RECIPIENT

SPECIFICATIONS

Product No. : Q13MC1461001700

MODEL : MC-146

SPEC. No. : Q13-133-22A

DATE: Sep. 3. 2013

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
MC-146 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 Q13MC1461001700.
The model is MC-146.

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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[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		1.0		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	± 10	$\times 10^{-6}$	CL = 12.5 pF Ta = + 25 ± 3 °C Level of drive : 0.1 μW Not include aging
3	Motional resistance		R1	65 Max.	kΩ	CI meter : Saunders 140B Level of drive : 0.5 μW
4	Motional capacitance		C1	1.9 Typ.	fF	
5	Shunt capacitance		C0	0.8 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 # 4
8	Frequency Aging		f_age	± 3	$\times 10^{-6}$/year	Ta = + 25 °C ± 3 °C Level of drive : 0.1 μW

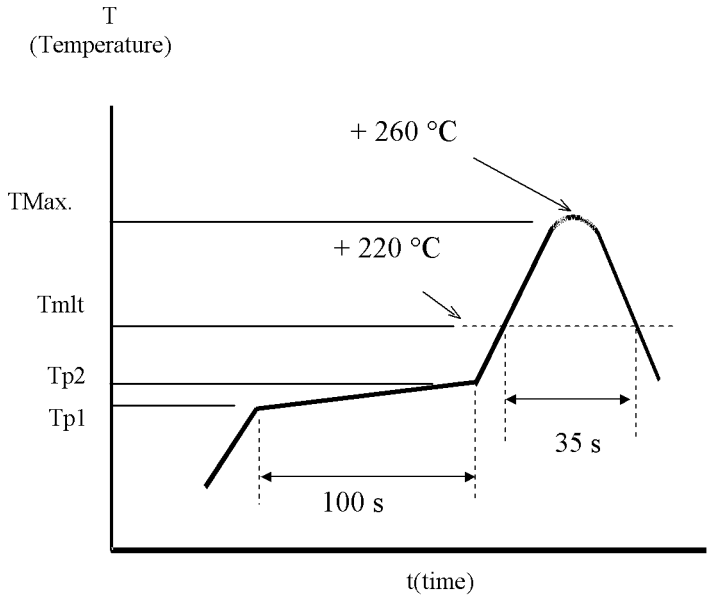
[4] Environmental and Mechanical characteristics

No.	Items	Value *1*2 $\Delta f/f$ [1×10^{-6}]	Conditions
1	Shock	*3 ± 5	100 g dummy (EPSON TOYOCOM Standard) drop from 1500 mm height on to the concrete 3 directions 10 times
2	Vibration	*3 ± 3	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	Resistance to soldering heat (Reflow characteristics)	*3 ± 5	Treat the Reflow 2 times by the following profile in the next page
4	High temperature storage	*3 a) ± 20 b) ± 10	a) + 125 °C × 1 000 h b) + 85 °C × 1 000 h
5	Low temperature storage	*3 ± 10	- 55 °C × 1 000 h
6	Temperature humidity storage	*3 ± 10	+ 85 °C × 85 %RH × 1000 h
7	Temperature cycle	*3 ± 10	- 55 °C ↔ + 125 °C 30 minutes at each temperature 100 cycles
8	Shear	No peeling-off at a soldered part	10 N press the side for 10 s ±1 s. 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. Ref. IEC 60068-2-21
10	Substrate bending	No peeling-off at a soldered part	Bending width reaches 3mm and hold for 5 s ± 1 s × 1 time Ref. IEC 60068-2-21
11	Solderability	Termination must be 95 % covered with fresh solder	Dip termination into solder bath at + 235 ± 5 °C for 3 s (Using rosin flux)
12	Solvent resistance	The marking shall be legible	Ref. JIS C 0052 or IEC 60068-2-45

Note
1. *1 Each test done independently.
2. *2 Measuring 1 h to 24 h later leaving in room temperature after each test.
3. *3 Pre conditionings
    1. + 125 °C × 24 h to +85 °C × 85 %RH × 48 h → reflow 2 times
    2. Initial value shall be after 24 h at room temperature.
4. Shift series resistance at after above tests should be less than ± 15 % or less than ± 5 kΩ
   In case Resistance to soldering heat, high temperature storage (± 125 °C ×1 000 h) shift series resistance at after above tests should be less than ± 20 % or ± 10 kΩ

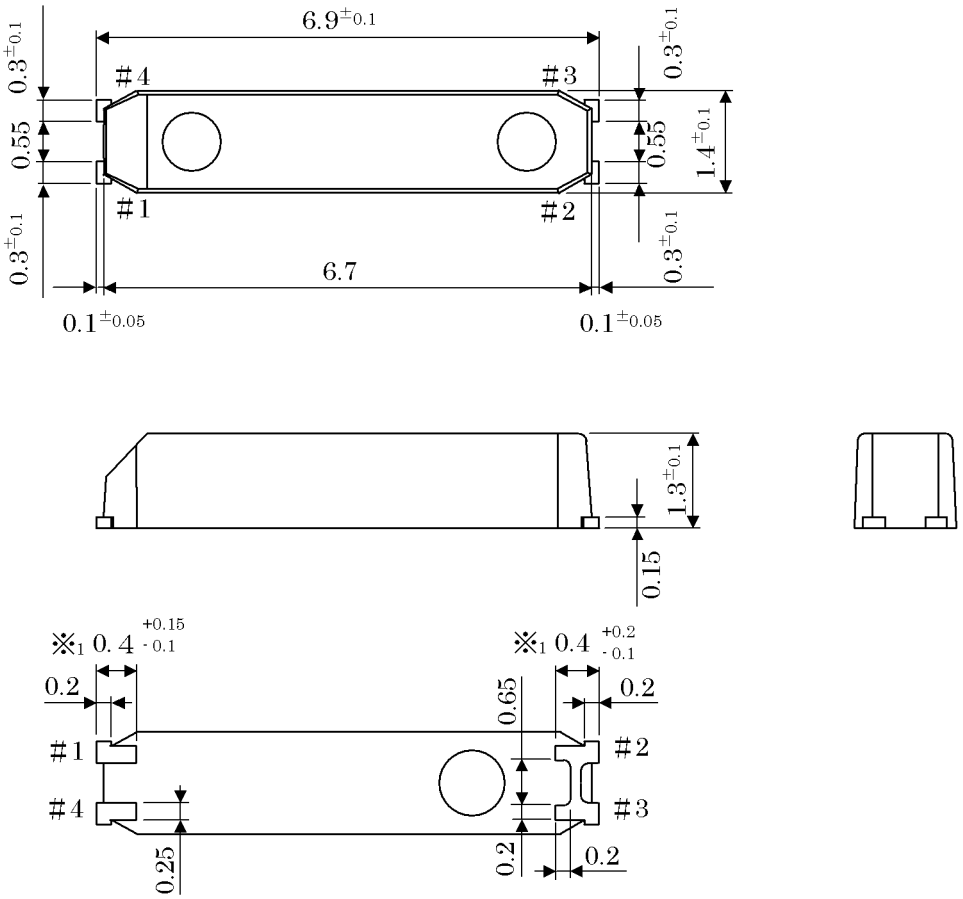
♦Air- reflow

Pre heating temperature : Tp1～Tp2 = + 170 °C
Peak temperature must not exceed + 260 °C and the duration of over + 220 °C should be 35 s



[5] Dimensions and Marking layout

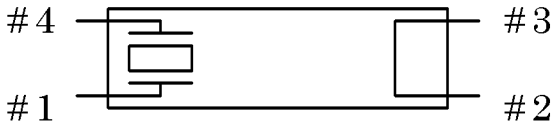
1. Dimensions



※1 : Available area for soldering

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

2. Internal Connection



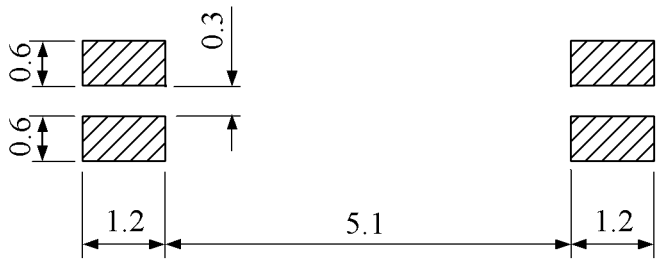
Terminal thickness	0.15 mm
Lead Frame	42Alloy
Terminal treatment	Pb Free Solder plate 15 ± 10 μm
Molding	Epoxy Compound (Halide free)
Compound color	Black

Do not connect # 2 and # 3 terminals to any external circuits (including GND).

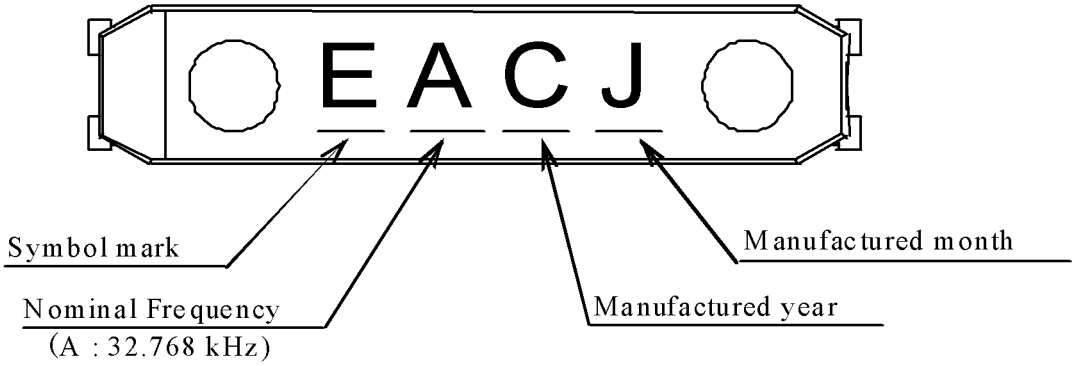
Type	MC-146	Unit	1 = 1 mm

3. Recommended soldering pattern

Unit : 1 = 1 mm



4. Marking layout



Symbol of Manufacturing year

Year digit	1	2	3	4	5	6	7	8	9	0
Marking	A	B	C	D	E	F	G	H	J	K

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

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

Type	MC-146	Unit	1 = 1 mm

[6] Notes

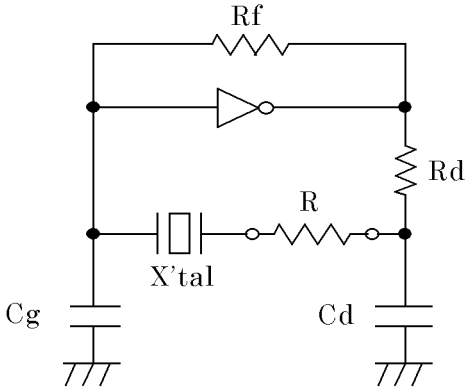
1. Max two (2) times reflow is allowed. Once miss soldering is happened, hand work soldering by soldering iron is recommended. (+ 350 °C × within 5 sec.)

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 no 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
$|-R| > CI \times (5 \sim 10)$

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

6. To avoid mull function, no pattern under or near the crystal 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.
   Please check your condition in advance to maintain shock level to be smallest.

9. Depending on the conditions, ultrasonic cleaning may cause resonant damage of the internal crystal unit. 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.

10. Ink marking may be damaged by some kind of solvent, please take precautions when choosing solvent by your selves.

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

TAPING SPECIFICATION

1. APPLICATION

This document is applicable to MC-146.

2. CONTENTS

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

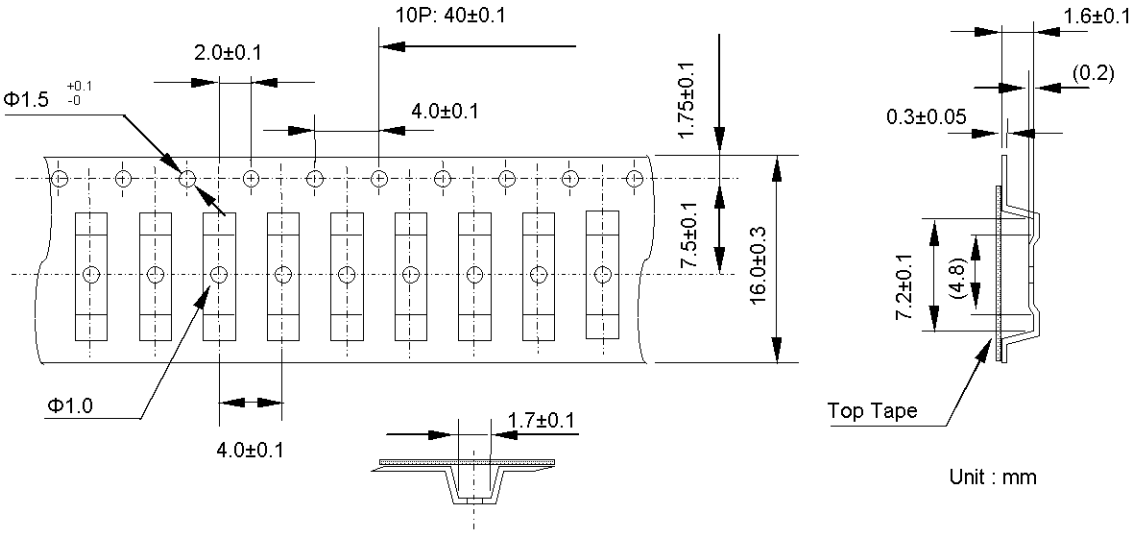
[1] Taping specification

Subject to EIA-481 and IEC 60286

(1) Tape dimensions TE1604L

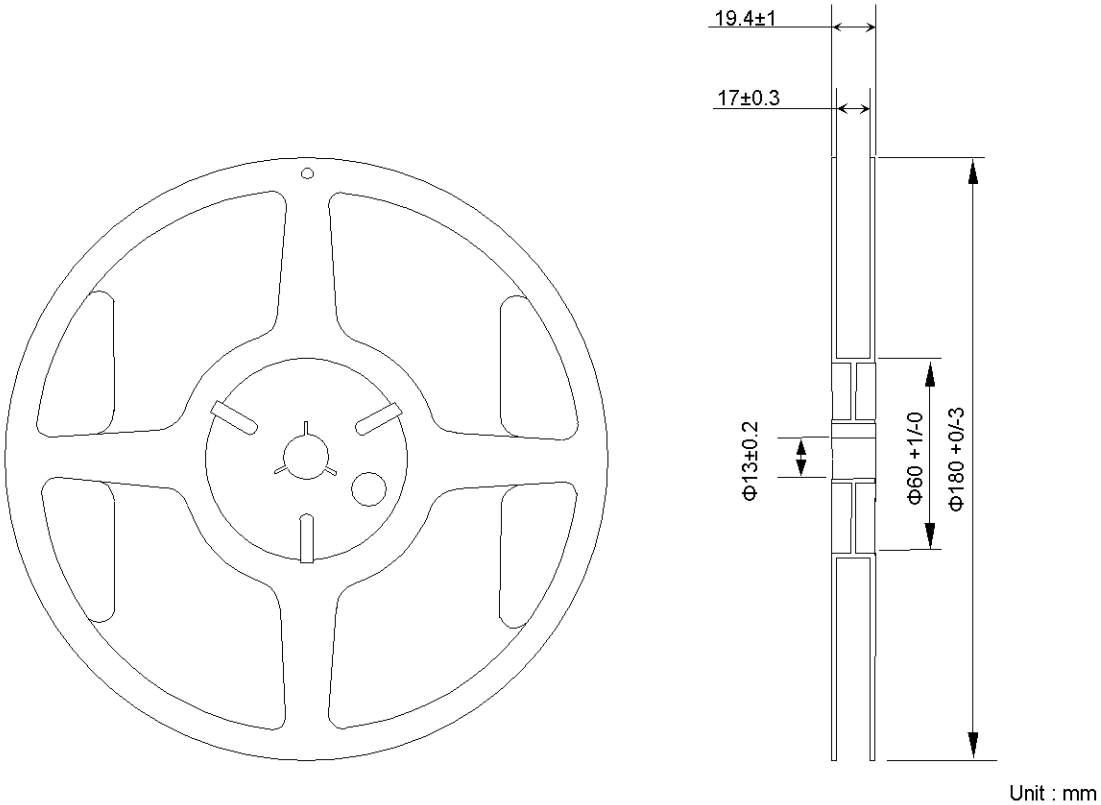
Material of the Carrier Tape : PS

Material of the Top Tape : PET+PE



(2) Reel dimensions

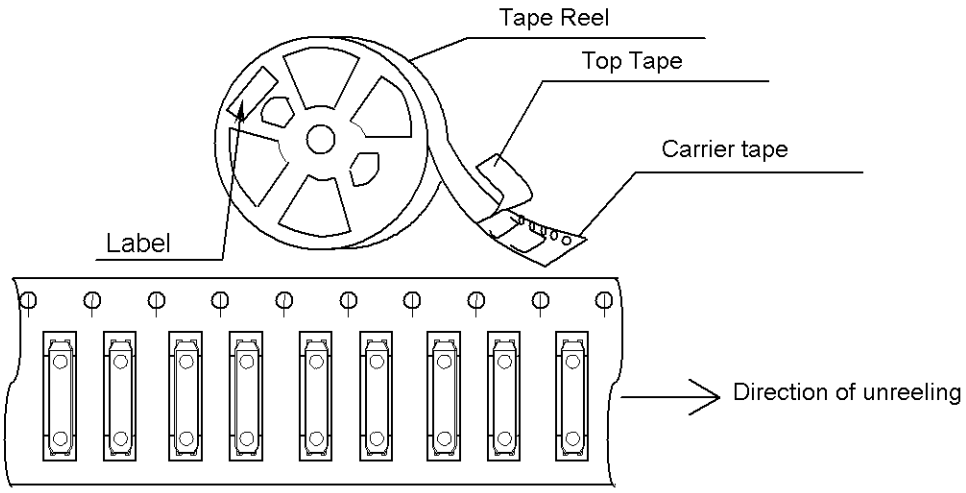
Material of the Reel : PS



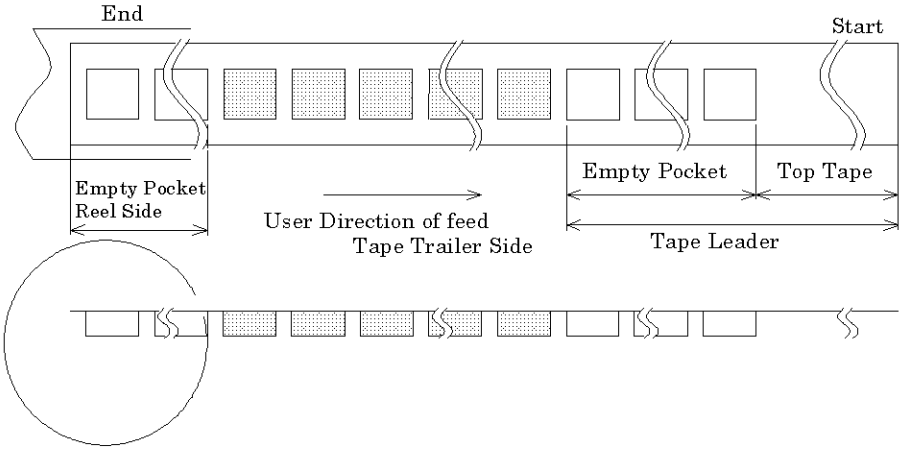
Form and Size of reel window shows are one of the example

(3) Packing

(a) Tape & Reel



(b) Start & End Point



Item		Empty Space
Tape Leader	Top Tape	Min. 1 000 mm
	Carrier Tape	Min. 160 mm
Tape Trailer	Top Tape	Min. 0 mm
	Carrier Tape	Min. 160 mm

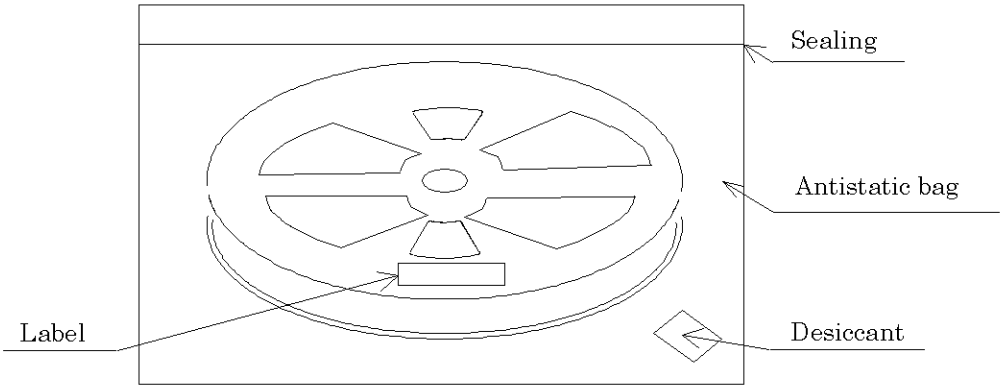
(4) Peel force of the cover tape

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

(b) peel speed : 300 mm/min

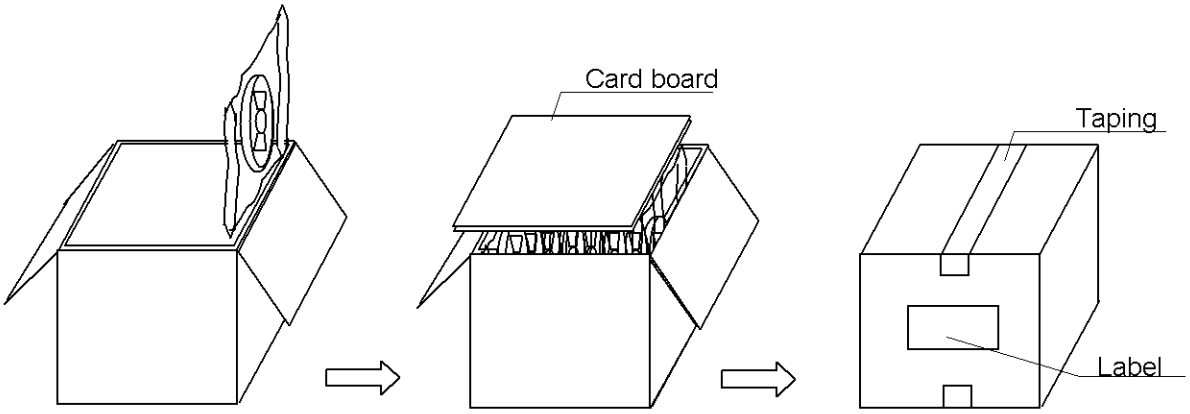
[2] Shipping Carton

a) Packing to antistatic bag



b) Packing to shipping carton

If there are room in the outer box, material is put in a shock absorbing together.



[3] 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) Shipping carton marking

- Shipping carton marking shall consist of :
  1) Parts name
  2) Quantity

[4] Quantity

- 3 000 pcs./reel

[5] 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.

[6] Handling

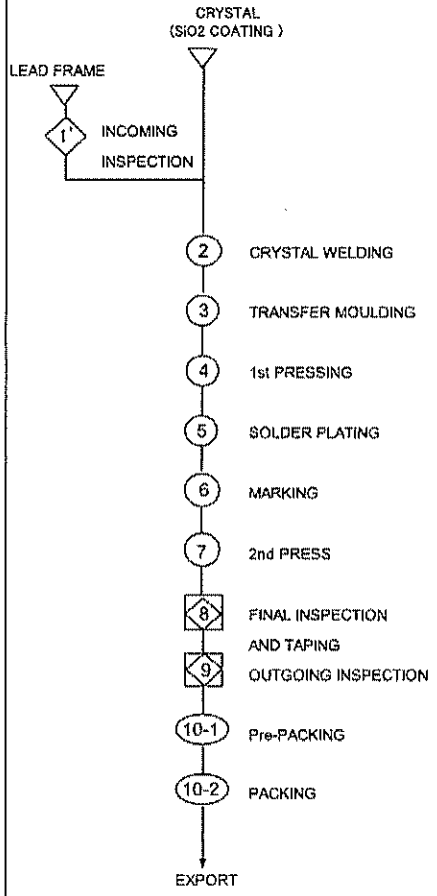
To handle with care to prevent the damage of tape, reel and products.

– PROCESS QUALITY CONTROL –

CODE : MC-146

Control No : M-9803-AGE-2 SURFACE MOUNTING TYPE CRYSTAL MC–146

10-Sep-08



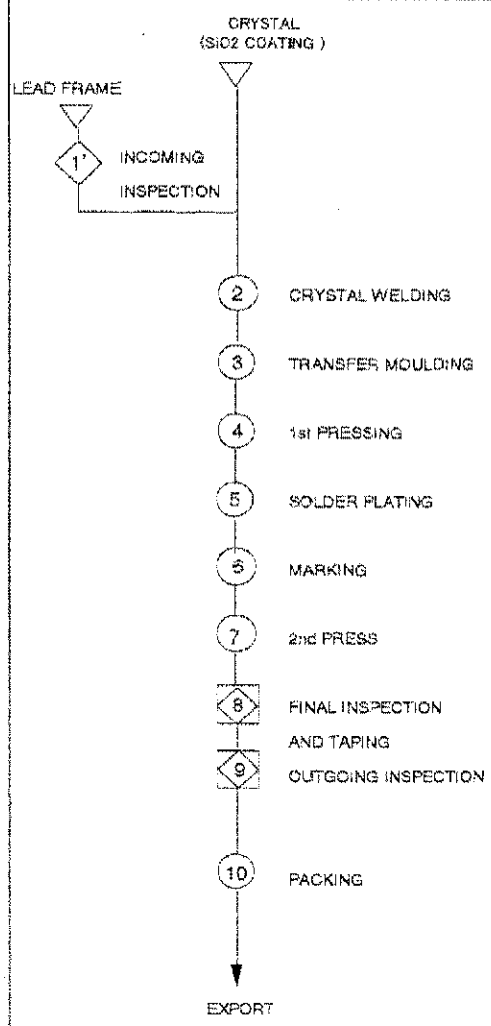
MANUFACTURING PROCESS CHART	No	RESPONSIBLE SECTION	STANDARD AND SPECIFICATIONS	INSPECTION AND CONTROL ITEMS	INSPECTION METHOD	MEASURING INSTRUMENTS	DATA COLLECTION
	1'	MALAYSIA PLANT (Sub-Contractor)	PURCHASING SPECIFICATION	APPEARANCE	SAMPLING	MICROSCOPE	IN-COMING INSPECTION
	2	MALAYSIA PLANT (Sub-Contractor)	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	SAMPLING	MICROSCOPE	PROCESS DATA SHEET
			MANUFACTURING INSTRUCTION SHEET	DIMENSION	SAMPLING	T.M.S	PROCESS DATA SHEET
	3	MALAYSIA PLANT (Sub-Contractor)	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	SAMPLING	VISUAL INSPECTION	PROCESS DATA SHEET
	4	MALAYSIA PLANT (Sub-Contractor)	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	SAMPLING	MICROSCOPE	PROCESS DATA SHEET
	5	MALAYSIA PLANT (Sub-Contractor)	SOLDER PLATING	S.P THICKNESS	SAMPLING	FLUOROSCOPY	PROCESS DATA SHEET
			SPECIFICATION SHEET	APPEARANCE	SAMPLING	VISUAL INSPECTION	PROCESS DATA SHEET
	6	MALAYSIA PLANT (Sub-Contractor)	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	SAMPLING	VISUAL INSPECTION	PROCESS DATA SHEET
	7	MALAYSIA PLANT (Sub-Contractor)	MANUFACTURING INSTRUCTION	APPEARANCE	SAMPLING	MICROSCOPE	PROCESS DATA SHEET
				DIMENSION	SAMPLING	VERTICAL COMPARATOR	PROCESS DATA SHEET
	8	MALAYSIA PLANT (Sub-Contractor)	MANUFACTURING INSTRUCTION SHEET	ELECTRICAL CHARACTERISTIC	100% INSPECTION	T0 CHECKING By m/c	PROCESS DATA SHEET
			MANUFACTURING INSTRUCTION SHEET	TAPING STRENGTH	SAMPLING	PEEL BACK TESTER	PROCESS DATA SHEET
			QUALITY STD.	ELECTRICAL CHARACTERISTIC	SAMPLING	T0&CI CHECKER	OGI INSP.SHEET
	9	MALAYSIA PLANT (Sub-Contractor)	QUALITY STD.	APPEARANCE	SAMPLING	MICROSCOPE	OGI INSP.SHEET
	10-1	MALAYSIA PLANT (Sub-Contractor)	MANUFACTURING INSTRUCTION SHEET	EXPORT CUSTOMER LIST	— — —	— — —	EXPORT DOCUMENTS
			DAILY SHIPPING LIST	FREQUENCY			
				QUANTITY			
	10-2	MALAYSIA PIANT	MANUFACTURING INSTRUCTION SHEET	EXPORT CUSTOMER LIST	— — —	— — —	EXPORT DOCUMENTS
			DAILY SHIPPING LIST	FREQUENCY			
				QUANTITY			

— PROCESS QUALITY CONTROL —

CODE : MC-146

Control No : M-9803-AKE-1

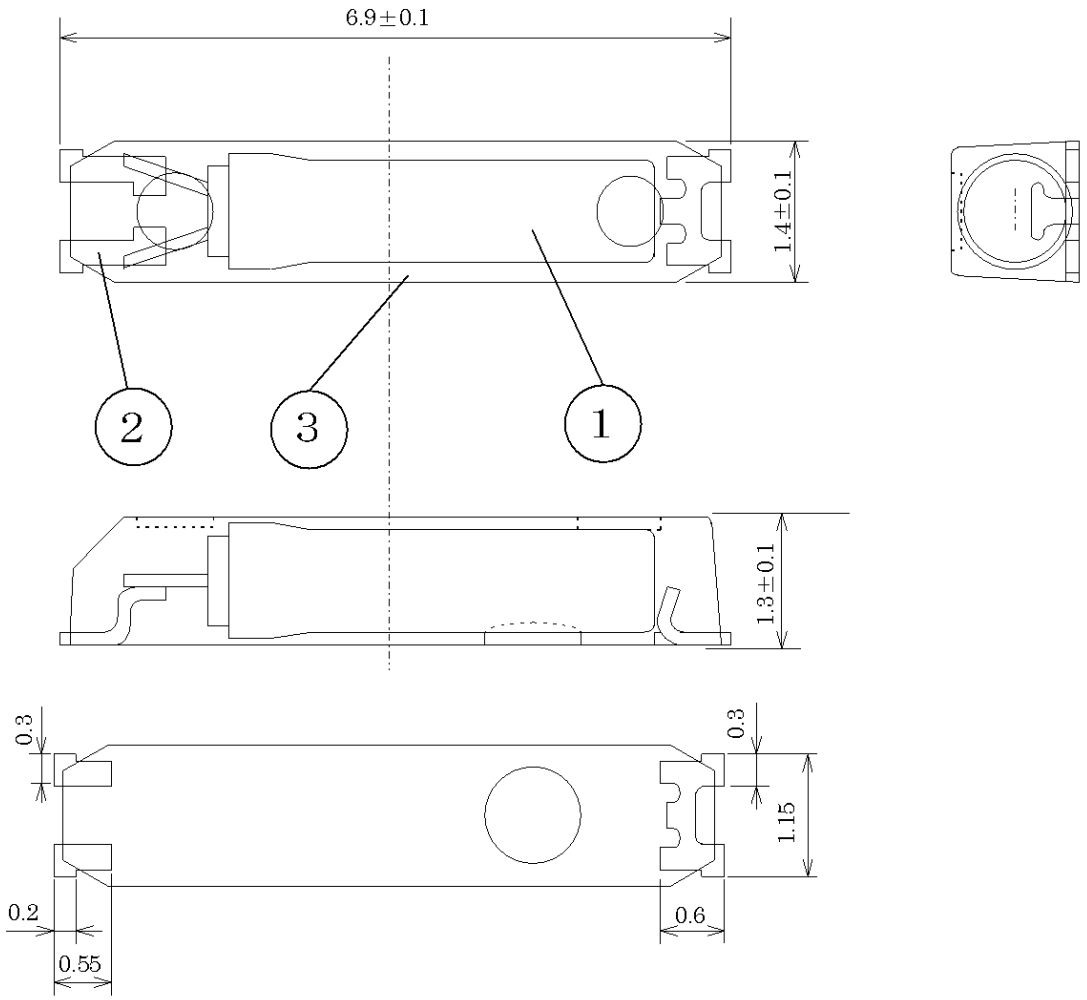
200.04.26



No	RESPONSIBLE SECTION	STANDARD AND SPECIFICATIONS	INSPECTION AND CONTROL ITEMS	INSPECTION METHORD	MEASURING INSTRUMENTS	DATA COLLECTION
1'	SUB-CONTRACTOR	PURCHASING SPECIFICATION	APPEARANCE	SAMPLING	PIUG GAUGES	IN-COMMING INSPECTION
		INCOMING INSPECTION STD.	DIMENSION		MICROSCOPE	DATA SHEET
2	SUB-CONTRACTOR	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	100% INSPECTION	MICROSCOPE	PROCESS DATA SHEET
		MANUFACTURING INSTRUCTION SHEET	DIMENSION	SAMPLING	T.M.S	PROCESS DATA SHEET
		MANUFACTURING INSTRUCTION SHEET	STRENGTH	SAMPLING	PUSH&PULL GAUGE	PROCESS DATA SHEET
3	SUB-CONTRACTOR	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	100% INSPECTION	MICROSCOPE	PROCESS DATA SHEET
				SAMPLING		PROCESS DATA SHEET
4	SUB-CONTRACTOR	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	SAMPLING	MICROSCOPE	PROCESS DATA SHEET
5	SUB-CONTRACTOR	SOLDER PLATING	S.P THICKNESS	SAMPLING	FLUOROSCOPY	PROCESS DATA SHEET
	SUB-CONTRACTOR	SPECIFICATION SHEET	APPEARANCE	SAMPLING	VISUAL INSPECTION	PROCESS DATA SHEET
6	SUB-CONTRACTOR	MANUFACTURING INSTRUCTION SHEET	APPEARANCE	SAMPLING	VISUAL INSPECTION	PROCESS DATA SHEET
7	SUB-CONTRACTOR	MANUFACTURING INSTRUCTION	APPEARANCE	SAMPLING	MICROSCOPE	PROCESS DATA SHEET
			DIMENSION	SAMPLING	INSPECTION JIG	PROCESS DATA SHEET
8	SUB-CONTRACTOR	MANUFACTURING INSTRUCTION SHEET	ELECTRICAL CHARACTERISTIC	100% INSPECTION	F0 CHECKING By m/c	PROCESS DATA SHEET
		MANUFACTURING INSTRUCTION SHEET	TAPING STRENGTH	SAMPLING	STRENGTH TESTER	PROCESS DATA SHEET
		QUALITY STD.	ELECTRICAL CHARACTERISTIC	SAMPLING	T0&CI CHECKER	OGI INSP.SHEET
9	SUB-CONTRACTOR	QUALITY STD.	APPEARANCE	SAMPLING	MICROSCOPE	OGI INSP.SHEET
10	SUB-CONTRACTOR	MANUFACTURING INSTRUCTION SHEET	EXPORT CUSTOMER LIST			EXPORT DOCUMENTS
		DAILY SHIPPING LIST	FREQUENCY			
			QUANTITY			

MC－146 Structure diagram

Unit：mm



No.	Name of Part	Material	Remarks
①	Crystal C-5SH	――――	――――
②	Lead	4 2 Alloy	Solder Plating (Pb free)
③	Molding	Epoxy Compound (Halide free)	――――

RELIABILITY TEST DATA

Product Name : MC-146 (Halide free mold)

The Company evaluation condition
We evaluate environmental and mechanical characteristics by the following test condition . **No. F-M-980301-05-001EH**

No.	ITEM	TEST CONDITIONS	VALUE *1 *2 Δ f / f [1 × 10^{-6}]	TEST Qty [n]	FAIL Qty [n]
1	Shock	100 g dummy (ETC Standard) drop from 1 500 mm height on to the concrete 3 directions 10 times	*3 ± 5	22	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)	*3 ± 3	22	0
3	Resistance to soldering heat	For convention reflow soldering furnace (2 times) The measurement is after 24 h	± 5	22	0
4	High temperature storage	a) +125℃× 1 000 h b) +85 ℃× 1 000 h	*3 a) ± 20 *3 b) ± 10	a) 22 b) 22	a) 0 b) 0
5	Low temperature storage	-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	Shear	10 N press for 10 s ± 1 s Ref. IEC 60068-2-21	No peeling - off at a solder part	22	0
9	Pull - off	10 N press for 10 s ± 1 s Ref. IEC 60068-2-21	No peeling - off at a solder part	22	0
10	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	22	0
11	Solderability	Dip termination into solder bath at +235 ℃ ± 10 ℃ for 3 s (Using Rosin Flux)	Termination must be 95 % covered with fresh solder	11	0
12	Solvent resistance	Ref. JIS C 0052 or IEC 60068-2-45	The marking shall be legible	11	0

Notes
1. *1 Each test done independently.
2. *2 Measuring 1 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 after above tests should be less than ±15 % or less than ±5 kΩ.
   In case Resistance to soldering heat,high temperature storage (+125 ℃ × 1 000 h) shift series resistance at after above tests should be less than ±20 % or less than ±10 kΩ.

Qualification Data

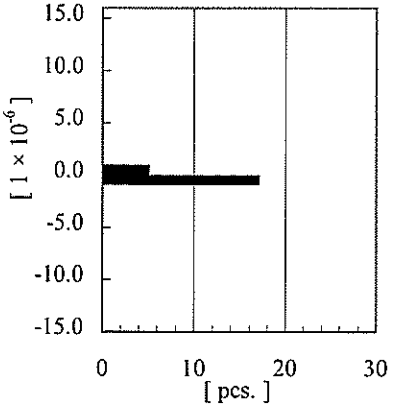
Product Name : MC-146 (Halide free mold)

Δ f / f

No. F-M-980301-05-002EH

1. Shock

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

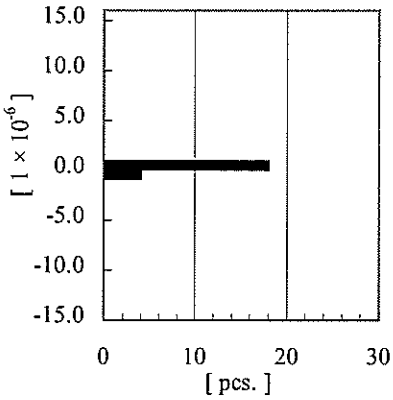


2. Vibration

10 Hz to 55 Hz amplitude 0.75 mm

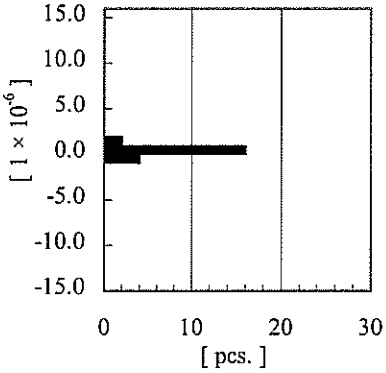
55 Hz to 500 Hz acceleration 98 m/s^2

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



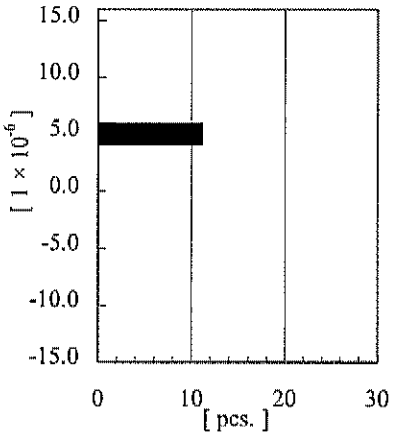
3. Resistance to oldering heat

For convention reflow furnace (2 times) After 24 h



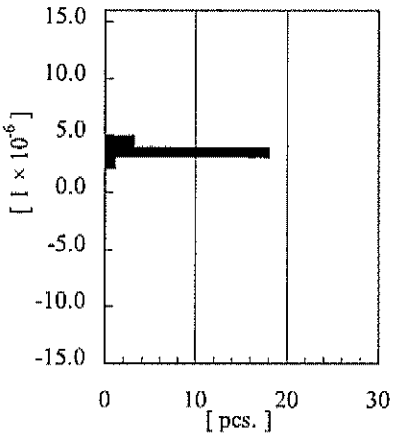
4. High temp. storage

a) +125 ℃× 1 000 h



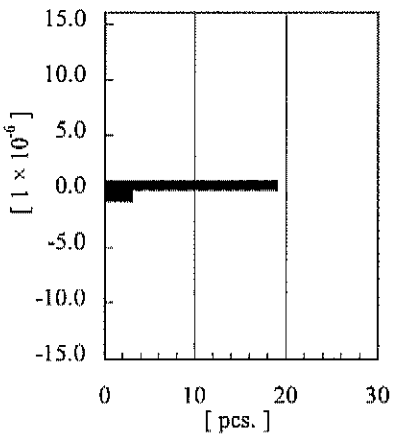
4. High temp. storage

b) +85 ℃× 1 000 h



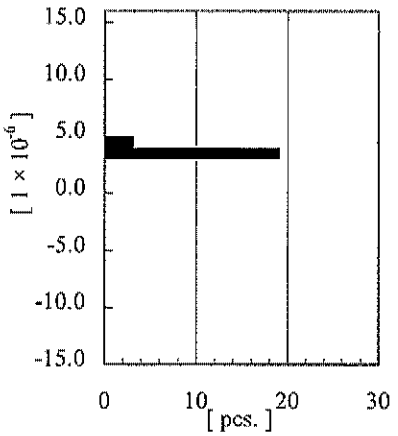
5. Low temp. storage

-55 ℃× 1 000 h



6. Temp. humidity storage

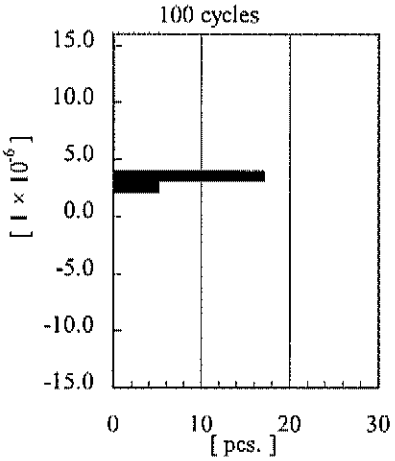
+85 ℃× 85 %RH × 1 000 h



7. Temp. cycle

-55 ℃ ⇔ +125 ℃

100 cycles



Qualification Data

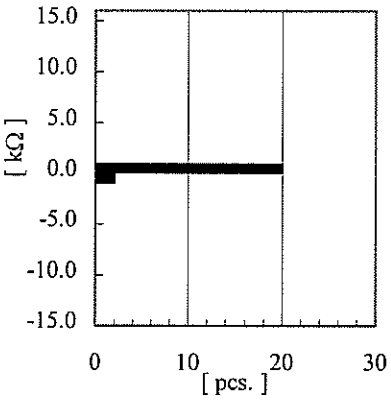
Product Name : MC-146 (Halide free mold)

Δ CI

No. F-M-980301-05-003EH

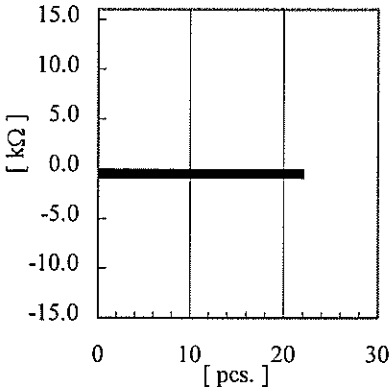
1. Shock

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



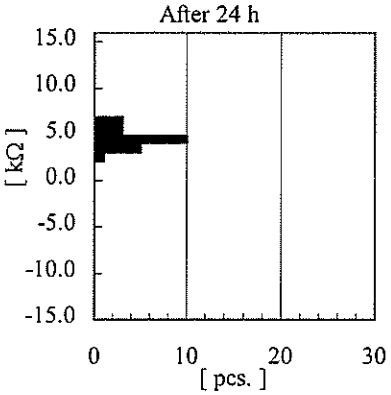
2. Vibration

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 ˋ 3 directions)



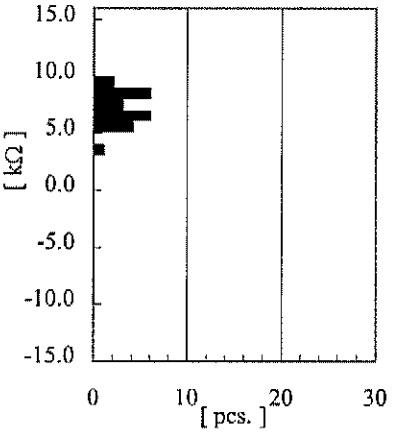
3. Resistance to soldering heat

For convention reflow soldering furnace (2 times)
After 24 h



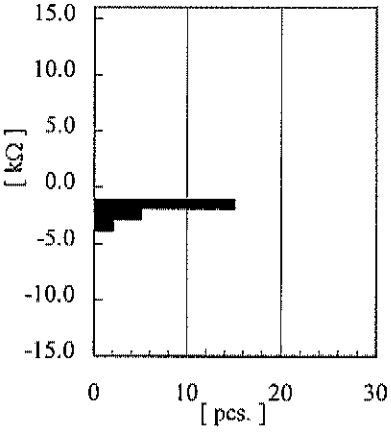
4. High temp. storage

a) +125 ℃× 1 000 h



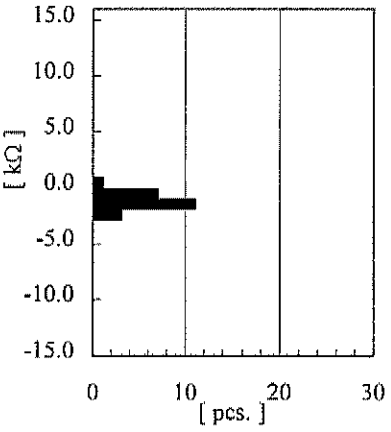
4. High temp. storage

b) +85 ℃× 1 000 h



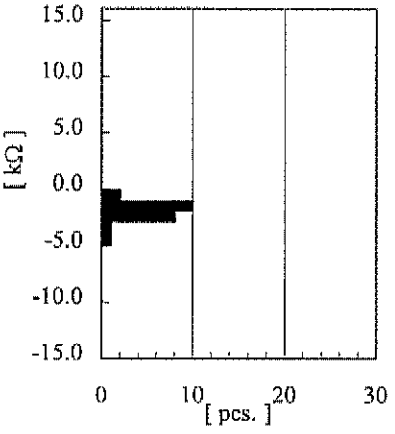
5. Low temp. storage

-55 ℃× 1 000 h



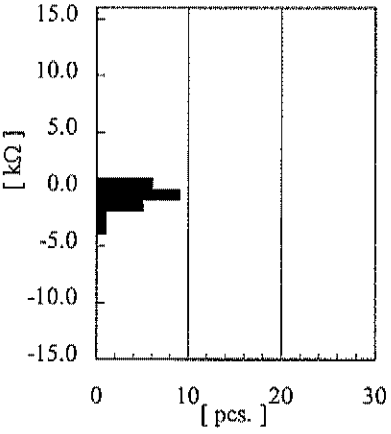
6. Temp. humidity storage

+85 ℃× 85 %RH × 1 000 h



7. Temp. cycle

-55 ℃ ⇔ +125 ℃
100 cycles



Qualification Data

EPSON
EXCEED YOUR VISION

To: Shenzhen Spreadwin Digital Technology Co

No.ST13-236
Sep.3.2013

SEIKO EPSON CORPORATION
TD・CS Quality Assurance Dept.

Product Name: MC-146
Subject: ESD and MSL

Thank you for choosing Seiko Epson Corp. as your Timing Device supplier.
We would like to report our reply about above issue as below.

1) E.S.D

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

·Human Body Model
(C=100 pF;R=1 500 Ω) : > ±1000 Volt

2) MSL

MC-146 : MSL Level 1