Crystal Bridge to the Future

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

SPECIFICATION

Customer:

Item: Crystal Unit

Type: NX2016SF

Nominal Frequency: 38.4 MHz

Customer's Spec. No.:

NDK Spec. No.: EXS00A-CS10107

Conforms to AEC-Q200 rev.D

Receipt

Revision Record

Rev.	Rev. Date	Items	Contents	Approved	Checked	Drawn
---	14. Feb. 2019	Issue	---	I. Miyahara	K.Nakashima	Y.Takaki
A	12.Jun.2020	7. Thermistor characteristics	Change	M.Sato	---	R.Omomo

1. Customer Specifications Number :

2. NDK Specification Number : EXS00A-CS10107

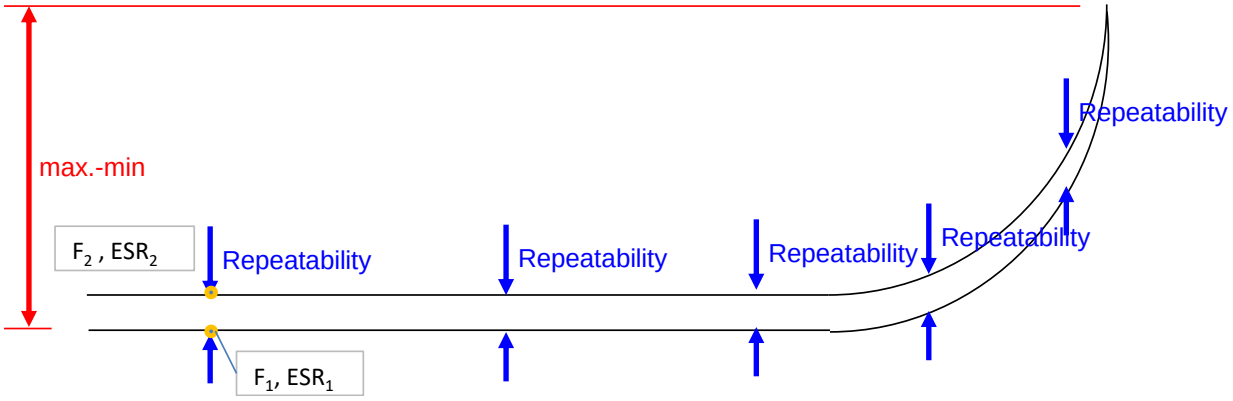
3. Type : NX2016SF

4. Electrical Characteristics

	Parameters	SYM.	Electrical Spec.				Notes
			Min	TYP	MAX	Units	
1	Nominal frequency	f_{nom}		38.4		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 to +85°C (Reference +29°C)
			-30	-	+30	*ppm*	at -40 to +105°C (Reference +29°C)
5	Equivalent resistance	-	-	-	30	Ω	IEC π-Network / Series
6	Load capacitance	C_L	-	8	-	pF	IEC π-Network
7	Level of drive	DL	-	10	200	μW	-
	Temperature coefficient spec. (*Compliant with Qualcomm Mini-Spec. 80-V9690-28 Rev. B*)						
8	Inflection point	T0	27.5	29	30.5	°C	
9	Constant range	C0	-10	-	10	ppm	
10	1st order curve fitting parameter	C1	-0.4	-	-0.1	ppm/°C	
11	2nd order curve fitting parameter	C2	-4.5	-	+4.5	x 10^{-4} ppm/°C^2	
12	3rd curve fitting parameter	C3	+8.5	-	+11.5	x 10^{-5} ppm/°C^3	
13	Shunt Capacitance	Cp	0.3	-	1.3	pF	Not grounded
14	Motional Capacitance	Cm	1.2	-	3.1	fF	Not grounded
15	Motional Inductance	Lm	5.5	-	14.3	mH	Not grounded
16	Pulling Sensitivity	S	7	-	16	ppm/pF	CL=8pF/ Not grounded This value is calculated by following formula. $\text{Pulling Sensitivitiy(PS) [ppm/pF]} = \frac{C_m \times 1000}{2(C_p + C_L)^2}$ Unit: C_0 (pF), C_1 (fF) and C_L (pF)
17	Quality factor (Q)	-	75,000	-	-	-	-
18	Spurious mode series resistance	-	11,000	-	-	Ω	±1MHz
19	Aging	-	-0.7	-	+0.7	ppm/year	1st year
20	Frequency drift after reflow	-	-2	-	+2	ppm	after two reflow passed.
21	Insulation resistance	-	500	-	-	MΩ	Terminal to terminal insulation resistance also terminal to cover insulation resistance when DC100V ±15V is applied.
22	Operating temperature range	-	-40	-	+105	°C	-
23	Storage temperature range	-	-40	-	+105	°C	-
24	Air-tightness	-	-	-	1.1×10^{-9}	Pa m^3/s	Helium leak detector

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

Measurement condition		Freq.	ESR
Drive level	0.01uW to 100uW 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}	<3ppm	<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%



6. 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 -30°C	±100	ppb/°C
Residual frequency stability slope	Ta = -30 to +85°C	±50	ppb/°C
Residual frequency stability slope	Ta = +85 to +105°C	±100	ppb/°C
5°C small orbit hysteresis	Ta = -40 to -30°C	±250	ppb/°C
5°C small orbit hysteresis	Ta = -30 to +85°C	±50	ppb/°C
5°C small orbit hysteresis	Ta = +85 to +105°C	±250	ppb/°C

6. 1. Residual frequency stability slope

Condition 1A - Test condition (continuous temperature rate change of ~1.0°C/min)
Measure FT points every 1°C, heating up from -40 to +105°C, subtract a fifth-order polynomial best fit, and then calculate the slope of the residual.

6.2. 5°C small orbit hysteresis 1

Condition 1B Hysteresis 1 test condition (continuous temperature rate change of ~1.0°C/minimum):

- Measure FT points every 0.5°C while cycling the 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 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.

6.3. 5°C small orbit hysteresis 2 : ±100 ppb (magnitude) peak-peak. Ta = -30 to +85°C
: ±400 ppb (magnitude) peak-peak. Ta = -40 to +105°C

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

- 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. 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)	-	-1%	100	+1%	kohm	-
3	B constant (+25/+50 °C)	-	-1%	4250	+1%	K	-
4	Rated power (at 25 °C)	-	-	-	100	mW	-

8. Examination results document

Since a performance is guaranteed, an examination results document does not submit.

9. Application drawing

9.1. Dimension Drawing : EXD14B-00584
9.2. Taping and Reel figure : EXK17B-00370
9.3. Holder Marking : EXH11B-00319
9.4. Reliability assurance Item : EXS30B-00933

10. Notes on use

10-1 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.

10-2 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.

10-3 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.)

11. Notes on storage

11-1 When storing the product in high temperature and high humidity condition for a long time, product characteristics (solder ability 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.

11-2 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.

12. Other Requests

12-1 Please use this specification only for confirmation of the specification of this product.

12-2 If there is a change request, please contact within three weeks from issue date. If there is no communication, we will deliver the product under the contents of this specification. In addition, if the product delivery date is within 3 weeks and there is a change request, we will consult the processing separately.

12-3 NOTES THAT ARE DESCRIBED IN THIS DOCUMENT, IF YOU DID NOT COMPLY WITH THE PROHIBITIONS, AND OTHER PLEASE, INCLUDING THE FAILURE CORRESPONDENCE OR COMPENSATION OR DAMAGES, WE CAN NOT ASSUME THE RESPONSIBILITY, PLEASE UNDERSTAND.

13. Prohibited items

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 temperature: 265°C, 10 sec

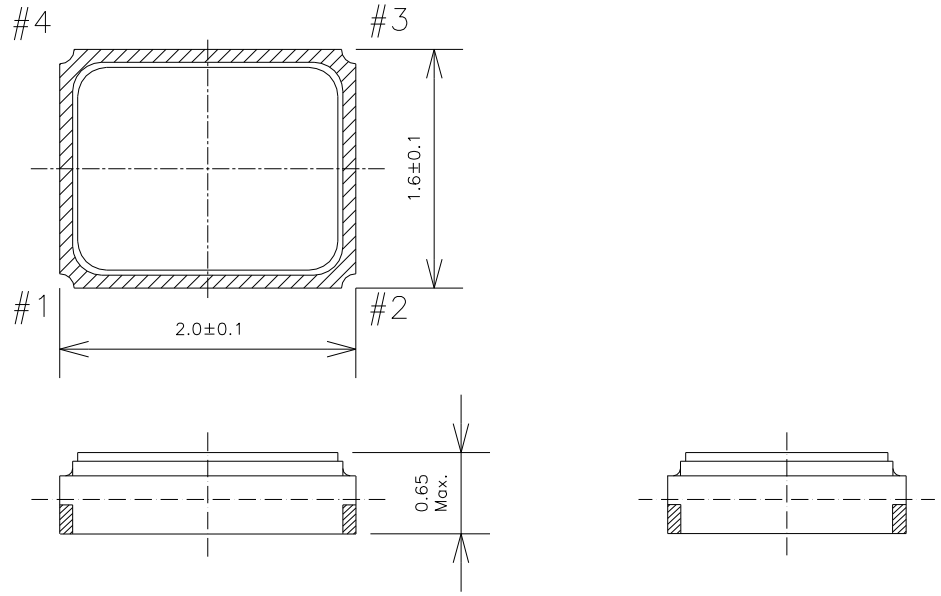
Heating: 230°C or higher, 40 sec

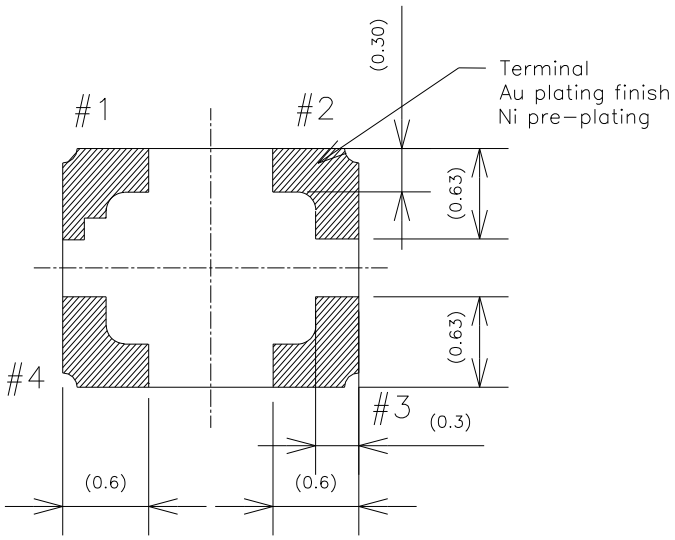
Preheating: 150°C to 180°C, 120 sec

Reflow passage times: three times

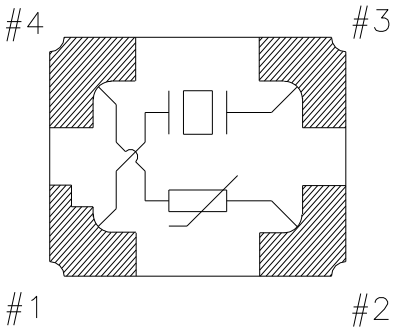
(2) Manual soldering heat resistance

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





Terminal land connection (TOP VIEW)



#1	XTAL IN
#2	THERMISTOR OUT, GND
#3	XTAL OUT
#4	THERMISTOR IN

	Date of Revise	Charge	Approved	Reason
A	15.Oct.2019	R.Omomo	M.Sato	Revise Land pattern to Recommended.

	Date	Name	Third Angle Projection	Tolerance	Scale
Drawn	15. Mar. 2013	15. Mar. 2013	Dimension:mm	----	--/--
Designed	15. Mar. 2013	15. Mar. 2013	Title	Drawing No.	Rev.
Checked	15. Mar. 2013	15. Mar. 2013	**NX2016SF** Dimension Drawing	**EXD14B-00584(1/2)**	**A**
Approved	15. Mar. 2013	15. Mar. 2013			

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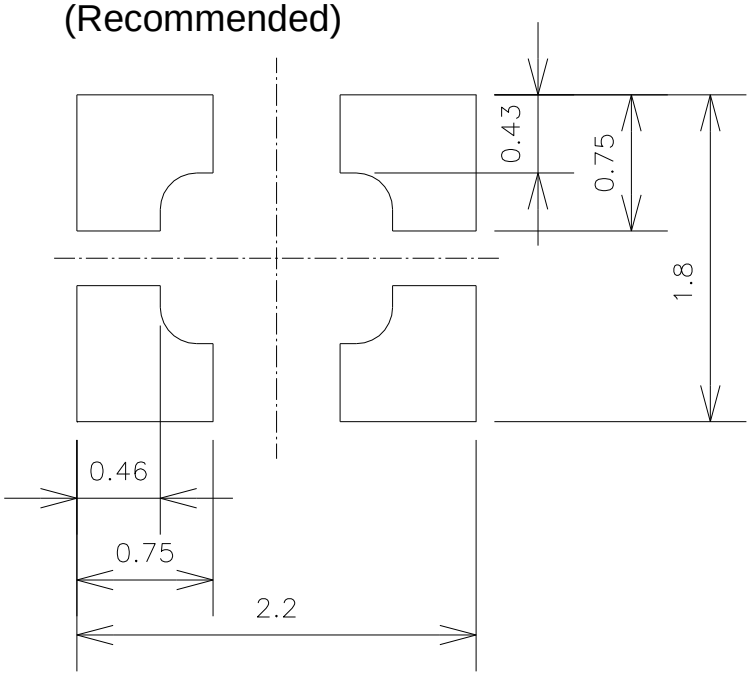
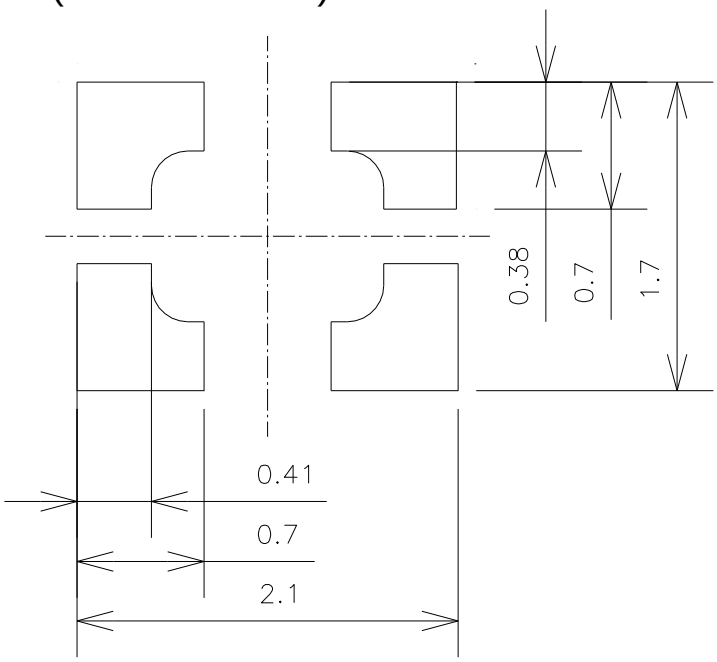
LAND PATTERN1
(Recommended)



LAND PATTERN2
(Recommended)



	Date of Revise	Charge	Approved	Reason
A	15.Oct.2019	R.Omomo	M.Sato	Revise Land pattern to Recommended.

	Date	Name	Third Angle Projection	Tolerance	Scale
Drawn	15. Mar. 2013	T.Asamizu	Dimension:mm	----	--/--
Designed	15. Mar. 2013	T.Asamizu	Title	Drawing No.	Rev.
Checked	15. Mar. 2013	I.Miyahara	**NX2016SF** Dimension Drawing	**EXD14B-00584(2/2)**	**A**
Approved	15. Mar. 2013	M.Kubota			

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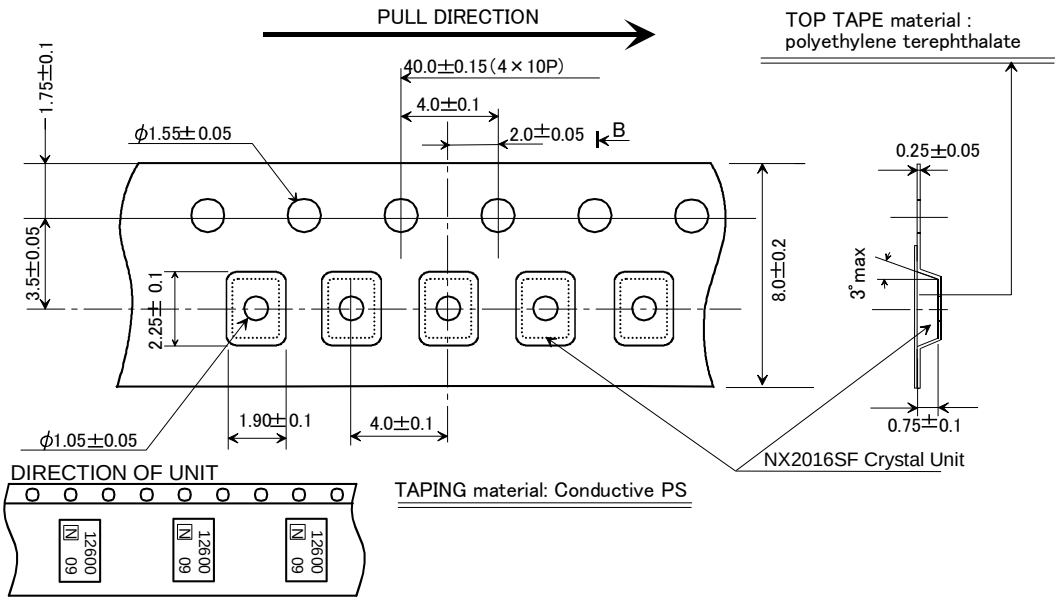
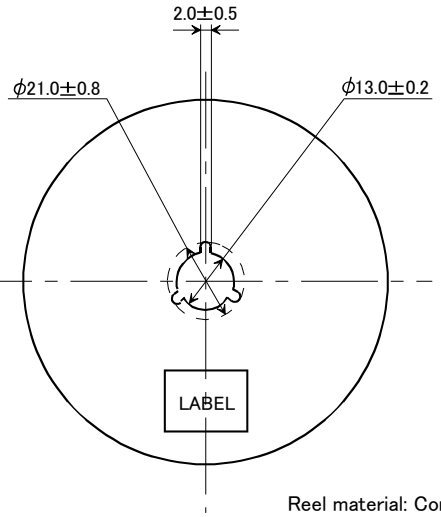
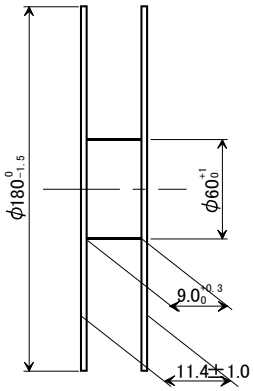
Form M-1

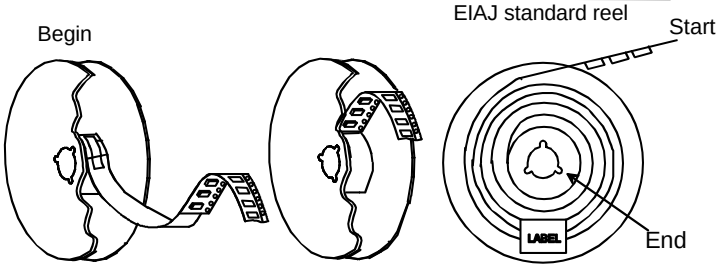






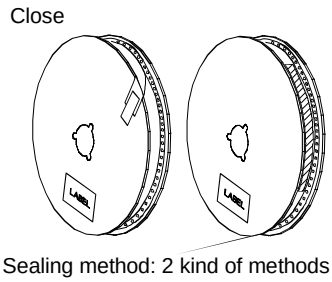
Reel material: Conductive PS

EIAJ standard reel



Roll method: 2 kind of methods

3000pcs-Product Tape



Sealing method: 2 kind of methods

	Date of Revise	Charge	Approved	Reason
A	3 Oct. 2016	H. Ohkubo	H. Murakoshi	Addition of roll method and sealing method.

	Date	Name	Third Angle Projection	Tolerance	Scale
Drawn	30 Jul. 2013	H. Ohkubo	Dimension:mm		/
Designed	30 Jul. 2013	H. Ohkubo	Title	Drawing No.	Rev.
Checked	----------	---------	**NX2016SF Taping and Reel Spec.**	**EXK17B-00370**	A
Approved	30 Jul. 2013	K. Oguri			

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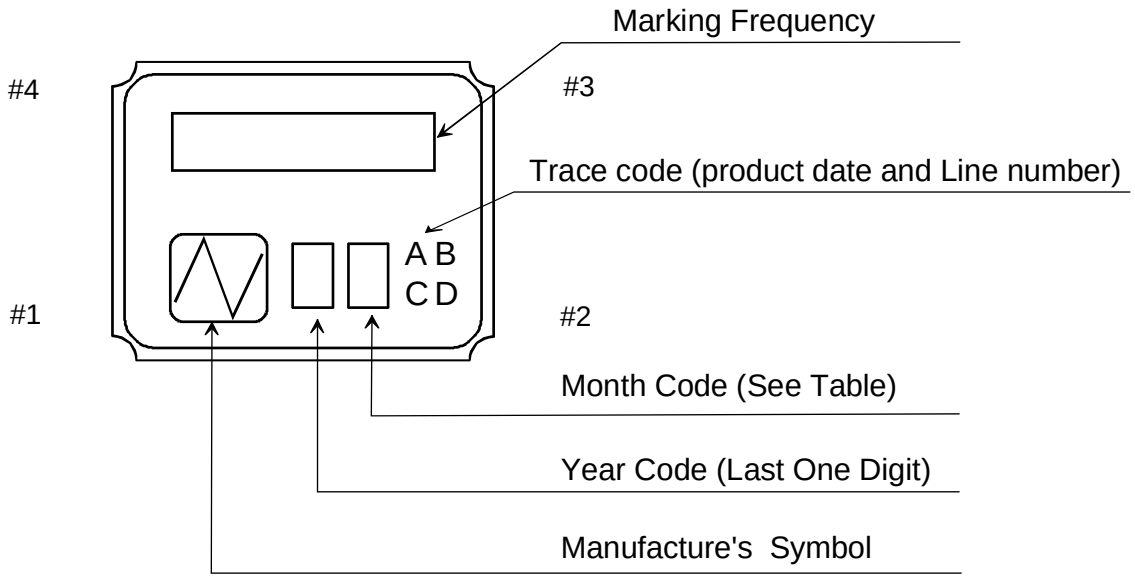

NOTE

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.

	Date of Revise	Charge	Approved	Reason
A	10. Jul. 2008	T.Asamizu	K.Kubota	Delete application period.

	Date	Name	Third Angle Projection	Tolerance	Scale
Drawn	14. Feb. 2006	T.Asamizu	Dimension:mm		/
Designed	14. Feb. 2006	T.Asamizu	Title	Drawing No.	Rev.
Checked	14. Feb. 2006	I.Miyahara	**Crystal Holder Marking**	**EXH11B-00319**	A
Approved	14. Feb. 2006	K.Okamoto			

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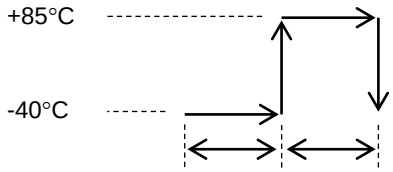
Reliability assurance item (1/2)

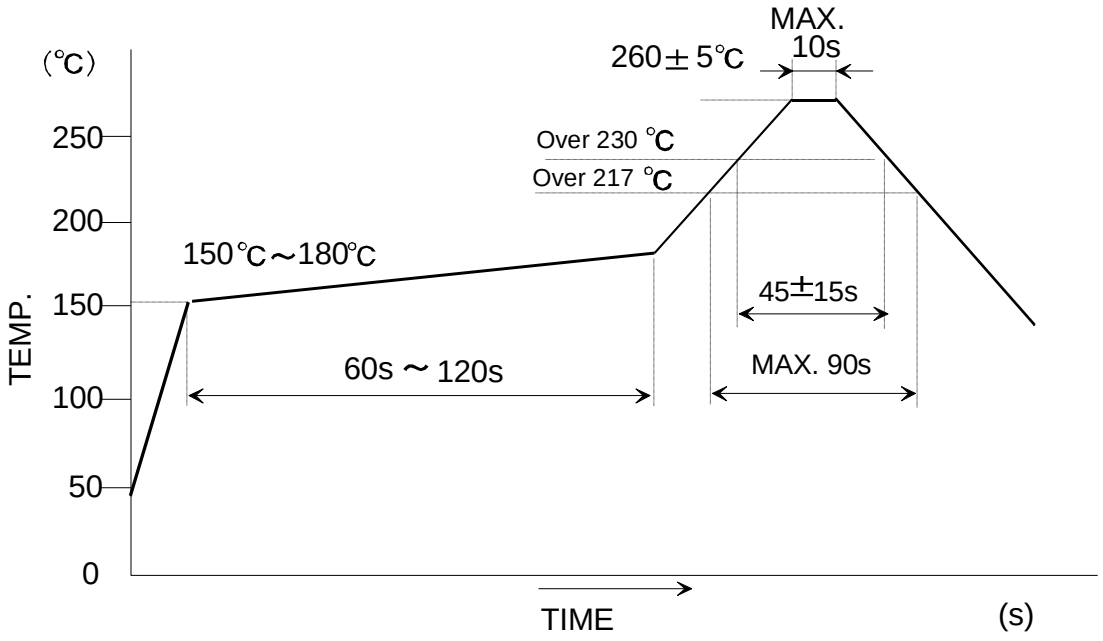
(page: 1/2)

No.	Test Item	Test Methods		Spec. Code
1	High temperature	Temperature: +85 °C Test time: 500 Hr.		B, D
2	Cold resistance	Temperature: –40 °C Test time: 500 Hr.		A, D
3	Humidity	at +85 °C with 80 to 85 % RH for 500 hours.		B, D
4	Thermal shock	Temperature cycle as shown in (Fig.1) for 100 cycle.  ONE CYCLE (Fig.1)		A, D
5	Vibration	Frequency Range	10 to 2000Hz	A, D
		Amplitude or Acceleration	1.52 mm or 20 G	
		1 cycle	20 minutes	
		Test time	Three mutually perpendicular axes each 12 times.	
6	Shock 1	Shock	3000 Gs 0.3 msec.	A, D
		Test time	Six mutually perpendicular axes each 1 times.	
7	Shock 2	Shock	Device are put on the weight of 200 g and dropped on concrete board.	A, D
		Height	1.5 m	
		Drop times	Six mutually perpendicular axes each 10 times.	
8	Solerability	Residual heat temperature	150 °C	C
		Residual heat time	60 to 120 sec	
		Peak temperature	240°C (more than 215 °C 10 to 30 sec)	
9	Reflow resistance	Temperature cycle as shown in (Fig2.) for 3 cycle.		B, D

Specification code	Specification
A	$\Delta F/F \leq \pm 1.0$ ppm $\Delta CI \leq \pm 20$ % or $\pm 15\ \Omega$ greater value
B	$\Delta F/F \leq \pm 2.0$ ppm $\Delta CI \leq \pm 20$ % or $\pm 15\ \Omega$ greater value
C	The electrodes shall acquire a new solder coat over at least 90 % of immersed area.
D	Thermistor resistance: $\Delta R/R \leq 5\%$

Reliability assurance item (2/2)

Recommended reflow profile



A: 150 to 180 °C (90 ± 30 sec.)
B: 230°C min. (45 ± 15 sec.)
C: Peak temperature. 260°C ± 5 °C (10sec. max.)
D: 217 °C Min. (90 sec. max.)