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C-16 Keyword	s Y2	device	Z4	electricity	E29	electrical machinery

Mitsubishi Electric Corporation

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





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



SiC Applied Inverter Unit for Railway Cars



High-Efficiency Totally-Enclosed Induction Motor

Effects or Remarks

- ◆ 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