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AUTOMATION + CONTROL + INSTRUMENTATION

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ON THE COVER

Global Automation is proud to present the Beijer Electronics X2 extreme family of rugged HMIs for tough environments.

The X2 extreme HMIs are certified by all major classification societies, and are designed to perform in rugged environments and in hazardous areas where gases, vapours and dust are present. Extended environmental capabilities include operating temperatures, high vibration and high-pressure wash-downs.

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For more information visit www.X2extreme.com.au.

GLOBAL AUTOMATION

Global Automation Asia-Pacific
www.globalautomation.com.au

REAPING THE BENEFITS OF THE INDUSTRIAL IoT

USING ULTRASMALL INDUSTRIAL PCs AS GATEWAYS

Jonney Chang, Advantech

One of the problems of implementing an IIoT strategy is having to deal with legacy systems on the plant floor.

The Industrial Internet of Things – the IIoT – is booming. That presents problems for those who manage legacy devices that lack a suitable connection capability. Fortunately, there is a cost-effective solution in the form of an ultrasmall industrial PC that acts as an IoT gateway. This approach allows such benefits as communication, big data analytics and proactive maintenance.

There is clear evidence that the IIoT is rapidly expanding in its reach. For instance, the number of devices connecting to the internet is growing at 15–20% a year and the total of connected objects will reach 25 billion by 2020, according to the research and advisory company Gartner. Another confirming data point is that RNR Market Research predicts that IoT data management demands will increase by 19.3% a year through 2022.

There are several reasons for the advance of the IIoT. One is that the cost of connecting a device has fallen, thanks in part to the continuing drop in price for semiconductor technology. Another driver for the growth of the IIoT is that a benefit of communication is an increase in available data. This means that manufacturing floors have access to sensor and other data that machines generate. In turn, this allows better decision-making about the health of a machine and a process. There can be, for example, big data analytics of an entire factory, which raises the possibility of tuning production to skew it to greater output with a resulting lower failure rate. Connectivity also enables two-way communication, with remote access, monitoring and control of manufacturing devices and systems. This could then move a factory from a reactive repair method of operation to one of proactive maintenance, resulting in less unplanned downtime, greater productivity and lower costs.

Those benefits, however, run into a stumbling block. According to IMS Research, about 85% of devices in use currently are legacy systems and often run standalone, isolated applications. Industrial systems tend to have long lifespans, with many in use for decades. Thus, many of these legacy systems lack any connection capability, have some sort of proprietary connection or are otherwise unable to link up with the modern IIoT. In the Industrial Internet of Things, communication is typically built on Ethernet and web-derived technologies like HTML5.

To overcome this legacy device barrier, plants can deploy an IoT gateway. This will serve as a bridge between legacy devices and the wider world of systems, the cloud and the Internet of Things. However, users need to be sure to select one with the right physical and communication characteristics.

The legacy challenge

Before getting into the parameters of an IoT gateway, first let us look at the nature of legacy systems. Consumer goods have a life expectancy that ranges from at 10 or so years for major appliances and systems down to as little as perhaps 12 or 18 months for mobile technology. Thus, new technology and related standards tend to propagate through consumer goods in relatively short order. That is one reason why some companies are turning to BYOD (bring your own device) IT strategies. This leverages the latest technology, which workers already possess, without requiring an IT procurement/deployment/support cycle.

Industrial equipment, in contrast, tends to have much longer life cycles. For instance, according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers, the life expectancy of heating, ventilation and air-conditioning equipment is 15–35 years.

A similar difference is found in the information processing space. Processors for consumer products may have a production life span of approximately five years. However, processors for industrial systems from major manufacturers have much longer production runs and industrial processor board makers take pains to keep any engineering changes to a minimum. This reduces the high cost of design changes, costly maintenance and upgrade efforts.

There are good reasons to take this approach. Industrial systems are subject to greater temperature changes, more vibration,

increased dust and other environmental extremes than is the case for consumer applications. Thus, industrial equipment and IT require special qualification and careful design to function. What's more, these control and automation systems must often carry out tasks in a manner that can be certified to be safe. Once a certification is obtained, there is even more reason not to make changes. Finally, for many applications that are only concerned with machine control, a simpler and less powerful processor may be more than enough, as proven by the still widespread use of 8- and 16-bit controllers in industrial applications.

What this means in the context of the IIoT is that many legacy systems were designed a decade or more ago. While the IIoT was certainly a possibility then, the basics of connectivity, protocols and programming languages were still being worked out. Consequently, industrial system designers frequently opted not to include any communication capabilities. Doing so simplified the design, saving money and increasing security. After all, a system that is not connected cannot be hacked or otherwise compromised by an outsider.

Those designs and applications that did include a communication capability had to settle on one of several competing approaches that were popular years ago. The choice might be right or wrong in light of the subsequent evolution of technology. But whatever the selection was, it constrained the communication channel and capabilities available to the system for the life of its use in the application.

Still, linking these legacy systems to the IIoT would bring substantial benefits. One is that this would break the barriers that separate operational and information technologies. If the connection is done correctly, one result will be the distance between the automation and control systems on one hand and the data analytics packages on the other would be erased. Data could then flow from the factory floor, be analysed, and appropriate actions and adjustments to manufacturing made. There also could be remote access and monitoring of systems in a plant, leading not only to better control but also better maintenance.

Bridging the gap

An IoT gateway can overcome the legacy challenge by linking systems on the factory floor with the IoT and on to the cloud. In effect, it supplies the missing communication capability. What's more, since it is a single and separate add-on unit, it can be upgraded and changed out as need be. It is also possible to install such a solution in stages, deploying it first to those systems that provide the greatest return on investment and then rolling it out to others when doing so makes the most sense.

An IoT gateway, like any communication solution, must be cost-effective. To see why, consider that it will be applied to legacy systems, so it may be going into situations where the other equipment is substantially or fully depreciated. This helps the bottom line of a manufacturing process but places constraints on any upgrade or add-on. After all, any addition to an existing system could have a significant impact on the bottom line and profitability, making it imperative that the IoT gateway be cost-effective.

In addition, a gateway must offer a wide and comprehensive protocol support. As an add-on, a gateway will have to successfully interface with a variety of PLCs and other devices, which may communicate via different interfaces and protocols. The gateway must be able to deal with all of these. The gateway should also handle data acquisition and protocol conversion of the data into an appropriate format. There is, on one hand, a benefit to increasing computing power at what is the edge of the network, particularly if it can be done without changing the entire structure and architecture of a system or machine. A gateway need not, on the other hand, offer extensive computing capabilities necessarily. This is because heavy-duty analysis can best be done elsewhere, such as in the cloud where compute power can be added on an ad hoc basis.

An industrial PC can meet these IoT gateway requirements and satisfy several other important parameters. Critically, an IPC can be both rugged and compact. The first is a necessity because the application is an industrial one, and so any device will be exposed to temperature, humidity, vibration and dust extremes. An IPC is designed and built to work reliably in such conditions.

As for the requirement that a solution be compact, the amount of available space may be very limited, which means that a communication solution should take up as little volume as possible.

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A related point is that a gateway must be modular. Given that it may need to fit into a small and arbitrarily sized space, it may be necessary for a solution to be tailored so that it offers only the bare minimum of functionality. This is easier to do if a gateway has as flexible a form factor and configuration as possible.

Finally, any IoT gateway must provide web and cloud access, as well as offering support for an HMI. The first option is important for any remote access, such as when connectivity from a distance is desired. The second is extremely useful when changes are going to be made locally. Again, a solution based on an IPC can offer such capabilities.

Reaping the benefits

When installed, an IoT gateway makes it possible to acquire, store, filter and analyse the data generated daily by systems on a factory floor. Such information can prove extremely valuable.

Consider, for example, a lathe used to process a metal part or a laser that welds two pieces together. Either machine could tally up how many parts are processed in an hour or a day, how long the operation takes and various other bits of information, such as a sensor reading as to how successful the material processing is. This data can be combined with other inputs from machines or systems. These can be earlier in the production process. They also can come in later in the sequence, such as a final quality control sensor and associated QC check.

This information can go through analysis, allowing, for instance, the spotting of trends. One machine may consistently output product that has a greater likelihood of being in spec and a lower chance of being rejected. A second may do just the opposite. Big data analytics can reveal such trends, particularly those that involve interaction between machines or conditions that only arise in specific machine processing sequences. The insights possible with this type and volume of data include determining which a machine or set of machines make the best product and offer the highest productivity. Such information, in turn, can lead to better and more streamlined processes, thereby increasing throughput, reducing cost, improving quality and even cutting energy consumption.

Beyond that, more data can improve machine maintenance. For example, linking information on the status of a system with the quality of its output and analysing this data can uncover patterns that can be used to predict machine health — even if there is not active machine health monitoring going on. These patterns and the associated data could then lead to proactive maintenance, allowing manufacturers to move from a reactive stance in which problems are fixed after they happen to one in which issues are resolved before a machine goes down and product is possibly ruined.

There are many benefits to such a proactive approach. Maintenance can, for one thing, be scheduled in advance and at those times when the impact on output is minimised. It could also turn out that maintenance can be reduced, thanks to only fixing machines when there is a need, and not according to some rigid schedule. Finally, the chance that production will be out-of-spec and therefore either reworked or scrapped can be lessened. Together with less unplanned downtime, these benefits can yield a substantial payback.

Conclusion

As pointed out earlier, the IIoT is growing rapidly, but there is a significant barrier: the substantial number of legacy systems that lack the required connectivity. Since these devices still function and represent a substantial investment, they are not going to be discarded. Therefore, to realise the full benefits of the IIoT, a way to bring these systems into it must be implemented.

IIoT integration can be achieved with an IoT gateway. It must, however, be cost-effective, support a wide variety of connection protocols and standards, and provide for remote access, as well as being rugged and compact. An ultrasmall industrial PC has the required form factor and can offer the needed capabilities. Deploying such a system, particularly if it is modular and can be rolled out as needed in stages, can be an efficient way to implement the IIoT.

The benefits of doing so include the acquisition, storage, filtering and analysis of data. This information can increase throughput, reduce costs and improve quality — thereby helping realise all that the IIoT has to offer.

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AGL uses digital twin to optimise power station

AGL Energy Ltd, formerly known as the Australian Gas Light Company, has been in existence for over 180 years, having been founded in Sydney in 1837. As the second company to be listed on the Sydney Stock Exchange, it is not only steeped in history but is recognised as an organisation that readily adapts to customer and market changes.

AGL Energy's Torrens Island Power Station (TIPS) is located on Torrens Island in South Australia, 18 km from Adelaide's CBD. The station burns natural gas to generate electricity with a total capacity of 1280 MW. As the largest power station in South Australia, it is a critical asset, even more so in light of the power generation challenges encountered by the state in recent years.

In striving to move to the next level, the team at TIPS decided to explore the possibility of implementing a process simulator, or 'digital twin', in 2013.

When evaluating their requirements, the team at TIPS took a number of factors into consideration. Not only did they want rigorous training for operators in all aspects of unit, common and local plant operations, they needed to ensure that failure and malfunction situations were addressed quickly and efficiently.

Another crucial aspect was the testing of control and logic modifications, or proposed alterations to plant operating regime (such as different burner patterns, lower minimum load, higher ramp rates, etc) without having a detrimental impact on operations. Being able to test process and equipment modification scenarios using live plant data, yet without affecting operations, was a huge attraction to the TIPS team. With all this in mind, and following a rigorous evaluation process, AGL selected Yokogawa's Plant+ as the process simulator.

With the decision made, AGL engineers moved quickly to implement, completing installation of their new digital twin in 2016. Although one of the initial plans was just to train plant operators, they were conscious of not falling into the trap that many do — just using the simulator as an operator training simulator. The team at TIPS, however, had far greater plans, starting with investigations into effects on unit operations when running without a boiler combustion air pre-heater.

Air heaters are an important component of unit operations from an efficiency perspective. Yet they also require a great deal of maintenance to ensure they are working correctly, with unit efficiency significantly affected when not functioning correctly. In periods of high demand it is not possible to go offline to resolve issues with air heaters, as the financial implications of doing so would be significant. Yet if an air heater failed during periods of high demand, or an air heater was not functioning at all, what would be the effect of running a unit without the heater? This was a scenario that AGL made a decision to test using their digital twin.

There was the very real possibility that one unit may have to run without the air heater during summer. To ascertain the impact on the unit, TIPS conducted testing on the simulator to determine the effects on the process and also define the limitations for the boiler and turbine.

"Obviously the unit would not achieve full output, but we needed to establish where the point at which the unit could be run safely and economically."

The process simulator is an ideal tool to try out the changes, by replicating operations to a high degree. Knowing that they could run multiple scenarios of unit operations without an air heater and monitor the impact on operations was ideal.

The team looked at several ways to run the 200 MW unit without an air heater, eventually deciding to initially run the unit at 100 MW. After various tests it was discovered that at about 160 MW the air and fuel became unstable so would require some tuning.

The team found they could take the unit through all loads up to 160 MW with a reduced ramp rate without any issues.

"Testing included closing in the stack damper slightly to see if it was an option to increase pressure to normal and this worked too. We also didn't need to force any of the safety system parameters and the trip settings were not breached."

Using their digital twin, TIPS confirmed their belief that running without an air heater would be possible. Not an ideal scenario, but knowing they can operate the affected unit to meet consumer demand in the short term and even operate other units without air heaters for short periods provides options. In the pressurised and high-profile environment of power generation in South Australia, AGL's adoption of a digital twin has provided clear evidence that process performance can be optimised in response to plant constraints.

A slightly longer version of this article can be read online at: https://bit.ly/2PU9Oee

Yokogawa Australia Pty Ltd

www.yokogawa.com/au

BATTERY DISCHARGE TESTER

The Megger Torkel 950 is used to perform load/discharge testing to determine the true capacity of battery systems. A 200 ADC current clamp that allows on-load testing is included with the kit. It can be programmed for constant current, constant power, constant resistance or other user-defined load profiles. It is available to rent from TechRentals.

When connected to the included BVM300 battery voltage monitor and logger, the unit becomes a complete discharge test system enabling cell-by-cell voltage measurement. This allows the user to easily identify the battery string that failed the load test. The tests are controlled by a built-in PC and results can be copied over to a USB memory stick.

The 950 works with battery systems ranging from 7.5 to 500 V and can discharge at up to 220 A. The test can be carried out without disconnecting the battery from the equipment that it serves. The unit will sound an alarm when the voltage reaches a level slightly above the final voltage. If the voltage drops to a level where there is a risk of discharging the battery, the test will stop automatically.

TechRentals

www.techrentals.com.au

PROGRAMMABLE AUTOMATION CONTROLLER

The RSTi-EP CPE115 1 GHz programmable automation controller from GE Automation & Controls is designed to run real-time deterministic control applications and is an upgrade from the CPE100 with the addition of DNP3, commonly found in the water, oil and gas industries.

DNP3 support makes the CPE115 suitable for RTU applications with the usability of a PLC, including Ethernet communication protocols such as Profinet, SRTP Client Server, Modbus TCP/IP, OPC UA Server and EGD. Users can take advantage of existing user logic and custom software libraries through GE's Proficy Machine Edition to save on time and overall development cost.

Featuring 1.5 MB of user memory, four Ethernet ports as well as both RS232 and RS485 serial ports, the latest cybersecurity threat protections and a wide operating temperature range of -40 to +70°C, the CPE115 is designed to improve performance, while reducing complexity and cost.

Control Logic Pty Ltd

www.controllogic.com.au

STAINLESS STEEL PANEL PC

iEi Integration's INOX-F15C-ULT3 15″ stainless steel fanless panel PC is powered by Intel's 6th generation Skylake ULT series of processors. The system also supports up to 32 GB of DDR4 SODIMM RAM.

This fanless panel PC features a full IP69K stainless steel housing and the 15″ touch screen comes with a choice of two options: a resistive touch screen or flat glass PCAP touch screen with 6H hardness. The stainless steel design and its IP69K rating make this panel PC a suitable option for deployment in the food manufacturing industry or any other industries where water ingress is an issue.

The system comes equipped with M12 connectors standard and supports a wide array of I/O inputs including two RS232/422/485 connectors, two GB Ethernet ports and two USB 2.0 ports, and it also supports some expansion options via a full-sized PCIe mini card slot, a half-size PCIe mini card slot and a M.2 B-Key.

The INOX-F15C-ULT3 supports many different storage options from the traditional 2.5″ HDD or SSD; to mSATA SSDs and finally the newer and faster M.2 B-Key standard which is faster and much more compact than that of a traditional 2.5″ drive.

ICP Electronics Australia Pty Ltd

www.icp-australia.com.au

SIGNAL SPLITTER

The Acromag SP-230 is a high-performance signal splitter that converts single millivolt, voltage, high voltage, current or thermocouple input into two proportional isolated 4–20 mA control signals. Each channel operates independently to prevent interaction between channels. Galvanic isolation eliminates ground loops, reduces noise and blocks transient signals. They are available in 2-wire loop-powered and 4-wire AC/DC-powered models.

The splitters provide easy configuration via USB with Windows software or Acromag's Agility app for Android. Each universal thermocouple or millivolt input (TC Type J, K, T, R, S, E, B, N or ±100 mV) scales independently at each output. User-selectable filtering (none, low, med, high) is provided, while user-configurable output range clamp levels support NAMUR-compliant operation. The splitters also support reverse-acting (inverse) output, as well as sink or source output wiring.

Along with 1500 V isolation, these splitters have a low 7 V two-wire loop burden, while providing high accuracy, linearity, stability and reliability.

The space-saving 17.5 mm design with pluggable terminals has a shock resistance of 25g and vibration resistance of 4g, along with a wide operating temperature range of -40 to 80°C. The units are also CE compliant, and have UL/cUL Class 1 Division 2 and ATEX Zone 2 approvals pending.

Metromatics Pty Ltd
www.metromatics.com.au

COLLABORATIVE PLANT DESIGN

Bentley Systems has announced the availability of OpenPlant CONNECT Edition, the latest of Bentley's plant design offerings that allows users in the process and manufacturing industries to improve design and operations with a collaborative, intelligent, 2D and 3D plant design environment based on open data standards. OpenPlant CONNECT Edition now provides owner-operators and engineering, procurement and construction companies the ability to design and manage their plant data through cloud-based services, while supporting asynchronous project visibility.

OpenPlant CONNECT Edition is the first application in Bentley's multidiscipline plant design to utilise iModelHub, Bentley's cloud service, which tracks all changes made to project designs and notifies users of changes. Participants can choose to synchronise to and from particular timeline milestones and can visualise, summarise, analyse and interpret the impact of ongoing changes. Utilising the integration between OpenPlant and iModelHub, users can synchronise 3D models from OpenPlant with iModelHub, to view and query the model data in a web-based interface. Users can also perform 2D and 3D consistency checking through integration with OpenPlant PID. A full history of all the changes made to the 3D model and 2D designs are synchronised to iModelHub, including who made changes, what was changed, when changes were made and the date the changes were completed.

Bentley Systems Pty Ltd
www.bentley.com/en-AU

OPTICAL ALIGNMENT SYSTEM

The Pruftechnik Optalign Smart RS5 uses a single laser and a 5-axis sensor, which contains two fully linearised biaxial position detectors and a precision inclinometer. It is designed to accurately measure relative shaft movement in five degrees of freedom. The concurrent 'Live Move' capability monitors the machine corrections in both horizontal and vertical directions with a laser and sensor that can be mounted at any angular position within the shaft.

The instrument also features SWEEP mode, which continuously collects a large number of measurements as the shafts are rotated and can help determine alignment condition. The InfiniRange function extends the detector surface to make it possible to measure machines that have a severe angular misalignment, or are at a distance from each other.

The RS5 incorporates a 3.5″ LED display with alphanumeric keyboard, navigation cursor and menu keys for a user-friendly interface. Additionally, the system has a Bluetooth module for wireless data transmission and PFD report generation capabilities. Alignment Center software is included so users can manage and share measurement files, and easily communicate with the device from a PC.

TechRentals

www.techrentals.com.au

EMBEDDED CONTROLLER

The Aaeon BOXER-6616 multicore embedded controller is a high-performance standalone embedded PC featuring Intel Pentium or Celeron processors, fanless operation, extensive I/O, compact size, low power consumption and robust construction.

The BOXER-6616 is based on the Intel System on Chip chipset to provide an embedded platform with support for Intel Pentium N4200 and Celeron N3350 processors. It is equipped with one SODIMM socket supporting up to 8 GB of DDR3L system memory, two Gigabit RJ45 ethernet connectors, four USB 3.0 ports, four RS232 ports and two RS232/422/485 ports. A 2.5″ SATA hard drive or an mSATA SSD can be internally mounted for operating system and data storage. System expansion is possible via one full-size Mini-Card slot and one half-size Mini-Card slot. The onboard Intel HD graphics engine supports high-resolution displays and provides HDMI as well as one VGA output.

The fanless design of the BOXER-6616 coupled with an operating temperature range of -20 to 70°C makes it suitable for use in industrial and embedded environments. It can be powered from a 9–24 VDC source, and an optional 100–240 VAC power pack is also available.

Interworld Electronics and Computer Industries

www.ieci.com.au

EMBEDDED PCS

This latest fanless embedded controller, powered by Intel's Coffee Lake processors, is the latest member of Neousys' Nuvo Series. The Nuvo-7000 features a significant increase in performance, a variety of I/O connections, flexible expansion and a wide operating temperature range.

Utilising the 6-core/12-thread configuration of Intel's 8th Generation Core Hexa-Core processor, the Nuvo-7000 Series delivers up to 50% computational performance gains over previous generation platforms. It also incorporates computer technologies like USB 3.1 Gen2, M.2 NVMe SSD, up to 32 GB DDR4-2666 RAM and Intel Optane memory, providing higher system performance. In addition, the Nuvo-7000 Series features multiple patented add-on technology options such as a cassette module accommodating PCI and PCIe cards and MezIO Module interface for extra functionality such as COM ports, digital I/O, CANbus and PoE+ ports.

The low power consumption embedded PC supports VGA, DVI and DisplayPort triple independent video outputs and a variety of resolutions up to 4K2K. In addition, the six Gigabit Ethernet ports feature 9.5 kB jumbo frames, teaming and IEEE 1588.

The Nuvo-7000 Series is capable of operating in temperatures as low as -25°C (cold boot) up to +70°C (at 100% loading) and is also equipped with a dependable power design allowing DC power input from 8 to 35 VDC.

The series is available in several models. It includes versions supporting a single PCI or PCIe slot, dual PCIe slots, a low-profile version with a 2.5″ hot-swappable 2.5″ drive bay and a vehicle version with built-in ignition control.

Backplane Systems Technology Pty Ltd
www.backplane.com.au

IOT PROCESSOR

The rNUC released by Kontron is a fanless ruggedised NUC (Next Unit Computing by Intel). Thermally designed to run fanless, the rNUC features the Intel NUC platform running the Intel Celeron J3455 Quad-Core 1.5 CPU.

The fanless application provides for smooth operation in hash environments from industrial to commercial applications where reliability is the main concern. It is an IoT-ready platform offering wireless AC + BT features.

The rNUC can be configured with 2 to 8 GB of DD3L memory, Intel HD graphics, Wireless-AC3168 + BT 4.2 Wi-Fi, 4x USB3, 1x M.2 slot with PCIe x1 lane, 1x Micro SDXC, onboard 32 Gb eMMC storage, software support for both Windows and Linux, and 12–19 VDC input.

Kontron Australia Pty Ltd
www.kontron.com.au

RFID READ/WRITE HEADS WITH IO-LINK

Pepperl+Fuchs RFID read/write heads with IO-Link offer simplicity and flexibility, making industrial networking more efficient. With auto-start functionality, integration is simplified, and combining them with Pepperl+Fuchs Ethernet IO-Link master offers a complete, flexible solution. These devices offer an IO-Link interface (V1.1) in accordance with the international standard IEC 61131-9. IO-Link enables easy and cost-effective integration of read data into higher-level networks.

RFID IO-Link read/write heads operate in the HF range according to ISO 15693 and offer a read/write range of up to 13 cm. The housing designs are rugged and compact, suitable for use in harsh industrial environments. They come in three housing sizes, each with unique advantages based on every application need. A complete solution of RFID components and Ethernet IO modules streamlines communication between all levels of automation, paving the way for Industry 4.0 applications. Each read/write head works with a number of RFID tags to suit a variety of applications.

Pepperl+Fuchs (Aust) Pty Ltd
www.pepperl-fuchs.com

IO-LINK CONVERTER FOR RS232 DEVICES

Serial RS232 communication is still used in many industrial applications. A typical example is the use of barcode scanners in the automobile or packaging industry.

Integrating RS232 interfaces into the existing control architecture is often expensive and time-consuming because special components are often necessary, such as RS232 cards for the controller. This represents an obstacle for many in switching to IO-Link, with the result that they are unable to consistently take advantage of the benefits of this modern communication standard.

The Balluff IO-Link converter for RS232 devices allows users to directly connect RS232 devices to an IO-Link terminal, without the need for RS232 cards. It offers a practical and simple-to-implement solution for uniform and comprehensive communication with all devices and bidirectional data transfer with the controller.

Balluff Pty Ltd
www.balluff.com.au

ADVANCES IN TEMPERATURE CALIBRATION PROCEDURES

*Ehren Kiker**

Recent developments eliminate the need for unnecessary calibrations and speed up the time it takes to do calibrations in the field.

Critical processes in the pharmaceutical and biosciences industries often require frequent calibration of temperature instrumentation. Calibration typically requires shutting down a process every six months or so to remove and replace an instrument (Figure 1), then taking the instrument to a lab where it may prove to be calibrated within specs.

Recent developments in temperature sensor technology now make it possible for a sensor to determine if it actually needs calibration, thus eliminating unnecessary lab calibrations. When a sensor does need calibration, other new developments cut the time needed for a calibration in half.

In this article, we'll look at the need for frequent calibrations in the life sciences industry, what's involved, and how sensor technology is making calibrations easier and less expensive.

Calibrate we must!

Recently, quality risk management (QRM) has become a mandatory regulatory requirement for drug manufacturers. The US

Food and Drug Administration (FDA) and the European Medicines Agency (EMA) publish guidelines and requirements which customers and vendors are expected to follow. Guidelines such as 'Process Validation: General Principles and Practices' by the FDA and Annex 15 issued by the EMA offer input to help drug manufacturers design processes correctly.

Also, ISO9001:2008-7.6, GMP and WHO regulations and standards all require equipment and instrumentation to be calibrated or verified at specific intervals against measurement standards traceable to international or national standards. The main issue with scheduled calibration cycles is the performance of instruments between calibrations.

The blue line in Figure 2 shows how an instrument can deviate over time because of sensor drift, ageing and other factors before being recalibrated back to initial specifications every six months. The deviation between calibrations must always remain below the acceptable level. However, the possibility for an undetected 'out of spec' situation gradually increases over time, resulting in an increased risk of product quality issues.

If a temperature sensor goes out of spec before the next calibration, difficult questions will have to be addressed:

1. When did it go out of spec?
2. How many batches have been affected since then?
3. Do the products made from those batches have to be recalled?

Ideally temperature sensors should be calibrated after each batch, but the costs of doing unnecessary calibrations include labour cost and lost production, and a certain amount of risk is involved in handling and perhaps damaging the instrument. In most cases, the calibration cycle is a statistical calculation based upon the risk of excessive drift of the sensor occurring versus the cost of conducting manual calibrations.

The batch nature of bioscience processes — where batches can run for days or weeks — doesn't really lend itself to such an approach. Fermentation is a good example.

Fermenting processes

Fermentation is used to cultivate cell cultures. The cultures consume a nutrient solution, multiply, and create the desired product. Fermentation typically takes place in a series of bioreactors. Bioreactors are usually made of 316L stainless steel and are jacketed to either cool or heat as required by the reaction.

The cell culture to be grown is placed in the bioreactor, which is filled with a nutrient solution. The nutrient solution varies based on the specific cell culture and desired product but typically consists of glucose, glutamine, hormones and other growth factors. Agitator blades make sure that the solution and cell culture mix thoroughly to promote efficient growth within the vessel. The bioreactors are connected in series, with each successive vessel larger than the previous to contain the increasing cell mass.

The product that results from the reactions can be anything from antibiotics to vaccines and other cell-based products. Typical waste products of the reactions are CO_2, ammonium and lactate. After the nutrient solution is consumed, the reaction is complete and the desired yield has been achieved, the solution moves to the harvesting process, where the product is separated from the dead cells and other waste products.

Fermentation batches essentially are broken up into several phases: sterile media preparation, fermentation, harvest, cleaning in place (CIP), final rinse and sterilisation in place (SIP). There are three common types of fermentation batch processes — single batch, intermittent harvest/fed batch and continuous batch:

- A single-batch fermentation process runs until there are no more nutrients left for culture to consume. A typical run is 7–14 days.
- Intermittent harvest batch runs are similar to a single batch except as nutrients are depleted and product is harvested, fresh nutrient solution is added to allow for longer batch cycles. A typical run is 2–3 weeks. Similarly, a fed-batch process adds nutrients and additional feed solutions, but puts off harvest until the end of the batch cycle. Vaccine production is typically intermittent harvest, while protein production is typically fed batch.
- A continuous batch continually adds nutrients and harvests product and waste with a cell retention device, resulting in higher production concentration. This type of batch is especially used for labile processes such as stem cell production. Nutrients and new cell culture are continuously added and harvesting is done without shutting down the process. The process is only brought down for maintenance, cleaning and sterilisation of the vessel or for calibration.

Figure 1: In the life sciences industries, just getting to a temperature sensor can be a problem because of the number of surrounding devices and the need to maintain cleanliness.

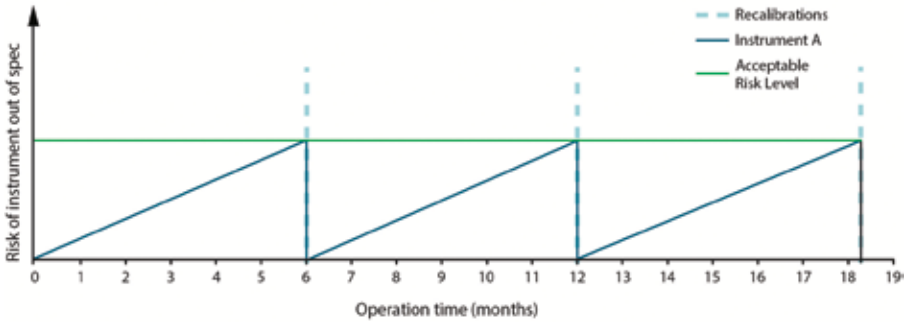


Figure 2: Six-month calibration cycle based on manufacturer's recommendation.

With batches lasting for several weeks — or even months — an undetected out-of-spec temperature sensor could ruin the entire batch, at the cost of several million dollars' worth of spoiled product.

That's because temperature is usually the most important measured parameter in fermentation processes. It's used to optimise growth and productivity and to monitor conditions in the vessel. Temperature is important in maintaining the solubility of the media as well as providing stable conditions for the produced protein. Fermenters usually have multiple sensors (Figure 3) monitoring temperature at various levels within the solution to maintain uniform temperature. Temperature sensors are also in the vessel jacketing to maintain adequate heating or cooling of the vessel.

Cleaning up

It's important that unwanted biological elements (eg, foreign bacteria) do not grow in vessels. Contamination of tanks can result in lost batches or even complete tear down and rebuild of the vessels. To this end, fermentation tanks are typically cleaned and sterilised between each batch with CIP and SIP procedures.

CIP is a cleaning process that consists of injecting hot water and introducing a base to neutralise acids, followed by another injection of hot water. Once done, the entire vessel is rinsed with water. SIP is a sterilisation process that consists of injecting steam into the vessel and holding the temperature at around 121°C for up to an hour.

CIP is commonly used for cleaning bioreactors, fermenters, mix vessels and other equipment used in biotech, pharmaceutical and food and beverage manufacturing. CIP is performed to remove or obliterate previous cell culture batch components. It removes in-process residues and control bioburden, and reduces endotoxin levels within processing equipment and systems. This is accomplished during CIP with a combination of heat, chemical action and turbulent flow to remove mineral precipitates and protein residues. Caustic solution (base) is the main cleaning solution, applied in single pass, with recirculation through the bioreactor followed by WFI (water for injection) or PW (pure water) rinse. Acid solution wash is used to remove mineral precipitates and protein residues.

Calibration

Three-wire, platinum 100Ω resistance temperature detectors (RTDs) are the most common sensor type used. High accuracy and fast response are very important for temperature measurement in fermenters, so sensors are regularly calibrated to maintain measurement accuracy. Sensors within a vessel are also compared to each other to monitor potential sensor drift.

Unlike CIP/SIP processes, calibration of sensors is not always performed between batch runs. One reason for this is that calibration is time-consuming and requires the entire process to be offline, resulting in less production. This results in trade-offs in measurement accuracy and reliability that could cause unacceptable levels of uncertainty to creep into the process between calibrations. Care must be taken by plant reliability engineers to balance these trade-offs when considering a calibration schedule.

Process reliability engineers must give careful thought and analysis when setting calibration frequencies. Calibrating too often results in unacceptable production reductions, while calibrating too seldom can result in out-of-spec product. Consideration should be given to products and sensors that have better long-term stability, lower drift and (if possible) self-monitoring to indicate if a sensor is out of tolerance in between calibration cycles.

Self-monitoring sensors

One of the most recent developments is self-calibrating temperature sensors that have a high-precision reference built into the temperature sensor itself. This is accomplished using a physical fixed point

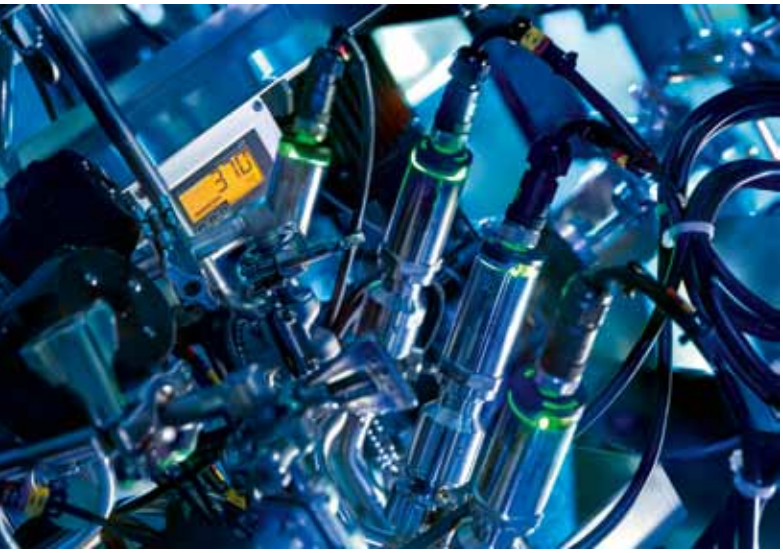


Figure 3: Multiple temperature sensors are used in a fermentation vessel.

Figure 4: Not having to disconnect wiring from a sensor can cut calibration time in half.

known as the Curie point or Curie temperature. The Curie point is the temperature at which the ferromagnetic properties of a material abruptly change. This change in properties can be detected electronically, which then enables the point at which the Curie temperature is reached to be determined.

The Curie point of a given material is a fixed constant that is specific to all materials of that given type. The sensor uses this value in the form of a reference sensor consisting of such a material. This provides a physical fixed point that can be used as a reference for comparison with the actual RTD temperature sensor. The Curie temperature of the material for batch processes is 118°C. Each time a cooling phase is initiated from a temperature greater than 118°C (eg, from 121°C during the cooling phase of a SIP process), the sensor is calibrated automatically.

When the Curie temperature of 118°C is reached, the reference sensor transmits an electrical signal. At the same time, a measurement is made in parallel via the RTD's temperature sensor. Comparison between these two values effectively is a calibration that identifies errors in the temperature sensor. If the measured deviation is outside set limits, the device issues an alarm or error message and perhaps also a local visual indication.

Since the calibration data acquired can be sent electronically and can be read using asset management software, it is then also possible to generate an auditable certificate of calibration automatically.

With such a sensor, calibration can now be carried out automatically each time the temperature passes through the Curie point in SIP processes. This reduces the risk of drift-related process errors which could lead to costly lost production. In some cases, it could allow a facility to reduce the frequency of manual calibration intervals, allowing for greater production.

Quicker calibrations

All sensors have to be calibrated eventually. This involves removing the sensor from the process, which takes time and is subject to errors. The biggest problem is that most sensors require disconnecting the wires while removing the sensor and then reconnecting them after calibration. While the procedure is fairly simple, wiring errors can occur. Wiring terminations are problematic in any manufacturing environment. Such a procedure typically takes about 30 minutes.

> IDEALLY TEMPERATURE SENSORS SHOULD BE CALIBRATED AFTER EACH BATCH, BUT THE COSTS OF DOING UNNECESSARY CALIBRATIONS INCLUDE LABOUR COST AND LOST PRODUCTION, AND A CERTAIN AMOUNT OF RISK IS INVOLVED IN HANDLING AND PERHAPS DAMAGING THE INSTRUMENT.

If the transmitter is improperly rewired or the wiring is damaged, the total calibration time could be increased by 10 to 20 minutes. In some cases, if the damage to the sensor wires is severe enough, it could require replacement of the calibrated temperature sensor.

Another recent development involves RTD sensors with a feature that does not require disconnecting wires when removing the sensor (Figure 4). The technician simply twists the top of the sensor a quarter turn and the sensor can be removed easily. Eliminating the need to disconnect and reconnect wiring cuts calibration time in half. A calibration can be performed in about 15 minutes.

Summary

Temperature is such a critical measurement in bioscience processes that the FDA and other agencies require regular calibration of temperature sensors. Most plants calibrate sensors every six months but sensors can drift out of calibration during that time, potentially ruining expensive batches. New technology makes it possible for RTDs to calibrate themselves at the end of each batch. And, when calibration is needed, another development eliminates the need to disconnect wires, cutting calibration time in half.

**Ehren Kiker is the National Product Marketing Manager for pressure and temperature products at Endress+Hauser. He has over 20 years of automation experience focusing on process measurement instrumentation.*

Endress+Hauser Australia Pty Ltd
www.au.endress.com

ULTRASONIC CLAMP-ON FLOWMETER

Offering a standard range of portable, fixed or custom-designed solutions, the Flotec range of ultrasonic clamp-on flowmeters uses the time-of-flight principle to measure the flow of liquids through a pipe.

With the low power function giving long battery life, and an internal storage capacity of 500,000 data points, the 400-RPF version can be used in the field for over 12 months between charges.

Additional clamp-on temperature sensor options, using a 2-channel temperature sensor input board, enable the meter to be used for energy flow measurement surveys, while adding the thickness transducer as one of the inputs removes the need for a separate thickness gauge.

Interfaces are provided for 4–20 mA analog, digital pulse, RS232 and Modbus.

Used extensively within the utilities networks, the meters have also been supplied for use in the building services, energy management, chemicals, pharmaceuticals and food industries.

With compact dimensions, a low 1200 g weight and IP67 rating, the 400-RPF is easily used in applications where portability is a key factor.

AUTECH Control Group Pty Ltd
www.autechcontrol.com.au

TEMPERATURE TRANSMITTER

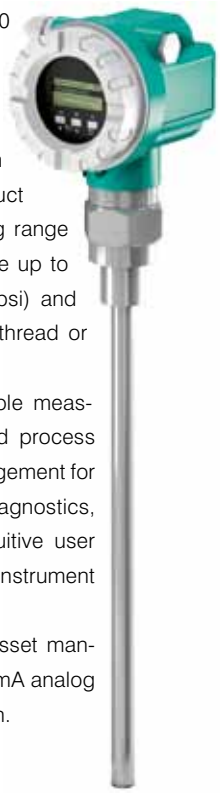
The Krohne OPTITEMP TT 53 is a universal programmable 2-wire temperature transmitter for resistance (RTD) and thermocouple (TC) elements. Aimed at the chemical, oil and gas and power generation industries, it features HART 7 communication, NAMUR NE 107 diagnostics and Ex approvals.

Available in both compact (C) and rail-mounted (R) versions, the transmitter can be programmed via PC or HART handheld, or wireless by using the OPTITEMP Connect mobile app for iOS and Android devices. The app can communicate with OPTITEMP TT 53 via the built-in near-field communication (NFC) or the optional OPTITEMP TT-CON BT configuration kit, a small Bluetooth modem. From a mobile device, the user can program, configure and monitor the transmitter and, for example, set mA outputs, perform an output simulation, view actual supply voltage, check the runtime counter and the current or historical process/ambient temperature log. Via HART 7 communication, some of these readings can also be made available to a PC.

The robust design of the OPTITEMP TT 53 offers vibration resistance up to 10g, a fast step response time and a high accuracy (±0.08% of span; max. ±0.08K), resulting in a high long-term stability (max. drift ±0.02% of span/year). With ATEX and IECEx approvals, the transmitter is suitable for use in hazardous areas. It also offers extended diagnostic information according to NAMUR NE 107, such as device error, sensor break monitoring and wiring conditions. It is also compliant to NAMUR recommendations NE 21, 43 and 53.

KROHNE Australia Pty Ltd
www.krohne.com.au

GUIDED RADAR LEVEL INSTRUMENT



The Pepperl+Fuchs guided radar LTC 50 is a basic device for level measurement in liquid that functions according to the time-of-flight method. The distance from the referent point (process connection of the measuring device) to the product surface is measured. It has a measuring range up to 12 m, operating temperature range up to 80°C, pressure range up to 6 bar (87 psi) and offers a process connection with a ¾″ thread or an adapter flange.

The device is designed to offer reliable measurement even for changing product and process conditions and has HistoROM data management for easy commissioning, maintenance and diagnostics, as well as Multi-Echo tracking. The intuitive user interface is in multiple languages and the instrument is ATEX, IECEx approved.

Seamless integration into control or asset management systems is via HART with 4–20 mA analog (standard) and Profibus PA as an option.

Pepperl+Fuchs (Aust) Pty Ltd
www.pepperl-fuchs.com

MEASURING WHEEL ENCODER

The Tru-Trac encoder from CL Encoder features an adjustable spring-tensioned mounting with the option of either a rubber or aluminium wheel. It can be used for tracking velocity, position and distance over a wide variety of surfaces.

A composite housing makes the product durable and eliminates static build-up. It can be mounted in almost any orientation and operate at speeds of over 15 m/s. The preassembled encoder can be fitted to new or existing machinery in minimal time while its simple-to-adjust torsion load ensures a firm grasp onto moving product without causing excess wear.

Suitable for OEMs, integrators, electricians and maintenance specialists, the encoder is a suitable solution for many applications such as web tension control, paper monitoring, glue dispensing, material length counting, printing, conveyors, labelling and material handling.

Control Logic Pty Ltd
www.controllogic.com.au

CONTRAST SENSORS

SICK KTS and KTX contrast sensors utilise SICK's TwinEye technology for improved contrast detection and sensing distance tolerance (±5 mm). They have a specially developed high-precision three-colour LED with its colour-mixed light spot, and jitter has been minimised.

IO-Link and additional integrated functions such as recipe management ensure versatility, while the multifunction 7-segment display provides simple yet customised sensor set-up, operation and visualisation.

The sensors detect high-gloss materials and complex contrasts, even on heavily jittering materials. The integrated colour mode also enables detection of minor contrast differences and colour features.

The KTX product family offers compatibility with previous models: the pattern for mounting the sensors and the electrical connectivity facilitate a 1:1 migration with previous SICK product families.

In its space-saving compact housing, the KTS contrast sensors come in CORE and PRIME configurations; these offer different levels of functionality, enabling a variety of different automation needs to be met individually and economically.

SICK Pty Ltd
www.sick.com.au

PRESSURE SWITCH

The WIKA PSM-550 pressure switch can switch electrical loads up to 230 VAC, 10 A with a non-repeatability of the switch point of ≤1%.

The pressure switch can be delivered both with setting ranges for gauge pressure (0–300 mbar to 10–30 bar) and with vacuum setting ranges (-1 to 0 bar and -0.8 to +5 bar).

It is therefore also suitable for monitoring vacuum circuits, eg, in cleaning processes. The robust instrument has an ingress protection of IP67. There is also a PSM-550 version for medium temperatures up to 170°C, which has wetted parts constructed from stainless steel.

The PSM-550 pressure switch has been designed for use in heavy-duty applications from pumps and hydraulic systems through to autoclaves.

WIKA Australia
www.wika.com.au

LASER DISTANCE SENSOR

The Micro-Epsilon optoNCDT 1750 laser sensor is able to measure distance and displacement up to 500 and 750 mm, bringing the total measurement range from 2 to 750 mm.

The robust and powerful laser sensor is suitable for measurement tasks in industrial automation applications. It also has a real-time surface compensation (RTSC) feature that can adapt quickly to changing surfaces, enabling measurement on fast-moving and changing surfaces. The laser triangulation sensor can also be used to measure on various surfaces and objects, such as semitransparent plastics and ceramics, PCB material, carbon and glass fibre-reinforced plastics.

As the sensor measures independently of the material and colour, it offers great flexibility for real-time quality inspection in almost any industry such as electronics production, automotive, packaging, machine building and automation technology. The laser sensor also has a small spot size, enabling detection of small objects.

An enhanced measurement algorithm and components are also integrated in the sensor, providing high bandwidth for dynamic applications. Its compact design also enables installation in confined and limited space.

It also offers a user-friendly web interface for operation and set-up using predefined presets. Up to eight user-specific sensor settings can be stored. The measurement output can be obtained via an analog or digital RS422 interface. The sensor itself is equipped with two switching outputs and one input to control different functions.

Bestech Australia Pty Ltd
www.bestech.com.au

DP FLOW TRANSMITTER

The VEGADIF 85 is a differential pressure transmitter developed with safety in mind, and also offers the option of measuring differential and static pressure simultaneously with one instrument. Housed in a compact single-chamber case, the transmitter is designed for economic efficiency and installation with low space requirements.

VEGADIF 85 is now qualified and approved according to SIL-2 (SIL-3) for manufacturing processes that depend on certified components.

Differential pressure transmitters are characterised by their high accuracy in measuring flow rates, even at pressures of only a few mbar. They also handle extreme temperatures with no problem. Many different process fittings are available in conjunction with single- or double-sided chemical seals: denoted as CSS or CSB respectively.

VEGADIF 85 sensors are also equipped with a second, piezoresistive detector, making it possible to measure both differential pressure and static pressure in parallel. For example, they ensure a high degree of fail-safety in pipelines by determining the dynamic pressure and the superimposed static pressure at the same time: a measuring task that previously required two separate pressure transmitters.

Bluetooth configuration is now available as an option, and includes current encryption modes at the interface level (via PC or smartphone) as well as the necessary access codes that protect the sensor from unauthorised access.

The electronics used in VEGADIF 85 are 100% intrinsically safe and flameproof according to ATEX, IECEx and CSA. This means that the instruments can be safely adjusted at any time, even during operation in hazardous areas.

VEGA Australia Pty Ltd
www.vega.com/au

COMPACT TEMPERATURE TRANSMITTER

The Acromag ST132-0600 thermocouple/millivolt input 2-wire transmitter is a tiny, puck-style unit 4.5 cm in diameter and easily scaled for -40 to 80°C input. It is designed to be a simple way to monitor temperatures inside an enclosure.

The transmitter can be mounted inside the panel and the input terminals' jumper shorted to measure ambient temperature without a sensor. The 4–20 mA output is connected to a PLC, DCS, controller or recorder. No thermocouple or other sensor is necessary. This approach uses the internal cold-junction compensation sensor within the transmitter as the ambient temperature sensor.

The product has advanced signal processing capabilities, variable range input and convenient USB programming. The transmitters can withstand harsh industrial environments and operate across a wide temperature range with low drift (<75 ppm/°C). They feature RFI, EMI, ESD, EFT and surge protection plus low radiated emissions.

Metromatics Pty Ltd
www.metromatics.com.au

pH SENSORS

The Leuze electronic Turtle Tough pH sensor features a compact solid-state, non-porous, cross-linked polymer embedded in a HDPE support matrix. This enables the sensor to hold excess KCl, assuring saturation at all temperatures for stability and long sensor service life in applications where little or no maintenance will be performed. The standard glass is many times stronger than common pH sensors and delivers a broad range performance. The CPVC immersion-style body has a ¾″ MNPT threaded connection on the front and back end.

Recommended applications include industrial, chemical, food and beverage, semiconductor, pharmaceuticals and wastewater. They are suitable for any measurement where aggressive chemical cleaning is needed to remove fouling or low-maintenance operation is required with minimal cleaning and recalibration.

The sensors are available with the Turtle Tough digital smart sensor technology (DSST). This plug-and-play sensor has a quick-connect fitting, eliminating the need for hard wiring to the analyser. Onboard sensor memory allows the storage of calibration data, analyser configurations and sensor service history. This allows the sensor to be conveniently maintained and calibrated off-site or in the laboratory and preprogrammed with calibration data and analyser configurations. This stored information automatically uploads to the analyser on connection and eliminates the need for any interaction with the analyser, greatly simplifying the change-out of sensors. A service log stored on the sensors is suitable for maintenance and quality assurance records.

Leuze electronic Pty Ltd
www.leuze.com.au

PRESSURE, TEMPERATURE AND VOLTAGE INDICATORS

Status Instruments has launched the DM650 series of pressure, temperature and voltage indicators with features including logging, relay output, user-configurable text display messages and the option of loop power.

The DM650TM version has an ABS IP67 housing and will accept RTD and T/C probe inputs with standard and custom probes available for surface, panel and direct mounting available.

Other features include a stainless steel IP65 housing, long-life lithium battery (user replaceable), max/min recall, 5000 reading data logger and USB configuration.

The relay can be configured as high/low/deviation with adjustable hysteresis, with latched or non-latched operation and can be used to alert on a low battery condition.

The loop-powered version is powered by the loop current and a single AA 3.6 V lithium battery is also fitted to allow display function and data logging to continue in the event of loss of loop current. This is useful for displaying error messages and maintains the log function, allowing the user to determine the loop loss period.

The battery life is dependent on the number of active features such as the alert LED and logging options but has a minimum life of two years.

Logged data can be retrieved by the USB interface or via the NFC Android interface in conjunction with the downloadable app.

All logged data is timestamped by the internal real-time clock and the NFC interface is also capable of starting a new log with different log modes.

Applications include food manufacturing and storage, beverages and pharmaceutical industries.

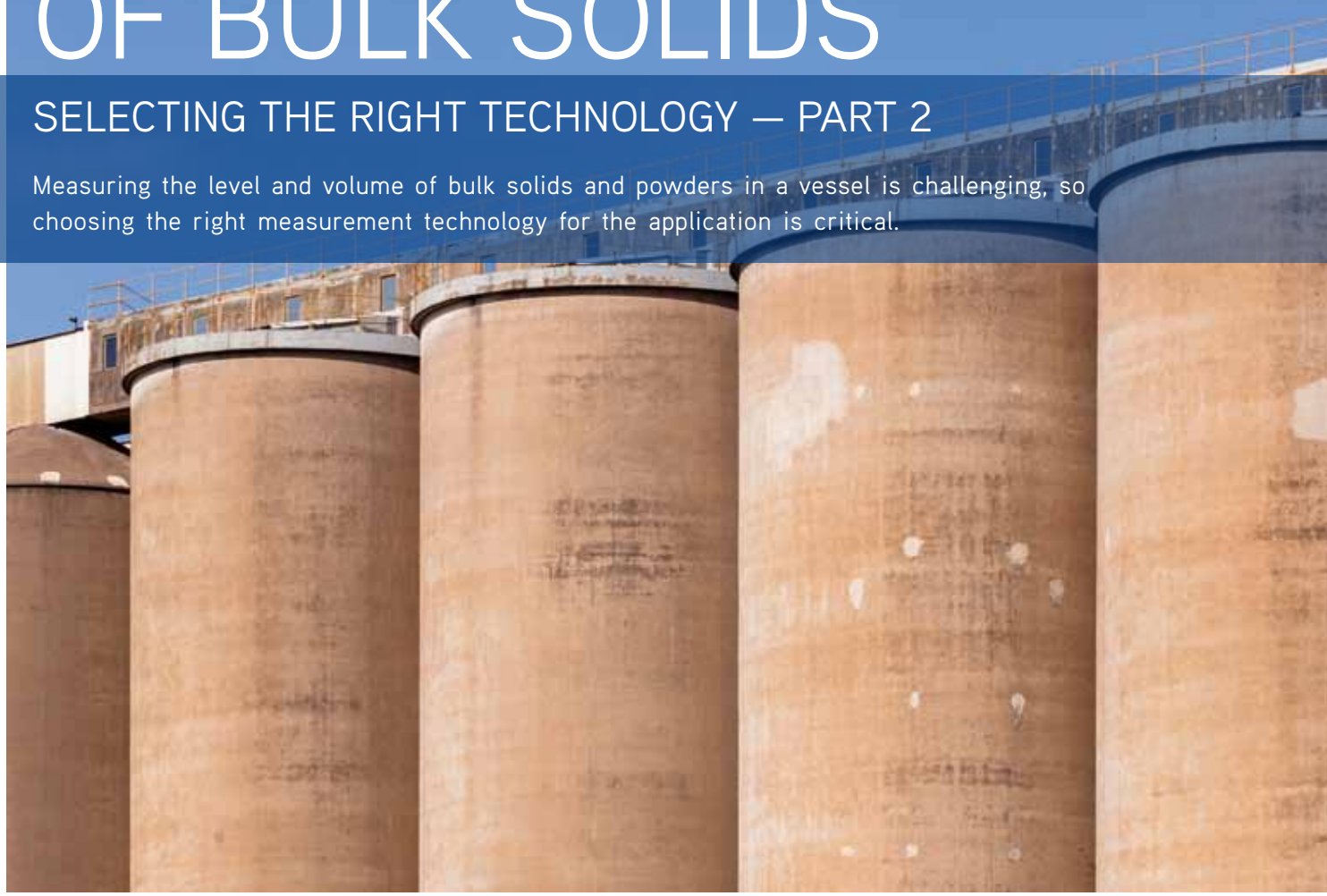
W&B Instruments Pty Ltd

www.wandbinstruments.com.au

MEASURING THE LEVEL AND VOLUME OF BULK SOLIDS

SELECTING THE RIGHT TECHNOLOGY — PART 2

Measuring the level and volume of bulk solids and powders in a vessel is challenging, so choosing the right measurement technology for the application is critical.



Measuring the level and volume of bulk solids and powders in a vessel is considerably challenging. In Part 1 of this article we examined the automated versus manual methods and looked at radar technologies. An alternative technology to radar comes in the form of the latest 3D solids scanners, which use acoustic phased-array antennas to deliver multiple point volume measurement and enable remote visualisation of a surface, therefore providing an unmatched degree of inventory control.

Acoustic phased-array antennas

3D solids scanners, based on acoustic technology, include an array of three antennas, which generate a mix of three audible dust-penetrating low-frequency acoustic signals, and receive multiple echo signals from the contents of a storage vessel. Using these integral antennas, the scanners continuously measure the direction and distance of each echoed signal, and generate a coordinate for each of the echoes inside the vessel. The built-in digital signal processor digitally samples and analyses the echoed signals and produces accurate measurements of the level and volume of the stored contents by mapping all of the signals across the entire surface within the beam angle of the device.

The wide beam angles produced by acoustic phased-array antenna devices are especially suited to very large vessels, which are typically used in bulk storage inventory applications. In these large vessels, the angle produced by the three frequencies used (2.7, 4.5 and 7 kHz) allows more of the surface to be 'seen' giving the greatest measurement accuracy with the fewest number of devices.

When the correct number of devices are installed in the right locations on a vessel, this enables the entire surface to be seen by the devices. This allows for optimisation of vessel storage capacity and can greatly improve optimisation of production efficiency.

3D mapping

Acoustic phased-array antenna devices not only provide continuous online volume measurement but also offer visualisation of the various peaks and valleys within vessels. The ability to visualise the formation of the material is important because uneven sidewall loading caused by uneven filling and emptying can cause a bin or silo to collapse, with potentially catastrophic consequences. 3D mapping provides a better understanding of how the material is distributed within the vessel, and therefore helps to prevent the threat of structural damage to the container. Also, as the 3D mapping is displayed on remote computer screens, it eliminates

the need for personnel to be put at risk by climbing vessels and being exposed to harsh conditions.

Matching the received data with known vessel dimensions allows 3D solids scanners to calculate product volume, enabling the immediate and continuous accurate listing of inventory value for accounting and financial reports. It also allows for annual or rolling inventory measurement, which is a primary requirement in preventing the over-purchasing or under-purchasing of products.

Efficient inventory management allows companies to have the right amount of stock in the right place at the right time, and ensures that capital is not tied up unnecessarily. Replacing a level measurement device with a 3D solids scanner can immediately save between 8% and 13% of the on-hand inventory cost. Based on an annual inventory carrying cost of between 25% and 52% of on-hand inventory, this translates into a lot of money and a quick return on investment.

Advanced features of acoustic phased-array antennas

New features allow for creating individual virtual sections within vessels and monitoring the average, minimum and maximum level within those particular sections. The virtual sections feature allows for use of a controls system to keep overall levels across the vessel even.

An additional new feature is the ability to set the centre of gravity per silo. Using this feature, when the centre of gravity moves outside the designated zone, an alarm is given. This provides a warning that the centre of gravity has shifted and there may be some structural concerns for the vessel itself. These additional features add even more safety and controls capability for solids monitoring.

Application characteristics

Whichever technology you select, there are certain variables that can affect accuracy and reliability in solids measurement. Therefore, it is important to select the right technology to best overcome each of these variables discussed below.

Uneven surface

Most technologies for measuring level or volume of solid materials are top-down measurements and depend on a signal reflecting from the surface back to the device. Guided wave radar is less affected than non-contacting radar by uneven surfaces since the microwave signal is more compact and guided by the probe. But that advantage can be quickly lost by the realisation that a probe is required and less of the surface is seen. Non-contacting radar is affected by uneven surfaces since much of the signal is not reflected directly back and instead may be redirected away from the device. For best results, the device needs to gather several smaller echoes concentrated in an area and then merge them into a single echo and have an effective way to decipher between the surface echoes and noise. Some newer non-contacting radar devices take advantage of advanced algorithms which do this step seamlessly inside the device.

Acoustic phased-array technology is not affected by the uneven surfaces and it triangulates all the measurement over a wide surface area, resulting in high accuracy volume and average level calculations.

Dielectrics and bulk density

The dielectric constant of some solids might be fairly low. For radar technology, this is a key indicator of the amount of signal that will be reflected back to the gauge and therefore the possible measuring range. Devices based on radar technology are not affected by bulk density. The acoustic technology is not affected by dielectric properties but can be affected by bulk density, although most solids materials do not absorb enough of the acoustic signal. In general, a bulk density below 0.2 g/cm^3 should be looked at carefully.

Dust

There is often a considerable amount of dust created during the fill cycle in solids applications. The amount of dust depends on the type of filling and the material. Radar and acoustic phased-array antenna technologies can both handle dust in the vapour space fairly well. However, a heavy layer of dust on the antenna can block the signal. With non-contacting radar, an air purge system may be required. However, some users may be reluctant to use air purging due to the cost of maintaining the airflow, or the fact that air purging may disturb the process. An alternative solution is provided by devices with a process seal antenna. With guided wave

Figure 1: Example of an acoustic phased-array solids scanner.

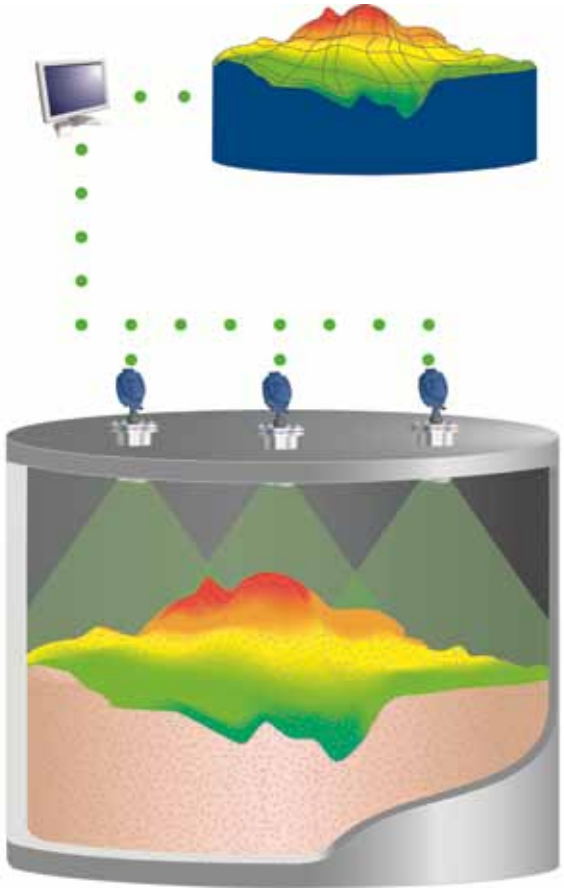


Figure 2: 3D mapping using a solids scanner.

radar, the natural flexing of the probe can knock off excessive dust build-up. The fact that acoustic devices operate at lower frequencies is an advantage in dusty applications, because low-frequency soundwaves are absorbed less as they travel through dust than high-frequency soundwaves. Also, the vibrating membranes in acoustic devices drive out any dust particles that coat the horns, making them inherently self-cleaning. In applications where the dust is especially sticky, non-stick antenna materials may be necessary.

Condensation and sticky build-up

Condensation is present in many solids applications — with the vessel ceiling being a common location, as this is normally the coldest spot. Unfortunately, this is also where top-down measurement devices are located. Condensation can also tie up dust and create a layer on the wetted parts that may cause problems if no action is taken. Even without condensation, some materials may just inherently create a sticky build-up. Guided wave radar is not affected by condensation, so is a good choice for applications where there is extreme condensation. But build-up on the probe may need to be monitored and devices that can monitor the signal strength using advanced diagnostics are helpful in these situations. Non-contacting radar may need air purging or a process seal antenna to cope with condensation-related issues, and sticky build-up can be minimised with these solutions as well. Diagnostics for signal strength can help determine if and when additional cleaning might be needed. Acoustic phased-array antenna technology includes self-cleaning functionality, which reduces the need for maintenance, but caking build-up can affect signal strength. A regular maintenance schedule may be required for extreme instances. Using a PTFE antenna can help reduce maintenance requirements in these cases.

Mounting location

The mounting location of a measurement device in relation to the vessel's filling location is important for most measuring technologies, as dust and the actual stream from the filling can disturb the measurement to a large extent. The closer the device is mounted to the filling point, the larger the risk of measurement interference. There are also cases where the material is blown into a silo through a pneumatic process. Due to the nature of acoustic phased-array antenna technology, measurements can be affected during such filling but the effect decreases with increased silo size.

With guided wave radar devices, the probe should be mounted as far away as possible from filling and emptying ports, to minimise wear and help avoid disturbances from the incoming product. Also, the probe should be regularly inspected for damage. The minimum recommended probe distance to silo wall or disturbing objects is 50 cm and the probe should not be able to touch the wall of the silo during operation. Best practice is to have a free-hanging probe but an anchored probe is sometimes needed for application reasons. The probe end should not be fixed for 30 m or longer probes. The probe must be slack when anchoring, to reduce the risk of breakage.

Non-contacting radar devices should not be mounted in the centre of the vessel or very close to the silo wall. General best practice is to mount non-contacting radar devices at 2/3 silo radius from the silo wall. The inlet stream of the product will interfere with

Figure 3: Non-contact radar air purging.

> THE MOUNTING LOCATION OF A MEASUREMENT DEVICE IN RELATION TO THE VESSEL'S FILLING LOCATION IS IMPORTANT FOR MOST MEASURING TECHNOLOGIES, AS DUST AND THE ACTUAL STREAM FROM THE FILLING CAN DISTURB THE MEASUREMENT TO A LARGE EXTENT.

readings if it is in the path of the non-contacting radar beam. Cone antennas and parabolic antennas should be mounted perpendicular to the ground and should protrude at least 10 mm into the vessel.

Acoustic phased-array antenna devices should also be mounted perpendicular to the ground to ensure highest accuracy. Devices should be mounted with the antenna at least 10 mm below the standpipe of the nozzle. It is also important to know the location of any obstacles in the vessel, as some obstacles may affect the measurement. If an obstacle can't be avoided by relocating the device, a neck extension can be used to extend the antenna past the obstacle. To get the highest accuracy, it is important to make sure the distance to walls and filling points is at least 600 mm and to use the recommended device quantities and locations as provided by the manufacturer.

Noise

Many bulk solids applications are in noisy environments. The noise can be generated by running engines, conveyor belts or during filling/emptying, depending on the method. Sound has no effect on radar-based devices. Acoustic devices might be impacted by noise around the 2.3, 4.5 and 7 kHz frequencies. However, it is rare that all three frequencies are disturbed at the same time and an acoustic phased-array antenna device can work even if two frequencies are compromised. The effect can often be mitigated with a different location of the device or possibly a different configuration.

Electrostatic discharges

In some applications, such as plastic pellets, electrostatic charges can build up and eventually discharge. Guided wave radar devices are most suitable for these applications. While their electronics can tolerate some static charge, providing a good earth ground for the electronics by anchoring the end of the probe to the vessel will create ground paths for discharge away from the electronics. If the product can build up static electricity, the probe should be properly grounded.

Open air applications

Open air applications include measurements on piles and distance control between conveyor belts and the pile. These types of applications have different properties compared to standard vessel applications. There are no walls or roof on which to install instruments, so the biggest challenge in these types of applications is to find an installation point. Protection from external factors like wind and rain can also be a challenge. Non-contacting radar or acoustic phased-array antenna technology is recommended in these types of applications. Non-contacting radar devices are not affected by outdoor conditions, though can only deliver a single-point measurement, while acoustic phased-array antenna devices will not be affected if the wind speed is less than 30 km/h.

Summary

Bulk solids measurement involves many different variables. With the variety of technology choices, this information should help you be better prepared to evaluate these technologies for your specific application.

Emerson Automation Solutions
www.emersonprocess.com.au

INTEGRATING I/Os INTO PROFIBUS PA

Whether it is called a multiplexer or a gateway, users will find several applications for the PROFIBUS PA device from Phoenix Contact. It comes in five profiles and bundles simple digital and analog inputs and outputs into one PROFIBUS PA telegram. Users can integrate analog and digital I/Os into the system via the PA head station, Radioline I/O modules and the four-channel NAMUR input module.

Since all signals are transferred to the control room from the field via PROFIBUS PA, users can perform the entire installation with standard PROFIBUS PA cables. The five application-specific head stations allow simple implementation in the field. No additional software is necessary due to the preconfigured head station.

The five head stations with specific function sets also use the regular RADIOLINE expansion modules. The entire assembly is IECEx/ATEX Zone 2 compliant, and the head station requires no programming. Setting up the communication telegram in this system is done from the DCS or PLC controller, and modules can be replaced without interfering with the software or configuration. Other advantages include inherent scalability and the ability to integrate into a host system via an EDD or GSD file.

Phoenix Contact Pty Ltd
www.phoenixcontact.com.au

CONVERTERS, GATEWAYS AND EDGE CONTROLLERS

The Beijer Electronics BoX2 is a series of protocol converters, IoT gateways and edge controllers that combine connectivity in different ways. The series is said to solve the challenge of finding smart ways to access data and bridge the gap between the worlds of industrial automation and IT. It makes information from a deep industrial level easily accessible in a structured, cloud-based data environment.

The series facilitates data exchange and transfers data securely to the cloud for remote access and analysis. It also allows users to create mobile solutions and add local control on the edge of the cloud to perform corrective measures on a machine. It is configured with smart ready-made functions to manage many scenarios, such as sharing data between PLCs of different makes; creating IoT solutions to store and access data in the cloud; presenting data on mobile devices via HTML5 screens and dashboards; integrating local CODESYS control; and adding smart functions such as local database storage, alarm servers, recipes, C# scripting, etc.

BoX2 is easily configured in WARP Engineering Studio where users interconnect machines and IT systems in the cloud. Smart local functions such as local database storage, alarm servers, data exchange, reporting and C# scripting are configured via Beijer's iX software.

The series is available in base, pro and extreme versions and can operate in tough environments including electrical noise, large temperature spans and vibration.

Global Automation Asia-Pacific
www.globalautomation.com.au

DELTA ROBOT ASSEMBLY

Comprising maintenance-free toothed belt axes, lubrication-free links, encoders and stepper motors, igus has developed an easy delta robot solution for assembly tasks. It is sourced directly from stock as a preassembled construction system or delivered ready to install.

The robot is based on three maintenance-free drylin ZLW toothed belt axes, lubrication-free igubal coupling bars and matching adapter plates. NEMA stepper motors and encoders ensure the quick handling of up to 1 kg with a precision of ±0.5 mm. The complete system has an installation space of up to 420 mm in diameter and can carry up to 5 kg at low speeds. The lightweight construction with aluminium and plastic provides high speeds with a pick rate of at least 60/min.

Depending on the user's requirements, the robot can be delivered as a preassembled construction kit with assembly instructions or as a ready-to-install system in a transport frame. As an option, the customer can use their own software and control system or the igus dryve D1 control system. The robot is suitable for simple assembly functions, pick-and-place tasks and applications in inspection technology.

Treotham Automation Pty Ltd

www.treotham.com.au

A NEW ERA OF CONNECTIVITY, THANKS TO OPC UA

Harry Mulder, Engineering Manager, Omron Electronics

OPC UA fulfils the connectivity requirements of industrial applications, by providing both vertical and horizontal communications to industrial controllers.

One of the biggest frustrations expressed by the manufacturing industry over the years has been the inability of controllers on the factory floor to exchange data with each other and with supervisory systems. This lack of connectivity and interoperability between devices has meant that basic data and other vital information has gone unreported. The main cause has been the absence of an adequate protocol and a method of data exchange that's appropriate for the automation industry. This article will discuss how many of these problems have been resolved with the advent of OPC UA.

Background

In the early days of industrial controllers, every automation vendor created their own (often proprietary) protocol over serial links. Despite these protocols all performing essentially the same function, incompatibility was immediately created whenever controllers from different vendors were used together. This prevented communication between devices and made connection to higher-level supervisor systems, like SCADA, all the more difficult. However, because ubiquitous internet connections did not exist, these networks were closed to the outside world and had none of the concerns we find today, such as cybersecurity risk.

Open vendor communication networks

With the inevitable push from end users, changes started to happen around 25 years ago, firstly in field networks. Vendor-neutral associations like the ODVA produced open network standards like DeviceNet and promoted them throughout industry. They gained popularity as more and more vendors embraced them in their products. This trend towards openness continues unabated to this day. EtherNet/IP, EtherCAT, Profibus and Profinet, to name a few, are all open vendor networks, meaning anyone can produce devices for them and at minimal cost.

Open networks allow one vendor's controllers to connect to, say, the drives of another vendor and the I/O blocks of a third vendor. This interoperability gives end users two distinct benefits. Firstly, as multiple vendors produce similar items, end users can choose a 'best of breed' technology, improving their overall systems. Pricing is also kept honest, as end users are no longer locked into one particular vendor who controls the price.

However, the trend towards openness in data or controller-level networks has been slower. This may be due in part to the uniqueness of the requirements; namely, the real-time exchange of complex data. Modbus RTU is probably the most commonly used industrial serial protocol and has became a de facto standard. While serial links are now considered legacy, the Modbus protocol can be encapsulated within the Ethernet TCP framework, to form Modbus/TCP. Its adoption has been quite widespread, mainly due its simplicity, which allows comparatively easy implementation. However, its relatively inefficient master/slave polling methodology and its treatment of data as being flat and dimensionless (ie, a set of raw bits, without data type) preclude it from many applications, such as real-time control.

OPC DA

The first real attempt at producing a robust, open vendor protocol, with high-level functionality required for both the automation and process control industries, came with the OPC DA standard in 1996 (now often referred to as OPC Classic). It was created by an industrial automation taskforce headed by Microsoft, and it represented a significant step forward from serial protocols.

OPC defines a set of interfaces, objects and methods, as well as events that can be based on a client's criteria. Variable data is handled in a much more sophisticated way — it's presented hierarchically with data type and with three attributes: value, quality and timestamp. These relate to measure, trustworthiness and freshness respectively. In addition, data indicating the status of the controller, such as its operating mode, presence of errors and much more, are automatically served up.

Client/server architecture is utilised by OPC primarily for scalability, as nodes can easily be added to the network. Here, a server node holds data and makes it accessible to one or more client nodes. Clients can be distributed across a network and can request data from a centralised server. The server listens on the network and responds to clients' requests. Networks can consist of multiple OPC servers, which can connect to multiple clients as required. A typical network is shown in Figure 1.

HMI/SCADA vendors were among the earliest adopters of OPC DA. Previously they had been forced to create their own custom drivers to extract data from third-party devices (mainly controllers). This consumed considerable resources and required much maintenance. The OPC DA standard allowed them to create a single driver for an OPC DA client, and abstracted them away from the more difficult task of interfacing to third-party devices. In many cases, the driver for the OPC DA server was sourced by the same vendor that supplied the hardware. Being the producer of the device, they had integral knowledge of it and were the obvious choice for a driver.

The OPC Foundation

The OPC Foundation was formed in 1994 to take on the administration and promotion of OPC. It's a vendor-neutral, non-profit consortium which today has over 500 members. It has been instrumental in the advancement of the suite of OPC standards, which includes Alarm & Events, Historical Data Access, Batch and others.

One important role of the OPC Foundation is the certification of products to ensure they fully comply with the standard. There are two methods are available for this: self-certification via the CTT (Compliance Test Tool) offered to members and independent, real-world testing by third-party laboratories.

OPC UA

OPC DA underwent three revisions over the years, but with the rapid adoption of the internet as a means of interconnecting industrial sites, it become clear that a more rigorous revamp was required. The end result was OPC UA (Unified Architecture), which was released in 2008.

Highest on its list of design priorities was backward compatibility with the OPC DA standard, so that existing installations did not need to be modified. Also high on the agenda was the move away from Microsoft's COM technology, which had restricted OPC's use exclusively to Microsoft's Windows platforms. The need for DCOM, which handled networked connections between computers, was also removed by the creation of a completely new communication stack. This was a relief as DCOM had proved problematic for many users.

The decision to make OPC UA usable on almost any hardware platform or operating system was so significant that it may have been the catalyst for changing the meaning for the OPC acronym. It originally stood for OLE for Process Control (DA signified Data Access). OLE means Object Linking and Embedding, a technique tied solely to the Microsoft Windows operating system. OPC now denotes Open Platform Communication, to signify its move to open systems.

OPC UA details

OPC UA utilises a service-orientated architecture (SOA), with well-defined services that negate the need for WSDL (Web Services Description Language). It uses two protocols: a binary protocol optimised for high performance and a web service (SOAP on HTTP). Another handy feature is the ability to discover devices on a network, which is useful in large networks.

OPC UA was made firewall-friendly expressly for internet connections, which also demand strong security. Authentication is supported, for both human users and applications, via either a password or digital certificate. The X.509 format of digital certificates is used by OPC UA, to safeguard the integrity of data messaging. Digital certificates are used to generate public encryption keys which are exchanged between nodes. They can be issued either by a trusted, external certifying authority (CA) or created locally from user details where they are known and self-certifying certificates. Certificates can be revoked and will eventually expire and require re-authentication.

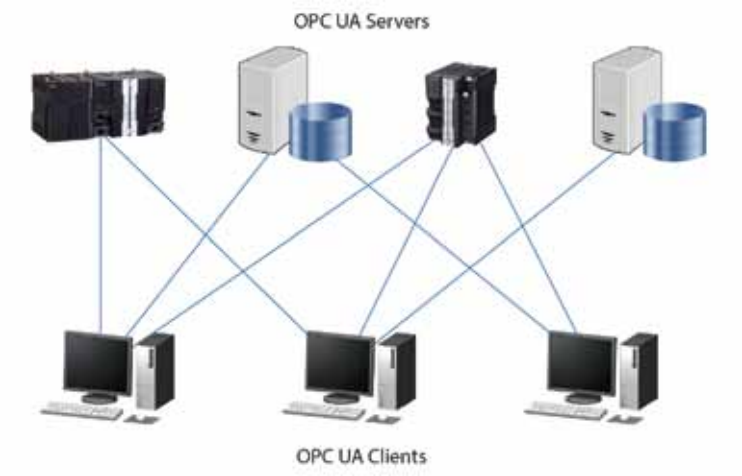


Figure 1: A typical OPC UA network.

Design Criteria of OPC UA	Meaning	OT priority	IT priority
Availability	Reliability, giving access whenever needed	Highest	Lowest
Integrity	True data, manipulation prevention	Medium	Medium
Confidentiality	Authentication and encryption, for disclosure prevention	Lowest	Highest

Table 1: The main design criteria of OPC UA and the conflicting priorities of the OT and IT departments.

Users decide on a security policy, which establishes the cipher strength (128 or 256 bits), encoding method and whether to just digitally sign or to sign and encrypt each message. Encryption ensures confidentiality, while a digital signature (a unique code generated by a hash function that is appended to each message) verifies a sender's authenticity and prevents both non-repudiation and man-in-the-middle attacks.

OPC UA is also designed for extensibility. The OPC Foundation continues to develop the standard, and the latest version (v1.04) was released in November 2017. This version added publish/subscribe functionality as an alternative to polling, to achieve more efficient use of network bandwidth.

More than an isolated standard

As OPC UA is an international standard (IEC 62541), it seeks to cooperate with other established industry standards. It integrates into the widely adopted IEC 61131-3 industrial programming standard and is listed as a recommendation for the RAMI 4.0 (Reference Architecture Model Industrie 4.0) paradigm.

OPC UA serves as a basis for both the PackML (Packaging Markup Language) standard for the packaging industry (ANSI/ISO-TR88) and EUROMAP 77, which defines the data exchange between injection moulding machines.

The next logical step

There can be little doubt that OPC UA is a robust standard which has established a long history in the industrial automation industry. But for all its advantages, the question of why it has not been more widely implemented should be asked.

Up until now, most OPC implementations have relied on gateway devices (usually PCs) that gather data from multiple field devices and serve it up as OPC UA. While workable, this configuration needs gateways — which means more hardware and software, adding to costs and maintenance. It also introduces latency, which can be a problem for real-time applications.

A simpler, more logical topology is for industrial controllers themselves to act as OPC UA servers. Controllers are already connected to most field devices and are usually good repositories of data, which they need to manipulate within their programs. OPC UA then just becomes another network protocol they support. This arrangement makes OPC UA more accessible and easier to use.

Conclusion

OPC UA effectively fulfils the unique requirements of industrial applications by providing both vertical and horizontal communications to industrial controllers, regardless of the vendor. This link has been missing for too long in many installations, but will need to be functioning if modern trends towards the IIoT, and the resulting cloud-based big data, are to become a reality.

Table 1 lists OPC UA's main design criteria. Fortunately, OPC UA manages to satisfy the rather divergent priorities of both the OT (operational technology) and IT (information technology) aspects of industrial control systems. It has been designed with internet connections in mind and is as secure and reliable as the underlying technology will allow.

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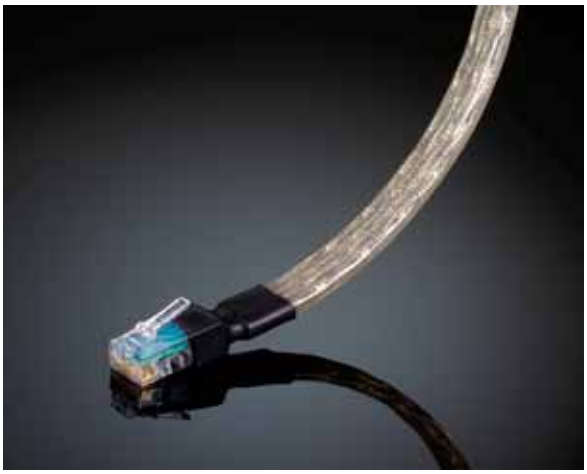

CLEANROOM CABLES

Designed for Class 1 cleanroom use, the contamination-free networking cables from Cicoil are free of halogens and do not shed surface particulates.

They are suitable for use in cryogenic environments and semiconductor manufacturing equipment applications. In addition, the cables meet the air cleanliness requirements of ISO 146441, exceed the outgassing requirements of ASTM E595 and are suitable for vacuum environments as well.

The range of Cicoil network cables includes Ethernet (Cat 5e and Cat 6a), dual shielded Camera Link cables, controlled impedance cables, USB (2.0 and 3.0), flexible coax (50Ω and 75Ω), HDMI and FireWire cables. The cables are available for quick delivery and are available completely assembled with connectors. Anti-friction coatings, custom shape and torsion designs are also available by request.

Providing long-term flex service life, the lightweight designs don't require internal lubricants and are an alternative to round cables. Cicoil's extrusion process allows individual shielded power and signal pairs to be separately encased in a single flat cable, while also meeting applicable data network speed and electrical requirements. Spacing, insulation thickness and overall cable shape are precisely controlled and the rectangular cross-section allows multiple flat cables to be stacked with almost no wasted dead space between cables.

The transparent Flexx-Sil rubber outer jacket is self-healing from small punctures and will not wear, crack or deform due to long-term exposure to deionised water, alcohol, tight routing, vibration, temperature extremes (-65 to +165°C), UV light, mechanical stress or many chemicals.

Treotham Automation Pty Ltd
www.treotham.com.au

DATA STORAGE SYSTEM

The iEi Integration IBX-660 Data Collection Server supports for up to four 2.5″ SSDs or HDDs and allows for up to 8 TB of storage.

It is powered by the Intel Atom E3845 1.9 GHz quad core processor, enabling the system to be both powerful and efficient with up to 8 GB of DDRL RAM.

The system has a rugged and fanless design and is intended to be deployed in hash environments. It supports a wide operating temperature range from -40 to +50°C and is also compliant with the military-grade MIL-STD-810G-514.6E-1 standard for vibration, making it suitable for installations in both a factory or vehicle environment.

The product has a fully integrated range of I/O, including two Gigabit Ethernet ports, two USB 3.0 ports, two USB 2.0 ports and a 9–36 V power input terminal block.

ICP Electronics Australia Pty Ltd
www.icp-australia.com.au

SCRAPED SURFACE HEAT EXCHANGER

Designed for both hygienic and industrial applications, the R Series from HRS Heat Exchangers uses a rotary scraper bar capable of rotational speeds up to 300 rpm, providing high levels of shear and mixing at the heat transfer surface, which dramatically increases heat transfer rates. This makes it particularly suitable for challenging heat transfer applications, such as those where the product has the potential to crystallise during processing or where aeration is required.

The scraper rod features both a helical mixing spiral (which reduces the pressure drop in the tube) and a series of scraper blades. Together these provide a continuous scraping action that mixes highly viscous products and reduces fouling. The unique design enables high-viscosity products to be pumped with reduced back pressure and lower energy use, in a compact unit that features a much smaller footprint than traditional heat exchangers for similar applications.

The gearbox design not only reduces noise but also allows multiple tubes to be fitted inside a single shell from a single electrical drive, further increasing the available heat transfer area within the same shell footprint and aiding maintenance. Cleaning and maintenance is further improved by the sealing system used in the R Series, which allows individual tubes to be removed for easy servicing and replacement if necessary.

The HRS R Series is available in two lengths (1 and 2 m) and with one-, three- or six-tube options providing a range of surface areas between 0.35 and 4.2 m^2.

HRS Heat Exchangers Australia New Zealand

www.hrs-heatexchangers.com/au/

NEW PRODUCTS

MOTOR FEEDBACK SYSTEM

The SES/SEM70 motor feedback systems feature a hollow shaft diameter of 25 mm and are installed directly on the motor shaft — so there is no need for any strap connections or mechanical couplings. After installation, it is also possible to read out the position of the rotor using the PGT11-S programming device, providing a reliable way of identifying installation errors. The small design saves space and weight and is rugged and wear-free due to bearing-free technology. Sick is also working on another size featuring a hollow shaft diameter of 50 mm, plus a safety variant that is SIL2-certified.

The multiturn variant with a mechanical gear mechanism — eliminating the need for additional components such as external buffer batteries — can capture up to 4096 revolutions.

The SES/SEM70 motor feedback systems are suitable for use in torque motors and rotary tables, as well as in the diverse area of direct drives within robot applications, injection moulding machines, woodworking centres, semiconductor technology and handling systems.

SICK Pty Ltd
www.sick.com.au

POWER MEASUREMENT I/O MODULE

The AXL F PM EF 1F power measurement module is the latest addition to the Axioline F I/O system range from Phoenix Contact.

The standard parameters for detecting energy and performance data are preset to facilitate easy start-up. If necessary, these parameters can be changed using PDI objects. For many use cases, voltages up to 400/690 V and phase currents and a neutral conductor current of up to 5 A can be directly connected without a transducer. If this is not sufficient, external transducers can be added to expand the measuring range.

The measured values are used to calculate values such as the active power, reactive power, and apparent power and energy. In addition, S0 pulses are available. The grid quality (THD) can be also analysed, making it easy to localise disturbance sources.

The Axioline F housing concept, in conjunction with secure electrical isolation, enables installation of the power measurement module without additional measures for isolating the adjacent I/O modules. The I/O system supports all popular Ethernet-based network protocols and is fast and easy to install.

Phoenix Contact Pty Ltd
www.phoenixcontact.com.au

TOTALISERS FOR FLOWMETERS WITH PULSE OR ANALOG OUTPUTS

Many applications call for converting flowmeter pulse or analog DC current signals to Ethernet for extended remote monitoring and control applications.

For flowmeters with a pulse output, Acromag's 989EN-4016 16-channel discrete I/O with counter/timers act as Modbus TCP/IP transmitters for instrumentation and control, remote monitoring and sub-metering applications. Applications include water usage sub-metering, liquid filling and transfer processes, including the use of discrete outputs for limit alarms and control.

The 989EN-4016 has eight configurable counter/timer channels with 32-bit up/down pulse event counters, 16-bit periodic timers for last pulse state and momentary latch alarms for each counter. It also has rugged operational features such as overtemperature, overcurrent and overvoltage output protection and wide operating temperature.

For flowmeters with a 4–20 mA current loop output, Acromag's 993EN-4016 16-channel DC current input to Modbus TCP/IP transmitter with configurable integration/totalisation functions is used. Each channel A/D is 16-bit resolution with a fast 8 ms scanning rate for all 16 channels. Sample averaging is software configurable as well as scaling registers on all channels along with automatic calibration and self-test feature.

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RFID technology ensures accurate paper production

It is clearly evident that digitalisation has left its mark on the paper industry. Does print media face an uncertain future or will haptic page turning hold its own? Both theories have their proponents, but German company Kabel Premium Pulp & Paper (Kabel) and its paper mill are showing no sign of dark clouds on the print horizon, with the company manufacturing high-quality paper around the clock.

Since 1896, Kabel has been manufacturing for the biggest printing houses in Europe. The Hagen-based company in Germany's Westphalia region initially manufactured newspaper; now it specialises in coated paper for high-quality catalogues and magazines, handling a total capacity of around 485,000 tons per year.

To maintain a strong overview of the multistep production process, Kabel utilises an RFID-based identification solution, with an integrated high-performance, wireless transmission system. This enables workers at Kabel to constantly track and determine in any given paper batch which production step is currently being processed.

Kabel produces each roll of paper — known as a 'tambour' — in line with client specifications, and overhead cranes transport them from one processing step to the next. Depending on the particular paper thickness, the rolls, measuring 7.20 m wide, carry around 50,000–60,000 m of product and weigh up to 20 tons.

Production faults in Hagen can mean tens of thousands of metres of paper wasted. Therefore, to keep a close eye on the production of each individual roll, Kabel uses a custom-made RFID solution from system integrator Intelligent Data Service (IDS) with 26 RFID reading devices provided by SICK.

"We required a solution to ensure the automatic detection of tambour cores in the production flow," explained Johannes Broer, who is responsible for IT at Kabel. "Our requirements included, among other things, reliable system components and wireless data transmission to our IT system. The components used are exposed to process-related contamination, dust and heat. They must be able to withstand contact with chemicals or machine oil.

"We therefore had to rule out optical detection-based solutions due to the risk of contamination."

Additionally, a solution with very short read times was required since the tambours are constantly in motion. "Apart from the fact that the reading stations can be hard for our workers to reach, the long identification numbers can also result in manual input errors," he continued. "Automated detection allows us to ensure accurate tracking and relieve some of the burden on our workers."

The tambour cores are marked with passive RFID tags, which are read at individual stations. When the tambour is rolled out for the first time, the system records which tambour core the batch is assigned to, and from this point on, each station will accurately read out via RFID which tambour core the paper is being wound into and from.

A total of 26 UHF RFID reading devices from SICK are being used at the factory in Hagen to decipher the passive tags on the cores. Depending on the reading distance, an RFU620 is used for a scanning range of up to 1 m and RFU630 for larger scanning ranges. Passive RFID tags have no energy source of their own that would require regular inspection and are more reliable than active tags when it comes to processing. They are the ideal option for objects that come under heavy mechanical strain such as tambour cores.

At Hagen there were a number of factors that had to be taken into consideration, including metal reflecting radio waves, which can result in system faults. It is for this reason that the RFID tags on the metal cores had to be chosen so that close proximity to metal wouldn't pose a risk of failure.

IDS integrated the SICK reading devices into its roll online tracking system, known as 'Rolf', which IDS developed itself. The system collects all results directly from the RFID reading devices, visualises them and makes the data available for further processing. This means that all process data can easily be viewed in the production database at Kabel and each tambour is directly assigned.

"It was a tall order and we are happy to have found the right partner in SICK," explained Rainer Marchewka, Managing Director of IDS. "We have been working with SICK for 15 years. We know that we can rely on them and also that long-term system support is guaranteed."

RFID-based roll tracking has now been in operation for over a year. "We are happy that we opted for this solution," said Broar. "In truth, we have worked with RFID-based identification solutions previously, albeit with active tags. These are indeed advantageous when it comes to reading range, but the battery runtimes were too short and also the tags were too susceptible in this environment. We are very pleased with this solution and the collaboration with IDS and SICK."

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AS I SEE IT

DMC VS RFID IN MANUFACTURING

The increasing discussions and regulations on complete traceability and reliable identification of products is making identification systems an inevitable part in manufacturing. Two technologies have been well received: The Data Matrix Code (DMC) and Radio Frequency Identification (RFID).

In order to choose DMC or RFID for your application, you have to understand the fundamental differences between the two technologies. Both have their advantages and disadvantages, and the wrong decision could have costly consequences. The technology you choose will mainly depend on the object being identified: based on size, shape and the environmental conditions.

DMC camera scanners can already reliably read dot patterns of only 2 by 2 mm, so DMC is suitable for very small products or round surfaces where there is little room for marking on the product. With DMC you can place a lot of information in a very small area. Article or batch numbers, manufacturing or expiration dates as well as other important manufacturing data can be stored permanently on the work piece across all processing steps.

Additionally, the error correction when reading a DMC is very high due to information redundancy and DMC's error correction algorithm, so that even 25–30% contamination or damage of the data field can be fully compensated.

RFID technology makes it possible to unambiguously identify every item that is equipped with an RFID data carrier. An RFID system in manufacturing consists of thousands of data carriers (also called tags or transponders) and a minimum of one read/write device (usually called a reader) with an antenna.

RFID tags are available in many different designs, some as simple as an adhesive tag, while others can be a hard tag such as a disc, bolt or glass tag. Tags of only a few millimetres in size can be used for tool identification and very large transponders for container identification.

Advantages of RFID are that the tag can be read or written without visual contact with the reader, the tag has almost unlimited rewritability and several tags can be read simultaneously. These features open up new usage possibilities that DMC cannot provide. If the RFID tag is integrated in a pallet or tool and you can't even see it, it can still be identified, even with the greatest possible contamination.

With the rewritability of the tags you also have the chance to change, delete or supplement the data on the chip at any time. Every production step can be documented, read and written directly on the RFID tag in or on the part. To avoid security issues, data can be encrypted, password protected or set to include a 'kill' feature to remove data permanently.

Ultimately, the decision to opt for one or the other technology is always a case-by-case decision.

DMC and RFID do not necessarily have to compete. Sometimes it may be beneficial to have a combination of both technologies. An example of a combination solution is an RFID label with a printed DMC. While the DMC can be read directly on the object with a scanner, the RFID tag fulfils further tasks. Thanks to the special technology, goods can be identified even when packaged. In addition, all relevant process data can be stored on the RFID data carrier and offer added value throughout the value chain.

Stefanie Roedl studied business administration and mechatronics, before gaining professional experience in various roles in development and product management for RFID. Stefanie now works in Industry Management as part of Balluff's worldwide automotive team.

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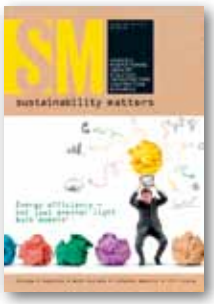

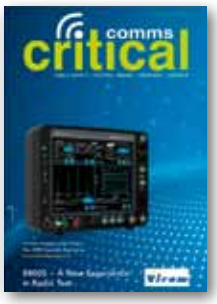

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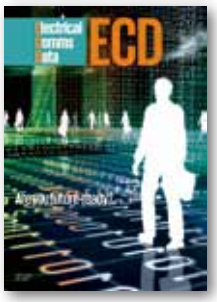

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