# INFORMATION

**PRODUCT No. :** **Q22MA4061014800**

**MODEL :** **MA-406**

**INFO. No. :** **A14-123-2A**

**DATE :** **May. 2. 2014**

**SEIKO EPSON CORPORATION**

**8548 Naka-minowa**
**Minowa-machi Kamiina-gun**
**Nagano-ken**
**399-4696 Japan**

INTRODUCTION

1. The contents is subject to change without notice.
   Please exchange the specification sheets regarding
   the product's warranty.

2. This sheet is not intended to guarantee or provide
   an approval of implementation of industrial patents.

3. We have prepared this sheet as carefully as possible.
   If you find it incomplete or unsatisfactory in any
   respect, We would welcome your comments.

This product complies with RoHS Directive.

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## Product No. / Model

The product No. of this crystal unit is Q22MA4061014800.

The model is MA-406.

## Contents


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| [ 2 ] | Operating range | 2 |
| [ 3 ] | Electrical characteristics | 2 |
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| [ 5 ] | Dimensions and marking layout | 4 |
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## [ 1 ] Absolute maximum ratings

| Item | Symbol | Rating value |
|---|---|---|
| Storage temperature | $T_{STG}$ | -55 °C to +125 °C |
| Maximum drive level | GL | 2 mW |

## [ 2 ] Operating range

| Item | Symbol | Value | | |
|---|---|---|---|---|
| | | Min. | Typ. | Max. |
| Operating temperature | TOPR | -20 °C | | +70 °C |
| Drive level | DL | | 100 μW | |

## [ 3 ] Electrical characteristics

| Item | Symbol | Value | Note |
|---|---|---|---|
| Frequency | $f_1$ | 8 MHz | |
| Frequency tolerance | ΔF/F | $\pm 50 \times 10^{-6}$ | CL = 18 pF<br>Ta= +25 °C ±3 °C<br>Drive level : 100 μW<br>not include aging |
| Series resistance | $R_1$ | 80 Ω Max | π circuit<br>Drive level : 100 μW<br>Ta = -20 °C to +70 °C |
| Shunt capacitance | $C_0$ | 5 pF Max. | |
| Frequency temperature characteristics | Top | $\pm 30 \times 10^{-6}$ | Ta = -20 °C to +70 °C<br>($0 \times 10^{-6}$at +25 °C ± 3 °C)<br>Drive level : 100 μW |
| Isolation resistance | IR | 500 MΩ Min. | DC 100 V, 60 sec.<br>between terminals or<br>terminal and case |
| Aging | fa | $\pm 5 \times 10^{-6}$/year | Ta = +25 °C ± 3 °C<br>Drive level : 100 μW |

## [ 4 ] Environmental and mechanical characteristics

Item No.3 to No.6 shall be tested after following pre conditioning
+85 ± 2 °C × 85 ± 5 %RH × 24 ± 1 h after 24 h at room temperature

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

| No. | Items | Value*1*2 | Conditions |
|---|---|---|---|
| | | Δ f/f [1 × $10^{-6}$] | |
| 1 | Drop | (2) ± 10 | Free drop from 750 mm height on a hard wooden board for 3 times (Board is thickness more than 30 mm) |
| 2 | Vibration | (2) ± 10 | 10 Hz to 55 Hz amplitude 0.75 mm<br>55 Hz to 500 Hz acceleration 98 $m/s^2$<br>10 Hz → 500 Hz → 10 Hz 15 min./cycle<br>6 h (2 hours , 3 directions) |
| 3 | High temperature storage | (1) a ) ± 50<br>b ) ± 10 | a) +125 °C × 1 000 h<br>b) +85 °C × 1 000 h |
| 4 | Low temperature storage | (1) ± 10 | -55 °C × 1 000 h |
| 5 | Temperature cycle | (1) ± 10 | -55 °C ⇔ +125 °C<br>30 min. at each temp. 100 cycles |
| 6 | Temperature humidity storage | (1) ± 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 the side for 10 s ± 1 s<br>Ref. IEC 60068-2-21 |
| 9 | Pull - off | No peeling-off at a soldered part | 10 N press the side for 10 s ± 1 s.<br>Ref. IEC 60068-2-21 |
| 10 | Solvent resistance | The marking shall be legible | Ref. JIS C 0052 or IEC 60068-2-45 |
| 11 | Solderability | Termination must be 90 % covered with fresh solder | Dip termination into solder bath at +230 °C ± 10 °C for 3 s (Using Rosin Flux) |

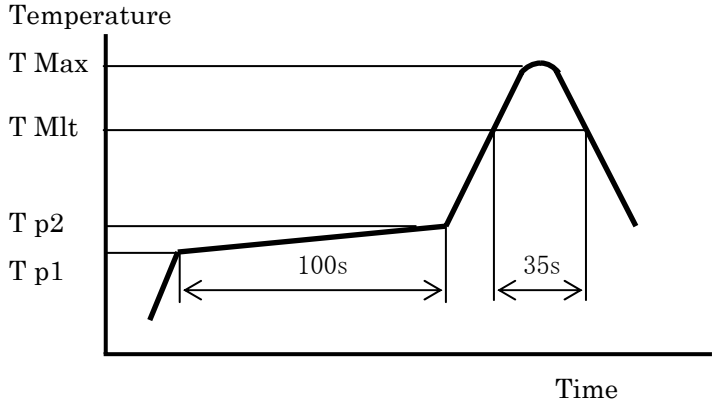
1. Item No.1 to No.7 resistance at before above tests should be less than ±20 % or less than under mentioned values.
2. *1 Each test done independently.
3. *2 Measuring 2 h to 24 h later leaving in room temperature after each test.
   (1) Measuring 24 h later leaving in room temperature after each test.
   (2) Measuring 2 h later leaving in room temperature after each test.

| Frequency | Vib. mode | ΔCI |
|---|---|---|
| 4.0 MHz ≤ f < 5.0 MHz | Fundamental | 50Ω |
| 5.5 MHz ≤ f < 12.0 MHz | | 10Ω |
| 12.0 MHz ≤ f ≤ 30.0 MHz | | 5Ω |
| 26.0 MHz ≤ f ≤ 64.0 MHz | 3rd overtone | 10Ω |

◆Reflow

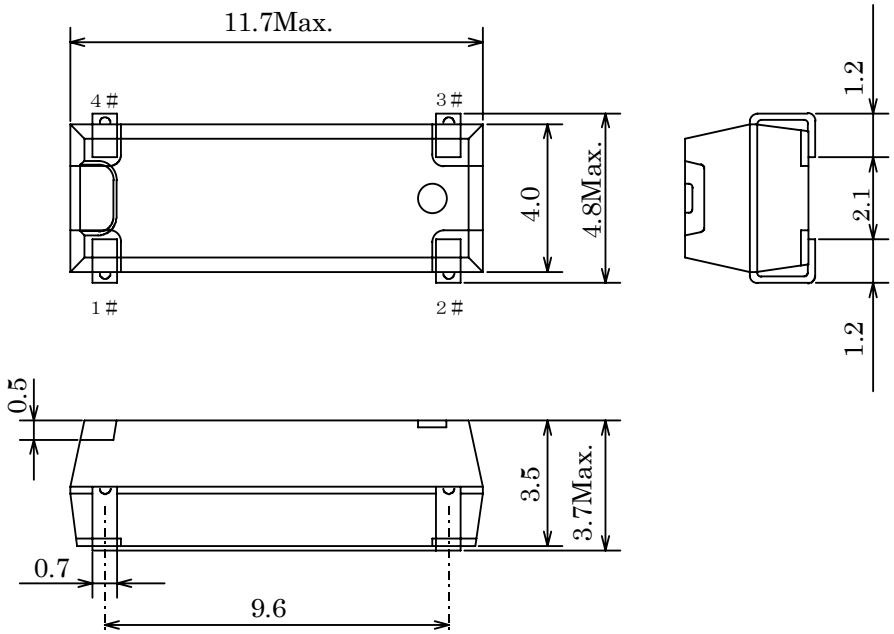
Pre Heating Temperature
T p1~T p2 = +170 °C
Heating Temperature
T Mlt = +220 °C
Peek Temperature
T Max = +260 °C

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

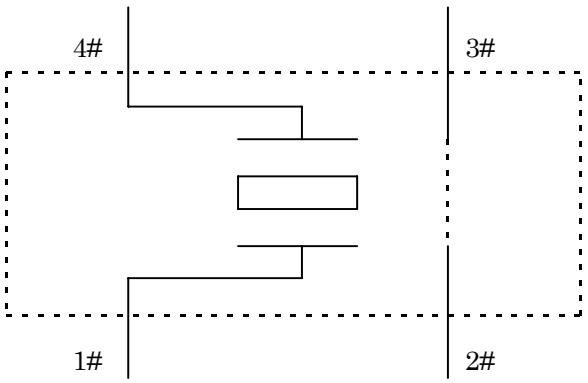


[ 5 ] Dimensions and marking layout

Dimensions




Circuit location



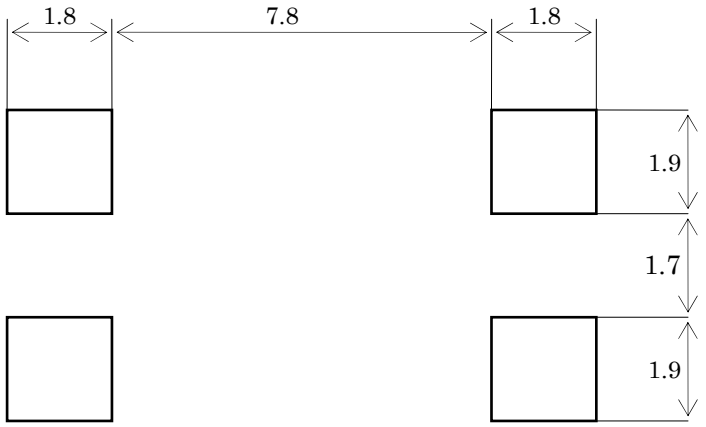

* Do not connect 2# and 3# terminals to any external terminals.

| Type | MA-406 | Terminal treatment | Pb Free solder plate | Unit | 1 = 1 mm |
|---|---|---|---|---|---|

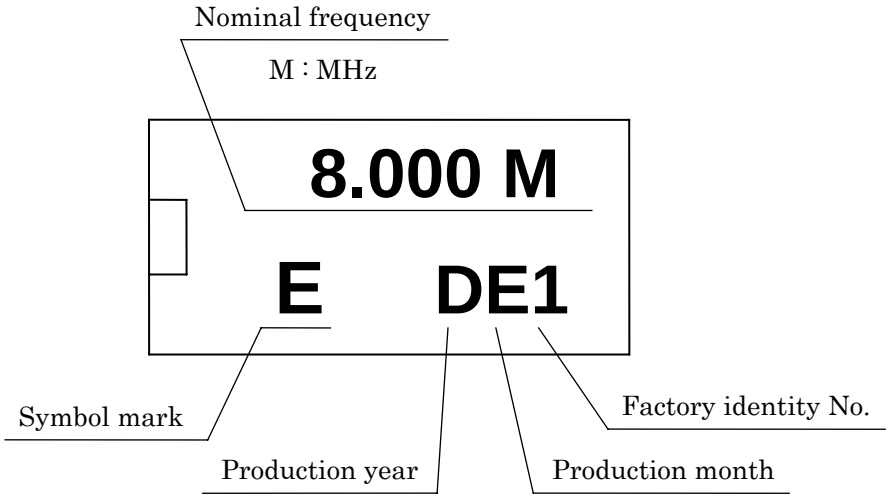
## [ 6 ] Recommendable patterning and marking layout

Recommendable patterning

Unit : mm




Marking layout




Marking table for Production year with the last one digit of Anno Domini

| The last one digit of A.D | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Production year of marking | A | B | C | D | E | F | G | H | J | K |

Marking table for Production month with the marking number

| Production month | Jan. | Feb. | ····· | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| Production month of marking | A | B | ····· | G | H | J | K | L | M |

- ♦ Nominal frequency is only example.
- ♦ Nominal frequency omits the figure below the forth place of decimals.
- ♦ The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

## [ 7 ] Notes

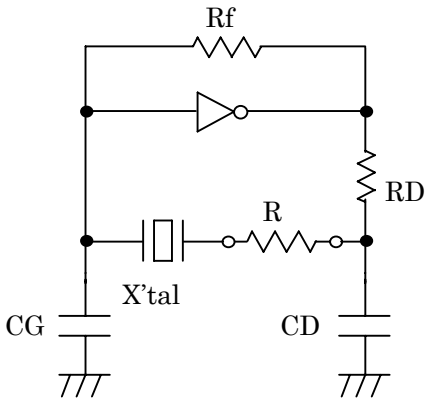
1. Max. two (2) times reflow is allowed. Once miss soldering is happen, hand work soldering by soldering iron is recommended. (+350 °C Max. × within 5 sec.)

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 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 × (5 ~ 10)

5. The shortest line patterning on board is recommendable.
   Too long line on board may cause of abnormal oscillation.

6. To avoid malfunction, no pattern under or near the X'tal 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.

9. Don't storage or use in the environment that temperature may change rapidly to avoid the condition.

10. Please refer to packing specification regarding how to storage the products in the pack.

# 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 carton | 3 |
| 〔3〕 | Shipping carton | |
| 〔4〕 | Marking | 4 |
| 〔5〕 | Quantity | |
| 〔6〕 | Storage environment | |
| 〔7〕 | Handling | |

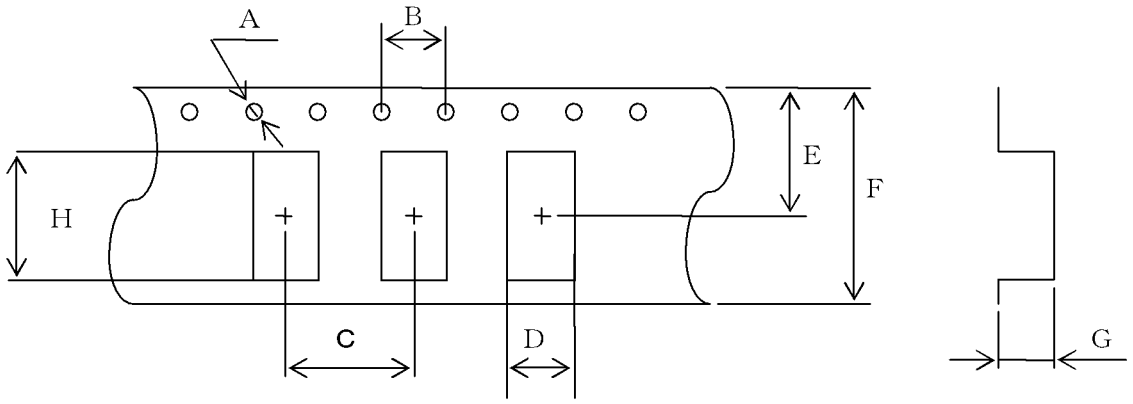
〔1〕 Taping specification

Subject to EIA-481 & IEC-60286

(1) Tape dimensions TE-2412L

Material of the carrier tape : Polystyrene

Material of the top tape : PET

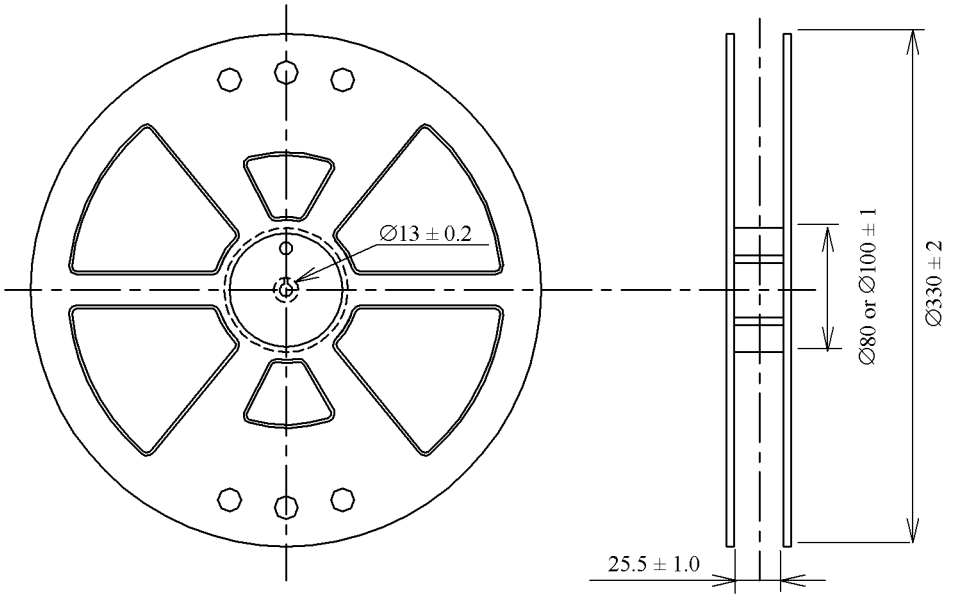



| Symbol | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Value | $\phi$ 1.5 ±0.1/-0 | 4.0 ±0.1 | 12.0 ±0.1 | 4.9 ±0.1 | 11.5 ±0.1 | 24.0 ±0.2 | 4.0 ±0.1 | 11.9 ±0.1 |

Unit : mm

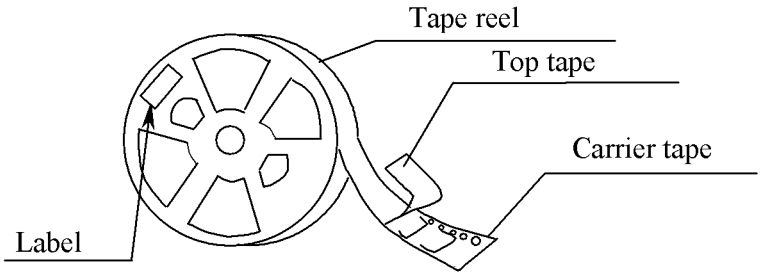
(2) Reel dimensions

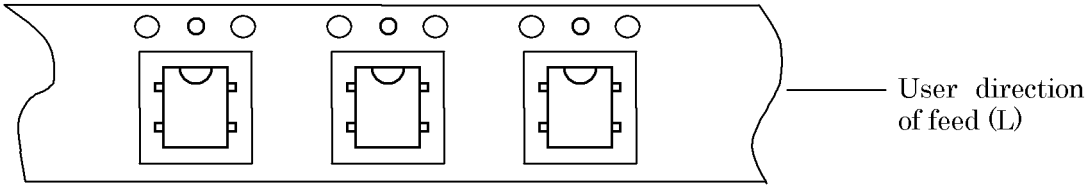
Material of the reel : Polystyrene



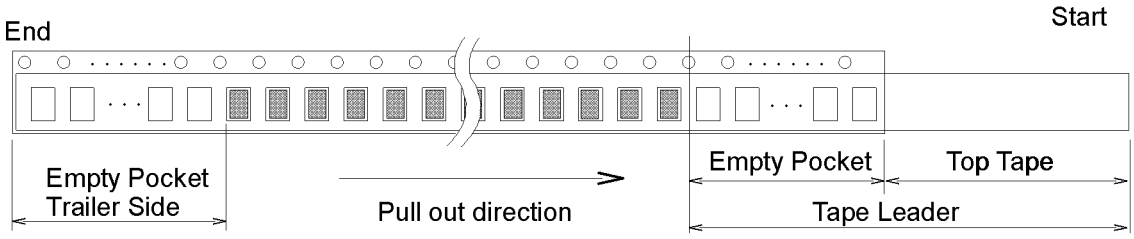
(3) Packing

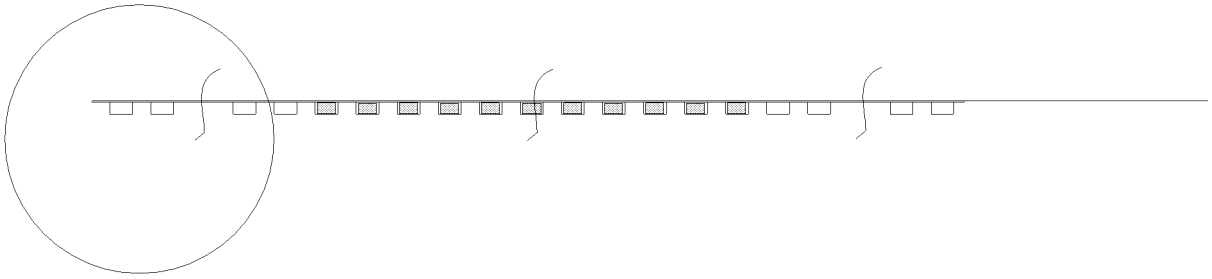
①Tape & reel




②Start & end point

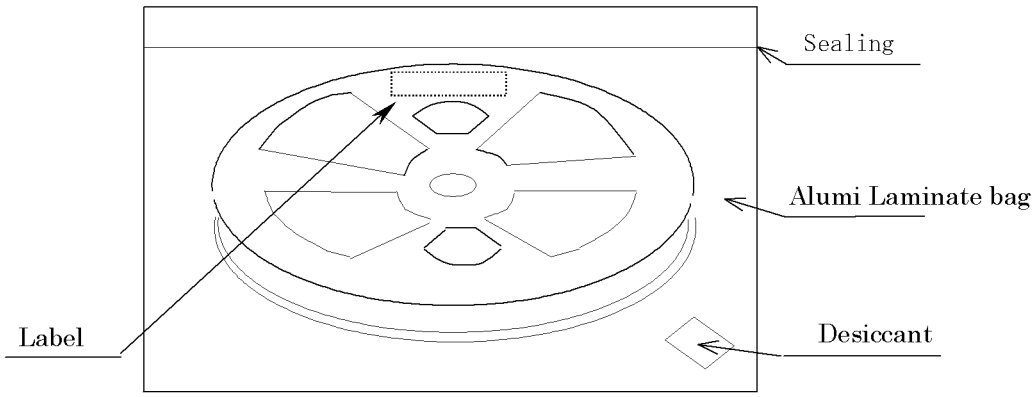


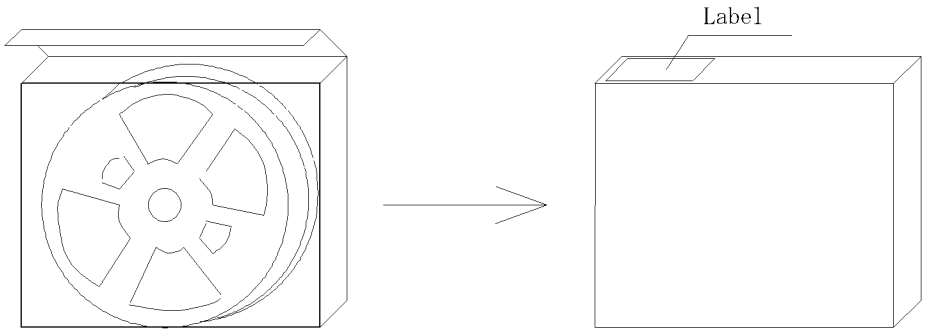
| Item | | Empty space |
|---|---|---|
| Tape leader | Top tape | Min. 1 000 mm |
| | Carrier tape | Min. 100 mm |
| Tape trailer | Top tape | Min. 0 mm |
| | Carrier tape | Min. 160 mm |

〔2〕 Inner carton

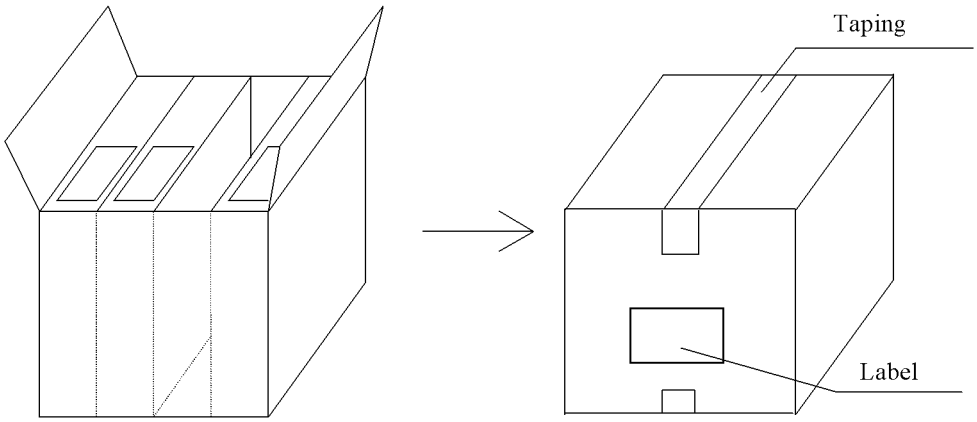
a) Packing to antistatic bag




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 name 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

・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.

# – P R O C E S S  Q U A L I T Y  C O N T R O L –

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No.68-00-1-AEE-1

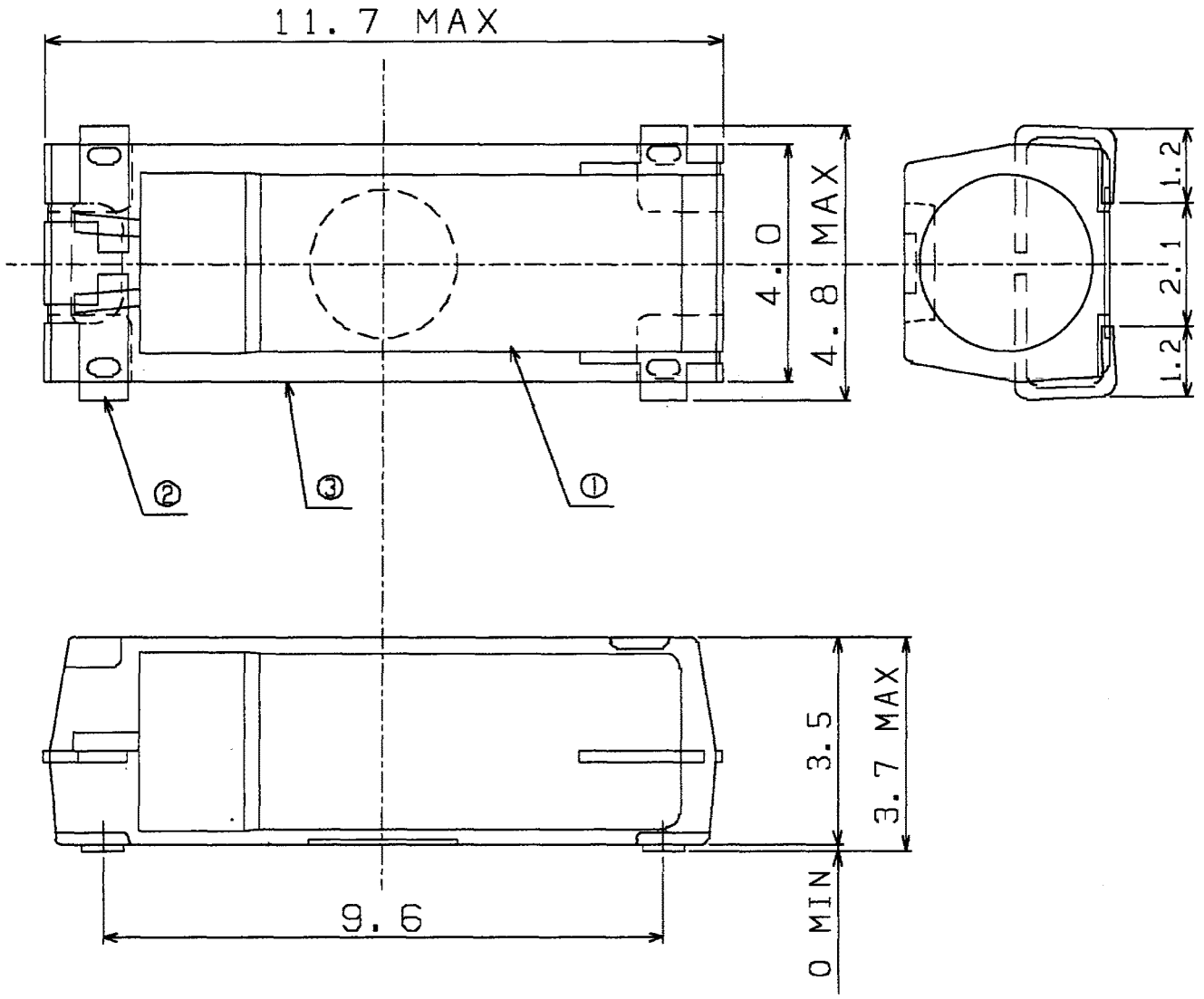
## MOLD TYPE AT STRIP CRYSTAL M A – 4 0 6

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

# Construction of MA Type Quartz Crystals(MA-406)

No. : M-990201-AE-4

unit : mm




| No | Name of Part | Material | Remarks |
|---|---|---|---|
| ① | Crystal CA-303 | | |
| ② | Lead | 42 Alloy | Pb Free Solder plate |
| ③ | Molding | Epoxy Compound (Halide free) | |

# 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<br>55 Hz to 500 Hz acceleration 98 $m/s^2$<br>10 Hz => 500 Hz => 10 Hz 15 min / cycle<br>6 h ( 2 h × 3 directions ) | ± 10 | 22 | 0 |
| 3 | High temperature storage | a) +125°C × 1 000 h<br>b) +85 °C × 1 000 h | *3 a) ± 50<br>*3 b) ± 10 | a) 22<br>b) 22 | a) 0<br>b) 0 |
| 4 | Low temperature storage | -55 °C × 1 000 h | *3 ± 10 | 22 | 0 |
| 5 | Temperature cycle | -55 °C <=> +125 °C<br>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<br>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<br>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 |

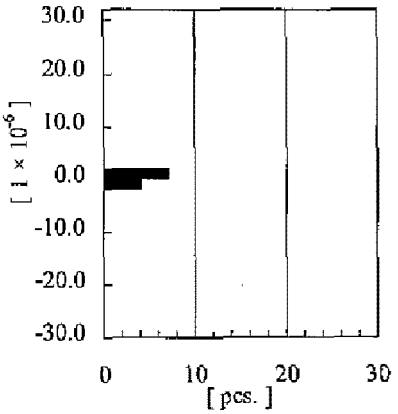
**Qualification Data**

## Product Name : MA-406

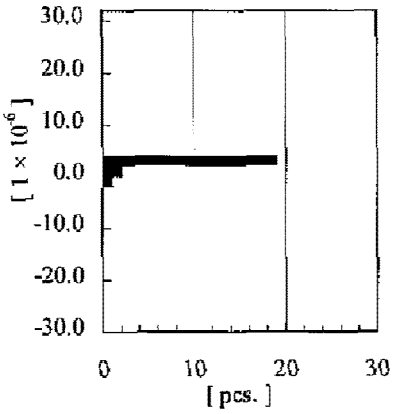
Δ f / f

No. M-990202-01-002E

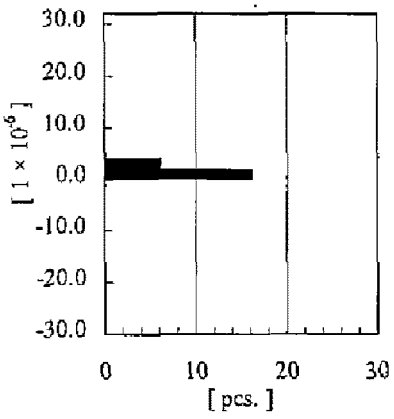
1. Drop
750 mm × 3 times



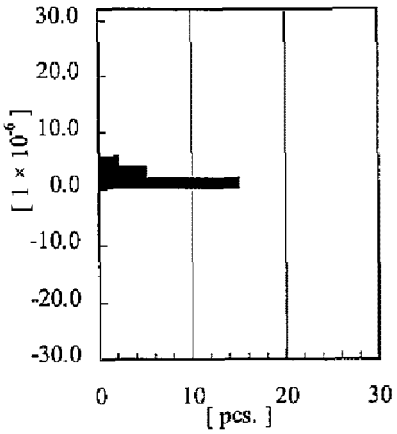

2. Vibration
10 Hz to 55 Hz amplitude 0.75 mm
55 Hz to 500 Hz acceleration 98 m/s²
15 min / cycle 6 h (2 h × 3 directions)



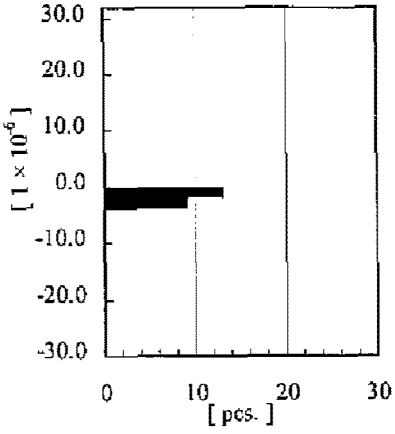

3. High temp. storage
a) +125 °C × 1 000 h



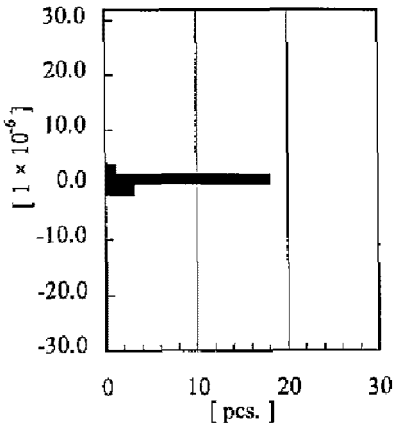

3. High temp. storage
b) +85 °C × 1 000 h



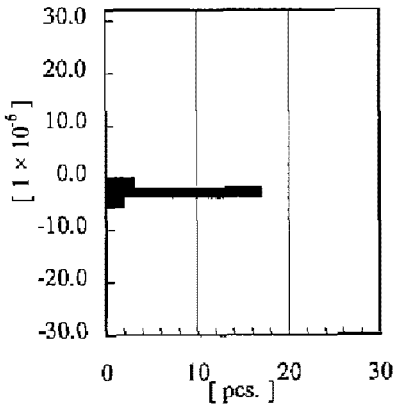

4. Low temp. storage
-55 °C × 1 000 h



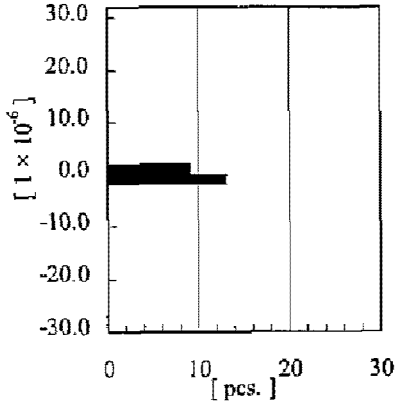

5. Temp. cycle
-55 °C ⇔ +125 °C
100 cycles




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



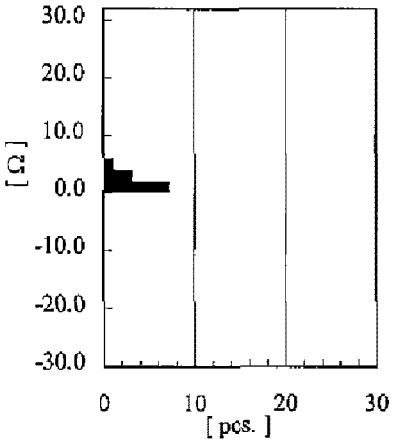

## Qualification Data

## Product Name : MA-406

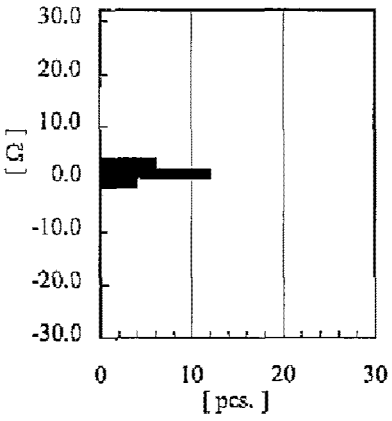
Δ CI

No. M-990202-01-003E

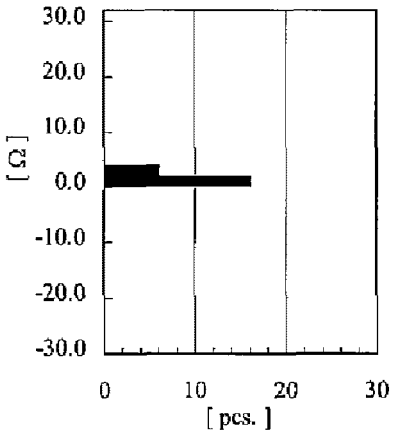
1. Drop
750 mm × 3 times



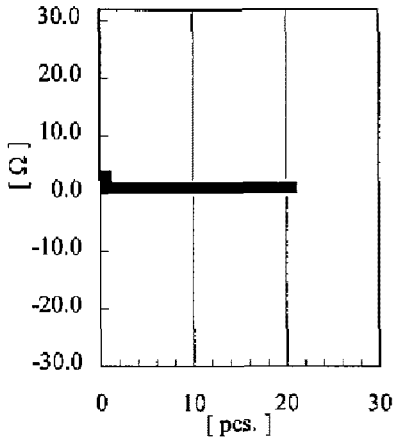

2. Vibration



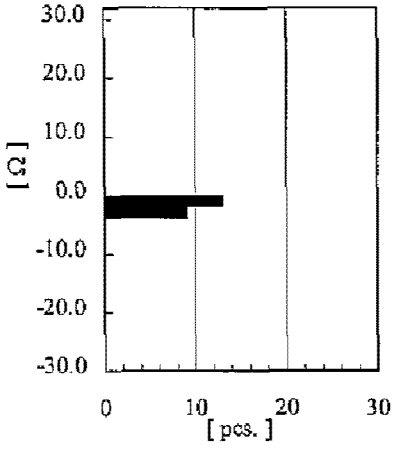

3. High temp. storage
a) +125 °C × 1 000 h



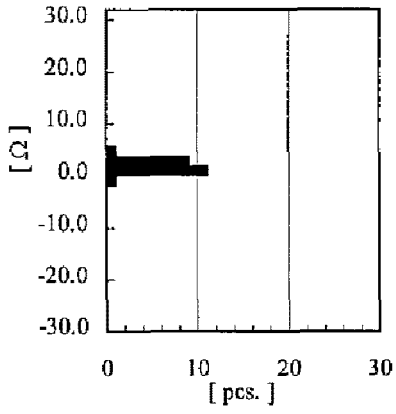

3. High temp. storage
b) +85 °C × 1 000 h



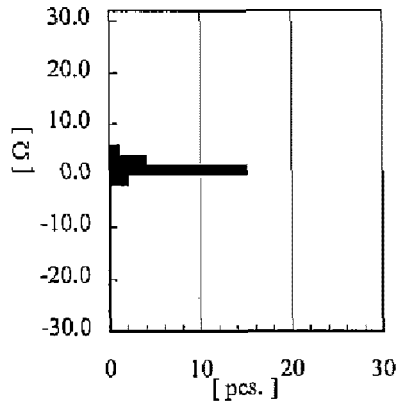

4. Low temp. storage
-55 °C × 1 000 h



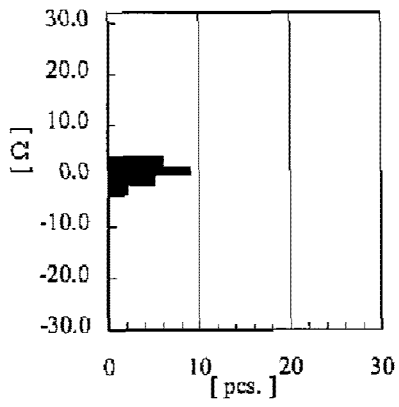

5. Temp. cycle
-55 °C ⇔ +125 °C
100 cycles




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




**Qualification Data**