Crystal Resonator Tuning Fork 32.768KHz.

1. Introduction

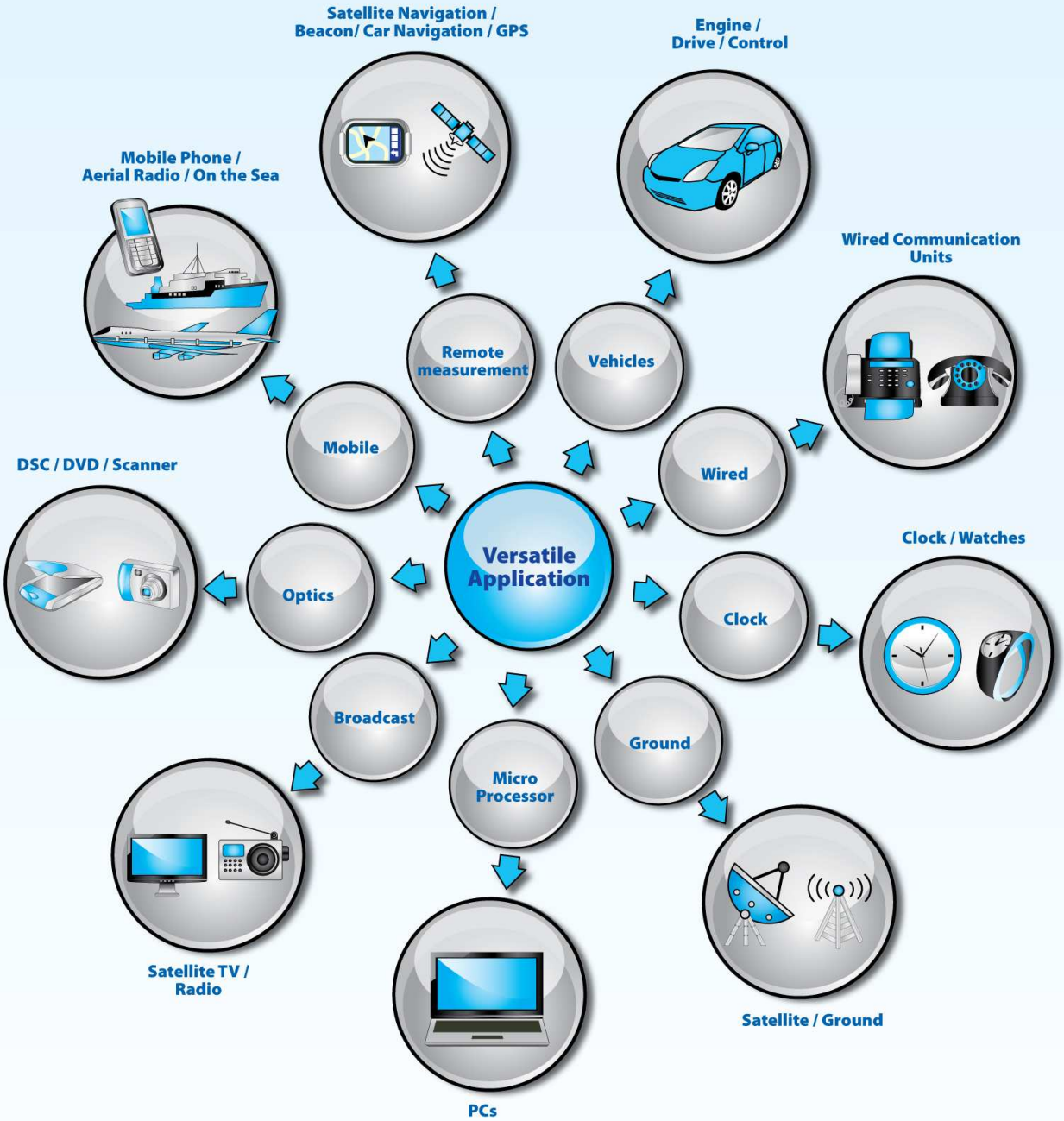
What is Quartz Crystal?

Quartz crystal has been also called the "water spirit" since early times. Also, Quartz crystal has been highly valued for its transparency, hardness and so on. In this way, quartz crystal is used for quartz crystal products in diverse ways in our daily life. Today, quartz crystal devices are made with synthetic quartz crystal instead of precious natural quartz crystal, and has become essential device and use with semiconductors (such as microprocessor)

For example —Quartz watches—

The most familiar application of quartz crystal would be quartz watches. Quartz watches have 300 times higher accuracy than mechanical watches which used to be popular in old times. This high accuracy was realized by the invention of the quartz crystal unit and IC. The representative frequency of quartz watch is 32.768kHz. When the frequency of 32768Hz is continued to be divided by 2 with use of IC, the standard clock of one pulse is obtained. This one pulse1 Hz is used in timing.

APPLICATIONS



3. Production process

For your understanding of the production ability and products quality of our company, please find our brief Production Process of crystal components:

(1) Cutting and Cutting Edge

(2) Processing in Rolling Machine

(3) Lapping and Polishing

(4) Sort Angle

(5) Sort Frequenc

(10) Inspection

(9) Sealing

(8) Pre-Sealing

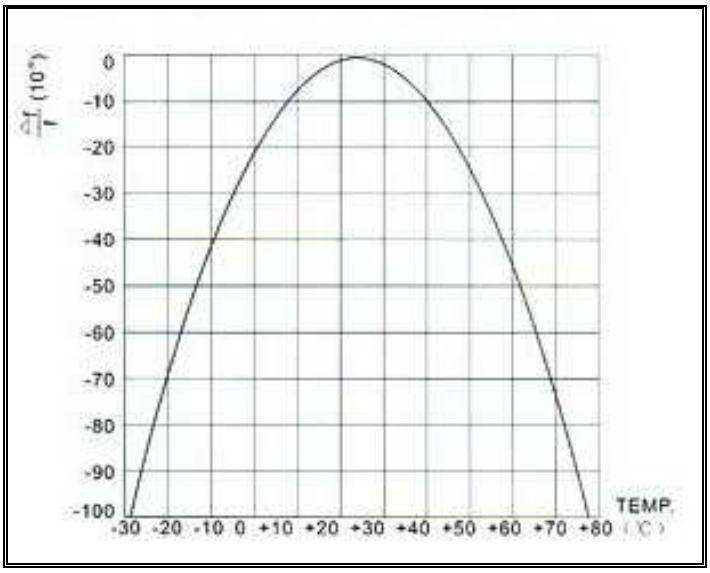
(7) Frequency Adjustment

Vacuum Evaporation

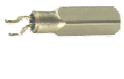
4. Tuning fork- Dip type

Item	Symbol	DT38	DT26
Model.			
Frequency Range	F	32.768KHz	
Frequency Tolerance	△f/f	± 20 ppm ± 50 ppm ± 100 ppm	± 20 ppm ± 50 ppm ± 100 ppm
Load Capacitance	CL	6pF / 12.5pF	
Operating Temp. Range	Tstg	-10℃ ~ +60℃	
Storage Temp. Range	Topr	-20℃ ~ +70℃	
Resistance of Series Resonance	Rs	30KΩ Max	40KΩ Max
Q-Factor		50,000 min	40,000 min
Drive Level	PWR	1μW	
Shunt Capacitance	C0	1.3pF ± 0.3 pF Max.	
Capacitance Ratio		650 max	
Insulation Resistance	IR	500MΩ at DC100 V	
Paraboric curvature Constant		-0.042ppm/C^2 Max	-0.042ppm/C^2 Max
Packing		Dip Type	

Frequency VS Temperature Curve



5. Tuning fork SMD type

Item	Symbol	ZMR206B	ZM206BJ	ZM146	ZM206	ZM315	ZM415	ZM405/406
Model								
Frequency Range	F	32.768KHz	32.768KHz	32.768KHz	32.768KHz	32.768KHz	32.768KHz	32.768KHz
Frequency Tolerance	△f/f	± 20 ppm	± 20 ppm	± 20 ppm	± 20 ppm	± 20 ppm	± 20 ppm	± 20 ppm
Load Capacitance	CL	12.5pF	12.5pF	12.5pF	12.5pF	12.5pF	12.5pF	12.5pF
Operating Temp. Range	Tstg	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃
Storage Temp. Range	Topr	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃	-40℃ ~ +85℃
Resistance of Series Resonance	Rs	50KΩ	65KΩ	65KΩ	50KΩ	60KΩ	60KΩ	50KΩ
Q-Factor		40K min	70K Typical	60K Typical	50K Typical	60K Typical	60K Typical	60K Typical
Drive Level	PWR	1uW	1uW	1uW	1uW	1uW	1uW	1uW
Shunt Capacitance	C0	1.35pF typical	1.3pF Typical	1.3pF Typical	1.3pF Typical	1.3pF Typical	1.3pF Typical	1.3pF Typical
Motional Capacitance	C1	2.0fF	1.5fF	1.9fF	3.3fF	3.0fF	3.0fF	2.0fF
Insulation Resistance	IR	500MΩ at DC100 V	500MΩ at DC100 V	500MΩ at DC100 V	500MΩ at DC100 V	500MΩ at DC100 V	500MΩ at DC100 V	500MΩ at DC100 V
Paraboric Curavature /Temperature Constant	K	-0.042ppm/C^2 Max	-0.034+/-0.06 ppm/C^2 Max	-0.034+/-0.06 ppm/C^2 Max	-0.034+/-0.06 ppm/C^2 Max	-0.034+/-0.06 ppm/C^2 Max	-0.034+/-0.06 ppm/C^2 Max	-0.034+/-0.06ppm/C^2 Max
Packing		SMD	SMD	SMD	SMD	SMD	SMD	SMD

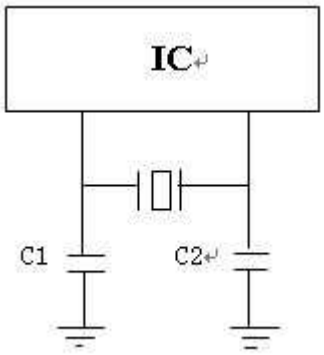
6. Precaution in Oscillator Design

Having a good design of oscillator circuits should be considered the following points.

1. Proper CL Value.

Load Capacitance (CL) refers to an effective external series capacitance in an assuming oscillation circuit that is viewed from the crystal inside. The load capacitance will determine the resonance frequency. Improper use of the CL may result in frequency shift from the expected frequency.

Normally, the IC supply will suggest the value of CL matching the circuit.



Equation of the Load Capacitance in Oscillation Circuit

CL=((C1 x C2) / (C1 + C2)) + Cs

Cs is the stray capacitance. Generally, 1~5pF, When CL is 12.5pF, value of C1 and C2 will be 16~22pF.

2.Drive Level(DL)

Drive Level (DL) is the power used during working and ensure drive level is less than the max value of drive level power

Use high frequency current probe to test the current of crystal resonator and use the following equation

DL= I^2 * RL

RL= RR(ESR)*(1+C0/CL)^2,

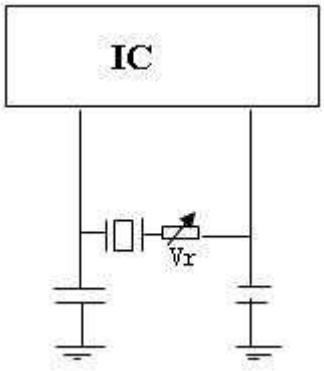
C0: static capacitance

CL: Load Capacitance

3. Negative Resistance

Negative resistance reflects the allowance and margin for oscillation motility. An insufficient negative resistance may cause unexpected trouble such as stop oscillation or slow start up time

The following step shows how to find the negative resistance.



Use the variable resistor in series with the resonator shown above

Adjust the value of VR to let the oscillator start or stop oscillation

When the oscillation from start to stop, measure the value of Vr

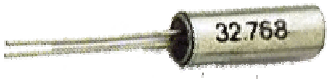
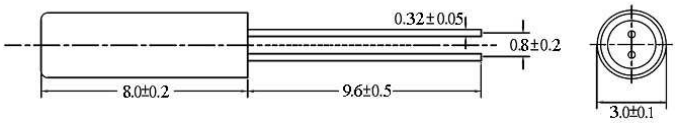
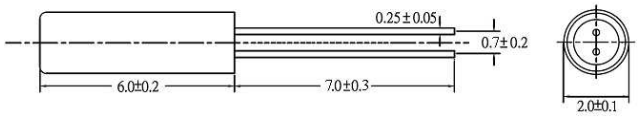
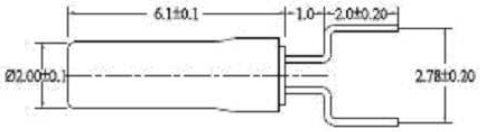
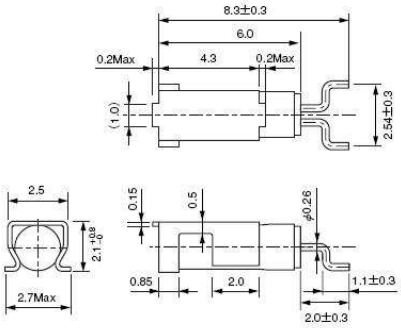
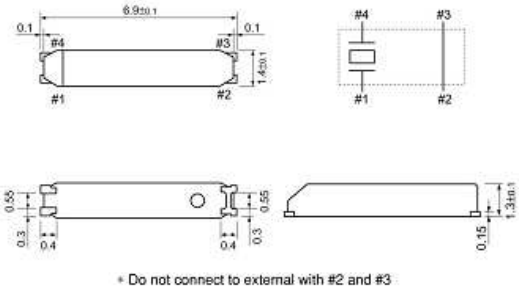
Get the value of ｜-R｜= R1+Vr.

R1= ESR (Equivalent Series Resistance)

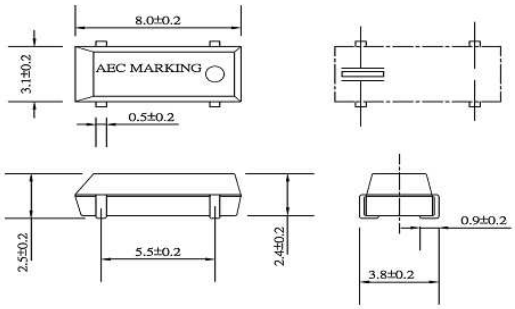
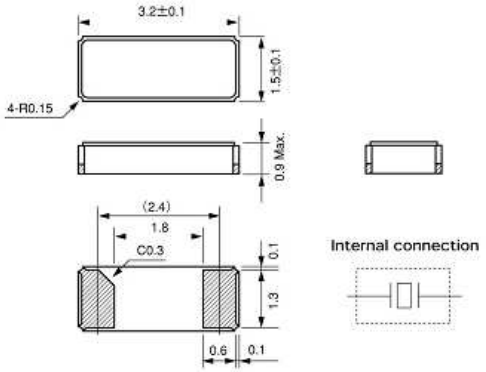
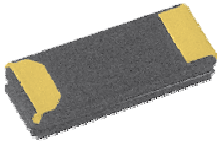
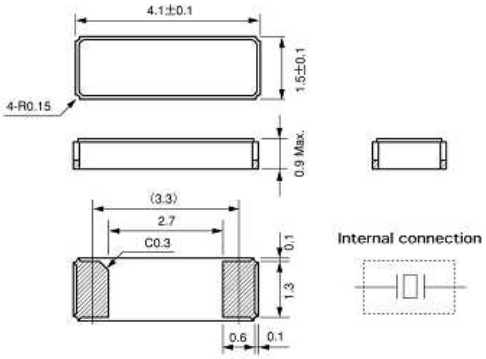
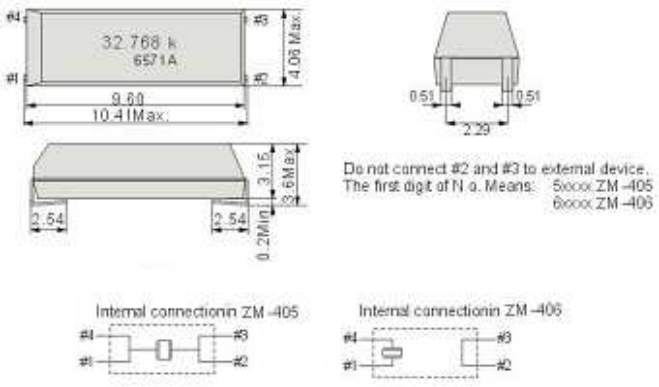
Recommended negative resistance

-R｜> 10*R1

7. Package model

Item	Description and dimension.
 DT38	
 DT26	
 ZM206	
 ZMR206B	
 ZM146	

7. Package model

 ZM206	
 ZM315	
 ZM415	
 ZM405/ 406	

8. Client Application Case

8.1 Thailand OEM manufacturer use DT26- Cylinder type 32.768KHz in the production of portable temperature measuring device.

8.2 Germany manufacturer use DT38 Cylinder type 3X8mm in manufacturing the product of measuring instrument.

8.3 An OEM factory in Italy uses the DT38 Cylinder type with +/-5ppm in the measuring instruments.

8.4 The measuring instrument manufacturer in Italy use SMD ZM206 for production of Measuring Instrument.

8.5 An USA telecom manufacturer use DT38- Cylinder type for manufacturer the fixed lines telephone set.

8.6 Brazil manufacturer use SMD ZMR206B- Cylinder type for production of Net Security device

8.7 Germany based Multinational company use DT38 Cylinder type for manufacturing of Telecom set in Brazil factory.

8.8 An OEM Energy meter manufacturer in Egypt use DT26 in its production of Digital Energy meter.

9. Why choose AEC?

1) The rule of our enterprise culture with the slogan
‘ Trust, quality and customer satisfaction are our first priority

2) Price we offer to provide enough profit for customer in keen competition.

3) Over 20 years experience in the frequency control products field

4) Four main types of products including thousand of models, what the items you need are just inside!

5) From Dip type to SMD type, all sizes range of our product’s packages, you can pick the one you need in a simple way

6) For your convenience to purchase, our products are all under RoHS Compliant with *SGS certificates*

7) Our technical departments are always here to suit your products’ needs

8) Strong R&D team to meet the market trend

9) Hi-tech factory facilities (equipment imported from Japanese, USA and Germany company) are introduced to enhance the capability and quality.

10) Total Quality Management
(3 steps: Vendor appraisal, in-processing test and final test)
ensure our quality can satisfy the customer requirement
Quality are verified under customer mass usage in diffierent products

10. Contact

“Quality and Customer Satisfaction are our first priority”

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