

# 7MBP300RA060

## IGBT-IPM R series

600V / 300A 7 in one-package

### Features

- Temperature protection provided by directly detecting the junction temperature of the IGBTs
- Low power loss and soft switching
- 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(at  $T_c=25^\circ\text{C}$  unless otherwise specified)

Item	Symbol	Rating		Unit	
		Min.	Max.		
DC bus voltage	$V_{DC}$	0	450	V	
DC bus voltage (surge)	$V_{DC(surge)}$	0	500	V	
DC bus voltage (short operating)	$V_{SC}$	200	400	V	
Collector-Emitter voltage	$V_{CES}$	0	600	V	
DB Reverse voltage	$V_R$	-	600	V	
INV Collector current	DC	$I_C$	-	300	A
	1ms	$I_{CP}$	-	600	A
	Duty=55.5%	$-I_C$	-	300	A
Collector power dissipation	One transistor	$P_C$	-	1040	W
DB Collector current	DC	$I_C$	-	100	A
	1ms	$I_{CP}$	-	200	A
Forward current of Diode		$I_F$	-	100	A
Collector power dissipation	One transistor	$P_C$	-	400	W
Junction temperature	$T_j$	-	150	$^\circ\text{C}$	
Input voltage of power supply for Pre-Driver	$V_{CC}^*1$	0	20	V	
Input signal voltage	$V_{in}^*2$	0	$V_z$	V	
Input signal current	$I_{in}$	-	1	mA	
Alarm signal voltage	$V_{ALM}^*3$	0	$V_{CC}$	V	
Alarm signal current	$I_{ALM}^*4$	-	15	mA	
Storage temperature	$T_{stg}$	-40	125	$^\circ\text{C}$	
Operating case temperature	$T_{op}$	-20	100	$^\circ\text{C}$	
Isolating voltage (Case-Terminal)	$V_{iso}^*5$	-	AC2.5	kV	
Screw torque	Mounting (M5)		-	3.5 $^*6$	N·m
	Terminal (M5)		-	3.5 $^*6$	N·m

\*1 Apply  $V_{CC}$  between terminal No. 3 and 1, 6 and 4, 9 and 7, 11 and 10.

\*2 Apply  $V_{in}$  between terminal No. 2 and 1, 5 and 4, 8 and 7, 12,13,14,15 and 10.

\*3 Apply  $V_{ALM}$  between terminal No. 16 and 10.

\*4 Apply  $I_{ALM}$  to terminal No. 16.

\*5 50Hz/60Hz sine wave 1 minute.

\*6 Recommendable Value : 2.5 to 3.0 N·m

- Electrical characteristics of power circuit (at  $T_c=T_j=25^\circ\text{C}$ ,  $V_{CC}=15\text{V}$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
INV	Collector current at off signal input	$I_{CES}$	$V_{CE}=600\text{V}$ input terminal open	-	-	1.0	mA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$	$I_C=300\text{A}$	-	-	2.8	V
	Forward voltage of FWD	$V_F$	$-I_C=300\text{A}$	-	-	3.0	V
DB	Collector current at off signal input	$I_{CES}$	$V_{CE}=600\text{V}$ input terminal open	-	-	1.0	mA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$	$I_C=100\text{A}$	-	-	2.8	V
	Forward voltage of Diode	$V_F$	$-I_C=100\text{A}$	-	-	3.0	V

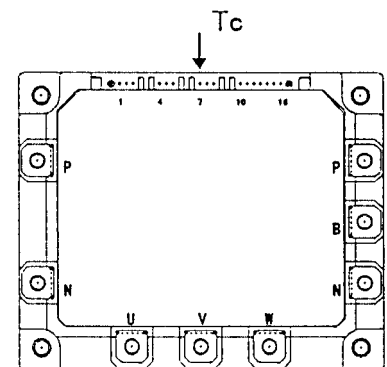


Fig.1 Measurement of case temperature

● Electrical characteristics of control circuit(at  $T_c=T_j=25^\circ\text{C}$ ,  $V_{cc}=15\text{V}$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power supply current of P-line side Pre-driver(one unit)	$I_{ccp}$	fsw=0 to 15kHz $T_c=-20$ to $100^\circ\text{C}$ *7	6	-	32	mA
Power supply current of N-line side three Pre-driver	$I_{ccn}$	fsw=0 to 15kHz $T_c=-20$ to $100^\circ\text{C}$ *7	24	-	114	mA
Input signal threshold voltage (on/off)	$V_{in(th)}$	ON	1.00	1.35	1.70	V
		OFF	1.70	2.05	2.40	V
Input zener voltage	$V_z$	$R_{in}=20\text{k ohm}$	-	8.0	-	V
Over heating protection temperature level	$T_{COH}$	$V_{DC}=0\text{V}$ , $I_c=0\text{A}$ , Case temperature, Fig.1	110	-	125	$^\circ\text{C}$
Hysteresis	$T_{CH}$		-	20	-	$^\circ\text{C}$
IGBT chips over heating protection temperature level	$T_{jOH}$	surface of IGBT chips	150	-	-	$^\circ\text{C}$
Hysteresis	$T_{jH}$		-	20	-	$^\circ\text{C}$
Collector current protection level	INV	$I_{oc}$	$T_j=125^\circ\text{C}$	450	-	A
	DB	$I_{oc}$	$T_j=125^\circ\text{C}$	150	-	A
Over current protection delay time (Fig.2)	$t_{DOC}$	$T_j=25^\circ\text{C}$ Fig.2	-	10	-	$\mu\text{s}$
Under voltage protection level	$V_{UV}$		11.0	-	12.5	V
Hysteresis	$V_H$		0.2	-	-	V
Alarm signal hold time	$t_{ALM}$		1.5	2	-	ms
SC protection delay time	$t_{SC}$	$T_j=25^\circ\text{C}$ Fig.3	-	-	12	$\mu\text{s}$
Limiting resistor for alarm	$R_{ALM}$		1425	1500	1575	ohm

\*7 Switching frequency of IPM

● Dynamic characteristics(at  $T_c=T_j=125^\circ\text{C}$ ,  $V_{cc}=15\text{V}$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Switching time (IGBT)	$t_{on}$	$I_C=300\text{A}$ , $V_{DC}=300\text{V}$	0.3	-	-	$\mu\text{s}$
	$t_{off}$		-	-	3.6	$\mu\text{s}$
Switching time (FWD)	$t_{rr}$	$I_F=300\text{A}$ , $V_{DC}=300\text{V}$	-	-	0.4	$\mu\text{s}$

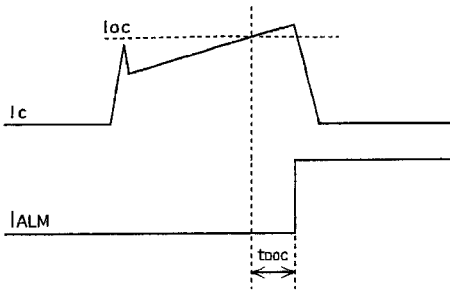


Fig.2 Definition of OC delay time

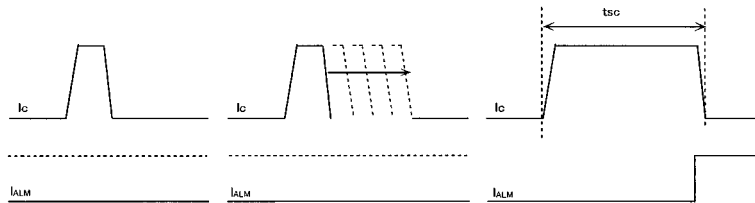


Fig.3 Definition of tsc

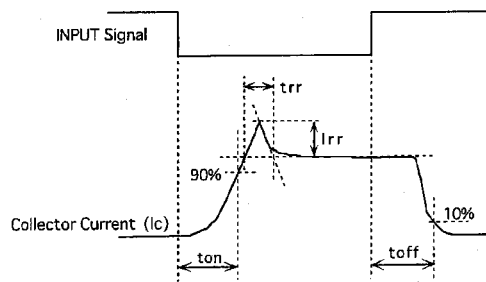


Fig.4 Definition of switching time

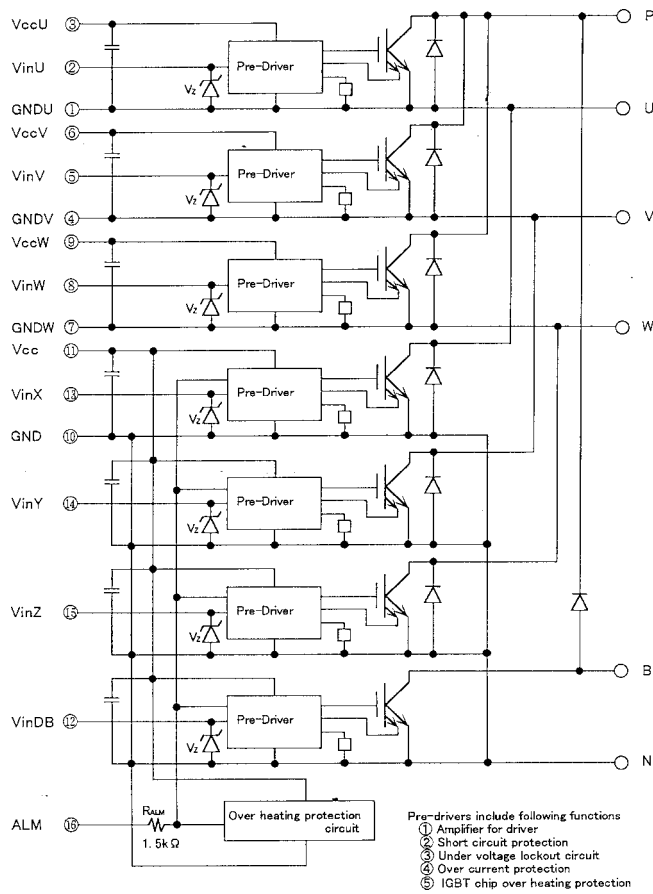
● Thermal characteristics(  $T_c=25^\circ\text{C}$ )

Item	Symbol	Typ.	Max.	Unit		
Junction to Case thermal resistance	INV	IGBT	$R_{th(j-c)}$	-	0.12	$^\circ\text{C/W}$
		FWD	$R_{th(j-c)}$	-	0.25	$^\circ\text{C/W}$
	DB	IGBT	$R_{th(j-c)}$	-	0.31	$^\circ\text{C/W}$
Case to fin thermal resistance with compound	$R_{th(c-f)}$	0.05	-	$^\circ\text{C/W}$		

● Recommendable value

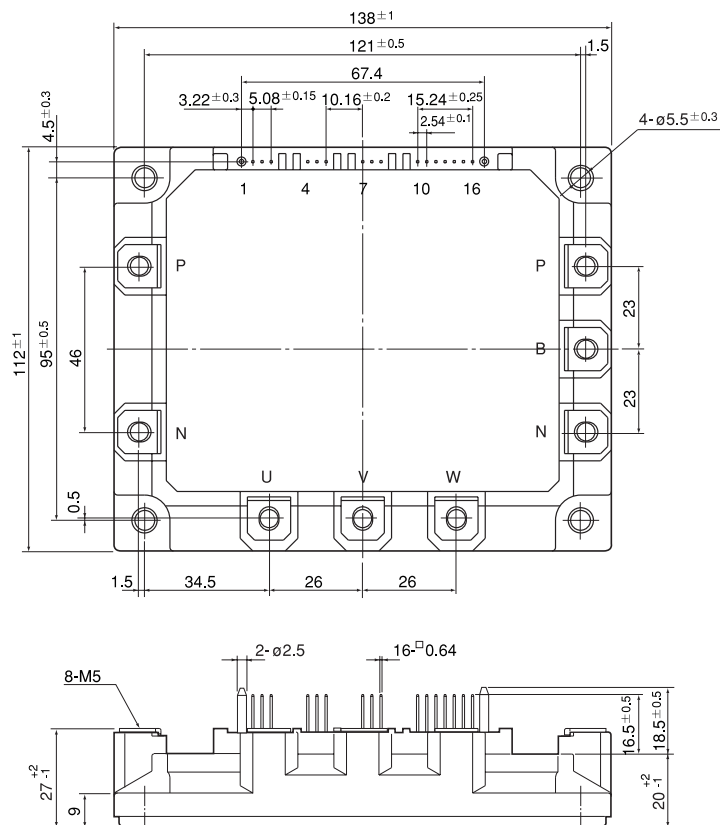
Item	Symbol	Min.	Typ.	Max.	Unit	
DC bus voltage	$V_{DC}$	200	-	400	V	
Operating power supply voltage range of Pre-driver	$V_{CC}$	13.5	15	16.5	V	
Switching frequency of IPM	fsw	1	-	20	kHz	
Screw torque	Mounting (M5)	-	2.5	-	3.0	N·m
	Terminal (M5)	-	2.5	-	3.0	N·m

Block diagram



Pre-drivers include following functions  
 a) Amplifier for driver  
 b) Short circuit protection  
 c) Undervoltage lockout circuit  
 d) Over current protection  
 e) IGBT chip over heating protection

Outline drawings, mm

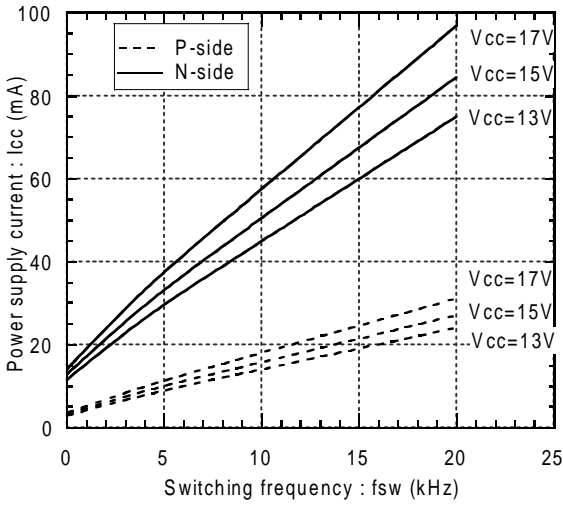


Mass : 920g

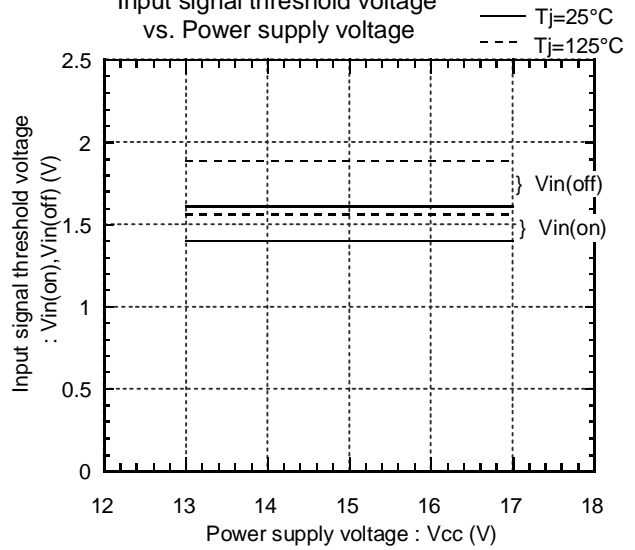
■ Characteristics (Representative)

● Control circuit

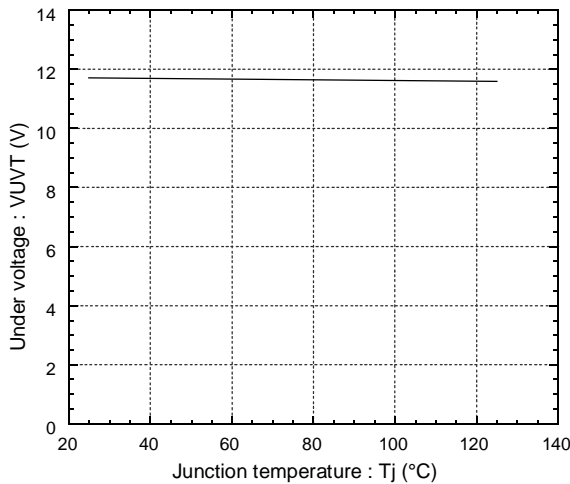
Power supply current vs. Switching frequency  
Tj=100°C



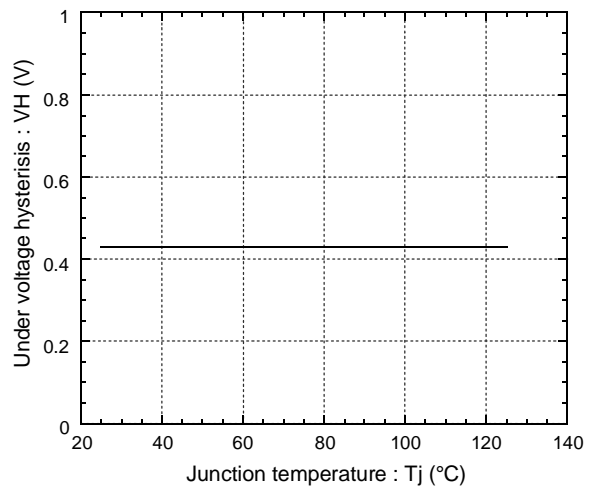
Input signal threshold voltage vs. Power supply voltage



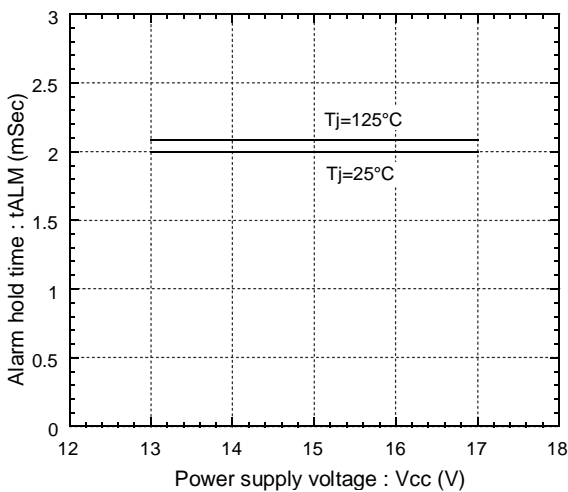
Under voltage vs. Junction temperature



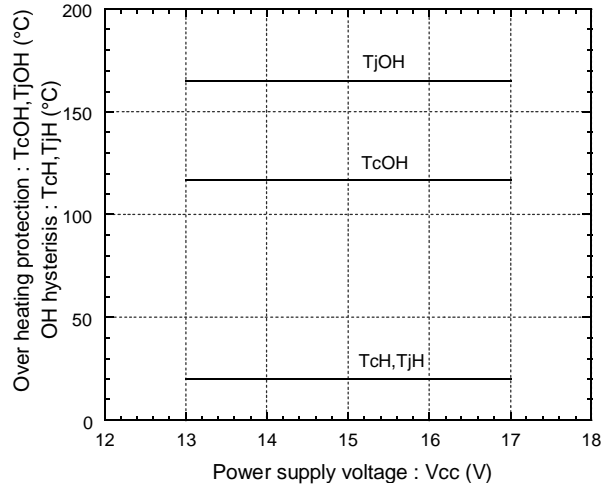
Under voltage hysteresis vs. Junction temperature



Alarm hold time vs. Power supply voltage

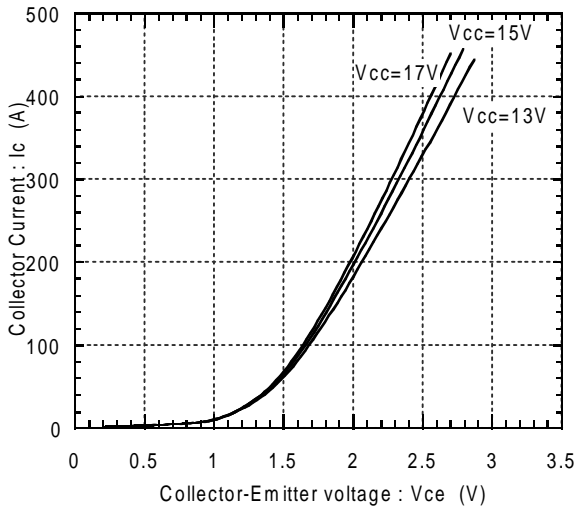


Over heating characteristics  
TcOH, TjOH, TcH, TjH vs. Vcc

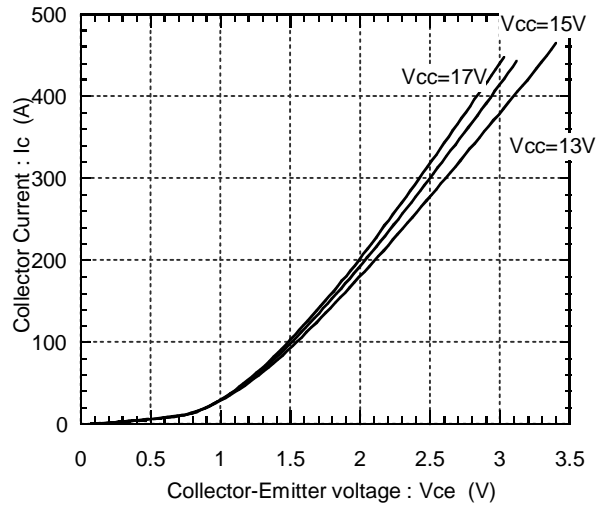


● Inverter

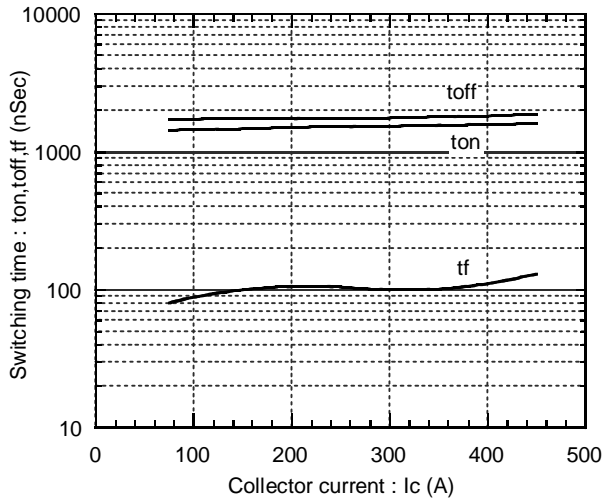
Collector current vs. Collector-Emitter voltage  
T<sub>j</sub>=25°C



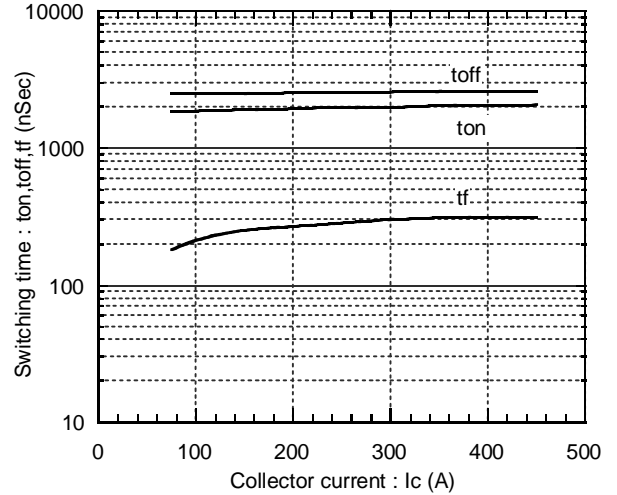
Collector current vs. Collector-Emitter voltage  
T<sub>j</sub>=125°C



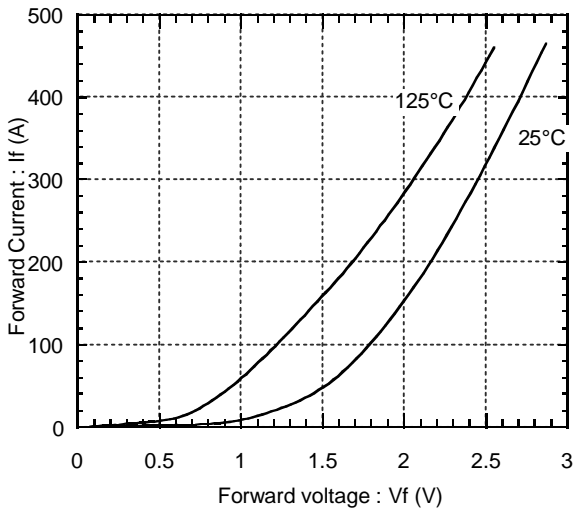
Switching time vs. Collector current  
E<sub>dc</sub>=300V, V<sub>cc</sub>=15V, T<sub>j</sub>=25°C



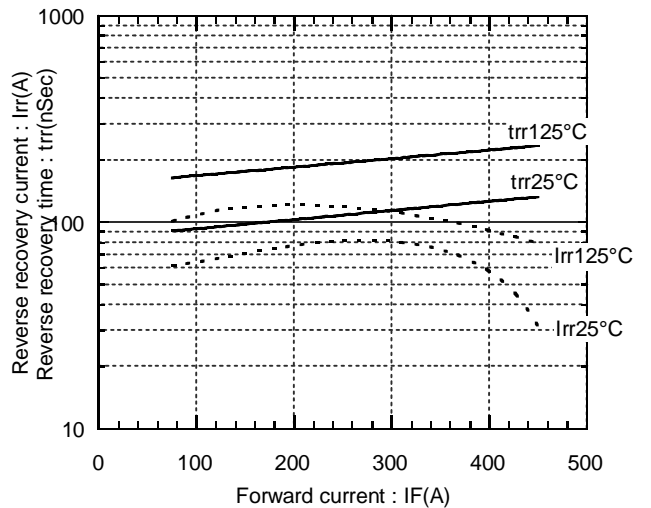
Switching time vs. Collector current  
E<sub>dc</sub>=300V, V<sub>cc</sub>=15V, T<sub>j</sub>=125°C



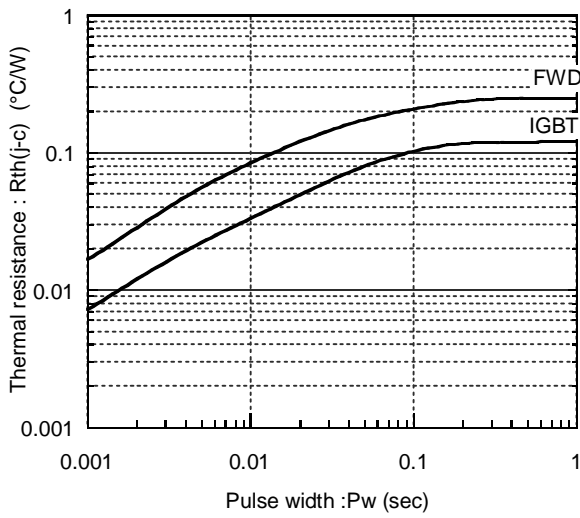
Forward current vs. Forward voltage



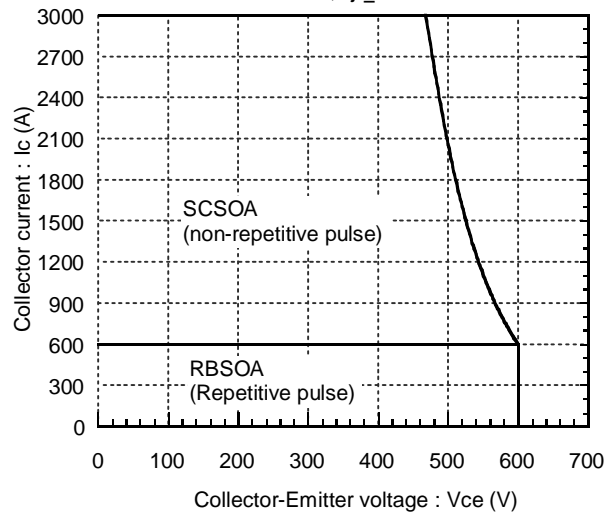
Reverse recovery characteristics  
trr, Irr vs. IF



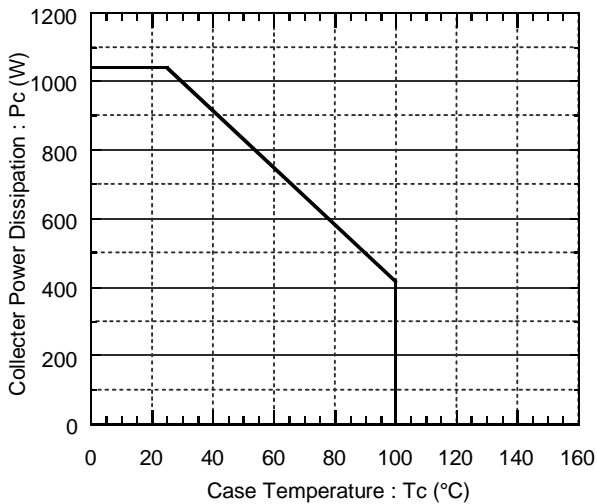
Transient thermal resistance



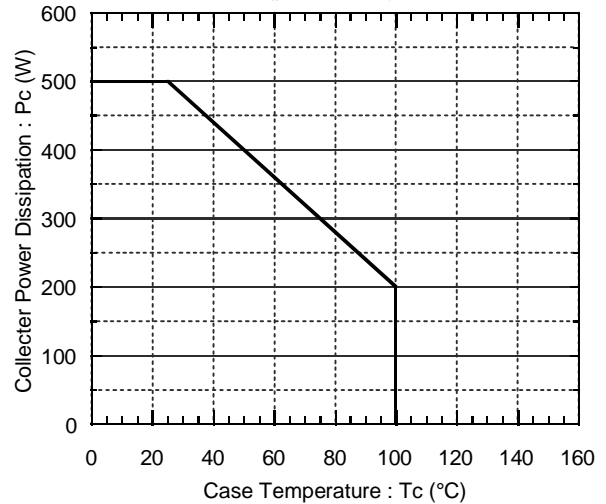
Reversed biased safe operating area  
 $V_{cc}=15V, T_j \leq 125^{\circ}C$



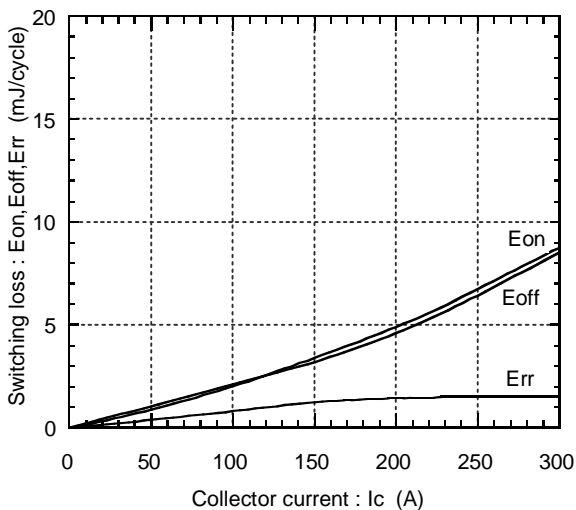
Power derating for IGBT  
(per device)



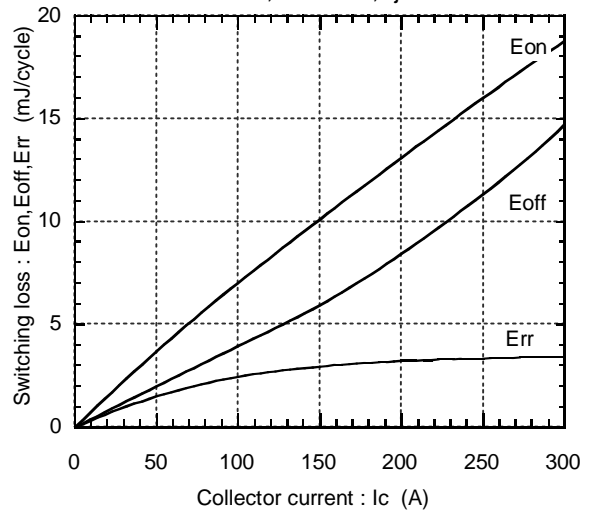
Power derating for FWD  
(per device)

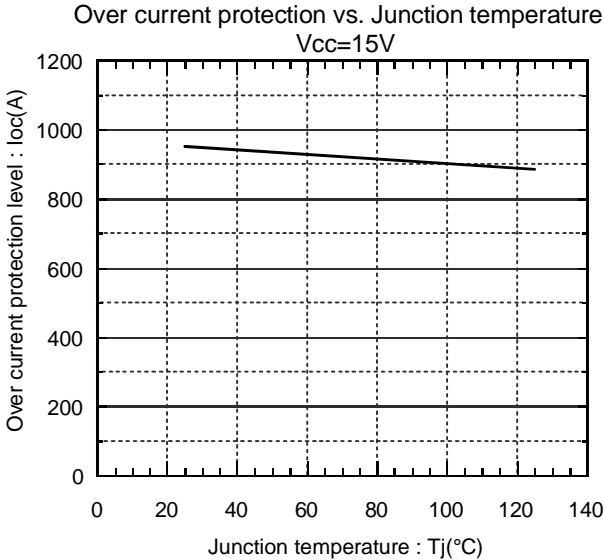


Switching Loss vs. Collector Current  
 $E_{dc}=300V, V_{cc}=15V, T_j=25^{\circ}C$



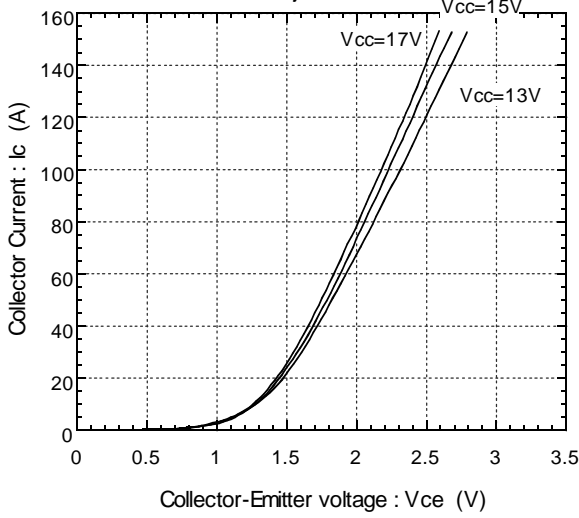
Switching Loss vs. Collector Current  
 $E_{dc}=300V, V_{cc}=15V, T_j=125^{\circ}C$



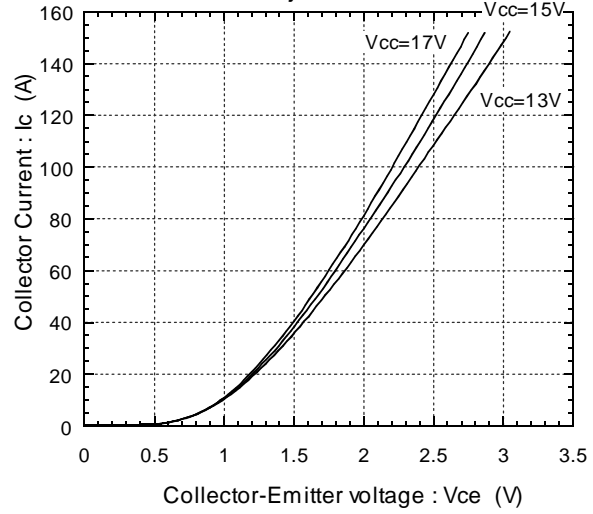


● Brake

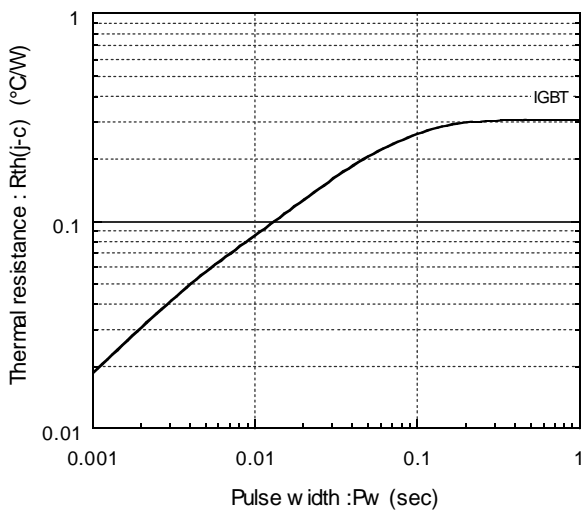
Collector current vs. Collector-Emitter voltage  
T<sub>j</sub>=25°C



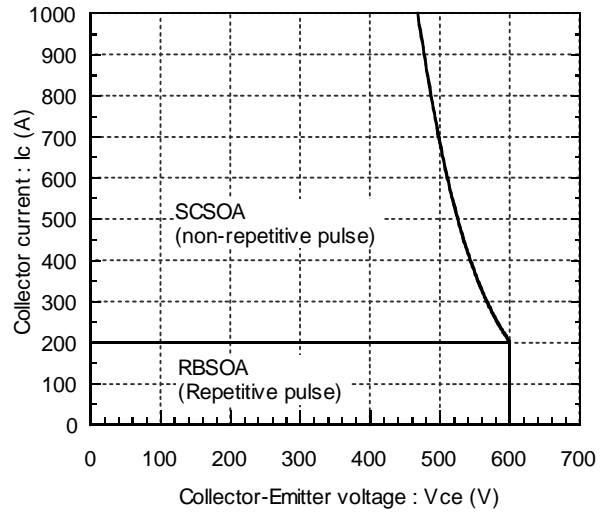
Collector current vs. Collector-Emitter voltage  
T<sub>j</sub>=125°C



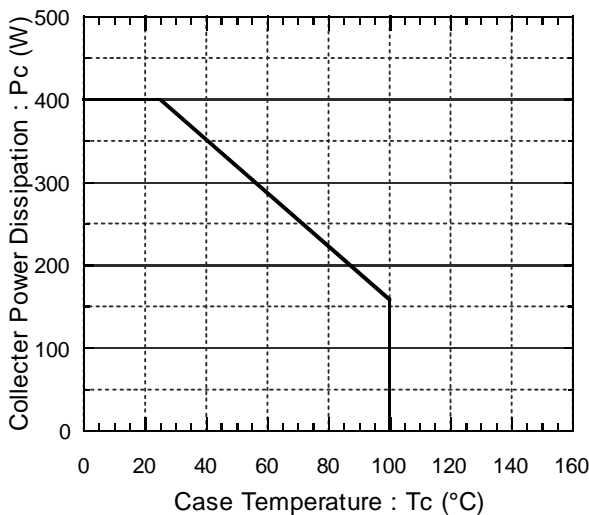
Transient thermal resistance



Reversed biased safe operating area  
V<sub>cc</sub>=15V, T<sub>j</sub> ≤ 125°C



Power derating for IGBT  
(per device)



Over current protection vs. Junction temperature  
V<sub>cc</sub>=15V

