

Cypress FM4 Tools Set-up with Keil 5.x

Mark Wickert, 9/4/16, Revised 1/6/22

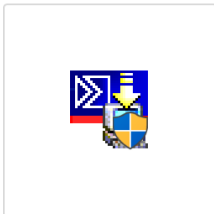
Introduction

This document will describe the details of setting up your own system with the ARM IDE Keil, and software drivers that support the Cypress FM4 board. To be clear, this software runs on Windows, e.g., version 7, 8, and 10 are all fine. If you have a Mac you can make this work by having a virtual machine installed running Windows. I use VMware Fusion, but Parallels should work.

Gathering Up the Software

The site for drivers and tools, and purchase of the Cypress FM4 is <http://www.cypress.com/documentation/development-kitsboards/sk-fm4-1761-s6e2cc-fm4-family-quick-start-guide>.

- Keil from <https://www.keil.com/download/product/>, you will want the evaluation version, which is free and has no time limit on it.



MDK535.EXE

The lab is switched over to Keil 5.36, which is the newest version available from ARM. This version requires a special pack configuration described later in this document.

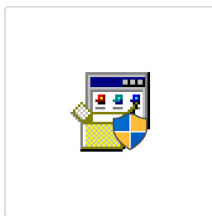
- The CMSISDap (Cortex® M software interface standard, Debug access port) driver.



CmsisDapDriverInstaller
V14.exe

No newer version is available,
I am using on my systems
I can supply this in lab

- Cypress/Spansion serial port viewer tool



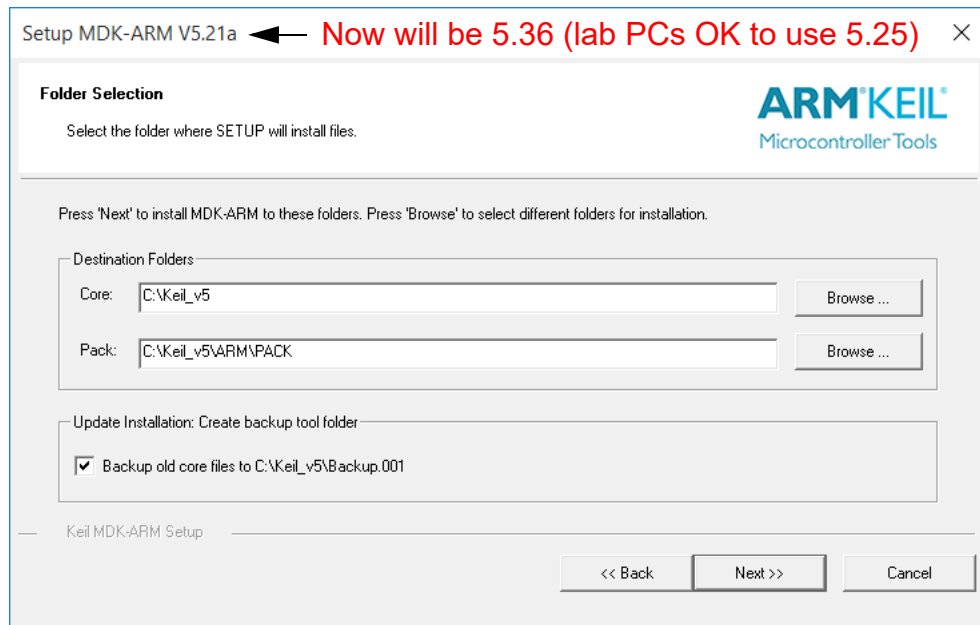
SerialPortViewerSetupV
5.8.3.exe

I can supply this in lab

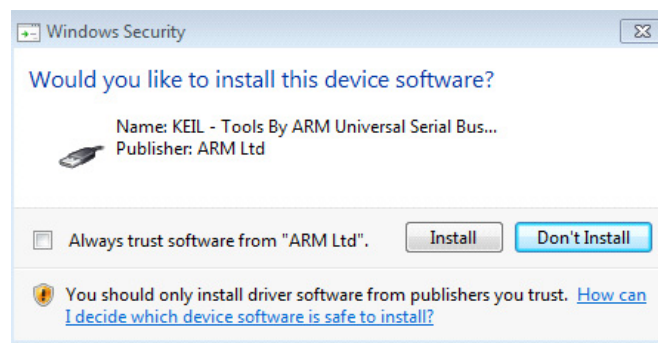
Step-by-Step Installation

Step 1: Installing Keil MDK and USB Drivers

Install Keil MDK 5.xx by double clicking on MDK5xx.exe installer file. Choose the default installation directory to avoid any path issues later on.



As the installation proceeds be sure to accept the installation of the USB drivers to make interfacing to the board possible. If you are not prompted for the USB driver install it likely means you



already have the drivers installed from using another device.

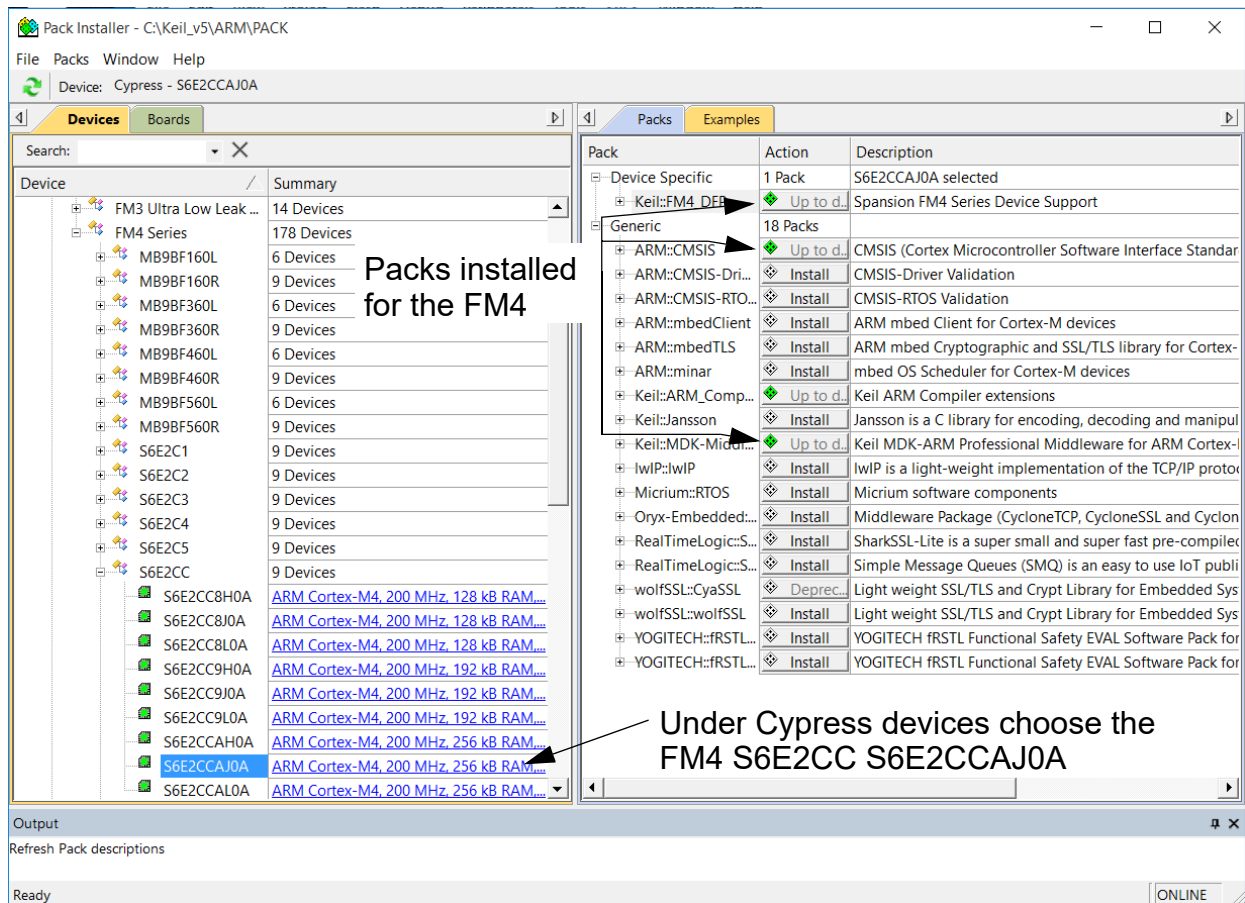
Step 2: Software Pack Installation

When you launch Keil for the first time the *Pack Installer* should start up. If not click the tool bar shown below:



From the left hand side of the *Pack Installer* choose the device FM4 S6E2CC S6E2CCAJOA. With this

selection packs on the right hand side of the *Pack Installer* will now be displayed for installation.



For Fall 2021 on the lab PCs ran **5.25**. I was successful with set-up and initial test if I fix the critical components in the *Pack Installer* as:

Device Specific	1 Pack	S6E2CCA0A selected
Keil::FM4_DFP	Up to date	Cypress FM4 Series Device Support
1.6.0 (2019-05-28)	Remove	Cypress FM4 Series Device Support
1.5.1 (2016-07-12)	Remove	Spansion FM4 Series Device Support
1.4.0 (2015-07-16)	Remove	Spansion FM4 Series Device Support
ARM::CMSIS	Update	CMSIS (Common Microcontroller Software Interface Standard)
5.8.0 (2021-06-24)	Install	CMSIS (Common Microcontroller Software Interface Standard)
5.6.0 (2019-07-10)	Remove	CMSIS (Cortex Microcontroller Software Interface Standard)
ARM::CMSIS-Driver	Update+	CMSIS Drivers for external devices
2.6.1 (2020-07-13)	Install+	CMSIS Drivers for external devices
2.4.1 (2019-07-11)	Remove	CMSIS Drivers for external devices
Keil::ARM_Compiler	Update	Keil ARM Compiler extensions for ARM Cortex-M devices
1.6.3 (2020-04-22)	Install	Keil ARM Compiler extensions for ARM Cortex-M devices
1.6.2 (2019-11-12)	Remove	Keil ARM Compiler extensions for ARM Cortex-M devices
Keil::MDK-Middleware	Update	Middleware for Keil MDK-Professional and Keil MDK-Lite
7.13.0 (2021-05-25)	Install	Middleware for Keil MDK-Professional and Keil MDK-Lite
7.10.0 (2019-11-08)	Remove	Middleware for Keil MDK-Professional and Keil MDK-Lite

In particular install and/or update

- Keil::FM4_DFP
- ARM::CMSIS
- Keil::MDK-Middleware

The screen shot above shows what it should look like when the packs are properly installed. Note the ARM::CMSIS and Keil::MDK-Middleware may not need to be upgraded if you have been using Keil for other devices.

Keil 5.36

On the newer 5.36 version of Keil some differences in the configuration are needed.

Right side of the Pack Manager under Keil 5.36

This does not work
This works

This is actually version 2.7 which works with CMSIS 5.7

This works

Pack	Action	Description
[-] Device Specific	1 Pack	S6E2CCA0A selected
[-] Keil::FM4_DFP	Up to date	Cypress FM4 Series Device Support
1.6.0 (2019-05-28)	Remove	Cypress FM4 Series Device Support
1.4.0 (2015-07-16)	Remove	Spansion FM4 Series Device Support
Previous		Keil::FM4_DFP - Previous Pack Versions
[-] Generic	51 Packs	
Alibaba::AliOSThings	Install	AliOS Things software pack
Arm-Packs::PKCS11	Install	OASIS PKCS #11 Cryptographic Token Interface
Arm-Packs::Unity	Install	Unit Testing for C (especially Embedded Software)
ARM::AMP	Install	Software components for inter processor commu
[-] ARM::CMSIS	Update	CMSIS (Common Microcontroller Software Interfa
5.8.0 (2021-06-24)	Unpack	CMSIS (Common Microcontroller Software Interfa
5.7.0 (2020-04-09)	Remove	CMSIS (Cortex Microcontroller Software Interface
5.6.0 (2019-07-10)	Remove	CMSIS (Cortex Microcontroller Software Interface
Previous		ARM::CMSIS - Previous Pack Versions
[-] ARM::CMSIS-Driver	Up to date	CMSIS Drivers for external devices
2.6.1 (2020-07-13)	Remove	CMSIS Drivers for external devices
Previous		ARM::CMSIS-Driver - Previous Pack Versions
ARM::CMSIS-Driver_Val...	Install	CMSIS-Driver Validation
ARM::CMSIS-FreeRTOS	Install	Bundle of FreeRTOS for Cortex-M and Cortex-A
ARM::CMSIS-RTOS_Vali...	Install	CMSIS-RTOS Validation
ARM::mbedClient	Install	ARM mbed Client for Cortex-M devices
ARM::mbedCrypto	Install	ARM mbed Cryptographic library
ARM::mbedTLS	Install+	ARM mbed Cryptographic and SSL/TLS library
ARM::minar	Install	mbed OS Scheduler for Cortex-M devices
ARM::PSA	Install	PSA (Platform Security Architecture)
...		
EmbeddedOffice::Flexi...	Install	Flexible Safety RTOS
[-] Keil::ARM_Compiler	Up to date	Keil ARM Compiler extensions for ARM Compiler
1.6.3 (2020-04-22)	Remove	Keil ARM Compiler extensions for ARM Compiler
Previous		Keil::ARM_Compiler - Previous Pack Versions
Keil::iMXT105x_MWP	Install+	NXP i.MX RT 1051/1052 MDK-Middleware exampl

You can now close the *Pack Installer* and move on to Step 3.

Step 3: CMSISDapDriver

Install the CMSISDapDriver, which of primary importance installs virtual serial port capability, thus allowing debug using a terminal program.

Step 4: Cypress/Spansion Serial Port Viewer

Finally install the Cypress/Spansion serial port viewer tool, which is a nicely featured RS232 terminal program, having automatic detection of devices when present.

Testing the Installation

To test the installation unpack the ZIP file Assignment1_sp2017.zip (much in common with ECE4680 Lab3_f2016.zip) at some convenient location on your system, I suggest a folder named Lib_DSP_FM4. The contents of this ZIP file are already in a folder, which has a structure as shown below (note more info about the file structure is found in Assignment1):

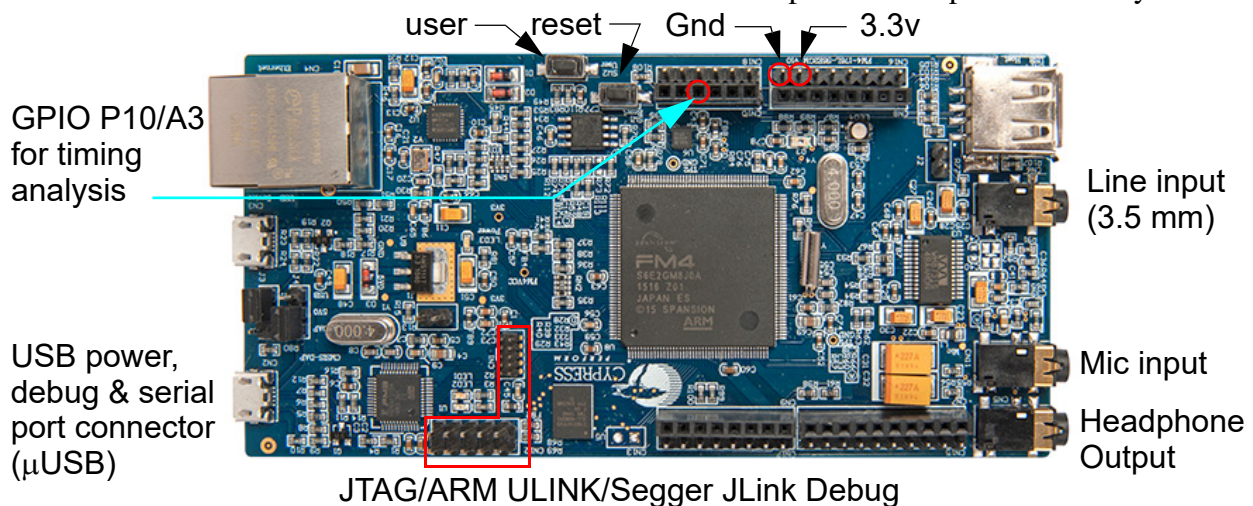
Name	Date modified	Type	
drivers	9/1/2016 9:03 PM	File folder	Driver C code
FM4_GUI_slider Libs	9/1/2016 9:03 PM	File folder	
lst	9/1/2016 9:03 PM	File folder	
MATLAB	9/1/2016 9:03 PM	File folder	
obj	9/3/2016 9:52 PM	File folder	
Python	9/2/2016 7:52 AM	File folder	Program C code (main, etc.)
RTE	9/1/2016 9:03 PM	File folder	
src	9/3/2016 2:41 PM	File folder	
FM4_GUI_slider	1/12/2016 2:16 PM	Application	
fm4_project.uvguix.mwickert	8/21/2016 10:14 PM	MWICKERT File	
fm4_project.uvoptx	8/5/2016 9:59 PM	UVOPTX File	
fm4_project	7/17/2016 1:15 PM	µVision5 Project	

Reay text m-code
Jupyter notebooks

Windows GUI slider control used for real-time parameters

Double-click to open project

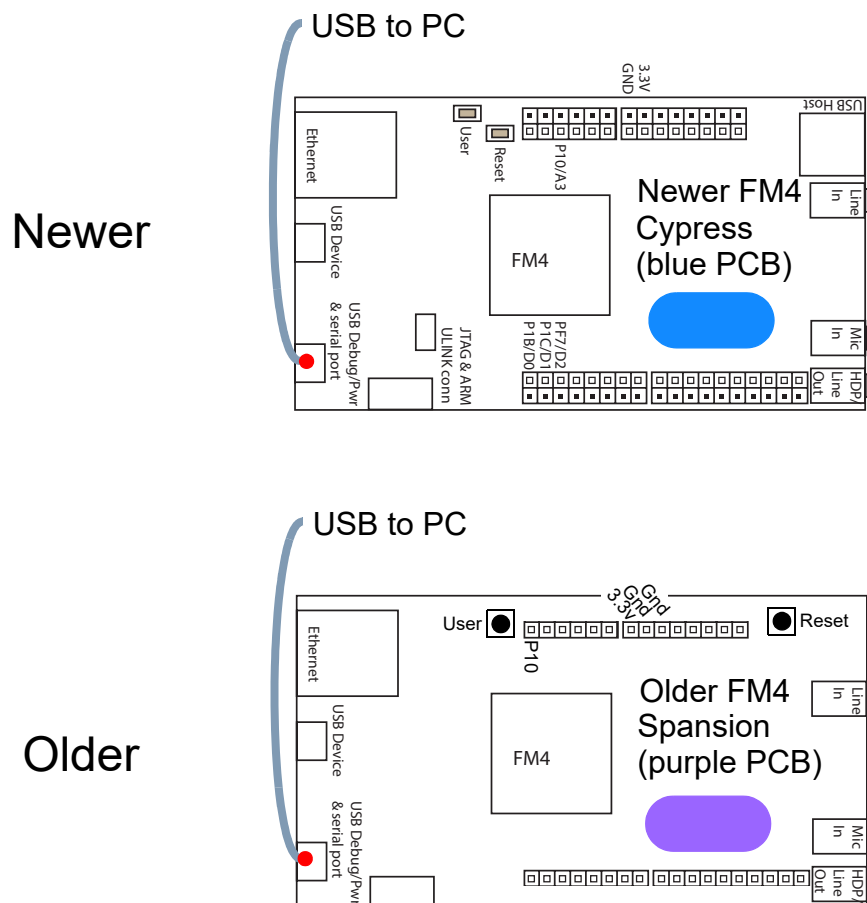
The Connect the FM4 Pioneer board to an available USB port. At this point it is likely that the



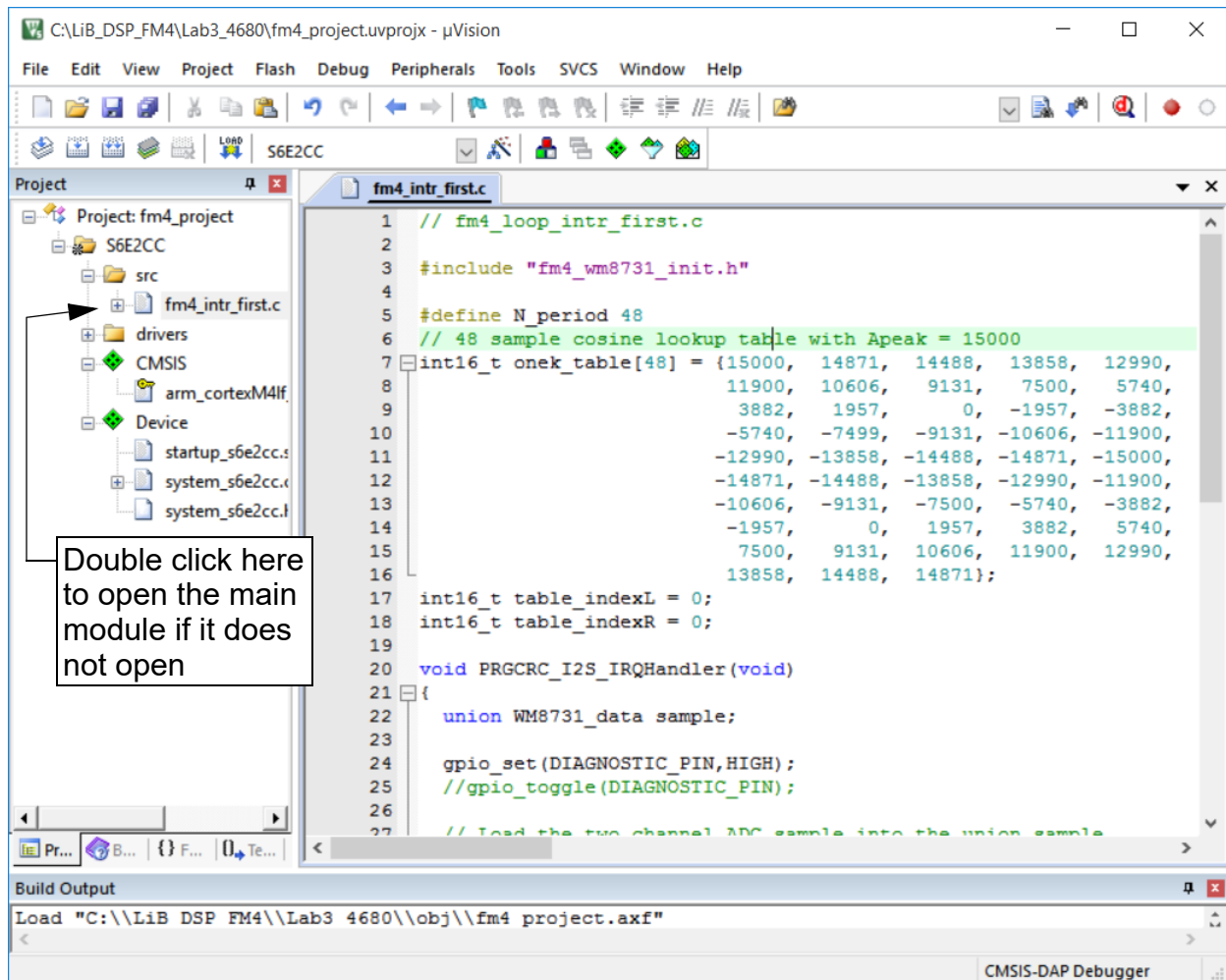
Spansion Serial Port Viewer, installed earlier, will detect the FM4 and virtual serial port connection. The serial port terminal is not needed at this time however.

Board Layout Differences

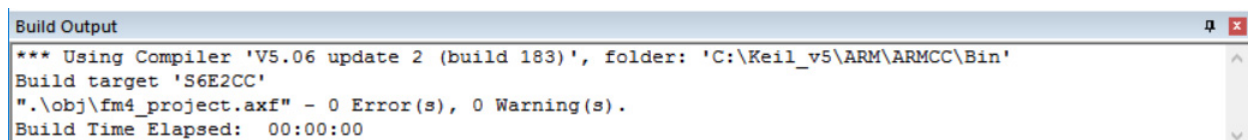
Check to see which version of the FM4 board you have: newer (blue PCB), older (purple PCB)



Moving on launch Keil and open the project found at the root level of ECE 5655 Assignment1/ ECE 4680 Lab3. When the project opens you should see something similar to the following:



To *build* the project press F7, press the toolbar button  or under the Project menu click **Build Target**. At the bottom of the Keil main window you should see 0 errors, 0 warnings:



To run the project press Ctrl+F5, press the target press  or from the Debug menu click **Start/Stop Debug Session** to start debugging the project. You can now run the project by pressing F5 (Run) or clicking the button  (this button is only visible when in the debug mode). My preference is to always debug projects so you can set break points, use watch windows, the memory window, and the Keil debugger command line, to name a few things available. An alternative is to simply download the project to flash directly via the button .

The main module program that is now running on the FM4 Pioneer Kit is:

```

// fm4_loop_intr_first.c
#include "fm4_wm8731_init.h"

```

```

#define N_period 48
// 48 sample cosine lookup table with Apeak = 15000
int16_t onek_table[48] = {15000, 14871, 14488, 13858, 12990,
                          11900, 10606, 9131, 7500, 5740,
                          3882, 1957, 0, -1957, -3882,
                          -5740, -7499, -9131, -10606, -11900,
                          -12990, -13858, -14488, -14871, -15000,
                          -14871, -14488, -13858, -12990, -11900,
                          -10606, -9131, -7500, -5740, -3882,
                          -1957, 0, 1957, 3882, 5740,
                          7500, 9131, 10606, 11900, 12990,
                          13858, 14488, 14871};

int16_t table_indexL = 0;
int16_t table_indexR = 0;

void PRGCRC_I2S_IRQHandler(void)
{
    union WM8731_data sample;

    gpio_set(DIAGNOSTIC_PIN, HIGH);
    //gpio_toggle(DIAGNOSTIC_PIN);

    // Load the two channel ADC sample into the union sample
    sample.uint32bit = i2s_rx();

    // Put table values in left and right channels
    sample.uint16bit[LEFT] = onek_table[table_indexL];
    sample.uint16bit[RIGHT] = onek_table[table_indexR];
    table_indexL = (table_indexL + 1) % N_period; // stride by 1 ==> 1 kHz
    table_indexR = (table_indexR + 2) % N_period; // stride by 2 ==> 2 kHz

    // Pass or push sample back out to the DAC
    i2s_tx(sample.uint32bit);

    NVIC_ClearPendingIRQ(PRGCRC_I2S_IRQn);
    gpio_set(DIAGNOSTIC_PIN, LOW);
}

int main(void)
{
    // Some #define options for initializing the audio codec interface:
    // FS_8000_HZ, FS_16000_HZ, FS_24000_HZ, FS_32000_HZ, FS_48000_HZ, FS_96000_HZ
    // IO_METHOD_INTR, IO_METHOD_DMA
    // WM8731_MIC_IN, WM8731_MIC_IN_BOOST, WM8731_LINE_IN
    fm4_wm8731_init (FS_48000_HZ, // Sampling rate (sps)
                    WM8731_LINE_IN, // Audio input port
                    IO_METHOD_INTR, // Audio samples handler
                    WM8731_HP_OUT_GAIN_0_DB, // Output headphone jack Gain (dB)
                    WM8731_LINE_IN_GAIN_0_DB); // Line-in input gain (dB)

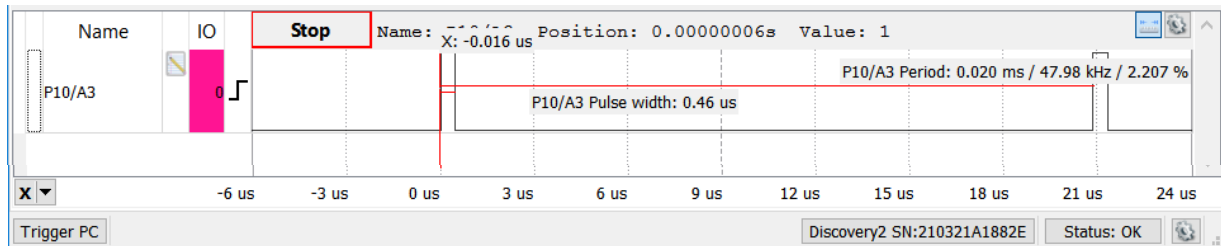
    while(1){}
}

```


Code Description

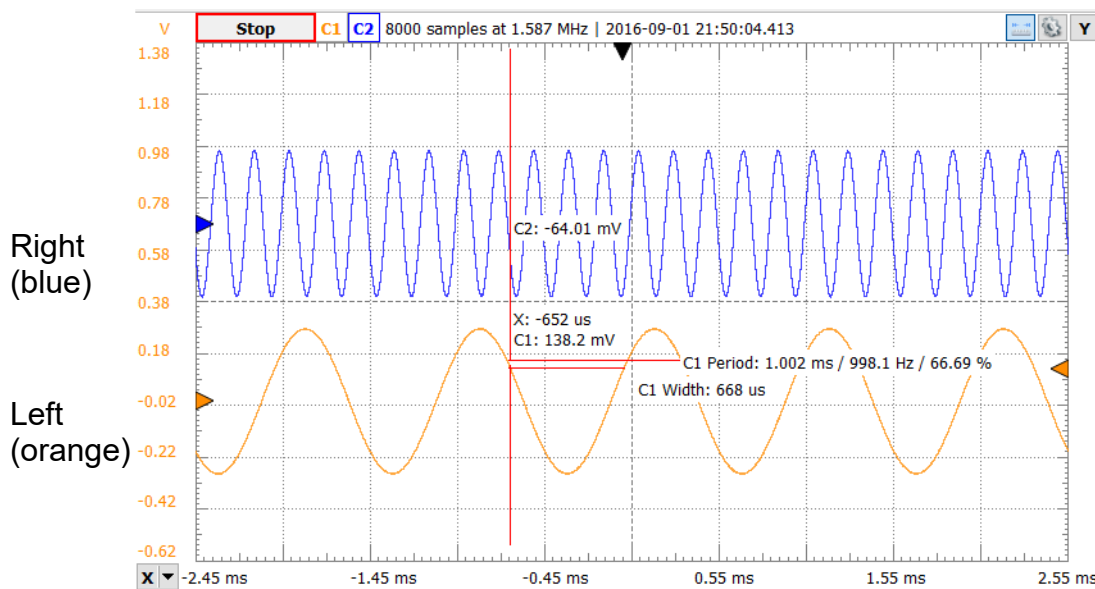
This code is sending samples from a sinusoidal waveform look-up table to WM8731 audio codec headphone output (DAC) on the FM4. The sampling rate is set to 48 kHz. The left channel of the output receives every sample from the table and then repeats while the right channel receives every other sample from the table and repeats. The table length is 48 samples and is one period of cosine. The left and right outputs are thus 1 KHz and 2 KHz sinusoids, respectively. The left and right audio input to the WM8731 (ADC) is read, but is not utilized by the program. All of the signal processing action takes place in the interrupt service routine `PRGCRC_I2S_IRQHandler`. Within `main` the WM8731 codec is initialized. For real-time performance analysis a GPIO pin, P10/A3, is also written to within the interrupt. A logic '1' is written at the start and logic '0' and the end.

To complete the software testing move on to test output waveforms from the board. Start by connecting the P10/A3 GPIO pin to a logic analyzer (best) or scope. The expected waveform is shown below (from Analog Discovery 2/Waveforms 3). Note the interrupt rate is 48 kHz as

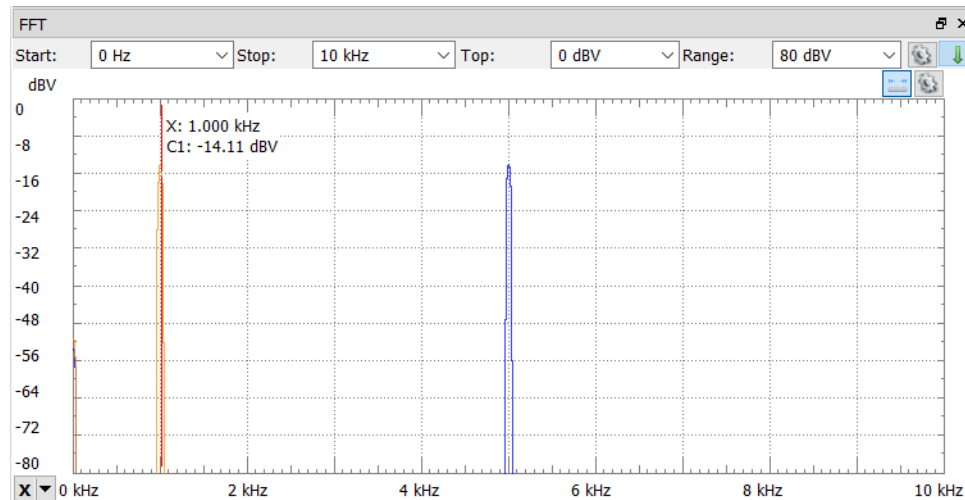


expected. The lab instructor will provide you with a male-to-male jumper wire.

Next take a look at the headphone outputs, both left and right channels, on the scope. The measurement should appear as shown below (results here again from the Analog Discovery 2):



FFT
spectral
analysis



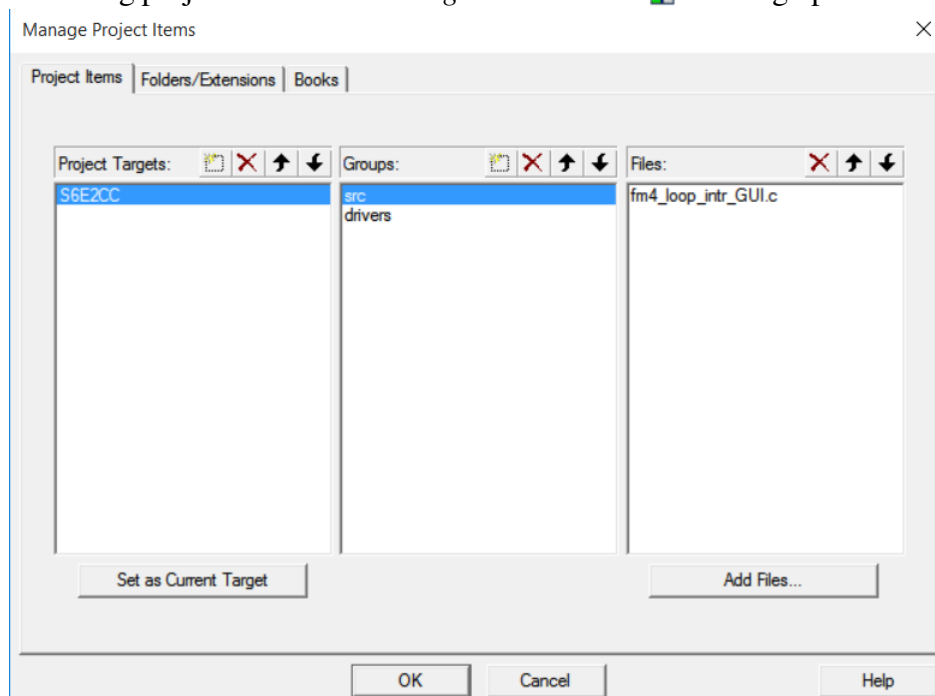
Note you will need to pull a 3.5 mm stereo cable with male phono plug ends and then use a phono plug to BNC adapter to connect to the scope.

Creating and Modifying Projects

A new Keil project can also be created, but most of the time we will just make a copy of an existing project and/or modify an existing project by changing the included files. In particular it is very easy in Keil to change which file in the project contains the C function main and include additional project source files.

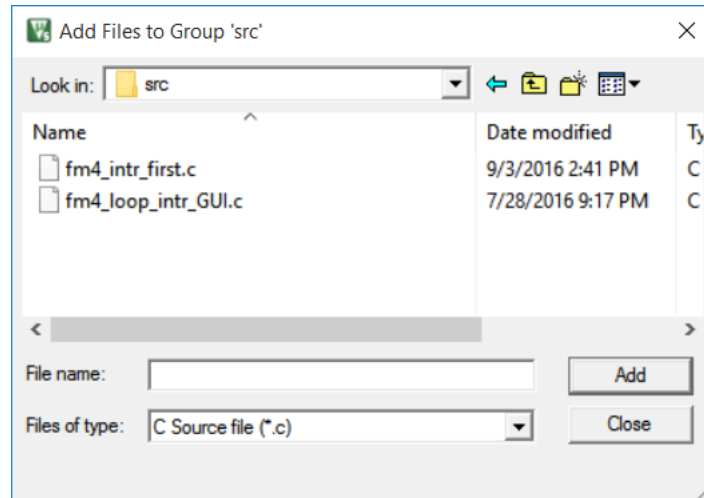
Modifying An Existing Project

To modify an existing project click the *building blocks* button  to bring up the Manage Project

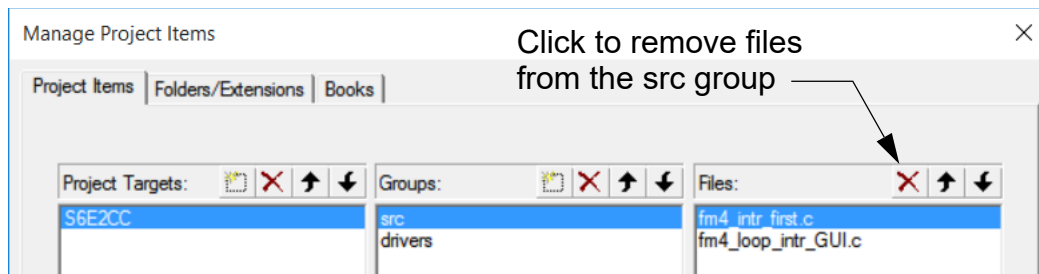


Items dialog. In the right pane you can add and delete files from the project. As shown in the screen shot above the `src` folder is highlighted, so this is where the deleted or added files will be visible in Keil's project directory tree. A typical use of this is when you want to make a copy of the module that contains `main()` or swap in a different module containing `main()`.

As an example clicking on **Add files...** and navigating to the `src` folder we see:



We add the file `fm4_loop_intr_GUI.c` and click **Close**. Back in the **Manage Project Items** dialog we see two files now in the `src` group. I know that both of these modules contain a `main()`



function, so I remove `fm4_intr_first.c`. You will be formally introduced to the GUI slider control interface in Assignment1/Lab3.

Creating a Clean Project

TBD