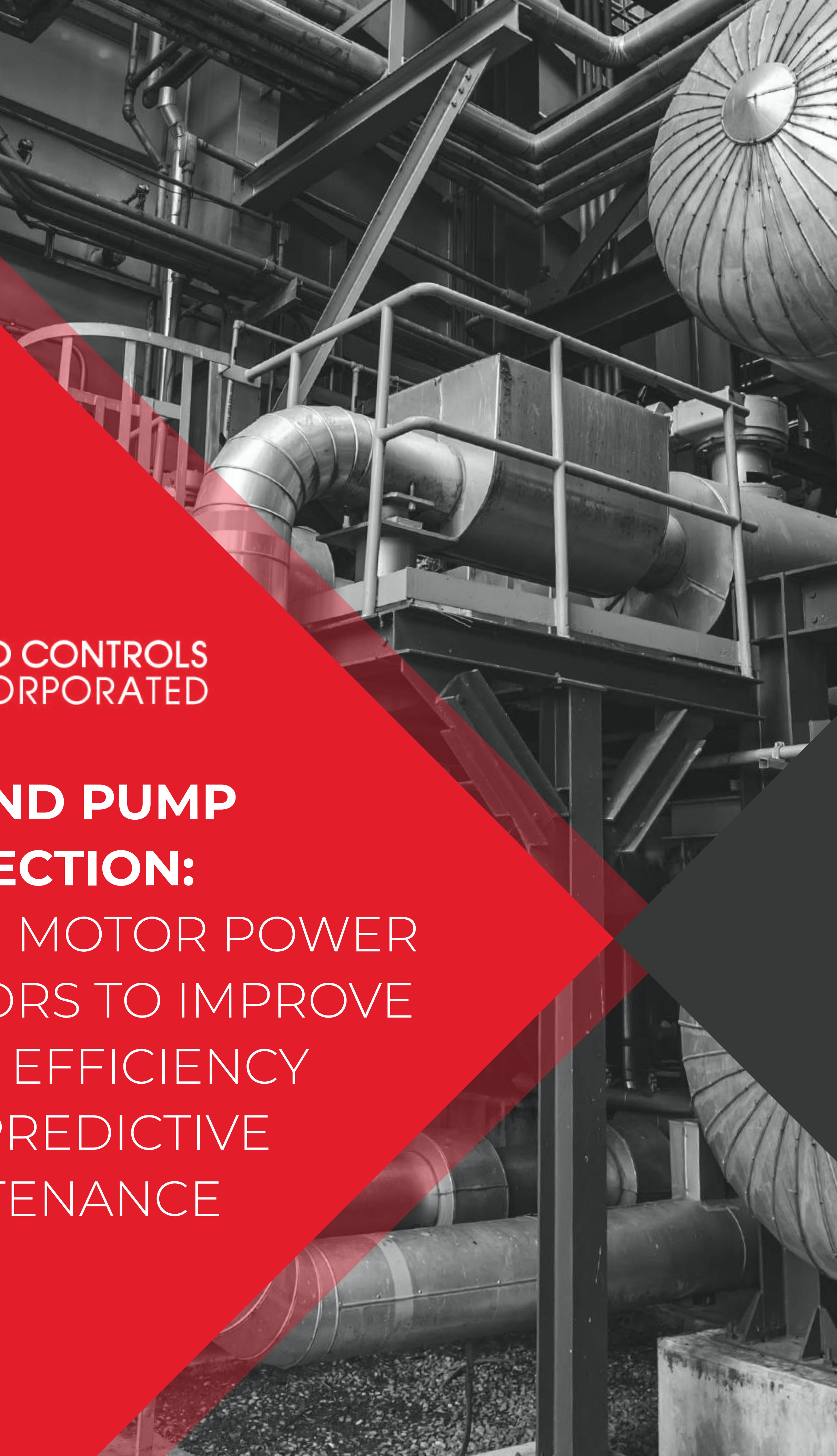


LOAD CONTROLS INCORPORATED

BEYOND PUMP PROTECTION:

USING MOTOR POWER SENSORS TO IMPROVE PUMP EFFICIENCY AND PREDICTIVE MAINTENANCE

TAKE ACTION TODAY
TO IMPROVE YOUR PUMP SYSTEM

Are you properly tracking in-feeds, flows, pressure and viscosity, process efficiency and changes to the pumping subsystem over time? Early fault detection based on motor power, along with proper intervention can protect your motors and pumps, improve efficiency, and extend their longevity even in the most dangerous and harmful conditions. And now, use this same data to improve energy efficiency, lower costs and improve reliability and uptime for your pumps.

LEARN MORE ABOUT THE BENEFITS OF POWER SENSING.
www.loadcontrols.com/pump

In our previous Whitepaper 'Using Power Sensing to Monitor and Protect Pumps' we detailed the advantages of implementing motor power sensing to a safe, well run pumping environment. Firms that measure motor power can sense and quickly react to failure conditions such as jams, clogs, dry running, cavitation, and broken impellers. This ability to diagnose failures greatly improves system uptime, and limits potentially expensive or dangerous impact of pump failures.

In addition to these benefits, pump motor power monitoring can provide important insights into pumping efficiency, potential system improvements, and energy cost savings opportunities. This motor power data can also deliver early warnings of pump system degradation, enabling improved predictive maintenance and corresponding uptime benefits.

MOTOR AND PUMP EFFICIENCY – ENERGY MANAGEMENT

If you're in the pumping industry or use pumps as a regular part of your role, you know the large impact that pumps, and mid-sized (1-100HP) electric motors have on the world's energy consumption. And while many industrial companies have tackled the energy footprint of their lighting and HVAC systems, motors and pumps remain a fertile ground for achieving potential energy savings.

It's estimated that over 70% of all pump motors are at least 20% oversized for the work they do. Motor power sensors and controls give key data to unlocking these savings opportunities.

When motor power (measured in HP) is aggregated over time it can easily be converted into kWh, the language of the electric bill. This can be useful for insights into power consumption for the most important assets in the pumping process. Power sensors also incorporate 'power factor' into their calculations, providing additional data on the true operational costs of motors and their contribution to monthly energy bills. By understanding energy trends at the device level over time, operators can initiate energy saving measures such as:

- **Determining when to replace motors with more efficient designs.** Comparing measured HP to rated HP of the motors can highlight large savings.
- **Replacing oversized motors with smaller motors or Variable Frequency Drives.** This change can provide payback in a few months.
- **Implement staggered or off-peak operations.** Spacing out the timing of peak demands can lower overall power usage and save significantly on the monthly energy bill.

Note: Check with your local electricity provider—the investment in motor power sensors may qualify for energy efficiency rebates, allowing you to instrument critical motors for low, or no cost.

MONITORING ENERGY CONSUMPTION, HOW IT WORKS IN ACTION

Image 1 shows a positive displacement pump power curve. With the discharge valve starting to close, the motor horsepower starts to increase with pressure in the pump. When the valve again opens, the HP drops back down to the normal pumping power. Each point along this curve reflects an instantaneous power measurement. When viewed in total, the area under this curve represents the pump's power consumption. One kilowatt of power, measured for an hour, is the kilowatt hour the user is billed for. A vertical rise in this curve will be reflected in a larger energy expense, so the ability to monitor and investigate trends over time can be a key strategy to controlling expenses.

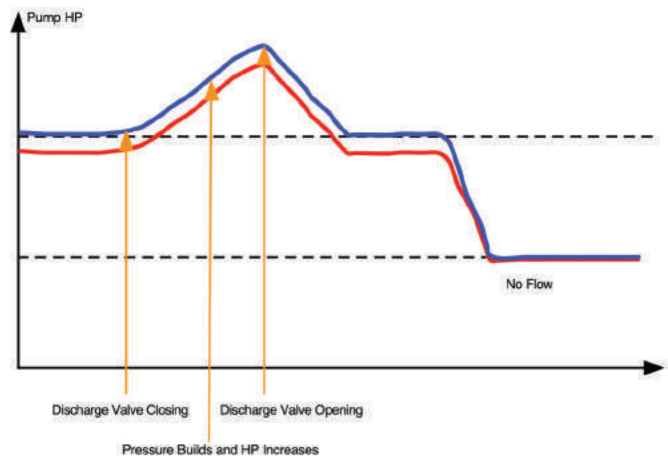


Image 1: Changes in power from steady state for a positive displacement pump

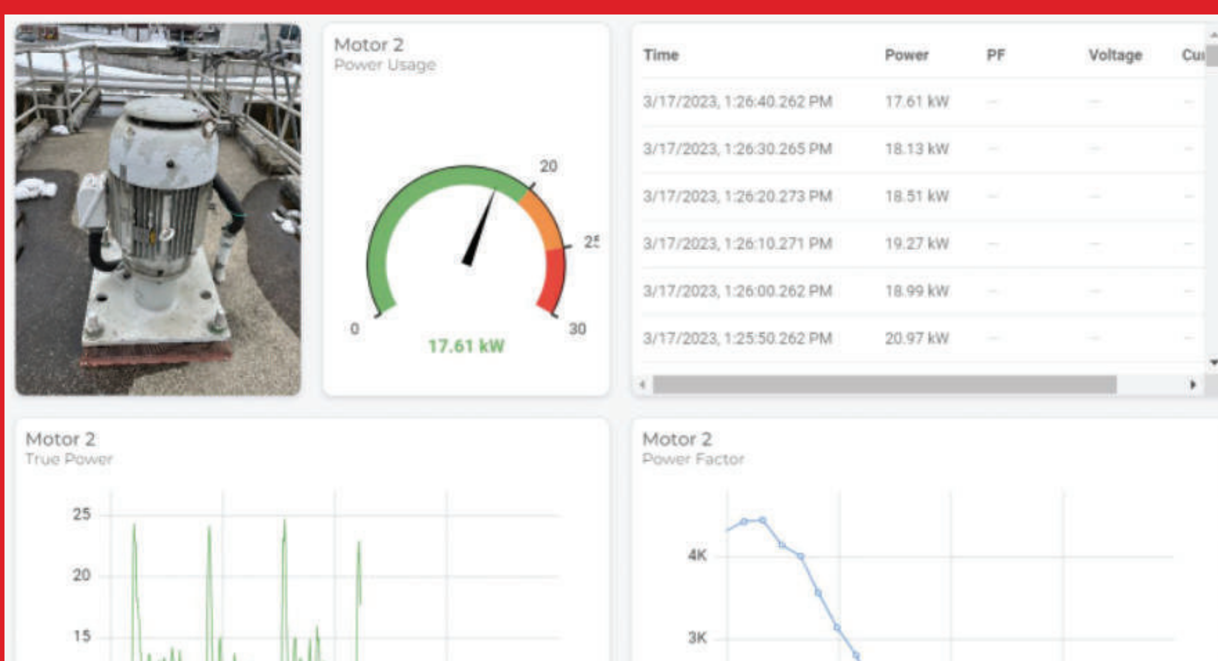
MOTOR NAMEPLATE SIZING AND POWER FACTOR

By comparing motor power data, generated by installed power sensors and controls, to sizing ratings stamped on the motor, it becomes easy to understand which motors are rated significantly larger than the required workload. It's exactly these motors that are candidates for 'right sizing' to deliver energy savings. The business case for this can support immediate replacement, or when the next major maintenance for the pump and motor is planned.

The electrical utility may also impose a "power factor" surcharge. This is the energy the power utility must produce and deliver (the full number of amps on the motor nameplate). But since they can only bill for the real, work, or power part, when power factor remains low across a plant, a low power factor surcharge is applied to the bill to enable the utility to recoup this difference. Power Factor surcharges are highest for lightly loaded, undersized pump motors. Comparing measured power levels to the nameplate HP capacity can indicate where pumps may potentially be oversized, and power factor surcharges are likely to impact the financial bottom line.

CASE STUDY, TOWN OF AMHERST WASTEWATER TREATMENT PLANT

The Town of Amherst Massachusetts Wastewater Treatment Plant provides waste treatment services for the town and its universities, a combined population of over 40,000 at peak residency. As part of an energy efficiency/water quality study, the WWTP implemented a network of water quality and pump motor power sensors. These sensors provide real-time and extended power usage for all key pumps and aerators. In addition to being able to develop new insights into the relationship between energy consumption and water quality, they are now able to compare energy usage among similar sized and function pumps and aerator motors. This data has provided new understanding of pump efficiency, pump degradation over time, and the need for proactive maintenance to enable high performance.



Images 2, 3: The Town of Amherst (MA) Wastewater Treatment Plant Power Sensor Initiative

INSIGHTS FOR PREVENTATIVE MAINTENANCE

Knowing this power levels of attached motors allows pumps to be rapidly shut down if error conditions are encountered. But this curve can also be monitored over time to track system degradation and enable improved prediction of impending faults.

Bearing wear, shaft misalignment, clogging and impingement, and other potential maintenance requirements affect the pump HP level proportionally. The more power the pump will pull to accomplish the same amount of work, the higher the measured HP. The entire curve will be offset by the change in power measured due to the maintenance concern, as shown in Image 4 in blue.

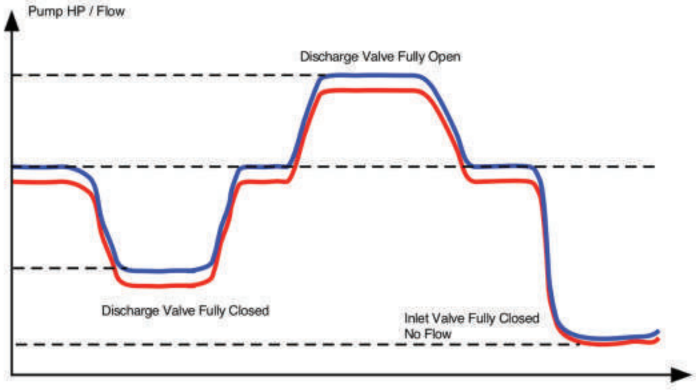


IMAGE 4: Changes in power from steady state with potential maintenance issue

Monitoring the vertical shift over time showing the increase in HP can provide insight into process efficiency and the potential need for proactive maintenance.

ELECTRICAL SIGNATURE ANALYSIS, INTO THE FUTURE OF PREDICTIVE MAINTENANCE

While changes in motor power over time offer important insight into impending maintenance needs, new opportunities for analyzing motor power data have arisen with recent advances in machine learning, networking/IoT and data science. By converting power signals (Voltage, Current and Power) from time-based measurements to frequencies, new wave forms are created that represent the 'sound' of the power signature. Comparing changes in the baseline signature waveform of healthy motors and pumps over time can indicate the early onset of performance issues and impending failures. These comparison techniques, under the umbrella term of Electrical Signature Analysis (ESA), include Motor Current Signature Analysis (MCSA), Instantaneous Power Analysis (IPA) and Park Vector Analysis (PVA).

While each technique offers unique strengths, all are aimed at early awareness and diagnosis of motor and pump failures such as motor imbalances, stator shorts, rotor breaks, and pump and bearing wear. Three key benefits of these approaches are:

- **A non-invasive installation.** No changes to the pumping environment are necessary to implement ESA.
- **Highly sensitive.** Impending maintenance issues can be identified much earlier than other approaches.
- **Location flexibility.** Unlike vibration sensors, the ESA solution can be installed in climate-controlled motor control cabinets away from environmental hazards.

SCHEDULE A CALL TODAY to find out more ways power sensoring can strengthen your industrial pump system.
www.loadcontrols.com/contact/

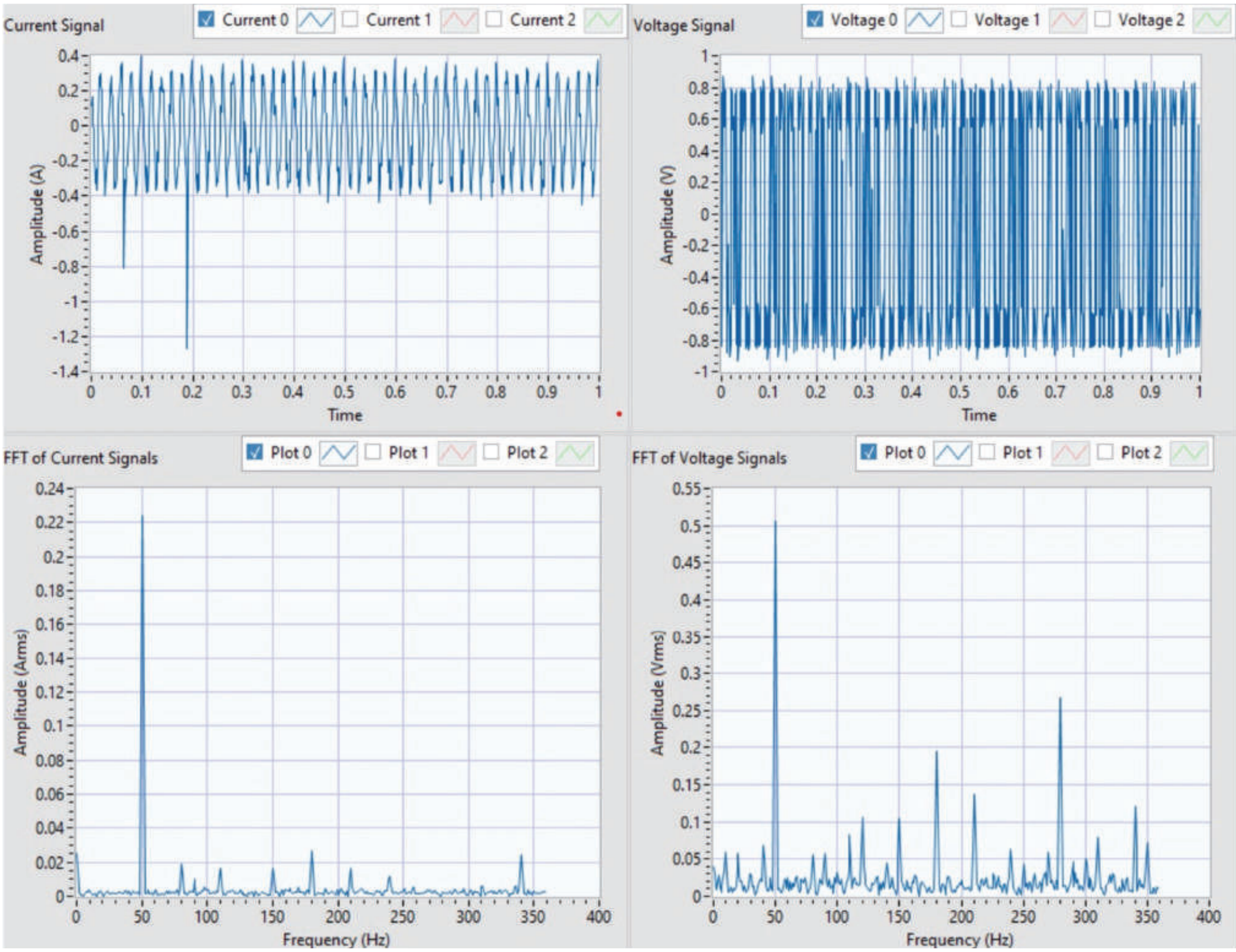


Image 5: Time and Frequency representations of motor power delivery signals. Source: Load Controls Pump Power Center of Excellence

CONCLUSION

In addition to protecting pumps and minimizing downtime, power monitoring can be an important element of a well-managed pump subsystem. Pump motor power levels and energy consumption provide valuable input about the status of and changes to the pumping subsystem over time. Knowing the energy footprint of each pump/motor combination enables informed decisions about efficiency and utilization. When viewed over time, this data can provide additional data on system degradation and maintenance needs. Advancing techniques for analyzing pump motor power will deliver new insights, pinpointing emerging failures and further improving uptime.

This can all be vital data for optimizing processes, protecting pumps from dangerous and harmful conditions, and maintaining an efficient pumping process into the future.

VISIT WWW.LOADCONTROLS.COM FOR MORE APPLICATION USE CASES AND PRODUCT INFORMATION, OR TO REQUEST A 30-DAY TRIAL.

ABOUT LOADCONTROLS

Load Controls was incorporated in 1984 with the vision of providing motor power sensors to the process manufacturing world. Decades later, we remain committed to that vision, with an ever-expanding product portfolio, a growing base of more than eleven thousand satisfied customers, and more than 170,000 controls installed to date.Load Controls has a track record of supplying and servicing motor monitoring solutions to the world's leading organizations.

Currently, our sensors and controls are used by:

- 9 out of 10 of the world's largest chemical processing firms
- 9 out of 10 of the world's largest pharmaceutical companies
- 7 out of 10 of the world's largest paper and pulp processing manufacturers

We sell our products directly around the globe, and through pump equipment distributors and electric component supply partners. We are based in Sturbridge, Massachusetts, in our own "mini-mill" brick building, a modern replica of the many red brick buildings that dot our regional landscape.

We manufacture all our controls and sensors here in Massachusetts. In 2022, we earned the ISO9001:2015 Certification, a testament to our continued quality management in the design, manufacture, and service of our 100% US-made industrial sensors and controls.

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