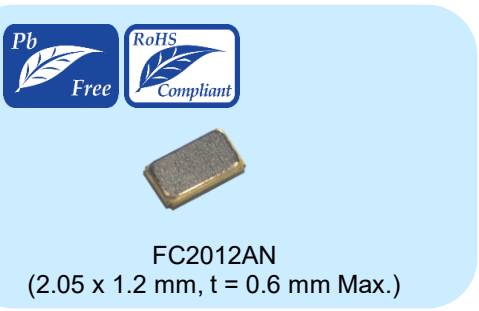
Low ESR 60 kΩ Max. (-40 °C to +105 °C) 32.768 kHz Crystal Unit: FC2012AN

Features

- Package size: 2.05 x 1.2 mm, t = 0.6 mm Max.
- Nominal frequency range: 32.768 kHz
- Frequency tolerance: ±20 x 10^{-6} (+25 °C ± 5 °C)
- Operating temperature: -40 °C to +105 °C
- ESR: 35 kΩ Typ. (+25 °C)
  50 kΩ Max. (-40 °C to +85 °C)
  60 kΩ Max. (-40 °C to +105 °C)



FC2012AN
(2.05 x 1.2 mm, t = 0.6 mm Max.)

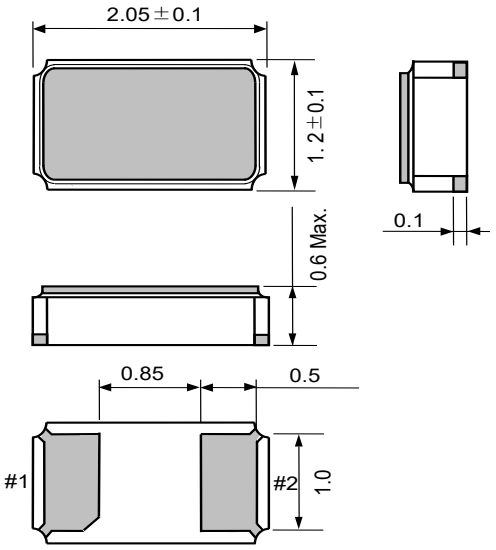
Applications

- Wearable products
- Low power MCUs for sub-clock
- Wireless modules for sub-clock

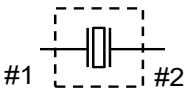
Description

The FC2012AN is a 32.768 kHz crystal unit with low ESR in compact package. This is equipped with a fully redesigned element based on our design and production technology know-how for tuning-fork crystal devices built up over many years. It is ideal for applications that require low current consumption, such as the expected growth of the IoT. It supports an operating temperature range of up to +105 °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



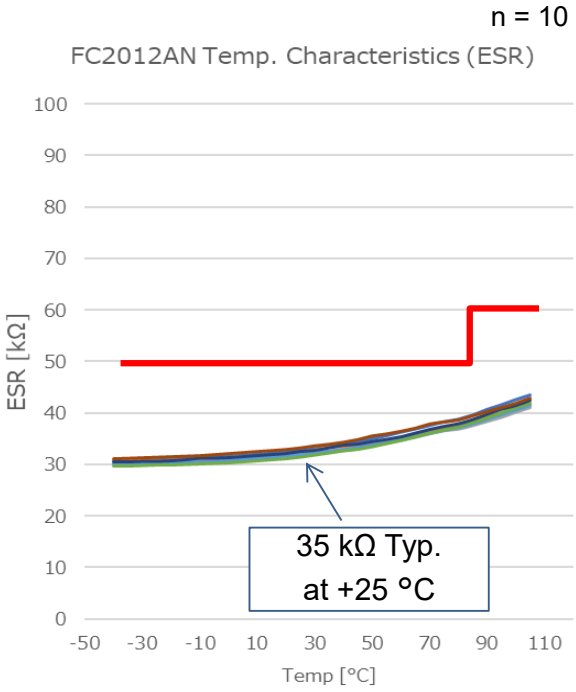
Internal Connection



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

Typical Performance

Low ESR



[1] Product Number / Product Name

(1-1) Product Number

X1A000171xxxx18 (Please contact Epson for details)

(1-2) Product Name (Standard Form)

FC2012AN 32.768000kHz 12.5 +20.0-20.0

① ② ③ ④

①Model ②Frequency ③Load capacitance (pF) ④Frequency tolerance ($x10^{-6}$, +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	µW	

[3] Operating Conditions

Item	Symbol	Rating value			Unit	Note
		Min.	Typ.	Max.		
Operating temperature range	T_use	-40	-	+105	°C	
Level of drive	DL	0.01	0.1	0.5	µW	
Load capacitance	CL	6	-	∞	pF	Please specify

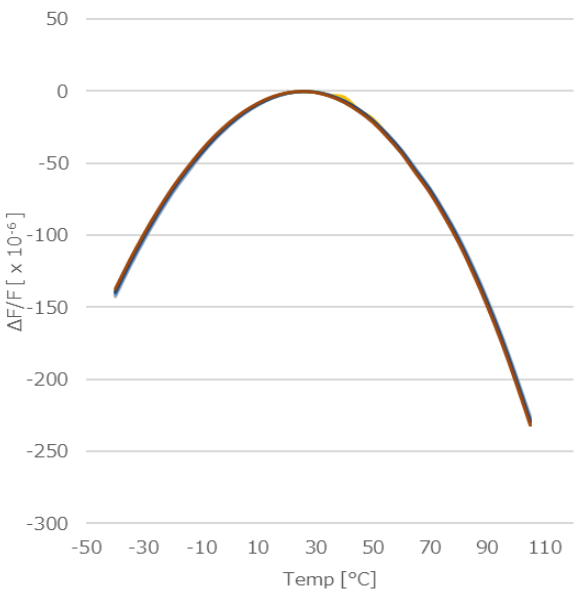
[4] Static Characteristics

Item	Symbol	Specifications	Unit	Condition / Remarks
Nominal frequency range	f_nom	32.768	kHz	
Frequency tolerance	f_tol	±20	$x10^{-6}$	T_use = +25 °C ± 3 °C DL = 0.1 µW Does not include frequency aging
Turnover temperature	Ti	+25 ± 5	°C	
Parabolic coefficient	B	-0.04 Max.	$x10^{-6}$ / °C^2	
Motional resistance (ESR)	R1	35 Typ. (+25 °C)	kΩ	Measuring instrument: Keysight 4294A DL = 0.5 µW
		50 Max. (-40 °C to +85 °C)		
		60 Max. (-40 °C to +105 °C)		
Motional capacitance	C1	8.4 Typ.	fF	
Shunt capacitance	C0	1.6 Typ.	pF	
Load capacitance	CL	9, 12.5	pF	
Isolation resistance	IR	200 Min.	MΩ	
Frequency aging	f_age	±3	$x10^{-6}$	T_use = +25 °C, First year, DL = 0.1 µW

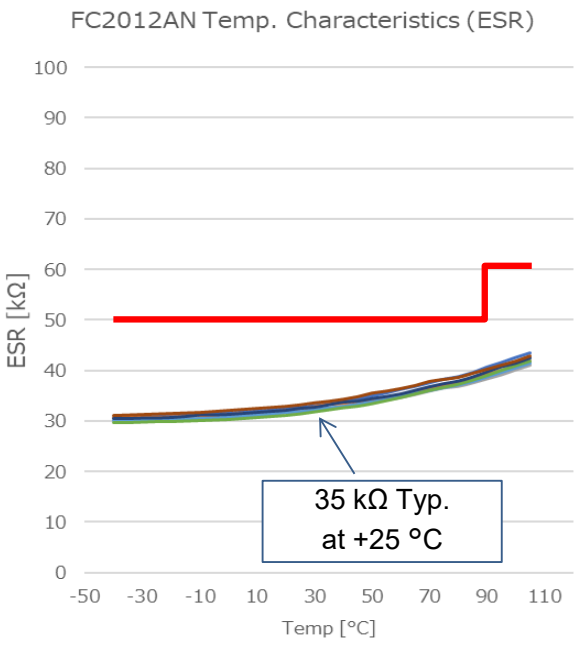
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[5] Frequency and ESR vs. Temperature Characteristics

n = 10



n = 10



[6] Marking Description

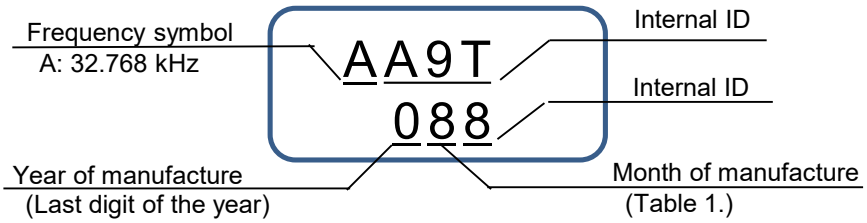
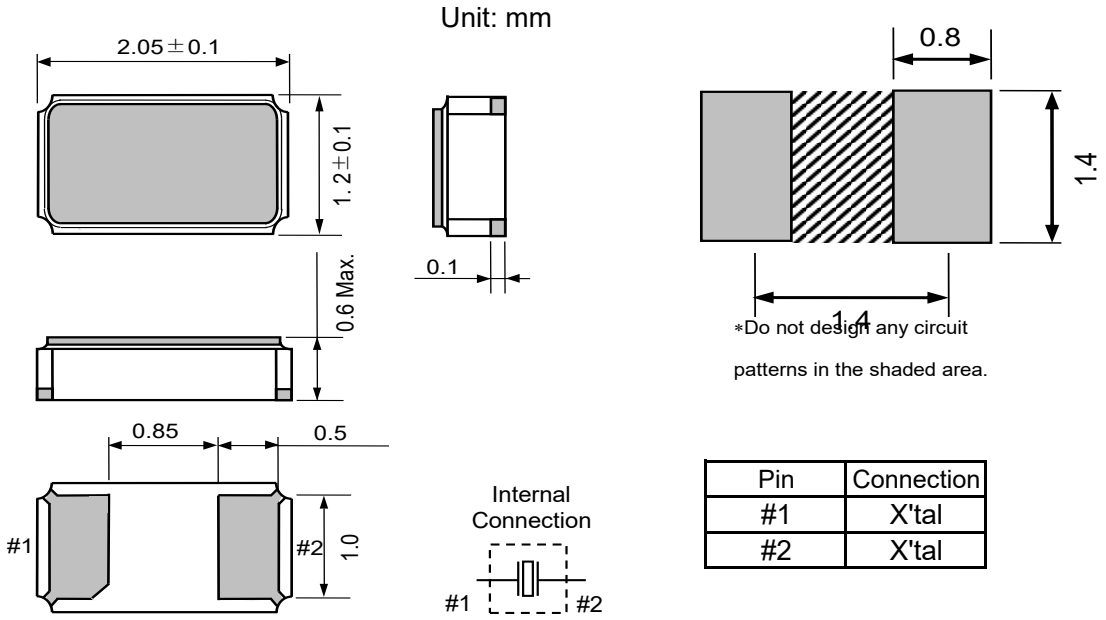


Table 1. Month of manufacture

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

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[7] Outline Drawing and Recommended Footprint



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

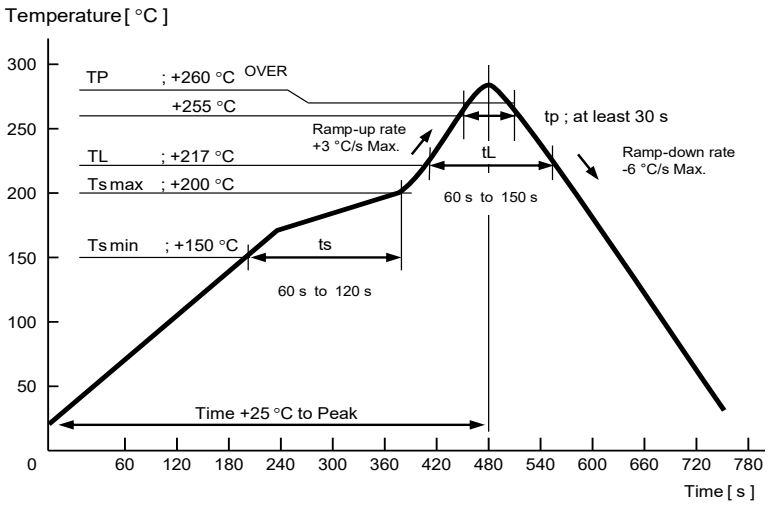
Reference weight Typ.: 4.3 mg

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)



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[10] Packing Information

(1) Packing Quantity

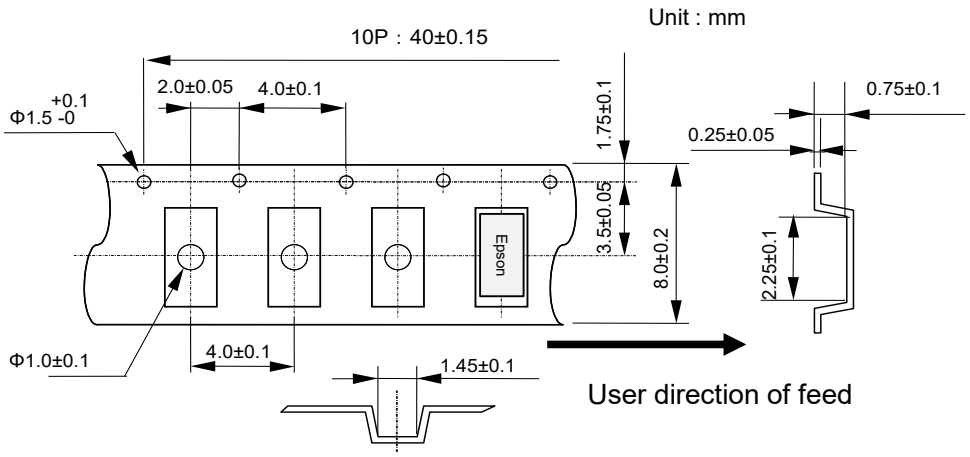
The last two digits of the Product Number (X1A000171xxxx18) are a code that defines the packing quantity
The standard is "18" for a 5 000 pcs/Reel.

(2) Taping Specification

Compliant to EIA-481, IEC 60286 and JIS C0806

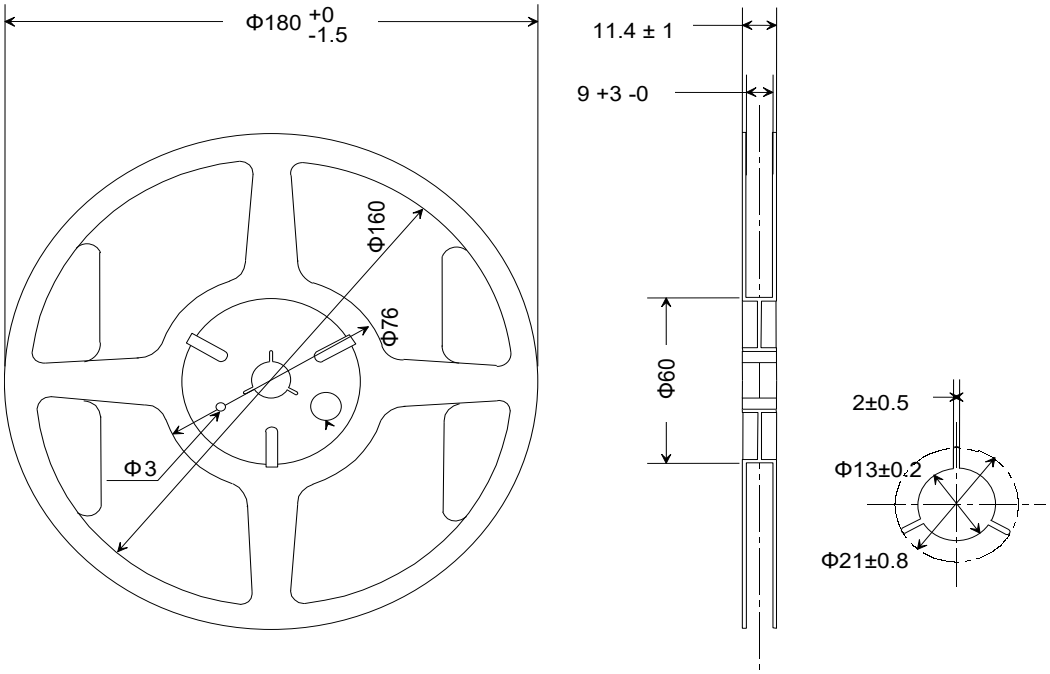
(2-1) Tape Dimensions

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)

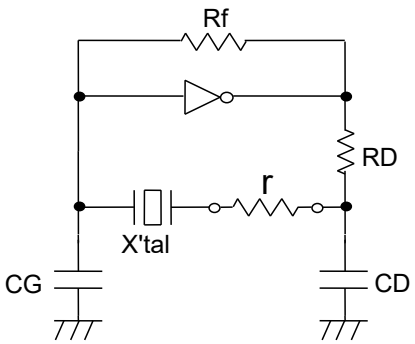


[11] Handling Precautions

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 ºC 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 + crystal unit series resistance value R1

Guideline for negative resistance |-R|:

|-R| > R1 Max. x 5

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

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