

RECIPIENT

## SPECIFICATIONS

**Product No. : Q13MC1462008500**

**MODEL : MC-146**

**SPEC. No. :**

**DATE: 20. Aug. 2021**

### SEIKO EPSON CORPORATION

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PREPARED \_\_\_\_\_ /

# 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 Q13MC1462008500.  
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	± 20	× 10 <sup>-6</sup>	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.	× 10 <sup>-6</sup> /°C <sup>2</sup>	
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	× 10 <sup>-6</sup> /year	Ta = + 25 °C ± 3 °C Level of drive : 0.1 μW	

#### [ 4 ] Environmental and Mechanical characteristics

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

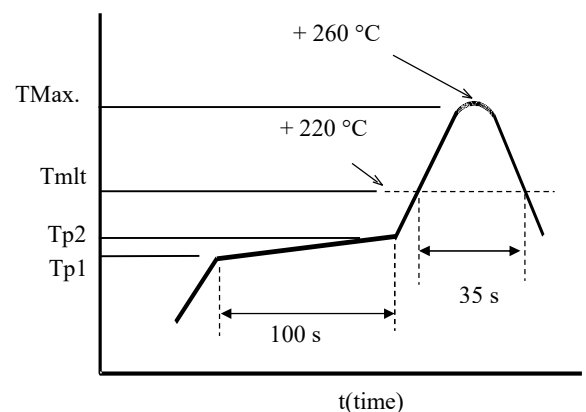
No.	Items	Value *1*2 $\Delta f/f [1 \times 10^{-6}]$	Conditions
1	Shock	*3 $\pm 5$	100 g dummy (EPSON Standard) drop from 1500 mm height on to the concrete 3 directions 10 times
2	Vibration	*3 $\pm 3$	10 Hz to 55 Hz amplitude 0.75 mm 55 Hz to 500 Hz acceleration 98 m/s <sup>2</sup> 10 Hz → 500 Hz → 10 Hz 15 min./cycle 6 h (2 hours , 3 directions)
3	Resistance to soldering heat (Reflow characteristics)	*3 $\pm 5$	For convention reflow soldering furnace (2 times)
4	High temperature storage	*3 a ) $\pm 20$ b ) $\pm 10$	a ) + 125 °C × 1 000 h b ) + 85 °C × 1 000 h
5	Low temperature storage	*3 $\pm 10$	- 55 °C × 1 000 h
6	Temperature humidity storage	*3 $\pm 10$	+ 85 °C × 85 %RH × 1000 h
7	Temperature cycle	*3 $\pm 10$	- 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 $\pm 1$ s. Ref. IEC 60068-2-21
9	Pull-off	No peeling-off at a soldered part	10 N press the side for 10 s $\pm 1$ 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 $\pm 1$ 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 $\pm 5$ °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.
 The value of series resistance after each reliability test is 85 kΩ Max.

#### ◆ Air- reflow

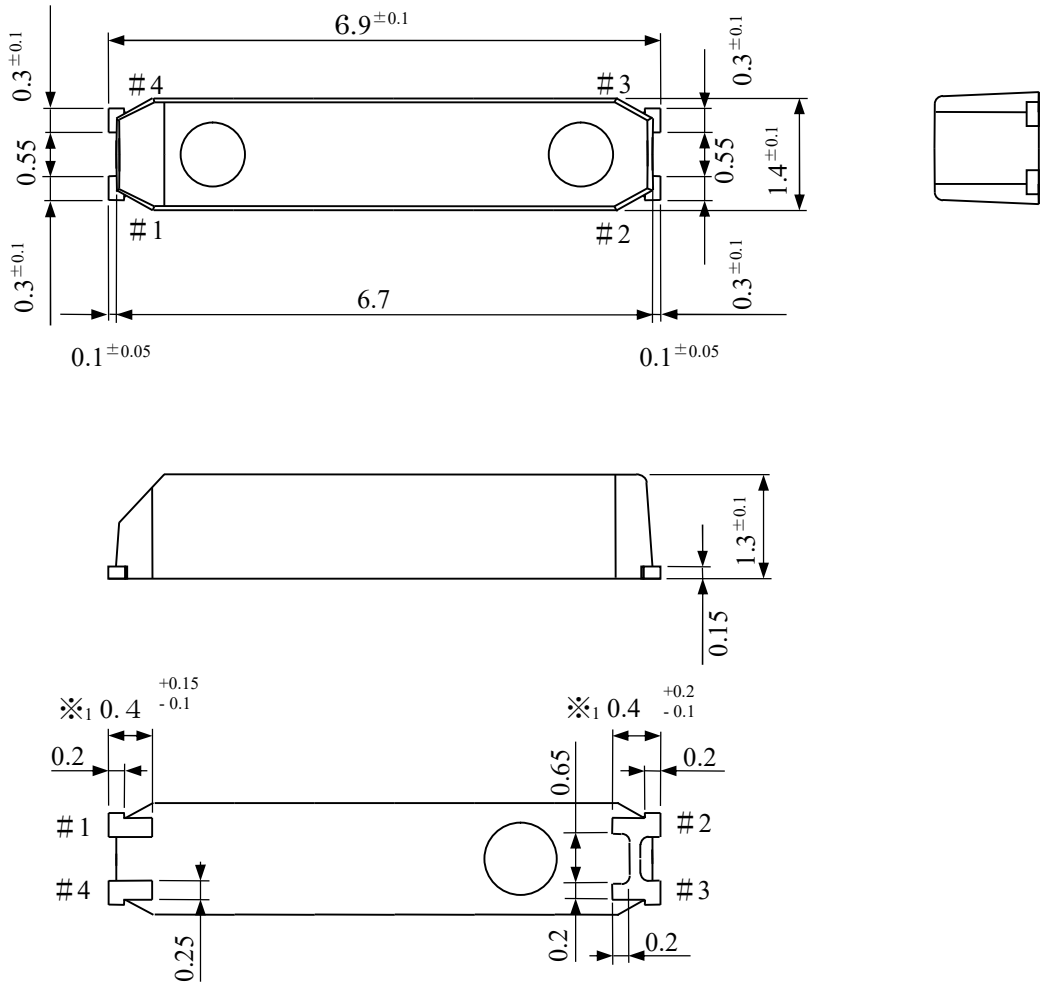
Pre heating temperature : Tp1~Tp2 = + 170 °C  
 Peak temperature must not exceed + 260 °C  
 and the duration of over + 220 °C should be 35 s

T  
(Temperature)



[ 5 ] Dimensions and Marking layout

1. Dimensions

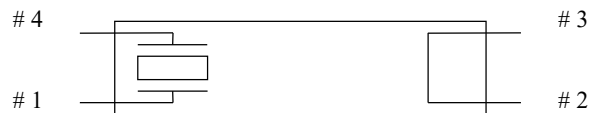


※<sub>1</sub> : Available area for soldering

※<sub>2</sub> . 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

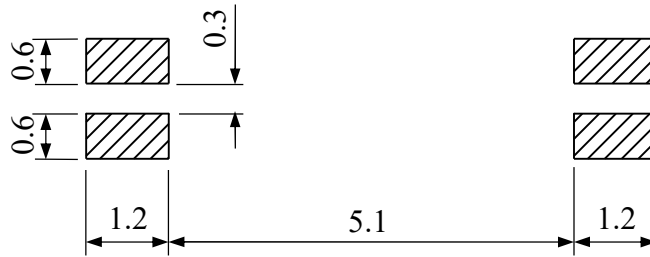


Do not connect # 2 and # 3 terminals to any external circuits (including GND).

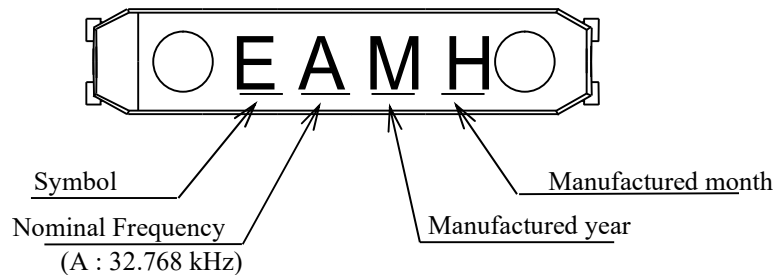
Type	MC-146	Unit	1 = 1 mm
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### 3. Recommended soldering pattern

Unit : 1 = 1 mm



### 4. Marking layout



#### Symbol of Manufacturing year

Year digit		1	2	3	4	5	6	7	8	9	0
Marking	Terminal Plating: Sn	M	N	R	S	T	U	V	W	X	Z

Year digit(1<sup>st</sup>) 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

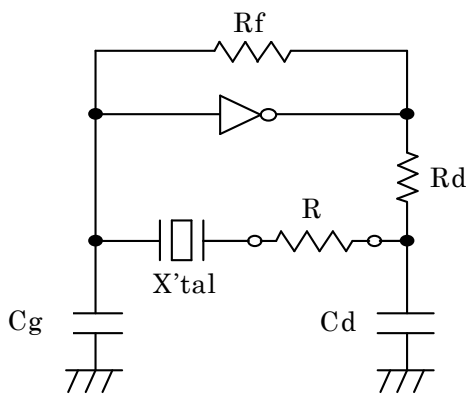
- ◆ The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

Type	MC-146	Unit	1 = 1 mm
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## [ 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.