F01 S3

pycom
go invent

F01 S3

pycom
go invent

IMPORTANT: These specifications may be subject to change without further notice.

F01 S3

pycom
go invent

Size
40mm x 16mm x 2.7mm
(with headers)

Temperature Range
−30 to +70 °C

1.0   Overview

With LoRa, WiFi, BLE and cellular LTE–CAT M1/ NB1,
the F01 S3 is Pycom's latest and most powerful,
MicroPython-programmable microcontroller
OEM module. It's the perfect enterprise grade IoT
platform for flexible multi-network creations and
rapid scaling of Things that connect to the Internet.

– Powerful Espressif ESP32 S3 CPU
– Semtech LoRa network module
– Sequans Monarch for dual cellular modes
  Cat-M1/NB1
– Flagship NXP Security chip
– Easily SMT mounts onto standard carrier
  boards, breadboards or M.2 boards
– Optional: External antenna connectors, RGB
  LED, Reset buttons and more
– Four Networks including WiFi, BLE, Cellular
  LTE–CAT M1/NB1, LoRa (and Sigfox as optional
  addition)
– World ready as one product covers all
  LoRa(WAN) frequencies (apart from
  433/470MHz) and LTE–M bands.
– MicroPython programmable with Ultra–Low
  power usage: a fraction of
– other connected microcontrollers.
– 28 IOs broken out on the module pads
– Size 40mm x 16mm x 2.7mm

2.0   Features

IMPORTANT: These specifications may be subject to change without further notice.

3.0 Specifications

3.1 CPU

– Microcontroller ESP32 S3

– Xtensa® dual-core 32-bit LX7 microcontroller, up to 240MHz.

– Hardware floating point acceleration

– Python multi–threading

– 512 KB of internal SRAM

– 384 KB of internal ROM

– 16 KB SRAM in RTC

3.2 Encryption

– Flagship SE050C2HQ 140nm NXP® IntegralSecurity architecture

– Common Criteria EAL 6+ certified up to OS level as a safe environment to

– run pre-installed NXP IoT applets, supporting full encrypted

– communications and secured lifecycle management

– RSA & ECC functionalities, high key length and future proof curves

– AES & 3DES encryption and decryption

– HMAC, CMAC, SHA-1, SHA-224/256/384/512 operations

– HKDF, MIFARE® KDF, PRF (TLS-PSK)

– Support of main TPM functionalities

– Secured flash user memory up to 50kB

– I2C Target (High-speed mode, 3.4 Mbit/s), I2C Controller (Fast-mode, 400 kbit/s)

– SCP03 (bus encryption and encrypted credential injection on applet and platform level)

– Standard (-25 to +85 °C) and extended temp range for industrial applications (-40 to +105 °C)

3.3 External Memory

– 8 Mbytes of RAM

– 8 Mbytes of flash

3.4 WiFi

– Expressif ESP32-S3

– 802.11b/g/n

3.5 Bluetooth

– Expressif ESP32-S3

– Low energy

– Bluetooth LE: Bluetooth 5, Bluetooth mesh

– Data rate: 2 Mbps

3.6 LoRa

– Semtech SX1261

– LoRaWAN stack – Class A, B & C Devices

– 868/915MHz LPWA Module

– Transmit up to +22dBm.

– Low power consumption

3.7 LTE CAT–M1/NB–IoT

– Sequans GM02S specification

– One single chip for both CAT M1 and NB1

– LTE CAT M1 – 23 dBm

– 3GPP release 13 compliant

– 3GPP Rel. 13 eDRX and PSM modes

– Power Consumption: enables up to 10 year battery life
  - Hibernation current: 1.5 μA (average)
  - eDRX current: <45 uA (avg) @ 8 Hyperframes
  - +23dBm for each band

3.8 RTC

– Running at 32kHzw

3.9 Security

– SSL/TLS support

– WPA Enterprise security

3.10 Hash / encryption

– SHA

– MD5

– DES

– AES

4.0 Block Diagram

Cellular Antenna   WiFi/BLE Antenna   LoRa Antenna

SIM Card Interface

LTE Modem

LoRA

Antenna Tunner Interface

UART

SPI

+3.3V   +VBAT

Flash 8MB

Power Management

SPI

ESP32-S3

I2C

SRAM 8MB

Crypto Security Chip

GPIO
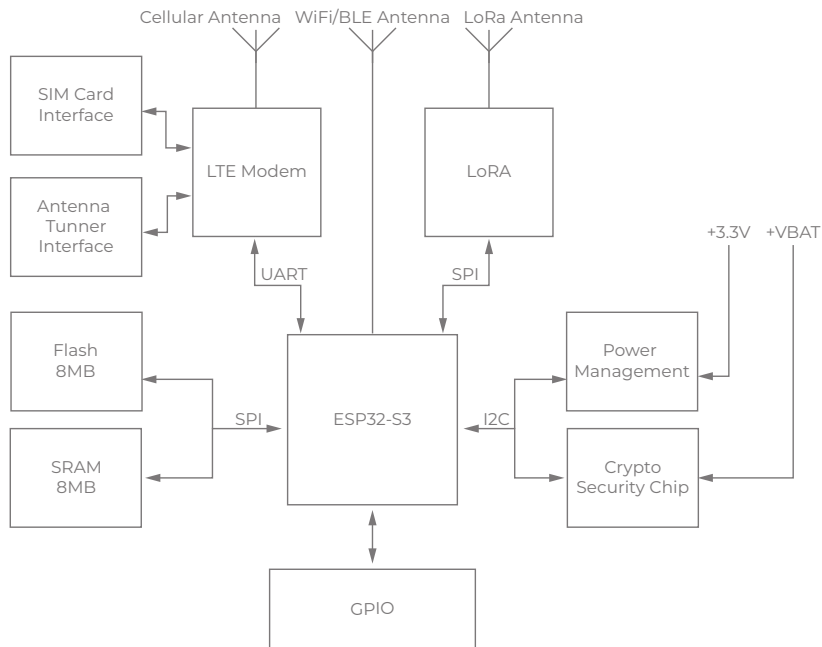
Figure 1 – System block diagram

5.0 Pinout

TBA

Figure 3– Module pinout diagram

-

IMPORTANT: These specifications may be subject to change without further notice.

6.0 Programming the device

6.1 Programming via USB UART

By default, the modules run an interactive python REPL on UART0 which is connected to P0 (RX) and P1 (TX) running at 115200 baud. The easiest way to connect to the F01 S3 is via development board, but any USB UART adapter will suffice. Code can be run via this interactive REPL or you can use our PyMakr plugin for Atom or Visual Studio Code to upload code to the board. Pymakr can also be accesses via the Pybytes cloud platform

6.2 Programming over WiFi

By default, the F01 S3 uses SmartConfig technology for seamless provisioning on Pybytes using Pycom's mobile app for iOS and Android

6.3 Programming via Telnet

Running on port 23 is a telnet server. This acts in a very similar way to the UART. It presents you with an interactive REPL and can also be used to upload code via PyMakr.

6.4 Programming over FTP

The F01 S3 also runs a FTP server that allows you to copy files to and from the device, include an SD card if one is connected. To connect to this FTP server, you need to use plain FTP (un–encrypted) with the following credentials:
User: micro
Password: python

7.0 Boot Modes

7.1 Bootloader Mode

In order to update the firmware of the F01 S3 device, it needs to be placed into bootloader mode. Once in bootloader mode you can use the Pycom firmware update tool to update to the latest official firmware. If you are developing your own firmware based on our open–source firmware, a flashing script is provided with the source code

7.2 Safe Boot Mode

The MicroPython firmware features a safe boot feature that skips the boot.py and main.py scripts and goes straight to the REPL. This is useful if the device is programmed with code that causes the device to crash or become inaccessible. To access this mode, you need to connect P12 to 3.3V and reset the device..

7.3 Boot modes

– Current firmware without running boot.py or main.py

– Previous firmware if the firmware was uploaded via OTA (without running boot.py and main.py)

IMPORTANT: These specifications may be subject to change without further notice.

7.4   Current consumption by power modes/features
running at 3.7V

Table 1 – Power consumption by feature

Mode	Min	Avg.	Max	Units
Idle (no radios)	–	TBD	–	mA
LTE Transmit	–	TBD	–	mA
WiFi AP	–	TBD	–	mA
WiFi client	–	TBD	–	mA
Bluetooth	–	TBD	–	mA
Deep sleep	–	TBD	–	mA

8.0   Memory Map

8.1   RAM

TBC

8.1   Flash

TBC

9.0   WiFi

9.1   Supported Features

–   802.11 b/g/n

–   02.11n MCS0-7 that supports 20 MHz and 40 MHz bandwidth

–   Single stream, data rate up to 150 Mbps

–   Adjustable transmitting power

9.2   Specification

9.3   WiFi Specification

Table 2 – WiFi Specification

Description	Min	Typ	Max	Units
Input Frequency (802.11n MCS0-7)	20	–	40	MHz
Tx mode (802.11g, 20 MHz) for 54Mbps, @15 dBm	–	220	–	mA
TX power mode for 11b, 1/11 Mbps	–	19.5	–	dBm
Rx Characteristics: Maximum Input Level				
11b, 1Mbps	–	5	–	dBm
11b, 11Mbps	–	5	–	dBm
11g, 6Mbps	–	5	–	dBm
11g, 54Mbps	–	0	–	dBm
11n, HT20, MCS0	–	5	–	dBm
11n, HT20, MCS7	–	0	–	dBm
11n, HT40, MCS0	–	5	–	dBm
11n, HT40, MCS7	–	0	–	dBm
Adjacent Channel Rejection				
11b, 11Mbps	–	35	–	dB
1g, 6Mbps	–	31	–	dB
11n, 54Mbps	–	14	–	dB
11n, HT20, MCS0	–	31	–	dB
11n, HT20, MCS7	–	13	–	dB
11n, HT40, MCS0	–	19	–	dB
11n, HT40, MCS7	–	8	–	dB

IMPORTANT: These specifications may be subject to change without further notice.

10.0 Bluetooth

10.1   Supported Bluetooth Hardware Features

– 2 Mbps PHY data rate

– Long Range Mode

– Channel selection algorithm 2

10.2   DC/RF Characteristics for Bluetooth Specifications -

TBA

IMPORTANT: These specifications may be subject to change without further notice.

11.0 LoRa

11.1 Supported LoRa(WAN) Features

11.2 LoRa Electrical Characteristics

Table 5 – FSK Receive Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
RXS_2FB	Sensitivity 2-FSK, RX Boosted, Split RF path for RX and TX	BR_F = 4.8 kb/s, FDA = 5 kHz, BW_F = 20 kHz	–	-117	–	dBm

Table 6 - FSK Transmit Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
TXOP	Power setting= 22dBm	868 MHz Band	–	21.5	–	dBm
		915 MHz Band	–	20.8	–	dBm
IDDTX	Power setting= 22dBm	868 MHz Band	–	124	–	mA
		915 MHz Band	–	112	–	mA

Table 7 - LoRa Transceiver Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
IDDRX	Recieve mode,DC-DC mode used,RX Boosted	868 MHz Band	–	15.5[1]	–	dBm
		915 MHz Band	–	15.5[1]	–	dBm
IDDRX	Recieve mode,LDO mode used,RX Boosted	868 MHz Band	–	20.0[1]	–	mA
		915 MHz Band	–	20.0[1]	–	mA
RXS_LB (125KHz)	Sensitivity LoRA,RX Boosted,Split RF path for RX and TX 125KHZ bandwith	SF=7	–	-124	–	dBm
		SF=12	–	-137	–	dBm
RXS_LB (250KHz)	Sensitivity LoRA,RX Boosted,Split RF path for RX and TX 250KHZ bandwith	SF=7	–	-121	–	dBm
		SF=12	–	-134	–	dBm

(1) IDDRX is tested under test FW and MCU is not in a sleep mode

IMPORTANT: These specifications may be subject to change without further notice.

Table 8 –LoRa Transmit Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
TXOP	TXOP= 22dBm	868 MHz Band	–	21.5	–	dBm
		915 MHz Band	–	20.8	–	dBm
IDDTX	TXOP= 22dBm	868 MHz Band	–	124	–	mA
		915 MHz Band	–	112	–	mA

Table 9 –LoRa Power Consumption

Conditions: Power supply=3.3 V, Temperature=25 °C;

Description	Min	Typ	Max	Unit
STM32L072 in stop mode with RTC(real time clock) SX1260 in cold start sleeping mode[1]	–	1.3	–	uA
STM32L072 in stop mode with RTC(real time clock) SX1260 in warm start sleeping mode without RC64K (64KHz RC oscillator)[2]	–	2.0	–	uA
STM32L072 in stop mode with RTC(real time clock) SX1260 in warm start sleeping mode without RC64K (64KHz RC oscillator)[2]	–	2.5	–	uA

(1) Cold start is equivalent to device at POR or when the device is wakingup from a sleeep modewith all blckks OFF.

(2) Warm start is only happening when the device is waking up from sleep mode with it's configuration retained.

IMPORTANT: These specifications may be subject to change without further notice.

12.0 Electrical Characteristics

12.1 Absolute Maximum rating

Table 7 – Absolute maximum Rating

Parameter	Symbol	Min	Typ.	Max	Unit
Supply Input Voltage	VIN	3.5	–	5.5	V
Supply Output Current	IOUT	–	–	1.2	A
Supply Output Voltage	V3V3	–	3.3	–	V
Storage temperature	TSTR	–	–	–	°C
Operating Temperature	TOPR	-40	–	85	°C
Moisture Sensitivity Level	MSL	–	1	–	–

12.2 Input/ Output Characteristics

Table 8 – Input/ Output Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit
Input low voltage	V IL	−0.3	–	0.25×V3V3	V
Input high voltage	V IH	0.75×V3V3	–	V3V3+0.3	V
Max Input sink	I SINK	–	6	12	mA
Current	–	–	–	–	–
Input leakage current	I IL	–	–	50	nA
Input pin capacitance	C pin	–	–	2	pF
Output low voltage	V OL	0.1×V3V3	–	–	V
Output high voltage	V OH	0.8×V3V3	–	–	V
Max Output source current	ISOURCE	–	6	12	mA

IMPORTANT: These specifications may be subject to change without further notice.
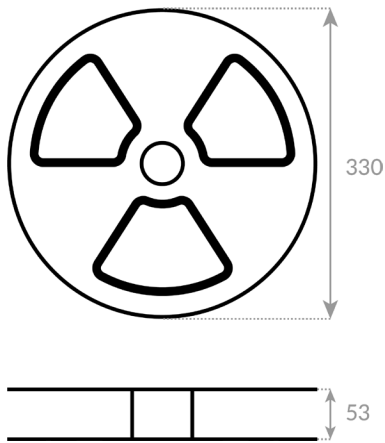
13.0 Sections to be Added

– Minimum Recommended Circuit

– Mechanical Specification

– Recommended Land Patterns

– Reference Layout

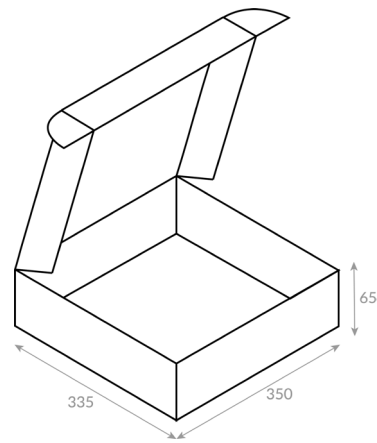– Soldering Profile

14.0 Packaging

14.1 Reel

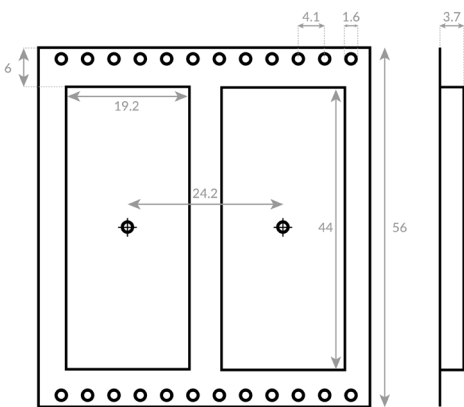*Figure4 – Mechanical drawing of reel – Units: mm*

330

53

14.3 Box

Figure 6 – Mechanical drawing of reel box – Units: mm

65

335   350

14.2 Tape

Figure 5 – Mechanical drawing of reel tape – Units: mm

4.1   1.6   3.7

6

19.2

24.2

44   56

IMPORTANT: These specifications may be subject to change without further notice.

15.0   Ordering Information

Table 9 – Ordering information

Product EAN	Description		Bundle	Contents

For more product accessories like expansion board or cases visit our website: http://www.pycom.io

IMPORTANT: These specifications may be subject to change without further notice.

16.0 Certification

FCC   TBD

IC   TBD

CE   TBD

Copies of the certificates can be found on our website.

Regulator Information

16.1   EU Regulatory Conformance
TBD (2014/53/EU)

16.2   Federal Communication Commission Interference Statement
TBD

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

16.2.1 RF Warning Statement
To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co–located or operating in conjunction with any other antenna or transmitter.

16.2.2 OEM integrator conditions
This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co–located with any other transmitter or antenna.

As long as the two conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end–product for any additional compliance requirements required with this module installed. To ensure compliance with all non–transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that the after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements.

The module is limited to OEM installation ONLY. The module is limited to installation in mobile or fixed application. We hereby acknowledge our responsibility to provide guidance to the host manufacturer in the event that they require assistance for ensuring compliance with the Part 15 Subpart B requirements.

IMPORTANT: These specifications may be subject to change without further notice.

IMPORTANT NOTE: In the event that these conditions cannot be met (for example certain laptop configurations or co–location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re–evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

16.2.3   End Product Labelling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labelled in a visible area with the following: "Contains FCC ID: 2AJMTGPY01R". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

The following FCC part 15.19 statement has to also be available on the label:

This device complies with Part 15 of 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.

16.2.4   Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

In the user manual of the end product, the end user has to be informed that the equipment complies with FCC radio–frequency exposure guidelines set forth for an uncontrolled environment.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

The end user manual shall include all required regulatory information/warning as show in this manual.

The maximum operating ambient temperature of the equipment declared by the manufacturer is –40~+85C

Receiver category 3

17.0   Revision History

Table 10 – Document revision history

Version	Initial Release
Draft 1.0 first draft release	May 2021