



## NXP I<sup>2</sup>C RGB LED dimmers PCA963x

# Color-mixing RGB LED drivers for mobile, entertainment, and architectural lighting

Set each LED to a specific brightness and dim or blink all of them with the same value. Special software features optimize I<sup>2</sup>C-bus commands in multi-LED control applications.

### Key features

- ▶ 25-mA (max) LED drivers
  - PCA9633: 4-bit driver
  - PCA9634: 8-bit driver
  - PCA9635: 16-bit driver
- ▶ LED brightness programmable in 256 steps per output
- ▶ Individual brightness control for general dimming or blinking of all LEDs
- ▶ Programmable push-pull or open-drain output structures (5-V tolerant)
- ▶ Selectable output-state change on Acknowledge and Stop commands
- ▶ Up to 126 software-programmable I<sup>2</sup>C-bus addresses
- ▶ Fast-mode Plus I<sup>2</sup>C-bus interface (30 mA / 1 MHz)
- ▶ Active-low enable ( $\overline{\text{OE}}$ ) pin for hardware dimming or backlight control
- ▶ Variety of package/pinout options

### Applications

- ▶ RGB and RGBA LED drivers
- ▶ Decorative LED lighting requiring 4000-pF buses
- ▶ LED status information
- ▶ LED displays requiring 1-MHz bus speeds
- ▶ LCD backlights
- ▶ Keypad backlights for cellular phones or handheld devices

The NXP LED drivers PCA963x are optimized for RGBA color mixing and are available in a variety of pin-out and package options. The family includes the PCA9633, a four-bit driver, the PCA9634, an eight-bit driver, and the PCA9635, a sixteen-bit driver.

The PCA9633 is available in three software-identical versions that offer different address combinations:

- ▶ 8-pin version: fixed I<sup>2</sup>C-bus address
- ▶ 10-pin version: two programmable address pins for up to four devices on the same I<sup>2</sup>C-bus
- ▶ 16-pin version: seven programmable address pins for up to 126 devices on the same I<sup>2</sup>C-bus

The PCA9634 and the PCA9635 have seven programmable address pins for up to 126 devices on the same I<sup>2</sup>C-bus

The PCA9634, the PCA9635, and the 16-pin version of the PCA9633 integrate an active-low output enable ( $\overline{\text{OE}}$ ) pin, which can be used for hardware dimming or backlight control.

All three drivers use the same basic architecture. Individual PWM controllers on each channel (one for each LED output) are used to set the LED brightness to a

specific value. The controllers are 8-bit, fixed-frequency functions that operate at 97 kHz and have a duty cycle that is adjustable from 0 to 99.6% in 256 linear steps.

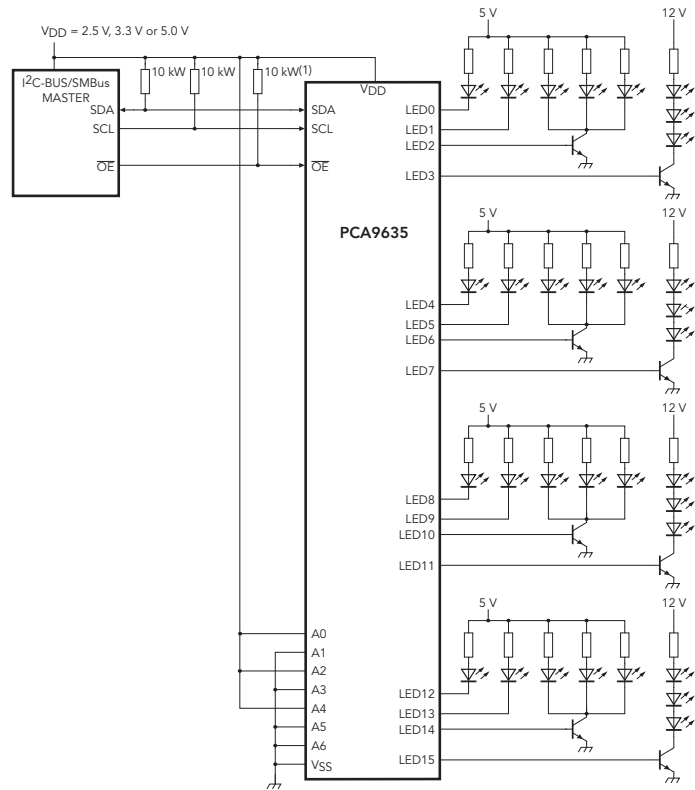
A group PWM controller is used to dim or blink all the LEDs with the same value. For group blinking, the driver uses a fixed frequency of 190 Hz or an adjustable frequency between 24 Hz and 10.73 seconds in 255 linear steps.

Each of the LED outputs can be programmed to be off, on (no PWM control), set at the value of its individual PWM controller, or at both individual and group PWM controller values.

The  $\overline{OE}$  pin supports asynchronous control of the LED outputs and can be used to set all the outputs to a defined logic state that is programmable by the I<sup>2</sup>C-bus. It can also be used for external PWM of the outputs, especially when multiple devices need to be dimmed or blinked together.

To minimize I<sup>2</sup>C-bus commands, there are four software-programmable Sub Call I<sup>2</sup>C-bus addresses that let all or a defined group of drivers respond to a common I<sup>2</sup>C-bus address. For example, in applications where several PCA9633 devices control identically connected multi-color LEDs, all the outputs can be turned on, turned off, or programmed to a new brightness value at the same time in a single sequence. Alternatively, the device groups can be given four addresses for a marquee-chasing effect.

The Software Reset (SWRST) call feature provides a quick, easy way for the I<sup>2</sup>C-bus



PCA9635 block diagram

master to reset the driver to its default state, setting the LED outputs to off.

The LED output drive can be programmed as an open-drain with a 25-mA current sink capability at 5 V or a push-pull with a 25-mA current sink and a 10-mA source capability at 5 V. Both output structures can drive FETs for higher voltage or current requirements.

The change of the output state can be selected to happen on the Acknowledge or the Stop command, so outputs can be updated one by one or all at once.

The I<sup>2</sup>C-bus is compatible with Fast-mode Plus (Fm+), supporting bus speeds up to 1 MHz and enabling faster data transfers. With 30-mA SDA outputs, it can drive

4000 pF without any bus buffers.

The drivers function over the industrial temperature range, support an operating voltage of 2.3 to 5.5 V, and have I/O that are tolerant to 5.5 V.

### Ordering information

Type number	Package	Number of pins
PCA9633D16	SO	16
PCA9633DP1	TSSOP (MSOP)	8
PCA9633DP2	TSSOP (MSOP)	10
PCA9633PW	TSSOP	16
PCA9633BS	HVQFN	16
PCA9633TK	HVSON	8
PCA9634D	SO	20
PCA9634PW	TSSOP	20
PCA9634BS	HVQFN	20
PCA9635PW	TSSOP	28