

Intelligent Power Module (R-Series)

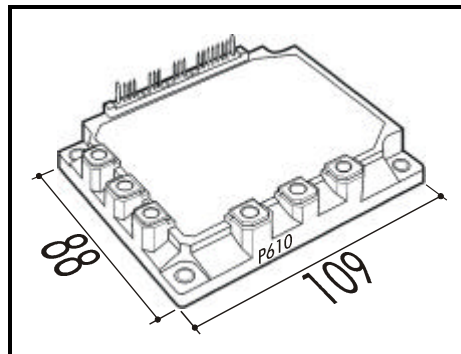
Maximum Ratings and Characteristics

Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

Items	Symbols	Ratings		Units
		Min.	Max.	
DC Bus Voltage	V_{DC}	0	450	V
DC Bus Voltage (surge)	$V_{DC}(\text{Surge})$	0	500	
DC Bus Voltage (short operating)	V_{SC}	200	400	
Collector-Emitter Voltage	V_{CES}	0	600	
Inverter	Continuous	I_C	75	A
Collector	1ms	I_{CP}	150	
Current	Duty=61.7%	$-I_C$	75	
Collector Power Dissipation One Transistor	P_C		320	W
Dynamic Brake	Continuous	I_C	50	A
Collector Current	1ms	I_{CP}	100	
Forward Current of Diode	I_F		50	
Collector Power Dissi. DB One Transistor	P_C		198	W
Voltage of Power Supply for Driver	V_{CC}	0	20	V
Input Signal Voltage	V_{IN}	0	V_Z	V
Input Signal Current	I_{IN}		1	mA
Alarm Signal Voltage	V_{ALM}	0	V_{CC}	V
Alarm Signal Current	I_{ALM}		15	mA
Junction Temperature	T_J		150	$^\circ\text{C}$
Operating Temperature	T_{OP}	-20	100	
Storage Temperature	T_{stg}	-40	125	
Isolation Voltage	A.C. 1min. V_{ISO}		2500	V
Screw Torque	Mounting *1		3.5	Nm
	Terminals *1		3.5	

Note: *1: Recommendable Value; 2.5 - 3.0 Nm (M5)

Outline Drawing



Electrical Characteristics of Power Circuit (at $T_J=25^\circ\text{C}$, $V_{CC}=15\text{V}$)

Items		Symbols	Conditions	Min.	Typ.	Max.	Units
INV	Collector Current At Off Signal Input	I_{CES}	$V_{CE}=600\text{V}$, Input Terminal Open			1.0	mA
	Collector-Emitter Saturation Voltage	$V_{CE}(\text{Sat})$	$I_C=75\text{A}$			2.8	V
	Forward Voltage of FWD	V_F	$-I_C=75\text{A}$			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	$V_{CE}(\text{Sat})$	$I_C=50\text{A}$			2.8	V
	Forward Voltage of FWD	V_F	$-I_C=50\text{A}$			3.3	V

Electrical Characteristics of Control Circuit (at $T_J=25^\circ\text{C}$, $V_{CC}=15\text{V}$)

Items		Symbols	Conditions	Min.	Typ.	Max.	Units
Current of P-Line Side Driver (One Unit)		I_{CCP}	$f_{sw}=0\sim 15\text{kHz}$, $T_c=-20\sim 100^\circ\text{C}$	3		18	mA
Current of N-Line Side Driver (Three Units)		I_{CCN}	$f_{sw}=0\sim 15\text{kHz}$, $T_c=-20\sim 100^\circ\text{C}$	10		65	
Input Signal Threshold Voltage		$V_{IN(th)}$	On	1.00	1.35	1.70	V
			Off	1.25	1.60	1.95	
Input Zener Voltage		V_Z	$R_{IN}=20\text{k}\Omega$		8.0		
Over Heating Protection Temperature Level		T_{COH}	$V_{DC}=0\text{V}$, $I_C=0\text{A}$, Case Temp.	110		125	$^\circ\text{C}$
Hysteresis		T_{CH}			20		
IGBT Chips Over Heating Protec. Temp. Level		T_{JOH}	Surface of IGBT Chip	150			
Hysteresis		T_{JH}			20		
Inverter Collector Current Protection Level		I_{OC}	$T_J=125^\circ\text{C}$	113			A
DB Collector Current Protection Level		I_{OC}	$T_J=125^\circ\text{C}$	75			
Over Current Detecting Time		t_{DOC}	$T_J=25^\circ\text{C}$		10		μs
Alarm Signal Hold Time		t_{ALM}		1.5	2		ms
Limiting Resistor for Alarm		R_{ALM}		1425	1500	1575	Ω
Under Voltage Protection Level		V_{UV}		11.0		12.5	V
Hysteresis		V_H		0.2			

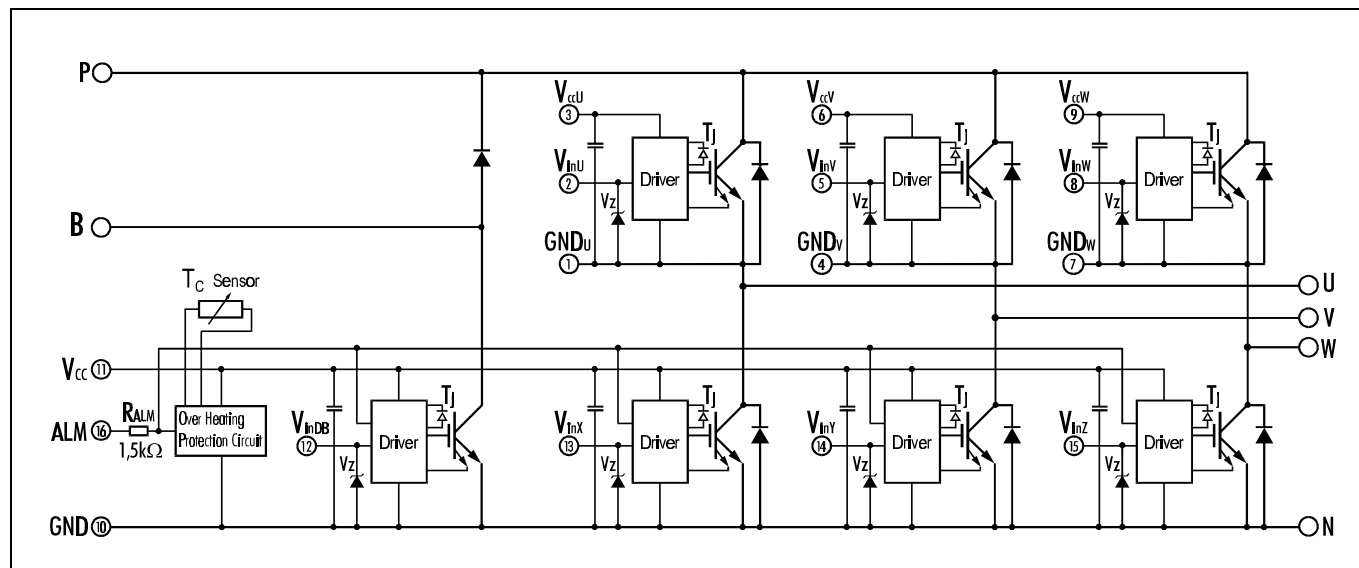
Dynamic Characteristics (at $T_c=T_J=125^\circ\text{C}$, $V_{CC}=15\text{V}$)

Items		Symbols	Conditions	Min.	Typ.	Max.	Units
Switching Time		t_{ON}	$I_C=75\text{A}$, $V_{DC}=300\text{V}$	0.3			μs
		t_{OFF}				3.6	
		t_{RR}	$I_F=75\text{A}$, $V_{DC}=300\text{V}$			0.4	

• Thermal Characteristics

Items	Symbols	Conditions	Min.	Typ.	Max.	Units
Thermal Resistance	$R_{th(j-c)}$	Inverter IGBT			0.39	°C/W
	$R_{th(j-c)}$	Diode			0.90	
	$R_{th(j-c)}$	DB IGBT			0.63	
	$R_{th(c-f)}$	With Thermal Compound		0.05		

■ Equivalent Circuit

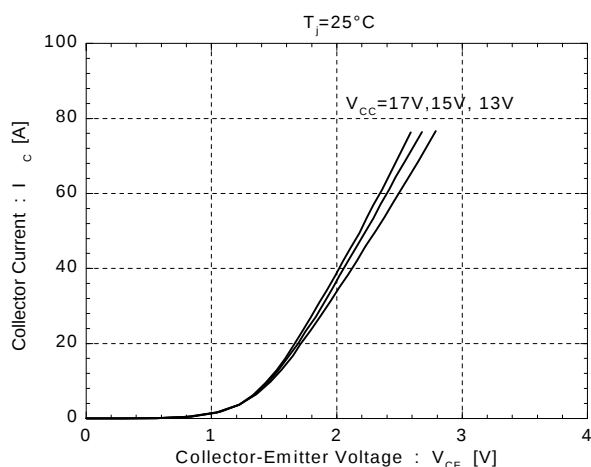


Drivers include following functions

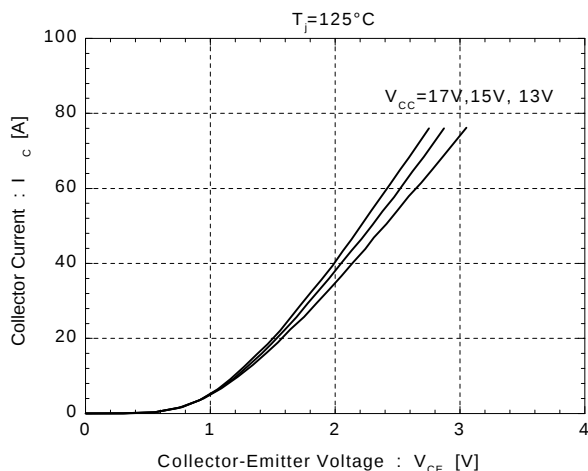
- Short circuit protection circuit
- Amplifier for driver
- Undervoltage protection circuit
- Overcurrent protection circuit
- IGBT Chip overheating protection

Dynamic Brake

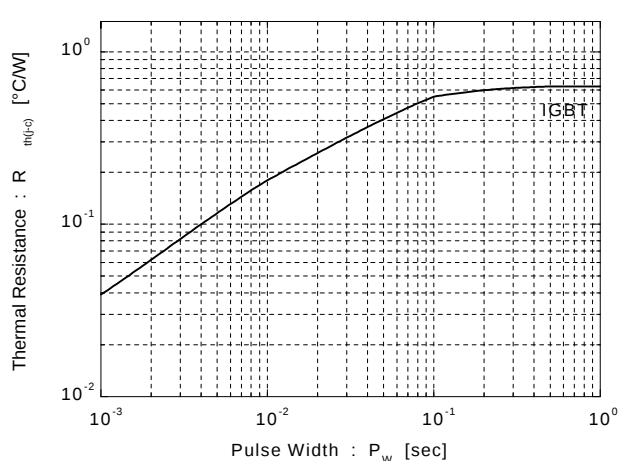
Collector Current vs. Collector-Emitter Voltage



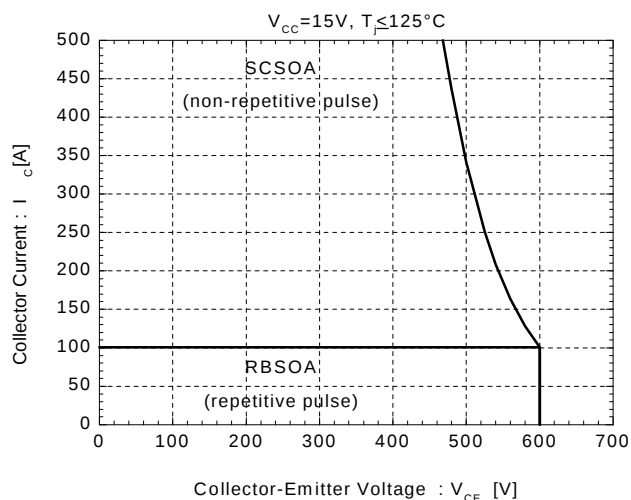
Collector Current vs. Collector-Emitter Voltage



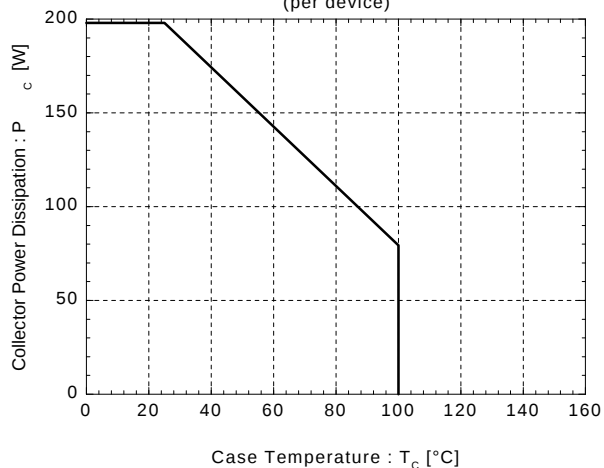
Transient Thermal Resistance



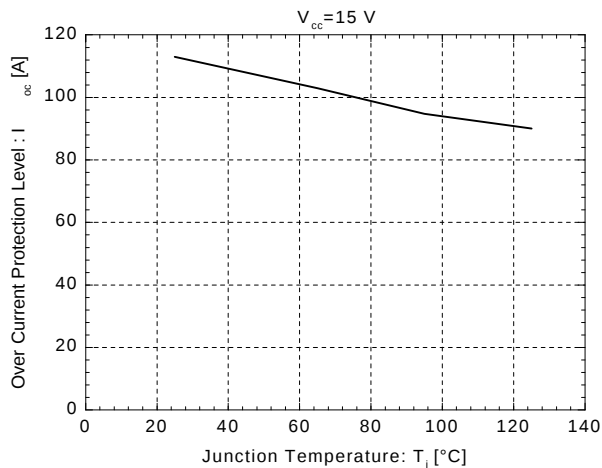
Reverse Biased Safe Operating Area



Power Derating For IGBT
(per device)

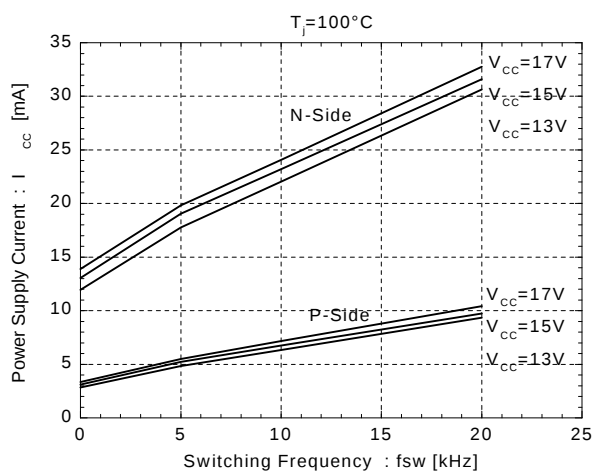


Over Current Protection vs. Junction Temperature

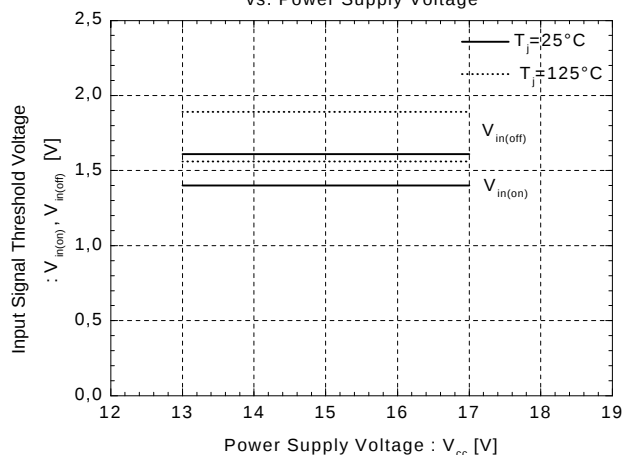


Control Circuit

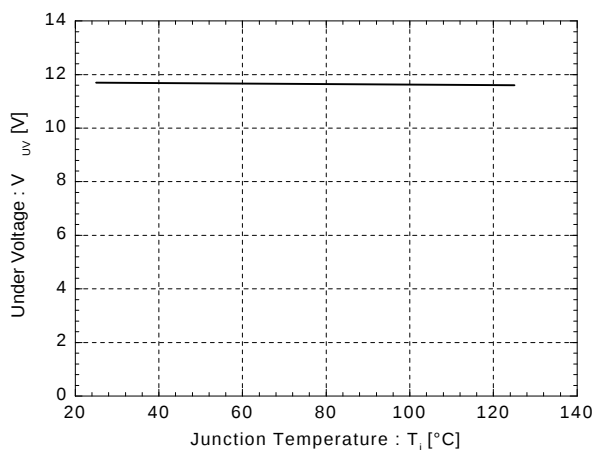
Power Supply Current vs. Switching Frequency



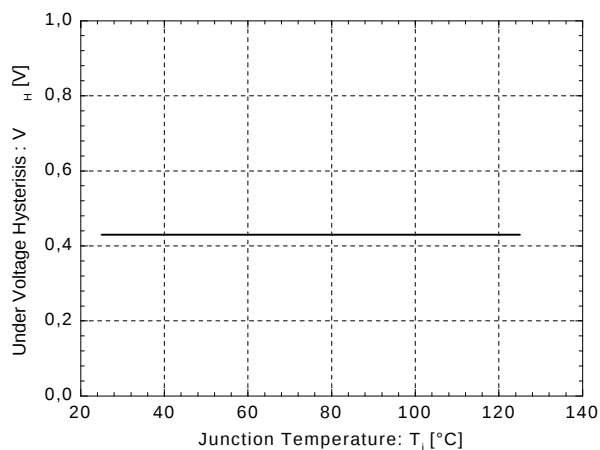
Input Signal Threshold Voltage
vs. Power Supply Voltage



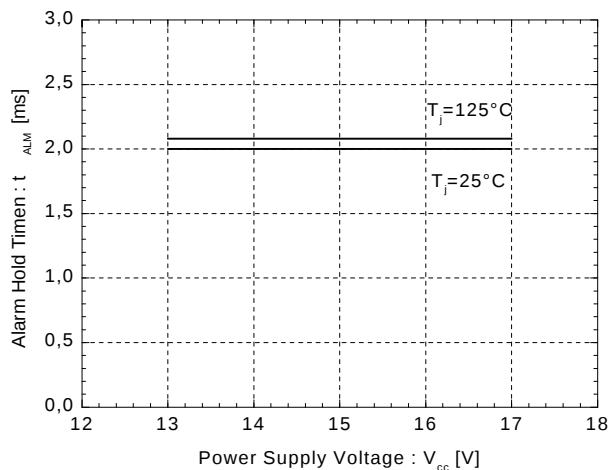
Under Voltage vs. Junction Temperature



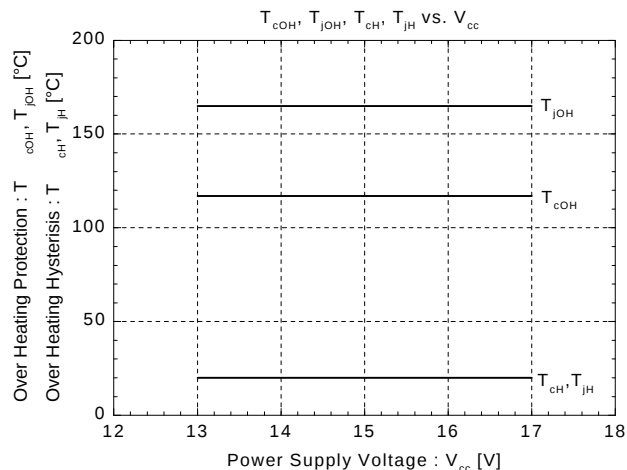
Under Voltage Hysteresis vs. Junction Temperature



Alarm Hold Time vs. Power Supply Voltage

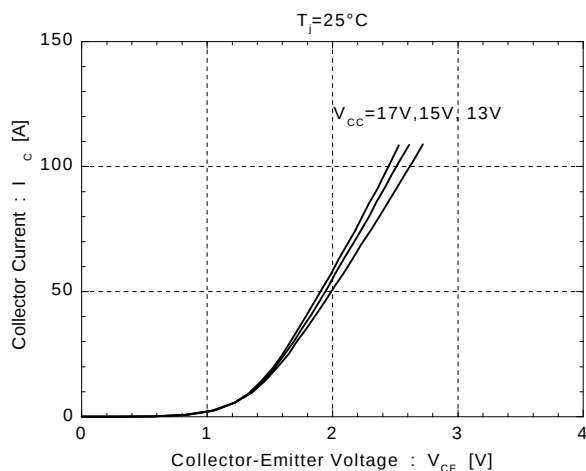


Over Heating Characteristics

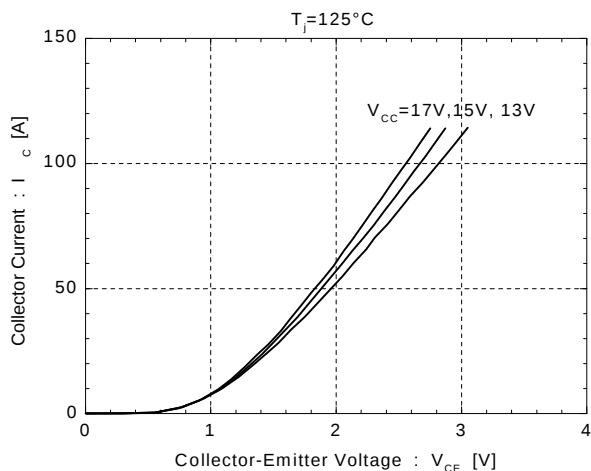


Inverter

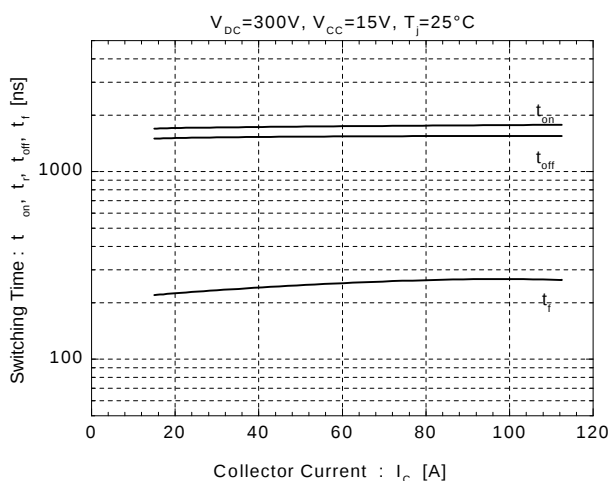
Collector Current vs. Collector-Emitter Voltage



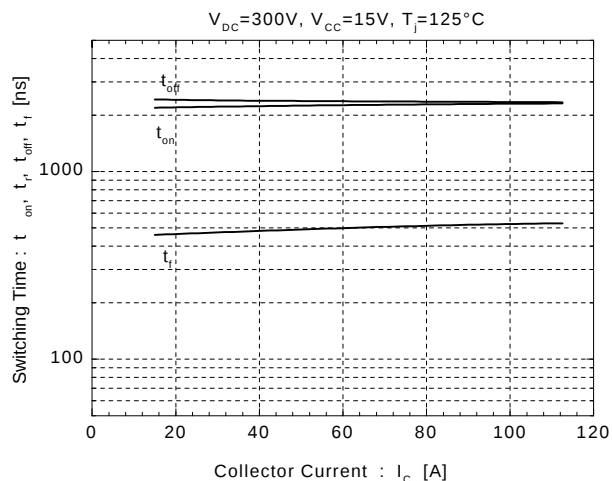
Collector Current vs. Collector-Emitter Voltage



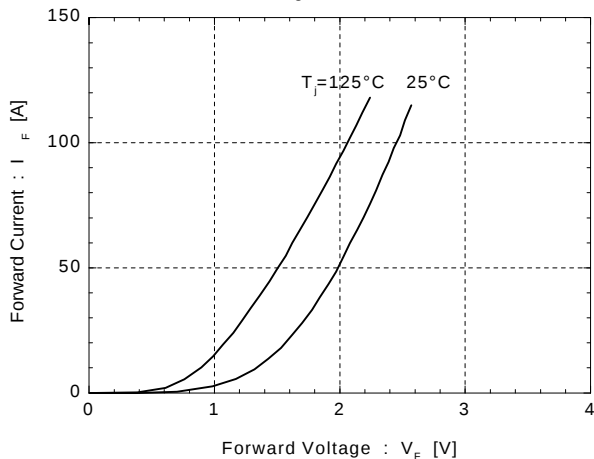
Switching Time vs. Collector Current



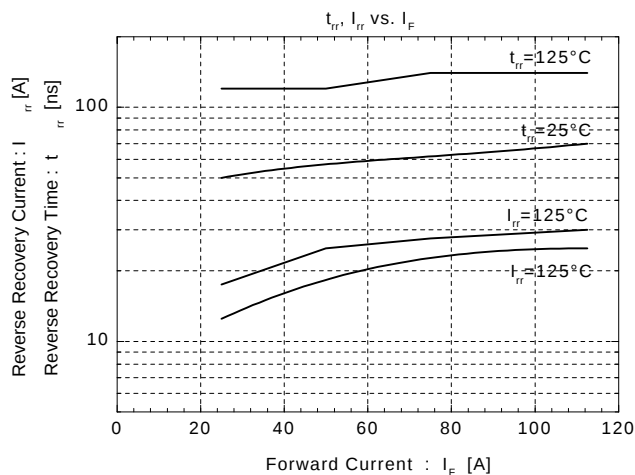
Switching Time vs. Collector Current



Forward Voltage vs. Forward Current

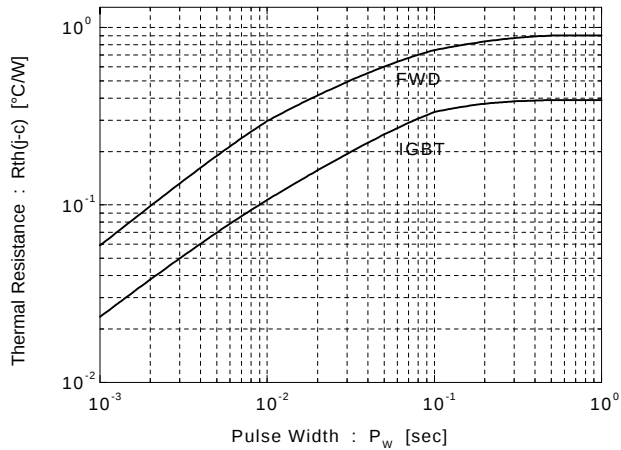


Reverse Recovery Characteristics

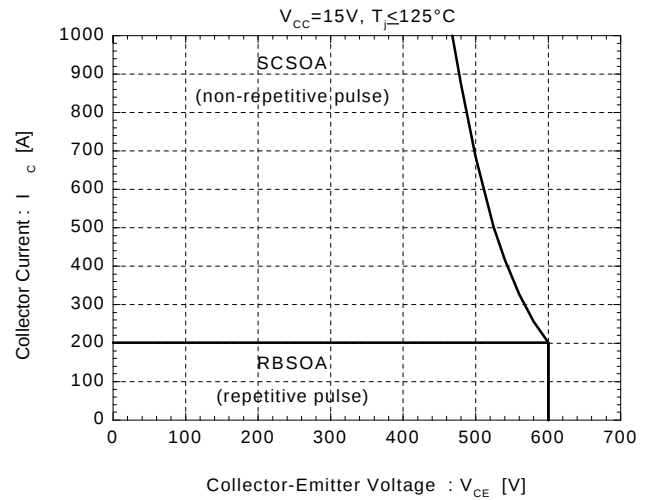


■ Inverter

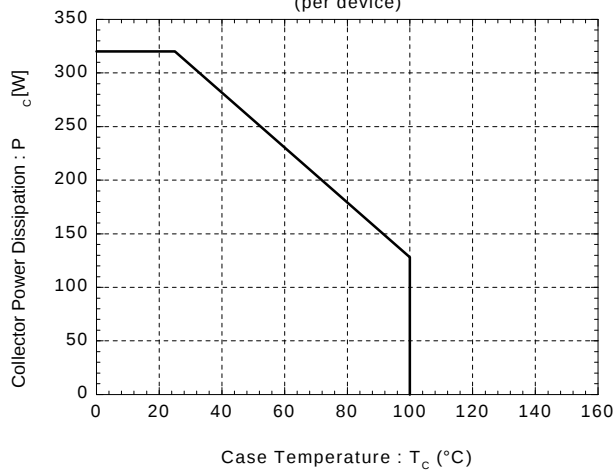
Transient Thermal Resistance



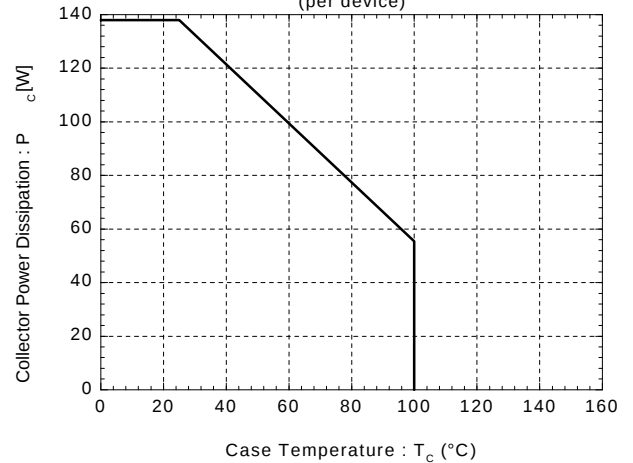
Reverse Biased Safe Operating Area



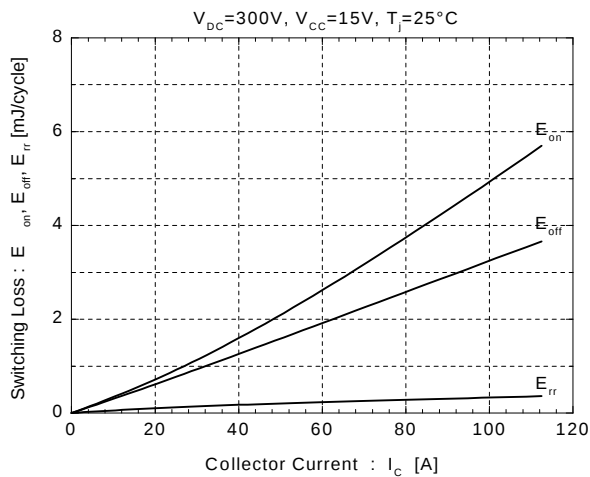
Power Derating For IGBT
(per device)



Power Derating For FWD
(per device)



Switching Loss vs. Collector Current



Switching Loss vs. Collector Current

