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# Smart Lights

*Release 2*

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**2023-04-12**



# SAFETY GUIDELINES

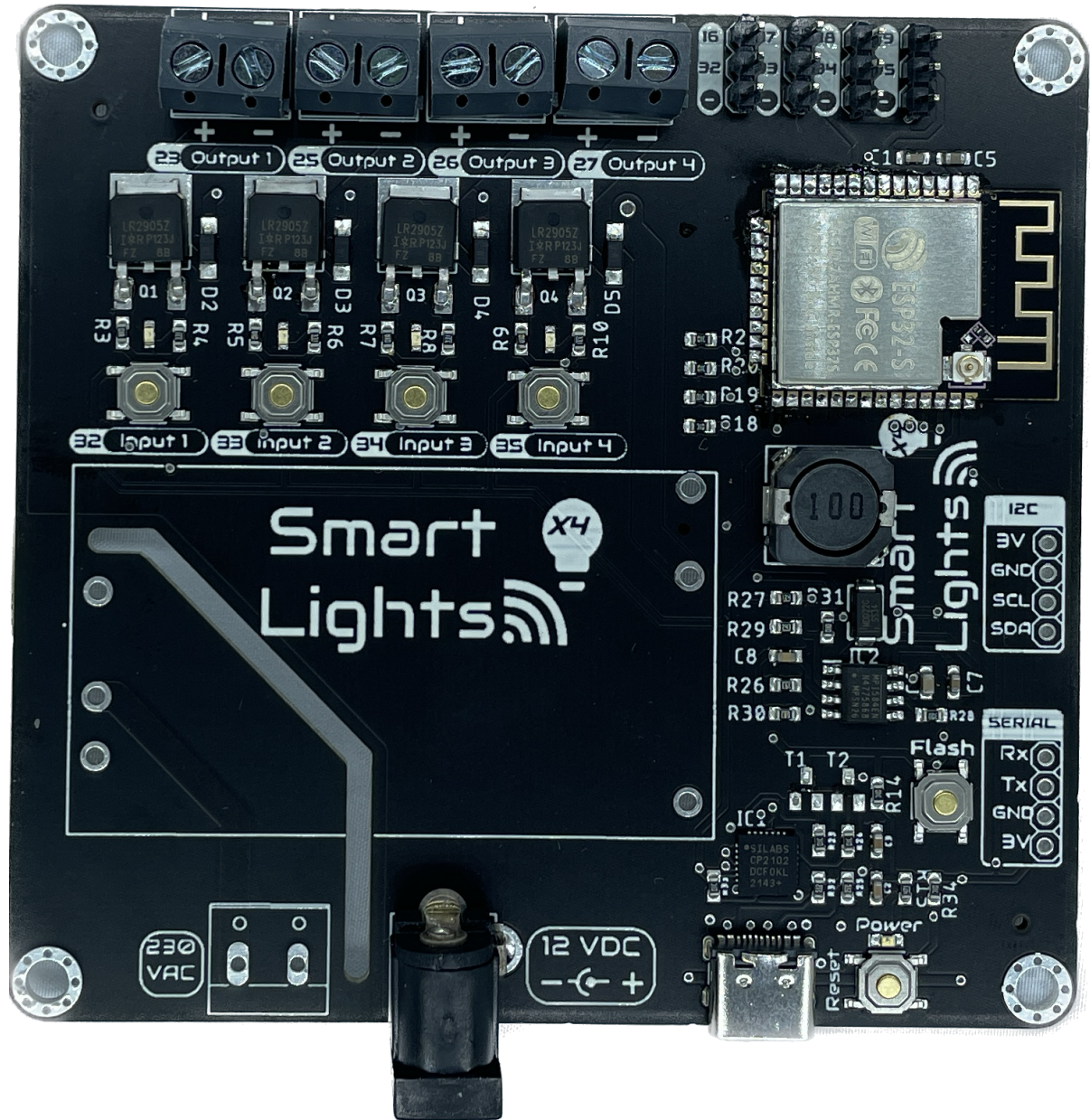
<b>1</b>	<b>Contents</b>	<b>3</b>
<b>2</b>	<b>Technical support</b>	<b>5</b>
2.1	Safety guidelines . . . . .	5
2.2	Getting started . . . . .	6
2.3	Programming . . . . .	10
2.4	FAQ . . . . .	15
2.5	Schematics and drawings . . . . .	15
2.6	Technical Specifications . . . . .	17





**Note:** You are on the documentation site of the X4 version. Please refer to X1 for documentation regarding the other board version.

### Smart Lights X4



Welcome to the documentation page of the Smart Lights X4, an electronic board based on the ESP32 with the target of controlling up to 4 dimmable led strips under 24VDC.

It can be powered from an standard electric socket (since the board can mount a 100 – 240V<sub>AC</sub> to 12V<sub>DC</sub>/24V<sub>DC</sub> power transformer) and being able to regulate 4 independent monochromes LED strips or one RGBW LED strip.



## CONTENTS

*Safety guidelines*

How to operate and manipulate the Smart Lights X4.

*Getting started*

First steps for configuring and working with the Smart Lights X4.

*Schematics and drawings*

Design files of the Smart Lights X4.



## TECHNICAL SUPPORT

If you have technical problems or cannot find the information that you need in the provided documentation, please contact me directly:

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**Board**

Smart Lights X4

**Revision**

2

**Date**

April 12, 2023

## 2.1 Safety guidelines

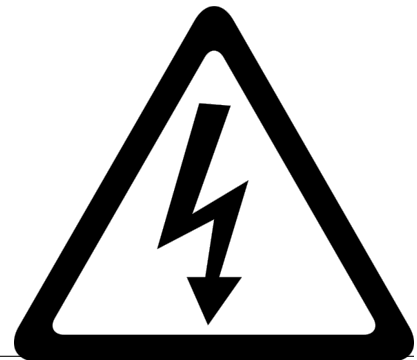
These safety guidelines, the operation instructions and the limit values listed in *Technical Specifications* are to be read carefully before operating the product.

**Caution:** This product has been designed for being used in domotic applications. It was not designed for any use involving serious risks or hazards that could lead to death, injury, serious physical damage, or loss of any kind without the implementation of exceptionally stringent safety precautions.

### 2.1.1 Risk of electric shock

The usage of this product could imply working with high voltage installations ( $100 - 240V_{AC}$ ). Perform any action, specially in the area with this symbol on the board, with the appropriate means and always with safety.

If you have any question, please check with technical support (*Technical support*) before taking any action potentially dangerous.



### 2.1.2 Protection against ESD

The Smart Lights X4 contains components sensitive to ESD, which can be damaged by inappropriate handling. It's therefore necessary to provide some safety precautions against ESD during the handling and operation.

### 2.1.3 Usage, transport and storage

During the use, transport and storage, this product must be protected from any mechanical stress (forces applied over the board or it's components), temperatures out of the data-sheet's range, high environmental humidity or aggressive atmospheres.

Avoid using it in areas where it cannot be assured the previously mentioned environmental conditions.



### 2.1.4 Repairs

If any of the components on the board gets damaged, a reparation is possible. This repair can be performed by yourself if you identify the problem and have the means for desoldering & soldering. If this is not the case, just write to the *Technical support* mail to reach a solution.

### 2.1.5 Disposal

In accordance with national and local environmental protection and material recovery and recycling regulations, electronic devices that can no longer be used (in case a repair is not possible) must be disposed of separately and not with normal household garbage.

### 2.1.6 Restriction of Hazardous Substances



The PCB and the electronic components mounted on the Smart Lights X4 have been manufactured attending to the EU rules restricting the use of hazardous substances (RoHS) in electrical and electronic equipment to protect the environment and public health.

## 2.2 Getting started

### 2.2.1 Soldering

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**Important:** Please note that some components in this board need to be soldered.

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If you have never soldered or you want to improve your soldering techniques I recommend you the [Adafruit Guide To Excellent Soldering](#)

For better understanding where is located each component on the board check out the *PCB* layout with the interactive BOM.

## 2.2.2 Powering

The Smart Lights X4 can be powered in two ways: through the DC Power Jack **or** through the AC Input, but not simultaneously.

**Caution:** Power the board only after making all the connections

### DC Power Jack

The DC Power Jack is a very common connector for home power supplies. The size of the one by default is a 5.5mm (outer) and 2.1mm (inner) diameter.

Since there are many power supplies with this connector it is important, before plugging any power supply to the board, checking out a few important details:

- The output voltage of the power supply has to be in the range of 5 to 24VDC.
- The power of the power supply is enough for the LEDs you want to power.
- The connector polarity is correct. Inner pole positive and outer negative



### AC Input

If you prefer not to use external power supplies you can assemble one of the following ones directly on the board:

- [HLK-40M Series](#): 40W power supplies with output voltages 5/9/12/15/24VDC
- [HLK-20M Series](#): 20W power supplies with output voltages 5/9/12/15/24VDC





**Danger:** If you are using the AC power **never touch the board while it is powered.**

### 2.2.3 I/O

The Smart Lights X4 supports up to 4 independent *analog outputs* and 8 *digital inputs/outputs*:

Table 1: Pinout table

GPIO	Input	Output	Name
16			Auxiliar 1
17			Auxiliar 2
18			Auxiliar 3
19			Auxiliar 4
23			Output 1
25			Output 2
26			Output 3
27			Output 4
32			Input 1
33			Input 2
34			Input 3
35			Input 4

#### Analog outputs:

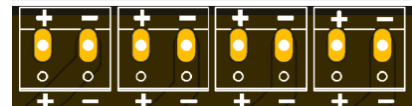
Each one of these outputs are PWM controlled individually through power mosfets. Despite the PCB layout should allow a correct heat dissipation, an additional heatsink would be recommendable for applications where a high current is expected (long LED strips or high intensity LEDs)

The connection port of each of the outputs is located on the top left part of the board and is done through 3.5mm screw terminals. The polarity of the connection is defined on the PCB silkscreen.

From left to right, the pin definition of each output is:

**Output 1**  
GPIO23

**Output 2**  
GPIO25





**Output 3**  
*GPIO26*

**Output 4**  
*GPIO27*

### Digital inputs/outputs:

The connection port of these pins is located on the top right part of the board and is done through 2.54 pins.

From this set of pins, there are two groups: inputs and auxiliary pins. The difference is that the input pins are pulled-down through 10k resistors and are connected on the PCB to the pushbuttons.

**Input 1**  
*GPIO32*

**Input 2**  
*GPIO33*

**Input 3**  
*GPIO34*

**Input 4**  
*GPIO35*



**Hint:** These pins correspond to the ADC\_1 (channels 4-7) of the ESP-32, and therefore can be used as analog inputs, always taking into account that are pulled-down already on the board.



The auxiliary pins access directly to the microcontroller pins and can behave as digital input/outputs. The intention of these auxiliary pins is to control LED rings on pushbuttons that have this feature

**Auxiliar 1**  
*GPIO16*

**Auxiliar 2**  
*GPIO17*

**Auxiliar 3**  
*GPIO18*

**Auxiliar 4**  
*GPIO19*

## 2.2.4 Communications

In addition to the I/O mentioned before, there is also a direct connection to:

### IIC ( $I^2C$ ) bus:

**SDA**  
*GPIO21*

**SCL**  
*GPIO22*

### Serial bus:

**Tx**  
*GPIO1*

**Rx**  
*GPIO3*

## 2.2.5 Enclosure

The Smart Lights X4 has been designed to fit in the electronics enclosure LK-PLC01, compatible with DIN rails and screws, and it is recommended for indoors only.

**External size**  
115x90x40mm

**Material**  
ABS Plastic

**Color**  
Transparent cover, black or beige base

## 2.3 Programming

**There are two main programming methods supported and tested with the Smart Lights X4:**

- ESPHome
- Arduino

In both scenarios, and if you are using the USB port or the Serial port for programming it, you will first need to enter the board into flashing mode. For that, press and hold the *Flash* pushbutton while you reset the board (pressing once the *Reset* pushbutton).

<b>Caution:</b> When flashing the board, make sure its only powered by the USB/Serial port.
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### 2.3.1 ESPHome

ESPHome is a well known platform for programming ESP-based devices with a very little effort. It is configured via YAML files and supports a wide range of functionalities and sensors.

**Important:** For using ESPHome, and all its functionalities, you need to have a [Home Assistant](#) instance running in the same network as your Smart Lights X4.

The Smart Lights X4 already comes with an embedded version of ESPHome, that would only require an OTA update to get it ready to work in your network:

1. Power the board, and let it run for 1-2 minutes. When the board cannot connect to a WiFi network, it will create a fallback hotspot.
2. Use a smartphone or tablet and go to the WiFi settings, connect to the recently created *Smart-Lights-X4* hotspot with the password *smartlights*.
3. Access to the captive portal and open the browser if doesn't pop up automatically.
4. Enter your network settings and press *Save*.

Now, your ESPHome device is ready to be found by Home Assistant in your network. Add it from the ESPHome section to add and edit a customized configuration file.

As an example of such configuration file (and the one flashed on the factory settings of the Smart Lights X4) with all the I/O:

```

1 substitutions:
2   device_name: "smart-lights-x4"
3   friendly_name: "Smart Lights X4"
4   project_name: "smart.lights_x4"
5   project_version: "1.0"
6   ap_ssid: "Smart-Lights-X4"
7   ap_pwd: "smartlights"
8
9 esphome:
10   name: "${device_name}"
11   name_add_mac_suffix: true
12   project:
13     name: "${project_name}"
14     version: "${project_version}"
15
16 esp32:
17   board: esp32dev
18   framework:
19     type: arduino
20
21 # Enable logging
22 logger:

```

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#### WiFi Networks

- NETGEAR
- Not your WiFi
- 3HuiTube\_2.4Ghz
- Hello World

#### WiFi Settings

SSID
Password
Save

#### OTA Update

Browse...	No file selected.
Update	

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```

23
24 # Enable Home Assistant API
25 api:
26
27 # Enable Over The Air updates
28 ota:
29
30 #Public location of this yaml file
31 dashboard_import:
32   package_import_url: github://JGAguado/
33   ↪Smart_Lights/docs/source/files/
34   ↪configuration.yaml@X4
35   import_full_config: false
36
37 # Enable fallback hotspot (captive portal) ↪
38 ↪in case wifi connection fails
39 captive_portal:
40
41 esp32_improv:
42   authorizer: none
43
44 improv_serial:
45
46 wifi:
47   ap:
48     ssid: "${ap_ssid}"
49     password: "${ap_pwd}"
50
51 light:
52   - platform: monochromatic
53     name: "Light 1"
54     id: light_1
55     output: l1
56   - platform: monochromatic
57     name: "Light 2"
58     id: light_2
59     output: l2
60   - platform: monochromatic
61     name: "Light 3"
62     id: light_3
63     output: l3
64   - platform: monochromatic
65     name: "Light 4"
66     id: light_4
67     output: l4
68
69 output:
70   - platform: ledc
71     id: l1
72     pin: GPIO23

```

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```
72 - platform: ledc
73   id: l2
74   pin: GPIO25
75 - platform: ledc
76   id: l3
77   pin: GPIO26
78 - platform: ledc
79   id: l4
80   pin: GPIO27
81
82 binary_sensor:
83 - platform: gpio
84   name: "PB1"
85   pin:
86     number: GPIO32
87   on_press:
88     then:
89     - light.toggle: light_1
90 - platform: gpio
91   name: "PB2"
92   pin:
93     number: GPIO33
94   on_press:
95     then:
96     - light.toggle: light_2
97 - platform: gpio
98   name: "PB3"
99   pin:
100     number: GPIO34
101   on_press:
102     then:
103     - light.toggle: light_3
104 - platform: gpio
105   name: "PB4"
106   pin:
107     number: GPIO35
108   on_press:
109     then:
110     - light.toggle: light_4
```

## 2.3.2 Arduino

If you are still interested in programming directly with the Arduino IDE, the procedure is no different than with any other ESP32 devices:

1. Open the Arduino IDE and go to File -> Preferences option.
2. Add to the *Additional Boards Manager URSLs* the url:

```
https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.
↪ json
```

3. Close the preferences and open in the menu Tools -> Board -> Boards Manager.

4. Search for *esp32* and install it. This might take some time.
5. Now you can select the board *ESP32 Dev Module* as the target board. Leave the rest of parameters by default.
6. Select the correct port and remember to enter the board into flashing mode before uploading the sketch.

## 2.4 FAQ

### After connecting everything and turning on the Smart Lights X4, the power LED doesn't turn on, why?

If the board is connected correctly and you cannot see the power LED on, disconnect the power immediately. Please check all the connections and measured with a multi-meter the resistance between 3V3 and gnd in any port (*I<sup>2</sup>C* or Serial). If the resistance is close to zero you have a short circuit somewhere in your board, please check your connections and any soldering you've made. If the problem persists reach [Technical support](#)

### Can I upload ESPHome directly from the Home Assistance setup running on my Raspberry Pi?

Yes you can, and actually this is one of the simplest and more effective way to upload ESPHome.

### Can I upload firmware through the Serial bus?

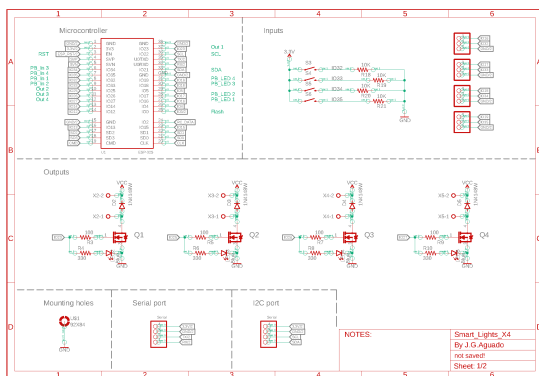
Yes you can, however this is only recommended if you have troubles using the USB port and you are familiar with the procedure.

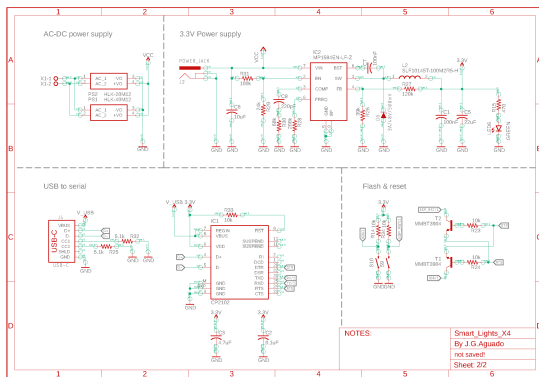
### I want to use the IIC port for expanding the possibilities, how can I do it?

Once you have located the sensor that you want to connect to the IIC port, check that is compatible with the 3.3V power supply from the Smart Lights X4. If this is the case, just connect it directly, power the board and update the firmware!

## 2.5 Schematics and drawings

### 2.5.1 Electronic schematics

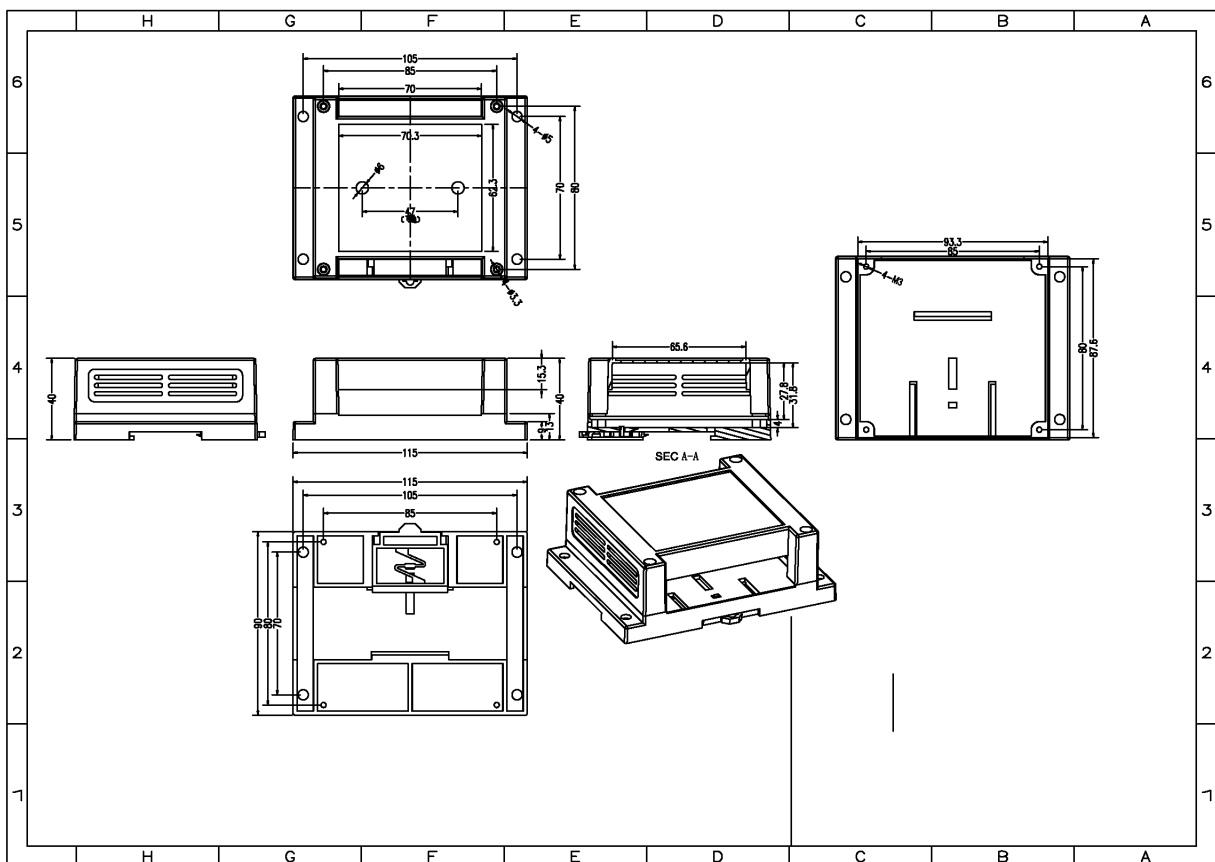




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### 2.5.2 PCB

### 2.5.3 Enclosure drawings



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## 2.6 Technical Specifications

### 2.6.1 Electrical

Parameter	Symbol	Min.	Max.	Unit
Supply voltage (AC)	$V_{AC}$	100	240	V
Supply voltage (DC)	$V_{DC}$	9	24	V
Power	$P$		40	W

### 2.6.2 Environment

Parameter	Symbol	Min.	Typ.	Max.	Unit
Working temperature <sup>1</sup>	$T_{amb}$	0	25	60	°C
Storage temperature <sup>1</sup>	$T_{amb}$	0	25	60	°C

<sup>1</sup> Based on components datasheets.