Preliminary

EconoPIM™3 模块 采用第七代沟槽栅/场终止 IGBT7 和第七代发射极控制二极管 带有温度检测 NTC

特性

- 电气特性
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 150 A / I_{CRM} = 300 A
  - 沟槽栅 IGBT7
  - 过载操作达 175°C
  - 低 V_{CEsat}
- 机械特性
  - 集成 NTC 温度传感器
  - 焊接技术
  - 铜基板
  - 低热阻的三氧化二铝 Al_2O_3 衬底

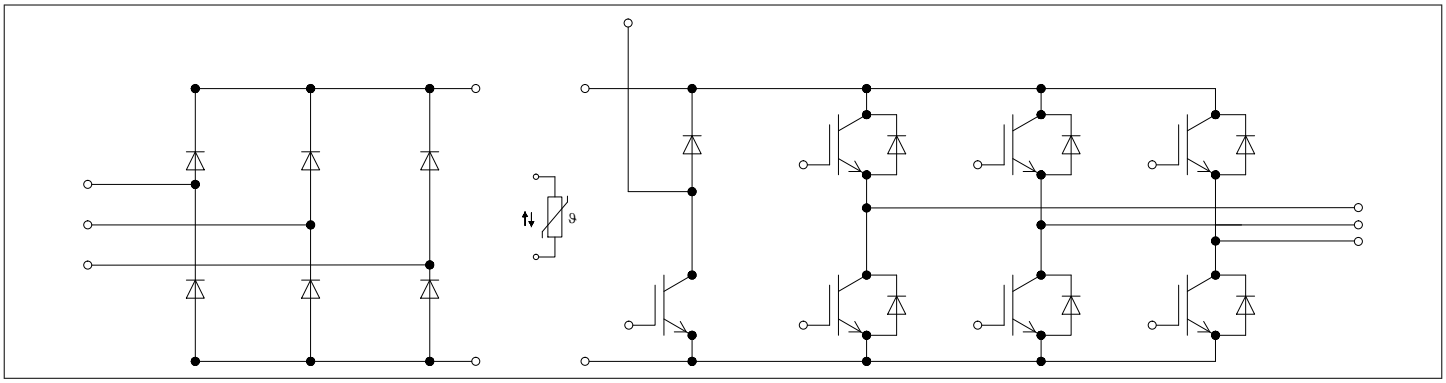
可选应用

- 辅助逆变器
- 电机传动
- 伺服驱动器

产品认证

- 根据 IEC 60747、60749 和 60068 标准的相关测试，符合工业应用的要求。

描述



内容

1 封装

表 1 绝缘协调

特征参数	代号	标注或测试条件	数值	单位
绝缘测试电压	V_{ISOL}	RMS, f = 50 Hz, t = 1 min	2.5	kV
模块基板材料			Cu	
内部绝缘		基本绝缘 (class 1, IEC 61140)	Al_2O_3	
爬电距离	d_{Creep}	端子至散热器	10.0	mm
电气间隙	d_{Clear}	端子至散热器	7.5	mm
相对电痕指数	*CTI*		> 200	
相对温度指数 (电)	*RTI*	住房	140	°C

表 2 特征值

特征参数	代号	标注或测试条件	数值			单位
			最小值	典型值	最大值	
杂散电感,模块	L_{sCE}			25		nH
模块引线电阻,端子-芯片	$R_{AA'+CC'}$	T_C=25°C, 每个开关		1.1		mΩ
模块引线电阻,端子-芯片	$R_{CC'+EE'}$	T_C=25°C, 每个开关		1.6		mΩ
储存温度	T_{stg}		-40		125	°C
模块安装的安装扭距	*M*	根据相应的应用手册进行安装 M5, 螺丝	3		6	Nm
重量	*G*			300		g

2 IGBT, 逆变器

表 3 最大标定值

特征参数	代号	标注或测试条件		数值	单位
集电极－发射极电压	V_{CES}		T_{vj} = 25 °C	1200	V
连续集电极直流电流	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 80 °C	150	A
集电极重复峰值电流	I_{CRM}	t_P = 1 ms		300	A
栅极－发射极峰值电压	V_{GES}			±20	V

表 4　　特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
集电极－发射极饱和电压	$V_{CE\,sat}$	I_C = 150 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.55	TBD	V
			T_{vj} = 125 °C		1.69		
			T_{vj} = 175 °C		1.77		
栅极阈值电压	V_{GEth}	I_C = 3.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
栅极电荷	Q_G	V_{GE} = ±15 V, V_{CE} = 600 V			2.5		µC
内部栅极电阻	R_{Gint}	T_{vj} = 25 °C			1		Ω
输入电容	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			30.1		nF
反向传输电容	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.105		nF
集电极-发射极截止电流	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.012	mA
栅极-发射极漏电流	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA
开通延迟时间(感性负载)	t_{don}	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω	T_{vj} = 25 °C		0.172		µs
			T_{vj} = 125 °C		0.183		
			T_{vj} = 175 °C		0.189		
上升时间(感性负载)	t_r	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω	T_{vj} = 25 °C		0.072		µs
			T_{vj} = 125 °C		0.077		
			T_{vj} = 175 °C		0.080		

表 4　　特征值 (continued)

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
关断延迟时间(感性负载)	t_{doff}	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.331 0.414 0.433		µs
下降时间(感性负载)	t_f	I_C = 150 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.103 0.198 0.262		µs
开通损耗能量 (每脉冲)	E_{on}	I_C = 150 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω, di/dt = 1700 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		16.6 24.9 29.6		mJ
关断损耗能量 (每脉冲)	E_{off}	I_C = 150 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω, dv/dt = 3200 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		10.4 15.9 19.9		mJ
短路数据	I_{SC}	$V_{GE} \leq$ 15 V, V_{CC} = 800 V, $V_{CEmax}=V_{CES}-L_{sCE}$*di/dt	$t_P \leq$ 8 µs, T_{vj} = 150 °C $t_P \leq$ 7 µs, T_{vj} = 175 °C		520 490		A
结－外壳热阻	R_{thJC}	每个 IGBT				0.290	K/W
外壳－散热器热阻	R_{thCH}	每个 IGBT, λ_{grease}= 1 W/(m*K)			0.0680		K/W
允许开关的温度范围	$T_{vj\,op}$			-40		175	°C

注:　$T_{vj\,op}$ > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

3 二极管,逆变器

表 5 最大标定值

特征参数	代号	标注或测试条件		数值	单位
反向重复峰值电压	V_{RRM}		T_{vj} = 25 °C	1200	V
连续正向直流电流	I_F			150	A
正向重复峰值电流	I_{FRM}	t_P = 1 ms		300	A
I2t-值	I^2t	t_P = 10 ms,	T_{vj} = 125 °C	2700	A^2s
		V_R = 0 V	T_{vj} = 175 °C	2250	

表 6 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
正向电压	V_F	I_F = 150 A,	T_{vj} = 25 °C		1.72	TBD	V
		V_{GE} = 0 V	T_{vj} = 125 °C		1.59		
			T_{vj} = 175 °C		1.52		
反向恢复峰值电流	I_{RM}	V_R = 600 V,	T_{vj} = 25 °C		65.3		A
		I_F = 150 A,	T_{vj} = 125 °C		91.8		
		V_{GE} = -15 V,	T_{vj} = 175 °C		107		
		$-di_F/dt$ = 1700 A/µs (T_{vj} = 175 °C)					
恢复电荷	Q_r	V_R = 600 V,	T_{vj} = 25 °C		10.3		µC
		I_F = 150 A,	T_{vj} = 125 °C		21.7		
		V_{GE} = -15 V,	T_{vj} = 175 °C		28.6		
		$-di_F/dt$ = 1700 A/µs (T_{vj} = 175 °C)					
反向恢复损耗（每脉冲）	E_{rec}	V_R = 600 V,	T_{vj} = 25 °C		3.27		mJ
		I_F = 150 A,	T_{vj} = 125 °C		7.32		
		V_{GE} = -15 V,	T_{vj} = 175 °C		9.88		
		$-di_F/dt$ = 1700 A/µs (T_{vj} = 175 °C)					
结－外壳热阻	R_{thJC}	每个二极管				0.463	K/W
外壳－散热器热阻	R_{thCH}	每个二极管,			0.0698		K/W
		λ_{grease}= 1 W/(m*K)					
允许开关的温度范围	$T_{vj\,op}$			-40		175	°C

注: $T_{vj\,op}$ > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

4 二极管,整流器

表 7 最大标定值

特征参数	代号	标注或测试条件		数值	单位
反向重复峰值电压	V_{RRM}	T_{vj} = 25 °C		1600	V
最大正向均方根电流(每芯片)	I_{FRMSM}	T_C = 100 °C		150	A
最大整流器输出均方根电流	I_{RMSM}	T_C = 100 °C		150	A
正向浪涌电流	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	1600	A
			T_{vj} = 150 °C	1400	
I2t-值	I^2t	t_P = 10 ms	T_{vj} = 25 °C	12800	A^2s
			T_{vj} = 150 °C	9800	

表 8 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
正向电压	V_F	I_F = 150 A	T_{vj} = 150 °C		0.97		V
反向电流	I_r	T_{vj} = 150 °C, V_R = 1600 V			1		mA
结－外壳热阻	R_{thJC}	每个二极管				0.333	K/W
外壳－散热器热阻	R_{thCH}	每个二极管, λ_{grease}= 1 W/(m*K)			0.0670		K/W
允许开关的温度范围	$T_{vj, op}$			-40		150	°C

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表 9 最大标定值

特征参数	代号	标注或测试条件		数值	单位
集电极－发射极电压	V_{CES}		T_{vj} = 25 °C	1200	V
连续集电极直流电流	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 90 °C	100	A
集电极重复峰值电流	I_{CRM}	t_P = 1 ms		200	A
栅极－发射极峰值电压	V_{GES}			±20	V

表 10　　特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
集电极－发射极饱和电压	$V_{CE\,sat}$	I_C = 100 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.50	TBD	V
			T_{vj} = 125 °C		1.64		
			T_{vj} = 175 °C		1.72		
栅极阈值电压	V_{GEth}	I_C = 2.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
栅极电荷	Q_G	V_{GE} = ±15 V, V_{CE} = 600 V			1.8		µC
内部栅极电阻	R_{Gint}	T_{vj} = 25 °C			1.5		Ω
输入电容	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			21.7		nF
反向传输电容	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.076		nF
集电极-发射极截止电流	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.01	mA
栅极-发射极漏电流	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA
开通延迟时间(感性负载)	t_{don}	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.169		µs
			T_{vj} = 125 °C		0.180		
			T_{vj} = 175 °C		0.187		
上升时间(感性负载)	t_r	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω	T_{vj} = 25 °C		0.063		µs
			T_{vj} = 125 °C		0.067		
			T_{vj} = 175 °C		0.070		

表 10　　特征值 (continued)

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
关断延迟时间(感性负载)	t_{doff}	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.310 0.390 0.410		µs
下降时间(感性负载)	t_f	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.110 0.190 0.250		µs
开通损耗能量 (每脉冲)	E_{on}	I_C = 100 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 4.3 Ω, di/dt = 1100 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		7.12 11.7 14.5		mJ
关断损耗能量 (每脉冲)	E_{off}	I_C = 100 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 4.3 Ω, dv/dt = 2800 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		6.93 10.6 13.3		mJ
短路数据	I_{SC}	$V_{GE} \leq$ 15 V, V_{CC} = 800 V, $V_{CEmax}=V_{CES}-L_{sCE}$*di/dt	$t_P \leq$ 8 µs, T_{vj} = 150 °C $t_P \leq$ 7 µs, T_{vj} = 175 °C		370 350		A
结－外壳热阻	R_{thJC}	每个 IGBT				0.373	K/W
外壳－散热器热阻	R_{thCH}	每个 IGBT, λ_{grease}= 1 W/(m*K)			0.0680		K/W
允许开关的温度范围	$T_{vj\,op}$			-40		175	°C

注:　*$T_{vj\,op}$ > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.*

6 二极管，制动-斩波器

表 11 最大标定值

特征参数	代号	标注或测试条件		数值	单位
反向重复峰值电压	V_{RRM}		T_{vj} = 25 °C	1200	V
连续正向直流电流	I_F			50	A
正向重复峰值电流	I_{FRM}	t_P = 1 ms		100	A
I2t-值	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	220	A^2s
			T_{vj} = 175 °C	200	

表 12 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
正向电压	V_F	I_F = 50 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.72	TBD	V
			T_{vj} = 125 °C		1.59		
			T_{vj} = 175 °C		1.52		
反向恢复峰值电流	I_{RM}	V_R = 600 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 550 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		37.3		A
			T_{vj} = 125 °C		44.3		
			T_{vj} = 175 °C		49.6		
恢复电荷	Q_r	V_R = 600 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 550 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.86		µC
			T_{vj} = 125 °C		7.05		
			T_{vj} = 175 °C		10.1		
反向恢复损耗（每脉冲）	E_{rec}	V_R = 600 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 550 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.13		mJ
			T_{vj} = 125 °C		2.34		
			T_{vj} = 175 °C		3.23		
结－外壳热阻	R_{thJC}	每个二极管				0.909	K/W
外壳－散热器热阻	R_{thCH}	每个二极管, λ_{grease}= 1 W/(m*K)			0.109		K/W
允许开关的温度范围	$T_{vj\,op}$			-40		175	°C

注: $T_{vj\,op}$ > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

7 负温度系数热敏电阻

表 13 特征值

特征参数	代号	标注或测试条件	数值			单位
			最小值	典型值	最大值	
额定电阻值	R_{25}	T_{NTC} = 25 °C		5		kΩ
R_{100} 偏差	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
耗散功率	P_{25}	T_{NTC} = 25 °C			20	mW
B-值	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2-1/(298,15\ K))]$		3375		K
B-值	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2-1/(298,15\ K))]$		3411		K
B-值	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2-1/(298,15\ K))]$		3433		K

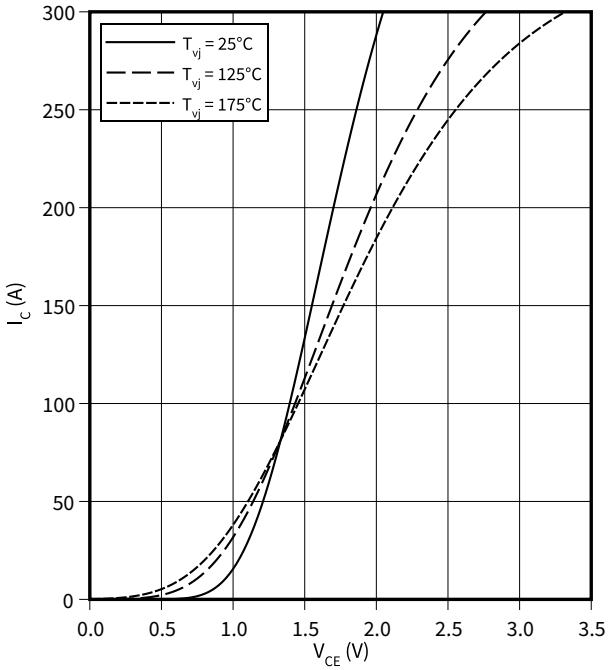
注: 根据应用手册标定

8 特征参数图表

输出特性 （典型), IGBT, 逆变器

$I_C = f(V_{CE})$

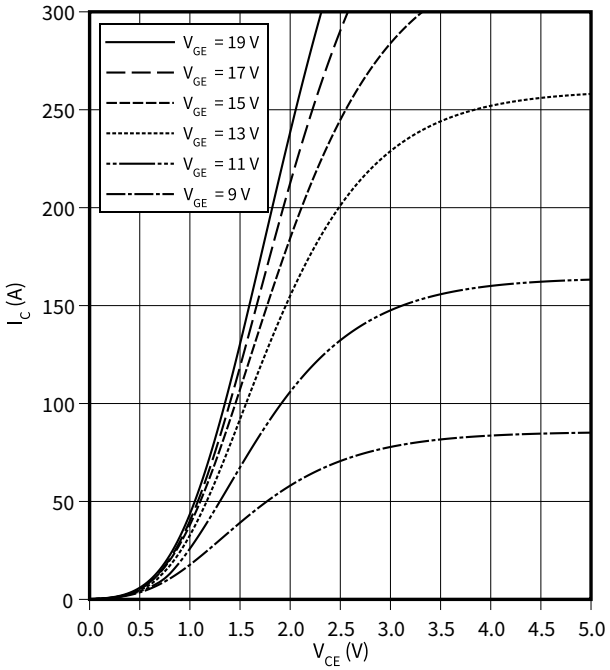
V_{GE} = 15 V



输出特性 （典型), IGBT, 逆变器

$I_C = f(V_{CE})$

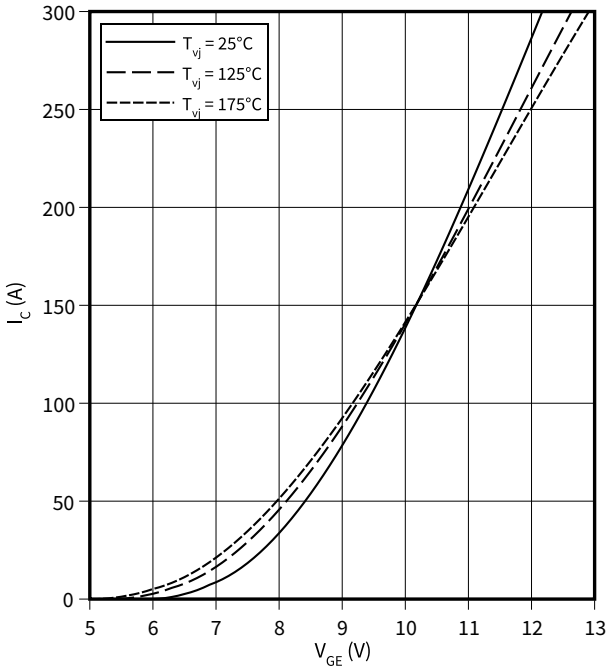
T_{vj} = 175 °C



传输特性 (典型), IGBT, 逆变器

$I_C = f(V_{GE})$

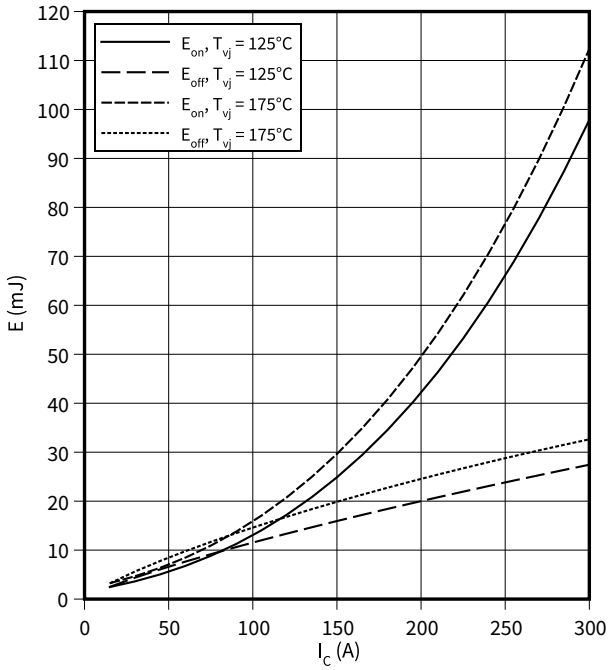
V_{CE} = 20 V



开关损耗 （典型), IGBT, 逆变器

$E = f(I_C)$

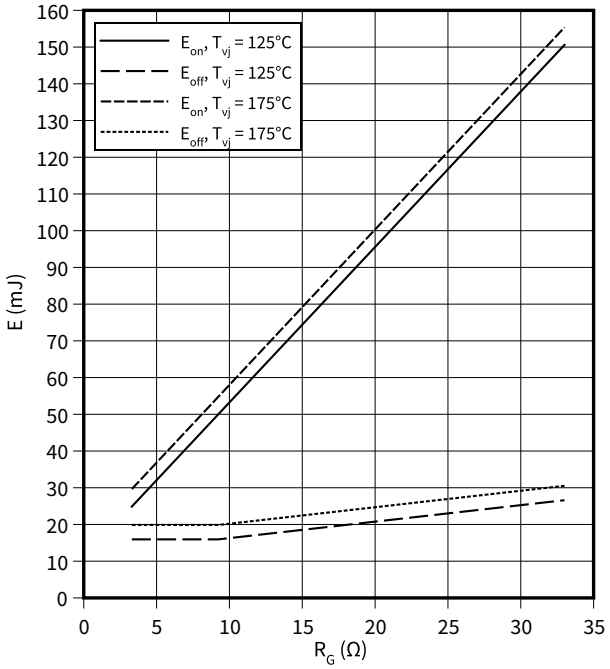
R_{Goff} = 3.3 Ω, R_{Gon} = 3.3 Ω, V_{CE} = 600 V, V_{GE} = ± 15 V



开关损耗 （典型), IGBT, 逆变器

$E = f(R_G)$

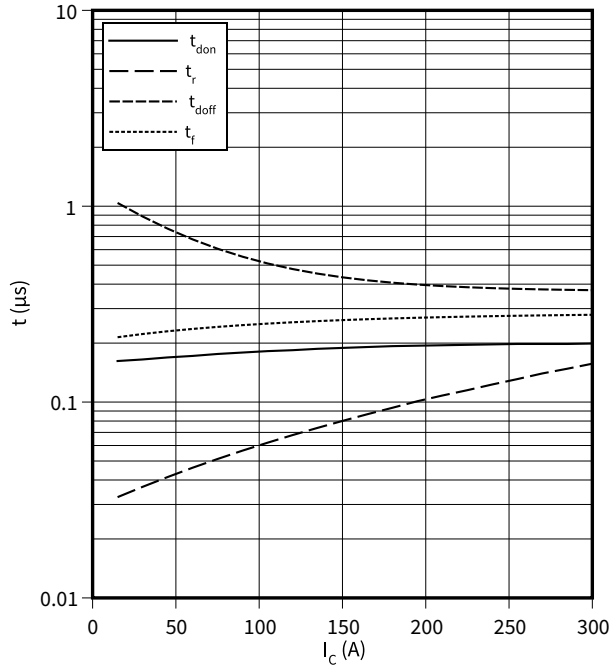
I_C = 150 A, V_{CE} = 600 V, V_{GE} = ± 15 V



??? （典型), IGBT, 逆变器

$t = f(I_C)$

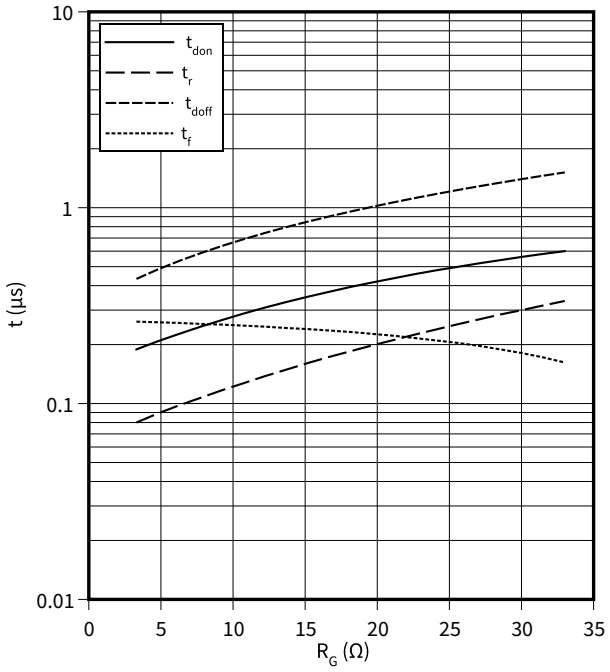
R_{Goff} = 3.3 Ω, R_{Gon} = 3.3 Ω, V_{CE} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



??? （典型), IGBT, 逆变器

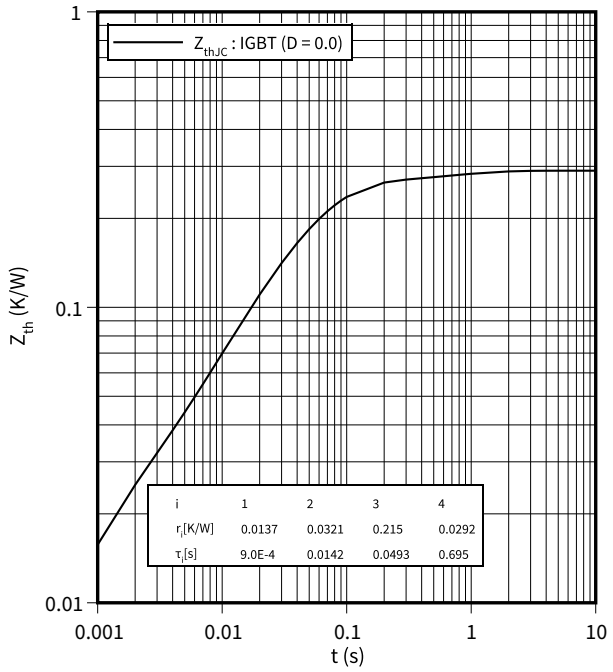
$t = f(R_G)$

I_C = 150 A, V_{CE} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



瞬态热阻抗 , IGBT, 逆变器

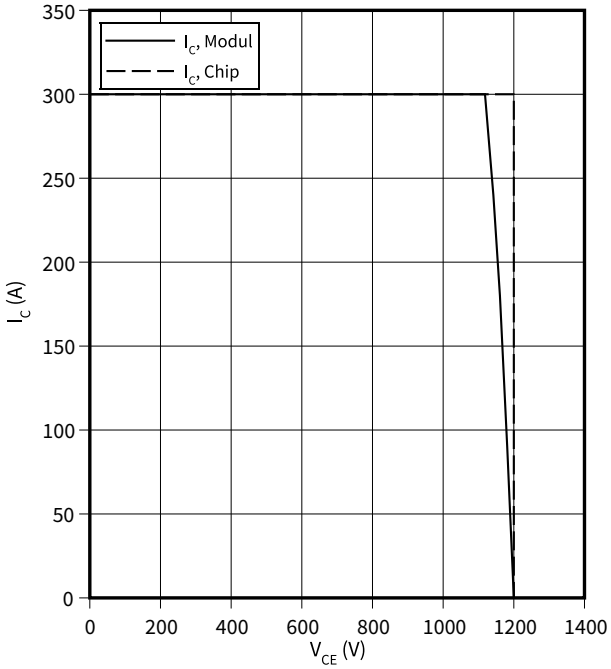
$Z_{th} = f(t)$



反偏安全工作区 （RBSOA）, IGBT, 逆变器

$I_C = f(V_{CE})$

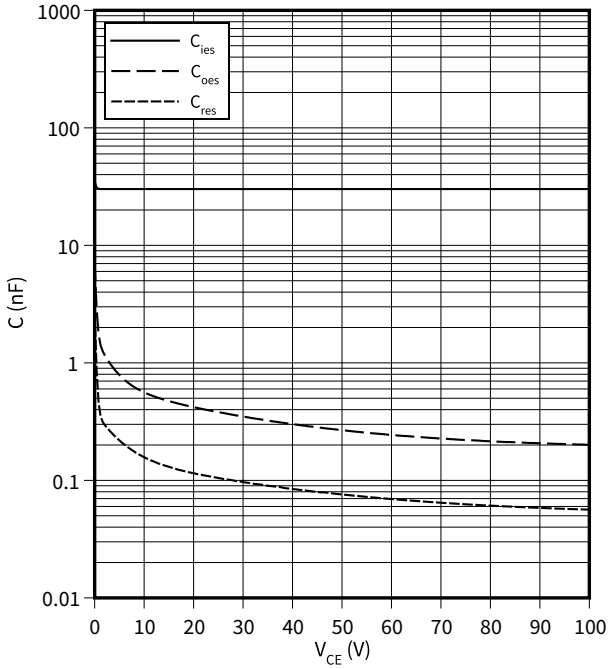
$R_{Goff} = 3.3\ \Omega$, $V_{GE} = 15$ V, $T_{vj} = 175$ °C



电容特性 （典型), IGBT, 逆变器

$C = f(V_{CE})$

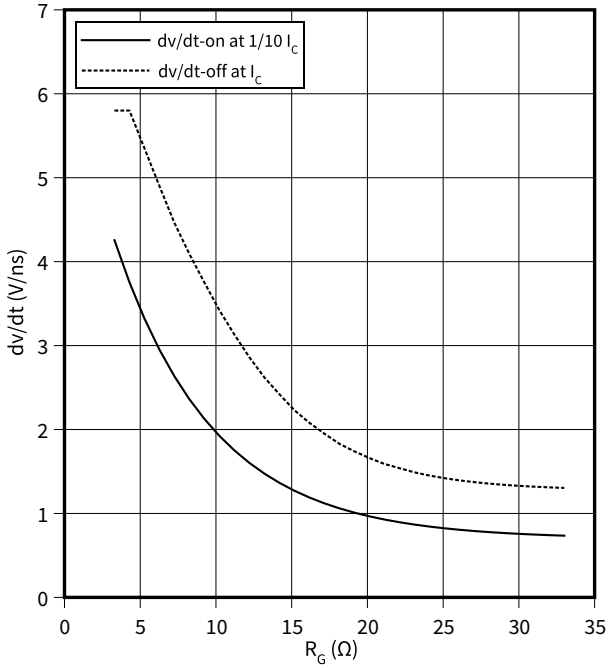
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



dv/dt （典型), IGBT, 逆变器

$dv/dt = f(R_G)$

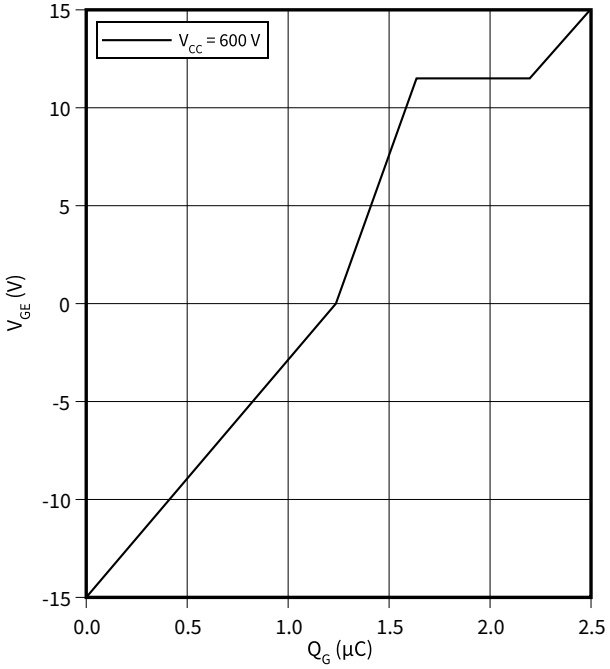
$I_C = 150$ A, $V_{CE} = 600$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 25$ °C



栅极电荷特性 （典型), IGBT, 逆变器

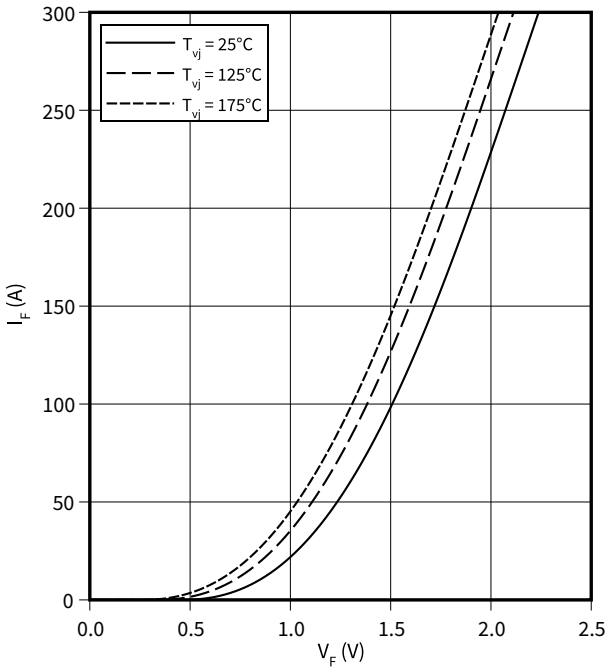
$V_{GE} = f(Q_G)$

$I_C = 150$ A, $T_{vj} = 25$ °C



正向偏压特性 （典型), 二极管,逆变器

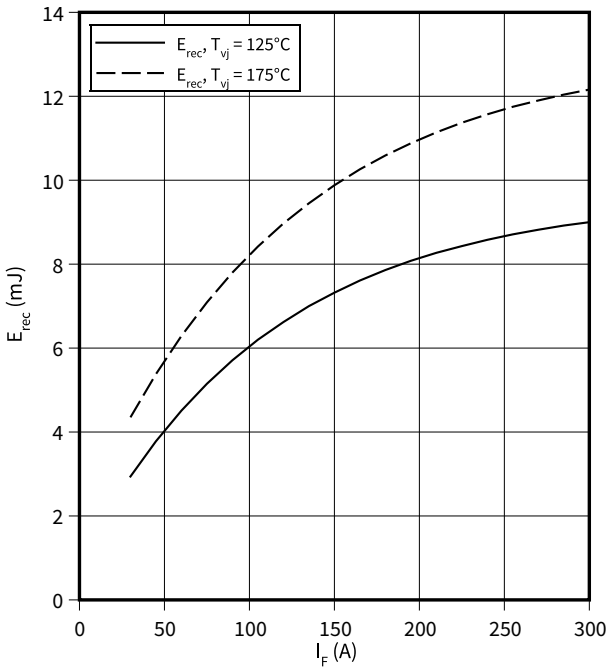
$I_F = f(V_F)$



开关损耗 （典型), 二极管,逆变器

$E_{rec} = f(I_F)$

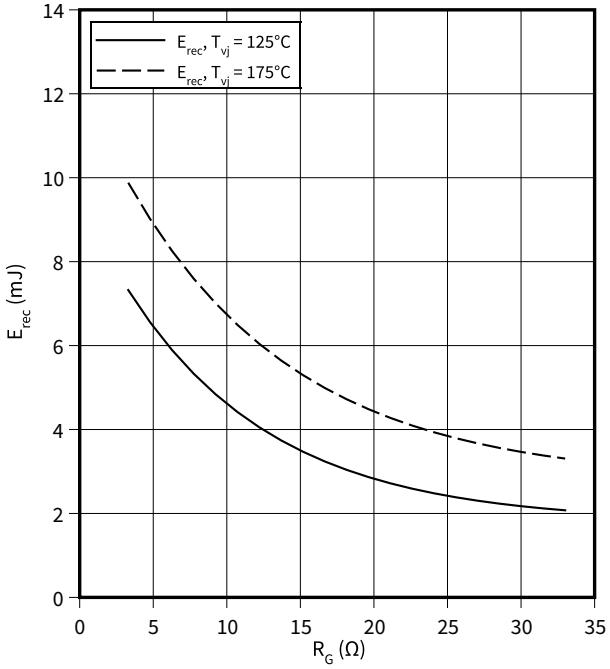
$R_{Gon} = 3.3\ \Omega$, $V_{CE} = 600$ V



开关损耗 （典型), 二极管,逆变器

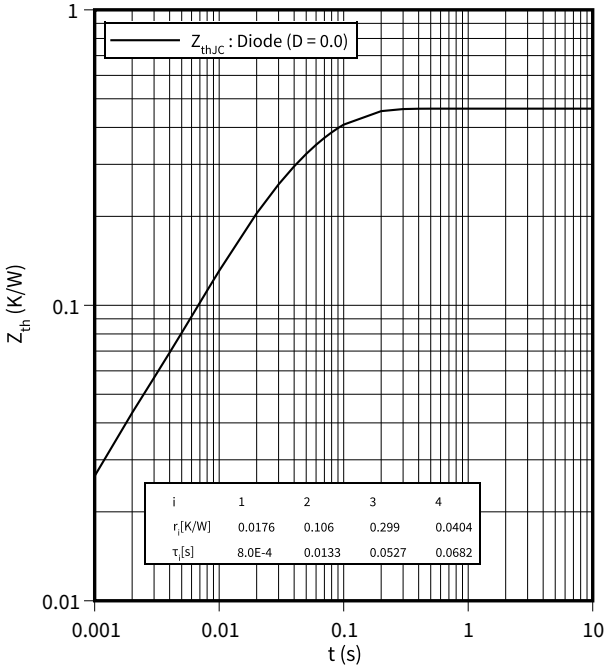
$E_{rec} = f(R_G)$

$V_{CE} = 600$ V, $I_F = 150$ A

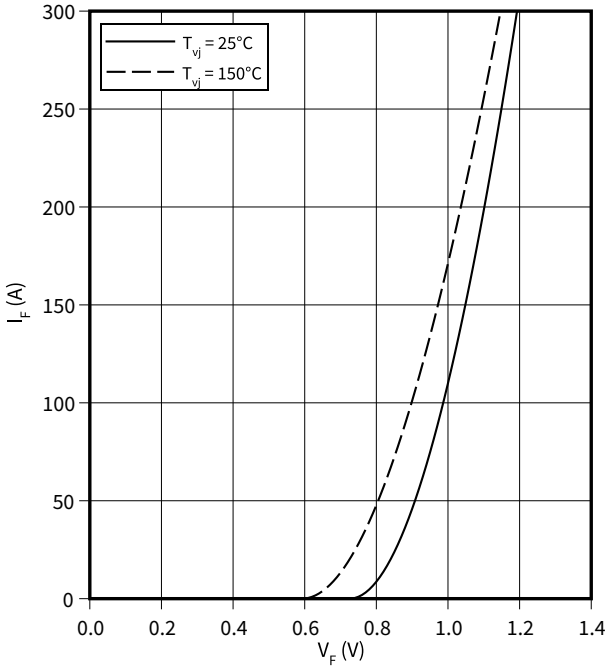


瞬态热阻抗 , 二极管,逆变器

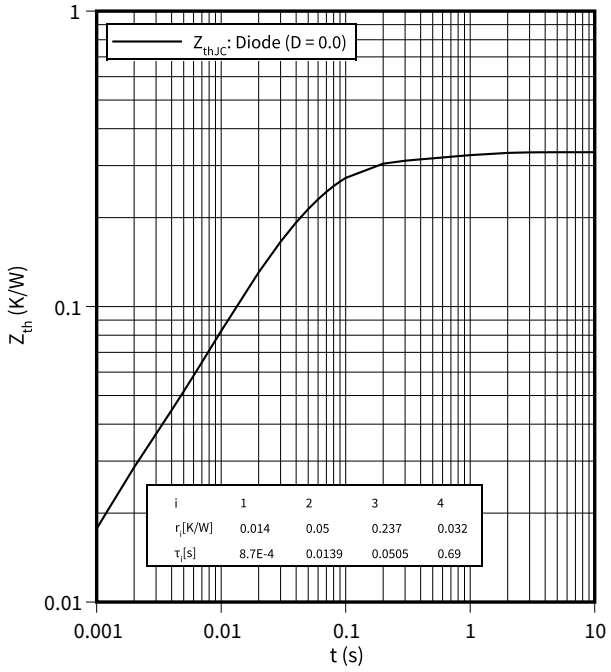
$Z_{th} = f(t)$



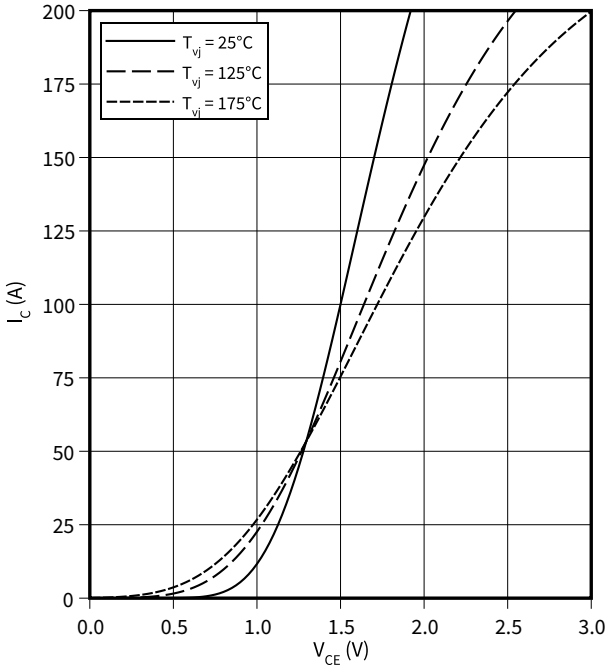
正向偏压特性 （典型), 二极管,整流器
$I_F = f(V_F)$



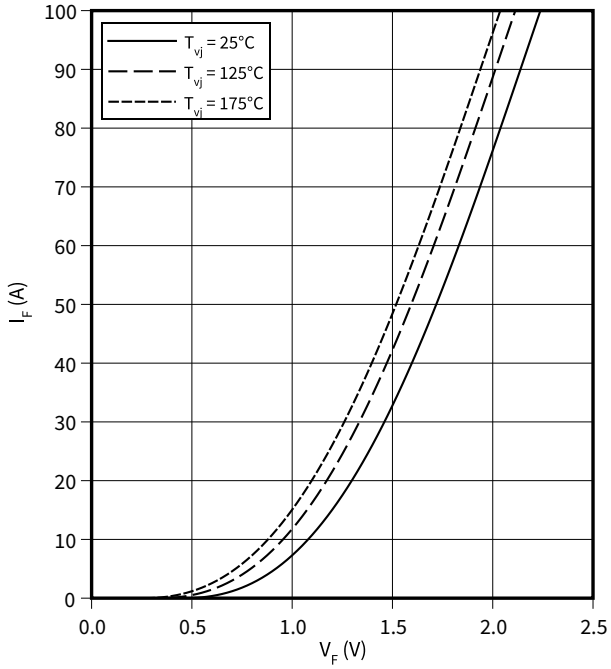
瞬态热阻抗 , 二极管,整流器
$Z_{th} = f(t)$



输出特性 （典型), IGBT, 制动-斩波器
$I_C = f(V_{CE})$
$V_{GE} = 15\ V$

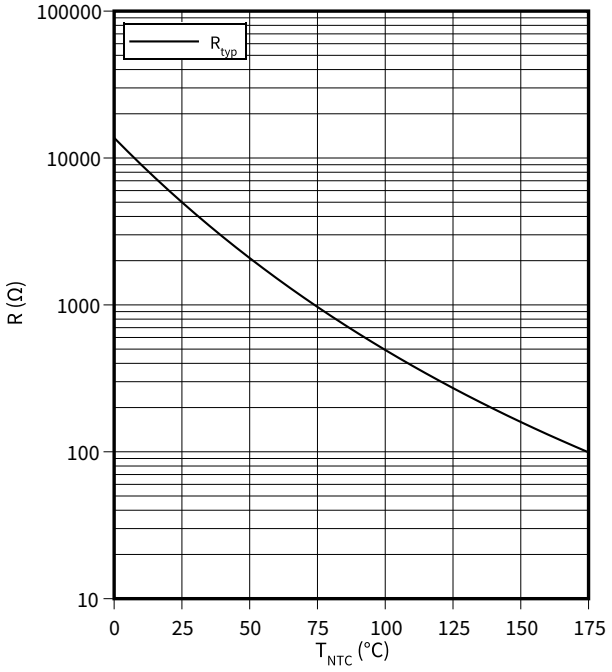


正向偏压特性 （典型), 二极管， 制动-斩波器
$I_F = f(V_F)$



温度特性, 负温度系数热敏电阻

$R = f(T_{NTC})$



9 电路拓扑图

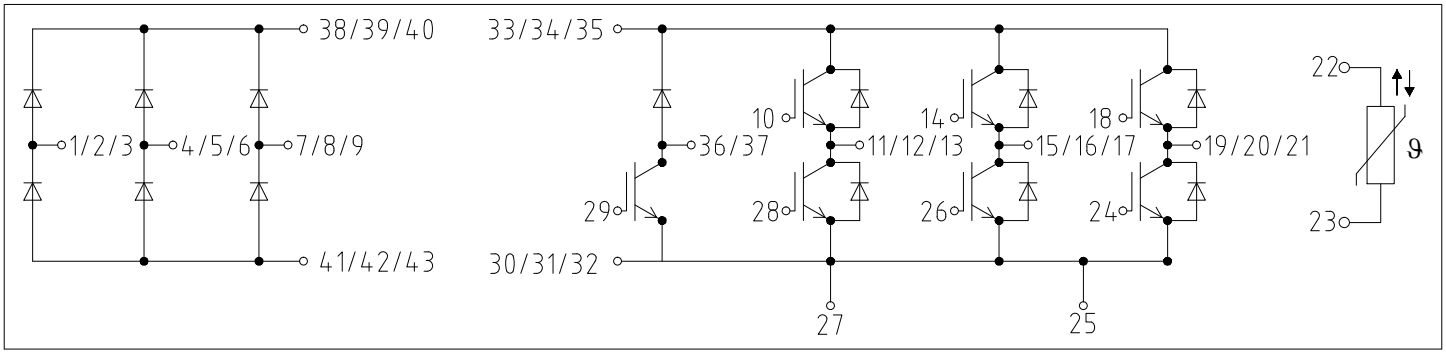

38/39/40
1/2/3
4/5/6
7/8/9
41/42/43
33/34/35
10
14
18
36/37
11/12/13
15/16/17
19/20/21
29
28
26
24
30/31/32
27
25
22
9
23

图 2

10 封装尺寸

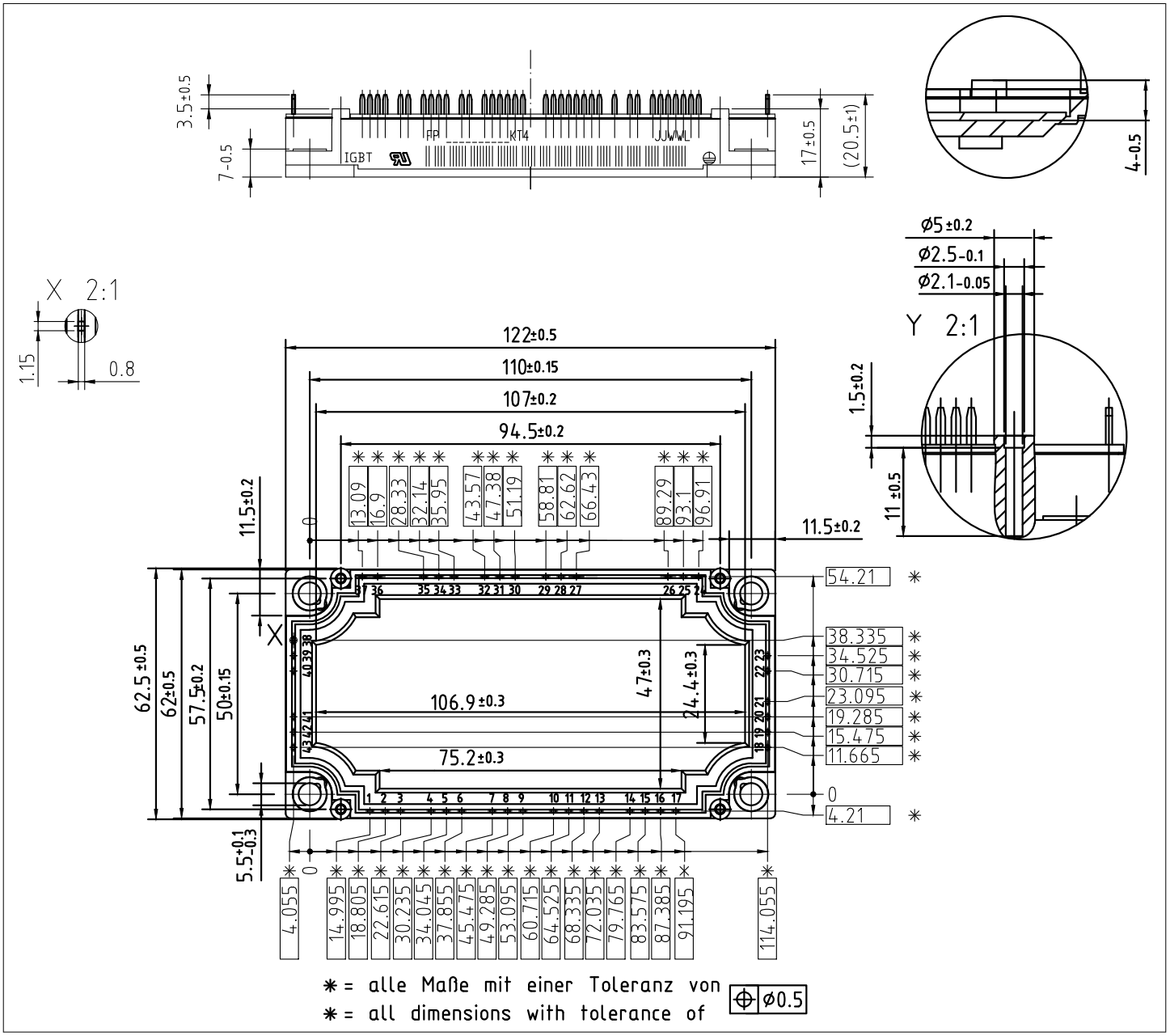

X 2:1
Y 2:1
122±0.5
110±0.15
107±0.2
94.5±0.2
11.5±0.2
62.5±0.5
62±0.5
57.5±0.2
50±0.15
106.9±0.3
75.2±0.3
47±0.3
24.4±0.3
5.5±0.1
Ø5±0.2
Ø2.5-0.1
Ø2.1-0.05
1.5±0.2
11±0.5
4-0.5
17±0.5
(20.5±1)
3.5±0.5
7-0.5
1.15
0.8
IGBT
FP
KT4
54.21
38.335
34.525
30.715
23.095
19.285
15.475
11.665
0
4.21
114.055
* = alle Maße mit einer Toleranz von Ø0.5
* = all dimensions with tolerance of

图 3

11 模块标签代码

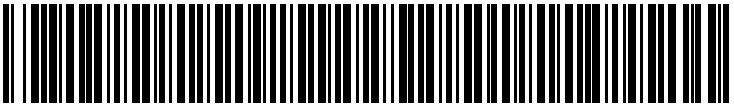
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 715491428465505499115 30	 715491428465505499115 30	

图 4

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Edition 2021-02-09

Published by

Infineon Technologies AG

81726 Munich, Germany

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