MtM Technology

Product Specification

Product Name: **M903L**

Bluetooth SiP Module

-BT 4.0 LE

Version: **XF**

Doc No:

Date: **Jun 14th, 2016**

Document History

Date	Revise Contents	Revise by	Version
Jan 23th,2013	Initial Version	Brian Juang	XA
Apr 22th,2013	Update PIN DEFINIATION and REFERENCE DESIGN CIRCUIT with wake up pin feature	Brian Juang	XB
Aug 21th,2013	Change mold design to metal lid	Brian Juang	XC
Oct 1st,2013	Add 10.SiP Module Preparation and 11. Package Information	Brian Juang	XD
Oct 23th,2013	Update 8.Reference Design Circuit and 4.1 Operating ambient temperature range	Brian Juang	XE
Jun 14th,2016	Add Antenna design guide and Modify Power consumption	Pj Chang	XF

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1 Description

The SiP module: M903L is a small size module that provides full function of Bluetooth 4.0 Low Energy in a tiny module via 32 pins LGA Foot Print. The M903L module provides everything required to create Bluetooth 4.0 Low Energy product with RF, baseband, MCU, qualified Bluetooth v4.0 stack and customer application running on a single IC.

M903L enables ultra-low power connectivity and basic data transfer for applications previously limited by the power consumption, size constraints and complexity of other wireless standards. The low power consumption and excellent radio performance make it the best solution for OEM /ODM customers who require embedded Bluetooth 4.0 Low Energy feature, such as, IP camera, car key, sport and fitness watch, mouse, led light bulb etc.

The module is based on CSR Bluetooth Low Energy single mode chipset provides Bluetooth Low Energy communication.

M903L provides command line interface (CLI) for being easily controlled by a host CPU through UART communication. It also contains a 16 bit MCU to run a variety of applications and for embedded application development.

For the software and driver development, we provide extensive technical document and reference software code for the system integration.

Hardware evaluation kit and development utilities will be released base on listed OS and processors to OEM customers.

2 Feature

- Bluetooth® v4.0 LE radio technology
- Up to +6.0 dBm Tx power with transmit power control.
- High sensitivity (-90.0 dBm.)
- Dimension: 9 x 9 x 1.3mm
- High performance low power 16-bits microcontroller core
- Fast Connection Setup.
- Internal crystal oscillator (16MHz). Internal 32kHz crystal oscillator for Sleep Timer
- Serial interface for host: UART, SPI
- Applications interface for sensor: ADC, SPI , I2C, GPIO, PWM
- Command line Interface (CLI) for host: Node mode setting, Security manager, L2CAP command, Connection Management, power manager command.

ORDRING INFORMATION

Part Number	Description
M903L	CLASS 2 Bluetooth single mode Module according BT-4.0. Bluetooth SMART

3 Block Diagram

The M903L module is designed based on the CSR Bluetooth 4.0 LE single mode chipset solution. It supports UART command line interface to connect to the host processor. The simplified block diagram of the M903L module is depicted in the Fig. below.
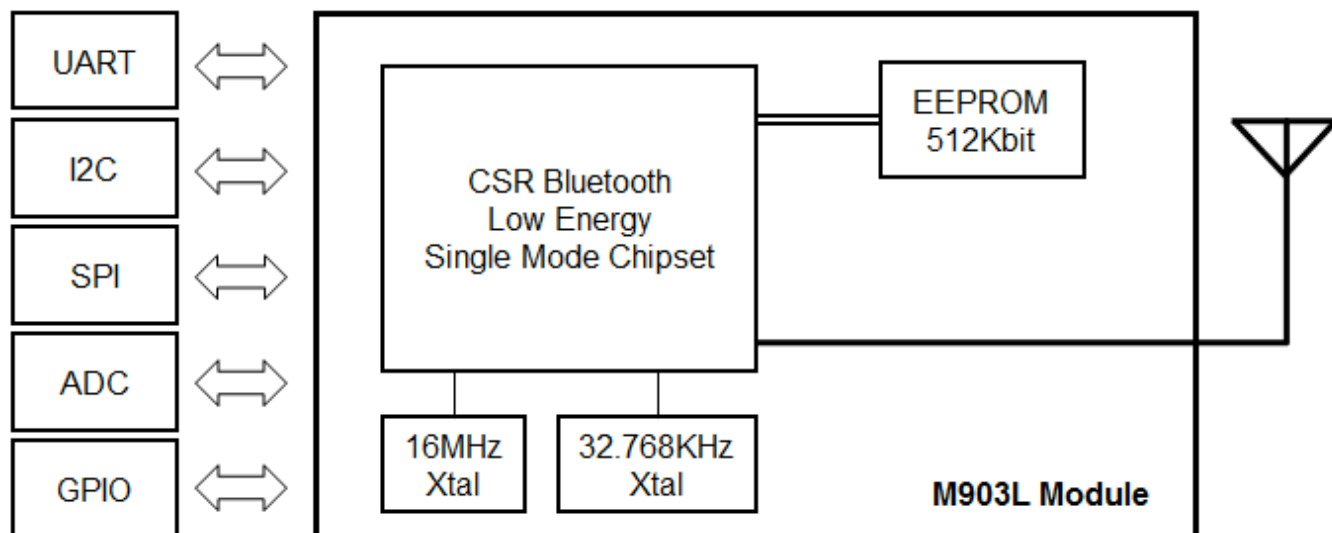
4 Technical Specification

4.1 Absolute Maximum Rating

No	Description		Value	Unit
Ratings Over Operating Free-Air Temperature Range				
1	Supply voltage	All supply pins must have the same voltage	–0.3 to 3.9	V
2	Voltage on any digital pin		–0.3 to +3.6	V
3	Operating ambient temperature range		–30 to 85	°C
4	Storage temperature range		–40 to 85	°C
5	Bluetooth RF inputs		10	dBm
6	ESD Protection: All pads, according to human-body model, JEDEC STD 22, method A114		2000	V
	Machine Model Contact Discharge per JEDEC EIA/JESD22-A115		200	V
	According to charged-device model, JEDEC STD 22, method C101		500	V

4.2 Recommendable Operation Condition

4.2.1 Temperature, humidity

The M903L module has to withstand the operational requirements as listed in the table below.

Operating Temperature	-30° to 85° Celsius	
Humidity range	Max 95%	Non condensing, relative humidity

4.2.2 Voltage

Power supply for the M903L module will be provided by the host via the power pins

Operating Condition	Min.	Typ.	Max.
DVDD_3V3	1.8	3.3	3.6
I/O supply voltage (VDD_PADS)	1.2	3.3	3.6

4.3 Wireless Specifications

The M903L module compliance with the following features and standards

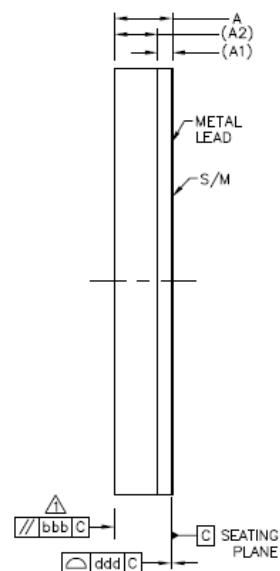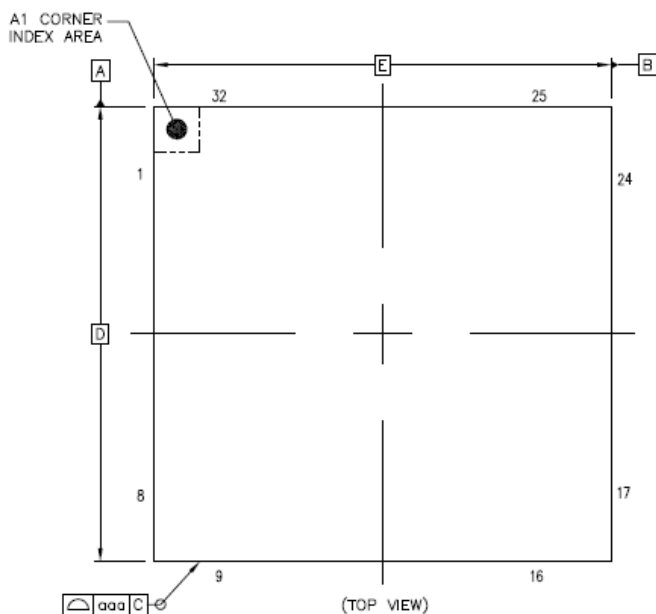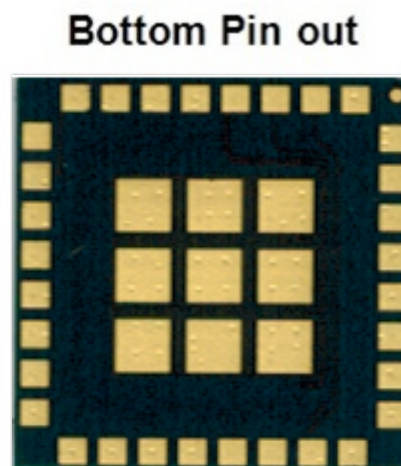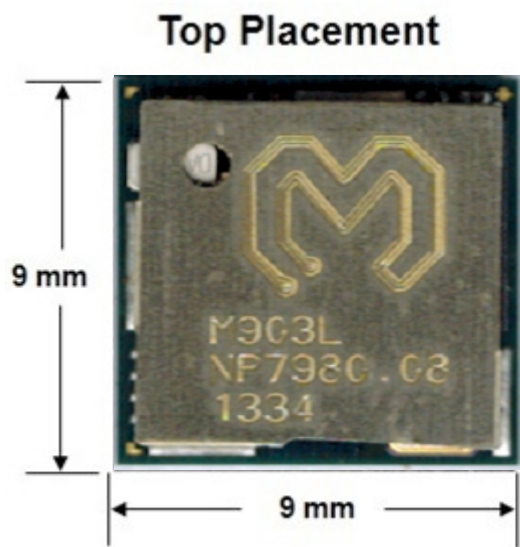| Features	Description
Bluetooth Standards	Bluetooth core v4.0 Low Energy
Antenna Port	Support Single Antenna for Bluetooth
Frequency Band	2.402 – 2.480 GHz

4.4 Radio Specifications Bluetooth 4.0 Low Energy

Features	Description
Frequency Band	2.402– 2.480 GHz (2.4 GHz ISM Band)
Number of selectable Sub channels	40 channels
Modulation	GFSK
Supported rates	<1Mbps
Maximum receive level	-10dBm (with PER < 8%)

4.5 Power Consumption

Item	Condition	Typ.
Tx mode	3.3V	16 mA
Rx mode	3.3V	16 mA
Sleep Mode	Dormant	<0.0006 mA
	Hibernate	<0.0015 mA
	Deep Sleep	<0.005 mA

5 Dimensions

The size and thickness of the M903L module 9mm (W) x 9mm (L) x 1.3mm (H):

Top Placement

9 mm

9 mm

Bottom Pin out

(BOTTOM VIEW)

	SYMBOL	COMMON DIMENSIONS		
		MIN.	NOR.	MAX.
TOTAL THICKNESS	A	---	---	1.3
SUBSTRATE THICKNESS	A1		0.31	REF
MOLD THICKNESS	A2		0.9	REF
BODY SIZE	D		9	BSC
	E		9	BSC
LEAD WIDTH	W	0.55	0.6	0.65
LEAD LENGTH	L	0.55	0.6	0.65
LEAD PITCH	e		0.9	BSC
LEAD COUNT	n		32	
EDGE BALL CENTER TO CENTER	D1		6.3	BSC
	E1		6.3	BSC
BODY CENTER TO CONTACT BALL	SD		0.45	BSC
	SE		0.45	BSC
BALL WIDTH	b	---	---	---
BALL DIAMETER			---	
BALL OPENING			---	
BALL PICTH	e1		---	
BALL COUNT	n1		---	
PRE-SOLDER		---	---	---
PACKAGE EDGE TOLERANCE	aaa		0.1	
MOLD FLATNESS	bbb		0.2	
COPLANARITY	ddd		0.08	
BALL OFFSET (PACKAGE)	eee		---	
BALL OFFSET (BALL)	fff		---	

6 Pin Assignments

The foot print dimension and pin definition is defined as below

| No	Pin Name	Pin Type	Description
1	DVDD_3V3	Power	Power input and regulator enable (active high)
2	NC	-	Reserved for internal use only
3	WAKE	Analogue	Pull up to wake up module from sleep mode
4	REG_IN	Input	Positive supply for Bluetooth radio and digital linear regulator.
5	GND	Ground	Ground connections.
6	RF	RF	Bluetooth transmitter / receiver.
7	GND	Ground	Ground connections.
8	NC	-	Reserved for internal use only
9	NC	-	Reserved for internal use only
10	NC	-	Reserved for internal use only
11	NC	-	Reserved for internal use only
12	NC	-	Reserved for internal use only
13	CSR_AIO_2	Analogue	Analogue programmable I/O line.
14	CSR_AIO_1	Analogue	Analogue programmable I/O line.
15	CSR_AIO_0	Analogue	Analogue programmable I/O line.
16	UART1_TX	Output	UART TX
17	USART1_RX	Input	UART RX
18	PIO_3	Bidirectional	Do not connect., reserved for internal used only
19	PIO_4	Bidirectional	I²C2 clock or programmable I/O line.
20	CSR_SPI_CLK	Bidirectional	SPI debug CLK (slave mode) or programmable I/O line.
21	CSR_SPI_CS	Bidirectional	SPI debug CS (slave mode) or programmable I/O line.
22	CSR_SPI_MOSI	Bidirectional	SPI debug MOSI (slave mode) or programmable I/O line.
23	CSR_SPI_MISO	Bidirectional	SPI debug MISO (slave mode) or programmable I/O line.
24	PIO_9	Bidirectional	Programmable I/O line.
25	PIO_10	Bidirectional	I²C2 data input / output or programmable I/O

			line.
26	PIO_11	Bidirectional	Programmable I/O line.
27	SPI_PIO#_SEL	Input	Selects Pin 20-23 as SPI debug interface or programmable I/O lines.
28	SMPS_LX	Output	High-voltage switch-mode regulator output.
29	CSR_I2C_PWR	Power	Do not connect., internal EEPROM I²C1 power
30	CSR_I2C_SCL	Output	Do not connect, internal EEPROM I²C1 clock
31	CSR_I2C_SDA	Bidirectional	Do not connect, internal EEPROM I²C1 data input / output
32	GND	Ground	Ground connections.
33-41	GND	Ground	Ground connections.

7 Recommend Footprint

SM Design

*PIN LAND FIGURE FOLLOW INNER DRAWAING
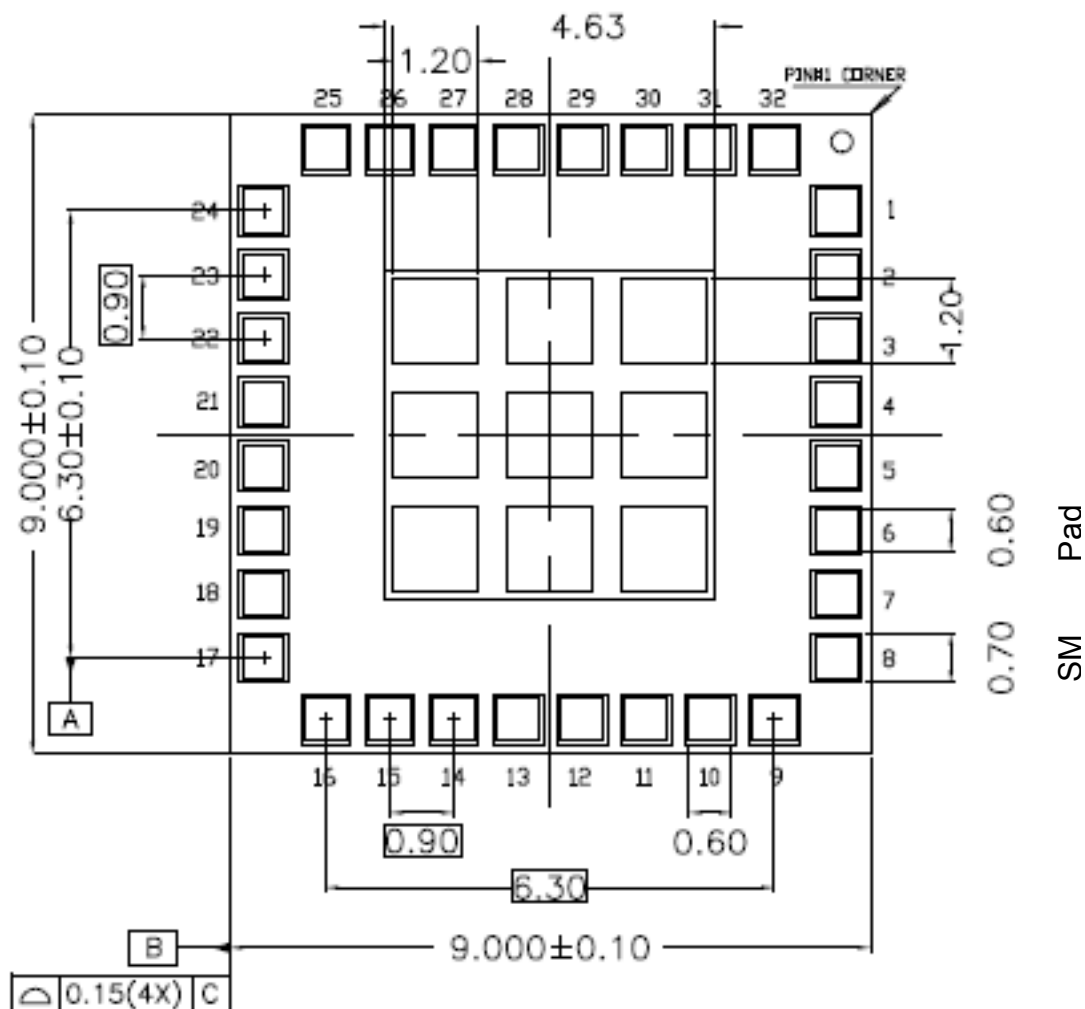
Note:

SM = Solder mask defined

Pad = Copper defined

8 Reference Design Circuit
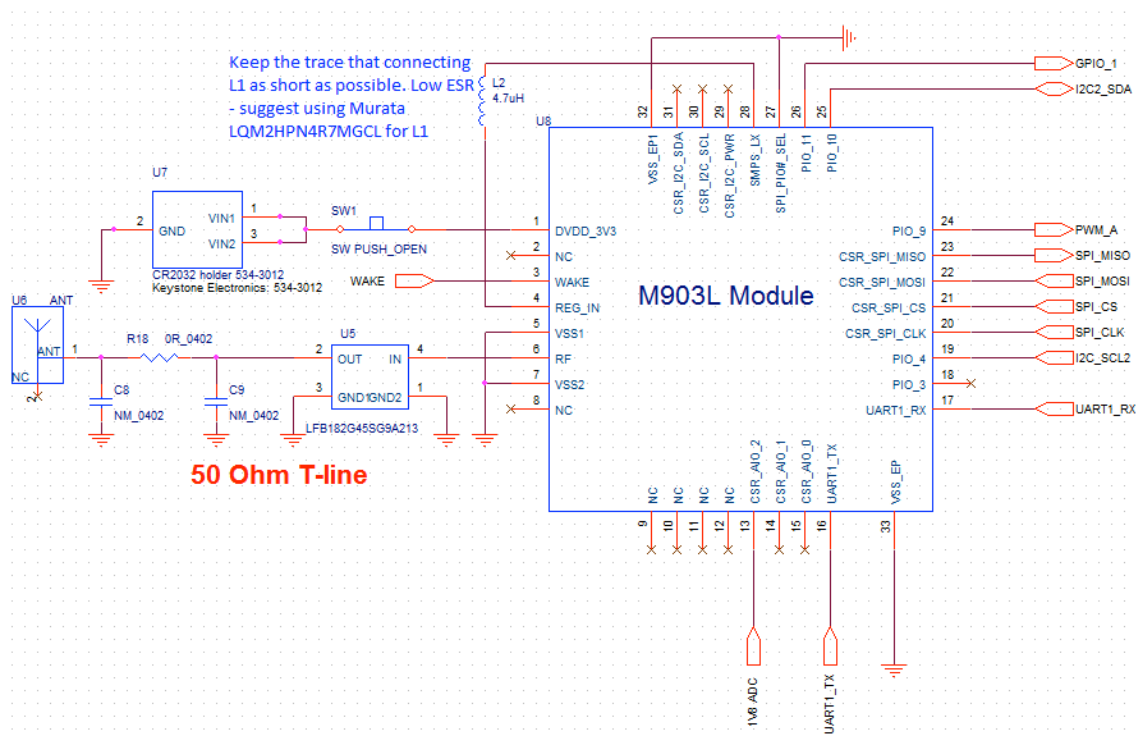
Note: U2 is band pass filter which optional. Ensure the L1 trace width >= 220um

9   Recommended Reflow Profile
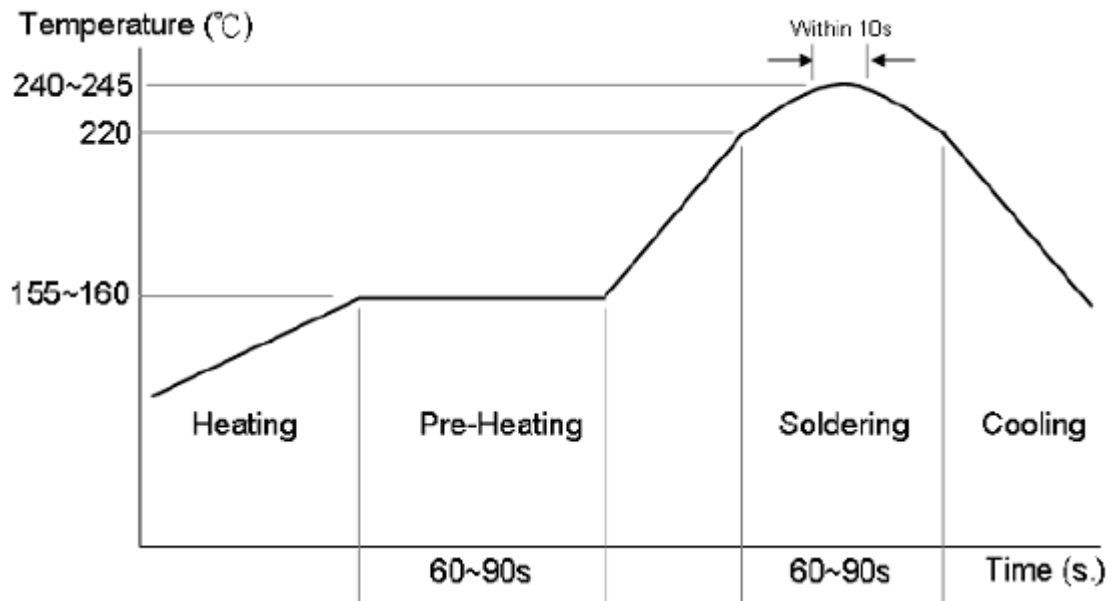
Profile Condition

    a. Suitable for Lead-Free solder

    b. Between 155~160°C : 60~90 sec.

    c. Above 220°C : 60~90 sec.

    d. Peak Temperature : 240~245 (<10 sec.)

10. External Antenna Design Guide

10.1 PCB Antenna Design Guide: **Peak Gain: -2dBi Typ./ Avg. Gain: -3.5dBi Typ. (XZ-V)**
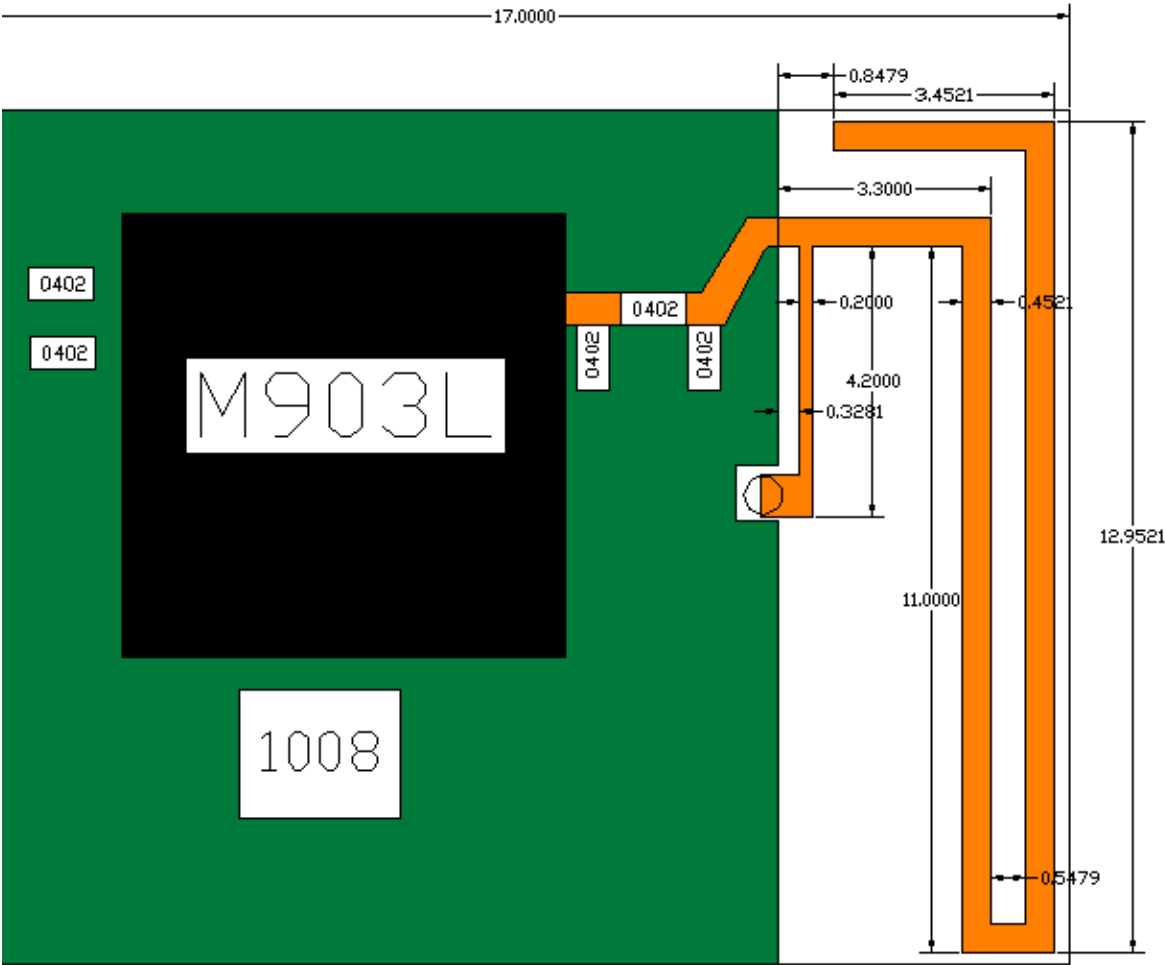
Return Loss

Radiation Patterns

XY-V/XY-H

XY-cut scanning direction

XZ-V/XZ-H

XZ-cut scanning direction

YZ-V/YZ-H

YZ-cut scanning direction

0.2 Chip Antenna Design Guide

ACX
Advanced Ceramic X
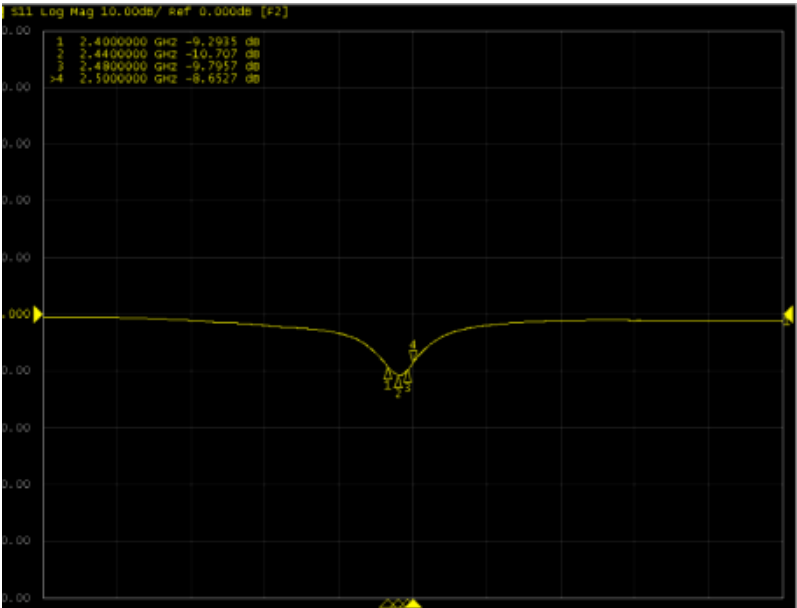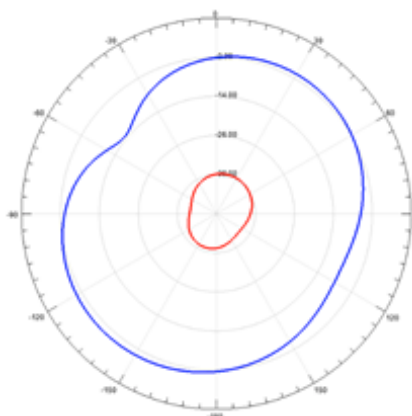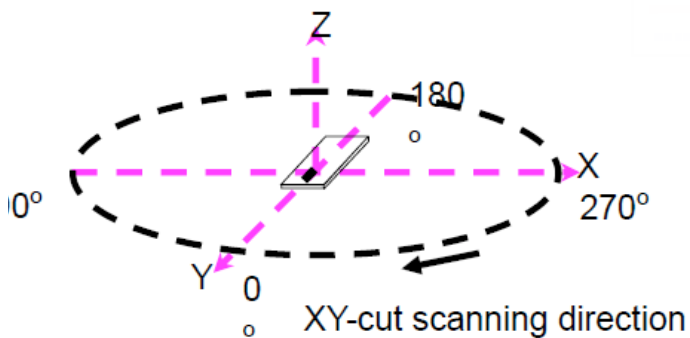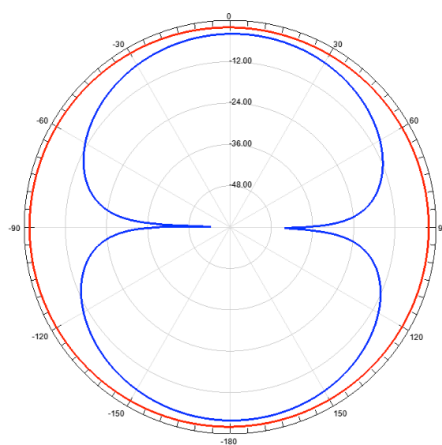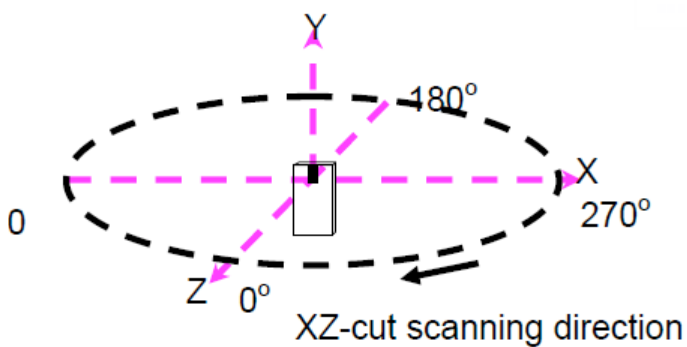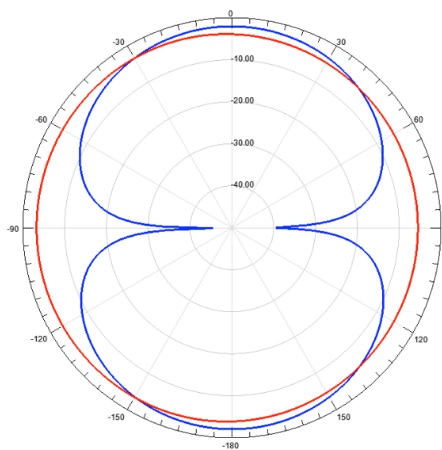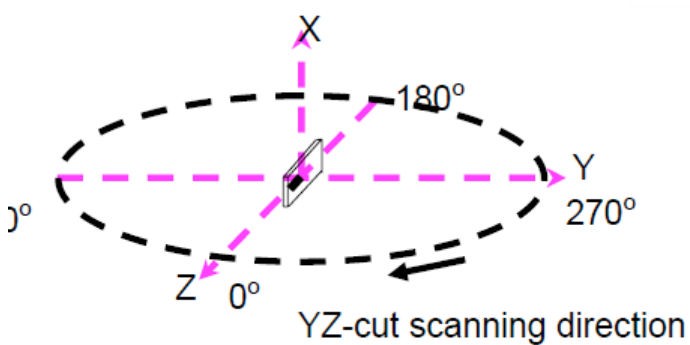
AT3216 Series
Multilayer Chip Antenna

Features

❖ Monolithic SMD with small, low-profile and
   light-weight type.
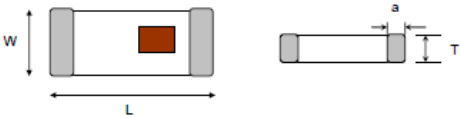
❖ Wide bandwidth

Applications

❖ Bluetooth/Wireless LAN/Home RF

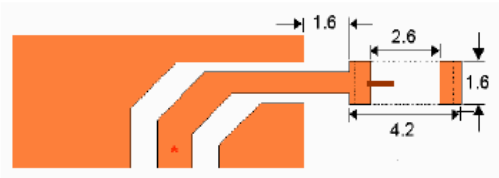❖ ISM band 2.4GHz applications

Specifications

Part Number	Frequency Range (MHz)	Peak Gain (XZ-V)	Average Gain (XZ-V)	VSWR	Impedance
AT3216 -B2R7HAA_	2400 ~ 2500	0.5 dBi typ.	-0.5 dBi typ.	2 max.	50 Ω

Unit : mm

Mark	L	W	T	a
Dimensions	3.2±0.2	1.6±0.2	1.3+ 0.1/-0.2	0.5±0.3

Without Matching Circuits

With Matching Circuits

M MtM Technology
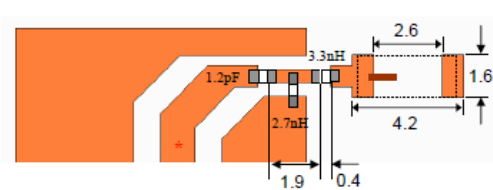
turn Loss\With Matching Circuits

m1
freq=2.360GHz
dB(S(2,2))=-10.236

m2
freq=2.590GHz
dB(S(2,2))=-10.194
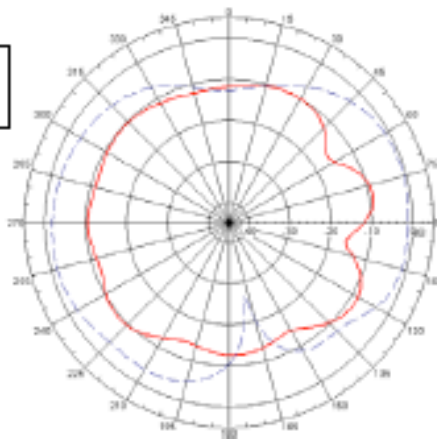
m3
freq=2.470GHz
dB(S(2,2))=-18.506
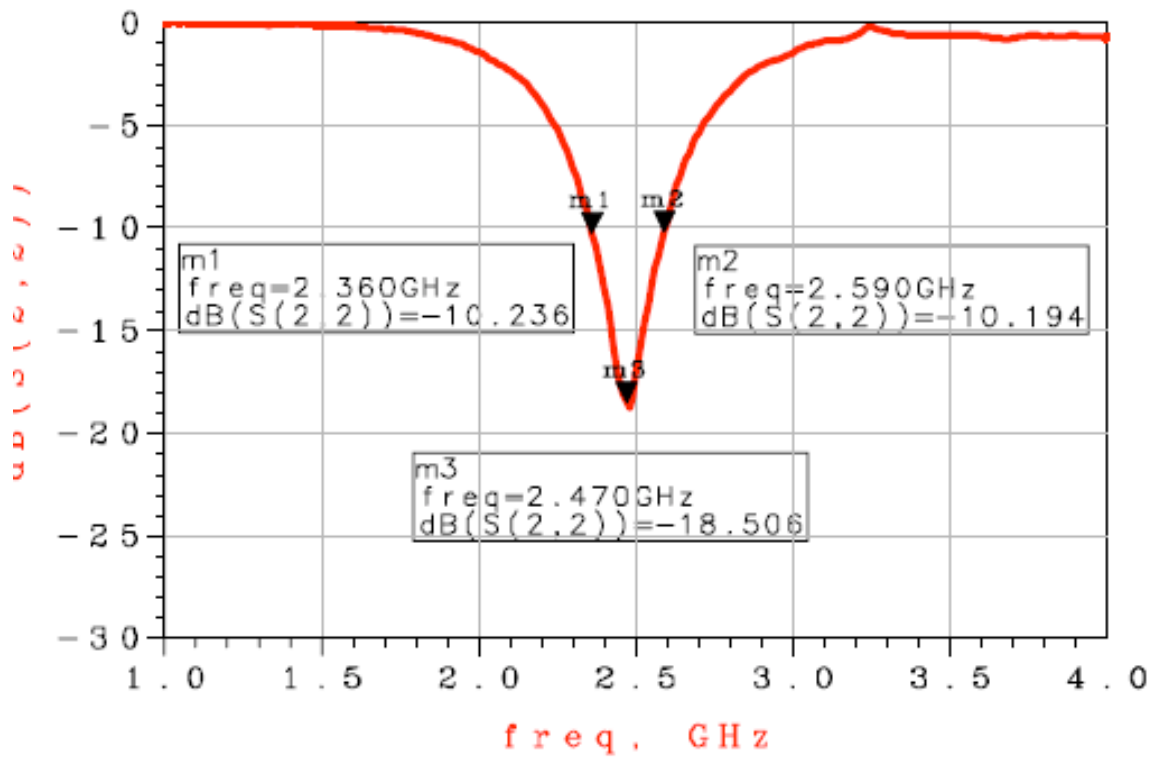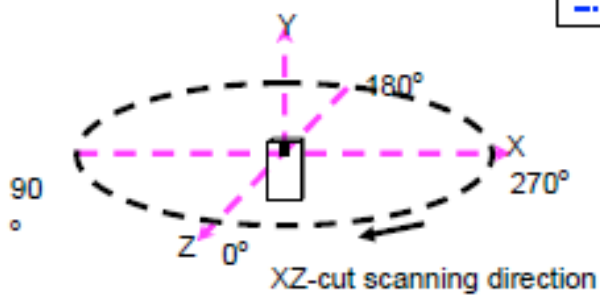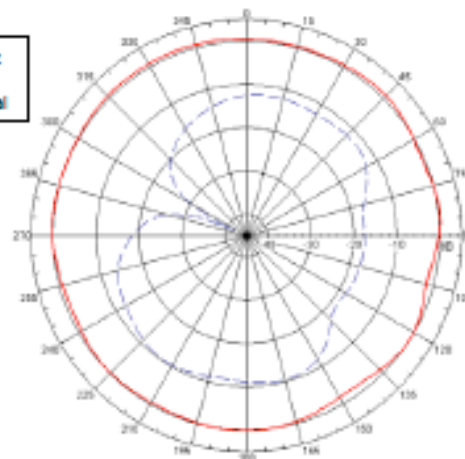
Radiation Patterns

XY-V/XY-H
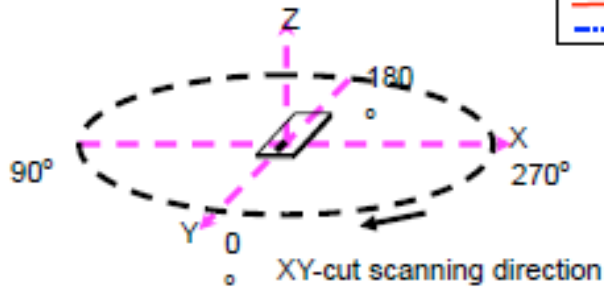
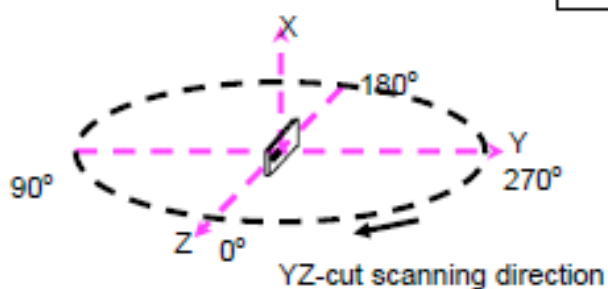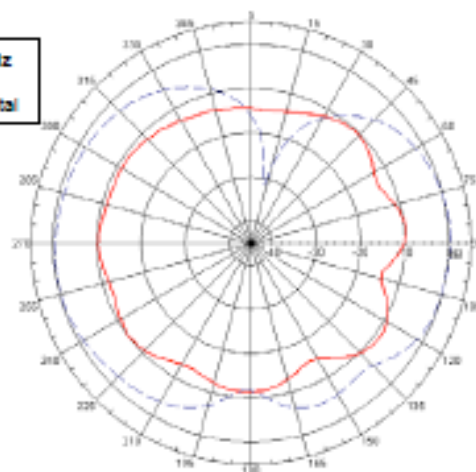

XY cut @2.45GHz
— Vertical
-·-·- Horizontal

XZ-V/XZ-H

XZ cut @2.45GHz
— Vertical
-·-·- Horizontal

YZ-V/YZ-H

YZ cut @2.45GHz
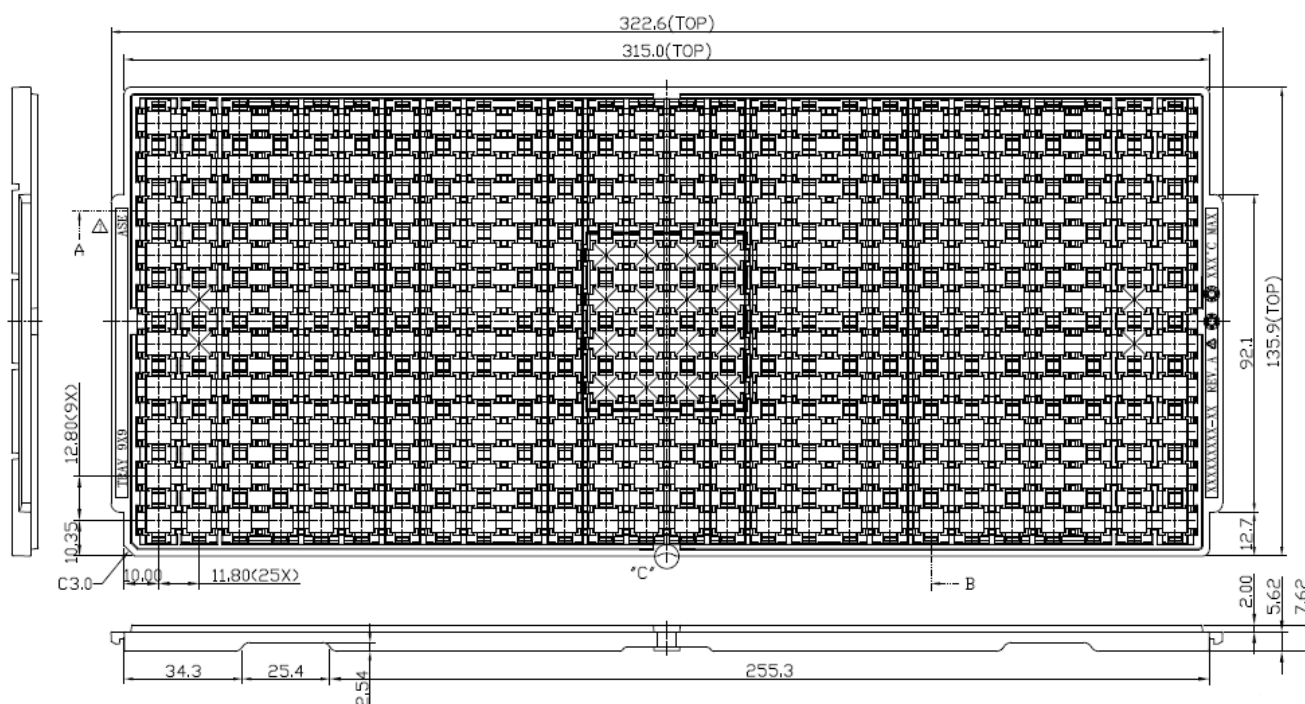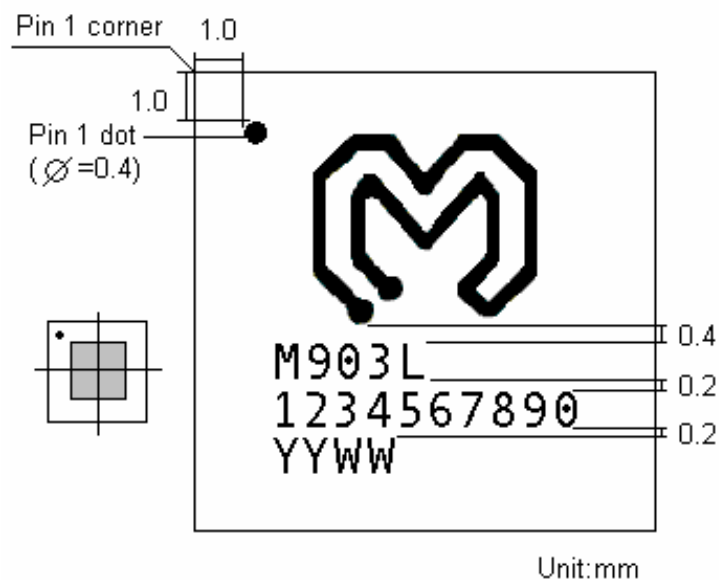— Vertical
······· Horizontal
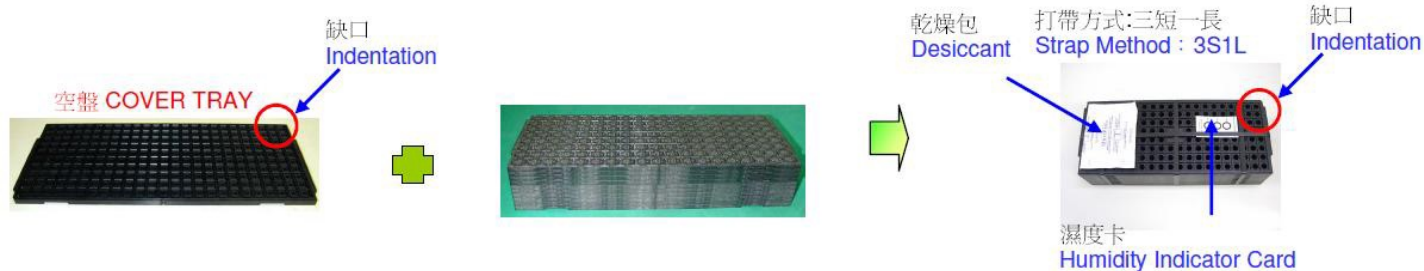
11.SiP Module Preparation

11.1 Handling

Handling the module must wear the anti-static wrist strap to avoid ESD damage. After each module is aligned and tested, it should be transport and storage with anti-static tray and packing. This protective package must be remained in suitable environment until the module is assembled and soldered onto the main board.

11.2 SMT Preparation

1. Calculated shelf life in sealed bag: 6 months at <40℃ and <90% relative humidity (RH).

2. Peak package body temperature: 250℃.

3. After bag was opened, devices that will be subjected to reflow solder or other high temperature process must.

    A.   Mounted within: 72 hours of factory conditions <30℃/60% RH.

    B.   Stored at ≦10% RH with N2 flow box.

4. Devices require baking, before mounting, if:

    A.   Package bag does not keep in vacuumed while first time open.

    B.   Humidity Indicator Card is >10% when read at 23±5℃.

    C.   Expose at 3A condition over 8 hours or Expose at 3B condition over 24 hours.

5. If baking is required, devices may be baked for 12 hours at 125±5℃.

12 .Package Information

12.1 Product Marking

12.2 Tray Drawing

Unit : mm

12.3 Packing Information

缺口 Indentation
空盤 COVER TRAY
乾燥包 Desiccant
打帶方式:三短一長 Strap Method：3S1L
缺口 Indentation
濕度卡 Humidity Indicator Card

真空袋 Dry-pack Bag(Al-Bag)
缺口 Indentation
一張粉紅色抗靜電氣泡布 1 piece of Pink Bubble Wrap
品質檢驗章 Q.A.Inspection Passed Stamp
包裝標籤 Packing Label

For partial bundle, please place 41PACLBW001 bubble sheet on top of the product until the product can't move inside the box.
針對零絡材料，請加放41PACLBW001氣泡布於材料上方，直到材料於內盒不會晃動為止

If the item create in barcode label, no need to fill in MSL,sealing date.
如果包裝標籤已定義則不須填上

級數 MSL
溫度(若無資料可空白) Temp (If no data, allow keeping empty)
封合日期 Sealing Date

將包好的包裝盤,連同粉紅色抗靜電氣泡布放入內箱中
Put The Packaged Tray And Pink Antistatic Bubble Warp

品質檢驗章 Q.A.Inspection Passed Stamp
包裝標籤貼於內盒左側 Packing Label stick at the left side of inner box

外箱內未滿6盒時，請以緩衝材填塞，不須另補空盒
Please place the cushion but the empty box to fill the spare space in the outer box, if the inner box q'ty is less than 6.

麥頭 ASECL Shipping Marked
品質檢驗章 Q.A.Inspection Passed Stamp
外箱 Outer Box

13. BQB / CE/FCC Certification

QDL Bluetooth® qualified design listing

The Bluetooth SIG Hereby Recognizes

MtM Technology
Member Company

M903L - CSR1010 Bluetooth Smart Module
Qualified Design Name

Declaration ID: D030940
Qualified Design ID: 84013
Specification Name: 4.1
Project Type: End Product
Model Number: M903L

Listing Date: 23 May 2016
Hardware Version Number: XE

Assessment Date: 23 May 2016
Software Version Number: 1.X 2.X or above