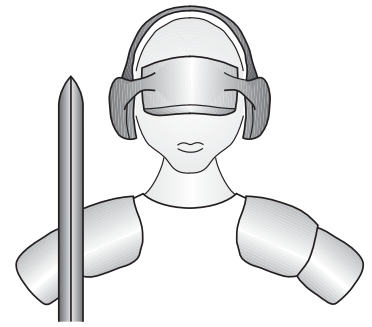


# LED-Warrior09



Code Mercenaries

## IEC62386 (DALI\*) Master with I2C Interface and two switch inputs

### 1. Features

- IEC62386 (DALI\*) master
- I2C to IEC62386 bridge
- Turns standard light switch into a IEC62386 master
- According to DIN EN 62386-103
- Simplified access to IEC62386
- Minimal external circuitry
- 5 V supply

#### 1.1 Variants

LED-Warrior09 is available in DIL8, SOIC8 packages, or as modules.

#### 1.2 LW09-01MOD

The LW09-01MOD is a ready to use module. It is primarily intended to be used as a I2C to IEC62386 bridge and needs a 5 V power supply. Two switches may be connected.

#### 1.3 LW09-02MOD

The LW09-02MOD is a ready to use module for stand alone devices. LW09-02MOD can be used to turn switches into IEC62386 controllers or as a I2C to IEC62386 bridge. It extracts its power supply from the IEC62386 bus and can provide some power for additional electronics like a RF receiver.

#### 1.4 Custom variants

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

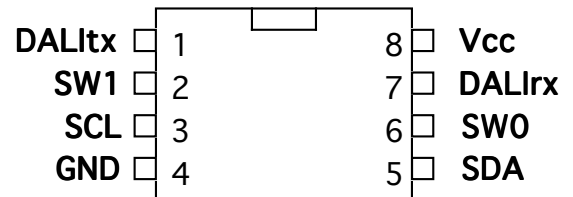
### 2. Functional overview

LED-Warrior09 is a type II IEC62386 master. It can coexist with other masters on the same bus but is not addressable.

LED-Warrior09 generates the necessary IEC62386 commands to set light levels from simple I2C commands, or two switch inputs.

Standard light switches can be turned into IEC62386 masters with the LED-Warrior09. The function of the two switch inputs is programmable via I2C. On/off switching and dimming can be controlled by one or two switches for individual IEC62386 ballasts, groups, or broadcast.

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



#### Vcc

5 V supply voltage positive input.

#### GND

Supply voltage negative input.

#### SDA

Data line of I2C interface.

High impedance input and open drain output.

#### SCL

Clock line of I2C interface.

High impedance input and open drain output.

#### DALIrx

Receive data input from IEC62386 bus.

Connect a IEC62386 bus receiver to this pin.

Positive logic, high = high level on bus.

High impedance input.

#### DALItx

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.

#### SW0, SW1

Switch inputs for direct lighting control.

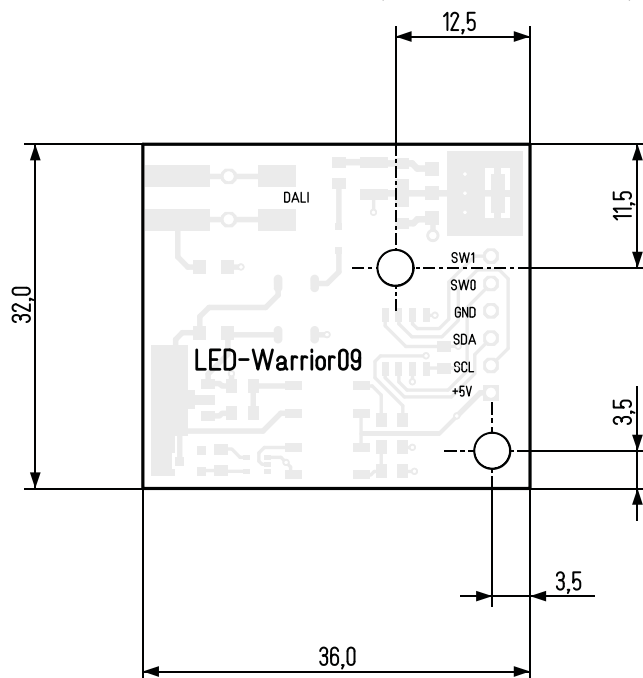
The function of these pins can be programmed via I2C.

Factory default setting is for two momentary switches to control on/off for short action and up/down dimming for press and hold.

Inputs with internal pull up resistors.

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## 3.1 Mechanical dimensions (LW09-01/02MOD)



Dimensions in mm  
 Height at thickest point:  $\leq 6.1$  mm  
 Mounting holes: 3.1 mm  
 Tolerances, outer contour:  $\pm 0.2$  mm

## 3.2 Pin Descriptions (LW09-01MOD)

### DALI

Two lines for the IEC62386 bus, not polarity sensitive, connect direct to the IEC62386 bus.

### SDA

Data line of I2C interface.  
 High impedance input and open drain output.

### SCL

Clock line of I2C interface.  
 High impedance input and open drain output.

### SW0, SW1

Switch inputs for direct lighting control. The function of these pins can be programmed via I2C. Factory default setting is for two momentary switches to control on/off for short action and up/down dimming for press and hold. Inputs with internal pull up resistors.

### +5V

Positive supply voltage input. +5 V required.

### GND

Ground supply voltage.

## 3.3 Pin Descriptions (LW09-02MOD)

### DALI

Two lines for the IEC62386 bus, not polarity sensitive, connect direct to the IEC62386 bus.

### SDA

Data line of I2C interface.  
 High impedance input and open drain output.

### SCL

Clock line of I2C interface.  
 High impedance input and open drain output.

### SW0, SW1

Switch inputs for direct lighting control. The function of these pins can be programmed via I2C. Factory default setting is for two momentary switches to control on/off for short action and up/down dimming for press and hold. Inputs with internal pull up resistors.

### +5V

Positive supply voltage output. Can supply up to 15mA at 5 V to external circuit like RF receiver modules.

### GND

Ground supply voltage.

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## 4. I2C Addressing

LED-Warrior09 uses \$20 (7 bit value, needs to be shifted and extended by R/W bit: 0100 000R) as the factory default I2C address.

Reassigning a different 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.

The register number is always reset to zero at the end of a transaction, so reading without first writing a register address always returns the content of the status register.

Register	R/W	Function	Data
\$00	R	Status	1 Byte
\$01	W	Command	2 Bytes
\$08	R/W	Config	4 Bytes
\$FE	W	Set Addr	2 Bytes

### 4.2 Status register

The status register is one byte that contains the bus status and command status flags:

7 - Bus Status, 0 = Bus OK, 1 = Bus fault

6 - Busy, 0 = ready, 1 = busy

5 - not used

4 - not used

3 - not used

2 - not used

1 - not used

0 - not used

Bus Status = 1 indicates that the bus is not working, either another device is pulling it permanently low or the bus is not connected. Commands to register 1 will be ignored if the bus is not working.

Busy = 1 indicates that the last command has not yet been transmitted. Any new command sent to register 1 will be ignored until the last command has been transmitted and the busy bit is cleared.

### 4.3 Command register

The command register has two bytes which directly contain the IEC62386 command. IEC62386 commands 0 to 31 and direct arc power control are supported.

#### 4.3.1 IEC62386 Commands

LW09 accepts the IEC62386 commands 0 to 31 and the direct arc power control command that directly sets the power value for the lamp. The commands are sent by writing two bytes to register \$01. LW09 will then transmit the command over the IEC62386 bus and indicate by the busy bit in the status register if the IEC62386 command has already been shipped.

The first byte contains the address information, the second holds either the lamp power value or command code.

#### 4.3.2 IEC62386 Address

The address byte format is used by the Command register as well as the Config register:

7 - Y, 0 = short address, 1 = group address

6 - A5, Address bit 5

5 - A4, Address bit 4

4 - A3, Address bit 3

3 - A2, Address bit 2

2 - A1, Address bit 1

1 - A0, Address bit 0

0 - S, 0 = DAPC, 1 = Command

The S Bit selects if the second byte is the direct arc power value (lamp power) or a command code. For the config register this bit is ignored.

The addressing mode is selected by the Y bit. If Y = 0 the A0..5 bits contain the 6 bit short address of the device (OAAA AAAS). Short addresses are direct addresses for up to 64 individual IEC62386 devices.

Group addressing can go to any of 16 groups of devices or to all devices on the IEC62386 bus (broadcast). If Y = 1 and A4 and A5 are both zero A0..3 contain the 4 bit group number to which the command is addressed (100A AAAS).

A broadcast command sets all A bits to 1:

1111 111S This command goes to all devices on the connected IEC62386 bus.

Address values 1010 0000 through 1111 1101 are invalid and will result in the command being ignored.

In case of a direct arc power control command the second byte directly sets the lamp power, where 0 is off and 254 is maximum, 255 is a mask value that stops any fading at the current power level.

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The functions of the other IEC62386 commands are described in the following section.

#### 4.3.3 \$00 - OFF

Command code \$00 switches the addressed lamp off.

#### 4.3.4 \$01 - UP

Command code \$01 fades the addressed lamp up for 200ms with its internally programmed rate.

#### 4.3.5 \$02 - DOWN

Command code \$02 fades the addressed lamp down for 200ms with its internally programmed rate.

#### 4.3.6 \$03 - STEP UP

Command code \$03 steps the power of the addressed lamp up by one step. It does not switch a lamp on.

#### 4.3.7 \$04 - STEP DOWN

Command code \$04 steps the power of the addressed lamp down by one step. It does not switch a lamp off.

#### 4.3.8 \$05 - Max Level

Command code \$05 sets a lamp to its internally programmed Max Level.

#### 4.3.9 \$06 - Min Level

Command code \$06 sets a lamp to its internally programmed Min Level.

#### 4.3.10 \$07 - Step Down And Off

Command code \$07 steps the power of the addressed lamp down by one step. If the lamp was already at its min level it is switched off.

#### 4.3.11 \$08 - On And Step Up

Command code \$08 steps the power of the addressed lamp up by one step. If the lamp was off it is switched on to its Min Level.

#### 4.3.12 \$09 - Enable DAPC Sequence

Command code \$09 enables the DAPC sequence mode. If following it DAPC commands are send with less than 200 ms spacing there will be no transition time between lamp power levels.

#### 4.3.13 \$1X - Go To Scene

Command codes \$10 to \$1F switch the addressed lamps to the scene number defined by the lower nibble (i.e. \$12 activates scene 2).

#### 4.3.14 \$0A-\$0F - Reserved

Command codes \$0A to \$0F are reserved for future IEC62386 extensions. LED-Warrior09 does transmit these codes if issued to the command register, but the reaction of any IEC62386 device to these codes is not defined.

#### 4.4 Config register

The config register controls the function of the two switch inputs. It is possible to program the inputs to work together for on/off, up/down control or independent. Each of the functions may address a single IEC62386 device, a group or broadcast to all devices.

For each input two bytes control its function. The first byte selects the mode of the input and the second sets the address of the device(s) controlled by the input.

The Format of the Config register is as follows:

Byte 0	Byte 1	Byte 2	Byte 3
Mode SW0	Addr SW0	Mode SW1	Addr SW1

Mode controls the function of the switch input. The bits in the mode bytes have the following function:

- 7 - Scene bit 3
- 6 - Scene bit 2
- 5 - Scene bit 1
- 4 - Scene bit 0
- 3 - reserved, write 0
- 2 - Mode bit 2
- 1 - Mode bit 1
- 0 - Mode bit 0

Mode numbers select the following functions:

- 0 - Two switch up/down dimming
- 1 - Two switch on/off
- 2 - Single switch dimming
- 3 - Single switch on/off
- 4 - Single switch go to scene
- 5 - Single switch step through scenes
- 6 - Single locking switch on/off

If a two switch option is selected for SW0 the mode bits for SW1 are ignored. Selecting a two switch option only for SW1 does not work.

Switches are assumed to be of a non-locking type (i.e. the contact is closed only as long as the switch is manually pressed), except for mode 6 which is explicitly for a locking type of switch like a classic light switch.

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**Two switch up/down dimming** sets the addressed devices to maximum level on a short press on SW0 and off on a short press on SW1. Holding down SW0 results in dimming up and holding SW1 dims down.

**Two switch on/off** only switches to maximum level or off and does not allow dimming, holding down a switch does not result in different behaviour.

**Single switch dimming** does toggle between off and maximum 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. Subsequent presses of the switch will toggle between up and down dimming. Dimming will stop at either maximum or minimum level.

**Single switch on/off** toggles the lamp between maximum power and off, holding down the switch does not result in different behaviour.

**Single switch go to scene** sets the lamp to the scene number defined by scene bits 0..3.

**Single switch step through scenes** sends a go to scene command every time the switch gets closed. The scene numbers step from 0 to the number defined by the scene bits 0..3 and then starts again with 0.

**Single locking switch on/off** can turn a standard locking light switch into a IEC62386 switch. It does send a "Max Level" command when the switch closes (SWx is pulled low) and a "Off" command when the switch is opened (SWx goes high),

The address byte has the same format as the address byte of the Command register (see 4.3.2). It defines which device, group, or all devices are addressed by the switch function.

If a two switch option is selected for SW0 the address byte for SW1 is ignored.

## 4.5 Set Address register

With the Set Address register it is possible to move LW09 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.

The first byte has to contain the address in normal format (i.e. values 0 to 127), the second byte must contain the value of the first byte XORed with \$FF.

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## 5. Absolute maximum ratings (Chip)

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-Warrior09 may result.

### 5.1 Operating specifications (Chip)

Supply voltage (V <sub>cc</sub> relative to GND):	4.5V to 5.25V
Operating temperature:	-40°C to +85°C
Supply current:	8mA max.
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 (LW09-01MOD)

Supply Voltage (V <sub>in</sub> relative to GND):	-0.5V to +6V
Input current (supply voltage):	max. 25mA
IEC62386 input voltage (differential):	max. 50V
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-Warrior09 may result.

### 5.3 Operating specifications (LW09-01MOD)

Supply Voltage (+5V relative to GND):	4.5V to 5.25V
Operating temperature:	-20°C to +65°C
IEC62386 input voltage (differential):	max. 24V
Supply current:	max. 25mA

### 5.4 Absolute maximum ratings (LW09-02MOD)

IEC62386 input voltage (differential):	max. 45V
IEC62386 input current:	max. 50 mA
Storage temperature:	-55°C to +100°C
ESD:	2000V human body model

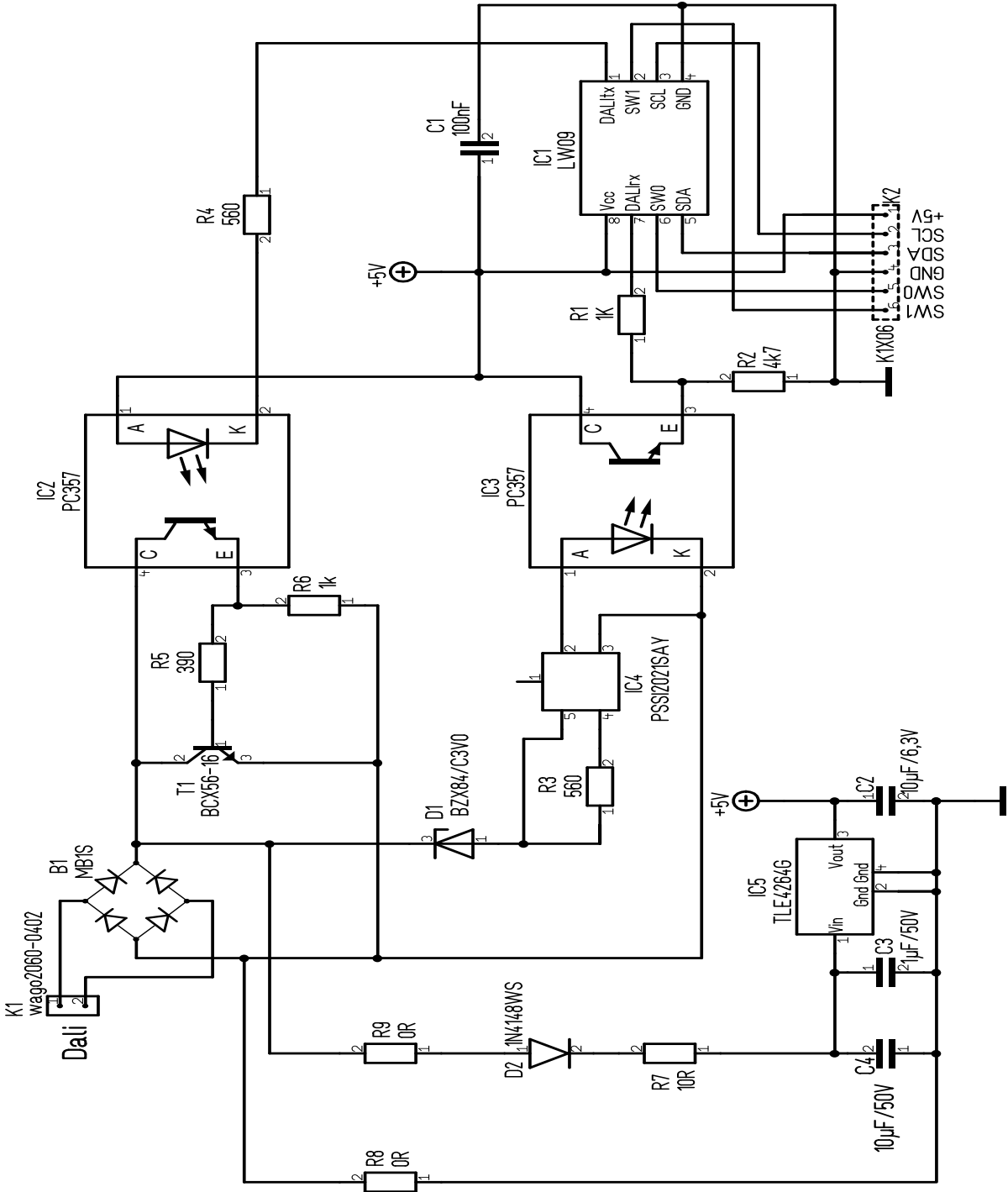
Absolute maximum ratings must not be exceeded or permanent damage to the LED-Warrior09 may result.

### 5.5 Operating specifications (LW09-02MOD)

Supply Voltage Output(V <sub>in</sub> relative to GND):	4.5V to 5.25V
Supply Output max. current:	15 mA
Operating temperature:	-20°C to +65°C
IEC62386 input voltage (differential):	max. 24V
IEC62386 bus current:	max. 25mA

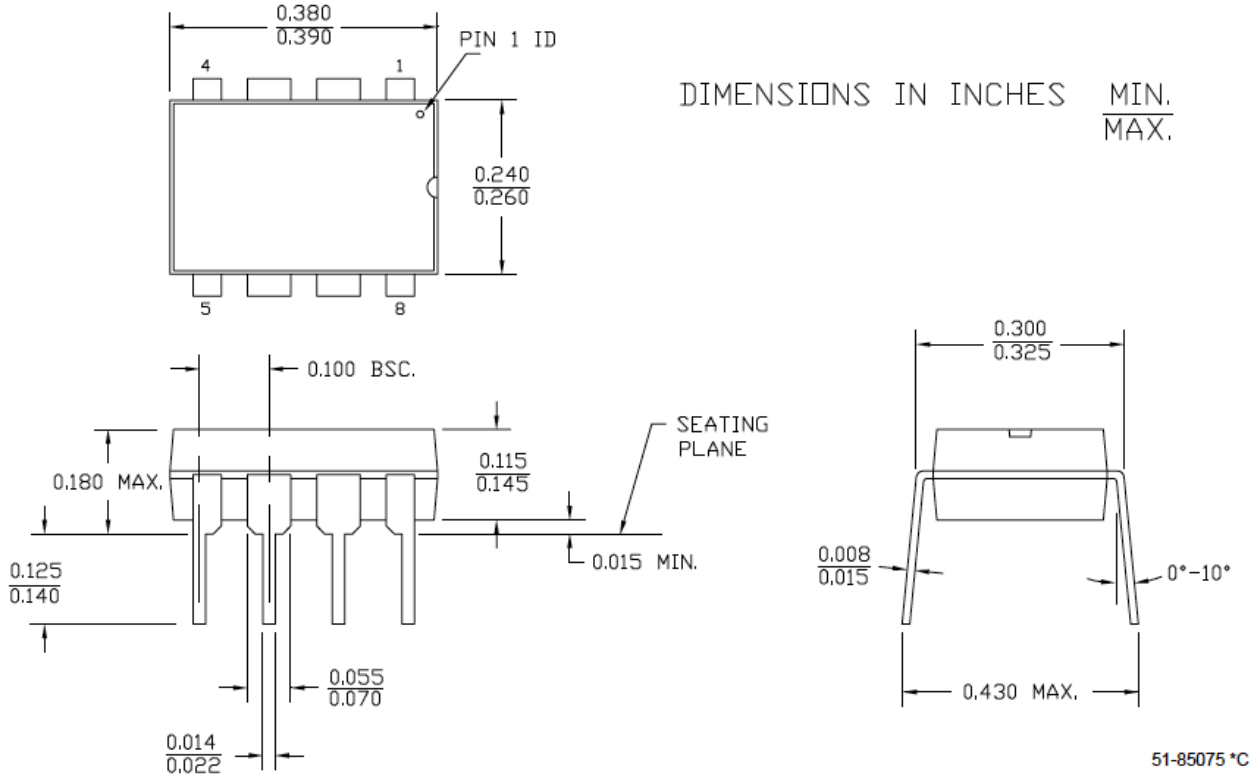
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## 6. Application circuit (LW09-02MOD)

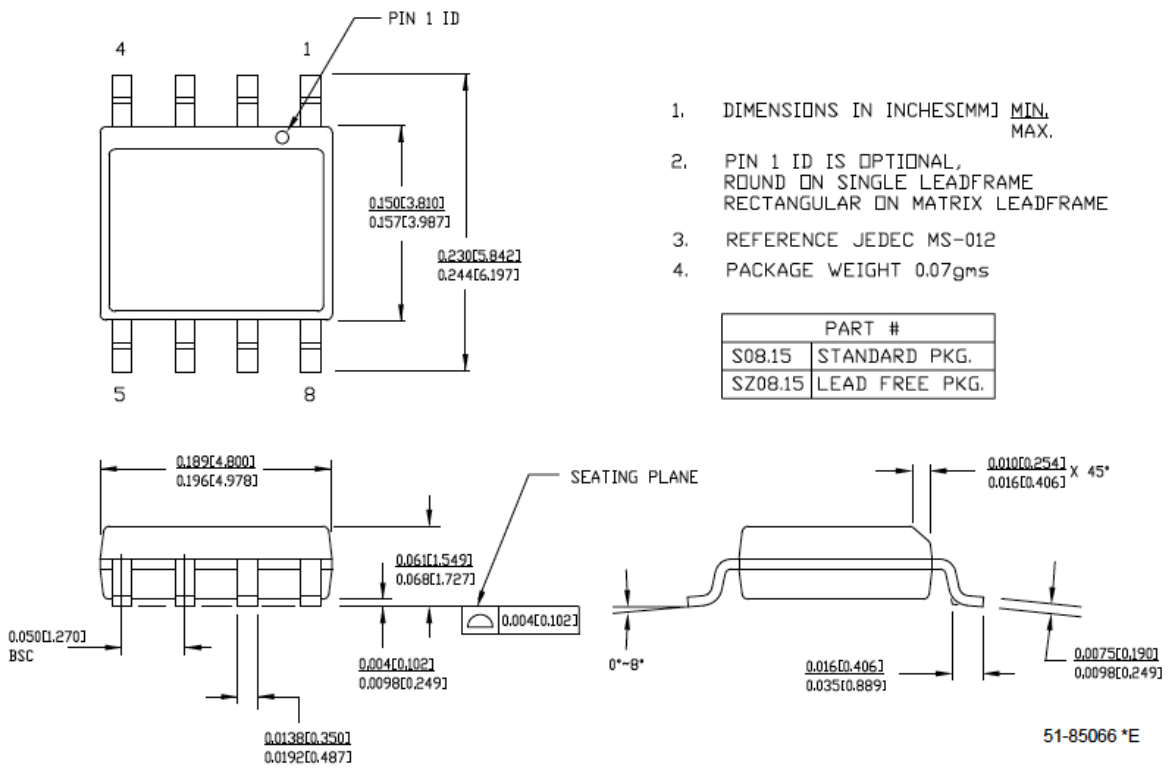


# LED-Warrior09

## 7. Package dimensions DIL 8



## 7.1 Package dimensions SOIC8





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## 8. Ordering information

Partname	Order Code	Package	MOQ	Description
LED-Warrior09-S	LW09-S	SOIC-8	97	Single chip IEC62386 master with I2C
LED-Warrior09-P	LW09-P	DIL 8	1	Single chip IEC62386 master with I2C
LED-Warrior09-01MOD	LW09-01MOD	Module	1	IEC62386 master with I2C module
LED-Warrior09-02MOD	LW09-02MOD	Module	1	IEC62386 master with supply voltage extraction

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 in single units.

### 8.2 Shipping version

LED-Warrior09 is currently shipping in version V1.0.0.1

#### 8.2.1 Revision History

V1.0.0.1 - Fixed a bug that did reset the configuration when reading I2C register \$08.

V1.0.0.0 - Initial shipping version.

### 8.3 FCC / CE

The LED-Warrior09 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 exerted 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.

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