



# Murata's Portfolio of SAW Devices Suit Various Car Systems

The company makes available appropriate SAW devices for the implementation of remote keyless entry and tire pressure monitoring system in automobiles.

Significant improvements in road traffic safety, transportation efficiency, and comfort have been noted recently with the growing adoption of intelligent transport system (ITS) among vehicles. Furthermore, various system development projects directed toward the implementation of better functions of existing systems are moving forward, while new transport systems are emerging and are expected to be implemented in the near future that would result to new services.

In further pursuit of convenience and security, the percentage of remote keyless entry (RKE) system installation in automobiles is also increasing, and the provision of a spare key is becoming a standard feature. As automation technology continuously advances, it is now possible to provide new functions with high value-added like bi-directional communications between an automobile and a portable terminal used as key in the form of card or key holder. Moreover, it has become possible to lock and unlock vehicle doors without using a car key, and now a keyless system for ignition is

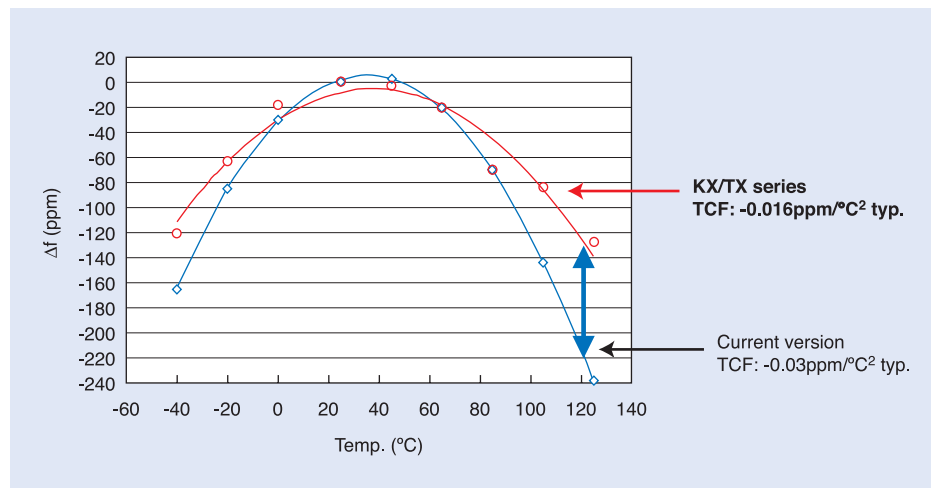


Fig. 2: Temperature characteristics of SAW resonators

also on its way to becoming a standard function.

As transmission rates become faster, it will also be possible to implement advanced security systems and to enable real-time confirmation of vehicle conditions. Functions like confirming the status of the tire pressure monitoring system (TPMS) using a key will also be common

in the future.

Car navigation systems are integrated with telematics systems, an in-vehicle service that provides various kinds of information. These integrated systems are provided with functions to obtain information on traffic congestion, to trace a stolen vehicle, or to report an emergency, in addition to the basic road guide functions. The car navigation system is expected to become a key feature of ITS down the road.

The integration of electronic toll collection (ETC) system on expressways with car navigation system is also being considered. When the Dedicated Short-Range Communication (DSRC) is put to practical use, the application of the ETC system would enable the automatic collection of parking fees as well as gas station charges or bills from drive-through, fast food restaurants. Various methods are being considered for using this system, including a service for providing traffic information and safety driving support.

The integration of more functions and features in an ITS would demand SAW

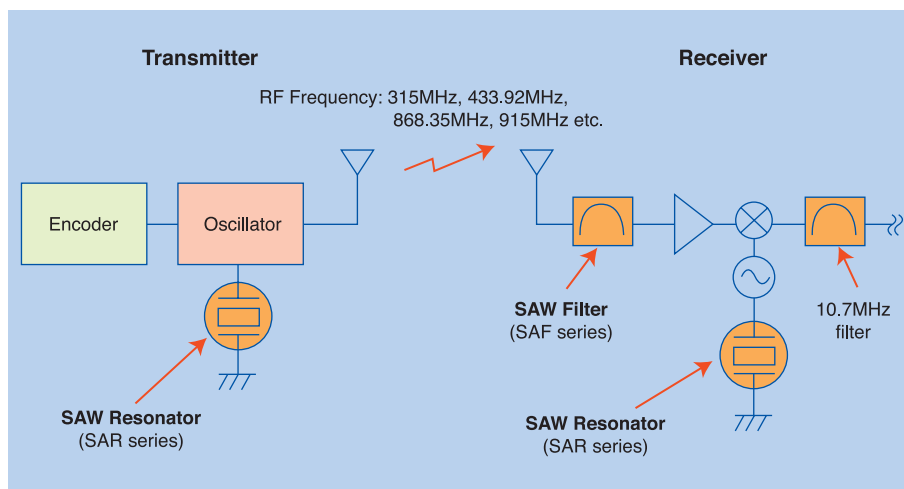
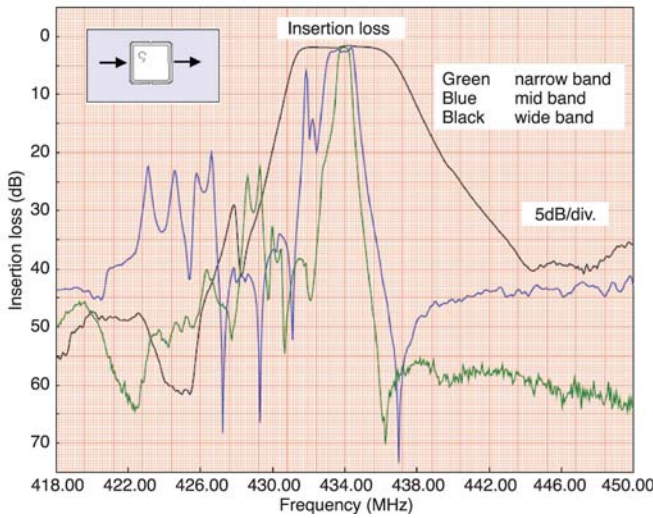
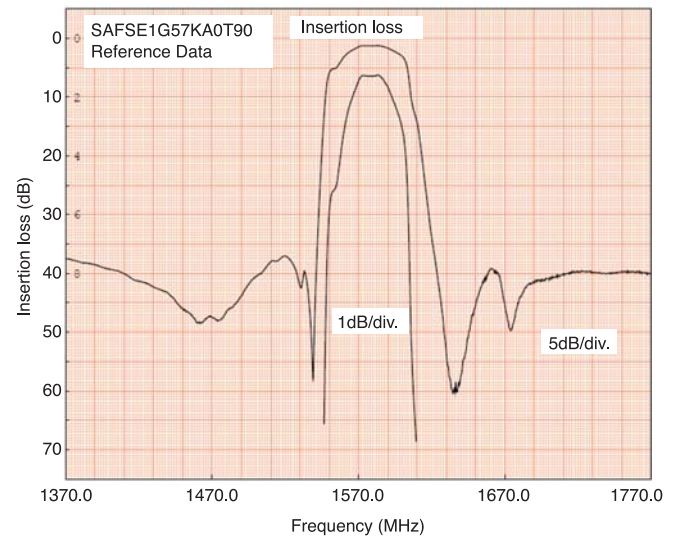


Fig. 1: Block diagram of a remote keyless entry system

**Enabling Car Technologies**



**Fig. 3: Typical characteristics of SAW filters used for RKE, TPMS (433.92MHz)**



**Fig. 4: Typical characteristics of GPS SAW filter**

devices that are capable of more diverse performance. Along this line, Murata Manufacturing Co., Ltd. endeavors to develop new products according to the demands of each system. The latest trends of SAW devices for vehicle installation are introduced below.

**SAW Resonators for RKE, TPMS**

SAW resonators are oscillators that use a SAW, and are capable of receiving and transmitting over a wide range of frequency from 300 to 800MHz band. These resonators exhibit high stability in all frequency, and make it possible to simplify the external components for oscillation circuits. Therefore, SAW resonators offer advantages like no circuit adjustments and low cost (See Fig. 1).

As the RKE system and the TPMS become highly functional, the demand leans toward the digitization of reception and transmission signals as well as the improvement of receiving sensitivity. Moreover, accuracy in higher frequencies and stable temperature characteristics are demanded for SAW resonators.

Murata makes available its SAW resonators - the SARCC\_KXD series for 300MHz band and the SARCC\_TXD for the 400MHz band. In the development of these products, the company adopted a new manufacturing process in order to achieve an initial tolerance level of  $\pm 50$ ppm, which is narrower than the conventional level of  $\pm 170$ ppm. This SAW resonator series (See Fig. 2) exhibits sta-

ble temperature characteristics with a typical temperature coefficient of  $-0.016$ ppm/sq.°C at 300MHz band, and features low resonance resistance of up to 1.5dB or  $20\Omega$ , or even less. At 315MHz, this  $3.0 \times 3.0 \times 1.15$ mm resonator series tips 1.0dB of resistance.

Murata also implemented optimal conditions during the construction process to provide very high reliability at an operating temperature range from  $-40$  to  $+125^\circ\text{C}$  as demanded by TPMS, and made available SARCC\_TX series for 300 and 400MHz band.

Some of the product's feature highlights include:

- Support narrow tolerance. Initial tolerance  $\pm 50$ ppm (300MHz and 400MHz band)
- Stable frequency characteristics. Temperature coefficient  $-0.016$ ppm/sq.°C typ. (300MHz band)
- Low resonance resistance. 1.5dB max. equal to  $20\Omega$  or less (1.0dB typ.: 315MHz)
- Small size.  $3.0 \times 3.0 \times 1.15$ mm (max.)
- High reliability. Guarantees operating range from  $-40$  to  $+125^\circ\text{C}$ .

**SAW Filters for RKE, TPMS**

SAW filters are installed in the front-end block of the RKE and TPMS receiving circuit for the 300MHz, 400MHz, and 800MHz bands in accordance with regional conditions. The SAW filter is also indispensable for improving the receiving sensitivity.

SAW filters are basically required to have low insertion loss and high attenu-

ation characteristics for the outside band. To improve the receiving sensitivity, which is considered most important for the receiving circuit, the narrowest band filter is generally required in order to eliminate interference waves.

Murata uses a quartz crystal substrate for narrow-band filters because this substrate has low temperature characteristics and has less temperature shift. Murata uses LT substrate for wideband filters to achieve low loss and a high attenuation amount.

On the other hand, a system that can receive multiple frequency signals is widely used as a common receiving circuit with TPMS or a combination system, and also as a countermeasure for RKE malfunctions. There is a market demand for filters with a midpoint passband to cover only the minimum required frequency band, and also for wideband filters with specifications to cover all frequency bands to be considered. Figure 3 shows the typical characteristics of SAW filters used for RKE and TPMS with wideband, middle band, and narrowband design.

Murata has introduced SAFDC series filters that comply with all frequencies used in Japan, as well as in the North American and European regions in package size of up to  $3.0 \times 3.0 \times 1.15$ mm, which is among the smallest in the industry.

Furthermore, the pin assignment of Murata's SAW filters is standard regardless of frequency and bandwidth so

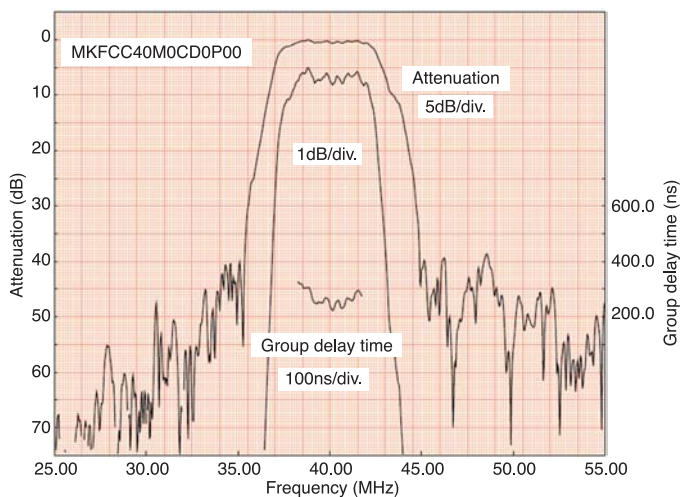


Fig. 5: Typical characteristics of BGS filters used for ETC, DSRC

that filter replacement becomes easy, and circuit manufacturers can use common substrate regardless of the country where the products are used. This standard arrangement will contribute to cost reduction.

The SAFDC series SAW filters exhibits a typical loss of 1.2dB for the 300MHz wideband design, using the LT substrate. Available in wide product lineup with big bandwidth variations, this SAW filter series is packed in  $3.0 \times 3.0 \times 1.15\text{mm}$ , and ensure high reliability with a guaranteed operating temperature range from  $-40$  to  $+125^\circ\text{C}$ .

Below are the series' highlight features:

- Wide range product lineup (Wide bandwidth variations)
- Low, loss, 1.2dB typ. (300MHz wideband design, LT substrate is used)
- Small size.  $3.0 \times 3.0 \times 1.15\text{mm}$
- High reliability. Guarantees operating temperature range from  $-40$  to  $+125^\circ\text{C}$ .

### SAW Filters for Car Navigation System

The car navigation system is considered to be a key component for an ITS and offers a number of potential prospects for integration with various systems. As there are various interference waves, there is a demand for even lower insertion loss and higher attenuation amount for SAW filters to ensure the receiving sensitivity of Global Positioning System (GPS).

When a car navigation system is integrated with telematics, for example, the SAW filter is required to eliminate the in-

terference waves produced by the transmission waves of telematics or the cellular phone system.

Murata has introduced a GPS radio frequency (RF) filter (See Fig. 4) that features a lower insertion loss and high attenuation amount, using the company's original electrode design technology and packaging technology. Because this fil-

ter has to be installed in vehicles, the GPS RF filter comes in a  $2.5 \times 2.0 \times 1.0\text{mm}$ , hermetically sealed ceramic package with superior liquid sealing, placing emphasis on reliability.

On the other hand, the number of cellular phones with built-in GPS is increasing. Thus, Murata has released GPS SAW filters targeted at the cellular phone market that are available in the industry's smallest size of  $1.35 \times 1.05 \times 0.6\text{mm}$  with a resin-molded chip-scale package (CSP) structure of resin. The resin CSP structured GPS SAW filters may be used also for car navigation systems, although that depends on the level of reliability required as a navigation system.

### 40MHz IF Filters for ETC, DSRC

An ETC allows toll fees to be collected without stopping a vehicle at the tollgate of expressway. This system is very convenient as well as environment friendly. For example, it can ease traffic congestion, reduce noise or gas emission near tollgates, and reduce the fuel consumption amount. Since the start of the ETC service in 2001 in Japan, ETC gates have been installed at almost all interchanges. Gates called smart ICs are also installed in several service areas and parking areas. Meanwhile, the ETC service in Korea that started last year, uses the same system as in Japan.

Murata has introduced a small-sized 40MHz intermediate frequency (IF) filter for the ETC receiver unit, featuring a maximum dimensions of  $3.0 \times 3.0 \times$

$1.15\text{mm}$ . This product uses the Bluestein-Gulyaev-Shimizu (BGS) wave, which is one of the transversal waves or shear horizontal (SH) component of BGS wave with SAW transmission characteristics (See Fig. 5).

The BGS wave features a characteristic that produces excitation by polarizing a piezoelectric ceramic substrate in the direction of the plane, and a characteristic that produces a complete reflection, while the vibration modes on the end faces of the substrate remain the same. Therefore, because Murata's BGS filters do not need to form a reflector in the filter, which is required for conventional filters, the size can be reduced.

There are various plans for wide-range application of the DSRC, which helped push the ETC system forward. Studies are being carried out on the use of 40MHz IF filters also for the ETC system.

### Future Direction

The number of elderly drivers is increasing with the rise in car ownership. As a result, there is a demand for cars with rich features and functions to promote comfort and to avoid problems like traffic accidents, severe traffic congestion, and environmental issues. The progress of car electronics is crucial for the construction of ITS through the connection and integration of people, road, and vehicle with the exchange of information. SAW devices are indispensable to this progress.

Murata's SAW devices have acquired the TS16949 standards, which is related to the quality control system, and are available in a wide-range product lineup for the vehicle-installed component market.

Murata will continue with its effort for product improvement by offering optimal SAW devices that satisfy various requirements for quality and management in addition to improving the characteristics and shapes demanded in the car electronics market.

### About This Article:

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