

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.			
Bus voltage	DC	V_{DC}	0	450	V	
	Surge	$V_{DC(surge)}$	0	500	V	
	Short operating	V_{sc}	200	400	V	
Collector-Emitter voltage *1		V_{CES}	0	600	V	
Inverter	Collector current	DC	I_C	-	50	A
		1ms	I_{CP}	-	100	A
		Duty=76.1% *2	$-I_C$	-	50	A
Collector power dissipation	One transistor *3	P_C	-	144	W	
	Collector current	DC	I_C	-	30	A
		1ms	I_{CP}	-	60	A
	Forward current diode		I_F	-	30	A
	Collector power dissipation	One transistor *3	P_C	-	144	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	
Input signal current		I_{in}	-	3	mA	
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	100	$^\circ\text{C}$	
Storage temperature		T_{stg}	-40	125	$^\circ\text{C}$	
Solder temperature *8		T_{sol}	-	260	$^\circ\text{C}$	
Isolating voltage (Terminal to base, 50/60Hz sine wave 1min.)		V_{iso}	-	AC2500	V	
Screw torque	Mounting (M5)		-	3.5	N·m	

Note

*1 : V_{CES} shall be applied to the input voltage between terminal P and U or ,u or W, N and U or V or W

*2 : $125^\circ\text{C}/\text{FWD } R_{th(j-c)} / (I_C \times V_F \text{ MAX}) = 125 / 1.263 / (50 \times 2.6) \times 100 = 76.1\%$

*3 : $P_C = 125^\circ\text{C}/\text{IGBT } R_{th(j-c)} = 125 / 0.87 = 144\text{W}$ [Inverter]

$P_C = 125^\circ\text{C}/\text{IGBT } R_{th(j-c)} = 125 / 0.87 = 144\text{W}$ [Breake]

*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

*5 : V_{in} shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 16,17,18 and 13.

*6 : V_{ALM} shall be applied to the voltage between terminal No.2 and 1, No6 and 5, No10 and 9, No.19 and 13.

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

*8 : Immersion time $10 \pm 1\text{sec}$.

Electrical characteristics (at T_c=T_j=25°C, V_{cc}=15V unless otherwise specified.)

● Main circuit

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	
Inverter	Collector current at off signal input	ICES	V _{CE} =600V V _{in} terminal open.	-	-	1.0	mA	
	Collector-Emitter saturation voltage	V _{CE(sat)}	I _c =50A	Terminal	-	-	2.5	V
				Chip	-	2.0	-	
	Forward voltage of FWD	V _F	-I _c =50A	Terminal	-	-	2.6	V
Chip				-	1.6	-		
Brake	Collector current at off signal input	ICES	V _{CE} =600V V _{in} terminal open.	-	-	1.0	mA	
	Collector-Emitter saturation voltage	V _{CE(sat)}	I _c =30A	Terminal	-	-	2.2	V
				Chip	-	1.75	-	
	Forward voltage of Diode	V _F	-I _c =30A	Terminal	-	-	3.3	V
Chip				-	1.9	-		
Turn-on time	ton	V _{DC} =300V, T _j =125°C		1.2	-	-	μs	
Turn-off time	toff	I _c =50A Fig.1, Fig.6		-	-	3.6		
Reverse recovery time	trr	V _{DC} =300V, I _c =50A Fig.1, Fig.6		-	-	0.3		
Maximum Avalanche Energy (A non-repetition)	P _{AV}	Internal wiring inductance=50nH Main circuit wiring inductance=54nH		30	-	-	mJ	

● Control circuit

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply current of P-line side pre-driver(one unit)	I _{ccp}	Switching Frequency : 0 to 15kHz T _c =-20 to 125°C Fig.7	-	-	18	mA
Supply current of N-line side pre-driver	I _{ccn}		-	-	65	mA
Input signal threshold voltage (on/off)	V _{in(th)}	ON	1.00	1.35	1.70	V
		OFF	1.25	1.60	1.95	V
Input zener voltage	V _Z	R _{in} =20k ohm	-	8.0	-	V
Alarm signal hold time	t _{ALM}	T _c =-20°C Fig.2	1.1	-	-	ms
		T _c =25°C Fig.2	-	2.0	-	ms
		T _c =125°C Fig.2	-	-	4.0	ms
Current limit resistor	R _{ALM}	Alarm terminal	1425	1500	1575	ohm

● Protection Section (V_{cc}=15V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Over Current Protection Level of Inverter circuit	I _{oc}	T _j =125°C	75	-	-	A
Over Current Protection Level of Brake circuit	I _{oc}	T _j =125°C	45	-	-	A
Over Current Protection Delay time	t _{DOC}	T _j =125°C	-	5	-	μs
SC Protection Delay time	t _{SC}	T _j =125°C Fig.4	-	-	8	μs
IGBT Chip Over Heating	T _{jOH}	Surface of IGBT chips	150	-	-	°C
Over Heating Protection Hysteresis	T _{jH}		-	20	-	°C
Under Voltage Protection Level	V _{UV}		11.0	-	12.5	V
Under Voltage Protection Hysteresis	V _H		0.2	0.5	-	V

● Thermal characteristics(T_c=25°C)

Item			Symbol	Min.	Typ.	Max.	Unit
Junction to Case thermal resistance *9	Inverter	IGBT	R _{th(j-c)}	-	-	0.87	°C/W
		FWD	R _{th(j-c)}	-	-	1.263	°C/W
	Brake	IGBT	R _{th(j-c)}	-	-	0.87	°C/W
Case to fin thermal resistance with compound			R _{th(c-f)}	-	0.05	-	-°C/W

*9 For 1 device, Case is under the device

● Noise Immunity (V_{DC}=300V, V_{cc}=15V, Test Circuit Fig.5)

Item	Condition	Min.	Typ.	Max.	Unit
Common mode rectangular noise	Pulse width 1μs, polarity ±, 10minuets Judge : no over-current, no miss operating	±2.0	-	-	kV
Common mode lightning surge	Rise time 1.2μs, Fall time 50μs Interval 20s, 10 times Judge : no over-current, no miss operating	±5.0	-	-	kV

● Recommendable value

Item	Symbol	Min.	Typ.	Max.	Unit
DC Bus Voltage	V _{DC}	-	-	400	V
Operating Supply Voltage of Pre-Driver	V _{cc}	13.5	15.0	16.5	V
Screw torque (M5)	-	2.5	-	3.0	Nm

● Weight

Item	Symbol	Min.	Typ.	Max.	Unit
Weight	W _t	-	270	-	g

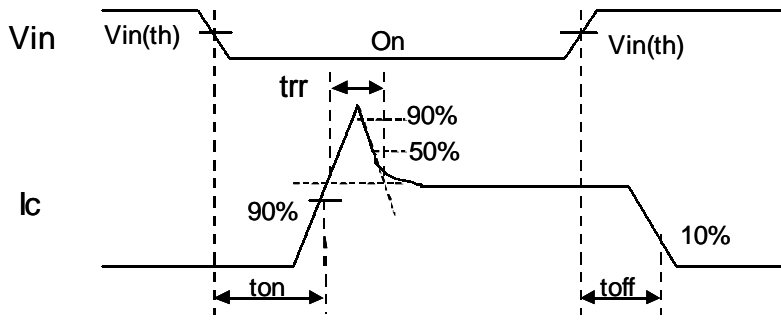
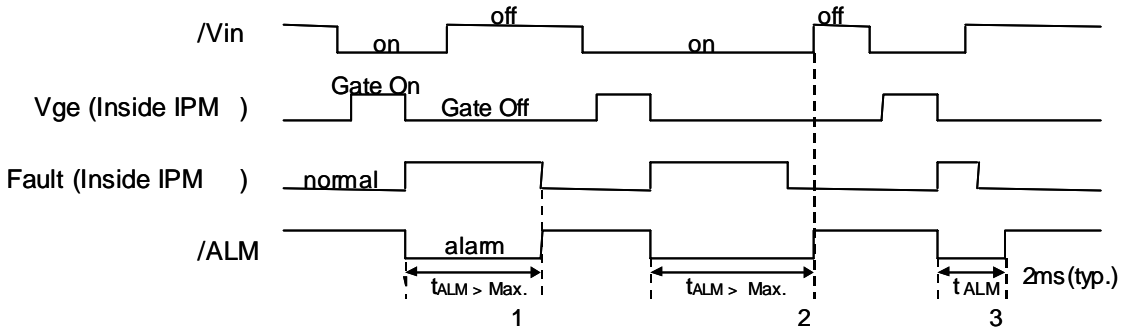


Figure 1. Switching Time Waveform Definitions



Fault : Over-current, Over-heat or Under-voltage

Figure 2. Input/Output Timing Diagram

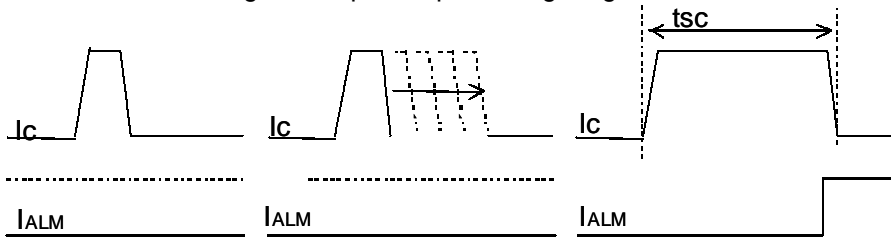


Figure.4 Definition of tsc

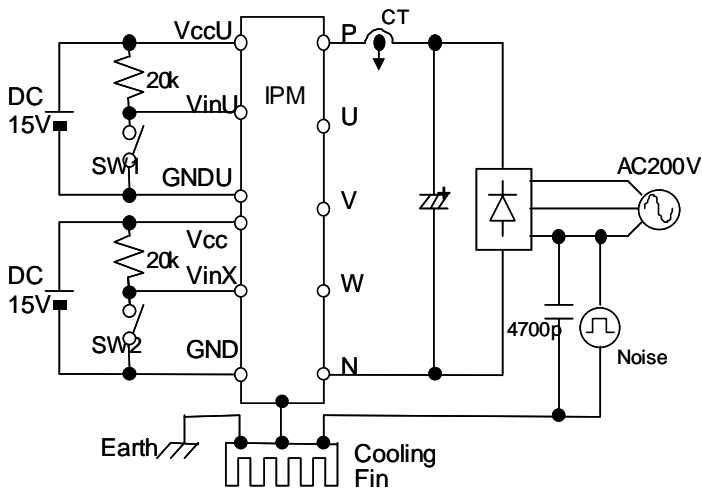


Figure 5. Noise Test Circuit

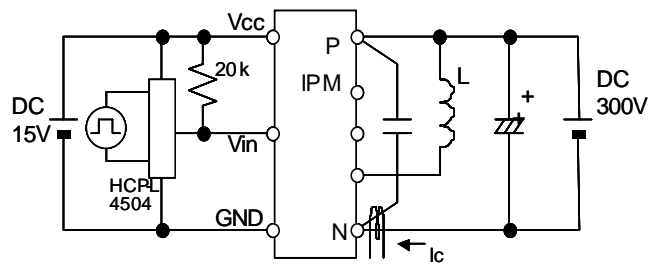


Figure 6. Switching Characteristics Test Circuit

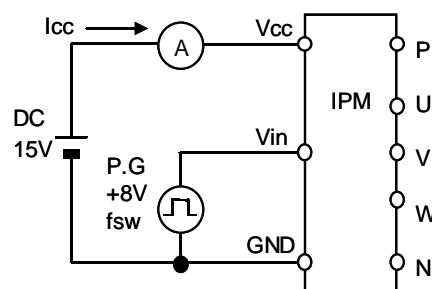
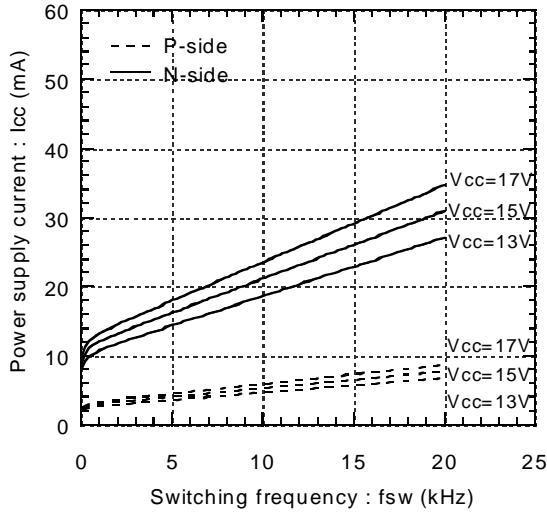


Figure 7. Icc Test Circuit

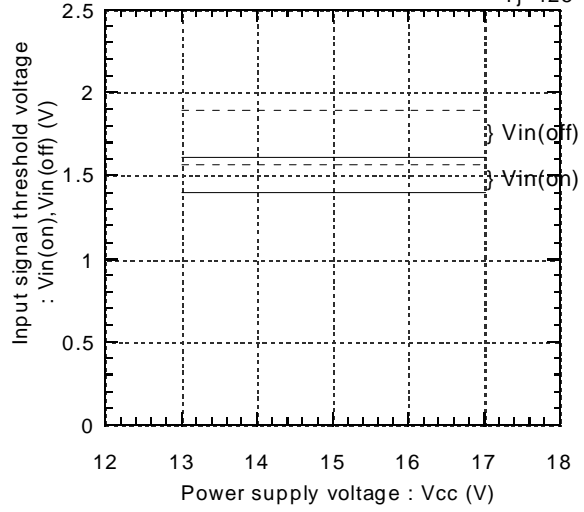
■ Characteristics

● Control circuit characteristics (Representative)

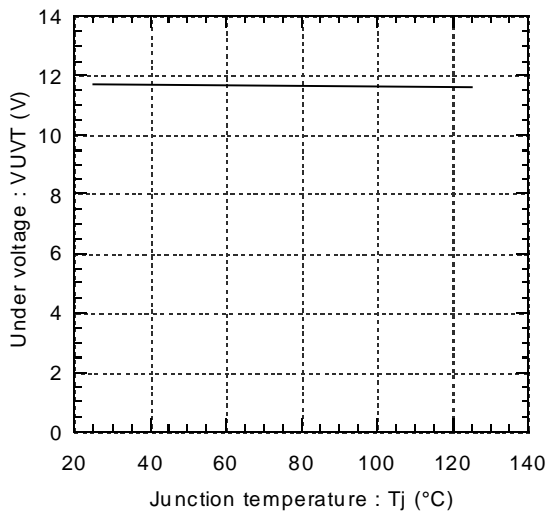
Power supply current vs. Switching frequency
Tc=125°C



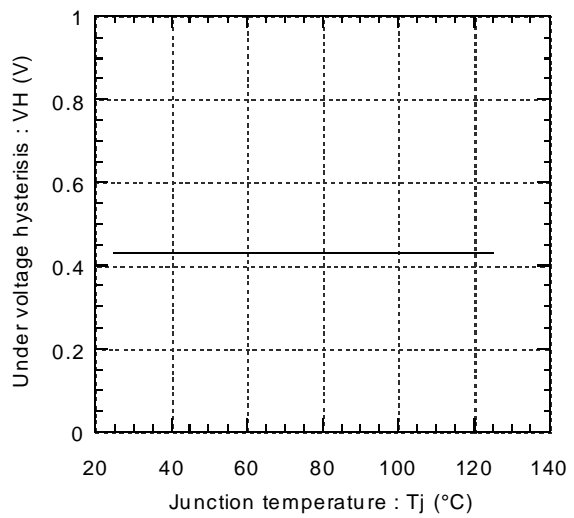
Input signal threshold voltage vs. Power supply voltage
— Tj=25°C
- - - Tj=125°C



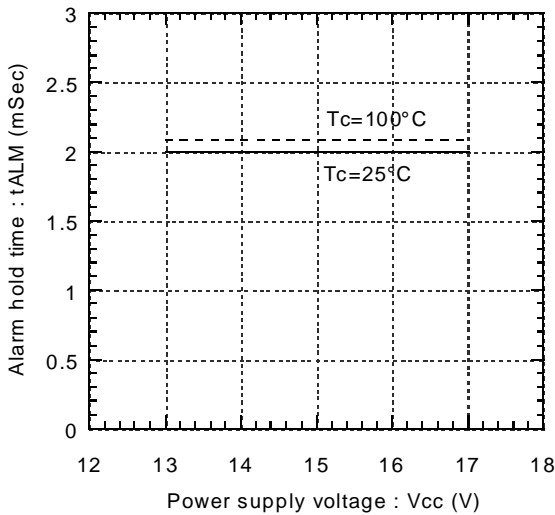
Under voltage vs. Junction temperature



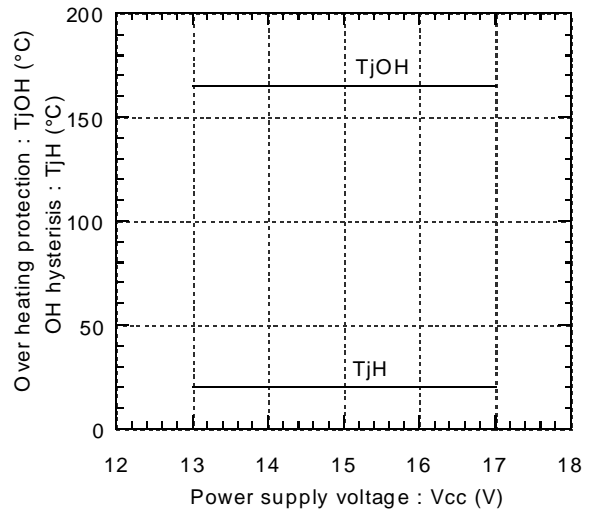
Under voltage hysteresis vs. Junction temperature



Alarm hold time vs. Power supply voltage

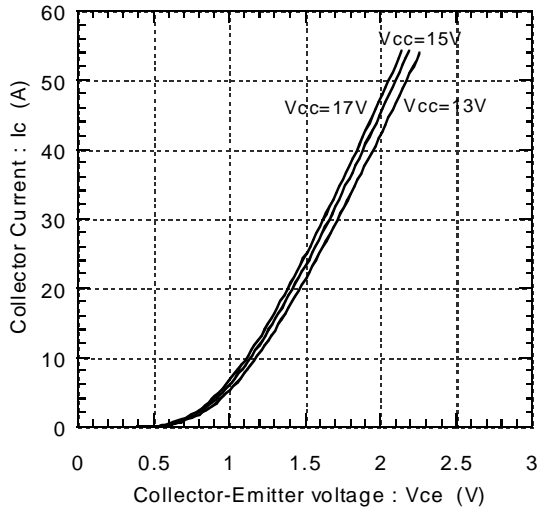


Over heating characteristics
TjOH, TjH vs. Vcc

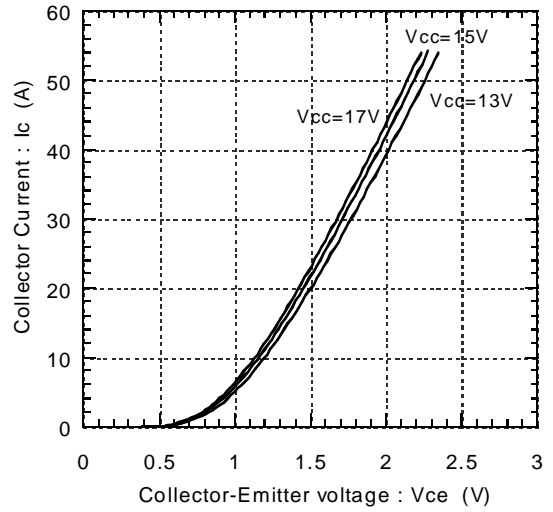


● Main circuit characteristics (Representative)

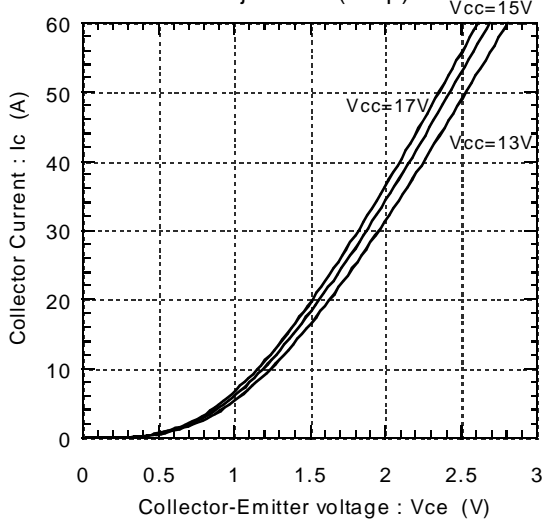
Collector current vs. Collector-Emittter voltage
Tj=25°C(Chip)



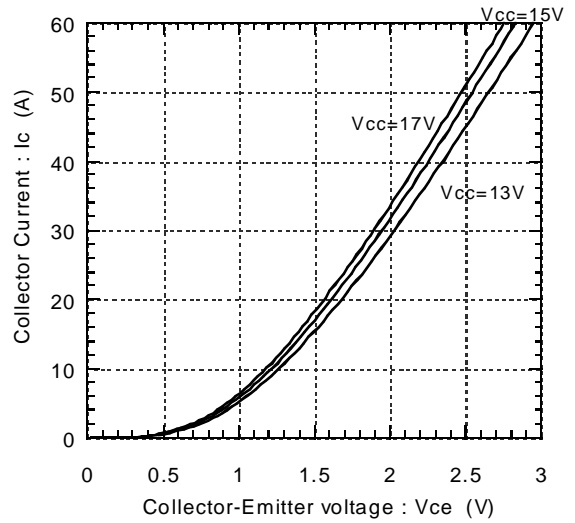
Collector current vs. Collector-Emittter voltage
Tj=25°C(Terminal)



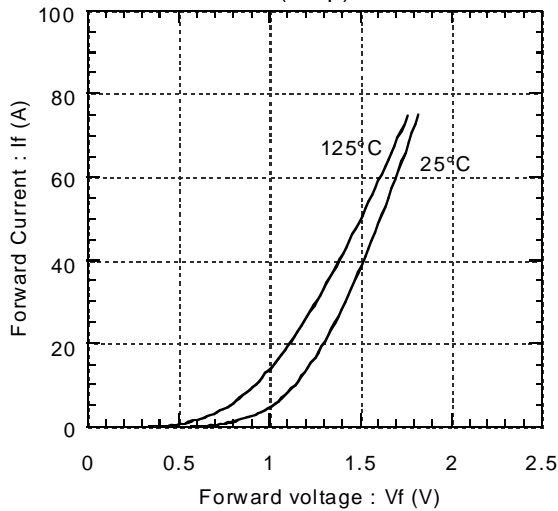
Collector current vs. Collector-Emittter voltage
Tj=125°C(Chip)



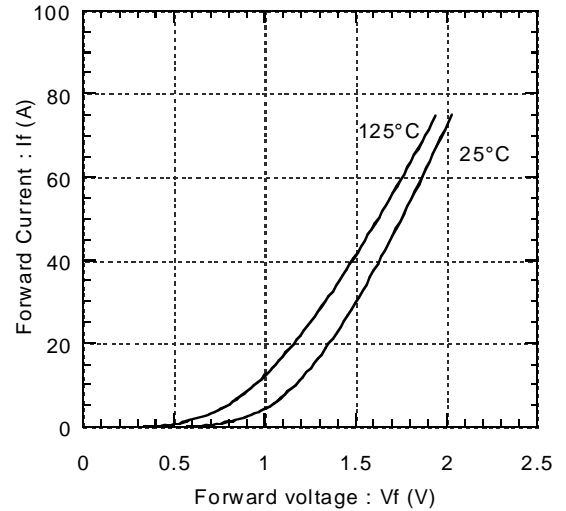
Collector current vs. Collector-Emittter voltage
Tj=125°C(Terminal)



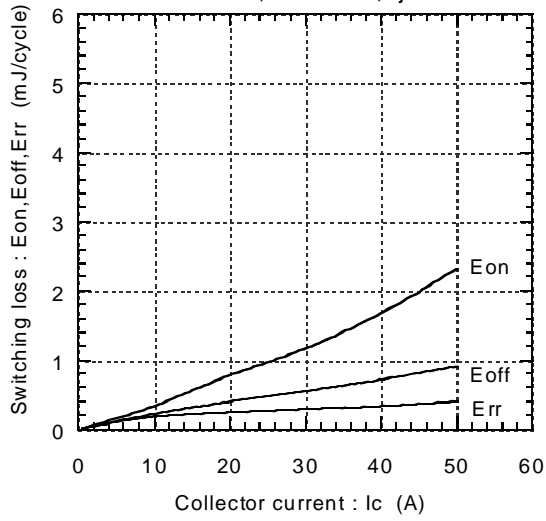
Forward current vs. Forward voltage
(Chip)



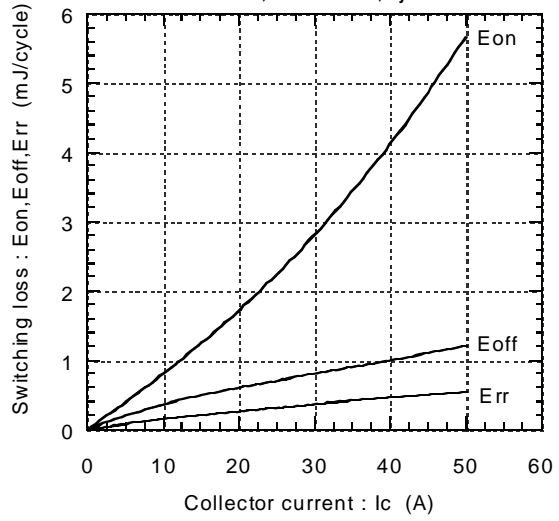
Forward current vs. Forward voltage
(Terminal)



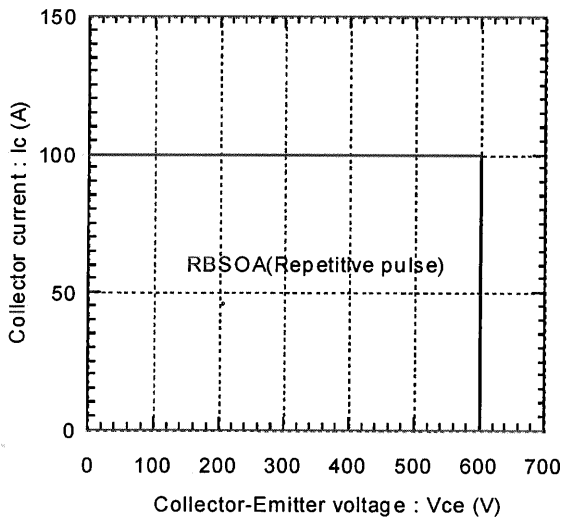
Switching Loss vs. Collector Current
 $E_{dc}=300V, V_{cc}=15V, T_j=25^\circ C$



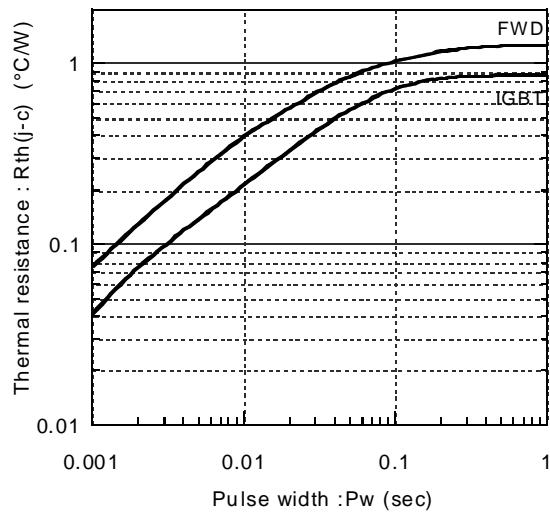
Switching Loss vs. Collector Current
 $E_{dc}=300V, V_{cc}=15V, T_j=125^\circ C$



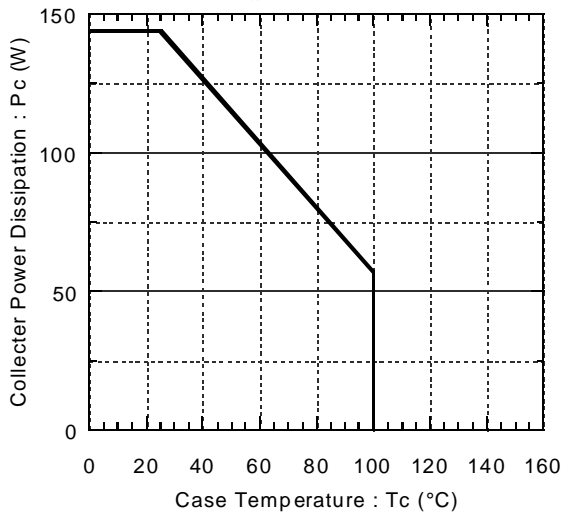
Reversed biased safe operating area
 $V_{cc}=15V, T_j \le 125^\circ C$



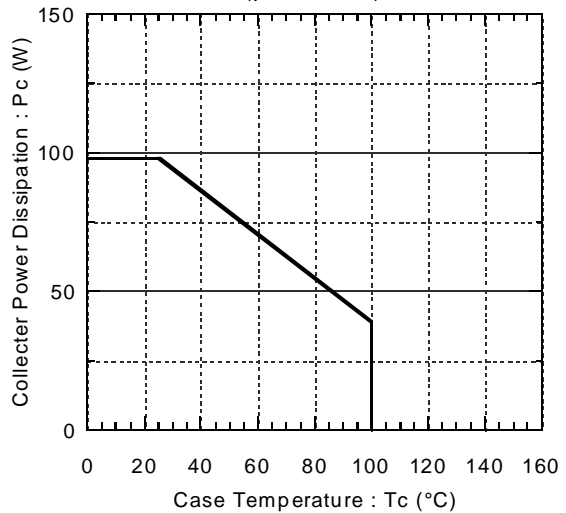
Transient thermal resistance

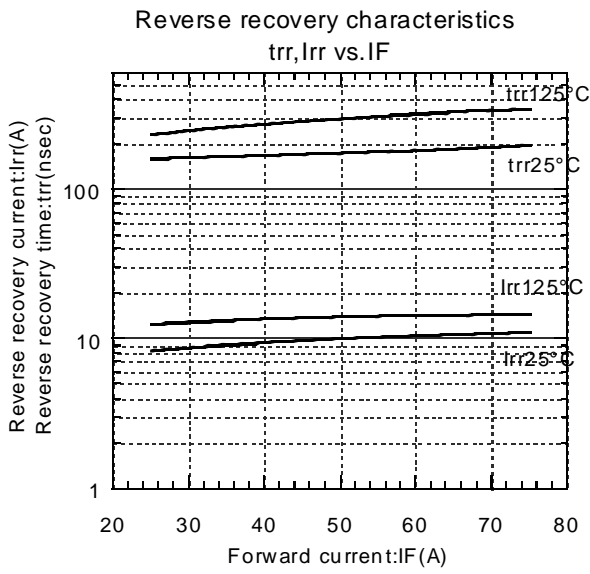
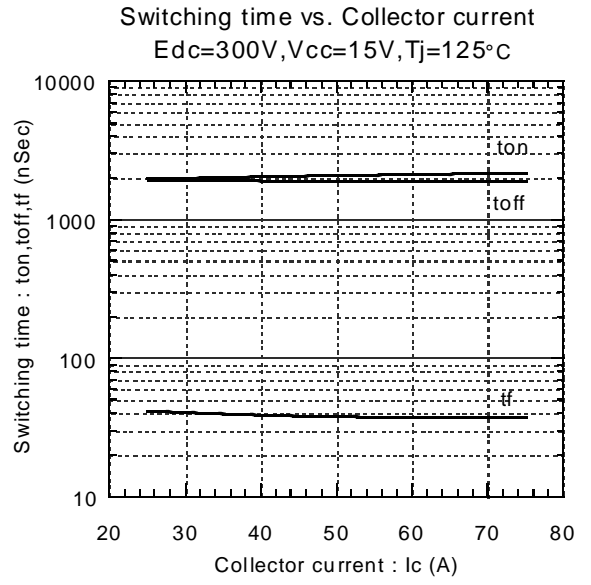
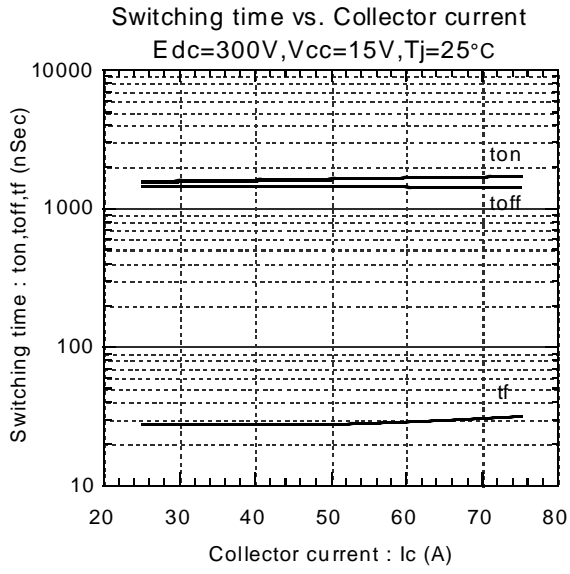


Power derating for IGBT
(per device)



Power derating for FWD
(per device)

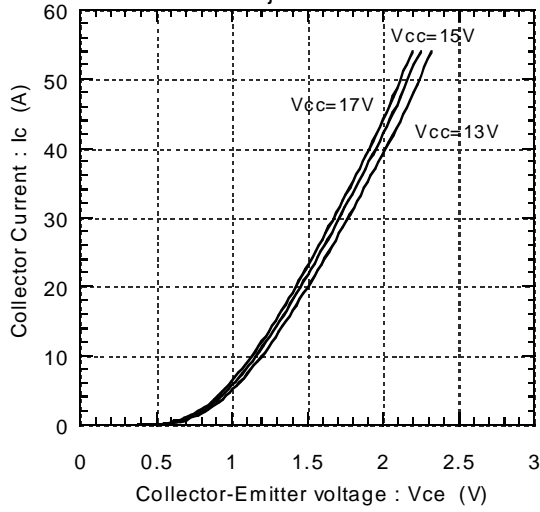




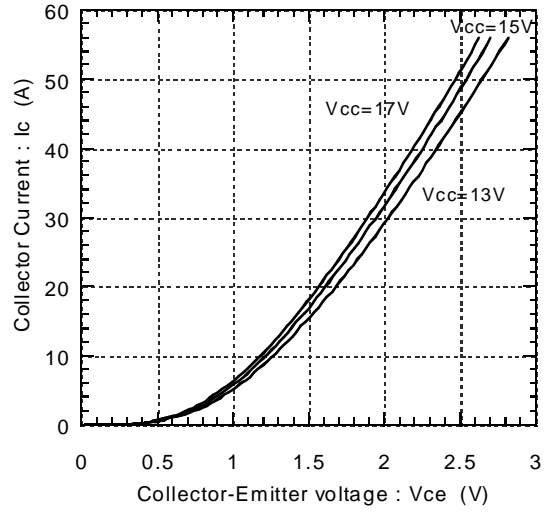
Characteristics

Dynamic Brake Characteristics (Representative)

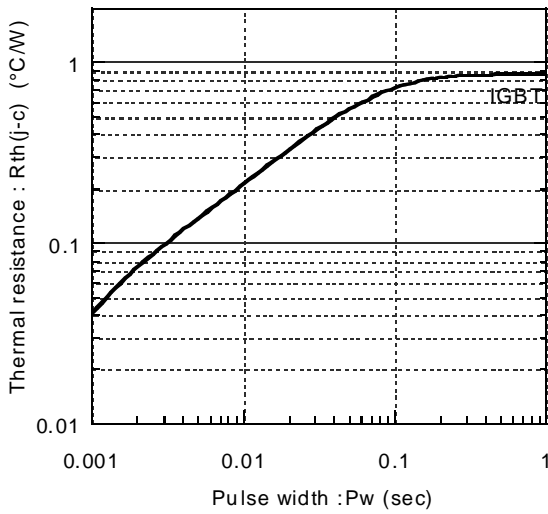
Collector current vs. Collector-Emitter voltage
T_j=25°C



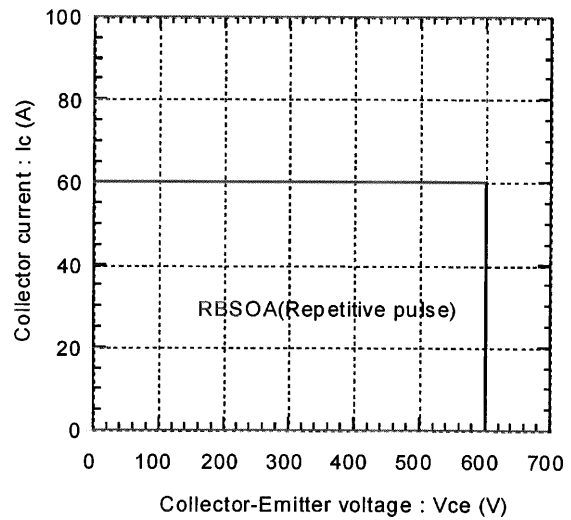
Collector current vs. Collector-Emitter voltage
T_j=125°C



Transient thermal resistance



Reversed biased safe operating area
V_{cc}=15V, T_j ≤ 125°C



Power derating for IGBT
(per device)

