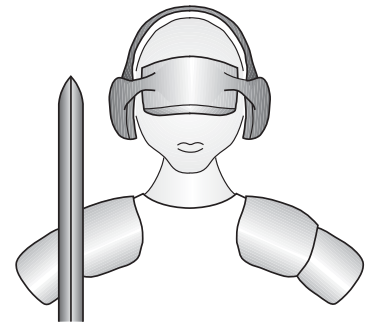# LED-Warrior13

IEC62386 Master with 16 switch inputs and I2C Interface

Code Mercenaries

1. Features
- IEC62386 type II master
- Turns standard light switch into a IEC62386 master
- 16 switch inputs, programmable functions
- I2C to IEC62386 bridge
- According to DIN EN 62386-103/2011
- 5 V supply

1.1 Variants
LED-Warrior13 is available in SSOP28 package.
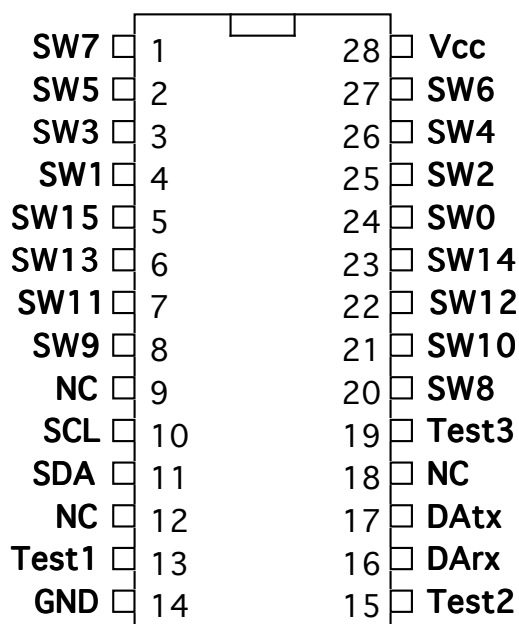Custom variants are possible for the chips.

2. Functional overview
LED-Warrior13 is a type II IEC62386 master. It can coexist with other masters on the same bus but is not addressable.

LED-Warrior13 generates the necessary IEC62386 commands to set light levels from 16 switch inputs or I2C commands.

Standard light switches can be turned into IEC62386 masters with the LED-Warrior13. The function of the 16 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 Description (Chip SSOP28)

SW7	1	28	Vcc
SW5	2	27	SW6
SW3	3	26	SW4
SW1	4	25	SW2
SW15	5	24	SW0
SW13	6	23	SW14
SW11	7	22	SW12
SW9	8	21	SW10
NC	9	20	SW8
SCL	10	19	Test3
SDA	11	18	NC
NC	12	17	DAtx
Test1	13	16	DArx
GND	14	15	Test2

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.

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.

SW0… SW15
Switch inputs for direct lighting control.
The function of these pins can be programmed via I2C.
Factory default setting is for all switches to work in dual switch dimming mode. The first pair of switches sends to the broadcast address, the following pairs to short addresses 0-6.
Active low inputs with internal pull up resistors.

4. I2C Addressing

LED-Warrior13 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	32 Bytes
$F0	R	Signature	6 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

LW13 accepts the IEC62386 comands 0 to 31 and the direct arc power control command that directly sets the power value for the lamp. The commands are send by writing two bytes to register $01. LW13 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 (0AAA 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.

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-Warrior13 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 sixteen switch inputs. It is possible to program pairs of 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 decive(s) controlled by the input.

Though if bit 0 of the address byte is 0 the switch sends an acr power command. In this case address and mode bytes are transmitted as the arc power command when the switch is closed.

The Format of the Config register is as follows:

```
 0 - ModeSW0
 1 - ModeSW2
 2 - ModeSW4
 3 - ModeSW6
 4 - ModeSW8
 5 - ModeSW10
 6 - ModeSW12
 7 - ModeSW14
 8 - AddressSW0
 9 - AddressSW2
10 - AddressSW4
11 - AddressSW6
12 - AddressSW8
13 - AddressSW10
14 - AddressSW12
15 - AddressSW14
16 - ModeSW1
17 - ModeSW3
18 - ModeSW5
19 - ModeSW7
20 - ModeSW9
21 - ModeSW11
22 - ModeSW13
23 - ModeSW15
24 - AddressSW1
25 - AddressSW3
26 - AddressSW5
27 - AddressSW7
28 - AddressSW9
29 - AddressSW11
30 - AddressSW13
```

31 - AddressSW15
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

Two switch options can be selected only on even numbered inputs (0, 2, 4…), the next odd numbered input will automatically be used as the second switch for the function (i.e. 0+1, 4+5…). If a two switch option is selected the mode bits for the odd numbered switch are ignored. Selecting a two switch option on a odd number switch 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.

Two switch up/down dimming sets the addressed devices to maximum level on a short press on the even switch and off on a short press on the odd input. Holding down the even input results in dimming up and holding the odd input 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 funtion.
If a two switch option is selected for an even numberes switch the address byte for the odd numbered switch is ignored.
If bit 0 of the address is zero the address byte and the mode byte are transmitted via IEC62386 as they are, resulting in an arc power command to the device(s) addressed by the address byte. This allows to directly set a desired power level on the closing of a switch.

4.5 Signature register
The signature register can be used to identify LED-Warrior13 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-Warrior13 has 13 as its product code value.
Version is the four BCD digit version number identifying the chips firmware version. I.e.

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V1.0.3.5 would be stored as $1035.

4.6 Set Address register

With the Set Address register it is possible to move LW13 to a different I2C address.

To prevent address reprogramming by mistke 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.

5.0 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-Warrior13 may result.

5.1 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

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6. Application circuit
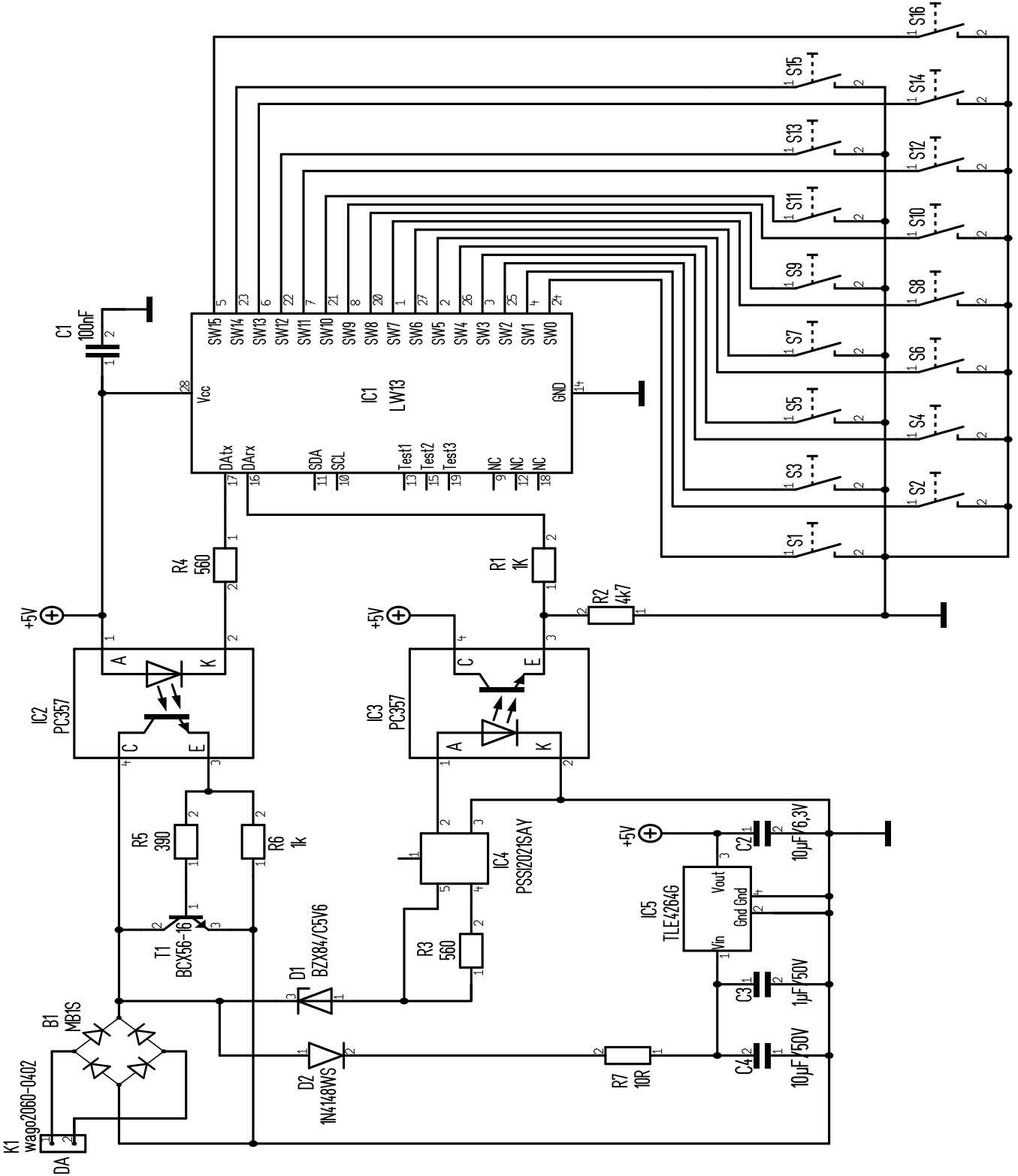
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7. Package dimensions SSOP 28

DIMENSIONS IN MILLIMETERS $\frac{MIN.}{MAX.}$
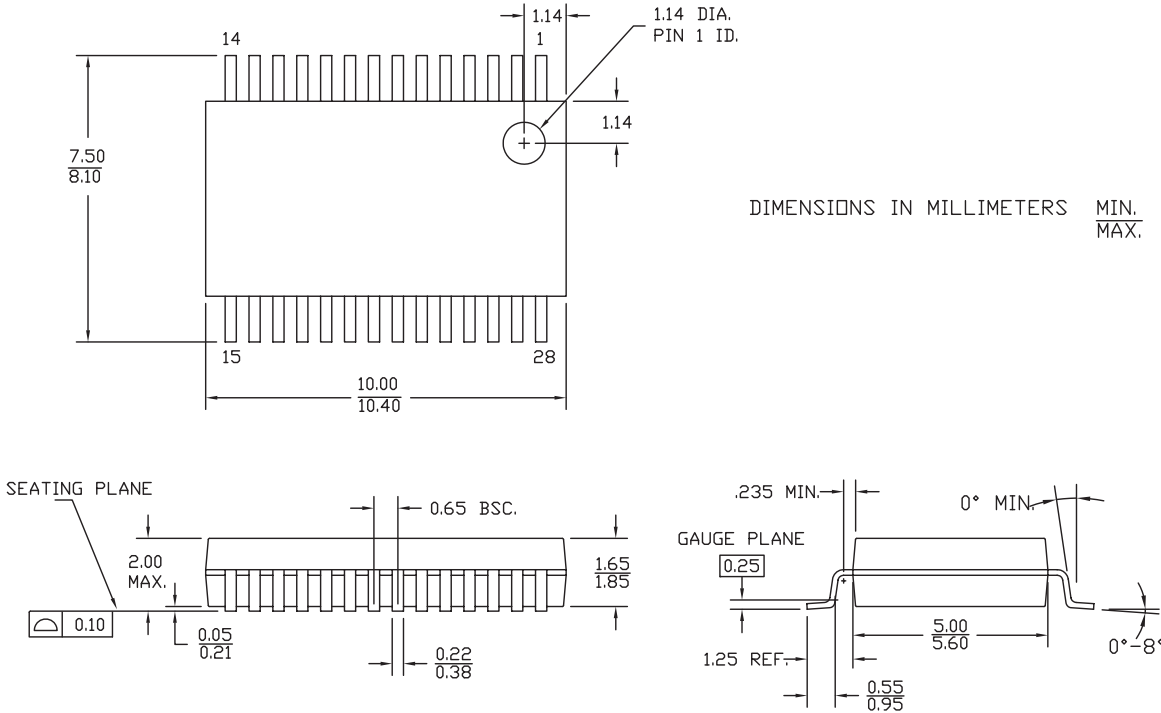
8. Ordering information

Partname	Order Code	Package	MOQ	Description
LED-Warrior13-S	LW13-S	SSOP-28	47	Single chip IEC62386 master with I2C

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

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

8.2 Shipping version
LED-Warrior13 is currently shipping in version V1.0.0.0

8.2.1 Revision History
V1.0.0.0 - Initial shipping version.

8.3 FCC / CE
The LED-Warrior13 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.

Legal Stuff

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