RECIPIENT

SPECIFICATIONS

Product No. : **X1E0002910001**

Model : **FA-20HS**

SPEC. No. : **A11-046-0B**

DATE : **Apr. 25. 2011**

***5 Oct. 4. 2011**

EPSON TOYOCOM CORPORATION

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CHECKED

M. Kaneko : CS Quality Assurance Department

Update History

Contents of change			Reason for change	Update date
Page	Current	Update		
2	[3] Electrical characteristics Pulling Sensitivity	20.85± 8%	Demand of customer	*1 Jul. 8. 2011
	Frequency perturbation	$\pm 0.5\times10^{-6}$		
	Maximum residual frequency temperature slope	± 0.05 ppm/°C		
	Frequency Drive Level Dependency	3×10^{-6}		
	Resistance Drive Level Dependency	20 %		
	Frequency Repeatability	0.7×10^{-6}		
	Resistance Repeatability	10%		
6	[6] Recommended soldering pattern and Marking layout	Pin #1 identified mark		
2	[3] Electrical characteristics		Demand of customer	*2 Aug. 23. 2011
	11 Second-order curve fitting coefficient	-1.0 to 6.0× e^{-4}		
	14 Maximum residual frequency temperature slope	Change a “condition” contents		
3	15 Hysteresis	$\pm 0.1\times10^{-6}$		
	[3] Electrical characteristics		Demand of customer	*3 Aug. 29. 2011
2	11 Second-order curve fitting Coefficient -1.0 to 6.0× e^{-4}	-6.0 to 6.0× e^{-4}		
2	13 Frequency perturbation	13 Maximum residual Frequency perturbation		
2	13 Frequency perturbation 5th polynomial fitting curve	Subtract off a 5th polynomial best fit		
3	15 Hysteresis $\pm 0.1\times10^{-6}$	$\pm 0.1\times10^{-6}$ (magnitude)		
	[3] Electrical characteristics		Demand of customer	*4 Sep. 22. 2011
2	11 Second-order curve fitting Coefficient -6.0 to 6.0× e^{-4}	-3.0 to 3.0× e^{-4}		
3	22 Frequency aging $\pm 1\times10^{-6}$/ year	$\pm 0.7\times10^{-6}$/ year		
	[3] Electrical characteristics		Demand of customer	*5 Oct. 5. 2011
2,3	14 Maximum residual frequency temperature slope	14A,14B Maximum residual frequency temperature slope		

SPECIFICATIONS

1. Application

This document is applicable to the crystal unit that are delivered
To Qualcomm Inc from Epson Toyocom Corp.

This product complies with RoHS Directive.

This Product supplied (and any technical information furnished, if any) by Epson Toyocom 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.

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 extra high reliability, such as satellite, rocket and other space systems, and medical equipment, the functional purpose of which is to keep life.

2. Product No. / Model

The product No. of this crystal oscillator unit is X1E0002910001.
The model is FA-20HS.

3. Packing

It is subject to the packing standard of Epson Toyocom 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 are subject to the agreement between the two parties.

6. Contents

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[1] Absolute maximum ratings

No.	Parameter	Rating value	Note
1	Storage temperature	-40 °C to +125 °C	Suppose to be within CI std. at +30 °C ± 3 °C

[2] Operating range

No.	Parameter	Symbol	Value		
			Min.	Typ.	Max.
1	Operating temperature	T_use	-30 °C	—	+105 °C
2	Level of drive	DL	10 μW	—	100 μW

[3] Electrical characteristics *3 *4

No.	Parameter	Symbol	Standard	Unit	Conditions
1	Nominal frequency	f	19.2	MHz	Fundamental
2	Frequency tolerance	f_tol	$\pm 10 \times 10^{-6}$	—	CL = 7 pF T_use = +30 °C±3 °C Drive level : 100 μW Not include aging
3	Motional resistance	R1	70 Max.	Ω	π circuit JIS C6701 Drive level : 100 μW T_use = -30 °C to +105 °C
4	Quality Factor	Q	75,000 Min.	—	
5	Spurious mode series resistance		1,100 Min.	—	± 1 MHz from operating frequency
6	Motional capacitance	C1	2.55 ± 8%	fF	
7	Shunt capacitance	C0	0.82 ± 8%	pF	
8	Pulling Sensitivity	PS	20.85± 8%	ppm/pF	CL = 7 pF
9	Frequency versus temperature characteristics	f_tem	$\pm 12 \times 10^{-6}$	—	T_use = -30 °C to +85 °C (Ref. at +30 °C±3 °C) above 85°C tolerance over temperature bound by third-order coefficient range 80-V9690-23 Rev.B Drive level : 100 μW
10	The average slope of f_tem	C_{1C}	-0.4 to -0.1	ppm/°C	between 25°C and 35 °C
11	Second-order curve fitting coefficient	C_{2C}	-3.0 to 3.0× e^{-4}	ppm/°C^2	Latest revision of Qualcomm's curve fit calculation table T_use = -30 °C to +105 °C
12	Third-order curve fitting coefficient	C_{3C}	8.5 to 11.5× e^{-5}	ppm/°C^3	
13	Maximum residual Frequency perturbation		$\pm 0.5 \times 10^{-6}$	—	T_use = -30 °C to +85 °C Subtract off a 5th polynomial best fit Drive level : 100 μW

No.	Parameter	Symbol	Standard	Unit	Conditions
14A	Maximum residual frequency temperature slope		± 0.05	ppm/°C	T_use = -30 °C to +85 °C in 1 °C step Temp rate change of ~1 °C/min*1
14B	Maximum residual frequency temperature slope		± 0.05	ppm/°C	5°C Small Orbit Hysteresis 1 T_use = -30 °C to +85 °C Example: 30 °C → 35 °C → 30 °C in 0.5 °C step Temp rate change of ~1 °C/min*2
15	Hysteresis		0.1×10^{-6} (magnitude)	—	30 °C → 35 °C → 30 °C in 0.5 °C step Temp rate change of ~1 °C/min*3
16	Frequency Drive Level Dependency	FDLD	3×10^{-6}	—	Max F-Min F Drive level : 0.01 μW to 100 μW to 0.01 μW (28Steps,29Points)
17	Resistance Drive Level Dependency	RDLD	20	%	(Max R-Min R)/ Min R Drive level : 0.01 μW to 100 μW to 0.01 μW (28Steps,29Points)
18	Frequency Repeatability	CompF	0.7×10^{-6}	—	ABS(FDLD1-FDLD2) Compare the deviation with each way of FDLD
19	Resistance Repeatability	CompR	10	%	ABS{(RDLD1-RDLD2)/ RDLD1} Compare the deviation with each way of RDLD
20	Isolation resistance	IR	500 Min.	MΩ	DC 100V × 60 sec. between each terminals
21	Frequency drift after 2 reflow	—	$\pm2\times10^{-6}$	—	T_use = +30 °C±3 °C (Ref. before reflow) Drive level : 100 μW
22	Frequency aging	f_age	$\pm 0.7 \times 10^{-6}$ / year	—	T_use = +30 °C±3 °C Drive level : 100 μW
23	Thermistor resistance	R25 °C	100	KΩ	Used ± 1%
24	Thermistor B-Constant	B25 /50°C	4250	K	Used ± 1%

*1 Subtract off a 5th order polynomial best fit and calculate the slope of the residual.

*2 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 5th order polynomial best fit for each of the 10 points, and calculate the slope of the residual for each of these heating and cooling 10 point curves.

*3 During every individual heating/cooling cycle there should be 11 points; discard the first and last point of each heating and cooling cycle.
Calculate the average difference between each pair of 9 same temperature cooling – heating frequency measurements.

[4] Environmental and mechanical characteristics

Item No.3 to No.6 shall be tested after following pre conditioning.

Pre conditioning：Test crystal must be leaving in room temperature for 24h after reflow × 3.

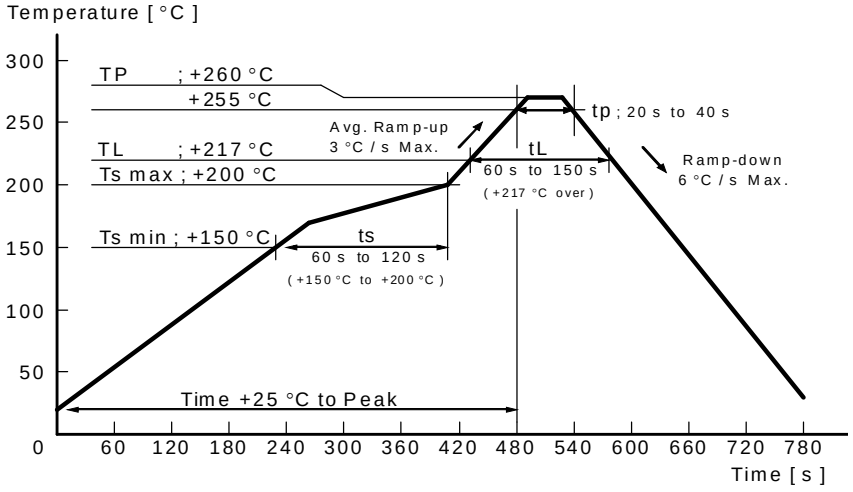
(The company evaluation condition：We evaluate it by the following examination item and examination condition.)

No.	Item	Value *1 *2	Test Conditions
		$\Delta f / f[1 \times 10^{-6}]$	
1	Drop	(2) ± 2	150 g dummy Jig (Epson Toyocom Standard) drop from 1 500 mm height on the Concrete 3 directions 10 times
2	Vibration	(2) ± 2	10 Hz to 55 Hz amplitude 0.75 mm 55 Hz to 500 Hz acceleration 98 m/s^2 10 Hz → 500 Hz → 10 Hz 15 min./cycle 6 h (2 hours , 3 directions)
3	High temperature storage	(1) ± 2	+85 °C × 1 000 h
4	Low temperature storage	(1) ± 2	-40 °C × 1 000 h
5	Temperature cycle	(1) ± 2	-40 °C ↔ +85 °C 30 minutes at each temp. 100 cycle
6	Temperature humidity storage	(1) ± 2	+85 °C × 85 %RH × 1 000 h
7	Resistance to soldering heat	± 2	For convention reflow soldering furnace (3 times)
8	Substrate bending	No peeling-off at a soldered part	Bend width reaches 3 mm and hold for 5 s ± 1 s × 1 time Ref. IEC 60068-2-21
9	Shear	No peeling-off at a soldered part	10 N press for 10 s ± 1 s Ref. IEC 60068-2-21
10	Pull – off	No peeling-off at a soldered part	10 N press for 10 s ± 1 s Ref. IEC 60068-2-21
11	Solder ability	Terminals must be 95 % covered With fresh solder.	Dip termination into solder bath at +230 °C ± 10 °C for 5 s (Using Rosin Flux)

< Notes >

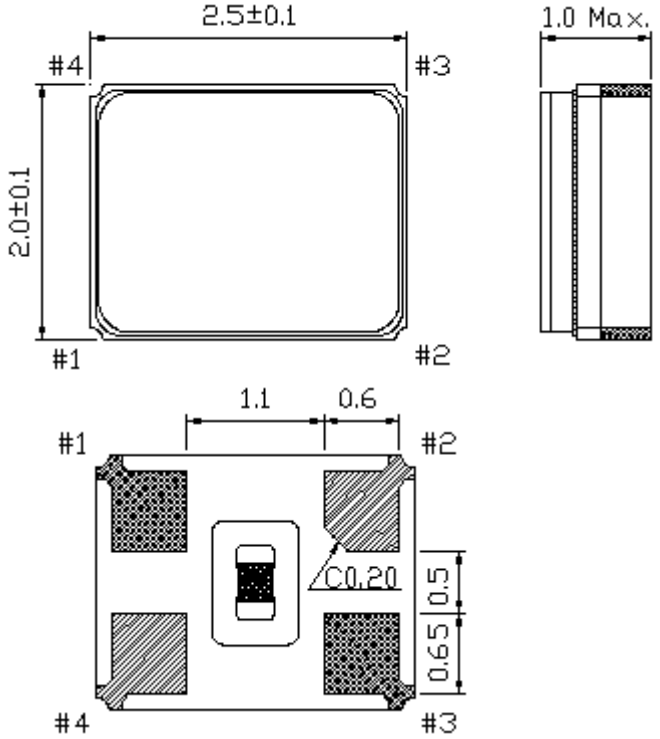
1. Item No.1 to No.10 resistance at before above tests should be less than ±20 % or less than ±10 Ω.
2. *1 each test done independently.
3. *2 measuring 2 h to 24 h later leaving in room temperature after each test.
   (1) Measuring 24 h later leaving in room temperature after each test.
   (2) Measuring 2 h later leaving in room temperature after each test.

Reflow condition (follow to IPC / JEDEC J-STD-020D.1)



[5] Dimensions and Circuit

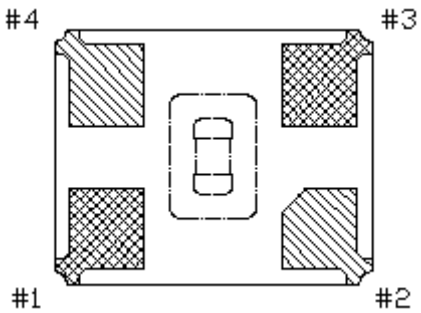
1) Dimension



Thermistor size : 0.6×0.3 Unit : mm

2) Circuit

(Top View)

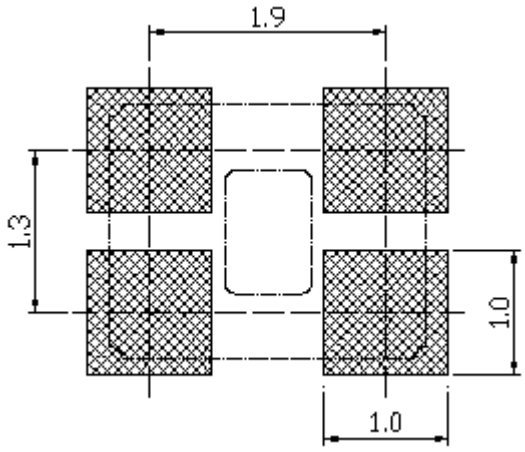


Pin	Connection
1	Xtal
2	GND, thermistor
3	Xtal
4	thermistor

Type	FA-20HS	Terminal treatment	Au plate	Unit	1 = 1mm

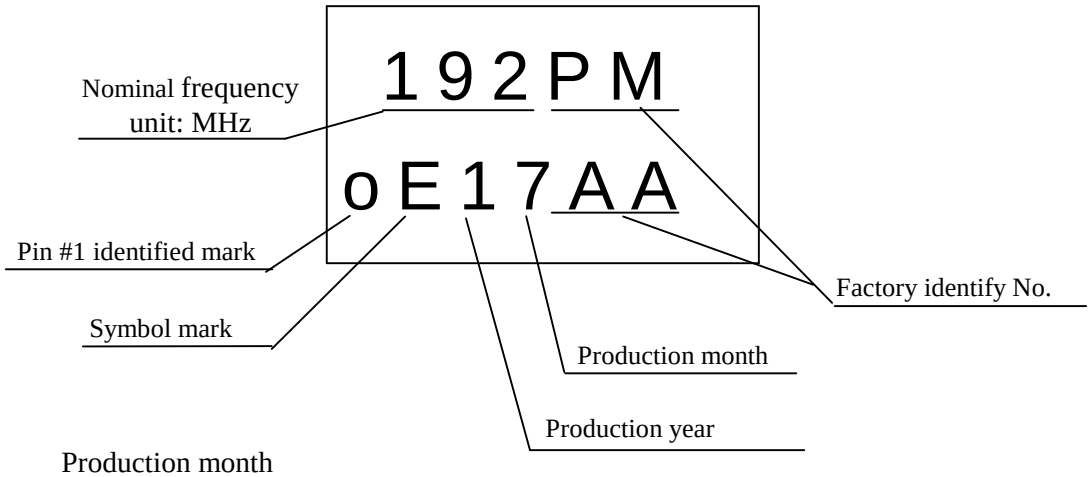
[6] Recommended soldering pattern and Marking layout

1) Recommended soldering pattern



Unit : mm

2) Marking layout



Production month

January	February	.....	October	November	December
1	2	.....	X	Y	Z

- Nominal frequency is only one example.
- Nominal frequency omits the figure below the first place of decimals.
  Ex) 19.2 MHz..... [192]
- The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

Type : FA-20HS	Unit : 1 = 1mm

[7] Notes

1. Max three (3) times re-flow is allowed. Its recommended to manually solder when not enough/no solder detected.
   (Using soldering iron at +280 °C Max. × within 5 seconds)

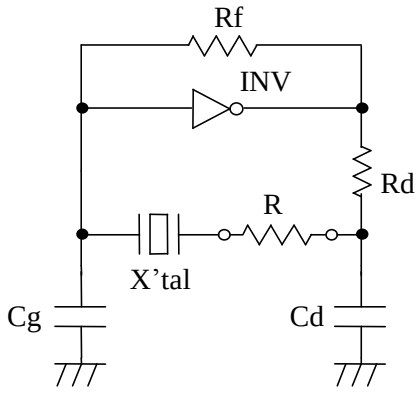
2. Recommended reflow soldering condition is below. (2 times maximum)

3. Patterning on a board should follow our company recommended pattern.

4. Applying excessive excitation force to the crystal resonator may cause deterioration damage.

5. Start up time of oscillation may be increased or no oscillation may occur unless adequate negative resistance is allocated in the oscillation circuit In order to avoid this, please provide enough negative resistance to the circuit design.

   How to check the negative resistance



(1) Connect the resister(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 × 5

6. It is recommended to do patterning to the oscillator as short as possible. Abnormal oscillation may happened if the line is too long.

7. To avoid malfunction, no pattern across or near the crystal is allowed.

8. Few data or readings taken at user side may be different from our company's data. Confirmation of the different value is necessary before application.

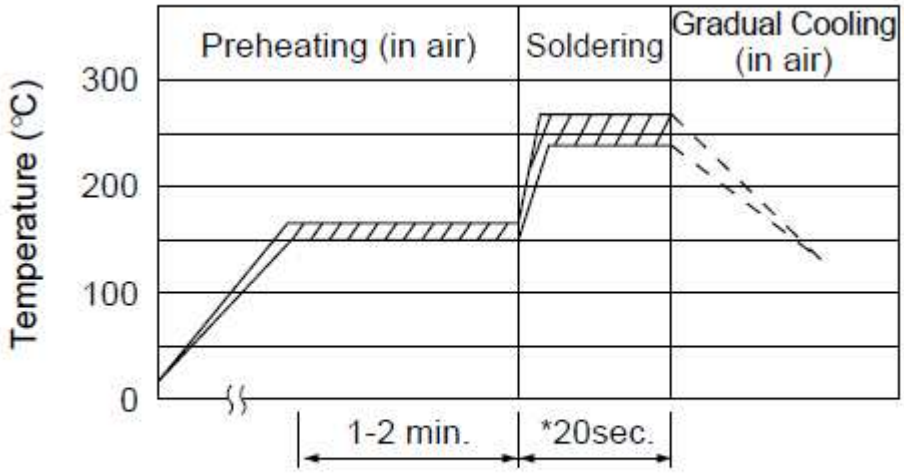
9. Too much exciting shock or vibration may cause deterioration on damage.
   The product may damage depends on the condition such as a shock in assembly machinery.
   Please check your process condition in advance to minimize and maintain the shock level.

10. This product may be affected to ultrasonic cleaning. It is depends on the cleaning conditions.
    (Cleaning machine type/power/time/content/position etc.)
    The warranty will not cover any damage due to this type of usage. Check conditions prior to use.

11. Condensation may occur when used/stored under high humidity condition.
    Please take precautions to prevent condensation.

12. Please refer to packing specification for the storage method and packing standard.

Recommend Temperature Profile for Soldering (example)



Preheating: 160±10°C, 1-2 min.
Soldering: 240-270°C, 20sec.

TAPING SPECIFICATION

1. APPLICATION

This document is applicable to FA-20HS

2. CONTENTS

Item No.	Item	Page
[1]	Taping specification	1 to 2
[2]	Inner carton	3
[3]	Shipping carton	
[4]	Marking	4
[5]	Quantity	
[6]	Storage environment	
[7]	Handling	

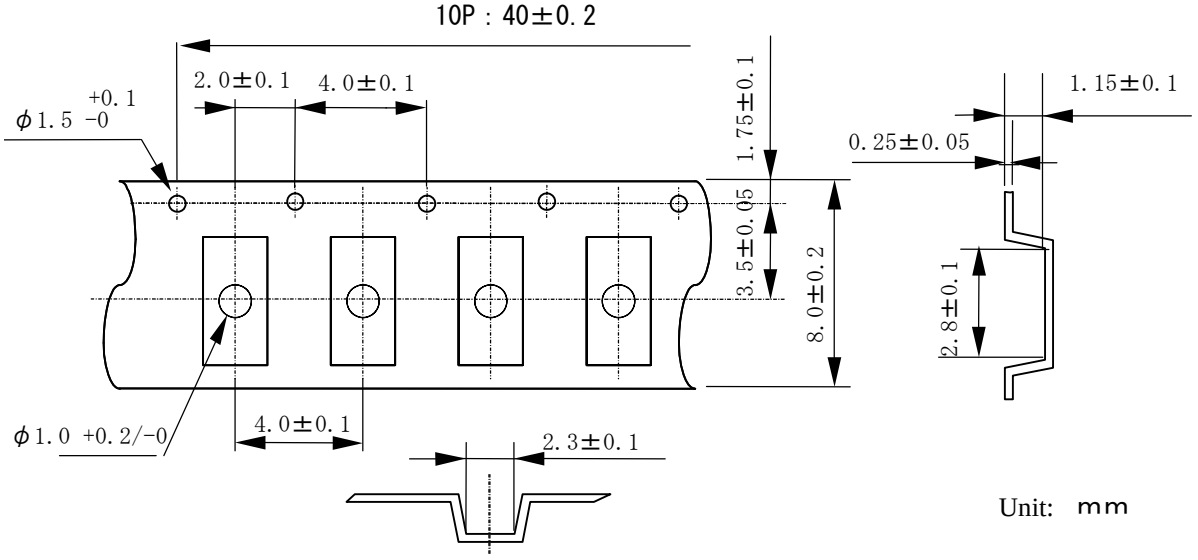
[1] Taping specification

Subject to EIA-481A & EIAJ RC-1009B

(1) Tape dimensions TE0804L

Material of the Carrier Tape : PS (Electrically conductive)

Material of the Top Tape : PET+PE

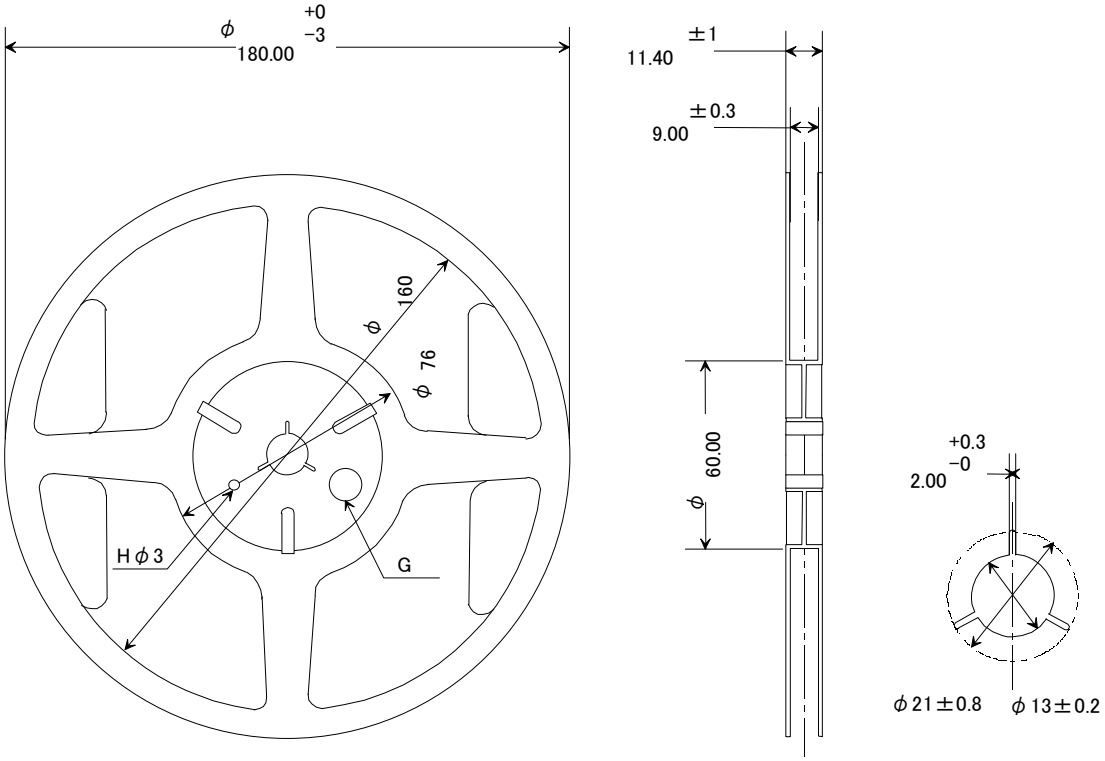


Unit: mm

(2) Reel dimensions EIAJ-RRM08B

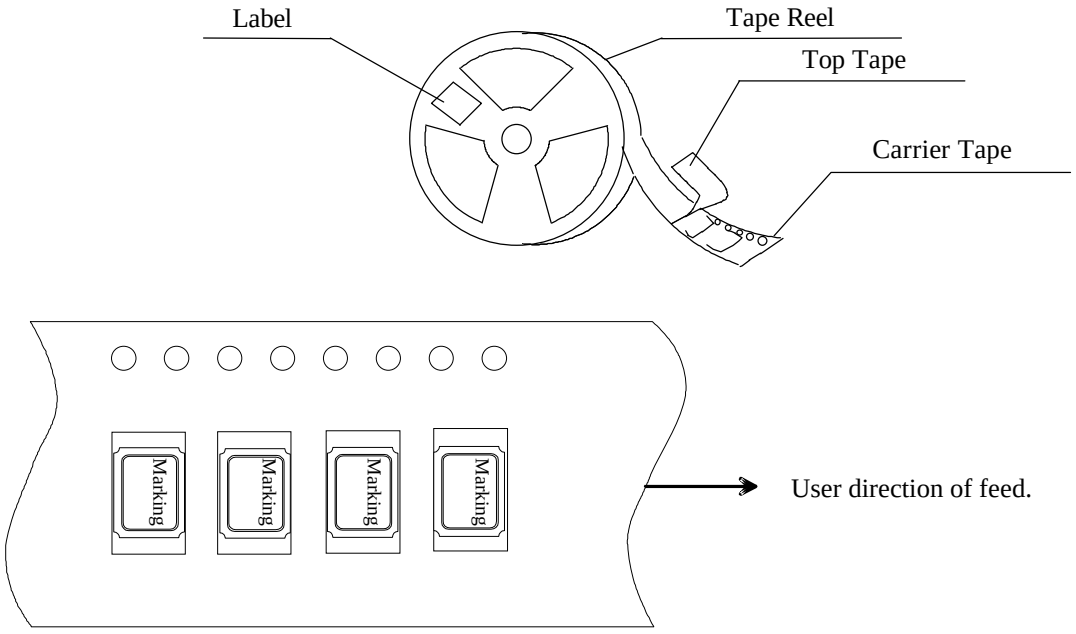
(a) Center material : PS

(b) Material of the Reel : PS

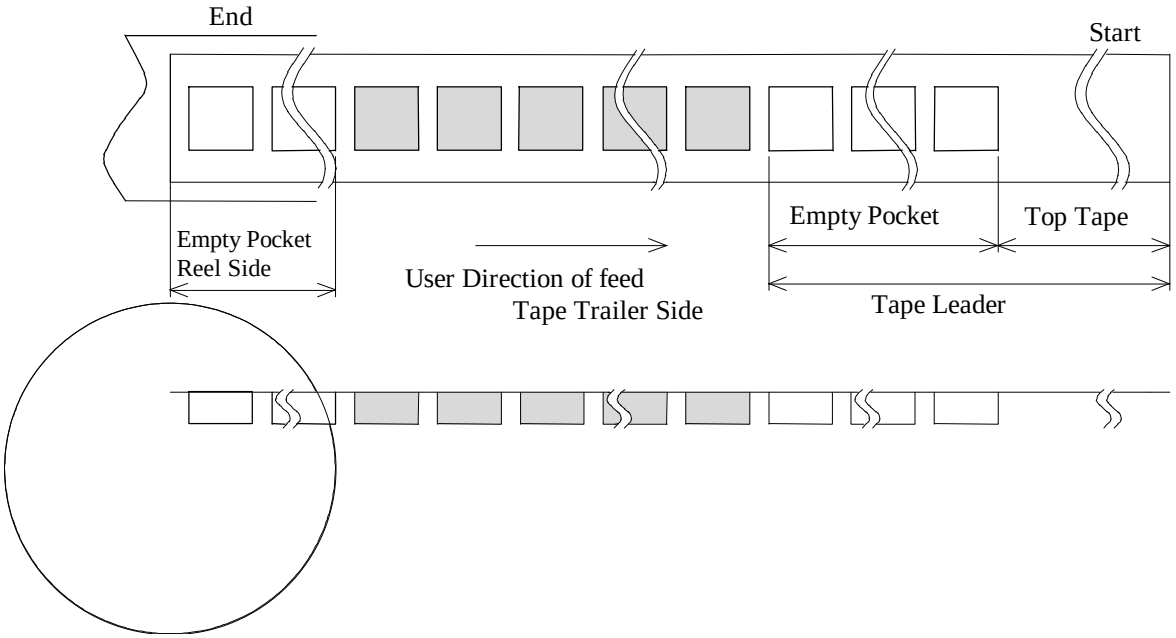


(3) Packing

(a) Tape & Reel



(b) Start & End Point



(c) Peel force of the cover tape

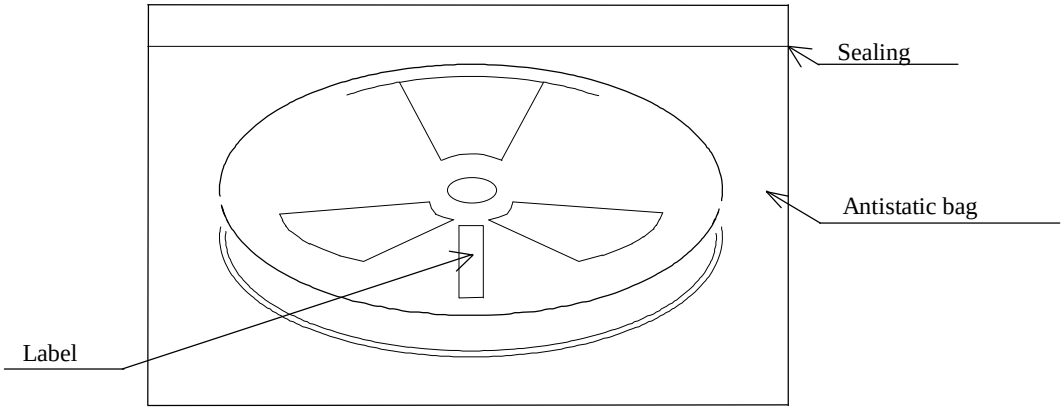
(1) angle : cover tape during peel off and the direction of unreeling shall be 165° to 180°.

(2) peel speed : 5 mm/s.

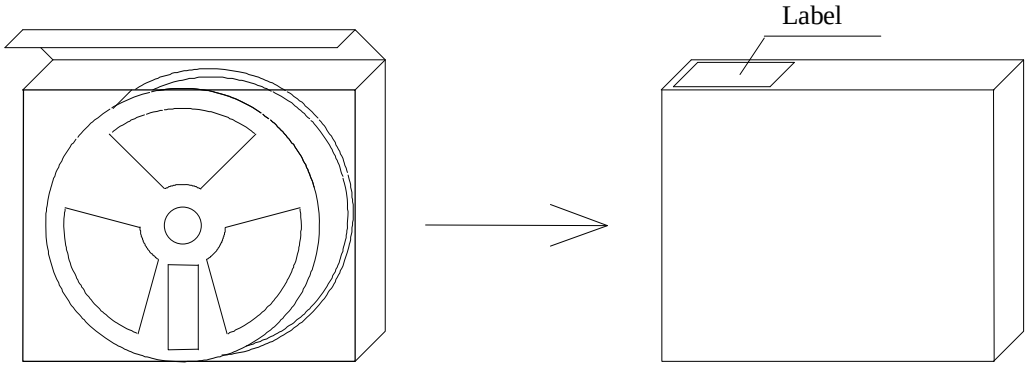
Item		Empty Space
Tape Leader	Top Tape	Min. 1 000 mm
	Carrier Tape	Min. 10 pockets
Tape Trailer	Top Tape	Min. 0 mm
	Carrier Tape	Min. 10 pockets

[2] Inner Carton

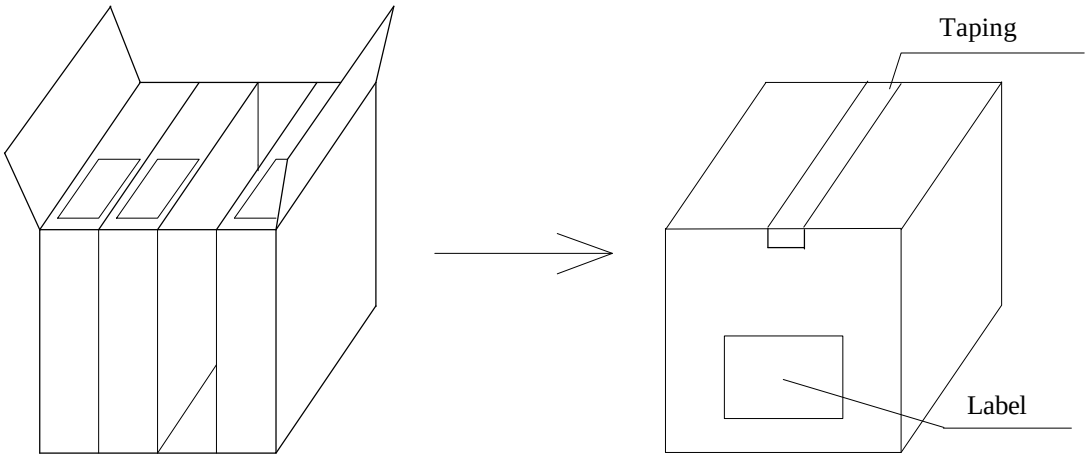
a) Packing to antistatic bag



b) Packing to inner carton



[3] Shipping Carton



[4] Marking

(1) Reel marking

- Reel marking shall consist of :

1) Parts name
2) Quantity
3) Manufacturing Date or symbol
4) Manufacturer's Date or symbol
5) Others (if necessary)

(2) Inner carton marking

- Same as Reel marking.

(3) Shipping carton marking

- Shipping carton marking shall consist of :

1) Parts name
2) Quantity

[5] Quantity

- 2,500 pcs./reel

However it is not the limit, in case that the order quantity does not fill with 2,500 pieces.
Packing quantity is defined by 14th and 15th digit of product number

14th and 15th digit of Product number	Quantity
00	2,500pcs
14	1,000pcs
12	250pcs

[6] Storage environment

(1) To storage the reel at +15 °C to +35 °C , 25 %RH to 85 %RH of Humidity.
(2) To open the packing just before using.
(3) Not to expose the sun.
(4) Not to storage with some erosive chemicals.
(5) Nothing is allowed to put on the reel or carton to prevent mechanical damage.

[7] Handling

To handle with care to prevent the damage of tape, reel and products.