Application Report
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Using the TPS3619 With MSP430™ Microcontrollers Can Reduce System Power Consumption With Charge Pumps

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ABSTRACT

The MSP430™ microcontrollers (MCUs) are ideal in applications in which battery life is critical. These microcontrollers require only 0.1 µA of current in low-power RAM retention mode. In this mode, the MCU must have power to retain volatile memory. In some systems with charge pumps, the TPS3619 can be used to shut down the charge pump to save system power consumption.

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1 Using the TPS3619 With MSP430 Microcontrollers

For many portable-power applications, the power consumed during shutdown mode is more critical than power consumed while active. This is particularly true for portable monitoring equipment such as digital thermometers, blood glucose meters, or battery-powered blood pressure monitors. In these applications, measurements are made, calculations are performed, and the result is displayed on a liquid crystal display (LCD) or stored in memory for future retrieval. To conserve battery life, the circuit usually enters a low-power sleep or standby mode between measurements. Because such a device may be active only a small percentage of the total time, the current drain on the battery during sleep mode significantly affects battery life.

Due to the volatile nature of the internal RAM of the microcontroller, a voltage source must be applied to retain data stored in RAM. In some systems that use charge pumps, a battery backup supervisor such as the TPS3619 lets the power supply to be disabled. The TPS3619 lets the battery directly supply power to the MSP430 MCU when the power supply is disabled. which saves system power consumption when the MSP430 MCU is in a low-power mode. Figure 1 shows a typical application that uses the TPS3619 and a charge pump with an MSP430 MCU.

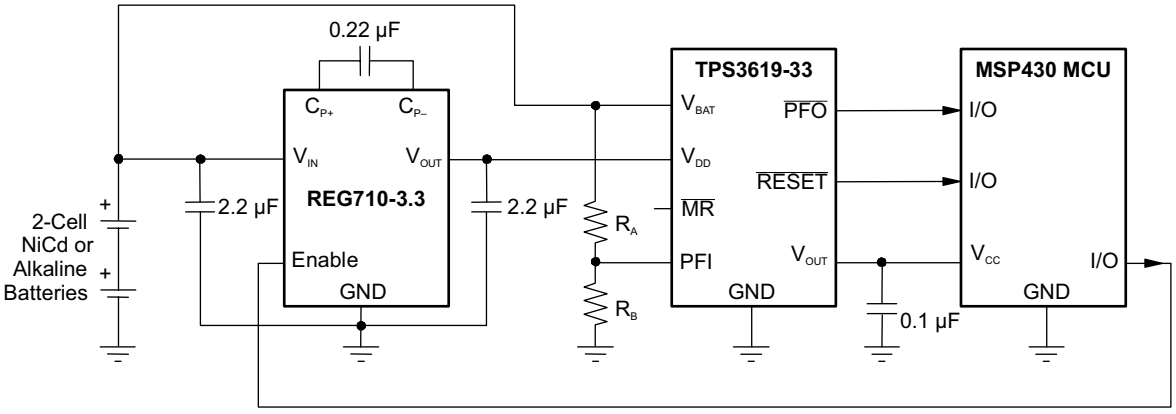

Figure 1. 2-Cell Battery to 3.3-V Power Solution for MSP430 MCU With SVS for RAM Retention

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The circuit in Figure 1 uses the REG710 charge pump to perform the 3.3-V power conversion from 2-cell alkaline or NiCad batteries. If desired, any other 2-cell boost converter with an enable feature can be used.

When the MSP430 MCU has processed and stored the data, the device can disable the REG710. When the REG710 is disabled, the output voltage decreases until the voltage falls below the internal trip voltage, V_{IT}. The backup supervisor now switches V_{OUT} from output of the REG710 to the V_{BAT} input. At the same time, the $\overline{\text{RESET}}$ pin goes low. This pin can be used to monitor when the SVS enters battery-backup mode. Using the reset signal from the TPS3619 to reset the MCU is not necessary, because the MSP430 MCU is powered directly from the battery. Doing so can make microcontroller latch in the reset state. If the reset function is required, the TPS3606 can be used in place of the TPS3619.

In addition to providing a battery-backup function, the TPS3619 can provide a low-battery detection function through the PFI pin. The PFI input of the TPS3619 connects to an internal comparator that has a 1.15-V threshold. When the voltage on the PFI pin falls below 1.15 V, the voltage at $\overline{\text{PFO}}$ goes low. Resistors R_A and R_B can be used to set a user-defined low-battery threshold and must be used for the MSP430 MCU, because the minimum operating voltage for the MSP430 is 1.8 V. This can be used to send a low-battery indicator to the user or to trigger the microcontroller to enter a low-power mode of operation. Because the input current of the PFI pin can cause an error in the sensed voltage, the parallel combination of R_A and R_B should be below 1 MΩ.

The low-battery detection feature is optional, and the designer should consider the amount of constant-current draw required by resistors R_A and R_B. Resistors R_A and R_B require approximately 2 µA (2 V/1 MΩ) of constant current. In many cases, the MSP430 MCU provides a low-battery detection feature on-chip that does not require constant current and provides a lower system-current option.

By using the TPS3619, the amount of current saved in low-power mode is approximately 65 µA. When the TPS3619 is in battery-backup mode, the current drawn from the battery is decreased to a maximum of only 0.5 µA. While active, the supply current required by the TPS3619-33 is typically only 17 µA.

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Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from May 19, 2003 to August 6, 2018	Page
• Editorial and formatting changes throughout document	1

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