# INFORMATION

**PRODUCT No. :** **Q22FA2380119400**

**MODEL :** **FA-238**

**INFO. No. :** **A13-969-8B**

**DATE :** **Jan. 9. 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.

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.

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.

## Product No. / Model

The product No. of this crystal unit is Q22FA2380119400.
The model is FA-238.

## Contents



## MSL

MSL level 1

## [ 1 ] Absolute maximum ratings

| No. | Item | Symbol | Rating value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| 1 | Storage temperature range | T_stg | - 40 | | + 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 | Depends on the Motional resistance and Frequency temperature characteristics specifications. |
| 2 | Level of drive | DL | | 100 | 200 | μW | Recommended : 100 μW |

## [ 3 ] Static characteristics

| No. | Item | Symbol | Value | Unit | Conditions |
|---|---|---|---|---|---|
| 1 | Nominal Frequency | f_nom | 24 | MHz | Fundamental |
| 2 | Frequency tolerance | f_tol | ± 30 | $\times 10^{-6}$ | CL = 18 pF<br>Ta = + 25 ± 3°C<br>DL : 100 μW<br>Not include aging |
| 3 | Motional resistance | R1 | 60 Max. | Ω | π circuit IEC 60444-2<br>Ta = - 20 °C ~ + 70 °C<br>DL : 100 μW |
| 4 | Shunt capacitance | C0 | 5.0 Max. | pF | π circuit and N.A. |
| 5 | Frequency temperature characteristics | f_tem | ± 30 | $\times 10^{-6}$ | Ta = - 20 °C ~ + 70 °C<br>(Ref. at + 25 °C ± 3 °C)<br>DL : 100 μW |
| 6 | Isolation resistance | IR | 500 Min. | MΩ | DC 100 V ± 15, 60 seconds<br>between each terminals |
| 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 | Shock | * 3 ± 10 | 100 g dummy Jig (ETC Standard) drop from 1 500 mm height on the Concrete 3 directions 10 times |
| 2 | Vibration | * 3 ± 5 | 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 | * 3 ± 10 | + 125 °C × 1 000 h |
| 4 | Low temperature storage | * 3 ± 5 | - 55 °C × 1 000 h |
| 5 | Temperature cycle | * 3 ± 5 | - 55 °C ↔ + 125 °C<br>30 minutes at each temp. 100 cycle |
| 6 | Temperature humidity storage | * 3 ± 10 | + 85 °C × 85 %RH × 1 000 h |
| 7 | Resistance to soldering heat | ± 5 | 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 | 20 N press for 10 s ± 1 s<br>Ref. IEC 60068-2-21 |
| 10 | Pull – off | No peeling-off at a soldered part | 10 N press for 10 s ± 1 s<br>Ref. IEC 60068-2-21 |
| 11 | Solderability | Terminals must be 95 % covered with fresh solder. | Dip termination into solder bath at + 235 °C ± 5 °C for 5 s<br>(Using Rosin Flux) |

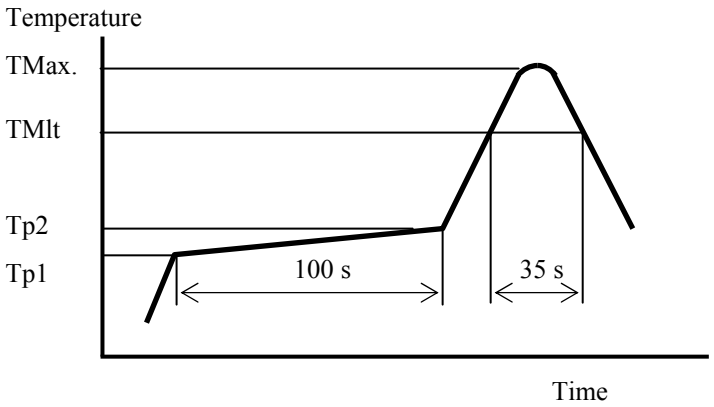
< Notes >

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.1 to No.6 shall be tested after following pre conditioning.
   Measuring 24 h later leaving in room temperature after Pre conditioning.
   Pre conditioning : Reflow 3 times.
4. Item No.1 to No.7, Shift motional resistance at after above tests should be less than 20 % or less than 10 Ω.

◆Reflow

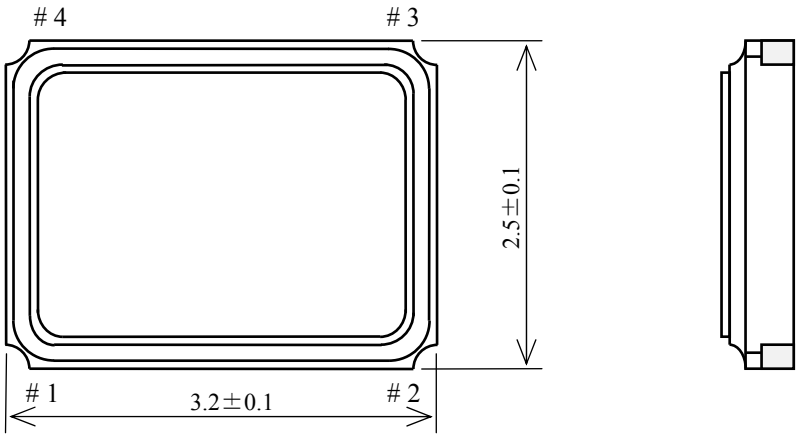
Pre Heating Temperature
Tp1 ~ Tp2 = + 170 °C
Heating Temperature
TMlt = + 220 °C
Peek Temperature
TMax. = + 260 °C

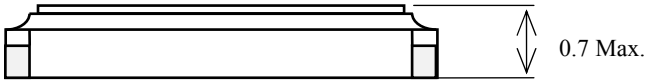
Point of measuring
In case of Solderability
Terminal.
In case of Resistance to soldering heat
Surface.

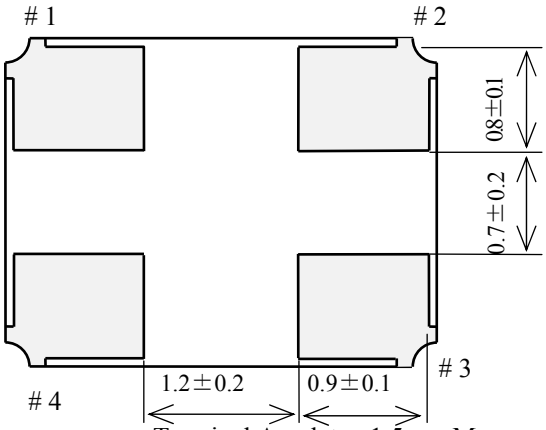


## [ 5 ] Dimensions and Circuit

1) Dimension



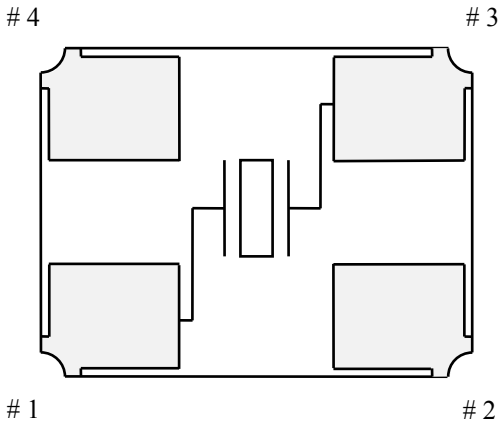




Terminal Au plate : 1.5 μm Max.

2) Circuit

( TOP VIEW )

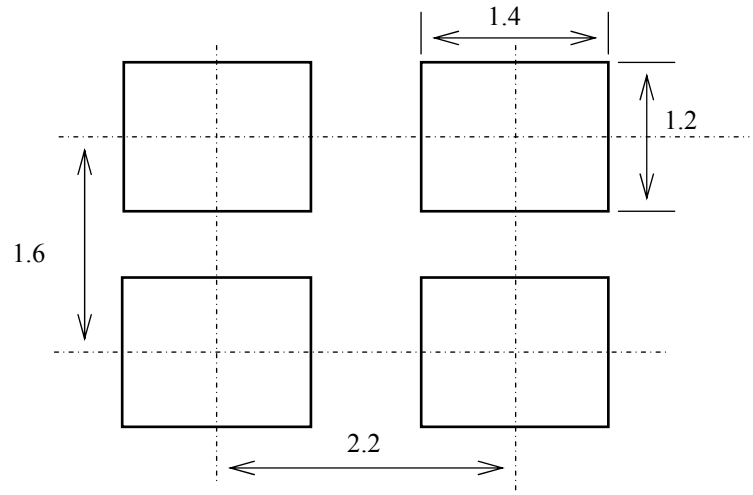



# 1 , # 3 : XTAL
# 2 , # 4 : GND （are connected to the cover）

| Type : FA-238 | Terminal treatment : Au plate | Unit : 1 = 1 mm |
|---|---|---|

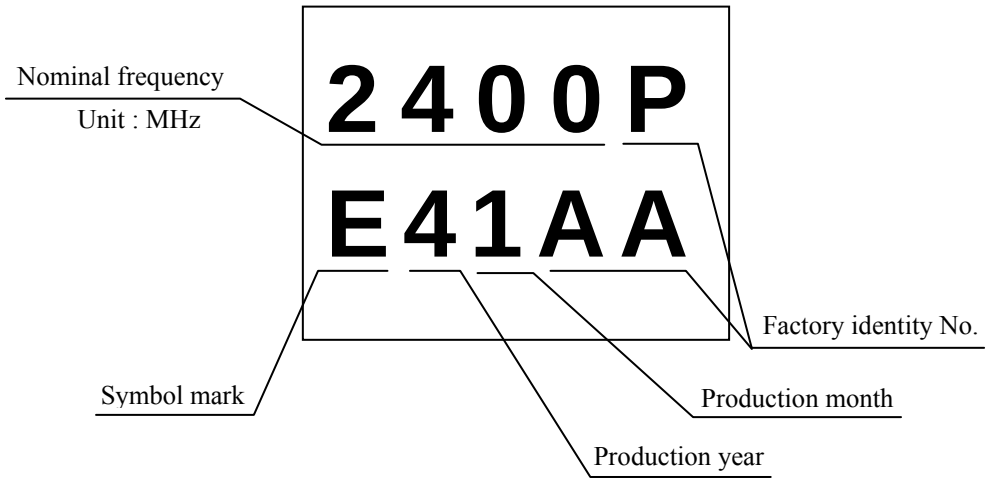
## [ 6 ] Recommended soldering pattern and Marking layout

1)Recommended soldering pattern




Unit : 1 = 1 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 second place of decimals.
  ex) 24 MHz ..... [2400]
- The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

Type : FA-238

## [ 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 +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.

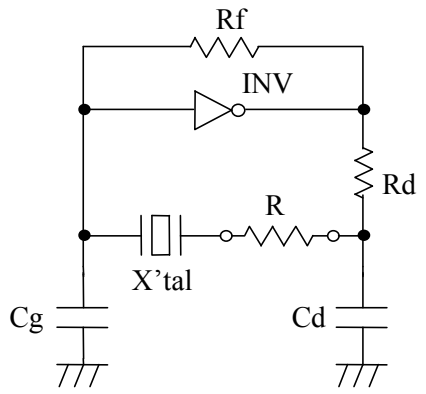
8. Applying excessive excitation Drive Level to the crystal Unit may cause deterioration damage.

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

## 1. APPLICATION

This document is applicable to FA-238

## 2. CONTENTS

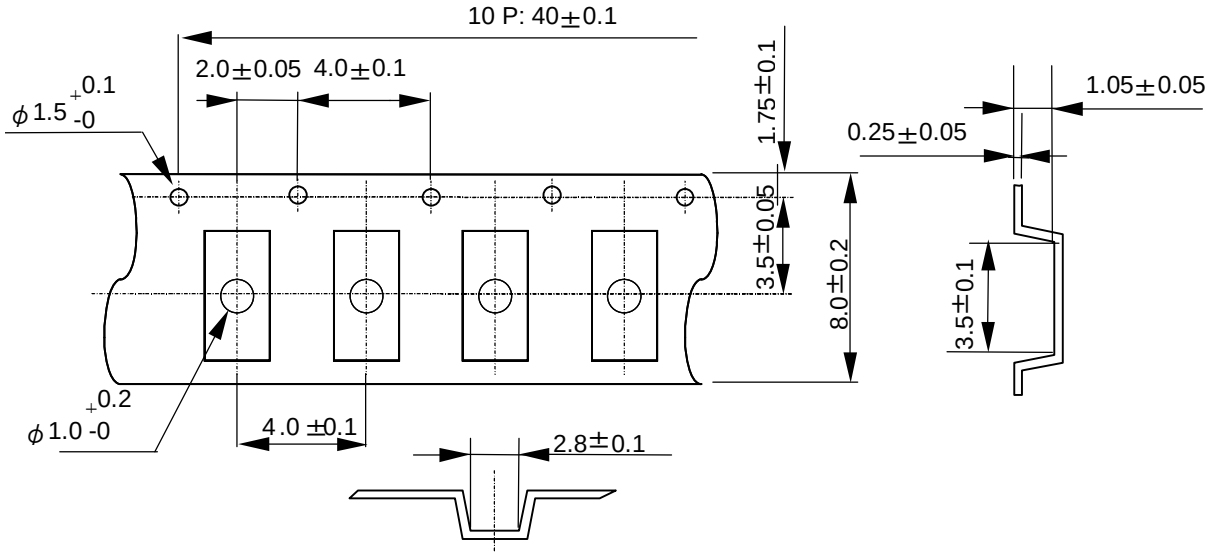
# [ 1 ] Taping specification

Subject to EIA-481 & IEC-60286

(1) Tape dimensions TE0804L

Material of the Carrier Tape : PS

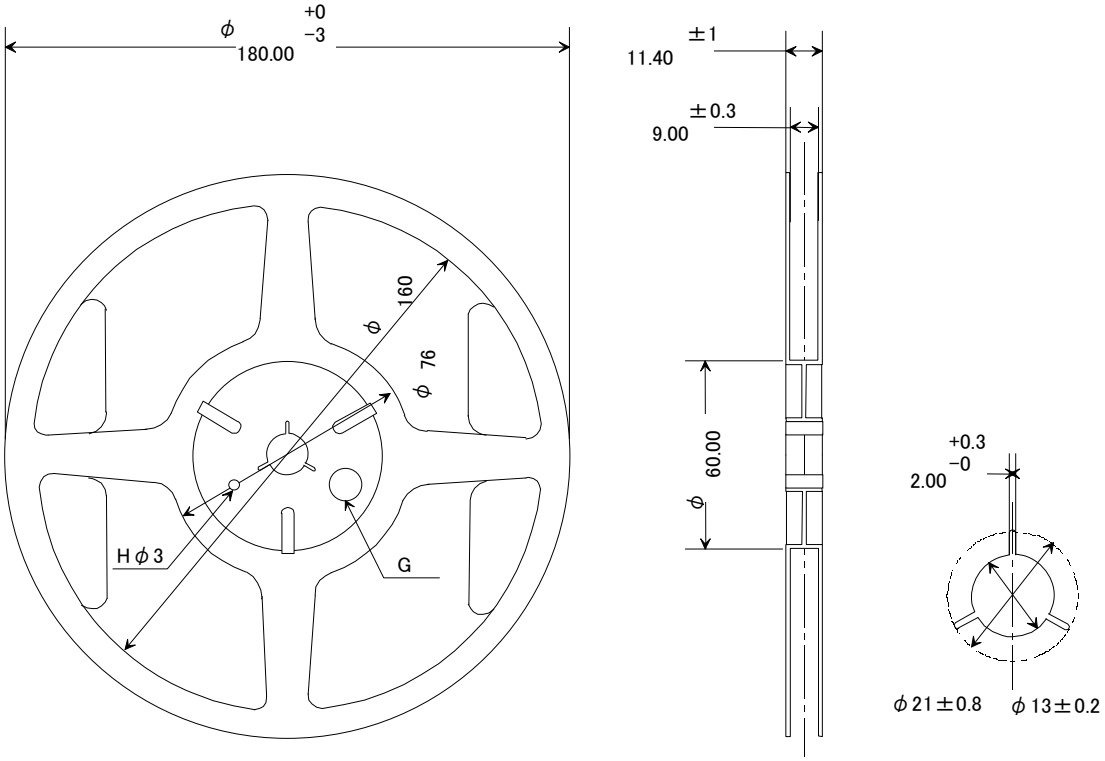
Material of the Top Tape : PET+PE




(2) Reel dimensions

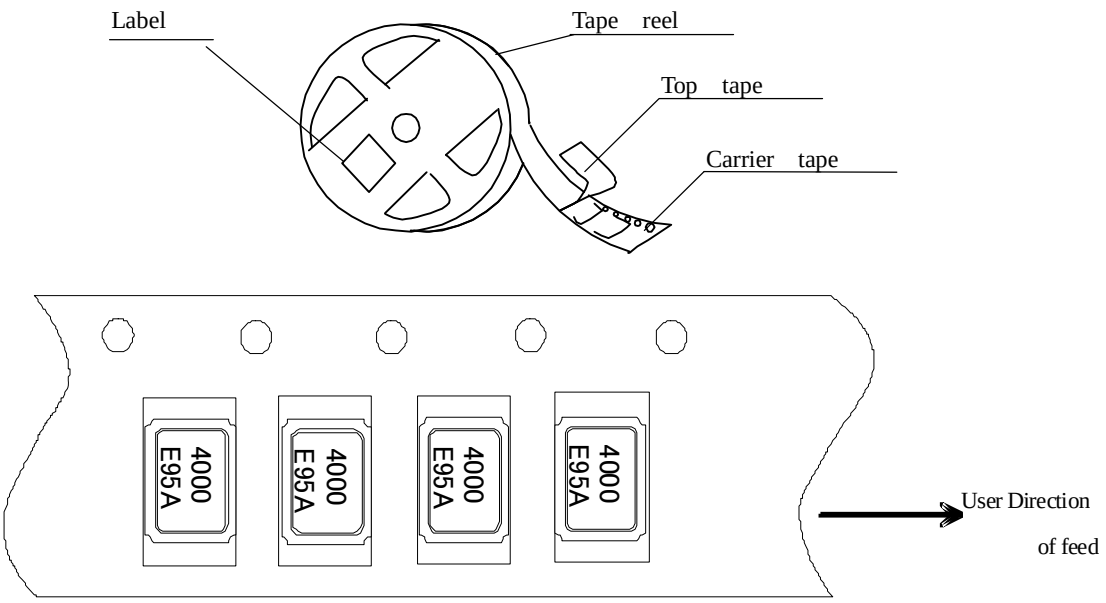
(a) Center material : PS

(b) Material of the Reel : PS

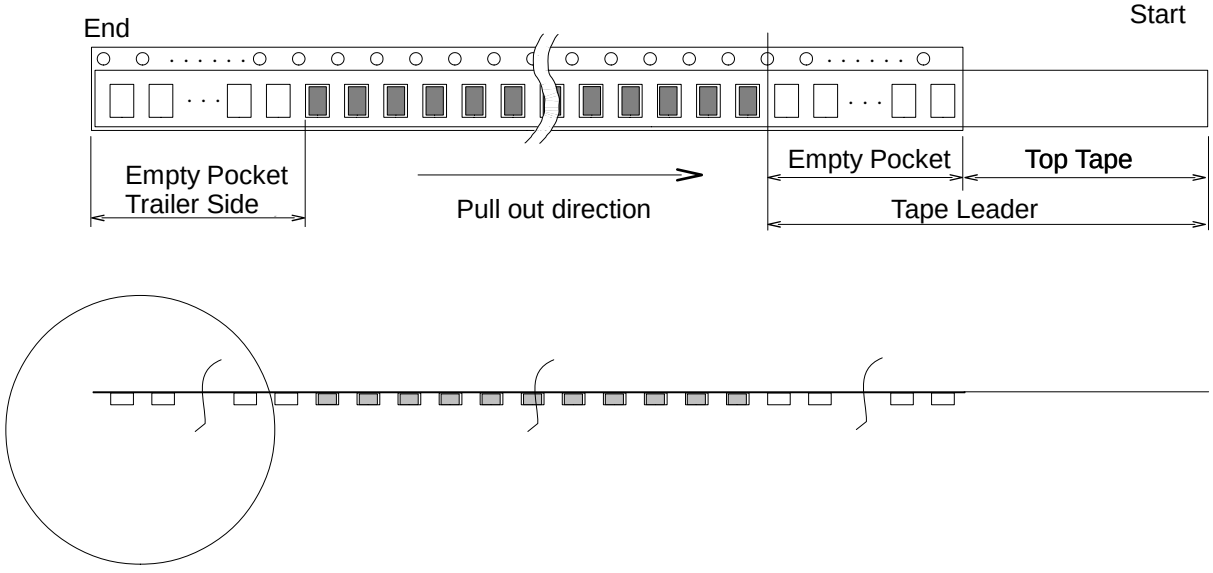


(3) Packing

(a) Tape & Reel




(b) Start & 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 |

(4) Peel force of the cover tape

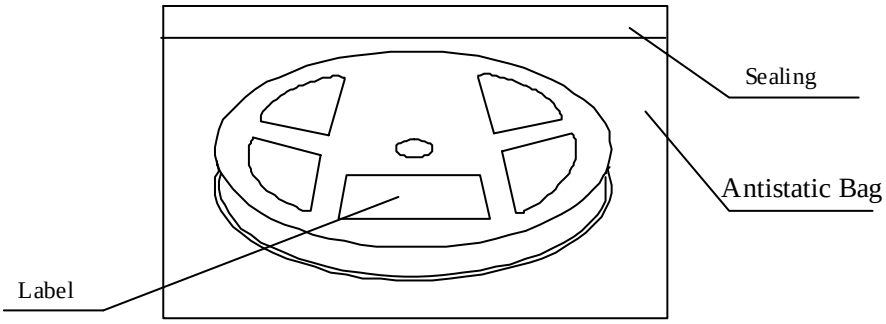
① angle : cover tape during peel off and the direction of unreeling shall be 165° to 180°.

② peel speed : 300 mm / min.

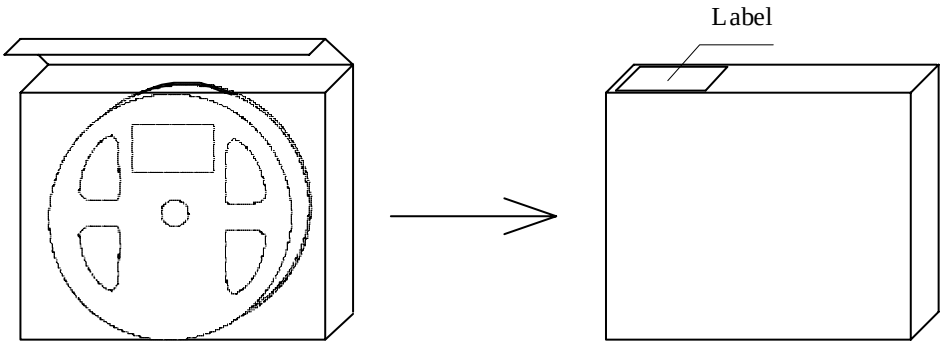
③ strength : 0.1 to 1 N.

## [ 2 ] Inner Carton

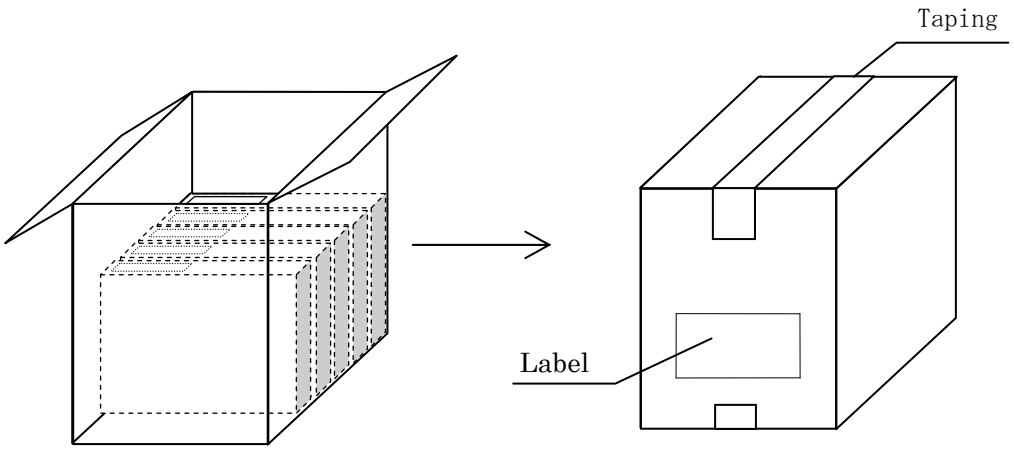
a) Packing to antistatic bag




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

- 3 000 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.

# - PROCESS QUALITY CONTROL -

2012.9.26

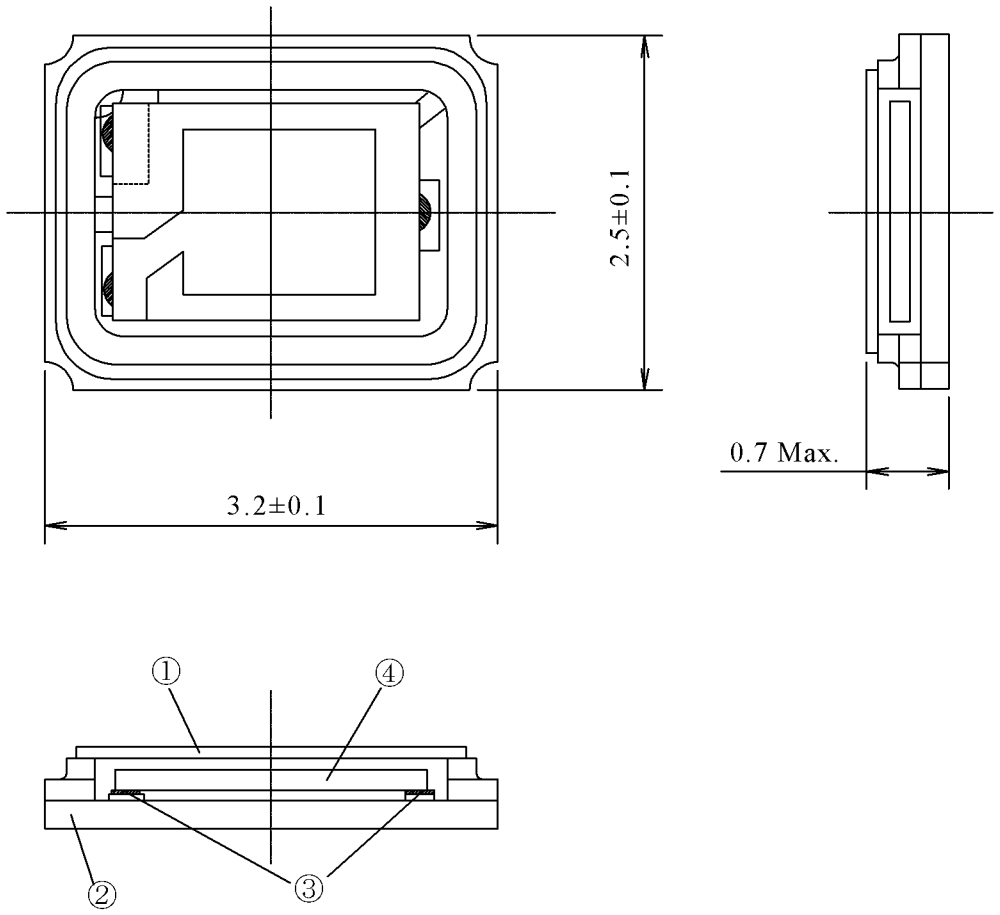
No. A-9911-02-AAE-3 **SMD TYPE AT STRIP CRYSTAL FA-238**

| Manufacturing process chart | No. | Section | Standards | Inspection, Control Items | Inspection Methods | Instrument | Record |
|---|---|---|---|---|---|---|---|
| CRYSTAL BLOCK | 1 | Inspection Section (Ina/Thai/China Plant) | Purchasing Specification<br>Incoming Inspection Standard | Dimension<br>Outer Appearance<br>Inner Appearance | Sampling<br>〃<br>〃 | Length Gauge<br>Visual Inspection<br>Visual Inspection | In-Coming Inspection Data Sheet |
| ① In-coming Inspection | 1' | Inspection Section (Ina/Malaysia/Thai Plant) | 〃 | Dimension<br>Outer Appearance | Sampling<br>〃 | Comparator<br>Microscope | 〃 |
| ② Wafer Cutting | 2 | Ploduction Section (Ina/Thai/China Plant) | Manufacturing Instruction Sheet | Cut Angle<br>Wafer Thickness | Sampling<br>〃 | X-ray Radio Grafic<br>Comparator | Process Data Sheet |
| ③ Wafer Lapping | 3 | Ploduction Section (Ina/Thai/China Plant) | 〃 | Frequency<br>Wafer Thickness | Sampling<br>〃 | Blank Osillator<br>Comparator | 〃 |
| Ceramic Package ④ Chip Cutting | 4 | Ploduction Section (Ina/Thai/China Plant) | 〃 | Dimension | Sampling | Comparator | 〃 |
| ⑤ Etching | 5 | Ploduction Section (Ina/Thai/China Plant) | 〃 | Frequency<br>Outer Appearance | Sampling<br>〃 | Blank Osillator<br>Microscope | 〃 |
| ① In-coming Inspection ⑥ Deposition | 6 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | 〃 | Frequency<br>Outer Appearance | Sampling<br>〃 | Blank Osillator<br>Microscope | 〃 |
| Lid ⑦ Mounting | 7 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | 〃 | Outer Appearance | Sampling | Microscope | 〃 |
| ① In-coming Inspection ⑧ Frequency Adjustment | 8 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | 〃 | Frequency | Sampling | NetworkAnalyzer | 〃 |
| | 9 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | 〃 | Outer Appearance | Sampling | Microscope | 〃 |
| ⑨ Welding | 10 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | 〃 | Package Leak | 100% Inspection | Leak Tester | 〃 |
| ⑩ Leak Test | 11 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | 〃 | Outer Appearance | Sampling | Microscope | 〃 |
| ⑪ Marking | 12 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | 〃 | Crystal Impedance<br>Frequency<br>Insulation Resistance<br>Temp. Characteristic | 100% Inspection<br>〃<br>〃<br>Sampling | Inspection M/C<br>〃<br>〃<br>〃 | 〃 |
| ⑫ Characteristic Inspection | | | | | | | |
| ⑬ Out-going Inspection | 13 | Inspection Section (Ina/Malaysia/Thai Plant/GKL) | Out-going Inspection Standard | Crystal Impedance<br>Frequency<br>Insulation Resistance<br>Outer Appearance | Sampling<br>〃<br>〃<br>〃 | Inspection M/C<br>〃<br>〃<br>Microscope | Out-going Inspection Data Sheet |
| ⑭ Taping | 14 | Ploduction Section (Ina/Malaysia/Thai Plant/GKL) | Manufacturing Instruction Sheet | Tape-Peel Strength | Sampling | Peeling Force Tester | Process Data Sheet |
| ⑮ Packing | 15 | Ploduction Controle Section (Ina/Malaysia/Thai Plant) | Manufacturing Instruction Sheet<br>Packing Instruction Sheet | Destination<br>Quantity | — | — | Delivery Slip |

# ＦＡ－２３８ Construction Drawing(3 Point Bonding)

No.：A-9911-AE-2

Unit：mm




| No | Parts NAME | Material | Surface Treatment |
|---|---|---|---|
| ① | LID | Covar | Ni Plating |
| ② | BASE | Ceramic・Covar | Au Plating |
| ③ | Ag Paste | Bonding Paste of Electric Conductor | |
| ④ | Crystal Chip | Crystal | Electrode Pattern(Cr+Ag) |

# RELIABILITY TEST DATA

## Product Name : FA-238 ( 16 ≦ f0 ≦ 32 MHz)

The Company evaluation condition

We evaluate environmental and mechanical characteristics by the following test condition . **No. F-A9911-07-001E**

| No. | ITEM | TEST CONDITIONS | VALUE *1 *2<br>Δ f / f<br>[1 × $10^{-6}$] | TEST Qty [ n ] | FAIL Qty [ n ] |
|---|---|---|---|---|---|
| 1 | Shock | 100g dummy Jig (SEIKO EPSON Standard)<br>drop from 1500 mm height on the Concrete<br>3 directions 10 times | ( 2 )<br>± 10 | 22 | 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 ) | ( 2 )<br>± 5 | 22 | 0 |
| 3 | High temperature storage | +125 °C × 1 000 h | ( 1 )<br>± 10 | 22 | 0 |
| 4 | Low temperature storage | -55 °C × 1 000 h | ( 1 )<br>± 5 | 22 | 0 |
| 5 | Temperature cycle | -55 °C ⇔ + 125 °C<br>30 min at each temp. 100 cycles | ( 1 )<br>± 5 | 22 | 0 |
| 6 | Temperature humidity storage | +85 °C × 85 %RH × 1 000 h | ( 1 )<br>± 10 | 22 | 0 |
| 7 | Resistance to soldering heat | For convention reflow soldering furnace<br>(3 times) | ± 5 | 22 | 0 |
| 8 | Substrate bending | Bend width reaches 3.0 mm and hold for<br>5 s ± 1 s × 1 time<br>Ref. IEC 60068-2-21 | No peeling - off at a solder part | 11 | 0 |
| 9 | Shear | 20 N press for 10 s ± 1 s<br>Ref. IEC 60068-2-21 | No peeling - off at a solder part | 11 | 0 |
| 10 | 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 |
| 11 | Solderability | Dip termination into solder bath at<br>+230 °C ± 10 °C for 5 s<br>(Using Rosin Flux) | Termination must be 90 % covered with fresh solder | 11 | 0 |

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.

**Qualification Data**

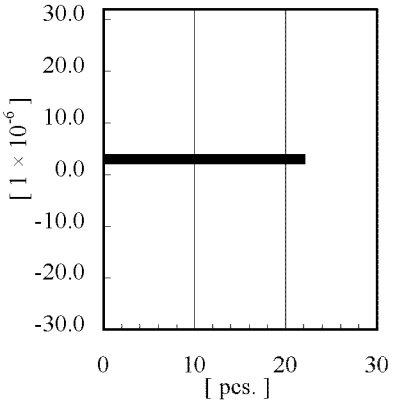
## Product Name : FA-238 ( 16 ≦ f0 ≦ 32 MHz)

Δ f / f

**No. F-A9911-07-002E**

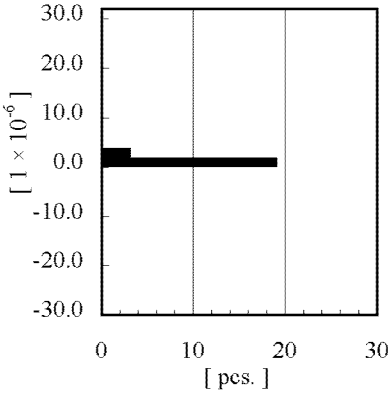
1. Shock

100g × 1500 mm × 3 directions × 10 times



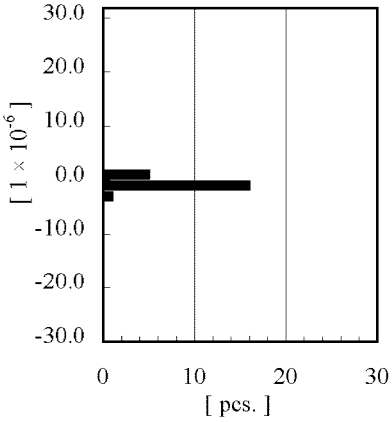

2. Vibration

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



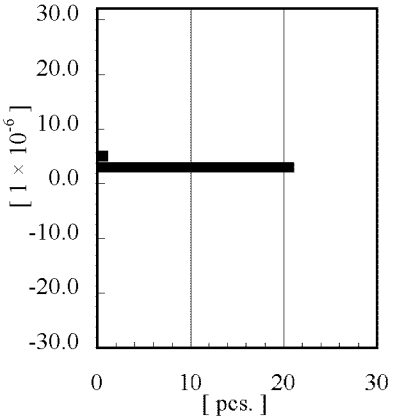

3. High temp. storage

+125 °C × 1 000 h



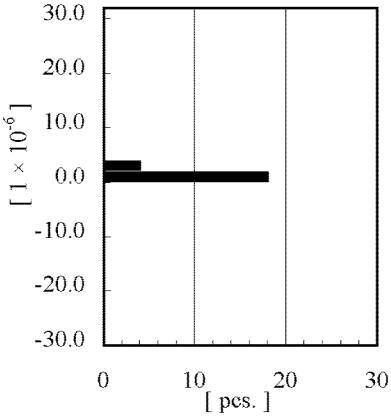

4. Low temp. storage

-55 °C × 1 000 h



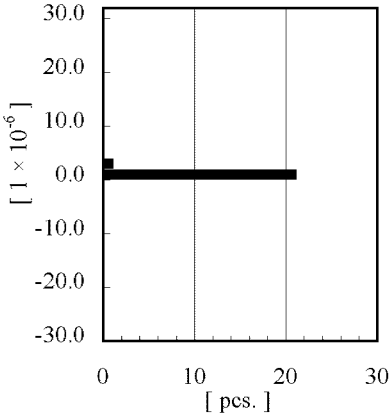

5. Temp. cycle

-55 °C ⇔ +125 °C
100 cycles



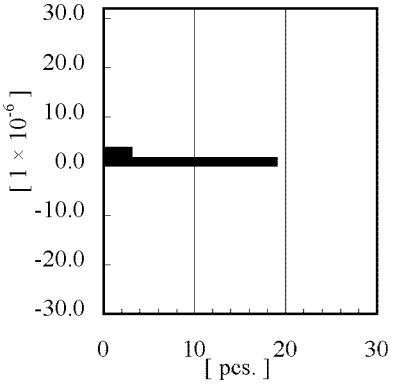

6. Temp. humidity storage

+85 °C × 85 %RH × 1 000 h




7. Resistance to soldering heat

For convention reflow soldering furnace (3 times)




**Qualification Data**

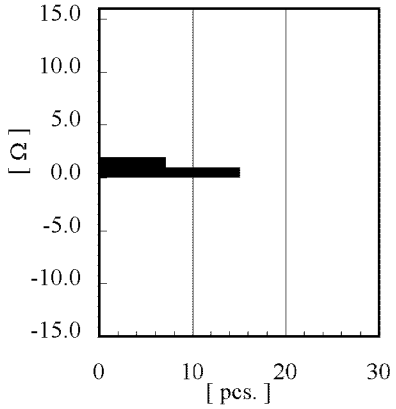
## Product Name : FA-238 ( 16 ≦ f0 ≦ 32 MHz)

ΔCI

**No. F-A9911-07-003E**

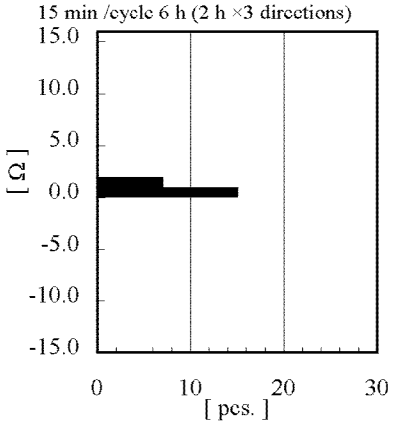
1. Shock

100g × 1500 mm ×
3 directions × 10 times



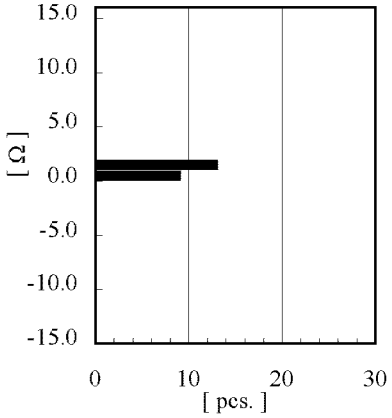

2. Vibration

10 Hz to 55 Hz amplitude 0.75 mm
55 Hz to 500 Hz acceleration 98 m/s$^2$
15 min /cycle 6 h (2 h ×3 directions)



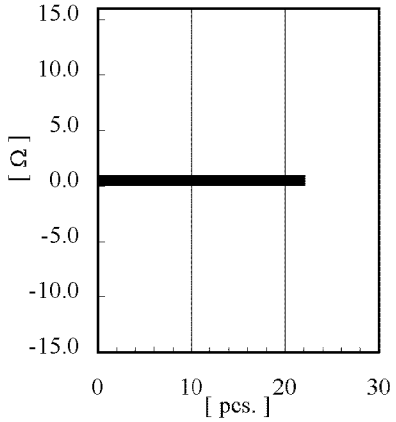

3.High temp. storage

+125 °C × 1 000 h



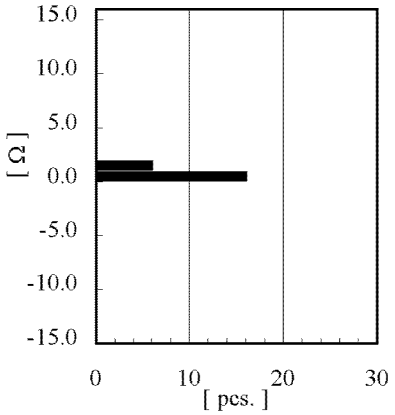

4. Low temp. storage

-55 °C × 1 000 h



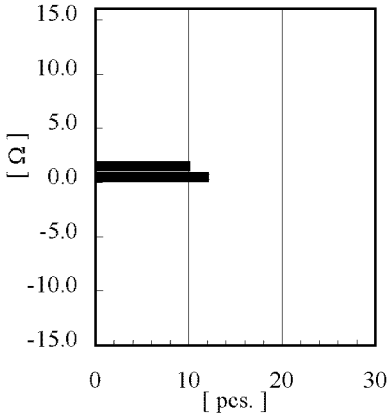

5. Temp. cycle

-55 °C ⇔ +125 °C
100 cycles



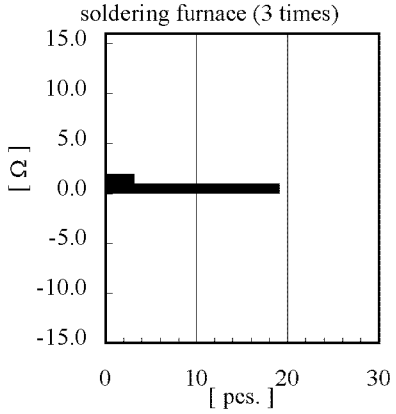

6. Temp. humidity storage

+85 °C × 85 %RH × 1 000 h




7. Resistance to soldering heat

For convention reflow
soldering furnace (3 times)




**Qualification Data**

**ATTN : Shenzhen RoadRover Technology Co., Ltd**

Quality and reliability data

No.ST13-470
Jan., 9, 2014
SEIKO EPSON CORP.
TD・CS QUALITY ASSURANCE DEPARTMENT

Type : FA-238

·Machine Model
(C=200 pF;R=0 Ω) : > ±250 Volt

·Human Body Model
(C=100 pF;R=1 500 Ω) : > ±2 000 Volt

Criterion : Frequency change rate exceeded ± $5\times10^{-6}$ or
Oscillation stopped as Failure.