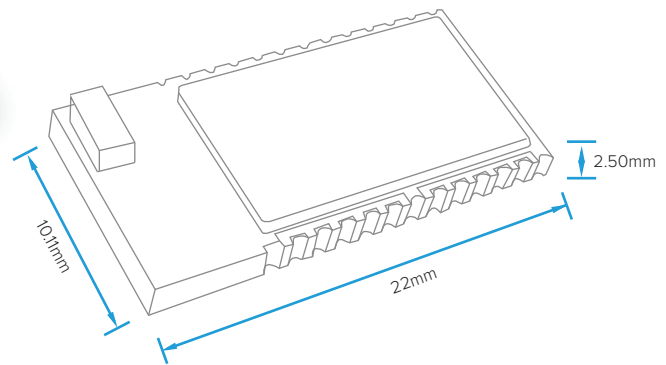
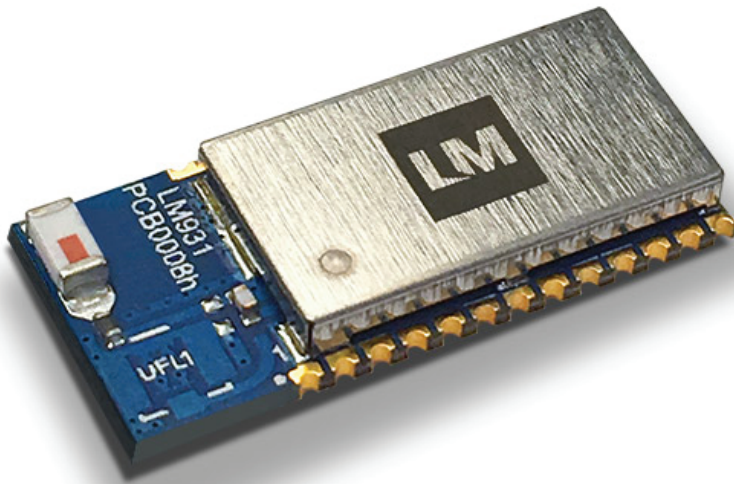


## LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product LM931  
 Part No See Last Page  
 Revised 29/AUG/2017



### Features

- Bluetooth® v4.1 specification
- 14 mA Current Consumption (at 0 dBm Tx Output Power)
- IC Antenna Onboard (Peak Gain = 0.5 dBi)
- 9 dBm Tx Output Power (Max) and -92 dBm Rx Sensitivity
- Over-the-Air Upgrade (OTAU) available
- Application Firmware Support
- IoT Applications available including Serial over GATT, Eddystone™ Beacon and Cloud Sensor & Cloud Collector
- Fully integrated module with no additional components required
- I<sup>2</sup>C and UART
- 9 digital and 3 analogue I/O (10-bit ADC)
- Wake-up interrupt and Watchdog timer
- 4 PWM channels
- 22mm x 10.11mm x 2.50mm
- SMT Side and Bottom Pads for easy production
- See our website for this products certifications
- RoHS, REACH and WEEE Compliant Solution

### Overview

The LM931 Bluetooth® low energy module is designed for use within embedded systems. It is implemented as a peripheral device within a product, while saving the developer valuable PCB space. The LM931 enables wireless communication with other nearby Bluetooth® low energy devices (e.g. iOS and Android) using a highly power efficient 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 communication 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 application. The LM931 incorporates 27 pin outs including UART and I<sup>2</sup>C 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. IoT Applications such as Serial over GATT, iBeacon™ and Key Fob (with RGB LED Controller) are available with the module's LM53X development kits. The firmware is customisable to meet your requirements.



## LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product  
Part No

LM931  
See Last Page

### General Specification

#### Wireless

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

#### Hardware

Chipset	Qualcomm®
Antenna	IC Antenna Onboard
Microcontroller (MCU)	16-bit RISC
EEPROM Memory	512 kB
RAM	64 kB
Programming Interface	SPI
Interfaces	I <sup>2</sup> C, UART, AIO and PIO
Power Supply	3V3 (3V6 Max)
Crystal Oscillators	32 kHz and 16 MHz
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), 15.9 mA (at 3 dBm) and <25 mA (at 9 dBm)
Current Consumption (Continuous Rx)	22 mA (Typical)
Range (in open space)	Up to 55m
Data Rate	Up to 1 Mbps
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	See our website for this products certifications
Compliance	RoHS, REACH and WEEE Compliant Solution

## LM931 Bluetooth® low energy Module

### Standalone (With Embedded Bluetooth® v4.1 Stack)

Product

LM931

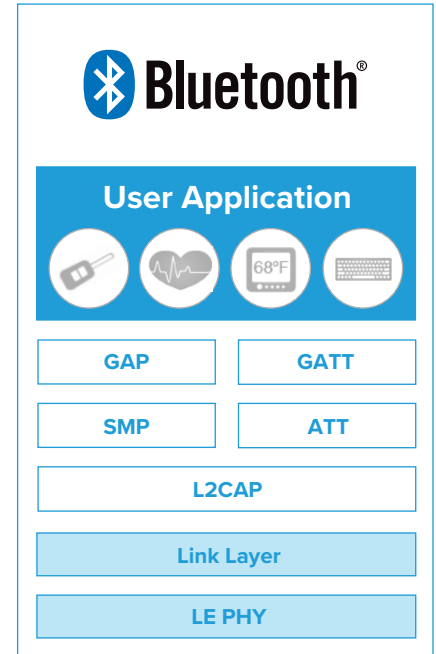
Part No

See Last Page

### IoT Applications

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

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



LM Technologies offer application support, including assisting the developer and creating new applications. LM provide firmware that can be customised to your specification.

Firmware available:

- Cloud Sensor
- Cloud Collector
- Eddystone™ Beacon
- URL Beacon
- iBeacon™
- Serial Server
- Console
- Key Fob (with RGB LED Controller)

# LM931 Bluetooth® low energy Module

## Standalone (With Embedded Bluetooth® v4.1 Stack)

Product  
Part No

LM931  
See Last Page

### Radio Frequency Characteristics

#### Transmit Power Measurements

##### Crystal Trim

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

##### Output Power

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

#### Receive Measurements

##### Limitation Sensitivity

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

##### Maximum Input Level

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

#### Current Consumption Test

##### Test Condition

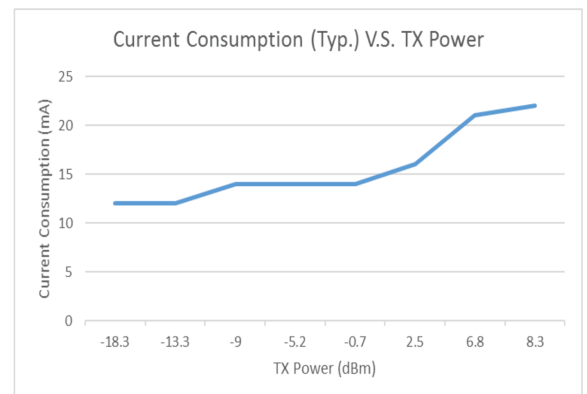
(BLE PRBS9 Channel 2442MHz Package Length 37)

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)

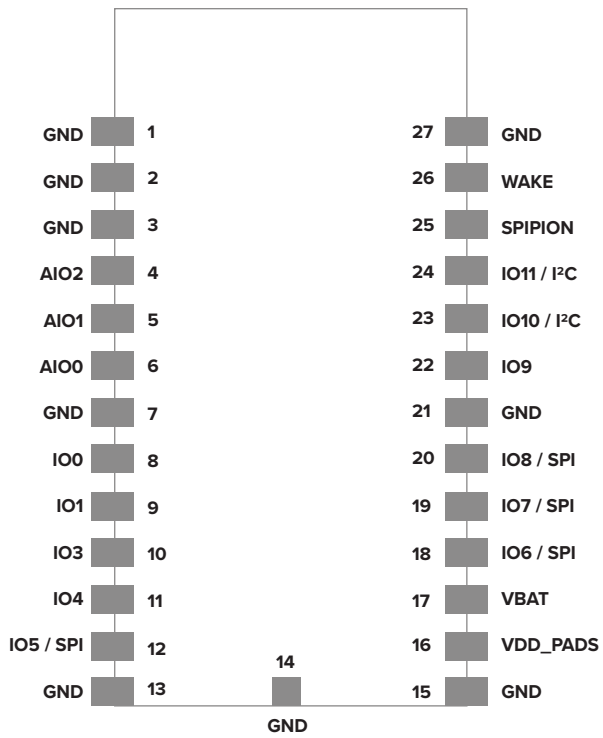
Product  
Part No

LM931  
See Last Page

## Powering

Use VDD\_PADS (Pin 16) or VBAT (Pin 17) to power the module.

## Pin Out



# LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product  
Part No

LM931  
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## 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	VDD_PADS	Power	Positive supply for all digital and analogue I/O Pins	1V2	3V3	3V6
17	VBAT	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 / I <sup>2</sup> C	I/O	Programmable Input Output (PIO) / SDA			VDD
24	IO11 / I <sup>2</sup> C	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.

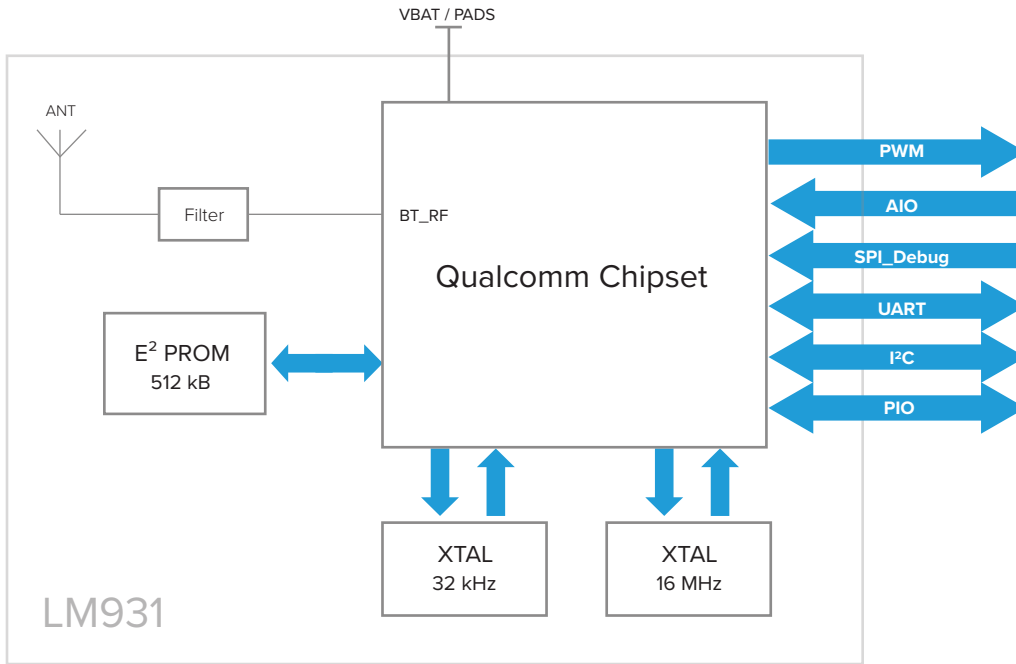
\* for PIO at P12, P18, P19 and P20 set P25 to Low.

**LM931 Bluetooth® low energy Module**  
 Standalone (With Embedded Bluetooth® v4.1 Stack)

Product  
 Part No

LM931  
 See Last Page

**Module Block Diagram**





# LM931 Bluetooth® low energy Module Standalone (With Embedded Bluetooth® v4.1 Stack)

Product

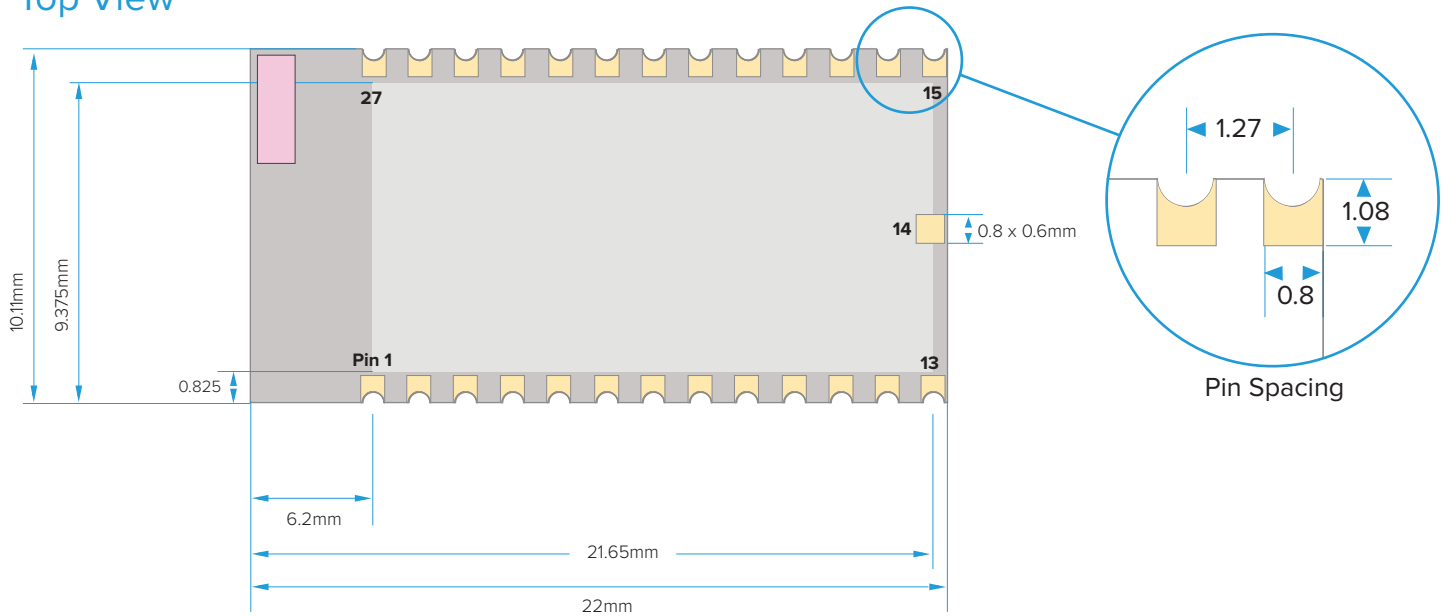
LM931

Part No

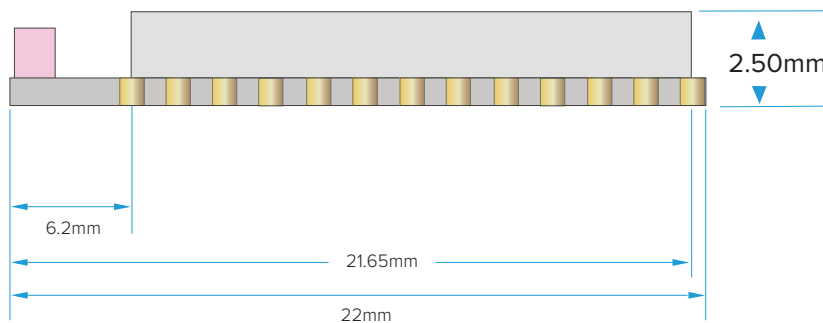
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## Physical Dimensions

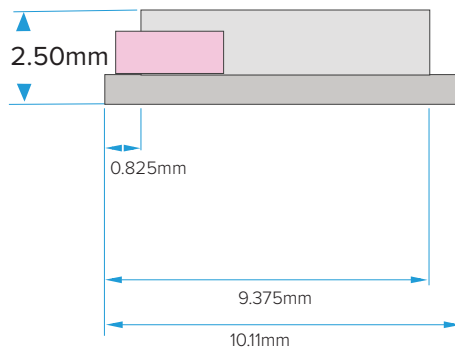
### Top View



### Front View



### Side View



# LM931 Bluetooth® low energy Module

Standalone (With Embedded Bluetooth® v4.1 Stack)

Product

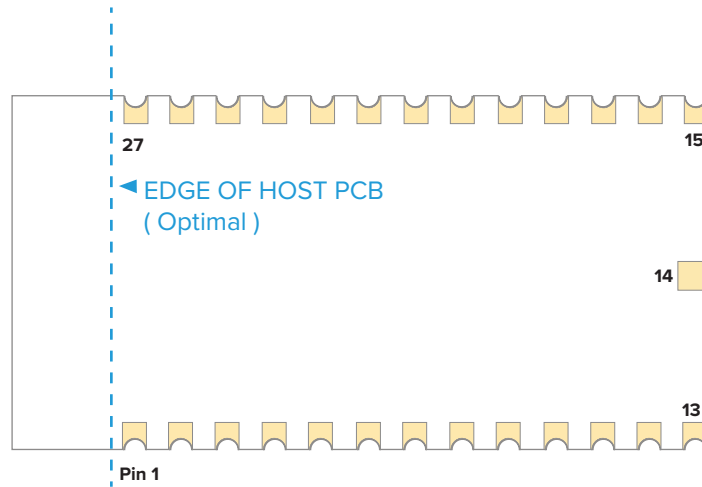
LM931

Part No

See Last Page

## PCB Footprint

Optimal Placement Position

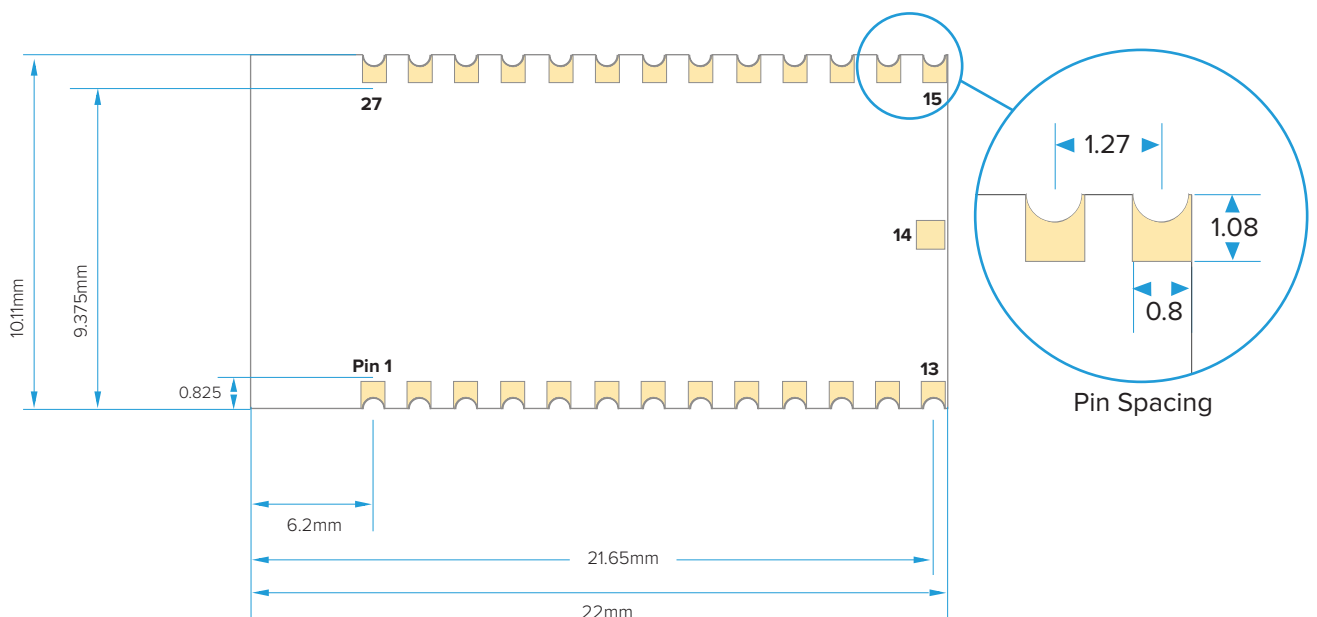


### Placement Note

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.)

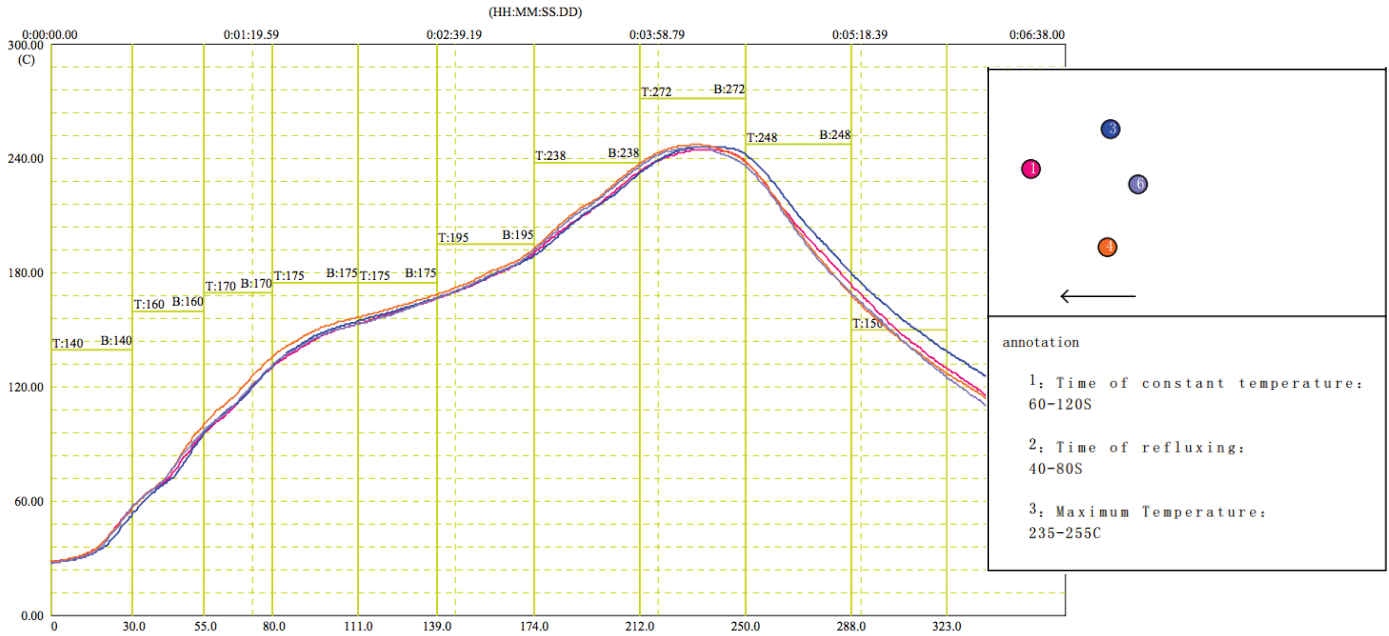


**LM931 Bluetooth® low energy Module**  
 Standalone (With Embedded Bluetooth® v4.1 Stack)

Product  
 Part No

LM931  
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**Soldering Reflow Chart**



	Preheat zone slope		Immersion time 150 to 180°C		Refluxing time 220°C		Maximum Temperature		cooling zone slope						
■	1.60	-26.67%	63.50	-91.25%	65.50	27.50%	245.2	34.67%	-1.79	-48.47%	--	--	--	--	--
■	1.60	-26.67%	65.50	-86.25%	68.50	42.50%	246.7	44.67%	-1.59	-56.38%	--	--	--	--	--
■	1.60	-26.67%	67.50	-81.25%	69.00	45.00%	247.6	50.67%	-1.68	-52.95%	--	--	--	--	--
■	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

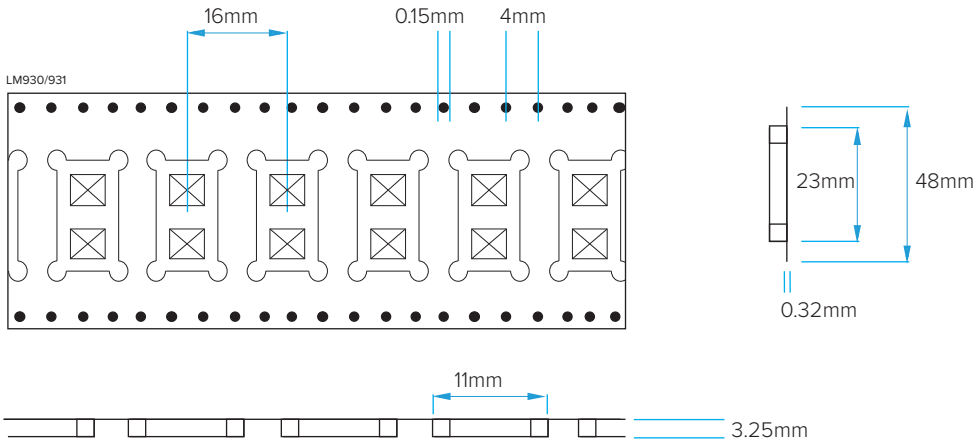
LM931

Part No

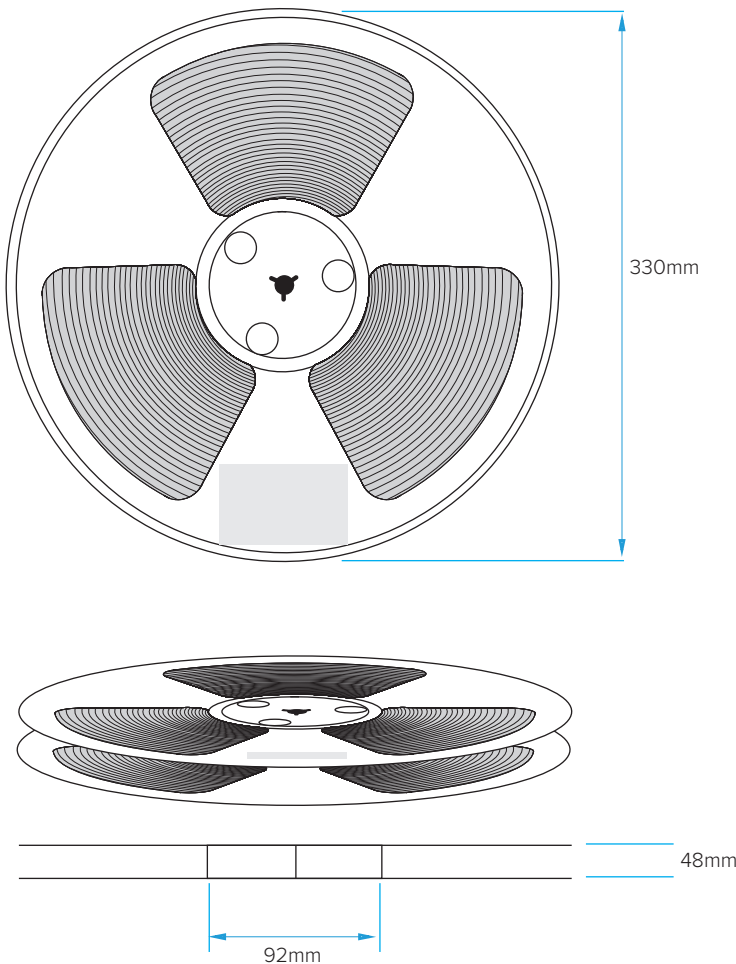
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**Tape and Reel Packaging**

**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

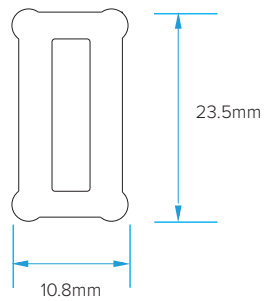
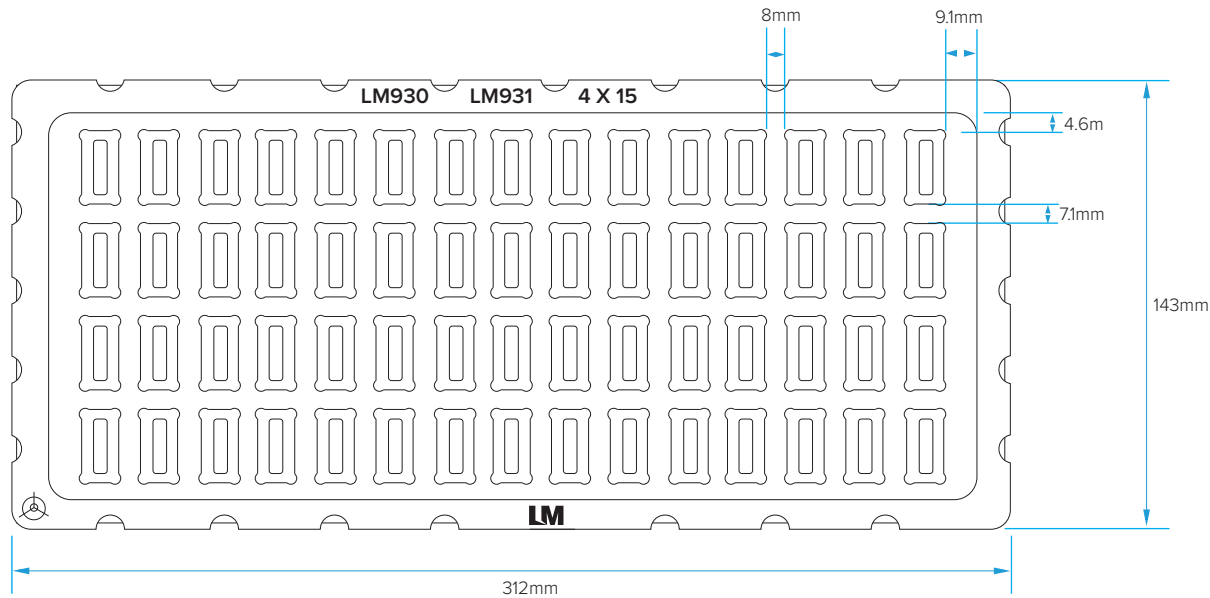
**LM931 Bluetooth® low energy Module**  
 Standalone (With Embedded Bluetooth® v4.1 Stack)

Product  
 Part No

LM931  
 See Last Page

**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):  
 $360\text{ mm} \times 325\text{ mm} \times 160\text{ mm}$

**Quantities**

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

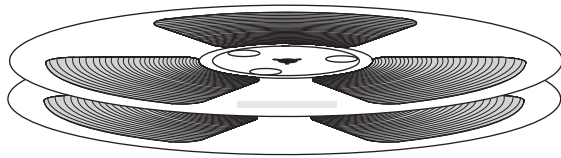
**LM931 Bluetooth® low energy Module**  
 Standalone (With Embedded Bluetooth® v4.1 Stack)

Product  
 Part No

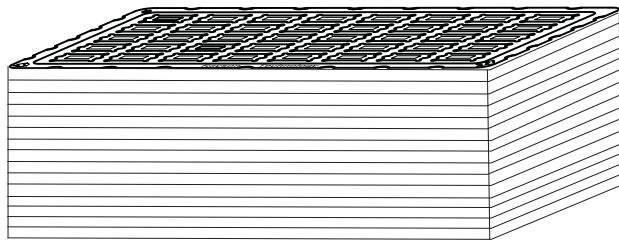
LM931  
 See Last Page

**Packaging for Tape & Reel / Tray**

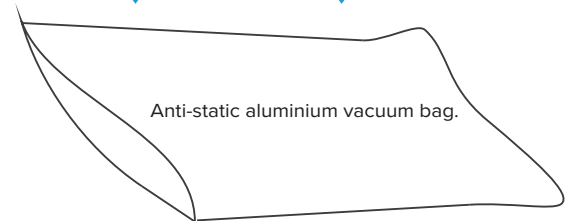
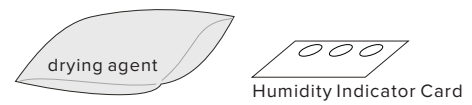
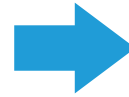
The trays/reels are stacked and inserted into an anti-static vacuum bag, with the anti-static, model name and moisture sensitive labels affixed.



Reels are place within a vacuum bag.

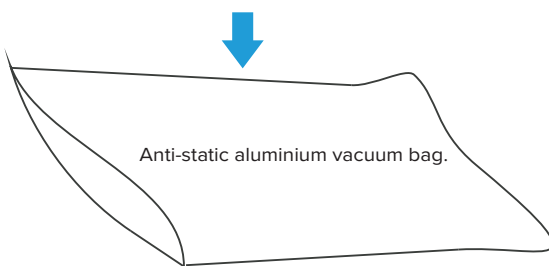


Trays are stacked up with an empty tray on the top.

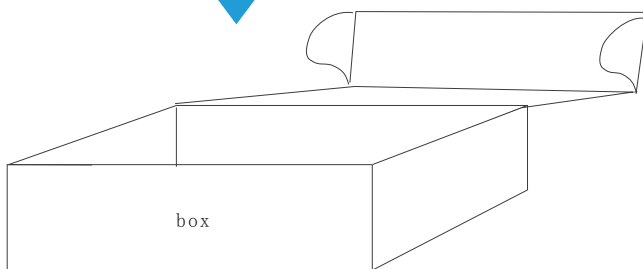


Anti-static aluminium vacuum bag.

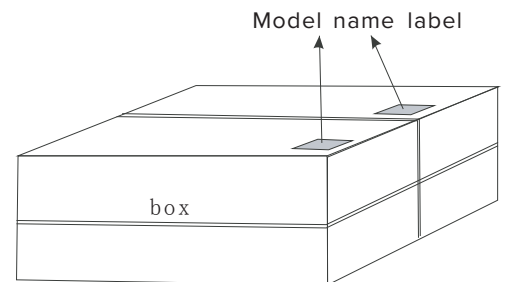
The vacuum bag is placed inside the box and a model name label affixed on the front-side of each box.



Anti-static aluminium vacuum bag.

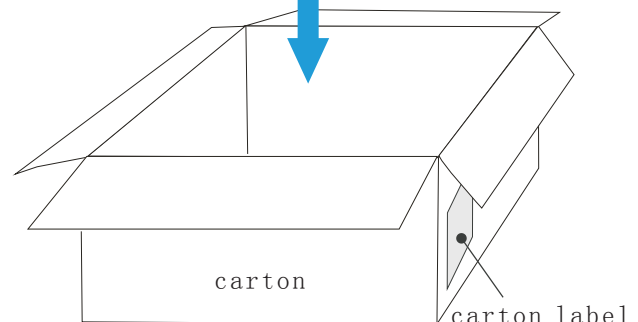


box



Model name label

box



carton

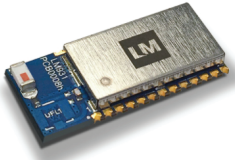
carton label

Each carton contains 4 boxes.

**LM931 Bluetooth® low energy Module**  
 Standalone (With Embedded Bluetooth® v4.1 Stack)

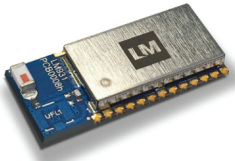
Product LM931  
 Part No See Below

**LM931 Packaging Options**



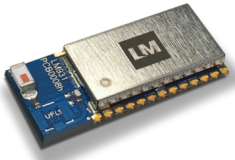
931-0551

**LM931 Module**  
 1 x LM931 SMT Plug & Play IC Antenna Module  
 Retail Pack (RP)



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