

RECIPIENT

SPECIFICATIONS

TYPE : MC-146

SPEC. No. : _____

DATE: _____

Epson Taiwan Technology & Trading Ltd.

10F, No.287, Nanking East Road, Sec.3,

Taipei, Taiwan, R. O. C.

Phone : +886 2-717-7360

Fax : +886 2-712-9164

SPECIFICATIONS

1. Application

This document is applicable to the crystal resonators that are delivered to from SEIKO EPSON Corp.

This product is not authorized for use as critical components in life support device or systems.

2. Production code

This crystal resonator's production code 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

Item No.	Item	Page
[1]	Absolute maximum ratings	2
[2]	Operating range	2
[3]	Static characteristics	2
[4]	Environmental and Mechanical characteristics	3 to 4
[5]	Dimensions and Marking layout	5 to 6
[6]	Notes	7

[1] Absolute maximum ratings

Item	Symbol	Rating value
Storage temperature	TSTG	-55°C to 125°C
Maximum drive level	DL	1.0 μW

[2] Operating range

Item	Symbol	Value		
		Min.	Typ.	Max.
Operating temperature range	TOPR	-40°C		85°C
Drive level	DL	0.01 μW	0.1 μW	0.5μW
Vibration mode		Fundamental		

[3] Static characteristics

Item	Symbol	Value	Note
Frequency	f1	32.768 kHz	
Frequency tolerance	$\Delta f/f$	± 20 ppm	CL = 12.5PF Ta = 25± 3°C, Drive level : 0.1 μW Not include aging
Series resistance	R1	Max. 65 kΩ	CI meter : Saunders 140B Drive level : 0.5 μW
Motional capacitance	C1	Typ. 1.9 fF	
Shunt capacitance	C0	Typ. 0.8 pF	
Turnover temperature	θT	25 ± 5°C	Values are calculated by the frequencies at 10, 25, 40°C with C-MOS circuit.
Temperature coefficient	a	Max. $-4.0 \times 10^{-8}/^{\circ}\text{C}^2$	
Isolation resistance	IR	Min. 500 MΩ	DC 100V, 60 seconds Between terminal #1 and terminal #4
Aging	fa	± 3 ppm / year	Ta = 25°C ± 3°C Drive level : 0.1 μW

[4] Environmental and Mechanical characteristics

No.	Items	Value	Conditions
1	Shock resistance	* $\Delta f/f : \pm 5$ ppm	100g dummy(SEIKO EPSON Standard), Natural drop from 150 cm height on to the concrete. 3 directions \times 10 cycles *2
2	Vibration resistance	* $\Delta f/f : \pm 3$ ppm	10 ~ 500Hz 1.5 mm p-p or 10G 10Hz \rightarrow 500Hz \rightarrow 10Hz : 15 minutes / cycle Log. Sweep 6Hrs (2 hours \times 3 directions) *2
3	Soldering heat resistance	$\Delta f/f : \pm 5$ ppm	Testing Process 1) Leave in $85 \pm 2^{\circ}\text{C} \times 85 \pm 5\% \text{RH} \times 24 \pm 1$ Hrs 2) Measure (Reference data) 24 hours later at leaving in room temperature after item 1) treatment 3) Treat the Reflow 2 times by the following profile in the next page 4) Measure the data at 1 hour and 24 hours after the item 3) treatment
4	High temperature storage	* $\Delta f/f : \pm 20$ ppm	$125^{\circ}\text{C} \times 1000$ hours *1
		* $\Delta f/f : \pm 10$ ppm	$85^{\circ}\text{C} \times 1000$ hours *1
5	Low temperature storage	* $\Delta f/f : \pm 10$ ppm	$-55^{\circ}\text{C} \times 1000$ hours *1
6	High temperature and humidity	* $\Delta f/f : \pm 10$ ppm	$85^{\circ}\text{C} \times 85\% \text{RH} \times 1000$ hours *1
7	Temperature cycle	* $\Delta f/f : \pm 10$ ppm	$-55^{\circ}\text{C} \leftrightarrow 125^{\circ}\text{C}$ 30 minutes at each temperature \times 100 cycles *1
8	Aging	* $\Delta f/f : \pm 3$ ppm	$25 \pm 3^{\circ}\text{C} \times 1$ year(No-bias)
		* $\Delta f/f : \pm 3$ ppm	$25 \pm 3^{\circ}\text{C} \times 1$ year(Bias by SEIKO EPSON STD circuit)
9	Adhesion	No peeling-off at a soldered part	10N press the side of product for 10 ± 1 seconds. Ref. EIAJ ET-7403 (Mechanical strength test for SMD)
10	Peeling strength	No peeling-off at a soldered part	10N press the center of bottom side for 10 ± 1 seconds. Ref. EIAJ ET-7403 (Mechanical strength test for SMD)
11	Bending	No peeling-off at a soldered part	Bending reaches 3mm at standing width, 90mm, and hold for 5 ± 1 seconds. Ref. EIAJ ET-7403 (Mechanical strength test for SMD)
12	Solderability of leads	Min. 90%	Leads were dipped 3 seconds in a solder bath of $230 \pm 10^{\circ}\text{C}$. (Using rosin flux)
13	Solvent resistance	Abnormal outer appearance (dull or unreadable) is not allowed.	Ref. EIAJ ED-4701 C-121

Note : 1) Above tests, No.1 to 12, should be tested independently and the measuring conditions at before and after the test are same

2) Shift of series resistance at before and after the test should be less than $\pm 15\%$ or less than $\pm 5k\Omega$.

In case high temperature storage($125^{\circ}\text{C} \times 1000$ hours), shift of series resistance at before and after the test should be less than $\pm 20\%$ or $\pm 10k\Omega$.

3) *1 : Measure 24 hours later at leaving in room temperature after each tests.

4) *2 : Measure 1 hour later at leaving in room temperature after each tests.

5) * $\Delta f/f$: The test Item No.1, No.2 and No.4 to No.8 are taken the following preconditions before starting the test.

(1) Leave in $85 \pm 2^{\circ}\text{C} \times 85 \pm 5\% \text{RH} \times 24 \pm 1$ Hrs

(2) Treat the Reflow 2 times with the following profile

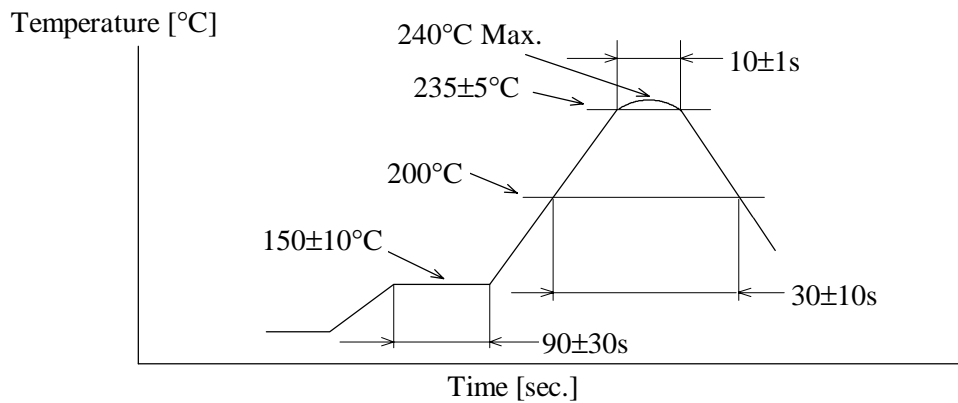
(3) Measure 24 hours later at leaving in room temperature before starting the each tests (The data are the reference).

◆ Infrared-reflow (EIAJ ED-4701)

Pre heating temperature: 150 ± 10 [$^{\circ}\text{C}$] Pre heating time: 90 ± 30 [sec.]

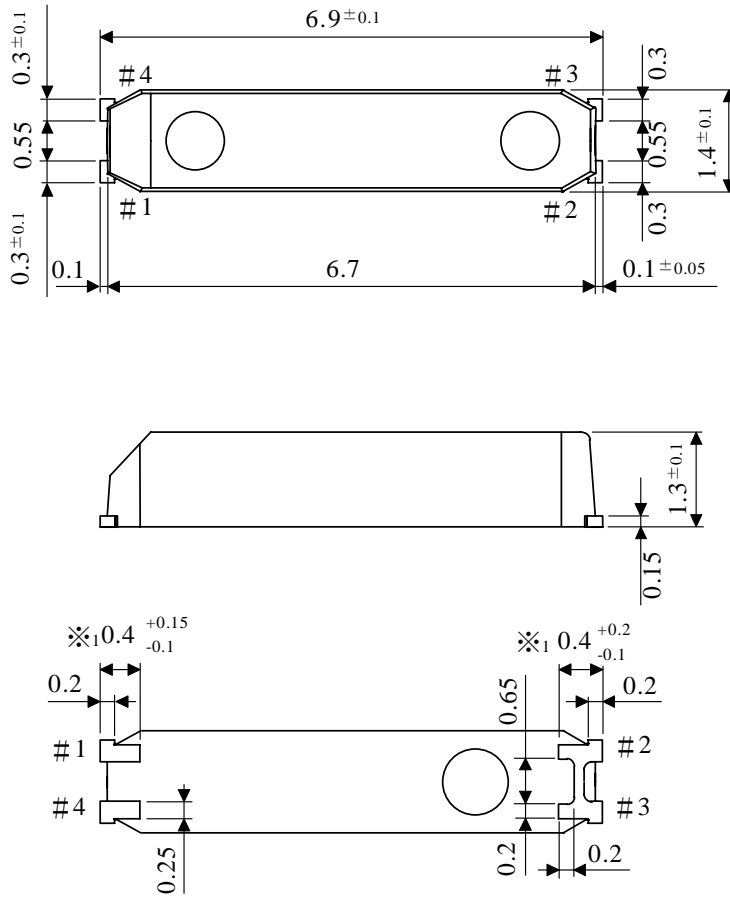
Heating temperature : 235 ± 5 [$^{\circ}\text{C}$] Heating time : 10 ± 1 [sec.]

Peak temperature must not exceed 240°C and the duration of over 200°C should be 30 ± 10 seconds.



[5] Dimensions and Marking layout

1. Dimensions



※₁: Available area for soldering

There are some cases that a part of the case of quartz resonator is covered by the molding material.

Terminal thickness	0.15mm
Lead Frame	42Alloy
Terminal treatment	Solder plate $15 \pm 10 \mu\text{m}$
Molding	Epoxy Compound
Compound color	Black

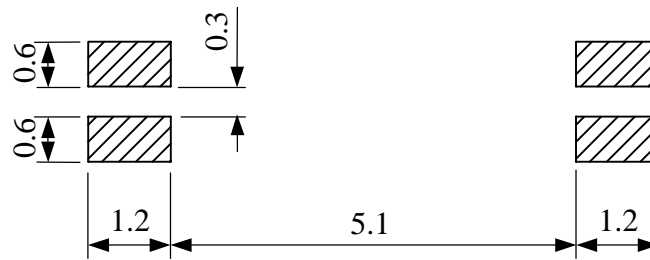
2. Internal Connection

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

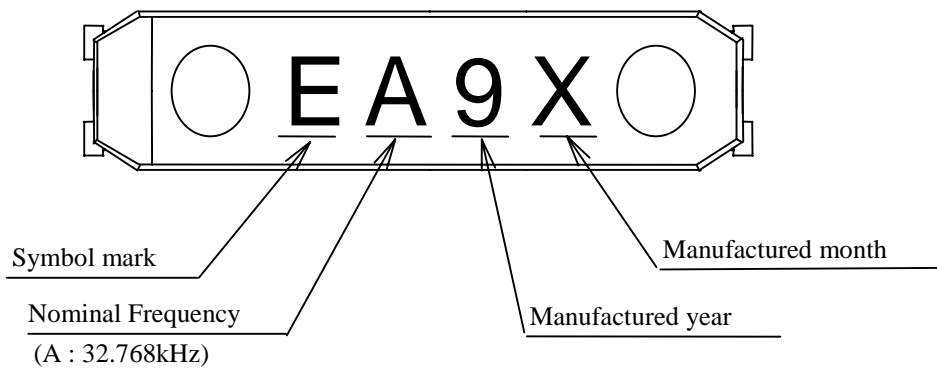
Type	MC-146	Terminal treatment	Solder plate	Unit	1 = 1 mm
------	--------	--------------------	--------------	------	----------

3. Recommended soldering pattern

Unit : 1 = 1 mm



4. Marking layout



Symbol of Manufacturing Month

Jan.	Feb.	Oct.	Nov.	Dec.
1	2	X	Y	Z

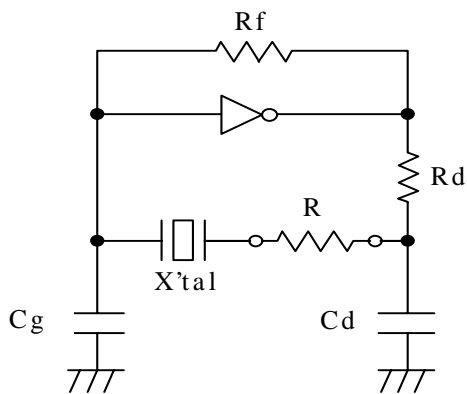
- ◆ The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

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 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. 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 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.
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.