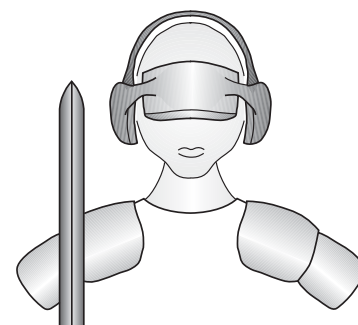


LED-Warrior01

HB LED driver module for low voltage input



Code Mercenaries

1. Features

- Input voltage 7 - 30V
- Constant current output, 350mA, 700mA, 1A
- Maximum output power 24W
- 1A max output
- Capable of driving 1..7 white LEDs
- Input transients up to 40V <0.5s
- Up to 95% efficiency
- PWM or analog control input for dimming
- Optimized for point-of-load regulation

1.1 Variants

LED-Warrior01 is available in variants for 350mA, 700mA and 1A output current.

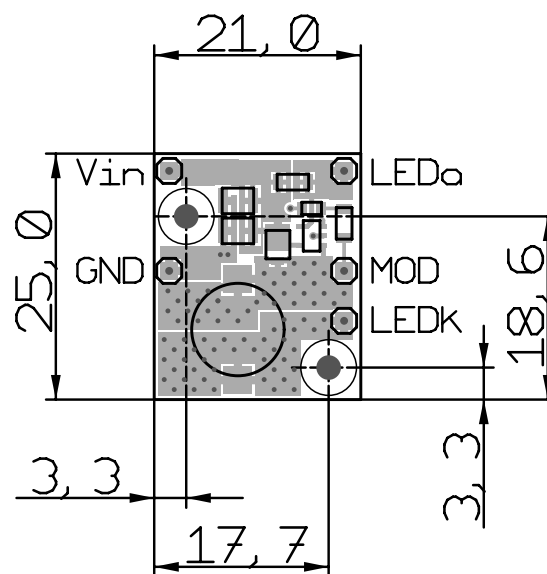
1.2 Custom variants

Custom output current versions are available on request. Minimum order quantities may apply.

2. Functional overview

LED-Warrior01 is a point-of-load regulator for LED lighting applications. By providing a highly efficient constant current regulation off a DC source LED-Warrior01 is perfectly suited for applications that require low DC levels for safety reasons, driving multiple LED groups in one luminaire, mobile or in-vehicle lighting, and to retrofit existing low voltage halogen installations.

3. Mechanical dimensions and connections



Height at thickest point: 7mm

Mounting holes are 2.5mm in diameter.

Solder pad holes are 0.9mm in diameter.

Tolerances:

Hole diameters: $-0.05 / +0.1$ mm

Hole positions: ± 0.05 mm

Outer contour: ± 0.2 mm

When mounting the module make sure to use insulating washers or use screw heads that are small enough to avoid contact to the surrounding PCB traces and components. When mounting on a conductive surface make sure to add spacers or an insulating layer under the module to avoid short circuits

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3.1 Pin Descriptions

Vin

Supply voltage positive input. Apply a DC voltage of 7V to 30V here.

GND

Supply voltage negative input and ground reference for MOD input.

LEDa

Positive output for LED, connect the anode of the first LED of the string to this pin.

LEDk

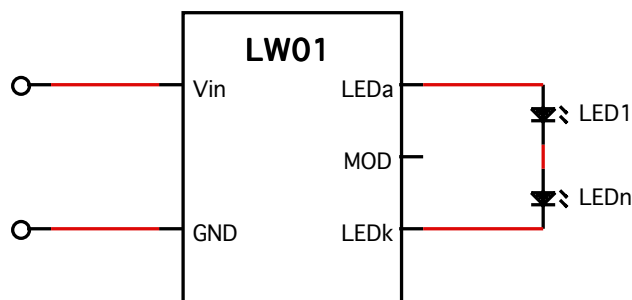
Negative output for LED, connect the cathode of the last LED of the string to this pin. This pin is not identical to GND!

MOD

Modulation and dimming input. Can be used for analog or PWM dimming (see section 5 for detailed description). Pulling this pin low disables the LED output and puts the LED-Warrior01 into a standby mode. This pin can be left unconnected if no brightness control is required.

4. Connecting the LEDs

The maximum number of LEDs that can be driven by LED-Warrior01 depends on the supply voltage and the combined forward voltage of the LEDs. Input voltage needs to be about 2V higher than the total forward voltage of the LED string for proper operation.



4.1 Reducing output ripple

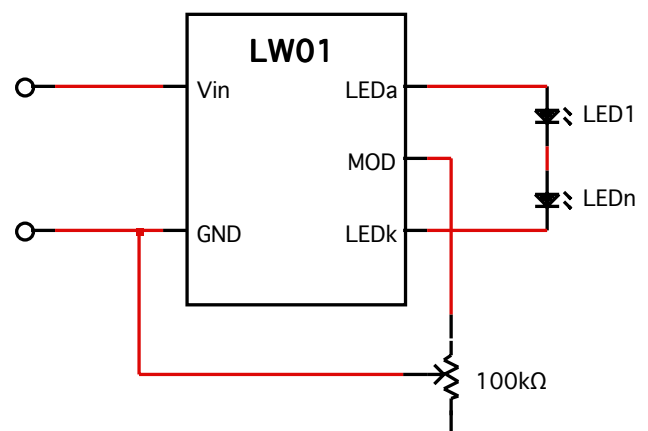
To reduce output ripple and possibly prevent EMC problem when the LEDs are mounted not immediately adjacent to the regulator a capacitor may be put parallel to the LEDs, preferable connected direct between LEDa and LEDk of the LED-Warrior01.

5. Brightness control

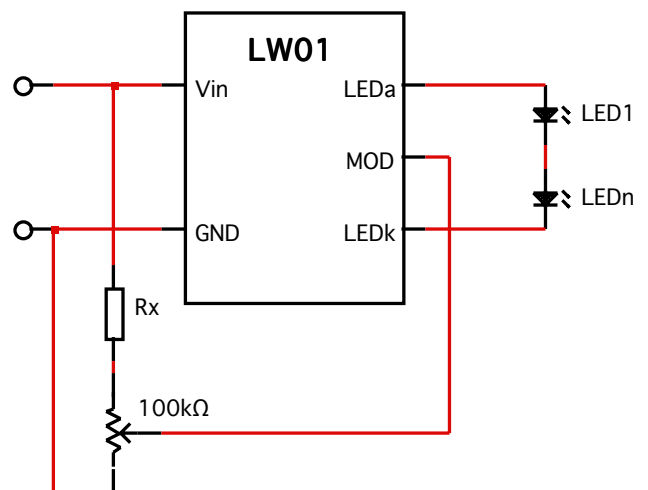
The MOD input allows analog or PWM brightness control of the LEDs.

By applying a 0.3V-2.5V level to the MOD input the output current can be controlled between 25% to 200% of the nominal value. Though driving the current over 100% is to be used very cautiously as this can exceed the maximum current for the regulator.

For simple dimming a 100kΩ potentiometer connecting between MOD and GND is recommended:



Setting the output current to values above the 100% setting requires either a 2.5V voltage reference or a voltage divider in the correct relation to your supply voltage:

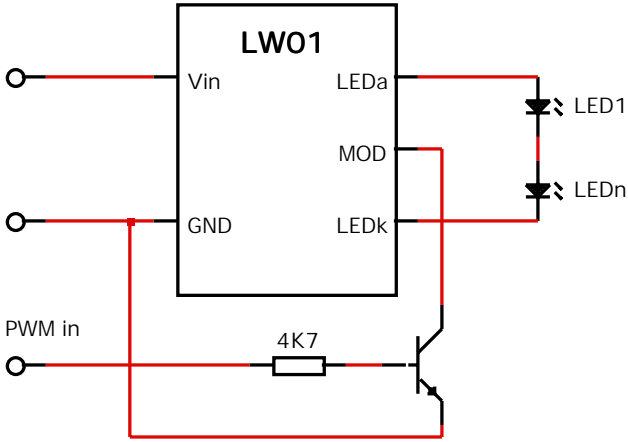


$$R_x = (V_{in}/2.5) * 100,000$$

Dimming from 1% to 100% brightness is possible with an open collector or open drain PWM signal up to 1kHz connected to MOD.

Example circuit for reducing output current by PWM:

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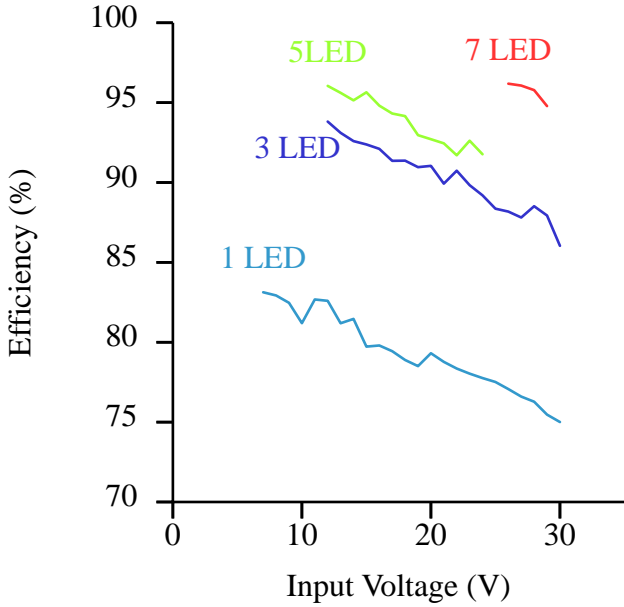


PWM frequencies significantly higher than 1kHz will be turned into analog dimming signals by the input low pass filter of LED-Warrior01.

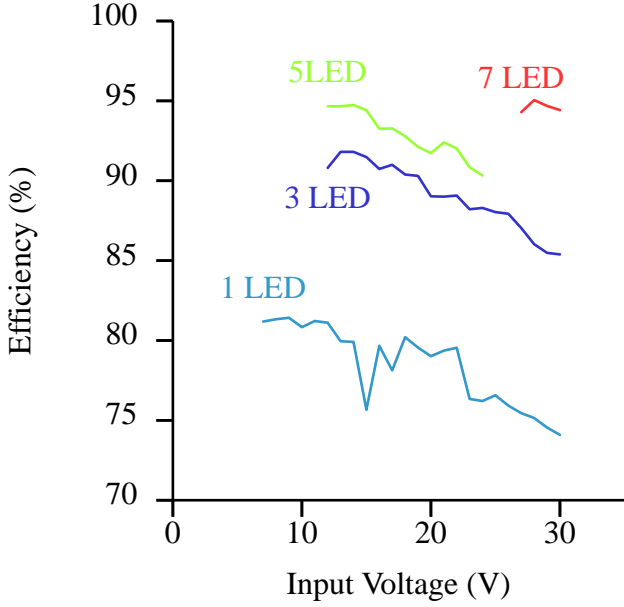
6. Regulator efficiency

The regulator efficiency depends on a number of parameters. Since there are a couple constant losses independent of the total power delivered by the regulator the basic rule is that the regulator is more efficient when used at higher power (i.e. more LEDs connected). A lower difference between input and output voltage does also increase the efficiency.

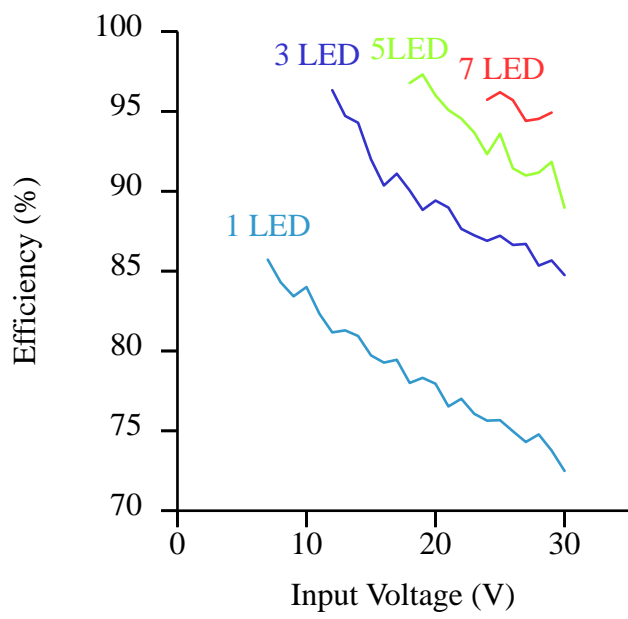
Efficiency LW01-700



Efficiency LW01-1000



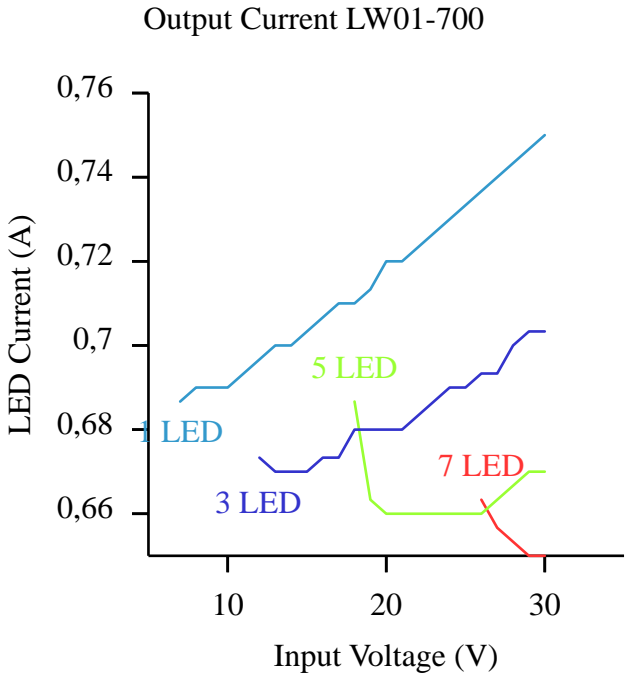
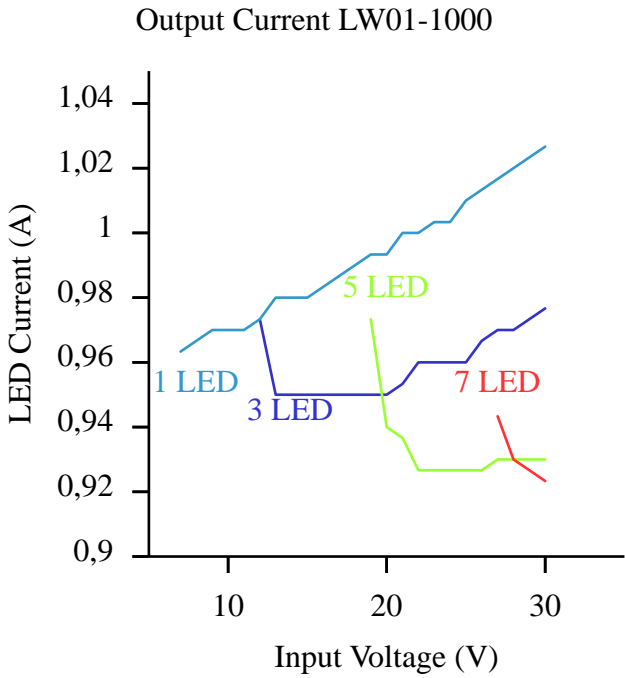
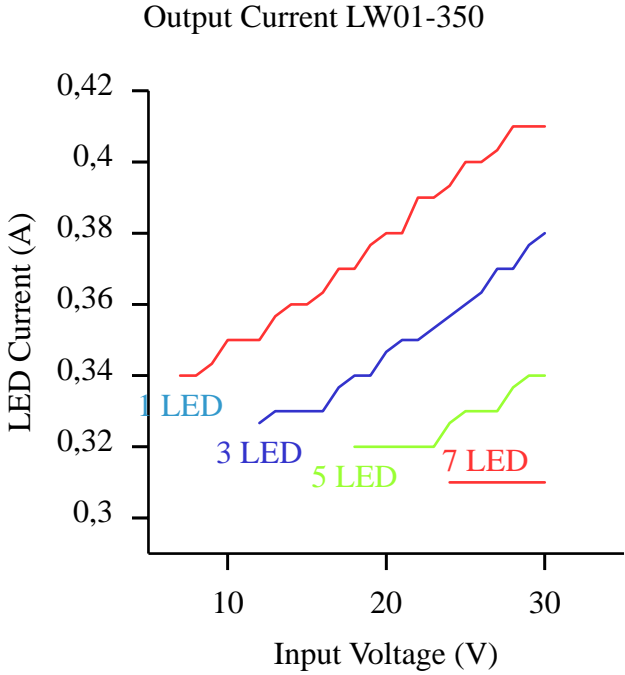
Efficiency LW01-350



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6.1 Output current

The output current varies somewhat depending on the forward voltage of LEDs and the input voltage. If a more precise output current is required it can be set by using the MOD input.



6.2 Reliability

The reliability data is based on data provided by component manufacturers:

Failure Rate (FIT): $55 * 10^{-9}h^{-1}$

Mean Time to Failure (MTTF): $1,8 * 10^7h$

7. FCC / CE

The LED-Warrior01 is sold as a module to be integrated into a device. As such it can not be FCC or CE approved.

Code Mercenaries has exerted greatest care in designing this module to minimize RF emission and assure safe and stable operation. Though the use of proper cable materials and correct integration into a device is crucial to assure product safety and interference free operation.

The integrator who assembles the module into a device has to take care for appropriate construction and testing.

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8. Absolute maximum ratings

Input Voltage (V_{in} relative to GND):	-0.3V to +30V (40V for 0.5sec)
MOD pin input voltage (relative to GND):	-0.3V to +6V
Input Current:	1.25A

Operating temperature:

LW01-350:	-30°C to +85°C in still air
LW01-700:	-30°C to +85°C in still air
LW01-1000:	-30°C to +65°C in still air

Absolute maximum ratings must not be exceeded or permanent damage to the LED-Warrior01 may result.

8.1 Thermal precautions

When operating at elevated ambient temperature, vertical mounting in an air volume sufficiently large to allow convection is recommended to reduce surface temperature of the regulator. Additional cooling measures can help to further reduce the regulator temperature and increase long term reliability.

No part of the module surface may exceed 125°C during operation at any time.

8.2 Electrical Characteristics

Input Voltage (V_{in}):	7V to 30V
Standby current (MOD grounded):	20 μ A to 40 μ A
Output current (tested parameter):	
LW01-350:	348mA \pm 20%
LW01-700:	699mA \pm 10%
LW01-1000:	1000mA \pm 10%

8.3 Failure modes

The most common failure mode seen when the regulator is destroyed due to overtemperature or overcurrent is a short circuit between V_{in} and GND.

Overvoltage typically also leads to a short circuit between V_{in} and GND, additionally the LEDs can be exposed to overvoltage in this case.

8.4 Recommended safety measures

An appropriate fuse or other current limiting measure in the power supply is required to prevent fire hazards in case of malfunctions.

Materials with low flash points must be kept away from the regulator. The surface temperature of parts of the regulator may reach up to 125°C surface temperature when used at elevated ambient temperatures and maximum power.

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9. Ordering information

Partname	Description	Color code	Description
LED-Warrior01-350	LW01-350	Orange	HB LED supply module for 350mA
LED-Warrior01-700	LW01-700	Violet	HB LED supply module for 700mA
LED-Warrior01-1000	LW01-1000	Brown	HB LED supply module for 1000mA

The modules listed here are standard products. Customized modules are available on request.

9.1 Packaging info

The modules are packaged in boxes of 30 units each.

9.2 Identifying current values

LED-Warrior01 modules are marked with a color dot to identify the current value of the module. The color dot also serves to identify that the module has been tested and is OK.

The color dot can be found on the coil of the module. Color codings are in the ordering information table.

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