LoRa Module Data Sheet

MP Part Number: **CMWX1ZZABZ-078**

For LoRa™

Revision History

Revision Code	Date	Description	Comments
A	June 8, 2016	Initial Draft	
B	July 1, 2016	Updated height and package info	
C	July 30, 2016	Revised some formats and ΔRF_OPH_V test condition from 2.4-3.7V to 2.2-3.6V. Updated some electronic Characteristics. Added the recommended land pattern.	
D	Aug 29, 2016	Updated the RF performance, Electrical Characteristics and power up sequence.	
E	Sep 28, 2016	Amended the pin description of PA0/WKUP1	
F	Oct 12, 2016	Amended the pin description of PA3 and PA2 Added label information	
G	Oct 13, 2016	Amended the pin description of MCU_nRST and BOOT0.	
H	Nov 7, 2016	Added Sample Part Number and MP Part Number	
I	Dec 1, 2016	Added weight info	
J	Dec 12, 2016	Added Sleep current info	
K	Feb 14, 2017	Added FCC and IC statements	

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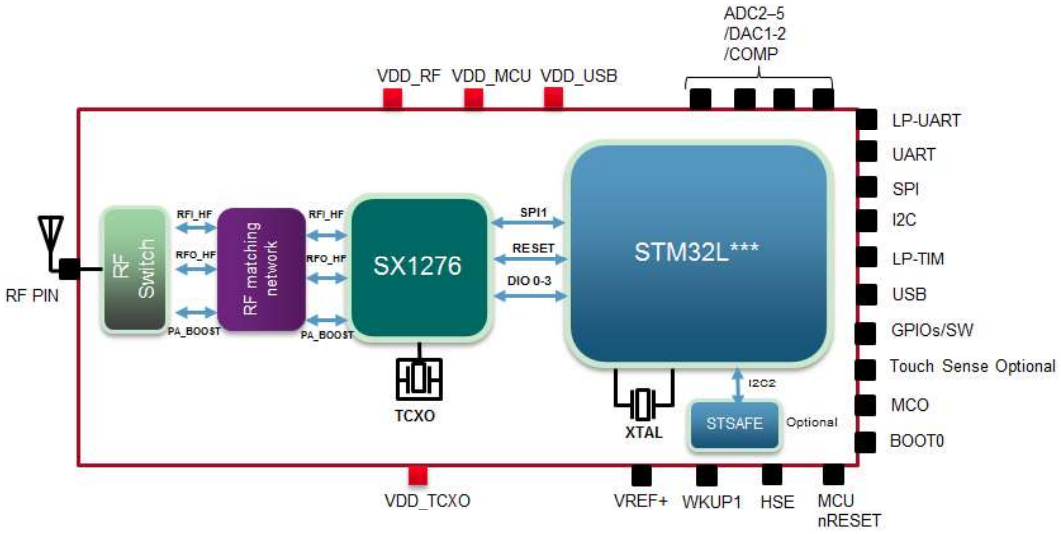
1. Features

Interfaces	: I2C, UART, USB, SPI
Main ICs	: STM32L, SX1276
Reference Clocks	: Integrated 32MHz clock (TCXO with frequency error=±2 ppm) and 32.768KHz clock (frequency error=±20 ppm)
Supported Frequencies	: 868 MHz, 915 MHz
Module Size	: 12.5 mm x 11.6 mm x 1.76 mm (Max)
Weight	: 0.48g (Typ)
Package	: Metal Shield can
RoHS	: This module is compliant with the RoHS directive

2. Part Number

Ordering Part Number	Description
B-L072Z-LRWAN1	Evaluation board (owned by ST)
CMWX1ZZABZ-**078**	P/N

3. Block Diagram

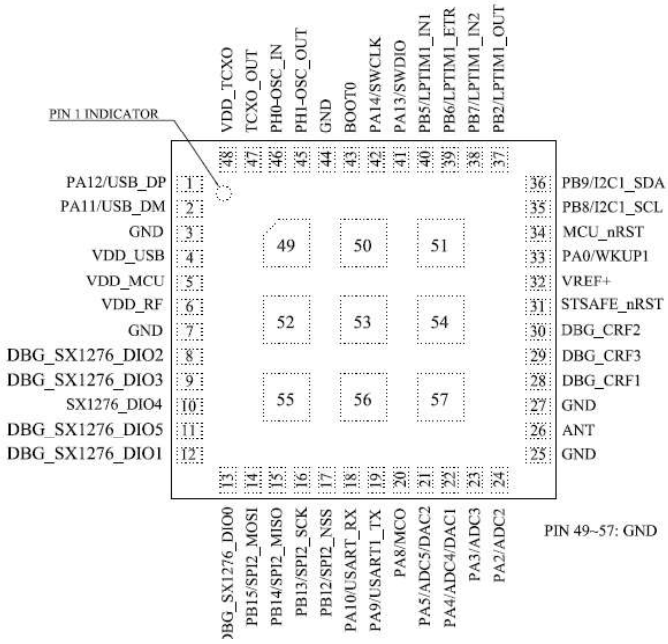


4. Dimensions, Marking and Terminal Configurations

Full datasheet with Terminal dimensions is available in my Murata. Check https://my.murata.com under the “LoRa/Sigfox Module, Type ABZ LoRa Support Site”.

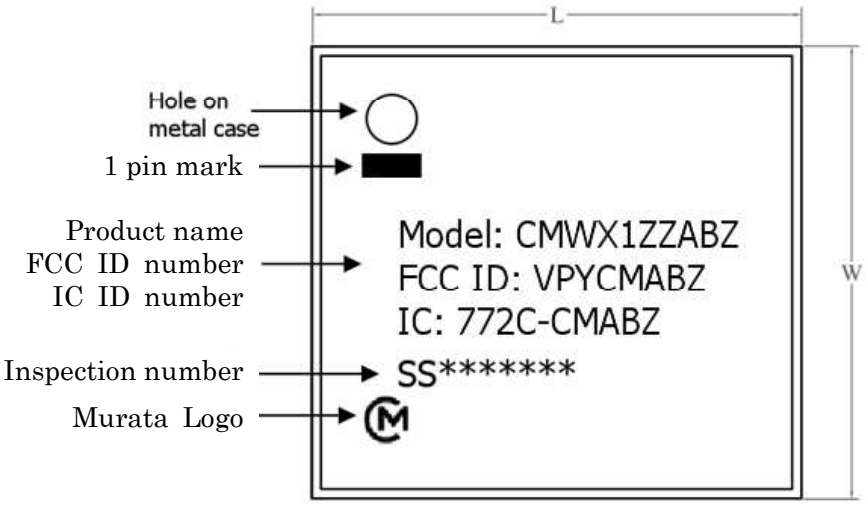
Terminal Configurations

< Top View >



16	PB13/SPI2_SCK	I/O	STM32L082_PB13	GPIO Mode:PB13 SPI2_SCK
17	PB12/SPI2_NSS	I/O	STM32L082_PB12	GPIO Mode:PB12 SPI2_NSS
18	PA10/USART1_RX	I/O	STM32L082_PA10	GPIO Mode:PA10 USART1_RX
19	PA9/USART1_TX	I/O	STM32L082_PA9	GPIO Mode:PA9 USART1_TX
20	PA8/MCO	I/O	STM32L082_PA8	GPIO Mode:PA8 MCO
21	PA5/ADC5/DAC2	I/O	STM32L082_PA5	GPIO Mode:PA5 COMP2_INM ADC_IN5 DAC_OUT2 Possible to connect to Pin10 for future usage. Contact ST for more information
22	PA4/ADC4/DAC1	I/O	STM32L082_PA4	GPIO Mode:PA4 COMP2_INM ADC_IN4 DAC_OUT1 Possible to connect to Pin11 for future usage. Contact ST for more information
23	PA3/ADC3	I/O	STM32L082_PA3	GPIO Mode:PA3 COMP2_ INP ADC_IN3 USART2_RX
24	PA2/ADC2	I/O	STM32L082_PA2	GPIO Mode:PA2 COMP2_OUT ADC_IN2 USART2_TX
25	GND	Ground	-	Ground
26	ANT	A,I/O	-	Transmit / Receive Antenna
27	GND	Ground	-	Ground
28	DBG_CRF1	I/O	STM32L082_PA1	Debug pin. Cannot be used as GPIO
29	DBG_CRF3	I/O	STM32L082_PC1	Debug pin. Cannot be used as GPIO
30	DBG_CRF2	I/O	STM32L082_PC2	Debug pin. Cannot be used as GPIO
31	STSAFE_nRST	I	-	Reset for Security IC
32	VREF+	Power	-	Reference Voltage For ADC and DAC
33	PA0/WKUP1	I/O	STM32L082_PA0	GPIO Mode:PA0 COMP1_OUT ADC_IN0
34	MCU_nRST	I	STM32L082_ nRST	NRST
35	PB8/I2C1_SCL	I/O	STM32L082_ PB8	GPIO Mode:PB8 I2C mode: SCL
36	PB9/I2C1_SDA	I/O	STM32L082_ PB9	GPIO Mode: PB9 I2C mode: SDA
37	PB2/LPTIM1_OUT	I/O	STM32L082_PB2	GPIO Mode:PB2 LPTIM1_OUT
38	PB7/LPTIM1_IN2	I/O	STM32L082_PB7	GPIO Mode:PB7

5. Label Information



6. Absolute Maximum Ratings

Table 3 Maximum ratings

Parameters		Min	Typ	Max	Unit
Storage Temperature		-40	25	+90	degC
Input RF Level		-	-	10	dBm
Supply Voltage	VDD_USB	-0.3	-	3.9	V
	VDD_MCU, VDD_RF, VDD_TCXO	-0.3	-	3.9	V
	VREF+	-0.3	-	V_{DD_MCU}+0.4	V

7. Operating Condition

Table 4 Operating specification

Parameters		Min	Typ	Max	Unit
Operating Temperature		-40	25	+85	degC
Supply Voltage	VDD_USB (USB peripheral used) (1)	3.0	-	3.6	V
	VDD_USB(USB peripheral not used) (1)	$V_{DD\_MCU\_min}$	V_{DD_MCU}	$V_{DD\_MCU\_max}$	V
	VDD_MCU,VDD_RF,VDD_TCXO	2.2(3)	-	3.6	V
	VREF+(2)	1.8	-	V_{DD_MCU}	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/Os.

(2) VREF+ is used to ensure a better accuracy on low-voltage inputs and outputs of ADC and DAC. Detailed information is on the STM32L082*** datasheet and user guider.

(3) When module is on +20dBm operation, the supply of the voltage should be set from 2.4V to 3.6V.

8. Electrical Characteristics

8.1 FSK/OOK Transceiver Specification

Conditions:

Supply voltage VDD=3.3 V, temperature = 25 °C, FXOSC = 32 MHz, FRF =868/915 MHz , 2-level FSK modulation without pre-filtering, FDA = 5 kHz, Bit Rate = 4.8 kb/s and terminated in a matched 50 Ohm impedance, shared Rx and Tx path matching, unless otherwise specified.

FSK/OOK Receiver Specification

Symbol	Description	Conditions	Min.	Typ	Max	Unit
RFS_F_HF	LnaBoost is turned on	FDA = 5 kHz, BR = 4.8 kb/s		-117.5		dBm
IDDR	Supply current in Receive mode	LnaBoost Off, band 1		22		mA
		LnaBoost On, band 1		23		mA

FSK/OOK Transmitter Specification

Symbol	Description	Conditions		Min.	Typ	Max	Unit
RF_OP	RF output power in 50 ohms on RFO pin (High efficiency PA)	Programmable with steps	Max		14		dBm
			Min		-5		dBm
RF_OPH	RF output power in 50 ohms on PA_BOOST pin(Regulated PA)	Programmable with 1dB steps	Max		18.5		dBm
			Min		2		dBm
ΔRF_ OPH_V	RF output power stability on PA_BOOST pin versus voltage supply.	VDD = 2.2 V to 3.6 V			+/-1		dB
ΔRF_T	RF output power stability versus temperature on PA_BOOST pin.	From T = -40 °C to +85 °C			+/-1.5		dB
IDDT	Supply current in Transmit	RFOP = +20 dBm, on			128		mA

	mode with impedance matching	PA_BOOST				
		RFOP = +17 dBm, on PA_BOOST		106		mA
		RFOP = +14 dBm, on RFO_HF pin		47		mA
		RFOP = + 7 dBm, on RFO_HF pin		34		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, FXOSC = 32 MHz, Error Correction Code (EC) = 4/5, Packet Error Rate (PER)= 1%, CRC on payload enabled, Payload length = 10 bytes. With matched impedances

LoRa Receiver Specification

Symbol	Description	Conditions	Min.	Typ	Max	Unit
IDDR_L	Supply current in receiver LoRa mode, LnaBoost off	Band 1, BW = 125 kHz		21.5		mA
		Band 1, BW = 250 kHz		22.2		mA
		Band 1, BW = 500 kHz		23.6		mA
RFS_L125_HF	RF sensitivity, Long-Range Mode, highest LNA gain, LnaBoost for Band1, using split Rx/Tx path 125 kHz bandwidth	SF = 6		-117.5		dBm
		SF = 7		-122.5		dBm
		SF = 8		-125.5		dBm
		SF = 9		-128.5		dBm
		SF = 10		-131.0		dBm
		SF = 11		-133.5		dBm
		SF = 12		-135.5		dBm
RFS_L250_HF	RF sensitivity, Long-Range Mode, highest LNA gain, LnaBoost for Band1, using split Rx/Tx path 250 kHz bandwidth	SF = 6		-114.0		dBm
		SF = 7		-119.0		dBm
		SF = 8		-122.0		dBm
		SF = 9		-125.0		dBm
		SF = 10		-127.5		dBm
		SF = 11		-130.0		dBm
		SF = 12		-133.0		dBm

LoRa Transmitter Specification

Symbol	Description	Conditions	Min.	Typ	Max	Unit
IDDT_L	Supply current in transmitter mode	RFOP setting = 14 dBm		47		mA
		RFOP setting = 10 dBm		36		mA
IDDT_H_L	Supply current in transmitter mode	Using PA_BOOST pin RFOP setting = 20 dBm		128		mA

8.3 Low power mode current

Conditions:

Power supply: 3.3V, Temp: Room, TCXO_VDD (pin 48 of the module) is connected to PA12 (Pin1 of the module)

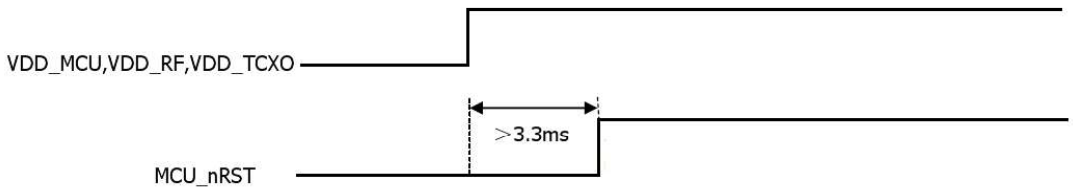
Mode	Description	Min.	Typ	Max	Unit
Mode0	STM32L0 in Stop mode with RTC (Real Time Clock) (*1) SX1276 in Sleep mode		1.65		uA
Mode1	STM32L0 in Standby mode with RTC (Real Time Clock) (*2) SX1276 in Sleep mode		1.40		uA

(*1) The Stop mode achieves the lowest power consumption while retaining the RAM and register contents and real time clock. All clocks in the V_{CORE} domain are stopped, the PLL, MSI RC, HSE crystal and HSI RC oscillators are disabled. The LSE or LSI is still running. The voltage regulator is in the low-power mode.
Some peripherals featuring wakeup capability can enable the HSI RC during Stop mode to detect their wakeup condition. The device can be woken up from Stop mode by any of the EXTI line, in 3.5us, the processor can serve the interrupt or resume the code. The EXTI line source can be any GPIO. It can be the PVD output, the comparator 1 event or comparator 2 event (if internal reference voltage is on), it can be the RTC alarm/tamper/timestamp/wakeup events, the USB/USART/I2C/LPUART/LPTIMER wakeup events.

(*2) The Standby mode is used to achieve the lowest power consumption and real time clock. The internal voltage regulator is switched off so that the entire VCORE domain is powered off. The PLL, MSI RC, HSE crystal and HSI RC oscillators are also switched off. The LSE or LSI is still running. After entering Standby mode, the RAM and register contents are lost except for registers in the Standby circuitry (wakeup logic, IWDG, RC, LSI, LSE Crystal 32 KHz oscillator, RCC_CSR register). The device exits Standby mode in 60 µs when an external reset (NRST pin), an IWDG reset, a rising edge on one of the three WKUP pins, RTC alarm (Alarm A or Alarm B), RTC tamper event, RTC timestamp event or RTC Wakeup event occurs.

9. Power Sequences

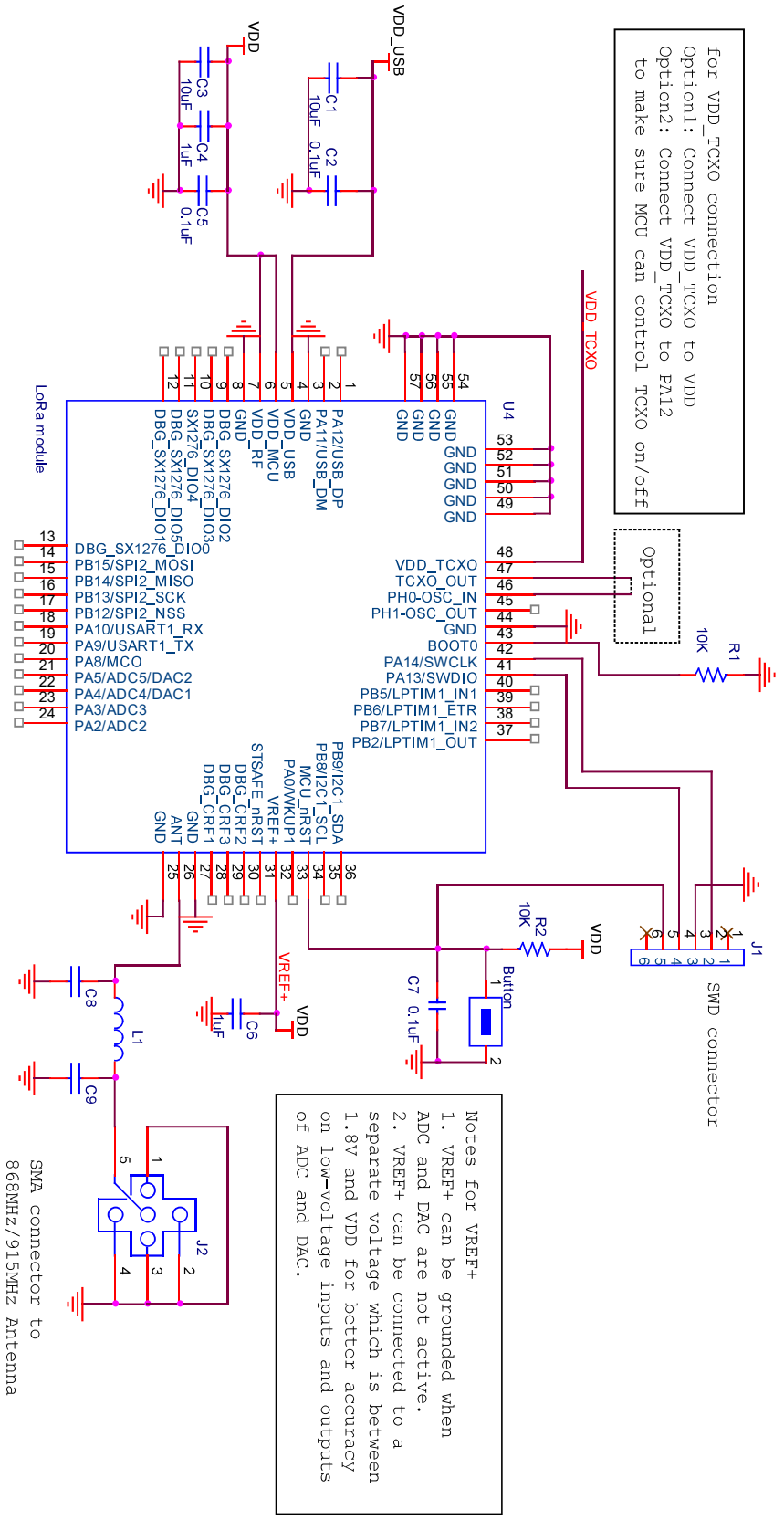
9.1 Power Up Sequence



10. Recommend Land Pattern

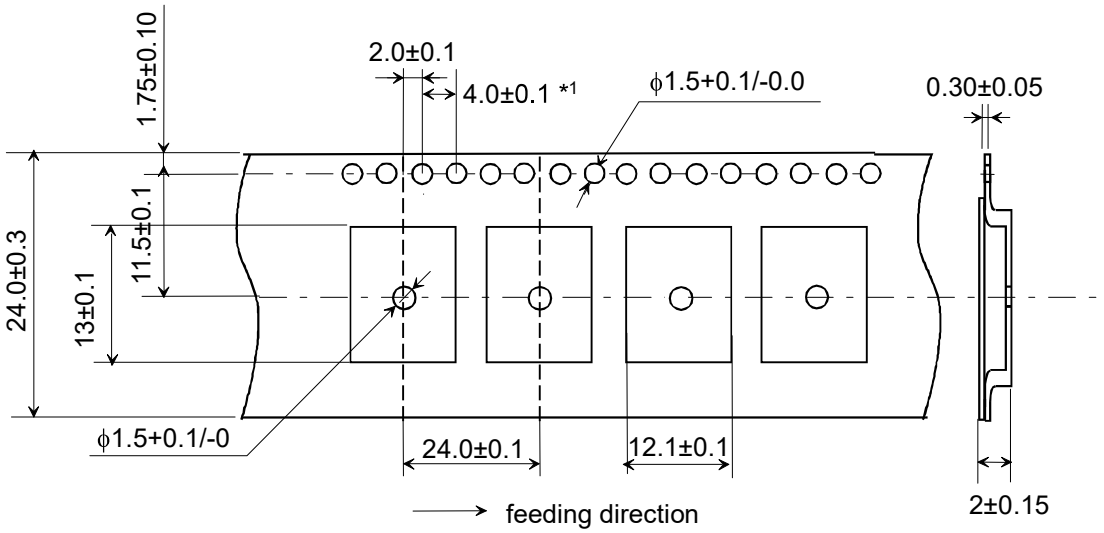
Full datasheet with recommended land pattern is available in my Murata. Check https://my.murata.com under the "LoRa/Sigfox Module, Type ABZ LoRa Support Site".

11. Reference circuit



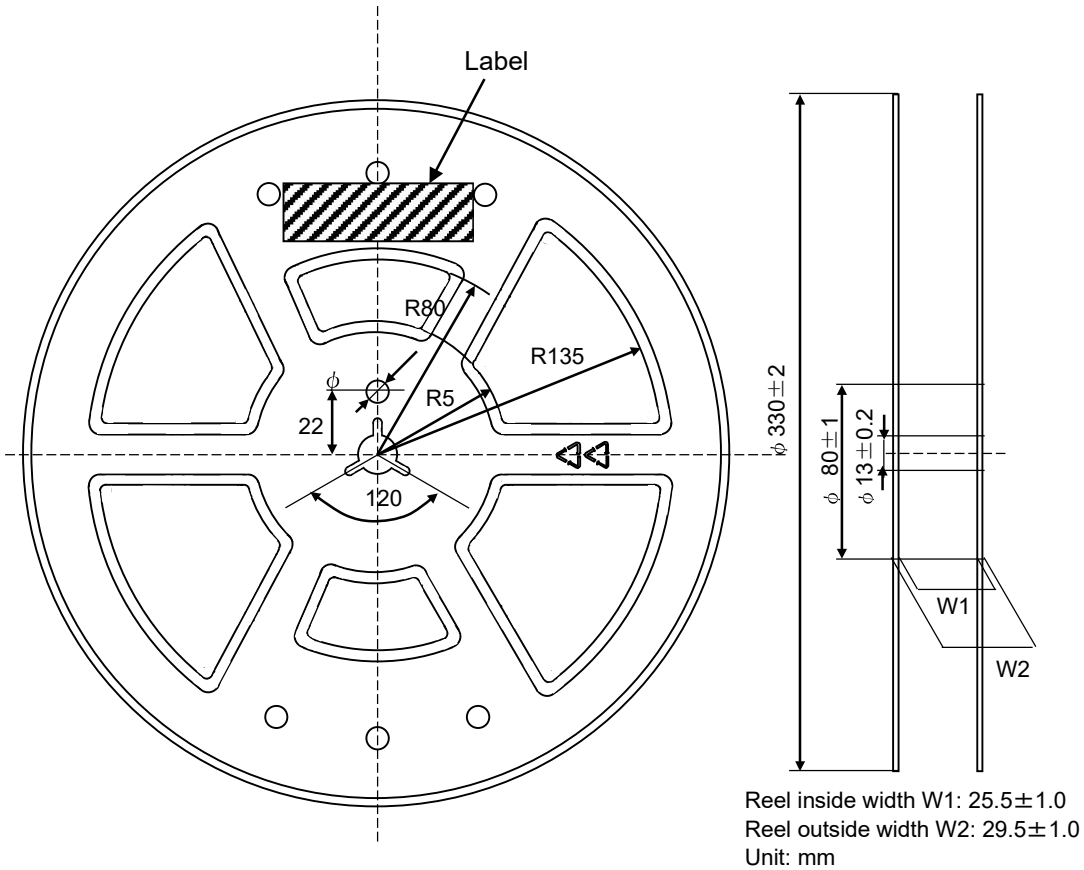
12. Tape and Reel packing

12.1 Dimension of Tape (Plastic tape)



(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

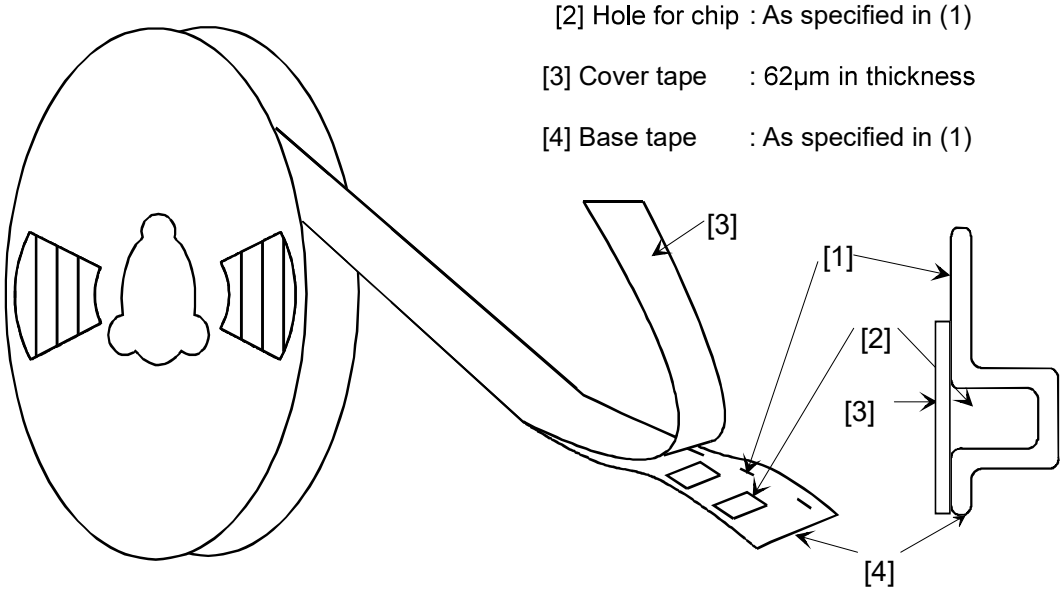
12.3 Taping Diagrams

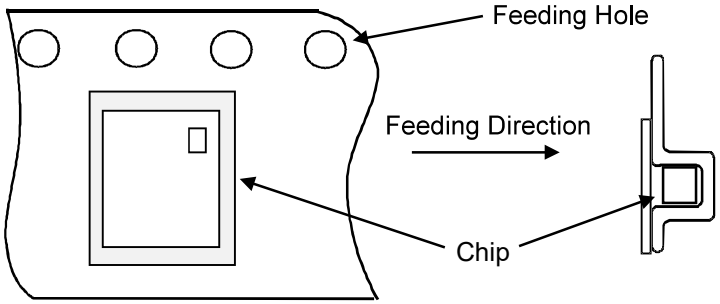
[1] Feeding Hole : As specified in (1)

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

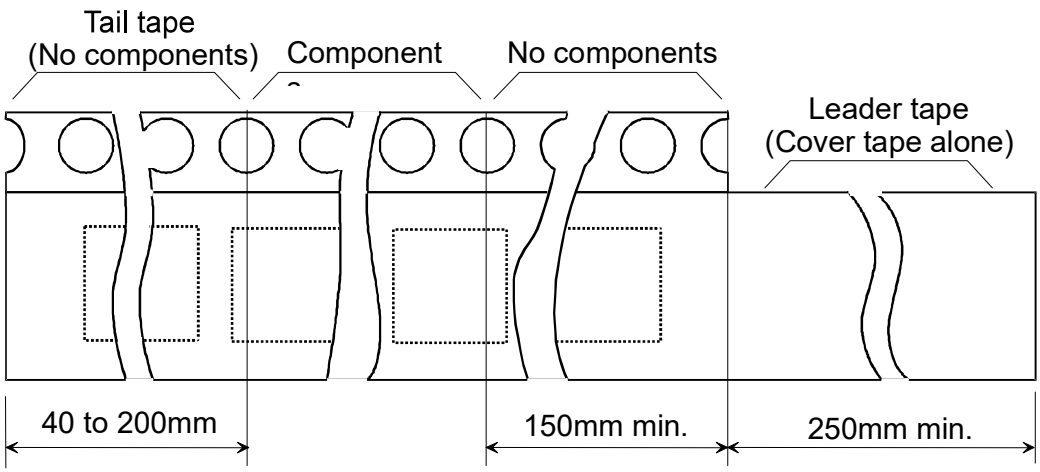
[3] Cover tape : 62μm in thickness

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



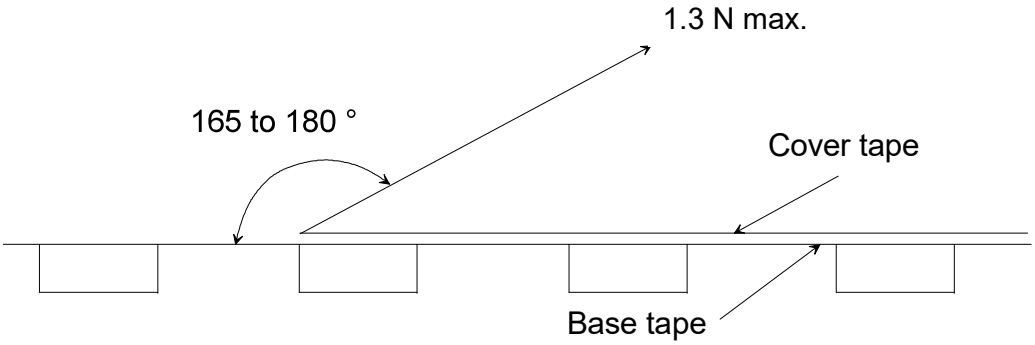


12.4 Leader and Tail tape

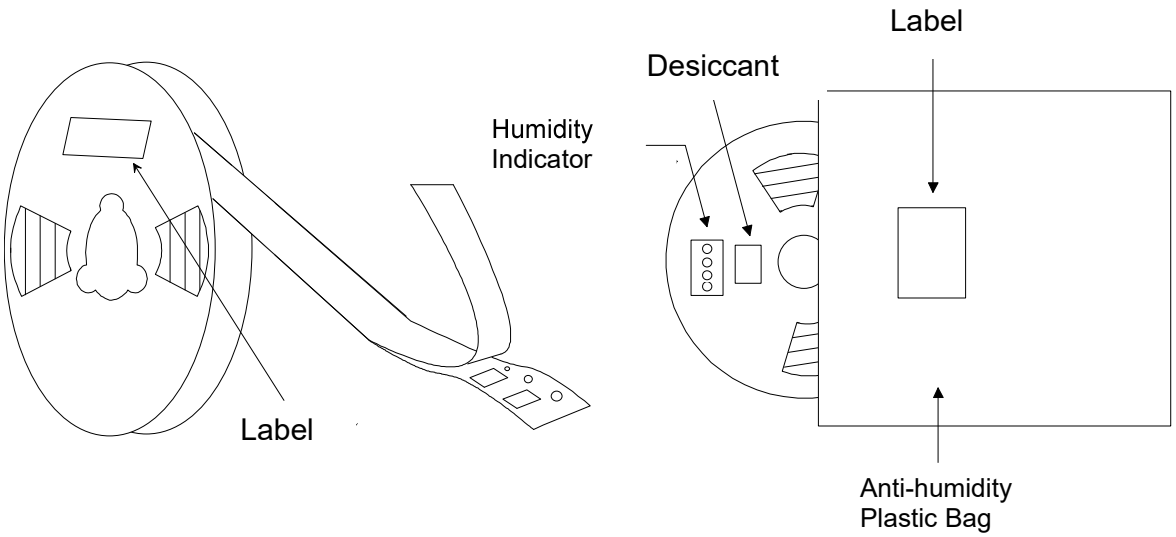


Feeding direction

- 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.



- 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.

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 solderbility 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.
- 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.

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 bear hands that may result in poor solderability.

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 :

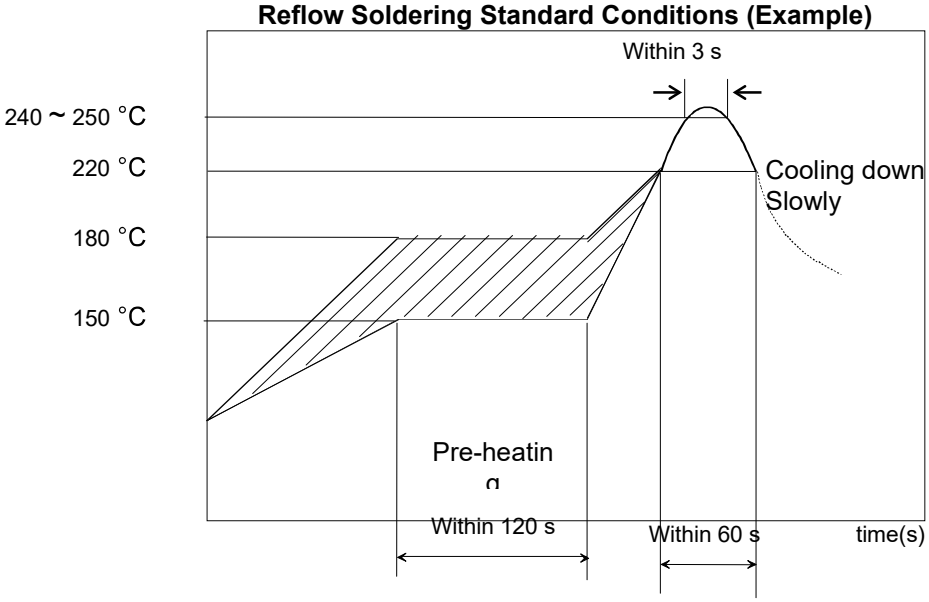
When placing products on the PCB, products may be stressed and broken by uneven forces from a worn-out chucking locating claw or a suction nozzle. To prevent products from damages, be sure to follow the specifications for the maintenance of the chip placer being used. For the positioning of products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

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 permitted.

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 specifications.
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: VPYCMABZ" or "Contains FCC ID: VPYCMABZ".

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-CMABZ”or “Contains IC: 772C-CMABZ”.

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 [SyChip] 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 antenna is Monopole Antenna and maximum gain is 1.04dBi.

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.