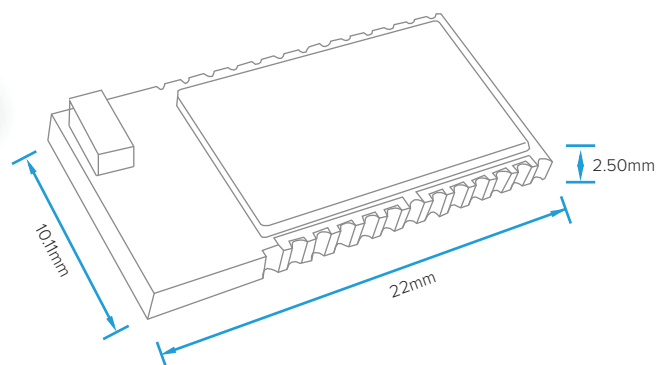
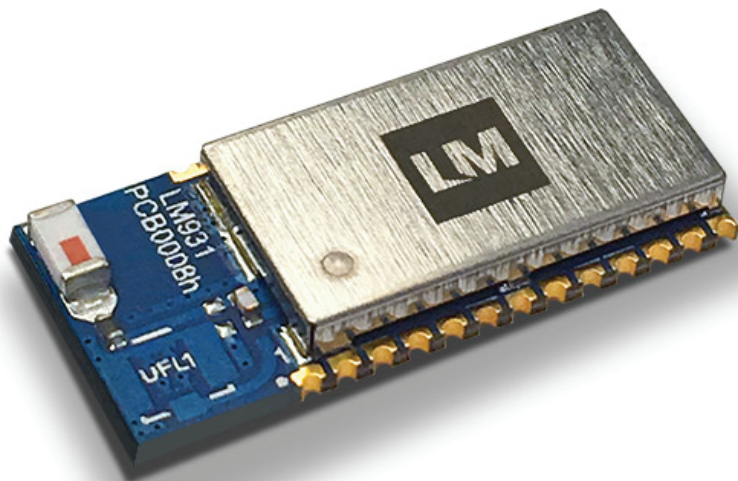




LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product	LM931
Part No (Tray)	931-0552
Part No (Tape& Reel)	931-0636
Revised	24/JAN/2017



Features

- Bluetooth® v4.1 specification
- 14 mA (at 0 dBm) Current Consumption (Tx Mode)
- IC Antenna Onboard (Peak Gain = 0.5dBi)
- 9 dBm Tx Output Power (Max) and -92 dBm Rx Sensitivity
- Over-the-Air Upgrade (OTAU) available
- Application Firmware Support
- GATT Server Applications available (Including Serial over GATT, iBeacon and Key Fob with an RGB LED)
- Fully integrated module with no additional components required
- I2C and UART
- 9 digital and 3 analogue I/O (10-bit ADC)
- Wake-up interrupt and Watchdog timer
- 4 PWM channels
- 22mm x 10.1mm x 2.50mm
- SMT Side and Bottom Pads for easy production
- IC, FCC, CE / RED Directive and SIG Certified Solution
- CE, RoHS, REACH and WEEE Compliant Solution

Overview

The LM931 Bluetooth® low energy module is designed for use within new and existing embedded systems. It is implemented as a peripheral device within products such as monitors, meters and printers, while saving the developer valuable PCB space. The LM931 enables you to wirelessly communicate with other nearby Bluetooth® v4.1 devices (e.g. iOS and Android) using a highly power efficient Bluetooth® low energy connection. The transmission output power ranges from 0 dBm to 9 dBm and can be configured to provide an extended battery life or a longer range.

This single core standalone module combines a Bluetooth® low energy radio using a Bluetooth® v4.1 stack, plus a microcontroller with 512 kB EEPROM for running the applications. The LM931 incorporates 27 pin outs including UART and I2C for interfacing with a wide range of peripheral devices like sensors. It's SMT side and bottom pads allow for easy manufacture and placement into your product. Application firmware and configuration settings can be preloaded to the module before supply.

LM offer bespoke integration into your product by supporting your developer. We can also assist in the development of new applications for the module. Demo applications such as iBeacon and Key Fob are available with the module's LM53X development kits. The application firmware is customisable to meet your requirements.



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General Specification

Wireless

Bluetooth® Standard	v4.1
Module Type	Standalone (Embedded Bluetooth® Stack)
Profiles	GATT-Based

Hardware

Chipset	CSR
Antenna	IC Antenna Onboard
Microcontroller (MCU)	16-bit RISC
EEPROM Memory	512 kB
RAM	64 kB
Program Interface	SPI
Interfaces	I2C, UART, AIO and PIO
Power Supply	3V3 (3V6 Max)
Crystal Oscillators	32 kHz and 16MHz
Development Kit	LM53X

RF Characteristics

Tx Output Power	0 dBm to 9 dBm
Rx Sensitivity	-92 dBm (Typical)
Current Consumption (Continuous Tx)	14 mA (at 0 dBm), 15.9mA (at 3dBm) and <25 mA (at 9dBm)
Current Consumption (Continuous Rx)	22 mA (Typical)
Range (in open space)	Up to 55m
Data Rate	Up to 1Mbps
Frequency	2.4 GHz to 2.485 GHz

Physical Characteristics

Operating Temperature	-30°C to +85°C
Dimensions (L x W x H)	22mm x 10.11mm x 2.50mm
Weight	0.83g
Certifications	IC, FCC, CE/ RED Directive and SIG Certified Solution
Compliance	RoHS, REACH and WEEE Compliant Solution



LM931 Bluetooth® low energy Module

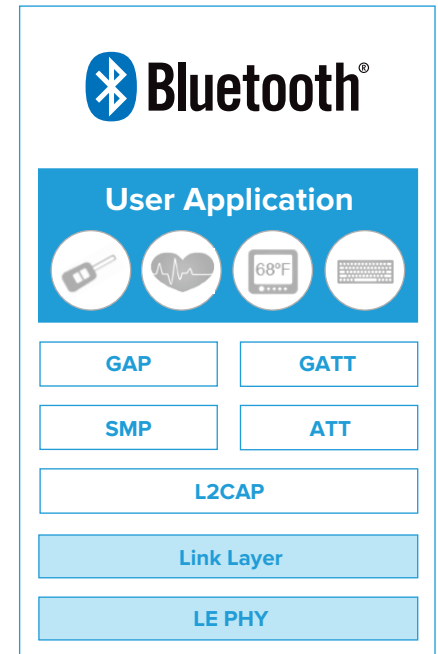
Standalone (With Embedded Bluetooth® v4.1 Stack)

Product	LM931
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Applications

The LM931 is a standalone module capable of running your Bluetooth® v4.1 application. Requiring no external MCU and supports a wide range of Bluetooth® low energy applications such as:

- Alert Tag
- Automotive Keyfob
- Beacon
- Blood Pressure Sensor
- Cycling Speed and Cadence Sensor
- Environment Sensor
- Glucose Sensor
- Health Thermometer
- Heart Rate Sensor
- Keyboard
- Multifunction Steering Wheel
- Mouse
- Running Speed and Cadence Sensor
- Security Tag
- Serial Communication
- Time Client
- Temperature and Pressure
- Weight Scale



LM Technologies offer Bluetooth® v4.1 application support, including assisting the developer and creating new applications. LM provide demo applications that can be customised to your specification.

Demo Applications available:

- iBeacon
- Key fob
- RGB LED Controller
- Serial Communication over GATT
- GPIO (for testing module I/O capabilities)



LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product LM931

Part No (Tray) 931-0552

Part No (Tape& Reel) 931-0636

Radio Frequency Characteristics

Transmit Power Measurements

Crystal Trim

Specification	Measurement	Unit
Frequency Offset ± 1 KHz	0.75KHz	KHz
Trim Value	12	-

Output Power

Specification			Measurement						Unit
Low Energy	Ppk	Ppk	2402MHz (CH0*)		2442MHz (CH20*)		2480MHz (CH39*)		
			Pav	Ppk	Pav	Ppk	Pav	Ppk	
	<Pav +3 dBm	-20 dBm<Pave<10dBm	8.1	8.4	8.4	8.6	9	9.2	dBm

Receive Measurements

Limitation Sensitivity

Low Energy	Specification	Measurement			Unit
		2402MHz (CH0*)	2442MHz (CH20*)	2480MHz (CH39*)	
	BER $\leq 30.8\%$ for receiving power is -70 dBm or better.	-93	-92	-93	dBm

Maximum Input Level

Low Energy	Specification	Measurement			Unit
		2402MHz (CH0*)	2442MHz (CH20*)	2480MHz (CH39*)	
	PER $\leq 30.8\%$ for receiving power is -10 dBm or better.	0	0	0	%

Current Consumption Test

Test Condition

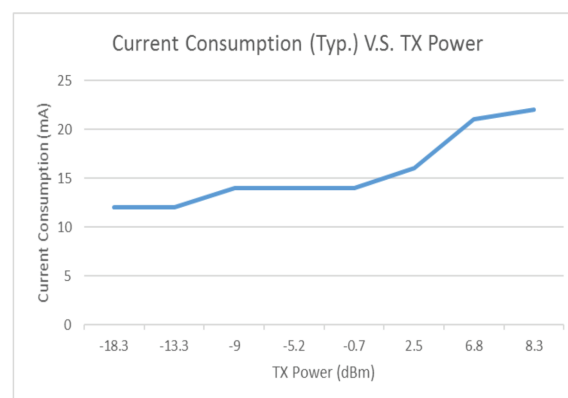
(BLE PRBS9 Channel 2442MHz Package Length 37)

Continuous TX: 14 mA (at 0 dBm), 15.9mA (at 3dBm) and <25 mA (at 9dBm)

Continuous Rx: 22 mA (typ.)

Power Boot Up: 3 mA (typ.)

Figure:





LM931 Bluetooth® low energy Module

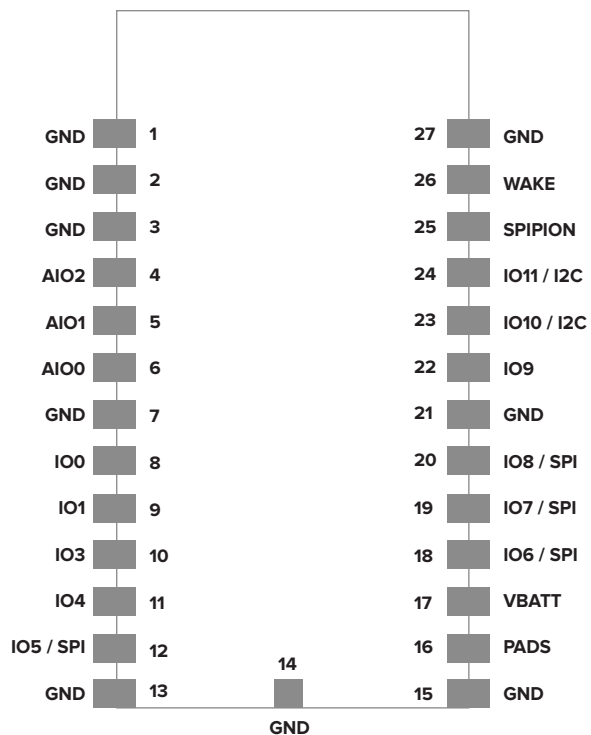
Standalone (With Embedded Bluetooth® v4.1 Stack)

Product	LM931
Part No (Tray)	931-0552
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Powering

The Pads (Pin 16) must be supplied with the same voltage as the Lithium ion battery (Pin 17).

Pin Out



**LM931 Bluetooth® low energy Module**

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product LM931

Part No (Tray) 931-0552

Part No (Tape& Reel) 931-0636

Pin Assignments

Pin	Name	Type	Description	Min	Typical	Max
1	GND	Ground	Common Ground		0V	
2	GND	Ground	Common Ground		0V	
3	GND	Ground	Common Ground		0V	
4	AIO2	Input	Analogue Input Output			VDD
5	AIO1	Input	Analogue Input Output			VDD
6	AIO0	Input	Analogue Input Output			VDD
7	GND	Ground	Common Ground		0V	
8	IO0	I/O	UART TX			VDD
9	IO1	I/O	UART RX			VDD
10	IO3	I/O	Programmable Input Output (PIO)			VDD
11	IO4	I/O	Programmable Input Output (PIO)			VDD
12*	IO5 / SPI	I/O	Programmable Input Output (PIO) / DEBUG_CLK			VDD
13	GND	Ground	Common Ground		0V	
14	GND	Ground	Common Ground		0V	
15	GND	Ground	Common Ground		0V	
16	PADS	Power	Positive supply for all digital and analogue I/O Pins	1V2	3V3	3V6
17	VBATT	Power	Module battery power supply DC	1V8	3V3	3V6
18*	IO6 / SPI	I/O	Programmable Input Output (PIO) / DEBUG_CS#			VDD
19*	IO7 / SPI	I/O	Programmable Input Output (PIO) / DEBUG_MOSI			VDD
20*	IO8 / SPI	I/O	Programmable Input Output (PIO) / DEBUG_MISO			VDD
21	GND	Ground	Common Ground		0V	
22	IO9	I/O	Programmable Input Output (PIO)			VDD
23	IO10 / I2C	I/O	Programmable Input Output (PIO) / SDA			VDD
24	IO11 / I2C	I/O	Programmable Input Output (PIO) / SCL			VDD
25	SPIPION	Input	High to enable the SPI debug interface, Low to enable PIO			VDD
26	WAKE	Input	Toggle to wake from Dormant Mode			VDD_BAT
27	GND	Ground	Common Ground		0V	

* for SPI at P12, P18, P19 and P20 set P25 to High.

* for PIO at P12, P18, P19 and P20 set P25 to Low.



LM931 Bluetooth® low energy Module

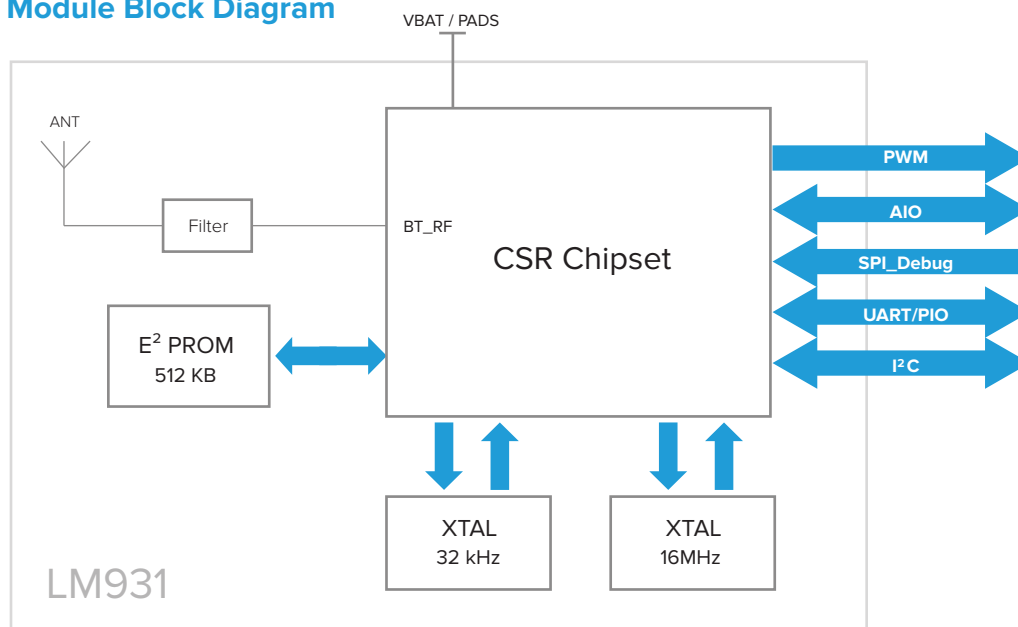
Standalone (With Embedded Bluetooth® v4.1 Stack)

Product LM931

Part No (Tray) 931-0552

Part No (Tape& Reel) 931-0636

Module Block Diagram





LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

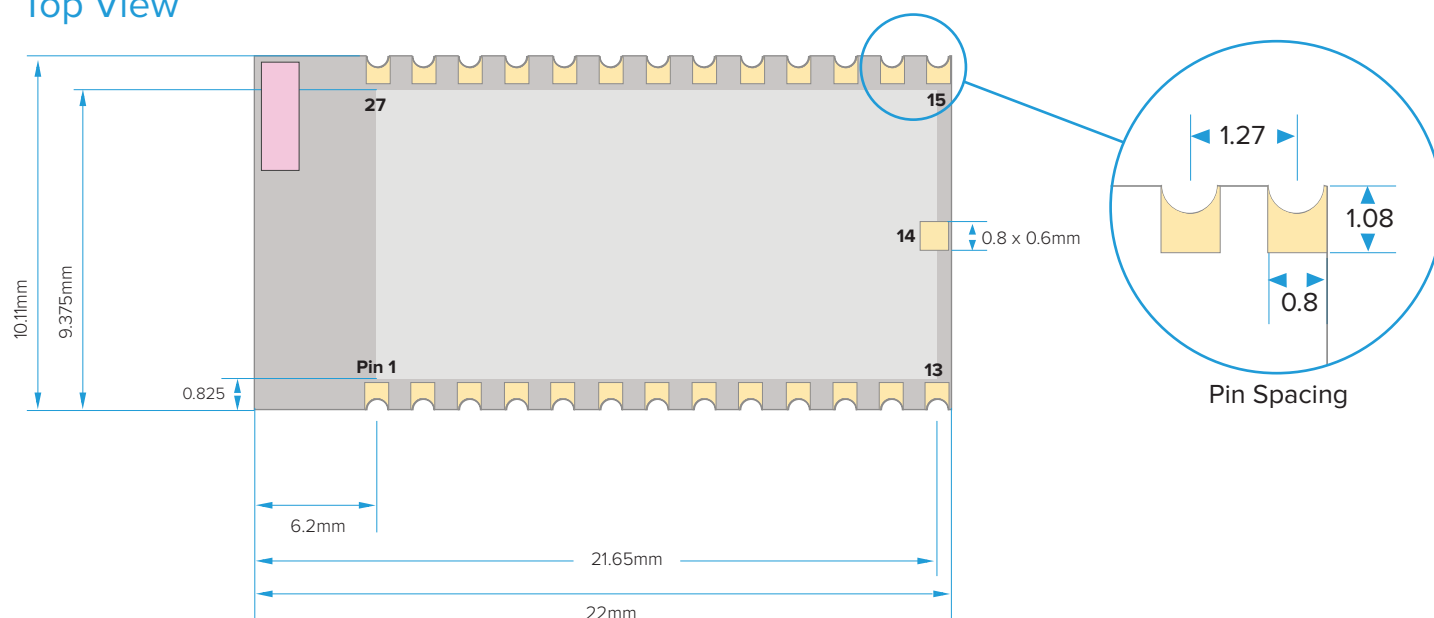
Product LM931

Part No (Tray) 931-0552

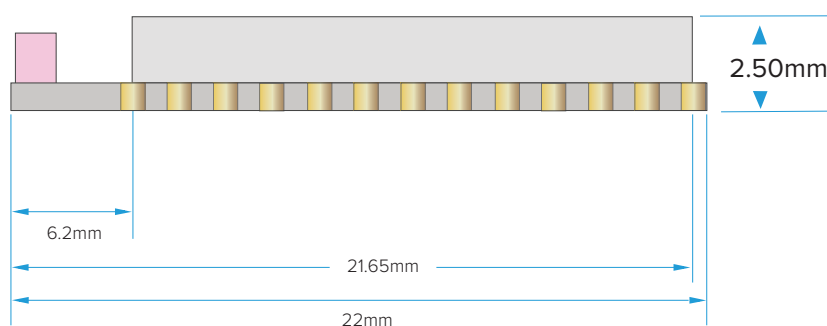
Part No (Tape & Reel) 931-0636

Physical Dimensions

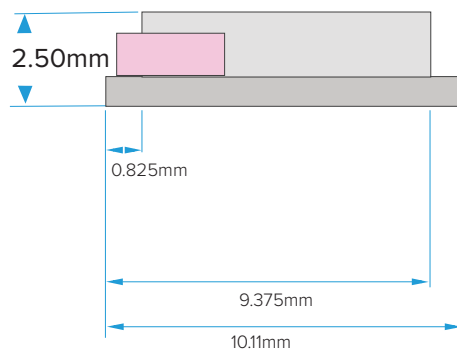
Top View



Front View



Side View





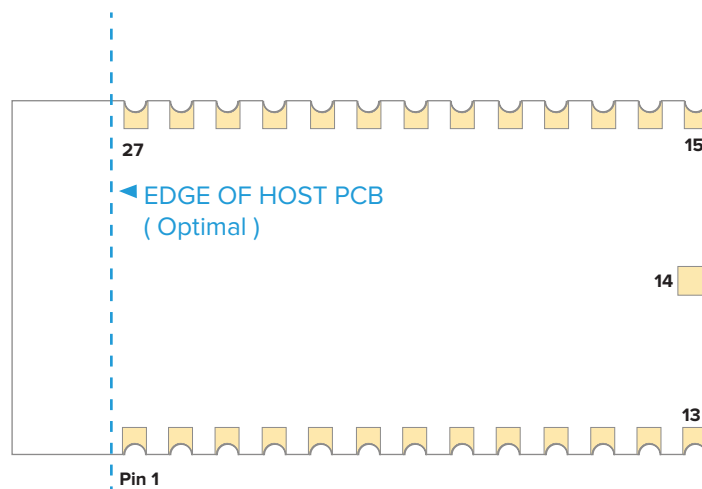
LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product	LM931
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PCB Footprint

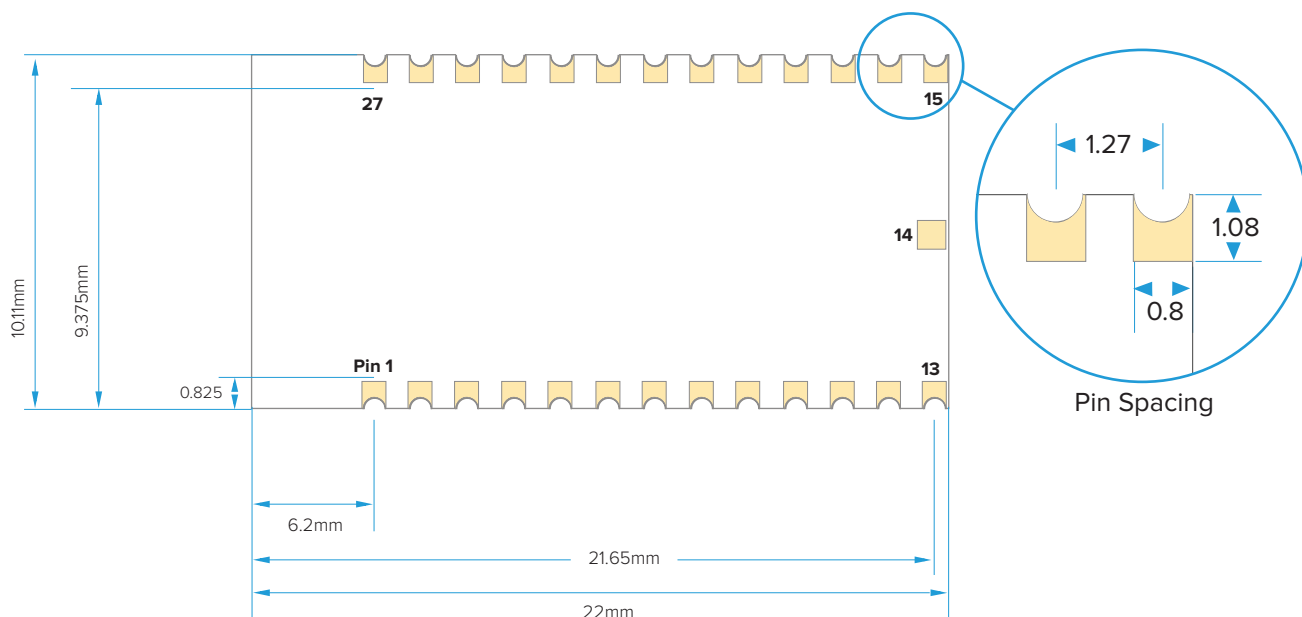
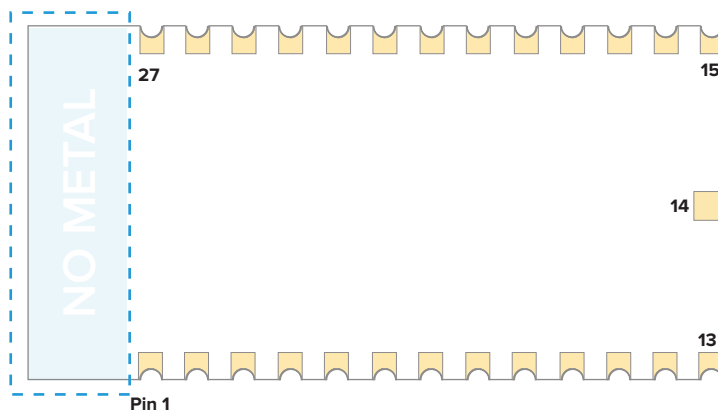
Optimal Placement Position



Placement Note
If the optimal placement position cannot be achieved, ensure there is no metal beneath the highlighted part of module.

NB

Aim to place the module away from interference.
(i.e: place the module at the edge of the board.)



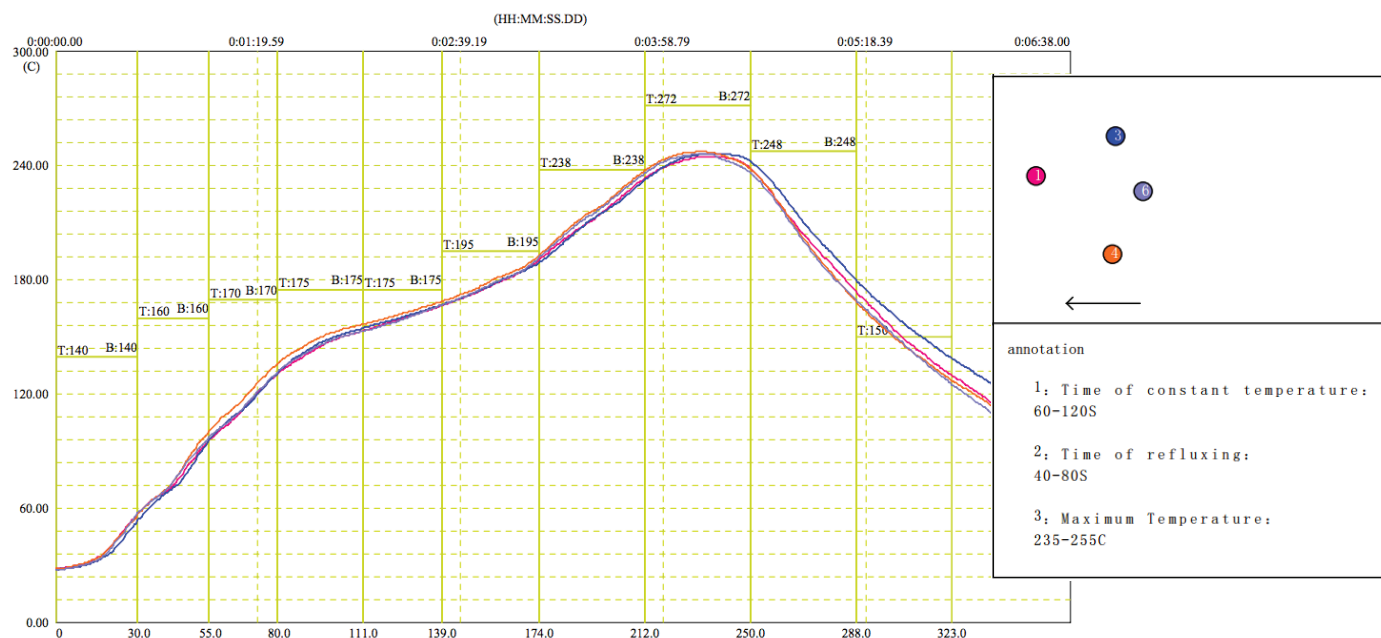


LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product LM931
Part No (Tray) 931-0552
Part No (Tape & Reel) 931-0636

Soldering Reflow Chart



	Preheat zone slope		Immersion time 150 to 180°C		Refluxing time 220°C		Maximum Temperature		cooling zone slope						
1	1.60	-26.67%	63.50	-91.25%	65.50	27.50%	245.2	34.67%	-1.79	-48.47%	--	--	--	--	--
2	1.60	-26.67%	65.50	-86.25%	68.50	42.50%	246.7	44.67%	-1.59	-56.38%	--	--	--	--	--
3	1.60	-26.67%	67.50	-81.25%	69.00	45.00%	247.6	50.67%	-1.68	-52.95%	--	--	--	--	--
4	1.70	-20.00%	62.50	-93.75%	67.50	37.50%	246.3	42.00%	-1.48	-60.73%	--	--	--	--	--



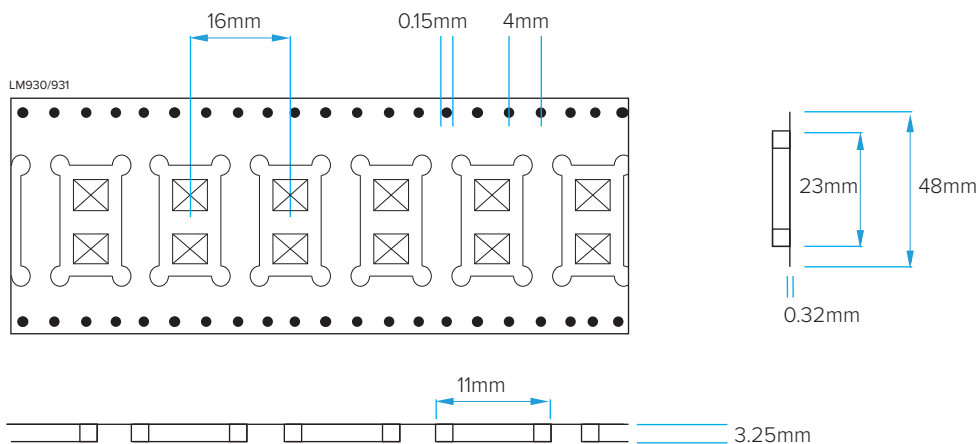
LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

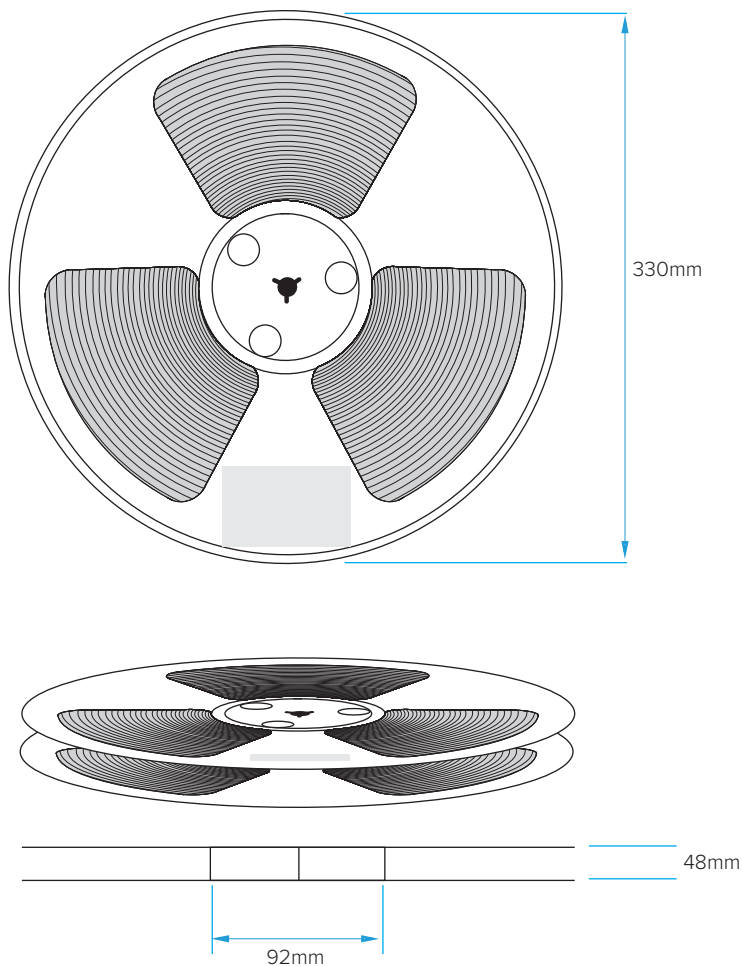
Product	LM931
Part No (Tray)	931-0552
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Tape and Reel Packaging

Tape Dimensions



Reel Dimensions



Notes

- Carton Dimensions (L x W x H): 360mm x 290mm x 370mm

Quantities

- 1250 modules per Tape
- 4 Boxes per Carton
- 5000 modules per Carton



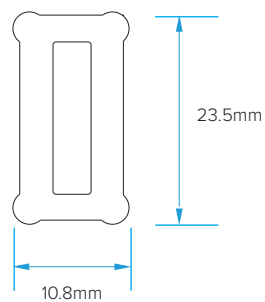
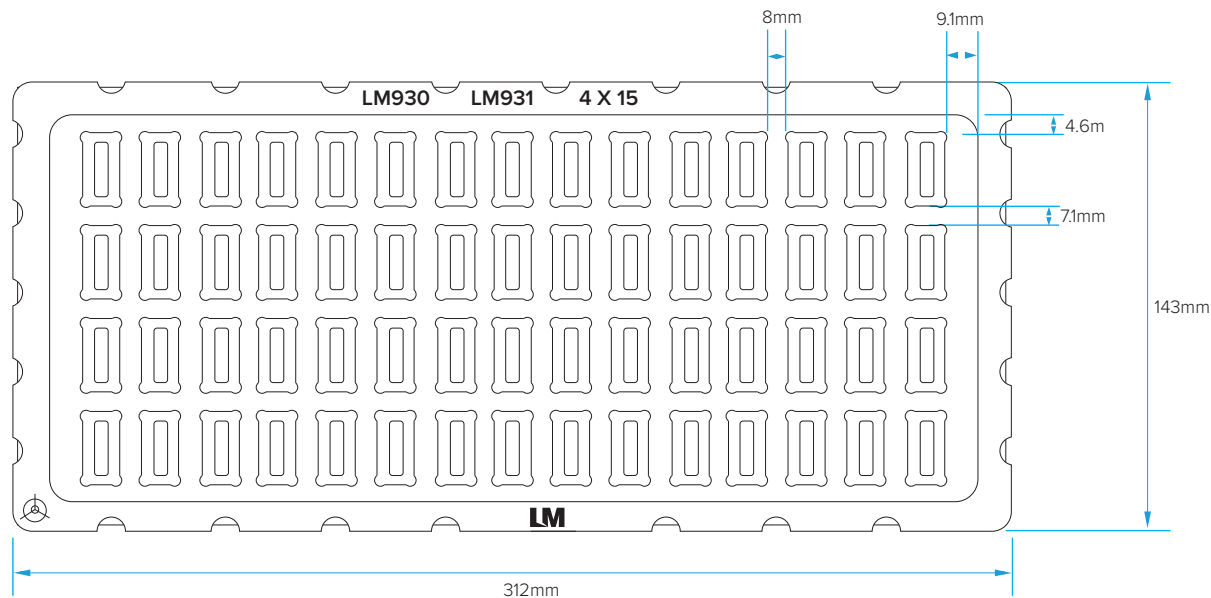
LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product	LM931
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Part No (Tape & Reel)	931-0636

Tray Packaging

Tray Dimensions



Notes

- Anti-Static PS Tray, Black .
- Electrical Resistance: $1\text{ M}\Omega < R < 100\text{ M}\Omega$.
- Thickness: $T = 0.8\text{ mm}$
- Carton Dimensions (L x W x H):
360mm x 325mm x 160mm

Quantities

- 60 modules per Tray
- 600 modules per Box
- 4 Boxes per Carton
- 2400 modules per Carton



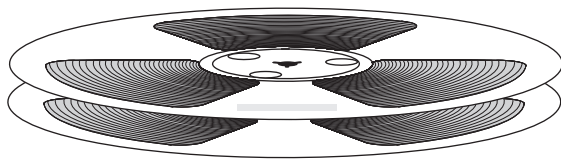
LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

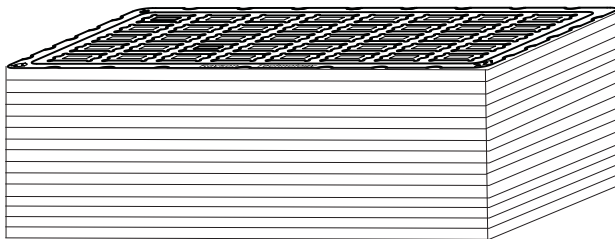
Product	LM931
Part No (Tray)	931-0552
Part No (Tape & Reel)	931-0636

Packaging for Tape & Reel / Tray

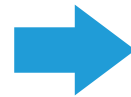
The trays/reels are stacked and inserted into an anti-static vacuum bag and the Anti-Static Label, Model Name Label and Moisture Sensitive Labels stuck on.



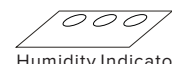
Reels are place within a vacuum bag.



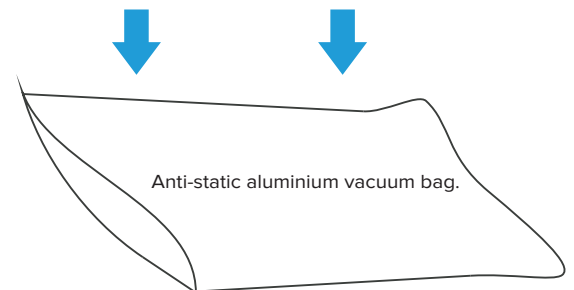
Trays are stacked up with an empty tray on the top.



drying agent

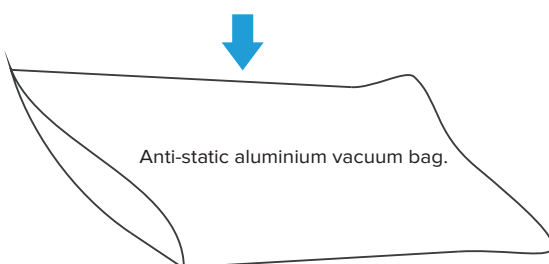


Humidity Indicator Card

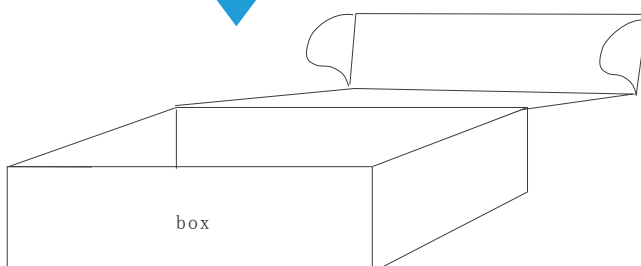


Anti-static aluminium vacuum bag.

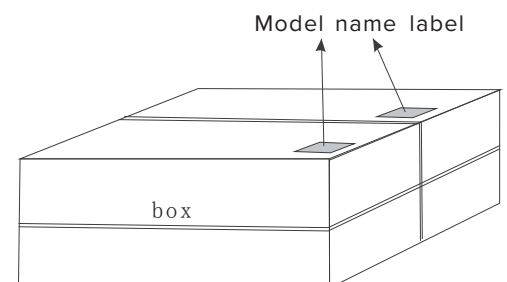
The vacuum bag is placed inside the box and a Model Name Label stuck on the front-side of each box.



Anti-static aluminium vacuum bag.

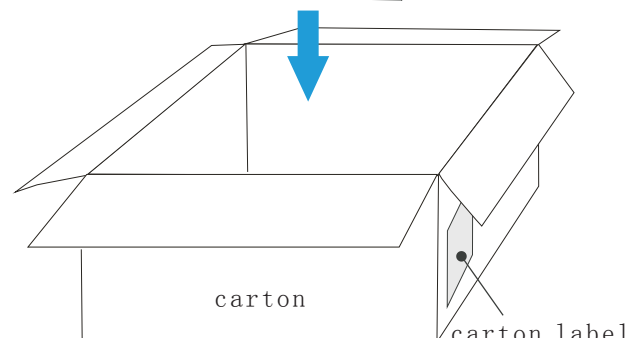


box



Model name label

box



carton

carton label

Each carton contains 4 boxes.



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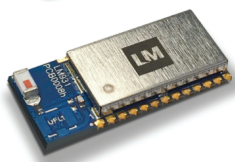
LM931 Packaging Options



931-0552

LM931 Module

1 x LM931 SMT Plug & Play IC Antenna Module
Tray



931-0636

LM931 Module

1 x LM931 SMT Plug & Play IC Antenna Module
Tape & Reel