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What is a “Piezo-Ceramics”?

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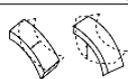
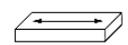
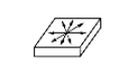
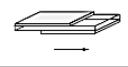
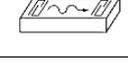
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► What is a "Piezo-Ceramics"?

What is a PIEZO-CERAMIC?

Some of the piezoelectric crystal can be claimed into the polycrystalline ceramics, though there is a spontaneous polarization in each of the fine crystals in the piezoelectric ceramics which is cancelled as a whole and shows no piezoelectricity. But when a high D.C. voltage is applied to such ceramics, the directions of the spontaneous polarizations are brought to uniformity and a Ferro electricity ceramics is attained. With some additives, the material with extremely stable frequency, temperature and aging characteristics is being used by TOKEN for ceramic filter. Compared with the single crystal, the piezoelectric ceramics has various advantageous features as follows:

Vibration Mode		Frequency (Hz)						
		1k	10k	100k	1M	10M	100M	1G
Flexural mode		■	■					
Length mode				■	■			
Area expansion mode				■	■			
Radius vibration				■	■			
Shear thickness mode					■	■		
Thickness expander mode					■	■	■	
Surface acoustic wave						■	■	■

Note : ————— show the direction of vibration

Ceramic Resonator Vibration Mode (Flexural mode, Length mode, Area expansion mode, Radius vibration, Shear thickness mode, Thickness expander mode, Surface acoustic wave) and Frequency Range

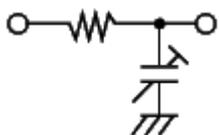
1. Can be mass-produced at low cost.
2. Can be formed into any desirable shape.
3. The direction of the polarization is easily attainable.
4. Chemically and physically stable.
5. Easy for fabrication.

Ceramic resonators use the mechanical resonance of piezoelectric ceramics. The oscillation mode varies with resonant frequency. The table on the right shows this relationship.

As a resonator device, quartz crystal is well-known. RC oscillation circuits and LC oscillation circuits are also used to produce electrical resonance. The following are the characteristics of PIEZO-CERAMIC.

1. High stability of oscillation frequency stability is between that of the quartz crystal and LC or RC oscillation circuits. The temperature coefficient of quartz crystal is $10^{-6}/^{\circ}\text{C}$ maximum and approximately 10^{-3} to $10^{-4}/^{\circ}\text{C}$ for LC or RC oscillation circuits. Compared with these, it is $10^{-5}/^{\circ}\text{C}$ at -20 to $+80^{\circ}\text{C}$ for ceramic resonators.
2. Small configuration and light weight The ceramic resonator is half the size of popular quartz crystals.
3. Low price, non-adjustment PIEZO-CERAMIC is mass produced, resulting in low cost and high stability. Unlike RC or LC circuits, ceramic resonators use mechanical resonance. This means it is not basically affected by external circuits or by the fluctuation of the supply voltage. Highly stable oscillation circuits can therefore be made without the need of adjustment.

The table briefly describes the characteristics of various oscillator elements.

Characteristics of Various Oscillator Elements						
Name	Symbol	Price	Size	Adjustment	Oscillation Frequency Initial Tolerance	Long-term Stability
LC		Inexpensive	Big	Required	$\pm 2.0\%$	Fair
CR		Inexpensive	Small	Required	$\pm 2.0\%$	Fair
Quartz Crystal		Expensive	Big	Not required	$\pm 0.001\%$	Excellent
Ceramic Resonator		Inexpensive	Small	Not required	$\pm 0.5\%$	Excellent