Technical Article

Easily Solve Design Challenges with MSP430™ MCUs

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Have you ever found a seemingly perfect microcontroller (MCU) that meets your design requirements, only to realize it doesn't scale in memory or offer flexibility in peripherals? As a designer, you face challenges every day, but the scalability of an MCU should not be one of them. In this article, I'll explain how MSP430 MCUs are able to:

- Address scalability challenges.
- Minimize board layout complexity and decrease BOM costs.
- Retain data in power loss situations.

Scalability challenges

Scalability is an important factor when selecting any MCU. It can be frustrating if you've already finished writing your firmware and then find yourself exceeding the available memory, without a pin-to-pin compatible higher memory option. The recently released MSP430FR2476, which contains 64 KB of nonvolatile FRAM memory, provides additional scalability to a portfolio that includes MCUs with as little as 0.5 KB of memory.

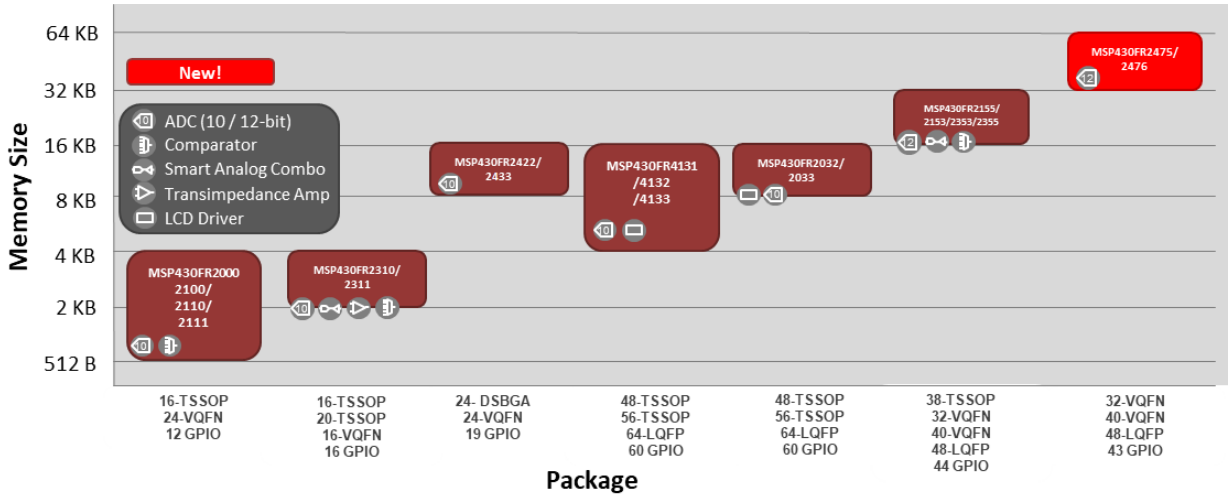

Figure 1. The MSP430 Value Line cost-optimized portfolio offers scalability across different feature sets

Minimize board layout complexity and decrease BOM costs

Flexibility is also an important selection criterion for an MCU. But what does flexibility mean? Flexibility could be the ability to scale across a portfolio with a mix of different peripherals such as analog-to-digital converters (ADCs) or trans-impedance amplifiers (TIAs). Flexibility could also mean being able to implement different functions in an MCU.

Maybe you need to emulate electrically erasable programmable read-only memory (EEPROM) with your MCU's memory. Perhaps you want pulse-width modulation (PWM) signals to replace the functionality of a digital-to-analog converter (DAC). While a fixed-function IC could handle some of these applications, it is possible, and likely more economical, to implement several functions on a single MCU. In addition to decreasing BOM cost, implementing different functions on a single chip also minimizes complex board layout and saves PCB space.

It is possible to realize the functions mentioned above and other MCU applications on a single MSP430FR2476 device and several other lower memory MSP430 devices. The e-book "Enhance simple analog and digital functions for $0.25" highlights these different functions, with software examples included.

Retaining data in power loss situations

In addition to scalability and flexibility, MSP430 devices have unique non-volatile FRAM-based memory architectures. If you are designing a system that requires the retention of critical information through power loss, an FRAM-based MCU provides value over a traditional MCU with flash memory.

One application in which it is important to save the state of the CPU and other peripherals in low and no-power situations is in a 5G base station. With the oncoming trend of wireless 5G networks, 5G base stations enable the connected of several wireless devices to a central hub, while providing much faster connectivity. Tapping into 5G's high-frequency spectrum requires many different components to make up the base station, including field-programmable gate arrays (FPGAs), integrated transceivers and high-speed data converters. Designers will need to guarantee a robust power design for these systems to ensure reliable operation, as network downtime can cost manufacturers large amounts of lost revenue and pose a major inconvenience to end users expecting a dependable internet connection. Additionally, in a 5G base station power design, power loss situations should be accounted for, to ensure the ability of the system to return to normal operation once power is restored.

MSP430FR2476 devices (and all MSP430 FRAM devices) are built specifically for power loss situations. With the compute through power loss (CTPL) library, these devices can save the state of the CPU and other peripherals in non-volatile FRAM memory and restore them when the power is back up, without a full system reset. One use case for the CPTL library could be logging information on different power rails in a system for use as a diagnostic feature in the event of a power loss or system failure.

Figure 2 shows an implementation of the CTPL library that accounts for a power loss situation.

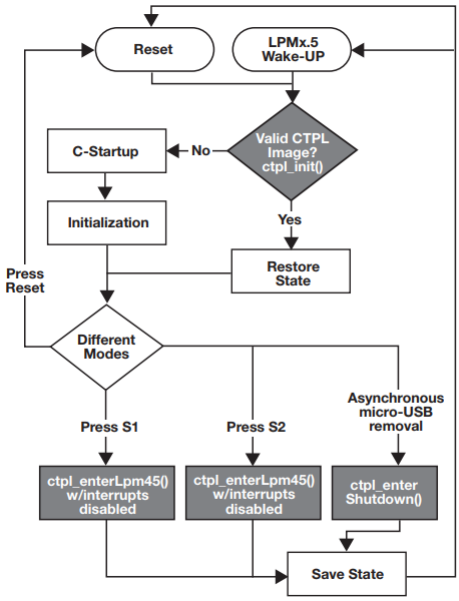

Figure 2. Flow of an algorithm using the CTPL library

The addition of the 64KB MSP430FR2476 makes it possible to use the Value Line portfolio in a much wider variety of applications where scalability is a pre-requisite. For more information on the MSP430 portfolio and some of the unique applications of the device, please feel free to refer to the links below.

Additional resources

- Request free software examples or order the MSP430FR2476 LaunchPad™ development kit.
- Check out the Intelligent System State Restoration after Power Failure with Compute Through Power Loss Utility reference design.

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