

## ProLine P50000: High Voltage Transducers for Voltage and Current Measurement in Railway Applications



Image 1: ProLine P50000 with protective covers (left) and without (right)

**The voltage and current transducers of the ProLine P50000 series are designed for use on rolling stock. Their calibrated range selection simplifies the measurement of electrical parameters. In addition, an integrated broad-range power supply allows the uncomplicated use with all standard power supply voltages throughout the world. The transducers are certified in accordance with the railway-specific standards. Their electrical and mechanical design is particularly robust and safe to ensure high availability.**

Nowadays, power electronics are extensively used in electric or diesel-electric locomotives and multiple units (EMU/DEMU), e.g., in the drive systems for traction motors or in the recuperation of braking energy for the power supply network. The control and monitoring of these processes requires the measurement of high electrical voltages and currents at various locations. Furthermore, the voltage and current transducers are used to identify fault conditions (with emergency shutdown), to measure performance and energy, or monitor auxiliary converters and accumulator batteries.

### ProLine P50000: Focused New Product Development

Based on decades of experience in the field of industrial measurement technology and traction power supply, Knick developed the completely new high-voltage transducer series ProLine P50000 that has been specially designed for voltage and current measurement in main and auxiliary circuits of rolling stock.

Typical applications include:

- main circuits in DC-powered commuter and mainline trains up to  $U_n = 3000\text{ V}$
- voltage measurement up to 4800 V
- drives / main converters in DC- and AC-powered commuter and mainline trains
- converters, rectifiers, inverters, and auxiliary converters
- monitoring of emergency and auxiliary converters
- control and safety/emergency shutdown systems
- energy measurement according to EN 50463
- substations of traction power systems

The development staff focused particularly on fire protection, EMC, electrical safety (isolation), and operation under extreme ambient conditions. Comprehensive certifications and conformity with the applicable railway standards ensure the suitability for railway applications. The completely new housing design meets the high demands of mobile applications. Another development goal was to implement innovative product features such as calibrated range selection and an integrated broad-range power supply in order to achieve a high level of performance and flexibility previously not provided by devices of this class – supporting users in the development of their own individual product or system solutions.

### Optimized Device Function with Protective Separation

Circuit design and device construction of the new ProLine P50000 ensure excellent transmission characteristics, which are reflected in zero stability, linearity, long-term stability, pulse fidelity, and immunity to interference. The ProLine P50000 transducers cover a wide input signal range, from millivolts – for example for measuring high currents via shunt resistors – up to kilovolts. The measured values are output as analog, unipolar or bipolar (standard) signals. The 3-port isolation between input, output, and power supply prevents measurement errors due to galvanic connections between the output signal and the power supply.

Knick's TransShield technology enables very compact high-voltage transformers with low leakage. Compared to conventional designs, they ensure the safe galvanic isolation of high input potentials even with compact housing dimensions. Another advantage is the safe isolation of high transient overvoltages (common-mode interferences) that could cause measurement errors at the output.

### Integrated Broad-Range Power Supply for Worldwide Use Without Problems

The integrated broad-range power supply for voltages from 24 to 230 V AC/DC makes external power supply units unnecessary and ensures trouble-free operation with alternating or direct voltages everywhere in the world. It provides for maximum safety even in unstable power supply networks. Separated, clearly assigned terminals make incorrect connection of the supply voltage practically impossible.

### Calibrated Range Selection

The unique selling point compared to other high voltage transducers is the P50000's calibrated range selection by means of which several input ranges up to  $\pm 4200$  V can be selected. After switching, the devices are able to maintain the specified high accuracy without requiring any recalibration. The calibrated range selection enables P50000 users to cover up to 80 input/output signal combinations with a single device and provide the control unit with the required standard signal (e.g., 4...20 mA or  $\pm 20$  mA), a clear advantage also with regard to inventory costs.

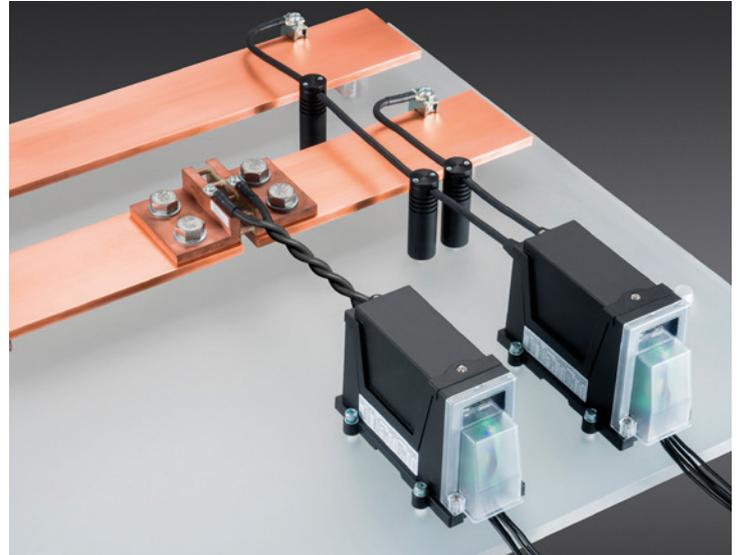


Image 2: Current measurement with shunt resistor (left), voltage measurement directly on the conductor rail



Image 3: Calibrated range selection

### Safety and Availability

Reliability, availability, and (functional) safety are of major significance in railway applications. The product design of the ProLine P50000 transducers minimizes the probability of failure and ensures high reliability. The MTBF (Mean Time Between Failures) is 155 years (ground benign) or 38 years (ground mobile). Maintenance is not required as the products were designed for wear-free operation and their electronic components are protected against environmental factors by complete vacuum encapsulation.

The integrity of the measurement function is continuously monitored within the entire measurement circuit. Detected malfunctions — e.g., due to open circuits at the input or output or due to internal device errors — can be reported to a control unit or a safety device via the analog output signal or a binary diagnostics contact.

### Designed for Harsh Environments

Products for operation on rolling stock must be particularly resistant to environmental factors. The requirements for electronic components are always based on an expected service life of at least 20 years. Extreme temperatures and fast temperature fluctuations such as those that may occur when entering or exiting tunnels should not have any impact on functionality. Accordingly, the temperature resistance of the P50000 models was designed for the temperature class TX (-40 °C ... +85 °C) according to EN 50155 / EN 50125-1 and EN 50463-2. Resistance to mechanical factors such as vibration or shock meets the requirements regarding rolling stock equipment as per IEC 61373. In addition, the products are specified for the altitude class AX as per EN 50125-1 (up to 4000 meters above sea level). Pollution of up to PD3 and overvoltage of up to OV3 is tolerated in compliance with the (railway) standards EN 50124-1 / IEC 62497-1, EN 50123-1, as well as EN 50178 and UL 347.

### Resistance to High Levels of Electromagnetic Interference

Electromagnetic interference from frequency converters and other interference sources on railway vehicles pose major challenges for accurate transducer functionality. General requirements for electromagnetic compatibility for railway applications are described in EN 50121-1. Requirements concerning surge voltages, ESD, transients, and EMC are listed in the EN 50121-3-2. The products of the P50000 series were subjected to comprehensive testing and were found to meet these standards. Their measuring function remains unaffected also in challenging electromagnetic environments.

Extensive EMC reports facilitate the integration in assembly groups or complete systems.

### Fire Protection — Fundamental for Railway Applications

Over the past few years, the topic of fire protection in railway vehicles has received a great deal of attention. In 2016, the applicable fire protection standard EN 45545-2 was updated to define the product requirements in terms of materials and components in the various hazard levels. The P50000 product series meets all requirements of EN 45545-2 up to hazard level HL3 for outdoor use.

### Safe Handling

The broad-range power supply and calibrated selection of input and output ranges allow for a flexible use of the devices and make them easy to integrate into automation systems. Also with regard to installation, the transducers of the P50000 series are versatile and straightforward. The devices can be mounted with four screws on either horizontal or vertical surfaces. Compared to existing solutions, the upright design with small base area saves space on the mounting surface. Alternatively, the transducers can be snapped onto DIN (top-hat) rails according to EN 50022. The terminals used to connect the power supply can easily be identified. They are separated and clearly marked to distinguish them from the other terminals. The terminals on the high-voltage/input side and the low-voltage/output side are covered to allow for a very small isolation distance to adjacent components. The covers also prevent humidity, dust, and dirt from impairing the isolation properties and they protect the metallic contact elements from corrosion. In addition, they prevent accidental contact with dangerous live parts and thus ensure the safety of people.



*Image 4: The P50000 transducers can also be mounted on a DIN rail. To prevent shock hazards, all terminals are located under protective covers.*

### Unique Quality Features

With its ProLine P50000, Knick offers top-quality high-voltage transducers for voltage and current measurement on railway vehicles. They provide innovative functions and features and comply with all currently applicable railway standards. This ensures that they can be used safely and dependably for a vast array of different measurement tasks.

The innovative quality features of the ProLine P50000 series are only encountered very rarely in conventional products currently in use. A comparable combination of these features has not been available on the market so far. Another thing that is not common to find on the market: It goes without saying that all products from Knick come with a detailed user manual. In addition, Knick offers a 5-year warranty on these new products.

# Product Report

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Measurement in Railway Applications

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