Murata Details Car LAN's Tight Frequency Tolerance Resonators

The required frequency tolerance depends on automotive manufacturers. Thus the company expanded its line up of ceramic resonators based on makers' demands.

There is a remarkable increase in the number of electronic components installed in automotives. Electronic applications are expanding rapidly in various parts of a vehicle, including the power train system like the engine control as well as the body, safety, and information systems. Because of this trend, even small cars today are installed with at least 10 electronic control units (ECUs) while high-end cars are installed with nearly 60 ECUs.

In ECU configurations, the microcomputer plays a pivotal role in the ECU control system. The resonator is a vital device that generates the timing clock of a microcomputer. There are two kinds of resonators - the quartz-crystal resonator that utilizes crystals, and the ceramic resonator that utilizes ceramics. These resonators are used for different applications depending on their respective characteristics. Quartz-crystal resonators are generally used in applications where tight frequency tolerance is required for the frequency. Meanwhile, ceramic resonators, which are cheaper than quartz-crystal resonators, are used mostly in applications like basic microcomputers where a ±1 to 2 percent of frequency tolerance is acceptable.

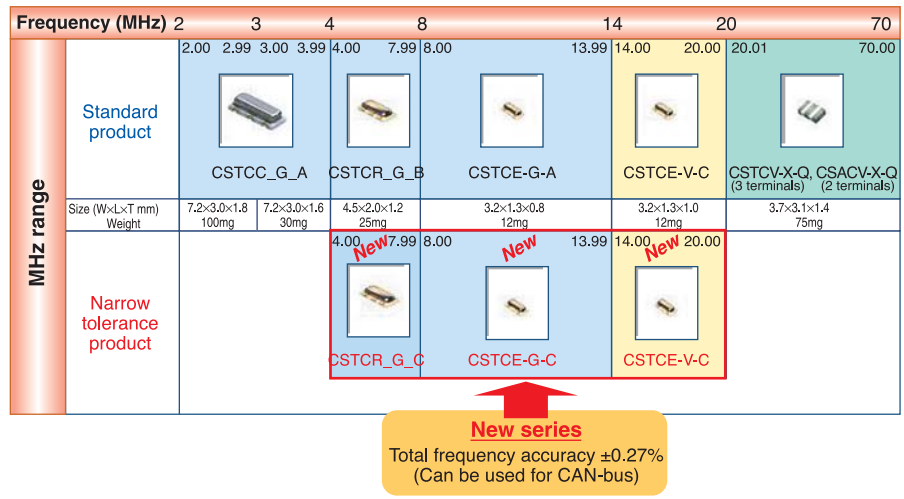

Fig. 2: Line up of CERALOCK products

The frequency tolerance of resonator required for a microcomputer installed in the ECU was about ±1 to 2 percent. Nowadays, however, this level is no longer practical. The additional installation of in-car local area network (LAN) that performs high-speed communications between ECUs, such as the Control Area Network (CAN) bus, demands communication accuracy of less than ±1.0 percent because the microcomputers used are equipped with this high-speed communication function. Specifically, when a CAN-bus performs high-speed communications of 500Kbps, an accuracy of ±0.3 percent or less is required for a resonator used in the ECU.

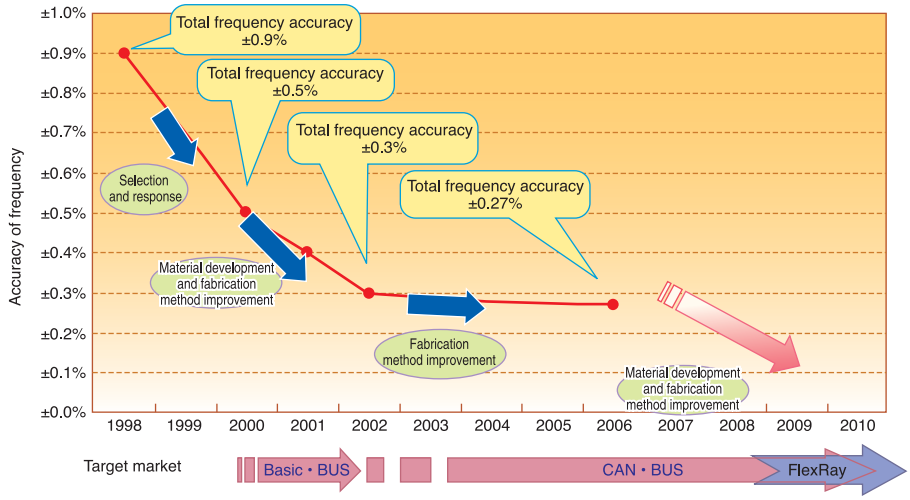

Fig. 1: Trend toward increasing accuracy of surface-mount device, CERALOCK, for automotive-use

To comply with such market needs, Murata Manufacturing Co., Ltd. directs its effort toward improving the frequency tolerance of its ceramic resonator, the CERALOCK, and has brought to the market the CERALOCK CSTCR_G_C Series, the CSTCE_G_C Series, and the CSTCE_V_C Series for automotive applications. Murata is offering a lineup that can be used with CAN-bus in the frequency range of 4 to 20MHz.

The characteristics and advantages of this CERALOCK for automotive use and the present technology trends are presented below.

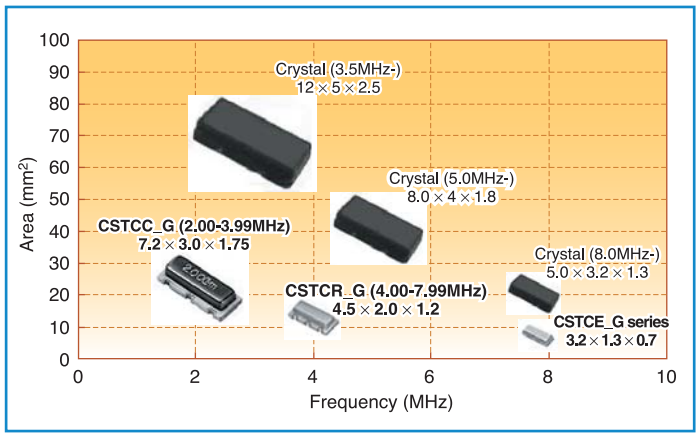

Fig. 3: Size comparison of CERALOCK and quartz-crystal resonator

Development Efforts For Tight Frequency Tolerance

Murata's drive to develop tight frequency tolerance CERALOCK resonators is aimed toward the expansion of their application areas while retaining their characteristics. As a result of Murata's development efforts, these products can operate at a wide temperature range of -40 to +125°C. They exhibit high resistance to vibration and shock, and are highly environment-friendly.

Frequency deviations are caused by variations in the initial frequency, by frequency shift, by temperature, or by secular changes. Most of the automotive-use CERALOCK released before 1998 had ±1.0 percent of the tolerance including these factors. To achieve the tighter frequency tolerance required for resonators used in CAN-equipped ECUs, Murata developed in 2002 the first automotive ceramic resonator that has a total frequency tolerance of ±0.3 percent. The high accuracy of this ceramic resonator was achieved by the development of a ceramic material that has a very small frequency shift caused by temperature as well as by the improvement of the processing technology for reducing the deviation factor.

There were, however, some cases where a resonator with less than ±0.3 percent was demanded because of the need to consider deviations caused by components other than the resonator, and also to assure the required margin for the ECU.

For that reason, Murata upgraded its lineup in order to achieve the level to ±0.27 percent total frequency tolerance by further improving the ceramic material that can suppress frequency deviations caused by temperature as well as by introducing the company's original ceramic processing technology for reducing initial variations of individual frequencies (See Fig. 1).

Meets Frequency Accuracy

Using the company's acquired technologies, Murata has released the CSTCR_G_C Series for 4 to 7.99MHz, the CSTCE_G_C Series for 8 to 13.99MHz, and the CSTCE_V_C Series for 14 to 20MHz. Murata is offering a lineup that can be used for a total frequency tolerance of up to ±0.27 percent in the frequency range of 4 to 20MHz (See Fig. 2). These products feature an initial frequency tolerance within ±0.07 percent. The frequency temperature dependence falls within ±0.13 percent while the frequency aging is within ±0.07 percent.

Murata's CERALOCK Series is 25 percent smaller than the standard quartz-crystal resonators used in the same frequency range (See Fig. 3). The size in 4 to 7.99MHz is 4.5 × 2.0mm while the size in 8 to 20MHz is 3.2 × 1.3mm.

Furthermore, CERALOCK is equipped with built-in load capacitors required for configuring oscillation circuits. This feature contributes to space-saving in the mounting area and reduces mounting cost. Previously, the piezo element and capacitor element are installed on the bottom substrate. Meanwhile, the new structure is that the bottom substrate takes the place of capacitors. This new structure can reduce the number of connecting locations and the configuration materials, and makes reliability higher (See Fig. 4).

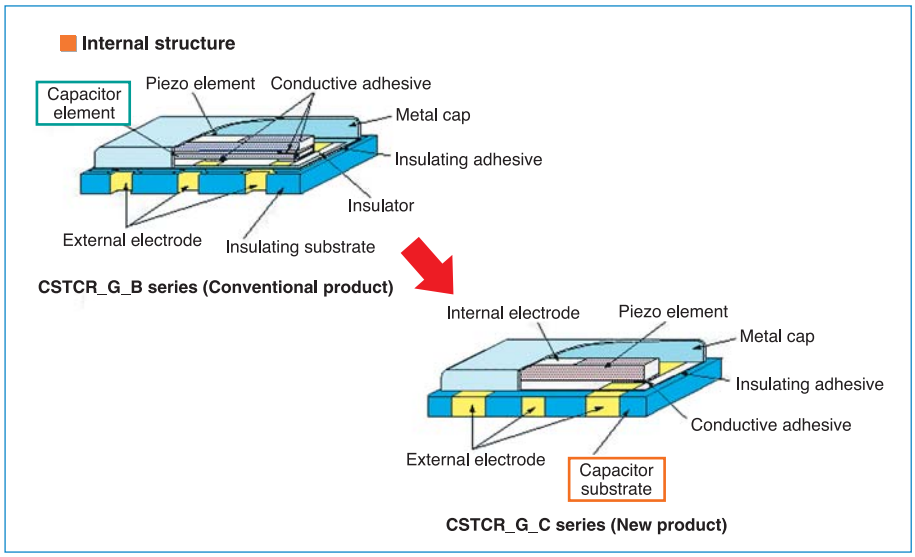

Fig. 4: CERALOCK product comparison

Advanced Resonators for FlexRay

The frequency tolerance required for car LAN like CAN-bus varies depending on each automotive manufacturer. The total frequency tolerance of ±0.27 percent cannot satisfy all manufacturers' requirements.

FlexRay for automotive applications as the next car LAN can be expected in the future. In this case, an even tighter frequency tolerance is demanded for the next-generation car LAN, FlexRay, as spread in automotive applications is expected to resonators used in FlexRay.

Murata will put in additional effort toward developing even tighter frequency tolerance resonators and supply easy-to-use products to the automotive market.

About This Article:

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