F2 PACK module with Gen.7 Trench/Fieldstop IGBT and Emitter Controlled diode and NTC

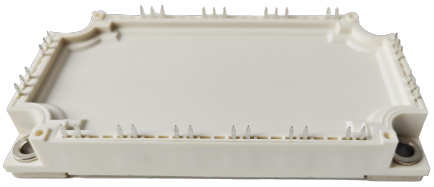
Features

• Electrical features

- V_{CES} = 1200 V
- $I_{C\ nom}$ = 100 A / I_{CRM} = 200 A
- Low V_{CEsat}
- Overload operation up to 175℃

• Mechanical features

- High power and thermal cycling capability
- Integrated NTC temperature sensor
- Copper base plate
- Al_2O_3 substrate with low thermal resistance



F2

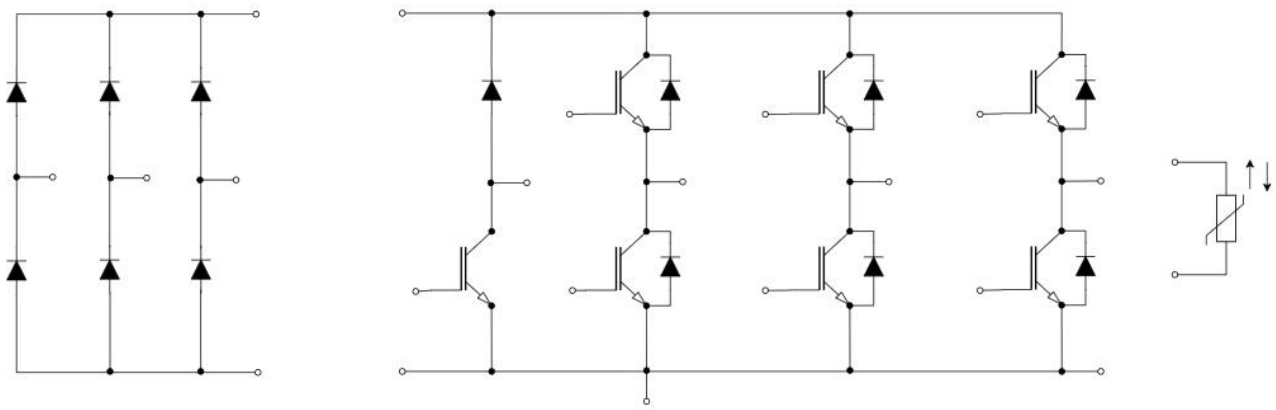
Typical Applications

• Auxiliary inverters

• Motor drives

• Servo drives

Description



Package Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS,f=50 Hz,t=60s	2.5	kV
Internal isolation		basic insulation(class 1,IEC 61140)	Al_2O_3	
Creepage distance	d_{creep}	terminal to heatsink	10.0	mm
Clearance	d_{clear}	terminal to heatsink	7.5	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	LCE		--	40	--	nH
Module Lead Resistance, Terminal to Chip	$R_{AA'+CC'}$	T_C=25℃, per switch	--	3	--	mΩ
Module Lead Resistance, Terminal to Chip	$R_{CC'+EE'}$	T_C=25℃, per switch	--	4	--	mΩ
Storage Temperature Range	T_{STG}		-40		125	℃
Mounting Torque, Screw M5	M	M5, Screw	3		6	N.m
Weight	G		--	300	--	g

IGBT, Inverter

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

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	±30	V
I_C	Collector Current @ T_C=25℃	200	A
	Collector Current @ T_C=100℃	100	A
I_{Cpuls}	Pulsed Collector Current，t_p limited by T_{jmax}	300	A

Characteristics (Tc = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage	I_C=100A，V_{GE}=15V	T_{vj}=25 °C	--	1.60	2.45	V
			T_{vj}=150 °C	--	1.95	--	
$V_{GE(th)}$	Gate Threshold Voltage	I_C=3 mA,V_{CE}=V_{GE}		5.0	6.0	7.0	V
I_{CES}	Collector-Emitter Leakage Current	V_{GE}=0V,V_{CE}=1200 V		--	--	1	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=30V,V_{CE}=0 V		--	--	100	nA
R_{Gint}	Internal Gate Resistance	f=1MHz		--	2.19	--	Ω
C_{ies}	Input Capacitance	V_{CE}=30V,V_{GE}=0 V, f=1MHz		--	12	--	nF
C_{oes}	Out Capacitance			--	0.904	--	nF
C_{res}	Reverse Transfer			--	0.057	--	nF
Q_G	Gate Charge	V_{CE}=600V, I_C=100A,V_{GE}=15V		--	0.384	--	μC
$t_{d(on)}$	Turn−On Delay Time	V_{CE}=600V,I_C=100A, V_{GE}=15V/-5V,R_{gon}=25Ω,R_{goff}=25Ω, Inductive Load		--	0.31	--	μs
t_r	Rise Time			--	0.1	--	
$t_{d(off)}$	Turn−off Delay Time			--	0.6	--	
t_f	Fall Time			--	0.12	--	
E_{on}	Turn−On Switching Loss per Pulse			--	22.3	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	8.8	--	
$t_{d(on)}$	Turn−On Delay Time	V_{CE}=600V,I_C=100A, V_{GE}=15V/-5V,R_{gon}=25Ω,R_{goff}=25Ω, Inductive Load,T_{vj}=150°C		--	0.3	--	μs
t_r	Rise Time			--	0.13	--	
$t_{d(off)}$	Turn−off Delay Time			--	0.65	--	
t_f	Fall Time			--	0.22	--	
E_{on}	Turn−on Switching Loss per Pulse			--	30.27	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	11.89	--	
I_{SC}	SC Data	V_{GE}=15V,V_{CC}≤800V, t_{SC}≤10us,T_{vj}≤150°C		--	350	--	A
R_{thJC}	Thermal resistance	Junction-to-Case (per IGBT)			0.328		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, Inverter

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

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	100	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	200	A

Characteristics (Tc=25℃ unless otherwise noted)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
V_F	Diode Forward Voltage	I_F=100A	T_j=25°C	--	1.60	2.40	V
			T_j=150°C	--	1.52	--	
Q_r	Recovered Charge	V_{CE}=600V,I_C=100A, V_{GE}=15V/-5V,R_{gon}=25Ω,R_{goff}=25Ω, Inductive Load		--	10.73	--	μC
I_{RM}	Peak Reverse Recovery Current			--	60.27	--	A
T_{rr}	Reverse Recovery Time			--	409	--	ns
E_{rec}	Reverse Recovery Energy			--	3.49	--	mJ
Q_r	Recovered Charge	V_{CE}=600V,I_C=100A, V_{GE}=15V/-5V,R_{gon}=25Ω,R_{goff}=25Ω, Inductive Load,T_{vj}=150°C		--	22.59	--	μC
I_{RM}	Peak Reverse Recovery Current			--	63.35	--	A
T_{rr}	Reverse Recovery Time			--	709	--	ns
E_{rec}	Reverse Recovery Energy			--	7.63	--	mJ
R_{thJC}	Thermal resistance	Junction-to-Case (per diode)			0.508		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.

Diode, Rectifier

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

Symbol	Description	Test Condition	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	T_{Vj}=25°C	1600	V
I_F	Diode Continuous Forward Current	T_c=100°C	100	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	T_c=100°C	200	A

Characteristics (Tc=25℃ unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
V_F	Diode Forward Voltage	I_F = 100A, T_j = 150 °C	--	1.21	--	V
I_R	Reverse Current	T_j=175°C, V_R=1600V	--	2	--	mA
R_{thJC}	Thermal resistance	Junction-to-Case (per diode)	--	0.364	--	K/W
$T_{vj\ op}$		Temperature under switching conditions	-40		175[3)]	℃

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

IGBT, Chopper

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

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	±30	V
I_C	Collector Current @ T_C=25℃	100	A
	Collector Current @ T_C=80℃	50	A
I_{CM}	Pulsed Collector Current，t_p=1s	150	A

Characteristics (Tc = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage	I_C=50A，V_{GE}=15V	T_{vj}=25°C	--	1.45	2.15	V
			T_{vj}= 150°C	--	1.70	--	
$V_{GE(th)}$	Gate Threshold Voltage	I_C=1mA,V_{CE}=V_{GE}		5.0	6.0	7.0	V
I_{CES}	Collector-Emitter Leakage Current	V_{GE}=0V,V_{CE}=1200V		--	--	1	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=30V,V_{CE}=0V		--	--	200	nA
R_{Gint}	Internal Gate Resistance	f=1MHz		--	1.2	--	Ω
C_{ies}	Input Capacitance	V_{CE}=25V,V_{GE}=0V, f=1MHz		--	7.38	--	nF
C_{oes}	Out Capacitance			--	0.525	--	nF
C_{res}	Reverse Transfer			--	0.038	--	nF
Q_G	Gate Charge	V_{CE}=600V, I_C=50A,V_{GE}=15V		--	0.28	--	μC
$t_{d(on)}$	Turn−On Delay Time	V_{CE}=600V,I_C=50A, V_{GE}=15V/-5V,R_{gon}=15Ω,R_{goff}=15Ω, Inductive Load		--	0.16	--	μs
t_r	Rise Time			--	0.04	--	
$t_{d(off)}$	Turn−off Delay Time			--	0.3	--	
t_f	Fall Time			--	0.2	--	
E_{on}	Turn−On Switching Loss per Pulse			--	2.95	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	4.3	--	
$t_{d(on)}$	Turn−On Delay Time	V_{CE}=600V,I_C=50A, V_{GE}=15V/-5V,R_{gon}=15Ω,R_{goff}=15Ω, Inductive Load,T_{vj}=150°C		--	0.11	--	μs
t_r	Rise Time			--	0.04	--	
$t_{d(off)}$	Turn−off Delay Time			--	0.37	--	
t_f	Fall Time			--	0.32	--	
E_{on}	Turn−on Switching Loss per Pulse			--	5.18	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	6.13	--	
I_{SC}	SC Data	V_{GE}=15V,V_{CC}≤600V, t_{SC}≤10us,T_j≤150°C		--	285	--	A
R_{thJC}	Thermal resistance	Junction-to-Case (per IGBT)			0.42		K/W
$T_{vj\ op}$		Temperature under switching conditions		-40		175[4)]	℃

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

Diode, Chopper

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

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	25	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	50	A

Characteristics (Tc=25℃ unless otherwise noted)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
V_F	Diode Forward Voltage	I_F=25A	T_j=25°C	--	1.35	2.00	V
			T_j=175°C	--	1.15	--	
Q_r	Recovered Charge	V_{CE}=600V,I_C=50A, V_{GE}=15V/-5V,R_{gon}=15Ω,R_{goff}=15Ω, Inductive Load		--	2.56	--	μC
I_{RM}	Peak Reverse Recovery Current			--	54.5	--	A
T_{rr}	Reverse Recovery Time			--	87	--	ns
E_{rec}	Reverse Recovery Energy			--	1.15	--	mJ
Q_r	Recovered Charge	V_{CE}=600V,I_C=50A, V_{GE}=15V/-5V,R_{gon}=15Ω,R_{goff}=15Ω, Inductive Load,T_{vj}=150°C		--	8.81	--	μC
I_{RM}	Peak Reverse Recovery Current			--	61.2	--	A
T_{rr}	Reverse Recovery Time			--	398	--	ns
E_{rec}	Reverse Recovery Energy			--	4.02	--	mJ
R_{thJC}	Thermal resistance	Junction-to-Case (per diode)			0.66		K/W
$T_{vj\ op}$		Temperature under switching conditions		-40		175[5)]	℃

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

NTC Characteristics (Tc = 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 ℃,R_{100}=493.3Ω	-5	--	5	%
P_{25}	Power Dissipation		--	--	20.0	mW
$B_{25/50}$	B-value	R2=R25exp[B25/50(1/T2- 1/(298.15K))]	--	3375	--	K
$B_{25/80}$	B-value	R2=R25exp[B25/80(1/T2- 1/(298.15K))]	--	3411	--	K
$B_{25/100}$	B-value	R2=R25exp[B25/100(1/T2- 1/(298.15K))]	--	3433	--	K

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

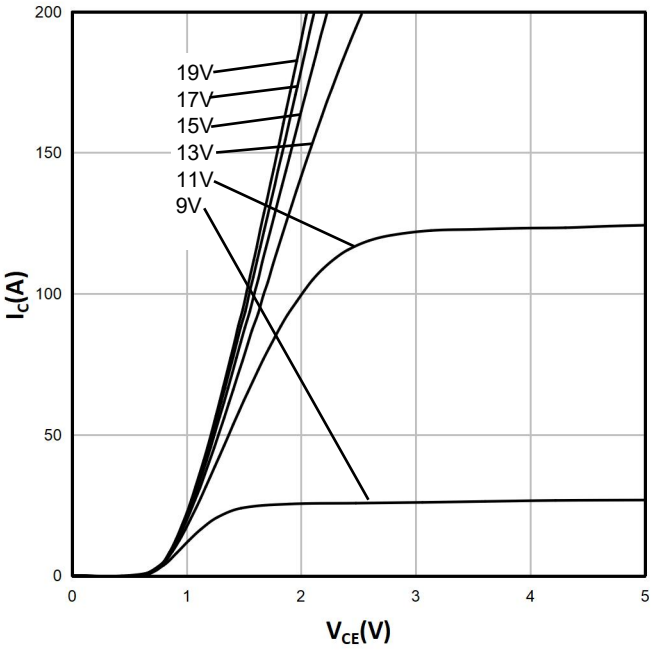


Figure2.output characteristic IGBT,Inverter(typical)
T_{vj}=150°C

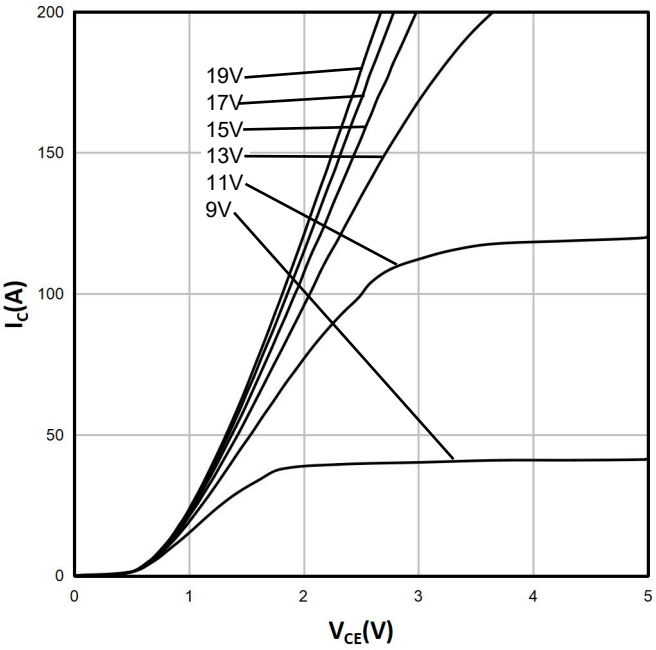


Figure3. $V_{CE(sat)}$ vs. Temperature,Inverter(typical)

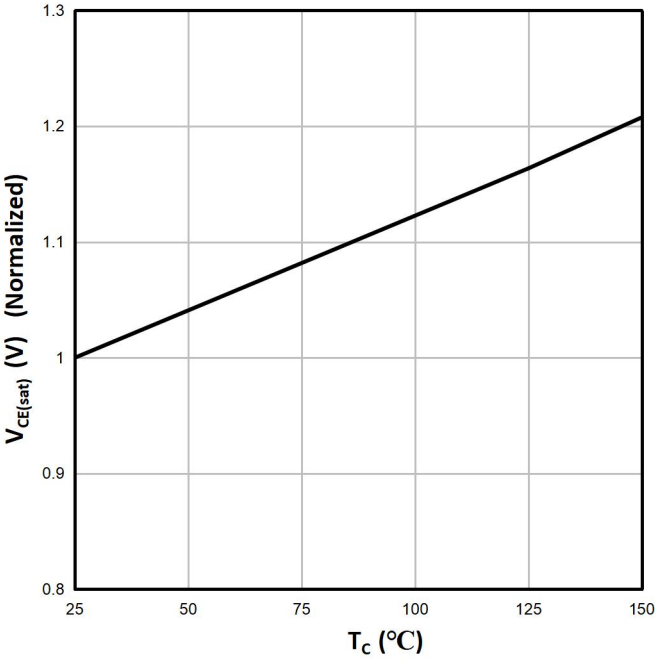


Figure4.transfer characteristic IGBT,Inverter(typical)
V_{CE}=20V

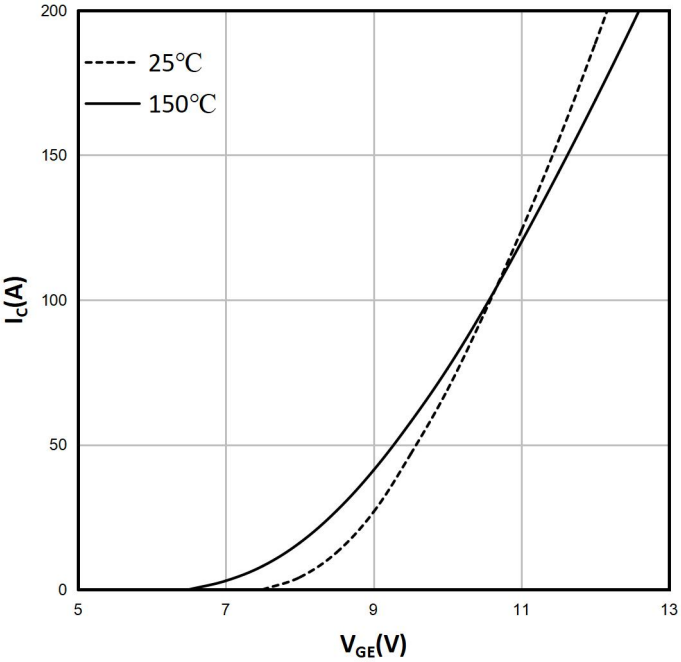


Figure5. V_{TH} vs. Temperature,Inverter(typical)

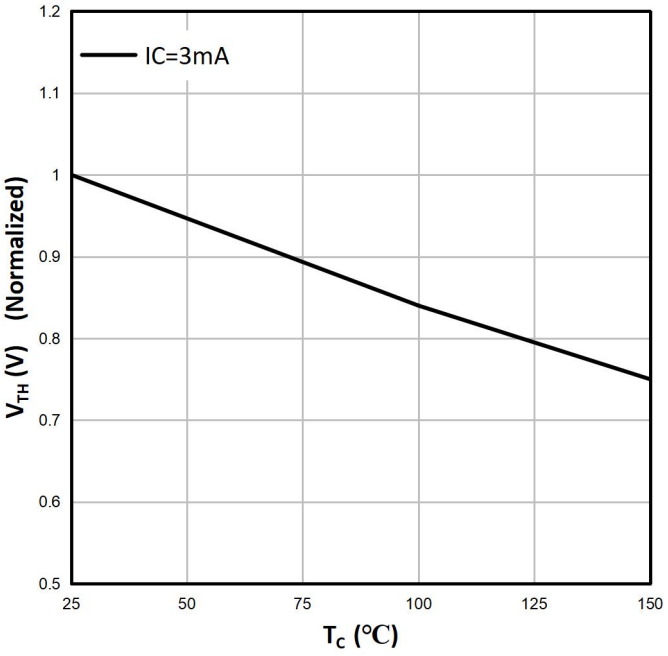


Figure6. Gate Charge Waveform,Inverter(typical)
Vcc=600V

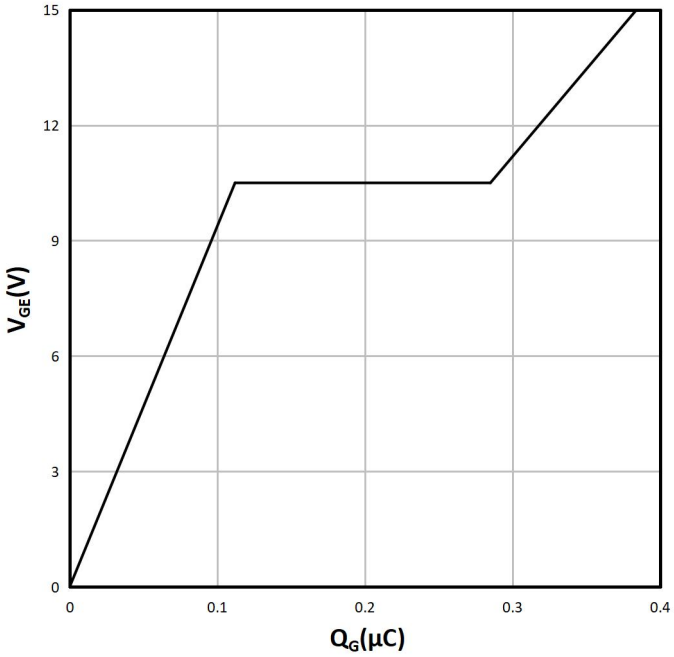


Figure7.switching losses IGBT,Inverter(typical)
Vcc=600V,Rgon=25Ω,Rgoff=25Ω,Vge=15V/-5V

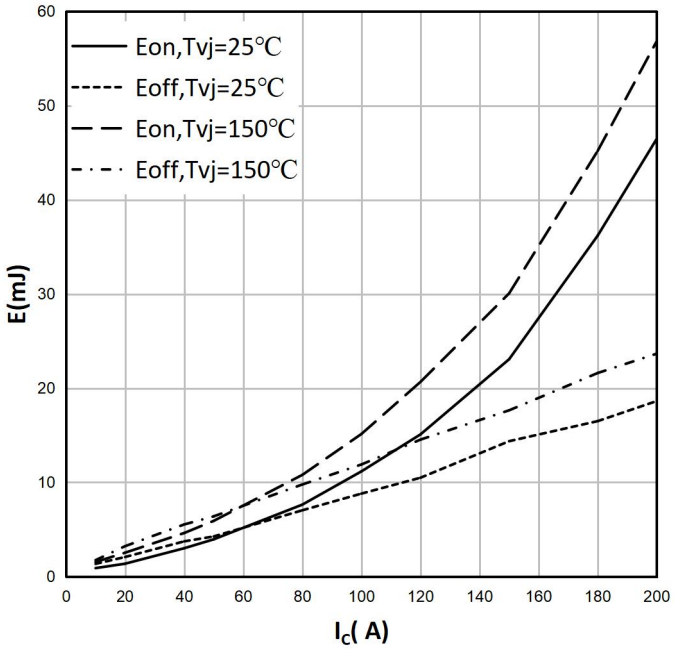


Figure8.switching losses IGBT,Inverter(typical)
Vcc=600V,IC=100A,Vge=15V/-5V

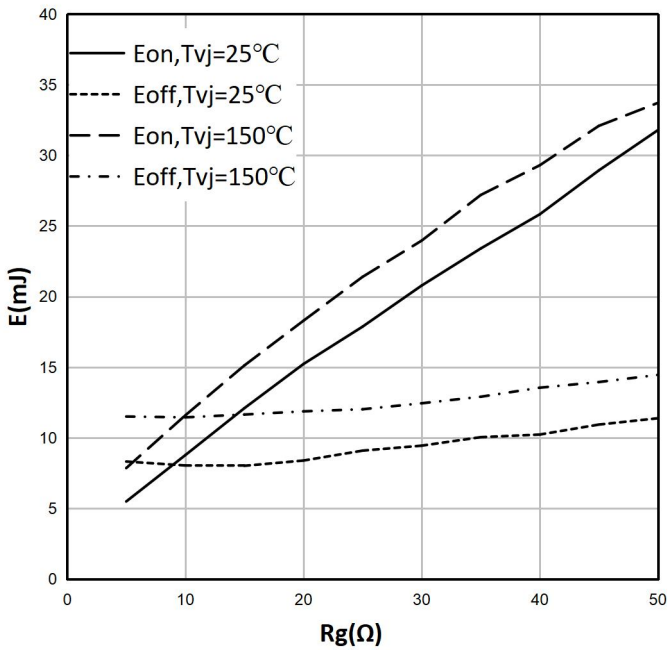


Figure9.FBSOA, IGBT, Inverter (typical)
D=0, Tc=25℃,Tj<=175℃,Vge=15V

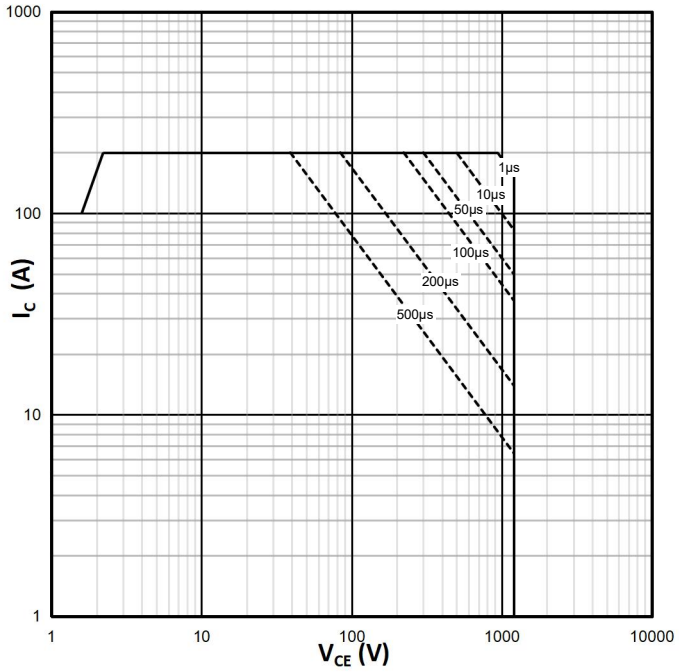


Figure10.transient thermal impedance,IGBT, Inverter (typical)

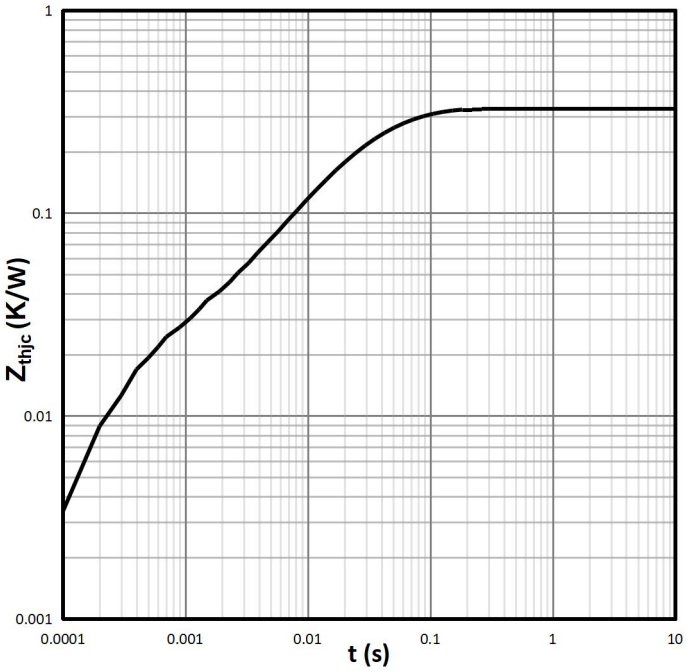


Figure11.forward characteristic of Diode,Inverter (typical)
V_{GE}=0V

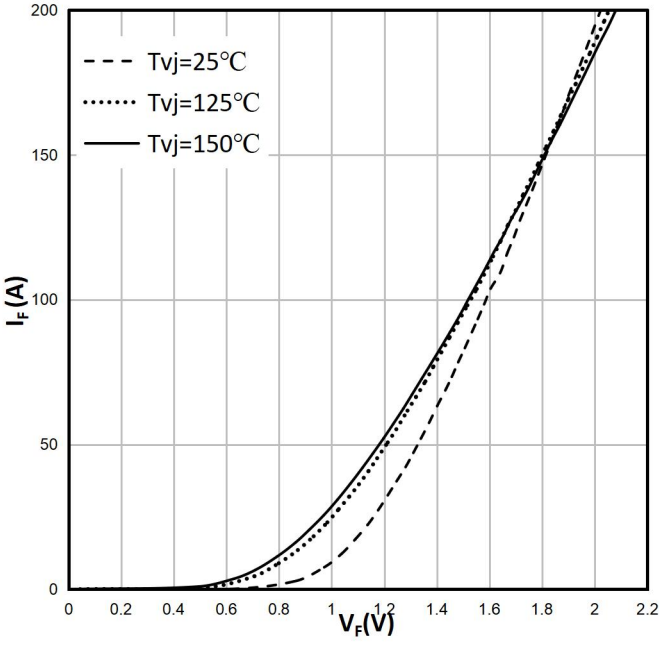


Figure 12.Reverse Recovery Energy Loss vs. IC ,Inverter (typical)
Vcc=600V,Rgon=25Ω,Rgoff=25Ω,Vge=15V/-5V

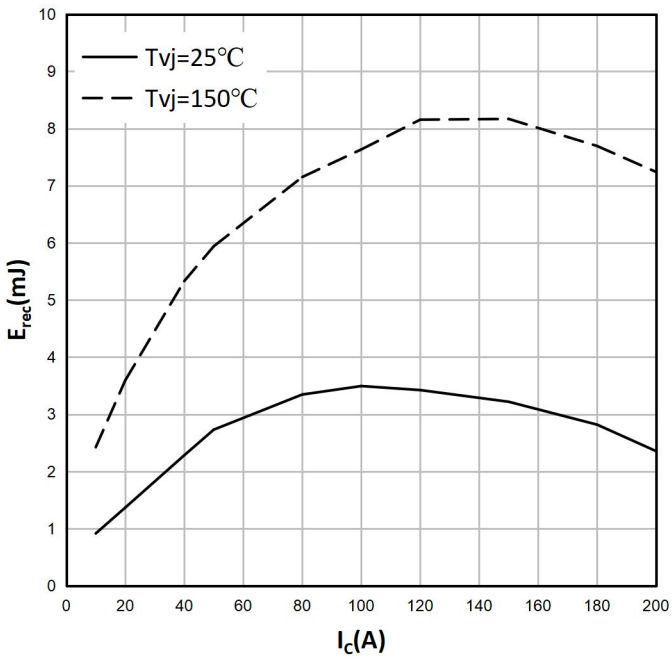


Figure13.Reverse Recovery Energy Loss vs. RG ,Inverter(typical)
Vcc=600V,IC=100A,Vge=15V/-5V

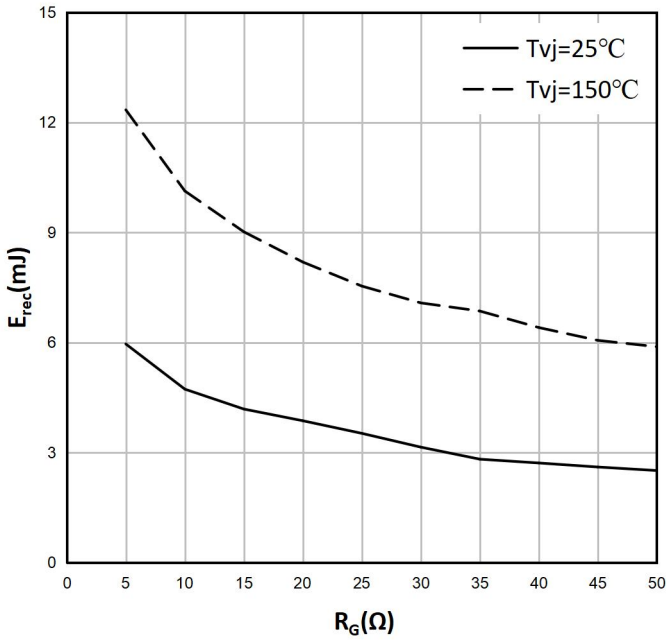


Figure14.transient thermal impedance, Diode,Inverter (typical)

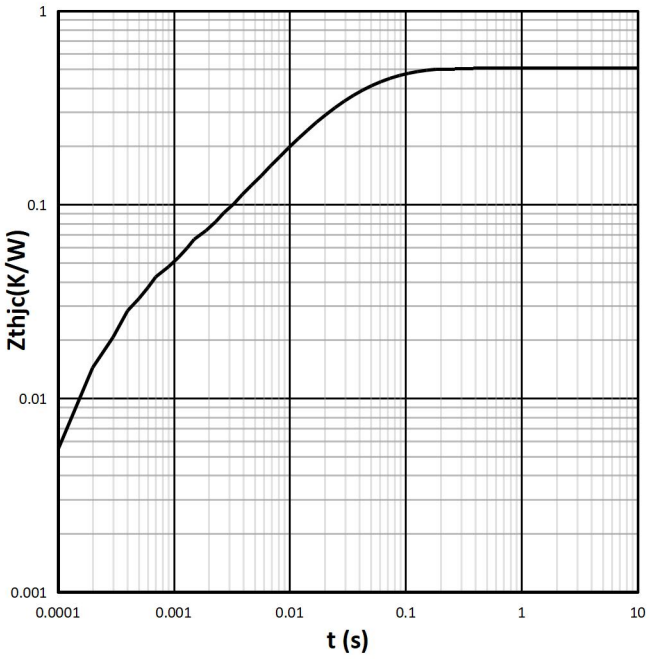


Figure15.forward characteristic of Diode,Rectifier(typical)
V_{GE}=0V

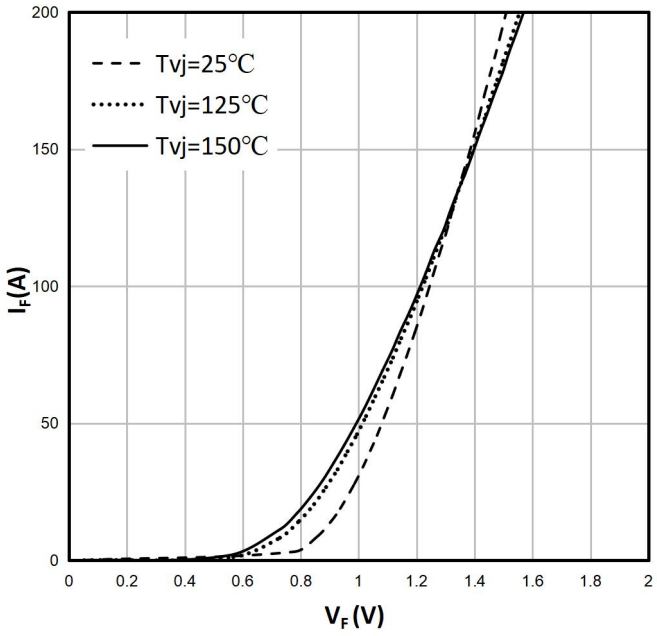


Figure 16.transient thermal impedance,Diode, Rectifier(typical)

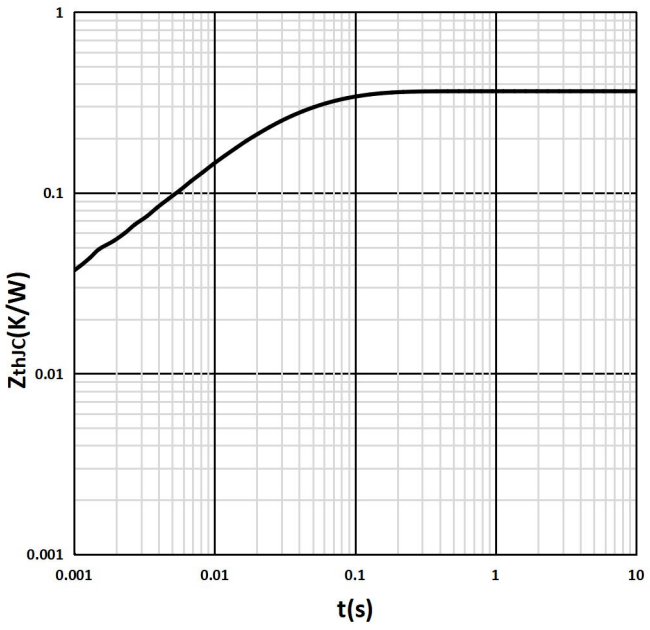


Figure17.output characteristic IGBT,Brake-Chopper (typical)

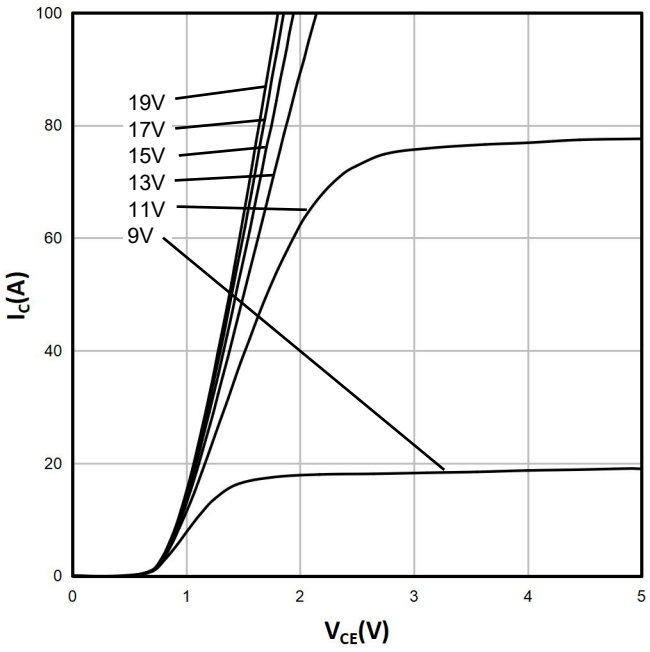


Figure18.output characteristic IGBT,Brake-Chopper (typical)

T_{vj}=150°C

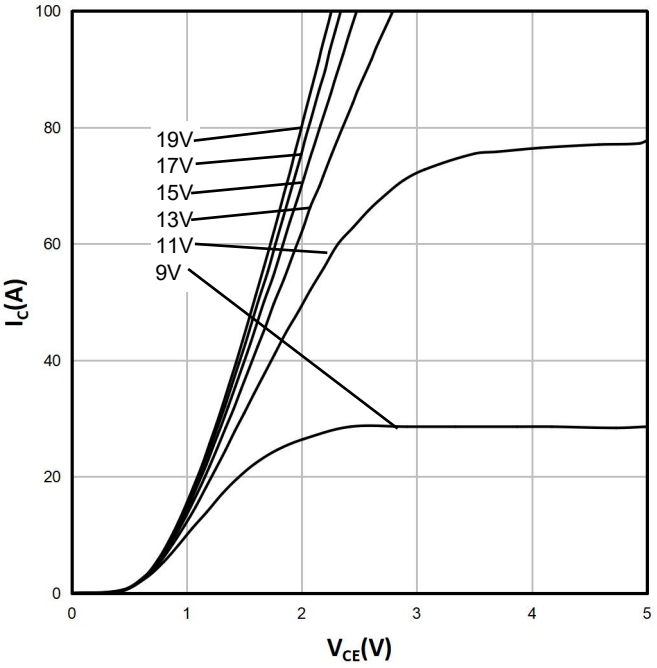


Figure19. $V_{CE(sat)}$ vs. Temperature, IGBT, Brake-Chopper (typical)

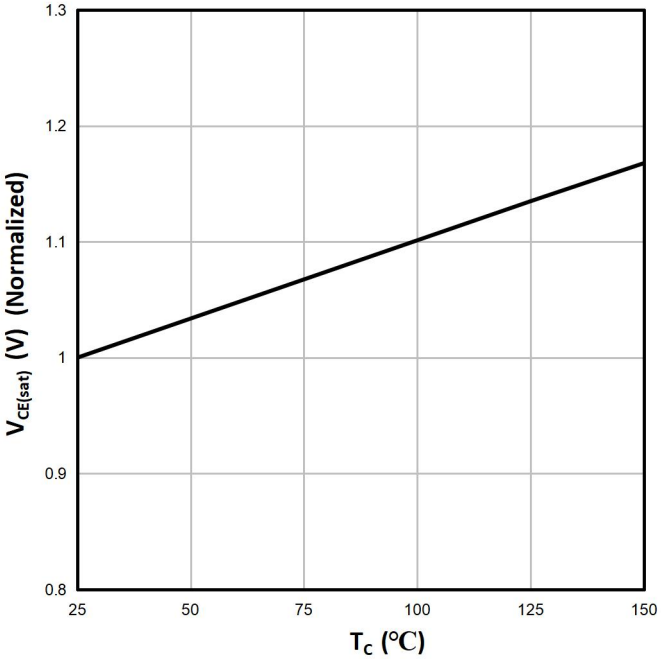
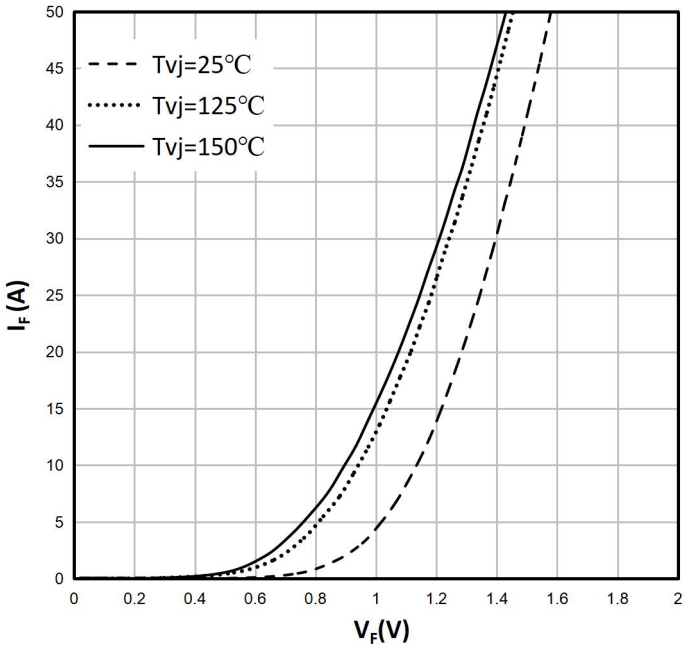
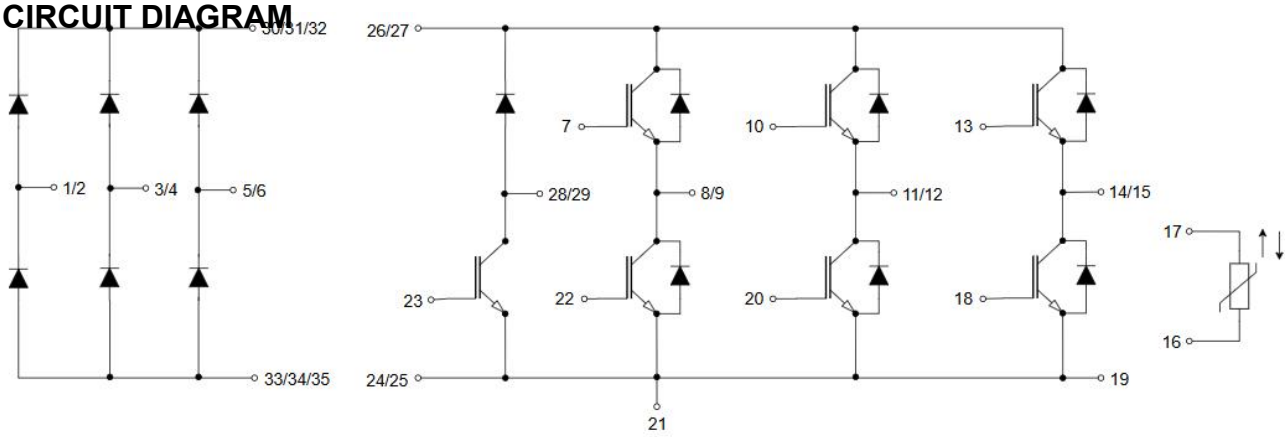


Figure20.forward characteristic of Diode,Brake-Chopper (typical)

V_{GE}=0V



CIRCUIT DIAGRAM



PACKAGE DIMENSION