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## Energy efficiency – doing more with less

**Why energy efficiency? 06**

Using energy more efficiently is critical to business and national competitiveness

**ABB solves 100-year-old electrical engineering puzzle 16**

New technology to enable future DC grid

Power and productivity  
for a better world™





Auxiliary converters and battery chargers for WAG 9 locomotives

# Keeping India on the go

Power electronics transform heavy-haul freight locomotives of the Indian Railways, one of the top five, longest rail networks in the world.

**M**ain-line locomotives are the workhorses of the railways, hauling thousands of tons of freight across long distances. More than 60 percent of freight haulage takes place on the electrified section of the golden quadrilateral (rail tracks connecting Delhi, Mumbai, Chennai and Kolkata) that covers the busiest routes.

Recently, Central Railways received six of the WAG 9 series of locomotives from Chittaranjan Locomotive Works, equipped with the very latest insulated gate bipolar transistor (IGBT) converters supplied by ABB. The youngest member of the high voltage switch family, IGBT controls the flow of high currents through a 15 volt high-impedance voltage source, using very low control power to do so. Simply put, IGBTs are used for the delivery and control of power to the motor in the traction system of electric engines.

It replaces the previous inverter generation represented by gate turn-off (GTO) thyristors, offering as much as about four times higher switching frequency. This reduces the current requirement and consequently the heat generated, it also provides smoother acceleration and reduces traction noise.

The WAG 9 weighs in at 135 tons compared to the 127 tons of conventional engines, giving it better traction on steep inclines and increasing haulage capacity from 5050 metric tons to 5500 metric tons. The IGBT technology has been successfully used in high-speed trains in Europe and Japan.

Ajni Loco Shed in Central Railway's Nagpur Division will receive 15 engines in all, through the year. Explaining the significance of adding the new WAG 9 to its stable, Divisional Railway Manager, Brijesh Dikshit said, "Sandwiched as it is between the Deccan Plateau and the Sahyadri Range, the Nagpur Division has some of the most treacherous track within the subcontinent. Hauling 5000-plus tons up steep gradients and through torrential monsoons has been a tremendous challenge. The fast switching that the IGBT power device allows, requires a smaller braking distance and allows quick brake release when needed."

The introduction of the IGBT-based converter has improved the input power factor so the loco can build up power in a shorter time and maintain it for a longer time than its predecessor. However, the three-phase WAG 9's single, greatest advantage

is its per-axle isolation. Earlier, the GTO converter per bogie forced three axles out of service in case of traction motor failure, now if one wheel develops a problem; the engine continues to run on five wheels.

The ultra-modern technology brings ease of use, especially as the microprocessor-based step-less control incorporates an effective slip/slide control system – for the first time allowing the loco operator to maintain speed in bad terrain or weather.

Technological R&D in this field continues to raise blocking voltages, increase switching frequency and reduce losses, and holds out even more potential for optimization in the future.

**For more information:** [www.abb.com/railway](http://www.abb.com/railway)