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# – Chapter 1 –

## Features and structure

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## 1 Features of the V-IPM

An IPM (intelligent power module) is an intelligent IGBT module combining a built-in control IC which includes a drive circuit and a protection circuit. The V-IPM (V-series IPM) has the following features:

### 1.1 VR-IGBT chip

- Trade-off characteristic between the turn-off switching energy ( $E_{\text{off}}$ ) and the saturation voltage ( $V_{\text{ce(sat)}}$ ) is improved by applying the 6th generation IGBT (V-series), so that the total loss is reduced.

### 1.2 Built-in drive circuit

- Drives the IGBT under the optimized gate control conditions.
- No negative power supply is needed since it has minimum gate impedance between the drive circuit and the IGBT devices.
- Four isolated power supply units are required: one (1) on the lower arm side, three (3) on the upper arm side.

### 1.3 Built-in protection circuit

- Overcurrent protection (OC), short-circuit protection (SC), controlled power supply under voltage protection (UV), overheat protection (TjOH) and an external alarm output (ALM) are integrated.
- OC and SC are functions to protect the IGBT against breakdown caused by an over current or a load short-circuit. Each IGBT has an on-chip current sensor which can detect the collector current of each IGBT. This feature can protect the IPM module against an over current and a short circuit that may occur in any IGBT.
- UV is the protective function that works against a drive power supply voltage drop. Every control IC has this function.
- TjOH provides a high-speed over temperature protection by using an on-chip temperature sensor.
- ALM sends an alarm signal to the outer peripheral control unit of the IPM when an OC, SC, UV and/or TjOH occur. Additionally the IPM initiates a safe soft stop of the system. \*1

\*1 See [Chapter 3 Description of functions] for details of protective functions of each IPM.

### 1.4 Built-in brake circuit (7in1 IPM)

- A brake circuit can be configured by adding an external resistor that consumes electric power during regeneration.
- The brake circuit has a drive circuit and protection circuit, same as the inverter unit.

### 1.5 RoHS compliant

- All products of the V-IPM series are compliant with the RoHS directive.

## 2 Features of the V-IPM by package

### 2.1 Low power type (P629: 6in1 with lower arm alarm output)

20 A to 50 A for 600V and 10 A to 25 A for 1200V are lined up as the low power type V-IPM.

(P629 package)

- P629 package has a copper base plate with excellent heat dissipation performance.
  - Terminal pitch of the control terminals is a standard 2.54 mm (0.1 inch).
  - Main terminals are flat type solder pin and the height is the same as the control terminals. Therefore, it enables to solder the main terminals and control terminals to the same PCB.
  - The IGBT is protected against abnormal overheating by an on-chip temperature sensor. \*1
  - Over current protection is realized by the on-chip sense IGBT current sensor. \*1
  - Compatible mounting dimensions with the R-IPM-series P619 package.
- \*1 Although the protective function is applied to the upper arm side, but no alarm output function is available for the upper arm.

### 2.2 Medium-power small-package type (P626: 6in1 with upper and lower arm alarm output)

50A to 75A for 600V and 25A to 50A for 1200V are lined up as the medium-power small-size package type.

(P626 package)

- Terminal pitch of the control input terminals is a 2.54mm (0.1inch) standard pitch.
- Main terminals are flat type solder pin and the height is the same as the control terminals. Therefore it enables the main and control terminals to be soldered to the same PCB
- The IGBT is protected against abnormal overheating by an on-chip temperature sensor
- Over current protection is realized by the on-chip sense IGBT current sensor.

### 2.3 Medium-power thinner package type (P630: 6in1 / 7in1 with upper and lower arm alarm output function)

50A to 200A for 600V and 25A to 100A for 1200V are lined up as the medium-power thinner package type. Additionally, there is a low thermal impedance type for 100A ~ 200A/600V and 50A ~ 100A/1200V.

(P630 package)

- Terminal pitch of the control input terminals is a 2.54mm (0.1inch) standard pitch that can be connected by using a general-purpose connector or by soldering. Guide pins assist insertion of a PCB to the IPM.
- Screw size for the main terminals is M4.

- The screw size for mounting to the heat sink is M4, which is the same as the main terminals.
- Solder less connection is also possible for electrical connection (main terminals and control terminals), which facilitates easy disconnection.
- The IGBT is protected against abnormal overheating by an on-chip by the on-chip temperature sensor.
- Over current protection is realized by the on-chip sense IGBT.

#### **2.4 High power type (6in1 / 7in1 with upper and lower arm alarm output function)**

200A to 400A for 600V and 100A to 200A for 1200V are lined up as the high power type

(P631 package)

- Main DC bus input terminals (P1, P2, N1, N2), brake terminal (B) and output terminals (U, V, W) are located in proximity to each other and the package structure permits easy main wiring. Terminals P1, P2 and terminals N1, N2 are electrically connected to each other respectively.
- Screw size for the main terminals is M5 which allows large current.
- The screw size for mounting to a heat sink is M5, which is the same size as the main terminals.
- Solder less electrical connection is also possible and it can realize easy disconnection.
- The IGBT is protected against abnormal overheating by an on-chip temperature sensor.
- This package has two different boss heights. The PCB height from the base of the IPM can be set to 17.0 mm or 18.5 mm by changing the boss height (See Figure 1-12).
- Over current protection is realized by the on-chip sense IGBT.
- Mounting dimensions are compatible with the R-IPM-series P612 package products (excluding control terminal positions).

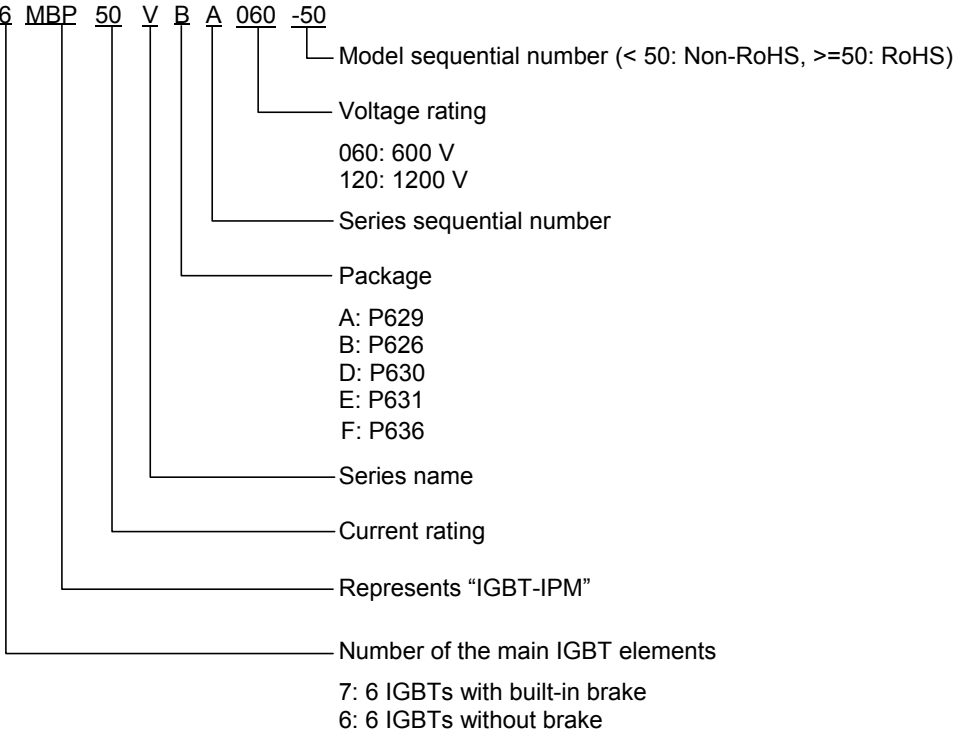
#### **2.5 Medium power small package type (6in1 / 7in1 with upper and lower arm alarm output)**

50A to 100A for 600V and 25A to 50A for 1200V are lined up as the medium power type (P636 package)

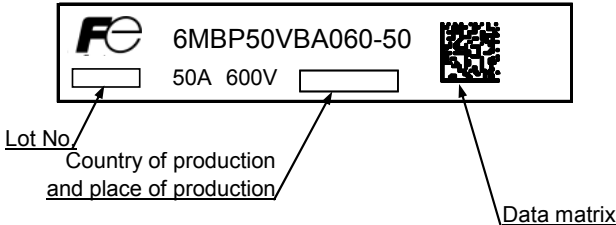
- Terminal pitch of the control input terminals is a 2.54mm (0.1inch) standard pitch.
- Main terminals are flat type solder pin and the height is the same as the control terminals.  
It enables the main and control terminals to be soldered to the same PCB
- The IGBT is protected against abnormal overheating by an on-chip temperature sensor.
- Over current protection is realized by the on-chip sense IGBT current sensor.

### 3 Description nomenclature and lot code

• Type



• Label



## 4 Line-up

### 600V Series

Package Current rating	P629	P626	P630	P631	P636
20A	6MBP20VAA060-50	-	-	-	-
30A	6MBP30VAA060-50	-	-	-	-
50A	6MBP50VAA060-50	6MBP50VBA060-50	7/6MBP50VDA060-50	-	7/6MBP50VFN060-50
75A	-	6MBP75VBA060-50	7/6MBP75VDA060-50	-	7/6MBP75VFN060-50
100A	-	-	7/6MBP100VDA060-50 7/6MBP100VDN060-50	-	7/6MBP100VFN060-50
150A	-	-	7/6MBP150VDA060-50 7/6MBP150VDN060-50	-	-
200A	-	-	7/6MBP200VDA060-50 7/6MBP200VDN060-50	7/6MBP200VEA060-50	-
300A	-	-	-	7/6MBP300VEA060-50	-
400A	-	-	-	7/6MBP400VEA060-50	-

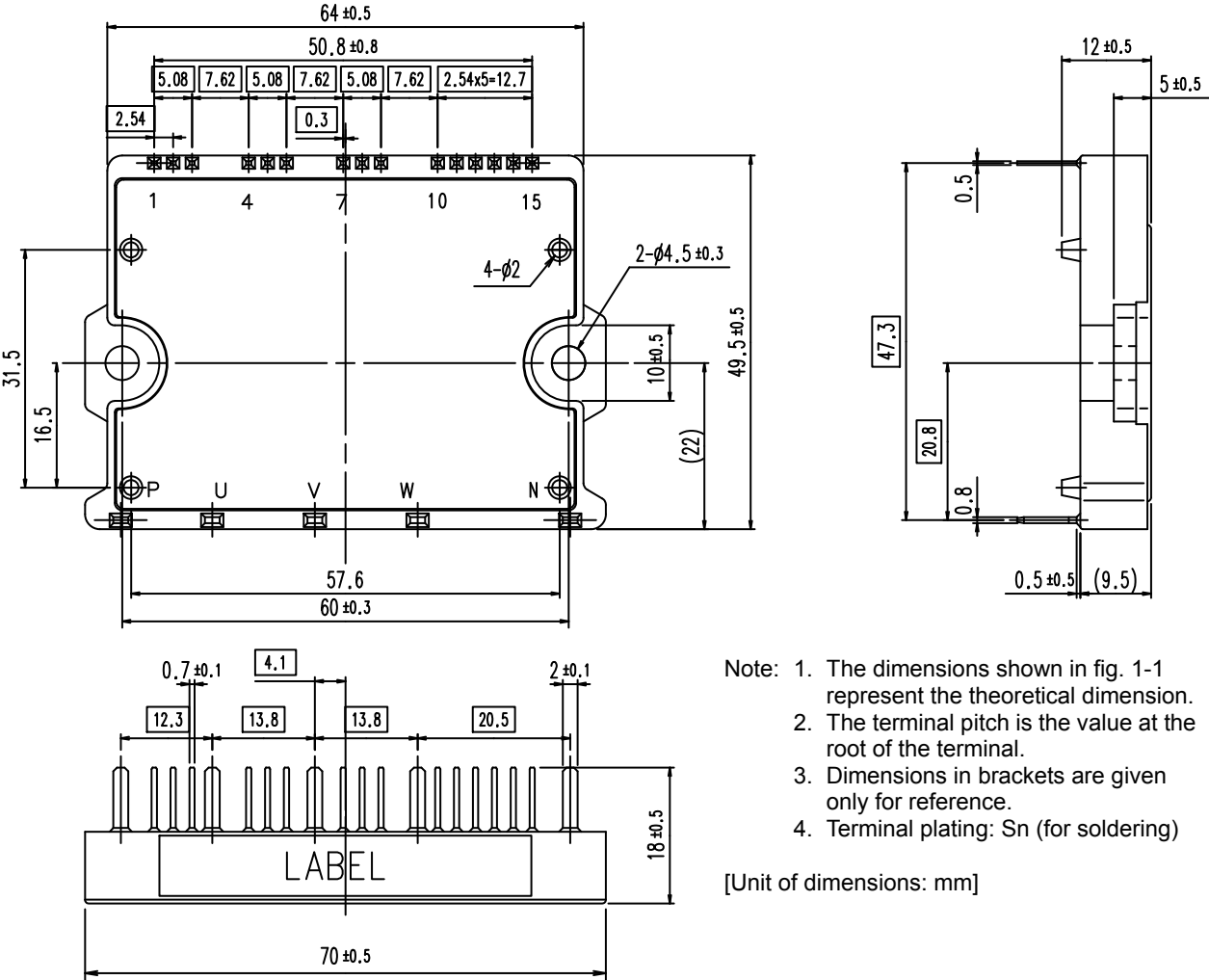
Note) 7/6MBP\*\*\*VDN060-50 is low thermal resistance version

### 1200V Series

Package Current rating	P629	P626	P630	P631	P636
10A	6MBP10VAA120-50	-	-	-	-
15A	6MBP15VAA120-50	-	-	-	-
25A	6MBP25VAA120-50	6MBP25VBA120-50	7/6MBP25VDA120-50	-	7/6MBP25VFN120-50
35A	-	6MBP35VBA120-50	7/6MBP35VDA120-50	-	7/6MBP35VFN120-50
50A	-	6MBP50VBA120-50	7/6MBP50VDA120-50 7/6MBP50VDN120-50	-	7/6MBP50VFN120-50
75A	-	-	7/6MBP75VDA120-50 7/6MBP75VDN120-50	-	-
100A	-	-	7/6MBP100VDA120-50 7/6MBP100VDN120-50	7/6MBP100VEA120-50	-
150A	-	-	-	7/6MBP150VEA120-50	-
200A	-	-	-	7/6MBP200VEA120-50	-

Note) 7/6MBP\*\*\*VDN120-50 is low thermal resistance version

5 Package outlines

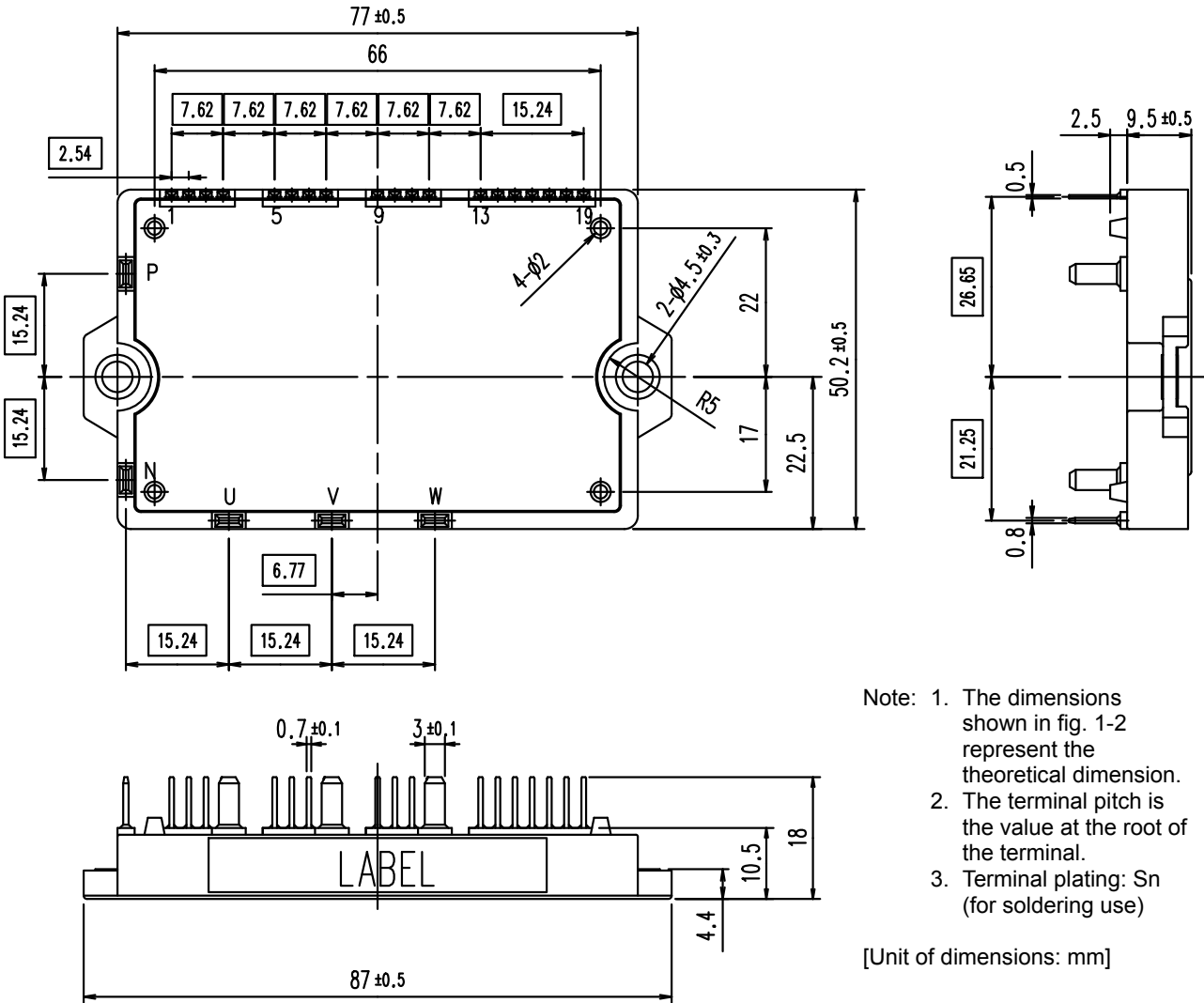


Note: 1. The dimensions shown in fig. 1-1 represent the theoretical dimension.  
2. The terminal pitch is the value at the root of the terminal.  
3. Dimensions in brackets are given only for reference.  
4. Terminal plating: Sn (for soldering)

[Unit of dimensions: mm]

Figure 1-1 Package outline drawing for P629

Target type: 6MBP20VAA060-50, 6MBP30VAA060-50, 6MBP50VAA060-50,  
6MBP10VAA120-50, 6MBP15VAA120-50, 6MBP25VAA120-50



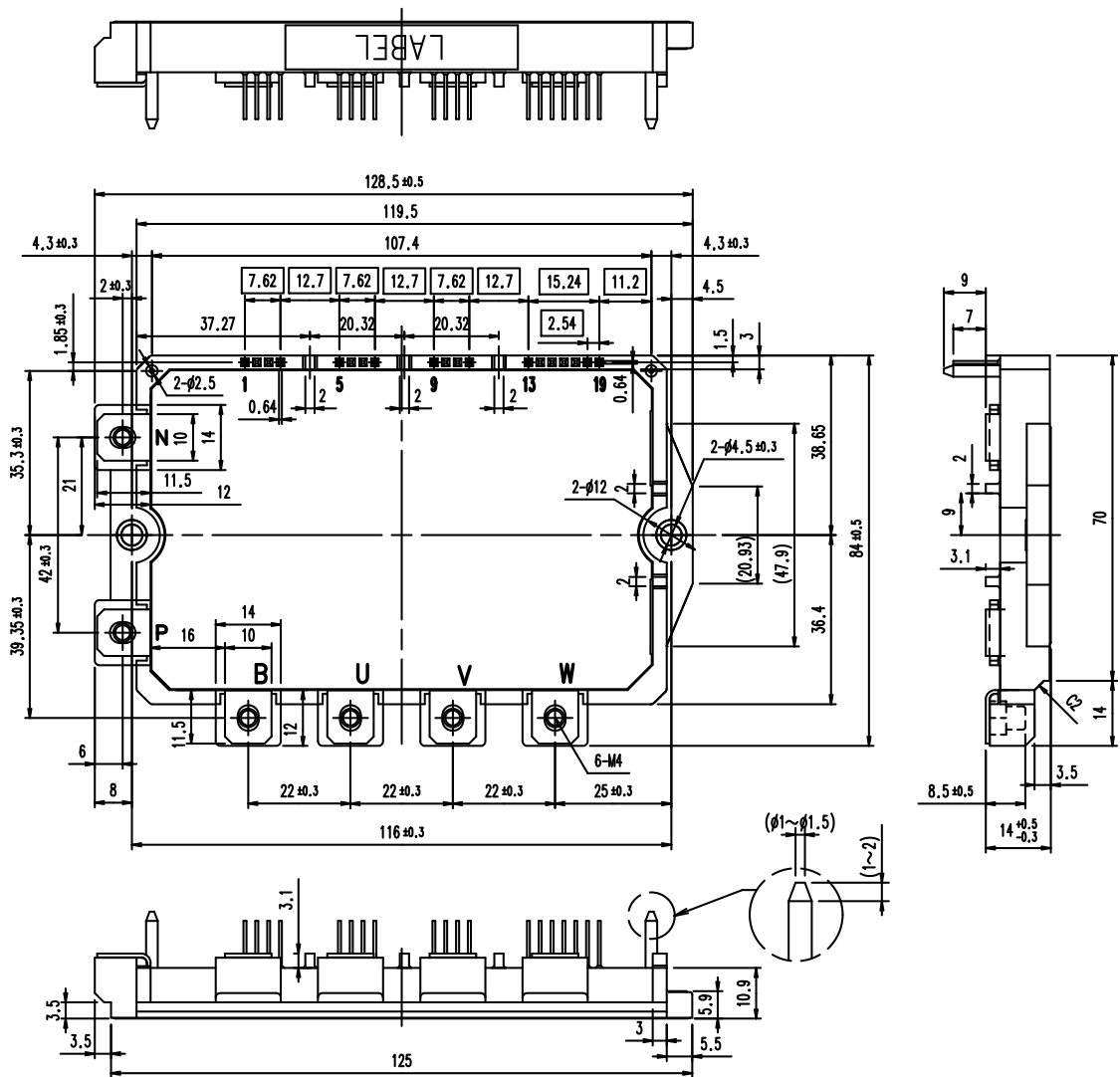
- Note: 1. The dimensions shown in fig. 1-2 represent the theoretical dimension.  
 2. The terminal pitch is the value at the root of the terminal.  
 3. Terminal plating: Sn (for soldering use)

[Unit of dimensions: mm]

Figure 1-2 Package outline drawing for P626

Target type: 6MBP50VBA060-50, 6MBP75VBA060-50,  
 6MBP25VBA120-50, 6MBP35VBA120-50, 6MBP50VBA120-50





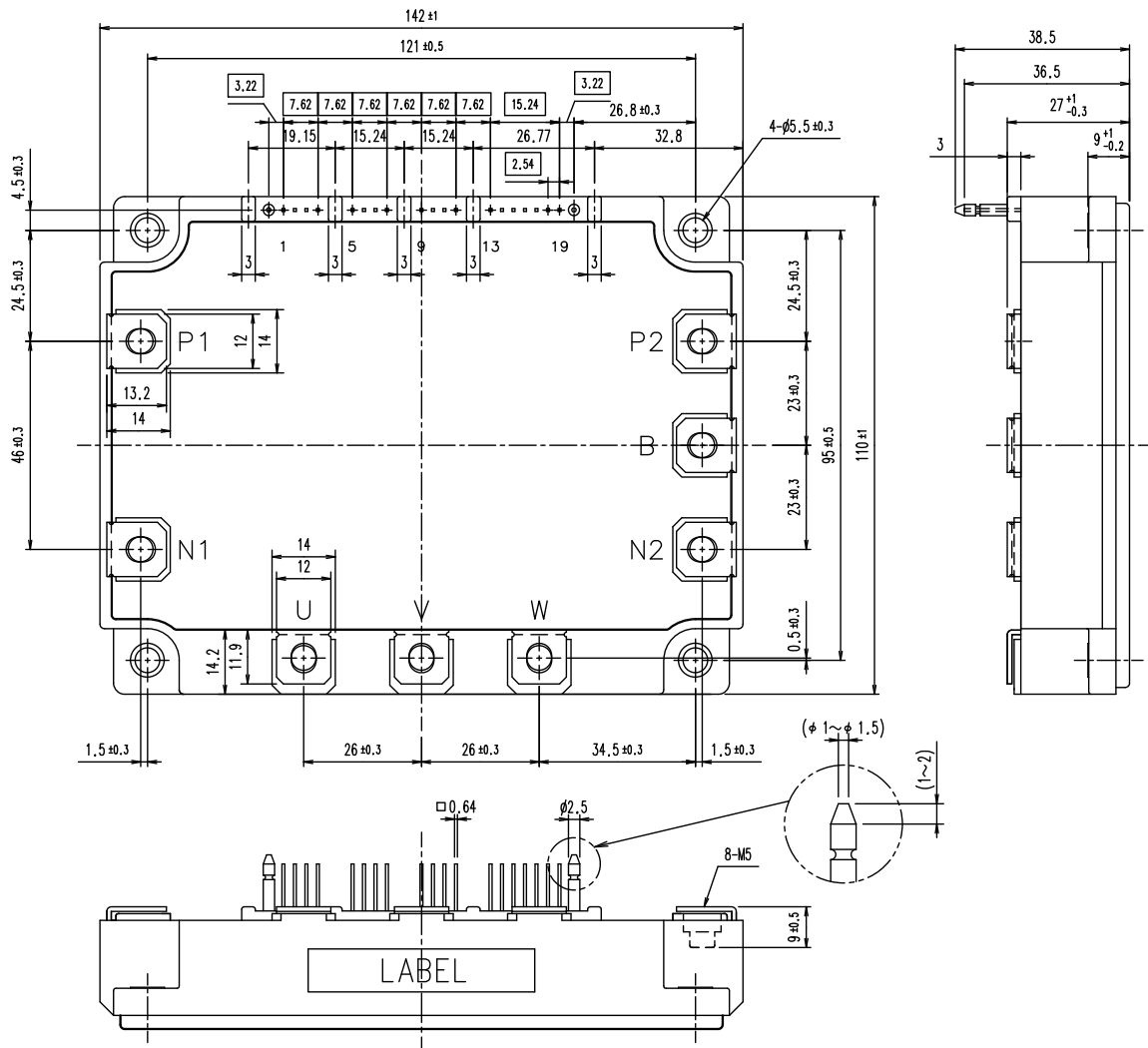
- Note: 1. The dimensions shown in fig. 1-3 represent the theoretical dimension.  
 2. The terminal pitch is the value at the root of the terminal.  
 3. Dimensions given in brackets are for reference.  
 4. Main terminal plating: Ni  
 Control terminal plating: Ni plating on the ground, Au plating on the surface.  
 (for connector and soldering use)  
 5. The guide pins located on both sides of a control terminal are made of brass.  
 (They are insulated internally and are not connected to any object.)

[Unit of dimensions: mm]

Figure 1-3 Package outline drawing for P630

Target type:

7/6MBP50VDA060-50, 7/6MBP75VDA060-50, 7/6MBP100VDA060-50, 7/6MBP100VDN060-50, 7/6MBP150VDA060-50,  
 7/6MBP150VDN060-50, 7/6MBP200VDA060-50, 7/6MBP200VDN060-50, 7/6MBP25VDA120-50, 7/6MBP35VDA120-50,  
 7/6MBP50VDA120-50, 7/6MBP50VDN120-50, 7/6MBP75VDA120-50, 7/6MBP75VDN120-50, 7/6MBP100VDA120-50,  
 7/6MBP100VDN120-50

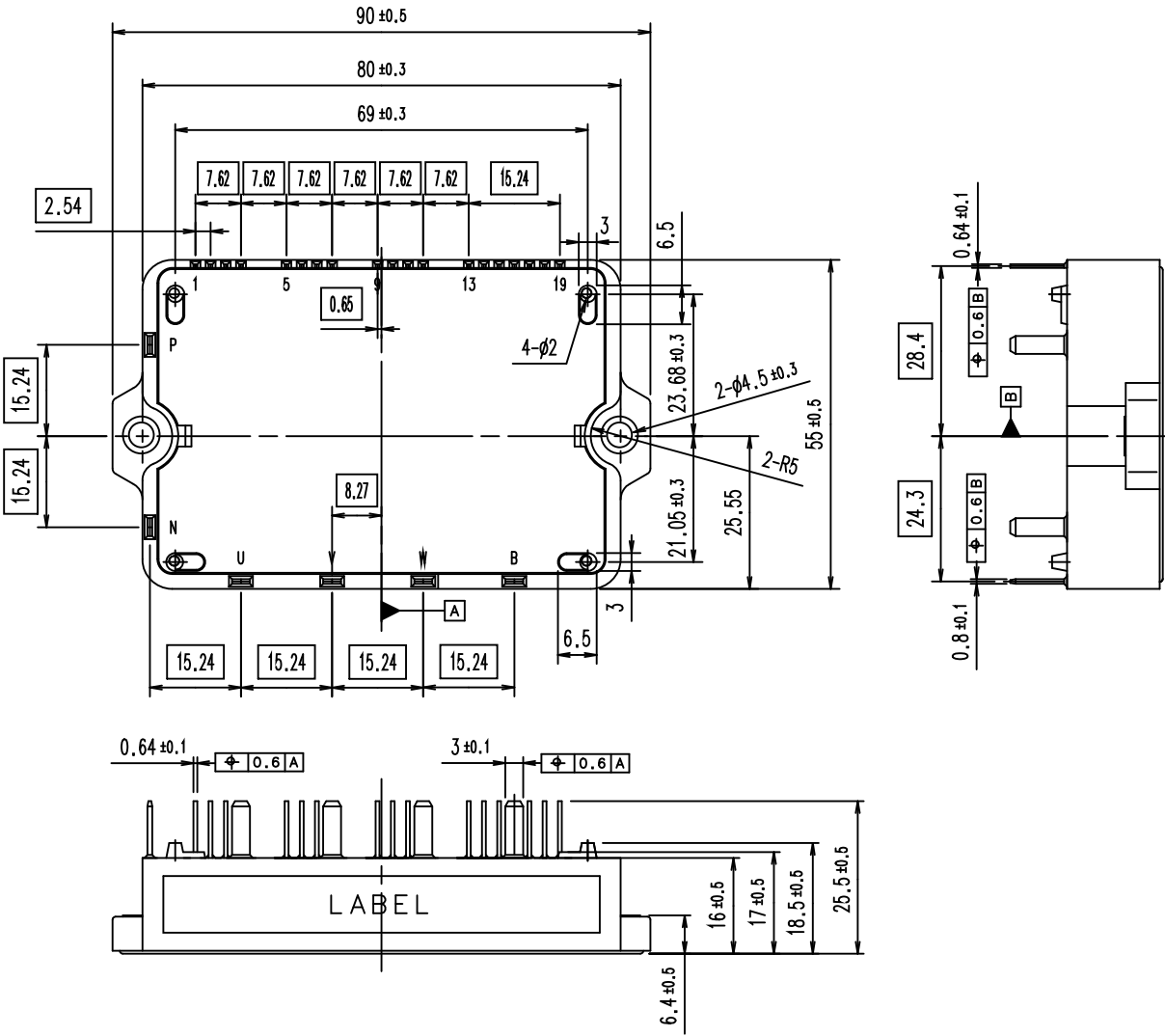


- Note: 1. The dimensions shown in fig. 1-4 represent the theoretical dimension.  
 2. The terminal pitch is the dimension measured at the root.  
 3. Dimensions given in brackets are for reference only.  
 4. Main terminal plating: Ni  
 Control terminal plating: Ni plating on the ground, Au plating on the surface.  
 (for connector reflow soldering use)  
 5. The guide pins located on both sides of a control terminal are made of brass.  
 (They are insulated internally and are not connected to any object.)

[Unit of dimensions: mm]

Figure 1-4 Package outline drawing for P631

Target type: 7/6MBP200VEA060-50, 7/6MBP300VEA060-50, 7/6MBP400VEA060-50,  
 7/6MBP100VEA120-50, 7/6MBP150VEA120-50, 7/6MBP200VEA120-50



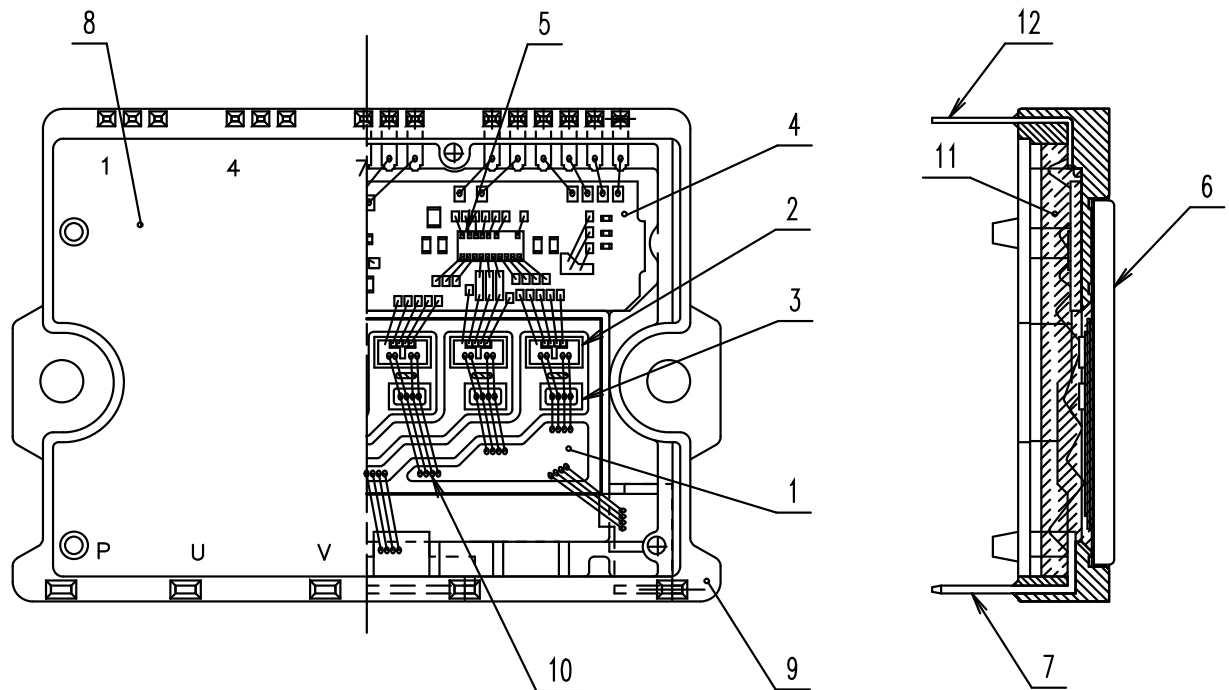
Note: 1. The dimensions shown in fig. 1-5 represent the theoretical dimension.  
 2. The terminal pitch is the value at the root of the terminal.  
 3. Terminal plating: Sn (for soldering use)

[Unit of dimensions: mm]

Figure 1-5 Package outline drawing for P636

Target type: 7/6MBP50VFN060-50, 7/6MBP75VFN060-50, 7/6MBP100VFN060-50,  
 7/6MBP25VFN120-50, 7/6MBP35VFN120-50, 7/6MBP50VFN120-50

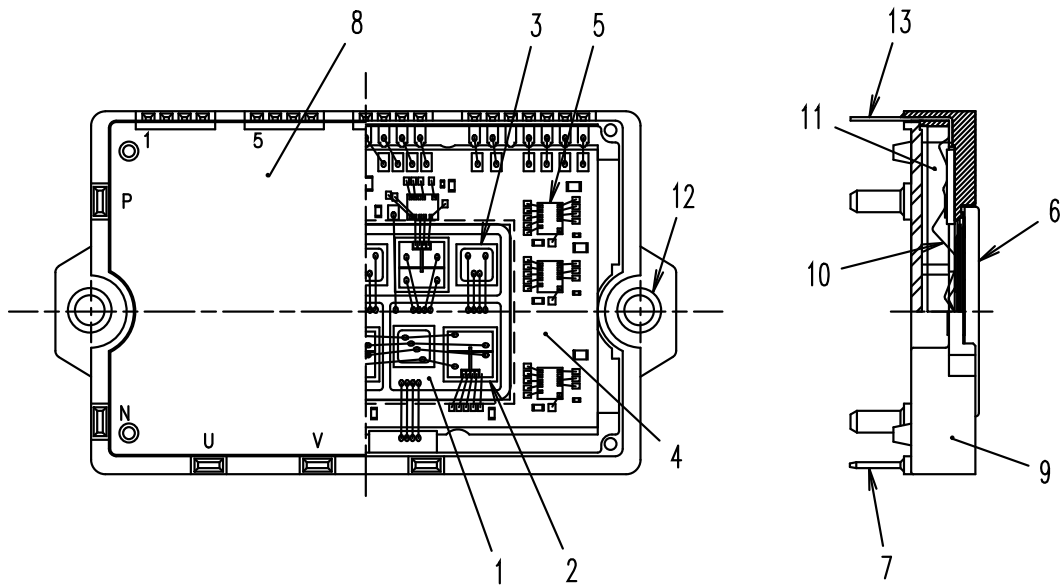
## 6 Structure



\* This drawing is prepared for explanation of the material. It does not represent accurate chip size or layout.

No.	Component	Material (main)	Remarks
1	Isolation substrate	Ceramic	
2	IGBT chip	Silicon	
3	FWD chip	Silicon	
4	Printed Circuit Board (PCB)	Glass reinforced Epoxy resin	Halogen Free
5	IC chip	Silicon	
6	Base Plate	Cu	Ni plating
7	Main Terminal	Cu	Sn plating
8	Lid	PPS resin	UL 94V-0
9	Case	PPS resin	UL 94V-0
10	Wiring	Aluminum	
11	Silicone Gel	Silicone resin	
12	Control Terminal	Brass	Sn plating

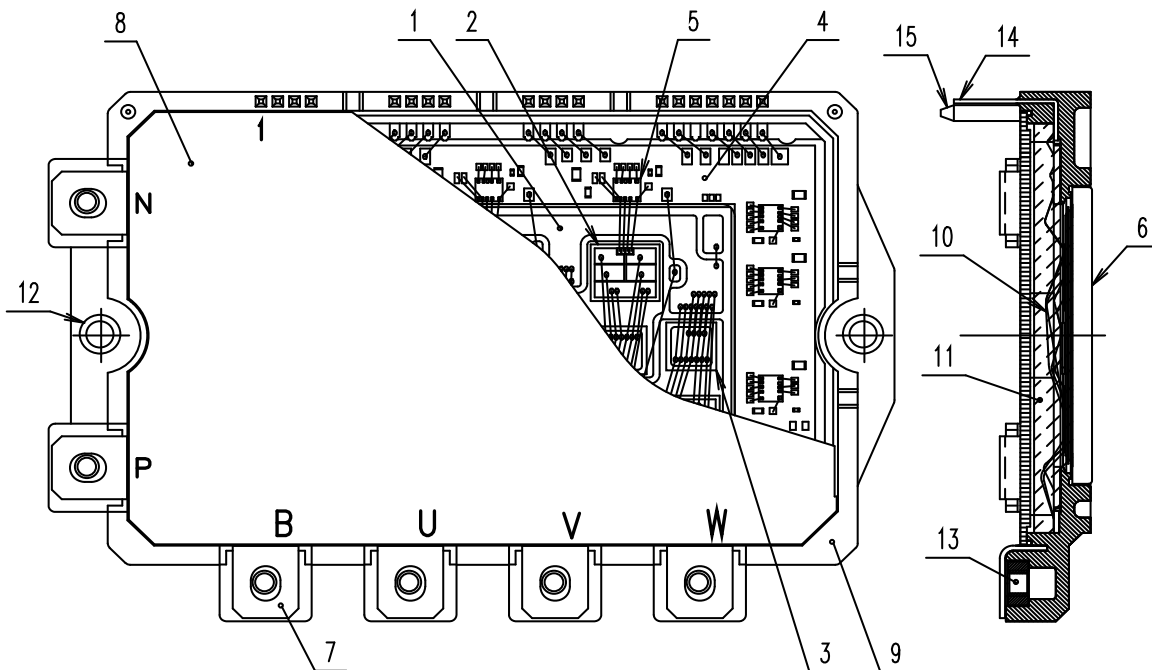
Figure 1-6 Structure and material list (P629)



\* This drawing is prepared for explanation of the material. It does not represent accurate chip size or layout.

No.	Component	Material (main)	Remarks
1	Isolation substrate	Ceramic	
2	IGBT chip	Silicon	
3	FWD chip	Silicon	
4	Printed Circuit Board (PCB)	Glass reinforced Epoxy resin	Halogen Free
5	IC chip	Silicon	
6	Base Plate	Cu	Ni plating
7	Main Terminal	Cu	Sn plating
8	Lid	PPS resin	UL 94V-0
9	Case	PPS resin	UL 94V-0
10	Wiring	Aluminum	
11	Silicone Gel	Silicone resin	
12	Ring	SUS	
13	Control Terminal	Brass	Sn plating

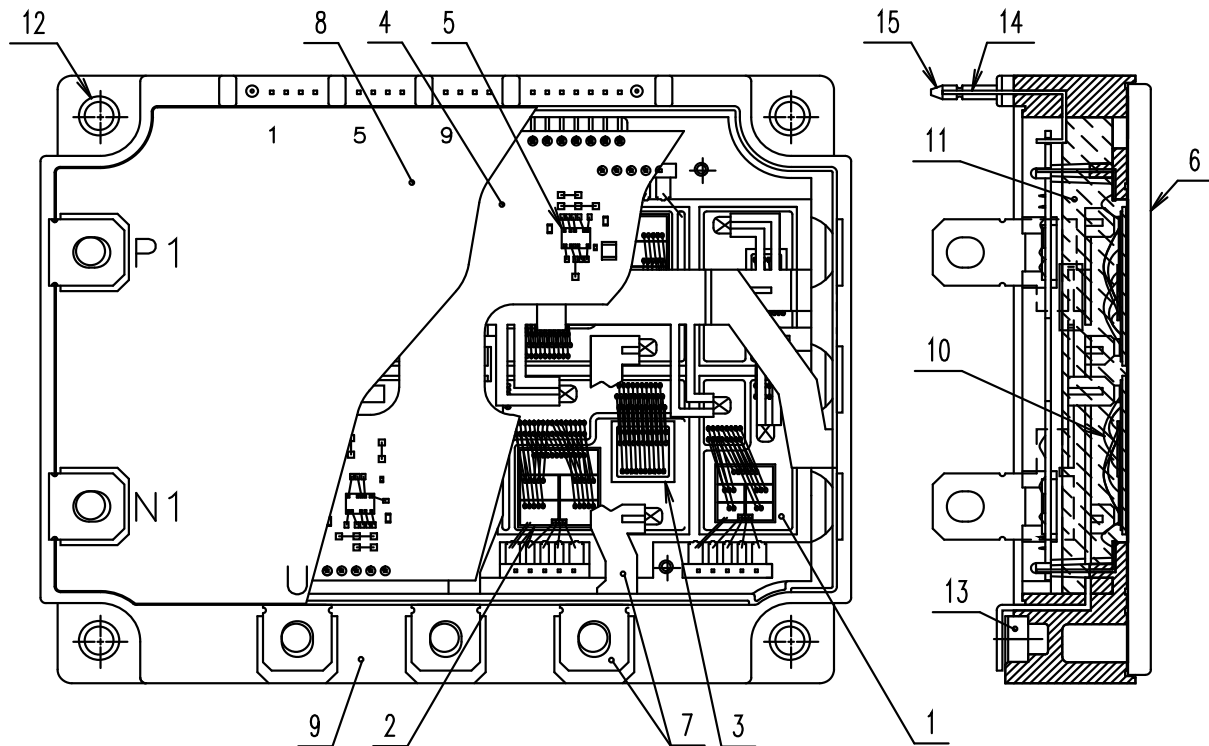
Figure 1-7 Structure and material list (P626)



\* This drawing is prepared for explanation of the material. It does not represent accurate chip size or layout.

No.	Component	Material (main)	Remarks
1	Isolation substrate	Ceramic	
2	IGBT chip	Silicon	
3	FWD chip	Silicon	
4	Printed Circuit Board (PCB)	Glass reinforced Epoxy resin	Halogen Free
5	IC chip	Silicon	
6	Base Plate	Cu	Nickel plating
7	Main Terminal	Cu	Surface: Ni plating
8	Lid	PPS resin	UL 94V-0
9	Case	PPS resin	UL 94V-0
10	Wiring	Aluminum	
11	Silicone Gel	Silicone resin	
12	Ring	SUS	
13	Nut	Fe	Trivalent chromate treatment
14	Control terminal	Brass	Au plating on Ni plating
15	Guide pin	Brass	

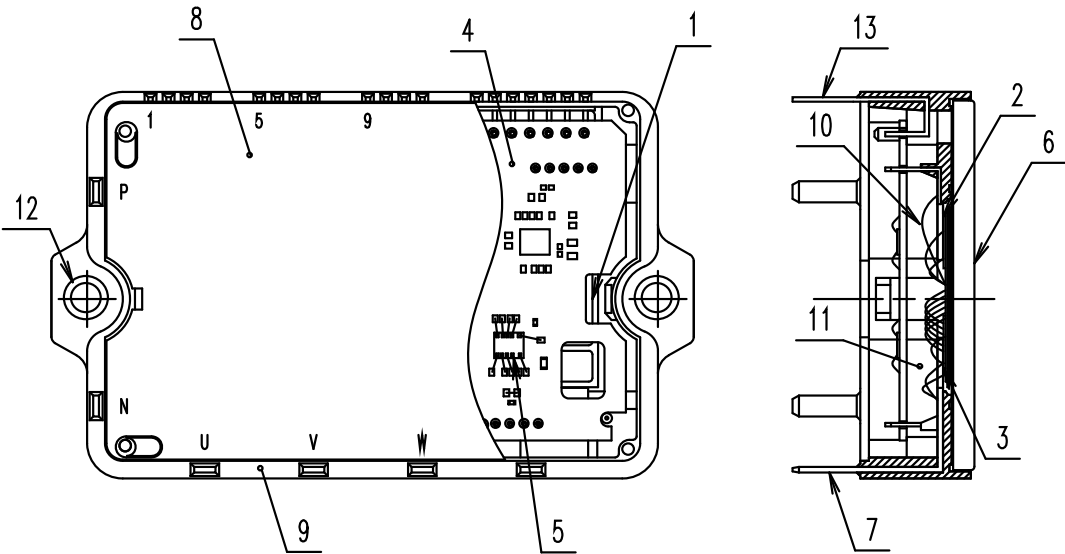
Figure 1-8 Structure and material list (P630)



\* This drawing is prepared for explanation of the material. It does not represent accurate chip size or layout.

No.	Component	Material (main)	Remarks
1	Isolation substrate	Ceramic	
2	IGBT chip	Silicon	
3	FWD chip	Silicon	
4	Printed Circuit Board (PCB)	Glass reinforced Epoxy resin	Halogen Free
5	IC chip	Silicon	
6	Base Plate	Cu	Nickel plating
7	Main Terminal	Cu	Surface: Ni plating
8	Lid	PPS resin	UL 94V-0
9	Case	PPS resin	UL 94V-0
10	Wiring	Aluminum	
11	Silicone Gel	Silicone resin	
12	Ring	SUS	
13	Nut	Fe	Trivalent chromate treatment
14	Control terminal	Brass	Au plating on Ni plating
15	Guide pin	Brass	

Figure 1-9 Structure and material list (P631)



\* This drawing is prepared for explanation of the material. It does not represent accurate chip size or layout.

No.	Component	Material (main)	Remarks
1	Isolation substrate	Ceramic	
2	IGBT chip	Silicon	
3	FWD chip	Silicon	
4	Printed Circuit Board (PCB)	Glass reinforced Epoxy resin	Halogen Free
5	IC chip	Silicon	
6	Base Plate	Cu	Ni plating
7	Main Terminal	Cu	Sn plating
8	Lid	PPS resin	UL 94V-0
9	Case	PPS resin	UL 94V-0
10	Wiring	Aluminum	
11	Silicone Gel	Silicone resin	
12	Ring	SUS	
13	Control Terminal	Brass	Sn plating

Figure 1-10 Structure and material list (P636)



- **Main terminals of IPM (screw type)**

The structure of the main terminal is shown in Figure 1-9:

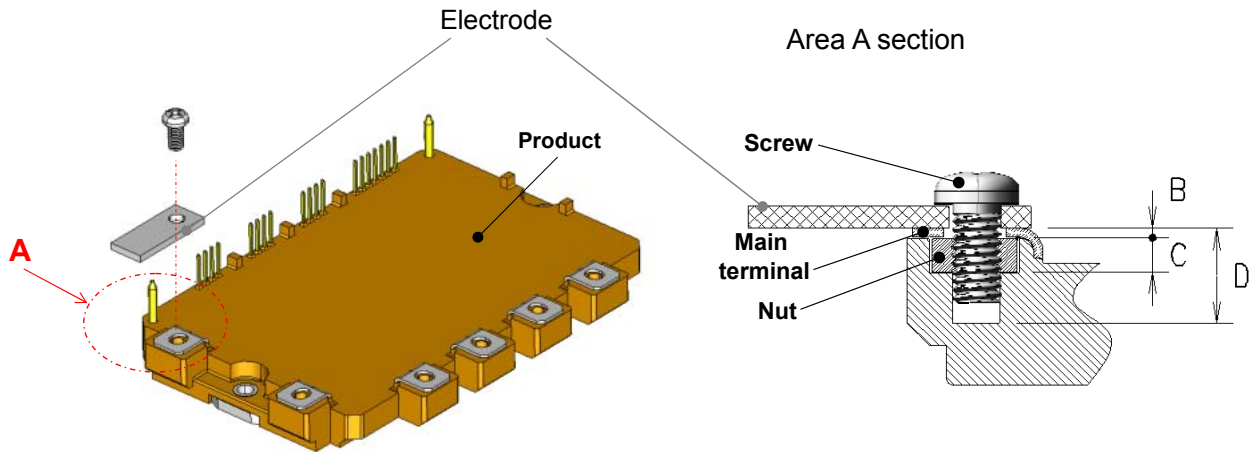


Figure 1-11 Structure of main terminal unit of the IPM (Example: P630)

Table 1-1 Specification for IPM main terminal unit

PKG	Screw standard	Terminal tab thickness (B)	Nut depth (C)	Screw hole depth (D)
P630	M4	0.8	3.5	8.5±0.5
P631	M5	1.0	4.0	9.0±0.5

(Unit: mm)

- **Guide pins of IPM**

The guide pins located on both sides of control terminal portions of P630 and P631 are made of brass. They are insulated in the interior and are not connected to any circuits.

- Height of boss on lid of P636

P636 package has two different boss heights (2.5 mm and 1.0 mm) on the lid. The PCB height can be set to 18.5 mm or 17.0 mm by changing the boss height.

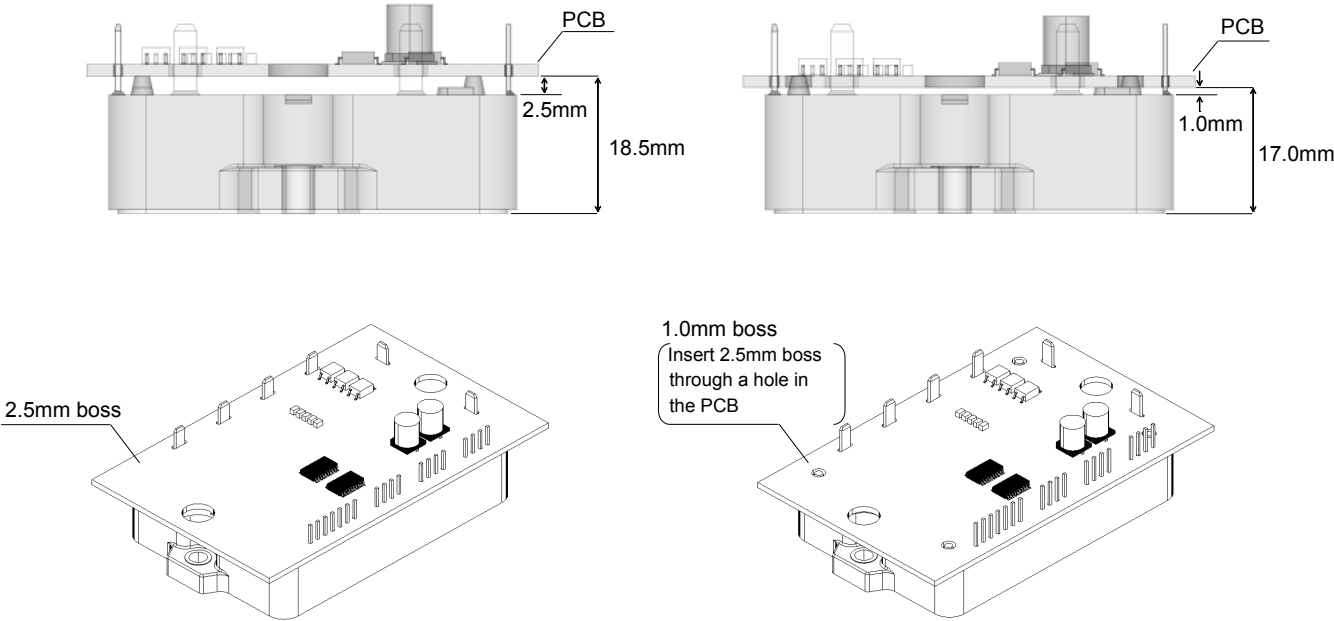


Figure 1-12 Selecting from two different boss heights