

# 6MBP50VBA060-50

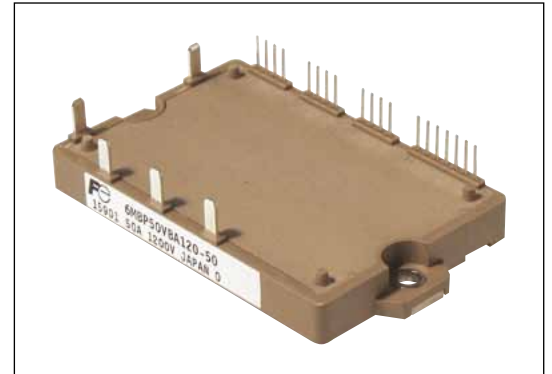
IGBT Modules

## IGBT MODULE (V series)

600V / 50A / IPM

### ■ Features

- Temperature protection provided by directly detecting the junction temperature of the IGBTs
- Low power loss and soft switching
- Compatible with existing IPM-N series packages
- High performance and high reliability IGBT with overheating protection
- Higher reliability because of a big decrease in number of parts in built-in control circuit



### ■ Maximum Ratings and Characteristics

● Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ ,  $V_{cc}=15\text{V}$  unless otherwise specified)

Items	Symbol	Min.	Max.	Units
Collector-Emitter Voltage (*1)	$V_{CES}$	0	600	V
Short Circuit Voltage	$V_{SC}$	200	400	V
Collector Current	DC	$I_c$	50	A
	1ms	$I_c$ pulse	100	A
	Duty=100% (*2)	$-I_c$	50	A
Collector Power Dissipation	1 device (*3)	$P_c$	169	W
Supply Voltage of Pre-Driver (*4)	$V_{CC}$	-0.5	20	V
Input Signal Voltage (*5)	$V_{in}$	-0.5	$V_{CC}+0.5$	V
Alarm Signal Voltage (*6)	$V_{ALM}$	-0.5	$V_{CC}$	V
Alarm Signal Current (*7)	$I_{ALM}$	-	20	mA
Junction Temperature	$T_j$	-	150	$^\circ\text{C}$
Operating Case Temperature	$T_{opr}$	-20	110	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-40	125	$^\circ\text{C}$
Solder Temperature (*8)	$T_{sol}$	-	260	$^\circ\text{C}$
Isolating Voltage (*9)	$V_{iso}$	-	AC2500	Vrms
Screw Torque	Mounting (M4)	-	1.7	Nm

Note \*1:  $V_{CES}$  shall be applied to the input voltage between terminal P-(U,V, W) and (U,V, W)-N.

Note \*2:  $Duty=125^\circ\text{C}/R_{th(j-c)D} / (I_F \times V_F \text{ Max.}) \times 100$

Note \*3:  $P_c=125^\circ\text{C}/R_{th(j-c)Q}$

Note \*4:  $V_{CC}$  shall be applied to the input voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 14 and 13.

Note \*5:  $V_{in}$  shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 16~18 and 13.

Note \*6:  $V_{ALM}$  shall be applied to the voltage between terminal No.2 and 1, 6 and 5, 10 and 9, 19 and 13.

Note \*7:  $I_{ALM}$  shall be applied to the input current to terminal No.2,6,10 and 19.

Note \*8: Immersion time  $10 \pm 1$ sec. 1time.

Note \*9: Terminal to base, 50/60Hz sine wave 1minute.

● Electrical Characteristics (T<sub>j</sub>=25°C, V<sub>cc</sub>=15V unless otherwise specified)

Items	Symbol	Conditions	Min.	Typ.	Max.	Units		
Inverter	Collector Current at off signal input	I <sub>ces</sub>	V <sub>ce</sub> =600V	-	-	1.0	mA	
	Collector-Emitter saturation voltage	V <sub>ce(sat)</sub>	I <sub>c</sub> =50A	Terminal	-	-	2.00	V
				Chip	-	1.40	-	V
	Forward voltage of FWD	V <sub>f</sub>	I <sub>f</sub> =50A	Terminal	-	-	2.30	V
Chip				-	1.80	-	V	
Switching time	t <sub>on</sub>	V <sub>dc</sub> =300V, T <sub>j</sub> =125°C	1.1	-	-	μs		
	t <sub>off</sub>	I <sub>c</sub> =50A	-	-	2.1	μs		
	t <sub>rr</sub>	V <sub>dc</sub> =300V I <sub>f</sub> =50A	-	-	0.3	μs		
Supply current of P-side pre-driver (per one unit)	I <sub>ccp</sub>	Switching Frequency= 0-15kHz	-	-	11	mA		
Supply current of N-side pre-driver	I <sub>ccn</sub>	T <sub>c</sub> =-20~110°C	-	-	34	mA		
Input signal threshold voltage	V <sub>in</sub> (on)	Vin-GND	ON	1.2	1.4	1.6	V	
	V <sub>in</sub> (off)		OFF	1.5	1.7	1.9	V	
Over Current Protection Level	I <sub>oc</sub>	T <sub>j</sub> =125°C	75	-	-	A		
Over Current Protection Delay time	t <sub>ooc</sub>	T <sub>j</sub> =125°C	-	5	-	μs		
Short Circuit Protection Delay time	t <sub>sc</sub>	T <sub>j</sub> =125°C	-	2	3	μs		
IGBT Chips Over Heating Protection Temperature Level	T <sub>joh</sub>	Surface of IGBT Chips	150	-	-	°C		
Over Heating Protection Hysteresis	T <sub>jh</sub>		-	20	-	°C		
Under Voltage Protection Level	V <sub>uv</sub>		11.0	-	12.5	V		
Under Voltage Protection Hysteresis	V <sub>h</sub>		0.2	0.5	-	V		
Alarm Signal Hold Time	t <sub>alm(oc)</sub>	ALM-GND T <sub>c</sub> =-20~110°C	V <sub>cc</sub> ≥ 10V	1.0	2.0	2.4	ms	
	t <sub>alm(uv)</sub>			2.5	4.0	4.9	ms	
	t <sub>alm(tjoh)</sub>			5.0	8.0	11.0	ms	
Resistance for current limit	R <sub>alm</sub>		960	1265	1570	Ω		

● Thermal Characteristics (T<sub>c</sub> = 25°C)

Items		Symbol	Min.	Typ.	Max.	Units
Junction to Case Thermal Resistance (*10)	Inverter	R <sub>th(j-c)Q</sub>	-	-	0.74	°C/W
	FWD	R <sub>th(j-c)D</sub>	-	-	1.27	°C/W
Case to Fin Thermal Resistance with Compound		R <sub>th(c-f)</sub>	-	0.05	-	°C/W

Note \*10: For 1device, the measurement point of the case is just under the chip.

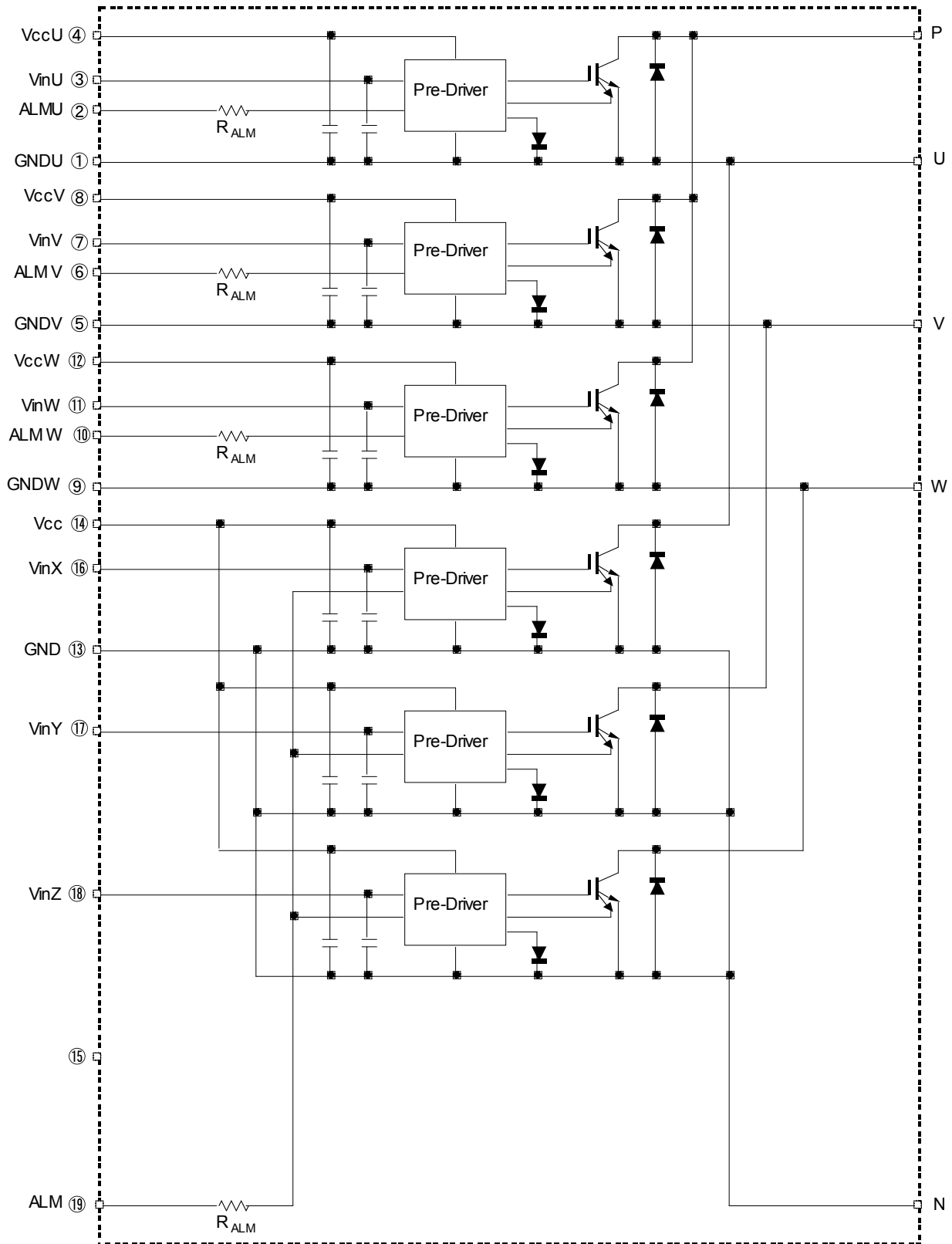
● Noise Immunity (V<sub>dc</sub>=300V, V<sub>cc</sub>=15V)

Items	Conditions	Min.	Typ.	Max.	Units
Common mode rectangular noise	Pulse width 1μs, polarity ±, 10 minute Judge : no over-current, no miss operating	±2.0	-	-	kV

● Recommended Operating Conditions

Items	Symbol	Min.	Typ.	Max.	Units
DC Bus Voltage	V <sub>dc</sub>	-	-	400	V
Power Supply Voltage of Pre-Driver	V <sub>cc</sub>	13.5	15.0	16.5	V
Arm shoot through blocking time for IPM's input signal	t <sub>dead</sub>	1.0	-	-	μs
Screw Torque (M4)	-	1.3	-	1.7	Nm

■ Block Diagram

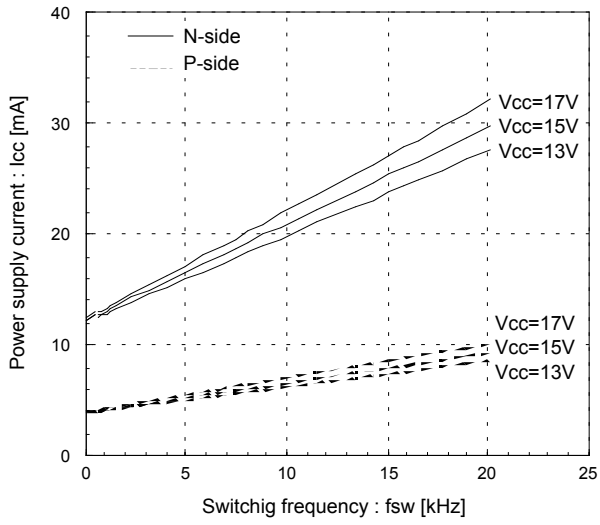


Pre-drivers include following functions

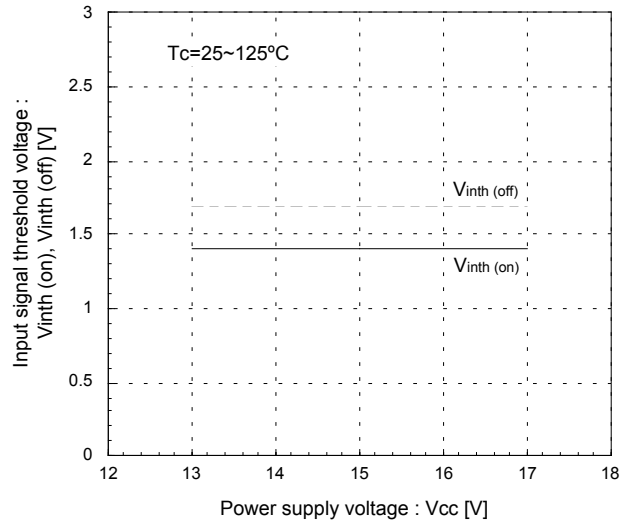
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

■ Characteristics (Representative)

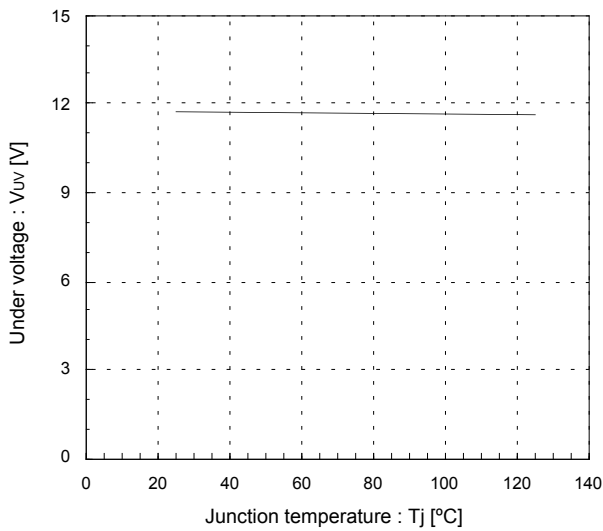
Power supply current vs. Switching frequency  
T<sub>j</sub>=25°C (typ.)



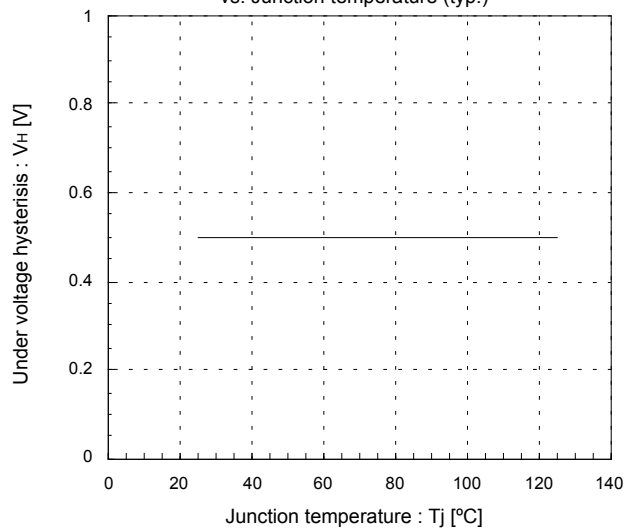
Input signal threshold voltage  
vs. Power supply voltage (typ.)



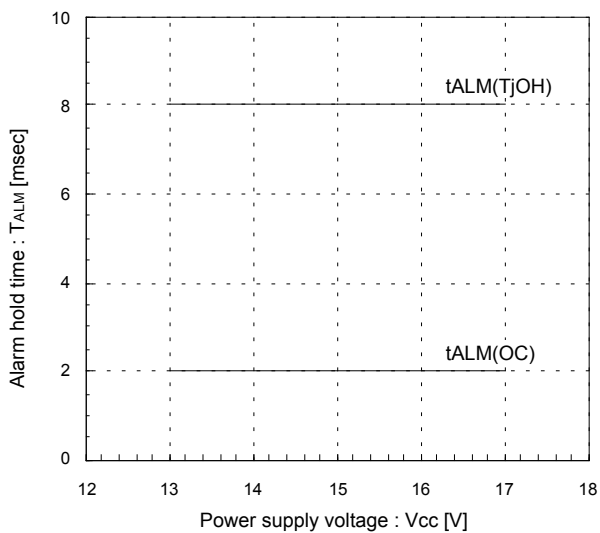
Under voltage vs. Junction temperature (typ.)



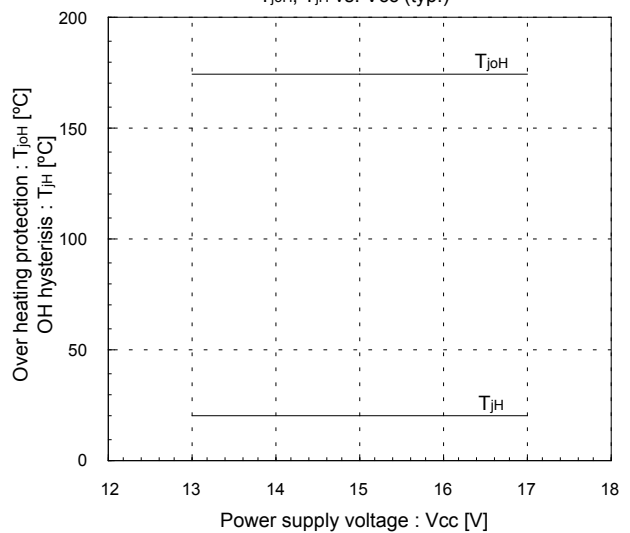
Under voltage hysteresis  
vs. Junction temperature (typ.)



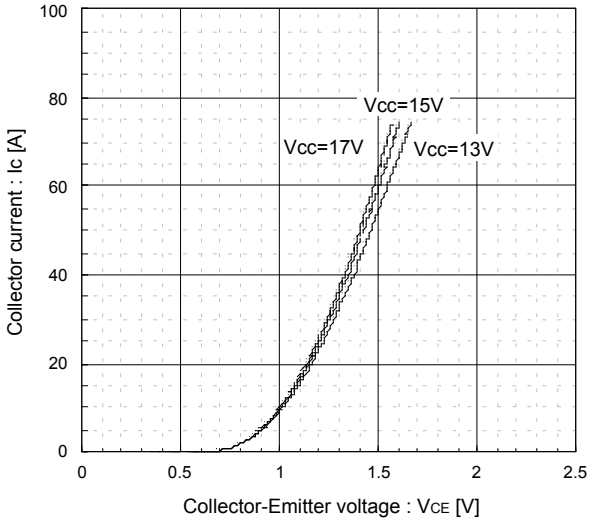
Alarm hold time vs. Power supply voltage (typ.)



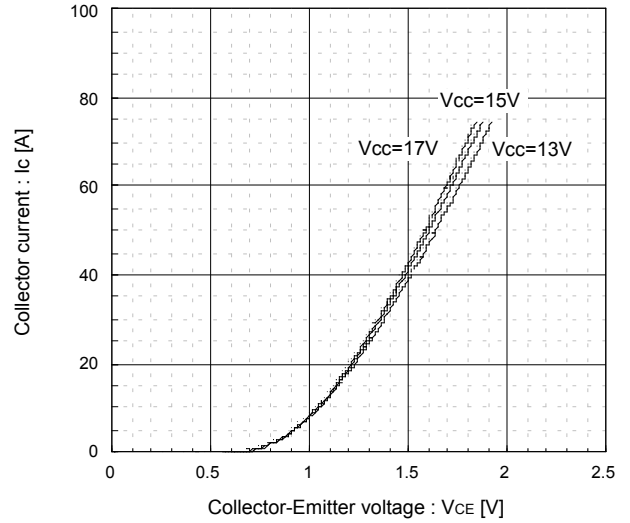
Over heating characteristics  
T<sub>joH</sub>, T<sub>jH</sub> vs. Vcc (typ.)



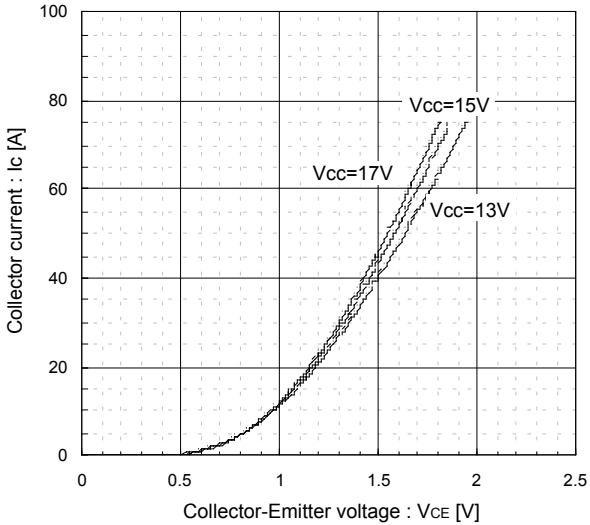
Collector current vs. collector-Emitter voltage  
T<sub>j</sub>=25°C [Chip] (typ.)



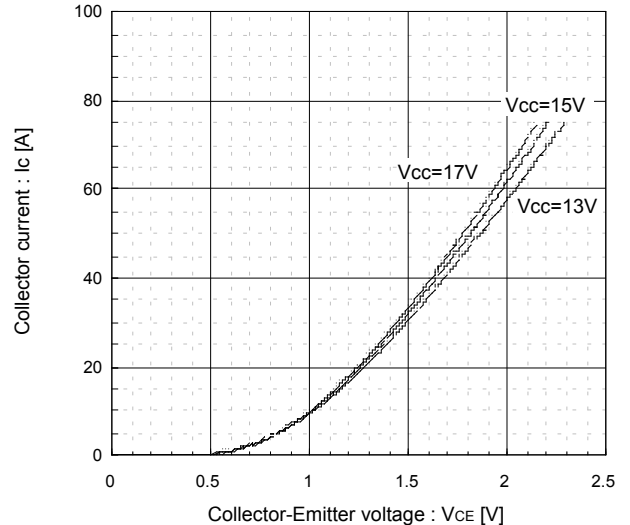
Collector current vs. collector-Emitter voltage  
T<sub>j</sub>=25°C [Terminal] (typ.)



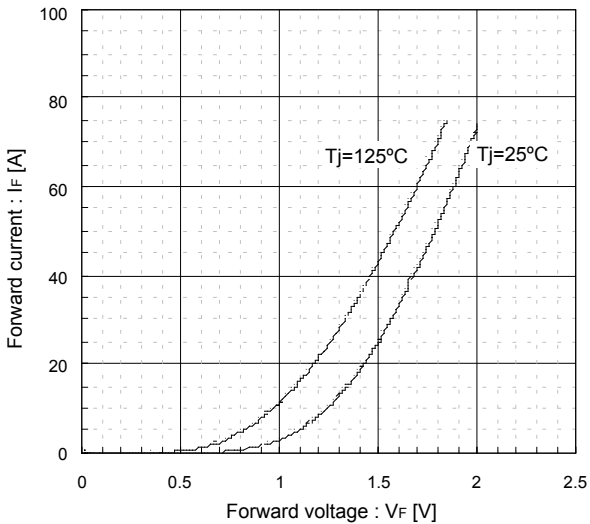
Collector current vs. collector-Emitter voltage  
T<sub>j</sub>=125°C [Chip] (typ.)



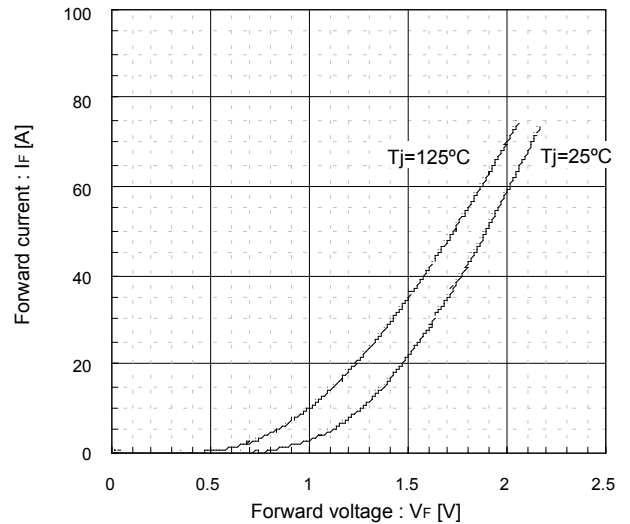
Collector current vs. collector-Emitter voltage  
T<sub>j</sub>=125°C [Terminal] (typ.)



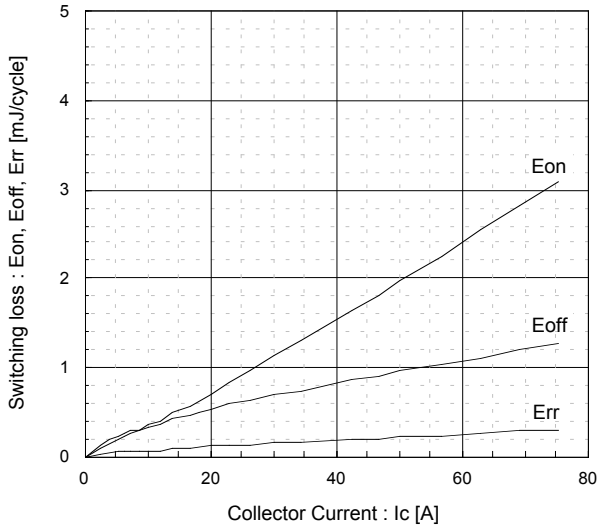
Forward current vs. Forward voltage  
[Chip] (typ.)



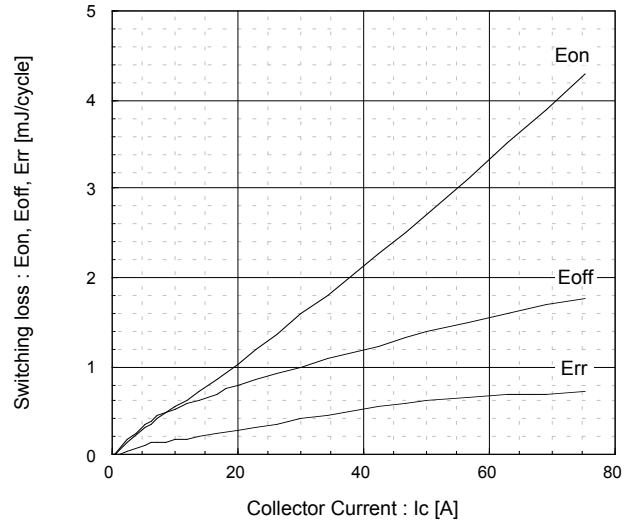
Forward current vs. Forward voltage  
[Terminal] (typ.)



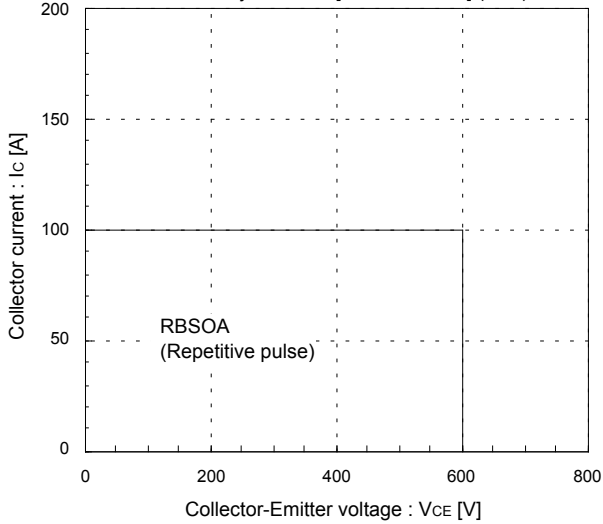
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=25^\circ C$



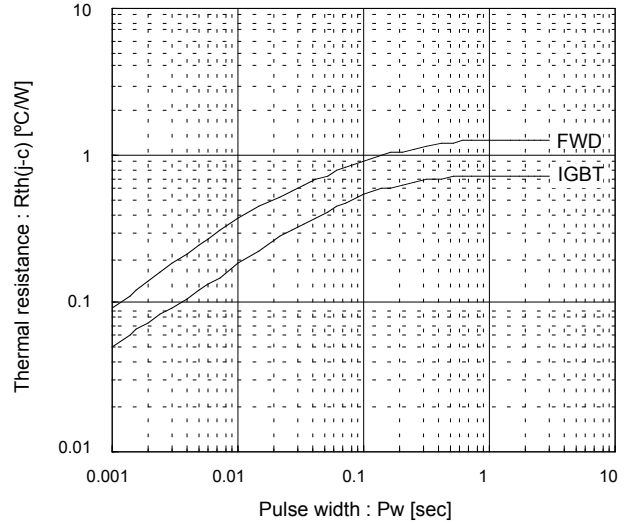
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=125^\circ C$



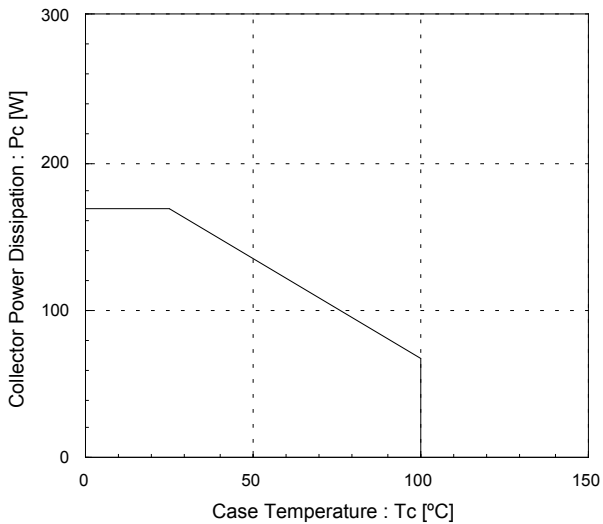
Reversed biased safe operating area  
 $V_{CC}=15V, T_J \le 125^\circ C$  [Main Terminal] (min.)



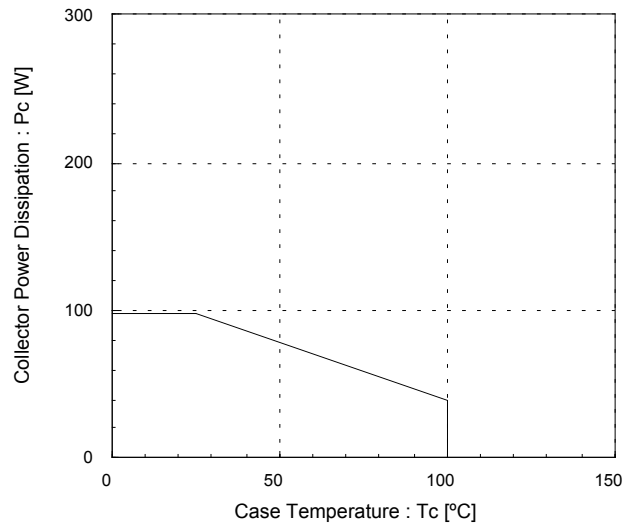
Transient thermal resistance (max.)

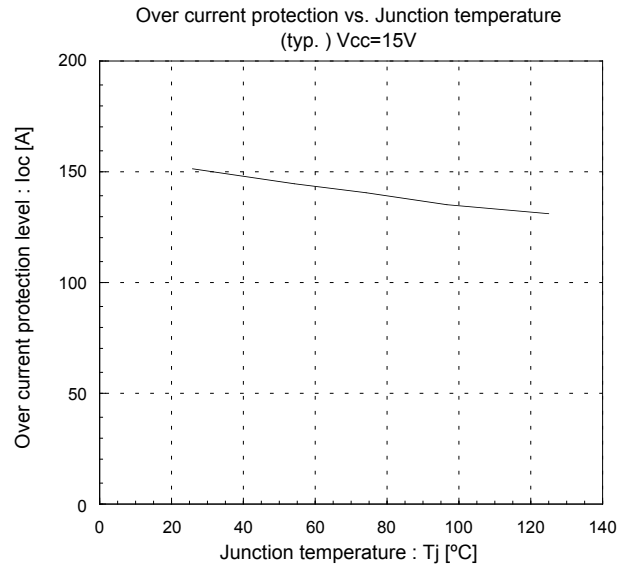
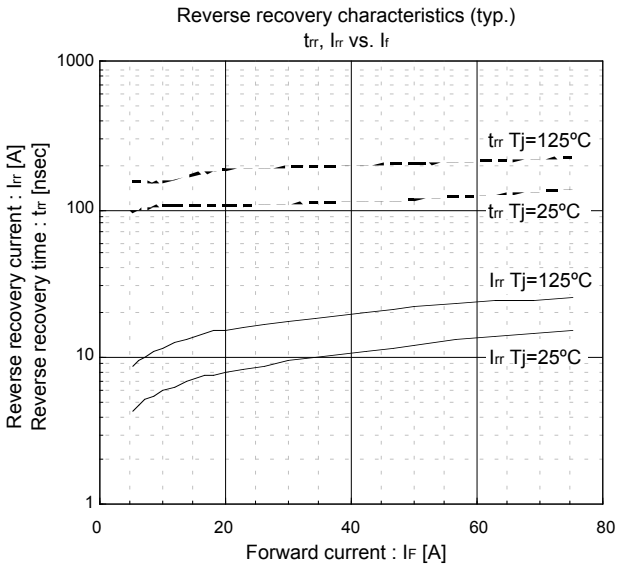
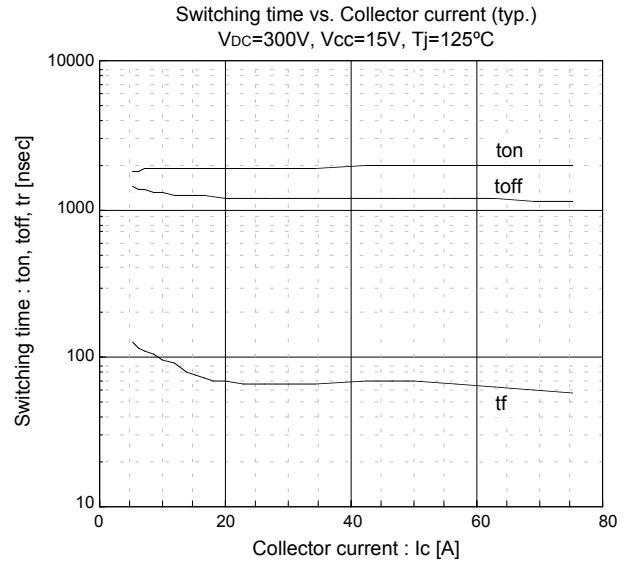
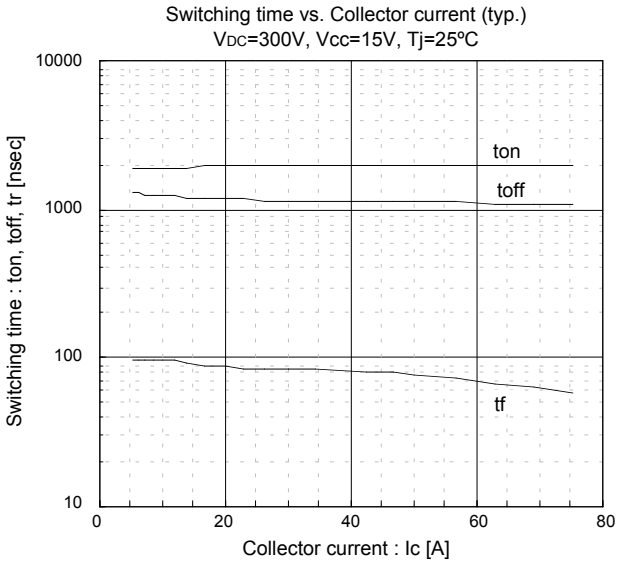


Power derating for IGBT (max.)  
 [per device]

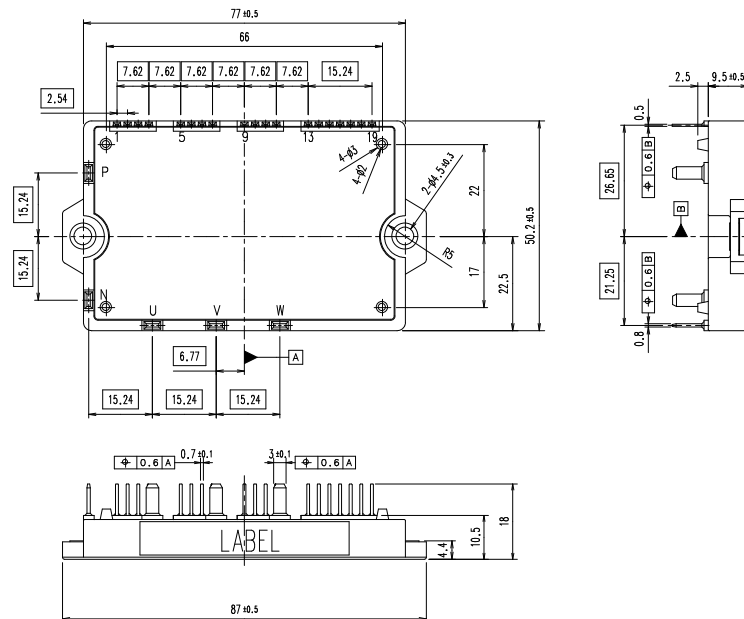


Power derating for FWD(max.)  
 [per device]





■ Outline Drawings, mm



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  - Measurement equipment
  - Machine tools
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  - Personal equipment
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