Crystal Unit

■NX1612SD Data Sheet
(for Mobile Communications)

Application
Communications equipment

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)

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

Pb free

1. Item : Crystal Unit

2. Type : NX1612SD

3. Nominal Frequency : 38.400 MHz

4. NDK Spec. No. : EXS00A-CS12755

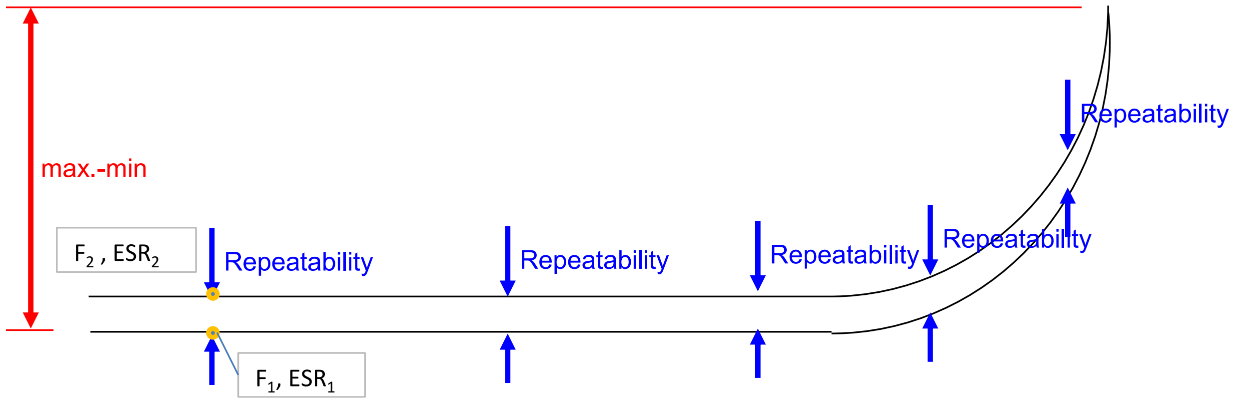
5. NDK Parts No. : CS12755-38.4M

6. Electrical Specifications

	Parameters	SYM.	Electrical Spec.				Notes
			Min	TYP	MAX	Units	
1	Nominal frequency	f_{nom}	38.400			MHz	-
2	Overtone order	-	Fundamental			-	AT-CUT
3	Frequency tolerance	-	-10	-	+10	ppm	at +25°C
4	Frequency versus temperature characteristics	-	-12	-	+12	ppm	at -30~+85°C The reference temperature shall be +29°C
5	Equivalent resistance	-	-	-	50	Ω	IEC π-Network / Series
6	Load capacitance	C_L	-	8	-	pF	IEC π-Network
7	Level of drive	DL	10	-	200	μW	-
8	Temperature coefficient						
8-1	Inflection point	-	27.5	29	30.5	°C	-
8-2	Constant range	C0	-10	-	10	ppm	-
8-3	Third-order curve fitting coefficient	C3	8.5	-	11.5	x 10^{-5} ppm/°C^3	The curve can be modeled as a third-order polynomial. $f(t) = c_3(t - t_0)^3 + c_2(t - t_0)^2 + c_1(t - t_0)$
8-4	Second-order curve fitting coefficient	C2	-4.5	-	+4.5	x 10^{-4} ppm/°C^2	
8-5	First-order curve fitting coefficient	C1	-0.4	-	-0.1	ppm/°C	
9	Pulling Sensitivity	S	7	-	16	ppm/pF	CL=8pF/ Not grounded This value is calculated by following formula. $S = [ppm/pF] = \frac{C_m \times 1000}{2(C_p + C_L)^2}$ Unit: C_p(pF), C_m(fF) and C_L(pF)
10	Quality factor (Q)	-	75,000	-	-	-	-
11	Spurious mode series resistance	-	1,100	-	-	Ω	±1MHz
12	Aging	-	-0.7	-	0.7	ppm	1^{st} year
13	Frequency drift after reflow	-	-2	-	+2	ppm	after two reflow passed.
14	Insulation resistance	-	500	-	-	MΩ	Terminal to terminal insulation resistance also terminal to cover insulation resistance when DC100V ±15V is applied.
15	Operatable temperature range	-	-30	-	+105	°C	-
16	Storage temperature range	-	-40	-	+105	°C	-
17	Air-tightness	-	-	-	1.1×10^{-9}	Pa m^3/s	-

7. Drive level dependency (DLD) : Measurement method and specs are defined below.

Measurement condition		Freq.	ESR
Drive level	0.01uW to 200uW to 0.01uW		
Number of points	29 points (15 points up, 15 points down)		
Max. – Min. spec.	Difference between max and min in two way measurement. Freq.: F_{MAX}-F_{MIN} ESR: (ESR_{MAX}-ESR_{MIN})/ESR_{MIN}	<6ppm	<20%
Repeatability spec.	Repeatability of two way measurement in above condition. Freq.: F_2-F_1 ESR: (ESR_2-ESR_1)/ESR_1 ESR_1: first measurement on each drive levels ESR_2: second measurement on each drive levels	<0.7ppm	<10%



7.1. Crystal perturbation specification 1 (residual frequency stability slope)

Item	Condition	Specification	Unit
Residual frequency stability slope (residual = difference from fifth-order curve fit) *	Ta = - 30 to - 15°C Ta = - 15 to + 70°C Ta = + 70 to + 85°C	± 100 (maximum) ± 50 (maximum) ± 100 (maximum)	ppb/°C
5°C small orbit hysteresis 1 *	Ta = - 30 to - 15°C Ta = - 15 to + 70°C Ta = + 70 to + 85°C	± 100 (maximum) ± 50 (maximum) ± 100 (maximum)	ppb/°C

* Must meet the 1A and 1B conditions:

- Condition 1A – Test condition (continuous temperature rate change of ~1.0°C/minute):
  - Measure frequency vs. temperature (FT) points every 1°C, heating up from - 30 to + 85°C, subtract a fifth-order polynomial best fit and then calculate the slope of the residual.
  - The residual slope should be within ±100 ppb/°C for - 30 to - 15°C, ± 50 ppb/°C for - 15 to 70°C and ±100 ppb/°C for + 70 to + 85°C

- Condition 1B – Hysteresis 1 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 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 1 A for each of the 10 points, and then calculate the slope of the residual for each of these heating and cooling 10 point curves. – The residual slope should be within ±100 ppb/°C for - 30 to - 15°C, ± 50 ppb/°C for - 15 to 70°C and ±100 ppb/°C for + 70 to + 85°C

7.2. Crystal perturbation specification 2 (small orbit hysteresis 2)

Item	Condition	Specification	Unit
5°C small orbit hysteresis 2 *	Ta = - 30 to + 85°C	100 (magnitude)	ppb pk-pk

* Must meet condition 2:

- Condition 2 – Hysteresis 2 test condition (continuous temperature rate change of ~1.0°C/minimum):
  - 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. This results in nine temperature points. Calculate the average measured peak-to-peak frequency difference for these nine temperature points.
  - The average difference is the magnitude of the small orbit hysteresis 2.

8. Thermistor characteristics

8.1. Size : 0.6×0.3×0.15 (mm)
8.2. Resistance value (at +25°C) : 100 (kΩ) ±1%
8.3. B Constant (+25/+50°C) : 4250 (K) ±1%
8.4. Rated power (at 25°C) : 100 (mW) Max.

Mounted conditions

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

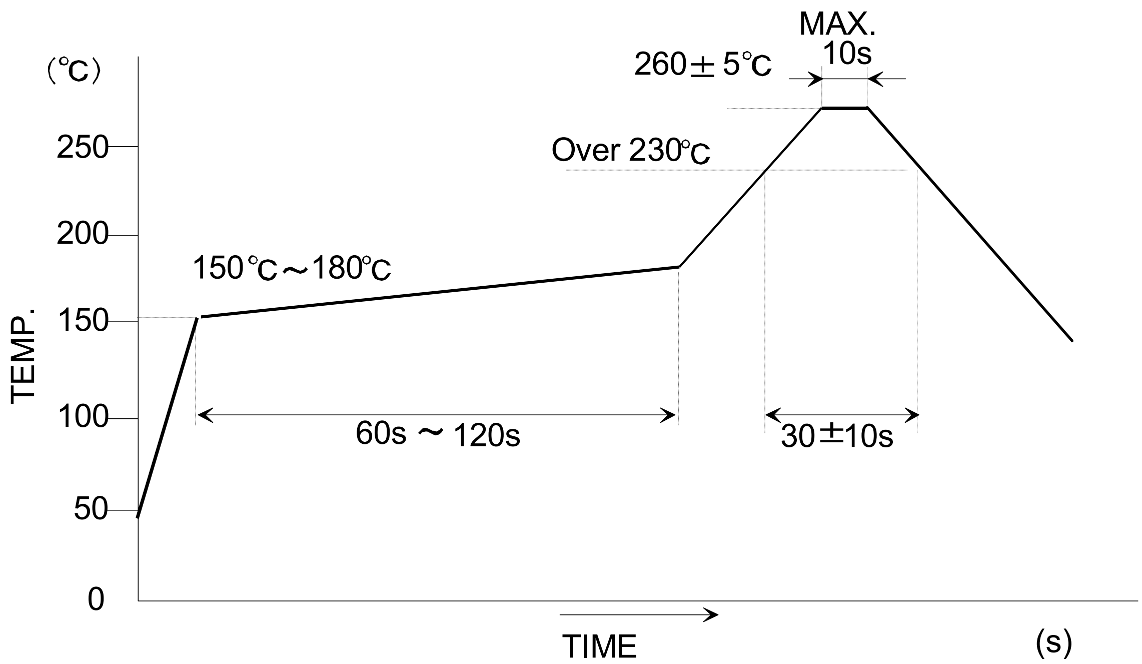
(1) Reflow soldering heat resistance

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

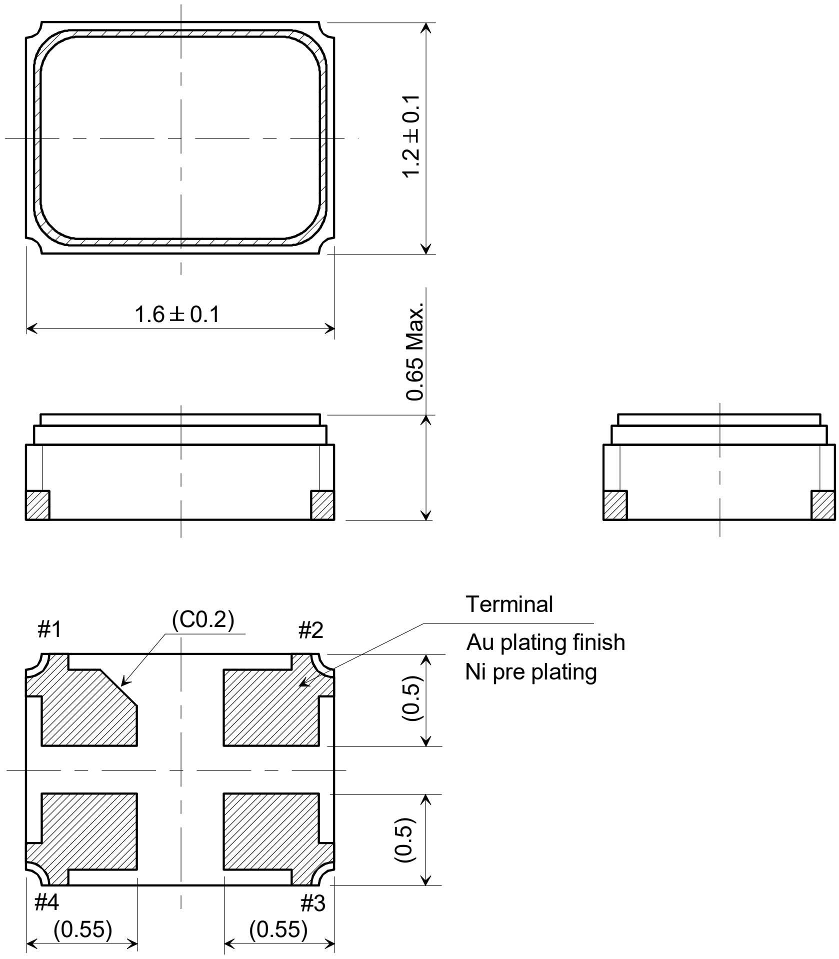
Pressing a soldering iron of 400°C on the terminal electrode for four seconds (twice).

Recommendation reflow condition

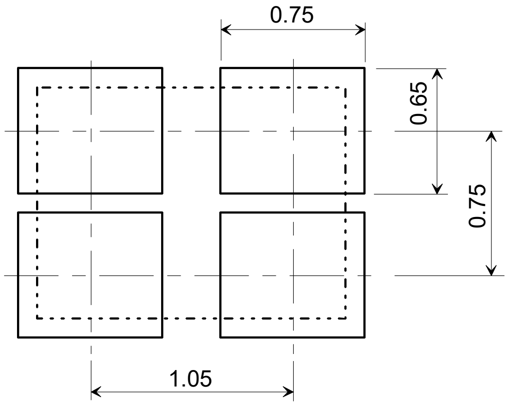


Dimension drawing

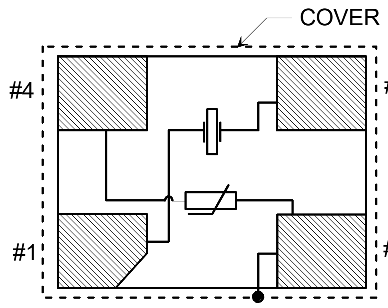
Unit：mm
Tolerance：+/-0.1mm



Land pattern (Recommended)

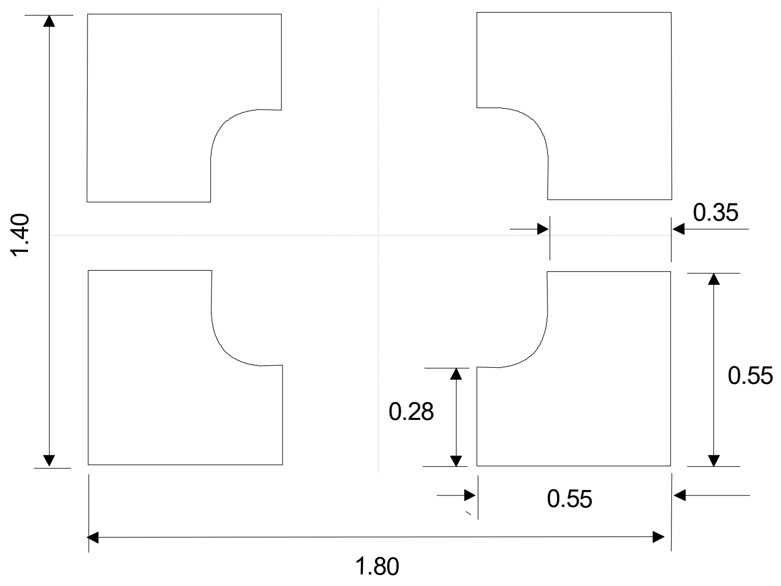


Terminal land connection (TOP VIEW)

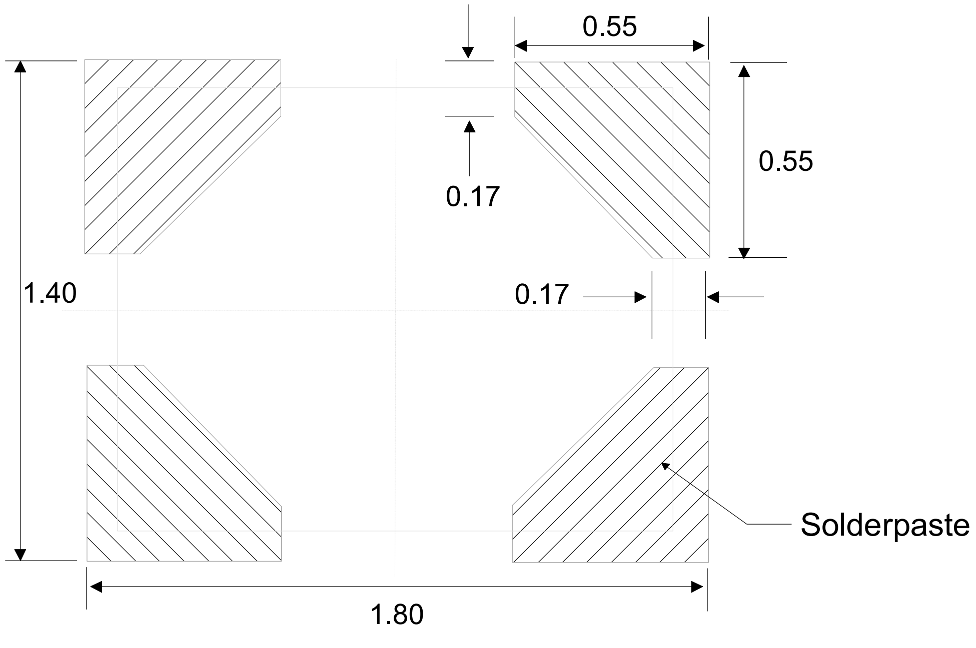


#1: Crystal IN
#2: Thermistor OUT and GND
#3: Crystal OUT
#4: Thermistor IN

LAND PATTERN (TYPICAL)

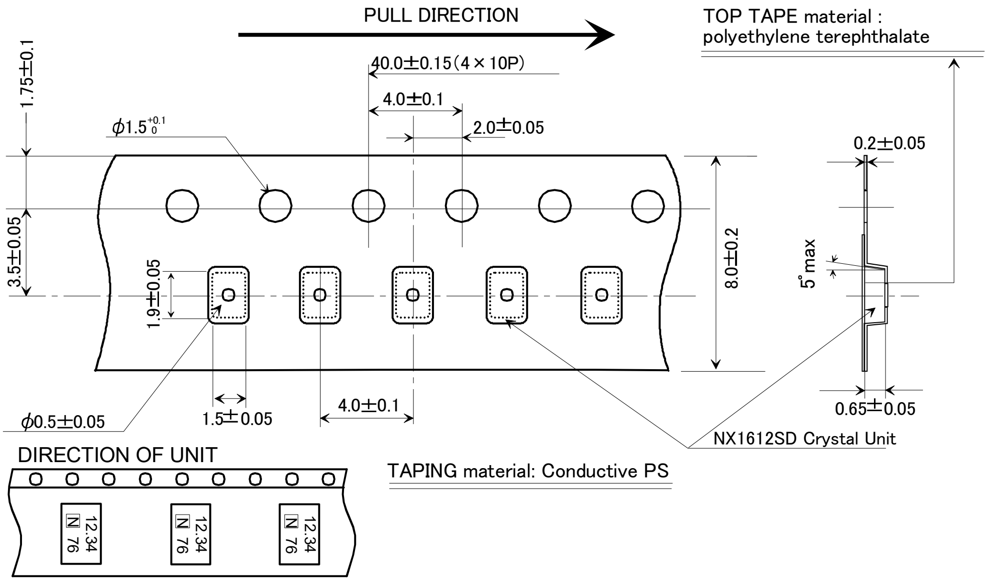


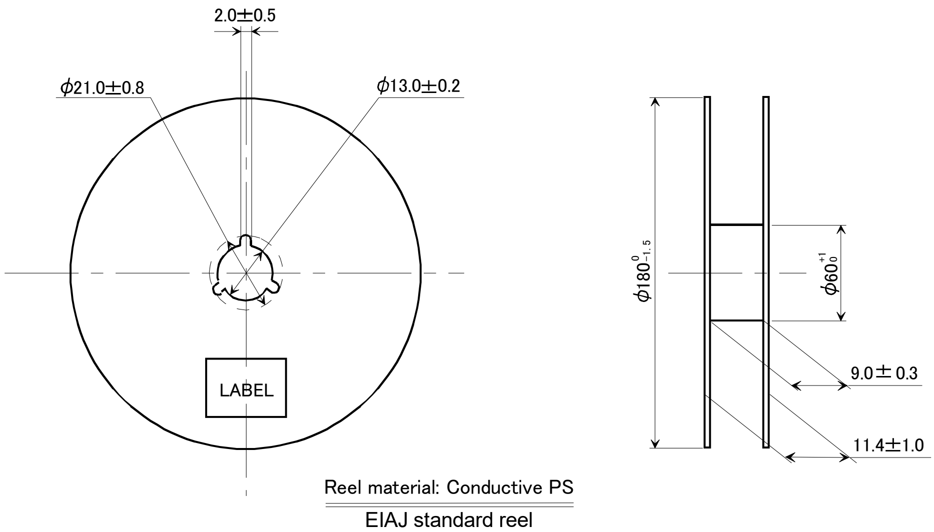
stencil pattern (TYPICAL)

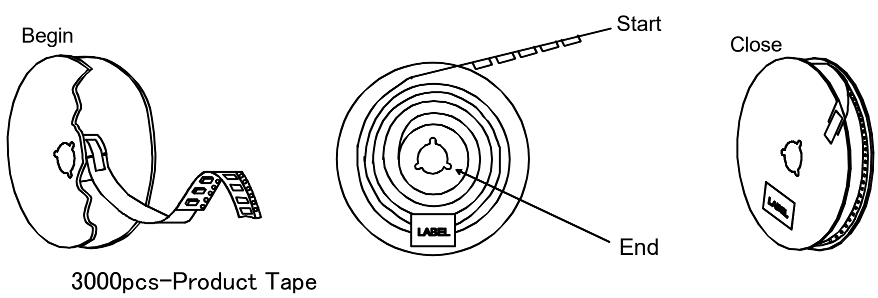


Taping and reel spec.

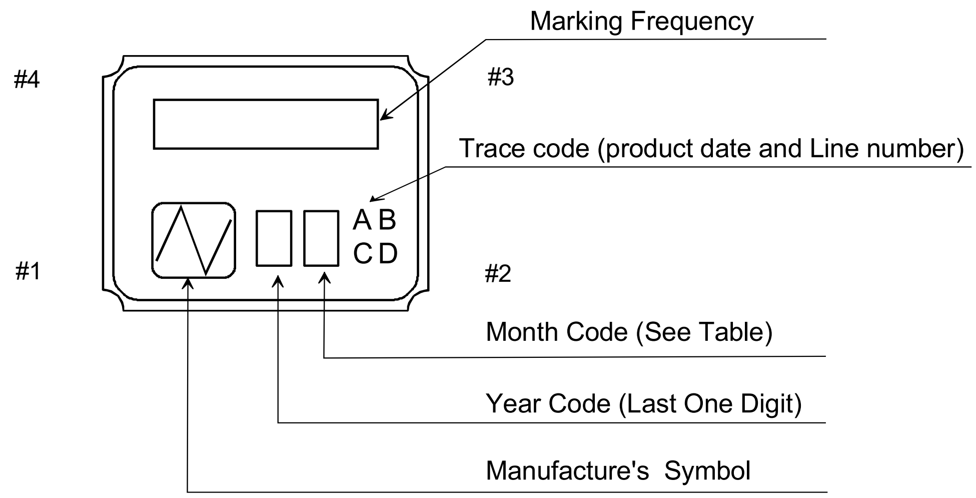
3,000pcs / reel (Reel dimension : φ180 mm)







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.