



Early Warning System for Production Systems

Often it is small modules in production systems, such as rotary encoders, which make it necessary to shutdown the plant for their replacement in case of faults, thus resulting in enormous costs, which are out of all proportion to their actual price. This can be avoided by the use of rotary encoders which are capable of self diagnosis and can indicate internal problems so that maintenance can be planned as early as possible.

If small modules in a plant or machinery break down without notice, the costs for the replacement part are usually out of all proportion to the damage caused by the interruption of production. For example, in the paper industry the costs of each hour of interrupted production are on the order of \$7000 and more. As rotary encoders are among the key components of modern



machinery and plant control units, it makes sense to equip these components with a diagnostic system which continuously monitors the internal functionality of the rotary encoder and therefore provides a basis for initiating maintenance measures in good time.

Did You Know...

...that over a hundred HEIDENHAIN rotary encoders are in use every day during the extraordinary Le Rêve theater production at the Wynn Las Vegas? The show is set in a one million gallon (water) capacity theater and features acrobatic diving and feats of strength with state-of-the-art special effects.

Le Rêve, meaning "Dream" in French, immerses the audience with a cast of 85 characters into a world of fantasy, adventure, and intrigue. The original cost of the production itself is estimated at \$130 million and has just celebrated its five-year anniversary. The aqua theater-in-the-round is truly unique and features an elaborate 84,000 pound automated turntable mounted to the ceiling called the carousel. This carousel is critical in the acrobatic displays in the air, and contains 20 winches which aid in manipulating performers and scenery.

The automation system at Le Rêve is comprised of 131 different axes of motion. This includes a system of underwater lifts and high speed winches used to fly the performers and scenery. HEIDENHAIN's precision measurement rotary encoders run on the majority of these axes.

"The HEIDENHAIN encoders do a very important job here and have been very reliable over the years," explained Shaun Quinn, Head of Automation at Le Rêve. "During the show, we have up to 60 winches all moving seamlessly at the same time and it is imperative that they be dead on in order to maintain safety



The Le Rêve automation system covers 131 different axes of motion.

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The rotary encoders used in today's production plant are often subjected to high mechanical stresses in the form of shock and vibrations

as well as high temperatures. The following typical component specifications reflect these stresses: Vibration-resistance up to 100 m/s², shock resistance up to 1,000 m/s², axial load 100 N and radial load up to 300 N. Under these general conditions a positioning accuracy of 0.1 mm must still be ensured.

Typical Causes of Failure of Rotary Encoders

It is therefore no wonder that rotary encoders break down in spite of their being very

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robust. The following are some of the “typical” reasons for the breakdown of rotary encoders.

- **Worn-out ball bearings due to poor installation:**
The connection of the rotary encoder to the motor shaft can be made by means of a coupling (typical for shaft encoders) or by plugging onto the shaft (typical for hollow shaft encoders), whereby the rotary encoder is prevented from rotating by means of a torque support. If the specified minimum tolerances are not complied with, imbalance results, which causes premature wear to the ball bearings. The result: a wobbling of the increment disc. Individual areas lose contrast, which in turn causes the loss of several pulses. Specifically this means: The rotary encoder still functions, but the entire drive unit becomes irregular as the frequency inverter attempts to compensate for these fluctuations.
- **The “loose contact”:**
Imbalance of the drive unit may put excessive strain on soldered joints and (terminal) contacts, so that bad contacting causes sporadic faults.
- **Soiling in the rotary encoder causes dust particles to be deposited on the increment disc:**
When dust particles are present on the incremental disc, suddenly the rotary encoder then detects two increment lines as one, and therefore produces one pulse too few. This can happen for example with assembly under difficult conditions with high levels of dust if the connection cover is opened. (In such cases it is advisable to use versions with external plug connections.)
- **Moisture in the connector or in the housing:**
If, for example, cables are used which are too thin, moisture can penetrate into the rotary encoder through the cable gland and cause sporadic malfunctions
- **Overheating:**
As the rotary encoders are often installed behind a fan, the exhaust air from the motor is passed over the encoder. If a motor bearing is faulty, the hot exhaust air from the motor can cause the failure of the rotary encoder.

A fault with many installations is also the fact that monitoring of the rotary encoder is only implemented in the frequency inverter. However, between the inverter and the rotary encoder there are enough cables and terminals to cause problems. For example, a crushed cable can lead to an interruption of the signal, which is mistakenly interpreted as an encoder fault by the inverter and results in the user exchanging a component, without the actual fault being remedied.

In order to avoid such false diagnoses and sudden failures of rotary encoders – and rather to “announce” these in advance – Leine & Linde (a HEIDENHAIN Corporation sister company) has integrated a unique early warning system into its rotary encoders. Called **Advanced Diagnostic System™ (ADS™)**, this system for automatic self-diagnosis works as follows:

Integrated Early Warning System

For example, the rotary encoder internally monitors the completeness of the pulses and the correct pulse sequence (Fig. 1). Even a single counter difference from the programmed division is registered by the system and reported via a

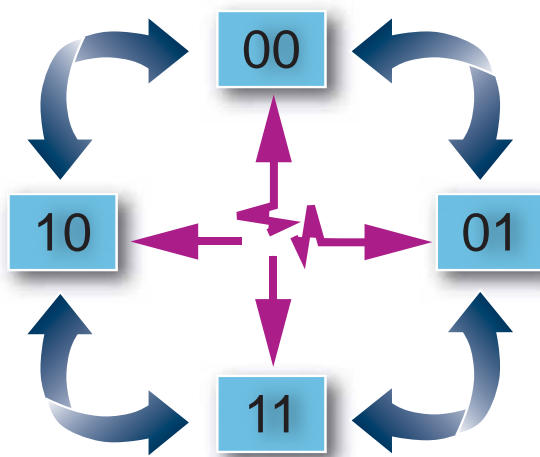


Fig. 1: By means of the “Advanced Diagnostic System”, each counter difference is recognized regardless of the direction of rotation. If the correct pulse sequence (green arrows) is interrupted (red arrows), an error message is given.

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Did You Know... *continued from Page 1*

and artistic integrity. We need to have an extreme amount of control, reliability, and repeatability, and between our software and encoders, we do.”

Quinn continued, “The HEIDENHAIN EQN 425 encoders are used in this system not only because of the high accuracy and reliability of their sinusoidal incremental signals, but also for the absolute feature which the system uses for redundancy. The absolute aspect also allows for easier maintenance due to no loss of position during power down and startup procedures.”

For more information on HEIDENHAIN’s EQN 425, please go to www.heidenhain.com. For show information, visit www.wynnlasvegas.com and click on “Entertainment”.

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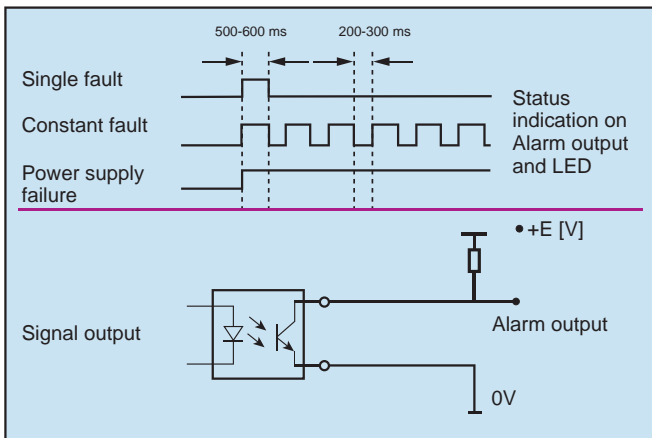


Fig. 2: According to the type of fault, the error message is made on the basis of various signal sequences, which are output via a potential-free optocoupler.

potential-free switching output (Fig. 2); this can, for example, be evaluated and displayed by an overriding system control system. For this an additional wire is necessary. In parallel to the switching output, the fault is indicated by a flashing LED on the rear of the housing. In case of upgrading, this enables the ADS™ to be used without additional wiring. Often, rotary

encoders are installed in visible positions, so that a sporadic visual check by the user is sufficient. The flashing LED can be easily seen at a distance of 10 m.

As part of ADS, Leine and Linde stores the time of the fault and the corresponding error code in the rotary encoder so that the user has the opportunity to read out and analyze the error code via an RS-232 interface (once the encoder has been removed). For statistical purposes the number of operating hours, the speed of rotation and the current temperature are also measured in the encoder.



In addition, the highest and lowest temperature is stored. There is also a differentiation between individually occurring errors and continuous problems.

The evaluation software provides the user with an overview of the type of rotary encoder problem, the time of the fault and the condition and encoder data.

For more information on the new ADS technology, visit www.leinelinde.com

HEIDENHAIN Offers Safety-oriented Rotary Encoders In a Small Footprint

Opening up the market for innovations in the automation, medical, and electronics equipment industries, HEIDENHAIN Corporation offers a new generation of rotary encoders with IP 64 protection, absolute position-value formation, and functional safety, all within a 35 mm diameter housing size. These small rotary encoders are known as HEIDENHAIN's 1000 Series and are designed to be especially useful as single-encoder measurement feedback systems in safety-oriented applications.

HEIDENHAIN's safety-oriented position encoders with functional safety provide two independently formed position values via a serial



EnDat interface. They are certified according to the EN ISO 13849, EN 61508 and EN 954-1 standard for performance level d, safety integrity level 2 and category 3, respectively. The EnDat 2.2 version of these new absolute rotary encoders with serial data transfer offers a single-turn resolution of 23 bits, and a multi-turn resolution of 12 bits. The supply voltage range is from 3.6 V to 14 V.

Eight new rotary encoders round out HEIDENHAIN's 1000 Series including the ECN 1013, ECN 1025, EQN 1025, EQN 1035, ROC 1013, ROC 1025, ROQ 1025 and ROQ 1035.

For more information, visit www.heidenhain.com

Dear Abbé...

Question: I am in the process of implementing HEIDENHAIN's EnDat 2.2 encoder interface and I was wondering if you offer any tools that will help us understand the functionality?

Answer: In addition to a library of application notes, we also offer what is known as an EnDat Demo Kit.

The EnDat Demo Kit is intended for demonstration of the capabilities of the EnDat interface and, on the other hand, for communication with EnDat encoders on the basis of mode commands.

The EnDat Demo Kit thus supports the design process in the following way:

- First, communication via mode commands can be tested outside the control loop
- It can be used as a reference in the course of integration of the EnDat master into the control loop
- Service for encoders together with the ATS software

The EnDat demo kit consists of the following components:

- IK 215 (PCI card for connecting EnDat encoders)
- EQN 1337 (multi-turn rotary encoder)
- Cable: EQN 1337 to IK 215
- Software on CD

Contact your local area sales manager for details on pricing and availability.



The EnDat Demo Kit helps deepen your understanding of both the capabilities of the EnDat interface and the mode commands at the heart of the communications protocol for EnDat encoders.

Leine & Linde Offers Heavy Duty Encoder With Common Bore Size

Well known for providing extremely robust encoders for harsh environments, Leine & Linde now offers a new encoder in the hollow shaft 800 series that comes equipped with a one-inch bore size. **Now available in North America through HEIDENHAIN Corporation**, this new option from Leine & Linde makes this encoder a strong option for common speed and measurement applications, and of particular use in those that require high vibration and shock resistance.

Named the Leine & Linde XHI 803 model, this intelligent new incremental encoder has an extremely robust housing with a cover of anodized



aluminum, and is rated IP 66 (67). It is available with through-going hollow shafts of 12, 16 and 25 mm, and holds line counts up to 10,000. It has HTL, 1Vpp, and TTL outputs.

The 803 encoder, as with all 800 series, is available with Leine & Linde's Advanced Diagnostic System (ADS) and up to 5-pole commutation. The use of ADS is on the increase as a strong incorporated early warning device.

ATEX versions are available.

For more information, visit www.leinelinde.com



HEIDENHAIN Maximizes Resources for Customers

*By Rick Korte
President, HEIDENHAIN Holding*

The North American machine equipment business has undergone extraordinary changes in the last couple of years. As an important provider of motion control solutions to this business, we too saw the fluctuations in the marketplace and knew that we needed to adapt to this business climate. To that end, HEIDENHAIN Corporation and its sister companies are in the final stages of successful corporate consolidation efforts. These changes have allowed us to maximize our vast internal resources to better meet the needs of our customers in both the OEM (Original Equipment Manufacturers) and end user markets.

As many know, HEIDENHAIN Corporation is based in Schaumburg, IL and is the North American wholly owned subsidiary of DR. JOHANNES HEIDENHAIN GmbH in Traunreut, Germany. In 2008, a keen watch on the world marketplace set into motion a plan to better meet the business needs of our customers in North America. To this end, the products of many of our sister companies have been melded into the sale and distribution channels that originate out of the HEIDENHAIN headquarters in Schaumburg, IL. This includes those of RENCO Encoders Inc., METRONICS®, Leine & Linde, RSF Elektronik Inc., Numerik Jena, Acu-Rite Companies Inc. and ANILAM. The extremely positive results of this integration are already

being seen by customers in the form of an even broader and more extensive product offering all in one place. The increased amount of available expertise in this field is second to none, and we have taken great strides to simplify the contact channels for all our customers. This now means that a single point-of-contact can help customers with precision measurement components from a uniquely large resource pool. Very specific solutions for small motion applications can be found quickly as well as large package solutions bundled easily.

Because of the many integrations that have taken place, all of our product offerings now originate from our very best production facilities. These world class facilities hold rigorous documentation, procedures and quality control systems firmly in place. And our combined engineering resources have served to only strengthen HEIDENHAIN's already solid and well established R&D departments.

We, at HEIDENHAIN, know that our customers are working harder with less, and we believe our efforts to consolidate many of your motion control sources to one powerful location will serve you well.

CONTACT INFORMATION

For more information about HEIDENHAIN and any of the products or services mentioned here, please feel free to contact us.



HEIDENHAIN
The Measure of Excellence

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