RECIPIENT

SPECIFICATIONS

Product No. : **Q22MA4062207300**

MODEL : **MA-406**

SPEC. No. : **A16-648-2B**

DATE : **Jan. 10. 2017**

SEIKO EPSON CORPORATION

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SPECIFICATIONS

1. Application

1) This document is applicable to the crystal unit that are delivered to from Seiko Epson Corp.

2) RoHS compliant
MA-406 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 Q22MA4062207300.
The model is MA-406.

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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[2]	Operating range	2
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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	Depends on the Environmental characteristics specifications.

[2] Operating range

No.	Item	Symbol	Rating value			Unit	Note
			Min.	Typ.	Max.		
1	Operating temperature range	T_use	- 20		+70	°C	
2	Level of drive	DL	1		100	μW	

[3] Static characteristics

No.	Item	Symbol	Value	Unit	Conditions
1	Nominal Frequency	f_nom	8	MHz	Fundamental
2	Frequency tolerance	f_tol	±50	$\times 10^{-6}$	CL = 20 pF Ta = +25 ±3°C DL : 100 μW Not include aging
3	Motional resistance	R1	80 Max.	Ω	π circuit IEC 60444-2 Ta = Operating temperature range DL : 100 μW
4	Shunt capacitance	C0	5.0 Max.	pF	π circuit and N.A.
5	Frequency temperature characteristics	f_tem	±50	$\times 10^{-6}$	Ta = Operating temperature range (Ref. at +25 °C ±3 °C) DL : 100 μW
6	Isolation resistance	IR	500 Min.	MΩ	DC 100 V, 60 seconds Between terminal # 1 and terminal # 4
7	Frequency Aging	f_age	±5	$\times 10^{-6}$/year	Ta = +25 °C ±3 °C

[4] Environmental and mechanical characteristics

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

No.	Item	Value *1 *2 $\Delta f / f [1 \times 10^{-6}]$	Test Conditions
1	Drop	±10	Free drop from 750 mm height on a hard wooden board for 3 times (Board is thickness more than 30 mm)
2	Vibration	±10	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	* 3 a) ±50 * 3 b) ±10	a) +125 °C × 1 000 h b) +85 °C × 1 000 h
4	Low temperature storage	* 3 ±10	- 55 °C × 1 000 h
5	Temperature cycle	* 3 ±10	- 55 °C ↔ +125 °C 30 minutes at each temp. 100 cycle
6	Temperature humidity storage	* 3 ±20	+ 85 °C × 85 %RH × 1 000 h
7	Resistance to soldering heat	±8	For convention reflow soldering furnace (2 times)
8	Shear	No peeling-off at a soldered part	20 N press for 10 s ±1 s Ref. IEC 60068-2-21
9	Pull – off	No peeling-off at a soldered part	10 N press for 10 s ±1 s Ref. IEC 60068-2-21
10	Solvent resistance	The marking shall be legible	Ref. JIS C 0052 or IEC 60068-2-45
11	Solderability	Terminals must be 95 % covered with fresh solder.	Dip termination into solder bath at + 235 °C ±5 °C for 5 s (Using Rosin Flux)

< Notes >

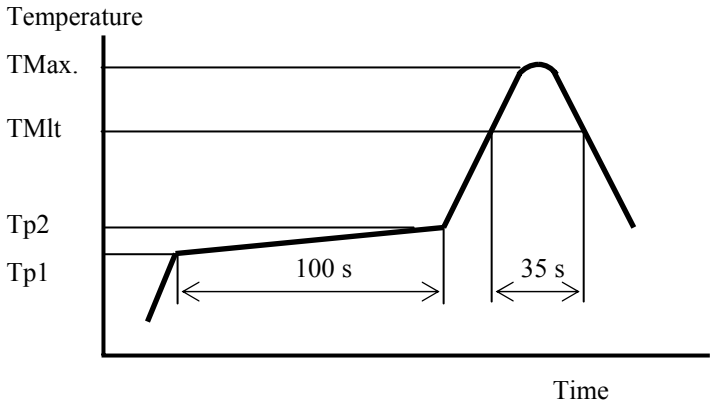
1. *1 Each test done independently.
2. *2 Measuring 2 h to 24 h later leaving in room temperature after each test.
3. *3 Item No.3 to No.6 shall be tested after following pre conditioning.
   Measuring 24 h later leaving in room temperature after Pre conditioning.
   Pre conditioning : + 85 °C ± 2 °C × 85 %Rh ± 5 %Rh × 24 h ± 1 h → reflow 2 times
4. Item No.1 to No.7, Shift motional resistance at after above tests should be less than 20 % or less than under mentioned values.

Frequency	Vib. mode	ΔCI
4.0 MHz ≤ f_nom < 5.5 MHz	Fundamental	50 Ω
5.5 MHz ≤ f_nom < 12.0 MHz		10 Ω
12.0 MHz ≤ f_nom < 30.0 MHz		5 Ω
26.0 MHz ≤ f_nom ≤ 64.0 MHz	3rd overtone	10 Ω

◆Reflow

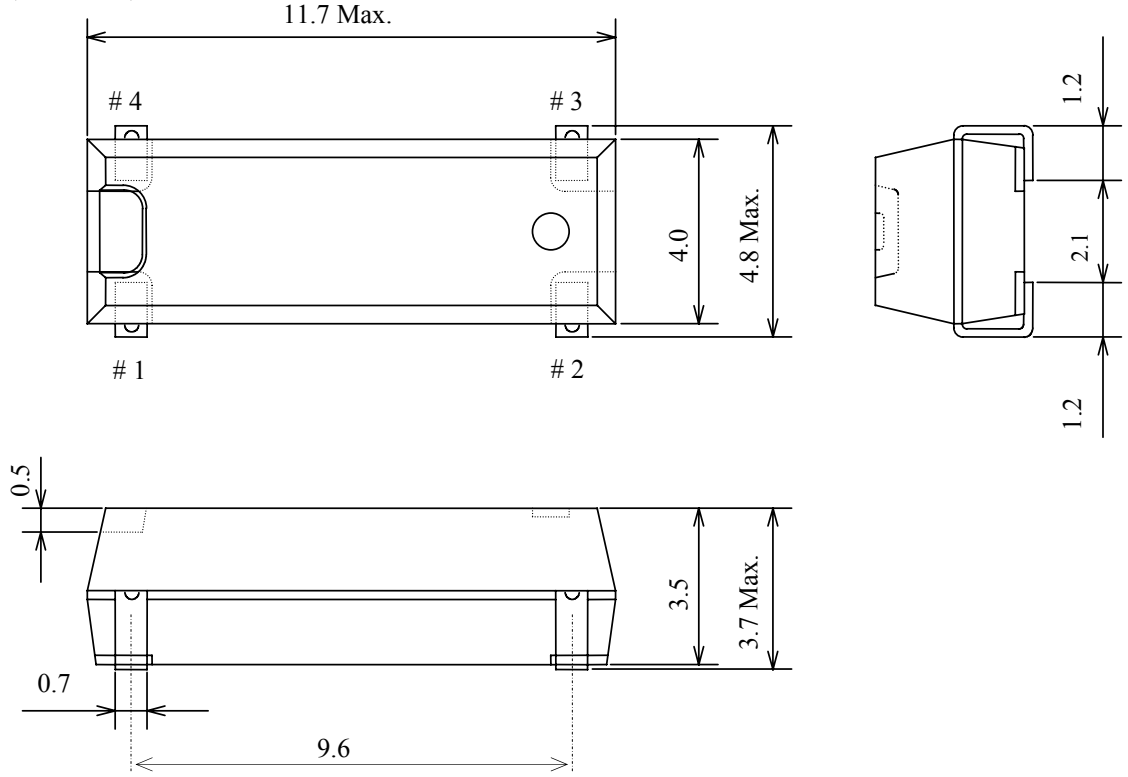
Pre Heating Temperature
Tp1 ~ Tp2 = +170 °C
Heating Temperature
TMlt = +220 °C
Peek Temperature
TMax. = +260 °C

Point of measuring
In case of Solderability Terminal.
In case of Resistance to soldering heat Surface.



[5] Dimensions and Circuit

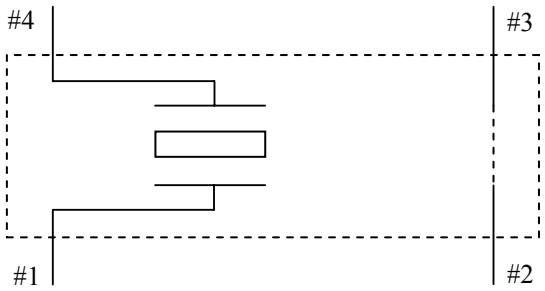
1) Dimension （Unit：mm）



Metal may be exposed on the top or bottom of this product.
This will not affect any quality, reliability or electrical spec.

Terminal treatment : Pb Free solder plate

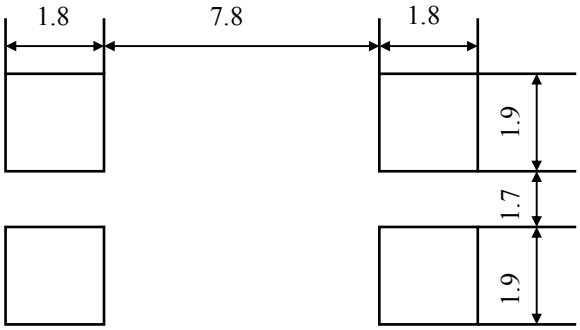
2) Circuit location



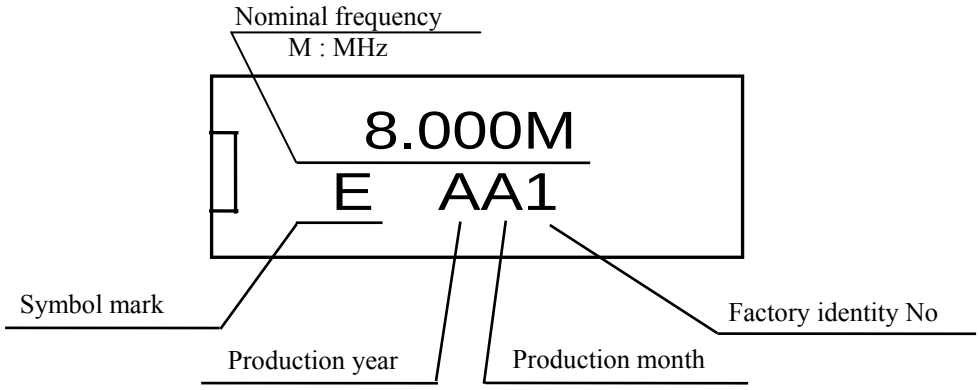
* Do not connect # 2 and # 3 terminals to any external terminals.

[6] Recommended soldering pattern and Marking layout

1) Recommendable patterning



2) Marking layout



Symbol of Manufacturing year

Year digit		1	2	3	4	5	6	7	8	9	0
Marking	Terminal Plating: Sn-Bi or Sn-Ag	A	B	C	D	E	F	G	H	J	K
Marking	Terminal Plating: Sn	M	N	R	S	T	U	V	W	X	Z

Year digit(1st) 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

- Nominal frequency is only one example.
- Nominal frequency omits the figure below the 3 digits under decimal point.
- The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

[7] Notes

1. Max. two (2) times re-flow is allowed. Its recommended to manually solder when not enough/no solder detected.(Using soldering iron at +350 °C Max × within 5 seconds)

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

3. 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.

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

5. Condensation may occur when products are used/stored under remarkable temperature change.

6. 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.

7. When the substrate of oscillation become dewy, the crystal frequency is changed or stopped. Please use under without the dewfall.

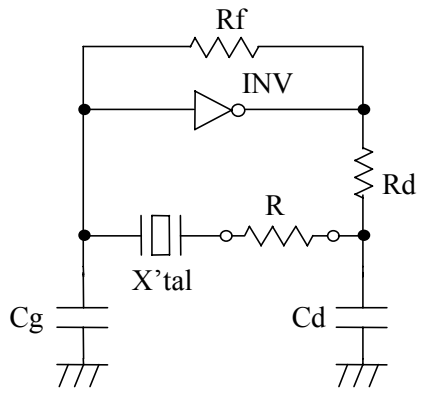
8. Applying excessive excitation Drive Level to the crystal Unit may cause deterioration damage.

9. 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.

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

11. 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

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

TAPING SPECIFICATION

Ⅰ. Application

This standard will apply to MA-406.

Ⅱ. Contents

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

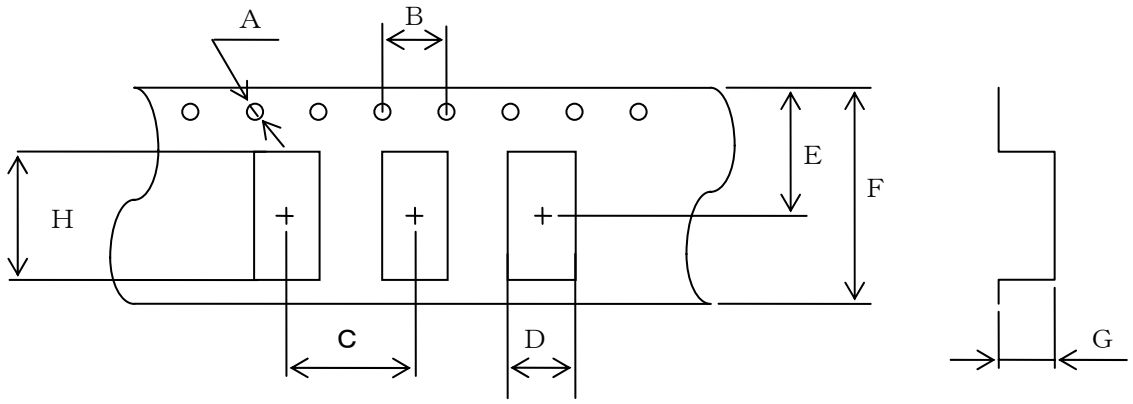
〔1〕 Taping specification

Subject to EIA-481 & IEC-60286

(1) Tape dimensions TE-2412L

Material of the carrier tape : Polystyrene

Material of the top tape : PET

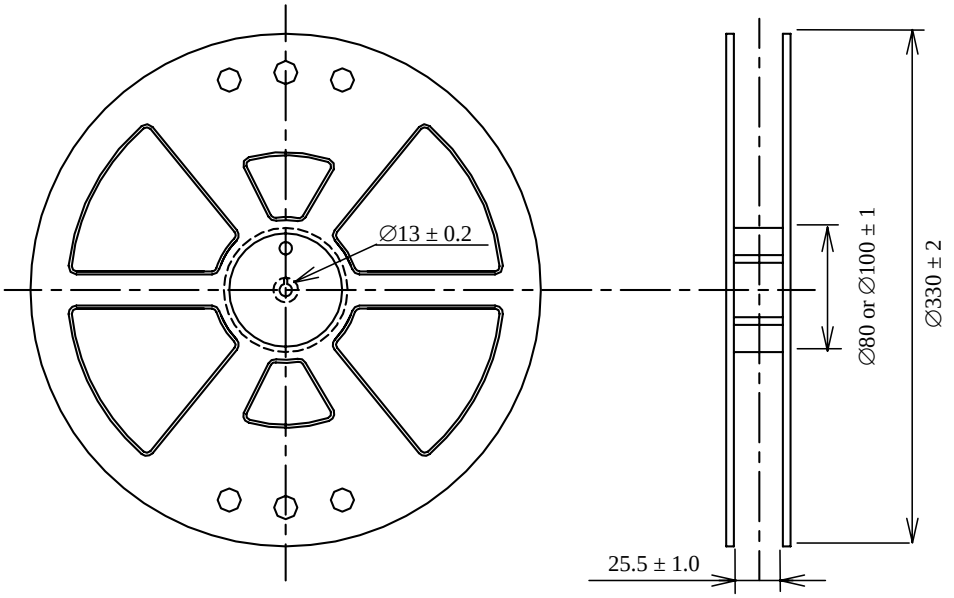


Symbol	A	B	C	D	E	F	G	H
Value	ϕ 1.5 ±0.1/-0	4.0 ±0.1	12.0 ±0.1	4.9 ±0.1	13.25 ±0.1	24.0 ±0.2	4.0 ±0.1	11.9 ±0.1

Unit : mm

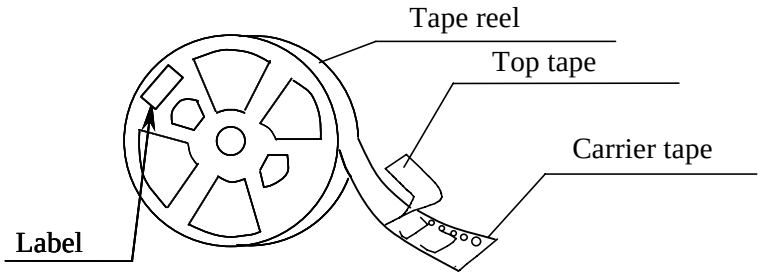
(2) Reel dimensions

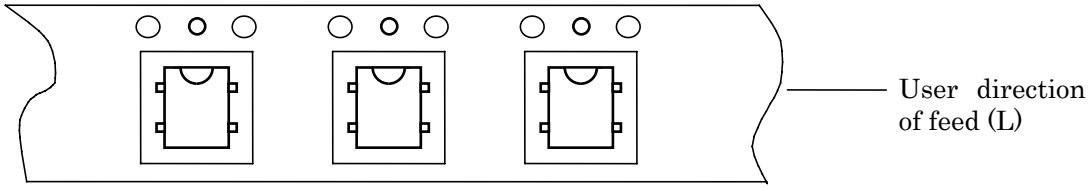
Material of the reel : Polystyrene



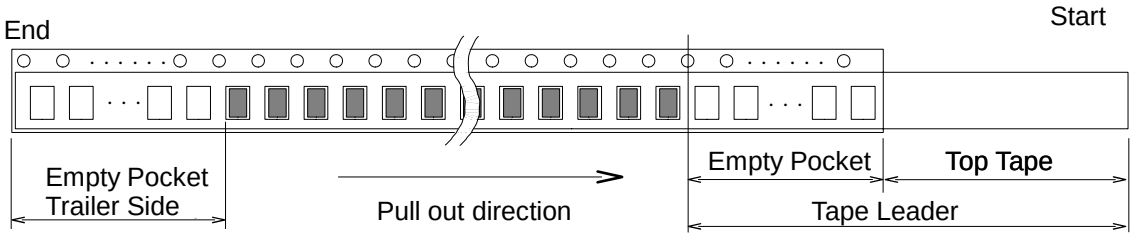
(3) Packing

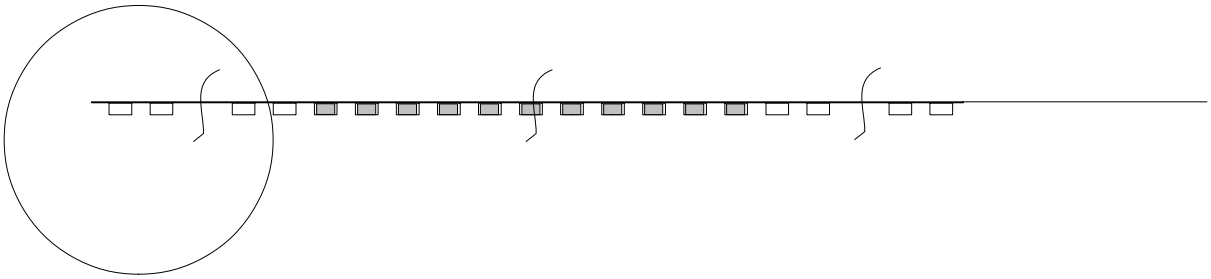
①Tape & reel





②Start & end point

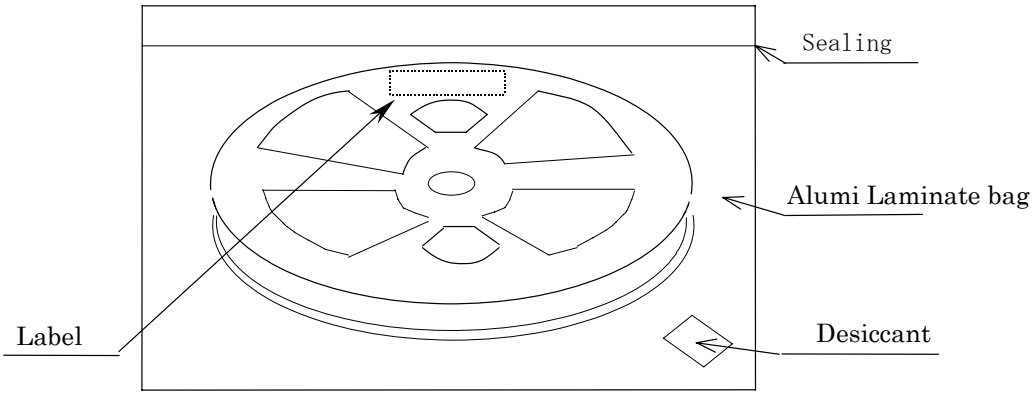




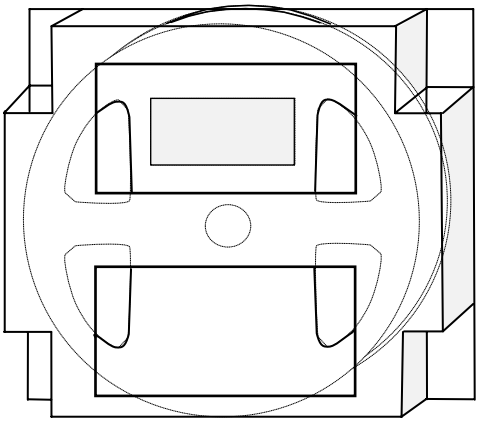
Item		Empty space
Tape leader	Top tape	Min. 1 000 mm
	Carrier tape	Min. 100 mm
Tape trailer	Top tape	Min. 0 mm
	Carrier tape	Min. 160 mm

〔2〕 Inner Sleeve

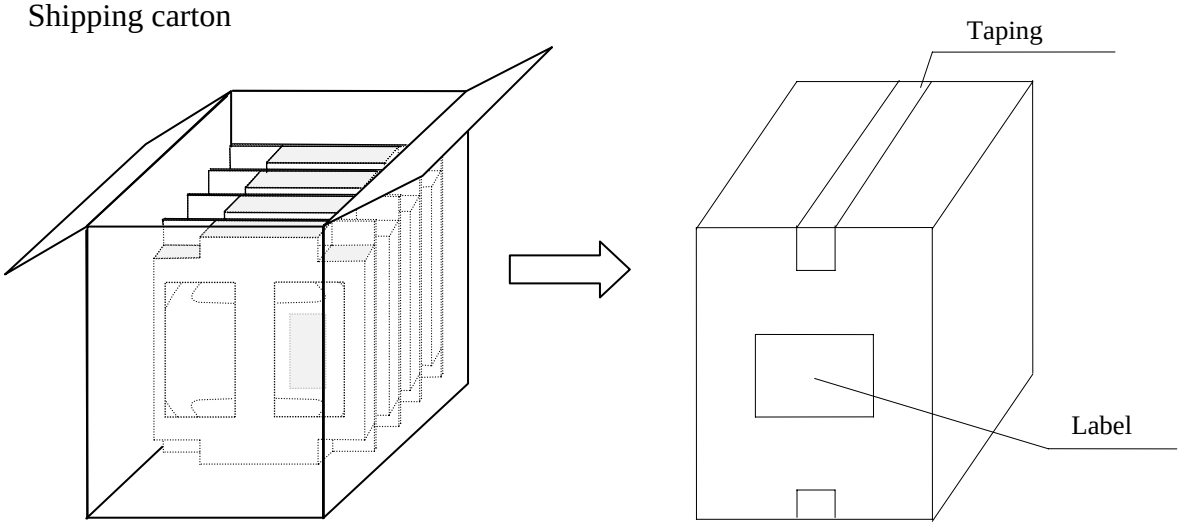
a) Packing to antistatic bag



b) Packing to inner sleeve



〔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 name or symbol
5) Others (if necessary)

(2) Shipping carton marking

・Shipping carton marking shall consist of :

1) Parts name
2) Quantity

〔5〕 Quantity

・1 000 pcs./reel

〔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.

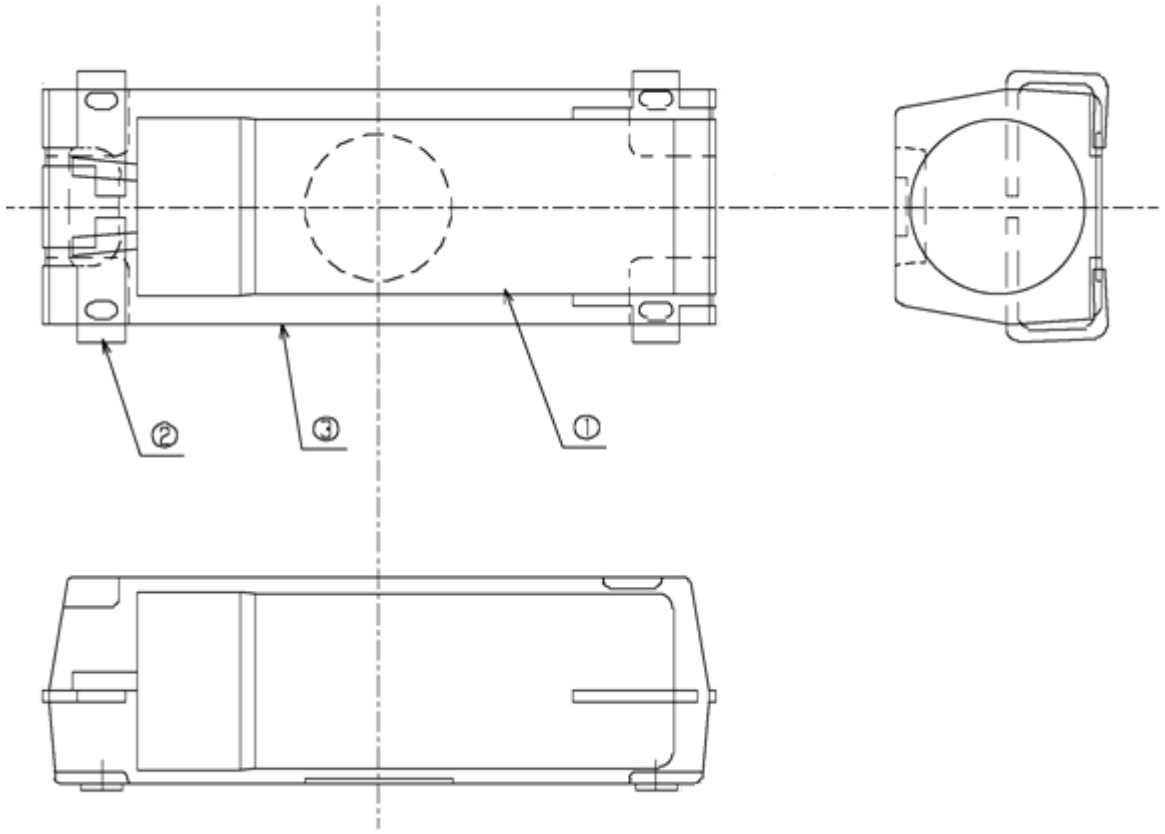
No.68-00-1-AEE-2

MOLD TYPE AT STRIP CRYSTAL M A － 4 0 6

MA406_Q_0001
'14.10.2

Manufacturing process chart	No.	Section In Charge	Standards	Inspection,Control Item	Inspection Methods	Instruments	Record
CA-303 Crystal ▽	1'	Inspection Section	Purchasing Specification,In-coming Inspection Standard	Shape Appearance	Sampling 〃	Visual Inspection Microscope	In-coming Data Sheet
Lead Frame ▽	2	Subcontractor	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
1' In-coming Inspection	3	Subcontractor	Manufacturing Instruction Sheet	Appearance	〃	Visual Inspection	Process Data Sheet
	4	Subcontractor	Solder Plating Specification	Plating Thickness Appearance	Sampling 100% Inspection	Fluorescent X-ray Visual Inspection	Process Data Sheet
② Crystal Welding	5	Subcontractor	Manufacturing Instruction Sheet	Appearance	100% Inspection	Visual Inspection	Process Data Sheet
③ Transfer Mold	6	Subcontractor	Manufacturing Instruction Sheet	Appearance Shape	Sampling 〃	Microscope Dial Gauge Caliper	Process Data Sheet
④ Solder Plating	7	Subcontractor	Manufacturing Instruction Sheet	Crystal Impedance Frequency	100% Inspection 〃	Characteristics Inspection Machine	Process Data Sheet
⑤ Marking ⑥ Press	8	Subcontractor	Specification Outgoing Inspection Standard	Crystal Impedance Frequency Isolation Resistance Appearance	Sampling 〃 〃 〃	CI Meter Frequency Counter I.R Tester Microscope	Outgoing Inspection Data Sheet
7 Finish Products Inspection	9	Subcontractor	Manufacturing Instruction Sheet	Tape Peeling Force	Sampling	Peeling Force Tester	Process Data Sheet
8 Outgoing Inspection	10	Subcontractor	Manufacturing Instruction Sheet Daily Shipping List	Destination Quantity			Delivery Slip
⑨ Taping ⑩ Packing							

Structure Diagram 構造図	Rev.01
Model 型式	**MA-406**
Document No. 管理№	MA-406_D_0001



No.	Name of Part 部品名
①	Crystal Unit 水晶振動子
②	Lead リード
③	Transfer molding compound モールド

RELIABILITY TEST DATA

Product Name : MA-406

The Company evaluation condition

We evaluate environmental and mechanical characteristics by the following test condition . **No. M-990202-01-001E**

No.	ITEM	TEST CONDITIONS	VALUE *1 *2 Δ f / f [1 × 10^{-6}]	TEST Qty [n]	FAIL Qty [n]
1	Drop	Free drop from 750 mm height on a hard wooden board for 3 times (Board is thickness more than 30 mm)	± 10	11	0
2	Vibration	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 h × 3 directions)	± 10	22	0
3	High temperature storage	a) +125°C × 1 000 h b) +85 °C × 1 000 h	*3 a) ± 50 *3 b) ± 10	a) 22 b) 22	a) 0 b) 0
4	Low temperature storage	-55 °C × 1 000 h	*3 ± 10	22	0
5	Temperature cycle	-55 °C <=> +125 °C 30 min at each temp. 100 cycles	*3 ± 10	22	0
6	Temperature humidity storage	+85 °C × 85 %RH × 1 000 h	*3 ± 20	22	0
7	Resistance to soldering heat	Reflow furnace with the condition 2 times	± 8	22	0
8	Shear	20 N press for 10 s ± 1 s Ref. IEC 60068-2-21	No peeling - off at a solder part	11	0
9	Pull - off	10 N press for 10 s ± 1 s Ref. IEC 60068-2-21	No peeling - off at a solder part	11	0
10	Solvent resistance	Ref. JIS C 0052 or IEC 60068-2-45	The marking shall be legible	5	0
11	Solderability	Dip termination into solder bath at +230 °C ± 10 °C for 3 s (Using Rosin Flux)	Termination must be 90 % covered with fresh solder	11	0

Notes

1. *1 Each test done independently.
2. *2 Measuring 2 h to 24 h later leaving in room temperature after each test.
3. *3 Pre conditionings Initial value shall be after 24 h at room temperature.
4. Shift series resistance at before above tests should be less than 20 % or less than under mentioned values.

Vib. mode	Frequency	Δ CI
Fundamental	4.0 MHz ≦ f < 5.0 MHz	50 Ω
	5.5 MHz ≦ f < 12.0 MHz	10 Ω
	12.0 MHz ≦ f < 30.0 MHz	5 Ω
3rd overtone	26.0 MHz ≦ f ≦ 64.0 MHz	10 Ω

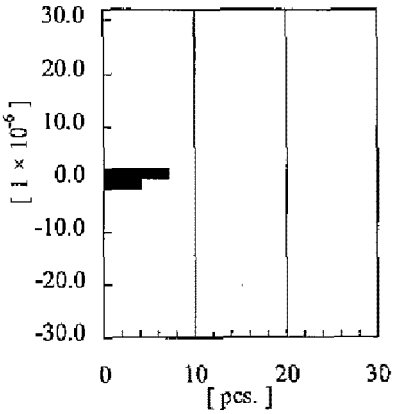
Qualification Data

Product Name : MA-406

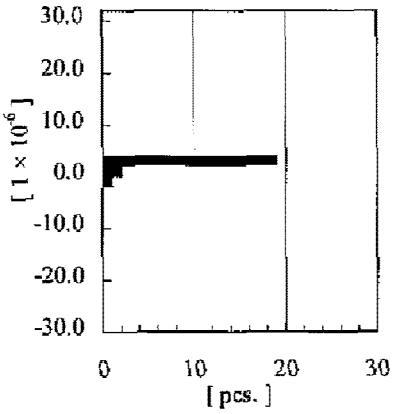
Δ f / f

No. M-990202-01-002E

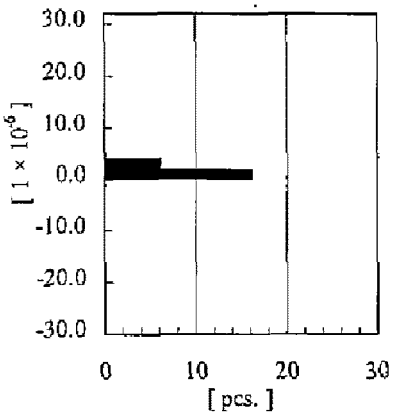
1. Drop
750 mm × 3 times



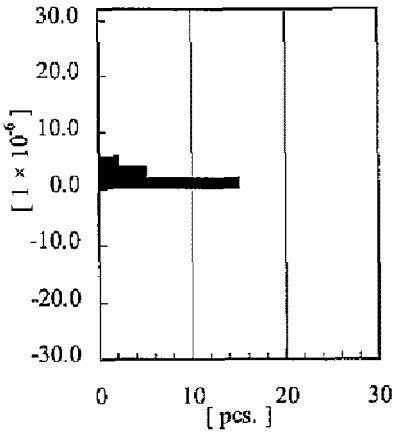
2. Vibration
10 Hz to 55 Hz amplitude 0.75 mm
55 Hz to 500 Hz acceleration 98 m/s²
15 min / cycle 6 h (2 h × 3 directions)



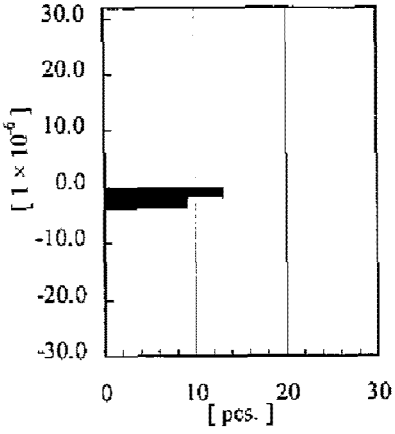
3. High temp. storage
a) +125 °C × 1 000 h



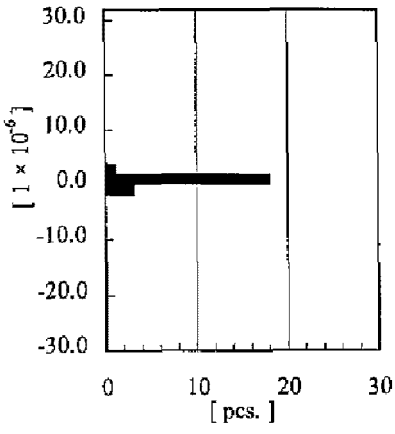
3. High temp. storage
b) +85 °C × 1 000 h



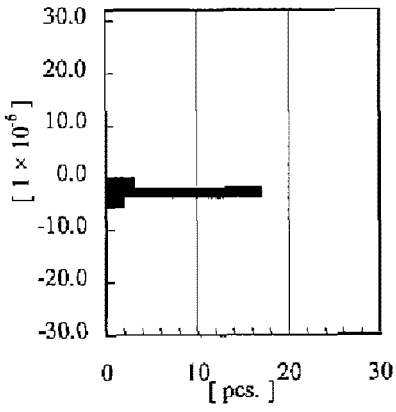
4. Low temp. storage
-55 °C × 1 000 h



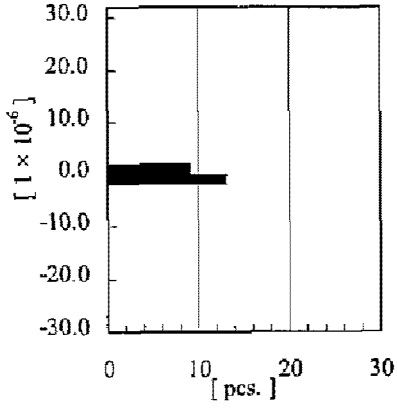
5. Temp. cycle
-55 °C ⇔ +125 °C
100 cycles



6. Temp. humidity storage
+85 °C × 85 %RH × 1 000 h



7. Resistance to soldering heat (Reflow characteristics)
Reflow furnace with the condition
2 times



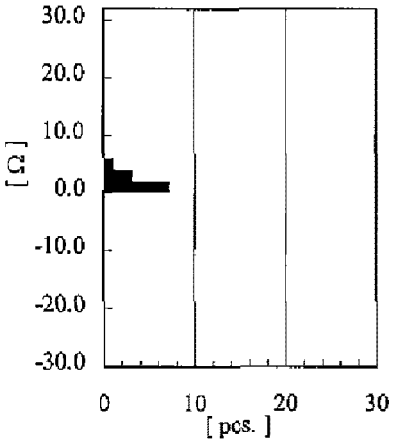
Qualification Data

Product Name : MA-406

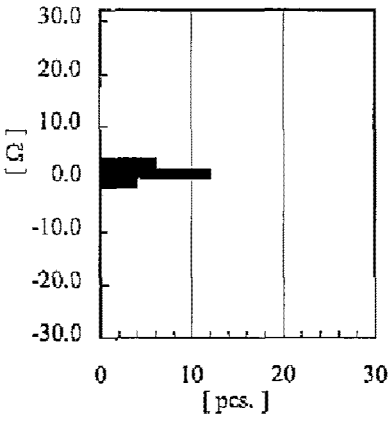
Δ CI

No. M-990202-01-003E

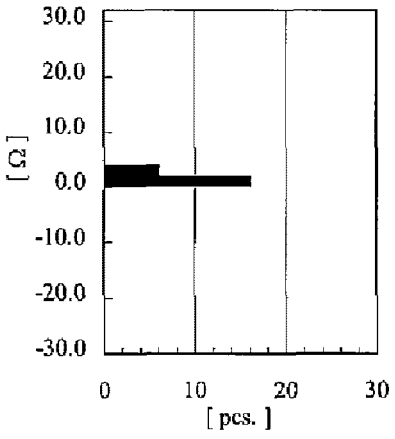
1. Drop
750 mm × 3 times



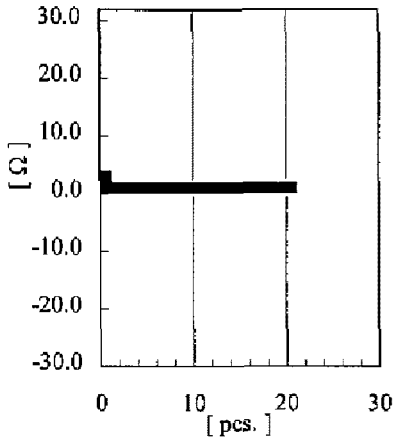
2. Vibration



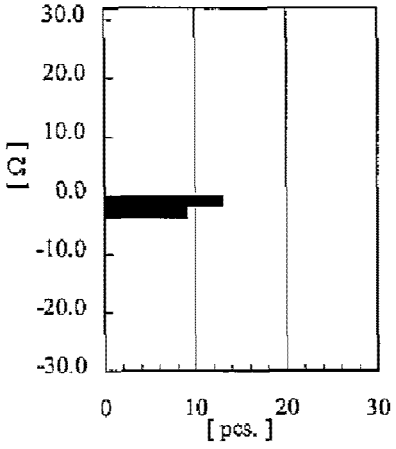
3. High temp. storage
a) +125 °C × 1 000 h



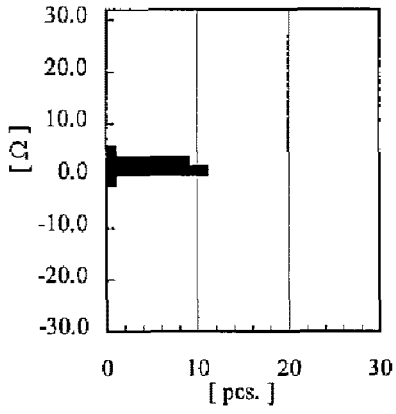
3. High temp. storage
b) +85 °C × 1 000 h



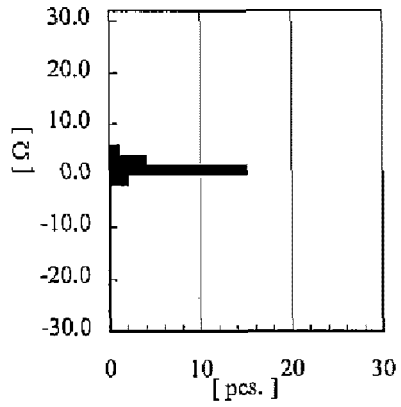
4. Low temp. storage
-55 °C × 1 000 h



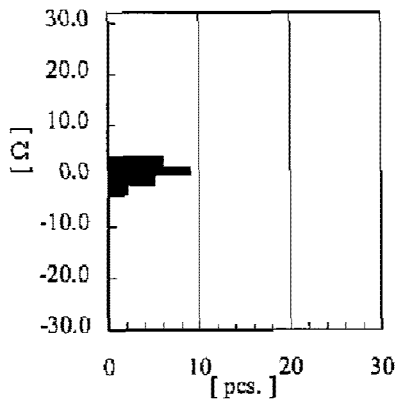
5. Temp. cycle
-55 °C ⇔ +125 °C
100 cycles



6. Temp. humidity storage
+85 °C × 85 %RH × 1 000 h



7. Resistance to soldering heat (Reflow characteristics)
Reflow furnace with the condition
2 times



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