Conveyor control system for mining

By C du Plessis, ifm electronic

The conveyor control system described in this article allows connection of all stations in a conveyor system.

In the mining industry conveyors are used to transport the raw material from underground facilities to the processing plant. The mineral bearing rock has to be moved over a long distance via robust conveyor systems. These conveyors can be longer than 2 km and have to be very flexible owing to changes in the locations of the mining fields. The conveyor control system developed by ifm electronic (referred to in this article as ‘the company’) allows connection of all stations in a conveyor system e.g. rope switches, emergency stop switches, belt alignment switches, temperature sensors, speed sensors, start-up alarms and more.

The AS-i (Actuator Sensor Interface) conveyor control system is a hot-pluggable alternative to conventional wiring technologies that is easy to use and easy to extend. Speed, reduction of installation, plant and maintenance costs and high availability are features of this manufacturer-independent interface system. The AS-i is ideally suited for the robust transmission of small quantities of data under rugged industrial conditions. It has proven itself and has become accepted as the standard for the networking of sensors and actuators in many application areas for economic and other reasons. The two-core cable for data and energy transmission, the connection in the clamping technology, the mapping in the PLC as an I/O component assembly, and extensive diagnostic possibilities lead to significant savings in project planning, installation, documentation, maintenance, and downtime in the case of failures.

The AS-i is designed for the lowest level of the automation hierarchy where it offers an easy, reliable, and fast transfer with optimal price-performance ratio. Higher-level systems such as Profinet DP, EtherNet IP, Modbus, DeviceNet or CANopen are connected via gateways.

Decentralised solutions relieve the control system. Depending on the extent of the set-up, this permits cycle times of typically 2 ms for one AS-i branch. The system can be flexibly extended and may be commissioned in partial areas only. It reduces the communication on higher-level field buses and offers an increased failure resistance through autonomous sub-areas.

The AS-i shadow logo designates devices that have been certified by the independent AS-i centre. This permits simultaneous problem-free operation of devices from different manufacturers on one AS-i branch.

The heart of the system is the AS-i master or the AS-i gateway with respective diagnostic possibilities. Current PLC or PC software solutions can continue to be used as the AS-i acts like an I/O card in a downward direction. The devices control and monitor the data exchange with the modules and AS-i sensors/actuators according to the master-slave principle. Viewed from the primary field bus, the gateway acts as slave participant with up to 248 bits of input and 186 bits of output data (V 2.1). Power is supplied via AS-i power supply units with data decoupling. Bus-terminators or tuners and repeaters permit line extension beyond 100 m. For this purpose, the repeater separates the primary and secondary sides electrically to achieve increased safety in case of a short circuit. An unlimited amount of repeaters may be operated in star configuration but no more than two in sequence. Together with the repeater, a further AS-i power supply unit must be used to provide power to the additional AS-i circuit.

Slaves are available in many designs, binary or analogue, for use in the field, either in a switch cabinet or in the terminal box. For the EX areas, solutions with ATEX approval are also available.

With a manual address-programming device, individual modules can be addressed and configured easily at a desk or directly on site. However, it is also possible to address an entire AS-Interface branch via the AS-i master.

Based on the same technology and the same protocol, safety-oriented components such as rope switches, emergency-stop devices, opto-electronic protective devices and safety guard interlocking devices can also be integrated. This only requires the installation of one safety monitor and some safe slaves on the branch. A mixed operation of both safe and non-safe AS-i slaves is easily achieved. The safety monitor monitors the data communication on the AS-i line. For the safe slaves, dynamic code sequences (8 x 4-bit data sequence) that are stored in each slave are transmitted. These are ‘learned’ by the safety monitor during commissioning. During operation, the safety monitor compares the expected with the actual sequence in each cycle and carries out a safe shut-down within 40 ms if there are any deviations, e.g. as a result of device failure, communication problems or the like. The time for re-activation is 100 ms. Safe field and switch cabinet modules are available as slaves, including intelligent safety sensors and safety command devices with an AS-i chip. The system can be used up to control system category 4 according to EN 954-1.
Drift monitoring of conveyor belt installations

A belt drift switch has been designed for heavy duty applications and used for drift monitoring of conveyor belt installations. The belt drift switches are used to protect the installations from damage or destruction in the event of belt drift and are positioned in pairs on both sides of the conveyor belt. The ball bearing stainless steel actuating roller is resistant to wear and is used for belt speeds up to approximately 5 m/s. The device features a robust aluminium housing and is equipped with two force-actuated changeover contacts with snap-action function and two adjustable switching points (5 ° to 15 °, 15 ° to 35 °).

Inadmissible belt drift occurs when the belt edge approaches the end of the supporting rollers through lateral movement and surpasses it, resulting in the actuator (roller lever) being operated and displaced. In case of displacement of the actuator, the cam operating switches are activated. The switching angle can be set via an adjustable camshaft. In this way, a pre-warning can be implemented in addition to the safety shutdown. As soon as the belt moves correctly, the roller lever automatically returns to its home position.

Conclusion

The conveyor control system consists of the AS-i master, AS-i power supply, the safety monitor/relay device, AS-i cable and various I/O modules (safe and non-safe). The main benefits and features of 'the company’s' conveyor control system is a safe control system that is cost effective. It allows for fast and flexible expansion and status of rope pull switches and emergency stop switches that are displayed locally by the AS-i master display and also remotely in the PLC and on SCADA.

References


Conrad du Plessis began his career in 1996 in the Pulp and Paper industry. After gaining an extensive background in industrial automation he joined ifm electronic in 2008 in the position of field sales engineer and owing to his extensive PLC experience he was appointed as product specialist for AS-i systems in 2010. In 2012 he became product manager and has since developed a team of highly trained product specialists in AS-i, Octavis condition monitoring systems and R360 mobile control systems. Enquiries: Tel. 012 450 0370 or email info.za@ifm.com