



# Simplifying the Troubleshooting of Intercity Trains While Enhancing Worker Safety

## Case Study

### Situation Analysis

Germany's railway network forms an essential part of the country's transport system. Typical of most countries in Western Europe, the majority of tracks depend on overhead power to move the many electric trains that ply across the country. From Hamburg in the north, to Munich in the south; the capital Berlin, to Aachen just east of the German-Dutch border, it is critical that each train maintains its timetable. This consistency and reliability provide passengers with the confidence to make appointments based around the schedules of this public transportation means.

To ensure dependability, today's trains are fitted with numerous electronics—from smaller power circuits such as internal climate controls and door automation, to higher power controls such as speed controls used to provide megawatts of power. One particularly critical component on each train is the power inverter, which is commonly enclosed in 1.5 x 1.0 x 0.5 mm metal housing to reduce EMI distortions and limit acoustic levels. These inverters pull in power from the 15 kV AC overhead lines that electrify Germany's extensive railway network. The inverters output as much as 3 MW in order to power intercity trains operating at speeds that can exceed 250 km/hr. It is through the use of pulse width modulated (PWM)



Agilent  
Wireless  
Remote  
Connectivity  
Solution

signal outputs from the inverter, and the use of variable frequency drives (VFDs), that train speeds are effectively controlled.

Each inverter consists of various power switches that generate significant amounts of heat. This temperature, along with voltage points and other system data are monitored by an extensive control system. When any of the operating parameters fall outside of the allowable range, system alerts trigger; notifying workers of possible train malfunctions and prompting an investigation to determine corrective actions. When a discrepancy is found, the carriage is immediately removed from service to allow specialized personnel to correct the situation.

If the engineer suspects the problem is the inverter, the inverter and housing are typically moved to an offsite location that is more conducive to conducting detailed troubleshooting. There the inverter can be set up to simulate actual running conditions, i.e. with various levels of loading on the inverter being simulated. That allows the troubleshooting engineer to measure and monitor the temperature across various points on the inverter. The measurements are made at several points simultaneously over a set duration, which allows temperature measurements to be monitored and logged. This data helps identify the problem so that the proper correction actions can be made.



## Problem Resolution

With the Agilent Wireless Remote Connectivity Solution, a handheld multimeter is connected to an Agilent U1177A IR-to-Bluetooth® adapter. The adapter uses Bluetooth to establish communication with an Android-based phone or tablet PC. By installing Agilent Mobile Meter (a free Android-based application) on the tablet or PC or Android, the Bluetooth link makes it possible to easily and safely monitor the inverter.

When the inverter is not sealed, the wireless data collection capabilities extend up to ten meters. Even in situations where the inverter is enclosed in a sealed housing, the Agilent solution works up to two meters. This allows actual running conditions to be simulated for the troubleshooting process. It also makes it easy to collect data from multiple connections at various points on the inverter.

The Mobile Meter application logs test data for long durations of testing, which often makes it easier for the engineer to identify and address the problem. The Agilent Wireless Remote Connectivity Solution also protects the troubleshooting engineer. Since there is no physical connection between the user and the inverter while it is operational, the engineer is safeguarded from the risk of incurring an electric jolt.

## Summary

Train operators have much to gain by using the Agilent Wireless Remote Connectivity Solution. The system simplifies data logging tasks. Using the solution also eliminates the complexity of reaching into an almost fully-enclosed half-inch casing. Readings no longer need to be logged and analyzed later. With the free data-logging application from Agilent, the engineer can view live readings, and switch from point-to-point, or view data from up to three points simultaneously.

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