

# **W-LAN Module Data Sheet**

**802.11b/g module**

**Product Part Number: LBWA1ZZVK7-539**

## Revision History

Revision Code	Date	Description	Comments
-	2011/11/29	First Issue	
A	2012/03/02	Updated: 6. Operating Condition - Operating Temperature Range - Specification Temperature Range - Supply Voltage Range	
B	2012/03/30	Update: 6. Operating Condition Remove Specification Temperature Range	
D	2012/05/08	Updated: 6. Operating Condition - Operating Temperature Range - Specification Temperature Range	
E	2012/06/21	Updated: 12. Reference Circuit - Antenna matching circuit	
F	2012/10/31	Updated: 4. Terminal Configuration  Updated: 12. Reference Circuit	

**Notice for Murata Wireless Modules.**

Please read the specification including NOTICE (Page20), PRECONDITION TO USE OUR PRODUCTS (Page23) and Disclaimer (Page24) in this datasheet before using the Murata Wireless Modules.

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Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Murata products and disclaimers thereto appears at the end of this specification sheet.

## ● Module Features

- Murata LBWA1ZZVK7 module integrates WLAN function.
- WLAN: IEEE 802.11 b, g, compliant.
- Typical WLAN Transmit Power (typical):
  - +19.5dBm at 11Mbps, CCK (11b)
  - +15.0dBm at 54Mbps, OFDM (11g)
- Typical WLAN Sensitivity (typical):
  - 88dBm at 8% PER, 11Mbps
  - 74dBm at 10% PER, 54Mbps
- Module size: 16.5x11.5mm typical.
- Module height: 2.2mm max.
  
- FCC (USA) and IC (Canada) Certification will be supported with mono-pole type antenna.
  
- Murata LBWA1ZZVK7 module consists of the following components
  - Texas Instruments CC3000 SoC – WLAN baseband and RF converter
  - Clock sources – Both Fast Clock and Slow Clock are integrated.
  - Front End Module – A combination of PA and a switch
  - Band Pass Filter – Filtering out of band noise and interference
  - EEPROM – A non volatile memory
  - Power FET switch – minimizing leakage current in shutdown mode. The switching mode power source provides 3.3V supply for the CC3000 from either battery or MCU the board.
  - Level Shifter – Supporting 1.8V and 3.3V Host Interface.

Seamless integration with several Texas Instruments MSP430 and Stellaris processors

SPI host interface for WLAN

RoHS: This module is compliant with the RoHS directive.

### 1. Scope

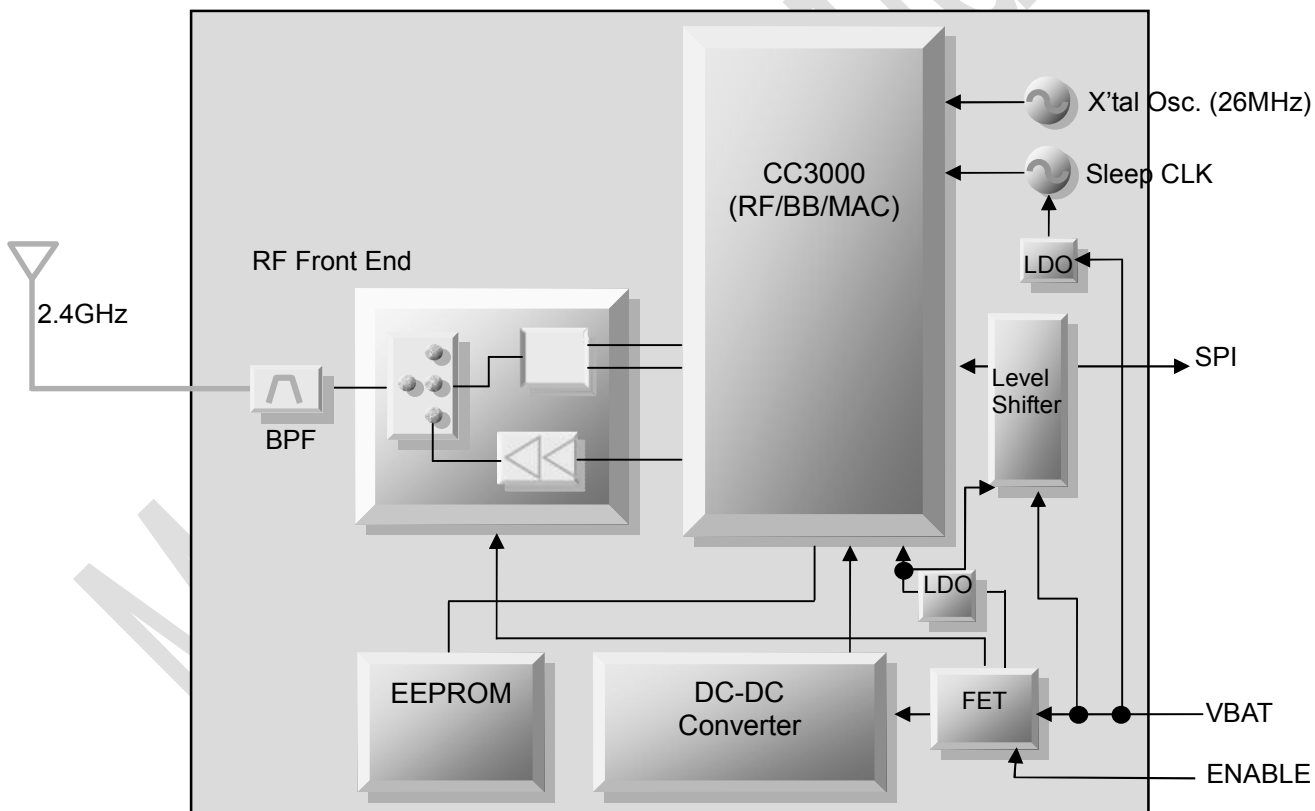
This specification is applied to the IEEE802.11 b/g WLAN module.

- Host Interface
  - W-LAN : SPI
- IC/Firmware
  - W-LAN BB/MAC : CC3000
  - FEM for CC3000 : TriQuint TQM679002A (E2.6)
- Reference Clock : 26MHz Reference Clock is integrated.
- Sleep Clock : 32.768kHz oscillator is integrated.
- Weight : T.B.D (mg)
- MSL : Level3
- RoHS : This module is compliant with the RoHS directive.

### 2. Part Number

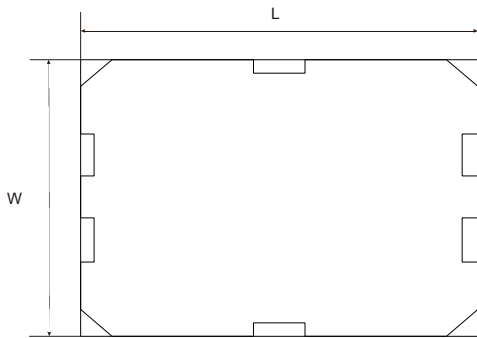
Part Number	LBWA1ZZVK7-539
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### 3. Block Diagram



### 4. Dimensions and Terminal Configurations

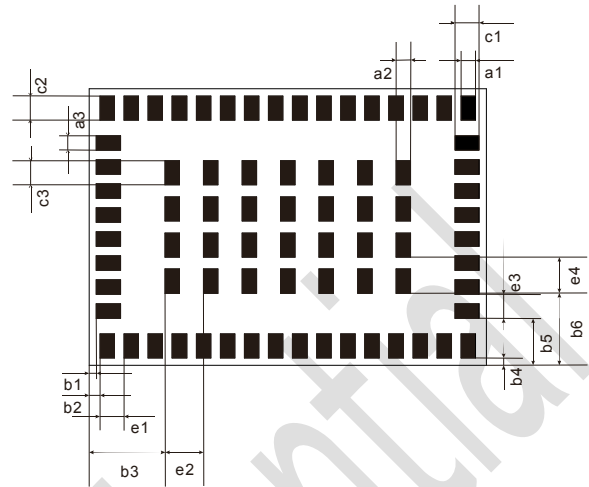
<Top View>



<Side View>



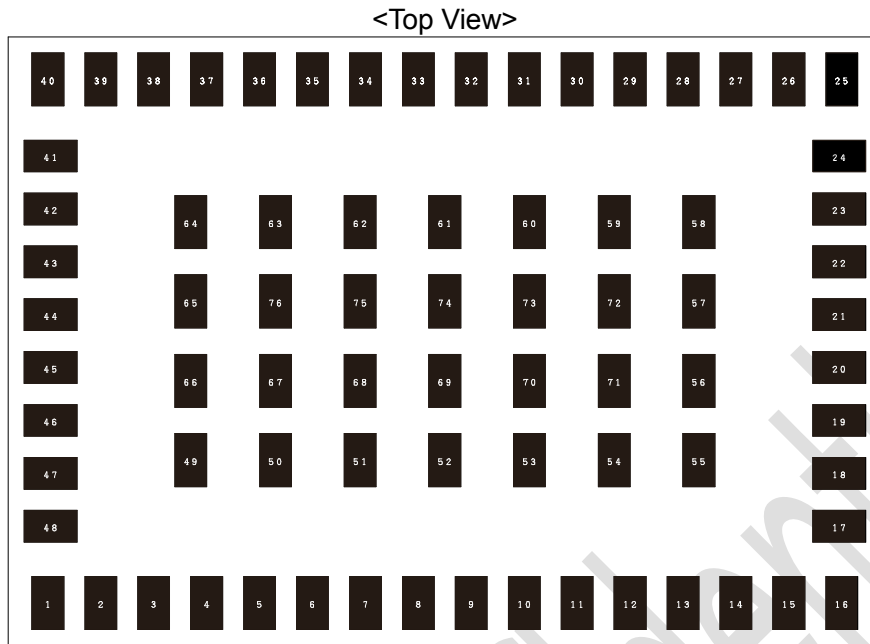
<Bottom View>



(unit: mm)

Mark	Dimensions	Mark	Dimensions	Mark	Dimensions
L	16.5 +/- 0.2	W	11.5 +/- 0.2	T	2.20 Max
a1	0.6 +/- 0.1	a2	0.6 +/- 0.1	a3	0.6 +/- 0.1
b1	0.3 +/- 0.2	b2	0.45 +/- 0.200	b3	3.15 +/- 0.200
b4	0.3 +/- 0.2	b5	1.95 +/- 0.20	b6	3.0 +/- 0.2
c1	1.0 +/- 0.1	c2	1.0 +/- 0.1	c3	1.0 +/- 0.1
e1	1.0 +/- 0.1	e2	1.6 +/- 0.1	e3	1.0 +/- 0.1
e4	1.5 +/- 0.1	-	-	-	-

## Terminal configuration



No.	Terminal Name	Type	Power	System	Connection to IC Terminal		Description
1	GND	-	-	-	-	-	Ground
2	ENABLE	I	-	-	FET	FET	Module Enable Power Supply Input
3	GND	-	-	-	-	-	Ground
4	VBAT	I	-	-	FET LDO Level Shifter	FET LDO Level Shifter	Power Supply Input
5	GND	-	-	-	-	-	Ground
6	GND	-	-	-	-	-	Ground
7	GND	-	-	-	-	-	Ground
8	GND	-	-	-	-	-	Ground
9	WL_RS232_RX	I/O	-	WLAN	3000	RS232_Rx	Need to connect to FUNC2 pin
10	WL_RS232_TX	I/O	-	WLAN	3000	RS232_Tx	RS232_Tx
11	WL_EN1	-	-	-	3000	WL_EN	Connect to WL_EN2
12	UART_DBG	-	-	WLAN	3000	WL_UART_DBG	Logger
13	WL_EN2	I	-	WLAN	3000	BT_EN	Connect to WL_EN1
14	GND	-	-	-	-	-	Ground
15	GND	-	-	-	-	-	Ground
16	GND	-	-	-	-	-	Ground
17	GND	-	-	-	-	-	Ground
18	SPI_CLK	IO	-	WLAN	3000	SPI_CLK	SPI Clock from the host
19	SPI_DI	IO	-	WLAN	3000	SPI_DIN	SPI Data-in from the host
20	GND	-	-	-	-	-	Ground
21	SPI_CS	IO	-	WLAN	3000	SPI_CS	SPI Chip select
22	SPI_DO	IO	-	WLAN	3000	SPI_DOUT	SPI Data-out from the host
23	SPI_IRQ	IO	-	WLAN	3000	SPI_IRQ	SPI Interrupt Request
24	GND	-	-	-	-	-	Ground
25	GND	-	-	-	-	-	Ground
26	GND	-	-	-	-	-	Ground
27	FUNC5/NC	IO	-	-	3000	NC	NC
28	SCL	-	-	-	3000	SCL	I2C to EEPROM

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&lt; Specification may be changed by Murata without notice &gt;

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							Connect to SCL_EEPROM pin
29	SDA	-	-	-	3000	SDA	I2C to EEPROM Connect to SDA_EEPROM pin
30	NS_URAT_DBG						
31	FUNC4	IO	-	-	3000	NS_UARTD	Networking subsystem UART Debug line
32	FUNC2	IO	-	-	3000	FUNC2	Need to connect to WL_RS232_RX pin
33	GND	-	-	-	-	-	Ground
34	GND	-	-	-	-	-	Ground
35	SDA_EEPROM	-	-	-	Memory	EEPROM	Connect to SDA pin
36	SCL_EEPROM	-	-	-	Memory	EEPROM	Connect to SCL pin
37	GND				3000	NC (D)	NC
38	GND	-	-	-	-	-	Ground
39	GND	-	-	-	-	-	Ground
40	GND						Ground
41	GND						Ground
42	GND	-	-	-	-	-	Ground
43	GND	-	-	-	-	-	Ground
44	2.4G_ANT	I/O	-	WLAN	-	-	RF transmitter output and RF receiver input
45	GND	-	-	-	-	-	Ground
46	GND	-	-	-	-	-	Ground
47	GND	-	-	-	-	-	Ground
48	GND	-	-	-	-	-	Ground
49 ~ 76	GND	-	-	-	-	-	Ground



## 5. Rating

Parameter		min.	max	unit
Storage Temperature		-40	85	deg.C
Supply Voltage	VBAT	-0.5	4.5	V
	ENABLE	-0.5	4.5	V

## 6. Operating Condition

Parameter		min.	typ.	max	unit
Operating Temperature Range		-40	-	+85	deg.C
Specification Temperature Range		-20	+25	+70	deg.C
Supply Voltage	VBAT	2.7	3.3	3.6	V
	ENABLE(ON State)	1.5	3.3	VBAT	V
	ENABLE (OFF State)	0	-	0.3	V

[Note] All RF characteristics in this datasheet are defined by Specification Temperature Range

## 7. Input/Output Terminal Characteristic

	min.	max	unit
V <sub>IH</sub> : High-level input voltage	2.0	-	V
V <sub>IL</sub> : Low-level input voltage	-	0.8	V
V <sub>OH</sub> : High-level output voltage	VBAT	-	V
V <sub>OL</sub> : Low-level output voltage	0	VBAT	V

## 8. WLAN Power Up/Down Sequence

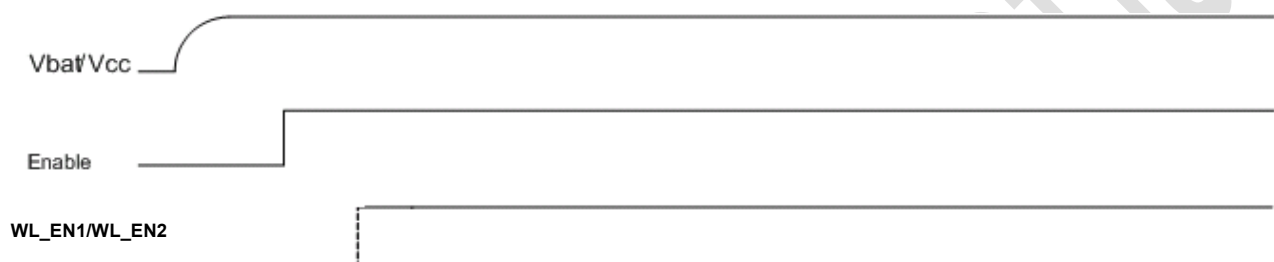
### 8.1 Power Up Sequence

The following sequence describes device powerup from shutdown. ENABLE starts the initialization sequence, and subsequent events are automatic.

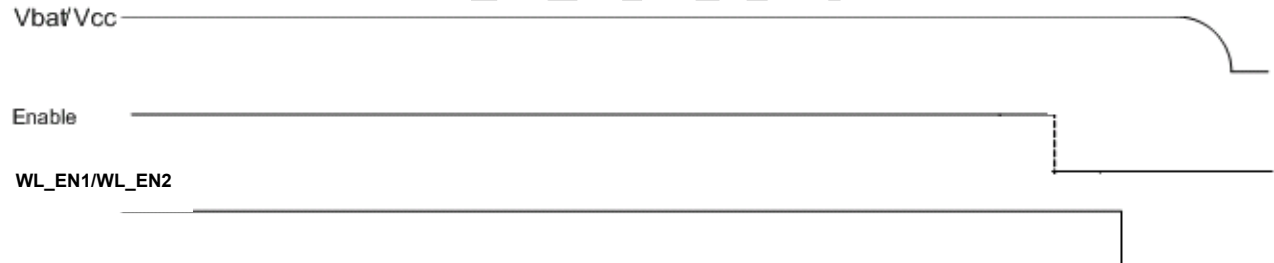
Power up requirements:

1. No signals are allowed on the IO pins if no IO power supplied, because the IOs are not 'failsafe'. Exceptions are SLOWCLK, XTALP and which are failsafe and can tolerate external voltages with no VDDS and DC2DC.
2. VBAT , VIO, and SLOWCLK must be stable before releasing EN.

The LBWA1ZZVK7 module should activate the power on with only one control enable line from the MCU. Below is the wake up sequence.



### 8.2 Power Down Sequence



## 9. HOST Interface

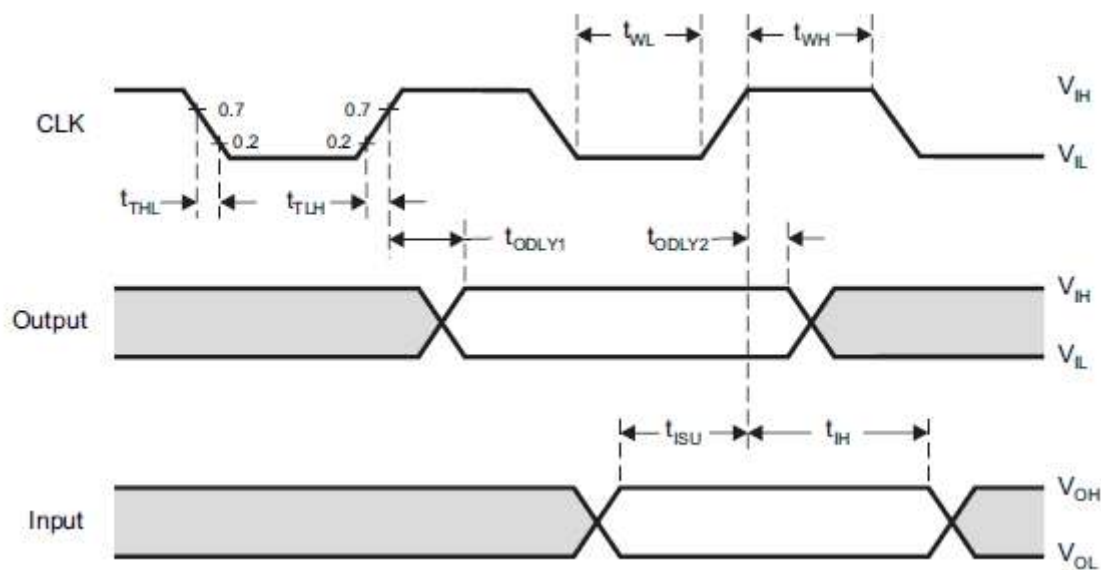
### 9.1 Host interface: SPI

### 9.2 SPI Interface timing

#### 9.2.1 SPI Clock Switching Characteristic

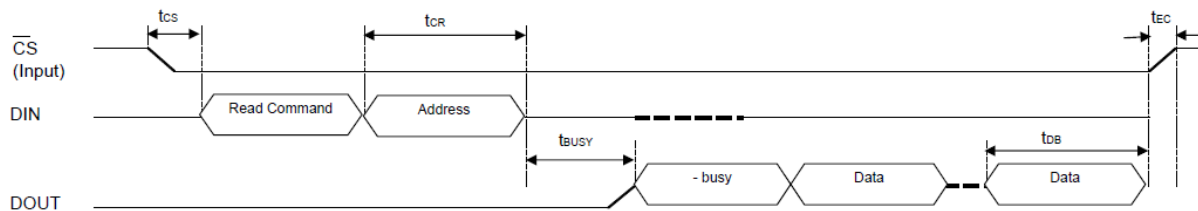
PARAMETER			MIN	MAX	UNIT
$f_{\text{clock}}$	Clock frequency, CLK	$CL \leq 10\text{pF}$	0	48	MHz
DC	Low/High duty cycle	$CL \leq 10\text{pF}$	40	60	%
$t_{\text{WL}}$	Pulse duration, CLK low	$CL \leq 10\text{pF}$	5		ns
$t_{\text{WH}}$	Pulse duration, CLK high	$CL \leq 10\text{pF}$	5		ns
$t_{\text{TLH}}$	Rise time, CLK	$CL \leq 10\text{pF}$		4.3	ns
$t_{\text{THL}}$	Fall time, CLK	$CL \leq 10\text{pF}$		3.5	ns
$t_{\text{ISU}}$	Setup time, input valid before CLK $\uparrow$	$CL \leq 10\text{pF}$	5		ns
$t_{\text{IH}}$	Hold time, input valid after CLK $\uparrow$	$CL \leq 10\text{pF}$	5		ns
$t_{\text{ODLY1}}$	Delay time, CLK $\downarrow$ to output valid	$CL \leq 10\text{pF}$	4	15	ns
$t_{\text{ODLY2}}$	Delay time, CLK $\downarrow$ to output invalid	$CL \leq 10\text{pF}$	5	15	ns

SPI Timing

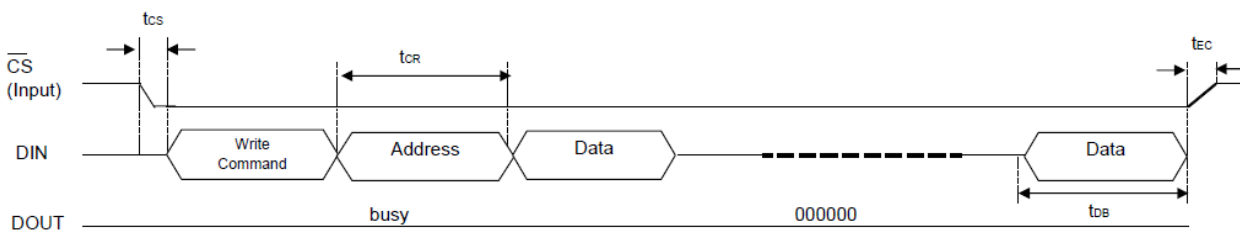


### 9.2.2 SPI Data Switching Characteristic

#### SPI Inter face read



#### SPI Inter face write



Parameter		MIN	MAX	Unit
tcs	Delay time, $\overline{CS} \downarrow$ to DIN read/write command valid	0		16 Clock Cycle
tcr	Delay time, DIN read command invalid to DOUT/DIN card reponse valid		1	16 Clock Cycle
tbusy	Fixed busy delay till DOUT data valid	1	7	32 Clock Cycle
tec	Delay time, DOUT data invalid to $\overline{CS} \uparrow$	0		16 Clock Cycle
tdb	Data Block Size		1	32 Clock Cycle

## 10. Electrical Characteristics

### 10.1 DC/RF Characteristics for IEEE802.11b

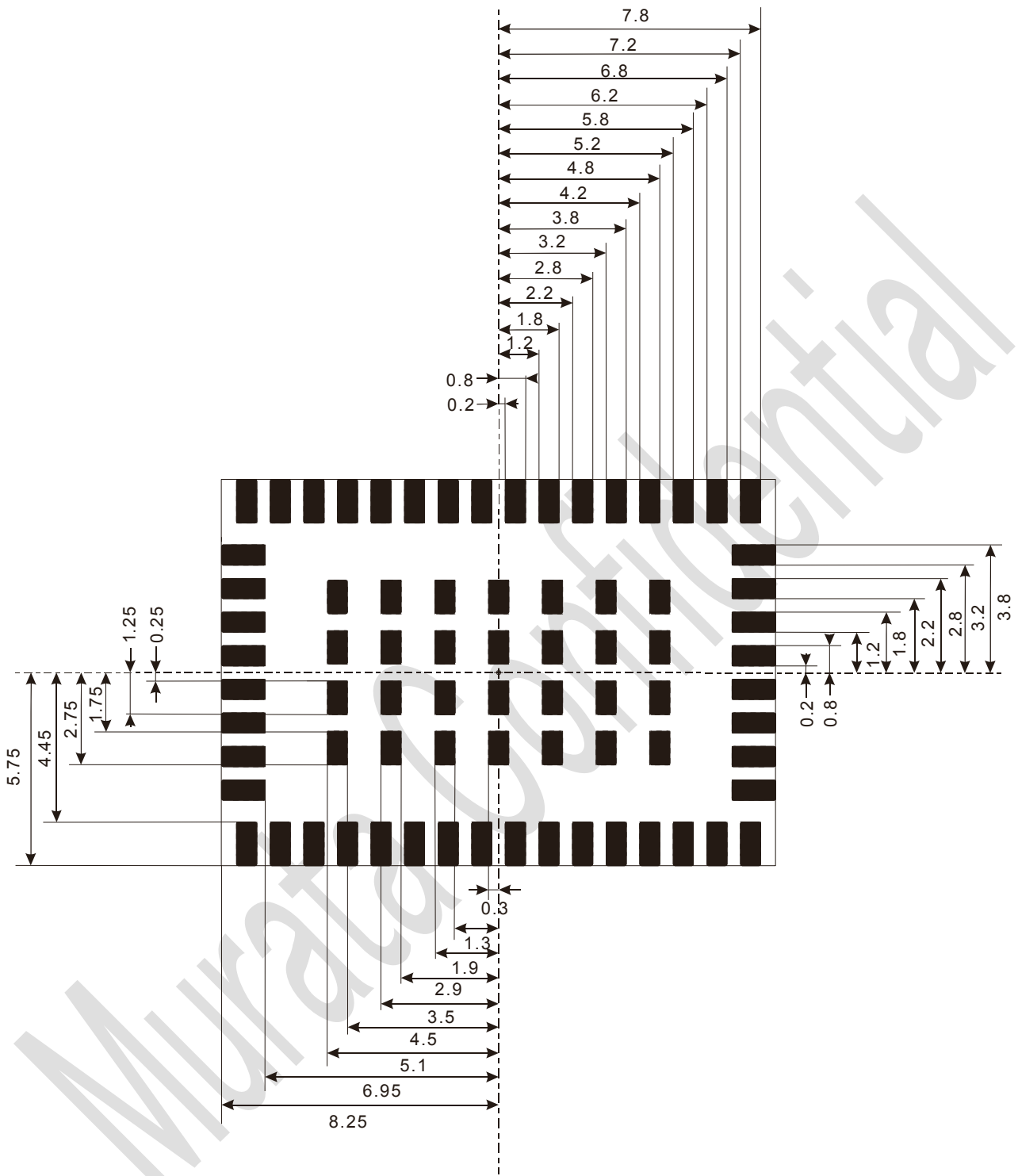
11Mbps mode unless otherwise specified. 25deg.C, VBAT=3.6V, ENABLE=1.8V

Items	Contents			
Specification	IEEE802.11b			
Mode	DSSS / CCK			
Frequency	2400 - 2500MHz			
Data rate	1, 2, 5.5, 11Mbps			
- DC Characteristics -	min.	typ.	max.	unit
1. DC current				
1) Tx mode	-	292		mA
2) Rx mode	-	92		mA
- Tx Characteristics -	min.	typ.	max.	unit
2. Power Levels		+19.5		dBm
3. Spectrum Mask				
1) 1st side lobes	-	-	-30	dBr
2) 2nd side lobes	-	-	-50	dBr
4. Power-on and Power-down ramp	-	-	2	μsec
5. RF Carrier Suppression	15		-	dB
6. Modulation Accuracy (EVM)	-	-	35	%
- Rx Characteristics -	min.	typ.	max.	unit
7. Minimum Input Level Sensitivity				
1) 11Mbps (FER ≤ 8%)	-	-	-76	dBm
8. Maximum Input Level (FER ≤ 8%)	-10	0	-	dBm

10.2 DC/RF Characteristics for IEEE802.11g  
 54Mbps mode unless otherwise specified. 25deg.C, VBAT=3.6V, ENABLE =1.8V

Items	Contents			
Specification	IEEE802.11g			
Mode	OFDM			
Frequency	2400 - 2483.5MHz			
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps			
- DC Characteristics -	min.	typ.	max.	unit
1. DC current				
1) Tx mode	-	180		mA
2) Rx mode	-	92		mA
- Tx Characteristics -	min.	typ.	max.	unit
2. Power Levels		+15		dBm
3. Spectrum Mask				
1) at fc +/- 11MHz	-		-20	dBr
1) at fc +/- 20MHz	-		-28	dBr
1) at fc +/- 30MHz	-		-40	dBr
4. Spurious Emissions				
1) 30MHz to 1GHz	-		-36	dBm
2) 1GHz to 12.75GHz	-		-30	dBm
3) 1.8GHz to 1.9GHz	-		-47	dBm
4) 5.15GHz to 5.3GHz	-		-47	dBm
5. Constellation Error (EVM)	-		-25	dB
- Rx Characteristics -	min.	typ.	max.	unit
6. Minimum Input Level Sensitivity				
1) 54Mbps (PER ≤ 10%)	-		-65	dBm
7. Maximum Input Level (PER ≤ 10%)	-20		-	dBm

### 11. Land pattern



(unit : mm)

## 12. Reference Circuit

**[NOTE 1]**

In our schematic, pull-up resistors for EEPROM\_SCL and EEPROM\_SDA are unnecessary.

However, you can add pull-up resistor for them if necessary. Our recommend is 10k ohm.

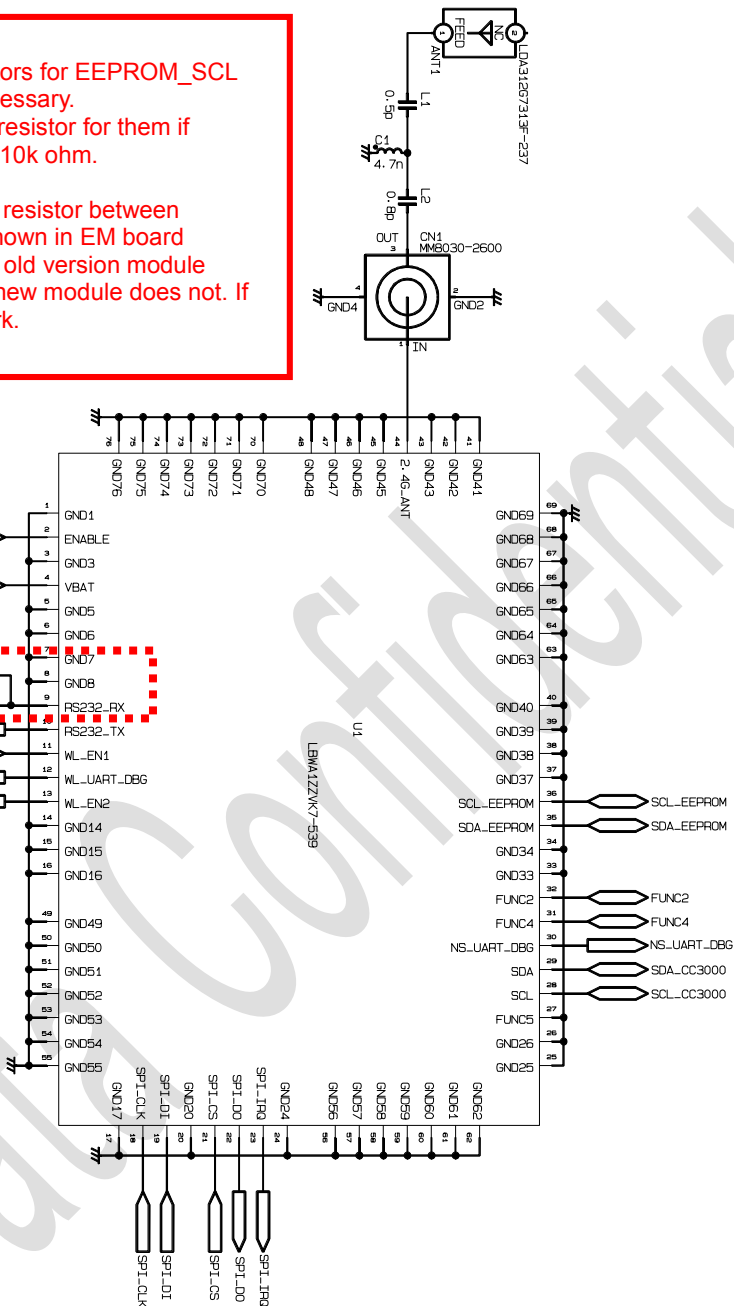
**[NOTE 2]**

Please DO NOT place 2k ohm resistor between RS232\_RX and FUNC2 as shown in EM board schematic. EM board has an old version module which requires 2kOhm while new module does not. If you place 2kohm, it won't work.

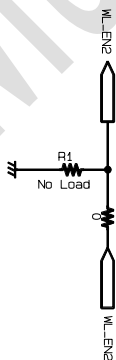
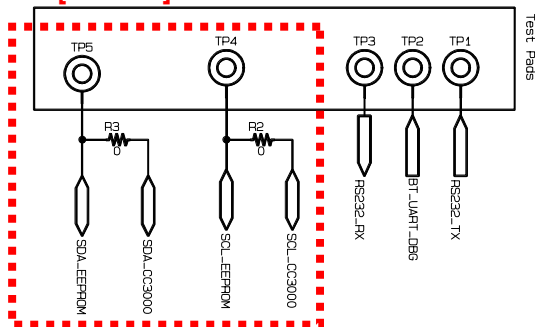
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Please refer [NOTE 2]



Please refer [NOTE 1]



Reference Schematic for LBMA1ZZVK7-539

20/6/2012



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### 13. Evaluation board of LBWA1ZZVK7-TEMP

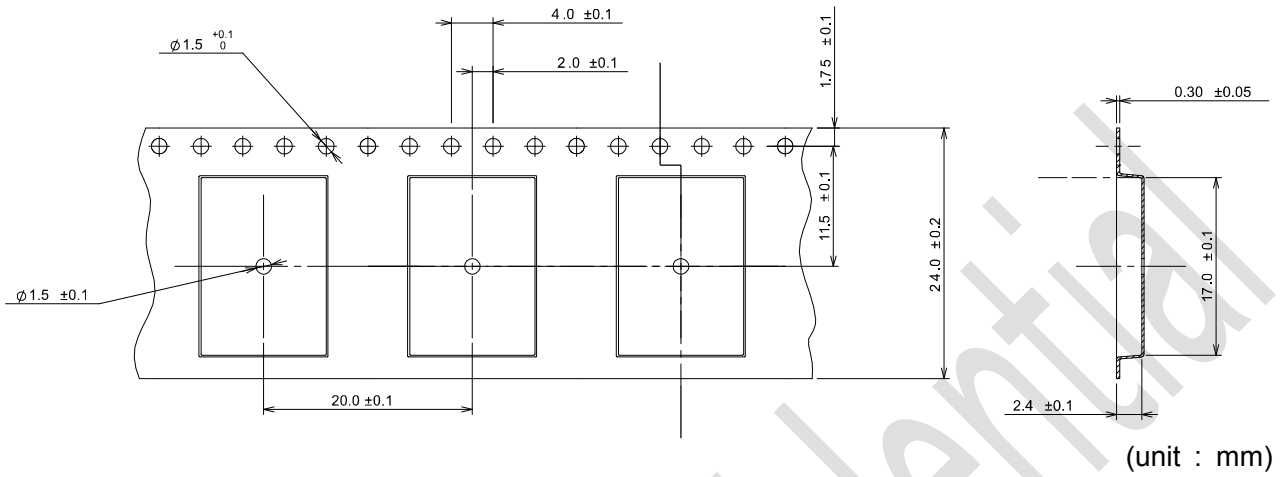
LBWA1ZZVK7-TEMP Evaluation Module board (EM board) enables a pre-defined interface and form factor solution for compatibility with other TI microcontroller development boards such as MSP430 Experimenter's board and Stellaris LM3S9B96-DK. The LBWA1ZZVK7 Module and EM board will communicate over the SPI interface through the 20pin connector.

Evaluation Module board (EM board ) Part Number	LBWA1ZZVK7-TEMP-D
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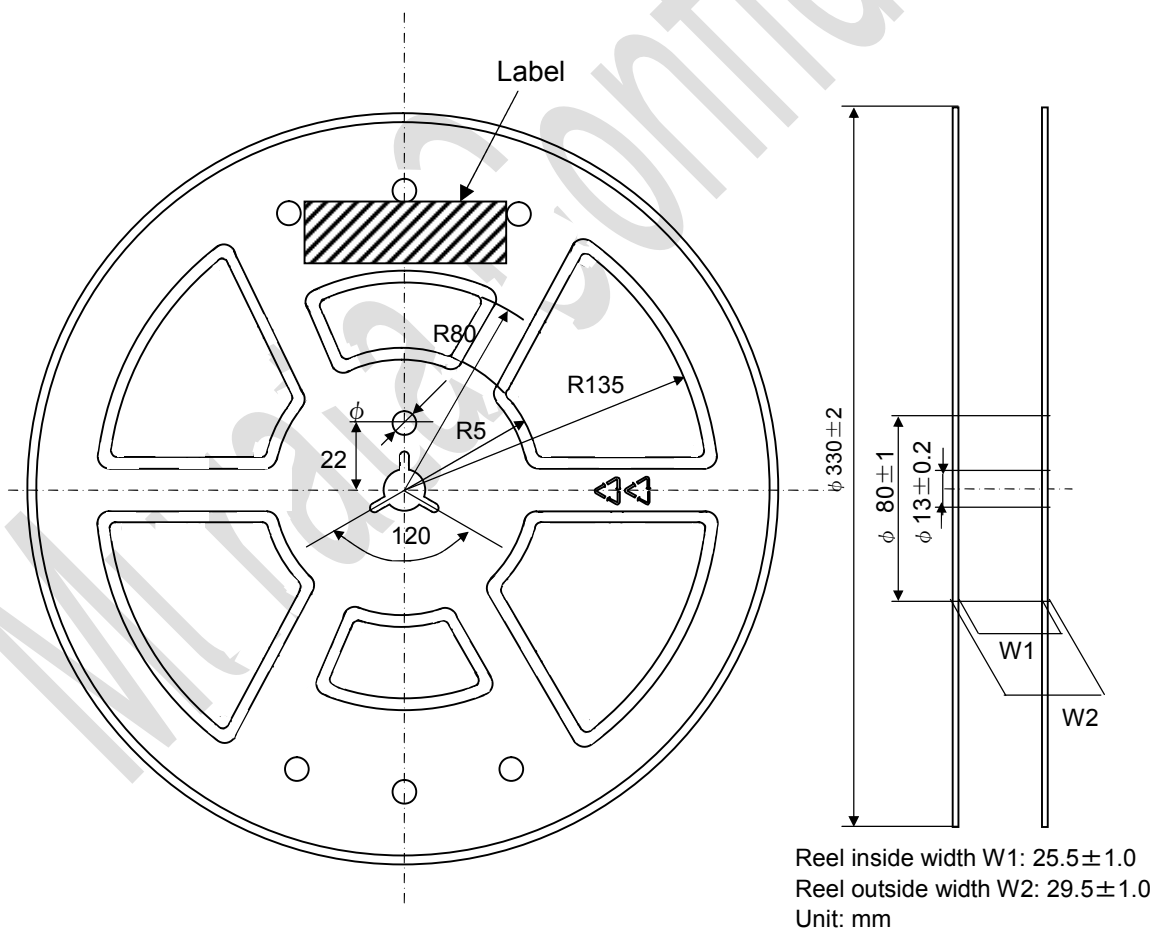
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## 14. Tape and Reel Packing

### (1) Dimensions of Tape (Plastic tape)



### (2) Dimensions of Reel



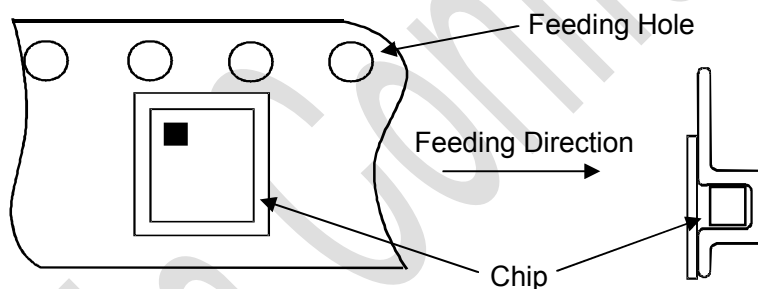
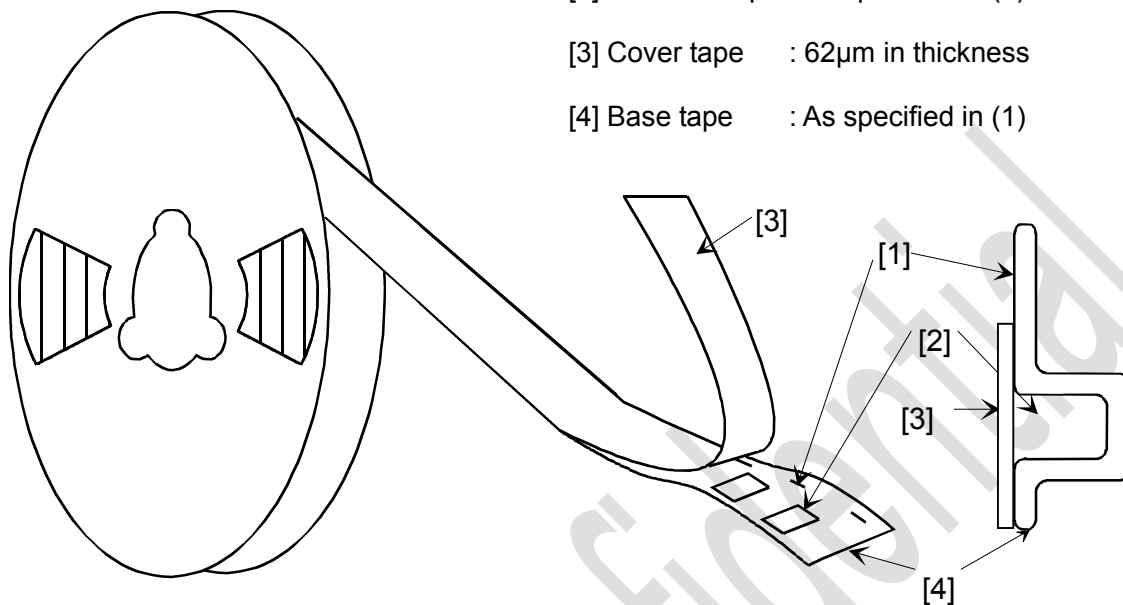
(3) Taping Diagrams

[1] Feeding Hole : As specified in (1)

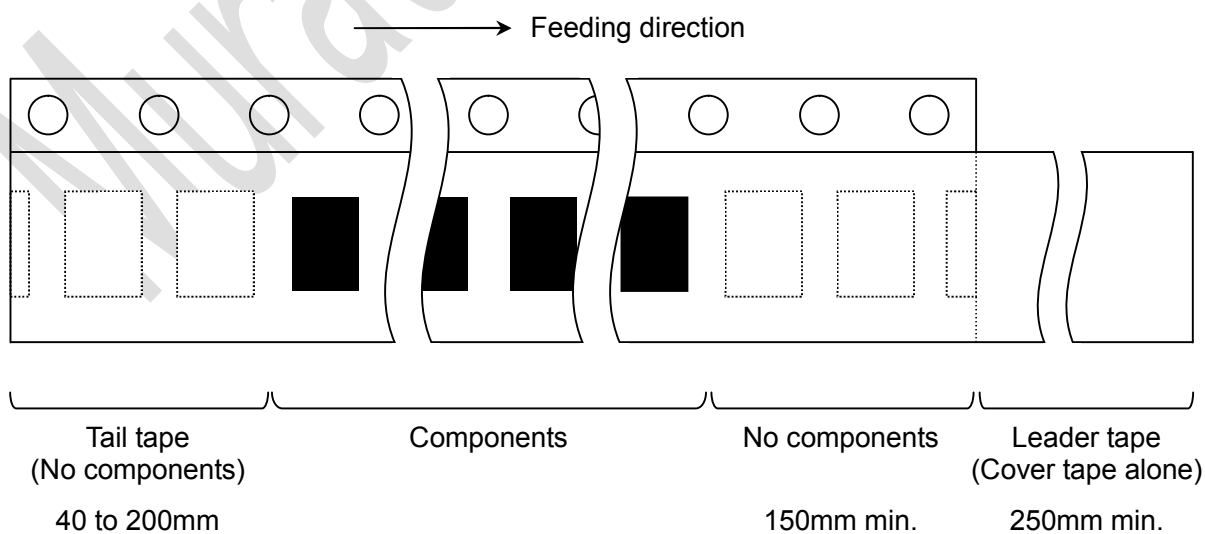
[2] Hole for chip : As specified in (1)

[3] Cover tape : 62μm in thickness

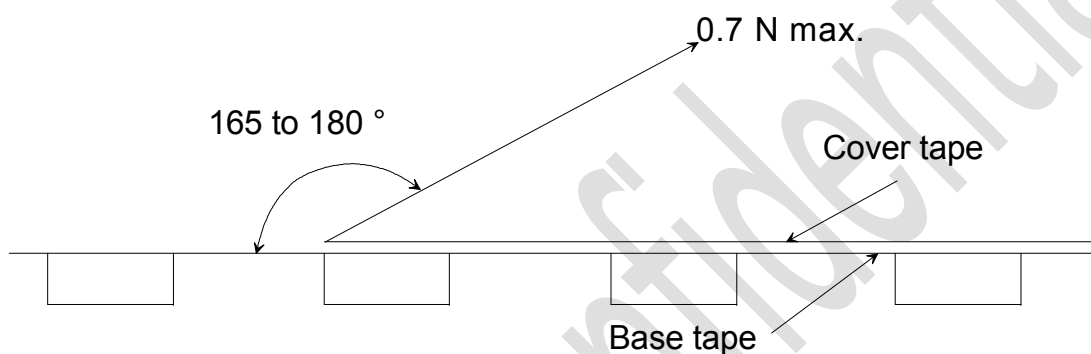
[4] Base tape : As specified in (1)



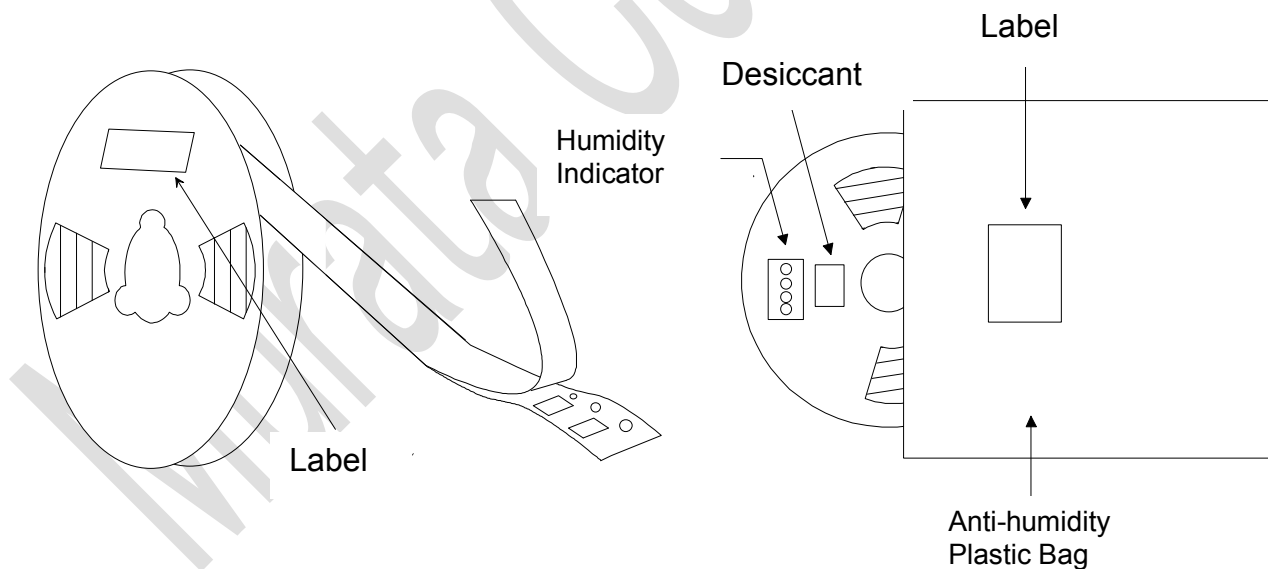
(4) Leader and Tail tape



- (5) The tape for chips are wound clockwise, the feeding holes to the right side as the tape is pulled toward the user.
- (6) The cover tape and base tape are not adhered at no components area for 250mm min.
- (7) Tear off strength against pulling of cover tape : 5N min.
- (8) Packaging unit : 500pcs./ reel
- (9) material : Base tape : Plastic  
Real : Plastic  
Cover tape, cavity tape and reel are made the anti-static processing.
- (10) Peeling of force : 0.7N max. in the direction of peeling as shown below.



- (11) Packaging (Humidity proof Packing)



Tape and reel must be sealed with the anti-humidity plastic bag. The bag contains the desiccant and the humidity indicator.

## ● NOTICE

### Storage Conditions:

Please use this product within 6month after receipt.

- The product shall be stored without opening the packing under the ambient temperature from 5 to 35deg.C and humidity from 20 to 70%RH.

(Packing materials, in particular, may be deformed at the temperature over 40deg.C.)

- The product left more than 6months after reception, it needs to be confirmed the solderbility before used.

- The product shall be stored in non corrosive gas (Cl<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub>, No<sub>x</sub>, etc.).

- Any excess mechanical shock including, but not limited to, sticking the packing materials by sharp object and dropping the product, shall not be applied in order not to damage the packing materials.

This product is applicable to MSL3 (Based on JEDEC Standard J-STD-020)

- After the packing opened, the product shall be stored at <30deg.C / <60%RH and the product shall be used within 168hours.

- When the color of the indicator in the packing changed, the product shall be baked before soldering.

Baking condition : 125 +5/-0deg.C, 24hours, 1time

The products shall be baked on the heat-resistant tray because the material (Base Tape, Reel Tape and Cover Tape) are not heat-resistant.

### Handling Conditions :

Be careful in handling or transporting products because excessive stress or mechanical shock may break products.

Handle with care if products may have cracks or damages on their terminals, the characteristics of products may change. Do not touch products with bear hands that may result in poor solderability and destroy by static electrical charge.

### Standard PCB Design (Land Pattern and Dimensions) :

All the ground terminals should be connected to the ground patterns. Furthermore, the ground pattern should be provided between IN and OUT terminals. Please refer to the specifications for the standard land dimensions.

The recommended land pattern and dimensions is as Murata's standard. The characteristics of products may vary depending on the pattern drawing method, grounding method, land dimensions, land forming method of the NC terminals and the PCB material and thickness. Therefore, be sure to verify the characteristics in the actual set. When using non-standard lands, contact Murata beforehand.

### Notice for Chip Placer :

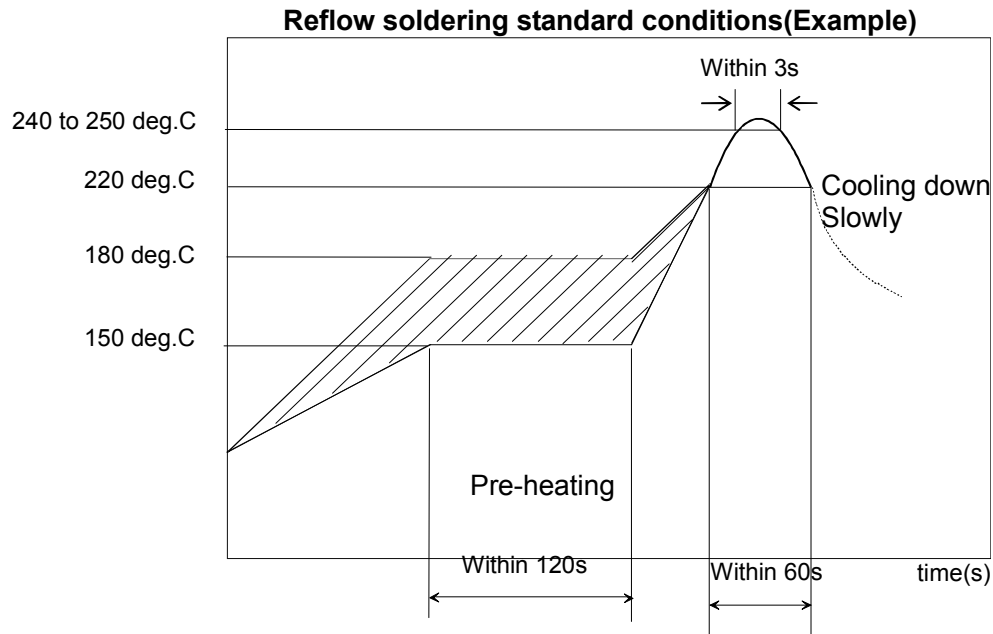
When placing products on the PCB, products may be stressed and broken by uneven forces from a worn-out chucking locating claw or a suction nozzle. To prevent products from damages, be sure to follow the specifications for the maintenance of the chip placer being used. For the positioning of products on the PCB, be aware that mechanical chucking may damage products.

## Soldering Conditions :

The recommendation conditions of soldering are as in the following figure.

When products are immersed in solvent after mounting, pay special attention to maintain the temperature difference within 100 °C. Soldering must be carried out by the above mentioned conditions to prevent products from damage. Set up the highest temperature of reflow within 260 °C.

Contact Murata before use if concerning other soldering conditions.



Please use the reflow within 2 times.

Use rosin type flux or weakly active flux with a chlorine content of 0.2 wt % or less.

## Cleaning:

Since this Product is Moisture Sensitive, any cleaning is not permitted.

## Operational Environment Conditions:

Products are designed to work for electronic products under normal environmental conditions (ambient temperature, humidity and pressure). Therefore, products have no problems to be used under the similar conditions to the above-mentioned. However, if products are used under the following circumstances, it may damage products and leakage of electricity and abnormal temperature may occur.

- In an atmosphere containing corrosive gas ( Cl<sub>2</sub>, NH<sub>3</sub>, SO<sub>x</sub>, NO<sub>x</sub> etc.).
- In an atmosphere containing combustible and volatile gases.
- Dusty place.
- Direct sunlight place.
- Water splashing place.
- Humid place where water condenses.
- Freezing place.

If there are possibilities for products to be used under the preceding clause, consult with Murata before actual use.

As it might be a cause of degradation or destruction to apply static electricity to products, do not apply static electricity or excessive voltage while assembling and measuring.

## Input Power Capacity:

Products shall be used in the input power capacity as specified in this specifications. Inform Murata beforehand, in case that the components are used beyond such input power capacity range.



## ● PRECONDITION TO USE OUR PRODUCTS

PLEASE READ THIS NOTICE BEFORE USING OUR PRODUCTS.

Please make sure that your product has been evaluated and confirmed from the aspect of the fitness for the specifications of our product when our product is mounted to your product.

All the items and parameters in this product specification/datasheet/catalog have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment specified in this specification. You are requested not to use our product deviating from the condition and the environment specified in this specification.

Please note that the only warranty that we provide regarding the products is its conformance to the specifications provided herein. Accordingly, we shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this specification.

WE HEREBY DISCLAIMS ALL OTHER WARRANTIES REGARDING THE PRODUCTS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THAT THEY ARE DEFECT-FREE, OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS.

The product shall not be used in any application listed below which requires especially high reliability for the prevention of such defect as may directly cause damage to the third party's life, body or property. You acknowledge and agree that, if you use our products in such applications, we will not be responsible for any failure to meet such requirements. Furthermore, YOU AGREE TO INDEMNIFY AND DEFEND US AND OUR AFFILIATES AGAINST ALL CLAIMS, DAMAGES, COSTS, AND EXPENSES THAT MAY BE INCURRED, INCLUDING WITHOUT LIMITATION, ATTORNEY FEES AND COSTS, DUE TO THE USE OF OUR PRODUCTS IN SUCH APPLICATIONS.

- Aircraft equipment.
- Aerospace equipment
- Undersea equipment.
- Power plant control equipment
- Medical equipment.
- Transportation equipment (vehicles, trains, ships, elevator, etc.).
- Traffic signal equipment.
- Disaster prevention / crime prevention equipment.
- Burning / explosion control equipment
- Application of similar complexity and/ or reliability requirements to the applications listed in the above.

We expressly prohibit you from analyzing, breaking, reverse-engineering, remodeling altering, and reproducing our product. Our product cannot be used for the product which is prohibited from being manufactured, used, and sold by the regulations and laws in the world.

We do not warrant or represent that any license, either express or implied, is granted under any our patent right, copyright, mask work right, or our other intellectual property right relating to any combination, machine, or process in which our products or services are used. Information provided by us regarding third-party products or services does not constitute a license from us to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from us under our patents or other intellectual property.

Please do not use our products, our technical information and other data provided by us for the purpose of developing of mass-destruction weapons and the purpose of military use.

Moreover, you must comply with "foreign exchange and foreign trade law", the "U.S. export administration regulations", etc.

Please note that we may discontinue the manufacture of our products, due to reasons such as end of supply of materials and/or components from our suppliers.

By signing on specification sheet or approval sheet, you acknowledge that you are the legal representative for your company and that you understand and accept the validity of the contents herein. When you are not able to return the signed version of specification sheet or approval sheet within 30 days from receiving date of specification sheet or approval sheet, it shall be deemed to be your consent on the content of specification sheet or approval sheet. Customer acknowledges that engineering samples may deviate from specifications and may contain defects due to their development status. We reject any liability or product warranty for engineering samples. In particular we disclaim liability for damages caused by

- the use of the engineering sample other than for evaluation purposes, particularly the installation or integration in the product to be sold by you,
- deviation or lapse in function of engineering sample,
- improper use of engineering samples.

We disclaim any liability for consequential and incidental damages.

If you can't agree the above contents, you should inquire our sales.

## ● Disclaimer

Please read this notice before using the Murata Wireless Modules.

Please note that the only warranty that Murata Manufacturing Co., Ltd. ("MURATA") provides regarding our products including but not limited to hardware, software and other materials provided by MURATA ("PRODUCTS") is its conformance to the specifications provided herein. Accordingly, MURATA shall not be responsible for any defects in the PRODUCTS or equipment incorporating the PRODUCTS, which are caused under the conditions other than those specified in this specification.

MURATA HEREBY DISCLAIMS ALL OTHER WARRANTIES REGARDING THE PRODUCTS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THAT THE PRODUCTS ARE DEFECT-FREE, OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS.

YOU AGREE TO INDEMNIFY AND DEFEND MURATA AND ITS AFFILIATES AGAINST ALL CLAIMS, DAMAGES, COSTS, AND EXPENSES THAT MAY BE INCURRED, INCLUDING WITHOUT LIMITATION, ATTORNEY FEES AND COSTS, DUE TO THE USE OF THE PRODUCTS.

The PRODUCTS is designed and manufactured for general consumer applications, and not for any particular application, so testing and use of the PRODUCTS shall be conducted at your own risk and responsibility. Specifically, please observe the following:

- i) Please conduct validation and verification of the PRODUCTS in actual condition of mounting and operating environment before commercial shipment of the equipment.
- ii) Please pay attention to minimize any mechanical vibration or shock, not to drop the PRODUCTS or a substrate that contains the PRODUCTS during transportation.
- iii) Since the application of static electricity or overvoltage may cause defect in the PRODUCTS or deterioration of its reliability, caution must be taken against exposure to any static electricity generated by electrified items such as work benches, soldering irons, tools, carrying containers, etc.
- iv) Caution shall be taken to avoid overstress to the PRODUCTS during and after the soldering process.
- v) Since the applied soldering method may deteriorate the reliability, thorough evaluation is recommended.
- vi) In case the PRODUCTS is to be used in equipment or electric circuit that requires high safety or reliability function or performances, sufficient reliability evaluation check for safety shall be performed before commercial shipment and moreover, due consideration to install a protective circuit is strongly recommended at customer's design stage. Please provide and appropriate fail-safe function on your product to prevent any damages that may be caused by the abnormal function or the failure of the PRODUCTS.

Notwithstanding the foregoing, the PRODUCTS shall not be used in any application listed below which requires especially high reliability for the prevention of such defect as may directly cause damage to the third party's life, body or property.

- Aircraft equipment.
- Aerospace equipment
- Undersea equipment.
- Power plant control equipment
- Medical equipment.
- Transportation equipment (vehicles, trains, ships, etc.).
- Traffic signal equipment.
- Disaster prevention / crime prevention equipment.
- Data-processing equipment
- Application of similar complexity and/ or reliability requirements to the applications listed in the above.



MURATA's warranty as provided in Clause 1 above that the PRODUCTS comply with descriptions expressly specified in the specifications shall be effective for a period of six (6) months from the date of delivery.

MURATA shall not be liable for any defects that occur in dry packed products that are installed more than six (6) months after shipment.

MURATA's liability under this warranty shall be limited to the PRODUCTS that are returned during the warranty period to the address designated by MURATA and that are determined by MURATA not to conform to such warranty. If MURATA elects to repair or replace the PRODUCTS, MURATA shall have reasonable time to repair the PRODUCTS or provide replacements. Repaired PRODUCTS shall be warranted for the remainder of the original warranty period. Replaced PRODUCTS shall be warranted for a new full warranty period.

For avoidance of doubt, MURATA shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than MURATA including improper installation or testing, or for any PRODUCTS that have been altered or modified in any way by an entity other than MURATA. Moreover, MURATA shall not be liable for any defects that result from your or third party's design, specifications or instructions for the PRODUCTS.

Testing and other quality control techniques are used to the extent MURATA deems necessary. Unless mandated by government requirements, MURATA does not necessarily test all parameters of each of the PRODUCTS.

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Please note that we may discontinue the manufacture of the PRODUCTS, due to reasons such as end of supply of materials and/or components from our suppliers.