RoHS Compliant
Directive 2011/65/EU

SPECIFICATION

Customer: RIC-VIVO

Item:	Crystal Unit
Type:	NX2016SF
Nominal Frequency:	19.2 MHz
Customer's Spec. No.:	---
NDK Spec. No.:	EXS00A-CS09986

Receipt

Revision Record

Rev.	Rev. Date	Items	Contents	Approved	Checked	Drawn
---	22. Jun. 2016	Issue	---	I. Miyahara	T. Asamizu	Y. Takaki

NIHON DEMPA KOGYO CO., LTD.

1. Customer Specifications Number : ---

2. NDK Specification Number : EXS00A-CS09986

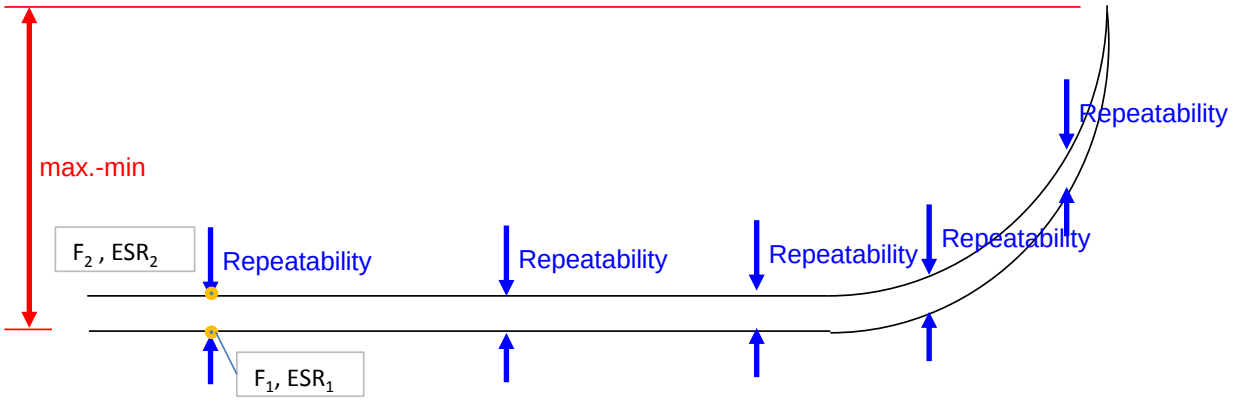
3. Type : NX2016SF

4. Electrical Characteristics

	Parameters	SYM.	Electrical Spec.				Notes
			Min	TYP	MAX	Units	
1	Nominal frequency	f_{nom}		19.2		MHz	-
2	Overtone order	-		Fundamental		-	AT-CUT
3	Frequency tolerance	-	-10	-	+10	ppm	at +25°C
4	Frequency stability over temperature	-	-12	-	+12	ppm	at - 30 to +85°C The reference temp. shall be +32°C
5	Equivalent resistance	-	-	-	80	Ω	IEC π-Network / Series
6	Load capacitance	C_L	-	7	-	pF	IEC π-Network
7	Level of drive	DL	-	10	100	μW	-
8	Temperature coefficient (*Compliant with Qualcomm Mini-Spec. 80-V9690-26*)						
8.1	Inflection temperature	T0	+30.5	+32	+33.5	^oC	-
8.2	Constant range	C0	-10	-	10	ppm	-
8.3	1st order coefficient range	C1	-0.4	-	-0.1	ppm/^oC	-
8.4	2nd order coefficient range	C2	-4.5	-	+4.5	x 10^{-4} ppm/$^oC^2$	-
8.5	3rd order coefficient range	C3	+8.5	-	+11.5	x 10^{-5} ppm/$^oC^3$	-
9	Shunt Capacitance	C_p	0.3	-	1.3	pF	Not grounded
10	Motional Capacitance	C_m	1.2	-	3.1	fF	Not grounded
11	Motional Inductance	L_m	22.2	-	57.3	mH	Not grounded
12	Pulling Sensitivity	PS	8.7	-	29.1	ppm/pF	at CL = 7pF This value is calculated by following formula. $\text{Pulling Sensitivitiy(PS) [ppm/pF]} = \frac{C_m \times 1000}{2(C_p + C_L)^2}$
13	Q-factor	-	75,000	-	-	-	-
14	Spurious resistance	-	1,100	-	-	Ω	within Fnom +/- 1MHz
15	Insulation Resistance	-	500	-	-	M Ω	Terminal to terminal insulation resistance also terminal to cover insulation resistance must be 500MΩ (Min.) when DC100V ±15V is applied.
16	Air-tightness	-	-	-	1.1×10^{-9}	Pa m^3/s	Helium leak detector
17	Operating temperature range	-	-30	-	+105	°C	-
18	Storage temperature range	-	-40	-	+105	°C	-
19	Frequency drift after reflow	-	-2	-	+2	ppm	after two reflow passed.
20	Aging	-	-0.7	-	+0.7	ppm	1st year
		-	-5	-	+5	ppm	7th years

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. Residual frequency stability slope : ±50 ppb/°C Max.

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

The residual is defined as the difference between the crystal measured FT curve and the 5th order polynomial fit of the FT curve. Frequency is measured between -30 to +85°C every 1°C. Residual slope is calculated by the formula below.

$$FIT\Delta f(t_N) = a(t_N - t_0)^5 + b(t_N - t_0)^4 + c(t_N - t_0)^3 + d(t_N - t_0)^2 + e(t_N - t_0) + f$$
$$t_1 = -30, t_2 = -29, \cdots t_{114} = +84, t_{115} = +85°C$$
$$t_0 = +32°C$$

$$RES(t_N) = F(t_N) - FIT\Delta f(t_N)$$
$$RES\_SLP = RES(t_{N+1}) - RES(t_N)$$

7.1. 5°C small orbit hysteresis 1 : ±50 ppb/°C Max. Ta = -30 to +85°C

Condition1B 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 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.
- The residual slope should be within +/-50 ppb/°C.

7.2. 5°C small orbit hysteresis 2 : 100 ppb (magnitude) peak-peak. Ta = -30 to +85°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.

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.

9. Examination results document

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

10. Application drawing

10.1. Dimension Drawing	: EXD14B-00584
10.2. Taping and Reel figure	: EXK17B-00371
	: EXK17B-00370
10.3. Holder Marking	: EXH11B-00319
10.4. Reliability assurance Item	: EXS30B-00808

11. Notice

11.1. Order items are manufactured according to specification. As to conditions, which are not indicated in this specification and unpredictable such as applied condition and oscillation margin, please check them beforehand.

11.2. Unless we receive request for modification within 3 weeks from the issue date of this NDK specification sheet, we will supply products according to this specification. Also, if you'd like to modify specification of order, which has been placed with delivery request within 3 weeks from the issue data of this specification sheet, we would like to discuss with you separately.

11.3. In no event shall the company be liable for any product failure resulting from an inappropriate handling or operation of the product beyond the scope of its guarantee.

11.4. Where any change to the process condition is made due to the change(s) in the production

line, inform personnel of the specifications.

11.5. Should this specification data give rise to any disputes relating to any intellectual property rights or any other rights of a third person, the company shall not indemnify anyone for any damage. Their disclosure must not be construed as the grant of a license to use any of the intellectual property rights owned by the company.

11.6. If you intend to use products listed on this specification for applications that may result in loss of life or assets (controls relating to safety, medical equipment, aeronautical equipment, space equipment, etc.), please do not fail to advise us of your intention beforehand.

11.7. In the company's production process whatever amount of ozone depleting substances (ODS) as specified in the Montreal protocol is not used.

11.8. Information contained in this specification must not be quoted, reproduced or used for other purposes including processing either in part or in full without obtaining prior approval from the company.

11.9. The appearance color has a different case by purchasing it more than 2 suppliers of the component, but characteristic and reliability are guaranteed.

11.10. In case of the product long time keep at high temperature and humidity, may affect product characteristic (solder ability) and a packing condition.
Please keep at storage condition of temperature +5°C ~+35°C, humidity ~85%RH.

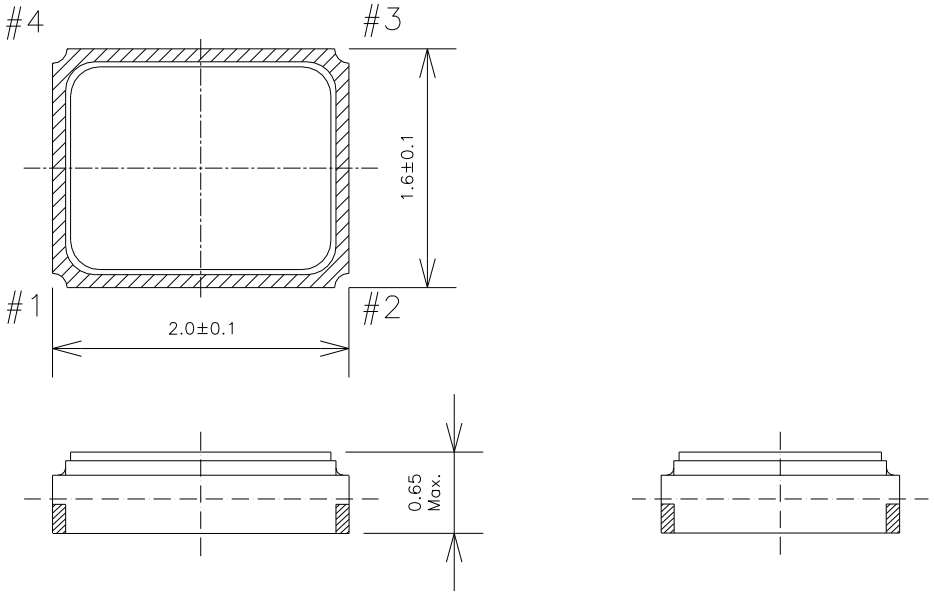
11.11. Crystal units will be damaged by ultrasonic welding process due to resonance of crystal wafer itself. NDK does not recommend using ultrasonic welding. If Ultra Sonic welding used, NDK strongly recommend verifying crystal unit damage by ultrasonic weld.

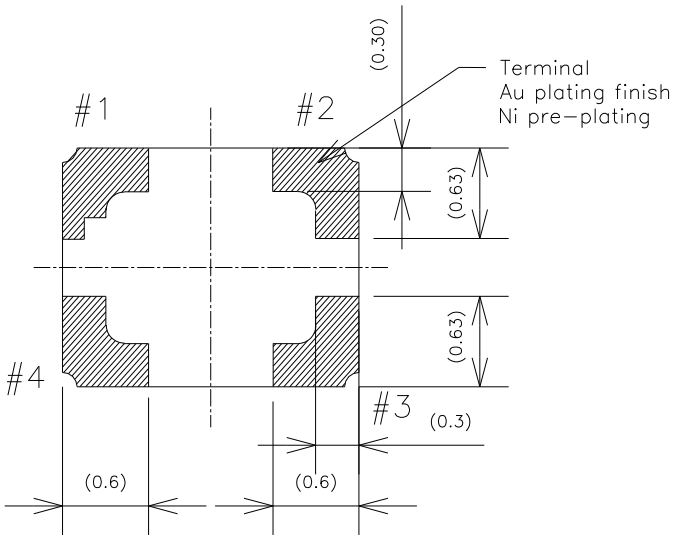
12. Prohibited items

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

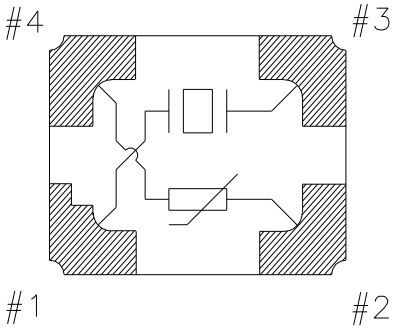
(1) Reflow soldering heat resistance
Peak temperature: 265°C, 10 sec
Heating: 230°C or higher, 40 sec
Preheating: 150°C to 180°C, 120 sec
Reflow passage times: twice

(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

	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)**	
Approved	15. Mar. 2013	15. Mar. 2013			

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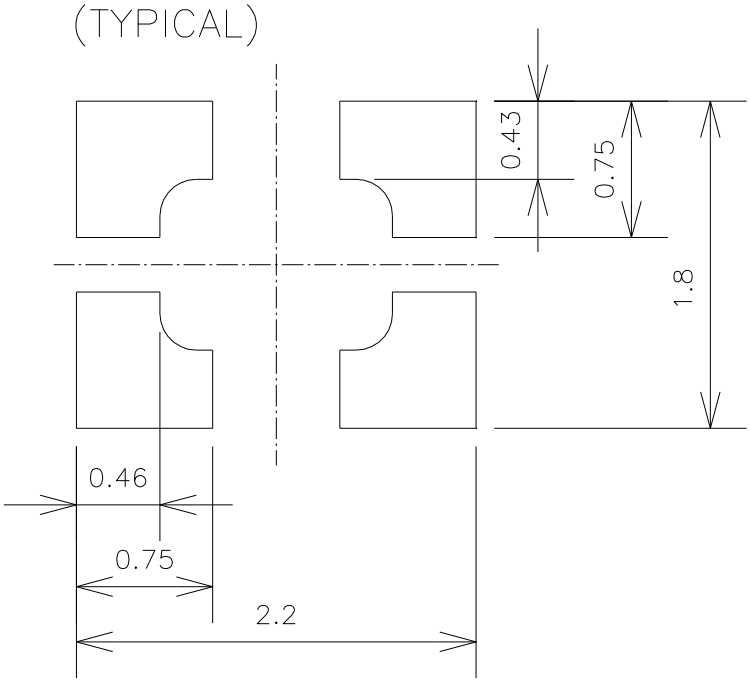
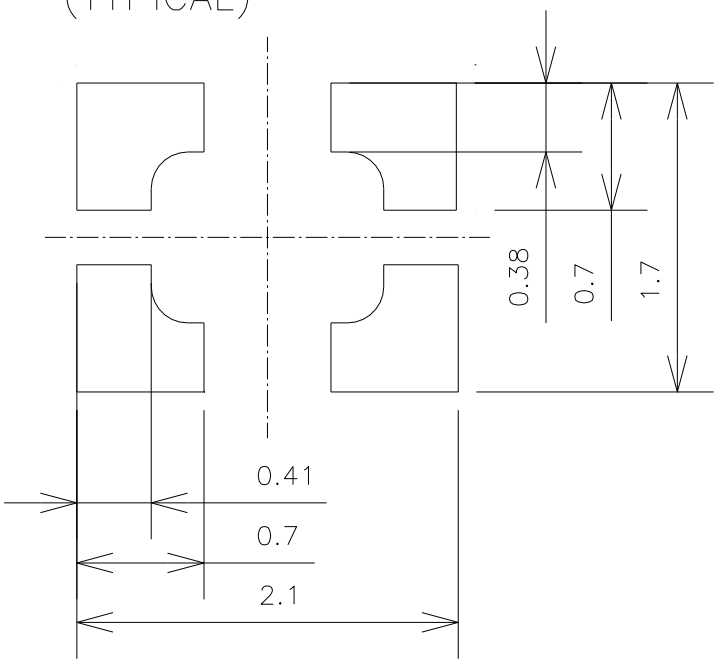
LAND PATTERN 1
(TYPICAL)



LAND PATTERN 2
(TYPICAL)



	Date of Revise	Charge	Approved	Reason

	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)**	
Approved	15. Mar. 2013	M.Kubota			

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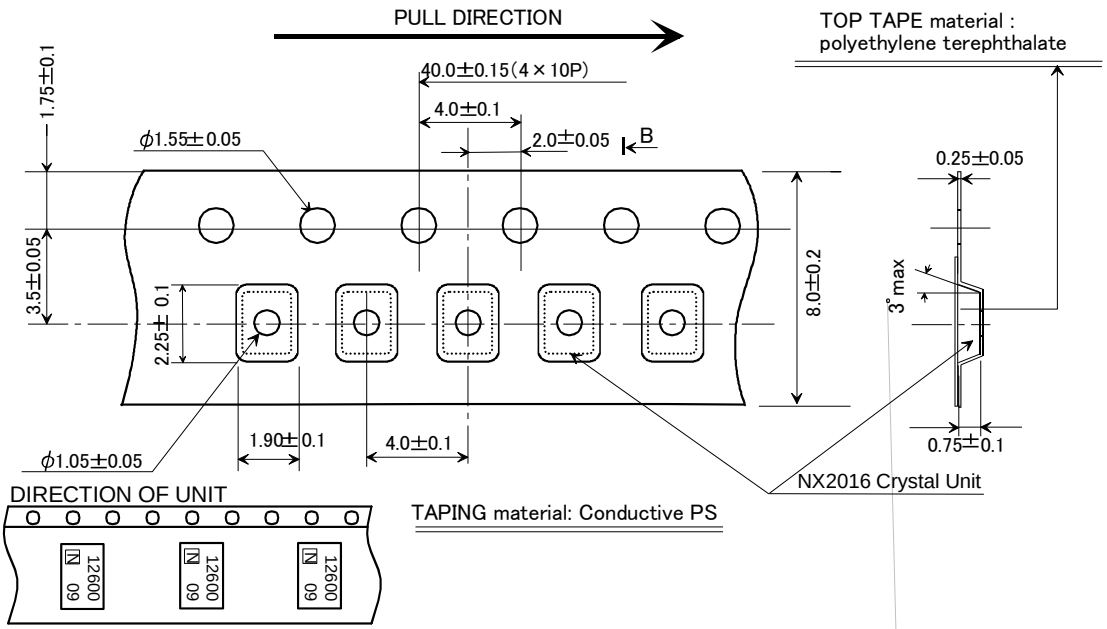
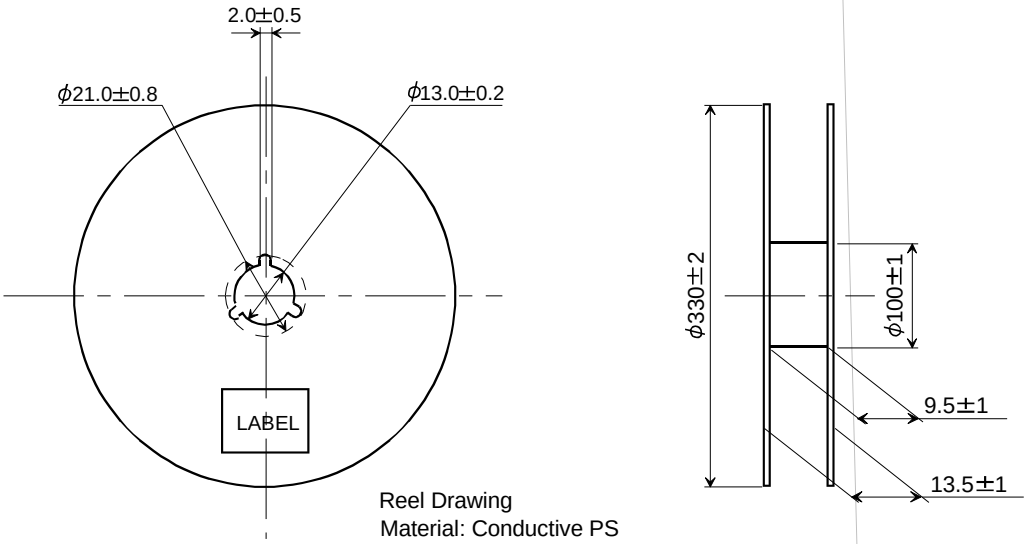
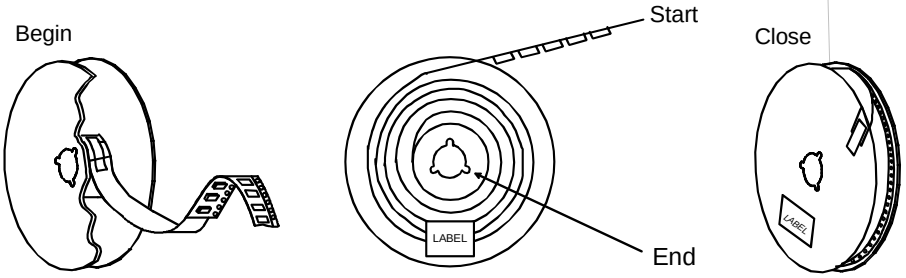
Form M-1

This packing drawing is specified for mass-production







10000pcs-Product Tape

	Date of Revise	Charge	Approved	Reason

	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-00371**	---
Approved	30 Jul. 2013	K. Oguri			

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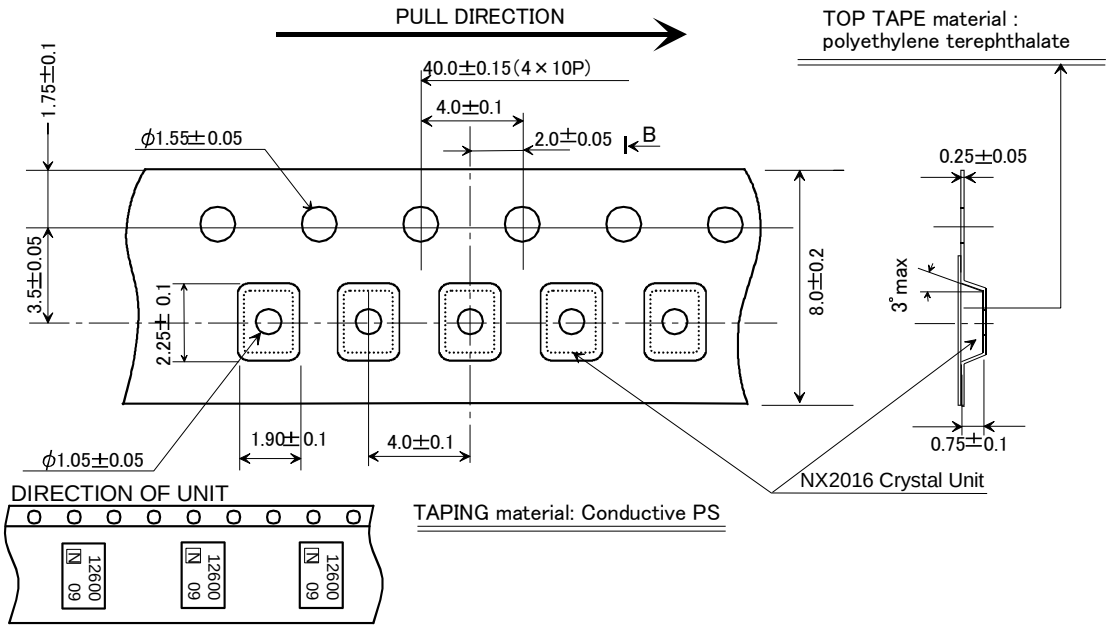
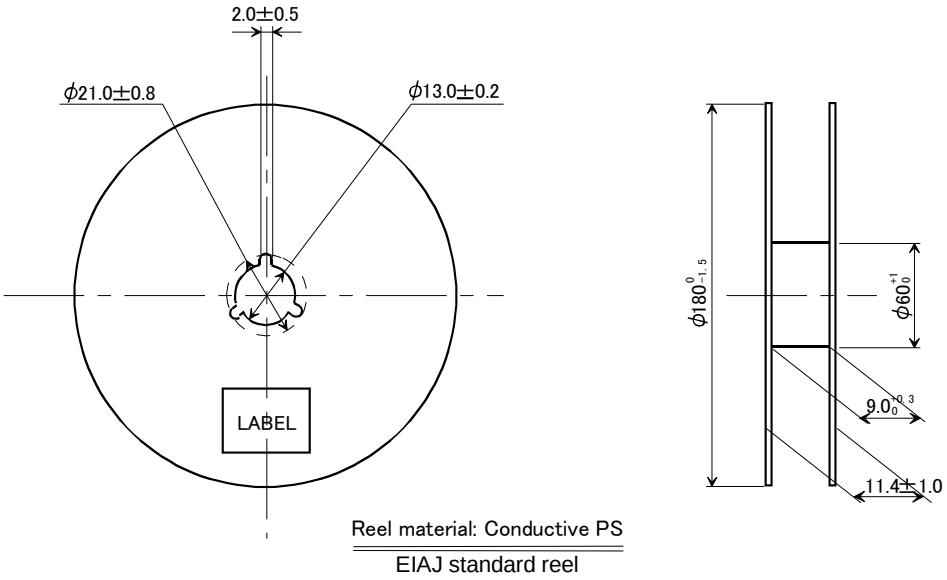
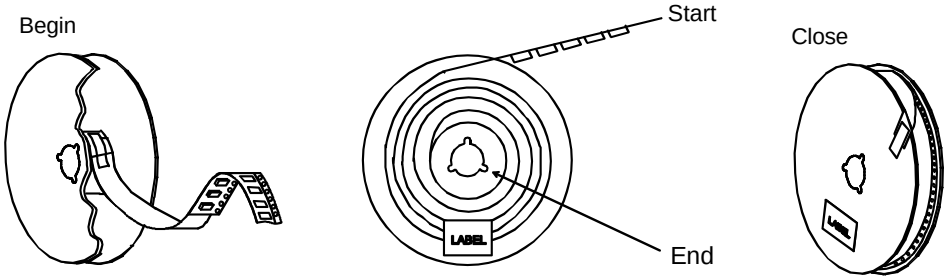
Form M-1

This packing drawing is specified for pre-production







3000pcs-Product Tape

	Date of Revise	Charge	Approved	Reason

	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**	
Approved	30 Jul. 2013	K. Oguri			

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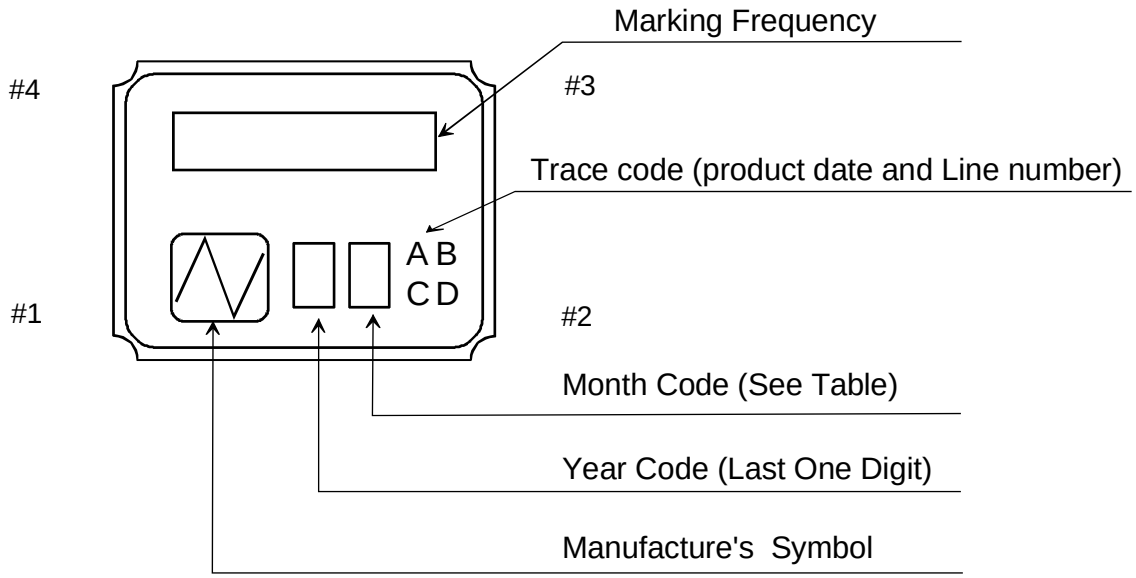
Form M-1



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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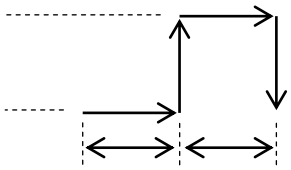
Reliability assurance item (1/1)

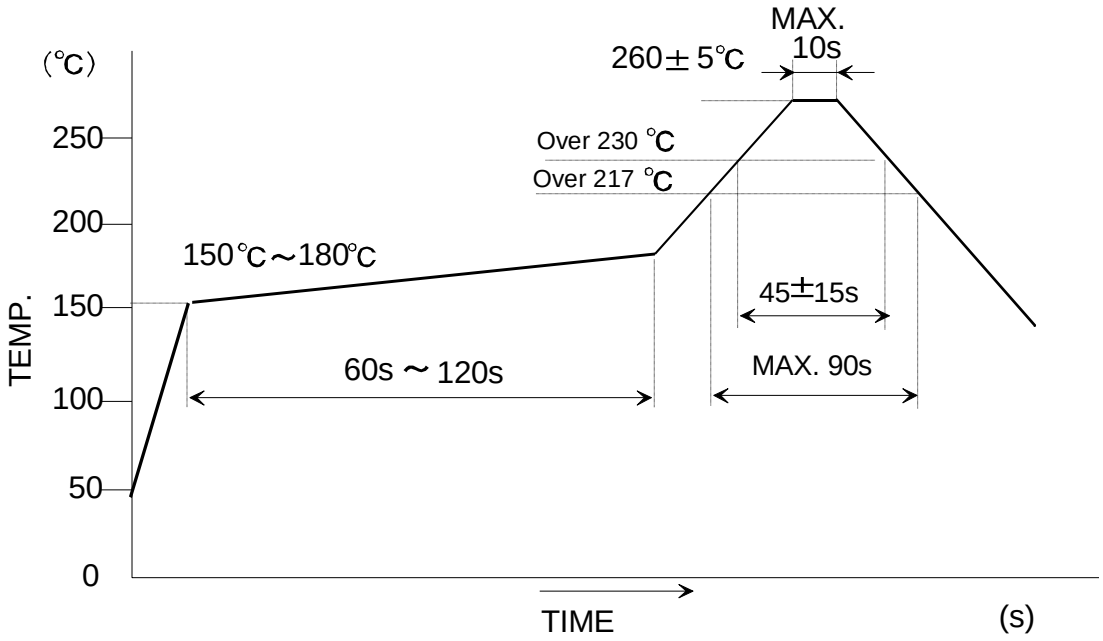
(page: 1/2)

No.	Test Item	Test Methods		Spec. Code
1	High temperature	Temperature: +85 °C Test time: 500 Hr.		A, C
2	Cold resistance	Temperature: –40 °C Test time: 500 Hr.		A, C
3	Humidity	at +85 °C with 80 to 85 % RH for 500 hours.		A, C
4	Thermal shock	Temperature cycle as shown in (Fig.1) for 100 cycle.  ONE CYCLE (Fig.1)		A, C
5	Vibration	Frequency Range	10 to 2000Hz	A, C
		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, C
		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, C
		Height	1.5 m	
		Drop times	Six mutually perpendicular axes each 10 times.	
8	Solerability	Residual heat temperature	150 °C	B
		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.		A, C

Specification code	Specification
A	$\Delta F/F \leq \pm 1.0$ ppm $\Delta CI \leq \pm 15$ % or $\pm 2\ \Omega$ greater value
B	The electrodes shall acquire a new solder coat over at least 90 % of immersed area.
C	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.)