# Chapter 1

## Features

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GBT-IPMs Characteristics

An intelligent power module (IPM) has the following characteristics when compared with a combination of IGBT modules and drive circuits.

1.1 Built-in drive circuit
- IGBT gate drives operate under optimal conditions.
- Since the wiring length between the internal drive circuit and IGBT is short and the impedance of the drive circuit is low, no reverse bias DC source is required.
- The R-series IPM (R-IPM) devices require four control power sources, one source on the lower arm side, and three individual sources on the upper arm side with proper circuit isolation.

1.2 Built-in protection circuits
- The following built-in protection circuits are included in the R-IPM devices:
  (OC): Overcurrent protection
  (SC): Short-circuit protection
  (UV): Undervoltage protection for control power source
  (OH): Overheating protection
  (ALM): External alarm output
- The OC and SC protection circuits provide protection against IGBT damage caused by overcurrent or load short-circuits. These circuits monitor the collector current using detection elements incorporated in each IGBT and thus can minimize the possibility of severe damage to the IGBT. They also protect against arm short-circuits.\(^1\)
- The UV protection circuit is in all of the IGBT drive circuits. This circuit monitors the Vcc supply voltage level against the IGBT drive Vin.
- The OH protection circuit protects the IGBT and FWD from overheating. It also monitors the insulating substrate’s temperature with temperature detection elements installed on the insulating substrates inside the IPM.
  (Case temperature overheating protection: TcOH)\(^2\)
• Additionally, each IGBT chip contains a temperature detection element on the IGBT die, which allows the OH to act rapidly when abnormally high chip temperatures are detected. (Junction temperature overheating protection: TjOH)

• The ALM circuit outputs an alarm signal to outside of the IPM, making it possible to shutdown the system reliably by outputting the alarm signal to the microcontroller which controls IPM when the circuit detects an abnormal condition (specified above).[^2]

[^1]: The N-line shunt resistance method is used for overcurrent detection of small-capacity types.

[^2]: Refer to Chapter 3 “Description of Functions” for the protective functions of each IPM.

1.3 Built-in brake circuit (7 in 1 IPM)

• For a motor control inverter application, a brake circuit can be built to protect bus overvoltage by just adding a power dissipating resistor.

• The drive circuits and protection circuits are included in the brake IGBT in the same way as inverter IGBTs.
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2 IPM Characteristics by Series

2.1 R-IPM, R-IPM3 series

2.1.1 Small-capacity types

A lineup of small-capacity types with 15 to 30 A for 600 V systems and 15 A for 1200 V systems is available. (P617, P619 package)

- P617 package products are a type without a copper base, while P619 package products are a type with a copper base, which further improves the heat radiation ability.
- The control input terminals have a standard pitch of 2.54 mm.
- The shape of the main terminals is the Faston shape, and as the height is the same as that of the control input terminals, connection by the same printed boards is possible with the soldering method as well as with the connector method.
- By improvement of the trade-off between Vce(sat) and switching loss, the total loss has been improved.
- The chip is protected from abnormal heating by IGBT chip overheating protection.

2.1.2 Medium-capacity types (alarm output only for the lower arm)

A lineup of medium-capacity types with 50 to 150 A for 600 V systems and 25 to 75 A for 1200 V systems is available. (P610, P611 package)

- The control input terminals have a standard pitch of 2.54 mm, they are arranged in one line, and connection is possible with one connector for general use. A guide pin makes insertion of the connector for the printed board easy.
- The main power source inputs (P, N), the brake output (B), and the output terminals (U, V, W) are arranged close to each other, and the main wiring is a simple package construction.
- As the main terminals are M5 screws, large currents can be connected securely.
- The screw diameter for connection to the heat sink is M5, the same as for the main terminals.
- As all electrical connections are made by screws or connectors, soldering is not required and removal is easy.
- By improvement of the trade-off between Vce(sat) and switching loss, the total loss has been improved.
- The chip is protected from abnormal heating by IGBT chip overheating protection. *3

*3 There is no alarm output from the upper arm side.

2.1.3 Medium-capacity types (with upper arm alarm output function)

A lineup of medium-capacity types with 50 to 150 A for 600 V systems and 25 to 75 A for 1200 V systems is available. (P621 package)

- OC, SC, UV, and TjOH alarm signals can be output from the upper arm. This allows secure protection against trouble from ground faults, etc. *4
- As the main terminals are M5 screws, large currents can be connected securely.
- The screw diameter for connection to the heat sink is M5, the same as for the main terminals.
• As all electrical connections are made by screws or connectors, soldering is not required and removal is easy.
• By improvement of the trade-off between $V_{ce(sat)}$ and switching loss, the total loss has been improved.
• The chip is protected from abnormal heating by IGBT chip overheating protection.

*4 The $T_{cOH}$ alarm is output only from the lower arm.

2.1.4 Large-capacity types (alarm output only for the lower arm)

A lineup of large-capacity types with 200 to 300 A for 600 V systems and 100 to 150 A for 1200 V systems is available. (P612 package)

• The layout of the control input terminals is the same as for the medium-capacity standard package, and correspondence is possible with one connector type.
• The main power source inputs (P, N), the brake output (B), and the output terminals (U, V, W) are arranged close to each other, and the main wiring is a simple package construction.
• As the main terminals are M5 screws, large currents can be connected securely.
• The screw diameter for connection to the heat sink is M5, the same as for the main terminals.
• As all electrical connections are made by screws or connectors, soldering is not required and removal is easy.
• By improvement of the trade-off between $V_{ce(sat)}$ and switching loss, the total loss has been improved.
• The chip is protected from abnormal heating by IGBT chip overheating protection.

*5 There is no alarm output from the upper arm side.

2.2 Econo IPM series

The Econo IPM series is a lineup with 50 to 150 A for 600 V systems and 25 to 75 A for 1200 V systems. (P622 package)

• In comparison with the medium-capacity types, the mounting area has been reduced by approximately 30% and the mass has been reduced by approximately 40%, contributing to reduction of the device size.
• As the height is the same as that of Econo DIMs (Econo Diode Modules), connection is possible with the same printed circuit boards.
• OC, SC, UV, and $T_{J OH}$ alarm signals can be output from the upper arm. This makes secure protection against trouble from ground faults etc. possible.
• The chip is protected from abnormal heating by IGBT chip overheating protection.
### Definition of Type Name and Lot No.

**Type name**

- **Additional model number (if necessary)**
- **Voltage rating**
  - 060: 600 V
  - 120: 1200 V
- **Additional number of series**
- **Series name**
  - R: R-IPM
  - RT: R-IPM3
  - TE: Econo IPM
- **Inverter IGBT current rating**
  - 50: 50 A
- **Indicates IGBT-IPM**
- **Number of main elements**
  - 7-chip circuit with built-in brake
  - 6-chip circuit without dynamic brake

**Lot No.**

- **Additional number (01 to 99)**
- **Month of production**
  - 1: Jan.
  - 9: Sep.
  - 0: Oct.
  - N: Nov.
  - D: Dec.
- **Year of production**
  - 4: 2004
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## 4 Lineup

### 600 V system, 15 to 75 A

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5 Outline Drawings

Fig. 1-1  Outline Drawing (P617)

Type name: 6MBP15RH060, 6MBP20RH060, 6MBP30RH060
Fig. 1-2  Outline Drawing (P619)

Type name: 6MBP20RTA060, 6MBP15RA120
Fig. 1-3  Outline Drawing (P610)

Type name: 6MBP50RA060, 6MBP75RA060, 6MBP50RTB060, 6MBP75RTB060, 6MBP25RA120

7MBP50RA060, 7MBP75RA060, 7MBP50RTB060, 7MBP75RTB060, 7MBP25RA120
Type name: 6MBP100RA060, 6MBP150RA060, 6MBP100RTB060, 6MBP150RTB060, 6MBP50RA120, 6MBP75RA120
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Fig. 1-5  Outline Drawing (P612)

Type name: 6MBP200RA060, 6MBP300RA060, 6MBP100RA120, 6MBP150RA120
7MBP200RA060, 7MBP300RA060, 7MBP100RA120, 7MBP150RA120
**Fig. 1-6  Outline Drawing (P621)**

Type name: 6MBP50RTJ060, 6MBP75RTJ060, 6MBP100RTJ060, 6MBP150RTJ060, 6MBP25RTJ120, 6MBP50RTJ120, 6MBP75RTJ120, 7MBP50RTJ060, 7MBP75RTJ060, 7MBP100RTJ060, 7MBP150RTJ060, 7MBP25RTJ120, 7MBP50RTJ120, 7MBP75RTJ120
Fig. 1-7  Outline Drawing (P622)

Type name: 6MBP50TEA060, 6MBP75TEA060, 6MBP100TEA060, 6MBP150TEA060
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7MBP25TEA120, 7MBP50TEA120, 7MBP75TEA120
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