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Fieldbus Diagnostics and Asset Management

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The Diagnostic Power Conditioner detects long-term faults in the Foundation Fieldbus segments and thus supports plantwide asset management

Whilst many plant operators today already record the data from control system components, field devices or motors in an asset management system, physical layer components, i.e. the infrastructure for connecting field devices and control systems, are mostly only documented. Turck offers a solution for this with a growing range of products that can be managed with FDT/DTM in an asset management system. The latest member of this range is the Diagnostic Power Conditioner System which can monitor Foundation Fieldbus networks for long periods, thus creating entirely new possibilities for plantwide asset management.

Nowadays, the typical three layer structure of the automation pyramid is implemented in virtually all process engineering plants. The lower layer or field level contains the physical interfaces to the processes. The process level is the middle layer. This is where the process control system operates for controlling and visualising the processes involved. The top layer or management level is where the ERP systems manage plant data and present it.

Whilst the management level is normally connected to the

process level via Ethernet, more and more users are implementing the fieldbus for the connection between the process level and the field level. This enables both installation costs and long-term operating costs to be considerably reduced. A fieldbus architecture supports the decentralised structure of a modern processing plant and expands the structure of a decentralised process control system down to the sensor and the control elements. In addition to these installation benefits, fieldbus solutions also offer benefits dur-



Asset management for fieldbus connections: Turck has completed its range of manageable physical layer components with the new DPC system (Diagnostic Power Conditioner).

ing the ongoing operation of a plant since additional information can be transferred as well as process values and manipulated variables.

Asset management systems require information

In order to be able to manage and evaluate the large volume of data involved, more and more plant operators are using asset management systems. These kinds of solutions are designed to minimise maintenance requirements, supply plant status information at any time and reduce operating costs. To achieve this, the asset management system must be able to know the current status of the plant at any time, i.e. have access to detailed information about all assets used in the plant.

This first requires the assets to be defined. These are classified as either dynamic or static assets. Plant components that supply information to the asset management system are called "dynamic assets". These mostly include control system components, field devices, motors or complete package units.

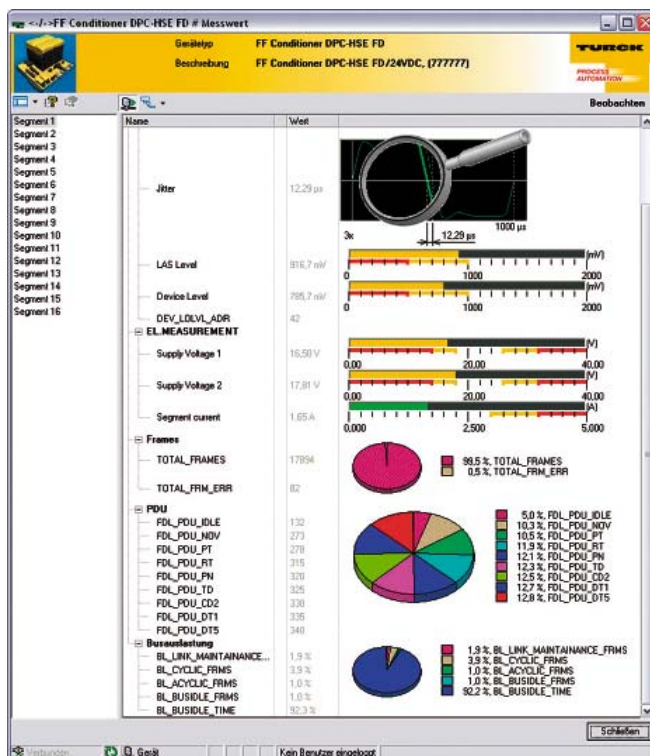
As these components are increasingly being connected to the process control system via state-of-the-art fieldbus systems, a large amount of diagnostic and additional information can be transferred without affecting the process data. However, a plant also contains other

components that can still only be managed as documents in an asset management system. These so-called static assets are stored in a database as data sheets, function descriptions, installation requirements and engineering tools. Typical static assets to date included pipe systems, tanks and physical layer components. This includes the entire infrastructure for connecting field devices and control systems.

Fieldbus becomes a manageable asset

As a typical physical layer manufacturer Turck has recognised the challenges of asset management early and added "manageable" solutions to its product portfolio for the areas of interface technology and intrinsically safe remote I/O. To complete its range of manageable physical layer components, the sensor, fieldbus and interface specialist has now developed a solution for bus-to-bus communication, i.e. fieldbus technology.

This system is not only optically based on the intrinsically safe excom remote I/O but also its diagnostics functions. Already with remote I/Os, Turck has placed importance on the use of standards to transfer diagnostic and additional information to the higher-level system. The end user can either evaluate the information via Profibus or display it after graphic preparation with



Long-term fieldbus diagnostics: The DTM of the new DPC system even detects creeping changes in individual fieldbus segments.

one of the DTM's certified by the FDT Group.

The new Foundation Fieldbus Diagnostic Power Conditioner System (DPC System) is able to detect long-term faults such as jitter or noise on a Foundation Fieldbus segment. With its ability to localise fault sources quickly, it supports the user in commissioning a fieldbus system and is also able to detect creeping changes within the individual fieldbus segments. A suitable alarm function enables fieldbus-related installation faults and even failures to be prevented completely.

Comprehensive galvanic isolation

The DPC System primarily provides a redundant supply of up to 16 segments with max. 800 mA output current and max. 30 VDC output voltage for each segment. In practical applications this also enables the implementation of long-distance segments up to 1900 m in length. The ADU (Advance Diagnostic Unit) records the fieldbus signal with its characteristics without any feedback. To ensure this Turck has implemented complete galvanic isolation.

After all, it wouldn't make sense to diagnose the bus and add a new error source at the same time. It is therefore impor-

tant not only to isolate the individual segments from each other, but also to guarantee this isolation between the segments and the power supply, between the segments and the ADU, as well as between the segments and the bus system that transfers the diagnostics data to the higher-level system. The raw data from the ADUs is converted at a central location into usable diagnostics data thus providing a diagnostics interface for information on all connected segments.

Foundation Fieldbus High Speed Ethernet

In order to ensure that the transmission of the recorded diagnostics data to the higher-level system is safe, the Foundation Fieldbus H1 cannot be used. After all, the diagnostics data is required to show any faults in the H1 segments. If faults occurred in a segment, it would not be possible to also transmit the diagnostics data required. Furthermore, this would produce too much diagnostics information on each H1 segment, which would overload the limited band width of 31.25 Kbit/s. A separate diagnostics bus is therefore used. For this Turck uses the High Speed Ethernet (HSE) of the Fieldbus Founda-

Turck Group

Today Turck is one of the world's leading groups of companies in the field of industrial automation. With more than 2500 employees working in 25 countries and agencies in another 60 countries, the sensor, fieldbus, connectivity and interface specialist achieves a total revenue of more than 300 million Euros. With more

than 13000 single products the family-owned company offers highly efficient product solutions for factory and process automation. The company has continued to set new standards with superior products such as revolutionary sensors without reduction factor or ultra-compact and modular fieldbus and remote I/O systems, also for use in explosion hazardous areas.

The protocol for this remains the same and only the physical layer is different. The Foundation Fieldbus High Speed Ethernet is used today as an interface to the control system and to connect up multiple H1 segments, which are converted to HSE using so-called "linking devices", to the control system via an interface card. A second use is the connection of HSE linking devices to asset management systems. In this case the only diagnostics data, alarms and parameters are taken from the H1 segments and transferred to the asset management system via HSE.

This brings two benefits: In the first place, the asset management system can exchange all diagnostics information, alarms and parameter data with the individual Foundation Fieldbus devices via a standard Ethernet interface. Secondly, the diagnostics information, alarms and parameter data does not have to be transferred through the entire process control system in order to then be exchanged via Ethernet between the process control system and the asset management system. In this way, the diagnostics information, alarms and parameter data are available both in the asset management system and in the process control system.

It therefore makes sense to transfer the diagnostics data about the physical layer to the asset management system using High Speed Ethernet so that the number of interfaces for diagnostics in the automation pyramid is kept to a minimum and standardised. The interface to the asset management in the Diagnostic Power Conditioner

system is an HSE field device. This is really a field device with sensors called ADUs.

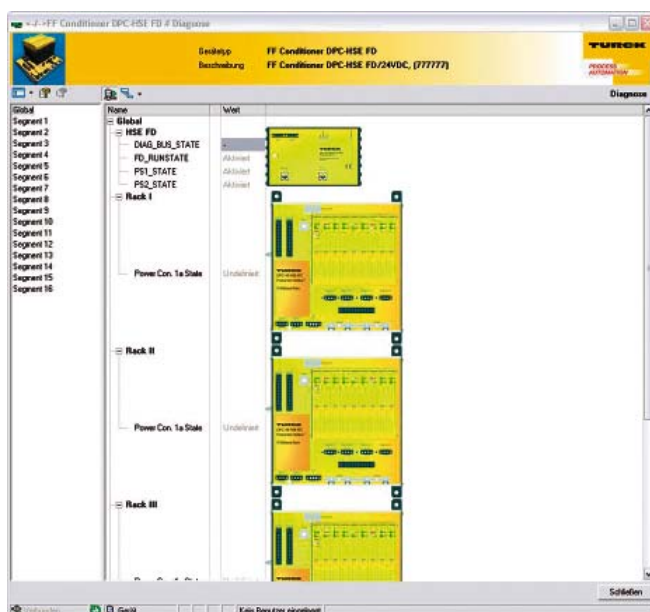
This field device also contains Foundation Fieldbus function blocks in which the individual diagnostics values are mapped. In this way the physical layer diagnostics data can be transferred to the higher-level system via the same block library as has been well-established for years with pressure, temperature, level or flow transmitters. The segment diagnostics data is therefore transferred to the higher-level system using the same protocol but via a separate bus (HSE). As the segment diagnostics is provided by an HSE field device, the values are transferred via standard function blocks and the alarm signalling with standard FF alarms.

The Foundation Fieldbus Diagnostic Power Conditioner System can be connected easily using standard Ethernet components so that an existing Ethernet structure can be used for segment diagnostics. Thanks to the use of Ethernet, there is no limit to the number of HSE field devices to be connected or the length of the HSE.

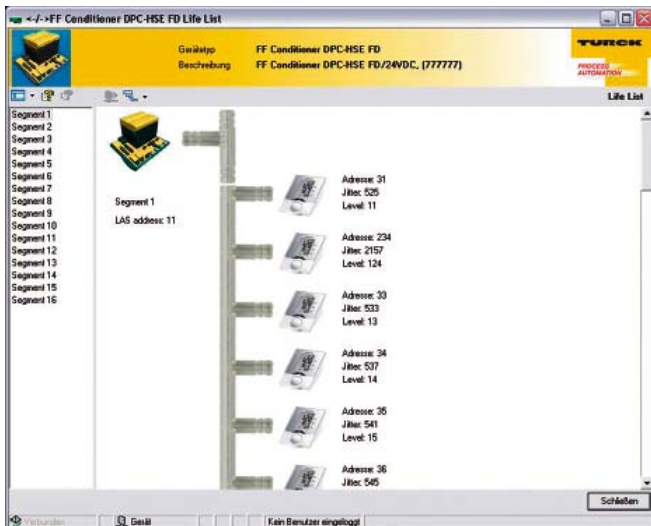
Fieldbus diagnostics

A lot of data can be measured on a digital bus. In order not to distract the user from essential information and in order to detect long-term weaknesses, the individual values are divided up into different groups. The DPC system normally supplies diagnostics data from three areas:

- Diagnostics from the physical layer, Foundation Fieldbus H1



Hardware system diagnostics: The Diagnostic Power Conditioner continuously monitors the entire periphery and displays faults such as voltage drop or temperature drift.



The live list shows the address, the signal location, jitter and signal amplitude for each individual field device connected to the segment. The addressing window is used to manage all the HSE field devices.

- Diagnostics about the DPC System itself, since the hardware itself should also be a manageable asset
- Diagnostics about HSE communication

The diagnostics of Foundation Fieldbus H1 is the most important data. The results are divided into the groups "Electrical measured values" and "Communication measured values". Information on the quality of a segment is mostly based on factors such as jitter, noise, ripple and signal amplitude. These are electrical measured values that change over the service life of a plant – mostly more than 20 years – and therefore deviate from the values during and after commissioning.

This also demonstrates the main task of the DPC System. It

can not only determine the normal state of a segment during commissioning but also continuously monitors the range of measured values for each individual segment. The communication parameters follow a similar principle. The DPC System can thus detect whether the number of frame errors and token sequence errors is increasing. For the plant operator it is also useful to see online whether sufficient free communication time is available for an additional field device on a segment.

All relevant values, and if necessary many more, can be displayed online for the plant operator via a Device Description (DD) or a DTM. However, this is not normally done in practice since no operator wishes to examine the quality of all

segments or deal with their characteristics. These tasks are handled by the HSE field device in the DPC System. It monitors all segments and generates a pre-alarm or main alarm if values are outside of the set limits, so that the plant operator is given early notification of any change in the physical layer by means of a standard FF alarm. Appropriate alarm limits that can be edited at any time by the maintenance team are stored in the blocks. The HSE field device not only transfers diagnostics values but also evaluates the bus signal recorded by the ADU, forms the diagnostics information and assesses it. In this way, the individual data elements are prepared and transferred via a standard communication method (Foundation Fieldbus High Speed Ethernet) to the higher-level system.

HSE field device DTM

The individual values and parameters are graphically presented by an HSE field device DTM developed by Turck so that the operator does not have to view unimportant fieldbus diagnostics information. This can be shown in a wide range of FDT frames, which can be used as stand-alone tools or in embedded in modern asset management systems. The DTM enables offline and online parameterisation, a display of the individual measured values, and the visualisation of the different statistics using pie charts.

A live list shows the address, the signal location, the jitter and the signal amplitude for each

individual field device connected to the segment. An addressing window enables all HSE field devices to be managed. All measured values can be recorded over a long period in a trending function. Diagnostics can be presented graphically for the entire system as well as for each individual segment. The symbols from the appendix of NE107 are used to integrate the classification of diagnostics signals in daily plant operations.

Conclusion

Turck's new Foundation Fieldbus Diagnostic Power Conditioner System (DPC System) is a solution that opens up previously unimagined possibilities in asset management for the plant operator. The DPC System not only provides support in commissioning a fieldbus solution but also continuously monitors the individual fieldbus segments. This enables imminent plant faults or failures to be detected in time to initiate counter measures.

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