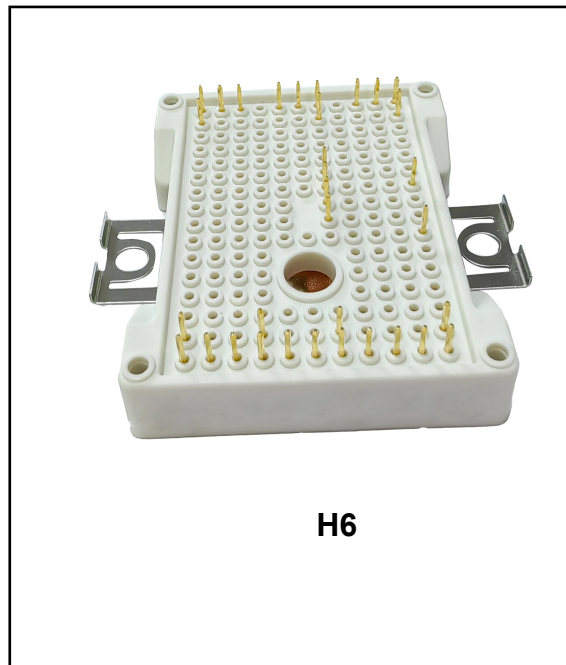


3-Level NPC Inverter Module with 650V Trench Stop IGBTs

Features

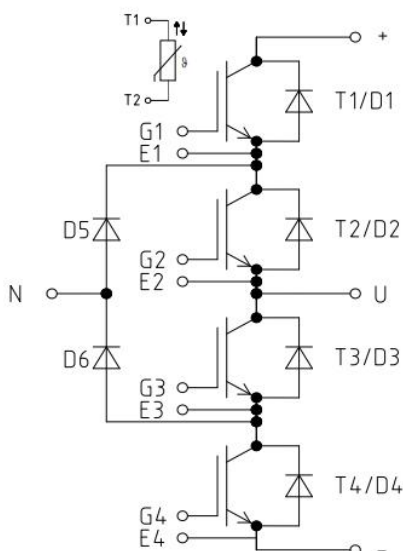
- Electrical features
 - 650V Trench Stop IGBTs
 - Low Inductive Design
 - Low Switching Losses
 - Low Inductive Layout
 - Thermistor
- Mechanical features
 - Compact Design
 - Solderable Pins
 - Al₂O₃ Substrate with Low Thermal Resistance



Typical Applications

- 3-Level-Applications
- 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	2.5	kV
Internal isolation		basic insulation(class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{creep}	terminal to heatsink	11.5	mm
Clearance	d_{clear}	terminal to heatsink	10	mm
Comparative tracking index (electrical)	CTI		>200	
RTI Elec.	RTI	housing	140	°C

Package Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray Inductance	LCE		--	15	--	nH
Module Lead Resistance, Terminal to Chip	$R_{CC'+EE'}$		--	2	--	mΩ
Storage Temperature Range	T_{STG}		-40		125	°C
Mounting torque for module mounting	M	-Mounting according to valid application note	40	--	80	N
Weight	G		--	39	--	g

IGBT (T1、T2、T3、T4)
Absolute Maximum Ratings (T_C = 25°C unless otherwise noted)

Symbol	Description	Value	Unit
V _{CES}	Collector-Emitter Voltage	650	V
V _{GES}	Gate-Emitter Voltage	± 30	V
I _{CDC}	Continuous Collector Current @ T _C = 80°C (T _{JMAX} = 175°C)	150	A
I _{CM}	Pulsed Collector Current, t _p limited by T _{vj max}	300	A
T _{Jmax}	Maximum Junction Temperature	175	°C
P _D	Power Dissipation @ T _C = 25°C	455	W
	Power Dissipation @ T _C = 100 °C	227	W

Characteristics (T_C=25°C unless otherwise noted)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
V _{CE(sat)}	Collector–Emitter Saturation Voltage	I _C =150A, V _{GE} = 15V	T _{vj} = 25 °C	--	1.35	1.90	V
			T _{vj} = 150 °C	--	1.50	--	
V _{GE(TH)}	Gate–Emitter Threshold Voltage	I _C =3mA, V _{CE} =V _{GE}		4.0	--	5.5	V
I _{CES}	Collector–Emitter Cutoff Current	V _{GE} = 0 V, V _{CE} = 650 V		--	--	200	μA
I _{GES}	Gate-Emitter Leakage Current	V _{GE} = ±30 V, V _{CE} = 0 V, T _{vj} = 25°C		--	--	± 100	nA
R _{Gint}	Internal Gate Resistance	T _{vj} = 25 °C		--	1.45	--	Ω
C _{ies}	Input Capacitance	V _{CE} =25V, V _{GE} =0V, f=1MHz		--	11900	--	pF
C _{oes}	Output capacitance			--	505	--	pF
C _{res}	Reverse Transfer			--	71.4	--	pF
Q _G	Gate Charge	T _J = 25°C V _{CE} = 400 V, I _C = 150 A V _{GE} = -5 V to +15 V		--	0.356	--	μC
t _{d(on)}	Turn–On Delay Time	V _{CE} =400V, I _C =150A, V _{GE} = -5 V to +15 V, R _{gon} =25Ω, R _{goff} =50Ω Inductive Load T _{vj} =25°C		--	260	--	ns
t _r	Rise Time			--	50	--	
t _{d(off)}	Turn–off Delay Time			--	1280	--	
t _f	Fall Time			--	130	--	
E _{on}	Turn–On Switching Loss per Pulse			V _{CE} =400V, I _C =150A, V _{GE} = -5 V to +15 V, R _{gon} =25Ω, R _{goff} =50Ω T _J =175°C		--	8.7
E _{off}	Turn Off Switching Loss per Pulse	--	17.53			--	
t _{d(on)}	Turn–On Delay Time	--	350			--	ns
t _r	Rise Time	--	50			--	
t _{d(off)}	Turn–off Delay Time	--	1270			--	
t _f	Fall Time	--	190	--			
E _{on}	Turn–on Switching Loss per Pulse			--	12.2	--	mJ
E _{off}	Turn Off Switching Loss per Pulse			--	15.5	--	
R _{thJC}	Thermal resistance	Junction-to-Case (per IGBT)		--	0.294	--	K/W
T _{vj op}		Temperature under switching conditions		-40		175 ¹⁾	°C

¹⁾T_{vj op} > 150°C is only allowed for operation at overload conditions.

Diode (D1、D2、D3、D4、D5、D6)

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

Symbol	Description	Value	Unit
V _{RRM}	Repetitive Peak Reverse Voltage	650	V
I _F	Diode Continuous Forward Current	150	A
I _{FM}	Diode Maximum Forward Current t _p =1ms	300	A

Characteristics (T_c=25°C unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
V _F	Diode Forward Voltage	I _F = 150 A, T _J = 25°C	--	1.60	2.30	V
		I _F = 150 A, T _J = 175°C	--	1.40	--	
T _{rr}	Reverse Recovery Time	V _{CE} =400V, V _{GE} = -5 V to +15 V, I _F =150A,R _G =25Ω T _{vj} =25°C	--	165	--	ns
I _{RM}	Peak Reverse Recovery Current		--	79	--	A
Q _{rr}	Recovered Charge		--	5,7	--	μC
E _{rec}	Reverse Recovery Energy		--	1.6	--	mJ
T _{rr}	Reverse Recovery Time	V _{CE} =400V, V _{GE} = -5 V to +15 V I _F =150A,R _G =25Ω, T _J =175°C	--	260	--	ns
I _{RM}	Peak Reverse Recovery Current		--	91.2	--	A
Q _{rr}	Recovered Charge		--	13.9	--	μC
E _{rec}	Reverse Recovery Energy		--	3.2	--	mJ
R _{thJC}	Thermal resistance	Junction-to-Case (per diode)	--	0.319	--	K/W
T _{vj op}		Temperature under switching conditions	-40		175 ²⁾	°C

²⁾T_{vj op} > 150°C is only allowed for operation at overload conditions.

NTC Characteristics (T_c = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
R ₂₅	Rated Resistance		--	5.0	--	kΩ
ΔR/R	Deviation of R100	T _c =100 °C, R ₁₀₀ =493.3Ω	-5	--	5	%
P ₂₅	Power Dissipation		--	--	20.0	mW
B _{25/50}	B-value	R ₂ =R ₂₅ exp[B _{25/50} (1/T ₂ - 1/(298.15K))]	--	3375	--	K
B _{25/80}	B-value	R ₂ =R ₂₅ exp[B _{25/80} (1/T ₂ - 1/(298.15K))]	--	3411	--	K
B _{25/100}	B-value	R ₂ =R ₂₅ exp[B _{25/100} (1/T ₂ - 1/(298.15K))]	--	3433	--	K

Figure1.output characteristic IGBT,Inverter(typical)
 $T_{vj}=25^{\circ}\text{C}$

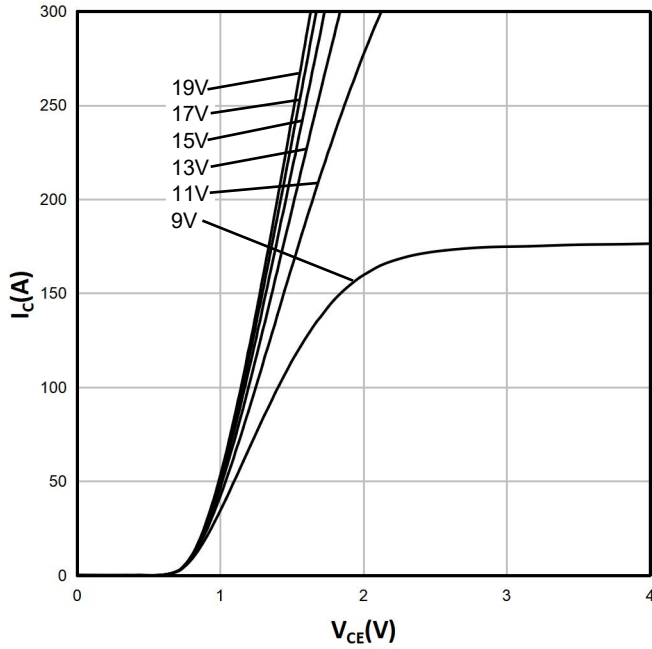


Figure2.output characteristic IGBT,Inverter(typical)
 $T_{vj}=150^{\circ}\text{C}$

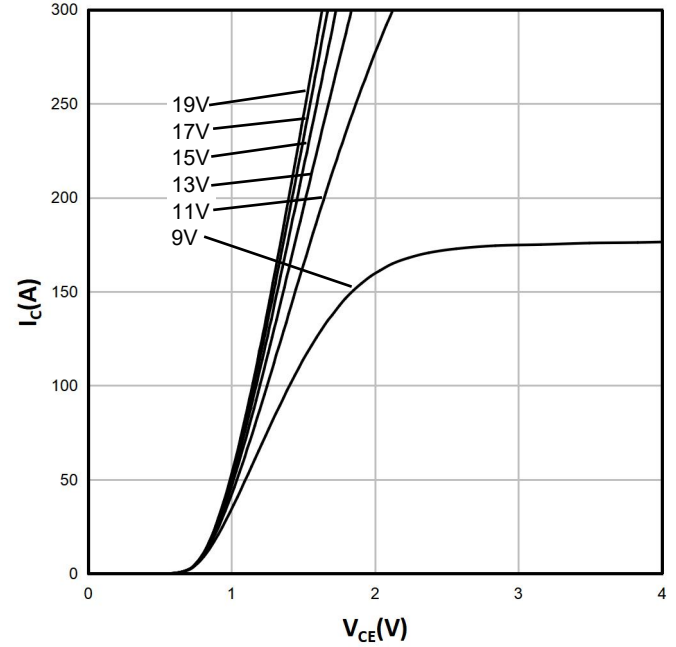


Figure3. $V_{CE(sat)}$ vs. Temperature

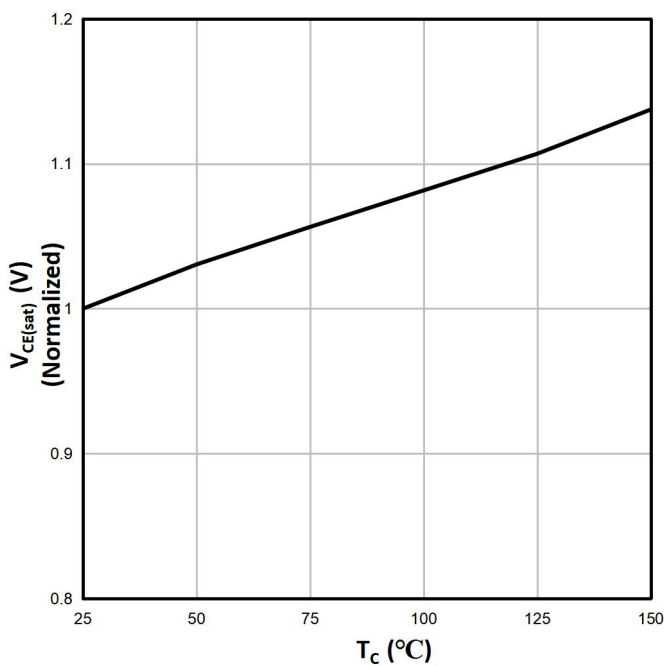


Figure4.transfer characteristic IGBT,Inverter(typical)
 $V_{CE}=20\text{V}$

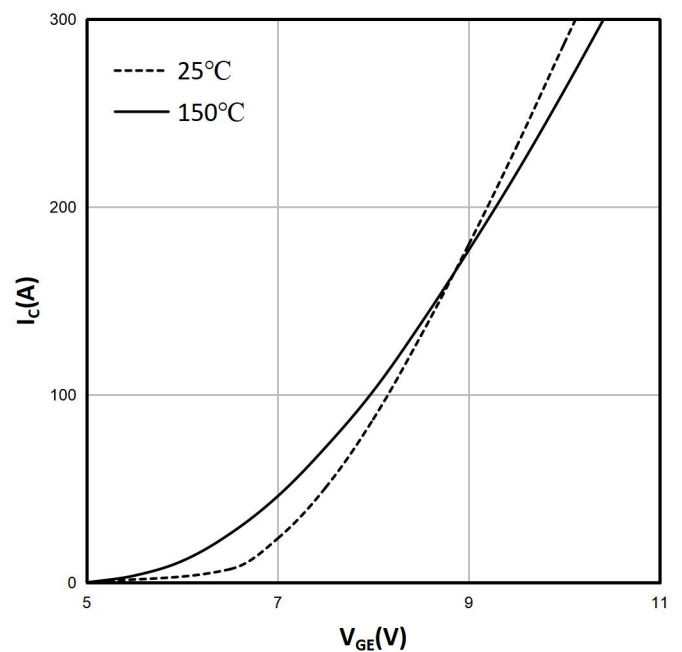


Figure5. V_{TH} vs. Temperature

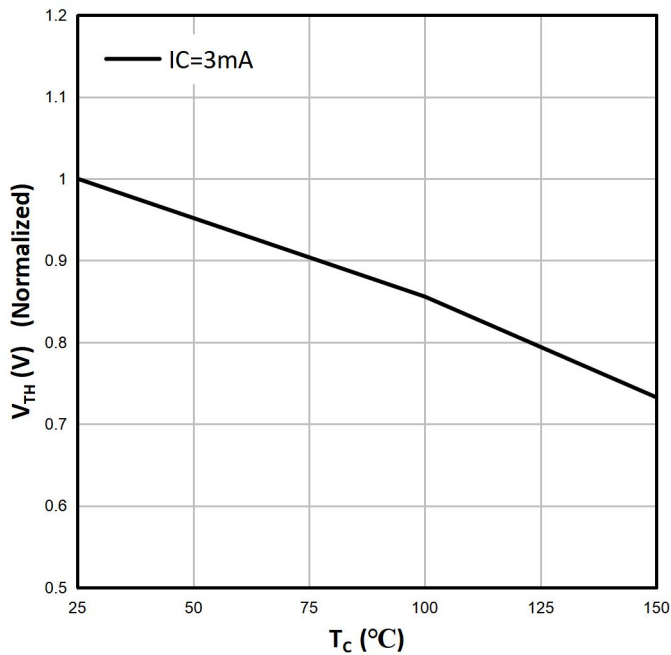


Figure6. Gate Charge Waveform

$V_{CC}=480V$

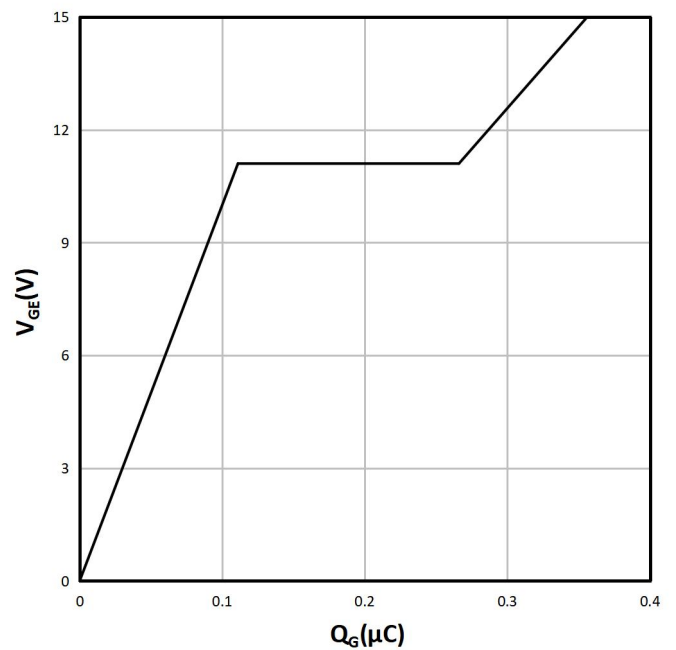


Figure7. switching losses IGBT, Inverter (typical) (T_1 , T_4)

$V_{CC}=400V$, $R_{gon}=25\Omega$, $R_{goff}=50\Omega$, $V_{ge}=15V/-5V$

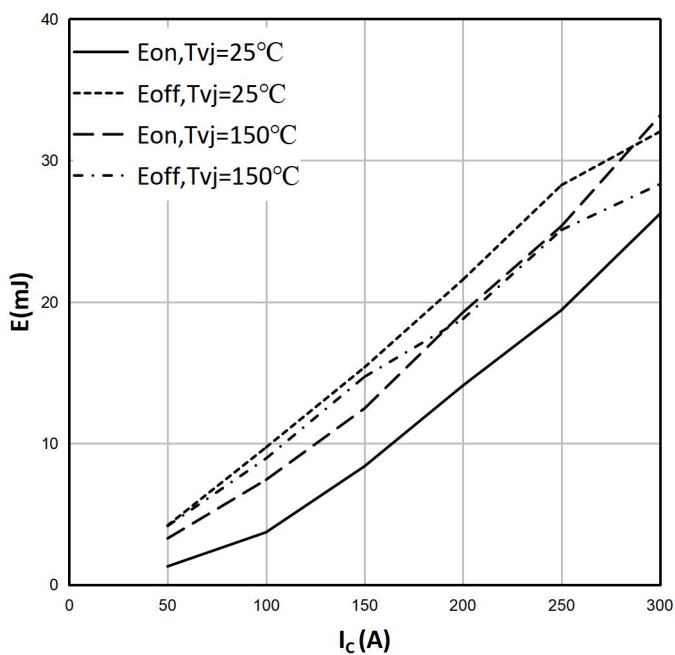


Figure8. switching losses IGBT, Inverter (typical) (T_1 , T_4)

$V_{CC}=400V$, $I_C=150A$, $V_{ge}=15V/-5V$

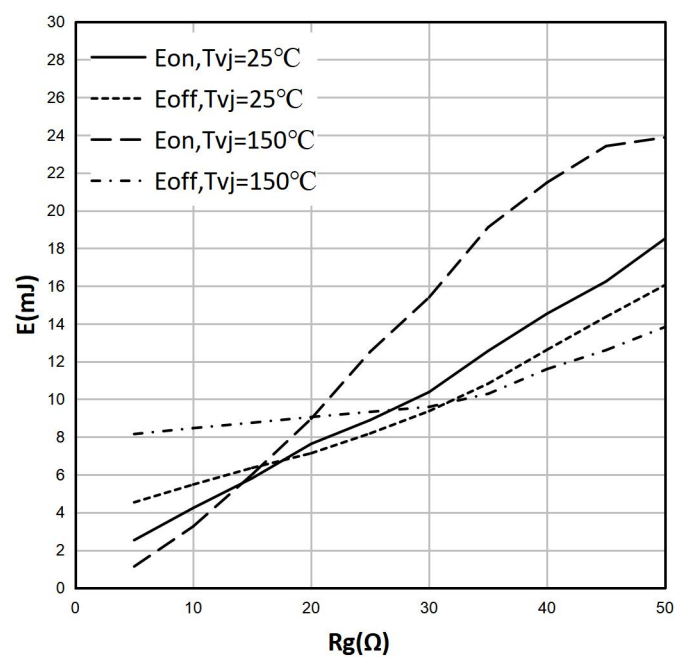


Figure9.switching losses IGBT,Inverter(typical) (T2, T3)

$V_{cc}=400V, R_{gon}=25\Omega, R_{goff}=50\Omega, V_{ge}=15V/-5V$

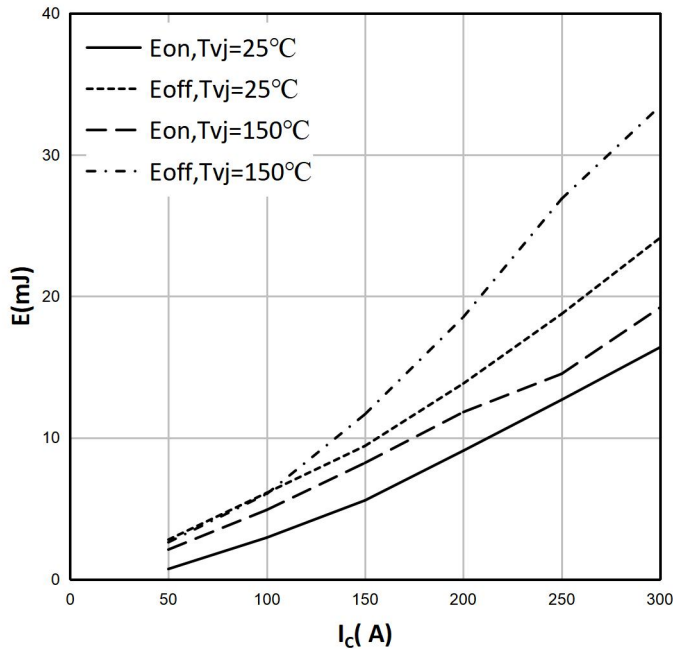
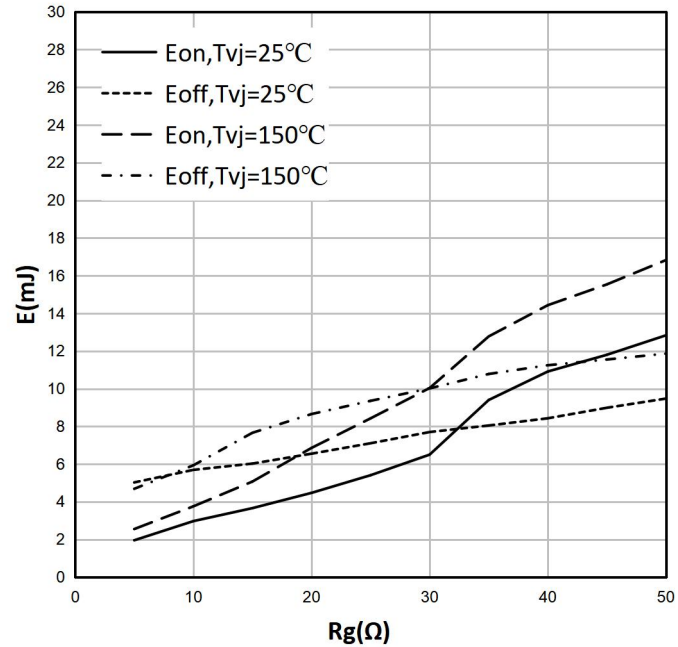


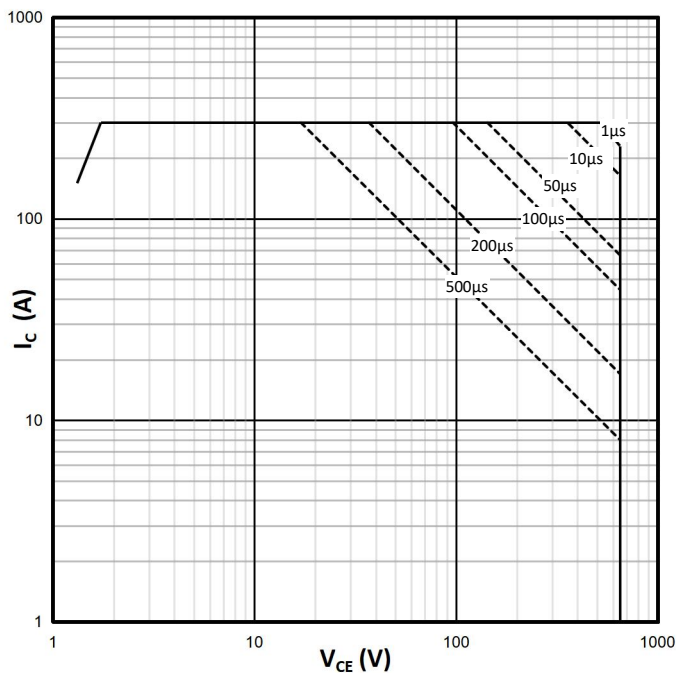
Figure10.switching losses IGBT,Inverter(typical) (T2, T3)

$V_{cc}=400V, I_C=150A, V_{ge}=15V/-5V$

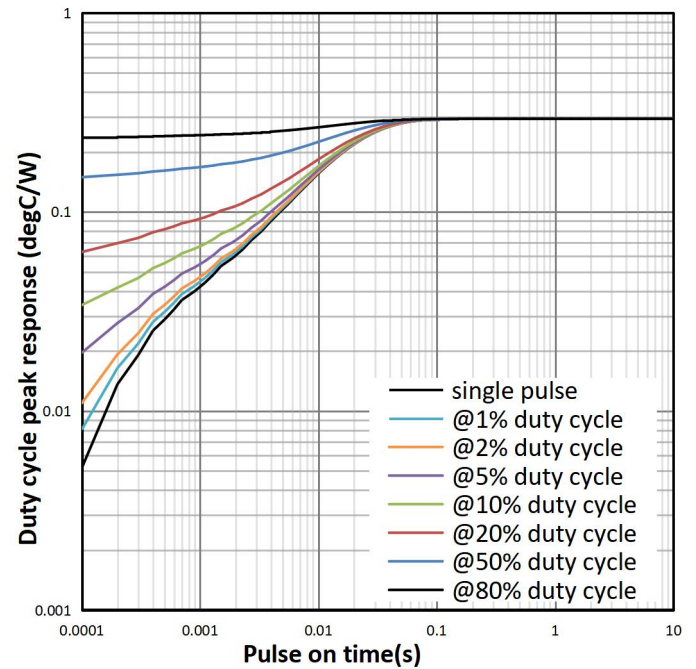


**Figure11. FBSOA
IGBT,Inverter(typical) (T1, T2, T3, T4)**

$D=0, T_c=25^\circ C, T_j \leq 175^\circ C, V_{ge}=15V$

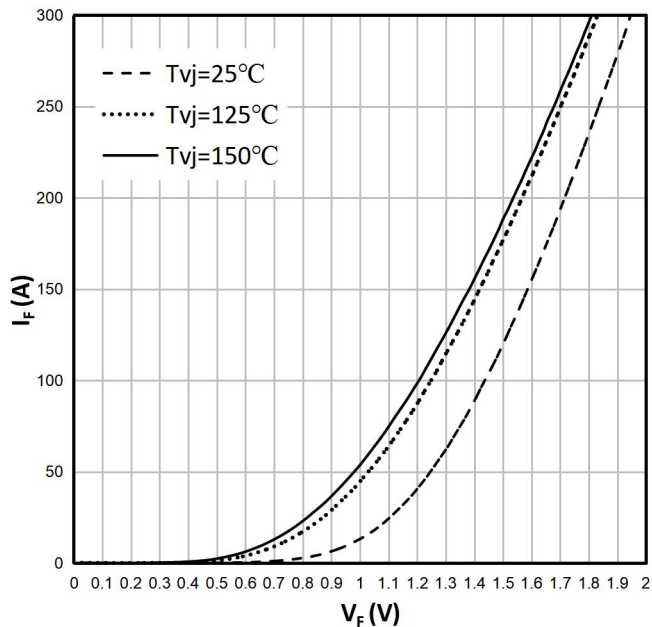


**Figure12. transient thermal impedance
IGBT,Inverter(typical) (T1, T2, T3, T4)**



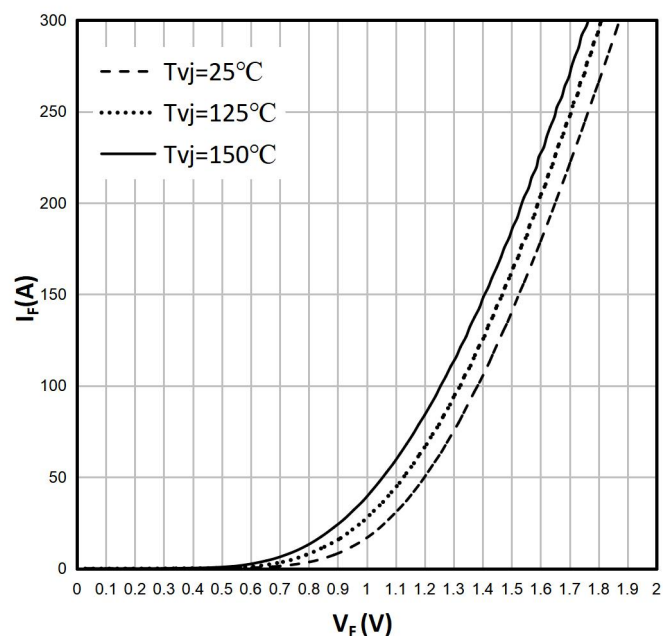
**Figure13. forward characteristic of Diode,Inverter(typical)
(D1, D2, D3, D4)**

$V_{GE}=0V$



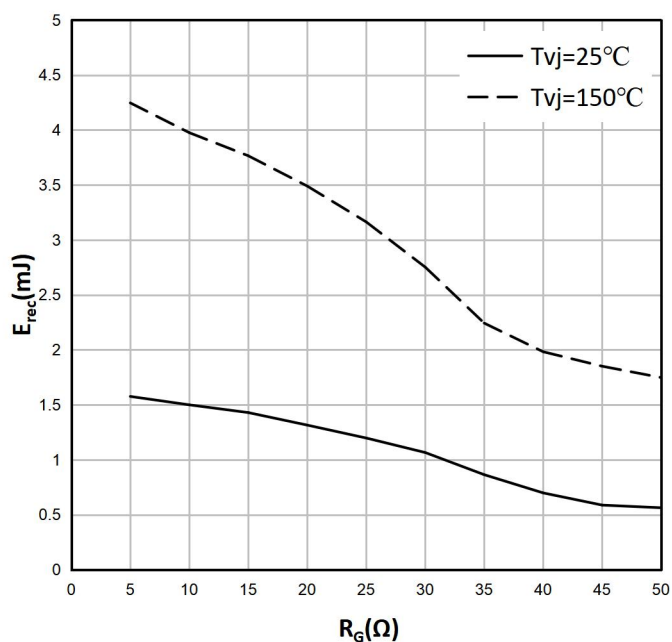
**Figure14. forward characteristic of Diode,Inverter(typical)
(D5, D6)**

$V_{GE}=0V$



**Figure15.Reverse Recovery Energy Loss vs.vs. R_G
(D1, D4)**

$V_{CC}=400V, I_C=150A, V_{GE}=15V/-5V$



**Figure16.Reverse Recovery Energy Loss vs. I_C
(D1, D4)**

$V_{CC}=400V, R_G=25Ω, V_{GE}=15V/-5V$

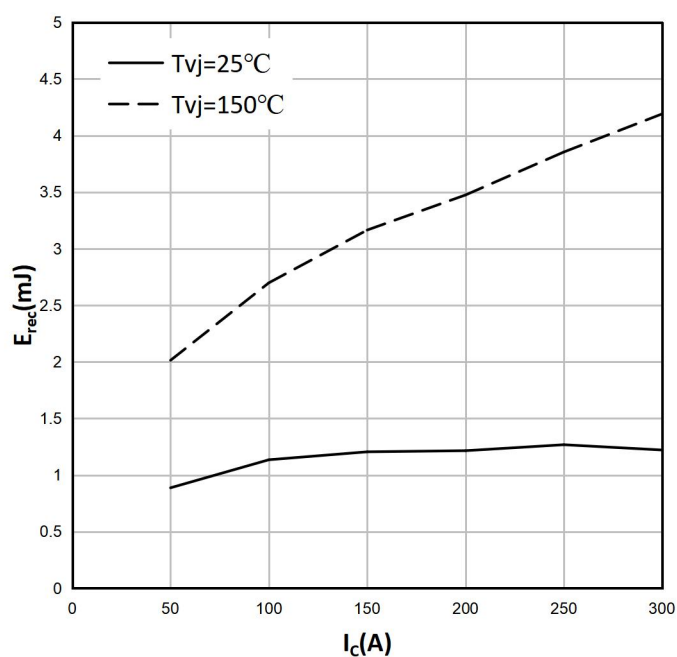


Figure17.Reverse Recovery Energy Loss vs. R_G (D2, D3)

$V_{cc}=400V, I_C=150A, V_{ge}=15V/-5V$

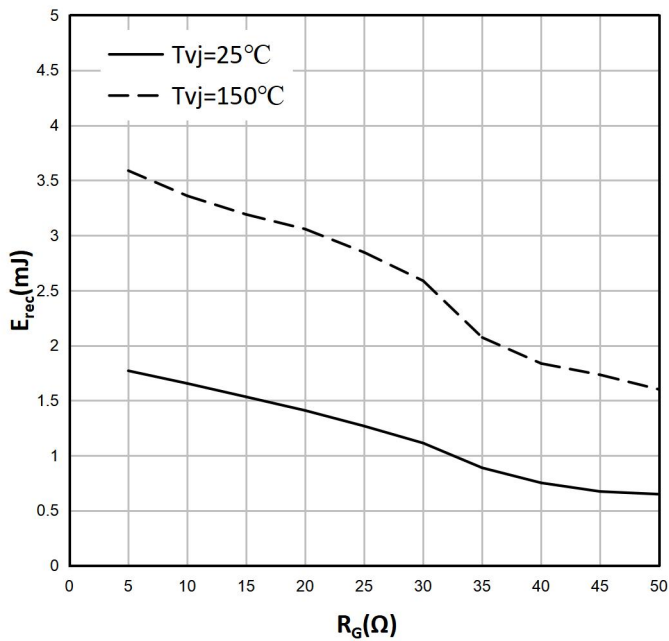


Figure18.Reverse Recovery Energy Loss vs. I_C (D2, D3)

$V_{cc}=400V, R_g=25\Omega, V_{ge}=15V/-5V$

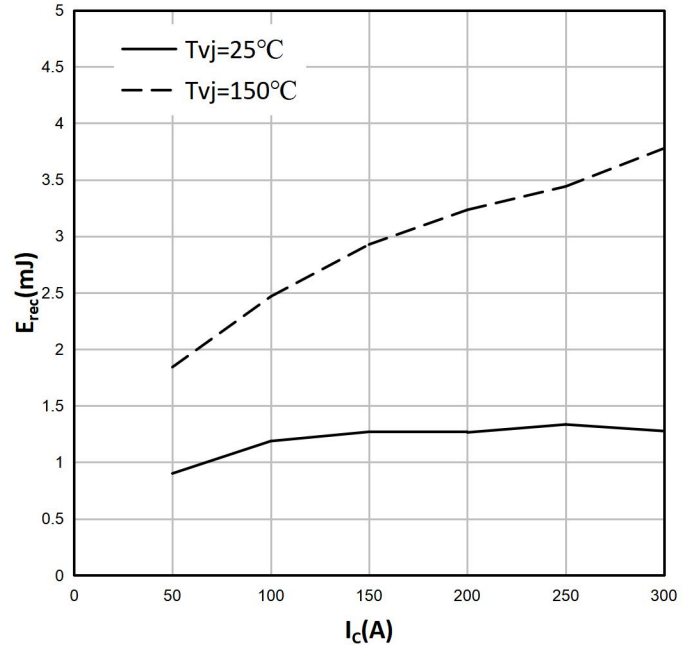


Figure19.Reverse Recovery Energy Loss vs. R_G (D5, D6)

$V_{cc}=400V, I_C=150A, V_{ge}=15V/-5V$

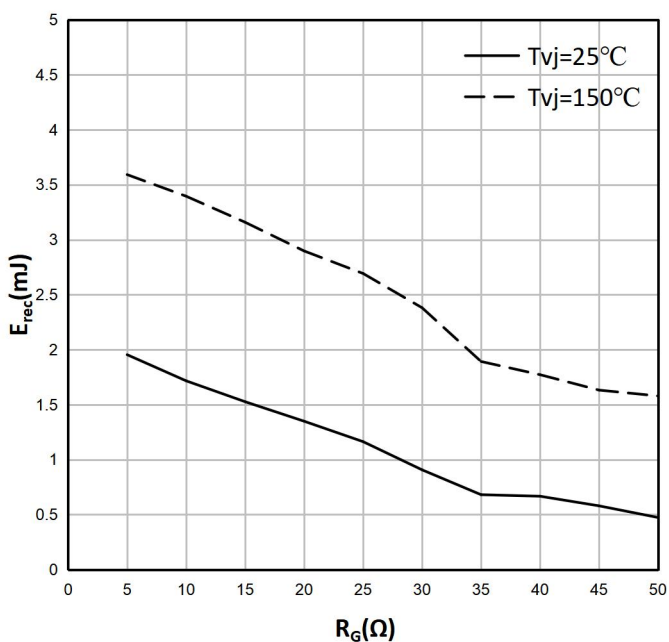
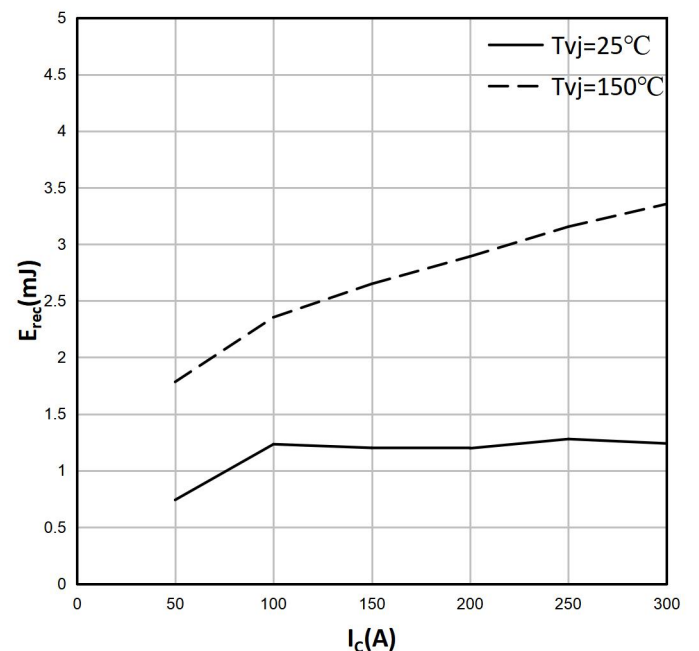
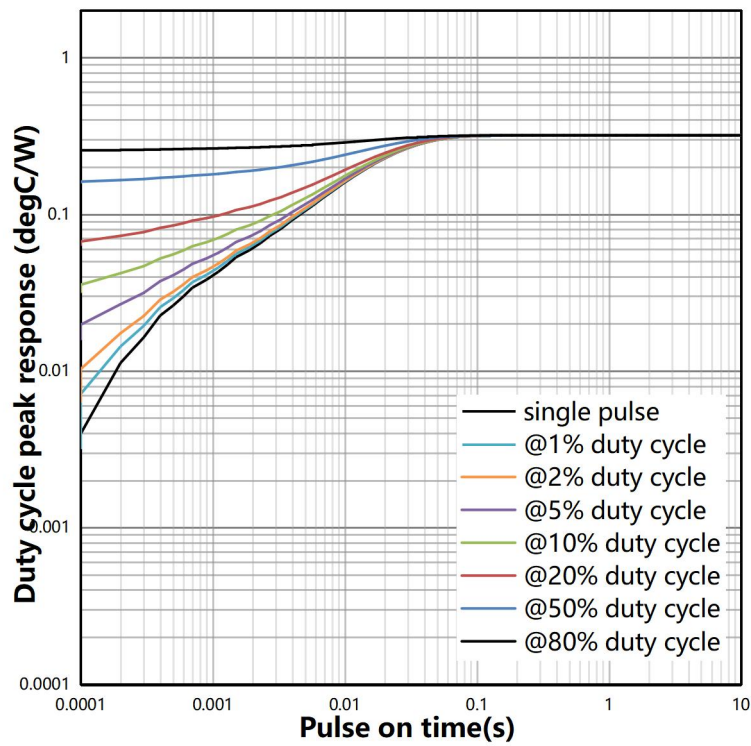


Figure20.Reverse Recovery Energy Loss vs. I_C (D5, D6)

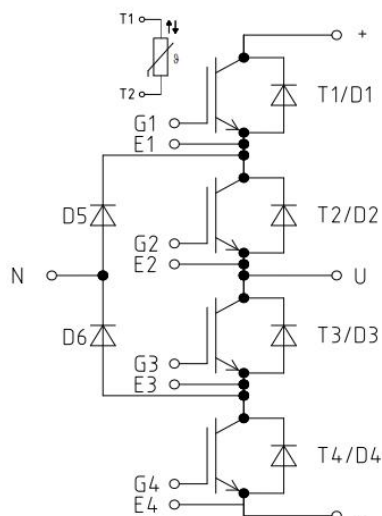
$V_{cc}=400V, R_g=25\Omega, V_{ge}=15V/-5V$



**Figure21. transient thermal impedance-FRD
(D1, D2, D3, D4, D5, D6)**

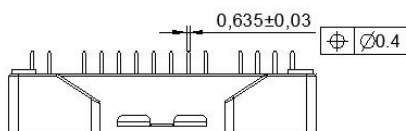


CIRCUIT DIAGRAM

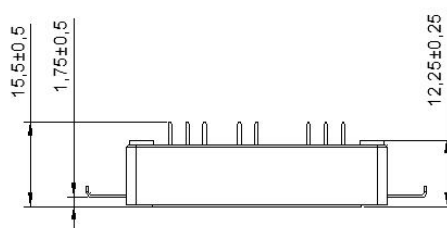


PACKAGE DIMENSION

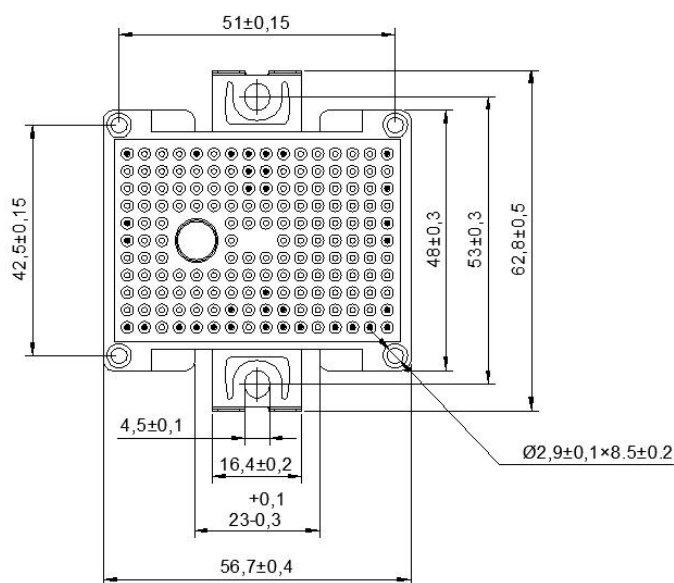
Dimensions in Millimeters



SIDE VIEW



SIDE VIEW



TOP VIEW

