

Single-Chip Flow Metering Solution With the CC13x2R Wireless MCUs



Low power is very important in flow meter designs where a battery life of at least 10 years must be ensured. The CC13x2 and CC26x2 (see [Figure 1](#)) SimpleLink™ low-power RF wireless MCU products from Texas Instruments™ are designed toward low power in both the application/metrology and for RF communication.

In many cases a flow meter reports the measurement rather infrequently using the RF functionality—very often just a few times per day. Low current consumption for RF transmission is still important because it keeps peak currents low and ensures longer lifetime at the end of the battery life. However, it is often more challenging to keep the average current on the metrology low. The flow must be monitored continuously and will often require the MCU to wake up many times per second. In addition to the main Arm® Cortex®-M4F application MCU, the CC13x2 and CC26x2 wireless MCU platform has a sensor controller, which is a separate 16-bit MCU coprocessor that is highly optimized for handling low-power measurements.

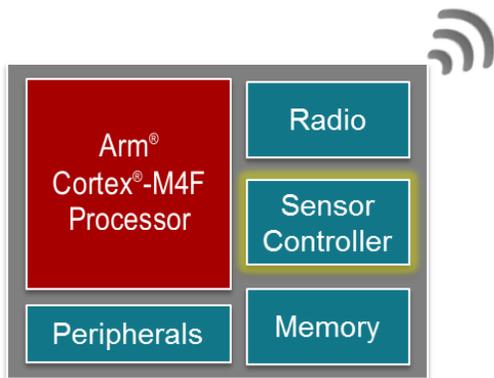


Figure 1. CC13x2 and CC26x2 Block Diagram

Principles of Flow Meter Measurement: There are many ways to implement a flow meter. The focus of this document is on an inductive measurement principle. This method is popular because it is more robust against tampering. We will also look at a case

where the Sensor Controller is just counting pulses. Because the sensor controller in the CC13x2 and CC26x2 device platform is a programmable MCU, it can also handle other measurement principles (for example, capacitive methods).

Sensor Controller—System Block Diagram: The sensor controller is part of a system with analog and digital peripherals all tuned toward ultra-low power (see [Figure 2](#)). The analog peripherals include a 12-bit ADC, two comparators, a programmable current source, and an 8-bit DAC (voltage reference). The digital peripherals include three timers, an ultra-low-power counter, a 10-ns time-to-digital converter (TDC), SPI interface, and a hardware multiplier. These peripherals can be combined with the sensor controller in numerous ways to handle both analog and digital sensors with very low power consumption.

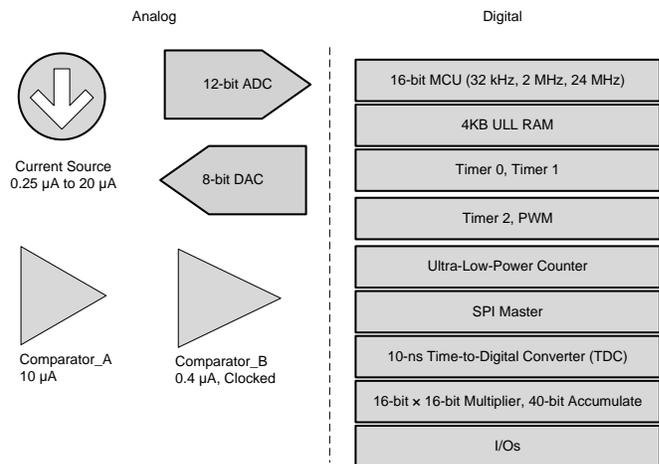


Figure 2. Sensor Controller Block Diagram

Inductive Principle: In a mechanical flow meter, the flow of gas or water causes a disc to rotate. The disc is partly covered by metal and is rotating above two inductors. The inductors are part of an LC tank, and they will oscillate when excited by short current pulse. Due to losses, the oscillations will slowly die out. The decay time of the oscillators is dependent on whether or not the inductor is under the metallic part of the disc. This placement can be detected by counting the number of pulses generated when feeding the signal through a comparator. By using two inductors placed 90 degrees apart, it is possible to find out how fast the disc is rotating and also the direction of rotation. The

rotation speed is a measure of the flow and the direction is used to check for tampering attempts. The inductive principle is explained in more detail in the [Low-Power Water Flow Measurement With Inductive Sensing Reference Design](#).

Sensor Controller Implementation: Figure 3 shows a simplified overview of the blocks in the sensor controller that were active during the measurement. The 2-MHz clock mode offered in the CC13x2 and CC26x2 sensor controller is a perfect mode of operation for the inductive measurement principle. The fast 2-MHz turnon time of the oscillator ensures very low start-up energy so that high-frequency measurements (100 Hz) can be performed at very low power (see Table 1). The DAC is used as a programmable voltage reference for the comparator as well as in the initial calibration of the system.

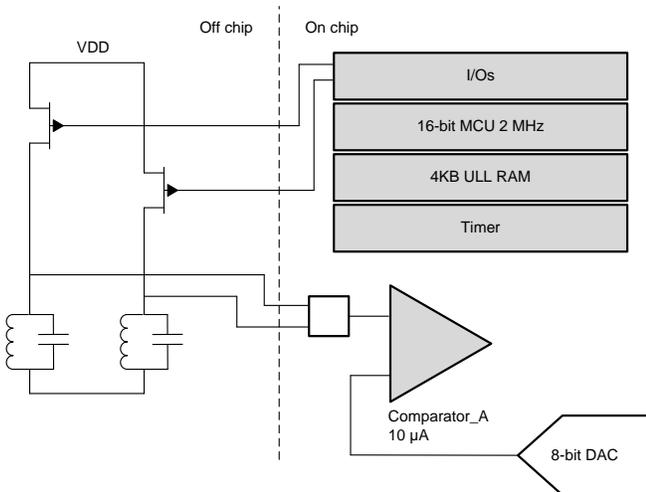


Figure 3. Inductive Sensing Principle (Simplified)

Table 1. Frequency Measurements Performed With Low Power

	Frequency	
	16 Hz	100 Hz
Typical average current consumption	1.6 µA	3.9 µA

Pulse Counting: In a two-device system where the metrology is handled by a separate MCU, the sensor controller can be used to count and timestamp pulses from the metrology MCU.

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Given that the sensor controller system also contains a dedicated counter, the metrology can be handled in a very low-power way. Typical current consumption measurements for selected temperatures are listed in Table 2 for a 12-Hz counting application.

Table 2. Temperature and Current Consumption for a 12-Hz Counting Application

Temperature	Typical Average Current Consumption
-40	0.8 µA
25	0.9 µA
40	1.1 µA
60	1.8 µA
85	4.4 µA

RF Protocol Solutions: TI offers the CC13x2 and CC26x2 wireless MCU platform with multiple wireless protocol stacks. The available stacks are both customer-modifiable and standard-based protocols (such as the [Wireless M-Bus Protocol Software](#) and the TI 15.4-Stack that is available in the [SimpleLink CC13x2 Software Development Kit](#)). The CC1352 device is offered with multiband capabilities so it is possible to combine a long-range Sub-1 GHz solution with a [Bluetooth®](#) low energy, Thread, and (or) Zigbee® solution at 2.4 GHz.

1 Related Documentation

- [Sensor Controller Studio product page](#)

Application Reports:

- [Getting Started With the CC13xx and CC26xx Sensor Controller](#)
- [Integrating Sensor Controller Studio Examples Into ProjectZero](#)
- [Wireless Motion Detector With SimpleLink™ Sub-1 GHz Wireless MCU](#)

Training Videos:

- [SimpleLink™ Academy: Introduction to Sensor Controller](#)
- [LC-Sensing – A Key Subsystem in Smart Water and Heat Meters](#)
- [Single-Chip Smart Water Meter with Dual-Band RF and Infrared Port](#)

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