Using Smart Devices for Better Decision Making in Modern Control Systems

Smart-connected control systems can benefit from a new generation of three-phase monitor relays that monitor and protect equipment from voltage faults and make data available via Modbus TCP.

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INTRODUCTION

Many industries are using smart devices with embedded communication to improve decision making, simplify troubleshooting, and increase efficiency. Companies that use this new technology can increase their competitive advantages. Embedded communication in devices is the heart of IoT.

New phase monitor devices with Modbus TCP communication dramatically change the way equipment is monitored and controlled in smart network control systems. These smart devices give users both control and data connectivity in one device for a fraction of the cost of installing a power monitor.

These new products empower systems with a rich variety of data including system faults, line voltages, and operating frequency. SCADA monitoring using real-time data can detect and alert support personnel of problems at remote installations. Building IOT devices into control systems can create a wealth of data from processes, systems, and machines for use in the cloud.

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The Next Industrial Revolution

THE IMPACT OF IoT TECHNOLOGY

Search Google for "Internet of Things" (IoT) and you will find about 5 billion articles listed. There are over 8 million listings for news about the "Industrial Internet of Things" (IIot). More than 16 million videos about the "Internet of Medical Things" (IoMT) are available for viewing.

These results should not be surprising considering the world is in the beginning stages of the next Industrial Revolution. IoT provides valuable insights into how machines and processes perform using connected smart devices that share and exchange real time data within modern control systems.

A McKinsey survey estimates IoT will have a $2 trillion impact on GDP by 2030 from just four sectors: Healthcare, Manufacturing, Mobility and Retail. Connected medical devices alone are expected to rise to $52 billion by 2022.

MAKING DATA AVAILABLE WITHIN A SMART NETWORK

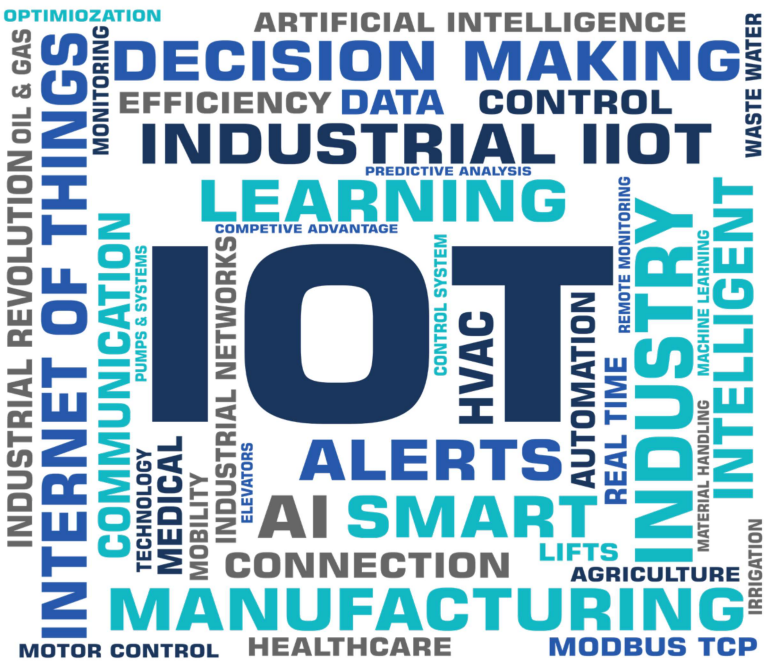
Many industries are already using IoT to make data continuously available to the entire facility operation, improving decision making, simplifying troubleshooting, improving timing and efficiency.

By embedding communication to the lowest possible level in a system, the system can then operate in a smart manner. Connectivity allows smart products to be monitored within the network, outside of the actual product. Data shared across a smart network supports the evolution to machine learning and artificial intelligence. These two advancements provide facility managers new tools to improve the performance and efficiency of their processes.

THE BENEFITS OF SMART NETWORKS

A Deloitte study estimated that machine learning reduces downtime by 15 to 30%, increases production throughput by 20%, reduces maintenance costs by 30% and increases quality up to 35%.

Other benefits include predictive analysis to proactively prevent machine problems and eliminate unnecessary service calls. Knowing the system's current state also assists in load planning and organization. As a system expands, engineers can optimally place new loads reducing demand charges and other utility fees.



There is also the benefit of eliminating "sneakerware". Historically, operators have to physically walk to the equipment and record readings on a clipboard. Now they sit in front of their computers and obtain readings for analysis.

AFFORDABLE, BASIC TECHNOLOGY

Companies that not only embrace but actively manage this new technology early on will increase their competitive advantages in their markets. Some companies developing IoT products are focused on technological sophistication, rather than more basic requirements of the actual applications. This could be problematic as most end users - the operators using these products daily - desire affordable solutions that satisfy basic functional requirements.

There is one major obstacle to overcome: No IoT connectivity standards exist today. Multiple groups are involved in trying to create one universal standard. Unfortunately, no consensus on standards has been agreed upon.

DECIDING ON AN ACCEPTABLE NETWORK PROTOCOL

Considering the above, what is an acceptable protocol for current industrial networks? Ethernet based networks appear to be viable for quite some time, barring a game changing technological breakthrough. Even with a breakthrough, it will take a long time to change out the prolific installed base existing today.

"The new PC1MDUL relay makes data available to facility managers for continuous monitoring, real time alerts and intelligent troubleshooting."

The oldest and most open protocol (free to use for all) is Modbus. Developed in the 1970's, this standard is commonly used in many industries. The Modbus protocol was extended for use on Ethernet networks, referred to as Modbus TCP. Combining the advantages of the original Modbus with the speed and scalability of Ethernet, Modbus TCP is an excellent choice.

PHASE MONITOR RELAYS WITH MODBUS TCP

Macromatic Industrial Controls has developed a phase monitor relay with Modbus TCP communication. The new PC1MDUL relay makes data available to facility managers for continuous monitoring, real time alerts and intelligent troubleshooting of voltage systems. This allows for more intelligent decision making. Knowing the history of voltage disturbances assists in predictive analysis. Instead of responding to expensive emergencies, replacing critical equipment that is deteriorating can be efficiently planned.

The Heart of IoT Systems

PROTECTING CRITICAL EQUIPMENT FROM VOLTAGE FAULTS

New products that embed communication in phase monitor relays can dramatically change the way equipment is monitored and controlled in smart network control systems. These smart devices give users both control and data connectivity in one device for a fraction of the cost of installing a power monitor.

Phase Monitoring Devices (PMD) protect valuable motors and other three-phase equipment from damage caused by voltage faults. When triggered by a fault in the control circuit, PMD output contacts annunciate or disconnect the equipment. A technician must physically inspect the phase monitor's status indicator LED to understand what type of fault occurred. Based on the flashing sequence, the technician can determine the cause of the trip unbalance, overvoltage, undervoltage, phase loss, or phase reversal.

Three-Phase Monitor Relay without Communication

This manual process is effective but not always efficient. The troubleshooting technician must travel to the site of the installation, secure any necessary PPE to open the panel for live visual inspection, inspect the PMD, decipher the flashing sequence to troubleshoot the root cause, record the fault, and close the panel.

Only then can the technician obtain the needed materials to correct the problem.

THAT WAS THEN AND THE FUTURE IS NOW

The new Macromatic PC1MDUL eliminates the inefficiency of manual inspection. This relay in the PC Series adds embedded communication using the Modbus TCP protocol. The device is a phase monitor relay and an advanced sensor with communication providing access to real time and historical data.

This data can be used for local monitoring, remote (SCADA), or IoT applications. A wealth of live three-phase system data and fault history is available through the industrial Ethernet network via Modbus TCP. Gateways can extend data access to remote networks and the cloud through the Internet.

Embedded communications in devices is the heart of IoT. PC Series PMDs make on-demand data available for inspections, logging, and reporting. Real-time data allows for analytics, predictive and preventative maintenance, and machine learning.

The PC Series' built-in communication enables monitoring and control through HMI, SCADA, Web, and mobile devices. Data driven troubleshooting – seeing the fault and its cause it on your laptop or tablet – reduces the time for data gathering and decision making. The result is reduced downtime and service costs. Critical systems can implement heartbeat functionality creating failsafe, closed loop protection.

PC1MDUL Three-Phase Monitor Relay with Communication

COMMUNICATION WITH PROTECTION

PC Series PMDs provide the same high level of protection offered on legacy PMDs including local direct control of motor starters. No additional relays or contactors are required.

The PC Series PMDs have separate control power inputs supporting redundant and uninterruptable control power systems for critical applications. Continuous True RMS Sensing provides highly accurate measurement in the most challenging applications.

Adjustable protection thresholds – set locally on the device - allow protection to be customized during the installation without special equipment or software. Fault history

records facilitate troubleshooting faults that occur during after-hours or on weekends. Discerning patterns and/or trends is also made easier. Optional local manual reset protects operator safety by preventing unexpected restart of equipment.

AN AFFORDABLE ALTERNATIVE TO POWER MONITORS

PC series PMDs provide an economical solution for users wanting a connected control system. These PMDs combine the functionality of phase monitors, voltmeter, frequency meter, and PLC I/O modules in one device.

"The PC Series gives users both motor control and data connectivity for a fraction of the cost of a power monitor."

Simple setting of the protection thresholds using dials on the device eliminates the need for a computer or mobile device at installation. Modbus protocol is open source eliminating any license fees and reducing hardware costs.

Previously, users wanting to communicate phase monitor data on an industrial network required installation of a power monitor, resulting in loss of direct motor starter control and increased costs up to several thousand dollars. The PC Series gives users both motor control and data connectivity for a fraction of the cost.

The PC Series can be connected to an existing HMI to display voltage and fault data locally while simultaneously communicating via the Industrial network to other devices.

Implementing Communication

SIMPLIFY WITH HMI DISPLAYS

The PC Series phase monitor relay empowers Human Machine Interface (HMI) displays with a rich variety of data including system faults, line voltages, and operating frequency. Information from the phase monitor and other sources can be combined and displayed on the HMI, safely away from hazardous environments, live circuits, and moving parts.

Information from the PC Series can be displayed within existing HMI screen layouts to bring more data to operators without the need for separate panel indicators, stack lights, or flashers. Information can also be used in screens customized to application needs making critical information available at a glance.

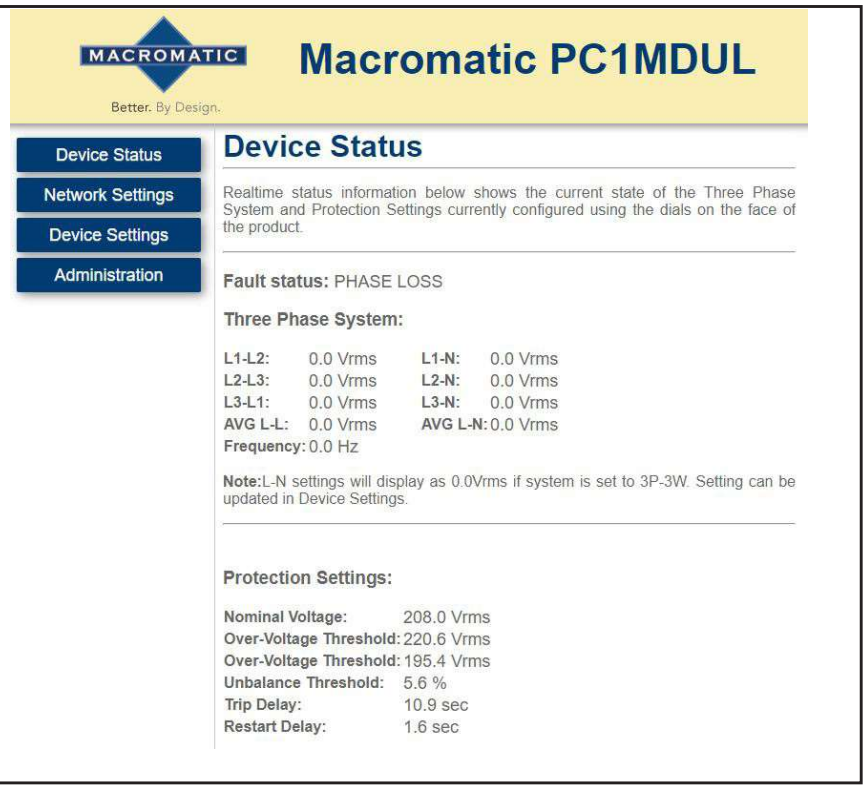
PC Series phase monitors operate as Modbus TCP Servers. Clients devices such as PLCs request data from the server and the server replies back to the client with the requested information.

The PC1MDUL is connected by a standard Ethernet patch cable from its Ethernet port on the front face to an Ethernet switch or directly to the PLC (if supported). The PLC will pull data from the PC1MDUL and route it to the HMI to be displayed.

REMOTE DATA SAVES WITH SCADA

Remote Supervisory Control and Data Acquisition (SCADA) monitoring operations can be optimized using data from the PC Series phase monitor relay. Real-time fault status can be used to detect and alert support personnel of problems at remote installations.

Technical staff can troubleshoot faults using the fault type, voltage, and frequency information from the PC1MDUL without needing to travel to the installation site. Service personnel can be dispatched with proper tools and replacement parts to correct the problem reducing downtime and travel costs.



If remote communications to the site are down, on-site personnel can still access valuable real-time troubleshooting information by accessing the built-in webserver on board the PC1MDUL from a laptop, phone, or other device.

Simply plug-in or wirelessly connect to the Ethernet network of the control system and enter the device name or IP address into a web browser for instant access.

CONTROLS WITHOUT BORDERS

Cloud Computing and big data concepts are transforming traditional control, monitoring, and maintenance.

Machine learning and Artificial Intelligence(AI) can be leveraged within cloud platforms to do predictive maintenance, trend analysis, and optimization powered by massive amounts of data.

The potential of these technologies is huge, but they are limited by the amount of data provided to them. Building IOT Devices into control systems will create a wealth of data from your processes, systems, and machines for use in the cloud.

Network infrastructure such as routers and gateways provide a secure path for IOT devices to bring their information to its end destination, whether it's the plant control room, remote monitoring center, or the cloud for advanced analytics.

Distributed installations that are connected using the Internet require remote configuration and management. For this reason, the PC Series device settings can be managed both over Modbus TCP and using the built-in webserver allowing changes to be made from anywhere.

CONCLUSION

Macromatic PC Series Three-Phase Relays provide both control and data connectivity in one economical device. These smart devices combine the functionality of phase monitors, voltmeter, frequency meter and PLC I/O modules. Companies that use this industry-leading technology can improve decision making, simplify troubleshooting and increase efficiency. Using these smart devices in a connected communication network, using HMI displays, SCADA monitoring and IoT devices, can create a wealth of data for use in the cloud.