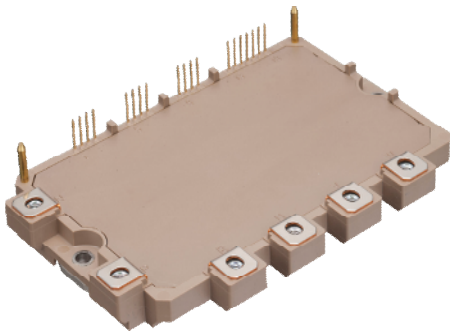
7MBP150XDA065-50

IGBT Modules

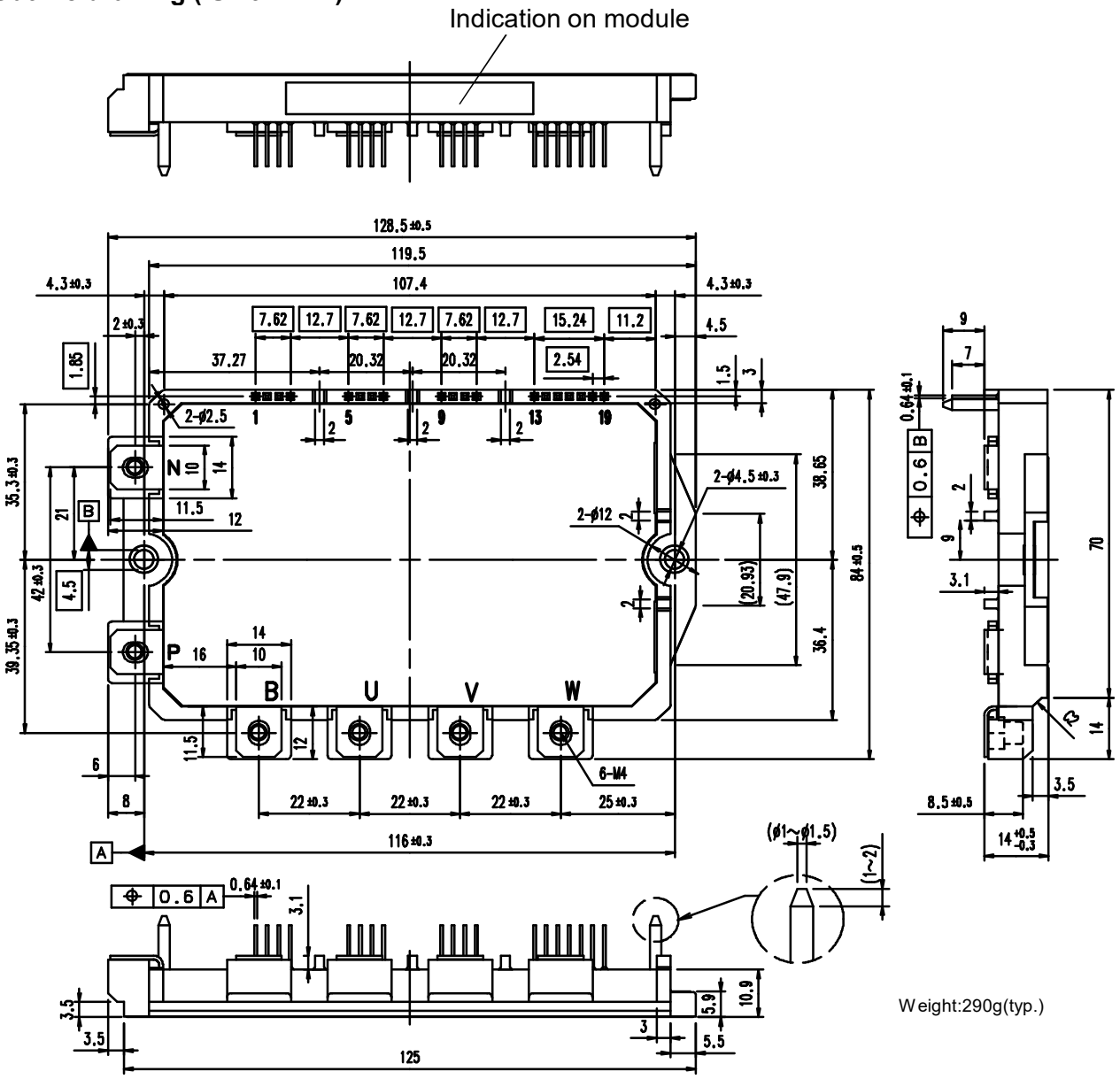
IGBT Module (X series)
650V / 150A / IPM



■ 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

■ Outline drawing (Unit : mm)



Weight:290g(typ.)

FM6M2019a
2023/03

■ Absolute maximum ratings

T_C=25°C, T_{vj}=25°C, V_{CC}=15V unless otherwise specified

Items		Symbol	Conditions	Min.	Max.	Units
Collector-Emitter voltage		V_{CES}	*1	-	650	V
Short circuit voltage		V_{SC}	*2	200	400	V
Inverter	Collector current	I_C	DC	-	150	A
		I_{CP}	1ms	-	300	A
		$-I_C$	Duty=100% *3	-	150	A
	Total power dissipation	P_{tot}	IGBT 1 device *4	-	500	W
Brake	Repetitive peak reverse voltage	V_{RRM}	Diode part		650	V
	Collector current	I_C	DC	-	75	A
		I_{CP}	1ms	-	150	A
	Forward current of diode	I_F		-	75	A
	Total power dissipation	P_{tot}	IGBT 1 device *4	-	272	W
Supply voltage of pre-driver		V_{CC}	*5	-0.5	20	V
Input signal voltage		V_{in}	*6	-0.5	V_{CC}+0.5	V
Alarm signal voltage		V_{ALM}	*7	-0.5	V_{CC}	V
Alarm signal current		I_{ALM}	*8	-	20	mA
Virtual junction temperature		T_{vj}		-	175	°C
Operating virtual junction temperature		T_{vjop}		-	150	°C
Operating case temperature		T_c		-20	125	°C
Storage temperature		T_{stg}		-40	125	°C
Solder temperature		T_{sol}	*9	-	260	°C
Isolating voltage		V_{isol}	*10	-	2500	Vrms
Mounting torque of screws to heat sink		M_s	Mounting(M4)	1.3	1.7	Nm
Mounting torque of screws to terminals		M_t	Main terminals(M4)	1.3	1.7	Nm

Notes
*1: V_{CES} shall be applied to the input voltage between terminal P-(U,V, W) and (U,V, W,B)-N.
*2: In the case of the load inductance to be over 1μH.
*3: Duty=150°C/$R_{th(j-c)D}$/(I_F×V_F Max.)×100
*4: P_{tot}=150°C/$R_{th(j-c)Q}$
*5: V_{CC} shall be applied to the input voltage between terminal No.4 and 1, 8 and 5, 12 and 9,14 and 13.
*6: V_{in} shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9,15～18 and 13.
*7: V_{ALM} shall be applied to the voltage between terminal No.2 and 1 , 6 and 5 , 10 and 9 , 19 and 13.
*8: I_{ALM} shall be applied to the input current to terminal No.2,6,10 and 19.
*9: Immersion time 10±1sec. 1 time.
*10: Terminal to base, 50/60Hz sine wave 1 min. All terminals should be connected together during the test.

■ Electrical characteristics

● Main circuit

T_{vj}=25°C, V_{CC}=15V unless otherwise specified

Item		Symbol	Conditions		Min.	Typ.	Max.	Units
Inverter	Collector current at off signal input	I_{CES}	V_{CE} = 650V		-	-	1.0	mA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$	I_C = 150A	Terminal	-	-	1.80	V
				Chip	-	1.15	-	V
	Forward voltage of FWD	V_F	I_F = 150A	Terminal	-	-	2.25	V
				Chip	-	1.50	-	V
Brake	Collector current at off signal input	I_{CES}	V_{CE} = 650V		-	-	1.0	mA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$	I_C = 75A	Terminal	-	-	1.5	V
				Chip	-	1.15	-	V
	Forward voltage of FWD	V_F	I_F = 75A	Terminal	-	-	2.1	V
				Chip	-	1.65	-	V
Switching time *11		t_{on}	I_C = 150A, V_{DC} = 300V, T_{vj} = 150°C		0.5	-	-	μs
		$t_{d(on)}$			0.5	-		μs
		t_{off}			-	-	2.0	μs
		$t_{d(off)}$			-	-	1.7	μs
		t_{rr}	I_F = 150A, V_{DC} = 300V, T_{vj} = 150°C		-	-	0.5	μs

*11: Turn on time (t_{on}) = $t_{d(on)}$ + t_r , Turn off time (t_{off}) = $t_{d(off)}$ + t_f

● Control circuit

T_{vj}=25°C, V_{CC}=15V unless otherwise specified

Item	Symbol	Conditions		Min.	Typ.	Max.	Units
Supply current of P-side pre-driver (per one unit)	I_{ccp}	Switching frequency (f_{SW}) = 0～15kHz, T_C = -20～125°C		-	-	19	mA
Supply current of N-side pre-driver	I_{ccn}			-	-	67	mA
Input signal threshold voltage	$V_{inth(on)}$	V_{in}-GND	ON	1.2	1.4	1.6	V
	$V_{inth(off)}$		OFF	1.5	1.7	1.9	V

● Protection circuit

T_{vj}=25°C, V_{CC}=15V unless otherwise specified

Item		Symbol	Conditions		Min.	Typ.	Max.	Units
Over current protection level	Inverter	I_{OC}	T_{vj}=150°C		225	-	-	A
	Brake			Resistance load	113	-	-	A
Over current protection delay time		t_{dOC}	T_{vj}=150°C		-	4.0	-	μs
Short circuit protection delay time		t_{dSC}	T_{vj}=150°C		-	1.0	-	μs
IGBT chips over heating protection temperature level		T_{jOH}	Surface of IGBT chips		175	-	-	°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
Alarm signal hold time		$t_{ALM(OC)}$	ALM-GND		1.0	2.0	2.4	ms
		$t_{ALM(UV)}$	T_C=-20～125°C	V_{cc}≧10V	3.5	4.0	4.5	ms
		$t_{ALM(TjOH)}$			7.0	8.0	9.0	ms
Alarm signal voltage		V_{ALMH}	ALM-GND, without protection		14.5	-	15.0	V
Resistance for current limit		R_{ALM}			960	-	1570	Ω

■ Thermal resistance characteristics (T_c = 25℃)

Item			Symbol	Min.	Typ.	Max.	Units
Thermal resistance junction to case *12	Inverter	IGBT	$R_{th(j-c)Q}$	-	-	0.3	K/W
		FWD	$R_{th(j-c)D}$	-	-	0.39	K/W
	Brake	IGBT	$R_{th(j-c)Q}$	-	-	0.55	K/W
		FWD	$R_{th(j-c)D}$	-	-	0.88	K/W
Thermal resistance case to heat sink *13			$R_{th(c-s)}$	-	0.05	-	K/W

*12: For 1 device , the measurement point of the case is just under the chip.
*13: This is the value which is defined mounting on the additional heat sink with 1 W/(m·K) thermal grease.

■ Noise immunity (V_{DC}=300V, V_{CC}=15V)

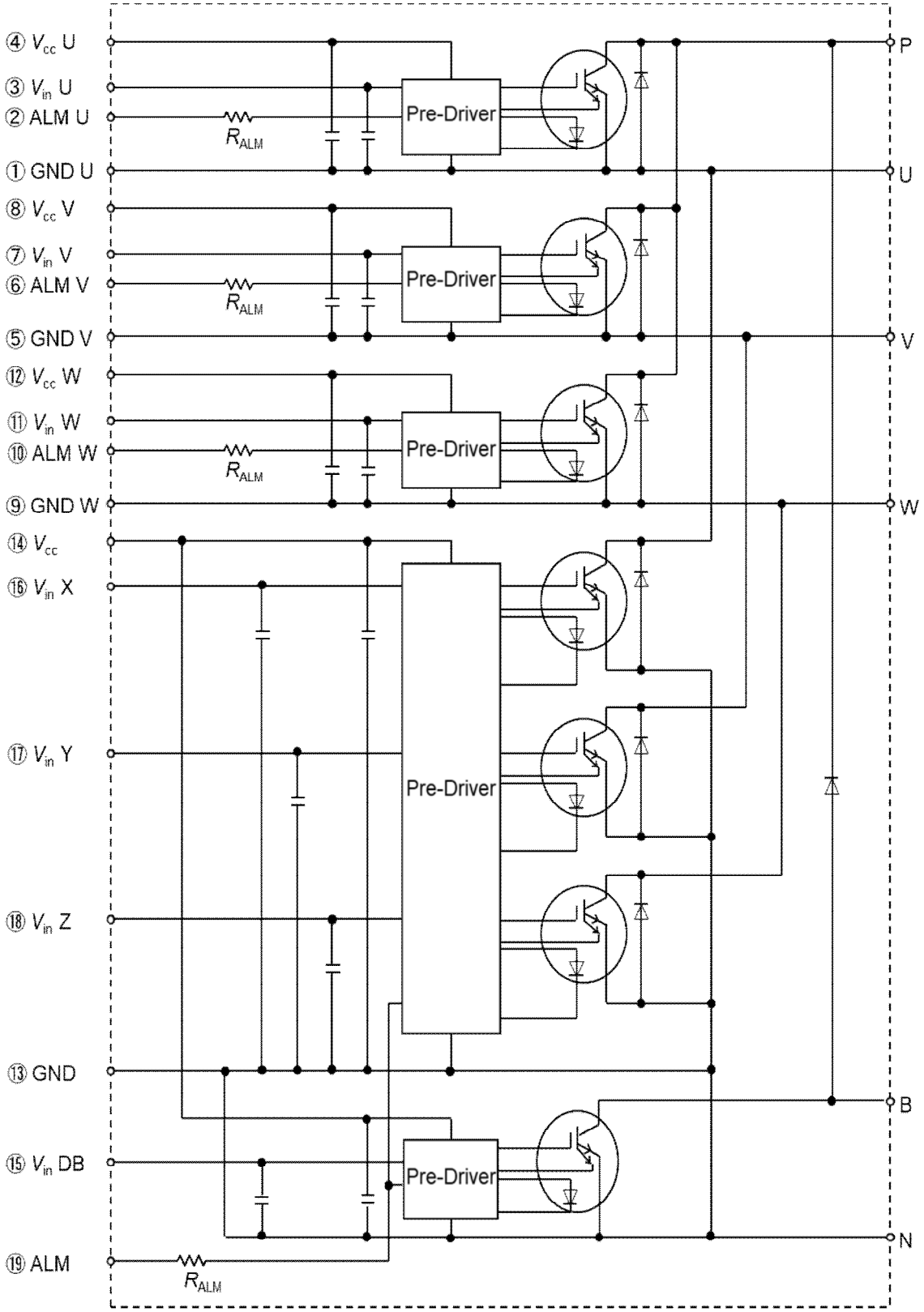
Item	Conditions	Min.	Typ.	Max.	Units
Common mode rectangular noise	Pulse width 1μs,polarity ±,10min. Judge : no over-current, no miss operating	±2.0	-	-	kV

■ Recommended operating conditions

Item	Symbol	Min.	Typ.	Max.	Units
DC bus voltage	V_{DC}	-	-	400	V
Power supply voltage of pre-driver	V_{CC}	13.5	15.0	16.5	V
Switching frequency of IPM	f_{SW}	-	-	20.0	kHz
Arm short through blocking time for IPM's input signal *14	t_{dead}	1.5	-	-	μs
Screw torque (M4)	-	1.3	-	1.7	Nm

*14: $t_{dead} = t_{off} - t_{d(on)}$

■ Block diagram

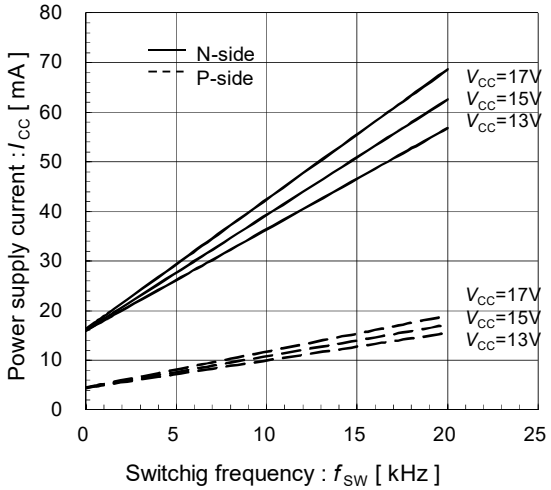


Pre-drivers include following functions
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

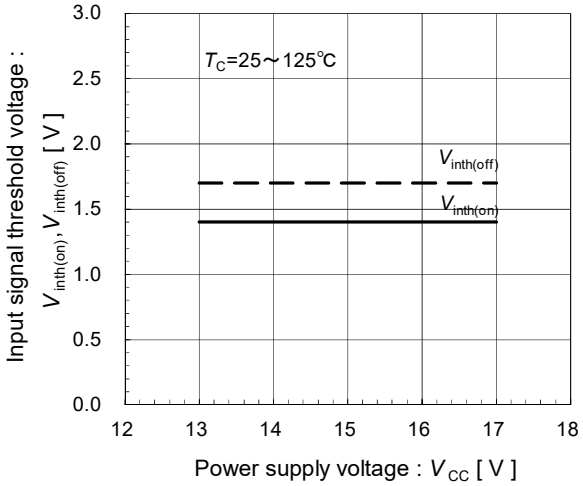
■ Characteristics (representative)

● Control circuit

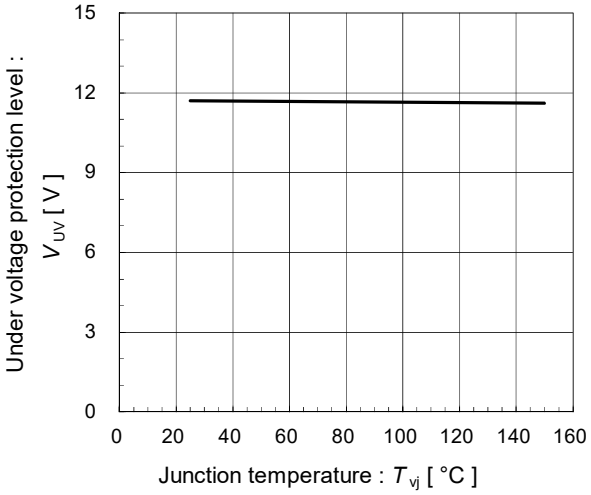
Power supply current vs. Switching frequency (typ.)
T_{vj}= 25°C



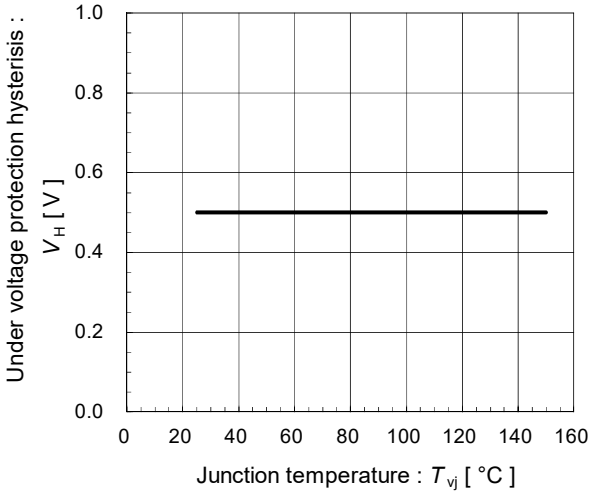
Input signal threshold voltage
vs. Power supply voltage (typ.)



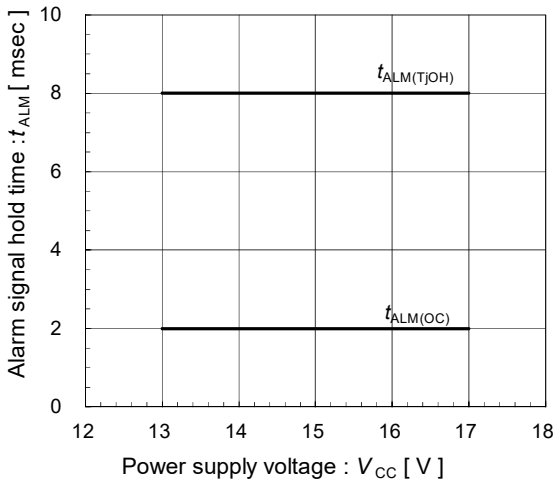
Under voltage protection level
vs. Junction temperature (typ.)



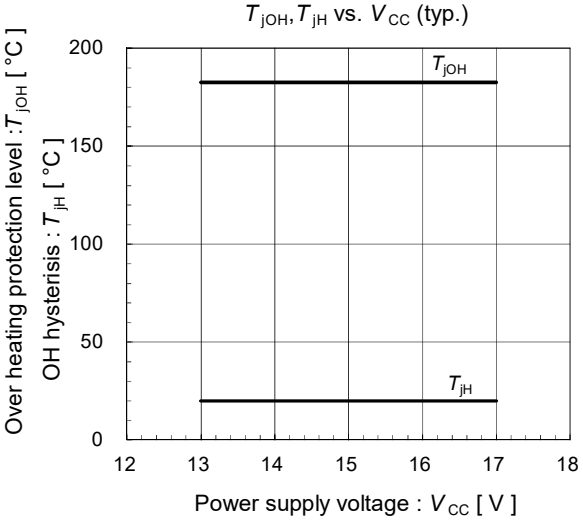
Under voltage protection hysterisis
vs. Junction temperature (typ.)



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

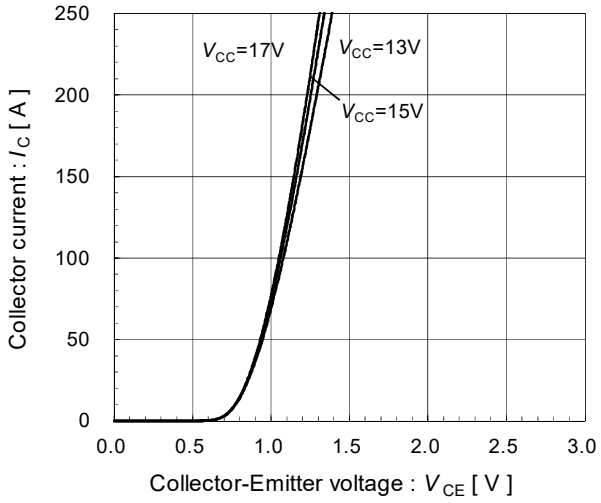


Over heating characteristics
T_{jOH}, T_{jH} vs. V_{CC} (typ.)

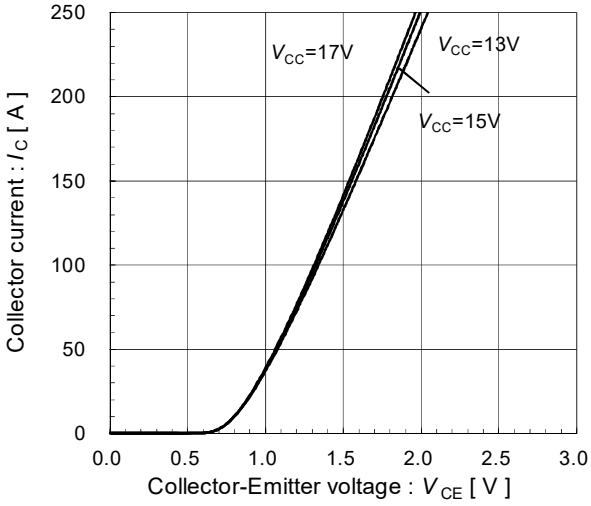


● Inverter

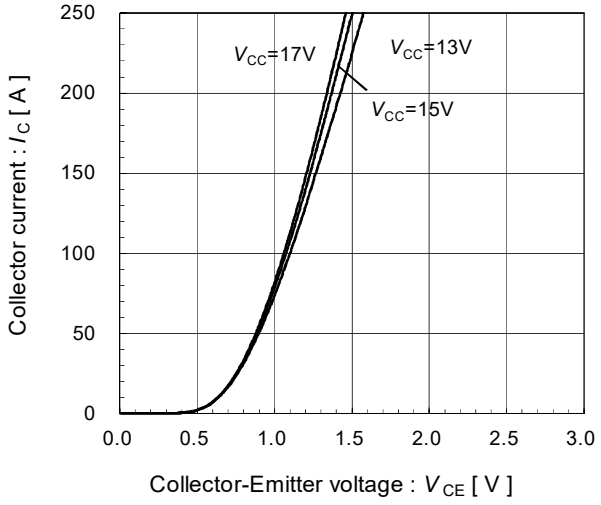
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=25°C [Chip]



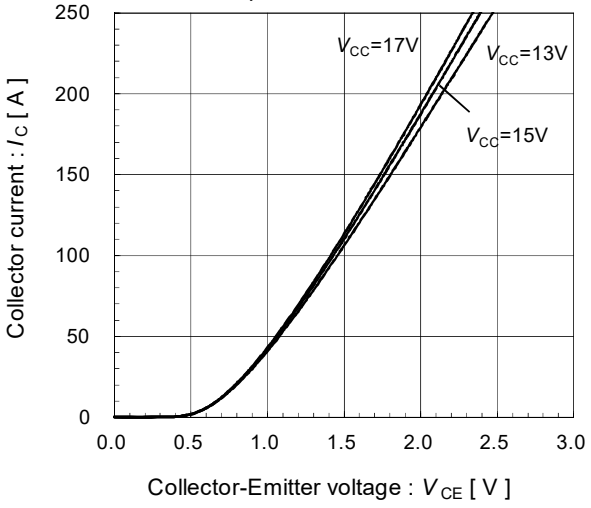
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=25°C [Terminal]



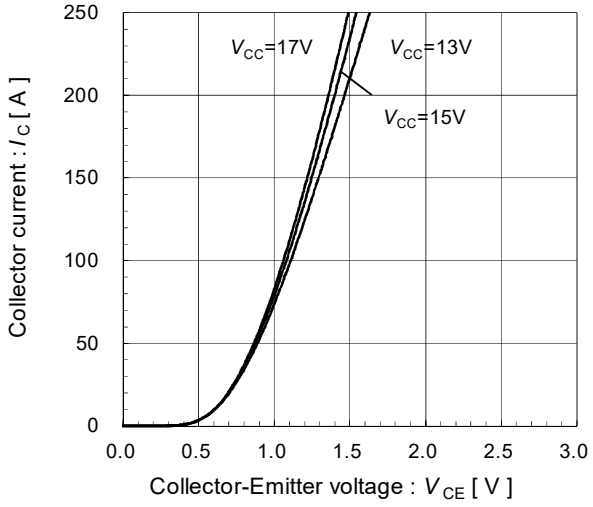
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=125°C [Chip]



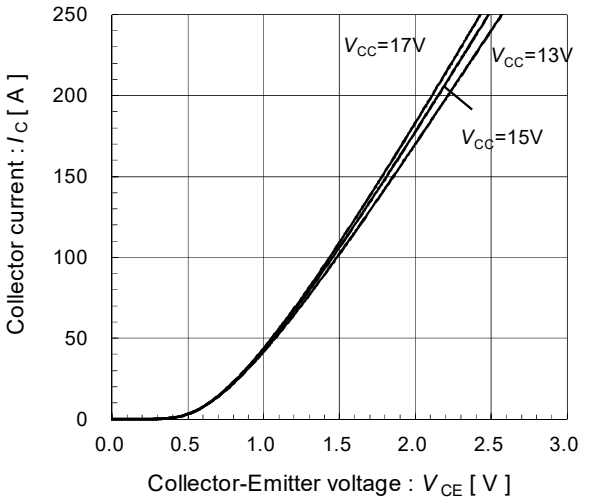
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=125°C [Terminal]



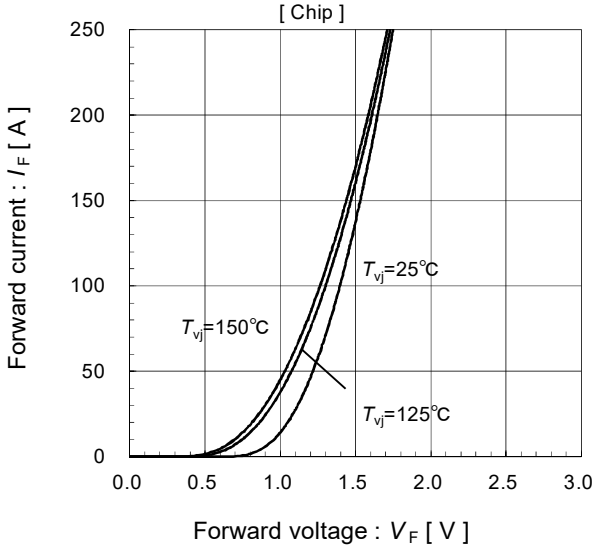
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=150°C [Chip]



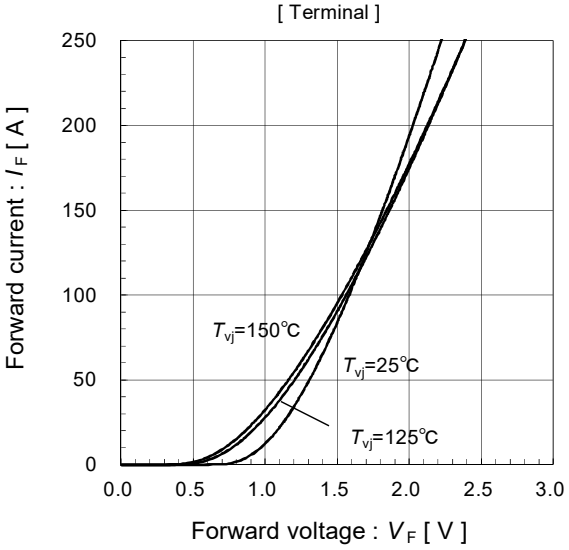
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=150°C [Terminal]



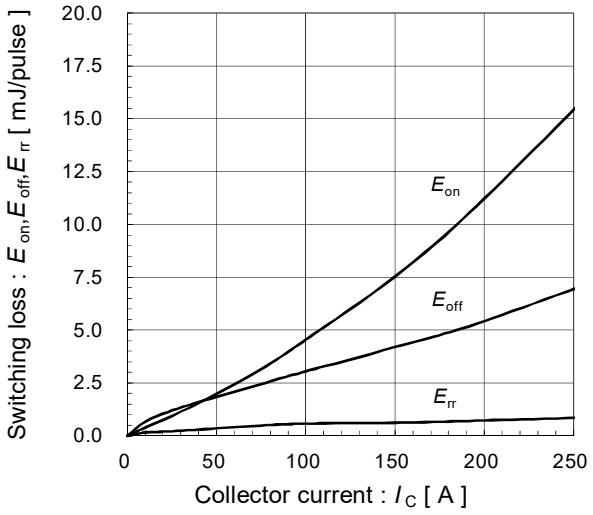
Forward current vs. Forward voltage (typ.)
[Chip]



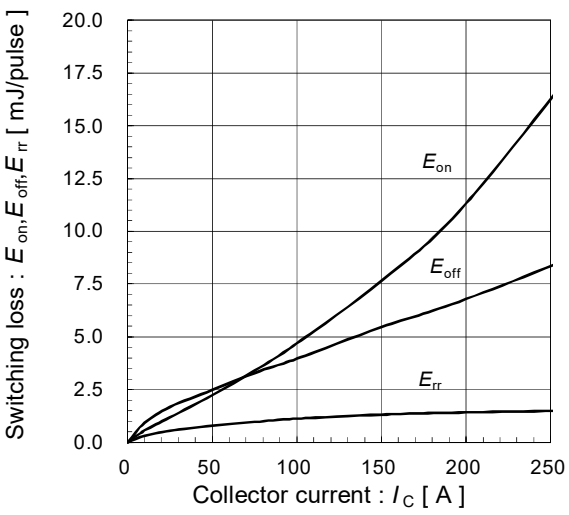
Forward current vs. Forward voltage (typ.)
[Terminal]



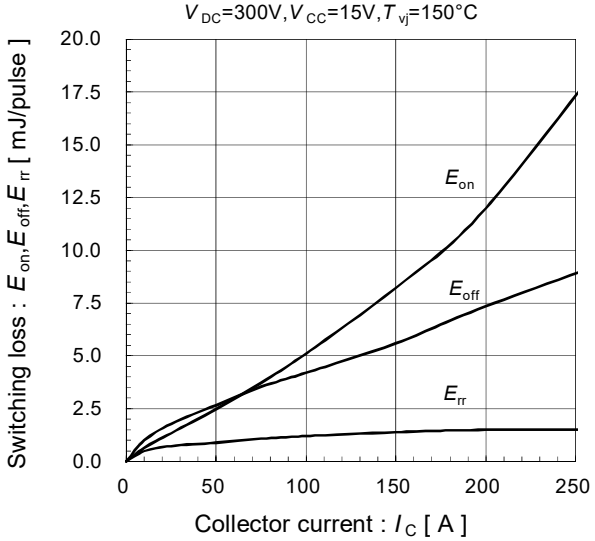
Switching loss vs. Collector current (typ.)
V_{DC}=300V, V_{CC}=15V, T_{vj}=25°C



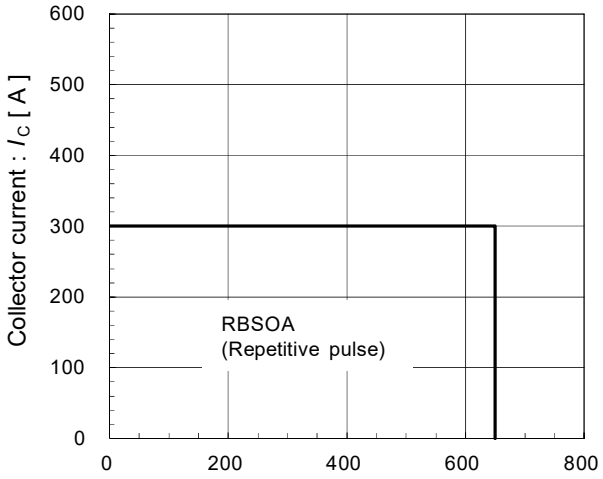
Switching loss vs. Collector current (typ.)
V_{DC}=300V, V_{CC}=15V, T_{vj}=125°C



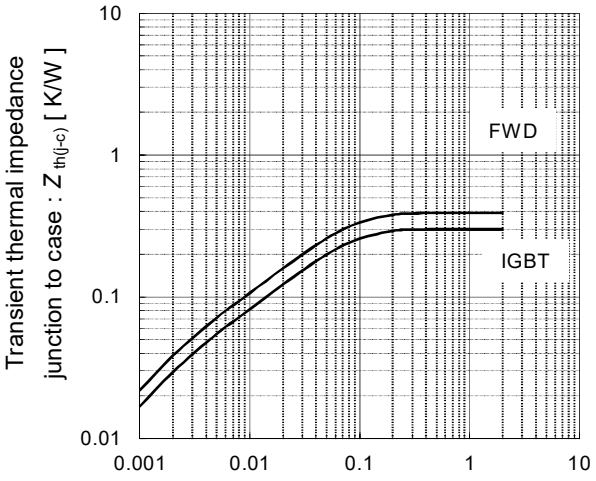
Switching loss vs. Collector current (typ.)
V_{DC}=300V, V_{CC}=15V, T_{vj}=150°C



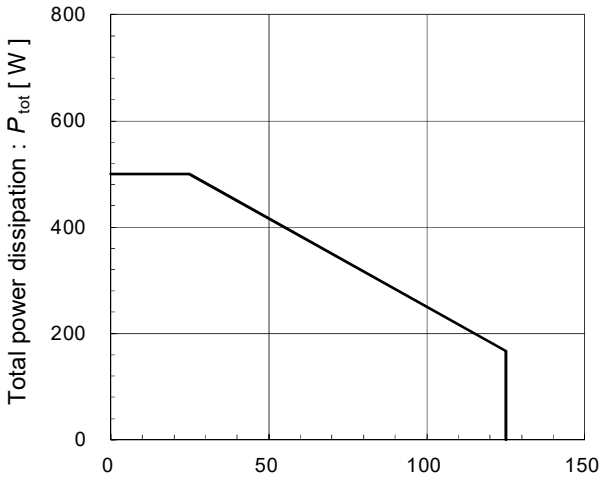
Reversed biased safe operating area (max.)
V_{CC}=15V, T_{vj}=150°C



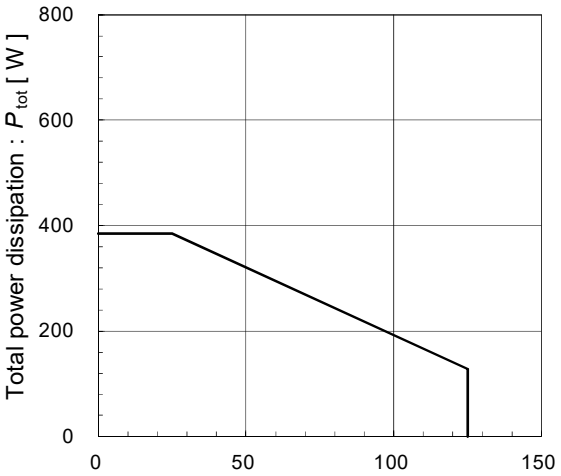
Transient thermal resistance (max.)



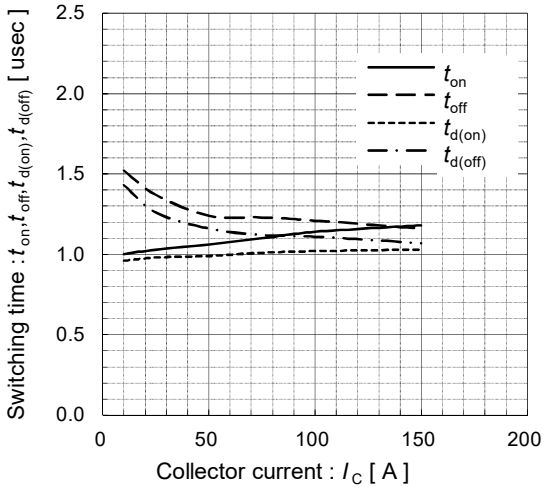
Power derating for IGBT (max.)
[per device]



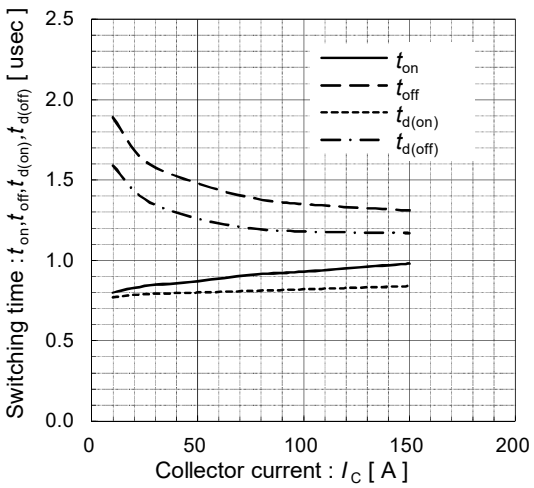
Power derating for FWD (max.)
[per device]



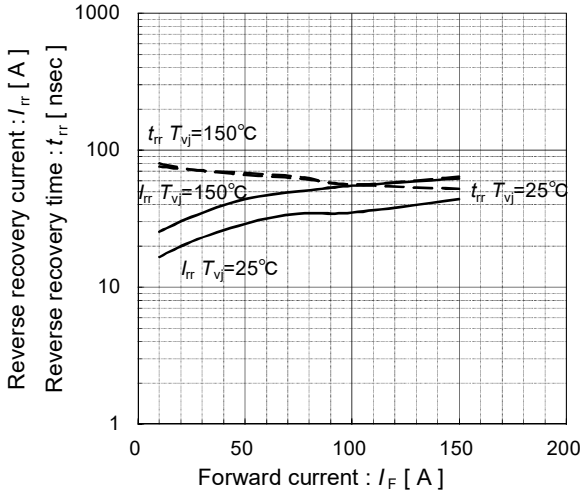
Switching time vs. Collector current (typ.)
V_{DC}=300V, V_{CC}=15V, T_{vj}=25°C



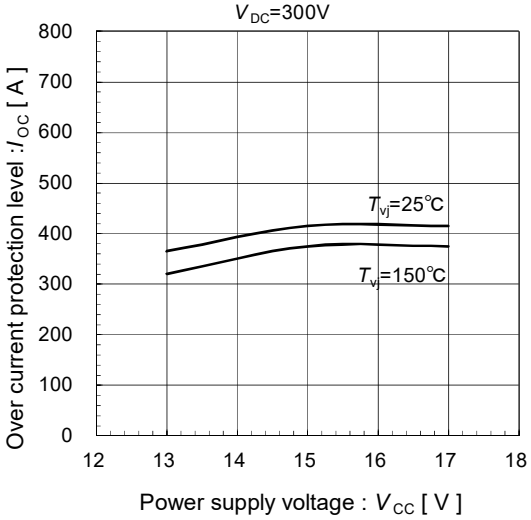
Switching time vs. Collector current (typ.)
V_{DC}=300V, V_{CC}=15V, T_{vj}=150°C



Reverse recovery characteristics (typ.)
V_{DC}=300V, V_{CC}=15V

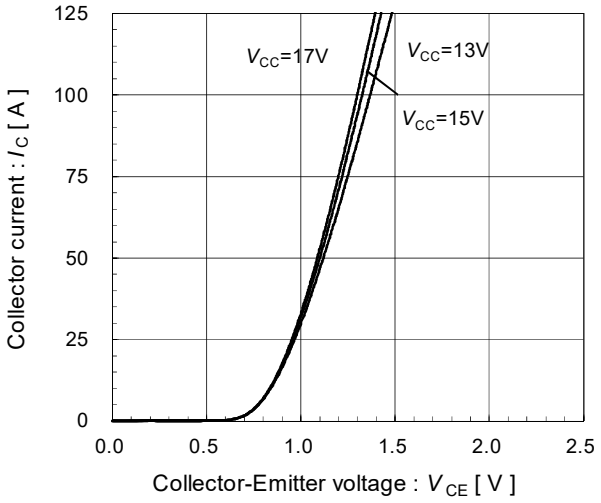


Over current protection vs. Power supply voltage (typ.)
V_{DC}=300V

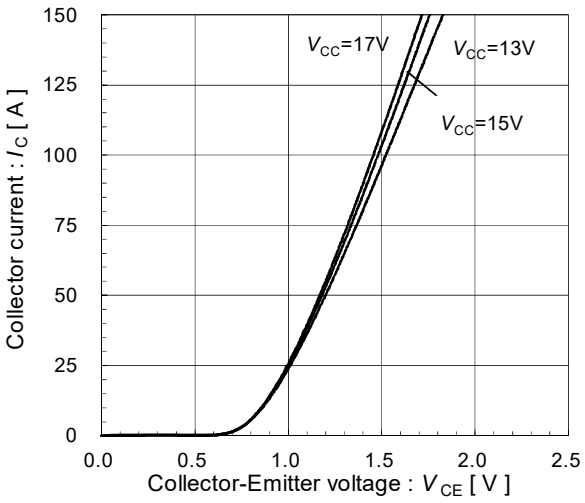


● Brake

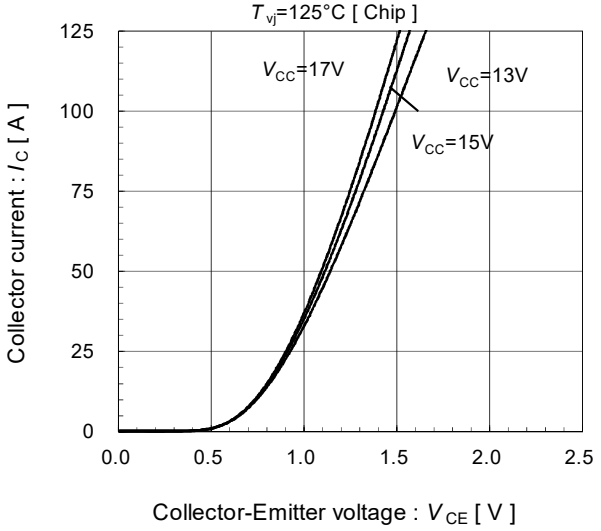
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=25°C [Chip]



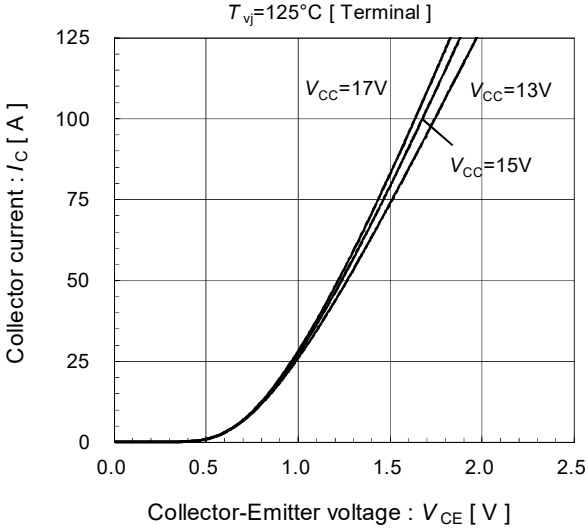
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=25°C [Terminal]



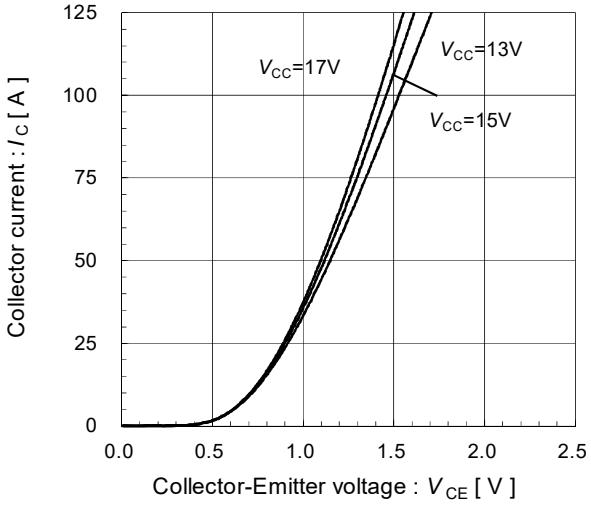
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=125°C [Chip]



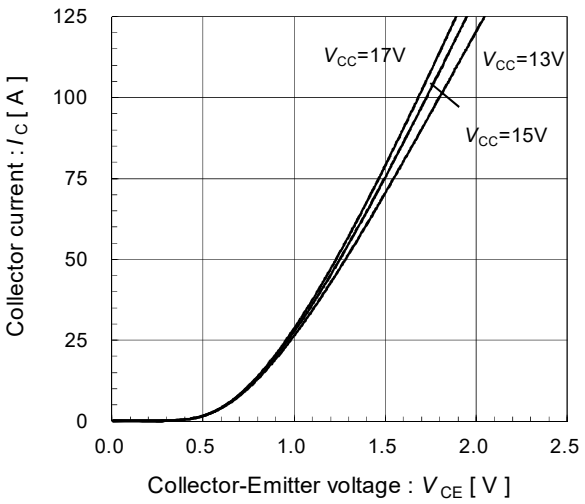
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=125°C [Terminal]



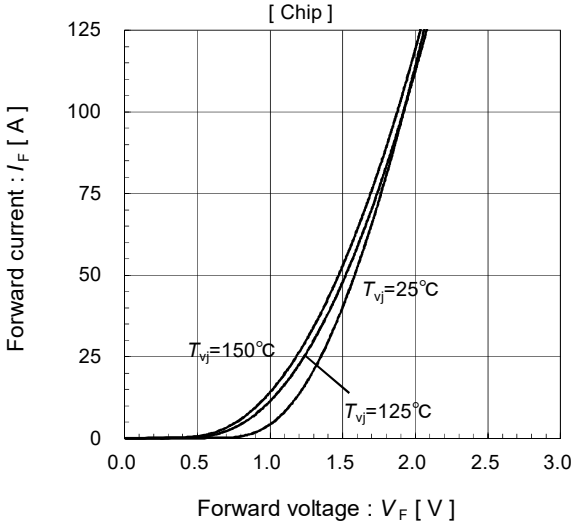
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=150°C [Chip]



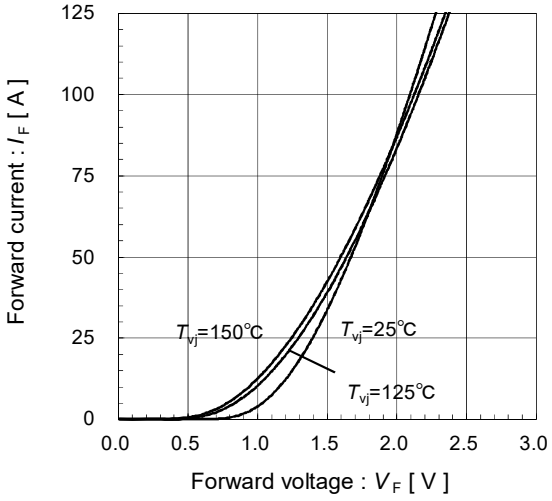
Collector current vs. Collector-Emitter voltage (typ.)
T_{vj}=150°C [Terminal]



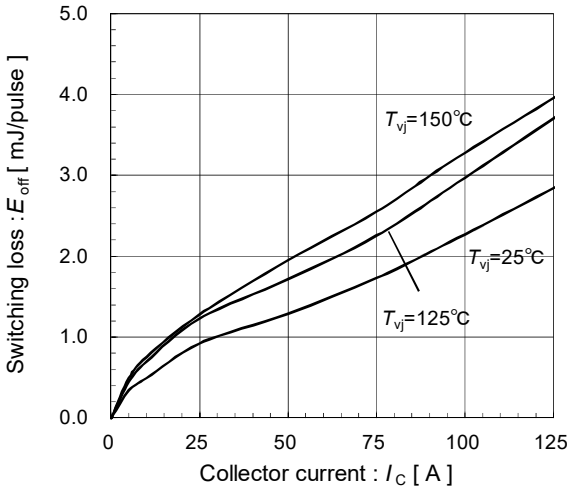
Forward current vs. Forward voltage (typ.)
[Chip]



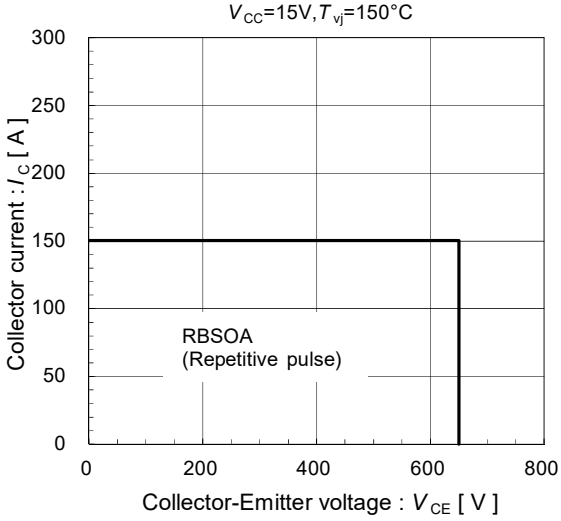
Forward current vs. Forward voltage (typ.)
[Terminal]



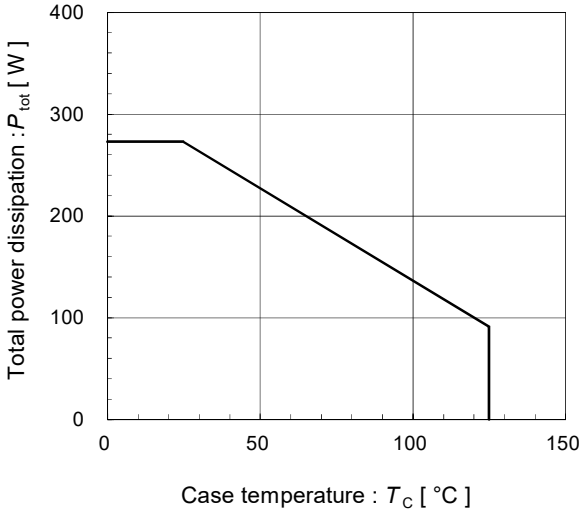
Switching loss vs. Collector current (typ.)
V_{DC}=300V, V_{CC}=15V, Resistive load



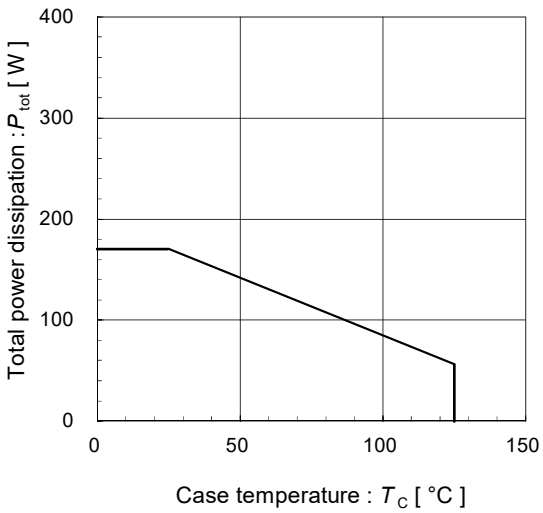
Reversed biased safe operating area
V_{CC}=15V, T_{vj}=150°C



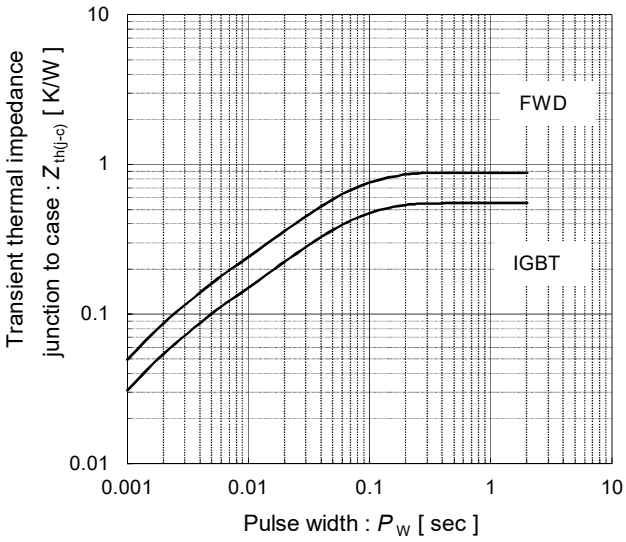
Power derating for IGBT (max.)
[per device]



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



Transient thermal resistance (max.)



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