



eXtreme Fast Control for conveyor belt monitoring systems used in industry and mining

Continental: Fast, high-precision measurement technology provides early detection of belt damage



On site in Borneo: Hans Christian Enders, Industrial Solutions division of Continental Engineering Services GmbH, next to the control cabinet of the BRD system.

Splicing failures between the individual segments of a conveyor belt or longitudinal slots caused by sharp-edged objects can easily cause major damage to equipment used in the bulk material handling industry or in mining. In order to identify such problems at an early stage, and to avoiding the often significant associated repair costs, ContiTech and Continental Engineering Services developed two conveyor belt monitoring systems. These systems require very fast, highly precise logging and processing of sensor data. EtherCAT and eXtreme Fast Control (XFC) from Beckhoff provide an efficient solution.



In Borneo, the ContiTech conveyor system is used in opencast coal mining and for loading transport vessels.

Continental Engineering Services GmbH (CES), based in Frankfurt am Main, Germany, has been operating worldwide as an independent provider of engineering services since 2006. Together with ContiTech Transportbandsysteme GmbH, based in Northeim, Germany, CES developed two different electronic belt monitoring systems in the Conti Protect series for integrated conveyor systems sold by ContiTech. These systems are designed, manufactured, and tested according to the demanding standards of the automotive industry.

The first system was termed Splice Elongation Measurement (SEM). It detects serious faults in the splices between the segments of the conveyor belts, which can be up to 10 cm thick, 4 m wide, and 10 km long. The latest development is the Belt Rip Detection (BRD) system, which can detect emerging longitudinal slits in a conveyor belt at an early stage. Both monitoring systems stop the conveyor in the event of an emergency, and also enable remote maintenance by ContiTech personnel, if required. In this way, it is possible to optimize operating costs, increase system availability, and reduce the risk of accidents.

Reliably capturing test signals at high conveyor speeds

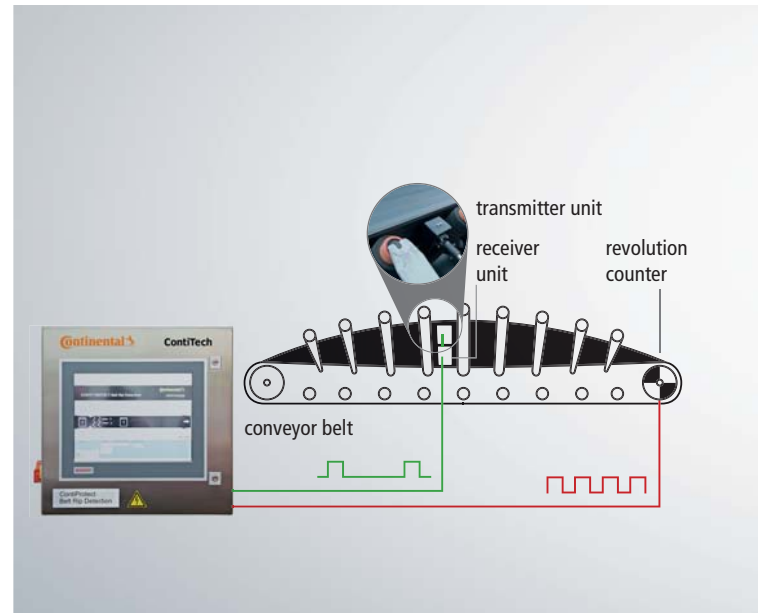
Both systems are based on the electromagnetic induction effect. For the BRD system, conductor loops are vulcanized into the conveyor belt. They transmit a high-frequency test signal between a transmitter and a receiver. If such a loop is damaged, the signal on the receiver side fails; the system control detects this and automatically stops the conveyor. In this way, it is possible to reliably detect emerging longitudinal slits at several monitoring points during conveyor operation, even at full belt speed. SEM involves precision length measurement of the splices, which are the connections between the conveyor belt segments, weighing up to 40 tons. Steel bands integrated in the joints generate the induction effect.

For SEM, the number of measuring points is defined by the number of conveyor belt segments, usually around 50 of them. For the BRD system, conductor loops should ideally be provided every 50 meters, although in some cases they may be 100 to 200 meters apart, depending on the application. Conveyor speeds of up to 40 km/h make great demands on data acquisition and sampling rates. BRD logs around 2,000 values per second, and SEM logs up to 400,000 values per second for high-precision measurement of length down to a fraction of a millimeter, taking into account the unavoidable vibrations of the conveyor belt.

Control technology must be fast, precise, and robust

SEM already met the enormous demands on data processing speed back in 2010, with the help of PC-based control technology from Beckhoff. Hans Christian Enders from the CES Industrial Solutions division explains: "Of crucial importance is EtherCAT, which enables high-performance, real-time Ethernet communication down to the I/O level. The Distributed Clocks and Timestamp functionality in XFC form the basis for extremely precise data acquisition. Based on our excellent experience with SEM, we decided to use Beckhoff technology again for the BRD system."

The technology not only offers outstanding performance, it is also very robust, as Hans Christian Enders continues: "We have been using Beckhoff technology for many years and under the most difficult conditions, including high EMC,



The BRD system logs the signal induced by the transmitter unit, as well as the belt speed, via a revolution counter.

dust and vibration loads, large temperature fluctuations, and high humidity. We have never experienced a technical problem. In a copper mine at an altitude of 3,000 meters in Chile, for example, the control technology is exposed to extreme temperature conditions and particulate matter. What's more, the system passed this endurance test not only within the IP 67-rated control cabinet, but also exposed, as the door is often left open for weeks on end. The BRD system also copes with extreme temperatures and high humidity, such as in an opencast coal mine in Borneo. The built-in CP6202 Panel PC with IP 65-protected front causes no trouble at all, not even when subjected to cleaning or as a result of EMC loads originating from the large, multi-megawatt drives."



At a glance

Solutions for conveyor systems

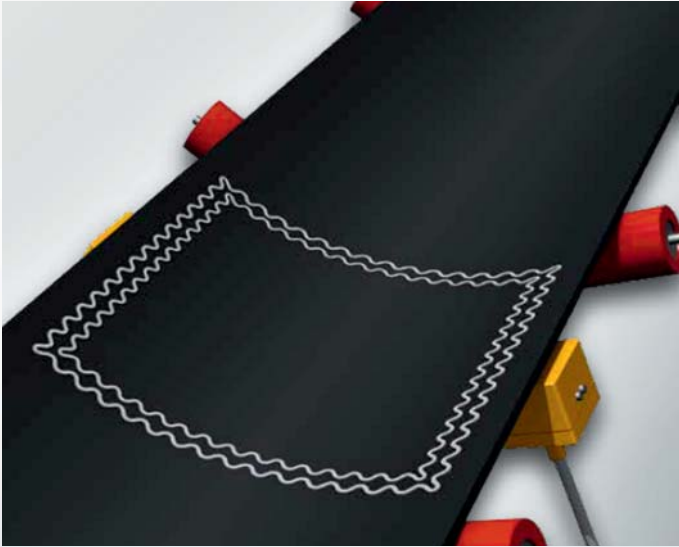
Reliable monitoring systems for conveyor belts

Customer benefit

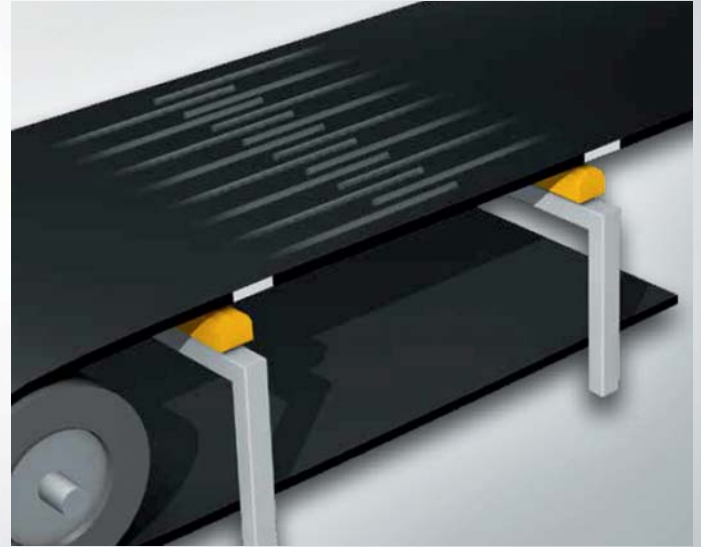
Optimized system availability and reduced risk of accidents

Applied PC Control

- EtherCAT: high-performance data communication, optionally via fiber optic cables
- XFC: high-precision data processing with distributed clocks, timestamp and oversampling features
- TwinCAT: efficient engineering with user-friendly scope function



Transmitter units and the conductor loop in the conveyor belt with BRD



Transmitter units and the junction of two belt segments with SEM

Fast data communication and fast engineering

The CP6202 Panel PC with 15-inch touchscreen is used for the control system, equipped with TwinCAT automation software and TwinCAT PLC HMI for visualization. The modular I/O level features EtherCAT Terminals, including an EL3702 XFC analog input terminal with oversampling. Special oversampling data types enable multiple scans of process values within a communication cycle and the transfer of all data in an array. The so-called oversampling factor refers to the number of samples within a communication cycle.

In the conveyor belt monitoring systems, the oversampling value is 100, i.e. 100 samples per 1 ms cycle time. This makes it possible to transfer huge amounts of data – 2,000 and 400,000 signals per second respectively for the BRD and SEM systems – to the Industrial PC (IPC) with exceptional processing speed. Hans Christian Enders mentions another advantage: “The EtherCAT communication is not only extremely powerful, it also supports communication via fiber optic cables. This is particularly important for us, in view of the fact that in some of our installations the measuring points can be several hundred meters away from the control cabinet.”

Speed also played a major role in the development of the SEM. For the first system, the company only had half a year available, including sensor development. Hans Christian Enders continues: “TwinCAT was very helpful. Thanks to the efficient programming interface and the use of existing software components or function blocks, we were able to reduce the development time drastically. Additional benefits include simplified troubleshooting using the TwinCAT scope functionality, enabling single-step debugging and user-friendly curve display and signal analysis. In this way, correct hardware installation can be verified quickly, which is a particularly important factor during commissioning.”

Scalability and openness of the control system

In addition to the speed and real-time capability of the PC-based control technology, CES also benefited from its scalability and system openness, as Hans Christian Enders explains: “The control technology can be easily adapted to individual customer requirements. For example, it is quite straightforward to integrate a client data structure based on PROFIBUS or CAN via the appropriate I/O terminals, without restrictions in terms of the EtherCAT communication required for the actual data processing.”

By nature, PC-based control technology also demonstrates openness by leveraging IT technologies. For example, remote maintenance for the conveyor systems installed around the world can be implemented without great effort, based on established tools such as TeamViewer. This results in significant savings in time and travel expense. Via the TwinCAT SMTP server, it is possible to integrate webcams for visual monitoring of measuring points. Hans Christian Enders sees further potential for the future: “With the transition to TwinCAT 3, we will benefit from the integration in Visual Studio®. A first application written with this development tool already exists before we started using TwinCAT 3. We use it in the context of our industrial radar sensors and will make this solution even more efficient and valuable as we further expand our use of TwinCAT 3.”

Further information:

www.conti-engineering.com

www.contitech.de

www.beckhoff.com/XFC