D5 PACK module with Gen.7 Trench/Fieldstop IGBT and Emitter Controlled diode

Features

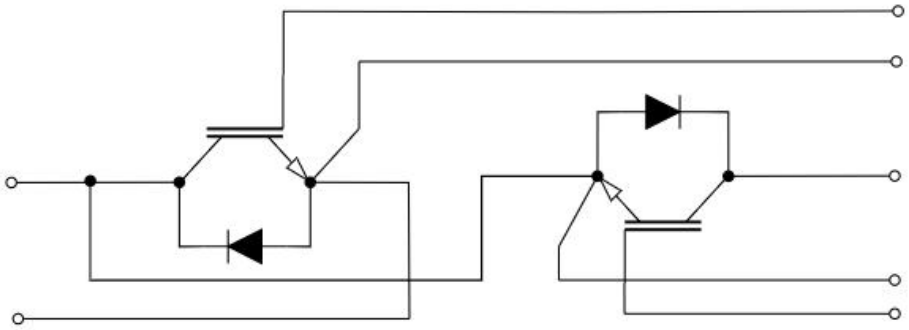
- Electrical features
  - V_{CES} = 1200 V
  - IC $_{nom}$ = 450 A / I_{CRM} = 900 A
  - V_{CEsat} with positive temperature coefficient
- Mechanical features
  - Standard housing
  - 4 kV AC 1 min insulation
  - High creepage and clearance distances
  - High power density
  - Isolated base plate
  - Package with CTI >200

D5

Typical Applications

- Three-level applications
- Commercial agriculture vehicles
- High-power converters
- Motor drives
- Servo drives
- Solar applications
- UPS systems

Description



Package Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS,f=50Hz,t=60s	4.0	kV
Internal isolation		basic insulation(class 1,IEC 61140)	ZTA	
Creepage distance	d_{creep}	terminal to heatsink	29.0	mm
Creepage distance	d_{creep}	terminal to terminal	23.0	mm
Clearance	d_{clear}	terminal to heatsink	23.0	mm
Clearance	d_{clear}	terminal to terminal	11.0	mm
Comparative tracking index (electrical)	CTI		>200	
RTI Elec.	RTI	housing	140	℃

Package Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Stray Inductance	L_{sCE}			--	20	--	nH
Module Lead Resistance, Terminal to Chip	$R_{CC'+EE'}$	T_C=25°C, per switch		--	0.5	--	mΩ
Storage Temperature Range	T_{STG}			-40		125	℃
M	M	-Mounting according to valid application note	M5, Screw	3.0	--	6.0	Nm
M	M	-Mounting according to valid application note	M6, Screw	3.0	--	6.0	Nm
Weight	G			--	340	--	g

IGBT

Absolute Maximum Ratings (Tc = 25°C unless otherwise noted)

Symbol	Description	Note or test condition		Value	Unit
V_{CES}	Collector-Emitter Voltage	T_{vj} = 25 °C		1200	V
I_{CDC}	Continuous collector current	$T_{vj\,max}$ = 175 °C	T_C = 90 °C	450	A
I_{CM}	Pulsed Collector Current	t_p limited by $T_{vj\,max}$		900	A
V_{GES}	Gate-emitter peak voltage			±30	V

Characteristics (Tc = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage	I_C =450 A, V_{GE} = 15 V	T_{vj} = 25 °C	--	1.45	2.25	V
			T_{vj} = 150 °C	--	1.70	--	
			T_{vj} = 175 °C	--	1.75	--	
$V_{GE(TH)}$	Gate−Emitter Threshold Voltage	V_{GE} = V_{CE}, I_C = 5 mA, T_{vj} = 25°C		5.0	6.0	7.0	V
I_{CES}	Collector−Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} =1200V, T_{vj}= 25°C		--	--	2	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE} = ±30V, V_{CE} = 0 V, T_{vj} = 25°C		--	--	±200	nA
R_{Gint}	Internal Gate Resistance	T_{vj} = 25 °C		--	1.34	--	Ω
C_{ies}	Input Capacitance	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V		--	66.5	--	nF
C_{oes}	Out Capacitance			--	2.29	--	nF
C_{res}	Reverse Transfer Capacitance			--	0.225	--	nF
Q_G	Gate Charge	V_{GE} = ±15 V, V_{CC} = 600 V		--	1.80	--	μC
$t_{d(on)}$	Turn−On Delay Time	I_C = 450A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_G = 1.0 Ω	T_{vj} = 25 °C	--	0.331	--	μS
			T_{vj} = 150 °C	--	0.375	--	
			T_{vj} = 175 °C	--	0.380	--	
t_r	Rise Time	I_C =450A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_G = 1.0 Ω	T_{vj} = 25 °C	--	0.060	--	μS
			T_{vj} = 150 °C	--	0.072	--	
			T_{vj} = 175 °C	--	0.073	--	
$t_{d(off)}$	Turn−off Delay Time	I_C = 450 A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_{Goff} = 1.0 Ω	T_{vj} = 25 °C	--	0.672	--	μS
			T_{vj} = 150 °C	--	0.766	--	
			T_{vj} = 175 °C	--	0.782	--	
t_f	Fall Time	I_C = 450 A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_G = 1.0 Ω	T_{vj} = 25 °C	--	0.082	--	μS
			T_{vj} = 150 °C	--	0.183	--	
			T_{vj} = 175 °C	--	0.186	--	
E_{on}	Turn−On Switching Loss per Pulse	I_C =450A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_G = 1.0 Ω ($T_{vj\,max}$= 175 °C)	T_{vj} = 25 °C	--	10.14	--	mJ
			T_{vj} = 150 °C	--	20.21	--	
			T_{vj} = 175 °C	--	22.49	--	
E_{off}	Turn Off Switching Loss per Pulse	I_C = 450A, V_{CC} = 600 V,	T_{vj} = 25 °C	--	44.05	--	mJ

		V_{GE} = 15 /-5V, R_G = 1.0 Ω ($T_{vj\ max}$= 175 °C)	T_{vj} = 150 °C	--	58.68	--	
			T_{vj} = 175 °C	--	60.63	--	
I_{SC}	SC Data	V_{GE} ≤ 15 V, V_{CC} =600 V, V_{CEmax}=V_{CES}-L_{sCE}.di/dt	t_P ≤ 10 µs, T_{vj}=150 °C	--	1900	--	A
R_{thJC}	Thermal resistance	Junction-to-Case (per IGBT)		--	0.076	--	K/W
$T_{vj\ op}$	Temperature under switching conditions			-40	--	175[1)]	℃

[1)] $T_{vj\ op}$ > 150℃ is only allowed for operation at overload conditions.

Diode

Absolute Maximum Ratings (Tc = 25°C unless otherwise noted)

Symbol	Description	Note or test condition	Value	Unit
V_{RRM}	Repetitive peak reverse voltage	T_{vj} = 25 °C	1200	V
I_F	Continuous DC forward current		450	A
I_{FM}	Diode Maximum Forward Current	t_P = 1 ms	900	A

Characteristics （Tc=25℃ unless otherwise noted）

Symbol	Parameter	Test Condition		Value			Unit
				Min	Typ	Max	
V_F	Diode Forward Voltage	I_F = 450 A, V_{GE} = 0 V	T_{vj} = 25 °C	--	1.40	2.80	V
			T_{vj} = 150 °C	--	1.25	--	
Q_r	Recovered Charge	I_C = 450 A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_G = 1.0 Ω ($T_{vj\ max}$= 175 °C)	T_{vj} = 25 °C	--	5.68	--	µC
			T_{vj} = 150 °C	--	18.72	--	
			T_{vj} = 175 °C	--	22.89	--	
I_{RM}	Peak Reverse Recovery Current	I_C = 450A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_G = 1.0 Ω ($T_{vj\ max}$= 175 °C)	T_{vj} = 25 °C	--	194	--	A
			T_{vj} = 150 °C	--	243	--	
			T_{vj} = 175 °C	--	256	--	
E_{rec}	Reverse recovery energy	I_C = 450 A, V_{CC} = 600 V, V_{GE} = 15 /-5V, R_G = 1.0 Ω ($T_{vj\ max}$= 175 °C)	T_{vj} = 25 °C	--	6.10	--	mJ
			T_{vj} = 150 °C	--	16.65	--	
			T_{vj} = 175 °C	--	19.42	--	
R_{thJC}	Thermal resistance, junction to case	per diode		--	0.078	--	K/W
$T_{vj\ op}$	Temperature under switching conditions			-40	--	175[2)]	℃

[2)] $T_{vj\ op}$ > 150℃ is only allowed for operation at overload conditions.

Figure1.output characteristic IGBT,Inverter(typical)
T_{vj}=25°C

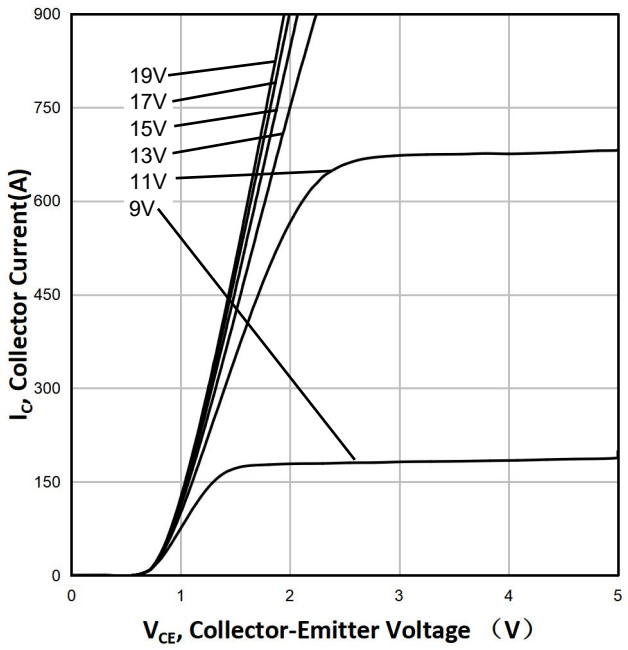


Figure2.output characteristic IGBT,Inverter(typical)
T_{vj}=150°C

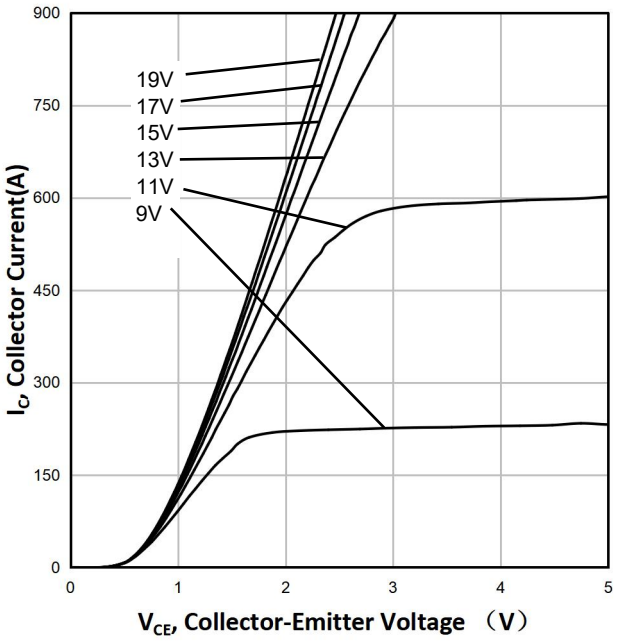


Figure3. $V_{CE(sat)}$ vs. Temperature

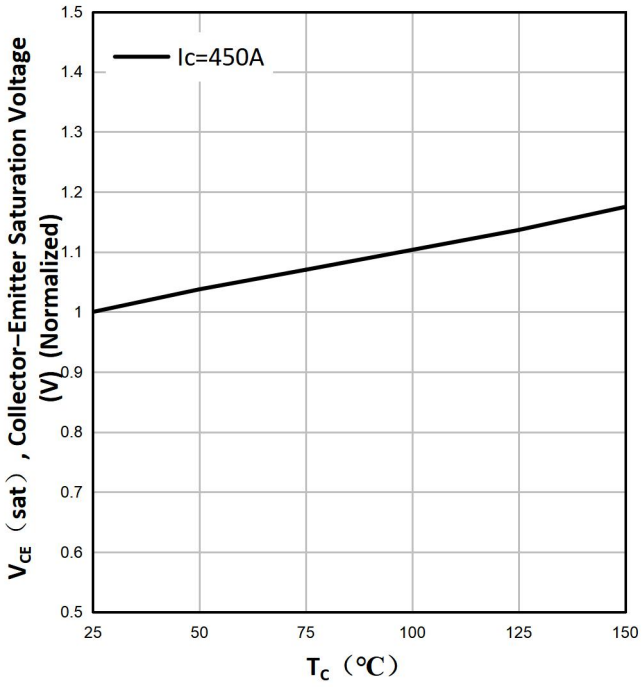


Figure4.transfer characteristic IGBT,Inverter(typical)
V_{CE}=20V

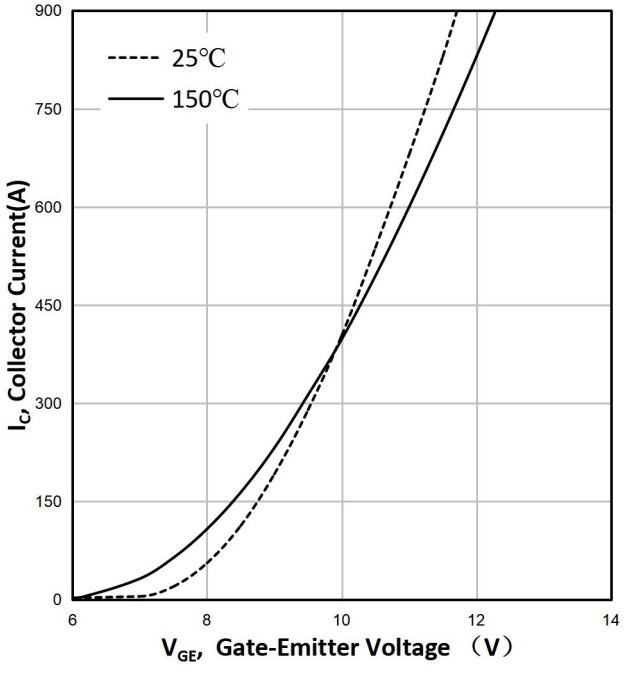


Figure5. V_{TH} vs. Temperature

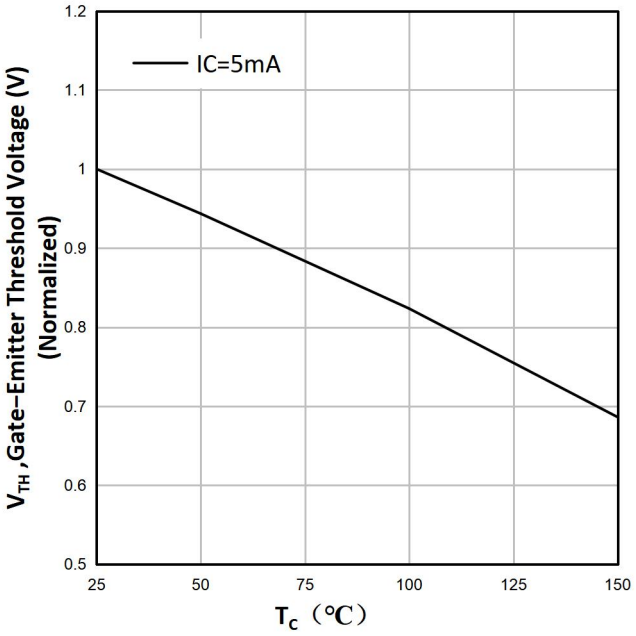


Figure6. Gate Charge Waveform

Vcc=600V

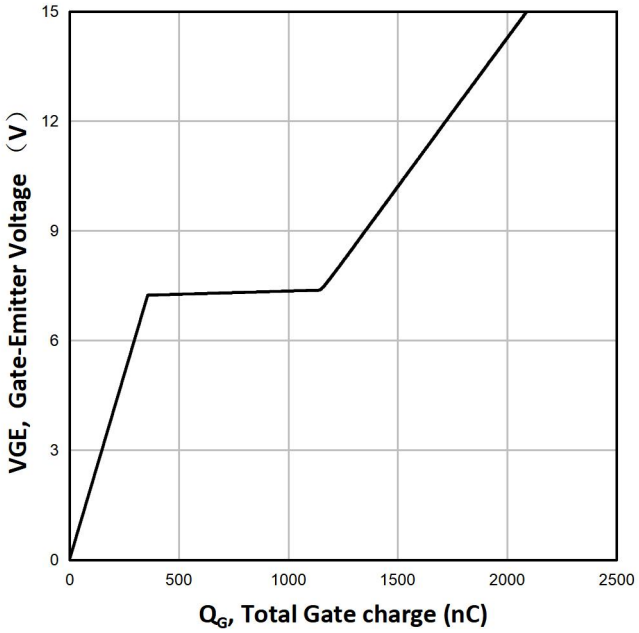


Figure7. Saturation Voltage vs. V_{GE}

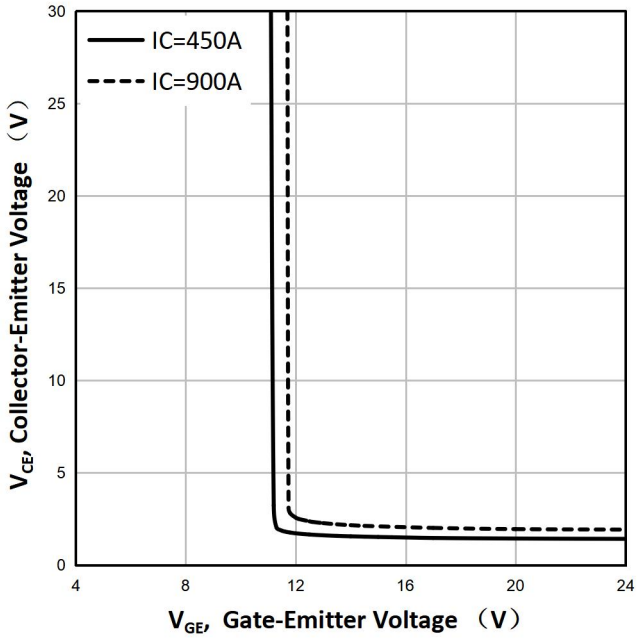


Figure8. Ptot vs. Case Temperature

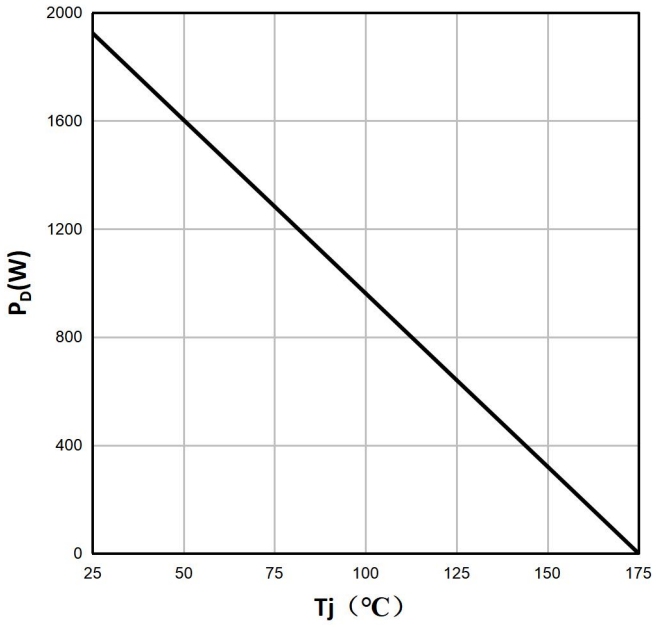


Figure9.switching losses IGBT,Inverter(typical)
Vcc=600V,IC=450A，Vge=15V/-5V,Tvj=25°C

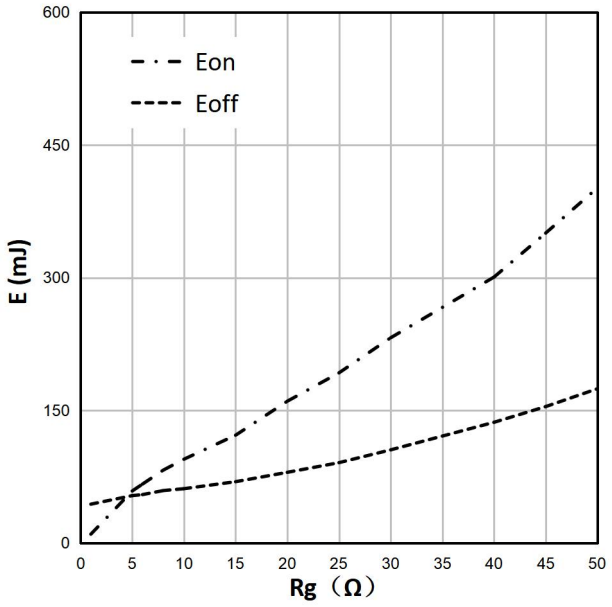


Figure10.switching losses IGBT,Inverter(typical)
Vcc=600V,IC=450A，Vge=15V/-5V, Tvj=150°C

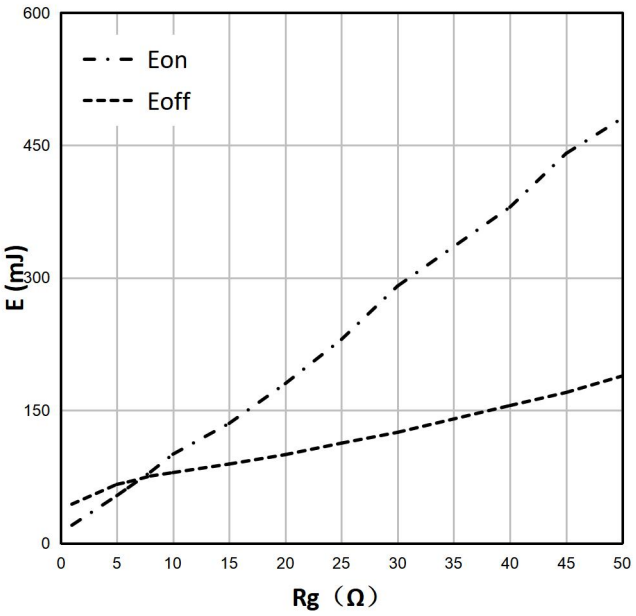


Figure11.switching losses IGBT,Inverter(typical)
Vcc=600V,Rgon=10Ω,Rgoff=10Ω,Vge=15V/-5V,Tvj=25°C

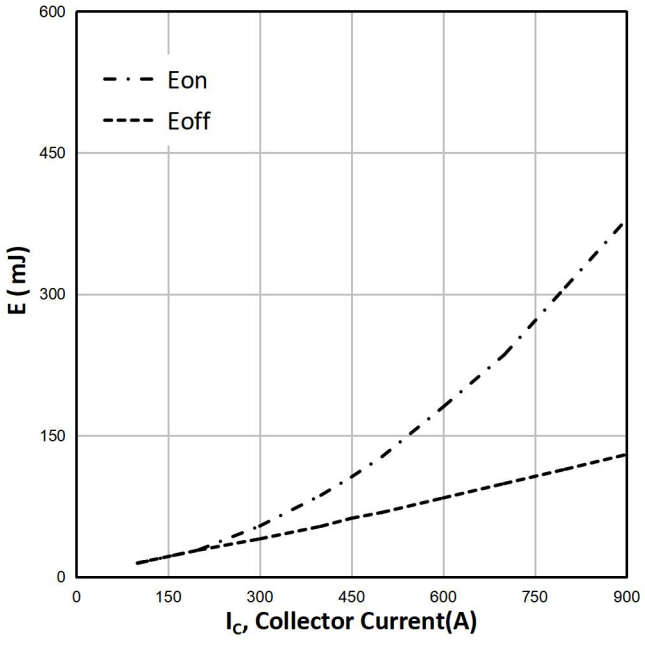


Figure12.switching losses IGBT,Inverter(typical)
Vcc=600V,Rgon=10Ω,Rgoff=10Ω,Vge=15V/-5V,Tvj=150°C

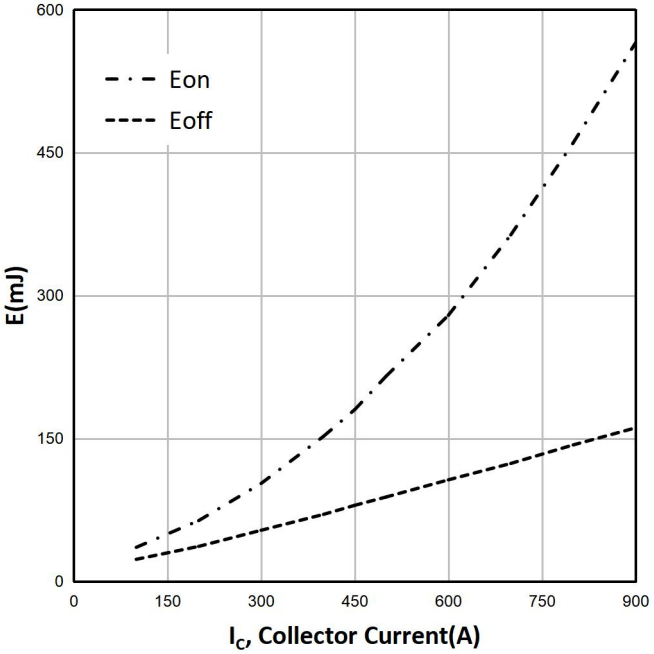


Figure13.FBSOA IGBT
D=0, Tc=25℃,Tj<=175℃,Vge=15V

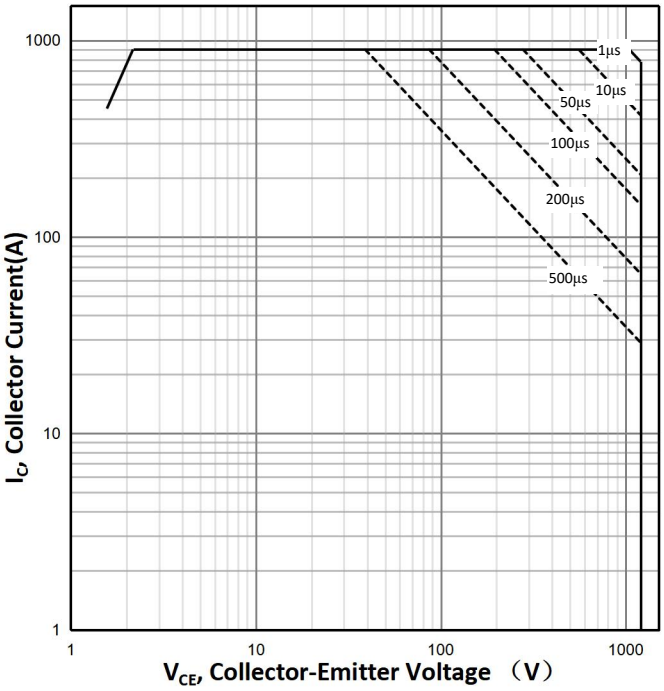


Figure14.transient thermal impedance-IGBT

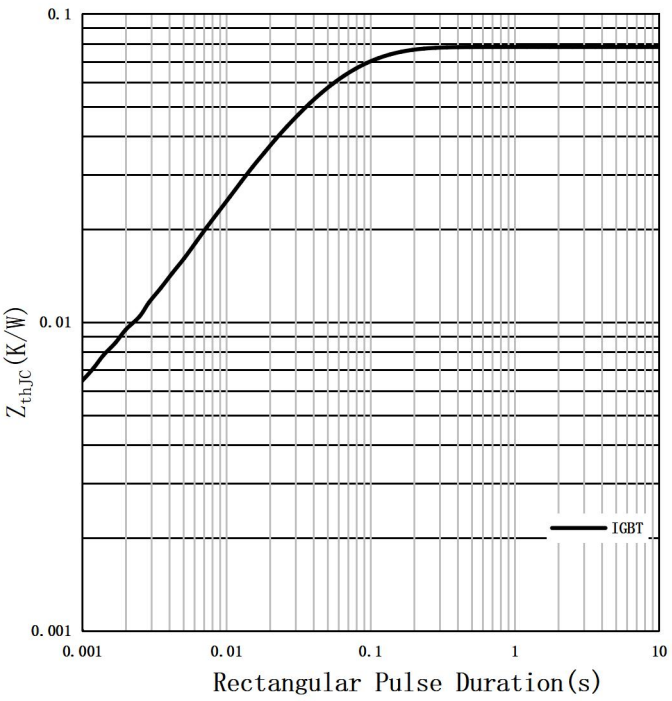


Figure15. forward characteristic of Diode,Inverter(typical)
V_{GE}=0V

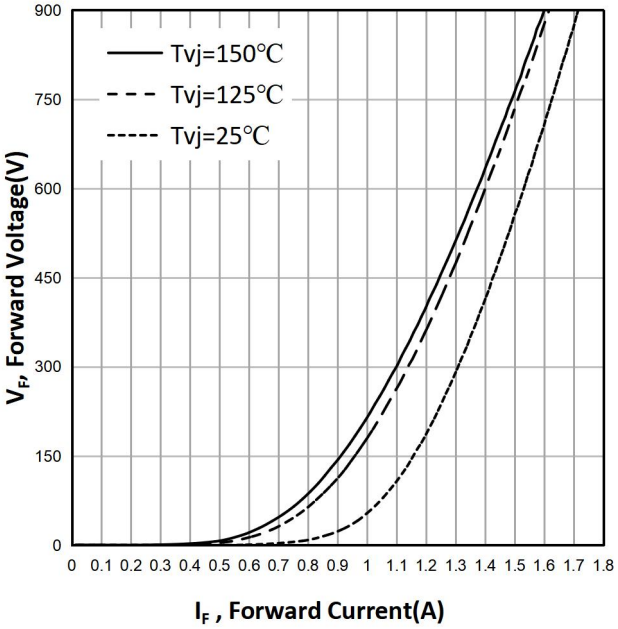


Figure 16.Reverse Recovery Energy Loss vs. IC
Vcc=600V,Rgon=10Ω,Rgoff=10Ω,Vge=15V/-5V

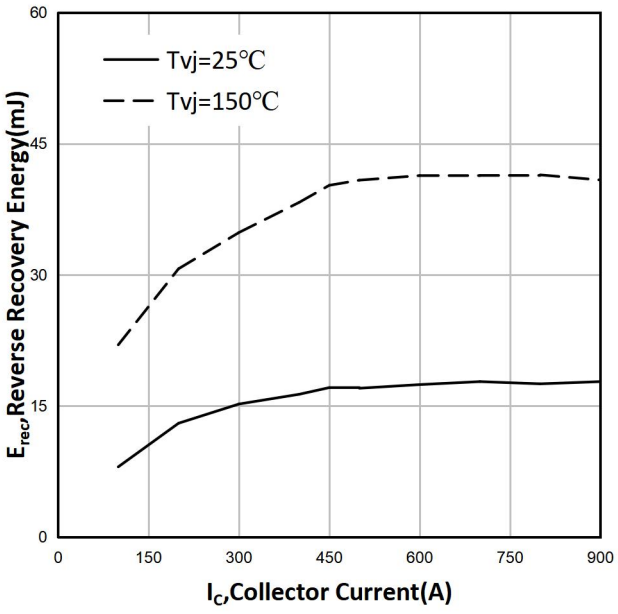


Figure 17.Reverse Recovery Energy Loss vs. R_G

Vcc=600V,IC=450A，Vge=15V/-5V

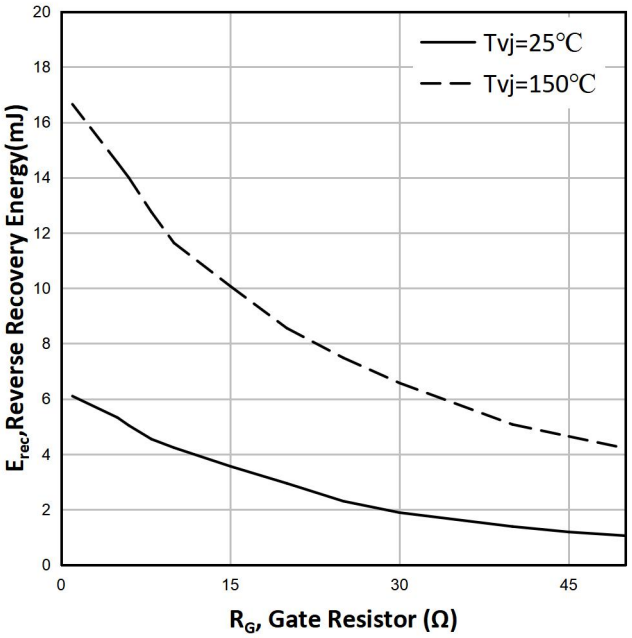
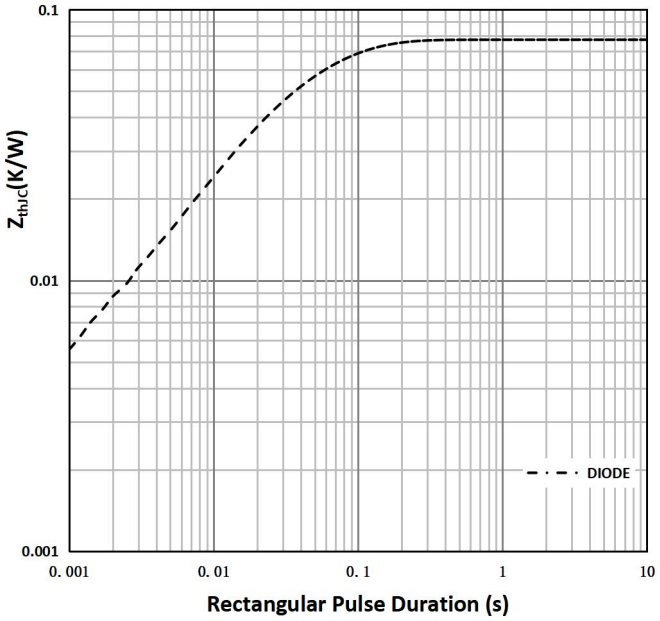
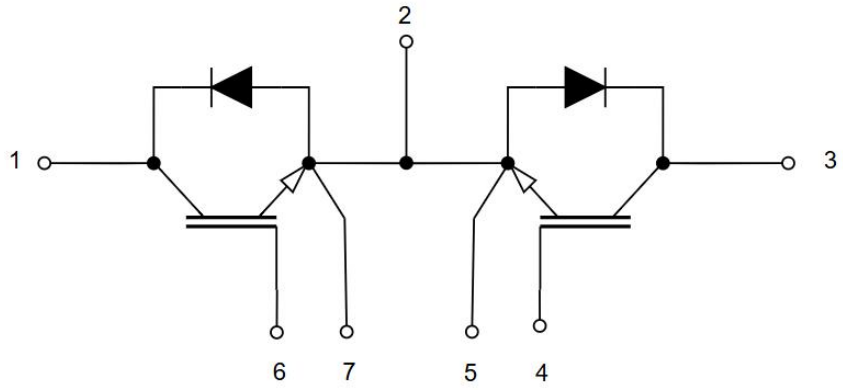


Figure18.transient thermal impedance-FRD



CIRCUIT DIAGRAM



PACKAGE DIMENSION