Technology Focus

Murata Amplifies Radio Wave Isolation in SAW Devices

Today's mobile handsets have come to carry a wide variety of features, including camera, music player, Global Positioning System (GPS), digital terrestrial mobile broadcasting reception like one-segment system in Japan, and Bluetooth technology, and applications have been remarkably diversifying. In addition to mobile phone functionality, consumers needs have become more and more diverse in terms of design features as represented by the growing popularity of ultra thin design terminals.

As mobile phones have become increasingly downsized, multifunctional and diversified, one of the technologies that underpinned this trend is the significant miniaturization and increased functionalities of electronic parts and components. The high-frequency filter, which sorts out radio waves received by an antenna and get only what is needed in order to make stable communications possible, is an indispensable electronic component for a mobile phone. Among them, the surface acoustic wave (SAW) filter is one of the electronic components that have contributed to the evolution of mobile phones by taking advantage of its characteristics, such as small size and high selectivity.

The main applications of SAW devices, which are used for mobile phones, include not only Code Division Multiple Access (CDMA) protocol-compliant duplexers, interstage filters for transmission and reception, and Global System for Mobile Communications (GSM) protocol-compliant top filters for reception, but also those that contribute to making mobile phones increasingly multifunctional, like GPS, Wi-Fi, Bluetooth and one-segment broadcasting.

Murata Manufacturing Co., Ltd. works on developing new products for a wide variety of applications for mobile phones. The most recent trends in SAW devices for mobile phone applications are described below.

Duplexers

The CDMA protocol requires a duplexer for conducting transmission and reception simultaneously. The duplexer is a high-frequency component that allows the transmitting filter and the receiving filter to be shared using a single antenna by making use of a branch circuit. The most important feature required for a duplexer is to ensure an adequate isolation, a yardstick that shows how much they are electrically separated from each other, between the transmission and the reception. The second most important feature next to ensuring isolation characteristics needed for actual use is to lower losses of the transmission and reception filters.

As an example, transmission and isolation characteristics of a Band 5 or 800MHz band-enabled duplexer with a product size of 2.5 × 2.0 × 0.6mm are shown in Fig. 1. Generally, there is a trade-off between isolation and loss of filter characteristics. However, this product achieves a typical transmission isolation as high as 60dB with reception loss of around 1.8dB despite the trade-off problem.

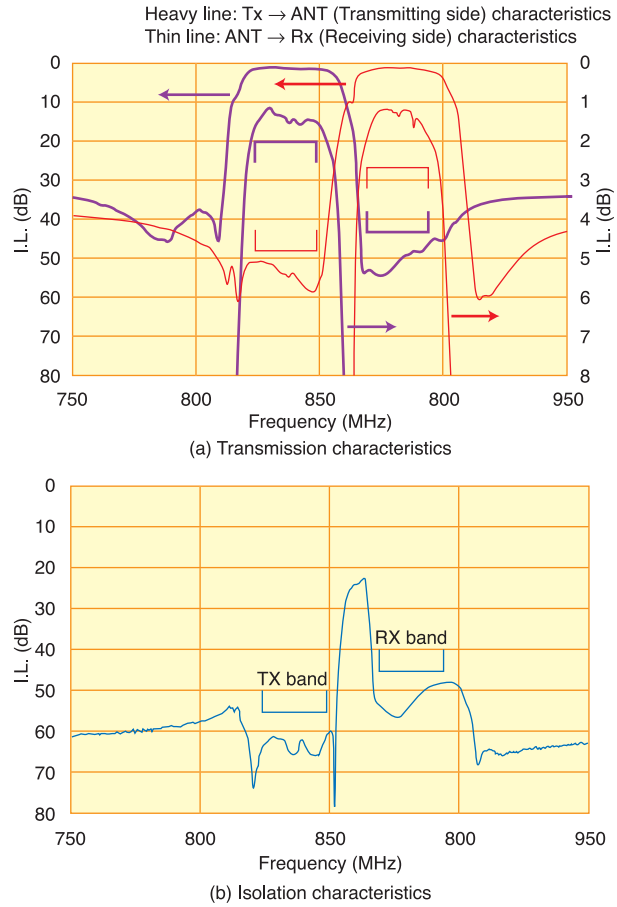

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Fig. 1: Electrical characteristics of W-CDMA Band 5 (800 MHz band)-compliant duplexer

As a second example, Fig. 2 shows the characteristics of a Band 1 or 2GHz band-enabled duplexer that measures 3.0 × 2.5 × 1.1mm. Though it had traditionally been difficult to reduce losses of SAW devices for Band 1 or 2GHz band, Murata Manufacturing introduced a new proprietary design technology to realize filter characteristics with extremely low losses, that is, a typical transmission loss of 1.4dB and a typical reception loss of 1.8dB, while ensuing isolation characteristics needed for actual use. As the loss becomes comparable to that of a duplexer using a dielectric, which has traditionally been predominant for Band 1 or 2GHz band, could be achieved with SAW devices, they have replaced dielectric to become the mainstream duplexers.

Murata Manufacturing is working on expanding its lineup of SAW duplexers that can handle a wide range of bands as prescribed by 3GPP or the 3rd Generation Partnership Project standards by making full use of its high-isolation and low-loss design technologies. In addition, given that new bands compliant with next-generation high-speed telecommunications will be standardized, the company intends to support them aggressively. Simultane-

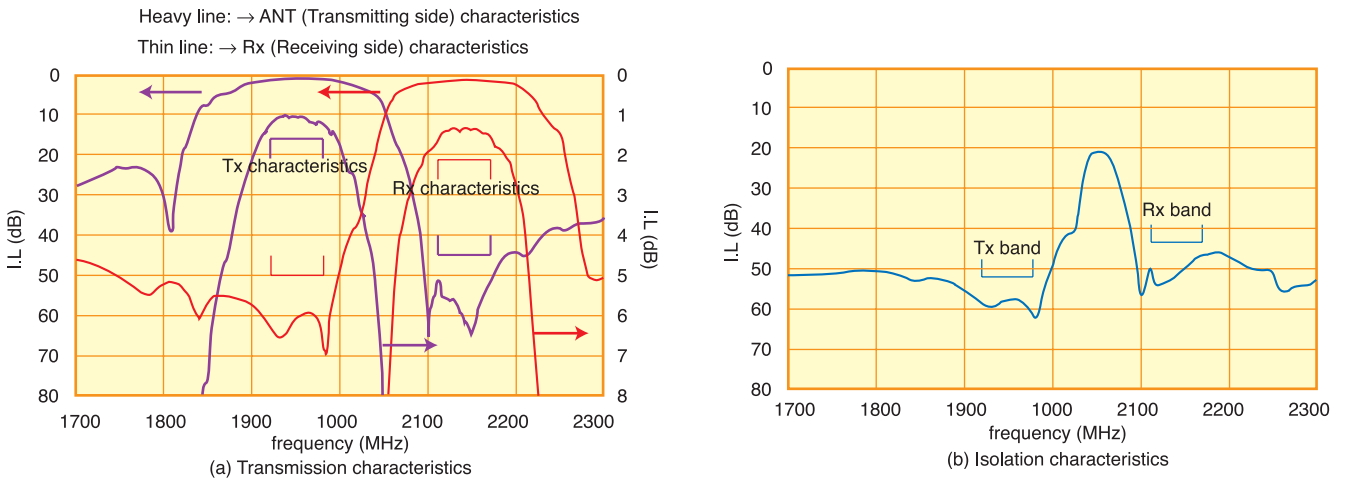

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Fig. 2: Electrical characteristics of W-CDMA BAND 1 (2GHz band)-compliant duplexer

ously, the company will develop even smaller duplexes, and eventually release in the market a product type compliant with balanced output on the reception side, whose market demand is on the rise.

Filters

There are CDMA-compliant interstage transmitting and receiving filters, and GSM-compliant top receiving filters as SAW filters to be applied to high-frequency wireless communication circuits of mobile phones.

Murata Manufacturing has achieved low loss and high attenuation in terms of electrical characteristics to come up with a wide variety of compact and low profile products in an effort to meet the needs for various circuit configurations. In order to contribute to the reduction of mounting area on a circuit substrate amid multiband trends for wireless communication circuits, the company has commercialized a dual filter with product size of $1.8 \times 1.35 \times 0.5$mm, in which single filters for two bands measuring $1.35 \times 1.05 \times 0.5$mm are integrated into one. In addition to this, the company has come up with more unique products by making full use of its original technical expertise, including a 1-in/4-out product, that is, a dual filter whose input port is unified, and a 2-in/2-out product whose balanced output port is unified, as well. By unifying the ports on the input side, the number of ports of the switch to be connected to the filter can be reduced. Moreover, by unifying the balanced ports on the output side, the number of ports of the high-frequency IC to be connected to the filter can be reduced (See Fig. 3). The integration of the ports as mentioned above was made possible by the company's ingenuity in designing SAW filters in terms of impedance and phase alignment. Thanks to these filters, it has become possible to contribute to simplifying peripheral circuits or to downsizing the whole circuit for high-frequency wireless communication circuits, which have become increasingly multiband-compliant.

Murata Manufacturing aims to scale down the sizes of both single and dual filters even further and increase their performance, while expanding its lineup of products featuring unified input or output port capabilities.

Filters Fit for Different Areas

As mobile phones become multifunctional, an increasing number of models are outfitted with GPS, Bluetooth and Wi-Fi capabilities for short-distance wireless telecommunications, and one-segment broadcasting reception capabilities. As these applications are mounted on a single mobile terminal in a combined manner, it is essential to assess interference between waves transmitted and received by a mobile phone and communication waves of various applications. For this reason, a filter is needed to let radio waves of a mobile phone pass through without affecting the necessary band of each application, and get rid of them. Radio waves used by transmitting and receiving of a mobile phone have come to comply with multiple bands, and as frequency bands for transmitting and receiving of a mobile phone exist in the neighborhood of the necessary band of each application, precipitous filter characteristics are required. In addition, large attenuation characteristics are desirable for a frequency band for transmitting and receiving of a mobile phone, which is away from the necessary band. In order to satisfy these needs, Murata Manufacturing has made available lineups of SAW filters for each application.

For example, Fig. 4 shows the electrical characteristics of a top filter that mea-

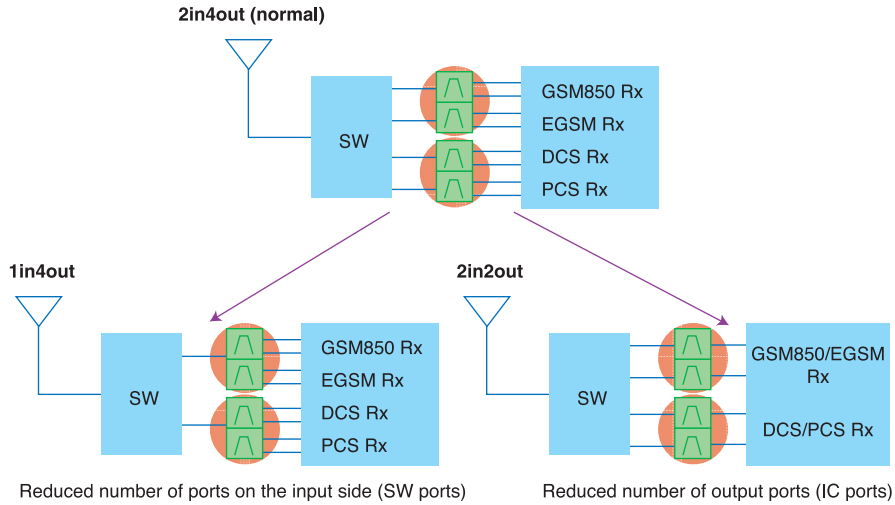

Fig. 3: Example of an input/output port configuration of a dual filter

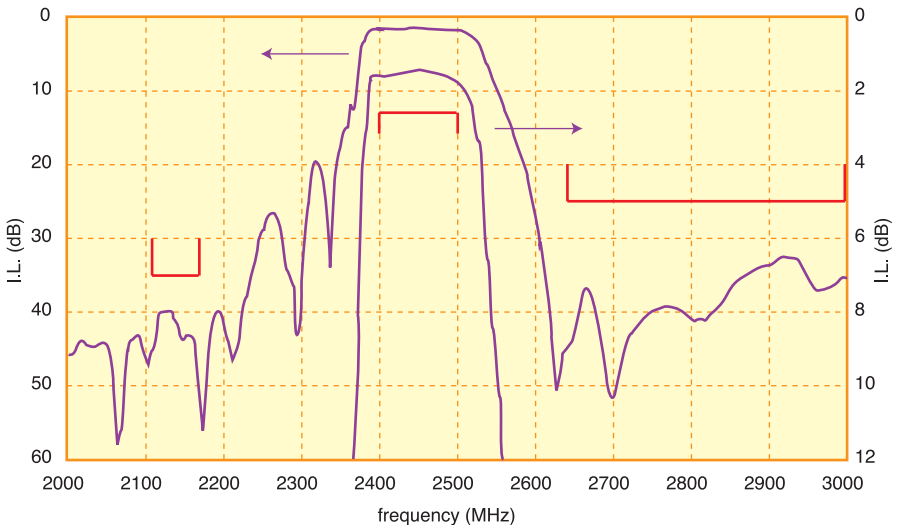

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Fig. 4: Electrical characteristics of a top filter for Wi-Fi

sures 1.35 × 1.05 × 0.5mm for Wi-Fi. There is a reception band for Band 1 or 2GHz band of a mobile phone in the low-pass range of the Wi-Fi band or 2.5GHz band. In order to prevent them from interfering with each other, large attenuation characteristics are called for.

In order to realize this, Murata Manufacturing applied the high-attenuation design method, which is normally employed for interstage filters. As the top filter for Wi-Fi is designed for both transmitting and receiving, power durability is required against the transmitted power. Under the conventional design method, it was difficult to ensure power durability. Murata Manufacturing has introduced its unique high-attenuation design technology with high power durability, compliant at 24dBm, and yet achieving top-rated low-loss and high-attenuation characteristics.

In the future, the company will employ this design technology to work on expanding its lineup of top filters for multiple-input multiple-output (MIMO) wireless telecommunication technology, which is applied to high-speed telecommunications.

Future Direction

The company has set out specific development areas in reference to its future products.

In order to make mobile phones even smaller and to simplify their design, moves are gaining momentum to incorporate high-frequency passive components into a single package. With this as a backdrop, needs for transfer molds and lower height are apparent. In order to meet these needs, Murata Manufacturing has brought out a new device using Buried Propagating layer Acoustic Wave (BPAW) to the market. The company intends to keep developing BPAW devices along with SAW devices in a bid to come out with products intended for transfer mold modularization and discrete semiconductors.

The performance of high-frequency ICs and high-frequency components around ICs has improved, which has given rise to needs for balanced output duplexers on the receiving end. Murata Manufacturing will apply its expertise on designing balance-type filters, which has been developed to date for the interstage filter area, to duplexers, and also in an effort to expand its range of products compliant with various bands.

There is no end in sight to the evolution of mobile phones. The actual progression from today's third-generation (3G) mobile phones to fourth-generation (4G) mobile phones through 3.9-generation (3.9G) is expected with the demand for higher-speed communications. When switching to 3.9G or 4G mobile phones, frequency bands to be used for mobile phones will most likely become even higher. With an eye toward this trend, Murata will pursue the development using SAW devices, and take it as one of the key technical challenges down the road.

Note: *The Bluetooth trademarks are owned by Bluetooth SIG, Inc., United States of America.*

About This Article:

The author of this article, Toshishige Koreeda, works in the Product Engineering Section 1, Microwave Products Department 1 at Kanazawa Murata Manufacturing Co., Ltd.