# SAW Devices by Murata Keep Eye on Mobile Phone Trends

*The company has combined novel technologies to its design and manufacturing techniques to develop compact SAW duplexers with favorable characteristics.*

The integration of a wide range of functions characterizes today's mobile phones. Among these functions include, camera, Global Positioning Systems (GPS) navigation, mobile TV broadcasting like the one-seg system in Japan, short-range communication like the Bluetooth technology, and mobile wallet using FeliCa IC technology. Apart from these diverse applications, the designs of mobile handset, ranging from slim to slide types, have also become varied to accommodate the demand of consumers. The use of more compact and high-performance electronic components provides support to realize these trendy features.

Specifically, high-frequency filters, which enable stable communications by picking only the necessary signals from radio waves received by an antenna, are indispensable electronic component for a mobile phone. The surface acoustic wave (SAW) device is one of the electronic components that have contributed to the evolution of mobile phones in terms of size reduction, expansion of functionality, and increase in specification by taking advantage of the small size and high-selectivity feature of a SAW device.

Mobile phones are evolving even further, and the demand for development of technologies, such as diversity and multiple-input, multiple-output (MIMO) technologies that can achieve better communication quality and higher communication speed is increasing. The development of radio frequency (RF) circuits with multi-band and multi-mode support is moving ahead. The increase in the number of mobile phone subscribers in emerging industrial countries, such as China and India, also drives the demand growth for SAW devices. China, in particular, adopts its own communication system for mobile phones.

For these reasons, the number of components mounted on an RF circuit in a single mobile phone continues to increase as expected. Murata Manufacturing Co., Ltd. is working on the development of SAW devices for mobile phones in order to meet the various needs mentioned above. The latest development trends in SAW devices for mobile phone applications are described below.

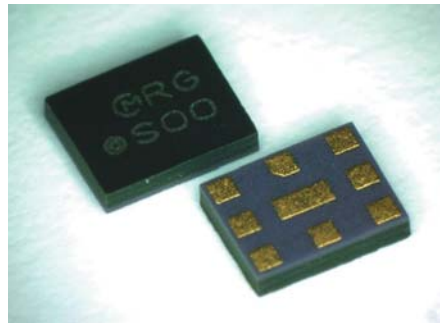


**Fig. 1: Murata's Band 5 SAW duplexer measuring 2.5 × 2.0 × 0.55mm**

## Balanced Type SAW Duplexer

The duplexer prevents the flow of signals from the transmission circuit to the receiving circuit by simultaneously filtering the transmission signals, or the signals that flow from the transmission circuit to the antenna circuit, and the receiving signals, or the signals that flow from the antenna circuit to the receiving circuit, that have different frequency bands in each frequency bandwidth. The SAW duplexer performs a duplexer function to simultaneously transmit and receive signals using the SAW principle. It is a product that takes advantage of the small size and high-selectivity feature of a SAW device.

An RFIC used for mobile phone converts the signals from a baseband into transmission signals and also converts the received signals into signals that can be processed in the baseband, and nowadays, high-performance RFIC for mobile phones are widely available. An RFIC that does not need the conventionally required inter-stage filter for receiving signals is becoming common. When the inter-stage filter for receiving signals is used, an unbalanced duplexer is required for the receiving port. On the other hand, when the inter-stage filter for the receiving signals is not used, a balanced duplexer is required for the receiving port.

Murata offers a balanced type SAW duplexer with highly favorable characteristics. This product has been developed using the company's low-loss technology, high-selectivity technology, low temperature coefficient technology, and broadband implementation technology.

### *Band 5 SAW duplexer*

The Band 5 SAW duplexer, as introduced below, is an example of a balanced type SAW duplexer. To improve the receiver sensitivity of wireless communications and to maintain a stable communication quality, low insertion loss and high attenuation characteristics are demanded of a duplexer. In addition, high isolation characteristics are also required of the duplexer in order to prevent the

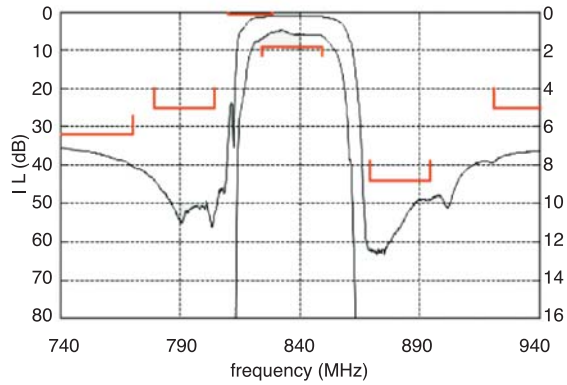


**Fig. 2: Transmission characteristics of Band 5 balanced SAW duplexer**

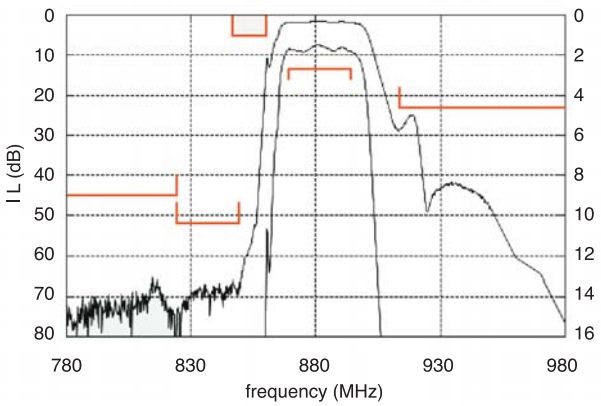


**Fig. 3: Reception characteristics of Band 5 balanced SAW duplexer**

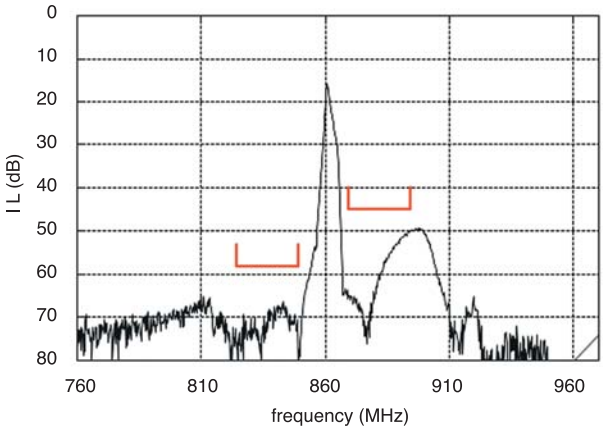


**Fig. 4: Isolation characteristics of Band 5 balanced SAW duplexer**

flow of signals from the transmission circuit to the receiving circuit.

Murata mass produces a SAW duplexer with outside dimensions of 2.5 × 2.0 × 0.55mm (See Fig. 1) and achieves favorable characteristics, including: 1) a typical in-band insertion loss of 1.4dB on the transmission frequency band and 1.8dB on the receiver frequency band; and 2) a typical attenuation of 67dB on the transmission frequency band and 49dB on the receiver frequency band in terms of isolating the transmission circuit from the receiving circuit (See Figs. 2, 3 and 4).

## Dual SAW Filter for TD-SCDMA

The Time Division Synchronous Code Division Multiple Access (TD-SCDMA) is the air interface specification pursued by China as one of the communication methods of third-generation mobile phones. The number of mobile phone subscribers in China has steadily increased over the years, reaching 770 million subscribers in April 2010. China Mobile Limited has the largest number of subscribers and is pouring its efforts into widespread adoption of TD-SCDMA.

An increase in the demand for SAW filters for TD-SCDMA application is highly expected. The notable characteristic of TD-SCDMA is its adoption of a technique to switch transmission and receiver by time division. Although TD-SCDMA does not require a duplexer, it requires filters for transmission and receiver.

Two frequency bands are assigned for TD-SCDMA. The two frequency bands through which the traffic passes are between 1880MHz and 1920MHz and between 2010MHz and 2025MHz. SAW filters are installed in mobile phones for transmission and receiver on these two bands. At present, a single-type SAW filter is used for the respective band, in this case two single filters are used, one each for transmission and receiver.

Murata has developed a dual SAW filter (See Fig. 5) for TD-SCDMA application and has started its mass production. This dual SAW filter incorporates two single filter functions in a single package measuring 1.5 × 1.1 × 0.5mm to reduce the mounting area on a circuit board. The reduction of the mounting area is not only contributed by scaling down the size of the component, but by the high functionality of the filter through the integration of peripheral components.

The company has made full use of its original technologies, including 1-in/2-out and 1-in/4-out products to develop this dual filter with a unified unbalanced input port. The number of ports of a switch to be connected to the filter or the number of switches can be reduced because of the unified unbalanced ports on the input side.

The newly developed prototype 1-in/2-out dual SAW filter for TD-SCDMA application is presented as an example. This dual SAW filter offers favorable characteristics (See Figs. 6 and 7), including a typical insertion loss of 1.6dB on the band between 1880MHz and 1920MHz and 1.8dB on the band between 2010MHz and 2025MHz.

## Future Product Directions

The demand for duplexers that can be used with various bands or duplexers that support different frequency bands and filters are continuously rising in order to keep up with the mobile phone's requirements for diversification and multi-band support. Murata plans to expand its lineup of SAW duplexers and SAW filters with outstanding characteristics, which can be used with various bands, by adopting the appropriate design technologies for the characteristics required for each band.

To achieve further size reduction of high-frequency wireless communication circuits, efforts to develop a modular design to incorporate multiple peripheral circuit components, including SAW duplexers and SAW filters into a single package are gaining momentum. Additionally, demands for profile reduction and measures for achieving higher reliability are

*(Continued on page 41)*

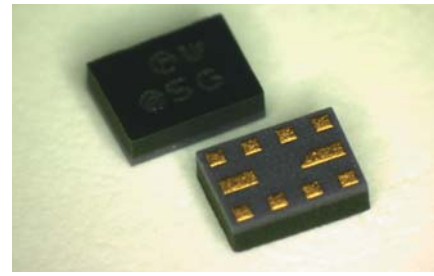

**Fig. 5: Murata's dual SAW filter measuring 1.5 × 1.1 × 0.5mm**

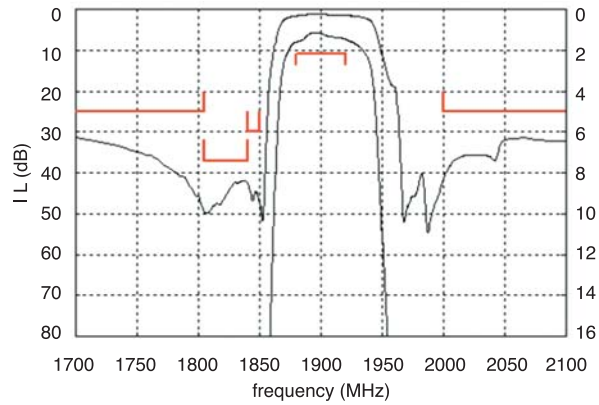


**Fig. 6: Characteristics of frequency between 1880 and 1920MHz**

# SAW Devices by Murata Keep Eye on Mobile…

*(Continued from page 37)*

also emerging. In order to meet these demands, Murata has already commercialized a compact filter with outside dimensions of 0.8 × 0.6mm that uses Murata's BPAW boundary elastic wave or Buried Propagating layer Acoustic Wave filter as another solution for making smaller filters. The BPAW filter has a planer type or flat plate type laminated structure that does not require formation of an air-sealing hollow structure. This makes the filter suitable for size and profile reduction and becomes highly reliable. Murata intends to meet technological demands, such as favorable characteristics, size and profile reduction, and higher reliability by selecting and using optimal technologies, including various device design technologies and the company's original structure and manufacturing technologies.

Mobile phones continue to evolve from 3G mobile phones through 3.9-generation (3.9G) mobile phones to fourth-generation (4G) mobile phones with an aim toward even faster communications. Multi-band-compliant mobile phones are expected to move ahead as the frequency bands used for mobile phones become even higher. Murata will pursue expanding the application areas of filter devices and endeavor to resolve relevant technological issues in order to contribute to the development of wireless communications technology.

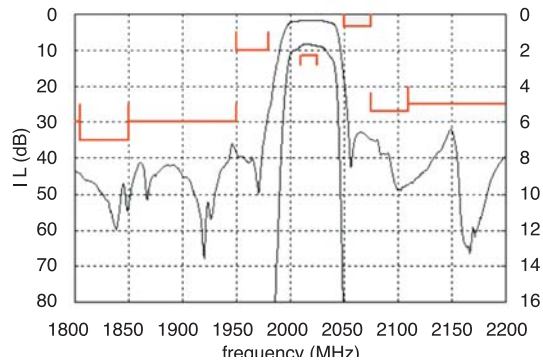


**Fig. 7: Characteristics of frequency between 2010 and 2025MHz**

## About this Article:

*The author, Kenta Kurahashi, is from the Product Engineering Section 1, Microwave Products Department 1, Kanazawa Murata Manufacturing Co., Ltd.*