



Overcoming Challenges of High-Density Temperature Monitoring with Ethernet

Background

Temperature monitoring is a critical factor and one of the most highly monitored process variables in the process control industry. Monitoring temperature is essential to ensure optimal performance, safety, and even compliance with various regulations. Traditional temperature monitor systems often rely on sensors such as RTDs or thermocouples, directly coupled to a dedicated temperature transmitter, which can get costly and complex to install and maintain, especially when a large number of points need to be monitored within an area. However, thanks to advancements in process control instrumentation there are now high-density temperature monitoring systems that can leverage Ethernet connectivity, offering significant improvements in data transmission speeds, efficiency, and cost savings. This whitepaper explores the benefits of high-density temperature monitoring systems compared to traditional temperature monitoring systems with a focus on the TCS Temperature Concentrator System used with the HES HART-to-Ethernet Gateway System demonstrating how they can improve efficiency and throughput speed in temperature monitoring systems.

Challenges of a High-Density and Non-Concentrated Temperature Monitoring System

Within the process control industry, precise temperature monitoring is crucial not only for ensuring product quality but also for safety reasons as well. Temperature may need to be monitored at different ranges within several different parts of a facility, requiring the need for many different types of thermocouples and RTDs connected to dedicated temperature transmitters for each zone or point that needs to be monitored. This brings several challenges including complex wiring and installation, costly and long lead wire extension cables, high cost of dedicated transmitters per point, and often space limitations for temperature transmitter installations.

One of the biggest aforementioned challenges of a temperature monitoring system that doesn't utilize a high-density concentrated monitoring solution is the complex and costly wiring and installation of the overall system. A traditional non-high-density monitoring system would require an extensive wiring infrastructure, with each

temperature sensor connected to a dedicated temperature transmitter via individual wires for each pairing. This can result in a maze of cables that need to be carefully managed and installed. The complexity only increases with each sensor type and transmitter within the monitoring system, leading to time-consuming installations, more potential for errors, and maintenance challenges as the equipment and extension wire age. Incorrect wiring within the system can lead to faulty temperature readings and sometimes even damage the monitoring equipment. When an issue arises within a large temperature monitoring system with extensive wiring, locating the exact source of the problem can be challenging which can lead to longer repair times and thus increased downtime.

The cost implications within a traditional temperature monitoring system that involves temperature transmitters can also be significant. The need for multiple temperature sensors, transmitters, and extensive wiring translates to high initial setup costs. Each temperature transmitter not only adds to the overall cost of equipment but also requires additional power and space. Ongoing maintenance cost is another concern as routine maintenance of equipment is necessary to ensure accurate readings and operation. Some examples of maintenance of the sensors and transmitters can be calibration of transmitters, replacement of faulty sensors or transmitters, and inspection of the complex wiring, which all incur costs. Additionally, the power consumption of several transmitters adds to the overall operational expenses, either through multiple regulated bulk power supplies and marshaling cabinets or higher-end control system cards that provide loop power to the transmitters, all of which directly increase the overall cost of the system.

Managing data from numerous temperature transmitters in a traditional temperature monitoring system also has its cost and configuration challenges. Each sensor-transmitter pair must be wired back to a centralized control system such as a BCPS (Basic Process Control System) or PLC (Programmable Logic Controller), creating high costs including analog input cards and lots of copper twisted pair. Once wired, all control system inputs need to be configured and ranged, tagged, and assigned to an input register.

Consider a chemical plant that needs to monitor 100 temperature points within its processing facility. In a traditional temperature transmitter-based monitoring system, each of the 100 temperature sensors would need to be individually wired to a temperature transmitter, potentially involving hundreds of meters of cable and wiring through the plant. This requires significant labor and time. With each transmitter costing multiple hundreds or even thousands of dollars, the initial setup of just the transmitters alone could easily exceed costs in the tens of thousands of dollars. Once set up, each temperature transmitter requires detailed configuration and documentation within the control or monitoring system. If the temperature transmitters have to be installed in hazardous areas, expensive explosion-proof housings or a complex intrinsically-safe network of barriers and marshaling cabinets must be designed and procured, further leading to higher ongoing maintenance overhead and costs.

The traditional approach to temperature monitoring in the process control industry involves several challenges that not only drive up the initial setup and ongoing maintenance costs but may also complicate the monitoring system's management while reducing operational efficiency. Addressing these issues can be accomplished with a more efficient and cost-effective temperature concentrator or remote I/O system such as the TCS Temperature Concentrator System.

Overcome Temperature Monitoring Challenges with Remote I/O

The challenges of a traditional temperature monitoring system can be effectively addressed using a high-density temperature monitoring system such as the TCS Temperature Concentrator System from Moore Industries. The TCS consists of a TCM Temperature Concentrator Module used alongside a HMC HART-to-MODBUS

Converter or a HES HART-to-Ethernet Gateway System. This system allows efficient and cost-effective transmission of all temperature process variable signals over MODBUS-RTU, MODBUS/TCP, or HART-IP digital networks, immensely reducing wiring requirements. Each TCM has 16 I/O channels allowing up to 16 sensors to connect to one TCM. When the TCM is used with the HMC HART-to-MODBUS Converter, two TCMs can be connected to each HMC allowing these three modules to do the work of 32 temperature transmitters at a fraction of the cost and setup time. (See Figure 1 below for the setup of the TCS with the HMC.) If your facility has an Ethernet backbone available, consider using the HES HART-to-Ethernet System with the 16-channel TCMs. The HES allows up to eight TCMs to be connected to it thus replacing 128 temperature transmitters with just nine modules. (See Figure 2 below for the setup of the TCS with the HES.)

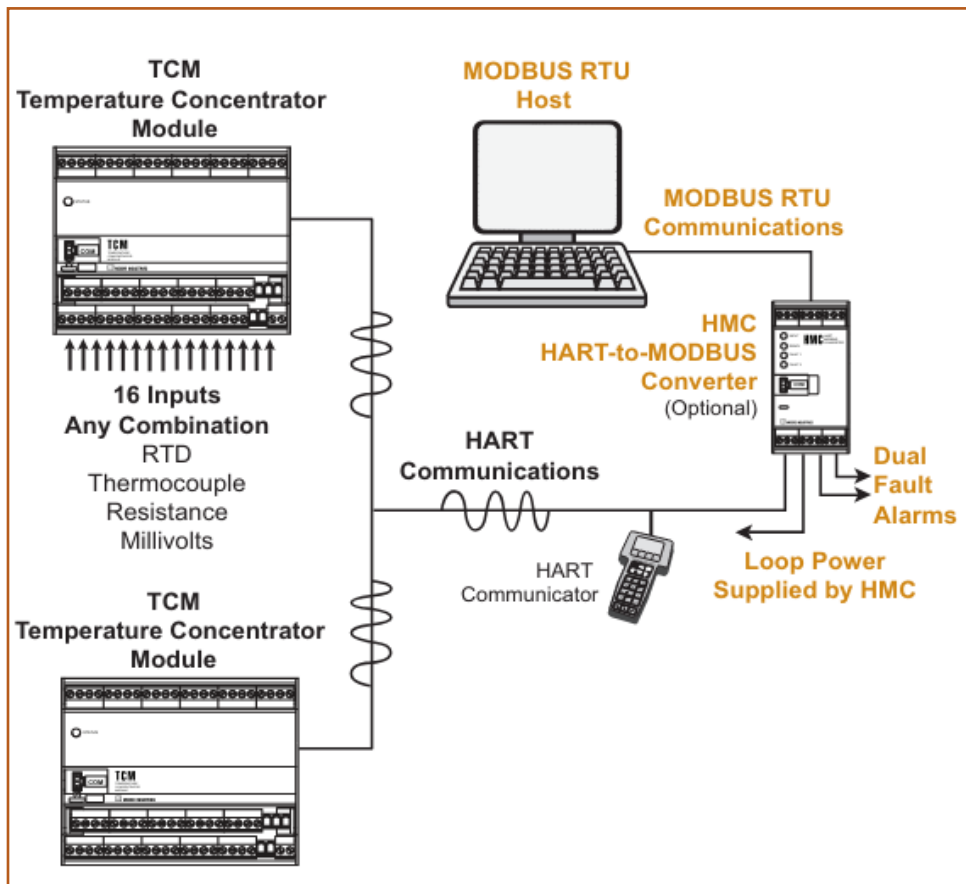


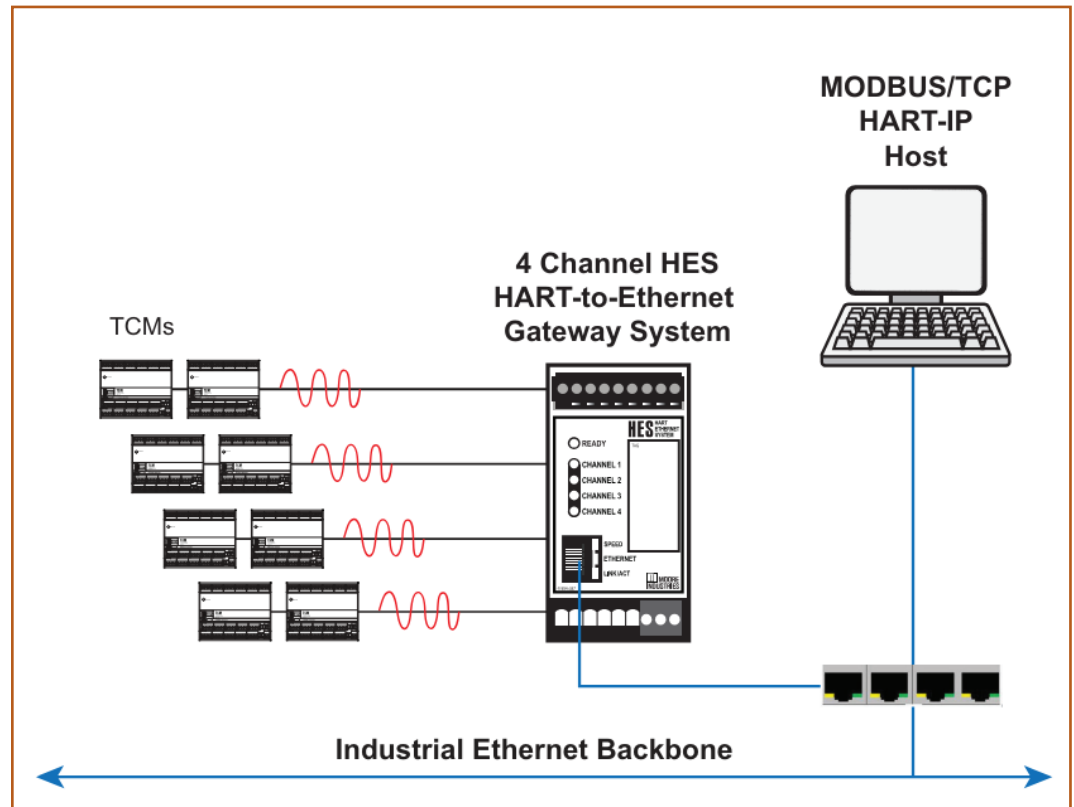
Figure 1. The TCS being used with the HMC in MODBUS RTU Communications Mode.

One of the primary benefits of a concentrated system like the TCS is cost reduction. Traditional systems require a separate temperature transmitter for each sensor, leading to high equipment costs. The TCS consolidates signals from multiple sensors, reducing the number of instruments needed. This concentration not only lowers the initial equipment costs but also reduces the amount of wiring required, which in turn decreases installation and maintenance costs. With fewer transmitters and less wiring, the overall system becomes much more manageable and cost-effective.

Efficiency is another area where the TCS excels. Installing and maintaining a traditional system with numerous transmitters can be labor-intensive and time-consuming. The TCS simplifies installation by requiring fewer instruments and less wiring infrastructure. This streamlined setup reduces the time and labor needed for installation. System uptime is also simplified, as there are fewer components to manage and troubleshoot, enhancing the system's reliability and minimizing ongoing maintenance efforts.

A concentrated temperature monitoring system like the TCS uses a single instrument to handle multiple temperature sensor signals. The installation process is simplified, requiring less time and effort. Data management is more efficient too, as the TCS aggregates data from multiple sensors and sends it as a unified digital stream to the host system.

Figure 2. TCS consisting of eight TCMs and a four channel HES HART-to-Ethernet Gateway System monitoring 128 temperature points.



Leveraging Ethernet-Based Temperature Monitoring for Cost Efficiency and Enhanced Performance

The integration of Ethernet-based temperature monitoring systems offers numerous advantages over traditional methods, significantly enhancing efficiency and reliability. By leveraging the existing Ethernet infrastructure within a facility, an Ethernet-based temperature monitoring system can reduce installation and maintenance costs, streamline data transmission, and improve overall scalability.

Cost Reduction in Installation and Maintenance

Ethernet-based systems consolidate multiple temperature sensor measurements and transmit them over a single Ethernet link. This approach not only minimizes the amount of wiring needed but also simplifies the installation process. With fewer instruments to manage and install, the potential for wiring errors is reduced, and maintenance becomes more straightforward and less time-consuming.

The TCS Temperature Concentrator System demonstrates these advantages by consolidating multiple sensor signals over an Ethernet infrastructure. When the HES HART-to-Ethernet module is used with the 16-channel TCM Temperature Concentrator Module, inputs are converted to MODBUS/TCP or HART-IP open industrial protocols and transmitted long distances over Ethernet to a control or monitoring system. By eliminating the need for individual transmitters and extensive wiring for each sensor, an Ethernet-based TCS substantially cuts down on hardware and installation costs.

Additionally, if temperature monitoring needs to be performed in hazardous areas where the method of protection is intrinsically-safe, the 16 channel TCMs can be used with single or dual channel I.S. barriers, further reducing wiring terminations and barrier costs.

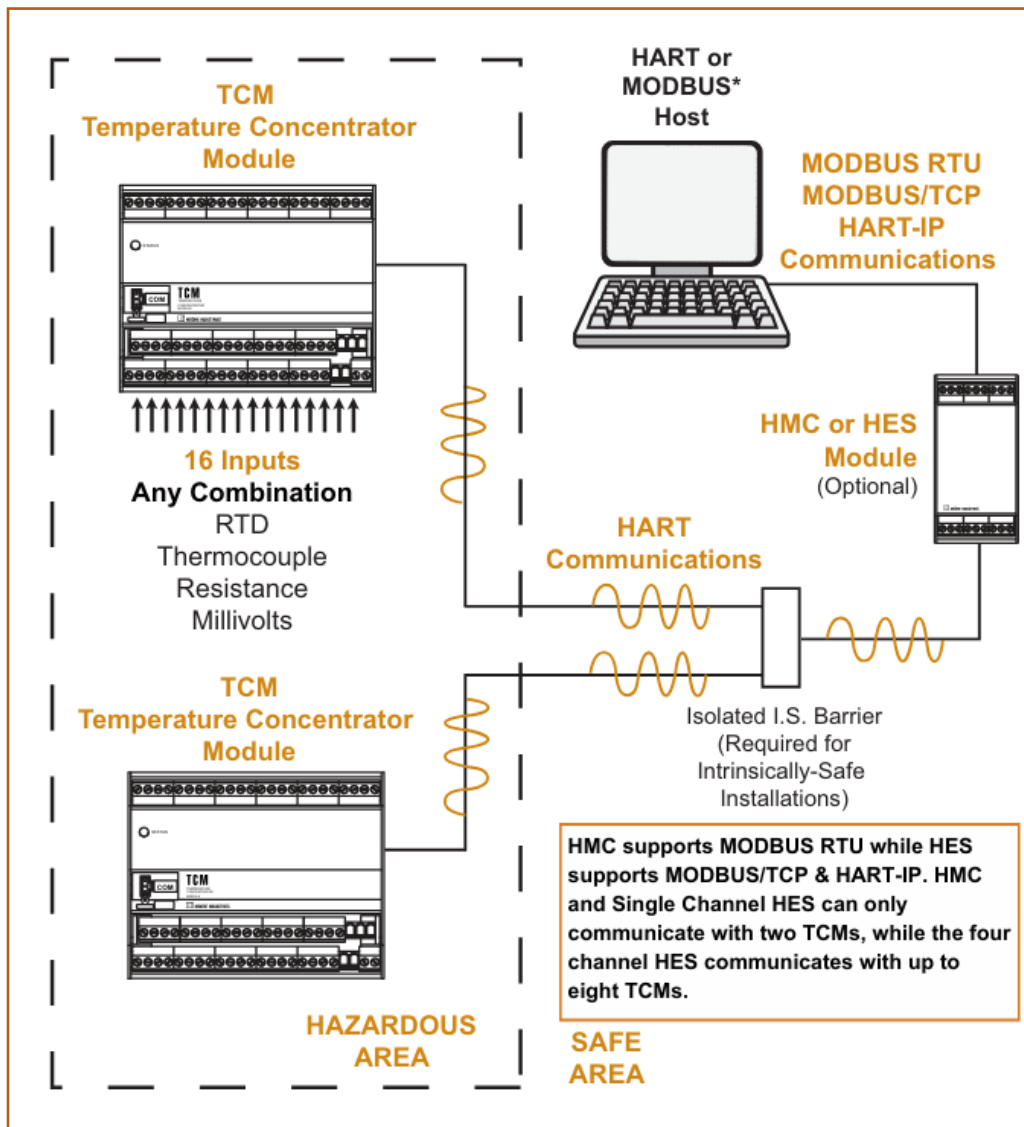


Figure 3. TCMs can be connected to a HMC HART-to-MODBUS RTU converter or a HES HART-to-Ethernet Gateway System to economically transmit several temperature signals to a host system, utilizing an I.S. barrier for intrinsically-safe areas.

Speed and Efficiency of Data Transmission

Ethernet-based temperature monitoring systems offer significant improvements in data transmission speed and efficiency compared to traditional systems. Ethernet links provide high-speed data transfer rates, ensuring that temperature data is transmitted quickly and reliably from the sensors to the control or monitoring system. This rapid data transmission allows for more timely and accurate monitoring and control of industrial processes, enhancing operational efficiency and safety.

The HES HART-to-Ethernet Gateway System is a key component in optimizing data transmission within the TCS Ethernet-based temperature monitoring system. By converting the temperature signals from the TCM modules to Ethernet-compatible formats, such as MODBUS/TCP or HART-IP, the HES facilitates seamless integration with existing network infrastructure. This integration ensures that real-time process variable data is readily accessible, either through a control system or a web browser, enabling more efficient monitoring and decision-making.

Enhanced Scalability and Flexibility

One of the most significant advantages of Ethernet-based temperature monitoring is its scalability. Traditional systems often face limitations in terms of the number of sensors and the complexity of the wiring required. In contrast, Ethernet systems can easily expand to accommodate additional sensors without the need for extensive new wiring. This scalability is crucial for facilities that anticipate growth or changes in their monitoring needs.

The Ethernet-based TCS Temperature Concentrator System utilizing the HES allows flexibility and scalability for high-density temperature monitoring applications. For instance, a single-channel HES can connect to one or two TCMs, while a four-channel HES can support up to eight TCMs, with each TCM handling up to 16 input channels. This configuration enables the monitoring of up to 128 temperature points with minimal additional instrumentation, providing a cost-effective and efficient solution for expanding temperature monitoring capabilities.

Conclusion

Adopting high-density temperature monitoring systems over Ethernet provides substantial benefits compared to traditional temperature transmitter-based monitoring processes. Traditional methods have extensive wiring, multiple sensors, and transmitters, and pose significant challenges in terms of cost, complexity, and efficiency. The TCS Temperature Concentrator System addresses these issues by consolidating multiple temperature sensor signals into single, high-speed data packets, drastically reducing the number of instruments and wiring required.

By leveraging the existing Ethernet infrastructure, facilities can achieve more reliable and efficient temperature monitoring, leading to improved process control and operational efficiency. The TCS demonstrates these advantages, providing a robust and scalable solution for both general-purpose and hazardous area applications. By concentrating multiple sensor signals and transmitting them over digital network links, the TCS system significantly reduces installation and maintenance costs while enhancing the overall performance of temperature monitoring systems.



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