Innovative Power Devices for a Sustainable Future

Mitsubishi Electric power modules are at the forefront of the latest energy innovations that seek to solve global environmental issues while creating a more affluent and comfortable society for all. Some of these innovations are photovoltaic (PV) and wind power generation from renewable energy sources, smart grids realizing efficient supply of power, hybrid/electric vehicles (HVs/EVs) that take the next step in reducing carbon emissions and fuel consumption, and home appliances that achieve ground-breaking energy savings. Whether in appliances, railcars, EVs or industrial systems, our power modules are key elements in changing the way energy is used.
Focus Technology

7th-Generation 1,200V-Class IGBT Chip Technology
Cutting-edge technology realizes energy-saving inverter devices

- Latest thin-wafer processing (n-drift layer) achieves thinner wafer than 6th-generation devices
- Performance improved by combining CSTBT™ and light punch-through (LPT) structures
- Inverter system power dissipation minimized by its superior performance (lower VCEsat and Eoff)

*CSTBT: Mitsubishi Electric’s unique IGBT that makes use of carrier cumulative effect

A small surface mount package IPM has been newly developed for fan and low-power motor drive applications

**Key Features**
- Optimal pin layout realizes easier PCB wiring design and enables smaller PCB size
- Newly integrated interlock function in addition to conventional protection features for robust operation
- Bootstrap diode is integrated for the P-side drive power supply like conventional DIPIPM™ series, reducing the number of peripheral external parts

Modules realizing single-control power supply and photocoupler-less systems for household appliances and low-capacity inverters

**Key Features**
- Transfer-molded structure incorporating a high thermal conductivity insulation sheet provides heat
- High-voltage IC equipped with drive, protection and level-shift circuits for direct control via input signals from a CPU or microcomputer
- Compact board and highly reliable equipment realized through single power-supply and photocoupler-less systems
- Includes built-in bootstrap diode (BSG)

Modules with built-in control and protection circuits for AC servo robots and PV power generation

**Key Features**
- Built-in protection circuits for short-circuiting, power supply undervoltage and overheating
- Highly compatible package with simplified printed circuit board (PCB) design
- Special intelligent power modules (IPMs) for power conditioners in PV power generation systems

IGBT modules for general-purpose inverters used in various applications

**Key Features**
- Various low-inductance packages and power chips available
- Compatible with high-frequency, high-voltage (1,700V) applications
- Large-capacity modules available for renewable energy systems

High voltage, large capacity and high reliability are realized for traction and power transmission application

**Key Features**
- Two types of package are realized: “std type” with large output power and “LV100/HV100 type” for various inverter capacity by easy parallel connection
- The abundant field experience more than 20 years especially in the application of bullet train
- High reliability due to a long lifetime design and a robust design against severe environment

Modules realizing high performance and reliability for propulsion inverters in HVs/EVs

**Key Features**
- Built-in temperature analog output function realizing highly reliable drive train
- High-power/temperature cycle life ensures high reliability
- Compliant with the End-of-life Vehicles Directive, regulations relating to substances of environmental concern
- High traceability in managing materials/components throughout the entire production process for each product

A small Surface mount package IPM has been newly developed for fan and low-power motor drive applications.

**Main Features**
- Optimal pin layout realizes easier PCB wiring design and enables smaller PCB size.
- Insulation distance between pins ensured, realizing easier board mounting without coating process.
- Newly integrated interlock function in addition to conventional protection features for robust operation.
- Installing RC-IGBT simultaneously realizes compact package and low loss performance can go together.
- Bootstrap diode is integrated for the P-side drive power supply like conventional DIPIPM series, reducing the number of peripheral external parts.

*1 Reverse-conducting IGBT

### Type name | Rated current | Rated voltage | Chips | BSC | Protection | Shape
--- | --- | --- | --- | --- | --- | ---
SP1SK** | 1A | 600V | RC-IGBT | Embedded | UV | Surface mount package
SP1SL** | 1A | 600V | HVIC | Embedded | SC | Surface mount package
SP3SK** | 3A | 600V | LVIC | Embedded | OT | Surface mount package
SP3SL** | 3A | 600V | BSD | Embedded | VOT | Surface mount package

**Term**
- VOT: Analog temperature output
- UV: Power supply under-voltage protection
- SC: Short-circuit protection
- OT: Over Temperature protection
- IL: Inter Lock
- BSC: Bootstrap capacitor

**Under development**
All-in-one intelligent power modules equipped with 3-phase converter and brake circuit in addition to inverter circuit

**Feature Products**

<Main Features>
- Encapsulated with transfer molded resin, integrates three-phase converter, inverter, brake and control IC
- Built-in converter and brake enable system size to be reduced and save design cost, contributing to total cost reduction
- Lower PCB inductance pattern reduces noise, thereby reducing design time and countermeasure parts required for noise reduction
- Built-in BSD\(^*1\) with 1,200V withstand voltage reduces number of external parts and improves reliability

\(^*1\) BSD: Bootstrap diode
\(^*2\): Available without brake circuit

PSS05MC1FT, PSS10MC1FT, PSS15MC1FT, PSS25MC1FT, PSS35MC1FT, PSS50MC1F6

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**Customer Support**

EVA series, evaluation boards for each DIPIPM™
Various evaluation boards to easy support system design

- SLIMDIPTM evaluation board EVA01-SLIM
- SLIMDIPTM evaluation board EVA15-SLIM
- Super mini DIPIPM™ evaluation board EVA11-SDIP
- DIPIPM™ evaluation board EVA14-DIP+
- DIPIPM™ evaluation board EVA03-DIP+

* For further information, please contact sales office.
## Line-up of DIPIPM™

### Series Matrix of 600V / 500V DIPIPM™

<table>
<thead>
<tr>
<th>IC (A)</th>
<th>SLIMDIP</th>
<th>Super mini</th>
<th>Mini</th>
<th>Large</th>
<th>CIB/CI</th>
<th>Super mini</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>PSS05S62F6-AG</td>
<td>PSS05S61F6</td>
<td>PSS05S61F6-C</td>
<td></td>
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<td>PSS50S61F6</td>
<td>PS21A79</td>
<td>PSS50MC1F6</td>
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<td>PS21A79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- *1*: PSSxxS6x2F6 has OT function, PSSxxS6x2F6 has VOT function.
- *2*: A50Hz, 1minute.Coresponds to isolation voltage 2500Vrms in the case the convex-shaped heat sink.
- *3*: High melting point solder (Lead Over 85%) is used for chip soldering of PSSxxS6x1F6 only.
- *4*: Molding resin insulation for PSSxxS6x1F6-C.
- *5*: PSS50NC1F6 is not included brake.

**[Term]**
- CIB: Converter Inverter Brake, CI: Converter Inverter
- HVIC: High Voltage IC, LVIC: Low Voltage IC
- BSD: Bootstrap Diode
- SC: Short Circuit protection
- OT: Over Temperature protection
- CSTBT: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect.

### Application circuit of super mini DIPIPM™

![Application circuit diagram](image-url)
### Series Matrix of 1200V DIPIPMTM

<table>
<thead>
<tr>
<th>Series Matrix of 1200V DIPIPMTM</th>
<th>1200V</th>
<th>DIPIPMTM+</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V_{ce}(V)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>I_{c}(A)</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Mini</strong></td>
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<td></td>
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<tr>
<td><strong>Large</strong></td>
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<tr>
<td><strong>DIPIPMTM+</strong></td>
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<td></td>
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<td><strong>Ver.6</strong></td>
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<td></td>
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<td><strong>Ver.4</strong></td>
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<td><strong>CIB/CI</strong></td>
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<td>PSS05S72FT</td>
<td>PS22A72</td>
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<td>PS22A76</td>
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<td>PSS35S2A2FT</td>
<td>PS22A78-E</td>
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<td><strong>50</strong></td>
<td>PSS50S2A2FT</td>
<td>PS22A79</td>
</tr>
<tr>
<td><strong>75</strong></td>
<td>PSS75S2A2FT</td>
<td></td>
</tr>
</tbody>
</table>

### Type Name Definition of DIPIPMTM

- **PS**: Please contact to the sales offices.
- **Options**: Voltage class, Function, Package, Series, Device, Circuit construction, Rated current, Chip type, DIPIPMTM

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**Terms**:
- **BOSD**: Bootstrap Diode
- **CSTBT**: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect.
- **HVIC**: High Voltage IC, **LVIC**: Low Voltage IC
- **UV**: Supply Under Voltage protection, **OT**: Over Temperature protection, **SC**: Short Circuit protection
- **VOT**: Analog temperature output
- **RoHS**: Restriction of hazardous substances in electrical and electronic equipment
- **CIB**: Converter Inverter Brake, **CI**: Converter Inverter

[Notes] *1: PSS**NC1FT is not included brake

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**Specifications**:
- **Pin type**: —
- **Insulation voltage**: 2500Vrms, 2500Vms, 2500Vms
- **Insulation structure**: Insulation sheet, Insulation sheet, Insulation sheet
- **Rohs directive**: Compliant, Compliant, Compliant
- **Fault output**: N-side, N-side, N-side
- **Emitter pin of N-side**: Open, Open, Open
- **Active input**: High(V5), High(V5), High(V5), High(V5)
- **P-side/N-side**: P-side/N-side, P-side/N-side, P-side/N-side, P-side/N-side/Brake
- **Emittor of N-side**: N-side, N-side, N-side, N-side
- **Series**: —
- **Ic** (A): 5, 10, 15, 25, 35, 50, 75
- **V_{ce}(V)**: 75, 50, 35, 30, 20, 15, 10
- **Notes**

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**Chip**:
- **IGBT/MOSFET**: CSTBT
- **CSTBT**
- **CIB/CI**
- **Options**
- **Function**
- **Series**
- **Package**
- **Circuit construction**
- **Rated current**
- **Chip type**
- **DIPIPMTM**

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**Overview**:
- **CSTBT**: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect.
Outline Drawing of DIPIPM™

Super mini DIPIPM Ver.6
MOSFET Super mini DIPIPM
Long (A)

Mini DIPIPM (PSSxxS71F6)
1200V Mini DIPIPM

Mini DIPIPM (PSSxxS51F6)

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Mini DIPIPM (PSSxxS51F6-C)
Zigzag(C)

Large DIPIPM

DIPIPM+

SLIMDIP
Long

SLIMDIP
Short

---

*5 For the “A” package 6-in-1 (CG1A) main pin shape, select either solder pin or screw type inverters with enhanced energy savings

*6 The new resin-insulated metal baseplate, originally introduced in 7th-generation IGBT modules, eliminates the solder-attached section, increasing the TM*1 and a diode incorporating a RFC *2 structure

*3 Conventional product: IPM L1-Series

*2 RFC: Relaxed field cathode

*1 CSTBT™: Mitsubishi Electric’s unique IGBT that utilizes the carrier cumulative effect

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New Products
Solder pin

Screw

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Short-circuit protection (SC), Over-temperature protection (OT)

---

Representative reference is “A” package with screw terminal and straight layout (CG1A).
<Main Features>
- Power loss has been reduced with the introduction of the 7th-generation IGBT produced using CSTBT™ and a diode incorporating a RFC structure that contributes to reducing the power consumed in inverters.
- The new resin-insulated metal baseplate, originally introduced in 7th-generation IGBT modules, eliminates the solder-attached section, increasing the thermal cycle lifetime and improving inverter reliability.
- In addition to the built-in functions of the previous product, automatic switching speed control, error detection function and Bootstrap diode (BSD) contribute to lowering inverter loss and shortening design time.
- The introduction of PC-TIM™ contribute to simplifying the inverter assembly process (optional).

1 CSTBT™: Mitsubishi Electric’s unique IGBT that utilizes the carrier cumulative effect
2 RFC: Relaxed field cathode
3 Conventional product: IPM L-Series
4 Built-in functions: Supply Undervoltage lock protection (UV), Short-circuit protection (SC), Over-temperature protection (OT)
5 PC-TIM: Phase change-thermal interface material

■ "A" package main pin shape and layout
For the "A" package 6-in-1 (CG1A) main pin shape, select either solder pin or screw type.
For the pin layout, select either straight or L-shaped.

Main pin shape                  Main pin layout
Main pin: Solder pin            Straight
Main pin: Screw                 L-shaped

■ Lineup

<table>
<thead>
<tr>
<th>Vdc(V)</th>
<th>Package</th>
<th>Main pin shape</th>
<th>Main pin layout</th>
<th>ic(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>650V</td>
<td>A package</td>
<td>Screw</td>
<td>Straight</td>
<td>PM60CG1A120*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L-shaped</td>
<td>PM60CG14L120*</td>
</tr>
<tr>
<td></td>
<td>Solder pin</td>
<td>Straight</td>
<td>PM60CG1A120*</td>
<td>PM60CRG1A120*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L-shaped</td>
<td>PM60CG14L120*</td>
<td>PM60CRG14L120*</td>
</tr>
<tr>
<td>1200V</td>
<td>A package</td>
<td>Screw</td>
<td>Straight</td>
<td>PM80CG1A120*</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>L-shaped</td>
<td>PM80CG14L120*</td>
</tr>
<tr>
<td></td>
<td>Solder pin</td>
<td>Straight</td>
<td>PM80CG1A120*</td>
<td>PM80CRG1A120*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L-shaped</td>
<td>PM80CG14L120*</td>
<td>PM80CRG14L120*</td>
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<tr>
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<td>B package</td>
<td>Screw</td>
<td>PM100CG1A120*</td>
<td>PM100CRG1A120*</td>
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<td></td>
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<td></td>
<td>PM100CG1A120*</td>
<td>PM100CRG1A120*</td>
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<tr>
<td></td>
<td>C package</td>
<td>Screw</td>
<td>PM150CG1A120*</td>
<td>PM150CRG1A120*</td>
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* New Product

Representative reference is "A" package with screw terminal and straight layout (CG1A).
### Matrix of IPM Modules 650V/600V

(No.: Number of outline drawing, see page 11 to 12)

<table>
<thead>
<tr>
<th>Voice(V)</th>
<th>650V</th>
<th>600V</th>
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<tr>
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</tr>
<tr>
<td>PM100CG1A065*</td>
<td>C 12</td>
<td>PM100CG1B065*</td>
</tr>
<tr>
<td>PM100RG1A065*</td>
<td>C 12</td>
<td>PM100RG1B065*</td>
</tr>
<tr>
<td>PM100RG1B065*</td>
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<td>PM100RG1B065*</td>
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<td>PM100CG1AP065*</td>
<td>C 09</td>
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<td>C 09</td>
<td>PM100CG1AP065*</td>
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<td>PM100CG1AL065*</td>
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<tr>
<td>PM100CG1PL065*</td>
<td>C 09</td>
<td>PM100CG1PL065*</td>
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<tr>
<td>PM100CG1ER065*</td>
<td>C 09</td>
<td>PM100CG1ER065*</td>
</tr>
<tr>
<td>PM100RG1AP065*</td>
<td>C 09</td>
<td>PM100RG1AP065*</td>
</tr>
<tr>
<td>PM100RG1AL065*</td>
<td>C 09</td>
<td>PM100RG1AL065*</td>
</tr>
<tr>
<td>PM100RG1PL065*</td>
<td>C 09</td>
<td>PM100RG1PL065*</td>
</tr>
</tbody>
</table>

| 200      |      |      |
| PM200CG1A065* | C 11 | PM200RG1A065* | C 11 |
| PM200RG1B065* | C 10 | PM200RG1B065* | C 10 |
| PM200CG1AP065* | C 11 | PM200CG1AP065* | C 11 |
| PM200CG1AP065* | C 11 | PM200CG1AP065* | C 11 |
| PM200CG1AL065* | C 11 | PM200CG1AL065* | C 11 |
| PM200CG1PL065* | C 11 | PM200CG1PL065* | C 11 |
| PM200CG1ER065* | C 11 | PM200CG1ER065* | C 11 |
| PM200RG1AP065* | C 11 | PM200RG1AP065* | C 11 |
| PM200RG1AL065* | C 11 | PM200RG1AL065* | C 11 |
| PM200RG1PL065* | C 11 | PM200RG1PL065* | C 11 |

| 400/450  |      |      |
| PM400CG1A065* | C 11 | PM400RG1A065* | C 11 |
| PM400RG1B065* | C 10 | PM400RG1B065* | C 10 |
| PM400CG1AP065* | C 11 | PM400CG1AP065* | C 11 |
| PM400CG1AP065* | C 11 | PM400CG1AP065* | C 11 |
| PM400CG1AL065* | C 11 | PM400CG1AL065* | C 11 |
| PM400CG1PL065* | C 11 | PM400CG1PL065* | C 11 |
| PM400CG1ER065* | C 11 | PM400CG1ER065* | C 11 |
| PM400RG1AP065* | C 11 | PM400RG1AP065* | C 11 |
| PM400RG1AL065* | C 11 | PM400RG1AL065* | C 11 |
| PM400RG1PL065* | C 11 | PM400RG1PL065* | C 11 |

### IGBT chip

- **CSTBT**
  - Emitter sensor installed
  - Built-in emitter sensor

- **CSTBT**
  - Built-in emitter sensor

- **CSTBT**
  - Built-in emitter sensor

- **CSTBT**
  - Built-in emitter sensor

- **CSTBT**
  - Built-in emitter sensor

- **CSTBT**
  - Built-in emitter sensor

### Fault output

- **UV**: Under Voltage-lock protection
- **OT**: Over-temperature protection
- **SC**: Short-Circuit protection

### Compliant

- **D**: L Series
- **B4**: S-DASH SERVO
- **B5**: V Series

### Connection

- **D**: L Series
- **B4**: S-DASH SERVO
- **B5**: V Series

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**Notes**

1. **Full-gate CSTBT**: PCM (Plugged Cell Merged) CSTBT
2. **Non-recommended**: Please contact to the sales offices.

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**Term**

- **UV**: Supply Under Voltage-lock protection
- **OT**: Over-temperature protection
- **SC**: Short-Circuit protection
- **CSTBT**: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect
- **RoHS**: Restriction of hazardous substances in electrical and electronic equipment

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9
### Matrix of IPM Modules 1200V (No.: Number of outline drawing, see page 11 to 12)

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Series</th>
<th>G1 Series</th>
<th>LT Series</th>
<th>St Series</th>
<th>V1 Series</th>
<th>L Series</th>
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</thead>
<tbody>
<tr>
<td>25</td>
<td></td>
<td>PM25CG1A120*</td>
<td>PM25CL1A120</td>
<td>PM25CS1D120</td>
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<td>PM25CG1B120*</td>
<td>PM25CL1B120</td>
<td>PM25CL1D120</td>
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<td>C 05</td>
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<td>PM25RG1A120*</td>
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<td>PM50RL1A120</td>
<td>PM50CL1D20</td>
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<td>C 05</td>
</tr>
</tbody>
</table>

**IGBT chip**

- CSTBT™: Emitter sensor installed
- CSTBT™: Built-in current sensor
- CSTBT™: Built-in temperature sensor
- CSTBT™: Built-in current sensor
- CSTBT™: Built-in temperature sensor
- CSTBT™: Built-in current sensor
- CSTBT™: Built-in temperature sensor

**Fault output**

- UV: P-side/N-side
- OT: P-side/N-side
- SC: P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side
- P-side/N-side

**Compatibility**

- Compliant: L Series, V Series
- Non-recommended: Please contact to the sales offices.

---

**Notes**

- 1: Full-gate CSTBT™
- 2: PCM (Plugged Cell Merged) CSTBT™

**Term**

- UV: Supply Under Voltage-lock protection
- OC: Short-Circuit Protection
- OT: Over-temperature protection
- OC: Over-current protection
- RoHS: The restriction of the use of certain Hazardous Substances in electrical and electronic equipment
Outline Drawing of IPM

10
PM50,75,100,150,200CG1B/
RG1B065
PM25,35,50,75,100CG1B/
RG1B120

11
PM200,300,400,450CG1C/
RG1C065
PM100,150,200CG1C/
RG1C120

12
PM50,75,100CG1A/CG1AL/
RG1A065
PM25,35,50CG1A/CG1AL/
RG1A120
**New Products**

- New structure realizes improved reliability (improved thermal cycle lifetime)

**Base plate**
- Solder
- Ceramic insulation board
- Wire
- Silicone gel

**NX package structure comparison**

- 7th-generation IGBT
  - Compared to standard (std) package structure
  - Resin insulated metal baseplate
  - Thick metal substrate (TMS)
  - Adopts SoLid Cover (SLC) Technology
  - Standard package is not available for CIB
- Resin added pattern thickness
- 7th-generation IGBT
  - Ultra sonic bonding adopted

- Possible to select the control pin shape (soldered terminals/press-fit terminals)
- Solder attachment process eliminated

**Main Features**

- New modules equipped with three-phase converter, inverter, and brake circuit (CIB), contributes to simplifying design for inverter systems
- CIB modules contribute to compact inverter systems by reducing package size by 36% compared to the Mitsubishi Electric's existing module (CIB)
- Power loss has been reduced with the introduction of the 7th-generation IGBT produced using CSTBT™*
2 and a diode incorporating a relaxed field of cathode (RFC) structure
- The new structure introduced eliminates the solder-attached section, increasing the thermal cycle lifetime, which contributes to improving the reliability of inverters
- The introduction of press-fit pins and PC-TIM*1 contribute to simplifying the assembly process for inverters

*1 PC-TIM: Phase change - thermal interface material
*2 CSTBT™: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect

RoHS directive compliant

**Outline Drawing of MOSFET Modules**

**Series Matrix of MOSFET Modules**

<table>
<thead>
<tr>
<th>VgsS (V)</th>
<th>75V</th>
<th>100V</th>
<th>150V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ip (A)</td>
<td>Connection</td>
<td>Connection</td>
<td>Connection</td>
</tr>
<tr>
<td>100</td>
<td>FM200TU-07A</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>200</td>
<td>FM400TU-07A</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>300</td>
<td>FM600TU-07A</td>
<td>T</td>
<td>T</td>
</tr>
</tbody>
</table>

Connection

**Line-up of MOSFET Modules**

- RoHS directive compliant
- Unit: mm

**Outline Drawing of MOSFET Modules**

- FM200TU-07A, -2A, -3A
- FM400TU-07A, -2A, -3A
- FM600TU-07A, -2A, -3A

**Detail Diagram**
New Products

New lineup contributes to simplifying design, downsizing, energy-saving of industrial inverters.

IGBT Module T/T1-Series

<Main Features>

- New modules equipped with three-phase converter, inverter, and brake circuit (CIB), contributes to simplifying design for inverter systems
- CIB modules contribute to compact inverter systems by reducing package size by 36% compared to the Mitsubishi Electric’s existing module (CIB)
- Power loss has been reduced with the introduction of the 7th-generation IGBT produced using CSTBT™ and a diode incorporating a relaxed field of cathode (RFC) structure
- The new structure introduced eliminates the solder-attached section, increasing the thermal cycle lifetime, which contributes to improving the reliability of inverters
- The introduction of press-fit pins and PC-TIM™ contribute to simplifying the assembly process for inverters

*1 PC-TIM: Phase change - thermal interface material
*2 CSTBT™: Mitsubishi Electric’s unique IGBT that makes use of the carrier cumulative effect

- New structure realizes improved reliability (improved thermal cycle lifetime)

NX package structure comparison

6th-generation IGBT

Compared to standard (std) package structure

6th-generation IGBT

- Press-fit terminal support (NX)
  - Possible to select the control pin shape (soldered terminals/press-fit terminals)
  - Solder attachment process eliminated

Press-fit pin

1. Main pin

2. Signal pin

Adopts SoliD Cover (SLC) Technology

Standard package is not available for CIB
IGBT Modules

Feature Products

Contributes to realizing smaller, energy-saving large-capacity inverters

Power Modules for 3-level Inverters

Main Features
- Compatible with 3-level inverters, reducing power consumption approx. 30% \(^{1}\)
- New package developed\(^{2}\) contributing to lower inductance and simplified inverter circuit structure
- IGBT specifications optimized\(^{3}\) with development of new compact, low-inductance package
- 4-in-1\(^{4}\) and 1-in-1/2-in-1\(^{5}\) lineup contributes to improved compactness and freedom in inverter design

\(^{1}\) Comparison between 3-level inverter incorporated in this device and 2-level inverter in conventional device.

\(^{2}\) 1-in-1/2-in-1 type external dimensions of 130x67mm, 4-in-1 type external dimensions of 115x82mm, new package developed with innovative terminal positioning.

\(^{3}\) IGBT specifications optimized for 3-level inverters, adopting CSTBT\(^{\text{TM}}\) (Mitsubishi Electric’s unique IGBT that makes use of the carrier cumulative effect).

\(^{4}\) 4-in-1 module with one 3-level inverter arm in one package.

\(^{5}\) Bidirectional switch model as emitter common connection.

Lineup

<table>
<thead>
<tr>
<th>Main application</th>
<th>Model</th>
<th>Module type</th>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Circuit structure</th>
<th>External dimensions (WxD:mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125-500kW inverter</td>
<td>CM400ST-24S1</td>
<td>IGBT</td>
<td>1200V</td>
<td>400A</td>
<td>4-in-1</td>
<td>115x82</td>
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<td>500kW - inverter</td>
<td>CM1250HA-24S</td>
<td>IGBT</td>
<td>1200V</td>
<td>1400A</td>
<td>1-in-1</td>
<td>130x67</td>
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<td>RM1300HA-24S</td>
<td>Diode</td>
<td>1200V</td>
<td>1400A</td>
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<td>CM1000HA-34S</td>
<td>IGBT</td>
<td>1700V</td>
<td>1000A</td>
<td>1-in-1</td>
<td>130x67</td>
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<td>CM500C2Y-24S</td>
<td>IGBT</td>
<td>1200V</td>
<td>500A</td>
<td>2-in-1</td>
<td>130x67</td>
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</tbody>
</table>

Evolution of IGBT Module Series

4th-generation of IGBT
- F Series
  - Standard (Std) type
  - MPD type
- NF Series
- S/S1 Series
  - Standard (Std) type
  - MPD type

5th-generation of IGBT
- NF Series
- S/S1 Series
  - Standard (Std) type
  - MPD type

6th/11th-generation of IGBT
- S Series, S1 Series
  - NX type
- NFH Series
  - Standard (Std) type
  - NX type

7th-generation of IGBT
- T Series
  - NX type
  - Standard (Std) type

Type Name Definition of IGBT Modules

CM 600 D Y -13 T

- Series name
- Voltage class
- Outline drawing and other specifications
- Connection type
- Rated current capacity
- IGBT module

Features of IGBT Module Series

S Series
- Lineup includes various package types
- 6th-generation CSTBT\(^{\text{TM}}\) delivers low-loss performance
- Thinner package (Height: 17mm) (NX type)
- Suited to large-capacity applications (MPD type)

MPD: Mega power dual

NFH Series
- High-speed CSTBT\(^{\text{TM}}\) delivers low-loss performance
- Soft switching (resonant) turn-off function (ZVS)
- Enhanced inner wiring (skin effect)

CSTBT\(^{\text{TM}}\): Mitsubishi Electric’s unique IGBT that makes use of the carrier cumulative effect.

RoHS directive (2011/65/EU) compliant

Contact the sales offices for details.
### Matrix of IGBT Modules 650V/600V

<table>
<thead>
<tr>
<th>Vce(V)</th>
<th>650V</th>
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<td>T/T1-Series</td>
<td>XN Type</td>
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<td>50</td>
<td>CM500UX-13T**</td>
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<td>75</td>
<td>CM700UX-13T**</td>
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<td>100</td>
<td>CM1000UX-13T**</td>
<td>M 44</td>
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<tr>
<td>150</td>
<td>CM1500UX-13T**</td>
<td>M 44</td>
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<tr>
<td>200</td>
<td>CM2000UX-13T**</td>
<td>M 44</td>
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<td>225</td>
<td>CM2250UX-13T**</td>
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<td>300</td>
<td>CM3000UX-13T**</td>
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<tr>
<td>400</td>
<td>CM4000UX-13T**</td>
<td>M 44</td>
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<tr>
<td>450</td>
<td>CM4500UX-13T**</td>
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<td>600</td>
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<td>1000</td>
<td>CM10000UX-13T**</td>
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**Note:**}

### Matrix of IGBT Modules 1200V

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<th>Ic(A)</th>
<th>T/S1-Series std Type</th>
<th>Connection No.</th>
<th>S/S1-Series std Type</th>
<th>Connection No.</th>
<th>S/S1-Series std Type</th>
<th>Connection No.</th>
<th>S/S1-Series std Type</th>
<th>Connection No.</th>
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<td>400</td>
<td>CM400ST-24S*</td>
<td>S 35</td>
<td>CM400CY-24S*</td>
<td>C1 11</td>
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<td>450</td>
<td>CM450CY-24S*</td>
<td>C1 32</td>
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<td>500</td>
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<td>600</td>
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**Note:**
- **: Under Development
- ★ : New Product
- Non-recommended: Please contact to the sales offices.
Line-up of IGBT Modules

Matrix of IGBT Modules 1200V (No.: Number of Outline Drawing, see page 19 to 23)
## Matrix of IGBT Modules 1700V

RoHS directive (2011/65/EU) compliant

<table>
<thead>
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<th>Voltage</th>
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<td><strong>T-Series</strong></td>
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<tr>
<td>1000</td>
<td>CM1000HA-34S*</td>
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<tr>
<td>1400</td>
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</tr>
</tbody>
</table>

**Connection**

- **H**: Not connected
- **D**: Dotted connection
- **T**: Two parallel connections
- **R**: One parallel connection
- **M**: Normal connection
- **E**: End connection

* : New Product  ★ : Under Development
Line-up of IGBT Modules

01 CM75,100MX-12A
02 CM100,150,200RX-12A
03 CM300,400DX-12A
04 CM35,50,75,100MXA-24S
05 CM75TX-24S
06 CM600,1000DXL-24S
07 CM75,100TL/RL-12NF
08 CM150,200,300DY-12NF
09 CM200TL/RL-12NF
Outline Drawing of IGBT Modules

10 CM400DY-12NF
CM200DY-24NF
CM300DY-24A
CM300DY-24S
CM150,200DY-34A

11 CM600DY-12NF
CM400DY-24NF
CM400DY-24NF
CM400DY-24S
CM500DY-24A
CM600DY-24S
CM300DY-24A
CM300DY-24S
CM300DY-24NF
CM300DY-24NF
CM600DY-24NF
CM800DY-24S

12 CM600DU-24NF
CM800DU-24S

13 CM100,150DUS-12F
CM200DU-12NFH
CM100,150DU-24NFH

14 CM300,400DU-12NFH
CM200,300DU-24NFH

15 CM600DU-12NFH
CM400,600DU-24NFH

16 CM400,600HA-24A
CM500HA-34A

17 CM900,1400DUC-24S
CM1000DUC-34SA

18 CM400DY-34A

Unit: mm
Outline Drawing of IGBT Modules

Unit: mm

28 CM300, 450, 600DX-13T
CM225, 300, 450, 600DX-24T

29 CM1000DX-24T

30 CM100, 150, 200DY-13T
CM100, 150DY-24T

31 CM300, 400DY-13T
CM200, 300DY-24T

32 CM600DY-13T
CM450, 600DY-24T
CM450, 600C1Y-24T

33 CM100, 150, 200TX-13T
CM100, 150, 200TX-24T
CM100, 150TX-34T

34 CM150, 200RX-13T
CM100, 150RX-24T

35 CM400ST-24S1

36 CM500C2Y-24S
CM1400HA-24S
CM1000HA-34S
RM1400HA-24S
Optimal package internal structure realizes improved heat dissipation, and rated current as conventional products, contributing to inverter configurations and capacities.

*3 Comparison of X Series CM1200HC-66X and H Series CM1200HC-66H

RFC : Relaxed field of cathode

4. As of Apr. 5, 2018, based on Mitsubishi Electric research

3.3kV 450A/600A parallel to enable use as the gate double-sided mounting to increased power output in inverter systems
**New Products**

### X Series HVIGBT Modules

**Existing compatible package: Standard type**
Contributes to smaller, higher-capacity inverter systems by expanding lineup

<table>
<thead>
<tr>
<th>Voltage (kV)</th>
<th>Std. Type 1.7kV</th>
<th>Std. Type 3.3kV</th>
<th>Std. Type 4.5kV</th>
<th>Std. Type 6.5kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2400A/3600A</td>
<td>1200A/1800A</td>
<td>900A/1350A/1500A</td>
<td>600A/900A/1000A</td>
</tr>
</tbody>
</table>

### New common frame package: LV100/HV100 type
Class-leading current density contributes to increased power output in inverter systems

<table>
<thead>
<tr>
<th>Voltage (kV)</th>
<th>LV100 Type 1.7kV</th>
<th>LV100 Type 3.3kV</th>
<th>LV100 Type 4.5kV</th>
<th>HV100 Type 3.3kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000A/1200A</td>
<td>450A/600A</td>
<td>450A/600A</td>
<td>225A/300A</td>
</tr>
</tbody>
</table>

### Main Features
- Power loss reduced by incorporating 7th-generation IGBT and RFC*1 diode
- Industry-leading power*2 for increased inverter capacity
- External size reduced 33% while maintaining the same voltage resistance and rated current as conventional products, contributing to inverter downsizing
- Optimal package internal structure realizes improved heat dissipation, humidity resistance and flame retardance, increasing product life

*1 RFC : Relaxed field of cathode
*2 3.3kV - 6.5kV (as of Apr. 5, 2018 based on Mitsubishi Electric research)
*3 Comparison of X Series CM1200HC-66X and H Series CM1200HC-66H

### Positioning from conventional series

**H Series (CM1200HC-66H)**

**X Series (CM1200HC-66X)**

**X Series B Type (CM1200HC-66X)**

### Characteristics graph

- ON state voltage reduced approx. 40%
- Saturation voltage between collector and emitter (H Series vs. X Series)
- Thermal resistance comparison (H Series vs. X Series)

### Output current characteristics

Conditions: Tj=125℃, Voc=1800V, PF=0.85, f=50Hz, T=80℃

- Switching carrier frequency [Hz]
- Inverter output current [Amps]

**Terminal temperature rise suppressed thanks to three AC main terminals**

**Terminal height ensured to enable use as the gate driver substrate for double-sided mounting**

**Low internal inductance**

**Various current ratings for optimal system design**

- Inverter capacities
- 1 parallel: 450A, 600A, 900A, 1350A, 1800A, 2400A
- 2 parallel: 900A, 1200A, 1800A, 2400A
- 3 parallel: 1350A, 1800A, 2400A
- 4 parallel: 1800A, 2400A

Two 450A and 600A products added to the LV100 3.3kV product lineup combined with other parallel products in answer to the need of inverters with various capacities

**Package features (LV100 type)**

- Terminal layout optimized for easy paralleling
- Low internal inductance
**Series Matrix of HVIGBT/HVIPM**

<table>
<thead>
<tr>
<th>No.</th>
<th>Type Series</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>H CM400DY-50H</td>
<td>D1 B 10</td>
</tr>
<tr>
<td>250</td>
<td>H CM400DY-66H</td>
<td>D1 B 15</td>
</tr>
<tr>
<td>300</td>
<td>H CM500DG-66X**</td>
<td>D2 A 20</td>
</tr>
<tr>
<td>1200</td>
<td>H CM1200HC-34H</td>
<td>H C 06</td>
</tr>
<tr>
<td>2400</td>
<td>H CM2400HC-34H</td>
<td>H C 17</td>
</tr>
</tbody>
</table>

**Series Matrix of HVDIODE Modules**

<table>
<thead>
<tr>
<th>No.</th>
<th>Type Series</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>H CM2000DG-130H</td>
<td>H D 07</td>
</tr>
<tr>
<td>250</td>
<td>H CM2000DG-130F</td>
<td>D D 24</td>
</tr>
<tr>
<td>300</td>
<td>H CM300DG-90S</td>
<td>D D 24</td>
</tr>
<tr>
<td>1200</td>
<td>H CM1200HC-34H</td>
<td>H C 06</td>
</tr>
<tr>
<td>2400</td>
<td>H CM2400HC-34H</td>
<td>H C 17</td>
</tr>
</tbody>
</table>

**Evolution of HVIGBT Module Series**

- **H Series**
- **N Series**
- **S Series**
- **X Series**

**Type Name Definition of IGBT Modules**

- **CM 1800 H C -66 X**
  - Voltage class
  - Outline drawing and package type
  - Connection type
  - Rating current class

---

*Under Development*
Outline Drawing of HVIGBT Modules

01
CM600DY-34H
CM600E2Y-34H
CM800DZ-34H
CM800DZB-34N

02
CM1200,1600HC-34H

03
CM1200HCB-34N
CM800HB-50H,66H
CM800HC-66H

04
CM1200DB/DC-34N
CM1200DC-34S

05
CM1200E4C-34N
CM1800,2400HC-34N

06
CM1800,2400HC-34N
CM1800,2400HC-34H
CM1200HB/HC-50H,66H
CM800E4C/E6C-66H
CM900HB/HC-90H

07
CM400HG-66H
CM200HG-130H

08
CM1000HC-66R
CM800HC-90R

09
CM1200HG-66H
CM900HG-90H
CM400E2G/E4G-130H
CM600HG-130H

Unit:mm
**Outline Drawing of HVDIODE Modules**

- **CM1800HG-66X, CM900HGB-90X**
- **CM1350, 1500HG-90X**
- **CM600HGB-130X**
- **CM900HG-130X**
- **CM1000HG-130XA**

- **CM1000DA-34X**
- **CM1200DA-34X**
- **CM450DA-66X**
- **CM600DA-66X**

- **CM2400HCB, CM3600HC-34X**
- **CM1350HC-90X**
- **CM1200HCB, CM1800HC-66X**
- **CM225DE-130XA**
- **CM300DE-130XA**

**Unit:mm**

- **RM1200DB-34S**
- **RM1800HE-34S**
- **RM1200HE-66S**
- **RM600HE-90S**

- **RM400,600DY-66S**
- **RM1000,1500DC-66F**
- **RM1200DB-66S**
- **RM900DB/HC-90S**
New Products

Package with 6-in-1 connection and integrated water-cooled fin contributes to more compact, high-power inverters for EVs/HEVs

<Main Features>
- Integrated direct water-cooling structure with cooling fins and 6-in-1 connection contribute to more compact inverters for EVs/HEVs
- Direct lead bonding (DB) structure ensures high reliability
- Loss further reduced by incorporating 7th-generation IGBT built with a CSTBT™ structure
- Completely lead-free, conforms to RoHS directives (2011/65/EU)
- Suitable for a variety of electric and hybrid vehicle inverters

Structure incorporates transfer molding and original direct inductance
DLB structure reduces internal wiring resistance and inductance
- Completely Pb-free (including the pins)

Features

Common
- Long power/temperature cycle life
- High-precision on-chip temperature sensor
- High traceability in managing materials/components for each product throughout the entire production process

J Series T-PM (Transfer-molded Power Module)
- Structure incorporates transfer molding and original direct lead bonding (DLB) technique
- DLB structure reduces internal wiring resistance and inductance
- Completely Pb-free (including the pins)

J1 Series (6-in-1)
- Cooling fin integrated direct water-cooled structure and 6-in-1 configuration contribute to minimize the automobile inverter
- DLB structure realizes high reliability
- Installation of the 7th generation IGBT adapting the CSTBT™ structure realizes a further reduction in loss
- On-chip current sensor that enables high-speed current-cutoff protection is installed

Matrix of 650V Power Modules (No.: Number of outline drawing, please refer to page 30)

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Series (A)</th>
<th>J1 Series</th>
<th>650V</th>
<th>J Series</th>
<th>T-PM</th>
<th>Connection</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Power Module with pin fin</td>
<td>Connection</td>
<td>No.</td>
<td>CT300DJG060**</td>
<td>D</td>
<td>02</td>
</tr>
<tr>
<td>300</td>
<td></td>
<td>CT600CJ1A060</td>
<td>C</td>
<td>01</td>
<td>CT600DJH060**</td>
<td>D</td>
<td>03</td>
</tr>
<tr>
<td>600</td>
<td></td>
<td>CT700CJ1A060*</td>
<td>C</td>
<td>01</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>700</td>
<td></td>
<td>CT1000CJ1B060*</td>
<td>C</td>
<td>04</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Connection
C: Connection
D: Connection

Matrix of 1200V Power Modules (No.: Number of Outline Drawing, please refer to page 30)

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Series (A)</th>
<th>1200V</th>
<th>J1 Series</th>
<th>Connection</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td></td>
<td>CT300CJ1A120**</td>
<td>C</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td></td>
<td>CT600CJ1B120*</td>
<td>C</td>
<td>04</td>
<td></td>
</tr>
</tbody>
</table>

Connection
C: Connection

Type Name Definition of Power Modules for Electric and Hybrid Vehicles

CT 600 C J1B 120
- Voltage class
- Series name and structure
- Connection type
- Rating current class
- CT: IGBT

★: New Product ★★: Under Development
■ Outline Drawing of Power Modules for Electric and Hybrid Vehicles

01 CT600CJ1A060
   CT700CJ1A060
   CT300CJ1A120

02 CT300DJG060

03 CT600DJH060

04 CT1000CJ1B060
   CT600CJ1B120

Unit: mm