LM951 Bluetooth® Dual Mode Module
Standalone (With Embedded Bluetooth® v4.1 Stack)

Product	LM951
Part No (Tray)	951-0643
Part No (Tape & Reel)	951-0641
Revised	24/JAN/2017

Bluetooth®

18.9mm

2.55mm

12.71mm
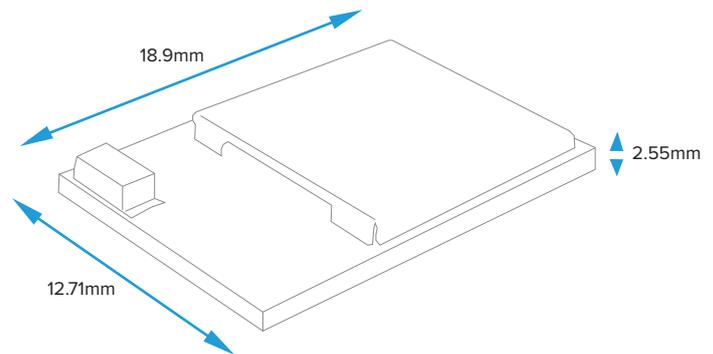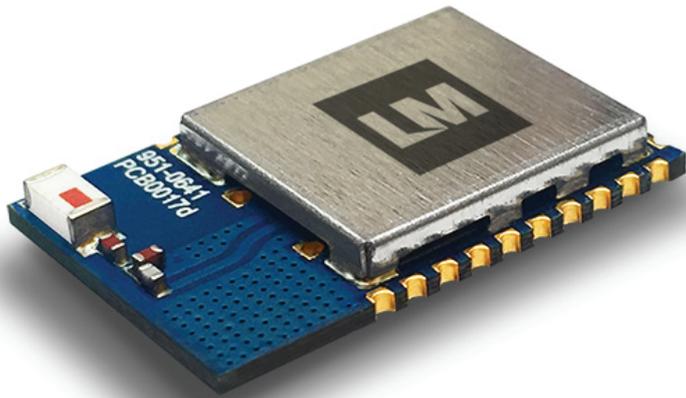
Features

- Bluetooth® Dual Mode (v2.0, v2.1, v4.0 and v4.1)
- Class 2 Tx Output Power
- Low Power Consumption
- IC Antenna Onboard
- Serial Port Profile (SPP)
- Programmable Standalone Module (With Embedded Bluetooth® v4.1 Stack)
- Application Firmware support
- Includes UART to SPP Bridge Application

- Requires no external hardware
- I2C, UART and USB 2.0 (Full Speed)
- Individual PWM channels (3 on dedicated LED pads)
- 6 digital and 3 analogue I/O
- 18.9mm x 12.71mm X 2.55mm
- SMT Side and Bottom Pads for easy production
- RoHS, REACH and WEEE Compliant Solution

Overview

The LM951 Bluetooth® Dual Mode module is a versatile and cost effective solution designed for use as a GAP Central (master) or GAP Peripheral device. This allows your embedded system to wirelessly communicate with other nearby Bluetooth® v2.0, 2.1 and Bluetooth® v4.0, v4.1 enabled devices (e.g. iOS and Android). The LM951 is also ideal for streaming high quality data and establishing Bluetooth® low energy connections.

This single core standalone module combines a Bluetooth® v2.0, v2.1 and Bluetooth® v4.0, v4.1 radio using a dual mode Bluetooth® v4.1 stack, plus a microcontroller unit with an 8 Mbit flash memory for running the application. It also incorporates 29 pin outs, including I2C, UART and USB for interfacing with sensors and many other peripheral devices. It's SMT side and bottom pads allow for easy manufacture and placement within your product.

LM offer bespoke integration into your product by supporting your developer, including development of new applications for the module. We also offer Bluetooth® v4.1 demo applications, which can be customised to your specification. The module can be used as a bridge between Bluetooth® v2.0, 2.1 and Bluetooth® v4.0, v4.1 devices, using our SPP to UART Bridge Application. Developed firmware and configuration settings can be preloaded to the module before supply.

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General Specification

Wireless

Bluetooth® Standard	v4.1 (Backwards compatible with v2.0, v2.1 and v4.0)
Module Type	Standalone (Configurable with AT Commands)
Profiles	SPP

Hardware

Chipset	CSR
Antenna	IC Antenna Onboard
Microcontroller (MCU)	80 MHz RISC MCU
Flash Memory	8 Mbit
RAM	56 KB (12K x 24-bit)
Program Interface	SPI
Interfaces	I2C, UART, USB 2.0 (Full Speed), AIO, PIO and PWM
Power Supply	5V (VCHG/VBUS) or 2V8 (VBAT)
Crystal Oscillators	26 MHz
Development Kit	LM55X

RF Characteristics

Data Rate	Up to 3Mbps
Frequency	2.4 GHz to 2.485 GHz

Physical Characteristics

Operating Temperature	-40°C to +85°C
Dimensions (L x W x H)	18.9mm x 12.71mm x 2.55mm
Weight	0.84 g
Certifications	TBA
Compliance	RoHS, REACH and WEEE

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Firmware

The LM951 Bluetooth® Dual Mode module is configured by using AT commands in configuration mode. The AT command set controls the primary operations such as information enquiry, connection/ disconnection set up and settings. The LM951 module is configured via its UART interface from a microcontroller or PC, using a MCU software or Hercules SETUP utility respectively. At the start of every power up cycle the LM951 enters the configuration mode.

Please refer to the AT Commands user manuals for the BR / EDR and Bluetooth® low energy connection configurations details:

AT Commands Manual – BR / EDR - http://lm-technologies.com/951atc
AT Commands Manual – Bluetooth® LE Connections - http://lm-technologies.com/951atb

AT commands are used to establish BR/ EDR and Bluetooth® LE connections. In data mode, data can be transmitted and received between the Bluetooth® v2.0, 2.1 and Bluetooth® Smart devices via the LM951 (Bluetooth® Dual Mode Module). By using our SPP to UART Bridge application. And the UART interface represents the data channel once a connection is established. To break the connection and enter the configuration mode again, the LM951 has to be powered off.

Default Factory Settings

Device Settings

- Discoverable : YES
- Device Name: LM951_PROTO_01
- Echo of command: YES
- Response to commands: YES
- Default Security mode 2.1

UART Settings

- Baud rate : 19200
- Stop bit : ONE
- Parity bits: NONE
- Flow Control: None

Bluetooth® v2.0, 2.1 Profile Settings

- SPP Role : SLAVE
- Escape sequence check enabled: YES

Bluetooth® Low Energy Settings

- GAP Role: Central
- GATT ROLE: Client

SSP 2.1 Settings

- IoTypesSupported : io capability keyboard only
- ForceManInTheMiddle : TRUE
- DynamicPinEnb: TRUE,

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Bluetooth® Applications

The LM951 module can run full application code for a wide range of industries. This includes the automotive, M2M (industrial cable replacement), EPOS, health & fitness and consumer electronics (e.g. printers and wearable technologies) industries.
Only limited by the imagination of the embedded developer.

The LM951 modules can run Bluetooth® v2.0, 2.1 or Bluetooth® v4.0, v4.1 applications. Depending on whether the embedded developer requires a low-energy Bluetooth® connection, a high-quality data stream Bluetooth® connection or both simultaneously.

LM Technologies offer both Bluetooth® v4.0, v4.1 and Bluetooth® v2.0, 2.1 application support. This includes assisting the developer and creating new applications with the LM951 modules:

- Alert Tag
- Key Fob
- Beacon
- Blood Pressure Sensor
- Cycling Speed and Cadence Sensor
- Environment Sensor
- Glucose Sensor

- Health Thermometer
- Heart Rate Sensor
- Keyboard
- Multifunction Steering Wheel
- Mouse
- Printer
- Running Speed and Cadence Sensor

- Security Tag
- Serial Communication
- Time Client
- Temperature and Pressure
- Weight Scale

Example Applicaiton

LM SPP to UART Bridge Application

The LM951 module can act as a "bridge" between a Bluetooth® v2.0, 2.1 device and a Bluetooth® v4.0, v4.1 device. By using our Bluetooth® Dual Mode application SPP to UART Bridge. Allowing Bluetooth® v2.0, 2.1 data to be transmitted to a Bluetooth® v4.0, v4.1 device through the LM951 or vice versa
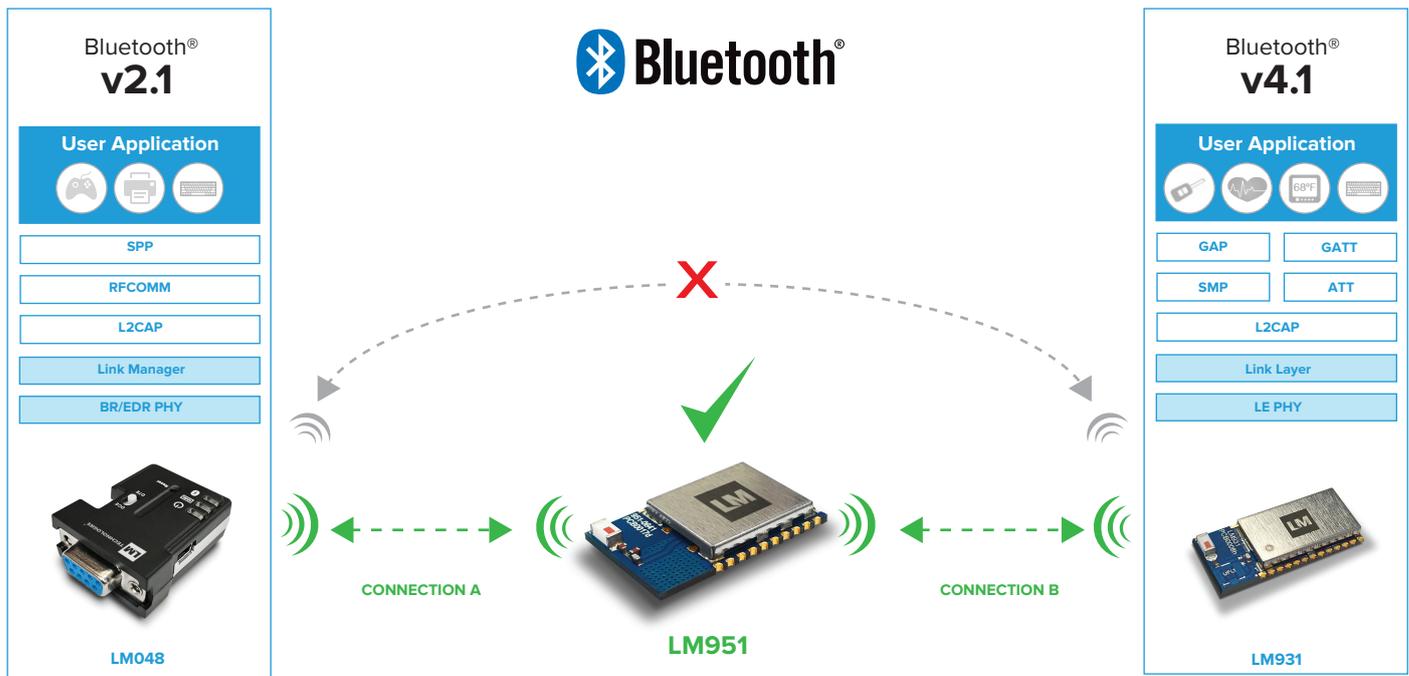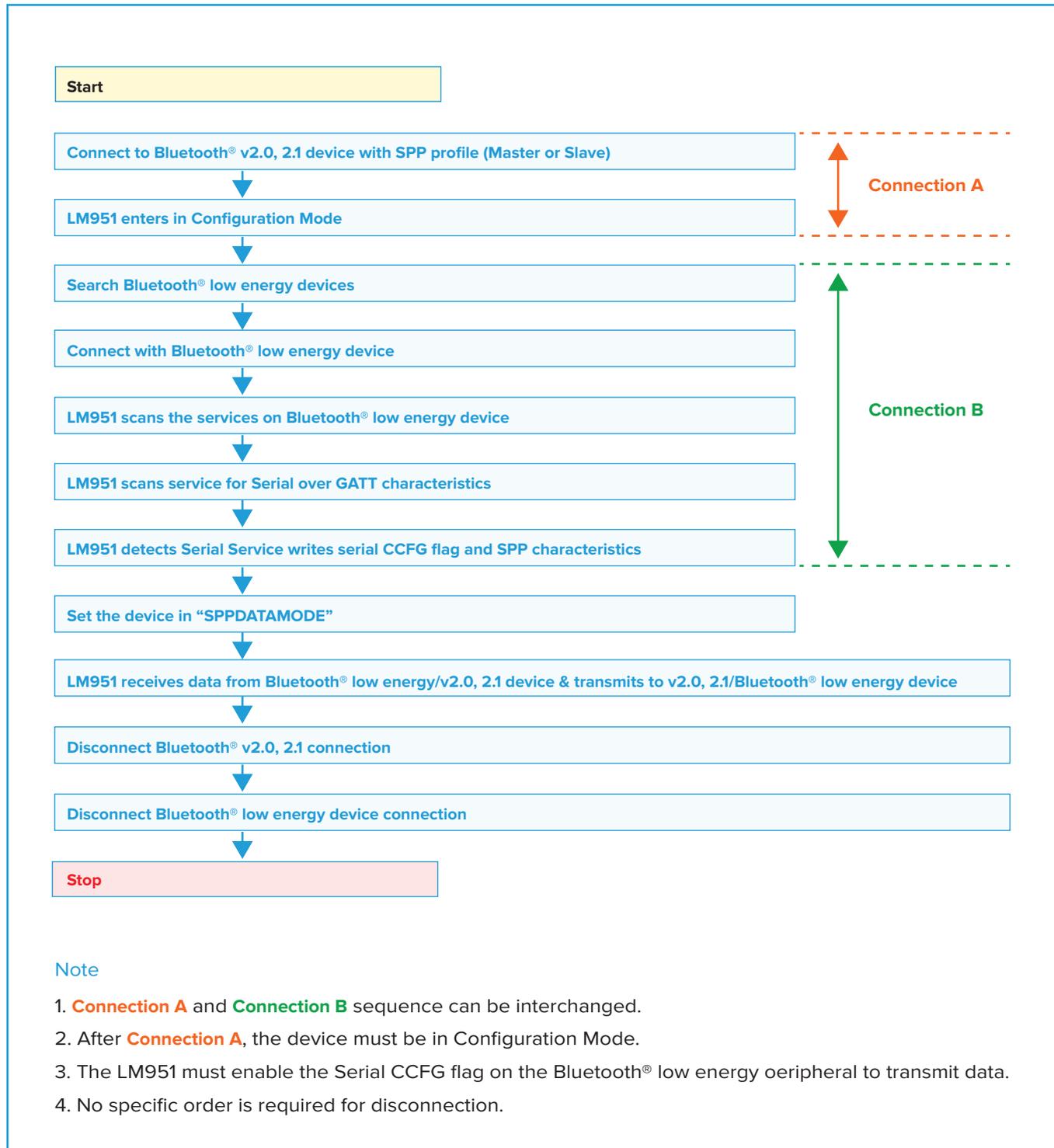

- **UART over GATT:** Bluetooth® v2.0, 2.1 data to a Bluetooth® v4.0, v4.1 device, for example our LM931

- **UART over SPP:** Bluetooth® Smart data to a Bluetooth® v2.0, 2.1 device, for example our LM048

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The SPP to UART Bridge application flow diagram below outlines the steps to setup the "bridge":

Start

Connect to Bluetooth® v2.0, 2.1 device with SPP profile (Master or Slave)

↓

LM951 enters in Configuration Mode

Connection A

↓

Search Bluetooth® low energy devices

↓

Connect with Bluetooth® low energy device

↓

LM951 scans the services on Bluetooth® low energy device

Connection B

↓

LM951 scans service for Serial over GATT characteristics

↓

LM951 detects Serial Service writes serial CCFG flag and SPP characteristics

↓

Set the device in "SPPDATAMODE"

↓

LM951 receives data from Bluetooth® low energy/v2.0, 2.1 device & transmits to v2.0, 2.1/Bluetooth® low energy device

↓

Disconnect Bluetooth® v2.0, 2.1 connection

↓

Disconnect Bluetooth® low energy device connection

↓

Stop

Note

1. **Connection A** and **Connection B** sequence can be interchanged.

2. After **Connection A**, the device must be in Configuration Mode.

3. The LM951 must enable the Serial CCFG flag on the Bluetooth® low energy oeripheral to transmit data.

4. No specific order is required for disconnection.

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Powering

- The LM951 can be powered in one of 2 ways:

  1) Powered through the VCHG/VBUS (Pin 21)
  2) Powered from a Lithium ion / Lithium polymer battery through VBAT (Pin 19)
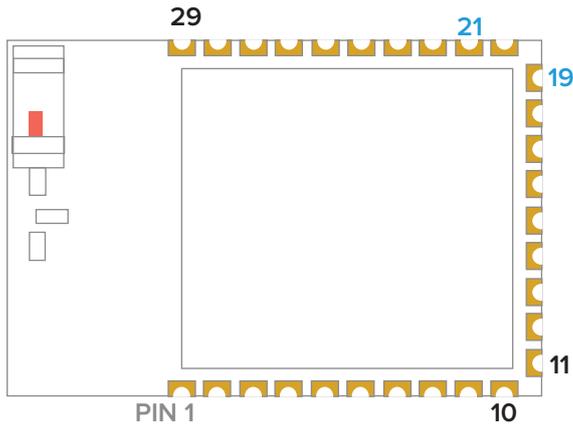
Pin Outs
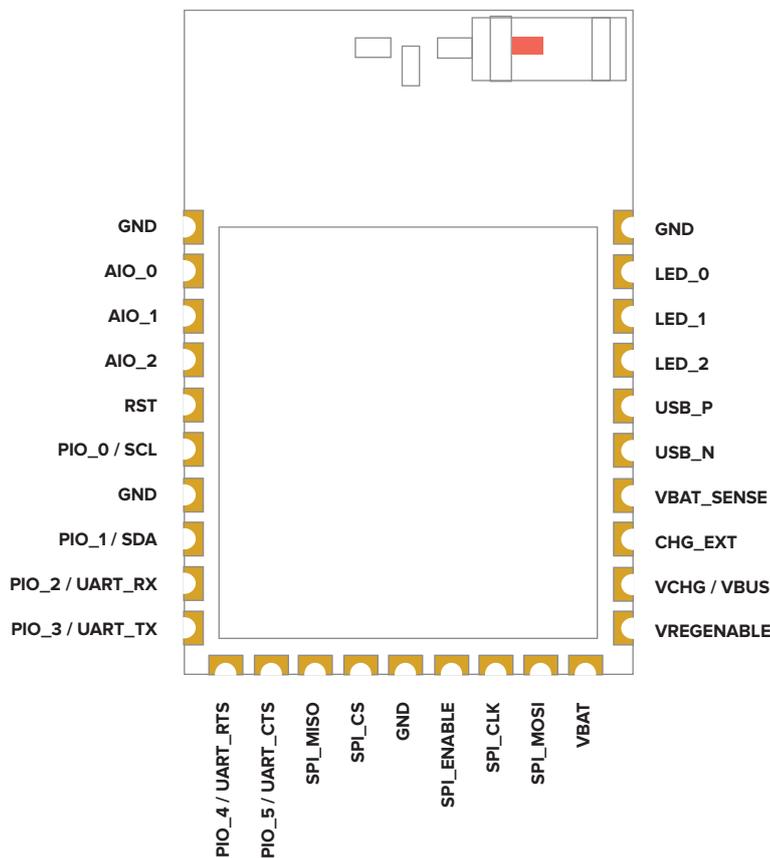
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Pin Assignments

Pin	Name	Type	Description	Typical
1	GND	Ground	Common Ground	0V
2	AIO_0	Input	Analog Input	0V - VDD
3	AIO_1	Input	Analog Input	0V - VDD
4	AIO_2	Input	Analog Input	0V - VDD
5	RST	Input	Reset	0V - VDD
6	PIO_0/ SCL	I/O	Programmable Input / Output or I2C Serial Clock	0V - VDD
7	GND	Ground	Common Ground	0V
8	PIO_1/ SDA	I/O	Programmable Input / Output or I2C Serial Data	0V - VDD
9	PIO_2/ UART_RX	I/O	Programmable Input / Output or UART Receive	0V - VDD
10	PIO_3/ UART_TX	I/O	Programmable Input / Output or UART Transmit	0V - VDD
11	PIO_4/ UART_RTS	I/O	Programmable Input / Output or UART RTS	0V - VDD
12	PIO_5/ UART_CTS	I/O	Programmable Input / Output or UART CTS	0V - VDD
13	SPI_MISO	I/O	SPI Master In Slave Out	0V - VDD
14	SPI_CS	I/O	SPI Chip Select	0V - VDD
15	GND	Ground	Common Ground	0V
16	SPI_ENABLE	I/O	SPI Enable (CSR)	0V - VDD
17	SPI_CLK	I/O	SPI Clock	0V - VDD
18	SPI_MOSI	I/O	SPI Master Out Slave In	0V - VDD
19	VBAT	Power	Battery input	2V8
20	VREGENABLE	Power	Voltage Regulator Enable	1V
21	VCHG/VBUS	Power	Battery Charger Input/ Positive Power Supply	5V (3V - 6.5V)
22	CHG_EXT	Power	External Battery Charge Control	0V - 6.5V & 0mA-20mA
23	VBAT_SENSE	Power	Battery Charger Sense Input	200mV (195mV - 205mV)
24	USB_N	I/O	USB Negative	0V - VDD
25	USB_P	I/O	USB Positive	0V - VDD
26	LED_2	Output	PWM / LED 2	0V - VDD
27	LED_1	Output	PWM / LED 1	0V - VDD
28	LED_0	Output	PWM / LED 0	0V - VDD
29	GND	Ground	Common Ground	0V

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Module Block Diagram

VCHG / VBAT

ANT

Filter

BT_RF

CSR Chipset

FLASH
8 Mbit

SIO

XTAL
26MHz

PWM

AIO

SPI (Debug)

UART/PIO
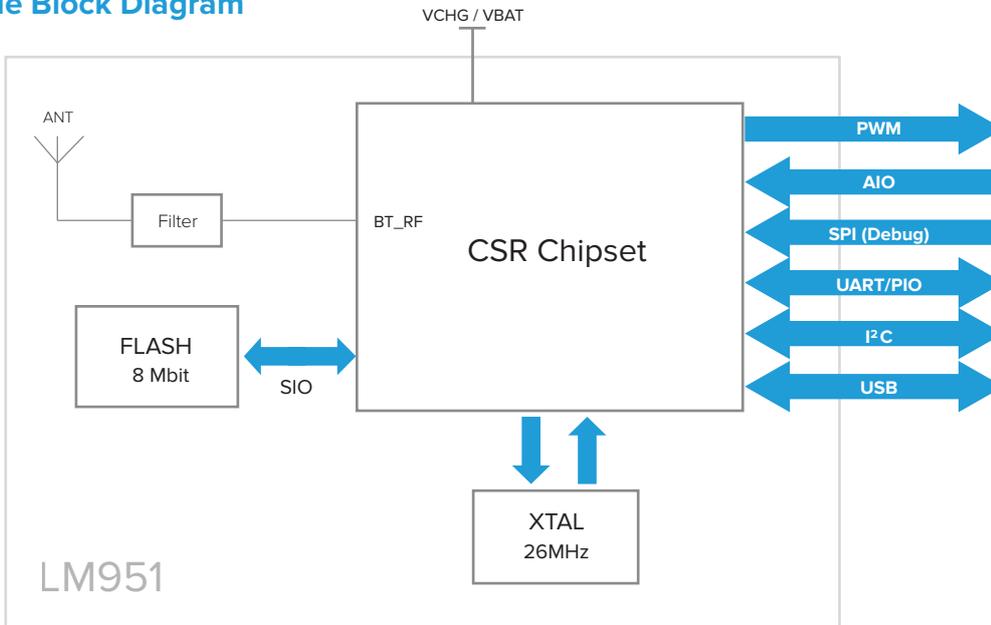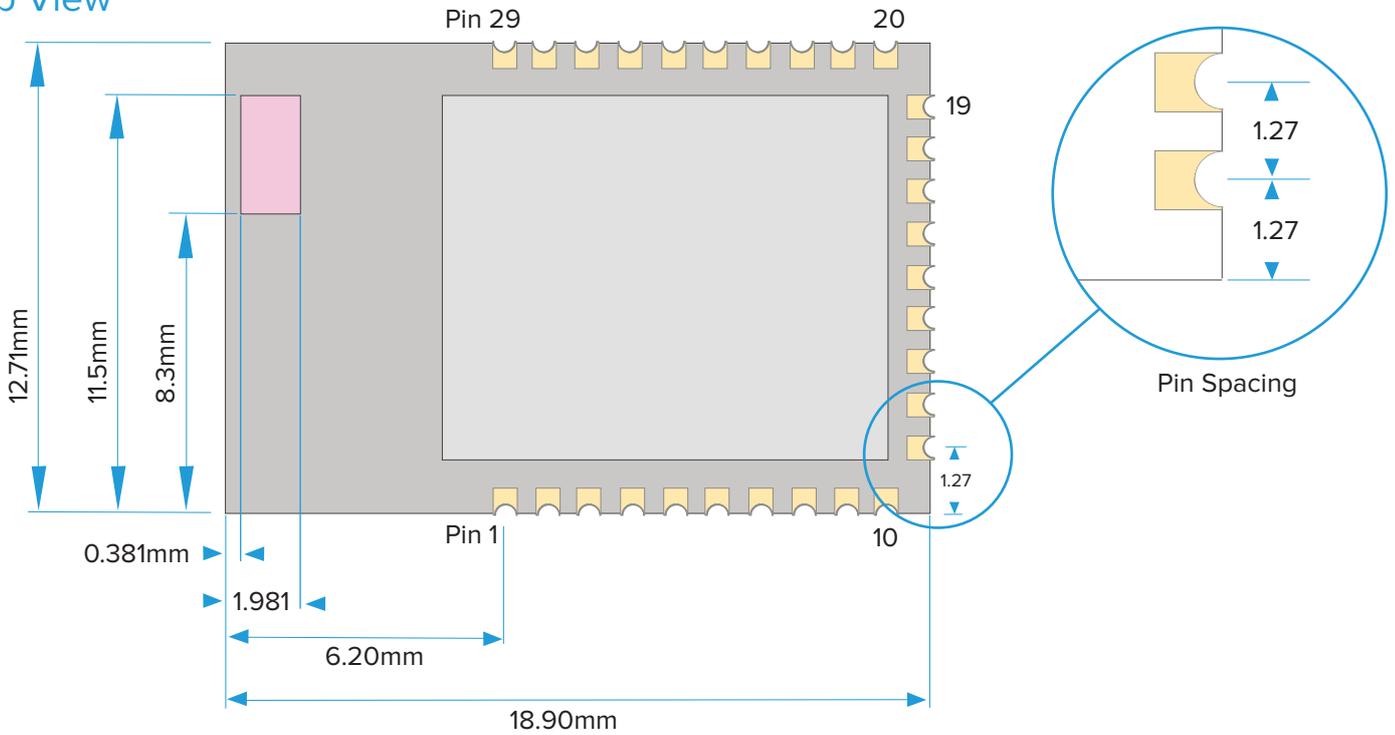
I²C

USB

LM951

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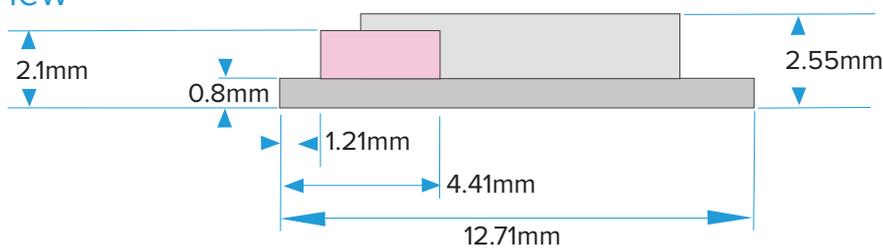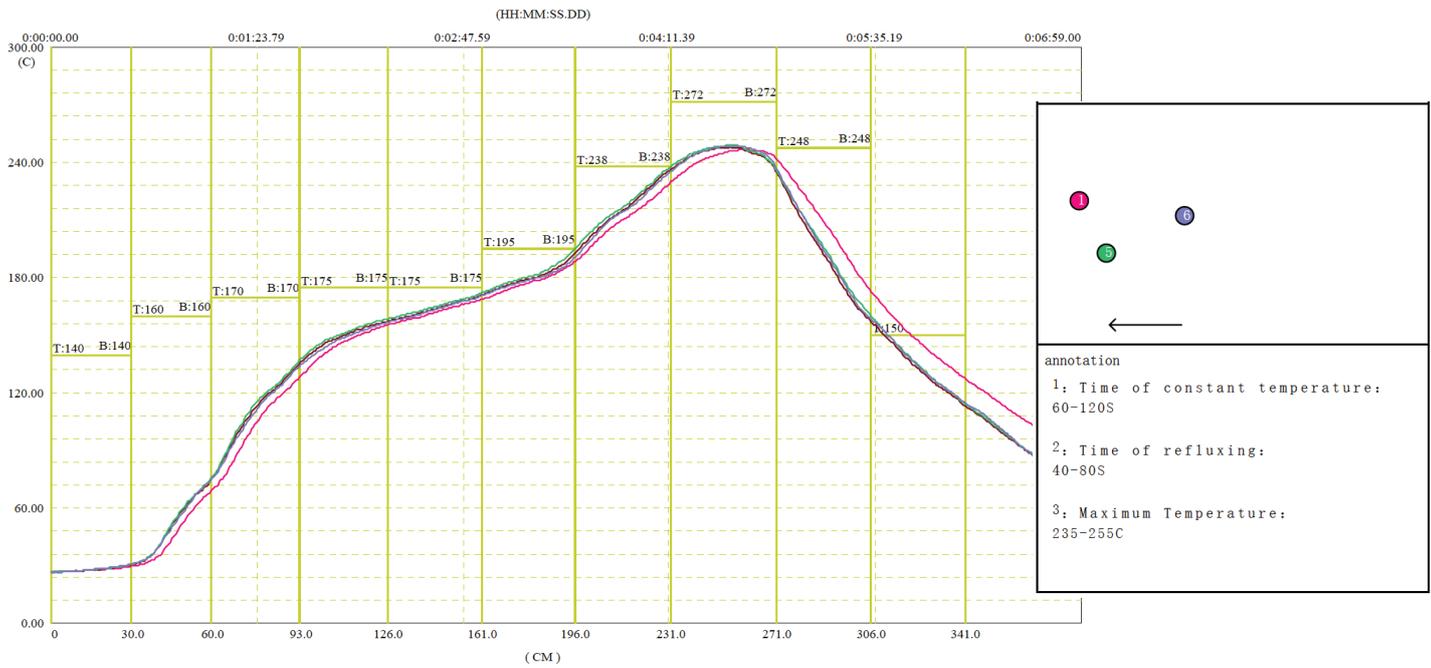Part No (Tape & Reel)   951-0641

Physical Dimensions

Top View
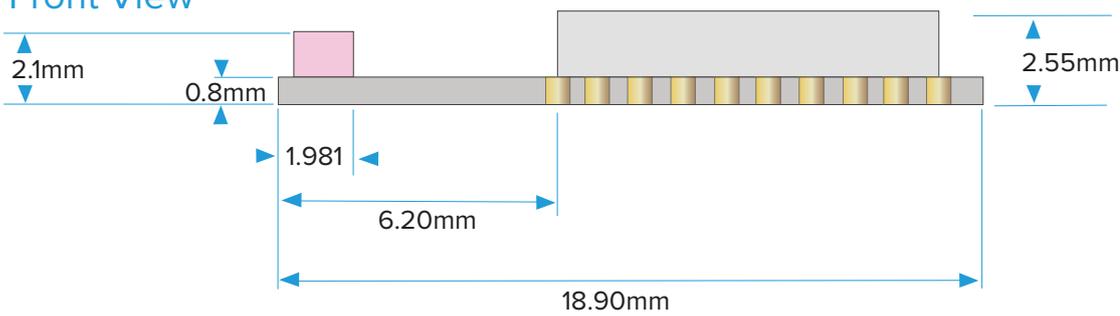
Pin 29   20

12.71mm
11.5mm
8.3mm

Pin 1   10

19

1.27

0.381mm
1.981
6.20mm
18.90mm

1.27
1.27

Pin Spacing

Front View

2.1mm
0.8mm
1.981
6.20mm
18.90mm

2.55mm

Side View

2.1mm
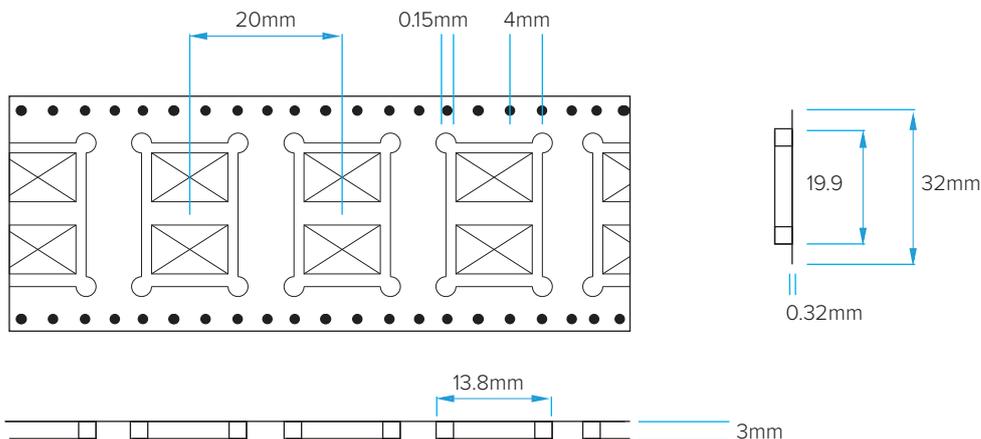0.8mm
1.21mm
4.41mm
12.71mm

2.55mm

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PCB Footprint

Optimal Placement Position

◄ EDGE OF HOST PCB
(Optimal)

Pin 1
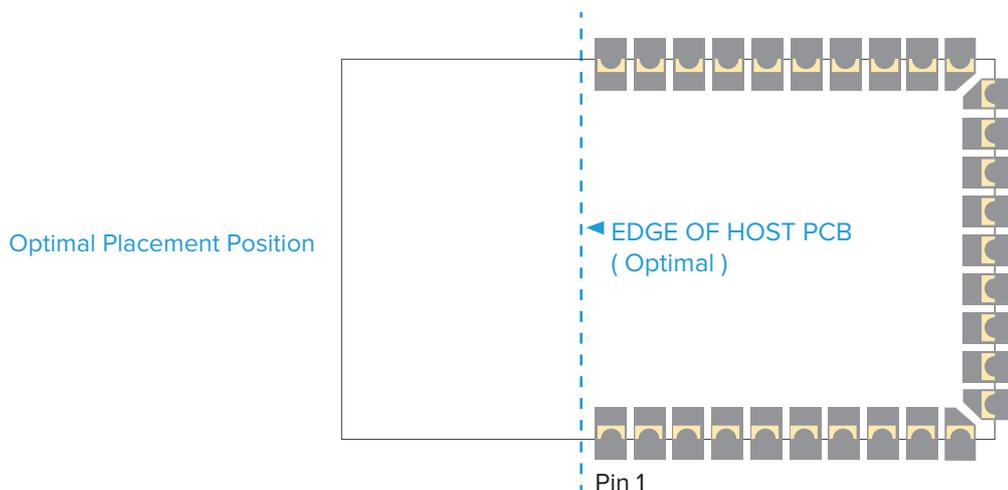
Placement Note
If the optimal placement position cannot be achieved, ensure there is no metal beneath the highlighted part of module.

NB
Aim to place the module away from interference. (i.e: place the module at the edge of the board.)
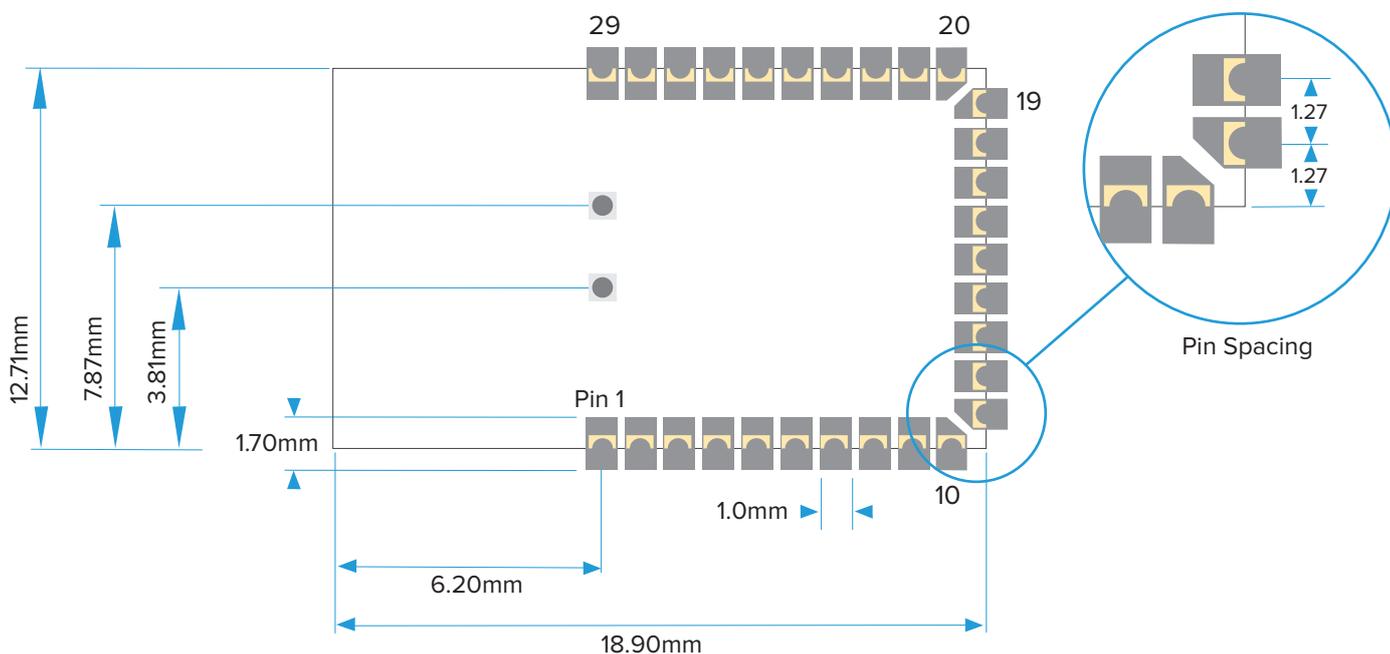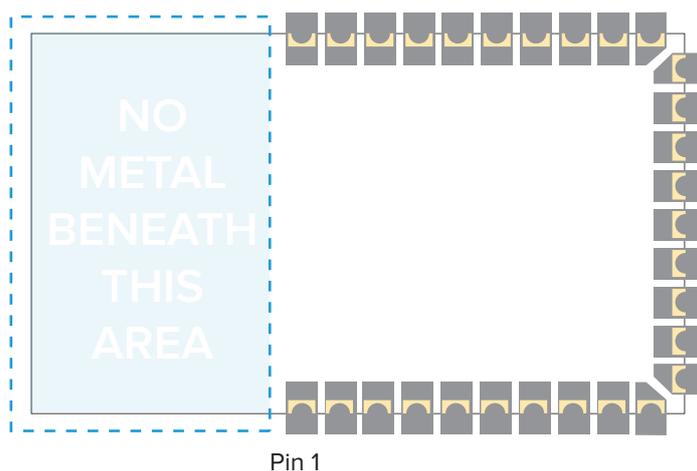
NO METAL BENEATH THIS AREA

Pin 1

29   20

19

12.71mm

7.87mm

3.81mm

1.70mm

Pin 1

10

1.0mm

6.20mm

18.90mm

1.27

1.27

Pin Spacing

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Soldering Reflow Chart

annotation

1: Time of constant temperature: 60-120S

2: Time of refluxing: 40-80S

3: Maximum Temperature: 235-255C

	Preheat zone slope		Immersion time 150 to 180℃		Refluxing time 220℃		Maximum Temperature		cooling zone slope	
🟥	1.80	-13.33%	76.00	-60.00%	65.50	27.50%	247.0	46.67%	-1.70	-52.00%
🟥	1.90	-6.67%	76.50	-58.75%	64.50	22.50%	248.3	55.33%	-2.44	-22.40%
🟩	2.10	5.00%	75.50	-61.25%	67.00	35.00%	249.2	61.33%	-2.13	-34.67%
🟦	1.80	-13.33%	75.50	-61.25%	63.50	17.50%	248.9	59.33%	-2.36	-25.50%

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Tape and Reel Packaging

Tape Dimensions

20mm | 0.15mm | 4mm
19.9 | 32mm
0.32mm
13.8mm
3mm

Reel Dimensions

330mm

36mm

92mm
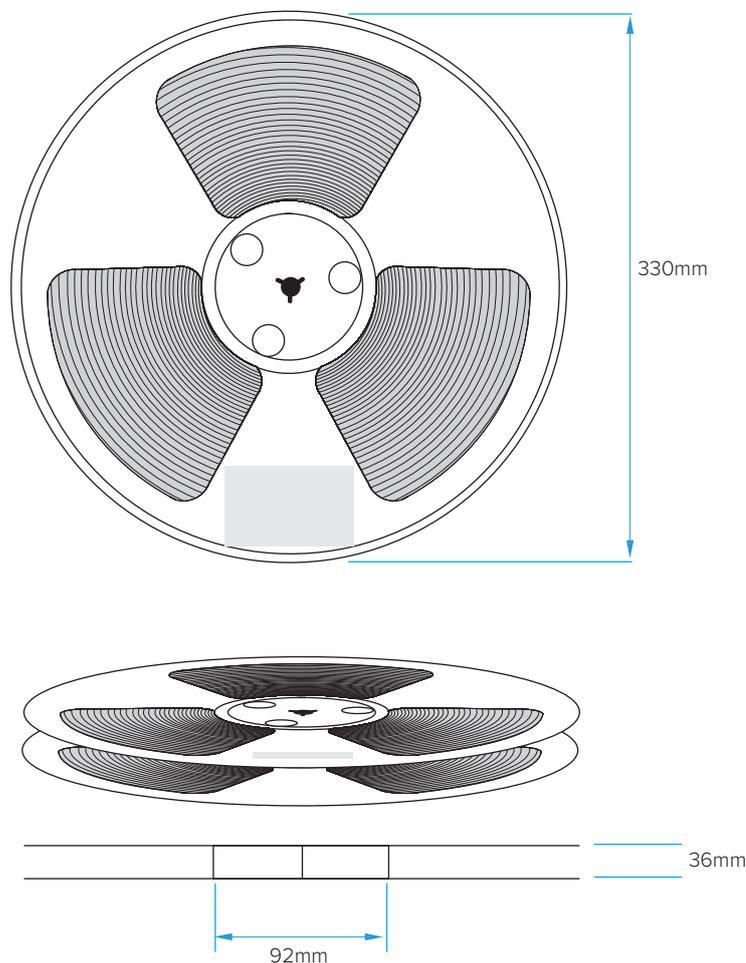
Notes
- Carton Dimensions (L x W x H): 360mm x 290mm x 370mm

Quantities
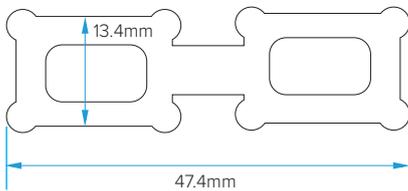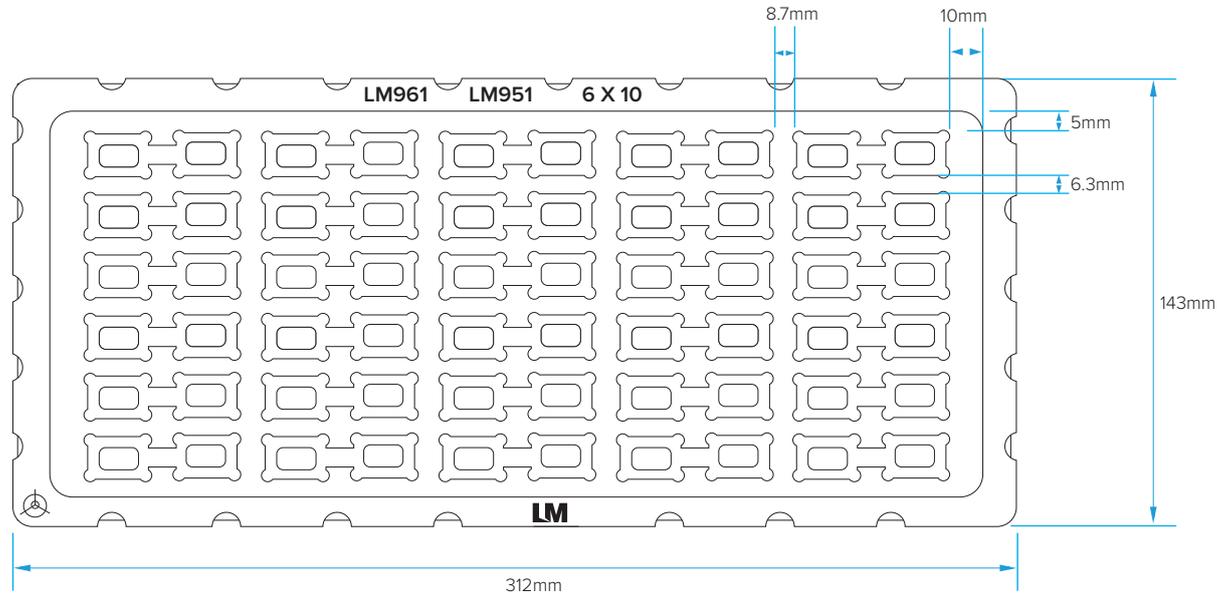- 1000 modules per Tape
- 4 Boxes per Carton
- 4000 modules per Carton

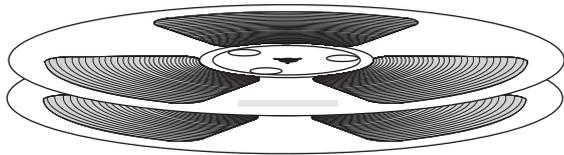## LM951 Bluetooth® Dual Mode Module
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Tray Packaging

Tray Dimensions

Notes

- Anti-Static PS Tray, Black .
- Electrical Resistance: 1 MΩ< R< 100MΩ .
- Thickness: T= 0.8 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

LM951 Bluetooth® Dual Mode Module
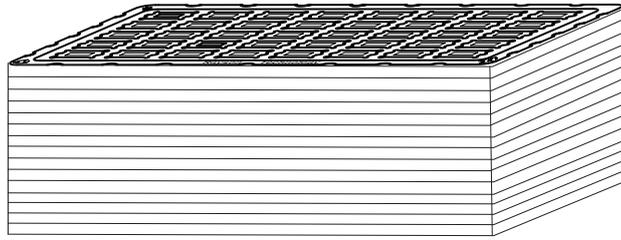Standalone (With Embedded Bluetooth® v4.1 Stack)

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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.
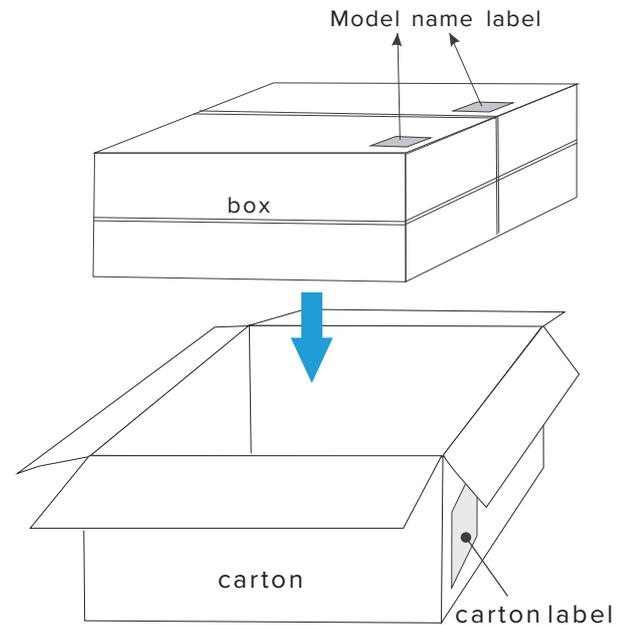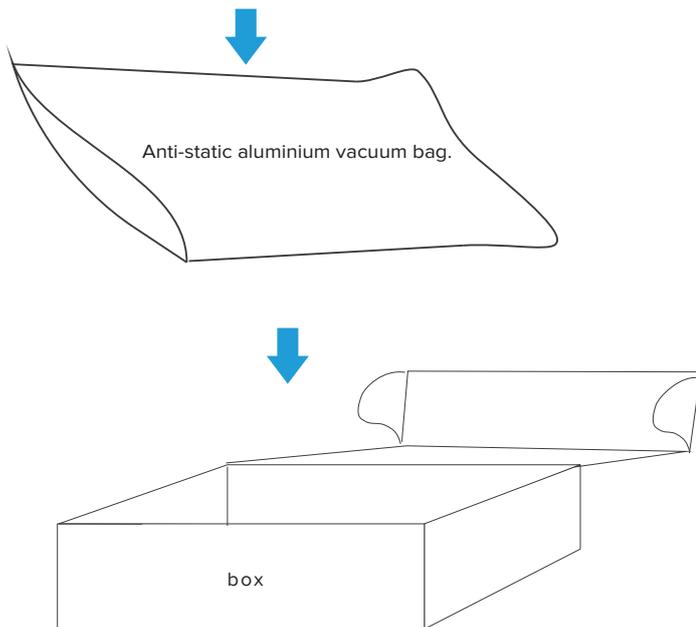
drying agent

Humidity Indicator Card

Reels are place within a vacuum bag.

Anti-static aluminium vacuum bag.

Trays are stacked up with an empty tray on the top.
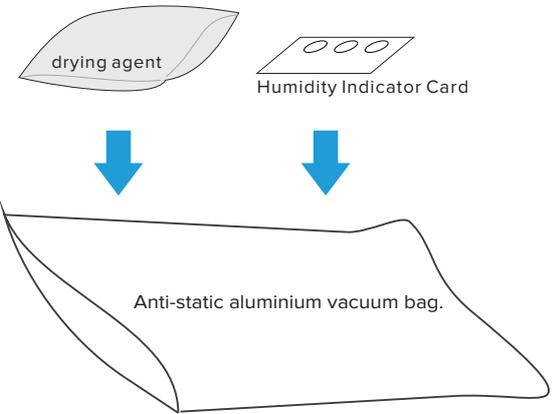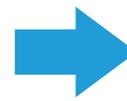
The vacuum bag is placed inside the box and a Model Name Label stuck on the front-side of each box.

Anti-static aluminium vacuum bag.

box

Model name label

box

carton

carton label

Each carton contains 4 boxes.

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LM951 Packaging Options

951-0643

LM951 Module
1 x LM951 SMT Plug & Play IC Ant Module
Tray

951-0641

LM951 Module
1 x LM951 SMT Plug & Play IC Ant Module
Tape & Reel

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