LoRa modem Module Data Sheet

Semtech SX1262 Chipset for LoRa

Design Name: Type1SJ
Sample P/N : LBAA0QB1SJ-977SMP
MP P/N : LBAA0QB1SJ-977

This Datasheet is preliminary version, and subject to change without notice

Revision History

Revision Code	Date	Description	Comments
	April 14, 2023	Initial Draft	

TABLE OF CONTENTS

1. Scope

Interfaces	: UART
Main ICs	: STM32L, SX1262
Reference Clocks	: Integrated 32MHz clock (TCXO with frequency error=±3.0 ppm) and 32.768KHz clock (frequency error=±20 ppm)
Supported Frequencies	: EU868MHz, US915MHz, AS923MHz, KR920MHz, AU915MHz, IN865MHz, RU864MHz
Module Size	: 10.0 mm x 8.0 mm x 1.60 (max) mm.
Weight	: 0.28g (Typ.)
Package	: Resin mold
RoHS	: This module is compliant with the RoHS directive
MSL*	: Level 3

*This product is moisture sensitive. Please check the detail in 13.1 Storage Condition section.

2. Part Number

Ordering Part Number	Description
LBAA0QB1SJ-977SMP	Engineering sample
LBAA0QB1SJ-TEMP-EVK	Evaluation board
LBAA0QB1SJ-977	MP P/N

"Type1SJ" is design name of this module. Design name may be used in certification test report.

3. Block Diagram
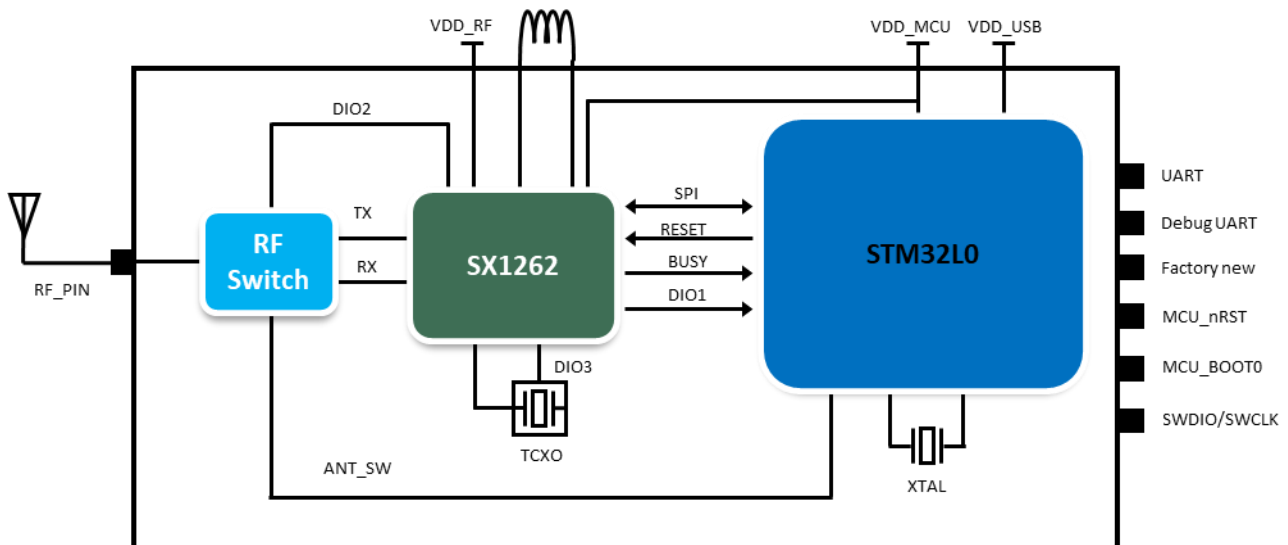
4. Certification info

USA/Canada

FCC ID	VPYLBAA0QB1SJ
IC	772C-LBAA0QB1SJ

Europe
    EN300 220-2 V3.2.1 compliant.

Brazil
    Anatel ID : 14760-20-08488

5. Dimensions, Marking and Terminal Configurations

< TOP VIEW >

B

C

1SJ

SS0123456

D

E

A

< BOTTOM VIEW >

< SIDE VIEW >

T
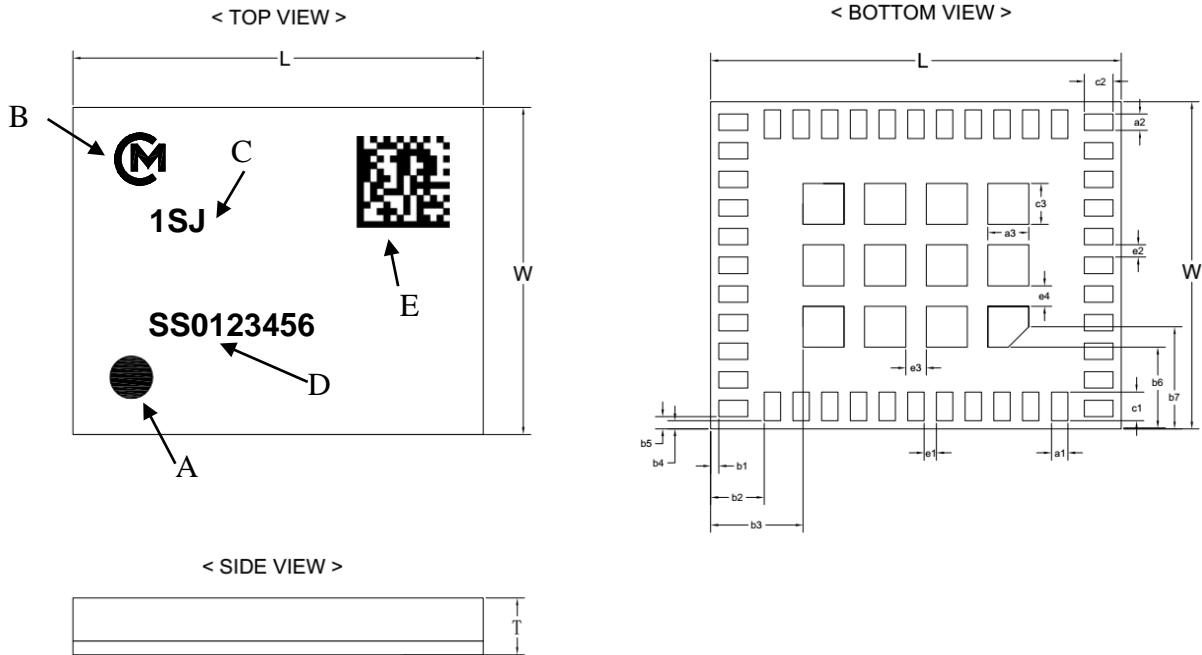
Marking	Meaning
A	Pin 1 Marking
B	Murata Logo
C	Module Type
D	Inspection Number
E	2D code (internal use)

Table 1 Dimension (Unit: mm)

Mark	Dimension	Mark	Dimension	Mark	Dimension
L	10.0±0.2	**W**	8.0±0.2	**T**	1.60 max
a1	0.4±0.1	**a2**	0.4±0.1	**a3**	1.0±0.1
b1	0.2±0.15	**b2**	1.3±0.15	**b3**	2.3±0.15
b4	0.2±0.15	**b5**	0.3±0.15	**b6**	2.0±0.15
b7	2.5±0.15	**c1**	0.7±0.1	**c2**	0.7±0.1
c3	1.0±0.1	**e1**	0.3±0.1	**e2**	0.3±0.1
e3	0.5±0.1	**e4**	0.5±0.1		

Structure

Shield
Resin
Mold

RLC   SP3T   TCXO   SX1262   XTAL   STM32L082

PWB Substrate
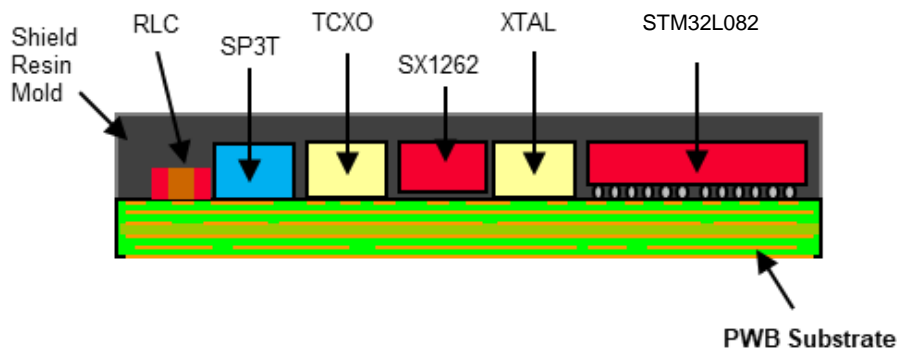
Terminal Configurations

< TOP VIEW >
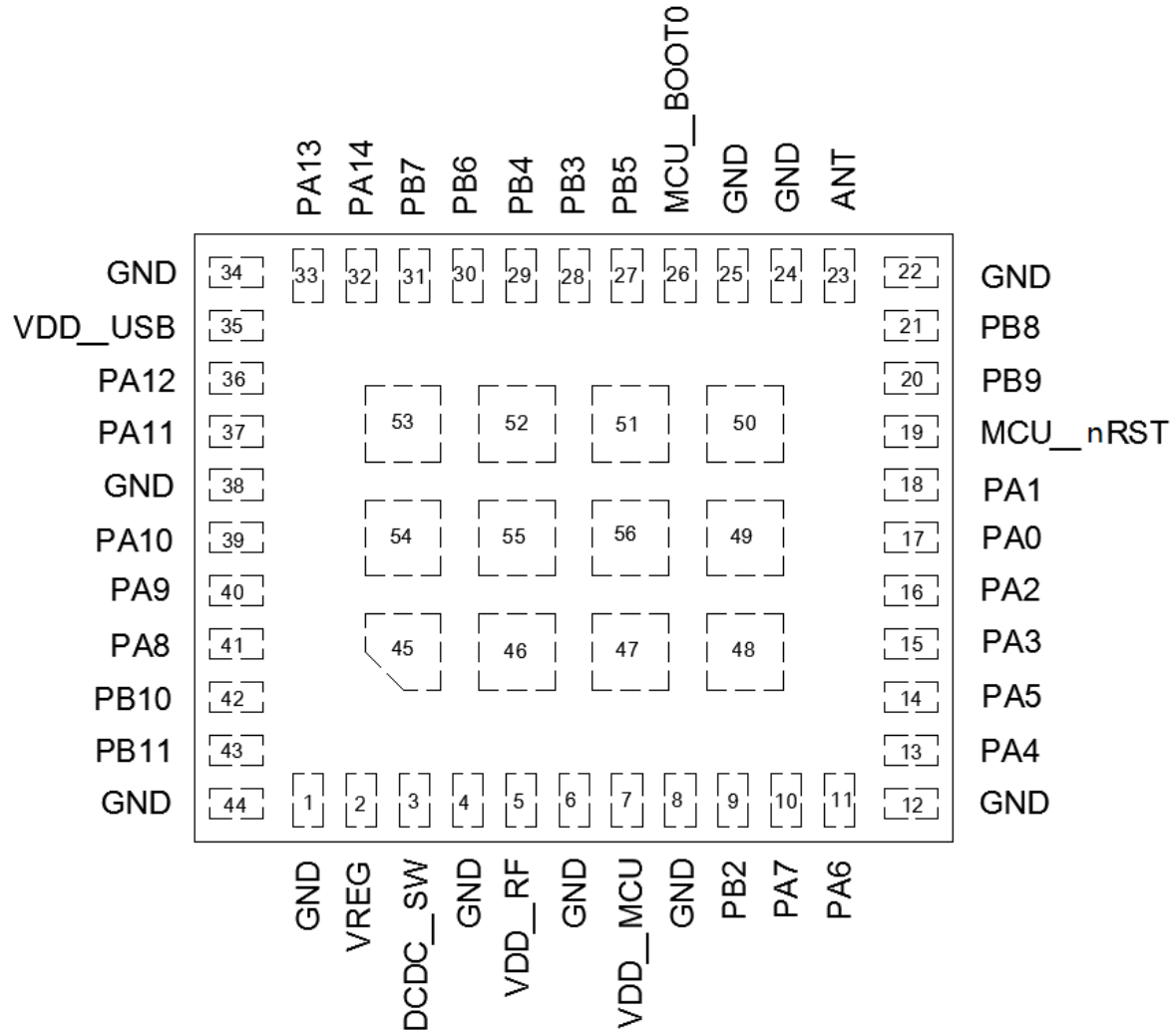
NO.	Terminal Name	NO.	Terminal Name	NO.	Terminal Name	NO.	Terminal Name
1	GND	13	PA4	25	GND	37	PA11
2	VREG	14	PA5	26	MCU_BOOT0	38	GND
3	DCDC_SW	15	PA3	27	PB5	39	PA10
4	GND	16	PA2	28	PB3	40	PA9
5	VDD_RF	17	PA0	29	PB4	41	PA8
6	GND	18	PA1	30	PB6	42	PB10
7	VDD_MCU	19	MCU_nRST	31	PB7	43	PB11
8	GND	20	PB9	32	PA14	44	GND
9	PB2	21	PB8	33	PA13	45~56	GND
10	PA7	22	GND	34	GND		
11	PA6	23	ANT	35	VDD_USB		
12	GND	24	GND	36	PA12		

Table 2 Terminal Configurations

Pin NO.	Terminal Name	Type	Connection to IC terminal	Description
1	GND	Ground	-	Ground
2	VREG	O	SX1262_VREG	Regulated output voltage from internal regulator LDO/DC-DC
3	DCDC_SW	O	SX1262_DCC_SW	DC-DC Switcher Output
4	GND	Ground	-	Ground
5	VDD_RF	Power	SX1262_VBAT / VDD_IN	Power supply for RF IC
6	GND	Ground	-	Ground
7	VDD_MCU	Power	SX1262_VBAT_IO,STM32L082_VDD / VDDA / VREF+	Power supply for MCU and RF IC
8	GND	Ground	-	Ground
9	PB2	I/O	STM32L082_PB2	Unused
10	PA7	I/O	STM32L082_PA7	Factory new
11	PA6	I/O	STM32L082_PA6	Unused
12	GND	Ground	-	Ground
13	PA4	I/O	STM32L082_PA4	Unused
14	PA5	I/O	STM32L082_PA5	Unused
15	PA3	I/O	STM32L082_PA3	Debug_USART_RX
16	PA2	I/O	STM32L082_PA2	Debug_USART_TX
17	PA0	I/O	STM32L082_PA0	Unused
18	PA1	I/O	STM32L082_PA1	Unused
19	MCU_nRST	I	STM32L082_nRST	Reset for MCU
20	PB9	I/O	STM32L082_PB9	Unused
21	PB8	I/O	STM32L082_PB8	Unused
22	GND	Ground	-	Ground
23	ANT	A, I/O	-	Transmit / Receive antenna
24	GND	Ground	-	Ground
25	GND	Ground	-	Ground
26	MCU_BOOT0	I	STM32L082_BOOT0	BOOT0 for MCU
27	PB5	I/O	STM32L082_PB5	Unused
28	PB3	I/O	STM32L082_PB3	Unused
29	PB4	I/O	STM32L082_PB4	Unused
30	PB6	I/O	STM32L082_PB6	Unused
31	PB7	I/O	STM32L082_PB7	Unused
32	PA14	I/O	STM32L082_PA14	SWCLK
33	PA13	I/O	STM32L082_PA13	SWDIO
34	GND	Ground	-	Ground
35	VDD_USB	Power	STM32L082_VDD_USB	Power supply for MCU
36	PA12	I/O	STM32L082_PA12	Unused
37	PA11	I/O	STM32L082_PA11	Unused

38	GND	Ground	-	Ground
39	PA10	I/O	STM32L082_PA10	Command_USART_RX
40	PA9	I/O	STM32L082_PA9	Command_USART_TX
41	PA8	I/O	STM32L082_PA8	Unused
42	PB10	I/O	STM32L082_PB10	Unused
43	PB11	I/O	STM32L082_PB11	Unused
44	GND	Ground	-	Ground
45~56	GND	Ground	-	Ground

Notes: GPIO pins are to be left OPEN if not used.

6. Absolute Maximum Ratings

Table 3 Maximum ratings

Parameters		Min	Typ	Max	Unit
Storage Temperature		-40	25	+85	degC
Input RF Level		-	-	10	dBm
Supply Voltage	VDD_RF, VDD_MCU, VDD_USB	-0.3	-	3.9	V

7. Operating Condition

Table 4 Operating specification

Parameters		Min	Typ	Max	Unit
Operating Temperature		-40	25	+85	degC
Supply Voltage	VDD_RF, VDD_MCU	2.0	-	3.6	V
	VDD_USB (USB peripheral used) [1]	3.0	-	3.6	V
	VDD_USB (USB peripheral not used) [1]	VDD_MCU_min	VDD_MCU	VDD_MCU_max	V

(1) VDD_USB must respect the following conditions:
  - When VDD_MCU is powered on (VDD_MCU < VDD_MCU_min), VDD_USB should be always lower than VDD_MCU.
  - When VDD_MCU is powered down (VDD_MCU < VDD_MCU_min), VDD_USB should be always lower than
   VDD_MCU.
  - In operating mode, VDD_USB could be lower or higher than VDD_MCU.
  - If the USB is not used, VDD_USB must be tied to VDD_MCU to be able to use PA11 and PA12 as standard I/O.

8. Electrical Characteristics
8.1. FSK Transceiver Specification

Conditions:

Supply voltage =3.3 V, Temperature = 25 °C, TCXO = 32 MHz, F_{RF} =868/915 MHz, all RF impedances matched, transmit mode output power defined in 50 Ohm load, FSK BER = 0.1%, 2-level FSK modulation without pre-filtering, BR = 4.8 kb/s, FDA = 5 kHz, BW_F = 20 kHz double-sided, unless otherwise specified.

FSK Receive Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
RXS_2FB	Sensitivity 2-FSK, RX Boosted, Split RF path for RX and TX	BR_F = 4.8 kb/s, FDA = 5 kHz, BW_F = 20 kHz		-117		dBm

FSK Transmit Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
TXOP	Power setting = 22 dBm	868MHZ Band		21.5		dBm
		915MHZ Band		20.8		dBm
IDDTX	Power setting = 22 dBm	868MHZ Band		124		mA
		915MHZ Band		112		mA

8.2. LoRa Transceiver Specification

Conditions:

The table below gives the electrical specifications for the transceiver operating with LoRaTM modulation.

Following conditions apply unless otherwise specified: Supply voltage = 3.3 V, Temperature = 25 °C, TCXO = 32 MHz, F_{RF} =868/915 MHz, all RF impedances matched, transmit mode output power defined in 50 Ohm load, Error Correction Code (EC) = 4/5, Packet Error Rate (PER)= 1%, CRC on payload enabled, Payload length = 10 bytes.

LoRa Receive Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
IDDRX	Receive mode, DC-DC mode used, RX Boosted,	868MHZ Band		15.5[1]		mA
		915MHz Band		15.5[1]		mA
IDDRX	Receive mode, LDO mode used, RX Boosted	868MHZ Band		20.0[1]		mA
		915MHz Band		20.0[1]		mA
RXS_LB (125KHz)	Sensitivity Lora, RX Boosted, Split RF path for RX and TX. 125KHz bandwidth	SF = 7		-124		dBm
		SF = 12		-137		dBm
RXS_LB (250KHz)	Sensitivity Lora, RX Boosted, Split RF path for RX and TX. 250KHz bandwidth	SF = 7		-121		dBm
		SF = 12		-134		dBm

(1) IDDRX is tested under test FW, and MCU is not in sleep mode.

LoRa Transmit Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
TXOP	TXOP setting = 22 dBm	868MHZ Band		21.5		dBm
		915MHZ Band		20.8		dBm
IDDTX	TXOP setting = 22 dBm	868MHZ Band		124		mA
		915MHZ Band		112		mA

8.3. Low power mode current

Conditions: Power supply=3.3 V, Temperature=25 °C;

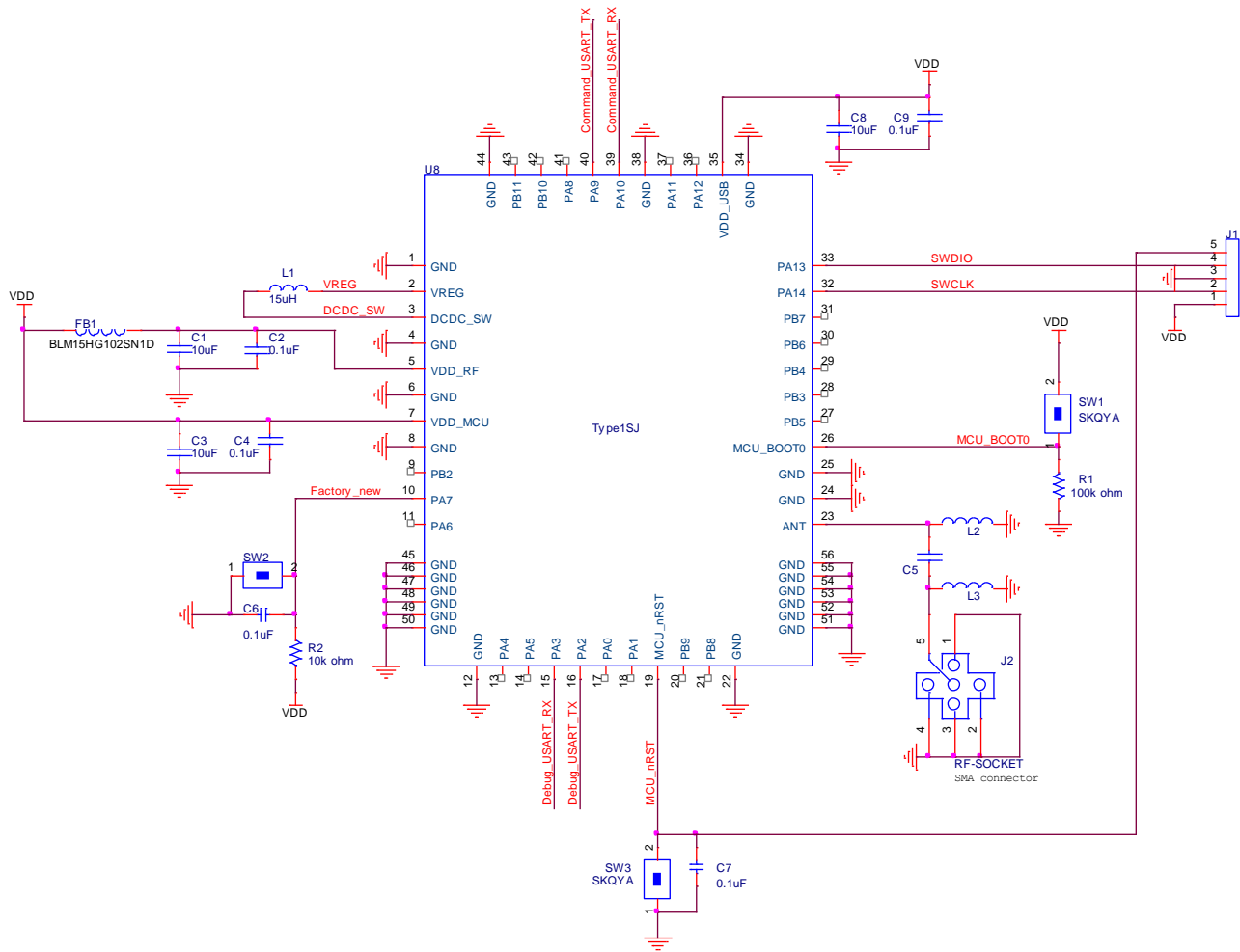| Description	Min	Typ	Max	Unit
STM32L082 in stop mode with RTC (Real Time Clock) SX1262 in cold start sleep mode[1]		1.3		uA
STM32L082 in stop mode with RTC (Real Time Clock) SX1262 in warm start sleep mode without RC64K(64kHz RC oscillator)[2]		2.0		uA
STM32L082 in stop mode with RTC (Real Time Clock) SX1262 in warm start sleep mode with RC64K(64kHz RC oscillator)[2]		2.5		uA

1. Cold start is equivalent to device at POR or when the device is waking up from sleep mode with all blocks OFF.
2. Warm start is only happening when device is waking up from sleep mode with its configuration retained.

9. Power Sequences

9.1. Power Up Sequence

10. Recommend Land Pattern

< TOP VIEW >

Notes：

1. Dimension unit is millimeter (Angle unit is degree).
2. This land pattern is for reference only.
     Consult your manufacturing group to ensure your company's manufacturing guidelines are met.
3. Thermal vias in the land pattern of the exposed pad shall be connected to a system ground
     plane. Failure to do so may compromise the thermal and/or functional performance of the
     device.
4. Square package-dimension apply in both "X" and "Y" directions.

11. Reference Circuit

12. Tape and Reel Packing

12.1. Dimension of Tape

feeding direction

(unit: mm)

12.2. Dimensions of Reel

Reel inside width W1: 25.5±1.0
Reel outside width W2: 29.5±1.0
Unit: mm

Preliminary & Confidential
< Specification may be changed by Murata without notice >
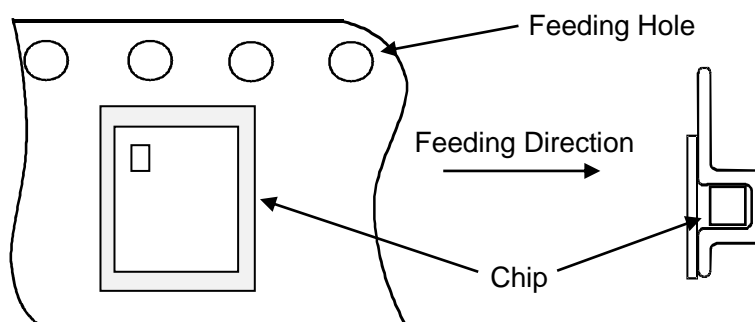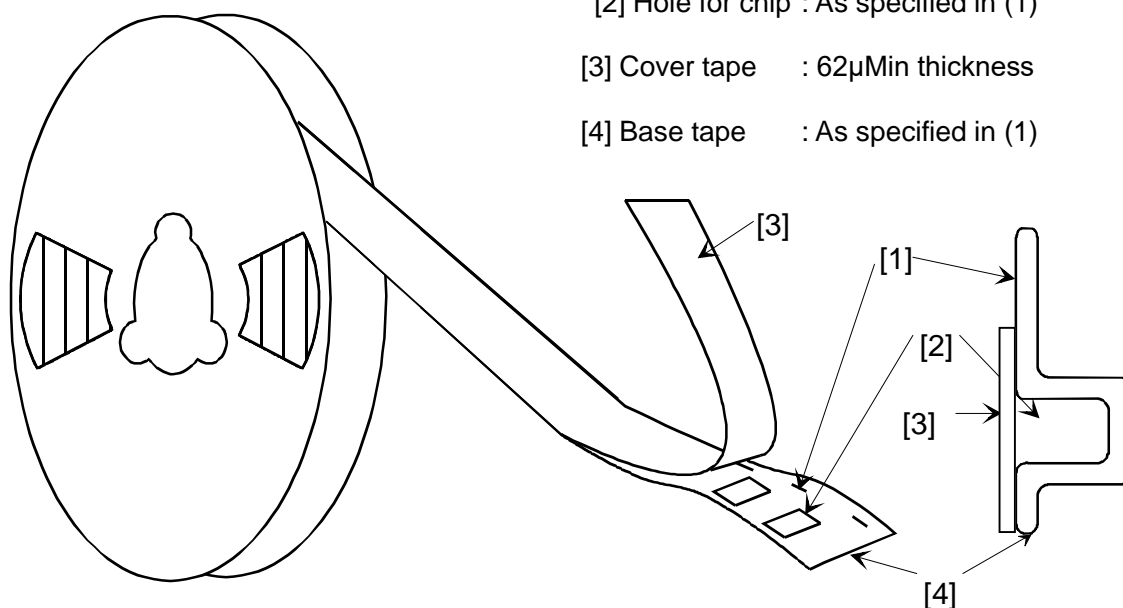Murata (China) Investment Co., Ltd.

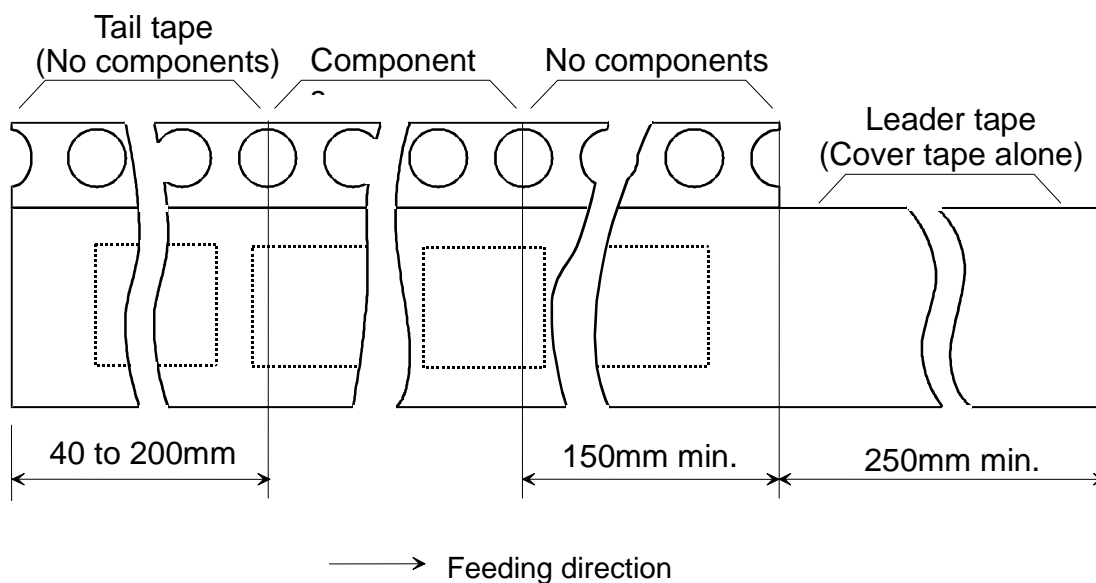## 12.3. Taping Diagrams

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

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

[3] Cover tape : 62μMin thickness

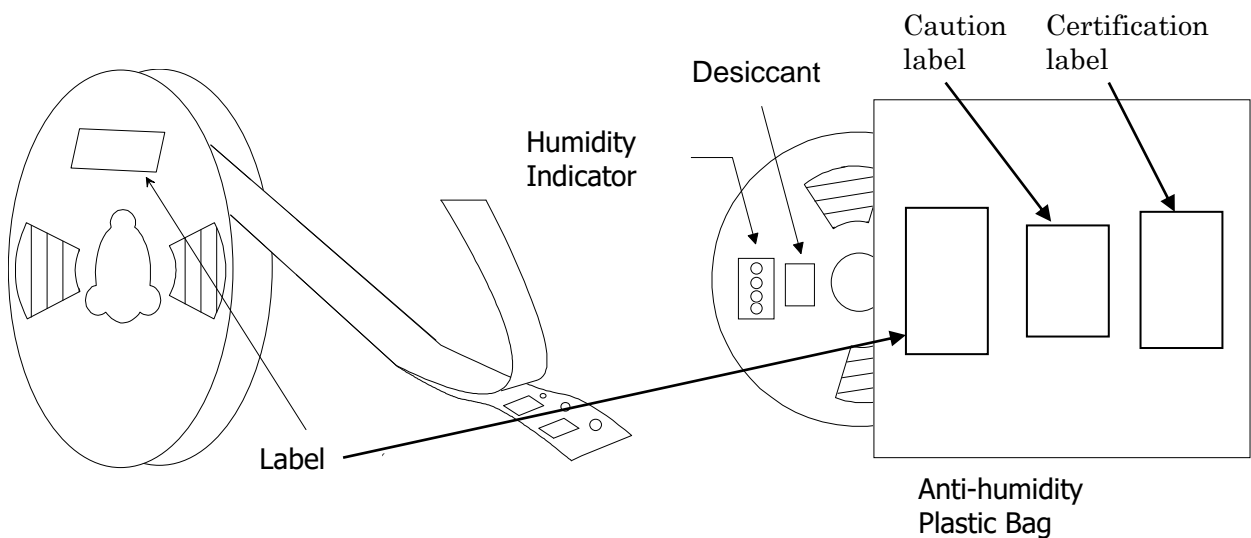[4] Base tape : As specified in (1)

[3]

[1]

[2]

[3]

[4]

Feeding Hole

Feeding Direction

Chip

12.4. Leader and Tail Tape

Tail tape
(No components)

Component

No components

Leader tape
(Cover tape alone)

40 to 200mm

150mm min.

250mm min.

Feeding direction

- The tape for chips are wound clockwise, the feeding holes to the right side as the tape is pulled toward the user.
- The cover tape and base tape are not adhered at no components area for 250mm Min.
- Tear off strength against pulling of cover tape: 5N Min.
- Packaging unit : 1000 pcs/ reel
- Material
  - ➢ Base tape : Plastic
  - ➢ Reel   : Plastic
  - ➢ Cover tape, cavity tape and reel are made the anti-static processing.
- Peeling of force: 1.3N max. in the direction of peeling as shown below.

1.3 N max.

165 to 180 °

Cover tape

Base tape
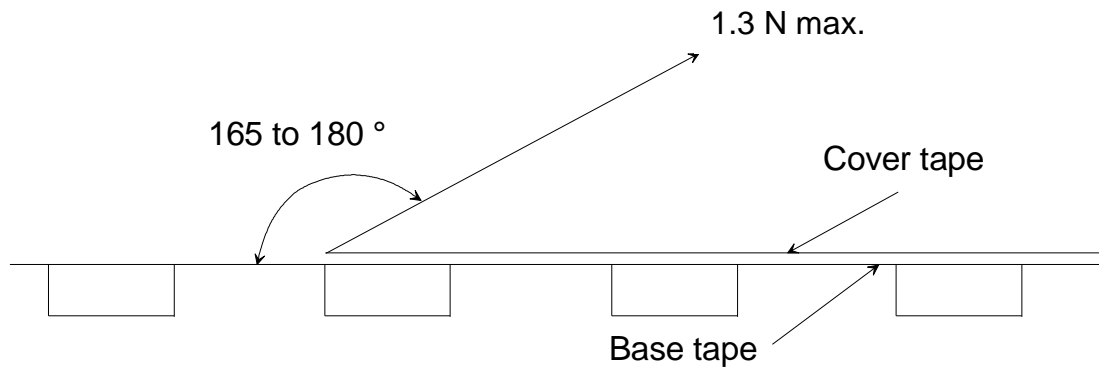
- Packaging (Humidity proof Packing)

Desiccant

Caution label

Certification label

Humidity Indicator

Label

Anti-humidity Plastic Bag

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

13. Notice

13.1. 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 35 °C and humidity from 20 ~ 70 %RH.
(Packing materials, in particular, may be deformed at the temperature over 40 °C)
- The product left more than 6months after reception, it needs to be confirmed the solder ability before used.
- The product shall be stored in non-corrosive gas (CL2, NH3, SO2, NOx, 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 IPC/JEDEC J-STD-020)
- After the packing opened, the product shall be stored at <30 °C / <60 %RH and the product shall be used within 168 hours.
Please record and manage the time after opening.
- Product should be repacked with desiccating agent immediately after using.
- When the color of the indicator in the packing changed, the product shall be baked before soldering.
Baking condition: 125 +5/-0 °C, 24 hours, 1 time
The products shall be baked on the heat-resistant tray because the material (Base Tape, Reel Tape and Cover Tape) are not heat-resistant.

*For the MSL standard, see IPC/JEDEC J-STD-020 (can be downloaded from www.jedec.org).
If the storage environment is not conducted above standard conditions, it will cause some issue (e.g., Operation issue, Overcurrent, Malfunction) we shall not be responsible for that.
Before using please refer to "PRECONDITIONS TO USE MURATA PRODUCTS"

13.2. 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 bare hands that may result in poor solder ability and destroy by static electrical charge.

13.3. 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.

13.4. 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.

13.5. Soldering Conditions :
The recommendation conditions of soldering are as in the following figure.
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.

Reflow soldering standard conditions (Example)
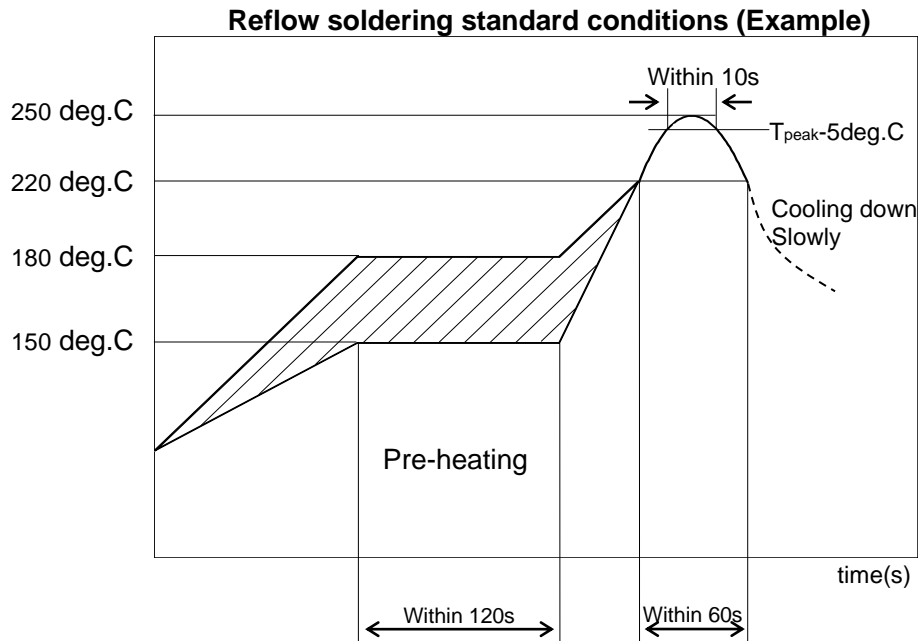
Please use the reflow within 2 times.
Use rosin Type flux or weakly active flux with a chlorine content of 0.2 wt % or less.

13.6. Cleaning :
Since this Product is Moisture Sensitive, any cleaning is not recommended. If any cleaning process is done the customer is responsible for any issues or failures caused by the cleaning process.

13.7. 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 (CL2, NH3, SOx, NOx, 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.

13.8. Input Power Capacity :
Products shall be used in the input power capacity as specified in this specification.
Inform Murata beforehand, in case that the components are used beyond such input power capacity range.

14. Regulatory Statements

14.1. FCC Statements

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.

Cet appareil est conforme à la section 15 des réglementations de la FCC. Le fonctionnement de l'appareil est sujetaux deux conditions suivantes :
(1) cet appareil ne doit pas provoquer d'interférences néfastes, et
(2) cet appareil doit tolérer les interférences reçues, y compris celles qui risquent de provoquer un fonctionnement indésirable.

Note: This product has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This product generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this product does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

Please take attention that changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment should be installed and operated with a minimum distance 20cm between the radiator and your body

Cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre le radiateur et votre corps

When the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can be use wording "Contains transmitter module FCC ID: VPYLBAA0QB1SJ" or "Contains FCC ID: VPYLBAA0QB1SJ".

14.2. IC Statements

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device.
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radioexempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

When the Industry Canada certification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can be use wording "Contains transmitter module IC: 772C-LBAA0QB1SJ"or "Contains IC: 772C-LBAA0QB1SJ".

14.3. General Statements

The module is limited to OEM installation ONLY.

The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.

Therefore, the final host product must be submitted to Murata for confirmation that the installation for the module into the host is in compliance with regulations of FCC and IC Canada. Specially, if an antenna other than the model documented in the Filing is used, a Class 2 Permissive Change must be filed with the FCC.
Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

The LoRa module is for use with external antenna ONLY.

The certified antennas include:
(1) Monopole Antenna (LPRS: ANT-SS900) with peak gain 1.04dBi.
(2) PCB pattern Antenna with peak gain 1.0dBi.
(3) Flexible Antenna (Molex: 2111400100) with peak gain 1.0dBi.

This module has been approved by FCC to operate with the antenna types with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

14.4. ANATEL Statements

14760-20-08488

Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados.

15. 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.

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