SiC Power Modules

Please visit our website for further details.

Revised publication, effective May 2015.
Superseding publication of HG-802B Sep. 2014.
Specifications subject to change without notice.

2015
Innovative Power Devices for a Sustainable Future

Power devices are a key component in power electronics products for contributing to the realization of a low-carbon society. Attracting attention as the most energy-efficient power device is one made using new material, silicon-carbide (SiC). The material characteristics of SiC have led to a dramatic reduction in power loss and significant energy savings for power electronics devices. Mitsubishi Electric began the development of elemental SiC technologies in the early 1990s and has since introduced them to achieve practical energy-saving effects for products manufactured using SiC. Innovative SiC power modules are contributing to the realization of a low-carbon society and more affluent lifestyles.

SiC: Silicon Carbide-Compound that fuses silicon and carbon at a ratio of one-to-one.

Merits of Incorporating SiC Power Modules

Traction
- Size and weight of traction inverters reduced
- Regenerative performance enhanced
- Noise reduced

Home appliances
- Energy savings increased
- Cooling system more compact
- Equipment more compact/thinner

Electric/hybrid vehicles
- Power loss reduced
- Cooling system more compact
- Regenerative power used efficiently

Building facilities
- Power loss reduced
- Greater layout freedom as the result of smaller equipment

Industrial equipment
- High torque, high speed, size reduced
- Cooling system more compact
- Manufacturing productivity enhanced

Renewable energies
- Energy conversion efficiency improved
- Passive components downsized
- Quieter high-speed operation
SiC with superior characteristics

- Quieter high-speed operation
- Passive components downsized
- Energy conversion efficiency improved

Renewable energies

for a Sustainable Future

Innovative Power Devices

- Manufacturing productivity enhanced
- Cooling system more compact
- High torque, high speed, size reduced

Traction, industrial equipment, building facilities, electric vehicles, renewable energies, home appliances...

SiC: Silicon Carbide - Compound that fuses silicon and carbon at a ratio of one-to-one.

Merits of Incorporating SiC Power Modules

- Greater layout freedom as the result of smaller equipment
- Power loss reduced
- Regenerative power used efficiently
- Cooling system more compact
- Equipment more compact/thinner
- Energy savings increased

SiC power modules appropriated by application

<table>
<thead>
<tr>
<th>Application</th>
<th>Product name</th>
<th>Model</th>
<th>Rating</th>
<th>Connection</th>
<th>States</th>
<th>Insert pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial equipment</td>
<td>Hybrid SiC-PM</td>
<td>PMH2000SU1D060</td>
<td>600</td>
<td>6-in-1</td>
<td>Commercially available</td>
<td>P3</td>
</tr>
<tr>
<td></td>
<td>Full SiC-IPM</td>
<td>PMH75-120-Sxxx</td>
<td>1200</td>
<td>6-in-1</td>
<td>Sample available</td>
<td>P4</td>
</tr>
<tr>
<td></td>
<td>Full SiC Power Modules</td>
<td>FMF400BX-24A</td>
<td>1200</td>
<td>4-in-1</td>
<td>Sample available</td>
<td>P4</td>
</tr>
<tr>
<td></td>
<td>Hybrid SiC Power Modules for</td>
<td>CMH150DY-24NH</td>
<td>2000</td>
<td>2-in-1</td>
<td>Sample available</td>
<td>P5</td>
</tr>
<tr>
<td></td>
<td>High-frequency Switching</td>
<td>CMH150DY-24NH</td>
<td>1200</td>
<td>2-in-1</td>
<td>Sample available</td>
<td>P5</td>
</tr>
<tr>
<td></td>
<td>Applications</td>
<td>CMH200DY-24NH</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMH200DU-24NH</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMH300DU-24NH</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMH400DU-24NH</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMH500DU-24NH</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large Hybrid SiC-IPM * Si M</td>
<td>CMH100BY-24NH</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Application</td>
<td>CPH70A24A</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPH10A24A</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPH20A24A</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPH30A24A</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPH40A24A</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPH50A24A</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPH60A24A</td>
<td>600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Home appliances</td>
<td>Hybrid SiC, DIPPEC*</td>
<td>600</td>
<td>20Arms</td>
<td>Interleaved</td>
<td>Commercially available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PSH0D371AF-A</td>
<td>750</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SiC high temperature operation

- With SiC, owing to the high dielectric breakdown, power loss is reduced and high-voltage is easier to achieve, it is possible to use SiC power electronics devices. However, SiC has three times the band gap width of silicon, preventing the flow of leakage current and enabling operation at high temperatures.

- SiC has three times the heat conductivity of silicon, which improves heat dissipation.

Power loss reduced

SiC has approximately 10 times the critical breakdown strength of silicon. Furthermore, the drift layer that is a main cause of electrical resistance is one-tenth of the thickness. This allows a large reduction in electrical resistance and, in turn, reduces power loss. This SiC characteristic enables dramatic reductions in conductivity loss and switching loss in power devices.
600V/200A Hybrid SiC-IPM for Industrial Equipment
PMH200CS1D060  New

SiC-SBD incorporated in an IPM with a built-in drive circuit and protection functions

Power loss reduction of approx. 20% contributes to enhancing the performance of industrial machinery

- **Features**
  - Hybrid combination of SiC-SBD and IGBT with current and temperature sensors implemented for IPM supplies high functionality and low loss enabling high torque and motor speed
  - Recovery loss (Err) reduced by 95% compared to the conventional product*
  - Package compatible with the conventional product* making replacement possible

* Conventional product: Mitsubishi Electric S1 Series PM200SC1D060

**Internal circuit diagram**

**Main specifications**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Mounted Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200V/75A 6in1</td>
<td>• Built-in drive circuit</td>
</tr>
<tr>
<td></td>
<td>• Under-voltage protection</td>
</tr>
<tr>
<td></td>
<td>• Short-circuit protection</td>
</tr>
<tr>
<td></td>
<td>• Over temperature protection (Monitoring IGBT chip surface)</td>
</tr>
</tbody>
</table>

**Power loss comparison**

- Si-IPM
  - Condition: Vcc=300V, Io=85Arms, fc=15kHz, VD=15V, P.F=1, Modulation=1, three-phase modulation, Tj=125˚C
  - Power loss [W] FWD_SW, FWD_DC, IGBT_SW, IGBT_DC
  - Approx. 20% reduction

- Hybrid SiC-IPM
  - Power loss [W] FWD_SW, FWD_DC, IGBT_SW, IGBT_DC
  - Approx. 20% reduction

1200V/75A Hybrid/Full SiC-IPM for Industrial Equipment
PMH75-120-Sxxx*/PMF75-120-Sxxx*

**Sample available**

Built-in drive circuit and protection functions realize high functionality

- **Features**
  - Incorporates SiC-MOSFET with current sensor and built-in drive circuit and protection functions to deliver high functionality
  - Significant reduction in power loss compared to the conventional product*
  - Package compatible with the conventional product*

* Conventional product: Mitsubishi Electric IPM L1 Series PM75CL1A120

**Internal circuit diagram**

**Main specifications**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Mounted Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200V/400A</td>
<td>• Power loss reduced approx. 70% compared to the conventional product*</td>
</tr>
<tr>
<td></td>
<td>• Low-inductance package adopted to deliver full SiC performance</td>
</tr>
<tr>
<td></td>
<td>• Contributing to realizing smaller/lighter inverter equipment by significantly reducing the package size and realizing a mounting area approx. 60% smaller compared to the conventional product*</td>
</tr>
</tbody>
</table>

**Power loss comparison**

- Si-IPM
  - Condition: Vcc=600V, Io=222Arms (assuming a 110kW inverter), fc=15kHz, P.F=0.8, Modulation=1, three-phase modulation, Tj=125˚C
  - Power loss [W] FWD_SW, FWD_DC, Tr_SW, Tr_DC
  - Approx. 70% reduction

- Full SiC module
  - Power loss [W] FWD_SW, FWD_DC, Tr_SW, Tr_DC
  - Approx. 70% reduction

- **Product lineup**
  - Comparison with conventional product package
  - 1200V/400A (4-in-1) 1pcs
  - or 1200V/800A (2-in-1) 1pcs
  - Si Power module
  - 1200V/400A (2-in-1) 2pcs
  - Full SiC Power module

**Package size**

- 1200V/400A: 92.3 × 121.7mm
- 1200V/800A: 92.3 × 121.7mm

**Applications**

- 400A
- 800A
- 4-in-1
- 2-in-1

**Footprint reduction**

- Approx. 60%

**Sample available**

**Tentative No.**
Contributes to reducing size/weight of industrial-use inverters with the mounting area reduced by approx. 60%

**Features**
- Power loss reduced approx. 70% compared to the conventional product
- Low-inductance package adopted to deliver full SiC performance
- Contributes to realizing smaller/lighter inverter equipment by significantly reducing the package size and realizing a mounting area approx. 60% smaller compared to the conventional product

**Product lineup**

<table>
<thead>
<tr>
<th>Applications</th>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Circuit configuration</th>
<th>Package size (D × W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial equipment</td>
<td>1200V</td>
<td>400A</td>
<td>4-in-1</td>
<td>92.3 x 121.7mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>800A</td>
<td>2-in-1</td>
<td></td>
</tr>
</tbody>
</table>

**Internal circuit diagram**

- **1200V/400A Full SiC Power module**
  - 
  - **1200V/800A Full SiC Power module**
  - **1200V/400A Full SiC Power module**
  - **1200V/800A Full SiC Power module**

**Power loss comparison**

1200V/400A
- Full SiC Power module:
  - Condition: Vcc=600V, Io=110Arms (assuming a 55kW inverter), fc=15kHz, P.F=0.8, Modulation=1, three-phase modulation, Tj=125°C
  - Approx. 70% reduction

1200V/800A
- Full SiC Power module:
  - Condition: Vcc=600V, Io=222Arms (assuming a 110kW inverter), fc=15kHz, P.F=0.8, Modulation=1, three-phase modulation, Tj=125°C
  - Approx. 70% reduction

**Comparison with conventional product package**

- Si Power module 1200V/400A(2-in-1) 2pcs
- Full SiC Power module 1200V/400A(4-in-1) 1pcs or 1200V/800A(2-in-1) 1pcs

Approx. 60% Footprint reduction

**Sample available**

Contributes to reducing size/weight of industrial-use inverters with the mounting area reduced by approx. 60%
For optimal operation of power electronics devices that conduct high-frequency switching
Contributes to realizing highly efficient machinery that is smaller and lighter by reducing power loss and enabling higher frequencies

**Features**

- Power loss reduction of approx. 40% contributes to higher efficiency, smaller size and weight reduction of total system
- Suppresses surge voltage by reducing internal inductance
- Package compatible with the conventional product*  
  *Conventional product: Mitsubishi Electric NFH Series IGBT Modules

**Recovery waveform (FWD)**

**Power loss comparison**

**Product lineup**

<table>
<thead>
<tr>
<th>Applications</th>
<th>Model</th>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Circuit configuration</th>
<th>External size (D x W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>CMH100DY-24NFH</td>
<td>1200V</td>
<td>100A</td>
<td>2-in-1</td>
<td>48 x 94mm</td>
</tr>
<tr>
<td></td>
<td>CMH150DY-24NFH</td>
<td></td>
<td>150A</td>
<td></td>
<td>48 x 94mm</td>
</tr>
<tr>
<td></td>
<td>CMH200DY-24NFH</td>
<td></td>
<td>200A</td>
<td></td>
<td>62 x 108mm</td>
</tr>
<tr>
<td></td>
<td>CMH300DY-24NFH</td>
<td></td>
<td>300A</td>
<td></td>
<td>62 x 108mm</td>
</tr>
<tr>
<td></td>
<td>CMH400DY-24NFH</td>
<td></td>
<td>400A</td>
<td></td>
<td>80 x 110mm</td>
</tr>
<tr>
<td></td>
<td>CMH600DY-24NFH</td>
<td></td>
<td>600A</td>
<td></td>
<td>80 x 110mm</td>
</tr>
</tbody>
</table>
More efficient power modules for PV power conditioner applications

- **Features**
  - Hybrid structure achieved with SiC Schottky barrier diode and 7th-generation IGBT chips
  - Power loss reduction of approx. 25% compared to the conventional product
  - Helps downsize PV inverter system thanks to modified short-circuit protection scheme

  *Conventional product: Mitsubishi Electric Large DIPIPMTM PS61A99

---

1700V/1200A Hybrid SiC Power Modules for Traction Inverters CMH1200DC-34S

- **Features**
  - Power loss reduced approximately 30% compared to the conventional product
  - Highly reliable design appropriate for use in traction
  - Package compatible with the conventional product

- **Main specifications**

<table>
<thead>
<tr>
<th>Module</th>
<th>Max. operating temperature</th>
<th>Isolation voltage</th>
<th>Collector-emitter saturation voltage</th>
<th>Switching loss (850V/1200V)</th>
<th>Capacitive charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si-IGBT @150°C</td>
<td>150°C</td>
<td>4000Vrms</td>
<td>2.3V</td>
<td>turn-on 140mJ</td>
<td>2.3V</td>
</tr>
<tr>
<td>SiC-SBD @150°C</td>
<td>9.0µC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

High-power/low-loss/highly reliable modules appropriate for use in traction inverters

- **Features**
  - Power loss reduction of approx. 40% contributes to higher efficiency, smaller size and weight reduction of total system
  - Suppresses surge voltage by reducing internal inductance
  - Package compatible with the conventional product

*Conventional product: Mitsubishi Electric Large DIPIPMTM PS61A99

---

More efficient power modules for PV power conditioner applications

- **Features**
  - Hybrid structure achieved with SiC Schottky barrier diode and 7th-generation IGBT chips
  - Power loss reduction of approx. 25% compared to the conventional product
  - Helps downsize PV inverter system thanks to modified short-circuit protection scheme

  *Conventional product: Mitsubishi Electric Large DIPIPMTM PS61A99

---

1700V/1200A Hybrid SiC Power Modules for Traction Inverters CMH1200DC-34S

- **Features**
  - Power loss reduced approximately 30% compared to the conventional product
  - Highly reliable design appropriate for use in traction
  - Package compatible with the conventional product

- **Main specifications**

<table>
<thead>
<tr>
<th>Module</th>
<th>Max. operating temperature</th>
<th>Isolation voltage</th>
<th>Collector-emitter saturation voltage</th>
<th>Switching loss (850V/1200V)</th>
<th>Capacitive charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si-IGBT @150°C</td>
<td>150°C</td>
<td>4000Vrms</td>
<td>2.3V</td>
<td>turn-on 140mJ</td>
<td>2.3V</td>
</tr>
<tr>
<td>SiC-SBD @150°C</td>
<td>9.0µC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

High-power/low-loss/highly reliable modules appropriate for use in traction inverters

- **Features**
  - Power loss reduction of approx. 40% contributes to higher efficiency, smaller size and weight reduction of total system
  - Suppresses surge voltage by reducing internal inductance
  - Package compatible with the conventional product

*Conventional product: Mitsubishi Electric Large DIPIPMTM PS61A99

---
Utilizing SiC enables high-frequency switching and contributes to reducing the size of peripheral components

- **Features**
  - Incorporating SiC chip in the Super mini package widely used in home appliances
  - The SiC chip allows high-frequency switching (up to 40kHz) and contributes to downsizing the reactor, heat sink and other peripheral components
  - Adopts the same package as the Super mini DIPIPMTM to eliminate the need for a spacer between the inverter and heat sink and to facilitate its implementation

- **Internal block diagram (Full SiC DIPPFCTM)**

- **Power loss comparison**

- **Interleaved PFC circuit configuration (for Hybrid SiC DIPPFCTM)**

- **Merits of combined use of SiC DIPIPMTM and DIPPFCTM**
  - No need to use spacer for adjusting height when attaching heat sink
  - Integration of PFC circuit and drive IC made it possible to reduce the mounting area and make component more compact such as simplifying the wiring pattern
SiC Power Module Lineup

600V/200A Hybrid SiC-IPM for Industrial Use
PMH200CS1D060

1200V/75A Hybrid/Full SiC-IPM for Industrial Use
PMH75-120-Sxxx*
PMF75-120-Sxxx*

1200V/400A, 1200V/800A Full SiC Power Modules for Industrial Use
FMF400BX-24A
FMF800DX-24A

Hybrid SiC Power Modules for High-frequency Switching Applications
CMH100DY-24NFH
CMH150DY-24NFH

Hybrid SiC Power Modules for High-frequency Switching Applications
CMH 2000DU-24NFH
CMH 3000DU-24NFH

Hybrid SiC Power Modules for High-frequency Switching Applications
CMH 400DU-24NFH
CMH 600DU-24NFH

Large Hybrid SiC DIPIPM™ for PV Application
PSH50Y2A2A6

1700V/1200A Hybrid SiC Power Modules for Trancion Inverters
CMH1200DC-34S

Hybrid/Full SiC DIPPFC™ for Home Appliances
PSH20L91A6-A / PSF20L91A6-A

Terminology

SiC —— Silicon Caride
IPM —— Intelligent Power Module
DIPIPM —— Dual-In-Line Package Intelligent Power Module
DIPPFCTM —— Dual-In-Line Package Power Factor Correction
IGBT —— Insulated Gate Bipolar Transistor
Tr —— Transistor

FWD-SW —— Diode switching loss
FWD-DC —— Diode DC loss
Tr-SW —— Transistor switching loss
Tr-DC —— Transistor DC loss
IGBT-SW —— IGBT switching loss
IGBT-DC —— IGBT DC loss
PV —— Photovoltaics
CSTBT —— Mitsubishi Electric’s unique IGBT that makes use of the carrier cumulative effect
Development of Mitsubishi Electric SiC Power Devices and Power Electronics Equipment Incorporating Them

Mitsubishi Electric began developing SiC as a new material in the early 1990s. Pursuing special characteristics, we succeeded in developing various elemental technologies.

In 2010, we commercialized the first air conditioner in the world equipped with a SiC power device. Furthermore, substantial energy-saving effects have been achieved for traction and FA machinery. We will continue to provide competitive SiC power modules with advanced development and achievements from now on.

Development of these modules and applications has been partially supported by Japan’s Ministry of Economy, Trade and Industry (METI) and New Energy and Industrial Technology Development Organization (NEDO).
Mitsubishi Electric began developing SiC as a new material in the early 1990s. Pursuing special characteristics, we succeeded in developing various elemental technologies. In 2010, we commercialized the first air conditioner in the world equipped with a SiC power device. Furthermore, substantial energy-saving effects have been achieved for traction and FA machinery. We will continue to provide competitive SiC power modules with advanced development and achievements from now on.

Development of these modules and applications has been partially supported by Japan’s Ministry of Economy, Trade and Industry (METI) and New Energy and Industrial Technology Development Organization (NEDO).

* The year and month listed are based on press releases or information released during the product launch month in Japan.

** 1 Researched on press releases by Mitsubishi Electric. 2 Currently under development, as of May 2015.

** Contributing to the realization of a low-carbon society and more affluent lifestyles **

---

### Key Milestones

**2014**

- **February 2014**
  - Developed EV motor drive system with built-in SiC inverter

- **May 2014**
  - Began shipping samples of hybrid SiC power modules for high-frequency switching applications

- **November 2014**
  - Launch Large Hybrid SiC DIPIM™ for PV Application

**2013**

- **February 2013**
  - Developed SiC for application in elevator control systems

- **March 2013**
  - Delivered auxiliary power supply systems for railcars

- **May 2013**
  - Launched SiC power modules

- **December 2013**
  - Launched railcar traction inverter with full SiC power module

**2015**

- **January 2015**
  - Launched power conditioner for PV equipped with full SiC-IPM

---

*Researched on press releases by Mitsubishi Electric.*
SiC POWER MODULES

Please visit our website for further details.
www.MitsubishiElectric.com

Keep safety first in your circuit designs!

- Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that troubles may occur with them. Troubles with semiconductors may lead to personal injury, fire, or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as [1] placement of substitutes, auxiliary circuits, [2] use of nonflammable material or [3] prevention against any malfunction or mishap.

Notes regarding these materials

- These materials are intended as a reference to assist our customers in the selection of the Mitsubishi semiconductor product best suited to the customer’s application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.
- Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third party’s rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
- All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor in order to verify the changes and obtain the latest information.
- The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss arising from these inaccuracies or errors. Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Electric Semiconductor home pages (http://www.MitsubishiElectric.com/semiconductors/).
- When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information on a trial basis before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss resulting from the information contained herein.
- Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, railroad, or underwater reaper uses.
- The prior written approval of Mitsubishi Electric Corporation is necessary to repackage or reproduce in whole or in part these materials.
- If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination. Any deviation or transport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
- Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for further details on the materials or the products contained herein.

Eco Changes is the Mitsubishi Electric Group’s environmental statement, and expresses the Group’s stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
www.MitsubishiElectric.com

Revised publication, effective May 2015.
Superseding publication of HG-802B Sep. 2014.
Specifications subject to change without notice.
©2015 Mitsubishi Electric Corporation