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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^{\circ} Cortex^{\circ}-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

UG-1541

EVAL-ADUCM410QSPZ PHOTOGRAPH



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 μ F and 0.1 μ F capacitors. Each device supply pin is also decoupled with a 10 μ F and 0.1 μ F 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 asynchronic 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 k Ω 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.

| 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. |

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

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 | ADUCM | <i>A</i> 4100 | QSPZ/EV | AL- | |
|----------|------|-------|---------------|---------|-----|---|
| | | | - | | | - |

| ADUCM410QSP1Z | Pin Connections | to Arduino Pins |
|---------------|------------------------|-----------------|
|---------------|------------------------|-----------------|

| EVAL-ADUCM410QSPZ (CSP_BGA)/ | |
|---|-------------|
| 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 |

| | - |
|--|-------------|
| EVAL-ADUCM410QSPZ (CSP_BGA)/ EVAL-ADUCM410QSP1Z (WLCSP) R3 Header Pins | Arduino Pin |
| P19 (EVAL-ADUCM410OSPZ) 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) | |
| AINO | ADC5 |
| AIN1 | ADC4 |
| AIN2 | ADC3 |
| AIN3 | ADC2 |
| AIN4 | ADC1 |
| AIN14 | ADC0 |

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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).

| C:) ► Analog Devices ► ADuCM410 ► |
|--|
| n library 🔹 Share with 🔹 New folder |
| Name |
| 👢 common |
| 👢 examples |
| ADI.ico |
| 📄 License.txt |
| 🎯 uninstallADuCM410.exe |
| |
| 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...).
- Open the M410_GPIO.uvprojx file, located in the ADuCM410\examples\M410_GPIO\ARM folder.
 Opening the file launches an example project.
- 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.

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CMSIS PACK IN KEIL µVISION5

After the Keil μ Vision5° IDE is installed, open the application and use the following steps to properly set up the ADuCM410 device from the IDE:

 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.

uCM410_DieC\Embedded_Projects\examples\M410_BoardTest\ARM\M4

herals <u>T</u>ools <u>S</u>VCS <u>W</u>indow <u>H</u>elp

| V 👗 📥 🐐 | > 🗇 🙆 | | |
|----------|---|--|--------|
| ‡ | 📄 n 😢 Pack Instal | ller | |
| <u> </u> | Install or up that contain Componen | odate Software Packs n Software ts | ****** |
| 6.0 | 4 ·*·@bri | ef: | |

- 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).
- 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

| Software Packs indor: Analog Devices evice: ADuCM410 olset ARM arch | Software Pack Pack AnalogDevices ADuCM410_DFP.0.5.0 URL: www.analog.com |
|---|--|
| Analog Devices Analog Devices ADuCM41x Series ADuCM410 ARM | The ADuCM410 is a Precision Analog Microcontroller, 16-Bit Analog I/O with MDIO interface, ARM Cortex M33 Typical applications include Optical networking - 100G, 200G and 400G modules, Industrial control and automation systems. Smart sensors, precision instrumentation and Base station systems. |
| | |

Figure 7. ADuCM410 Device in Keil µVision5

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LIBRARY AND PROJECT OPTIONS FOR ADUCM410 IN KEIL $\mu\text{VISION5}$

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.

| P 内 内 内 律 | 🛱 //= //= 🖉 ucDACupdate 🗸 🗸 | |
|---------------|--|--|
| 🗸 🐔 🛔 💸 | 🕎 🌰 | |
| wic.c Core_cn | Manage Run-Time Environment | |
| 4 5 | Select Software Components for the project | |

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.
- Click the General Options category, and ensure the selected device is Analog Devices ADuCM410 under the Target tab.

| ategory: | | | | | |
|--------------------|-----------------|---|---------------|---------------|-------------------|
| eneral Options | | | | | |
| tatic Analysis | | | | | |
| tuntime Checking | 1 | | | | |
| C/C++ Compiler | Library Options | 12 | MISRA | -C:2004 | MISRA-C:1998 |
| Assembler | Target O | utput | Library (| Configuration | Library Options 1 |
| Output Converter | Processor varia | | | | |
| Custom Build | Processor vola | 00000 | 00135255 | _ | |
| Build Actions | ⊖ Core | Con | ex-M33 | 1 | |
| Linker | # De /// | Ana | ooDevices A | DUCM410 | Ph. |
| Debugger | . Device | | -3 | | |
| Simulator | O CMSIS-Pack | Non | 6 | | |
| CADI | - amore Laar | | | | |
| CMSIS DAP | Endian mode | B | nating point | settings | |
| GDB Server | | | eening period | er an ige | |
| I-jet/JTAGjet | · Litte | E | PU | VFPv5 single | precision ~ |
| J-Link/J-Trace | Big | 1.4 | | 104 | |
| TI Stellaris | BE32 | - E | (edisters | 15 | |
| Nu-Link | = BE8 | | | | |
| PE micro | | | | | |
| ST-LINK | P DSP Extensio | n | | TrustZon | 0 |
| Third-Party Driver | | in an | | Mode Sec | curie - |
| TI MSP-PET | Advanced SI | ND (NEC | N). | 1000 | |

Figure 9. IAR Project Setting

| 7 | ARM Compiler | 1.6.0 0.1.0 | Cortex Microcontroller Software Interface Components Unified Device Drivers compliant to CMSIS-Driver Specifications Compiler Extensions for ARM Compiler 5 and ARM Compiler 5 Startup, System Setup System Startup for ADuCM410 | |
|-----------|--------------|----------------|---|---|
| 4 | ARM Compiler | 1.6.0 0.1.0 | Unified Device Drivers compliant to CMSIS-Driver Specifications Compiler Extensions for ARM Compiler 5 and ARM Compiler 5 Startup, System Setup System Startup for ADuCM410 | |
| v | ARM Compiler | 1.6.0 0.1.0 | Compiler Extensions for ARM Compiler 5 and ARM Compiler 5 Startup, System Setup System Startup for ADuCM410 | |
| ~ | | 0.1.0 | Startup, System Setup System Startup for ADuCM410 | |
| | | 0.1.0 | System Startup for ADuCM410 | |
| | | | | |
| | | | | |
| present (| | 0.1.0 | Wake up timer low level library for ADuCM410 | |
| v | | 0.1.0 | Watch dog timer low level library for ADuCM410 | |
| V | | 0.1.0 | UART low level library for ADuCM410 | |
| - | | 0.1.0 | General Purpose Timer low level library for ADuCM410 | _ |
| | | 0.1.0 | SPI interface low level library for ADuCM410 | |
| | | 0.1.0 | Power Management low level library for ADuCM410 | |
| | | 0.1.0 | Pulse Width Modulation low level library for ADuCM410 | |
| | | 0.1.0 | Programmable Logic Array low level library for ADuCM410 | |
| | | 0.1.0 | MDIO interface low level library for ADuCM410 | |
| ~ | | 0.1.0 | External interrupt library for ADuCM410 | |
| | | 0.1.0 | I2C interface low level library for ADuCM410 | |
| ~ | | 0.1.0 | GPIO low level library for ADuCM410 | |
| | | 0.1.0 | Flash controller low level library for ADuCM410 | |
| L | | 0.1.0 | DMA low level library for ADuCM410 | - |
| ~ | 1.0 | 0.1.0 | DAC low level library for ADuCM410 | |
| ~ | | 0.1.0 | common file that required for all ADuCM410 projects | |
| 5 | | 0.1.0 | CRC low level library for ADuCM410 | |
| | | 0.1.0 | Analog Comparator Jow level library for ADuCM410 | 1 |
| | | | ▼ 0.1.0 0.1.0 0.1.0 0.1.0 0.1.0 0.1.0 0.1.0 0.1.0 0.1.0 0.1.0 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ▼ 0.1.0 ● 0.1.0 ● 0.1.0 ● 0.1.0 ● 0.1.0 ● 0.1.0 ● 0.1.0 | |

Figure 10. Peripheral Libraries

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

| Category: | | | | |
|--------------------|---|---|-------------------------------|---------------------------------------|
| Seneral Options | | | | |
| Static Analysis | | | | |
| Runtime Checking | 12.0 | | | 10001 0 1000 |
| C/C++ Compiler | Library C | options 2 | MISRA-C 2004 | MISRA-C:1998 |
| Assembler | Target | Output | Library Configuration | Library Options 1 |
| Output Converter | Library | | Description | |
| Custom Build | Library, | 100 | Description. | 11.00 |
| Build Actions | Normal | 1 () () () () () () () () () (| Use the normal configuration | in of the C/C++ |
| Linker | | | file descriptor support, no m | ultibytes in printf and |
| Debugger | | | scanf, and no hex floats in s | strtod. |
| Simulator | 1000 CO. 100 | | | |
| CADI | Configuration | n file: | | |
| CMSIS DAP | STOOLKIT_ | DIR\$\inc\c\ | DLib_Config_Normal.h | |
| GDB Server | C Eachla the | | in flores. | |
| I-jet/JTAGjet | | ead support | t in ilbrary | |
| J-Link/J-Trace | Library low | -level interfa | ice implementation | CMSIS |
| TI Stellaris | ○ None | | stdout/stdem | Dilles Chillip |
| Nu-Link | # Semihost | ed | Via semihosting | ET ONE OWING |
| PE micro | LAR been | oneint. | O Via SWO | DSP library |
| ST-LINK | - Press Servers | door u | 0 10 0110 | |
| Third-Party Driver | | | | · · · · · · · · · · · · · · · · · · · |
| TI MSP-PET | | | | |

Figure 11. IAR Library Configuration

 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

 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.

| Category: | Factory Setting | 31 |
|---|--|-------|
| Seneral Options Static Analysis Runtime Checking C/C++ Compiler Assembler Output Converter Custom Build | #define Diagnostics Checksum Encodings Extra Options Config Library Input Optimizations Advanced Output List Linkar configuration file | |
| Build Actions | STOOLKIT DIRS\config\inker\AnalogDevices\ADuCM410flas | |
| Debugger Simulator CADI CMSIS DAP GDB Server | Edt Configuration file symbol definitions: (one per line) | - |
| I-jet/JTAGjet J-Link/J-Trace TI Stellaris Nu-Link PE micro ST-LINK Third-Party Driver | | 8. |
| TI MSP-FET | | - |

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.

| and the first of the second se | Factory Settings |
|--|--|
| eneral Options tatic Analysis unitime Checking C/C++ Compiler Assembler Output Converter Custom Build Build Actions Linker Debuopser Simulator CADI CADI CADI CADI CADI CADI CADI CADI | Setup Download Images Extra Options Multicore Plugins Verify download Suppress download Use flash loader(s) Override default. Loard file STOOLKIT_DIRS/config/flashloader/AnalogDevices/IR Edit Perform mass erase before flashing |
| TI MSP-FET | |

Figure 14. Debugger Configuration

| Seneral Options Static Analysis Runtime Checking C/C++ Complier Assembler | Setup Download Images Extra Options Multicore Plugins |
|--|--|
| Output Converter | Driver 🛛 🕅 Run to |
| Custom Build | J-Link/J-Trace main |
| Build Actions | Setup macros |
| Debugger | Use macro file(s) |
| GDB Server GDB Server I-jet/JTAGjet J-Link/J-Trace TI Stellaris Nu-Link PE micro | Device description file Qvertide default STOOL/OT_DIRS/config/debugger/AnalogDevices/ADUCM410- |

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.

| ategory: | e | | | | | Factory Settings |
|--|--|---|-----------------------|---------------------------------------|-------|------------------|
| Seneral Options katic Analysis katic Analysis katic Analysis (C4 + Compiler Assembler Output Converter Custum Build Build Actions Linker Debugger Simulator CADI CADI CADI CADI CADI CADI CADI CADI | Setup Conne Reset Hait before JTAG/SWO * Auto Initial © Exed Adaptive | tion Bread bootloader speed 1000 | kpoints kHz kHz | Clock setup CPU dook: SWO dook: | 0 | MHz 64z |
| JUNI/J Frace TI Stellaris Nu-Link PE micro ST-LINK Thid-Party Driver TI MSP-FET TI XDS | ETM/ETB | B | | | | |

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 μ Vision5 and IAR Embedded Workbench development.

Table 4 shows the mIDAS-Link pin configuration.

| 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 | RESET |
| 17 | P1.1/SOUT |

Table 4. mIDAS-Link Pin Labels

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.

| 🗞 SUB-20 Firmware Update Tool 🛛 v1.3.0 | |
|--|---------------|
| | Set Boot Mode |
| | Update |
| | |

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.
- 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

| SUB-20 Pins |
|-------------|
| J6-10 |
| J6-9 |
| J6-7 |
| 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.

| | STORE STORE | stimute_on other the | bug/Exe/M410_GPID.he | × | Browse. |
|------------------------------|-----------------------|------------------------|----------------------|---|---------|
| itor Status | | | | | |
| r download ess Download a | and plus Reset on han | dware before click >St | lant< | | |
| | | | | | |

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**.



Figure 20. Mass Erase and Program Options in MI2CFTWSD

- On the EVAL-ADUCM410QSPZ or EVAL-ADUCM410QSP1Z board, press the SERIAL_DOWNLOAD button and pulse the RESET button to set up the device in I²C download mode.
- Click the Start button in the MI2CFTWSD window. If the I²C connection is established, the status shows the ADuCM410 is connected, as shown in Figure 21.

| | Presenter (Severage e a | (M410_GPIO\(AR\(Debu | gitxel/M410_GP10.hex | Brow |
|------------------------------------|--------------------------|----------------------|----------------------|------|
| onitor Status | | | | |
| uilding up conne lequesting CPU | iction ID | | | |
| PUID Respons | e Received | | | |
| | DUCALLES SADADOT | | | |
| Conscied to A | DuCM410 1024-892 | | | |
| Conscied to A | DuCM410 1024/892 | | | |
| Conscied to A | DuCM410 1824-892 | | | |
| Loonsched to A | DuCM410 1024B9Z | 1 | 1 | - |

Figure 21. I²C Connection Established

 After I²C 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.

| | ADAD WALE-1 (example) | r/M410_GPIO/IAR\De | bug\Exe\M410_GPIO he | ¢ | Browse |
|---|--|-----------------------|----------------------|---|--------|
| Ionitor Status | | | | | |
| No Programmir No Verity select Send Remote P | ite ig selected ted Run to kernel | | | | |
| Soft Reset exer For new download Press Download | uted 1 and plus Reset on Han | dware before click >S | hatk | | v |

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).

M410 FPU - IAR Embedded Workbench IDE Edit View Project J-Link Tools Windo File Add Files... 한 👌 🕒 🝙 Add Group... Workspace [1] Import File List... Debug Add Project Connection... Files Edit Configurations... 🗆 🌒 M410_FPU -📮 🛋 apps Remove × HE 🖸 ADuCM L-⊞ 🗟 main.c Create New Project... t -🕀 🛋 common . Add Existing Project... -🖯 蔰 startup -🕀 🖬 startup Options... ÷. └─⊞ 💽 system_ –🖽 🛋 Output Version Control System 0323-010 0 Make 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.

| Collegory. Collegory Static Analysis | | | | | |
|---|-------------------|-------|--------------|---------------|-------------------|
| CELL Creating | Library Options | 2 | MISRA | I-C:2004 | MISRA-C:1998 |
| Accembler | Target Ou | tput | Library C | Configuration | Library Options 1 |
| Output Converter | Processor variant | | | | |
| Custom Build | OCore | Corte | e-M33 | - | |
| Build Actions | C. ogov | | | | 10000 |
| Linker | Qevice | Analo | gUevices A | DUCM410 | 0- |
| Debugger Simulator | OCMSIS-Pack | None | | | 1 million 1 |
| CADI | Endian mode | Flo | ating points | ettings | |
| GDB Server | (d) Little | F | NU | VEPv5 single | precision ~ |
| I-jet/JTAGjet J-Link/J-Trace TI Statistis | C Big C BE32 | D | (egisteri | 16 | |
| PE micro | W BES | 13 | ådvanced S | IMD (NEON) | |
| Third Party Driver | - | | DSP Extensi | ion | |
| | | | | | |

Figure 24. IAR IDE General Options

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EVAL-ADUCM410QSPZ/EVAL-ADUCM410QSP1Z User Guide

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).



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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.

| main.c 🗙 system_ADuCM410.c ADuCM410.h | ₹ Terminal I/O | → ‡ × | Disassembly | | | | |
|---|--------------------|---------------|-------------|--------------------|-------------|-----------------|-------------|
| | f0 Output | Log file: Off | Go to | ~ | Memory | ~ 🗈 | |
| <pre>#include "DioLib.h"</pre> | 1 + 0.3 = 1.300000 | ~ | | | | | |
| #include "ClkLib.h" | 1 - 0.3 = 0.700000 | | Disassembly | | | | |
| | | | 0x3 | 926: 0x4825 | LDR.N | R0, [PC, #0x94] | [a,b] = [a] |
| int main (void) | 1 1 0.00 0.000000 | | 0x3 | 928: 0x7800 | LDRB | R0, [R0] | |
| | | | 0x3 | 92a: 0xf050 0x0001 | ORRS V | RO, RO, #1 | |
| float a,b; | | | 0x3 | 92e: 0x4923 | LDR.N | R1, [PC, #0x8c] | 15252 |
| float fPlus, fMinus, fMul, fDiv; | | | 0x3 | 930: 0x7008 | STRB | R0, [R1] | |
| WdtGo(false); | | | a = 1. | 0; | | | |
| ClkSetup(&gClkSetup); | | | 0x3 | 932: 0xeeb7 0x0a00 | 0 VMOV.F32 | S0, #1 | |
| | | | b = 0. | 3) | | | |
| INIT(): | | | 0x3 | 936: Uxeddf UxUali | : VLDR | 51, [PC,#124] | |
| SafetyWait(): | | | tPlus | = a + b; | | | |
| bulcoyhuro(), | | | 0x3 | 93a: 0xee30 0x1a20 |) VADD.F32 | S2, S0, S1 | |
| TED ON(). | | | fMinus | = a - b; | | | |
| LIED_ON (), | | | Ux3 | 93e: Uxee3U Ux8a6t |) A20B.E35 | 516, 50, 51 | |
| | | | fMul = | a * b; | | | |
| a = 1.0; | | | 0x3 | 942: 0xee60 0x8a20 | 0 VMUL.F32 | S17, S0, S1 | |
| b = 0.3; | | | tDiv = | а / Ь; | | | |
| fPlus = a + b; | | | Ux3 | 946: Uxee80 Ux9a20 | J VDIV.F32 | S18, S0, S1 | |
| fMinus = a - b; | | | DEBUG_ | MESSAGE("1 + 0.3 = | * %t",tPlus |); | |
| fMul = a * b; | | | Uxa | 94a: Uxeell UxUall | J VMOV | RU, 52 | |
| fDiv = a / b; | | | Uxa | 94e: 0x1000 0x1891 | : BL | aeab1_f2d | 3787875 |
| No. | | | Uxa | 952: 0x0002 | MOVS | R2, R0 | |
| DEBUG_MESSAGE("1 + 0.3 = %f", fr | P. | | Uxa | 954: UXUUUD | MOVS | R3, R1 | |
| DEBUG_MESSAGE("1 - 0.3 = %f", fM | 1: | | Ux3 | 955: Ux491a | LDR.N | RI, [PC, #0x68] | 1.1.1. |
| DEBUG MESSAGE ("1 * 0.3 = %f", fM | í. | | Ux3 | 958: Ux481a | LDR.N | RU, [PC, #Ux68] | 1.1.1 |
| DEBUG MESSAGE ("1 / 0.3 = %f", fI |); | | 0x3 | 95a: UxtUOO Oxf8bo | 1 BL | sprintf | 1.1.1 |
| | | | DEBUG_ | MESSAGE("1 + 0.3 = | = %f",fPlus |); | |

Figure 26. IAR FPU Example Program Output

| Analog Devices ADuCM410 <u>X</u> tal (MHz): 160.0 | | | | | Code G | eneration – Compiler: | Use defau | lt compiler version | 6 💌 |
|--|-------------|----------|---------|---------|---------|--------------------------|------------|---------------------|--------|
| perating | system: | None | | - | | | | | |
| ystem Vi | ewer File: | | | | 🔽 Us | e MicroLIB | | 🕅 Big Endian | |
| ADuCM4 | 10.svd | | | | Floatin | ng Point Ha | rdware: | Single Precision | • |
| Use C | Sustom File | | | | | | | | |
| Read/0 | nly Memo | ry Areas | | | Read/V | /rite Memor | y Areas | | |
| default | off-chip | Start | Size | Startup | default | off-chip | Start | Size | Nolnit |
| | ROM1: | | | C | | RAM1: | | | |
| | ROM2: | | | C | | RAM2: | | | |
| Г | ROM3: | | | C | Г | RAM3: | | | |
| | on-chip | | | | | on-chip | | | |
| - | IROM1: | 0x0 | 0x80000 | ۲ | | IRAM1: | 0x20000000 | 0x18000 | ~ |
| V | | | | - | - | ID AM2. | | | |

Figure 27. Keil General Options

 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.

| nalog Devices ADuCM410 Xtal (MHz): 160.0 | | | | | -Code G | eneration – Compiler: | Use defau | t compiler version | 6 💌 | |
|---|---------------|-------------------|-------------|---------|---------|---------------------------|-------------------|--------------------|----------|--|
| Operating | system: | None | Xtal (MHz): | | | | | | | |
| System Viewer File: | | | | | | Use MicroLIB 🔲 Big Endian | | | | |
| ADuCM410.svd | | | | | Floatin | ng Point Ha | rdware: | Single Precision | • | |
| Use C | Custom File | 3 | | | | | - | | | |
| Read/C | off-chip | ry Areas Start | Size | Startup | default | /rite Memo off-chip | ry Areas Start | Size | Nolnit | |
| | ROM1: | | | C | | RAM1: | | | | |
| Г | ROM2: | | | C | | RAM2: | | | | |
| Г | ROM3: | | | 0 | Г | RAM3: | | | | |
| | on-chip | | | | | on-chip | | | | |
| - | IROM1: | 0x0 | 0x80000 | ۲ | ~ | IRAM1: | 0x20000000 | 0x18000 | V | |
| | 1001110000000 | - | | 0 | | IRAM2: | | | | |

Figure 28. Keil General Options

| Disa | ssembly | | | and the second |
|------|----------|------------|--------|--|
| 0x | 00000E1C | 900D | STR | r0,[sp,#0x34] |
| | 34: | fPlus = | a + b; | |
| 0x | 00000E1E | ED9D0A0E | LDC | p10,c0,[sp,#0x38] |
| 0x | 00000E22 | ED9D1A0D | LDC | p10,c1,[sp,#0x34] |
| 0x | 00000E26 | EE300A01 | CDP | p10,#0x3,c0,c0,c1,#0 |
| 0 x | 00000E2A | ED8D0A0C | STC | p10,c0,[sp,#0x30] |
| | 35: | fMinus = | a – b | * |
| 0.8 | 00000E2E | ED9D0A0E | LDC | p10,c0,[sp,#0x38] |
| 0 x | 00000E32 | ED9D1A0D | LDC | p10,c1,[sp,#0x34] |
| 0.8 | 00000E36 | EE300A41 | CDP | p10,#0x3,c0,c0,c1,#2 |
| 0x | 00000E3A | ED8D0A0B | STC | p10,c0,[sp,#0x2c] |
| | 36: | fMul = a | * b; | |
| 0 x | 00000E3E | ED9D0A0E | LDC | p10,c0,[sp,#0x38] |
| 0 x | 00000E42 | ED9D1A0D | LDC | p10,c1,[sp,#0x34] |
| 0.8 | 00000E46 | EE200A01 | CDP | p10,#0x2,c0,c0,c1,#0 |
| 0x | 00000E4A | ED8D0A0A | STC | p10,c0,[sp,#0x28] |
| | 37: | fDiv = a | / b; | |
| | 38: | ERDERDERDE | 28282 | |
| 0 x | 00000E4E | ED9D0A0E | LDC | p10,c0,[sp,#0x38] |
| 0.8 | 00000E52 | ED9D1A0D | LDC | p10,c1,[sp,#0x34] |
| 0 x | 00000E56 | EE800A01 | CDP | p10,#0x8,c0,c0,c1,#0 |
| 0x | 00000E5A | ED8D0A09 | STC | p10,c0,[sp,#0x24] |
| < | | | | |
| | main. | c 💽 con | nmon.c | 👕 system_ADuCM410.c 🕒 startup_ADuCM41 |
| | 31 | | | |
| | 32 | a = | 1.0; | |
| | 33 | h = | 0 3. | |
| | 24 | <u>0</u> – | 0.5, | |
| | 34 | IPIU | s = a | + <u>b;</u> |
| | 35 | fMin | us = a | a – <u>b;</u> |
| > | 36 | fMul | = a ' | * b; |
| | 37 | fDiv | = a | / b: |
| | 20 | | - | |

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.

 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 | ΤE | ST_SF | NAX_I | MODE | 0 | |
|----------|----|-------|-------|-------|----|---|
| //#defin | e | TEST | SRAI | M_MOI | DE | 1 |
| //#defin | e | TEST | SRAI | M MOI | DE | 2 |
| //#defin | e | TEST | SRAI | M_MOI | DE | 3 |

Figure 30. IAR SRAM Setup main.c

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 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).

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| Files | \$ | • |
|-------------------------|----|---|
| 🗆 🌒 M410_SramMode - Deb | ~ | |
| ⊣-Ģ 🛋 apps | | |
| ADuCM410_Setup.c | | |
| └─⊞ 🗟 main.c | | |
| - 🕀 📫 common | | |
| ⊣-Ģ 🛋 startup | | |
| —⊞ 🖬 startup_ADuCM410.s | | |
| └─⊞ 🗟 system_ADuCM410.c | | |
| └─⊞ 📹 Output | | |

//#define USER_SRAM_MODE 3

MODULE ?cstartup

#define USER_SRAM_MODE 0
//#define USER_SRAM_MODE 1
//#define USER_SRAM_MODE 2

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

| // us | er-: | select | able | SR | AM mo | ode | | | |
|-------|------|--------|-------|-----|-------|-----|----|----|----|
| defin | e s | ymbol | USEF | SR/ | AM_M(| DDE | = | 0; | |
| //def | ine | symbo | ol US | ER_ | SRAM | MOL | DΕ | = | 1; |
| //def | ine | symbo | ol US | ER | SRAM | MOL |)Ε | = | 2; |
| //def | ine | symbo | ol US | ER | SRAM | MOL |)E | = | 3; |
| | | | | - | | | | | |

| Figure 32. IAR SRAM Setup ADuCM410flash_ | _SramMode.icf Macros |
|---|----------------------|
|---|----------------------|

| isramTestFunc: | | | |
|--------------------------------------|--------------|-----------------|--|
| 0x10000000: 0x2000 | MOVS | RO, #O | |
| 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 | |
| <pre>for(uint32_t i=0;i<10;</pre> | i++) | | |
| 0x1000000c: 0x1c40 | ADDS | RO, RO, #1 | |
| <pre>for(uint32_t i=0;i<10;</pre> | i++) | | |
| 0x1000000e: 0x280a | CMP | RO, #10 | |
| 0x10000010: 0xd207 | BCS.N | 0x10000022 | |
| LED_TOGGLE(); | | | |

Figure 33. IAR SRAM Output at Mode 0

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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.

- 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.
 - 🔟 M410_SramMode.uvprojx
 - 💰 M410_SramMode0.sct
 - 💰 M410_SramMode1.sct
 - 💑 M410_SramMode2.sct
 - 💑 M410_SramMode3.sct
 - 🛄 SetSramMode0.s
 - 🛄 SetSramMode1.s
 - SetSramMode2.s
 - 🛄 SetSramMode3.s

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

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 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).

| Project | д | × | |
|---|----------|-------|-------|
| Project: M410_SramMode | | | |
| 🖻 💭 Target 1 | | | |
| 🖻 🗁 App | | | |
| ADuCM410_Setup.c | | | |
| main.c | - | | |
| SetSramMode0.s | | 3-021 | |
| | | 2032 | |
| Figure 35. Set Up SetSrammodeu.s | | | |
| <pre>#define TEST_SRAM_MODE</pre> | 0 |) | |
| //#define TEST_SRAM_MOI | Ε | 1 | |
| //#define TEST SRAM MOI | Ε | 2 | |
| //#define TEST SRAM MOI |)E | 3 | 3-022 |
| | | | 2032 |

Figure 36. Set Up M410_SramMode0.sct

- 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.

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| Options for Targ | iet 'Target 1' | | | | |
|--|---|---|-----------------|------|---|
| evice Target O | utput Listing User C/C+- | Asm Linker Debug Utilities | | | |
| 🔲 <u>U</u> se Memory L | ayout from Target Dialog | ⊠/O Base | e 🗌 | | |
| Make RW | Sections Position Independe | ent <u>B</u> /O Base | 0×00000000 | | |
| Make RO | Sections Position Independe | nt R/ <u>W</u> Base | e 0x20000000 | | |
| Do <u>n</u> 't Sear | ch Standard Libraries | disable Warnings | | | |
| Scatter .\M | 410_SramMode0.sct | | | Edit | 1 |
| Scatter File | 410_SramMode0.sct | | | Edit | |
| Scatter File | 410_SramMode0.sct | | | Edit | * |
| Scatter File \M <u>Misc</u> controls Linker control string -st | 410_SramMode0.sct ou Cortex-M33*.o orary_type=microlib -fpu=vfp ummary_stderr -info summar | v2 −strict −scatter ".\M410_SramMod ysizes −map −xref −callgraph −symb | e0.sct" pols | Edit | |



| Disass | embly | | | |
|--------------|-----------------|-------------|-------------|-------------------------------------|
| 0x0 | FFFFFC | AAAA | ADD | r2,sp,#0x2a8 |
| 0 x 0 | FFFFFFE | AAAA | ADD | r2,sp,#0x2a8 |
| | 37: { | | | |
| 0x1 | 0000000 | B082 | SUB | sp,sp,#8 |
| | 38: | for (ui | nt32_t i=0; | ;i<30;i++) |
| | 39: | { | | |
| 0x1 | 0000002 | 2000 | MOVS | r0,#0 |
| 0x1 | 0000004 | 9001 | STR | r0,[sp,#4] |
| 0x1 | 0000006 | E/FF | B | 0x1000008 |
| 0x1 | 0000008 | 2010 | CMB | r0,[Sp,#4] |
| 01 | 000000A | 2010 | DUT | 0-10000040 |
| < | | | | |
| | 36 - | 🔹 🚺 #end | startup_ADu | CM410.s 🗋 common.c 📄 common.h 🗋 sys |
| | 37 0 1 | " •••••• | | |
| | | | (| |
| | 30 | 101 | (urnesz_ | L I=0,I<30,I++) |
| _ | 39 🖓 | { | | |
| | 40 | | LED_TOGGI | LE(); |
| | 41 | | for (uint: | 32 t j=0;j<800000;j++); |
| | 42 - | } | | |
| | 43 -3 | | | |
| | 10 | | | |
| | | | Figur | e 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 (I²C or MDIO), and ensure the user source code sets Flash Address 0x01FFC = 0xFFFFFFFF.

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

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 μ Vision 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 I²C 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).



I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).



ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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