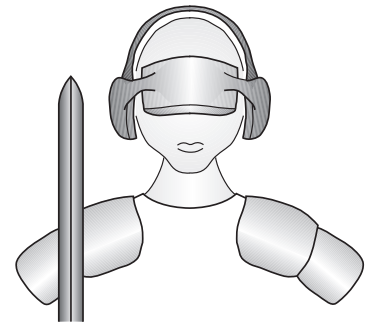# LED-Warrior10

PWM Dimmer Controller

Code Mercenaries

1. Features
- PWM Dimmer Controller
- 730 Hz for flicker free operation
- Potentiometer input
- Dual button and single button dimming
- Programmable power-on value
- Programmable minimum value
- Logarithmic dimming
- Minimal external circuitry
- 5 V supply (chip)
- 5.5 V to 40 V supply (module)
- Max. 4 A PWM output (module)

1.1 Variants
LED-Warrior10 is available in DIL8, SOIC8 packages, and as a module.

1.2 LW10-01MOD
The LW10-01MOD is a ready to use module that provides a PWM signal to control a LED driver and a power output to directly supply constant voltage LEDs.

1.3 Custom variants
Custom variants are possible for the chips as well as for the modules.

2. Functional overview
LED-Warrior10 is a dimmer controller for LED applications. It generates a PWM signal to either control a LED driver or to directly supply constant voltage LED modules.
The LED brightness can be controlled either by a potentiometer, two buttons, or a single button. A power-on value may be set if the LED should always switch on to a certain brightness level when power is applied.

3. Pin Descriptions (Chip SOIC-8 or DIL-8)

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/PWM   □ 1      8 □  Vcc
Pot_In □ 2      7 □  Dim
Down   □ 3      6 □  PWM
GND    □ 4      5 □  Up
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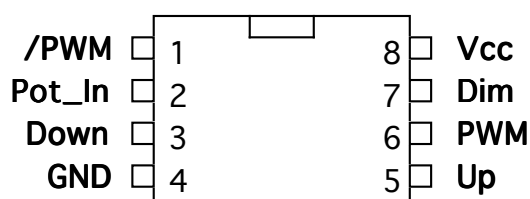
Vcc
5 V supply voltage positive input.

GND
Supply voltage negative input.

PWM
730 Hz PWM signal output, positive logic, high = LED power on.
Duty cycle 0.1% to 100%, constant low for off, constant high for maximum.
CMOS level output.

/PWM
Inverted PWM signal, negative logic, high = LED power off.
Duty cycle 0.1% to 100%, constant high for off, constant low for maximum.
CMOS level output.

Dim
Input for single button dimming. Connect a switch closing to GND.
Internal pull up resistor.

Up
Input for dual button dimming to increase brightness. Connect a switch closing to GND.
Internal pull up resistor.

Down
Input for dual button dimming to decrease brightness. Connect a switch closing to GND.
Internal pull up resistor.

Pot_In
Input for center tap of a potentiometer. Connect the two ends of the potentiometer to GND and Vcc. LED-Power will be switched off when the center tap is close to GND and go to full 100% when close to Vcc. Tying the input to GND will disable the brightness control via the potentiometer and allow button inputs to take over.
Potentiometers should be linear and in the range of 1 kΩ to 200 kΩ. Small potentiometer values generate higher standby current.

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3.1 Mechanical dimensions (LW10-01MOD)
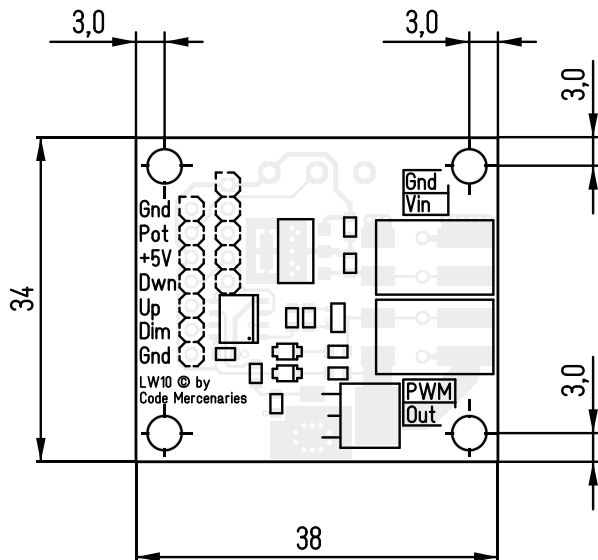
Dimensions in mm
Height at thickest point: < 6.5 mm
Tolerances:
Outer contour: ±0.2mm

3.2 Pin Descriptions (LW10-01MOD)

Dim
Input for single button dimming. Connect a switch closing to GND.
(Pot must be connected to Gnd for button operation.)
Internal pull up resistor.

Up
Input for dual button dimming to increase brightness. Connect a switch closing to GND.
(Pot must be connected to Gnd for button operation.)
Internal pull up resistor.

Dwn
Input for dual button dimming to decrease brightness. Connect a switch closing to GND.
(Pot must be connected to Gnd for button operation.)
Internal pull up resistor.

PWM
Positive logic PWM output to control a LED driver, high = lamp on
Open collector output with 4k7 pull up to +5V.

Out
PWM power output. Provides a chopped low side signal to directly drive constant voltage LED assemblies. Connect the kathode end of the LEDs here and the anode to the positive power supply.
May be used as an inverted PWM output to control a LED driver.
Up to 4 A
Open drain output with 4k7 pull up to +5V.

Pot
Input for center tap of a potentiometer. Connect the two ends of the potentiometer to GND and Vcc. LED-Power will be switched off when the center tap is close to GND and go to full 100% when close to Vcc. Tying the input to GND will disable the brightness control via the potentiometer and allow button inputs to take over.

Vcc
+5V regulated power for the potentiometer.

Vin
Positive supply voltage 5.5 to 40 V.

GND
Ground supply voltage.

4. Dimming by Potentiometer
The position of the potentiometer directly controls the LED brightness. 0% is selected when the potentiometer is close to GND and 100% when it is close to Vcc.
To ensure reliable operation there are dead zones at either end of the potentiometer range. Any value within ~10% of GND is considered full off. Values closer to Vcc than about 90% are considered 100% on. Any value within 5% of GND disables the potentiometer control to enable button control.
If the potentiometer input is not used it must be connected to GND to allow the button dimming function to take over. A potentiometer with 5 mm pin spacing can be soldered into the module.

4.1 Dimming by single button
Single button dimming does toggle between off and last on level if pressed briefly. Holding down the switch when the lamp is off will result in up dimming, if the lamp is on dimming will go down. Pressing the button again when the lamp is on will dim in the opposite direction as last time.
Dimming will stop at either maximum or minimum level.

4.2 Dimming by dual button

Two switch up/down dimming sets the output to last on level on a short press on Up and off on a short press on Down. Holding Up results in dimming up and holding Down dims down.

4.3 Setting power on value

The current lamp power value may be stored as the power-on value. The next time power is applied LW10 will directly go to the stored power value. To set the power-on value dim to the desired brightness, then press and hold any of the buttons until a double flash of the lamp signals that the new value has been stored. Storing the brightness value is triggered if the button remains pressed for about 5 seconds after the minimum or maximum value has been reached.

The brightness value that was active before the button was pressed and held down will be stored. When the button is released after the double flash the brightness will be returned to the new stored value.

4.4 Setting minimum value

Some LED setups will not produce light at the lower dimming levels of LW10. Especially when dimming replacement LED lamps this effect can cause a bad user experience.

A minimum level can be set to which the LED will go when the Up or Dim button is pressed while the LED is off. It will also be the lower limit for dimming down when the LED is on.

Setting the minimum value works similar to setting the power on value. Dim to the intended minimum value. Then press and hold any of the buttons. A double flash will indicate that LW10 has stored the value as the power on value. Do not release the button, keep holding it until a second double flash happens.

Now LW10 has restored the power on value to its former value and set the min value to the dimming value that was active before the button was pressed.

To reset the min value switch the LED off by a short press on Dim or Down. Then press and hold any button until the second double flash. This restores 0.1% as the minimum dimming value.

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5. Absolute maximum ratings (Chip)
Supply voltage (Vcc relative to GND): .... -0.5V to +6V
Input voltage into any pin (relative to GND): .... GND - 0.5V to Vcc + 0.5V
Input current into any pin: .... -25mA to +50mA
Storage temperature: .... -55°C to +100°C
ESD: .... 2000V human body model

Absolute maximum ratings must not be exceeded or permanent damage to the LED-Warrior10 may result.

5.1 Operating specifications (Chip)
Supply voltage (Vcc relative to GND): .... 4.5V to 5.25V
Operating temperature: .... -40°C to +85°C
Supply current: .... max. 12 mA
Sleep current (10 sec after LED off): .... typ. 400 μA
Internal pull up resistors: .... min. 4kΩ max. 8kΩ typ. 5.6kΩ
Input low voltage: .... max. 0.8V
Input high voltage: .... min. 2.1V

5.2 Absolute maximum ratings (Modules)
Supply Voltage (Vin relative to GND): .... 0V to +45V
Input current (supply voltage): .... max. 50mA
Storage temperature: .... -55°C to +100°C
ESD: .... 2000V human body model
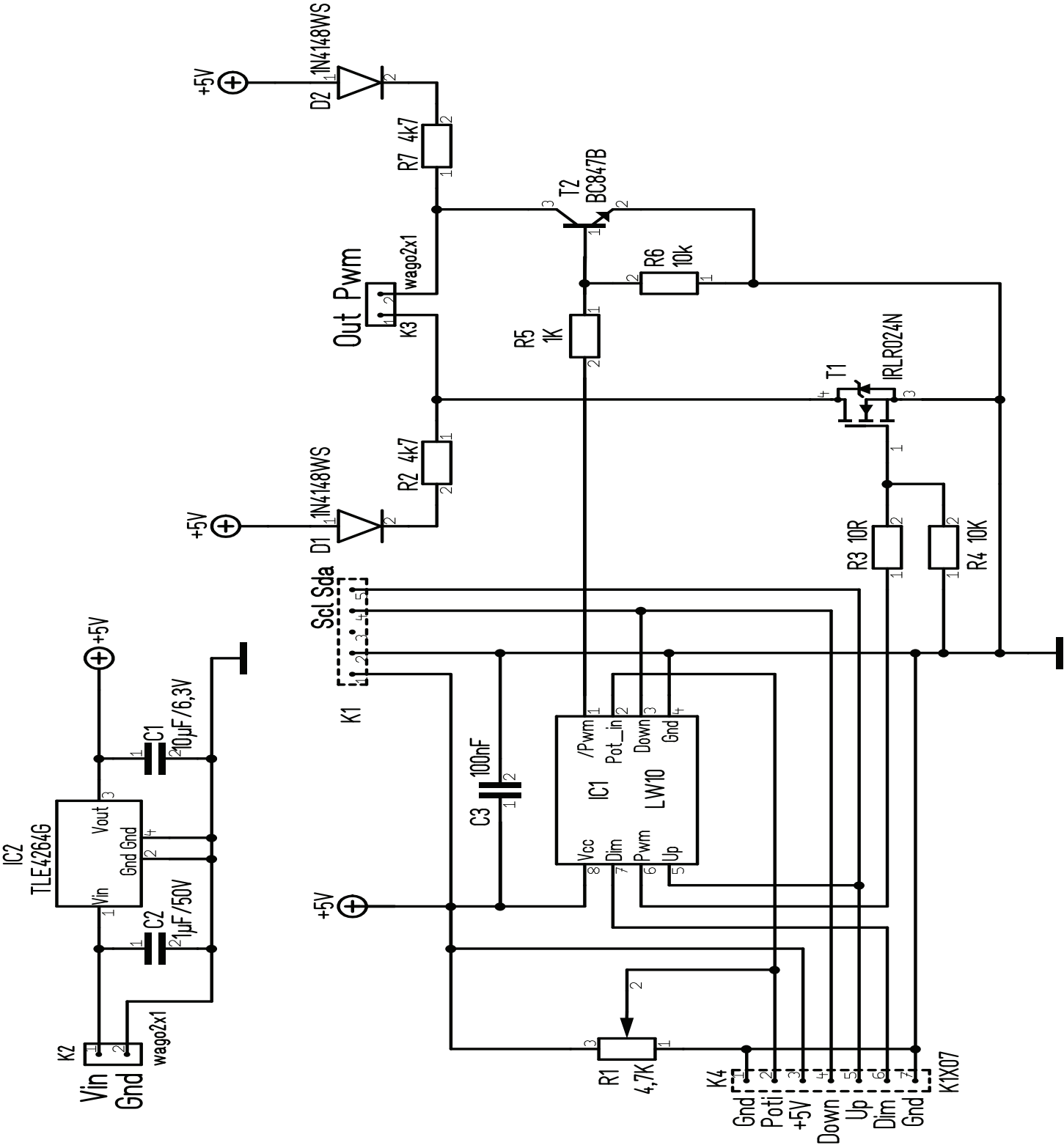
Absolute maximum ratings must not be exceeded or permanent damage to the LED-Warrior10 may result.

5.3 Operating specifications (LW10-01MOD)
Supply Voltage (Vin relative to GND): .... 5.5V to +40V
Operating temperature: .... -40°C to +85°C
Supply current: .... max. 25mA
Sleep current (10 sec after LED off): .... typ. 6 mA
Out low sink current: .... max. 4 A
PWM low sink current: .... max. 25mA
PWM, Out high pull up resistance to 5V: 4k7Ω

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6. Application circuit

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7. Package dimensions DIL 8

DIMENSIONS IN INCHES   MIN.
                       MAX.

0.380 / 0.390
PIN 1 ID
0.240 / 0.260
0.100 BSC.
0.180 MAX.
0.115 / 0.145
SEATING PLANE
0.125 / 0.140
0.015 MIN.
0.055 / 0.070
0.014 / 0.022
0.300 / 0.325
0.008 / 0.015
0°–10°
0.430 MAX.

51-85075 *C
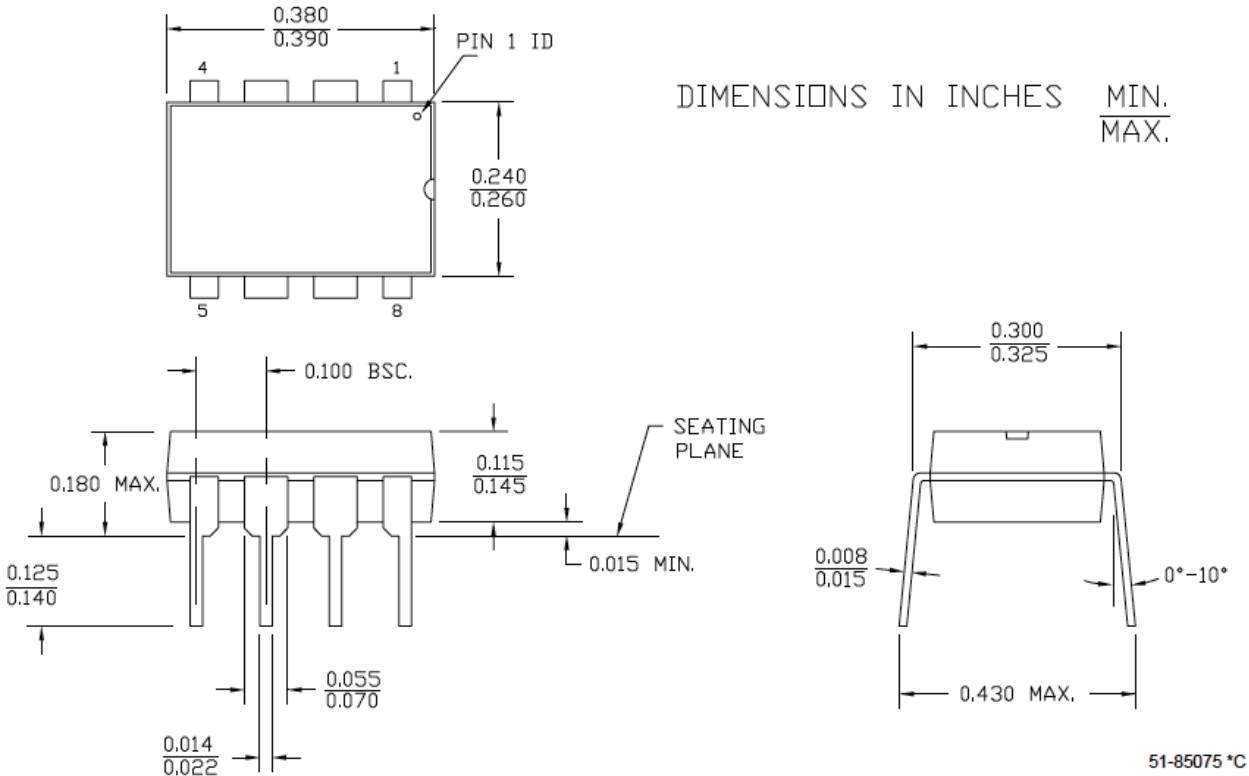
7.1 Package dimensions SOIC8

PIN 1 ID
0.150[3.810] / 0.157[3.987]
0.230[5.842] / 0.244[6.197]

1. DIMENSIONS IN INCHES[MM] MIN. MAX.
2. PIN 1 ID IS OPTIONAL, ROUND ON SINGLE LEADFRAME RECTANGULAR ON MATRIX LEADFRAME
3. REFERENCE JEDEC MS-012
4. PACKAGE WEIGHT 0.07gms

PART #	
S08.15	STANDARD PKG.
SZ08.15	LEAD FREE PKG.

0.189[4.800] / 0.196[4.978]
0.061[1.549] / 0.068[1.727]
SEATING PLANE
0.050[1.270] BSC
0.004[0.102] / 0.0098[0.249]
0.004[0.102]
0.0138[0.350] / 0.0192[0.487]
0°–8°
0.010[0.254] / 0.016[0.406] X 45°
0.016[0.406] / 0.035[0.889]
0.0075[0.190] / 0.0098[0.249]

51-85066 *E

LED-Warrior10

Code Mercenaries

8. Ordering information

Partname	Order Code	Package	MOQ	Description
LED-Warrior10-S	LW10-S	SOIC-8	97	PWM dimmer controller chip
LED-Warrior10-P	LW10-P	DIL 8	1	PWM dimmer controller chip
LED-Warrior10-01MOD	LW10-01MOD	Module	1	PWM dimmer controller module

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

8.1 Packaging info
SOIC-8 chips are packaged in tubes of 97 units each. The SOIC-8 chips are not individually marked and are sold only in full tubes.

DIL-8 chips are packaged in tubes with 53 chips each.

The modules are packaged bulk in anti static bags.

8.2 Shipping version
LED-Warrior10 is currently shipping in the inital release version V1.0.0.2

8.3 FCC / CE
The LED-Warrior10 is sold as a chip or module to be integrated into a device. As such it can not be FCC or CE approved.
Code Mercenaries has excerted greatest care in designing this chip and 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.

Code Mercenaries
Hard- und Software GmbH
Karl-Marx-Str. 147a
12529 Schönefeld
Germany
Tel: +49-3379-20509-20
Fax: +49-3379-20509-30
Mail: support@codemercs.com
Web: www.codemercs.com

HRB 9868 CB
Geschäftsführer: Guido Körber, Christian Lucht