

DESCRIPTION

The TS Quartz Temperature Sensors are tuning-fork quartz crystals vibrating in a torsional mode. They are designed so that their frequency is both extremely sensitive to temperature and highly linear. For example, the 172.0 kHz design has a sensitivity of roughly +46.4 ppm/°C. This high sensitivity offers the ability to detect fine changes in temperature; the degree depending on the implementation. Further, this frequency-based technique has the advantage of being immune to amplitude noise in the measurement system; a feature not shared by thermocouple, thermistor, or RTD based temperature sensing techniques. Lastly, remote temperature sensing is possible by using an antenna to pick up the frequency of the EM waves emitted by the sensor.

FEATURES

- Frequency-based sensing
- High shock resistance
- Low aging
- Designed and manufactured in the USA

APPLICATIONS

- High resolution temperature measurement
- Temperature-critical process control/monitoring
- Wireless temperature measurement
- Human health monitoring

SMD TERMINATIONS

Designation	Termination
SM1	Gold Plated (Lead Free)
SM3	Solder (60/40 Sn-Pb)
SM5	Solder (Lead Free)

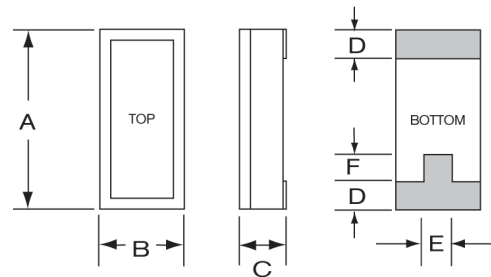
TS1



TS4



DIMENSIONS



DIM	TS1 MAXIMUM		TS4 MAXIMUM	
	inches	mm	inches	mm
A	0.330	8.38	0.210	5.33
B	0.155	3.94	0.085	2.16
C (SM1)	0.070	1.78	0.050	1.27
C (SM3)	0.075	1.90	0.053	1.35
C (SM5)	0.075	1.90	0.053	1.35
D	0.055	1.40	0.046	1.16
E	0.070	1.78	0.020	0.51
F	0.070	1.78	0.025	0.64

STANDARD FREQUENCIES

- 172.0 kHz
- 190.5 kHz
- 262.144 kHz
- 300.0 kHz
- 325.0 kHz
- 350.0 kHz

SPECIFICATIONS

Specifications are typical at 25°C unless otherwise noted. Specifications are subject to change without notice. Tighter specifications available. Please contact factory.

TYPICAL PARAMETERS

Parameters will vary according to frequency.

Standard Frequencies ¹	<u>172.0 kHz</u>	<u>262.144 kHz</u>
Standard Calibration Tolerances ²	200 ppm (0.02%) 500 ppm (0.05%) 10000 ppm (1.0%)	200 ppm (0.02%) 500 ppm (0.05%) 10000 ppm (1.0%)
Load Capacitance	5 pF (< 180 kHz)	4 pF (≥ 180 kHz)
Quality Factor Q	See Graph	
Motional Capacitance C ₁	See Graph	
Motional Resistance R ₁	See Graph	
Drive Level	0.5 μW	0.5 μW
Aging, first year ³	3 ppm MAX.	3 ppm MAX.
Shock, Survival	5,000 g	5,000 g
Vibration, Survival	20 g, 10-2,000 Hz swept sine	
Max Process Temperature ⁴	260°C for 20 sec.	

1. Other frequencies available. Please contact factory.
2. Other calibration tolerances available. Please contact factory.
3. Aging data from similar quartz oscillator crystal.
4. For detailed information refer to Tech Note 27.

FREQUENCY-TEMPERATURE MODEL

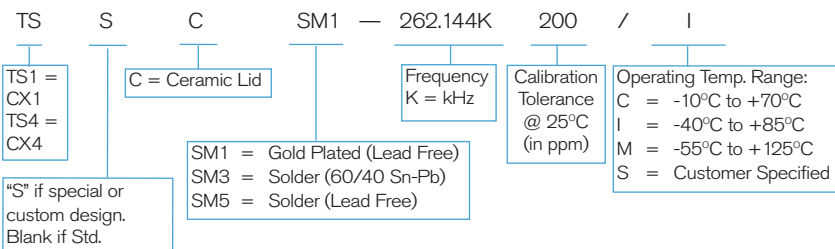
Although the frequency-temperature characteristic of the TS sensor is nearly linear, it is not exactly so. A better model is a second-order polynomial in temperature:

$$F(T) = F(T_0) [1 + \alpha(T - T_0) + \beta(T - T_0)^2]$$

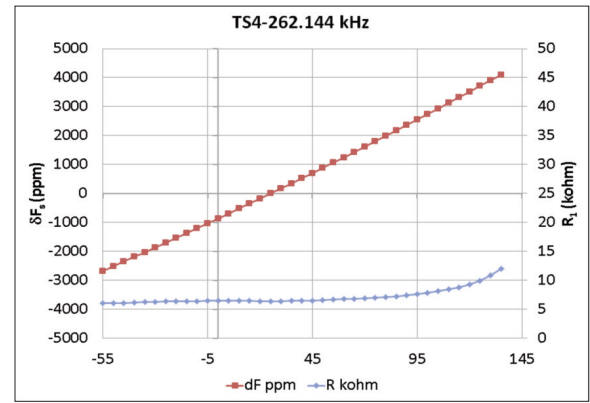
While higher-order polynomial models are possible, a second-order model is usually sufficient. Taking $T_0 = 25^\circ\text{C}$, typical values for α and β are as follows:

Frequency (kHz)	α (ppm/°C)	β (ppm/°C ²)
172.000	46.4	0.036
262.144	34.5	0.018

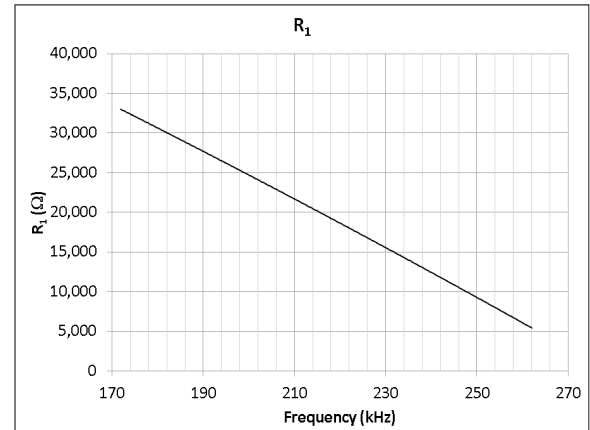
HOW TO ORDER TS TEMPERATURE SENSORS



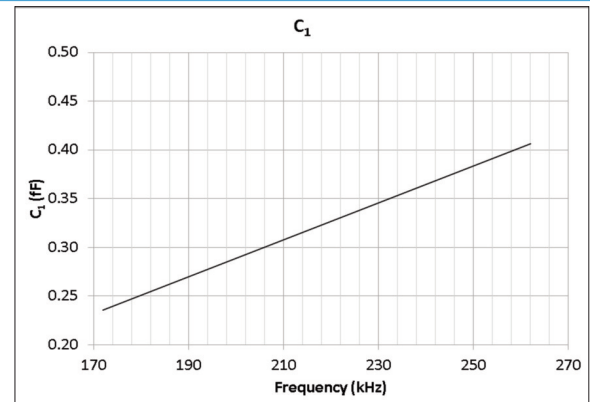
FREQUENCY AND R1 VS TEMPERATURE



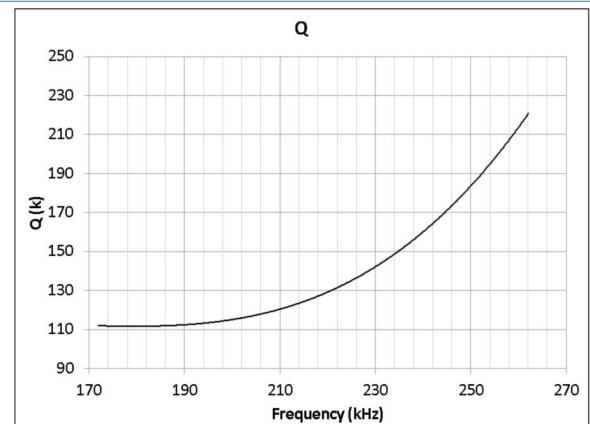
MOTIONAL RESISTANCE R₁



MOTIONAL CAPACITANCE C₁



QUALITY FACTOR Q



10162 - Rev D