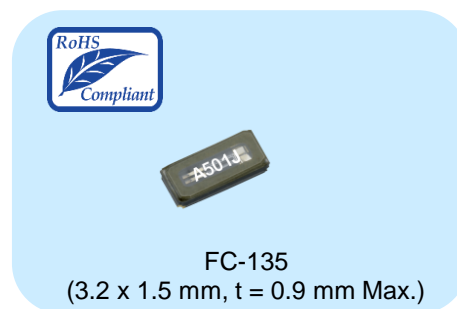


## 3.2 x 1.5 mm size 32.768 kHz Crystal Unit: FC-135

### Features

- Package size: 3.2 x 1.5 mm, t = 0.9 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 +85 °C  
(-40 °C to +105 °C) Please contact Epson
- ESR: 70 k $\Omega$  Typ.



### Applications

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

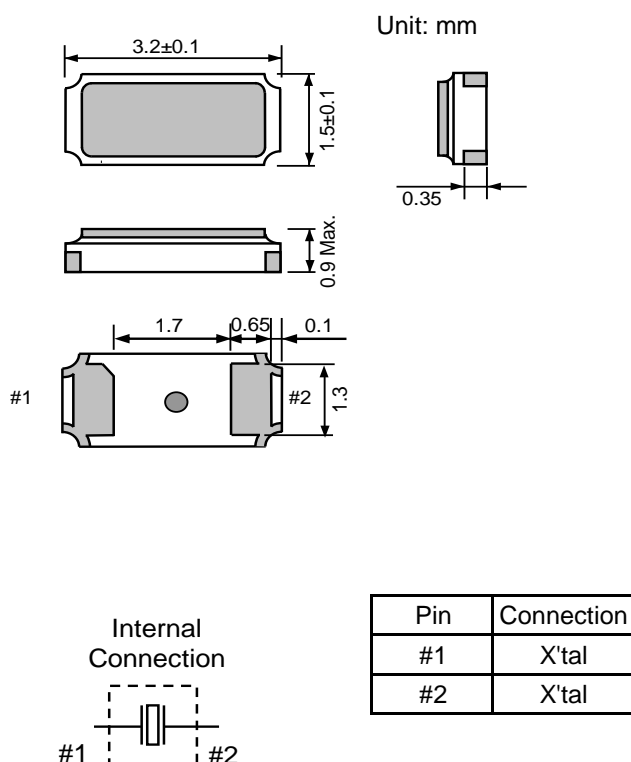
### Description

The FC-135 is a widely adopted 32.768 kHz crystal unit that has been used worldwide since its release in 2002.

Ideal for MCU sub-clocks and modules from consumer devices to industrial equipment applications. For extended temperature range applications up to +105 °C, please contact Epson.

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.

### Outline Drawing and Terminal Assignment



## [ 1 ] Product Number / Product Name

(1-1) Product Number

Q13FC1350xxxx00 (Please contact Epson for details)

(1-2) Product Name (Standard Form)

FC-135 32.768000kHz 12.5 +20.0-20.0

① ② ③ ④

①Model ②Frequency ③Load capacitance (pF) ④Frequency 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	1.0	μW	Not destroyed

## [ 3 ] Operating Conditions

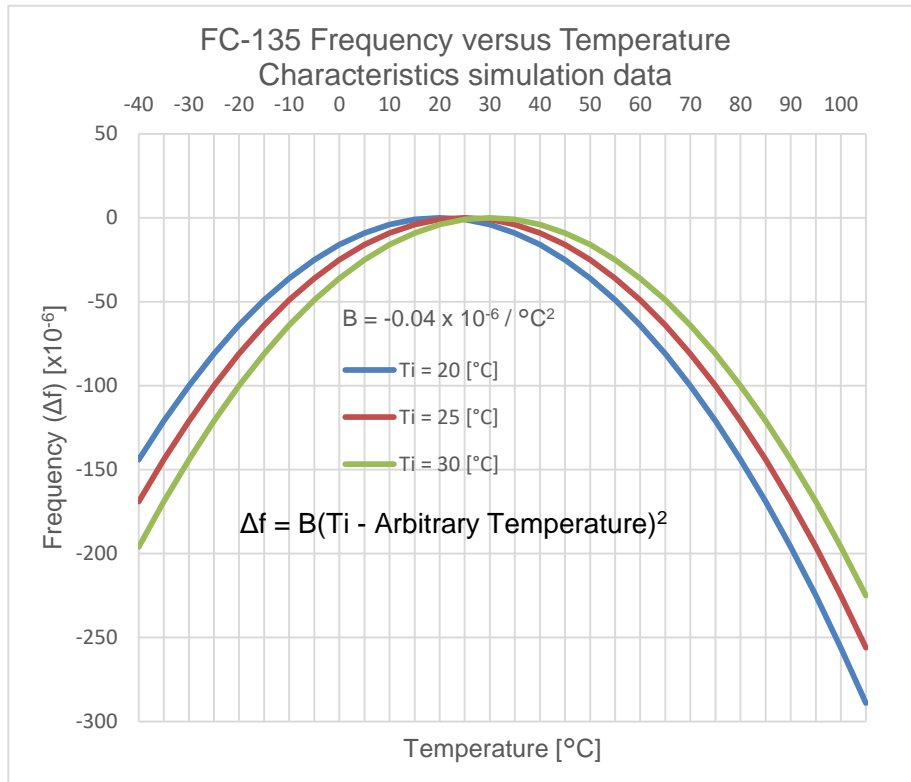
Item	Symbol	Rating value			Unit	Note
		Min.	Typ.	Max.		
Operating temperature range	T_use	-40	-	+85	°C	Please contact Epson
		-40	-	+105		
Level of drive	DL	0.01	0.1	0.5	μW	Please contact Epson
		0.01	0.5	1.0		

## [ 4 ] Static Characteristics

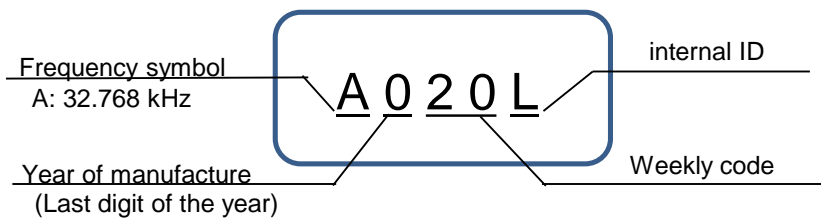
Item	Symbol	Specifications	Unit	Condition / Remarks
Nominal frequency range	f_nom	32.768	kHz	
Frequency tolerance	f_tol	±20	$\times 10^{-6}$	T_use = +25 °C ± 3 °C DL = 0.1 μW Does not include frequency aging
Turnover temperature	Ti	+25 ± 5	°C	
Parabolic coefficient	B	-0.04 Max.	$\times 10^{-6} / ^\circ\text{C}^2$	
Motional resistance (ESR)	R1	70 Typ.	kΩ	Measuring instrument: Saunders: 140-B CI meter DL = 0.5 μW
Motional capacitance	C1	3.4 Typ.	fF	
Shunt capacitance	C0	1.0 Typ.	pF	
Load capacitance	CL	7, 9, 12.5	pF	Please specify
Isolation resistance	IR	500 Min.	MΩ	
Frequency aging	f_age	±3 Max	$\times 10^{-6}$	T_use = +25 °C, DL = 0.1 μW First year

## [ 5 ] Frequency versus Temperature Characteristics

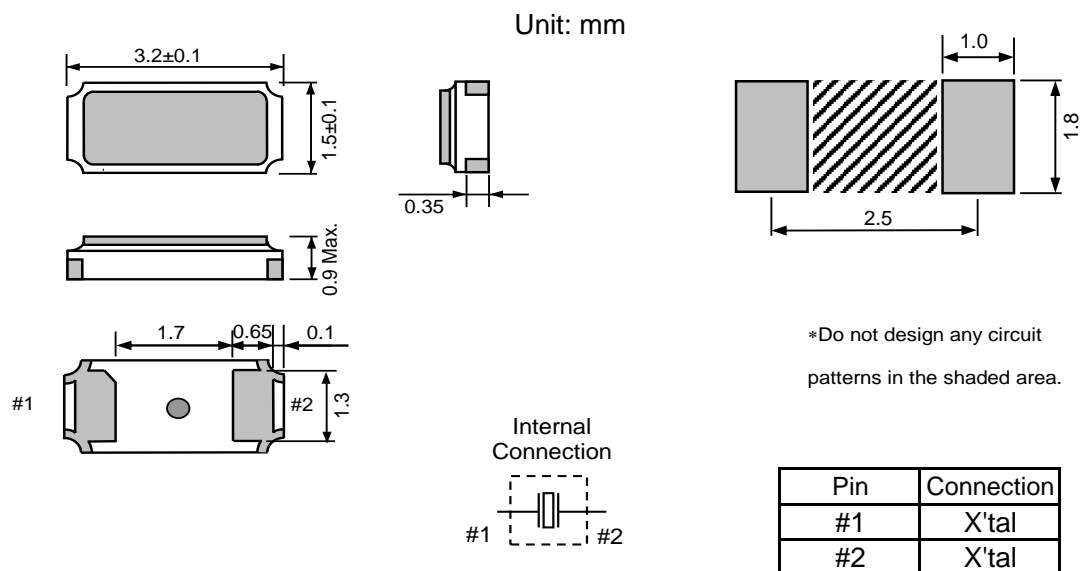
Simulation data



## [ 6 ] Marking Description



[ 7 ] Outline Drawing and Recommended Footprint



Reference weight Typ.: 11 mg

Terminal coating: Au plating

[ 8 ] Moisture Sensitivity Level

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

[ 9 ] Reflow Profile

(1) Standard profile (Type. E)

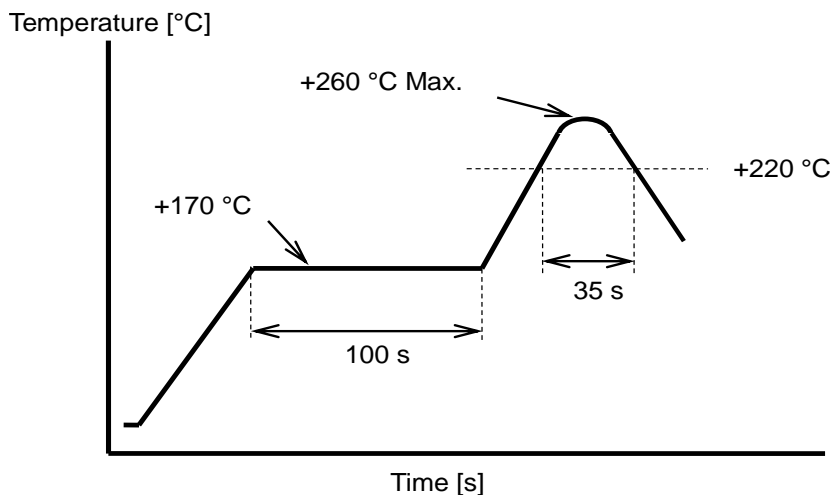
Conditions of hot air convection reflow

Pre heating temperature: +170 °C

Pre heating time: 100 s

Heating temperature: +220 °C

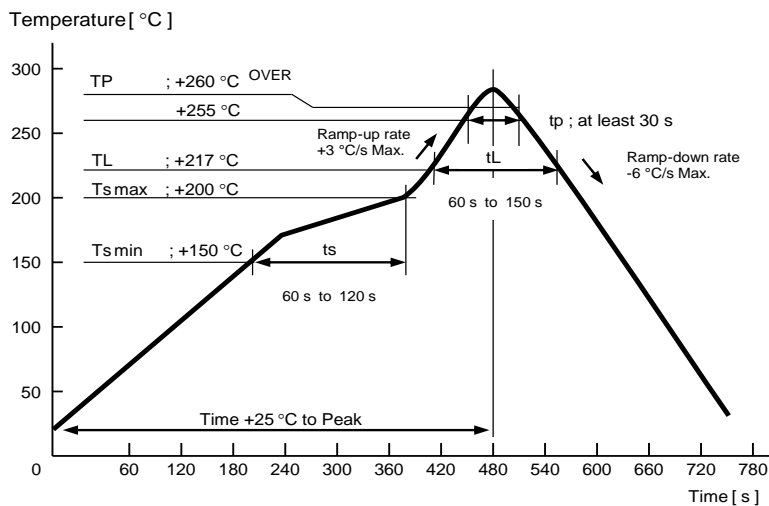
Heating time: 35 s



(2) Optional profile (IPC/JEDEC J-STD-020D.1)

Note: For the option, the shift amount in the reliability test is different.

Please contact Epson for details



## [ 10 ] Packing Information

## (1) Packing Quantity

The last two digits of the Product Number (Q13FC1350xxxx00) are a code that defines the packing quantity.  
The standard is "00" for a 3 000 pcs/Reel.

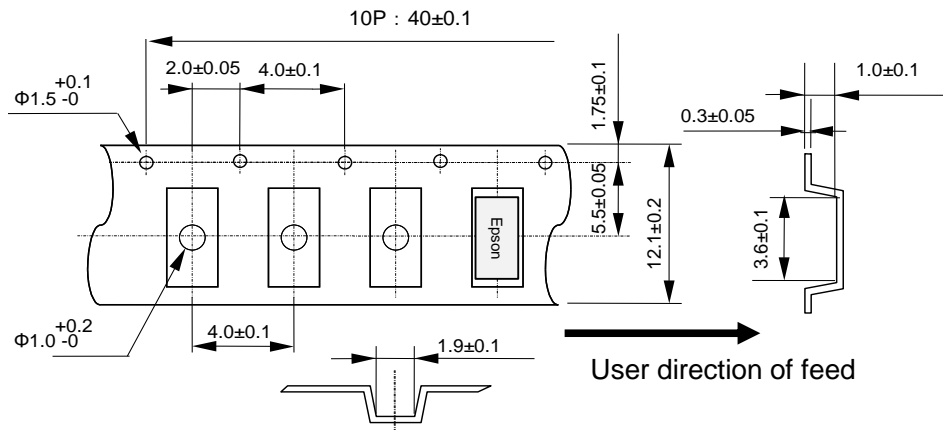
## (2) Taping Specification

Compliant to EIA-481, IEC 60286 and JIS C0806

## (2-1) Tape Dimensions

Carrier Tape Material : PS (Polystyrene)

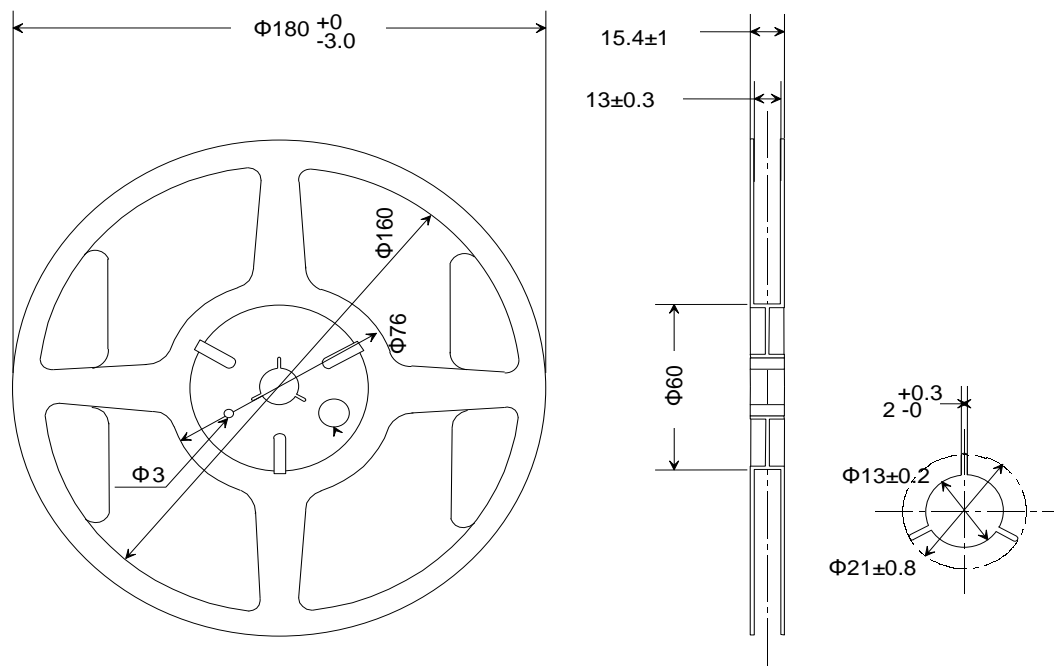
Top Tape Material : PET (Polyethylene Terephthalate) +PE (Polyethylene)



## (2-2) Reel Dimensions

Center Material : PS (Polystyrene)

Reel Material : PS (Polystyrene)



## [ 11 ] Handling Precautions

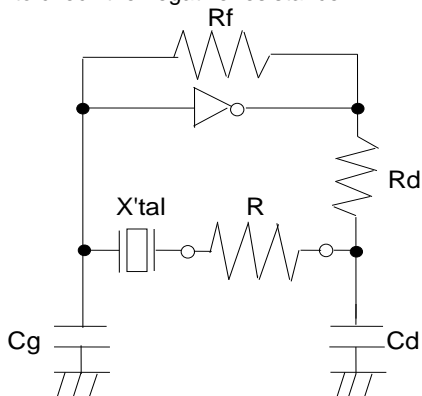
Prior to using this product, please carefully read the section entitled "Precautions" on our Web site (<https://www5.epsondevice.com/en/information/#precaution>) for instructions on how to handle and use the product properly to ensure optimal performance of the product in your system.

Before using the product under any conditions other than those specified therein, please consult with us to verify and confirm that the performance of the product will not be negatively affected by usage under such conditions.

In addition to the foregoing precautions, in order to avoid the deteriorating performance of the product, we strongly recommend that you DO NOT use the product under ANY of the following conditions:

1. This product should be reflowed no more than 3 times. If rework is needed after reflow, please correct it with a soldering iron with the tip set for a temperature of +350 ° C or less and only contact each terminal once and for no more than 5 seconds. If this product is mounted on the bottom of the board during a reflow please check that it soldered down properly afterwards.
2. This product can be damaged by mechanical shock during the soldering process depending on the equipment used, process conditions, and any impact forces experienced. Always follow appropriate procedures, particularly when changing the assembly process in anyway and be sure to follow applicable process qualification standards before starting production.
3. Product failures during the warranty period only apply when the product is used according to the recommended operating conditions described in the specifications. Products that have been opened for analysis or damaged will not be covered. It is recommended to store and use in normal temperature and humidity environments described in the specifications to ensure frequency accuracy and prevent moisture condensation. If the product is stored for more than one year, please confirm the pin solderability prior to use.
4. Keep PCB routing from the output terminal(s) to the load as short as possible for best performance.
5. The use of ultrasonic technology for cleaning, bonding, etc. can damage the Xtal unit inside this product. Please carefully check for this consideration before using ultrasonic equipment for volume production with this product.
6. If the oscillation circuit is exposed to condensation, the frequency may change or oscillation may stop. Do not use in any conditions where condensation occurs.
7. If an excessive excitation is applied to the crystal unit, the characteristics may be degraded or destruction may occur. Design the oscillation circuit so that the excitation level is appropriate.
8. Depending on the method and conditions used to measure characteristic values such as frequency, deviation from our measured values may occur. Please check and verify the characteristics before use.
9. Do not route any signal lines, supply voltage lines, or GND lines underneath the area where the oscillators are mounted including any internal layers and on the opposite side of the PCB. To avoid any issues due to interference of other signal lines, please take care not to place signal lines near the product as this may have an adverse affect on the performance of the product.
10. If sufficient negative resistance is not provided by the oscillation circuit, the Xtal may not oscillate or take a long time to start. Please design the circuit as follows:

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) per instruction in (2) above.
- (4) Get the negative resistance  
 $-R = R + R1$  value.
- (5) Recommended -R  
 $-R > R1 \times 5$

## 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 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.

### ■ Explanation of marks used in this datasheet



#### ●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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