

Technical Article

It May Be Small, but It's Powerful



DaveS

In a world where memory and pin count increase on an almost daily basis, we sometimes hear questions asking why we continue to develop and release microcontrollers (MCUs) with only a few kilobytes (KBs) of memory. Well the answer is really quite simple. There are hundreds of applications that can benefit by using a low-power MCU to replace standard logic or other analog circuits. Often these MCU-based solutions provide new functionality and flexibility, bringing additional value to a design.

As an example, we could connect a temperature sensor to the analog-to-digital converter (ADC) and with a few lines of control code we can build a simple temperature controller. The diagram below shows the system using the [LMT88](#) temperature sensor and a potentiometer to create a simple closed loop on / off control system by switching a relay to control a heating element.

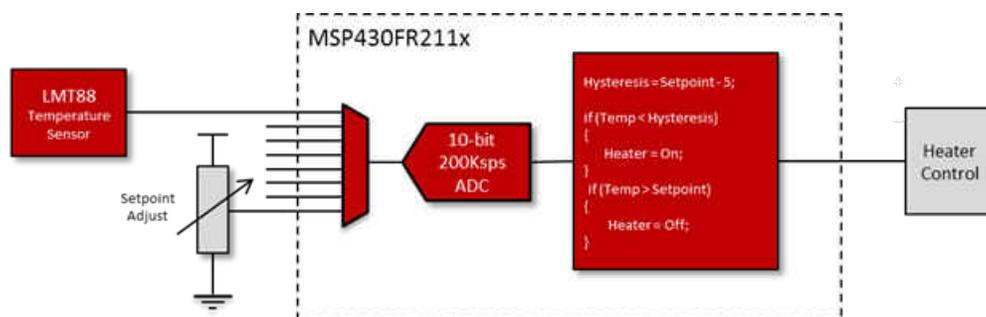


Figure 1. Block diagram of a simple temperature control system

By changing the temperature sensor to an ultraviolet (UV) sensor we could build a simple UV exposure monitor that measures UV levels over a given time period, or by using a simple moisture sensor we could maintain soil moisture levels by controlling an irrigation system. While these types of applications can be built with a few simple active and passive components such as a thermistor and a comparator, we can easily add a programmable element into the feature set or enable more advanced control features such as implementing a proportional term controller to control a variable heating element or a variable speed pump. We can easily enable an interface to allow the user to change the set point or to vary the level of hysteresis, it isn't always as simple to do with a hard wired analog or fixed function IC based solution.

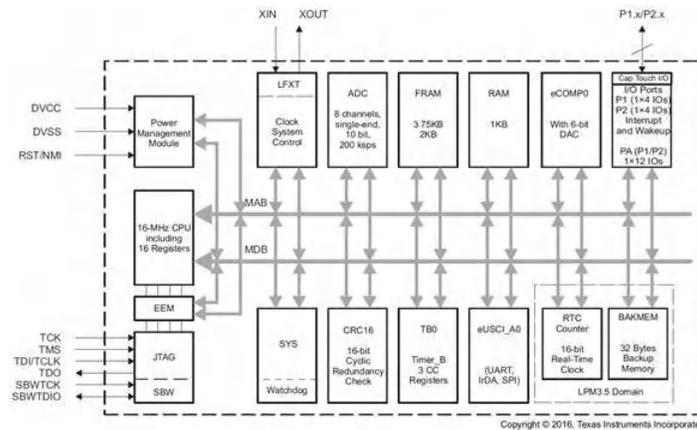
We have recently released two new MSP430™ MCUs with low pin count that are perfect for many simple applications. With up to 4 KB of embedded ferroelectric random access memory (FRAM), plus 1 KB of RAM, these devices offer a compiler friendly alternative to many of the 8-bit MCU's on the market today. These new low cost MSP430 MCU devices are a great entry point to see what FRAM is all about. Offering great flexibility for programmers, FRAM's unique ability to operate as both non-volatile program and non-volatile data memory allows developers to customize the partitioning of program and data memory that was previously not possible with conventional flash and RAM combinations. Along with this flexibility, FRAM offers significant energy savings when writing to memory compared to EEPROM or flash memory, you can find out more about FRAM technology [here](#).

The [MSP430FR2110](#) and [MSP430FR2111](#) MCUs pack a significant feature set into a tiny 3x3 mm package. Besides offering up to 4 KB of embedded ultra-low power FRAM non-volatile program storage, they also include:

- 10-bit 200K sample ADC with eight external input channels

- Low-power comparator with a 6-bit programmable threshold
- Real-time counter with low-power backup memory
- Hardware UART / SPI serial interface

With 1K pricing under \$0.50 for the MSP430FR2110 MCU, this cost effective, feature packed device is already finding many new applications, what would you do with it?



To begin development we have the low cost (\$15.99) [MSP-EXP430FR2311 LaunchPad™](#) development kit, there is also a 20 pin TSSOP target socket board, [MSP-TS430PW20](#).

How to get started:

- For further information and full product details visit the [product folder](#).
- Order the [MSP-EXP430FR2311 LaunchPad](#) kit.
- You can order [samples](#) today to try these new devices out yourself.
- Move to the MSP430 FRAM Value Line with this [migration guide](#).

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated