WHITE PAPER

Mass Flow Controllers

Real-Time EtherCAT® Data Acquisition Benefits

Brooks Instrument explains the benefits of real-time EtherCAT data acquisition capabilities. Find out how our products can improve the performance of your process!

Enabling Early Detection of Potential Process Issues

Enhance Operational Performance & Value of GF100 Series MFCs

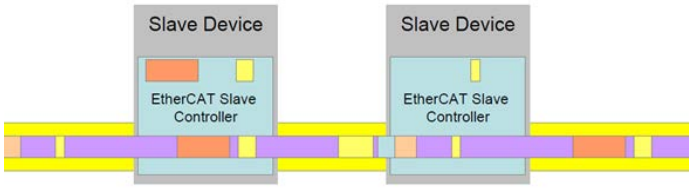
In many advanced manufacturing applications, there is a growing demand for the kind of high-speed, flexible machine communications supplied by Ethernet-based bus architectures.

EtherCAT is an Ethernet-based communication protocol introduced in 2003. A recognized international standard since 2007, EtherCAT provides exceptional performance for automation applications requiring real-time information and rapid reaction times.

Mass flow controller (MFC) technology can make sophisticated use of these capabilities. Protocols such as EtherCAT offer the opportunity to enhance how critical MFC diagnostic and performance information is shared with, and used by, higher-level machine control systems. These are key reasons why Brooks Instrument introduced semiconductor implementation of the EtherCAT interface on its GF100 Series product platform.

How EtherCAT Works

EtherCAT uses a master/slave architecture as well as a processing "on the fly" principle to ensure real-time capabilities without delays. The EtherCAT master sends a telegram that passes through each node as it moves downstream. Each slave device reads the data "on the fly" and adds its data to the frame. This unique technology allows a slave node to receive and forward an EtherCAT message before the node processes the data, which means the information can be spread at a much faster pace, reducing response time. Once the last node detects an open port, the message gets sent back to the master.



Each slave device reads the data "on the fly" and adds its data to the frame.

By connecting the last node in the series back to an Ethernet port in the master device, this line topology configuration can be converted to a ring topology. The ring topology enables redundancy, ensuring that if there is a malfunction in the system, such as a broken cable, up-time is maximized and communication continues. This can be critical in systems with short cycle times so that processes can continue to run smoothly with minimal interruption.

High Speed Data Exchange

PDO, or process data objects, are variables that are continuously transferred between the slave and the master in a high-speed data exchange. During network configuration, the user must configure the data to be exchanged. RxPDO Mapping defines the data that is sent from the master to the device and TxPDO Mapping defines the data that is sent from the device to the master.

The Brooks GF100 Series MFC with EtherCAT defines a default PDO mapping for each device profile that the user can select, or a flexible PDO mapping which can be configured with up to 10 objects that must have the appropriate PDO access permission. Examples of PDO objects that can be mapped include active exception status, as well as flow, pressure and temperature readings.

Mapping an object requires the user to specify the object's index, sub index, and size in bits in the PDO Mapping object. Objects with a data type that is not a multiple of 8 bits may require that a "pad" object be included so that the next object starts on an 8-bit boundary. It is best practice to group objects that are not a multiple of 8 bits so that only one "pad" is required, as the "pad" object counts as one of the 10 objects that can be configured. Configuring and assigning a flexible PDO allows for less network traffic and a more simplified system, eliminating metrics that are not applicable for a given application and allowing the user to focus only on the most crucial system attributes.

Now that we understand EtherCAT's messaging architecture, our next blog post will examine the way this architecture is used by the GF100 Series to capture and communicate a range of error and exception messages to the automation control system. More on GF100 Series MFCs with EtherCAT.

Leveraging Embedded Diagnostics

Leveraging the real-time data acquisition capabilities of EtherCAT, the GF100 Series MFCs detect exception conditions and reports these via EtherCAT. These exceptions can also be seen on the integrated device display and can be masked separately from the network if the user chooses to.

The severity of the exception will affect how it may be displayed and what action the device may take when the exception occurs. These alarms can be crucial in the early detection of potential issues in a process.

- **FAIL Status:** Component failures or configuration issues that may result in the device being grossly inaccurate or otherwise unable to control flow, will place the device into a safe state, but are unlikely to occur.
- **ERR Status:** Errors are typically process related and report conditions that may affect flow accuracy. Some errors allow for user configurable limits, enabling customized process monitoring for conditions such as process flow or pressure being out of range, or customized process deviation error bands.
- **WARN Status:** Alerts are informational notifications to the user about the device such as warm up, mounting orientation and input voltage.

The default PDO mapping includes a summary attribute that displays the active exception status of the device using EtherCAT's high-speed data exchange. This ensures the user is receiving concise and relevant exception information by only using one object in the PDO. The display of any exception condition on the device LCD screen can also be enabled or disabled individually for additional customization.

Through hundreds of thousands of installations, the GF100 Series has proven its value as the fastest and most accurate MFC series in the industry. With the addition of real-time information that EtherCAT supports, engineers have powerful new reasons to "design-in" GF100 Series MFCs, and thereby enhance the performance, control and long-term return on investment of their advanced automation systems, particularly for semiconductor applications.

See the performance yourself:
Request a FREE demo GF100 Series MFC with EtherCAT now!