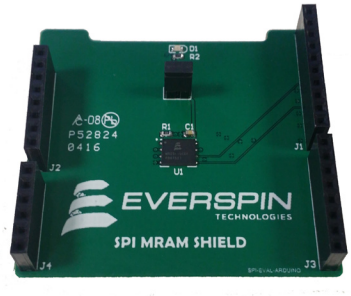
## MR25H00-EVAL MRAM Evaluation Board

The MR25H00-EVAL MRAM evaluation board from Everspin is an Arduino-derived MRAM Shield that will interface with any Arduino-derived microcontroller host board with standardized UNO pinout.




### The Evaluation Board

The evaluation board is populated with a 4Mbit Everspin MR25H40 SPI MRAM for evaluation of any of the Everspin Product Families listed below.

| Everspin Product Family | Density | Temperature Grades |
|---|---|---|
| MR25H256 | 256 Kb / 40MHz | Industrial / AEC-Q100 Grade 1 |
| MR25H10 | 1 Mb / 40MHz | Industrial / AEC-Q100 Grade 1 |
| MR20H40 | 4Mb / 50MHz | Industrial |
| MR25H40 | 4 Mb / 40MHz | Industrial / AEC-Q100 Grade 1 |

### Host Board Support

The MR25H00-EVAL Evaluation board employs a pin out that is compatible with the Arduino form factor UNO pinout. The board utilizes the SPI interface on UNO pins D10, D11, D12, and D13. The HOLD and WP pins are connected to digital pins D8 and D9. See **Appendix A – MR25H00-EVAL Schematic and Layout** for more detail.

By using this common MCU evaluation board pinout, the MR25H00-EVAL board is compatible with a large number of MCU evaluation boards. For example, the following four MCU series listed below with Arduino-derived host boards will work for evaluation using the SPI MRAM Evaluation board.

| Host Board Supplier | MCU | Host Board |
|---|---|---|
| ST Micro | STM32F411RET6 Series | NUCLEO-F411RE |
| Freescale | Kinetis MCU Series | Kinetis Freedom |
| NXP | LCP Series MCU | LPCXpresso |
| Renesas | ARM Cortex™-A9 processor Series | GR-PEACH: RZ/A1H |

We use the NUCLEO-F411RE host board as the example for setup in this Guide.

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# SETUP: MR10Q010 - EVAL MRAM EVALUATION BOARD

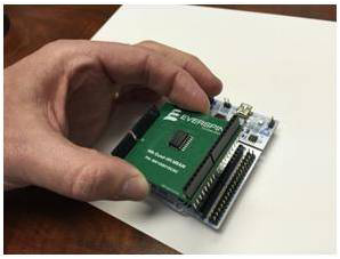
Besides the MCU host board and the Everspin MR25H00-EVAL Evaluation board, you will need:

- Computer with Internet access and USB port.
- A USB cable, with standard A to mini B connectors.
- Everspin example code from www.mbed.org.

## Step 1: *Download the USB Driver for your MCU Host Board*

| Host Board | USB Driver |
|---|---|
| NUCLEO-F411RE | Host Board Description and Drivers |
| Kinetis Freedom | Host Board Description and Drivers |
| LPCXpresso | Host Board Description and Drivers |
| GR-PEACH: RZ/A1H | Host Board Description and Drivers |
| Other | Host Board home page |

## Step 2: *Plug in the SPI Evaluation board and connect it to your computer via the USB port.*



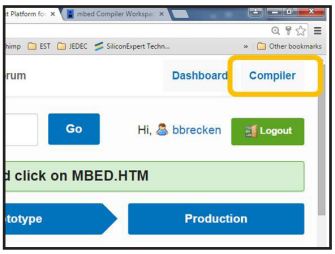
First, plug the MR25H00-EVAL board into your MCU host board, then connect the host board to your PC using the USB cable. The MCU host board will enumerate as a composite USB device that includes a built in debugger, storage device and a virtual com port.

A new drive will be created on your computer with a drive name as assigned by the host board. We are using the NUCLEO-411RE as an example for this Setup description.

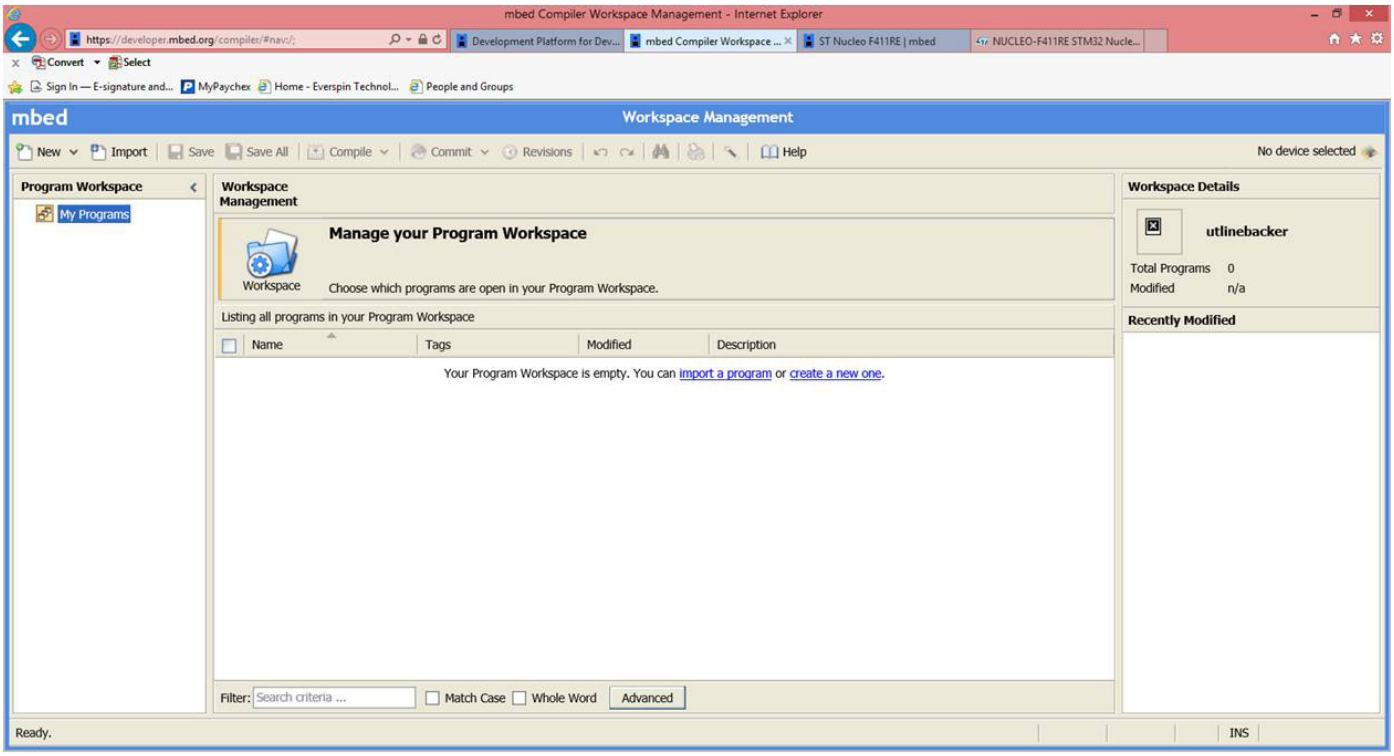
# Setup (Continued)

## Step 3: *Log in to ARM mbed and create a Workspace on your computer.*

1. Log in to developer.mbed.org. (If you do not already have an **mbed** account, you will need to create one.)
2. After logging in, click on the **Compiler** button on the upper right section of the screen.



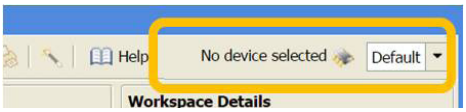

3. The **mbed** compiler will bring up the **Workspace Management** screen.

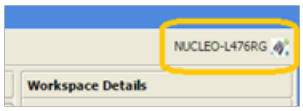


# Setup (Continued)

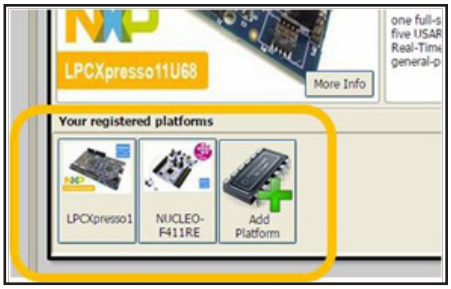
## Step 4: *Load the platform for the host board you are using*

1. The button on the upper right of the Workspace Management screen will read **No device selected** or, if you have previously loaded a platform, the name of the host board for that platform will appear, as in the **NUCLEO-411RE** case shown.

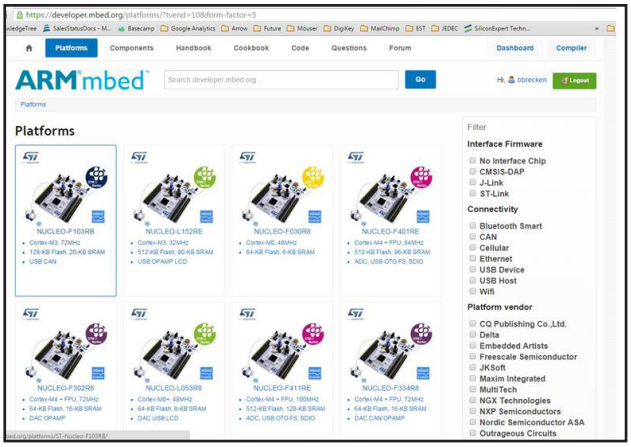



2. In either case, click on the button to open the available compiler platforms screen. Select the host board platform you wish to load or, if it is not present, then select **Add**.

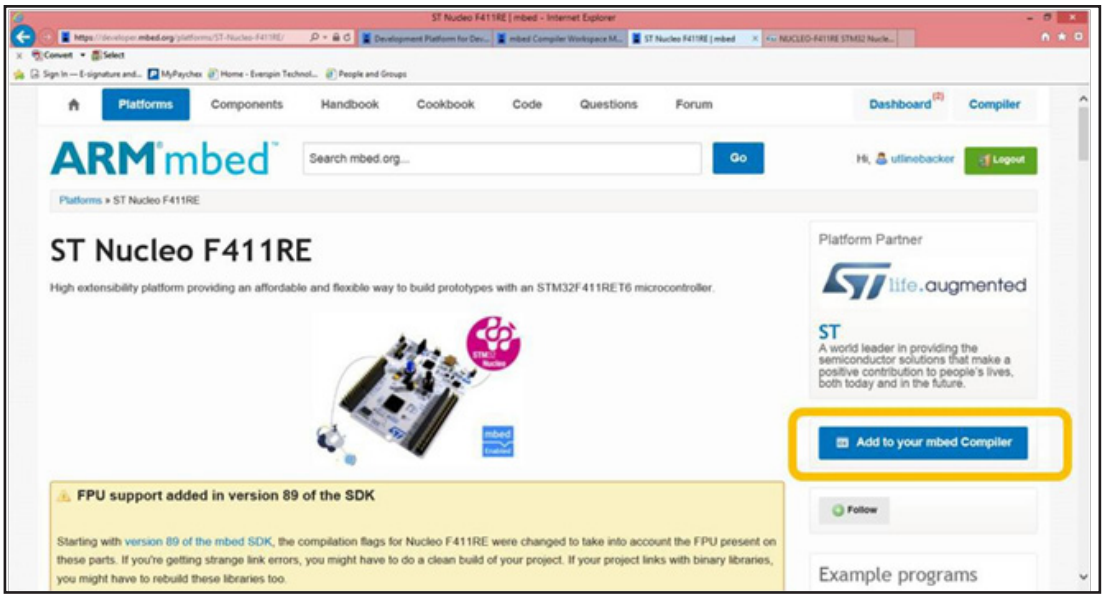



3. ***Adding a platform to your Workspace***. If you selected **Add, mbed** will display a scrolling list of available platforms. Find the MCU host board you are using and click on the image.

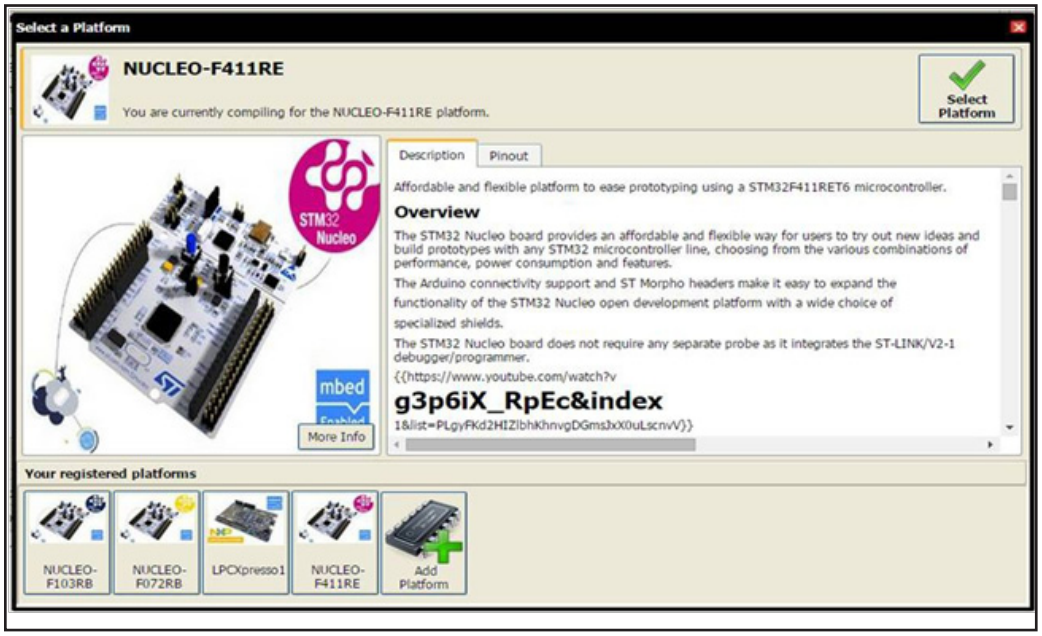


## Setup (Continued)

4. **mbed** will open a new window as an information page for that host platform, such as the NUCLEO-411RE example here. To add this platform to your workspace, click on the **Add to your mbed Compiler** button.



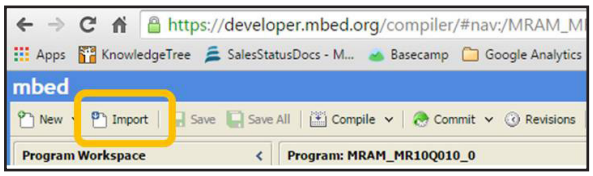

5. The platform will be added to your registered platforms list.



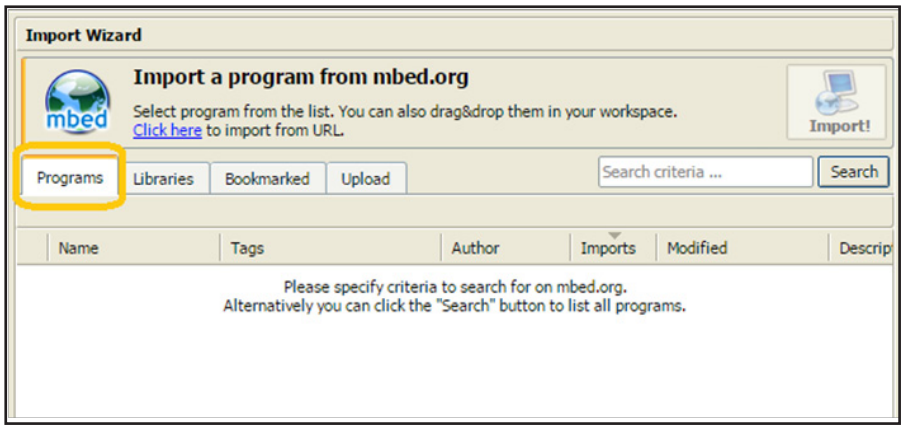
## Setup (Continued)

### Step 5: *Import the Everspin Serial MRAM demonstration program. The example code is available on www.mbed.org.*

1. In your Workspace, click **Import**.




2. The **Import a program** dialog box will open. Click on the **Programs** tab.

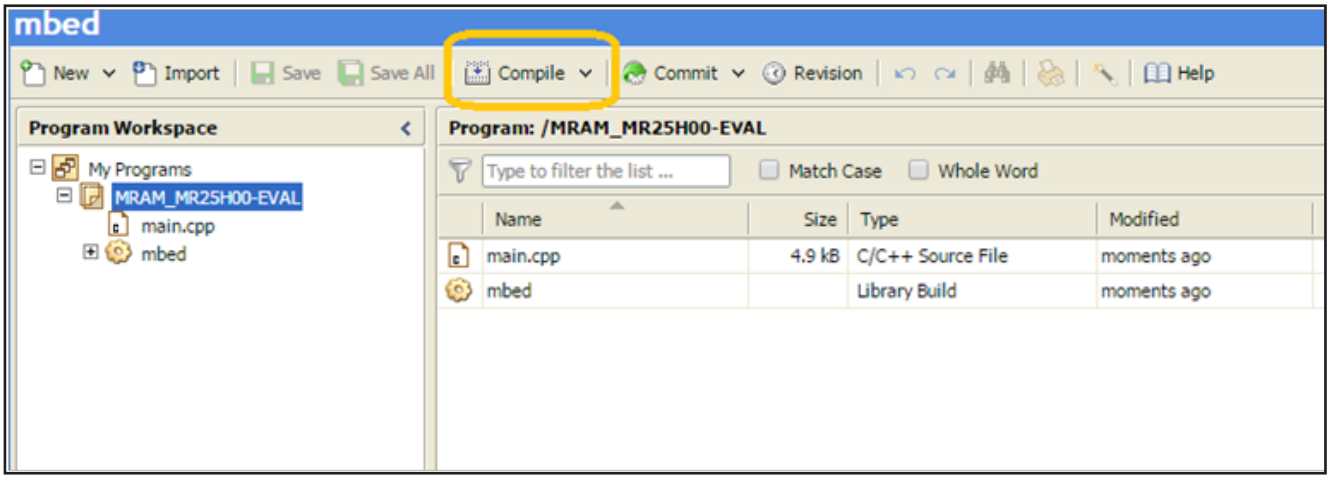



3. Search for the "MR25H00-EVAL" program, select it and click **Import!**
4. The demonstration program will now appear in the Program Workspace.

# Setup (Concluded)

## Step 6: *Compile the binary file and and load to your MCU evaluation board.*

1. Highlight the **MRAM_MR25H00-EVAL** program folder in your **Program Workspace** tree in the left-hand column.
2. Click **Compile** in the top menu.




3. The program will be compiled and the binary (.bin) file created will automatically be downloaded to your computer's designated download location.
4. Drag and drop the binary file into the host board drive that you created in **Step 2.** When the file is dropped into the folder, your MCU host board will begin to program. The LED on you host board may blink a few times to confirm that the program is loading. When the program is fully loaded, the binary file will automatically delete from your MCU host board drive.

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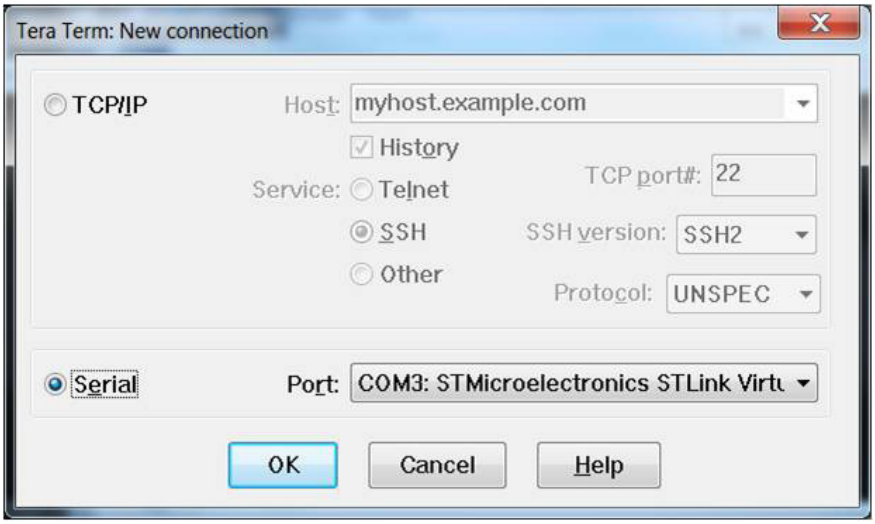
# Run the Demonstration

## Step 1: *Use a terminal emulator to run the demonstration.*

1. Use your favorite terminal emulator. For this example, we used the Tera Term emulator from SourceForge at http://en.osdn.jp/projects/ttssh2/releases/.
2. After installing, open Tera Term and select the serial port associated with your host board to create a new connection.
3. Configure the serial port under **Setup->Serial port with: 115200 baud, 8-N-1**.




4. Press any key on the keyboard or the **Reset** button on your MCU host board to run the demonstration and view the demonstration output on the terminal emulator.
5. Every time the demo is run, the test count is incremented to demonstrate memory non-volatility and the performance is calculated for reading/writing the full array.

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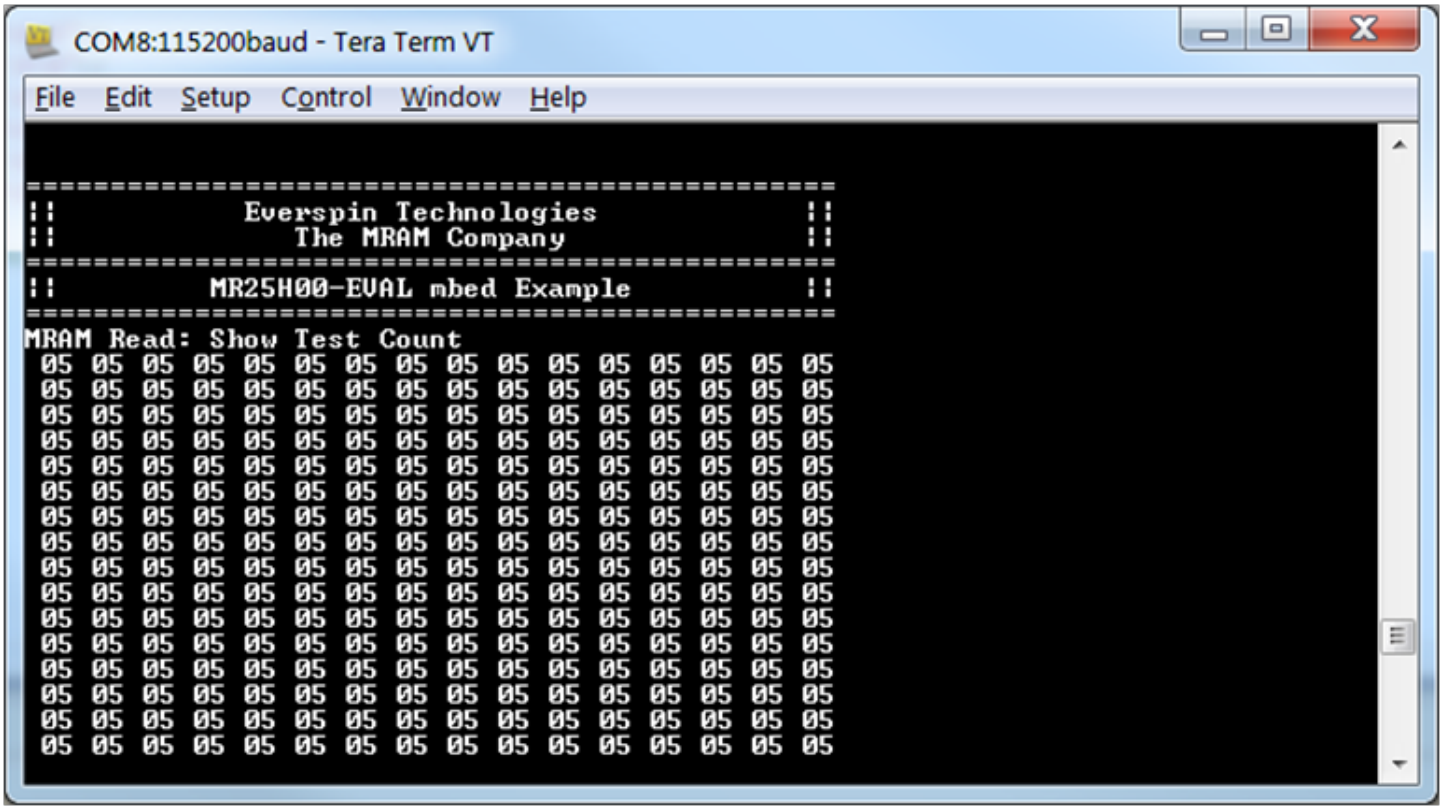
## Run the Demonstration (Concluded)

The time to access the memory is extremely fast and does not require any wait states like flash. Read performance will be observed to be slightly slower than writes due to the error checking performed by the program. In reality, Write / Read performance for MRAM is symmetrical.




**NOTE:** In order to evaluate smaller memory densities, simply change the value of *MRAM_SIZE* at the top of main.cpp file and recompile:

| Desired Density | *MRAM_SIZE* value |
|---|---|
| 256Kbit | 0x2000 |
| 1Mbit | 0x8000 |
| 4Mbit | 0x20000 |

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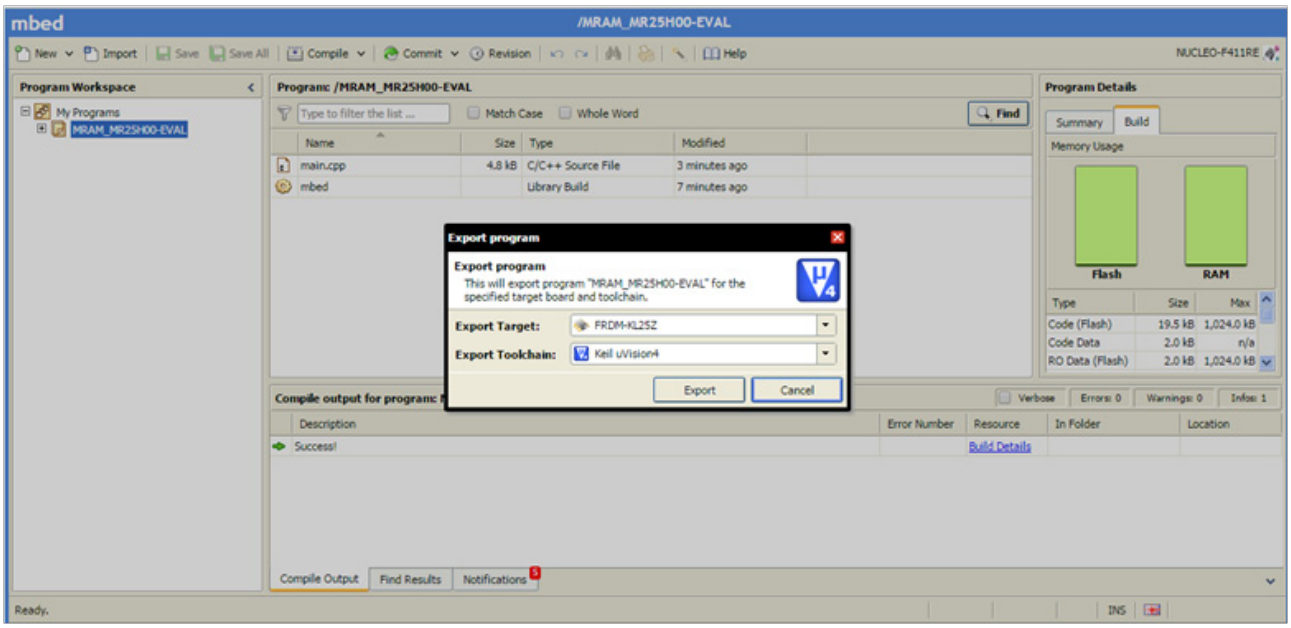
## Export the Demonstration Code to Other Toolchains

***You may export the demonstration code to work with other ARM-based toolchains.***

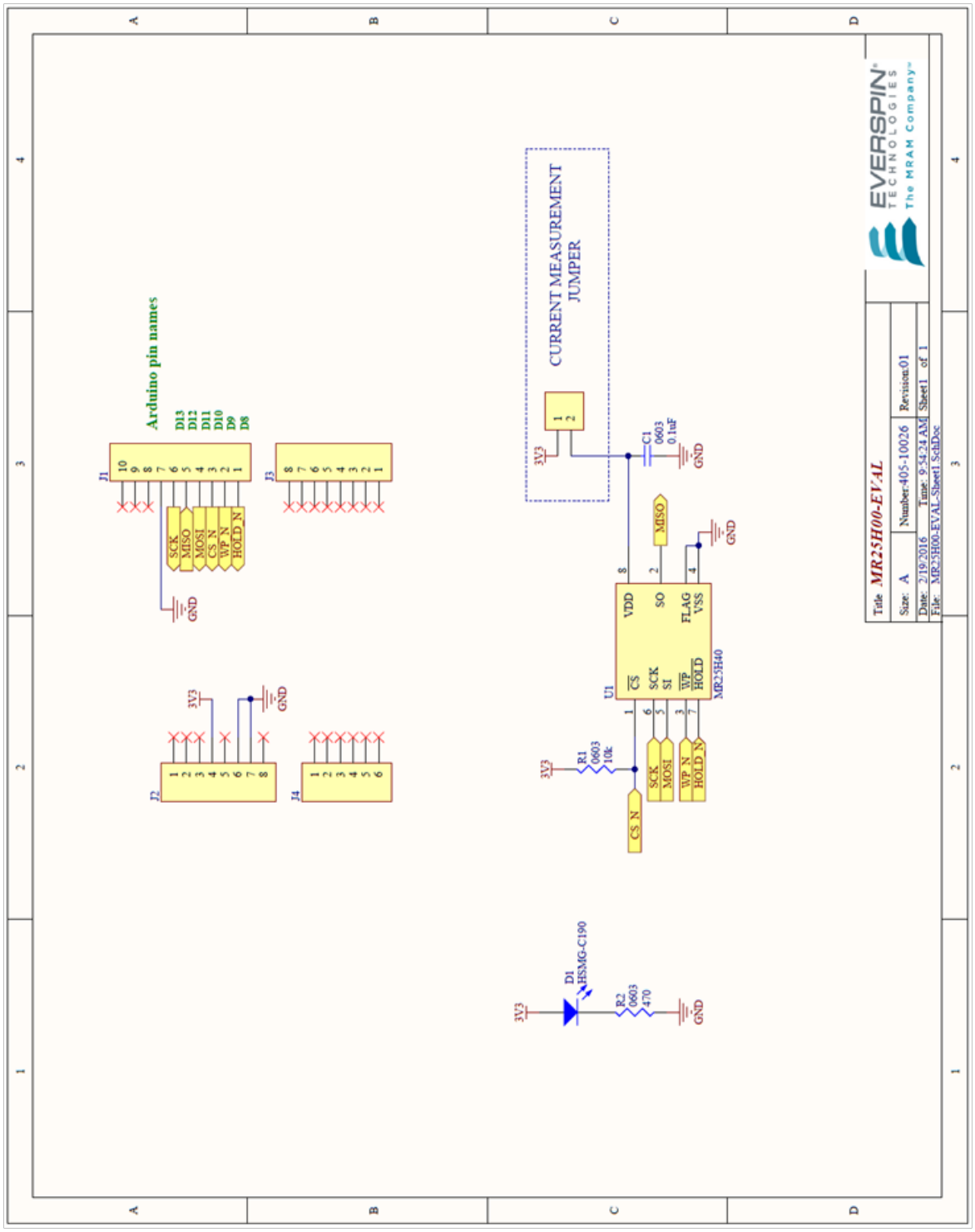
1. Once you have the Everspin MR25H00-EVAL example program loaded into ARM mbed you may export it for development in production ARM tool chains.
2. Right click on the MRAM_MR25H00-EVAL program in the left column of the workspace and select **Export Program**.
3. Using **Export Target** and **Export Toolchain** in the dialog box, pick the target MCU host board and Toolchain for export and click on the **Export** button. The Everspin MR25H00-EVAL example code will be exported to the tool chain you selected.




**Questions?**

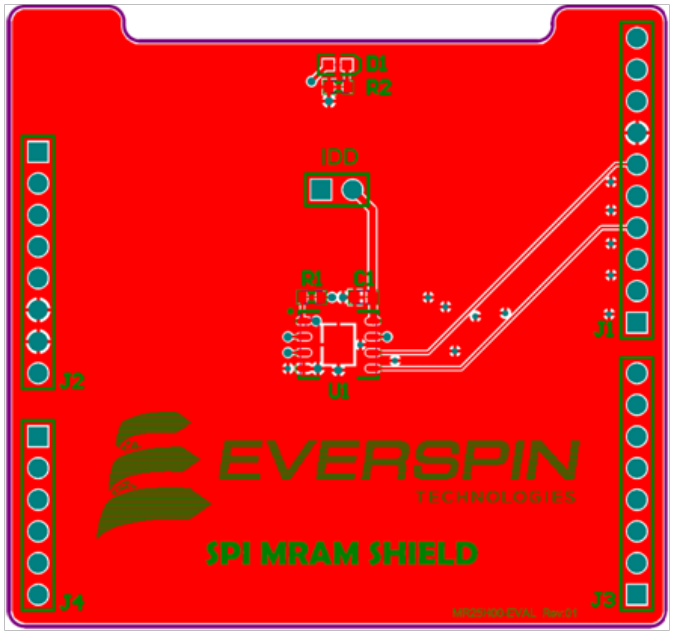
We are here to help. Please use the Information Request on our web site to let us know how we can be of assistance.

# Appendix A: MR25H00-EVAL Schematic

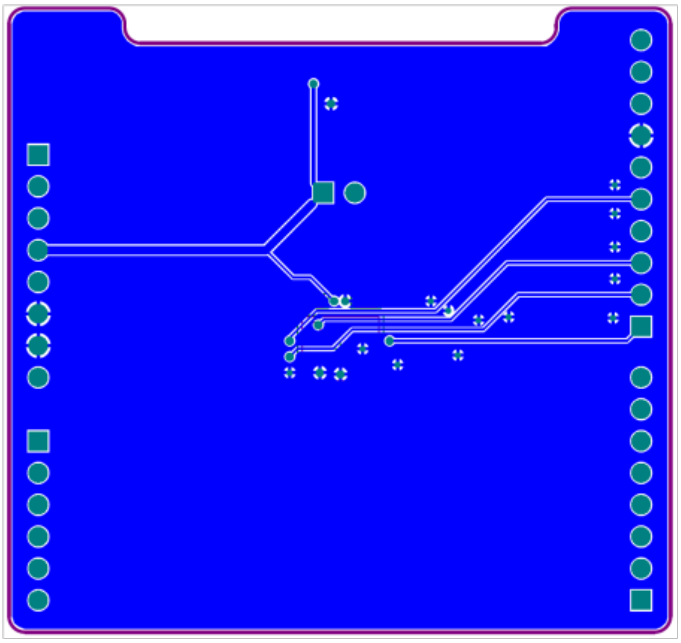


# Appendix A (Cont'd): MR25H00-EVAL PCB Layout

## PCB Top




## PCB Bottom



## REVISION HISTORY

| Revision | Date | Description of Change |
|---|---|---|
| 1.0 | February 24, 2016 | Initial Release MR25H00-EVAL User Guide. |

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