

SiC Applied Inverter Drive System for Railway Cars

Features

- ◆ First in industry to develop railway traction inverter that applies SiC^{*1} (silicon carbide) power semiconductor module
- ◆ Power loss of power semiconductor module is reduced by approximately 30%^{*2}
- ◆ Cubic volume and installation area of inverter control unit has been reduced by approximately 40% compared to conventional models
- ◆ Boosts performance of electric brakes and increases regenerative ratio^{*3} by 51%
- ◆ High-frequency switching drive reduces higher harmonic wave loss of motor

^{*1} Silicon Carbide: 1:1 compound of carbon and silicon

^{*2} Compared to power semiconductor made using Si (silicon)

^{*3} Regenerative power ratio during deceleration with respect to power consumed during acceleration

Basic Concept or Summary

- ◆ Developed 1700V/1200A 2-in-1 power semiconductor module using latest generation Si-IGBT and SiC-SBD^{*4}, and applied to railway traction inverter used to drive railway cars.
- ◆ Application of SiC-SBD to a flywheel diode reduces IGBT diode loss and diode recovery loss. Changing to high frequency with inverter switching reduces higher harmonic wave loss of motors.
- ◆ Large current characteristics of latest generation Si-IGBT and SiC-SBD are utilized, boosting regenerative brake performance in high-speed range in combination with electric loading motors. This achieves a regenerative ratio of 51% (design value).

^{*4} Schottky Barrier Diode: Diode using Schottky barrier in connection between semiconductor and metal



<http://www.mitsubishielectric.co.jp/me/kaeru/sic/>



SiC Power Module
(1700V/1200A x 2 elements)



SiC Applied Inverter Unit for Railway Cars



High-Efficiency Totally-Enclosed Induction Motor

- ◆ Low-loss of inverters, reduced higher harmonic wave loss of motors and increase in regenerative brake performance achieved 38.6%⁵ reduction in power consumption compared to conventional inverter system.
- ◆ This work was partially supported by NEDO (New Energy and Industrial Technology Development Organization) project "Novel Semiconductor Power Electronics Project Realizing Low Carbon-emission Society".

⁵ Average value actually measured on operating railway car

Installation in Practice or Schedule

Domestic Mar.2013 Tokyo Metro Ginza Line 01 Series
Apr.2014 Odakyu Electric Railway 1000 Series
Jun.2015 Shinkansen Bullet Train N700 Series

Overseas July 2014: Kiev, Ukraine, operation of updated train cars started
2016: USA, shipment of MNR M9 train cars began
2016: Taiwan, shipment of train cars for Taichung Subway began
2016: Singapore, shipment of train cars for Thomson Line began
2016: Boston, USA, shipment of train cars for MBTA began

Contact: Mitsubishi Electric Corporation, Traffic Business Group
Tel: +81-3-3218-1293 Fax: +81-3-3218-2641
<http://www.mitsubishielectric.co.jp/society/traffic/>