Knick

Application Report

On Site: Safety on the Railway

Knick isolators in Berlin trams

Background

The Berliner Verkehrsbetriebe (BVG) is Germany's largest public transport company. With more than 550 tramcars on a network measuring about 182 km, it operates the most extensive tram system in Germany.

Power supply is provided by 55 substations that are distributed over the whole network. Each substation consists of several feeder points each of which supplies the required overhead voltage of 600V and a current of approx. 3500A.

This current must be permanently monitored for possible interferences by a di/dt controller. In case of problems (e.g. short circuit), the controller immediately switches the feeder point off. The controller takes account of the current value and slew rate to avoid impermissible current rises during each start of a tram.

To connect instruments like the di/dt controller and the overhead line protection, an appropriate shunt resistor is connected in the circuit (cf. Fig. "Circuit principle"). This shunt supplies a measuring signal of e.g. 60 mV at a current of 2500 A.
To protect the subsequent instruments, the 60 mV are measured via an isolation amplifier.

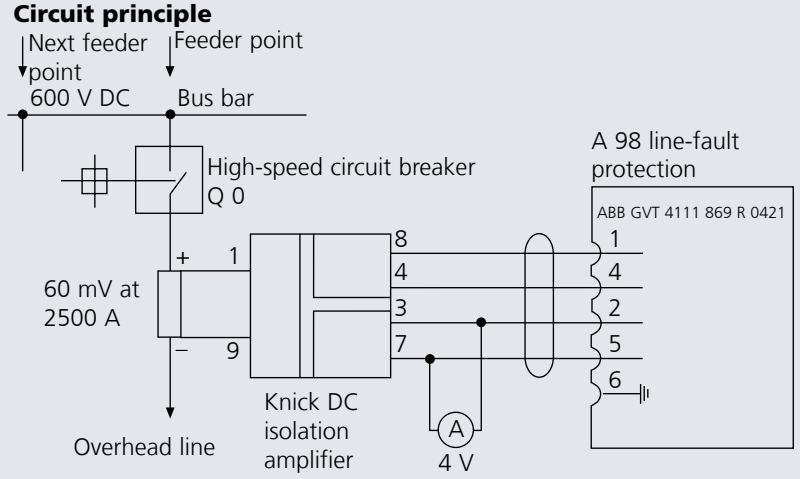
Since the measuring signal from the shunt tends to be highly susceptible to interference, the isolation amplifier must meet the highest quality standards.

Considerable problems occurred because all feeder points for the Berlin tram system are connected through a bus bar in a rectifier station. When one feeder point was switched off by the safety system, other feeder points automatically went off-line as well.

First, it was not clear why this happened. On closer inspection, the simple isolation amplifiers, which were used for decoupling, turned out to be unsuitable. Only the VariTrans® P 40000 isolation amplifier with its extremely high common-mode rejection of 115 dB (1000 V, tr = 1 µS) could solve this problem.

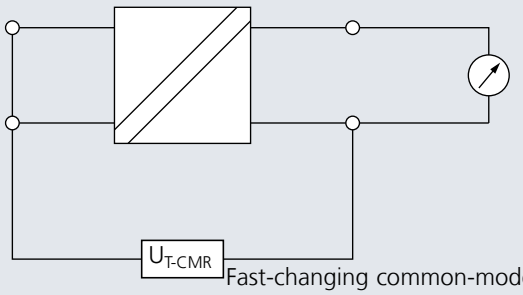
Obviously, the problem was that the measuring signal was influenced by a common-mode interference which was transmitted through the bus bar.

Circuit principle



Shunt line, twisted
Input of isolation amplifier 0 ± 150 mV Output of isolation amplifier 0 ± 10 mV

Common-mode interference signal



Fast-changing common-mode interference signals (e.g. 1000 V_{pp}, t: 1µs

Knick has developed the VariTrans® P 40000 isolation amplifiers specifically for railway applications. They stand out by their very efficient common-mode rejection, accurate transmission and high isolation.

11 substations (with a total of 99 feeder points) of the Berlin tram system have already been equipped with Knick isolation amplifiers. As the problems ceased to occur in the retro-fitted substations, it is now planned to retrofit further substations.

Control cabinet

VariTrans® P 41000 with calibrated switching of up to 16 input/output ranges

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