Chapter 1

Product Outline

Contents Page

1. Introduction

The objective of this note is introducing Fuji IGBT Intelligent-Power-Module "Compact Type".
At first, the product outline of this module is described.
Secondary, the terminal symbol and terminology used in this note and the specification sheet are explained. Next, the design guideline on signal input terminals and power terminals are shown using its structure and behavior. Furthermore, recommended wiring and layout, and the mount guideline are given.

Feature and functions

1.1 Built-in drive circuit

- IGBT gate drives operate under optimal conditions.
- Control IC of upper side arms are built-in the high voltage level shift circuit (HVIC).
- This IPM is possible for driven directly by the microprocessor. Of course, the upper side arm can also drive directly. Voltage level of input signal is 3.3V or 5V.
- 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.
- This IPM devices require four control power sources.
  One of power supplies is IGBT drive of the lower side arm and a power supply of control IC.
  The other three power supplies are power supplies of the IGBT drive of the upper side arm with proper circuit isolation.
  Thanks to the built-in bootstrap diodes for the power supplies of high side drive, it is needless to prepare other isolation power supplies for high side drive.

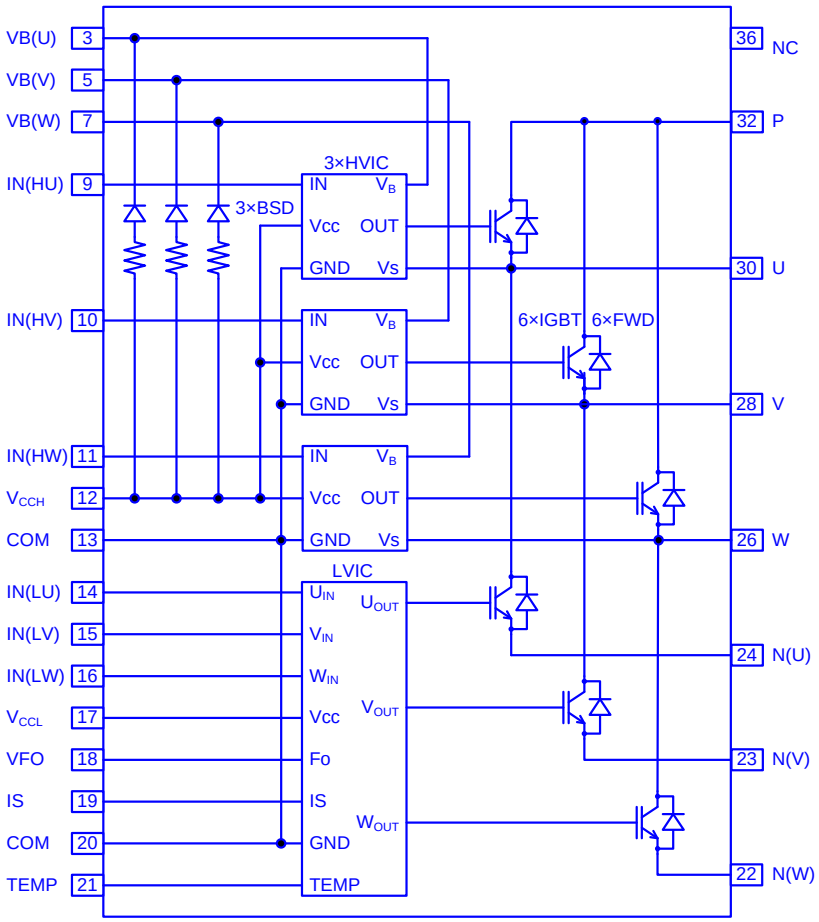


Fig.1-1 Block Diagram of Internal circuit

1.2 Built-in protection circuits

- The following built-in protection circuits are included in this IPM devices:
  (OC): Over current protection
  (UV): Under voltage protection for power supplies of control IC
  (LT): Temperature sensor output function or (OH): Overheating protection
  (FO): Fault status output

- The OC protection circuits provide protection against IGBT damage caused by over current, load short-circuits or arm short-circuits.
  These circuits monitor the emitter current using external shunt resistor in each lower side IGBT and thus can minimize the possibility of severe damage to the IGBTs.
  They also protect against arm short-circuits.
- The UV protection circuit is in all of the IGBT drive circuits.
  This circuit monitors the V_{CCH}, V_{CCL} and VB(*)[*1] supply voltage level against the IGBT drive voltage.
- The OH protection circuit protects this IPM from overheating.
  This OH protection circuit is built into control IC of a lower side arm (LVIC).
- The FO function outputs an fault signal, making it possible to shutdown the system reliably by outputting the fault signal to the micro processor unit which controls this IPM when the circuit detects abnormal conditions.

1.3 Compact

•The package of this product with an aluminum base, which further improves the heat radiation ability.
•The control input terminals have a shrink pitch of 1.778mm(70mil).
•The power terminals have a standard pitch of 2.54mm(100mil).
•By improvement of the trade-off between the Collector-Emitter saturation voltage Vce(sat) and switching loss, the total loss has been improved.

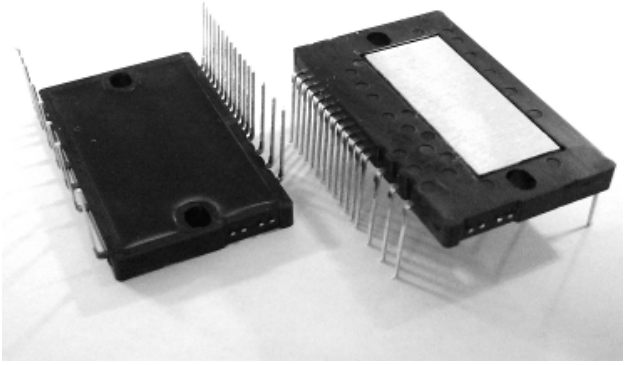


Fig.1-2 External view

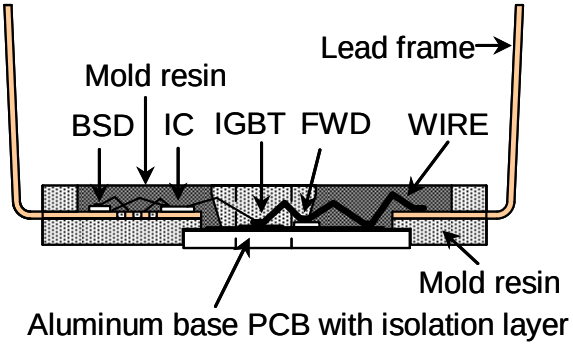


Fig.1-3 Package cross section

2. Product line-up

Table. 1-1 Line-up

Type name	Rating of IGBT		Isolation Voltage [Vrms]	Variation	Main Applications
	Voltage [V]	Current [A]			
6MBP15VRA060-50	600	15	1500Vrms Sinusoidal 60Hz, 1min. (Between shorted all terminals and case)	LT*1	Room Air Conditioner Compressor drive Heat pump applications Fan Motor drive
6MBP15VRB060-50				OH*1	
6MBP15VRC060-50				LT*1 OH*1	
6MBP15VRD060-50				LT*1	

*1 (LT): Temperature sensor output function
(OH):Overheating protection

3. Definition of Type Name and Marking Spec.

• Type Name

6 MBP 15 VR A 060 –50

- Additional model number
  50 : RoHS
- Voltage rating
  060 : 600V
- Additional number of series
  A ,D: Temperature sensor output function
  B : Case temperature overheating protection
  C: Temperature sensor out and Over heating protection
- Series name
  VR: Package type
- IGBT current rating
  15: 15A
- Indicates IGBT-IPM
- Number of transistor elements
  6 : 6-chip circuit of three phase bridge

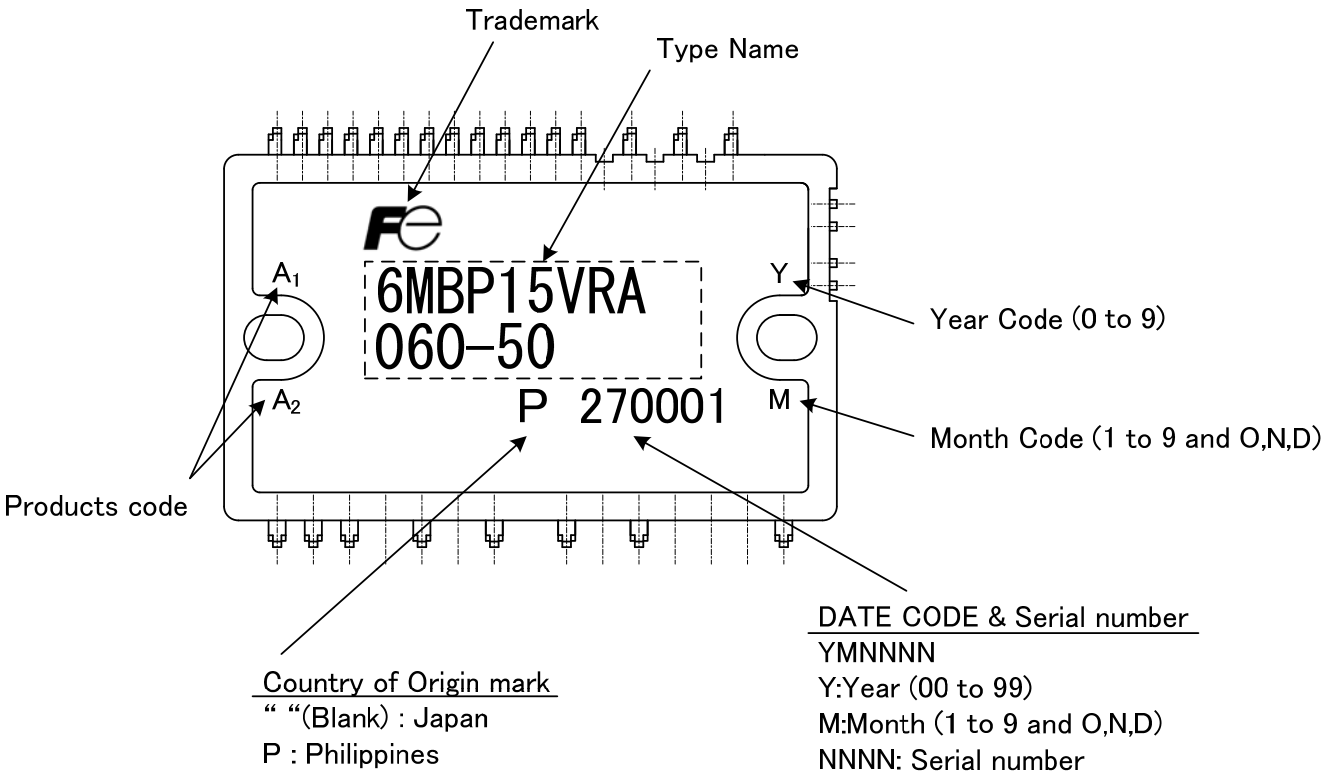
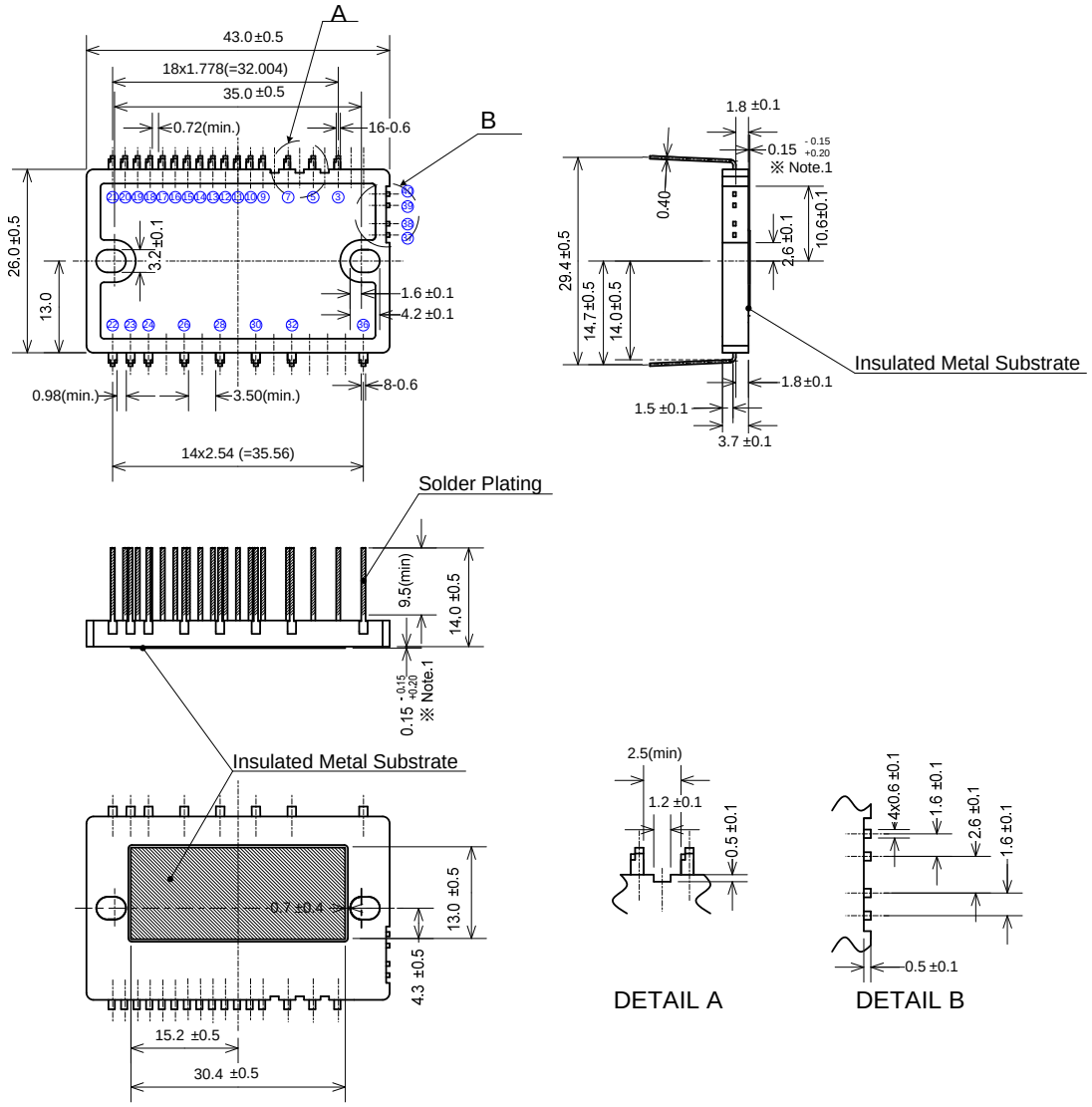


Fig.1-4 Marking Specification

4. Package outline dimensions



Note.1
The IMS (Insulated Metal Substrate) deliberately protruded from back surface of case.
It is improved of thermal conductivity between IMS and heat-sink.

Pin No.	Pin Name
3	VB(U)
5	VB(V)
7	VB(W)
9	IN(HU)
10	IN(HV)
11	IN(HW)
12	V_{CCH}
13	COM
14	IN(LU)
15	IN(LV)
16	IN(LW)
17	V_{CCL}
18	VFO
19	IS
20	COM
21	Temp

Pin No.	Pin Name
22	N(W)
23	N(V)
24	N(U)
26	W
28	V
30	U
32	P
36	NC

Fig.1-5. Case outline drawings

5. Absolute Maximum Ratings

An example of the absolute maximum ratings of 6MBP15VRA060-50 is shown in Table 1-2

Table 1-2 Absolute Maximum Ratings at Tj=25°C,Vcc=15V (unless otherwise specified)

Item	Symbol	Rating	Unit	Description
DC Bus Voltage	V_{DC}	450	V	DC voltage that can be applied between P-N(U),N(V),N(W) terminals
Bus Voltage (Surge)	$V_{DC(Surge)}$	500	V	Peak value of the surge voltage that can be applied between P-N(U),N(V),N(W) terminals in switching
Collector-Emitter Voltage	V_{CES}	600	V	Maximum collector-emitter voltage of the built-in IGBT chip and repeated peak reverse voltage of the FWD chip
Collector Current	$I_{C@25}$	15	A	Maximum collector current for the IGBT chip Tc=25 °C, Tj=150 °C
Peak Collector Current	$I_{CP@25}$	45	A	Maximum pulse collector current for the IGBT chip Tc=25 °C, Tj=150 °C
Diode Forward current	$I_{F@25}$	15	A	Maximum forward current for the FWD chip Tc=25 °C, Tj=150 °C
Peak Diode Forward current	$I_{FP@25}$	45	A	Maximum pulse forward current for the FWD chip Tc=25 °C, Tj=150 °C
Collector Power Dissipation	P_{D_IGBT}	38.5	W	Maximum power dissipation for one IGBT element at Tc=25 °C, Tj=150 °C
FWD Power Dissipation	P_{D_FWD}	20.5	W	Maximum power dissipation for one FWD element at Tc=25 °C, Tj=150 °C
Operating Junction Temperature of Inverter block	T_j	-40 ~ +150	°C	Junction temperature of the IGBT and FWD chips during continuous operation
High-side Supply Voltage	V_{CCH}	-0.5~20	V	Voltage that can be applied between COM and V_{CCH} terminal
Low-side Supply Voltage	V_{CCL}	-05~20	V	Voltage that can be applied between COM and V_{CCL} terminal
High-side Bias Supply Voltage	$V_{B(U)-COM}$ $V_{B(V)-COM}$ $V_{B(W)-COM}$	-0.5~620	V	Voltage that can be applied between VB(U) terminal and COM, VB(V) terminal and COM, VB(W) terminal and COM.
High-side Bias Voltage for IGBT gate driving	VB(U) VB(V) VB(W)	20	V	Voltage that can be applied between U terminal and VB(U) terminal , V terminal and VB(V) terminal , W terminal and VB(W) terminal.
Input Signal Voltage	V_{IN}	-0.5 ~ V_{CCH}+0.5 -0.5 ~ V_{CCL}+0.5	V	Voltage that can be applied between COM and each Vin terminal
Input Signal Current	I_{IN}	3	mA	Current that flows between COM and each Vin terminal
Fault Signal Voltage	V_{FO}	-0.5 ~ V_{CCL}+0.5	V	Voltage that can be applied between COM and VFO terminal
Fault Signal Current	I_{FO}	1	mA	Sink current that flows from VFO to COM terminal
Over Current sensing Input Voltage	V_{IS}	-0.5 ~ V_{CCL}+0.5	V	Voltage that can be applied between COM and IS terminal
Operating Junction Temperature of Control circuit block	T_j	-40 ~ +150	°C	Junction temperature of the control circuit block

Table 1-2 Absolute Maximum Ratings at Tj=25°C,Vcc=15V (Continued)

Item	Symbol	Rating	Unit	Descriptions
Operating Case Temperature	T_C	-40 ~ +125	°C	Operating case temperature (temperature of the aluminum plate directly under the IGBT or the FWD)
Storage Temperature	T_{stg}	-40 ~ +125	°C	Range of ambient temperature for storage or transportation, when there is no electrical load
Isolation Voltage	Viso	AC 1500	Vrms	Maximum effective value of the sine-wave voltage between the terminals and the heat sink, when all terminals are shorted simultaneously. (Sine wave = 60Hz / 1min)

The Collector Emitter Voltages specified in absolute maximum rating

In the absolute maximum rating, some items are specified on the collector emitter voltage of IGBTs below. In operating mode, the voltage between P and N(*) is usually applied to the one side of upper or lower side IGBT.

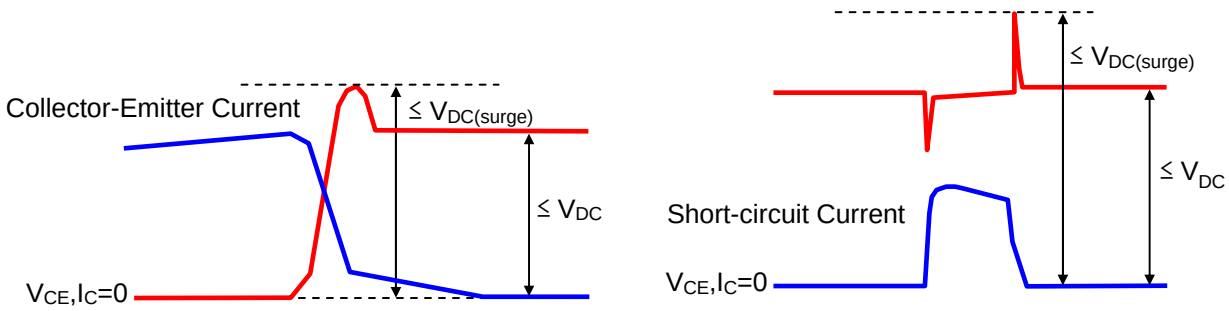
Therefore, the voltage applied between P and N(*) must not exceed absolute maximum ratings of IGBT. The Collector-Emitter voltages specified in absolute maximum rating are described in following.

N(*): N(U),N(V),N(W)

V_{CES} :Absolute Maximum rating of IGBT Collector Emitter Voltage.

V_{DC} :DC bus voltage Applied between P and N(*).

$V_{DC(Surge)}$:The total of DC bus voltage and surge voltage which generated by the wiring (or pattern) inductance from P-N(*) terminal to the bulk capacitor.



(a) In Turn-off Switching (b) In Short-circuit

Fig. 1-6 The Collector- Emitter voltages to be considered.

There are two situations to be considered like Fig. 1-6. In this Fig., $V_{DC(surge)}$ is different in the each situation. Thus, V_{DC} should be set considering these situation.
V_{CES} represents absolute maximum rating of IGBT Collector-Emitter Voltage. And $V_{DC(Surge)}$ is specified considering the margin of the surge voltage which is generated by the wiring inductance in this IPM. Furthermore, V_{DC} is specified considering the margin of the surge voltage which is generated by the wiring (or pattern) inductance from P-N(*) terminal to the bulk capacitor.