

Encoders: The Unsung Heroes of Manufacturing

Your comprehensive guide to implementing and understanding encoders in manufacturing.



SICK
Sensor Intelligence.

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What is an Encoder?

Manufacturers need encoders, but they don't really want to think about them. Encoders are arguably one of the most necessary sensors in manufacturing, but many aren't sure what to consider when installing them.

Encoders are sensors that translate motion into an electrical signal that can be interpreted by a control device. They provide data about position, angle, and rotation counts. This data can be used to determine speed and position, making encoders the perfect solution for accurate position detection in industrial automation.

Encoders use different types of technologies to create a signal, including mechanical, magnetic, resistive, and optical. For example, in optical sensing, the encoder provides feedback based on the interruption of light.

There are two main types of encoders — absolute and incremental — each providing different kinds of information. Absolute encoders provide a unique position signal that describes the specific location of a system within its range of motion, while incremental encoders produce a pulsed signal as their position changes, providing fast and precise feedback.

Types of Encoders



INCREMENTAL

These encoders generate an output signal each time the shaft rotates a certain amount. They're useful for determining speed and direction but do not track absolute position.



ABSOLUTE

These encoders provide a unique output value for each shaft position, making them capable of maintaining accurate position information when power is lost.



LINEAR

These encoders translate linear movement into digital signals. They're often used in machinery for linear motion applications like CNC machines.

Considerations for Selecting an Encoder

So how do you know what encoder will work best for your application? Selecting the right encoder for a specific application involves considering several key factors.

Type of Encoder

The first decision is what type of encoder you may need. The specific requirements of your application will largely dictate the type of encoder you need. For example, if you need to measure linear distance, a linear encoder or a wire draw encoder would be suitable.

Incremental encoders are simpler and less costly, providing fast and precise feedback, and are ideal when only speed feedback is necessary. Absolute encoders provide a unique position signal that describes the specific location of a system within its range of motion, making them suitable when position feedback is necessary.

Range and Resolution

The range and resolution of the encoder are crucial factors. The range refers to the total movement that the encoder can measure, while the resolution refers to the smallest increment of movement that the encoder can detect.

Physical Size and Mounting Options

The physical size of the encoder and the available mounting options are important to ensure it fits within your system. This can be a crucial factor, especially in applications where space is limited.

Calibration and Availability

Calibration is another important consideration, especially for absolute encoders. Also consider the availability of the encoder and its interchangeability with other models or brands.

Cost vs. Performance

Balance between budget and required specifications. It's important to find an encoder that meets your performance requirements but also fits within your budget.

Environmental Conditions

The operating environment can greatly affect the performance and lifespan of an encoder. Consider factors such as temperature, humidity, vibration, and dust or debris in the environment.



Hollow Shaft Encoders

A hollow shaft incremental encoder is a type of rotary encoder that provides velocity feedback and is typically used in positioning and motor speed feedback applications. These are often referred to as HS35 class and HS25 class encoders.

Hollow shaft encoders are often utilized because they are more compact than solid shaft encoders, making them ideal for applications where space is limited. These encoders can be directly mounted to a motor shaft and affixed using a flexible tether or torque arm to prevent the encoder from rotating. This makes the installation, positioning, and alignment easier.

Hollow shaft encoders are more forgiving in terms of shaft sizing, especially in length. They can be mounted onto a wide range of shaft sizes. The hollow shaft insulation acts as a galvanic separator and thermal decoupler. It reliably eliminates shaft currents, bearing corrosion, and wear while keeping down encoder temperature.

Hollow shaft encoders offer moderate resistance against shock and vibration. This is particularly beneficial in industrial environments where machinery often experiences significant amounts of physical stress.

Get Your Encoder - FAST!

If you're looking for an encoder where you don't have to think about it after you buy it, SICK has the answer for you. There are several encoder options out there, but lately, there has been buzz about some HS35 and HS25 class encoders having very long lead times and even some production issues. With SICK's DGS80, we can solve that problem for you and give you a much shorter lead time – even as short as one week, depending on what you need!

SICK's DFS20/DFS25 and DGS80 encoders are built or stocked in Minneapolis, Minnesota. That means you don't have to wait weeks – or even sometimes months – to get your encoder. Our incremental encoders can ship from our factory so you can receive what you need in a matter of days, not weeks.

DFS20 / DFS25: Made in the USA for High Performance and Reliability

High Resolution: more precise positioning for applications that require high accuracy.

Reduced Costs: Spare parts inventory requirements are reduced because a single programmable DFS2x encoder can be used across a variety of applications.

Reduced Machine Downtime: Wide operating temperature range and high tolerance of shock and vibration reduce machine downtime.

DGS80: The new generation of Large Bore Encoders in the HS35 class

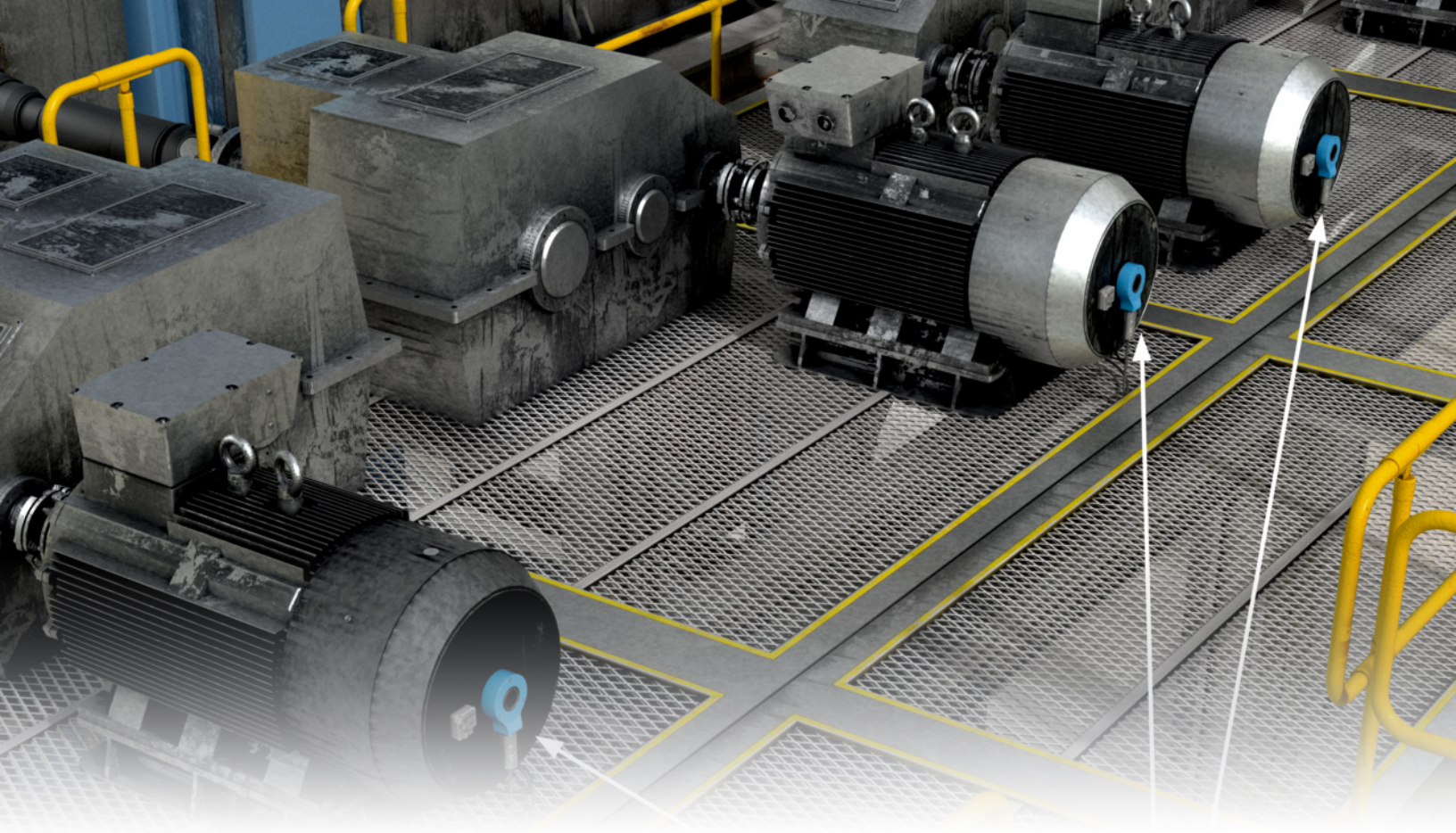
Easy Installation: Universal tethers and reliable clamping ring help to reduce set-up time.

Simplicity: Large bore eliminates the need for special couplings and allows simple integration into numerous applications.

Space Saving: Compact design allows for seamless integration in designs where space is limited.

High Resolution: Gain high resolution of up to 8,192 pulses per revolution, capable of measuring speeds up to 3,600 revolutions per minute.





The DGS80 at Work

But perhaps you're curious how the SICK DGS80 encoder can impact day-to-day work in industrial applications? It is effectively used in various industrial applications to improve efficiency and precision, making a significant difference in various industrial automation applications.

The large resolution range means the encoder is well-suited for many different industrial applications such as printing, scanning and elevator speed control. Industrial applications such as speed measurement of AC motors, printing, scanning.

For example, the DGS80 encoder is used to detect the position of overhead traveling crane gears. This helps in precise positioning and movement of the crane, improving safety and efficiency.

If you're looking to control speed on conveyors, the DGS80 encoder can be used to calculate belt speed and running direction. This helps in maintaining the correct speed and direction of the conveyor belt, ensuring the smooth flow of materials.



Solid Shaft Encoders

Solid shaft encoders are a type of encoder that have a solid center that rotates with the shaft. This type of encoder offers excellent mechanical stability and robustness for applications where accuracy and durability are critical. Solid shaft encoders are typically used in heavy machinery, industrial equipment, and high-speed applications.

These encoders are mounted directly onto a solid shaft, providing a compact and reliable solution for position sensing. They are widely used in various industrial applications, such as robotics, machine tools, and automation systems.

One of the main factors to consider when choosing between hollow shaft and solid shaft encoders is the accuracy requirements of the application. Solid shaft encoders offer better accuracy and are often better suited to applications that require high-resolution feedback. However, the installation of solid shaft encoders may require additional steps such as coupling and alignment, which can increase installation time and effort.



Advantages of Encoders for Robotics Automation

Robotic automation has revolutionized various industries, from manufacturing to healthcare, by offering increased efficiency, precision, and cost-effectiveness. A key component that plays a crucial role in this automation process is the encoder. Encoders are sensors that convert motion into an electrical signal, which can be interpreted by a control device in the robotic system.

Enhanced Precision and Accuracy

By using encoders, robots can perform tasks with a high degree of accuracy, reducing errors, and improving overall productivity.

Real-Time Feedback

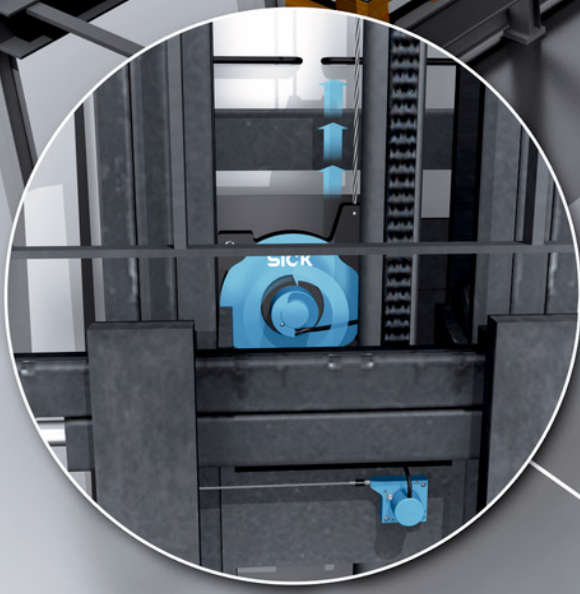
Can move robotic arms to a precise point at the right time. This helps the robot know where it is and how it's moving around.

Improved Efficiency

Allows for optimal movement and operation of the robot, resulting in reduced energy consumption, faster operation times, and increased efficiency.

Versatile and Cost Effective

Encoders can reduce the need for manual labor, decrease errors, and increase efficiency, all of which can lead to substantial cost savings over time.



Considerations When Integrating Encoders in Robotics

An estimated 70 percent of production costs are due to design decisions. When selecting an encoder, be sure to evaluate its effect on the robot assembly process and overall existing operation. Consider details such as size, shape, structure, and compatibility with the robot's design for a seamless installation and integration.

It's crucial to choose the right type of encoder that best fits the specific requirements of the robotic system. Encoders play a vital role in robotic automation. Their ability to provide precise, real-time feedback improves accuracy, efficiency, and versatility in a wide range of applications.

While the initial investment may be significant, the long-term benefits make encoders a cost-effective solution for many businesses. As technology continues to advance, the role of encoders in robotic automation is likely to become even more critical.



Considerations When Integrating Encoders in Robotics

Space Constraints

Installation space is always limited in robots, especially in compact cobots. Encoders should have the smallest footprint possible.

Complex Dynamics

Designing control laws for robot dynamics can be difficult due to the non-linearities associated with robot dynamics.

Positioning Accuracy

Achieving exact and repeatable positioning without exceeding the cost limit for robot production, including encoder assembly, is a challenge.

Power Loss

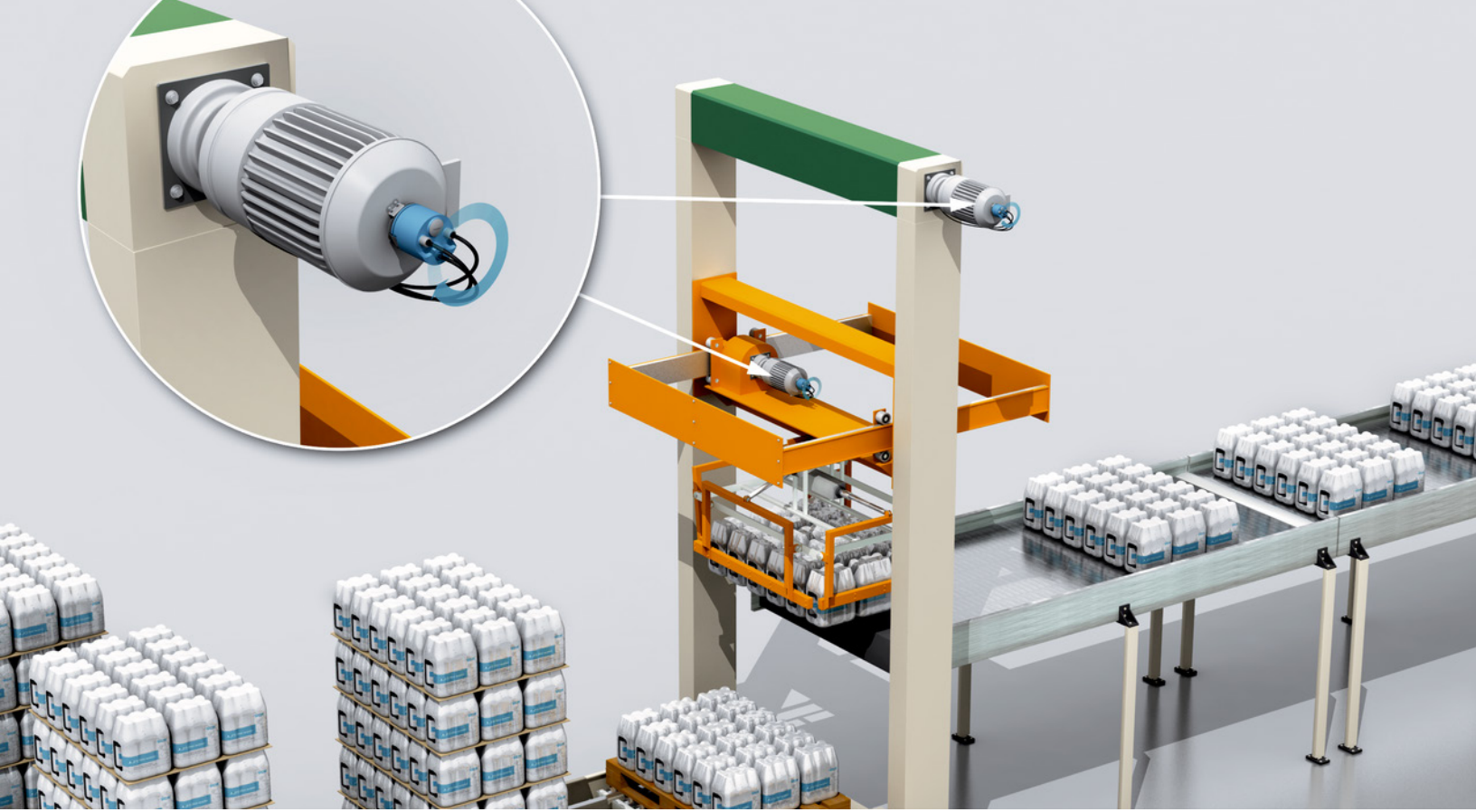
Incremental encoders lose positional data if the system loses power, necessitating a homing sequence at startup.

Cost and Complexity

Absolute encoders are typically more expensive and complex than incremental encoders.

Stiffness Compensation

The robot joint motor needs an encoder to servo. Due to the gear ratio, the output joint needs an encoder that defines its specific accurate position in space and supports overall robot trajectory accuracy requirements.



Advantages of Encoders for Conveyors

Encoders on conveyors offer significant advantages in material handling and packaging systems. They provide precise control over the conveyor's motion, enabling accurate positioning and speed management. This precision enhances the efficiency and productivity of the system, optimizing operations and reducing waste.

Encoders also contribute to increased safety by providing real-time feedback, which can be used to prevent accidents and malfunctions. They offer high accuracy across the entire length of the conveyor belt, ensuring consistent performance. Even over long distances, encoders maintain their performance, making them suitable for large-scale conveyor systems.

With their ability to support adjustable-height transfer systems, encoders bring flexibility to variable-height conveyors. Encoders play a critical role in enhancing the performance, safety, and efficiency of conveyor systems.

Primarily, encoders used on conveyors are classified as absolute and incremental based on functionality. The absolute rotary encoder provides a unique code for each shaft position, offering precise position tracking. Incremental rotary encoders, on the other hand, output pulses correlating to the amount of rotation, allowing for the calculation of position through pulse counting.

The Critical Role of Encoders on Conveyors

Encoders play a crucial role in conveyor systems used in material handling and packaging. These functionalities of encoders help in achieving efficiency, precision, and coordination in conveyor systems used in material handling and packaging. Here's how they contribute.

Motion Feedback

Encoders, when combined with measuring wheels, provide vital motion feedback. The wheel rides on the conveyor belt or material surface, and as it turns, the rotating shaft creates electrical pulses that the encoder sends to the controller.

Precise Timing

Material transported by conveyors relies on encoder feedback for coordinated functions like cut-to-length, container filling, product inspection/rejection, and pick-and-place. Once the encoder has sent a predetermined number of pulses to the control system, it activates the cutting device, dispenser, camera, actuator, or pick-and-place robot.

Cut-to-Length Functions

In cut-to-length functions, the encoder generates a fixed number of pulses, which then determine the length of travel. When the encoder has sent the predetermined number of pulses to the control system, it activates the cutting device.

Conveyor Speed and Direction

Encoder feedback can be used to monitor belt speed and direction, as well as the position of objects on the conveyor.

Integration with Vision Systems

For many conveyor applications, incremental encoders are used in tandem with vision sensors to aid with operations such as product marking, inspection, and pick and place. The function of the encoder is to indicate belt speed, with the rate of encoder pulses generally equivalent to the resolution requirements of the receiving device.

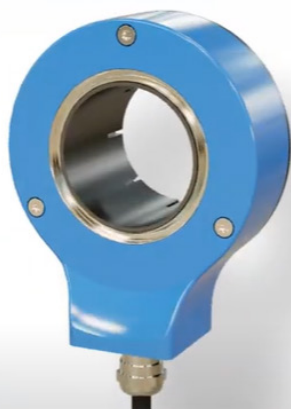
Surface-Mounted Conveyor Feedback

An effective means of obtaining conveyor feedback is to read directly from the belt itself, using a precision measuring wheel attached to a rotary incremental encoder.



WANT TO LEARN MORE ABOUT ENCODERS FROM SICK?

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DGS80

Rugged incremental encoder with large hollow shaft diameters