

DONGGUAN NANJING ELECTRONICS LTD.,

Insulated Gate Bipolar Transistor Modules

S3L225R12GA7H_C20 3-Level NPC1 Inverter Module

电气特性/Features and Benefits:

- 1200V 沟槽栅/场终止工艺
 1200V Trench Gate / Field Termination Process
- 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

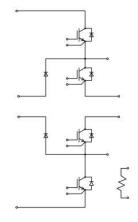
Energy Storage System

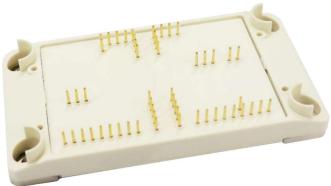
• 光伏逆变器

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	T25°C	V _{CES}	1200	V
Collector-Emitter voltage	$T_{\text{vj}}=25^{\circ}\text{C}$	V CES	1200	v
连续集电极直流电流		T _o	225	۸
Continuous DC collector current		IC nom	223	A
集电极重复峰值电流	tp 受限于 Tvj op	Lony	450	Α
Repetitive peak collector current	th X bk 1 1 vl ob	ICRM	430	A
栅极-发射极电压		$V_{\rm GE}$	±20	V
Gate emitter voltage		V GE	120	•

特征值 / Characteristic Values

Parameter	Conditions		Symbol		Value		Unit
1 at ameter	Conditions		Symbol	Min.	Тур.	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	$ m 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		μС
内部栅极电阻 Internal gate resistor			RGint				Ω
输入电容 Input capacitance	CIMIL V. 25 V.V. OV.	T. 250C	Cies		34.5		nF
反向传输电容 Reverse transfer capacitance	f=1MHz, V _{CE} =25 V, V _{GE} =0 V	T _{vj} =25°C	Cres		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		
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	$t_{\rm r}$		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		ns
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	tf		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} =5 Ω di/dt = 3100 A/ μ s (Tvj = 150 °C)	Tvj=25°C Tvj=125°C Tvj=150°C	Eon		17.7 22.8 23.9		
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} =5 Ω dv/dt = 8400 V/ μ s (Tvj = 150 °C)	Tvj=25°C Tvj=125°C Tvj=150°C	$E_{ m off}$		7.54 10.6 11.0		mJ
结-外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		RthJC		0.183		K/W
在开关状态下温度 Temperature under switching conditions			T _{vj} op	-40		175	°C

<u>IGBT, T2/T3</u>

最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压	T _{vi} =25°C	Vces	1200	V
Collector-Emitter voltage	1vj-25 C	VCES	1200	·
连续集电极直流电流		I _{C nom}	225	A
Continuous DC collector current		1C nom	223	A
集电极重复峰值电流	tp 受限于 Tvj op	Icrm	450	A
Repetitive peak collector current	th Xrx 1 Trjop	ICRM	750	A

Typical Characteristics

栅极-发射极电压	Vor	+20	V
Gate emitter voltage	V GE	±20	, v

特征值 / Characteristic Values

Parameter	Conditions		Symbol		Value		Unit
rarameter	Conditions		Symbol	Min.	Тур.	Max.	
集电极-发射极饱和电压	V _{GE} =15V, I _C =225A	T _{vj} =25°C			1.75	2.25	
Collector-Emitter saturation voltage	V _{GE} =15V, I _C =225A	$T_{vj}=125^{\circ}C$	V _{CEsat}		2.14		
Conector-Emitter saturation voltage	V _{GE} =15V, I _C =225A	$T_{vj}=150$ °C			2.22		V
栅极-发射极阈值电压	I _C =7.8mA, V _{GE} = V _{CE}	T _{vj} =25°C	V _{GE(th)}	5.50	6.10	6.70	
Gate-Emitter threshold voltage	ic-7.8mA, vGE- vCE	1 _{VJ} -23 C	V GE(th)	3.30	0.10	0.70	
棚电荷	V _{GE} =-15V+15V		QG		2.10		μС
Gate charge	VGE-13 V 113 V		QG .		2.10		μ
内部栅极电阻			D at				
Internal gate resistor			RGint				Ω
输入电容			C		24.5		E
Input capacitance	CAMIL W 25 V V OV	T. 250C	Cies		34.5		nF
反向传输电容	$f=1$ MHz, $V_{CE}=25$ V, $V_{GE}=0$ V	$T_{vj}=25$ °C	C	G	0.22		
Reverse transfer capacitance			Cres		0.23		nF
集电极-发射极截止电流	V 1000V V 0 V	E 2500					١.
Collector-emitter cut-off current	$V_{CE}=1200V$, $V_{GE}=0$ V	$T_{vj}=25$ °C	I _{CES}			1	m/
栅极-发射极漏电流			_				ļ .
Gate-emitter leakage current	$V_{CE}=0$ V, $V_{GE}=20$ V	$T_{vj}=25^{\circ}C$	I _{GES}			100	nA
正义3777日中台	I _C =225A, V _{CE} =600 V	T _{vj} =25°C			108		
开通延迟时间	$V_{GE}=\pm 15 \text{ V}, R_G=5\Omega$	T _{vj} =125°C	t _{d on}		92		
Curn-on delay time	(电感负载)/(inductive load)	T _{vj} =150°C			97		
	I _C =225A, V _{CE} =600 V	T _{vj} =25°C			62		
上升时间	$V_{GE}=\pm 15 \text{ V}, R_{G}=5\Omega$	$T_{vi}=125$ °C	$t_{\rm r}$		63		
Rise time	(电感负载)/(inductive load)	T _{vj} =150°C			66		
V lies a level les	I _C =225A, V _{CE} =600 V	T _{vi} =25°C			266		ns
关断延迟时间	$V_{GE}=\pm 15 \text{ V}, R_{G}=5\Omega$	T _{vj} =125°C	t _{d off}		293		
Turn-off delay time	(电感负载)/(inductive load)	T _{vj} =150°C			303		
	I _C =225A, V _{CE} =600 V	T _{vj} =25°C			68		
下降时间	$V_{GE}=\pm 15 \text{ V}, R_{G}=5\Omega$	T _{vi} =125°C	$t_{\rm f}$		108		
Fall time	(电感负载)/(inductive load)	$T_{vi}=150$ °C			120		
	I _C =225A, V _{CE} =600 V	Tvj=25°C			10.0		
开通损耗能量(每脉冲)	$V_{GE}=\pm 15 \text{ V}, R_G=5\Omega$	=	Eon		18.0 21.2		
Turn-on energy loss per pulse	$di/dt = 2700 \text{ A/}\mu\text{s}$	Tvj=125°C	Lon		22.5		
	$(Tvj = 150 ^{\circ}C)$	Tvj=150°C			22.3		m.
₩ W T + E + T ← AV E	$I_{\rm C}$ =225A, $V_{\rm CE}$ =600 V	Tvj=25°C			7.70		111.
关断损耗能量(每脉冲)	$V_{GE}=\pm 15 \text{ V}, R_G=5\Omega$	Tvj=125°C	Eoff		10.9		
Turn-off energy loss per pulse	$dv/dt = 8300 \text{ V/}\mu\text{s}$	Tvj=150°C			11.7		
4. 从声执阳	(Tvj = 150 °C)	<u> </u>		-			
结-外壳热阻	每个 IGBT / per IGBT		RthJC		0.183		K/V
Thermal resistance, junction to case 在开关状态下温度				1			
			т.	40		175	°C
Temperature under switching conditions			T _{vj} op	-40		175	'(
Conditions							1

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	T _{vi} =25°C	V _{RRM}	1200	V
Repetitive peak reverse voltage	1 _{vj} =23 ⁻ C	VRRM	1200	·
连续正向直流电流		I_{F}	300	۸
Continuous DC forward current		1F	300	A
正向重复峰值电流	tp 受限于 Tvj op	I _{max} ,	600	Α
Repetitive peak forward current	th X by 1 1 vl ob	IFRM	000	A
I²t 值	$t_p=10 \text{ms}, \sin 180^{\circ}, T_i=125^{\circ}\text{C}$	I ² t	20000	A^2S
I ² t-value	tp=101118, SH1100 , 1j=123°C	11	20000	AS

特征值 / Characteristic Values

Parameter	Conditions		Symbol		Value		Unit
rarameter	Conditions		Symbol	Min.	Тур.	Max.	
正向电压	I _F =300A, V _{GE} =0V I _F =300A, V _{GE} =0V	T _{vj} =25°C T _v =125°C	$V_{\rm F}$		1.55 1.68		V
Forward voltage	I _F =300A, V _{GE} =0V	$T_{vj}=123 \text{ C}$ $T_{vj}=150 \text{ °C}$	V F		1.66		·
	I _F =300A,	T _{vj} =25°C			140		
	-di _F /dt=3000A/μs(T _{vj} =150°C)	$T_{\nu j}=125^{\circ}C$	I_{RM}		179		A
Peak reverse recovery current	$V_R = 600V, V_{GE} = -15V$	$T_{\nu j}=150$ °C			218		
恢复电荷	I _F =300A,	T _{vj} =25°C			25.3		
	-di _F /dt=3000A/ μ s(T _{vj} =150°C)	$T_{\nu j}=125^{\circ}C$	Qr		44.1		μC
Recovered charge	$V_R = 600V, V_{GE} = -15V$	$T_{\nu j}=150$ °C			61.5		
	I _F =300A,	T _{vj} =25°C			9.30		
	-di _F /dt=3000A/μs(T _{vj} =150°C)	$T_{\nu j}=125^{\circ}C$	Erec		17.6		mJ
Reverse recovered energy	$V_R = 600V, V_{GE} = -15V$	$T_{\nu j}=150^{\circ}C$			20.5		
结-外壳热阻	每个二极管 / per diode		R _{thJC}		0.323		K/W
Thermal resistance, junction to case	V ,		-4130		- 1.5 - 5		
eses 在开关状态下温度							
Temperature under switching			T _{vj} op	-40		175	°C
conditions							

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	T :-250C	V _{RRM}	1200	V	
Repetitive peak reverse voltage	T_{vj} =25°C	V RRM	1200	V	
连续正向直流电流		I_{F}	200	Α	
Continuous DC forward current		IF.	200	A	
正向重复峰值电流	tp 受限于 Tvj op	Inne	400	A	
Repetitive peak forward current	th X by 1 1 vj ob	IFRM	400	A	
I ² t 值	t _p =10ms, sin180°, T _i =125°C	I ² t	10000	A^2S	
I ² t-value	tp=101118, SH1100 , 1j=123.C	1-1	10000	A-S	

特征值 / Characteristic Values

Parameter	Conditions		Cymbol		Value		Unit
rarameter	Conditions		Symbol	Min.	Тур.	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	T_{vj} =25°C T_{vj} =125°C T_{vj} =150°C	VF		1.58 1.70 1.66		V
反向恢复峰值电流 Peak reverse recovery current	$ \begin{array}{c} I_F\!\!=\!\!200A, \\ -di_F/dt\!\!=\!\!2800A/\mu s (T_{\nu j}\!\!=\!\!150^\circ C) \\ V_R\!\!=\!\!600V, V_{GE}\!\!=\!\!-15V \end{array} $	T_{vj} =25°C T_{vj} =125°C T_{vj} =150°C	\mathbf{I}_{RM}		122 141 147		A
恢复电荷 Recovered charge	$I_F{=}200A, \\ -di_F/dt{=}2800A/\mu s(T_{vj}{=}150^{\circ}C) \\ V_R{=}600V, V_{GE}{=}{-}15V$	T_{vj} =25°C T_{vj} =125°C T_{vj} =150°C	Qr		18.3 29.8 34.2		μС
反向恢复损耗(每脉冲) Reverse recovered energy	$I_F \!\!=\!\! 200A, \\ -di_F \!/ dt \!\!=\!\! 2800A/\mu s (T_{vj} \!\!=\!\! 150^{\circ} C) \\ V_R \!\!=\!\! 600V, V_{GE} \!\!=\!\! -15V$	T _{vj} =25°C T _{vj} =125°C T _{vj} =150°C	Erec		6.90 11.9 13.7		mJ
结-外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		RthJC		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	T =250C	V	1200	W
Repetitive peak reverse voltage	$T_{\text{vj}}=25^{\circ}\text{C}$	\mathbf{V}_{RRM}	1200	·
连续正向直流电流		I_{F}	300	Δ.
Continuous DC forward current		1F	300	A
正向重复峰值电流	tp 受限于 Tvj op	Inne	600	А
Repetitive peak forward current	th X by 1 1 vl ob	I _{FRM}	000	A
I ² t 值	$t_p=10 \text{ms}, \sin 180^{\circ}, T_j=125^{\circ}\text{C}$	I ² t	14000	A^2S
I ² t-value	tp=10fils, shifted , 1j=125 C	11	14000	AS

特征值 / Characteristic Values

Parameter	Conditions		Symbol		Value		
rarameter	Conditions		Symbol	Min.	Тур.	Max.	
正向电压	I _F =300A, V _{GE} =0V	T _{vj} =25°C			1.64		
Forward voltage	$I_F=300A, V_{GE}=0V$	$T_{vj}=125$ °C	V_{F}		1.79		V
rotward voltage	$I_F=300A, V_{GE}=0V$	$T_{vj}=150$ °C			1.75		
	I _F =300A,	T _{vj} =25°C			154		
	$-di_F/dt=3400A/\mu s(T_{vj}=150^{\circ}C)$	T _{vj} =125°C	I_{RM}		192		A
Peak reverse recovery current	$V_R=600V, V_{GE}=-15V$	$T_{\nu j}=150^{\circ}C$			221		
恢复电荷 Recovered charge	I _F =300A,	T _{vj} =25°C			9.62		
	$-di_F/dt=3400A/\mu s(T_{vj}=150^{\circ}C)$	$T_{vj}=125$ °C	\mathbf{Q}_{r}		44.1		μC
	$V_R = 600V, V_{GE} = -15V$	$T_{vj}=150^{\circ}C$			49.6		

Typical Characteristics

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

<u>负温度系数热敏电阻/NTC-Thermistor</u>

特征值/Characteristic Values

Parameter	Conditions	Value			Unit
R25	T=25°C		5		ΚΩ
△R/R		-5		5	%
B-value	B (25/50), tolerance ±3%		3375		K
B-value	B (25/100), tolerance ±3%		3433		K

<u>模块 / Module</u>

Parameter	Conditions	Symbol		Value		Unit
绝缘测试电压	RMS, f=50Hz, t=1min		3200			V
Isolation test voltage	Taris, i sorie, t illini	Visol	3200			,
内部绝缘				Al2O3		
Internal isolation				711203		
爬电距离	端子至散热器 / terminal to heatsink		11.5 6.8			mm
Creepage distance	端子至端子 / terminal to terminal					
电气间隙		9.4 5.5			mm	
Clearance						
相对电痕指数		CTI	> 400			
Comperative tracking index		CII				
相对温度指数 (电)	housing	RTI	140			
RTI Elec.	nousing	KII				
储存温度		T _{stg}	-40		125	°C
Storage temperature		1 stg	-40		123	
模块安装的扭矩		М	2.0		5.0	Nm
Mounting torque for modul mounting		IVI	2.0		3.0	INIII
重量		W		268		a
Weight		YV		200		g

IGBT T1/T4

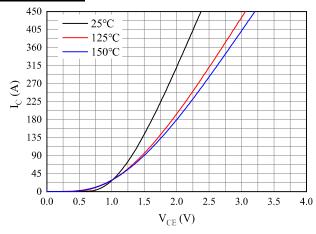


图 1. 典型输出特性 (VGE=15V)

Figure 1. Typical output characteristics (VGE=15V)

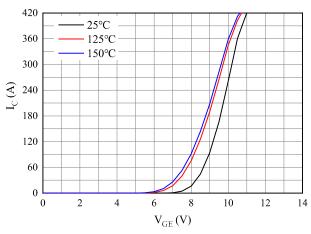


图 3. 典型传输特性(Vce=20V)

Figure 3. Typical transfer characteristic(V_{CE}=20V)

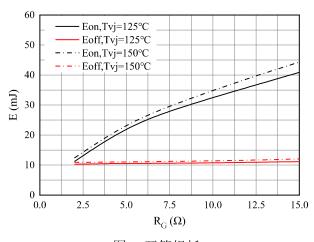


图 5. 开管损耗

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

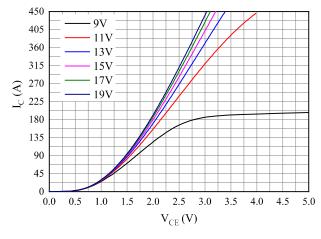


图 2. 典型输出特性 (T_{vi}=150℃)

Figure 2. Typical output characteristics (Tvj=150°C)

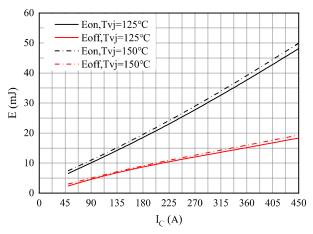


图 4.开管损耗

Figure 4. Switching losses of IGBT, V_{GE} =±15V, Rg=5 Ω , V_{CE} =600V

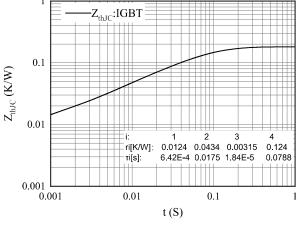


图 6. 瞬态热阻抗 IGBT

Figure 6. Transient thermal impedance IGBT, $_{\text{ZthJC}=f(t)}$

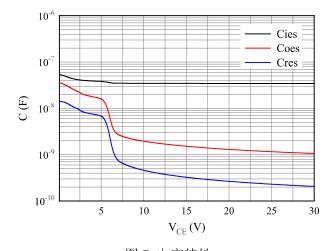


图 7. 电容特性 Figure 7. Capacitance characteristic

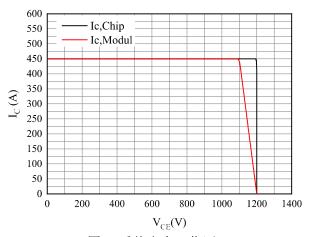


图 8. 反偏安全工作区 Figure 8. RBSOA V_{GE}=±15V, Rgoff=5Ω, Tvj=150℃

IGBT T2/T3

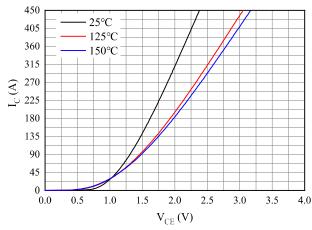


图 9. 典型输出特性 (V_{GE}=15V) Figure 9. Typical output characteristics (VGE=15V)

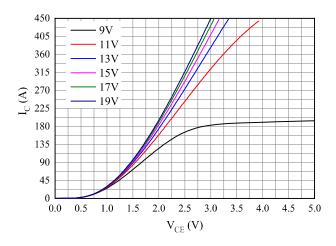


图 10. 典型输出特性 (T_{vj}=150℃) Figure 10. Typical output characteristics (Tvj=150℃)

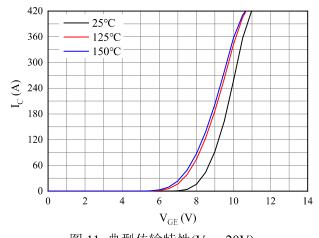


图 11. 典型传输特性(V_{CE}=20V) Figure 11. Typical transfer characteristic(VCE=20V)

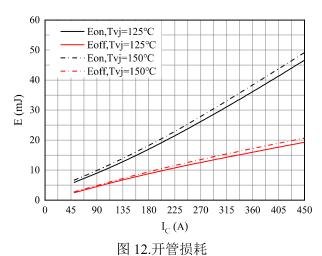


Figure 12. Switching losses of IGBT, $V_{GE}=\pm 15V$, $Rg=5\Omega$, $V_{CE}=600V$

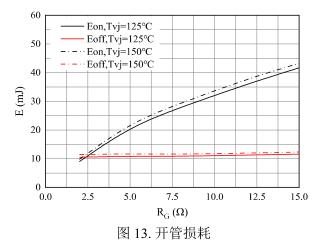


Figure 13. Switching losses of IGBT, $V_{GE}=\pm 15$ V,lc=225A, $V_{CE}=600$ V

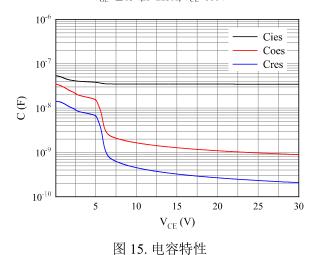


Figure 15. Capacitance characteristic

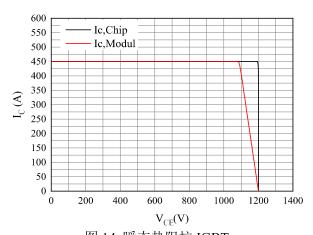


图 14. 瞬态热阻抗 IGBT Figure 14. Transient thermal impedance IGBT, ZthJC=f(t)

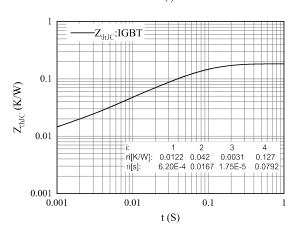


图 16. 反偏安全工作区 Figure 16. RBSOA V_{GE}=±15V, Rgoff=5Ω, Tvj=150℃

二极管 D1/D4

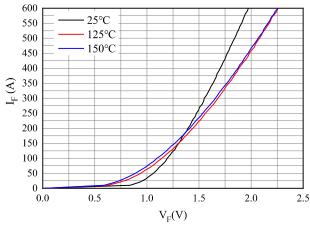


图 17. 正向偏压特性 二极管 Figure 17. Forward characteristic of Diode

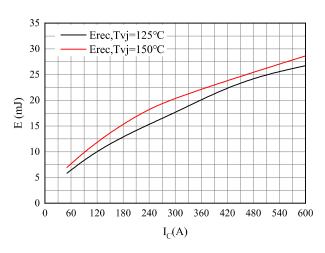


图 18. 开关损耗 二极管 Figure 18. Switching losses of Diode Rg =5 Ω , $V_{\rm CE}$ =600V

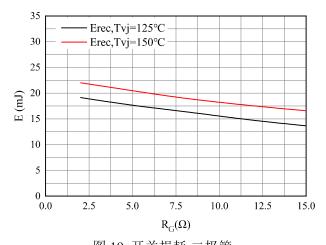


图 19. 开关损耗 二极管 Figure 19. Switching losses of Diode I_F =300A, V_{CE}=600V

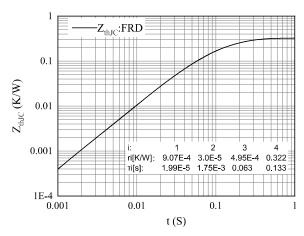


图 20. 瞬态热阻抗 FRD Figure 20. Transient thermal impedance FRD , $_{ZthJC=f(t)}$

二极管 D2/D3

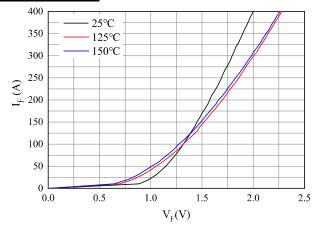


图 21. 正向偏压特性 二极管 Figure 21. Forward characteristic of Diode

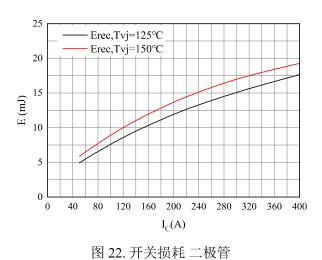


Figure 22. Switching losses of Diode $Rg = 5\Omega$, $V_{CE} = 600V$

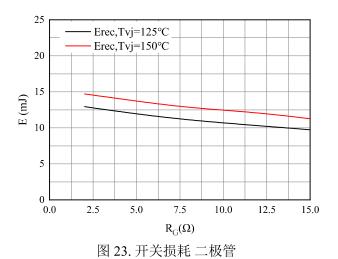


Figure 23. Switching losses of Diode I_F =200A, V_{CE} =600V

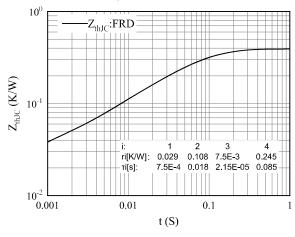


图 24. 瞬态热阻抗 FRD Figure 24. Transient thermal impedance FRD , $_{ZthJC=f(t)}$

二极管 D5/D6

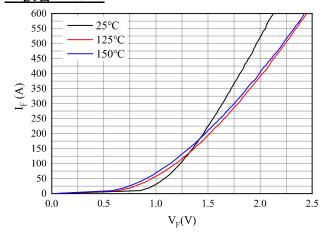


图 25. 正向偏压特性 二极管 Figure 25. Forward characteristic of Diode

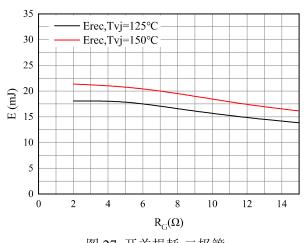


图 27. 开关损耗 二极管 Figure 27. Switching losses of Diode If=300A, V_{CE}=600V

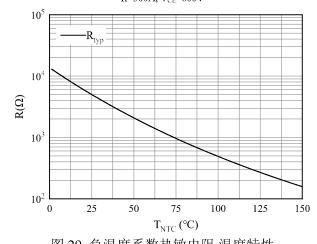


图 29. 负温度系数热敏电阻 温度特性 Figure 29. NTC-Thermistor-temperature characteristic

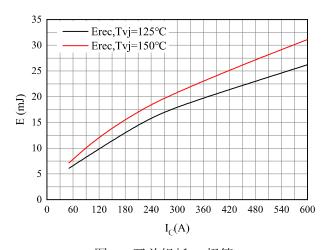


图 26. 开关损耗 二极管 Figure 26. Switching losses of Diode Rg =5Ω, V_{CE}=600V

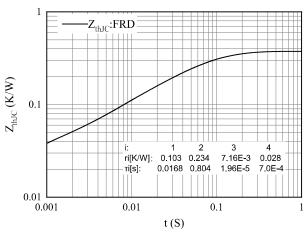
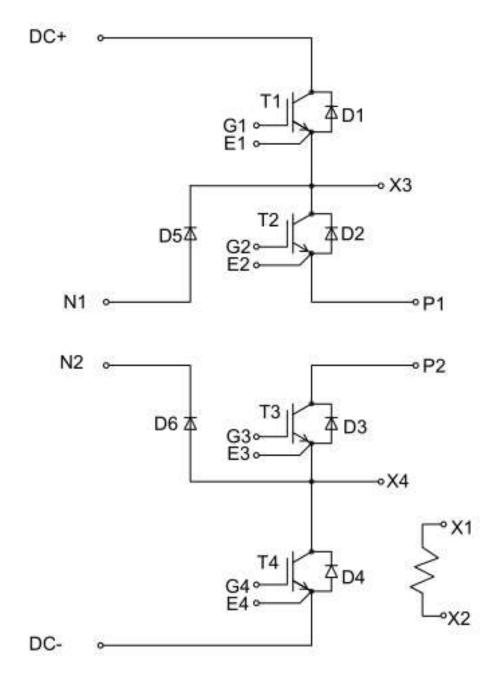
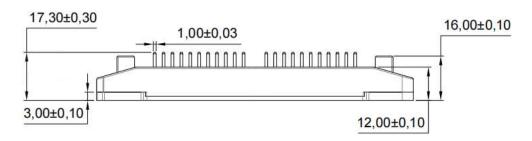


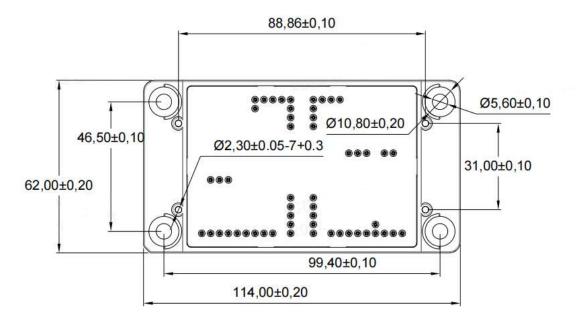
图 28. 瞬态热阻抗 FRD Figure 28. Transient thermal impedance FRD , $_{ZthJC=f(t)}$

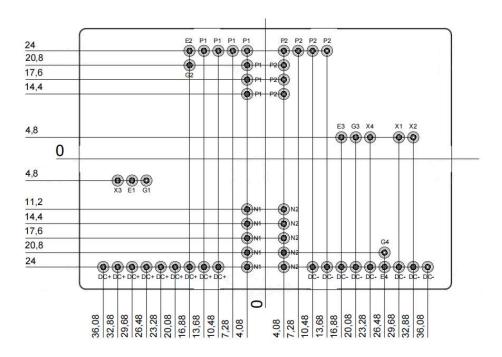
接线图/Circuit Diagram



封装尺寸 / Package outlines







vision history

Dimensions in (mm)