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FAQ: How to Unlock the True Potential of Industrial Vibration Monitoring

Written By
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CONTROL

FAQ

How to Unlock the True Potential of Industrial Vibration Monitoring

Machine health monitoring is undergoing rapid and highly beneficial changes. Aided by Industry 4.0 technologies such as industrial internet of things (IIoT) sensors and globally standardized digital protocols like IO-Link, today's vibration analysis is faster and more effective at detecting fault conditions than traditional analog approaches. In turn, making smarter, data-driven decisions increases safety, reliability, and performance.

This FAQ explores the evolution and considerations for maximizing the value of industrial vibration monitoring.

Why are accelerometers a staple in industrial condition monitoring toolkits?

A: For about as long as plants have practiced predictive maintenance, vibration has been recognized as an invaluable window into machine health. Accelerometers capture machine vibrations and convert them into quantifiable signals, making it possible for maintenance teams to detect wear, imbalance, or bearing faults before these issues lead to costly downtime.

Over the years, accelerometers have become increasingly adept at translating vibrations into actionable insights. As a result, maintenance teams can spot developing problems earlier than ever and take proactive steps to extend machinery life.

How do MEMS-based vibration monitoring devices compare to piezoelectric sensors and transmitters?

A: Micro-Electro-Mechanical Systems (MEMS) accelerometers contain tiny, machined structures that register changes in capacitance, making them great for applications with slower vibration or tilt measurements. Piezoelectric devices, on the other hand, rely on crystals that generate an electrical charge under mechanical stress, which boosts their ability to detect higher-frequency signals and endure demanding environments.

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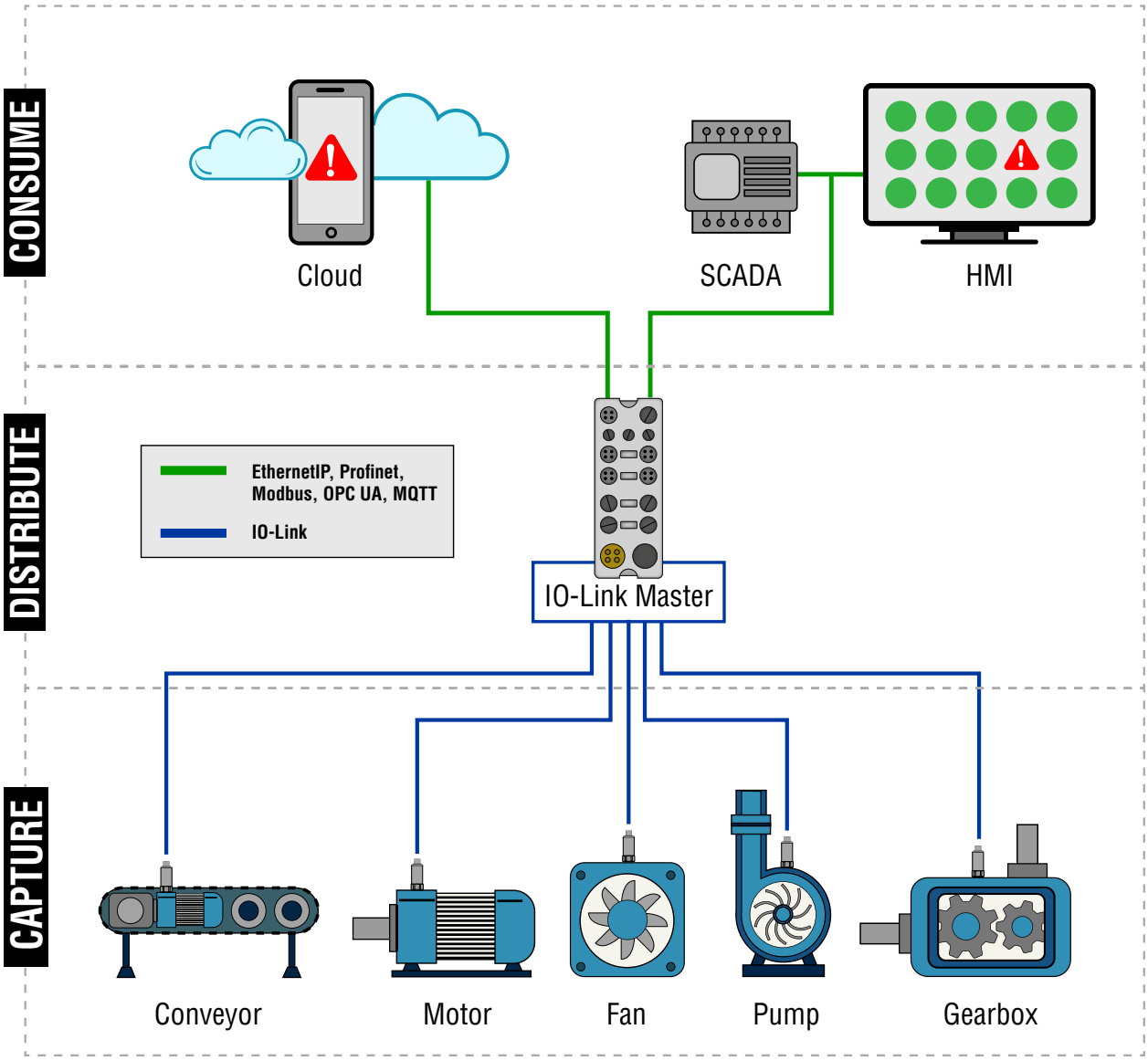
IO-Link

VIBRATION MONITORING USING MODEL 674A91

- Simple connection to your local network using IO-Link communication
- No control cabinets or extensive wiring required
- Accurate equipment condition assessment and automated alerts
- Data processing in the sensor without the complexity and high price
- Leverage your existing control network for real-time monitoring

Industrial-grade machine protection with proven piezoelectric accelerometers that integrate directly into your existing control platform. Machine condition is continuously monitored for common fault conditions, enabling timely and predictable scheduling of maintenance before major damage, failure, or production downtime. Unlike intermittent single-measurement systems, this solution provides comprehensive, around-the-clock protection.



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Which technology is better for predictive maintenance, and why?

A: When it comes to spotting trouble before a catastrophic failure, high-frequency signals are often the first indicators. Piezoelectric sensors excel here, capturing nuances like bearing faults or misalignment in their early stages, often up to 10 kHz, for condition monitoring. MEMS sensors, with a narrower bandwidth, usually catch issues only after they become more pronounced.

For low-frequency applications, MEMS can be a cost-effective, power-friendly solution. But if your goal is to catch subtle vibrations from rotating equipment or early-stage bearing faults, piezoelectric remains the preferred choice.

How does IO-Link change the paradigm for vibration monitoring?

A: IO-Link supports earlier fault detection by enabling the transfer of digital machine health data from IIoT sensors on the factory floor directly to a centralized system.

For PCB Piezotronics, integrating our proven piezoelectric technology with an IO-Link digital interface was the next logical step in pushing vibration monitoring forward. We evaluated multiple protocols and chose IO-Link for its open standards, straightforward integration, and robust data handling — all of which would make it easier for our customers to adopt.

What really stood out to our team was IO-Link's bidirectional communication, which lets us embed more "intelligence" in the sensor itself, reducing extra hardware and installation time. And with over 61 million IO-Link nodes in use worldwide, the technology has clearly established itself as a global standard, continually gaining ground in modern manufacturing.

What role do IO-Link masters play?

A: Think of the IO-Link master as your central command station, connecting multiple IO-Link sensors to your higher-level control system. Each sensor plugs into the master with standardized cables and configuration tools, which minimizes the wiring you'd see with purely analog setups. Since the master handles data routing to the PLC, Ethernet network, or cloud platform, scaling up your sensor network is straightforward. It's one of the most cost-effective ways to bring intelligent vibration data into your local network.

Why should companies move from analog devices to the digital realm?

A: When we talk about digital sensors providing "deeper insights," we're referring to more than just how data is transmitted. With a digital interface, sensors can perform basic signal processing right at the source, sending multiple parameters like peak acceleration, root mean square (RMS) velocity, crest factor, or temperature through one output. Instead of a single vibration measurement, users get a broader view of machine health without needing separate devices or dedicated processors.

Additionally, since IO-Link supports bidirectional communication, you can remotely adjust settings, receive diagnostic alerts, and tap into sensor-specific data. Most of these capabilities simply aren't feasible with analog devices.

Can you provide a real-world example of the benefits of using vibration sensors with the IO-Link universal digital protocol?

A: One example is an ethanol plant that needed to track multiple fault conditions on large industrial fans. With traditional analog sensors, each fan would have required its own control cabinet, as well as analog-to-digital converters and specialized PLC programming. The approach would have cost tens of thousands of dollars while only providing a single data point per fan.

Instead, the plant adopted PCB Model 674A91 accelerometers with IO-Link, which supply peak acceleration, RMS, velocity, and temperature, and send data directly to a centralized system. It not only saved on capital and labor expenses, but also gave the maintenance team a clear, detailed picture of each fan's health, enabling more proactive maintenance.

What capabilities should plants look for when choosing an IO-Link vibration sensor solution?

- Consider whether the sensor's core technology (ideally piezoelectric) delivers the frequency range needed to detect both subtle and high-impact vibrations.
- Check if the sensor can capture a variety of measurements (like RMS, peak, velocity, and temperature) for a more complete picture of machine health.
- Look for smart features, such as onboard signal processing or edge computing, to further streamline diagnostics without extra hardware.
- And most importantly, confirm that the sensor is easy to install, configure, and maintain, so you can focus on analyzing data rather than wrestling with setup challenges.

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