



FRAM

MSP-EXP430FR5739 Experimenter's Board



Welcome to the future of embedded memory technology.

Ferroelectric Random Access Memory (FRAM) is a non-volatile, next generation memory solution that improves upon existing end equipments while enabling future applications.



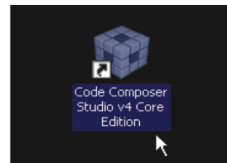
How do I get started with FRAM?

1. Software and Driver Installation

Go to www.ti.com/fram. Here, you can learn more about FRAM and download free code-limited compilers & debuggers, including:

- Code Composer Studio™ version 4 (CCS)
- IAR Embedded Workbench Kickstart

Both will install the necessary drivers for the MSP-EXP430FR5739.



2. Connecting the Hardware

Connect the MSP-EXP430FR5739 Experimenter's Board using the included USB cable to a Windows-enabled PC. If prompted, please allow Windows to install the software automatically. This also supplies power to the MSP-EXP430FR5739 Experimenter's Board.



3. The Demo Application

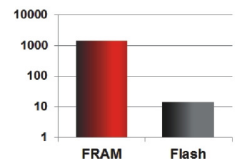
The MSP430FR5739 MCU is pre-programmed with demo firmware, offering 4 operating modes.

- Press S1 to cycle through operating modes (1 - 4)
- 4 LEDs [LED5 - LED8] are used to indicate the selected mode
- Press S2 to enter the selected mode
- Once in a mode,
 - Press S2 to toggle the LED display and UART transmission on/off (This is useful for measuring current consumption. Refer to MSP-EXP430FR5739 User's Guide for more considerations)
 - Press S1 to go back to the mode selection menu
- At anytime, press RST to reset the Experimenter's Board

Mode 1) FRAM maximum write speed test

The MSP430FR5739 device writes to FRAM at more than 100x faster than traditional Flash-based devices. To demonstrate this speed, the eight LEDs increment for every 100kB of data that is written to the FRAM block.

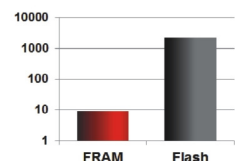
Write Speeds (kB/s)



Mode 2) FRAM ultra-low current consumption test

This mode writes to FRAM at ~12kB/s, which is the maximum speed of Flash-based devices. The eight LEDs increment for every 100kB of data that is written. This visually demonstrates the speed benefits of FRAM vs Flash (Mode 1 vs Mode 2).

Power Consumption (uA)



Mode 3) Bubble level accelerometer demo

This mode starts with a calibration cycle, so ensure that your MSP430FR5739 Experimenter's Board is set down on a flat surface. The accelerometer is calibrated once the 2 center LEDs are lit. Now, the tilt of the board is reflected by the 8 LEDs. Accelerometer data is measured and written to the FRAM block at speeds significantly faster than Flash.

Mode 4) Temperature sensor demo

This mode starts with a calibration cycle. The temperature sensor is calibrated once the 2 center LEDs are lit. Now, any deviation from the starting temperature is reflected by the 8 LEDs. Temperature data is measured and written to the FRAM block at speeds significantly faster than Flash.

4. FRAM Graphical User Interface (GUI)

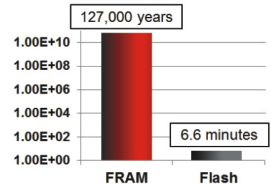
In addition to the on-board LEDs, the MSP430FR5739 device has been pre-programmed to send data to the PC via USB using a timer-based UART. When the MSP-EXP430FR5739 Experimenter's Board is plugged into the PC, simply launch FRAM_GUI.exe

In Modes 1 and 2, 2 primary datapoints are displayed:

- Instantaneous write speeds (kB/s) to demonstrate the high write speeds of FRAM
- Remaining endurance of the memory block (%) to demonstrate FRAM's virtually unlimited write endurance

In Modes 3 and 4, the LED display is mimicked on the GUI, based on the data from the accelerometer or temperature sensor.

Write Endurance



5. Start your own FRAM-based applications!

You can find more information about FRAM technology, available FRAM-based MSP430 devices, user guide for this kit, videos and more at www.ti.com/fram!

MSP-EXP430FR5739 Experimenter's Board

Virtually unlimited write endurance
New realm of Ultra-Low Power
Previously impossible write speeds
Non-volatile, unified memory block



FRAM



Learn more @

www.ti.com/fram

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NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lscs/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lscs/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

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