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(Specifications are subject to change without notice.)

Released in February 2019

# Quartz Crystal

## Product Catalogue



# Creating Time - Optimizing Time - Enriching Time

Seiko Instruments Inc. (SII), founded in 1937 as a member of the Seiko Group specializing in the manufacture of watches, has leveraged its core competency in high precision watches to create a wide range of new products and technologies.

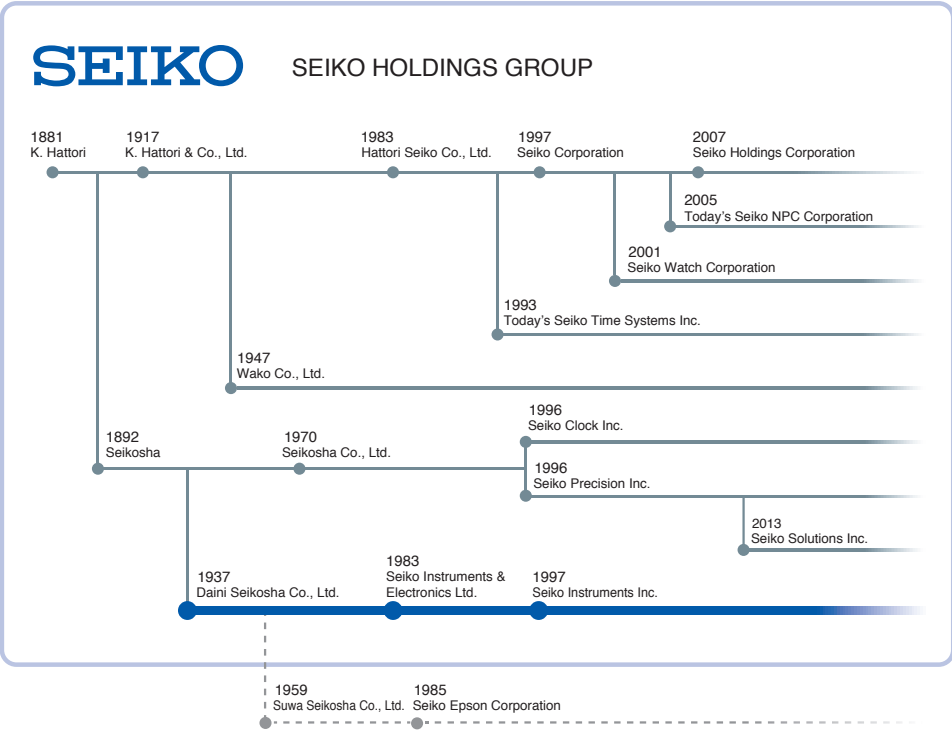
Over the years SII has developed high-precision processed parts and machine tools that pride themselves on their sub-micron processing capability, quartz crystals that came about as a result of our quartz watch R&D, and electronic components such as micro batteries. Optimizing our extensive experience and expertise, we have since diversified into such new fields as compact, lightweight, exceedingly quiet thermal printers, and inkjet printheads, a key component in wide format inkjet printers for corporate use.

SII, in the years to come, will maintain an uncompromised dedication to its time-honored technologies and innovations of craftsmanship, miniaturization, and efficiency that meet the needs of our changing society and enrich the lives of those around us.



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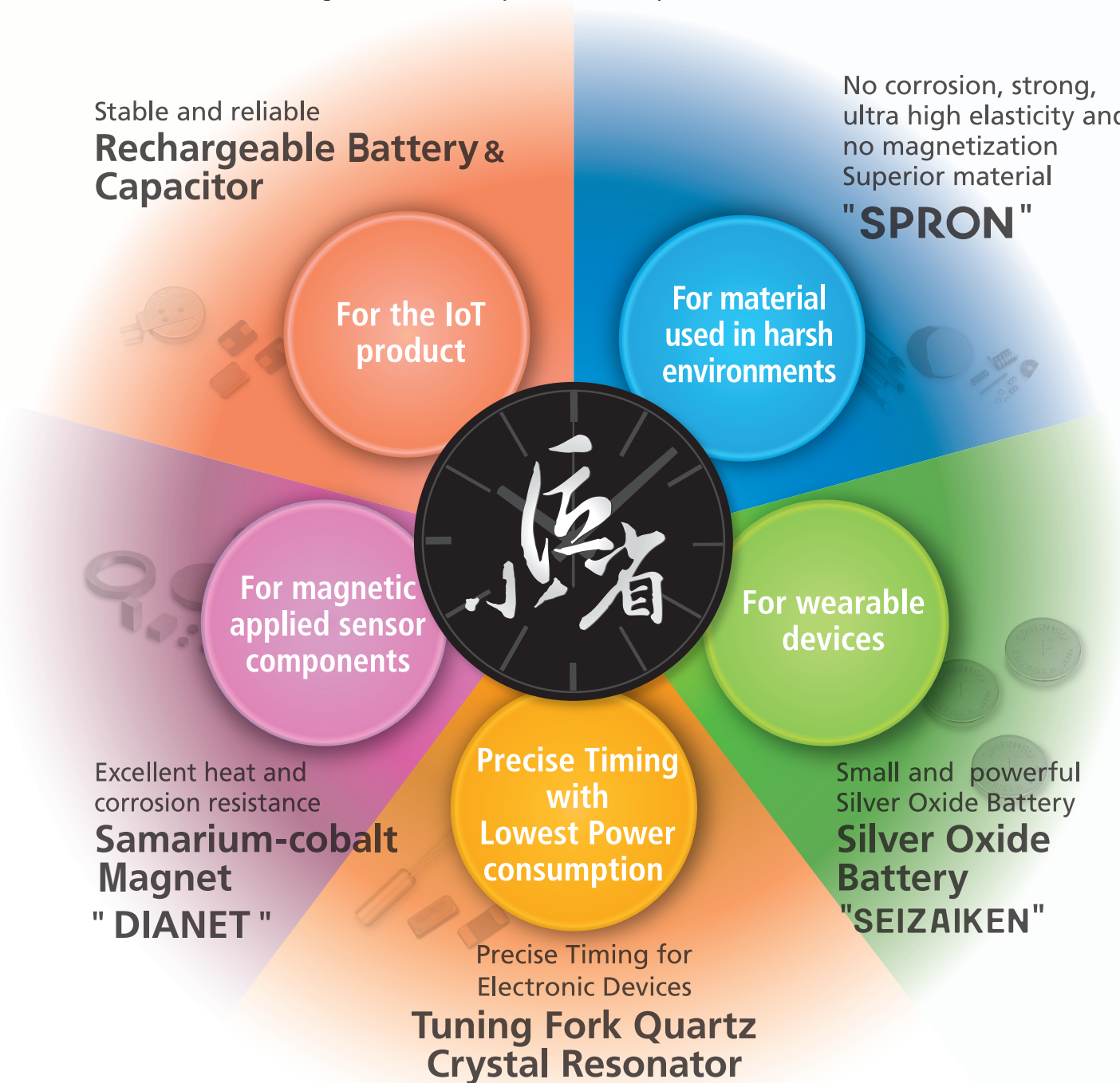


## Product Introduction

# PRECISION, CRAFTSMANSHIP and MINIATURIZATION

## Leveraging Watch Making Technology

🕒 With Precision, we apply our Craftsmanship to provide Miniaturization advantages to customers' product development around the world.



## Electronic Components and High-performance Materials

SII's electronic components were originally derived from the development and manufacturing of quartz watches.



Since 1953

No corrosion, strong,  
ultra high elasticity  
Co-Ni alloy product

"SPRON"

The sophisticated metal product, "SPRON", was born as a material to be used in a "mainspring", which is a drive source of mechanical watches. "SPRON" has been used for over 50 years as a drive source of watches by utilizing its high elasticity, high strength, and high heat resistance. Evaluated highly for its corrosion resistance and durable quality, "SPRON" is used for key devices in various fields like valves in semiconductor manufacturing equipment and dental treatment devices.



Since 1975

Small and powerful  
Silver Oxide Battery  
"SEIZAIKEN"

A small-sized primary battery that features a large electrical capacity and almost no voltage drop until the last stage of electrical discharge even though its minimum diameter is 4 mm. Since the birth of quartz watches, we have developed batteries to increase their electrical capacity. We have also pursued better leakage resistance and long term reliability characteristics. It is expected to be used as a power supply for disposable, wearable, IoT, and the low energy Bluetooth products.



Since 1976

Precise Timing for  
Electronic Devices  
Tuning Fork Quartz  
Crystal Resonator

Tuning Fork Quartz Crystal Resonators were developed as the basis for accuracy in the Quartz Watch. Our high quality and reliability was prioritized to meet the stringent requirements for watches. Recent demand in IoT developments where devices are required to operate with low power consumption and accurate communication protocol timing have increased the demand for smaller components with the same rugged reliability as is required in watches. For applications which require absolute lowest power consumption, our Timing Crystals are available in our Low CL specifications.



Since 1979

Excellent heat and  
corrosion resistance  
Samarium-cobalt  
Magnet  
"DIANET"

"DIANET", which has its origin in rotor magnets of quartz watches, has superior heat resistance and strong magnetic force even though its outside diameter is only 1 mm or less. The Sendai Unit acquired IATF 16949 Quality Management System for the automotive production industry. "DIANET" is used for a wide range of automotive products, and its advanced quality and performance are highly recognized. In addition, "DIANET" is also used in actuators of cameras for smart phones and medical devices.



Since 1988

Stable and reliable  
Rechargeable Battery  
and Capacitor

The rechargeable batteries supporting a wide temperature range of -40°C to 85°C are available in our lineup. They are suitable for operating very low power consumption devices, for backup power supply of clock and memory functions of a wide range of products. The capacitor will correspond to the new needs of energy harvesting devices. Capacitors are extremely useful in various applications.









# Quartz Crystal Products

With Precision, we apply our Craftsmanship to provide Miniaturization advantages to customers' developed products around the world.

## Features

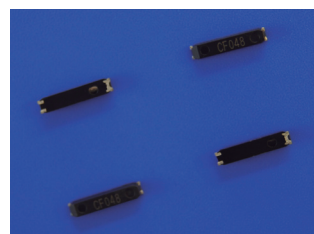
- Mirror finishing wafer processing technology
- Manufacturing capacity for expanded wafer processing
- Largest Quartz wafer in the industry
- Extensive experience and manufacturing knowledge for Quartz tuning fork crystals

## SMD type Quartz Crystal Resonator (Ceramic package)

Line up		Size (mm)	Frequency Tolerance (ppm) (%)	Parabolic Coefficient (10 <sup>-6</sup> /°C <sup>2</sup> )	Load Capacitance (pF)	Motional Resistance (kΩ)	Operating Temp. (°C)	Storage Temp. (°C)	Remarks
SC-32S		3.2x1.5x0.85	±20	(-0.030±10%)	6, 7, 9, 12.5	70	-40 to +85	-55 to +125	
SC-32P		3.2x1.5x0.85	±20	(-0.033±10%)	6, 7, 9, 12.5	50	-40 to +85	-55 to +125	Low ESR type
SC-32A		3.2x1.5x0.85	±20	(-0.030±10%)	6, 7, 9, 12.5	70	-55 to +125	-55 to +125	For automotive use
SC-20S		2.0x1.2x0.60	±20	(-0.030±10%)	6, 7, 9, 12.5	70	-40 to +85	-55 to +125	
SC-20T		2.0x1.2x0.35	±20	(-0.033±10%)	6, 7, 9, 12.5	75	-40 to +85	-55 to +125	Low height 2 terminals / 4 terminals
SC-20A		2.0x1.2x0.60	±20	(-0.030±10%)	6, 7, 9, 12.5	90	-55 to +125	-55 to +125	For automotive use
SC-16S		1.6x1.0x0.50	±20	(-0.036±10%)	6, 7, 9, 12.5	90	-40 to +85	-55 to +125	
SC-12S		1.2x1.0x0.50	±20	(-0.036±10%)	6, 7, 9, 12.5	90	-40 to +85	-55 to +125	2 terminals / 4 terminals

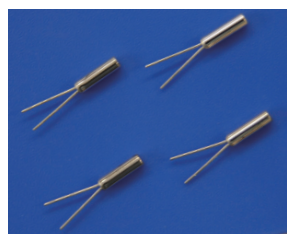
\* Please contact us and specify your requirements.

## SMD type Quartz Crystal Resonator (Plastic mold)




SSP-T7-F  
SSP-T7-FL

## Cylinder type Quartz Crystal Resonator



VT-200-F  
VT-200-FL  
VT-150-F  
VT-120-F  
VTC-120-F

## SMD type Crystal Oscillator (Ceramic package)

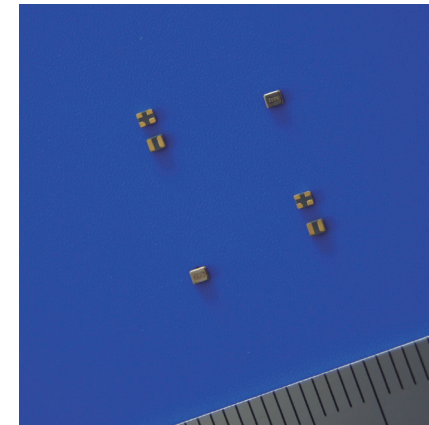
Line up		Size (mm)	Frequency tolerance (ppm)	Frequency temperature coefficient -40 to +85°C (ppm)	Current consumption Typ. (μA)	Supply voltage (V)	Temperature Compensated voltage (V)	Operating Temp. (°C)
SH-32S		3.2x1.5x0.9	±3	±50	1.0	1.3 to 5.5	2.0 to 5.5	-40 to +85

## Application



# Ceramic package

## SC-12S



## FEATURES

- Ultra small size package (1.2 × 1.0 × 0.5mm max.).
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

## APPLICATIONS

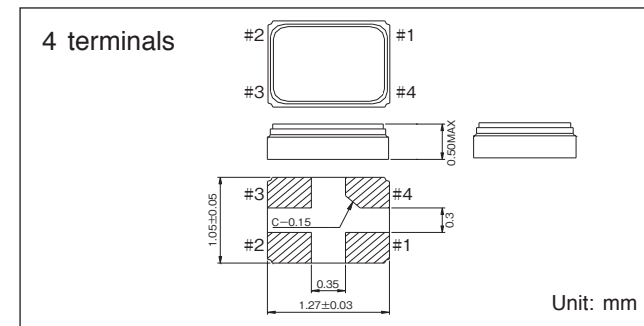
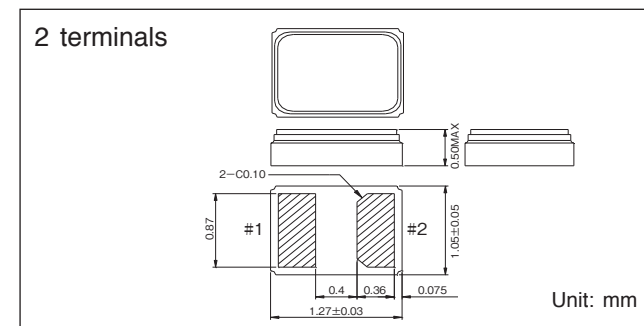
Mobile Phone, Wearable, Module, Sub-clock function for a variety of Microcontroller, etc.

## STANDARD SPECIFICATIONS

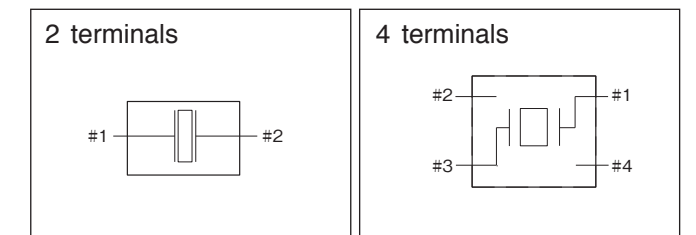
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications		Conditions / Notes
		2 terminals	4 terminals	
Nominal Frequency	f_nom	32.768kHz		
Frequency Tolerance	f_tol	±20×10 <sup>-6</sup>		* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C		
Parabolic Coefficient	B	(-0.036±10%) × 10 <sup>-6</sup> /°C <sup>2</sup>		
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF		* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	90kΩ max.		
Absolute Maximum Drive Level	DLmax.	0.3μW max.		
Level of Drive	DL	0.1μW typ.		
Shunt Capacitance	C <sub>0</sub>	1.4pF typ.		
Frequency Ageing	f_age	±5×10 <sup>-6</sup>		+25±3°C, First Year
Operating Temperature	T_use	-40°C to +85°C		
Storage Temperature	T_stg	-55°C to +125°C		Storage as single product

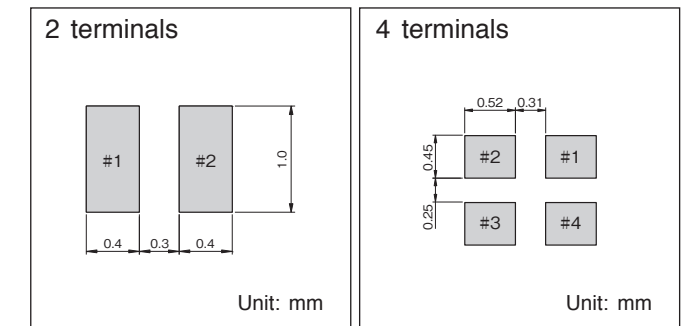
## DIMENSIONS



## INTERNAL LEAD CONNECTION



## RECOMMENDED SOLDERING PATTERN

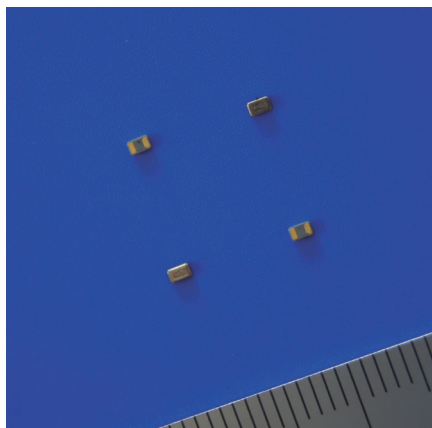


**Remark** Please make sure there is no pattern under SC-12S on the circuit board.



# Ceramic package

## SC-16S



### FEATURES

- SMD type suitable for high density surface mounting.
- Thin type with height 0.5mm max.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

### APPLICATIONS

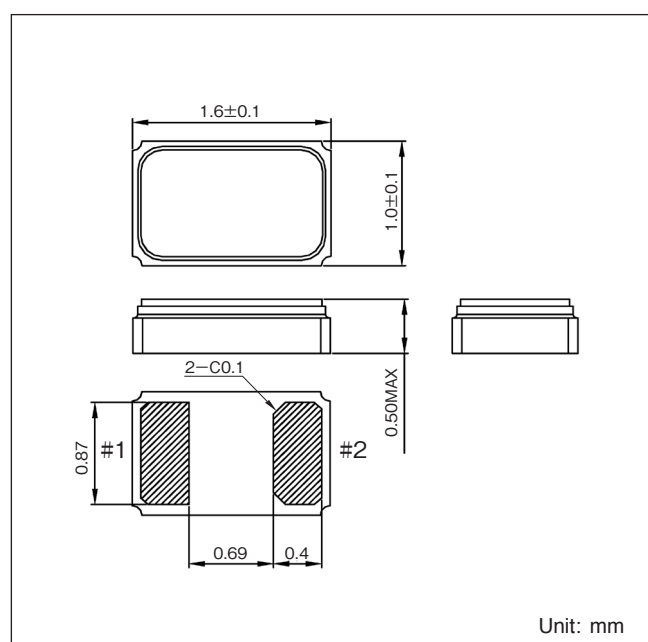
Mobile Phone, Wearable, Module, Sub-clock function for a variety of Microcontroller, etc.

### STANDARD SPECIFICATIONS

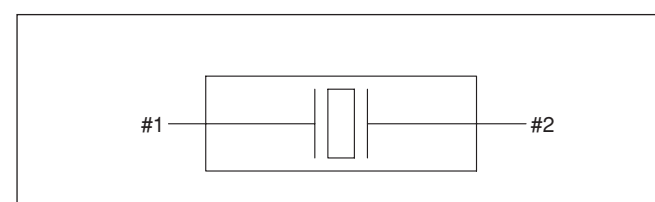
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f <sub>nom</sub>	32.768kHz	
Frequency Tolerance	f <sub>tol</sub>	±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	T <sub>i</sub>	+25±5°C	
Parabolic Coefficient	B	(-0.036±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	90kΩ max.	
Absolute Maximum Drive Level	DL <sub>max.</sub>	0.5μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	1.2pF typ.	
Frequency Ageing	f <sub>age</sub>	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T <sub>use</sub>	-40°C to +85°C	
Storage Temperature	T <sub>stg</sub>	-55°C to +125°C	Storage as single product

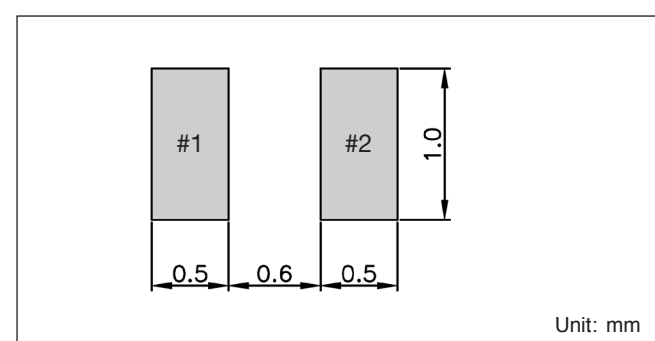
### DIMENSIONS



### INTERNAL LEAD CONNECTION



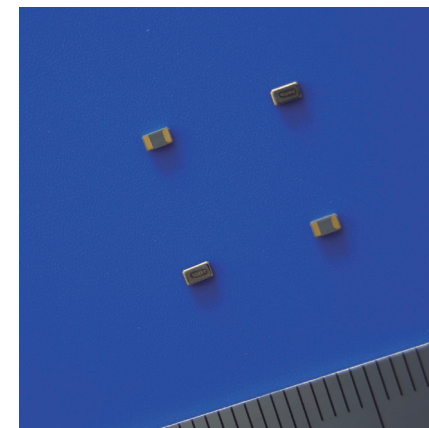
### RECOMMENDED SOLDERING PATTERN



**Remark** Please make sure there is no pattern under SC-16S on the circuit board.

# Ceramic package

## SC-20S



### FEATURES

- Thin type with height 0.6mm max.
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

### APPLICATIONS

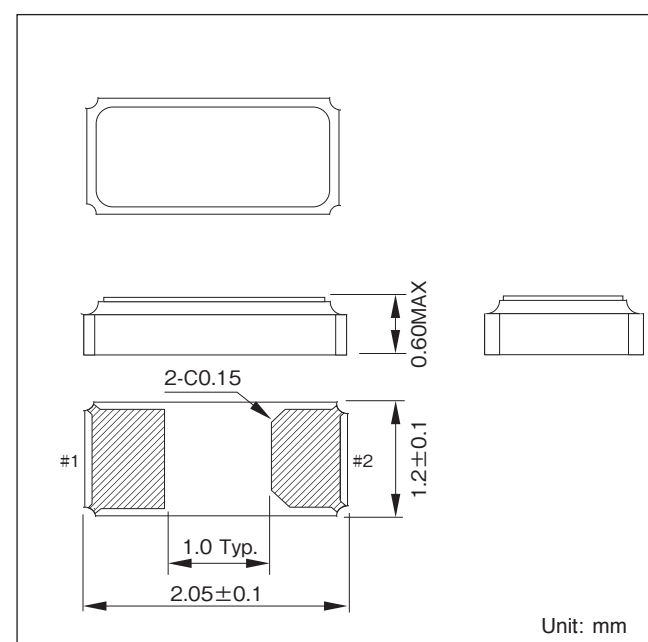
Mobile Phone, Wearable, Module, Sub-clock function for a variety of Microcontroller, etc.

### STANDARD SPECIFICATIONS

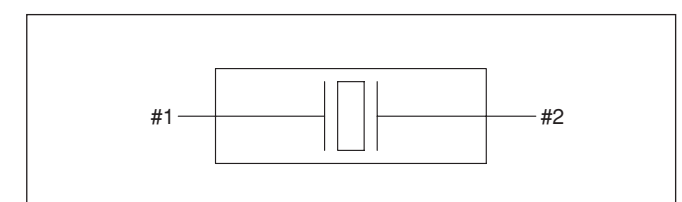
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f <sub>nom</sub>	32.768kHz	
Frequency Tolerance	f <sub>tol</sub>	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	T <sub>i</sub>	+25±5°C	
Parabolic Coefficient	B	(-0.030±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	70kΩ max.	
Absolute Maximum Drive Level	DL <sub>max.</sub>	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	1.3pF typ.	
Frequency Ageing	f <sub>age</sub>	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T <sub>use</sub>	-40°C to +85°C	
Storage Temperature	T <sub>stg</sub>	-55°C to +125°C	Storage as single product

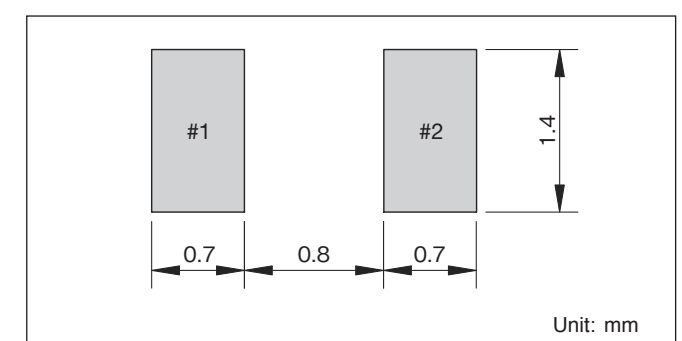
### DIMENSIONS



### INTERNAL LEAD CONNECTION



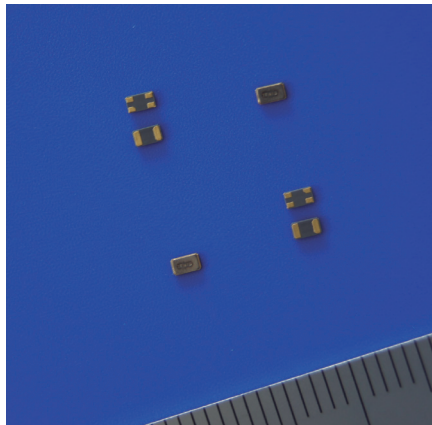
### RECOMMENDED SOLDERING PATTERN



**Remark** Please make sure there is no pattern under SC-20S on the circuit board.

# Ceramic package

## SC-20T



### FEATURES

- Ultra thin type with height 0.35mm max.
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

### APPLICATIONS

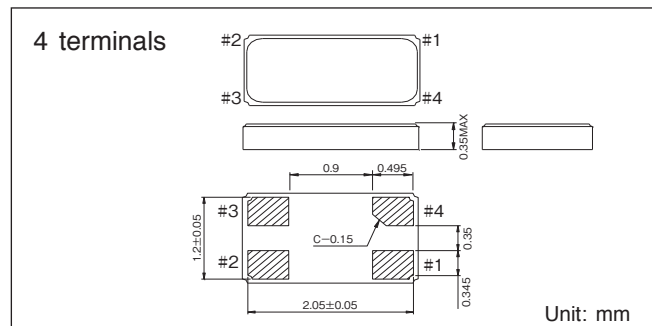
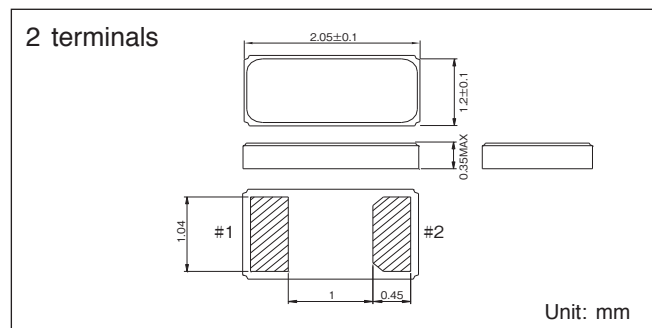
Smart card, Wearable, Module, Sub-clock function for a variety of Microcontroller, etc.

### STANDARD SPECIFICATIONS

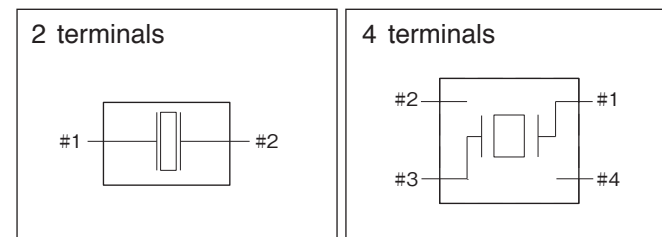
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications		Conditions / Notes
		2 terminals	4 terminals	
Nominal Frequency	f_nom	32.768kHz		
Frequency Tolerance	f_tol	±20×10 <sup>-6</sup>		* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C		
Parabolic Coefficient	B	(−0.033±10%)×10 <sup>-6</sup> /°C <sup>2</sup>		
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF		* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>i</sub>	75kΩ max.		
Absolute Maximum Drive Level	DLmax.	1.0μW max.		
Level of Drive	DL	0.1μW typ.		
Shunt Capacitance	C <sub>0</sub>	1.0pF typ.	0.8pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>		+25±3°C, First Year
Operating Temperature	T_use	−40°C to +85°C		
Storage Temperature	T_stg	−55°C to +125°C		Storage as single product

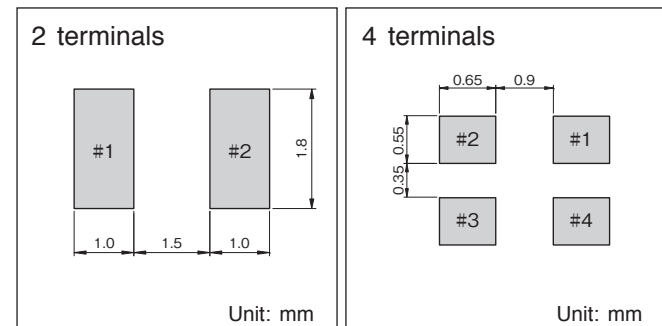
### DIMENSIONS



### INTERNAL LEAD CONNECTION



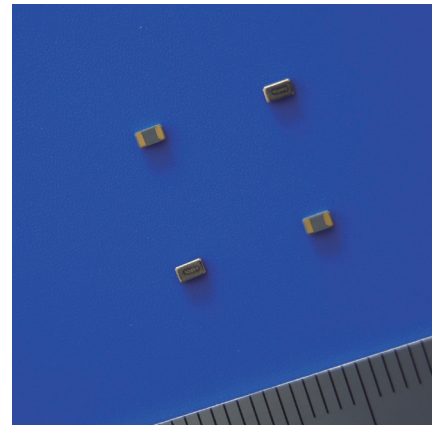
### RECOMMENDED SOLDERING PATTERN



**Remark** Please make sure there is no pattern under SC-20T on the circuit board.

# Ceramic package

## SC-20A (For automotive use)



### FEATURES

- Conforms to "AEC-Q200".
- Thin type with height 0.6mm max.
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

### APPLICATIONS

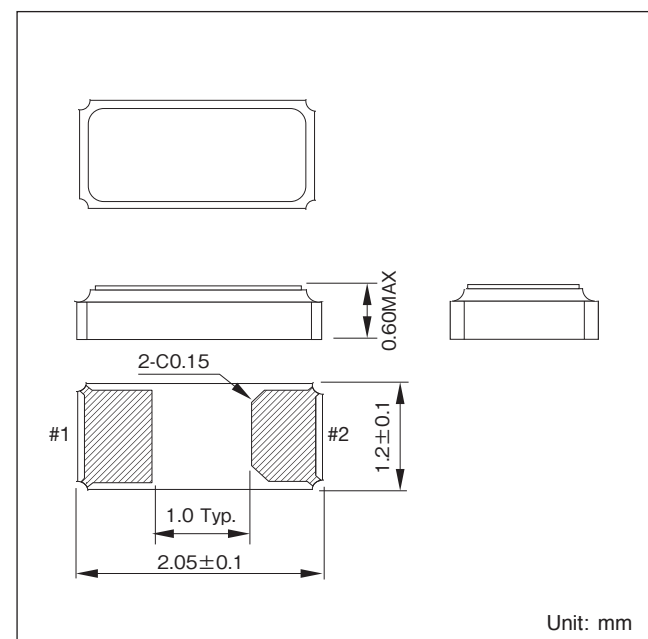
Car Audio, Car Navigation, ECU sub-clock, In-vehicle clock etc.

### STANDARD SPECIFICATIONS

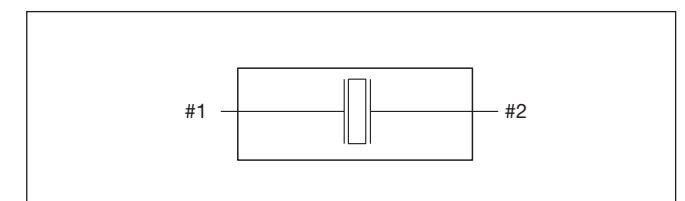
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(−0.030±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>i</sub>	90kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	1.3pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	−55°C to +125°C	
Storage Temperature	T_stg	−55°C to +125°C	Storage as single product

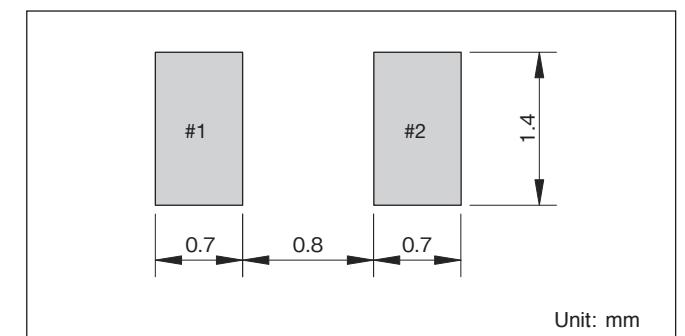
### DIMENSIONS



### INTERNAL LEAD CONNECTION



### RECOMMENDED SOLDERING PATTERN

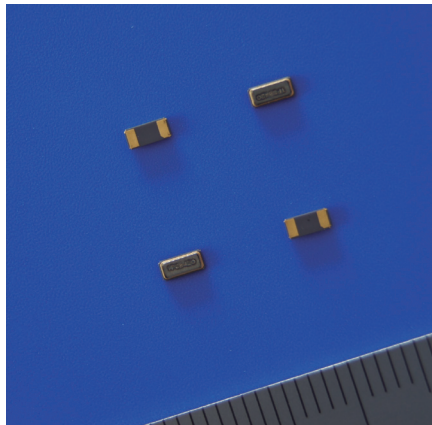


**Remark** Please make sure there is no pattern under SC-20A on the circuit board.



## Ceramic package

### SC-32S



#### FEATURES

- Thin type with height 0.85mm max.
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

#### APPLICATIONS

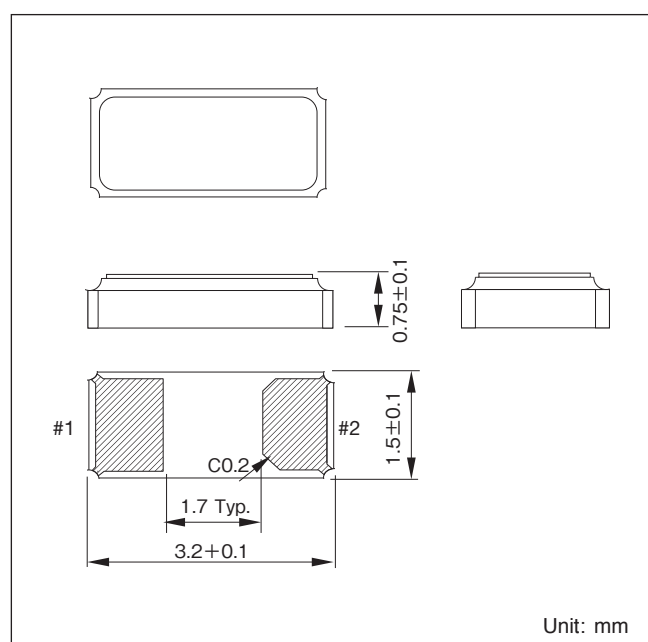
Mobile Phone, Wearable, Module, Sub-clock function for a variety of Microcontroller, etc.

#### STANDARD SPECIFICATIONS

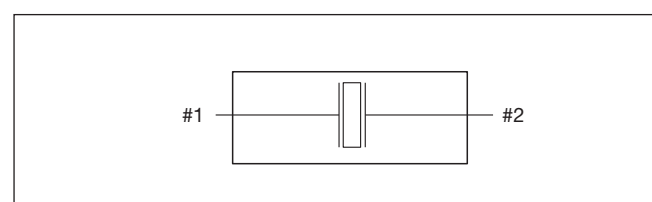
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz    38.4kHz	
Frequency Tolerance	f_tol	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.030±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	70kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	1.0pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-40°C to +85°C	
Storage Temperature	T_stg	-55°C to +125°C	Storage as single product

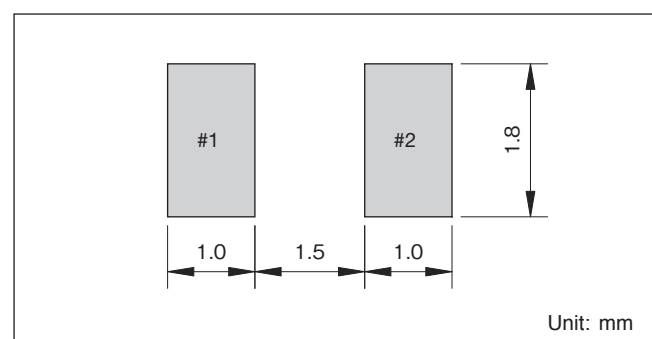
#### DIMENSIONS



#### INTERNAL LEAD CONNECTION



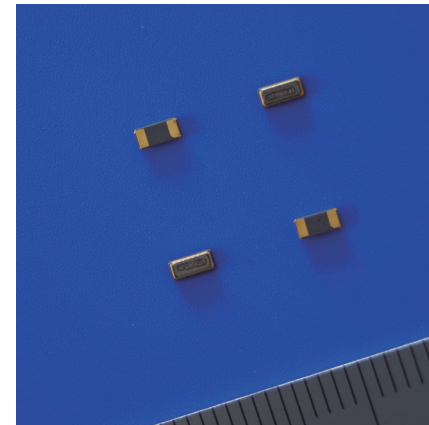
#### RECOMMENDED SOLDERING PATTERN



**Remark** Please make sure there is no pattern under SC-32S on the circuit board.

## Ceramic package

### SC-32A (For automotive use)



#### FEATURES

- Conforms to "AEC-Q200".
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

#### APPLICATIONS

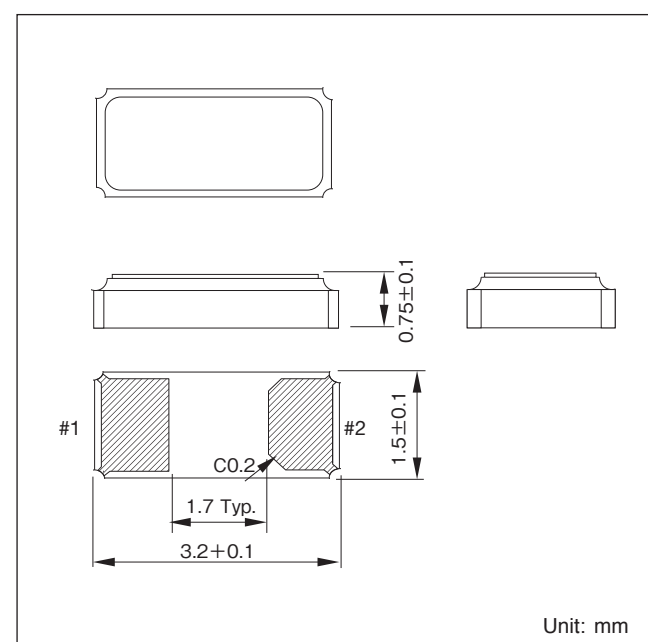
Car Audio, Car Navigation, ECU sub-clock, In-vehicle clock etc.

#### STANDARD SPECIFICATIONS

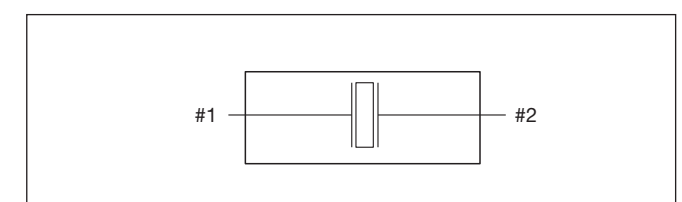
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.030±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	70kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	1.0pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-55°C to +125°C	
Storage Temperature	T_stg	-55°C to +125°C	Storage as single product

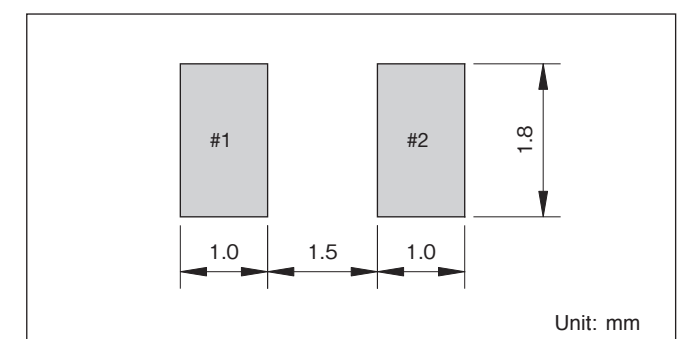
#### DIMENSIONS



#### INTERNAL LEAD CONNECTION



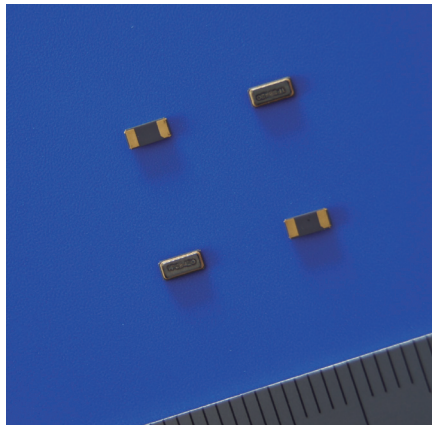
#### RECOMMENDED SOLDERING PATTERN



**Remark** Please make sure there is no pattern under SC-32A on the circuit board.

## Ceramic package

### SC-32P (R1=50kΩ max.) Low ESR Series



#### FEATURES

- Suitable for Microcontroller with Low ESR (R1=50kΩ max.).
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Pb-free.
- Complies with EU RoHS directive.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

#### APPLICATIONS

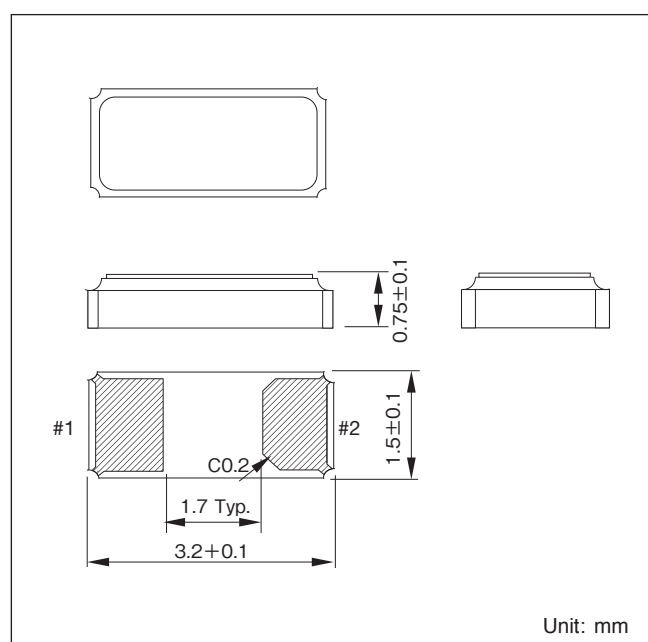
PC, Tablet, BLE Module, Wearable

#### STANDARD SPECIFICATIONS

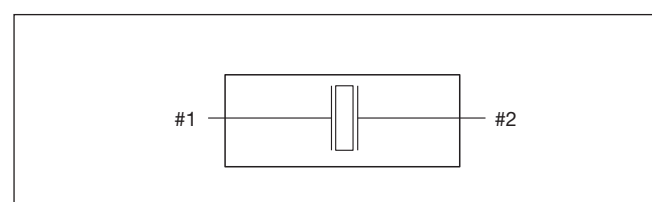
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.033±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	50kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	1.0pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-40°C to +85°C	
Storage Temperature	T_stg	-55°C to +125°C	Storage as single product

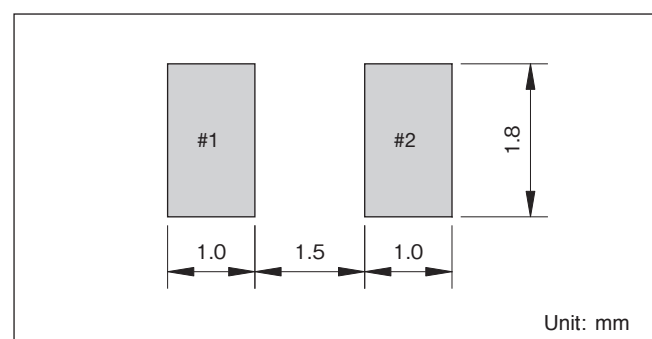
#### DIMENSIONS



#### INTERNAL LEAD CONNECTION



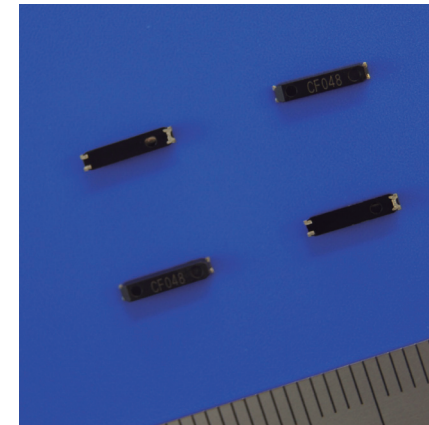
#### RECOMMENDED SOLDERING PATTERN



**Remark** Please make sure there is no pattern under SC-32P on the circuit board.

## Plastic mold

### SSP-T7-F



#### FEATURES

- Thin type with height 1.4mm max.
- SMD type suitable for high density surface mounting.
- Excellent shock and heat resistance.
- Complies with EU RoHS directive.
- Complete Halogen-free.
- Pb-free.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.

#### APPLICATIONS

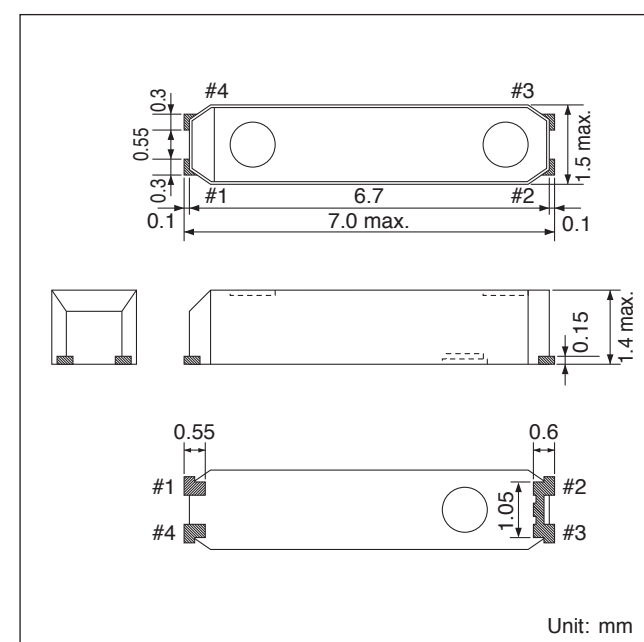
Mobile Phone, Wearable, Module, Sub-clock function for a variety of Microcontroller, etc.

#### STANDARD SPECIFICATIONS

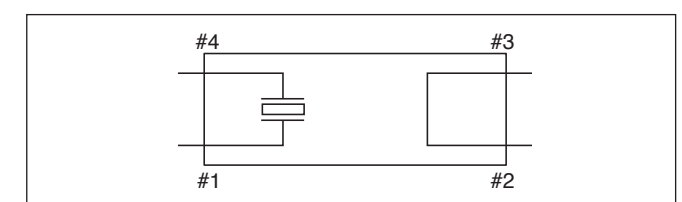
Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.033±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	65kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	0.9pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-40°C to +85°C	
Storage Temperature	T_stg	-55°C to +125°C	Storage as single product

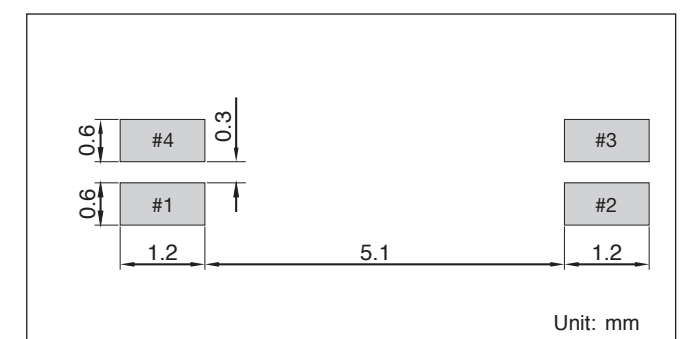
#### DIMENSIONS



#### INTERNAL LEAD CONNECTION



#### RECOMMENDED SOLDERING PATTERN

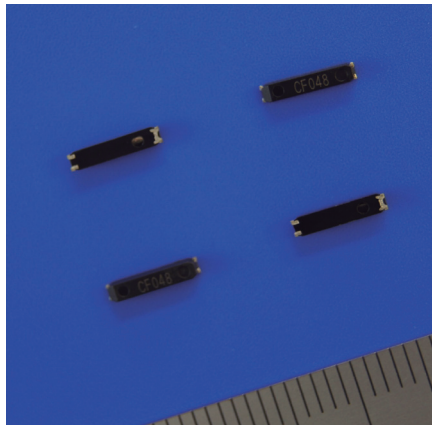


**Remark** Please make sure there is no pattern under SSP-T7-F on the circuit board.



## Plastic mold

### SSP-T7-FL (SMD type low CL resonator for low-power microcontrollers)



#### FEATURES

- Consumes one tenth the standby power of general crystal resonators (with a load capacitance of 12.5 pF) (\*1).
  - Excellent low drive characteristics.
  - Complies with EU RoHS directive.
  - Complete Halogen-free, Pb-free.
  - Built-in crystal resonator processed by high reliable photo-lithographic technology.
- (\*1) When using a microcontroller that supports low CL.

#### APPLICATIONS

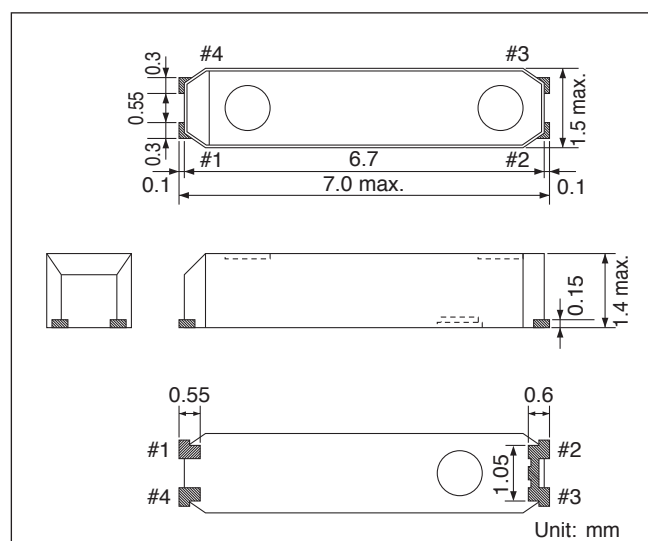
- Consumer electronics products for saving standby energy consumption.
- The devices which is operated by the battery requiring a long battery life.

#### STANDARD SPECIFICATIONS

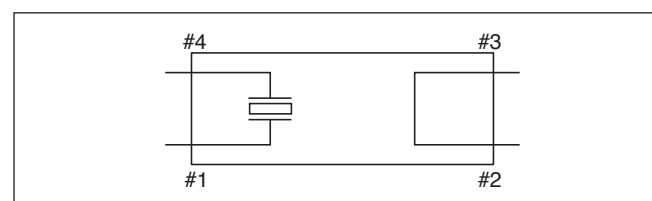
Conditions where not specified (Temperature: 25±2°C, DL: 0.01μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.033±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	3.7pF, 4.4pF, 6.0pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	65kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.01μW typ.	
Shunt Capacitance	C <sub>0</sub>	0.9pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-40°C to +85°C	
Storage Temperature	T_stg	-55°C to +125°C	Storage as single product

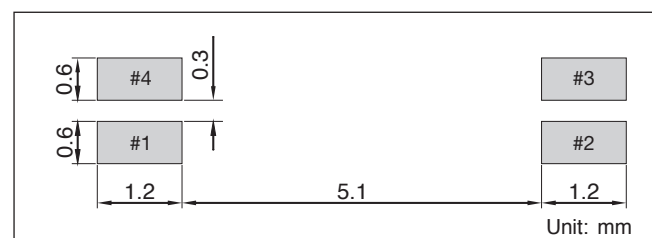
#### DIMENSIONS



#### INTERNAL LEAD CONNECTION



#### RECOMMENDED SOLDERING PATTERN



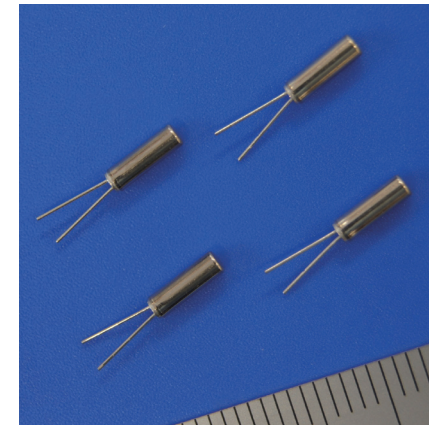
**Remark** Please make sure there is no pattern under SSP-T7-FL on the circuit board.

#### CAUTION

The SSP-T7-FL is designed for use in ultra-low-power microcontrollers. Do not use this resonator in regular microcontrollers as it might cause problems with oscillation.

## Cylinder

### VT-200-F



#### FEATURES

- 2.0Φ tubular package.
- Built-in crystal resonator processed by high reliable photo-lithographic technology.
- Excellent shock resistance and environmental characteristics.
- Pb-free.
- Complies with EU RoHS directive.

#### APPLICATIONS

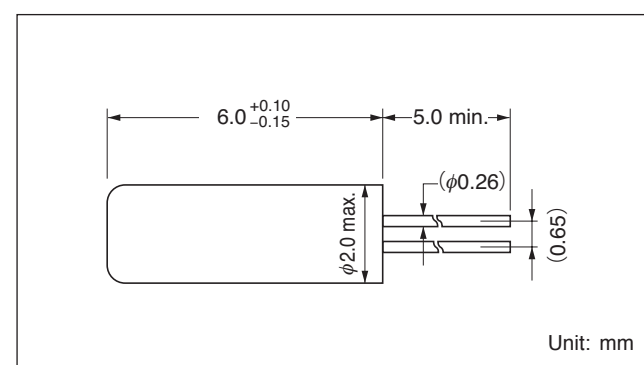
Clocks, Timers, Water/Electricity Meters,  
Remote controllers,  
Sub-clock function for a variety of Microcontroller, etc.

#### STANDARD SPECIFICATIONS

Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

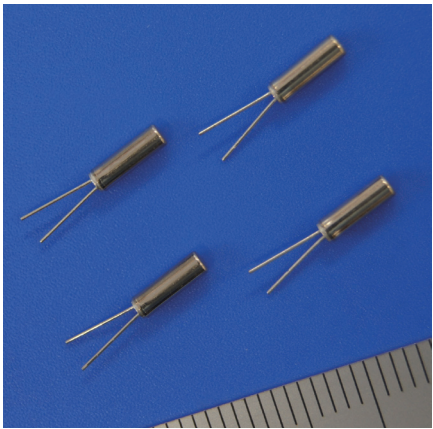
Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.035±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	50kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	0.9pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-40°C to +85°C	
Storage Temperature	T_stg	-40°C to +85°C	Storage as single product

#### DIMENSIONS



**Remark** Please make sure there is no pattern under VT-200-F on the circuit board.

VT-200-FL (Cylinder type low CL resonator for low-power microcontrollers)



FEATURES

- Consumes one tenth the standby power of general crystal resonators (with a load capacitance of 12.5 pF) (\*1).
  - Built-in crystal resonator processed by high reliable photo-lithographic technology.
  - Excellent low drive characteristics.
  - Pb-free.
  - Complies with EU RoHS directive.
- (\*1) When using a microcontroller that supports low CL.

APPLICATIONS

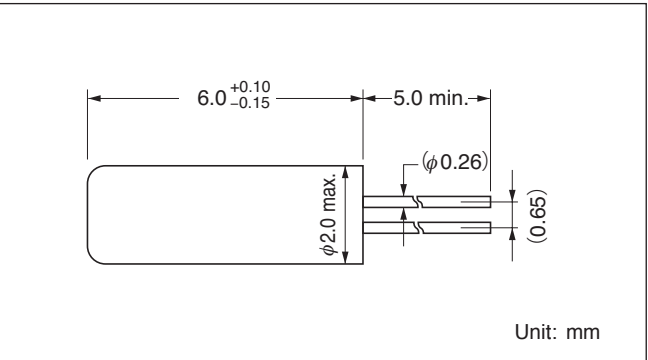
- Consumer-electronics products for saving standby energy consumption.
- The devices which is operated by the battery requiring a long battery life.

STANDARD SPECIFICATIONS

Conditions where not specified (Temperature: 25±2°C, DL: 0.01μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.035±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	3.7pF, 4.4pF, 6.0pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	50kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.01μW typ.	
Shunt Capacitance	C <sub>0</sub>	0.9pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-40°C to +85°C	
Storage Temperature	T_stg	-40°C to +85°C	Storage as single product

DIMENSIONS

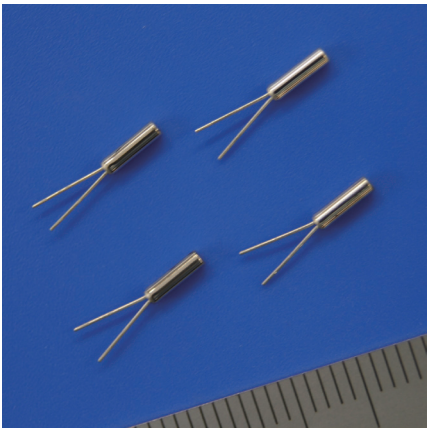


Remark Please make sure there is no pattern under VT-200-FL on the circuit board.

CAUTION

The VT-200-FL is designed for use in ultra-low-power microcontrollers. Do not use this resonator in regular microcontrollers as it might cause problems with oscillation.

VT-150-F



FEATURES

- 1.5Φ tubular package.
- Built-in crystal resonator processed by high reliable photolithographic technology.
- Excellent shock resistance and environmental characteristics.
- Complies with EU RoHS directive.
- Pb-free.

APPLICATIONS

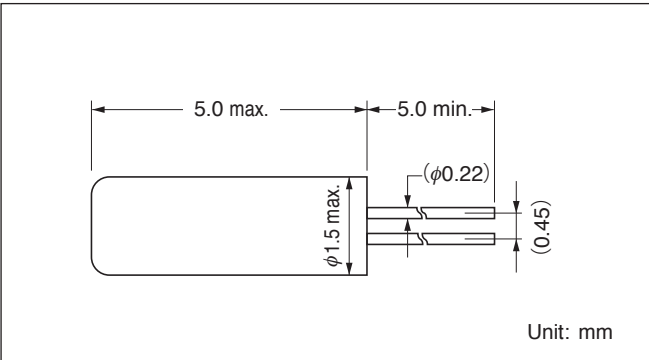
Clocks, Timers, Water/Electricity Meter,  
Remote controllers, Sub-clock function for a variety of  
Microcontroller, etc.

STANDARD SPECIFICATIONS

Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.035±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	50kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	0.9pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-10°C to +60°C	
Storage Temperature	T_stg	-30°C to +70°C	Storage as single product

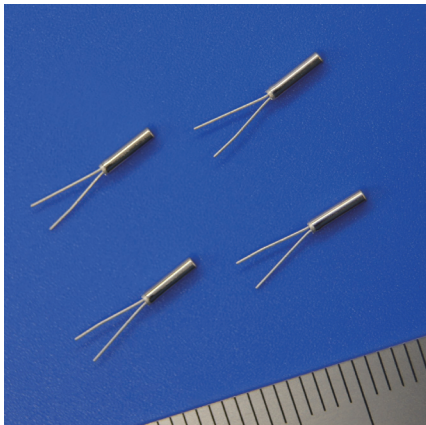
DIMENSIONS



Remark Please make sure there is no pattern under VT-150-F on the circuit board.



VT-120-F



FEATURES

- 1.2Φ tubular package.
- Built-in crystal resonator processed by high reliable photolithographic technology.
- Excellent shock resistance and environmental characteristics.
- Complies with EU RoHS directive.
- Pb-free.

APPLICATIONS

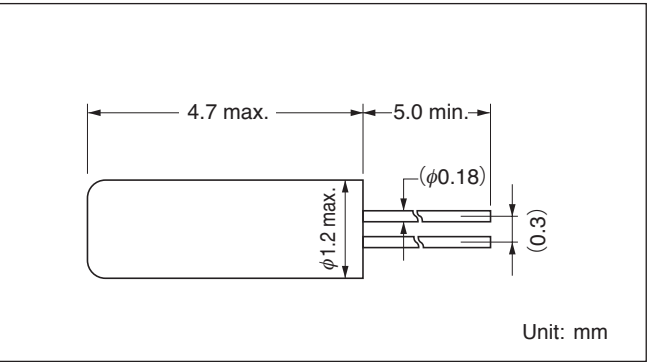
Small/Thin Watches.  
Sub-clock function for a variety of Microcontroller etc.

STANDARD SPECIFICATIONS

Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

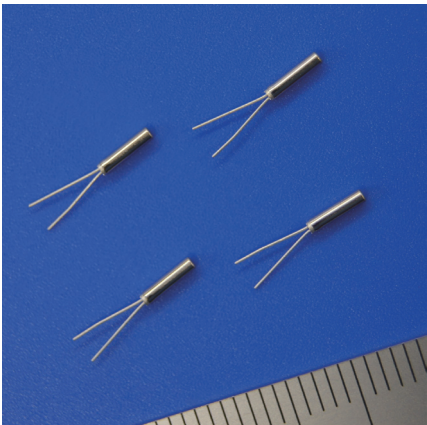
Item	Symbol	Specifications	Conditions / Notes
Nominal Frequency	f_nom	32.768kHz	
Frequency Tolerance	f_tol	±5×10 <sup>-6</sup> , ±10×10 <sup>-6</sup> , ±20×10 <sup>-6</sup>	* Please contact us about available tolerance.
Turnover Temperature	Ti	+25±5°C	
Parabolic Coefficient	B	(-0.035±10%)×10 <sup>-6</sup> /°C <sup>2</sup>	
Load Capacitance	C <sub>L</sub>	6.0pF, 7.0pF, 9.0pF, 12.5pF	* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	50kΩ max.	
Absolute Maximum Drive Level	DLmax.	1.0μW max.	
Level of Drive	DL	0.1μW typ.	
Shunt Capacitance	C <sub>0</sub>	0.8pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>	+25±3°C, First Year
Operating Temperature	T_use	-20°C to +60°C	
Storage Temperature	T_stg	-30°C to +70°C	Storage as single product

DIMENSIONS



**Remark** Please make sure there is no pattern under VT-120-F on the circuit board.

VTC-120-F



FEATURES

- 1.2Φ tubular package.
- Built-in crystal resonator processed by high reliable photolithographic technology.
- Excellent shock resistance and environmental characteristics.
- Complies with EU RoHS directive.
- Pb-free.

APPLICATIONS

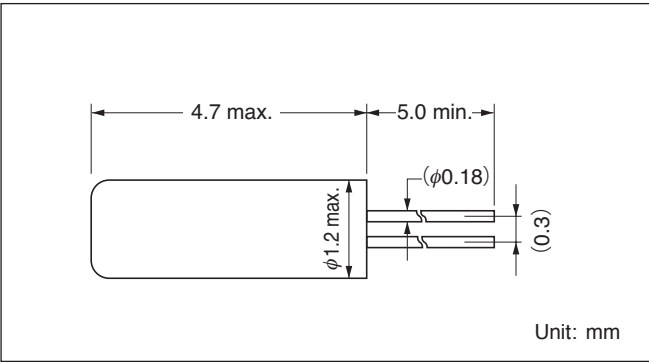
Radio-controlled clock

STANDARD SPECIFICATIONS

Conditions where not specified (Temperature: 25±2°C, DL: 0.1μW)

Item	Symbol	Specifications			Conditions / Notes
Nominal Frequency	f_nom	40.0034kHz	60.0035kHz	77.5036kHz	
Frequency Tolerance	f_tol	±20×10 <sup>-6</sup>			* Please contact us about available tolerance.
Turnover Temperature	Ti	+23±5°C	+22±5°C		
Parabolic Coefficient	B	(-0.035±10%)×10 <sup>-6</sup> /°C <sup>2</sup>			
Load Capacitance	C <sub>L</sub>	10.0pF			* Please contact us about available CL.
Motional Resistance (ESR)	R <sub>1</sub>	65kΩ max.	50kΩ max.		
Absolute Maximum Drive Level	DLmax.	1.0μW max.			
Level of Drive	DL	0.1μW typ.			
Shunt Capacitance	C <sub>0</sub>	0.80pF typ.	0.75pF typ.	0.70pF typ.	
Frequency Ageing	f_age	±3×10 <sup>-6</sup>			+25±3°C, First Year
Operating Temperature	T_use	-20°C to +60°C			
Storage Temperature	T_stg	-30°C to +70°C			Storage as single product

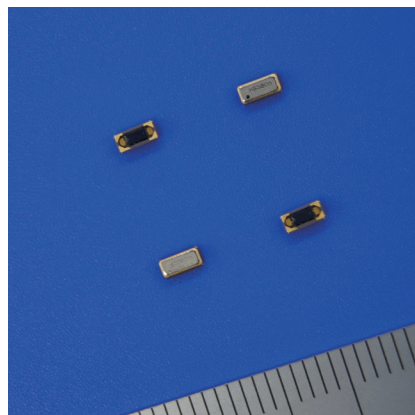
DIMENSIONS



**Remark** Please make sure there is no pattern under VTC-120-F on the circuit board.

# Oscillator

## High Accuracy Crystal Oscillator 32.768kHz SH-32S



### FEATURES

- Excellent frequency accuracy and Temperature characteristics
- Low current consumption
- Pb-free
- Incorporated highly reliable photolithographic crystal resonator

### APPLICATIONS

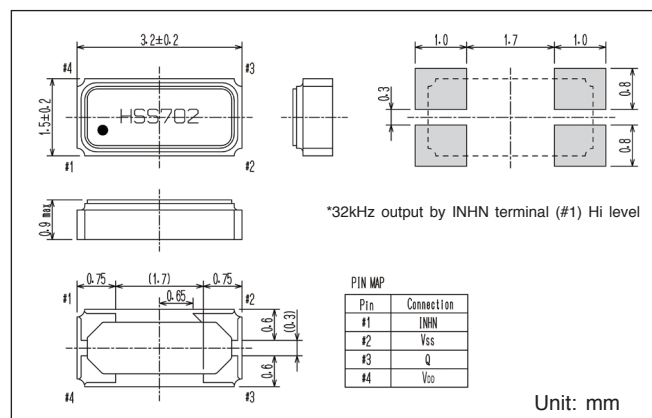
Smart Meter, IoT, Wearable device, Industry device, High precision timing device, Event data recorder

### STANDARD SPECIFICATIONS

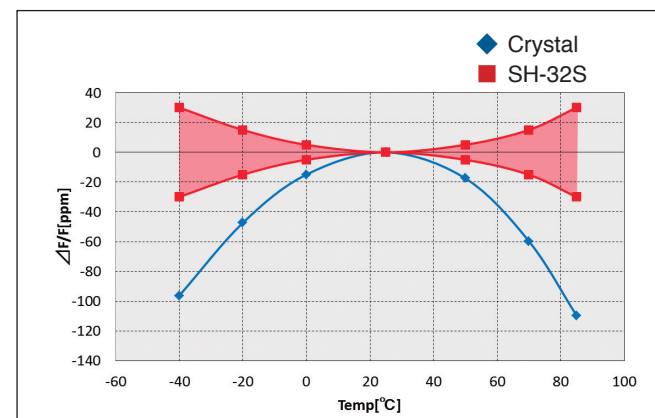
Item	Symbol	Specifications	Unit	Conditions / Notes
Nominal Frequency	f_nom	32.768	kHz	
Voltage	Supply	V <sub>DD</sub>	1.3 to 5.5	V (*1)
	Temperature Compensated	V <sub>TEM</sub>	2.0 to 5.5	V
Temperature range	Storage	T <sub>stg</sub>	-55 to +125	°C
	Operating	T <sub>use</sub>	-40 to +85	°C
Frequency Tolerance	f_tol	±3	×10 <sup>-6</sup>	+25°C, V <sub>DD</sub> =3.3V
Temperature range	f0-Tc	±50	×10 <sup>-6</sup>	-40 to +85°C (+25°C is reference)
Frequency / voltage coefficient	f0_V <sub>DD</sub>	±1	×10 <sup>-6</sup> /V	
Current consumption	I <sub>DD</sub>	1.0 Typ.	μA	V <sub>DD</sub> =3.3V, No load condition
		2.0 Max.	μA	
Symmetry	SYM	50±10	%	Load : 15pF
Rise time / Fall time	tr/tf	50 Max.	ns	Load : 15pF, output level 20 to 80%
Input voltage	V <sub>IL</sub>	0.2V <sub>DD</sub> Max.	V	INHN terminal
	V <sub>IH</sub>	0.8V <sub>DD</sub> Min.	V	INHN terminal
Output voltage	V <sub>OL</sub>	0.4 Max.	V	I <sub>OL</sub> =0.4mA, V <sub>DD</sub> =2.0V
	V <sub>OH</sub>	V <sub>DD</sub> -0.4 Min.	V	I <sub>OH</sub> =-0.4mA, V <sub>DD</sub> =2.0V
Output load condition (CMOS)	C <sub>LOUT</sub>	15 Max.	pF	CMOS Loading
Start-up time	t <sub>str</sub>	0.5 Max.	sec	+25°C
Frequency aging	f_aging	±3	×10 <sup>-6</sup>	+25°C, V <sub>DD</sub> =3.3V, First Year

Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition. (\*1) When the supply voltage becomes 2 V or less, the frequency temperature compensation operation is inactivated.

### DIMENSIONS



### TEMPERATURE CHARACTERISTIC



# Oscillator

### ABSOLUTE MAXIMUM RATING

Item	Symbol	Condition	Rated	Unit
Power Supply & Voltage range	V <sub>DD</sub>	Between V <sub>DD</sub> -V <sub>SS</sub>	-0.3 to +6.5	V
Input Voltage range	V <sub>in</sub>	Input terminal (INHN)	-0.3 to V <sub>DD</sub> +0.3	V
Output Voltage range	V <sub>out</sub>	Output terminal (Q)	-0.3 to V <sub>DD</sub> +0.3	V
Output Power supply	I <sub>out</sub>	Output terminal (Q)	±10	mA

\* In order to run SH-32S stability, please be mounted Ceramic • Chip Condensor by more than 0.1μF near SH-32S between V<sub>DD</sub>-V<sub>SS</sub>.

### POWER CONSUMPTION

Item	Symbol	Condition	MIN	TYP	MAX	Unit
Power consumption of starting (Temperature compensation interval in 2sec)	I <sub>DD</sub>	INHN=V <sub>DD</sub> =3.3V, C <sub>LOUT</sub> =0pF Ta=-40°C to +85°C	-	1.0	2.0	μA
		INHN=V <sub>DD</sub> =5.0V, C <sub>LOUT</sub> =0pF Ta=-40°C to +85°C	-	1.5	3.0	μA
Power consumption of booting	I <sub>BOOT</sub>	INHN=V <sub>DD</sub> =3.3V, C <sub>LOUT</sub> =0pF Ta=-40°C to +85°C	-	1.5	2.5	μA
Power consumption of Disable	I <sub>DIS</sub>	INHN=V <sub>SS</sub> =0V, C <sub>LOUT</sub> =0pF Ta=-40°C to +85°C	-	0.6	1.5	μA

\* In order to be short for oscillation starting time (t<sub>str</sub>), It is the power consumption booting when increased the oscillation drive capability. Booting circuit works until 0.5sec (t<sub>str</sub>+0.5s) from the power supply starting to oscillation starting.

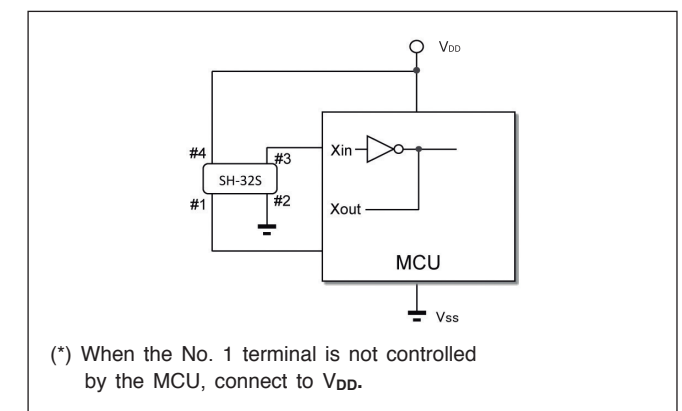
### THE FUNCTION FOR INHN TERMINAL

Input terminal (INHN)	Output terminal (Q)	Oscillation	Notes
"H" Level	32.768kHz output	Oscillation	-
"L" Level	Hi-Z	Oscillation	-
OPEN	-	-	Unavailable

### FREQUENCY TOLERANCE AND TEMPERATURE CHARACTERISTICS

Temperature range (°C)	Frequency Tolerance (×10 <sup>-6</sup> )
0 to +50	±20
-10 to +60	±30
-20 to +70	±40
-40 to +85	±50

### THE EXAMPLE FOR CIRCUIT CONNECTION WITH MCU





# Check sheet for crystal products selection

When considering our crystal resonator / oscillator, please inform the following items. We will propose applications, characteristics etc. of the usage conditions.

1. Products of interest

(1) Cylinder type resonator

☐VT-200-F

☐VT-200-FL

☐VT-150-F

(2) Plastic mold type resonator

☐VT-120-F

☐VTC-120-F

(3) Ceramic package type resonator

☐SSP-T7-F

☐SSP-T7-FL

☐SC-32S

☐SC-32A

☐SC-32P

☐SC-32S (38.4kHz)

☐SC-20S

☐SC-20T

☐SC-20A

☐SC-16S

☐SC-12S

(4) Oscillator

☐SH-32S

2. Applications

3. Semiconductors usage

(1) Semiconductors

☐Microcontroller

☐ASIC

☐RTC

☐Others

☐Manufactuer product name

(2) Purpose of usage

☐Timekeeping

☐Stand-by

☐Communication

☐Others

4. Required specification for the resonator

(1) Nominal Frequency (f\_nom)

☐32.768kHz

☐Others

kHz

(2) Operating Temperature (T\_use)

☐-40 to +85°C

☐Others

°C

(3) Frequency Tolerance (25±2°C) (f\_tol)

☐±20ppm

☐±10ppm

☐±5ppm

☐Others

ppm

(4) Load Capacitance (C<sub>L</sub>)

☐12.5pF

☐9pF

☐7pF

☐6pF

☐Others

pF

(5) Number of terminals (For SC-20T, SC-12S)

☐2 terminals

☐4 terminals

5. Required specification for the oscillator

(1) Frequency-temperature coefficient (fo\_Tc)

☐±50ppm (-40 to +85°C)

☐±40ppm (-20 to +70°C)

☐±30ppm (-10 to +60°C)

☐±20ppm (0 to +50°C)

6. Special requirement

e.g.) Automotive usage or medical device usage or special quality requirement.

7. Others

# Environmental Activites

## SII Group Environmental Policy

### Environmental Concept

SII Group will continue to harmonize its corporate activities with the global environment, designate the "Three Green" concept consisting of Green Process, Green Products and Green Life as our basic concept, promote and conduct environmental activities, and contribute to the establishment of a sustainable society that can coexist with nature.

## Environmental Actions taken by Quartz Crystal Division

### 1. Provide Environmentally Friendly Products and Services

- Promote LCA (Life Cycle Assessment)
- Promote lead-free soldering
- Expand "Green Purchasing"
- Expand lineup of SII's green products
- Scheduled to be Halogen-free

### 2. Save Energy and Contribute to diminish Global warming

- Energy Saving in Production Process
- Promoting measures for more efficient operation of air conditioning equipment, etc. to reduce CO<sub>2</sub> emissions while expanding sales.

### 3. Maintain zero emissions, and promote resource saving as well as recycling, and the reduction of industrial waste

- Promoting to abolish any toxic or dangerous material, use environment-friendly substitutes and re-use; quartz crystal electrode membrane, plastic mold resin, lead frame, etc.
  - Promoting resource saving and 3R (Reduce, Re-use, Re-cycle) activities.

### 4. Encourage Employees to contribute to the Protection of the Environment in their every day life, personal as well as the professional





- Stop using ozone-layer depleting materials:
  - SII discontinued specific fluorine at the end of 1991.
  - SII discontinued trichloroethane at the end of 1992.
  - SII discontinued mehtylene chloride at the end of 1996.

Establish a green procurement standard, specify materials to be entirely eliminated from products, and promote activities to observe international legal regulations (RoHS and WEEE directives, etc.).

### 5. Green Life

- Our manufacturing site is located close to Ohirasan Natural Park. Accordingly we promote planting trees at our site and contributing to local communities by communicating with local residents.

### 6. Trend of Miniaturizing of SMD Quartz Crystal Unit

Products				
	SSP-T7-F	SC-32S	SC-16S	SC-12S
Area (mm²Max.)	10.5	5.3	1.9	1.43
Height (mmMax.)	1.4	0.85	0.5	0.5
Weight (mg)	28	12	2.8	2.0

## 1. MOUNTING PRECAUTIONS Lead Type Crystal Units

- Structure  
Tubular crystal units (VT) are hermetically sealed using glass (see Figures 1 and 2).

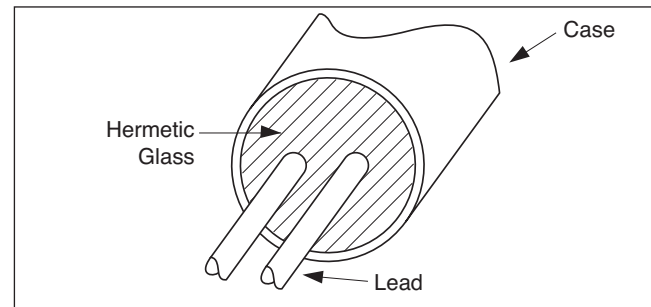


Figure 1

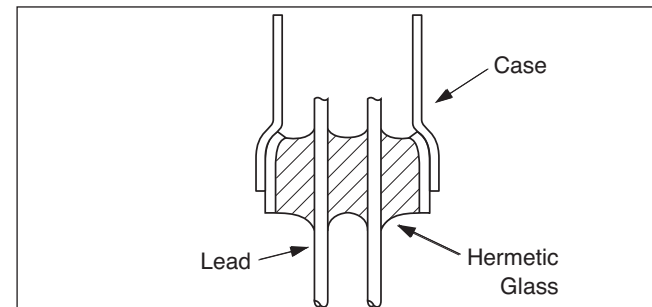


Figure 2

- Unbending the lead
  - DO NOT pull the lead excessively if unbending a lead or removing a crystal unit. The excessive force may crack the glass and reduce the degree of vacuum. This may eventually result in deterioration of the characteristics and may also break the crystal chip (see Figure 3).
  - Unbend the lead by pressing on the bent part from both the upper and lower sides with fixing the bottom of lead tightly (see Figure 4).

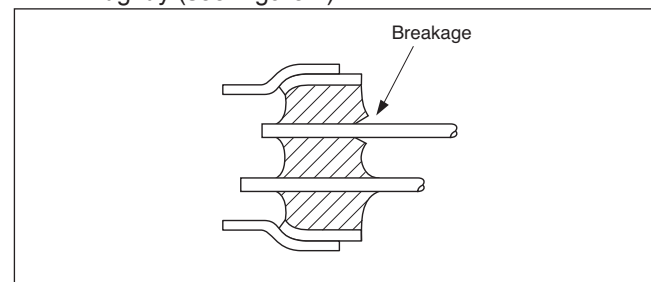


Figure 3

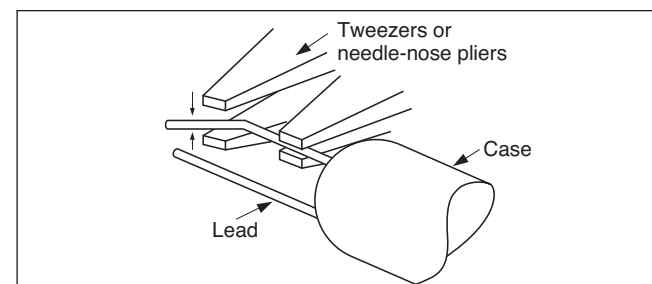


Figure 4

- Bending the lead
  - Bend the lead so that the lead will remain straight for more than 0.5mm from the case when soldering a crystal unit after bending. If not, the glass may be cracked (see Figures 5 and 6).
  - Always leave a length greater than 2.0mm when bending a lead after soldering (see Figure 7).

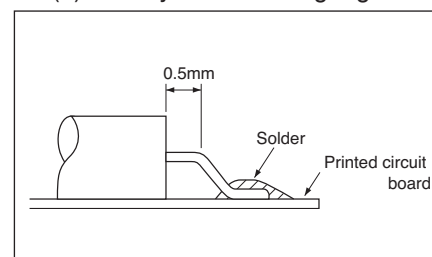


Figure 5

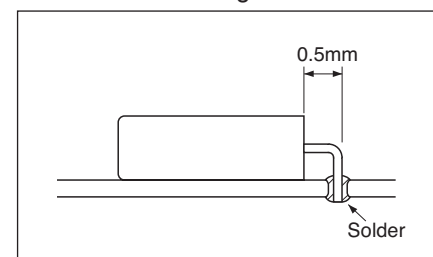


Figure 6

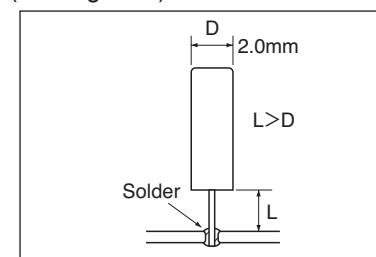


Figure 7

Soldering directly to the case will reduce the degree of vacuum and may result in deterioration of the characteristics and may break the crystal chip.

Make the length from the case to the printed circuit board (L) longer than the case diameter (D) so that the lead wire will not be pulled in case the crystal unit falls over.

## 2. Precautions for mounting plastic molded products

- If the board is deformed such as bending after mounting on the board, peeling of the soldered part between the crystal resonator and the board, the crack in the plastic molding, destruction of the internal element, etc. may occur. Especially when dividing the board on which it is mounted, there is a possibility that a large stress may be applied at the time of division. Please consider board layout and cutting method to minimize stress on products.
- When the product is automatically mounted on the board, if a large impact is applied to the crystal resonator, there is a possibility that characteristics may change / deteriorate or the product may be broken. When mounting automatically, please set conditions considering the shock to the crystal unit. Also, please conduct the mounting test beforehand and confirm that there is no influence on the characteristics to the crystal resonator.

## 3. Precautions for mounting ceramic package products

- If the board is deformed such as bending after mounting on the board, peeling of the soldered part between the crystal resonator and the board, the crack in the ceramic package, destruction of the internal element, etc. may occur. Especially when dividing the board on which it is mounted, there is a possibility that a large stress may be applied at the time of division. Please consider board layout and cutting method to minimize stress on products.
- When the product is automatically mounted on the board, if a large impact is applied to the crystal resonator, there is a possibility that characteristics may change / deteriorate or the product may be broken. When mounting automatically, please set conditions considering the shock to the crystal unit. Also, please conduct the mounting test beforehand and confirm that there is no influence on the characteristics to the crystal resonator.
- The cracks may be occurred in the soldered part by repeating the harsh temperature change for a long time when mounting the product on a board having a expansion coefficient different from that of the ceramics used in the crystal package. When using under such circumstances, please conduct test beforehand at your company and confirm that there is no influence on the crystal unit.
- Ceramic packages are small and thin products. So when you repair the rework after mounting, please give due consideration to the selection and handling of the tools to be used.

## 4. SOLDERING

- Cylinder  
The soldering position has to be at the lead wire more than 1.0mm away from the glass seal.  
A long time for heating at high temperature may result in deterioration of the characteristics and may break the crystal unit.  
If crystal unit is unavoidably heated, heat the lead part at 300°C or lower for 5 seconds or less and please make sure to keep the case below 150°C.
- Ceramic package, Plastic mold, Oscillator  
An example of the reflow temperature profile is shown as follows (see Figure 8).

Example of SMD product soldering conditions  
(260°C peak: Lead-free products)

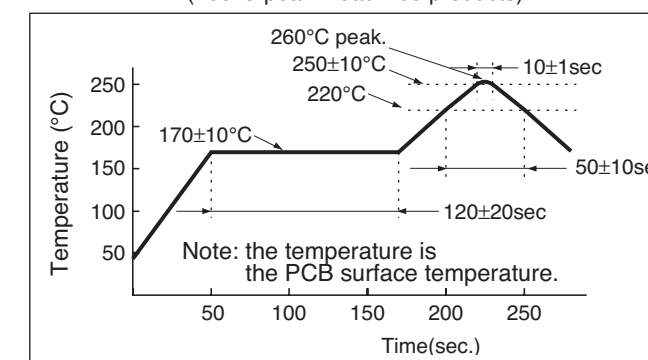


Figure 8

## 5. CLEANING

- Since a small, thin crystal chip is used for tuning fork crystal units and the frequency approximates that of an ultrasonic cleaner, the crystal chip may break easily. Therefore, DO NOT perform ultrasonic cleaning.

## 6. MECHANICAL SHOCK

- Quartz crystal units are designed to withstand a drop from 75cm onto a concrete at least 3 times. However, their crystal chips may break depending on the conditions when they are dropped. Ensure that the crystal unit functions normally before use if the crystal units have been dropped or subjected to an excessive mechanical shock.
- Unlike chip parts such as resistors, and capacitors, the SMD crystal unit has a crystal chip which is hermetically sealed inside. Therefore, check the influence of shock during automatic mounting or influence of deposition of case to the board by ultrasonic vibration before use.
- Avoid mounting crystal unit to the board with mechanical vibration source including ultrasonic vibration source. If the crystal unit is unavoidably mounted to the same board with mechanical vibration source, check that the crystal unit functions normally.



# Quartz Crystal Unit Handling Precautions

## 7. Handling

- The crystal oscillator has an IC mounted on the backside of the package. Although it is resin-sealed, please do not directly touch the IC surface with tweezers, rigid tools and fixtures. If you scratch the IC, it may cause a malfunction, so be very careful.

## 8. Usage Condition

- Consider temperature and humidity in the product to be used, please use in the environment within the temperature range. When used in applications exposed to high humidity, malfunction due to dew condensation is a concern, so please take sufficient measures to prevent dew condensation.

## 9. Precautions for Oscillator

- Mounting**  
The oscillator has polarity, it may cause malfunctions or destruction. if mounting by the opposite direction.
- About the input terminals**  
Please follow the specifications of each product when use the input terminal.
- Board wiring**  
Power supply line / Ground pattern line should use a thick pattern to reduce the impedance.  
Signal line should uses a thick pattern to reduce the impedance. It should be short for the distance to the connected IC.  
For avoid noise effect, please make sure there is no pattern under crystal unit.
- Noise**  
If excessive external noise is applied to the terminals, the issue such as latch-up phenomenon and electro-static breakdown may be happened.
- Heat stress**  
There is a risk of degradation of the crystal unit / IC due to a sudden temperature change. It should use under the specification.
- Power supply time**  
For avoid malfunction, it should be careful power-on time.

## 10. Precautions for handling reels

- Crystal products are degraded in characteristics when exposed for long periods under high or low temperature environments. Then, it should store at normal temperature and normal humidity.  
Avoid storing for a long time and mount the crystal units immediately after unpacked.

Normal temperature / humidity conditions: +15 to 35°C / 25 to 85%RH

- When delivered with tape reel, the tape reel may deform if large impact is applied.

# Oscillation Circuit Design Precautions

## 1. DRIVE LEVEL (DL)

- The drive level of a crystal unit is shown by the level of the operating power or the current consumption (see Figures 9, 10, and 11).  
Operating the crystal unit at an excessive power level will result in the degradation of its characteristics, which may cause frequency instability or physical failure of the crystal chip.  
Design your circuit within absolute maximum drive level.

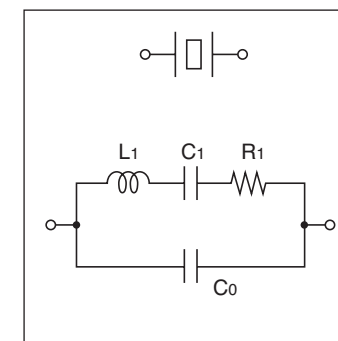


Figure 9

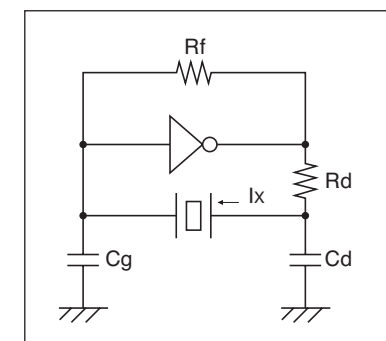


Figure 10

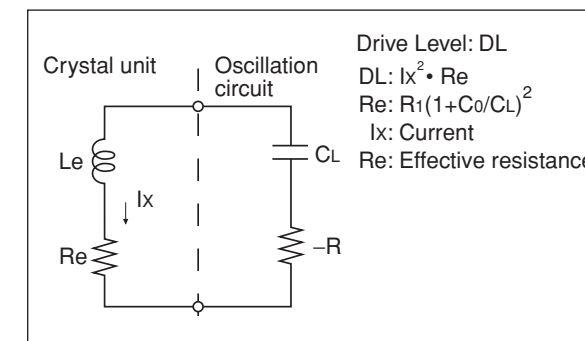


Figure 11

## 2. OSCILLATION FREQUENCY AND LOAD CAPACITANCE (CL)

- The load capacitance (CL) is a parameter for determining the frequency of the oscillation circuit. The CL is represented by an effective equivalent capacitance that is loaded from the oscillation circuit to both ends of the crystal unit (see Figure 12).  
The oscillation frequency varies depending upon the load capacitance of the oscillation circuit. In order to obtain the desirable frequency accuracy, matching between the load capacitances of the oscillation circuit and the crystal unit is required. For the use of the crystal unit, match the load capacitances of the oscillation circuit with the load capacitances of the crystal unit.

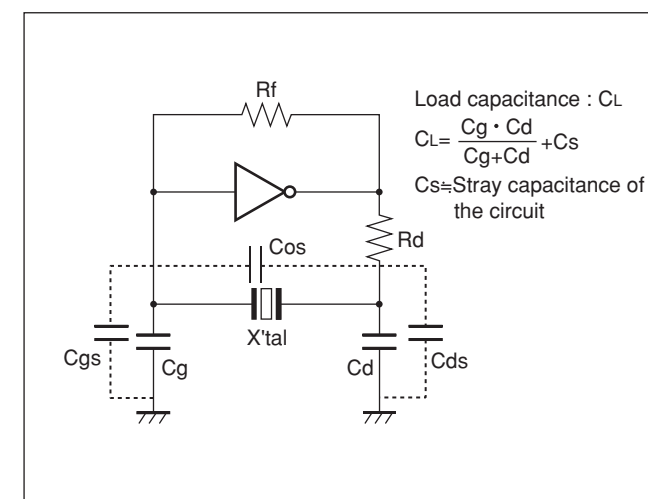


Figure 12

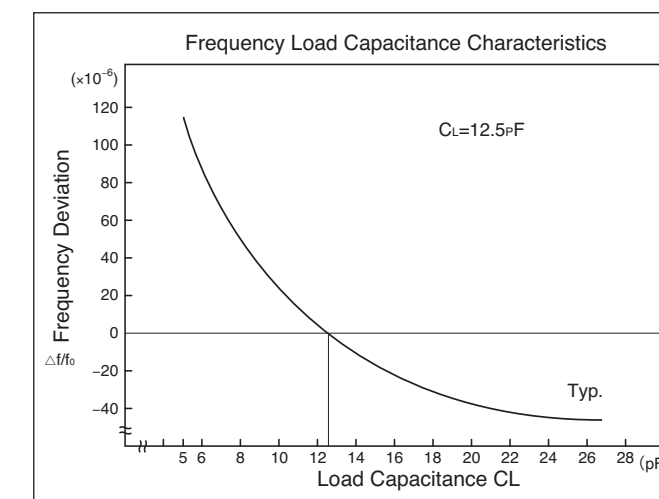


Figure 13

### 3. OSCILLATION ALLOWANCE

To ensure stable oscillation, the negative resistance of the circuit should be significantly larger than the equivalent series resistance (the oscillation allowance is large). Ensure that the oscillation allowance is at least five times as large as the equivalent series resistance.

### Oscillation Allowance Evaluation Method

Add resistor “Rx” to the crystal unit in series and ensure that the oscillation starts or stops. The approximate negative resistance of the circuit is the value obtained by adding the effective resistance “Re” to the maximum resistance “Rx” when the oscillation starts or stops after gradually making Rx value larger.

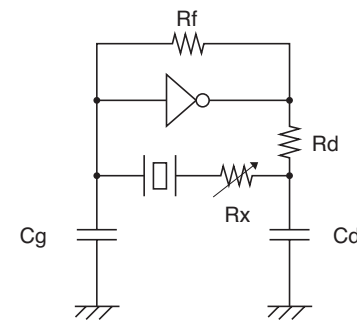


Figure 14

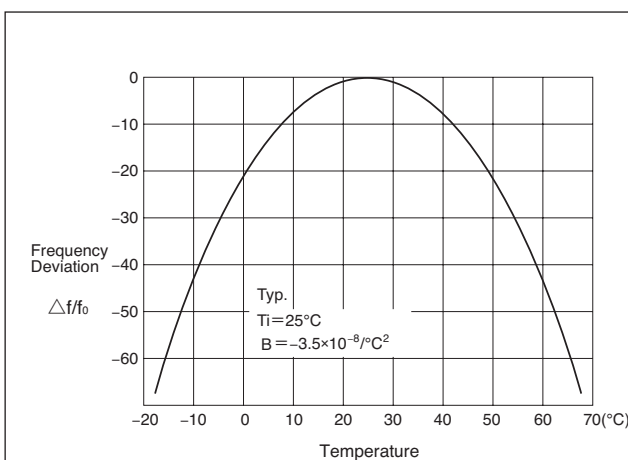
**Negative resistance  $| -R | = R_x + R_e$**

$I-R_I$  is a value at least five times as large as the maximum equivalent series resistance ( $R_1 \text{ max.}$ ) of the crystal unit.

\*Re is the effective resistance value during oscillation.

$$Re = R_1 \left(1 + \frac{C_0}{C_L}\right)^2$$

## FREQUENCY-TEMPERATURE CURVE



### Frequency Temperature Characteristics

Frequency temperature characteristics of tuning fork crystals is shown by negative quadratic curve which has a peak at 25°C as per left graph.

Please make sure to consider the temperature range and frequency accuracy you need since magnitude of frequency variation becomes larger and larger as the temperature range becomes wider.

[Approximation formula of frequency temperature characteristics]

$$f_{\text{tem}} = B (T - T_i)^2$$

B : Parabolic coefficient

T : Given temperature

Ti: Turnover temperature

## LEAD TYPE PRODUCTS

After products are inserted in polyethylene bags, the bags are placed in boxes for shipping.

Product name	Quantity per lot	Quantity per bag	Quantity per box
VT-200-FL / VT-200-F / VT-150-F	10,000 pcs.	500 pcs	20 bags
VT-120-F / VTC-120-F	20,000 pcs.	1,000 pcs	20 bags

## SMD PRODUCTS

Product name	Quantity per reel
SSP-T7-F/SSP-T7-FL SC-32S/SC-32A/SC-32P/SC-20S/SC-20T/ SC-20A/SH-32S	3,000 pcs.
SC-16S/SC-12S	5,000 pcs

## TAPE AND REEL CONFIGURATION

- Reel configuration

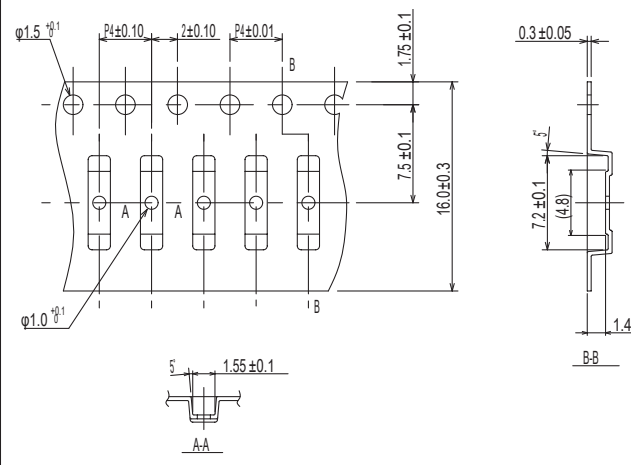
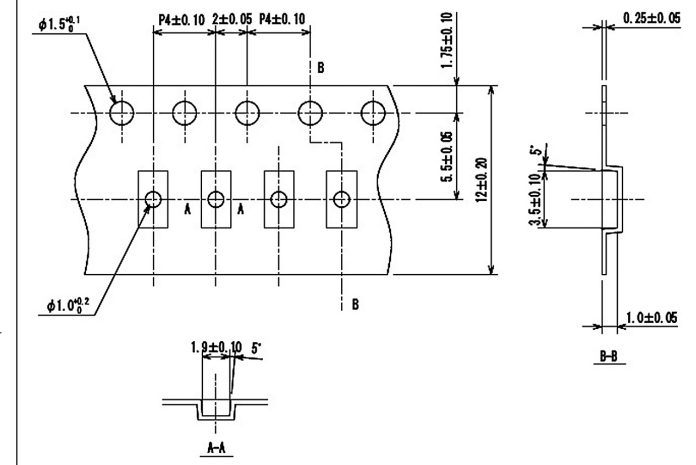
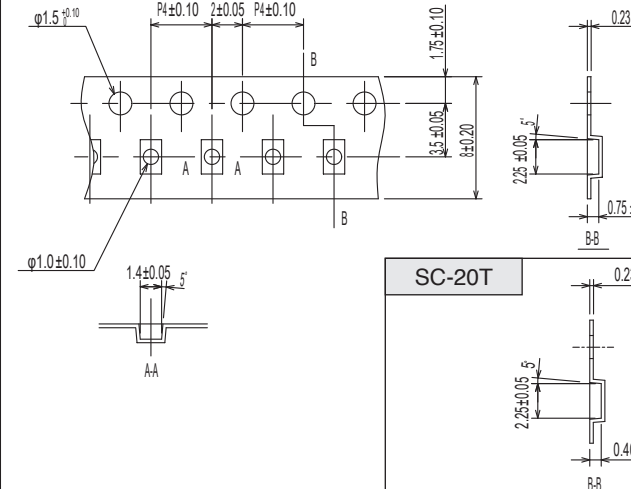
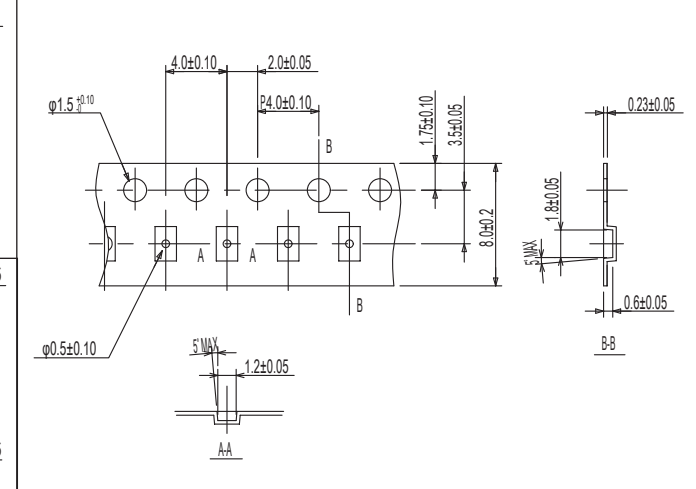
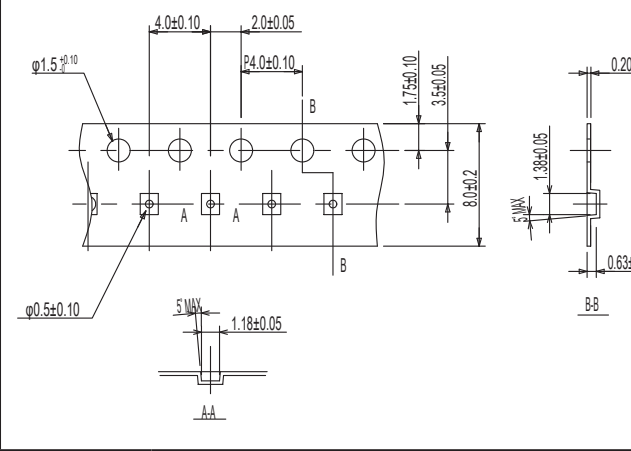
Product name	Reel inner width	Reel outer width	Product name	Reel inner width	Reel outer width
SSP-T7-F/SSP-T7-FL	17.0mm	19.4mm	SC-32S/SC-32A/SC-32P/SH-32S	13.0mm	15.4mm

Product name	Reel inner width	Reel outer width
SC-20S/SC-20T/SC-20A/ SC-16S/SC-12S	9.0mm	11.4mm



• Emboss tape configuration

Unit: mm

<div><p>Product name</p><p>SSP-T7-F/SSP-T7-FL</p></div>	<div><p>Product name</p><p>SC-32S/SC-32A/SC-32P/SH-32S</p></div>
<div><p>Product name</p><p>SC-20S/SC-20T/SC-20A</p></div>	<div><p>Product name</p><p>SC-16S</p></div>
<div><p>Product name</p><p>SC-12S</p></div>	

• Precautions for handling reels

- (1) Store at normal temperature and normal humidity (refer to standard conditions of JIS Z-8703 laboratory). Avoid storing for a long time and mount the crystal units immediately after unpacked.  
[Normal temperature: +15 to 35°C Normal humidity: 25 to 85%RH]
- (2) Handle outside boxes and reels with care.  
Tapes and reels may be deformed by external pressure.

MEMO

MEMO