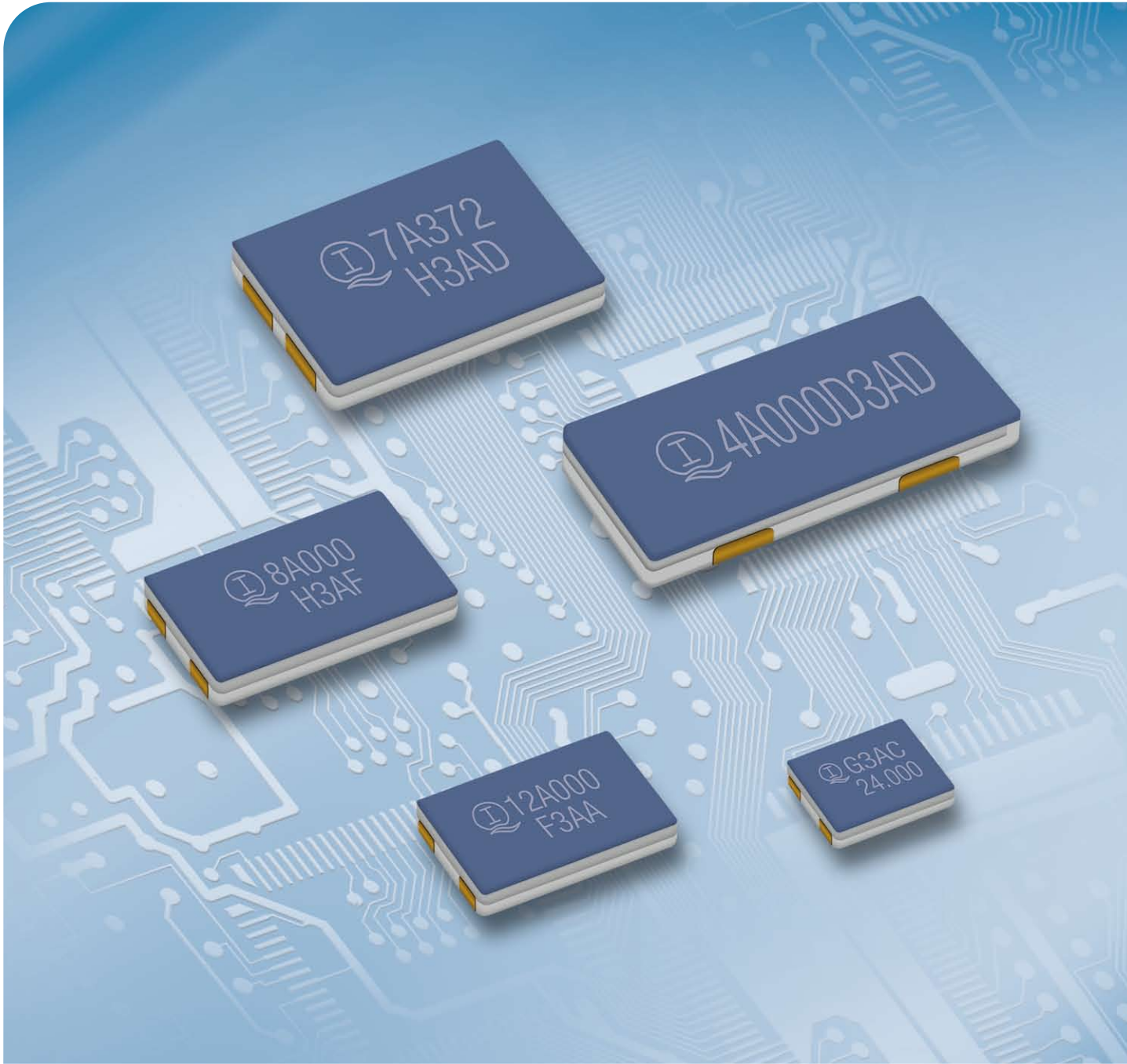




INTERQUIP ELECTRONICS CO LTD
應達利電子有限公司



Professional Manufacturer of Quartz Crystal Devices

Organized for Quality/Dedicated to Service



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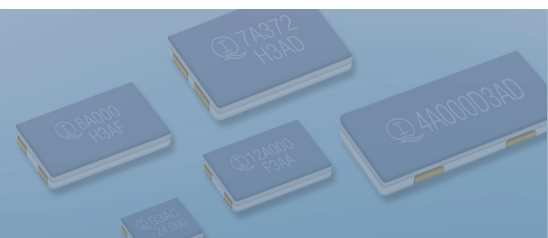
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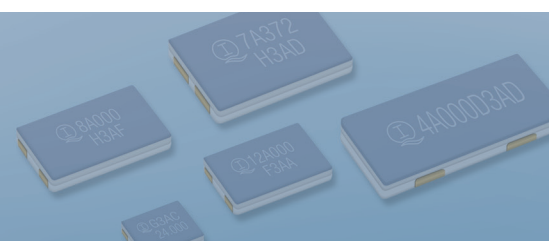
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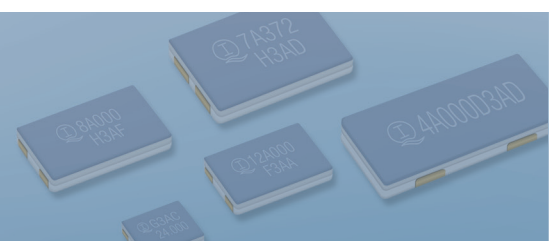
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GENERAL HISTORY

The use of quartz crystals to stabilize the frequency of oscillators can be based on the following important events.

In 1880, during their research into crystalline materials, the Curies noted that when quartz was mechanically deformed a proportional electrical charge was produced. This phenomenon is known as the Piezoeffect. "Piezo" stemming from the Greek language which means pressure.

In 1913 Meissner managed to produce electrical oscillations with the help of feedback. The decisive breakthrough came in 1921 when Cady, with the help of Meissner feedback, made the first successful experiments with piezoelectric resonators of quartz for frequency stabilization.

During the 1960's, the quartz crystal industry underwent substantial changes in both the range of devices which it could offer the electronic industry and also in the level of understanding of the modes of motion in quartz resonators. In the early 1960's Dr. William Shockle present the energy trapping theory for thickness shear modes in high frequency quartz resonators and the invention of the Monolithic Crystal Filter was the result of theoretical and experimental work carried out by Dr. William D. Beaver. Dr. Beaver also applied the theory of Energy Trapping to obtain optimum practical designs for quartz crystal resonators which allow for the optimum suppression of unwanted resonances for specified motional inductances. This work was performed at Bell Telephone Laboratories, Inc. In January of 1970, Dr. Beaver founded Comtec Laboratory which was the start of the formation of the Interquip Group of Companies.

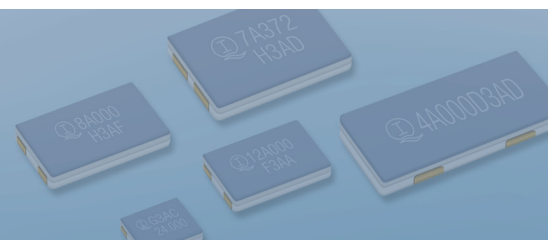
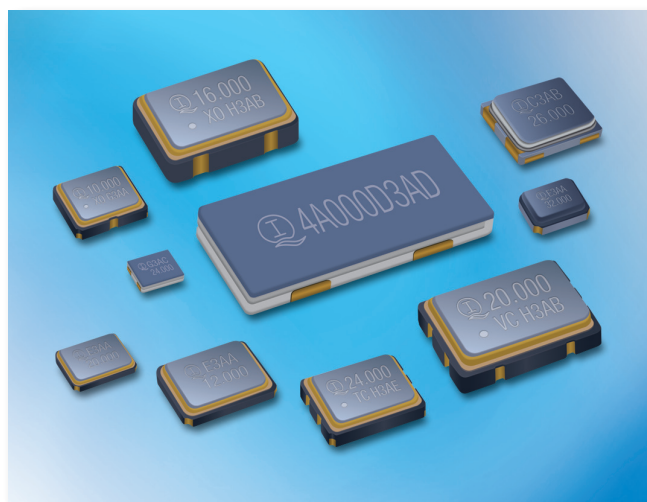
In the early 1970's, work was carried out to develop new and more productive processes and equipment for use in the manufacture of quartz crystal devices. The Interquip Group employs such equipment in the production of standard precision and moderate precision crystal resonators. The development effort is a continuing one and the work to improve quality, and productivity goes on. The current development work involves the design and development of new products. These new products include surface mount quartz resonators

and oscillators which are enclosed in quartz enclosures, which have very low profiles, small volume and weight.

Through out the history of quartz crystal devices, there has been a constant pressure for higher precision, smaller size and lower cost. We at Interquip Electronics are working hard to meet the requirements of the new technologies.

Quartz crystal resonators are manufactured using a more involved process than used to produce any other passive electronic component. And now we face the added challenge of intense product miniaturization. Interquip has met this challenge with breakthrough technology with the development of its SMAQ series of quartz crystal resonators. The new series of resonators are added to Interquip's standard line of ceramic packaged SMT devices, and a large family of source mount quartz resonators of other configurations.

The experience of more than 30 years in the development and manufacture of quartz crystal units and our adherence to strict quality control procedures, enables Interquip to produce quartz crystal devices to meet the highest standards. The technical assistance we supply to our customers and the close cooperation with their design departments, ensures our accurate and economical production of quartz products for their applications.



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APPLICATIONS

Interquip is now supplying quartz crystal devices for the following applications among others:

- Mobile and fixed telephone equipment
- Measuring and test equipment
- Navigation systems
- Broadcast and television receivers
- Crystal controlled clocks
- Entertainment equipment
- Personal computers and peripherals
- Automotive instrumentation and controls
- Wireless network and control equipment

RAW MATERIAL

Of all the known piezoelectric materials crystalline silicon dioxide, SiO₂ is the most practical raw material for resonators. This results from the mechanical and chemical stability together with favorable piezoelectric constants.

The very small internal frictional losses in the material allow for the manufacture of electromechanical resonators of very high quality factors.

Silicon dioxide in nature is found in different forms.

Crystalline quartz is one of these forms. However, quartz of suitable size and necessary purity is seldom found in nature. For that reason the growing process for cultured quartz has been developed. Interquip Limited owns its own facility for growing high purity crystalline quartz.

The synthesis is achieved from hot saturated solutions of silicon dioxide in large steel autoclaves at a temperature of approximately 400°C and a pressure of 2,000 kg/sq.cm.

The growth of the crystals takes place on seed plates which are suspended in the autoclaves. The growth rate can be as much as 2 mm per day. In order to achieve a high purity and high quality quartz a controlled slow rate of growth is preferred.

Natural quartz stones are used as a nutrient in the culturing process. Under the conditions of high temperature and pressure in a caustic aqueous solution the nutrient quartz dissolves and because of a temperature differential which is maintained in the autoclaves, the quartz flows from the nutrient zone of the autoclave to the growth zone. There the quartz nucleates on the seed plates and the crystals grow.

MODES OF VIBRATION AND FREQUENCY RANGES

Like all elastic materials quartz is able to vibrate in many different modes. In each mode of vibration not only the fundamental mode but also overtone modes can be excited.

The frequency range over which quartz crystal resonators are manufactured by Interquip Electronics is from about 1 MHz to 200 MHz, using different modes of device vibration for particular frequency ranges. The acoustic displacement for thickness shear mode resonance is illustrated in Figure 1 and Figure 2.

Thickness Shear Mode Fundamental AT - Cut 1 MHz - 55 MHz Thickness Shear Mode	Fundamental BT - Cut 18 MHz - 80 MHz
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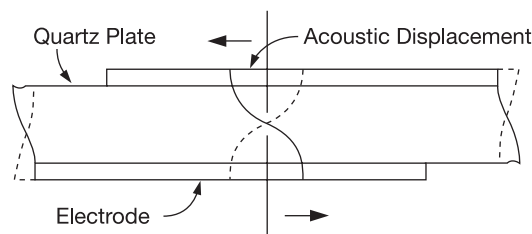


Figure 1 - Fundamental Thickness Shear Deformation

3 to 9 Overtone, AT-Cut, Thickness Shear Mode 5 MHz - 200 MHz

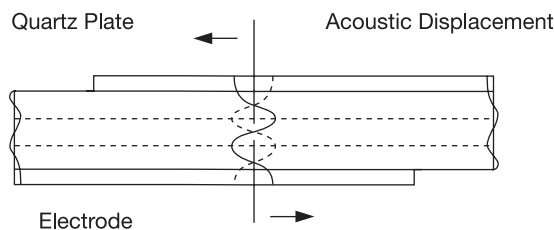
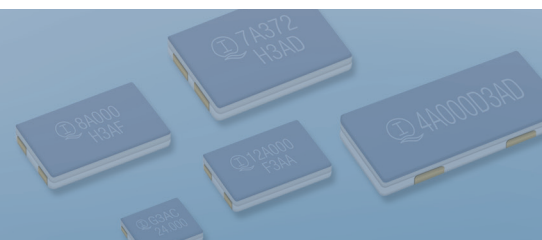


Figure 2 - Third Overtone Thickness Shear Deformation

EXCITATION OF THE RESONATOR

As a result of the piezoelectric effect, quartz is an electro-mechanical transformer. A mechanical deformation is excited by the application by an electrical a.c. field. The magnitude of the deformation depends on the frequency of the applied a.c. field



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relative to the resonant frequency of the quartz element, which is determined mainly by the crystallographic orientation of the quartz element, the dimensions of the quartz element and the electrodes which are applied to its surfaces.

The field is applied to the crystal by electrodes of a very thin metal film which is evaporated onto the surface of the crystal element under high vacuum.

The size of the electrodes also establish the parameters of the equivalent electrical circuit of the quartz resonator.

For each mode of vibration, there is an optimal angle of cut, with respect to the crystallographic axes of the quartz, which controls the deviation of frequency of the quartz crystal resonator over the temperature range.

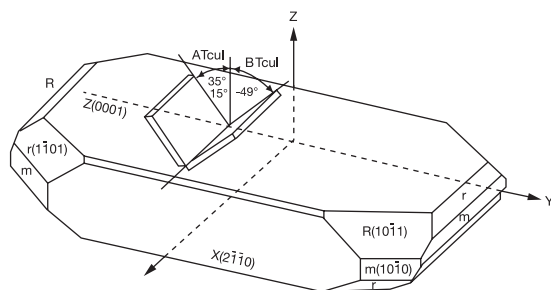


Figure 3 - Orientation angle of a Z-plate quartz crystal

DEFINITIONS AND CHARACTERISTICS

Quartz Crystal Resonator

Quartz crystal resonators are passive electrical components which are electro-mechanical resonators with very low loss during resonance. The natural frequency of these resonators results from the vibrating mass and the elasticity of the quartz medium. The mechanical vibration is excited by means of the piezoelectric effect of the crystalline quartz.

The quartz crystal resonator consists of a quartz element with electrodes on its major surfaces, which is mounted onto a support and encapsulated in a hermetically sealed enclosure. The quartz crystal resonator has two leads or terminals and in some applications. A third lead is attached to the metal enclosure to allow it to be grounded.

Mode of Motion

The resonator is designed for a certain mode of motion such as,

thickness shear mode. Furthermore the overtones of these modes of motion can be excited.

Oscillator Crystal - Filter Crystal

According to their application, we distinguish between resonators which are designed for oscillator and filter applications.

Oscillator Crystal is the term given to quartz resonators which are used in oscillator circuits to control and stabilize the frequency. Oscillators are circuits which output a signal having very stable frequency, which are employed in wireless applications as a carrier frequency signal and in digital application as a clock signal.

Filter Crystal is the term given to quartz resonators which are used in filter networks to determine the transmission properties of the network. The characteristics of the quartz crystal filters are determined by the equivalent parameters of the quartz crystal resonators. Crystal filters are electrical circuits which are employed to select a band of frequencies.

Quartz Crystal Resonator Equivalent Circuit

The equivalent parameters of a quartz resonator are represented in the crystal equivalent circuit, which is shown in Fig.4

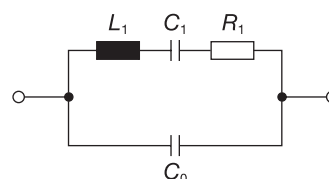


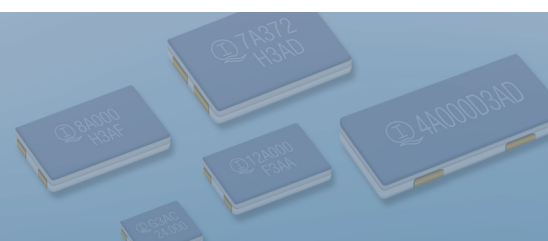
Figure 4

Motional Inductance, L_1

The motional inductance, L_1 , corresponds to the vibrating mass of the quartz resonator. For thickness shear mode resonators the motional inductance is inversely proportional to the effective electrode area.

Motional Capacitance, C_1

The elasticity of the quartz resonator appears as a motional capacitance, C_1 . Compared with the capacitances of LC-circuits usually used in communications circuits, the motional capacitance of quartz crystal resonators are relatively small values, and the value is directly proportional to the area of the electrode on the quartz element.



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Motional Resistance, R_1

The motional resistance is a measure of the dissipated energy of the quartz crystal resonator during resonance. Many factors contribute to the value of the motional resistance including the internal Q of the quartz, the surface finish of the quartz element, the degree of energy trapping and the area and thickness of the electrode being some of the more important factors.

Shunt Capacitance, C_0

The shunt capacitance, C_0 , results from the static capacitance between the electrodes on the quartz element plus the capacitance of the mounting structure and enclosure.

Quality Factor, Q

The quality factor Q is the ratio of stored energy to dissipated energy during resonance. Its value is given by the Equation 1. Common values for the quality factor Q of quartz crystal resonators range from 25,000 to 300,000. Quality factors up to 2,000,000 can be achieved with high precision crystals.

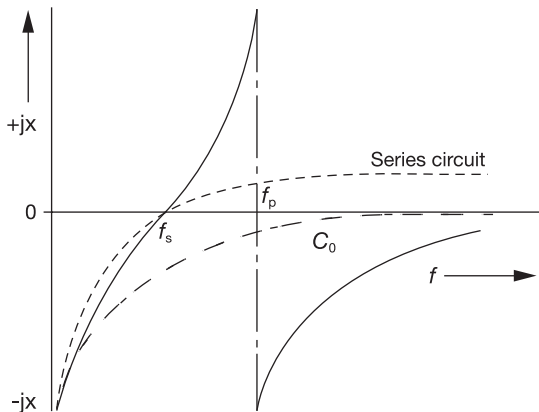


Figure 5 - The reactive impedance of the equivalent circuit.

Quality factor

$$Q = \frac{2\pi f_s L_1}{R_1} = \frac{1}{2\pi f_s R_1 C_1} \quad \text{Eqn. 1}$$

Series Resonant Frequency, f_s

(refer to Eqn. 2 and 3) Neglecting the losses an ideal series resonant frequency f_s may be calculated by using Equation 2 and an ideal parallel resonant frequency f_p is obtained, by using Equation 3.

The series resonant frequency is the frequency for which the impedance shown in Fig.4 becomes zero if the motional resistance, R_1 , is neglected.

Series resonance frequency

$$f_s = \frac{1}{2\pi\sqrt{L_1 C_1}} \quad \text{Eqn. 2}$$

Parallel resonance frequency

$$f_p = \frac{1}{2\pi\sqrt{\frac{C_0 \cdot C_1}{C_0 + C_1} L_1}} \quad \text{Eqn. 3}$$

Parallel Resonant Frequency, f_p

At the parallel resonant frequency, f_p , the impedance becomes infinite if the motional resistance, R_1 , is neglected. The frequency difference between the series resonant frequency and the parallel resonant frequency is given by the Equation 4.

Relative frequency difference

$$C_1 = C_0/r n^2 \quad \text{Eqn. 4}$$

Ratio of Capacitance, r

The ratio of capacitance, r , given by Equation 5, varies and is characteristic of the mode of vibration, the crystal cut and the enclosure. Example: For AT-cut crystals operating in the fundamental thickness shear mode, r is greater than 200 and is typically 250. When thickness shear mode crystals operate in the overtone mode, the value of r must be multiplied by the square of the order of the overtone, n , as is shown in Equation 6.

$$r = C_0/C_1 \quad \text{Eqn. 5}$$

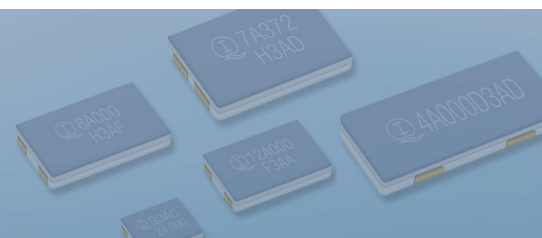
$$r n - r n^2 \quad \text{Eqn. 6}$$

As the static capacitance C_0 produced by the electrodes and enclosure remains constant, the dynamic capacitance C_1 will diminish by the factor of n^2 in the overtone mode as is shown in Equation 7.

$$\frac{f_p - f_s}{f_s} = \frac{1}{2} - \frac{C_1}{C_0} = \frac{1}{2r} \quad \text{Eqn. 7}$$

Impedance Locus of the Resonant Frequency, f_r Frequency of Minimal Impedance, f_m Impedance at Zero Phase Angle, R_r

The impedance locus, which shows the real and imaginary component of the impedance of the resonator as a function of frequency, illustrates that, because of the presence of the parallel capacitance, the resonator is not purely resistive at the series resonance frequency, see Fig.6. The frequency near the series resonance, at which the crystal is resistive is called resonant frequency, f_r . The frequency at which the impedance of the crystal is at its minimum, is called the frequency of minimal impedance, f_m . The spacing of these frequencies become larger with increasing distance of the center of the impedance circle from the real axis which is directly related to $1/\omega C_0$, and the resonant resistance,



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R_1 , belonging to f_r becomes higher. As the diameter of the circle depends on X_0 and the distance of the circle center to the real axis depends on X_0 , the circle sags with decreasing X_0 relatively against the real axis. Finally, the crystal becomes no longer resistive at any frequency at a certain ratio of X_0 / R_1 , see Fig. 7.

In that case the parallel capacitance, C_0 , has to be compensated by an inductance in parallel to the crystal.

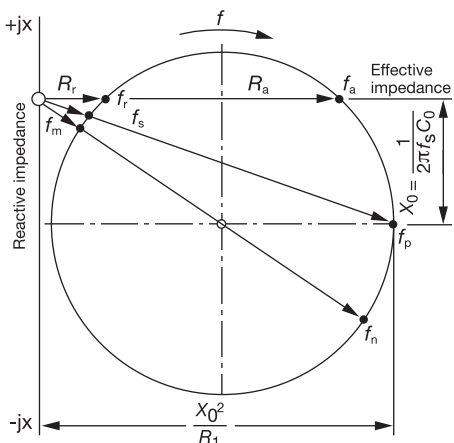


Figure. 6

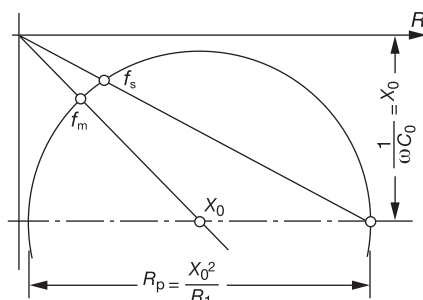


Figure. 7

Frequency of Maximal Impedance, f_n Antiresonant Frequency, f_a Antiresonant Resistance, R_a

Near the parallel resonance appears accordingly the frequency of max. impedance f_n , and the antiresonance frequency f_a with the corresponding antiresonance resistance R_a .

Resonant frequency, f_L with Load capacitance, C_L

By a series connection of a load capacitance with the quartz resonator, Fig.8, the resonant frequency is pulled higher to the load resonant frequency f_L . This frequency also appears, if the load capacitance is connected in parallel to the quartz crystal, see Fig.9. For the definition of the load capacitance occurring in a circuit, the stray capacitance between the components and the electrical connections as well as the internal capacitances of the

semiconductor devices must be taken into consideration. The relative frequency changes resulting from the load capacitance versus the series resonance frequency is expressed in the Equations 8 and 9.

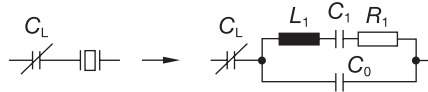


Figure 8

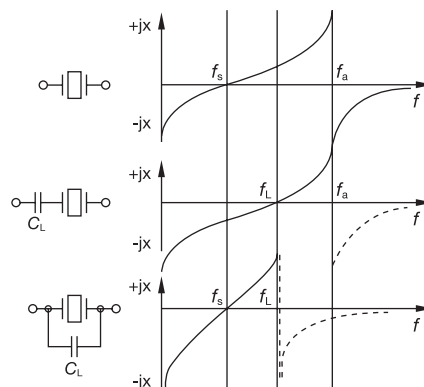


Figure 9

Relative frequency change

$$L_0 = \frac{f_L - f_s}{f_s} = \frac{C_1}{2(C_0 + C_L)} \quad \text{Eqn. 8}$$

Frequency offset

$$L_0 = \frac{f_L - f_r}{f_r} = \frac{C_1}{2(C_0 + C_L)} \quad \text{Eqn. 9}$$

Load Resonance, Pulling Range

The frequency change resulting from the effect of the load capacitance is also called frequency offset L_0 which is given by Equation 8. Using a variable load capacitance (trimmer), we can obtain the pulling range with C_{L1} and C_{L2} for minimal and maximal value of the load capacitance. This pulling range is given by Equation 10. For small changes, we obtain by differentiating.

Pulling range

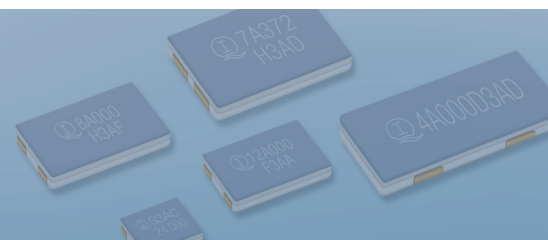
$$\frac{f_{L1} - f_{L2}}{f_s} = C_1 \frac{C_{L2} - C_{L1}}{2(C_0 + C_{L1})(C_0 + C_{L2})} \quad \text{Eqn. 10}$$

Pullability

The relative frequency change for a given change of the load capacitance is also called pullability of the quartz crystal. This is given by Equation 11.

Pullability

$$S = \frac{f_{L1} - f_{L2}}{f_s (C_{L1} - C_{L2})} = \frac{df}{fdC_L} = \frac{C_1}{2(C_0 + C_L)^2} \quad \text{Eqn. 11}$$



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Equivalent Series Resistance (ESR) R_L

The combination of load capacitance and quartz crystal unit can be regarded as a new quartz crystal resonator with transformed equivalent parameters. For series connection of load capacitance and quartz we have the equivalent series resistance R_L , which is given by Equation 12.

Equivalent series resistance

$$R_L = R_1 \left(1 + \frac{C_0}{C_L} \right)^2 \quad \text{Eqn. 12}$$

It must be taken into consideration that stray capacitances, C_0 (parallel to the quartz crystal unit), or parts of the load capacitance have to be added to the value of C_0 . That means that the actual effective series resistance in the circuit may be substantially increased by stray capacitances being in parallel to the quartz crystal unit.

Equivalent Parallel Resistance (EPR) R_{aL}

For parallel connection we obtain the equivalent parallel resistance by using Equation 13.

Equivalent parallel resistance

$$R_{aL} = \frac{1}{R_1 (2\pi f a)^2 (C_0 + C_L)^2} \quad \text{Eqn. 13}$$

Frequency Deviation versus Temperature

The frequency of a quartz resonator is a complex function of the temperature coefficients of the elastic constants of the quartz. Therefore, the temperature coefficients are not specified, but the allowed frequency change in a particular temperature range is specified. We define temperature ranges as follows:

Operating Temperature Range

The operating temperature range is the temperature range in which the quartz crystals resonators meet all specified requirements.

Operable Temperature Range

The operable temperature range is the temperature range in which resonators can be operated, i.e. in which crystal resonators function but do not necessarily meet specified tolerances.

Storage Temperature Range

The transport and storage temperature range is the temperature range in which crystal resonators may be stored or transported for brief periods. The resonators should not be affected by storage at these temperatures.

Frequency Deviation versus Temperature for AT-Cut Quartz Crystals

Within the operating temperature range, the frequency deviation versus temperature is normally stated as maximum frequency change, usually in relation to the stray capacitances nominal frequency at a defined reference temperature. The reference temperature is usually $+25^\circ\text{C}$. For the AT-cut thickness shear mode of oscillation, the frequency deviation versus temperature is equivalent to a cubic equation (Fig.10).

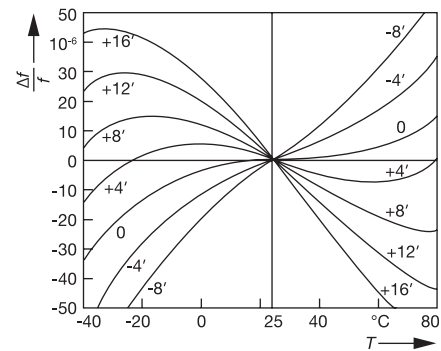


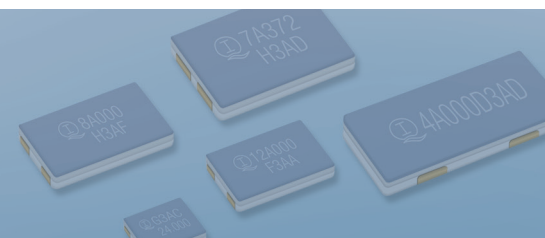
Figure 10

The slope at the point of inflection (at around $25\text{...}30^\circ\text{C}$) can be present within specified tolerances by choice of the angle of cut. Fig.10 shows the frequency deviation versus temperature as example for seven different angles of cut. For these characteristic curves of the frequency deviation versus temperature there result a different optimal angle for cut for each temperature range. Physical limits are thus imposed on the minimization of frequency change in a specified temperature range, whereby dispersions of the cut angle caused by manufacturing also have to be taken into consideration. The frequency changes valid for certain temperature ranges, considering different angles of cut, are shown on Fig.10.

Frequency Deviation Versus Temperature for BT-Cut Quartz Crystal

The frequency deviation versus temperature for BT-cut, can be given by the approximate Equation 14. The constant "a" is a characteristic quantity for mode of vibration and cut. The turnover point temperature T_0 of the parabola (temperature coefficient-0) is influenced within certain limits by the choice of the angle of cut. Fig.11 shows the frequency deviation versus temperature for the BT-cut quartz resonator. The approximate value of "a" is $0.042\text{PPM}/(\text{Deg.C})^2$. For the determination of tolerances the scattering of the values of "a" and T_0 has to be taken into account.

$$\frac{\Delta F}{F} = -a (T - T_0)^2 \quad \text{Eqn. 14}$$



Technical Survey

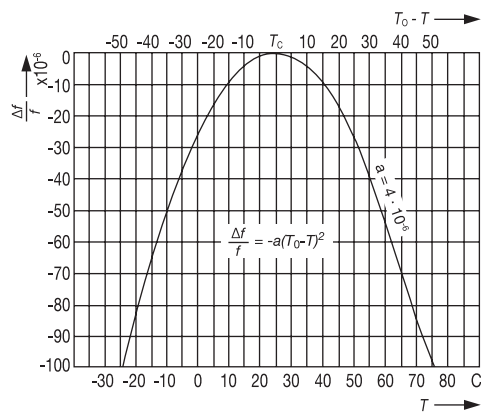


Figure 11

Drive Level, DL

The amplitude of mechanical vibrations of quartz crystals is proportional to the amplitude of the current flowing through the resistance R_1 . An excessive rise of current can result in the destruction of the quartz blank by exceeding the tensile strength of the quartz crystal. Before reaching this limit of tensile strength, the elastic features of the quartz material will change, which results in a change of the resonance frequency. Due to the drive level, $I^2 R_1$, local warming in the quartz blank results in a frequency change. The magnitude and direction of these frequency changes are dependent on the quartz current, resonance resistance, frequency, vibrator dimensions and angle of cut. Therefore, no generally accepted data can be given about the frequency dependence on drive level.

Rated Drive Level

When ordering quartz crystals, the customers should specify the drive level during operation to ensure that during manufacture the crystal may be adjusted to nominal frequency with the correct drive level. This drive level is stated as power or voltage at a specified resonant resistance.

Low Drive Level

As important as specifying the maximum value of drive level, is the specification of the minimum drive level that the resonator will experience. If the application circuit in which the resonator must function, will provide the resonator with a drive level of less than 20 micro watts, it may be necessary to process the resonators to function in such a circuit. The minimum drive level must be specified.

Aging

Aging of quartz crystal resonators (frequency aging) means the relative frequency change over a certain period of time. The largest aging rate occurs during the first weeks after manufacture of quartz crystals. The aging rate normally decreases exponentially with time. The aging test is carried out according to IEC 68-2-2. The test

specifies the relative frequency change between measurements at the second and thirty-first day. During this time the crystals are passively stored at a temperature of +85°C, or other higher temperature to accelerate the aging process.

Frequency Tolerances

The frequency tolerances are the permissible deviation from nominal frequency under specific test conditions.

They include:

- the adjustment tolerance,
- the frequency change dependent on temperature,
- the frequency change dependent on time,
- the frequency change caused by drive level,
- the frequency change due to specified mechanical stress, shock and vibration.

Accuracy of Adjustment

The adjustment tolerance is the permissible deviation from the nominal frequency due to variation in manufacture. It is stated as relative to the frequency at a given temperature, generally, 25°C.

Standard values for AT-cut crystals are +50PPM, +30PPM, +20PPM, +10PPM and +5PPM.

Spurious Responses

In addition to its main resonance each crystal has other resonances which are known as spurious responses, which are normally much higher in ESR than the main resonance. In the case of thickness shear mode crystals the spacing between the main resonance and the spurious responses are relatively small, so that interference is possible, if the spurious responses are not sufficiently suppressed in activity for special applications. For the suppression of the spurious responses, the required values of the motional capacitance and inductance are a factor. A high suppression of the spurious responses is usually only possible for small values of the motional capacitance.

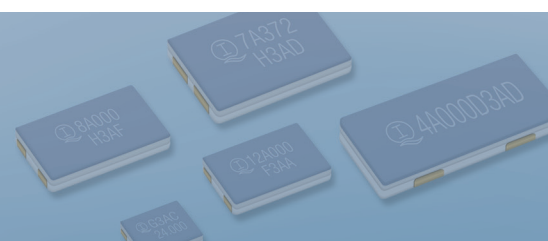
Spurious Response Suppression

The suppression of spurious responses is expressed by the relationship of main resonance resistance to the resistance of the strongest spurious responses, generally given by the ratio in dB.

In general, for oscillator crystals a suppression of the spurious responses, with respect to the main resonance resistance of 4 dB is satisfactory, whereas crystals used in filter applications may require a suppression of more than 40dB.

QUARTZ CRYSTAL MEASUREMENTS

Methods of the measurement of quartz crystal unit parameters



Technical Survey

Two methods are generally used in the characterization of quartz crystal resonators. The methods are given below:

- a) **Active Method** - IEC Method 302 in which a test oscillator is employed, and
- b) **Passive Method** - IEC Method 444 in which a standard Pi-Circuit is employed.

Active Method

In this method the quartz crystal unit parameters, which include resonant frequency f_r , motional resistance R_1 , motional capacitance C_1 and motional inductance L_1 , Load resonant frequency f_l , and Load resonant resistance can be measured and calculated. The temperature dependence of the parameters can also be measured.

With the active method the quartz crystal units can be measured fast and inexpensively. But because of the accuracy limitations, it is not recommended where frequency tolerance of +5PPM or less is required.

The method, which is stipulated in IEC Publication 302, involves the substitution of two load capacitance C_{L1} and C_{L2} of precisely known values. Using two load capacitances minimize the effect of stray capacitance on the results of the measurement.

In the active method the quartz crystal unit is employed as the frequency determining unit to the feedback path of the test oscillator. The frequency of the quartz unit is indicated on a frequency counter. R_1 can be determined by substitution of non-inductive resistor, and comparing the amplitude of the signal of the oscillator to the amplitude when the resonator is in the circuit. When the amplitudes are equal then the R_1 of the resonator is considered to be that of the substituted resistor.

To determine the values of the motional parameters the series resonant frequency, f_r , is measured without the presence of a load capacitance and the load resonant frequencies, f_{L1} and f_{L2} , are measured by sequentially switching in the 2 load capacitances C_{L1} and C_{L2} in series with the resonator under test.

Three resonant frequencies are then known which are f_r , the series resonant frequency with out load capacitance, f_{L1} the loaded resonant frequency with load capacitance C_{L1} and f_{L2} the loaded resonant frequency with load capacitance C_{L2} . With these five known and measured values the value of the shunt capacitance C_0 , the value of the motional capacitance C_1 and the value of the motional inductance L_1 may be calculated from Equations 15, 16 and 17 respectively.

The shunt capacitance

$$C_0 = \frac{C_{L2}(f_{L2}-f_r) - C_{L1}(f_{L1}-f_r)}{f_{L1} - f_{L2}} \quad \text{Eqn. 15}$$

The motional capacitance

$$C_1 = \frac{2(f_{L2}-f_r)}{f_r} (C_0+C_{L2}) \quad \text{Eqn. 16}$$

The motional inductance

$$L_1 = \frac{1}{8\pi^2 f_r (f_{L2}-f_r) (C_0+C_{L2})} \quad \text{Eqn. 17}$$

Note that in Equation 16 and 17 that f_{L1} may be exchanged for f_{L2} if the exchange is made of C_{L1} for C_{L2} in the corresponding equation.

Interquip Limited employs both computer assisted manual and fully automatic testing facilities, which utilize this testing procedure.

Passive Method

In this method, the measurements are made with the resonator in a -network according to IEC Publication 444. The test circuit is shown in Figure 12. Using this test arrangement, it is possible to measure the zero phase frequency, the three dB bandwidth of the resonator, and the ESR by comparing the transmission amplitude of the -circuit with the resonator in the circuit and when short circuited. Knowing the ESR and the 3dB bandwidth, the values of the motional capacitance and inductance may be calculated using Equations 18, 19 and 20 which are given below. Also, by measuring the transmission amplitude at a frequency and comparing it with the short circuit value the static capacity, may be calculated.

The accuracy of the determined values of C_1 and L_1 depends on the accuracy of the measured value of R_1 .

At Interquip, the measurements of the crystal units with frequencies higher than 100MHz are made with compensated C_0 (if not otherwise required). The C_0 compensation is made with a coil and varactor circuit in parallel with the crystal unit. During the calibration cycle, the coil is automatically tuned with a varactor so as to essentially null out the shunt capacity across the resonator. This allows for the measurement of the zero phase frequency, which because of the resistance of the quartz resonator and the presence of the shunt capacitance if not tuned out, may not be possible.

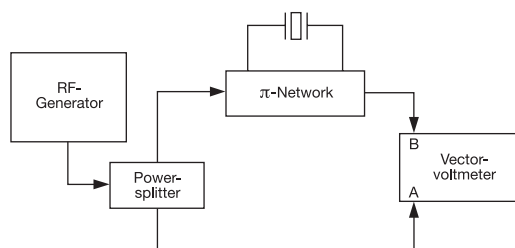
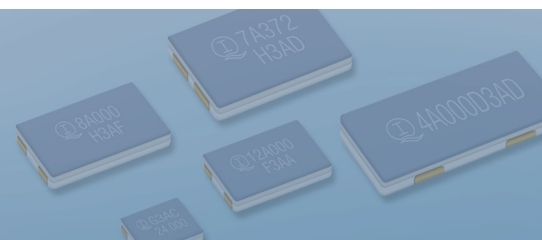


Figure 12



Technical Survey

$$R_1 = R_T \left[\frac{V_{BS}}{V_{AS}} \frac{V_{AQ}}{V_{BQ}} - 1 \right], R_T = 25 \text{ Ohms} \quad \text{Eqn. 18}$$

$$C_1 = \frac{\Delta f (\pm \varphi)}{2\pi f r^2 (R_1 + 25)} \quad \text{Eqn. 19}$$

$$\Delta f (\pm \varphi) = | f (45^\circ) - f (-45^\circ) | \quad \text{Eqn. 20}$$

VAQ, VBQ are the A and B-channel voltages with the crystal inserted in the -network, VAS and VBS are the voltages when a short is used instead.

MOUNTING SYSTEMS

The mounting system is that fixture within the enclosure onto which the electroded quartz element is fixed with conductive epoxy or solder. In order to retain the inherent high quality factor of the quartz crystal resonator, it is necessary to mount the resonator in low loss supports. The supply of electrical energy to the electrodes is provided via the mounting system.

The mounting system must also be designed in such a fashion that it induces a minimum of stress to the quartz element as the mounting system expands or contracts as it is exposed to increasing or decreasing temperature. Stress variation over the temperature range can induce changes to the normal frequency versus temperature characteristic.

The mounting system ensures that the crystal is protected from mechanical shocks, chemical and climatic influences, as well as foreign particles from the atmosphere are kept away from the crystal by the enclosure.

ENCLOSURES

Standard Metal Through-hole Enclosures

The primary function of the enclosures for quartz crystal resonators is to protect the very fragile and sensitive electroded quartz element so that its full potential as a highly stable resonant element can be achieved. The enclosure is hermetically sealed and filled with an inert gas or a vacuum environment as may be required by the application in which the resonator will be used.

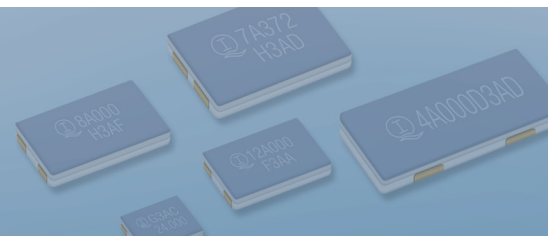
Surface Mount Enclosures

Currently, the demand for surface mount quartz resonators are very strong. Surface mount resonators take many forms. The earliest form involved combining a resonator encapsulated in a metal enclosure with an insulating plastic base plate to obtain a surface mount device. More recently ceramic and All Quartz surface mount enclosures have been developed. These enclosures are shown in details in the specification sections of the catalog.



 **INTERQUIP ELECTRONICS CO LTD**
應達利電子有限公司

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Tel: +852 2413 5515 Fax: +852 2413 7053 <http://www.interquip.com>



Technical Survey

TO: INTERQUIP ELECTRONICS CO., LIMITED

QUARTZ CRYSTAL RESONATOR SPECIFICATION SAMPLE / ORDER FORM

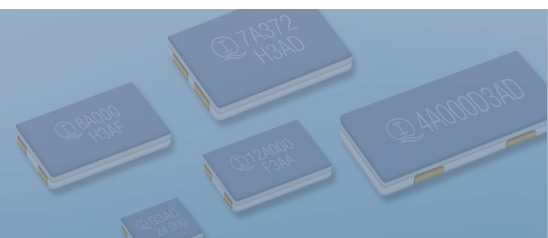
Form: _____ Date: _____
Company: _____ Telephone: _____
Fax No.: _____ E-mail: _____
Address: _____

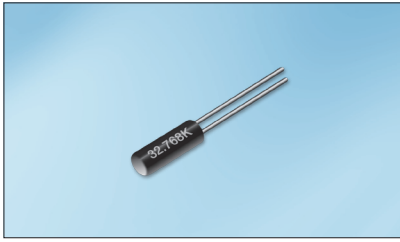
Application: _____
Quantity Required: _____

Holder Type (Series): _____
Frequency: _____ (MHz/KHz)
Mode of Vibration: _____ (Fundamental, 3rdO.T, 5thO,T)
Load Capacitance: _____ pF
Frequency Thlerance at 25°C ± 3°C: _____ PPM
Equivalent Series Resistance: _____ Ohm Max
Shunt Capacitance (C0): _____ pf Max
Motional Capacitance (C1): _____ fFMax
Drive Level: _____ μW
Temperature Characteristic: _____ PPM
Operating Temperature Range: _____ °C
Storage Temperature Range: _____ °C
Insulation Resistance: 500M Ohm Min
Aging: _____ PPM/Year

Special Requirements: _____

Please kindly fill in specification and fax to Interquip Electronics Co., Limited
at (852) 2413 7053 or email to iql@interquip.com





FEATURES

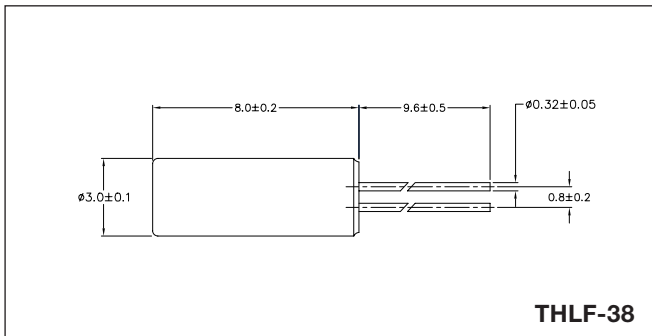
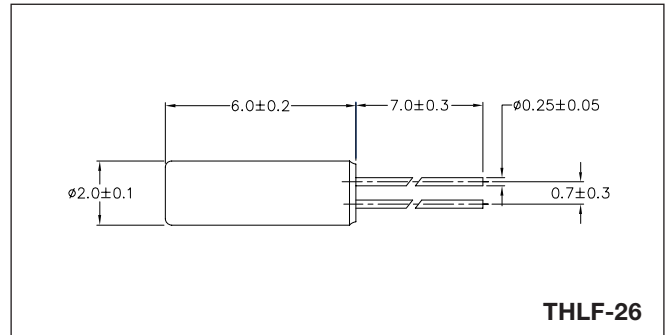
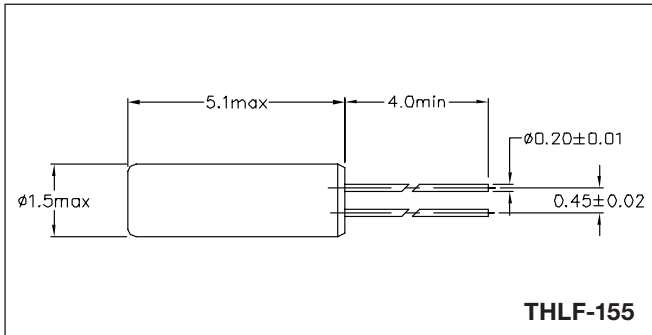
- Small Sizes
- High Performance / Cost Ratio
- Wide Frequency Range



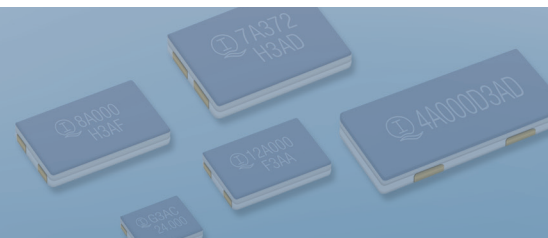
Parameters		Specifications		
Product Series 產品系列		THLF-155	THLF-26	THLF-38
Nominal Frequency 標稱頻率	f_0	Standard : 32.768KHz Optional : 30KHz ~ 200KHz		
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm		
Load Capacitance 負載電容	C_L	12.5pF or customer specify		
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.034±0.006ppm/°C ²		
Operating Temperature Range 工作溫度範圍	T _{OPR}	-20°C ~ +70°C		
Storage Temperature Range 儲存溫度範圍	T _{STG}	-55°C ~ +125°C		
Drive Level 激勵功率	DL	1μW Max.		
Series Resistance (ESR) 串聯諧振阻抗	R ₁	65KΩ Max.	50KΩ Max.	
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.		
Aging 老化率	Δf_A	±5ppm/Year Max.		

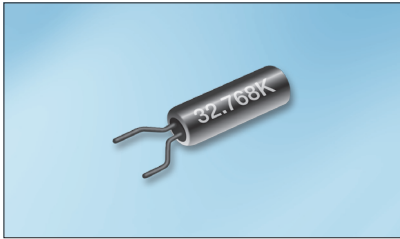
Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



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FEATURES

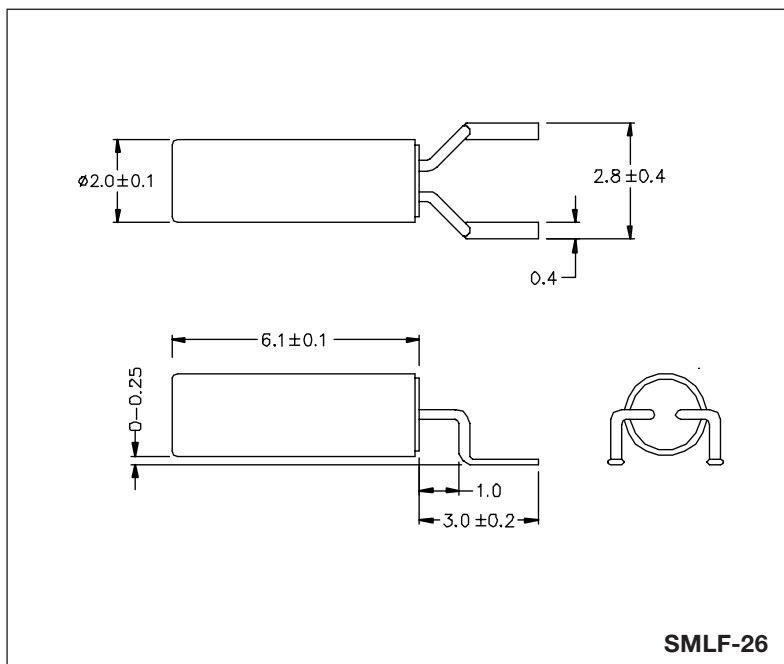
- Small Size
- Surface Mount
- Pick and Place Assembly



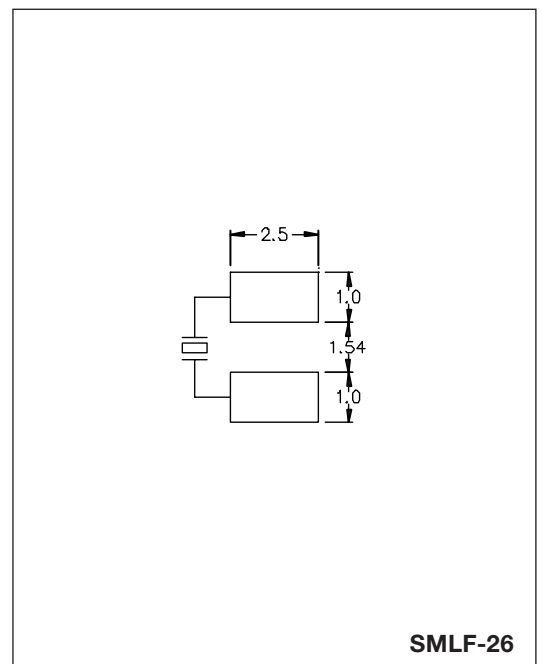
Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	Standard : 32.768KHz Optional : 30KHz ~ 200KHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm
Load Capacitance 負載電容	C_L	12.5pF or customer specify
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.034±0.006ppm/°C ²
Operating Temperature Range 工作溫度範圍	T _{OPR}	-20°C ~ +70°C
Storage Temperature Range 儲存溫度範圍	T _{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.001mW Max.
Series Resistance (ESR) 串聯諧振阻抗	R ₁	50KΩ Max.
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

Please consult our sales representatives for other specifications.
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DIMENSION (mm)



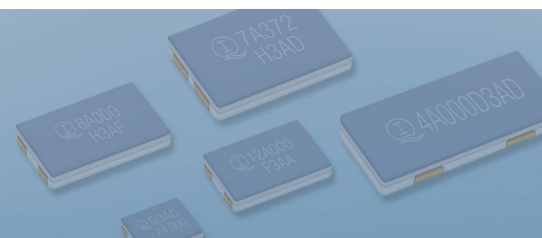
SOLDERING PATTERN (mm)



Handling instructions.

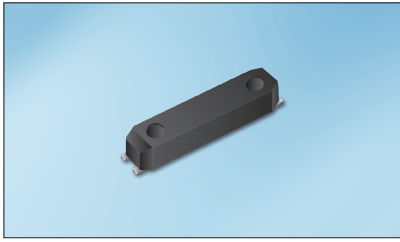
- 1 Soldering on the body of the enclosure should be strictly avoided as it might damage the crystal.
Rubber adhesive is recommended to hold the crystal on the PCB.
直接焊接於晶體外殼上可引致內部結構受損。如需固定晶體外殼，建議使用工業橡膠。
- 2 Maximum reflow soldering temperature at +235°C for 5 seconds.
迴流焊最高溫度為 +235°C，維持不多於 5 秒。

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SMLF-145

TUNING FORK RESONATORS (SMD) 表貼音叉式諧振器



FEATURES

- Surface Mount
- Pick and place assembly
- Reflow solderable

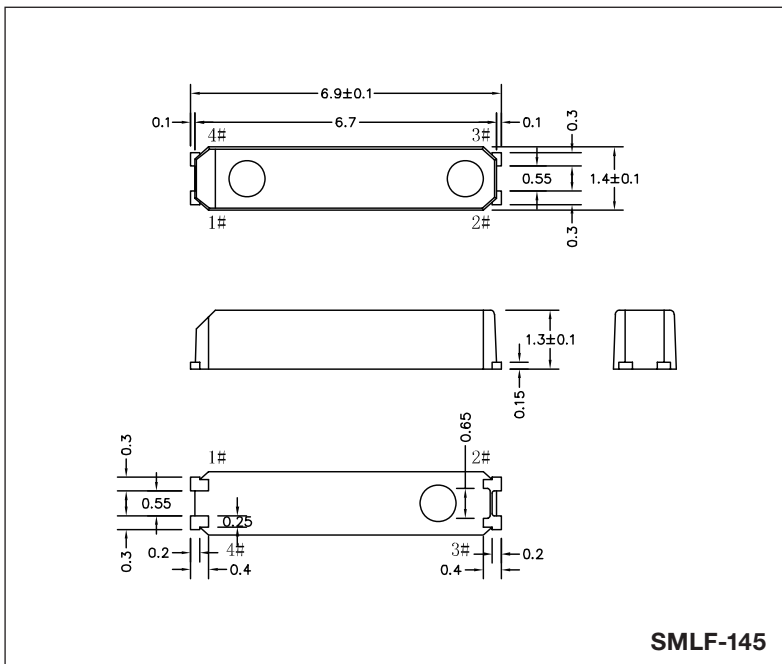
RoHS II
Compliant

Low frequency (KHz) crystal resonators

Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	32.768KHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm
Load Capacitance 負載電容	C_L	12.5pF
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.034±0.006ppm/°C ²
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.001mW Max.
Series Resistance (ESR) 串聯諧振阻抗	R_1	70KΩ Max.
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

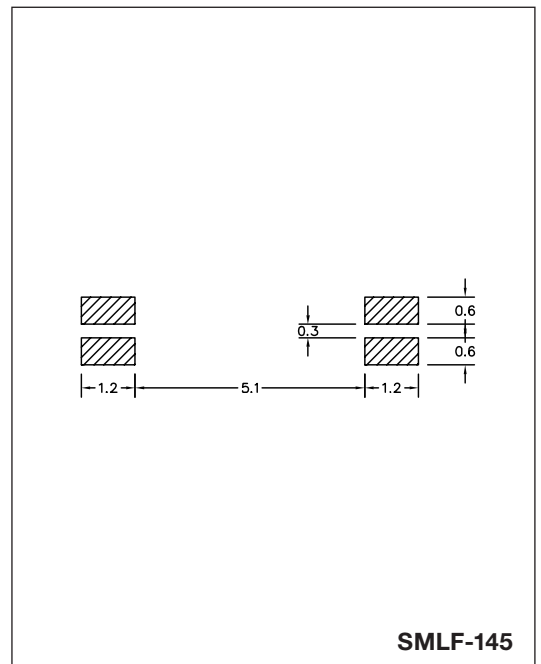
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DIMENSION (mm)



SMLF-145

SOLDERING PATTERN (mm)



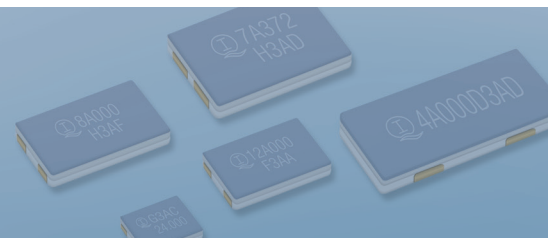
SMLF-145

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Tel: +852 2413 5515 Fax: +852 2413 7053 <http://www.interquip.com>





FEATURES

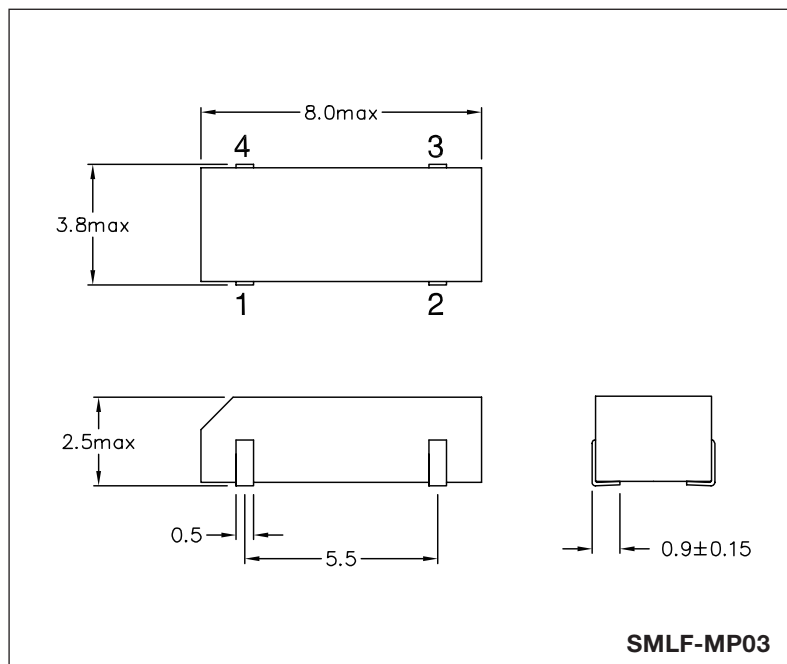
- Surface Mount
- Pick and place assembly
- Reflow solderable



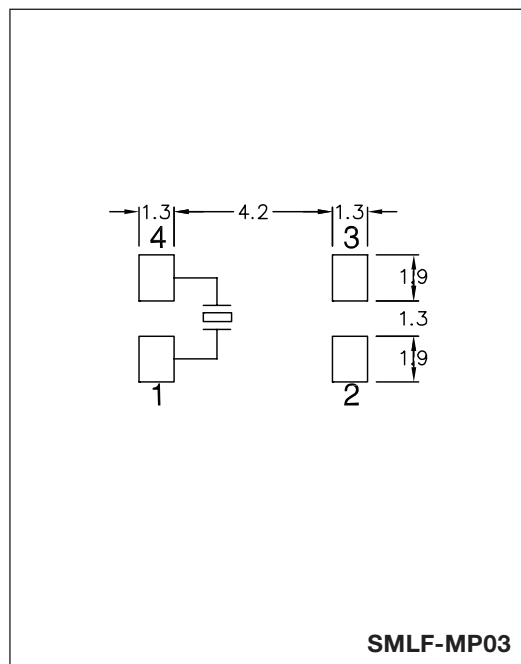
Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	32.768KHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm
Load Capacitance 負載電容	C_L	12.5pF or customer specify
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.034±0.006ppm/°C ²
Operating Temperature Range 工作溫度範圍	T _{OPR}	-20°C ~ +70°C
Storage Temperature Range 儲存溫度範圍	T _{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.001mW Max.
Series Resistance (ESR) 串聯諧振阻抗	R ₁	50KΩ Max.
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

Please consult our sales representatives for other specifications.
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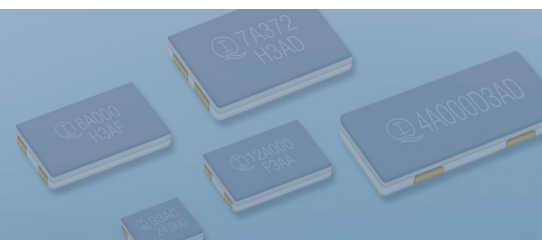
DIMENSION (mm)



SOLDERING PATTERN (mm)

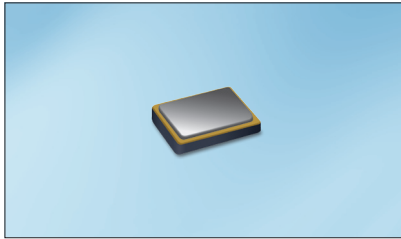


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SMLF-1610

TUNING FORK RESONATORS (SMD) 表貼音叉式諧振器



FEATURES

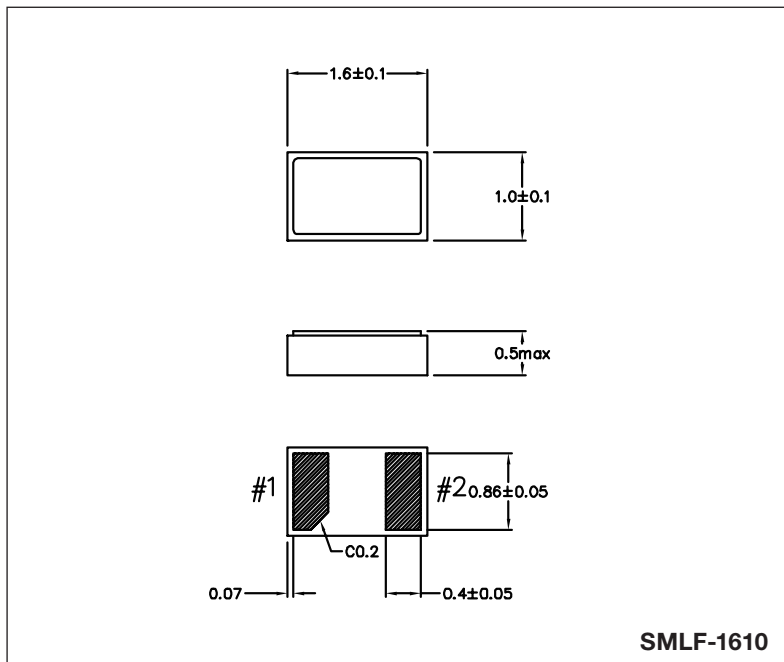
- Ultra-Compact design
- Surface Mount with Ceramic Package
- Reflow solderable



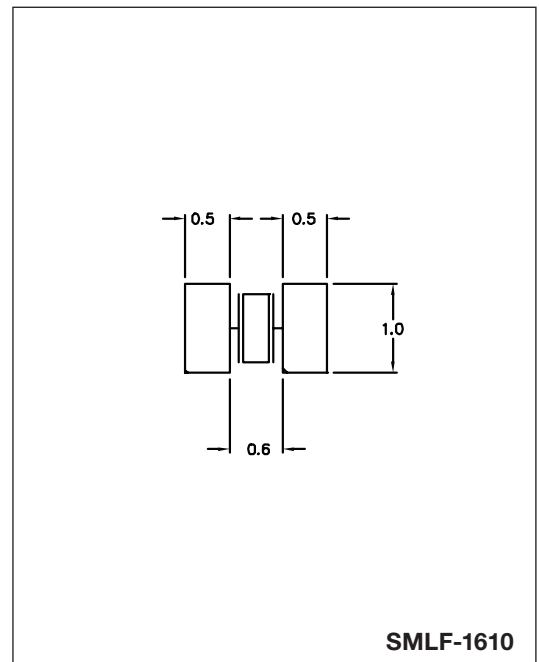
Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	32.768KHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm
Load Capacitance 負載電容	C_L	12.5pF or customer specify
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.03±0.01ppm/°C ²
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.5μW Max.
Series Resistance (ESR) 串聯諧振阻抗	R_1	90KΩ Max.
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SOLDERING PATTERN (mm)

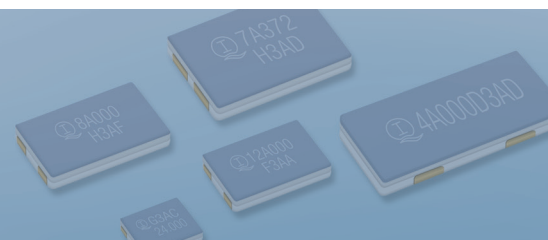


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本公司保留修改規格的權利。

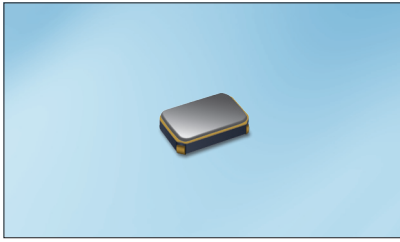


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Low frequency (KHz) crystal resonators



FEATURES

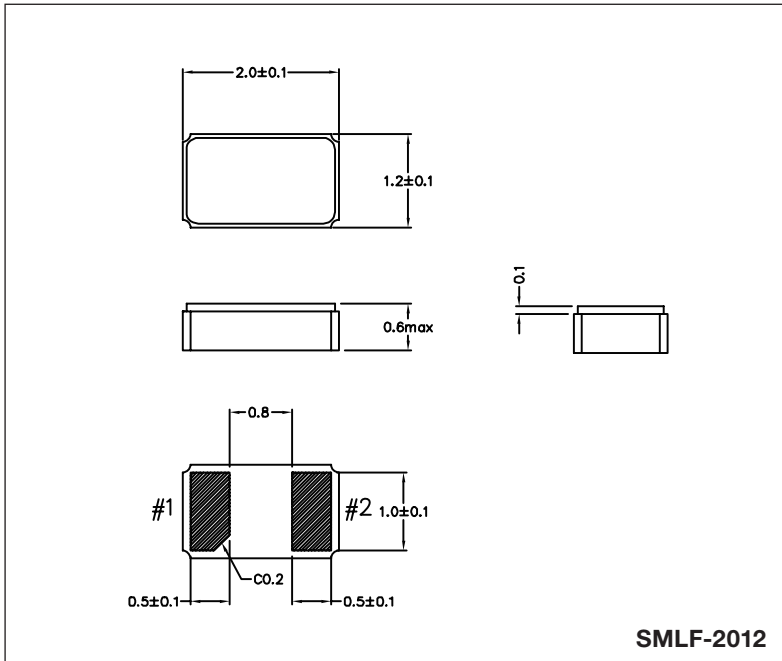
- Compact design
- Surface Mount with Ceramic Package
- Reflow solderable



Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	32.768KHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm
Load Capacitance 負載電容	C_L	12.5pF or customer specify
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.03±0.01ppm/°C ²
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.5μW Max.
Series Resistance (ESR) 串聯諧振阻抗	R_1	90KΩ Max.
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

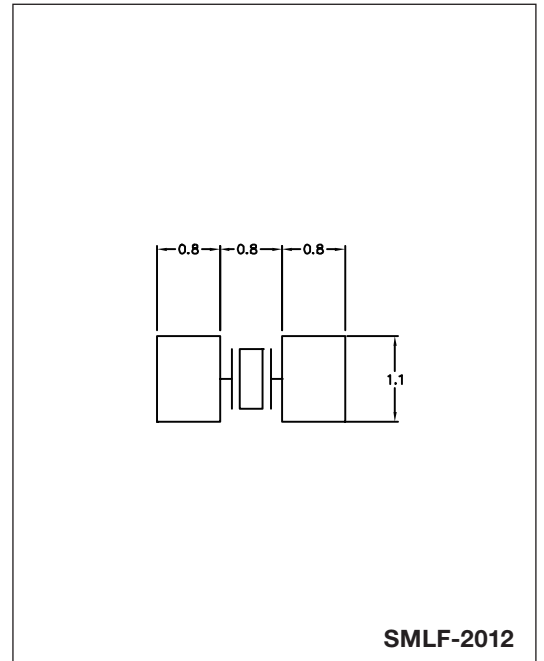
Please consult our sales representatives for other specifications.
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DIMENSION (mm)



SMLF-2012

SOLDERING PATTERN (mm)



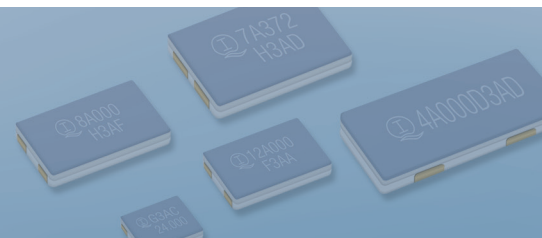
SMLF-2012

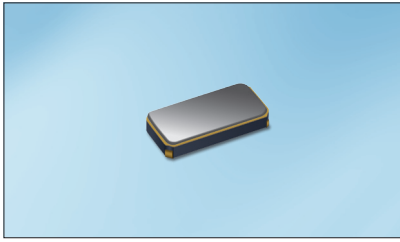
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FEATURES

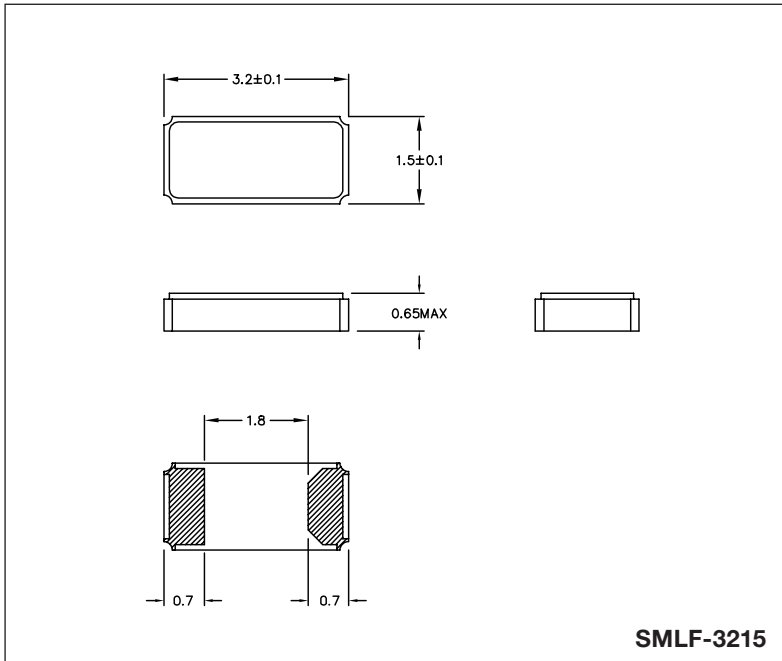
- Small size
- Surface Mount with Ceramic Package
- Reflow solderable



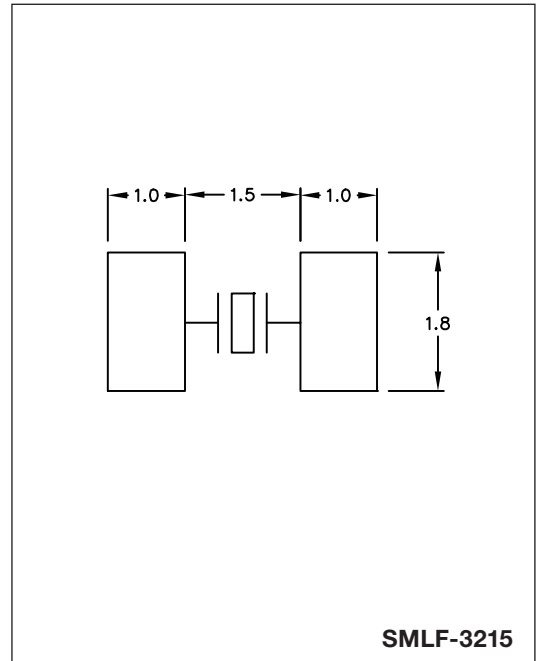
Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	32.768KHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm
Load Capacitance 負載電容	C_L	12.5pF or customer specify
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.03±0.01ppm/°C ²
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.5μW Max.
Series Resistance (ESR) 串聯諧振阻抗	R_1	70KΩ Max.
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SOLDERING PATTERN (mm)

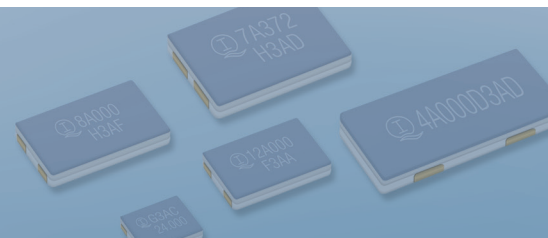


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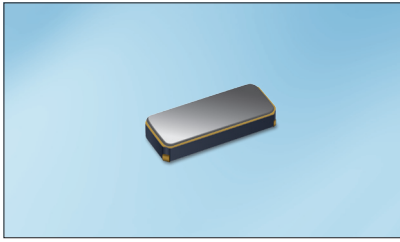
Flat A, 9th Floor, On Shing Industrial Building, 2-16 Wo Liu Hang Road, Fotan, N.T., Hong Kong
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SMLF-4115

TUNING FORK RESONATORS (SMD) 表貼音叉式諧振器

Low frequency (KHz) crystal resonators



FEATURES

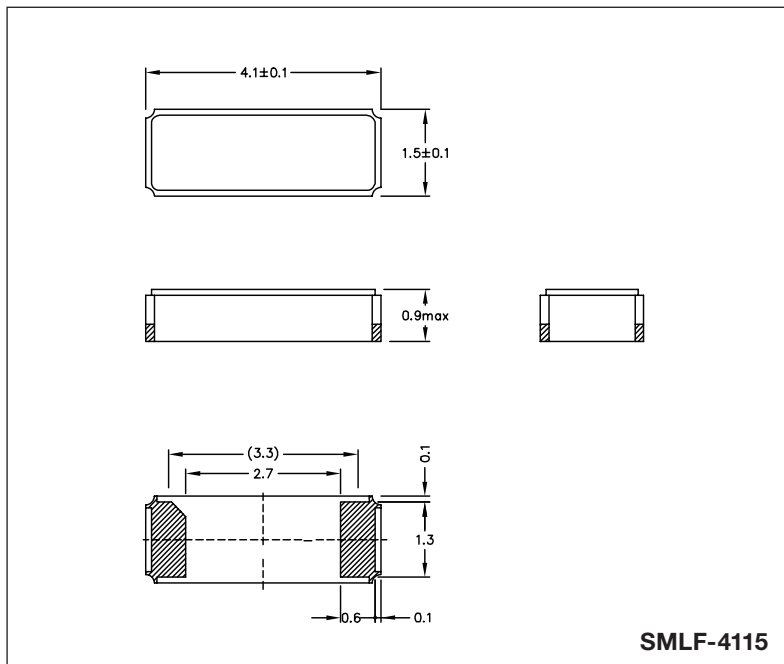
- Surface Mount with Ceramic Package
- Reflow solderable



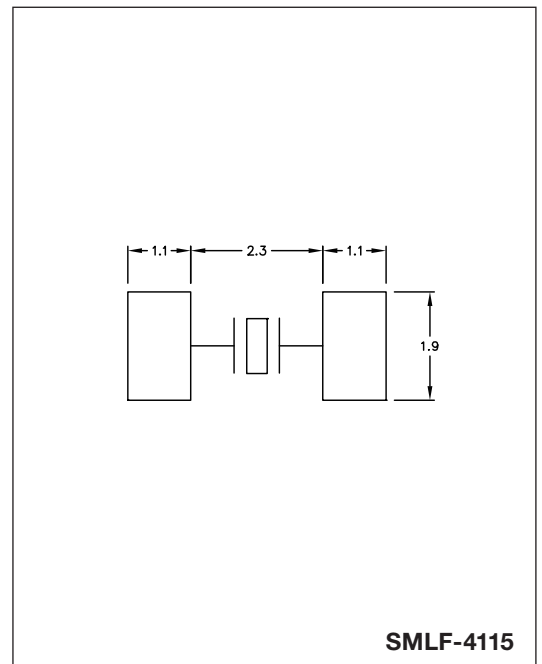
Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	32.768KHz
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 20\text{ppm}$
Load Capacitance 負載電容	C_L	12.5pF or customer specify
Temperature Coefficient 溫度系數	$\Delta f/f$	$-0.034 \pm 0.006 \text{ppm}/^\circ\text{C}^2$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	1 μW Max.
Series Resistance (ESR) 串聯諧振阻抗	R_1	70K Ω Max.
Insulation Resistance 絕緣阻抗	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 5\text{ppm}/\text{Year}$ Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SOLDERING PATTERN (mm)

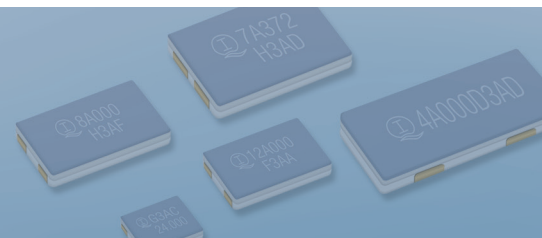


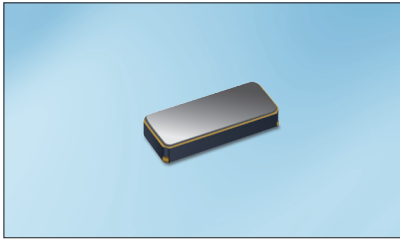
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FEATURES

- Surface Mount with Ceramic Package
- Reflow solderable

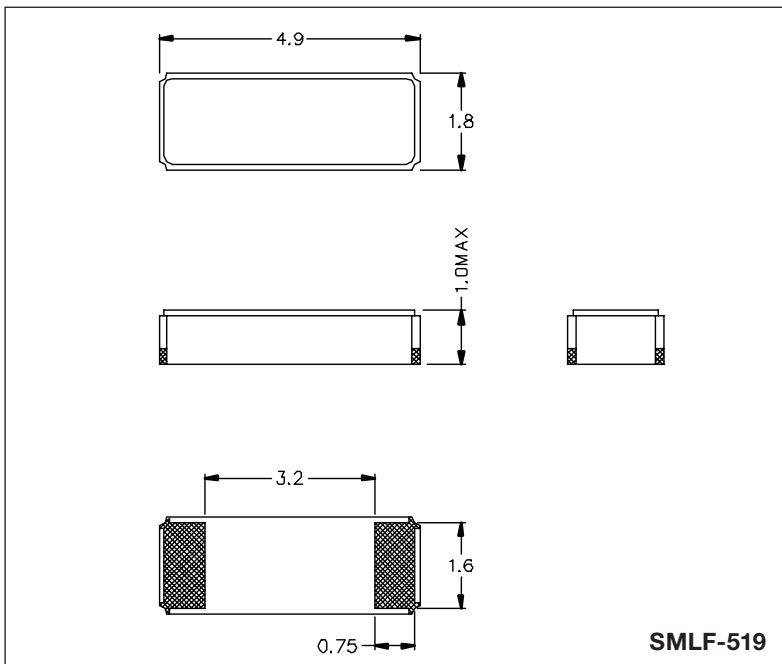


Low frequency (KHz) crystal resonators

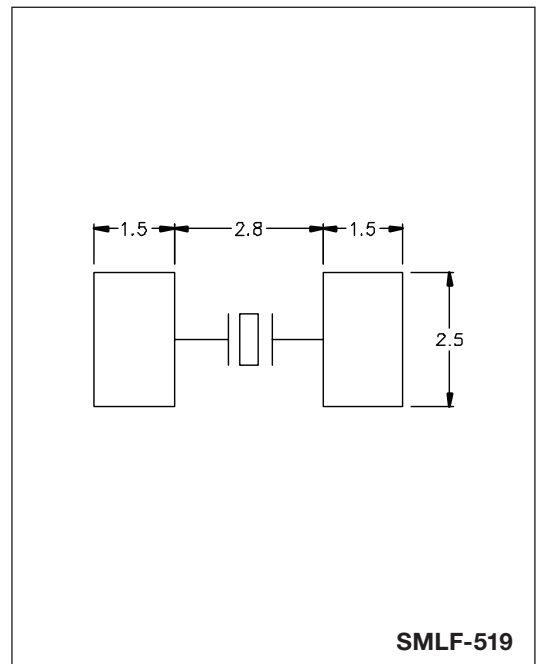
Parameters		Specifications
Nominal Frequency 標稱頻率	f_0	32.768KHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm
Load Capacitance 負載電容	C_L	12.5pF or customer specify
Temperature Coefficient 溫度系數	$\Delta f/f$	-0.034±0.006ppm/°C ²
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	1μW Max.
Series Resistance (ESR) 串聯諧振阻抗	R_1	70KΩ Max.
Insulation Resistance 絕緣阻抗	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

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DIMENSION (mm)



SOLDERING PATTERN (mm)

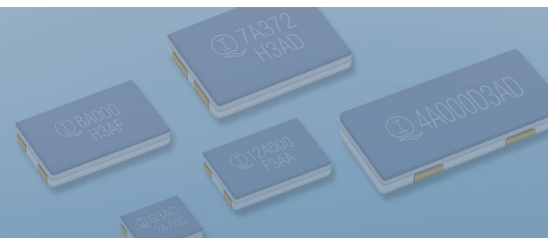


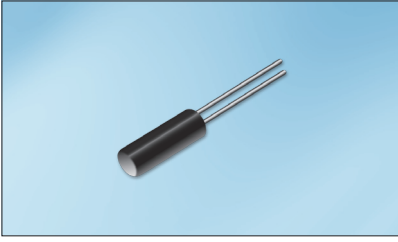
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FEATURES

- AT-cut crystal performance
- Ideal for Microprocessor Applications



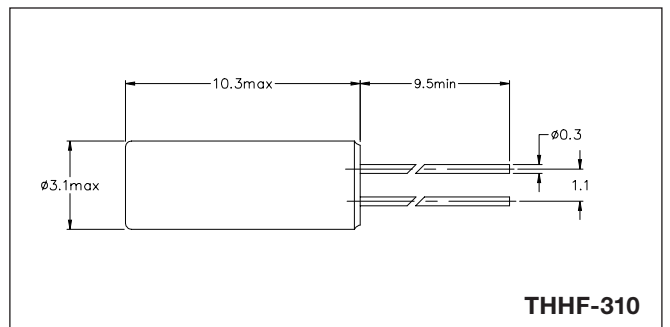
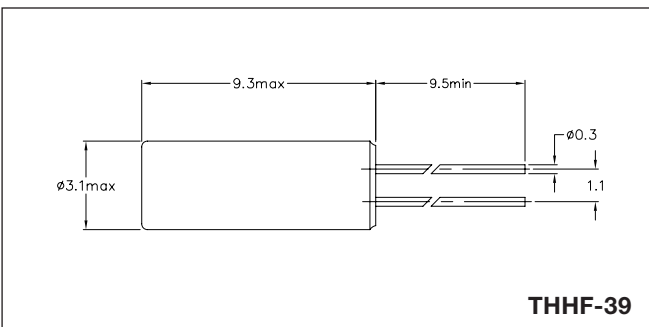
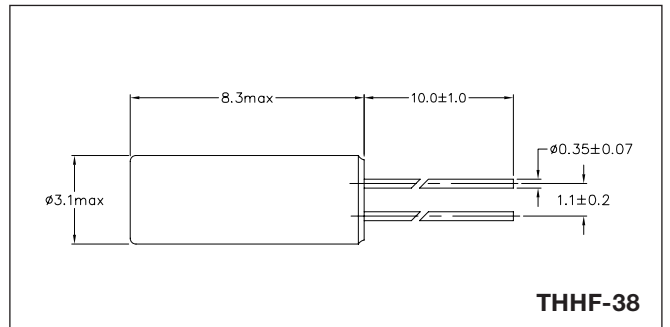
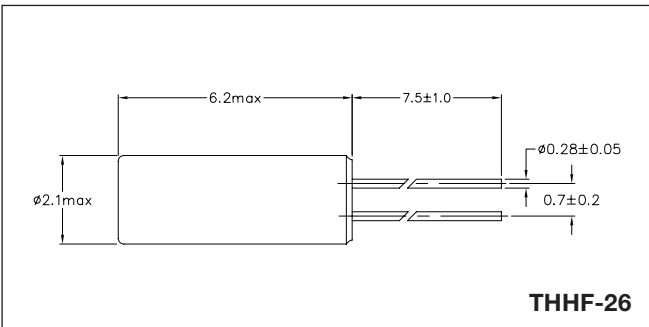
Parameters		THHF-26	THHF-38	THHF-39	THHF-310
Nominal Frequency Range 標稱頻率範圍	f_0	6.0 ~ 48.0MHz	6.0 ~ 48.0MHz	4.0 ~ 6.0MHz	3.579 ~ 4.0MHz
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±10ppm, ±30ppm			
Load Capacitance 負載電容	C_L	18pF or customer specify			
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±10ppm, ±30ppm			
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C			
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C to 125°C			
Drive Level 激勵功率	DL	0.1mW (1mW Max.)			
Shunt Capacitance 靜態電容	C_0	7pF Max.			
Insulation Resistance 絕緣電阻	IR	500MΩ Min.			
Aging 老化率	Δf_A	±5ppm/Year Max.			

SERIES RESISTANCE (ESR) 串聯諧振阻抗

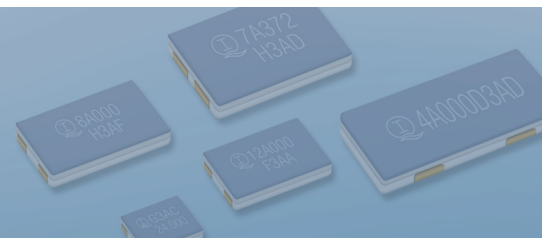
Frequency Range	$3.579 < f_0 \leq 6$	$6 < f_0 \leq 12$	$12 < f_0 \leq 20$	$20 < f_0 \leq 36$	$36 < f_0 \leq 48$ (3rd overtone)
ESR	150Ω Max.	100Ω Max.	70Ω Max.	50Ω Max.	80Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



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本公司保留修改規格的權利。





FEATURES

- AT-cut crystal performance
- Wide frequency range
- Standard and moderate precision available
- Low profile package
- AEC-Q200 Qualified



Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	3.5MHz ~ 40.0MHz (Fundamental)
		30.0MHz ~ 80.0MHz (3rd Overtone)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±10ppm, ±30ppm
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±10ppm, ±30ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C to 125°C
Drive Level 激勵功率	DL	0.1mW (1mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

SERIES RESISTANCE (ESR) 串聯諧振阻抗

Frequency Range	$3.5 < f_0 \leq 4.5$	$4.5 < f_0 \leq 6$	$6 < f_0 \leq 8$	$8 < f_0 \leq 12$	$12 < f_0 \leq 15$	$15 < f_0 \leq 18$
ESR	120Ω Max.	90Ω Max.	70Ω Max.	60Ω Max.	40Ω Max.	30Ω Max.

Frequency Range	$18 < f_0 \leq 40$	$30 < f_0 \leq 35$ (3.O.T)	$35 < f_0 \leq 40$ (3.O.T)	$40 < f_0 \leq 80$ (3.O.T)
ESR	25Ω Max.	100Ω Max.	80Ω Max.	70Ω Max.

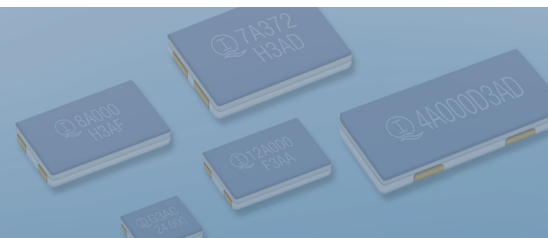
Please consult our sales representatives for other specifications.
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DIMENSION (mm)

Series	Height (H)
THHF-49S3	3.5mm Max.
THHF-49S2A	2.5mm Max.
THHF-49S2B	2.3mm Max.

THHF-49S3/THHF-49S2A/THHF-49S2B

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SMHF-49B/SMHF-49C/ SMHF-49D

SURFACE MOUNT QUARTZ CRYSTAL RESONATORS 表貼石英晶體諧振器

High frequency (MHz) crystal resonators



FEATURES

- AT-cut crystal performance
- Wide frequency range
- Low profile package
- Tape & Reel Packing
- AEC-Q200 Qualified



Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	3.5MHz ~ 40.0MHz (Fundamental) 30.0MHz ~ 80.0MHz (3rd Overtone)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±10ppm, ±30ppm
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±10ppm, ±30ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C to 125°C
Drive Level 激勵功率	DL	0.1mW (1mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

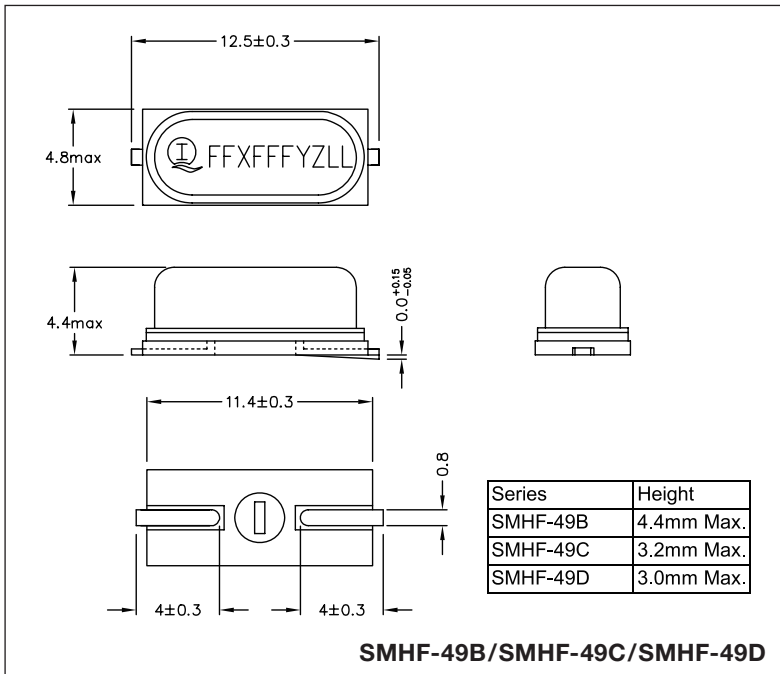
SERIES RESISTANCE (ESR) 串聯諧振阻抗

Frequency Range	$3.5 < f_0 \leq 4.5$	$4.5 < f_0 \leq 6$	$6 < f_0 \leq 8$	$8 < f_0 \leq 12$	$12 < f_0 \leq 15$	$15 < f_0 \leq 18$
ESR	120Ω Max.	90Ω Max.	70Ω Max.	60Ω Max.	40Ω Max.	30Ω Max.

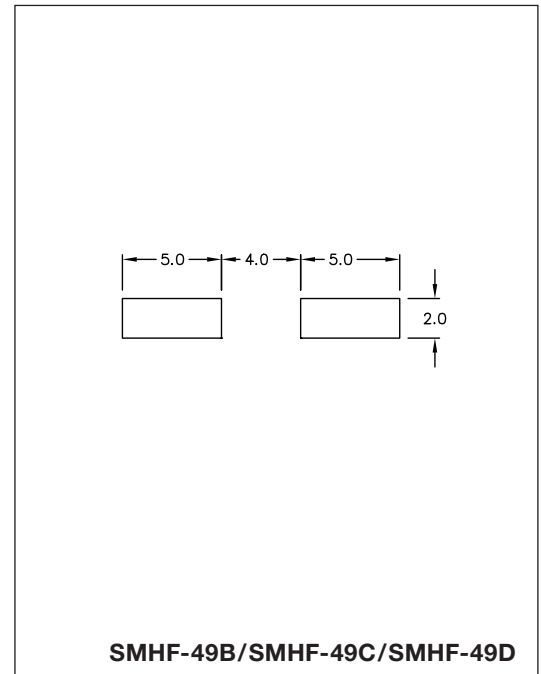
Frequency Range	$18 < f_0 \leq 40$	$30 < f_0 \leq 35$ (3.O.T)	$35 < f_0 \leq 40$ (3.O.T)	$40 < f_0 \leq 80$ (3.O.T)
ESR	25Ω Max.	100Ω Max.	80Ω Max.	70Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



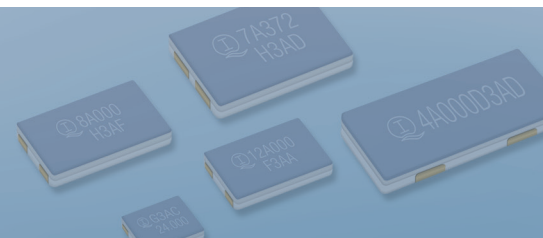
SOLDERING PATTERN (mm)



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SMHF-49M

SURFACE MOUNT QUARTZ CRYSTAL RESONATORS 表貼石英晶體諧振器



FEATURES

- AT-cut crystal performance
- High reliability
- Low cost for high performance
- Tape & Reel Packing
- AEC-Q200 Qualified



Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	3.5MHz ~ 40.0MHz (Fundamental) 30.0MHz ~ 80.0MHz (3rd Overtone)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±10ppm, ±30ppm
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±10ppm, ±30ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C to 125°C
Drive Level 激勵功率	DL	0.1mW (1mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

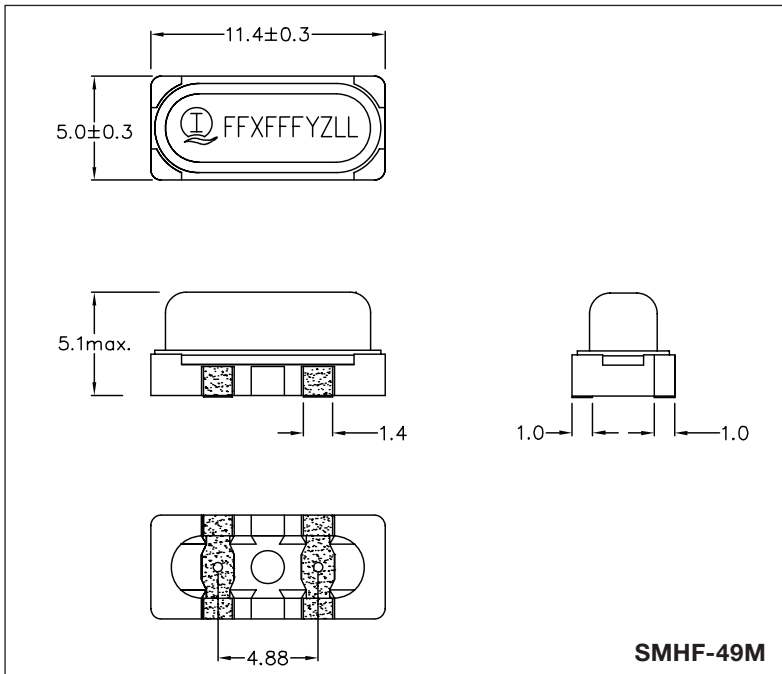
SERIES RESISTANCE (ESR) 串聯諧振阻抗

Frequency Range	$3.5 < f_0 \leq 4.5$	$4.5 < f_0 \leq 6$	$6 < f_0 \leq 8$	$8 < f_0 \leq 12$	$12 < f_0 \leq 15$	$15 < f_0 \leq 18$
ESR	120Ω Max.	90Ω Max.	70Ω Max.	60Ω Max.	40Ω Max.	30Ω Max.

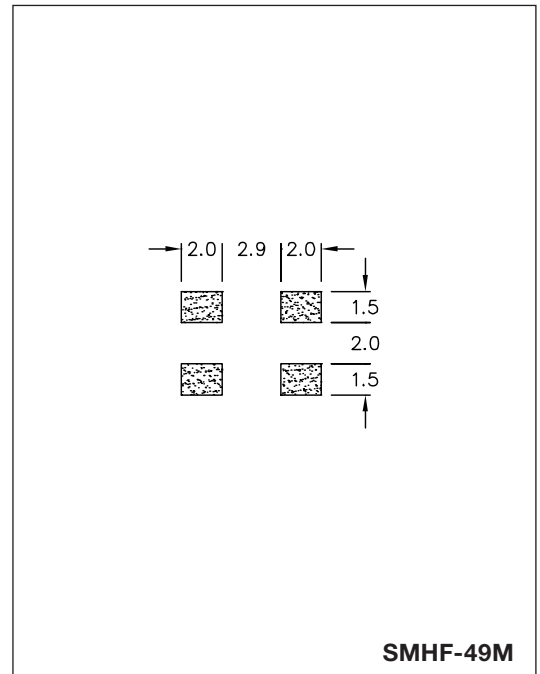
Frequency Range	$18 < f_0 \leq 33$	$30 < f_0 \leq 35$ (3.O.T)	$35 < f_0 \leq 40$ (3.O.T)	$40 < f_0 \leq 80$ (3.O.T)
ESR	25Ω Max.	100Ω Max.	80Ω Max.	70Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



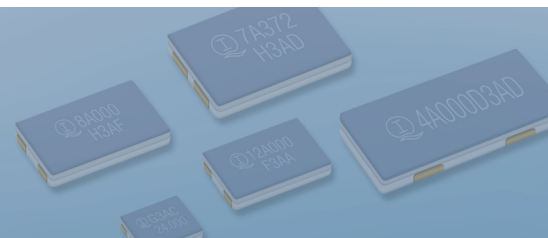
SOLDERING PATTERN (mm)



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SMHF-49N

SURFACE MOUNT QUARTZ CRYSTAL RESONATORS 表貼石英晶體諧振器

High frequency (MHz) crystal resonators



FEATURES

- AT-cut crystal performance
- High reliability
- Low cost for high performance
- Tape & Reel Packing
- AEC-Q200 Qualified



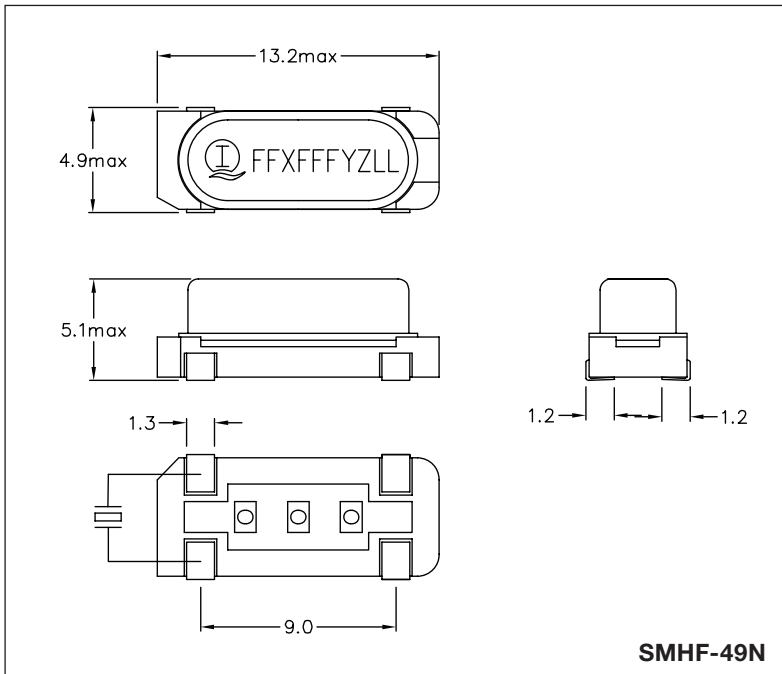
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	3.5MHz ~ 40.0MHz (Fundamental) 30.0MHz ~ 80.0MHz (3rd Overtone)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±10ppm, ±30ppm
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±10ppm, ±30ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C to 125°C
Drive Level 激勵功率	DL	0.1mW (1mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

SERIES RESISTANCE (ESR) 串聯諧振阻抗						
Frequency Range	$3.5 < f_0 \leq 4.5$	$4.5 < f_0 \leq 6$	$6 < f_0 \leq 8$	$8 < f_0 \leq 12$	$12 < f_0 \leq 15$	$15 < f_0 \leq 18$
ESR	120Ω Max.	90Ω Max.	70Ω Max.	60Ω Max.	40Ω Max.	30Ω Max.

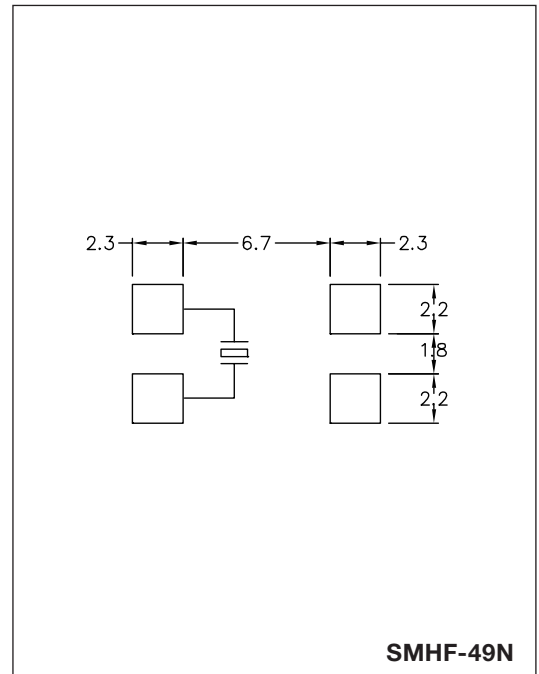
Frequency Range	$18 < f_0 \leq 33$	$30 < f_0 \leq 35$ (3.O.T)	$35 < f_0 \leq 40$ (3.O.T)	$40 < f_0 \leq 80$ (3.O.T)
ESR	25Ω Max.	100Ω Max.	80Ω Max.	70Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



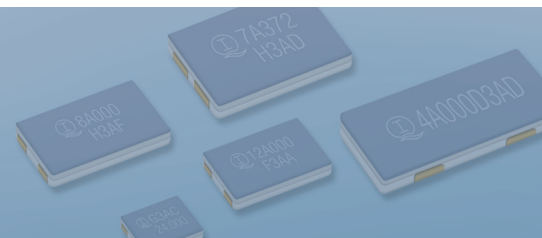
SOLDERING PATTERN (mm)



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I INTERQUIP ELECTRONICS CO LTD
應達利電子有限公司

Flat A, 9th Floor, On Shing Industrial Building, 2-16 Wo Liu Hang Road, Fotan, N.T., Hong Kong
Tel: +852 2413 5515 Fax: +852 2413 7053 <http://www.interquip.com>





FEATURES

- Ceramic epoxy sealed SMD package
- Ultra-light weight and ultra-miniature size
- Wide frequency range
- Suitable for HDD, SSD, USB, Blu-ray
- Low cost option to consumer grade products

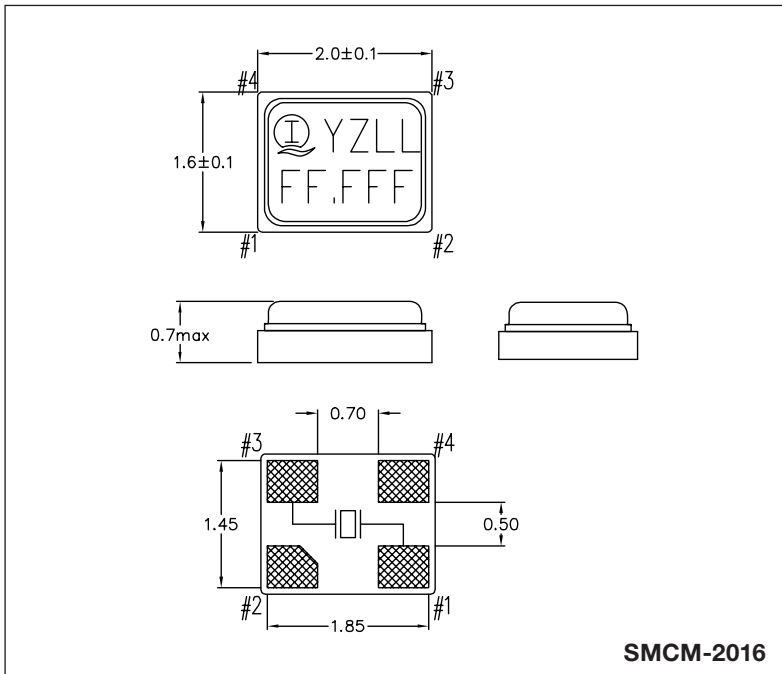


Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	24.0MHz ~ 50.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Load Capacitance 負載電容	C_L	6pF to 12pF
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-10^\circ\text{C} \sim +70^\circ\text{C}$, $-30^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.01mW (0.2mW Max.)
Shunt Capacitance 靜態電容	C_0	5pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.

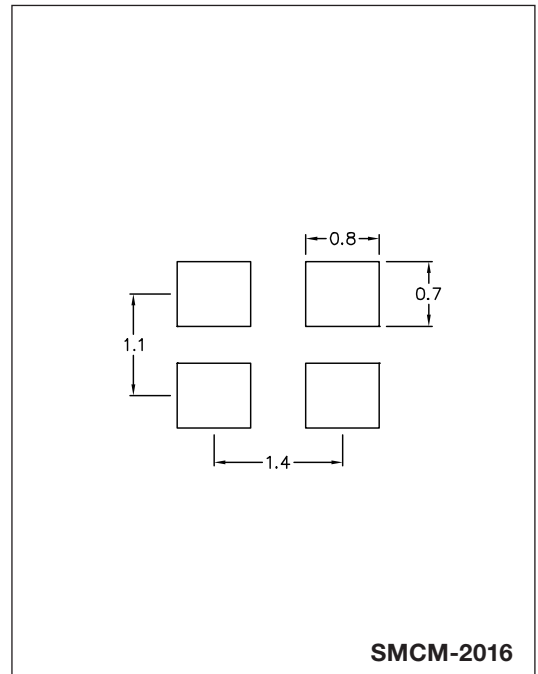
SERIES RESISTANCE (ESR) 串聯諧振阻抗		
Frequency Range	$24 < f_0 \leq 30$	$30 < f_0 \leq 50$
ESR	150 Ω Max.	100 Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SOLDERING PATTERN (mm)

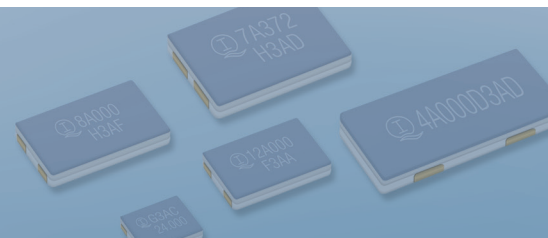


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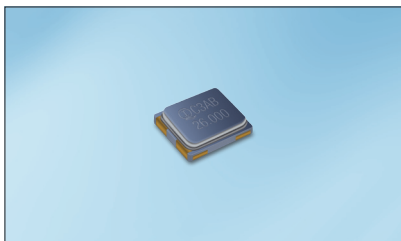
Flat A, 9th Floor, On Shing Industrial Building, 2-16 Wo Liu Hang Road, Fotan, N.T., Hong Kong
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SMCM-3225

CERAMIC BASE METAL COVER QUARTZ CRYSTAL RESONATORS (SMD) 表貼陶瓷底座金屬蓋石英晶體諧振器

High frequency (MHz) crystal resonators



FEATURES

- Ceramic epoxy sealed SMD package
- Ultra-light weight and ultra-miniature size
- Wide frequency range
- Suitable for mobile phone / smart phone
- Low cost option to consumer grade products



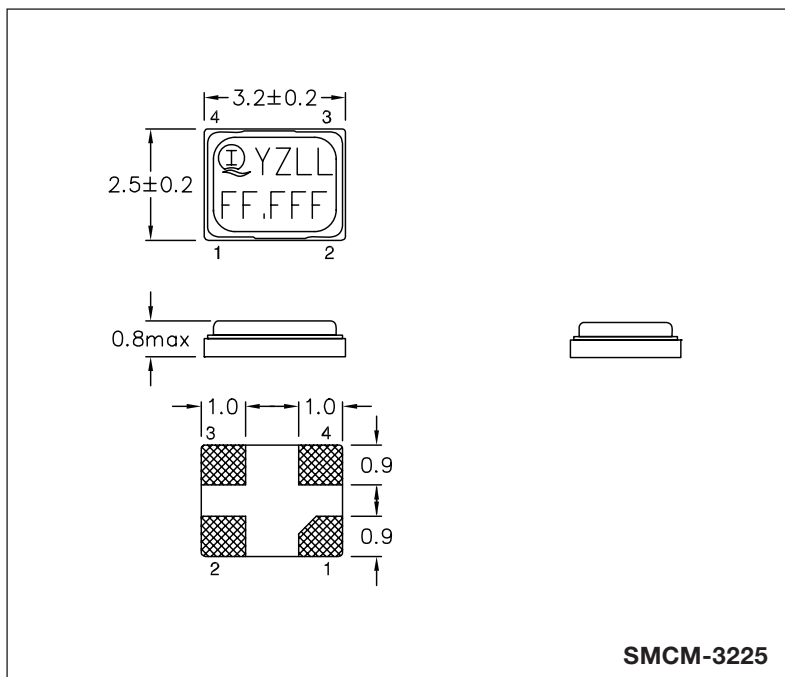
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	12.0MHz ~ 40.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Load Capacitance 負載電容	C_L	10pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	5pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 5\text{ppm/Year Max.}$

SERIES RESISTANCE (ESR) 串聯諧振阻抗

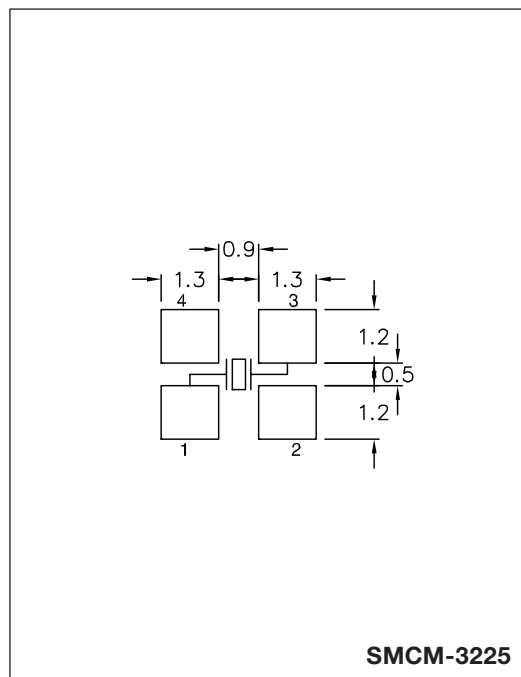
Frequency Range	$12 < f_0 \leq 20$	$20 < f_0 \leq 25$	$25 < f_0 \leq 30$	$30 < f_0 \leq 40$
ESR	120 Ω Max.	80 Ω Max.	60 Ω Max.	50 Ω Max.

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DIMENSION (mm)



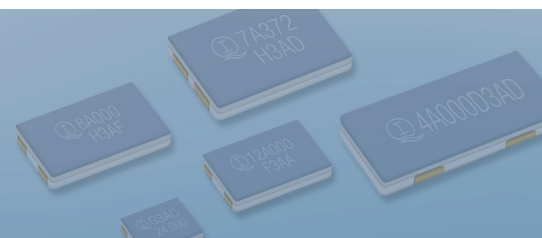
SOLDERING PATTERN (mm)



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FEATURES

- All ceramic epoxy sealed SMD package
- Ultra-light weight and ultra-miniature size
- Wide frequency range
- Low cost option to consumer grade products



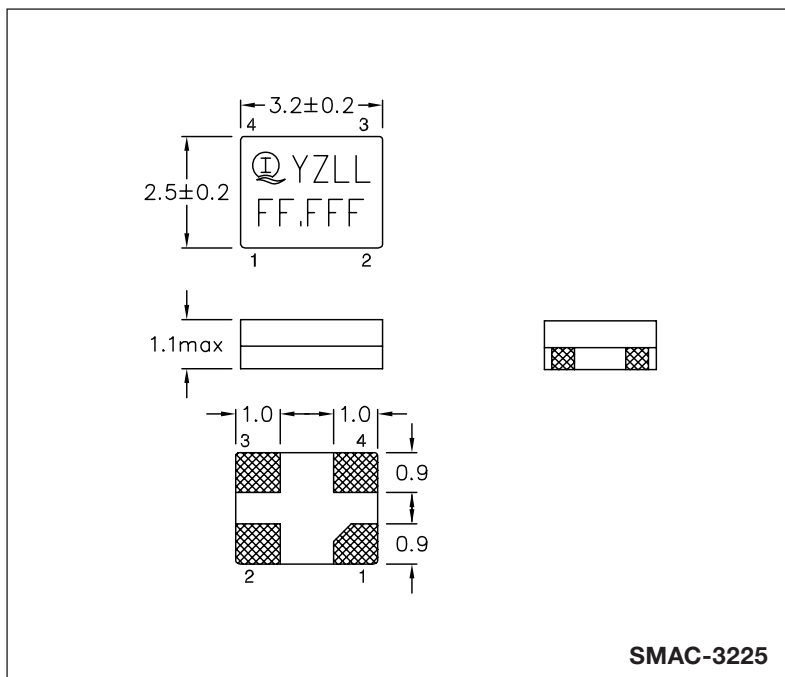
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	12.0MHz ~ 48.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Load Capacitance 負載電容	C_L	10pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	5pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 5\text{ppm/Year Max.}$

SERIES RESISTANCE (ESR) 串聯諧振阻抗

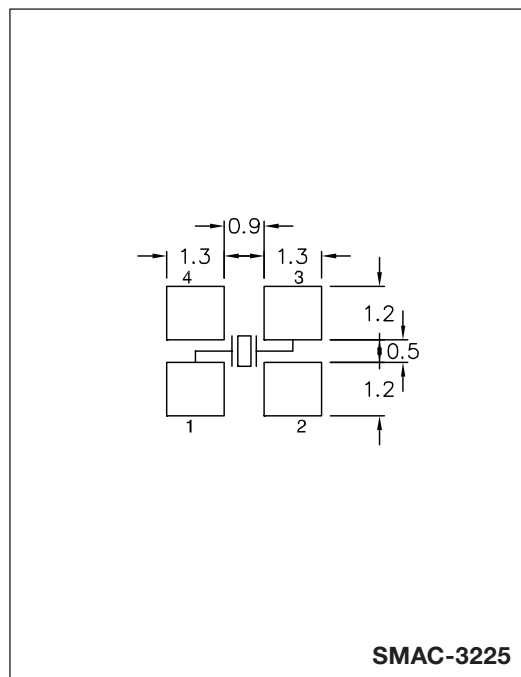
Frequency Range	$12 < f_0 \leq 16$	$16 < f_0 \leq 25$	$25 < f_0 \leq 30$	$30 < f_0 \leq 48$
ESR	120 Ω Max.	60 Ω Max.	50 Ω Max.	35 Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

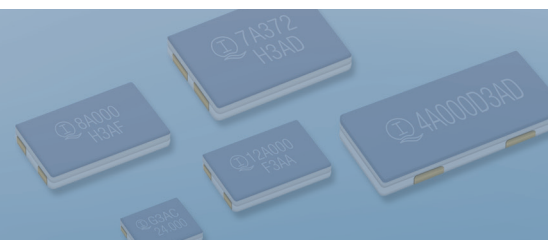
DIMENSION (mm)

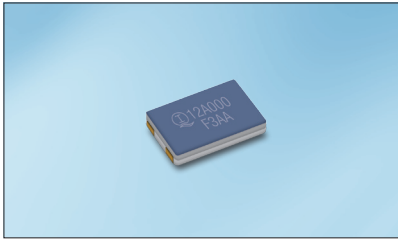


SOLDERING PATTERN (mm)



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本公司保留修改規格的權利。





FEATURES

- All ceramic epoxy sealed SMD package
- Wide frequency range
- 2 / 4 pads version available
- Low cost option to consumer grade products

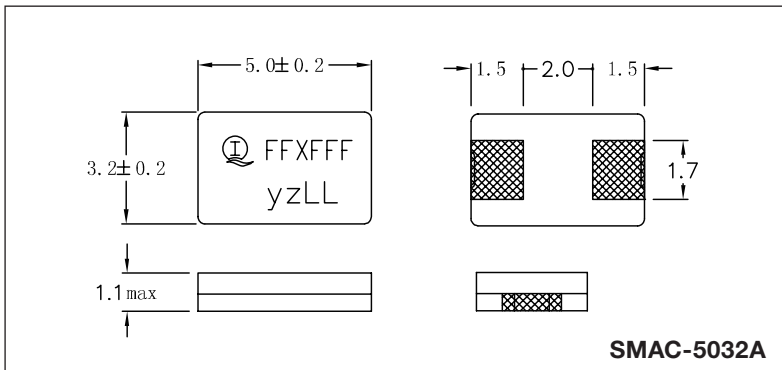


Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	8.0MHz ~ 48.0MHz (Fundamental)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm, ±30ppm, ±50ppm
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±20ppm, ±30ppm, ±50ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

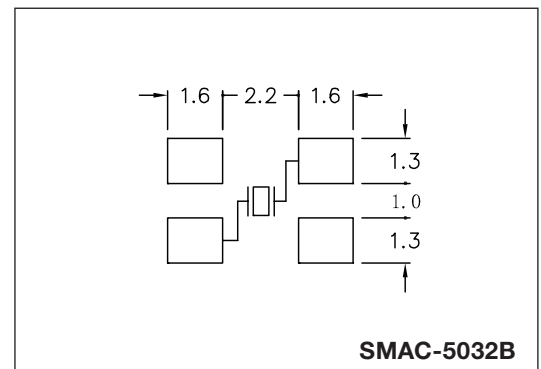
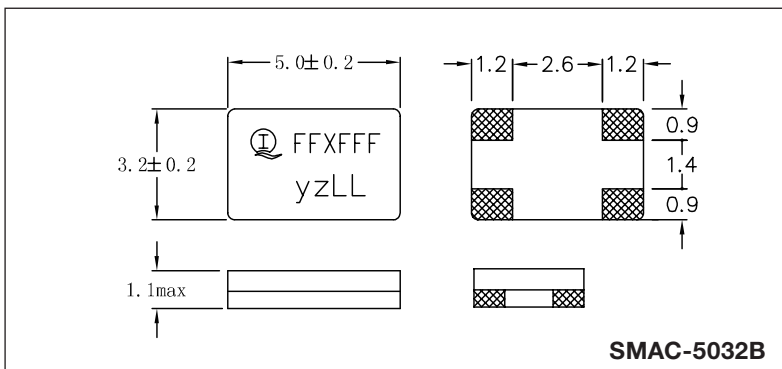
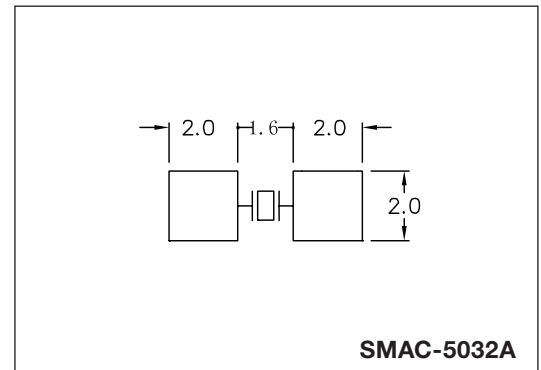
SERIES RESISTANCE (ESR) 串聯諧振阻抗				
Frequency Range	$8 < f_0 \leq 10$	$10 < f_0 \leq 12$	$12 < f_0 \leq 16$	$16 < f_0 \leq 48$
ESR	100Ω Max.	80Ω Max.	60Ω Max.	30Ω Max.

Please consult our sales representatives for other specifications.
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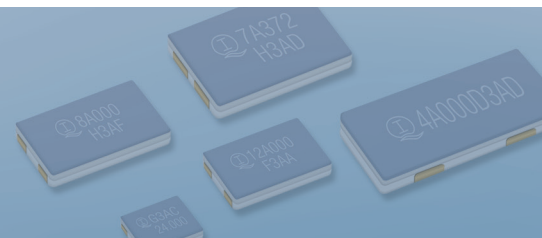
DIMENSION (mm)

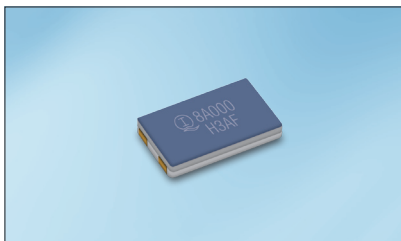


SOLDERING PATTERN (mm)



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FEATURES

- All ceramic epoxy sealed SMD package
- Wide frequency range
- 2 / 4 pads version available
- Low cost option to consumer grade products



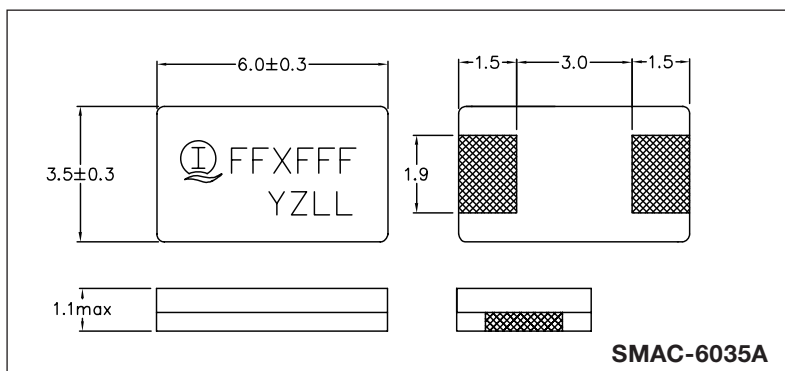
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	8.0MHz ~ 40.0MHz (Fundamental)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±20ppm, ±30ppm, ±50ppm
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±20ppm, ±30ppm, ±50ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±5ppm/Year Max.

SERIES RESISTANCE (ESR) 串聯諧振阻抗

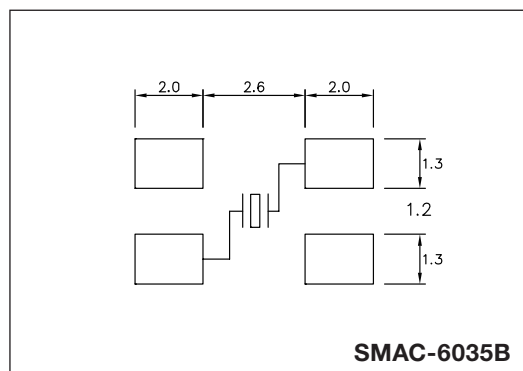
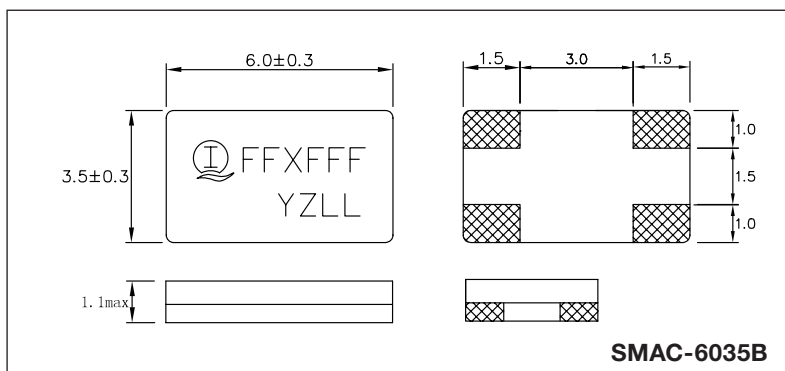
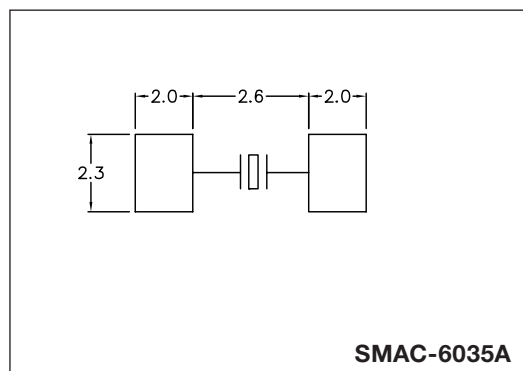
Frequency Range	$8 < f_0 \leq 10$	$10 < f_0 \leq 12$	$12 < f_0 \leq 16$	$16 < f_0 \leq 40$
ESR	100Ω Max.	80Ω Max.	60Ω Max.	30Ω Max.

Please consult our sales representatives for other specifications.
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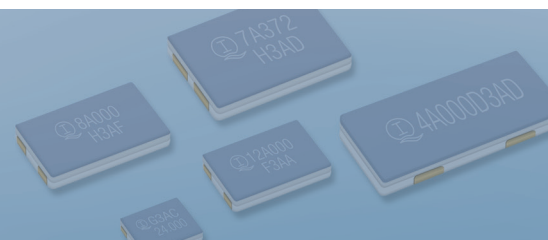
DIMENSION (mm)



SOLDERING PATTERN (mm)



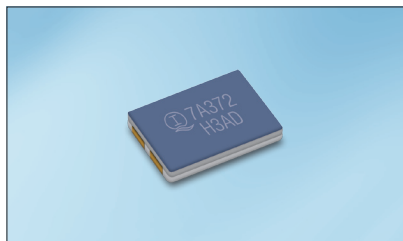
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SMAC-7050

ALL CERAMIC QUARTZ CRYSTAL RESONATORS (SMD) 表貼全陶瓷封裝石英晶體諧振器

High frequency (MHz) crystal resonators



FEATURES

- All ceramic epoxy sealed SMD package
- 2 / 4 pads version available
- Low cost option to consumer grade products



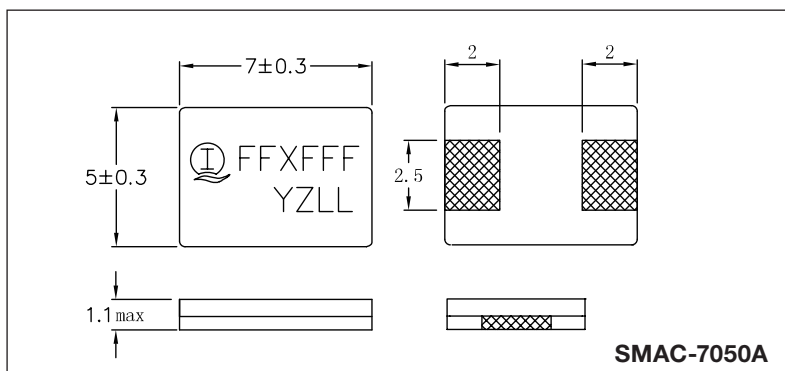
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	6.0MHz ~ 12.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 5\text{ppm/Year Max.}$

SERIES RESISTANCE (ESR) 串聯諧振阻抗

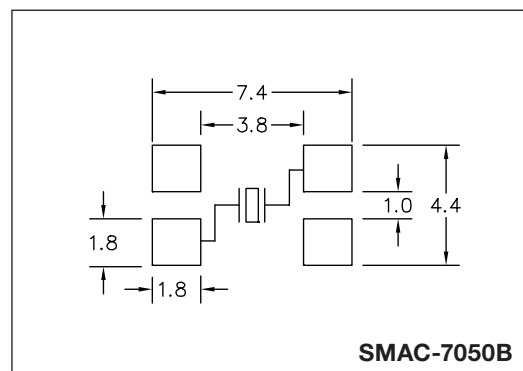
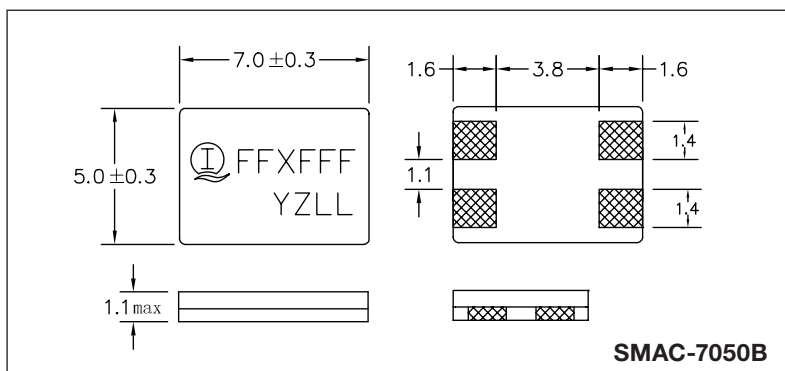
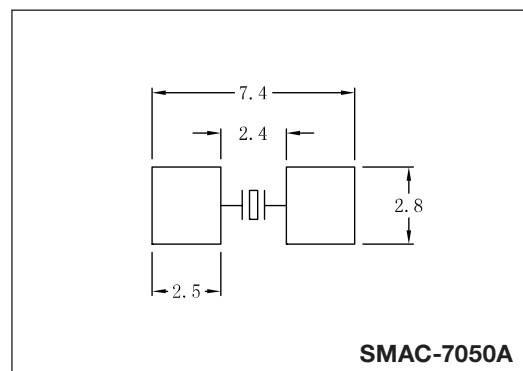
Frequency Range	$6 < f_0 \leq 8$	$8 < f_0 \leq 12$
ESR	80 Ω Max.	60 Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



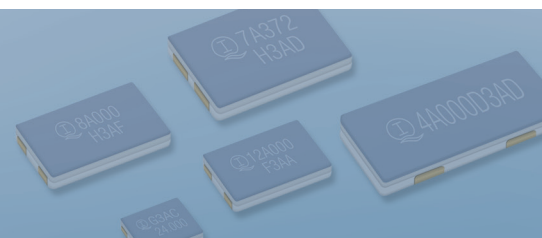
SOLDERING PATTERN (mm)

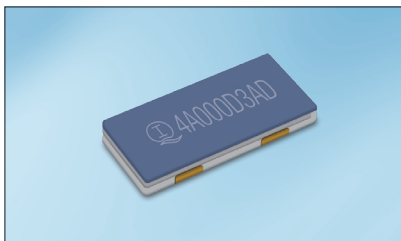


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Tel: +852 2413 5515 Fax: +852 2413 7053 <http://www.interquip.com>





FEATURES

- All ceramic epoxy sealed SMD package
- 2 / 4 pads version available
- Small and thinnest package for low frequency
- Low cost option to consumer grade products



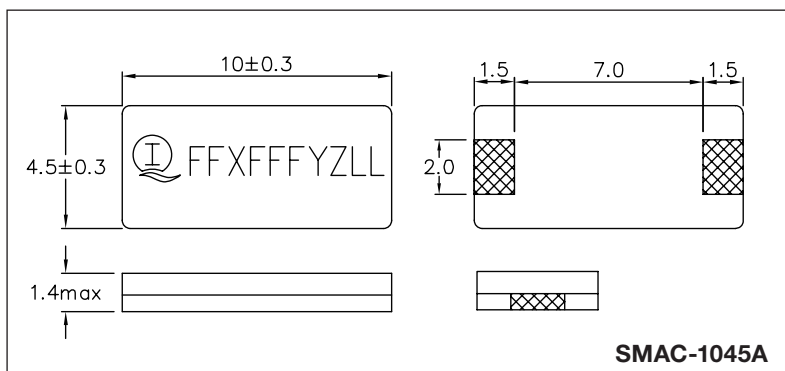
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	3.2768MHz ~ 7.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$, $\pm 50\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 5\text{ppm/Year Max.}$

SERIES RESISTANCE (ESR) 串聯諧振阻抗

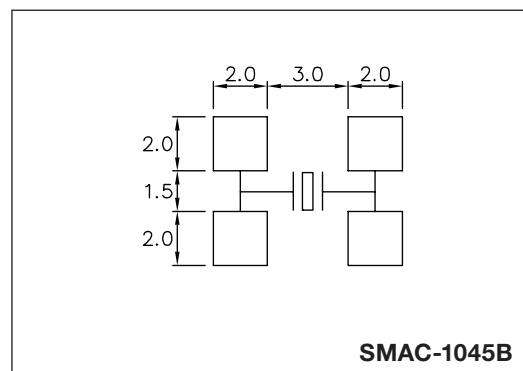
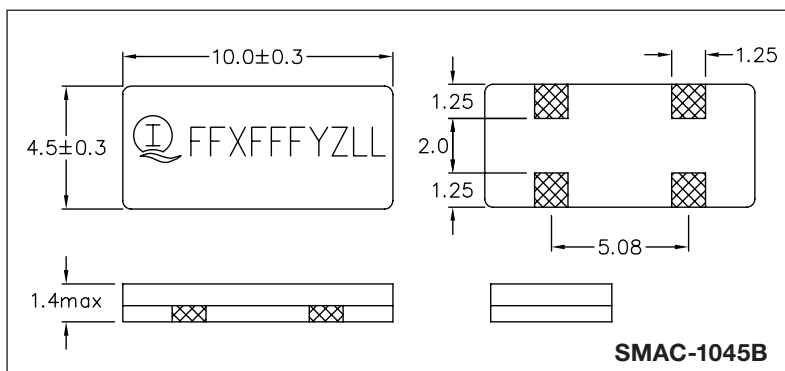
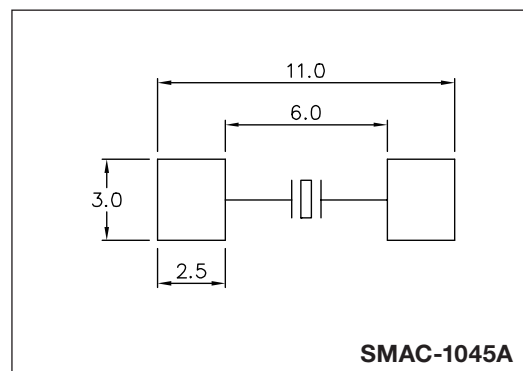
Frequency Range	$3.2768 < f_0 \leq 7$
ESR	120 Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

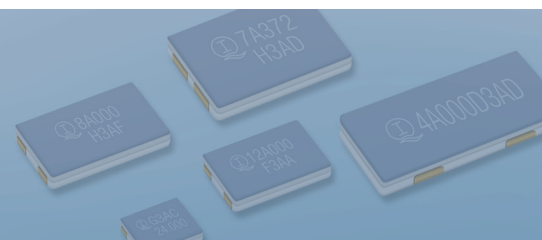
DIMENSION (mm)

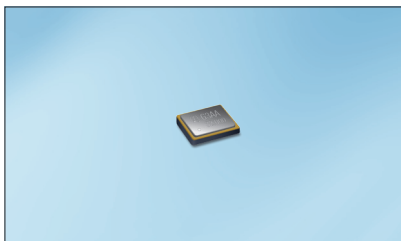


SOLDERING PATTERN (mm)



All specifications are subject to change without prior notice.
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FEATURES

- Surface mount ceramic enclosures
- High reliability seam welded package
- Ultra-light weight and ultra-miniature size
- Wide frequency range



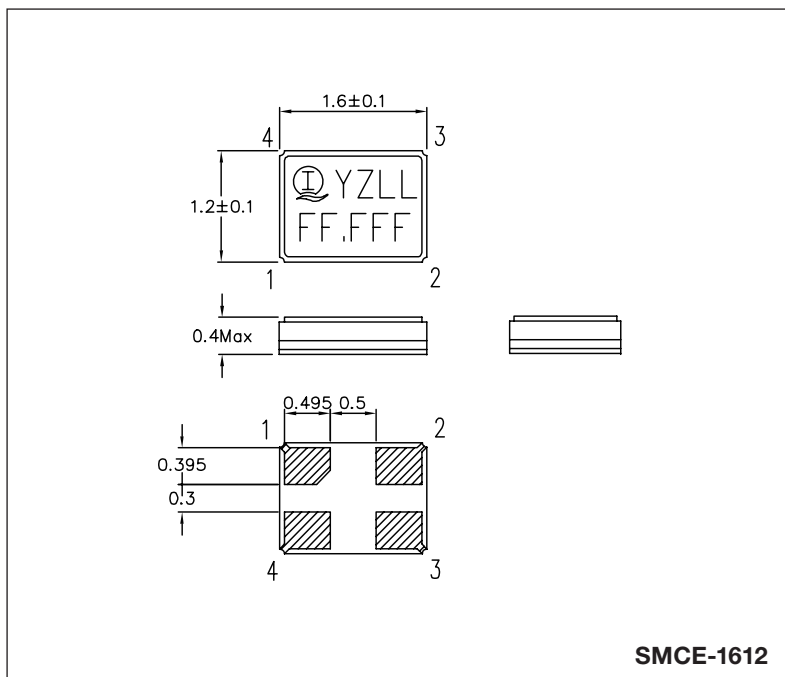
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	26.0MHz ~ 80.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Load Capacitance 負載電容	C_L	6pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 20\text{ppm}$, $\pm 30\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW Max.
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 3\text{ppm/Year}$ Max.

SERIES RESISTANCE (ESR) 串聯諧振阻抗

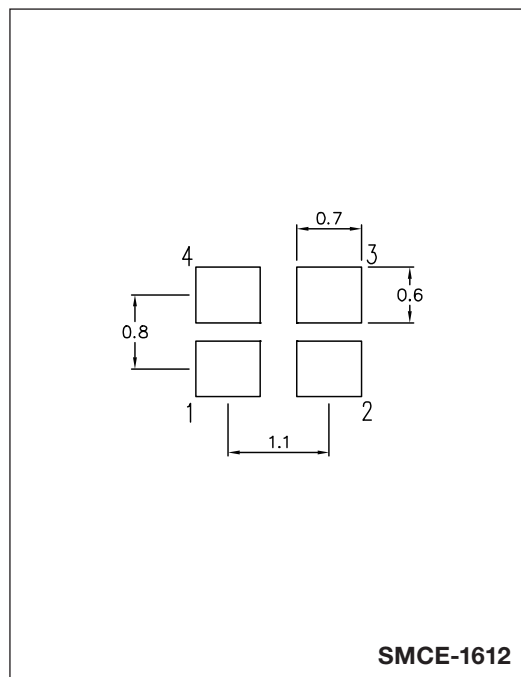
Frequency Range	$26 < f_0 \leq 30$	$30 < f_0 \leq 80$
ESR	150 Ω Max.	150 Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SOLDERING PATTERN (mm)

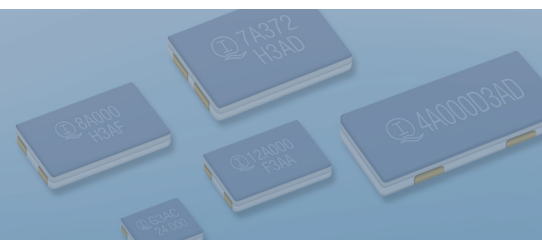


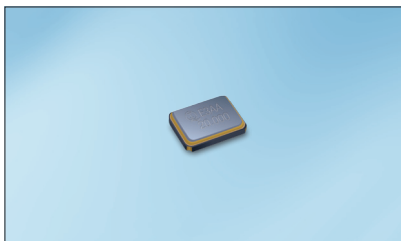
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FEATURES

- Surface mount ceramic enclosures
- High reliability seam welded package
- Ultra-light weight and ultra-miniature size
- Suitable for automotive applications
- Wide frequency range



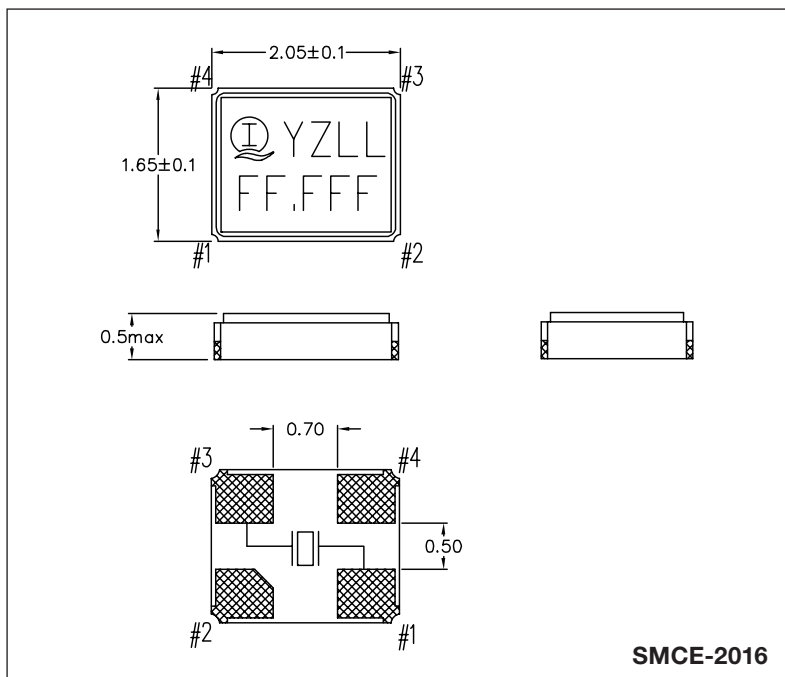
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	24.0MHz ~ 60.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Load Capacitance 負載電容	C_L	10pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 3\text{ppm/Year Max.}$

SERIES RESISTANCE (ESR) 串聯諧振阻抗

Frequency Range	$24 < f_0 \leq 32$	$32 < f_0 \leq 48$	$48 < f_0 \leq 60$
ESR	100 Ω Max.	80 Ω Max.	60 Ω Max.

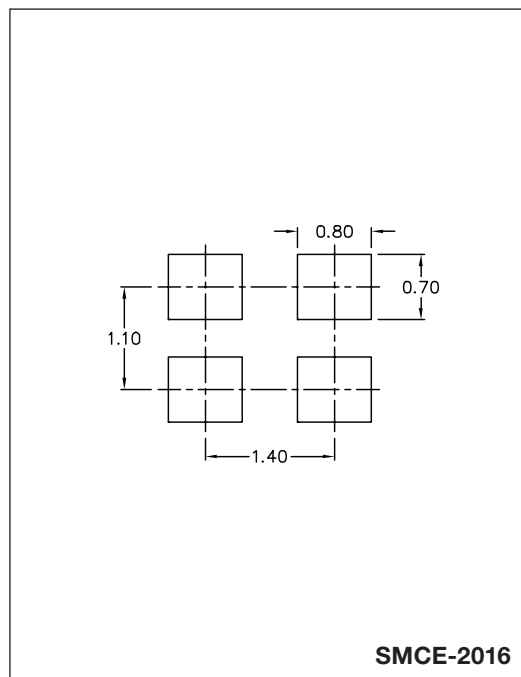
Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



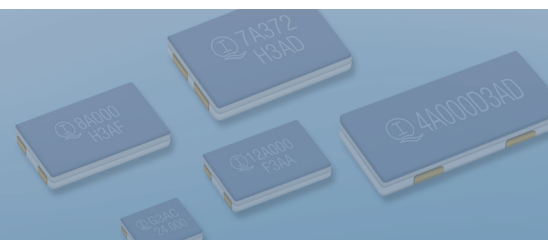
SMCE-2016

SOLDERING PATTERN (mm)



SMCE-2016

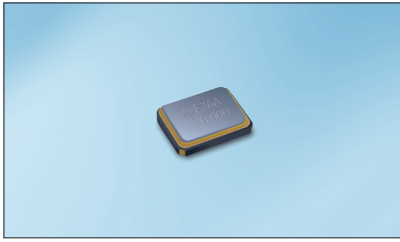
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SMCE-2520

CERAMIC ENCLOSURE QUARTZ CRYSTAL RESONATORS (SMD) 表貼縫焊式陶瓷封裝石英晶體諧振器

High frequency (MHz) crystal resonators



FEATURES

- Surface mount ceramic enclosures
- High reliability seam welded package
- AEC-Q200 Qualified
- Wide frequency range

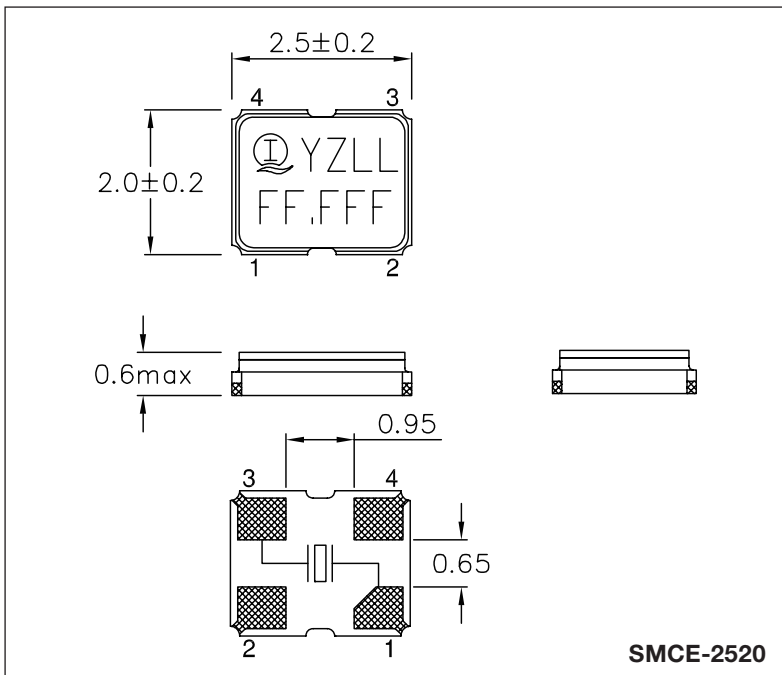


Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	16.0MHz ~ 50.0MHz (Fundamental)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Load Capacitance 負載電容	C_L	10pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 3\text{ppm/Year Max.}$

SERIES RESISTANCE (ESR) 串聯諧振阻抗			
Frequency Range	$16 < f_0 \leq 26$	$26 < f_0 \leq 35$	$35 < f_0 \leq 50$
ESR	150 Ω Max.	100 Ω Max.	60 Ω Max.

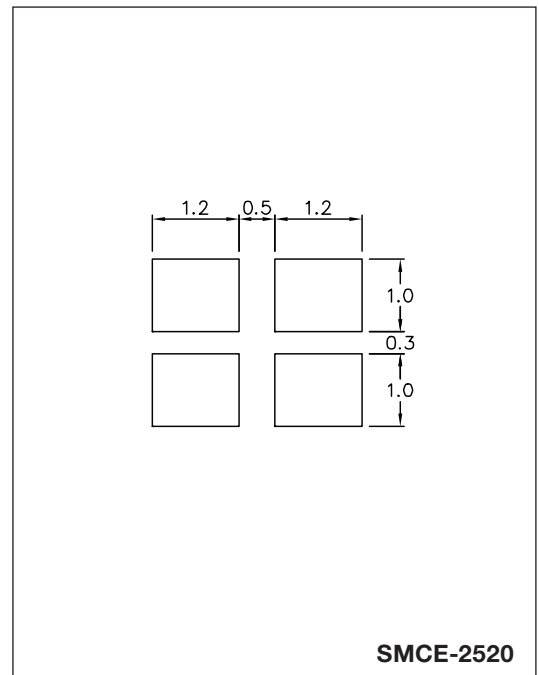
Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SMCE-2520

SOLDERING PATTERN (mm)



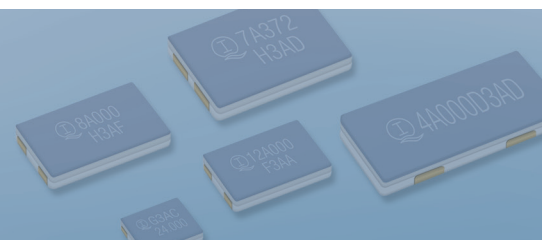
SMCE-2520

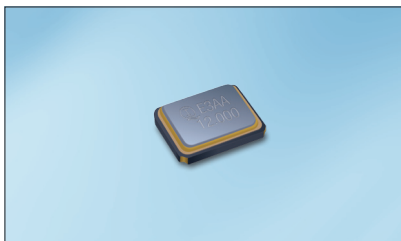
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FEATURES

- Surface mount ceramic enclosures
- High reliability seam welded package
- AEC-Q200 Qualified
- Wide frequency range



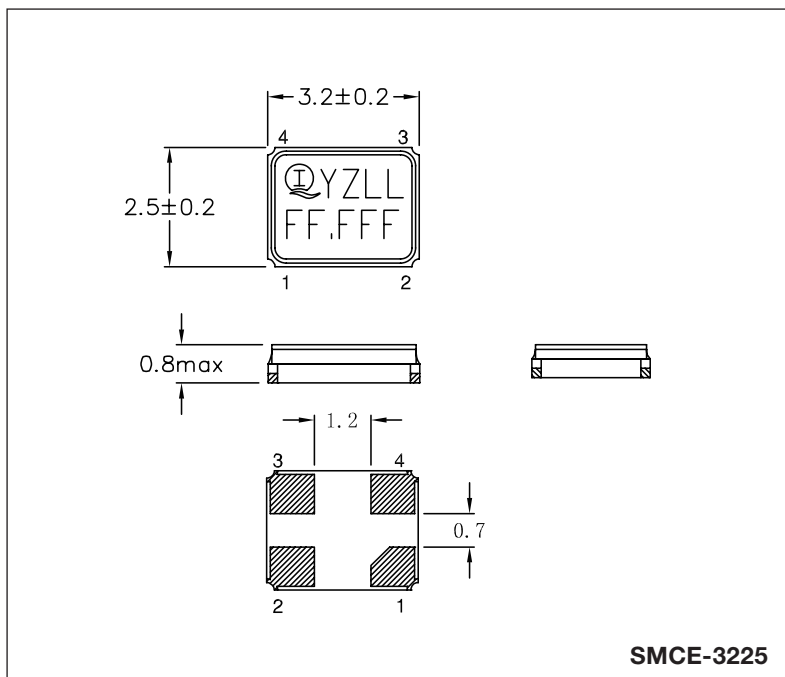
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	10.0MHz ~ 50.0MHz (Fundamental)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±10ppm, ±30ppm
Load Capacitance 負載電容	C_L	10pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±10ppm, ±30ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±3ppm/Year Max.

SERIES RESISTANCE (ESR) 串聯諧振阻抗

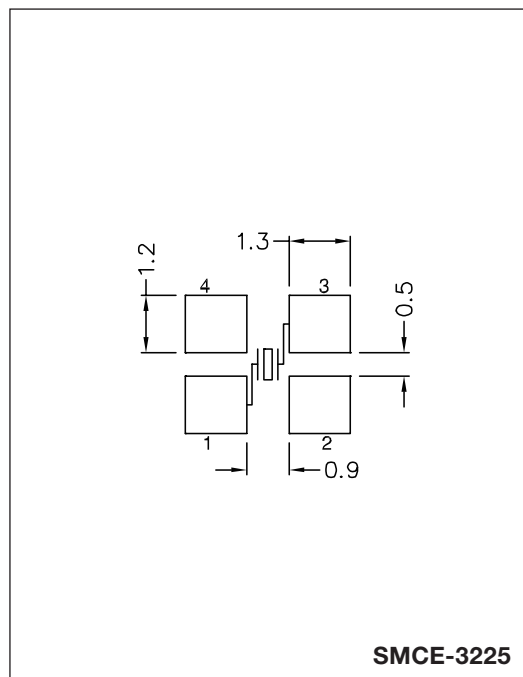
Frequency Range	$10 < f_0 \leq 12$	$12 < f_0 \leq 35$	$35 < f_0 \leq 50$
ESR	350Ω Max.	100Ω Max.	60Ω Max.

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SOLDERING PATTERN (mm)

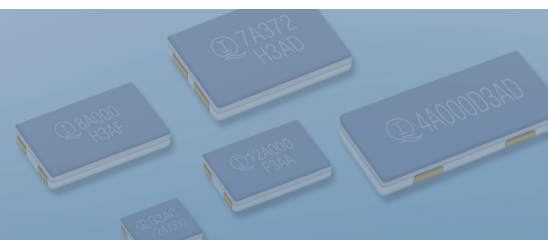


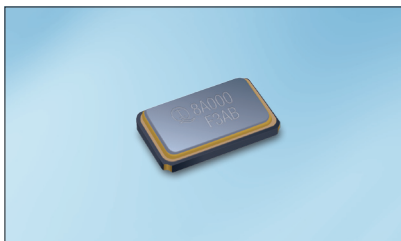
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FEATURES

- Surface mount ceramic enclosures
- High reliability seam welded package
- AEC-Q200 Qualified
- Wide frequency range

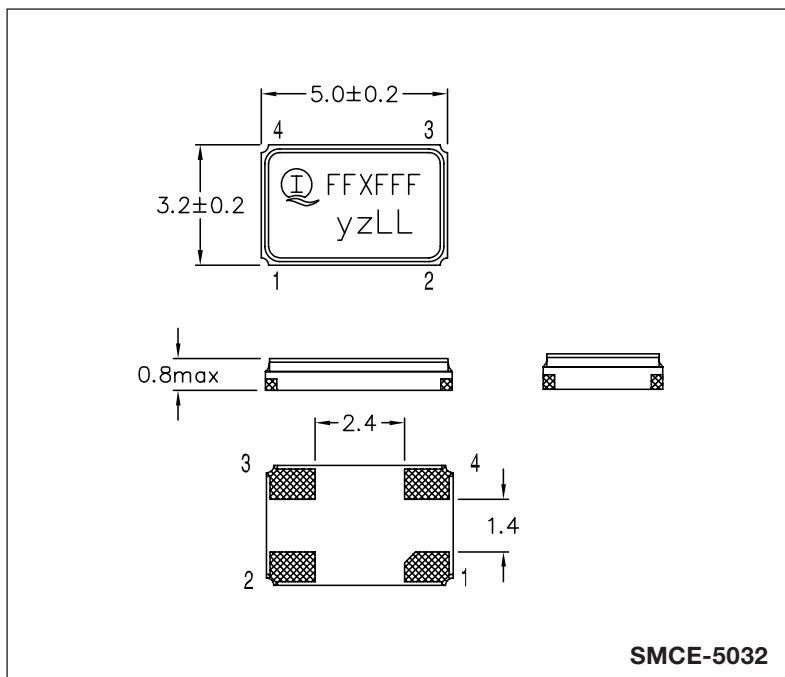


Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	8.0MHz ~ 50.0MHz (Fundamental) 40.0MHz ~ 80.0MHz (3.O.T)
Frequency Tolerance, Ta=25°C ± 3°C 常溫頻率偏差	$\Delta f/f$	±10ppm, ±30ppm
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	±10ppm, ±30ppm
Operating Temperature Range 工作溫度範圍	T_{OPR}	-20°C ~ +70°C, -40°C ~ +85°C
Storage Temperature Range 儲存溫度範圍	T_{STG}	-55°C ~ +125°C
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500MΩ Min.
Aging 老化率	Δf_A	±3ppm/Year Max.

SERIES RESISTANCE (ESR) 串聯諧振阻抗					
Frequency Range	$8 < f_0 \leq 16$	$16 < f_0 \leq 25$	$25 < f_0 \leq 30$	$30 < f_0 \leq 50$	$40 < f_0 \leq 80$ (3.O.T)
ESR	80Ω Max.	50Ω Max.	40Ω Max.	35Ω Max.	80 ~ 100Ω Max.

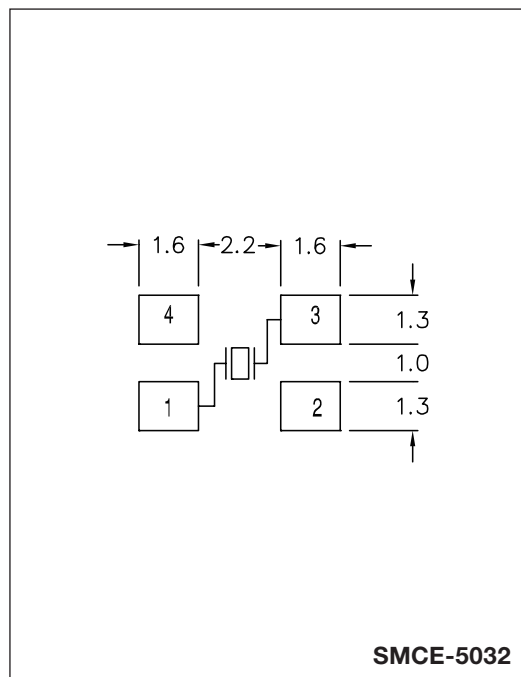
Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SMCE-5032

SOLDERING PATTERN (mm)



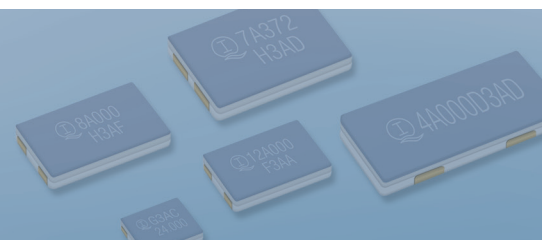
SMCE-5032

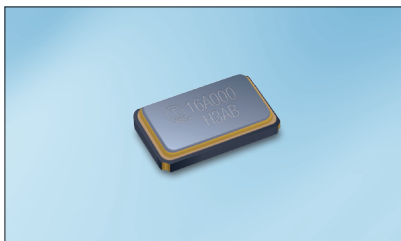
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FEATURES

- Surface mount ceramic enclosures
- High reliability seam welded package
- AEC-Q200 Qualified
- Wide frequency range



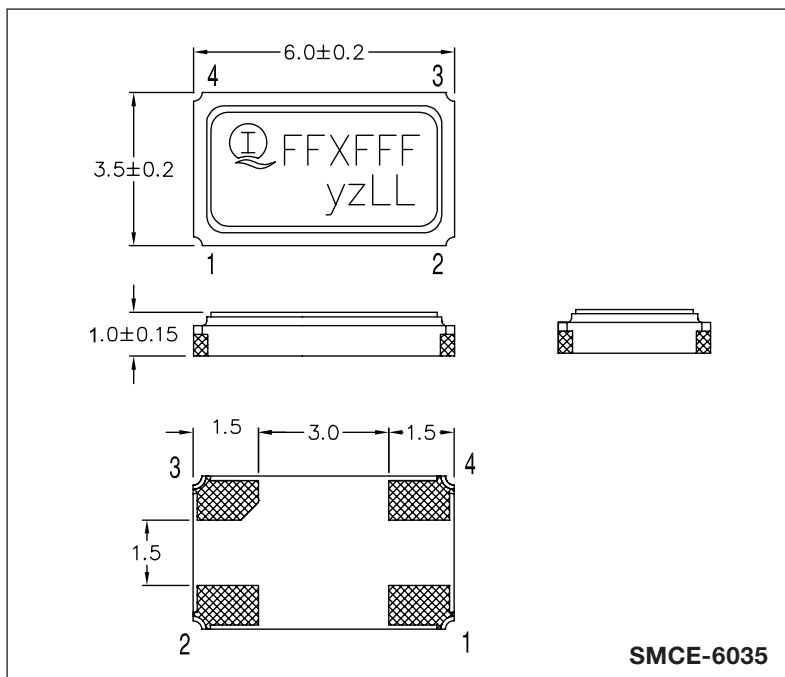
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	8.0MHz ~ 50.0MHz (Fundamental) 40.0MHz ~ 80.0MHz (3.O.T)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 3\text{ppm/Year Max.}$

SERIES RESISTANCE (ESR) 串聯諧振阻抗

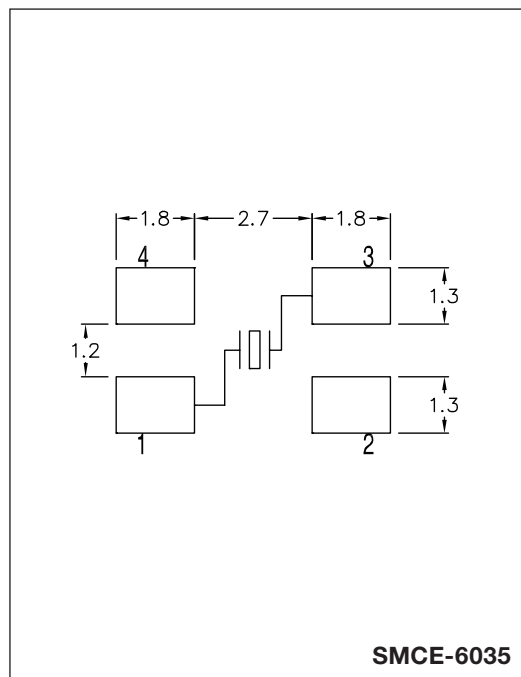
Frequency Range	$8 < f_0 \leq 12$	$12 < f_0 \leq 16$	$16 < f_0 \leq 25$	$25 < f_0 \leq 30$	$30 < f_0 \leq 50$	$40 < f_0 \leq 80$ (3.O.T)
ESR	80 Ω Max.	60 Ω Max.	50 Ω Max.	35 Ω Max.	25 Ω Max.	80 ~ 100 Ω Max.

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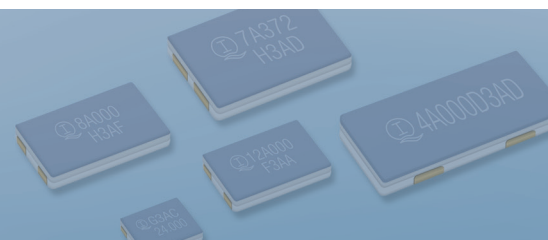
DIMENSION (mm)



SOLDERING PATTERN (mm)



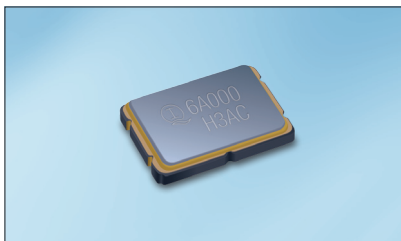
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SMCE-7050

CERAMIC ENCLOSURE QUARTZ CRYSTAL RESONATORS (SMD) 表貼縫焊式陶瓷封裝石英晶體諧振器

High frequency (MHz) crystal resonators



FEATURES

- Surface mount ceramic enclosures
- High reliability seam welded package
- AEC-Q200 Qualified
- Wide frequency range



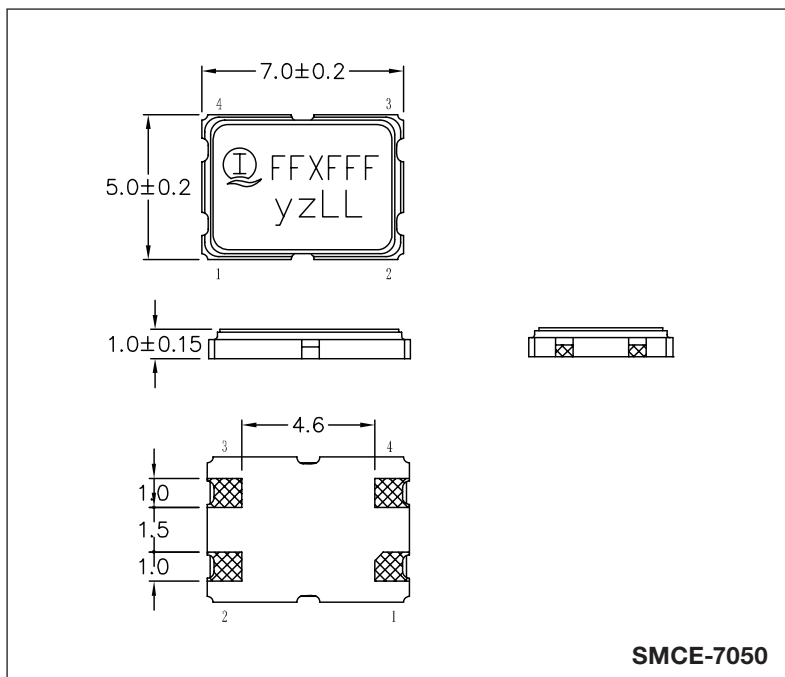
Parameters		Specifications
Nominal Frequency Range 標稱頻率範圍	f_0	6.0MHz ~ 30.0MHz (Fundamental) 30.0MHz ~ 125.0MHz (3.O.T)
Frequency Tolerance, $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$ 常溫頻率偏差	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Load Capacitance 負載電容	C_L	18pF or customer specify
Frequency Tolerance over Operating Temperature Range with refer to 25°C 相對於常溫的頻率溫度特性	$\Delta f/f$	$\pm 10\text{ppm}$, $\pm 30\text{ppm}$
Operating Temperature Range 工作溫度範圍	T_{OPR}	$-20^\circ\text{C} \sim +70^\circ\text{C}$, $-40^\circ\text{C} \sim +85^\circ\text{C}$
Storage Temperature Range 儲存溫度範圍	T_{STG}	$-55^\circ\text{C} \sim +125^\circ\text{C}$
Drive Level 激勵功率	DL	0.1mW (0.5mW Max.)
Shunt Capacitance 靜態電容	C_0	7pF Max.
Insulation Resistance 絕緣電阻	IR	500M Ω Min.
Aging 老化率	Δf_A	$\pm 3\text{ppm}/\text{Year}$ Max.

SERIES RESISTANCE (ESR) 串聯諧振阻抗

Frequency Range	$6 < f_0 \leq 8$	$8 < f_0 \leq 16$	$16 < f_0 \leq 30$	$30 < f_0 \leq 40$ (3.O.T)	$40 < f_0 \leq 125$ (3.O.T)
ESR	100 Ω Max.	80 Ω Max.	50 Ω Max.	100 Ω Max.	80 Ω Max.

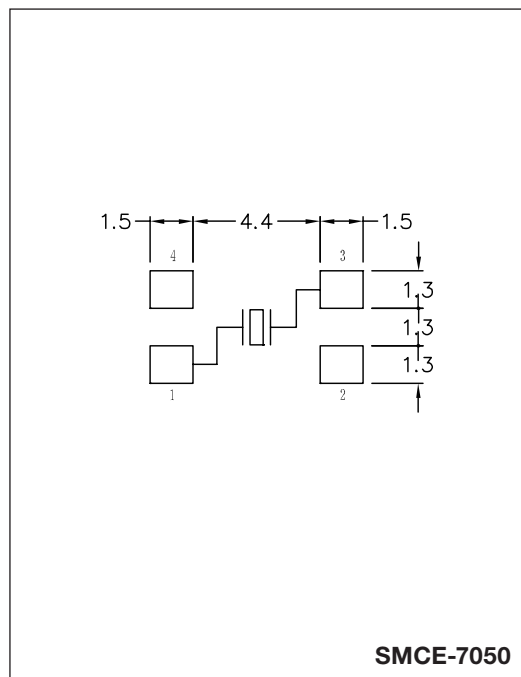
Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



SMCE-7050

SOLDERING PATTERN (mm)



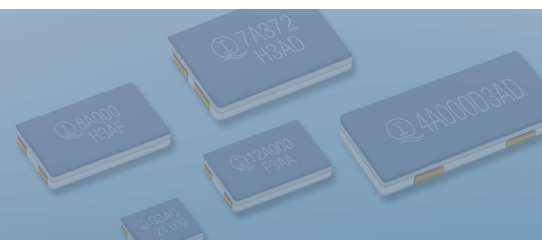
SMCE-7050

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Crystal Oscillators Application Guide

1. Introduction

Oscillators are used in electronic systems for frequency and clock signal generation. Different types of oscillators are used depending on the frequency accuracy, output signal form, power consumption and size required. The most important parameter of an oscillator specification is frequency accuracy. This has three main components.

- *Initial accuracy or adjustment accuracy under nominal conditions.*
Initial accuracy is defined as the difference between specified frequency and output frequency of an oscillator which cannot be trimmed after manufacture. The range and accuracy of frequency setting should be specified for oscillators with trimming possibility.

- *Frequency stability with respect to temperature.*

If compensation methods are not used, the quartz oscillator has approximately the frequency-temperature characteristics of the quartz crystal used. High stability can be achieved, even for simple crystal oscillators by careful choice of the angle of cut. For attainable values, please refer to the Figure 14 in the section on quartz crystals. Compensation is needed to improve on these values and is often cheaper than the selection of narrow angles of cut. The highest frequency stability is reached by temperature stabilization of the quartz crystal, as in an ovenized crystal oscillator.

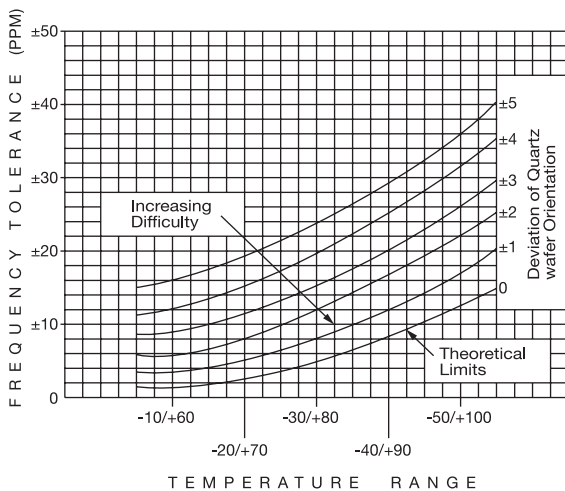


Figure 14: Frequency - Temperature Characteristics and Manufacturing Difficulty of an AT - Cut Crystal Units

- *Aging*

The change in output frequency over time is called aging. This includes the aging effects of the crystal and of the oscillator circuit itself. Aging of the crystal resonance frequency normally occurs logarithmically, the initial aging rate being far higher than later. Each other component of the oscillator ages according to corresponding rules, however due to the complexity of the circuitry employed, total aging effects can vary strongly. Other important parameters of frequency stability are

- *supply sensitivity*
- *sensitivity to load variations*
- *phase noise and short-term stability*
- *mechanical factors.*

2. The Different Types of Crystal Oscillators

There are four main types of oscillators:

- *Standard Packaged Crystal Oscillators (PXO)*
- *Voltage Controlled Crystal Oscillators (VCXO)*
- *Voltage Controlled Temperature Compensate Crystal Oscillator (VC-TCXO)*
- *Temperature Compensated Crystal Oscillators (TCXO)*
- *Oven Controlled Crystal Oscillators (OCXO)*

Oscillator which combine characteristics of more than one of these categories are also possible, such as the temperature compensated, voltage controlled (often referred to as the TCVCXO); and the ovenized voltage controlled quartz oscillators.

2.1 Packaged Crystal Oscillators (PXO)

The term PXO includes all those oscillators which have quartz crystal resonator, oscillator circuit and output stage in one package. The frequency-temperature characteristic is about the same as that of the quartz crystal used. Most PXOs are clock oscillators, miniature oscillators used to generate a microprocessor clock signal.

The main characteristics of a PXO are

- *nominal frequency*
- *initial accuracy or trimming range*
- *frequency stability as a function of temperature*
 - as a function of time (aging)*
 - as a function of output load*
 - as a function of supply voltage*
- *output signal and load conditions*
- *supply voltage and current*
- *mechanical dimensions*
- *electrical connections*

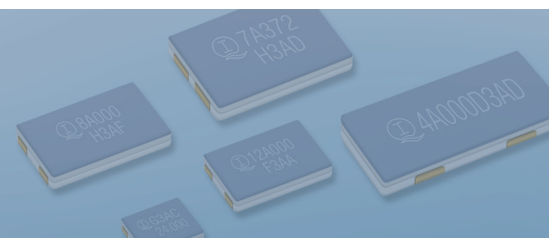
2.2 Voltage Controlled Crystal Oscillators (VCXO)

Crystal Oscillators which can be modulated or tuned using external voltage control are called Voltage Controlled Crystal Oscillators, or VCXOs. Typical applications of VCXOs are narrow band frequency modulation, PLL-systems, frequency shift keying in data transfer, and digital switching.

Special characteristics of a VCXO are (in addition to those already mentioned under PXOs):

- *pull range*
- *control voltage or frequency/voltage slope*
- *linearity of modulation*
- *modulation bandwidth*

The values of these parameters are strongly interdependent. A large range, for example, limits the linearity and frequency stability possible. When the range is relatively limited, the frequency is considerably more stable than that of LC-Oscillators. High demands on the tuning range cause further limitations. Modulation linearity specification is possible using static definition of the tuning behavior and/or the distortion factor of the demodulated output signal. Attainable values of individual parameters are contained in the following table:



Crystal Oscillators Application Guide

Pull range	Up to + 200 x 10 ⁻⁶
Linearity	2% ... 20%
Modulation bandwidth	Up to 15 KHz
Frequency stability	5 ... 10 x 10 ⁻⁶

Typical VCXO data

Varactors or voltage dependent capacitance diode is used as a voltage dependent load capacitance for VCXO frequency adjustment. VCXO's with a wide frequency tuning range are only possible if the quartz resonator used is in the fundamental mode. Pull range is proportional to the motional capacitance, C_1 , of the resonator, which depends on the resonator design and on the overtone of the quartz resonator. The trimming range between load capacitance values of 10 and 30 pF is around 350 ppm in the fundamental mode (for a crystal with motional capacitance of 18 fF); for the same component, the tuning range in the third overtone is 39ppm, and only 14ppm in the fifth overtone. A greater range can be obtained at higher frequencies if the frequency of a fundamental mode quartz resonator is multiplied. A certain increase in tuning range is also possible if inductors are added to the standard circuit.

Interquip is now offering VCXO's which feature fundamental mode quartz resonators at frequencies up to 55 MHz. These VCXO's offer absolute pull range of up to +150 ppm. The absolute pull range is the minimum frequency change from nominal frequency after reducing the pull range for variations due to initial frequency adjustment, changes caused by the temperature dependence of the quartz resonator, aging and variations related to changes in the supply voltage and output load conditions.

VCXO's employing PLL circuits to multiply the fundamental mode frequency up to a higher output frequency are now available up to 170 MHz. These VCXO's offer pull ranges similar to the fundamental mode units but they have higher phase noise.

Modulation signal bandwidth is another important VCXO parameter. It is strongly related to the RC-time constant resulting from the capacitance diode controlling resistor and the effective capacitance in the oscillating network itself.

It is imperative that the quartz crystal used is free of spurious resonance near the main resonance, as coincidence of modulation sidebands with spurious resonance's can lead to distortion.

2.3 Temperature Compensated Crystal Oscillators (TCXO)

Crystal oscillators whose change in frequency over the temperature range are compensated by using temperature dependent passive components are called Temperature Compensated Crystal Oscillators (TCXO). The main specification characteristics are the same as those of the PXO.

TCXO's provide constant frequency over a broad temperature range, 10-20 times more stable than a quartz crystal alone, and are used for applications with a wider temperature range (max. -55...+85°C).

Further TCXO advantages are small size, low power consumption, and immediate attainment of operating state.

Widespread use in telephone and wireless applications has led to a drastic reduction in size, power consumption and price of TCXO's. The higher the frequency stability required over a specified temperature range, the higher the price and the larger the size. TCXO's can be designated to have a frequency-temperature stability similar to that of simple OCXO's, but are no longer cheaper.

Attainable parameter values are contained in the table shown in the following:

Comp. Technique/Temp. range	Frequency stability
Direct -30 to +75°C	±2.0 PPM
Direct 0 to +50°C	±1.5 PPM
Indirect -40 to +90°C	±1.0 PPM
Digital -40 to +90°C	±0.2 PPM

Typical TCXO data

2.3.1 Direct Compensation

Here a thermistor-capacitor combination is placed in the RF-circuit directly, as shown in Figure 15. The effective temperature-dependent load capacitance results from a parallel-series transformation of the parallel combination of thermistor and capacitor.

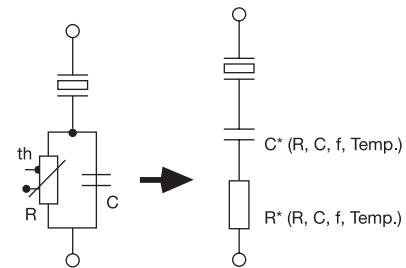


Fig. 15 Typical pulling network used for direct compensation and series equivalent

The advantage is that stabilized voltage and capacitance diode are not required. Smaller dimensions and no problems at low supply voltages result. Parameters of the crystal and the circuitry have to be included in compensation run; so in practice the accuracy of the direct method is limited to about +2ppm (for a temperature range of -40°C to 85°C) by parameter spread.

2.3.2 Indirect Compensation

The other common compensation method is to use a thermistor-resistor network to generate the needed compensating voltage for a voltage controlled oscillator; a simple well-known network is shown in Figure 16.

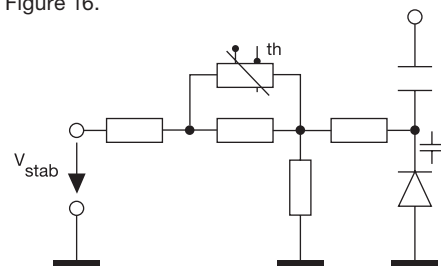


Figure 16

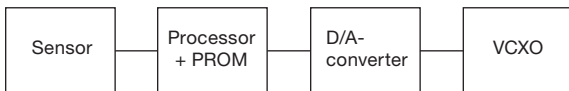


Crystal Oscillators Application Guide

This example network shows only monotonic rising voltage with increasing temperature. The crystal's angle of cut must therefore be selected with turnover points outside the operating temperature range. More complex networks, with thermistors in series and parallel allow compensation beyond the turnover temperatures too; so S-shaped AT-cut turnover temperatures too; so S-shaped AT-cut characteristics with smaller frequency deviations can be used. Iterative computer methods are employed to calculate the resistors of such networks.

2.3.3 Digital Compensation

The analogue temperature sensor signal (voltage, resistance) is digitized by A/D conversion, and calls up from memory the voltage value necessary for frequency compensation. This digital value is then applied to the capacitor diode via a D/A converter and causes compensation of the temperature dependent frequency deviation of the crystal.



Simplified model of the digitally temperature compensated crystal oscillator

Using this method practically every voltage correction of the temperature-frequency curve is possible, limited theoretically only by the memory size and the resolution of the A/D and D/A converter. Digitally switched load capacitors are possible too, instead of the capacitance diode. In practice, accuracies better than .01ppm are not realistic, due to crystal limitations. Over the next few years, as micro processor technology improves, analogue compensation methods will be replaced by the DTCXO.

2.4 Oven Controlled Crystal Oscillators (OCXO)

Crystal Oscillators with internal temperature stabilisation are called Oven Controlled Crystal Oscillators (OCXO). Having a constant crystal temperature results in the highest possible frequency stability. The main disadvantages are the large amount of power needed to maintain the internally stabilized temperature of about 70...90°C, and the warm-up time of several minutes. Standby circuits are generally used with stationary devices; the OCXO is maintained in operation once the equipment is switched off, to avoid waiting times and problems due to hysteresis effects. Mobile OCXO's must feature small size, low power consumption and short run-in time. SC-cut crystals are sometimes used to achieve short warm-up some frequency over-oscillation due to temperature gradients.

The warm-up performance of an OCXO requires the specification of additional ratings:

- Warm-up time of a defined frequency stability. (Often separately specified for two or more temperatures and frequency stabilities).
- Power consumption during warm-up time
- Power consumption during operation.

The table shown in the following contains typical data.

	Single Oven	Double Oven
Frequency stability/Temp.	10 ⁻⁸ ...10 ⁻¹⁰ /°C	2x10 ⁻¹² /°C
Frequency stability/Time	10 ⁻⁶ ...10 ⁻⁸ /yr	10 ⁻⁸ /yr
Short term stability (τ=1s)	10 ⁻¹⁰ ...10 ⁻¹¹	10 ⁻¹¹ ...10 ⁻¹²
Run-in time	~15min (10 ⁻⁸)	~3h (10 ⁻⁹)
Power consumption	0.5...10W	5...40W
Volume	15...200 cm ³	1000 cm ³

Typical OCXO data

A single Oven OCXO is shown in the following diagram.



Thermal isolation OCXO block diagram

The oven unit contains a crystal, oscillation circuit, temperature sensor and heater. The inside temperature is held constant over a wide outside temperature range to within fractions of a degree centigrade by using a temperature control circuit. The oven temperature is chosen at about 5 to 15°C above the highest possible outside temperature. Specially cut crystals, whose frequency-temperature curve turnover point coincides with the oven temperature, are used in the oscillation circuit. This method ensures that temperature changed cause only very small alterations to frequency. Proportional temperature control uses a thermistor constructed bridge circuit in the oven to assess deviation from the optimal oven temperature. The differential voltage is amplified and used in controlling the power to the heat sources.

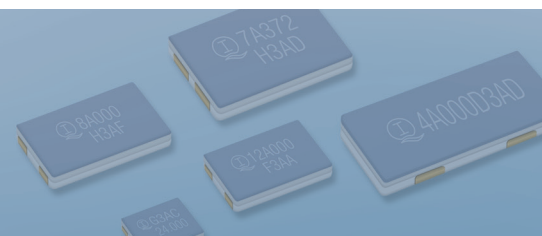
Oven Controlled Crystal Oscillator

Interquip offers OCXO's over a wide frequency range to meet the needs of today's demanding requirements. The following guidelines are provided to enable the user to select or specify the oscillator that best fits their application.

The OCXO achieves its stability by containing a precision quartz resonator and other temperature sensitive elements, that influence the frequency stability, within an oven unit. The temperature of the oven is sensed by a thermistor which is contained in a balanced bridge network or other temperature control circuit. The control circuit controls the power to the heating elements that are mounted onto the oven unit, so that the oven temperature is maintained within a desired nearly constant temperature range. The oven unit and other critical components are surrounded by thermal insulation which minimizes the loss of thermal energy and buffers it from the temperature variation of the ambient environment in which the OCXO is employed. By keeping the precision quartz resonator at a nearly constant temperature, the frequency stability with respect to ambient temperature change can be significantly greater than can be realized by temperature compensation circuits.

Interquip's OCXO's can be employed to meet the following range of requirements:

- Frequency Range: 5 MHz to 80 MHz
- Frequency-Temperature Stability: ± 100 ppb to ± 1 ppb
- Frequency-Time Stability: ± 50ppb to ± 0.5ppb per day
: ± 500ppb to ± 30ppb per year
- Allan Variance: ± 5x10E-10 to ± 5x10E-12 (tau - 1 second)
- Phase Noise: -100 dBc to -130dBc at 10Hz
: -145 dBc to -155dBc at 100KHz from oscillator frequency
- G sensitivity: ± 500b/G to ± 0.2ppb/G



Crystal Oscillators Application Guide

Interquip offers OCXO's which employs either an AT cut, SC cut or BT cut precision quartz resonator. These resonators are encapsulated in glass or metal enclosures. It should be noted that where as the SC-cut quartz resonators provide some degree of superior technical performance over AT-cut quartz resonators, they are also more difficult to manufacture. Therefore, oscillators that employ SC-cut quartz resonators are more expensive than oscillator which contain AT-cut quartz resonators. If the superior technical performance provided by the SC-cut quartz resonator is not required by the application, then an oscillator employing an AT-cut resonator should be specified to obtain cost savings.

If you require an oscillator which is not covered by these standards or you need an enclosure which is dimensionally different, then please contact Interquip for a custom oscillator design. Please fill in the "Quartz Crystal Oscillator Specification/Order Form" which is provided on page 43 and send it to Interquip for immediate review and reply.

3. Glossary of Terms Used

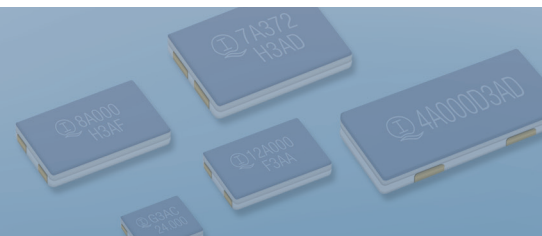
The reader is referred to the International Electrotechnical Commission Standard Publication 679-1, "Quartz Crystal Controlled Oscillators, Part 1, General Information, Test Conditions and Methods" for a complete list of technical terms and their definitions, which are applicable to crystal controlled oscillators. The list of terms given below is limited to only the most prominent. Interquip Limited welcomes any enquiries that the reader may have and will provide the standard definition of the terms as given in the above mentioned IEC standard in addition to the application of the terms to the subject oscillators.

Nominal frequency	the output frequency of the oscillator as specified in the data sheet
Frequency tolerance	allowed maximum of frequency deviation from nominal frequency under certain operating conditions
Frequency offset	frequency difference to be adjusted at reference temperature in order to minimize absolute deviation from nominal frequency over temperature
Adjustment frequency	adjustment frequency = nominal frequency + frequency offset
Reference temperature	25+2°C unless stated otherwise
Operating temperature range	temperature range in which the output signal is within the tolerance with respect to frequency, amplitude and other attributes
Long-term stability (aging)	changes in oscillator frequency over long time periods (based on irreversible changes in the values or characteristics of the components)
Short-term stability	stochastic excursions of the output frequency from the mean value; useful measures are phase noise (frequency domain) and Allan-variance (time domain)
Spectral purity	includes harmonic distortion and spurious responses



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Crystal Oscillators Application Guide

TO: INTERQUIP ELECTRONICS CO., LIMITED

QUARTZ CRYSTAL RESONATOR SPECIFICATION SAMPLE / ORDER FORM

Form: _____ Date: _____
Company: _____ Telephone: _____
Fax No.: _____ E-mail: _____
Address: _____

Application: _____

Quantity Required: _____

Holder Type (Series): _____

Frequency: _____ MHz

Frequency Stability: _____ PPM

Frequency Stability vs. Aging: _____ PPM/Year

Frequency Stability vs. Temperature: _____ PPM

Frequency Stability vs. Supply Voltage: _____ PPM

Frequency Stability vs. Load: _____ PPM

Operating Temperature Range: _____ °C

Storage Temperature Range: _____ °C

Supply Voltage: _____ V

Current Consumption: _____ mA Max

Output Waveform: _____

Output Symmetry: _____ %

Output Voltage VOL: _____ VDD

Output Voltage VOH: _____ VDD

Output Load: _____ pF

Rise/Fall Time: _____ ns Max

Duty Cycle: _____

Frequency Control Range: _____ PPM Min

Control Voltage Range: _____ V

Start-up Time: _____ ms

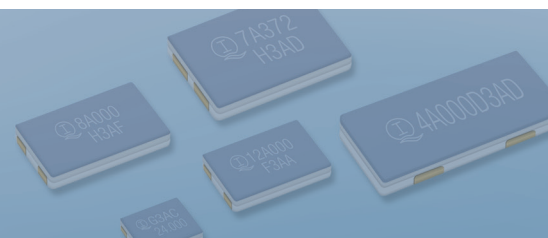
Special Requirements: _____

Please kindly fill in specification and fax to Interquip Electronics Co., Limited
at (852) 2413 7053 or email to iql@interquip.com



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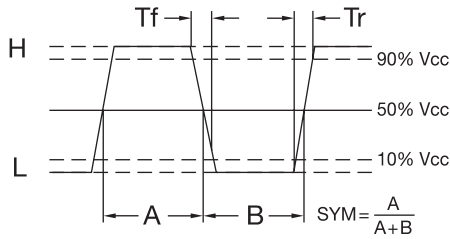
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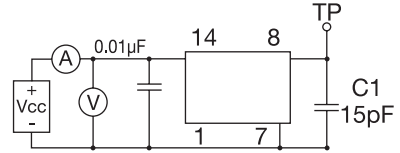
Crystal Oscillators Application Guide

OUTPUT WAVEFORMS AND RECOMMENDED TEST CIRCUITS

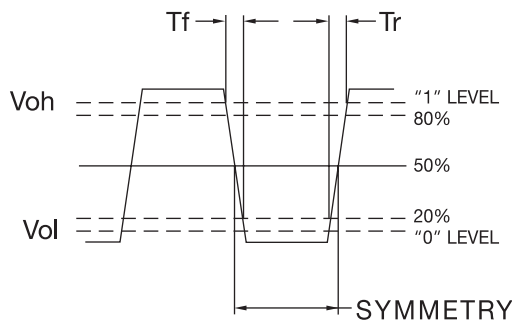
TYPICAL CMOS WAVE FORM



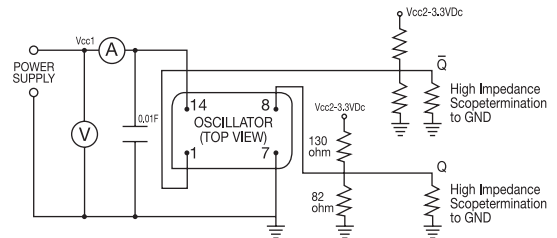
CMOS TEST CIRCUIT



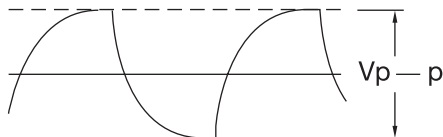
ECL / PECL WAVE FORM



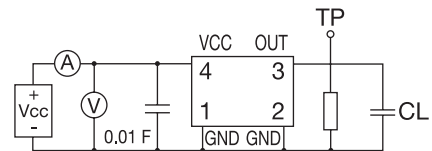
ECL / PECL TEST CIRCUIT



TYPICAL CLIPPED SINE WAVE FORM

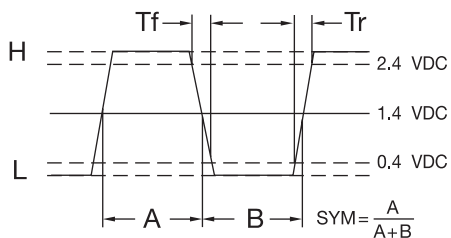


SINE TEST CIRCUIT

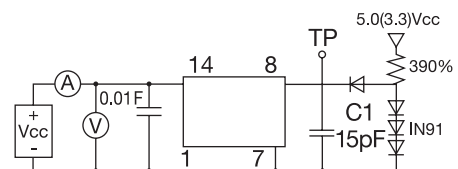


$CL=10\text{pF}$ (including fixture and probe capacitances)
 $RL=10\text{k}\Omega$

TYPICAL TTL WAVE FORM

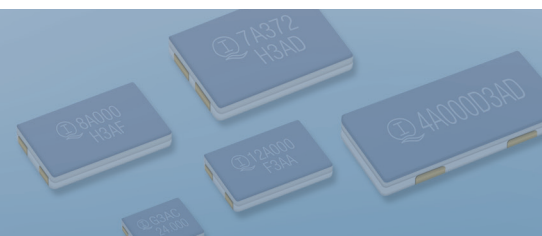


TTL TEST CIRCUIT



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186-B Series

SMD PLASTIC ENCAPSULATION QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器

Standard crystal oscillators



FEATURES

- Pick and place assembly
- Low supply voltage version available

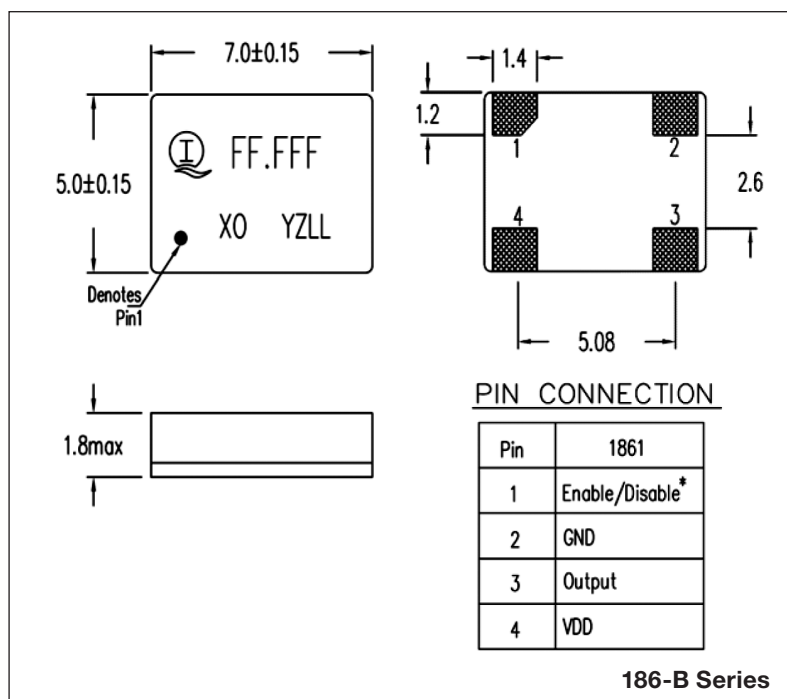


Parameters		Specifications	
Output Waveform 輸出波型	CMOS		
Frequency Range 頻率範圍	32.768KHz	1MHz ~ 50MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	1.6V ~ 5.5V	0.8V ~ 5.5V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±10ppm, ±15ppm, ±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm		
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C		
Current Consumption (Idd) 消耗電流	0.1mA Max.	10mA Max.	
Rise & Fall Time 上 / 下沿時間	20ns Max.	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%		
Output Voltage 輸出電壓	V _{OH}	90% VDD	
	V _{OL}	10% VDD	
Output Load 輸出負載	15pF		
Start-up Time 起動時間	10ms Max.		
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C		

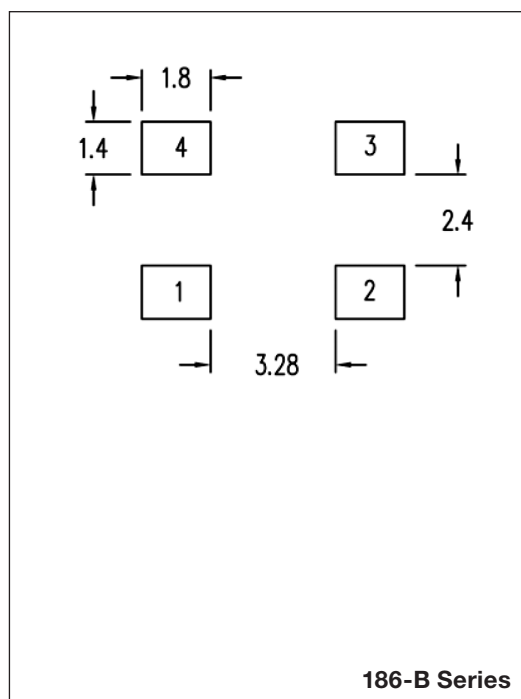
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

Please consult our sales representatives for other specifications
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



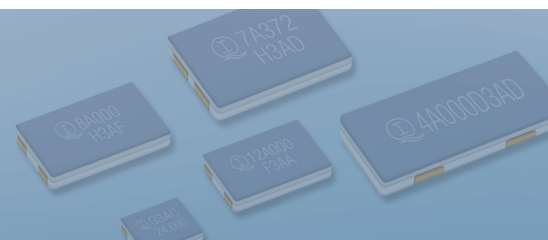
SOLDERING PATTERN (mm)



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178-B Series

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Standard crystal oscillators



FEATURES

- Small size
- Pick and place assembly
- Low supply voltage version available

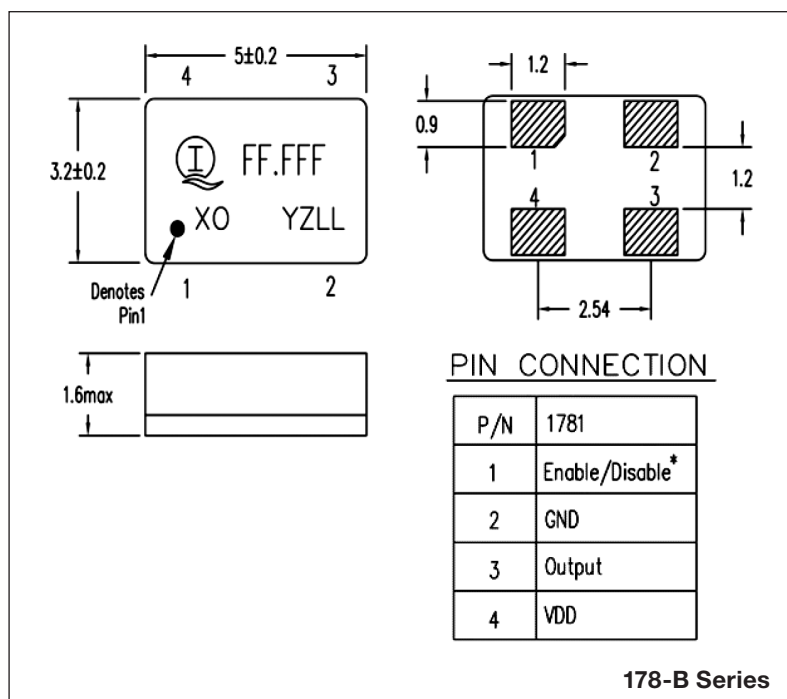


Parameters		Specifications	
Output Waveform 輸出波型		CMOS	
Frequency Range 頻率範圍	32.768KHz	1MHz ~ 50MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	1.6V ~ 5.5V	0.8V ~ 5.5V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±10ppm, ±15ppm, ±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm		
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C		
Current Consumption (Idd) 消耗電流	0.1mA Max.	10mA Max.	
Rise & Fall Time 上 / 下沿時間	20ns Max.	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%		
Output Voltage 輸出電壓	V _{OH}	90% VDD	
	V _{OL}	10% VDD	
Output Load 輸出負載	15pF		
Start-up Time 起動時間	10ms Max.		
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C		

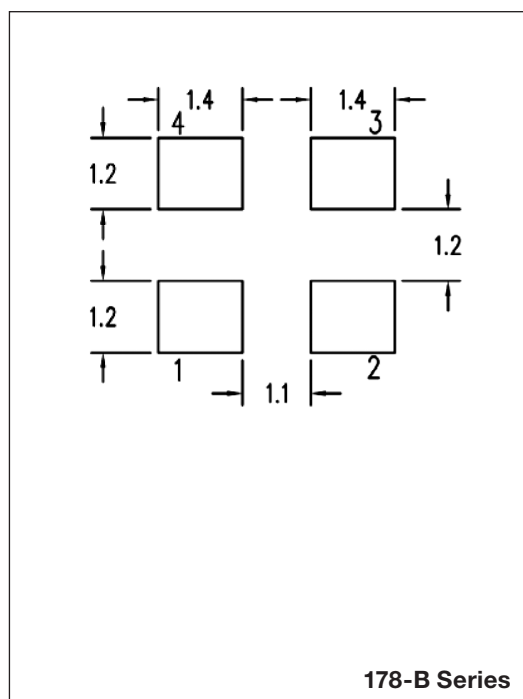
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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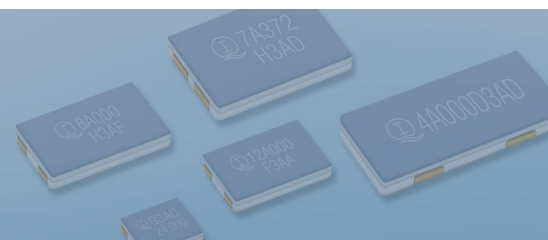
DIMENSION (mm)



SOLDERING PATTERN (mm)



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166-B Series

SMD PLASTIC ENCAPSULATION QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器

Standard crystal oscillators



FEATURES

- Small size
- Pick and place assembly
- Low supply voltage version available

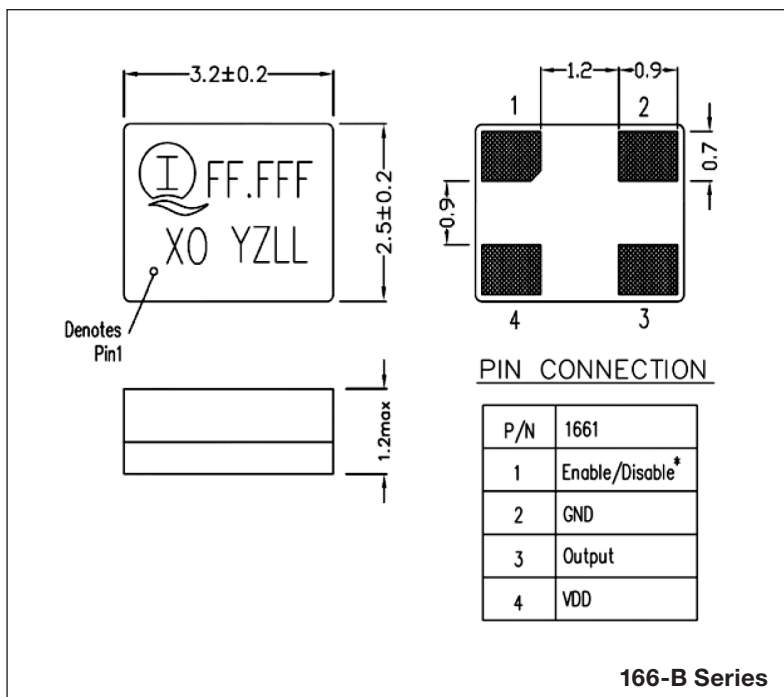


Parameters	Specifications	
Output Waveform 輸出波型	CMOS	
Frequency Range 頻率範圍	1MHz ~ 50MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	0.8V ~ 5.5V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±10ppm, ±15ppm, ±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C	
Current Consumption (Idd) 消耗電流	10mA Max.	
Rise & Fall Time 上 / 下沿時間	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD
	V _{OL}	10% VDD
Output Load 輸出負載	15pF	
Start-up Time 起動時間	10ms Max.	
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C	

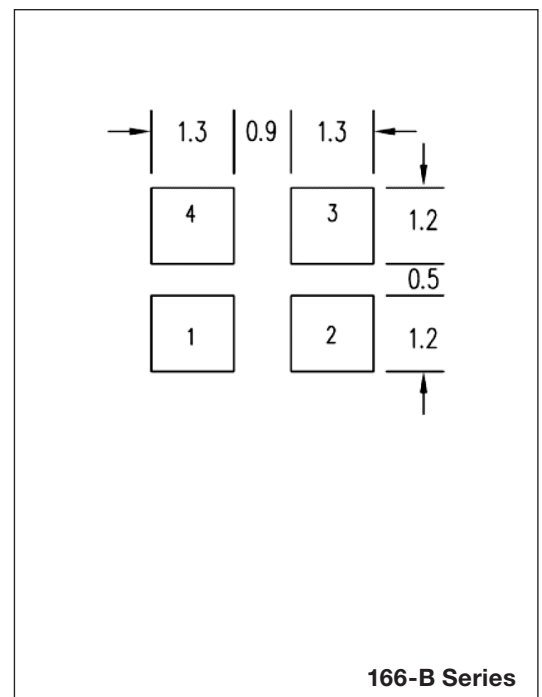
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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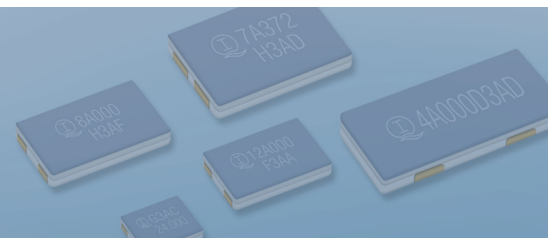
DIMENSION (mm)



SOLDERING PATTERN (mm)

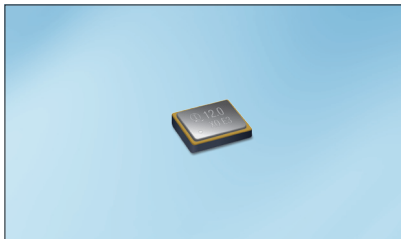


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176 Series

SMD CERAMIC ENCLOSURE QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器



FEATURES

- Ultra-miniature size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available

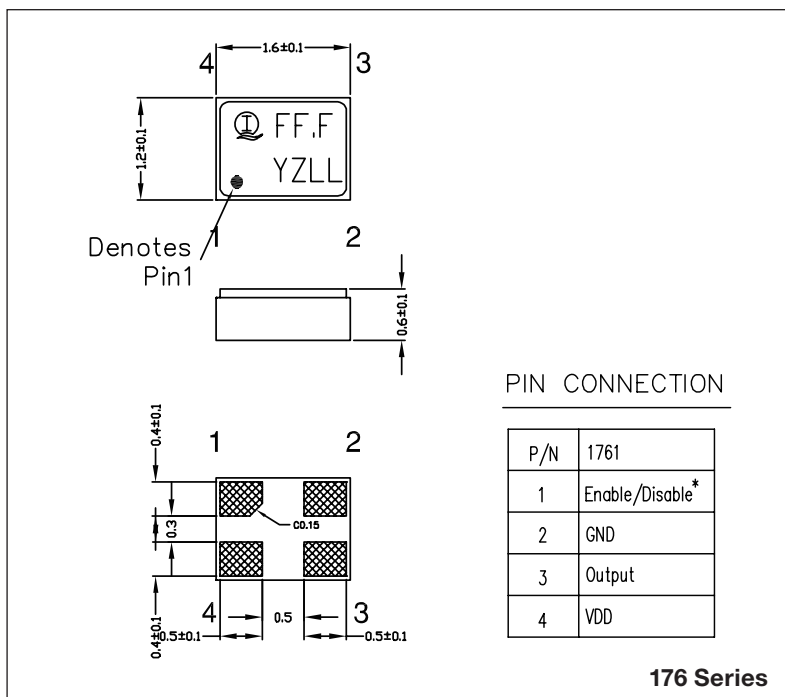


Parameters	Specifications	
Output Waveform 輸出波型	CMOS	
Frequency Range 頻率範圍	1.25MHz ~ 40MHz	40MHz ~ 80MHz
Supply Voltage Range (Vdd) 工作電壓範圍	1.8V ~ 3.3V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C	
Current Consumption (Idd) 消耗電流	10mA Max.	15mA Max.
Rise & Fall Time 上 / 下沿時間	8ns Max.	5ns Max.
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD
	V _{OL}	10% VDD
Output Load 輸出負載	15pF	
Start-up Time 起動時間	10ms Max.	
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C	

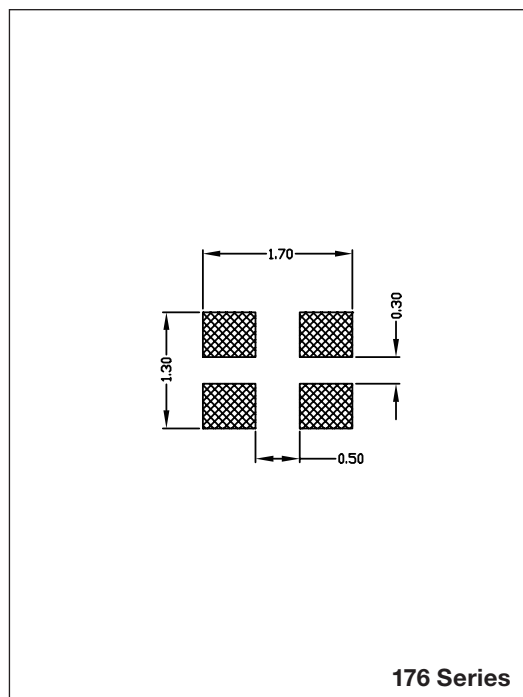
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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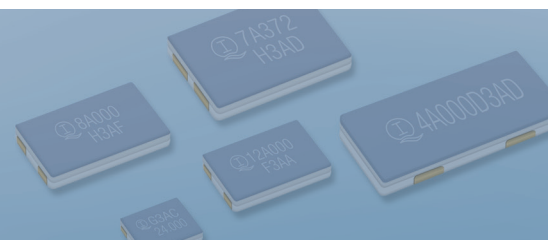
DIMENSION (mm)



SOLDERING PATTERN (mm)



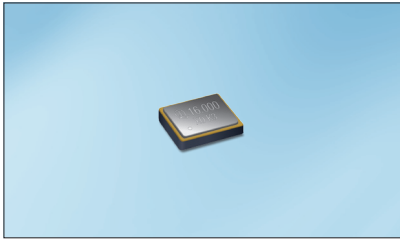
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168 Series

SMD CERAMIC ENCLOSURE QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器

Standard crystal oscillators



FEATURES

- Ultra-miniature size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available

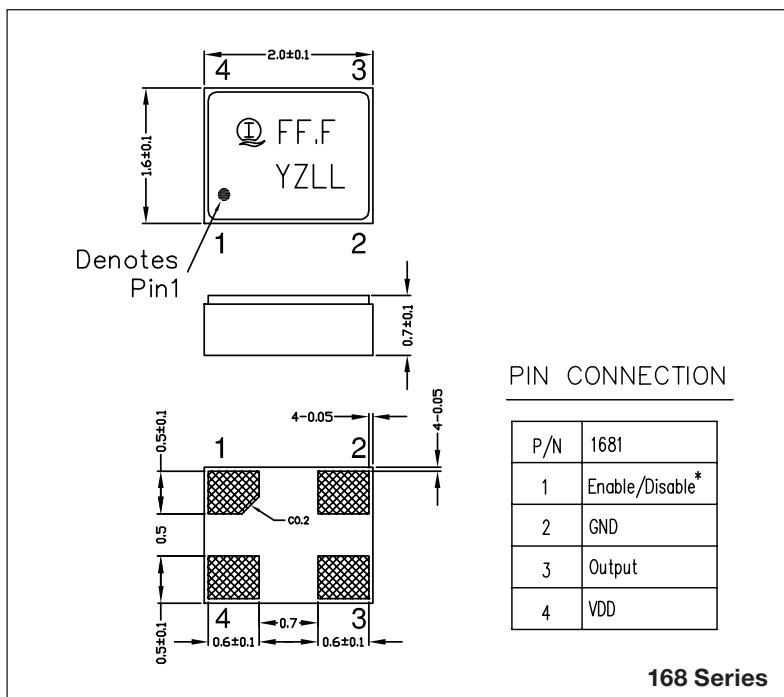


Parameters		Specifications	
Output Waveform 輸出波型		CMOS	
Frequency Range 頻率範圍		1.25MHz ~ 40MHz	40MHz ~ 80MHz
Supply Voltage Range (Vdd) 工作電壓範圍		1.8V ~ 3.3V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**		±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍		-20°C ~ +70°C, -40°C ~ +85°C	
Current Consumption (Idd) 消耗電流		10mA Max.	15mA Max.
Rise & Fall Time 上 / 下沿時間		8ns Max.	5ns Max.
Output Symmetry 輸出對稱性		40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD	
	V _{OL}	10% VDD	
Output Load 輸出負載		15pF	
Start-up Time 起動時間		10ms Max.	
Storage Temperature Range 儲存溫度範圍		-55°C ~ +125°C	

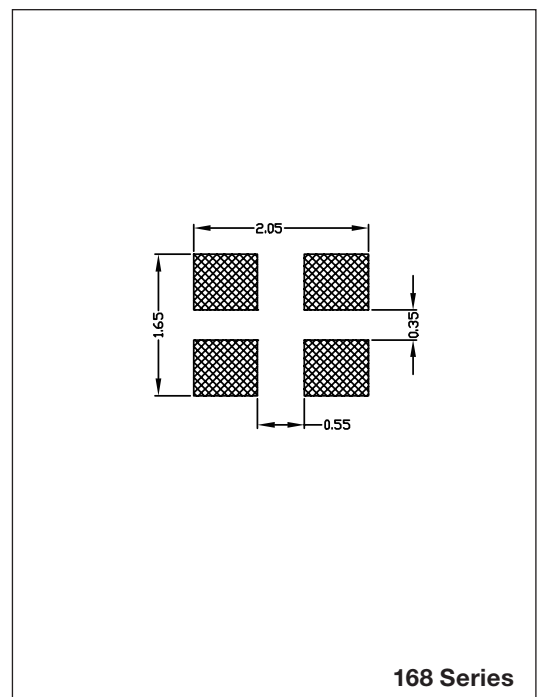
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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DIMENSION (mm)



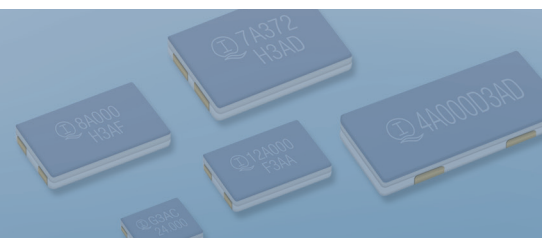
SOLDERING PATTERN (mm)



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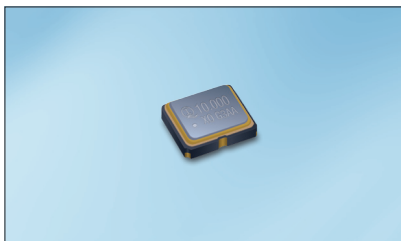
I INTERQUIP ELECTRONICS CO LTD
應達利電子有限公司

Flat A, 9th Floor, On Shing Industrial Building, 2-16 Wo Liu Hang Road, Fotan, N.T., Hong Kong
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165 Series

SMD CERAMIC ENCLOSURE QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器



FEATURES

- Ultra-miniature size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available

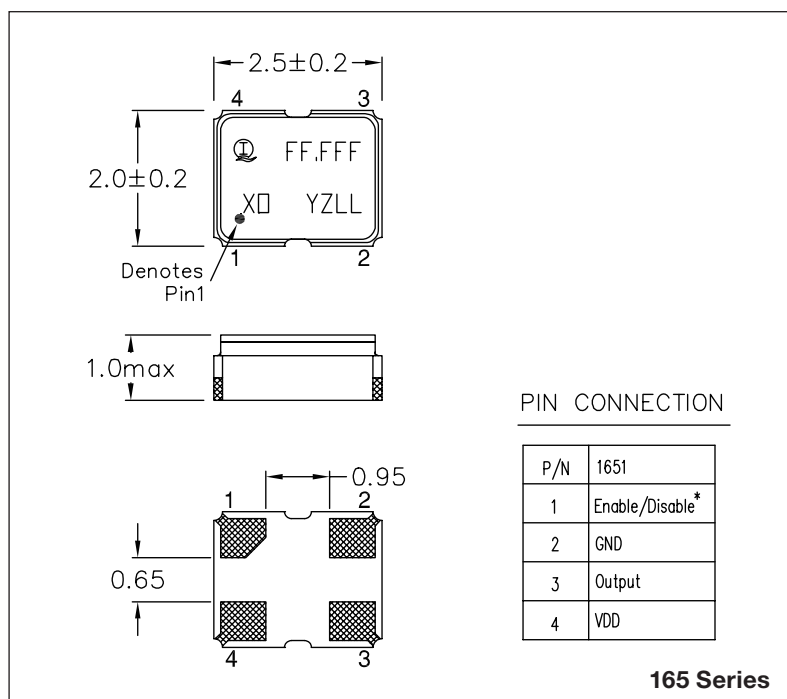


Parameters	Specifications		
Output Waveform 輸出波型	CMOS		
Frequency Range 頻率範圍	32.768KHz	1.25MHz ~ 50MHz	50MHz ~ 80MHz
Supply Voltage Range (Vdd) 工作電壓範圍	1.6V ~ 5.5V	0.8V ~ 5.5V	1.62V ~ 3.63V
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm		
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C		
Current Consumption (Idd) 消耗電流	0.1mA Max.	10mA Max.	20mA Max.
Rise & Fall Time 上 / 下沿時間	20ns Max.	8ns Max.	5ns Max.
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%		
Output Voltage 輸出電壓	V _{OH}	90% VDD	
	V _{OL}	10% VDD	
Output Load 輸出負載	15pF		
Start-up Time 起動時間	10ms Max.		
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C		

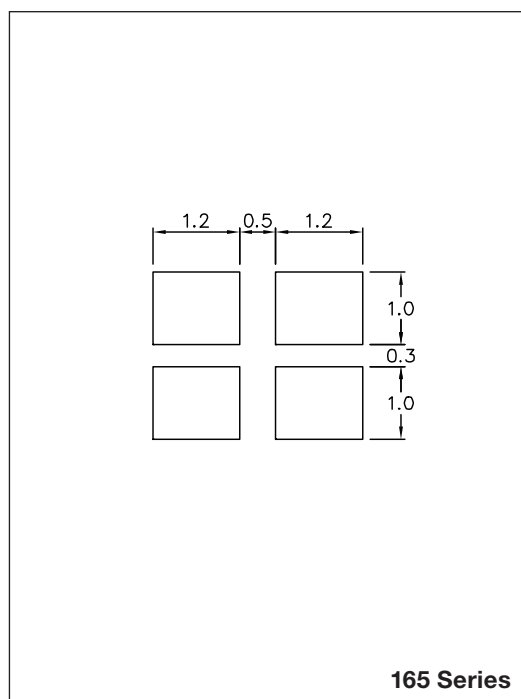
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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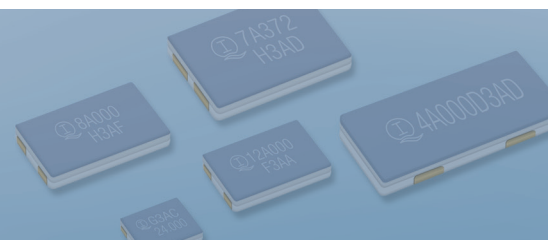
DIMENSION (mm)



SOLDERING PATTERN (mm)



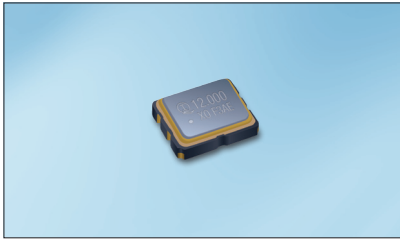
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163 Series

SMD CERAMIC ENCLOSURE QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器

Standard crystal oscillators



FEATURES

- Miniature size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available

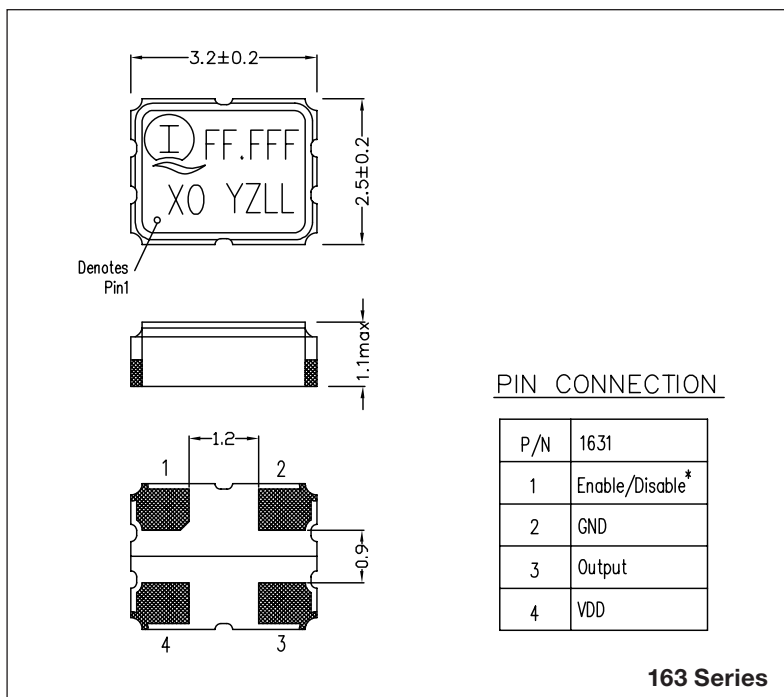


Parameters		Specifications		
Output Waveform 輸出波型		CMOS		
Frequency Range 頻率範圍		32.768KHz	1MHz ~ 50MHz	50MHz ~ 160MHz
Supply Voltage Range (Vdd) 工作電壓範圍		1.6V ~ 5.5V	0.8V ~ 5.5V	1.62V ~ 3.63V
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**		±10ppm, ±15ppm, ±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm		
Operating Temperature Range 工作溫度範圍		-20°C ~ +70°C, -40°C ~ +85°C		
Current Consumption (Idd) 消耗電流		0.1mA Max.	10mA Max.	20mA Max.
Rise & Fall Time 上 / 下沿時間		20ns Max.	8ns Max.	5ns Max.
Output Symmetry 輸出對稱性		40% ~ 60%, 45% ~ 55%		
Output Voltage 輸出電壓	V _{OH}	90% VDD		
	V _{OL}	10% VDD		
Output Load 輸出負載		15pF		
Start-up Time 起動時間		10ms Max.		
Storage Temperature Range 儲存溫度範圍		-55°C ~ +125°C		

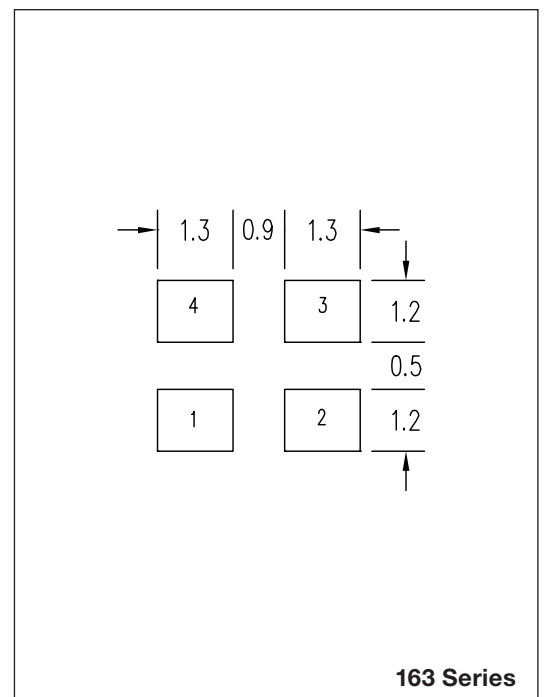
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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DIMENSION (mm)



SOLDERING PATTERN (mm)

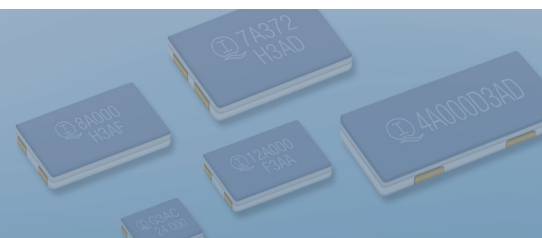


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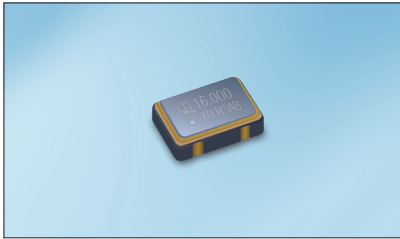
INTERQUIP ELECTRONICS CO LTD
應達利電子有限公司

Flat A, 9th Floor, On Shing Industrial Building, 2-16 Wo Liu Hang Road, Fotan, N.T., Hong Kong
Tel: +852 2413 5515 Fax: +852 2413 7053 http://www.interquip.com



160-B Series

SMD CERAMIC ENCLOSURE QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器



FEATURES

- Small size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available



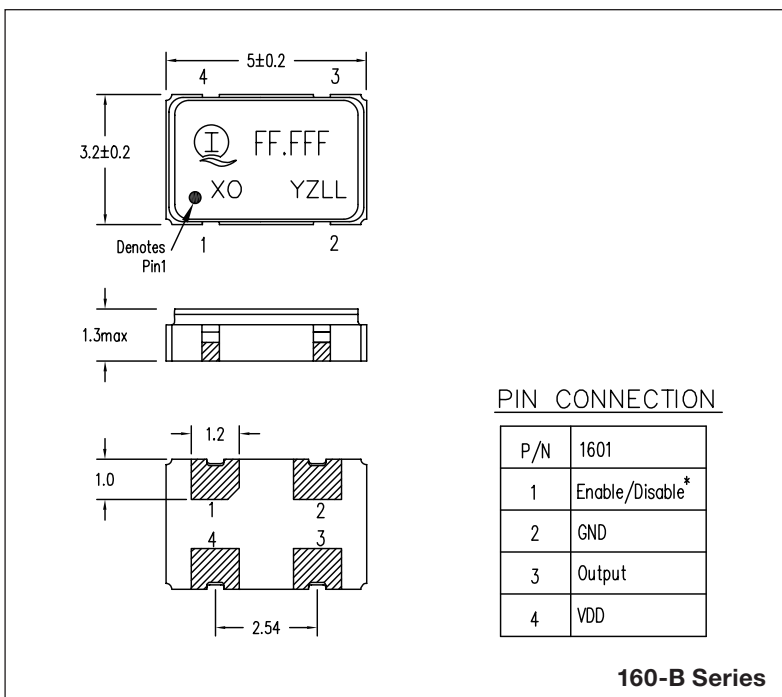
Standard crystal oscillators

Parameters	Specifications		
Output Waveform 輸出波型	CMOS		
Frequency Range 頻率範圍	32.768KHz	1MHz ~ 50MHz	50MHz ~ 160MHz
Supply Voltage Range (Vdd) 工作電壓範圍	1.6V ~ 5.5V	0.8V ~ 5.5V	1.62V ~ 3.63V
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±10ppm, ±15ppm, ±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm		
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C		
Current Consumption (Idd) 消耗電流	0.1mA Max.	10mA Max.	20mA Max.
Rise & Fall Time 上 / 下沿時間	20ns Max.	8ns Max.	5ns Max.
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%		
Output Voltage 輸出電壓	V _{OH}	90% VDD	
	V _{OL}	10% VDD	
Output Load 輸出負載	15pF		
Start-up Time 起動時間	10ms Max.		
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C		

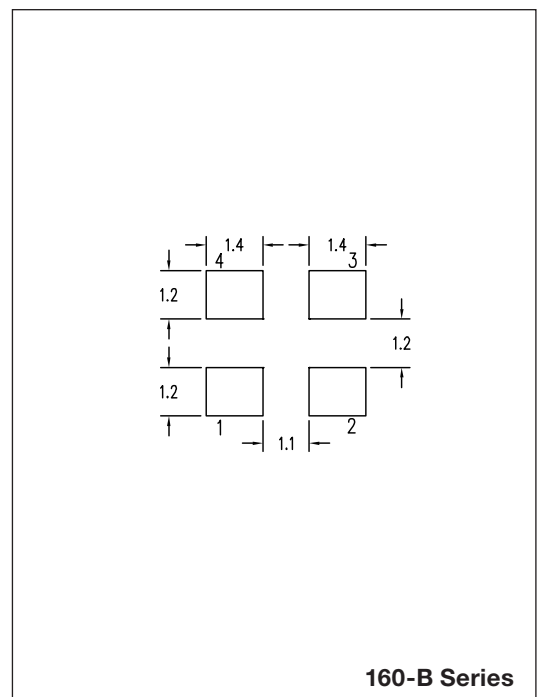
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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DIMENSION (mm)



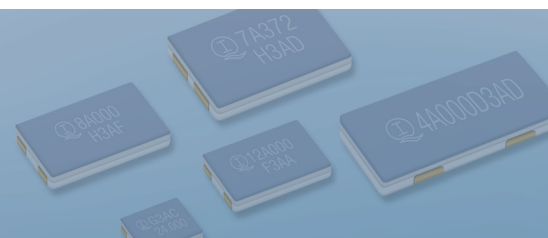
SOLDERING PATTERN (mm)



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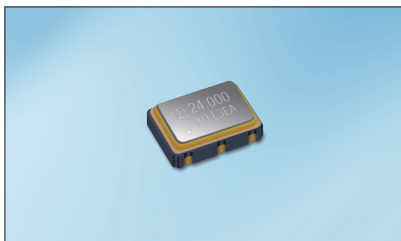
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160-E/F Series

SMD CERAMIC ENCLOSURE QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器

Standard crystal oscillators



FEATURES

- Small size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available

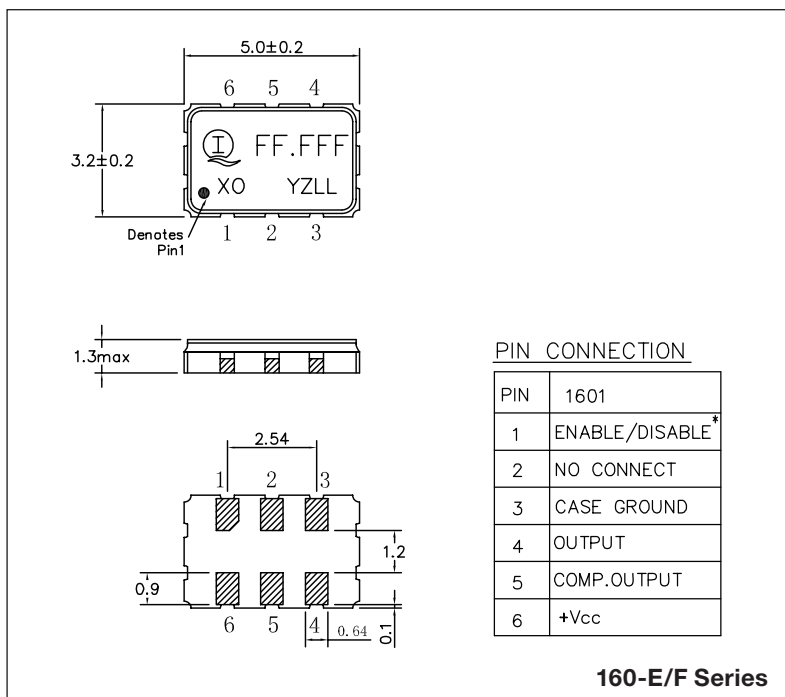


Parameters		Specifications	
Series 系列		160-E Series	160-F Series
Output Waveform 輸出波形		LVPECL	LVDS
Frequency Range 頻率範圍		10MHz ~ 800MHz	
Supply Voltage Range (Vdd) 工作電壓範圍		2.5V , 3.3V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差 **		±25ppm, ±30ppm, ±50ppm	
Operating Temperature Range 工作溫度範圍		-20°C ~ +70°C , -40°C ~ +85°C	
Current Consumption (Idd) 消耗電流		100mA Max.	
Rise & Fall Time 上 / 下沿時間		1.5ns Max.	
Output Symmetry 輸出對稱性		45% ~ 55%	
Output Voltage 輸出電壓	VOH	Vdd - 1.025V Min.	1.40V Typ.
	VOL	Vdd - 1.620V Max.	1.10V Typ.
Output Load 輸出負載		50ohm	100ohm
Start-up Time 起動時間		10ms Max.	
Storage Temperature Range 儲存溫度範圍		-55°C ~ +125°C	

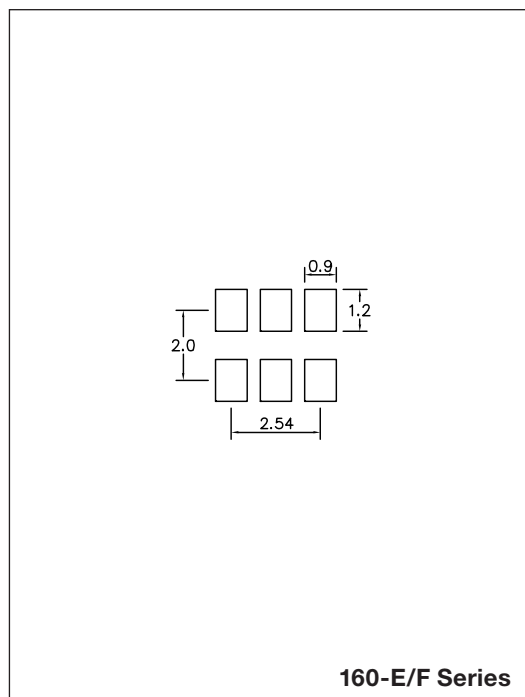
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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DIMENSION (mm)



SOLDERING PATTERN (mm)

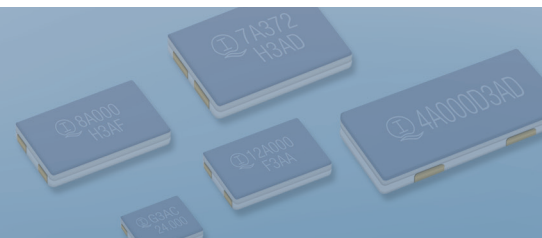


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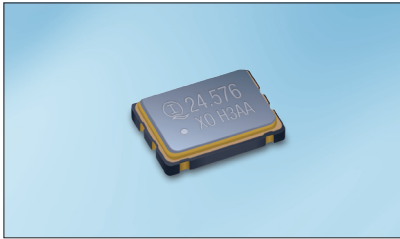
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149-B Series

SMD CERAMIC ENCLOSURE QUARTZ CRYSTAL OSCILLATORS 表貼石英晶體振盪器



FEATURES

- Small size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available



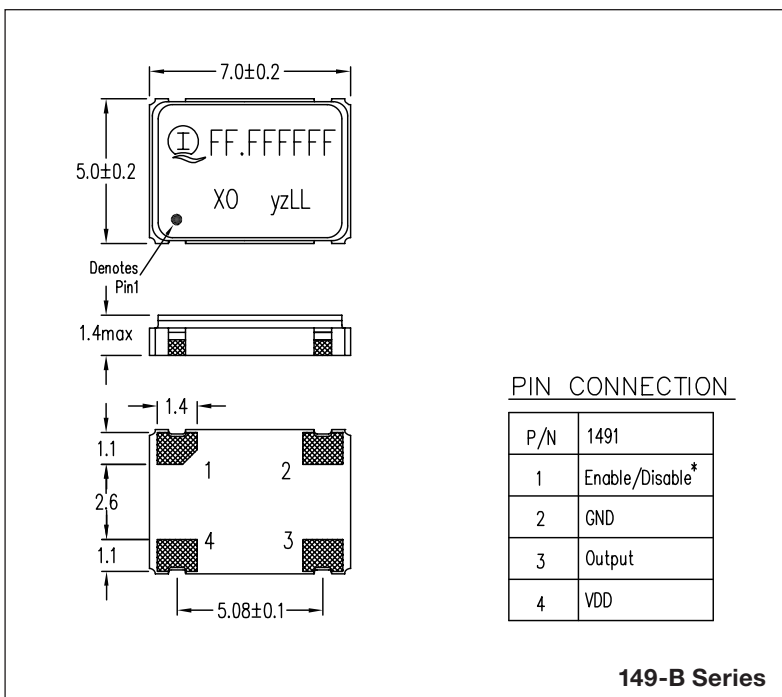
Standard crystal oscillators

Parameters		Specifications		
Output Waveform 輸出波型		CMOS		
Frequency Range 頻率範圍		32.768KHz	1MHz ~ 50MHz	50MHz ~ 160MHz
Supply Voltage Range (Vdd) 工作電壓範圍		1.6V ~ 5.5V	0.8V ~ 5.5V	1.62V ~ 3.63V
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**		±10ppm, ±15ppm, ±20ppm, ±25ppm, ±30ppm, ±50ppm, ±100ppm		
Operating Temperature Range 工作溫度範圍		-20°C ~ +70°C, -40°C ~ +85°C		
Current Consumption (Idd) 消耗電流		0.1mA Max.	10mA Max.	20mA Max.
Rise & Fall Time 上 / 下沿時間		20ns Max.	8ns Max.	5ns Max.
Output Symmetry 輸出對稱性		40% ~ 60%, 45% ~ 55%		
Output Voltage 輸出電壓	V _{OH}	90% VDD		
	V _{OL}	10% VDD		
Output Load 輸出負載		15pF		
Start-up Time 起動時間		10ms Max.		
Storage Temperature Range 儲存溫度範圍		-55°C ~ +125°C		

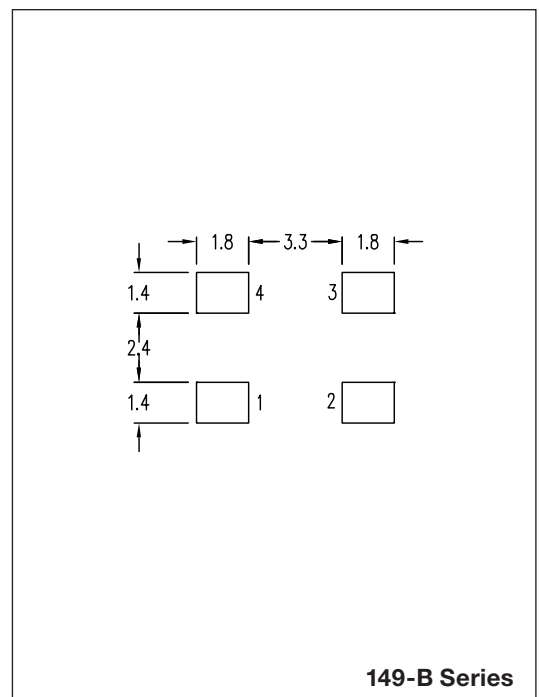
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包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

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DIMENSION (mm)



SOLDERING PATTERN (mm)

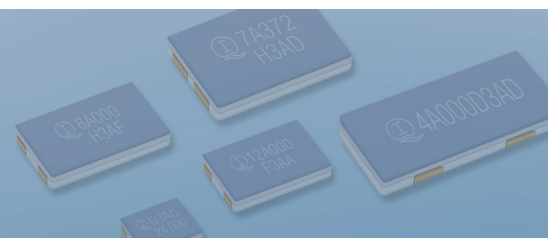


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FEATURES

- Small size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available

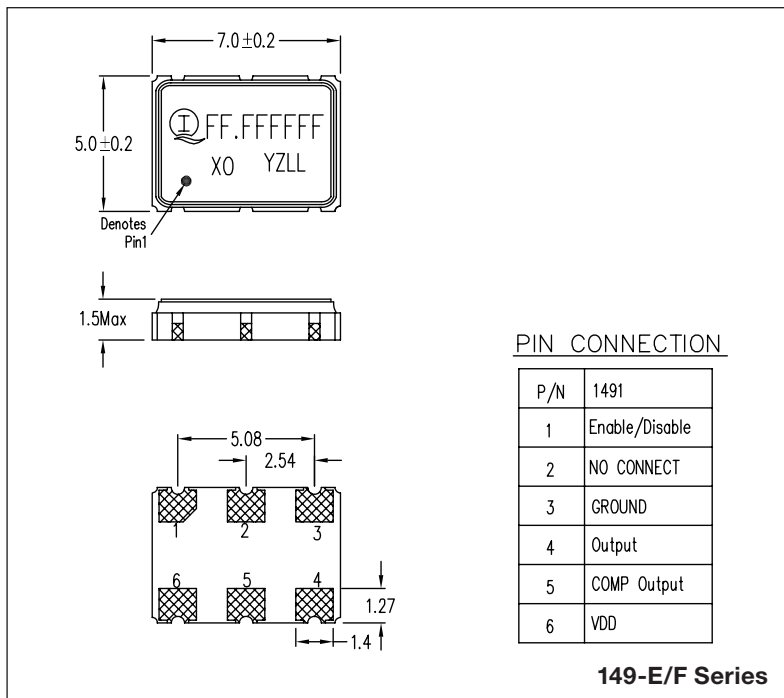


Parameters		Specifications	
Series 系列		149-E Series	149-F Series
Output Waveform 輸出波型		LVPECL	LVDS
Frequency Range 頻率範圍		10MHz ~ 800MHz	
Supply Voltage Range (Vdd) 工作電壓範圍		2.5V , 3.3V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差 **		±25ppm, ±30ppm, ±50ppm	
Operating Temperature Range 工作溫度範圍		-20°C ~ +70°C , -40°C ~ +85°C	
Current Consumption (Idd) 消耗電流		100mA Max.	
Rise & Fall Time 上 / 下沿時間		1.5ns Max.	
Output Symmetry 輸出對稱性		45% ~ 55%	
Output Voltage 輸出電壓	VOH	Vdd - 1.025V Min.	1.40V Typ.
	VOL	Vdd - 1.620V Max.	1.10V Typ.
Output Load 輸出負載		50ohm	100ohm
Start-up Time 起動時間		10ms Max.	
Storage Temperature Range 儲存溫度範圍		-55°C ~ +125°C	

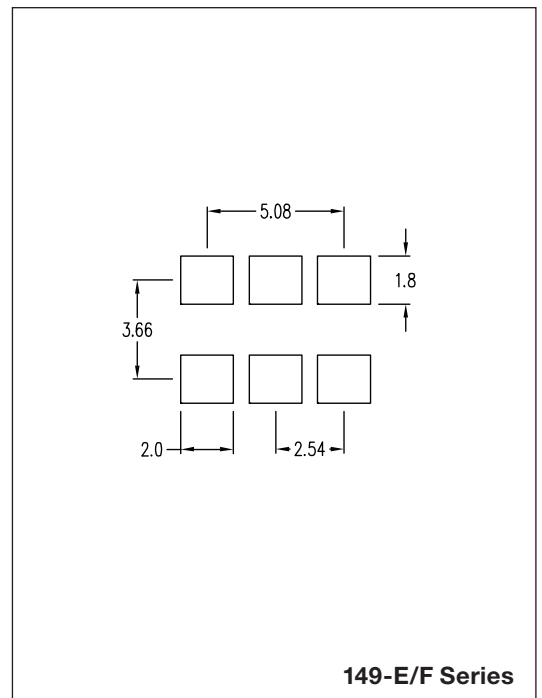
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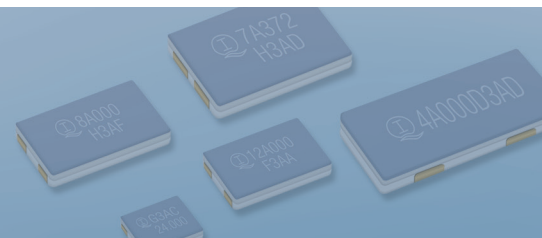
DIMENSION (mm)



SOLDERING PATTERN (mm)

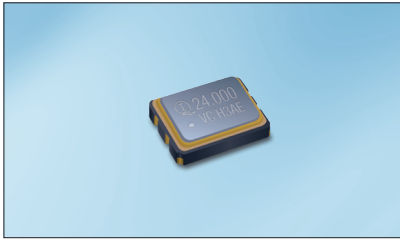


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VC800 Series

SMD VOLTAGE CONTROLLED QUARTZ CRYSTAL OSCILLATORS 表貼壓控石英晶體振盪器



FEATURES

- Ultra-Compact size
- Low profile
- Pick and place assembly
- High reliability seam welded package



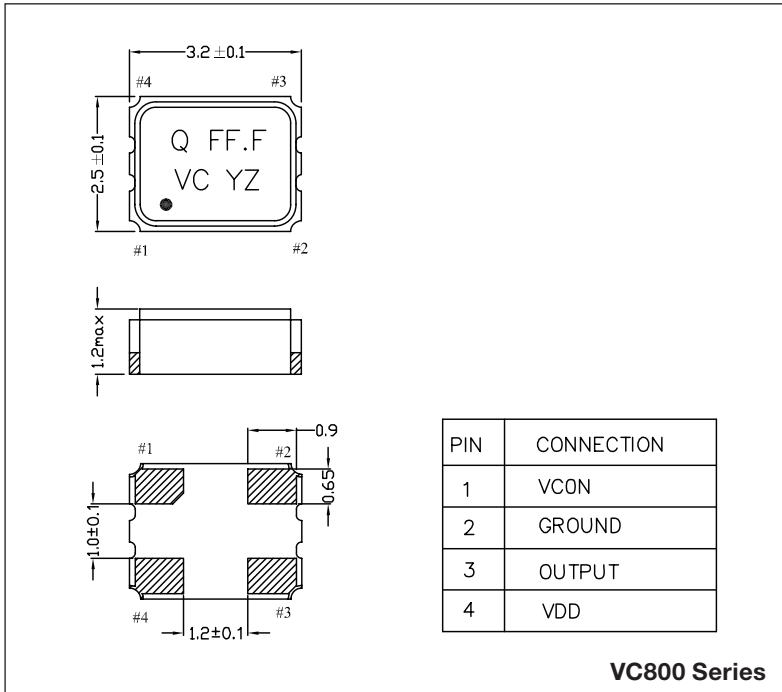
Voltage controlled crystal oscillators (VCXO)

Parameters	Specifications	
Output Waveform 輸出波型	CMOS	
Frequency Range 頻率範圍	1.0MHz ~ 54.0MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	1.8V, 2.8V, 3.3V, 5.0V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差 **	±25ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C, -40°C ~ +125°C	
Current Consumption (Idd) 消耗電流	20mA typ.	
Rise & Fall Time 上 / 下沿時間	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD
	V _{OL}	10% VDD
Control Voltage Range 控制電壓範圍	0.90V±0.90V, 1.4V±1V, 1.65V±1.35V, 2.5V±2.0V	
Absolute Pulling Range 絕對牽引範圍	50ppm Min.	
Modulation Bandwidth (BW) 調制頻寬	5KHz Min.	
Output Load 輸出負載	15pF	
Start-up Time 起動時間	10ms Max.	
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C	

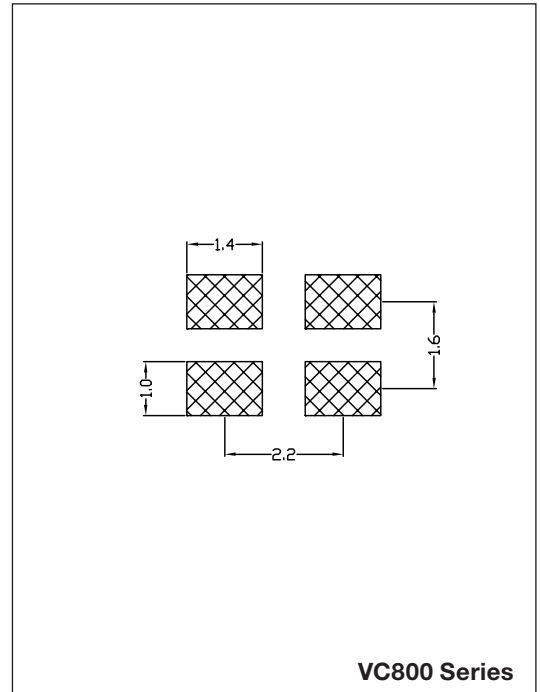
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DIMENSION (mm)



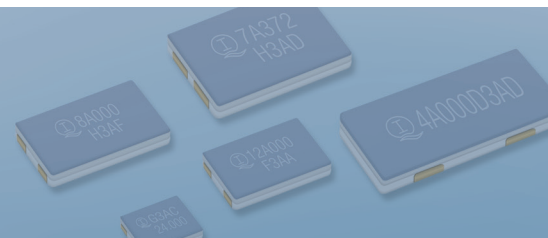
SOLDERING PATTERN (mm)



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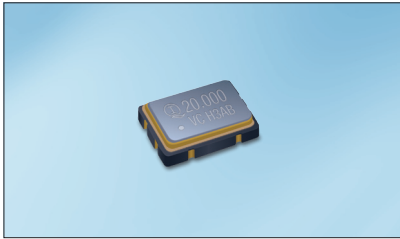
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VC600 Series

SMD VOLTAGE CONTROLLED QUARTZ CRYSTAL OSCILLATORS 表貼壓控石英晶體振盪器

Voltage controlled crystal oscillators (VCXO)



FEATURES

- Compact size
- Low profile
- Pick and place assembly
- High reliability seam welded package

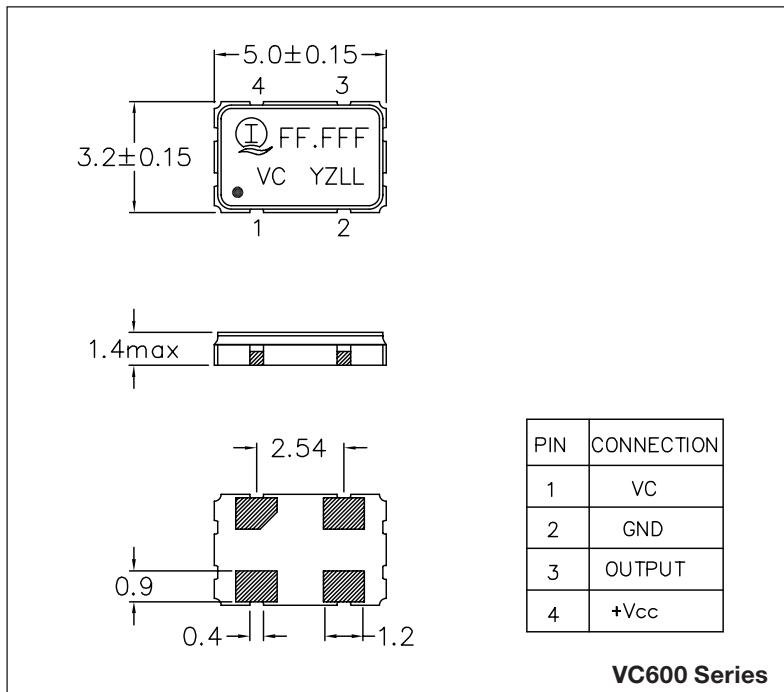


Parameters	Specifications	
Output Waveform 輸出波型	CMOS	
Frequency Range 頻率範圍	1.0MHz ~ 54.0MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	1.8V, 2.8V, 3.3V, 5.0V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±25ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C, -40°C ~ +125°C	
Current Consumption (Idd) 消耗電流	20mA typ.	
Rise & Fall Time 上 / 下沿時間	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD
	V _{OL}	10% VDD
Control Voltage Range 控制電壓範圍	0.90V±0.90V, 1.4V±1V, 1.65V±1.35V, 2.5V±2.0V	
Absolute Pulling Range 絕對牽引範圍	50ppm Min.	
Modulation Bandwidth (BW) 調制頻寬	5KHz Min.	
Output Load 輸出負載	15pF	
Start-up Time 起動時間	10ms Max.	
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C	

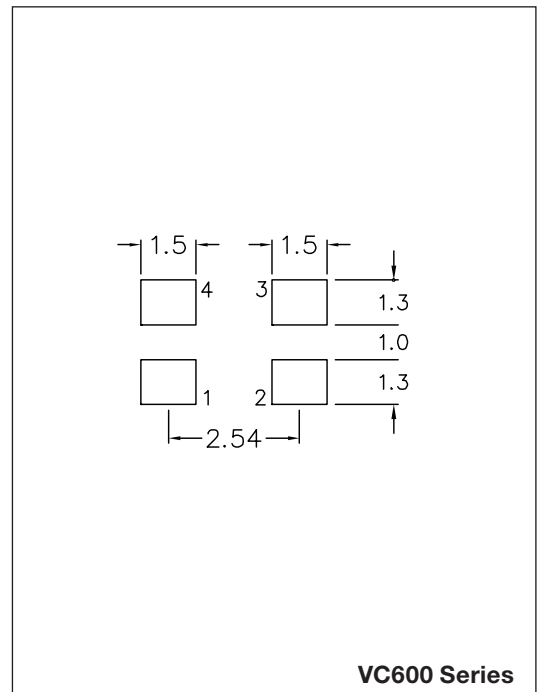
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DIMENSION (mm)



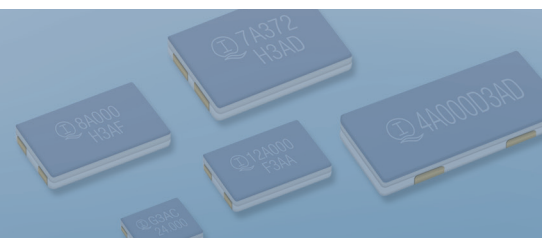
SOLDERING PATTERN (mm)



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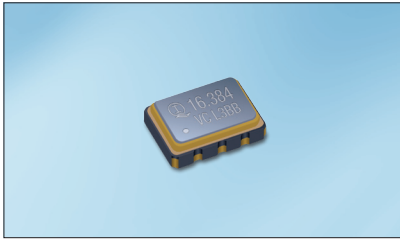
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VC620-B Series

SMD VOLTAGE CONTROLLED QUARTZ CRYSTAL OSCILLATORS 表貼壓控石英晶體振盪器



FEATURES

- Compact size
- Low profile
- Pick and place assembly
- High reliability seam welded package



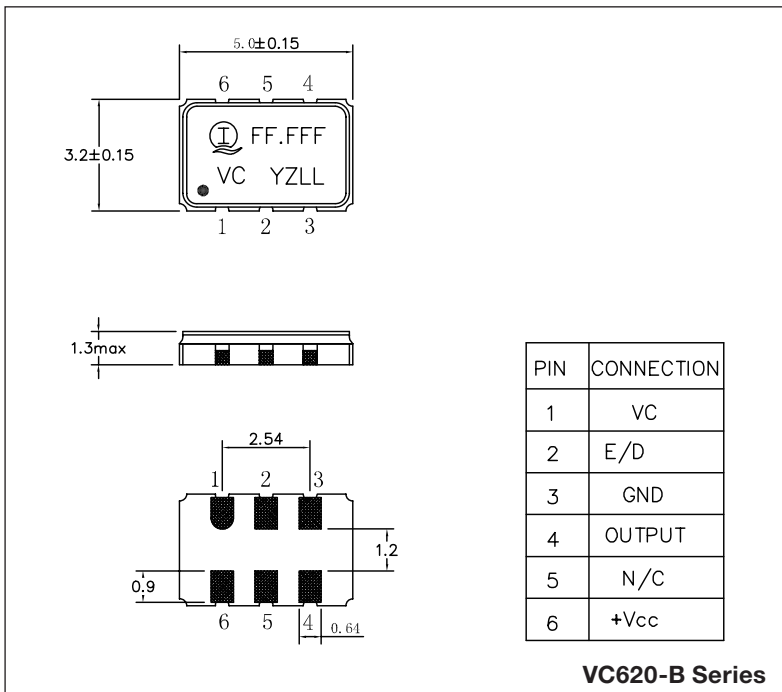
Voltage controlled crystal oscillators (VCXO)

Parameters	Specifications	
Output Waveform 輸出波型	CMOS	
Frequency Range 頻率範圍	1.0MHz ~ 54.0MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	1.8V, 2.8V, 3.3V, 5.0V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差 **	±25ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C, -40°C ~ +125°C	
Current Consumption (Idd) 消耗電流	20mA typ.	
Rise & Fall Time 上 / 下沿時間	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD
	V _{OL}	10% VDD
Control Voltage Range 控制電壓範圍	0.90V±0.90V, 1.4V±1V, 1.65V±1.35V, 2.5V±2.0V	
Absolute Pulling Range 絕對牽引範圍	50ppm Min.	
Modulation Bandwidth (BW) 調制頻寬	5KHz Min.	
Output Load 輸出負載	15pF	
Start-up Time 起動時間	10ms Max.	
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C	

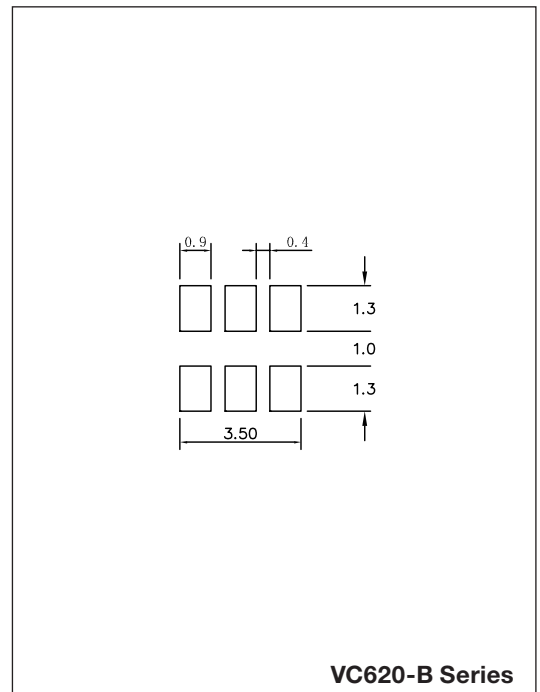
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DIMENSION (mm)



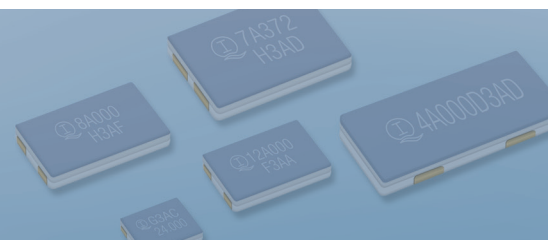
SOLDERING PATTERN (mm)

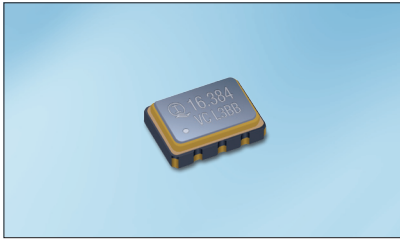


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FEATURES

- Compact size
- Low profile
- Pick and place assembly
- High reliability seam welded package

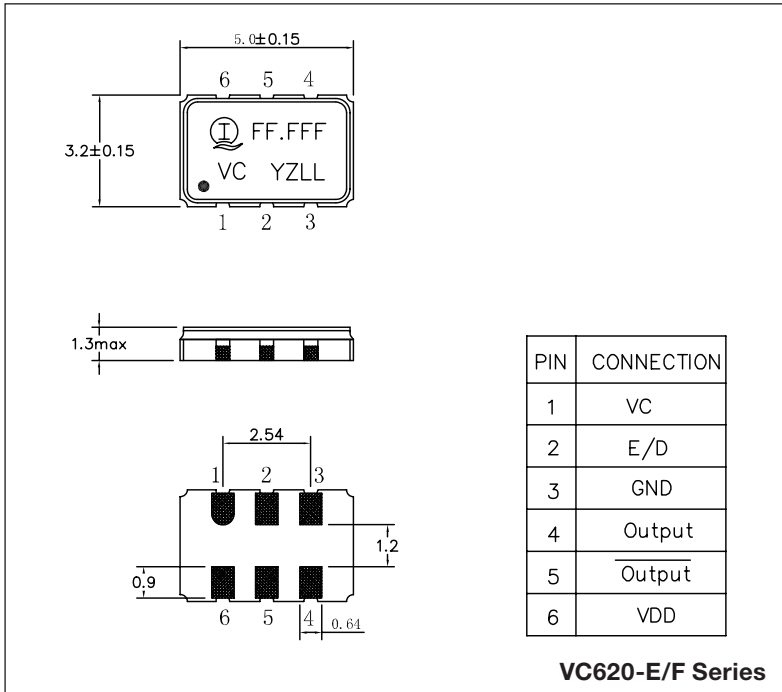


Parameters		Specifications	
Series 系列		VC620-E Series	VC620-F Series
Output Waveform 輸出波型		LVPECL	LVDS
Frequency Range 頻率範圍		10MHz ~ 800MHz	
Supply Voltage Range (Vdd) 工作電壓範圍		3.3V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**		±25ppm, ±30ppm, ±50ppm	
Operating Temperature Range 工作溫度範圍		-20°C ~ +70°C, -40°C ~ +85°C	
Current Consumption (Idd) 消耗電流		100mA Max.	
Rise & Fall Time 上 / 下沿時間		1.5ns Max.	
Output Symmetry 輸出對稱性		45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	Vdd - 1.025V Min.	1.40V Typ.
	V _{OL}	Vdd - 1.620V Max.	1.10V Typ.
Control Voltage Range 控制電壓範圍		1.6V±1.35V	
Absolute Pulling Range 絕對牽引範圍		50ppm Min.	
Output Load 輸出負載		50ohm	100ohm
Modulation Bandwidth (BW) 調制頻寬		5KHz Min.	
Start-up Time 起動時間		10ms Max.	
Storage Temperature Range 儲存溫度範圍		-55°C ~ +125°C	

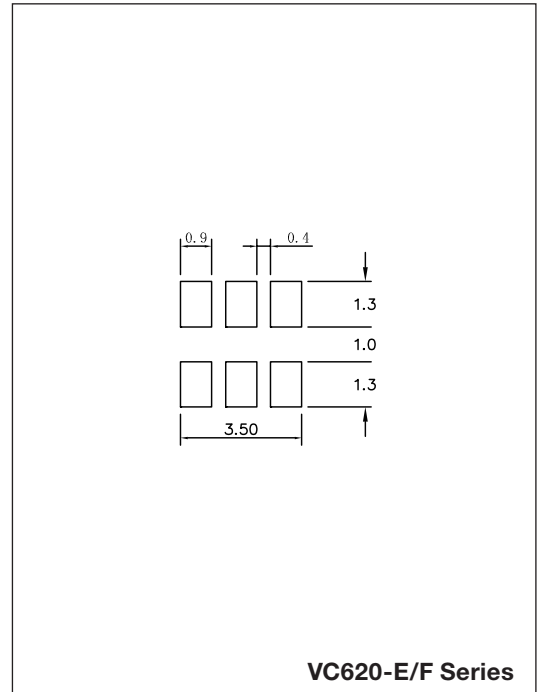
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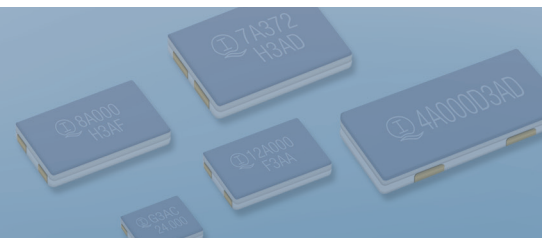
DIMENSION (mm)

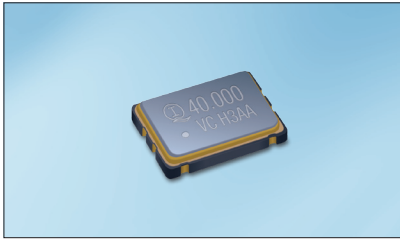


SOLDERING PATTERN (mm)



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FEATURES

- Compact size
- Low profile
- Pick and place assembly
- High reliability seam welded package

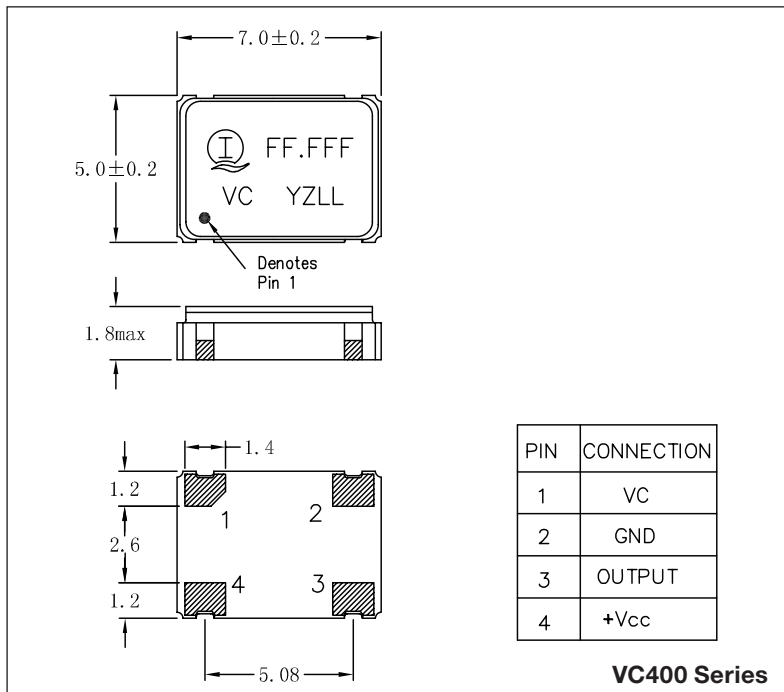


Parameters	Specifications	
Output Waveform 輸出波型	CMOS	
Frequency Range 頻率範圍	1.0MHz ~ 54.0MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	1.8V, 2.8V, 3.3V, 5.0V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差 **	±25ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C, -40°C ~ +125°C	
Current Consumption (Idd) 消耗電流	20mA typ.	
Rise & Fall Time 上 / 下沿時間	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD
	V _{OL}	10% VDD
Control Voltage Range 控制電壓範圍	0.90V±0.90V, 1.4V±1V, 1.65V±1.35V, 2.5V±2.0V	
Absolute Pulling Range 絕對牽引範圍	50ppm Min.	
Modulation Bandwidth (BW) 調制頻寬	5KHz Min.	
Output Load 輸出負載	15pF	
Start-up Time 起動時間	10ms Max.	
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C	

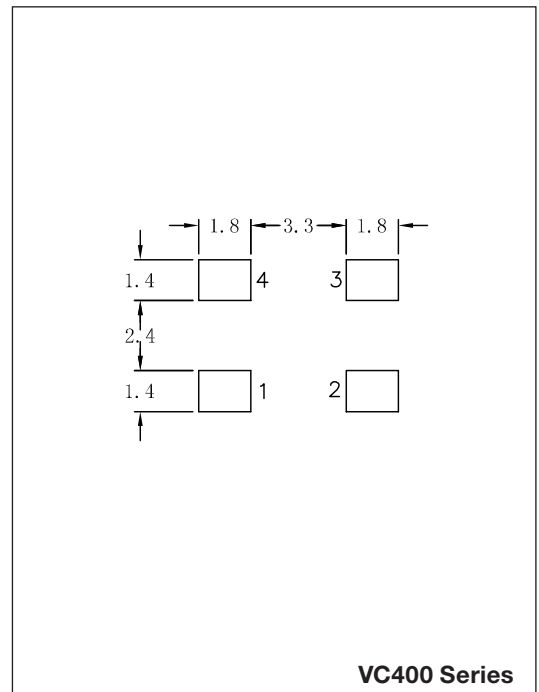
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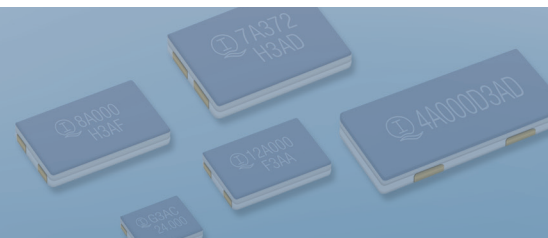
DIMENSION (mm)



SOLDERING PATTERN (mm)



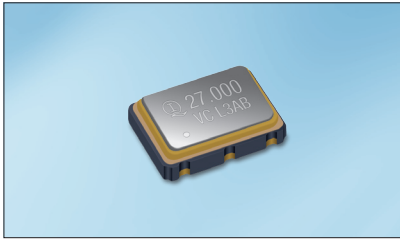
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VC420-B Series

SMD VOLTAGE CONTROLLED QUARTZ CRYSTAL OSCILLATORS 表貼壓控石英晶體振盪器

Voltage controlled crystal oscillators (VCXO)



FEATURES

- Compact size
- Low profile
- Pick and place assembly
- High reliability seam welded package

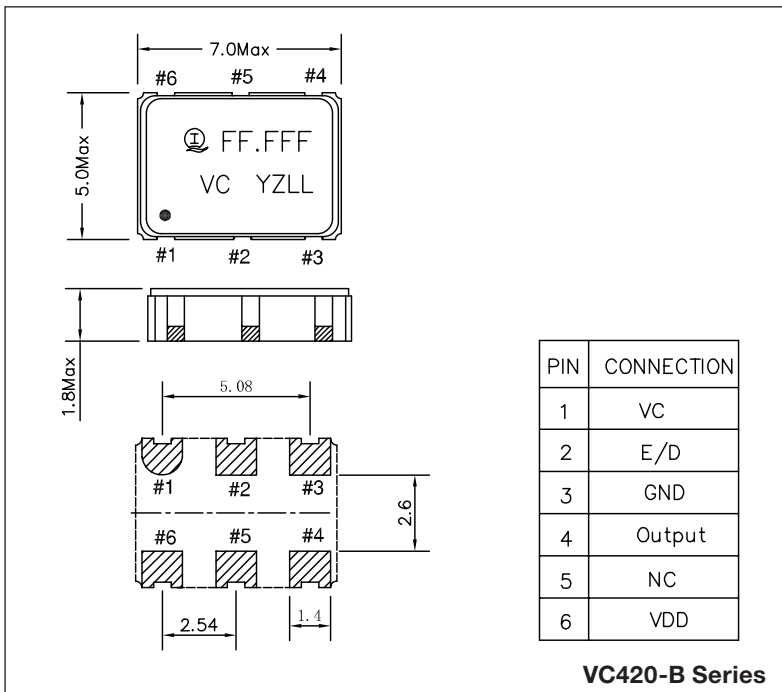


Parameters	Specifications	
Output Waveform 輸出波型	CMOS	
Frequency Range 頻率範圍	1.0MHz ~ 54.0MHz	
Supply Voltage Range (Vdd) 工作電壓範圍	1.8V, 2.8V, 3.3V, 5.0V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**	±25ppm, ±50ppm, ±100ppm	
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C, -40°C ~ +125°C	
Current Consumption (Idd) 消耗電流	20mA typ.	
Rise & Fall Time 上 / 下沿時間	8ns Max.	
Output Symmetry 輸出對稱性	40% ~ 60%, 45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	90% VDD
	V _{OL}	10% VDD
Control Voltage Range 控制電壓範圍	0.90V±0.90V, 1.4V±1V, 1.65V±1.35V, 2.5V±2.0V	
Absolute Pulling Range 絕對牽引範圍	50ppm Min.	
Modulation Bandwidth (BW) 調制頻寬	5KHz Min.	
Output Load 輸出負載	15pF	
Start-up Time 起動時間	10ms Max.	
Storage Temperature Range 儲存溫度範圍	-55°C ~ +125°C	

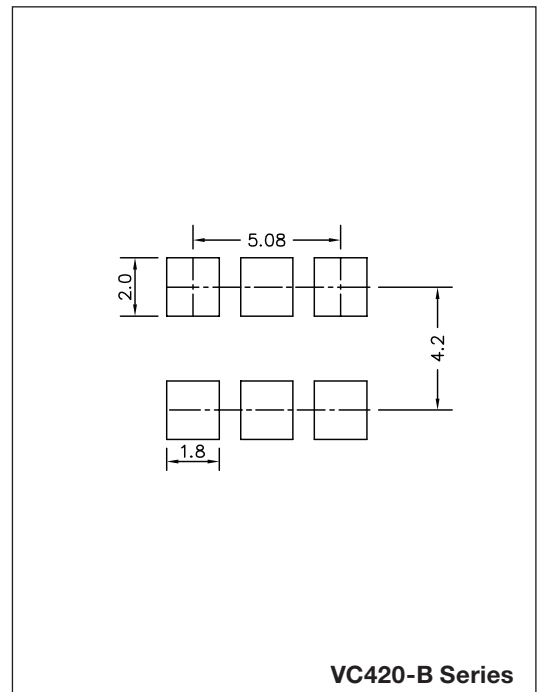
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DIMENSION (mm)



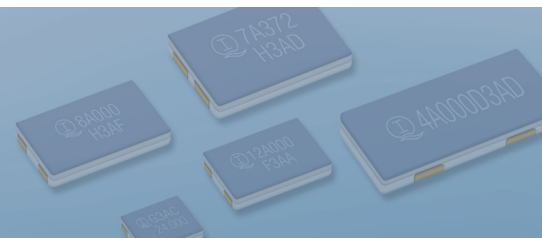
SOLDERING PATTERN (mm)

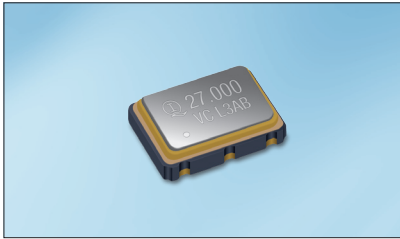


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Tel: +852 2413 5515 Fax: +852 2413 7053 <http://www.interquip.com>





FEATURES

- Compact size
- Low profile
- Pick and place assembly
- High reliability seam welded package

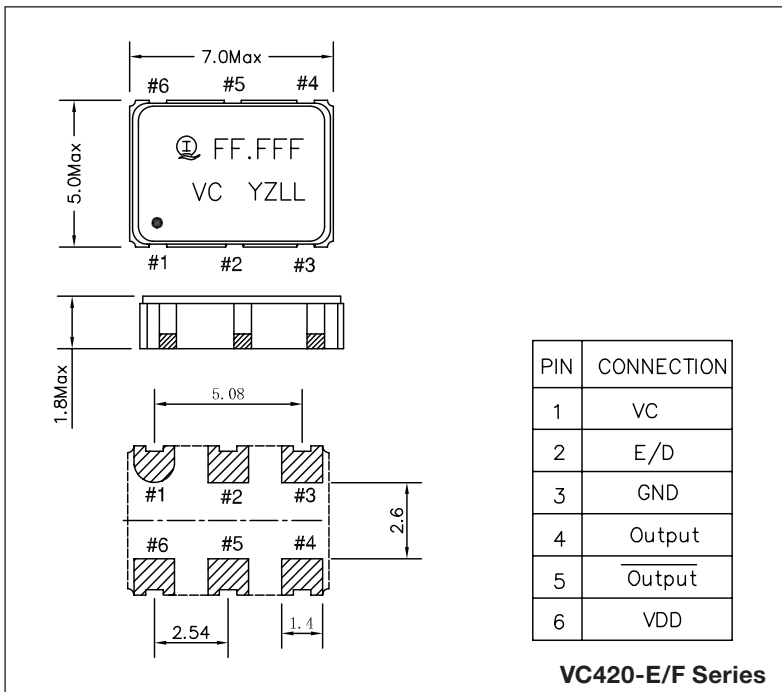


Parameters		Specifications	
Series 系列		VC420-E Series	VC420-F Series
Output Waveform 輸出波型		LVPECL	LVDS
Frequency Range 頻率範圍		10MHz ~ 800MHz	
Supply Voltage Range (Vdd) 工作電壓範圍		3.3V	
Overall Frequency Stability with refer to 25°C** 相對於 25°C 的總頻率偏差**		±25ppm, ±30ppm, ±50ppm	
Operating Temperature Range 工作溫度範圍		-20°C ~ +70°C, -40°C ~ +85°C	
Current Consumption (Idd) 消耗電流		100mA Max.	
Rise & Fall Time 上 / 下沿時間		1.5ns Max.	
Output Symmetry 輸出對稱性		45% ~ 55%	
Output Voltage 輸出電壓	V _{OH}	Vdd - 1.025V Min.	1.40V Typ.
	V _{OL}	Vdd - 1.420V Max.	1.10V Typ.
Control Voltage Range 控制電壓範圍		1.6V±1.35V	
Absolute Pulling Range 絕對牽引範圍		50ppm Min.	
Output Load 輸出負載		50ohm	100ohm
Modulation Bandwidth (BW) 調制頻寬		5KHz Min.	
Start-up Time 起動時間		10ms Max.	
Storage Temperature Range 儲存溫度範圍		-55°C ~ +125°C	

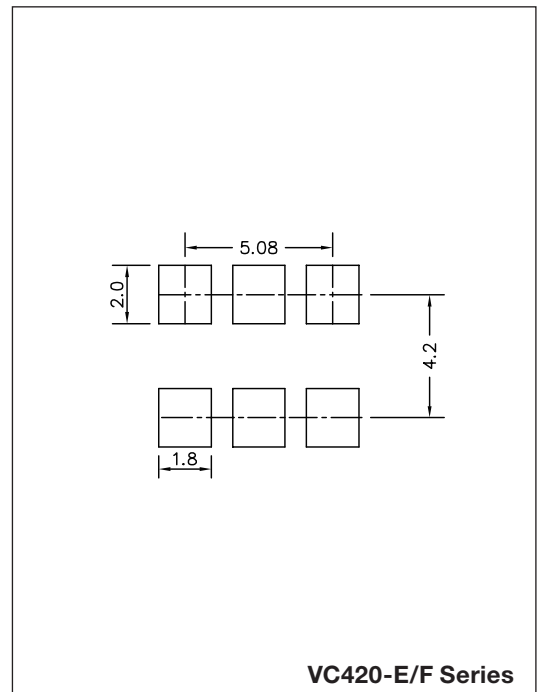
** Inclusive of initial frequency tolerance at 25°C, operating temperature range, supply voltage change, load variation and 1st year aging.
包括在常溫頻率偏差、工作溫度範圍的頻率偏差、首年老化率、工作電壓及負載變化造成的頻率偏差。

Please consult our sales representatives for other specifications
如對其他規格查詢，請與我司銷售人員聯繫

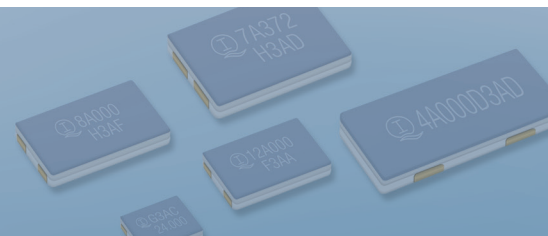
DIMENSION (mm)



SOLDERING PATTERN (mm)



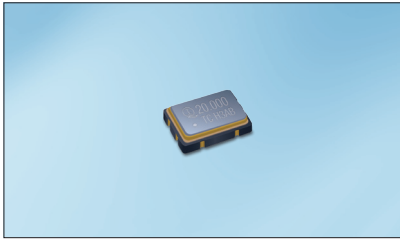
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TC900-K Series

SMD TEMPERATURE COMPENSATED QUARTZ CRYSTAL OSCILLATORS 表貼溫度補償石英晶體振盪器

Temperature compensated crystal oscillators (TCXO)



FEATURES

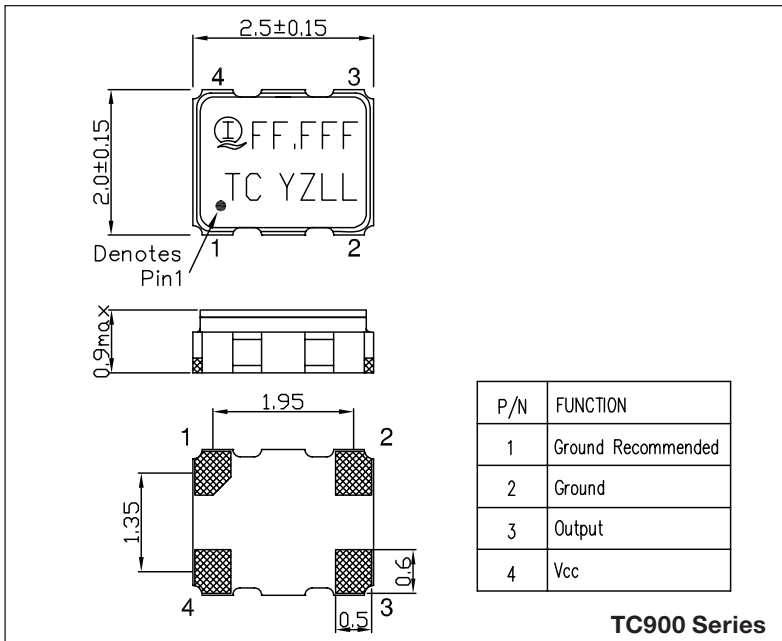
- Ultra-miniature size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available



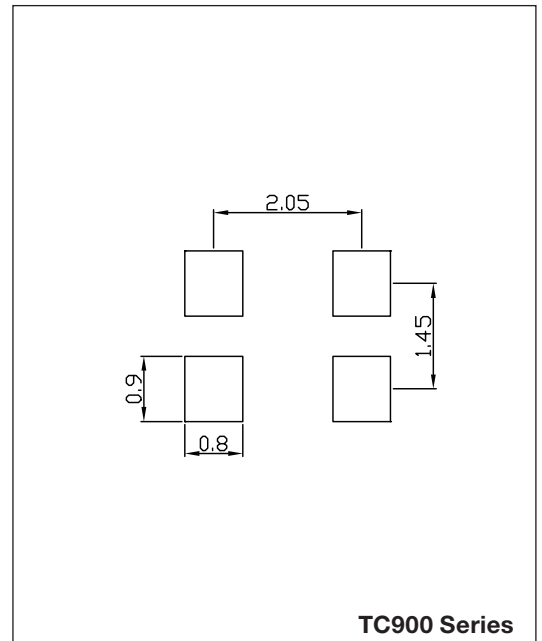
Parameters		Specifications	
Series 系列		TC900-B Series	TC900-K Series
Output Waveform 輸出波形		CMOS	Clipped Sine
Frequency Range 頻率範圍		2.500MHz to 54.000MHz	8.000MHz to 52.000MHz
Supply Voltage Range (Vdd) 工作電壓範圍		1.8V, 2.0V, 2.5V, 2.8V, 3V, 3.3V	
Operating Temperature Range 工作溫度範圍		0°C ~ +70°C , -20°C ~ +70°C , -40°C ~ +85°C	
Frequency Stability 頻率偏差			
vs. Room Temp. (25°C ± 3°C) 相對常溫		±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm	
vs. Operating Temp. 相對工作溫度		±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm	
vs. Voltage Change (±5%) 相對電壓變化		±0.3ppm Max	
vs. Load Change (±5%) 相對負載變化		±0.3ppm Max	
vs. Aging (First Year) 相對首年老化率		±1ppm	
Current Consumption (Idd) 消耗電流		10mA Max.	2mA Max.
Rise & Fall Time 上 / 下沿時間		10ns Max.	
Output Symmetry 輸出對稱性		45% ~ 55%	
Output Voltage 輸出電壓	Vp-p	-	0.8V Min.
	VOH	0.8Vdd	-
	VOL	0.5V	-
Output Load 輸出負載		15pF	10k ohms // 10pF
Pullability 牽引範圍 (for VCTCXO)		±15ppm Typ.	
Control Voltage Range 控制電壓範圍 (for VCTCO)		0.90V±0.90V, 1.4V±1V, 1.5V±1V	
Phase Noise @ 1kHz Offset		-130dBc/Hz Max.	
Start-up Time 起動時間		3ms Max.	
Storage Temperature Range 儲存溫度範圍		-40°C ~ +85°C	

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DIMENSION (mm)



SOLDERING PATTERN (mm)

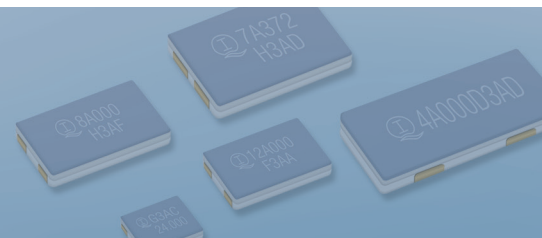


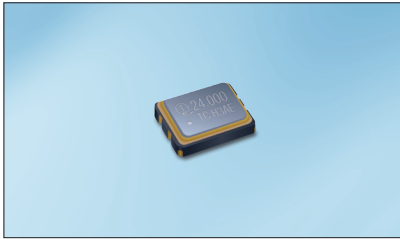
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FEATURES

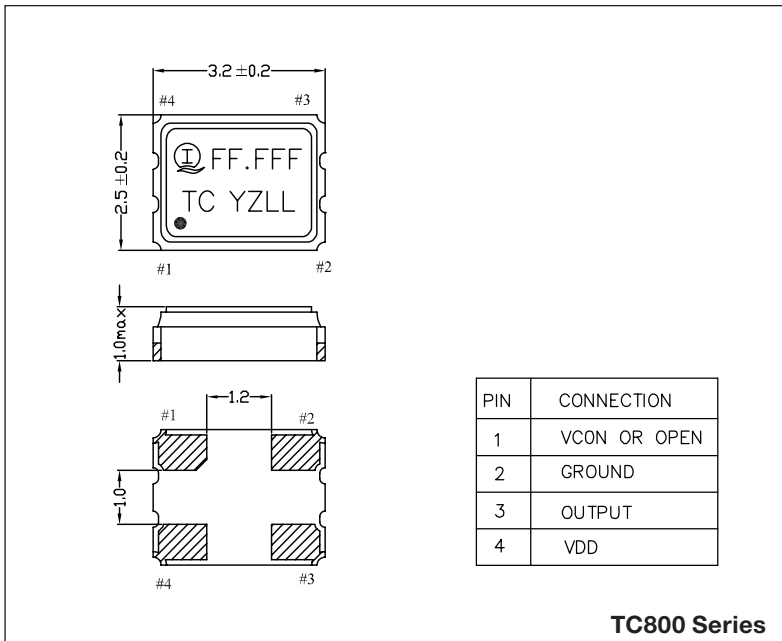
- Miniature size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available



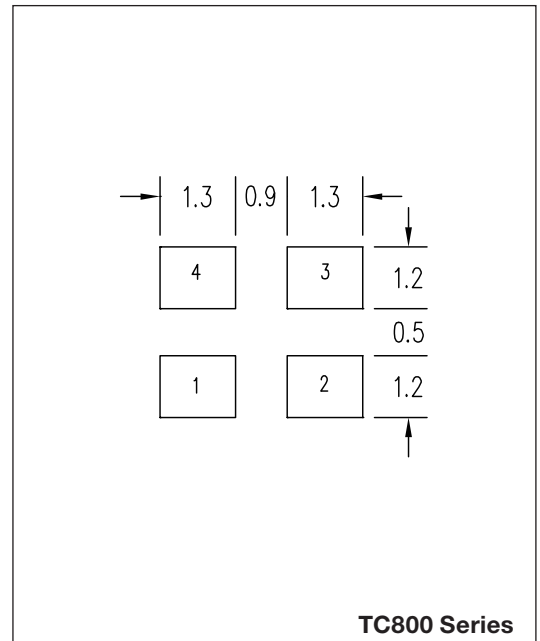
Parameters		Specifications	
Series 系列		TC800-B Series	TC800-K Series
Output Waveform 輸出波型		CMOS	Clipped Sine
Frequency Range 頻率範圍		2.500MHz to 54.000MHz	8.000MHz to 52.000MHz
Supply Voltage Range (Vdd) 工作電壓範圍		1.8V, 2.0V, 2.5V, 2.8V, 3V, 3.3V	
Operating Temperature Range 工作溫度範圍		0°C ~ +70°C, -20°C ~ +70°C, -40°C ~ +85°C	
Frequency Stability 頻率偏差			
vs. Room Temp. (25°C ± 3°C) 相對常溫		±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm	
vs. Operating Temp. 相對工作溫度		±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm	
vs. Voltage Change (±5%) 相對電壓變化		±0.3ppm Max	
vs. Load Change (±5%) 相對負載變化		±0.3ppm Max	
vs. Aging (First Year) 相對首年老化率		±1ppm	
Current Consumption (Idd) 消耗電流		10mA Max.	2mA Max.
Rise & Fall Time 上 / 下沿時間		10ns Max.	
Output Symmetry 輸出對稱性		45% ~ 55%	
Output Voltage 輸出電壓	Vp-p	-	0.8V Min.
	VOH	0.8Vdd	-
	VOL	0.5V	-
Output Load 輸出負載		15pF	10k ohms // 10pF
Pullability 牽引範圍 (for VCTCXO)		±15ppm Typ.	
Control Voltage Range 控制電壓範圍 (for VCTCO)		0.90V±0.90V, 1.4V±1V, 1.5V±1V	
Phase Noise @ 1kHz Offset		-130dBc/Hz Max.	
Start-up Time 起動時間		3ms Max.	
Storage Temperature Range 儲存溫度範圍		-40°C ~ +85°C	

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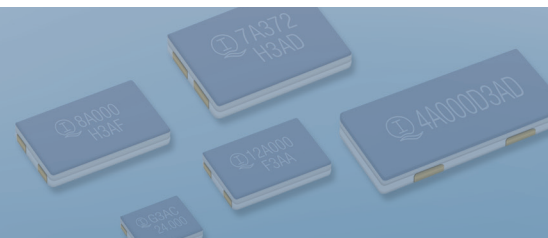
DIMENSION (mm)

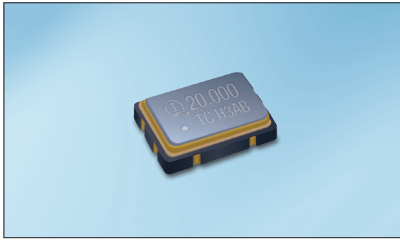


SOLDERING PATTERN (mm)



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FEATURES

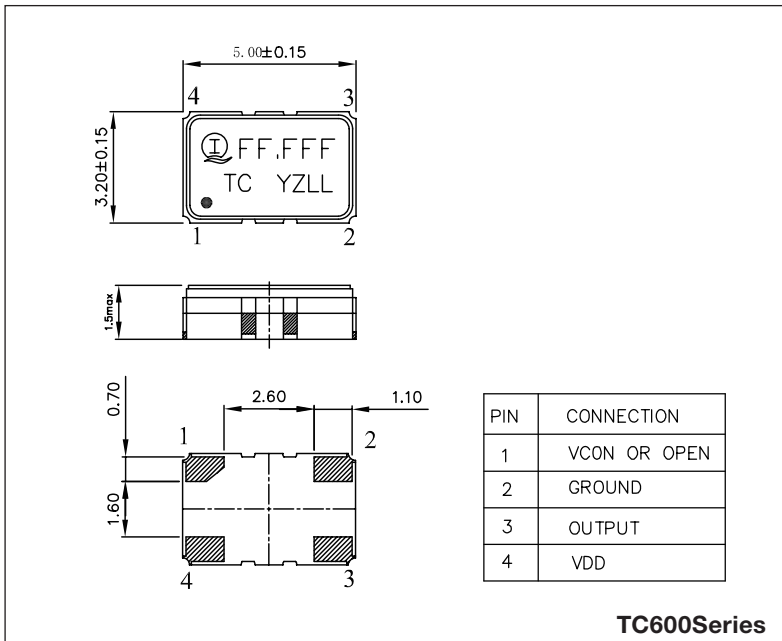
- Compact size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available



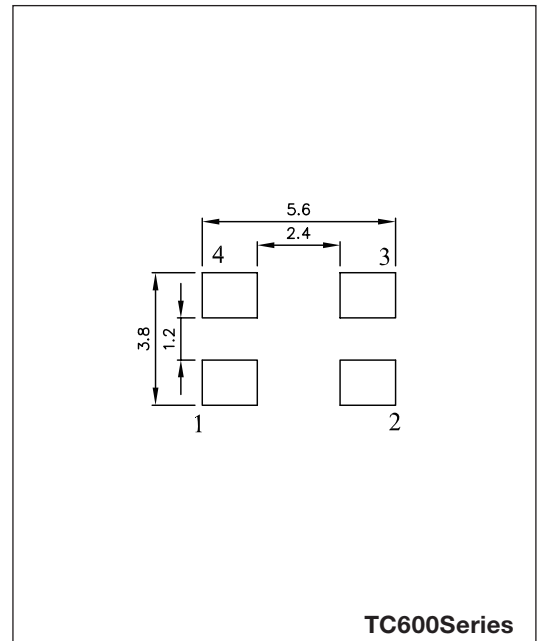
Parameters		Specifications	
Series 系列		TC600-B Series	TC600-K Series
Output Waveform 輸出波形		CMOS	Clipped Sine
Frequency Range 頻率範圍		2.500MHz to 54.000MHz	6.400MHz to 52.000MHz
Supply Voltage Range (Vdd) 工作電壓範圍		1.8V, 2.0V, 2.5V, 2.8V, 3V, 3.3V	
Operating Temperature Range 工作溫度範圍		0°C ~ +70°C, -20°C ~ +70°C, -40°C ~ +85°C	
Frequency Stability 頻率偏差			
vs. Room Temp. (25°C ± 3°C) 相對常溫		±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm	
vs. Operating Temp. 相對工作溫度		±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm	
vs. Voltage Change (±5%) 相對電壓變化		±0.3ppm Max	
vs. Load Change (±5%) 相對負載變化		±0.3ppm Max	
vs. Aging (First Year) 相對首年老化率		±1ppm	
Current Consumption (Idd) 消耗電流		10mA Max.	2mA Max.
Rise & Fall Time 上 / 下沿時間		10ns Max.	
Output Symmetry 輸出對稱性		45% ~ 55%	
Output Voltage 輸出電壓	Vp-p	-	0.8V Min.
	VOH	0.8Vdd	-
	VOL	0.5V	-
Output Load 輸出負載		15pF	10k ohms // 10pF
Pullability 牽引範圍 (for VCTCXO)		±15ppm Typ.	
Control Voltage Range 控制電壓範圍 (for VCTCO)		0.90V±0.90V, 1.4V±1V, 1.5V±1V	
Phase Noise @ 1kHz Offset		-130dBc/Hz Max.	
Start-up Time 起動時間		3ms Max.	
Storage Temperature Range 儲存溫度範圍		-40°C ~ +85°C	

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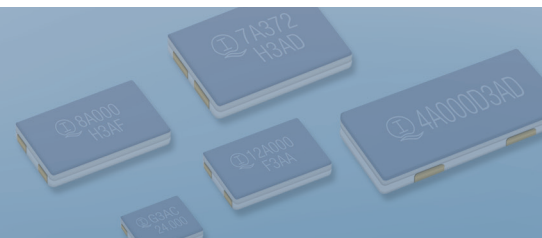
DIMENSION (mm)



SOLDERING PATTERN (mm)

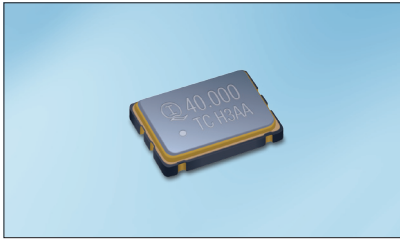


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TC413-K Series

SMD TEMPERATURE COMPENSATED QUARTZ CRYSTAL OSCILLATORS 表貼溫度補償石英晶體振盪器



FEATURES

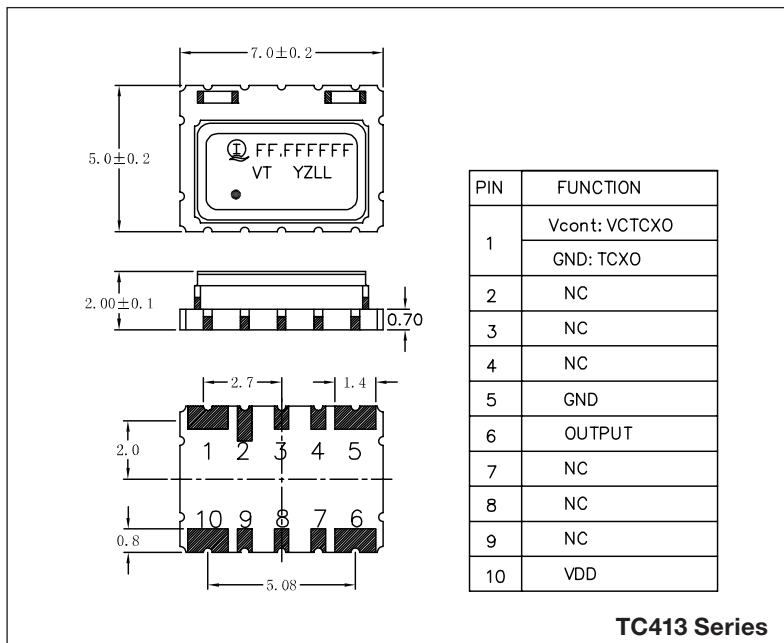
- Compact size
- High reliability seam welded package
- Pick and place assembly
- Low supply voltage version available



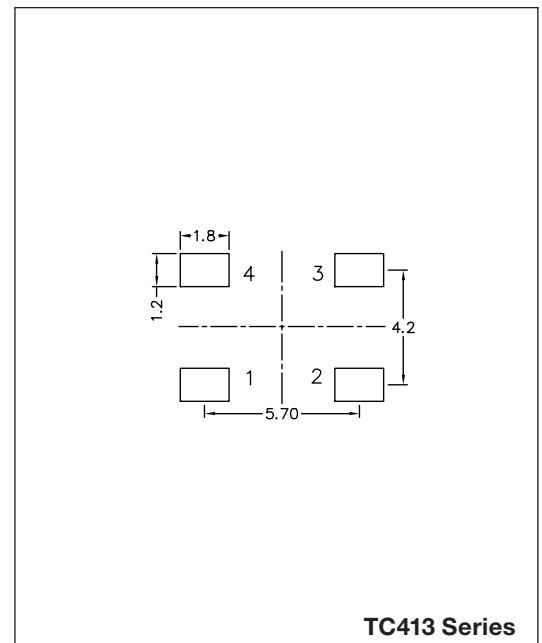
Parameters	Specifications
Output Waveform 輸出波型	Clipped Sine
Frequency Range 頻率範圍	10.0MHz to 30.0MHz
Supply Voltage Range (Vdd) 工作電壓範圍	3.3V, 5.0V
Operating Temperature Range 工作溫度範圍	-20°C ~ +70°C, -40°C ~ +85°C
Frequency Stability 頻率偏差	
vs. Room Temp. (25°C ± 3°C) 相對常溫	±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm
vs. Operating Temp. 相對工作溫度	±0.5ppm, ±1.0ppm, ±1.5ppm, ±2.0ppm, ±2.5ppm
vs. Voltage Change (±5%) 相對電壓變化	±0.3ppm Max
vs. Load Change (±5%) 相對負載變化	±0.3ppm Max
vs. Aging (First Year) 相對首年老化率	±1ppm
Current Consumption (Idd) 消耗電流	5mA Max.
Rise & Fall Time 上 / 下沿時間	10ns Max.
Output Symmetry 輸出對稱性	45% ~ 55%
Output Voltage 輸出電壓	Vp-p
Output Load 輸出負載	0.8V Min.
Pullability 牽引範圍 (for VCTCXO)	10k ohms // 10pF
Control Voltage Range 控制電壓範圍 (for VCTC)	±5ppm Min.
Phase Noise @ 1kHz Offset	1.4V±1V or 1.5V±1V
Start-up Time 起動時間	-130dBc/Hz Max.
Storage Temperature Range 儲存溫度範圍	10ms Max.
	-55°C ~ +125°C

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DIMENSION (mm)



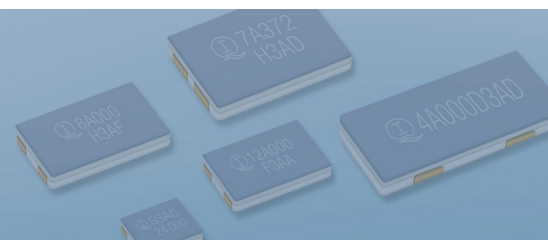
SOLDERING PATTERN (mm)



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I INTERQUIP ELECTRONICS CO LTD
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Temperature compensated crystal oscillators (TCXO)



FEATURES

- SC-Cut Crystal
- High precision
- Low aging
- Low phase noise



Parameters	Specifications		
	460	470	480
Frequency Range 頻率範圍	5.0MHz ~ 16.384MHz		
Standard Frequency 標準頻率	5.0MHz	5.0MHz	10.0MHz
	8.192MHz	16.384MHz	13.0MHz
	10.0MHz		16.384MHz
	13.0MHz		-
Long Term Stability Per Year 年老化率	±5x10 ⁻⁸ Max	±5x10 ⁻⁸ Max	±5x10 ⁻⁸ Max
Long Term stability Per Day 日老化率	±5x10 ⁻¹⁰ Max	±5x10 ⁻¹⁰ Max	±5x10 ⁻¹⁰ Max
Short Term Stability Allan Var. for Tau = 1 sec 短期老化率	±5x10 ⁻¹² Max	±5x10 ⁻¹² Max	±5x10 ⁻¹² Max
Frequency Stability 頻率偏差			
vs. Operating Temp. 相對工作溫度	±5x10 ⁻⁸ Max	±2x10 ⁻⁹ Max	±2x10 ⁻⁹ Max
vs. Load Variation ±10% (50Ω Load) 相對負載變化	±3x10 ⁻¹⁰ Max	±3x10 ⁻¹⁰ Max	±3x10 ⁻¹⁰ Max
vs. Supply Voltage Variation ±10% 相對電壓變化	±3x10 ⁻¹⁰ Max	±3x10 ⁻¹⁰ Max	±3x10 ⁻¹⁰ Max
Operating Temperature Range 工作溫度範圍	-10°C to +70°C	-10°C to +70°C	-10°C to +70°C
Storage Temperature Range 儲存溫度範圍	-55°C to +85°C	-55°C to +85°C	-55°C to +85°C
Frequency Adjustment 頻率調整範圍	±3x10 ⁻⁷ Max	±3x10 ⁻⁷ Max	±3x10 ⁻⁷ Max
Supply Voltage 工作電壓	12Vdc ± 10%	12Vdc ± 10%	5Vdc ± 10%
Current Consumption at 25°C 工作電壓 (常溫)	120mA Max.	120mA Max.	300mA Max.
Current Consumption at Warm Up 工作電壓 (暖機)	500mA Max.	500mA Max.	800mA Max.
Output Signal 輸出波型	Sine	Sine	HCMOS
Level 輸出水平	225mV Min.	225mV Min.	10KΩ / 15pf
Warm Up Time (Within 5x10 ⁻⁸) 暖機時間	5 Min Max.	5 Min Max.	5 Min Max.
Warm Up Time (Within 2x10 ⁻⁸) 暖機時間	8 Min Min.	8 Min Min.	8 Min Min.
Phase Noise 相位噪聲	10Hz	-125dBc/Hz	-122dBc/Hz
	10KHz	-155dBc/Hz	-152dBc/Hz
Shock 衝擊	175g		
Vibration 振動	1-500Hz, 10g		
Humidity 濕度	98% at +35°C		

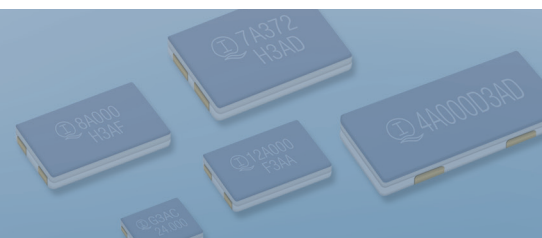
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DIMENSION (mm)

CONN	FUNCTION
1	V Ref Out
2	Electrical Tuning
3	Ground, Case
4	RF Output
5	+ 12 VDC

OC400

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FEATURES

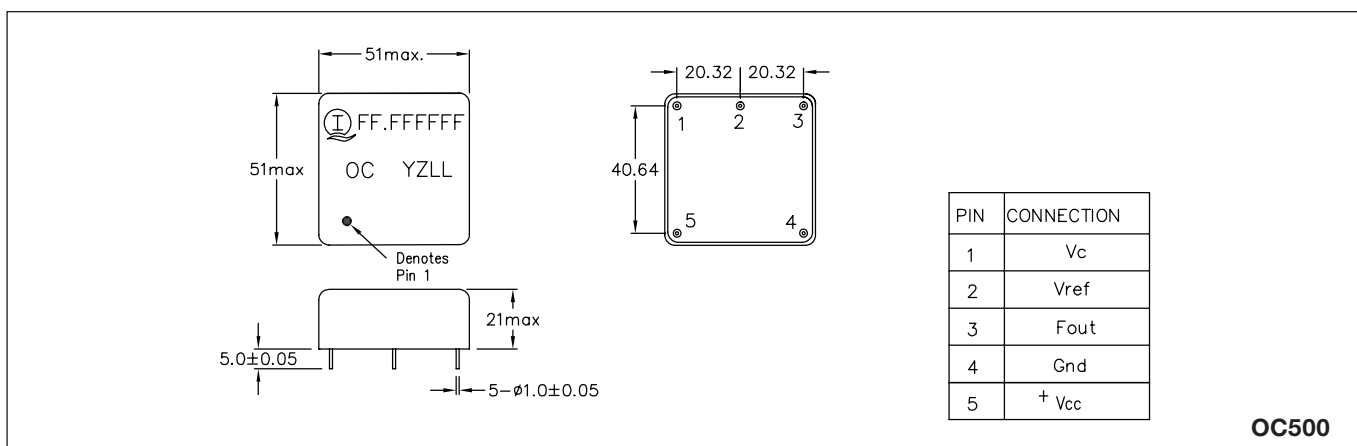
- SC-Cut Crystal
- High precision
- Low aging
- Low phase noise



Parameters	Specifications		
	560	570	580
Frequency Range 頻率範圍	5.0MHz ~ 20.0MHz		
Standard Frequency 標準頻率	5.0MHz	5.0MHz	10.0MHz
	8.192MHz	16.384MHz	13.0MHz
	10.0MHz		16.384MHz
	13.0MHz	-	-
Long Term Stability Per Year 年老化率	$\pm 5 \times 10^{-8}$ Max	$\pm 5 \times 10^{-8}$ Max	$\pm 5 \times 10^{-8}$ Max
Long Term stability Per Day 日老化率	$\pm 5 \times 10^{-10}$ Max	$\pm 5 \times 10^{-10}$ Max	$\pm 5 \times 10^{-10}$ Max
Short Term Stability Allan Var. for Tau = 1 sec 短期老化率	$\pm 5 \times 10^{-12}$ Max	$\pm 5 \times 10^{-12}$ Max	$\pm 5 \times 10^{-12}$ Max
Frequency Stability 頻率偏差			
vs. Operating Temp. 相對工作溫度	$\pm 5 \times 10^{-8}$ Max	$\pm 5 \times 10^{-9}$ Max	$\pm 5 \times 10^{-9}$ Max
vs. Load Variation $\pm 10\%$ (50 Ω Load) 相對負載變化	$\pm 3 \times 10^{-10}$ Max	$\pm 3 \times 10^{-10}$ Max	$\pm 3 \times 10^{-10}$ Max
vs. Supply Voltage Variation $\pm 10\%$ 相對電壓變化	$\pm 3 \times 10^{-10}$ Max	$\pm 3 \times 10^{-10}$ Max	$\pm 3 \times 10^{-10}$ Max
Operating Temperature Range 工作溫度範圍	-10°C to +70°C	-10°C to +70°C	-10°C to +70°C
Storage Temperature Range 儲存溫度範圍	-55°C to +85°C	-55°C to +85°C	-55°C to +85°C
Frequency Adjustment 頻率調整範圍	$\pm 3 \times 10^{-7}$ Max	$\pm 3 \times 10^{-7}$ Max	$\pm 3 \times 10^{-7}$ Max
Supply Voltage 工作電壓	12Vdc $\pm 10\%$	12Vdc $\pm 10\%$	5Vdc $\pm 10\%$
Current Consumption at 25°C 工作電壓 (常溫)	120mA Max.	120mA Max.	300mA Max.
Current Consumption at Warm Up 工作電壓 (暖機)	500mA Max.	500mA Max.	800mA Max.
Output Signal 輸出波型	Sine	Sine	HCMOS
Level 輸出水平	225mV Min.	225mV Min.	10K Ω / 15pf
Warm Up Time (Within 5×10^{-8}) 暖機時間	5 Min Max.	5 Min Max.	5 Min Max.
Warm Up Time (Within 2×10^{-8}) 暖機時間	8 Min Min.	8 Min Min.	8 Min Min.
Phase Noise 相位噪聲	10Hz	-125dBc/Hz	-122dBc/Hz
	10KHz	-155dBc/Hz	-152dBc/Hz
Shock 衝擊	175g		
Vibration 振動	1-500Hz, 10g		
Humidity 濕度	98% at +35°C		

Please consult our sales representatives for other specifications.
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DIMENSION (mm)



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FEATURES

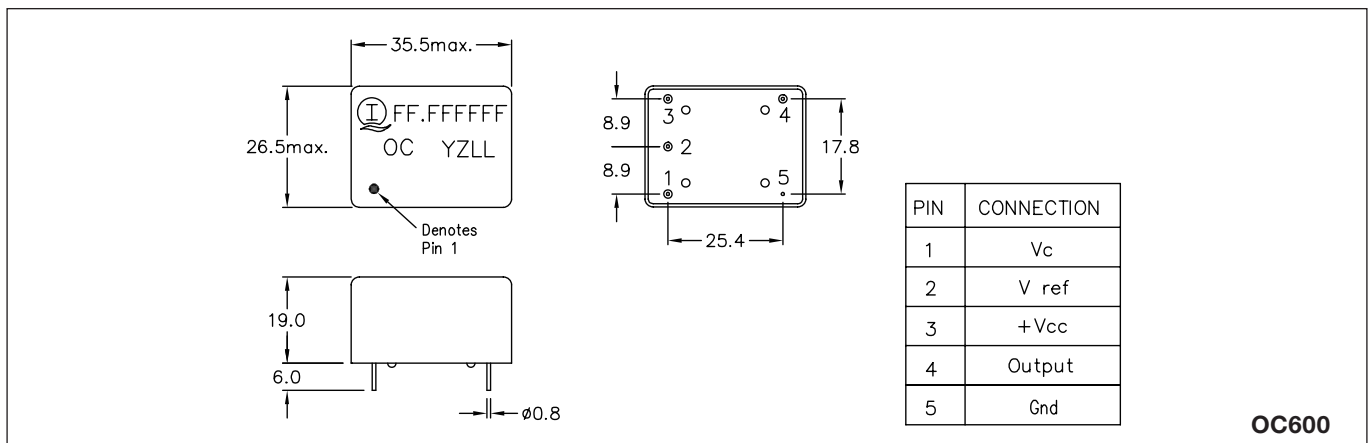
- SC / AT-Cut Crystal
- High precision
- Low aging
- Low phase noise



Parameters	Specifications		
	660	670	680
Frequency Range 頻率範圍	4.0MHz ~ 30.0MHz		
Standard Frequency 標準頻率	10.0MHz	4.096MHz	4.096MHz
	13.0MHz	5.0MHz	5.0MHz
	26.0MHz	8.192MHz	10.0MHz
	-	10.0MHz	16.384MHz
	-	13.0MHz	-
Long Term Stability Per Year 年老化率	±5x10 ⁻⁸ Max	±3x10 ⁻⁷ Max	±3x10 ⁻⁷ Max
Short Term Stability Allan Var. for Tau = 1 sec 短期老化率	±5x10 ⁻¹¹ Max	±5x10 ⁻¹⁰ Max	±5x10 ⁻¹⁰ Max
Frequency Stability 頻率偏差			
vs. Operating Temp. 相對工作溫度	±1.5x10 ⁻⁸ Max	±2x10 ⁻⁷ Max	±1x10 ⁻⁷ Max
vs. Load Variation ±10% (50Ω Load) 相對負載變化	±5x10 ⁻⁹ Max	±5x10 ⁻⁹ Max	±5x10 ⁻⁹ Max
vs. Supply Voltage Variation ±10% 相對電壓變化	±3x10 ⁻¹⁰ Max	±3x10 ⁻¹⁰ Max	±3x10 ⁻¹⁰ Max
Operating Temperature Range 工作溫度範圍	-10°C to +70°C	-10°C to +70°C	-10°C to +70°C
Storage Temperature Range 儲存溫度範圍	-55°C to +85°C	-55°C to +85°C	-55°C to +85°C
Frequency Adjustment 頻率調整範圍	±3ppm	±3ppm	±3ppm
Supply Voltage 工作電壓	12Vdc ± 10%	12Vdc ± 10%	5Vdc ± 10%
Current Consumption at 25°C 工作電壓 (常溫)	220mA Max.	220mA Max.	220mA Max.
Current Consumption at Warm Up 工作電壓 (暖機)	400mA Max.	400mA Max.	400mA Max.
Output Signal 輸出波型	HCMOS		
Warm Up Time (Within 1x10 ⁻⁷) 暖機時間	3 Min Max.	3 Min Max.	3 Min Max.
Phase Noise 相位噪聲	10Hz	-110dBc/Hz	
	100Hz	-125dBc/Hz	
	1KHz	-135dBc/Hz	
	10KHz	-145dBc/Hz	
	100KHz	-150dBc/Hz	
Shock 衝擊	175g		
Vibration 振動	1-500Hz, 10g		
Humidity 濕度	98% at +35°C		

Please consult our sales representatives for other specifications.
如對其他規格查詢，請與我司銷售人員聯繫

DIMENSION (mm)



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FEATURES

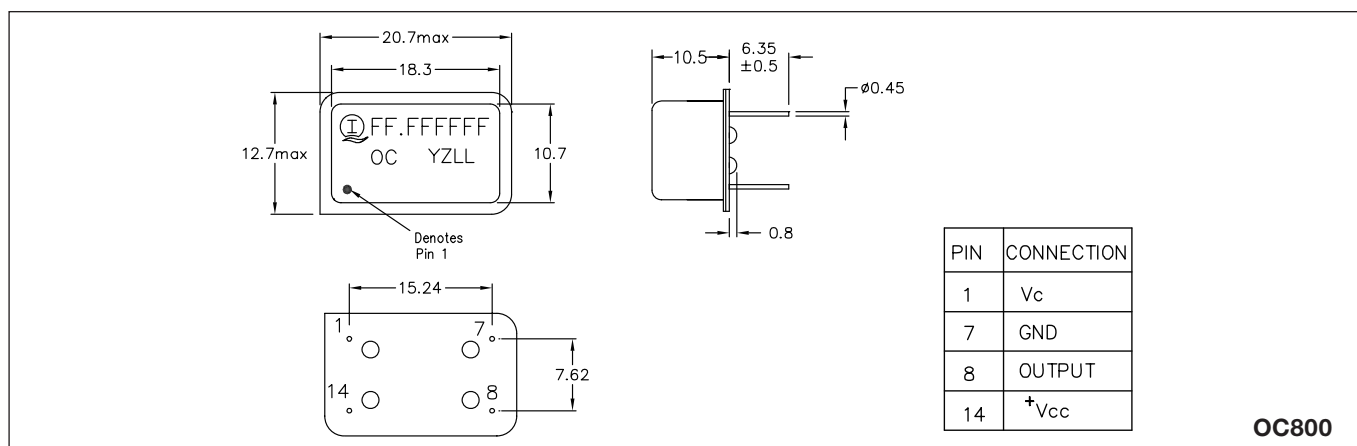
- SC / AT-Cut Crystal
- High precision
- Fast warm up
- Low power consumption



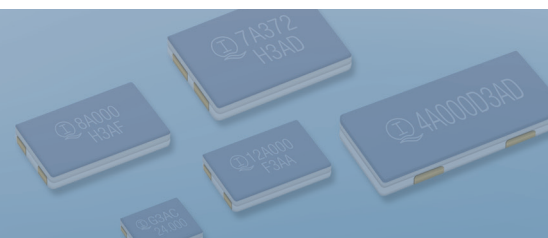
Parameters	Specifications	
Frequency Range 頻率範圍	10.0MHz ~ 20.0MHz	
Initial Stability 初始頻率偏差	±500ppb	
Frequency Stability 頻率偏差		
vs. Operating Temp. 相對工作溫度	±500ppb	
vs. Load Variation ±10% (50Ω Load) 相對負載變化	±20ppb	
vs. Supply Voltage Variation ±10% 相對電壓變化	±20ppb	
Long Term Stability Per Year 老化率	±0.5ppm	
Operating Temperature Range 工作溫度範圍	-20°C to +70°C	
Storage Temperature Range 儲存溫度範圍	-40°C to +85°C	
Frequency Adjustment 頻率調整範圍	±5ppm	
Supply Voltage 工作電壓	5.0Vdc ± 5%	
Current Consumption at 25°C 工作電壓 (常溫)	220mA Max.	
Current Consumption at Warm Up 工作電壓 (暖機)	500mA Max.	
Output Signal 輸出波型	CMOS	
Control Voltage Range 控制電壓範圍	2.5V ±2.0V	
Slope 斜率	Positive	
Warm Up Time (Within 1x10 ⁻⁷) 暖機時間	5 Min Max.	
Input Impedance 輸入阻抗	10KΩ Min.	
Phase Noise 相位噪聲	10Hz	-100dBc/Hz
	100Hz	-125dBc/Hz
	1KHz	-135dBc/Hz
	10KHz	-145dBc/Hz
	100KHz	-150dBc/Hz

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