Handling Instructions

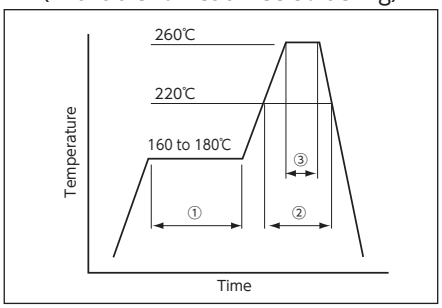
■ Soldering

Our products are designed so they may withstand the same standard reflow soldering temperatures as most other electronics components. However, if the reflow temperature is higher than our specification allows, the performance may be affected. Avoid soldering the product at temperatures higher than specified.
For the reflow temperature profile of SMD products, refer to the figure below.

①	Preheat	160 to 180℃	120sec.
②	Primary heat	220℃	60sec
③	Peak	260℃	10sec. max.

※ The reflow temperature profile may vary depending on the product model, specifications and frequency range. Refer to the individual product specifications for details.

Reflow Temperature Profile
(Available for lead free soldering)



■ Cleaning

◎General cleaning solutions or ultrasonic cleaning may be used to clean our crystal products, but verification tests are recommended prior to use.
◎Tuning fork crystals resonate at frequency bands that are close to the washing frequency of ultrasonic cleaning machines and this may cause resonance deterioration in the crystal. Therefore the use of ultrasonic cleaning machines to clean tuning fork crystals should be avoi-ded. After applying ultrasonic cleaning, the functionality of crystals should be verified by testing the performance of the end product.

■ Shock

Crystal products are designed to resist shock, but if the products receive excessive shocks or are dropped on the ground, be sure to check for any damages before using.

■ Mounting

〈SMD crystal products〉

Surface mount crystals are designed to be compatible with most automatic mounting processes, but some processes may exert excessive shock which may damage the crystal. Therefore test mounting of the crystal prior to mass production is necessary.
If there is a possibility that PCB may be warped, make sure the warping is not to such a degree that the crystal products' operating characteristics or soldering conditions will be negatively affected.
Avoid mounting and processing by Ultrasonic welding because this method has a possibility of an excessive vibration spreading inside the crystal products and becoming the cause of characteristic deterioration and not oscillating.

〈Lead type〉

When bending, forming, or mounting leaded crystal products be careful not to put too much pressure on the glassed part of the base, as it may crack and negatively affect the crystals' performance.

■ Storage

Storing crystal products at high temperatures or high humidity may deteriorate the soldering condition of pins. Do not store in direct sunlight or damp environments.

■ Others

〈Crystal Resonators〉

◎When excessive voltage is applied to crystal resonators, their performance may be affected or the crystal blank may be damaged. When handling the product, use the product within the specifications provided.
◎Negative resistance determines the tolerance margin of a circuit that oscillates the resonator. We recommend that the negative resistance be at least five times the standard series resistance for standard applications.

〈Crystal Oscillators〉

◎C-MOS is used for internal circuit of crystal oscillators. To prevent latch-up phenomena or static electricity, take careful note.
◎Some crystal oscillators do not have internally connected bypass capacitors. When using the product, use a capacitor with a good high frequency characteristic of 0.01μF between Vcc and GND (e.g. Ceramic chip capacitor) and connect it at the shortest pos-sible distance. For details, refer to the specifications of each individual product.

〈Monolithic Crystal Filters〉

◎Take care so that the input pin and the output pin do not close on the PCB.
◎If the floating capacity of a PCB (on which a crystal filter is to be mounted) is too large, circuit tuning may be required to cancel out the excess floating capacity.
◎When excessive voltage is applied to crystal filters, their performance may be affected or the crystal blank may be damaged. When handling the product, use at its input level equal to or less than -10dBm.

RoHS/ELV Compliant Lead-free and Halogen-free products from KDS.

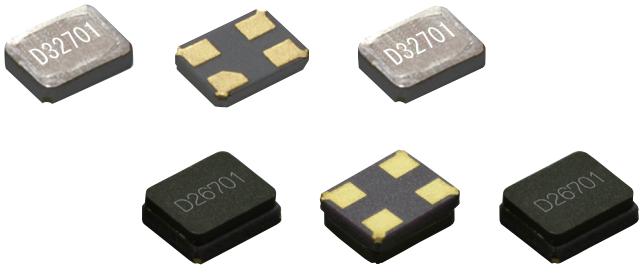
KDS is fully committed to environmental protection and has been proactively working to comply with the major environmental regulations such as RoHS Directive (Directive of the Restriction of the use of certain Hazardous Substances : 2011/65/EU and (EU) 2015/863), ELV Directive (End-of-Life Vehicles Directive : 2000/53/EC) and Halogen-free activities etc. The below spreadsheet provide the current status of the product compliance in each environmental regulations. Please visit our website for the latest information.(https://www.kds.info)

As of sept.30.2023

	Type	RoHS/ELV Compliant	Halogen-free	Pb-free	Materials of pin	Note
Crystal Resonators/ MHz Band Crystal Resonators	DX1008J SERIES	○	○	○	Ni/Au	
	DSX1210A	○	○	○	Ni/Au	
	DSX1612S	○	○	○	Ni/Au	
	DSX211S, DSX211SH	○	○	○	Ni/Au	
	DSX221SH	○	○	○	Ni/Au	
	DSX321SH	○	○	○	Ni/Au	
	DSX210GE	○	○	Pb in sealing-glass	Ni/Au	Pb in sealing-glass is exempted from RoHS/ELV Directive.(*)
	DSX320GE	○	○	Pb in sealing-glass	Ni/Au	Pb in sealing-glass is exempted from RoHS/ELV Directive.(*)
	DSX211G	○	○	Pb in sealing-glass	Ni/Au	Pb in sealing-glass is exempted from RoHS/ELV Directive.(*)
	DSX321G, DSX321GK	○	○	Pb in sealing-glass	Ni/Au	Pb in sealing-glass is exempted from RoHS/ELV Directive.(*)
	DSX530GA	○	○	Pb in sealing-glass	Ni/Au	Pb in sealing-glass is exempted from RoHS/ELV Directive.(*)
Tuning Fork Crystal Resonators/ kHz Band Crystal Resonators	DT-26, DT-261	○	○	○	Sn	
	DT-38, DT-381	○	○	○	Sn	
	DMX-26S	○	○	High temperature solder	Sn	High temperature solder used inside the product is exempted from RoHS/ELV Directive.(*)
	DST1210A	○	○	○	Ni/Au	
	DST1610A	○	○	○	Ni/Au	
	DST210AC	○	○	○	Ni/Au	
	DST310S	○	○	○	Ni/Au	
Crystal Resonators with dedicated temperature sensor/ MHz Band Crystal Resonators	DSR1210ATH	○	○	○	Ni/Au	
	DSR1612ATH	○	○	○	Ni/Au	
	DSR211STH	○	○	○	Ni/Au	
	DSR221STH	○	○	○	Ni/Au	
Temperature Compensated Crystal Oscillators (TCXO)	DSA/DSB1612 SERIES	○	○	○	Ni/Au	
	DSA/DSB211 SERIES	○	○	○	Ni/Au	
	DSA/DSB221 SERIES	○	○	○	Ni/Au	
	DSA/DSB321 SERIES	○	○	○	Ni/Au	
	DSA/DSB535 SERIES	○	○	○	Ni/Au	
	DSK1612ATD	○	○	○	Ni/Au	
	DSK321STD	○	○	○	Ni/Au	
Real Time Clock Module (RTC)	DD3225TS, DD3225TR	○	○	○	Ni/Au	
Simple Packaged Crystal Oscillators (SPXO)	DS1008J SERIES	○	○	○	Ni/Au	
	DSO1612AR	○	○	○	Ni/Au	
	DSO211S SERIES	○	○	○	Ni/Au	
	DSO221S SERIES	○	○	○	Ni/Au	
	DSO223S SERIES	○	○	○	Ni/Au	
	DSO321S SERIES	○	○	○	Ni/Au	
	DSO323S SERIES	○	○	○	Ni/Au	
	DSO531S SERIES	○	○	○	Ni/Au	
	DSO533 SERIES	○	○	○	Ni/Au	
	DLO555MBA	○	○	○	Sn	
	DSO751S SERIES	○	○	○	Ni/Au	
	DSO753S SERIES	○	○	○	Ni/Au	
Voltage Controlled Crystal Oscillators (VCXO)	DSV221SV	○	○	○	Ni/Au	
	DSV321S	○	○	○	Ni/Au	
Monolithic Crystal Filters	DSF334 SERIES	○	○	○	Ni/Au	
	DSF444 SERIES	○	○	○	Ni/Au	
	DSF633 SERIES	○	○	○	Ni/Au	
	DSF753 SERIES	○	○	○	Ni/Au	

* RoHS Directive and ELV Directive exemptions are granted for high temperature solder, lead content in low-melting glass of DSX-G Series.

Quartz Devices
Crystal resonators



〈Example〉 **D S X 5 3 0 G A**

Surface mount crystal resonator	D S X
Length First 2 digits of the dimention (L<2mm) First digit of the dimention in Millimeter (2≦L<10mm)	5 3
Width First 2 digits of the dimention (L<2mm) First digit of the dimention in Millimeter (2mm≦L)	3 0
Number of terminals 0: two terminals 1: four terminals	G
Sealing method G: glass seal S: seam weld A: melting alloy	A
Product characteristics	

D S X 1 6 1 2 S

Crystal Resonators

Description

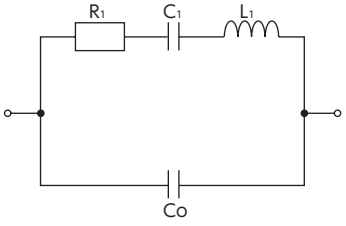
●MHz Band Crystal Resonators

A resonator using thickness-sheer mode and has high stability during temperature variations. There are many packages and sizes available for various applications.

●kHz Band Crystal Resonators(Tuning Fork Crystal Resonators)

A resonator with low power consumption and a tuning fork shaped crystal blank. Common application includes watches and mobile phones.

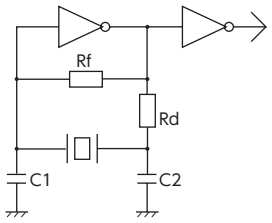
Terminology

Fundamental Crystal Resonators	Crystal resonator designed to oscillate in the lowest-order (fundamental) oscillation mode.
Overtone Crystal Resonators	Crystal resonator designed to oscillate in the overtone oscillation mode (third, fifth, and seventh).
Overtone Order	Desired order of vibration mode, (odd) integer multiples of the fundamental mode.
Vibration Mode	One factor which determines the mechanical vibration behavior of a crystal blank is cutting angle. Examples of such vibration behaviors are thickness-sheer mode and flexure mode.
Nominal Frequency	The specified center frequency of the crystal.
Load Capacitance	The effective external capacitance that determines the resonance frequency of a crystal resonator. When this capacitance is small, the crystal resonator is vulnerable to changes in the circuit characteristics, thus deteriorating the frequency stability.
Drive Level	Loading condition of crystal resonator, which is determined by electric current or power applied to the crystal blank. Electric power P is determined by the following equation: $P= I^2 \cdot R_1$, where I represents electric current and R1 represents series resistance.
Series Resistance	The resistance of the crystal at the series resonance frequency, also called the equivalent series resistance (ESR).
Frequency Tolerance (Crystal Resonators)	Allowable deviation from nominal at room temperature (25 deg.C), indicated in parts per million ($\times 10^{-6}$).
Frequency Characteristics over Temperature (Crystal Resonators)	Allowable deviation of frequency at room temperature, in parts per million ($\times 10^{-6}$). This is the maximum value within the operating temperature range.
Aging	The frequency change of the crystal operated at specific conditions for a certain period of time.
Operating Temperature Range	Temperature range over which the crystal resonator can be operated within allowable deviation range.
Storage Temperature Range	Temperature range, which crystal resonator can be stored at without any deterioration or damage independently.
Turnover Temperature	The temperature at the peak of the parabolic curve that a crystal in kHz shows with temperature. It is expected that the crystal will have a steady oscillation if the peak temperature is within the working temperature range.
Parabolic Coefficient	The temperature co-efficient of a parabolic curve shown in frequency vs. temperature.
Plastic-encapsulated (SMD) type	Crystal resonators encapsulated with resin.
Cylindrical type	Crystal resonators in cylindrical constructions, which are generally in kHz frequency range.
Equivalent Circuit to Crystal Resonator	An equivalent circuit near the resonance point of the crystal resonator is shown below. It consists of a series circuit including series motional inductance (L_1), series capacitance (C_1) and series resistance (R_1), with the resonator's terminal-to-terminal capacitance (shunt capacitance: C_0) connected in parallel with the series circuit. The smaller the size of the resonator, the greater the average values of R1 and L1. 

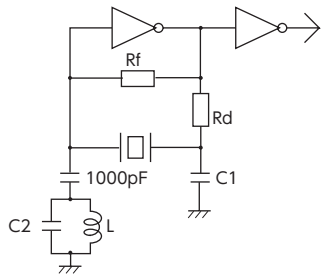
Oscillation Circuit

Oscillation Circuit of Crystal Resonator

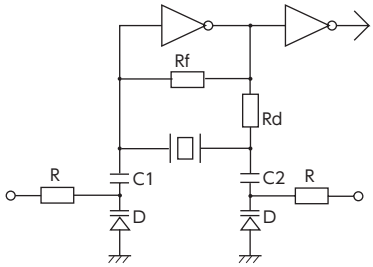
Oscillation Circuit of Fundamental Mode



Oscillation Circuit of Overtone Mode



VCXO Circuit



Oscillation Circuit of Fundamental Mode :
A circuit that allows the crystal resonator to oscillate in the fundamental mode.

Oscillation Circuit of Overtone Mode :
A circuit that allows the crystal resonator to oscillate in a high-order oscillation mode (overtone mode). (However, the circuit can be used at the composition of oscillation circuit of fundamental mode.)

VCXO Circuit :
An oscillation circuit with a frequency control function that utilizes the load capacitance characteristic of the crystal resonator.

Tips for Circuit Design

[IC Selection]
Selecting an IC according to the oscillation frequency.
〈Example〉 4069UB : From the kHz range to around 8 MHz
7WU04 : 4 to 30MHz
7WHU04 : 20 to 60MHz

[Feedback Resistance]
The feedback resistance for DC bias is necessary to continue the oscillation of a resonator. Generally, a resistance of 10 MΩ and above is used for oscillation in the kHz range, and a resistance of 1 MΩ and above is used for oscillation in the MHz range.
For overtone oscillation, a resistance of 1 kΩ may be used.

[Control Resistance]
Limits the current that flows into resonator, adjusts the negative resistance and drive level, prevents abnormal oscillation of resonator and suppresses frequency fluctuations.

[Capacitor C1, C2]
Adjusts the negative resistance and drive level, prevents abnormal oscillation of resonator.

[Bypass Capacitor]
This component is required to lower the impedance of the power-supply system inserted between the power-supply pin and ground pin of the IC. Mount as closely as possible to the IC, using a bypass capacitor with a capacitance suitable for the oscillation frequency.

〈Example〉 kHz range : 10 to 100 μF
MHz range : 0.01 to 0.1 μF

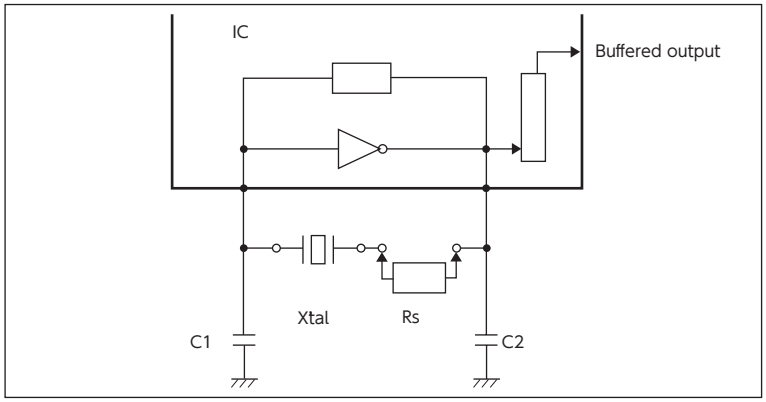
[Line Pattern]
Mount parts of a oscillation circuit as closely as possible to the IC and don't put signal line of the oscillator circuit closely or cross another signal line.

Oscillation Circuit

Confirmation on Operation of Oscillation Circuit

【Negative Resistance】

As the figure shows, raise one end of the crystal resonator from the oscillation circuit and insert a resistor (Rs). Change the value of the inserted resistor (Rs). The value at which oscillation stops represents negative resistance. KDS measures the value not only at room temperature but also at low temperature, at high temperature and regards the lowest value as the negative resistance.
The negative resistance value of the circuit should generally be at least five times the standard series resistance.



Measurement Circuit for Negative Resistance

【Load Capacitance】

Minimize the difference of the oscillation frequency by making the load capacitance of a oscillation circuit and that of a resonator equal.

【Drive Level】

Absolute Maximum Value ; See “Drive Level” in the table of each page.
The adequate drive level differs according to the crystal resonator type and overtone order.

MHz Band Crystal Resonators
Fundamental Mode: 300μW max., 200μW max., 100μW max. Overtone Mode: 1mW max., 500μW max.

Tuning Fork Crystal Resonators
2μW max., 1μW max.

The smaller a resonator becomes, the tighter its specification becomes.

(Measurement Method)
Calculation based on the measured amperage flowing through a resonator and the resistance of that with a high-frequency current probe.

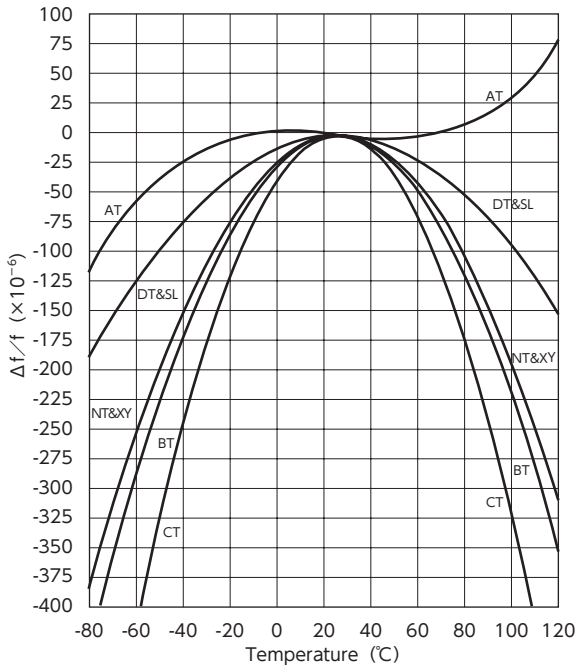
Drive Level $P = (I/2\sqrt{2})^2 \cdot R$

【Inquiry About The Oscillation Circuit】

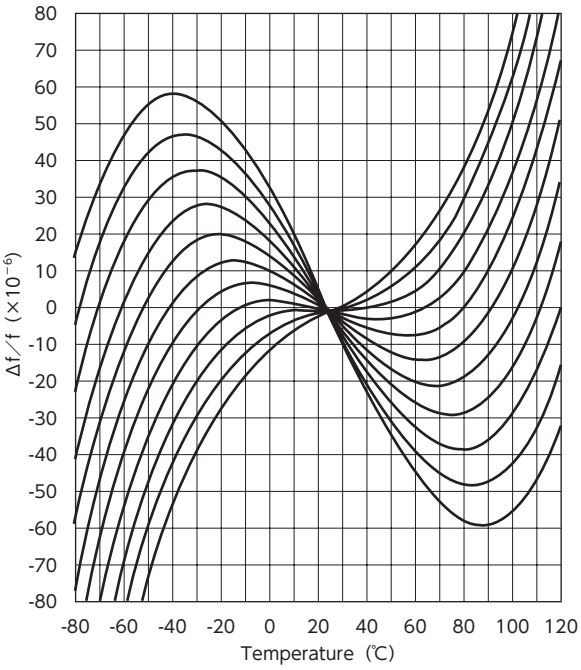
Regarding inquiries concerning oscillation circuit and its matching with the ICs you are using, please directly contact our sales department or leave us an e-mail from our website(click “CONTACT US” from the top page → select “TECHNICAL SUPPORT”).

Cut Angle and Frequency Characteristics over Temperature

Temperature Characteristics for Various Cuts

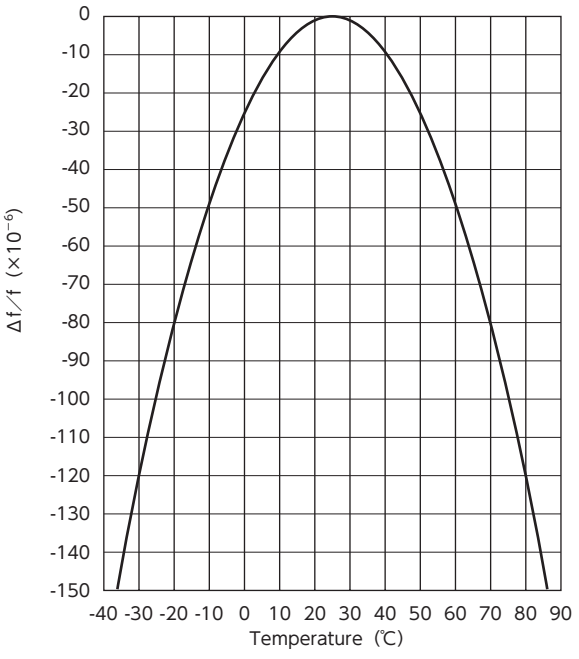


Temperature Characteristics for AT Cuts

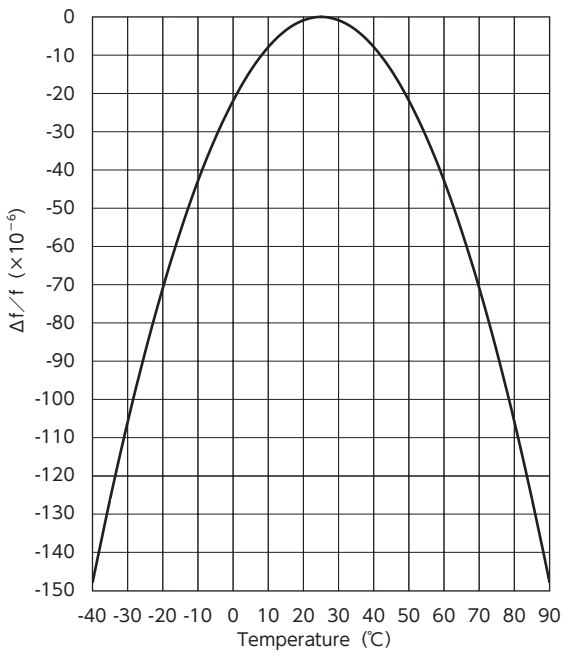


Difference of cutting angle between each temperature curve is 2'.

Temperature Characteristics for BT Cuts

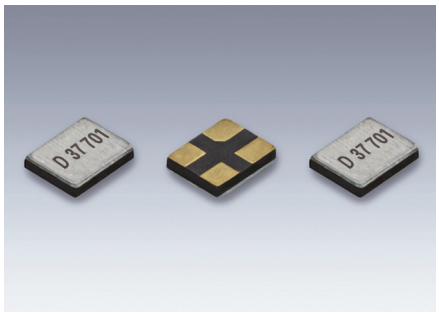


Temperature Characteristics for Tuning Fork Crystal Resonator



SMD Crystal Resonators / MHz Band Crystal Resonators

DSX1210A



Actual size

■ Features

- 1210 size ultra miniature and lightweight SMD crystal resonator with a low profile of 0.28mm
- High precision and high reliability (Frequency aging specification of $\pm1\times10^{-6}$/1 year or $\pm3\times10^{-6}$/5 years is available for cell phone or wireless communication systems etc.)
- Allowing for high density surface mounting.
- AEC-Q200 Compliant

Pb-Free

RoHS Compliant

■ Applications

- Small mobile devices for next generation such as mobile communications, short-range wireless modules, digital AV equipment and PC.
- Wearable devices

■ Standard Specification

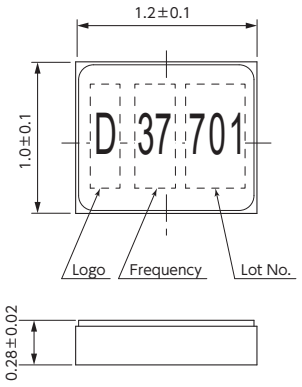
Item \ Type	DSX1210A			
Frequency Range	32MHz	37.4MHz / 38.4MHz / 40MHz	48MHz/52MHz	76.8MHz/80MHz
Overtone Order	Fundamental			
Load Capacitance	8pF, 10pF, 12pF			
Drive Level	10μW (100μW max.)			
Frequency Tolerance	$\pm10\times10^{-6}$, $\pm20\times10^{-6}$ (at 25℃)			
Series Resistance	100Ω max.	60Ω max.	40Ω max.	30Ω max.
Frequency Characteristics over Temperature	$\pm12\times10^{-6}$, $\pm30\times10^{-6}$ / −30 to +85℃ (Ref. To 25℃)			
Storage Temperature Range	−40 to +85℃			
Packing Unit (1)	3000pcs./reel (φ180)			

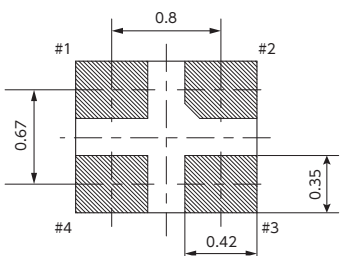
(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level:LEVEL1 (IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

[mm]

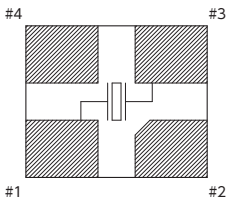
■ Dimensions





■ Internal Connections

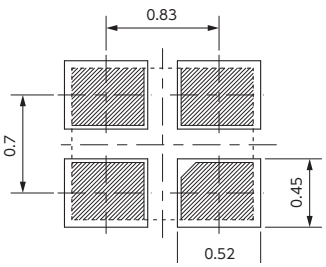
〈Top View〉



1 & # 3 connected to quartz element
2 & # 4 connected to the cover

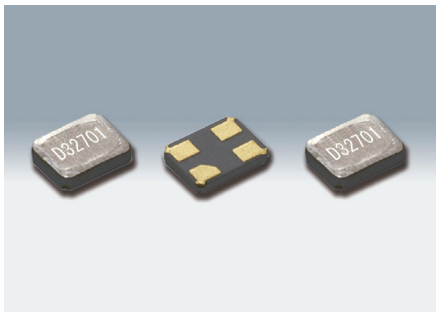
■ Recommended Land Pattern

〈Top View〉



SMD Crystal Resonators / MHz Band Crystal Resonators

DSX1612S



Actual size

■ Features

- 1612 size ultra miniature and lightweight SMD crystal resonator with a low profile of 0.35 mm.
- High precision and high reliability (Frequency aging specification of $\pm1\times10^{-6}$/1 year or $\pm3\times10^{-6}$/5 years is available for cell phone or wireless communication systems etc.)
- Allowing for high density surface mounting.

■ Applications

- Small mobile devices for next generation such as mobile communications, short-range wireless modules, digital AV equipment and PC.
- Wearable devices

Pb-Free

RoHS Compliant

■ Standard Specification

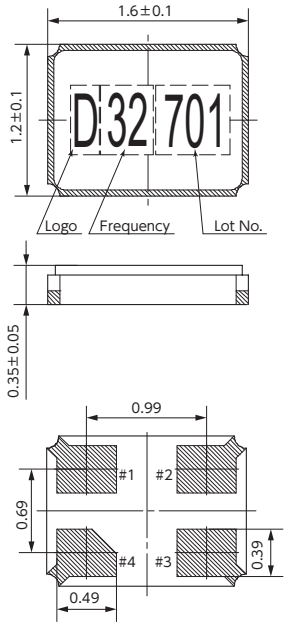
Item \ Type	DSX1612S		
Frequency Range	24 to 32MHz	32 to 40MHz	40 to 54MHz
Overtone Order	Fundamental		
Load Capacitance	8pF, 10pF, 12pF		
Drive Level	10μW (100μW max.)		
Frequency Tolerance	$\pm10\times10^{-6}$, $\pm20\times10^{-6}$ (at 25℃)		
Series Resistance	100Ω max.	50Ω max.	
Frequency Characteristics over Temperature	$\pm15\times10^{-6}$, $\pm30\times10^{-6}$ / −30 to +85℃ (Ref. To 25℃)		
Storage Temperature Range	−40 to +85℃		
Packing Unit (1)	3000pcs./reel (φ180)		

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level:LEVEL1 (IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

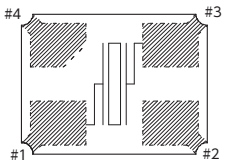
[mm]

■ Dimensions



■ Internal Connections

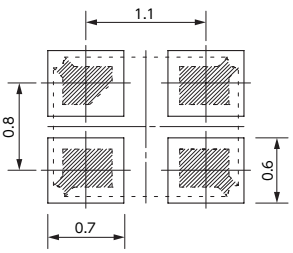
〈Top View〉



1 & # 3 connected to quartz element
2 connected to the cover
4 open (unconnected)
2 & # 4 recommended GND connection

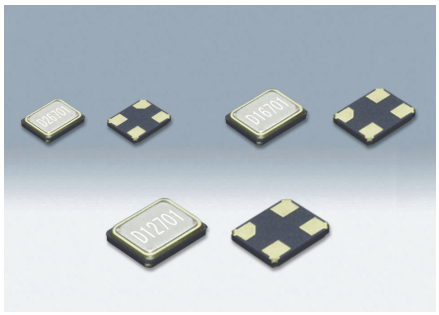
■ Recommended Land Pattern

〈Top View〉



SMD Crystal Resonators / MHz Band Crystal Resonators

DSX211S/DSX211SH/DSX221SH/DSX321SH



Actual size DSX211S/SH ▭ DSX221SH ▭ DSX321SH ▭

■ Features

- Miniature and lightweight SMD crystal resonator
  - DSX211S/SH : 2016 size 0.45mm height
  - DSX221SH : 2520 size 0.45mm height
  - DSX321SH : 3225 size 0.65mm height
- Excellent heat resistance, High precision and high reliability
- Offers a wide range of frequencies
  - DSX211S : 76.8MHz, 80MHz, 96MHz
  - DSX211SH : 16MHz to 60MHz
  - DSX221SH : 12MHz to 54MHz
  - DSX321SH : 12MHz to 50MHz
- AEC-Q200 Compliant (expect for DSX211S)
- Frequency Characteristics over Temperature
  ±50×10^{-6}/ −40 to +105℃ is available for Industrial Equipment.

Pb-Free

RoHS Compliant

■ Applications

- Telecommunication products, short-range wireless modules and other small devices such as DVC, DSC, PC.
- Automotive applications such as multimedia devices (AEC-Q200 Compliant).
- Industrial equipment

■ Standard Specification

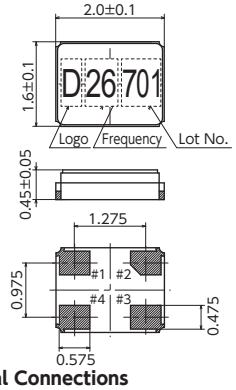
Item \ Type	DSX211SH		DSX211S	DSX221SH			DSX321SH		
Frequency Range	16 to 30MHz	30 to 60MHz	76.8MHz/80MHz/96MHz	12 to 24MHz	24 to 30MHz	30 to 54MHz	12 to 20MHz	20 to 32MHz	32 to 50MHz
Overtone Order	Fundamental								
Load Capacitance	8pF, 10pF, 12pF								
Drive Level	10μW (100μW max.)		10μW (400μW max.)	10μW (200μW max.)					
Frequency Tolerance	±20×10^{-6}(at 25℃)								
Series Resistance	100Ω max.	50Ω max.	30Ω max.	120Ω max.	50Ω max.	40Ω max.	80Ω max.	50Ω max.	40Ω max.
Frequency Characteristics over Temperature	±30×10^{-6} / −30 to +85℃ (Ref. to 25℃)								
Storage Temperature Range	−40 to +85℃								
Packing Unit (1)	3000pcs./reel(φ180)								

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level:LEVEL1 (IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

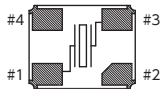
■ DSX211S/DSX211SH [mm]

■ Dimensions



■ Internal Connections

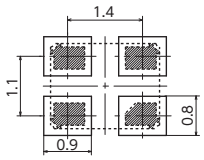
〈Top View〉



#1 & #3 connected to quartz element
#2 & #4 connected to the cover
#2 & #4 recommended GND connection

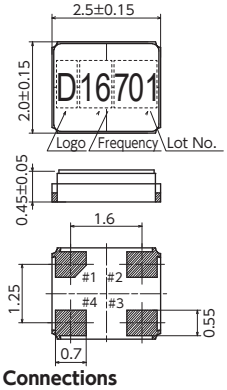
■ Recommended Land Pattern

〈Top View〉



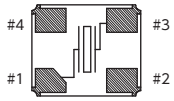
■ DSX221SH [mm]

■ Dimensions



■ Internal Connections

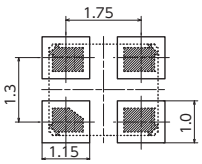
〈Top View〉



#1 & #3 connected to quartz element
#2 & #4 connected to the cover
#2 & #4 recommended GND connection

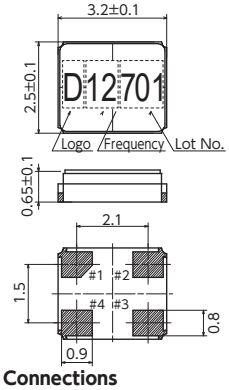
■ Recommended Land Pattern

〈Top View〉



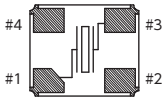
■ DSX321SH [mm]

■ Dimensions



■ Internal Connections

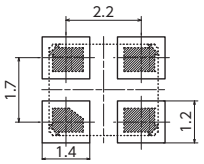
〈Top View〉



#1 & #3 connected to quartz element
#2 & #4 connected to the cover
#2 & #4 recommended GND connection

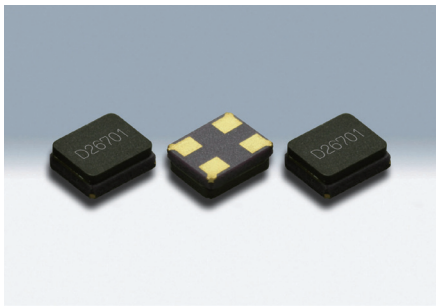
■ Recommended Land Pattern

〈Top View〉



SMD Crystal Resonators / MHz Band Crystal Resonators

DSX211G



Actual size

RoHS Compliant

■ Features

- 2016 size miniature and lightweight SMD crystal resonator with a low profile of 0.65mm.
- High precision and high reliability
- Offers a wide range of frequencies from 20MHz up to 64MHz.
- AEC-Q200 Compliant
- Frequency Characteristics over Temperature ±50×10^{-6}/ −40 to +105℃ is available for Industrial Equipment.

■ Applications

- Telecommunication products and other small devices such as DVC, DSC, PC, USB.
- Automotive applications such as multimedia devices (AEC-Q200 Compliant)
- Industrial equipment

■ Standard Specification

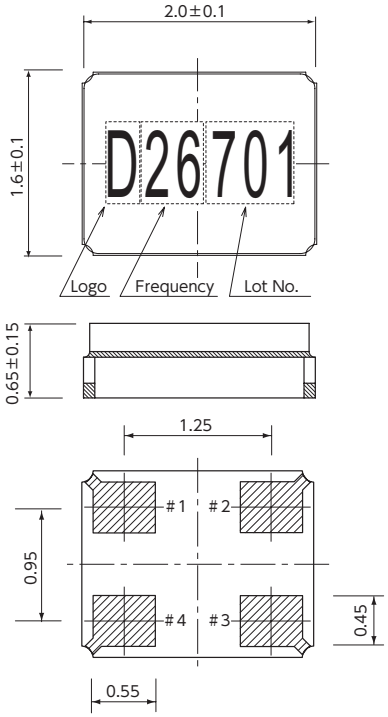
Item \ Type	DSX211G			
Frequency Range	20 to 24MHz	24 to 30MHz	30 to 36MHz	36 to 64MHz
Overtone Order	Fundamental			
Load Capacitance	8pF, 10pF, 12pF			
Drive Level	10μW (100μW max.)			
Frequency Tolerance	±20×10^{-6} (at 25℃)			
Series Resistance	200Ω max.	150Ω max.	120Ω max.	80Ω max.
Frequency Characteristics over Temperature	±30×10^{-6} / −30 to +85℃ (Ref. to 25℃)			
Storage Temperature Range	−40 to +85℃			
Packing Unit (1)	3000pcs./reel (φ180)			

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level:LEVEL1 (IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

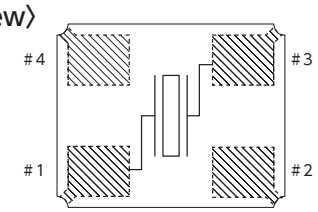
[mm]

■ Dimensions



■ Internal Connections

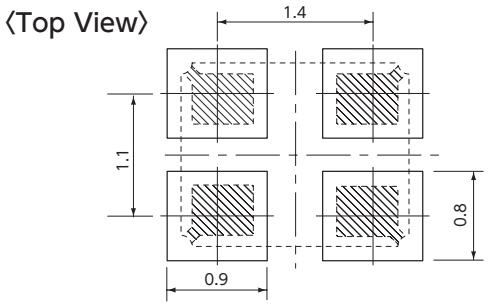
〈Top View〉



#1 & #3 connected to quartz element
#2 & #4 GND connected or N.C. available

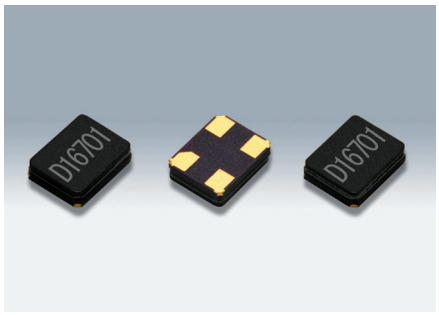
■ Recommended Land Pattern

〈Top View〉



SMD Crystal Resonators / MHz Band Crystal Resonators

DSX321G



Actual size

■ Features

- 3225 size miniature and lightweight SMD crystal resonator.
  Height DSX321G (over 12MHz): 0.75mm
  DSX321G (12MHz or under): 0.85mm
- Excellent heat resistance, High precision and high reliability (Frequency aging specification of $\pm1\times10^{-6}$/1 year or $\pm3\times10^{-6}$/5 years is available for cell phone or wireless communication systems etc.)
- Offers a wide range of frequencies from 7.9MHz up to 64MHz.
- AEC-Q200 Compliant
- Frequency Characteristics over Temperature $\pm50\times10^{-6}$/ −40 to +105℃ is available for Industrial Equipment.

RoHS Compliant

■ Applications

- Telecommunication products, short-range wireless modules and other small devices such as DVC, DSC, PC.
- Automotive applications such as Bluetooth, wireless LAN, GPS/GNSS,RKE (Remote Keyless Entry), safety controls and multimedia devices (AEC-Q200 Compliant)
- Industrial equipment

■ Standard Specification

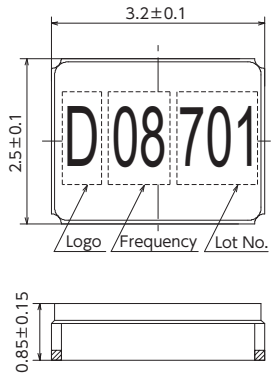
Item \ Type	DSX321G						
Frequency Range	7.9 to 9MHz	9 to 9.8MHz	9.8 to 11MHz	11 to 12MHz	12 to 20MHz	20 to 27MHz	27 to 64MHz
Overtone Order	Fundamental						
Load Capacitance	8pF, 10pF, 12pF						
Drive Level	10μW (200μW max.)						
Frequency Tolerance	$\pm20\times10^{-6}$ (at 25℃)						
Series Resistance	400Ω max.	300Ω max.	150Ω max.	100Ω max.	80Ω max.	60Ω max.	50Ω max.
Frequency Characteristics over Temperature	$\pm30\times10^{-6}$ / −30 to +85℃ (Ref. to 25℃)						
Storage Temperature Range	−40 to +85℃						
Packing Unit (1)	3000pcs./reel (φ180)						

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level:LEVEL1 (IPC/JEDEC J-STD-033)

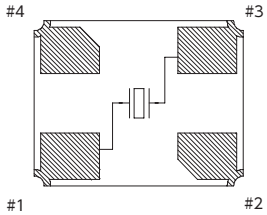
Consult our sales representative for other specifications.

■ DSX321G (12MHz or under) [mm]

■ Dimensions

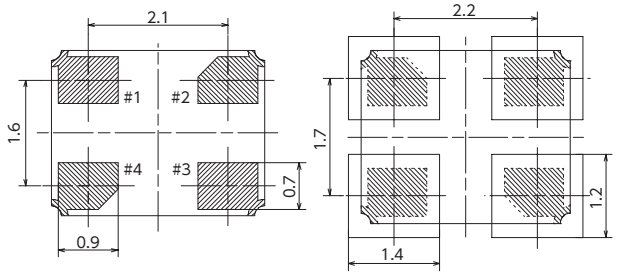


■ Internal Connections
〈Top View〉



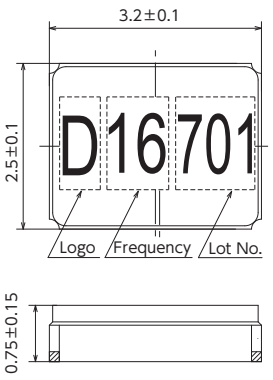
#1 & #3 connected to quartz element
#2 & #4 GND connected or N.C. available

■ Recommended Land Pattern
〈Top View〉

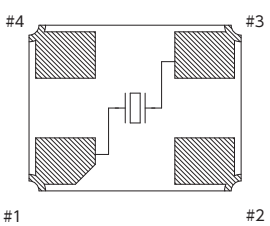


■ DSX321G (over 12MHz) [mm]

■ Dimensions

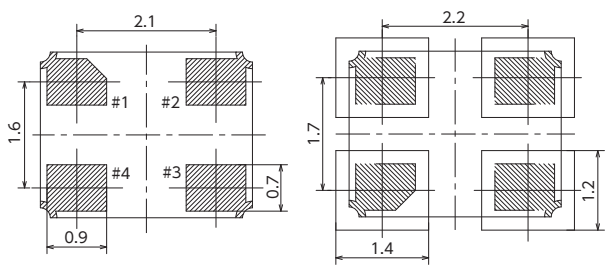


■ Internal Connections
〈Top View〉



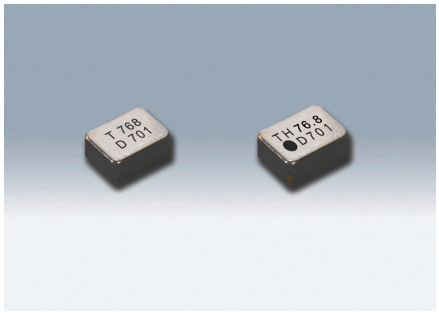
#1 & #3 connected to quartz element
#2 & #4 GND connected or N.C. available

■ Recommended Land Pattern
〈Top View〉



SMD Crystal Resonators with dedicated temperature sensor / MHz Band Crystal Resonators

DSR1210ATH/DSR1612ATH



Actual size DSR1210ATH ▫ DSR1612ATH ▫

■ Features

- DSR1210ATH: 1210size, height 0.45mm
  DSR1612ATH: 1612size, height 0.55mm
- Built-in NTC thermistor

■ Applications

- Mobile phones
- GPS/GNSS
- Wearable devices

Pb-Free

RoHS Compliant

■ Standard Specification

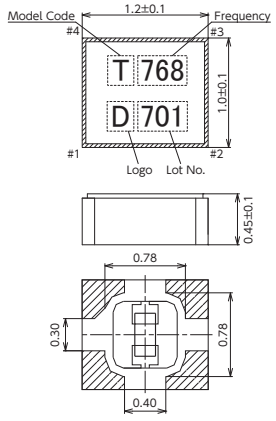
Item \ Type	DSR1210ATH	DSR1612ATH
Frequency Range	76.8MHz	38.4MHz / 52MHz / 76.8MHz
Overtone Order	Fundamental	
Load Capacitance	6pF, 7pF, 8pF	
Drive Level	10μW (100μW max.)	
Frequency Tolerance	±10×10^{-6} (at 25℃)	
Series Resistance	80Ω max.	
Frequency Characteristics over Temperature	±12×10^{-6} / −30 to +85 ℃	
Storage Temperature Range	−40 to +125 ℃	
Thermistor Resistance	100kΩ (at +25℃)	22kΩ / 100kΩ(at +25℃)
Thermistor B-constant	4250K (+25℃ to +50℃)	3380K / 4250K(+25℃ to +50℃)
Packing Unit (1)	3000pcs./reel (φ180)	

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level : LEVEL 1(IPC/JEDEC J-STD-033)

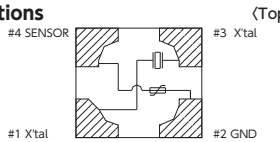
Consult our sales representative for other specifications.

■DSR1210ATH [mm]

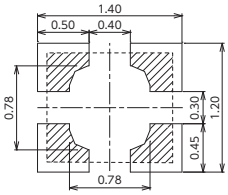
■ Dimensions



■ Internal Connections 〈Top View〉

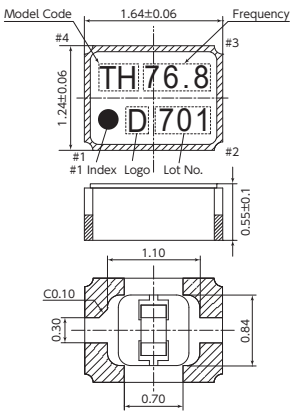


■ Recommended Land Pattern 〈Top View〉

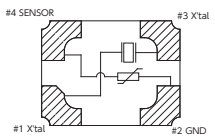


■DSR1612ATH [mm]

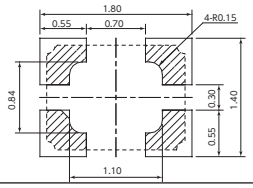
■ Dimensions



■ Internal Connections 〈Top View〉

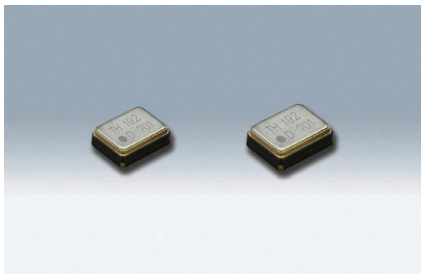


■ Recommended Land Pattern 〈Top View〉



SMD Crystal Resonators with dedicated temperature sensor / MHz Band Crystal Resonators

DSR211STH/DSR221STH



Actual size DSR211STH DSR221STH

■ Features

- DSR211STH: 2016size,
  height 0.7mm (19.2MHz / 26MHz)
  0.6mm (38.4MHz)
  DSR221STH: 2520size height 0.9mm
- Built-in NTC thermistor

■ Applications

- Mobile phones
- GPS/GNSS
- Wearable devices
- UWB

Pb-Free

RoHS Compliant

■ Standard Specification

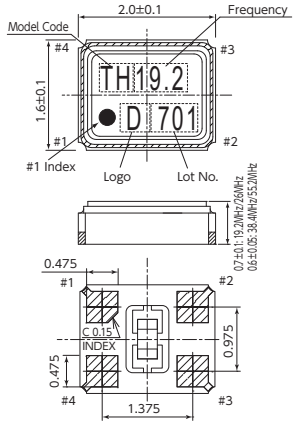
Item \ Type	DSR211STH	DSR221STH
Frequency Range	19.2MHz / 26MHz / 38.4MHz / 55.2MHz	19.2MHz / 26MHz
Overtone Order	Fundamental	
Load Capacitance	6pF, 7pF, 8pF	
Drive Level	10μW (100μW max.)	
Frequency Tolerance	±10×10^{-6} (at 25℃)	
Series Resistance	80Ω max.	
Frequency Characteristics over Temperature	±12×10^{-6} / −30 to +85 ℃	
Storage Temperature Range	−40 to +125 ℃	
Thermistor Resistance	10kΩ / 22kΩ / 100kΩ (at +25℃)	
Thermistor B-constant	3435K (+25 to +85℃) / 3380K / 4250K (+25 to +50℃)	
Packing Unit (1)	3000pcs./reel (φ180)	

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level : LEVEL 1(IPC/JEDEC J-STD-033)

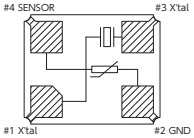
Consult our sales representative for other specifications.

■ DSR211STH [mm]

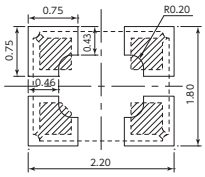
■ Dimensions



■ Internal Connections 〈Top View〉

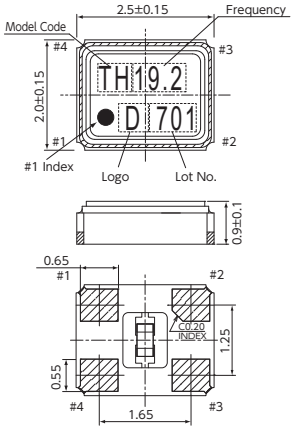


■ Recommended Land Pattern 〈Top View〉

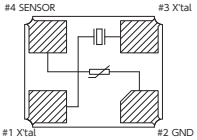


■ DSR221STH [mm]

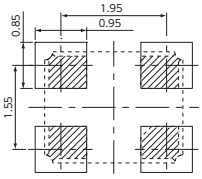
■ Dimensions



■ Internal Connections 〈Top View〉

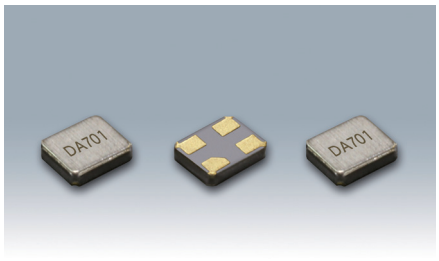


■ Recommended Land Pattern 〈Top View〉



SMD Tuning Fork Crystal Resonators / kHz Band Crystal Resonators

DST1210A



Actual size

■ Features

- 1210 size ultra miniature SMD tuning fork crystal resonator with a low profile of 0.3mm
- A ceramic package with a metal lid providing high precision and reliability.
- Suitable for mobile communications and consumer devices.
- Metal lid connected to GND terminal to reduce EMI.

■ Applications

- Mobile communications and consumer devices, etc.
- Smart card and Wearable devices

Pb-Free

RoHS Compliant

■ Standard Specification

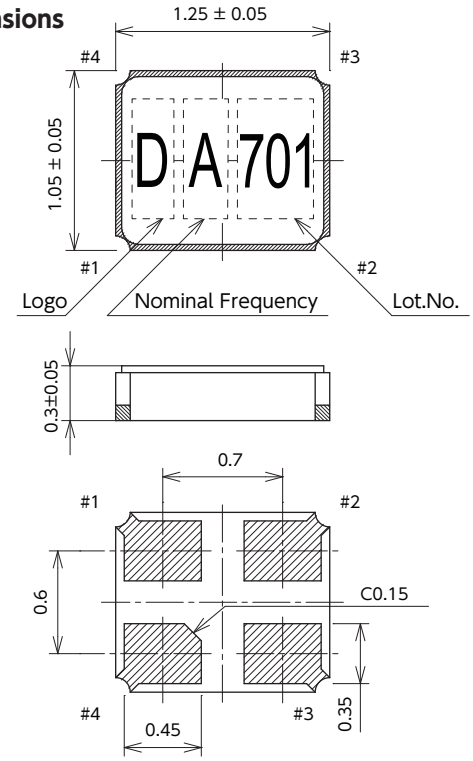
Item \ Type	DST1210A
Frequency Range	32.768kHz
Load Capacitance	7pF, 9pF, 12.5pF
Drive Level	0.1μW (0.2μW max.)
Frequency Tolerance	±20×10^{-6}(at 25℃)
Series Resistance	80kΩ max.
Turnover Temperature	+25℃±5℃
Parabolic Coefficient	−0.04×10^{-6}/℃^{2} max.
Operating Temperature Range	−40 to +85℃
Storage Temperature Range	−40 to +85℃
Shunt Capacitance	1.0pF typ.
Packing Unit (1)	3000pcs/reel (φ180)

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level : LEVEL 1(IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

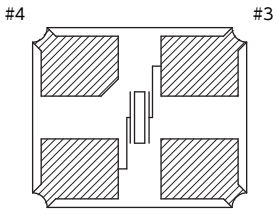
[mm]

■ Dimensions



■ Internal Connections

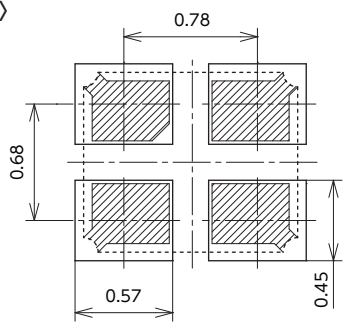
〈Top View〉



1 & # 3 connected to quartz element
2 connected to the cover
4 open (unconnected)
2 recommended GND connection

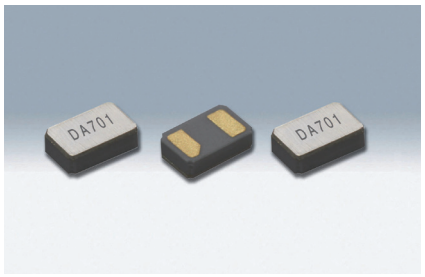
■ Recommended Land Pattern

〈Top View〉

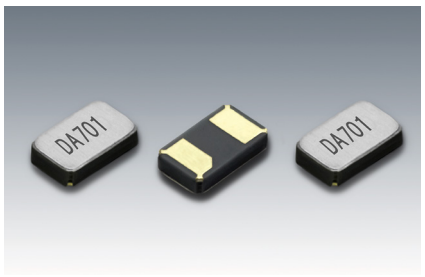


SMD Tuning Fork Crystal Resonators / kHz Band Crystal Resonators

DST1610A/DST210AC



DST1610A Actual size



DST210AC Actual size

■ Features

- Ultra miniature SMD tuning fork crystal resonator
  DST1610A: 1610size, height 0.45mm
  DST210AC: 2012size, height 0.5mm
- A ceramic package with a metal lid providing high precision and reliability.
- Suitable for mobile communications and consumer devices.
- Series Resistance 50kΩ max. available.
- AEC-Q200 Compliant (DST210AC)

Pb-Free

RoHS Compliant

■ Applications

- Mobile communications and consumer devices, etc.

■ Standard Specification

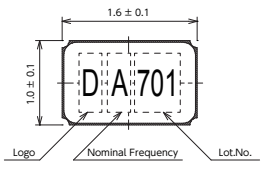
Item \ Type	DST1610A	DST210AC
Frequency Range	32.768kHz	
Load Capacitance	4pF, 6pF, 7pF, 9pF, 12.5pF	6pF, 7pF, 9pF, 12.5pF
Drive Level	0.1μW (0.5μW max.)	
Frequency Tolerance	±20×10^{-6}(at 25℃)	
Series Resistance	50/80kΩ max.	
Turnover Temperature	+25℃±5℃	
Parabolic Coefficient	−0.04×10^{-6}/℃^{2} max.	
Operating Temperature Range	−40 to +85℃	
Storage Temperature Range	−40 to +85℃	
Shunt Capacitance	1.6/1.3pF typ.	
Packing Unit (1)	3000pcs/reel (φ180)	

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level : LEVEL 1(IPC/JEDEC J-STD-033)

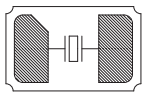
Consult our sales representative for other specifications.

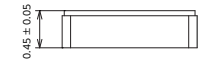
■ DST1610A [mm]

■ Dimensions

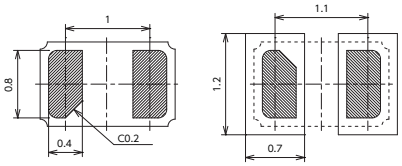


■ Internal Connections



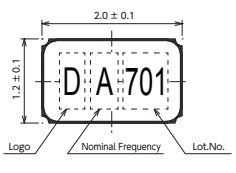


■ Recommended Land Pattern
<Top View>

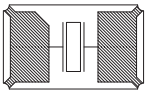


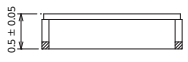
■ DST210AC [mm]

■ Dimensions

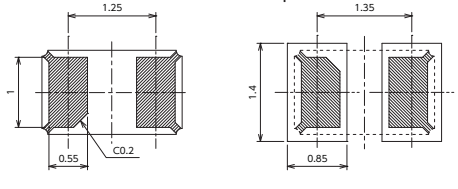


■ Internal Connections
〈Top View〉



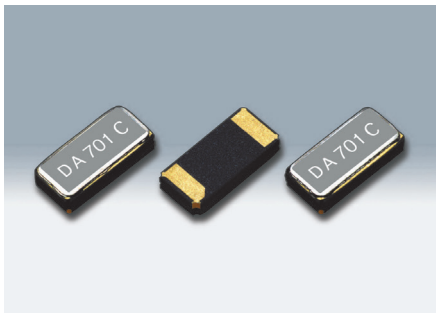


■ Recommended Land Pattern
<Top View>



SMD Tuning Fork Crystal Resonators / kHz Band Crystal Resonators

DST310S



Actual size

■ Features

- 3215 size miniature and lightweight SMD tuning fork crystal resonator with a low profile of 0.75mm.
- A ceramic package with a metal lid providing high precision and reliability.
- Series Resistance 50kΩ max. available.
- AEC-Q200 Compliant

Pb-Free

RoHS Compliant

■ Applications

- Mobile communications, radio-controlled clock, digital home appliances.
- Automotive applications such as multimedia devices (AEC-Q200 Compliant).

■ Standard Specification

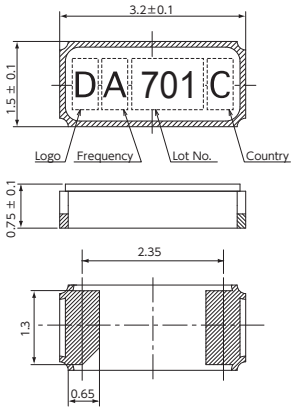
Item \ Type	DST310S
Frequency Range	32.768kHz
Load Capacitance	7pF, 9pF, 12.5pF
Drive Level	0.2μW (1.0μW max.)
Frequency Tolerance	±20×10^{-6} (at 25℃)
Series Resistance	50kΩ max.
Turnover Temperature	+25℃±5℃
Parabolic Coefficient	−0.04×10^{-6}/℃^{2} max.
Operating Temperature Range	−40 to +85℃
Storage Temperature Range	−40 to +85℃
Shunt Capacitance	1.3pF typ.
Packing Unit (1)	3000pcs./reel (φ180)

(1) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level : LEVEL 1(IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

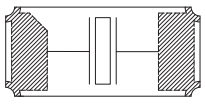
[mm]

■ Dimensions



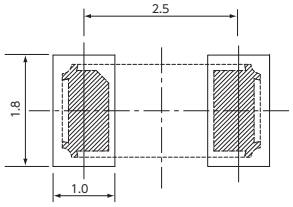
■ Internal Connections

<Top View>



■ Recommended Land Pattern

<Top View>



SMD Tuning Fork Crystal Resonators / kHz Band Crystal Resonators

DMX-26S

Actual size 

■ Features

- Plastic molded SMD tuning fork crystal of heat-resistance DT-26 and DT-261
- Automatic mounting and reflow soldering applicable.
- Suitable for digital AV equipment, PC, gaming equipment as well as many other applications.
- AEC-Q200 Compliant

RoHS Compliant

■ Standard Specification

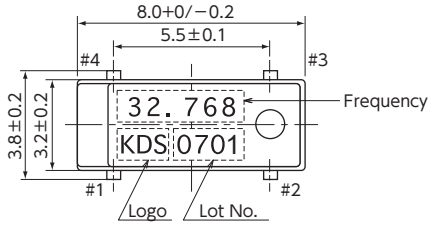
Item \ Type	DMX-26S
Frequency Range	32.768kHz (30 to 90kHz)
Load Capacitance	7pF, 9pF, 12.5pF
Drive Level	1.0μW (2.0μW max.)
Frequency Tolerance	±20×10^{-6}(at 25℃)
Series Resistance	50kΩ max. (1)
Turnover Temperature	+25℃±5℃ (1)
Parabolic Coefficient	−0.04×10^{-6}/℃^{2} max.
Operating Temperature Range	−40 to +85℃
Storage Temperature Range	−40 to +85℃
Shunt Capacitance	1.25pF typ. (1)
Packing Unit (2)	2500pcs./reel (φ330)

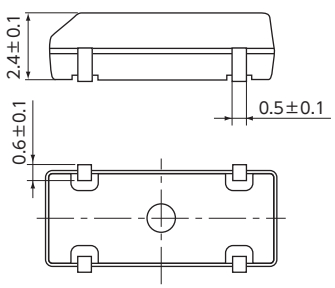
(1) custom specification will be provided for the frequency other than 32.768kHz.
(2) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level : LEVEL 1(IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

[mm]

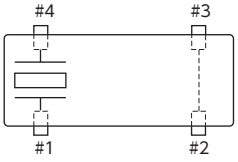
■ Dimensions





■ Internal Connections

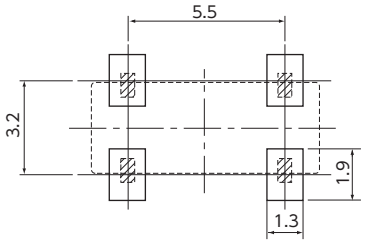
<Top View>



#2 & #3 open (unconnected)

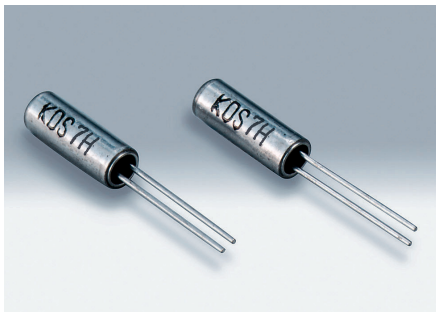
■ Recommended Land Pattern

<Top View>



Tuning Fork Crystal Resonators / kHz Band Crystal Resonators

DT-38, DT-381/DT-26, DT-261



Low power consuming tuning fork crystal resonators are suitable not only for wristwatches but also for a wide range of other applications from industrial equipment to the clock functions in consumer and household electronics.

Pb-Free

RoHS Compliant

■ Features

- A cylindrical type tuning fork crystal resonator

■ Standard Specification

Item \ Type	DT-38	DT-381	DT-26	DT-261
Frequency Range	32.768kHz	20 to 90kHz	32.768kHz	28 to 90kHz
Load Capacitance	12.5pF (1)			
Drive Level	1.0μW (2.0μW max.)			
Frequency Tolerance	±20×10^{-6} (at 25℃)			
Series Resistance	30kΩ max. (2)		40kΩ max. (2)	
Turnover Temperature	+25℃±5℃			
Parabolic Coefficient	−0.04×10^{-6}/℃^{2} max.			
Operating Temperature Range	−10 to +60℃			
Storage Temperature Range	−20 to +70℃			
Shunt Capacitance	1.3pF typ.	(2)	1.1pF typ.	(2)

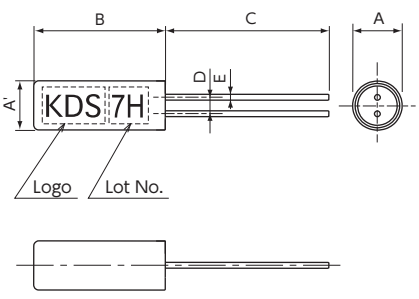
(1) Other capacitance value is available upon your request.
(2) Upon customer request.
(3) Moisture prevention packing is unnecessary.
Moisture Sensitivity Level : LEVEL 1(IPC/JEDEC J-STD-033)

Consult our sales representative for other specifications.

■ Dimensions[mm]

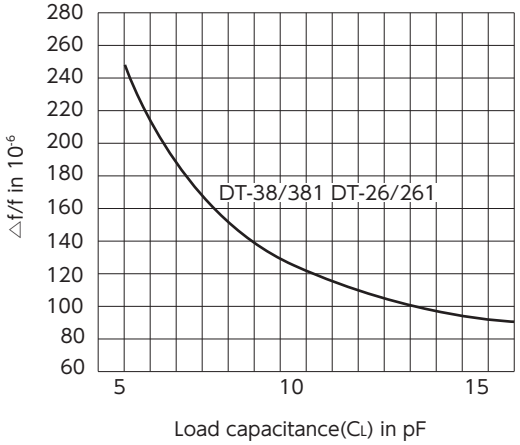
Type	A'	A	B	C	D	E
DT-38, DT-381	φ3.0	φ3.0 $^{+0.1}_{-0.2}$	8.0 $^{+0.3}_{-0.2}$	10.0±1.0	1.1±0.2	φ0.35±0.07
DT-26, DT-261	φ2.0	φ2.0 $^{+0}_{-0.2}$	6.0 $^{+0.1}_{-0.2}$	7.5±1.0	0.7±0.2	φ0.28±0.05

■ Dimensions [mm]

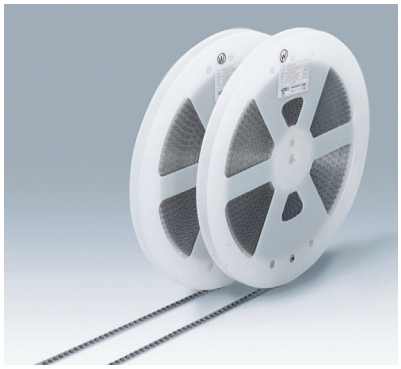


D: Measured from the root of leads

■ Load Capacitance Characteristics (Example)



Emboss Carrier Tape (SMD Crystal Resonators)



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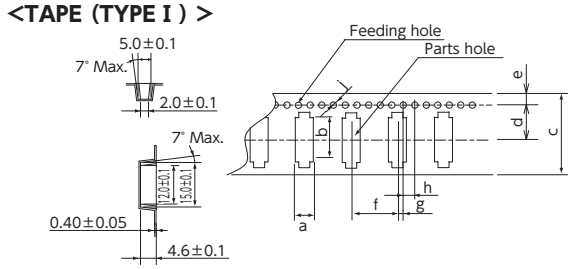
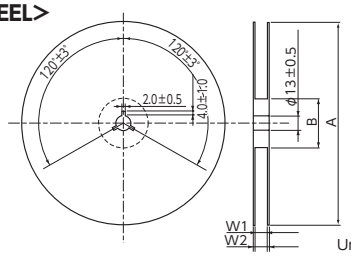


Unit : mm

<REEL>



Unit : mm

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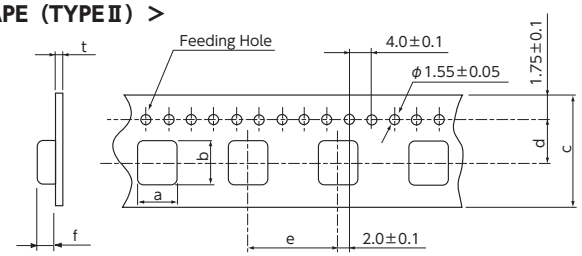

Unit : mm

■ Standard Specification

MHz Band Crystal Resonators / Crystal Resouators with dedicated temperature sensor

TYPEⅡ	a	b	c	d	e	f	t	A	B	W1	W2
DSX530GA/GK	3.6 ±0.1	5.45 ±0.10	12.0 ±0.2	5.50 ±0.10	8.0 ±0.1	1.55 ±0.10	0.30 ±0.05	ϕ180 +0/−3	ϕ60 +1.0/−0	13.0 +0.3	15.4 ±1.0
DSX321G/GK DSX320GE	2.8 ±0.1	3.5 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	1.0 ±0.1	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSX321SH	2.7 ±0.1	3.4 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	1.4 ±0.1	0.25 ±0.05	ϕ180 +0/−3	ϕ60.0 +1/−0	9.0 ±0.3	11.4 ±1.0
DSX221SH	2.25 ±0.1	2.7 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.8 ±0.05	0.25 ±0.05	ϕ180 +0/−3	ϕ60.0 +1/−0	9.0 ±0.3	11.4 ±1.0
DSX211S/SH	1.9 ±0.1	2.3 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.65 ±0.10	0.25 ±0.05	ϕ180 +0/−3	ϕ60.0 +1/−0	9.0 ±0.3	11.4 ±1.0
DSX211G	1.85 ±0.10	2.25 ±0.10	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.95 ±0.10	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSX210GE	2.0 ±0.1	2.4 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.95 ±0.1	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSX1612S	1.45 ±0.15	1.85 ±0.15	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.45 ±0.15	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSX1210A	1.17 ±0.05	1.42 ±0.05	8.0 +0.3/−0.1	3.50 ±0.05	4.0 ±0.1	0.48 ±0.05	0.20 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DX1008JS/JT	1.0 ±0.05	1.2 ±0.05	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.45 ±0.05	0.20 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSR221STH	2.25 ±0.1	2.7 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	1.15 ±0.10	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSR211STH	1.9 ±0.1	2.3 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.85 ±0.10	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSR1612ATH	1.40 ±0.1	1.80 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.70 ±0.10	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DSR1210ATH	1.3 ±0.1	1.5 ±0.1	8.0 ±0.2	3.5 ±0.05	4.0 ±0.1	0.65 ±0.01	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0

kHz Band Crystal Resonators

DMX-26S	4.1 ±0.1	8.5 ±0.1	16.0 ±0.3	7.5 ±0.1	8.0 ±0.1	2.7 ±0.1	0.30 ±0.05	ϕ330 ±2	ϕ80 ±1	17.5 ±1.0	21.5 ±1.0
DST310S	1.70 ±0.05	3.40 ±0.05	12.0 ±0.2	5.50 ±0.05	4.0 ±0.1	0.95 ±0.05	0.25 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	13.0 ±0.3	15.5 ±1.0
DST210AC	1.45 ±0.1	2.3 ±0.1	8.0 ±0.2	3.50 ±0.05	4.0 ±0.1	0.65 ±0.10	0.20 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DST1610A	1.28 ±0.05	1.79 ±0.05	8.0 +0.3/−0.1	3.50 ±0.05	4.0 ±0.1	0.65 ±0.10	0.20 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0
DST1210A	1.17 ±0.05	1.42 ±0.05	8.0 +0.3/−0.1	3.50 ±0.05	4.0 ±0.1	0.48 ±0.05	0.20 ±0.05	ϕ180 +0/−3	ϕ60 +1/−0	9.0 ±0.3	11.4 ±1.0

※1: To indicate product name and other information, place those information on a label, and affix the label on one side of the flange.
2: For DSX321G, DSX1612S pin No.1 is located on the sprocket-hole side of the tape.
3: For other models, the insertion direction is not specified.