

HCG450FL065E3RD 650V/450A 3-Level NPC IGBT Module

I型三电平NPC逆变模块 I Type 3-Level NPC Inverter Module

特性

Features

- I型NPC三电平逆变模块
I type NPC Three-Level Inverter Module
- 650V 沟槽栅/场截止工艺
650V Trench Gate/Field-Stop Process
- 低 V_{CEsat} /低开关损耗
Low V_{CEsat} / 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&低电感设计
Compact and Low Inductance Design
- 采用DBC技术的隔离散热器
Isolated Heatsink using DBC Technology

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
- 电能质量/APF/SVG

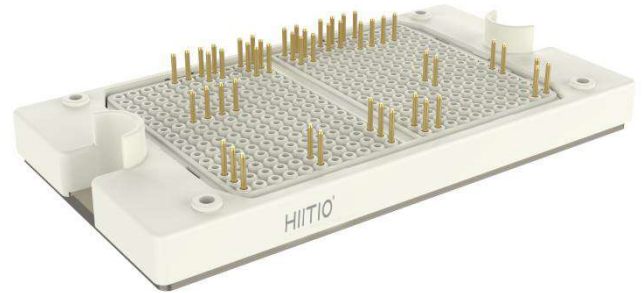
关键参数[T1&T4/D5&D6]

Key Parameters

Parameter	Symbol	Value	Unit
集电极-发射极电压 Collector-emitter voltage	V_{CES}	650	V
连续集电极直流电流 Continuous DC collector current	I_{Cnom}	450	A
集电极重复峰值电流 Repetitive peak collector current	I_{CRM}	900	A
集电极-发射极 饱和电压 Collector-Emitter saturation voltage	$T_{vj}=25^{\circ}C$	1.45	V
	$T_{vj}=125^{\circ}C$	1.66	
IGBT结-散热器热阻 IGBT thermal resistance	R_{thJH}	0.202	K/W
Diode结-散热器热阻 Diode thermal resistance	R_{thJH}	0.318	K/W
开通损耗能量 Turn-on energy	$T_{vj}=25^{\circ}C$	8.18	mJ
	$T_{vj}=125^{\circ}C$	10.03	
关断损耗能量 Turn-off energy	$T_{vj}=25^{\circ}C$	11.36	
	$T_{vj}=125^{\circ}C$	11.54	

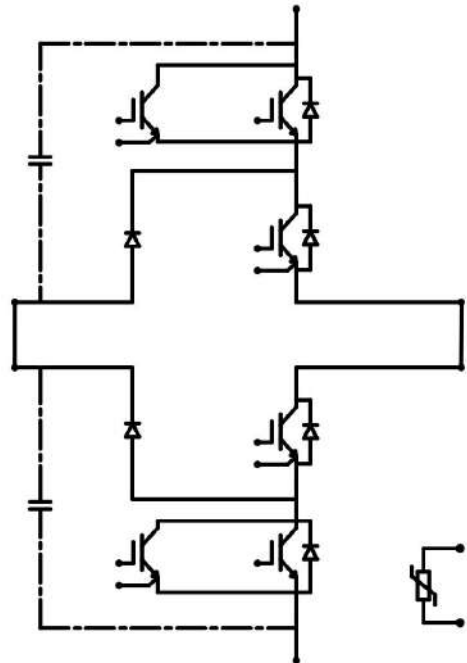
模块外观

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	RMS, f = 50Hz, t = 60s	V_{ISOL}	3	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 ₂ O ₃	
爬电距离 Creepage distance		d_{Creep}	> 12.7	mm
电气间隙 Clearance		d_{Clear}	> 12.7	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}		23		nH
储存温度 Storage temperature		T_{stg}	-40		125	°C
允许开关的温度范围 Temperature under switching conditions		$T_{vj(op)}$	-40		150	°C
重量 Weight		G		260		g

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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}	650	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}	346	A
集电极重复峰值电流 Repetitive peak collector current	t_p limited by $T_{vj\max}$	I_{CRM}	900	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}\text{C}, T_{vj} = T_{vj\max}$	P_{tot}	470	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	$I_C = 450\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	$V_{CE(sat)}$		1.47	1.9	V
		$T_{vj} = 125^{\circ}\text{C}$			1.66		
		$T_{vj} = 150^{\circ}\text{C}$			1.71		
栅极阈值电压 Gate threshold voltage	$I_C = 3\text{mA}, V_{GE} = V_{CE}, T_{vj} = 25^{\circ}\text{C}$		V_{GEth}	4.5	5.0	5.5	V
栅极电荷 Gate charge	$V_{GE} = \pm 15\text{V}, V_{CE} = 400\text{V}, I_C = 450\text{A}$		Q_G		1278		nC
输入电容 Input capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 30\text{V}, V_{GE} = 0\text{V}$		C_{ies}		35.88		nF
反向传输电容 Reverse transfer capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 30\text{V}, V_{GE} = 0\text{V}$		C_{res}		0.708		nF
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$		I_{CES}			100	μA
栅极-发射极漏电流 Gate-emitter leakage current	$V_{CE} = 0\text{V}, V_{GE} = \pm 30\text{V}, T_{vj} = 25^{\circ}\text{C}$		I_{GES}			± 1.2	μA
开通延迟时间（感性负载） Turn-on delay time (inductive load)	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	$t_d(on)$		429		ns
		$T_{vj} = 125^{\circ}\text{C}$			405		
		$T_{vj} = 150^{\circ}\text{C}$			399		
上升时间（感性负载） Rise time (inductive load)	$R_{Gon} = R_{Goff} = 12\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$	t_r		87		ns
		$T_{vj} = 125^{\circ}\text{C}$			91		
		$T_{vj} = 150^{\circ}\text{C}$			92		
关断延迟时间（感性负载） Turn-off delay time (inductive load)	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	$t_d(off)$		1042		ns
		$T_{vj} = 125^{\circ}\text{C}$			1012		
		$T_{vj} = 150^{\circ}\text{C}$			998		
下降时间（感性负载） Fall time (inductive load)	$R_{Gon} = R_{Goff} = 12\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$	t_f		64		ns
		$T_{vj} = 125^{\circ}\text{C}$			68		
		$T_{vj} = 150^{\circ}\text{C}$			68		
开通损耗能量（每脉冲） Turn-on energy loss per pulse	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$ $R_{Gon} = R_{Goff} = 12\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$	E_{on}		8.18		mJ
		$T_{vj} = 125^{\circ}\text{C}$			10.03		
		$T_{vj} = 150^{\circ}\text{C}$			10.31		
关断损耗能量（每脉冲） Turn-off energy loss per pulse	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$ $R_{Gon} = R_{Goff} = 12\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$	E_{off}		10.36		mJ
		$T_{vj} = 125^{\circ}\text{C}$			11.54		
		$T_{vj} = 150^{\circ}\text{C}$			11.67		

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(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, $\lambda_{grease} = 3.4W/(m^{\circ}K)$ Per IGBT, $\lambda_{grease} = 3.4W/(m^{\circ}K)$	R_{thJH}		0.202		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}	650	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	253	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}C, T_{vj} = T_{vj\ max}$	P_{tot}	299	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	640	A

表 6 特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 320A, V_{GE} = 0V$	$T_{vj} = 25^{\circ}C$	V_F		1.39	1.9	V
		$T_{vj} = 125^{\circ}C$			1.47		
		$T_{vj} = 150^{\circ}C$			1.48		
反向恢复峰值电流 Peak reverse recovery current	$V_R = 400V$ $I_F = 200A$ $V_{GE} = +15/-5V$ $R_{Gon} = R_{Goff} = 12\Omega$ Inductive Load	$T_{vj} = 25^{\circ}C$	I_{RM}		102		A
		$T_{vj} = 125^{\circ}C$			127		
		$T_{vj} = 150^{\circ}C$			137		
反向恢复电荷 Recovered charge		$T_{vj} = 25^{\circ}C$	Q_r		5.4		μC
		$T_{vj} = 125^{\circ}C$			9.2		
		$T_{vj} = 150^{\circ}C$			11.0		
反向恢复损耗（每脉冲） Reverse recovery energy		$T_{vj} = 25^{\circ}C$	E_{rec}		1.0		mJ
		$T_{vj} = 125^{\circ}C$			1.96		
		$T_{vj} = 150^{\circ}C$			2.4		
结—散热器热阻 Thermal resistance, junction to heatsink	每个IGBT, $\lambda_{grease} = 3.4W/(m^{\circ}K)$ Per IGBT, $\lambda_{grease} = 3.4W/(m^{\circ}K)$		R_{thJH}		0.318		K/W
最高结温 $T_{vj\ max}$			$T_{vj\ max}$		175		$^{\circ}C$

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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}	650	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}	271	A
集电极重复峰值电流 Repetitive peak collector current	t_p limited by $T_{vj\max}$	I_{CRM}	640	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}\text{C}, T_{vj} = T_{vj\max}$	P_{tot}	411	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	$I_C = 320\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$V_{CE(sat)}$	1.52 1.63 1.72	2.1	V
栅极阈值电压 Gate threshold voltage	$I_C = 1.5\text{mA}, V_{GE} = V_{CE}, T_{vj} = 25^{\circ}\text{C}$	V_{GEth}	4.6	5.03	5.6	V
栅极电荷 Gate charge	$V_{GE} = \pm 15\text{V}, V_{CE} = 400\text{V}, I_C = 360\text{A}$	Q_G		684		nC
输入电容 Input capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 30\text{V}, V_{GE} = 0\text{V}$	C_{ies}		19.2		nF
反向传输电容 Reverse transfer capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 30\text{V}, V_{GE} = 0\text{V}$	C_{res}		0.32		nF
集电极—发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$	I_{CES}			100	μA
栅极—发射极漏电流 Gate-emitter leakage current	$V_{CE} = 0\text{V}, V_{GE} = \pm 30\text{V}, T_{vj} = 25^{\circ}\text{C}$	I_{GES}			± 1.0	μA
开通延迟时间（感性负载） Turn-on delay time (inductive load)	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$t_{d(on)}$	610 576 563		ns
上升时间（感性负载） Rise time (inductive load)	$R_{Gon} = 30\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_r	154 161 164		ns
关断延迟时间（感性负载） Turn-off delay time (inductive load)	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$t_{d(off)}$	854 868 867		ns
下降时间（感性负载） Fall time (inductive load)	$R_{Gon} = 30\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_f	88 85 60		ns
开通损耗能量（每脉冲） Turn-on energy loss per pulse	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$ $R_{Gon} = 30\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{on}	14.18 15.91 16.85		mJ
关断损耗能量（每脉冲） Turn-off energy loss per pulse	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-5\text{V}$ $R_{Gon} = 30\Omega$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{off}	12.6 13.7 14.1		mJ

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(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, $\lambda_{grease} = 3.4W/(m^{\circ}K)$ Per IGBT, $\lambda_{grease} = 3.4W/(m^{\circ}K)$	R_{thJH}		0.231		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}	650	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	173	A
总耗散功率 Total Power dissipation	$T_h = 80^{\circ}C, T_{vj} = T_{vj\ max}$	P_{tot}	225	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	480	A

表 10 特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 240A, V_{GE} = 0V$	$T_{vj} = 25^{\circ}C$	V_F		1.58	2.0	V
		$T_{vj} = 125^{\circ}C$			1.69		
		$T_{vj} = 150^{\circ}C$			1.71		
反向恢复峰值电流 Peak reverse recovery current	$V_{CE} = 400V$ $I_C = 200A$ $V_{GE} = +15/-5V$ $R_{Gon} = 30\Omega$ Inductive Load	$T_{vj} = 25^{\circ}C$	I_{RM}		61		A
		$T_{vj} = 125^{\circ}C$			75		
		$T_{vj} = 150^{\circ}C$			81		
反向恢复电荷 Recovered charge		$T_{vj} = 25^{\circ}C$	Q_r		4.6		μC
		$T_{vj} = 125^{\circ}C$			7.6		
		$T_{vj} = 150^{\circ}C$			9.2		
反向恢复损耗（每脉冲） Reverse recovery energy		$T_{vj} = 25^{\circ}C$	E_{rec}		0.57		mJ
		$T_{vj} = 125^{\circ}C$			1.28		
		$T_{vj} = 150^{\circ}C$			1.59		
结—散热器热阻 Thermal resistance, junction to heatsink	每个IGBT, $\lambda_{grease} = 3.4W/(m^{\circ}K)$ Per IGBT, $\lambda_{grease} = 3.4W/(m^{\circ}K)$	R_{thJH}			0.423		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$			175		$^{\circ}C$

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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}	650	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	183	A
总耗散功率 Total Power dissipation	$T_C = 80^{\circ}\text{C}, T_{vj} = T_{vj\max}$	P_{tot}	225	W
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\max}$	I_{FRM}	480	A

表 12 特征值/Characteristic values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 240\text{A}, V_{GE} = 0\text{V}$	V_F		1.37	2.0	V
				1.41		
				1.50		
结-散热器热阻 Thermal resistance, junction to heatsink	每个IGBT, $\lambda_{grease} = 3.4\text{W}/(\text{m}^{\circ}\text{K})$ Per IGBT, $\lambda_{grease} = 3.4\text{W}/(\text{m}^{\circ}\text{K})$	R_{thJH}		0.423		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 11 特征值/Characteristic values

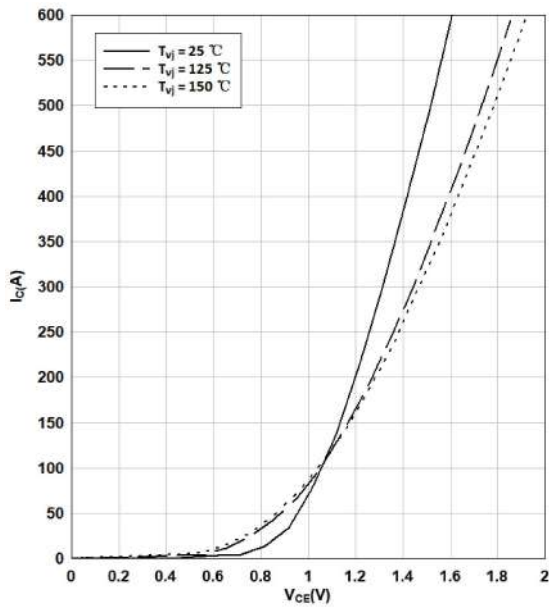
Parameter	Conditions	Symbol	Value	Unit
额定电阻值 Rated resistance	$T_{NTC} = 25^{\circ}\text{C}$	R_{25}	5	k Ω
R_{100} 偏差 Deviation of R_{100}	$T_{NTC} = 100^{\circ}\text{C}, R_{100} = 493\ \Omega$	$\Delta R/R$	± 5	%
耗散功率 Power dissipation	$T_{NTC} = 25^{\circ}\text{C}$	P_{25}	20.0	mW
B-值 B-value	$R_2 = R_{25}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

HCG450FL065E3RD

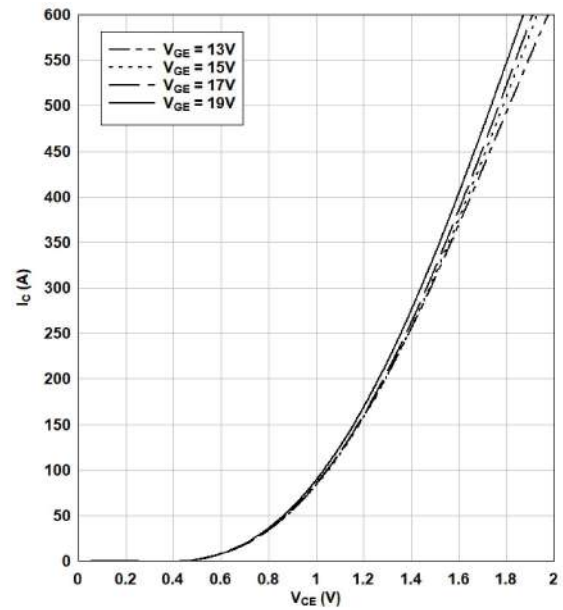
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特征参数图表/Characteristics diagrams

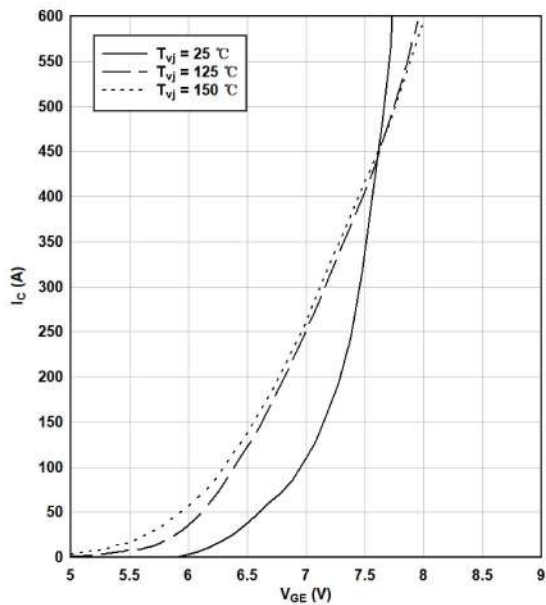
输出特性（典型），IGBT (T1/T4), 逆变器
Output characteristic (typical), IGBT(T1/T4), Inverter
 $I_C = f(V_{CE})$
 $V_{GE} = 15V$



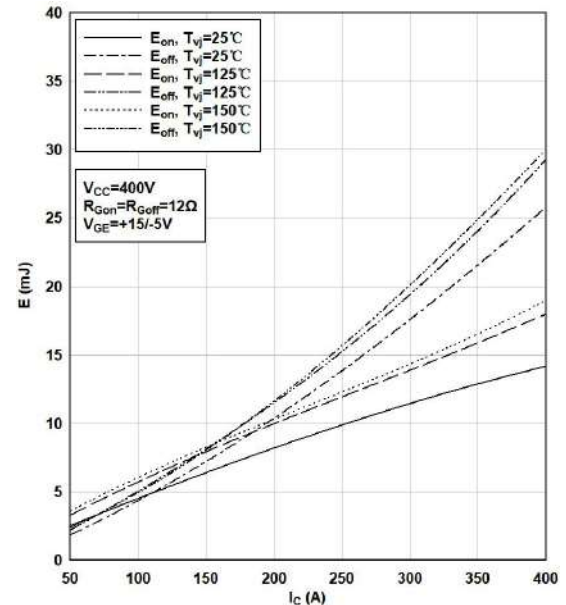
输出特性（典型），IGBT(T1/T4), 逆变器
Output characteristic field (typical), IGBT(T1/T4), Inverter
 $I_C = f(V_{CE})$
 $T_{vj} = 150^\circ C$



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
 $E = f(I_C)$
 $V_{CE} = 400V, R_{Gon} = R_{Goff} = 12\Omega, V_{GE} = +15/-5V$

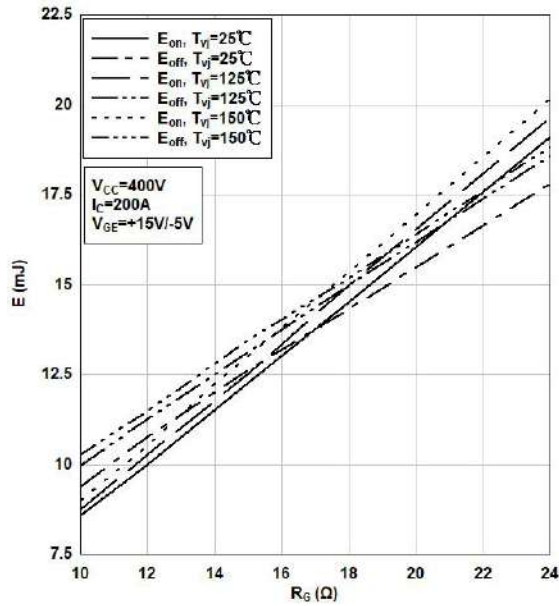


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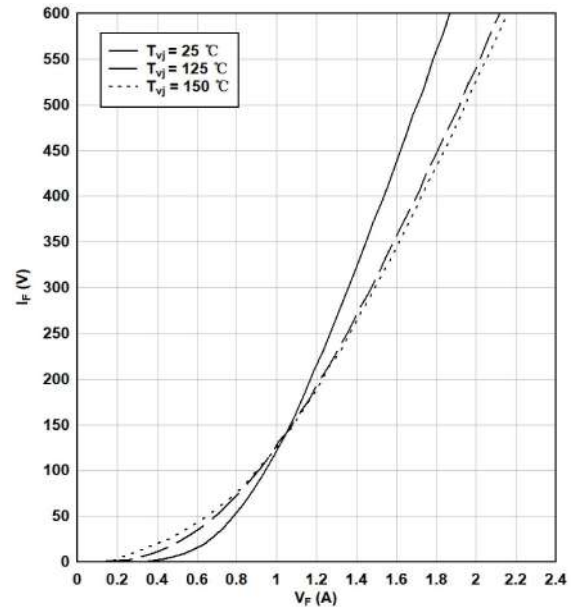
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

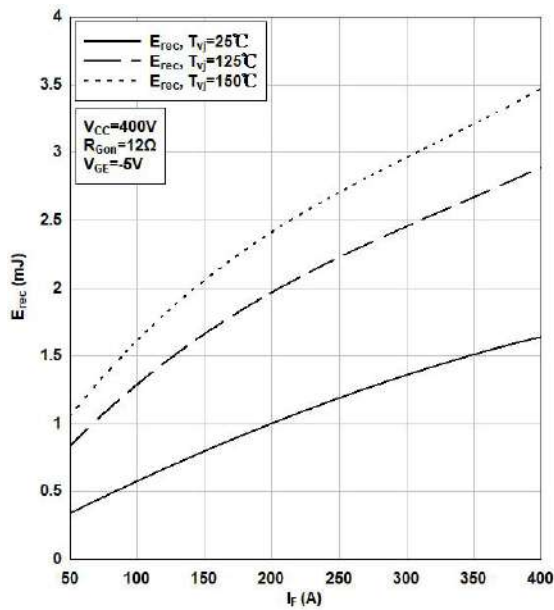
开关损耗 (典型), IGBT(T1/T4), 逆变器
Switching losses (typical), IGBT(T1/T4), Inverter
 $E = f(R_G)$
 $I_C = 200A$, $V_{CE} = 400V$, $V_{GE} = +15/-5V$



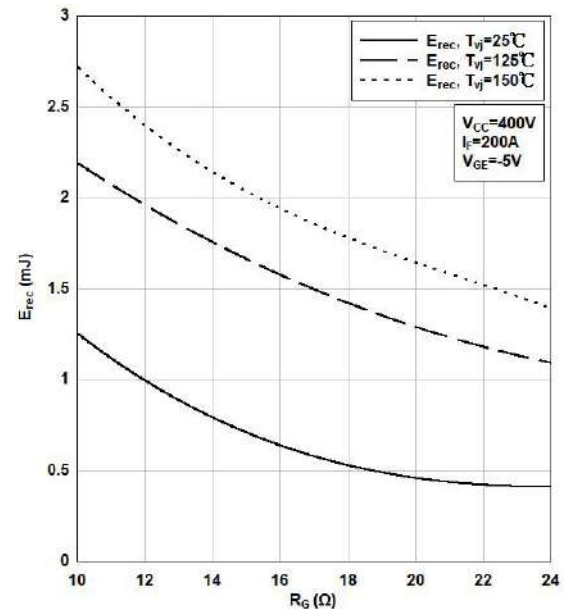
正向特性 (典型), 二极管(D5/D6)
Forward characteristic (typical), Diode(D5/D6)
 $I_F = f(V_F)$



开关损耗 (典型), 二极管(D5/D6)
Switching losses (typical), Diode(D5/D6)
 $E_{rec} = f(I_F)$
 $V_{CE} = 400V$, $R_{Gon} = 12.0\Omega$



开关损耗 (典型), 二极管(D5/D6)
Switching losses (typical), Diode(D5/D6)
 $E_{rec} = f(R_G)$
 $I_F = 200A$, $V_{CE} = 400V$

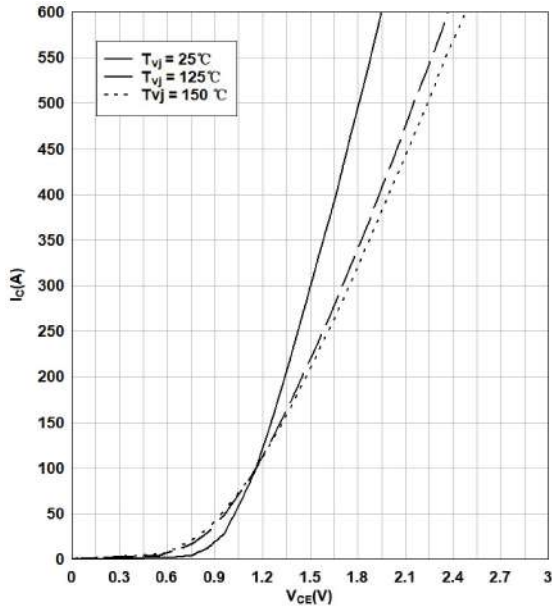


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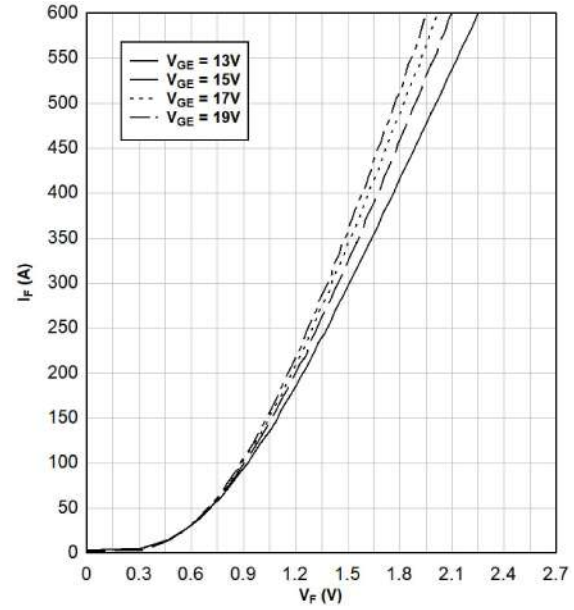
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

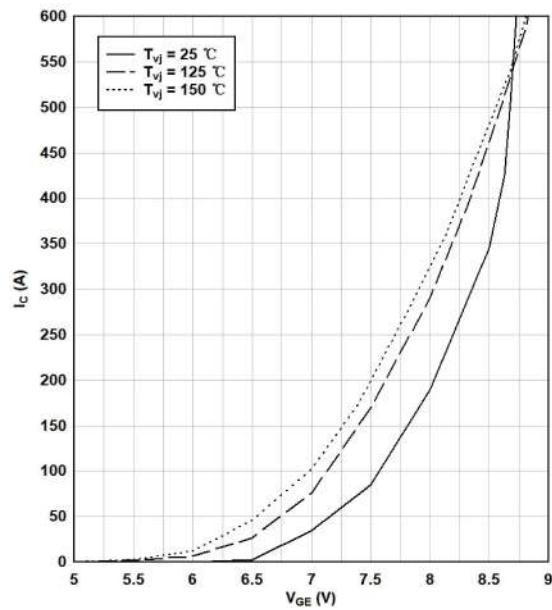
输出特性 (典型), IGBT(T2/T3), 逆变器
Output characteristic (typical), IGBT(T2/T3), Inverter
 $I_C = f(V_{CE})$
 $V_{GE} = 15V$



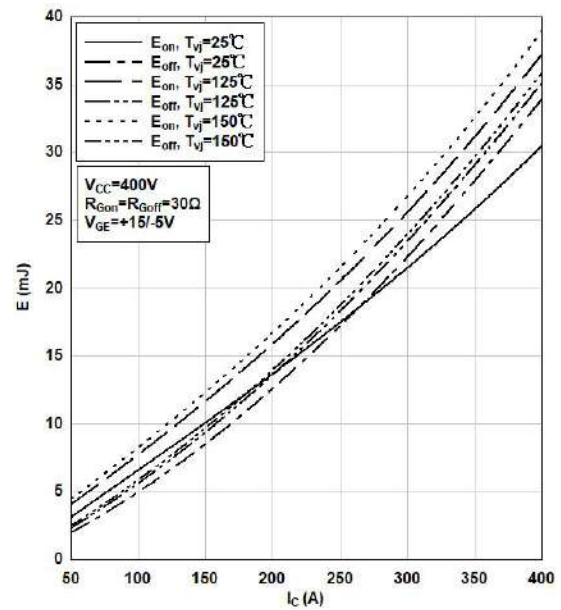
输出特性 (典型), IGBT(T2/T3), 逆变器
Output characteristic (typical), IGBT(T2/T3), Inverter
 $I_C = f(V_{CE})$
 $T_{vj} = 150^\circ C$



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
 $E = f(I_C)$
 $V_{CE} = 400V$, $R_{Gon} = R_{Goff} = 30\Omega$, $V_{GE} = +15/-5V$

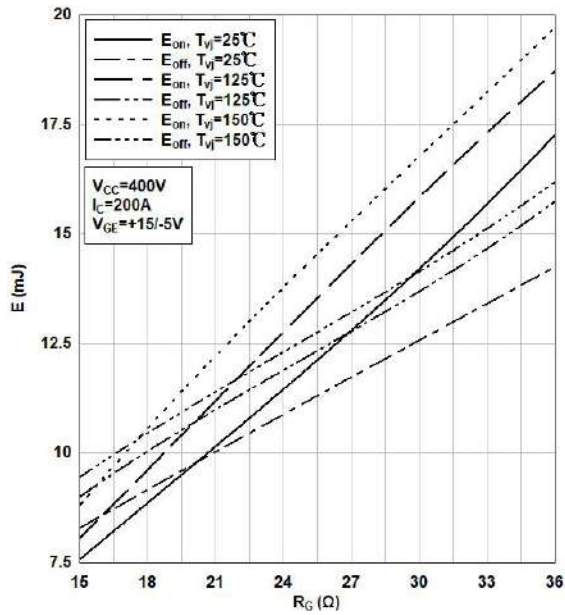


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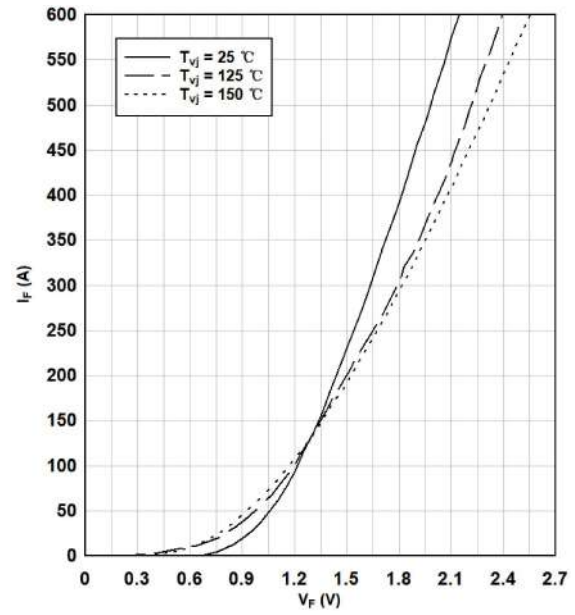
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

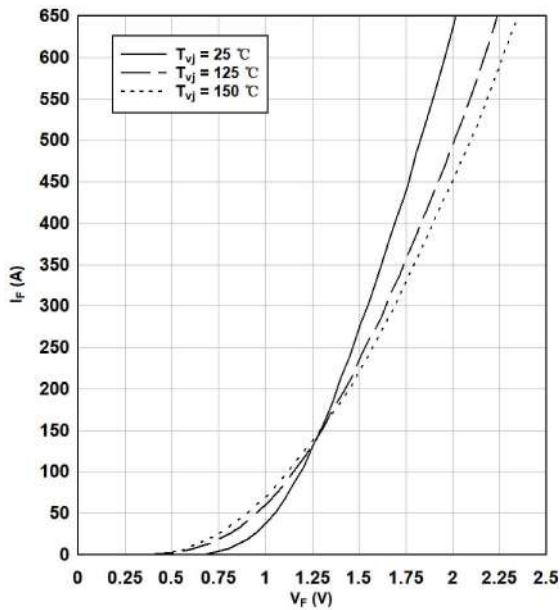
开关损耗 (典型), IGBT(T2/T3), 逆变器
Switching losses (typical), IGBT(T2/T3), Inverter
 $E = f(R_G)$
 $I_C = 200A$, $V_{CE} = 400V$, $V_{GE} = +15/-5V$



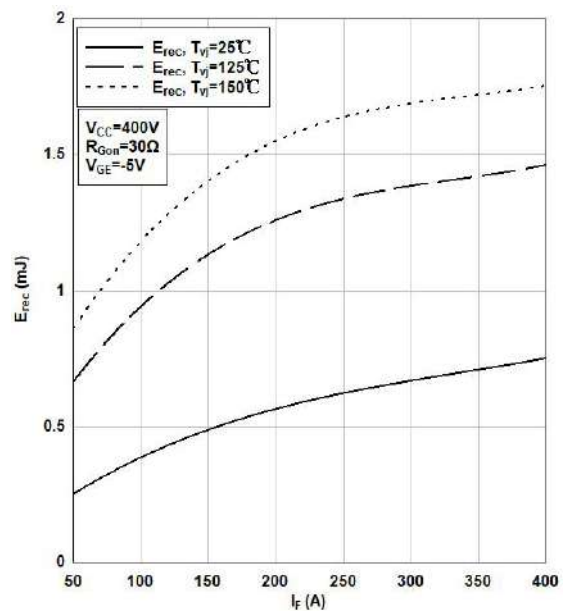
正向特性 (典型), 二极管(D1/D4)
Forward characteristic (typical), Diode(D1/D4)
 $I_F = f(V_F)$



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)
 $E_{rec} = f(I_F)$
 $V_{CE} = 400V$, $R_{Gon} = 30\Omega$

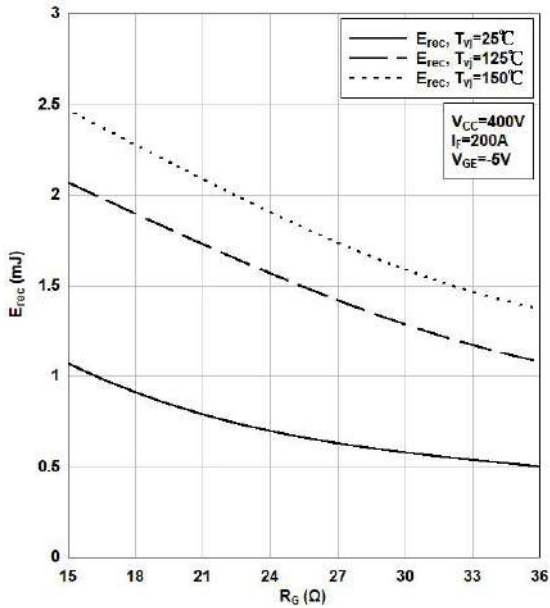


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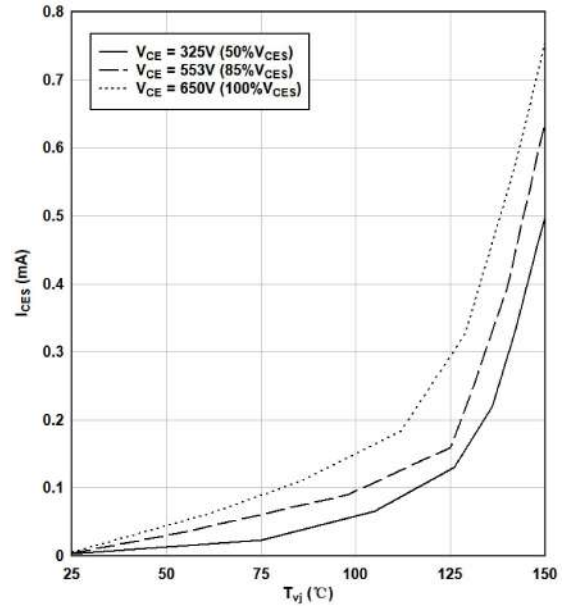
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

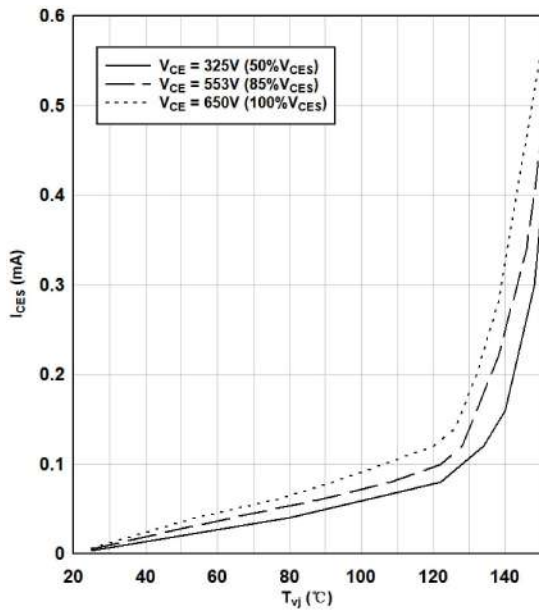
开关损耗 (典型), 二极管(D1/D4)
Switching losses (typical), Diode(D1/D4)
 $E_{rec} = f(R_G)$
 $I_F = 200A$, $V_{CE} = 400V$



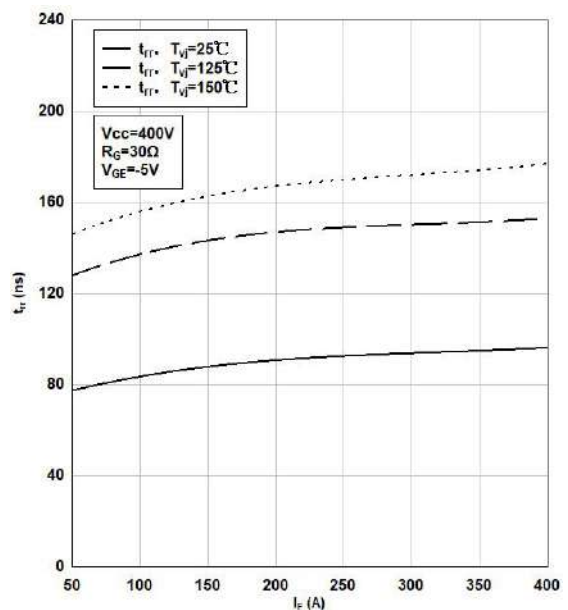
集电极-发射极截止电流 (典型), IGBT(T1/T4)
Collector-emitter cut-off current (typical), IGBT(T1/T4)
 $I_{CES} = f(T_{vj})$



集电极-发射极截止电流 (典型), IGBT(T2/T3)
Collector-emitter cut-off current (typical), IGBT(T2/T3)
 $I_{CES} = f(T_{vj})$



二极管反向恢复时间(典型), Diode(D1/D4)
Diode reverse recovery time (typical), Diode(D1/D4)
 $t_{rr} = f(I_F)$

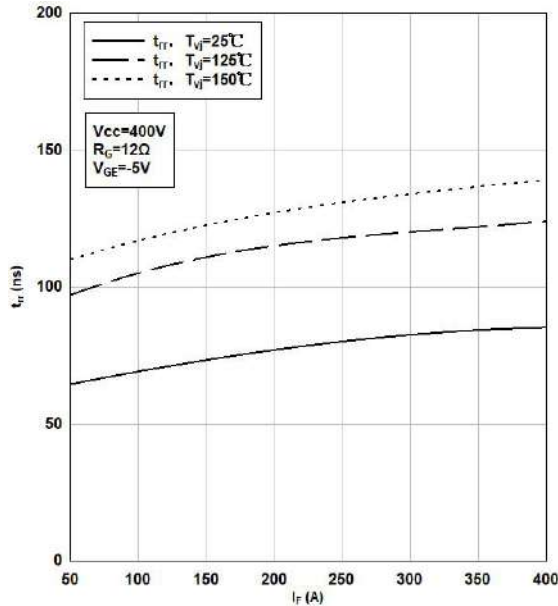


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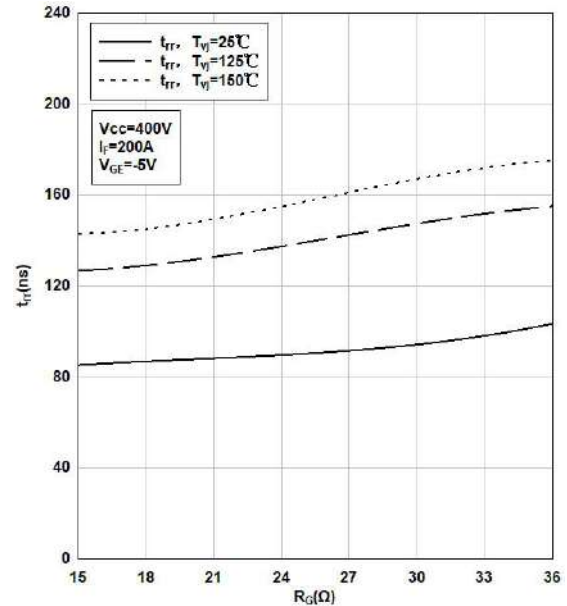
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

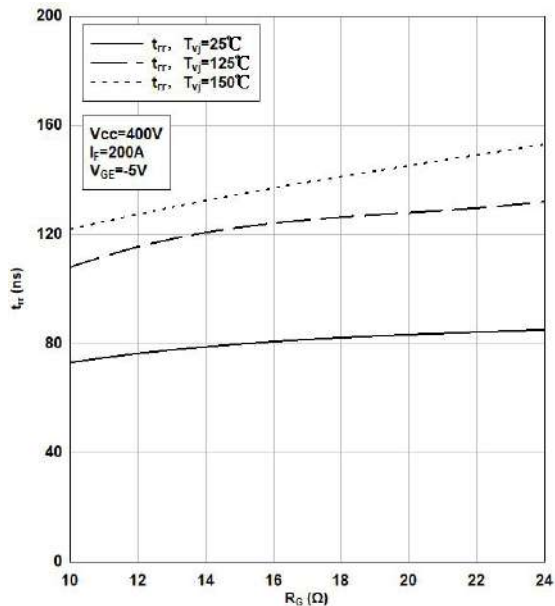
二极管反向恢复时间(典型), Diode(D5/D6)
Diode reverse recovery time (typical), Diode(D5/D6)
 $t_{rr} = f(I_F)$



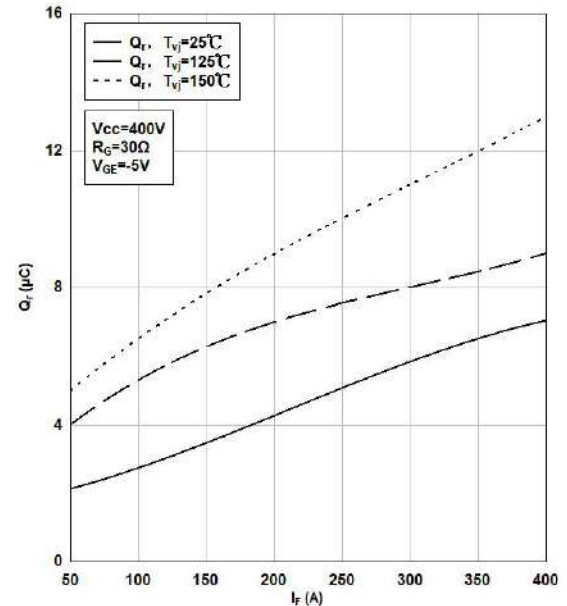
二极管反向恢复时间(典型), Diode(D1/D4)
Diode reverse recovery time (typical), Diode(D1/D4)
 $t_{rr} = f(R_G)$



二极管反向恢复时间(典型), Diode(D5/D6)
Diode reverse recovery time (typical), Diode(D5/D6)
 $t_{rr} = f(R_G)$



二极管反向恢复电荷(典型), Diode(D1/D4)
Diode reverse recovery charge (typical), Diode(D1/D4)
 $Q_{rr} = f(I_F)$

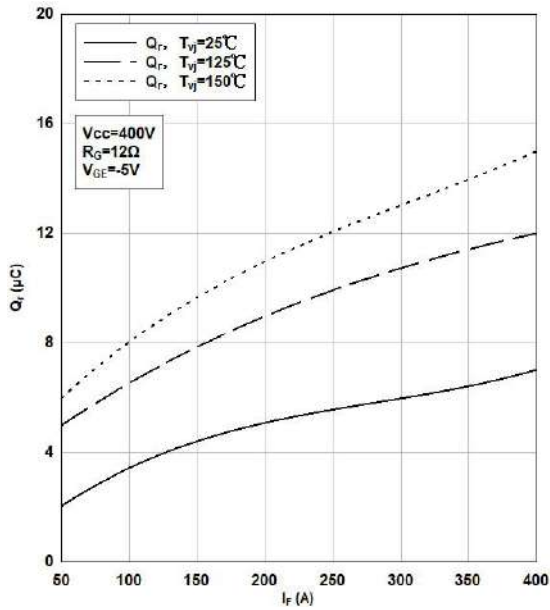


HCG450FL065E3RD

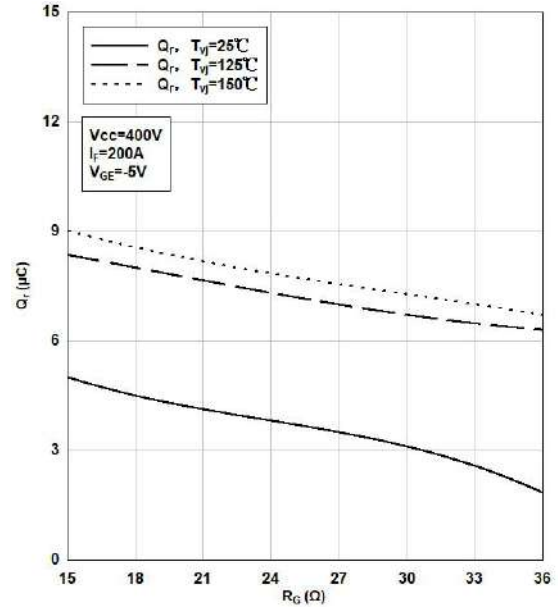
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

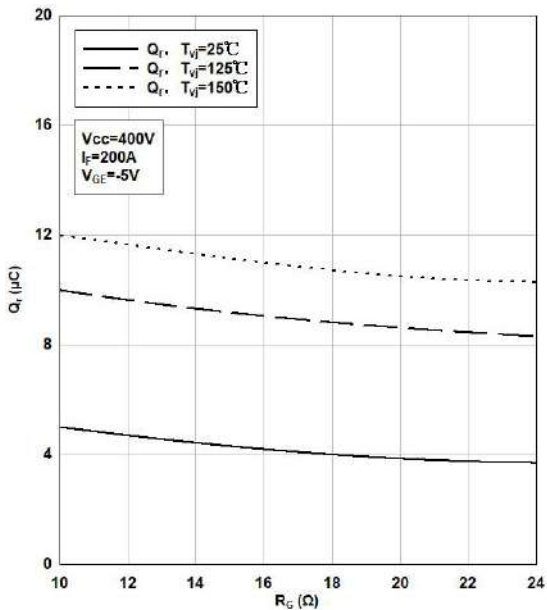
二极管反向恢复电荷(典型), Diode(D5/D6)
Diode reverse recovery charge (typical), Diode(D5/D6)
 $Q_{rr} = f(I_F)$



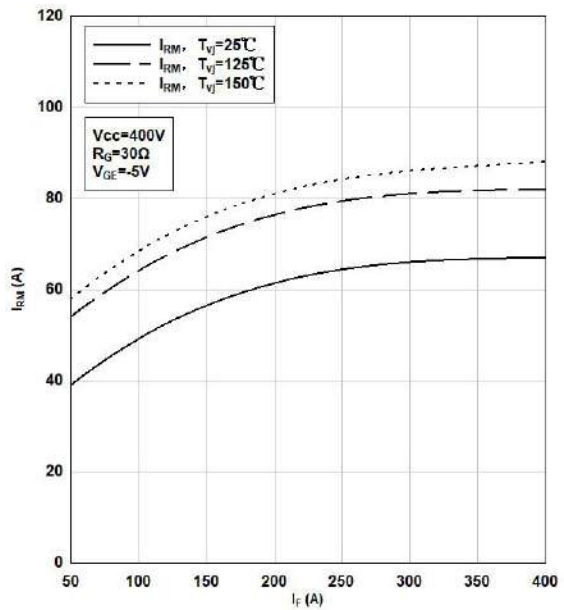
二极管反向恢复电荷(典型), Diode(D1/D4)
Diode reverse recovery charge (typical), Diode(D1/D4)
 $Q_{rr} = f(R_G)$



二极管反向恢复电荷(典型), Diode(D5/D6)
Diode reverse recovery charge (typical), Diode(D5/D6)
 $Q_{rr} = f(R_G)$



二极管反向恢复峰值电流(典型), Diode(D1/D4)
Diode peak reverse recovery current (typical), Diode(D1/D4)
 $I_{rrm} = f(I_F)$

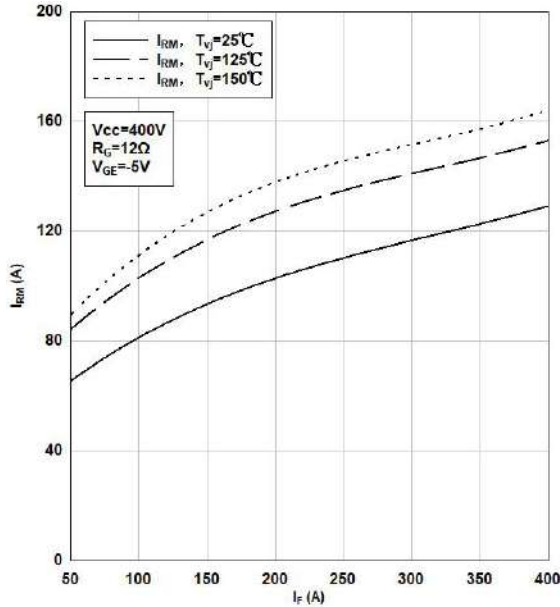


HCG450FL065E3RD

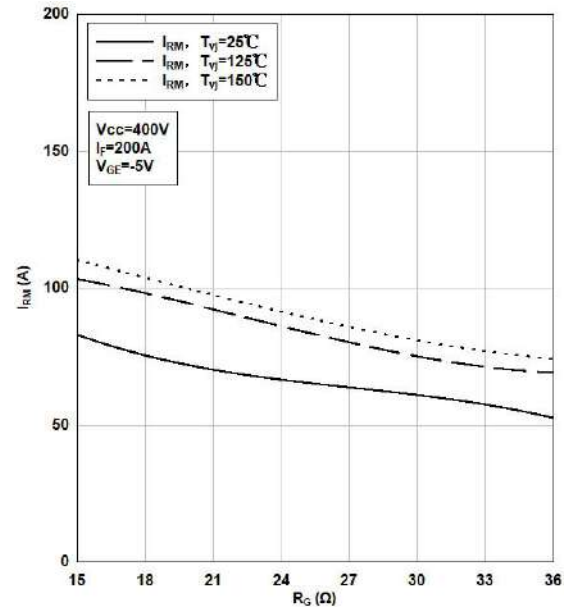
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

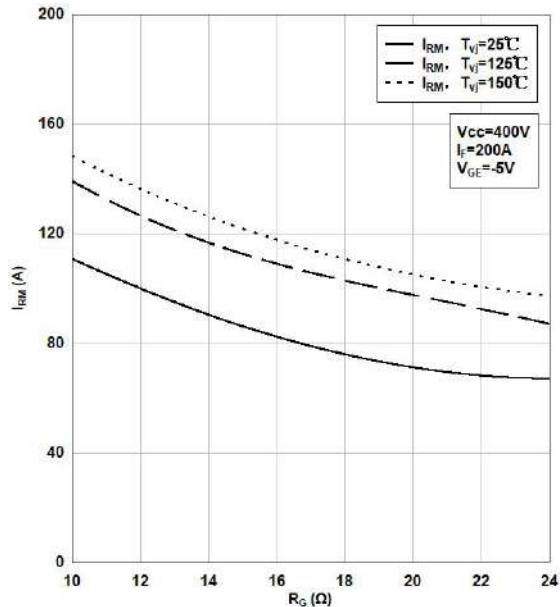
二极管反向恢复峰值电流(典型), Diode(D5/D6)
Diode peak reverse recovery current (typical), Diode(D5/D6)
 $I_{rrm} = f(I_F)$



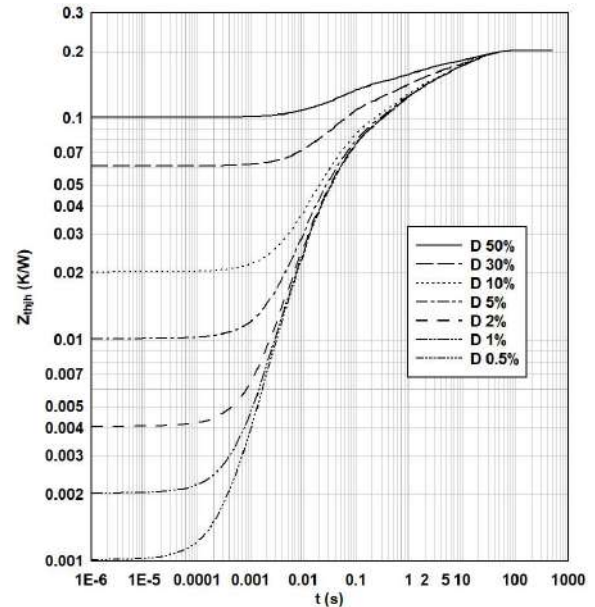
二极管反向恢复峰值电流(典型), Diode(D1/D4)
Diode peak reverse recovery current (typical), Diode(D1/D4)
 $I_{rrm} = f(R_G)$



二极管反向恢复峰值电流(典型), Diode(D5/D6)
Diode peak reverse recovery current (typical), Diode(D5/D6)
 $I_{rrm} = f(R_G)$



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



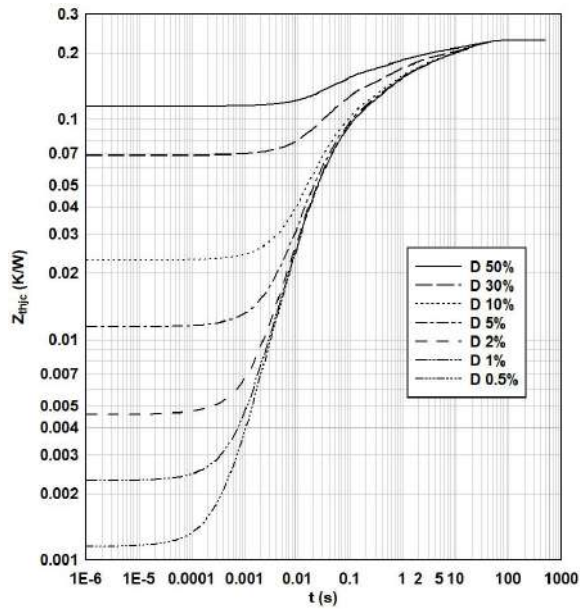
HCG450FL065E3RD

650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics diagrams

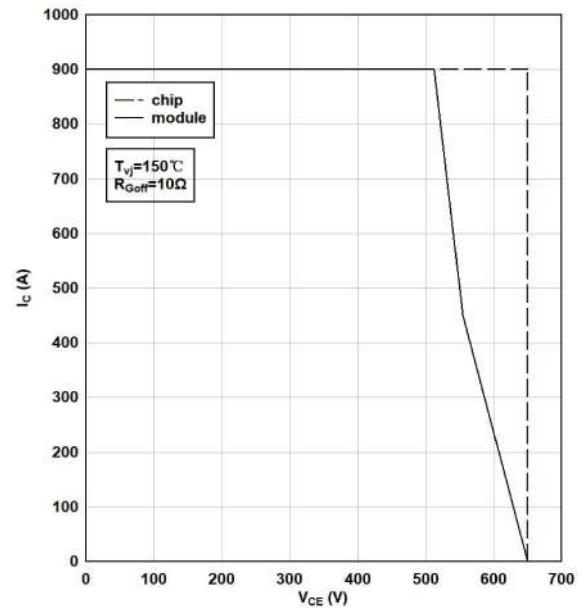
瞬态热阻抗, IGBT(T2/T3)

Transient thermal impedance, IGBT(T2/T3)

 $Z_{thjc} = f(t)$


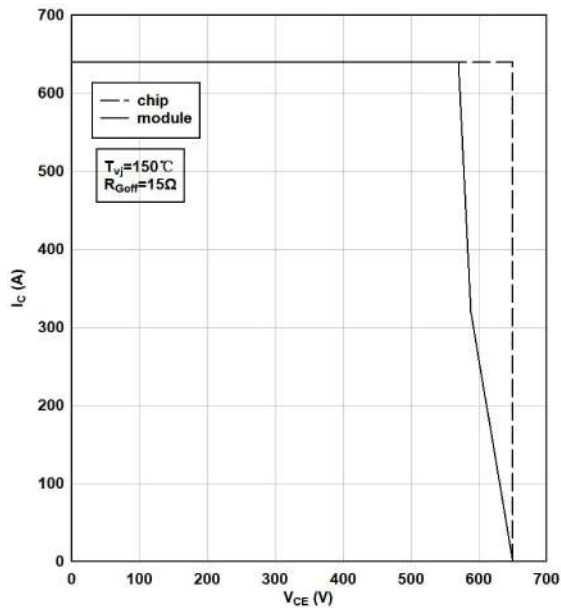
反偏安全工作区 IGBT, 逆变器 (T1/T4)

Reverse bias safe operating area IGBT, Inverter(T1/T4)

 $I_C = f(V_{CE})$


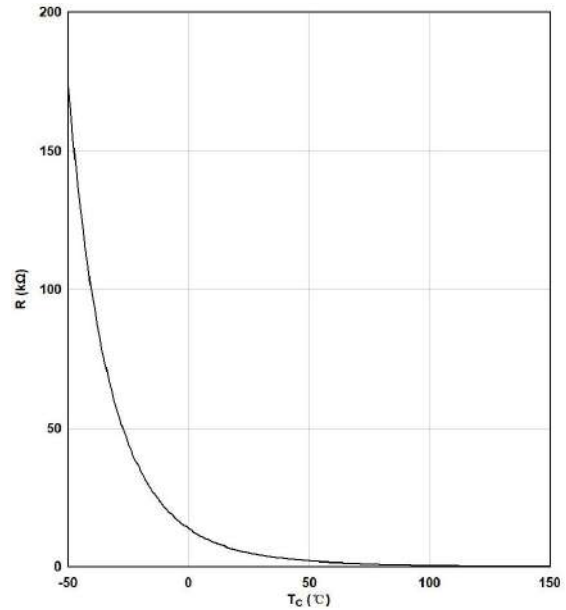
反偏安全工作区 IGBT, 逆变器 (T2/T3)

Reverse bias safe operating area IGBT, Inverter(T2/T3)

 $I_C = f(V_{CE})$


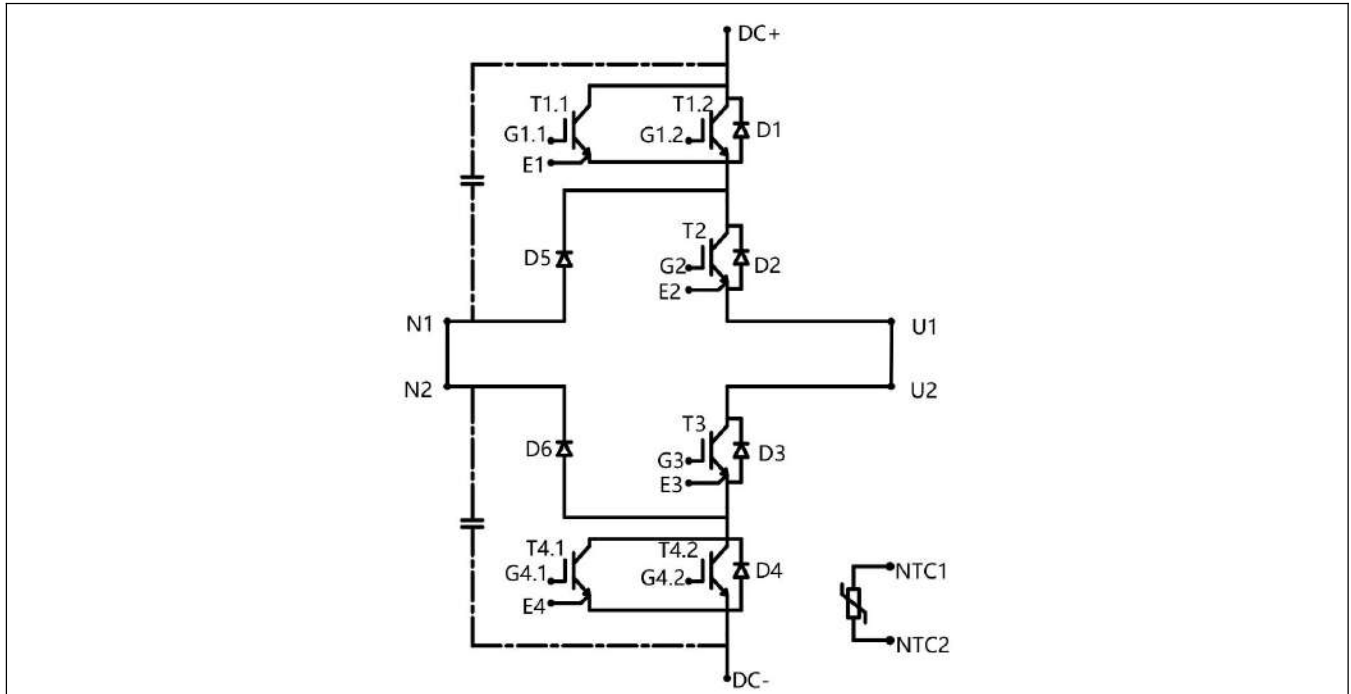
负温度系数热敏电阻温度特性

NTC-Thermistor-temperature characteristic(typical)

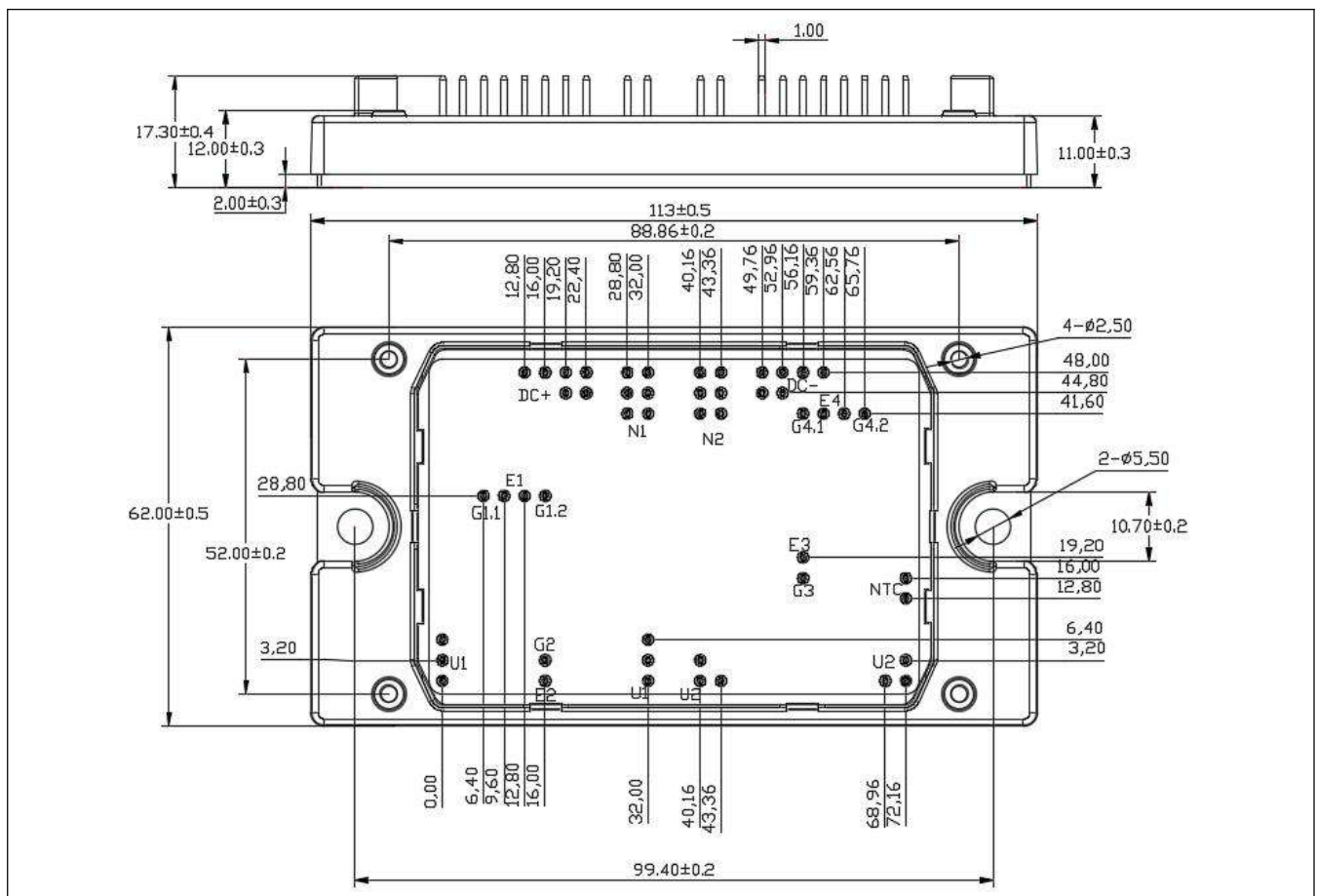
 $R = f(T_C)$


HCG450FL065E3RD 650V/450A 3-Level NPC IGBT Module

电路拓扑图 / Circuit diagram



封装尺寸 / Package outlines



HCG450FL065E3RD 650V/450A 3-Level NPC IGBT Module

模块标签信息/ Module marking information

Marking Diagram

HCG450FL065E3RD = Specific Device

P4CQ22420010001 = Lot Traceability

ACP-E3 = Package Type

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

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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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