Technology Focus

Murata Shrinks Further Isolator to Fit Today's Mobile Phones

Nowadays, the adoption of International Mobile Telecommunications 2000 (IMT-2000) standard for 3G mobile phones is advancing. Under the IMT-2000 banner, the use of the Wideband Code Division Multiple Access (W-CDMA) system in particular is spreading in Japan and Europe. This shows the ongoing evolution of mobile communication standards from one generation to another.

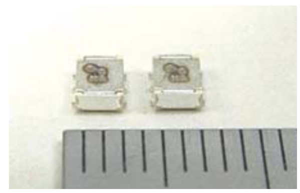
The recent hike in transmission rate and multiplication of functions in mobile phones resulted in an increase in the number of components and current consumption. Moreover, a review of the number of frequency bands used for mobile phones reveals that there should be a switch from conventional dual-band to triple-band in order to meet the rise in demand for mobile phone services. This change will increase the number of mobile phone components further. Given the circumstances, there are now stronger requirements for radio frequency (RF) components of mobile phones to become more miniaturized, thin, lightweight and efficient to bring down current consumption.

To meet these requirements, Murata Manufacturing Co. Ltd. had developed the CES20 series. The low-profile isolators serve in 2GHz-band mobile phones.

How Isolators Work

An isolator passes signals in the forward direction. It blocks the signals in the reverse direction.

The isolator mainly works in the internal RF unit of a mobile phone. Fig. 1 shows a block diagram for a general RF unit.



CES20 series 2GHz-band isolator for W-CDMA equipment

A human body near an antenna of a mobile phone causes the antenna impedance to fluctuate remarkably. This fluctuation causes reflection of some of the signals output from the power amplifier at the antenna and their return to the power amplifier. The reflected signals have adverse effects, such as lowering the power load efficiency and generating unnecessary signals, for example, adjacent channel interference waves. Placing an isolator after the power amplifier can reduce the effective load fluctuation in relation to the power amplifier output at the occurrence of antenna impedance fluctuations.

Thus, using an isolator can prevent lowering of efficiency of power amplifier. It also reduces current consumption and lengthens duration of voice calls. Use of the isolator can also reduce the adjacent channel power ratio (ACPR).

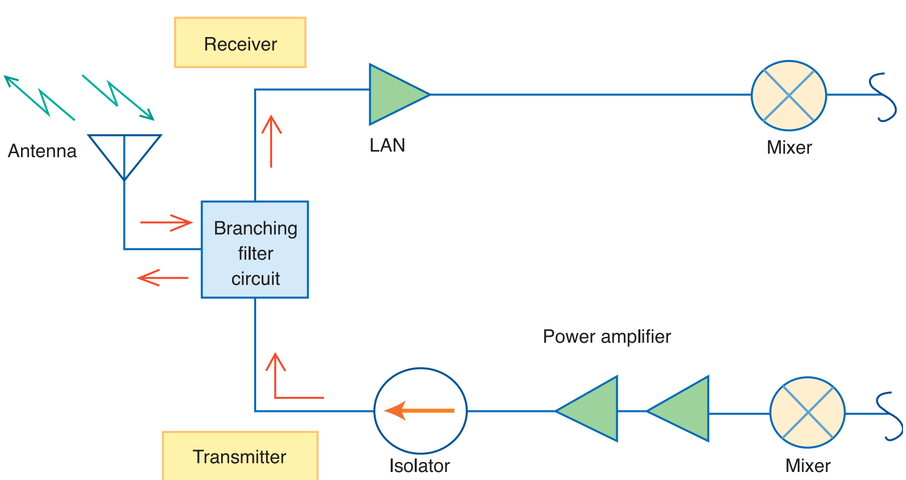


Fig. 1: RF circuit block diagram

World's Smallest

The CES20 series measures 3.2 × 2.5 × 1.2mm (maximum height) (L × W × H). Its volume is about 60 percent of that of Murata's CES30 series (conventional model), which measures 3.2 × 3.2 × 1.6mm (maximum height) (L × W ×H).

The CES20 is the world's smallest isolator that complies with 2GHz-band W-CDMA. With its compact profile, the CES20 has a mass of 0.034g, which is about half that of conventional model (Fig. 2).

Design Approaches

Fig. 3 shows sample electric characteristics of the 2GHz-band isolator for W-CDMA phones. The 2GHz-band isolator has achieved an insertion loss of 0.5dB maximum (merit value: 0.40dB) and an isolation of 14.5dB minimum (merit value: 16.5dB) in the frequency band from 1,920MHz to 1,980MHz at normal temperatures, which are equivalent of the electric characteristics of the conventional model. The isolator has also achieved a VSWR of 1.25 maximum (merit value: 1.10) at input (return loss[1]: 19.1dB minimum).

The CES20 series has realized a miniature, low-profile design while maintaining the electric characteristics of the conventional model. Similar to the conventional model, the CES20 series features a wideband of input reflection characteristic and the reduction of input reflection fluctuations. Fig. 4 shows the waveform charts for comparison of electric characteristics between the CES20 series and conventional model. Fig. 5 shows the input impedance fluctuations of the CES20 series, the CES30 series, and the CE040 series for comparison.

The graphs in Fig. 5 plot the impedance in the passing band (low frequency of 1,920MHz, center frequency of 1,950MHz, and high frequency of

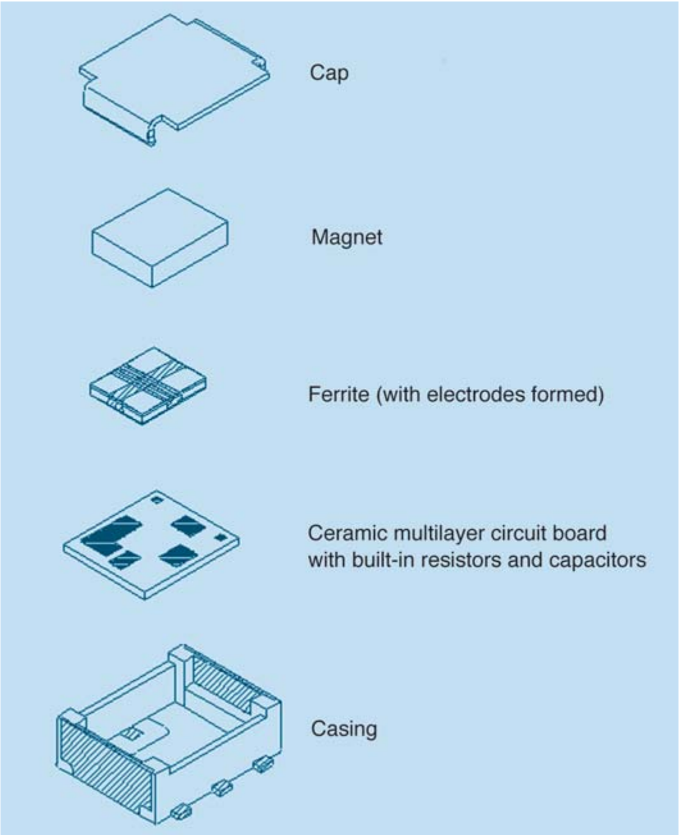


Fig. 2: Structure of the CES20 series isolator

1,980MHz) of the 2GHz-band isolator for W-CDMA phones. The wideband of input reflection characteristic and reduction of input reflection fluctuations greatly improve the impedance matching to the power amplifier placed at the input to the isolator. The impedance-matching performance of the isolator results in the reduction of current consumption in the RF transmission system and contributes to the longer voice calls.

Changing Materials

To realize the horizontal dimensions of the CES20 series, Murata reduced the size of the ceramic multilayer circuit board by about 80 percent from the conventional size. To ensure the same level of impedance-matching performance as that of the conventional model with the limited area of circuit board, Murata employed a new material that provides higher specific inductive capacity than that of the conventional material of ceramic multilayer circuit board. The new material also has higher capacitance (Q) than that of the conventional material, and largely contributes to the reduction of losses of the isolator.

Meanwhile, to realize the height of the CES20 series, Murata reduced the thickness of the magnet. Since simple reduction of magnet thickness would disable the application of sufficient operating magnetic field to the ferrite, the company used a new material for the magnet, one that provides an enhanced maximum energy product (BH max). These two improvements led Murata to realize the world's smallest isolator.

Environmentally Sound

Components for mobile phones are subject to increasingly strict requirements for environmental protection. These include the restriction in the use of hazardous substances and the adoption of

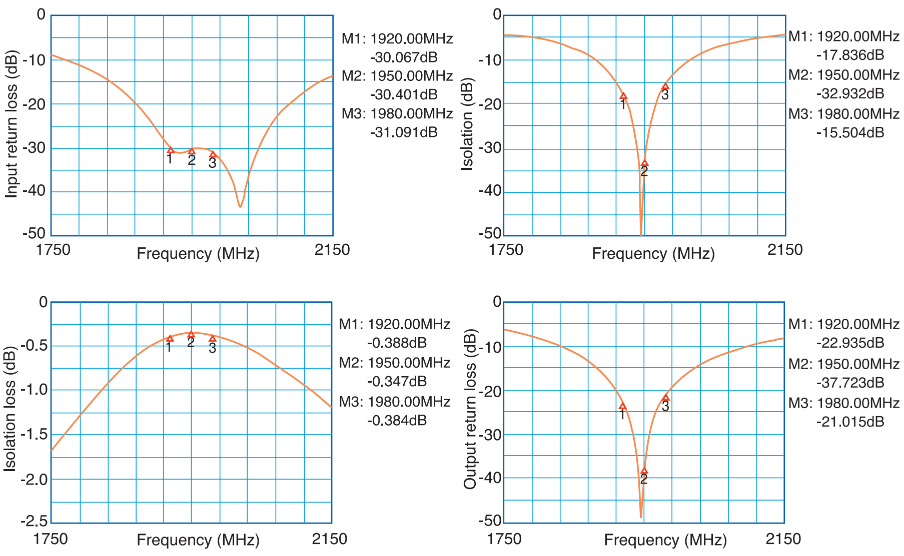
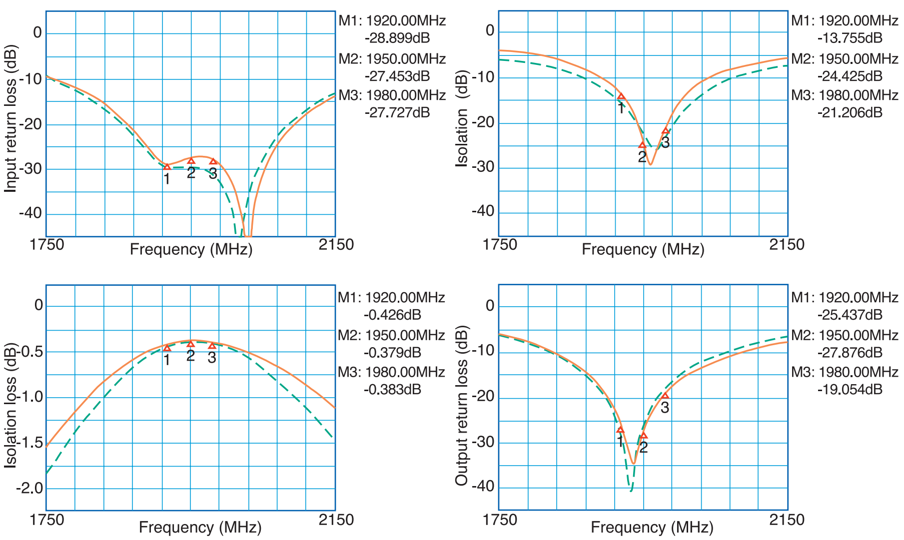


Fig. 3: Sample characteristics of 2GHz-band isolator for W-CDMA equipment



Solid lines indicate the characteristics of the CES20 series.
Dotted lines indicate the characteristics of the conventional model (CES30 series).

Fig. 4: Comparison of electric characteristics between CES30 series and conventional model

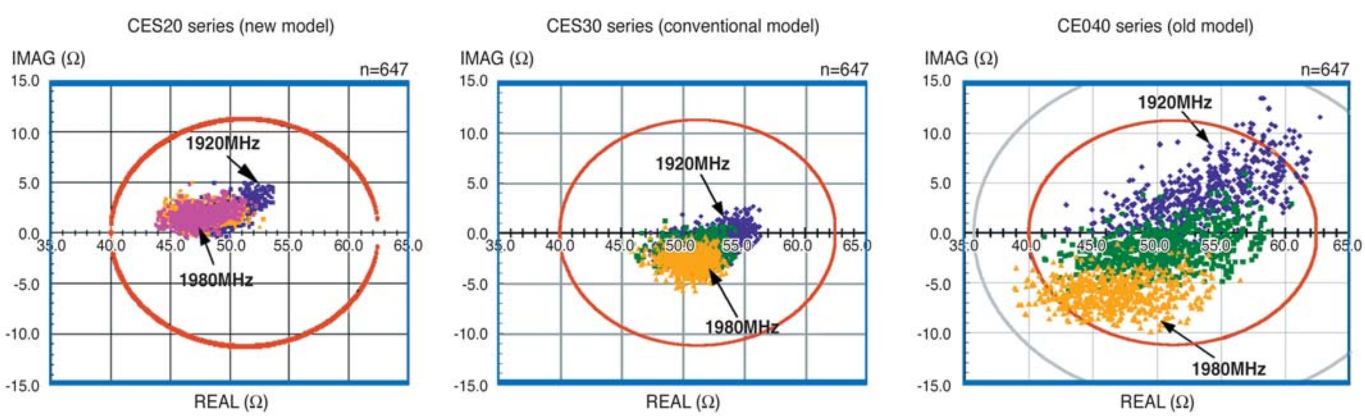


Fig. 5 : Comparison of in-band impedance fluctuation at the input among CES20 series, conventional mode, and old model

lead-free solder. Particularly, in Europe, with the Restriction of the Use of Certain Hazardous Substances (RoHS) Directive, electrical and electronic equipment entering the region from July 1, 2006 should be free of certain hazardous substances.

Murata designed the CES20 series to comply with the RoHS directive. The CES20 series can also handle a peak temperature of 260ºC at reflow soldering using lead-free solder.

Mobile Fit

The CES20 series can operate with frequencies from 1.7GHz to 2.0GHz. Available in different formats, it will work in various radio equipment such as W-CDMA phones in Japan and Personal Communications Service (PCS) mobile handsets in other countries.

The low-profile design requirement for microwave components of mobile communication equipment will continue to grow. Even after developing the ultra-small CES20 series, Murata will continue to review the basic structure if the isolator and develop products that are thinner and deliver higher performance. It will leverage its ferrite electrode formation technology and the advantages of ceramic multilayer circuit board.

Note:

1 The return loss is obtained as follows:

Return loss [dB] = 20 × log <(VSWR + 1)/(VSWR - 1)>

About This Article:

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