

## Error Diagnostics with Sensitive Process

### New memory technologies for signal traces and data readouts using FDT/DTM technology

**When faults occur in a system, identifying their cause is the most important requirement for implementing measures to prevent the possibility of them occurring in the future. The following article illustrates how the new functions of the TURCK interface devices provide suitable tools for this purpose.**

Maintenance engineers responsible for the availability of a system know the problem only too well. The causes of system faults are often very difficult to determine. Autonomous systems in particular are not provided with a convenient data archiving facility, which would otherwise considerably simplify the search for the cause of the system fault.

Device integrated data archiving can also be useful for centrally controlled systems, for example, with system faults that are accompanied by a fault in communication. Data that was generated before the fault was detected and rectified is irretrievably lost.

As processes and the automation of processes become increasingly more complex, troubleshooting becomes considerably more important. Problems often occur that do not initially seem to be traceable or reproducible. The cause of the fault can only be localised and rectified with great difficulty.

This is where the technology of the new Turck interface modules is particularly useful. A data memory is continuously overwritten and also retains the data in the non-volatile memory in the event of a power failure. In this way, an interface device is turned into a transient recorder in which the recorded signal trace can be read at any time with the FDT/DTM technology. The PC can then be used to display and further process the time trace.

The continuous recording of process variables enables an existing system to be analysed. The evaluation of the recorded data helps the planning engineer to optimise the existing system and estimate the effects of system expansions. Weak points can be localised, and the effect of improvements made can be logged and verified.

This therefore increases the transparency of the system function and thus an understanding of the causal interrelationships involved. For this, the process variables are stored in a ring memory with the measuring cycle time of the device. The pointer moves continuously forward. The oldest data is overwritten every time the end of the memory is reached. The memory always contains the most recently recorded signal trace. In the event that a previously defined trigger condition is present, recording is stopped after the post-trigger time has elapsed. This transient can then be read out and analysed at a later time using the DTM. The actual function of the interface module, i.e. the recording of input signals and the output to the analog and digital outputs continues in the background and is not affected by the data storage.

Whether the emphasis is on "What happens after a critical state is exceeded?" or "What was the cause of the fault?" is not important. The individual selection of the trigger position in the recorded transient allows the settings to be made as required.

The sequence of measured values around the trigger event to be saved is determined by the pretrigger and the post-trigger settings which can be defined as required in the range between 0–100%. The absolute duration of the signal trace to be stored may vary according to the different requirements of the process concerned. The time periods required may range from a few minutes up to several months. Both the pretrigger time and the post-trigger time can therefore be set within a large time period by means of buttons and the display, or also by means of the DTM. In this way, an optimum display of the critical range is ensured.

A trigger is the occurrence of a specific event that has been defined beforehand. The trigger can be activated locally at the device by means of pushbuttons/display or also using the DTM interface on the PC.

Possible trigger conditions:

- **Undershoot/overshoot of a limit value**  
The measured value is continuously compared with the defined limit value. The trigger is activated as soon as an undershoot or overshoot is detected. Measuring is stopped after the post-trigger time has elapsed. The data is retained until the system is reactivated.
- **Out-of-range values**  
The measured value, such as the speed of a motor, must not go outside of a specified speed range. In this case, the trigger will be activated.
- **Manual triggering by actuating a button combination on the device.**
- **External triggering by means of an additional digital input on the device.**
- **Power down**

Recording is stopped in the event of a power failure. After the power supply is restored, further recording in the ring memory can be prevented so that the trace of measured values recorded before the power failure is retained in the memory. Turck interface devices use memory modules with the new FRAM technology for storing measured values. The memory function of FRAM (ferroelectric random access memory) modules is based on the ferroelectric effect of a special material that stores the information in the electrical polarisation of its crystal structure. The polarisation of the material, and thus also the information is permanently retained for several years after an external electrical field has been switched off. The FRAM memory cell is also very similar to the cell of a dynamic memory and also boasts the same properties in terms of speed and virtually unlimited number of possible write/read cycles.

The new technology therefore closes the gap between the volatile and non-volatile memories. The pin compatibility with widely used serial EEPROMs and considerably lower energy requirements make FRAMs the ideal solution for fast data storage in "embedded systems".

The strengths of these memories are fully utilised as integral components of Turck interface devices, particularly for fault diagnostics in sensitive areas, and offer the user a wide range of benefits compared to conventional memory technologies. Turck interface devices are currently provided with a 32 KByte measured value memory. The time range that can be stored with this size depends on the scan rate and the internal representation of the measured values. A temperature measuring transducer with a slow measuring cycle time can store several hours in the ring memory. With higher scan rates, such as for speed monitors, only a few minutes of measured values can be stored.

Whilst memory size is not an important factor in the field of PCs, with embedded systems such as these interface devices, memory costs money. The larger the memory used, the greater the financial investment necessary. In this case, every kilobyte counts, and the limits of possibility are soon reached when the storing of long signal traces is required. However, as processes may last for days and weeks, in some cases an interface device may therefore be required to compress possibly enormous data volumes, whilst nevertheless ensuring that the essential characteristics of the recorded signal trace can be recognised.

Suitable intervals are formed if the required duration of the transient exceeds the capacity of the data memory available. The measured values occurring in these intervals are stored temporarily, and at the end of an interval the smallest and largest of these values are determined and stored in the non-volatile memory. This compression function thus makes it possible to store a measuring range of any duration. A graph illustrates the quality of the event.

In future this device family will feature an additional function by which the recorded signal traces can be transmitted via the analog output. Unlike the static forcing of an output, this function will allow the simulation of entire system sections and their time characteristics. The reproduction of measured signal traces and also the stimulation of a system with synthetically generated signals are also conceivable. During the commissioning of a system, this will enable subcomponents to be tested and optimised before the entire system is completed. In this way, it is possible to simulate situations that normally do not occur, and test the practical limits of a process.

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