LED controllers

Voltage-switch drivers, constant-current drivers, and Flash LED drivers
LEDs are used in a wide range of applications, from low-end status indicators to high-end video displays. System designers often need the ability to control these LEDs, but can’t afford to tie up the system processor to do so. NXP’s LED controllers solve this problem, performing a variety of control tasks while offloading the system processor. Having sent instructions to the LED controller, the processor is free to engage in other tasks or go into a low-power state.

NXP’s LED controllers offer a variety of features needed in LED-driving applications. Some of these features include:

- Blinking and dimming capability
- Pulse-width modulation (PWM) for LED control
- Color mixing capabilities
- Fast-mode Plus (Fm+) communication channel with data transfer rate of up to 1 Mbps over the I²C-bus.
- Different output drive types (push-pull, open-drain voltage switch or constant-current driver)
- Independent control of LEDs
- LED status and fault reading
- Short-circuit protection
- Over-temperature protection

The devices are classified in three groups: voltage-switch drivers, constant-current drivers, and Flash LED drivers. These groups are discussed below.

**Voltage-Switch Drivers**

Voltage-switch output driver devices control the LED connected to the output pin by switching the connection to ground or supply on or off. A series resistor connected between the LED and the device limits the current that flows through the LED into the device.

Voltage-switch devices have the advantage of dissipating the heat outside the device, in the series resistor. Therefore the device is insensitive to heat dissipation and is good for driving multiple LEDs in series, with different forward-bias voltages (Vf), from the same supply.

**Constant-Current Drivers**

A current-regulated LED driver results in the LED light remaining constant with the supply-voltage fluctuations. NXP constant-current LED drivers are used for low-current luminary lighting applications requiring accurate lighting control independent of supply voltage, temperature, and LED forward-bias voltage.

**Flash LED Drivers**

NXP Flash LED Drivers are high-efficiency, maximum-output, small footprint devices with touch capability and an indicator LED output feature. These devices are highly integrated with hardware and I²C interface modes.

The LED controllers are supported by application boards and daughter cards, an established manufacturing infrastructure that supports high volumes, and several technical documents. NXP helps system designers make lighting affordable, in everything from indoor consumer electronics and appliances to outdoor decorative lighting.
## LED Controllers Selection Guide

| Device | Function | Number of Device Addresses | Operating Voltage Range | Standby Current | Type of LED Drive | Max LED Drive Current | Max LED Drive Voltage | Output Type | Default Pin LED Output State | Number of PWMs | I2C, Fm, or direct | I2C, Fm Output Enable | Programmable Output Delay | Dimming Capability | Blinking Capability | Pattern Sequencer | LED Error Detection | Oscillator Calibration | I2C, Fm, or direct | Oscillator Frequency | Temperature Shutdown | Number of Device Addresses | Individual PWM Frequency | Status |
|--------|----------|-----------------------------|--------------------------|-------------------|------------------|----------------------|-----------------------|-------------|--------------------------------|----------------|---------------------------|------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|------------------------|--------------------------|-----------------|
| PCA9550 Blinker | 2 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | Y | N | N | N | N | N | N | N | N | FC, Fm, 2 | Y | 320 KHz | - | 0.172 Hz | 44 Hz | In Production |
| PCA9551 Blinker | 4 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | N | N | N | N | N | Y | N | N | N | HC, Fm, 1 | N | 330 KHz | - | 0.172 Hz | 44 Hz | - | In Production |
| PCA9552 Blinker | 8 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | N | N | N | N | N | Y | N | N | N | Fm, 8, 4 | Y | 8 MHz | Y | 31.5 KHz | 122 Hz | In Development |
| PCA9553 Blinker | 16 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | N | N | N | N | N | Y | N | N | N | Fm, 8, 4 | Y | 8 MHz | Y | 31.5 KHz | 122 Hz | In Development |
| PCA9554 Dimmer & Blinker | 2 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | Y | N | N | N | Y | N | N | N | N | HC, Fm, 2 | Y | 320 KHz | - | 0.172 Hz | 32 Hz | - | In Production |
| PCA9555 Dimmer & Blinker | 4 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | N | N | N | N | N | Y | N | N | N | Fm, 8, 4 | Y | 8 MHz | Y | 31.5 KHz | 122 Hz | In Development |
| PCA9556 Dimmer & Blinker | 8 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | N | N | N | N | N | Y | N | N | N | Fm, 8, 4 | Y | 8 MHz | Y | 31.5 KHz | 122 Hz | In Development |
| PCA9557 Dimmer & Blinker | 16 | 2.7 V - 5.5 V | Voltage switch | 25 mA | 5 V | Open Drain | In-2 Input | Y | 2 | 256 | N | N | N | N | N | Y | N | N | N | Fm, 8, 4 | Y | 8 MHz | Y | 31.5 KHz | 122 Hz | In Development |

### LED Flash Drivers Selection Guide

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<td>1</td>
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<td>Y</td>
<td>Y</td>
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PCA9622 Application Example

Architectural Lighting

Mobile Phone Application Example

Car Radio Backlight
Application Support
For added application support, NXP offers the following application reports on the LED driver family devices:

- **AN10579**: Driving LED light bars using NXP Solutions
- **AN10733**: Flash LED App. Note
- **AN264**: I²C Devices for LED Display Control App. Note
- **AN10315**: LED Dimmer Board

For more information, visit [http://ics.nxp.com/products/led.drivers/](http://ics.nxp.com/products/led.drivers/)

NXP offers evaluation modules and demo boards that can be used to develop software and evaluate the performance of the LED controllers and LED Flash drivers.

**OM6275 – I²C 2005-1 Evaluation Board**
Easy experimentation and training module. I²C-bus connects to LED controllers, other I²C peripherals, and daughter cards. USB Connection. GUI interface allows direct control of device without programming.

**OM6279 – LED Dimmer Demo Board**
NXP LED controllers and GPIO in simulated mobile phone application showing RGB LED color mixing, LED blinking and dimming, and backlight LED control applications.

**OM6281 – PCA9698 Daughter Card for I²C 2005-1**
PCA9698 40-bit GPIO with easy access to all 40 I/O pins and several LEDs. Demonstrates using PCA9530 2-bit LED dimmer to dim and/or blink all 40 outputs using the /OE input of the PCA9698.

**OM6282 – PCA9633 Daughter Card for I²C 2005-1**
Demonstrates LED blinking, dimming, and RGBA color mixing using PCA9633 with individual 256-step PWM per channel and global 256-step PWM. Select any of the 64 I²C addresses with the on-board DIP switch.

**OM6286 – PCA9633 Demo Board**
Evaluate LED dimming and blinking features of the PCA9633 4-bit (RGBA) PWM LED driver. RJ-45 jack allows series connection to multiple boards to evaluate long-distance Fm+ bus and P82B96.

**OM6287 – PCA9698 Daughter Card for I²C 2005-1**
PCA9698 40-bit GPIO with easy access to all 40 I/O pins and several LEDs. Demonstrates using PCA9530 2-bit LED dimmer to dim and/or blink all 40 outputs using the /OE input of the PCA9698.

**OM6288 – LED Flash Driver Demo Board**
Provides access to the reset, flash, touch and brightness controls of the SSL3250A. The board also has a USB port and GUI software that can be used to control the SSL3250A.