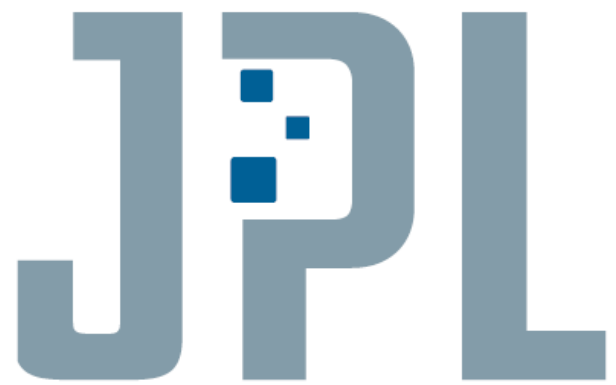


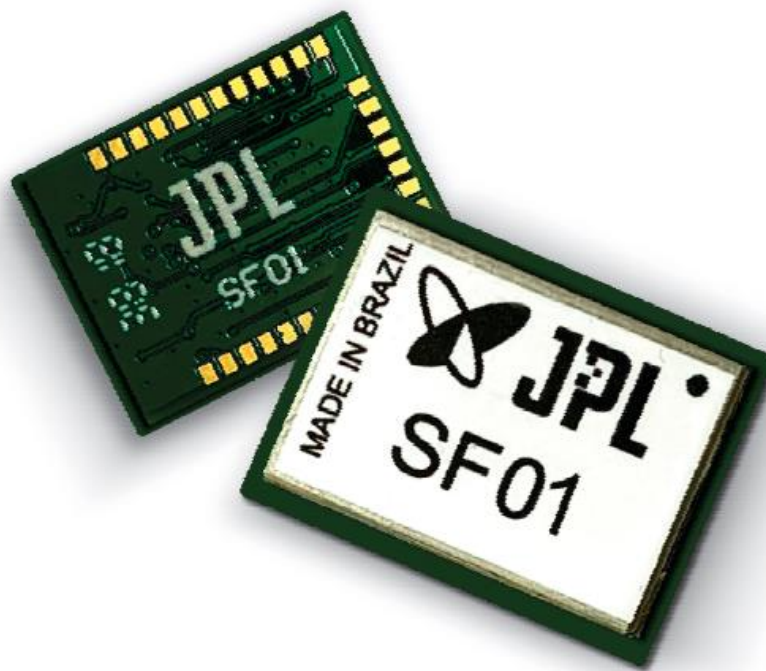


Connecting the physical world to digital

SF01

COMPACT SIGFOX MODULE FOR RCZ2/RCZ4 Datasheet Rev – 3.0

SF01 SIGFOX Module for RCZ2/RCZ4 Datasheet Rev – 3.0



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1. Revision History

Number	Revision	Date	Description
1	REV 0.1	Apr/2019	Initial draft
2	REV 1.0	Jul/2019	Voltage spec. updated
3	REV 2.0	Aug/2019	SF01 realease – SIGFOX Verified, mechanical outline update, footprint addition.
4	REV 3.0	Nov/2019	Footprint update, packing and ordering addition.

2. Overview

The SF01 is a miniaturized SIGFOX module for RCZ2 and RCZ4. It is suitable for using as a SIGFOX modem, communication through UART interface (CLI/AT commands), as well as the main application processor embedding the user code in its onboard MCU.

SF01 module is a cost-effective, high performance, low-power solution to be used in a wide range of products. It presents very low current consumption both in active and low-power MCU modes providing excellent battery lifetime and allowing for operation on small batteries and in energy harvesting applications.

2.1. General Features

- ✓ SIGFOX™ Module for RCZ2 and RCZ4;
- ✓ Small form factor: [13mm (L) x 17.5mm (W) x 2.2 mm (H)];
- ✓ Package type: 31-pin SMD;
- ✓ MCU provides capability to embed user application code;
- ✓ CLI/AT SIGFOX™ modem operation mode capability;
- ✓ High performance, low-power Cortex-M0™ 32-bit microcontroller;
- ✓ Programmable 160kB Flash;
- ✓ 110 kB Flash free for user embedded application
- ✓ 24kB RAM with retention (two 12 kB banks)
- ✓ Debug SWD interface;
- ✓ 1xUART interface;
- ✓ 1xSPI interface;
- ✓ 1xI2C interface;
- ✓ 1 single ended or differential 10-bit ADC analog input;
- ✓ Up to 11 GPIOs;
- ✓ Watch dog;
- ✓ DMA controller;
- ✓ Battery voltage and temperature sensors;
- ✓ Voltage range: 2.7V up to 3.6V;
- ✓ Programmable RF output power up to +24 dBm CW;
- ✓ TX mode current consumption: 170mA @ 22.5dBm;
- ✓ RX mode current consumption: 20mA;
- ✓ Excellent performance of receiver sensitivity: down to -130 dBm (@600bps, GFSK);
- ✓ Operating temperature: -30°C up to +85°C

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WARNING

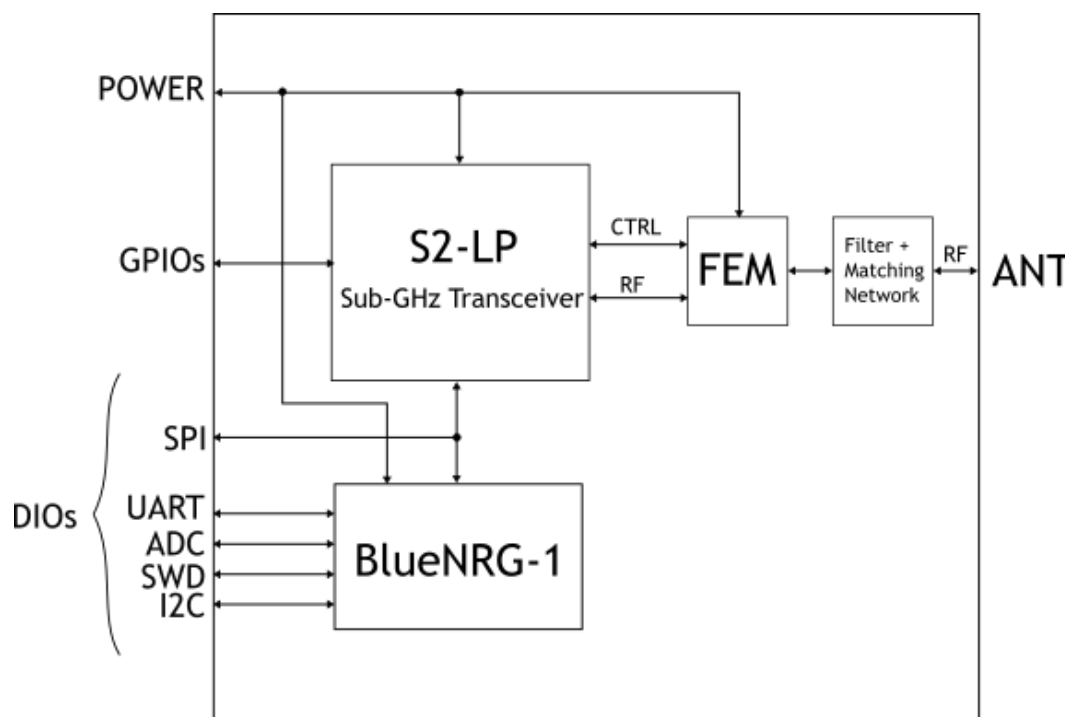
All SIGFOX data is saved into BlueNRG Flash memory. Thus, every uplink/downlink causes a new Flash data overwriting.

User must be aware of Flash data retention be greater than 10 years at 85 °C. The Flash is rated to have a Flash cycling of 10.000 write/erase cycles. Therefore, SF01 is recommended for applications which few daily packets are sent. Eg. An application which requires an average of 5 daily transmissions might work over 5 years.

3. Block Diagram

The SF01 Module block diagram is show in **Figure 1**.

Figure 1 - Module Block Diagram



The SF01 is composed by a BlueNRG microcontroller, a sub-1GHz transceiver (S2-LP), Front-End Module and filter/matching network.

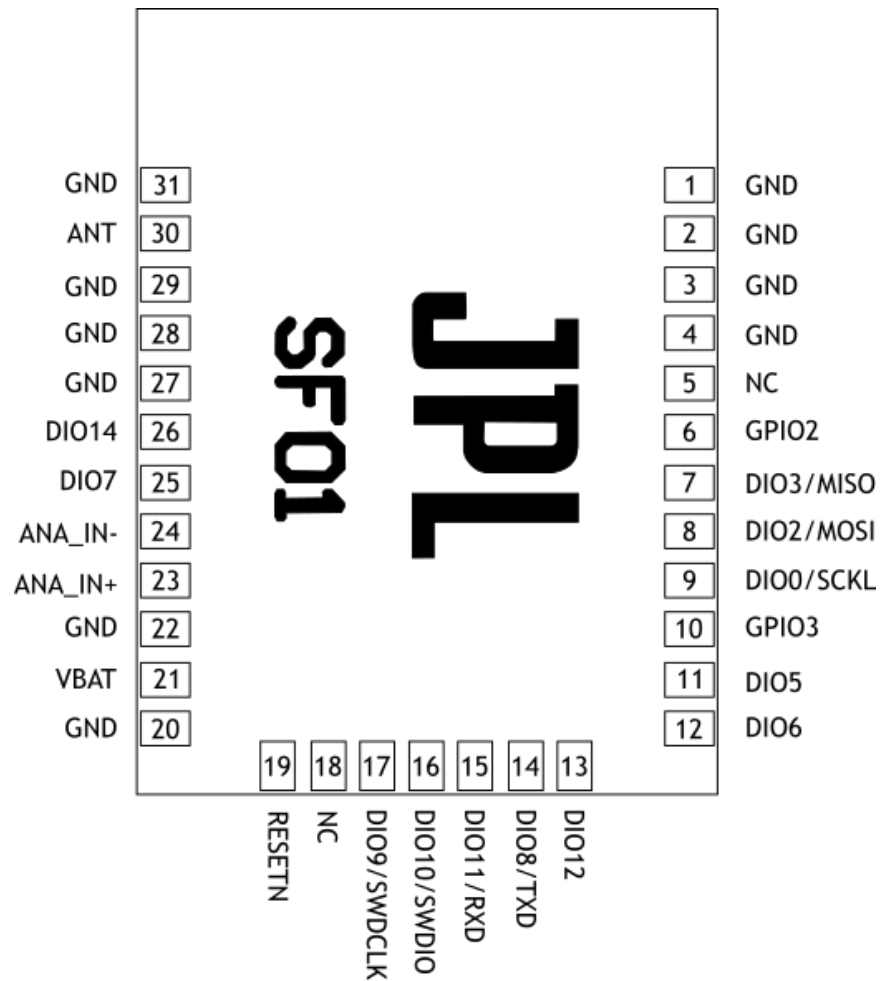
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4. Pin Description

4.1. Bottom View Pin Description

Figure 2 illustrates SF01 module bottom-view pinout description. The module is a SMT 31-pin, small form factor module.

Figure 2 - Pin Diagram, SMD-31 (BOTTOM VIEW)



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4.2.Pin List

Table 1 shows pin names, nature type, programmable IO and a quick description.

Table 1 - Pin Description

Pin	Name	I/O	Type	Description
1	GND	-	Analog	Analog ground
2	GND	-	Analog	Analog ground
3	GND	-	Analog	Analog ground
4	GND	-	Analog	Analog ground
5	NC	-	-	-
6	GPIO2	I/O	Digital	General purpose S2-LP I/O
7	DIO3 MISO	I	Digital	SPI master input internally connected to SDO pin of S2-LP
8	DIO2 MOSI	O	Digital	SPI master output internally connected to SDI pin of S2-LP
9	DIO0 SCLK	O	Digital	SPI master clock internally connected to SCLK pin of S2-LP
10	GPIO3	I/O	Digital	General purpose S2-LP I/O It must be tied to DIO7
11	DIO5 SDA	I/O	Digital	General purpose BlueNRG I/O I2C SDA
12	DIO6 SCL	I/O	Digital	General purpose BlueNRG I/O I2C SCL
13	DIO12 ¹	I/O	Digital	General purpose BlueNRG I/O
14	DIO8 TXD	I/O	Digital	General purpose BlueNRG I/O UART TX
15	DIO11 RXD	I/O	Digital	General purpose BlueNRG I/O UART RX
16	DIO10 SWDIO	I/O	Digital	General purpose BlueNRG I/O Programmable Interface Data
17	DIO9 SWDCLK	I/O	Digital	General purpose BlueNRG I/O Programmable Interface Clock
18	NC	-	-	-
19	RESETN	I	Digital	Active low system reset
20	GND	-	Power	Analog ground
21	VBAT	-	Power	Power supply
22	GND	-	Power	Analog ground
23	ANA_IN+	I	Analog	ADC positive input
24	ANA_IN-	I	Analog	ADC negative input

¹ It is possible to set DIO12 as wake-up source.

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25	DIO7 ²	I/O	Digital	General purpose BlueNRG I/O It must be tied to GPIO3
26	DIO14	I/O	Digital	General purpose BlueNRG I/O
27	GND	-	Power	Ground
28	GND	-	Power	Ground
29	GND	-	Power	Ground
30	ANT	I/O	RF	Antenna pin
31	GND	-	Power	Ground

5. Absolute Maximum Ratings

Table 2 - Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
VBAT	Module input voltage	0 – 3.9	V
OT	Operating Temperature	-30 to +85	°C
ST	Storage Temperature	-40 to +125	°C

6. DC Characteristics

Table 3 - DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	Module input voltage	2.7	3.3	3.6	V
Current	TX current consumption @ +22.5 dBm and modulating	-	170	-	mA
	RX current consumption		20	-	mA
	Sleep current ³		3.1		uA

² Bootloader is activated by hardware by forcing DIO7 during power-up or hardware reset. Otherwise, application residing in the Flash memory will be launched. The customer application must ensure that DIO7 is forced low during power-up. Bootloader protocol is described in a separate application note.

³ The 3.1 uA sleep current value is under the following conditions: BlueNRG in sleep mode, S2-LP in shutdown and FEM in shutdown mode. This current can be reduced to 1.5uA in case RAM retention is not needed.

7. I/O Specifications

Table 4 - I/O Specifications

Symbol	Parameter	Min	Typ	Max	Condition	Unit
VIL	Low level input voltage			0.3*VBAT	IOH = 3mA	V
VIH	High level input voltage	0.65*VBAT			IOL = 3mA	V
VOL	Low output voltage			0.4	IOH = 3mA	V
VOH	High output voltage	0.7*VBAT				
IOL	Low drive strength		5.6		VOL=0.4V	mA
			6.6		VOL=0.42V	
			3		VOL=0.45V	
IOL	High drive strength		11.2		VOL=0.4V	
			13.2		VOL=0.42V	
			6		VOL=0.45V	
IOH	Low drive strength		10.6		VOH=2.4V	
IOH	High drive strength		19.2		VOH=2.4V	
IPUD	Current source/sink from IOs with pull enabled	40		60	Static supply VBAT=3.6V	uA

All IOs are in high impedance under reset whereas in low power modes DIO0 to DIO8 are configured in high impedance state and DIO9 is in input state with internal pull up.

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8. RF Specifications

Table 5 - RCZ2 RF Characteristics

RCZ2 RF Characteristics				
Parameter	Min	Typ	Max	Unit
Uplink frequency (TX)		902.2		MHz
Downlink frequency (RX)		905.2		MHz

Table 6 - RCZ4 RF Characteristics

RCZ4 RF Characteristics				
Parameter	Min	Typ	Max	Unit
Uplink frequency (TX)		920.8		MHz
Downlink frequency (RX)		922.3		MHz

Table 7 - General RF Characteristics

General RF Characteristics @ VBAT = 3.3V and Temp = +25°C				
Parameter	Min	Typ	Max	Unit
Output Power CW		24		dBm
Receiver Sensitivity		-130		dBm
2 nd Harmonics (conducted tests)		38		dBc
3 rd Harmonics (conducted tests)		33		dBc
Output Impedance		50		Ω

9. Crystal Specifications

Table 8 - BlueNRG HS Crystal Oscillator

Parameter	Min	Typ	Max	Unit
Crystal frequency		16		MHz
Crystal frequency tolerance	-50		50	ppm

Table 9 - S2-LP Crystal Oscillator

Parameter	Min	Typ	Max	Unit
Crystal frequency		24		MHz
Crystal frequency tolerance	-15		15	ppm

Both crystal tolerances includes only stability over temperature and 5 years aging. In the S2-LP case the static frequency deviation is already compensated for through calibration.

10. Reference Schematic

Figure 3 - Reference Schematic

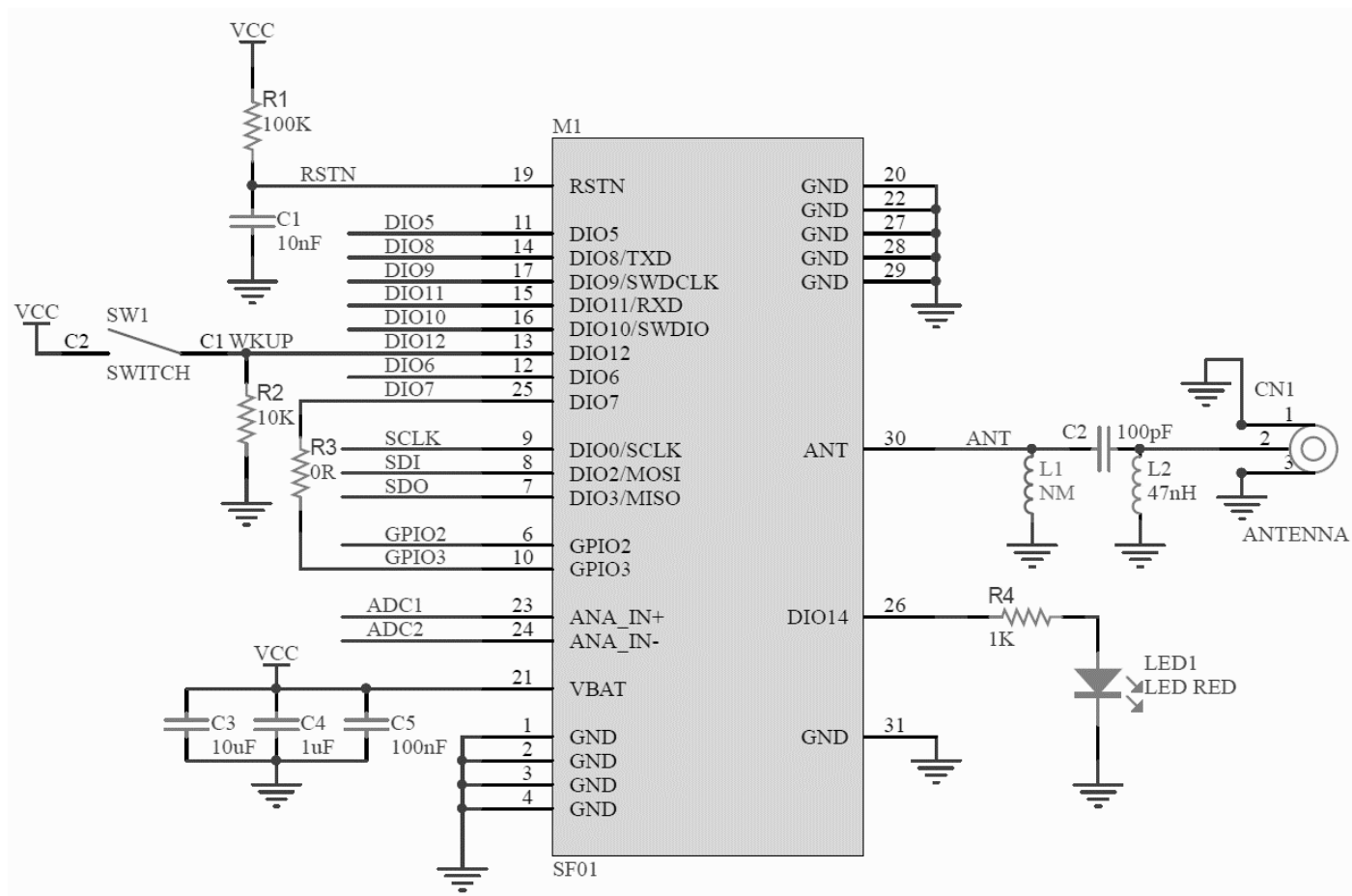


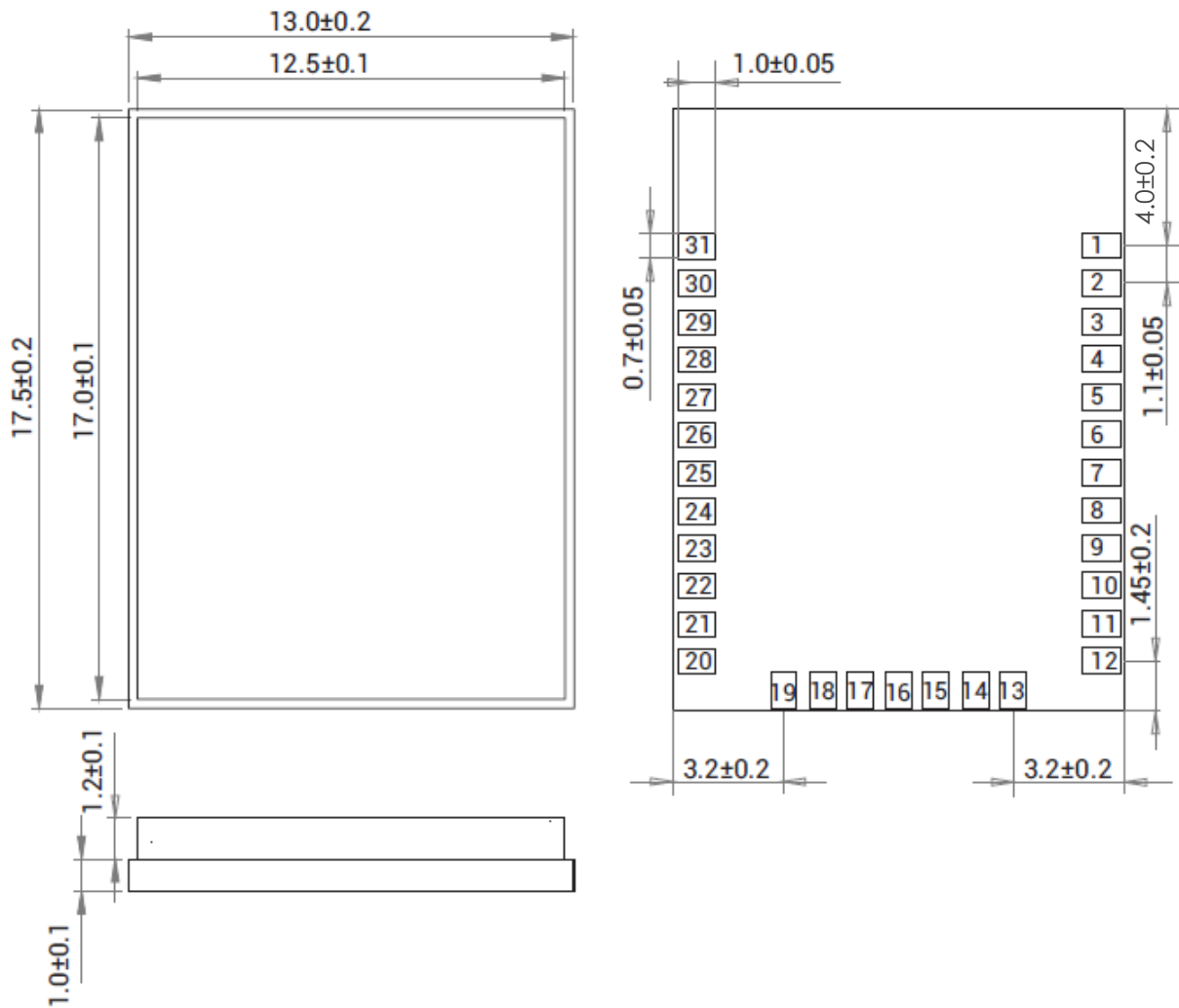
Figure 3 illustrates a basic reference schematic. SF01 ANT net is connected to a PI-matching network in order to cope with some mismatches added due to the final application PCB design. Also, this matching network can be used to retune the antenna if needed. The capacitor C2 works as a short in this range of frequency and the inductor L2 is intended to provide ESD protection.

BE AWARE of the connection between pin 25 and pin 10. It must be connected to work properly, as the GPIO3 from S2LP generates an interruption and DIO7 from BlueNRG senses the interruption after each transmission or reception.

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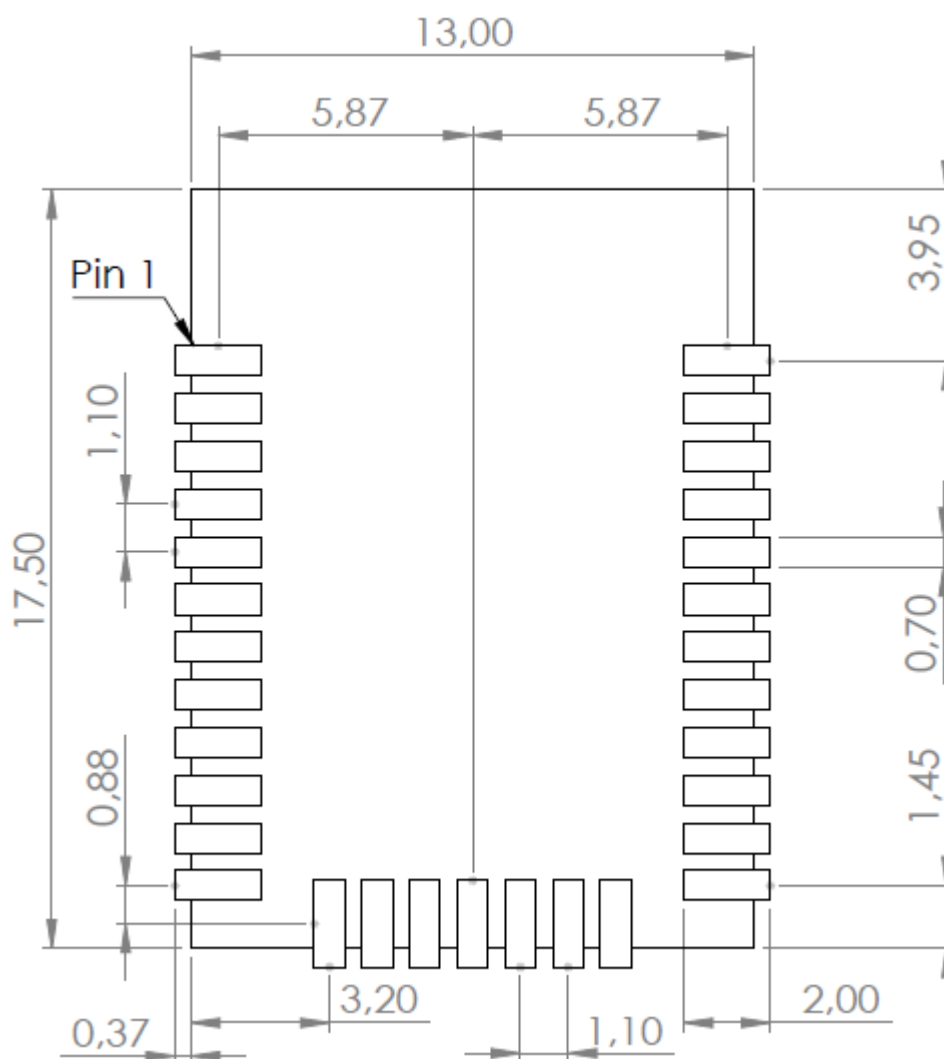
11. Installation Guide

Figure 4 – Mechanical Outline (dimensions in mm)



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Figure 5 – Recommended Footprint Layout (TOP VIEW)



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12. SMT and Backing Recommendation

Figure 6 - Solder Temperature Profile

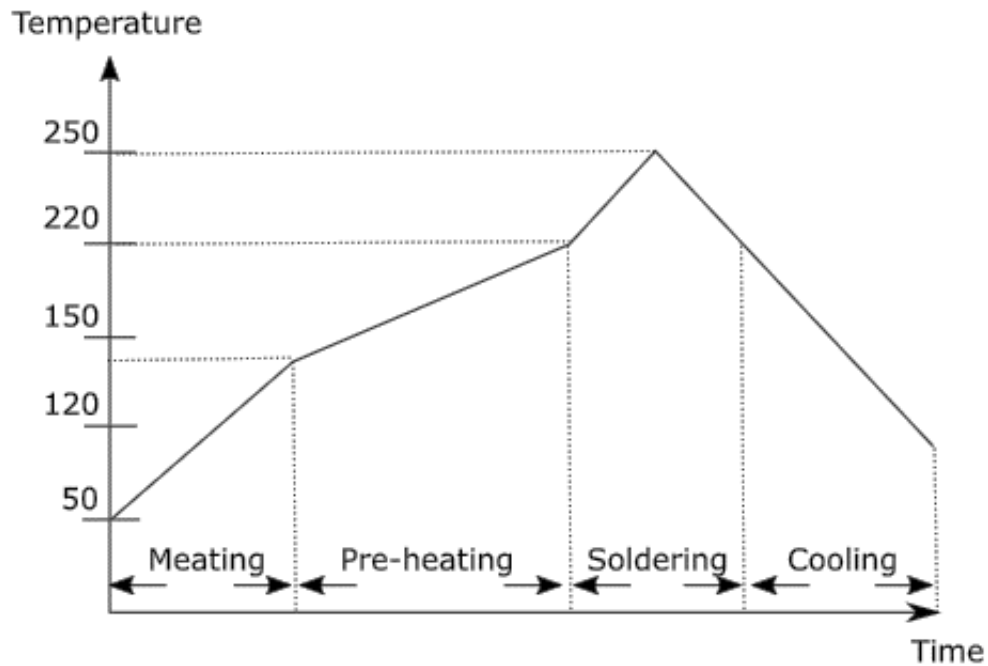


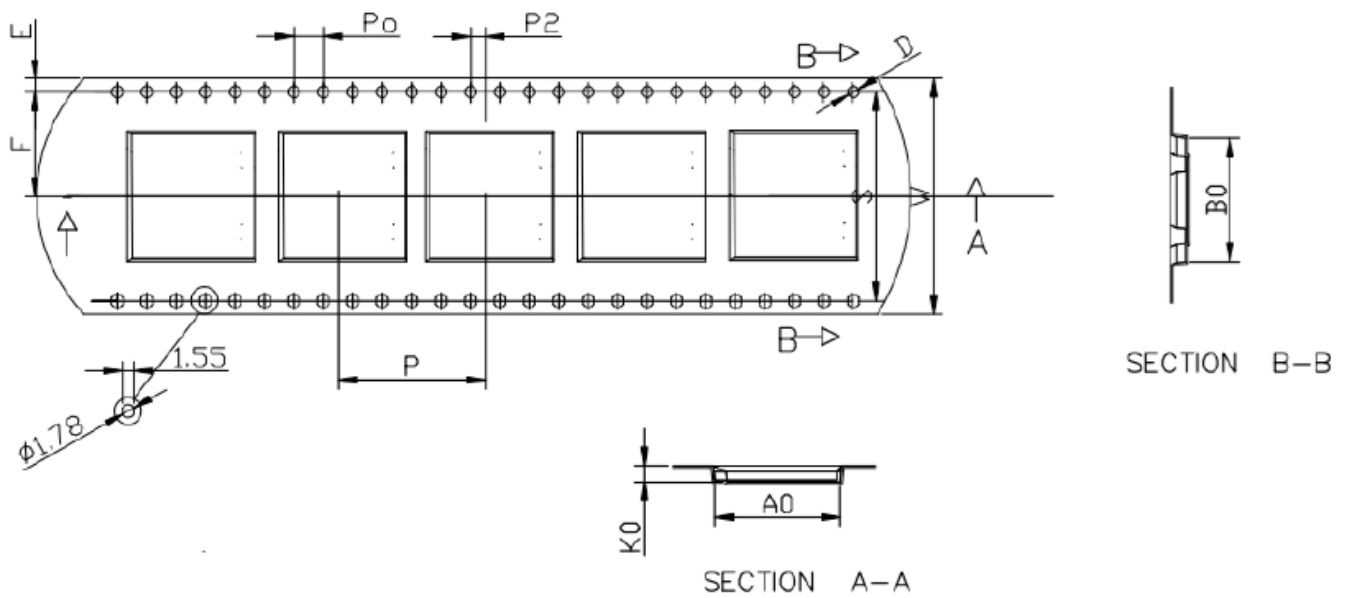
Table 10 - Backing Phases and Temperatures

Phase	Temperature	Time (s)
Pre-heating	150 °C – 200 °C	80 - 120
Soldering	220 °C	60 ± 10
Max peak temp	250 °C	

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13. Packing

Figure 7 – Tape Dimension

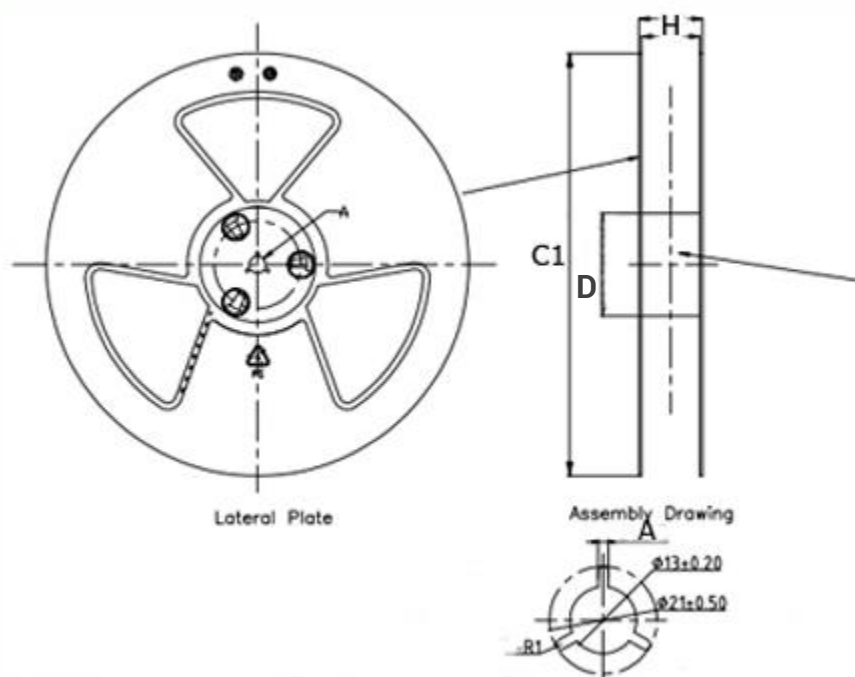


Symbol	A0	B0	K0	P0	P	P2
Dimension [mm]	13.6±0.1	18.1±0.1	2.5±0.1	4.0±0.1	20.0±0.1	2.0±0.1

Symbol	W	T	E	F	D
Dimension [mm]	32.0±0.3	0.3±0.05	1.75±0.1	14.2±0.1	1.5±0.1

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Figure 8 – Reel Dimension



Symbol	A	C1	H	B1	T	D
Dimension [mm]	2.20 ± 0.2	330.0 ± 1.0	32.50 ± 0.5	10.75 ± 0.2	2.00 ± 0.3	100.0 ± 2.0

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14. Ordering Information

Table 11 – Ordering Information

Order Code	Packing	Quantity
SF01-TR	Tape & Reel	1500 pcs
SF01-JR	JPL-Reel	custom (1 to 1499 pcs)
SF01-CT	Cut Tape	custom