



# Murata Advances Gains on Coaxial Connector with Switch

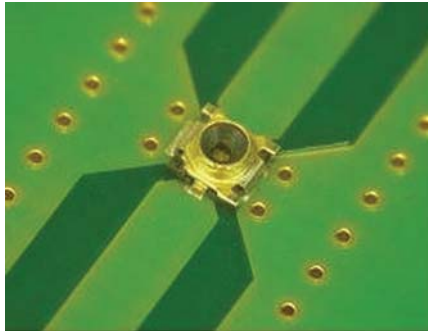
*Because of the proliferation of slimmer, feature-rich mobile handsets that work in high frequency bands, ultra-small electronic parts become highly in demand.*

**M**urata Manufacturing Co., Ltd. has made commercially available the world's first high-frequency coaxial connector with switch designed mainly for inspection of mobile handsets. This connector can efficiently measure circuits with high precision.

In 1999, Murata introduced the SWD Series high-frequency coaxial connector with switch measuring  $3.0 \times 3.0 \times 1.75\text{mm}$  for the wireless devices market. During that time, the wireless devices market continues to rapidly grow worldwide as mobile terminals become multi-band and equipped with various functions. Murata's SWD Series connector has contributed widely to simplify and improve accurate measurements.

In 2007, Murata introduced the small-sized SWF Series connector that inherited the characteristics of the SWD Series connector to cope with smaller and slimmer mobile terminals. Today, this connector series is highly regarded by users.

As the trend for smaller and thinner mobile terminals continues, a growing number of terminals compatible with high frequency band are expected to flourish because of the integration of additional functions. Amid these developments, demand for smaller and lower-profile parts com-



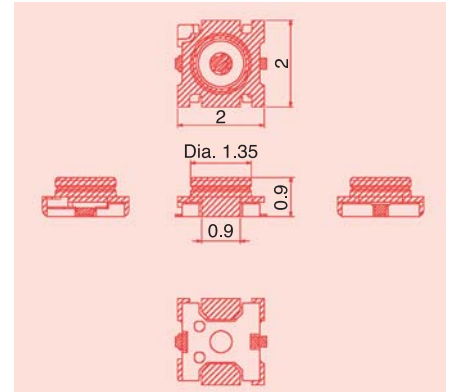
**Photo 1: SWG Series connector**

patible with high frequency band to be used in these terminals becomes strong.

In order to cope with recent demands, Murata has introduced the SWG Series ultra-small high-frequency coaxial connector with switch measuring  $2.0 \times 2.0 \times 0.9\text{mm}$ , the smallest in its class. The SWG Series is even smaller and thinner than the SWF Series with dimensions of  $2.5 \times 2.5 \times 1.4\text{mm}$  and can be used for high-frequency applications of up to 11GHz (Photo 1).

## Operation of Connector with Switch

Fig. 1 shows the structure of a connector with switch. In the normal state, two internal terminals - the movable and fixed terminals - are put in conduction or On



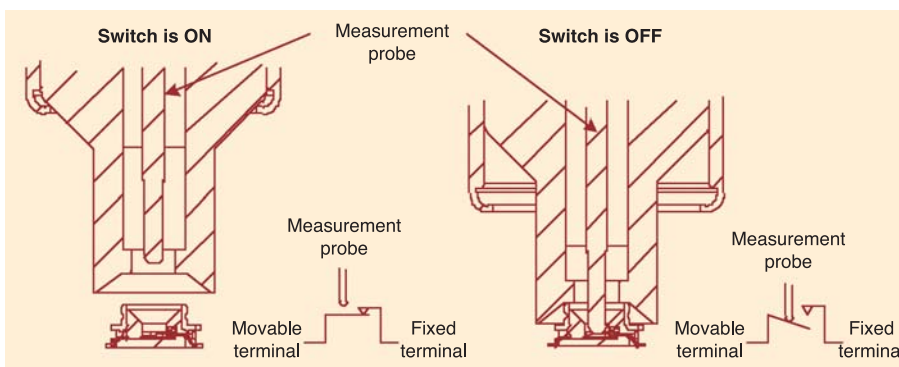
**Fig. 2: Outside dimensions of the connector (unit: mm)**

mode. When the dedicated measurement probe is inserted on top of the connector, the movable terminal with a simple beam structure is displaced. As a result, the contact between the movable terminal and the fixed terminal becomes disconnected, thus depicting the Off mode. Continuity between the movable terminal and the measurement probe can be achieved. The connector with switch provides this signal path switching function.

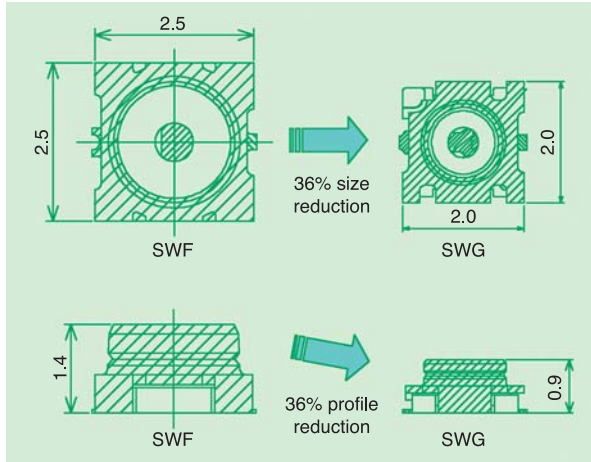
Normally, a connector with switch is mounted between a radio circuit and an antenna. It is used as a connector for measuring the radio output wherein the reception from the antenna of a wireless terminal, such as a cellular phone, is cut off. Measurement is enabled even after a printed circuit board (PCB) is assembled in the devices' housing. When the automatic measurement probe is used, the measurement can be performed automatically and productivity will improve.

## Outline of SWG Connector with Switch

Murata has developed the SWG Series, placing emphasis on size reduction, high-frequency characteristics, and highly reliable mechanical structure by making full use of the 3D Finite Element Method



**Fig. 1: Structure of connector with switch**



**Fig. 3: Size comparison between the SWG Series and a conventional product (unit: mm)**

(FEM) analysis technology and high-frequency circuit simulation technology. The company has accumulated these technologies through years of product development since introducing the world's first connector with switch until today. Fig. 2 shows the dimensions of the SWG Series connector with switch.

**Small-size, low-profile**

The SWG Series has a height of 1.0mm or less, which is approximately 36 percent lower than the SWF Series. With its lower height, the new series can contribute to reducing the profile of mobile terminals. With dimensions of 2.0 × 2.0mm (L × W), the footprint of the SWG Series is approximately 36 percent smaller compared with the SWF Series when mounted on the PCB. As a result, much higher density mounting is enabled when the SWG Series is used (Fig. 3).

**High-frequency characteristics**

The SWG Series can use higher and wider operating frequency range from DC to 11GHz compared with conventional products that use an operating frequency range of DC to 6GHz. When the switch is On, the voltage standing wave ratio (VSWR) is maximum at 1.2 in the DC to 3GHz range; maximum at 1.3 in the 3 to 6GHz range; and maximum at 1.5 in the 6 to 11GHz range. It also features favorable insertion loss of maximum 0.1dB in the DC to 3GHz range; maximum 0.2dB in the 3 to 6GHz range; and maximum 0.5dB in the 6 to 11GHz range. The isolation characteristics between the movable terminal and the fixed terminal of the SWG Series when the switch is Off indi-

cate a minimum 20dB in the DC to 3GHz range; minimum 15dB in the 3 to 6GHz range; and minimum 10dB in the 6 to 11GHz range.

**Operating life**

The number of times the measurement probe can be repeatedly mated and unmated is 100, which is the same as that of the SWF Series, and the highest in the industry for a connector with switch of this size.

**Mountable using placement equipment**

Because the SWG Series has a leadless chip shape, it uses less mounting space and can be mounted using placement equipment. The taping can be selected between 3,000 pieces per reel and 10,000 pieces per reel. The SWG Series can be mounted on a PCB by reflow solder.

**Compatible measurement probe**

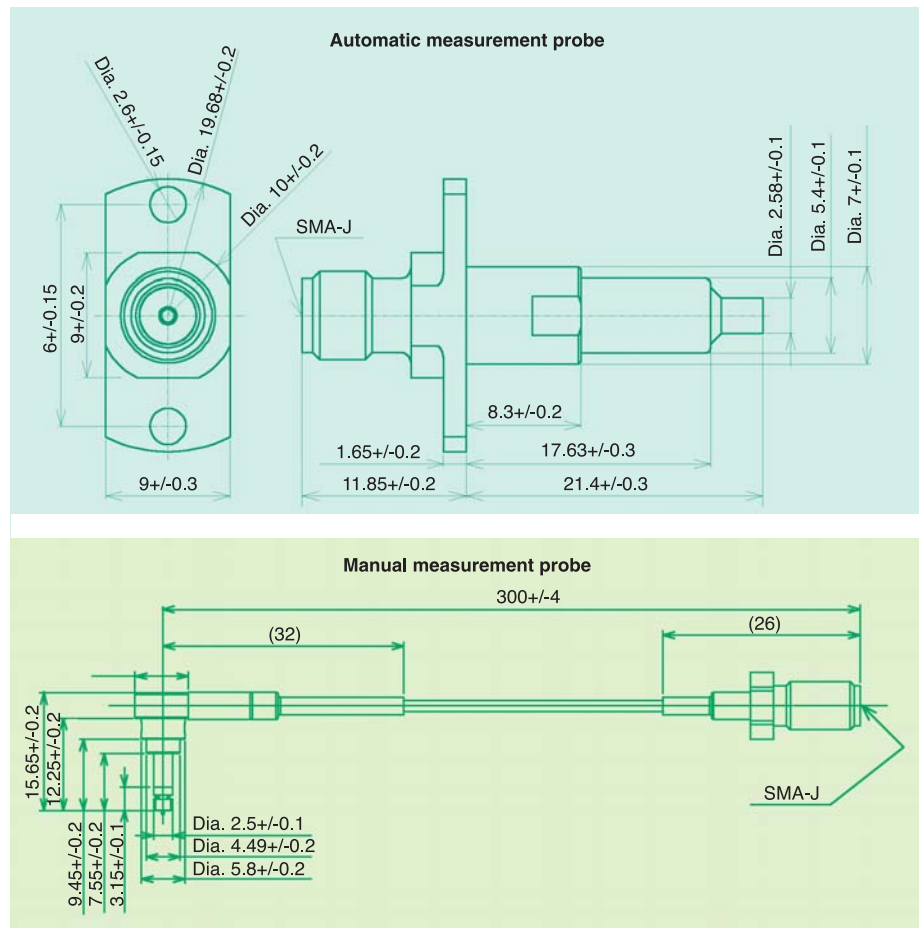
Two types of measurement probes can be used with the SWG Series: the manual measurement type probe with lock mechanism, which can be used for prototype equipment evaluation, and the automatic measurement type probe, which enables automatic measurement at high speed in a mass-production line (Fig. 4). The lock mechanism of the manual measurement type probe has been improved so it firmly mates with the connector and maintains a secure connection in spite of further reduction in the SWG Series profile.

**Design Technology**

**Materials**

Murata selected the materials used for the SWG Series connector based on its extensive know-how on manufacturing connectors with switch that the company has accumulated over the years. The SWG Series connector consists of a movable

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**Fig. 4: Outside dimensions of the measurement probe (unit: mm)**

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terminal that has simple beam structure, a fixed terminal that is equipped with a contact portion to the movable terminal, a resin case that contains these terminals, and an external terminal that contains this resin case.

The company selected the optimal stainless steel material for the movable terminal to ensure a stable contact point pressure against repeated displacement. The company chose the optimal copper alloy material for the external terminal to minimize the deterioration of the fitting strength even after repeated mating and unmating of the measurement probe and also to assure the stability of part dimensions. Gold plating was applied for the surface treatment of both internal and external terminals with consideration given to better contact resistance and solder wettability.

Engineering plastics with high heat resistance were selected for the resin case giving consideration to withstanding high-temperature reflow soldering compliant with lead-free solder, and to ensure excellent high-frequency characteristics and high dimensional accuracy after injection molding.

## **Mechanism design**

When the movable terminal has a cantilever beam structure, it is difficult to

assure a sufficient contact force with the fixed terminal. Therefore, a simple beam structure has been adopted for the movable terminal as in the case of the conventional products. The company has optimized the shape to assure maximum spring characteristics within the product size of  $2.0 \times 2.0 \times 0.9$ mm. Furthermore, Murata has applied a structure with double contact points for the movable and fixed terminals, which inherited the characteristics of previous connector with switch products.

## **Electrical design**

The company has optimized the shapes of the movable and fixed terminals in order to gain high-matching, high frequency characteristics of up to 11GHz. As a result, the company has achieved low insertion loss.

Murata has adopted the abovementioned structure for the movable terminal to maintain the spring characteristics and to assure enough displacement amount, thus achieve high isolation characteristics.

## **Anti-flux, solder wicking measures**

When the connector becomes smaller and lower in profile, the physical distance from the soldering portions to the contact portions of the movable terminal and the fixed terminal will become shorter. Because of this, the flux and the solder move towards the contact points

while the connector is mounted, creating a risk of the switch function being inhibited. This can cause a contact defect with the probe.

The company has provided measures against flux and solder wicking for the SWG connectors, as is the case with conventional products.

Flux penetrates the extremely small gaps between the terminals and the resin case during the seeping process (capillary phenomenon). To prevent this solder wicking, Murata has provided enough clearance between the inner terminal and the resin case to provide an area that can block flux penetration. Different types of plating are used in some parts of the internal and external terminals to resist solder wicking.

## **Future Developments**

Murata plans to offer new products in a timely manner to meet its customer needs with considerations for size and cost reduction so that the applications of the connectors with switch will expand as the mobile terminal and radio communications markets develop further.

## **About This Article:**

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