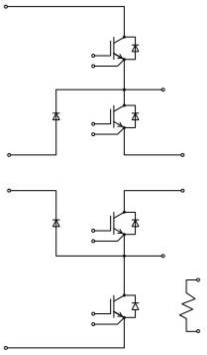
3-Level NPC1 Inverter Module

特性/ Features



1050V 沟槽栅/场终止技术

1050V Trench with Field Stop Technology

- 低开关损耗

  Low switching losses
- Vcesat 正温度系数

  Vcesat with positive Temperature Coefficient
- 采用氮化硅 AMB 基板

  Si_3N_4 substrate with Low thermal resistance

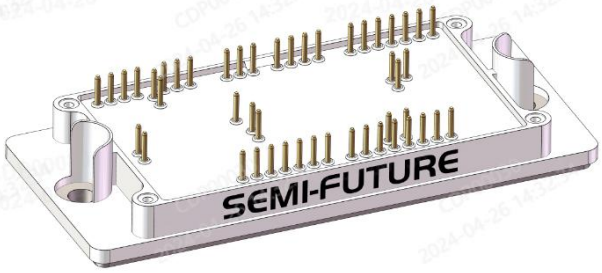
典型应用/ Applications:

- 储能系统

  Energy Storage System
- 光伏逆变器

  Solar Inverters
- 不间断电源

  Uninterruptable Power Supplies Systems



V_{CE} = 1050V，$I_{C\ nom}$ = 400A / I_{CRM} = 800A

IGBT, T1/T4

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压 Collector-Emitter voltage	T_{vj} = 25°C	V_{CES}	1050	V
集电极电流 Implemented collector current		I_{CN}	400	A
连续集电极直流电流 Continuous DC collector current	T_C = 80°C, T_{vjmax} = 175°C	$I_{C\ nom}$	380	A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1ms	I_{CRM}	800	A
栅极-发射极电压 Gate Emitter voltage		V_{GE}	±20	V
结温 Junction Temperature		T_j	-40 to +175	℃

特征值 / Characteristic Values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
集电极-发射极饱和电压 Collector-Emitter saturation voltage	V_{GE} = 15V, I_C = 400A V_{GE} = 15V, I_C = 400A V_{GE} = 15V, I_C = 400A	T_{vj} = 25°C T_{vj} = 125°C T_{vj} =150°C	V_{CEsat}		1.69 2.06 2.17	2.00	V
栅极-发射极阈值电压 Gate-Emitter threshold voltage	I_C = 6.5mA, V_{GE} = V_{CE}	T_{vj}=25°C	$V_{GE(th)}$	4.40	4.70	5.10	
栅电荷 Gate charge	V_{GE} = -15V…+15V		Q_G		1.63		µC
内部栅极电阻 Internal gate resistor			R_{Gint}		0.80		Ω
输入电容 Input capacitance	f = 100KHz, V_{CE} = 25V, V_{GE} = 0V, T_{vj} = 25°C		C_{ies}		28.6		nF
输出电容 Output capacitance			C_{oes}		1.02		nF
反向传输电容 Reverse transfer capacitance			C_{res}		0.11		nF
集电极-发射极截止电流 Collector-Emitter cut-off current	V_{CE} = 1050V , V_{GE} = 0V	T_{vj} = 25°C	I_{CES}			100	uA
栅极-发射极漏电流 Gate-Emitter leakage current	V_{CE} = 0V, V_{GE} = 20V	T_{vj} = 25°C	I_{GES}			1	uA
开通延迟时间 Turn-on delay time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Gon} = 8Ω, (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		132 117 114		ns
上升时间 Rise time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Gon} = 8Ω, (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		43 47 50		
关断延迟时间 Turn-off delay time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Goff} = 15Ω (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		544 586 597		
下降时间 Fall time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Goff} = 15Ω (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		61 93 99		
开通损耗能量（每脉冲） Turn-on Energy loss per pulse	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Gon} = 8Ω, di/dt = 3200A/us(T_{vj} = 150°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		11.7 17.1 18.9		mJ
关断损耗能量（每脉冲） Turn-off Energy loss per pulse	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Goff} = 15Ω, dv/dt = 5400V/us(T_{vj}= 150°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		8.89 11.7 12.0		
结-散热器 Thermal resistance, junction to heatsink	Thermal grease, Thickness = 100um ±2% = 3.0W/mK		R_{thJH}		0.129		K/W
结-外壳热阻 Thermal resistance, junction to case			R_{thJC}		0.088		

IGBT, T2/T3

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压 Collector-Emitter voltage	T_{vj} = 25°C	V_{CES}	1050	V
集电极电流 Implemented collector current		I_{CN}	400	A
连续集电极直流电流 Continuous DC collector current	T_C = 80°C, T_{vjmax} = 175°C	$I_{C\ nom}$	380	A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1ms	I_{CRM}	800	A
栅极-发射极电压 Gate Emitter voltage		V_{GE}	±20	V
结温 Junction Temperature		T_j	-40 to +175	℃

特征值 / Characteristic Values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
集电极-发射极饱和电压 Collector-Emitter saturation voltage	V_{GE} = 15V, I_C = 400A V_{GE} = 15V, I_C = 400A V_{GE} = 15V, I_C = 400A	T_{vj} = 25°C T_{vj} = 125°C T_{vj} =150°C	V_{CEsat}		1.68 2.04 2.13	2.00	V
栅极-发射极阈值电压 Gate-Emitter threshold voltage	I_C = 6.5mA, V_{GE} = V_{CE}	T_{vj}=25°C	$V_{GE(th)}$	4.40	4.70	5.10	
栅电荷 Gate charge	V_{GE} = -15V…+15V				1.63		µC
内部栅极电阻 Internal gate resistor					0.80		Ω
输入电容 Input capacitance	f = 100KHz, V_{CE} = 25V, V_{GE} = 0V, T_{vj} = 25°C		C_{ies}		28.7		nF
			C_{oes}		1.02		nF
反向传输电容 Reverse transfer capacitance			C_{res}		0.11		nF
集电极-发射极截止电流 Collector-Emitter cut-off current	V_{CE} = 1050V , V_{GE} = 0 V	T_{vj} = 25°C	I_{CES}			100	uA
栅极-发射极漏电流 Gate-Emitter leakage current	V_{CE} = 0V, V_{GE} = 20V	T_{vj} = 25°C	I_{GES}			1	uA
开通延迟时间 Turn-on delay time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Gon} = 8Ω, (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\ on}$		117 108 108		ns
上升时间 Rise time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Gon} = 8Ω, (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		52 58 60		

关断延迟时间 Turn-off delay time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Goff} = 15Ω (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\ off}$		529 568 575		
下降时间 Fall time	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Goff} = 15Ω (电感负载) / (Inductive load)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		56 78 88		
开通损耗能量（每脉冲） Turn-on Energy loss per pulse	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Gon} = 8Ω, di/dt = 2600A/us(T_{vj} = 150°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		11.9 17.2 18.7		mJ
关断损耗能量（每脉冲） Turn-off Energy loss per pulse	I_C = 200A, V_{CE} = 600V V_{GE} = ±15V, R_{Goff} = 15Ω, dv/dt = 5300V/us(T_{vj} = 150°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		8.52 11.3 12.0		
结-散热器 Thermal resistance, junction to heatsink	Thermal grease, Thickness = 100um ±2% = 3.0W/mK				0.128		K/W
结-外壳热阻 Thermal resistance, junction to case			R_{thJC}		0.089		

二极管,D5/D6

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1050	V
正向电流 Implemented forward current		I_{FN}	300	A
连续正向直流电流 Continuous DC forward current	T_C = 80°C, T_{vjmax} = 175°C	I_F	240	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1ms	I_{FRM}	600	A
I^2t 值 I^2t-value	t_p = 10ms, sin180°, T_j = 125°C	I^2t	11000	A^2S
结温 Junction Temperature		T_j	-40 to +175	℃

特征值 / Characteristic Values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	I_F = 300A, V_{GE} = 0V I_F = 300A, V_{GE} = 0V I_F = 300A, V_{GE} = 0V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_F		2.60 2.16 2.15		V
反向恢复峰值电流 Peak reverse recovery current	I_F = 200A, -di$_F$/dt = 3900A/μs (T_{vj} = 150°C) V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		90 138 186		A
恢复电荷 Recovered charge	I_F = 200A, -di$_F$/dt = 3900A/μs (T_{vj} = 150°C) V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_{rr}		9.70 24.8 32.1		μC

反向恢复损耗（每脉冲） Reverse recovered energy	I_F = 200A, -di$_F$/dt = 3900A/µs (T_{vj} = 150°C) V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		3.95 9.68 11.7		mJ
结-散热器 Thermal resistance, junction to heatsink	Thermal grease, Thickness = 100um ±2% = 3.0W/mK		R_{thJH}		0.204		K/W
结-外壳热阻 Thermal resistance, junction to case			R_{thJC}		0.145		

二极管,D1/D2/D3/D4

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1050	V
正向电流 Implemented forward current		I_{FN}	300	A
连续正向直流电流 Continuous DC forward current	T_C = 80°C, T_{vjmax} = 175°C	I_F	240	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1ms	I_{FRM}	600	A
I^2t 值 I^2t-value	t_p = 10ms, sin180°, T_j = 125°C	I^2t	11000	A^2S
结温 Junction Temperature		T_j	-40 to +175	℃

特征值 / Characteristic Values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	I_F = 300A, V_{GE} = 0V I_F = 300A, V_{GE} = 0V I_F = 300A, V_{GE} = 0V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_F		2.70 2.32 2.23		V
反向恢复峰值电流 Peak reverse recovery current	I_F = 200A, -di$_F$/dt = 3000A/µs (T_{vj} = 150°C) V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		96 147 160		A
恢复电荷 Recovered charge	I_F = 200A, -di$_F$/dt = 3000A/µs (T_{vj} = 150°C) V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		9.68 24.7 29.8		µC
反向恢复损耗（每脉冲） Reverse recovered energy	I_F = 200A, -di$_F$/dt = 3000A/µs (T_{vj} = 150°C) V_R = 600V, V_{GE} = -15V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		3.32 10.68 13.1		mJ
结-散热器 Thermal resistance, junction to heatsink	Thermal grease, Thickness = 100um ±2% = 3.0W/mK		R_{thJH}		0.202		K/W
结-外壳热阻 Thermal resistance, junction to case			R_{thJC}		0.147		

负温度系数热敏电阻/NTC-Thermistor

特征值/Characteristic Values

Parameter	Conditions	Value			Unit
R25	T = 25℃		5		KΩ
△R/R		−5		5	%
B−value	B (25/50), tolerance ±3%		3375		K
B−value	B (25/100), tolerance ±3%		3433		K

模块 / Module

Parameter	Conditions	Symbol	Value			Unit
绝缘测试电压 Isolation test voltage	RMS, f = 50Hz, t = 1min	V_{ISOL}	4000			V
内部绝缘 Internal isolation			Si4N3			
爬电距离 Creepage distance			12.7			mm
相对电痕指数 Comperative tracking index		CTI	> 600			
相对温度指数 (电) RTI Elec.	housing	RTI	140			
储存温度 Storage temperature		T_{stg}	-40		125	°C
模块安装的扭矩 Mounting torque for modul mounting		M	2.0		5.0	Nm
重量 Weight		W		180		g

IGBT T1/T4

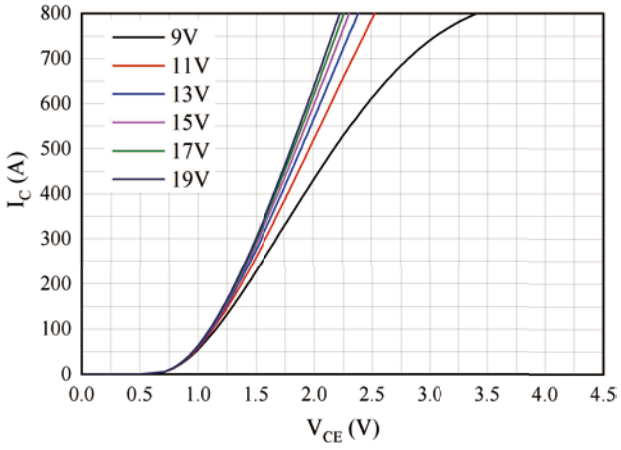


图 1. 典型输出特性 (T_{vj} = 25℃)
Figure 1. Typical output characteristics (T_{vj} = 25℃)

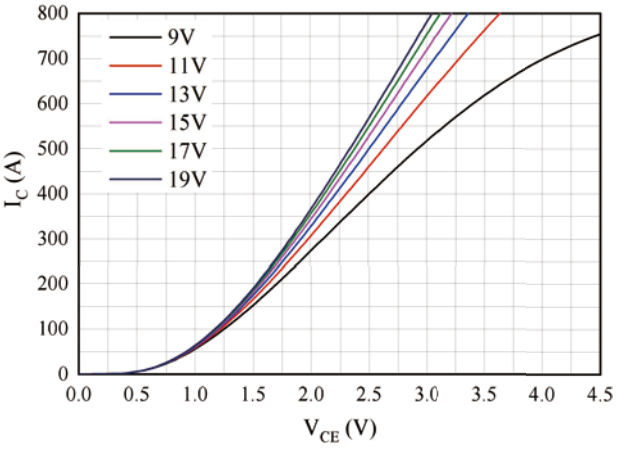


图 2. 典型输出特性 (T_{vj} =150℃)
Figure 2. Typical output characteristics (T_{vj} =150℃)

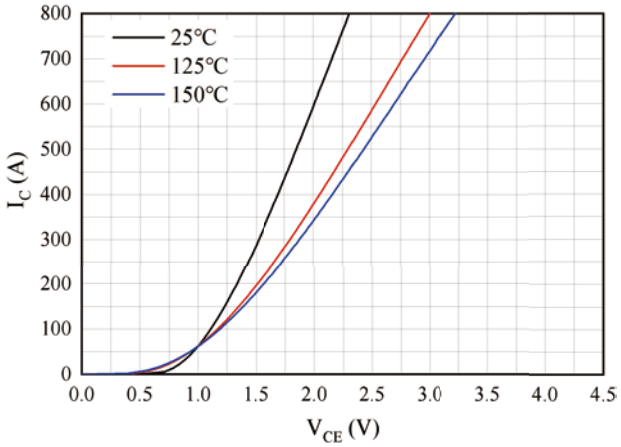


图 3. 典型输出特性 (V_{GE} = 15V)
Figure 3. Typical output characteristics (V_{GE} = 15V)

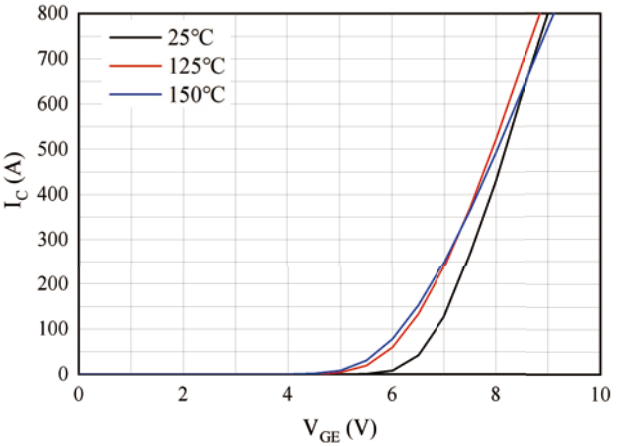


图 4. 典型传输特性(V_{CE} = 20V)
Figure 4. Typical transfer characteristic(V_{CE} = 20V)

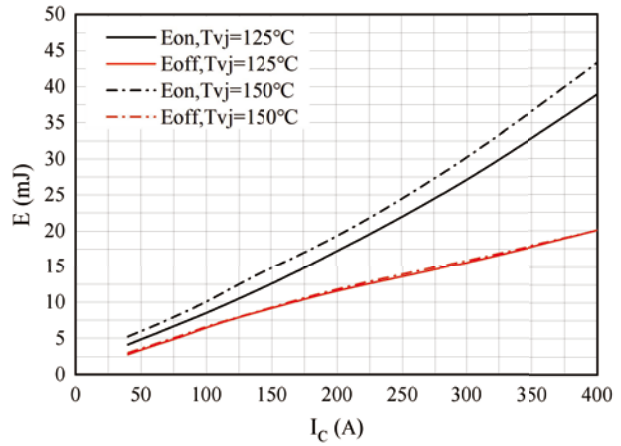


图 5.开关损耗
Figure 5. Switching losses of IGBT，
V_{GE} = ±15V, Rgon = 8Ω， Rgoff = 15Ω, V_{CE} = 600V

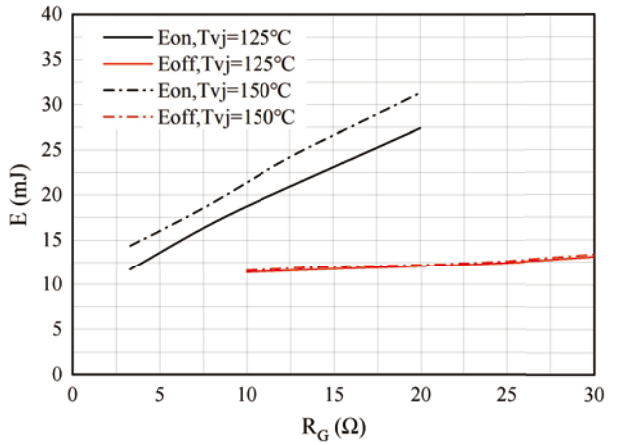


图 6. 开关损耗
Figure 6. Switching losses of IGBT,
V_{GE} = ±15V,Ic = 200A, V_{CE} = 600V

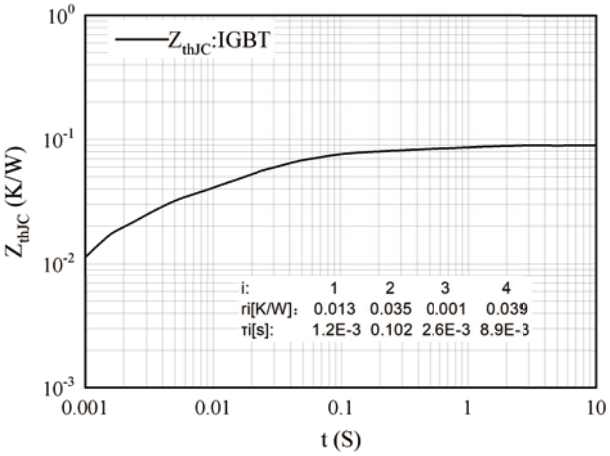


图 7. 瞬态热阻抗 IGBT
Figure 7. Transient thermal impedance IGBT, $Z_{thJC} = f(t)$

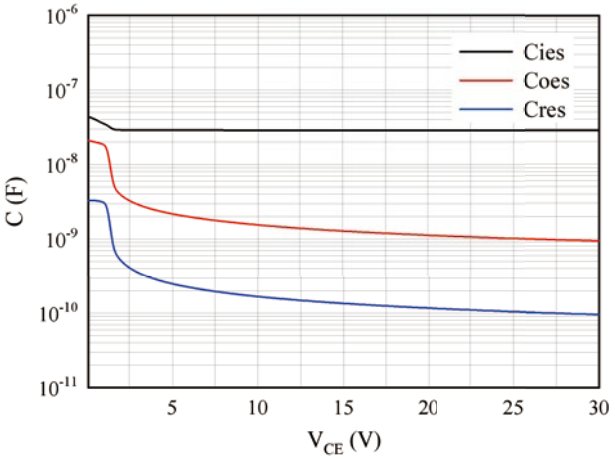


图 8. 电容特性
Figure 8. Capacitance characteristic

IGBT T2/T3

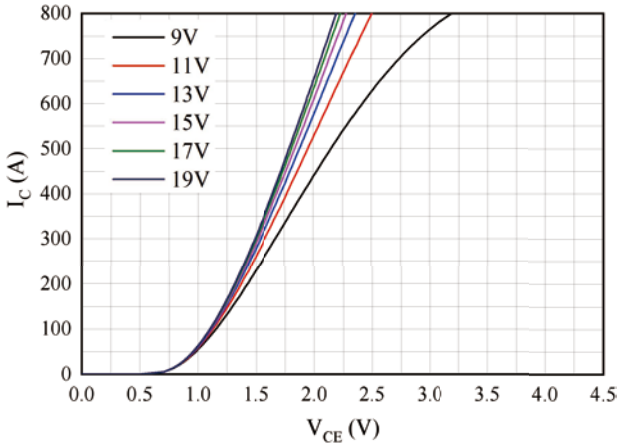


图 9. 典型输出特性 (T_{vj} = 25℃)
Figure 9. Typical output characteristics (T_{vj} = 25℃)

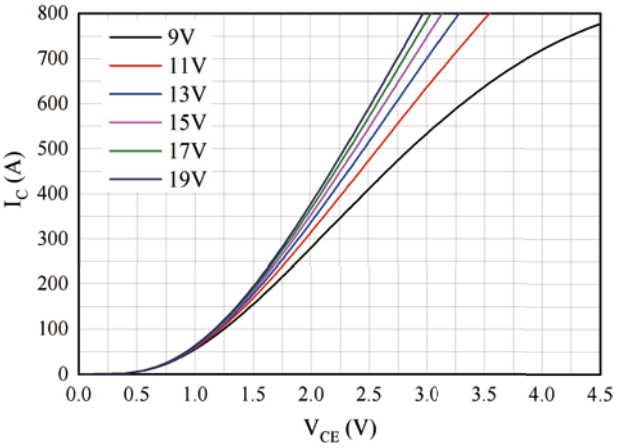


图 10. 典型输出特性 (T_{vj} = 150℃)
Figure 10. Typical output characteristics (T_{vj} = 150℃)

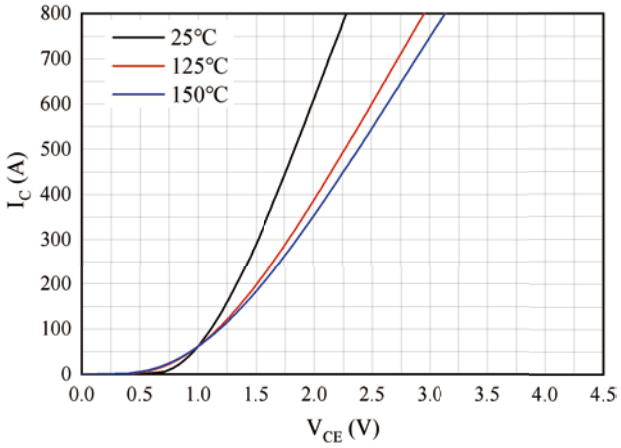


图 11. 典型输出特性 (V_{GE} = 15V)
Figure 11. Typical output characteristics (V_{GE} = 15V)

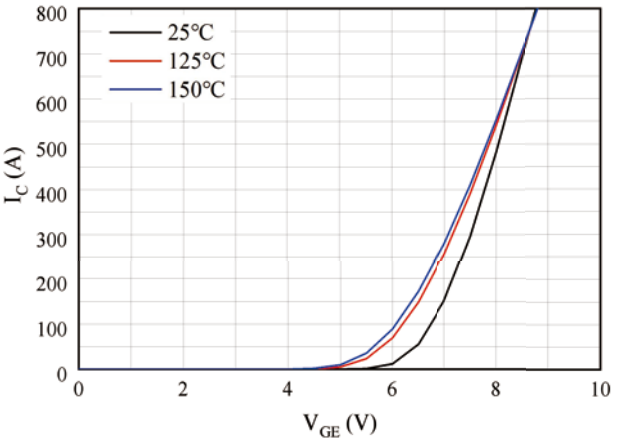


图 12. 典型传输特性(V_{CE} = 20V)
Figure 12. Typical transfer characteristic(V_{CE} = 20V)

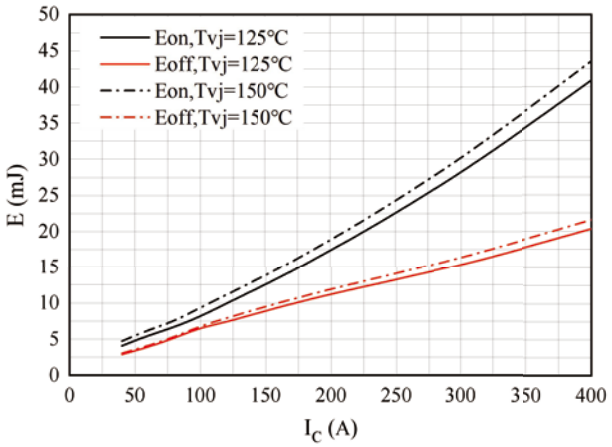


图 13.开关损耗

Figure 13. Switching losses of IGBT，

V_{GE} = ±15V, Rgon = 8Ω，Rgoff = 15Ω, V_{CE} = 600V

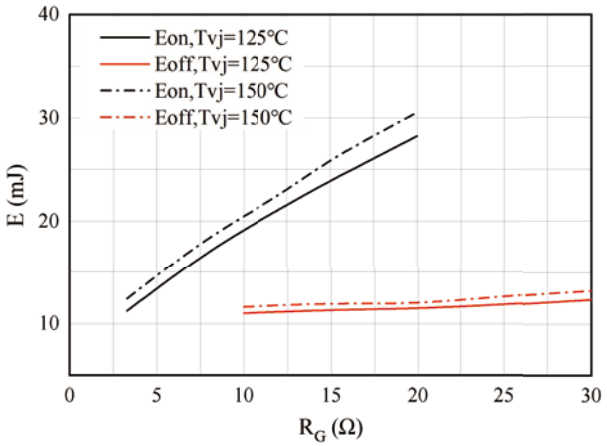


图 14. 开关损耗

Figure 14. Switching losses of IGBT,

V_{GE} = ±15V,Ic = 200A, V_{CE} = 600V

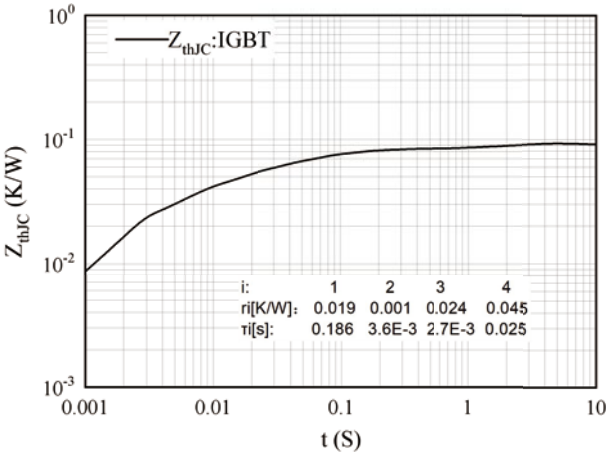


图 15. 瞬态热阻抗 IGBT

Figure15. Transient thermal impedance IGBT,

Z_{thJC} = f(t)

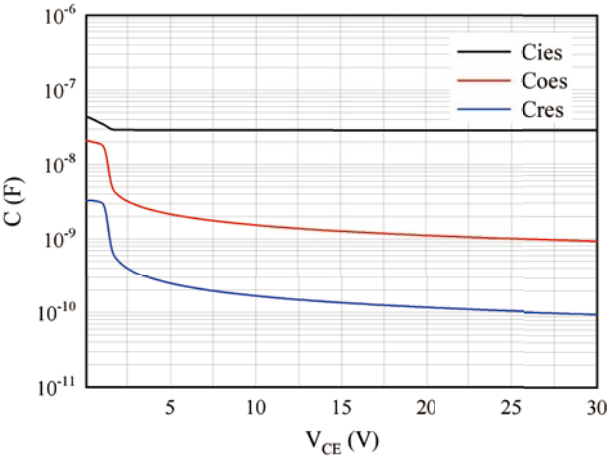


图 16. 电容特性

Figure 16. Capacitance characteristic

二极管 D1/D2/D3/D4

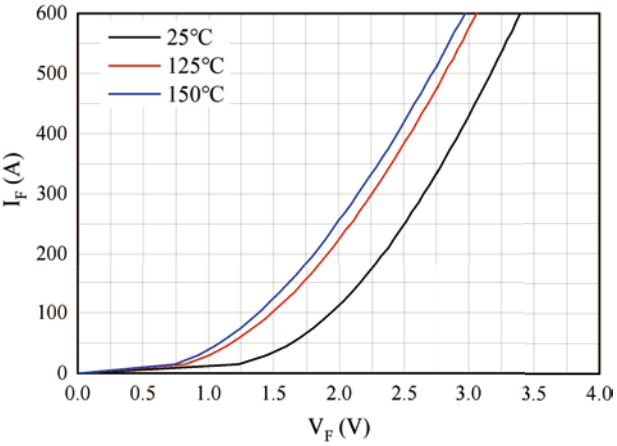


图 17. 正向偏压特性 二极管

Figure 17． Forward characteristic of Diode

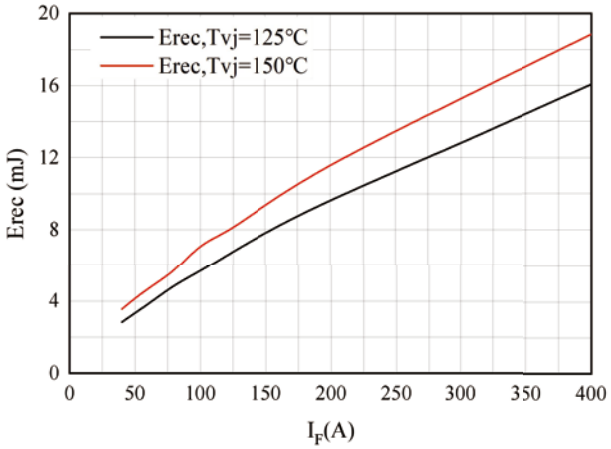


图 18. 开关损耗 二极管

Figure 18． Switching losses of Diode

Rgon = 8Ω, V_{CE} = 600V

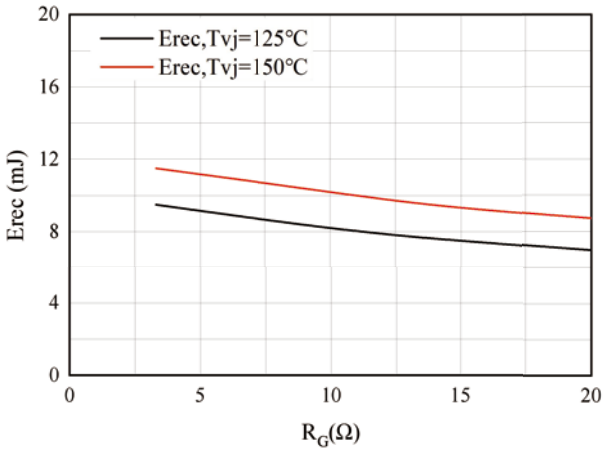


图 19. 开关损耗 二极管
Figure 19. Switching losses of Diode
I_F = 200A, V_{CE} = 600V

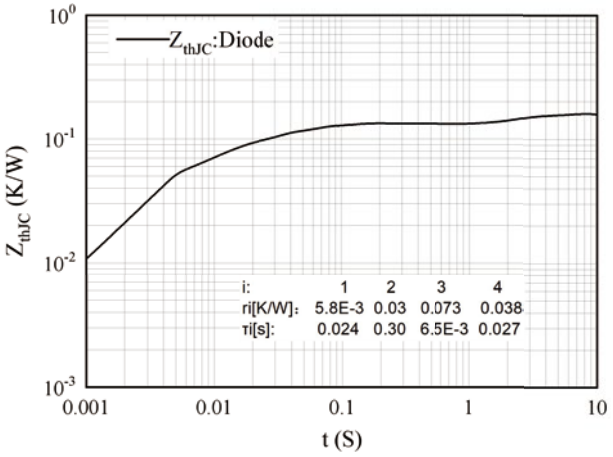


图 20. 瞬态热阻抗 二极管
Figure 20. Transient thermal impedance Diode
Z_{thJC} = f(t)

二极管 D5/D6

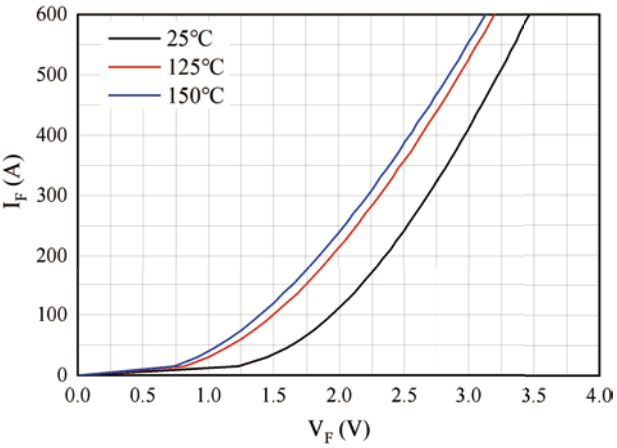


图 21. 正向偏压特性 二极管
Figure 21. Forward characteristic of Diode

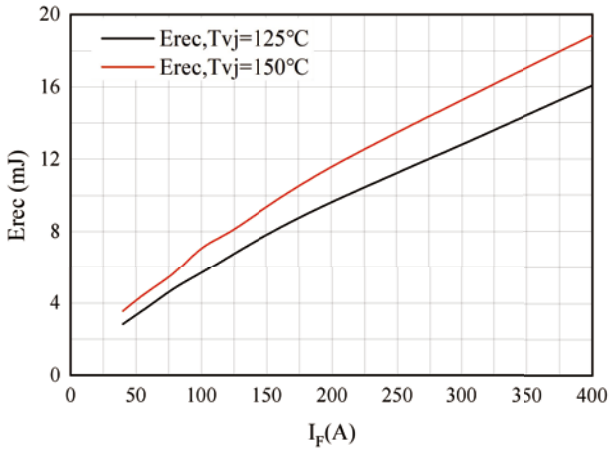


图 22. 开关损耗 二极管
Figure 22. Switching losses of Diode
Rgon = 8Ω, V_{CE} = 600V

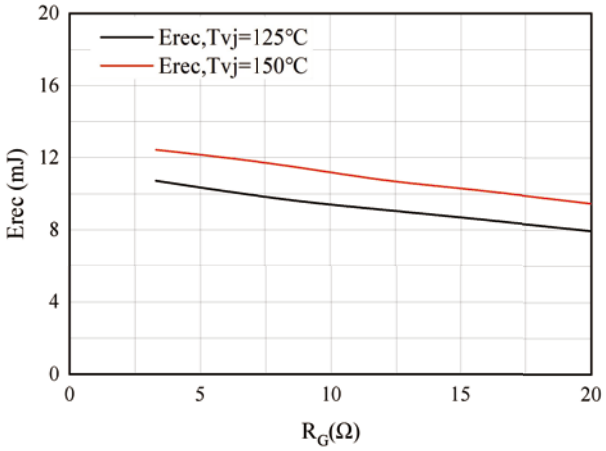


图 23. 开关损耗 二极管
Figure 23. Switching losses of Diode
I_F = 200A, V_{CE} = 600V

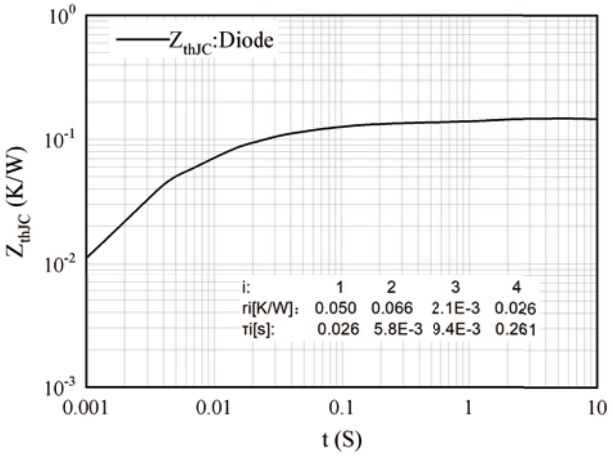


图 24. 瞬态热阻抗 二极管
Figure 24. Transient thermal impedance Diode
Z_{thJC} = f(t)

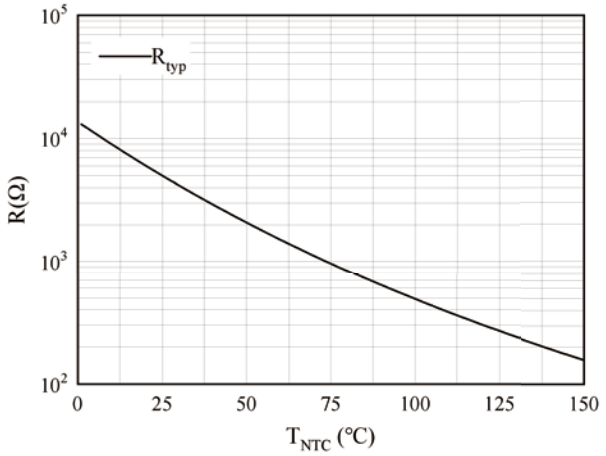
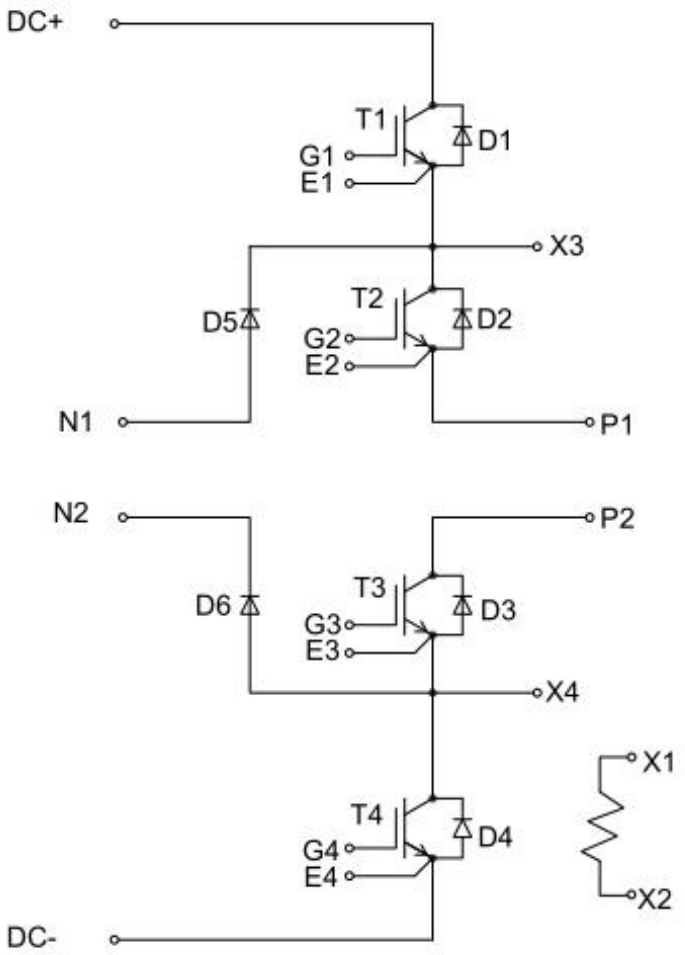


图 25. 负温度系数热敏电阻 温度特性

Figure 25. NTC-Thermistor-temperature characteristic

接线图/Circuit Diagram



封装尺寸 / Package outlines