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USER REPORT

Rohde & Schwarz GmbH & Co. KG plant in Teisnach, Germany

High-precision micro parts made of Teflon – manufactured on micro machines from WITTMANN BATTENFELD

With the production of micro parts made of Teflon by micro injection molding, Rohde & Schwarz plays a pioneer role in the market. These high-frequency technology components, until recently still produced as turned parts, are now manufactured on machines from WITTMANN BATTENFELD specially designed for injection molding of small and micro parts.

The family-owned company Rohde & Schwarz, established in 1933 and based in Munich, has now stood for high quality standards, precision and innovation in all areas of wireless communication technology for more than 80 years. The electronics group with a workforce of just under 10,000 employees is a leading global player in its business areas of measurement technology, radio and media technology, safe communication and cyber safety, as well as radio monitoring and radio orientation technology. In the fields of mobile radio, EMC measurement technology and broadcasting and measurement technology for digital terrestrial television, Rohde & Schwarz is the global market leader.

The company's facility in Teisnach was opened in 1969. The role of the Teisnach plant, where more than 1,400 workers are employed, is that of a system supplier and competence center for mechanical and electronic manufacturing in the network of Rohde & Schwarz. The product portfolio supplied by the Teisnach plant ranges from high-precision and surface engineering, housing technology, manufacturing of circuit boards and the assembly of electro-mechanical components right up to testing and automation solutions. In the area of high-precision mechanical engineering, Rohde & Schwarz in Teisnach offers both non-cutting machining processes and cutting production technologies such as turning, milling and drilling in combination with appropriate high-precision surface engineering.

For the production of high-precision plastic parts with tolerances down to +/- 7 µm, Rohde & Schwarz has been using micro injection molding machines from WITTMANN BATTENFELD since the end of 2012. In November 2012, the

Microsystem 50 machine model designed for injection molding of micro parts was commissioned. In November 2014, this was followed by a *MicroPower* 15/7.5, a micro machine of the latest generation from WITTMANN BATTENFELD. As a fully integrated production cell, the *MicroPower* is equipped with a W8VS2 Scara robot from WITTMANN and an integrated TEMPRO Micro temperature controller also specially developed for micro applications. Apart from their high cost-efficiency and productivity, the machines from the *MicroPower* series stand out primarily by their extremely high precision, which is partly achieved by the use of a two-step screw-and-plunger injection aggregate with shot volumes ranging from 0.05 to 4 cm³. And this high standard of precision is exactly what Rohde & Schwarz needs for the production of its micro parts primarily built into the high-frequency components also assembled at Rohde & Schwarz. The company produces 100% of the molds made of hardened steel in-house. Its mold-making shop is equipped with high-precision eroding machines, with the help of which mold components are manufactured primarily by wire-cut EDM within tolerances down to +/- 3 µm. The equipment is also designed in-house at Rohde & Schwarz. This not only enables the company to manufacture molds with the accuracy required for the production of its high-precision parts, but also offers the advantage of short lead times in mold production for highly flexible response to market demands and the needs of its customers. Typical micro parts made by Rohde & Schwarz in Teisnach are, for example, power plugs with a tolerance margin around +/- 12 µm between the internal and external conductors.

The company's latest product newly developed in the area of high-precision micro injection molding is a Teflon spacer used in high-frequency components. This part, originally manufactured as a turned part, can now be produced by micro injection molding at significantly lower cost than before. The complex preparatory work necessary to achieve the changeover of this originally turned part made of Teflon to production by micro injection molding was due primarily to the specific characteristics of Teflon. Since certain gases and/or fluorine compounds, which are detrimental to health, can be released at high temperatures in hot processing of Teflon, several analyses had to be carried out to ascertain which decomposition products may be formed, in which quantities these are released, and whether they could involve health hazards for the workers. The quantities of decomposition products depend not only on the plastic material processed as such, but also on the additives contained in it and, last but not least, the hot processing method used and the temperatures involved. The micro injection molding machines from WITTMANN BATTENFELD operating at a temperature of about 350° C are completely encased and equipped with an extraction unit.

To identify the gases released, a thermo microbalance combined with an infrared spectrometer was used. An analysis of the changes in mass and outgassing substances was carried out. The changes in mass were measured with the thermo

balance. Integrated flow controllers ensured precisely regulated flow quantities for two flushing gases and one shielding gas. The gases released from the samples by the thermal analysis were passed directly into the Fourier-Transform infrared spectrometer, which covers a spectral range from 500 cm^{-1} up to 6.000 cm^{-1} . The data were transferred online during the measurements. With this method, Rohde & Schwarz was able to prove beyond doubt that processing of the Teflon used does not involve any health or safety hazard for the workers.

Next, a trial mold was produced to examine how Teflon can be processed on a micro injection molding machine. Following a positive outcome and calculation of the shrinkage behavior, Rohde & Schwarz undertook the construction of a mold for series production, which was manufactured on a high-precision eroding machine in the company's own mold making shop. After sampling and adjustment of the mold and investigation of process capability, the release for series production could be granted.

With the production of micro parts made of Teflon by high-precision micro injection molding, Rohde & Schwarz plays the part of a pioneer in the market. These elements, originally manufactured as turned parts, are produced on two micro machines from WITTMANN BATTENFELD which, due to their specific design, offer a high level of process reliability and precision and are consequently ideally suited for continuous production of parts whose tolerances are in the magnitude of one thousandth. In order to achieve these extremely low tolerance margins, the micro machines stand in an air-conditioned room where both temperature and humidity are kept constant. For the same reasons, the molds and the material are also stored in this room.

Since the parts produced with the micro machines do not have to be deburred, the downstream finishing required for turned parts is dispensed with, which makes for a significantly more cost-efficient production of the elements. Apart from the positive results which Rohde & Schwarz has achieved with the micro machines from WITTMANN BATTENFELD in the production of Teflon parts, the company particularly appreciates the machines' modest space requirements, which are due to the design of the machines as well as the complete integration of the robots and peripheral appliances specially developed for these machines, and the integrated image processing device. Moreover, the micro machines from WITTMANN BATTENFELD equipped with rotary disks perfectly fit the mold concept of Rohde & Schwarz and are therefore quickly upgradable. Furthermore, Rohde & Schwarz appreciates the possibility of purchasing both machines and peripherals from a single source within the WITTMANN Group. Johann Haimerl, responsible for high-precision technology in the company, puts it in a nutshell: "At WITTMANN BATTENFELD we have just one contact partner for the entire package. That facilitates negotiations enormously."

The micro injection molding segment at Rohde & Schwarz has seen rapid growth since its introduction in 2012 and is expected to grow further, since for reasons of precision and cost-effectiveness it is planned to gradually introduce the production of other parts by micro injection molding instead of turning and milling.



Fig. 1: High-precision micro injection molding at Rohde & Schwarz in an air-conditioned room



Fig. 2: f.l.t.r.: Gottfried Hausladen, Sales WITTMANN BATTENFELD, Johann Haimerl, High-precision Technology at Rohde & Schwarz, Martin Philipp-Pichler, Sales *MicroPower* at WITTMANN BATTENFELD

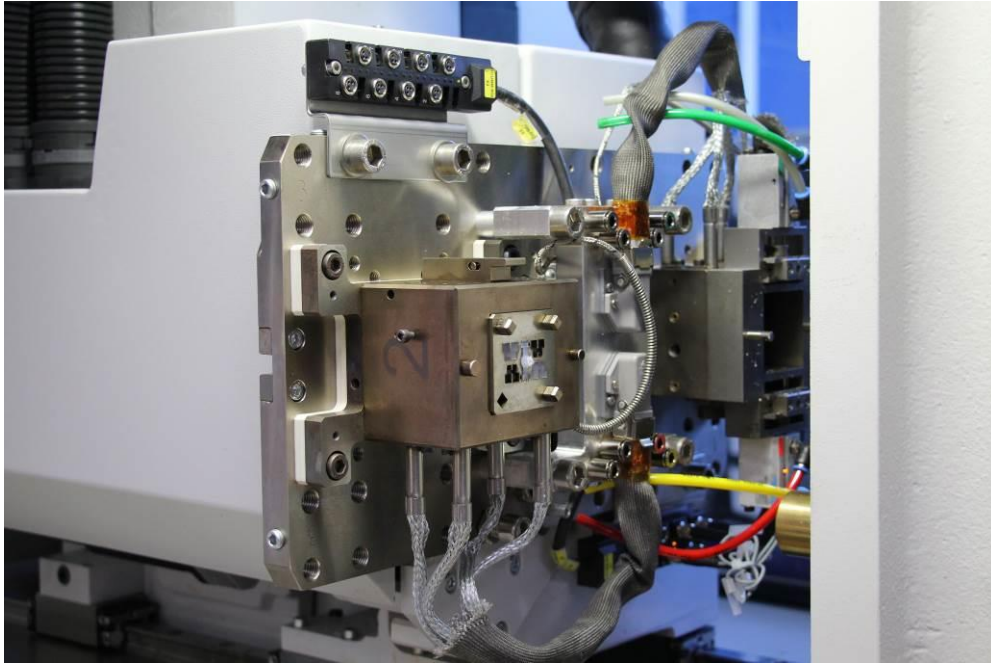


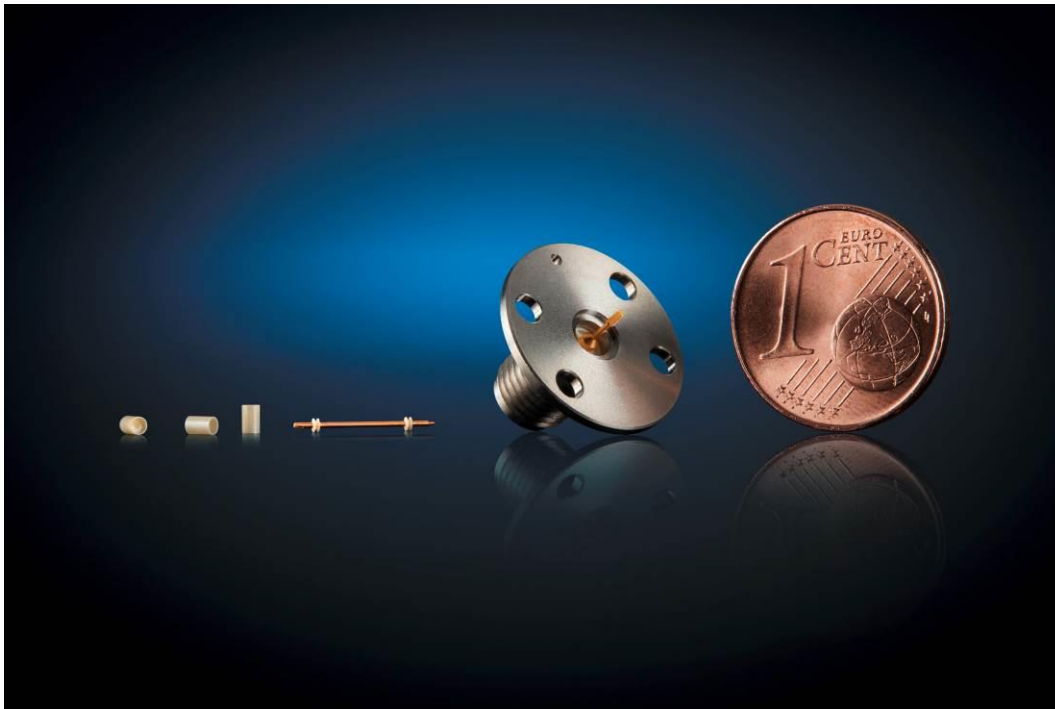
Fig. 3: Mold for injection molding micro parts made of Teflon

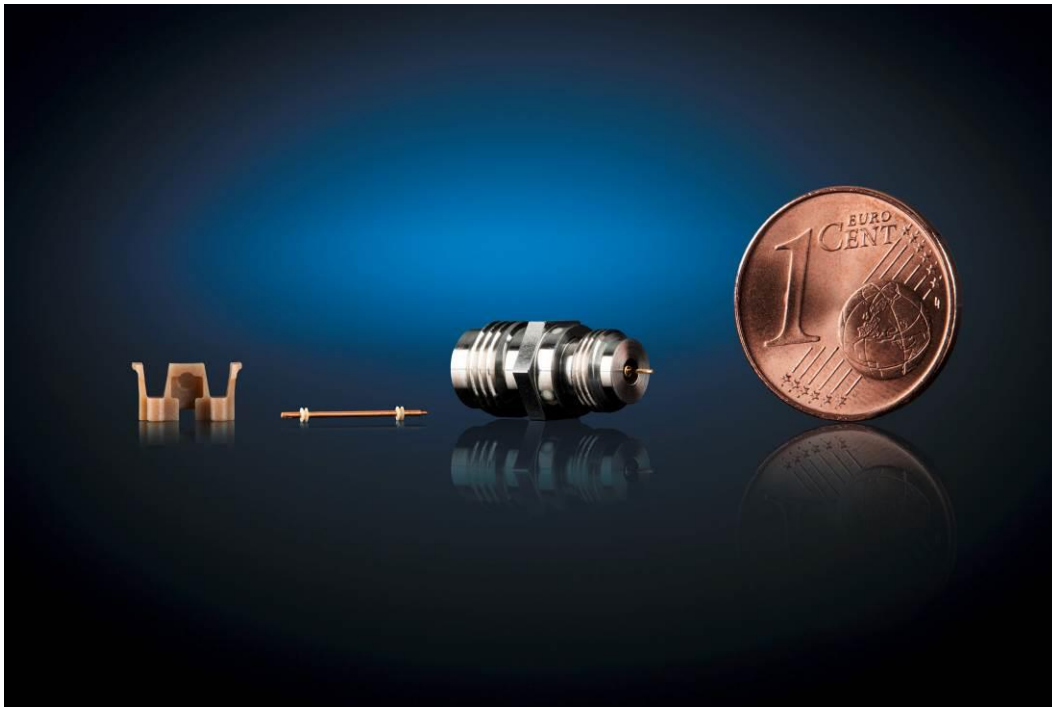


Fig.. 4: Storage of the material in the air-conditioned room next to the machines



Fig. 5: High-precision Teflon parts to be built into high-frequency components





Figs. 6a + 6b: Micro parts produced at Rohde & Schwarz (photos: courtesy of Rohde & Schwarz)

The WITTMANN Group

The WITTMANN Group is a worldwide leader in the manufacturing of injection molding machines, robots and peripheral equipment for the plastics industry. Headquartered in Vienna/Austria, the WITTMANN Group consists of two main divisions, WITTMANN BATTENFELD and WITTMANN, which operate 9 production facilities in 6 countries, including 32 direct subsidiary offices located in all major plastics markets around the world.

WITTMANN BATTENFELD focuses on independent market growth in the manufacturing of state-of-the-art injection molding machines and process technology, providing a modern and comprehensive range of machinery in a modular design that meets the actual and future requirements of the plastic injection molding market.

WITTMANN's product range includes robots and automation systems, material handling systems, dryers, gravimetric and volumetric blenders, granulators, mold temperature controllers and chillers. With this comprehensive range of peripheral equipment, WITTMANN can provide plastics processors with solutions that cover all

production requirements, ranging from autonomous work cells to integrated plant-wide systems.

The syndication of the WITTMANN Group has led to connectivity between all product lines, providing the advantage plastics processors have been looking for in terms of a seamless integration of injection molding machines, automation and auxiliary equipment – all occurring at a progressive rate.

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