HEIDENHAIN

Solutions for Industrial Automation

Contents

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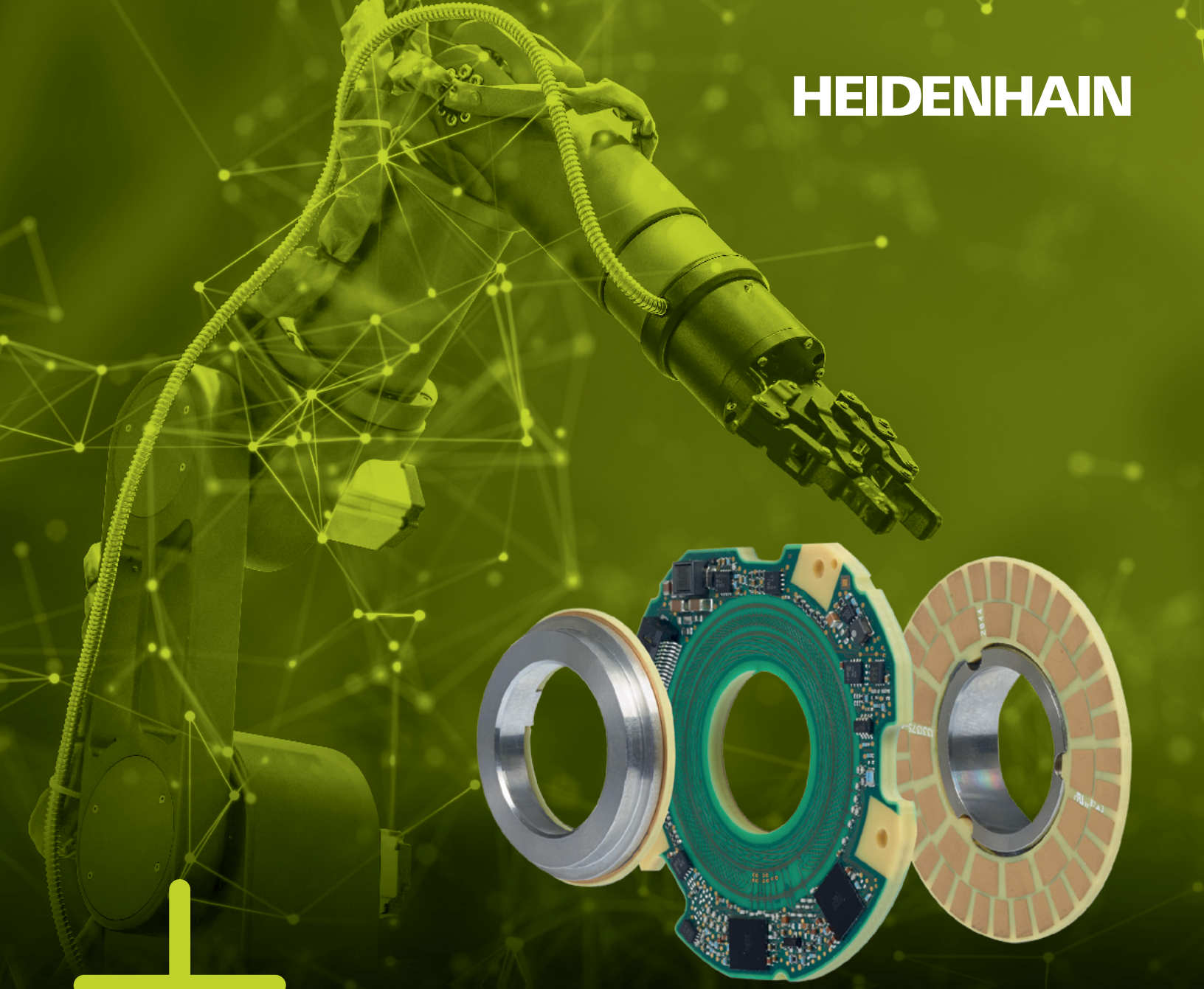

The KCI 120 D*plus* dual encoder
High-accuracy robot motion

Imagine the benefits of motor feedback and position measurement from a single compact rotary encoder installable on all robot axes.
Look no further than the new KCI 120 D*plus* dual encoder from HEIDENHAIN. It lets you master the inaccuracies that plague dynamic, highly articulated robots, such as gearbox backlash and forces induced by the application at the end effector. The KCI 120 D*plus* turns a conventional articulated robot into a high-accuracy production system and a dependable cobot.

Advanced robotics solutions

Discover more here

HEIDENHAIN CORPORATION
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A one-of-a-kind perspective on how to get started with automation

At HEIDENHAIN, we occupy an interesting place in the automation value and supply chains. Not only do we often get to work with end users on the processes they're trying to automate, but we also supply subcomponents to the automation OEMs from whom end users buy.

In other words, we have a hands-on understanding of how important cost-of-ownership is for OEMs and return on investment is for end users. Plus, our reach extends beyond North America, giving us exposure to automation problems and solutions of almost every type.

While adoption is accelerating, and will only continue to, one of the understandable hang-ups is that large-scale automation basically requires a top-to-bottom structure, where all that automation plays into larger management systems. It's not just a robot doing a task, it's a robot doing a task with human collaboration, to either work with a product over or move it to the next step of the process together. This also speaks to the difficulty of retrofitting tools or processes that were originally designed to be done manually, or that are part of a larger manual operation. And that's just on the floor level. Then, you have management services that you have to consider.

So, how can manufacturers think about introducing automation and how can robotics suppliers help in the transition? Let's walk through a few of the considerations in play during the early stages of industrial automation.

The user's mindset

There are two major factors driving adoption of industrial automation. On the front end, there's a new generation of operators that are used to working in the digital world with all the information about anything they've ever wanted at their fingertips.

They think: If we can do that in our day to day life, why not in our factory? Why not in our machines? There's nothing stopping us from having all the information we want in a digital format. This is forcing the industry forward on a variety of levels.

Meanwhile, the structure around automation has improved to the point where it's priming the movement. There are more companies and systems doing big data analysis and cloud computing. It's the infrastructure that can provide good, usable information based on all the data being collected.

Users know automation is available and needs to be taken advantage of, but they may not understand the subcomponents that can help them activate it. That's where we can help users and automation OEMs figure out how to collect the information they want and make it actionable.

Starting small

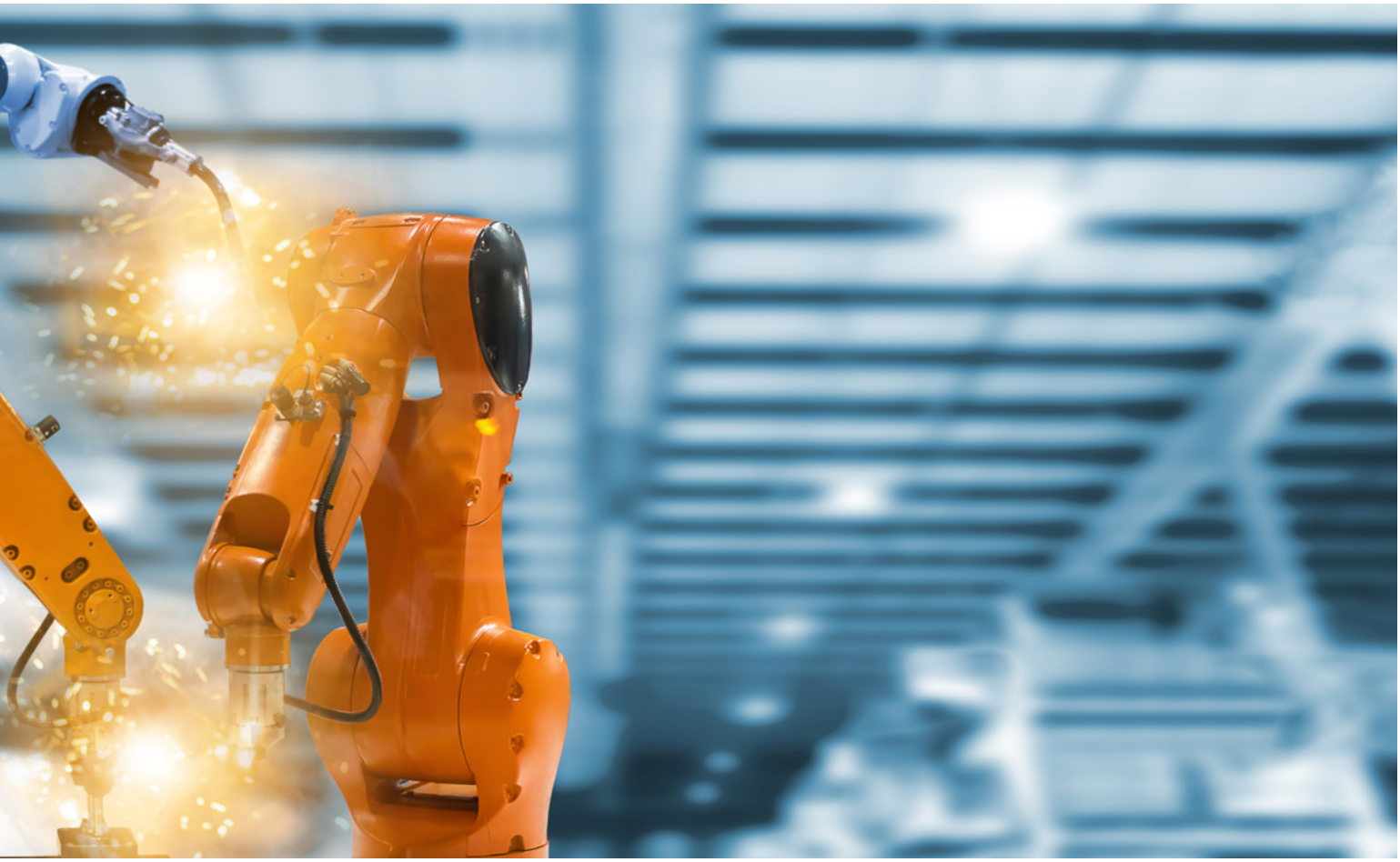
End users should start simple by identifying what they want to accomplish. They should find where it makes the most sense, somewhere that will have the most effective impact. Buy-in and clear answers to some simple questions can jump start the process:

- What do you want to automate?
- What do you want to improve and how do you want it to fit in?
- Do you want people involved in the area?

With a basic framework in place, it easier to dive another layer deeper, narrowing down the fundamental characteristics of the automation:

- How fast do you want it to move?
- How accurately do you want it to move?
- Is a certain level of functional safety required?

That's where the feedback systems,



motors and controls we make come in. These components play a huge role in determining the performance and reliability of these fundamental functions.

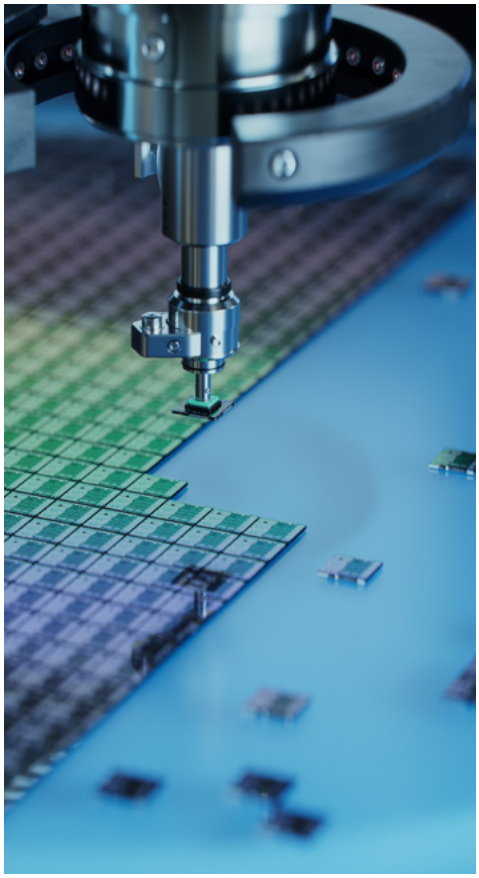
Automating can be that big, grand idea, but it doesn't have to be. Make incremental improvements, get a taste for it, then start thinking bigger.

Active monitoring

Automation can be a pick-and-place robot or AGV, but it can also take the form of data collection, and the rolling up of that data into something actionable. For example, implementing temperature control for sensitive quality areas in the plant is something everyone should be doing, but it can be automated—leading to lesser room for error and one less thing to worry about.

Actionable monitoring comes down to where sensors are deployed and how they communicate out. Temperature, vibration, magnetic flux, etc., the proximity of feedback devices to core motion elements makes them the ideal vessel for these other sensors; the closer to the core, the more revealing and accurate the information. Today, our encoders can do more than ever and are in a constant state of redevelopment to achieve a smaller footprint and transfer more information without sacrificing our legendary accuracy. Bus operation is even an option, where multiple linked encoders and sensors send one communication stream back to the controller

Moving beyond speed and throughput, we're thinking about environmental conditions, making it easier to recognize when things are operating at the best, conditionally, and what situations can lead to that. Users are starting to understand what the capabilities are—beyond just predictive, to proactive maintenance schedules—and the potential return on their investment when alerts or actions are triggered automatically.



Getting machines to talk to each other

While active monitoring is a nice way in the automation door, the other big question users have is how data gets sent around. It's one thing to have information a machine can use independently, but in complex workflows, machines need to communicate clearly with each other. This is where the right interfaces come in.

This means of transmission acts as the language that devices use to communicate. Our interface technology is purely serial and bidirectional. The latest version, EnDat 3 has graduated from fundamental reading and writing classes to college-level language courses. Instead of just talking about motion, it's talking about temperature, motor coils, etc., and in a common language most controllers and other devices will recognize

The interface once had two additional information slots. Now it can handle up to 16 and it's able to do more things at once. It's opening the possibilities of what sort of component-level information the end user can activate. It can essentially function as a component network.

This kind of technology can quickly move robotics and workflows towards seamless integration, where you're able to just plug a robot or device in and it already understands what it is talking to and how.

If you're looking to gain an autonomous edge, we can help. Find out more about the component-level solutions we provide. ■

Introducing the KxI Encoder Series for Collaborative Robotics

vimeo

HEIDENHAIN US 03:09

HEIDENHAIN

KCI 120D*plus* and KCI 1300 Inductive Rotary Encoders

High reliability, accuracy and dynamic performance

The medical rehabilitation field is seeing a rise in robot-assistant physical therapy, accompanied by steady advances in exoskeleton technology. The motor feedback sensors used in these highly specialized solutions must ensure patient comfort and safety through maximum reliability, accuracy, durability and dynamic performance. The KCI 1300 and KBI 1300 rotary encoders from HEIDENHAIN enhance medical technology applications with a low profile and low mass. Alternatively, the KCI 120D*plus* dual encoder offers twice the functionality, delivering position measurement and motor feedback in a single, compact rotary encoder.

Medical technology encoders

Discover more here

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Machine tool automation

What it is and why it's needed

From the first punch card-driven CNC controls that debuted decades ago to the newest closed-loop boring tools on the market today, automation has touched nearly every aspect of the machining industry. And machine tool automation is only growing more common as technology becomes cheaper and more easily integrated into machine tools. But what is it? What are its benefits, its challenges? Read on to learn more.

What is machine tool automation?

Machine tool automation uses the latest developments in hardware, software and controls to perform machining tasks with less, or no, human intervention. This takes multiple forms. For example, when you program a cut into a CNC control using CAD or CAM, the machining of that part is fully automated. Or, a machine tool could use automated tool loading, which switches out workpieces without any operator intervention.

This automation can be partial (also known as "open-loop"), where an operator still monitors feedback and makes adjustments manually, or total ("closed-loop"), wherein the machine tool itself makes adjustments as it operates. In both cases, the tool leverages software and hardware in order to simplify and speed up operations.

Why machine tool automation is needed

There are many reasons why a shop would consider automating its machine tools. Machinists are facing skyrocketing demand for parts, sometimes on short timetables. Parts may require extremely complex geometries, fine details or other factors that would be very time-consuming without automation. And those parts will only grow more complex as technology grows more advanced—consider what's under the hood of a sedan from 1995 versus one from 2023.

Along with all this, while employment numbers have bounced back significantly in the wake of the COVID-19 pandemic, shops of all sizes still deal with worker shortages. Operators need to maintain or increase their productivity, despite having fewer people in the shop. Add all this together and you have an industry ripe for automation.

4 benefits of machine tool automation

The advantages of automation are many and vary by operation, but here are some of its biggest benefits:

Productivity

The more aspects of your shop you automate, the more time operators have each

shift. They focus on more fulfilling, higher-level work—and won't get dragged down by labor when there are fewer people on the floor. Depending on how automated a shop is, it may even be able to run outside of working hours. The end result: more parts machined per day, happier workers, higher productivity and better ROI.

Safety

Automated solutions are perfect for dangerous, dull and dirty tasks—the fewer of those tasks humans have to perform during operation, the fewer opportunities there are for someone to get hurt. Even something as simple as better ergonomics lowers the risk of repetitive-motion injuries, protecting workers—and maintaining productivity.

Quality assurance

Even the most skilled machinists make mistakes. We're only human, after all. And the tighter the tolerances, the more complex the part or the larger the production run, the more damaging each error becomes.

When you program a design into a CNC control, you can rest assured the machine will make the same cuts or bores every time. Increasingly sensitive real-time monitoring also ensures that if variance does occur, either the operator or the tool itself can adjust to compensate in the moment, rather than after the part is fully machined. Repeatability remains high, waste remains low.

Predictive maintenance

Performance monitoring doesn't just spot and correct errors. It can also call out when a tool's components start to wear and identify exactly where in the machining process the performance is degrading. Components that might have otherwise gone unnoticed and even done damage to the tool are spotted; operators can, as a result, swap out components or tools before equipment failure. Productivity loss is minimal, tool life is extended and ROI reflects it.

Potential challenges for adopting machine tool automation

Machine tool automation presents mostly benefits—but it can create some challenges, as well.

Initial investment

For starters, there's the initial investment. Automated machine tools can be more expensive—sometimes significantly so—than their less-advanced counterparts.

Hesitation is an understandable reaction, especially if owners want to standardize their equipment across the entire floor. But it's important to remember that these

> “Depending on how automated a shop is, it may even be able to run outside of working hours. The end result: more parts machined per day, happier workers, higher productivity and better ROI.”

machines offer quicker ROI—and, thanks to boosts in productivity, they add more value over time.

Skills gap

Standardization may also exacerbate the skills gap—that is, the gap between the skills your operators need and the ones they currently have. Even a single new tool with features unfamiliar to operators can cause confusion or slow down production as workers get used to the tool. If a shop doesn’t standardize, workers will have to remember multiple different ways of operation depending on which tool they happen to be using. That’s a recipe for inefficiency. By contrast, the more standardized your shop floor becomes, the more productive it gets (and the easier it is to train employees). Once your most experienced operators get comfortable with new machines, ROI will skyrocket. Plus, younger generations of workers are excited about the possibilities offered by automation; with the right training and onboarding, shops will see boosted recruitment.

Tech support

Finally, the more digital and online your machine tools are, the more tech support and cybersecurity you’ll need. You may need to establish an entirely new role

or partnership dedicated to machine maintenance (at least until operators are completely with the equipment). Plus, as soon as your tools are connected to the internet (or even simply to each other via Bluetooth), they're vulnerable to bad actors and could be subject to data protection regulations (such as the California Consumer Privacy Act). Machinists will have to adjust to calling tech support or considering cybersecurity implications as they work. Fortunately, it's not difficult to train for these challenges. The end result is a truly modern workforce: confident with new machines, able to deftly navigate tech support issues and knowledgeable about best security practices.

These challenges are real—but they're all surmountable. With careful planning, strategic investment and open conversations with staff, your shop can adopt automated machine tools with minimal fuss and maximum ROI.

Industries embracing machine tool automation

The big question here is not "which industries are embracing machine tool automation," it's "which industries are not embracing it?" The benefits we've discussed apply to virtually every manufacturing sector, and companies are embracing automation accordingly.

Here are just a few of the industries adopting automation in their everyday operations:

- Automotive
- Aerospace
- Electronics
- Medical devices
- Energy
- Consumer goods
- Space technology
- Metal fabrication

What the future of machine tool automation holds

Automation in machine tooling advances by leaps and bounds every year. Some features once thought to be science fiction are already in use—and others are well on their way. Advances in machine vision will soon make tools even better at monitoring performance. Widespread adoption of 3D printing may lead to easier prototyping and faster iteration of new designs.

And things are getting more advanced from there. We're already seeing the industry embrace digital twin technology, which models a machine's operation using a programming station. These twins replicate a machine's behavior, cutting parameters and functions for review—exactly replicating how a real tool would run. This saves the shop floor time they'd otherwise spend on setup, simulation and debugging. It also increases reliability and productivity.

Now consider augmented reality, which is already taking off in manufacturing as a training and diagnostic tool. Touchscreen displays with real-time information are pretty convenient, but imagine if you could monitor the tool's performance with a 3D view of each component overlaid on the actual tool itself. Special glasses and headsets, which are constantly evolving, make such applications possible.

There's also artificial intelligence and machine learning. Real-time optimization and predictive maintenance are already occurring, but as machines get smarter their solutions become more effective. They can anticipate repairs farther out. And their human operators can work with this information to machine the best parts possible.

So, what does the future hold? In a word: everything. Automation has a way of transforming every industry it touches—making things easier for operators, letting them do more things at once and in general enabling success once thought impossible. Now it's our turn! ■

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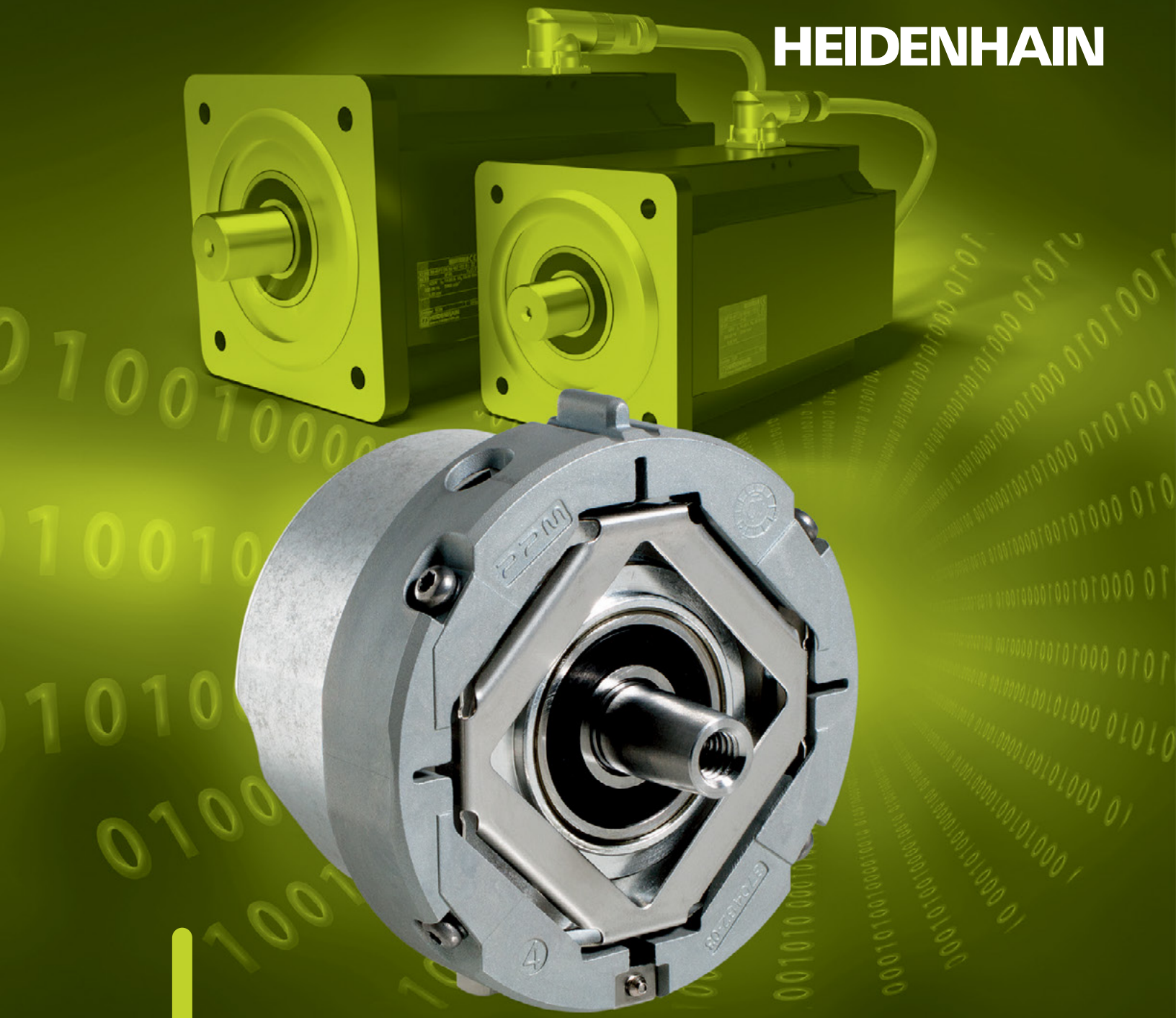

ECN 1300 and EQN 1300

Absolute rotary encoders with integrated diagnostics

The ECN 1300 and EQN 1300 absolute rotary encoders from HEIDENHAIN, featuring optical scanning, are the industry standard for feedback systems in servomotors. Their built-in diagnostics and robust components ensure superb signal quality and availability, thereby meeting the essential requirements of safety-related applications. Along with motor feedback, these encoders also provide all of the information needed for initial setup, monitoring and diagnostics, ensuring machine availability from the get-go.

Encoders for every motor

Discover more here

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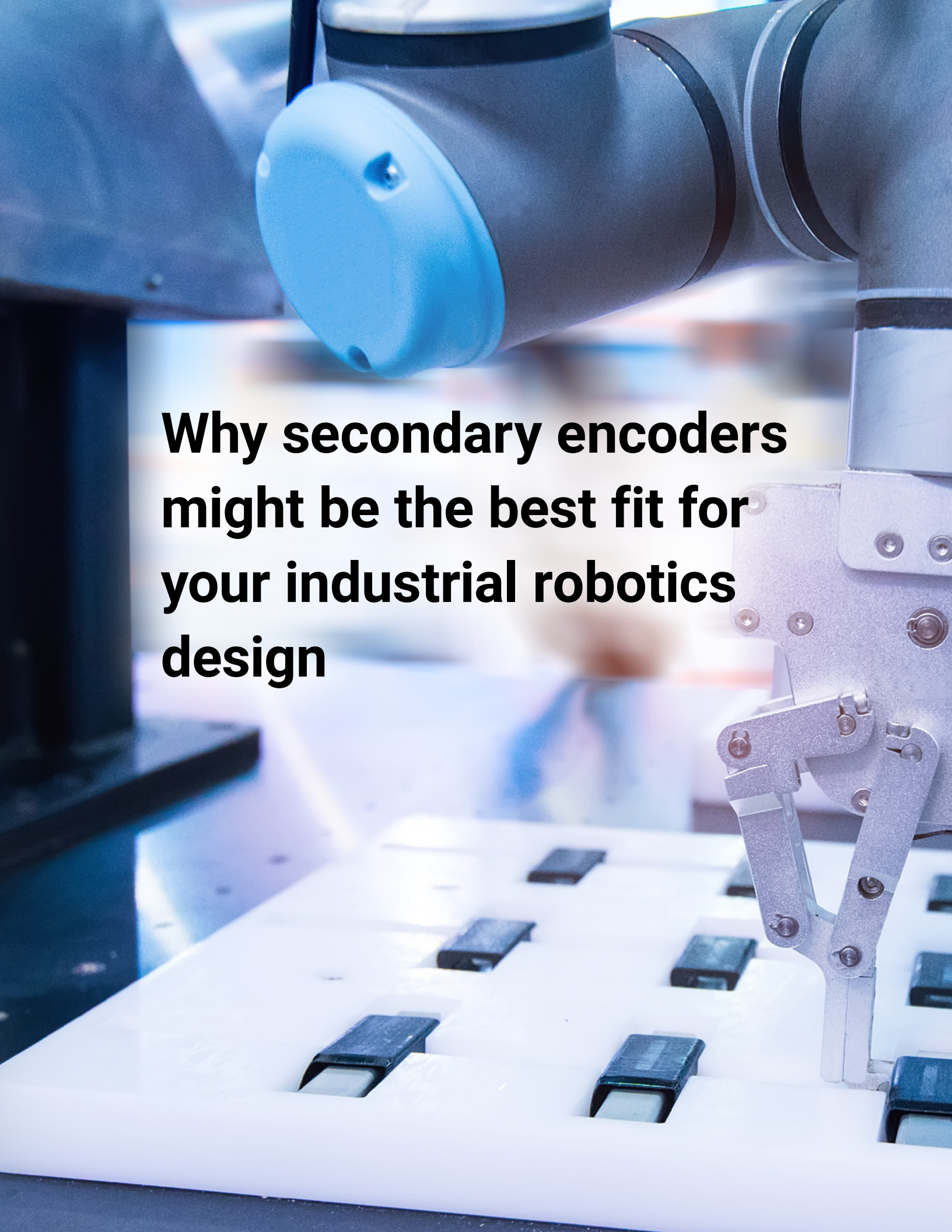


Why secondary encoders might be the best fit for your industrial robotics design

Industrial robots are fast, powerful and durable. Unfortunately, when it comes to some tasks, **they struggle to offer sufficient position accuracy.**

Consider robotics work that requires both a carefully positioned and guided tool center point and significant maneuverability. Such work necessitates multiple axes, which all require their own motors and feedback. Using the feedback from each servo motor opens up opportunities for zero position error, backlash and joint elasticities which can add up over the multiple axes. Plus, the machining process may affect the rigidity of the robot's mechanics, and therefore accuracy.

There are advanced calibration methods available, and they do help with repeatability. However, absolute position accuracy is lower by comparison (often worse by a factor of ten). This makes first-gen robots unsuitable for many applications (e.g., the aerospace industry). That's where **secondary encoders** mounted on the outside of the robotic joint come in. Every HEIDENHAIN, RSF, and AMO encoder offers superior accuracy, whether it's an **ECA 4000 angle encoder** or the AMO WMRA. But when it comes to RSF MCR 15 /16, or the AMO WMIA. When it comes to industrial robotics, rotary encoders are often the best fit.

Benefits of using secondary encoders for robotic applications

Encoders make industrial robots accurate enough to perform positionally accurate machining and handling tasks on large components. Let's talk about how.

Position sensing and feedback

The better an encoder can process and communicate feedback, the more accurately it can communicate movement metrics and the actual position of the robot's tool center point. But with that sensitivity comes a drawback: strong vibrations and electromagnetic interference can affect encoder performance. Inductive encoders from AMO can help

to solve that problem. They're robust, resistant to strong vibrations and their EnDat interface stands up to electromagnetic interference.

In addition, secondary angle encoders, mounted after each gear train, capture a robot joint's actual position, protecting against zero position error and backlash, and measuring retroactive forces. The result: absolute position accuracy improves by 70 to 80 percent. Modular angle encoders use scale drum or tape and separate scanning units, which make them ideal for challenges unique to the hollow-shaft diameters and spatial constraints unique to many robots.

Multi-axis coordination

Robot joints are fully interdependent, so the movements of each axis must be carefully controlled at all times in order to maintain precision and repeatability. The continuous feedback provided by a secondary angle encoder enables that control, regardless of how many axes upon which the robot operates (key in any situation, but especially with large components).

Common types of rotary encoders used in robotics

HEIDENHAIN ECA 4000

The ECA 4000 encoder is great secondary position feedback for robotic joints providing reliable scanning and high accuracy position information. This encoder offers scanning reliability thanks to its large scanning fields and special signal processing. This, combined with their robust graduation and wide mounting and operating tolerances make for a dependable system.

RSF MCR 15 / 16

These absolute optical encoder from RSF focus on providing flexibility and ease of use while also delivering high accuracy and performance. These solutions come in a variety of serial interfaces including EnDat, BiSS C, Yaskawa, and more. The easy installation due to the large mounting tolerances and LED indicator allows engineers to use this encoder in a variety of ways without issue while maintaining high accuracy.

RSF
MCR 15

AMO WMIA

The AMO WMIA are inductive scanning encoders, allowing them to operate in contaminated environments that may pose problems for optical or magnetic scanning solutions. The unique inductive technology, combined with the high IP rating of the encoder head, provides high reliability and availability in the worst of contaminated conditions. Combined with the flexibility of interface options, this solution is ideal towards improving the tool center point accuracy of any robotic system.

General criteria for robotics

When choosing an encoder, before you even think about performance aspects, there are some general factors to consider:

Needs

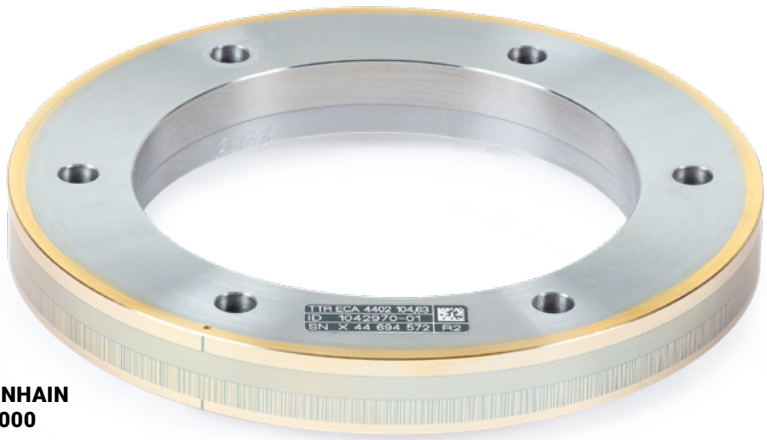
What is the ultimate application of this robot? Whether it's assembling aircraft fuselage or making precise cuts across large components, consider your robot's needs when choosing an encoder.

Cost

Manufacturers must consider how much an encoder costs, and whether that encoder will truly add value in the long run. An encoder may have a higher price upfront, but lower costs elsewhere in the design process. What's more, higher-cost encoders often give robotics manufacturers an edge in the market thanks to better functional safety, higher accuracy and fewer costs in the long run.

Operating environment

The environment in which the robot works may determine just how robust an encoder needs to be or what kind of scanner would work best. Beyond the forces and vibrations an encoder must deal with during operation, there are also conditions like dust, temperature or humidity. Will the encoder need an enclosure? Will vibration reach over 30-40 Gs, likely requiring a magnetic scanner? Is it highly clean,



HEIDENHAIN
ECA 4000

AMO
WMRA

allowing for a more accurate optical scanner? What's perfect for one environment may be ill-suited for another.

Flexibility

In addition, consider the variants available. Every component in a robot can raise geometric constraints. It's best to use rotary encoders versatile enough to fit these constraints or to have matchable variants. You can also look for modular models, or kits you assemble yourself—they may require more know-how during setup, but it can be very beneficial to tailor a robot exactly to your needs.

Assembly

Roughly 70 percent of production costs come up during the design phase before the robot is even active. Making changes to design or processes after operations commence costs even more. Therefore, easy-to-mount encoders can save a lot of time and money. The simpler the setup, the fewer work steps and hours of training necessary to build and install each robot.

Safety

Whatever the job, risk to human operators (and to robots themselves) must be kept to a minimum. Look for a dual encoder certified in accordance with Safety Integrity Levels (SIL) and Performance Levels (PL). Use an interface such as EnDat for simpler implementation of a complete system. This speeds up design time and minimizes error-related delays.

Performance characteristics to consider

Once you get past the basics, the actual mechanics and performance characteristics of the encoder come into play:

Automation Q&A: How do manufacturers begin implementing automation?

vimeo

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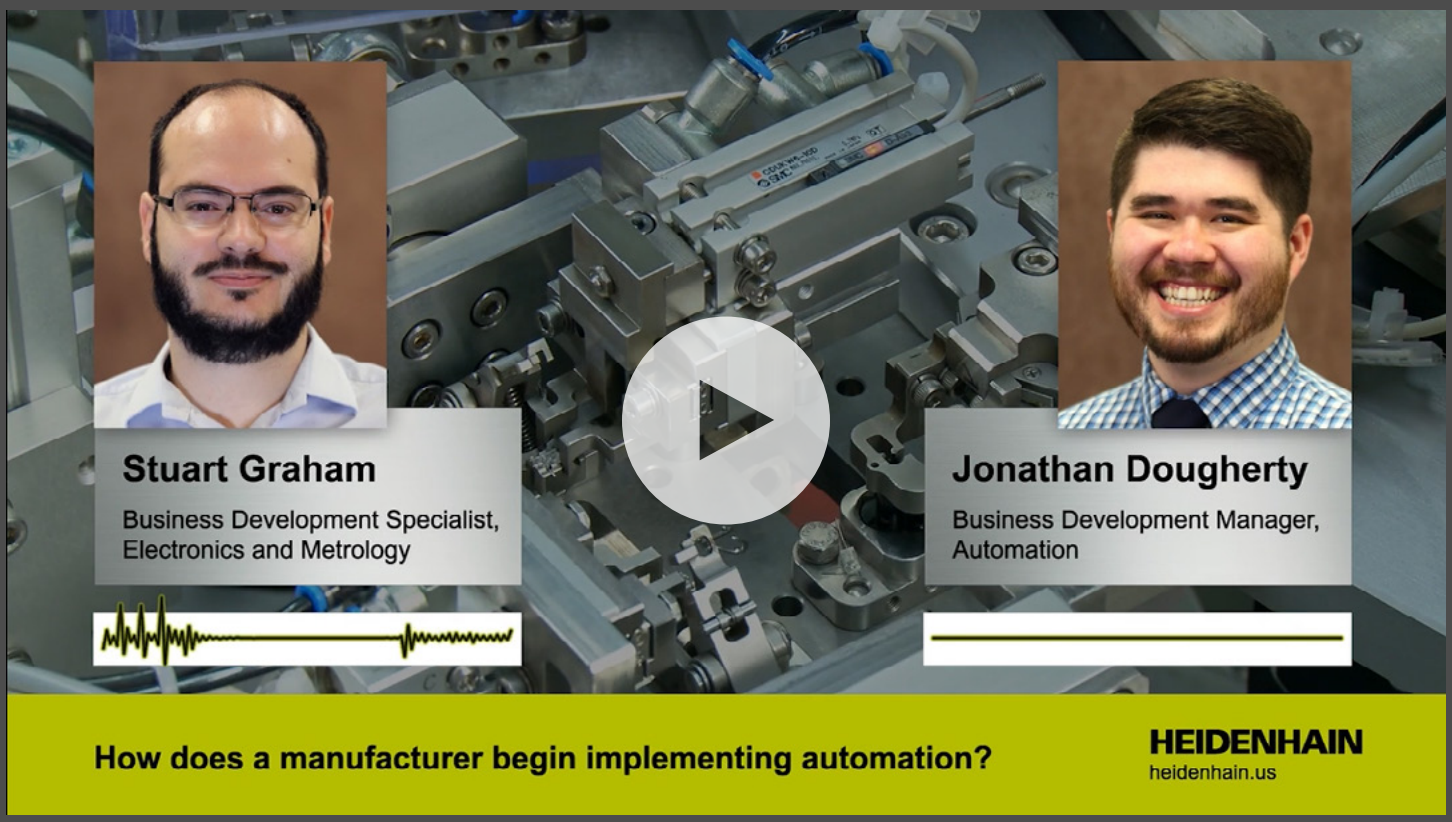


Quality assurance

QA can be a time-consuming process, but some encoders can speed it up significantly. Some don't need a calibration run and can operate as soon as they're mounted—the encoder equivalent to "plug and play." There are encoders with electronic mounting diagnostics that perform immediate safety checks to make sure they're correctly installed. And some models feature electronic ID labels accessible through the interface and can store their own data, enabling automated setup.

Maintenance posture

Manufacturers need machines that can deliver a lot of real-time data through a reliable interface. Any encoder should provide constant, precise measurements and deliver detailed condition data (such as error messages or warnings based on valuation numbers). This resulting diagnostic information can then be analyzed to anticipate needed maintenance or troubleshoot quickly. For even better operation, use an encoder with the EnDat 3 interface; it transfers data faster, requires fewer cables and monitors the temperature of everything from the robot arm to the inside of the cabinet.

Wide tolerances

There are many risks inherent in robotics: zero point error in joints, reversal errors in gearboxes or load bearing issues due to material elasticity. These factors—known collectively as hysteresis—can cause serious issues during manufacturing. Temperature swings and aging components come into play, as well. The right encoder compensates for these effects.

Automation and robotics are growing more prevalent, across more industries, every year. In the constantly evolving, ever-more demanding automation market, your choice of encoder can take your robotics designs from good to next level. Make sure you consider all options and learn how to select the right one. Your operators and your bottom line will thank you for it! ■

HEIDENHAIN

+ Secondary encoders for position measurement

High accuracy for industrial robots

Having an additional, high-accuracy angle encoder on every robot axis can create significant improvements in absolute position accuracy. Mounted downstream from the motor's gear system, secondary encoders measure the actual position of each robot joint. Ideal solutions for this role are modular angle encoders, such as the WMRA from AMO with inductive scanning and the MCR 15 from RSF with optical scanning. They are the perfect choice for large shaft diameters and challenging mounting spaces.

Advanced robotics solutions

WMRA solutions from AMO
MCR 15 solutions from RSF

HEIDENHAIN CORPORATION
www.heidenhain.us

The ‘in between’ state of industrial automation

In a sense, industrial automation has one foot in the future and one foot in the past. We have companies making cars in fully automated factories and others with little to no automation. Sure, there will always be a gap between larger companies, with seemingly unlimited resources, and the local shop, but the automation gap is quite wide despite consistently accelerating adoption.

As a supplier of subcomponents to robotics OEMs and motion control systems, we have an interesting role—and vantage point—in the automation space. We see that most companies are still in some sort of discovery phase—early automation. They’re experimenting, trying to sort out what to automate, how, and if data fits in.

That may not sound like much, but that’s major progress in thinking from just a few years ago; cost still felt prohibitive, and then there was the uncomfortable question of if robots would absorb the jobs of coworkers. Through demonstration and raw exposure, it’s become clear that some monotonous industrial tasks should be done by machines; there’s more consistency, speed and reliability. And instead of replacing people, it frees them up to advance in other critical areas of the business, use creative thinking or engineering skills, etc.

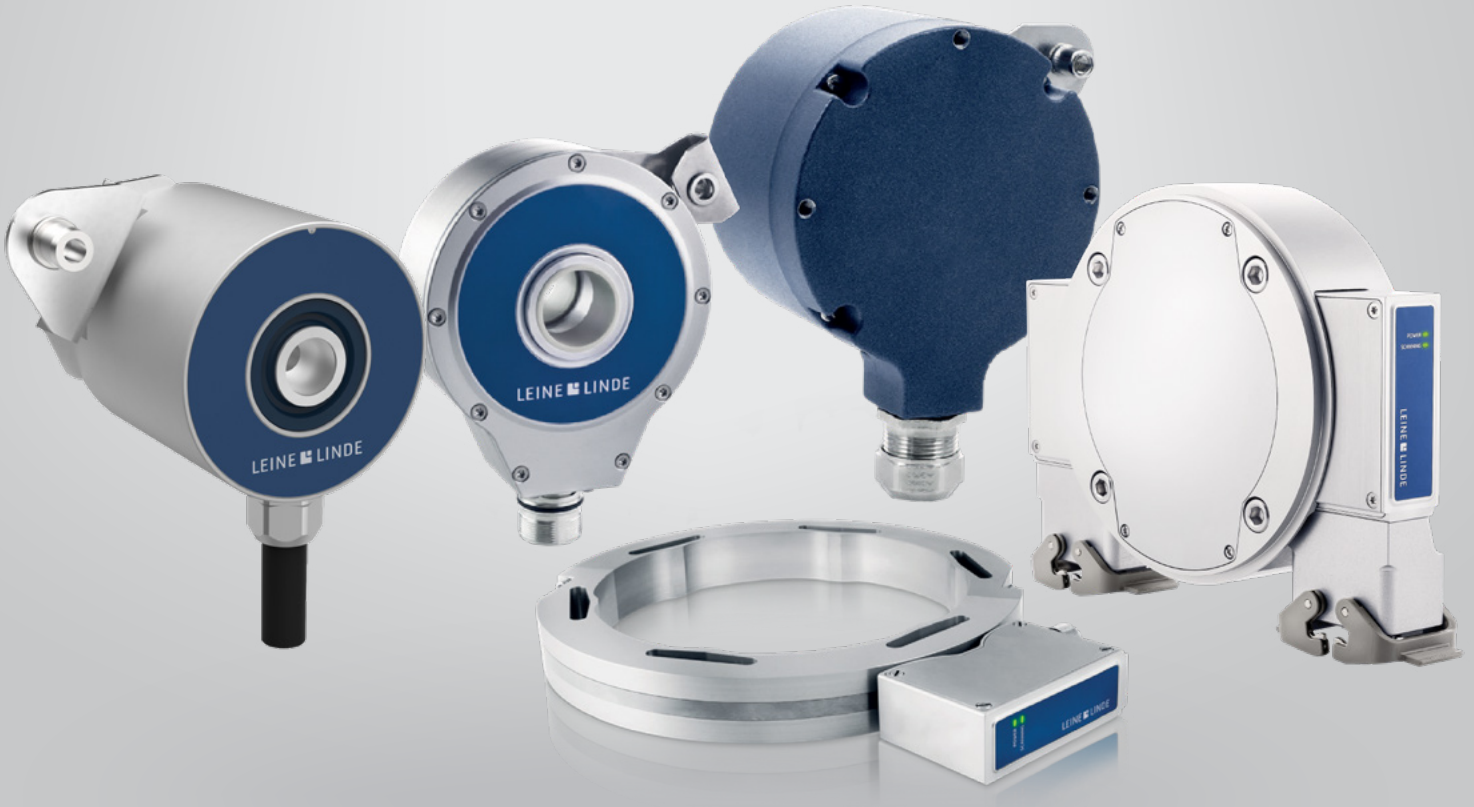
With an appreciation for what automation can accomplish on the floor now widely accepted, the next hang-up for users is how to sync it all up. If data is in the picture, how is it communicated and how is it acted upon? Thinking about where data from an automated system fits into management services is a big shift from traditional manufacturing.

What’s being done to make the shift easier? For one, the cloud computing infrastructure is there, ready to be capitalized on. More vendors and systems than ever are providing big data analysis and cloud computing that help provide really good, actionable information from all automation data.

The cloud is a tantalizing tool for any business, if it can source enough good data. That’s a big “if” and it’s one of the areas we’re thinking about too. We’re

LEINE LINDE

We make encoders and sensors robust enough to keep things running for decades.



NEW!
M500 Series

Our new line of inductive encoders is designed to meet the challenges of today, as well as the requirements of tomorrow.

LEARN MORE

Compact
700 Series

Designed to withstand the toughest of challenges while at the same time being small enough to fit in tight spaces.

LEARN MORE

Heavy Duty
800 Series

Trusted incremental encoder for heavy-duty environments.

LEARN MORE

Bearlingless
2000 Series

For large shafts, tight spaces and long durability.

LEARN MORE

Leine Linde is valued member of the HEIDENHAIN family of brands

> “Through demonstration and raw exposure, it’s become clear that some monotonous industrial tasks should be done by machines; there’s more consistency, speed and reliability. And instead of replacing people, it frees them up to advance in other critical areas of the business, use creative thinking or engineering skills, etc.”

putting a lot of energy into consolidating sensors, data and transmission hardware—gathering more useful information while taking up less space. And we’re going beyond the legendary, high-precision motion feedback we’re known for.

Beyond simply speed and throughput, encoders can now record environmental conditions like temperature and vibration. We’re creating a streamlined communication network from the component level and delivering it via one communication channel. This kind of consolidation makes it simple to know if an unmanned system is operating at its best conditionally and what situations can lead to it.

Users are just starting to wrap their heads around the potential of expanded sensing. Most have seen words like “industrial internet of things”, “big data analysis” and “industry 4.0” as concepts or buzzwords instead of practical implementation. But as these technologies get more born out, people are seeing the true advantages to operational automated systems.

Today, component-level sensing is being implemented into systems across America and the globe in a disjointed way. Within the next 5-10 years, we think you’ll start to see a standardization. The industry will sort through what’s necessary, helpful or frivolous.

There’s a good chance that as the buzzwords and concepts we’ve discussed become reality, we’re going to see some amazing marriages between manual workers and automated machines; in place of physical- and task-separation, having the best of both worlds will become more commonplace and unlock efficiency. Today’s robots are just scratching the surface and it’s exciting to be part of whatever comes next. ■

HEIDENHAIN

EQN 437 Rotary Encoders

Protect your capital investments and processes

The EQN 437 absolute multiturn rotary encoder features a functionally safe hollow shaft connection that eliminates failures such as the risk of slippage on a friction-type shaft connection. Its accurate position-measurement data is reliably transferred to the machine controller through the EnDat 2.2 interface, which also transmits all of the information needed for initial setup, monitoring and diagnostics. When used with a functionally safe controller, this encoder attains a rating of SIL 2 or Performance Level “d” for safety-related applications, thereby protecting your capital investments and your production processes.

Encoders for every motor

Discover more here

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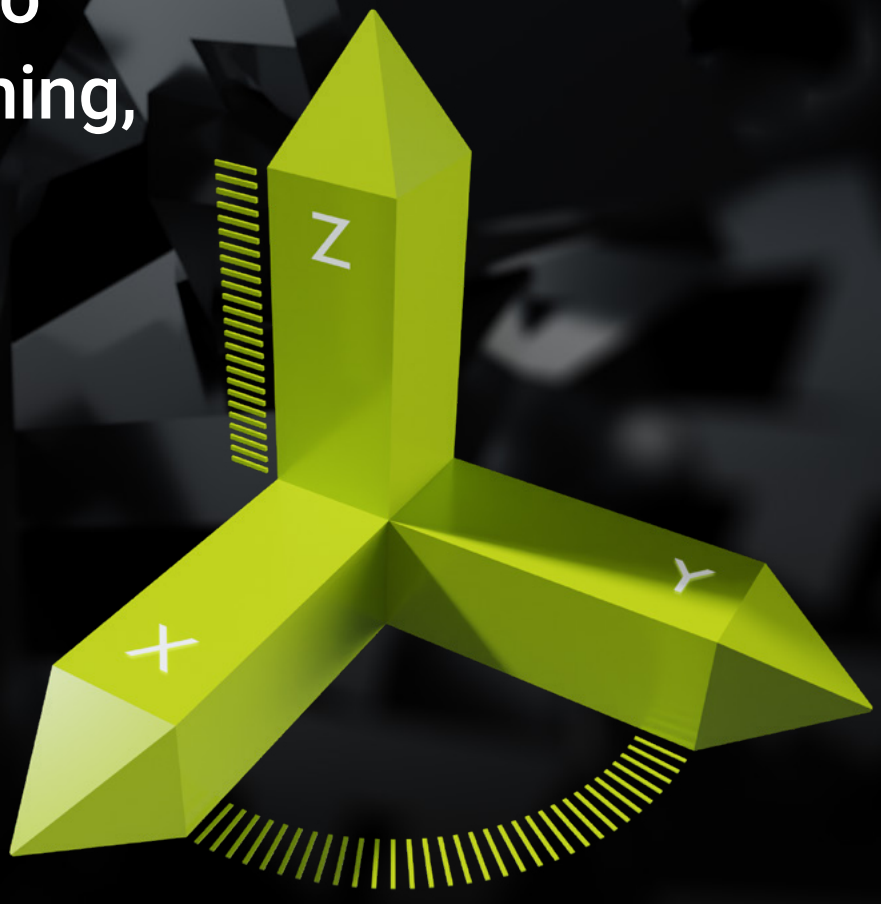
Unlock CNC success with the TNC Club

Your Direct Line to Expert Help, Training, and Community



Whether you're programming your first machine or optimizing complex workflows, having the right support makes all the difference. The TNC Club connects you directly with HEIDENHAIN experts, advanced training, and a network of professionals who understand the real challenges of using TNC controls.

What You'll Gain

- Personalized support from seasoned NC specialists
- Access to exclusive training, live sessions, and workshops
- A fast-track to expert troubleshooting and insights
- Opportunities to influence future HEIDENHAIN products with your feedback
- A community of peers solving real-world CNC problems

Built for Your Success

From boosting your skills to keeping your machines running at peak performance, the TNC Club gives you practical tools that drive results—plus the connections that keep you ahead of the curve.

Two Ways to Get Involved

✅ **Essential Access – Always Free**

- Direct access to knowledgeable support
- Resources tailored to your registered machines
- Timely updates and insights

⭐ Premium Experience – For Advanced Users

- Full access to in-depth training via HIT software
- Customized education with HEIDENHAIN trainers (on-site or remote)
- Invitations to all exclusive events, webinars, and advanced content
- $1,300 for the first year, $1,100 annually after

You can upgrade or adjust anytime—it's all about what works best for you.

Let's Make Great Machines Run Even Better

Wherever you are on your CNC journey, the TNC Club is here to help you grow. Visit us in Schaumburg, IL, or bring our expertise directly to your shop floor. You'll find the training, support, and people who can elevate your work—starting today.

Connect. Learn. Thrive. ■

Register for the TNC Club!

Powering precision in machining

Acu-Rite Solutions, a trusted name in the machine tool industry, delivers advanced, American-made technology designed to elevate manual machining to new heights. As a HEIDENHAIN brand, Acu-Rite Solutions brings decades of innovation to the shop floor, equipping machinists with the tools to boost precision, streamline operations, and increase profitability—no matter their experience level.

Smart, Scalable Solutions for Manual Machining

Whether you're running a single knee mill or managing a fleet of machines, Acu-Rite Solutions offers scalable technology to match your needs. Their portfolio spans entry-level CNC controls, digital readouts (DROs), and encoders & accessories, all optimized for ease of use and reliability.

CNC Controls

Acu-Rite Solutions' MILL**PWR**^{G2} and TURN**PWR** CNC controls offer full-featured automation for manual mills and lathes. These systems combine conversational and G-code programming with large, high-resolution color displays, intuitive interfaces, and innovative features

like Position-Trac™, which restores the workpiece zero point after power loss.

Customers can expect:

- Seamless retrofits to over 100 machine makes and models
- Faster prototyping and setup times
- Full 3D contouring capabilities
- Time-to-ROI averaging less than 30 days

"The MILL**PWR**^{G2} changes the prototyping procedures totally, making it much quicker and allowing for creative changes more easily—saving time and money."

—Dan Kubin, Tattoo Machine Builder, DK Rotary

Digital Readouts (DROs)

Acu-Rite Solutions DRO systems eliminate manual calculations and provide real-time axis positioning. From the DRO100 to the advanced DRO300, and even the tablet-based droPWR, these systems enhance quality control, improve part consistency, and cut waste.

Key advantages include:

- Large, ambient-light adaptive displays
- Graphical programming guidance
- Multilingual interface support
- Enhanced metrology options (DRO203Q)

5 Reasons to Choose Acu-Rite Solutions

1. **Boost Accuracy:** Achieve tighter tolerances and less scrap
2. **Save Time:** Reduce setup, programming, and rework
3. **Increase Profitability:** Improve throughput and see ROI in under 30 days
4. **Made in the USA:** Designed, built, and supported domestically
5. **Easy to Learn:** Ideal for both seasoned machinists and students

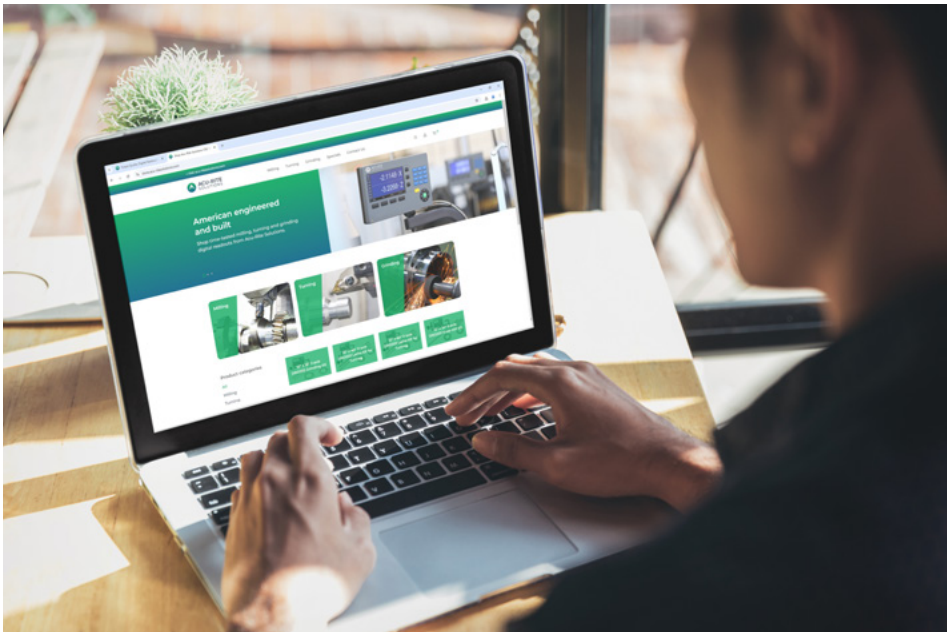
Encoders & Accessories

Acu-Rite's durable encoders and smart accessories like edge finders and custom mounting brackets extend the precision of CNC and DRO systems. Options like the SENC 50, SENC 150, and LMF 9310 encoders ensure reliable performance in even the harshest environments.

- Over 1,000,000 glass scales in use today
- Accessories tailored for 100+ machine makes and models
- Simplified installation and reliable performance

"We found the DRO quite easy to retrofit onto the machine, and were thrilled that the mounting brackets and all were included in the kit."

—Rich Pekelney, SF Maritime National Historical Park Association



Get Started

Whether you're retrofitting a single machine or scaling up shop capabilities, Acu-Rite Solutions makes it easy:

- Buy Online: 26 popular kits available in the Acu-Rite Solutions Store
- Get Support: On-demand resources and North American tech reps
- Work With an Expert: Personalized help with selection, installation, and training

"Students can quickly go to the control for the first time, understand how it works, and write a simple program."

—Garret Parker, Department Head, Randolph Community College

Shop the New Acu-Rite Solutions Online Store

The new Acu-Rite Solutions website now features a streamlined online store designed to make product selection and purchasing easier than ever. Customers can browse milling, turning, and grinding kits, select their machine tool make and model from dropdown menus, and conveniently order online. The store includes an interactive zip code lookup tool to connect users with local Channel Partners, and online purchases automatically generate leads for partner follow-up and support. With intuitive navigation, broader product visibility, and seamless ordering, the online store enhances the customer experience while driving high-quality leads and increased market reach.

Visit www.acuritesolutions.com to learn more and transform your machining accuracy and efficiency today. ■

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