Crystal Bridge to the Future

Crystal Unit

■NX1612SD Data Sheet
(for Automotive)

Application
Automotive

Features
Crystal unit with built-in Thermistor

- **Integrated with a crystal unit to eliminate space in circuit design (Conventionally, a crystal unit and a temperature sensor are mounted on the same board.)**
- **A crystal element and a temperature sensor (thermistor) are mounted in the same airtight chamber, and the temperature closer to the crystal element can be detected, thereby improving the frequency temperature compensation compared with the conventional crystal unit.**
- **Ultra-compact and low profile (Typ. : 1.6×1.2 mm, H Max. : 0.65 mm)**
- **Surface-mount crystal unit (Available for reflow soldering)**
- **Reflow temperature profile (Available for lead free soldering)**
- **Conforms to AEC-Q200.**

RoHS Compliant
Directive 2011/65/EU
Directive (EU) 2015/863

Pb free

AEC-Q200

1. Item : Crystal Unit

2. Type : NX1612SD

3. Nominal Frequency : 76.8 MHz

4. NDK Spec. No. : EXS00A-CS14439

5. NDK Parts No. : CS14439-76.8M

6. Electrical Specifications

	Parameters	SYM.	Electrical Spec.				Notes
			min	typ	max	Units	
1	Nominal frequency	f_{nom}	76.800			MHz	---
2	Overtone order	-	Fundamental			-	---
3	Frequency tolerance	-	-10	-	+22	$\times10^{-6}$	at +25°C +/-3°C, DL=250uW
4	Frequency versus temp. characteristics	-	-16	-	+16	$\times10^{-6}$	at -30~+85°C (The reference temperature shall be +25°C)
			-35	-	+35	$\times10^{-6}$	at -40~+105°C The reference temperature shall be +25°C
			-35	-	+55	$\times10^{-6}$	at -105~+115°C The reference temperature shall be +25°C
5	Equivalent resistance	-	-	-	30	Ω	IEC π-Network / Series
6	Load capacitance	C_L	-	7	-	pF	IEC π-Network
7	Level of drive	-	10	200	250	μW	---
8	Inflection point	T0	22.5	24.5	26.5	°C	Inflection point is specified at max drive level: $t = (t_0 - \frac{C2}{3C3})$
9	Constant range	C0	-10	-	+22	ppm	---
10	1st order curve fitting parameter	C1	-0.5	-	-0.1	ppm/°C	---
11	2nd order curve fitting parameter	C2	-6.0	0	+6.0	x 10^{-4} ppm/°C^2	---
12	3rd curve fitting parameter	C3	+8.5	10	+11.5	x 10^{-5} ppm/°C^3	---
13	Pulling Sensitivity	S	10	-	15	ppm/pF	CL=7pF/ Not grounded S(ppm/pF)=C_m/{2*(C_p+CL)^2} Unit: C_p(pF), C_m(fF) and C_L(pF)
14	Quality factor (Q)	-	50,000	-	-	-	-
15	Spurious mode series resistance	-	1,100	-	-	Ω	f_{nom} +/-1 MHz
16	Frequency Aging	-	-0.7	-	+0.7	ppm	year (at +25°C)
17	Frequency drift after reflow	-	-2	-	-2	ppm	after two reflow passed.
18	Insulation resistance	T_{opr}	-40	-	+125	°C	---
19	Operable temperature range	T_{str}	-40	-	+125	°C	---
20	Storage temperature range	-	500	-	-	MΩ	When terminal to terminal and terminal to cover were applied at DC100V ±15V.
21	Air-tightness	-	-	-	1.1×10^{-9}	Pa m^3/s	---

7. Other Specifications

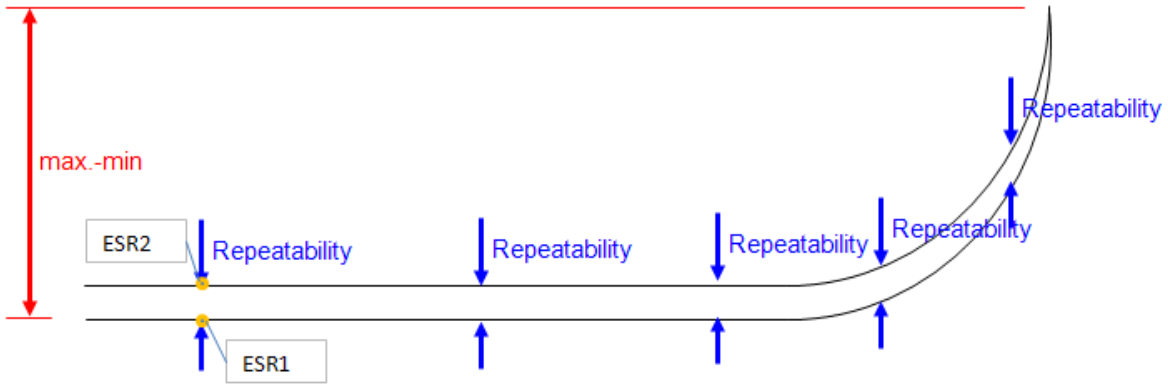
7.1 Drive level dependency (DLD)

Measurement method and specs are defined below.

Item		Maximum - minimum	Maximum	Repeatability	Condition
Drive level dependency	Frequency	< 6.0 ppm	X	< 0.7 ppm	0.01 µW to 250 µW to 0.01 µW
	ESR	X	30 Ω	< 10%	

Notes:

1. Number of points: 15 points up and 15 points down = 29 total data points.
2. Maximum - minimum: Difference between the maximum and minimum in a two-way measurement. For frequency, the change rate is (max - min) < 6 ppm.
3. Max: ESR max at 250 uW, drive level max is 30 Ω.
4. X represents “don’t care” or not specified.
5. Repeatability: Repeatability of the two-way measurement in the above condition. For ESR, the change rate is (ESR2 - ESR1)/ESR1 < 10%.
6. ESR1: This is the first measurement on each drive level.
7. ESR2: This is the second measurement on each drive level; for example, how to specify each parameter.



7.2 Crystal perturbation specification 1 (residual frequency stability slope)

Item	Condition	Specification (maximum values)	Unit
Residual frequency stability slope (residual = difference from fifth-order curve fit)	Ta = -40 to -30ºC	±100	ppb/ºC
	Ta = -30 to +85ºC	±50	
	Ta = +85 to +105ºC	±100	
	Ta = +105 to +115ºC	±150	
5ºC small orbit hysteresis 1 *	Ta = -40 to -30ºC	±100	ppb/ºC
	Ta = -30 to +85ºC	±50	
	Ta = +85 to +105ºC	±100	
	Ta = +105 to +115ºC	±150	

Note: * Must meet these 1A and 1B conditions:

Condition 1A - Test condition (continuous temperature rate change of ~1.0°C/minute

- Measure FT points every 1°C, heating up from -40°C to +115°C, subtract a fifth-order polynomial best fit, and then calculate the slope of the residual.

Condition1B - Test condition (continuous temperature rate change of ~1.0ºC / minute)

- Measure FT points every 0.5ºC while cycling temperature over a 5ºC small temperature orbit, an example 5ºC small orbit temperature cycle is +30ºC to +35ºC to +30ºC.
- During every individual heating/cooling cycle there should be 11points; discard the first point of each heating and cooling cycle; this leaves 10 points for each heating and cooling cycle. Subtract the fifth-order polynomial best fit from 1A for each of the 10 points, and then calculate the slope of the residual for each of these heating and cooling 10 point curves.

7.3 Crystal perturbation specification 2 (small orbit hysteresis 2)

Item	Condition	Specification (maximum values)	Unit
5ºC small orbit hysteresis 2	Ta = -40 to -30ºC	400	ppb peak-to-peak
	Ta = -30 to +85ºC	100	ppb peak-to-peak
	Ta = +85 to +115ºC	400	ppb peak-to-peak

Condition 2 test condition (continuous temperature rate change of ~1.0°C/minute)

- Measure FT points every 0.5°C while cycling temperature over a 5°C small temperature orbit, an example 5°C small orbit temperature cycle is +30°C to +35°C to +30°C.
- During every individual heating/cooling cycle there should be 11 points; discard the first and last point of each heating and cooling cycle, which results in 9 temperature points. Calculate the average measured peak-to-peak frequency difference for these 9 temperature points.
- The average difference is the magnitude of the small orbit hysteresis 2.
- The temperature is based on thermistor.

7.4 Thermistor characteristics

	Parameters	SYM.	MIN.	TYP.	MAX.	UNITS	Notes
1	Size	-	0.6 x 0.3 x 0.15			mm	-
2	Resistance value (at +25°C)	-	-	100	-	kΩ	-
3	B constant (+25/+50 °C)	-	-	4250	-	K	-
4	Rated power (at 25 °C)	-	-	-	100	mW	-
5	Operating Temperature range	-	-40	-	+125	°C	-
6	Storage temperature range	-	-40	-	+125	°C	-

Mounted conditions

Be sure to use the product under the following conditions. Otherwise, the characteristics deterioration or destruction of the product may result.

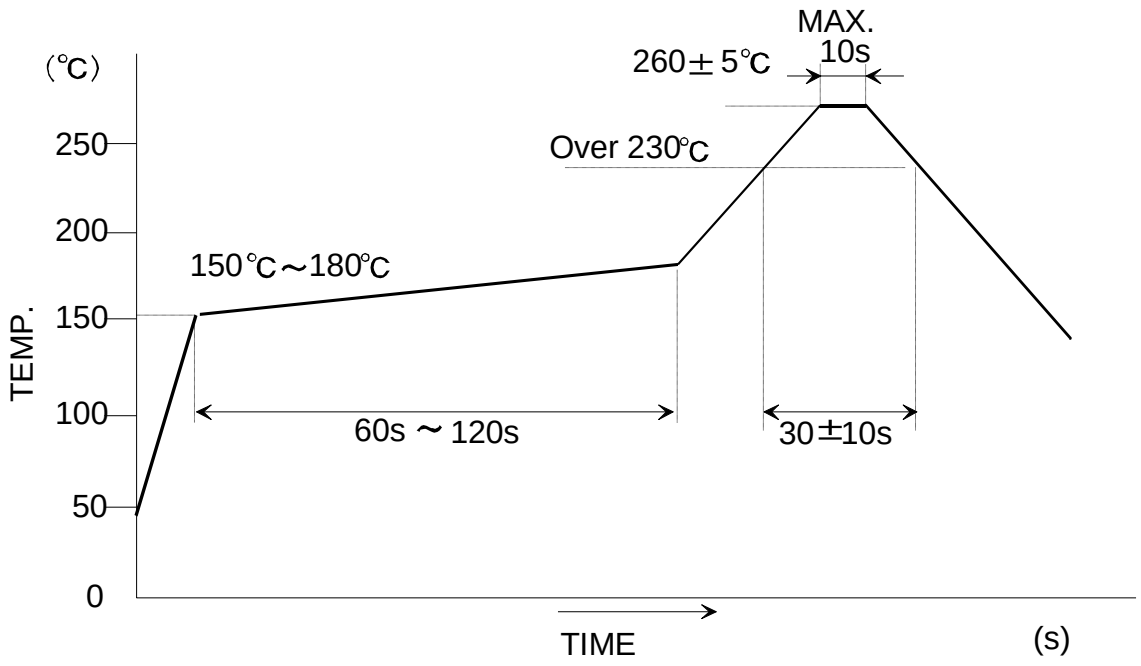
(1) Reflow soldering heat resistance

Peak Temp.	: 265°C, 10sec.
Heating	: 230°C or higher, 40sec.
Preheating	: 150~180°C, 120sec.
Reflow passage times	: twice

(2) Manual soldering heat resistance

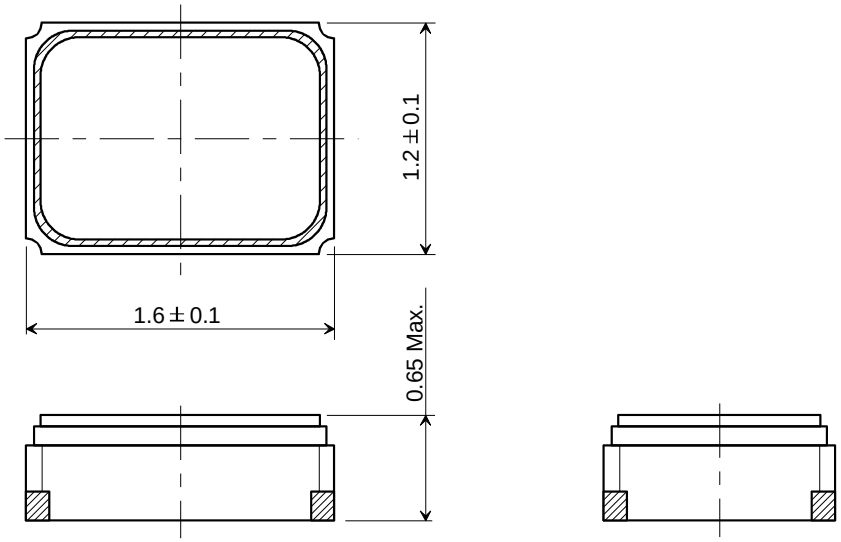
Pressing a soldering iron of 400°C on the terminal electrode for four seconds (twice).

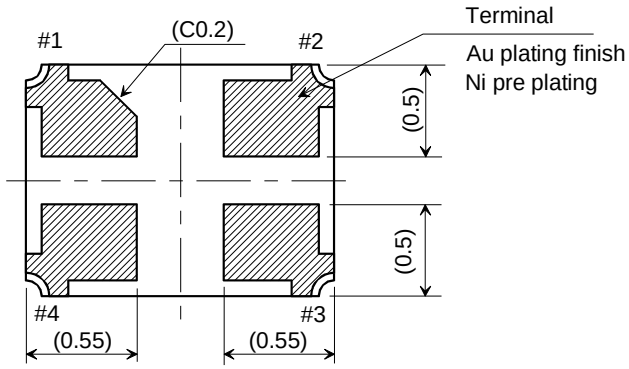
Recommendation reflow condition



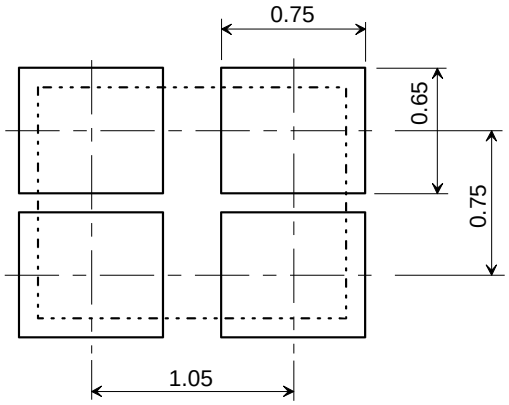
Dimension drawing

Unit : mm
Tolerance : +/-0.1mm

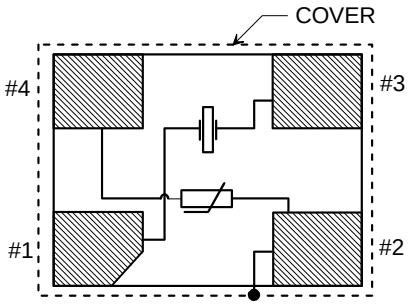




Land pattern (Recommended)

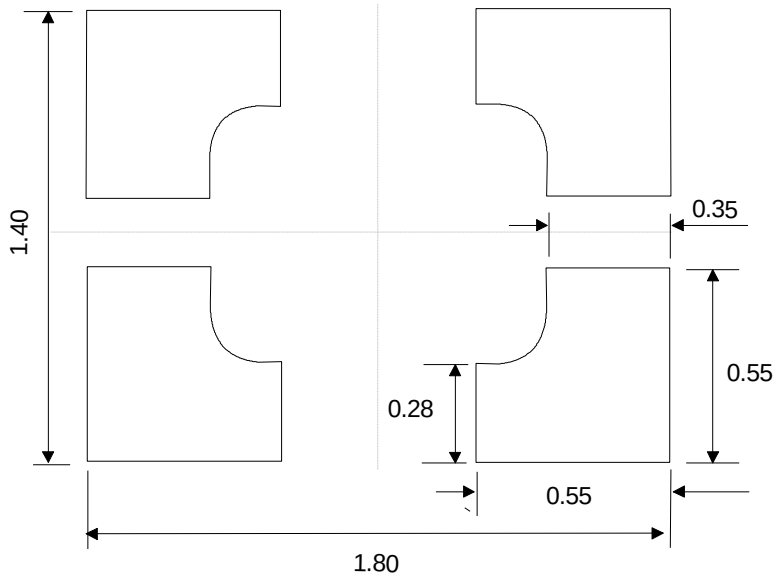


Terminal land connection (TOP VIEW)

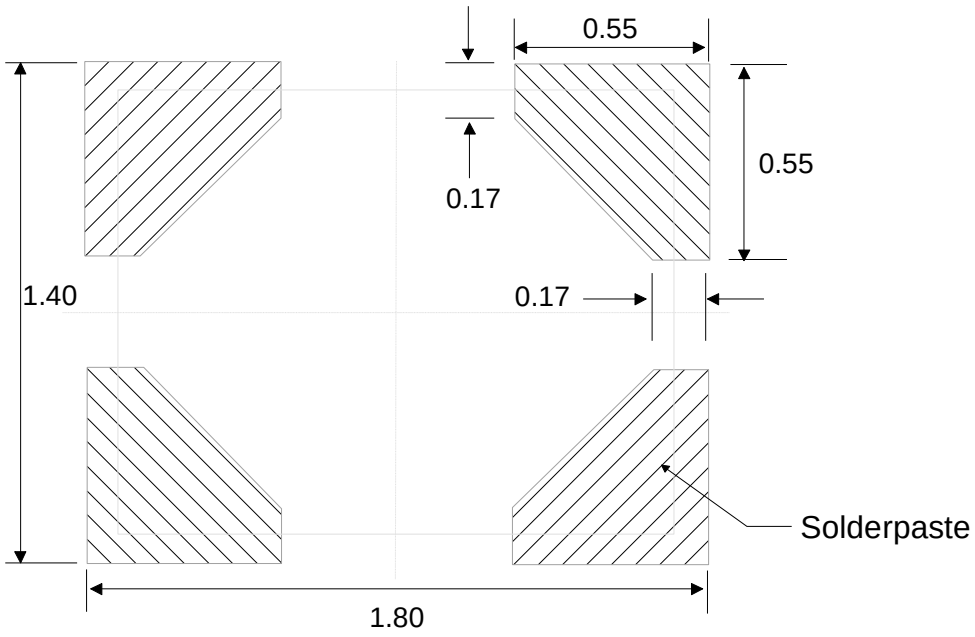


#1: Crystal IN
#2: Thermistor OUT and GND
#3: Crystal OUT
#4: Thermistor IN

LAND PATTERN (TYPICAL)

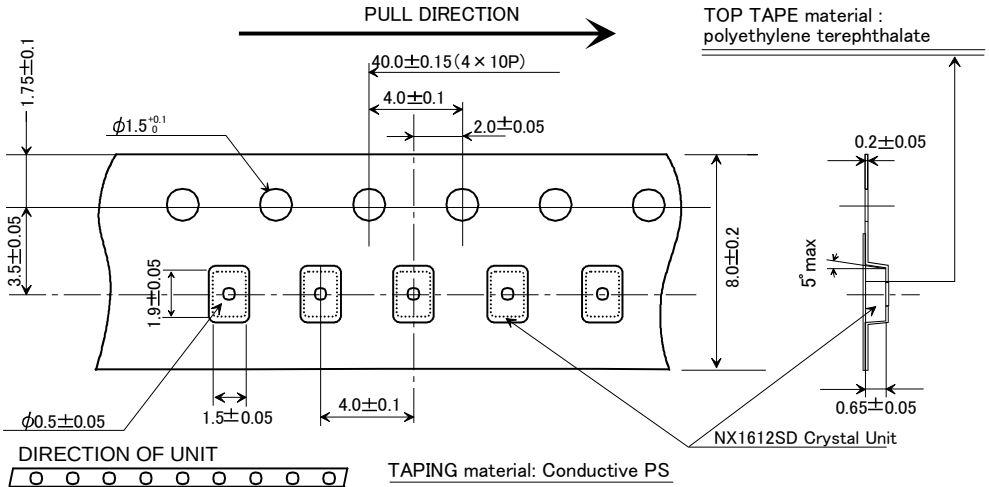


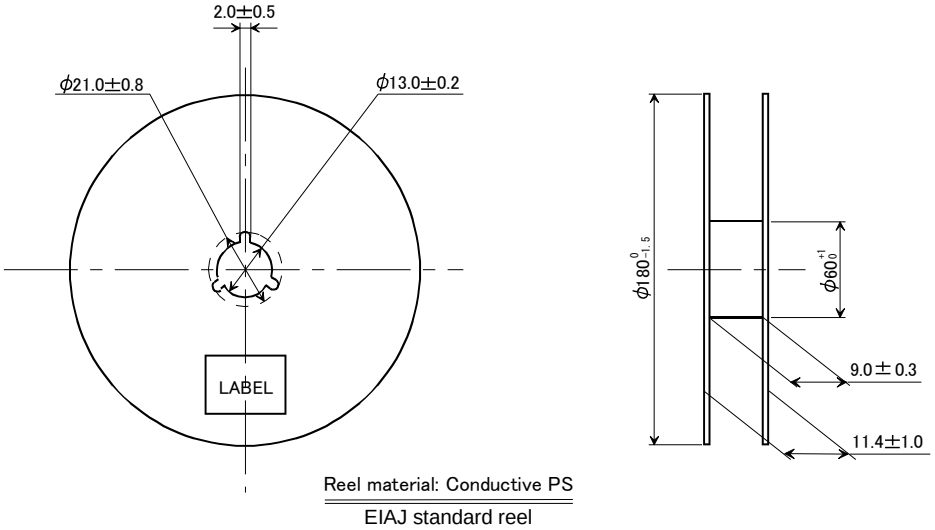
stencil pattern (TYPICAL)

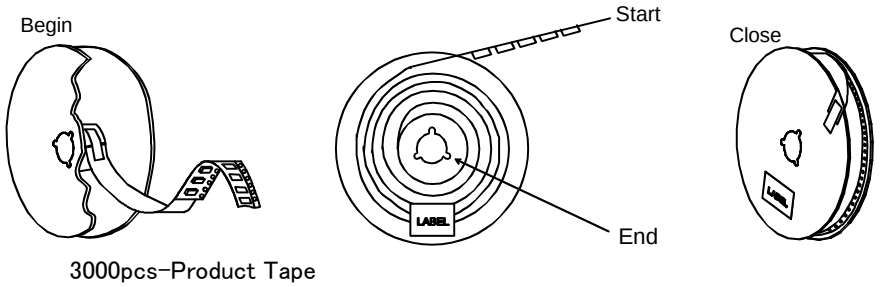


Taping and reel spec. ①

3,000pcs / reel (Reel dimension : φ180 mm)



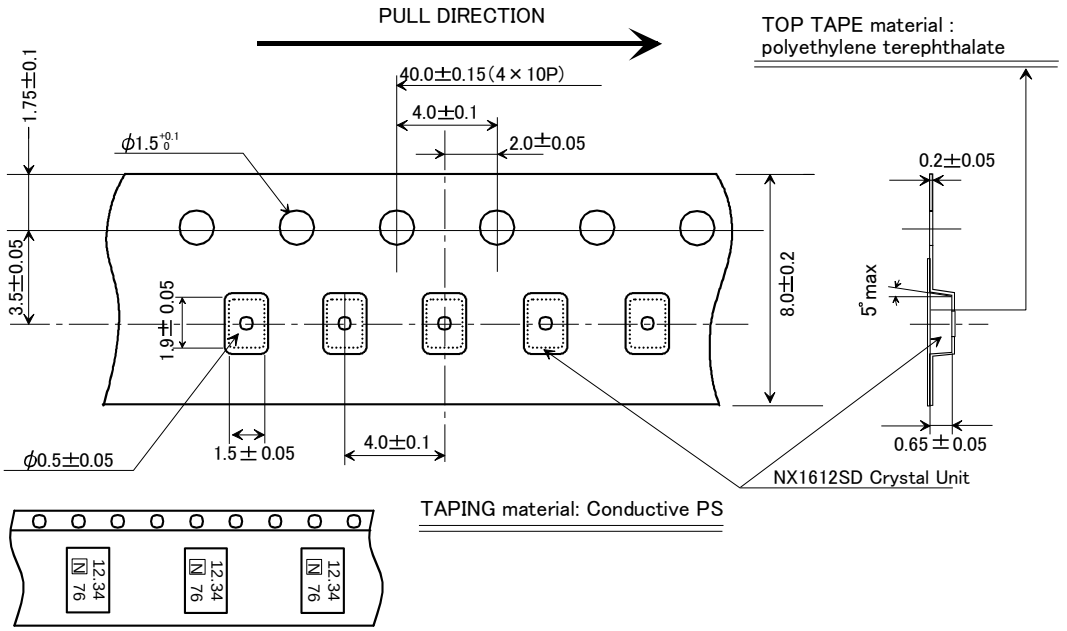


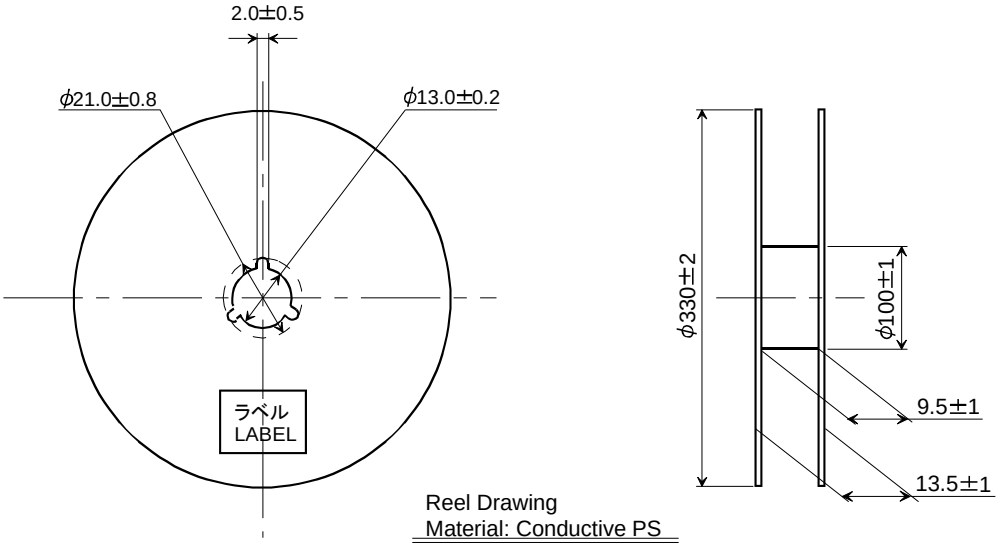


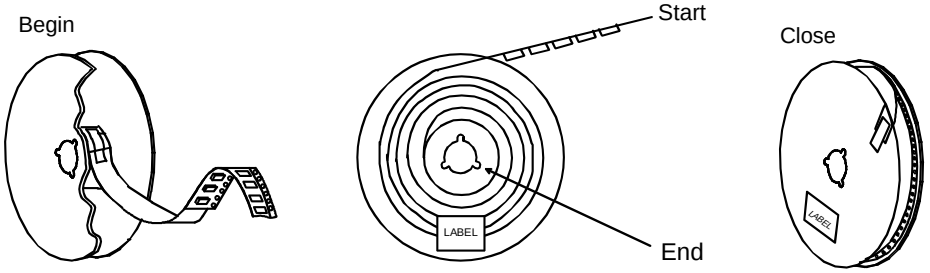
3000pcs-Product Tape

Taping and reel spec.②

10,000pcs / reel (Reel dimension : φ330 mm)

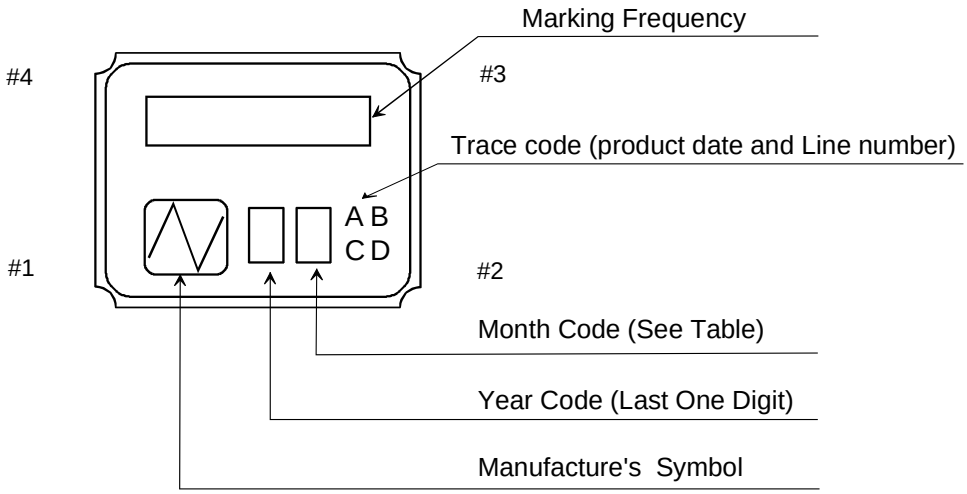






10000pcs-Product Tape

Marking spec.



NOTE

1. Month Code Table

Month	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May.	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.
Month Code	1	2	3	4	5	6	7	8	9	X	Y	Z

*Marking digits are not include a decimal point and dot mark.

Notes on use

1. Even if the appearance color etc. of the product differs by purchasing the component parts by more than two companies, there is no influence on the characteristics and reliability.
2. Since the crystal unit is a passive component, it is important to have appropriate circuit conditions. Please be sure to check the circuit conditions before using the crystal units, and ensure the necessary circuit margin, and confirm that the desired frequency is output. Moreover, please check the circuit conditions when using an existing crystal unit for another model or board. If the circuit conditions are not appropriate, there is a risk of oscillation stop or frequency deviation.
3. IN THE CASE OF THE FOLLOWING ITEMS, WE ARE NOT RESPONSIBLE FOR WARRANTY / COMPENSATION.
   (1) WHEN PRODUCTS OF THIS SPECIFICATION ARE USED FOR EQUIPMENT RELATED TO HUMAN LIFE OR PROPERTY, IT IS THE RESPONSIBILITY OF THE CUSTOMER TO CONFIRM THE INFLUENCE ON THIS PRODUCT AND EQUIPMENT TO BE USED BEFOREHAND, CONDUCT NECESSARY SAFETY DESIGN (INCLUDING REDUNDANT DESIGN, MALFUNCTION PREVENTION DESIGN, etc.), AND PLEASE USE IT AFTER SECURING SUFFICIENT SAFETY OF EQUIPMENT.
      1. SAFETY-RELATED EQUIPMENT SUCH AS AUTOMOBILES, TRAINS, SHIPS, etc., OR EQUIPMENT DIRECTLY INVOLVED IN OPERATION
      2. AIRCRAFT EQUIPMENT
      3. SPACE EQUIPMENT
      4. MEDICAL EQUIPMENT
      5. MILITARY EQUIPMENT
      6. DISASTER PREVENTION / CRIME PREVENTION EQUIPMENT
      7. TRAFFIC LIGHT
      8. OTHER EQUIPMENT REQUIRING THE SAME PERFORMANCE AS THE ABOVE-MENTIONED EQUIPMENT

   (2) IN CASES WHERE IT IS NOT INDICATED IN THE REQUESTED STANDARD AND IS USED UNDER CONDITIONS OF USE (INCLUDING CIRCUIT MARGIN etc.) THAT CAN NOT BE PREDICTED AT THE PRODUCTION STAGE.

   (3) WHEN USING ULTRASONIC WELDING MACHINE. (THERE IS A POSSIBILITY THAT THE CHARACTERISTIC DEGRADATION IS CAUSED BY THE RESONANCE PHENOMENON OF THE PIEZOELECTORIC MATERIAL.(EXAMPLE; CRYSTAL PIECE))
   WE WILL NOT TAKE ANY RESPONSIBILITY FOR THE INFLUENCE OF THE CUSTOMERS' PROCESS.SO, PLEASE SUFFICIENTLY EVALUATE AT A SAMPLE STEP WHEN YOU USE ULTRASONIC WELDING MACHINE.

   (4) USING RESIN MOLD MAY AFFECT THE PRODUCT CHARACTERISTIC.
   PLEASE MAKE SURE TO TELL OUR SALES CONTACT WHEN YOU USE RESIN MOLD. WE WILL PERFORM INDIVIDUAL CORRESPONDENCE ABOUT A DELIVERY SPECIFICATION AND AN EVALUATION METHOD. IN ADDITION, IF YOU USE RESIN MOLD WITHOUT CONTACTING US, AND CAUSES DAMAGES AGAINST A CUSTOMER OR A THIRD PARTY, WE WILL NOT BE LIABLE FOR THE DAMAGES AND OTHER RESPONSIBILITIES BECAUSE WE CONSIDER IT IS UNDER SELF-RESPONSIBILITY USING RESIN MOLD. WE WILL NOT TAKE ANY RESPONSIBILITY FOR THE INFLUENCE OF THE CUSTOMERS' PROCESS. PLEASE SUFFICIENTLY EVALUATE AT A SAMPLE STEP WHEN YOU USE RESIN MOLD.

(5) WHEN PERFORMING IMPROPER HANDLING THAT EXCEEDS THE GUARANTEED RANGE.

4. This product cannot be used for equipment related to the safety of automobiles or equipment directly involved in operation.(example: air bag, TPMS, engine control, steering control, brake control etc.)

Notes on storage

1. When storing the product in high temperature and high humidity condition for a long time, product characteristics (solderability etc.) and packaging condition may be deteriorated. Please store product at temperature + 5°C ~ + 35°C, humidity 85% RH or less. The product is an electronic component, so please do not storage and use, under a dewing state.
2. The product storage deadline is 12 months after delivery in unopened state. Please use within storage deadline. If you exceed storage deadline, please check the product characteristics etc, please use.

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