INFORMATION

PRODUCT No. : **X1A000061000200**

MODEL : **FC-12M**

INFO. No. : **A14-081-6A**

DATE : **Jul. 1. 2014**

SEIKO EPSON CORPORATION

8548 Naka-minowa
Minowa-machi Kamiina-gun
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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.

1) This product complies with RoHS Directive.
2) 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.
3) 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 X1A000061000200.
The model is FC-12M.

Contents

[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		0.5		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	$\times 10^{-6}$	CL = 12.5 pF Ta = + 25 ± 3°C Level of drive : 0.1 μW Not include aging
3	Motional resistance		R1	90 Max.	kΩ	CI meter : Saunders 140B Level of drive : 0.5 μW
4	Motional capacitance		C1	6.4 Typ.	fF	
5	Shunt capacitance		C0	1.3 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.	$\times 10^{-6}$ /°C^2	
7	Isolation resistance		IR	500 Min.	MΩ	DC 100 V± 15, 60 seconds Between terminal # 1 and terminal # 2
8	Frequency Aging		f_age	± 3	$\times 10^{-6}$/year	Ta = + 25 °C ± 3 °C Level of drive : 0.1 μW

[4] Environmental and Mechanical characteristics

No.	Items	Value	Conditions
1	Shock resistance	*3Δ f/f : ± 20 × 10^{-6}	100g dummy(Epson Toyocom Standard), Natural drop from 1 500 mm height on to the concrete. 3 directions × 10 times *2
2	Vibration resistance	*3Δ f/f : ± 5 × 10^{-6}	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) *2
3	Soldering heat resistance	*3Δ f/f : ± 8 × 10^{-6}	For convention reflow soldering furnace (3 times)
4	High temperature storage	*3Δ f/f : ± 15 × 10^{-6}	+ 125 °C × 1 000 h *1
		*3Δ f/f : ± 7 × 10^{-6}	+ 85 °C × 1 000 h *1
5	Low temperature storage	*3Δ f/f : ± 10 × 10^{-6}	-55 °C× 1 000 h *1
6	High temperature and humidity	*3Δ f/f : ± 10 × 10^{-6}	+ 85 °C × 85%RH × 1 000 h *1
7	Temperature cycle	*3Δ f/f : ± 10 × 10^{-6}	- 55 °C ↔ + 125 °C 30 minutes at each temperature × 100 cycles *1
8	Sealing	*3 1 × 10^{-8} hPa•l / s Max.	For He leak detector
9	Shear	No peeling-off at a soldered part	10 N press for 10 ± 1 s. Ref. IEC 60068-2-21
10	Pull - off	No peeling-off at a soldered part	10 N press for 10 ± 1 s. Ref. IEC 60068-2-21
11	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
12	Solderability	More than 95 % covered by solder	Dip into methyl alcohol solution of rosin for 3 sec. at + 235 ± 5 °C

< Notes >

*1 Each test shall be done independently.

*2 Measuring 2 h to 24 h later leaving in room temperature after each test. Drive level : 0.5 μW

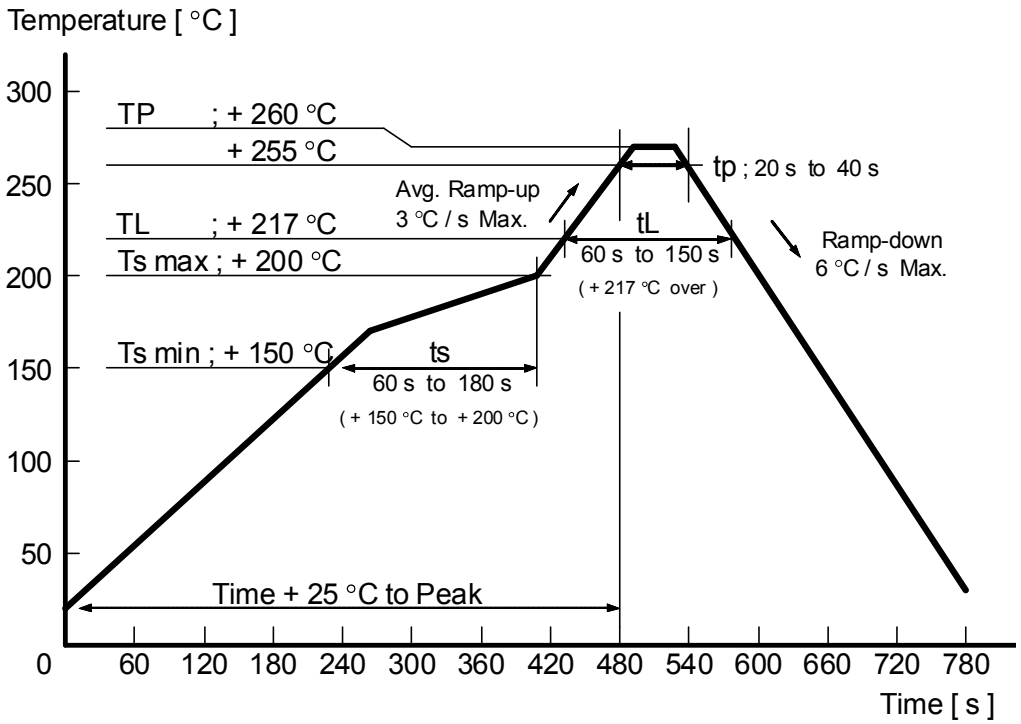
*3 Pre conditionings

1. + 125 °C × 24 h to + 85 °C × 85 % × 168 h ± 1 h → reflow 3 times
2. Initial value shall be after 24 h at room temperature.

Shift of series resistance at before and after the test should be less than ± 30 % or less than ± 20 kΩ.

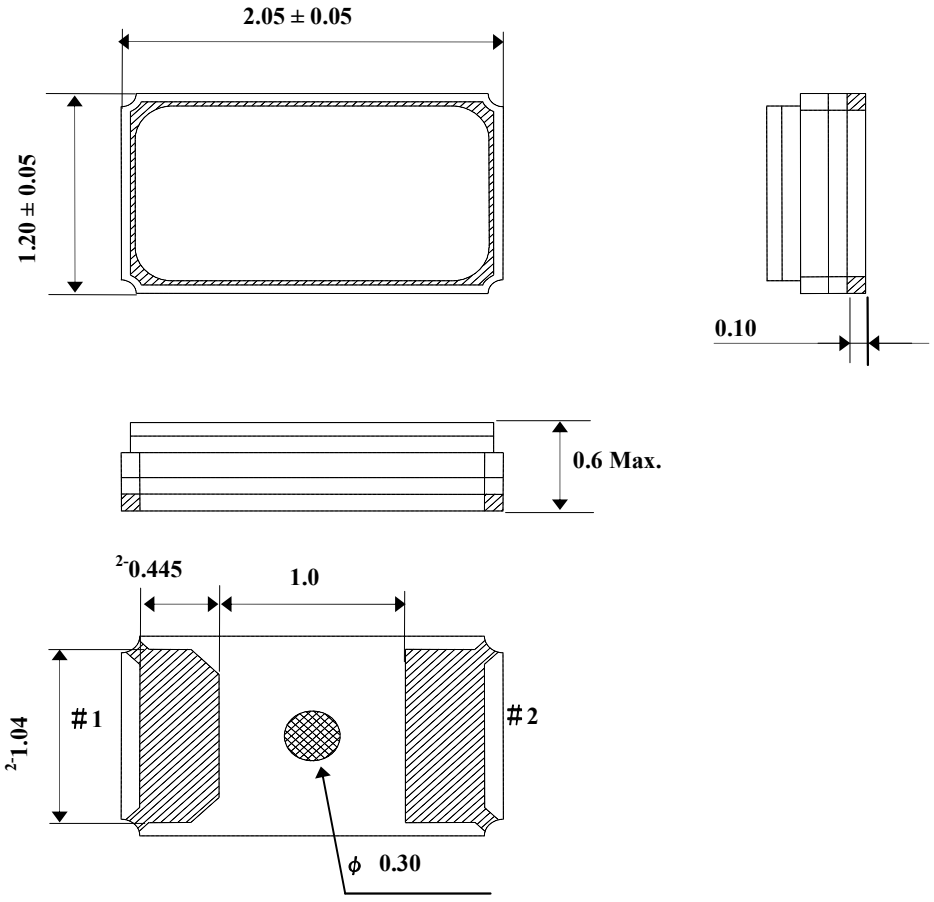
In case high temperature storage(+ 125 °C × 1 000 h), Soldering heat resistance,shift of series resistance at before and after the test should be less than ± 40 % or ± 30 kΩ.

♦ Reflow condition (follow to IPC / JEDEC J-STD-020C)

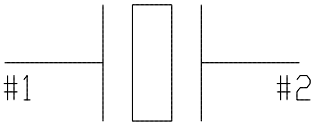


[5] Dimensions and Marking layout

1. Dimensions



2. Internal Connection

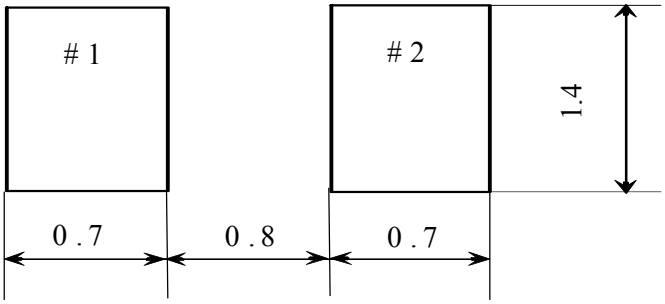


Package : Ceramic(Al_2O_3)
Terminal Au plate : 0.5 μm Min.
Lid : Metal

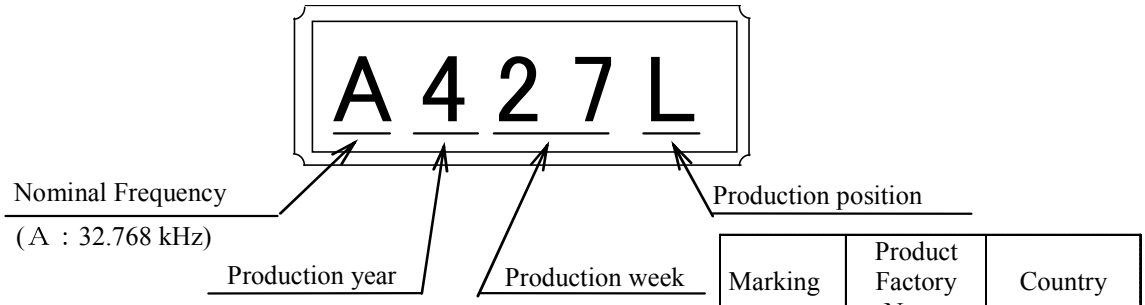
Type	FC-12M	Unit	1 = 1 mm

3. Recommended soldering pattern

Unit : 1 = 1 mm



4. Marking layout



Marking	Product Factory Name	Country
J	INA	Japan
L	ETMY	Malaysia

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

Type	FC-12M	Unit	1 = 1 mm

[6] Notes

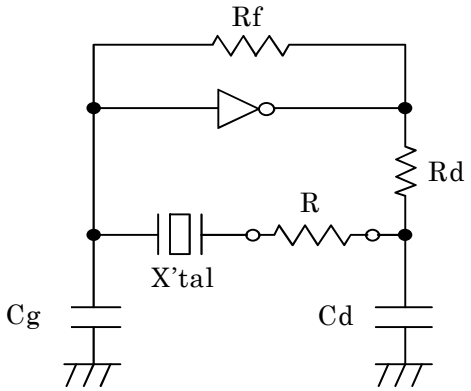
1. Max three (3) times reflow is allowed. Once miss soldering is happened, hand work soldering by soldering iron is recommended. (+ 350 °C × within 5 s)

2. Patterning should be followed by our recommended one.

3. Applying excessive excitation force to the crystal resonator 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 resonator.
(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. This device must be stored at the normal temperature and humidity conditions before mounting on a board.

7. 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.

8. Depending on the conditions, ultrasonic cleaning may cause resonant damage of the internal crystal resonator. 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.

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

TAPING SPECIFICATION

1. APPLICATION

This document is applicable to FC-12M.

2. CONTENTS

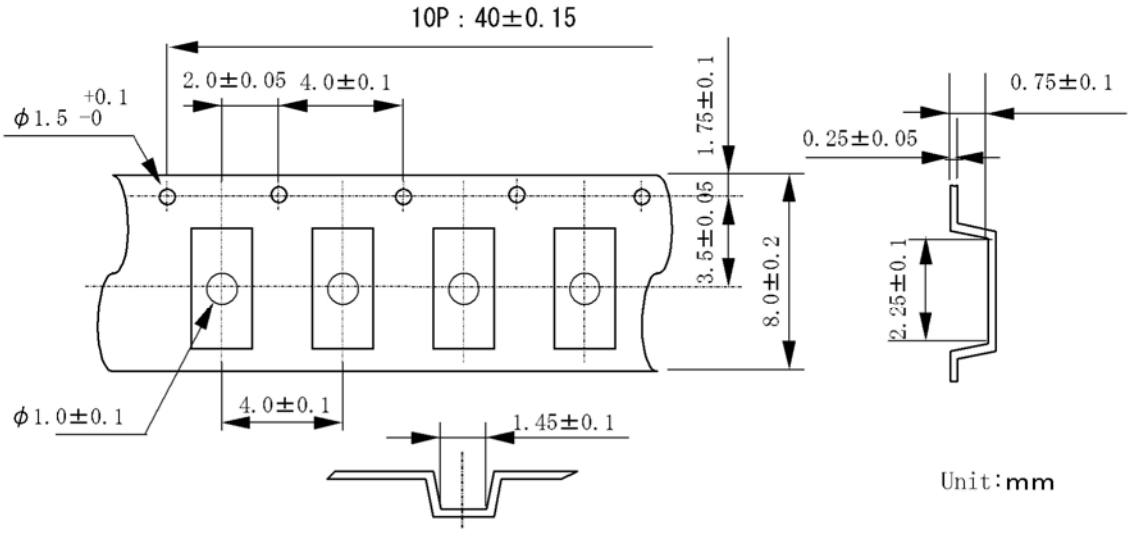
[1] Taping specification

Subject to EIA-481 , IEC 60286.

(1) Tape dimensions TE1204L

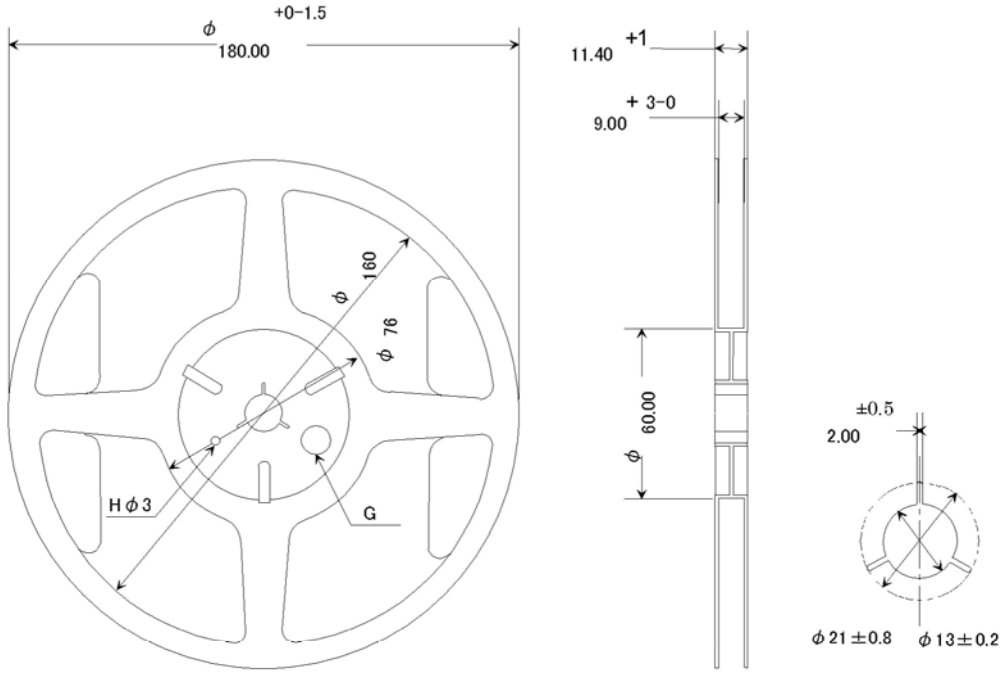
Material of the Carrier Tape : PS (Electrically conductive)

Material of the Top Tape : PET+PE



(2) Reel dimensions

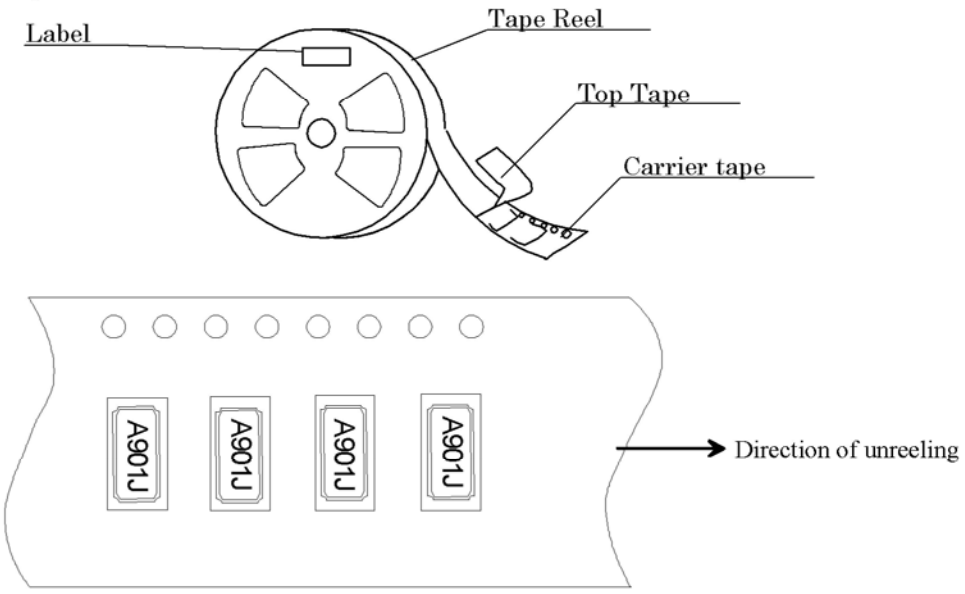
Material of the Reel : PS



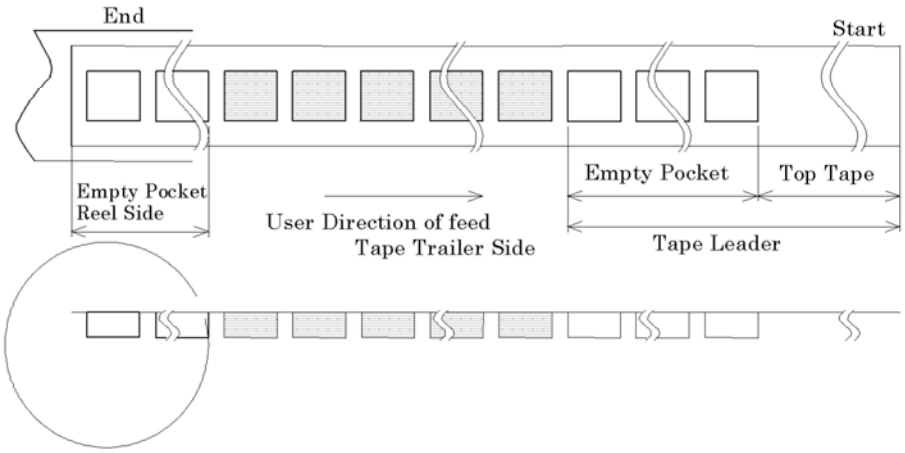
Form and Size of reel window shows are one of the example

(3) Packing

(a) Tape & Reel



(b) Start & End Point



Item		Empty Space
Tape Leader	Top Tape	Min. 1 000 mm
	Carrier Tape	Min. 80 mm
Tape Trailer	Top Tape	Min. 0 mm
	Carrier Tape	Min. 80 mm

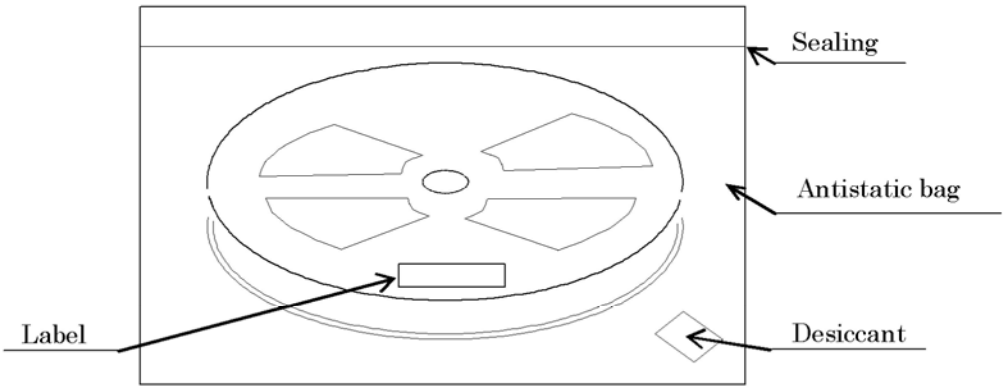
(4) Peel force of the cover tape

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

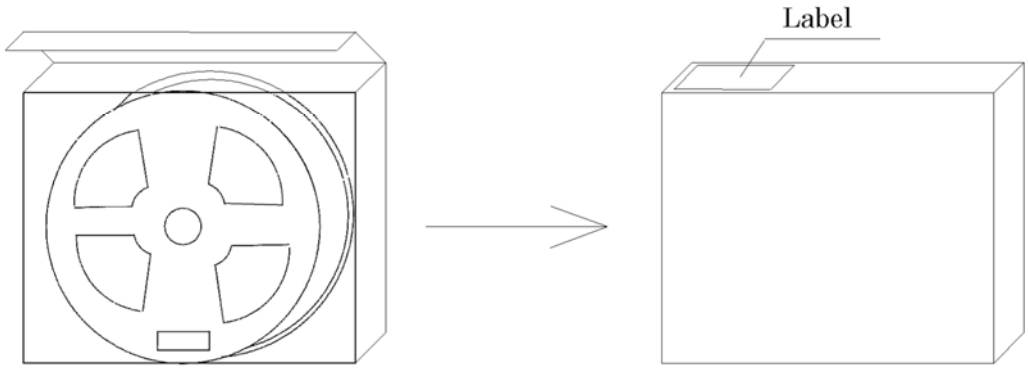
(b) peel speed : 300 mm/min

[2] Inner Carton

a) Packing to antistatic bag

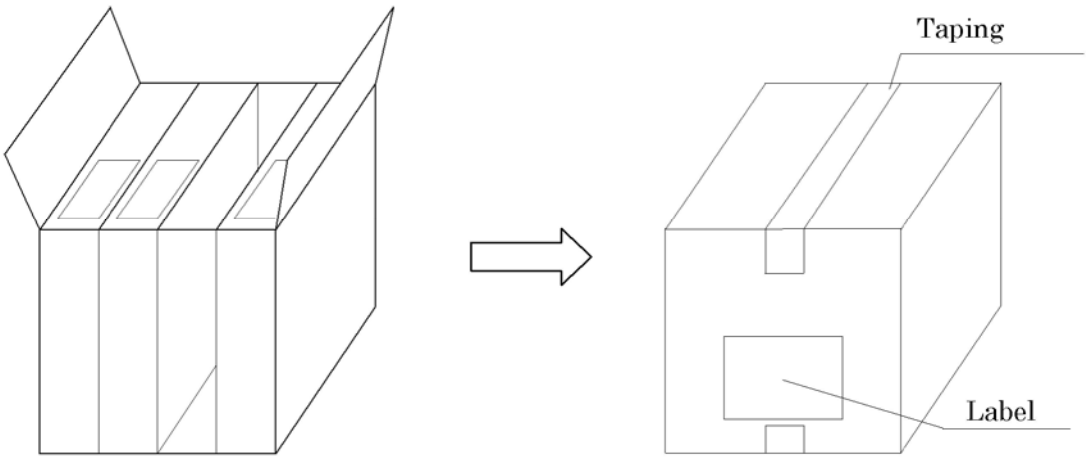


b) Packing to innercarton



[3] Shipping Carton

- Put inner boxes into an outer box.
- If there are room in the outer box,material is put in a shock absorbing together.



[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) Before open the packing, we recommend to keep less than +30 °C and 85 %RH of Humidity, and to use it less than 6 months after delivery.

(2) We recommend to open Package in immediately before use. After open Package, We recommend to keeps less than 6 month. No need dry air before soldering work if it is less than temperature +30 °C, 85 humidity %RH.

(3) Not to storage with some erosive chemicals.

(4) Nothing is allowed to put on the reel or carton to prevent mechanical damage

[7] Handling

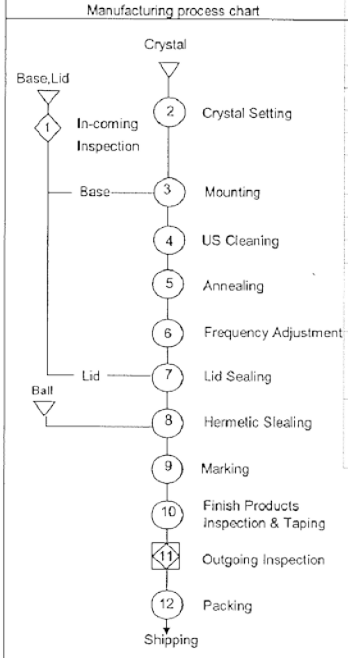
To handle with care to prevent the damage of tape, reel and products.

PROCESS QUALITY CONTROL

FC-12M

No. C-0702-AIE-2

2008/11/14



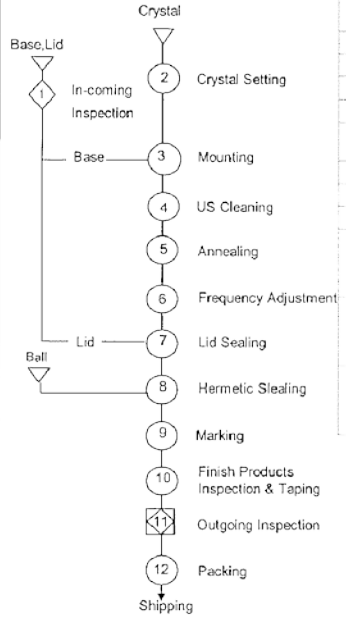
No.	Section In Charge	Standard	Inspection Control Item	Inspection Methods	Instruments	Record
1	Inspection Section	Purchasing Specification	Appearance	Sampling	Microscope	In-coming Inspection Data Sheet
	(INA Plant QA)	Incoming Inspection Standard	Demension	Sampling	Tool Microscope	
2	INA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
3	INA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
4	INA Plant	Manufacturing Instruction Sheet	–	–	–	–
5	INA Plant	Manufacturing Instruction Sheet	–	–	–	–
6	INA Plant	Manufacturing Instruction Sheet	Frequency	100% Inspection	Frequency Adjustment Machine	Data Sheet
7	INA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
8	INA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
9	INA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
10	INA Plant	Manufacturing Instruction Sheet	Frequency	100% Inspection	Characteristics Inspection Machine	Process Data Sheet
			Crystal Inpedance	100% Inspection		
			Appearance	100% Inspection	Microscope	
11	INA Plant	Specification	Electrical Characteristics	Sampling	Measuring Equipment	Outgoing Inspection Data Sheet
		Outgoing Inspection Standard	Appearance	Sampling	Microscope	
			Demension	Sampling	Tool Microscope	
12	INA Plant	Packing Instruction	Customers	–	–	Shipping List
		Daily Shipping List	Type	–	–	
			Quantity	–	–	

PROCESS QUALITY CONTROL

FC-12M

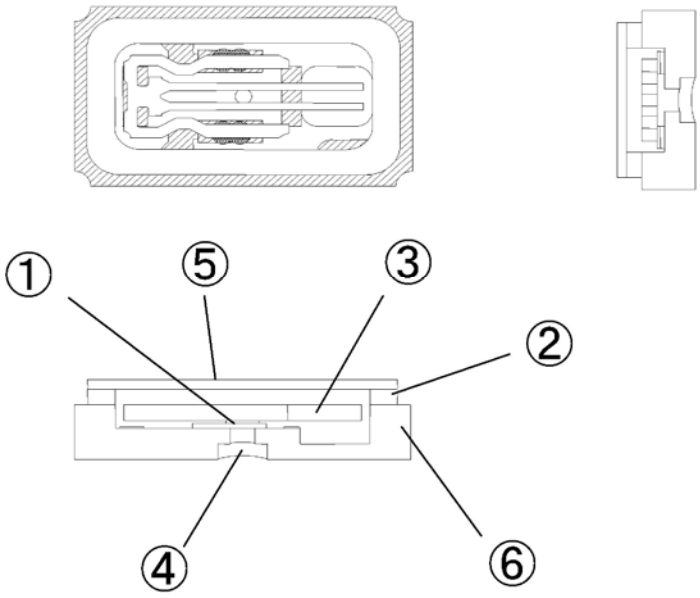
No. C-0702-AME-1

2010/1/27



No.	Section In Charge	Standard	Inspection Control Item	Inspection Methods	Instruments	Record
1	Inspection Section	Purchasing Specification	Appearance	Sampling	Microscope	In-coming Inspection Data Sheet
	(AKITA Plant QA)	Incoming Inspection Standard	Demension	Sampling	Tool Microscope	
2	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
3	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
4	MALAYSIA Plant	Manufacturing Instruction Sheet	–	–	–	–
5	MALAYSIA Plant	Manufacturing Instruction Sheet	–	–	–	–
6	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Frequency Adjustment Machine	Data Sheet
7	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
8	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
9	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
10	MALAYSIA Plant	Manufacturing Instruction Sheet	Frequency	100% Inspection	Characteristics In-spection Machine	Process Data Sheet
			Crystal Inpedance	100% Inspection		
			Appearance	100% Inspection	Microscope	
11	MALAYSIA Plant	Specification	Electrical Characteristics	Sampling	Measuring Equipment	Outgoing Inspection Data Sheet
		Outgoing Inspection Standard	Appearance	Sampling	Microscope	
			Demension	Sampling	Tool Microscope	
12	MALAYSIA Plant	Packing Instruction	Customers	–	–	Shipping List
		Daily Shipping List	Type	–	–	
			Quantity	–	–	

Structure diagram FC-12M



LIST		
Name of part		Material
①	Crystal Adhesive	Ag Paste
②	Sealing	Seal ring
③	Crystal chip	tuning fork
④	Sealing	Au/Ge
⑤	Lid	Kovar
⑥	Package	Ceramic(Al2O3)

RELIABILITY TEST DATA

Product Name : FC-12M

The Company evaluation condition

We evaluate environmental and mechanical characteristics by the following test condition . **No. F-C-0702-06-004E**

No.	ITEM	TEST CONDITIONS	VALUE *1 *2 $\Delta f / f$ [1×10^{-6}]	TEST Qty [n]	FAIL Qty [n]
1	Shock resistance	100 g dummy (ETC Standard) drop from 1 500 mm height on to the concrete 3 directions 10 times	*3 ± 20	22	0
2	Vibration resistance	10 Hz to 55 Hz amplitude 0.75 mm 55 Hz to 500 Hz acceleration 98 m/s2 10 Hz → 500 Hz → 10 Hz 15 min / cycle 6 h (2 h × 3 directions)	*3 ± 5	22	0
3	Resistance to soldering heat	IPC/JEDEC J-STD-020C Reflow (3 times)	± 8	22	0
4	High temperature storage	a) +125℃× 1 000 h b) +85 ℃× 1 000 h	*3 a) ± 15 *3 b) ± 7	a) 22 b) 22	a) 0 b) 0
5	Low temperature storagc	-55 ℃× 1 000 h	*3 ± 10	22	0
6	Temperature humidity storage	+85 ℃× 85 %RH × 1 000 h	*3 ± 10	22	0
7	Temperature cycle	-55 ℃ ⇔ +125 ℃ 30 min at each temp. 100 cycles	*3 ± 10	22	0
8	Sealing	For He leak detector	*3 1×10^{-8} hPa·l / s Max.	11	0
9	Shear	10 N press for 10 s ± 1 s 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 Ref. IEC 60068-2-21	No peeling - off at a solder part	11	0
11	Substrate bending	Bend width reaches 3 mm and hold for 5 s ± 1 s × 1 time Ref. IEC 60068-2-21	No peeling - off at a solder part	11	0
12	Solderability	Dip termination into solder bath at +235 ℃ ± 5 ℃ for 3 s (Using Rosin Flux)	Termination must be 95 % covered with fresh solder	11	0

Notes

*1 Each test shall be done independently.

*2 Measuring 2 h to 24 h later leaving in room temperature after each test. Drive level : 0.5 μ w

*3 Pre conditionings

1. +125 °C × 24 h to +85 °C × 85 % × 168 h ± 1 h→ reflow 3 times
2. Initial value shall be after 24 h at room temperature.

Shift of series resistance at before and after the test should be less than ±30 % or less than ±20 kΩ.

In case high temperature storage(+125 °C × 1 000 h), Soldering heat resistance,shift of series resistance at before and after the test should be less than ±40 % or ±30 kΩ.

Qualification Data

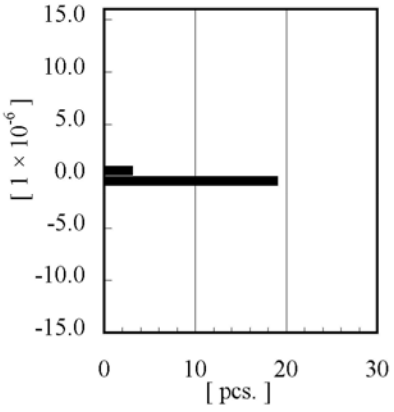
Product Name : FC-12M

Δ f / f

No. F-C-0702-06-005E

1. Shock

1 500 mm × 3 directions × 100 g × 10 times

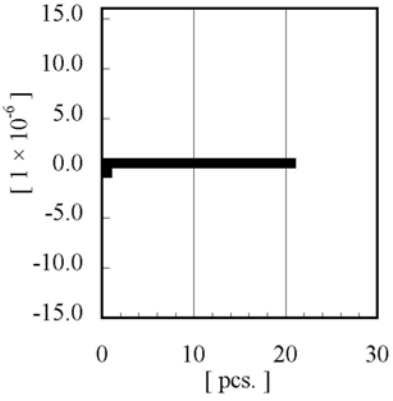


2. Vibration

10 Hz to 55 Hz amplitude 0.75 mm

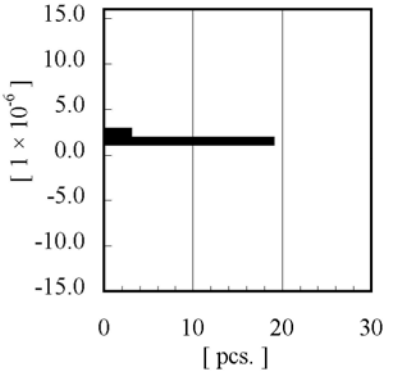
55 Hz to 500 Hz acceleration 98 m/s^2

15 min / cycle 6 h (2 h ×3 directions)



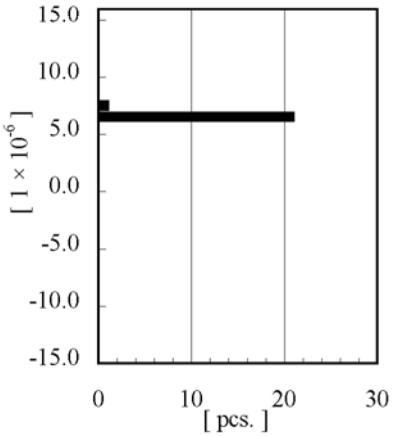
3. Resistance to soldering heat

For convention reflow furnace (3 times) After 24 h



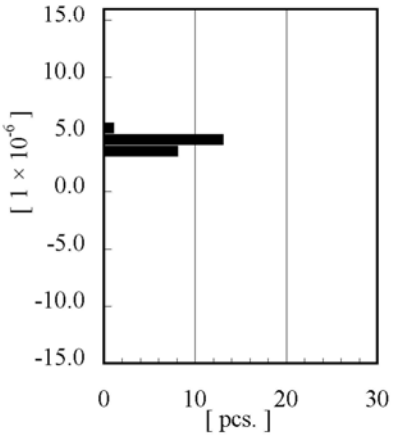
4. High temp. storage

a) +125 ℃× 1 000 h



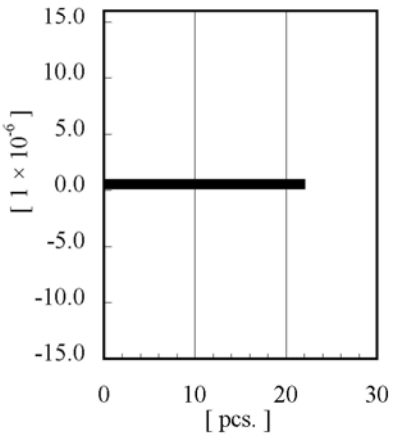
4. High temp. storage

b) +85 ℃× 1 000 h



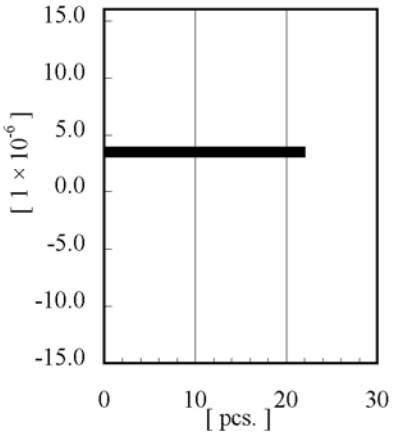
5. Low temp. storage

-55 ℃× 1 000 h



6. Temp. humidity storage

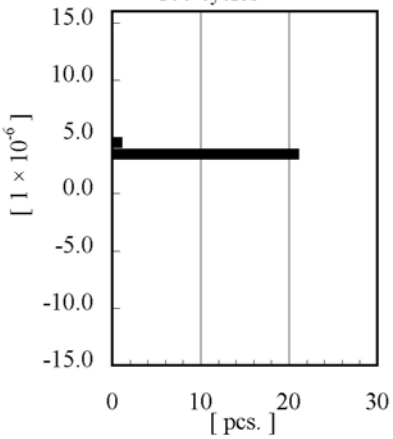
+85 ℃× 85 %RH × 1 000 h



7. Temp. cycle

-55 ℃ ⇔ +125 ℃

100 cycles



Qualification Data

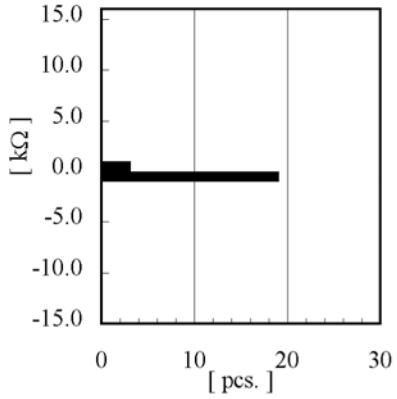
Product Name : FC-12M

Δ CI

No. F-C-0702-06-006E

1. Shock

1 500 mm × 3 directions × 100 g × 10 times

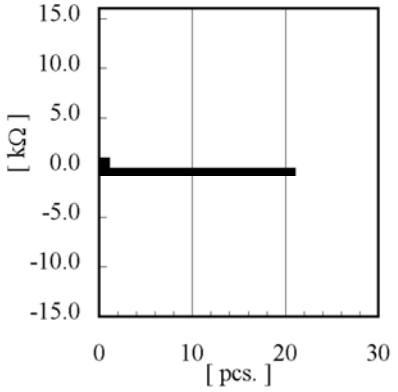


2. Vibration

10 Hz to 55 Hz amplitude 0.75 mm

55 Hz to 500 Hz acceleration 98 m/s^2

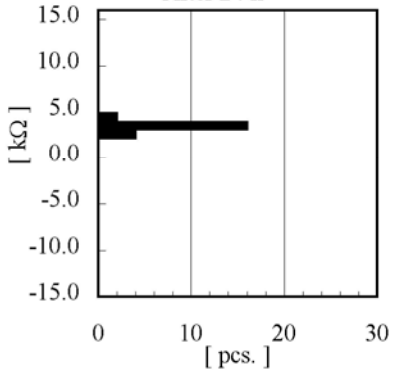
15 min / cyc. 6 h (2 h ×3 directions)



3. Resistance to soldering heat

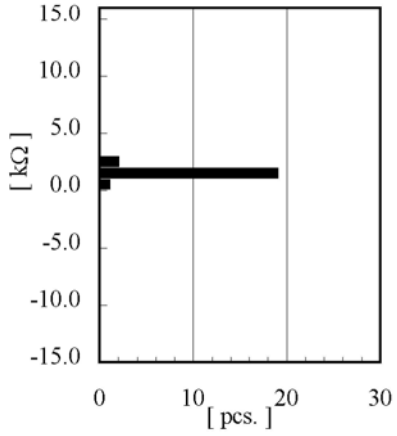
For convention reflow soldering furnace (3 times)

After 24 h



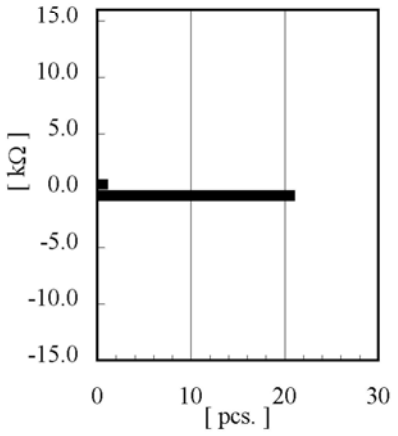
4. High temp. storage

a) +125 ℃× 1 000 h



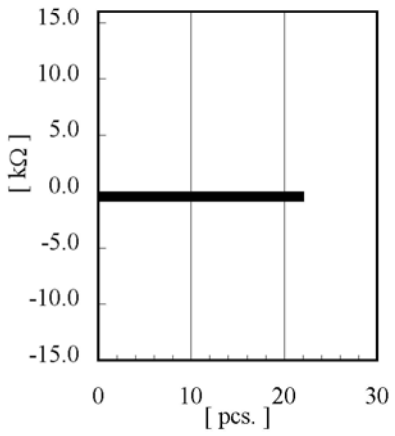
4. High temp. storage

b) +85 ℃× 1 000 h



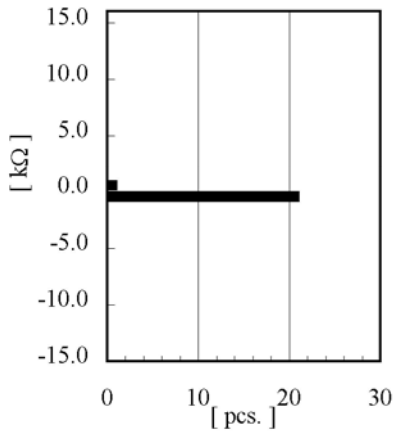
5. Low temp. storage

-55 ℃× 1 000 h



6. Temp. humidity storage

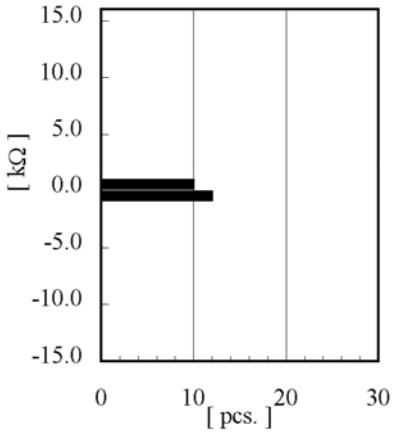
+85 ℃× 85 %RH × 1 000 h



7. Temp. cycle

-55 ℃ ⇔ +125 ℃

100 cycles



Qualification Data