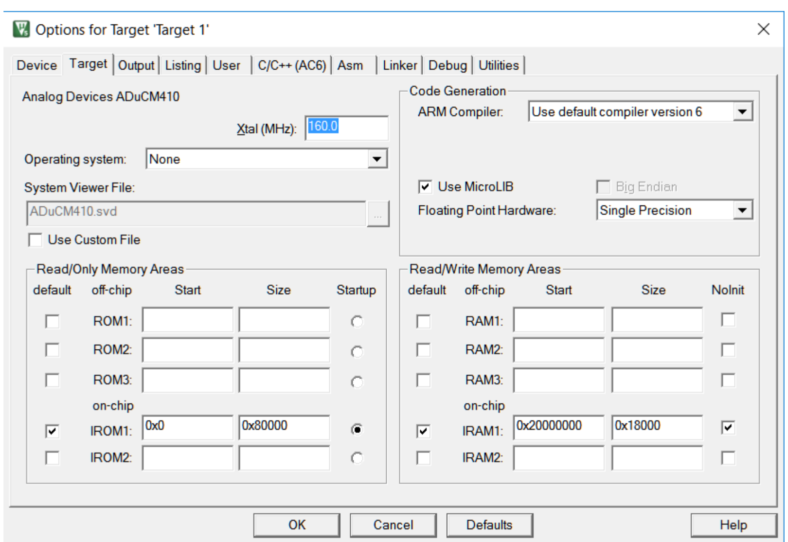
*Figure 25. Keil **Flash** Dropdown Menu Options*

2. Selecting the **Configure Flash Tools** option opens the window shown in Figure 28. Click the **Target** tab, and ensure the **Floating Point Hardware** dropdown box is set to the **Single Precision** option, as shown in Figure 28.



20323-012

Figure 26. IAR FPU Example Program Output



20323-014

Figure 27. Keil General Options

3. After establishing the settings shown in Figure 28, run the FPU example code from the **C:\Analog Devices\ADuCM410\examples\M410_FPU** folder in the example code folder. In debug mode, the output **Disassembly** window displays fractional values of the variables, as shown in Figure 29.

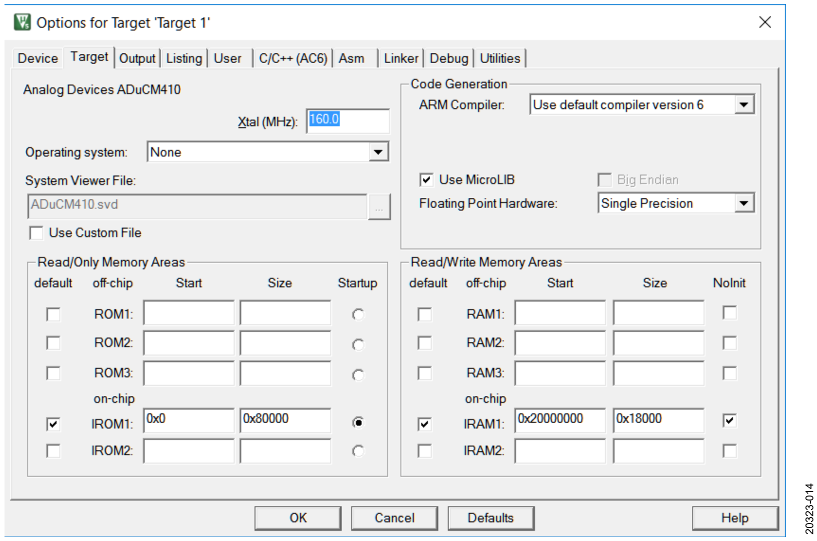


Figure 28. Keil General Options

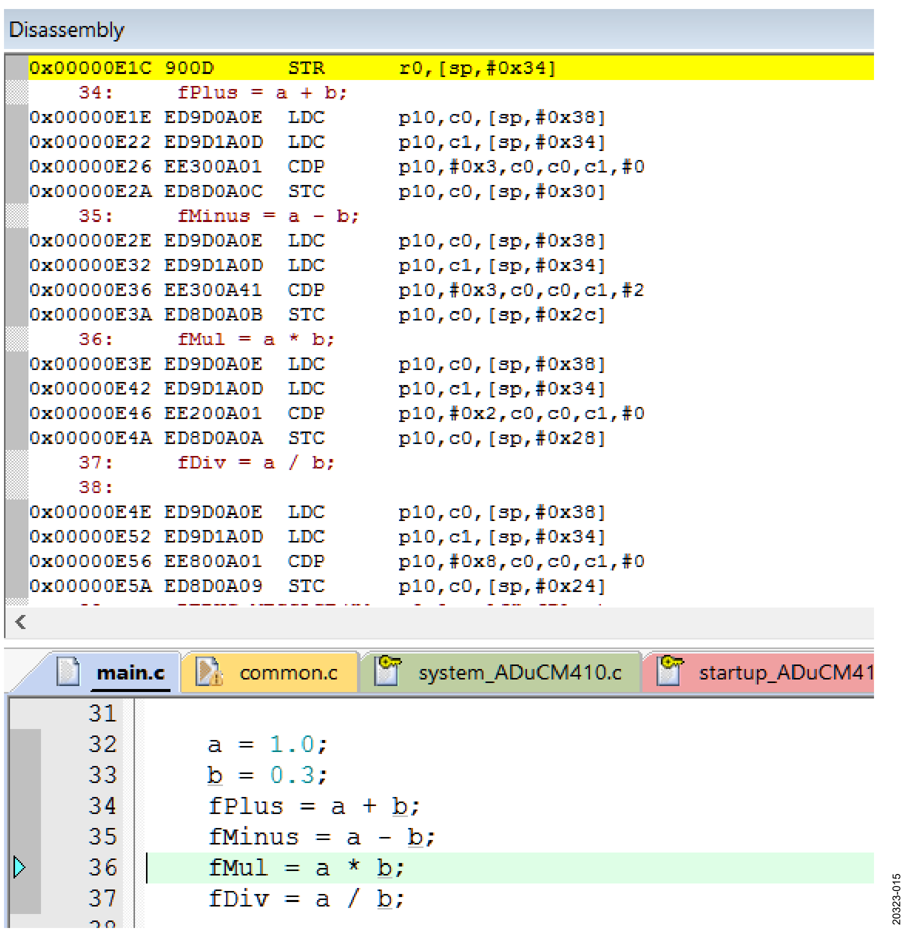


Figure 29. Keil FPU Example Program Output

SRAM MODE SETTINGS

Configuration settings are available on the Keil and IAR software tool environments. To properly set up and test the static random access memory (SRAM) modes, go to the example projects located in the **M410_SramMode** installer.

IAR SRAM Mode

Three file settings must be completed to configure the corresponding SRAM mode: **main.c**, **startup_ADuCM410.s**, and **ADuCM410flash_SramMode.icf**.

1. After the example program is opened from the IAR IDE, ensure that the macros shown in Figure 30 are set up and commented in to select the SRAM mode the linker file is operating in. The **M410_SramMode** example code (see Figure 31) uses a linker file, the **ADuCM410flash_SramMode.icf** file (see Figure 32) placed in the **IAR** folder within the **SramMode** example program.

```
#define TEST_SRAM_MODE   0
//#define TEST_SRAM_MODE   1
//#define TEST_SRAM_MODE   2
//#define TEST_SRAM_MODE   3
```

20323-016

*Figure 30. IAR SRAM Setup **main.c***

5. Configure the macros shown in Figure 30, Figure 31, and Figure 32 to run the SRAM modes. Ensure the **main.c**, **startup_ADuCM410.s**, and **ADuCM410flash_SramMode.icf** macros are selected with the correct SRAM mode.
6. Users can select the desired **USER_SRAM_MODE** macro as shown in Figure 31 and Figure 32. Users can also select the **TEST_SRAM_MODE** macro as shown in Figure 30. By default, the example program is running in **TEST_SRAM_MODE 0**. Ensure the **main.c** macro, which runs the debug mode, shows that the instruction SRAM (ISRAM) is placed in debug mode. If the ISRAM is in debug mode, the **Disassembly** window from the **View** menu bar displays the **isramTestFunc** with the 0x10000000 address (see Figure 33).

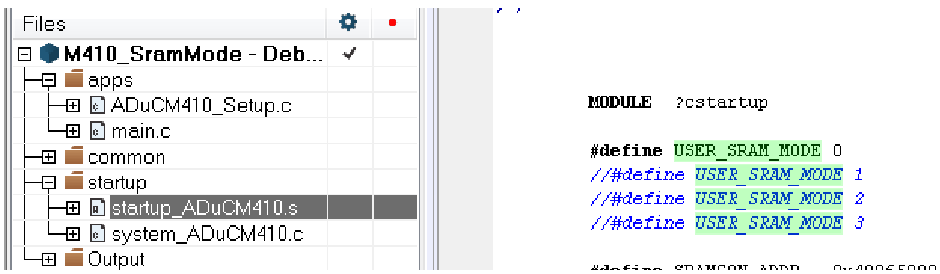


*Figure 31. IAR SRAM Setup **startup_ADuCM410.s** SRAM Modes*

```
// user-selectable SRAM mode
define symbol USER_SRAM_MODE = 0;
//define symbol USER_SRAM_MODE = 1;
//define symbol USER_SRAM_MODE = 2;
//define symbol USER_SRAM_MODE = 3;
```

20323-018

*Figure 32. IAR SRAM Setup **ADuCM410flash_SramMode.icf** Macros*

```
isramTestFunc:
    0x10000000: 0x2000         MOVS       R0, #0
    0x10000002: 0xe004         B.N        0x1000000e
      for(uint32_t j=0;j<100000;j++);
    0x10000004: 0x1c49         ADDS       R1, R1, #1
      for(uint32_t j=0;j<100000;j++);
    0x10000006: 0x4a07         LDR.N      R2, [PC, #0x1c]   ...
    0x10000008: 0x4291         CMP        R1, R2
    0x1000000a: 0xd3fb         BCC.N      0x10000004
    for(uint32_t i=0;i<10;i++)
    0x1000000c: 0x1c40         ADDS       R0, R0, #1
    for(uint32_t i=0;i<10;i++)
    0x1000000e: 0x280a         CMP        R0, #10           ...
    0x10000010: 0xd207         BCS.N      0x10000022
      LED_TOGGLE();
```

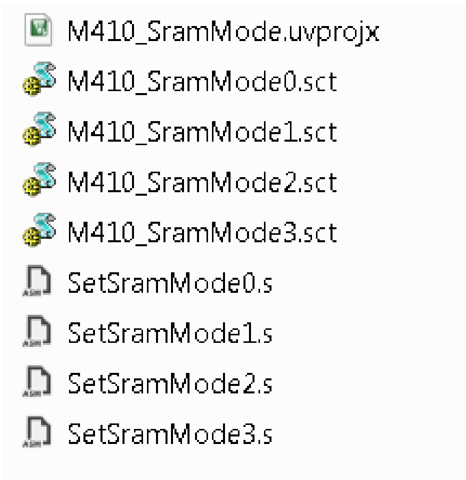
20323-019

Figure 33. IAR SRAM Output at Mode 0

Keil SRAM Mode

Several **.sct** and **.s** files from the example program allow users to select the desired SRAM: **M410_SramModeX.sct** and **SetSramModeX.s**. The X in the file name specifies mode number (0 to 3) for the SRAM.

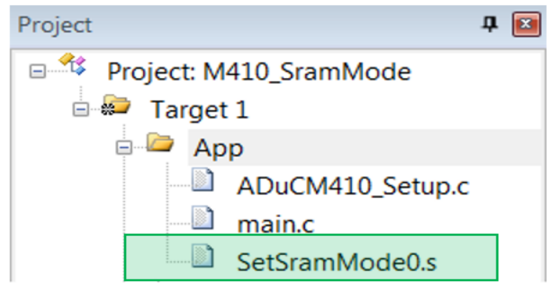
1. After the example program is opened from the Keil IDE, the files located in the same folder are shown. Ensure that the **.sct** and **.s** files from the example folder (see Figure 34) are used with the corresponding SRAM mode being tested.



20323-020

*Figure 34. SRAM Mode **.sct** and **.s** Files*

7. By default, the **M410_SramMode** macro uses SRAM Mode 0. The **SetSramMode0.s** assembly file is added to the subdirectory shown in Figure 35. Specify which SRAM mode to test in the **main.c** file. By default, SRAM Mode 0 is tested (see Figure 36).



20323-021

*Figure 35. Set Up **SetSramMode0.s***

```
#define TEST_SRAM_MODE  0
//#define TEST_SRAM_MODE  1
//#define TEST_SRAM_MODE  2
//#define TEST_SRAM_MODE  3
```

20323-022

*Figure 36. Set Up **M410_SramMode0.sct***

8. After following Step 1 and Step 2, proceed to set up the **.sct** file located in **Flash** > **Configure Flash Tools** > **Linker**. Refer to Figure 37 to check the settings circled in green are correct and that the correct scatter file is chosen (based on the SRAM mode configuration).
9. Running the settings in Figure 38 shows that the ISRAM is placed in debug mode via the **Disassembly** window.

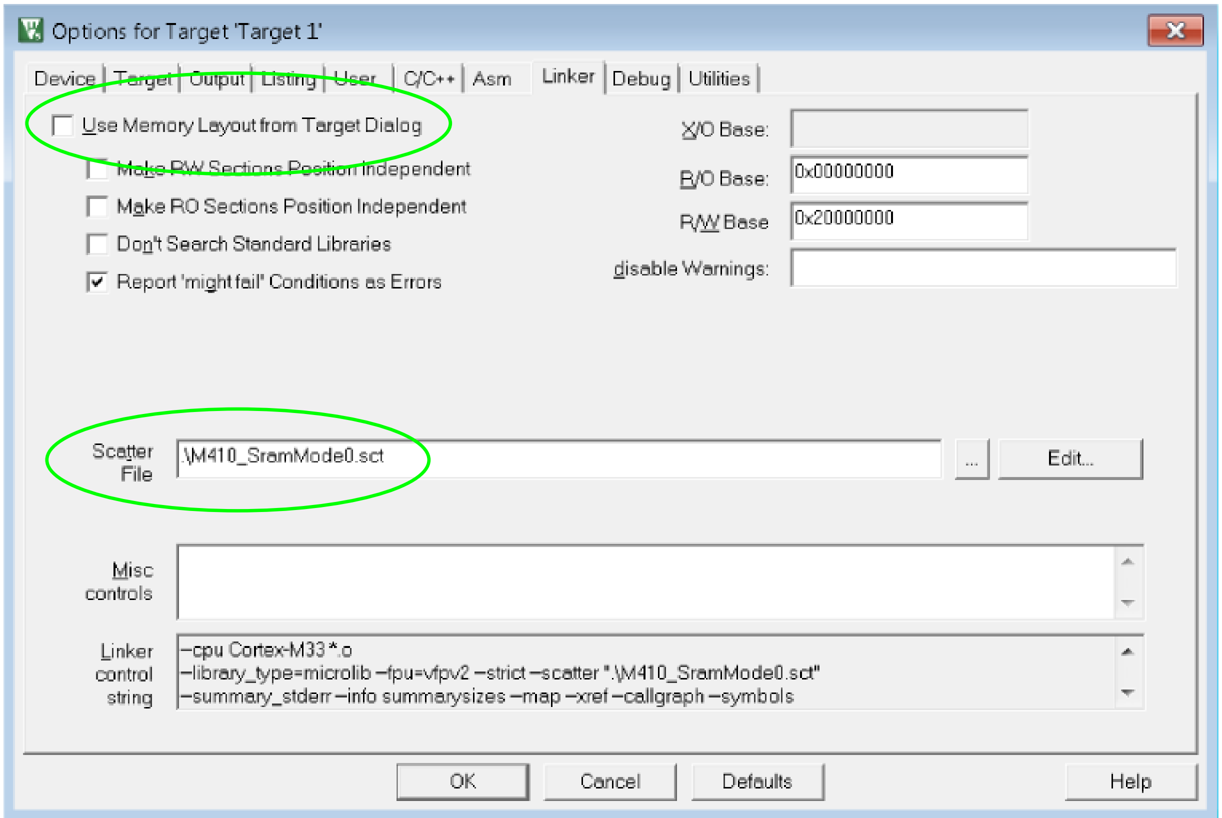


Figure 37. Keil SRAM Output Mode 0

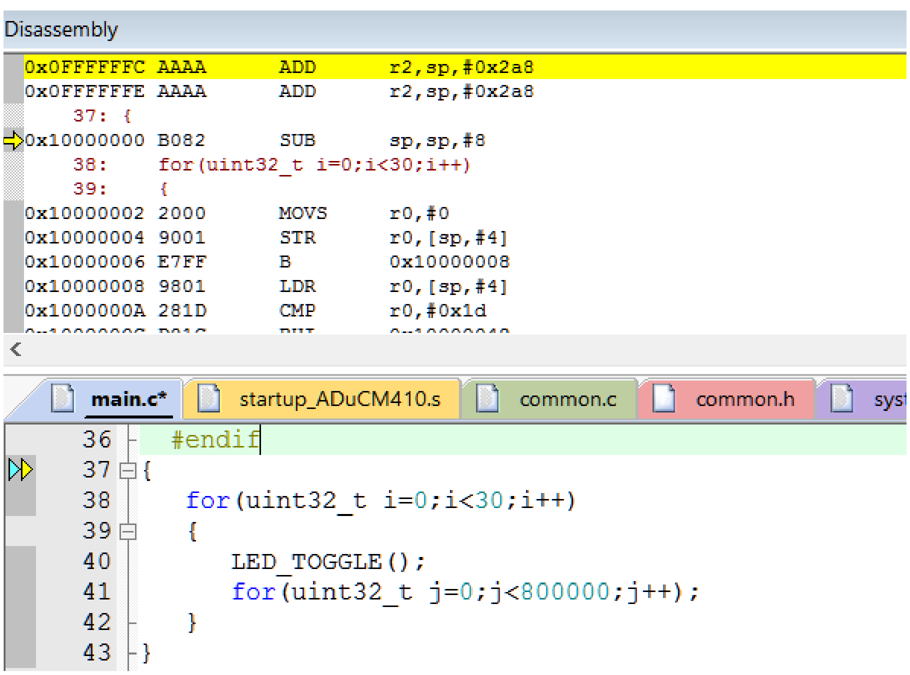


Figure 38. Flash Configuration Setup

SAFE CODE DEBUGGING/DEVELOPMENT RECOMMENDATIONS

The ADuCM410 code development and programming tools are similar or identical to those used on other Analog Devices microcontroller devices and to microcontrollers from other companies. Care must be taken to ensure the device can be reprogrammed to avoid lockup situations. In a lockup, the connection to the ADuCM410 via programming/debug tools is no longer possible.

This section lists scenarios that can cause lockup situations. If a lockup situation occurs, recommendations are provided to recover a device.

SCENARIOS THAT CAUSE DEVICE LOCKUPS

Page 0 Checksum Error

Address 0x1FFC contains a 32-bit checksum for Flash Page 0.

The on-chip kernel performs a checksum on Page 0 excluding 0x1FFC to 0x1FFF. If the kernel result does not match the value at 0x1FFC or if 0x1FFC value is not 0xFFFFFFFF, the kernel detects corruption of Page 0 and does not exit to user code, resulting in a device lockup. See the ADuCM410 hardware reference manual (UG-1807) for information about an integrity check of the internal Flash Page 0 by the on-chip kernel.

To recover from this situation, mass erase the device via the downloader tool (I^2C or MDIO), and ensure the user source code sets Flash Address 0x01FFC = 0xFFFFFFFF.

The example code for the ADuCM410 configures Flash Address 0x01FFC = 0xFFFFFFFF.

See **page0_checksum** in the **system_ADuCM410.c** file.

User Flash Pages—Corruption of Reserved Locations

The top six 32-bit locations of each flash block are reserved, and care must be taken not to overwrite these locations. The flash signature for each block and the write protection settings are stored in these six locations. See the ADuCM410 Hardware Reference Manual for information about flash user space organization.

Ensure the top 32-bit location in each flash page is reserved.

See the example programs included in the installer for details.

Unexpected Resets

Unexpected watchdog resets, software resets, power-on resets, or external resets can cause debug/programming sessions to end abruptly because these resets break the SWD interface between the J-Link and the Cortex core.

If the user source code results in regular resets, try mass erasing the user flash via the downloader and restart the debug session.

Power Saving Modes

If the user code puts the Cortex core into a power-down state, the power-down causes issues after a power cycle for the debug tools that use the SWD interface. Tools like J-Link require the Cortex core to be fully active.

Keil CMSIS Pack

For Keil µVision users only, ensure Keil CMSIS pack Version 1.4.0 or later is being used.

RECOVERING LOCKED UP DEVICES

Mass erase the device via either the MDIO or I^2C downloader tool.

PROGRAMMABLE LOGIC ARRAY (PLA) TOOL

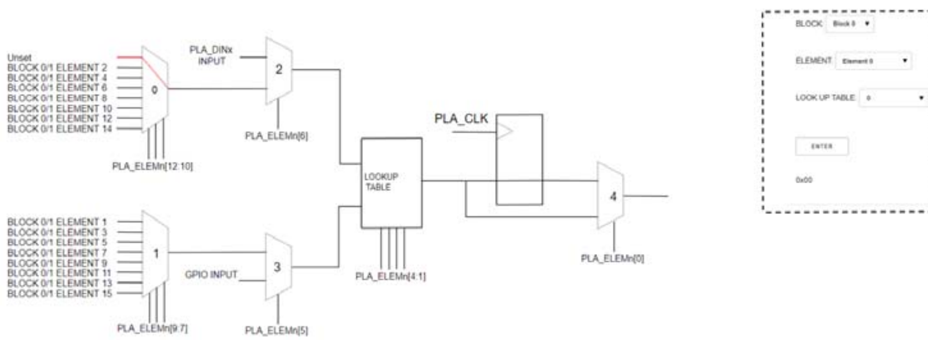
The ADuCM410 integrates a PLA that consists of two independent but interconnected PLA blocks. Each block consists of 16 elements, giving a total of 32 elements listed from Element 0 to Element 31. The PLA tool is a graphical tool that allows easy configuration of the PLA. The PLA tool can be found on the ADuCM410 installer, under the **Tools** folder. With the PLA tool, the correct output value is determined after all the options from the tool is properly selected.

CONFIGURING THE GATES AND OUTPUT

PLA elements contains a two-input lookup table that can be configured to generate logic output function based on the two inputs and flip flop in the PLA, as shown in Figure 39. Each PLA element in a block can be connected to other elements in the same block by configuring the output of Mux 0 and Mux 1.

The user can select respective inputs that correspond to the PLA_ELEMx register bits. See the ADuCM410 Hardware Reference Manual for a complete list of possible connections for the element GPIO input/output, and for the lookup table configuration in the PLA.

After the inputs are selected from the GUI, ensure that the **BLOCK**, **ELEMENT**, and **LOOK UP TABLE** options are selected in the top right portion of the tool. Click the **ENTER** button to generate the output of PLA (see Figure 39).



20323-121

Figure 39. Programmable Logic Array Tool

I[2]C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

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