Technology Focus

Murata Integrates Switch to Coaxial Connector, Improves Inspection Process

Murata Manufacturing Co., Ltd. is among the firsts to release in the market a high-frequency coaxial connector with switch for inspection mainly for cellular phones.

At present, the mobile terminal or radio communications equipment market including cellular phones is expanding robustly worldwide. As these terminals and equipment go multi-band, being capable of multiple frequency, and multifunctional, and are equipped with built-in antennas, there is an increasing demand for connectors with switch.

In 1999, Murata introduced its SWD type, small-sized high-frequency coaxial connector with switch, and it remains popular to this date.

The mobile terminal and radio communications equipment market continues to grow at a rapid pace. Further size reduction and lower profile connectors are sought for the parts to be used in such equipment. Recently, Murata has introduced among the world's smallest class, the SWF type ultrasmall high-frequency coaxial connector with switch that is even smaller and lower-profile than the SWD type.

What is a Connector With Switch?

Figure 1 shows the function of a connector with switch.

In the normal state, two internal terminals, that is the movable and the fixed terminals, are put in the conduction mode (On mode). When the dedicated measurement probe is inserted from the top of the connector, the movable terminal with the flat spring structure is displaced. As a result, the contact between the movable terminal and the fixed terminal is disconnected (Off mode). Continuity between the movable terminal and the measurement probe can be achieved. This signal path switching function is provided in the connector with switch.

Normally, the connector with switch is installed between a radio circuit and an antenna in a lot of cases. It is used as a connector for measuring the radio output in a condition where reception from the antenna of a cellular phone or similar equipment is cut off. Measurement is enabled even after a printed circuit board (PCB) is assembled in the equipment housing. When the automatic measurement probe is used, the measurement can be performed automatically and productivity will improve.

Outline of SWF Connector With Switch

Murata has developed the SWF type with emphasis on size reduction, high-frequency characteristics, and high mechanical reliability by making full use of the 3D Finite Element Method (FEM) analysis technology and the high-frequency circuit simulation technology, which the company has accumulated through years of product development efforts until today, since introducing the first connector with switch. The shape of this SWF type connector with switch is presented in Fig. 2.

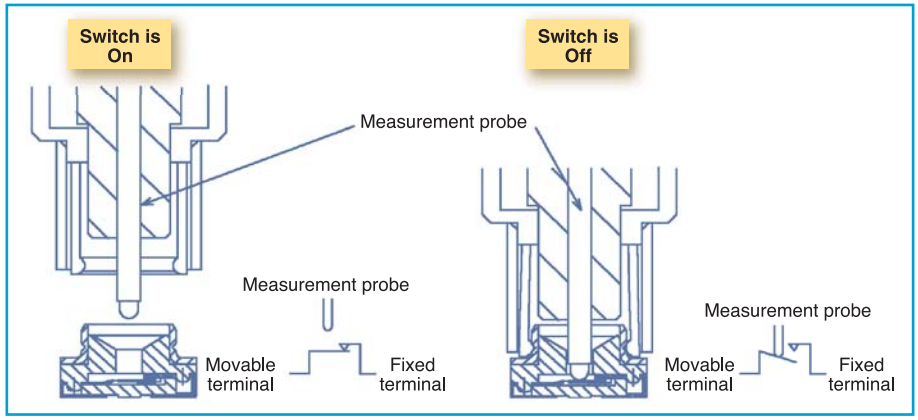

Fig. 1: Structure of connector with switch

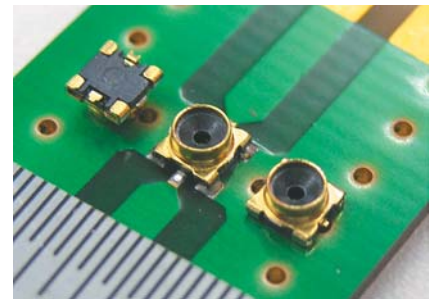

Image of an SWF type connector

Small-size, low-profile

The product height of the SWF type is 1.5mm or less, which is approximately 20 percent lower than the conventional SWD type. The outside dimensions of the SWF model is 2.5mm long and 2.5mm wide. The footprint of the SWF type is approximately 30 percent smaller compared with the conventional SWD type when this connector is mounted on the PCB. Therefore, even higher density mounting is enabled when the SWF type is used.

High-frequency characteristics

The SWF type can work on a wide operating frequency range from DC to 6GHz. When the switch is On, the voltage standing wave ratio (VSWR) is maximum 1.2 in the DC to 3GHz range and maximum 1.3 in the 3 to 6GHz range. The insertion loss is maximum 0.1dB in the DC to 3GHz range and maximum 0.2dB in the 3 to 6GHz range. The isolation characteristics between the movable terminal and the fixed terminal of the SWF type when the switch is Off are minimum 20dB in the DC to 3GHz range and minimum 15dB in the 3 to 6GHz range.

100 times guaranteed usage

The number of times the measurement probe can be repeatedly mated and un-

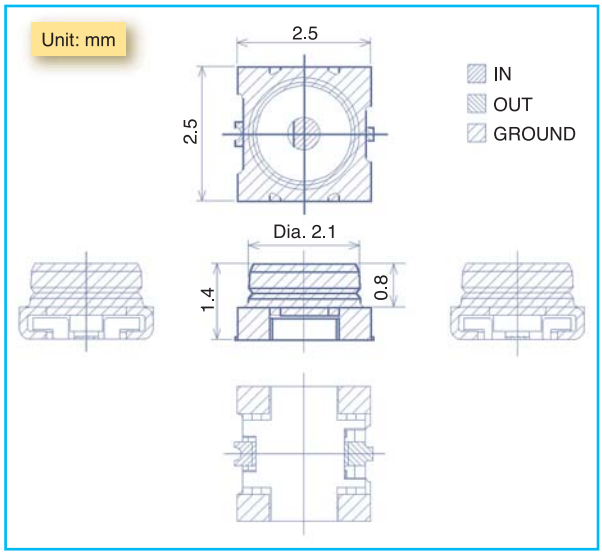

Fig. 2: Outside dimensions of connector

mated is 100, which is among the highest in the industry for a connector with a switch of this size.

Compatible with automatic mounting machine

Because the SWF type has a leadless chip shape, it uses less mounting space, and also can be mounted using automatic mounting machines. Two types of taping can be selected, namely, 2,000 connectors per reel and 8,000 connectors per reel. The SWF type can be mounted on a PCB by reflow soldering.

Measurement probe

The shape of the connection portion of the SWF type to the measurement probe has the same shape as that of the conventional SWD type. Therefore, the probes used with SWD type can also be used with the SWF type. Two types of probes can be used: 1) the manual measurement type probe with lock mechanism, which can be used for prototype unit evaluation, and 2) the automatic measurement type probe, which enables automatic measurement at high speed in a mass-production line (See Fig. 3).

Design Technology

Materials

The SWF type connector consists of a movable terminal that has flat spring structure, a fixed terminal that has a contact portion with this movable terminal, a resin case that contains these terminals, and an external terminal that contains this resin case.

Murata has selected the optimal stainless steel material for the movable terminal with consideration given to assuring a stable contact point pressure against repeated displacement. It also selected the optimal copper alloy material for the external terminal with consideration given to minimizing deterioration of the fitting strength even after repeated mating and unmating of the measurement probe and also to assuring the stability of part dimensions. A gold plating for surface treatment of both internal and external terminals was applied with consideration given to contact resistance and solder wettability.

A high heat resistant engineering plastic for the resin case was chosen with consideration given to withstanding high-temperature reflow soldering compliant with lead-free solder and to ensuring 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, Murata adopted a both-sides supported beam structure for the movable terminal as in the case of the conventional SWD type. The company has optimized the shape, however, to assure maximum spring characteristics within its product size of 2.5 × 2.5 × 1.4mm.

Electrical design

Murata has reduced electrical mismatch to a minimum and optimized it in order to achieve a low insertion loss. With regard to isolation, more stable characteristics can be generally achieved when the contact portion distance between the movable terminal and fixed terminal is longer, and a longer displacement amount of the movable terminal is better. In this case, the stress load on the movable terminal will become larger according to the displacement distance, and this will lead to deterioration of the spring characteristics. The company has adopted the above-mentioned structure for the movable terminal, however, and therefore the spring characteristics and a satisfactory displacement amount are assured, and high isolation characteristics have been achieved.

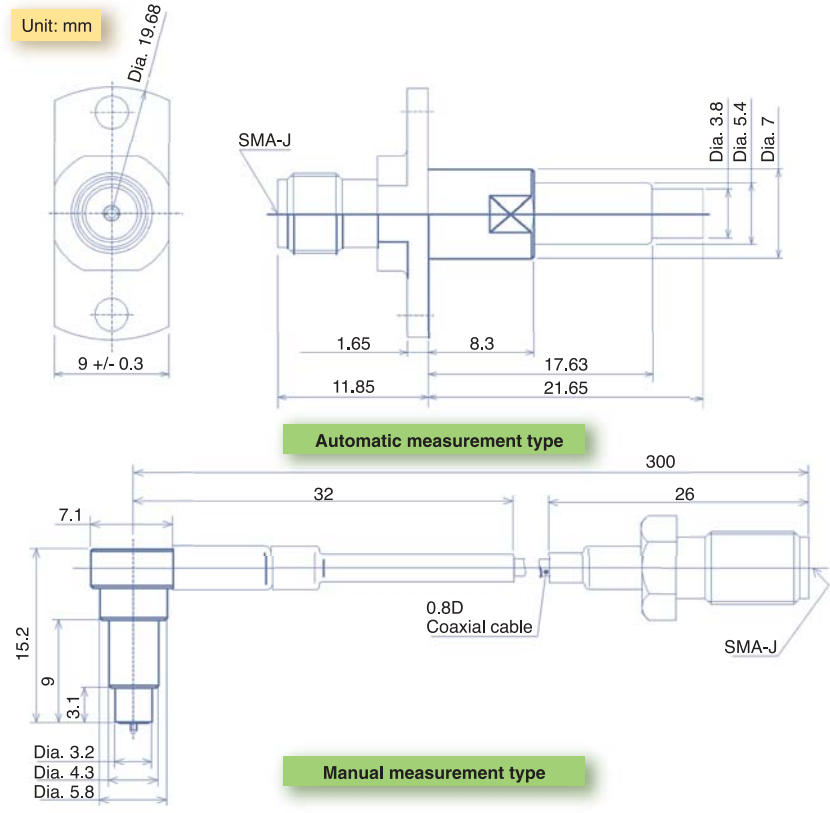

Fig. 3: Outside dimensions of measurement probe

Anti flux, solder wicking measures

When the connector becomes smaller and lower profile, it is obvious that the distance from the soldering portions to the contact portions of the movable terminal and the fixed terminal will become shorter. Therefore, it is necessary to give enough consideration to preventing flux and solder penetration into these contact portions.

Flux penetrates the extremely small gaps between the terminals and resin case in the seeping process or capillary phenomenon. To prevent flux wicking, the company has provided enough clearance between the inner terminal and 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 customer needs with considerations for size reduction, cost reduction, mechanical strength, and high-frequency operation capacity so that the applications of the connectors with switch will expand as the mobile terminal or radio communications market develops further.

About This Article:

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