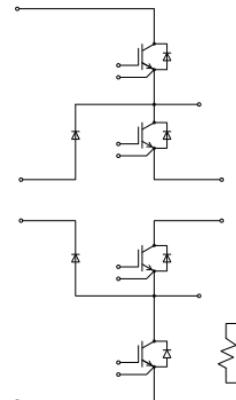


3-Level NPC1 Inverter Module

电气特性/ Features and Benefits:

- 1200V 沟槽栅/场终止工艺
1200V Trench with Field Stop Technology
- 低开关损耗
Low switching losses
- Vcesat 正温度系数
Vcesat has a positive temperature coefficient



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



$V_{CES} = 1200V$, $I_{C\text{ nom}} = 225A$ / $I_{CRM} = 450A$

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	$T_{vj}=25^\circ C$	V_{CES}	1200		V
连续集电极直流电流 Continuous DC collector current		$I_{C\text{ nom}}$	225		A
集电极重复峰值电流 Repetitive peak collector current	tp 受限于 T_{vj} op	I_{CRM}	450		A
栅极-发射极电压 Gate emitter voltage		V_{GE}	± 20		V

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	$V_{GE}=15V$, $I_c=225A$ $V_{GE}=15V$, $I_c=225A$ $V_{GE}=15V$, $I_c=225A$	V_{CEsat}		1.75 2.14 2.22	2.25	V

栅极-发射极阈值电压 Gate-Emitter threshold voltage	I _C =7.8mA, V _{GE} = V _{CE}	T _{vj} =25°C	V _{GE(th)}	5.50	6.10	6.70	
栅电荷 Gate charge	V _{GE} =-15V...+15V		Q _G		2.10		μC
内部栅极电阻 Internal gate resistor			R _{Gint}		--		Ω
输入电容 Input capacitance		f=1MHz, V _{CE} =25 V, V _{GE} =0 V	C _{ies}		34.5		nF
反向传输电容 Reverse transfer capacitance			C _{res}		0.23		nF
集电极-发射极截止电流 Collector-emitter cut-off current	V _{CE} =1200V , V _{GE} = 0 V	T _{vj} =25°C	I _{CES}			1	mA
栅极-发射极漏电流 Gate-emitter leakage current	V _{CE} =0 V, V _{GE} = 20 V	T _{vj} =25°C	I _{GES}			100	nA
开通延迟时间 Turn-on delay time	I _C =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	t _{d on}		108 98 95		ns
上升时间 Rise time	I _C =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	t _r		54 57 57		
关断延迟时间 Turn-off delay time	I _C =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	t _{d off}		270 300 302		
下降时间 Fall time	I _C =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	t _r		83 125 135		
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I _C =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω di/dt = 3100 A/μs (T _{vj} = 150 °C)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	E _{on}		17.7 22.8 23.9		mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I _C =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω dv/dt = 8400 V/μs (T _{vj} = 150 °C)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	E _{off}		7.54 10.6 11.0		
结-外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R _{thJC}		0.183		K/W
在开关状态下温度 Temperature under switching conditions			T _{vj op}	-40		175	°C

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}	1200	V
连续集电极直流电流 Continuous DC collector current		I _{C nom}	225	A
集电极重复峰值电流 Repetitive peak collector current	tp 受限于 T _{vj op}	I _{CRM}	450	A

栅极-发射极电压 Gate emitter voltage		V _{GE}	±20	V
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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 =225A V _{GE} =15V, I _c =225A V _{GE} =15V, I _c =225A	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	V _{CESat}	1.75	2.25	V
栅极-发射极阈值电压 Gate-Emitter threshold voltage	I _c =7.8mA, V _{GE} = V _{CE}	T _{vj} =25°C		2.14	2.22	
栅电荷 Gate charge	V _{GE} =-15V...+15V	Q _G		2.10		μC
内部栅极电阻 Internal gate resistor		R _{Gint}	--			Ω
输入电容 Input capacitance	f=1MHz, V _{CE} =25 V, V _{GE} =0 V	C _{ies}	34.5			nF
反向传输电容 Reverse transfer capacitance		C _{res}	0.23			nF
集电极-发射极截止电流 Collector-emitter cut-off current	V _{CE} =1200V , V _{GE} = 0 V	T _{vj} =25°C	I _{CES}		1	mA
栅极-发射极漏电流 Gate-emitter leakage current	V _{CE} =0 V, V _{GE} = 20 V	T _{vj} =25°C			100	nA
开通延迟时间 Turn-on delay time	I _c =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	t _{d on}	108		ns
上升时间 Rise time	I _c =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C		92		
关断延迟时间 Turn-off delay time	I _c =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C		97		
下降时间 Fall time	I _c =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω (电感负载) / (inductive load)	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	t _r	62		ns
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I _c =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω di/dt = 2700 A/μs (T _{vj} = 150 °C)	Tvj=25°C Tvj=125°C Tvj=150°C		63		
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I _c =225A, V _{CE} =600 V V _{GE} =±15 V, R _G =5Ω dv/dt = 8300 V/μs (T _{vj} = 150 °C)	Tvj=25°C Tvj=125°C Tvj=150°C	E _{on}	18.0 21.2 22.5		mJ
结-外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT	R _{thJC}	0.183			K/W
在开关状态下温度 Temperature under switching conditions		T _{vj op}	-40		175	°C

二极管,D1/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	$T_{vj}=25^\circ\text{C}$	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current		I_F	300	A
正向重复峰值电流 Repetitive peak forward current	tp 受限于 T_{vj} op	I_{FRM}	600	A
I^2t 值 I^2t -value	$t_p=10\text{ms}, \sin 180^\circ, T_j=125^\circ\text{C}$	I^2t	20000	A^2s

特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F=300\text{A}, V_{GE}=0\text{V}$	V_F		1.55		V
	$I_F=300\text{A}, V_{GE}=0\text{V}$			1.68		
	$I_F=300\text{A}, V_{GE}=0\text{V}$			1.66		
反向恢复峰值电流 Peak reverse recovery current	$I_F=300\text{A},$	I_{RM}		140		A
	$-\frac{dI_F}{dt}=3000\text{A}/\mu\text{s} (T_{vj}=150^\circ\text{C})$			179		
	$V_R=600\text{V}, V_{GE}=-15\text{V}$			218		
恢复电荷 Recovered charge	$I_F=300\text{A},$	Q_r		25.3		μC
	$-\frac{dI_F}{dt}=3000\text{A}/\mu\text{s} (T_{vj}=150^\circ\text{C})$			44.1		
	$V_R=600\text{V}, V_{GE}=-15\text{V}$			61.5		
反向恢复损耗 (每脉冲) Reverse recovered energy	$I_F=300\text{A},$	E_{rec}		9.30		mJ
	$-\frac{dI_F}{dt}=3000\text{A}/\mu\text{s} (T_{vj}=150^\circ\text{C})$			17.6		
	$V_R=600\text{V}, V_{GE}=-15\text{V}$			20.5		
结-外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode	R_{thJC}		0.323		K/W
在开关状态下温度 Temperature under switching conditions		$T_{vj op}$	-40		175	$^\circ\text{C}$

二极管,D2/D3

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	$T_{vj}=25^\circ\text{C}$	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current		I_F	200	A
正向重复峰值电流 Repetitive peak forward current	tp 受限于 T_{vj} op	I_{FRM}	400	A
I^2t 值 I^2t -value	$t_p=10\text{ms}, \sin 180^\circ, T_j=125^\circ\text{C}$	I^2t	10000	A^2s

特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	I _F =200A, V _{GE} =0V I _F =200A, V _{GE} =0V I _F =200A, V _{GE} =0V	V _F		1.58 1.70 1.66		V
反向恢复峰值电流 Peak reverse recovery current	I _F =200A, -dI/dt=2800A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	I _{RM}		122 141 147		A
恢复电荷 Recovered charge	I _F =200A, -dI/dt=2800A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	Q _r		18.3 29.8 34.2		μC
反向恢复损耗 (每脉冲) Reverse recovered energy	I _F =200A, -dI/dt=2800A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	E _{rec}		6.90 11.9 13.7		mJ
结-外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode	R _{thJC}		0.39		K/W
在开关状态下温度 Temperature under switching conditions		T _{vj op}	-40		175	°C

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}	1200		V
连续正向直流电流 Continuous DC forward current		I _F	300		A
正向重复峰值电流 Repetitive peak forward current	t _p 受限于 T _{vj op}	I _{FRM}	600		A
I ² t 值 I ² t-value	t _p =10ms, sin180°, T _j =125°C	I ² t	14000		A ² S

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	V _F		1.64 1.79 1.75		V
反向恢复峰值电流 Peak reverse recovery current	I _F =300A, -dI/dt=3400A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	I _{RM}		154 192 221		A
恢复电荷 Recovered charge	I _F =300A, -dI/dt=3400A/μs(T _{vj} =150°C) V _R =600V, V _{GE} =-15V	Q _r		9.62 44.1 49.6		μC

反向恢复损耗 (每脉冲) Reverse recovered energy	I _F =300A, -dI/dt=3400A/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}		6.90 18.1 19.7		mJ
结-外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode	R _{thJC}		0.37			K/W
在开关状态下温度 Temperature under switching conditions		T _{vj op}	-40		175	°C	

负温度系数热敏电阻/NTC-Thermistor

特征值/Characteristic Values

Parameter	Conditions	Value			Unit
R ₂₅	T=25°C		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}	3200		V
内部绝缘 Internal isolation			Al ₂ O ₃		
爬电距离 Creepage distance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal		11.5 6.8		mm
电气间隙 Clearance			9.4 5.5		mm
相对电痕指数 Comperative tracking index		CTI	> 400		
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	268		g

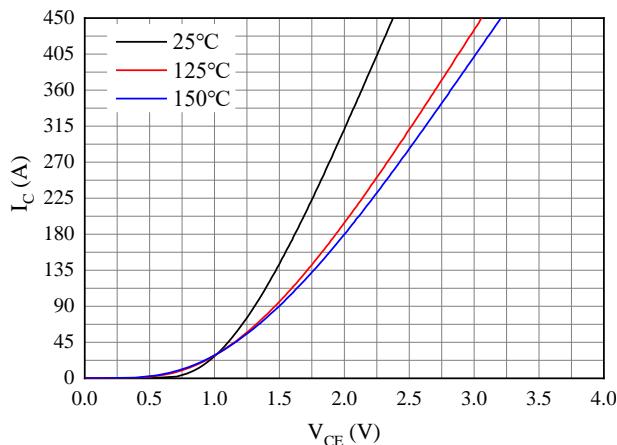
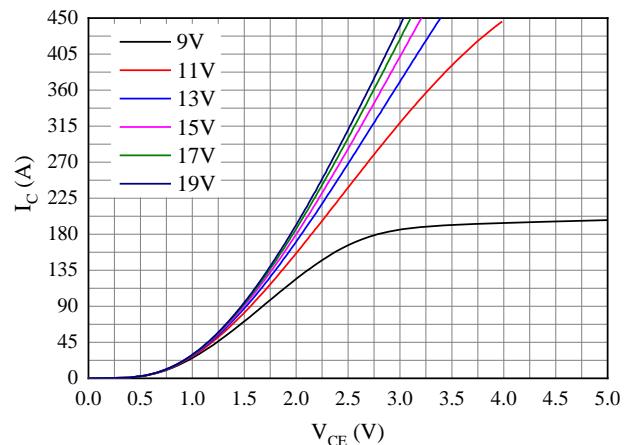
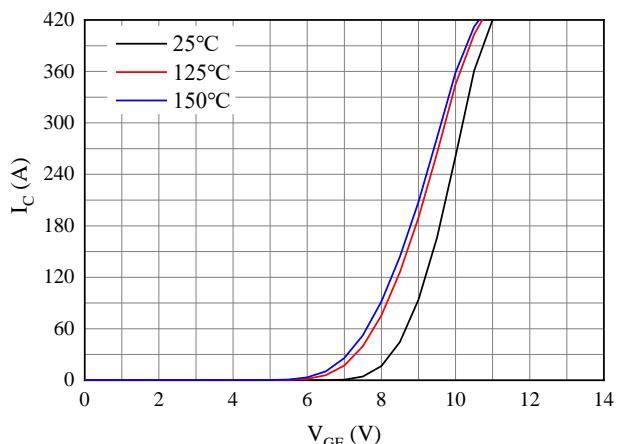
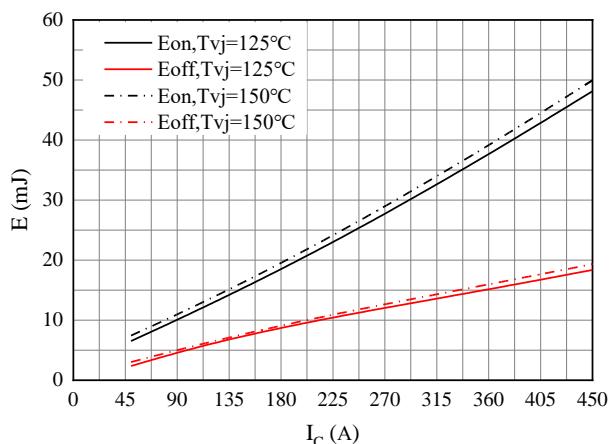
IGBT T1/T4图 1. 典型输出特性 ($V_{GE}=15V$)Figure 1. Typical output characteristics ($V_{GE}=15V$)图 2. 典型输出特性 ($T_{vj}=150^{\circ}C$)Figure 2. Typical output characteristics ($T_{vj}=150^{\circ}C$)图 3. 典型传输特性($V_{CE}=20V$)Figure 3. Typical transfer characteristic($V_{CE}=20V$)

图 4. 开管损耗

Figure 4. Switching losses of IGBT,

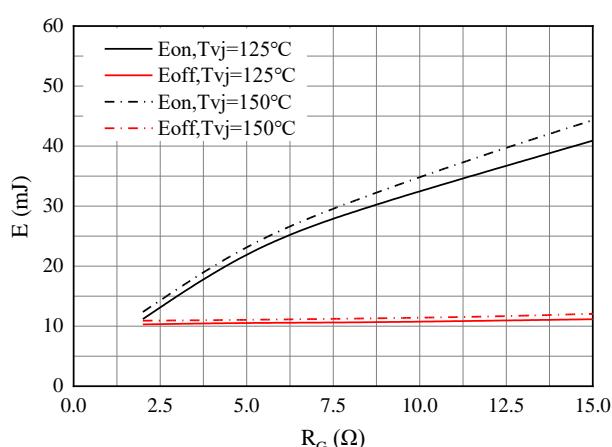
 $V_{GE}=\pm 15V, R_g=5\Omega, V_{CE}=600V$ 

图 5. 开管损耗

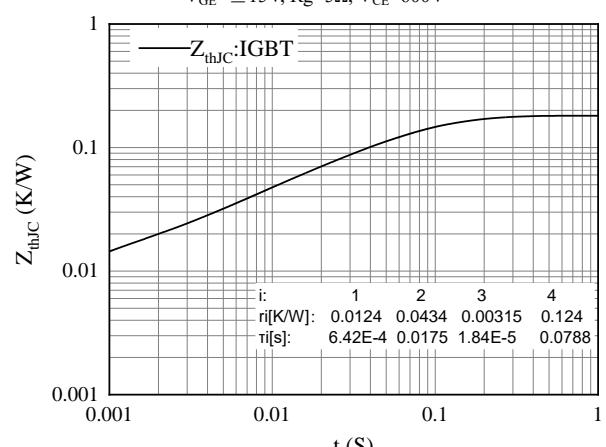
Figure 5. Switching losses of IGBT,
 $V_{GE}=\pm 15V, I_c=225A, V_{CE}=600V$ 

图 6. 瞬态热阻抗 IGBT

Figure 6. Transient thermal impedance IGBT,
 $Z_{thJC}=f(t)$

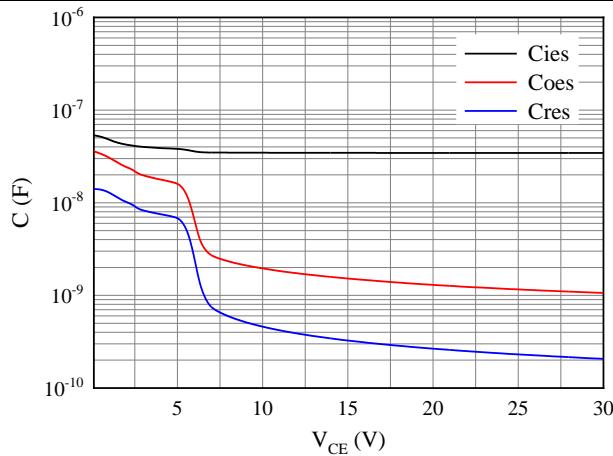


图 7. 电容特性
Figure 7. Capacitance characteristic

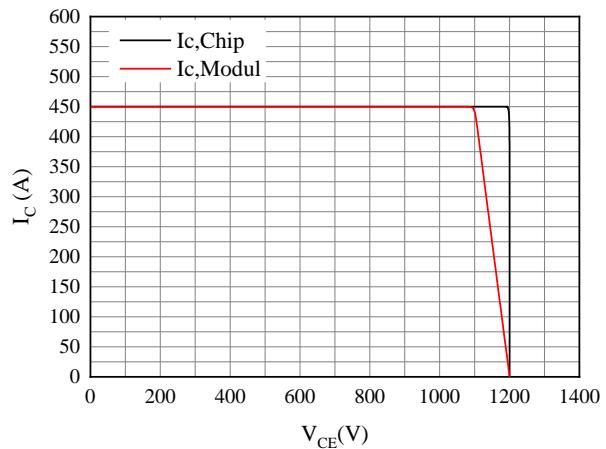


图 8. 反偏安全工作区
Figure 8. RBSOA
 $V_{GE} = \pm 15V$, $R_{goff} = 5\Omega$, $T_{vj} = 150^\circ C$

IGBT T2/T3

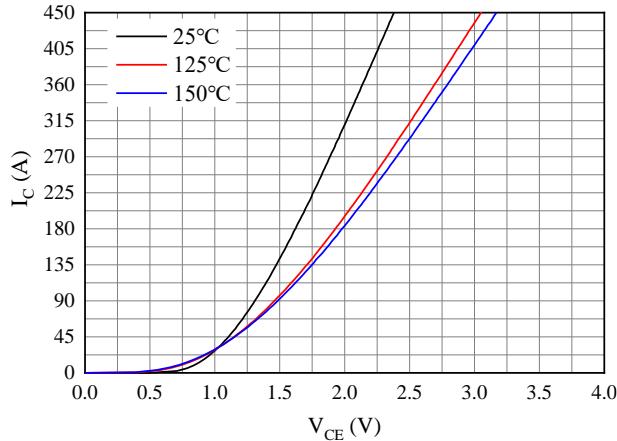


图 9. 典型输出特性 ($V_{GE}=15V$)
Figure 9. Typical output characteristics ($V_{GE}=15V$)

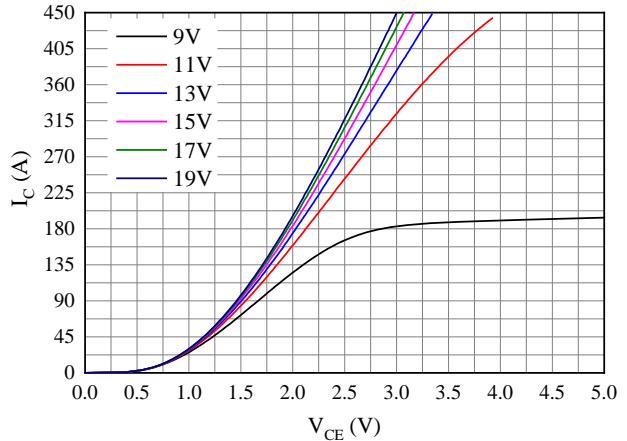


图 10. 典型输出特性 ($T_{vj}=150^\circ C$)
Figure 10. Typical output characteristics ($T_{vj}=150^\circ C$)

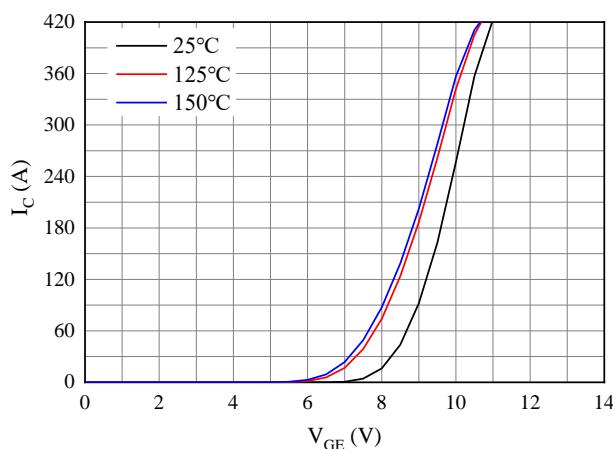


图 11. 典型传输特性($V_{CE}=20V$)
Figure 11. Typical transfer characteristic($V_{CE}=20V$)

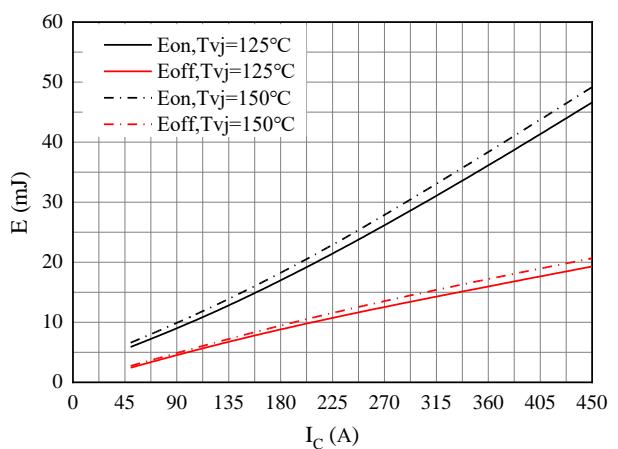


图 12. 开管损耗
Figure 12. Switching losses of IGBT,
 $V_{GE} = \pm 15V$, $R_g = 5\Omega$, $V_{CE} = 600V$

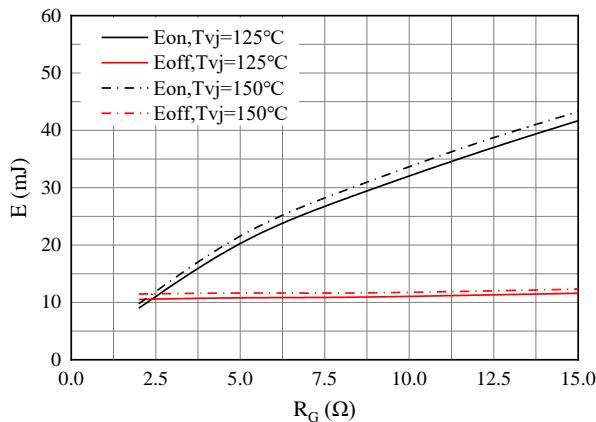


图 13. 开管损耗

Figure 13. Switching losses of IGBT,
 $V_{GE} = \pm 15V, I_c = 225A, V_{CE} = 600V$

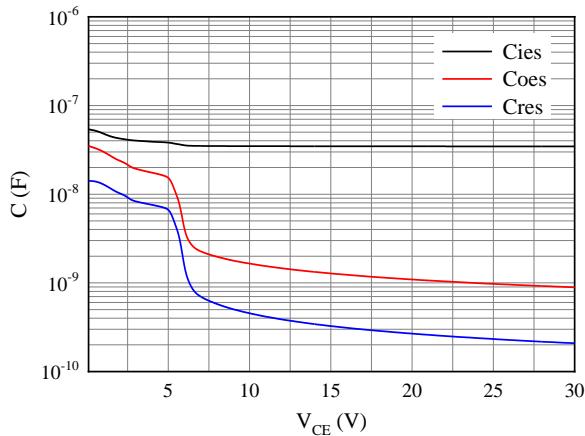


图 15. 电容特性

Figure 15. Capacitance characteristic

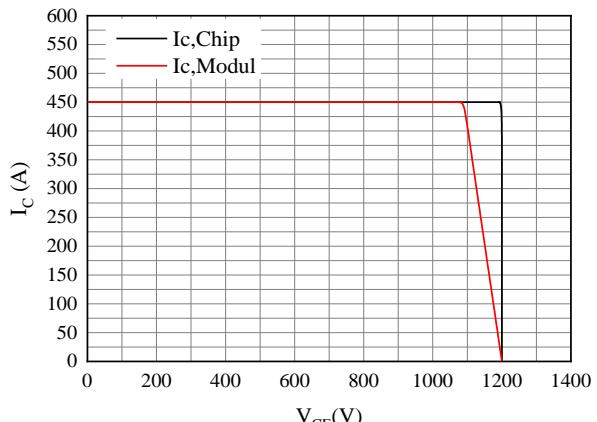


图 14. 瞬态热阻抗 IGBT

Figure 14. Transient thermal impedance IGBT,
 $Z_{thJC}=f(t)$

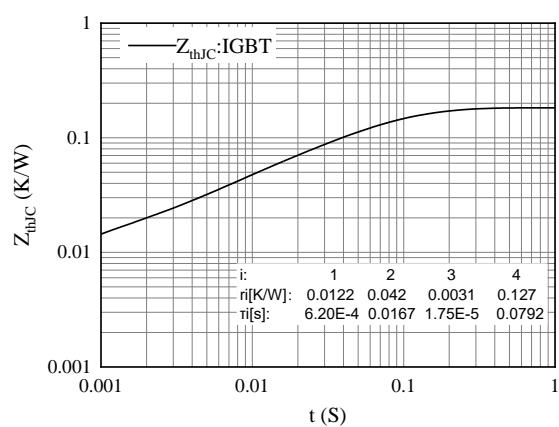


图 16. 反偏安全工作区

Figure 16. RBSOA

$V_{GE} = \pm 15V, R_{goff} = 5\Omega, T_{vj} = 150^\circ C$

二极管 D1/D4

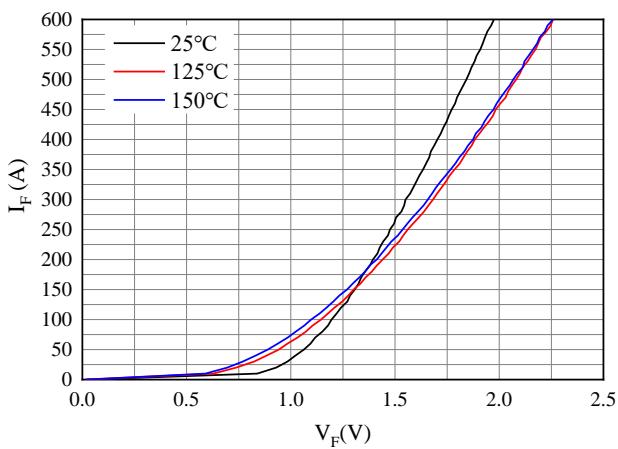


图 17. 正向偏压特性 二极管

Figure 17. Forward characteristic of Diode

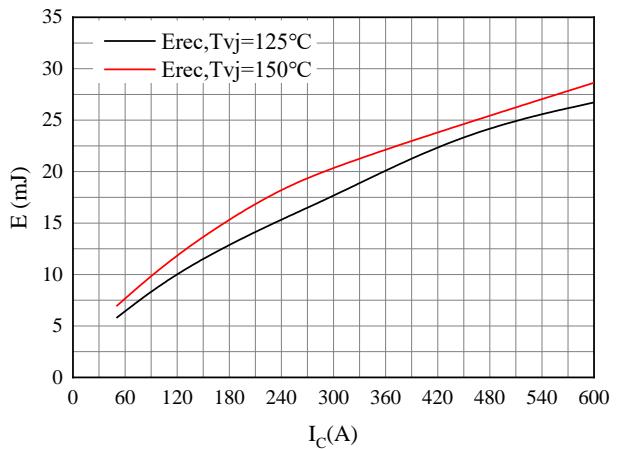


图 18. 开关损耗 二极管

Figure 18. Switching losses of Diode

$R_g = 5\Omega, V_{CE} = 600V$

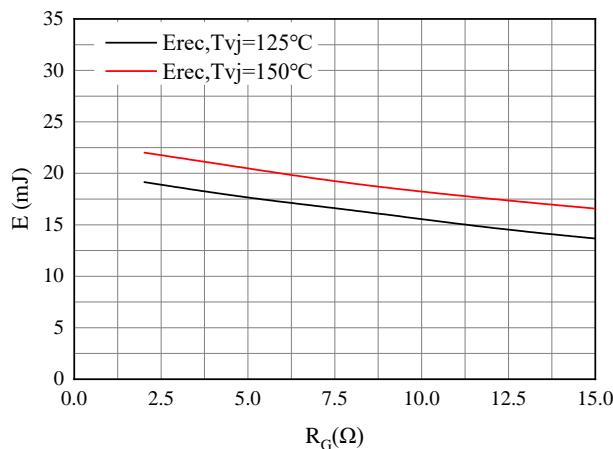


图 19. 开关损耗二极管

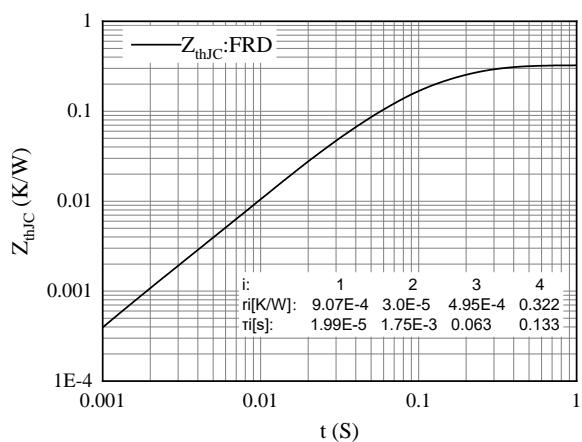
Figure 19. Switching losses of Diode
 $I_F = 300A, V_{CE} = 600V$ 

图 20. 瞬态热阻抗 FRD

Figure 20. Transient thermal impedance FRD ,
 $Z_{thJC}=f(t)$

二极管 D2/D3

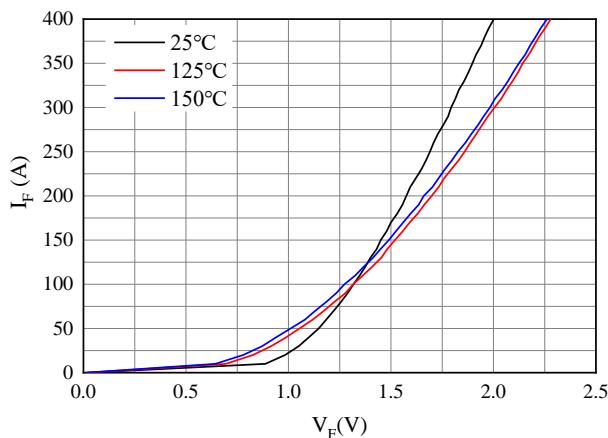


图 21. 正向偏压特性二极管

Figure 21. Forward characteristic of Diode

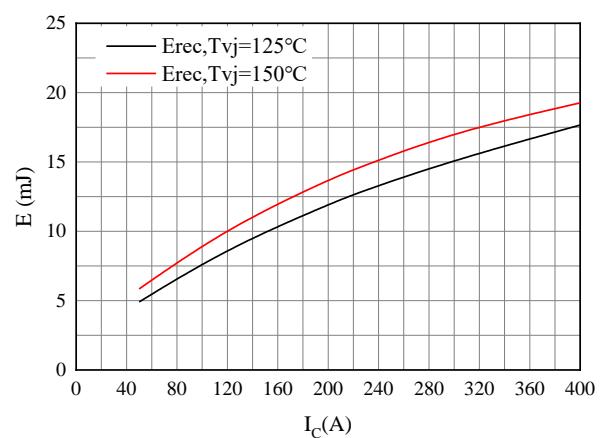


图 22. 开关损耗二极管

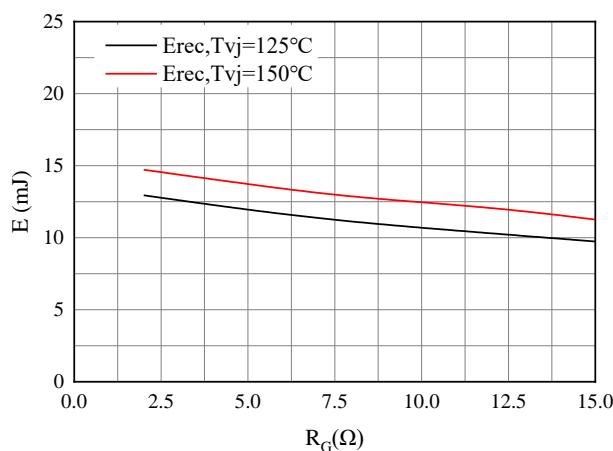
Figure 22. Switching losses of Diode
 $R_g = 5\Omega, V_{CE} = 600V$ 

图 23. 开关损耗二极管

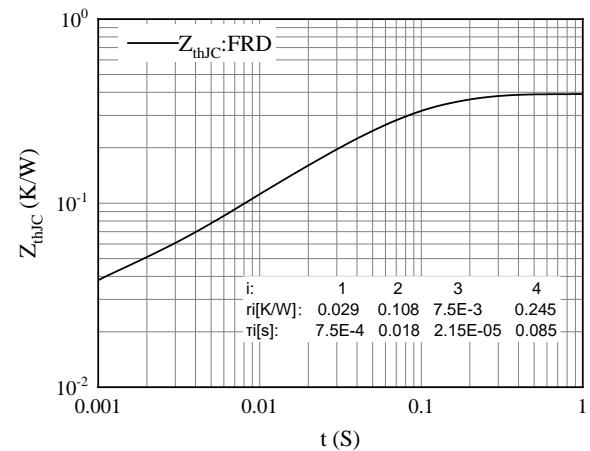
Figure 23. Switching losses of Diode
 $I_F = 200A, V_{CE} = 600V$ 

图 24. 瞬态热阻抗 FRD

Figure 24. Transient thermal impedance FRD ,
 $Z_{thJC}=f(t)$

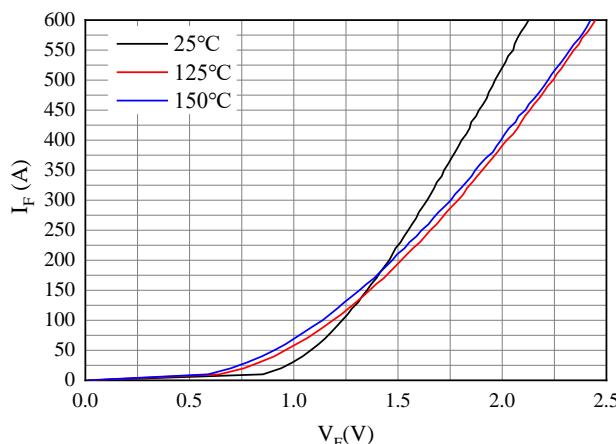
二极管 D5/D6

图 25. 正向偏压特性 二极管

Figure 25. Forward characteristic of Diode

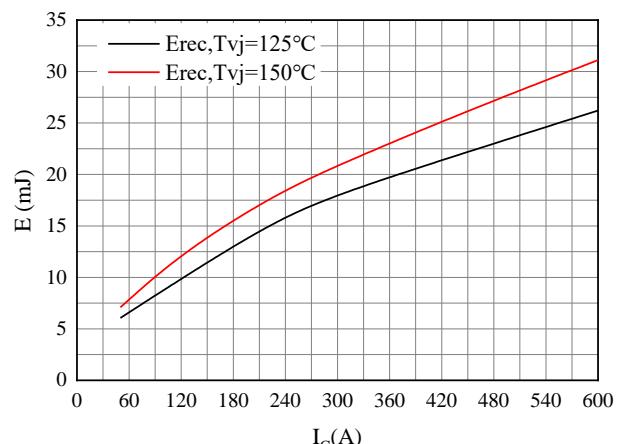


图 26. 开关损耗 二极管

Figure 26. Switching losses of Diode

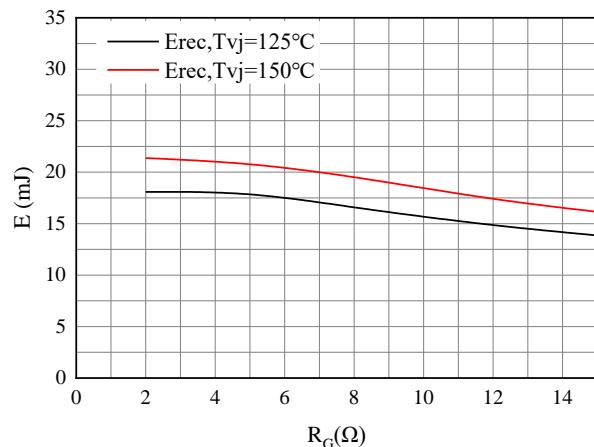
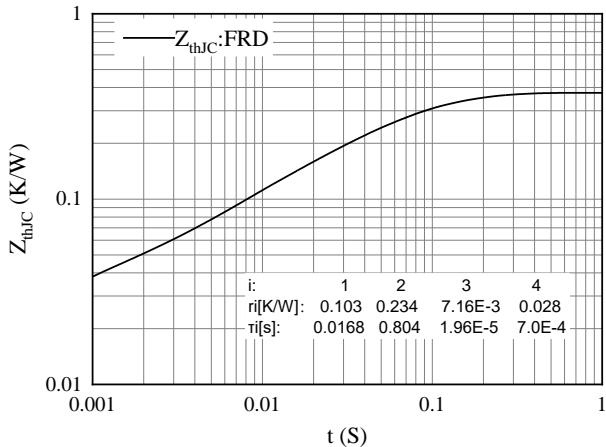
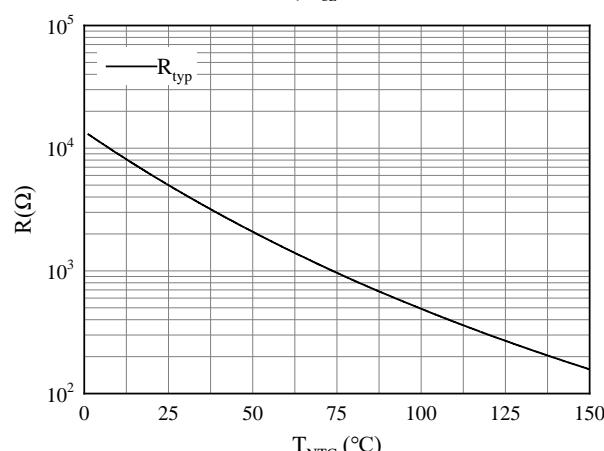
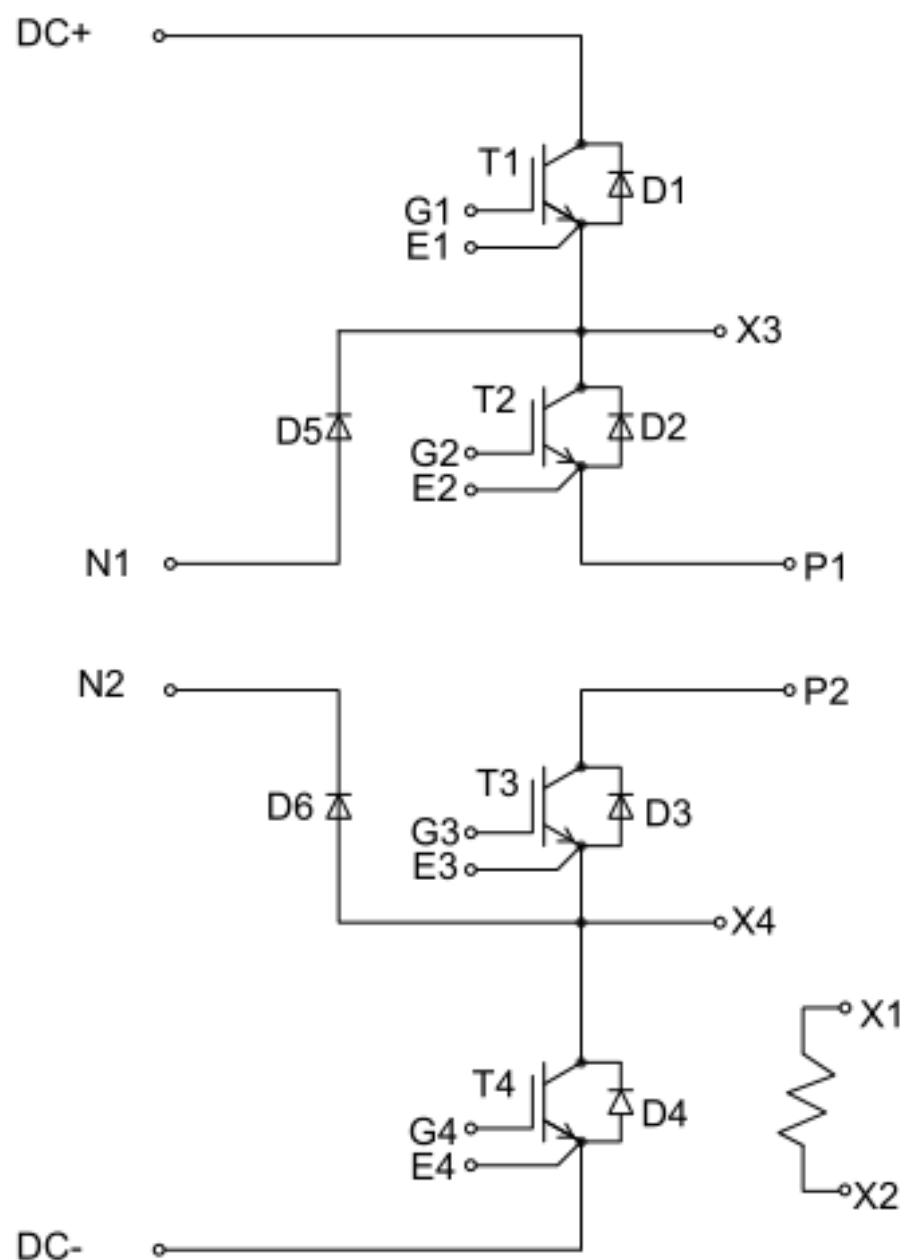
 $R_g = 5\Omega, V_{CE} = 600V$ 图 27. 开关损耗 二极管
Figure 27. Switching losses of Diode
 $I_f=300A, V_{CE}=600V$ 图 28. 瞬态热阻抗 FRD
Figure 28. Transient thermal impedance FRD ,
 $Z_{thJC}=f(t)$ 

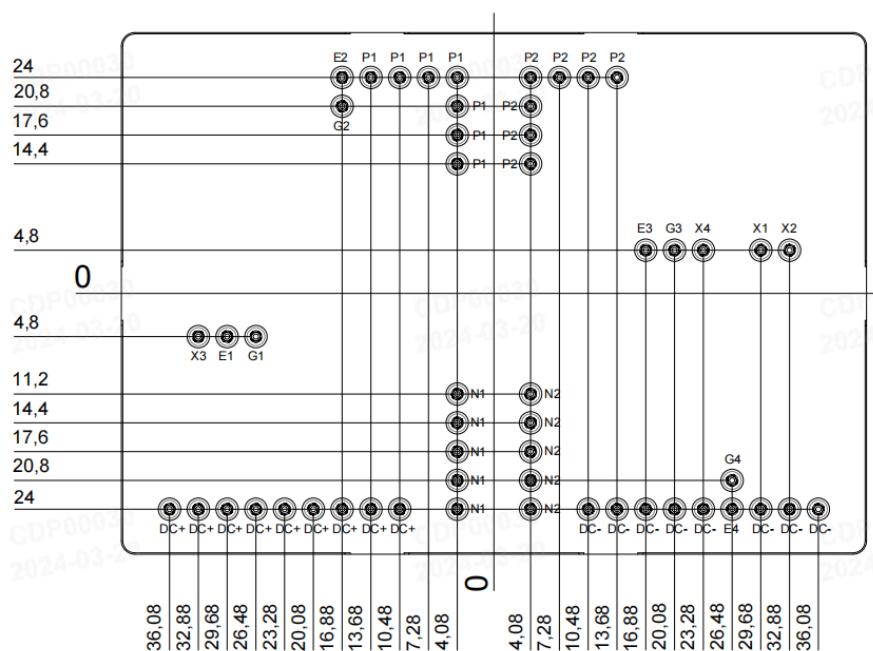
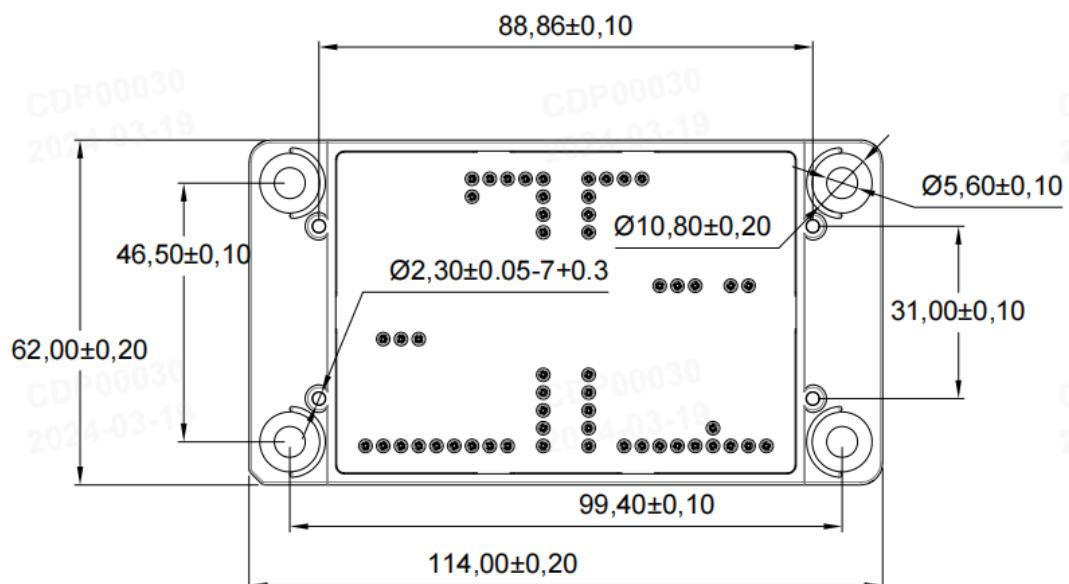
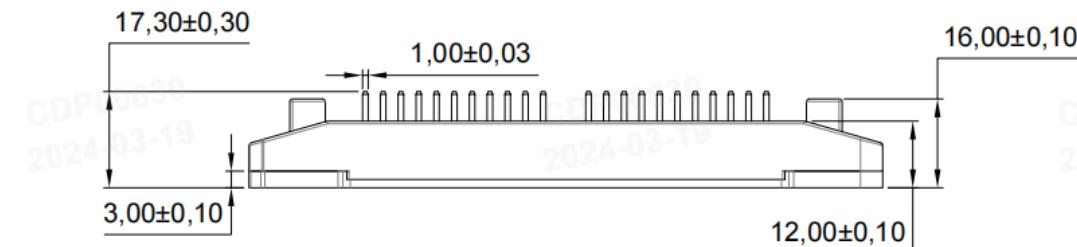
图 29. 负温度系数热敏电阻 温度特性

Figure 29. NTC-Thermistor-temperature characteristic

接线图/Circuit Diagram



封装尺寸 / Package outlines



vision history