Smart Edge Computing

User Manual
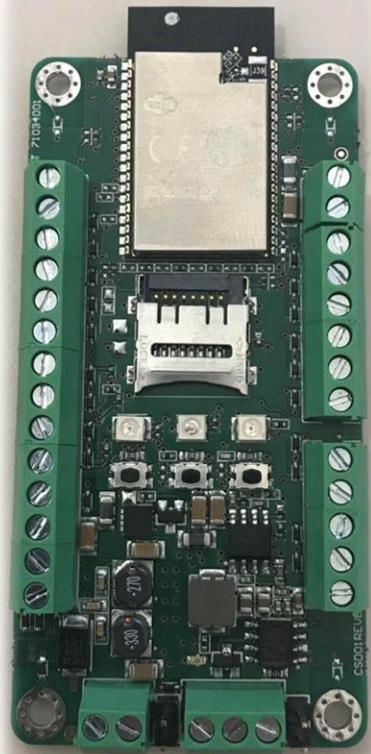
SENSE-D01

IoT Sensor to Cloud with ESP32-D0WDQ6 processor

REVISION HISTORY

Revision	Date	Note	Ref
1.0	09 March 2020	First Official Release.	LM
1.1	29 April 2020	Official Release.	LM
1.2	08 June 2020	Information added on connectors signal. Document's layout corrected	LM
1.3	11 June 2020	Add Others information on Expansion connectors	LM
1.4	15 June 2020	Add FCC ID in introduction	LM
1.3	25 June 2020	Global review	SB

# INDEX

Chapter 1.
INTRODUCTION

- Warranty
- Information and assistance
- RMA number request
- Safety
- Electrostatic discharges
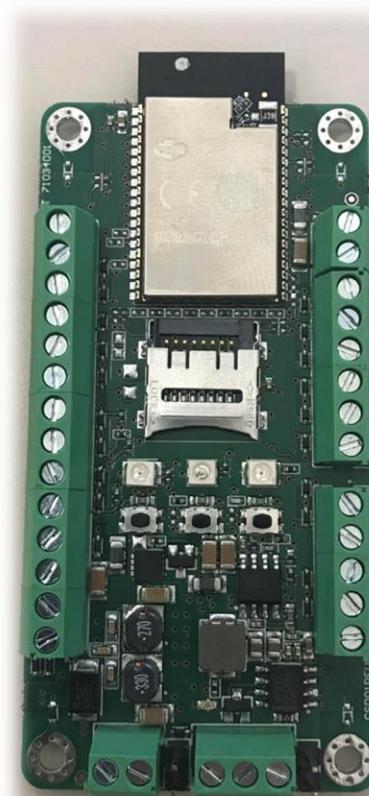
1.1 Warranty

This product is subject to the Italian Law Decree 24/2002, acting European Directive 1999/44/CE on matters of sale and warranties to consumers.

The warranty on this product lasts for 1 year.

Under the warranty period, the Supplier guarantees the buyer assistance and service for repairing, replacing or credit of the item, at the Supplier's own discretion.

Shipping costs that apply to non-conforming items or items that need replacement are to be paid by the customer.

Items cannot be returned unless previously authorized by the supplier.

The authorization is released after completing the specific form available on the web-site http://www.seco.com/en/prerma (RMA Online). The RMA authorization number must be put both on the packaging and on the documents shipped with the items, which must include all the accessories in their original packaging, with no signs of damage to, or tampering with, any returned item.

The error analysis form identifying the fault type must be completed by the customer and has must accompany the returned item.

If any of the above mentioned requirements for the RMA is not satisfied, the item will be shipped back and the customer will have to pay any and all shipping costs.

Following a technical analysis, the supplier will verify if all the requirements, for which a warranty service applies, are met. If the warranty cannot be applied, the Supplier will calculate the minimum cost of this initial analysis on the item and the repair costs. Costs for replaced components will be calculated separately.

Warning!
All changes or modifications to the equipment not explicitly approved by SECO S.p.A. could impair the equipment's functionalities and could void the warranty

1.2   Information and assistance

What do I have to do if the product is faulty?

SECO S.p.A. offers the following services:

- SECO website: visit http://www.seco.com to receive the latest information on the product. In most cases it is possible to find useful information to solve the problem.
- SECO Sales Representative: the Sales Rep can help to determine the exact cause of the problem and search for the best solution.
- SECO Help-Desk: contact SECO Technical Assistance. A technician is at disposal to understand the exact origin of the problem and suggest the correct solution.

  E-mail: technical.service@seco.com

  Fax (+39) 0575 340434

- Repair centre: it is possible to send the faulty product to the SECO Repair Centre. In this case, follow this procedure:
  - Returned items must be accompanied by a RMA Number. Items sent without the RMA number will be not accepted.
  - Returned items must be shipped in an appropriate package. SECO is not responsible for damages caused by accidental drop, improper usage, or customer neglect.

Note: Please have the following information before asking for technical assistance:

- Name and serial number of the product;
- Description of Customer's peripheral connections;
- Description of Customer's software (operating system, version, application software, etc.);
- A complete description of the problem;
- The exact words of every kind of error message encountered.

1.3   RMA number request

To request a RMA number, please visit SECO's web-site. On the home page, please select "RMA Online" and follow the procedure described.

A RMA Number will be sent within 1 working day (only for on-line RMA requests).

1.4   Safety

The SENSE D01 board uses only extremely-low voltages.

While handling the board, please use extreme caution to avoid any kind of risk or damages to electronic components.

> **!**
>
> Always switch the power off, and unplug the power supply unit, before handling the board and/or connecting cables or other boards.
>
> Avoid using metallic components - like paper clips, screws and similar - near the board when connected to a power supply, to avoid short circuits due to unwanted contacts with other board components.
>
> If the board has become wet, never connect it to any external power supply unit or battery.
>
> Check carefully that all cables are correctly connected and that they are not damaged.

1.5   Electrostatic discharges

The SENSE D01 board, like any other electronic product, is an electrostatic sensitive device: high voltages caused by static electricity could damage some or all the devices and/or components on-board.

> **!**
>
> Whenever handling a SENSE D01 board, ground yourself through an anti-static wrist strap. Placement of the board on an anti-static surface is also highly recommended.

Chapter 2.
OVERVIEW

- Introduction
- Technical specifications
- Electrical specifications
- Mechanical specifications
- Block diagram
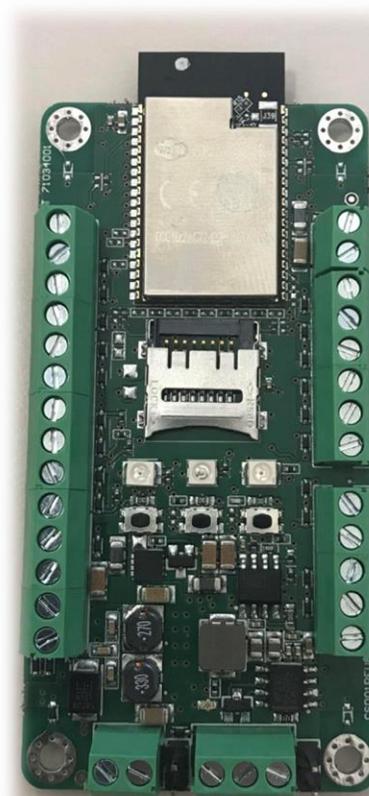
2.1   Introduction

SENSE D01 BOARD is an embedded Board with a form factor of just 86.36 x 40mm based on a module of Espressif ESP32-WROVER.

ESP32-WROVER is a powerful, generic WiFi-BT-BLE MCU module that targets a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as voice encoding, music streaming and MP3 decoding. This module is provided in two versions: one with a PCB antenna, the other with an IPEX antenna. ESP32- WROVER features a 4 MB external SPI flash and an additional 8 MB SPI Pseudo static RAM (PSRAM).

The core of this module is the ESP32-D0WDQ6 chip. The chip embedded is designed to be scalable and adaptive. There are two CPU cores that can be individually controlled, and the CPU clock frequency is adjustable from 80 MHz to 240 MHz. The user may also power off the CPU and make use of the low-power co-processor to constantly monitor the peripherals for changes or crossing of thresholds.

ESP32 integrates a rich set of peripherals, ranging from capacitive touch sensors, Hall sensors, SD card interface, Ethernet, high-speed SPI, UART, I²S and I²C. The integration of Bluetooth, Bluetooth LE and Wi-Fi ensures that a wide range of applications can be targeted, and that the module is all-around: using Wi-Fi allows a large physical range and direct connection to the Internet through a Wi-Fi router, while using Bluetooth allows the user to conveniently connect to the phone or broadcast low energy beacons for its detection. The sleep current of the ESP32 chip is less than 5 μA, making it suitable for battery powered and wearable electronics applications. The module supports a data rate of up to 150 Mbps, 802.11b at 13.5dBm and 802.11g,n at 18.5 dBm of output power at the antenna to ensure the widest physical range.

As such the module does offer industry-leading specifications and the best performance for electronic integration, range, power consumption, and connectivity. The operating system chosen for ESP32 is FreeRTOS with LwIP; TLS 1.2 with hardware acceleration is built in as well. Secure (encrypted) over the air (OTA) upgrade is also supported, so that users can upgrade their products even after their release, at minimum cost and effort.

This embedded module supports these peripherals: SD Card, CAN Bus, UART, ADC and DAC, 3 LEDs and 8 GPIO. This board is suitable both for IoT applications, due to its rich connectivity, and for industrial applications, since it can accept supply voltages in the range +9VDC ÷ + 36VDC (absolute voltage range). Please refer to following chapter for a complete list of all peripherals integrated and characteristics.

This device complies with the FCC Rules and Contains Transmitter Module FCC ID: 2AC7Z-ESP32WROVER.

2.2 Technical specifications

Module

Espressif ESP32-WROVER Module

Flash

4 MB

PSRAM

8 MB

Mass Storage

microSD Card slot

Networking

WiFi: 802.11 b/g/n (802.11n up to 150 Mbps)

Bluetooth: Bluetooth v4.2 BR/EDR and BLE specification

Peripherals

SD card, UART, SPI, SDIO, I2C, LED PWM, Motor PWM, I2S, IR, pulse counter, GPIO, capacitive touch sensor, ADC, DAC

Power supply: $+12V_{DC} \div + 24V_{DC}$ recommended.

                        Minimum Current 1A @ 24Vdc
                        $+9V_{DC} \div +36V_{DC}$ absolute

Operating temperature: $-40°C \div +60°C$

Dimensions: 86.36 x 40 mm

2.3   Electrical specifications

The SENSE D01 board can be supplied with any voltage in the range $+9V_{DC} \div +36V_{DC}$ range (absolute voltage range).

This voltage can be supplied through a standard a 2-position Terminal Block (P1).

Power IN PCB terminal block - P1	
Pin	Signal
1	V_{IN}
2	GND

2.4   Mechanical specifications

The board dimensions are 86.36 x 40 mm.

The printed circuit of the board is made of six layers, some of them are ground planes, for disturbance rejection.
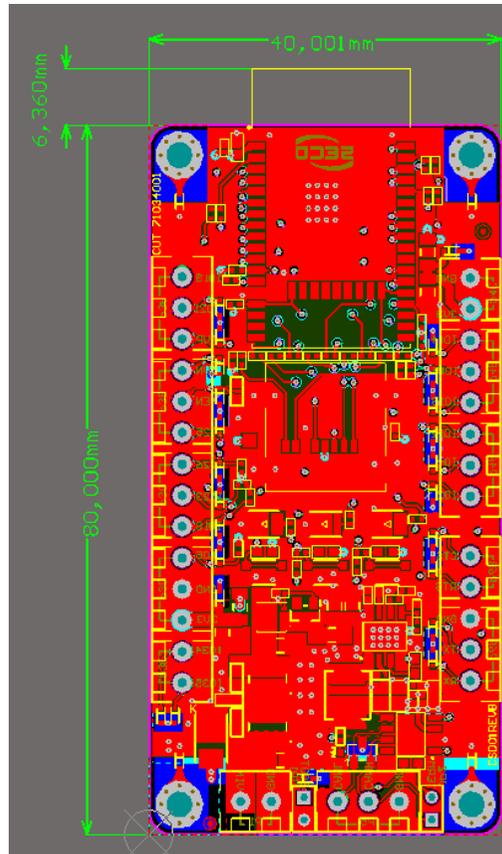
2.5   Block diagram and Hw configuration

Block diagram is described below.
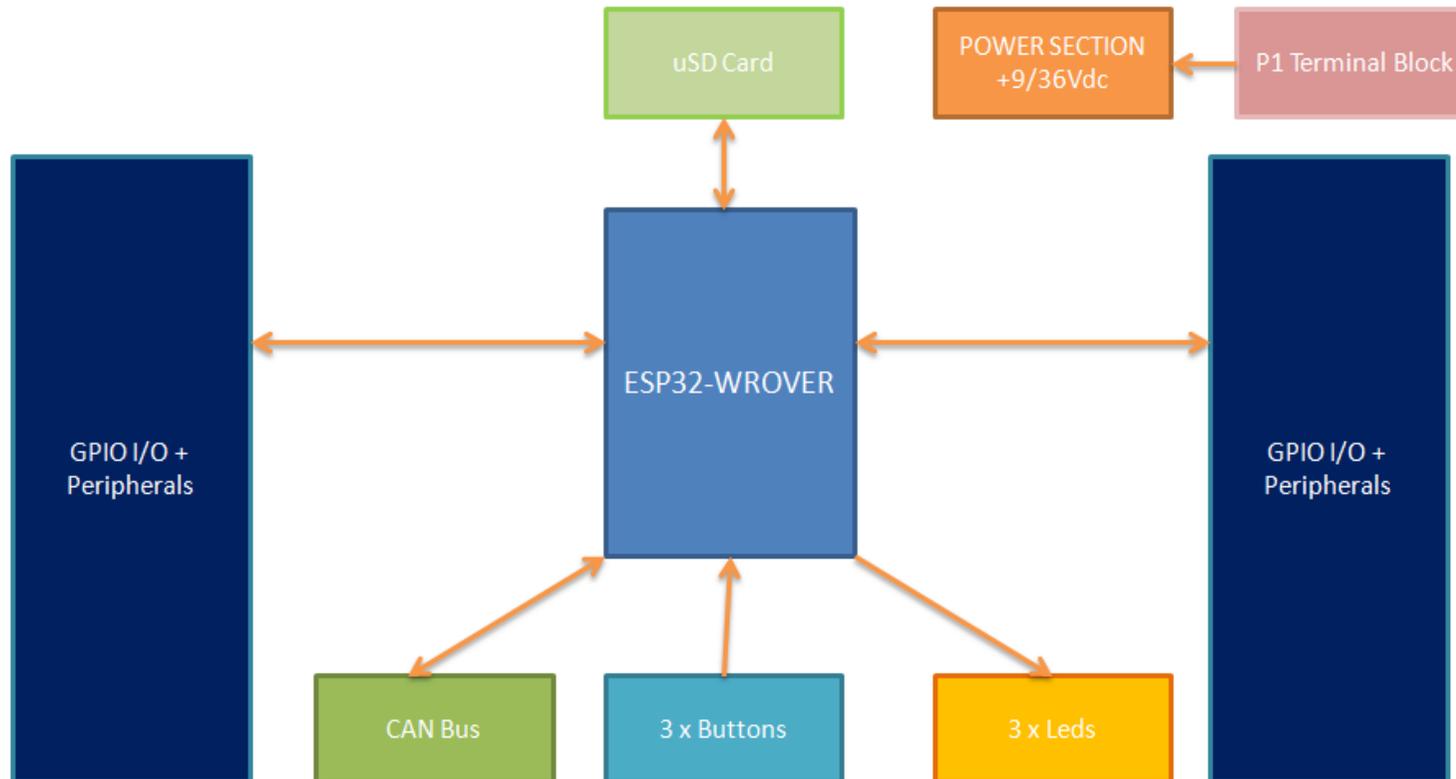
Chapter 3.
CONNECTORS

- Introduction
- Connectors overview
- Connectors description
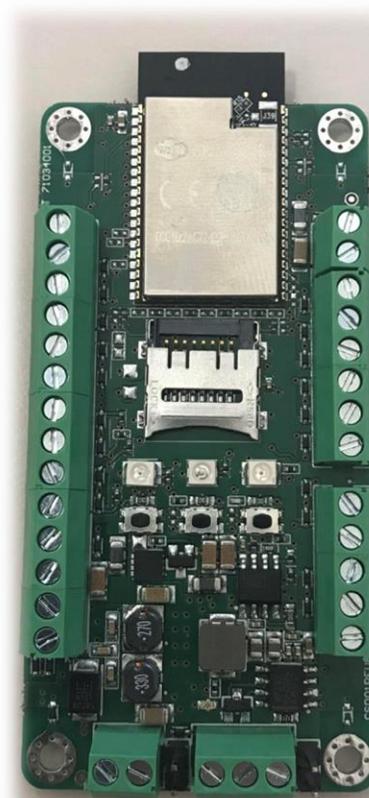
3.1   Introduction

On SENSE D01 board, there are several connectors located on the upper plane.
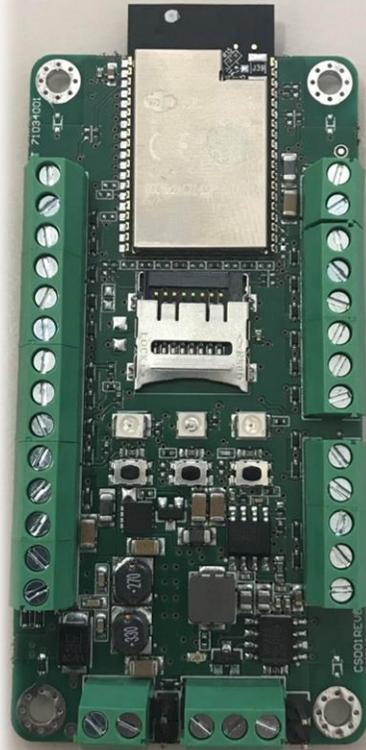
TOP VIEW

BOTTOM VIEW

! Please be aware that, depending on the configuration purchased, the appearance of the board could be slightly different from the above pictures.

3.2 Connectors overview

| Name	Description	Name	Description
P1	DC IN Terminal Block	P6A, P6B	UART Connector
P2	uSD Card Connector	SW1	EN
P3A, P3B, P3C, P3D, P3E	Expansion Connector #1	SW2	Button 2
P4A, P4B, P4C	Expansion Connector #2	SW3	Button 3
P5	CAN Connector		

3.3 Connectors description

The Sense D01 board offers the possibility of accessing directly to some of the various features offered by ESP32 processor through the pin multiplexing. For this reason, onboard there are two dedicated connectors, P3 and P4, which are standard Ultra Low Profile PCB Terminal Blocks.

For details concerning pin multiplexing possibilities on the connectors please also refer to the manual of the ESP32-WROVER module (https://www.espressif.com/sites/default/files/documentation/esp32-wrover_datasheet_en.pdf). Please consider that, due to the internal connections of the signals, not all the interfaces normally offered by ESP32 module can be used. Always refer to the interfaced enumerated in the following tables.

3.3.1 Expansion Connector #1

This connector offers the following possibilities:

- Up to 9x GPIOs, six of them managed also in Ultra low Power States
- Up to 6x Capacitive sensing GPIs
- Up to 6x analogic Inputs
- Up to 2 DAC Outputs
- General Purpose SPI interface

Expansion Connector #1 - Terminal Block P3						
Pin nr.	Pin Name	GPIO Interface	SPI Interface	A/D Interface	D/A Interface	Deep State GPIO
P3A-1 (*)	IO19	GPIO19	VSPIQ			
P3A-2 (**)	IO21	GPIO21	VSPIHD			
P3A-3	SENSOR_VP	GPIO36		ADC1_CH0		RTC_GPIO0
P3B-1	SENSOR_VN	GPIO39		ADC1_CH3		RTC_GPIO3
P3B-2				N.C.		
P3B-3	IO25	GPIO25		ADC2_CH8	DAC_1	RTC_GPIO6
P3C-1	IO26	GPIO26		ADC2_CH9	DAC_2	RTC_GPIO7
P3C-2	IO23	GPIO23	VSPID			
P3C-3	IO18	GPIO18	VSPICLK			
P3D-1	IO5	GPIO5	VSPICS0			
P3D-2	GND	GND				

P3D-3	3V3	3V3 Vdc		
P3E-1 (***)	IO34	GPIO34	ADC1_CH6	RTC_GPIO4
P3E-2 (***)	IO35	GPIO35	ADC1_CH7	RTC_GPIO5

(*) The pin P3A-1 can be used only in case it is not used as CTS interface on connector P6B-2

(**) The signals on pin P3A-2 are available only in case that the module doesn't have the CAN Bus transceiver mounted (connector P5)

(***) connector P3E is available only in case that the module purchased doesn't have the two pushbutton SW2 and SW3 mounted. In this case, among the functionalities provided by the ESP32 module, there is also the possibility of using these pins as external pushbuttons.

3.3.2 Expansion Connector #2

This connector, that can be completely used only in case that the microSD card slot P2 is not mounted, offers the following possibilities:

- SD Host interface
- SDIO/SPI Slave interface (to communicate with the processor using SDIO interface)
- Up to 6x GPIOs, all of them managed also in Ultra low Power States
- Up to 6x Capacitive sensing GPIs
- Up to 6x analogic Inputs
- General Purpose SPI interface
- JTAG interface

Expansion Connector #2 - Terminal Block P4								
Pin nr.	Pin Name	SDIO/SPI Slave	GPIO	Capacitive Sensing	General Purpose SPI	A/D Interface	Deep State GPIO	SD Host Interface	JTAG Interface
P4A-1	IO2	SD_DATA0	GPIO2	TOUCH2	HSPIWP	ADC2_CH2	RTC_GPIO12	HS2_DATA0	
P4A-2	IO4	SD_DATA1	GPIO4	TOUCH0	HSPIHD	ADC2_CH0	RTC_GPIO10	HS2_DATA1	
P4A-3	IO12	SD_DATA2	GPIO12	TOUCH5	HSPIQ	ADC2_CH5	RTC_GPIO15	HS2_DATA2	MTDI
P4B-1	IO13	SD_DATA3	GPIO13	TOUCH4	HSPID	ADC2_CH4	RTC_GPIO14	HS2_DATA3	MTCK
P4B-2	IO15	SD_CMD	GPIO15	TOUCH3	HSPICS0	ADC2_CH3	RTC_GPIO13	HS2_CMD	MTDO
P4B-3	IO14	SD_CLK	GPIO14	TOUCH6	HSPICLK	ADC2_CH6	RTC_GPIO16	HS2_CLK	MTMS
P4C-1	3V3	3V3 Vdc							
P4C-2	GND	GND							

When SD card is available on SENSE-D01 module, only P4C portion of the connector will be available

3.3.3 Optional CAN Interface

This PCB terminal block offer the possibility to connect SENSE-D01 module to a CAN Bus network. The interface is provided by ESP32 processor through a SN65HVD23 CAN Bus Transceiver.

By plugging a jumper on JP2, it is possible to insert also the 120 Ohm termination required.

CAN Interface - Terminal Block P5	
Pin	**Signal**
P5-1	CANL
P5-2	CANH
P5-3	GND

Please be aware that, when the module is provided with CAN Bus interface installed, then it will not be possible use UART signals RTS and CTS (PCB Terminal block P6B will be not mounted).

3.3.4 UART Interface

On this connector, it is available a 4-wire UART interface at TTL level.

P6B connector will be available only in case that the module is provided without Can Bus interface (i.e. CAN Bus interface will limit the UART interface to RX and TX signals only).

UART Interface - Terminal Block P6	
Pin	**Signal**
P6A-1	RX
P6A-2	TX
P6A-3	GND
P6B-1	RTS
P6B-2	CTS

3.3.5 Buttons / LED

On the module, there are up to three pushbuttons. The first one, SW1, is always available, and must be used to turn on/off the module.

The other two pushbuttons, SW2 and SW3, are optional, and can be user-programmed. They are managed through ESP 32-WROVER pins IO34 and IO35.

There are also four LEDS onboard.

Green LED D28 always shows when the module is powered.

Green LED D1, Blue LED D2 and Yellow LED D10 are user-programmable, considering that they are managed by ESP 32-WROVER pins IO27, IO32 and IO33, respectively.

Chapter 4.
FW SETUP

- Development Environment
- Firmware Download
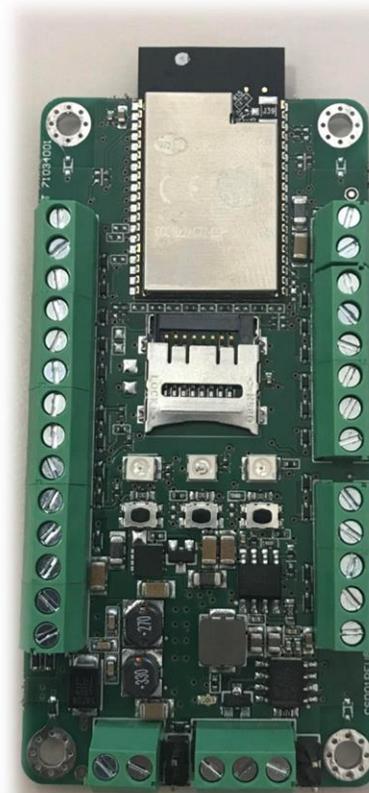
4.1   Development Environment

All the software documentation you need to create a new firmware project and use the ESP32 chip is contained in the official Espressif's documentation pages.

You can start from this reference page:
https://docs.espressif.com/projects/esp-idf/en/latest/get-started/index.html#

Here are some tags to useful sections to get started with development.

Setting up Development Environment
https://docs.espressif.com/projects/esp-idf/en/latest/esp32/get-started/index.html#installation-step-by-step

Creating Your Project
https://docs.espressif.com/projects/esp-idf/en/latest/esp32/get-started/index.html#step-5-start-a-project

4.2   Firmware Download

Below is a brief description of the steps to be carried out for loading and testing the firmware.

- Connect a USB to Serial adapter to the P6A connector (Rx, Tx, GND signals needs to be connected to the Tx, Rx, GND signals of the USB serial adapter);
- Close the JP1 Jumper (Boot) to let Firmware initiate in Download Mode at boot for downloading firmware through the serial port.
- Power up the board and use Espressif's official Flash Download Tools to run the flash command.
- After the firmware has been flashed you can remove the JP1 Jumper (Boot) and restart the board with the SW1 (EN) button, or by removing and reconnecting the power, to start the firmware in Normal Execution Mode.

On this page the official documentation about the Flash onto the Device
https://docs.espressif.com/projects/esp-idf/en/latest/esp32/get-started/index.html#step-9-flash-onto-the-device

- After downloading the bin file, open a serial terminal with the setup shown below, choose your COM Port as you have configured.
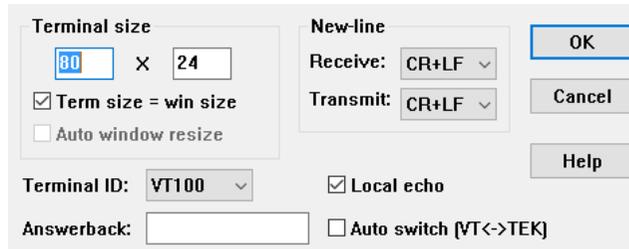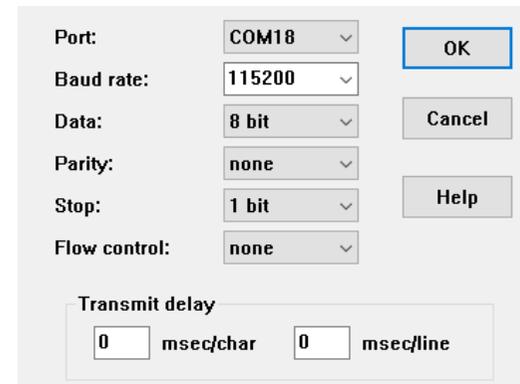
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