

6MBP400VEA060-50

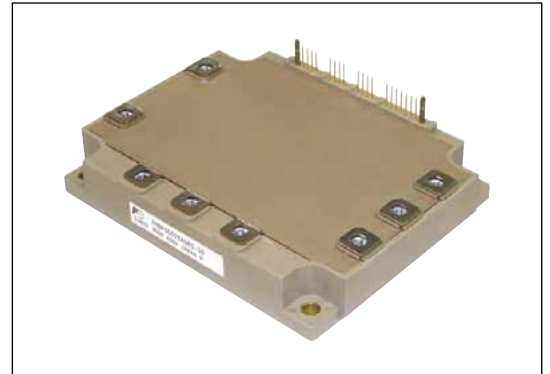
IGBT Modules

IGBT MODULE (V series)

600V / 400A / 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



■ Maximum Ratings and Characteristics

● Absolute Maximum Ratings (T_c=25°C, V_{cc}=15V 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		
Inverter	Collector Current	DC	I _c	-	400	A
		1ms	I _{CP}	-	800	A
		Duty=68.6% (*2)	-I _c	-	400	A
Collector Power Dissipation	1 device (*3)	P _c	-	1086	W	
Brake	Collector Current	DC	I _c	-	-	A
		1ms	I _{CP}	-	-	A
	Forward Current of Diode	I _F	-	-	A	
	Collector Power Dissipation	1 device (*3)	P _c	-	-	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	°C		
Operating Case Temperature	T _{opr}	-20	110	°C		
Storage Temperature	T _{stg}	-40	125	°C		
Solder Temperature (*8)	T _{sol}	-	260	°C		
Isolating Voltage (*9)	V _{iso}	-	AC2500	Vrms		
Screw Torque	Terminal (M5)	-	-	-		
	Mounting (M5)	-	-	3.5	Nm	

Note *1: V_{CEs} shall be applied to the input voltage between all Collector and Emitter.

[P1-(U,V,W,B) , P2-(U,V,W,B) , (U,V,W,B)-N1 , (U,V,W,B)-N2]

Note *2: Duty=125°C/R_{th(j-e)D}/(I_F×V_F Max.)×100

Note *3: P_c=125°C/R_{th(j-e)Q} (Inverter & Brake)

Note *4: V_{CC} shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 14 and 13.

Note *5: V_{in} shall be applied to the input voltage between terminal No.2 and 1, 6 and 5, 10 and 9, 15~18 and 13.

Note *6: V_{ALM} shall be applied to the voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 19 and 13.

Note *7: I_{ALM} shall be applied to the input current to terminal No.4, 8, 12 and 19.

Note *8: Immersion time 10±1sec. 1 time

Note *9: Terminal to base, 50/60Hz sine wave 1min. All terminals should be connected together during the test.

● Electrical Characteristics ($T_j=25^\circ\text{C}$, $V_{cc}=15\text{V}$ unless otherwise specified)

Items	Symbol	Conditions	Min.	Typ.	Max.	Units		
Inverter	Collector Current at off signal input	I_{CES}	$V_{CE}=600\text{V}$	-	-	1.0	mA	
	Collector-Emitter saturation voltage (*10)	$V_{CE(sat)}$	$I_C=400\text{A}$	Terminal	-	-	2.05	V
				Chip	-	1.25	-	V
	Forward voltage of FWD (*10)	V_F	$I_F=400\text{A}$	Terminal	-	-	2.60	V
Chip				-	1.80	-	V	
Brake	Collector Current at off signal input	I_{CES}	-	-	-	mA		
	Collector-Emitter saturation voltage (*10)	$V_{CE(sat)}$	-	-	-	V		
			-	-	-	V		
Forward voltage of FWD (*10)	V_F	-	-	-	V			
		-	-	-	V			
Switching time	t_{on}	$V_{DC}=300\text{V}$, $T_j=125^\circ\text{C}$, $I_C=400\text{A}$	1.1	-	-	μs		
	t_{off}		-	-	2.1	μs		
	t_{rr}	$V_{DC}=300\text{V}$, $I_F=400\text{A}$	-	-	0.3	μs		
Supply current of P-side pre-driver (per one unit)	I_{ccp}	Switching Frequency= 0-15kHz $T_c=-20\sim 110^\circ\text{C}$	-	-	45	mA		
Supply current of N-side pre-driver	I_{ccn}		-	-	135	mA		
Input signal threshold voltage	$V_{in(th)(on)}$	$V_{in}-\text{GND}$	ON	1.2	1.4	1.6	V	
	$V_{in(th)(off)}$		OFF	1.5	1.7	1.9	V	
Over Current Protection Level	Inverter	I_{OC}	$T_j=125^\circ\text{C}$	600	-	-	A	
				Brake	-	-	-	A
Over Current Protection Delay time	t_{dOC}	$T_j=125^\circ\text{C}$	-	5	-	μs		
Short Circuit Protection Delay time	t_{sc}	$T_j=125^\circ\text{C}$	-	2	3	μs		
IGBT Chips Over Heating Protection Temperature Level	T_{jOH}	Surface of IGBT Chips	150	-	-	$^\circ\text{C}$		
Over Heating Protection Hysteresis	T_{jH}		-	20	-	$^\circ\text{C}$		
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 $T_c=-20\sim 110^\circ\text{C}$	$V_{CC} \geq 10\text{V}$	1.0	2.0	2.4	ms	
	$t_{ALM(UV)}$			2.5	4.0	4.9	ms	
	$t_{ALM(TjOH)}$			5.0	8.0	11.0	ms	
Resistance for current limit	R_{ALM}		960	1265	1570	Ω		

Note *10: The Max value is a case where it measures from P2-(U,V,W,B) , (U,V,W,B)-N2.

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

Items		Symbol	Min.	Typ.	Max.	Units	
Junction to Case Thermal Resistance (*11)	Inverter	IGBT	$R_{th(j-c)Q}$	-	-	0.115	$^\circ\text{C}/\text{W}$
		FWD	$R_{th(j-c)D}$	-	-	0.175	$^\circ\text{C}/\text{W}$
	Brake	IGBT	$R_{th(j-c)Q}$	-	-	-	$^\circ\text{C}/\text{W}$
		FWD	$R_{th(j-c)D}$	-	-	-	$^\circ\text{C}/\text{W}$
Case to Fin Thermal Resistance with Compound		$R_{th(c-f)}$	-	0.05	-	$^\circ\text{C}/\text{W}$	

Note *11: For 1device, the measurement point of the case is just under the chip.

● Noise Immunity ($V_{dc}=300\text{V}$, $V_{cc}=15\text{V}$)

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

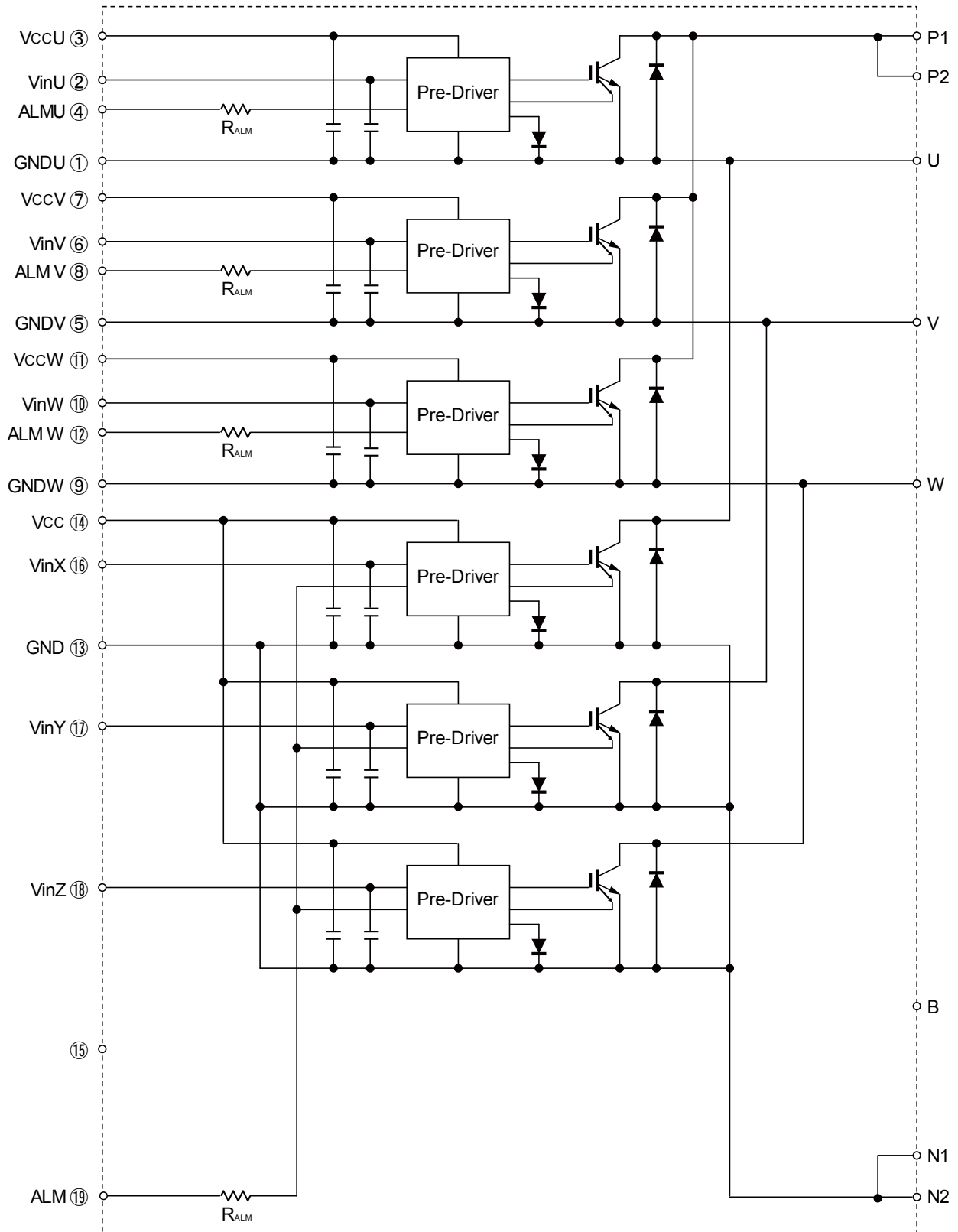
● Recommended Operating Conditions

Items	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	kHz
Arm shoot through blocking time for IPM's input signal	t_{dead}	1.0	-	-	μs
Screw Torque (M5)	-	2.5	-	3.5	Nm

● Weight

Items	Symbol	Min.	Typ.	Max.	Units
Weight	W_i	-	940	-	g

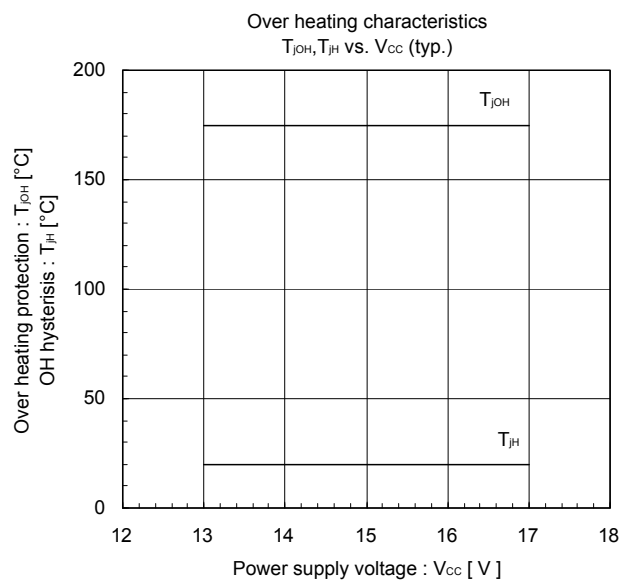
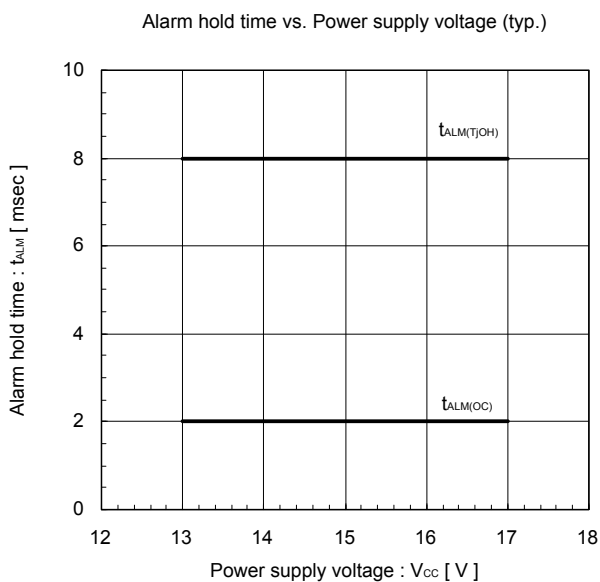
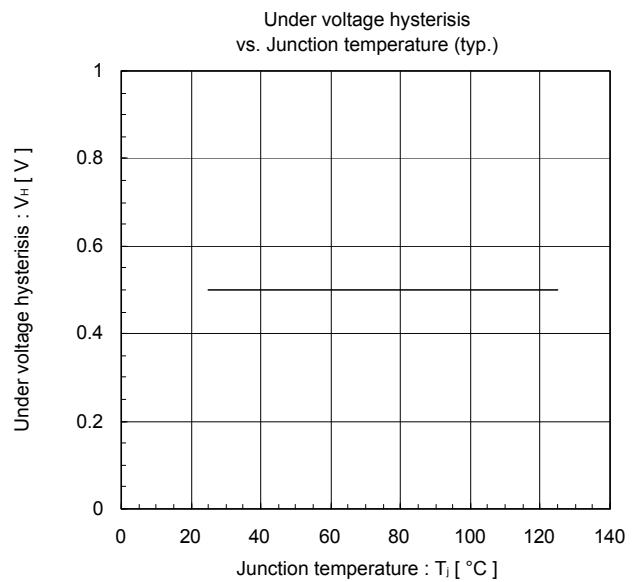
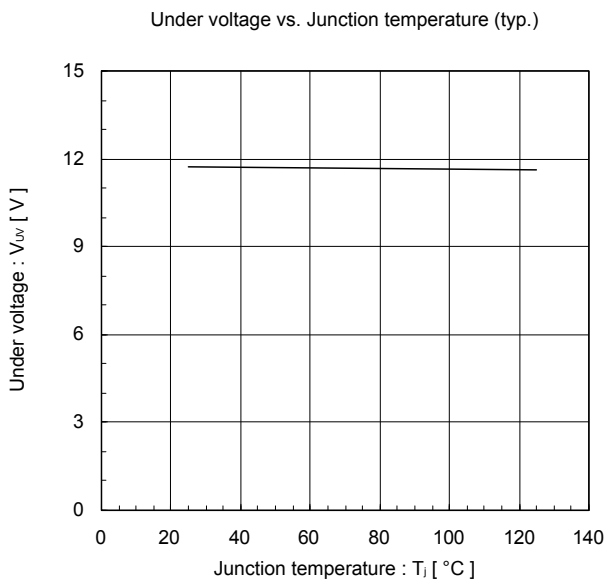
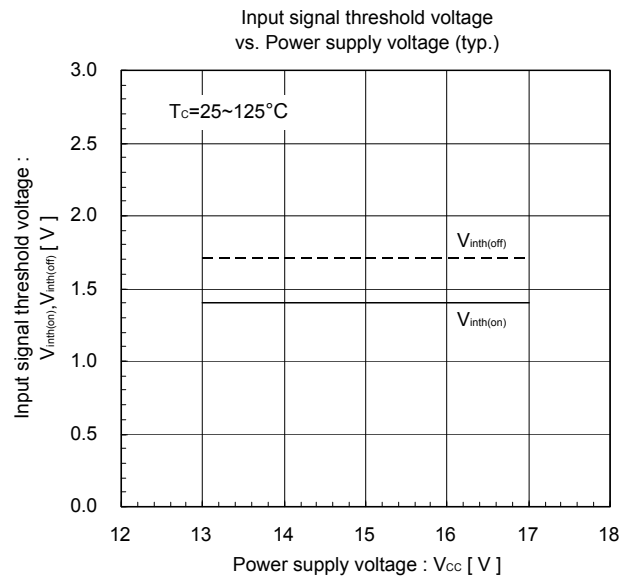
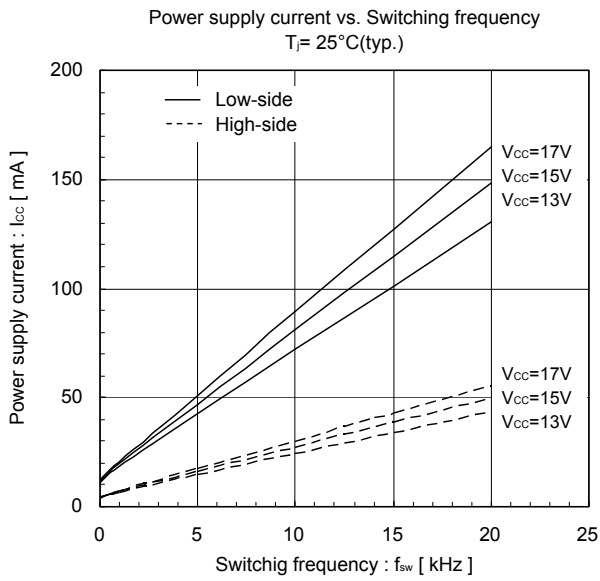
■ Block Diagram



Pre-drivers include following functions

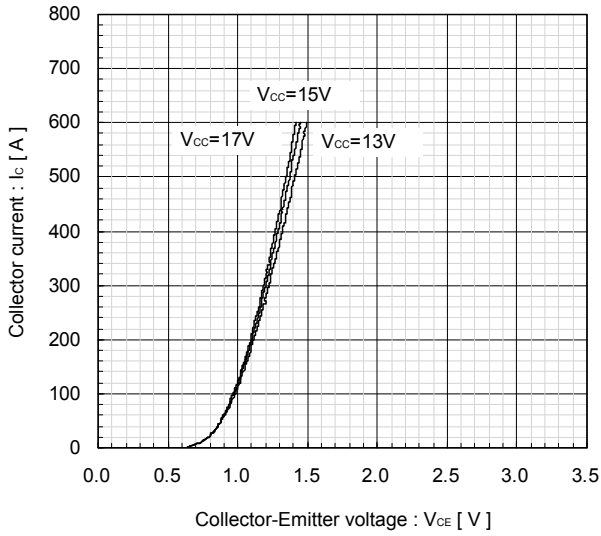
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

■ Characteristics (Representative)

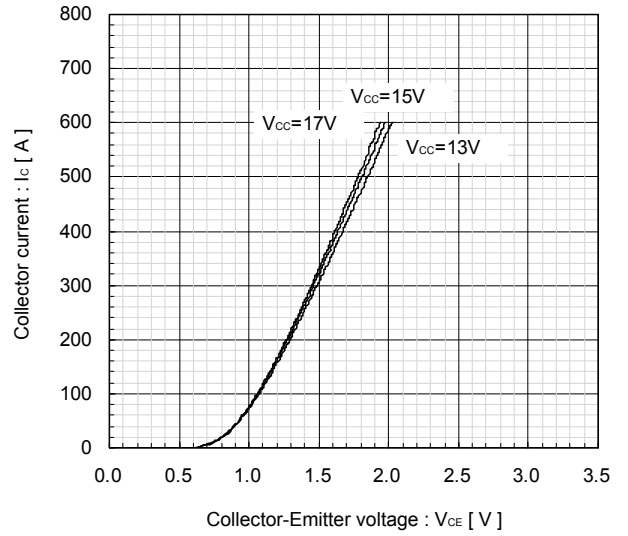


Inverter

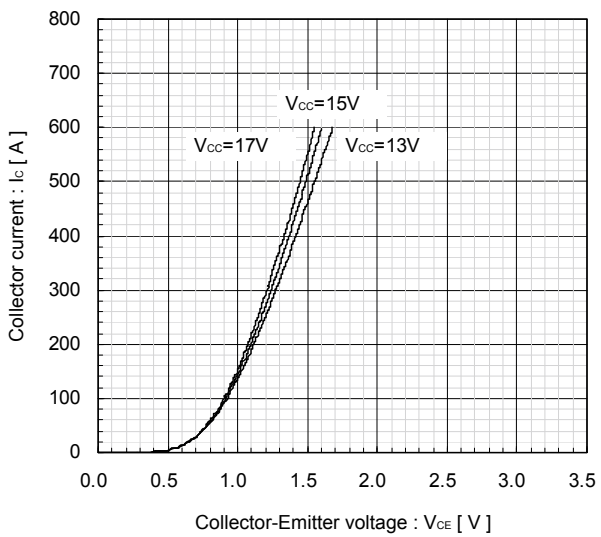
Collector current vs. Collector-Emitter voltage
 $T_j=25^\circ\text{C}$ [Chip] (typ.)



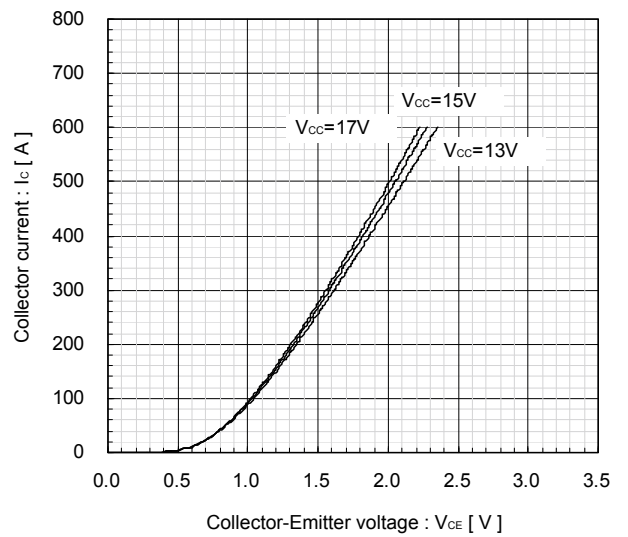
Collector current vs. Collector-Emitter voltage
 $T_j=25^\circ\text{C}$ [Terminal] (typ.)



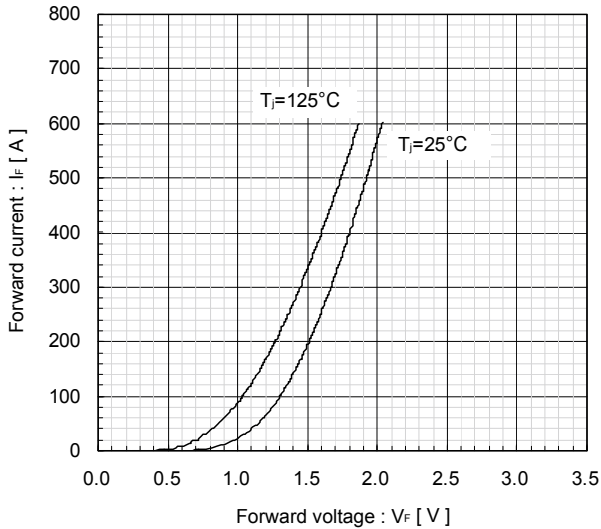
Collector current vs. Collector-Emitter voltage
 $T_j=125^\circ\text{C}$ [Chip] (typ.)



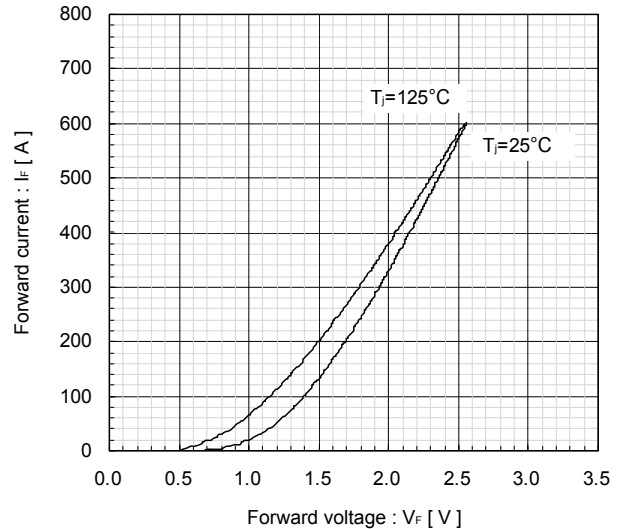
Collector current vs. Collector-Emitter voltage
 $T_j=125^\circ\text{C}$ [Terminal] (typ.)



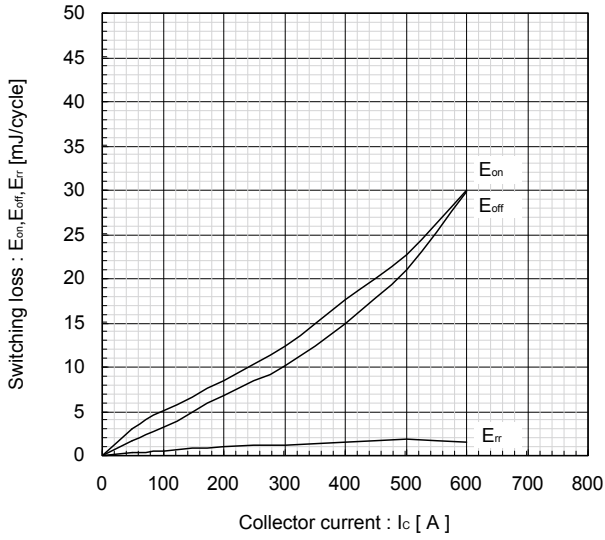
Forward current vs. Forward voltage
 [Chip] (typ.)



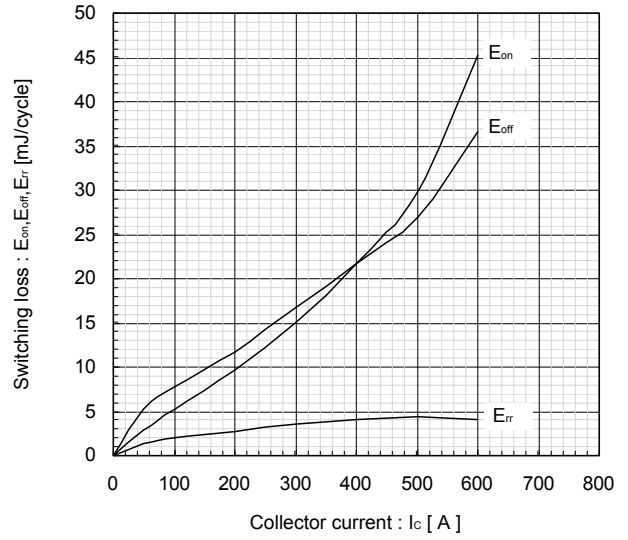
Forward current vs. Forward voltage
 [Terminal] (typ.)



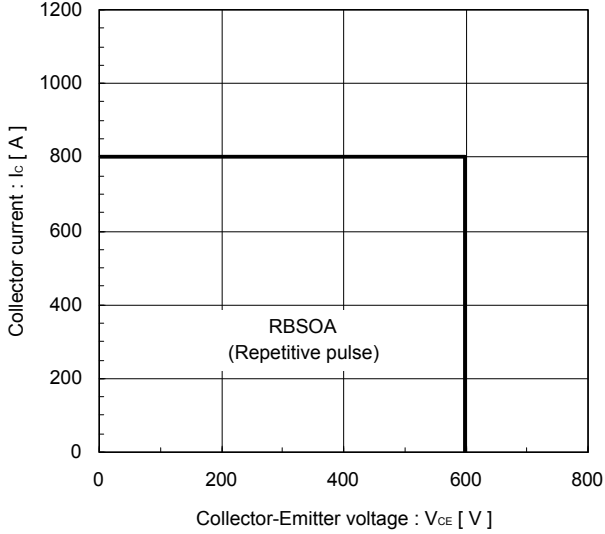
Switching Loss vs. Collector Current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_j=25^\circ C$



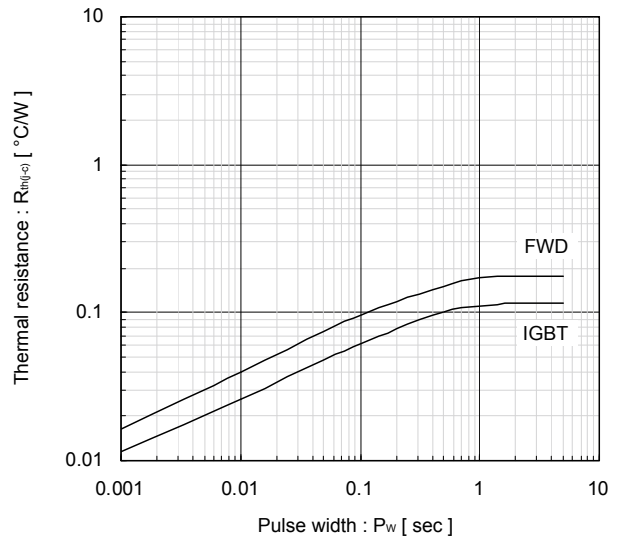
Switching Loss vs. Collector Current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_j=125^\circ C$



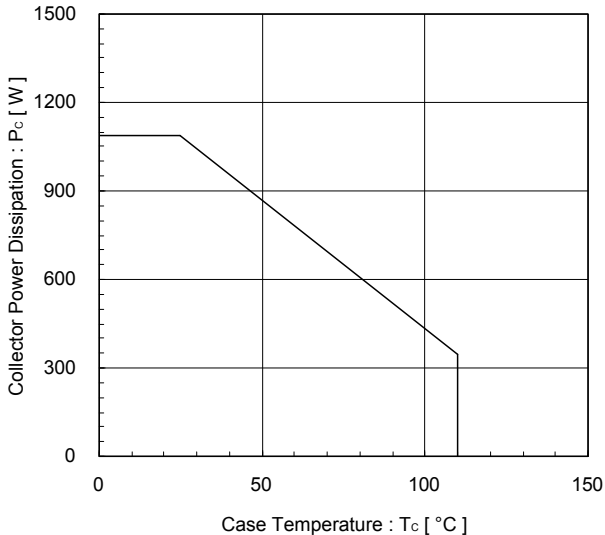
Reversed biased safe operating area
 $V_{CC}=15V, T_j \le 125^\circ C$ [Main Terminal] (min.)



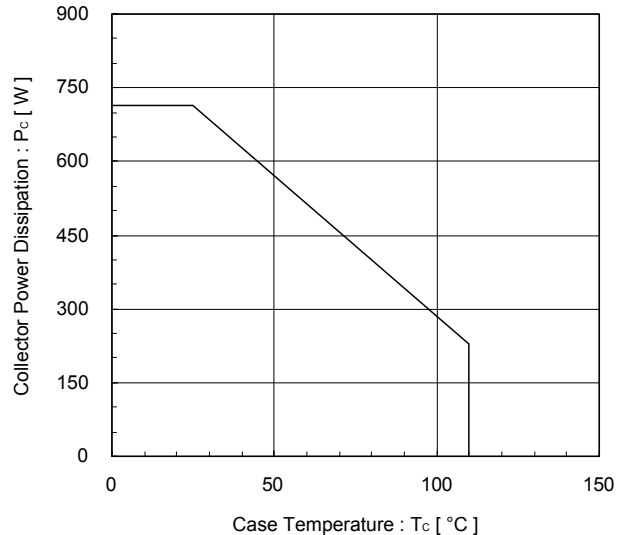
Transient thermal resistance (max.)



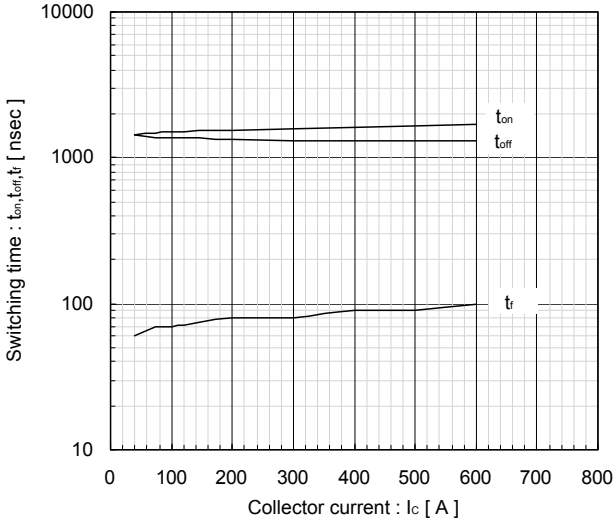
Power derating for IGBT (max.)
 [per device]



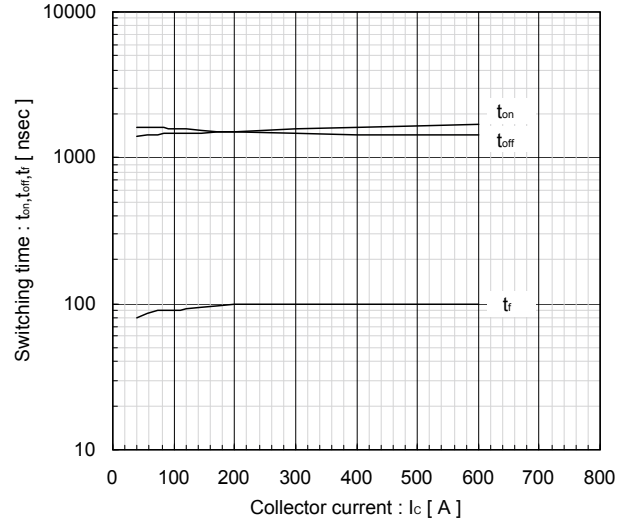
Power derating for FWD (max.)
 [per device]



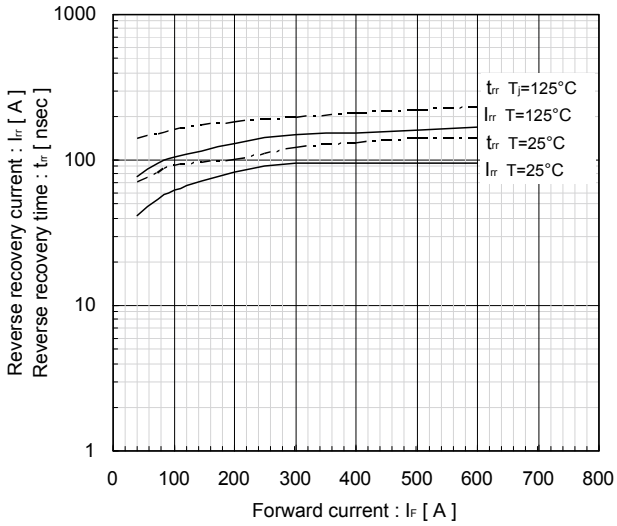
Switching time vs. Collector current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_J=25^\circ C$



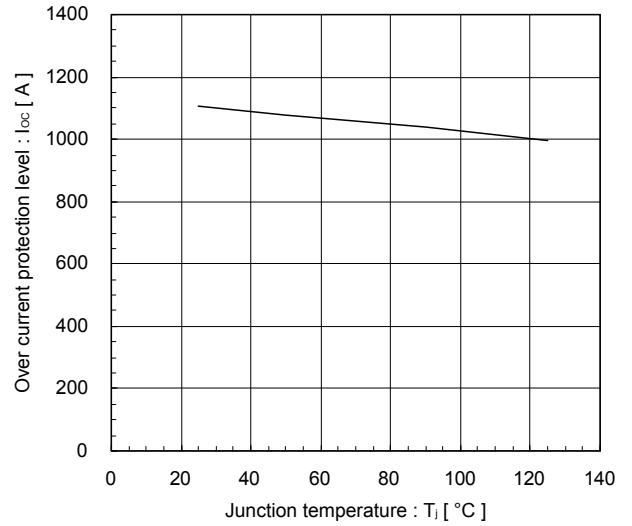
Switching time vs. Collector current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_J=125^\circ C$



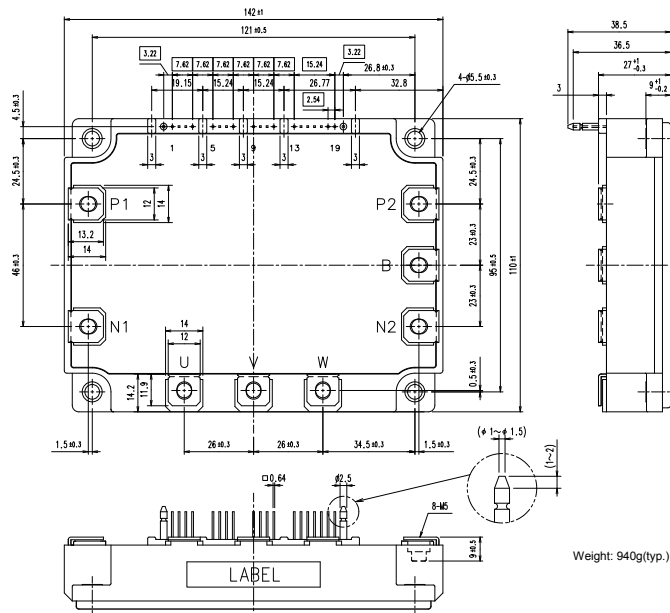
Reverse recovery characteristics (typ.)
 t_{rr}, I_{rr} vs. I_F



Over current protection vs. Junction temperature (typ.)
 $V_{CC}=15V$



■ Outline Drawings, mm



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IGBT Modules

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