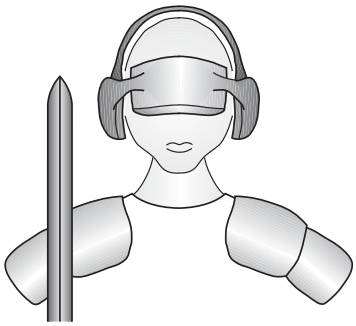
LED-Warrior12

IEC62386 slave, one to four channels PWM and I2C output



Code Mercenaries

1. Features

- IEC62386 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
- IEC62386 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

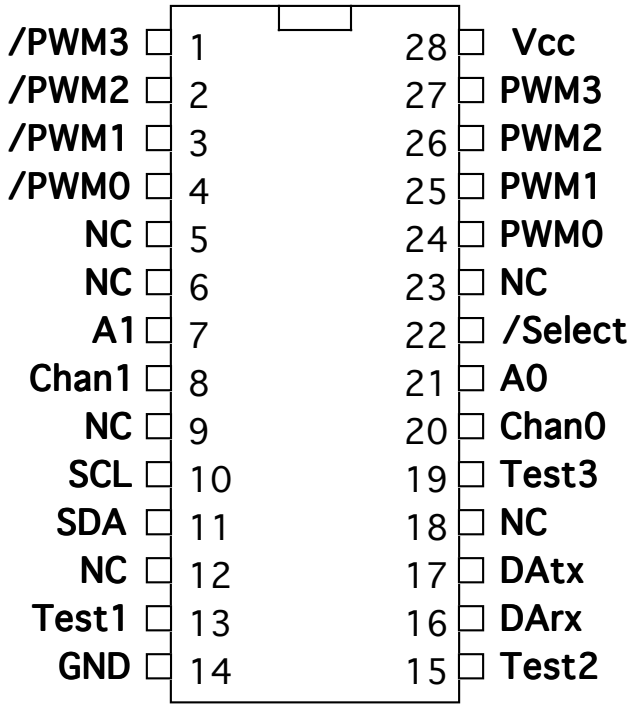
LED-Warrior12 is a multichannel IEC62386 slave device identifying as LED luminaires (type 6). It shows up on the IEC62386 bus as 1 to 4 IEC62386 devices. The number of active channels is selected at power up by setting two pins.

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 IEC62386 channels. This can be used to factory program luminaires to a certain IEC62386 mode.

The complete IEC62386 command set is implemented in LED-Warrior12.

3. Pin Descriptions



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 IEC62386 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.

DArx
Receive data input from IEC62386 bus. Connect a IEC62386 bus receiver to this pin.
Positive logic, high = high level on bus.
High impedance input.

DAtx
Transmit data output to IEC62386 bus. Connect a IEC62386 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 IEC62386 channels. The value on these pins plus one is the number of IEC62386 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_1A_0R).
Depending on the status of the A0, A1 pins the LED-Warrior12 will respond to the adresses $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	IEC62386 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 IEC62386 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 IEC62386.
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 IEC62386 command. One byte for each channel, 0 = log, 1 = linear.

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 IEC62386:
0 = off
65535 = maximum output

4.6 IEC62386 Config
This register allows to read and write the complete IEC62386 configuration data in one block. The data block covers IEC62386 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 IEC62386 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 IEC62386 **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 IEC62386 **memory banks**
LED-Warrior12 implements IEC62386 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 IEC62386 standard.
There is only a single copy of memory bank 1 for all four channels.

6. Absolute maximum ratings

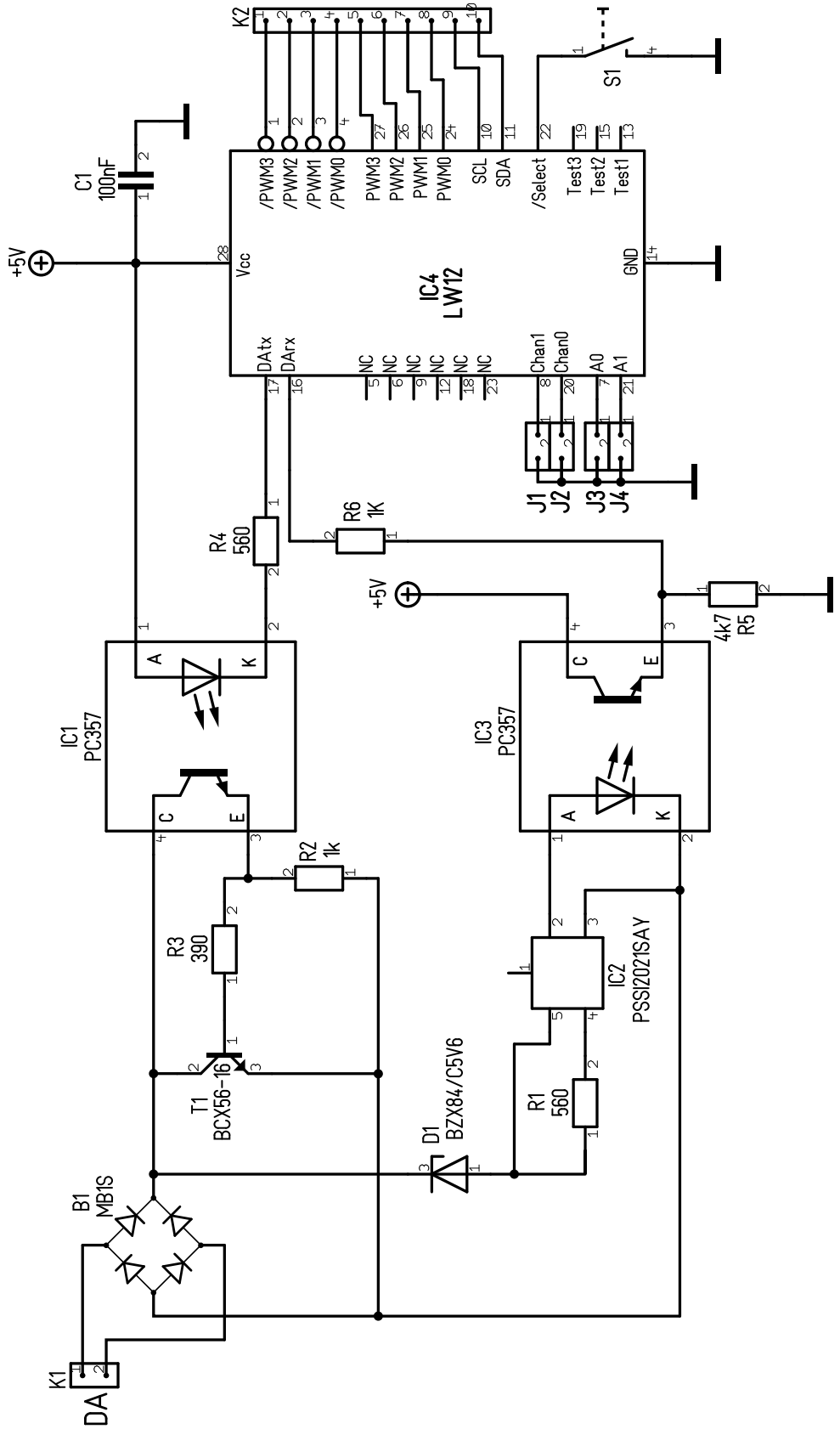
Supply voltage (Vcc relative to GND): ..... -0.5V to +6V
Input voltage into any pin (relative to GND): ..... GND - 0.5V to Vcc + 0.5V
Input current into any pin: ..... -25 to +50mA
Storage temperature: ..... -55°C to +100°C
ESD: ..... 2000V human body model

Absolute maximum ratings must not be exceeded or permanent damage to the LED-Warrior12 may result.

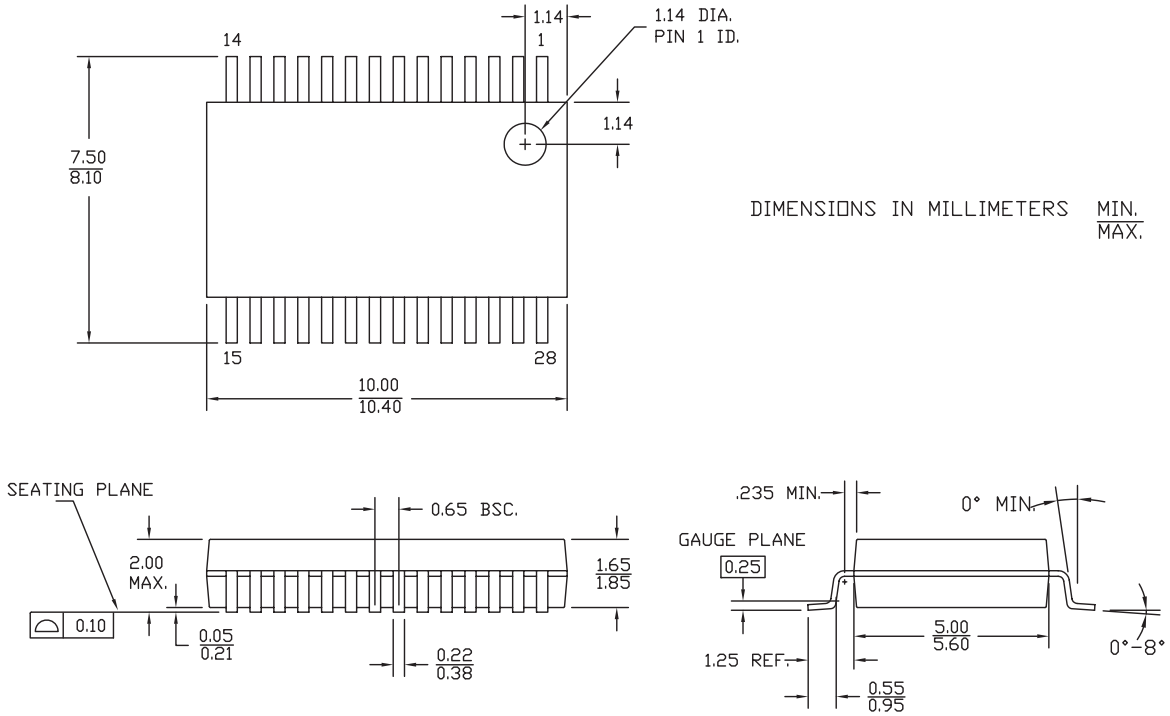
6.1 Operating specifications

Supply voltage (Vcc 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

7. Application circuit



8. Package dimensions SSOP28



9. Ordering information

Partname	Order Code	Package	MOQ	Description
LED-Warrior12-S	LW12-S	SSOP28	47	Single chip IEC62386 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

V1.0.0.5 is the current shipping version.

9.2.1 Version Info

V1.0.0.5 - Bugfix - Fixed an internal race condition that could lead to lost receive packets if a very narrow timing window was met.

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.

9.2.2 Document history

V1.0.3 - Added version update
V1.0.2 - Corrected application circuit
V1.0.1 - Release info for chip V1.0.0.4

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 excerted 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.

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

HRB 9868 CB
Geschäftsführer: Guido Körber, Christian Lucht