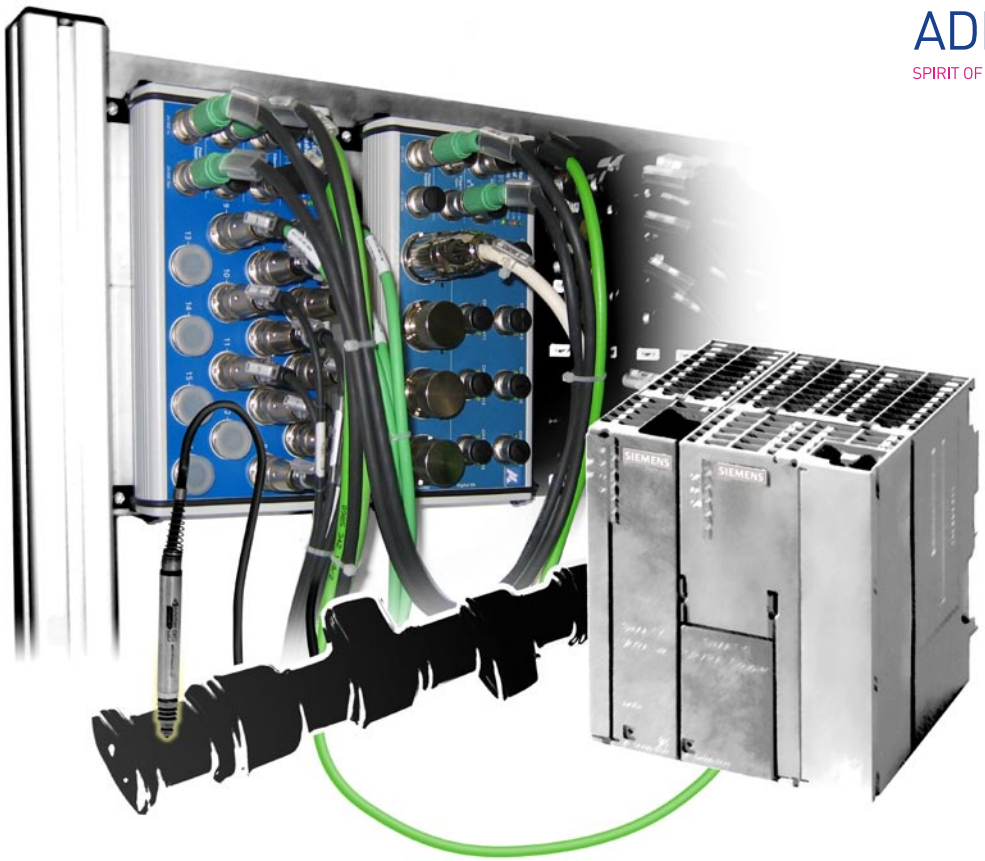


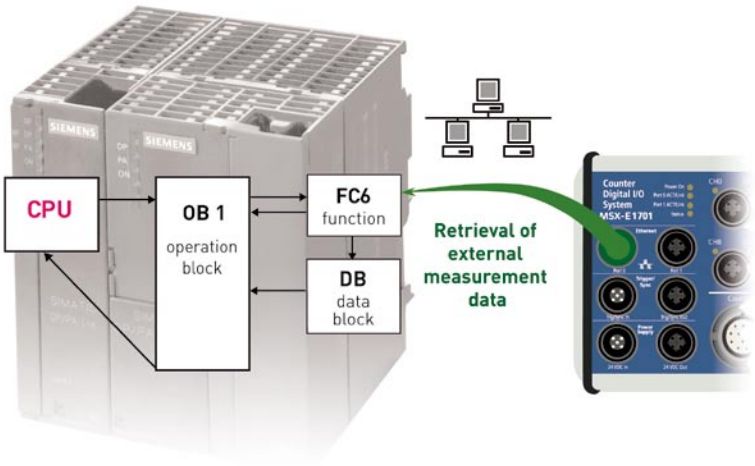
'Length measurement for quality check'

Intelligent Ethernet I/O modules make PLC more effective

With field buses, the generation change to the Ethernet is well underway. At the same time, the application area of programmable controllers (PLC) is being extended to previously "critical" applications. Although a PLC is ideal for managing I/O at low speed – with a rapid acquisition of measurements, signal analysis and value calculation, the PLC has until now met its limits in many cases. Using an example of a measuring system integrated in a crankshaft test bench, the following article describes how intelligent Ethernet I/O modules, Ethernet and a standard protocol such as TCP/IP can be used to carry out complex "rapid" measuring tasks or signal processing (e.g. determining average values) simply, reliably and cost-effectively via a PLC.

High flexibility and good value components have helped the PLC concept to reach its triumphant success. Alongside control and regulation, PLCs are increasingly taking over other tasks such as alarms, visualisation and data logging. Sensors and actuators ceased to be discrete some time ago, but can be combined directly with the PLC at reduced wiring costs. Ethernet networks have proven themselves in office IT for a long time now. The link between office IT and manufacturing IT meets the information, monitoring and security requirements of modern management simultaneously. However...

Phone: +49 7229 1847-0
Fax: +49 7229 1847-222
info@addi-data.com
www.addi-data.com



If a PLC receives data from an external device, FC6 is used to indicate the parameters of that device (e.g. absolute address, size of the received data, memory location, etc.). So there is either no difference or only a slight one between the ways how TCP/IP and serial connections proceed.

The hurdles to be overcome

Working in series makes programmable logic controllers slower than hardwired programmed logic controllers. So is it really the end of applications as far as rapid measurements are concerned? Definitely not: Demanding tasks such as the simultaneous reading of several channels or the simultaneous acquisition of several signal types which originate from inductive/digital transducers, shaft encoders or analog inputs are carried out using highperformance electronic measuring equipment. Examples of this are an acquisition of several measuring values in a buffer in order to make data available later or a very rapid acquisition and assessing of values independent of the PLC cycle.

The challenge: Length measurement on rotating parts

The high revolutions of modern drives require the highest precision when manufacturing crankshafts. Quality control is a must. One of the testing tasks is length measurement for the acquisition of measuring values in defined intervals on the turning crankshaft. Here the measuring machine can be directly integrated in the manufacturing process or in a separate test room.

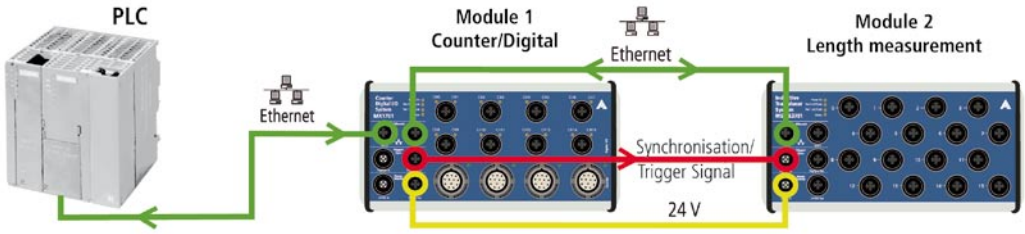
In the example described, a SIMATIC S7 controller controls the crankshaft test bench. In addition to the normal inputs/outputs for valves and light barriers, other I/O, e.g. for an incremental shaft encoder, are required for testing the crankshaft. The shaft encoder supplies appropriate information on angles for recording positioning on the turning test item. The angle data is then assigned to the relevant measuring value. The simultaneous acquisition of the surface and the position enables the work piece to be corrected precisely where the surface faults are actually present.

This computation-intensive task can only be implemented with a PLC at considerable cost and depends, among other things, on the cycle time.

What the electronic measuring equipment must be able to do

- Simultaneously record surface quality and position in order to be able to perform precise corrections at known fault sites
- Calculate minimum and maximum values or average values in order to categorise any irregularities within or outside a predefined tolerance or to relieve the load on the PLC
- Be deployed directly in the production hall near the test item
- Work reliably at high temperatures and with splash water
- Connect easily to the PLC
- Communicate via standard Ethernet in order to also forward values to the IT level for prompt assessment of production quality
- Perform parameterisation without programming, e.g. over an integrated web interface
- Perform diagnostics and monitoring without special programs or SPC
- On-board temporary storage so that no values are lost

Synchronisation MSX-E1701/ MSX-E3701



Phone: +49 7229 1847-0 info@addi-data.com
Fax: +49 7229 1847-222 www.addi-data.com

ADDI-DATA®
SPIRIT OF EXCELLENCE

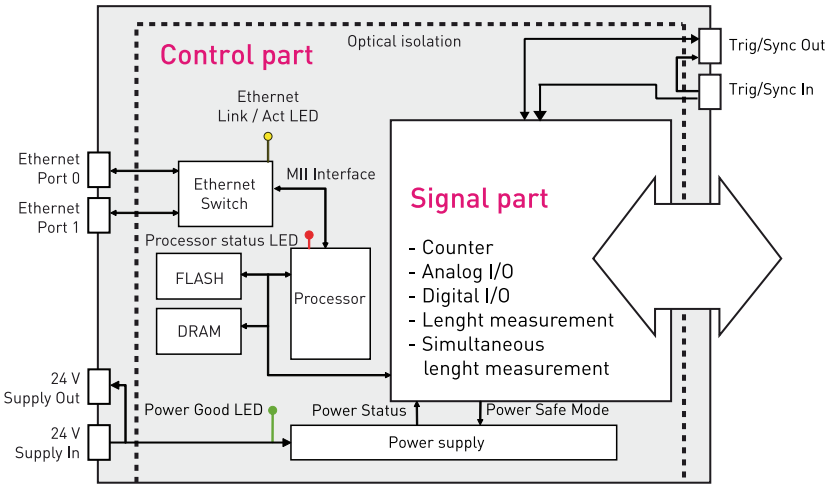
TCP/IP: Tried and tested but still state-of-the-art

Ethernet TCP/IP is a widely distributed protocol at office/IT level and production level and is in no way an outdated solution, even if it was developed in the 70s. TCP/IP, the Transmission Control Protocol/Internet Protocol, is a family of network protocols, which is also known as Internet Protocol due to its major importance for the Internet. Proof that the protocol is no "toy" is provided by the decision taken by the US Ministry of Defence in 1982 to introduce TCP/IP as a standard for every military computer network. This standard also currently allows electronic measuring equipment (and others) to be integrated in networks without problems.

No special lines or communication buses are needed to connect the PLC to the modules. Additional modules can be added to the network very easily. A small software enhancement is sufficient for the PLC to be able to access the additional modules.

The PLC simply needs an Ethernet controller which can manage the TCP/IP protocol. There are both hardware solutions (communication processor – CP) and software solutions for this, whereas in this case a hardware solution was used due to the high number of measuring values.

A separate hardware controller enables faster communication and reduces the load on the PLC CPU less than software Ethernet management over the PLC CPU.



The modules are organized in two parts: the control part is common to all module types and allows a reliable and fast communication as well as signal processing when needed.
The signal part features the specific function of each module type: counter, digital I/O, analog I/O, length measurement, ...

It comes down to communication

In the synchronous communications process, the PLC triggers the individual measurements of the modules, i.e. the acquisition begins as soon as it is required. The trigger starts in this way, e.g. two measurements over 16 channels each; then the measuring stops automatically. Measuring is synchronous with the PLC cycle and the measurements are started explicitly.

The measuring values are not available "immediately", but only when the acquisition by the module has been carried out. This requires the measuring to be triggered by the PLC and the I/O module to then transfer the values to the PLC.

Asynchronous acquisitions are made regardless of the cycle, i.e. the measuring values are available continually. In this mode, the PLC collects the measuring values when it needs them.

This means nearly no effort on the PLC side. However, there is a risk that the values could be lost if the PLC is used elsewhere and cannot collect the data.

Ethernet I/O modules underpin the PLC

In order to lessen the load on the PLC and to acquire the shaft encoder data, this application involves combining two intelligent Ethernet modules from ADDI-DATA.

The Ethernet multifunction counter module MSX-E1701 is used to read and evaluate the incremental shaft encoder. The Ethernet module for length measurement, MSX-E3701, records the surface of the crankshaft using an inductive displacement transducer.

The MSX-E1701 counter module is parameterised so that a trigger signal is sent to the MSX-E3701 module automatically every 2 degrees, i.e. with an incremental shaft encoder with 3,600 increments, every 20 increments.

With the MSX-E3701 module, the number of channels or series of measurements, etc. to be recorded and the use of the trigger is set.

With both modules, the settings saved can automatically be loaded when they are powered up. As soon as the MSX-E3701 module receives a trigger signal from the MSX-E1701 counter module, measuring starts automatically. The acquisition is therefore triggered directly via the trigger input. Via the receive function (FC6), the PLC can access the values and save these in a data block (DB) (1 DWORD per channel). The words can then be further processed as required.

Due to their own intelligence (ARM9), the modules can carry out calculations, e.g. of the minimum, maximum and average values, independently.

Significant benefits of the MSX-E modules

- The MSX-E modules are used for length measurement and as a multifunction counter module.
- They can be cascaded and synchronised in the µs area and thus enable the simultaneous acquisition of measuring values and position.
- They have been developed for use in severe environmental conditions. The I/O modules can be used in the extended temperature range from -40 °C to +85 °C. They correspond to protection class IP 65 and are thus protected against splash water and dust. With these properties, the I/O modules normally manage without the "protection" of switch cabinets. This saves money and space in the measuring room or in the production hall. Furthermore, the modules are equipped with numerous protective circuits. This includes an optical isolation of up to 1,000 V and a short circuit and reverse polarity protection.
- Parameterisation and monitoring via web server save time, in particular when setting up measuring facilities, and create flexibility. The ADDI-DATA modules thus supply measuring values directly on the screen of the technician's PC who, thanks to this information, can for example check whether measuring values exist and are forwarded to the PLC.
- TCP/IP enables a simple connection to the PLC and the problem-free forwarding of measuring data to the IT level or remote maintenance with password protection and encryption.
- On-board RAM for data storage
- Software updates can be easily installed at any time on the MSX-E modules.

The product range includes modules with additional functionalities: Multifunction counter module with digital I/O (24 V); analog input module, e.g. for the acquisition of laser sensors; analog output module. An Ethernet module for the acquisition of temperature is in preparation.

The module connection is simple, since the connection block is identical for all modules. This comprises Ethernet, trigger/synchronisation and a 24 V power supply. M12 or M18 plug adapters simplify wiring compared with normal connectors and enable a rapid installation during the vibration-proof operation.

Summary:

1. Dealing with intelligent Ethernet I/O modules is easy for PLC programmers, because they are based on technologies in which the programmers are proficient.

2. The intelligent MSX-Exxxx series Ethernet I/O modules are a PLC-compatible, compact, local solution for measuring, controlling and regulating tasks. Without any expensive special concepts, users can implement multichannel, synchronous and dynamic measuring equipment based on standard Ethernet.

3. Since it is possible to combine different modules to one unit and configure them individually, measuring and control tasks which normally overload programmable logic controllers can be easily implemented.

Thus the difference between a modern PLC and a process control system is becoming increasingly less thanks to ADDI-DATA's I/O modules. ■

Author:
Dipl.-Wirt. Ing. (FH)
Dominik Reissner
Sales / Technical Support

Author:
Julien Krauth,
Software
Development

ADDI-DATA®
SPIRIT OF EXCELLENCE

ADDI-DATA GmbH
Airpark Business Center
Airport Boulevard B210
77836 Rheinmünster
Germany

Phone: +49 7229 1847-0
Fax: +49 7229 1847-222
info@addi-data.com
www.addi-data.com

www.addi-data.com