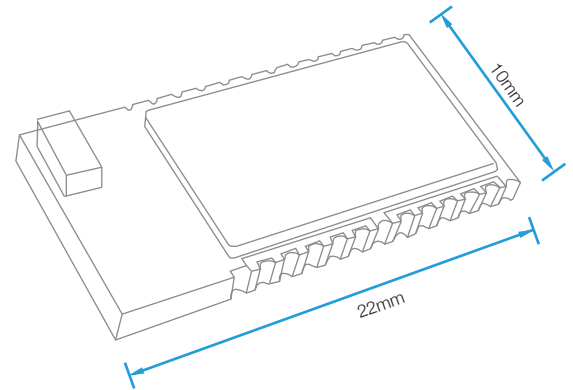
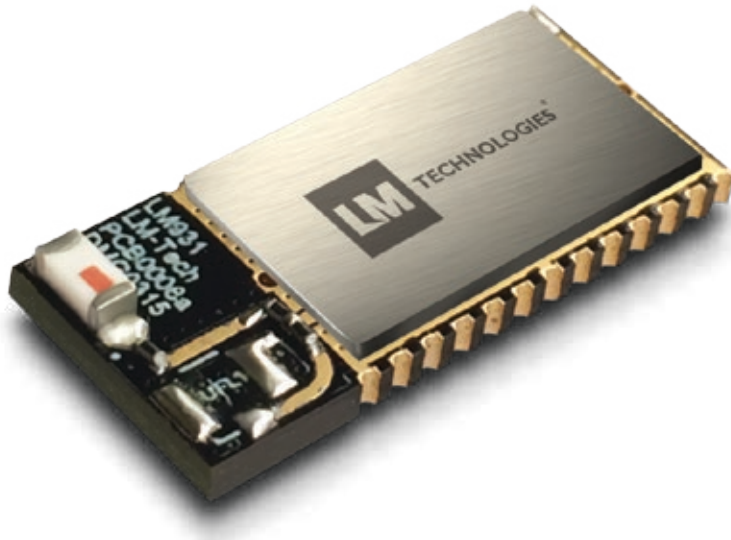




# LM931 Bluetooth BLE 4.1 Smart Module

## UART Class 1 with Onboard Antenna

Product LM931  
 Part No 931-0636  
 Revised 19/MAY/2015



### Features

- 128KB memory: 64KB RAM and 64KB ROM
- Bluetooth® v4.1 specification
- Low energy maximum transmit output power
- Support for Bluetooth v4.1 specification host stack including ATT, GATT, SMP, L2CAP, GAP
- RSSI monitoring for proximity applications
- <900nA current consumption in dormant mode
- Low Power 32kHz and 16MHz crystal
- Switch-mode power supply
- Receiver Sensitivity 92.5 dBm
- 12 digital PIOs
- 3 analogue AIOs
- UART
- 4 PWM modules
- 10-bit ADC
- Programmable general purpose PIO controller
- Wake-up interrupt and watchdog timer

### Overview

The LM931 Series of modules are BLE-only modules that run on their own host stack under the BT4.1 Standard. In addition to the host stack running on the module, a range of fully programmable BLE applications can be configured to run on the module.

LM can develop such applications to your own requirements and/or add your own firmware to our module.

We can pre-configure any applications that may require specific settings to be pre-loaded and provide modules with pre-determined device names if required.

With a battery added to the LM931 and placed into a housing, this module can also act as an iBeacon device awaiting instruction/data, or to pass on instruction/data automatically when in range of other BLE enabled devices.



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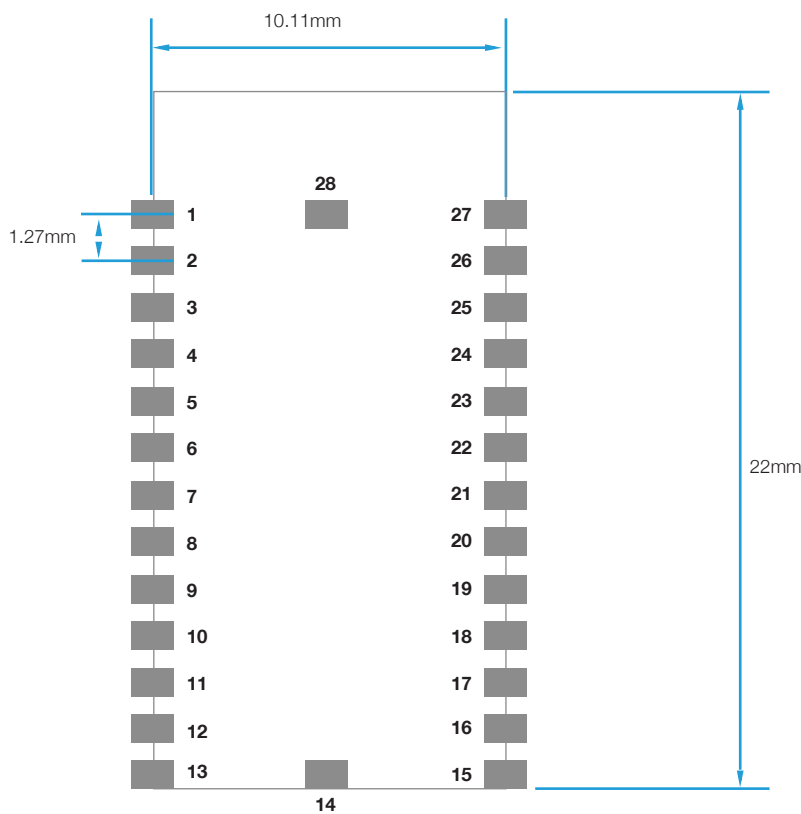
## UART Class 1 with Onboard Antenna

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### General Specification

Chipset	CSR 1012
Class	BLE Smart Class 1
Speed / Bandwidth	Up to 1Mbps (0.27Mbps throughput)
Range	0m - 100m in open space
Interface	I <sup>2</sup> C / SPI for EEPROM / flash memory ICs and peripherals
Standard Bluetooth	4.1
Frequency	2.400 to 2.4835 GHz
Hopping	Adaptive/sec 2MHz channel space
Profiles Supported	BLE Smart App's Only
Firmware	Fully programmable (Onboard stack)
Antenna Gain	Max 2 dBi
Power Supply	1.8-3.6 VBATT and 1.2-3.6 VDD PAD
Operating Temperature	-30°C to 85°C
Storage Temperature	-40°C to +85°C
Dimensions	22mm x 10mm x 2.8mm

### Pin Outs





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### Pin Assignments

Pin	Name	Type	Description
1	GND	Ground	Common Ground
2	GND	Ground	Common Ground
3	GND	Ground	Common Ground
4	AIO2	I/O	Programmable Input Output
5	AIO1	I/O	Programmable Input Output
6	AIO0	I/O	Programmable Input Output
7	GND	Ground	Common Ground
8	IO0	I/O	UART TX
9	IO1	I/O	UART RX
10	IO3	I/O	Programmable Input Output
11	IO4	I/O	Programmable Input Output
12	IO5	I/O	DEBUG_CLK
13	GND	Ground	Common Ground
14	GND	Ground	Common Ground
15	GND	Ground	Common Ground
16	PADS	Power	Positive supply for all digital I/O Ports
17	VBATT	Power	Module input supply, 3.3V DC
18	IO6	I/O	DEBUG_CS#
19	IO7	I/O	DEBUG_MOSI
20	IO8	I/O	DEBUG_MISO
21	GND	Ground	Common Ground
22	IO9	I/O	Programmable Input Output
23	IO10	I/O	Programmable Input Output
24	IO11	I/O	Programmable Input Output
25	SPIPION	Input	High to enable the SPI debug interface
26	WAKE	Input	Wake from Hibernate
27	GND	Ground	Common Ground
28	GND	Ground	Common Ground



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## 8 Electrical Characteristics

### 8.1 Absolute Maximum Ratings

Rating	Min	Max	Unit
Storage temperature	-40	85	°C
Battery (VDD_BAT) operation	1.8	4.4	V
I/O supply voltage	-0.4	4.4	V
Other terminal voltages <sup>(a)</sup>	VSS - 0.4	VDD + 0.4	V

<sup>(a)</sup> VDD = Terminal Supply Domain

### 8.2 Recommended Operating Conditions

Operating Condition	Min	Typ	Max	Unit
Operating temperature range	-30	-	85	°C
Battery (VDD_BAT) operation <sup>(a)</sup>	1.8	-	3.6	V
I/O supply voltage (VDD_PADS) <sup>(b)</sup>	1.2	-	3.6	V



# LM931 Bluetooth BLE 4.1 Smart Module

## UART Class 1 with Onboard Antenna

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### 8.3 Input/Output Terminal Characteristics

#### 8.3.1 Switch-mode Regulator

Switch-mode Regulator	Min	Typ	Max	Unit
Input voltage <sup>(a)</sup>	1.8	-	3.6	V
Output voltage	0.65	1.35	1.35	V
Temperature coefficient	-200	-	200	ppm/°C
<b>Normal Operation</b>				
Output noise, frequency range 100Hz to 100kHz	-	-	0.4	mV rms
Settling time, settling to within 10% of final value	-	-	30	µs
Output current (I <sub>max</sub> )	-	-	50	mA
Quiescent current (excluding load, I <sub>load</sub> < 1mA)	-	-	20	µA
<b>Ultra Low-power Mode</b>				
Output current (I <sub>max</sub> )	-	-	100	µA
Quiescent current	-	-	1	µA

<sup>(a)</sup> CSR1012 QFN is reliable and qualifiable to 4.3V (idle, active and deep sleep modes) and 3.8V (all modes), but there are minor deviations in performance relative to published performance values for 1.8V to 3.6V. For layout guidelines for 4.3V operation, see *CSR1012 Hardware Design Review Template*.

#### 8.3.2 Low-voltage Linear Regulator

Normal Operation	Min	Typ	Max	Unit
Input voltage	0.65	-	1.35	V
Output voltage	0.65	-	1.20	V

**Important Note:**

This regulator is only for CSR internal use. Section 7 shows CSR's recommended circuit connection.

#### 8.3.3 Digital Terminals

Input Voltage Levels	Min	Typ	Max	Unit
V <sub>IL</sub> input logic level low	-0.4	-	0.3 x VDD_PADS	V
V <sub>IH</sub> input logic level high	0.7 x VDD_PADS	-	VDD_PADS + 0.4	V
T <sub>r</sub> /T <sub>f</sub>	-	-	25	ns



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Output Voltage Levels	Min	Typ	Max	Unit
V <sub>OL</sub> output logic level low, I <sub>OL</sub> = 4.0mA	-	-	0.4	V
V <sub>OH</sub> output logic level high, I <sub>OH</sub> = -4.0mA	0.75 x VDD_PADS	-	-	V
T <sub>r</sub> /T <sub>f</sub>	-	-	5	ns

Input and Tristate Currents	Min	Typ	Max	Unit
With strong pull-up	-150	-40	-10	µA
I <sup>2</sup> C with strong pull-up	-250	-	-	µA
With strong pull-down	10	40	150	µA
With weak pull-up	-5.0	-1.0	-0.33	µA
With weak pull-down	0.33	1.0	5.0	µA
C <sub>I</sub> input capacitance	1.0	-	5.0	pF

### 8.3.4 AIO

Input/Output Voltage Levels	Min	Typ	Max	Unit
Input voltage	0	-	VDD_AUX	V
Output voltage	0	-	VDD_AUX	V

#### 8.3.4.1 Auxiliary ADC

Auxiliary ADC	Min	Typ	Max	Unit
Resolution	-	-	10	Bits
Input voltage range <sup>(a)</sup>	0	-	VDD_AUX	V
Accuracy (Guaranteed monotonic)	INL	-1	1	LSB
	DNL	0	1	LSB
Offset	-1	-	1	LSB
Gain error	-0.8	-	0.8	%
Input bandwidth	-	100	-	kHz
Conversion time	1.38	1.69	2.75	µs
Sample rate <sup>(b)</sup>	-	-	700	Samples/s



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### 8.4 ESD Protection

Apply ESD static handling precautions during manufacturing.

Table 8.1 shows the ESD handling maximum ratings.

Condition	Class	Max Rating
Human Body Model Contact Discharge per JEDEC EIA/JESD22-A114	2	2000V (all pins)
Charged Device Model Contact Discharge per JEDEC EIA/JESD22-C101	III	500V (all pins)

**Table 8.1: ESD Handling Ratings**

## 9 Current Consumption

Table 9.1 shows CSR1012 QFN total typical current consumption measured at the battery.

Mode	Description	Total Typical Current at 3V
Dormant	All functions are shut down. To wake them up, toggle the WAKE pin.	<900nA
Hibernate	VDD_PADS = ON, REFCLK = OFF, SLEEPCLK = ON, VDD_BAT = ON	<1.9µA
Deep sleep	VDD_PADS = ON, REFCLK = OFF, SLEEPCLK = ON, VDD_BAT = ON, RAM = ON, digital circuits = ON, SMPS = ON (low-power mode), 2.2ms wake-up time	<5µA
Idle	VDD_PADS = ON, REFCLK = ON, SLEEPCLK = ON, VDD_BAT = ON, RAM = ON, digital circuits = ON, MCU = IDLE, <1µs wake-up time	~1mA
RX / TX active	-	~16mA @ 3V peak current

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