ACP-3S 三电平ANPC模块
ACP-3S 3-Level ANPC Module

特性 Features

- 分立式三电平ANPC模块
  Split 3-Level ANPC Module
- 行业首创Easy 3B Plus封装
  The First Easy 3B Plus Package
- 低电感布局
  Low Inductive Layout
- 低V_{CEsat}/低开关损耗
  Low V_{CEsat} / Low Switching Losses
- 低关断电压应力
  Low Turn-off Voltage Stress
- 带铜基板
  With Copper Baseplate

应用 Application

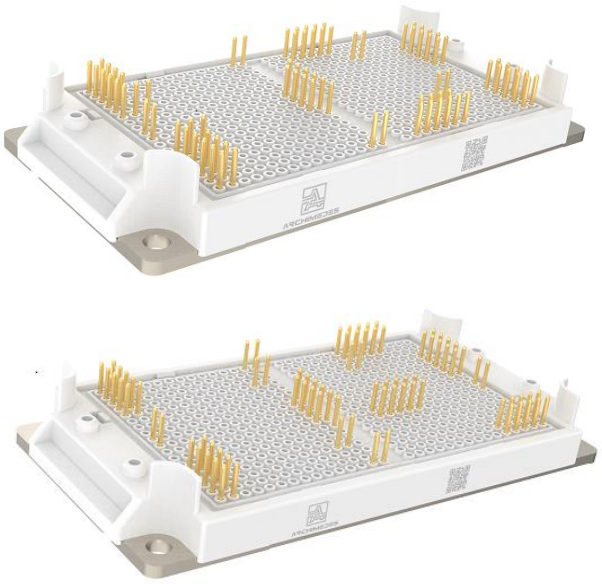
- 储能/PCS
- 光伏逆变器/Solar Inverter

关键参数[T2&T3/D2&D3] Key Parameters

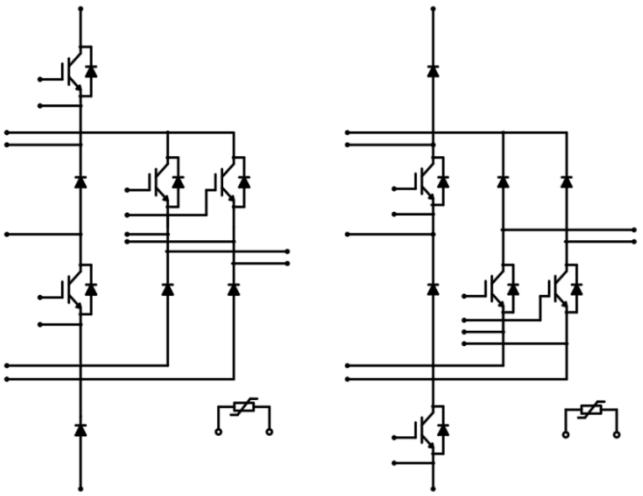
Parameter		Symbol	Value	Unit
集电极－发射极电压 Collector-emitter voltage		V_{CES}	1200	V
连续集电极直流电流 Continuous DC collector current		I_{Cnom}	1000	A
集电极重复峰值电流 Repetitive peak collector current		I_{CRM}	2000	A
集电极－发射极饱和电压 Collector-Emitter saturation voltage	T_{vj}=25℃	*V_{CEsat}	1.81	V
	T_{vj}=125℃		2.20	
IGBT结－壳热阻 IGBT thermal resistance		R_{thJC}	0.032	K/W
Diode结－壳热阻 Diode thermal resistance		R_{thJC}	0.044	K/W
开通损耗能量 Turn-on energy	T_{vj}=25℃	E_{on}	19.5	mJ
	T_{vj}=125℃		21.2	
关断损耗能量 Turn-off energy	T_{vj}=25℃	E_{off}	29.7	
	T_{vj}=125℃		34.4	

*Terminal to Terminal Data

模块外观 Module Appearance



电路拓扑 Circuit Topology



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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	DC, t = 3s	V_{ISOL}	6.0	
	RMS, f = 50Hz, t = 60s		4.2	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		d_{Creep}	＞14.0	mm
电气间隙 Clearance		d_{Clear}	＞9.85	mm
相对电痕指数 Comparative tracking index		*CTI*	≥600	

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}		30		nH
储存温度 Storage temperature		T_{stg}	-40		125	℃
允许开关的温度范围 Temperature under switching conditions		$T_{vj(op)}$	-40		150	℃
重量 Weight		*G*		360		g

IGBT/ T2&T3

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°C	V_{CES}	1200	V
连续集电极直流电流 Continuous DC collector current	T_H = 80°C, $T_{vj\,max}$ = 175°C	I_{CDC}	723	A
集电极重复峰值电流 Repetitive peak collector current	t_p limited by $T_{vj\,max}$	I_{CRM}	2000	A
总耗散功率 Total Power dissipation	T_H = 80°C, T_{vj} = $T_{vj\,max}$	P_{tot}	1250	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 = 1000A, V_{GE} = 15V	T_{vj} = 25°C	$V_{CE(sat)}$		1.81		V
		T_{vj} = 125°C			2.20		
栅极阈值电压 Gate threshold voltage	I_C = 10mA, V_{GE} = V_{CE}, T_{vj} = 25°C		V_{GEth}	4.0	4.8	6.0	V
栅极电荷 Gate charge	V_{GE} = +15/-8V, V_{CE} = 600V		Q_G		7375		nC
输入电容 Input capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{ies}		121.2		nF
输出电容 Onput capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{oes}		3.3		nF
反向传输电容 Reverse transfer capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{res}		1.05		nF
集电极－发射极截止电流 Collector-emitter cut-off current	V_{CE} = 1200V, V_{GE} = 0V, T_{vj} = 25°C		I_{CES}			500	μA
栅极－发射极漏电流 Gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25°C		I_{GES}			1000	nA
开通延迟时间（感性负载） Turn-on delay time (inductive load)	V_{CE} = 650V I_C = 400A V_{GE} = +15/-8V R_{Gon} = 3.3Ω R_{Goff} = 5.1Ω C_{GE}= 10nF Ls = 40nH Inductive Load （R_{Gon}、R_{Goff}、C_{GE}为T2-1/T2-2/T3-1/T3-2驱动配置）	T_{vj} = 25°C	$t_{d(on)}$		174		ns
		T_{vj} = 125°C			152		
上升时间（感性负载） Rise time (inductive load)		T_{vj} = 25°C	t_r		66		ns
		T_{vj} = 125°C			72		
关断延迟时间（感性负载） Turn-off delay time (inductive load)		T_{vj} = 25°C	$t_{d(off)}$		1050		ns
		T_{vj} = 125°C			1180		
下降时间（感性负载） Fall time (inductive load)		T_{vj} = 25°C	t_f		80		ns
		T_{vj} = 125°C			115		
开通耗损能量（每脉冲） Turn-on energy loss per pulse		T_{vj} = 25°C	E_{on}		19.5		mJ
		T_{vj} = 125°C			21.2		
关断损耗能量（每脉冲） Turn-off energy loss per pulse		T_{vj} = 25°C	E_{off}		29.7		mJ
		T_{vj} = 125°C			34.4		

（续）特征值/ Characteristic values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
结－壳热阻 Thermal resistance, junction to case		R_{thJC}		0.032		K/W
壳－散热器热阻 Thermal resistance, case to heatsink	每个IGBT，λgrease = 3.3W/(m*K) Per IGBT，λgrease = 3.3W/(m*K)	R_{thCH}		0.044		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$		175		℃

Diode/ D2&D3

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℃	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current	T_H = 80℃, $T_{vj\ max}$ = 175℃	I_F	490	A
总耗散功率 Total Power dissipation	T_H = 80℃, T_{vj} = $T_{vj\ max}$	P_{tot}	730	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	1200	A

表 6　特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	I_F = 600A, V_{GE} = 0V	T_{vj} = 25℃	V_F		1.47		V
		T_{vj} = 125℃			1.70		
反向恢复时间 Reverse recovery time	V_R= 650V I_F = 400A V_{GE} = -8V R_{Gon} = 3.3Ω C_{GE}= 10nF Ls = 40nH Inductive Load （R_{Gon}、C_{GE}为T2-1/ T2-2/T3-1/T3-2驱动配置）	T_{vj} = 25℃	t_{rr}		42		ns
		T_{vj} = 125℃			43		
反向恢复峰值电流 Peak reverse recovery current		T_{vj} = 25℃	I_{RM}		100		A
		T_{vj} = 125℃			101		
反向恢复电荷 Recovered charge		T_{vj} = 25℃	Q_r		2.9		μC
		T_{vj} = 125℃			3.1		
反向恢复损耗（每脉冲） Reverse recovery energy		T_{vj} = 25℃	E_{rec}		0.78		mJ
		T_{vj} = 125℃			0.81		
结－壳热阻 Thermal resistance, junction to case			R_{thJC}		0.063		K/W
壳－散热器热阻 Thermal resistance, case to heatsink	每个IGBT，λgrease = 3.3W/(m*K) Per IGBT，λgrease = 3.3W/(m*K)		R_{thCH}		0.067		K/W
最高结温 $T_{vj\ max}$			$T_{vj\ max}$		175		℃

IGBT/ T1&T4&T5&T6

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°C	V_{CES}	1100	V
连续集电极直流电流 Continuous DC collector current	T_H = 80°C, $T_{vj\,max}$ = 175°C	I_{CDC}	432	A
集电极重复峰值电流 Repetitive peak collector current	t_p limited by $T_{vj\,max}$	I_{CRM}	1200	A
总耗散功率 Total Power dissipation	T_H = 80°C, T_{vj} = $T_{vj\,max}$	P_{tot}	562	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 = 600A, V_{GE} = 15V	T_{vj} = 25°C	$V_{CE(sat)}$		1.48		V
		T_{vj} = 125°C			1.69		
栅极阈值电压 Gate threshold voltage	I_C = 3.0mA, V_{GE} = V_{CE}, T_{vj} = 25°C		V_{GEth}	3.3	4.1	4.9	V
栅极电荷 Gate charge	V_{GE} = +15/-8V, V_{CE} = 600V		Q_G		1560		nC
输入电容 Input capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{ies}		54.6		nF
输出电容 Onput capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{oes}		0.85		nF
反向传输电容 Reverse transfer capacitance	f = 1MHz, T_{vj} = 25°C, V_{CE} = 25V, V_{GE} = 0V		C_{res}		0.15		nF
集电极－发射极截止电流 Collector-emitter cut-off current	V_{CE} = 1100V, V_{GE} = 0V, T_{vj} = 25°C		I_{CES}			100	μA
栅极－发射极漏电流 Gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25°C		I_{GES}			500	nA
结－壳热阻 Thermal resistance, junction to case			R_{thJC}		0.085		K/W
壳－散热器热阻 Thermal resistance, case to heatsink	每个IGBT，λgrease = 3.3W/(m*K) Per IGBT，λgrease = 3.3W/(m*K)		R_{thCH}		0.084		K/W
最高结温 $T_{vj\,max}$			$T_{vj\,max}$		175		℃

Diode/ D1&D4&D5&D6

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°C	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current	T_H = 80°C, $T_{vj\,max}$ = 175°C	I_F	420	A
总耗散功率 Total Power dissipation	T_H = 80°C, T_{vj} = $T_{vj\,max}$	P_{tot}	576	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\,max}$	I_{FRM}	720	A

表 10　特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	I_F = 360A, V_{GE} = 0V	T_{vj} = 25℃	V_F		1.05		V
		T_{vj} = 125℃			1.10		
结－壳热阻 Thermal resistance, junction to case			R_{thJC}		0.088		K/W
壳－散热器热阻 Thermal resistance, case to heatsink	每个IGBT，λgrease = 3.3W/(m*K) Per IGBT，λgrease = 3.3W/(m*K)		R_{thCH}		0.077		K/W
最高结温 $T_{vj\ max}$			$T_{vj\ max}$		175		℃

Diode/ D7&D8&D9&D10

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℃	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current	T_H = 80℃, $T_{vj\ max}$ = 175℃	I_F	25	A
总耗散功率 Total Power dissipation	T_H = 80℃, T_{vj} = $T_{vj\ max}$	P_{tot}	86	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	60	A

表 12　特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	I_F = 30A, V_{GE} = 0V	T_{vj} = 25℃	V_F		3.07		V
		T_{vj} = 125℃			2.11		
结－壳热阻 Thermal resistance, junction to case			R_{thJC}		0.863		K/W
壳－散热器热阻 Thermal resistance, case to heatsink	每个IGBT，λgrease = 3.3W/(m*K) Per IGBT，λgrease = 3.3W/(m*K)		R_{thCH}		0.154		K/W
最高结温 $T_{vj\ max}$			$T_{vj\ max}$		175		℃

Diode/ D11&D12

表 13　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℃	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current	T_H = 80℃, $T_{vj\ max}$ = 175℃	I_F	100	A
总耗散功率 Total Power dissipation	T_H = 80℃, T_{vj} = $T_{vj\ max}$	P_{tot}	213	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	120	A

表 14　特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	I_F = 60A, V_{GE} = 0V	T_{vj} = 25℃	V_F		3.07		V
		T_{vj} = 125℃			2.11		
结－壳热阻 Thermal resistance, junction to case			R_{thJC}		0.367		K/W
壳－散热器热阻 Thermal resistance, case to heatsink	每个IGBT，λgrease = 3.3W/(m*K) Per IGBT，λgrease = 3.3W/(m*K)		R_{thCH}		0.078		K/W
最高结温 $T_{vj\ max}$			$T_{vj\ max}$		175		℃

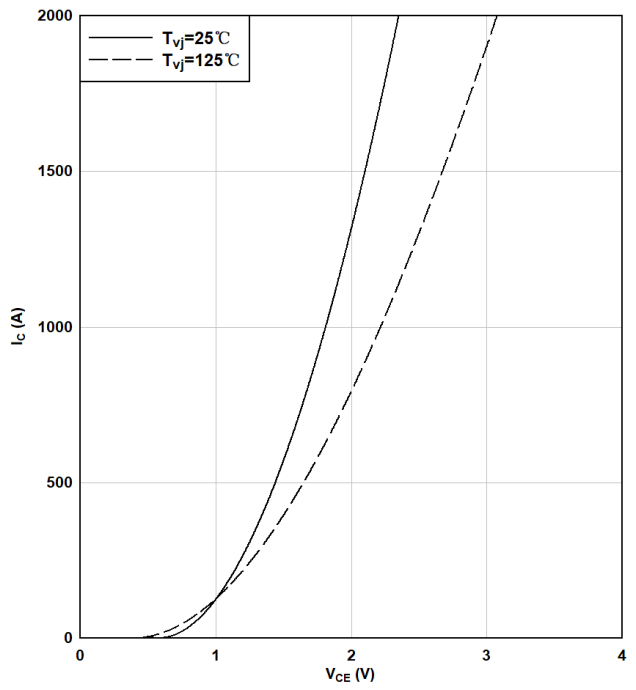
负温度系数热敏电阻/NTC-Thermistor

表 15　特征值/Characteristic values

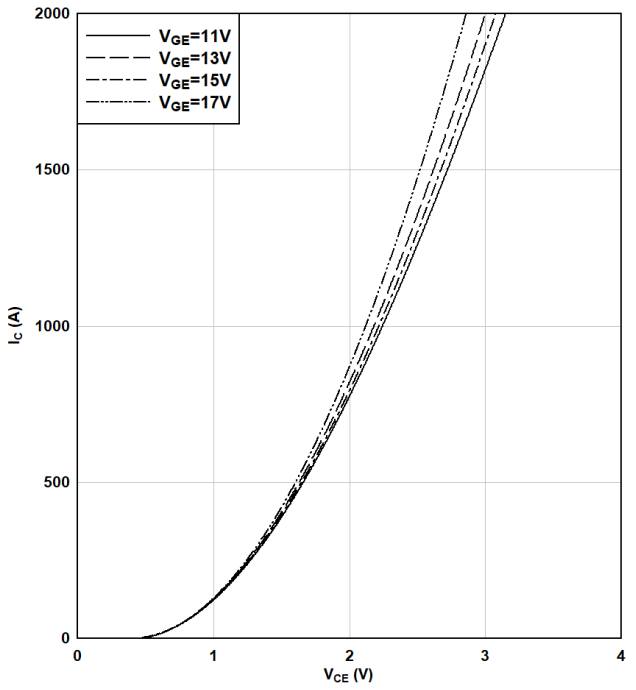
Parameter	Conditions	Symbol	Value	Unit
额定电阻值 Rated resistance	T_{NTC} = 25 ℃	R_{25}	5	kΩ
R_{100}偏差 Deviation of R_{100}	T_{NTC} = 100 ℃, R_{100} = 493 Ω	$\Delta R/R$	±5	%
耗散功率 Power dissipation	T_{NTC} = 25 ℃	P_{25}	20.0	mW
B-值 B-value	$R_2 = R_{25} \exp[B_{25/50}(1/T2-1/(298{,}15\ K))]$	$B_{25/50}$	3375	K
B-值 B-value	$R_2 = R_{25} \exp[B_{25/100}(1/T_2-1/(298{,}15\ K))]$	$B_{25/100}$	3433	K

特征参数图表/Characteristics Diagrams

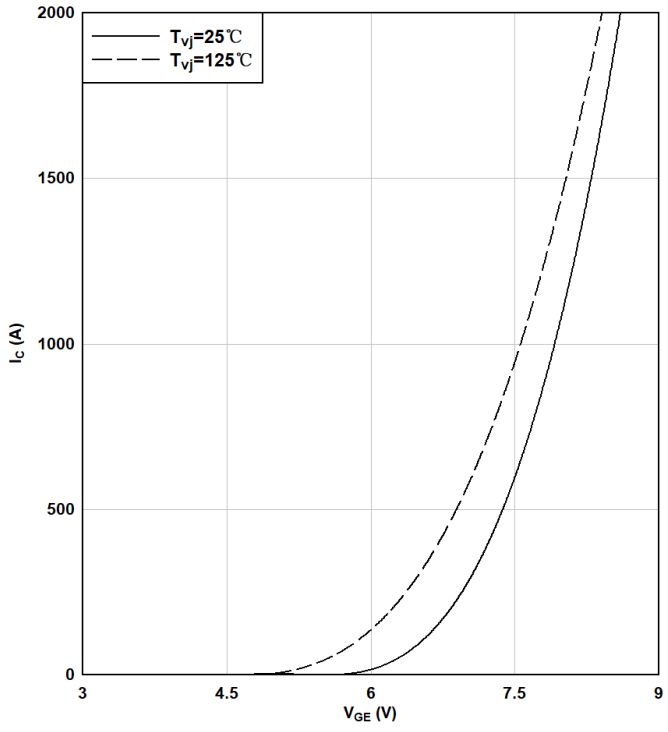
输出特性（典型）, IGBT (T2/T3), 逆变器
Output characteristic (typical), IGBT(T2/T3), Inverter
$I_C = f(V_{CE})$
V_{GE} = 15V



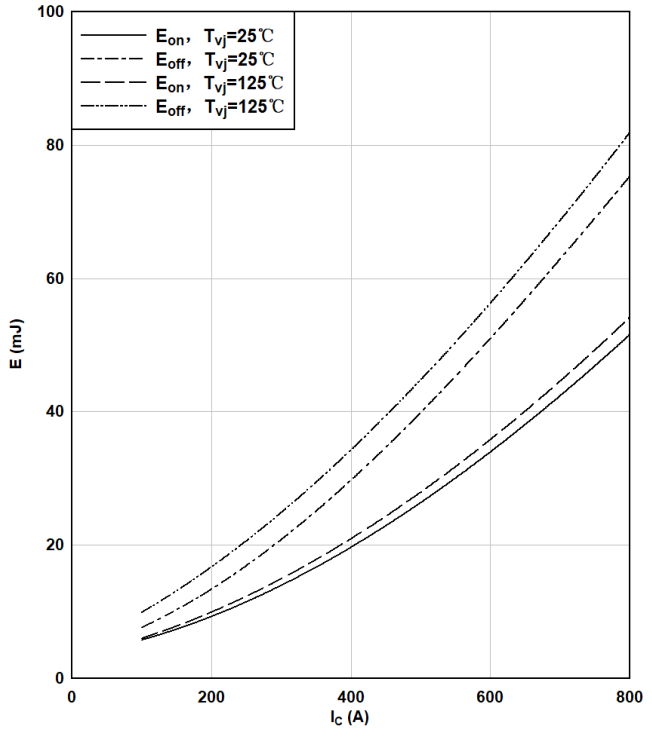
输出特性（典型）, IGBT(T2/T3),逆变器
Output characteristic field (typical), IGBT(T2/T3), Inverter
$I_C = f(V_{CE})$
T_{vj}=125℃



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

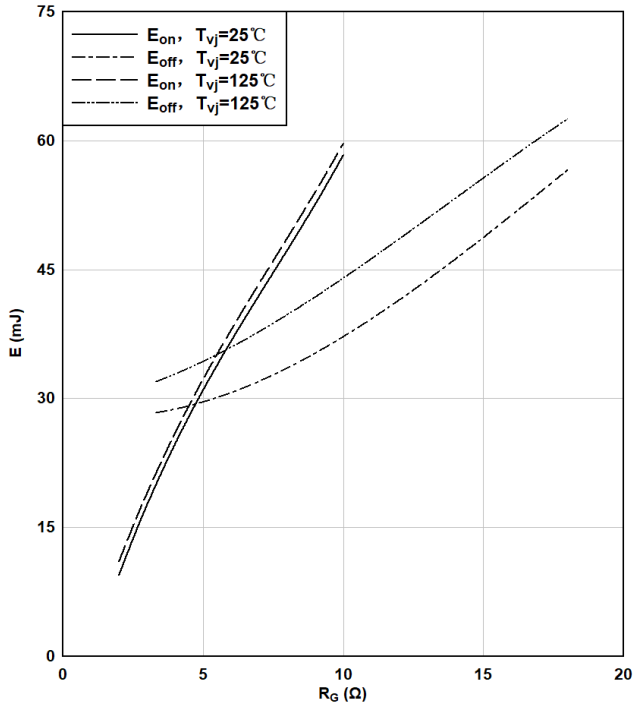


开关损耗（典型）, IGBT(T2/T3), 逆变器
Switching losses (typical), IGBT(T2/T3), Inverter
$E = f(I_C)$
V_{CE} =650V, R_{Gon} =3.3Ω, R_{Goff} =5.1Ω, C_{GE}= 10nF,V_{GE} = +15/-8V

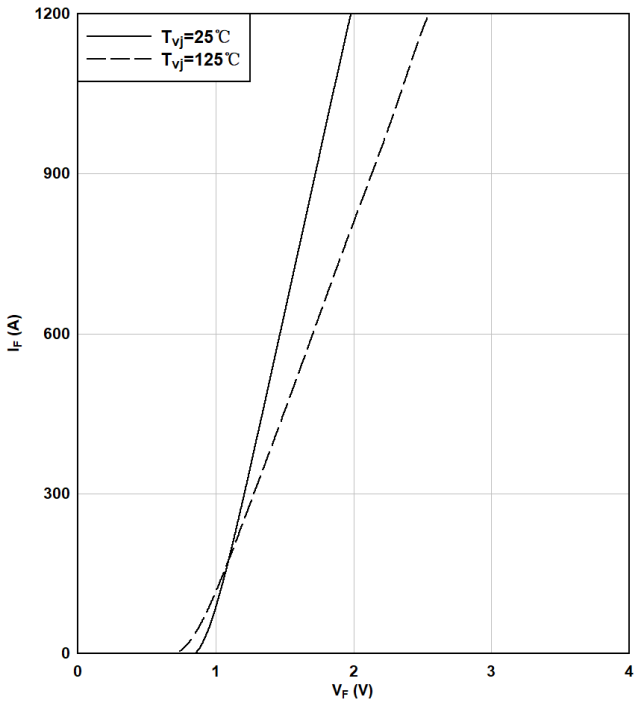


（续）特征参数图表/Characteristics Diagrams

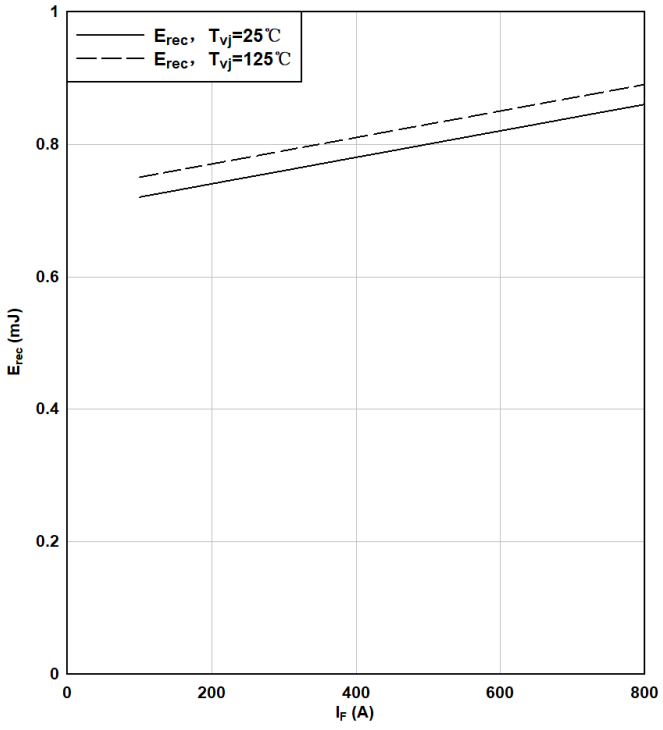
开关损耗 （典型）, IGBT(T2/T3), 逆变器
Switching losses (typical), IGBT(T2/T3), Inverter
$E = f(R_G)$
I_C= 400A, V_{CE} = 650V, V_{GE} = +15/-8V



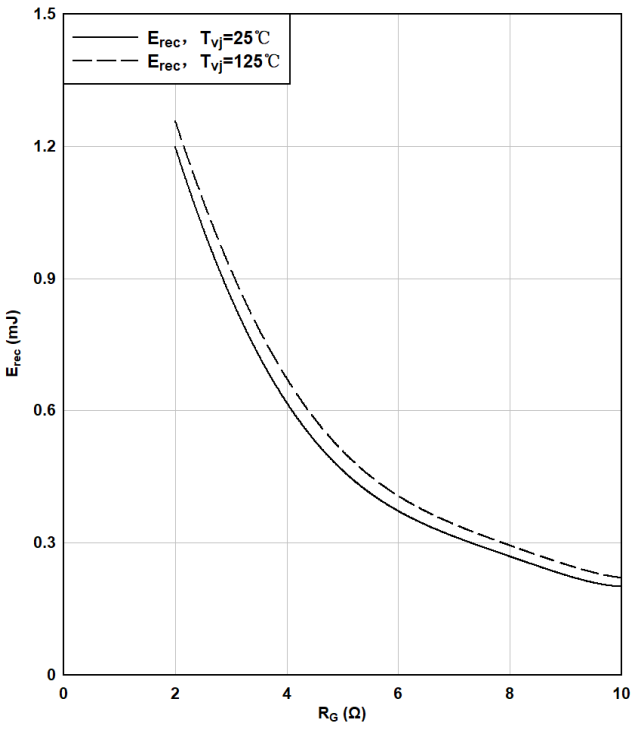
正向特性（典型), 二极管(D2/D3)
Forward characteristic (typical), Diode(D2/D3)
$I_F = f(V_F)$



开关损耗（典型), 二极管(D2/D3)
Switching losses (typical), Diode(D2/D3)
$E_{rec} = f(I_F)$
V_{CE} = 650V, R_{Gon} = 3.3Ω, C_{GE}= 10nF

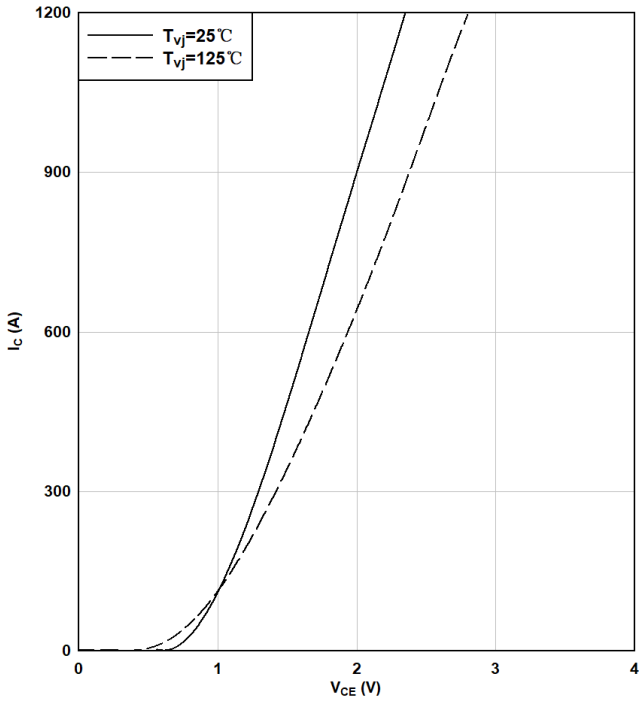


开关损耗（典型), 二极管(D2/D3)
Switching losses (typical), Diode(D2/D3)
$E_{rec} = f(R_G)$
I_F = 400A, V_{CE} = 650V

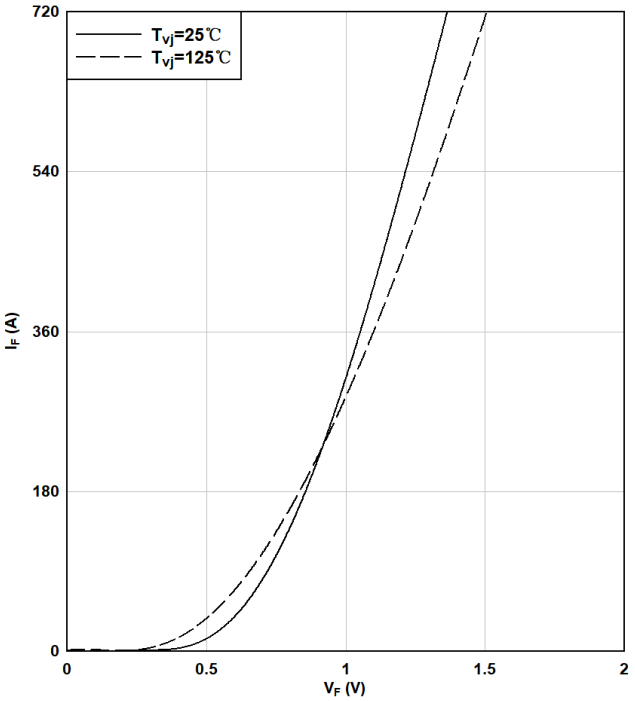


（续）特征参数图表/Characteristics Diagrams

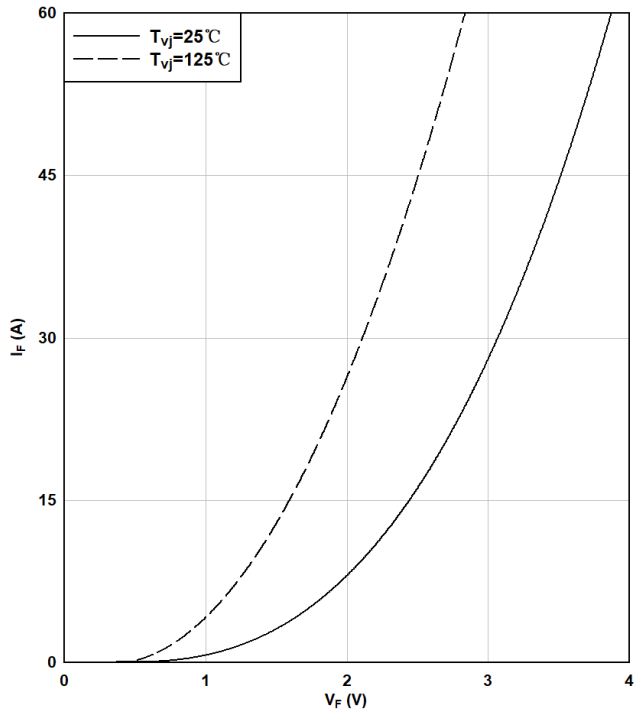
输出特性（典型）, IGBT (T1/T4/T5/T6), 逆变器
Output characteristic (typical), IGBT(T1/T4/T5/T6), Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15V$



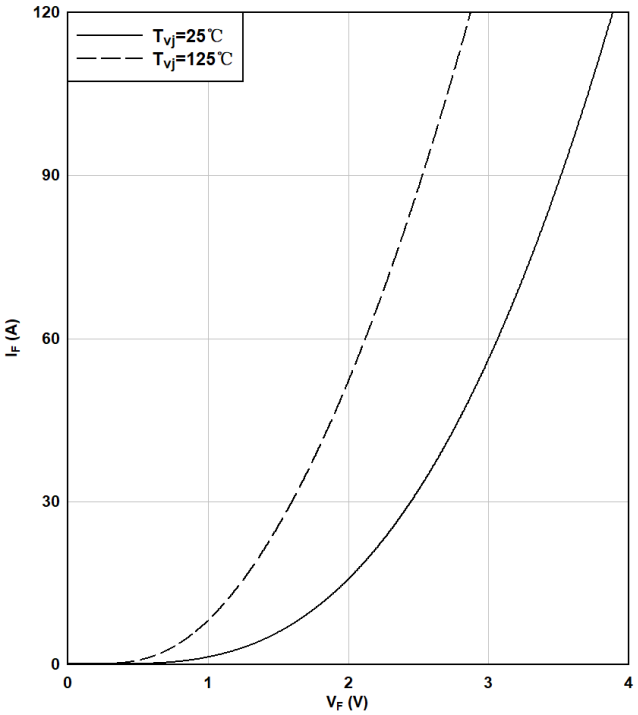
正向特性（典型), 二极管(D1/D4/D5/D6)
Forward characteristic (typical), Diode(D1/D4/D5/D6)
$I_F = f(V_F)$



正向特性（典型), 二极管(D7/D8/D9/D10)
Forward characteristic (typical), Diode(D7/D8/D9/D10)
$I_F = f(V_F)$

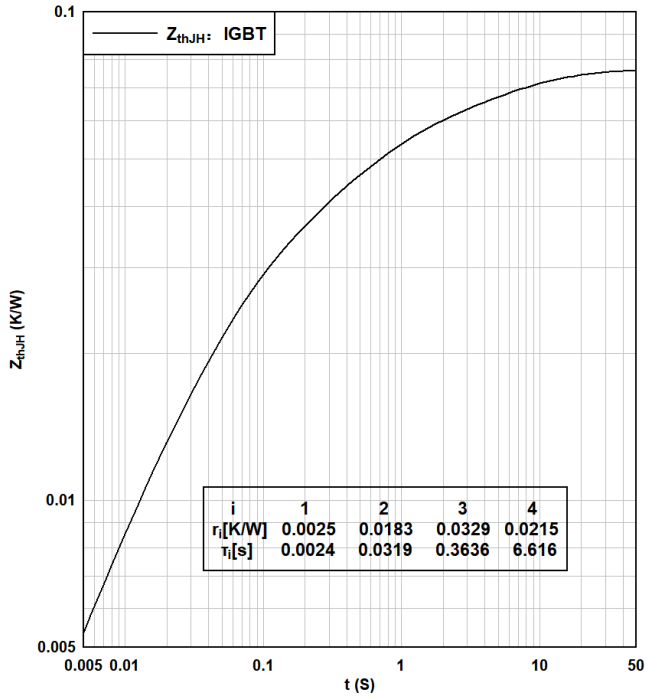


正向特性（典型), 二极管(D11/D12)
Forward characteristic (typical), Diode((D11/D12)
$I_F = f(V_F)$

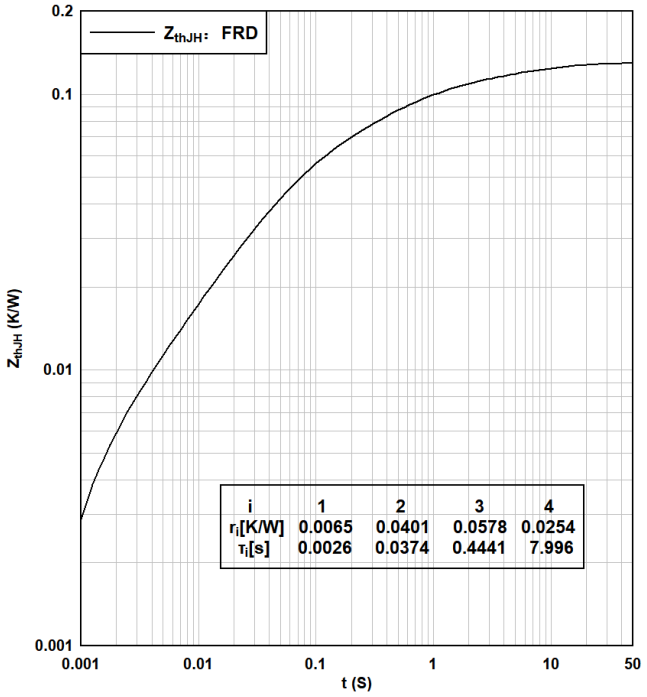


（续）特征参数图表/Characteristics Diagrams

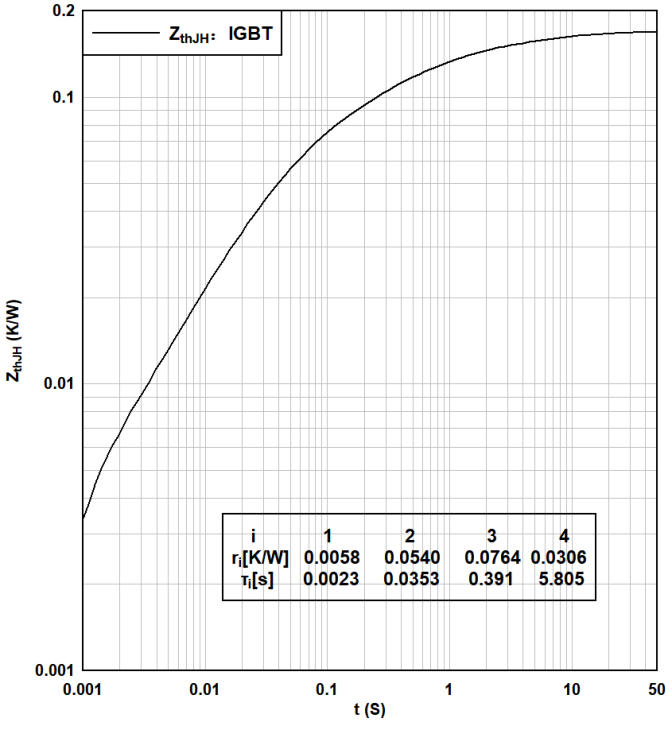
瞬态热阻抗，IGBT(T2/T3)
Transient thermal impedance, IGBT(T2/T3)
$Z_{thJH} = f(t)$



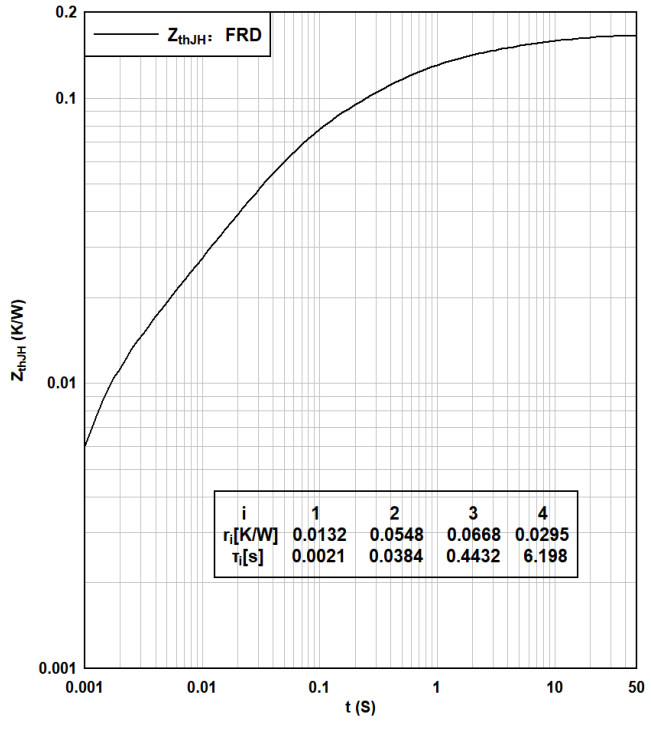
瞬态热阻抗，二极管(D2/D3)
Transient thermal impedance, Diode (D2/D3)
$Z_{thJH} = f(t)$



瞬态热阻抗，IGBT(T1/T4/T5/T6)
Transient thermal impedance, IGBT(T1/T4/T5/T6)
$Z_{thJH} = f(t)$

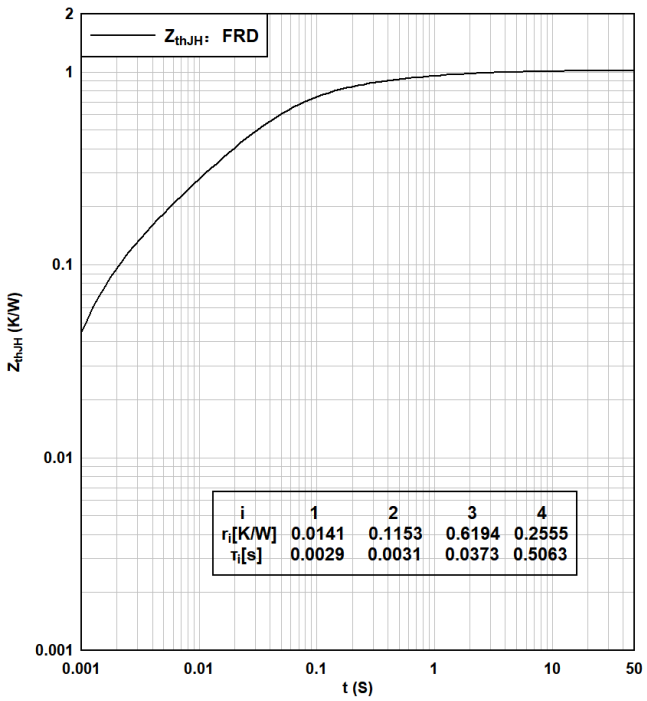


瞬态热阻抗，二极管(D1/D4/D5/D6)
Transient thermal impedance, Diode (D1/D4/D5/D6)
$Z_{thJH} = f(t)$

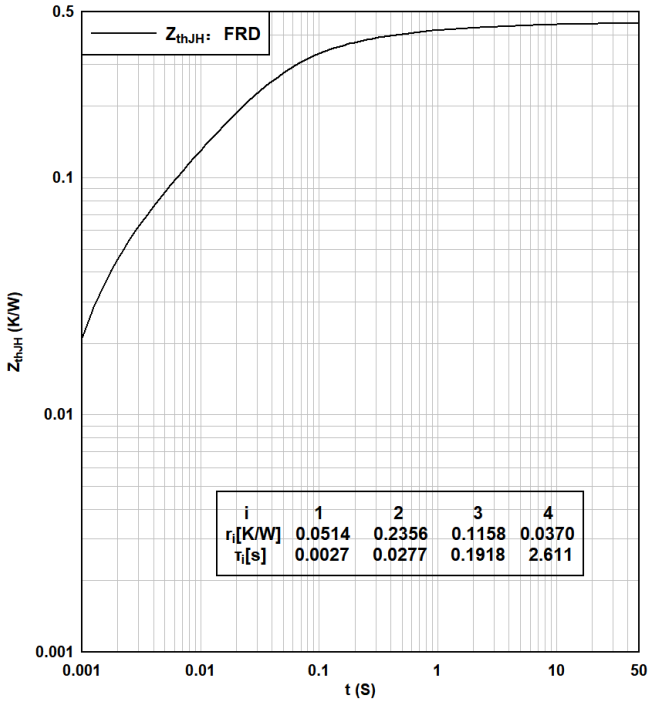


（续）特征参数图表/Characteristics Diagrams

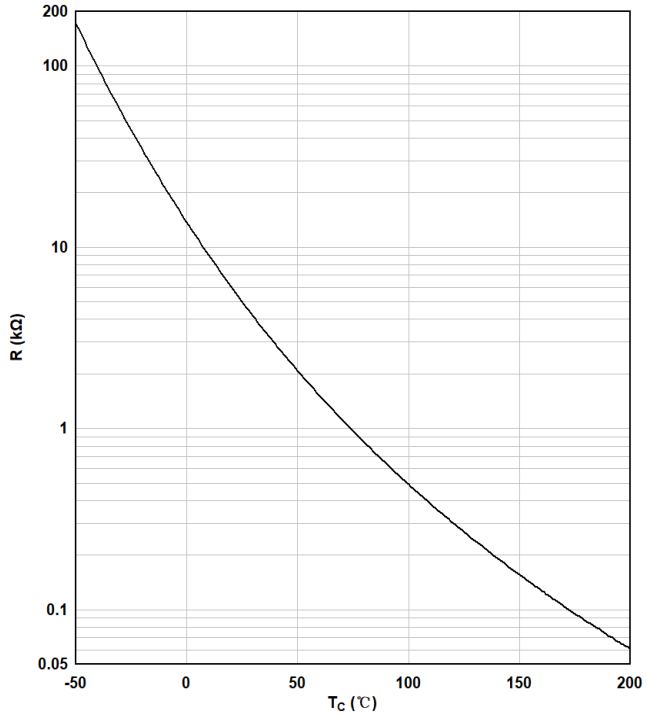
瞬态热阻抗，二极管(D7/D8/D9/D10)
Transient thermal impedance, Diode (D7/D8/D9/D10)
$Z_{thJH} = f(t)$



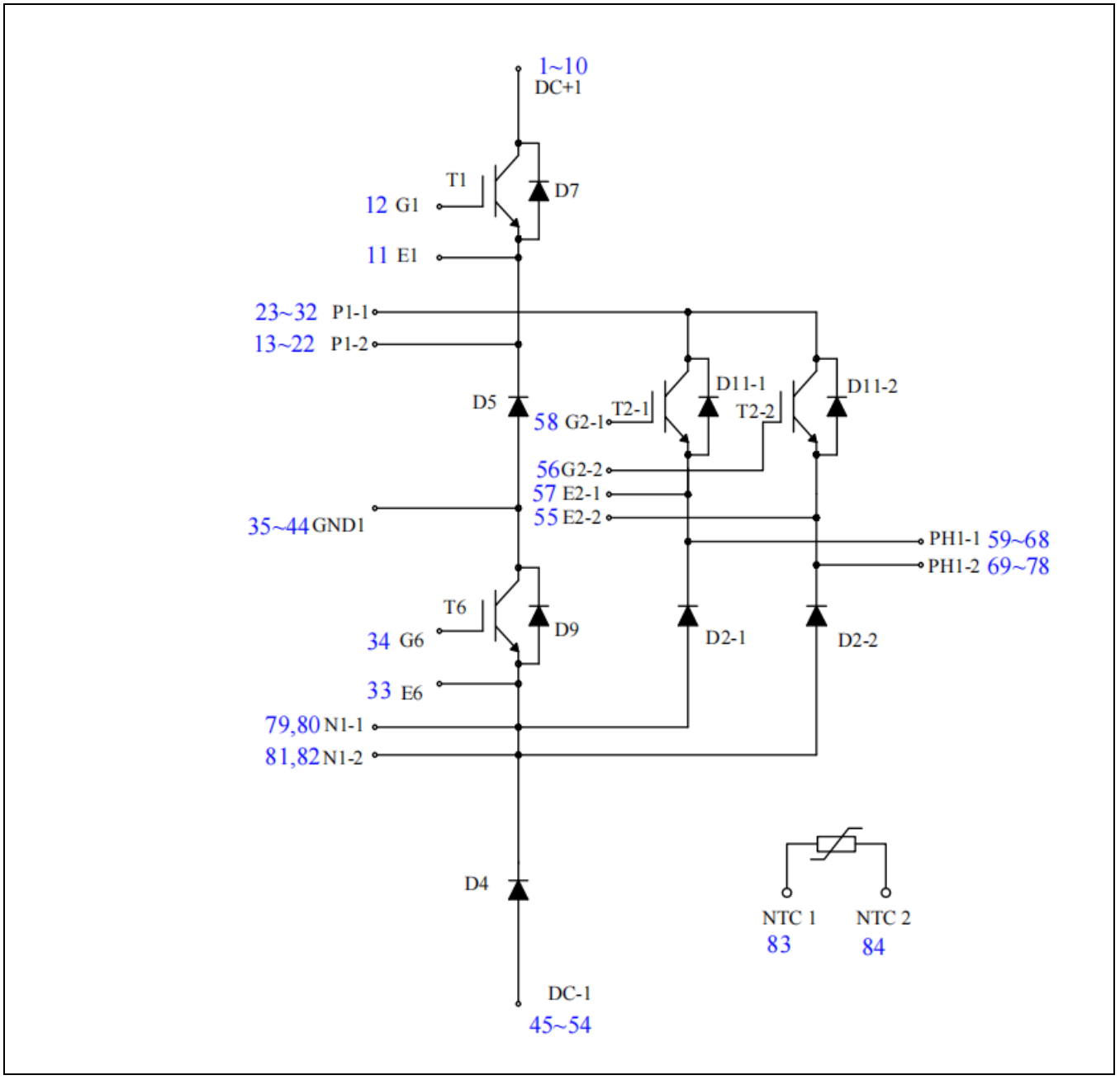
瞬态热阻抗，二极管(D11/D12)
Transient thermal impedance, Diode (D11/D12)
$Z_{thJH} = f(t)$



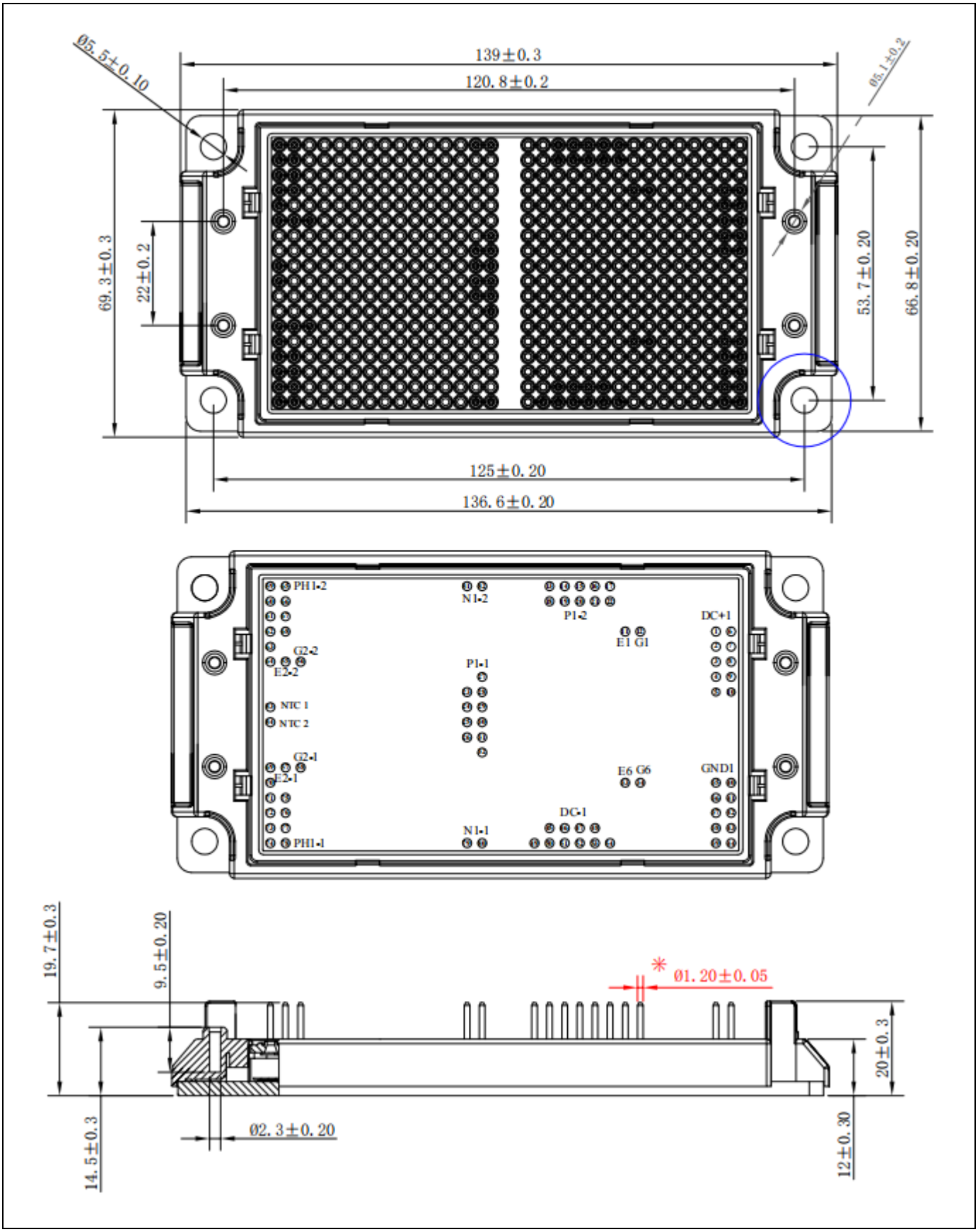
负温度系数热敏电阻温度特性
NTC-Thermistor-temperature characteristic(typical)
$R = f(T_C)$

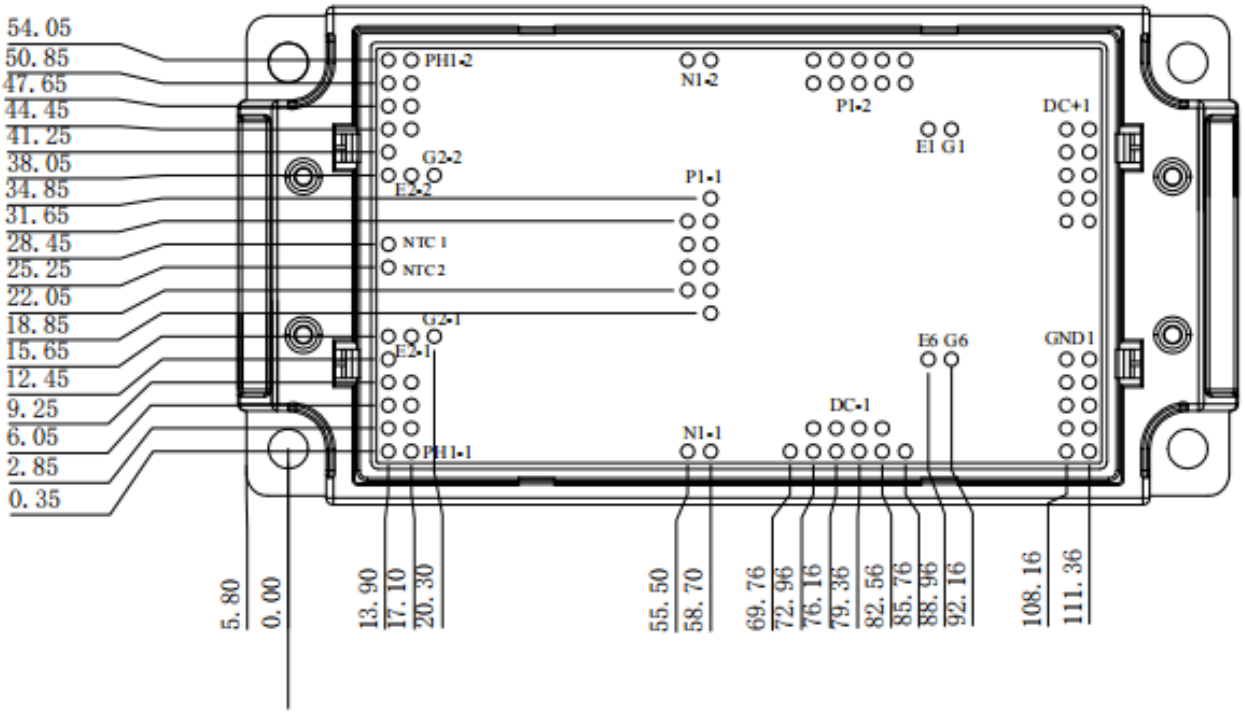


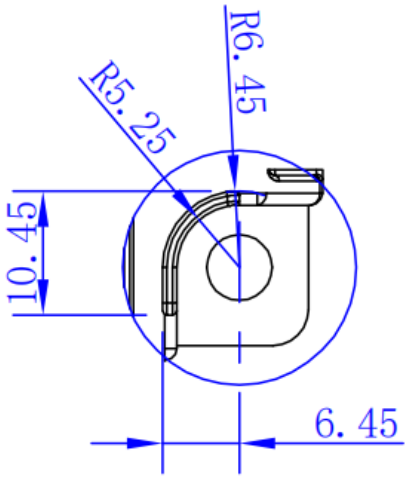
电路拓扑图 / Circuit Diagram@ AMG1K0L12P5H7RA



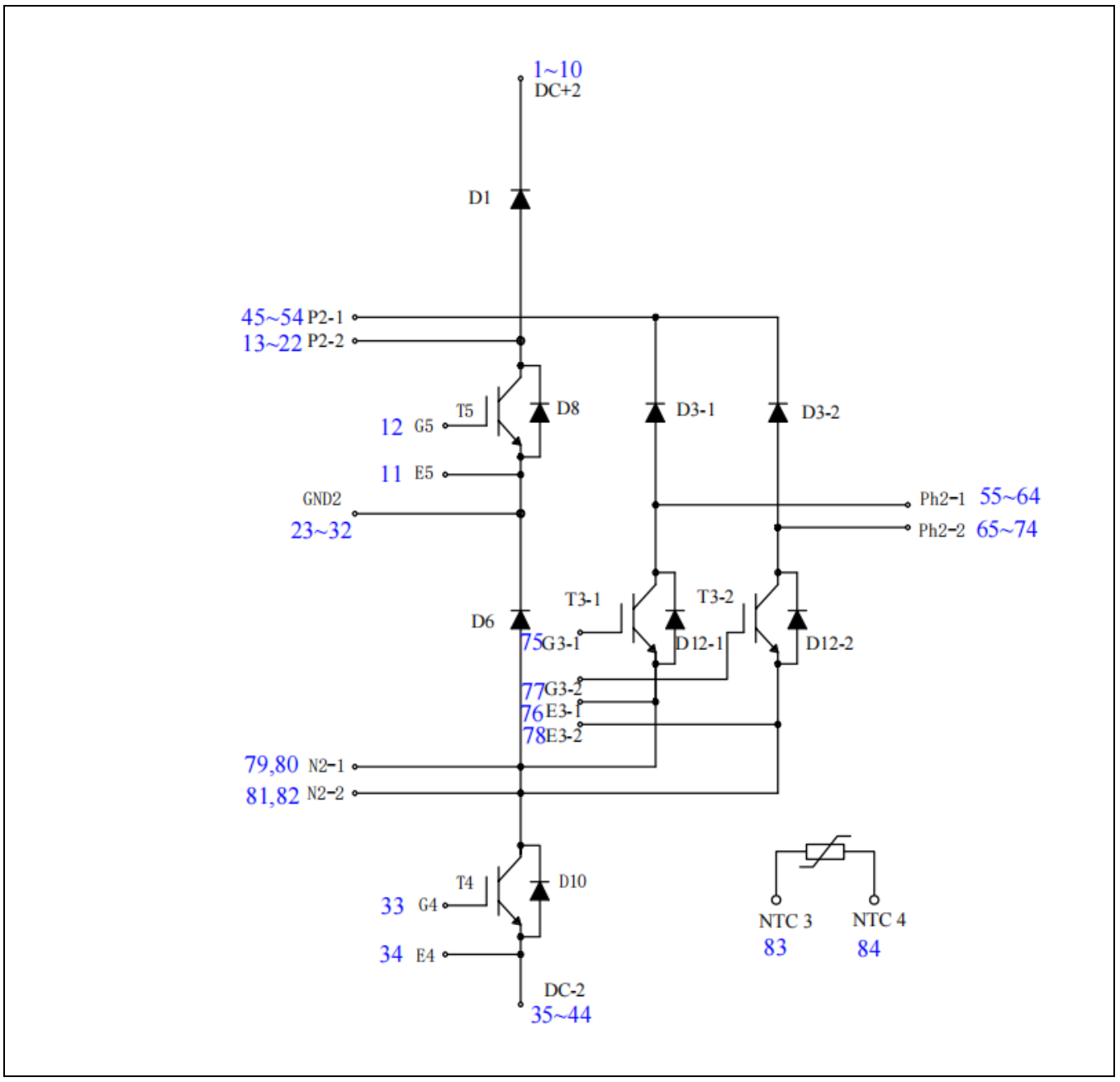
封装尺寸 / Package Outlines@ AMG1K0L12P5H7RA



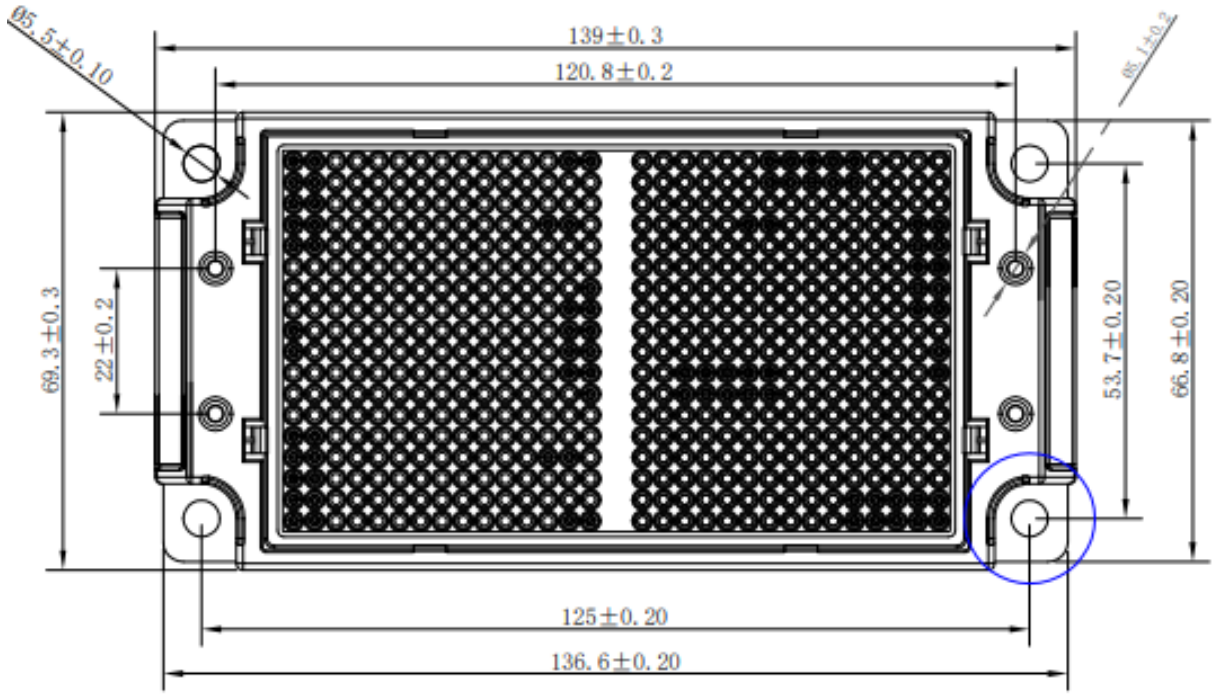

54.05
50.85
47.65
44.45
41.25
38.05
34.85
31.65
28.45
25.25
22.05
18.85
15.65
12.45
9.25
6.05
2.85
0.35
PH1-2
N1-2
P1-2
DC+1
E1 G1
G2-2
E2-2
P1-1
NTC 1
NTC 2
G2-1
E2-1
E6 G6
GND1
DC-1
N1-1
PH1-1
5.80
0.00
13.90
17.10
20.30
55.50
58.70
69.76
72.96
76.16
79.36
82.56
85.76
88.96
92.16
108.16
111.36

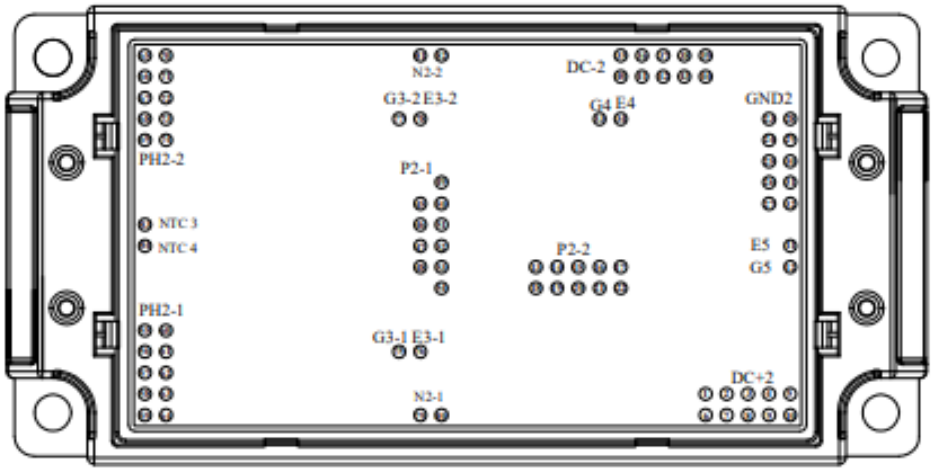

R6.45
R5.25
10.45
6.45

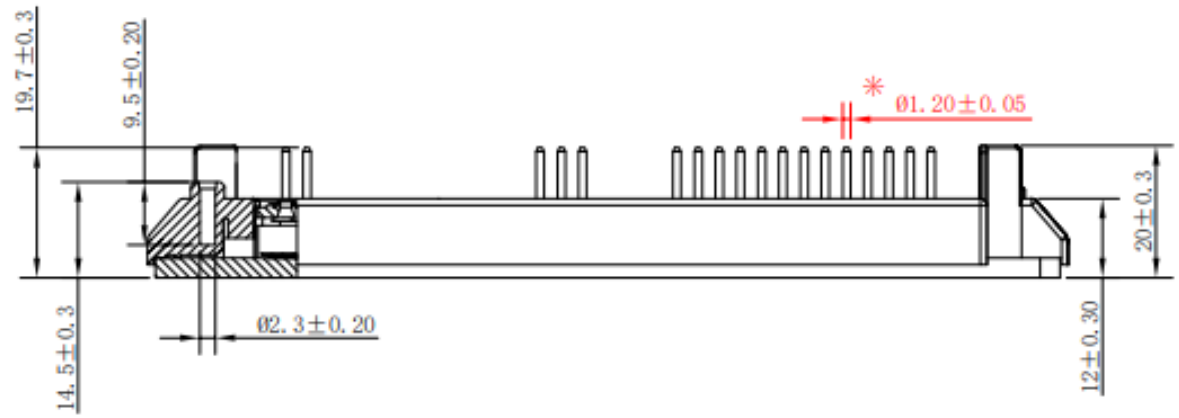
电路拓扑图 / Circuit Diagram@ AMG1K0L12P5H7RB

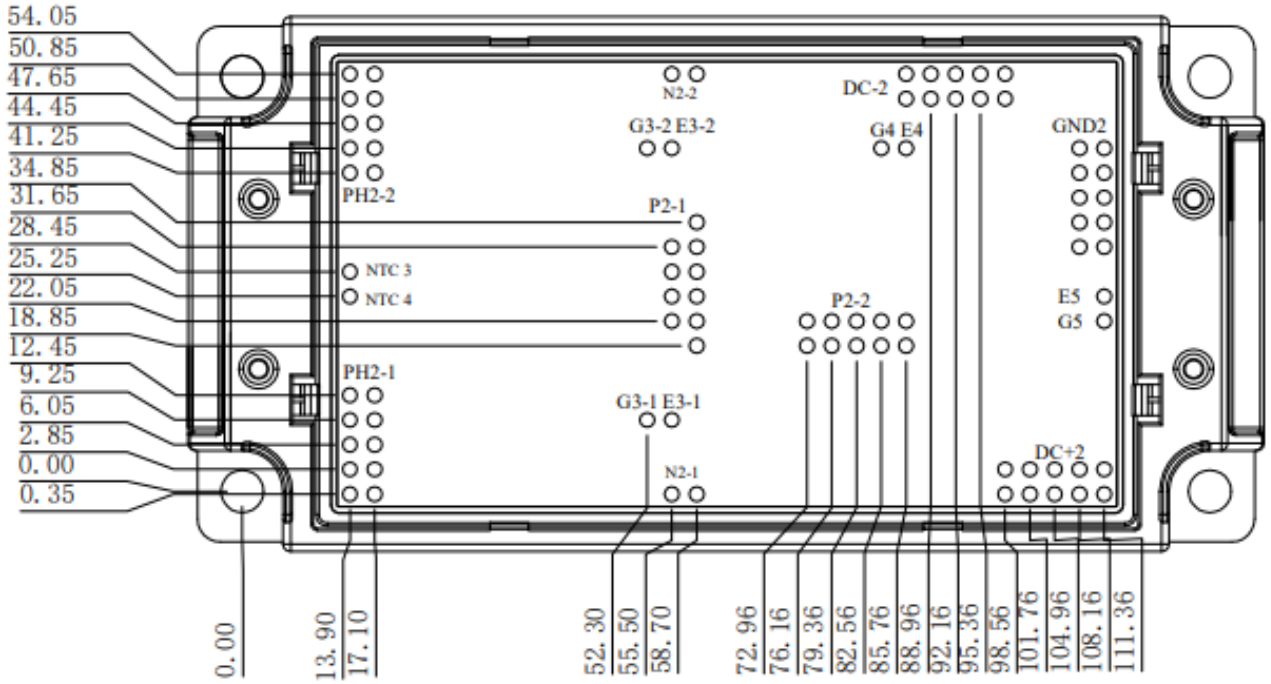


封装尺寸 / Package Outlines@ AMG1K0L12P5H7RB








54.05
50.85
47.65
44.45
41.25
34.85
31.65
28.45
25.25
22.05
18.85
12.45
9.25
6.05
2.85
0.00
0.35
PH2-2
PH2-1
NTC 3
NTC 4
N2-2
G3-2 E3-2
P2-1
G3-1 E3-1
N2-1
DC-2
G4 E4
P2-2
GND2
E5
G5
DC+2
0.00
13.90
17.10
52.30
55.50
58.70
72.96
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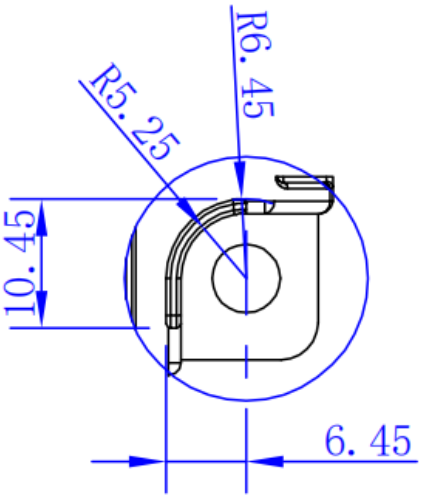
95.36
98.56
101.76
104.96
108.16
111.36


R6.45
R5.25
10.45
6.45

模块标签信息/ Module Marking Information

Marking Diagram
AMG1K0L12P5H7RA/AMG1K0L12P5H7RB = Specific Device
P5CQ22420010001 = Lot Traceability
ACP-3S Plus = Package Type

声明与使用条件/ Notices and conditions of use

1. 阿基米德保留手册的更改权；

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2. 本手册中提供的数据一部分为产品的典型值，实际出厂测试的数据与典型值略有差异，但我司保证这些差异不会影响产品的正常使用，如果产品信息发生变更，我司会及时更新手册，请随时关注；

   Part of the data provided in this manual is the typical value of the product, the actual factory test data and the typical value are slightly different, but our company guarantees that these differences will not affect the normal use of the product, if the product information changes, our company will update the manual in time, please pay attention at any time；

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   When applying our products, please do not exceed the maximum rating of the product, otherwise our company can not guarantee the reliability of the product application；

4. 产品在使用时，严禁触碰，断电后确认无残余电荷且产品已完全冷却后，才可以在有静电防护措施下触碰产品；

   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；

5. 购买产品时请认准我司商标，如有疑问请与本司联系。

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