AX-SIGFOX MINISTAMP
AX-SIGFOX ANTSTAMP

Ultra-Low Power, AT Command Controlled, Sigfox® Compliant Modules

The AX−SIGFOX modules are ultra−low power module solutions for a node on the Sigfox network with both up− and down−link functionality. The AX−SIGFOX modules connect to the customer application using a logic level RS232 UART. AT commands are used to send frames and configure radio parameters.

The AX−SIGFOX module comes in two flavors

- AX−SIGFOX MINISTAMP with 50 Ω Antenna Port
- AX−SIGFOX ANTSTAMP with On−board −5 dBi Chip Antenna

- Sigfox up−link and down−link functionality controlled by AT commands
- The AX−SIGFOX modules are part of a whole development and product ecosystem available from ON Semiconductor for any Sigfox requirement. Other parts of the ecosystem include
  - AX−Sigfox ultra−low power, AT command controlled, Sigfox compliant transceiver IC
  - Ready to go AX−Sigfox development kit with fully functional AX−Sigfox module including Sigfox subscription
  - Sigfox Ready certified reference design for the AX−Sigfox IC
  - AX−Sigfox API IC for customers wishing to write their own application software based on the ON Semiconductor Sigfox Library

- 18.2 x 22 x 3 mm^3 without chip antenna, 18.2 x 39.7 x 3 mm^3 with chip antenna
- Supply range from 1.8 V to 3.3 V
- −40°C to 85°C
- Temperature sensor
- Supply voltage measurements
- 10 GPIO pins
  - 4 GPIO pins with selectable voltage measure functionality, differential (1 V or 10 V range) or single ended (1 V range) with 10 bit resolution
  - 2 GPIO pins with selectable sigma delta DAC output functionality
  - 2 GPIO pins with selectable output clock
  - 3 GPIO pins selectable as SPI master interface

- Ultra−low power consumption
  - Charge required to send a Sigfox OOB packet at 14 dBm output power: 0.29 C
  - Deepsleep mode current: 500 nA
  - Sleep mode current: 1.6 μA
  - Standby mode current : 0.5 mA
  - Continuous radio reception at 869.525 MHz: 13 mA
  - Continuous radio transmission at 868.130 MHz
    for 14 dBm output power: 51 mA
    for 0 dBm output power: 21 mA
- The output power of AX−SIGFOX modules can be programmed in 1 dB steps from 0 dBm – 14 dBm. They are optimized for best power efficiency at 14 dBm output power. For modules optimized for other output power values e.g 0 dBm transmission with 10 mA please contact us.

- Carrier frequency 868.525 MHz
- Data−rate 600 bps
- Sensitivity: −126 dBm @ 600 bps, 869.525 MHz, GFSK
- 0 dBm maximum input power

- Carrier frequency 868.13 MHz
- Data−rate 100 bps PSK
- Maximum output power 14 dBm
- Power level programmable in 1 dBm steps from 0 dBm to 14 dBm

- Sigfox Ready certified
- EN 300 220

Publication Order Number:

Sigfox uses an Ultra Narrow Band (UNB) based radio technology to connect devices to its global network. The usage of UNB is key to providing a scalable, high−capacity network, with very low energy consumption, while maintaining a simple and easy to rollout star−based cell infrastructure.

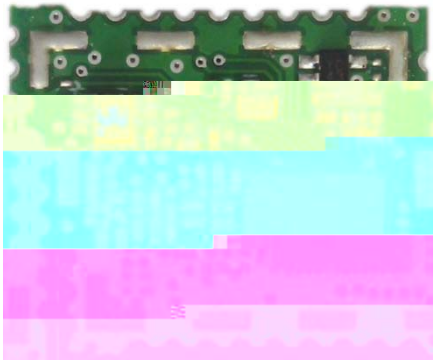
The network operates in the globally available ISM bands (license−free frequency bands) and co−exists in these frequencies with other radio technologies, but without any risk of collisions or capacity problems.

Sigfox currently uses the most popular European ISM band on 868 MHz (as defined by ETSI and CEPT) as well as 902 MHz in the USA (as defined by the FCC), depending on specific regional regulations.

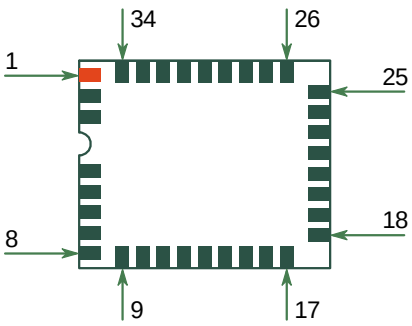
Sigfox only acts as a transport channel, pushing the data towards the customer's IT system.

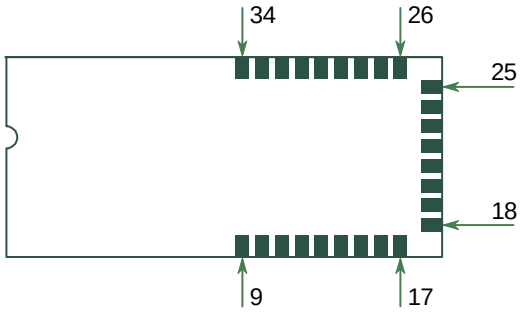
An important advantage provided by the use of the narrow band technology is the flexibility it offers in terms of antenna design. On the network infrastructure end it allows the use of small and simple antennas, but more importantly, it allows devices to use inexpensive and easily customizable antennas.

The Sigfox protocol is compatible with existing transceivers and is actively being ported to a growing number of platforms.



(Note that the actual product comes with a metal cap)





1*	GND	Ground
2*	NC	Do not connect
3*	NC	
4*	NC	
5*	GND	Ground
6*	ANT50Ω	50 Ω antenna port
7*	GND	Ground
8*	NC	Do not connect
9	NC	
10	GPIO8	General purpose IO
11	GPIO7	General purpose IO, selectable SPI functionality (MISO)
12	GPIO6	General purpose IO, selectable SPI functionality (MOSI)
13	GPIO5	General purpose IO, selectable SPI functionality (SCK)
14	GPIO4	General purpose IO, selectable ΣΔ DAC functionality, selectable clock functionality
15	CPU_LED	

31	GPIO2	General purpose IO, selectable ADC functionality
32	NC	Do not connect
33	NC	
34	GPIO3	General purpose IO, selectable ADC functionality

NOTE: All digital pins are Schmitt trigger inputs, digital input and output levels are LVCMOS/LVTTL compatible. Pins GPIO[3:0] must not be driven above VDD, all other digital inputs are 5 V tolerant.
All GPIO pins and UART_RX start−up as inputs with pull−up.

T_{AMB}	Operational ambient temperature		−40	27	85	°C
VDD	Supply voltage		1.8	3.0	3.3	V
I_{DS}	Deep sleep mode current	AT$P=2		500		nA
I_{SLP}	Sleep mode current	AT$P=1		1.6		μA
I_{STDBY}	Standby mode current			0.5		mA

I_{RX_CONT}	Current consumption in Sigfox RX test mode	AT$SR=1,1,−1		12.8		mA

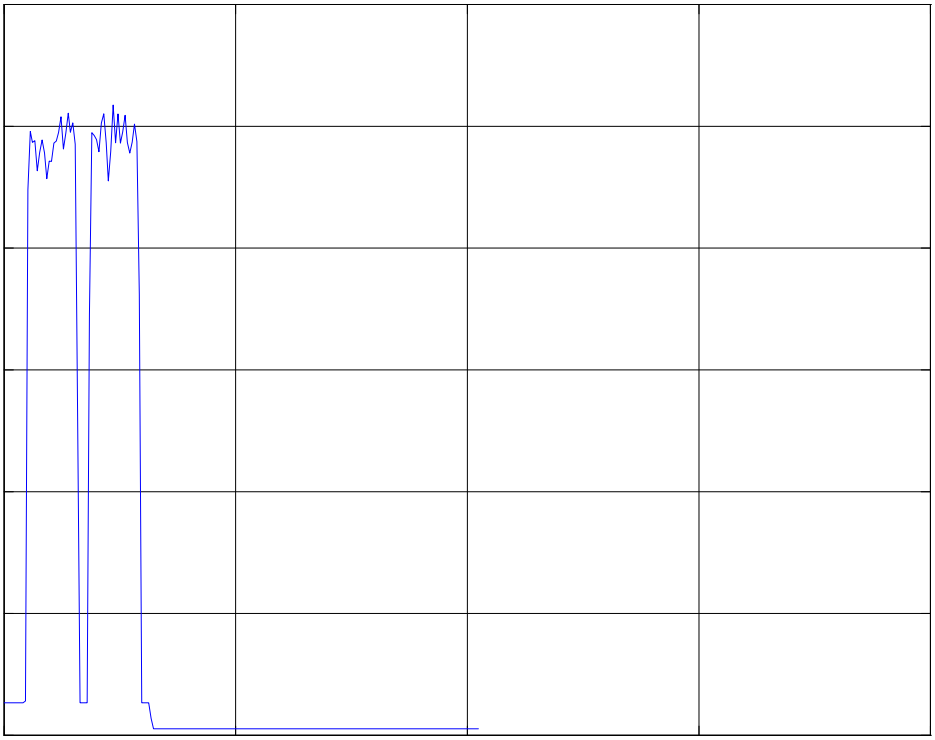
(Note 2)

$I_{TXMODAVG\_14}$	Modulated transmitter current			51.0		mA
$Q_{SFX\_OOB\_14}$	Charge to send a Sigfox out of band message	AT$S0		0.28		C
$Q_{SFX\_OOB\_14}$	Charge to send a bit	AT$SB=0		0.19		C
$Q_{SFX\_OOB\_14}$	Charge to send a bit with downlink receive message	AT$SB=0,1		0.33		C
$Q_{SFX\_LFR\_14}$	Charge to send the longest possible Sigfox frame (12 byte)	AT$SF=00112233445566778899aabb		0.37		C
$Q_{SFX\_LFR\_14}$	Charge to send the longest possible Sigfox frame (12 byte) with downlink receive	AT$SF=00112233445566778899aabb,1		0.46		C

(Notes 1 and 2)

$I_{TXMODAVG\_14}$	Modulated Transmitter Current			21.0		mA
$Q_{SFX\_OOB\_0}$	Charge to send a Sigfox out of band message	AT$S0		0.12		C
$Q_{SFX\_OOB\_0}$	Charge to send a bit	AT$SB=0		0.08		C
$Q_{SFX\_OOB\_0}$	Charge to send a bit with downlink receive message	AT$SB=0,1		0.14		C
$Q_{SFX\_LFR\_0}$	Charge to send the longest possible Sigfox frame (12 byte)	AT$SF=00112233445566778899aabb		0.27		C
$Q_{SFX\_LFR\_0}$	Charge to send the longest possible Sigfox frame (12 byte) with downlink receive	AT$SF=00112233445566778899aabb,1		0.29		C

1. The output power of AX−SIGFOX modules can be programmed in 1 dB steps from 0 dBm – 14 dBm. They are optimized for best power efficiency at 14 dBm output power. For modules optimized for other output power values e.g. 0 dBm transmission with 10 mA please contact us.
2. Antenna gain not included.



V_{T+}	Schmitt trigger low to high threshold point	VDD = 3.3 V		1.55		V
V_{T-}	Schmitt trigger high to low threshold point			1.25		V
V_{IL}	Input voltage, low				0.8	V
V_{IH}	Input voltage, high		2.0			V
V_{IPA}	Input voltage range, GPIO[3:0]		−0.5		VDD	V
V_{IPBC}	Input voltage range, GPIO[9:4], UART_RX, RESET_N		−0.5		5.5	V
I_L	Input leakage current		−10		10	μA
R_{PU}	Programmable pull−up resistance			65		kΩ

I_{OH}	Output Current, high Ports GPIO[9:0], UART_TX, TX_LED, RX_LED, CPU_LED, RADIO_LED	V_{OH} = 2.4 V	8			mA
I_{OL}	Output Current, low GPIO[9:0], UARTTX, TXLED, RXLED, TXLED, CPULED	V_{OL} = 0.4 V	8			mA
I_{OZ}	Tri−state output leakage current		−10		10	μA

SBR	Signal bit rate			100		bps
$f_{carrier}$	Carrier frequency			868.13		MHz
PTX_{min}	Lowest Transmitter output power	AT$CW=868130000,1,0		0		dBm
PTX_{max}	Highest Transmitter output power	AT$CW=868130000,1,14 (Note 1)		14		dBm
PTX_{step}	Programming step size output power			1		dB

$dTX_{tempPT7.2945}$ 325.7008 Tm(dTX)TTm0 Tc(1)T 350.306 4h983 refBT8 0 0 8 126.9354 341.0079 Tm-.TX

ADCRES	ADC resolution			10		bit
V_{ADCREF}	ADC reference voltage		0.95	1	1.05	V
Z_{ADC00}	Input capacitance				2.5	pF
DNL	Differential nonlinearity			± 1		LSB
INL	Integral nonlinearity			± 1		LSB
OFF	Offset			3		LSB
GAIN_ERR	Gain error			0.8		%

V_{ABS_DIFF}	Absolute voltages & common mode voltage in differential mode at each input		0		VDD	V
V_{FS_DIFF01}	Full swing input for differential signals	Gain x1	−500		500	mV
V_{FS_DIFF10}		Gain x10	−50		50	mV

V_{MID_SE}	Mid code input voltage in single ended mode			0.5		V
V_{IN_SE00}	Input voltage in single ended mode		0		VDD	V
V_{FS_SE01}	Full swing input for single ended signals	Gain x1	0		1	V

T_{RNG}	Temperature range		−40		85	°C
T_{ERR_CAL}	Temperature error			± 2		°C

The ‘CB’ command sends out a continuous pattern of bits, in this case 0xAA = 0b10101010:

AT$CB=0xAA,1
OK

This transitions the device into sleep mode. Out−of−band transmissions will still be triggered. The UART is powered down. The module can be woken up by a low level on the UART signal, i.e. by sending break.

AT$P=1
OK

AT	Dummy Command	Just returns ‘OK’ and does nothing else. Can be used to check communication.
AT$SB=bit[,bit]	Send Bit	Send a bit status (0 or 1). Optional bit flag indicates if AX−SIGFOX module should receive a downlink frame.
AT$SF=frame[,bit]		

AT$I=uint	Information	Display various product information: 0: Software Name & Version Example Response: AX−Sigfox 1.0.6