

Data Logging from SIMATIC S7 PLCs

With the auto.spy analyzer, two basically different types of data logging can be performed for SIMATIC S7 controllers: **polling-precise** and **cycle-precise** data logging. This document explains the differences between both methods and shall help to decide which auto.spy device driver is better suited for which measurement task. Finally, Tab. 1 briefly summarizes their essential characteristics.

Polling-precise data logging

This method, which is the most widespread one, is used for example in STEP 7 for observing variable tables and can also be found in Siemens communication libraries like PRODAVE or SOFTNET (via the SAPI-S7). Here, the analysis PC sends queries to the real-time operating system of the controller, which contain the addresses of one or more operands. The operating system reads the values of these operands from the corresponding memory areas and returns them in response. This process is repeated at a freely adjustable sampling rate, typically at intervals of at least 30 ms. There is no need to alter the control application for this purpose.

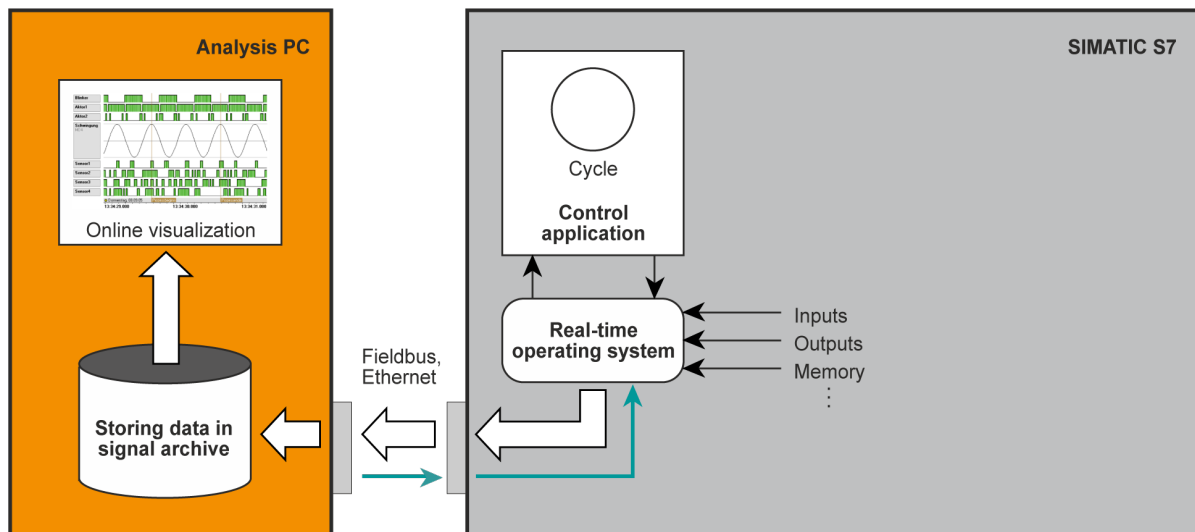


Fig. 1: Operating principle of polling-precise data logging

This leads to the following peculiarities: Requests for many operands quickly exceed the allowed user data limit for one read request and must be split into several smaller requests. The data of the composite response then originate from different PLC cycles! Furthermore, please note that the operating system (especially for S7-400) does not necessarily read the requested values at the beginning or end of a cycle, but also in the middle of a cycle, because the control application is processed in time slices of about 1 ms and thus is interrupted repeatedly. You must therefore be aware that the data of different queries may originate from different points in time (and therefore also program lines) within the PLC cycles. If this is not taken into account, consistency problems and faulty conclusions can be the result when evaluating the data.

Cycle-precise data logging

This logging method produces exactly one data set of the requested signals in each PLC cycle. To achieve this, a so-called monitoring application consisting of analysis blocks and a data buffer is generated during runtime of the machine and transferred into the PLC in addition to the control application before recording. An absolute block call to the first analysis block is inserted at the beginning of OB 1 in order to integrate the monitoring application into the cyclic program processing.

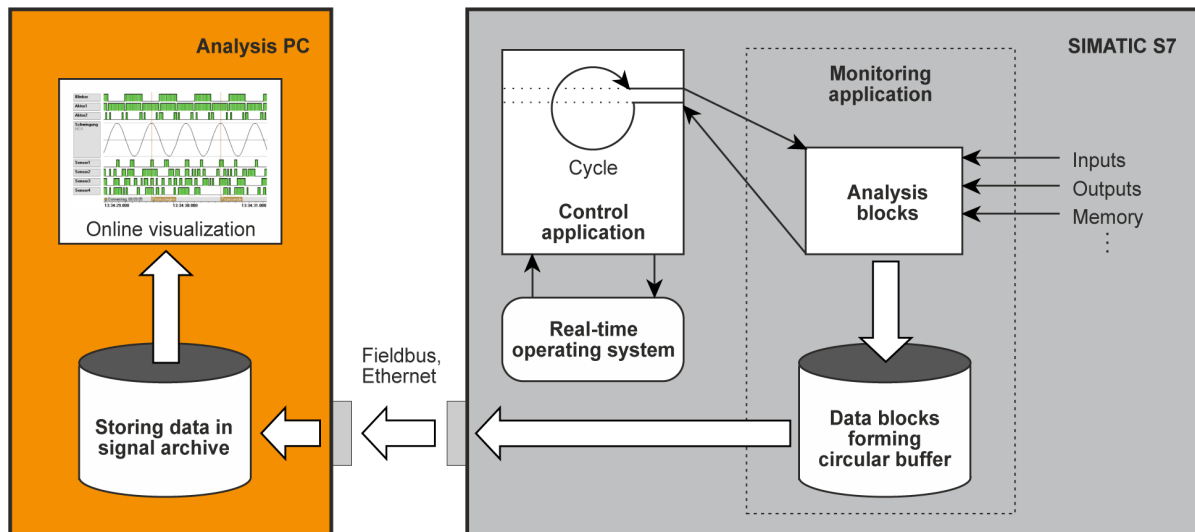


Fig. 2: Operating principle of cycle-precise data logging

The analysis blocks contain the actual recording functionality. In each cycle, they record the operands that were previously configured in the signal table. The logged data are temporarily stored in a circular buffer of data blocks, whose size is configurable. During recording, the analysis PC queries the state of this buffer and transfers the filled portions to its hard disk. At the same time, part of the data is displayed (online visualization).

In contrast to polling-precise recording, this method achieves high measuring accuracy and guarantees that no cycle is skipped during data logging. The sampling rate cannot be specified, but depends directly on the cycle time of the PLC. In other words, the recording works just as fast or slow as the PLC itself. However, any change of signals or trigger conditions causes more effort, because a new monitoring application has to be created and transferred first. But the integration into the PLC control program also enables the monitoring of occurring alarms (for example cyclic or hardware interrupts).

Due to the respective peculiarities of the two logging modes, you should try to use both methods in combination (e.g. to log bit memory edges cycle-precisely and room temperature polling-precisely), since neither of them is equally well suited for all applications.

Tab. 1: Comparison of polling-precise and cycle-precise data logging

Characteristics	Polling-precise data logging	Cycle-precise data logging
Supported PLC series	SIMATIC S7-300/400/1200/1500	SIMATIC S7-300/400/1200/1500
Usable fieldbuses	MPI / PROFIBUS / Industrial Ethernet	MPI / PROFIBUS / Industrial Ethernet
Modification of control application	not required	integration of additional code and data blocks required
Sampling rate / sampling distance	freely adjustable, actual sampling rate depends on several factors and may vary	directly bound to the cycle time of the PLC, one signal sample per cycle
Moment of data logging	cannot be controlled, may be different in each cycle	always at the beginning of the cycle
Recordable operand types	I / Q / M / DB / T / C / PI	I / Q / M / DB / T / C / PI
Binary timer output recordable	no	yes
Maximum number of signals per PLC	8192 (using 16 data sources)	512
Triggering on process signals	only on the analysis PC	already in the PLC
Interrupts can be monitored	no	yes (S7-300/400 only)
Offline recordings	not possible, permanent online connection required	possible (S7-300/400 only)
Typical applications	process engineering (temperature, pressure monitoring), many signals	high-speed hardware signals (alarms), sporadic software errors