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+) bi-directional communication channel with data transfer rate of up to 1 Mbps over the I²C-bus
- Ultra Fast-mode (UFm) uni-directional communication channel with data transfer rate of up to 5 Mbps over the I²C-bus
- SPI-compatible 3-wire serial uni-directional interface with data transfer rate of up to 25 Mbps over Serial Peripheral Interface (SPI)
- Different output drive types (push-pull, open-drain voltage switch or constant-current driver)
- Independent control of LEDs
- LED Open or Short status and fault reading
- Gradation control with programmable “breathing” effect
- 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 ($V_f$), 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 Flash Drivers Selection Guide

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PCA9622 Voltage Switch LED Driver Application Example

Architectural Lighting

PC9955A Constant Current LED driver Application Example

Automotive Instrument Cluster

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.

**OM6279 – 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.

**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.

**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.

**OM13483 – PCA9955A 16 channels LED demo board**
The OM13483 is an add-on to 9-pin connector of NXP’s I2C demo board 2005-1 or Fm+ I2C Bus development board. This daughter board makes it easy to test and design with the PCA9955A, a 16-channel Fast-mode Plus (Fm+) 57 mA constant current and outputs allow up to 20 V for LED supply.

**OM13321 – PCA9956A 24 channels LED demo board**
The OM13321 is an add-on to 9-pin connector of NXP’s I2C demo board 2005-1 or Fm+ I2C Bus development board. This daughter board makes it easy to test and design with the PCA9956A, a 24-channel Fast-mode Plus (Fm+) 57 mA constant current and outputs allow up to 20 V for LED supply.