Application of AS-Interface to a Small Angle Neutron Scattering Experiment

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Abstract: Actuator-Sensor-Interface according to IEC 62026-2 is a simple low level field bus system that is well established in industrial automation. It is designed for the easy connection of simple sensors and actuators like switches or valves and can be seen as a low level complement to primary fieldbus systems like PROFIBUS or DeviceNet. Although it is a well established and proven industrial technology, it is rarely seen in research applications.
In order to simplify cabling and improve overall diagnostics, Forschungszentrum Jülich introduced AS-Interface into the control system of the small angle neutron scattering experiment KWS2.

Actuator-Sensor-Interface AS-i

- Simple fieldbus system for the lowest field level (actuator and sensor level)
- Internationally standardized in EN50295 and IEC 62026-2
- Optimized for the interconnection of simple binary sensors and actuators
- Flexible topology + easy connection of devices
- Data and power over the same cable
- Good electro-magnetic compatibility
- IP67 protection

Standardized AS-i Compact Module (IP67)
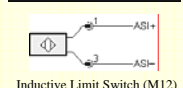
Inductive Limit Switch (M12) with integrated AS-i Interface
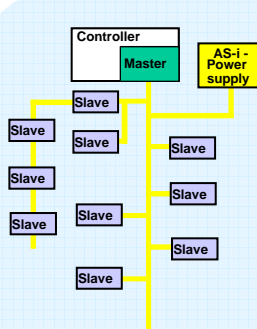
Features

- Master/Slave system with cyclic polling => deterministic
- Reaction time < 5ms
- Max. number of slaves: 31 (62 in extended mode)
- Data size: 4 Bit
- Bitrate: 167 kbit/s
- Cable: unshielded, not twisted, no termination
- Max. cable length: 100m (extensible to 300m via repeater)
- Arbitrary topologies: tree, star, ring,.....

Cable

- Unshielded flat cable with keying
- IP67, even after disconnecting
- Yellow: AS-i + power (> 2 A)
- Black: optional additional power
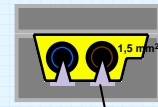
Piercing Connector

APM: Alternate Pulse Modulation

- Bitrate: 167 kbit/s
- Manchester Code => DC-free
- Sender: current source
- Differentiation at inductivity in power supply => voltage pulses seen by the receiver
- => easy to implement, low noise, robust
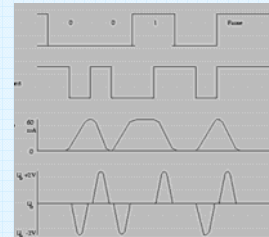
KWS1 + KWS2

- Classical 40m long pinhole instruments for Small Angle Neutron Scattering
- Built and operated by Jülich Centre of Neutron Science (JCNS) at FRM-II in Garching
- Detectors movable in 20 m tube
- Sample environment
- Collimation: 5 apertures + 18 movable neutron guide segments

KWS2 (Detector Tube and shielding of sample area)

KWS1 (Detector Tube and collimation under construction; AS-i compact modules in orange colour on right side of collimation)

Collimation of KWS2

AS-i bus with AS-i compact modules: 18 Airbox modules (IFM AC2046) and 5 4DI compact modules (IFM AC2032)

Physical Control System Structure
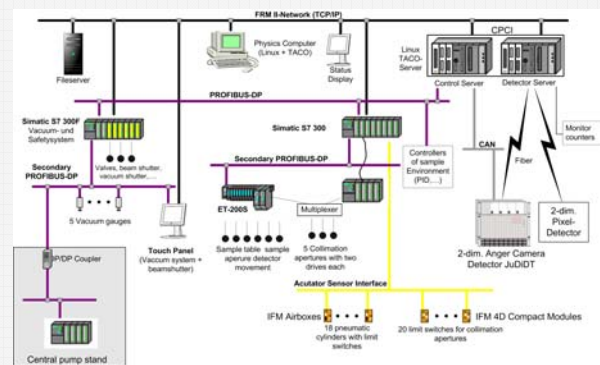
Status

- Stable operation of KWS2 for almost one year
- KWS1 under construction now
- Major cabling reduction
- Improved diagnostics
- Simple PLC programming interface (looks like local digital IOs)