Application Brief

Application of Low-Cost MSPM0 Series in Water Purifiers

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With the growing demand for high-quality drinking water and rising health awareness, the market for reverse osmosis (RO) water purifiers is expanding rapidly. RO systems use multiple filtration stages, including pre-filters, activated carbon filters, and RO membranes, to remove dissolved solids, heavy metals, and microorganisms.

As the control core of the system, the microcontroller unit (MCU) manages key tasks such as pump and valve control, communication with wireless module, user interface operation, etc. This application brief introduces how to use Arm® Cortex®-M0+ MCU MSPM0 series to design control modules for RO water purifiers.

Figure 1. Water Purifier

MSPM0 in Basic RO Water Purifiers

A basic RO water purifier typically focuses on providing essential purification and filtration control at an affordable cost while maintaining system reliability. The core functions include water level detection, pump and valve control, UV sterilization monitoring, and temperature sensing.

In this kind of systems, the microcontroller serves as the central controller managing sensing, actuation, indication, and protection logic. The MSPM0 series MCU, based on the Arm® Cortex®-M0+ core, provides a good balance of performance, integration, and low power for cost-sensitive RO purifier applications.

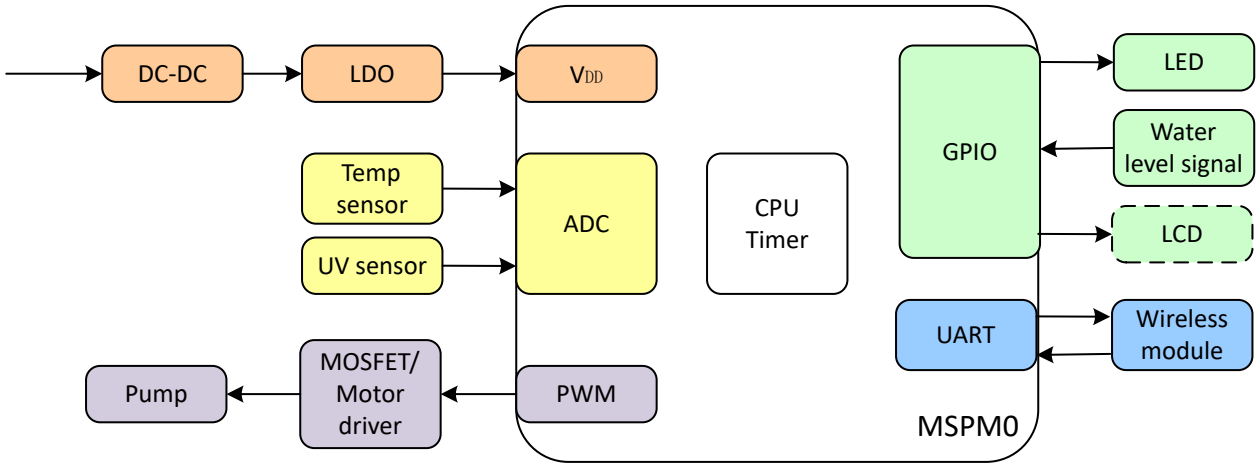

Figure 2. water purifier block diagram

Peripheral Requirements and Functions

In a basic RO system, several MCU peripherals are used to handle sensor inputs, actuator control, communication, and timing management:

- ADC: The ADC channels are used to measure analog signals from temperature sensors and UV sensors. These readings are used to monitor water safety, detect UV lamp intensity, and provide feedback for system health and control logic.
- GPIO: The GPIO pins are used for digital signal control and detection. They handle the on/off logic for the UV ballast and indication LEDs, and detect the state of the water level float switch for tank level monitoring and protection.
- PWM / Timer: PWM outputs are used to drive the high-pressure pump and solenoid valves through external MOSFETs or motor drivers. Timers help regulate actuation timing, control pump speed, and execute scheduled flushing operations.
- UART: The UART interface enables serial communication with optional wireless modules such as Bluetooth or Wi-Fi. This allows the purifier to support remote monitoring and mobile app connectivity for maintenance alerts or usage tracking.
- LCD: The LCD peripheral enables human-machine interaction functions and display data parameters such as temperature in real time. This is used in some higher-end products. It can be achieved through LCD peripherals or an external LCD driver.

Advantages of MSPM0 for Basic RO Applications

The MSPM0 series offers multiple advantages that make it suitable for basic RO purifier control modules:

- Integrated Analog Front-End: 12-bit SAR ADCs with multiple input channels for precise temperature and UV intensity sensing, reducing the need for external ADC components.
- Low-Power Efficiency: Industry-leading power consumption performance (< 1.5 µA standby, 71 µA/MHz active), supporting always-on monitoring with minimal energy cost.
- Flexible Control and Sensing: Multiple GPIOs, PWM timers, and communication interfaces allow seamless integration of pumps, solenoid valves and sensors within one MCU.
- Support LCD pheripherals in some device: Hardware based LCD drivers can display data in real time to enable human-machine interaction, in addition to providing basic functions. Compared to external LCD drivers, intergratred LCD peripherals offer higher integration and better cost-effectiveness.
- Compact and Cost-Effective: Available in low-pin-count packages (e.g., 20–32 pin), suitable for compact and cost-optimized PCB layouts in consumer RO systems.
- Scalable Architecture: MSPM0 provides software and pin-to-pin scalability, allowing users to upgrade from basic to smart RO designs using the same software base.

Recommended Device Family

For cost-optimized RO purifier designs, we will recommend MSPM0C110x or MSPM0H321x, offering:

- 8–64 KB Flash memory for core control and sensing functions
- 12-bit SAR ADC with up to 27 channels
- Multiple timers and PWMs for pump and valve control
- UART, I²C, and SPI communication support
- Low power operation suitable for standby sensing and scheduled control
- Multiple voltage supply: MSPM0C110x for 1.62-3.6V, MSPM0H321x for 4.5V-5.5V

Summary

This application brief demonstrates how to design control modules for basic RO water purifiers using TI's MSPM0 series of Arm® Cortex®-M0+ MCUs. The MSPM0 family enables high-accuracy sensing, intelligent control, and cost-effective system design, making it suitable for RO water purifier applications.

Start Using MSPM0 MCU

Select a low-cost MSPM0 LaunchPad™ development kit today to start evaluating the device for your RO water purifier control application. Explore the MSP Academy for sample codes and online training. Use the following links for more information:

- MSPM0 Overview Page
- MSPM0 Software Development Kit
- MSPM0 Academy
- MSPM0C1104 LaunchPad
- MSPM0C1106 LaunchPad
- MSPM0H3216 LaunchPad

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