Overview:

The SIGFOX-MOD is a ultra-low-power module family designed especially for sensor node applications. It is based on the S2-LP **transceiver** (**SIGFOX-MOD1**) or the S2-LPTX **transmitter** (**SIGFOX-MOD2**) of STMicroelectronics to run Sigfox narrow band protocol based on 868 MHz band. Sigfox protocol and AT-Commands are implemented on a STM32L051 microcontroller. Two versions for both -MOD1 and -MOD2 are available: one **with mounted chip antenna** (**-MODx-C**) and one for **external antenna** (**-MODx-E**) to guarantee full flexibility. The SIGFOX-MOD1/2 versions are **Sigfox verified.**

Both the SIGFOX-MOD1 and the SIGFOX-MOD2 modules can also be used to transfer **proprietary Sub-GHz protocols based on 868 MHz** band (**SUBGHZ-MOD1 and SUBGHZ-MOD2**). To reduce BOM cost, the module's 32bit ARM microcontroller can also be used to run **application software**.

General Features and specification:

- Dimension: 37.6 mm x 15 mm x 3,8 mm
- Power supply range: 1.8 V to 3.3 V
- Temperature range: -20°C to +70 °C (-40°C to +105°C under development)
- GPIO PINs: 15 PINs to be configured:
  - 4 x ADC
  - 3 x Timer
  - 1 x I2C
  - 1 x SPI (SIGFOX Module is in MASTER mode)
  - 1 x UART (AT commands implemented)
  - 10 x GPIO
- Energy Consumption: ~0,7J for a full frame @3,3V
- Sigfox High Performance Narrow-Band Receiver (only for -MOD1):
  Carrier frequency 869.525 MHz (RCZ1); Data-rate 600 bps
  Sensitivity -124 dBm @ 600 bps, 869.525 MHz, GFSK
- Sigfox High Performance Narrow-Band Transmitter:
  Carrier frequency 868.13 MHz (RCZ1)
  max. band occupation 192kHz; channel bandwidth 100Hz
  Data-rate 100 bps PSK
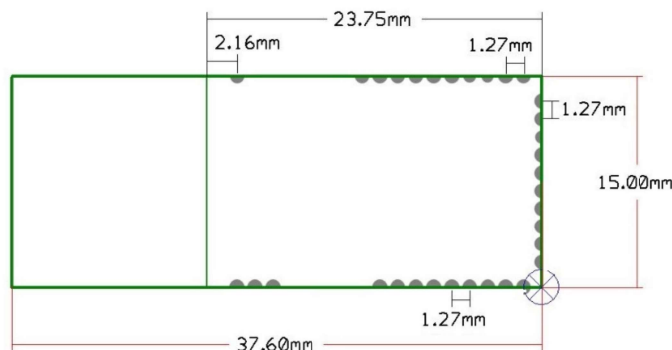 Maximum output Power +16 dBm

Dimensions:

Figure 1:   SIGFOX-MOD1/2-C/E dimensions, all dimensions in millimeter
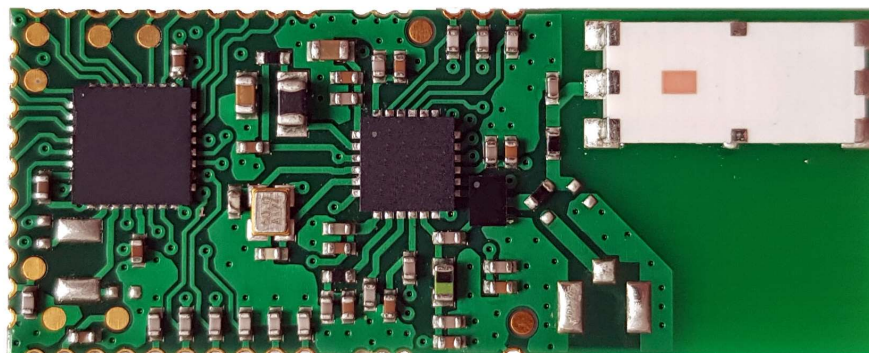
SIGFOX-MOD1/2-C and SUBGHZ-MOD1/2-C module:
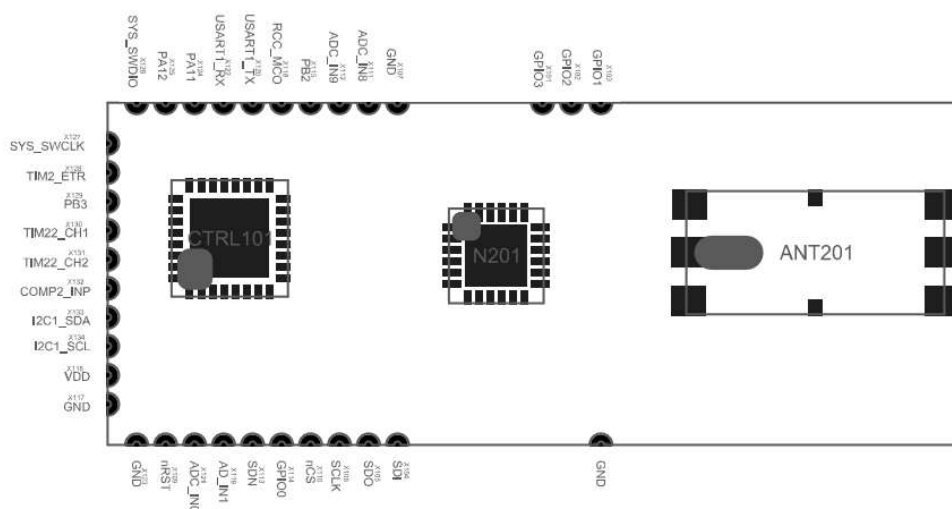

Figure 2:   SIGFOX-MOD1/2-C Top view

Figure 3:   SIGFOX-MOD1/2-C Layout

Pinout:

To maximize module usage flexibility most of the microcontroller ports and peripherals are layouted to the module pins. The module SIGFOX-MOD counts 34 pins which can be used. Accessing the module with the AT-commands as a transceiver connecting the application PCB to the Sigfox cloud most of the pins cannot be utilized.

The following table describes all the pins:

Pin	Name	Function
1	GPIO1	Used by SIGFOX MODULE
2	GPIO2	Used by SIGFOX MODULE
3	GPIO3	Used by SIGFOX MODULE
4	GND	Ground
5	ADC_IN8	FCO: GPIO OR Analog IN
6	ADC_IN9	FCO: GPIO OR Analog IN
7	PB2	FCO: General purpose IO
8	RCC_MCO	FCO: GPIO OR Microcontroller clock OUTPUT
9	USART1_TX	UART used to communicate with the module, Baud rate 115200, 1 Stop bit, No Parity
10	USART1_RX	UART used to communicate with the module, Baud rate 115200, 1 Stop bit, No Parity
11	PA11	FCO: General purpose IO
12	PA12	FCO: General purpose IO
13	SYS_SWDIO	Used by SIGFOX MODULE
14	SYS_SWCLK	Used by SIGFOX MODULE
15	TIM2_ETR	FCO: GPIO OR TIMER IN
16	PB3	FCO: General purpose IO
17	TIM22_CH1	FCO: GPIO OR TIMER OUT
18	TIM22_CH2	FCO: GPIO OR TIMER OUT
19	COMP2_INP	FCO: GPIO OR COMPERATOR
20	I2C1_SDA	FCO: I2C BUS
21	I2C1_SCL	FCO: I2C BUS
22	VDD	Power supply voltage
23	GND	Ground
24	GND	Ground
25	nRST	RESET (keep unconnected if not used)
26	ADC_IN0	FCO: GPIO OR Analog IN
27	ADC_IN1	FCO: GPIO OR Analog IN
28	SDN	Used by SIGFOX MODULE
29	GPIO0	Used by SIGFOX MODULE
30	nCS	Used by SIGFOX MODULE
31	SCLK	Used by SIGFOX MODULE
32	SDO	Used by SIGFOX MODULE
33	SDI	Used by SIGFOX MODULE
34	GND	Ground

FCO= for customization options

AT-COMMANDS (SIGFOX-MOD1/2 only):

The communication with the module is based on UART interface. The following UART configuration are used:

- Baud rate 115200
- 1 Stop bit,
- No Parity

Every command has to be terminated by CR or LF or CR/LF to trigger execution. There is no timeout implemented which is monitoring the duration of receiving the characters.

The module will terminate its response with CR/LF.

To communicate with the SIGFOX-MOD1-C the following AT-commands are implemented:

AT Command	Name	Description
AT	Check communication	Responds with OK
AT$SB=BIT,0	Send Bit	Send a bit status without reply BIT = { 0,1 } = uplink only
AT$SB=BIT,1	Send Bit with Reply (only for -MOD1)	Send a bit status with reply BIT = { 0,1 } Reply from SIGFOX cloud (always 8 bytes) = uplink and downlink
AT$SF=FRAME,0	Send Frame	Send payload data, 1 to 12 bytes without reply frame length can be 0 up to 12 bytes, each byte consists of 2 HEX characters, Example: **AT$SF=534947464F58** that means a frame consist of 6 bytes: **SIGFOX** will be sent = uplink only
AT$SF=FRAME,1	Send Frame with Reply (only for -MOD1)	Send payload data, 1 to 12 bytes with reply frame length can be 0 up to 12 bytes, each byte consists of 2 HEX characters, Example: **AT$SF=534947464F58** that means a frame consist of 6 bytes: **SIGFOX** will be sent Reply from SIGFOX cloud (always 8 bytes) = uplink and downlink
AT$I_InfoReq_?	Module Information	returning module information _InfoReq_ is an integer value [0-9] 0 : tbd 1 : read SW version of module firmware

		2 : read Sigfox SW version 3 : read MCU_API SW version 4 : read RF_API SW version 5 : read ChipID 6 : tbd 7 : tbd 8 : tbd 9 : tbd Example: **AT$I1?** Returns FW Version
AT$SO	Manually send out of band message	Send out-of-band message
AT$CW=FREQ,bit	Continuous Wave	enable/disable continuous wave FREQ in Hertz bit can be 0 or 1: 0: OFF 1: ON Example: **AT$CW=868130000,1** will switch on the sending of the carrier frequency
AT$IF=FREQ	Set Tx Frequency	Set the output carrier Frequency; FREQ in Hertz Example: **AT$IF=868132000** will set the carrier frequency to 868,132 MHz
AT$IF?	Get Tx Frequency	Get the current carrier frequency in Hertz Example: **AT$IF?** Will return the current carrier frequency in Hertz
AT$PM=uint	Set Power Mode	To save Power Module can be set in sleep mode, (not implemented yet)
AT$ID?	Read ID	returning SIGFOX ID
AT$PA?	Read PAC	returning current SIGFOX PAC
AT$EM=MODE	Set Emulator Mode	Set the emulator mode. This switches the module to use the public key. MODE can be 0 or 1: 0: use non public key 1: use public key Example: **AT$EM=1** will switch to public key usage

Note:

When calling commands (AT$SB / AT$SF) with reply on type SGIFOX-MOD2-X which are uplink only, data will be transmitted however the command will always run into timeout and answer with "ERROR".

SIGFOX-MOD1/2-E and SUBGHZ-MOD1/2-E module:

The SIGFOX-MOD1/2-E is has the same features as The SIGFOX-MOD1/2-C but instead of the chip antenna, an U.FL connector is mounted for usage of external antennas. This gives you the option to install the antenna outside of your housing or extend RF-range by other types of antennas.
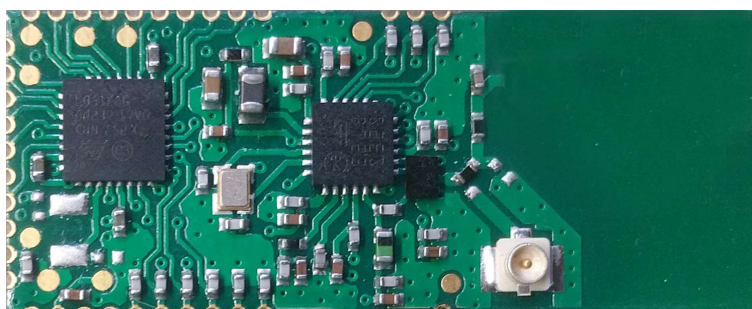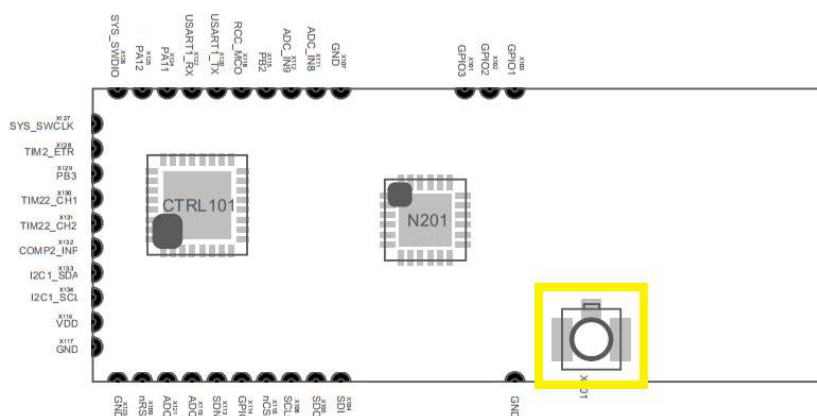

Figure 4:   SIGFOX-MOD1/2-E Top view

Figure 5:   SIGFOX-MOD1/2-E Layout

Specifications:

Absolut maximum ratings:

Absolute maxmum ratings are those values above which damage to the device may occur. Functional operation under these conditions is not implied. All Voltages refer to GND. Ambient enviroment temperature is defined to +25°C.

Parameter	Condition	Min	Typ	Max	Unit
Storage Temperature		-40	+25	+105	°C
Supply Voltage	Ambient Temperature	-0.3	+3	+3.9	V
Variation between all different ground pins				50	mV
Electrostatic discharge voltage (human body model)	Ambient Temperature	-500		+500	V

Operating range:

Parameter	Condition	Min	Typ	Max	Unit
Operating Temperature		-20	+25	+85	°C
Supply Voltage		+1.8	+3	+3.6	V

Power supply requirements:

Parameter	Condition	Min	Typ	Max	Unit
Voltage ripple	@50mA load transients			5	mV

Quickstartkit: SIGFOX-USB2:

The SIGFOX-USB2 is a baseboard with a SIGFOX-DEV1-C monted on it. The main purpose is to use it as a demonstration kit. It is ready to run from a PC or any other device with USB VCOM connectivity, and can be controlled at once with a standard terminal program of your choice.
The housing is availiable in different colours.

Figure 6:   Evaluation board as USB Dongle with housing

Evaluation Software:

Both USB Dongles are compatible to the free Windows Evaluation SW which is compatible to Win7/8/10 and both 32/64bit. Download at: https://www.xoveriot.com/sigfox-usb2-c/

The programm can read out the ID and PAC from the module and trigger an upload of up to 12 byte. The data to be transmitted can be entered either as an ASCII text or as HEX values. Even an download can be set to receive data from the Sigfox cloud. Please note, that these function need a Sigfox subscription and an activation of the ID as a prerequisite, to be working.

Together with the SIGFOX-USB1/2 it gives a you a quick-start without soldering, without HW development, without embedded SW development.

Of course the devices are compatible to any OS and system capable of USB-VCOM device support and an USB port, e.g. Linux, MacOS and almost any Desktop OS, Raspberry, BeagleBone and so on.

Ordering Information:

Example: SIGFOX – MOD1 – C - H

Device Family (mandatory)

SIGFOX   = with Sigfox FW

SUBGHZ   = without Sigfox FW

Baseboard Type (mandatory)

MOD   = Module only, no baseboard

DEV   = Nucleo/Arduino baseboard

CLK   = MikroBus baseboard

ASK   = Arrow ST Kit baseboard

USB   = USB baseboard

UPM   = USB power monitoring baseboard

Version (optional)

1   = transceiver module SubGhz: Rx and Tx / Sigfox: uplink and downlink

2   = transmitter module SubGhz: Tx only / Sigfox: uplink only

Antenna Type (optional)

none   = only baseboard without any module mounted

C   = chip antenna mounted on module

E   = connector for external antenna

Other Options (optional)

H   = housing

Certifications

CE Certifications
The SIGFOX-MOD module family has been measured according to the related EN and ETSI certification rules EN 301 489-3/2017, ETSI EN 300200-1, ESTI EN 300200-2, EN 61000-4-3, EN 55016-2-3, EN 55032 and are therefore prepared to meet compliance in the final product.

SIGFOX Certifications
The SIGFOX-MOD1 and SIGFOX-MOD2 modules have been awarded with the Sigfox Verified™ certificate M_006A_BB23_01 and M_006A_1A86_01 for RC1.

WEEE Registration
DE 69468905

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XoverIoT   **Rosenheim 09/2023**