Technology Focus

Murata's Compact Isolator Keeps Track of Mobile Phone Progress

The global mobile communications market today has seen a remarkable technical advancements from third-generation (3G) communications systems, such as Wideband Code Division Multiple Access (WCDMA) and CDMA2000, to 3.5G technology like High-Speed Downlink Packet Access (HSDPA) and CDMA2000 1x EV-DO, and to the even more advanced 3.9G Long Term Evolution (LTE) technology. With the adoption of such highly advanced systems, today's cellular phones now feature faster transmission speeds and increased number of functions. Consequently, the number of components installed in mobile phones has increased along with an increase in current consumption. The growing number of frequency bands being used by mobile phones is also becoming a trend along with the rapidly increasing subscribers and the rising demand for international roaming. Amid these circumstances, there has been an increasing need for smaller and lighter components with higher performance and feature lower current consumption to configure the radio frequency (RF) circuits being used in wireless communications.

To meet such demands, Murata Manufacturing Co., Ltd. has introduced one of the world's smallest 2.0sq.mm isolator called the CEG23 Series. The newly commercialized CEG23 Series isolators offer a 56 percent reduction in size from the company's conventional product. The series can be adapted to frequencies between 700MHz and 2GHz, and is suitable for a wide-range of mobile standards, such as Universal Mobile Telecommunication Service (UMTS) and CDMA.

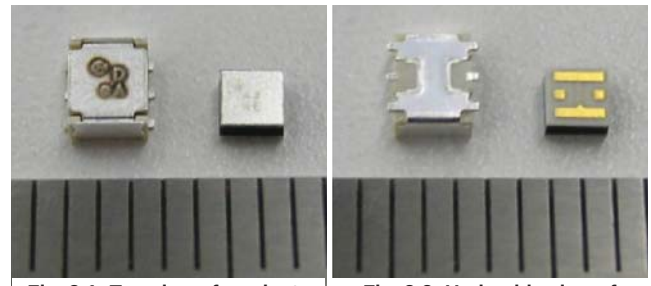

Fig. 2-1: Top view of products (left: conventional product, right: CEG23 Series)

Fig. 2-2: Underside view of products (left: conventional product, right: CEG23 Series)

Fig. 2: Outside appearance of the CEG23 Series isolator

Functions of an Isolator

Isolators are devices that pass signals in the forward direction, but block signals in the reverse direction. Isolators are used in the RF circuit of mobile phones. Fig. 1 shows the block diagram of a standard RF circuit.

When a human body is close to a mobile phone antenna, it causes the antenna's impedance to fluctuate significantly. When this impedance fluctuation occurs, a portion of the transmission power amplifier output signals bounces off the antenna and is sent back to the power amplifier. As the signals bounce back, problems such as a drop in the power amplifier's operating efficiency or the generation of unwanted signals like adjacent channel interference waves arise. If an isolator is installed in the output side of the power amplifier, it absorbs the signals that are bounced back from the antenna, and thereby reduces the fluctuations of the effective load at the power amplifier's output side. In other words, the isolator serves as an impedance matching device for the power amplifier and prevents a drop in the power amplifier's operating efficiency, reduces current consumption, and minimizes the degradation of the continuous talking time on a mobile phone. The isolator can also minimize the adjacent channel leak power ratio (ACPR), which can improve the quality of communications quality of a mobile phone.

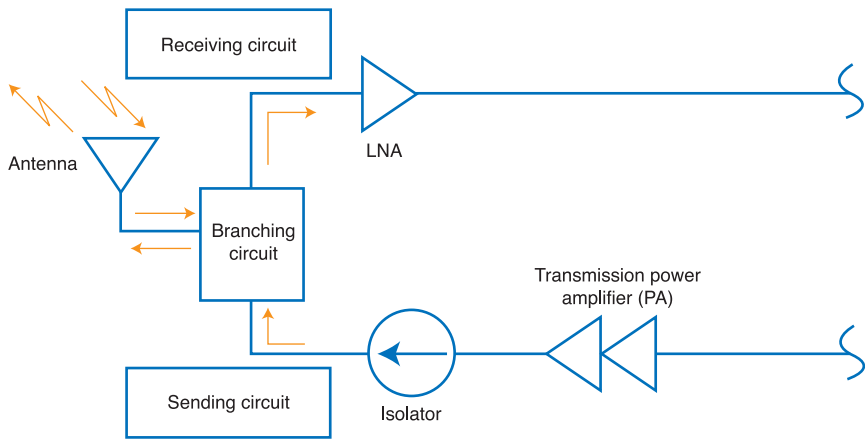

Fig. 1: Radio frequency circuit block diagram

Product Specifications

Profile

The CEG23 Series has a footprint size of 2.0 × 2.0mm. In comparison with the company's conventional 3.2 × 2.5mm product, the CEG23 Series isolators contribute significantly to the space-saving design of an RF circuit block. As shown in Fig. 2-2, the CEG23 Series isolators are equipped with a land grid array terminal, which unlike the terminal of a conventional product does not protrude outside the product, and thus reduces the mounting space. The CEG23 Series isolators have a maximum height of 1.0mm whereas the height of a conventional product is 1.2mm. Therefore, the CEG23 Series makes it possible to construct a lower-profile RF circuit, which in turn can reduce the profile of a mobile phone. The weight of the CEG23 Series is 0.013g, which is less than half the conventional product's weight of 0.034g. As a result, the CEG23 Series can also reduce the

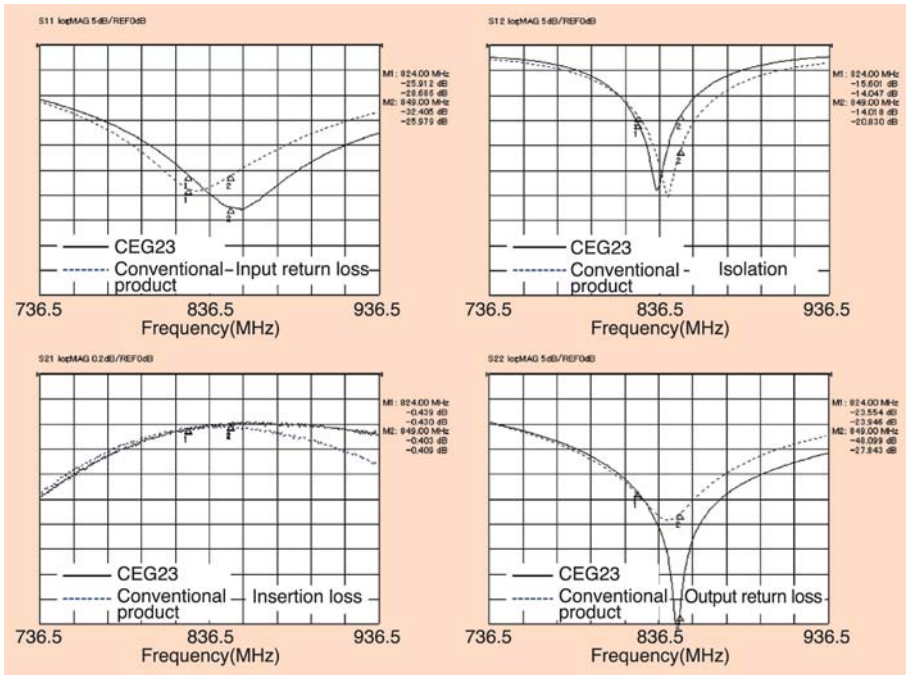

Fig. 3: Comparison of the electrical characteristics of an 800MHz-band

weight of mobile phones.

With a dramatic reduction in the footprint size and height, the CEG23 Series isolators promise a 56 percent reduction in volume from the company's conventional product in order to contribute to size and weight reduction of mobile phones. Fig. 2 shows the company's conventional product and the newly commercialized CEG23 Series product.

Electrical Characteristics

Figs. 3 and 4 give a comparison of the electrical characteristics between the CEG23 Series and a conventional products. Fig. 3 compares the electrical characteristics for the 800MHz band and Fig. 4 compares the characteristics for the 2GHz band.

The 800MHz-band CEG23 isolator in the 824 to 849MHz frequency range at room temperature has an insertion loss of 0.55dB or less, an isolation of 12.0dB or more, an input voltage standing wave ratio (VSWR) of 1.35 or less, which is equal to input return loss of 16.5dB or more, and an output VSWR of 1.50 or less, which is equal to an output return loss of 13.9dB or more. As shown in Fig. 3, the 800MHz-band CEG23 offers a performance value equal to that of a conventional product.

The relationship between a return loss and VSWR can be expressed by the following formula:

$$Return\ loss\ [dB] = 20 \times \log\ ((VSWR + 1) / (VSWR - 1))$$

The 2GHz-band CEG23 isolator in the frequency range of 1,920 to 1,980MHz at room temperature features an insertion loss of 0.55dB or less, an isolation of 12.0dB or more, an input VSWR of 1.35 or less, which is equal to input return loss of 16.5dB or more, and an output VSWR of 1.40 or less, which is equal to an output return loss of 15.5dB or more. As shown in Fig. 4, the 2GHz-band CEG23 offers a performance value equal to that of a conventional product.

In particular, the insertion loss of the CEG23 Series frequency characteristics tends to be broader than that of a conventional product. Therefore, the characteristics of the CEG23 Series are more suitable for broadband than a conventional product.

Structure

Fig. 5 shows the disassembly structural diagrams of the CEG23 Series and a conventional product. Basically, the CEG23 Series has three modifications from the conventional product.

The first modification was aimed at improving the characteristics. The conventional product has a flat inductor structure wherein the electrode is formed on one side of a ferrite. The CEG23 Series is equipped with a 3D inductor with a wire-wound structure that is connected via a through hole to the electrodes formed on both sides of the ferrite. The formation of electrodes on both sides of the ferrite in this manner makes it possible to maintain the inductance required for a compact ferrite, as well as to realize a high Q value. As a result, the compact CEG23 Series can achieve the same level of characteristics as a conventional product, even though the CEG23 isolator is smaller.

The second modification was aimed at reducing the price and size. The CEG23 Series does not require the casing used for a conventional product because the

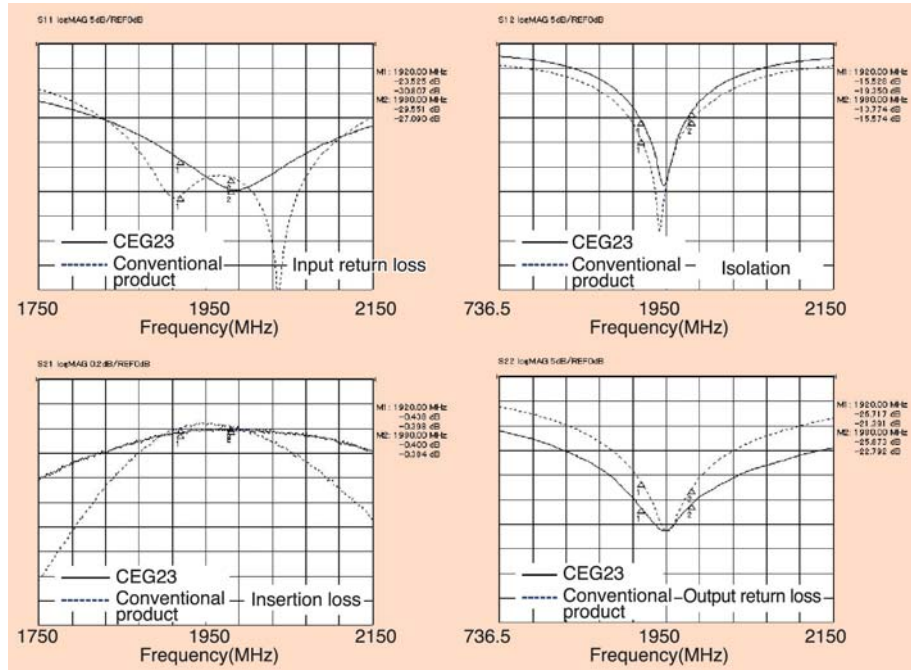

Fig. 4: Comparison of the electrical characteristics of a 2GHz-band isolator

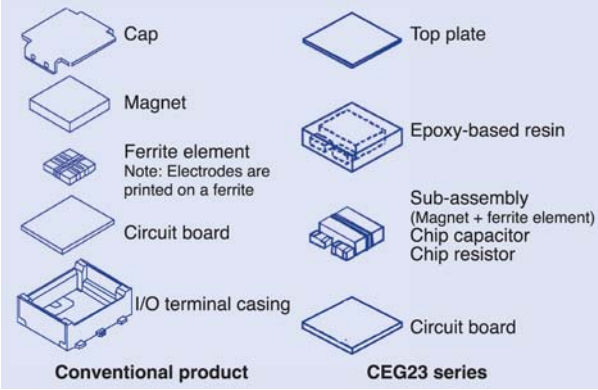

Fig. 5: Disassembly structural diagram of the CEG23 Series and conventional isolators (left: conventional product, right: CEG23 Series)

electrodes of the mounting terminal are formed directly on a ceramic circuit board, and the yoke that configures the magnetic circuit is installed on the top plate. This new design lowers the isolator's price and size with the reduction in material costs.

The third modification was aimed at providing higher reliability. The CEG23 Series has a resin sealer structure that uses an epoxy-based resin. This resin sealer structure assures the reliability of the internal connections between mounted components, and thus improves the reliability of the new product. An increasing number of devices now use resin on a part or on the entire parts of a mounting board after the product is mounted. The resin sealer structure of the CEG23 Series prevents any intrusion of resin into the isolator. This means that there is no risk of change in the CEG23 Series' characteristics because of resin application.

Conclusion

Murata has brought to the market one of the world's smallest isolator, the 2.0 × 2.0mm CEG23 Series with a maximum height of 1.0mm. The CEG23 Series offers the same-level characteristics as conventional products and has a high-reliability structure and low-cost manufacturing method. The CEG23 Series isolators can adapt to frequencies between 700MHz and 2GHz, and can be used in a wide-range of wireless equipment compatible with various communication systems, such as UMTS and CDMA. The application frequencies of the CEG23 Series have been expanded to include new markets that are under development for the product's future introduction, while the lineup is being improved.

As the wireless communication devices market shift toward multi-band mobile phones, there is a severe and growing demand for size and cost reduction among isolators with optimal characteristics. In order to develop compact and low-cost isolators with characteristics that meet market demands, Murata intends to expand its technical know how acquired over years of experience in order to create new technologies and move forward with the development of new products in the future. ❑