

Error-Free Order Picking

KEB Automation optimized four order picking workstations – intuitively guided using a ready-to-connect pick-to-light solution from Turck



Ethernet in the Ex Area

A Zone 2 Ethernet gateway for the excom high availability I/O system now enables Ethernet communication also in Ex areas



Powerful Duo for IIoT

The combination of IO-Link and Turck Cloud Services enables a continuous data flow from the sensor to the cloud – and back again

»The Digital Pathway«



Much has happened in recent months. The extent to which the corona virus has brought our social life as well as the world economy to their knees is unprecedented. Production sites have had to close down or have only been able to operate by observing stringent hygiene regulations. Transport capacity has become scarce and expensive, while trade fairs and visits to customers have no longer been possible. Employees have been working at home for months and we have all had to drastically restrict our social contacts.

Turck has been and still is faced with the problem of continuing to meet its customer's requirements while protecting the health of its employees and partners at the same time. We have been successful here – as well as elsewhere. For example, we have been optimizing our internal processes and IT solutions within the group over several years in order to respond to your requirements worldwide quickly and flexibly. We are now benefitting from this

process, which has enabled a form of efficient digital cooperation, which we are also expanding further.

By the way, our aim to position Turck as a leading digital automation company was already on the agenda before the onset of the corona virus. With our digital networkable solutions for efficient automation systems we are blazing the trail in the development of Industry 4.0 and IIoT. As specialists in smart sensors and decentralized automation in IP67, we are bringing intelligence to the machine and ensuring the reliable capture, processing and transfer of the relevant production data – from the sensor to the cloud.

What this means in specific terms can not only be seen in this issue of your customer magazine. Take a look inside our "digital shop window" at www.turck.com/dip and roam through our Digital Innovation Park, which we have recently opened as a response to the absence of any possibilities to attend trade fairs or make visits. The website offers a fast overview of all the latest automation topics, links to webinars, white papers and more, as well as the possibility to contact our experts directly.

Even if the initial easing of restrictions gives hope that the economy and our social life will soon pick up again, we have been strengthened by our digital pathway – in communicating with you, as well as in the solutions we offer. Stay tuned...

Yours sincerely

Christian Wolf, Managing Director

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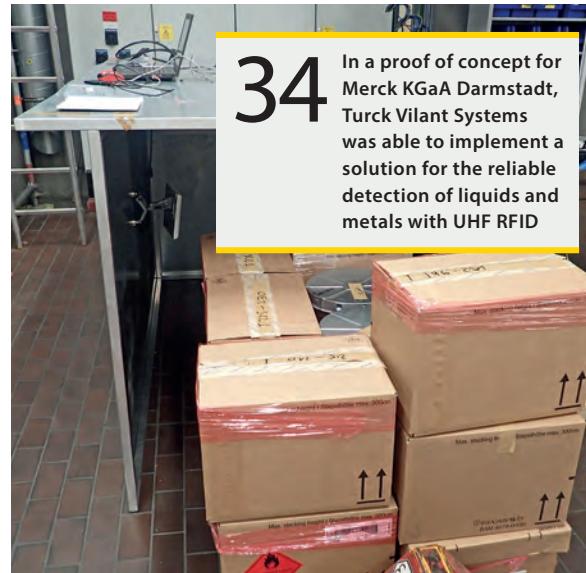
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Turck One of Germany's Top Employers Again



Turck continues to be one of Germany's top employers. In addition to the award from the Focus Business magazine, which the Mülheim automation specialist has now won for the third year in succession, the Stern magazine has come to the same result in the first employer ranking that it has carried out.

"We are really delighted to receive the many awards" says Turck managing director Christian Pauli. "It definitely shows that we have taken the right long-term approach with our HR strategy." HR director Daniela Leppler also regards it as confirmation: "According to Stern, a good working atmosphere and management behavior, as well as image and growth, are the most important factors for the willingness of employees to recommend their company. We were rated top among our competitors for both aspects as well for the further development opportunities we offer. This is fantastic feedback for our work, on which we can build further."

Stern developed its ranking in cooperation with Statista, the market research institute. Over 45,000 employees took part in the survey through the use of online access panels. According to the magazine, a total of 1.34 million assessments could be fed into the study.

The Focus ranking was drawn up in cooperation with kununu. In order to determine the top employers in Germany, kununu evaluated around four million assessments of more than 900,000 companies. Winners of the "Germany's Top Employer" award are only selected on the basis of the views of employees.

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Ethernet Communication for Ex Areas

With the first Zone 2 Ethernet gateway for the excom I/O system Turck is opening the world of the process industry for digitalization and Industry 4.0. All process data can thus now for the first time reach IT systems for analysis and evaluation at sufficient speed via a parallel data channel – a fast and easy way of implementing condition monitoring and predictive maintenance. Controllers and control systems are protected here from access attempts. The new GEN-3G multiprotocol device operates at high data rates in Profinet, Ethernet/IP or Modbus TCP networks without the need for manual intervention. The integrated gateway switch enables the implementation of linear topologies which can be connected easily in the network to form a ring.

IO-Link Starter Kit

Turck is now offering a compact starter kit for users wishing to discover the benefits of the IO-Link digital communication protocol. The IO-Link devices contained in the box enable users to set up their own system and thus gain hands-on experience in the technology. Besides Turck's TBEN-S IO-Link master with four universal PNP channels, the set also includes one RGB indicator light and two sensors: the BI10U uprox inductive sensor as well as the RU40U ultrasonic sensor. The IO-Link devices supply maintenance data for the condition monitoring of machines and plants as well as user data. The starter kit also contains a 230 V power supply unit, compatible cables (M12-M12 and M8-Ethernet RJ45) as well as a USB memory stick for easier commissioning. The Simple IO-Link Device Integration (SIDI) software also enables devices to be integrated in Profinet systems without any additional software.





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RGBW LED Strip With 19 Colors



Turck is expanding its offering of the WLS27 Series Strip Light to include programmable models with RGBW LEDs for use in indication, illumination and inspection applications. Banner Engineering developed these models with quality white light, sealed, chemical resistant housing, and a wide variety of colors and animation possibilities. The new WLS27 Pro comes in either IO-Link or discretely controlled Pro Editor compatible models. Banner's Pro Editor software allows users to program device status, colors and animations for control via three discrete inputs. The bright, high-quality light output of the WLS27 Pro makes it an ideal solution for illumination.

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Washdown Sensors with IO-Link and Factor 1



Turck's inductive washdown sensors for the food industry are now also available with IO-Link. Thanks to factor 1, the robust stainless steel threaded barrel sensors in M12, M18 and M30 designs have the same high switching distance on all metals including stainless steel. The IP68/IP69K devices are FDA-compliant and are characterized by a temperature range of -40...+100 °C. With the possibility of identification and integrated temperature monitoring, the IO-Link devices offer extended diagnostic options.

Ethernet Safety I/O Modules



The robust IP67 block I/O modules modules TBPN for Profisafe and TBIP Safety provide safety input and output signals directly from the field to the safety controller. The modules can alternatively be used as decentralized safety controllers in the field. This function optimizes modular machinery and also applications in which long bus cycle times to the central controller would require greater safety distances. The new block I/O devices provide four safety inputs and four universal inputs or outputs (FDX) in the field. The flexibility of the FDX ports in particular enables optimum coverage of the individual safety signal requirements of any application. The modules can be used for applications up to PL e, category 4, in safety circuits up to SIL CL 3. Actuators are provided with 2 amps per output, with up to 9 amps in total.

Bearing-Free IO-Link Rotary Encoder for Ex Areas

The QR24 non-contact encoder is now also available in a version for use in explosion protected areas Zones 2, 22 and 3GD. Contact-less measurement considerably outperforms bearing guided optical encoders in dust-laden environments since optical encoders are susceptible to dust. The sensor unit and positioning element on the QR24 are fully potted and cast as two totally sealed independent units. This gives the encoder optimum protection from dust, vibration, impact and shocks. Unlike encoders with magnetic positioning elements, the QR24 offers a greater resistance to magnetic field interference. Typical applications include the chemical, mining or food industries – particularly in mills. However many applications in the textile or wood-processing industry also require the use of an encoder with 3GD approval.



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Time Machine

Turck's first Zone 2 Ethernet gateway for its high availability I/O system excom now also brings Ethernet communication to hazardous areas

The dual Ethernet interface enables parallel data access to the process data for monitoring and optimization tasks; the redundant gateway guarantees maximum availability

Particularly with new installations, the long innovation cycles typical in the process automation sector call on engineers to look to the future – to the future of the installation as well as that of the automation technology. You don't have to be a prophet to understand that an in-depth diagnostics examination of processes and instrumentation will become even more important in the future.

System planners are faced with the question of how to design automation systems on any level so that additional data can also be used effectively. And even though its use is still not yet absolutely obligatory, production plants that have often been in operation for decades are now already integrating a channel for data-driven optimizations. Anyone currently working on an actual project must make their automation system open for what NAMUR calls monitoring and optimization (M+O).

Fieldbus bottleneck

With conventional fieldbus solutions, regardless of whether Profibus DP, Profibus PA or Foundation Fieldbus is used, the bus technology forms a bottleneck for extensive diagnostics that do not come from the sensor itself but which are carried out in the parent systems outside of the control systems. In other words, much of the meta data that fieldbus devices for HART, Profibus PA or Foundation Fieldbus systems can already supply and transfer today is only used occa-

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Turck's first Ethernet gateway for the excom I/O system opens up the process industry world to digitalization and Industry 4.0. All process data can thus reach IT systems via a parallel system fast enough for analysis and evaluation – a fast and easy way to implement condition monitoring and predictive maintenance. Controllers and control systems stay entirely unaffected by this and are protected from unauthorized access. Due to its compact design, the system is not only suitable for installation in the field but also in control rooms.

sionally for device swaps or for calibration due to the limited bandwidth (31.25 Kbit/s with Profibus PA and Foundation fieldbus, 1.5 Mbit/s with Profibus DP IS). The possibilities to optimize processes through the use of data or for the early detection of wear and contamination, i.e. predictive maintenance, are never used.

Parallel data access for monitoring and optimization
NAMUR has recognized this need and responded to it with its NAMUR Open Architecture (NOA) concept: NOA provides for the establishment of an additional data channel parallel to the automation pyramid, which has no effect on the sections between the field devices, I/O and control system level. The data is transferred below the control system level to the parallel channel and can be analyzed independently from the conventional automation technology. This enables the parallel channel to benefit even more from the short innovation cycles of the IT world than one would normally dare in the operational technology of plant automation and control. This architecture also excludes the possibility of external access to control systems.

Ethernet for excom opens parallel access to process data

With the first Zone 2 Ethernet gateway, Turck has opened its high availability excom I/O system for parallel data

access in explosion protected areas. In the fall of 2019, the automation specialist had already presented an Ethernet gateway for excom in the safe area. The gateway presented now is designed for use in Zone 2. The modular excom system with different electronic modules for inputs and outputs as well as other signal types is not affected if the gateway is replaced. This means that suitable intrinsically safe field devices can be connected for use right through to Zone 0. The modules and module racks of existing installations can still also be used with the new Ethernet gateways.

Today it is already possible for the automation system of an installation with excom to be designed for parallel data access in greenfield projects. In brownfield projects, most operators will probably only consider a switch to Ethernet if the control system has to be updated anyway. In this case, however, excom enables the installation to be designed for parallel data access via Ethernet in different scenarios while retaining the existing field devices. excom can be installed both centrally in the control room as well as remotely in Zone 2.

Space saving installation in the control room

As excom comes with Ex isolation already integrated, this eliminates the need for the interface technology and the appropriate control cabinets. The system replaces the I/O modules of the control system and



The Ethernet gateways can be integrated seamlessly in the excom system, while existing module racks as well as all other fieldbus system components can still be used

Namur pyramid: The parallel data access here helps to ensure the highest level of process security and availability, and allows the analysis of data for predictive maintenance in remote IT systems

SEAMLESS ETHERNET CONCEPT FOR ALL AREAS

The currently presented GEN-3G for the Ex area is the second Ethernet multiprotocol gateway for Turck's excom I/O system. The GEN-N has been available for use in the non-Ex area since last fall. With the two gateways, the automation specialist is now offering a seamless I/O system solution including an Ethernet connection. The connection is implemented via standard RJ45 connectors with at least CAT5e cable quality. The gateway supports 10/100 Mbit/s, half/full duplex transmission, auto negotiation and auto crossing. A GSDML and EDS file containing all the necessary configuration files and parameter sets are provided for configuring the relevant system. Changing the configuration and the parameters during operation is also possible through the use of suitable host systems. Besides the standard diagnostics scope of the Ethernet protocols, the gateways offer manufacturer-specific error codes that provide information on both the status of the system as well as that of the connected HART field instrumentation.



receives the signals of the field devices. These installations are therefore much more compact than solutions based on conventional interface technology. Turck's excom system also normally requires less space compared to other I/O systems with integrated Ex isolation. This can be a critical benefit, particularly in retrofit projects or in modular process plants.

The same system for all three zones

excom's unique selling point is its comprehensive system concept: The system can be used in the safe area as well as in Zone 2 and Zone 1. Even if the gateways and modules for the safe area are slightly different to the intrinsically safe modules, the system is considered as identical by the control system. The user can therefore use one DTM and the same operating philosophy over all zones and plant sections, which consequently reduces the effort required for training and allows the flexible deployment of operating personnel.

System approval saves re-approvals for expansions

The consistent system concept produces another unique feature: excom is approved as a complete system. The approval therefore not only includes electronic modules and module racks but also the installation in the housing together with the customer-specific components. This approval allows any combination of I/O modules and gateways of the system to be assembled. It is thus not only possible to replace a fieldbus gateway with an Ethernet gateway but even to carry out a complete refit with excom components – without the need for re-approval by the approval body. Plant operators carry out the necessary re-evaluation themselves of temperature values in the housing.

Ethernet multiprotocol

Turck's multiprotocol standard has been well-established in factory automation for many years. Multiprotocol devices can be used in the three Ethernet protocols Profinet, Ethernet/IP and Modbus TCP with or without any intervention by the user. The excom Ethernet gateways benefit from this development. The system can be used straightforwardly with all control

systems supporting Ethernet/IP, Profinet or Modbus TCP: For example, Siemens, Honeywell, Rockwell, Yokogawa, Emerson or Supcon.

High availability

excom also supports ring topologies in addition to Profinet S2 redundancy (two controllers). Even for Ethernet protocols that do not have their own redundancy specification, excom establishes system redundancy like the S2 standard, gateway redundancy and/or combinations of both. This makes it possible to achieve optimum availability even with Ethernet protocols, which do not provide native support for this function.

Cloud connection

Besides the transfer of time-critical user data to the control system, excom also features a second channel that provides the parallel data stream to any system. It is ideal for analyzing data firstly in an edge device and only then sending the results to the cloud. Turck also offers here alternative routes in addition to its proprietary cloud solution with industry specific data visualization and the encrypted Kolibri cloud protocol for the most demanding security requirements. The Turck cloud hardware also enables data to be transferred to one of the large cloud systems via MQTT or OPC UA.

Author | Jorge Garcia is product manager for process automation fieldbus technology at Turck

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Further information: www.turck.com/excom



»Ethernet in the Ex area«

**What are your reasons for acquiring a share in Asinco?**

For us, Asinco firstly offers us its know-how from the field of radar sensor technology and secondly its R&D expertise. This is particularly in the area of software development, which makes up around 50 percent of its business. This primarily covers the area of signal evaluation in the field of radar sensor technology.

Why has Asinco developed radar sensors?

The company originally operated in the field of rolling mill automation. Asinco originally collected the measurement signals with laser sensors. However, these only had a limited suitability for the applications and there was nothing yet available in the market in the field of high-precision radar sensors. The company therefore researched the area of high-precision radar sensor technology and developed the sensors. In our view, this technology is really easy to scale. At least easier than adapting the sensor technology to the industrial requirements present by the million in our automobiles.

How then is the cooperation with Asinco organized? Are there any joint projects?

We have made considerable advances in the field of fluid sensors, and a level sensor with radar technology will be developed that is based on our new fluid sensor platform. This will be particularly relevant for hydraulic applications in factory automation where guided microwaves or capacitive rods are currently used. Radar sensors can offer several benefits here. In the field of distance measurement, radar sensors are also a successful alternative to ultrasonic sensors for measuring larger distances, and also as an alternative to laser distance sensors, which are expensive and often susceptible to faults.

Aren't ultrasonic sensors a better choice in individual cases?

Not only in individual cases. This is another technology that will also have a valid use in the future next to radar sensors. In terms of costs, the ultrasonic sensor currently still has the advantage. This is also the case in certain environmental conditions. There are some materials that a radar sensor cannot detect. Anything made of plastic, concrete,

plaster, is more difficult to detect with radar technology, depending on type. Ultrasonic sensor technology also still has the advantage depending on the structure of what it is you wish to detect. With the range it's different: As soon as you go beyond six to eight meters, there is not much you can do with ultrasonic technology. These technologies will therefore always exist next to each other.

Where do you see the limits of radar sensors?

The costs are an issue first of all. At present you also have to be careful in safety-related applications in industrial environments. There are still as yet no radar sensors with safety approvals. If you want to develop a collision protection system on a vehicle used in a safety-related area where you also have to ensure personnel protection, this cannot at present be implemented with a radar sensor. However, I believe this will come in the future.

What is required for this?

The issue of redundancy has to be tackled



»As soon as you go beyond six to eight meters, there is not much you can do with ultrasonic technology«

Oliver Marks | Vice president business unit automation products

Turck acquired a minority share in Asinco 2019. The Duisburg-based company not only designs and markets leading closed-loop control systems for rolling mills, but has also developed a revolutionary radar measurement technology for position sensing as well as for distance and level measurement. Oliver Marks, vice president business unit automation, about the potential of radar sensor technology, new developments and predictive maintenance.

first of all. The downstream electronics in particular must be provided with appropriate redundancy so that it can obtain the relevant approval certificate from an approval body. I have now doubt that this is technically possible; it is just a question of getting the approval.

Where in your view do radar sensors have the greatest potential?

This would include level sensor applications, and the area of distance measurement is now already covered by the existing radar sensors. There is definitely a lot to do in the coming years. There is also potential in the implementation of image generating processes with radar technology, in which 2D or 3D distance images are generated. There are some very exciting applications for example in collision detection – not just for vehicles but also for robots. We have ongoing research projects in this area.

Does this involve the ability to detect with software the shape of the objects from the reflected radar signal? This is

similar to what a bat does using ultrasound, but both involve radiation that is reflected back.

Exactly. And the bat can do this so well because it has two ears. This setup is also necessary with radar sensors in order to detect space: using at least two reception antennas and perhaps even several transmission antennas. This is technically possible and has also already been implemented in part. It is now just a question of implementing this in industrial products. The main challenges here lie in the conditioning of the data. The customer wants to know which objects are in the way and where, or which parts of his machine moved and in which direction. Our close relationship with customers has provided us with a great deal of knowledge for this application know-how, which can now also be implemented into products.

What role can sensors play in an Industry 4.0 environment? What communication technologies are you using?

For us IO-Link is critical. It ensures cost efficient data transfer over the last meter

and with Com3 and IO-Link 1.1 is also fast enough. It also makes it possible to transfer more to the parent level than just the sensor signal. For example, you can also transfer the integrated temperature compensation data, which provides information about the actual temperature at the sensor. The calling of information about the status of the sensor is thus generally very easy. Our contactless encoder, for example, not only supplies the position of the encoder but also tells you whether the non-contact positioning element connected above it is still close enough or whether it could soon fail. There are many possible options in this area. You can thus obtain a great deal of the additional information which is essential for predictive maintenance and which can advance the development of Industry 4.0.

Author | The interview was conducted by Marie Christin Wiens, editor at the technical publication automation

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IO-Link makes it possible for higher-level systems to access additional data parallel to the measured value – a powerful tool for predictive maintenance



Powerful Duo for IIoT

With the combination of IO-Link and cloud services, Turck enables a continuous data flow from the sensor to the cloud - and back again

The cloud services of the four tech giants Apple, Microsoft, Amazon and Google can considerably simplify our day-to-day work: No longer storing holiday photos on the limited memory of a smartphone but in your personal online folder; synchronizing calendar entries and contacts on several devices at the same time; or working jointly on the planning document for a club event. Companies naturally also want to fully utilize the benefits of cloud computing in industrial applications – with special requirements but with one common goal: Using data efficiently without unnecessarily loading the network and memory capacity.

Industrial clouds are also required to filter the relevant values out from the large amount of information gathered by field devices such as sensors and RFID read/write heads, i.e. reducing big data to smart data.

The cloud is thus far more than just a memory storage facility. Instead, it supports users such as with the fast integration of newly connected devices, gives automatic warning of any critical anomalies or visualizes the operating times of different tools. For this Turck offers end-to-end communication from the sensor right through to the cloud and this in both directions. This provides an intelligent exchange between the field level, controller, data cloud and the responsible service employee as soon as necessary.

IO-Link allows access to additional data

The IO-Link communication standard today already enables digitalization to be started in the direct machine environment. Many field devices are now equipped with processors which provide information in addition to the user data, such as diagnostics data or device information.

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End-to-end bidirectional communication down to the sensor/actuator level and with access to additional data – IO-Link increases the potential of industrial cloud services. Turck is combining both technologies and is thus opening up different possibilities of process optimization for users. For example, the simplification of operating steps such as sensor replacement, keeping process parameters in view or setting up the automatic condition monitoring of machines.

IO-Link enables access to these additional values by higher-level systems in parallel with the actual measured value. This turns an IO-Link device such as a sensor into a talking participant, which in turn increases the usability of cloud services at the other end of the automation pyramid. With IO-Link and cloud solutions Turck is connecting two trailblazing technologies and is thus ensuring end-to-end continuity "up to the last meter".

Preprocessing of signals with decentralized intelligence

Remote intelligence is needed in order to restrict data usage above the field level to smart data. In other words, the signals are preprocessed already in the fieldbus module. Turck's TBEN-L-8IOL IO-Link master, for example, enables users to configure directly which variables are transferred to the cloud. The remote evaluation of data also means that time-critical measurements are carried out in the field without causing an additional load on the communication networks. This ensures that even process sequences completed in millisecond cycles are undisturbed, while only specific data is available for further use. The cloud offers several routes to it: via cables using Turck's TBEN-L5-PLC-10 IP67 controller or via a wireless connection using the TCG20 IP67 cloud gateway with a WiFi or a mobile network.

Device identification together with IODD update

Where can the benefits of cloud and IO-Link be seen? For example, with the identification of devices when technical personnel commission a sensor or carry out maintenance. These operations can waste valuable time and are also the source of occasional errors. Connecting the cloud to a central database with all IO-Link device descriptions therefore makes more sense. A newly connected device in the field then transfers its manufacturer and device ID to the cloud, including the parameters and communication properties. A comparison with the database is then carried out in order to identify the IODD belonging to the sensor. The cloud also visualizes device data and can adapt parameters in the device if required.

Fast sensor exchange when faults occur

The same applies to the replacement of devices in the event of fault. As soon as a sensor reports a fault, this information is sent directly to an employee via the cloud. For this it is also possible to program alarms for which notifications can be sent by email or SMS, in addition to the visual notifications in the dashboard. As the device configuration of the sensor can be stored in the cloud, the faulty IO-Link device can be replaced immediately without any problems. The bidirectional exchange of information makes it possible for the cloud to identify the type of replacement sensor connected and configure it with the appropriate parameters.

Warning of mechanical wear

IO-Link additional data can also provide information about poor mechanical running. If an inductive sensor

monitors the movement of a bolt for example, it can also provide information about the switching distance in addition to the switching pulse. As soon as the target reaches a critical distance to the sensor, this can also indicate increasing wear – the bolt has too much play. The cloud notifies maintenance engineers, who then have to act before the target is outside of the measuring range. However, early notifications mean that the service can already be carried out before this state is reached.

Value addition for condition monitoring

A measuring ultrasonic sensor also supplies data on signal quality in addition to the distance value. This gives users the possibility to not only query a level value, but also to receive an alarm, for example, if there is a buildup of foam on the surface of the liquid, which



The cloud independently uses information from the intelligent IO-Link device in order to identify a sensor



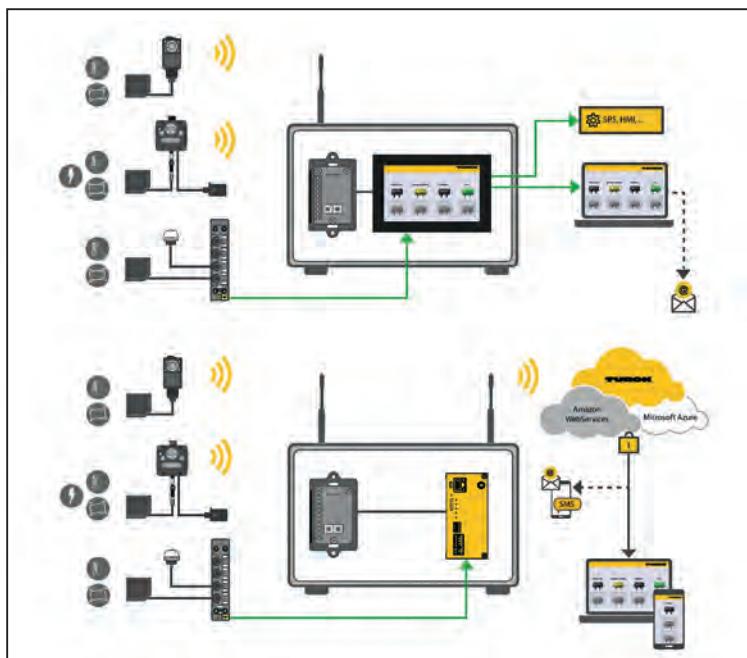
The inductive sensor signals whether its target has deviated from the specified switching distance – thus indicating possible wear



The ultrasonic sensor also indicates the buildup of foam on the surface as well as supplying the level value



Users can conveniently see in the cloud dashboard the operating hours of each individual tool



Turck's cloud service can be hosted on the customer's in-house server or as a public cloud in the central data center – communication is handled via an encrypted protocol

would corrupt the measured value. In this case IO-Link extends the condition monitoring to initiate a second monitoring. At the same time the cloud ensures that information on level and surface reaches the employees early on, irrespective of the location or terminal device.

Keeping process parameters in view

Added value number five: Relevant process parameters can also be recorded by means of additional information in the cloud. If different tools are used in a machine, operators have to take their specified lifetime into account where possible. The process parameters of each tool can be transferred to the cloud so that this data can be used or stored. This is made possible, for example, with Turck's inductive coupler. After a tool change, the tool and the cloud carry out a contactless exchange of the values, such as the operating time between each other. Users can then view in the cloud the number of hours in which the individual tools were used or the particular downtime of a machine.



Turck Cloud Solutions enable Velco to provide effective support today for its customers and reduce costs for service callouts worldwide

Digitalization "up to the last meter"

Connecting IO-Link and cloud services together – this is one strength of Turck's IIoT solution for companies looking for an end-to-end digitalization right through to the individual sensor in the machine. Whether for commissioning and maintenance, condition monitoring or process optimization, the potential of IO-Link devices can be used as required. The cloud used here brings device and machine data to the screens of different terminal devices. It provides information on limit value overshoots or faults and, thanks to its bidirectional IO-Link communication, is itself an active system node, such as for comparing device information in a database.

IIoT in practice

The company Velco GmbH in Velbert is an example of how today's users can already benefit from an end-to-end sensor to cloud solution. The pressurized vessel, rotor gunning machines and injection plants from Velco are used worldwide in blast furnaces, steelworks, foundries and in the refractory industry. In order to provide rapid support for users in the event of malfunctions, the special machines are provided with a remote monitoring function. As the previous solution could no longer meet the latest requirements, Velco now uses Turck's cloud based solution.

One page in a web browser enables this solution to provide an overview of all machines. Nobody has to note any addresses and thanks to responsive design everything can be run from a smartphone. Velco's customers who often hire out their machines to end users call up the dashboard of the Velco cloud and see their machines listed in the navigation window. If an employee clicks on one of the entries in the list, the dashboard provides a clear overview of all the relevant data. Besides some analog values such as water pressure or material level, there are also digital indicators such as for operating state or the status of the emergency stop button. The user can also see an operating hours counter and other numerical displays. The dashboard can be made up very easily by the users themselves – with just a few clicks and without any programming knowledge. The specialists can also remotely control the Velco machines via the dashboard if this is required for troubleshooting. The support technicians thus see from their desk whether the most minor faults such as "missing water supply" or "Emergency stop button pressed" can be excluded. Thanks to the additional data, they are able to effectively support any further troubleshooting.

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The Turck portfolio offers users a large range of different safety components – from the safety sensor to mechanical switches right through to safety controllers



Keep Safe!

Relay-based, centralized or decentralized: There are many routes to the safe machine – Turck supports users here with an extensive safety portfolio

Machinery Directive 2006/42/EU requires every manufacturer to assess the risk of their products in order to ensure the safety of persons that come into contact with the machine. Manufacturers follow a three step process in order to reduce the risk of danger caused by the machine to an acceptable residual risk: Risks first of all have to be minimized by design measures as much as possible. Residual risks must then be reduced through the implementation of technical protection measures. For the third step in the reduction, the manufacturer is required to create user information such as operating instructions, which must provide information on the correct and proper handling of a product.

When people talk about safety or machine safety, they usually mean the second step. However, the

design of these technical protection measures is not defined specifically. As a result, several different safety concepts exist with specific advantages and disadvantages: There are firstly centrally hardwired systems with safety relays, and secondly centrally wired applications with safety controllers or safety PLCs. A third variant involves the use of decentralized safety concepts with IP67 I/O modules combined with central safety PLCs or decentralized IP67 safety controllers. Passive safety solutions are also an option for suitable applications.

Central safety systems with relay technology
Like conventional automation technology, the automation of safety functions was originally based on relay technology. Safety relay technology is also still used



today. The logic is formed here using hardwired contacts. The advantage of these kinds of installations is the fact that they are relatively inexpensive in terms of hardware and can be understood worldwide. No software is used here. However, relay technology is definitely unmanageable for larger and more complex safety installations. The finding and diagnosis of faults are very costly. The self-testing of the system is also not possible.

Central systems with safety controllers

Above a certain level of complexity, the implementation of safety applications is cheaper through the use of safety controllers. Safety controllers or PLCs can run programs that – to put it simply – are written to link specific actions with certain conditions and Boolean operators (AND, OR, NOT, XOR). Although the wiring of these applications is simpler than with relay technology, all safety signals have to be routed to the central controller in the control cabinet, which therefore requires long commissioning times.

The advantage of the safety controller is the fact that safety programs can be copied and used multiple times for similar machines. Expansions of the safety functions can be implemented relatively easily. It is also possible to depict safety applications graphically

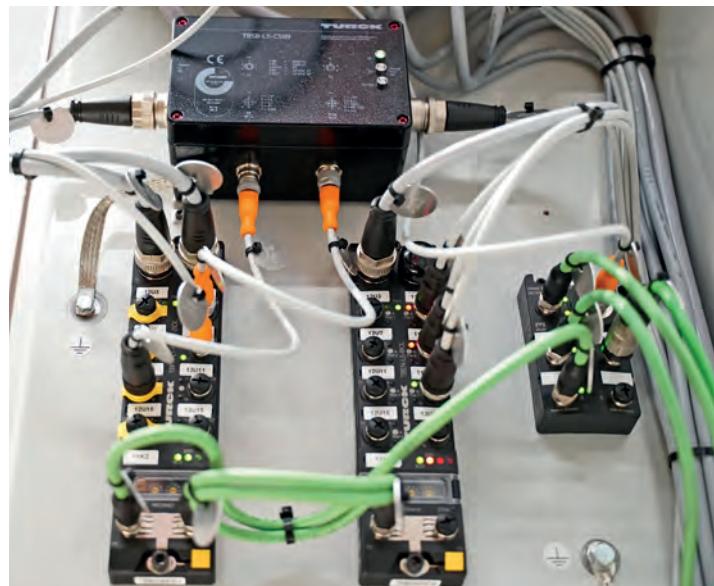
on HMIs. Information and signals are transferred both from the controller to the PLC and also from the PLC to the controller.

XS26 safety controller easily expandable

For central installations, Turck offers the SC10, SC26 and XS26 safety controllers from its partner Banner Engineering. All three devices can be used as a device/slave in Profinet, Modbus TCP or Ethernet/IP networks. This allows users to always have the same safety architecture and application, regardless of the market for which an installation is designed.

QUICK READ

Even for machine safety solutions, there is no such thing as a one-fits-all solution. Depending on the size and application, centrally controlled installations, decentralized or those with passive safety are the best. However, decentralized safety solutions with IP67 components are unavoidable for anyone looking for flexibility and short commissioning times for price-sensitive applications. For this Turck has the right safety portfolio for a wide range of application scenarios.



This safety application is controlled by the TBPN (left) for testing in the factory. A Profisafe controller then takes over the application in live operation at the end customer. All actuators connected to the IO-Link master (middle) are safely disconnected with the TBSB Box (above)

Safety programming by drag and drop

Users can write the programming of the controller application in Banner's free Safety Controller software. This provides an easy-to-use graphical user interface for configuring and simulating safety applications and various export options for the documentation. Ready-to-use program blocks for conventional safety components enable the programming of safety applications by drag and drop without having to write any program code. The programs can then be copied and transferred to other controllers using USB sticks. In this way, programs can be designed and tested on the desktop computer and then transferred later to the application. The wiring must be carried out locally in the field using conventional point-to-point connections.

The ISD safety protocol is a special feature of the SC10 safety controller. ISD (In-Series Diagnostics) enables up to 32 safety devices to be linked as slaves in one in-series connection. The protocol is modulated to 24 V. In this way, information on switch states and diagnostics of the safety sensors can be called up by the PLC. This feature is otherwise only offered by expensive safety PLCs with fieldbus or Ethernet communication.

Many safety controllers can also be expanded easily. If all inputs and outputs on the XS26 controller are assigned, additional I/O can be provided using expansion modules. Up to eight units can be added by the user. Input or output modules, as well as OSSD or relay modules are available.

The labor intensive wiring required for the commissioning of a central safety architecture is often a disadvantage. Local protection boxes can then be used as an intermediate solution, in which the decentralized IP20 controllers are installed.

Rapid commissioning through offline engineering

The safety application on Banner's autonomous safety

controller can be programmed and tested beforehand even if a machine or the individual machine module are still offline. The ability to test safety programs on the desktop computer and in the workshop considerably shortens the commissioning time. In live operation the central safety PLC can take over the application via a multiprotocol Ethernet connection. Integrated modular machines can thus control their safety functions locally at the module.

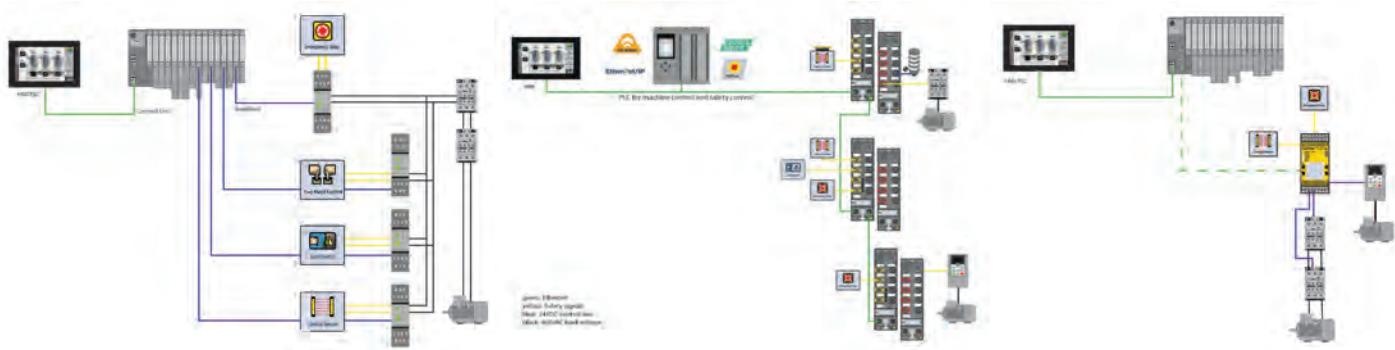
Decentralized safety concepts, centrally controlled

The use of decentralized safety installations with IP67 components is unavoidable for anyone wishing to minimize the setting up of central or decentralized protective housings in order to wire and commission their machines quickly. As is generally the case in automation technology, decentralized architectures are also being increasingly used in safety technology.

Two types of systems are used here: Decentralized concepts, which collect the safety signals on the IP67 I/O modules and bring them to the central safety PLC via fieldbuses or secure Ethernet protocols. And fully decentralized installations, which control safety applications directly in the field on IP67 safety controllers. Which of the two alternatives is better depends on the individual case. Both decentralized architectures offer the benefit of efficient wiring with Ethernet cables using standard connectors. The high information density and the possibility to exchange meta information simplify the commissioning and diagnostics of applications.

Long cycle times demand large safety distances

In applications using central safety PLCs, the protection devices may require larger distances from danger sources if longer reaction times have to be allowed for due to the bus cycle times required and the use of cascaded messages.



Turck's TBPN and TBIP safety I/O modules for Profisafe and for CIP safety can both be used for solutions requiring central or decentralized control. Both module versions are available as full safety modules with four safety-related universal inputs/outputs and four safety-related inputs which can collect up to 16 single-channel safety signals. The modules can reliably switch up to 2 amps per output, with up to 9 amps per module. They are suitable for use in applications up to PL e, Cat. 4, SIL CL 3.

If in certain applications fewer safety-related inputs/outputs are required while standard I/Os are needed at the same time, Turck offers an innovative special solution in the form of its hybrid modules, both for (TBPN) and CIP Safety (TBIP). The hybrid modules come with two safety digital inputs as well as two safety universal digital inputs or outputs and four universal standard digital inputs or outputs. They switch the same currents and can be used in the same safety categories as the full safety modules. The hybrid safety modules come with two Class A I/O-Link master ports; the second port can be used for safety disconnects.

All Turck safety modules have a safety controller on board, which can be used to implement preprocessing for time-critical applications or also safety applications without a connection to a failsafe PLC. The integration of a stand-alone application in a safety control system with Profisafe or CIP safety communication is always possible at a later time. The modules can be pro-

grammed easily with a software tool. Its integrated web server simplifies diagnostics and commissioning during operation. Their robust design with fully potted module electronics makes all modules suitable for use in harsh industrial environments. They comply with protection types IP65/IP67/IP69K and also operate reliably in an extended temperature range of -40...+70 degrees Celsius.

Decentralized safety concepts offer a high level of flexibility, shorten commissioning times and simplify modularization

Decentralized solution with passive safety

The so-called passive safety is a variant of decentralized safety concepts. These applications are relatively inexpensive and offer an ideal combination of the advantages of central and decentralized safety architectures. Unlike conventional safety technology, passive safety applications do not supply every actuator via a separate safety output. Passive safety simply ensures that the voltage of a group of actuators is safely disconnected in critical situations. For this the I/O groups used ensure full galvanic isolation between the sensor voltage (V1) and the actuator voltage (V2). The actuator system of the machine is switched off irrespective of its state.

Safety also with IO-Link

Turck offers a comprehensive concept of passive safety solutions. All Turck I/O components, including the IP67 I/O-Link master, offer full galvanic isolation of V1 and V2. Turck I/O hubs for transferring up to 16 digital signals via IO-Link also isolate V1 and V2. This makes it possible to design safety-related I/O-Link applications even without an IO-Link Safety protocol. The TBSB safety box was developed by Turck specifically for safety disconnections. It is connected to the safety channel of a safety module (from Turck or another manufacturer) in the field and safely switches off the actuator voltage of the downstream modules when a safety event occurs.

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Decentralized safety solutions: The TBSB safely disconnects the actuator voltage V2 of downstream components

Asparagus Pioneer

AvL Motion is breaking new ground – with a machine for the selective harvesting of white asparagus, 'garnished' with high precision sensors as well as RFID and fieldbus technology from Turck

Spring time is asparagus time. Hardly any other seasonal vegetable enjoys so much widespread popularity among restaurant goers and supermarket customers. Even in 150 BC Cato the Elder devoted himself to the cultivation of the "gourmet delight". For Sun King Louis XIV the delicacy also had to be on the menu at Christmas. Many centuries later, the culinary enthusiasm for these precious shoots still appears to

»Turck impressed us with the outstanding quality and fast delivery of their product.«

Arno van Lankveld | Managing director of AvL Motion



be unwavering. In Germany alone around 122,000 tons of asparagus were harvested in 2019 – The Federal Republic is the largest producer in Europe with over 22,000 hectares of cultivation area.

However, this fresh vegetable normally has to be painstakingly retrieved from the soil by hand before it reaches the plate. For the harvest in Germany between March and the end of June, farmers in Germany rely on harvest workers from Eastern and Southern Europe. However, a significant problem has appeared over recent years: farms are finding it increasingly more difficult to find seasonal workers. This caused the Dutch engineering consultants AvL Motion to undertake the development of a machine solution for harvesting white asparagus. Around three years later, the startup company from Noord-Brabant has now announced the development of the world's first fully autonomous, selective harvesting robot. A high-tech prototype was produced with a finely tuned sensor and control technology. Customers can already use it in the coming season.

Wanted: a selective harvesting machine

Company founder Arno van Lankveld grew up on an asparagus farm and is therefore well aware of the



considerable challenges involved in harvesting this much loved vegetable: "An asparagus plant develops many shoots that can grow in different directions. This makes the process more difficult." Normally only those spears that have broken through the soil are cut off and picked – the remaining tips are initially left in the raised beds in order to mature underneath the black and white insulation foil.

Up to now detecting which asparagus spear was ready for market could still only be done with the human eye. Harvesting machines were either able to cut all shoots at the same height and at the same time or were simply too slow. AvL Motion has now solved this problem with a robot which, at a constant speed of up to 3.6 kilometers per hour, autonomously detects asparagus tips, cuts the shoots, pulls them from the ground and takes them away on a conveyor belt. Only one worker is required for the operation; this person is required to sort the crop on a loading



Selective harvesting at the push of a button:
The AvL Compact S1560 moves at up to 3.6 kilometers an hour over the field and pulls asparagus spears automatically from the soil

area into crates, turn the machine by remote control at the end of a row and insert the insulation foil cover in the winder of the machine. "Growers are able to reduce their workforce by 83 percent," van Lankveld estimates.

Height control via ultrasonic sensor with IO-Link
Besides the pioneering spirit of the seven co-workers, the automation of such a complex operation particularly required the right technology. With one ultrasonic sensor causing problems in practical application, electrical engineer and software developer Jordi Hutjens found an alternative solution in the RU40U model from Turck. AvL Motion now uses two of the ultrasonic sensors with IO-Link to measure the distance between the asparagus bed and the pneumatically controlled internal frame of the machine. In spite of the partly dusty or rain-slicked subsoil, the sensors enable a stable measurement of the height, which

QUICK READ

The Dutch startup company AvL Motion put on the market a machine for the fully autonomous selective harvesting of white asparagus. In its search for an ultrasonic sensor for height control, the Dutch startup came across the IO-Link compatible RU40U from Turck. Through the subsequent collaboration more sensor technology was integrated in the vehicle, including miniature inductive proximity switches, precise encoders as well as LE550 laser sensors from Banner Engineering and the robust Li500-Q25 linear position sensor. AvL also uses the TN-Q14 RFID read/write head for the identification of harvesting modules, while the TBEN-S2-4IOL compact I/O module transfers IO-Link signals to the PLC.



Six to twelve harvesting modules are located on the machine, the controller uses the data from sensors to bring them in the right position

users can set on an HMI. "Turck impressed us with the outstanding quality and fast delivery of their product. We therefore stayed with the manufacturer for other components," says AvL CEO van Lankveld.

Optical process replaces trained eye

The harvesting process of the AvL Compact S1560 is very dynamic. Once the machine is positioned and set in motion, the surface of the soil is scanned. The precise location of an asparagus tip is detected by the main controller through the use of laser sensors, together with an additional optical process. The details of this remain the well-guarded secret of the inventors; the only basic requirement for it is that the soil is free of weeds. A variable number of harvesting modules move in the process round a circular track inside the robot. At present, this consists of twelve of the around 25 centimeter high cassettes. They are adjusted to the speed of the robot and control the entire process of inserting, cutting and gripping.

Fine tuning between target and harvesting module

The controller not only needs the coordinates of the selected asparagus spears to fine tune the harvesting process, but also a continuous flow of information on the position and movement of the modules. This starts with the query of how many cassettes are currently located in the buffer, i.e. how many are in park position, and those currently detecting an asparagus shoot in the circuit. For this AvL uses the tiny BI3-M08K inductive sensors. The exact identification of the harvesting modules is implemented with RFID – using the TN-Q14 HF read/write head, which reads the individual code of each cassette.

Added to this is the position detection provided by a rotary encoder. "The encoder rotates in the buffer area. This shows us for example, that a cassette is located at millimeter 20 or 30, AvL developer Hutjens explains. Once a harvesting machine starts its circuit, this passes a type NI10U-M12 uprox proximity switch, which sets the running of the timer for the harvesting

Fast I/O module with four IO-Link inputs: The TBEN-S2-4IOL compact multiprotocol device is used as an interface between sensors and PLC



Inspector with large detection range: When a cassette passes the NI10U-M12 proximity switch, the PLC starts the timer for a harvesting operation



The fully flush BI3-M08K miniature sensors in the buffer area detect with a high switching distance the number of harvesting cassettes



Thanks to its robust design and IP67 protection, the Li500-Q25 inductive linear position sensor can also be fitted outside above the front axle, in order to measure the piston position of the steering cylinder

process in the PLC. This multi-layered preparation is necessary in order to synchronize the movement of the cassettes when the machine is fully in motion.

As the asparagus spears do not grow in tidy rows, the harvesting modules can also move left or right in addition to their movement round the circular track. This is driven with compressed air and is therefore always delayed by a few tenths of a second. In order to nevertheless ensure the correct alignment of the cassettes, the PLC obtains information about the distance between the initial and target position of the modules, measured with LE550 laser sensors from Turck's optoelectronics partner Banner Engineering.

Turning maneuver by joystick

Operators use an external control module to control the speed and the hydrostatic steering of the harvesting machine. Two Turck encoders measure the wheel revolutions; AvL uses an inductive linear position sensor to measure the wheel position. For this the positioning element of the LI500-Q25 sensor is linked with the piston of the steering cylinder. In this way, the main controller calculates the angle of both wheels using only one value – and operators can turn the machine easily with a joystick. Unlike the models offered by the competition, farmers do not have to attach the AvL Compact S1560 to a tractor.

Compact I/O module for rapid data exchange

The engineers at AvL decided to use IO-Link communication both for the LE550 laser sensors as well as for the RU40U ultrasonic sensors. The interface supplies additional information in the data exchange and also simplifies the parameterization of the sensors. Turck's compact TBEN-S2-4IOL I/O module routes the IO-Link signals in the control cabinet quickly to the PLC. The communication to the controller is implemented with Profinet.

Deliveries at the start of the season

AvL Motion is proof that startups don't just have to operate only in the software sector or in the relevant digital hotspots. At the same time, however, the company shares the feelings and experiences of many startups – beginning with the solving of a customer requirement, through to the pressure of the expectation to present a functional end product in time. For AvL in time means: in time for the asparagus season. After months of meticulous work, the engineering consultants supplied the first harvesting machine to Neessen B.V., a company based in the Venlo area. According to company boss Arno van Lankveld the robot will be used in future without any operator control. "For the time being we are firstly focusing on what asparagus farmers need acutely".

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Light Chain

KEB Automation optimized four workstations with an assistance system for manual order picking – intuitively guided using a ready-to-connect pick-to-light solution from Turck

System suppliers provide their customers with complete packages from the concept to the implementation. Compared to the niche component business, this has the advantage of less dependence on other market players – end consumers in particular are also provided with a solution with perfectly matched products. If

these items are largely manufactured by the company itself and also come in a large range of variants, the system business soon becomes a challenge for the workers in assembly and logistics. A varied portfolio then involves a large number of different work steps, requiring a great deal of paperwork for orders and



KEB says goodbye to printed material lists and instructions: The pick-to-light assistance system guides employees intuitively and digitally through the packaging process



»We are now using around 250 PTL110 modules which enable us to implement everything we imagined. They are all running like they did on day one.«

Phillip Hannesen | KEB Automation

instructions. Added to this is the training of new employees, such as for the temporary workforce when employees are on vacation or ill.

This was also the case for KEB Automation, a medium-sized company and global specialist for drive and control technology. The company relies on a

comprehensive product offering – whether with controllers, HMI and frequency inverters for a mechanical engineering company or an electromagnetic system for starting, stopping and positioning wind turbines.

Potential analysis in Smart Factory OWL

“We are talking about several hundred device variants per workstation,” explains Phillip Hannesen, project engineer in electronics manufacturing at KEB headquarters in Barntrup. “This includes variants that are built so rarely that a new employee possibly doesn't know them at all.” Due to the large number of order lists and the sometimes long training times involved, we gradually came to the decision to introduce an assistance system for manual operations in production and packaging areas. An initial viewing example was available close by in the neighborhood: at the Smart Factory OWL demonstration platform in Lemgo. Here the KEB engineers tested an assembly station with light-controlled paperless operator guidance using pick-to-light. For Hannesen and his team this was the start signal for a pilot project that the East Westphalian experts implemented in collaboration with Turck.

Bus-capable system instead of cable bunches

The key requirement placed on the assistance system was a straightforward connection to the corporate SAP



QUICK READ

In order to increase quality and efficiency with manual order picking tasks, KEB Automation tested a light-controlled assistance system on a packaging workstation. Turck provided the drive and control technology supplier with a pick-to-light solution based on the PTL110 series from its optical sensor partner Banner Engineering. The ready to connect complete package consisting of power supply, connection cables and bus-compatible PTL modules, such as lights, touch buttons or sensors impressed with is easy installation and wireless communication at selected points. At its headquarters in Barntrup, KEB is now already using the system at four packaging stations. The assembly area is the next plant section to also be optimized.

One by one:
Thanks to the Modbus-compatible protocol, the PTL110 touch buttons can be cascaded easily, thus eliminating the need for labor intensive cabling



The software brings illustrated instructions onto the screen, the operation is confirmed using capacitive touch buttons

environment. We ultimately wanted to avoid having to maintain every change to a parts list in two databases. Thanks to their in-house expertise, KEB programmed a computer-supported user interface for touch monitors and then looked for the right pick-to-light solution with illuminated touch buttons or sensors. First results: "We definitely wanted to use bus-compatible components to reduce the installation effort at workstations with many compartments. Otherwise we would have had real bunches of cables on the shelves," Hanesen reported. The market launch of the PTL110 series from Turck's optoelectronics partner Banner Engineering therefore came exactly at the right time – cascadable individual devices with a multifunctional indication, optional touch button, optical sensor and alphanumeric display. The modules communicate with each other via a Modbus-compatible protocol.

Turck developed a ready-to-connect complete package for the easy onsite integration of the PTL devices, supplied by compact IP67 switched-mode power supply units and connected at both ends by pre-assembled cables plus a plug connector and Y splitter for feeding in the power supply at specific locations. An RS485-USB converter provides the connection to the computer. The new technical possibilities enabled KEB to constantly further develop the assistance system and the company's employees were also included in the development process from the start.

Cascading of 115 PTL modules

A packaging workstation was used first of all as a test environment in the pilot project before being integrated in more complex manufacturing areas. Employees took over here the final assembly operations on large devices in shifts and for example fastened housing



The PTL units operate at the collection points with optical detection, and just a movement of the foot underneath is needed for an acknowledgement

covers or type labels. Accessories were also picked for orders from shelf boxes and packed together in a carton. To increase quality and efficiency KEB initially installed 115 pick-to-light units. These are not only positioned above the shelf boxes but are also used to confirm operating steps on the monitors or to report to the system that a carton with its product and accessories has been moved to one of the loading areas.

Acknowledgement by touch or optical sensor

Employees start an operation by scanning in a device serial number. The associated SAP work plan appears automatically on the screens, and a type label is likewise printed automatically and the material list called. While the monitors show illustrated instructions, a PTL110 module indicates the route to the corresponding removal point. In this case, it lights up in green with a momentary yellow flashing as soon as the pick is acknowledged via the capacitive touch button. Different processes take place in the loading zone, where pallets are placed on low stands and the PTL devices are not therefore mounted at head height. "We got the idea from the fact that the tailgates of several cars can be opened with a foot movement," Hanesen recalls. KEB engineers therefore chose PTL modules with contactless detection for the collection points. Employees now carefully put down the packages with both hands and just have to place a foot underneath the optical sensor as an acknowledgement.

Put-to-light on the short term shelf

When working on the pilot project, Hanesen and the KEB equipment construction department focused less on responding to the company's needs but rather on



The user interface of the program provides employees with precise instructions about the next work step



The PTL110 modules in remote loading areas are connected wirelessly to the overall system

Devices like these frequency inverters are packed at KEB with the help of specific material plans

finding out all the possibilities of the new assistance system. "We therefore intentionally chose the full range of PTL110 devices," says Hanesen. This meant additionally: Lights with 14 different colors and with an animation function if needed. This proved to be worthwhile on one special shelf section, which stores material that is rarely required. KEB calls this system the "Smart Shelf", by which the computer automatically requests a material compartment from the high-bay warehouse which then temporarily has to be made available at the packaging workstation. Employees place the box required in the specified short term area, which in this case is indicated by a blue light, since it is a put-to-light operation. The system sends an instruction as soon as the compartment is no longer needed.

Wireless communication for remote areas

Workstations can be very extensive, particularly in goods packaging areas, due for example to the long conveyor belts, different shelf areas or remotely located loading areas. The pilot project implemented the use of a forklift truck route to cover the distance between core work zones and other locations for goods ready for shipment. Instead of the labor-intensive cabling of the PTL modules over several meters, the East Westphalian specialists used a wireless connection with Banner's DX80 wireless system. Transmitter and receiver were installed within 30 minutes. "Plug and play" was the answer here, Hanesen explained. The wireless solution has already

made an impression with KEB colleagues in the USA, who tested a mobile order picking station with 60 pick-to-light modules. Wireless communication would also be considered in future for combining an assistance system and intralogistic factory vehicles.

Other workstations fitted

"First packaging and then assembly" - this was KEB's schedule for developing the assistance system. Status review after almost a year: In Barntrup alone, the company with 1,500 employees installed four packaging workstations using pick-to-light and put-to-light technology, and involving the installation of more than 250 of the PTL110 devices. The transition on two assembly stations is currently in preparation. "Our exchange with Turck gave us many good ideas, and everyone who participated demonstrated a great deal of interest and ambition," Hanesen stated. The assistance system would now have to be advanced once more for use in production. This will also make use of other slaves as well as the PTL modules, including smart assembly units for screw operations and cameras that check whether components or cables are correctly positioned.

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Parking Assistance

A sensor supported parking system offers protection from parking damage for bulk liquid distributor ADPO in the port of Antwerp – autonomously controlled in the field by Turck's ARGEE logic in the I/O module

If you look at the figures for the port of Antwerp, the problem quickly becomes clear. The second largest harbor in Europe (by handling in tons) covers an area of 153 square kilometers, an area 44 times bigger than Central Park in New York. As the transshipment volume is constantly increasing – from 158 million tons (2009) to 238 million (2019) – and the potential space for expansions and adjoining logistics is limited, the handling of goods must be maximized in the existing area. One route towards this is the shortening of the handling times from the ships in dock to the transportation of the goods by rail or road.

After conventional containers, liquid bulk is the second largest type of cargo that is handled in Antwerp. Logistics companies like ADPO ensure the smooth unloading of tank and liquid container ships. The company operates a 35 hectare terminal on the left bank of the Scheldt for the loading and storage of liquid chemicals. ADPO customers have their goods warehoused, filled in containers and forwarded. The logistics company also offers a complete all-round carefree package for liquid chemical logistics – together with tank cleaning, loading and customs clearance. As the harbor space is in short supply, ADPO also has to increase its efficiency in goods handling.

Manual filling not efficient

Part of the plant on the Scheldt is a cargo terminal for liquid chemicals, which firstly have to be filled in drums before they can be transported further. Up to the middle of 2019, the filling process was still carried out manually. This required a truck with empty drums to be parked at a loading ramp. The filling was carried out manually with a hose. "Competition, however, is strong and that is also why we had to automate here in order to increase our efficiency," says Jan van Mechelen, project engineer at ADPO.

Parking maneuver damages loading ramps

Besides the slow filling speed, another drawback of this solution was the fact that the trucks had to be driven very close to the loading ramp. The flap on the truck trailer was only 40 centimeters deep. Reversing



A tight spot: Without a parking assistant it is almost impossible to bring the trailer precisely to a 40 centimeter distance to the ramp



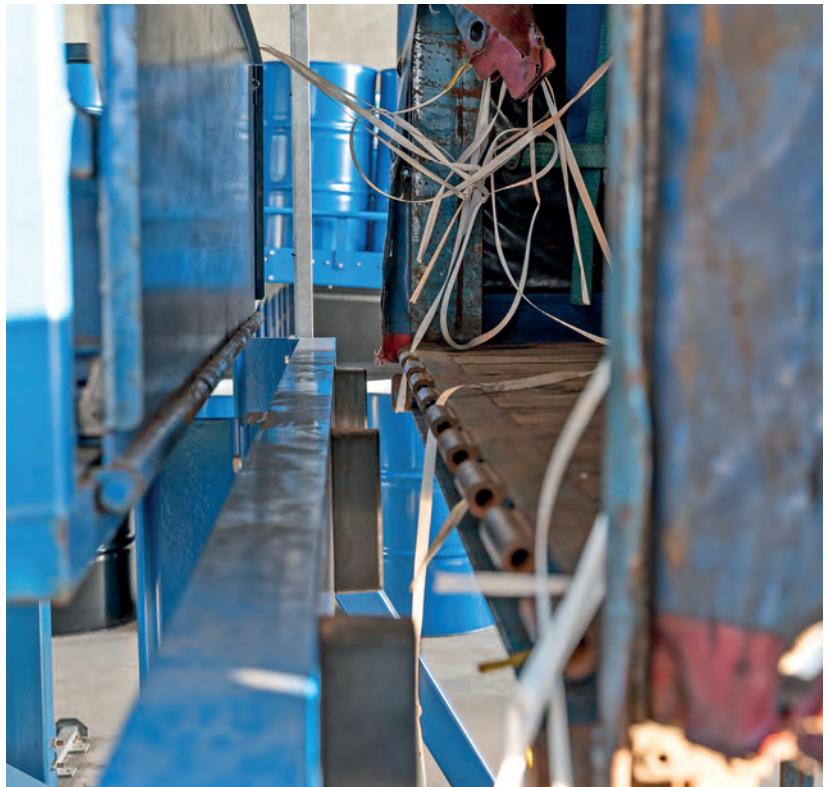
QUICK READ

Logistics services company ADPO fills liquid chemicals from ships into drums. As part of its automation of the drum filling and loading system, Turck installed a parking assistant for trucks at ADPO. The compact ARGEE logic controller in the FEN20 I/O module converts in the field the signals of a laser scanner for controlling a traffic light signal system. This enables drivers to see when they have to stop – and also if people are present within the protected area. This reliably prevents work accidents at ADPO as well as damage to the loading ramp and thus increases the availability of the automated drum filling system.

The truck must be close enough to the ramp for the flap to rest on it securely



The driver stops reversing when the red LED ring is lit



an 18 meter long articulated truck exactly to a distance of 40 centimeters is difficult. Till recently, drivers therefore reversed until the trailer hit the loading ramp. The ramp frequently had to be repaired as a result because the constant knocks from the truck tore the impact barrier out of its anchors.

ADPO in Aalst looked for an optimized solution for this primitive parking system to be included in the development of an automated drum filling system. The order was awarded to Turck's Belgian subsidiary Multiprox, which had already demonstrated its solution expertise in several projects with ADPO, such as an automated entrance opening for goods trains to the terminal site. In consultation with the responsible project engineer Jan van Mechelen, Turck Multiprox developed an automatic parking assistant: "We didn't want to regularly renew the loading supports in the optimized plant. The solution for the automatic filling system also had to detect the exact position of the truck," van Mechelen describes his requirement.

LED traffic light system indicates the distance to the ramp

Turck Multiprox had already developed a suitable solution for similar applications for major logistics companies. Each laser scanner monitors here one of the six parking bays. An LED traffic light indicator signals to the driver the actual distance to the ramp. If the truck is still too far away and the scanner does not detect an object, the traffic light remains unlit. As soon as the truck is within range of the scanner, the green LED ring lights up. The yellow ring lights up once the trailer is 120 centimeters away from the ramp, and the red ring lights up when the trailer is within 40 centimeters from the ramp so that the driver can stop the truck.



ADPO project engineer Jan van Mechelen could "considerably increase the efficiency of the drum filling system" with the Turck solution

When the filling was carried out manually, the precise docking location of the truck was not important since the drums were loaded by hand anyway. With the automated drum filling system, however, a conveyor belt is moved into the opened trailer. A worker standing there lifts the empty drums onto the convey-



Each scanner monitors a parking bay and thus ensures faster loading and additional safety



Mini controller in the field: The compact FEN20 I/O module (right) uses its integrated ARGEE logic to convert the switching signals of the laser scanner to the four states of the signal indicator

or belt. The rest of the filling process is carried out automatically. The precise parking of the trucks in their bays is therefore important.

Decentralized solution saves wiring and costs

The traffic light indicator is connected to a small decentralized controller unit which in turn processes the signals of a laser scanner. It detects here the trucks and outputs their distance to the position of the scanner. As this was actually developed for opening gates, its three digital output signals had to be converted for the signal lights of the LED traffic light indicator. This is implemented with Turck's ARGEE logic controller, which runs remotely on the FEN20 IP20 I/O module in the control cabinet. Simple if-then logic operations are used by ARGEE to convert the digital switching outputs to the appropriate output signals for the traffic light signals. Even using a compact controller for this task would have been an excessive solution.

Then FEN20 makes it possible to program simple logic commands using the browser-based ARGEE

programming environment. Programming here does not mean writing code. The "Flow Editor" makes it possible to use any web browser to create logic control plans via drop-down fields and buttons. The system specialists from Turck Multiprox took this on for ADPO. "For us it was important to have a turnkey solution that we can run straightforward. We did not want to engage our own programmer with it", says van Mechelen.

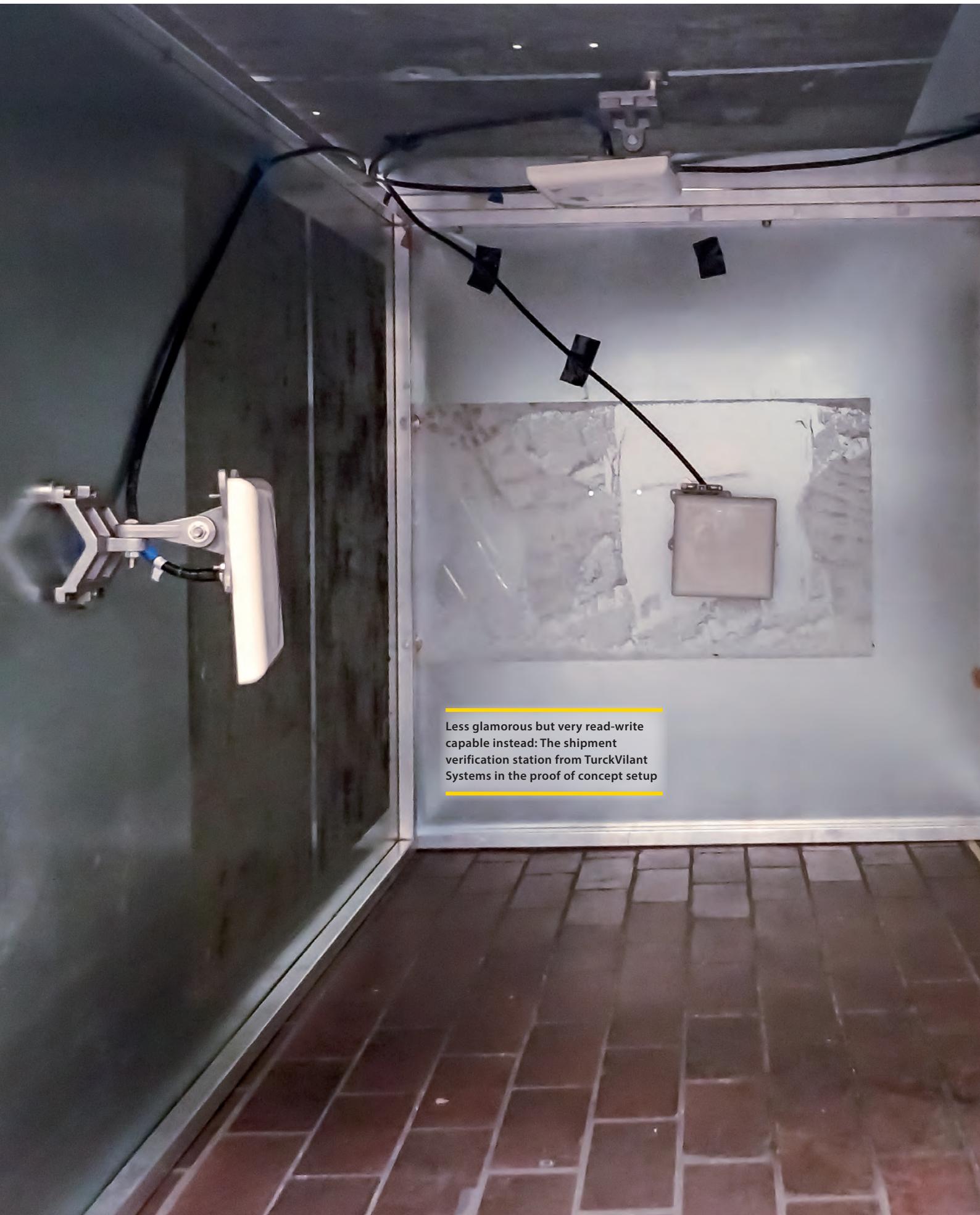
Safety and efficiency of drum filling increased

"The Turck Multiprox solution for automating the process considerably increased the efficiency of the drum filling. The loading time was previously much longer. We were also able to increase safety since the scanner also detects the presence of people in the parking area," van Mechelen sums up.

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Less glamorous but very read-write capable instead: The shipment verification station from TurckVilant Systems in the proof of concept setup

The Tracking Chambers

With its shipment verification station Turck Vilant Systems demonstrates in a proof of concept for Merck KGaA Darmstadt that containers with liquids and metal objects can be recorded reliably and quickly in UHF-RFID bulk read operations



If UHF-RFID technology is superman, water and metal are its kryptonite. This is due to the fact that metal shields the radiation and reflects it, while water on the other hand absorbs it – both prevent reliable read and write processes with passive UHF tags. At its Darmstadt site, Merck KGaA wanted to examine whether it was nevertheless possible to use UHF technology for the verification of pallet shipments. The company, which is particularly renowned for research-intensive pharmaceuticals, generates its sales in the healthcare, life science and performance materials sectors. It is particularly in the performance materials sector where Merck KGaA Darmstadt researches and develops products and solutions for which the company is less known – but which are represented in most households. This corporate division is where liquid crystals or OLED materials are produced for different types of screens, effect pigments for paints and cosmetics or materials for the semiconductor industry.

This is how Merck KGaA Darmstadt has also profited for years from the digitalization megatrend. As part of the digitalization of its own processes, the question was asked in Darmstadt to what extent the recording and verification of deliveries could be automated. In the logistics area, the answer to this question had for years inevitably been RFID. For larger ranges and the simultaneous recording of multiple tags with so-called bulk reading, only UHF technology can be considered. However, this technology presents a problem for liquids and metals. Both, liquid materials as well as metal containers such as barrels, play an important role at Merck KGaA Darmstadt. The company therefore had to first of all establish a solid basis of data from which it could be decided whether bulk readings with UHF-RFID could be used at all for the verification of the specific goods and primary products.

Yanick Luca Kleppinger, who at that time was working at Merck KGaA Darmstadt as part of his final undergraduate year, examined in his final year thesis the effect of different solvents on bulk detection with UHF-RFID technology. As part of this study Kleppinger also carried

QUICK READ

The reliable detection of several RFID tags on a pallet is a challenge, particularly when different objects and liquids are involved. At Merck KGaA Darmstadt initial tests on the verification of shipments with conventional RFID-UHF gates showed that not all substances could be read with sufficient speed and reliability. The UHF-RFID experts from Turck Vilant Systems took up the challenge and were able to demonstrate with their shipment verification station that even ethanol containers and randomly oriented tags could be identified reliably and quickly.



Polar liquids like ethanol are also reliably detected if the tag is positioned correctly

The shipment verification station even detects mixed pallets with different containers and randomly aligned tags reliably and at sufficient speed

out a proof of concept with regard to the question how well different chemicals and containers can be identified with UHF-RFID technology. In the test setup for this feasibility study, he tested the technology using examples of seven pallets that reflected the variety of containers and substances.

Variety of substances and containers tested
The first three test pallets contained cartons filled with glass bottles. The bottles on the first pallet were filled with ethanol, while those on the other two were filled with other solvents. The fourth pallet held ethanol containers made from plastic and pallet five two 200 liter metal drums. Pallet six carried eight smaller drums made from metal. The seventh pallet was used by Kleppinger to test different containers with powder, bottles, plastic objects and metal drums. The test with this mixed pallet also included the examination of whether the read results are reliable even with the random positioning of the UHF tags due to optimized packaging processes. The tests with a conventional RFID gate were promising. The detection of the ethanol pallets did however show differences to the detection of pallets with different solvents. Tags fixed to the inside of the ethanol containers in particular could not be reliably detected. The mixed pallet also presented problems for the conventional RFID gate.

Shipment verification station uses wave reflection on metal walls

The engagement of RFID integration specialists Turck Vilant Systems (TVS) brought a solution. The Turck subsidiary has 20 years of experience in the integration of UHF solutions in several sectors. Besides its own RFID middleware, TVS uses optimal hardware for the application at hand. "Detecting pallets with liquids in an RFID gate cannot be done with a conventional gate

setup," recalls Robert Paulus, the business development manager at TVS who took care of the proof of concept at Merck KGaA Darmstadt. The tags fixed inside were surrounded by liquids on all sides. As the ethanol still absorbs the waves, the inside tags are not detected. "We have had good results with our shipment verification station (SVS) in these kinds of applications, says Paulus. The SVS is a metal box on which the three walls and the ceiling are fitted with UHF read/write heads. The pallet with the objects to be identified is inserted through the remaining opening. "In the SVS we make use of the reflection of the waves on the metal walls. The effect is similar to that of a cabinet of mirrors. The electromagnetic waves are repeatedly reflected and thus also detect points on a pallet that cannot be reached by conventional RFID gates."

Polarity critical for readability

The test with the first three pallets showed that the three solvents had a different reaction to ultra high frequency waves. While the detection of the 120 tags on the pallet containing the ethanol bottles took 30 seconds, the bottles with different solvents could be read in two seconds. The tags on the bottles were read at virtually the same speed as the tags on the cartons, and so the difference had to be in the properties of the solvent. Literature to date had only mentioned that liquids had a dampening effect on electromagnetic waves. The three liquids had similar viscosities but differed significantly in their dampening properties. Kleppinger looked for a different molecular property that differentiated the three solvents: The result of his study was the polarity of the materials was the critical factor. If this finding can be confirmed with further tests, this will represent a new level of research in future on the effect of liquids on readability with UHF-RFID.



In this case the on-metal tags use the drum itself as an extended antenna

orientation of the tags. Small plastic objects that are filled automatically in cartons are also positioned randomly in the cartons. The read results of the SVS were nevertheless completely satisfactory and suitable for the process. All 82 tags were detected within two seconds – in spite of the random orientation of the tags.

Successful proof of concept result

"After our first test setups and the findings gained from them we were very skeptical about the detection of certain products," says Kleppinger. "Through the proof of concept that we carried out with Turck Vilant Systems we now know that even difficult products can be reliably and consistently detected with the right method."

With a read device like the shipment verification station the test pallets examined could be used reliably with all materials for verifying shipments at Merck KGaA Darmstadt and in very good to acceptable read times for logistical processes. Even with the most difficult substance ethanol, the bulk detection opera-

»Through the proof of concept that we carried out with Turck Vilant Systems we now know that even difficult products can be reliably and consistently detected with the right method.«

Yanick Luca Kleppinger | Merck KGaA Darmstadt



Selection and position of the tags critical

Besides the factors stated, successful read results also depend on the correct choice of tag. Turck Vilant Systems also provided its support here as well as with their optimum positioning on the bottles, drums or cartons. The test of the fourth pallet with ethanol containers made of plastic showed that the key to good readability is the fixing of the tags above the fill level of the ethanol. This enables all 21 tags to be read in two seconds. The tags also must not be covered by metal objects.

On-metal tags use metal as an antenna

The test of the tags on metal drums showed on the other hand that the position of the tags was less of a decisive factor. Special on-metal tags were used here, which use the metal drum as an extension of their antennas. All nine tags on the pallet were read within two seconds. The test with eleven smaller drums confirmed this result. With all read operations the tags should in all cases be pointing in the same direction as much as possible.

Mixed pallets with randomly oriented tags

The mixed pallets carrying drums, plastic containers, cartons and bottles could not ensure the uniform

tions with read times of up to 30 seconds were impressive. When using the right on-metal tags, metal containers likewise do not present a problem.

The upshot of Kleppinger's study and the included proof of concept is that, in addition to proving the suitability of RF identification for processes at Merck KGaA Darmstadt, they have also shown that the polarity of the liquids is a critical factor for the RFID read result. This finding ought to be considered with future assessments of UHF-RFID applications for liquids. Not every undergraduate research can claim the discovery of such an impact.

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Paperless Production

A Chinese manufacturer monitors the production process for copper pipes with a Turck RFID system with decentralized control using BL20 gateways

Copper pipes are wound on material frames during several production steps

Humans have been using copper for around 10,000 years. It is easy to work and has characterized an entire age. Why is the metal in such demand today? Because it is an excellent conductor of heat and electricity and is highly ductile as well as being highly durable. It can also be fully recycled. Chinese companies in particular are at present the source of the enormous demand on the world market, and they install around half of the copper mined globally. Not only in cars and high-tech products but also for example in houses, where copper pipes are the preferred choice for plumbing and heating installations.

Production control system requires real-time data
In order to stay competitive, companies have to increase their efficiency while being able to respond better to changes in requirements. The transition from

production-oriented to service and requirements-oriented production also means: greater coordination between man, machine and the product and the provision of more accurate information about the current material flow. A major Chinese manufacturer now has a solution using a production control system – using real-time data from the field. An RFID solution for this was recently supplied by Turck (Tianjin) Sensor Technology Co. – consisting of over 180 read/write heads and some 1,400 robust tags with IP69K protection.

Multi-layer process in metal forming

The company monitors machine and plant parameters such as power, flow rate or air pressure in its SCADA system. For the management of copper pipe production this is more difficult since they are the result of



»The gateway interacts with the MES, which considerably reduces the field wiring. Thanks to its powerful data processing capability, the RFID system operates completely independently.«

Gao Jianqiang | Turck Engineering Control Systems



Turck's Q175 read/write head accesses other remote tags via UHF-RFID technology

many individual processing steps. The process is still standard directly after smelting: with the casting of a round billet and the thermal forming at approx. 950 °C, in which a press converts the billet into a pipe. This involves the insertion of a metal cylinder (mandrel) horizontally into the heated metal, which looks like a macaroni noodle.

Various processes are performed with cold shaping in order to shape the pipes to the required diameter. A drum winding machine draws the pipe several times through narrow metal plates called dies, while a mandrel inside the pipe ensures that the internal diameter also reaches the required dimension. Whether it's pre-drawing, shaping the inner thread, soft annealing or finishing – the production process is distributed in which the work is performed in independent machines.

The product of the previous process becomes the raw material for the next machine – away from a rigid production line. Workers in the Chinese concern previously transferred all the production data manually – for example, information on raw material or process parameters. This was very labor intensive and meant that the data was rarely up to date.

Robust RFID tags for mounting on metal

In order to simplify material management, system

integrators at Turck Engineering Control Systems therefore provided an RFID solution in direct proximity to the machines. This is used to control the entire production process. The engineers made use of the fact here that the copper pipes are located on round metal frames during the production steps in the cold forming stage. The material information about a batch can be linked with the relevant frame, to which an RFID tag can be attached easily. For this Turck uses robust hard tags that are specially suited for mounting on metal and also stay fixed to the frame even when it is

QUICK READ

The production of copper pipes involves many production steps at independently operating machines. Turck equipped a Chinese manufacturer with an RFID system in order to control material flow and avoid the need for labor intensive manual documentation. Q175 read/write heads read out the numbers of metal frames from robust UHF tags. The BL20 modular I/O system transfers this to the company's production control system and at the same time controls the decentralized operation of the RFID readers.



The robust UHF tag can be mounted directly on the metal frame



A programmable gateway in Turck's BL20 I/O system controls the decentralized RFID readers – a great benefit considering the large number of production stations in the company

being rotated at high speed. The number of the particular material frame is stored on a tag, and is then assigned in the production management system to a particular batch. To do this, the production management system accesses the database.

Information exchange between RFID reader, UHF tag and MES

A Q175 RFID UHF read/write head is installed in the close proximity of each workstation. This reads the number of a material frame; and notably with UHF technology, since there is some distance between reader and tag, and the RFID tags are not always located directly in the detection range of the reader due to the rotations of the frame. The link to the production management system enables the exchange between tag, read/write head as well as the higher-level manufacturing execution system (MES).

When a copper pipe is drawn, the machine unwinds it from a metal frame, guides it through the reduction dies and then winds it back onto another frame at high speed. The RFID system ensures that the material data for the pipe can also be uniquely assigned when it is transferred to a second frame. To do this, the Q175 UHF readers read the frame numbers from the RFID tags and transfer them to the production management system. This again assigns the material data about the copper pipe to the appropriate frame and logs the production step at the same time. RFID assists in this way throughout the entire material flow.

Ethernet gateway as independent controller

The communication between the read/write heads and the production management system is provided

by Turck's BL20 I/O system, which also controls the decentralized operation of the RFID readers. In addition to different connection modules such as for RFID devices, it consists of a BL20-PG-EN-V3 programmable multiprotocol Ethernet gateway. This acts as an independent controller of each local RFID system, since no local PLC is in place and a number of field devices have to be addressed in real time.

"The gateway interacts with the MES, which considerably reduces the field wiring," says project manager Gao Jianqiang at Turck Engineering Control Systems. "Thanks to its powerful data processing capability, the RFID system operates completely independently. If a new read/write head has to be connected only a small I/O expansion module needs to be added."

Conclusion: Integration helper for Industry 4.0

Turck's RFID system supports the increasingly digitized manufacturing of the Chinese copper pipe manufacturer. It offers a real-time material tracking capability in production management, which also serves quality control, ensures the clear assignment of materials and transfers data on time inside the ongoing process. "This has considerably improved efficiency and punctuality in production," project manager Jianqiang sums up.

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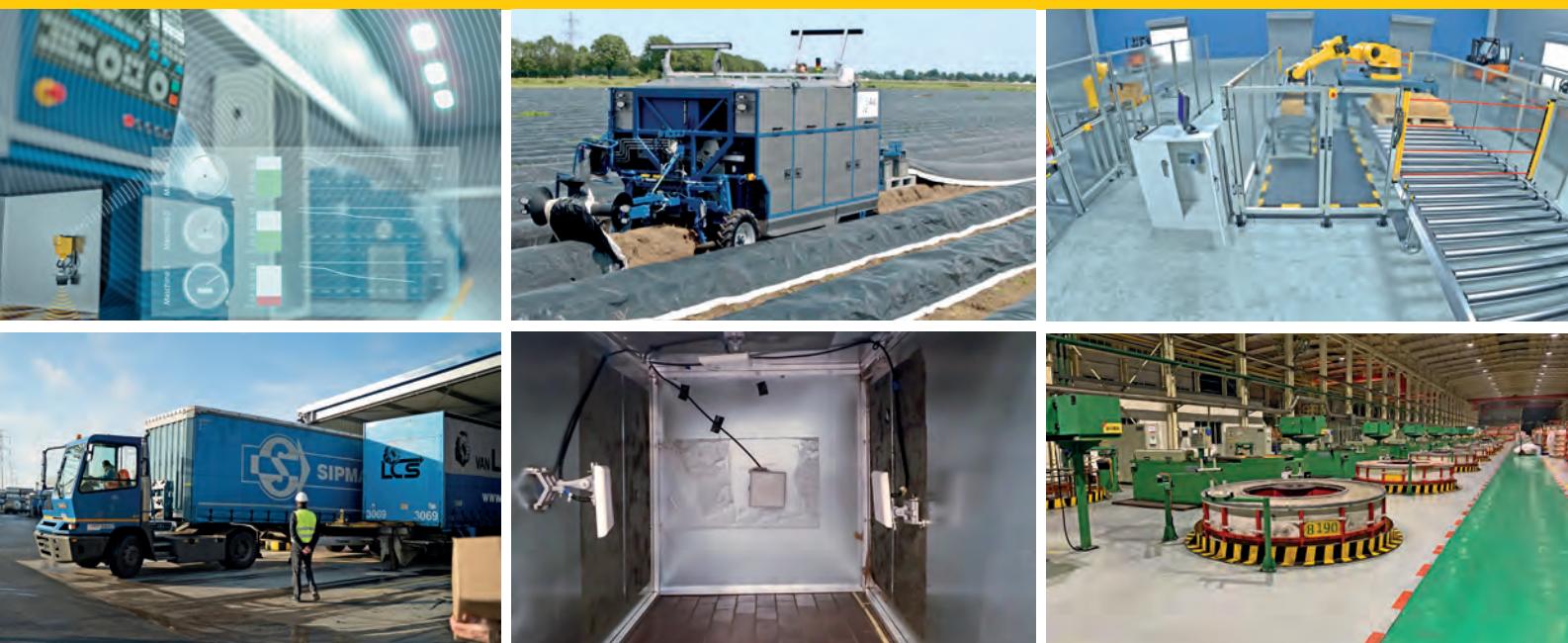
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