

## kHz Range Crystal unit

- Package size (2.05 mm × 1.2 mm × 0.6 mm)
- Fundamental mode
- Reference weight Typ.4.2 mg
- AEC Q200 compliant

### [ 1 ] Product Number / Product Name / Marking

(1-1) Product Number / Ordering Code

**X1A0001810003xx**

Last 2 digits code(xx) defines Quantity.

The standard is "18", 5 000 pcs/Reel.

(1-2) Product Name / Model Name

FC2012AA 32.768000 kHz 7.0 +20.0-20.0

### [ 2 ] Absolute maximum ratings

| Parameter           | Symbol | Specifications |      |      | Unit | Conditions                |
|---------------------|--------|----------------|------|------|------|---------------------------|
|                     |        | Min.           | Typ. | Max. |      |                           |
| Storage temperature | T_stg  | -55            | -    | +125 | °C   | Storage as single product |
| Maximum drive level | GL     | -              | -    | 0.5  | μW   |                           |

### [ 3 ] Specifications(characteristics)

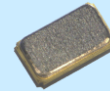
| Parameter                 | Symbol | Specifications |           |       | Unit                                | Conditions         |
|---------------------------|--------|----------------|-----------|-------|-------------------------------------|--------------------|
|                           |        | Min.           | Typ.      | Max.  |                                     |                    |
| Nominal frequency         | f_nom  | -              | 32.768000 | -     | kHz                                 |                    |
| Operating temperature     | T_use  | -40            | -         | +125  | °C                                  |                    |
| Level of drive            | DL     | -              | 0.1       | 0.5   | μW                                  |                    |
| Frequency tolerance       | f_tol  | -20            | -         | +20   | x 10 <sup>-6</sup>                  | +25 °C DL = 0.1 μW |
| Turnover temperature      | Ti     | +20            | +25       | +30   | °C                                  |                    |
| Parabolic coefficient     | B      | -              | -         | -0.04 | x 10 <sup>-6</sup> /°C <sup>2</sup> |                    |
| Load capacitance          | CL     | -              | 7.0       | -     | pF                                  |                    |
| Motional resistance (ESR) | R1     | -              | 40        | -     | kΩ                                  | +25 °C             |
|                           |        | -              | -         | 70    |                                     | -40 °C to +105 °C  |
|                           |        | -              | -         | 75    |                                     | -40 °C to +125 °C  |
| Motional capacitance      | C1     | -              | 8         | -     | fF                                  |                    |
| Shunt capacitance         | C0     | -              | 1.5       | -     | pF                                  |                    |
| Motional inductance       | L1     | -              | 3.2       | -     | kH                                  |                    |
| Frequency aging           | f_age  | -5             | -         | +5    | x10 <sup>-6</sup> /yea              | +25 °C, First year |

[ For other general specifications, please refer to the attached Full Data Sheet below ]

# AEC-Q200 compliant / high temperature (up to +125 °C) 32.768 kHz crystal unit: FC2012AA

## Features

- Package size: 2.05 x 1.2 mm, t = 0.6 mm Max.
- Nominal frequency range: 32.768 kHz
- Frequency tolerance:  $\pm 20 \times 10^{-6}$  (+25 °C  $\pm 5$  °C)
- Operating temperature: -40 °C to +125 °C
- ESR: 40 k $\Omega$  Typ. (+25 °C)  
70 k $\Omega$  Max. (-40 °C to +105 °C)  
75 k $\Omega$  Max. (-40 °C to +125 °C)



FC2012AA  
(2.05 x 1.2 mm, t = 0.6 mm Max.)

## Applications

- Sub-clock for automotive ECU microcomputers
- BLE sub-clock for automotive electronic key
- FA equipment

## Description

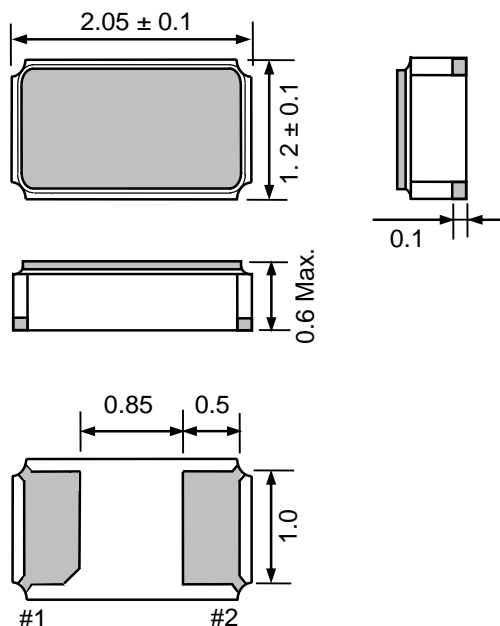
FC2012AA is an AEC-Q200 compliant, high temperature (up-to +125 °C), small size and low ESR 32.768 kHz crystal unit.

It is ideal for the growing automotive applications.

and FA (Factory Automation) equipment that require high-temperature operation up to +125 °C.

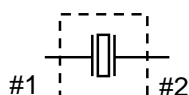
Epson is a leading supplier of kHz-band crystal units and offers a lineup of oscillators with built-in oscillator circuit ICs and real-time clock modules with built-in real-time clock ICs, in addition to crystal units. Epson is committed to providing the lowest power solution for our customers.

## Outline Drawing and Terminal Assignment



#1 #2

Internal  
Connection

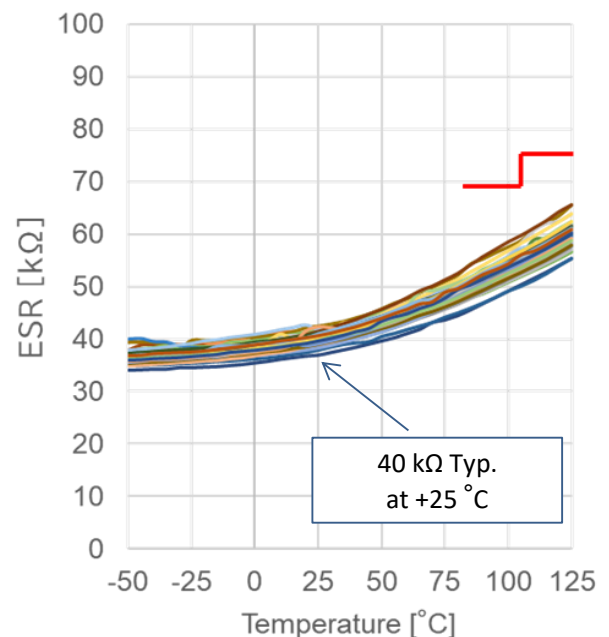


| Pin | Connection |
|-----|------------|
| #1  | X'tal      |
| #2  | X'tal      |

## Typical Performance

Low ESR n = 44

ESR Temperature Characteristics



## [ 1 ] Product Number / Product Name

## (1-1) Product Number

X1A000181xxxx18 (Please contact Epson for details)

## (1-2) Product Name (Standard Form)

FC2012AA 32.768000kHz 12.5 +20.0-20.0

a b c d

a: Model b: Frequency c: Load capacitance (pF) d: Frequency tolerance ( $\times 10^{-6}$ , +25 °C)

## [ 2 ] Absolute Maximum Ratings

| Item                      | Symbol | Rating value |      |      | Unit    | Note |
|---------------------------|--------|--------------|------|------|---------|------|
|                           |        | Min.         | Typ. | Max. |         |      |
| Storage temperature range | T_stg  | -55          | -    | +125 | °C      |      |
| Maximum level of drive    | GL     | -            | -    | 0.5  | $\mu$ W |      |

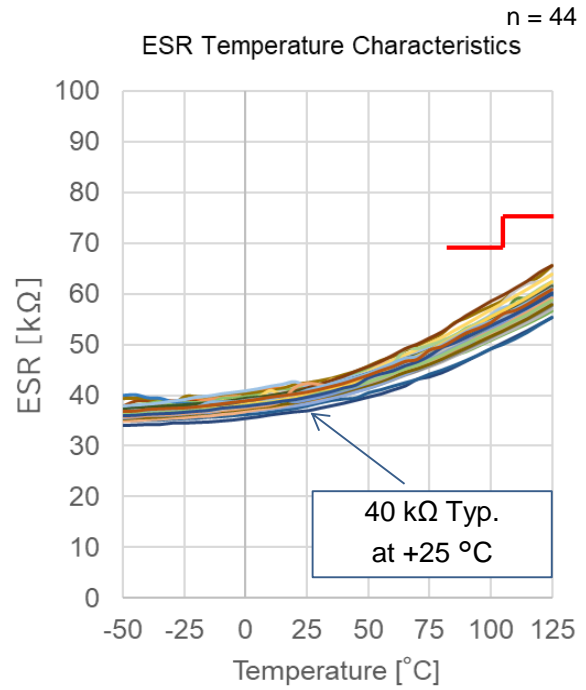
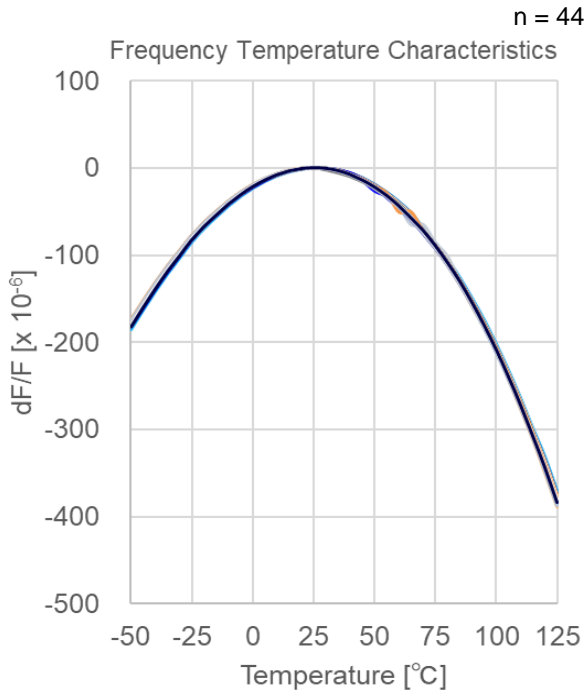
## [ 3 ] Operating Conditions

| Item                        | Symbol | Rating value |      |      | Unit    | Note                                  |
|-----------------------------|--------|--------------|------|------|---------|---------------------------------------|
|                             |        | Min.         | Typ. | Max. |         |                                       |
| Operating temperature range | T_use  | -40          | -    | +125 | °C      |                                       |
| Level of drive              | DL     | 0.01         | 0.1  | 0.5  | $\mu$ W |                                       |
| Load capacitance            | CL     | 7, 9, 12.5   |      |      | pF      | Please contact us for other CL values |

## [ 4 ] Static Characteristics

| Item                      | Symbol | Specifications                 | Unit                                | Condition / Remarks   |
|---------------------------|--------|--------------------------------|-------------------------------------|---|
| Nominal frequency range   | f_nom  | 32.768                         | kHz                                 |   |
| Frequency tolerance       | f_tol  | $\pm 20$                       | $\times 10^{-6}$                    | T_use = +25 °C $\pm$ 3 °C<br>DL = 0.1 $\mu$ W<br>Does not include frequency aging |
| Turnover temperature      | Ti     | +25 $\pm$ 5                    | °C                                  |   |
| Parabolic coefficient     | B      | -0.04 Max.                     | $\times 10^{-6} / ^\circ\text{C}^2$ |   |
| Motional resistance (ESR) | R1     | 40 Typ.<br>(+25 °C)            | k $\Omega$                          | Measuring instrument:<br>Keysight 4294A<br>DL = 0.5 $\mu$ W                       |
|                           |        | 70 Max.<br>(-40 °C to +105 °C) |                                     |   |
|                           |        | 75 Max.<br>(-40 °C to +125 °C) |                                     |   |
| Motional capacitance      | C1     | 8.0 Typ.                       | fF                                  |   |
| Shunt capacitance         | C0     | 1.5 Typ.                       | pF                                  |   |
| Isolation resistance      | IR     | 200 Min.                       | M $\Omega$                          |   |
| Frequency aging           | f_age  | $\pm 5$                        | $\times 10^{-6}$                    | T_use = +25 °C,<br>First year, DL = 0.1 $\mu$ W                                   |

[ 5 ] Frequency and ESR vs. Temperature Characteristics



[ 6 ] Marking Description

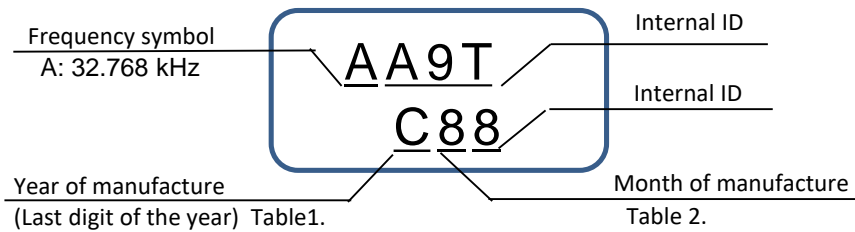


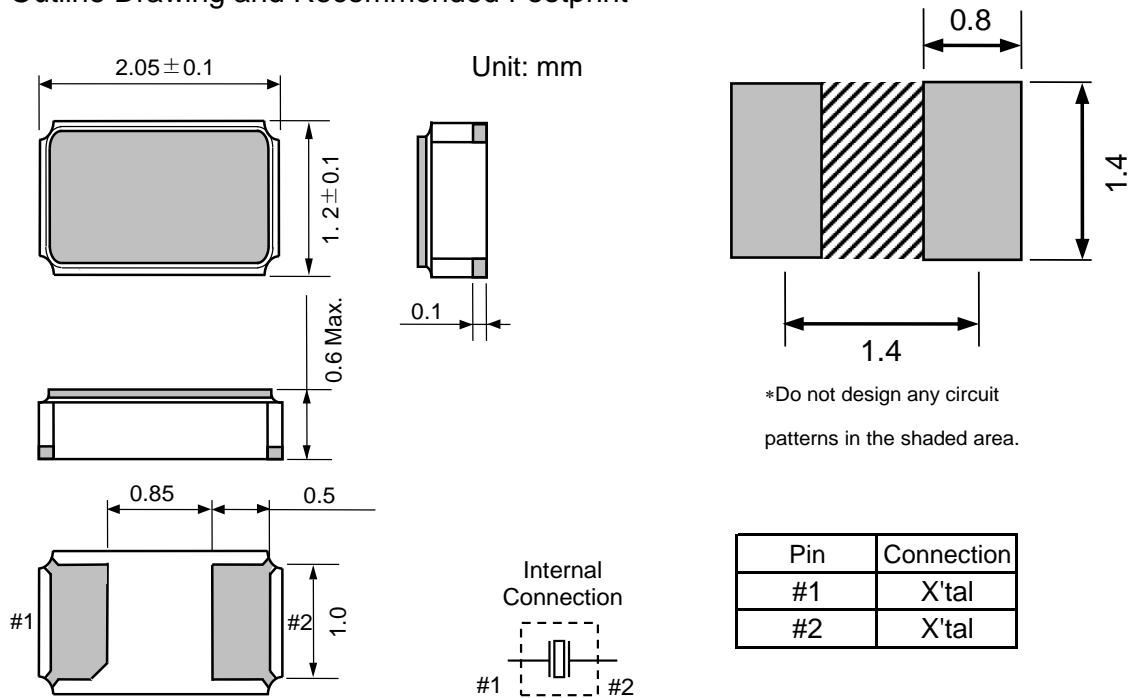
Table 1. Year of manufacture

|      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | xxx1 | xxx2 | xxx3 | xxx4 | xxx5 | xxx6 | xxx7 | xxx8 | xxx9 | xxx0 |
| Code | A    | B    | C    | D    | E    | F    | G    | H    | J    | K    |

Table 2. Month of manufacture

|       |     |     |     |     |     |     |     |     |     |     |     |     |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Code  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | X   | Y   | Z   |

[ 7 ] Outline Drawing and Recommended Footprint



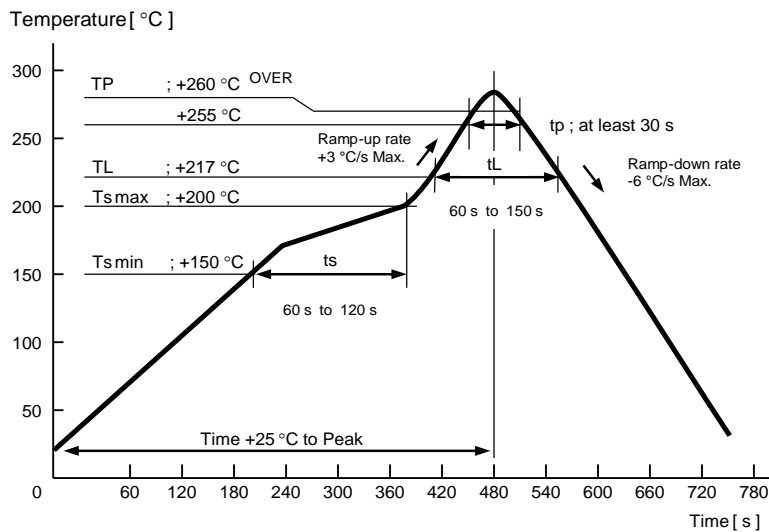
Reference weight Typ.: 4.2 mg

Terminal coating: Au plating

[ 8 ] Moisture Sensitivity Level

| Parameter | Specification | Conditions             |
|-----------|---------------|------------------------|
| MSL       | LEVEL1        | IPC/JEDEC J-STD-020D.1 |

[ 9 ] Reflow Profile (IPC/JEDEC J-STD-020D.1)



## [ 10 ] Packing Information

## (1) Packing Quantity

The last two digits of the Product Number (X1A000181xxxx18) are a code that defines the packing quantity  
The standard is "18" for a 5 000 pcs/Reel.

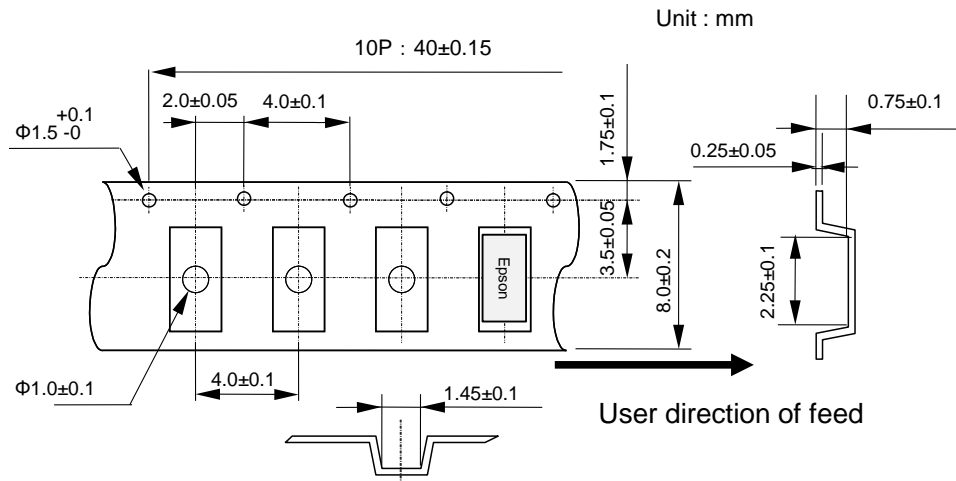
## (2) Taping Specification

Compliant to EIA-481, IEC 60286 and JIS C0806

## (2-1) Tape Dimensions

Carrier Tape Material : PS (Polystyrene)

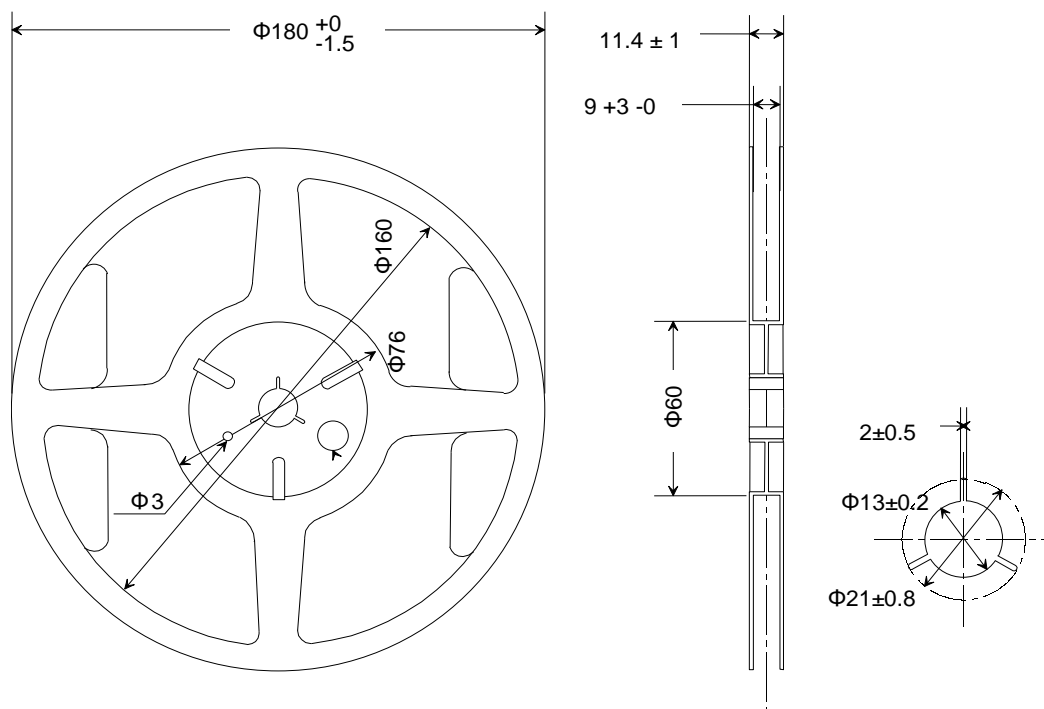
Top Tape Material : PET (Polyethylene Terephthalate) +PE (Polyethylene)



## (2-2) Reel Dimensions

Center Material : PS (Polystyrene)

Reel Material : PS (Polystyrene)

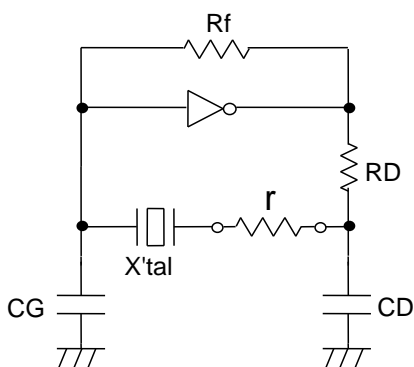


## [ 11 ] Handling Precautions

Please review the "Handling Precautions" on our website for proper handling and behavior to ensure the performance of your equipment/product. (<https://www5.epsondevice.com/en/information/#precaution>)  
In addition to the "Handling Precautions" on the website, please also pay attention to the following to avoid deterioration of product performance.

1. Max three (3) times reflow is allowed.  
In case of rework by soldering iron, its condition should be +350 °C max. + within 5 sec.
2. Applying excessive shock or vibration to the crystal unit may causes deterioration damage.  
The product may be damaged depends on the condition such as shock in assembly machine.  
Please check if your condition is safe in advance.  
And in case of assembly condition change, please check it again in advance.
3. Shortest line pattern on PCB is recommended.  
Too long line on PCB may causes abnormal oscillation.
4. Failures covered by free warranty period are limited to the cases where the product is used under the usage and environment described in the specifications. In addition, products that have been opened (including partially opened, modified, or intended to be opened) are not covered. In order to ensure frequency accuracy and prevent moisture condensation due to sudden temperature changes, it is recommended to store and use in normal room temperature and humidity.  
If the product is stored for a long period (one year or more), please check solderability of the terminals before use.
5. Ultrasonic cleaning may cause resonant damage of the crystal unit depend on its condition.  
Since we are unable to specify the conditions (type of cleaning unit, power, time, condition inside the bath, etc.) at your company, we cannot guarantee the performance of the product when it is cleaned by ultrasonic cleaner.
6. Condensation on oscillator circuit board may causes frequency shift or oscillation stop.  
Please use the product under the condition there is no condensation.
7. If excessive drive level is applied to the crystal unit, it may cause performance deterioration and damages. Please design appropriate drive level on the circuit.
8. Characteristics differences between our measurement and your company's measurement may occur depending on measurement method and conditions. Please check it thoroughly before use.
9. Do not place signal lines, power lines, or GND lines in mounting area of the product, its inner layer, or its back side. In order to avoid malfunction due to induction of other signal lines, please do not place signal lines near the product. It may affect product characteristics.
10. If there is no margin in negative resistance of the oscillator circuit, the crystal unit may not oscillate or may take a long time to oscillate. Therefore, negative resistance in the oscillator circuit should be at least five times of the crystal unit's equivalent series resistance. Please follow this circuit design rule.
11. Aging specifications are estimated value of frequency shift from reliability test results. It does not mean to guarantee product lifecycle.
12. If customer wants to use our product contrary to this caution and advice, please use it at your own risk.

<How to check the negative resistance>



- 1) Insert a pure resistance ( r ) in series with the crystal oscillator.
- 2) Adjust ( r ) to find the maximum ( r ) value that starts oscillation
- 3) Look at the value of ( r ) in the oscillation state of 2).

Negative resistance of the circuit  $|-R| =$

$r + \text{crystal unit series resistance value } R1$

Guideline for negative resistance  $|-R|$ :

$|-R| > R1 \text{ Max. } \times 5$

## PROMOTION OF ENVIRONMENTAL MANAGEMENT SYSTEM CONFORMING TO INTERNATIONAL STANDARDS

At Seiko Epson, all environmental initiatives operate under the Plan-Do-Check-Action (PDCA) cycle designed to achieve continuous improvements. The environmental management system (EMS) operates under the ISO 14001 environmental management standard.

All of our major manufacturing and non-manufacturing sites, in Japan and overseas, completed the acquisition of ISO 14001 certification.




ISO 14000 is an international standard for environmental management that was established by the International Standards Organization in 1996 against the background of growing concern regarding global warming, destruction of the ozone layer, and global deforestation.

## WORKING FOR HIGH QUALITY

In order to provide high quality and reliable products and services than meet customer needs, Seiko Epson made early efforts towards obtaining ISO9000 series certification and has acquired ISO9001 for all business establishments in Japan and abroad. We have also acquired IATF 16949 certification that is requested strongly by major manufacturers as standard.

IATF 16949 is the international standard that added the sector-specific supplemental requirements for automotive industry based on ISO9001.

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|   |  |
|---|--|
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|  | ● <b>Complies with EU RoHS directive.</b><br>*About the products without the Pb-free mark.<br>Contains Pb in products exempted by EU RoHS directive<br>(Contains Pb in sealing glass, high melting temperature type solder or other) |
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