

ACP-2 IGBT 模块 ACP-2 IGBT Module

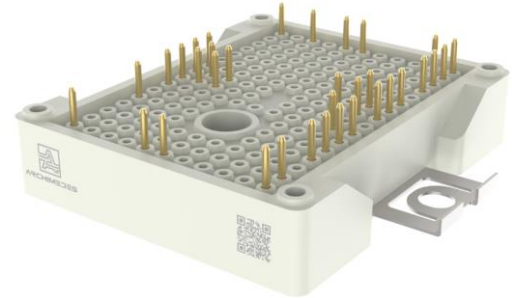
特性

Features

- 低电磁干扰
Low EMI
- 低开关损耗
Low Switching Losses
- V_{CEsat} 正温度系数
 V_{CEsat} with Positive Temperature Coefficient
- 低热阻三氧化二铝 (Al_2O_3) 衬底
 Al_2O_3 Substrate with Low Thermal Resistance
- 紧凑型设计
Compact Design
- 集成的安装夹使安装坚固
Rugged Mounting Due to Integrated Mounting Clamps

模块外观

Module Appearance



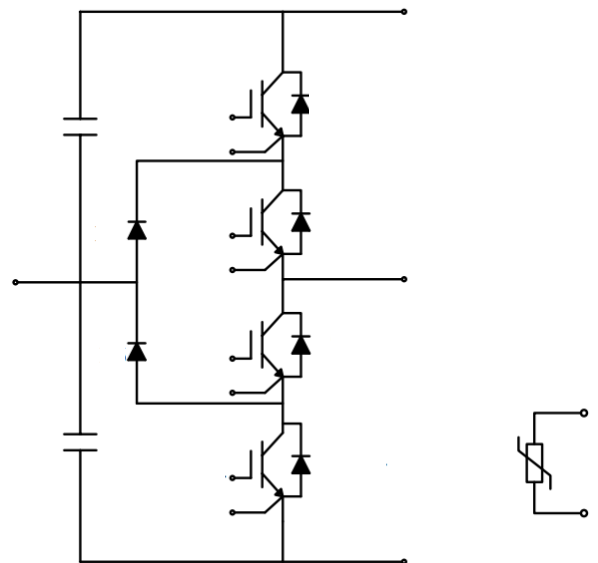
应用

Application

- 三电平应用/3-Level-Applications
- 储能/PCS
- 不间断电源/UPS Systems
- 太阳能系统/Solar Applications

电路拓扑

Circuit Topology



关键参数[T1&T4/D5&D6]

Key Parameters

Parameter	Symbol	Value	Unit
集电极-发射极电压 Collector-emitter voltage	V_{CES}	700	V
连续集电极直流电流 Continuous DC collector current	I_{Cnom}	150	A
集电极重复峰值电流 Repetitive peak collector current	I_{CRM}	300	A
集电极-发射极 饱和电压 Collector-Emitter saturation voltage	$T_{vj}=25^{\circ}C$	V_{CEsat} 1.44	V
	$T_{vj}=125^{\circ}C$	1.55	
IGBT结-散热器热阻 IGBT thermal resistance	R_{thJH}	0.7	K/W
Diode结-散热器热阻 Diode thermal resistance	R_{thJH}	0.75	K/W
开通损耗能量 Turn-on energy	$T_{vj}=25^{\circ}C$	E_{on} 2.07	mJ
	$T_{vj}=125^{\circ}C$	3.13	
关断损耗能量 Turn-off energy	$T_{vj}=25^{\circ}C$	E_{off} 2.8	
	$T_{vj}=125^{\circ}C$	3.74	

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封装/ Package

表 1 绝缘参数/Insulation coordination

Parameter	Conditions	Symbol	Value	Unit
绝缘测试电压 Isolation test voltage	RMS, f = 50Hz, t = 60s	V_{ISOL}	3.0	kV
模块基板材料 Material of module baseplate			Cu	
内部绝缘 Internal isolation	基本绝缘 (class 1, IEC 61140) Basic insulation (class 1, IEC 61140)		Al_2O_3	
爬电距离 Creepage distance	端子至散热器 Terminal to heatsink	d_{Creep}	11.5	mm
爬电距离 Creepage distance	端子至端子 Terminal to terminal	d_{Creep}	6.3	mm
电气间隙 Clearance	端子至散热器 Terminal to heatsink	d_{Clear}	10.0	mm
电气间隙 Clearance	端子至端子 Terminal to terminal	d_{Clear}	5.0	mm
相对电痕指数 Comparative tracking index		CTI	> 200	

表 2 特征值/Characteristic values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
杂散电感, 模块 Stray inductance module		L_{sCE}		15		nH
储存温度 Storage temperature		T_{stg}	-40		125	°C
端子安装扭矩 Terminal connection torque	根据相应的应用手册进行安装 Mounting according to valid application note	M4, 螺丝 M4, Screw	2.0		2.3	Nm
重量 Weight		G		39		g

IGBT/ T1&T4
表 3 最大标定值/Maximum rated values

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压 Collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	700	V
连续集电极直流电流 Continuous DC collector current	$T_h = 80^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	I_{CDC}	112	A
集电极重复峰值电流 Repetitive peak collector current	t_p limited by $T_{vj\max}$	I_{CRM}	300	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}\text{C}, T_{vj} = T_{vj\max}$	P_{tot}	135	W
栅极-发射极电压 Gate-emitter peak voltage		V_{GES}	± 20	V

表 4 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	$I_C = 150A, V_{GE} = 15V$	$T_{vj} = 25^{\circ}C$	$V_{CE(sat)}$		1.44	1.94	V
		$T_{vj} = 125^{\circ}C$			1.55		
栅极阈值电压 Gate threshold voltage	$I_C = 1mA, V_{GE} = V_{CE}, T_{vj} = 25^{\circ}C$		V_{GEth}	3.0	4.0	5.0	V
栅极电荷 Gate charge	$V_{GE} = \pm 15V, V_{CE} = 400V$		Q_G		390		nC
输入电容 Input capacitance	$f = 1MHz, T_{vj} = 25^{\circ}C, V_{CE} = 25V, V_{GE} = 0V$		C_{ies}		15.56		nF
反向传输电容 Reverse transfer capacitance	$f = 1MHz, T_{vj} = 25^{\circ}C, V_{CE} = 25V, V_{GE} = 0V$		C_{res}		0.134		nF
集电极—发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 700V, V_{GE} = 0V, T_{vj} = 25^{\circ}C$		I_{CES}			0.1	mA
栅极—发射极漏电流 Gate-emitter leakage current	$V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25^{\circ}C$		I_{GES}			200	nA
开通延迟时间（感性负载） Turn-on delay time (inductive load)	$V_{CE} = 300V$ $I_C = 150A$ $V_{GE} = +15/-8V$ $R_{Gon} = 7.5\Omega$ $R_{Goff} = 7.5\Omega$ $L_s = 50nH$ Inductive Load	$T_{vj} = 25^{\circ}C$	$t_{d(on)}$		161		ns
		$T_{vj} = 125^{\circ}C$			166		
上升时间（感性负载） Rise time (inductive load)		$T_{vj} = 25^{\circ}C$	t_r		60		ns
		$T_{vj} = 125^{\circ}C$			64		
关断延迟时间（感性负载） Turn-off delay time (inductive load)		$T_{vj} = 25^{\circ}C$	$t_{d(off)}$		230		ns
		$T_{vj} = 125^{\circ}C$			247		
下降时间（感性负载） Fall time (inductive load)		$T_{vj} = 25^{\circ}C$	t_f		33		ns
		$T_{vj} = 125^{\circ}C$			96		
开通损耗能量（每脉冲） Turn-on energy loss per pulse		$T_{vj} = 25^{\circ}C$	E_{on}		2.07		mJ
		$T_{vj} = 125^{\circ}C$			3.13		
关断损耗能量（每脉冲） Turn-off energy loss per pulse		$T_{vj} = 25^{\circ}C$	E_{off}		2.8		mJ
		$T_{vj} = 125^{\circ}C$			3.74		

(续) 特征值/ Characteristic values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
结—散热器热阻 Thermal resistance, junction to heatsink	每个IGBT, $\lambda_{grease} = 1W/(m^{\circ}K)$ Per IGBT, $\lambda_{grease} = 1W/(m^{\circ}K)$	R_{thJH}		0.7		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$	175			$^{\circ}C$

Diode/ D5&D6
表 5 最大标定值/Maximum rated values

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	$T_{vj} = 25^{\circ}C$	V_{RRM}	700	V
连续正向直流电流 Continuous DC forward current	$T_h = 80^{\circ}C, T_{vj\ max} = 175^{\circ}C$	I_F	109	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}C, T_{vj} = T_{vj\ max}$	P_{tot}	126	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	300	A

表 6 特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 150A, V_{GE} = 0V$	$T_{vj} = 25^{\circ}C$	V_F		1.62	2.0	V
		$T_{vj} = 125^{\circ}C$			1.53		
反向恢复峰值电流 Peak reverse recovery current	$V_R = 300V$	$T_{vj} = 25^{\circ}C$	I_{RM}		51		A
		$T_{vj} = 125^{\circ}C$			93		
反向恢复电荷 Recovered charge	$I_F = 150A,$ $R_{Gon} = 7.5\Omega$ $V_{GE} = -8V$ $L_s = 50nH$	$T_{vj} = 25^{\circ}C$	Q_r		3		μC
		$T_{vj} = 125^{\circ}C$			7		
反向恢复损耗（每脉冲） Reverse recovery energy	Inductive Load	$T_{vj} = 25^{\circ}C$	E_{rec}		0.67		mJ
		$T_{vj} = 125^{\circ}C$			1.76		
结—散热器热阻 Thermal resistance, junction to heatsink	每个二极管, $\lambda_{grease} = 1W/(m^{\circ}K)$ Per diode, $\lambda_{grease} = 1W/(m^{\circ}K)$	R_{thJH}			0.75		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$		175			$^{\circ}C$

IGBT/ T2&T3
表 7 最大标定值/Maximum rated values

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压 Collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	700	V
连续集电极直流电流 Continuous DC collector current	$T_h = 80^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	I_{CDC}	112	A
集电极重复峰值电流 Repetitive peak collector current	t_p limited by $T_{vj\max}$	I_{CRM}	300	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}\text{C}, T_{vj} = T_{vj\max}$	P_{tot}	135	W
栅极-发射极电压 Gate-emitter peak voltage		V_{GES}	± 20	V

表 8 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	$I_C = 150\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_{CE(sat)}$		1.44 1.55	1.9	V
栅极阈值电压 Gate threshold voltage	$I_C = 1\text{mA}, V_{GE} = V_{CE}, T_{vj} = 25^{\circ}\text{C}$		V_{GEth}	3.0	4.0	5.0	V
栅极电荷 Gate charge	$V_{GE} = \pm 15\text{V}, V_{CE} = 400\text{V}$		Q_G		390		nC
输入电容 Input capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		C_{ies}		15.56		nF
反向传输电容 Reverse transfer capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		C_{res}		0.134		nF
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 700\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$		I_{CES}			0.1	mA
栅极-发射极漏电流 Gate-emitter leakage current	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}, T_{vj} = 25^{\circ}\text{C}$		I_{GES}			200	nA
开通延迟时间（感性负载） Turn-on delay time (inductive load)	$V_{CE} = 300\text{V}$ $I_C = 150\text{A}$ $V_{GE} = +15/-8\text{V}$ $R_{Gon} = 7.5\Omega$ $R_{Goff} = 7.5\Omega$ $L_s = 50\text{nH}$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{d(on)}$		165 165		ns
上升时间（感性负载） Rise time (inductive load)		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	t_r		57 64		ns
关断延迟时间（感性负载） Turn-off delay time (inductive load)		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{d(off)}$		228 247		ns
下降时间（感性负载） Fall time (inductive load)		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	t_f		33 96		ns
开通损耗能量（每脉冲） Turn-on energy loss per pulse		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	E_{on}		1.95 3.15		mJ
关断损耗能量（每脉冲） Turn-off energy loss per pulse		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	E_{off}		2.25 3.65		mJ

(续) 特征值/ Characteristic values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
结—散热器热阻 Thermal resistance, junction to heatsink	每个IGBT, $\lambda_{grease} = 1W/(m^{\circ}K)$ Per IGBT, $\lambda_{grease} = 1W/(m^{\circ}K)$	R_{thJH}		0.7		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$		175		$^{\circ}C$

Diode/ D1&D4
表 9 最大标定值/Maximum rated values

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	$T_{vj} = 25^{\circ}C$	V_{RRM}	700	V
连续正向直流电流 Continuous DC forward current	$T_h = 80^{\circ}C, T_{vj\ max} = 175^{\circ}C$	I_F	109	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}C, T_{vj} = T_{vj\ max}$	P_{tot}	126	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	300	A

表 10 特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 150A, V_{GE} = 0V$	$T_{vj} = 25^{\circ}C$	V_F		1.62	2.1	V
		$T_{vj} = 125^{\circ}C$			1.53		
反向恢复峰值电流 Peak reverse recovery current	$V_R = 300V$ $I_F = 150A,$ $R_{Gon} = 7.5\Omega$ $V_{GE} = -8V$ $L_s = 50nH$ Inductive Load	$T_{vj} = 25^{\circ}C$	I_{RM}		50		A
		$T_{vj} = 125^{\circ}C$			93		
反向恢复电荷 Recovered charge		$T_{vj} = 25^{\circ}C$	Q_r		2		μC
		$T_{vj} = 125^{\circ}C$			7		
反向恢复损耗（每脉冲） Reverse recovery energy		$T_{vj} = 25^{\circ}C$	E_{rec}		0.57		mJ
		$T_{vj} = 125^{\circ}C$			1.67		
结—散热器热阻 Thermal resistance, junction to heatsink	每个二极管, $\lambda_{grease} = 1W/(m^{\circ}K)$ Per diode, $\lambda_{grease} = 1W/(m^{\circ}K)$	R_{thJH}			0.75		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$			175		$^{\circ}C$

Diode/ D2&D3
表 11 最大标定值/Maximum rated values

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}	700	V
连续正向直流电流 Continuous DC forward current	$T_C = 80^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	I_F	109	A
总耗散功率 Total Power dissipation	$T_C = 80^{\circ}\text{C}, T_{vj} = T_{vj\max}$	P_{tot}	126	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\max}$	I_{FRM}	300	A

表 12 特征值/Characteristic values

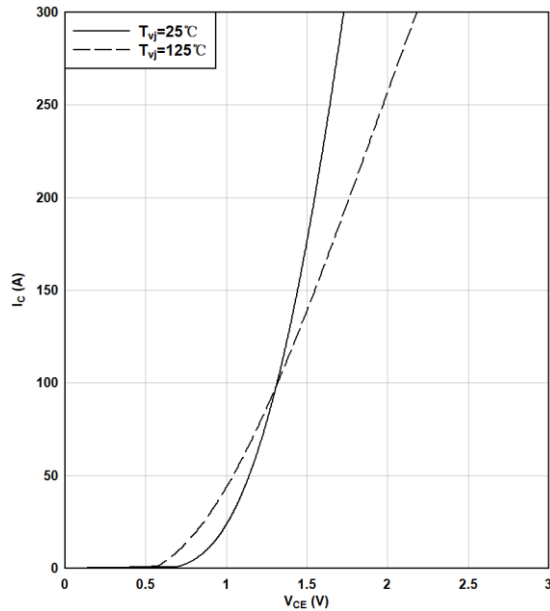
Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 150\text{A}, V_{GE} = 0\text{V}$	V_F		1.62	2.1	V
	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$			1.53		
结-散热器热阻 Thermal resistance, junction to heatsink	每个二极管, $\lambda_{grease} = 1\text{W}/(\text{m}^{\circ}\text{K})$ Per diode, $\lambda_{grease} = 1\text{W}/(\text{m}^{\circ}\text{K})$	R_{thJH}		0.75		K/W
最高结温 $T_{vj\max}$		$T_{vj\max}$	175			$^{\circ}\text{C}$

负温度系数热敏电阻/ NTC-Thermistor
表 13 特征值/Characteristic values

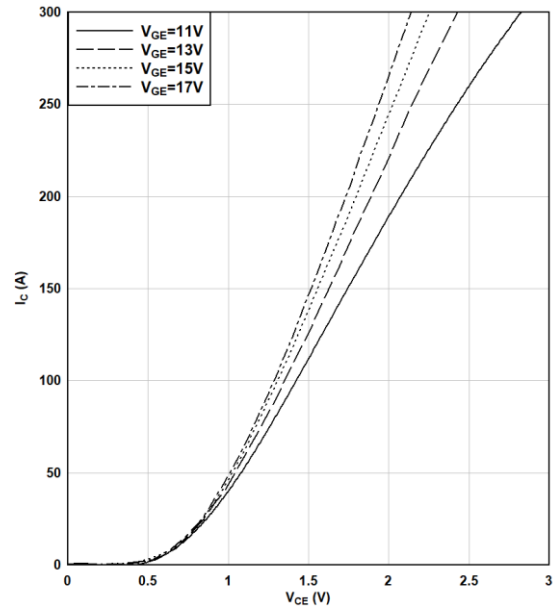
Parameter	Conditions	Symbol	Value	Unit
额定电阻值 Rated resistance	$T_{NTC} = 25^{\circ}\text{C}$	R_{25}	5	k Ω
R_{100} 偏差 Deviation of R_{100}	$T_{NTC} = 100^{\circ}\text{C}, R_{100} = 493\ \Omega$	$\Delta R/R$	± 5	%
B-值 B-value	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15\text{ K}))]$	$B_{25/50}$	3375	K
B-值 B-value	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15\text{ K}))]$	$B_{25/100}$	3433	K

特征参数图表/ Characteristics Diagrams

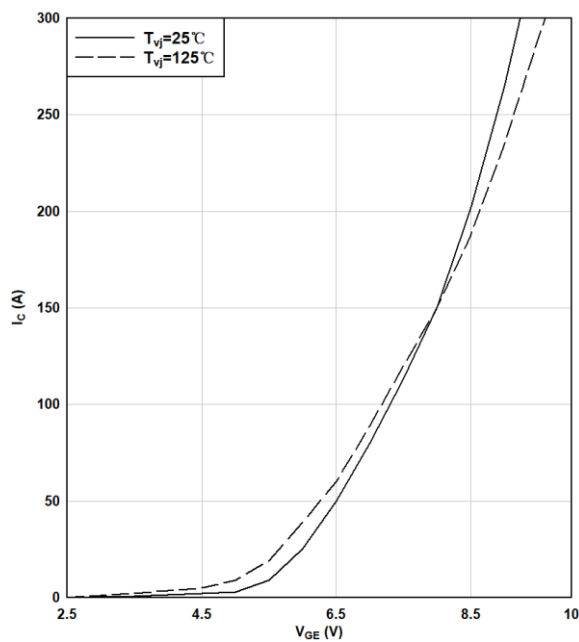
输出特性（典型），IGBT (T1/T4)，逆变器
Output characteristic (typical), IGBT(T1/T4), Inverter
 $I_C = f(V_{CE})$
 $V_{GE} = 15V$



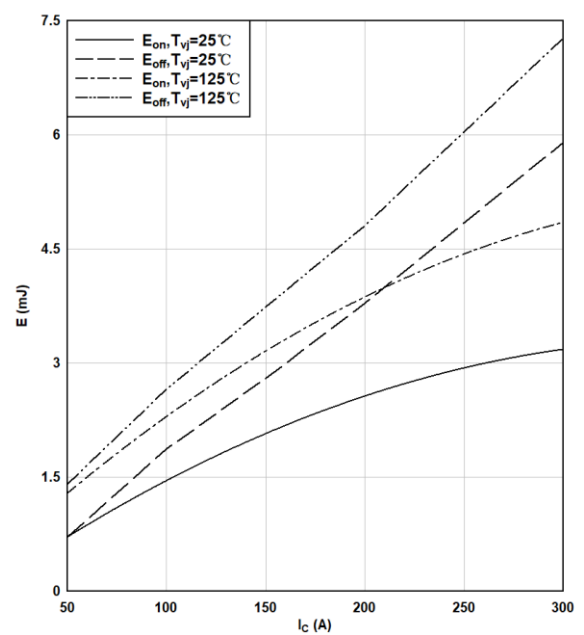
输出特性（典型），IGBT(T1/T4)，逆变器
Output characteristic (typical), IGBT(T1/T4), Inverter
 $I_C = f(V_{CE})$
 $T_{vj}=125^{\circ}C$



传输特性（典型），IGBT(T1/T4)，逆变器
Transfer characteristic (typical), IGBT(T1/T4), Inverter
 $I_C = f(V_{GE})$
 $V_{CE} = 20V$

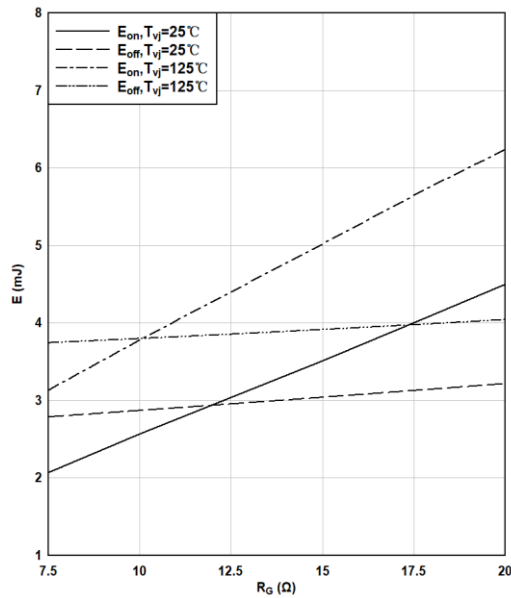


开关损耗（典型），IGBT(T1/T4)，逆变器
Switching losses (typical), IGBT(T1/T4), Inverter
 $E = f(I_C)$
 $V_{CE} = 300V$, $R_{Gon} = R_{Goff} = 7.5\Omega$, $V_{GE} = +15/-8V$

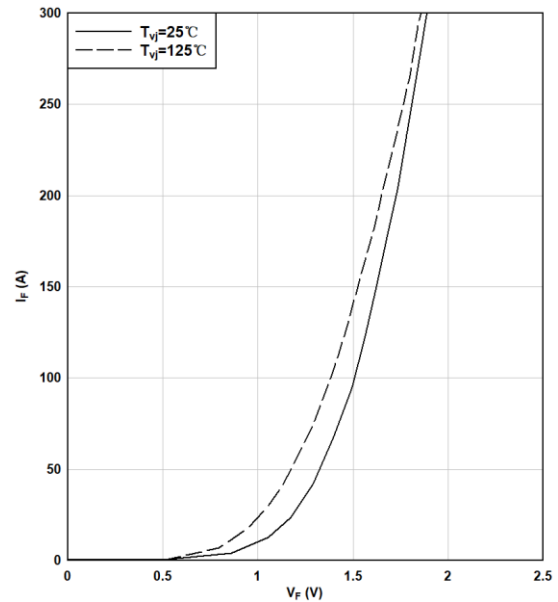


(续) 特征参数图表/Characteristics Diagrams

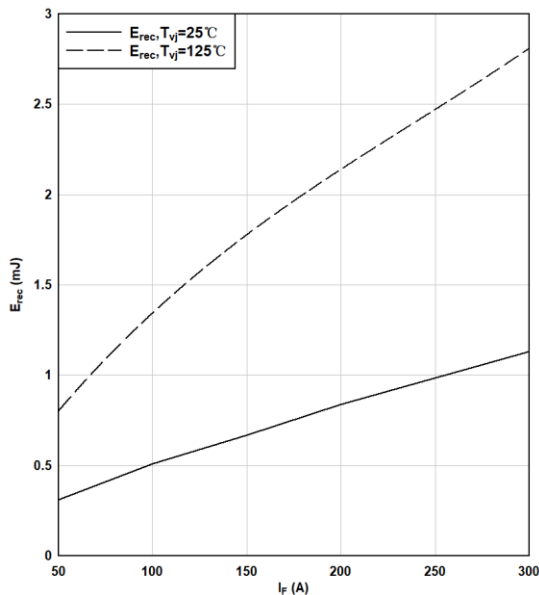
开关损耗 (典型), IGBT(T1/T4), 逆变器
Switching losses (typical), IGBT(T1/T4), Inverter
 $E = f(R_G)$
 $I_C = 150A$, $V_{CE} = 300V$, $V_{GE} = +15/-8V$



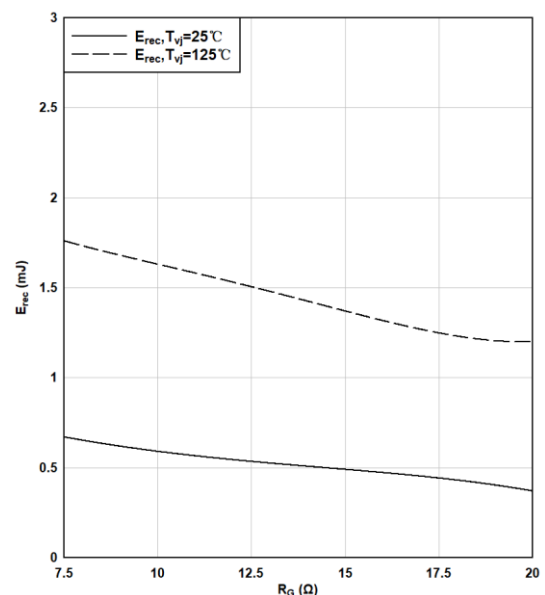
正向特性 (典型), 二极管(D5/D6)
Forward characteristic (typical), Diode(D5/D6)
 $I_F = f(V_F)$



开关损耗 (典型), 二极管(D5/D6)
Switching losses (typical), Diode(D5/D6)
 $E_{rec} = f(I_F)$
 $V_{CE} = 300V$, $R_{Gon} = 7.5\Omega$

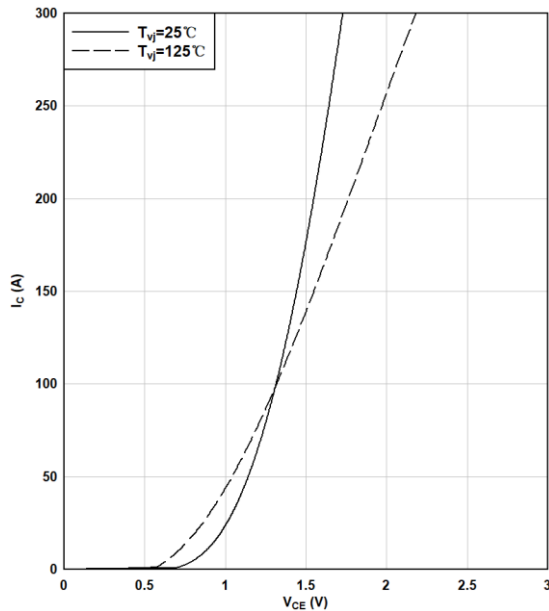


开关损耗 (典型), 二极管(D5/D6)
Switching losses (typical), Diode(D5/D6)
 $E_{rec} = f(R_G)$
 $I_F = 150A$, $V_{CE} = 300V$

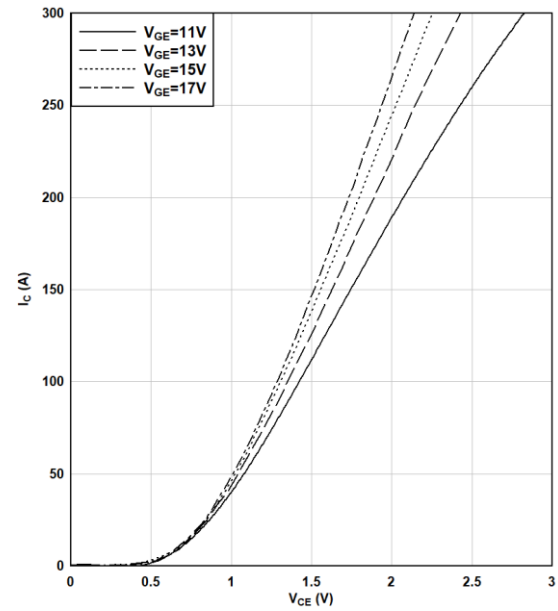


(续) 特征参数图表/Characteristics Diagrams

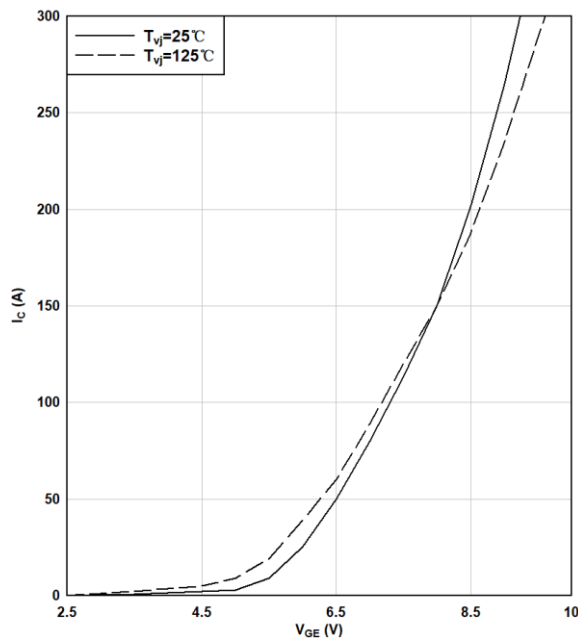
输出特性 (典型), IGBT(T2/T3), 逆变器
Output characteristic (typical), IGBT(T2/T3), Inverter
 $I_C = f(V_{CE})$
 $V_{GE} = 15V$



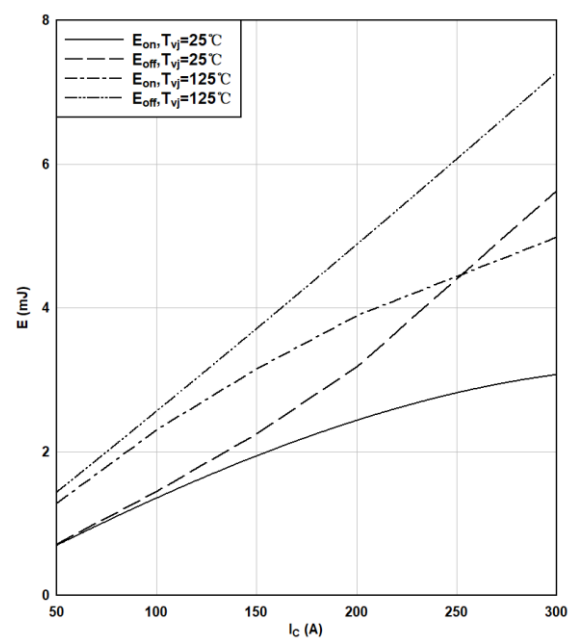
输出特性 (典型), IGBT(T2/T3), 逆变器
Output characteristic (typical), IGBT(T2/T3), Inverter
 $I_C = f(V_{CE})$
 $T_{vj} = 125^\circ C$



传输特性 (典型), IGBT(T2/T3), 逆变器
Transfer characteristic (typical), IGBT(T2/T3), Inverter
 $I_C = f(V_{GE})$
 $V_{CE} = 20V$

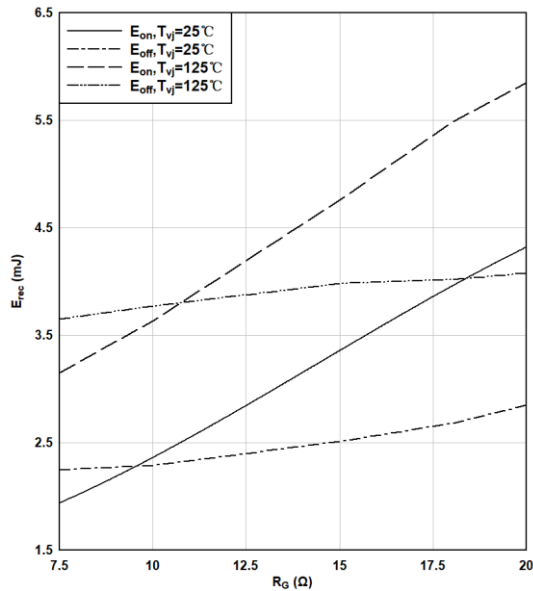


开关损耗 (典型), IGBT(T2/T3), 逆变器
Switching losses (typical), IGBT(T2/T3), Inverter
 $E = f(I_C)$
 $V_{CE} = 300V, R_{Gon} = R_{Goff} = 7.5\Omega, V_{GE} = +15/-8V$

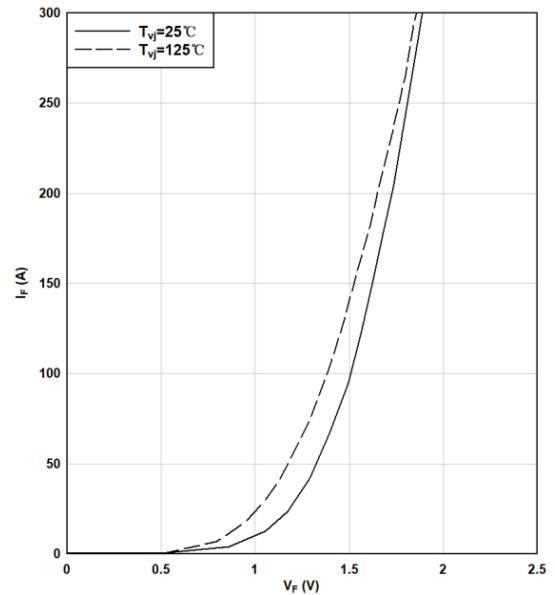


(续) 特征参数图表/Characteristics Diagrams

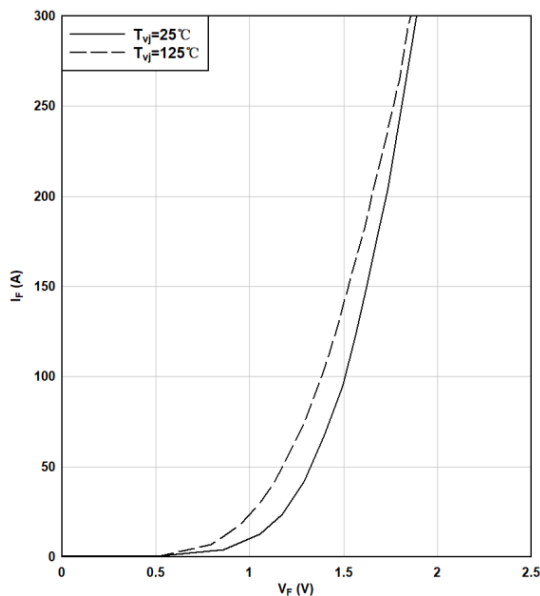
开关损耗 (典型), IGBT(T2/T3), 逆变器
Switching losses (typical), IGBT(T2/T3), Inverter
 $E = f(R_G)$
 $I_C = 150A$, $V_{CE} = 300V$, $V_{GE} = +15/-8V$



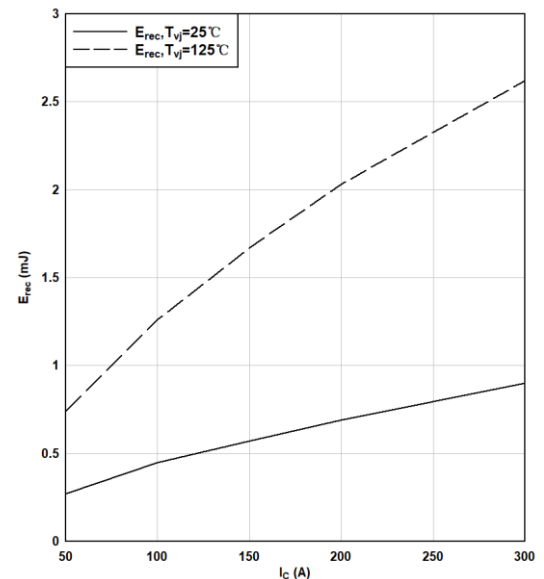
正向特性 (典型), 二极管(D1/D4)
Forward characteristic (typical), Diode(D1/D4)
 $I_F = f(V_F)$



正向特性 (典型), 二极管(D2/D3)
Forward characteristic (typical), Diode(D2/D3)
 $I_F = f(V_F)$

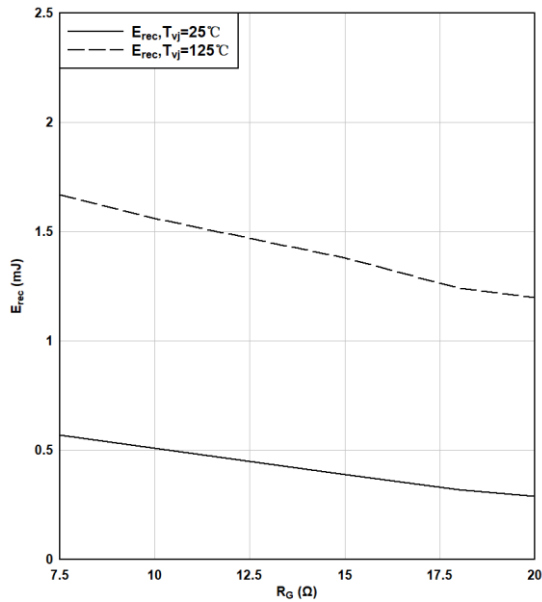


开关损耗 (典型), 二极管(D1/D4)
Switching losses (typical), Diode(D1/D4)
 $E_{rec} = f(I_F)$
 $V_{CE} = 300V$, $R_{Gon} = 7.5\Omega$

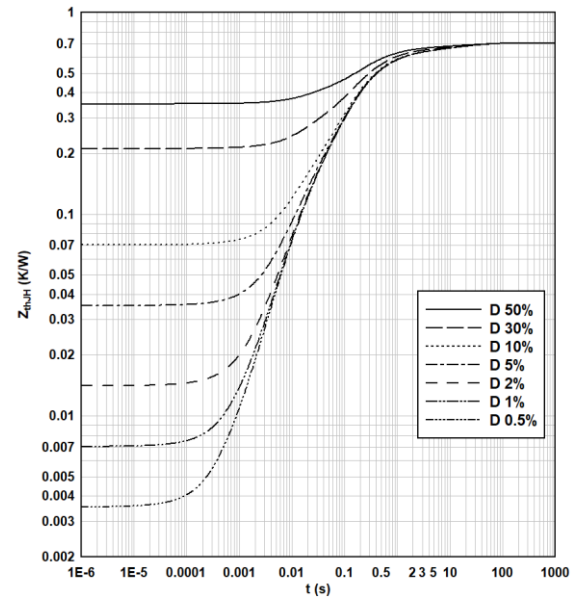


(续) 特征参数图表/Characteristics Diagrams

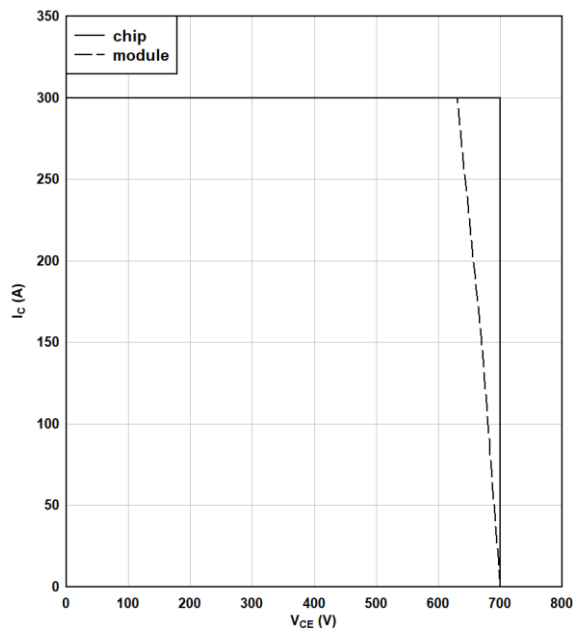
开关损耗 (典型), 二极管(D1/D4)
Switching losses (typical), Diode(D1/D4)
 $E_{rec} = f(R_G)$
 $I_F = 150A, V_{CE} = 300V$



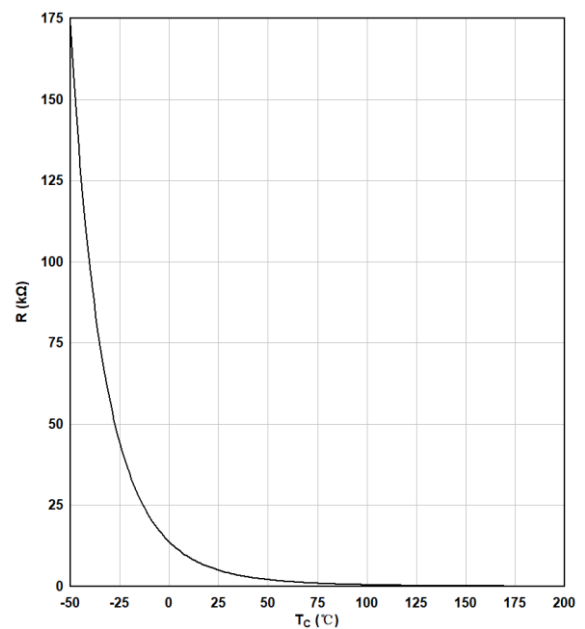
瞬态热阻抗, IGBT(T1/T2/T3/T4)
Transient thermal impedance, IGBT(T1/T2/T3/T4)
 $Z_{thJH} = f(t)$



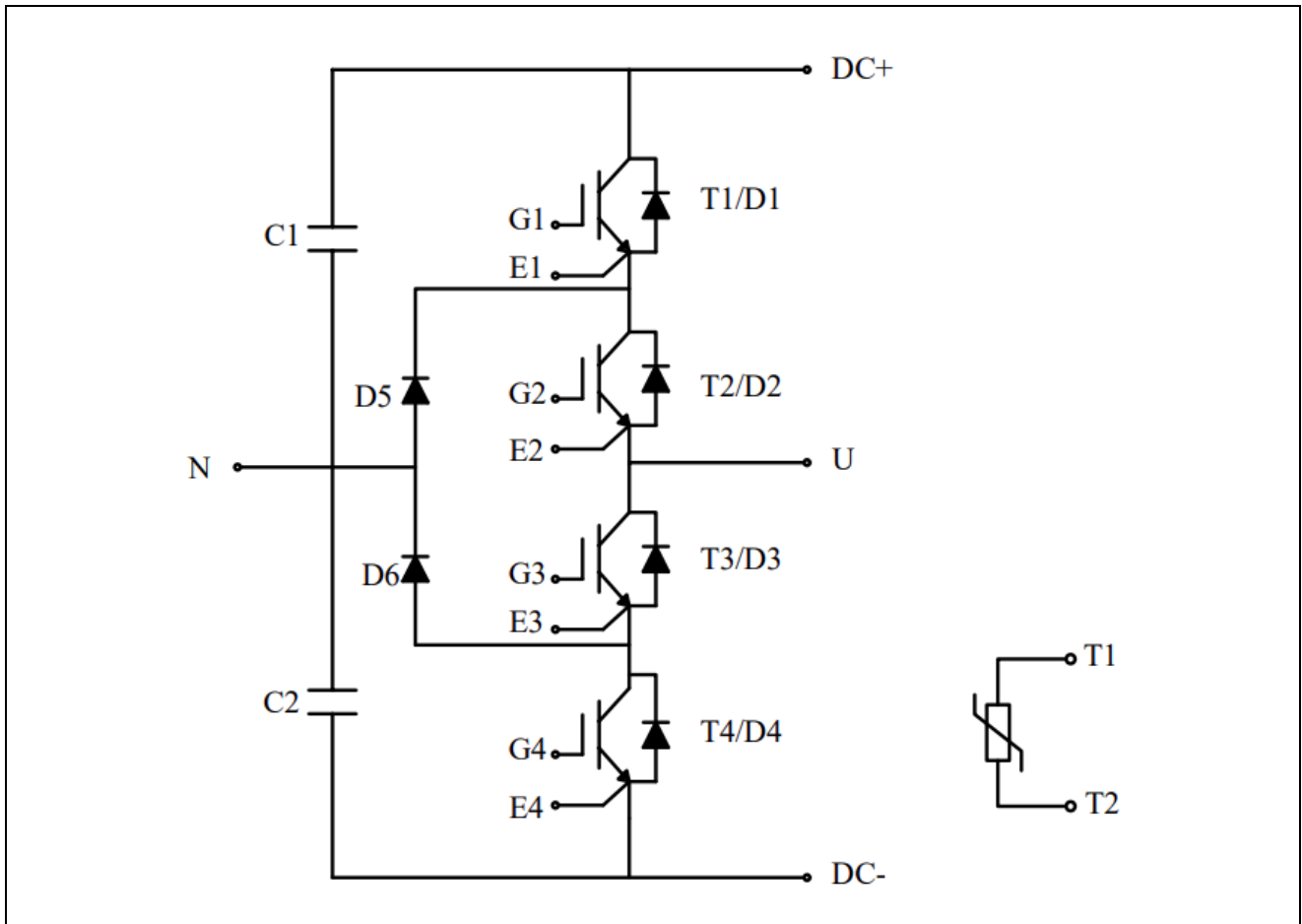
反偏安全工作区 IGBT, 逆变器 (T1/T2/T3/T4)
Reverse bias safe operating area IGBT, Inverter(T1/T2/T3/T4)
 $I_C = f(V_{CE})$



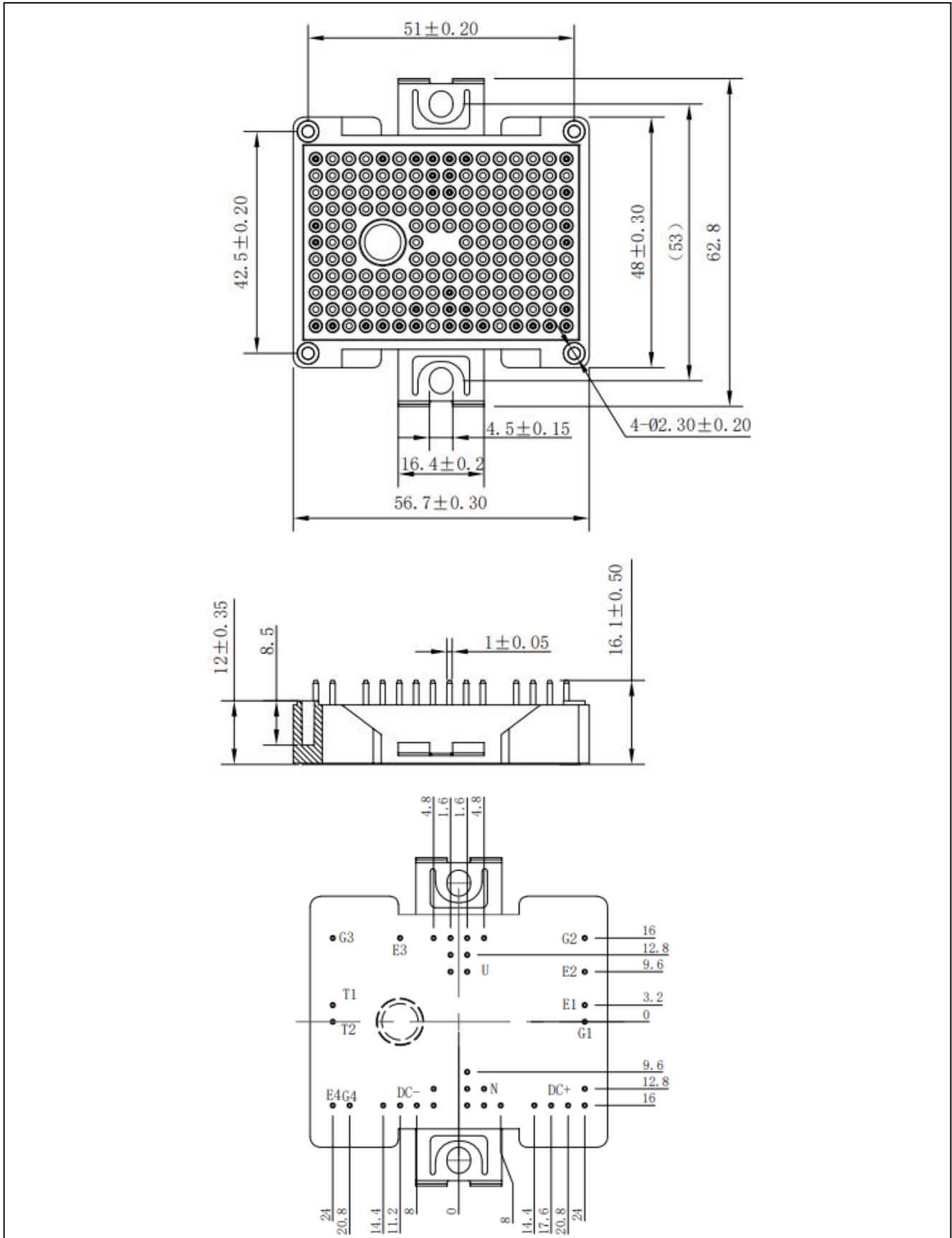
负温度系数热敏电阻温度特性 (典型)
NTC-Thermistor-temperature characteristic(typical)
 $R = f(T_C)$



电路拓扑图/ Circuit Diagram



封装尺寸/ Package Outlines



模块标签信息/ Module Marking Information**Marking Diagram**

AMG150L70P2H3RA = Specific Device Code

P2E2234A10001= Lot Traceability

ACP-2 = Package Type

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When the product is in use, it is strictly forbidden to touch the product. After power off, it is confirmed that there is no residual charge and the product has been completely cooled, and it can only be touched under electrostatic protection measures;

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