Ceramic Resonators Improves Tolerances

Ceramic resonators offer low cost and high reliability timing alternatives to quartz crystals. Murata Electronics launches tight frequency tolerance ceramic resonators for automotive CAN bus applications.

Passive components designed for the automotive sector must combine the highest reliability and lowest cost. Murata's new series of tight tolerance ceramic resonators can meet both requirements.

Reducing the cost and size

Previously, only higher cost quartz crystal resonators were considered for CAN bus application, due to tighter frequency tolerance requirements than for traditional automotive bus applications. The tight tolerance ceramic resonators frees the design engineers from having to use these higher cost components and still achieve desired performance and reliability targets.

The CSTCR-G-B, CSTCE-G-A, and the new CSTCE-V-A are the only ceramic resonators that meet the total frequency tolerance (initial tolerance + temperature tolerance + aging tolerance) of ± 0.3%. (Table 1). The new CSTCE-V-A is still under development but will be available by 2005. The CSTCR-G-B covers the frequency range of 4.00 MHz to 7.99 MHz (Table 2), CSTCE-G-A covers 8.00 MHz to 12.50 MHz (Table 3) and the new CSTCE-V-A covers 14.00 MHz to 20.00 MHz (Table 4).

The CSTCR (4.5 x 2.0mm) and CSTCE (3.2 x 1.3mm) are the world's smallest resonators for their respective frequency ranges. All three series are surface mount devices (SMD) with built in load capacitors. Operating temperature range is –40C to +125C, for the automotive version.

Tight tolerances

Three aspects must be considered to achieve the tighter frequency tolerance for a ceramic resonator: Tolerance, Stability and Correlation.

Tolerance is the specification that can be achieved for a resonator. The total tolerance is the addition of the initial tolerance, temperature tolerance and aging tolerance. Tighter tolerances are possible through design advancements, material refinement and manufacturing techniques. Design and material changes improve the temperature and aging characteristics of the resonator. The manufacturing changes improve the ability to sort to tighter initial tolerances.

Frequency Range	Series	Comments
4.00 MHz ~ 7.99 MHz	CSTCR-G-B	Surface Mount, Built in Load Caps
8.00 MHz ~ 12.50 MHz	CSTCE-G-A	Surface Mount, Built in Load Caps
14.00 MHz ~ 20.00 MHz	CSTCE-V-A	Surface Mount, Built in Load Caps

Table 1. Ceramic resonators for CAN bus applications.

Stability simply describes the capability of sustaining oscillation over worst case conditions such as minimum supply voltage, over temperature and most importantly the worst case resonator

Correlation is the difference in the measured frequency of the resonator in Murata's standard test circuit (simple unbuffered inverter) and the application circuit (micro-controller). The oscillation frequency correlation is extremely important for the initial tolerance accuracy of a ceramic resonator. For example a ceramic resonator measured using the standard test circuit as 8.000 MHz may oscillate at 8.156 MHz in your application circuit. The frequency correlation is caused by the differences in the oscillator, stray capacitance and various other items. The resonator can be sort to a very tight initial tolerance however if the oscillating frequency is centered on 8.156 MHz the part is outside of the requirement. The +0.156 MHz shift can be easily compensated for in the design of the resonator.

IC Evaluations

Tolerance is determined by the design of the resonator. However stability and correlation is determined by the IC evaluation. The micro-controller is evaluated with the ceramic resonators to determine the best possible circuit conditions to achieve stability / stable oscillation. In addition, frequency correlation is

measured to meet the tight initial frequency tolerance required. For the tight tolerance resonators the IC evaluation must be completed on the final circuit board layout. The final circuit boards provide the most accurate measurement of the frequency correlation. This measurement will account for the effects of stray capacitance on the oscillation frequency. Once the correlation is determined the frequency of the resonator is adjusted to compensate for the correlation. The IC evaluation is a free of charge service. More information can be found on the IC evaluation request form.

CSTCR-G-B (4.00 ~ 7.99 MHz)

Features
- Smallest SMD ceramic resonator over 4.00 MHz to 7.99 MHz
- Au terminals for conductive glue mounting (Pb free)
- Improved mechanical and drop shock resistance

Standard Tolerances

Initial	= ± 0.50%	
Temperature	= ± 0.15%	(-40C to +125C)
Aging	= ± 0.05%	

Tight Tolerances (over -40C to +125C)

Initial	= ± 0.10%
Temperature	= ± 0.15%
Aging	= ± 0.05%
Total	= ± 0.30%

Sample Status: Available
Production Status: Available

Table 2. CSTCR Series

CSTCE-G-A (8.00 ~ 12.50 MHz)

Features
- Smallest SMD ceramic resonator over 8.00 MHz to 12.5 MHz
- Au terminals for conductive glue mounting (Pb free)

Standard Tolerances

Initial	= ± 0.50%	
Temperature	= ± 0.20%	(-40C to +125C)
Aging	= ± 0.10%	

Tight Tolerance (over -40C to +125C)

Initial	= ± 0.10%
Temperature	= ± 0.15%
Aging	= ± 0.05%
Total	= ± 0.30%

Sample Status: Available
Production Status: Available

Table 3. CSTCE Series

CSTCE-V-A (14.00~20.00 MHz)

Under Development

Features
- Smallest SMD ceramic resonator over 14.00 to 20.00 MHz
- Au terminals for conductive glue mounting (Pb free)

Standard Tolerances

Initial	= ± 0.50%	
Temperature	= ± 0.30%	(-40C to +125C)
Aging	= ± 0.30%	

Tight Tolerance (over -40C to +125C)

Initial	= ± 0.10%
Temperature	= ± 0.15%
Aging	= ± 0.05%
Total	= ± 0.30%

Sample Status: 2005
Production Status: 2005

Table 4. New CSTCE Series

For additional questions on tight tolerance ceramic resonators please contact a Murata's Sales Representative or contact us through Technical Assistance (Please put "CAN BUS" for the Specific Application section).