

MERSEN

Real-Time Insight to Shoe vs. Third Rail Intimate Contact

Electrical systems specialist, Mersen has developed a monitoring system adapted for current collector devices used in subway and metro systems.

The third rail is just as essential for subways and metros as the overhead wire is for long-distance and high-speed trains: both supply electrified trains with electricity. Thanks to the current collector sliding along the power rail, the current drawn is transferred to the rail vehicle by a collector shoe usually made of copper impregnated graphite. Two rugged coil springs fitted on the current collector ensure constant contact against the power rail.

“The shoes are generally replaced every six to twelve months. However, Mersen’s shoes do last longer,” explains Mersen Sales Manager François Trama. Nevertheless, the shoe represents 70 percent of the total cost of ownership of the entire current collector device (CCD) during its lifespan.

Boosting Efficiency and Sustainability

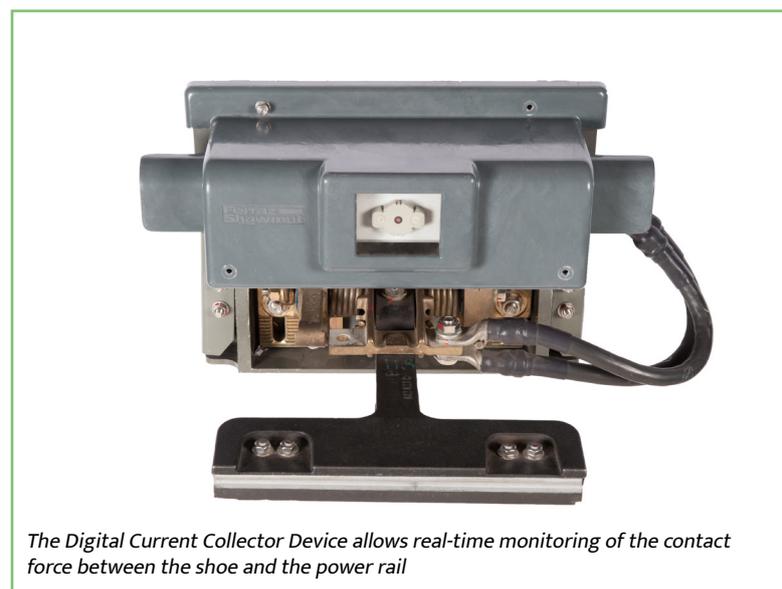
“After investing nearly four years of hard work, our project team has now devised a solution that will dramatically improve the comprehension of the CCD’s performance on duty,” declares Mechatronic Engineer Bilal Naim. Mersen’s solution to the problem is the Digital Current Collector Device (D-CCD), used for real-time monitoring of the contact force between the shoe and the power rail.

The clearly visible portion of the D-CCD is a black box, attached to the arm of the current collector and

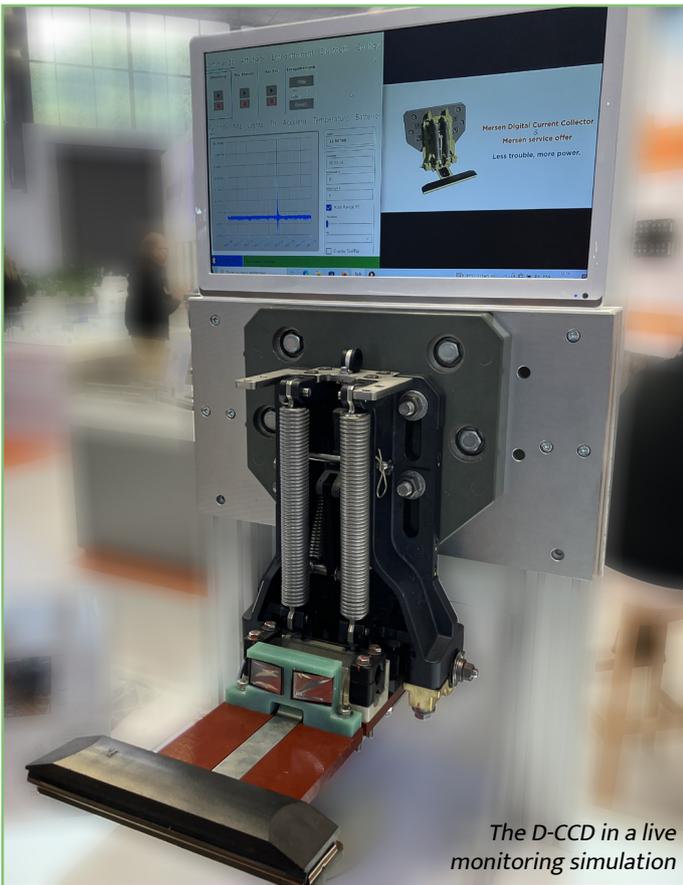
housing the so-called MAT, the Module Acquisition & Transmission. The MAT is composed of the readings recorder (strain gauge and temperature sensor) and of an electronic system processing the signals, storing the data and providing the wireless communication. The measured variables are:

- the temperature rise in the current collector
- the force applied on the third rail by the shoe (N)
- the shocks and vibrations applied to the current collector during its course
- optical sensors

All this data serves as an indicator for the condition of the collector shoe, the collector overall and the third rail. *“This information allows us to find out if the shoe is still operational or will have to be replaced shortly. It gives a clear insight of the quality of the third rail,”* reveals R&D Department Manager Olivier Dosda.



The Digital Current Collector Device allows real-time monitoring of the contact force between the shoe and the power rail



The D-CCD in a live monitoring simulation

the condition of their power rail / current collectors can be accommodated by Mersen with a plug-and-play solution easily integrated into Mersen current collectors.

Analysing Wear Behaviour

Those interested in monitoring their current collectors continuously will require to connect the train network to the MAT via an ethernet cable and a 24V supply voltage. The interface will transfer the data directly to the train system and extend the real time measurement.

This long-term monitoring feature in particular is what creates the best prerequisites for analysing the wear behaviour of the current collectors and for drawing the appropriate conclusions. Mersen aims to eventually arrive at predictive maintenance including plannable maintenance intervals, which will allow customers to operate their trains with improved reliability while also reducing total cost of ownership. Mersen is hoping that the data collected by the D-CCDs will help them optimise the design of their current collectors.

High-Efficiency Solution

As a global expert in electrical energy and advanced materials, Mersen ranks among the world's leading suppliers of current collectors. *“With the D-CCD, we are now offering our customers an exceedingly appealing high-efficiency solution that will give them an insight of what is going on between the 3rd rail and the carbon shoe which is the stepstone towards shoe life extension.”*

The Digital Current Collector Device was presented on several occasions and received great interest. A manufacturer from Korea is already planning to test the D-CCD on a vehicle operating on a new network. *“The wait for the first feedback from use in the real world is keeping us at the edge of our seats,”* announces Olivier Dosda.

To find out more visit our www.mersen.com or get in touch with us sales-ptrv.SBM@mersen.com.

Challenges During Development

The development of the measuring technology for the MAT posed a tremendous challenge to Mersen's engineers. *“Measuring the contact force with the greatest possible accuracy required us to be as close to the contact point as possible, but the voltage of 750V also made it necessary to provide for dependable insulation,”* explains Olivier Dosda. *“Two objectives that are hard to combine.”* Similarly challenging, the development of the electronic module working reliably in a difficult environment: high voltage, high level of shocks and vibrations, and electromagnetic effects.

The engineering team came with a specially designed strain gauge technology using thick-film strain gauges. Patented in 2018, this advanced technology detects deformations in the current collector arm during operation and allows precise characterisation of impacts occurring during operation.

The MAT module is a stand-alone unit without any connection nor interference with the train, battery-powered and designed with its own data storage. Customers who wish to test-drive the system and check



ROLLING STOCK SERVICE SPECIALIST



- Comprehensive data collection
 - Early-failure diagnostics
 - Customized maintenance programs
 - Reduction of unplanned downtime
 - Enhanced component lifespan
- Significant operational cost savings
- Increased system availability and safety