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# CY15FRAMKIT-001

## Serial F-RAM™ Development Kit Guide

Doc. No. 001-95689 Rev.\*B

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# Safety Information



## Regulatory Compliance

The CY15FRAMKIT-001 Serial F-RAM™ Development Kit is intended for use as a serial memory development platform for hardware or software in a laboratory environment. The board is an open-system design, which does not include a shielded enclosure. Therefore, the board may cause interference with other electrical or electronic devices in close proximity.

Attaching additional wiring to this product or modifying the product operation from the factory default may affect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

The CY15FRAMKIT-001, as shipped from the factory, has been verified to meet with the requirements of CE as a Class A product.



The CY15FRAMKIT-001 contains ESD-sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, and can discharge without detection. Permanent damage may occur to devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused CY15FRAMKIT-001 boards in the protective shipping package.



### End-of-Life/Product Recycling

The end-of-life cycle for this kit is five years from the date of manufacture mentioned on the back of the box. Contact your nearest recycler to discard the kit.

## General Safety Instructions

### ESD Protection

ESD can damage boards and associated components. Cypress recommends that the user perform procedures only at an ESD workstation. If an ESD workstation is not available, use appropriate ESD protection by wearing an antistatic wrist strap attached to the chassis ground (any unpainted metal surface) on the board when handling parts.

### Handling Boards

CY15FRAMKIT-001 boards are sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad if available. Do not slide the board over any surface.

# 1. Introduction



Thanks for your interest in the CY15FRAMKIT-001 Serial F-RAM Development Kit (DVK). The kit (shield) is designed as an easy-to-use and inexpensive development kit, showcasing the features of Cypress serial ferroelectric random access memory (F-RAM). Designed for flexibility, this kit offers footprint-compatibility with CY8CKIT-042 PSoC® 4 Pioneer Kit, CY8CKIT-040, CY8CKIT-042 BLE, third-party Arduino™ UNO R3, and several other Arduino kits. This board features a 256-Kbit SPI F-RAM, a 256-Kbit I<sup>2</sup>C F-RAM, three-pole DIP switch to control the I<sup>2</sup>C F-RAM device select pins, Arduino UNO compatible headers, and two debug headers. This kit supports power supply voltages of either 5.0 V or 3.3 V.

The CY15FRAMKIT-001 is a development kit for the Cypress Serial F-RAM memories. Cypress F-RAM is built on ferroelectric technology, which combines the nonvolatile data storage with the high-performance RAM. Serial F-RAMs provide fast writes at full bus speed. They do not have any write delays and data is instantly nonvolatile. They consume as low as 300  $\mu$ A active and 6  $\mu$ A standby current. Because of fast write speeds, serial F-RAMs need to be active for short periods, yielding very low energy consumption. Endurance is virtually unlimited offering 100 trillion read/write cycles.

## 1.1 Kit Contents

The CY15FRAMKIT-001 Serial F-RAM DVK includes the following contents, as shown in [Figure 1-1](#):

- CY15FRAMKIT-001 serial F-RAM DVK board
- Quick start guide

Figure 1-1. CY15FRAMKIT-001 Serial F-RAM DVK Contents



Visit [www.cypress.com/shop](http://www.cypress.com/shop) for more information. Inspect the contents of the kit; if any parts are missing, contact your nearest Cypress sales office for help.



## 1.2 PSoC Creator™

PSoC Creator is a state-of-the-art, easy-to-use integrated design environment (IDE). It introduces revolutionary hardware and software codesign, powered by a library of preverified and precharacterized PSoC Components™.

With PSoC Creator, you can:

- Drag and drop PSoC Components to build a schematic of your custom design
- Automatically place and route components and configure GPIOs
- Develop and debug firmware using the included component APIs

PSoC Creator also enables you to tap into an entire tools ecosystem with integrated compiler chains and production programmers for PSoC devices. For more information, visit [www.cypress.com/Creator](http://www.cypress.com/Creator).

## 1.3 Getting Started

This guide helps you to get acquainted with the Serial F-RAM DVK. The Kit Installation chapter describes the installation of the kit software. The Kit Overview chapter explains the features of the kit. The Hardware chapter details the hardware operation. The Examples Projects chapter describes the code examples. The Appendix provides the schematics, pin assignment, use of zero-ohm and 30-ohm resistors, and the bill of materials (BOM).

## 1.4 Additional Learning Resources

Visit [www.cypress.com/go/F-RAM](http://www.cypress.com/go/F-RAM) for additional learning resources in the form of datasheets and application notes. The baseboard-related resources are available in the following links.

- [CY8CKIT-042 PSoC 4 Pioneer Kit](#)
- [Arduino UNO R3](#)

## 1.5 Technical Support

For assistance, go to our support web page, [www.cypress.com/support](http://www.cypress.com/support), or contact our customer support at +1 (800) 541-4736 Ext. 2 (in the USA) or +1 (408) 943-2600 Ext. 2 (International).

## 1.6 Documentation Conventions

Table 1-1. Document Conventions for Guides

Convention	Usage
Courier New	Displays file locations, user-entered text, and source code: C:\...cd\icc\
<i>Italics</i>	Displays file names and reference documentation: Read about the <i>sourcefile.hex</i> file in the <i>PSoC Designer User Guide</i> .
<b>[Bracketed, Bold]</b>	Displays keyboard commands in procedures: <b>[Enter]</b> or <b>[Ctrl] [C]</b>
File > Open	Represents menu paths: File > Open > New Project
<b>Bold</b>	Displays commands, menu paths, and icon names in procedures: Click the <b>File</b> icon and then click <b>Open</b> .
Times New Roman	Displays an equation: $2 + 2 = 4$
Text in gray boxes	Describes cautions or unique functionality of the product.

# 2. Kit Installation



This section describes the installation of the CY15FRAMKIT-001 Serial F-RAM DVK software and prerequisites.

## 2.1 Prerequisite Software

You must install the PSoC Creator IDE or the Arduino IDE before using the kit. All Cypress software installations require administrator privileges. Administrator privileges are not required to execute the software after installation. Close all other Cypress software that is currently running before you install the kit software.

To download the PSoC Creator IDE, go to [www.cypress.com/psoccreator](http://www.cypress.com/psoccreator).

To download the Arduino IDE, go to [arduino.cc/en/Main/Software](http://arduino.cc/en/Main/Software).

## 2.2 Install Kit Software

Follow these steps to install the CY15FRAMKIT-001 Serial F-RAM DVK software:

1. Download the CY15FRAMKIT-001 DVK software from [www.cypress.com/go/CY15FRAMKIT-001](http://www.cypress.com/go/CY15FRAMKIT-001). The CY15FRAMKIT-001 software is available in three different formats (see Figure 2-1):

Figure 2-1. Available Formats for Downloading Serial F-RAM DVK Software

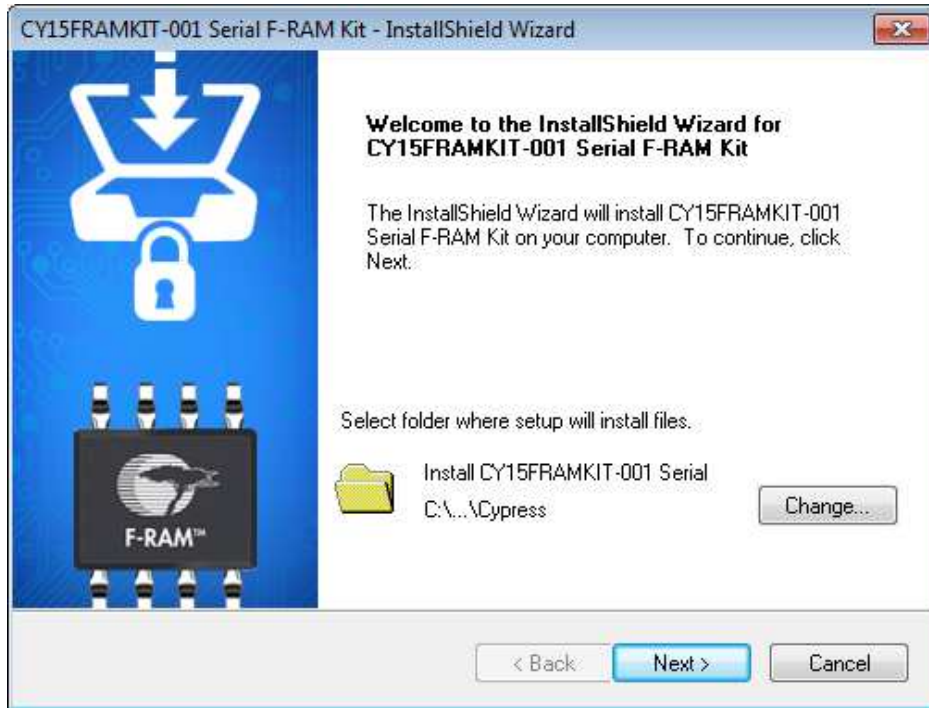


- **CY15FRAMKIT-001 Kit Setup:** This executable file installs only the kit contents, which include kit code examples, hardware files, and user documents.
  - **CY15FRAMKIT-001 CD ISO:** This file is a complete package, stored in a CD-ROM image format, which you can use to create a CD or extract using ISO extraction programs, such as WinZip or WinRAR. The file can also be mounted like a virtual CD using virtual drive programs such as Virtual CloneDrive and MagicISO. This file includes all the required firmware, hardware files, and user documents.
2. If you have downloaded the CD ISO file, mount it on a virtual drive. Extract the ISO contents if you do not have a virtual drive on which to mount. Double-click **cyautorun.exe** in the root directory of the extracted content or mounted ISO if "Autorun from CD/DVD" is not enabled on the PC. The installation window shown in Figure 2-2 will appear automatically.

**Note:** If you are using the Kit Setup file, then go to step 3 for installation.

3. The kit startup screen appears as shown in Figure 2-2. The default installation location is **Cypress** under **Program Files** folder.

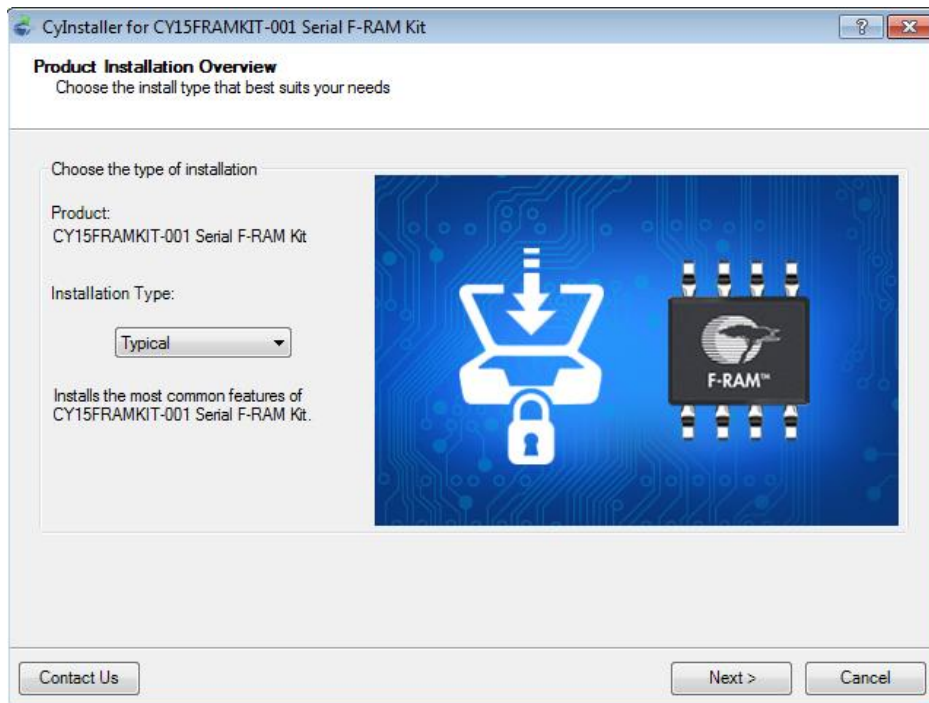
Figure 2-2. Kit Installer Startup Screen



Select the folder in which you want to install the CY15FRAMKIT-001 kit-related files. Choose the directory and click **Next**.

4. Select the **Typical installation** type in the **Product Installation Overview** window, as shown in [Figure 2-3](#). Click **Next**.

Figure 2-3. Product Installation Overview Window



When the installation begins, a list of packages appears on the installation page. A green check mark appears next to each package after successful installation.

5. If this is the first Cypress product that you have installed, enter your contact information or select the option **Continue without Contact Information**. Click **Finish** to complete the CY15FRAMKIT-001 kit installation.

After the installation is complete, the kit contents are available at <Install\_Directory>\CY15FRAMKIT-001 Serial F-RAM Kit\1.0. The default locations are as follows:

- Windows 7 (64-bit): C:\Program Files (x86)\Cypress\CY15FRAMKIT-001 Serial F-RAM Kit\1.0
- Windows 7 (32-bit): C:\Program Files\Cypress\CY15FRAMKIT-001 Serial F-RAM Kit\1.0

**Note:** For Windows 7/8/8.1 users, the installed files and the folder are read-only. To change the property, right-click the folder and choose **Properties > Attributes** and then disable the **Read-only** option. Click **Apply** and **OK** to close the window.

After the installation is complete, the following are installed on your computer:

- Kit documents
  - Quick start guide
  - Kit guide
  - Release note
- Firmware
  - PSoC 4 F-RAM SPI example project
  - PSoC 4 F-RAM I2C example project
  - Arduino UNO F-RAM SPI example project
  - Arduino UNO F-RAM I2C example project
- Hardware
  - Schematic
  - Layout
  - Gerber
  - PCB assembly drawing
  - Bill of materials (BOM)

## 2.3 Uninstall Software

The software can be uninstalled using one of the following methods:

- Go to **Start > Control Panel > Programs and Features**; select the appropriate software package and click **Uninstall**.
- Go to **Start > All Programs > Cypress > Cypress Update Manager > Cypress Update Manager**.
  - Select the “CY15FRAMKIT-001 Serial F-RAM Kit 1.0 Rev \*\*” row and click **Uninstall**. In the **Product Installation Overview** window, select **Remove** from the **Installation Type** drop-down menu. Follow the instructions to uninstall.

**Note:** This method will uninstall only the kit software and not all the other software that may have been installed along with the kit software.

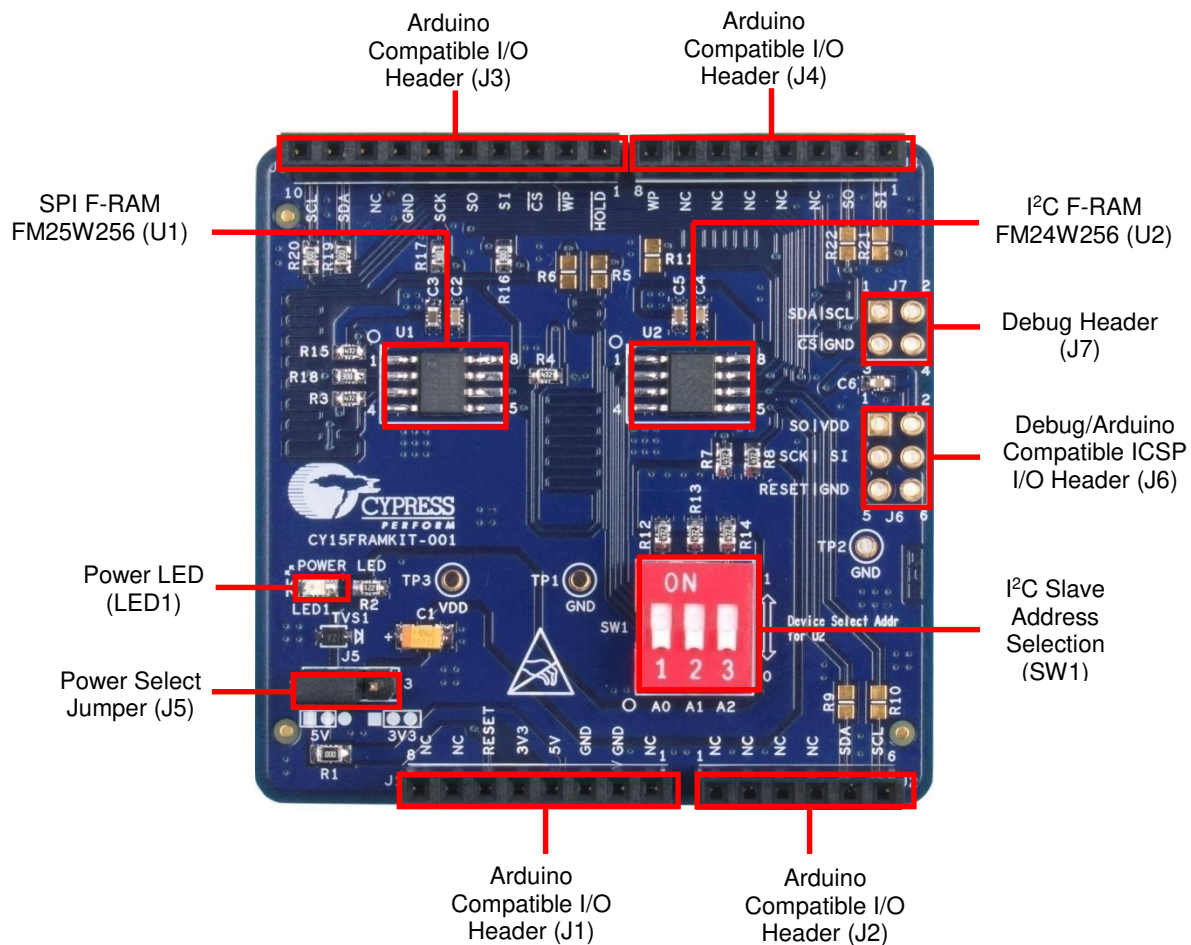
# 3. Kit Overview



## 3.1 CY15FRAMKIT-001 Serial F-RAM Development Kit Overview

The CY15FRAMKIT-001 Serial F-RAM DVK can be used to understand the features of the serial F-RAMs (SPI and I<sup>2</sup>C). The DVK is a shield board, which contains the 256-Kbit SPI F-RAM and 256-Kbit I<sup>2</sup>C F-RAM. It has four connectors that are Arduino UNO-compatible and connect to either Cypress PSoC 4 Pioneer Kit or Arduino UNO R3 board. These connectors are stackable and hence any other Arduino-compatible shields can be stacked on it. The kit has options to operate at either 3.3 V or 5.0 V. Figure 3-1 shows the DVK board and its general description.

Figure 3-1. General Description of DVK Board



Refer to section [A.5 Use of 30-ohm Resistors and No Load](#) to modify the CY15FRAMKIT-001 hardware by mounting two 30-Ω resistors to make it Arduino UNO R2-compatible.

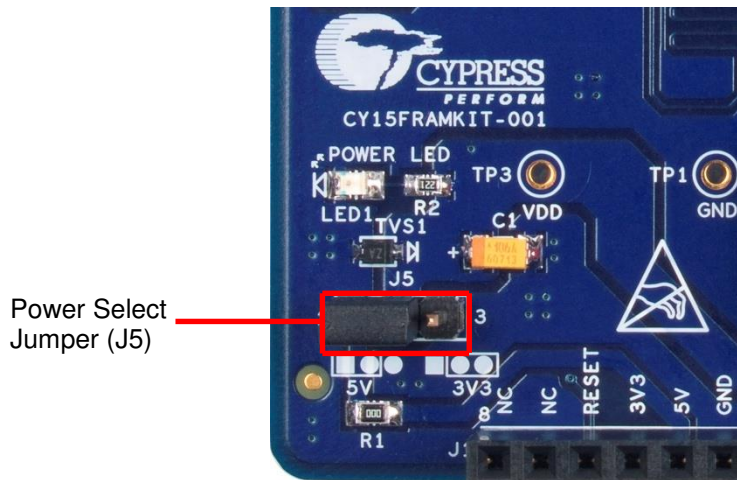
## 3.2 Kit Operation and Configuration Guide

### 3.2.1 Power Supply Jumper

CY15FRAMKIT-001 can operate at either 3.3 V or 5.0 V, selected through jumper J5, as shown in [Figure 3-2](#). The factory default jumper setting is 5.0 V (short pins 1 and 2). Arduino UNO R3 boards operate at 5.0 V and use the default setting of the jumper J5. The CY8CKIT-042 Pioneer Kit operates at either 3.3 V or 5.0 V. The default setting of the Pioneer Kit is 3.3 V. Therefore, depending on the voltage setting on the mother board, set jumper J5 to either 5.0 V (short pins 1 and 2) or 3.3 V (short pins 2 and 3).

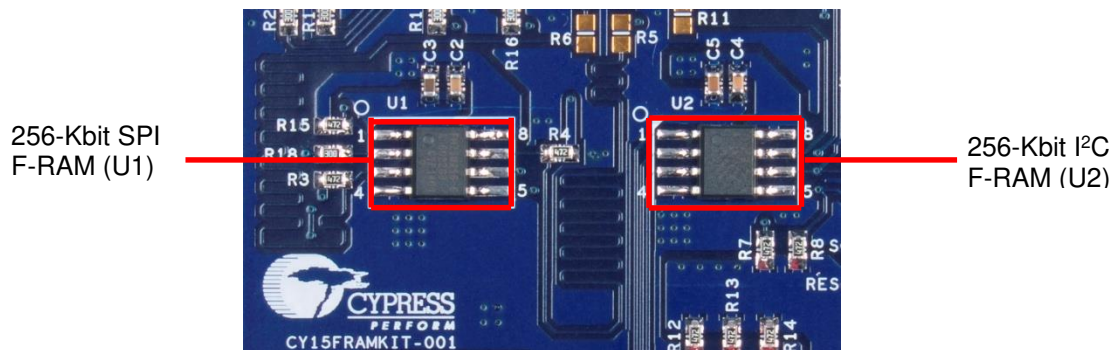
<b>CAUTION</b>	<ol style="list-style-type: none"> <li>1. Do not power the CY15FRAMKIT-001 board through an external power source. The board is designed to be powered by the mother board.</li> <li>2. The CY15FRAMKIT-001 operates from 2.7 V to 5.5 V. Exceeding the maximum voltage limit (5.5 V) can damage the board.</li> <li>3. For proper operation of the board, ensure that jumper J5 is set to match the operating voltage on the motherboard.</li> </ol>
----------------	---

Figure 3-2. Power Select Jumper



### 3.2.2 F-RAM Devices

Figure 3-3. Cypress Serial F-RAM Devices on the Board

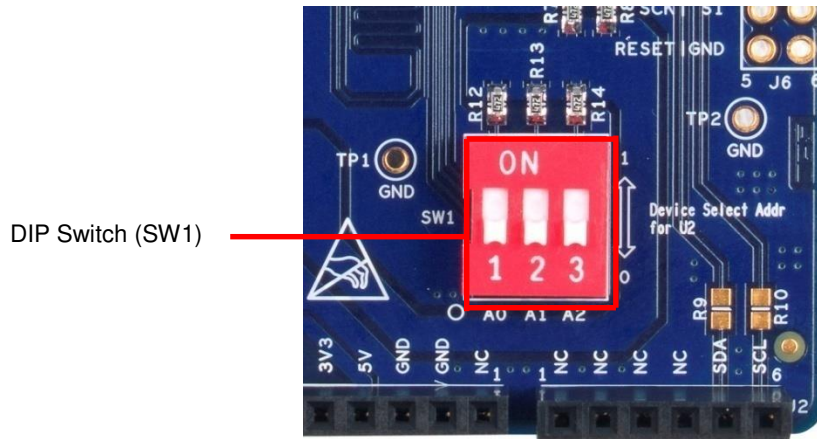


### 3.2.3 DIP Switch for I<sup>2</sup>C F-RAM Device Slave Address Select

The DVK provides a DIP switch option, as shown in [Figure 3-4](#), to configure the different slave address for the I<sup>2</sup>C F-RAM by assigning its individual slave select address pins (A2-A0) either to logic LOW '0' or logic HIGH '1'. When the DIP switch is in the ON position, it keeps the respective slave select address pin to logic HIGH using a 4.7 kΩ pull-up resistor. When the DIP switch is not in the ON position, the respective slave select address pins are kept at logic LOW by F-RAM device

through an internal weak pull-down resistor. The factory default setting for the DIP switch is not in the ON position which sets the values for A2, A1, and A0 to logic LOW '0'.

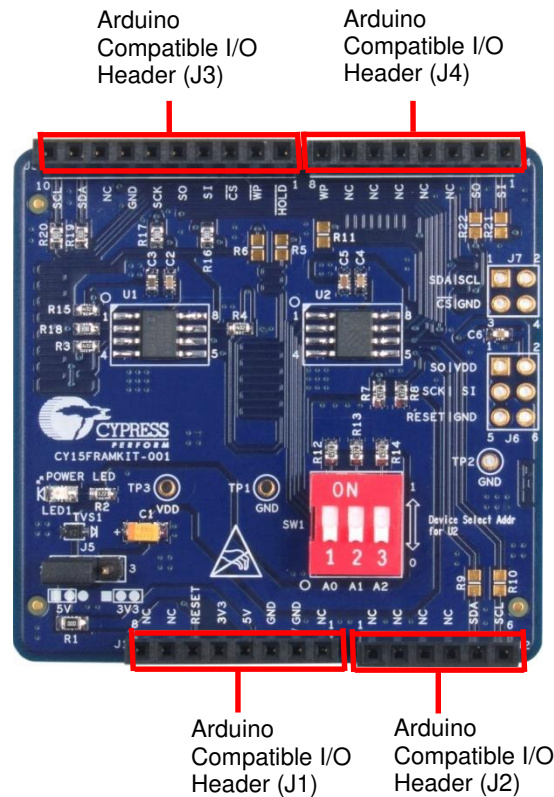
Figure 3-4. DIP Switch for I<sup>2</sup>C F-RAM A0, A1, and A2 Configuration



### 3.2.4 Connectors to CY8CKIT-042/Arduino UNO R3 Board

Figure 3-5 shows the Arduino-compatible connectors to the CY8CKIT-042/Arduino UNO R3 boards: J1, J2, J3, and J4. You can plug the DVK board into the CY8CKIT-042/Arduino UNO R3 board through these connectors. For schematic details, refer to the [Hardware chapter on page 17](#).

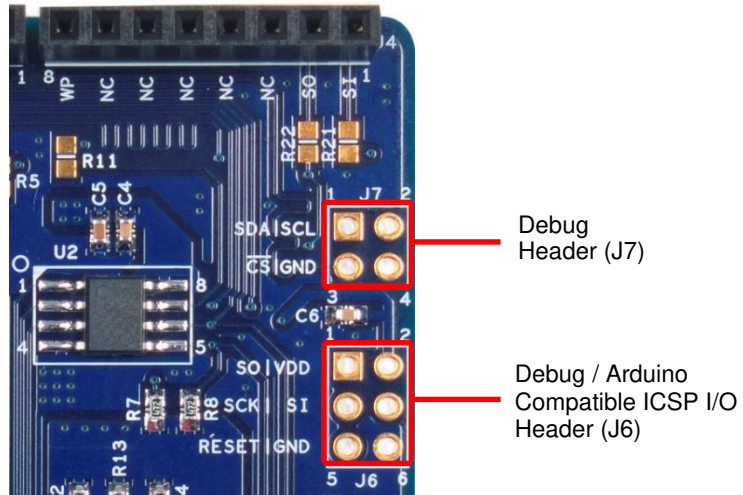
Figure 3-5. Connectors to CY8CKIT-042/Arduino UNO R3 Board



### 3.2.5 Debug Headers

Debug headers are provided for easy access to the SPI and I<sup>2</sup>C communication pins. As shown in [Figure 3-6](#), jumper J6 follows the in-circuit serial programming (ICSP) header pin layout and provides access to the SPI signals. Jumper J7 provides access to the chip select of the SPI F-RAM device and I<sup>2</sup>C communication signals.

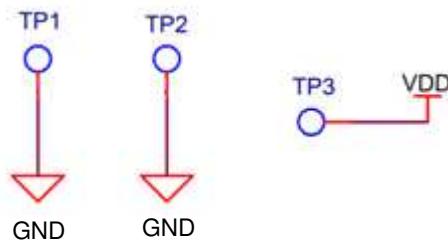
Figure 3-6. Debug Headers



### 3.2.6 Test Points

The DVK board provides V<sub>DD</sub> (TP3) and GND (TP1 and TP2) test points as shown in [Figure 3-7](#).

Figure 3-7. Test Points



**CAUTION** These test point are only for probing and measurement purposes. Do not power the kit using these test points to avoid any damage to the board.

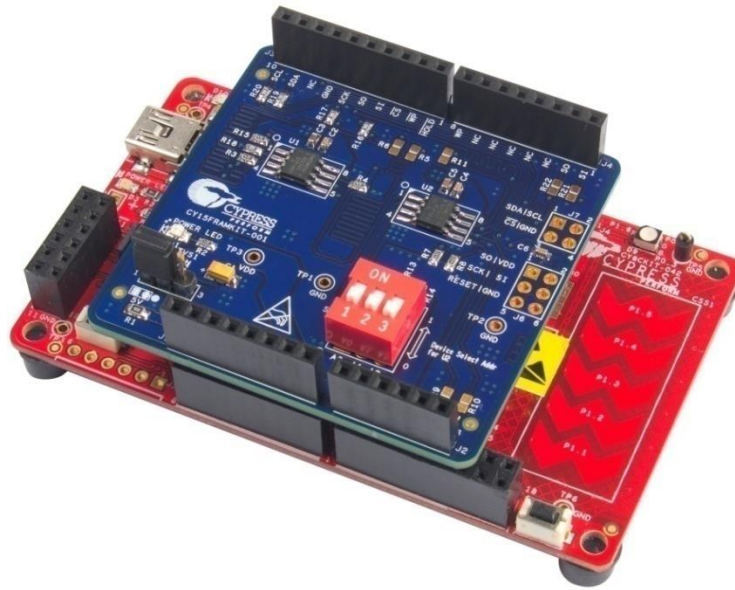
## 3.3 CY15FRAMKIT-001 with PSoC 4 Pioneer Kit

The CY15FRAMKIT-001 is plugged into the PSoC 4 Pioneer Kit (CY8CKIT-042) through four connectors: J1, J2, J3, and J4. The default operating voltage of serial F-RAM kit is 5.0 V. To match this, change the voltage setting on the PSoC 4 pioneer kit to 5.0 V. You can also operate at 3.3 V by selecting the 3.3 V power settings on both PSoC 4 pioneer and serial F-RAM kits.

**Note:** J2 on the CY15FRAMKIT-001 is a 6-pin, single row jumper. On the PSoC 4 Pioneer Kit, J2 is a 9x2 header. Therefore, J2 of the CY15FRAMKIT-001 plugs into the six pins on the extreme left of the outer row of the J2 header on the Pioneer board. This can be easily observed because the CY15FRAMKIT-001 can be inserted only in one direction.



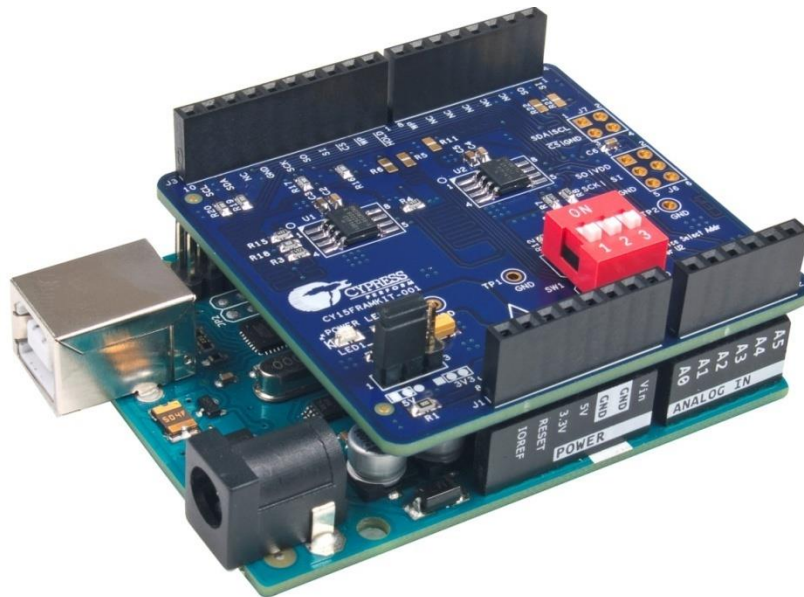
Figure 3-8. CY15FRAMKIT-001 Mounted on PSoC 4 Pioneer Kit



### 3.4 CY15FRAMKIT-001 with Arduino UNO R3 Kit

The CY15FRAMKIT-001 is plugged into the Arduino UNO R3 Kit through four connectors: J1, J2, J3, and J4. These connector pins are mapped one to one.

Figure 3-9. CY15FRAMKIT-001 Mounted on Arduino UNO R3 Kit



# 4. Hardware



## 4.1 Board Details

The CY15FRAMKIT-001 Serial F-RAM DVK consists of the following blocks as shown in Figure 4-1.

- 256-Kbit SPI F-RAM (U1)
- 256-Kbit I2C F-RAM (U2)
- Power select jumper (J5)
- Power LED (LED1)
- DIP switch for device address selection (SW1)
- Debug headers for SPI/I2C signals (J6, J7)
- Arduino-compatible connectors (J1, J2, J3, J4)

Figure 4-1. CY15FRAMKIT-001 Serial F-RAM DVK Details

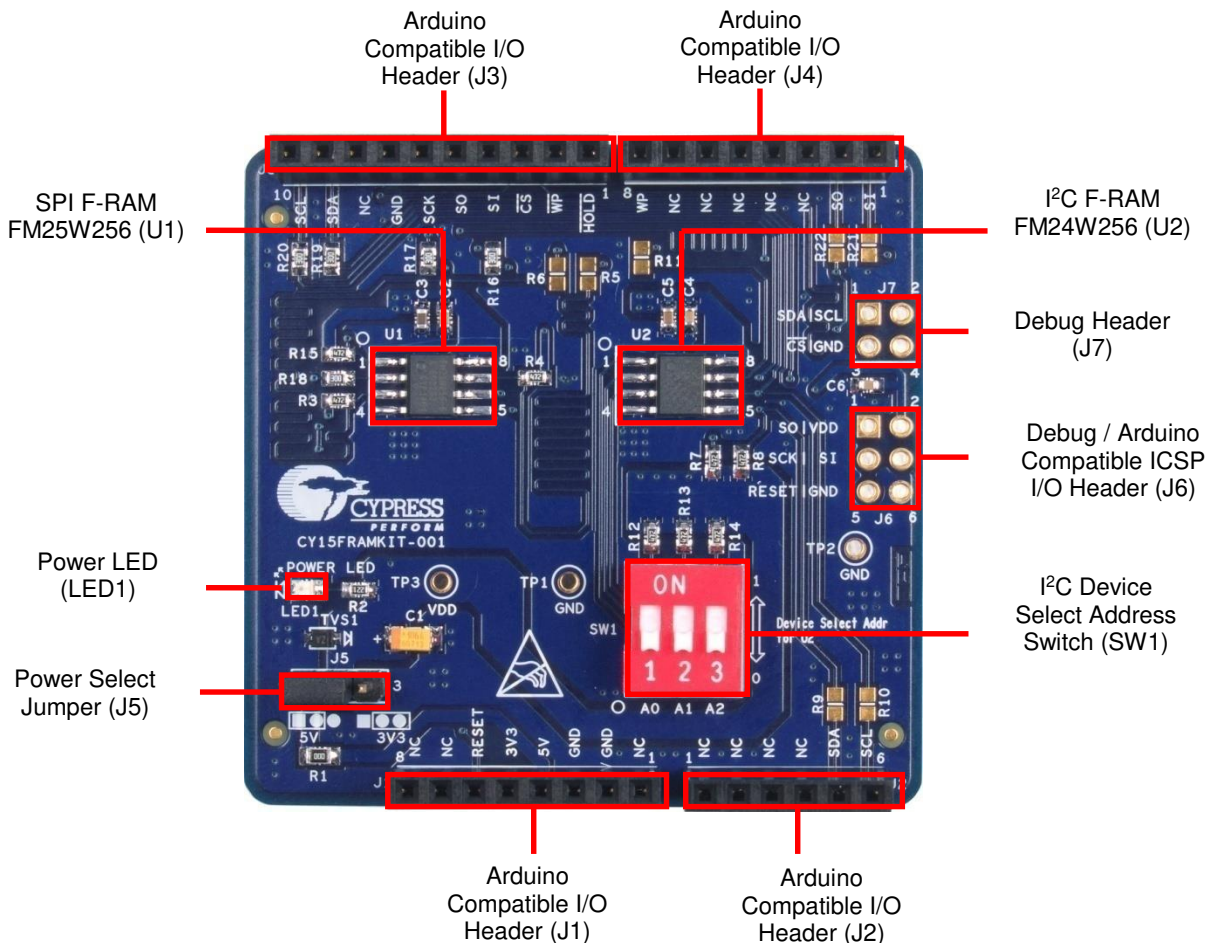
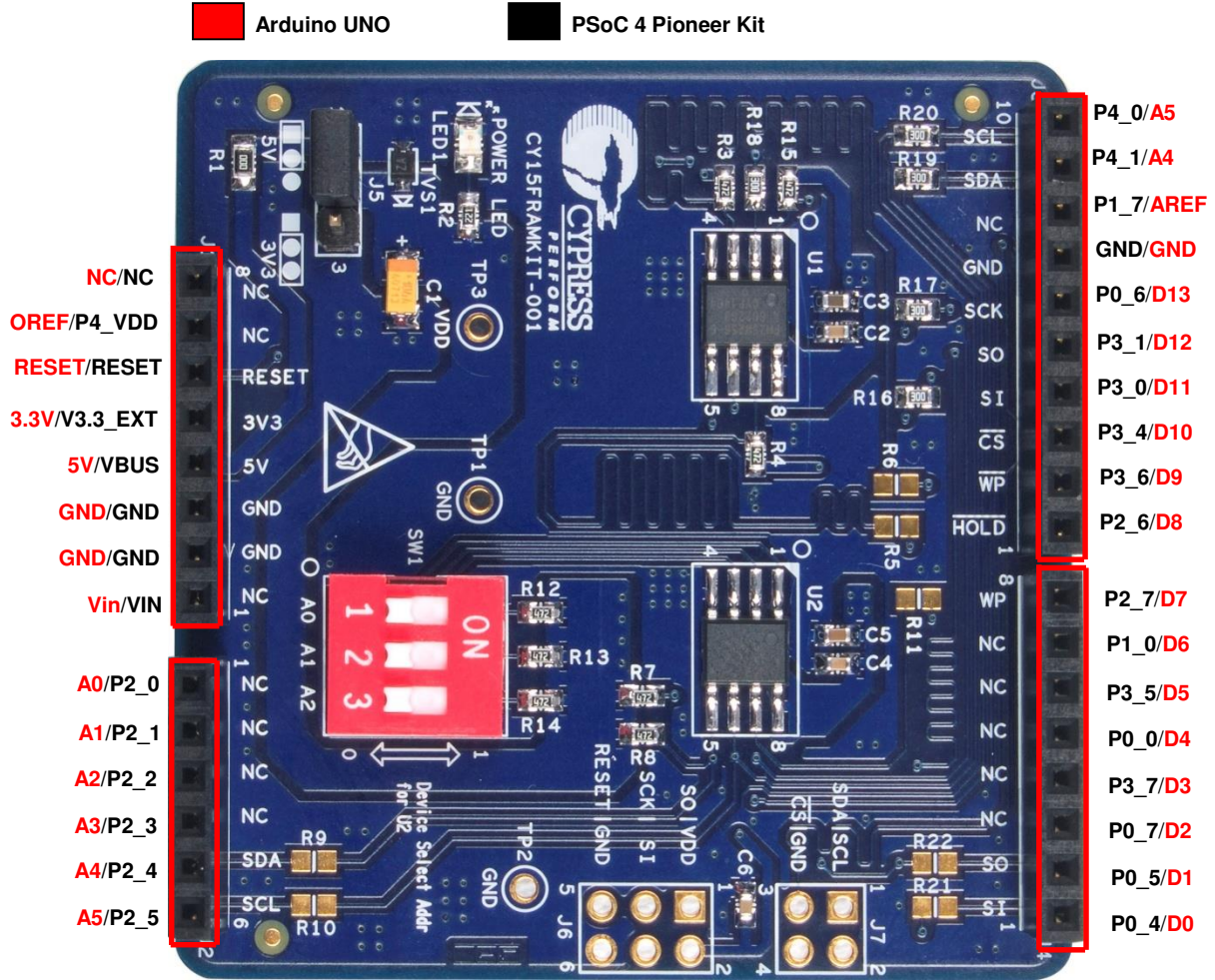


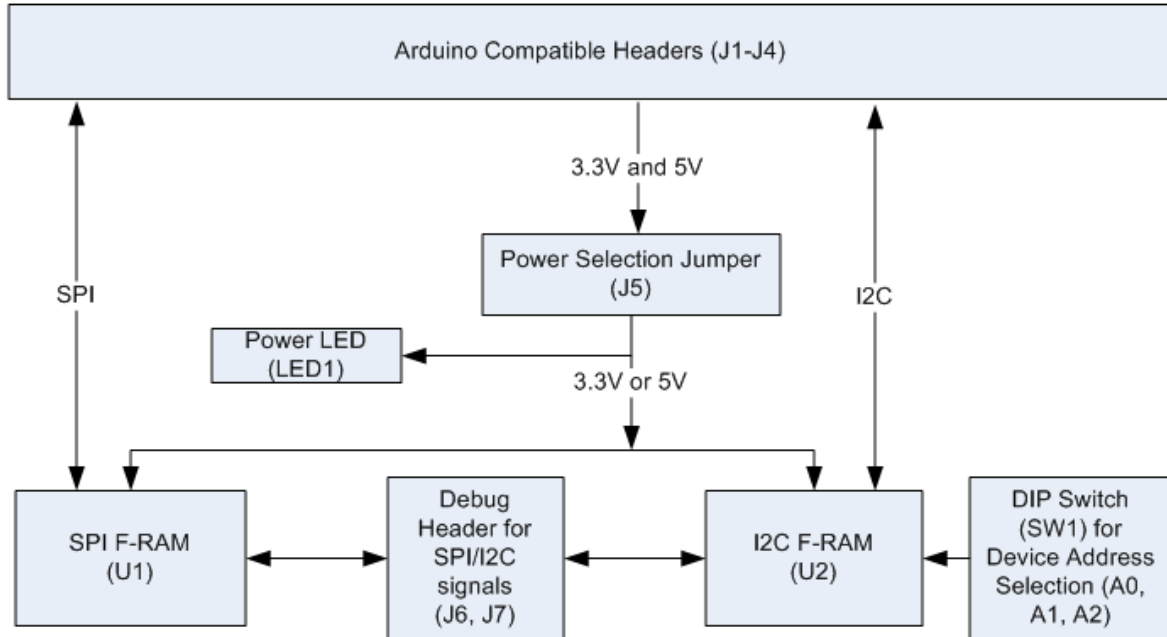
Figure 4-2. CY15FRAMKIT-001 Serial F-RAM DVK Pin Mapping for PSoC 4 Pioneer/Arduino UNO R3 Kit



## 4.2 Theory of Operation

This section provides the block-level description of the PSoC 4 Pioneer Kit.

Figure 4-3. Block Diagram



The CY15FRAMKIT-001 Serial F-RAM DVK provides 256-Kbit SPI and 256-Kbit I<sup>2</sup>C F-RAM devices. The DVK is a shield board, which can be plugged into the PSoC 4 Pioneer Kit or the Arduino UNO R3 Kit.

The CY15FRAMKIT-001 Serial F-RAM DVK has a power LED (LED1) indicating the power-ON condition. The kit can operate either at 3.3 V or 5 V selected through jumper J5. The kit also has the option to change the device address for the I<sup>2</sup>C F-RAM. The kit also provides debug headers for SPI / I<sup>2</sup>C signals.

## 4.3 Functional Description

### 4.3.1 SPI F-RAM Device (256-Kbit FM25W256)

The CY15FRAMKIT-001 Serial F-RAM DVK uses Cypress 256-Kbit SPI F-RAM device. The device pins are accessible for reads and writes through Arduino-compatible headers.

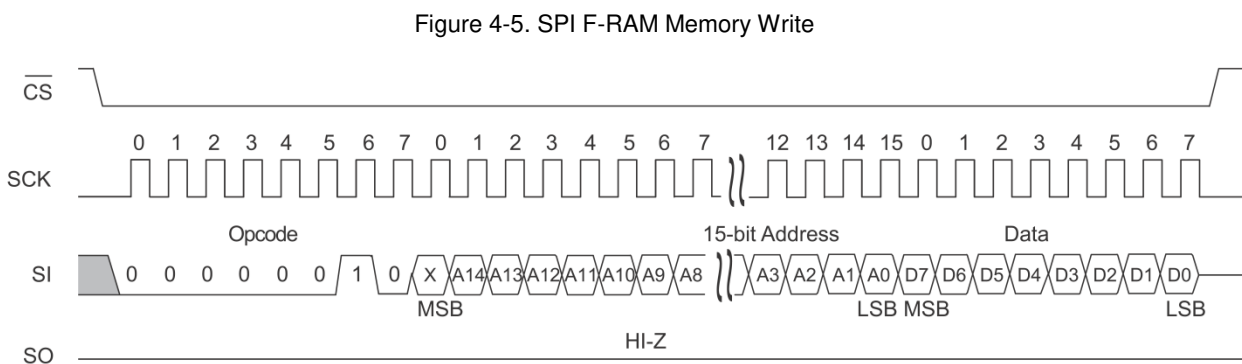
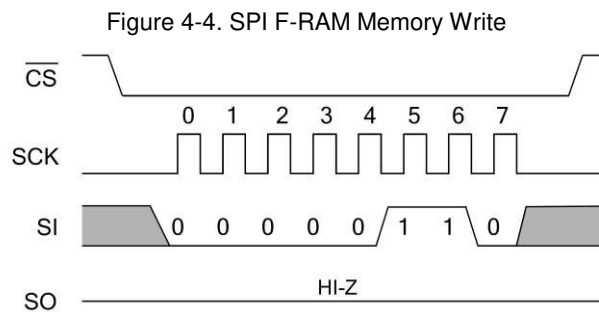
#### Features

- 256-Kbit ferroelectric random access memory (F-RAM) logically organized as 32K × 8
  - High-endurance 100 trillion (10<sup>14</sup>) read/writes
  - 151-year data retention
  - NoDelay™ writes
  - Advanced high-reliability ferroelectric process
- Fast serial peripheral interface (SPI)
  - Up to 20 MHz frequency
  - Direct hardware replacement for serial flash and EEPROM
  - Supports SPI mode 0 (0,0) and mode 3 (1,1)
- Sophisticated write protection scheme

- Hardware protection using the Write Protect ( $\overline{WP}$ ) pin
- Software protection using Write Disable instruction
- Software block protection for 1/4, 1/2, or the entire array
- Low power consumption
  - 250  $\mu\text{A}$  active current at 1 MHz
  - 15  $\mu\text{A}$  (typ) standby current
- Wide voltage operation:  $V_{DD} = 2.7\text{ V to }5.5\text{ V}$
- Industrial temperature:  $-40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$
- 8-pin small outline integrated circuit (SOIC) package
- Restriction of hazardous substances (RoHS) compliant

**Memory Write**

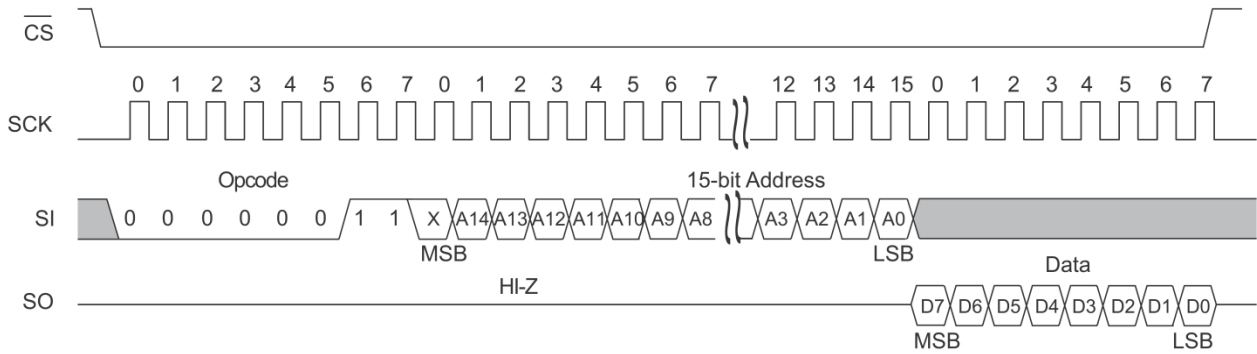
All writes to the SPI F-RAM begin with a WREN (Write Enable) opcode (0x06). The WRITE opcode (0x02) is followed by a two-byte address containing the 15-bit address (A14-A0) of the first data byte to be written into the memory. The upper bit of the two-byte address is ignored. The subsequent bytes after the two address bytes are data bytes, which are written sequentially. Addresses are incremented internally as long as the bus master continues to issue clocks and keeps  $\overline{CS}$  LOW. If the last address of 7FFFh is reached, the counter will roll over to 0000h. Data is written MSB first. The rising edge of  $\overline{CS}$  terminates a write operation. SPI F-RAM write operation is shown in the following figure.



**Memory Read**

After the falling edge of  $\overline{CS}$ , the bus master can issue a READ opcode (0x03). Following the READ command is a two-byte address containing the 15-bit address (A14-A0) of the first byte of the read operation. The upper bit of the address is ignored. After the read opcode and two address bytes are issued, the device drives out the read data byte on the next eight clocks on SO pin. The SI input is ignored during read data bytes. Subsequent bytes are data bytes, which are read out sequentially. Addresses are incremented internally as long as the bus master continues to issue clocks and  $\overline{CS}$  is LOW. If the last address of 7FFFh is reached, the counter will roll over to 0000h. Data is read MSB first. The rising edge of  $\overline{CS}$  terminates a read operation and tristates the SO pin. SPI F-RAM read operation is shown in the following figure.

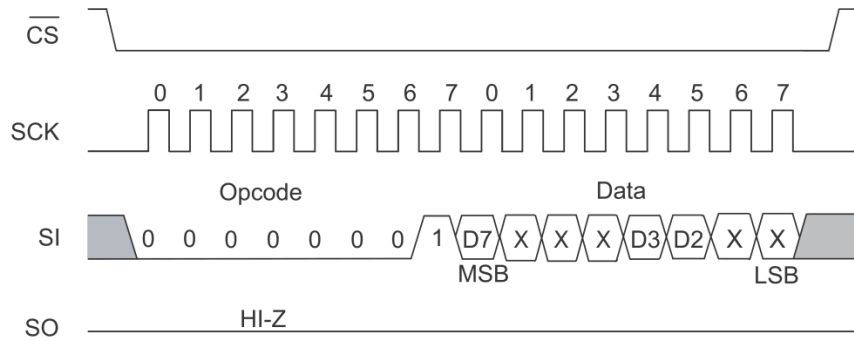
Figure 4-6. SPI F-RAM Memory Read



**Status Register Write**

The write status register WRSR command (0x01) allows the SPI bus master to write into the status register of the SPI F-RAM.

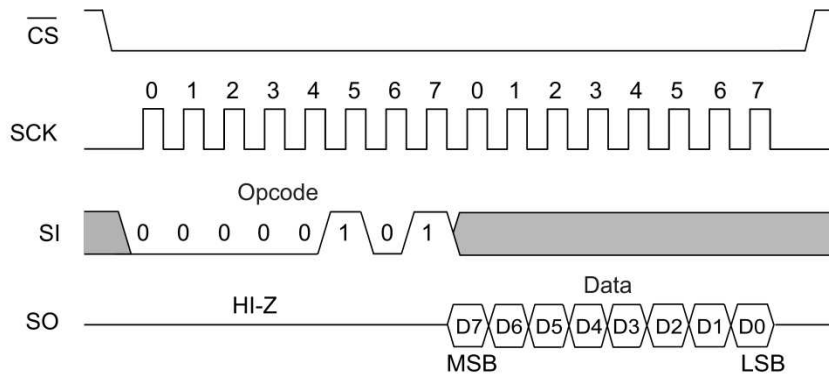
Figure 4-7. SPI F-RAM Status Register Write



**Status Register Read**

The read status register RDSR command (0x05) allows the bus master to verify the contents of the status register of the SPI F-RAM. Reading the status register provides information about the current state of the write-protection features. Following the RDSR opcode, the SPI F-RAM device will return one byte with the contents of the status register.

Figure 4-8. SPI F-RAM Status Register Read



For more details on the F-RAM device, refer to the [FM25W256 datasheet](#).

### 4.3.2 I<sup>2</sup>C F-RAM Device (256-Kbit FM24W256)

The CY15FRAMKIT-001 Serial F-RAM DVK uses the 256-Kbit I<sup>2</sup>C F-RAM device. The device is accessible for read and writes through Arduino-compatible headers.

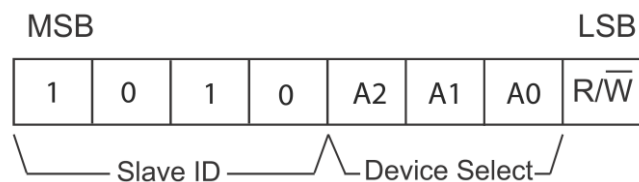
#### Features

- 256-Kbit F-RAM is logically organized as 32K × 8
  - High-endurance 100 trillion (10<sup>14</sup>) read/writes
  - 151-year data retention
  - NoDelay™ writes
  - Advanced high-reliability ferroelectric process
- Fast 2-wire serial interface (I<sup>2</sup>C)
  - Up to 1-MHz frequency
  - Direct hardware replacement for serial (I<sup>2</sup>C) EEPROM
  - Supports legacy timings for 100 kHz and 400 kHz
- Low power consumption
  - 100 μA active current at 100 kHz
  - 15 μA (typical) standby current
- Wide voltage operation: VDD = 2.7 V to 5.5 V
- Industrial temperature: -40 °C to +85 °C
- 8-pin small outline integrated circuit (SOIC) package
- Restriction of hazardous substances (RoHS) compliant

#### Slave Device Address

The first byte that the FM24W256 expects after a START condition is the slave address. As shown in [Figure 4-9](#), the slave address contains the device type or slave ID, the device select address bits, and a bit that specifies if the transaction is a read or a write. Bits 7-4 are the device type (slave ID) and should be set to 1010b for the FM24W256. These bits allow other function types to reside on the I<sup>2</sup>C bus within an identical address range. Bits 3-1 are the device select address bits. They must match the corresponding value on the external address pins to select the device. Up to eight FM24W256 devices can reside on the same I<sup>2</sup>C bus by assigning a different address to each. Bit 0 is the read/write bit ( $R/\overline{W}$ ).  $R/\overline{W} = '1'$  indicates a read operation and  $R/\overline{W} = '0'$  indicates a write operation.

Figure 4-9. I<sup>2</sup>C F-RAM Slave Device Address Register

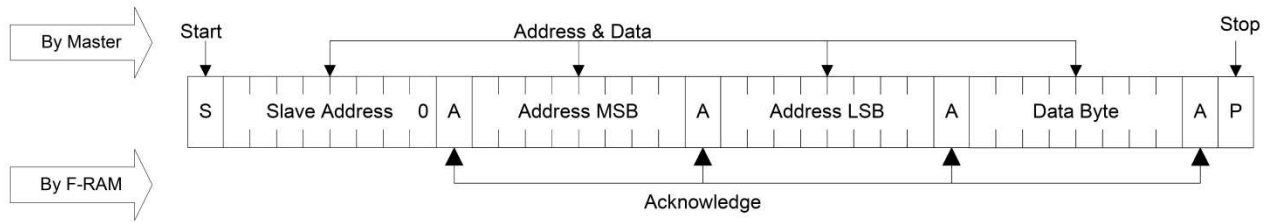


#### Memory Write

All writes begin with a slave address, then a memory address. The bus master indicates a write operation by setting the LSB of the slave address ( $R/\overline{W}$  bit) to a '0'. After addressing, the bus master sends each byte of data to the memory and the memory generates an acknowledge condition. Any number of sequential bytes may be written. If the end of the address range is reached internally, the address counter will wrap from 7FFFh to 0000h.

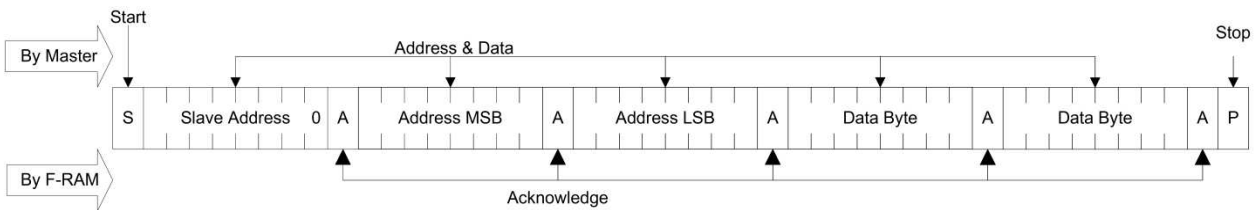
Single-Byte Write:

Figure 4-10. I<sup>2</sup>C F-RAM Single Byte Memory Write



Multi-Byte Write:

Figure 4-11. I<sup>2</sup>C F-RAM Multisystem Memory Write



Memory Read

There are two basic types of read operations: current address read and selective (random) address read. In a current address read, the FM24W256 uses the internal address latch to supply the address. In a selective read, the user performs a procedure to set the address to a specific value.

*Current Address and Sequential Read*

The FM24W256 uses an internal latch to supply the address for a read operation. A current address read uses the existing value in the address latch as a starting place for the read operation. The system reads from the address immediately following that of the last operation.

To perform a current address read, the bus master supplies a slave address with the LSB set to a '1'. This indicates that a read operation is requested. After receiving the complete slave address, the FM24W256 will begin shifting out data from the current address on the next clock. The current address is the value held in the internal address latch.

Beginning with the current address, the bus master can read any number of bytes. Thus, a sequential read is simply a current address read with multiple byte transfers. After each byte the internal address counter will be incremented.

Figure 4-12. I<sup>2</sup>C F-RAM Single Byte Current Address Read

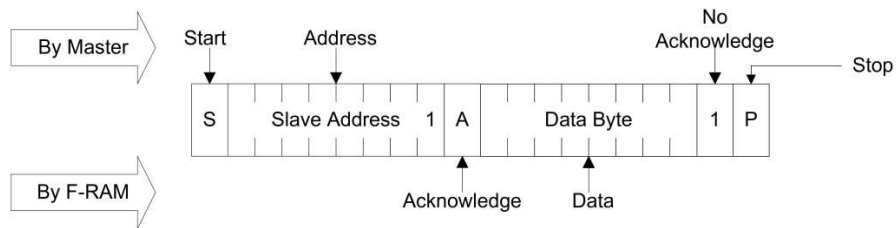
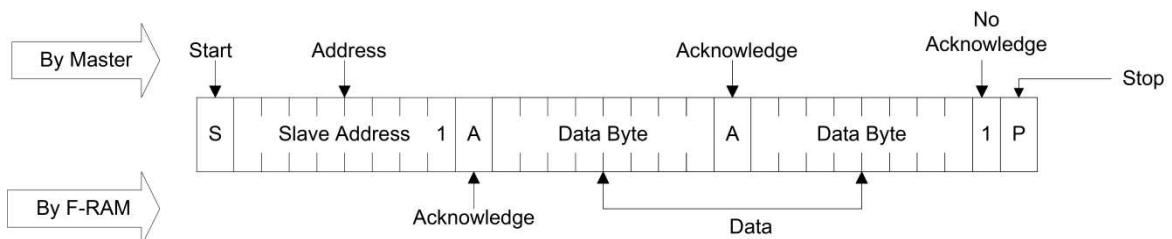


Figure 4-13. I<sup>2</sup>C F-RAM Multisystem Sequential Read



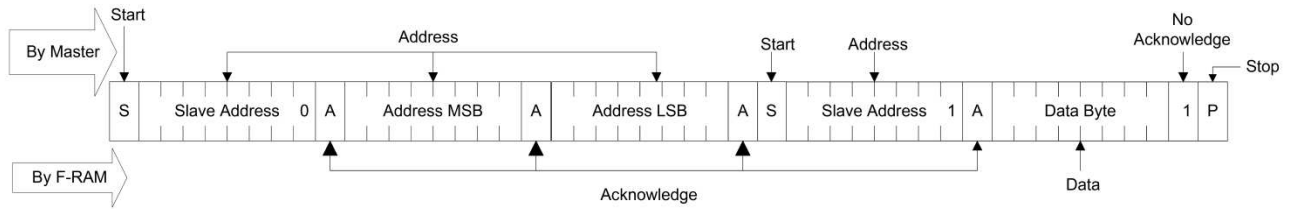


### Selective (Random) Read

A simple technique allows a user to select a random address location as the starting point for a read operation. This involves using the first three bytes of a write operation to set the internal address followed by subsequent read operations.

To perform a selective read, the bus master sends out the slave address with the LSB ( $R/\overline{W}$ ) set to 0. This specifies a write operation. According to the write protocol, the bus master then sends the address bytes that are loaded into the internal address latch. After the FM24W256 acknowledges the address, the bus master issues a START condition. This simultaneously aborts the write operation and allows the read command to be issued with the slave address LSB set to a '1'. The operation is now a current address read.

Figure 4-14. F-RAM I<sup>2</sup>C Selective (Random) Read



# 5. Example Projects



Cypress provides four example projects with the CY15FRAMKIT-001 Serial F-RAM DVK package. These example projects help you to understand the serial F-RAM interface with a microcontroller. The example projects are based on PSoC 4 Pioneer Kit and Arduino UNO R3 Kit.

Download the example projects from [www.cypress.com/go/CY15FRAMKIT-001](http://www.cypress.com/go/CY15FRAMKIT-001). The installer will place the example projects under <Install\_Directory>\CY15FRAMKIT-001 Serial F-RAM Kit\1.0\Firmware\ folder

The following example projects are PSoC 4-based and need the PSoC Creator software and the PSoC 4 Pioneer Kit.

- PSoC4\_FRAM\_SPI
- PSoC4\_FRAM\_I2C

The following example projects are Arduino-based and need Arduino IDE and Arduino UNO R3 Kit.

- Arduino\_FRAM\_SPI
- Arduino\_FRAM\_I2C

## 5.1 Programming PSoC 4 Pioneer Kit

Follow these steps to program the PSoC 4 example projects (PSoC4\_FRAM\_SPI project is shown here):

1. Launch PSoC Creator from **Start > All Programs > Cypress > PSoC Creator 3.1 > PSoC Creator 3.1**. If PSoC Creator is not installed, download from [www.cypress.com/psoccreator](http://www.cypress.com/psoccreator).
2. On the Start Page, under **Examples and Kits** section, choose **Kits > CY15FRAMKIT-001**. A list of example projects appears, as shown in [Figure 5-1](#). Click on the desired example project.