

6MBP400VEA060-50

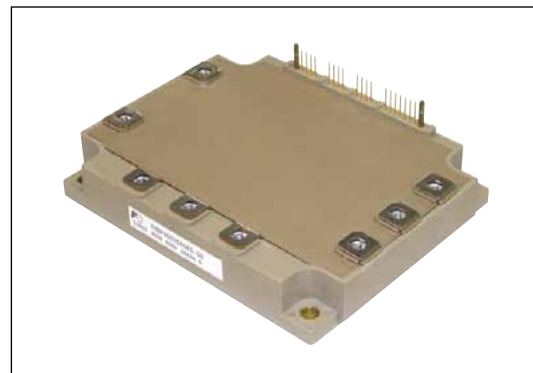
IGBT Modules

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 ($T_c=25^{\circ}\text{C}$, $V_{cc}=15\text{V}$ 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
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)	-	-	3.5	Nm
		Mounting (M5)				

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 $^{\circ}\text{C}/R_{th(j-c)D}/(I_F \times V_F \text{ Max.}) \times 100$

Note *3: $P_C=125^{\circ}\text{C}/R_{th(j-c)Q}$ (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 $\pm$ 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} =600V		-	-	1.0	mA
	Collector-Emitter saturation voltage (*10)	V _{CE(sat)}	I _c =400A	Terminal	-	-	2.05	V
				Chip	-	1.25	-	V
	Forward voltage of FWD (*10)	V _F	I _f =400A	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} =300V, T _J =125°C, I _c =400A		1.1	-	-	μs
		t _{off}			-	-	2.1	μs
		t _{rr}	V _{DC} =300V, I _F =400A		-	-	0.3	μs
Supply current of P-side pre-driver (per one unit)		I _{ccp}	Switching Frequency= 0-15kHz T _c =-20~110°C		-	-	45	mA
Supply current of N-side pre-driver		I _{ccn}			-	-	135	mA
Input signal threshold voltage		V _{in(th)(on)}	V _{in} -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°C		600	-	-	A
	Brake				-	-	-	A
Over Current Protection Delay time		t _{dOC}	T _J =125°C		-	5	-	μs
Short Circuit Protection Delay time		t _{SC}	T _J =125°C		-	2	3	μs
IGBT Chips Over Heating Protection Temperature Level		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
Alarm Signal Hold Time		t _{ALM(OC)}	ALM-GND T _c =-20~110°C	V _{CC} ≥ 10V	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	°C/W
		FWD	R _{th(j-c)D}	-	-	0.175	°C/W
	Brake	IGBT	R _{th(j-c)Q}	-	-	-	°C/W
		FWD	R _{th(j-c)D}	-	-	-	°C/W
Case to Fin Thermal Resistance with Compound			R _{th(c-f)}	-	0.05	-	°C/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

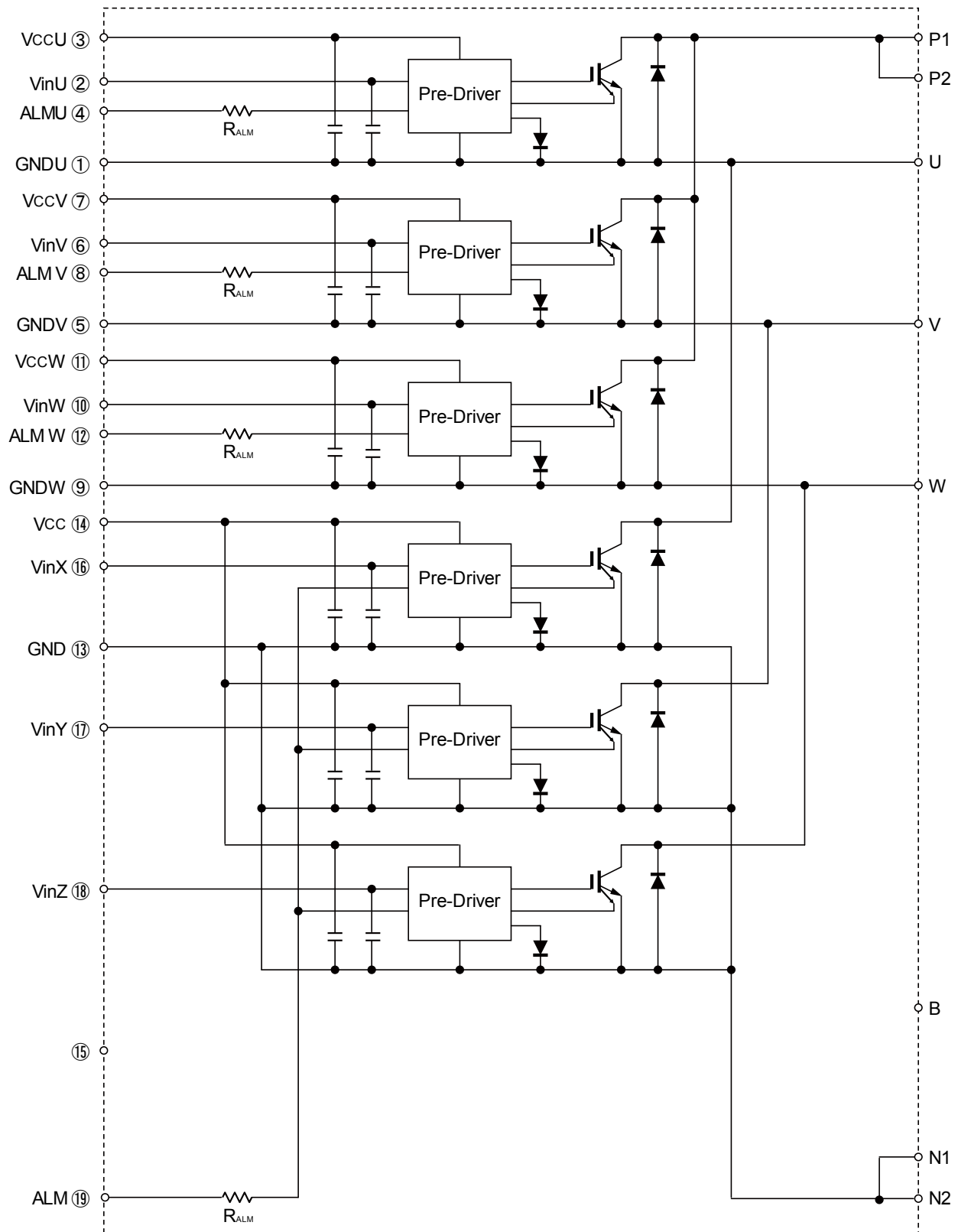
● Recommended Operating Conditions

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

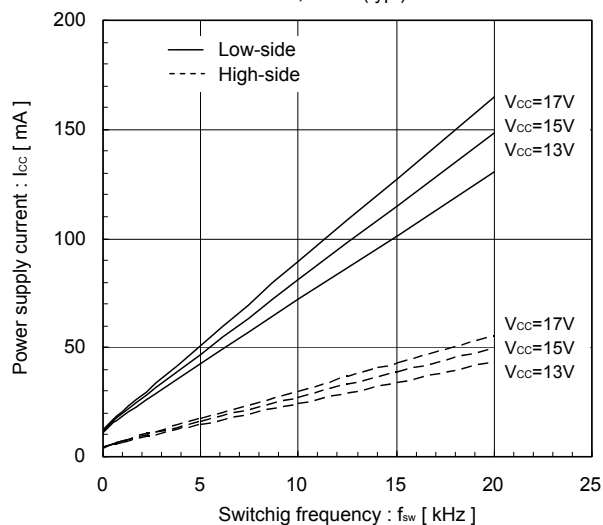


Pre-drivers include following functions

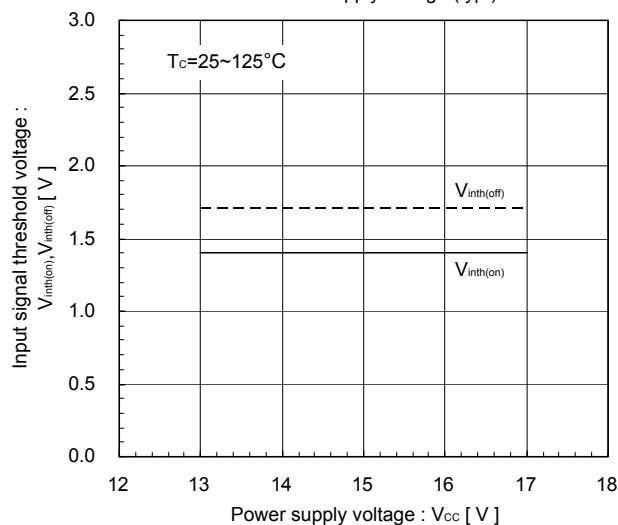
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

Characteristics (Representative)

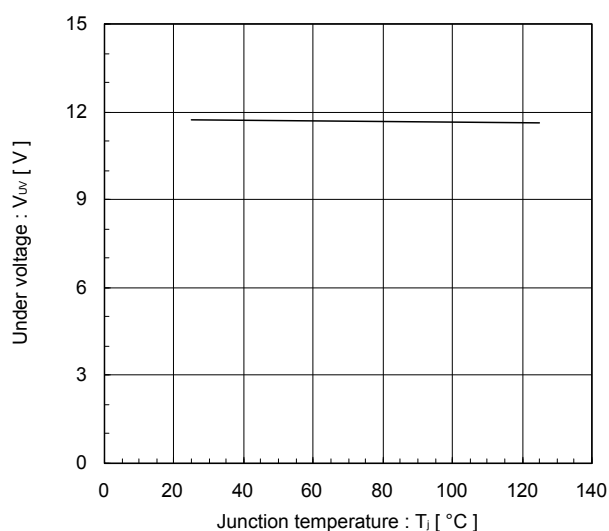
Power supply current vs. Switching frequency
 $T_J = 25^\circ\text{C}(\text{typ.})$



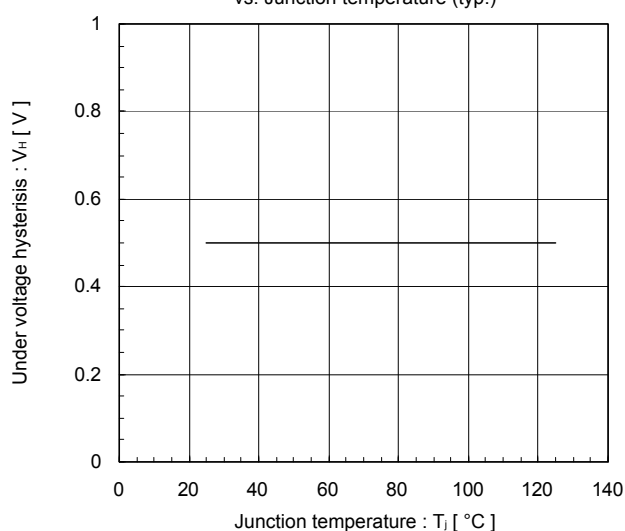
Input signal threshold voltage
 vs. Power supply voltage (typ.)



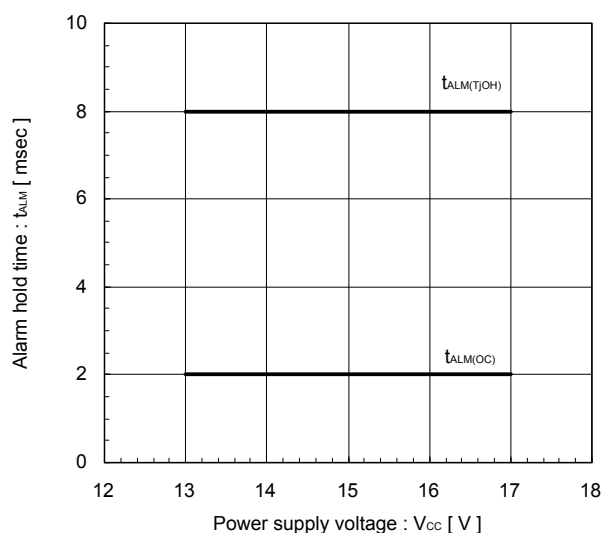
Under voltage vs. Junction temperature (typ.)



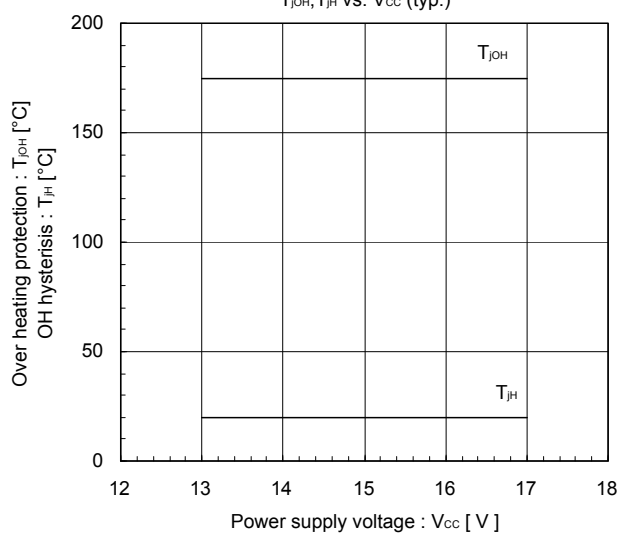
Under voltage hysteresis
 vs. Junction temperature (typ.)



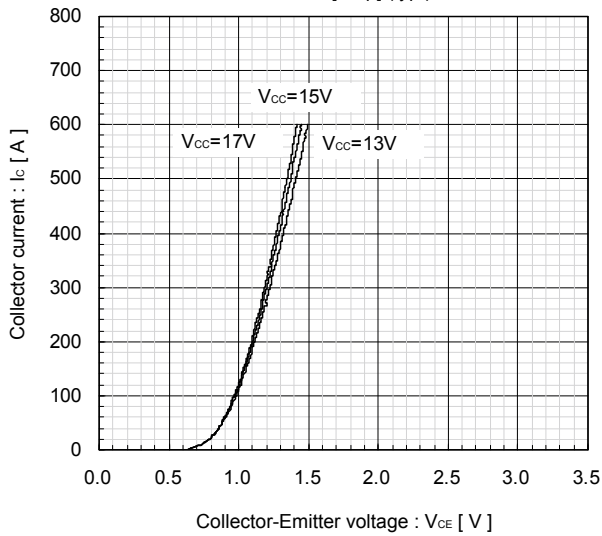
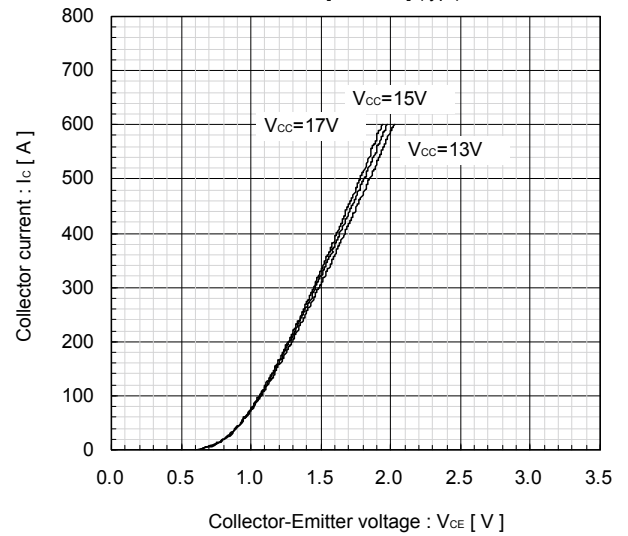
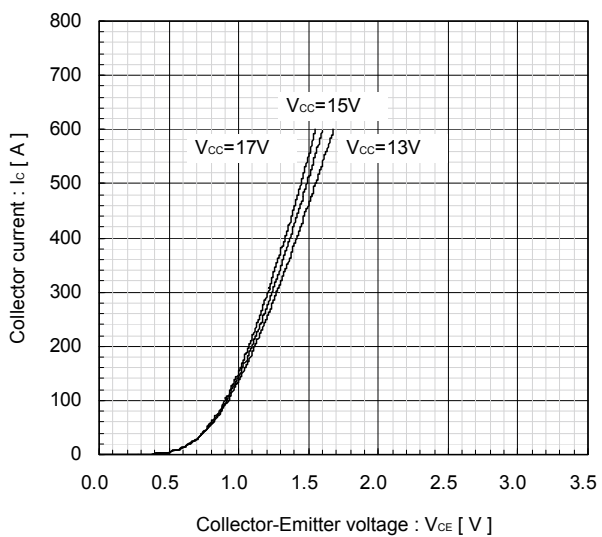
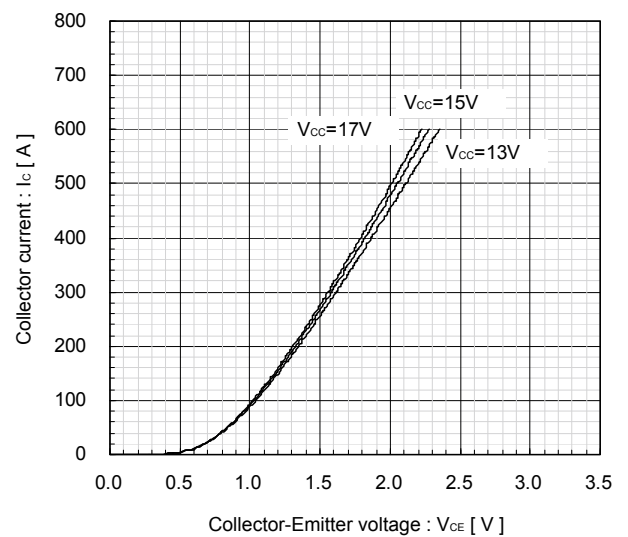
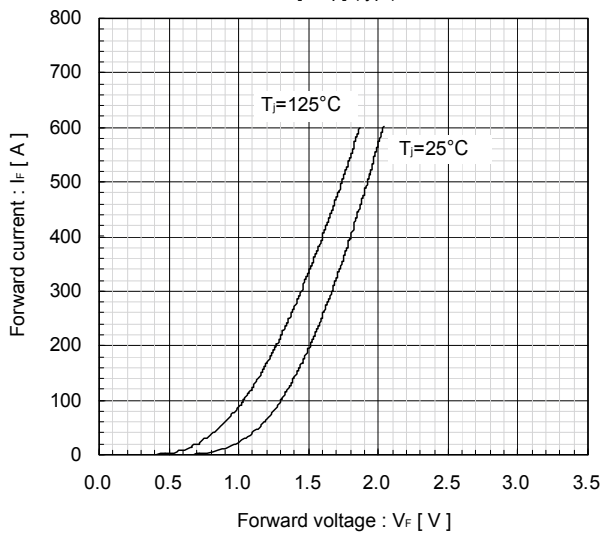
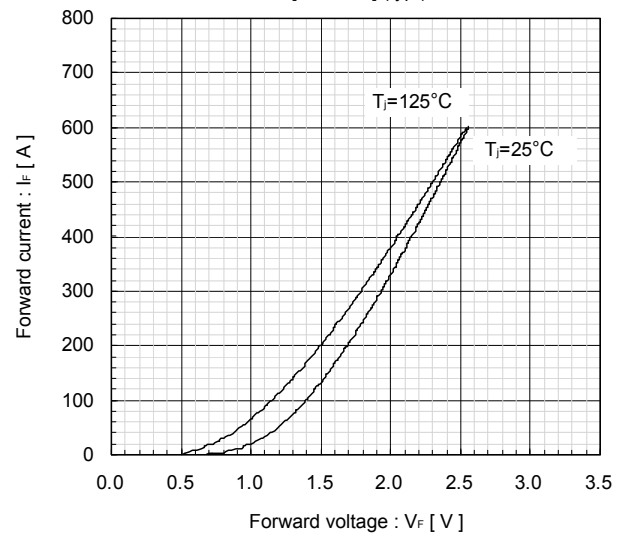
Alarm hold time vs. Power supply voltage (typ.)



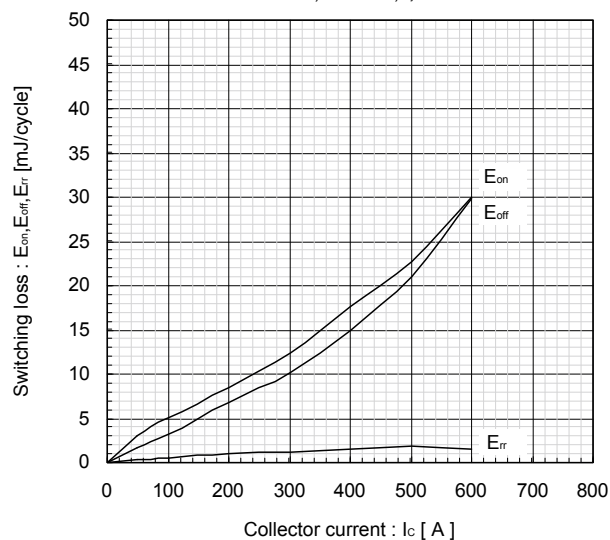
Over heating characteristics
 T_{JOH}, T_{JH} vs. V_{CC} (typ.)



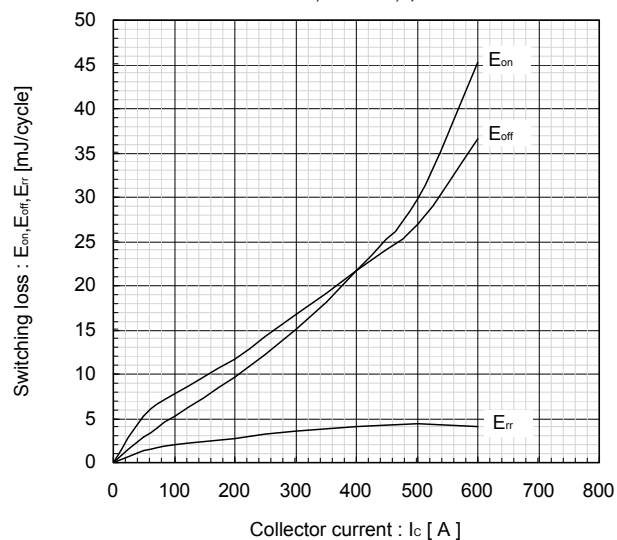
Inverter

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.)

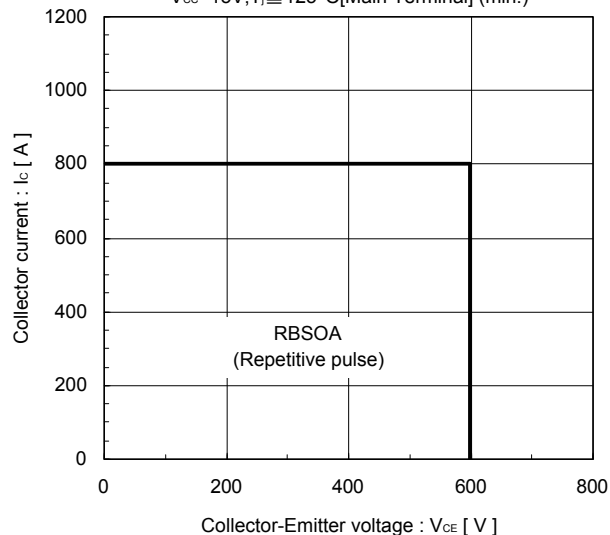
Switching Loss vs. Collector Current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_J=25^{\circ}C$



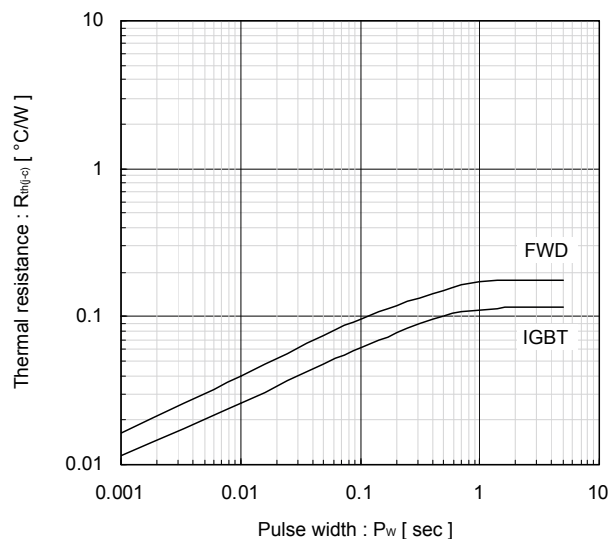
Switching Loss vs. Collector Current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_J=125^{\circ}C$



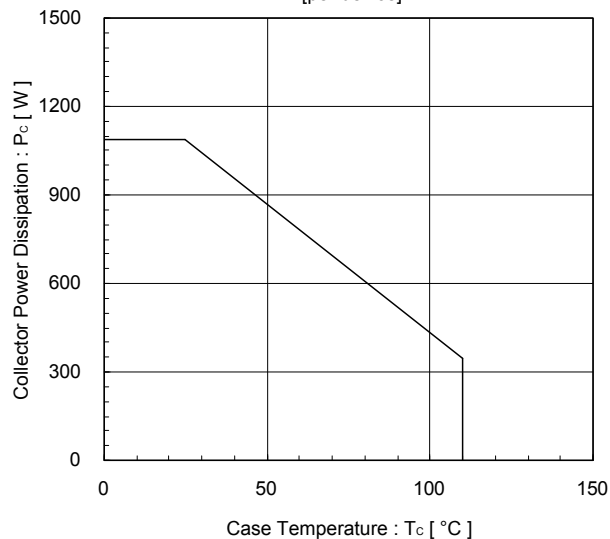
Reversed biased safe operating area
 $V_{CC}=15V, T_J \leq 125^{\circ}C$ [Main Terminal] (min.)



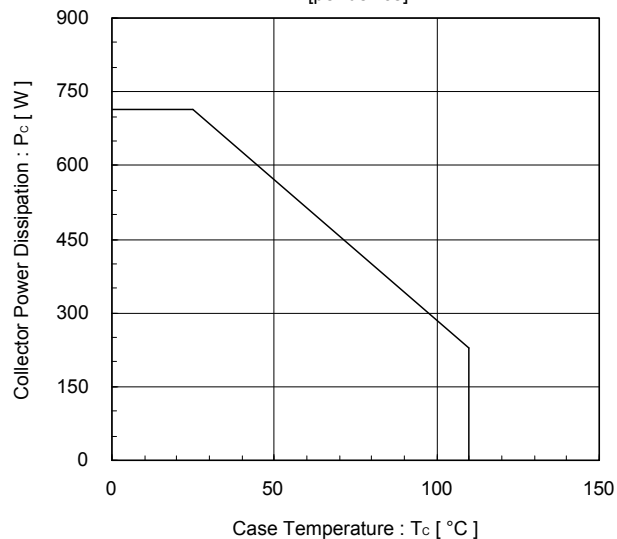
Transient thermal resistance (max.)



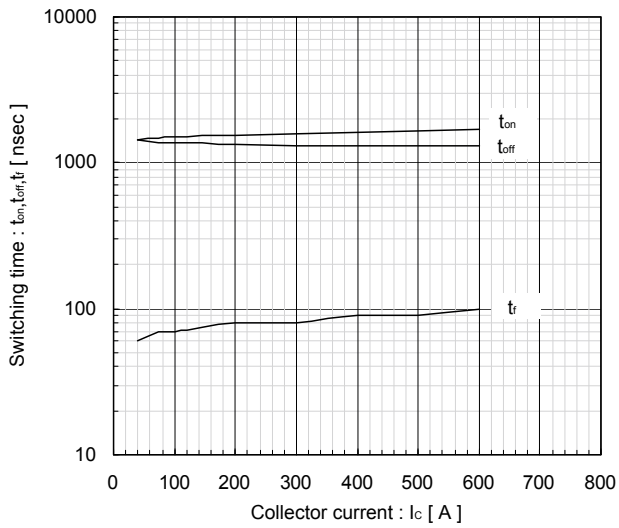
Power derating for IGBT (max.)
 [per device]



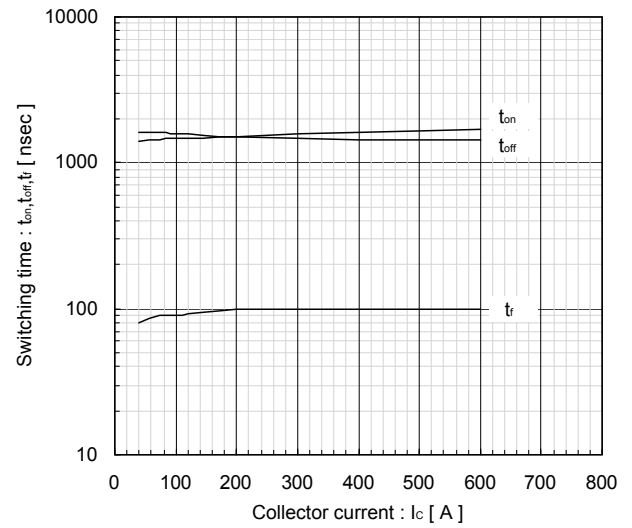
Power derating for FWD (max.)
 [per device]



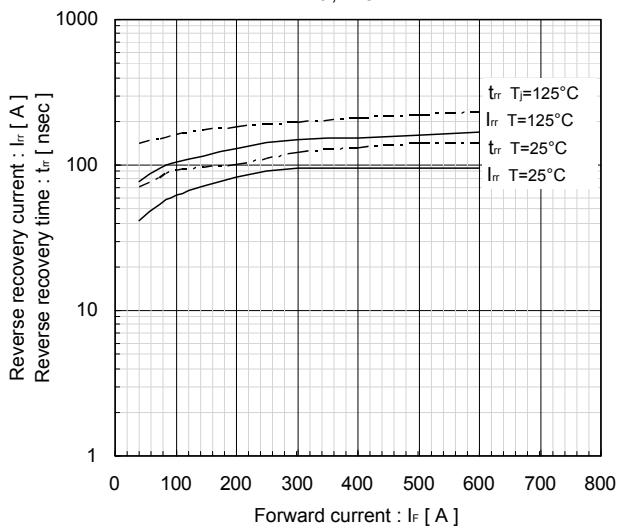
Switching time vs. Collector current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_J=25^{\circ}C$



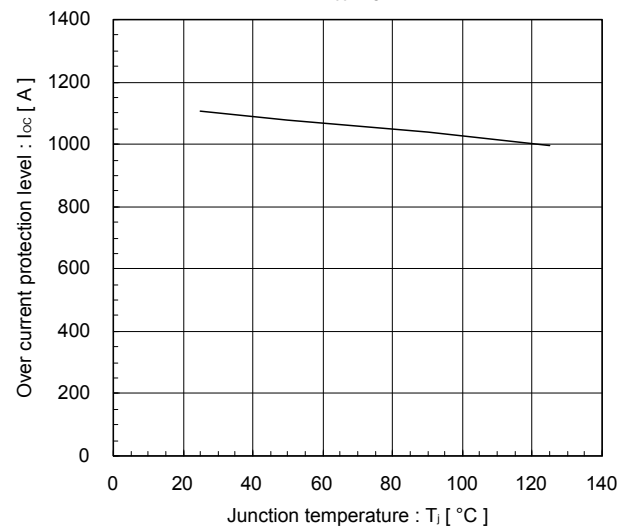
Switching time vs. Collector current (typ.)
 $V_{DC}=300V, V_{CC}=15V, T_J=125^{\circ}C$



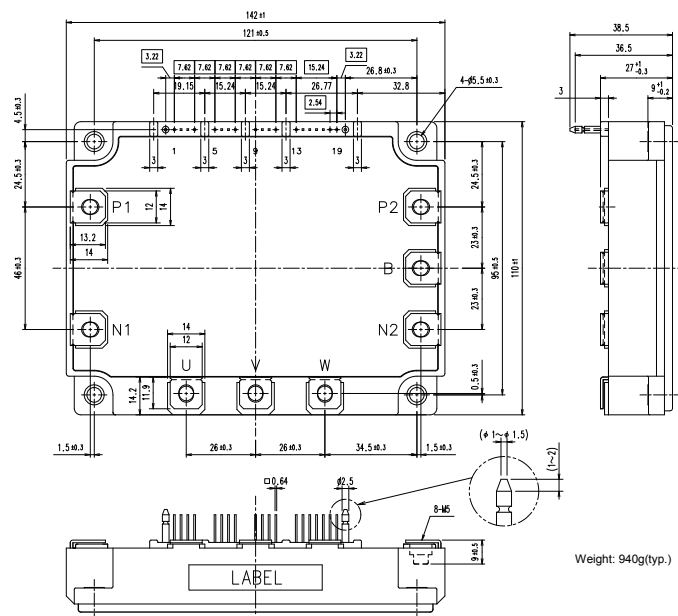
Reverse recovery characteristics (typ.)
 t_{rr}, I_{rr} vs. I_F



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



Outline Drawings, mm



WARNING

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• Machine tools	• Audiovisual equipment	• Electrical home appliances	• Personal equipment
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IGBT Modules

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