

On a drive for condition monitoring

Mitsubishi Electric has collaborated with their e-F@ctory Alliance Partner Schaeffler sensor technology to offer two Smart Condition Monitoring (SCM) solutions – one based on an integrated PLC solution and the other using the intelligent functions of the 800 Series Variable Speed Drives.

From a predictive maintenance perspective there is little doubt that applying vibration sensors to critical motors, fans, pumps and gearboxes is a great idea. However, once the sensors have been attached to these important pieces of plant, in order for predictive maintenance to deliver on the promise of lower maintenance costs and reduced downtime the data must be analysed and the information gleaned from them must be presented in a way that is convenient and relevant to the operations team.

Without being connected to a separate control, monitoring or visualisation system, the real advantage of a convenient early warning system for maintenance requirements is reduced. It's all well and good if a small LED changes from green to red out on a remote part of the plant but unless operators and maintenance engineers can see a clear beacon or monitor the information being provided easily from a control room or mobile device then the benefit is limited.

Making the best use of smart drives

Variable Speed Drives (VSDs) from mainstream vendors will often include some form of predictive maintenance feature that helps preserve the health of the VSD. These can vary from a simple set of maintenance timers that can supply simple run-time hours, to more advanced functions.

Once the set period has elapsed on a timer it will flag an output as a reminder that some maintenance is required. A modern VSD will go much further though; it can check the main capacitors or the inrush current on the circuit for anomalies. These more advanced measures can provide one of many life checks supported as standard on a higher-end device. They can even monitor the load characteristics of the equipment the VSD is controlling; making sure for instance that a driven pump is running within its optimum pumping curve.

This is where the first condition-based monitoring solution developed by Mitsubishi Electric in conjunction with one of its e-F@ctory Alliance Partners Schaeffler moves the game on considerably. By harnessing the valuable data from the sensor and using the VSD to process the information into actionable insight, a Mitsubishi Electric 800 Series VSD will not only look after itself but also the general health of the complete drive train – from the motor through to the driven equipment.

Utilising the PLC functionality built-in to an 800 Series VSD, specific application code has been developed to work in conjunction with Schaeffler sensors. This "plug and play" solution allows the operator to directly monitor the VSD, motor and the rotating equipment the motor is connected to via the connected VSD. The program has been developed to support two individual sensors per VSD so both the motor and a gearbox, pump, compressor or fan for example could be monitored by the VSD.

So how does it work?

All rotating electro-mechanical equipment will vibrate to one degree or another, however analysing and interpreting vibration patterns is recognised as a bit of a 'dark-art'. Fortunately, this is taken care of automatically by the Smart Condition Monitoring System.

Monitoring of simple drive elements such as motors, pumps and fans is based on physical vibrations transmitted through the solid metal of the housing. The system records three general parameters: ISO10816, RMS, and the peak-to-peak value based on the acceleration signal and its curve envelope. The information is given a trend curve over time and anomalies are then identified easily. Temperature monitoring is also included in the device which allows for monitoring and cross-reference with an additional related trend.

Given some basic parameters the smart sensor automatically determines the appropriate alarm thresholds. As soon as enough measurement data is available, the pre-set alarm thresholds are automatically replaced by the newly determined ones. It has the ability to monitor specific frequencies, such as those found in damaged rolling bearings, gear teeth and fan propellers.

Various component templates for entering specific operational data for fans, pumps, toothed belt drives, clutches, gearbox stages and shafts are included. A teach function allows the SCM sensor to learn how the machine behaves in its normal operating state and creates a memory map of the vibration readings. A database integrated into the sensor also contains data from Schaeffler for standard rolling bearings. By recognising imbalance, misalignment and knocking, the system detects damage to the relevant components.

The smart sensor mounted on the rotating equipment feeds information back into the VSD and the VSD compares these vibrations with a look-up table held inside the VSD's internal PLC. This then determines the condition of the motor and the VSD reports this information in one of three ways:

- A simple three colour beacon that the VSD has already been configured to support from the PLC code inside the VSD. Showing green for 'healthy', amber for 'pre-alarm' and red for 'tripped'. In a plant with a large number of systems in place, a bright visual check can still be very effective.
- The VSD's keypad / display offers more advanced on-site diagnostics giving specific reasons for pre-alarms and what can be checked to resolve the issues. This can also be used in conjunction with the colour beacon.
- The third option is to use a local touch-screen HMI. The programme is pre-configured for Mitsubishi Electric's GOT Series HMIs and can be scaled up or down to suit the size of GOT being used and comes with a set of pre-defined template screens to minimise engineering time.

This system can be used with any brand of motor and the user requires no prior knowledge of vibration analysis to interpret the alarm codes. While the solution can be ordered as a completely new system it can also be retrofitted to any Mitsubishi Electric F or A800 E2 model VSD. Regardless of how it is configured this package offers peace of mind for both VSD and drive train, giving practical early warning signals and preventing costly downtime and loss of production.

What if my system is more complex and I need more sensors?

The next step is a full Smart Condition Monitoring (SCM) solution that includes multiple sensors a physical PLC and an HMI. The SCM is an integrated solution that collects live data from the same Schaeffler sensors, analyses it and then provides updates and warnings to anything from a smart phone or single HMI to multiple levels of management systems.

The ability to link multiple SCM sensors back to a single controller means depending on the application, several machines or a complete production line can be monitored. The fact that the system can work as a stand-alone system or become part of a fully integrated predictive maintenance solution transferring its critical data to either the edge computing layer or straight to the enterprise layer, gives total flexibility and scalability.

Brewing up the benefits [Application example]

Muntons Malt, one of the UK's largest producers of malted barley uses an SCM system from Mitsubishi Electric to monitor fans and motors vital to its production process. Used to make beer, spirits and a range of popular foodstuffs, malted barley is produced in large batches where environmental conditions are critical to a consistent product. The operation team had previously experienced issues with difficult-to-reach bearings inside a large fan housing and wanted to stay ahead of the game in future.

Plant Engineer Michael Plawecki explains, "We were caught-out by a bearing inside a fan assembly that we only realised had problems when it was too late and we had to make an unscheduled stop on one of the lines to make repairs. Determined to learn from that lesson we found an ideal solution from Mitsubishi Electric, an automation brand we trusted.

We rely a lot of automation, electro-mechanical equipment and sensors to provide fine control over air flow, heat and moisture. Each batch is very valuable, not just in monetary terms but also to the customer, so we are now extremely pro-active when it comes to service and maintenance of our equipment.

The key for us was to find a system with predictive maintenance technology onboard that could be linked to the existing SCADA system and provide us with the maximum forewarning of any future issues yet was quick and easy to install."

Image captions:

Image 1: By harnessing data from the sensor and using the drive to process the information into actionable insight, a Mitsubishi Electric 800 Series VSD will look after itself as well as the general health of the complete drive train.

[Source: Mitsubishi Electric Europe B.V.]

Image 2: Mitsubishi Electric's SCM system can be used to monitor fans and motors vital to the barley malting process.

[Source: Mitsubishi Electric Europe B.V.]

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Note to Editor: if you would like the text in another language please contact Carolin Heel at DMA Europa – carolin@dmaeuropa.com.

About Mitsubishi Electric

With nearly 100 years of experience in providing reliable, high-quality products, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. Embracing the spirit of its corporate statement, Changes for the Better, and its environmental statement, Eco Changes, Mitsubishi Electric endeavors to be a global, leading green company, enriching society with technology. The company recorded consolidated group sales of approximately 40.7 billion dollars* in the fiscal year that ended on March 31, 2019.

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The role of Industrial Automation – UK Branch is to manage sales, service and support across its network of local branches and distributors throughout the United Kingdom.

**At an exchange rate of 111 Yen = 1 US Dollars, last updated 31.03.2019 (Source: Tokyo Foreign Exchange Market)*

Further Information:

Website: gb3a.mitsubishielectric.com

Email: automation@meuk.mee.com

Facebook: www.facebook.com/MEUKAutomation

Twitter: twitter.com/MEUKAutomation

YouTube: www.youtube.com/user/MitsubishiFAEU

LinkedIn: [www.linkedin.com Mitsubishi Electric - Automation Systems UK](http://www.linkedin.com/Mitsubishi Electric - Automation Systems UK)

Editor Contact

DMA Europa Ltd. : Carolin Heel

Tel: +44 (0)1562 751436

Web: www.dmaeuropa.com

Email: carolin@dmaeuropa.com

Company Contact

Mitsubishi Electric Europe B.V. Automation Systems Division : Garry Lewis, Manager - Marketing & Communications

Tel: +44 (0) 1707 288769

Fax: +44 (0) 1707 278695

Web: gb3a.mitsubishielectric.com

Email: automation@meuk.mee.com