# PLUG-N-PLAY ETHERCAT® I/O GATEWAY

## INTRODUCTION

The increasing interconnectedness of sensors, controllers, actuators, etc. in modern manufacturing presents significant challenges for communications equipment and protocols. EtherCAT® or ECAT technology has been developed to address these challenges. EtherCAT is a real-time Ethernet communications technology disclosed in the IEC Standard IEC61158, that has been applied in a variety of industrial applications. The EtherCAT Technology Group describes the functional principle of EtherCAT as: "The EtherCAT master sends a telegram that passes through each node. Each EtherCAT slave device reads the data addressed to it "on the fly" and inserts its data in the frame as the frame is moving downstream. The frame is delayed only by hardware propagation delay times." [1] EtherCAT communications are employed in applications as diverse as semiconductor process and packaging tools, injection molding, assembly and test, industrial printing, and robotics.

## PROBLEM

Specific problems exist with the implementation of EtherCAT technology in some applications. Field applications of EtherCAT can be complicated by the long distances that can exist between the locations of sensors, actuators, etc. and the ECAT Master Controller/ PC. This situation produces an increase in wiring complexity with concomitant increases in cost, system noise, and reduced performance. There can also be a need for additional I/O when the ECAT Master is not easily scalable. Finally, when there is limited space and density around an end device, effective EtherCAT implementation can require more compact I/O controllers.

## SOLUTION

MKS Instruments' EtherCAT MicroNode™ (Figure 1) provides a perfect solution for the resolution of the aforementioned problems with distributed EtherCAT I/O solutions. The MicroNode is a highly flexible I/O device that can connect multiple analog and digital I/O devices at their
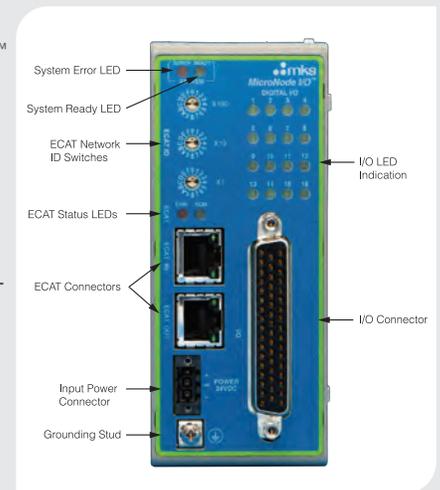


Figure 1. MKS Instruments' EtherCAT® MicroNode™ I/O unit.

point-of-use, dramatically reducing cabling complexity and the number of I/O devices required in many industrial applications. MicroNode's point-of-use distributed I/O solutions facilitate easier installation/modification, simpler and shorter cabling, and simplied troubleshooting in complex systems. Its compact form factor, light weight, and DIN rail mounting allow for easy field installation where space is extremely limited.

The MKS MicroNode features a combination of high-density analog and digital I/O points. MicroNode units have eight single-ended analog inputs and four single-ended analog outputs with 16-bit resolution and 16 digital I/O points that are individually configurable for input or output. Access to I/Os is via a 50-pin D-sub connector to interface with field I/O wiring. Highly visible status LEDs monitor device, EtherCAT, and all digital I/O points. These units also have high EMC
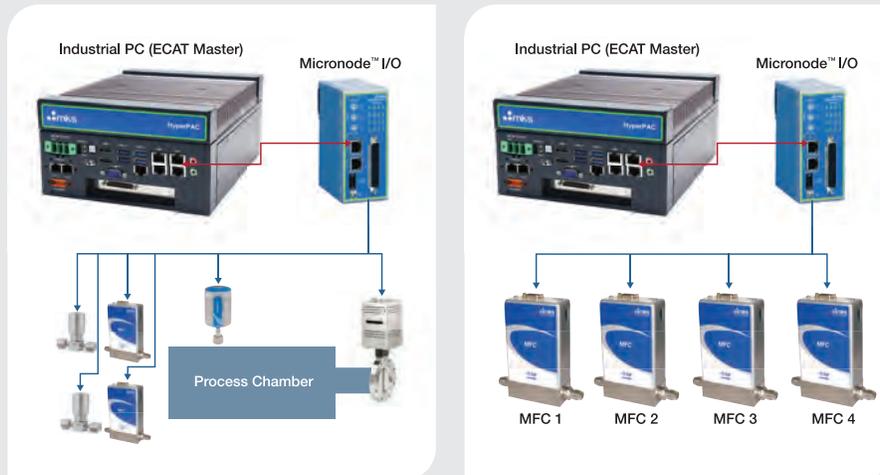
*Figure 2. Two typical applications of MKS EtherCAT® MicroNode™ I/O: (left) MicroNode™ used for gas on/off control, gas flow control, pressure sensing, and chamber pressure control; (right) MicroNode™ used to control multiple gas mass flow controllers.*

and ESD immunity for isolation from noise in industrial environments. The high number of mixed I/Os enables the use of a single MicroNode for monitoring and control of multiple devices. The MicroNode provides diagnostic capabilities over EtherCAT using CAT 5 network cabling for rapid alerts to fault detection.

Figure 2 illustrates the application of the MicroNode in typical semiconductor processing. In the application on the left, the MicroNode provides digital on/off I/O between the ECAT Master and two gas shutoff valves and analog I/O from the ECAT Master to control the gas flow in two mass flow controllers that determine the total gas flow into the process chamber. The MicroNode passes analog I/O from the Baratron® capacitance manometer sensor that monitors the pressure in the process chamber to the ECAT Master and passes the analog pressure control output from the Master to a pressure control valve downstream of the process chamber. In the simpler application shown on the right in Figure 2, the MicroNode unit provides an I/O interface for ECAT Master control of four mass flow controllers.

## CONCLUSION

MKS Instruments EtherCAT MicroNode provides a rapid, easy, and cost-effective solution for the migration of analog and digital I/O instrumentation to EtherCAT communications protocols. Its high-density analog and digital I/O significantly reduce the need for multiple network devices and dramatically simplifies system wiring, troubleshooting, and costs. The MicroNode's high visibility LEDs facilitate monitoring of device status and I/O health. Its ability to provide diagnostic capability over EtherCAT guarantees rapid fault detection and reduced trouble-shooting costs and downtime. MicroNode's off-the-shelf I/O solution, when combined with its low price and strong product support, makes it a great fit for any application requiring ECAT I/O.

### References

[1]     EtherCAT Technology Group, "EtherCAT - the Ethernet Fieldbus," EtherCAT Technology Group, [Online].
Available: https://www.ethercat.org/en/technology.html#1.1.

www.MKS.com