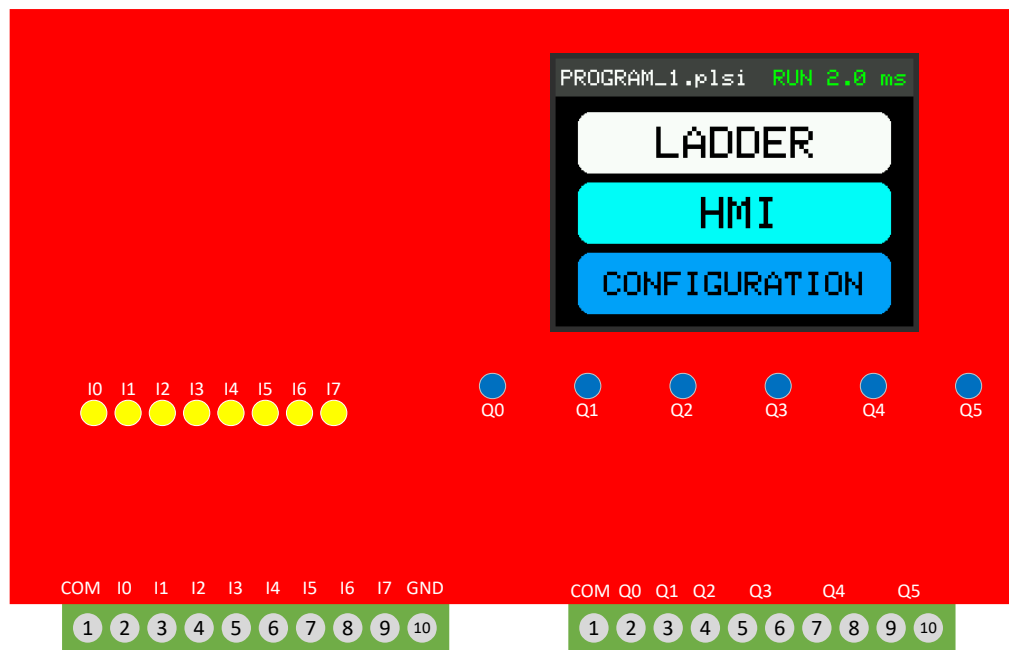


PLsi v0 Hardware Manual



Project page:

<https://github.com/ElPercha/PLsi>



Purpose of this document

This PLsi manual provides you with information to build a PLsi v0 unit, it comprises the board assembly, firmware download and a series of tests to validate the main functionalities. For wiring, configuration and programming information use the "PLsi v0 User Manual" instead.

Please, create an issue in the [PLsi repository](#) if you see that this manual is not clear enough or has opportunities to improve.

Document information

Manual Name: PLsi_v0_Hardware_Manual

Revision: A

Date: January 20, 2021

Revision history

Revision	Date	Description
A	March 20, 2021	First Revision

License

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This includes Hardware, Software, Documentation and all related contributions:



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Permissions

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- ✓ Modification
- ✓ Distribution
- ✓ Patent use
- ✓ Private use

Limitations

- ✗ Liability
- ✗ Warranty

Conditions

- ⓘ License and copyright notice
- ⓘ State changes
- ⓘ Disclose source
- ⓘ Same license

A full copy of the License is included on the Master branch of the project for reference:

<https://github.com/EIPercha/PLsi/blob/master/LICENSE>

Original copy with useful FAQ:

<https://www.gnu.org/licenses/gpl-3.0.html>

Disclaimer

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Safety Guidelines

All applicable local and national codes that regulate the installation and operation of your equipment shall be followed in order to minimize the risk of potential safety issues.

PLsi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

This manual contains 3 levels of hints:



WARNING:

Death, serious harm to health or equipment damage can result if the stated measures are not followed !



CAUTION:

Harm to health or equipment damage can result if the stated measures are not followed



TIP:

Important information that requires your special attention

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1. Introduction

The objective of the PLsi project is to create an PLC + HMI with the following main characteristics:

- Does not require external systems such as Laptops or Cellphones to be programmed
- To be used on Classroom for educational purposes, IOT applications or industrial low risk applications
- Software and Hardware with Industrial performance and features

The hardware version 0 of PLsi system is designed to be cheap and easy to build. It does not have SMD components, what makes the building process easy, fast and feasible using basic tools. The components selection was oriented to use easy to get and cheap elements.

The PLsi v0 is mainly composed by:

- Main board
- ESP32 module
- TFT 2.8" SPI Display module with touchscreen
- Terminal blocks and common electronic components

The PLsi v0 board is designed to support different input output configurations. This manual will cover the 2 main suggested configurations. For that reason, before to start, you have to select which version are you going to build, these are the 2 main options:

1. Digital version:
 - 8 digital inputs (5 to 26VDC)
 - 6 relay outputs (10A max per PLsi, external fuse required)
2. Analog version:
 - 6 digital inputs (5 to 26VDC)
 - 4 relay outputs (10A max per PLsi, external fuse required)
 - 2 Analog Inputs (0-5V)
 - 2 Analog Outputs (0-5V)

This definition will modify your component list. The details of which component is required on each version is covered on the following chapters.

1.1 Project documentation

The PLsi project is hosted on GitHub:

<https://github.com/ElPercha/PLsi>

The tree structure is divided in 3 main folders:

1. **doc**: Contains project documentation and auxiliary tools
2. **firm**: Contains the Firmware, it is designed using PlatformIO + Visual Studio
3. **hard**: Contains the Hardware documentation, mainly:
 - Circuit schematic
 - Component list
 - Board fabrication details
 - 3D Printed housing fabrication details

The most updated information is located on the master branch (link provided above), but it also might contain nightly builds of the firmware, hardware or any document. For this reason it is recommended to use the "releases", they are a more trustworthy information source.

Each release contains a snapshot of the full project site by the moment of his creation, plus the required binaries to flash the ESP32 module.

By the time this document was created, the latest available is the "v0.00.03".

It is recommended to use the latest available release to build your PLsi unit.

<https://github.com/ElPercha/PLsi/releases>

The details on how to use the binaries files to flash our PLsi are going to be covered in the next chapters.

1.2 Minimum system

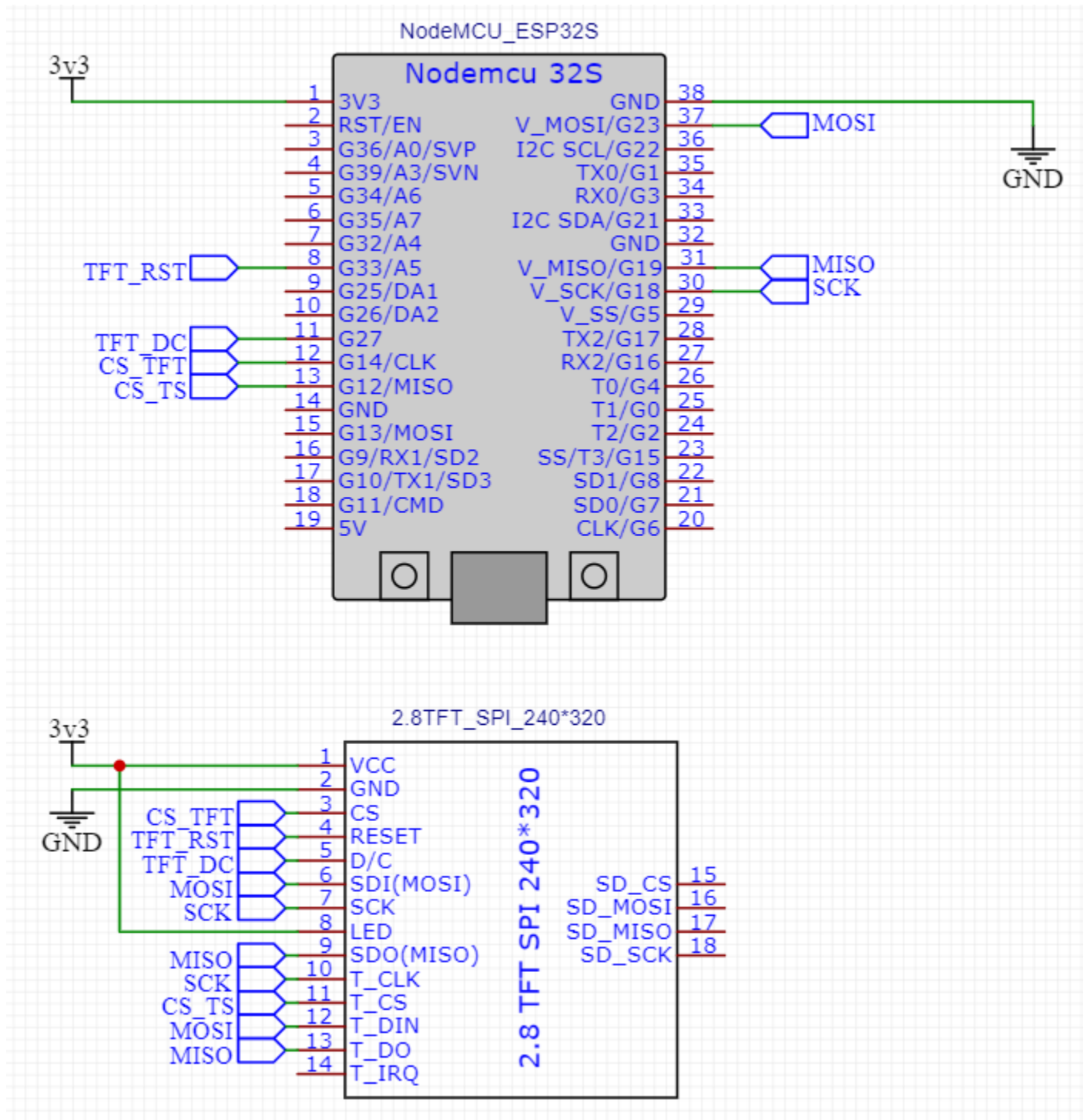
The easiest way to build a PLsi v0 is using the board designed for it, but for PLsi CPU testing purposes (with no Inputs Outputs) a limited system can be easily built.

It consist of:

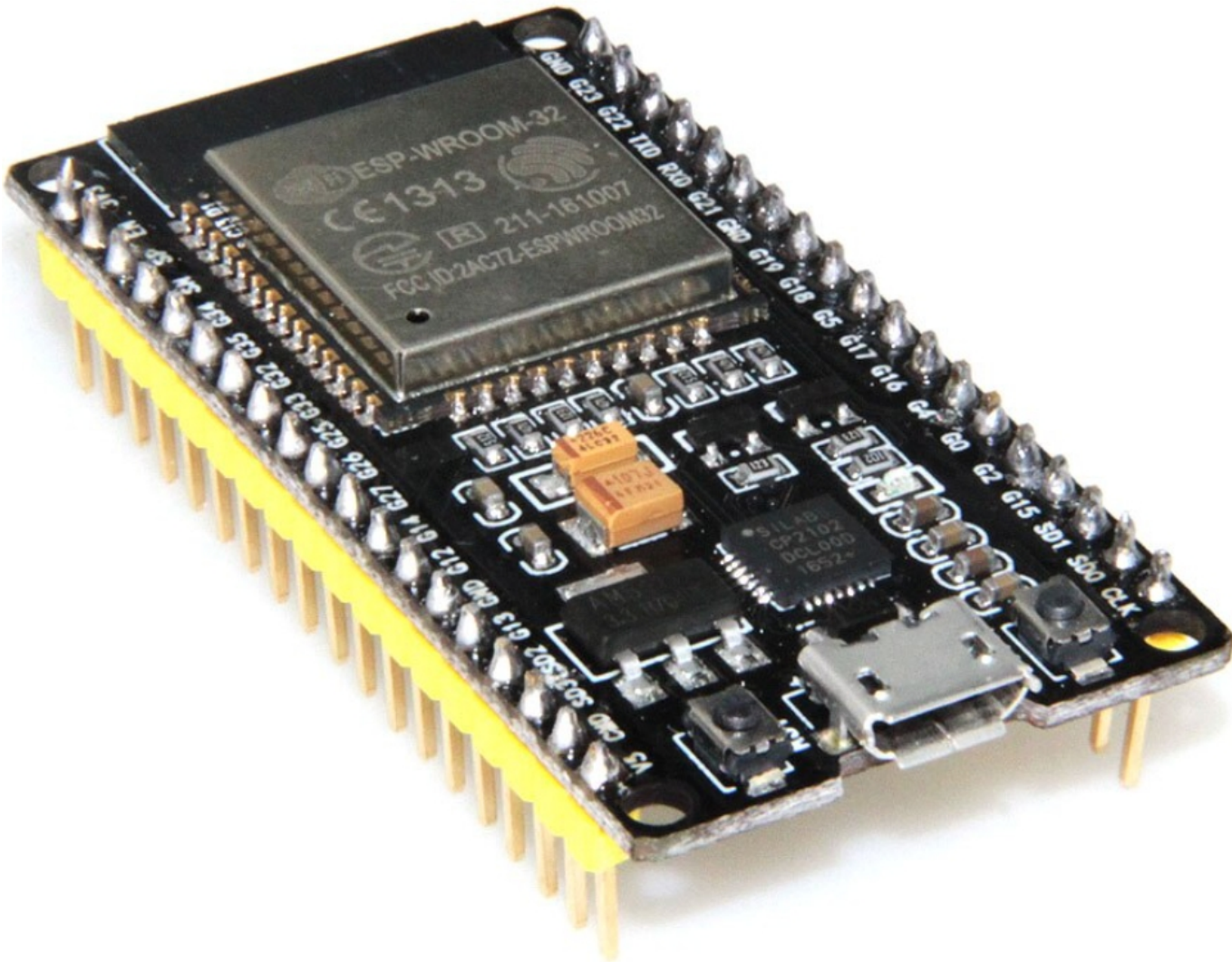
- ESP32 WROOM module
 - 38 pins version
 - They typically have yellow pin terminals
 - For test purposes you can use another ESP32 module as long as it has dual code, but the described model is required if you use the PLsi v0 board.
- 2.8" 320x240 SPI TFT Display – [LcdWiki info](#)
 - Driver ILI 9341
 - Touchscreen driver XPT2046
 - For test purposes you can use another display, as long as it has the same interface, resolution and drivers, but the described model is required if you use the PLsi v0 board.
- 9 Jumper cables for the ESP32 ← → Display connections.
- Micro USB cable and adapter with 1A capacity (recommended 2A)
 - This fed the ESP32 module and it is the main incoming supply voltage of the PLsi v0

The Firmware download procedure to ESP32 module is required. It is detailed in Firmware Download chapter.

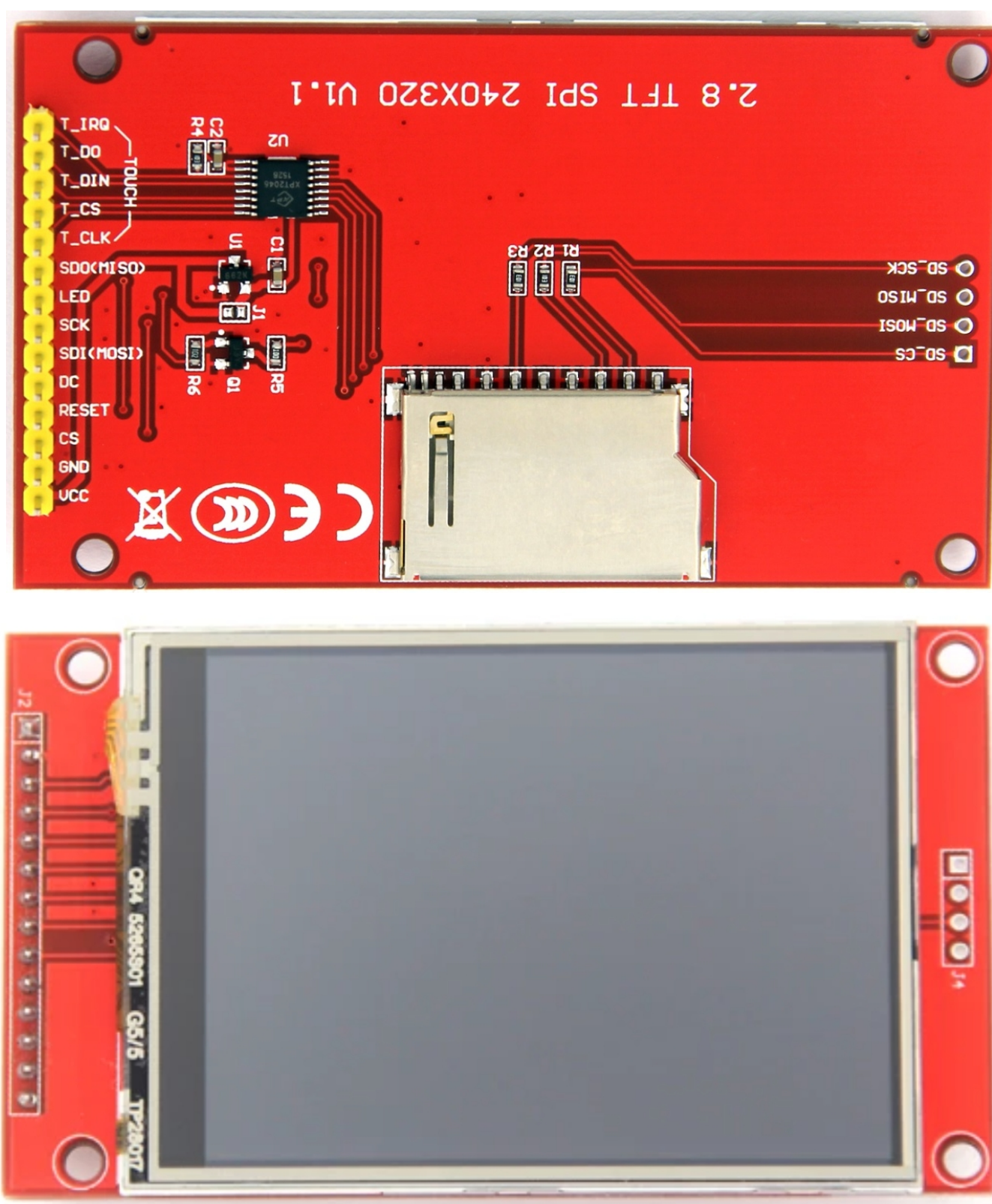
Required ESP32 ← → Display connections for minimal system:



Required ESP32 Module



Required display:



2. Board Assembly

The recommended way to build your PLsi is using the board designed for it.

All the required files to build the board are provided In the hard (hardware) folder. Each PLsi hardware version has his own folder.

PLsi v0 board main folder:

<https://github.com/EIPercha/PLsi/tree/master/hard/v0/board>

Folder content:

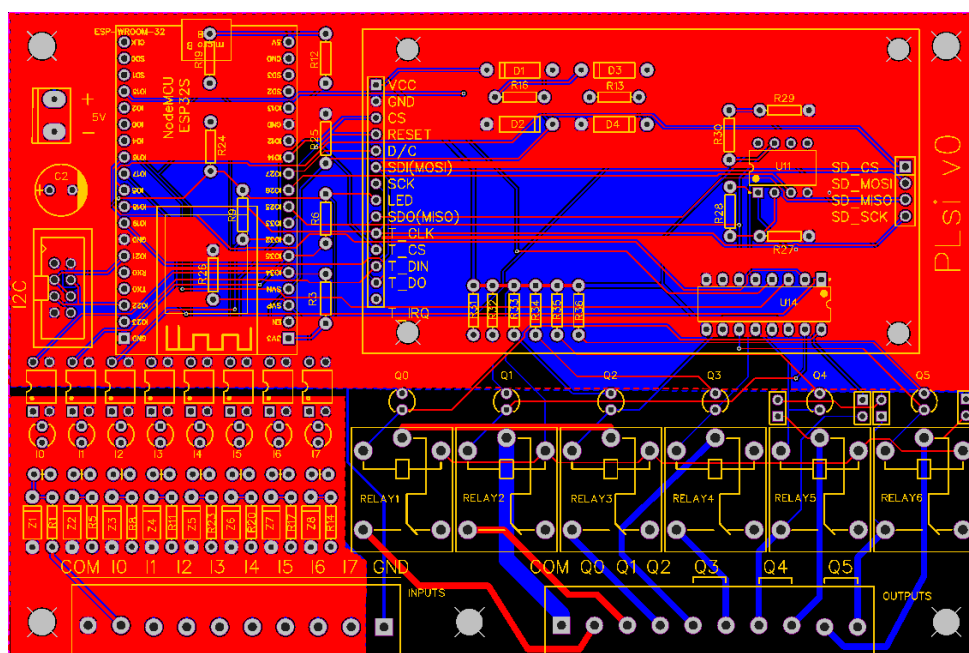
- Gerber Files
- EasyEDA source
- Altium source (it is a beta export option of the EasyEDA platform, not tested)
- Schematic
- BOM

The EasyEDA project is also public and for this reason you can directly clone the project, download or open the files from here:

https://oshwlab.com/funnyautomation/PLsi_0

The Boards used to prototype the PLsi v0 were ordered to:

<https://jlcpcb.com/>



2.2 Digital version

The hardware v0 digital version will have:

- 8 digital inputs (5 to 26VDC)
- 6 relay outputs (10A max per PLsi, external fuse required)

The component list with links to AliExpress options can be found here:

<https://github.com/ElPercha/PLsi/tree/master/hard/v0-CPU>

2.2.1 Component list

The following table has the list of components required to build your PLsi v0 digital:

Item	Designator	Description	Quantity
1	U1	NodeMCU_ESP32S	1
2	U2	Touch Screen Display	1
3	U14	ULN2003N	1
4	INPUTS, OUTPUTS	5.08 x 10 Terminal block	2
5	U2 – SD Card conenction pins	Dupont 2.54mm Male strip	4 pins
6	U1 and U2 - Optional socket	Dupont 2.54mm Female strip	2 x 40 pins
7	5V	Dupont 3 pins male	3 pins
8	P4	HDR-IDC-2.54-2X4P	1
9	C2	Capacitor 1000uF 9V	1
10	OPTO1, OPTO2, OPTO3, OPTO4, OPTO5, OPTO6, OPTO7, OPTO8	Optocupler PC817	8
11	Z1, Z2, Z3, Z4, Z5, Z6, Z7, Z8	Diode 5v1 – Zenner 1w	8
12	I0, I1, I2, I3, I4, I5, I6, I7	Leds 3mm Color 1	8
13	Q0, Q1, Q2, Q3, Q4, Q5	Leds 3mm Color 2	6
14	R3, R6, R9, R12, R13, R16, R19, R24	Resistor 10k	8
15	R1, R5, R8, R11, R14, R17, R20, R23	Resistor 1K x 1/2W	8
16	R2, R4, R7, R10, R15, R18, R21, R22	Resistor 510 ohms	8
17	R31, R32, R33, R34, R35, R36	Resistor 330 ohms	6
18	RELAY1, RELAY2, RELAY3, RELAY4, RELAY5, RELAY6	SRD-05VDC-SL-C	6

The latest version of the BOM (Bill of Materials) file, with more information, is available on:

<https://github.com/ElPercha/PLsi/tree/master/hard/v0-CPU/board/bom>

2.2.2 Assembly

There is no special considerations on the bulding process. This section will recommended a step by step secuencia to facilitate the assembly process:

2.3 Analog version

PLSi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

ANALOG resolution. Lineatization issue

2.3.1 Component list

PLSi is not fault-tolerant and must not be used to control equipment in hazardous environments

Item	Designator	Description	Quantity
1	U1	NodeMCU_ESP32S	1
2	U2	Touch Screen Display	1
3	U14	ULN2003N	1
4	INPUTS, OUTPUTS	5.08 x 10 Terminal block	2
5	U2 – SD Card conenction pins	Dupont 2.54mm Male strip	4 pins
6	U1 and U2 - Optional socket	Dupont 2.54mm Female strip	2 x 40 pins
7	5V	Dupont 3 pins male	3 pins
8	P4	HDR-IDC-2.54-2X4P	1
9	C2	Capacitor 1000uF 9V	1
10	OPTO1, OPTO2, OPTO3, OPTO4, OPTO5, OPTO6	Optocupler PC817	6
11	Z1, Z2, Z3, Z4, Z5, Z6	Diode 5v1 – Zenner 1w	6
12	I0, I1, I2, I3, I4, I5	Leds 3mm Color 1	6
13	Q0, Q1, Q2, Q3	Leds 3mm Color 2	4
14	R3, R6, R9, R12, R19, R24	Resistor 10k	6
15	R1, R5, R8, R11, R20, R23	Resistor 1K x 1/2W	6
16	R2, R4, R7, R10, R21, R22	Resistor 510 ohms	6
17	R31, R32, R33, R34	Resistor 330 ohms	4
18	RELAY1, RELAY2, RELAY3, RELAY4	SRD-05VDC-SL-C	4
19	D1, D2, D3, D4	Diode 1N4148	4
20	R25, R26, R37, R38, R39, R40	Resistor 10k 1%	6
21	R27,R29	Resistor 5k1	2
22	R28,R30	Resistor 3k3	2
23	U11	TLV2462CP	1

where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

2.3.2 Assembly

PLsi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

3. Firmware Download

PLsi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

3.1 Required files

PLsi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

3.2 Espressif download tool

PLsi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

3.3 Compile the source

PLsi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

3.3.1 PLsi customization

PLsi is not fault-tolerant and must not be used to control equipment in hazardous environments where the failure of the system could lead to death, people injury, or severe environmental damage. Refers to the Disclaimer notice for more information.

4. Hardware Validation

This step is optional but recommended.....

4.1 Digital Inputs validation

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4.2 Digital Outputs validation

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4.3 Analog Inputs validation

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4.4 Analog Outputs validation

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DIY: Como
construir:

listado de componentes

minimo para probar esp32 y display

explicacion del circuito

Detalles placa i2c etc
mencionar analogicos

construir placa

montaje paso a paso?

bajar firmware con
esp32 tool

0x1000 - bootloader_dio_40m.bin

0x8000 - partitions.bin

0xe000 - boot_app0.bin

0x10000 - firmware.bin

<https://www.espressif.com/en/products/socs/esp32/resources>

o compilar con
platformio no mucho
detalle

la herramienta esta incluida pero si quieres la ultima version proveer link
en la carpeta de la gherramienta esta el manual once you unzip

si tienen problemas que avisen