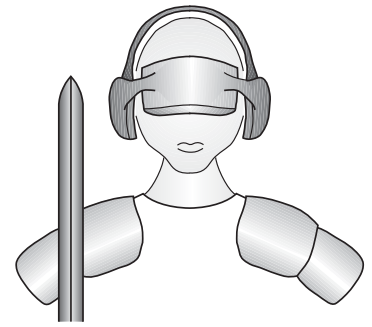


# LED-Warrior12



Code Mercenaries

**DALI slave, one to four channels**  
**PWM and I2C output**

## 1. Features

- DALI to PWM and I2C controller
- Pin selectable 1 to 4 channels
- Access to raw arc power values via I2C
- Access to mapped brightness values via I2C
- According to DIN EN 62386-101/-102/-207
- All protocol elements implemented
- Minimal external circuitry
- 4 PWM outputs at 730 Hz
- PWM ranging from 0.1% to 100%
- Logarithmic and linear dimming curves
- DALI configuration can be read/written via I2C
- 5 V supply (chip)

### 1.1 Variants

LED-Warrior12 is available in SSOP28 packages.

### 1.2 Custom variants

Custom variants are possible.

## 2. Functional overview

LED-Warrior12 is a multichannel DALI slave device identifying as LED luminaires (type 6). It shows up on the DALI bus as 1 to 4 DALI devices. The number of active channels is selected at power up by setting two pins.

The arc power values are translated into 730 Hz PWM signals that can be used to control LED power supplies. Alternatively the arc power values or 16 bit brightness values may be read out via I2C to be used by an external controller.

I2C allows to read and write the complete configuration data for all four DALI channels. This can be used to factory program luminaires to a certain DALI mode.

The complete DALI command set is implemented in LED-Warrior12.

## 3. Pin Descriptions

/PWM3	□ 1	28	□ Vcc
/PWM2	□ 2	27	□ PWM3
/PWM1	□ 3	26	□ PWM2
/PWM0	□ 4	25	□ PWM1
NC	□ 5	24	□ PWM0
NC	□ 6	23	□ NC
A1	□ 7	22	□ /Select
Chan1	□ 8	21	□ A0
NC	□ 9	20	□ Chan0
SCL	□ 10	19	□ Test3
SDA	□ 11	18	□ NC
NC	□ 12	17	□ DALItx
Test1	□ 13	16	□ DALIrx
GND	□ 14	15	□ Test2

### Vcc

5 V supply voltage positive input.

### GND

Supply voltage negative input.

### /Select

Input for physical selection. A switch closing to ground may be connected here to perform the physical selection in DALI addressing.

Input with internal pull up resistor.

### PWM0, PWM1, PWM2, PWM3

730 Hz PWM signal outputs. Positive logic.

high = power on to lamps.

Duty cycle 0.1% to 100%, constant low for off, constant high for maximum.

CMOS level output.

### /PWM0, /PWM1, /PWM2, /PWM3

Inverted PWM signals. Negative logic.

high = power off on lamps.

Duty cycle 0.1% to 100%, constant high for off, constant low for maximum.

CMOS level output.

# LED-Warrior12

## DALIr<sub>x</sub>

Receive data input from DALI bus. Connect a DALI bus receiver to this pin.

Positive logic, high = high level on bus.

High impedance input.

## DALIt<sub>x</sub>

Transmit data output to DALI bus. Connect a DALI bus driver to this pin.

Positive logic, high = high level on bus.

Open drain output with internal pull up resistor for high.

## SDA, SCL

I2C slave interface. Connect to I2C bus.

Open drain output, high impedance input.

## A0, A1

Lower address bits for I2C. The status of these two pins replaces the lower two bits of the I2C address. This allows to directly assign LED-Warrior12 to four different I2C addresses by hardware.

Inputs, internal pull up.

## Chan0, Chan1

Select pins for number of DALI channels. The value on these pins plus one is the number of DALI channels that will be active:

00 = channel 0 only

01 = channel 0 and 1

10 = channel 0, 1, and 2

11 = all 4 channels

Leave both pins open for 4 channel operation.

Inputs, internal pull up.

## NC

Unused pins, do not connect. May be used in future version of the chip.

## Test1, Test2

Used during production of the chip, do not connect.

## 4. I2C Addressing

The I2C address of LED-Warrior12 is defined by the upper five bits of the base address plus the value of the A0, A1 pins for the lowest two bits. The factory default I2C address is \$20 (7 bit value, will be shifted and extended by R/W bit and combined with the address pins: 0100 0A<sub>1</sub>A<sub>0</sub>R).

Depending on the status of the A0, A1 pins the LED-Warrior12 will respond to the addresses \$20, \$21, \$22, or \$23. Reassigning a different base address is possible via I2C commands.

## 4.1 I2C Commands

Commands are implemented via register addresses that are transmitted as the first byte following the I2C address byte. Reading from registers is done by first doing a write transaction transmitting the I2C address and the register number, then a restart and a read transaction.

Register	R/W	Function	Data
\$00	R	Status	1 Byte
\$04	R	Raw Data	4 Bytes
\$05	R	Lin/log	4 Bytes
\$08	R	PWM Values	8 Bytes
\$10	R/W	DALI Config	136 Bytes
\$F0	R	Signature	6 Bytes
\$FE	W	Set Addr	2 Bytes

## 4.2 Status register

The status register reports the number of active DALI channels:

7 - not used

6 - not used

5 - not used

4 - not used

3 - not used

2 - not used

1 - Chan1

0 - Chan0

## 4.3 Raw Data

The Raw Data register reports the "actual level" values. Fading is handled by the LED-Warrior12. A driver only needs to follow the values reported by LED-Warrior12 to provide the fading functions of DALI.

One byte for each channel represents the output power:

0 = off

254 = maximum output

255 = don't care, should never be reported

Mapping these values to a linear or logarithmic curve as indicated by the Lin/Log register is required.

## 4.4 Lin/Log

Contains the linear / logarithmic dimming flags as set by the Select Dimming Curve DALI command. One byte for each channel, 0 = log, 1 = linear.

# LED-Warrior12

## 4.5 PWM Values

The LED Values register provides 16 bit power values for each channel. Linear and logarithmic mapping is already included in this data depending on the mode set via DALI:

0 = off

65535 = maximum output

## 4.6 DALI Config

This register allows to read and write the complete DALI configuration data in one block. The data block covers DALI memory bank 1 (16 bytes) and the 30 bytes of persistent data for each of the four channels.

By reading and writing the data block it is possible to factory set LW12 to a certain DALI configuration to simplify installation in the field.

## 4.7 Signature register

The signature register can be used to identify LED-Warrior12 and get the revision information for the chips firmware. The content of the signature is fixed and can not be changed. It contains 6 bytes with the following content:

0 - Vendor MSB

1 - Vendor LSB

2 - Product MSB

3 - Product LSB

4 - Version MSB

5 - Version LSB

The 16 bit VendorID allows us to differentiate standard and custom chips. Standard chips use 0 as our ID.

Product is a 16 bit product code, LED-Warrior12 has 12 as its product code value.

Version is the four digit BCD version number identifying the chips firmware version. I.e. V1.0.3.5 would be stored as \$1035.

## 4.8 SetAddress register

With the SetAddress register it is possible to move LW12 to a different I2C address.

To prevent address reprogramming by mistake the address has to be send in normal and inverted format to register \$FE. The address is transmitted in 7 bit right aligned format (i.e. values range from 1 to 127), 0.

Values of 128 and more are not accepted.

## 5. Implemented DALI commands

LW12 implements all IEC62386-102:2009 commands.

It also implements the relevant commands for type 6 control gear according to IEC62386-207:2009.

## Command 149: Query Reset State

Returns the information if any settings have been changed since the last reset command. It does not verify if the settings have individually been set to their factory default values (as suggested by the test sequences in the standard).

Since LED-Warrior12 can not measure the lamp current, power, or temperature the following commands have no effect:

Command 224: Reference System Power

Command 225: Enable Current Protector

Command 226: Disable Current Protector

Since the corresponding functions are not implemented the following commands always return a negative answer:

Command 241: Query Failure Status

Command 242: Query Short Circuit

Command 243: Query Open Circuit

Command 244: Query Load Decrease

Command 245: Query Load Increase

Command 246: Query Current Protector Active

Command 247: Query Thermal Shut Down

Command 248: Query Thermal Overload

Command 249: Query Reference Running

Command 250: Query Ref Measurement Fail

Command 251: Query Current Protector Enabled

## Command 237: Query Gear Type

Returns DC supply possible, all other flags negative (=0)

## Command 239: Query Possible Operating Modes

Returns PWM possible, all other flags negative (=0) since the actual implementation of the driver stage is unknown to the LW12.

## Command 240: Query Features

Returns zero flags for all features, except physical selection, which is supported via the /Select input.

## 5.1 DALI memory banks

LED-Warrior12 implements DALI memory banks 0 and 1. Both banks use the default length with no vendor or OEM specific additional information.

Bank 1 can be written by the OEM as defined by the DALI standard.

There is only a single copy of memory bank 1 for all four channels.

# LED-Warrior1 2

---

## 6. Absolute maximum ratings

Supply voltage (V <sub>cc</sub> relative to GND):	-0.5V to +6V
Input voltage into any pin (relative to GND):	GND - 0.5V to V <sub>cc</sub> + 0.5V
Input current into any pin:	-25 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-Warrior12 may result.

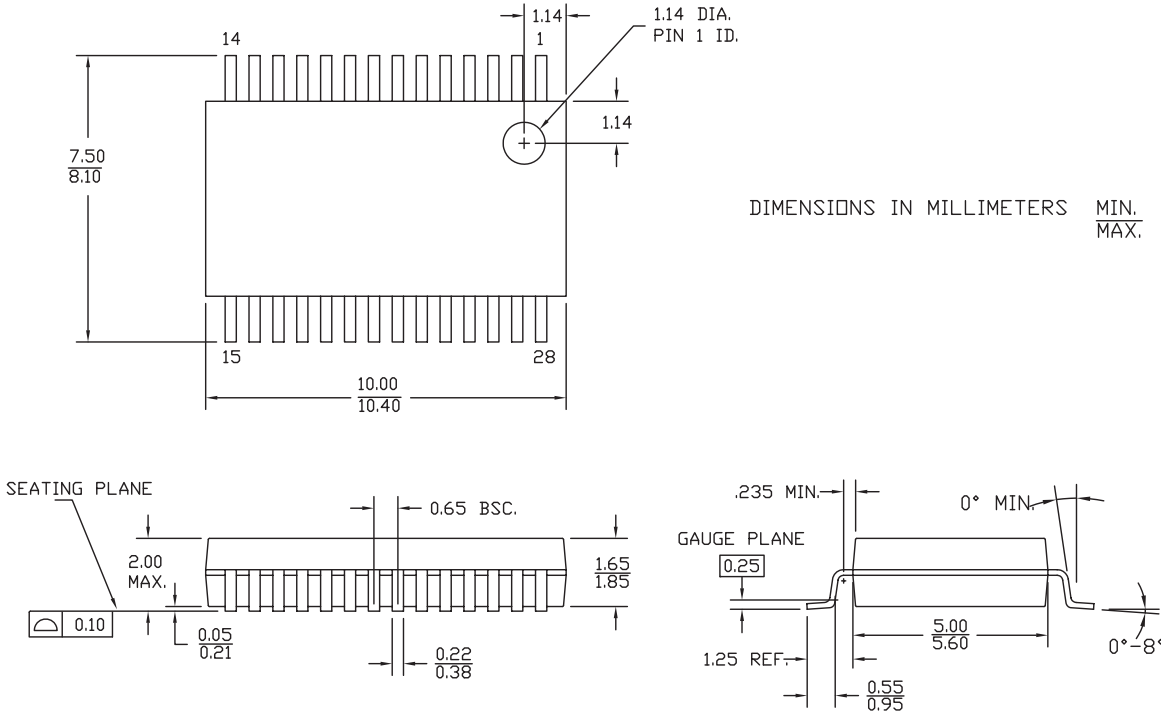
## 6.1 Operating specifications

Supply voltage (V <sub>cc</sub> relative to GND):	4.5V to 5.25V
Operating temperature:	-40°C to +85°C
Supply current:	40mA max.
Internal pull up resistors:	min. 4kΩ max. 8kΩ typ. 5.6kΩ
Input low voltage:	max. 0.8V
Input high voltage:	min. 2.1V
PWM, /PWM low maximum sink current:	min. 25mA
PWM, /PWM high maximum source current:	min. 10mA



# LED-Warrior1 2

## 8. Package dimensions SSOP28



# LED-Warrior12

## 9. Ordering information

Partname	Order Code	Package	MOQ	Description
LED-Warrior12-S	LW12-S	SSOP28	47	Single chip DALI to PWM and I2C controller

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

### 9.1 Packaging info

SSOP28 chips are packaged in tubes of 47 units each. The SSOP28 chips are not individually marked and are sold only in full tubes.

The modules are packaged in single units.

### 9.2 Shipping version

V1.0.0.4 is the current shipping version.

#### 9.2.1 Version Info

V1.0.0.4 - Bugfix - Reset Command did clear the short address.

Signature register added to I2C to simplify identification of the LW12.

V1.0.0.1 - V1.0.0.3 were not generally released.

V1.0.0.0 - Initial shipping version.

### 9.3 FCC / CE

The LED-Warrior12 is sold as a chip 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 chip 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.

### Legal Stuff

This document is ©1999-2018 by Code Mercenaries.

The information contained herein is subject to change without notice. Code Mercenaries makes no claims as to the completeness or correctness of the information contained in this document.

Code Mercenaries assumes no responsibility for the use of any circuitry other than circuitry embodied in a Code Mercenaries product. Nor does it convey or imply any license under patent or other rights.

Code Mercenaries products may not be used in any medical apparatus or other technical products that are critical for the functioning of lifesaving or supporting systems. We define these systems as such that in the case of failure may lead to the death or injury of a person. Incorporation in such a system requires the explicit written permission of the president of Code Mercenaries.

Trademarks used in this document are properties of their respective owners.

DALI is a registered trademark of DIIA.

Code Mercenaries

Hard- und Software GmbH

Karl-Marx-Str. 147a

12529 Schönefeld

Germany

Tel: +49-3379-20509-20

Mail: support@codemerces.com

Web: www.codemerces.com

HRB 9868 CB

Geschäftsführer: Guido Körber, Christian Lucht