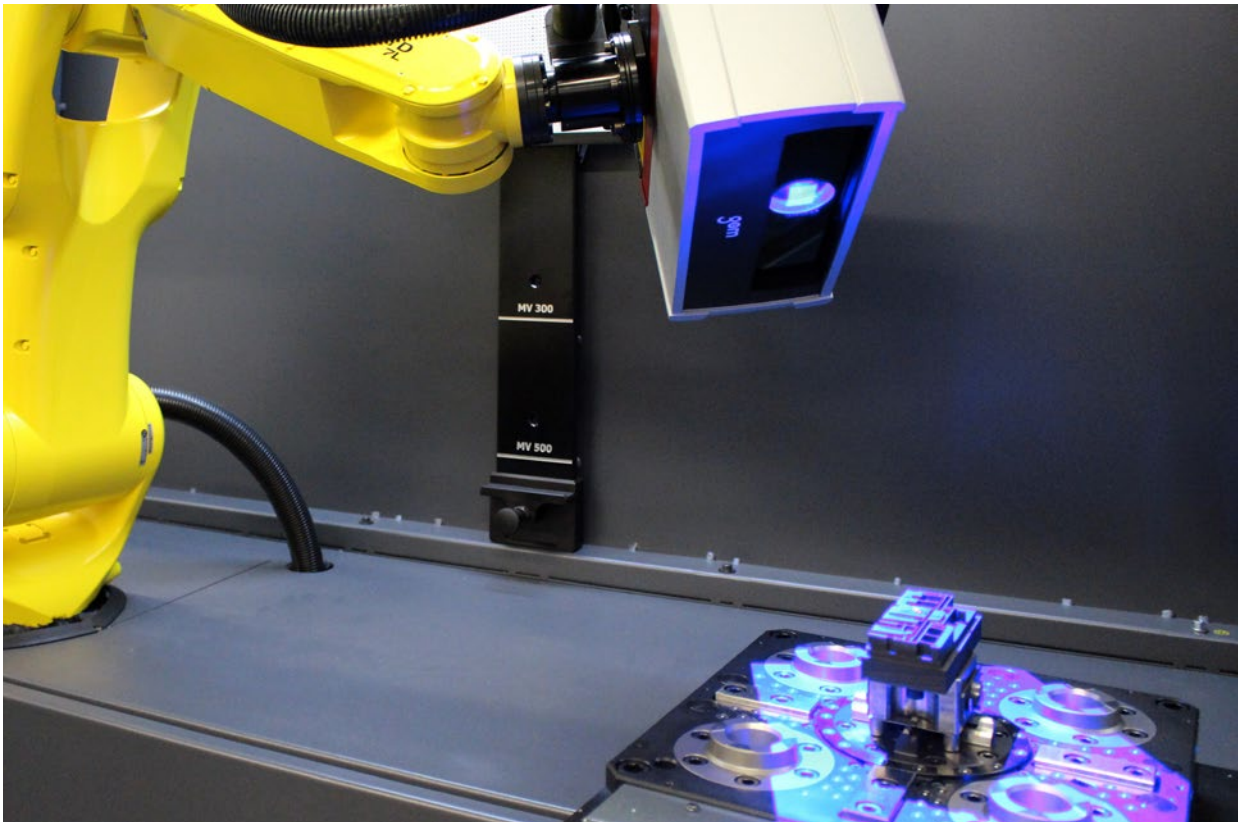
Application Note

Weidmüller: Automatically scanning electrodes and tools

Site / Country: Detmold / Germany
GOM System: ATOS ScanBox BPS
GOM Software: ATOS Professional
Company's field of work: Connectivity

One hundred percent quality, unmanned – Weidmüller, specialist in connectivity, relies on automated and production-integrated optical 3D coordinate measurement. The system change not only makes electrode production at Weidmüller more flexible, but also provides for complete measuring results.



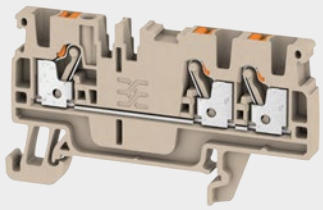
Clamp Valley is to connectivity as Silicon Valley is to software. The three largest players on the market here account for 80 percent of the global market share. Terminal central is not in the USA, but in Germany – more specifically, in Ostwestfalen-Lippe. The hidden champions of clamping technology, Phoenix-Contact, Wago and Weidmüller, are located here.

The Weidmüller Group, headquartered in Detmold, is the inventor of plastic-insulated terminal block. This fundamental connectivity product is essential in today's control cabinets of machine and system builders. With it, the Detmold company of about 4,700 employees (2017) grew to revenues of 740 mil. euros and now covers the entire field of industrial connectivity.

Terminals continue to be the most important product division for the Detmolders, however, and are manufactured by the millions every year in a wide variety of designs. Terminal blocks, such as the Weidmüller Klippon® Connect (also see info box) primarily consist of plastic with conductive metal elements. The corresponding injection molding tool is comprised of at least two parts, which are produced from hardened sectional steel in eroding machines.

Weidmüller terminal block

With the Klippon® Connect Universal range, the right solutions can be implemented with a unified standard. These include PUSH IN connection technology with integrated pushers, continuous cross-connectors, efficient markers, standardized check and test points on every contact point and a compensating mounting foot of the terminal block.



A typical Klippon® terminal block from Weidmüller, as it looks at the end of the process after coming out of the injection molding machine, including integrated metal parts.

With the PUSH IN connection technology, the conductor is inserted into the terminal connection up to the stop, creating a secure and gas-tight connection. This allows installations to be performed up to 50% faster compared to spring-cage terminals. The connection system accommodates both heavy and fine-stranded conductors, with and without wire end ferrules. To open the contact point, simply press on the pusher and the connected conductor can be removed; no special tools are required.

The goal: 100% quality through automation

To do so, electrodes are first milled from graphite. The size of the electrodes ranges from 15 × 15 mm to 200 × 200 mm. Once milled, they resemble the terminals, except for the dimension for the spark gap, thus forming the counterparts of the injection molds. In the spark gap, electricity flows between the electrode and metal, which erodes the hard steel with µ-level precision. "A deep groove in the graphite becomes a bridge in the steel, and vice versa," explains Ralf Runte, Group Leader Mechanical Processing Tooling at Weidmüller. "Every processing defect that goes through undetected here and is not discovered until production of the terminals costs us time and money. It doesn't happen very often, but we want to make sure that it doesn't happen at all." The challenge in doing so is monitoring the delicate electrode forms, which is not easy, particularly with the deep grooves. Some of them have widths of only 1.2 millimeters, at a depth of up to 15 millimeters. "It is important that the lower area has also been cleanly milled out. Our goal here is 100 % quality with the least possible effort. That means as few interventions and inputs by people as possible, and a high level of automation instead," according to Ralf Runte. "With that in mind, we have combined an EROWA ERC 80 robot with an ATOS ScanBox Series 4 from GOM into an automation solution." Automation is nothing new to Weidmüller and Runte's field. The vertical eroding machines first began to be equipped

with changing robots in 1994, with support from EROWA. "We already had an automation solution for measurement of electrodes and tools with the ERC 80 in connection with a tactile measuring machine," remembers Michael Horstmann, designated consultant from the automation specialist EROWA.

However, the measuring machine was a stand-alone solution. After milling, a quality program was written for each electrode by the vertical eroding specialists in the software Q-Measure. The points to be tested by the measuring machine were defined therein. The program is from the software company CERTA, a company of the EROWA Group, and is a module of the CERTA job management system, which also manages the ERC 80. Then the user had to place the electrode in the measuring machine, start the measuring program and wait for the result of the measurement. "Depending on how many measuring points were required, between 5 and 100, that could take up to ten minutes," Runte remembers.

Full-field data thanks to optical metrology

This process required too much time and too many manual interventions. "We wanted to enable a lot more flexibility and significantly decouple the measurement process from the presence time of the user," the Group Leader explains. That's why EROWA proposed loading the tactile measuring machine with the robot. But Ralf Runte was already familiar with the optical measuring machines from GOM (see info box also) from quality assurance, where they are used for checking the finished terminals: "We had repeatedly run intermittent trials for scanning electrodes and finished work pieces. Then I had the idea of also using them for automatic checking of the eroded parts."

This was because tactile measurement had a significant weakness, in his view: "The problem with tactile measurement is that it cannot 100% detect the deep area of the electrode – if the milling cutter is worn or broken, for example, and the groove isn't cleanly milled out as a result."

ATOS ScanBox

The ATOS ScanBox is an optical 3D coordinate measuring machine that was developed for quality control in production and manufacturing processes. Nine models are available for different part sizes and applications. Whereas mechanical measuring machines capture data in a point-based or linear manner, optical 3D coordinate measuring systems automatically provide full-field deviations of the 3D actual coordinates and the CAD data. The core of all ATOS ScanBox systems is the ATOS 3D scanner. Up to 16 million independent measuring points are captured within 1 to 2 seconds. The measuring data is characterized by very high detailed reproduction, thereby enabling very small component features to be measured.

The corresponding defect rate during milling is always very low – but when a defect occurs, it is not detected until the end of the process chain in the finished work pieces. "The big problem is that the delivery deadline can no longer be met then," says Runte. The complete work piece normally has to be re-manufactured; at the least, a great deal of rework has to be performed. "That's why we said that if we want to deliver 100% defect-free tools, we need a different system," explains Ralf Runte. "One that is no longer point-based, but instead measures surface-based. And ideally compares the measuring data directly to the CAD model. After all, that is our original model, on which everything is based. So that's how we arrived at the ATOS ScanBox."

First of all, it was examined whether the 3D coordinate measuring machine could even be used for this purpose. The measurement functioned flawlessly. The ATOS ScanBox measures the black graphite electrodes without pre-processing. And the optical measuring machine also captures the critical deep grooves of the electrodes, quickly and without defects.

Fig. 2: The electrodes sit on mounts which have chips that the CERTA software uses to control and monitor the robot, the pallet changer and the entire handling process for substituting the parts into the ATOS ScanBox

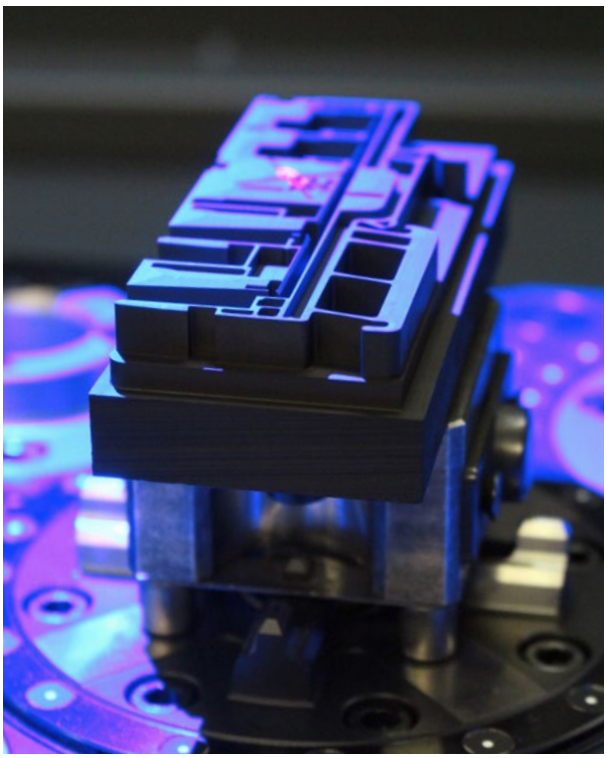


Fig. 1: The ATOS ScanBox measures even narrow and deep grooves in electrodes without trouble

ATOS ScanBox with Batch Processing System

The 3D coordinate measurement cell thus met the prerequisites for automation of the measurement and completeness of the data. "What was missing, was the automated loading and unloading of the measuring machine," explained Runte.

Following the successful tests, the order for the system was given to EROWA and GOM. Michael Horstmann from EROWA: "It was a pilot project for us and GOM. We built the system together – the ATOS ScanBox with Batch Processing System – and before it was installed at Weidmüller, engineers from both companies commissioned the system at GOM in Braunschweig. The challenge is not the mechanical aspect, but rather the coordination of the software and interfaces."

However, the result was convincing. The ATOS ScanBox and the EROWA system are completely connected and are controlled by the higher-level CERTA software. The system has now been operating very successfully in Detmold for over a year.

Automated measuring of up to 120 electrodes

The electrodes are located on mounts which have chips that the CERTA software uses to control and monitor the robot, the pallet changer and the entire handling process for substituting the parts into the ATOS ScanBox.
For the actual measurement process, the operator now flexibly defines in GOM Inspect Professional where the preset of the electrode to be measured is located.

"The user has to define what they want to measure and which electrode it is in the GOM system, based on the data from CERTA. To do so, several areas are selected and the zero point is determined. That happens relatively quickly, but we still want to automate that, as well," says Runte, describing his request to Björn Berensen, Technical Sales Representative at GOM. The goal is to transfer the zero point via PMI (Product Manufacturing Information) with the CAD exchange.

Björn Berensen: "This is our first project with an EROWA robot and we are facing several new challenges. However, we are certain that we will be able to implement these steps soon as well." In the next process step, the robot equips the GOM system with the parts that are to be measured from the pallet changer. Up to 120 electrodes and four UPC pallets with eroded work pieces can be placed there. Michael Horstmann: "And if capacity should ever run out, we can also expand the robot easily with a second ATOS ScanBox on the other side."

The robot finds the part from the pallet according to the part number saved in CERTA, inserts it into the ATOS ScanBox, the safety door is closed and the job management solution initiates measurement. In a short period of time, the ATOS ScanBox digitizes the entire surface of large electrodes, compares the measuring data to the CAD model and creates a PDF of the false color comparison. The preset data are then automatically forwarded to the subsequent eroding systems via the CERTA job management system.

Fig. 3: Ralf Runte, Group Leader Mechanical Processing Tooling at Weidmüller: „We have combined an EROWA ERC 80 robot with an ATOS ScanBox Series 4 from GOM into an automation solution."

Fig. 4: Up to 120 electrodes can fit in the system's magazine

CERTA

The solutions from CERTA Systems integrate all common applications from the fields of CAD/CAM and ERP/PPS, transfer the data in a neutral format and compile it in a central, object-oriented database. The data is provided to robots, measuring machines, machine tools and handling devices in order to automate and monitor manufacturing processes. In the reverse direction, operating and machine data is written back into the CERTA system and is thus available to ERP/PPS systems, for example, for analysis and recalculation.

Using the CAD comparison, the user classifies the quality of the electrodes. The ATOS ScanBox digitizes all sides and surfaces, combines them and compares the captured data to the CAD model. Deviations are identified by false colors in dependence on the present spark gap, so that the operator can identify the tolerance class of the part at a glance. "The false color comparison shows whether the part is in the tolerance range or if the deviation is too large," explains Ralf Runte. "In the latter case, the operator can decide whether the electrode is a reject or will be reworked."

Classification into "OK"/"Not OK" overnight

In the system's next work step, the ATOS ScanBox reports the completion of the measurement to the job management software, which in turn activates the robot in order to remove the electrodes and return them to the pallet changer. CERTA registers the pallet position, records the electrode as measured and starts the next job. "Except for the described minor details, that works absolutely flawlessly," the Group Leader says with satisfaction; "we haven't used any more defective electrodes since."

But Ralf Runte sees even more untapped potential in the process: "Our next goal is that the system independently carries out a classification into "OK"/"Not OK," based on predefined parameters, outside of operating hours; that is, overnight. In the morning, the user only has to glance at the evaluation to determine whether there's a defective part. Because during the day, I actually need the user to inspect the eroded work pieces. And, in a further step, we then also want to automatically inspect the finished work pieces on the system. We want to get there within the year."

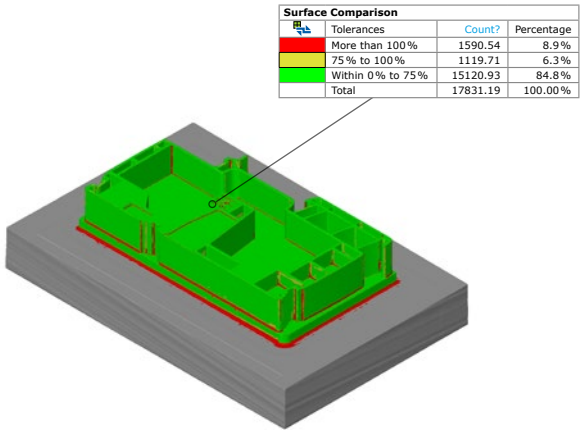


Fig. 5: The ATOS ScanBox digitizes all sides and surfaces, combines them and compares the captured data to the CAD model. Deviations are identified by false colors in dependence on the present spark gap

Fig. 6: Björn Berensen from GOM, Ralf Runte from Weidmüller and Michael Horstmann from EROWA are very satisfied with the results of the first joint pilot project

Weidmüller Interface GmbH & Co. KG

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GOM GmbH

GOM develops, produces and distributes software, machines and systems for 3D coordinate measuring technology and 3D testing based on latest research results and innovative technologies. With more than 60 sites and more than 1,000 metrology specialists, GOM guarantees professional advice, as well as support and service across the globe. More than 14,000 system installations improve the product quality and manufacturing processes in the automotive, aerospace and consumer goods industries.