

RECIPIENT

## SPECIFICATIONS

**Product No. : Q13MC1462008500**

**MODEL : MC-146**

**SPEC. No. :**

**DATE: 20. Aug. 2021**

### SEIKO EPSON CORPORATION

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CHECKED \_\_\_\_\_ /

PREPARED \_\_\_\_\_ /

# SPECIFICATIONS

## 1. Application

- 1) This document is applicable to the crystal unit that are delivered to from Seiko Epson Corp.
- 2) RoHS compliant  
MC-146 contains lead in high melting type solder which is exempted in RoHS directive.
- 3) This Product supplied (and any technical information furnished, if any) by Seiko Epson Corporation shall not be used for the development and manufacture of weapon of mass destruction or for other military purposes.  
Making available such products and technology to any third party who may use such products or technologies for the said purposes are also prohibited.
- 4) This product listed here is designed as components or parts for electronics equipment in general consumer use.  
We do not expect that any of these products would be incorporated or otherwise used as a component or part for the equipment, which requires an systems, and medical equipment, the functional purpose of which is to keep extra high reliability, such as satellite, rocket and other space life.

## 2. Product No. / Model

The product No. of this crystal unit is Q13MC1462008500.  
The model is MC-146.

## 3. Packing

It is subject to the packing standard of Seiko Epson Corp.

## 4. Warranty

Defective parts which originate with us are replaced free of charge in the case of defects being found with 12 months after delivery.

## 5. Amendment and/or termination

Amendment and/or termination of this specification is subject to the agreement between the two parties.

## 6. Contents

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[ 1 ] Absolute maximum ratings

No.	Item	Symbol	Rating value			Unit	Note
			Min.	Typ.	Max.		
1	Storage temperature range	T_stg	- 55		+ 125	°C	Suppose to be within CI STD at + 25 °C ± 3 °C.
2	Maximum level of drive	GL		1.0		μW	

[ 2 ] Operating range

No.	Item	Symbol	Rating value			Unit	Note
			Min.	Typ.	Max.		
1	Operating temperature range	T_use	- 40		+ 85	°C	
2	Level of drive	DL	0.01	0.1	0.5	μW	
3	Vibration mode		Fundamental				

[ 3 ] Static characteristics

No.	Item	Symbol	Value	Unit	Conditions	
1	Nominal Frequency	f_nom	32.768	kHz		
2	Frequency tolerance	f_tol	± 20	× 10 <sup>-6</sup>	CL = 12.5 pF Ta = + 25 ± 3 °C Level of drive : 0.1 μW Not include aging	
3	Motional resistance	R1	65 Max.	kΩ	CI meter : Saunders 140B Level of drive : 0.5 μW	
4	Motional capacitance	C1	1.9 Typ.	fF		
5	Shunt capacitance	C0	0.8 Typ.	pF		
6	Frequency temperature characteristics	Turnover temperature	Ti	+ 25 ± 5	°C	Values are calculated by The frequencies at + 10, + 25, + 40 °C with C-MOS circuit.
		Parabolic coefficient	B	- 0.04 Max.	× 10 <sup>-6</sup> /°C <sup>2</sup>	
7	Isolation resistance	IR	500 Min.	MΩ	DC 100 V ± 15, 60 seconds Between terminal # 1 and terminal # 4	
8	Frequency Aging	f_age	± 3	× 10 <sup>-6</sup> /year	Ta = + 25 °C ± 3 °C Level of drive : 0.1 μW	

#### [ 4 ] Environmental and Mechanical characteristics

(The company evaluation condition We evaluate it by the following examination item and examination condition.)

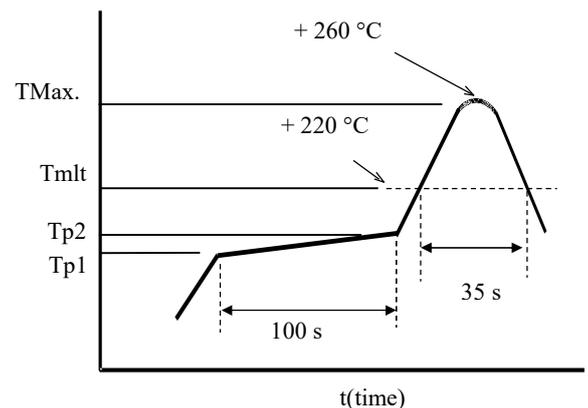
No.	Items	Value *1*2 $\Delta f/f [1 \times 10^{-6}]$	Conditions
1	Shock	*3 $\pm 5$	100 g dummy (EPSON Standard) drop from 1500 mm height on to the concrete 3 directions 10 times
2	Vibration	*3 $\pm 3$	10 Hz to 55 Hz amplitude 0.75 mm 55 Hz to 500 Hz acceleration 98 m/s <sup>2</sup> 10 Hz → 500 Hz → 10 Hz 15 min./cycle 6 h (2 hours , 3 directions)
3	Resistance to soldering heat (Reflow characteristics)	*3 $\pm 5$	For convention reflow soldering furnace (2 times)
4	High temperature storage	*3 a ) $\pm 20$ b ) $\pm 10$	a ) + 125 °C × 1 000 h b ) + 85 °C × 1 000 h
5	Low temperature storage	*3 $\pm 10$	- 55 °C × 1 000 h
6	Temperature humidity storage	*3 $\pm 10$	+ 85 °C × 85 %RH × 1000 h
7	Temperature cycle	*3 $\pm 10$	- 55 °C ↔ + 125 °C 30 minutes at each temperature 100 cycles
8	Shear	No peeling-off at a soldered part	10 N press the side for 10 s $\pm 1$ s. Ref. IEC 60068-2-21
9	Pull-off	No peeling-off at a soldered part	10 N press the side for 10 s $\pm 1$ s. Ref. IEC 60068-2-21
10	Substrate bending	No peeling-off at a soldered part	Bending width reaches 3mm and hold for 5 s $\pm 1$ s × 1 time Ref. IEC 60068-2-21
11	Solderability	Termination must be 95 % covered with fresh solder	Dip termination into solder bath at + 235 $\pm 5$ °C for 3 s (Using rosin flux)
12	Solvent resistance	The marking shall be legible	Ref. JIS C 0052 or IEC 60068-2-45

- Note
1. \*1 Each test done independently.
  2. \*2 Measuring 1 h to 24 h later leaving in room temperature after each test.
  3. \*3 Pre conditionings
    1. + 125 °C × 24 h to +85 °C × 85 %RH × 48 h → reflow 2 times
    2. Initial value shall be after 24 h at room temperature.
 The value of series resistance after each reliability test is 85 kΩ Max.

#### ◆ Air- reflow

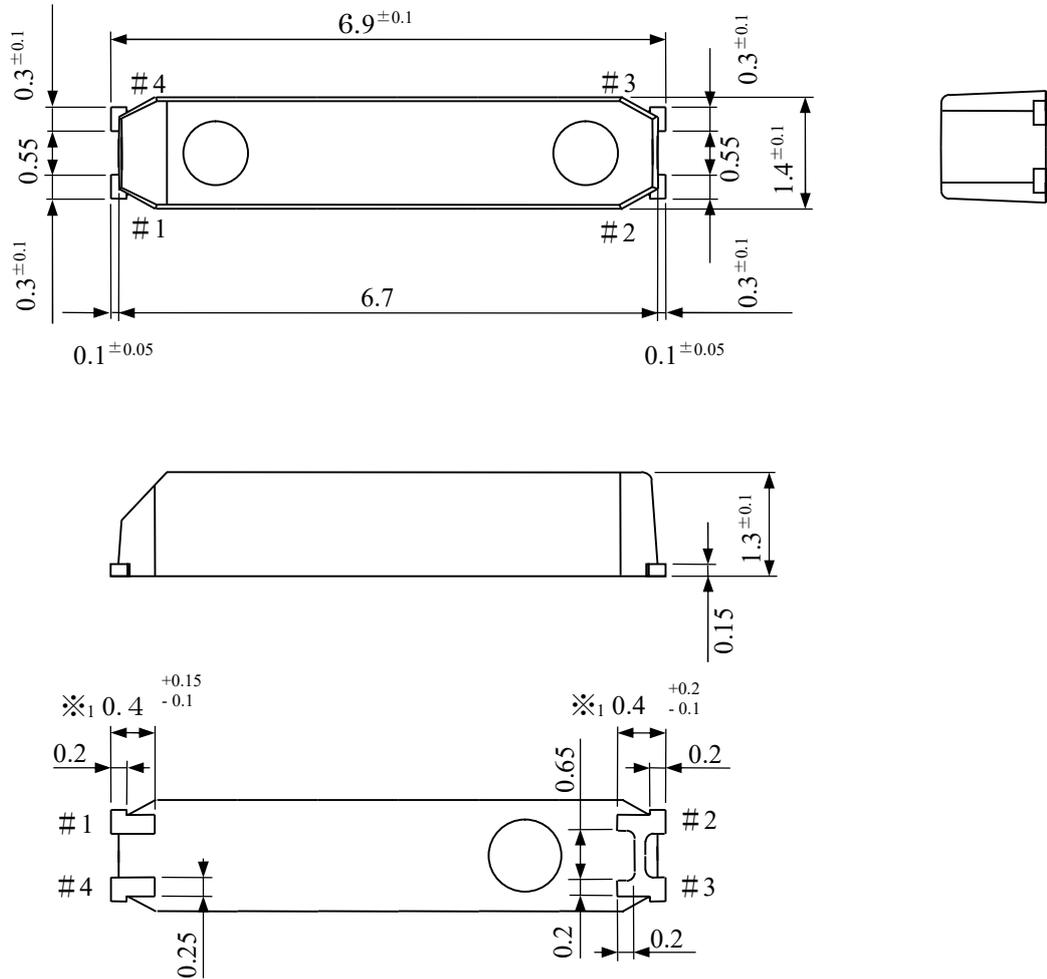
Pre heating temperature : Tp1~Tp2 = + 170 °C  
 Peak temperature must not exceed + 260 °C  
 and the duration of over + 220 °C should be 35 s

T  
(Temperature)



[ 5 ] Dimensions and Marking layout

1. Dimensions



- ※<sub>1</sub> : Available area for soldering
- ※<sub>2</sub> : Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

2. Internal Connection

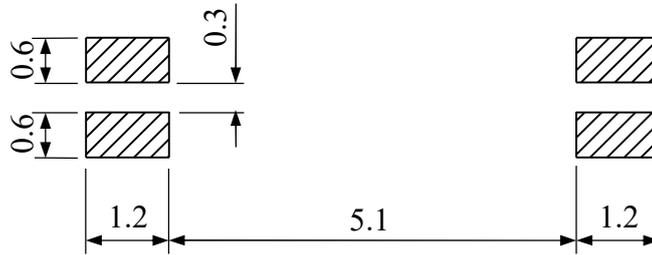


Do not connect # 2 and # 3 terminals to any external circuits (including GND).

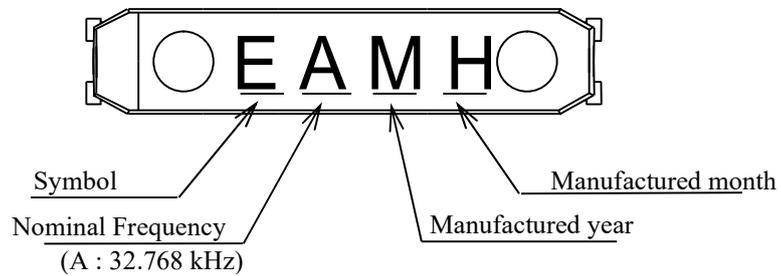
Type	MC-146	Unit	1 = 1 mm
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3. Recommended soldering pattern

Unit : 1 = 1 mm



4. Marking layout



Symbol of Manufacturing year

Year digit		1	2	3	4	5	6	7	8	9	0
Marking	Terminal Plating: Sn	M	N	R	S	T	U	V	W	X	Z

Year digit(1<sup>st</sup>) of the Production

Symbol of Manufacturing month

Month digit	1	2	3	4	5	6	7	8	9	10	11	12
Marking (Halide free)	A	B	C	D	E	F	G	H	J	K	L	M

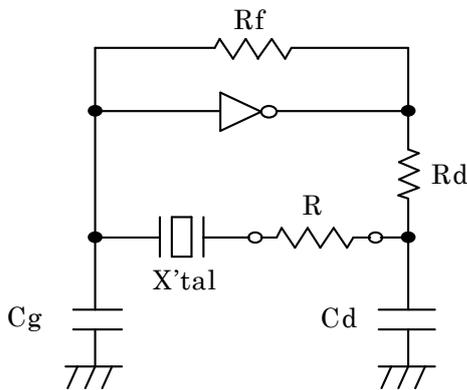
- ◆ The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

Type	MC-146	Unit	1 = 1 mm
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[ 6 ] Notes

1. Max two (2) times reflow is allowed. Once miss soldering is happened, hand work soldering by soldering iron is recommended. (+ 350 °C × within 5 sec.)
2. Patterning should be followed by our recommended one.
3. Applying excessive excitation force to the crystal unit may cause deterioration damage.
4. Unless adequate negative resistance is allocated in the oscillation circuit, start up time of oscillation may be increased, or no oscillation may occur.

How to check the negative resistance.



- (1) Connect the resistance (R) to the circuit in series with the crystal unit.
- (2) Adjust R so that oscillation can start (or stop).
- (3) Measure R when oscillation just start (or stop) in above (2).
- (4) Get the negative resistance  
 $-R = R + CI$  value.
- (5) Recommended  $-R$   
 $|-R| > CI \times (5 \sim 10)$

5. The shortest patterning line on board is recommendable.  
Too long line on board may cause of abnormal oscillation.
6. To avoid mull function, no pattern under or near the crystal is allowed.  
Solder paste should be more than 150 μm thickness.
7. This device must be stored at the normal temperature and humidity conditions before mounting on a board.
8. Too much exciting shock or vibration may cause deterioration on damage.  
Depending on the condition such as a shock in assembly machinery, the products may be damaged.  
Please check your condition in advance to maintain shock level to be smallest.
9. Depending on the conditions, ultrasonic cleaning may cause resonant damage of the internal crystal unit. Since we are unable to determine the conditions (type of cleaning unit, power, time, conditions inside the bath, etc.) to be used in your company, we cannot guarantee the safety of this unit when it is cleaned in an ultrasonic cleaner.
10. Ink marking may be damaged by some kind of solvent, please take precautions when choosing solvent by your selves.
11. Please refer to packing specification regarding how to storage the products in the pack.

Messrs.  

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( first · revised )

***Delivery Specifications***

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Product No : Quartz Crystal Unit SSP-T7-F

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Item code : Q-SPT7P0327620C5GF

---

Product form : 32.768kHz  $\pm 20 \times 10^{-6}$  / 12.5 pF

---

The number of copies :

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Date of Registrantion :

Receipt Column	Note

## 〈NOTICE〉

1. Advance agreement will be needed before changing any contents of the specification herein.
2. Provided that the information herein is subject to change, only revised pages shall be reissued.
3. When the product described herein includes Regulated Products subject The Wassenaar Arrangement etc, they may not be exported without authorization from the appropriate governmental authorities.
4. The contents of this specification including all figures and illustrations are proprietary information (copyright or know-how) of Seiko Instruments Inc. It is strictly prohibited to copy all or part of these specifications to third parties without permission.
5. In the case that the products described herein are used as part of any devices or equipment which might influence any one of the human body, human life and property, such as physical exercise equipment, medical equipment or vehicles, please let us know that.

Seiko Instruments Inc.  
Quartz Crystal Division  
Electronic Components Business

1-8, Nakase, Mihamaku, Chiba shi,  
Chiba 261-8507 Japan

Dept. of Issue

Sales Section

Dept. of Control

Quality Assurance Dept.

# Delivery Specifications

## 1.Scope

These specifications apply to QUARTZ CRYSTAL RESONATORS ( hereinafter referred to as RESONATORS ) to be manufactured by Seiko Instruments Inc. ( hereinafter referred to as SII ) to \_\_\_\_\_

## 2.Designation

RESONATORS are designated " SSP-T7-F"(32.768kHz ).

## 3.Shape and dimensions

As per the SSP-T7-F drawing shown on page 5 .

## 4.Electrical characteristics

Specified on page 2 through 3.

## 5.Shipment and packaging

- 5.1 (3,000) pcs are the standard lot size to which the lot number shall be allotted
- 5.2 The packaging shall conform to the resonator packaging standards.

## 6.Outgoing inspection

- 6.1 When mutually agreed, the outgoing inspection shall be conducted as per the standard on page 4.
- 6.2 The outgoing inspection slip is not basically affixed to each packaging.

## 7.Warranty

In the event that any defective RESONATORS or defective lot is found at incoming inspection at \_\_\_\_\_ and that any defect resulting from failures in process-control at SII after incoming inspection is found, good RESONATORS shall be supplied to \_\_\_\_\_ free of charge as a replacement .

In the event that any trouble or problems rising directly from RESONATORS occurs, it will be amicably settled between both parties, provided that warranty shall be done within the score of replacement of good RESONATORS.

## 8.Amendment or abolition of the specifications

Amendment or abolition of the specifications shall be made upon mutual consent between \_\_\_\_\_ and SII. If any problem arises , it shall be amicably settled between both parties.

## 9.Effectiveness of the specifications

These specifications are effective after receipt of returned copies with your approved sign.

## 10.Others

RoHS compliant

These products use Pb in high melting temperature type solders exempted by RoHS directive.

Resin including brominated Flame retardant and Antimony Trioxide ( $Sb_2O_3$ ), is not used on the product.

**[1] The maximum rating**

	Item	Symbol	Rating	Note
1	Storage temperature range	T_stg	-55 ~ +125	
2	Maximum drive level	DL max.	1.0 $\mu$ W max.	

**[2] Recommended Operating Condition**

	Item	Symbol	Rating	Note
1	Operating temperature range	T_use	-40 ~ +85	
2	Drive level	DL	0.1 $\mu$ W typ.	

**[3] Electrical -Characteristics**Measurement temperature : 25 $\pm$ 2

	Item	Symbol	Specifications	Conditions
1	Nominal frequency	f_nom	32.768 kHz	
2	Frequency tolerance	f_tol	$\pm 20 \times 10^{-6}$	
3	Load capacitance	C <sub>L</sub>	12.5 pF	
4	Motional resistance	R <sub>1</sub>	65 k $\Omega$ max.	Measured with ATI 4192A Impedance analyzer. OSC LEVEL = 0.1V
5	Q-value	Q	$40 \times 10^3$ min.	calculated with the following equation : $Q=(2\pi \cdot Fr \cdot L_1)/R_1$
6	Motional capacitance	C <sub>1</sub>	1.9 fF typ.	
7	Shunt capacitance	C <sub>0</sub>	0.8 pF typ.	Measured with ATI 4192A Impedance analyzer. OSC LEVEL = 0.1V
8	Turnover temperature	Ti	25 $\pm$ 5	Measure this coefficient at 3 points of 10 , 25 , and 40 using C-MOS circuit.
9	Parabolic coefficient	B	$(-3.5\pm 1.0) \times 10^{-8}/^2$	
10	Frequency ageing	f_age	$\pm 3 \times 10^{-6}$ / year	25 $\pm$ 3 , First year
11	Insulation resistance	IR	500 M $\Omega$ min.	Measured with ATI 4329A Insulation Resistance Meter. Apply DC100V.

**[4] Environment-proof · Mechanical property**

No	Item	Specifications	Conditions	
1	High temperature storage	$f/f = \pm 10 \times 10^{-6}$	After storage under 85 for 500 hrs, measure at room temperature.	*1
2	Low temperature storage	$f/f = \pm 10 \times 10^{-6}$	After storage under -40 for 500 hrs, measure at room temperature.	*1
3	High temperature and high humidity storage	$f/f = \pm 10 \times 10^{-6}$	After storage under 60 $\pm 2$ , 90 to 95% RH for 500 hrs, measure at room temperature.	*1
4	Thermal shock resistance	$f/f = \pm 10 \times 10^{-6}$	Measured at room temperature after 20 cycles. -25 +80 for 30 minutes.	*1
5	Mechanical shock resistance	$f/f = \pm 5 \times 10^{-6}$	Measure after free drop of the RESONATOR three times from the height of 75cm onto a wooden board.	*2
6	Vibration resistance	$f/f = \pm 5 \times 10^{-6}$	Amplitude 1.5mm and 10 ~ 60Hz with cycle time 2 ~ 3 minutes in 3 direction (X,Y,and Z axis)each for 2 hrs.	*2
7	IR Reflow	$f/f = \pm 10 \times 10^{-6}$	Measure after 1 time reflow under reflow profile specified in page 10	*1

## Note:

1. The above tests no. 1 to 7 must be conducted independently (not series tests)
2. \*1: Measure after 24 hours soak at room temperature .
3. \*2: Measure after 2 hours soak at room temperature .
4. R1 is 85kΩ max. after the each above tests.

## [5] Precautions

### (1) Recommended mounting conditions

Reflow profile                      As per reflow profile shown in page 10.  
 Manual soldering                      350    max. for 4 sec. max.

### (2) Cleaning

The crystal resonator may be destroyed by ultrasonic cleaning.

We don't guarantee the quality of the product with that cleaning method because such conditions as type of the washing machine, power, time, position in the bath, etc. can not be specified.

Please confirm ultrasonic cleaning is not giving any damage to the product before use when that cleaning method must be used.

## [6] Outgoing inspection standard

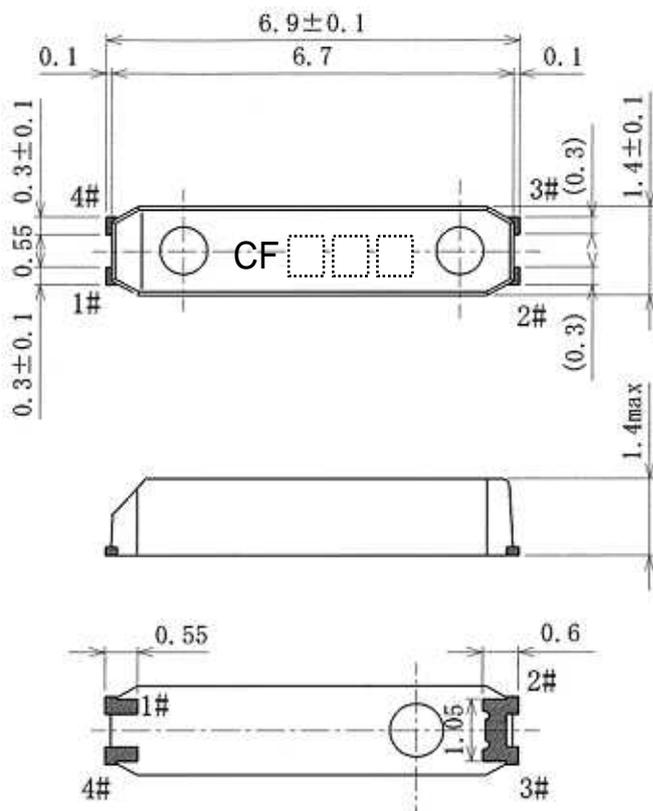
· The outgoing inspection shall be conducted as per the following standard .

· The sampling shall be performed according to the ANSI/ASQCZ1.4-1996 .

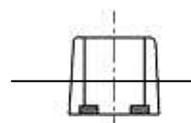
No	Item	Sampling level	AQL(%)
1	Frequency tolerance		1.0
2	Equivalent series resistance		1.0
3	Outer appearance		1.5
4	Others characteristics	Periodical quality inspection	

[7] Out Line Drawing

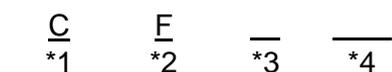
1. Out Line Drawing



\* The part of the cylinder inside resin mold may be sometimes exposed, however, it does not affect the characteristics of crystal unit.

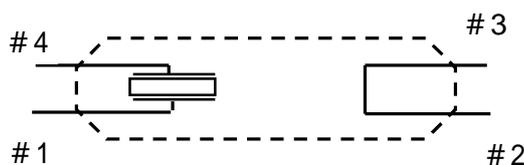


2. Marking



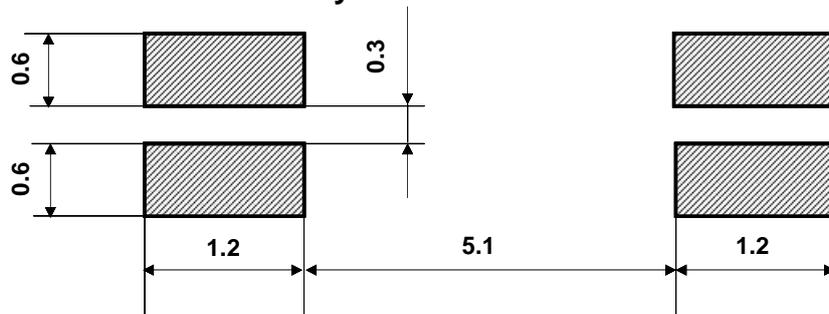
- \*1 Frequency
- \*2 Specification
- \*3 Year of Production  
(Last digit of year)
- \*4 Week of Production  
(01 ~ 52)

3. Lead Connection



Do not connect #2 and #3 to external device.

4. Recommended PAD lay-out



Unit = mm

Materials	42 Alloy Sn (100%)	Remarks	Unit 1=1mm
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## [8] Taping specification

### 1 . Drawing of tape dimensions

Carrier tape see Drawing page 8.

Reel for carrier tape see Drawing page 9.

### 2 . Material

Carrier tape : PS

Reel for carrier tape : HIPS

### 3 . Taping method

- (1) Taping shall be placed in tapes in such manner as to assure that marking of the components is visible as per Fig. 1

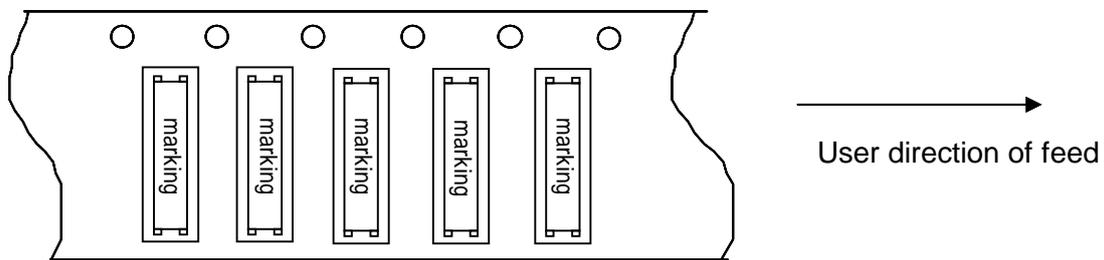


Fig. 1

#### (2) Reel

On the side of reel there shall be more than 40 blocks of "No components".  
The beginning of Carrier Tape shall be bent vertically and hooked on groove of reel.

#### (3) Leader

On the side of leader, there shall be more than 40 blocks of "No components "  
The length of Leader shall be over 400 mm.  
The Length of Stick Tape for Cover Tape shall be about 100 mm and  
Stick Tape shall never be detached.

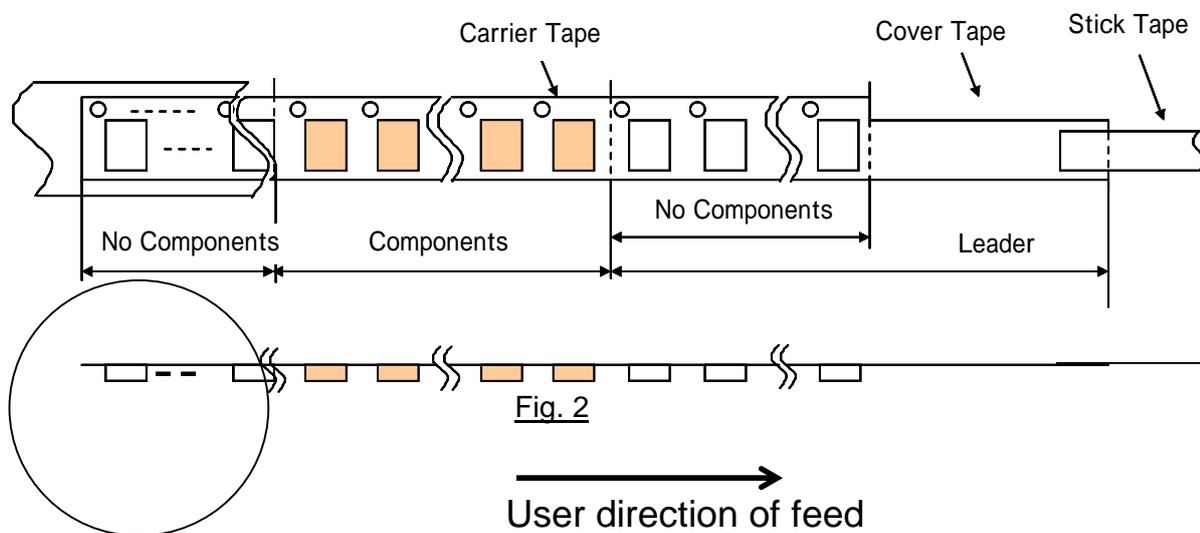
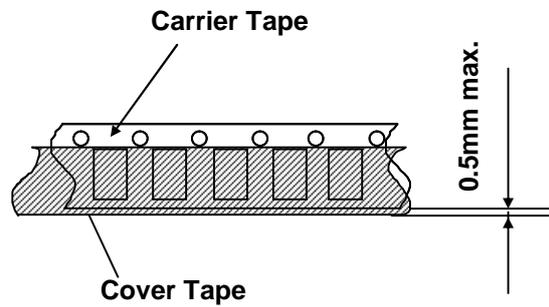


Fig. 2

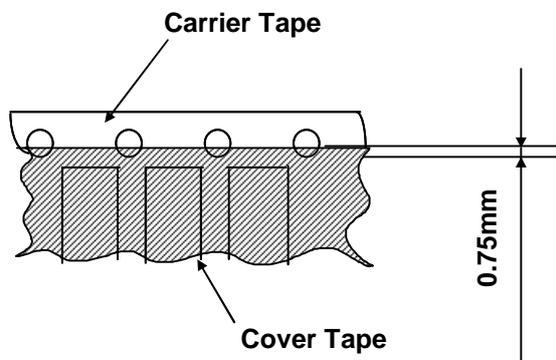
- (4) Gap between Carrier Tape and Cover Tape  
Cover Tape protrudes from Carrier Tape by 0.5mm max.

Fig. 3



Holes of Carrier Tape are covered with Cover Tape by 0.75mm max.

Fig. 4



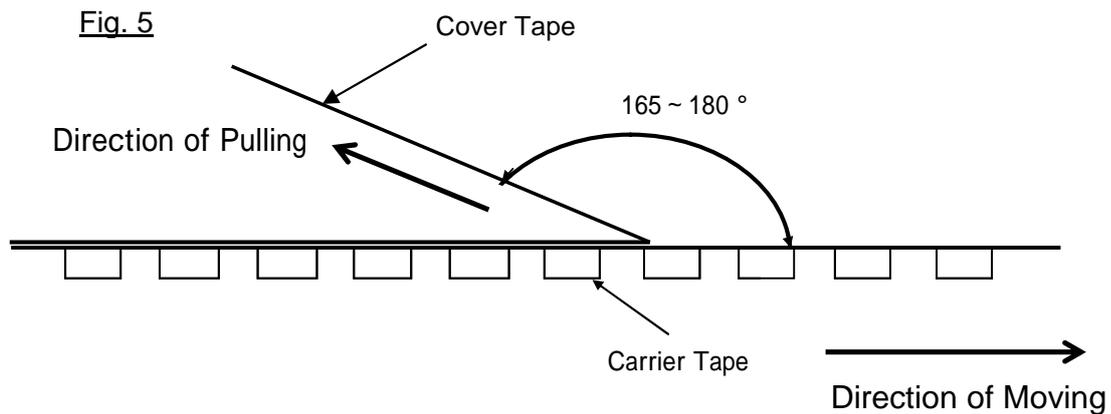
- (5) Peel strength

The method of testing is done as shown below.

The value of force is at the beginning of desealing.

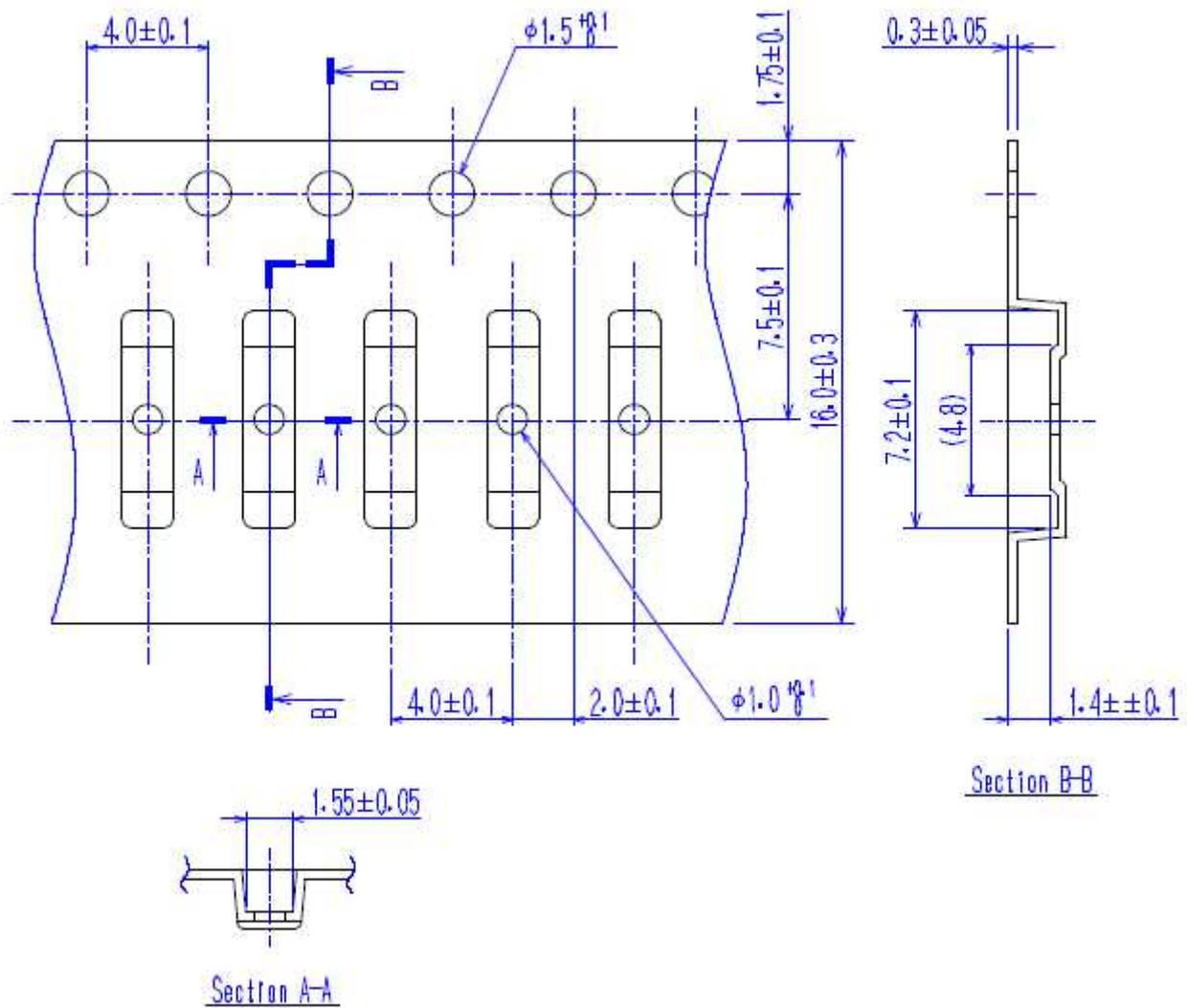
The Cover Tape peel forth shall be 0.1 ~ 1.3N at a peel speed of  $300 \pm 10$  mm/min.

Fig. 5



# Carrier tape

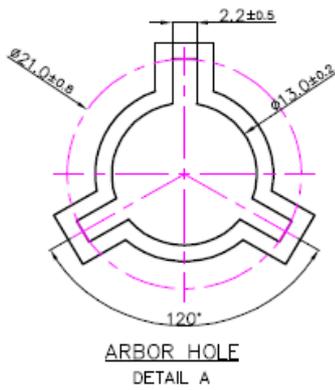
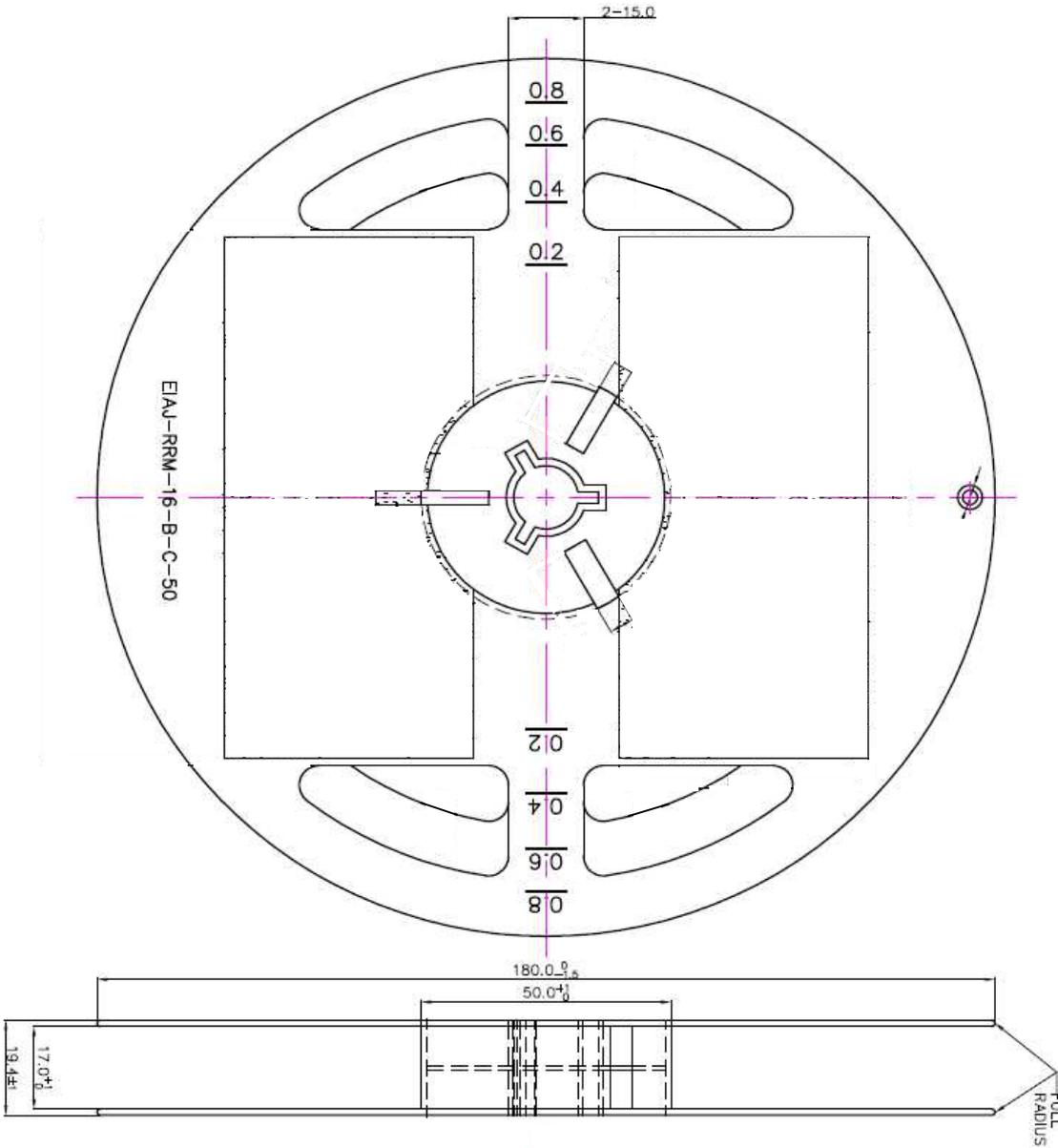
- (1) Conforms with EIA - 481  
 (2) Tolerance :  $\pm 0.2$

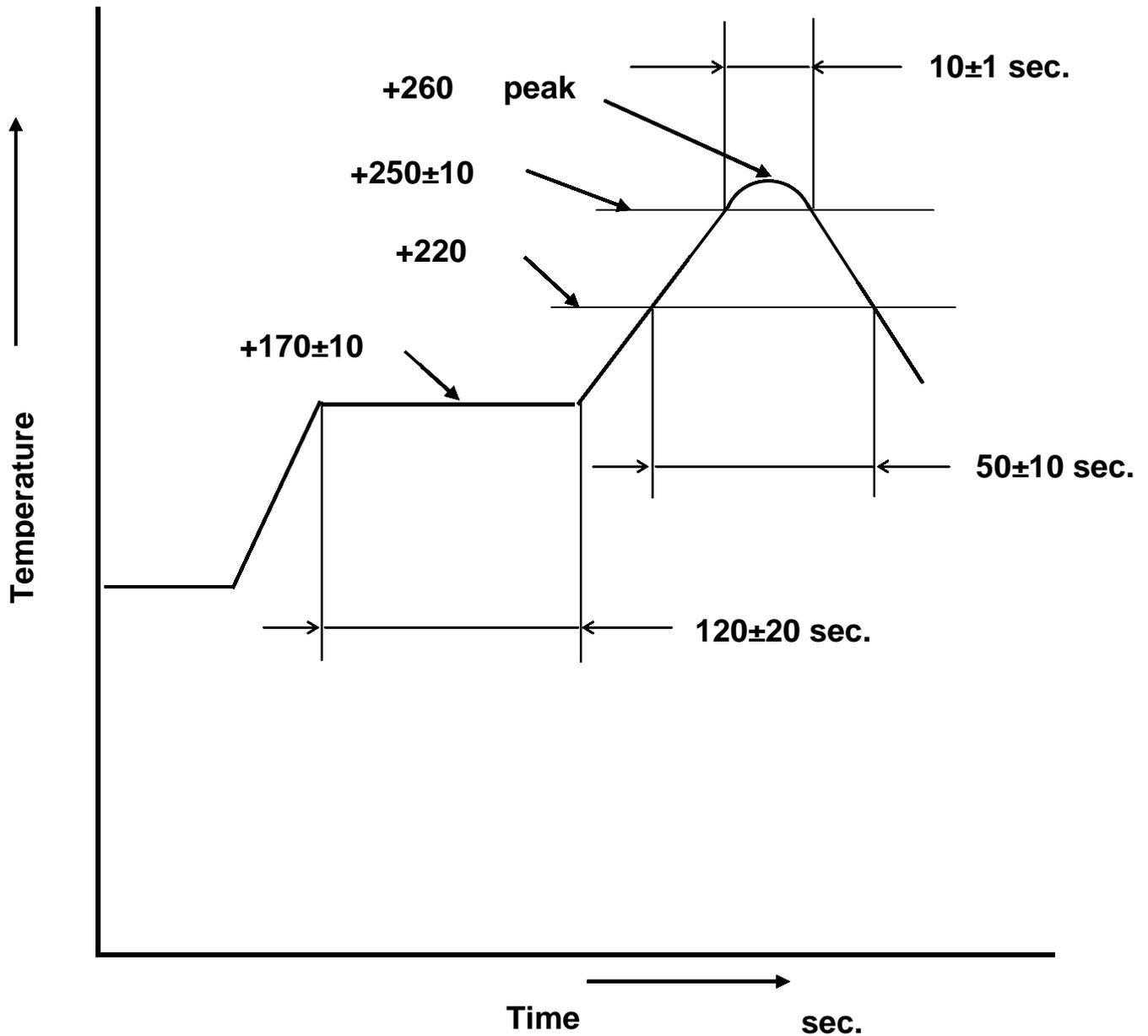


Unit 1=1mm

# Taping reel

- (1) Conforms with EIAJ ET-7200B
- (2) Quantity per reel : 3,000pcs./for a reel



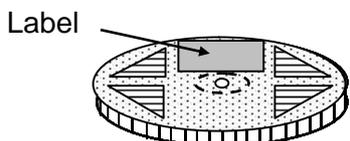
**[9] Reflow Profile**

**Note:** The temperature used herein means the temperature on the circuit board.

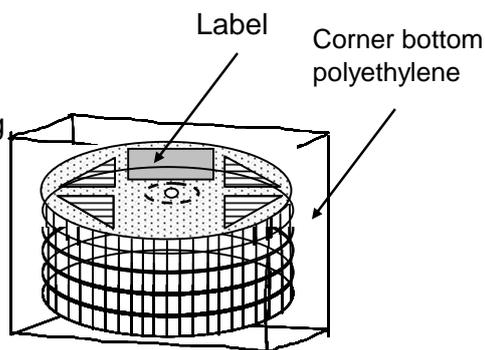
**Reflow :** 2 times max.

**[10] Outside box packing specification**

- (1) To attach the label every 1 volume of reel.
- (2) To insert it in the corner bottom Polyethylene bag for 5 reel Each

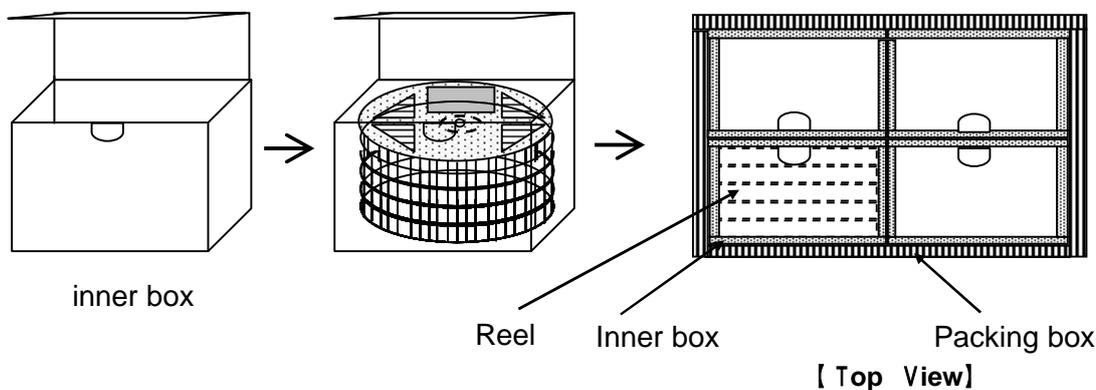


**[ Figure 1 ]**



**[ Figure 2 ]**

- (3) packing and reels  
To put 5reels into a inner box.  
4boxes are packed in packing box (max. 20reels)



**[ Top View ]**

- (4) Storage quantity  
· It makes N=3 , 000 pieces/Lot
- (5) Sample of the label display (display department, please refer to [Figure 1 ] [ Figure 2 ] )

Product bar code	PART	SSP-T7-F
	Lot No.	
	Quantity	3 , 000 pcs
Item bar code *	Calibre	32.768kHz 12.5pF/± 20 × 10 <sup>-6</sup>
	Remarks	RoHS Compliant
Quantity Lot. No. bar code	3,000 XXXX	

PART : Our company product name  
 Lot No. : Lot No. display  
 Quantity : Quantity  
 Calibre : Frequency, CL value, F0 deviation  
 Remarks: Marking etc.  
 \* : Item code

- (6) Storage environment  
A product avoids the direct ray and please store with the normal temperature and humidity .  
\* Temperature : 5 to 30 \* Humidity range : 80% max.