

HCG450FL065E3FC 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
- 内置直流电容
Integrated DC capacitor
- 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
- 采用铜基板技术
Using copper substrate 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	$T_{vj}=25^{\circ}C$	1.46	V
	$T_{vj}=125^{\circ}C$	1.65	
IGBT结-外壳热阻 IGBT thermal resistance	R_{thJH}	0.24	K/W
二极管结-外壳热阻 Diode thermal resistance	R_{thJH}	0.26	K/W
开通损耗能量 Turn-on energy	$T_{vj}=25^{\circ}C$	4.94	mJ
	$T_{vj}=125^{\circ}C$	7.28	
关断损耗能量 Turn-off energy	$T_{vj}=25^{\circ}C$	6.09	
	$T_{vj}=125^{\circ}C$	7.69	

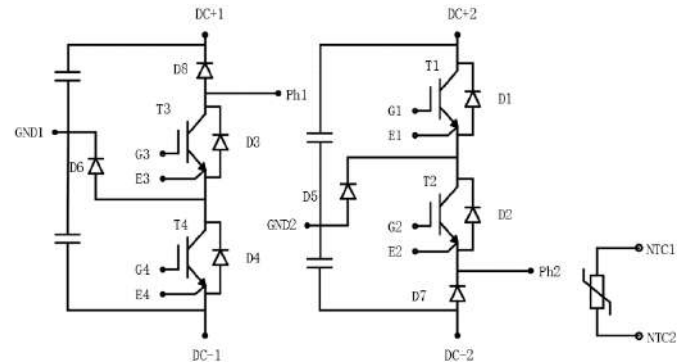
模块外观

Module Appearance



电路拓扑

Circuit Topology



关键参数[T2&T3/D7&D8]

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	$T_{vj}=25^{\circ}C$	1.46	V
	$T_{vj}=125^{\circ}C$	1.65	
IGBT结-外壳热阻 IGBT thermal resistance	R_{thJH}	0.24	K/W
二极管结-外壳热阻 Diode thermal resistance	R_{thJH}	0.235	K/W
开通损耗能量 Turn-on energy	$T_{vj}=25^{\circ}C$	4.04	mJ
	$T_{vj}=125^{\circ}C$	6.94	
关断损耗能量 Turn-off energy	$T_{vj}=25^{\circ}C$	6.96	
	$T_{vj}=125^{\circ}C$	8.32	

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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_2O_3	
爬电距离 Creepage distance	端子至散热器 Terminal to heatsink	d_{Creep}	> 12.7	mm
爬电距离 Creepage distance	端子至端子 Terminal to terminal	d_{Creep}	> 12.7	mm
电气间隙 Clearance	端子至散热器 Terminal to heatsink	d_{Clear}	> 12.7	mm
电气间隙 Clearance	端子至端子 Terminal to terminal	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}		20		nH
允许开关的温度范围 Temperature under switching conditions		$T_{vj(op)}$	-40		150	°C
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	M5, 螺丝 M5, Screw	3.0		6.0	Nm
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}	320	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	$T_C = 80^{\circ}\text{C}$, $T_{vj} = T_{vj\max}$	P_{tot}	396	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	$I_C = 450\text{A}$, $V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	$V_{CE(\text{sat})}$		1.46	1.9	V	
		$T_{vj} = 125^{\circ}\text{C}$			1.65			
栅极阈值电压 Gate threshold voltage	$I_C = 4.5\text{mA}$, $V_{GE} = V_{CE}$, $T_{vj} = 25^{\circ}\text{C}$		V_{GEth}		4.0		V	
栅极电荷 Gate charge	$V_{GE} = \pm 15\text{V}$, $V_{CE} = 400\text{V}$		Q_G		1300		nC	
输入电容 Input capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$, $V_{CE} = 20\text{V}$, $V_{GE} = 0\text{V}$		C_{ies}		53.5		nF	
输出电容 Output capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$, $V_{CE} = 20\text{V}$, $V_{GE} = 0\text{V}$		C_{oes}		1.55		nF	
反向传输电容 Reverse transfer capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$, $V_{CE} = 20\text{V}$, $V_{GE} = 0\text{V}$		C_{res}		0.04		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}			0.2	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}			300	nA	
开通延迟时间（感性负载） Turn-on delay time (inductive load)	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-8\text{V}$ $R_{Gon} = 7.5\Omega$ $R_{Goff} = 10\Omega$ $L_s = 50\text{nH}$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$	$t_{d(\text{on})}$		393		ns	
		$T_{vj} = 125^{\circ}\text{C}$			407			
上升时间（感性负载） Rise time (inductive load)		$T_{vj} = 25^{\circ}\text{C}$	t_r		68		ns	
		$T_{vj} = 125^{\circ}\text{C}$			73			
关断延迟时间（感性负载） Turn-off delay time (inductive load)		$I_C = 200\text{A}$ $V_{GE} = +15/-8\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	$t_{d(\text{off})}$		680		ns
			$T_{vj} = 125^{\circ}\text{C}$			744		
下降时间（感性负载） Fall time (inductive load)		$R_{Gon} = 7.5\Omega$ $R_{Goff} = 10\Omega$	$T_{vj} = 25^{\circ}\text{C}$	t_f		88		ns
			$T_{vj} = 125^{\circ}\text{C}$			91		
开通耗损能量（每脉冲） Turn-on energy loss per pulse		$L_s = 50\text{nH}$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$	E_{on}		4.94		mJ
			$T_{vj} = 125^{\circ}\text{C}$			7.28		
关断损耗能量（每脉冲） Turn-off energy loss per pulse			$T_{vj} = 25^{\circ}\text{C}$	E_{off}		6.09		mJ
			$T_{vj} = 125^{\circ}\text{C}$			7.69		

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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}		0.24		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	$T_C = 80^{\circ}C, T_{vj\ max} = 175^{\circ}C$	I_F	323	A
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	900	A
总耗散功率 Total Power dissipation	$T_C = 80^{\circ}C, T_{vj} = T_{vj\ max}$	P_{tot}	365	W

表 6 特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 450A, V_{GE} = 0V$	$T_{vj} = 25^{\circ}C$	V_F		1.45		V
		$T_{vj} = 125^{\circ}C$			1.53		
反向恢复峰值电流 Peak reverse recovery current	$V_{CE} = 400V$ $I_F = 200A$	$T_{vj} = 25^{\circ}C$	I_{RM}		158		A
		$T_{vj} = 125^{\circ}C$			173		
反向恢复电荷 Recovered charge	$V_{GE} = +15/-8V$ $R_{Gon} = 7.5\Omega$ $L_s = 50nH$	$T_{vj} = 25^{\circ}C$	Q_r		6.6		μC
		$T_{vj} = 125^{\circ}C$			10.7		
反向恢复损耗（每脉冲） Reverse recovery energy	Inductive Load	$T_{vj} = 25^{\circ}C$	E_{rec}		1.33		mJ
		$T_{vj} = 125^{\circ}C$			2.31		
结—散热器热阻 Thermal resistance, junction to heatsink	每个二极管, $\lambda_{grease} = 3.4W/(m^{\circ}K)$ Per diode, $\lambda_{grease} = 3.4W/(m^{\circ}K)$	R_{thJH}			0.26		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	$T_C = 80^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	I_{CDC}	320	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	$T_C = 80^{\circ}\text{C}, T_{vj} = T_{vj\max}$	P_{tot}	396	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	$I_C = 450\text{A}$, $V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	$V_{CE(sat)}$		1.46	1.9	V
		$T_{vj} = 125^{\circ}\text{C}$			1.65		
栅极阈值电压 Gate threshold voltage	$I_C = 4.5\text{mA}$, $V_{GE} = V_{CE}$, $T_{vj} = 25^{\circ}\text{C}$		V_{GEth}		4.0		V
栅极电荷 Gate charge	$V_{GE} = \pm 15\text{ V}$, $V_{CE} = 400\text{V}$		Q_G		1300		nC
输入电容 Input capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$, $V_{CE} = 20\text{V}$, $V_{GE} = 0\text{V}$		C_{ies}		53.5		nF
输出电容 Output capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$, $V_{CE} = 20\text{V}$, $V_{GE} = 0\text{V}$		C_{oes}		1.55		nF
反向传输电容 Reverse transfer capacitance	$f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$, $V_{CE} = 20\text{V}$, $V_{GE} = 0\text{V}$		C_{res}		0.04		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}			0.2	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}			300	nA
开通延迟时间（感性负载） Turn-on delay time (inductive load)	$V_{CE} = 400\text{V}$ $I_C = 200\text{A}$ $V_{GE} = +15/-8\text{V}$ $R_{Gon} = 7.5\Omega$ $R_{Goff} = 10\Omega$ $L_s = 50\text{nH}$ Inductive Load	$T_{vj} = 25^{\circ}\text{C}$	$t_{d(on)}$		417		ns
		$T_{vj} = 125^{\circ}\text{C}$			424		
上升时间（感性负载） Rise time (inductive load)		$T_{vj} = 25^{\circ}\text{C}$	t_r		69		ns
		$T_{vj} = 125^{\circ}\text{C}$			76		
关断延迟时间（感性负载） Turn-off delay time (inductive load)		$T_{vj} = 25^{\circ}\text{C}$	$t_{d(off)}$		722		ns
		$T_{vj} = 125^{\circ}\text{C}$			792		
下降时间（感性负载） Fall time (inductive load)		$T_{vj} = 25^{\circ}\text{C}$	t_f		86		ns
		$T_{vj} = 125^{\circ}\text{C}$			91		
开通损耗能量（每脉冲） Turn-on energy loss per pulse		$T_{vj} = 25^{\circ}\text{C}$	E_{on}		4.04		mJ
		$T_{vj} = 125^{\circ}\text{C}$			6.94		
关断损耗能量（每脉冲） Turn-off energy loss per pulse		$T_{vj} = 25^{\circ}\text{C}$	E_{off}		6.96		mJ
		$T_{vj} = 125^{\circ}\text{C}$			8.32		

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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}		0.24		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$		175		$^{\circ}C$

Diode/ D7&D8

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}	1200	V
连续正向直流电流 Continuous DC forward current	$T_C = 80^{\circ}C$, $T_{vj\ max} = 175^{\circ}C$	I_F	310	A
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\ max}$	I_{FRM}	900	A
总耗散功率 Total Power dissipation	$T_C = 80^{\circ}C$, $T_{vj} = T_{vj\ max}$	P_{tot}	404	W

表 10 特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 450A$, $V_{GE} = 0V$	$T_{vj} = 25^{\circ}C$	V_F		2.19		V
		$T_{vj} = 125^{\circ}C$			1.99		
反向恢复峰值电流 Peak reverse recovery current	$V_{CE} = 400V$ $I_F = 200A$	$T_{vj} = 25^{\circ}C$	I_{RM}		145		A
		$T_{vj} = 125^{\circ}C$			220		
反向恢复电荷 Recovered charge	$V_{GE} = +15/-8V$ $R_{Gon} = 7.5\Omega$	$T_{vj} = 25^{\circ}C$	Q_r		8.0		μC
		$T_{vj} = 125^{\circ}C$			21.3		
反向恢复损耗（每脉冲） Reverse recovery energy	$L_s = 50nH$ Inductive Load	$T_{vj} = 25^{\circ}C$	E_{rec}		2.23		mJ
		$T_{vj} = 125^{\circ}C$			5.65		
结—散热器热阻 Thermal resistance, junction to heatsink	每个二极管, $\lambda_{grease} = 3.4W/(m^{\circ}K)$ Per diode, $\lambda_{grease} = 3.4W/(m^{\circ}K)$	R_{thJH}			0.235		K/W
最高结温 $T_{vj\ max}$		$T_{vj\ max}$			175		$^{\circ}C$

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Diode/ D1&D2&D3&D4

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	60	A
正向重复峰值电流 Repetitive peak forward current	t_p limited by $T_{vj\max}$	I_{FRM}	150	A
总耗散功率 Total Power dissipation	$T_C = 80^{\circ}\text{C}$, $T_{vj} = T_{vj\max}$	P_{tot}	103	W

表 12 特征值/Characteristic values

Parameter	Conditions		Symbol	Value			Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F = 75\text{A}$, $V_{GE} = 0\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	V_F		1.41		
		$T_{vj} = 125^{\circ}\text{C}$			1.17		
结-散热器热阻 Thermal resistance, junction to heatsink	每个二极管, $\lambda_{grease} = 3.4\text{W}/(\text{m}^{\circ}\text{K})$ Per diode, $\lambda_{grease} = 3.4\text{W}/(\text{m}^{\circ}\text{K})$		R_{thJH}		0.92		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

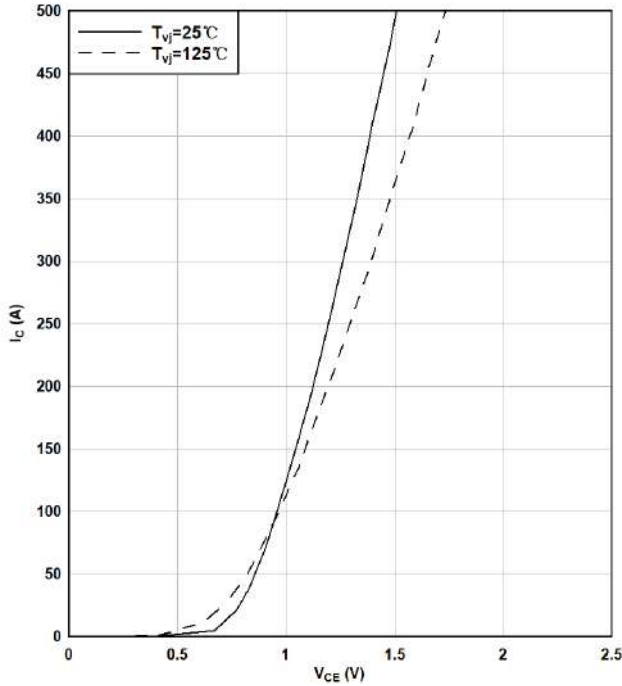
Parameter	Conditions	Symbol	Value	Unit
额定电阻值 Rated resistance	$T_{NTC} = 25^{\circ}\text{C}$	R_{25}	5	k Ω
R_{100} 偏差 Deviation of R_{100}	$T_{NTC} = 100^{\circ}\text{C}$, $R_{100} = 493\Omega$	$\Delta R/R$	± 5	%
耗散功率 Power dissipation	$T_{NTC} = 25^{\circ}\text{C}$	P_{25}	20.0	mW
B-值 B-value	$R_2 = R_{25}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

HCG450FL065E3FC

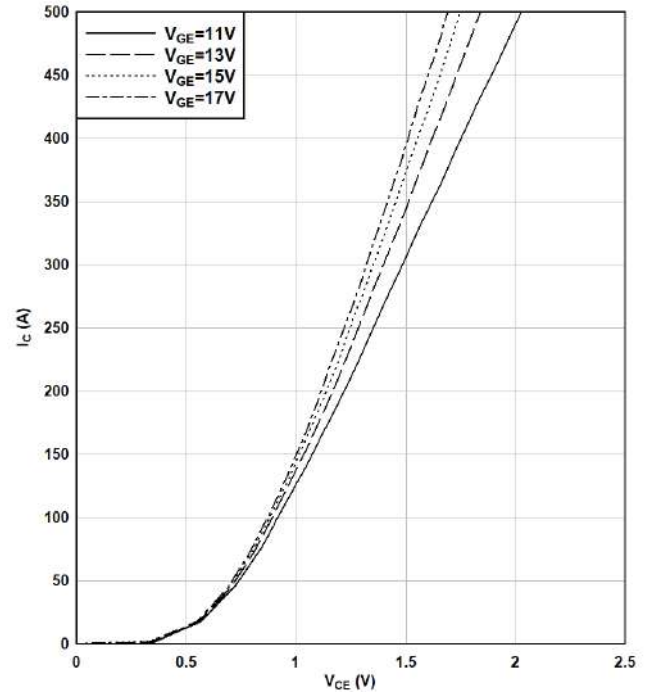
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特征参数图表/Characteristics Diagrams

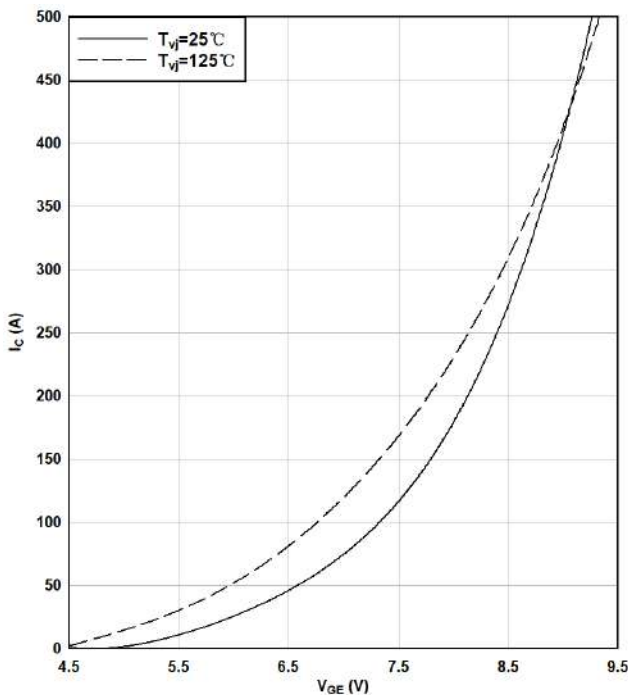
输出特性（典型），IGBT (T1/T4)，逆变器
Output characteristic (typical), IGBT(T1/T4), Inverter
 $I_C = f(V_{CE})$
 $V_{GE} = 15V$



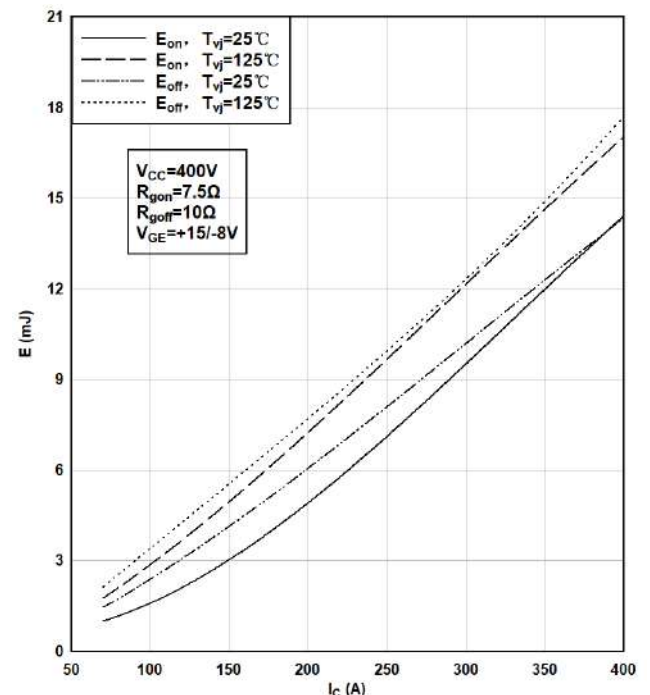
输出特性（典型），IGBT(T1/T4)，逆变器
Output characteristic (typical), IGBT(T1/T4), Inverter
 $I_C = f(V_{CE})$
 $T_{vj} = 125^\circ C$



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



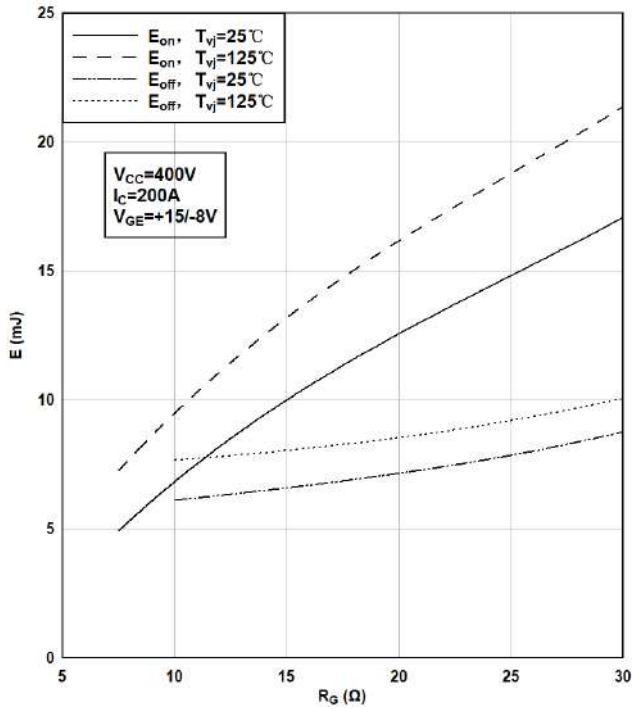
开关损耗（典型），IGBT(T1/T4)，逆变器
Switching losses (typical), IGBT(T1/T4), Inverter
 $E = f(I_C)$
 $V_{CE} = 400V$, $R_{Gon} = 7.5\Omega$, $R_{Goff} = 10\Omega$, $V_{GE} = +15/-8V$



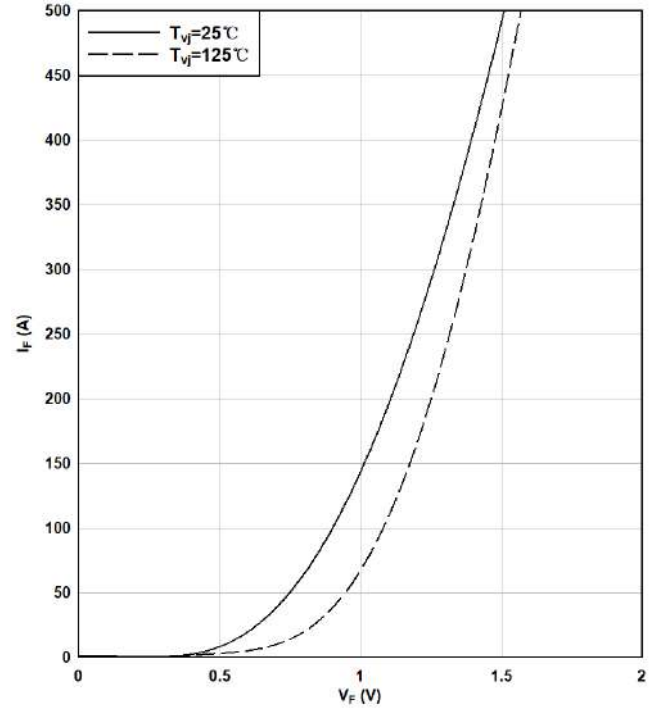
HCG450FL065E3FC 650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics Diagrams

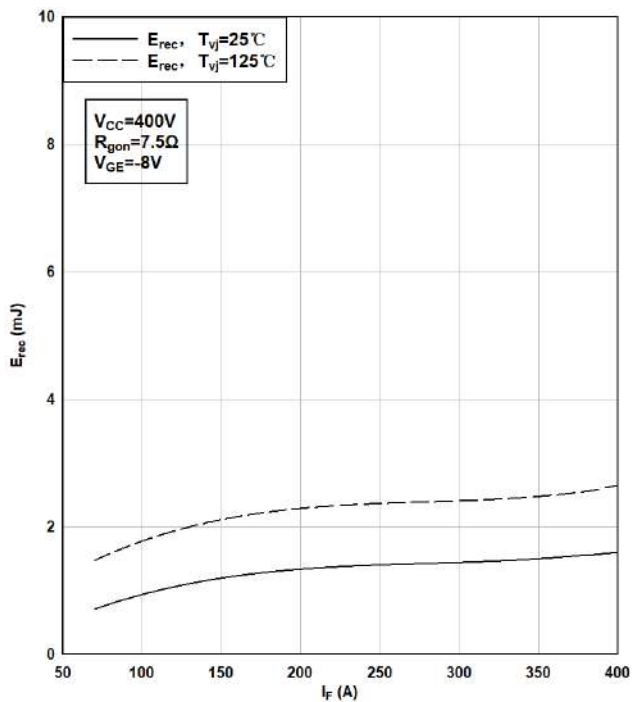
开关损耗 (典型), IGBT(T1/T4), 逆变器
Switching losses (typical), IGBT(T1/T4), Inverter
 $E = f(R_G)$
 $I_C = 200A$, $V_{CE} = 400V$, $V_{GE} = +15/-8V$



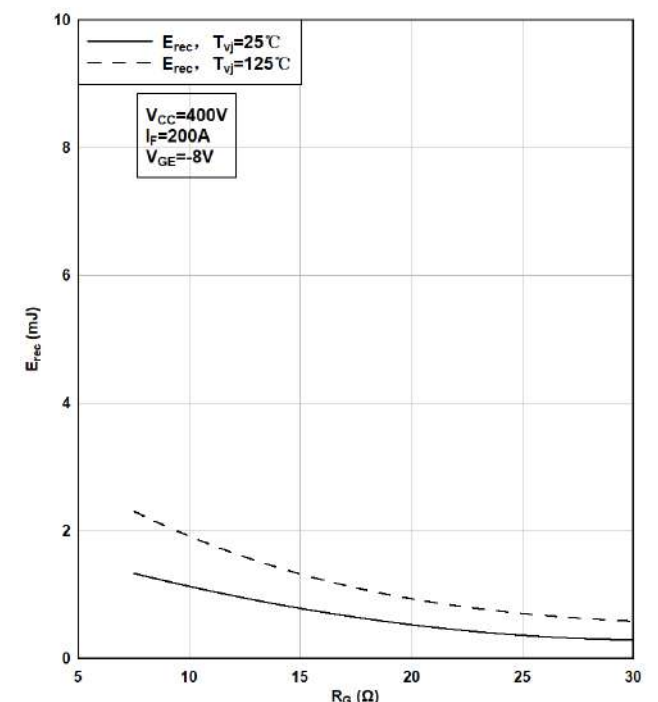
正向特性 (典型), 二极管(D5/D6)
Forward characteristic (typical), Diode(D5/D6)
 $I_F = f(V_F)$



开关损耗 (典型), 二极管(D5/D6)
Switching losses (typical), Diode(D5/D6)
 $E_{rec} = f(I_F)$
 $V_{CE} = 400V$, $R_{Gon} = 7.5\Omega$



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

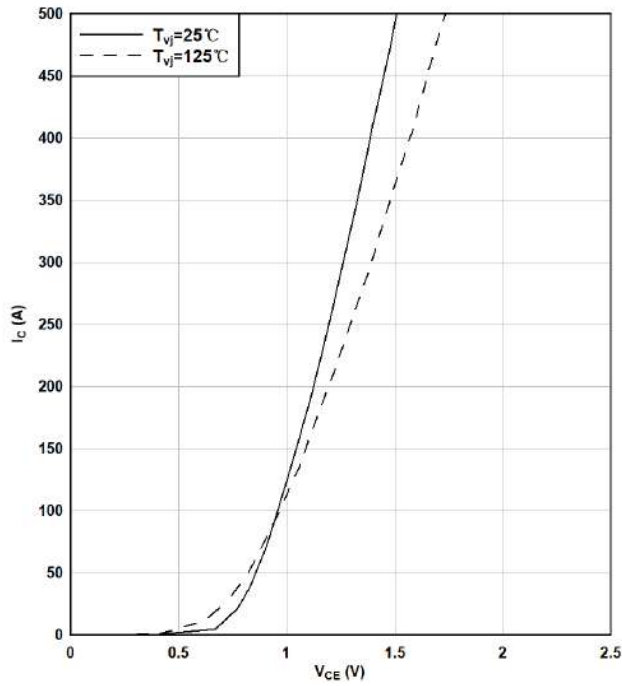


HCG450FL065E3FC

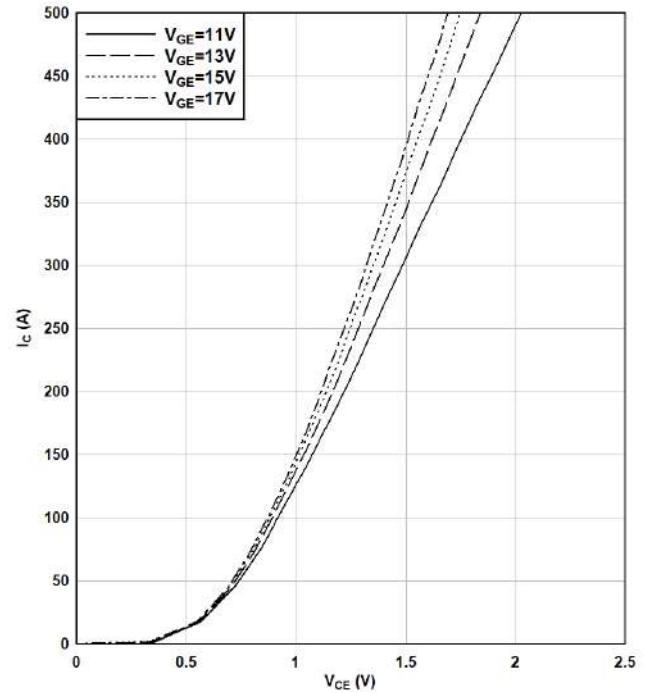
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics Diagrams

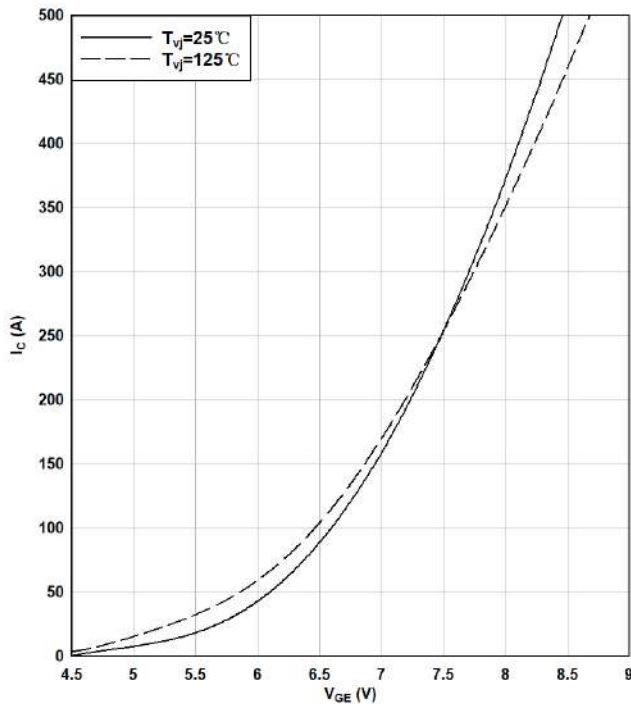
输出特性（典型），IGBT (T2/T3)，逆变器
Output characteristic (typical), IGBT(T2/T3), Inverter
 $I_C = f(V_{CE})$
 $V_{GE} = 15V$



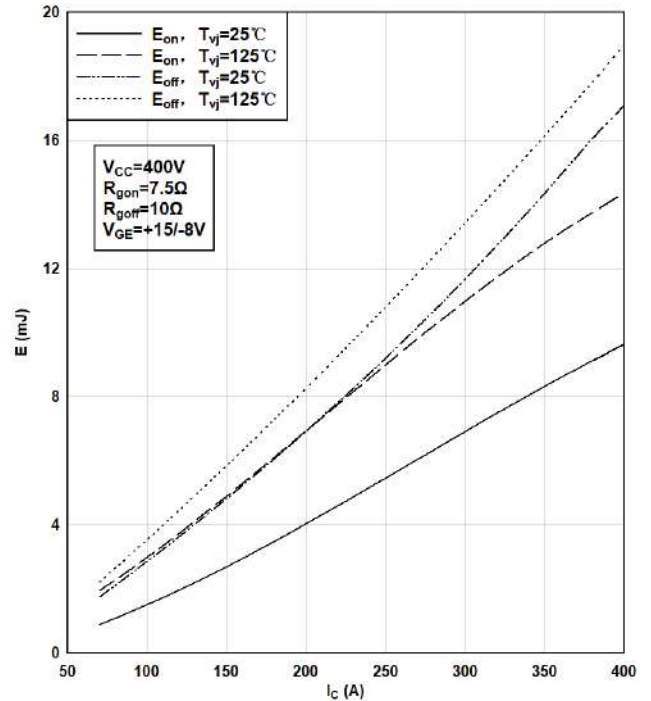
输出特性（典型），IGBT(T2/T3)，逆变器
Output characteristic (typical), IGBT(T2/T3), Inverter
 $I_C = f(V_{CE})$
 $T_{vj}=125^{\circ}C$



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
 $E = f(I_C)$
 $V_{CE} = 400V$, $R_{Gon}=7.5\Omega$, $R_{Goff}=10\Omega$, $V_{GE} = +15/-8V$

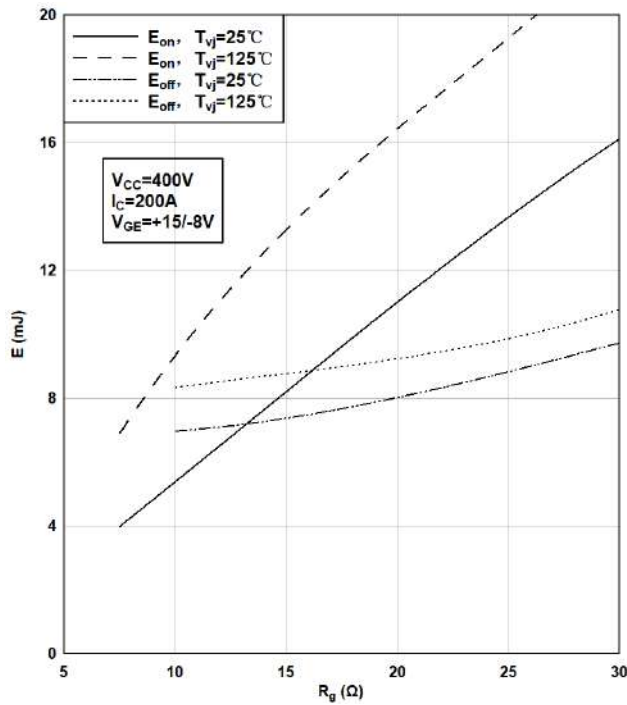


HCG450FL065E3FC

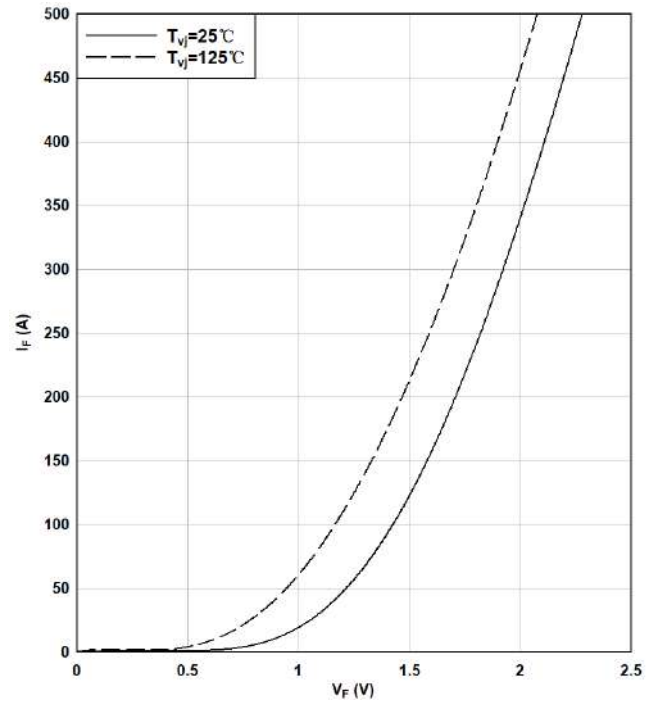
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics Diagrams

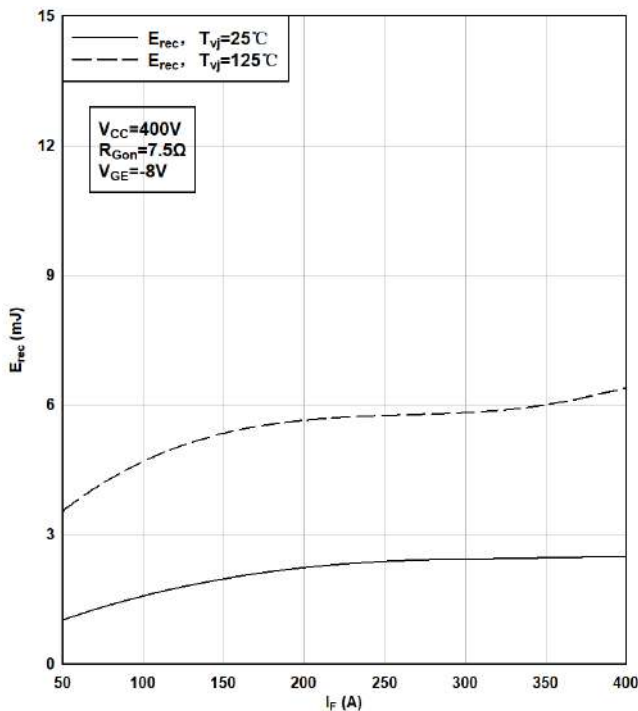
开关损耗 (典型), IGBT(T2/T3), 逆变器
Switching losses (typical), IGBT(T2/T3), Inverter
 $E = f(R_G)$
 $I_C = 200A$, $V_{CE} = 400V$, $V_{GE} = +15/-8V$



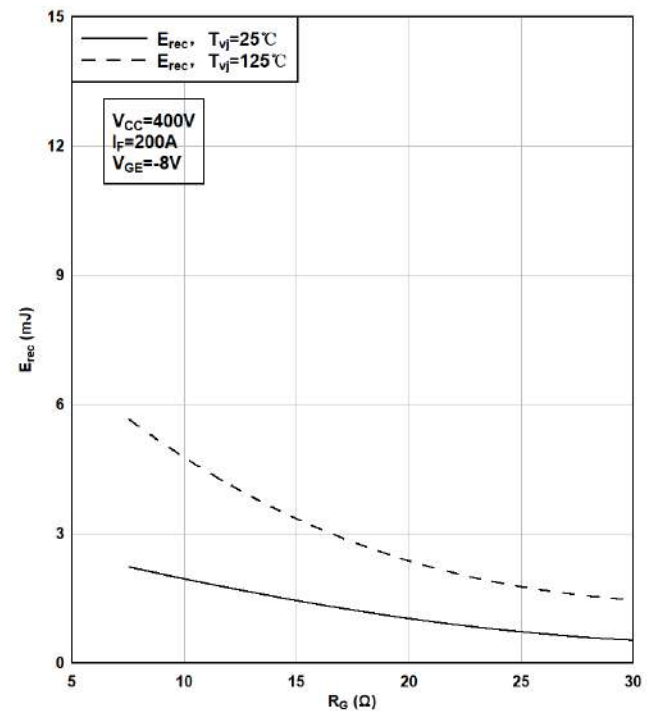
正向特性 (典型), 二极管(D7/D8)
Forward characteristic (typical), Diode(D7/D8)
 $I_F = f(V_F)$



开关损耗 (典型), 二极管(D7/D8)
Switching losses (typical), Diode(D7/D8)
 $E_{rec} = f(I_F)$
 $V_{CE} = 400V$, $R_{Gon} = 7.5\Omega$



开关损耗 (典型), 二极管(D7/D8)
Switching losses (typical), Diode(D7/D8)
 $E_{rec} = f(R_G)$
 $I_F = 200A$, $V_{CE} = 400V$

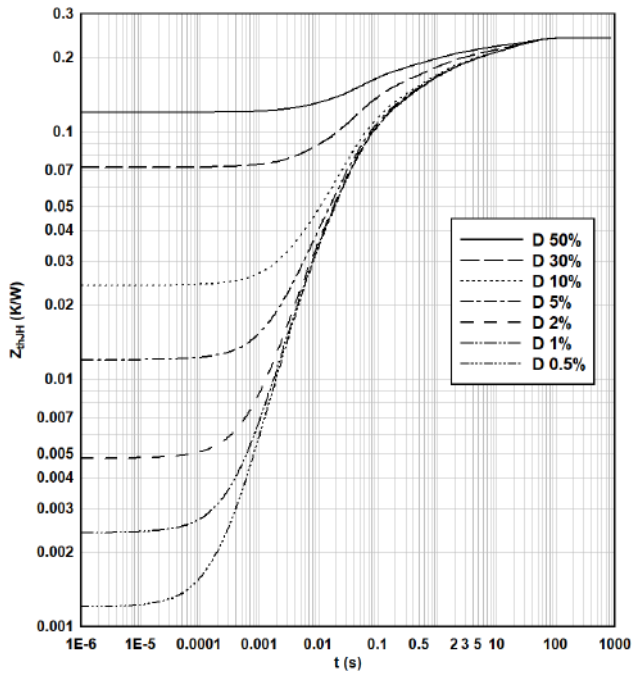


HCG450FL065E3FC

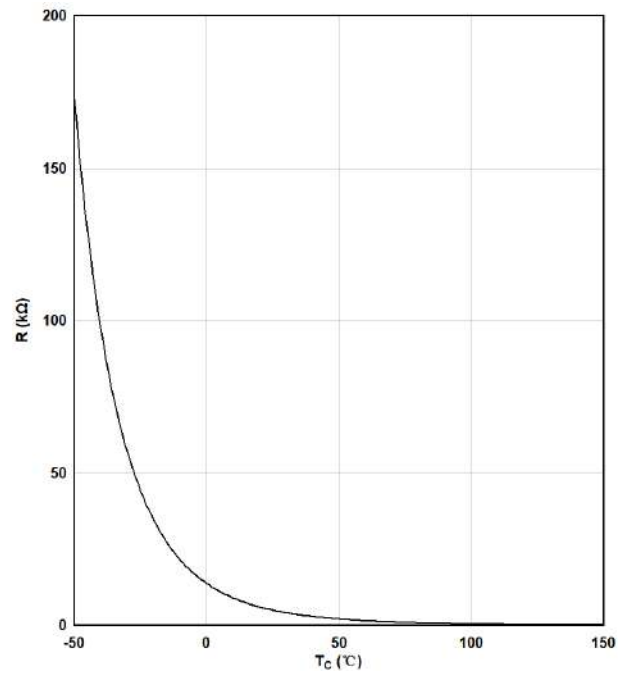
650V/450A 3-Level NPC IGBT Module

(续) 特征参数图表/Characteristics Diagrams

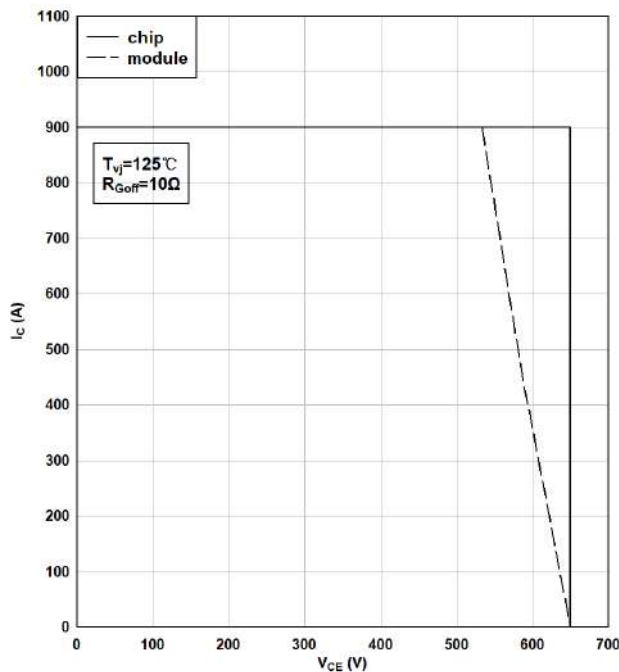
瞬态热阻抗, IGBT(T1/T2/T3/T4)
Transient thermal impedance, IGBT(T1/T2/T3/T4)
 $Z_{thJH} = f(t)$



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

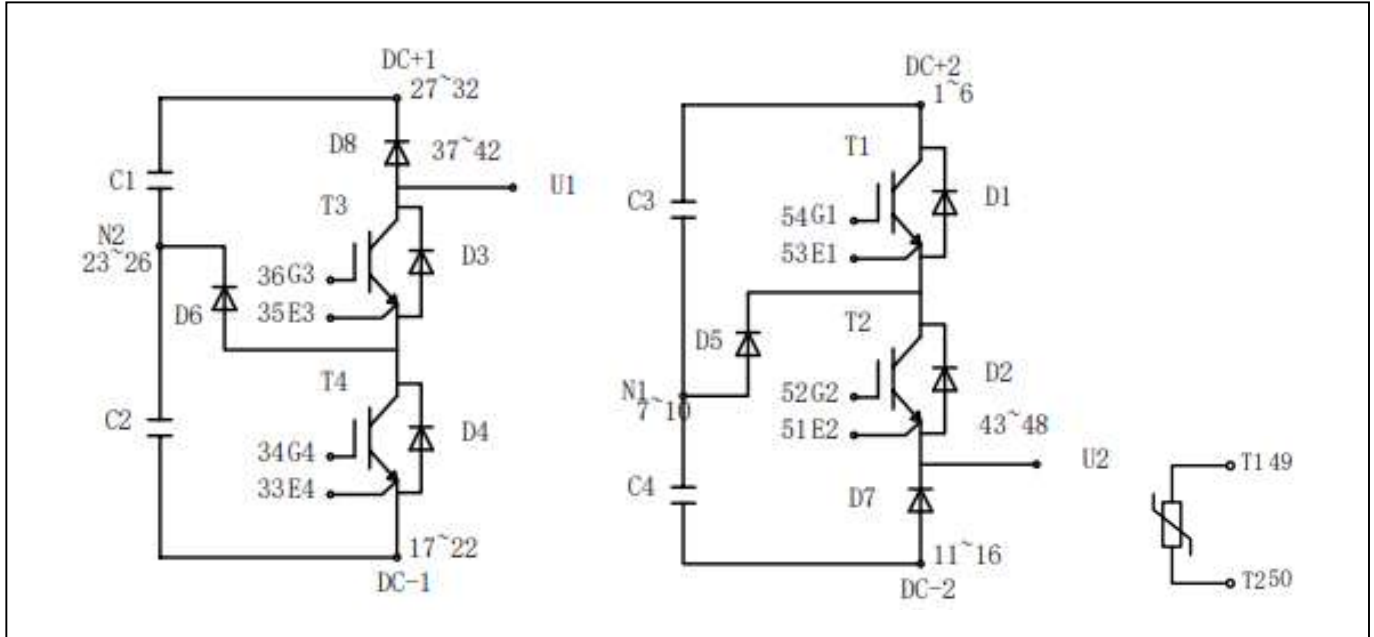


反偏安全工作区 IGBT, 逆变器 (T1/T2/T3/T4)
Reverse bias safe operating area IGBT, Inverter(T1/T2/T3/T4)
 $I_C = f(V_{CE})$



HCG450FL065E3FC 650V/450A 3-Level NPC IGBT Module

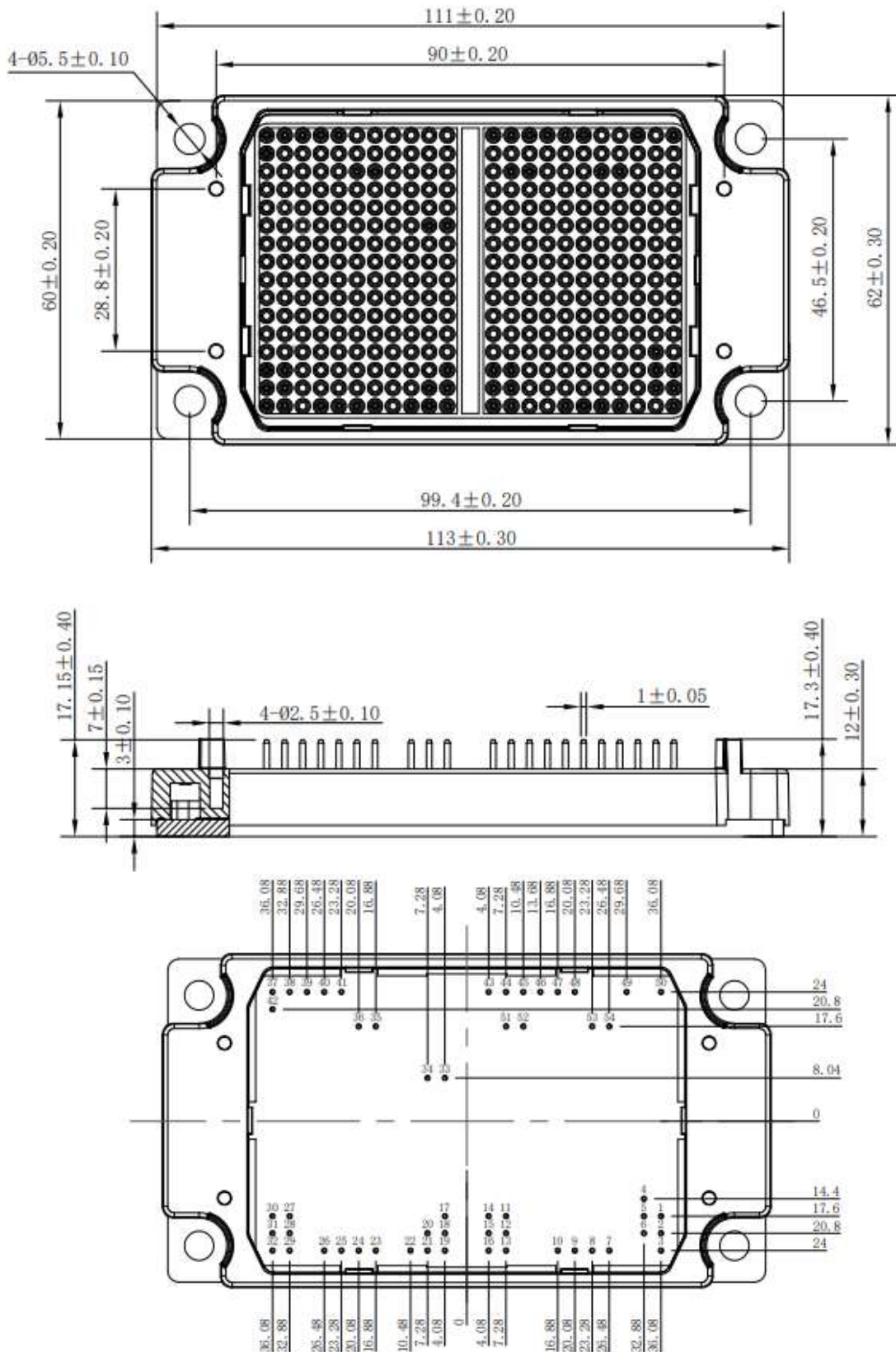
电路拓扑图/ Circuit Diagram



HCG450FL065E3FC

650V/450A 3-Level NPC IGBT Module

封装尺寸/ Package Outlines



HCG450FL065E3FC 650V/450A 3-Level NPC IGBT Module

模块标签信息/ Module Marking Information

Marking Diagram

HCG450FL065E3FC = Specific Device

P4CQ22420010001 = Lot Traceability

ACP-E3 = Package Type

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