



# The World's First Microcontroller with 4-Channel Constant High-Current Drive

## NEC

NEC Electronics America

**Designers of LED lighting are always looking for ways to reduce the cost and size of the power management solution in applications that use more than one LED. NEC Electronics has recently developed a solution that reduces both. The new 8-bit  $\mu$ PD78F8024 high-current driving (HCD)/LED microcontroller is a 4-channel constant-current driver with embedded flash memory integrated into a single chip for maximum savings of cost and space. Each of the MCU's constant-current driver channels implements an individual, hardware-based hysteretic regulator controller with a switching frequency up to 1MHz, which the MCU can control through pulse-width modulation (PWM) signals.**

NEC Electronics designed this MCU to be extremely flexible so as to meet a variety of application requirements. In addition to input voltages ranging from 9 to 38V, the  $\mu$ PD78F8024 also supports buck and boost modes. Buck mode, in which the LED's total forward voltage is less than its input voltage, is shown in Figure 1; boost mode, in which the LED's total forward voltage is greater than its input voltage, is shown in Figure 2.

In terms of flexibility, the  $\mu$ PD78F8024 is ideal for use in emergency vehicles (for example, police cars) that use a 12V battery in the U.S. and a 24V battery in Europe. The NEC Electronics solution can support both input voltages, in addition to a variety of sub-applications that require varying numbers of LEDs. As a result, designers can minimize their circuit design efforts by using the  $\mu$ PD78F8024 MCU throughout each series of diverse sub-applications.

The new MCU's four channels of constant-current drive can be leveraged in two principle ways. They can be treated as four independent channels, for example, in slot machines and in architectural color-mixing wall washers, both of which require that the on state, dimming level, and/or flashing sequence of each channel be controlled to generate a desired lighting effect. In entertainment lighting applications, the four "independent channels" treatment also can be used in conjunction with the MCU's UART interface to support DMX512-compliant lighting.

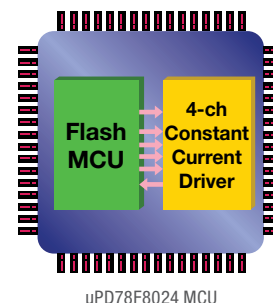
Alternatively, the four channels can be combined to generate arrays of up to 40 high-power LEDs. From a reliability standpoint, this second approach has built-in redundancy that ensures continuous operation of the remaining channels, should one channel experience an open failure. This approach is valuable for street and tunnel lighting applications.

Whenever possible, designers of LED lighting want to drive an LED at the highest possible current. However, depending on the volume available for implementing the thermal management solution, the LED's final drive current may need to be adjusted. To meet a variety of lighting needs, the  $\mu$ PD78F8024 supports output currents ranging from 350mA to more than 1.5A via external MOSFETs. Additionally, due to its four A/D converters and I<sup>2</sup>C interface, the  $\mu$ PD78F8024 is able to communicate with a temperature and/or ambient lighting sensor to dynamically change effective LED current via PWM dimming. LED

signs in outdoor lighting applications in particular can benefit from this added intelligence.

In addition to its intelligence and other benefits, the  $\mu$ PD78F8024 MCU also implements functionality that enables automatic shutdown of the MCU upon detection of over temperature, and automatic lockouts upon detection of under voltage. Further, the MCU comes in a 64-pin low profile quad flatpack (LQFP) package and operates at temperatures ranging from -20 to +85°C.

For additional support, NEC Electronics offers a full suite of software and hardware tools, including a C compiler, Appilet software for automatic sample code generation, full-function emulator and integrated debugger for design and development, and a PG-FP4 flash programmer for programming of user code into the MCU's flash memory.



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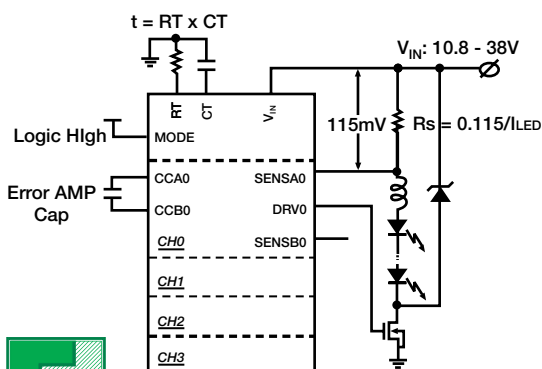


Figure 1.  $\mu$ PD78F8024 MCU in Buck Mode

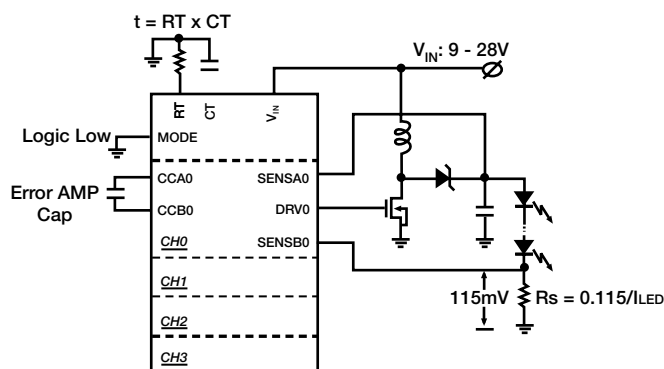


Figure 2.  $\mu$ PD78F8024 MCU in Boost Mode

