

Smart Edge Computing

User Manual



SENSE-D47

IoT Enhanced Sensor to Cloud with ESP32-D0WD-V3Q6 processor



www.seco.com

REVISION HISTORY

Revision	Date	Note	Ref
1.0	21 October 2020	First Release.	LM
1.1	30 October 2020	Internal Review of Hardware section	SB
1.2	04 November 2020	EDGEHOG section added, minor typo fixed	LP
1.3	16 November 2020	ROHS, FCC certification paragraph added Introduction paragraph updated Recommend Antennas added	GL

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For further information on this module or other SECO products, but also to get the required assistance for any and possible issues, please contact us using the dedicated web form available at <http://www.seco.com> (registration required).

Our team is ready to assist.

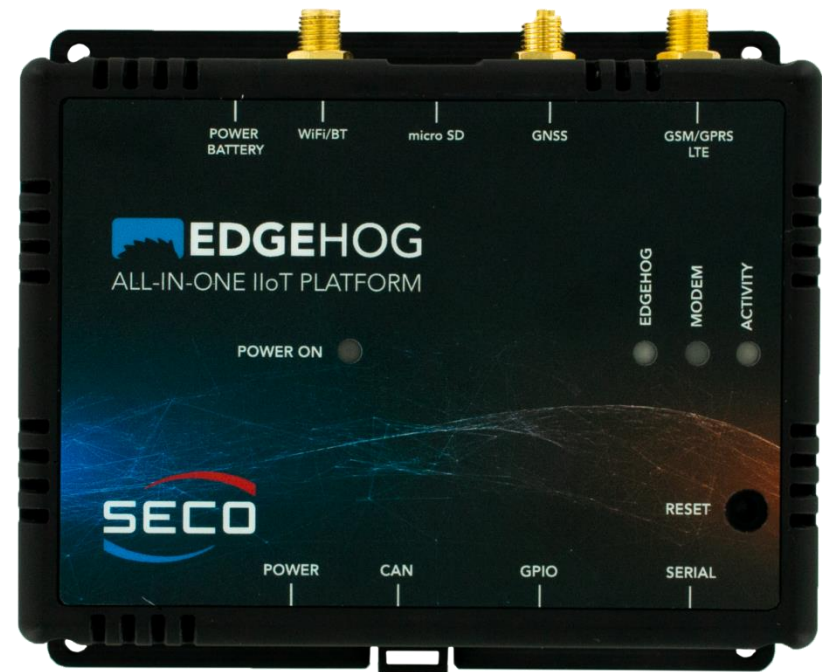


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Chapter 1. INTRODUCTION

- Warranty
- Information and assistance
- RMA number request
- Safety
- Electrostatic discharges
- RoHS compliance
- FCC certification



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.

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 D47 system uses only extremely-low voltages.

While handling the system, 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 D47 system, 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 D47 System, ground yourself through an anti-static wrist strap. Placement of the board on an anti-static surface is also highly recommended.

1.6 RoHS compliance

The SENSE-D47 system is designed using RoHS compliant components and is manufactured on a lead-free production line. It is therefore fully RoHS compliant.

1.7 FCC certification

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



Warning!

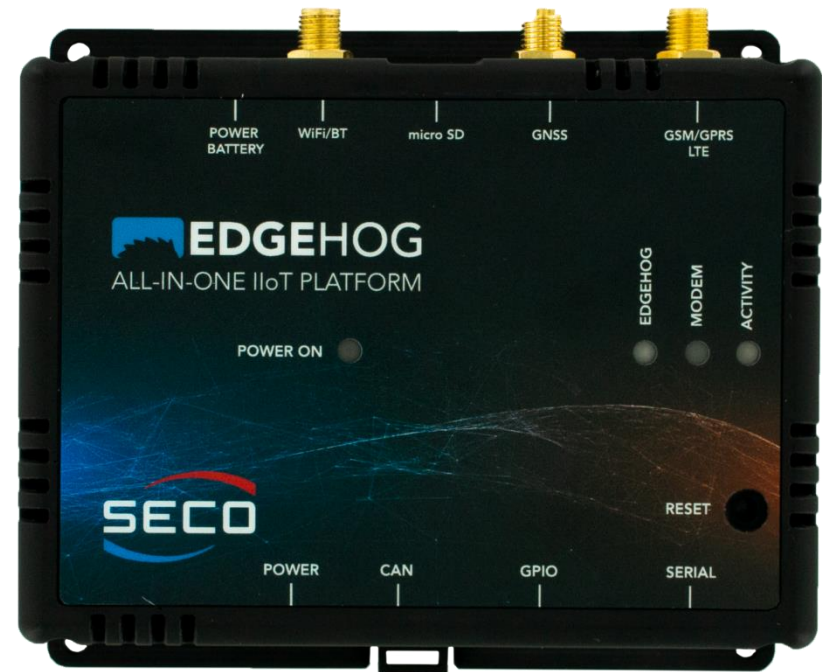
All changes or modifications to the equipment not explicitly approved by SECO S.p.A. could impair the equipment's functionalities and could void the warranty

To comply with FCC RF exposure compliance requirements, a separation distance of at least 20 cm must be maintained between the antenna of this device and all nearby persons.

SECO S.p.A.
Model: SYS-D47-IOT
FCC ID: 2ALZB-SYSD47IOT

Chapter 2. OVERVIEW

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



2.1 Introduction

SENSE D47 is a boxed module with a form factor of just 110 x 91 x 31 mm 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 with an IPEX antenna.

ESP32-WROVER-IE features a 16 MB external SPI flash and an additional 8 MB SPI Pseudo static RAM (PSRAM).

The core of the module is the ESP32-D0WD-V3 chip. The embedded chip 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 chip has also a low-power co-processor that can be used instead of the CPU to save power while performing tasks that do not require much computing power, such as monitoring of peripherals.

The integration of Bluetooth, Bluetooth LE and Wi-Fi ensure 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 μ A, 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 to 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. 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 module is suitable both for IoT applications, due to its rich connectivity, and for industrial applications, as it can accept supply voltages in the range $+9V_{DC} \div +24V_{DC}$. The board is also equipped with a GSM/GPRS module, SIM868, or Multi-Band CAT-M and NB-IoT 4g Module, SIM7080G, for communication of data to cloud if WiFi is unavailable. Both of them also offer GNSS (GPS) functionality.

Inside the system, a LiPo 2000mAh backup battery allows the working of the module also in absence of a direct power supply.

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 Modules:

FCC ID: 2AC7Z-ESP32WROVERE (BT/BLE/WiFi 2.4 GHz “Espressif ESP32-WROVER-IE”) and FCC ID: UDV-201607 (GSM/GPRS “SIM868”)

or

FCC ID: 2AC7Z-ESP32WROVERE (BT/BLE/WiFi 2.4 GHz “Espressif ESP32-WROVER-IE”) and FCC ID: 2AJYU-8VC0002 (Multi-Band CAT-M and NB-IoT 4g Module SIM7080G).

2.2 Technical specifications

Module

Espressif ESP32-WROVER-IE Module

Flash

16 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

Modem: SIM868 Quad-Band GSM/GPRS module with GNSS or SIM7080G Multi-Band CAT-M and NB-IoT module solution with GNSS

Peripherals

SD card, UART, I2C, ADC, GPIO, Can BUS, UART TTL/RS232

Power supply: +9V_{DC} ÷ +24V_{DC} recommended.
+8.1V_{DC} ÷ +26.4V_{DC} absolute
Optional 2000mAh rechargeable battery, LIR18650

Operating temperature: 0°C ÷ +45°C

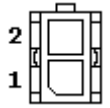
Dimensions: 110 x 91 x 31 mm

2.3 Electrical specifications

The SENSE D47 board can be supplied with any voltage in the range $+8.1V_{DC} \div +26.4V_{DC}$ range (absolute voltage range).

It is recommended to use a supply voltage in the range 9V .. 24VDC, however.

This voltage can be supplied through a standard 2-position Micro-Fit header (P1).



Power IN connector - P1	
Pin	Signal
1	V_{IN}
2	GND

2.4 Mechanical specifications

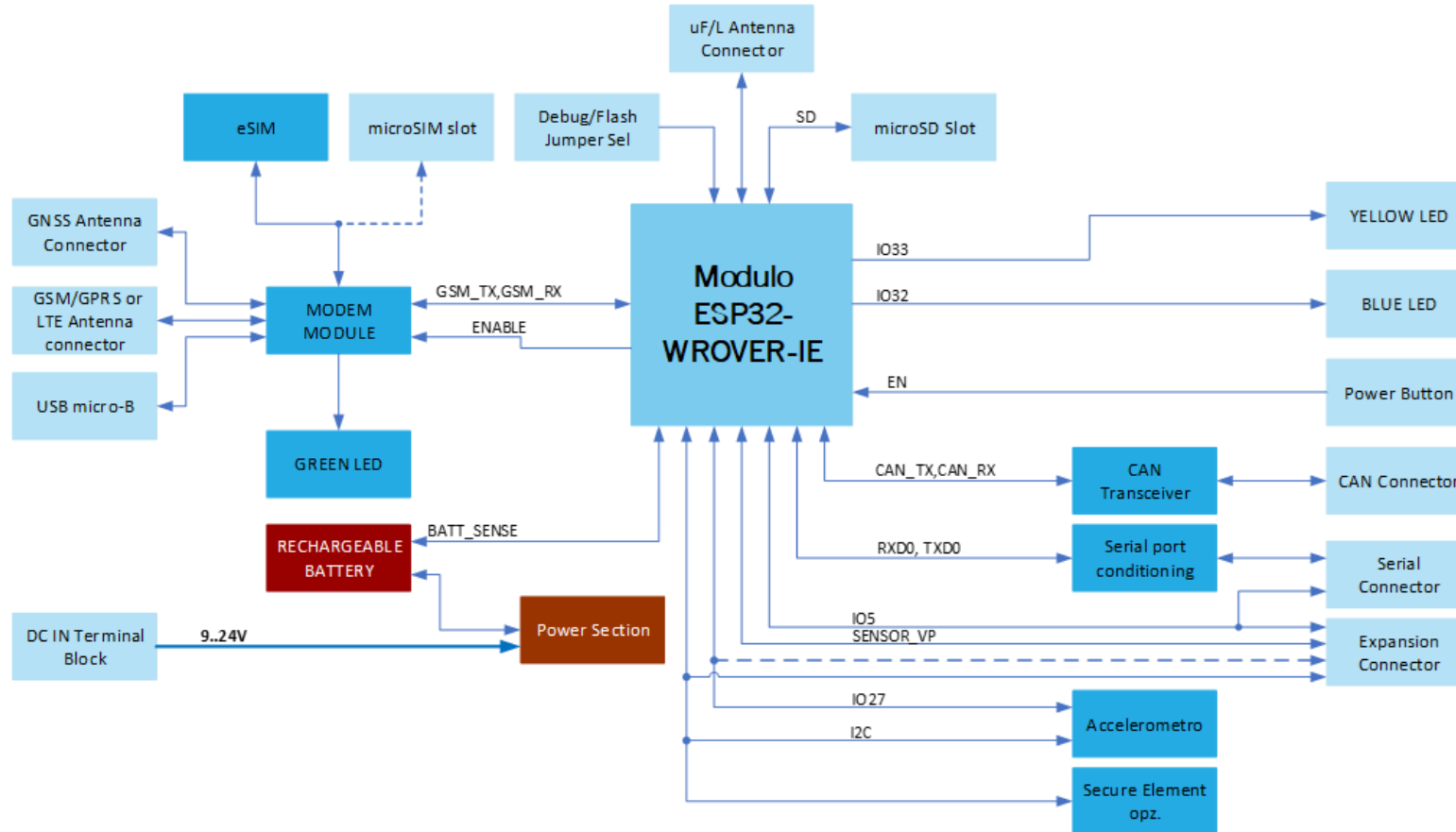
The dimensions are 110 x 91 x 31 mm.



The printed circuit of the internal board is made of six layers, some of them are ground planes, for disturbance rejection.

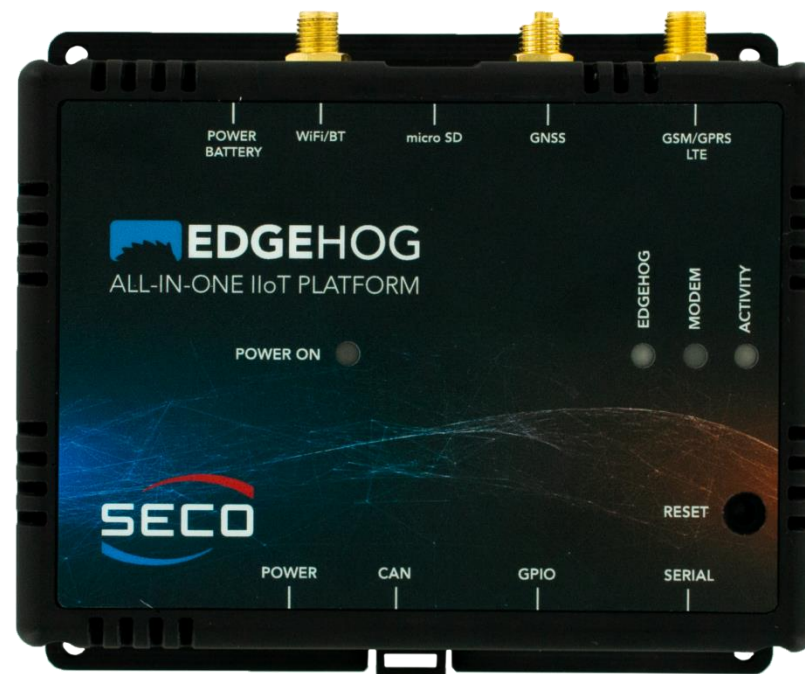
2.5 Block diagram

Block diagram is described below.



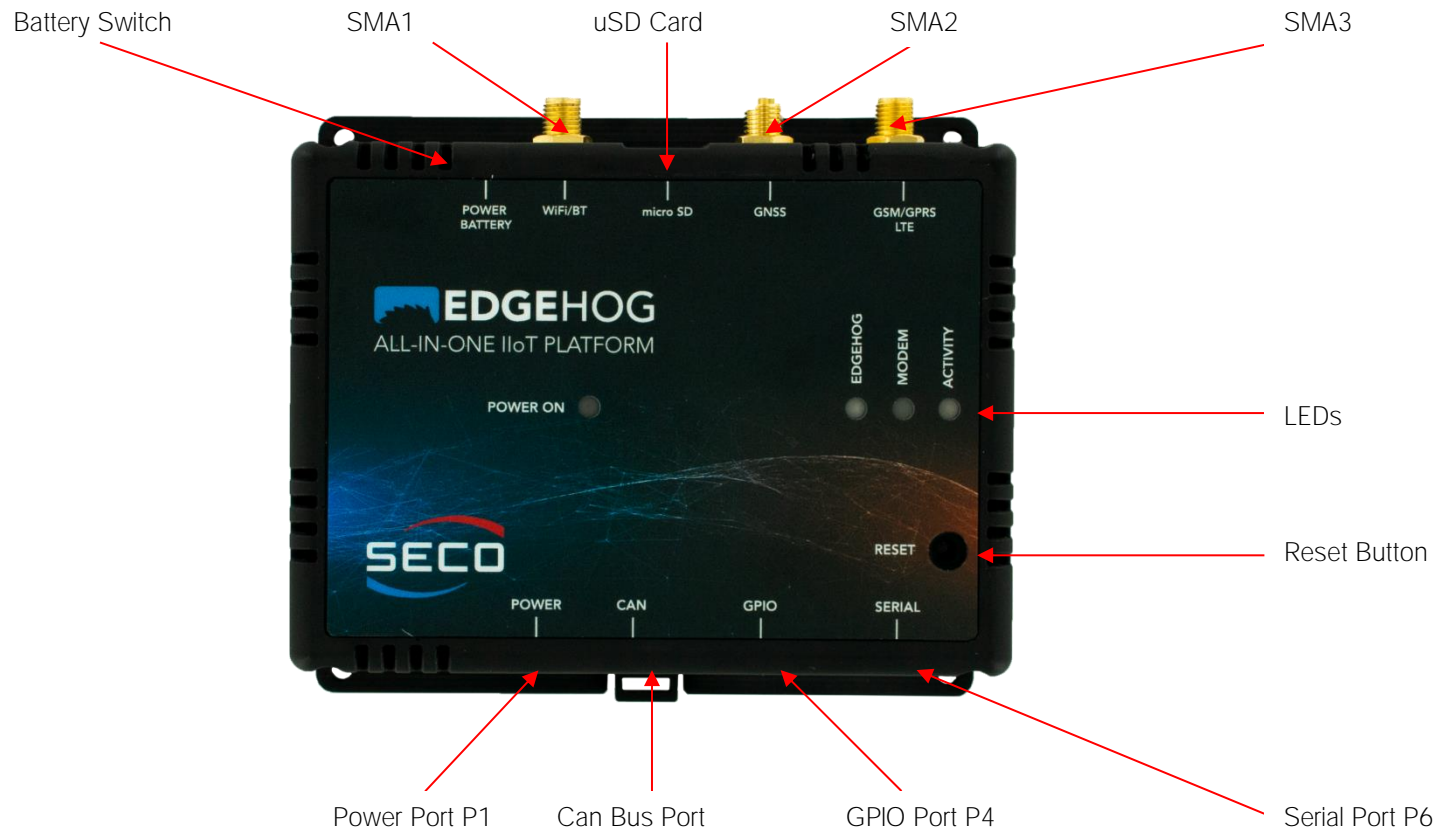
Chapter 3. CONNECTORS

- Introduction
- Connectors overview
- Connectors description



3.1 Introduction

On SENSE-D47 board, there are several connectors located on the lower and upper part of the enclosure. Moreover, there is a hardware reset button and three LEDs for activity, modem and EDGEHOG connection.



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

3.2 Connectors overview

Name	Description	Name	Description
P1	DC IN Micro Fit Header	P6	UART TTL/RS232 Connector
P2	Battery Switch	SMA1	WiFi/BT SMA
P3	μSD Card	SMA2	GNSS SMA
P4	GPIO Port	SMA3	GSM/GPRS/LTE SMA
P5	CAN Connector		

3.3 Connectors description

3.3.1 Battery switch P2

The Sense-D47 System can be powered with an optional LiPo battery, 2000mAh capacity. The battery switch P2 is used to disconnect the battery each time it is necessary to preserve the battery charge capability, i.e. to avoid that it discharges completely (e.g. during system shipment). At first use, power the board using connector P1 and slide the switch to the left position. In this position, the battery will be inserted and in charge.

3.3.2 μ SD Card Connector P3

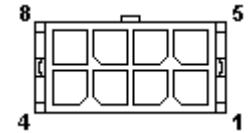
The connector P3 is a μ SD Card slot, push-push type. Please insert a micro SD Card if you want to increase storage of the SENSE D47 System.

3.3.3 GPIO Connector P4

GPIO Connector P4 is a micro-Fit connector, 2 x 4 poles, type MOLEX 43045-0801 or equivalent. Mating connector MOLEX 43025-0800 or equivalent with 43030 series Female Crimp terminal.

This connector offers the following possibilities:

- Up to 2x GPI managed also in Ultra low Power States
- Up to 3x GPIOs
- Up to 2x analogic Inputs
- General Purpose I2C Interface



GPIO Connector #1 - Terminal Block P4					
Pin nr.	Pin Name	GPIO Interface	I2C Interface	A/D Interface	Deep State GPIO
P4-1	3V3 OUT (*)		3.3V output, 1.5A Max		
P4-2(**)	SENSOR_VN	GPI39		ADC1_CH3	RTC_GPI3
P4-3 (***)	IO5	GPIO5			
P4-4 (****)	IO19	GPIO19	SCL		
P4-5	SENSOR_VP	GPI36		ADC1_CH0	RTC_GPIO
P4-6			N.C.		
P4-7(***)	IO18	GPIO18	SDA		
P4-8	GND		Power GND		

(*) 3.3V Out signal can be SW disabled when the system is powered by the internal battery, in order to avoid an excessive discharge

(**) The pin P4-2 is available only in case the system doesn't have the optional accelerometer mounted.

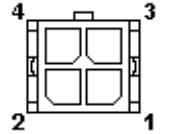
(***) the pin P4-3 can be used only in case it is not used as RTS interface on connector P6 (pin #1)

(****) When the optional accelerometer and/or Trusted Secure Element are mounted then these signals can be used exclusively as I2C interface

3.3.4 CAN Connector P5

The CAN interface is available on connector P5, which is a micro-Fit connector, 2x2 poles, type MOLEX 43045-0401 or equivalent. Mating connector MOLEX 43025-0400 or equivalent with 43030 series Female Crimp terminal.

This connector offers the possibility to connect SENSE-D47 module to a CAN Bus network. The interface is provided by ESP32 processor through a SN65HVD23 CAN Bus Transceiver.



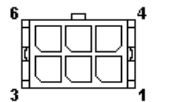
By plugging a jumper on JP2, it is possible to insert also the 120 Ohm termination required.

CAN Interface - Terminal Block P5	
Pin	Signal
P5-1	---
P5-2	GND
P5-3	CAN_L
P5-4	CAN_H

3.3.5 Serial Port Interface

The Serial Port interface is available on a micro-Fit connector, 2x3 poles, type MOLEX 43045-0601 or equivalent. Mating connector MOLEX 43025-0600 or equivalent with 43030 series Female Crimp terminal.

This serial port is available both with RS-232 or with TTL levels. The selection between the kind of interface is made using the internal jumper JP3...JP8 according to the table below



Serial Port Interface - P6		
Pin	RS-232 Signal	UART Signal
P6-1	---	IO5 (RTS#)
P6-2	GND	GND

P6-3	GND	GND
P6-4	RS232_Rx	UART_Rx
P6-5	RS232_Tx	UART_Tx
P6-5	+3.3V_OUT	

The IO5 pin, which is also available on connector P4 (pin #3), can be used to manage an external RS-485 transceiver. In this case it will be necessary to use this signal as RTS# signal, and drive it opportunely to select the flow direction on RS-485 port (transmit or receive).

Serial Port interface Selection- P6						
Interface Type	JP3	JP4	JP5	JP6	JP7	JP8
UART	Closed	Open	Open	Open	Open	Closed
RS-232	Open	Closed	Closed	Closed	Closed	Open

3.3.6 SMA Connectors

The SENSE-D47 module offers three different SMA connectors.

SMA1 Connector must be used for WiFi/BT antenna functionality.

SMA2 connector must be used for GPS (GNSS) functionality.

SMA3 connector must be used for GSM/GPRS or LTE antenna.

Please be aware that the module is not supplied with the external antennas, which must then be provided by the customer.

3.3.6.1 RECOMMENDED ANTENNAS

It is recommended that the system is used with antenna with characteristics non-pejorative than those indicated in the following tables.

WIFI Antenna Jinchang Electron JCW063	
Frequency Range	2400~2483.5MHz
Polarization	Linear
Gain (Zenith)	3.0dBi
V.S.W.R(min)	<2.0
Impedance	50Ω

LTE Antenna Jinchang Electron JCG108L	
Frequency Range	698~960/1710~2690MHz
Polarization	Linear
Gain (Zenith)	2.0dBi
V.S.W.R(min)	<2.5
Impedance	50Ω

GPS Active Antenna Jinchang Electron JCA002	
Frequency Range	1575.42±3MHz
Band Width	CF±5MHz
Polarization	RHCP
Gain (Zenith)	2.0dBic
V.S.W.R(min)	<1.5
Impedance	50Ω
Axial Ratio	3 dB (max)

3.3.7 Buttons / LED

On the module, there is a pushbutton SW1 (RESET), which must be used to restart the module. This is connected to the EN signal of the ESP32-WROVER.

There are also four LEDs onboard.

White LED (POWER ON) shows when the module is powered.

Blue LED (EDGEHOG) shows if the device is connected to EDGEHOG Cloud.

Yellow LED (ACTIVITY) shows WiFi/BT activity or various types of reports.

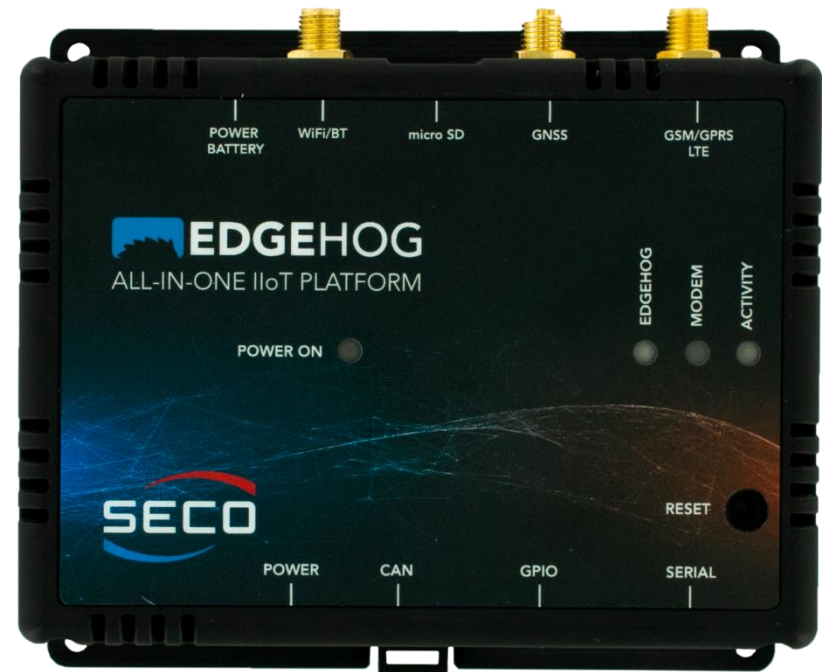
Green LED (MODEM) signals modem connection to a registered network and activity, according to the modem's signalling.

Blue and Yellow LEDs are user-programmable by firmware, considering that they are managed by ESP 32-WROVER pins IO32 and IO33, respectively.



Chapter 4. FW SETUP

- EDGEHOG Micro Firmware
- Development Environment
- Firmware Download



4.1 EDGEHOG Micro Firmware

The board, unless otherwise agreed with the customer, comes with a preloaded firmware that connects to EDGEHOG Cloud and allows remote management.

Among the main features of the EDGEHOG platform, provided by the EDGEHOG Micro Firmware, there are the possibility to view the connection status of the device and various information on the resources used in the system, perform FOTA (Firmware Over The Air) upgrades, geolocation of the device via A-GPS, upload configuration files and others.

Please, check the following links to have more information about the EDGEHOG platform.

[EDGEHOG.io](https://edgehog.io)

[EDGEHOG Documentation](#)

4.2 Development Environment

The device can also be used with a firmware other than EDGEHOG Micro. In this section and in the next one you can find how to create your own firmware and load it on the device.

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 the [Get Started](#) page and continue by carefully reading all the documentation provided by Espressif.

Although all pages of the documentation are important, we would like to point out some useful links to start with the development of your own project.

Here you can find how to [Setting up Development Environment](#).

This page shows how to [Creating Your Project](#) while at these links you can see how to [Configure](#) and [Build Your Project](#).

4.3 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 P6 connector (Rx, Tx, GND signals needs to be connected to the Tx, Rx, GND signals of the USB serial adapter); Check the [Connect your device](#) and [Establish Serial Connection](#) pages for more info.
- 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 or restart it with the SW1 (RESET) button and use Espressif's official Flash Download Tools to run the flash command. Check the [Flash onto the device](#) pages.
- After the firmware has been flashed you can remove the JP1 Jumper (Boot) and restart the board with the SW1 (RESET) button, or by removing and reconnecting the power, to start the firmware in Normal Execution Mode and see you firmware running.
- Once the firmware is running, you can open the serial port to monitor and debug. See the [Monitor](#) section to use the official tool.



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