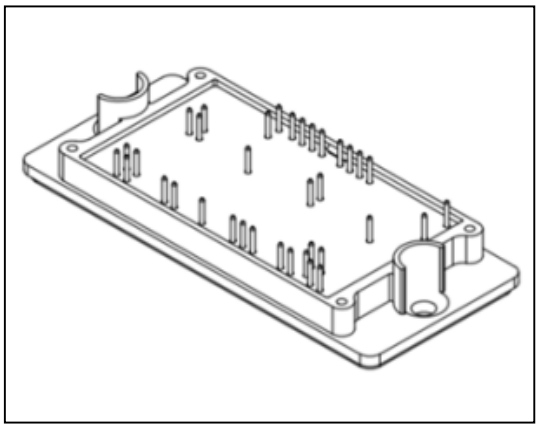
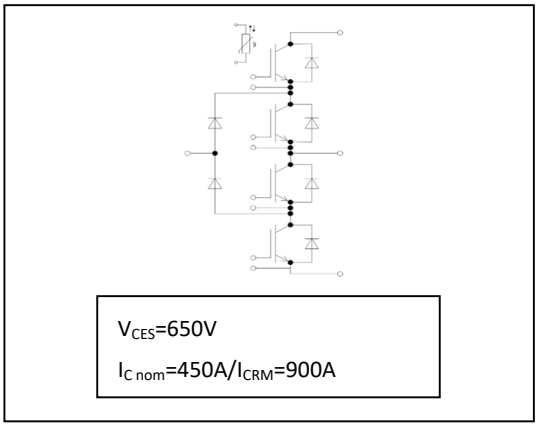
650V 450A IGBT I-Type 三电平模块





V_{CES}=650V

$I_{C\ nom}$=450A/I_{CRM}=900A

产品特性：

- 高可靠性中性点钳位
- 高速沟槽栅/场终止
- 发射极控制二极管
- 温度检测NTC热敏电阻

电气特性：

- 中点钳位三电平逆变
- 低杂散电感封装
- 内置快恢复二极管
- 内置热敏电阻
- 可焊接引脚封装

机械特性：

- 高功率循环和温度循环能力
- 铜基板提高坚固性
- 标准封装，兼容市场同类型模块

典型应用：

- 太阳能系统
- UPS系统
- 三电平应用

Q1/Q4 IGBT，逆变器

Maximum Rated Values / 最大额定值

Item	Symbol	Conditions	Value	Units
集电极－发射极电压 Collector-emitter voltage	V_{CES}	T_{vj}=25°C	650	V
连续集电极直流电流 Continuous DC collector current	$I_{C\ nom}$	T_C=25°C, T_{vjmax}=175°C	450	A
集电极重复峰值电流 Peak repetitive collector current	I_{CRM}	t_p=1ms	900	A
栅极－发射极峰值电压 Maximum gate-emitter voltage	V_{GES}		±20	V
最大工作结温 Maximum Operating Junction Temperature	T_{jmax}		175	°C

Q2/Q3 IGBT，逆变器

Maximum Rated Values / 最大额定值

Item	Symbol	Conditions	Value	Units
集电极－发射极电压 Collector-emitter voltage	V_{CES}	T_{vj}=25°C	650	V
连续集电极直流电流 Continuous DC collector current	$I_{C\ nom}$	T_C=25°C, T_{vjmax}=175°C	375	A
集电极重复峰值电流 Peak repetitive collector current	I_{CRM}	t_p=1ms	750	A
栅极－发射极峰值电压 Maximum gate-emitter voltage	V_{GES}		±20	V
最大工作结温 Maximum Operating Junction Temperature	T_{jmax}		175	°C

D1/D2/D3/D4 FRD，逆变器

D1/D2/D3D4 FRD, Inverter (Tj = 25°C, unless otherwise noted)

Item	Symbol	Conditions	Value	Units
反向重复峰值电压 Peak repetitive reverse voltage	V_{RRM}	T_{vj}=25°C	650	V
连续正向直流电流 Continuous DC forward current	I_F		150	A
正向重复峰值电流 Peak repetitive forward current	I_{FRM}	t_p=1ms	300	A

D5/D6 Diode，中性点钳位

D5/D6 Diode, Neutral point clamped (Tj = 25°C, unless otherwise noted)

Item	Symbol	Conditions	Value	Units
反向重复峰值电压 Peak repetitive reverse voltage	V_{RRM}	T_{vj}=25°C	830	V
连续正向直流电流 Continuous DC forward current	I_F		275	A
正向重复峰值电流 Peak repetitive forward current	I_{FRM}	t_p=1ms	825	A

模块
Module (Tj = 25oC, unless otherwise noted)

Item	Symbol	Value	Units
最大结温 Max junction temperature	Tjmax	1700	℃
允许工作温度 Operation temperature	Tjop	-40-150	℃
存储温度 Storage temperature	Tstg	-40-125	℃
绝缘耐压(RMS f=50Hz,t=1min) Isolation test voltage	VISO	2500	V

电气特性参数
Q1/Q4 IGBT，逆变器

Item	Symbol	Conditions		Min.	Typ.	Max.	Units
集电极－发射极饱和电压 Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C=200A,V_{GE}=15V	T_{vj}=25°C		1.25		V
			T_{vj}=125°C		1.65		V
			T_{vj}=150°C		1.80		V
栅极阈值电压 Gate threshold voltage	$V_{GE(th)}$	I_C=1mA, V_{CE}=V_{GE}, T_{vj}=25°C		5.51	5.55	5.59	V
栅极电荷 Gate charge	Q_G	V_{GE}=+15V,V_{CE}=400V			0.45		μC
输入电容 Input capacitance	C_{ies}	f=1MHz, T_{vj}=25°C, V_{CE}=25V, V_{GE}=0V			14.6		nF
输出电容 Output capacitance	C_{oes}	f=1MHz, T_{vj}=25°C, V_{CE}=10V, V_{GE}=0V			0.02		nF
反向传输电容 Reverse transfer capacitance	C_{res}	f=1MHz, T_{vj}=25°C, V_{CE}=10V, V_{GE}=0V			0.06		nF
集电极-发射极截止电流 Collector-emitter cut-off current	I_{CES}	V_{CE}=650V, V_{GE}=0V, T_{vj}=25°C		0.58	0.63	0.78	μA
栅极-发射极漏电流 Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V, T_{vj}=25°C		6.59	8.47	10.28	nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	$t_{d(on)}$	I_C=200A, V_{CE}=400V V_{GE}=±15V R_{Gon}=5 Ω R_{Goff}=5 Ω	T_{vj}=25°C		60		ns
			T_{vj}=125°C		70		ns
			T_{vj}=150°C		70		ns
上升时间(电感负载) Rise time, inductive load	t_r		T_{vj}=25°C		160		ns
			T_{vj}=125°C		170		ns
			T_{vj}=150°C		170		ns
关断延迟时间(电感负载) Turn-off delay time, inductive load	$t_{d(off)}$		T_{vj}=25°C		370		ns
			T_{vj}=125°C		380		ns
			T_{vj}=150°C		380		ns
下降时间(电感负载) Fall time, inductive load	t_f		T_{vj}=25°C		90		ns
			T_{vj}=125°C		110		ns
			T_{vj}=150°C		110		ns
开通损耗能量(每脉冲) Turn-on energy loss per pulse	E_{on}		T_{vj}=25°C		5.22		mj
			T_{vj}=125°C		5.28		mj
			T_{vj}=150°C		5.30		mj
关断损耗能量(每脉冲） Turn-off energy loss per pulse	E_{off}		T_{vj}=25°C		19.9		mj
			T_{vj}=125°C		21.1		mj
			T_{vj}=150°C		21.1		mj
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	Per IGBT / 每个 IGBT			0.28		K/W
开关工作温度范围 Temperature under switching conditions	$T_{vj\ op}$				-40-150°C		K/W

电气特性参数
Q2/Q3 IGBT，逆变器

Item	Symbol	Conditions		Min.	Typ.	Max.	Units
集电极－发射极饱和电压 Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C=200A,V_{GE}=15V	T_{vj}=25°C T_{vj}=125°C T_{vj}=150°C		1.25 1.66 1.80		V V V
栅极阈值电压 Gate threshold voltage	$V_{GE(th)}$	I_C=1mA, V_{CE}=V_{GE}, T_{vj}=25°C		5.0	5.59	6.5	V
栅极电荷 Gate charge	Q_G	V_{GE}=+15V,V_{CE}=400V			0.75		μC
输入电容 Input capacitance	C_{ies}	f=1MHz, T_{vj}=25°C, V_{CE}=25V, V_{GE}=0V			24.3		nF
输出电容 Output capacitance	C_{oes}	f=1MHz, T_{vj}=25°C, V_{CE}=10V, V_{GE}=0V			0.38		nF
反向传输电容 Reverse transfer capacitance	C_{res}	f=1MHz, T_{vj}=25°C, V_{CE}=10V, V_{GE}=0V			0.11		nF
集电极-发射极截止电流 Collector-emitter cut-off current	I_{CES}	V_{CE}=650V, V_{GE}=0V, T_{vj}=25°C			5		μA
栅极-发射极漏电流 Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V, T_{vj}=25°C			100		nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	$t_{d(on)}$	I_C=200A, V_{CE}=400V V_{GE}=±15V R_{Gon}=5 Ω R_{Goff}=5 Ω	T_{vj}=25°C T_{vj}=125°C T_{vj}=150°C		50 70 70		ns ns ns
上升时间(电感负载) Rise time, inductive load	t_r		T_{vj}=25°C T_{vj}=125°C T_{vj}=150°C		210 230 230		ns ns ns
关断延迟时间(电感负载) Turn-off delay time, inductive load	$t_{d(off)}$		T_{vj}=25°C T_{vj}=125°C T_{vj}=150°C		330 370 380		ns ns ns
下降时间(电感负载) Fall time, inductive load	t_f		T_{vj}=25°C T_{vj}=125°C T_{vj}=150°C		120 140 150		ns ns ns
开通损耗能量(每脉冲) Turn-on energy loss per pulse	E_{on}		T_{vj}=25°C T_{vj}=125°C T_{vj}=150°C		3.12 3.16 3.18		mj mj mj
关断损耗能量(每脉冲） Turn-off energy loss per pulse	E_{off}		T_{vj}=25°C T_{vj}=125°C T_{vj}=150°C		26 26.1 26.1		mj mj mj
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	Per IGBT / 每个 IGBT			0.28		K/W
开关工作温度范围 Temperature under switching conditions	$T_{vj\ op}$				-40-150°C		K/W

D1/D2/D3/D4 FRD，逆变器
Characteristic Values / 特征值

Item	Symbol	Conditions		Min.	Typ.	Max.	Units
正向电压 Forward voltage	V_F	I_F=150A，V_{GE}=0V	T_{vj}=25°C		1.41		V
			T_{vj}=125°C		1.35		V
			T_{vj}=150°C		1.32		V
反向恢复峰值电流 Peak reverse recovery current	I_{RM}	I_F=200A $-di_F/dt_{off}$=4130A/μs V_R =400 V	T_{vj}=25°C		91		A
			T_{vj}=125°C		94		A
			T_{vj}=150°C		96		A
恢复电荷 Recovery charge	Q_r		T_{vj}=25°C		40.3		uC
			T_{vj}=125°C		41		uC
			T_{vj}=150°C		41		uC
反向恢复损耗（每脉冲） Reverse recovery energy (per pulse)	E_{rec}		T_{vj}=25°C		11.38		mJ
			T_{vj}=125°C		11.5		mJ
			T_{vj}=150°C		11.5		mJ
反向恢复时间 Reverse recovery time	T_{RR}		T_{vj}=25°C		0.24		μs
			T_{vj}=125°C		0.31		μs
			T_{vj}=150°C		0.36		μs
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	Per diode / 每个二极管				0.41	K/W
工作温度 Temperature under switching conditions	T_{vjop}			-40		150	°C

D5/D6 Diode，中性点钳位
Characteristic Values / 特征值

Item	Symbol	Conditions		Min.	Typ.	Max.	Units
正向电压 Forward voltage	V_F	I_F=200A，V_{GE}=0V	T_{vj}=25°C		1.13		V
			T_{vj}=125°C		1.11		V
			T_{vj}=150°C		1.10		V
反向截止电流 Reverse cut off current	I_R	VR=650V			0.72		μA
反向恢复峰值电流 Peak reverse recovery current	I_{RM}	I_F=200A $-di_F/dt_{off}$=1700A/μs V_R =400 V	T_{vj}=25°C		69		A
			T_{vj}=125°C		73		A
			T_{vj}=150°C		73		A
恢复电荷 Recovery charge	Q_r		T_{vj}=25°C		40.3		uC
			T_{vj}=125°C		41		uC
			T_{vj}=150°C		41		uC
反向恢复损耗（每脉冲） Reverse recovery energy (per pulse)	E_{rec}		T_{vj}=25°C		11.38		mJ
			T_{vj}=125°C		11.5		mJ
			T_{vj}=150°C		11.5		mJ
反向恢复时间 Reverse recovery time	T_{RR}		T_{vj}=25°C		0.29		μs
			T_{vj}=125°C		0.35		μs
			T_{vj}=150°C		0.39		μs
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	Per diode / 每个二极管				0.41	K/W
工作温度 Temperature under switching conditions	T_{vjop}			-40		150	°C

负温度系数热敏电阻/NTC-Thermistor

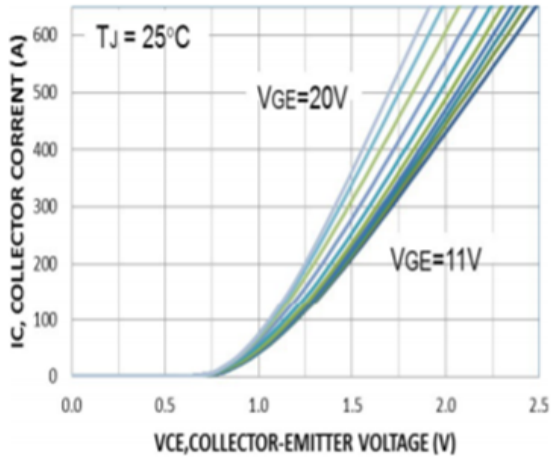
Electrical Characteristics特征值

Item	Symbol	Conditions	Min.	Typ.	Max.	Units
额定电阻值 Rated resistance	R25	Tc=25℃		5		KΩ
R100偏差 Deviation of R100	dR/R	TC=100℃, R100=490Ω	-5		5	%
耗散功率 Power dissipation	P25	TC=25℃		20		mW
B-值 B-Value	B25/50	R2=R25exp[B25/50(1/T2-1/(298.15k))]		3380		K
B-值 B-Value	B25/80	R2=R25exp[B25/80(1/T2-1/(298.15k))]		3411		K
B-值 B-Value	B25/100	R2=R25exp[B25/100(1/T2-1/(298.15k))]		3433		K

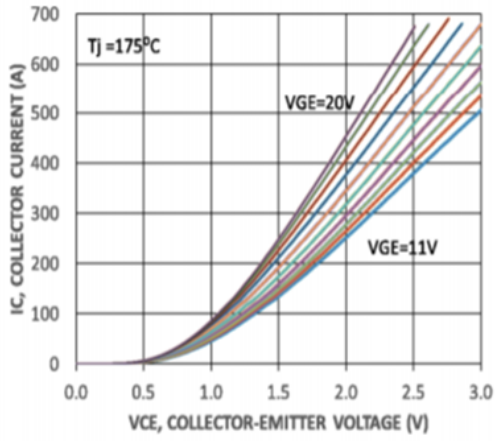
Module / 模块

Item	Symbol	Conditions	Value	Units
绝缘测试电压 Isolation test voltage	V_{ISOL}	RMS, f=50Hz, t=1min	2.5	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-散热片 / terminal to heatsink	>12.7	mm
电气间隙 Clearance		端子-散热片 / terminal to heatsink	>12.7	mm
模块引线电阻(端子-芯片) Module lead resistance, terminals - chip			4.8	mΩ
模块安装的安装扭矩 Mounting torque for module mounting			3.0-6.0	Nm

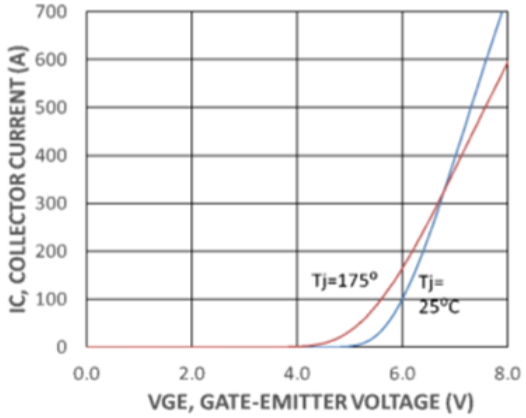
输出特性 Q1/Q4 IGBT，逆变器（典型）
IC=f(VCE), Tj = 25°C



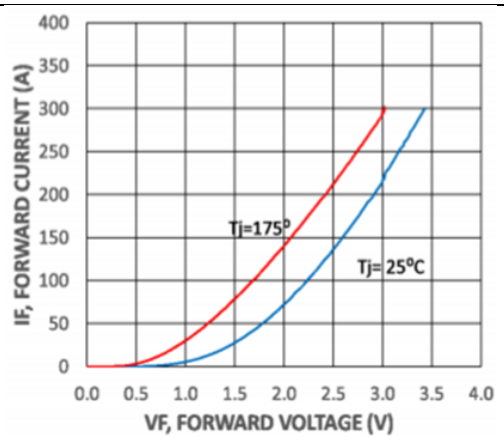
输出特性 Q1/Q4 IGBT，逆变器（典型）
IC=f(VCE), Tj = 175°C



传输特性 Q1/Q4 IGBT，逆变器(典型)
$I_C=f(V_{GE})$
$V_{CE}=20V$

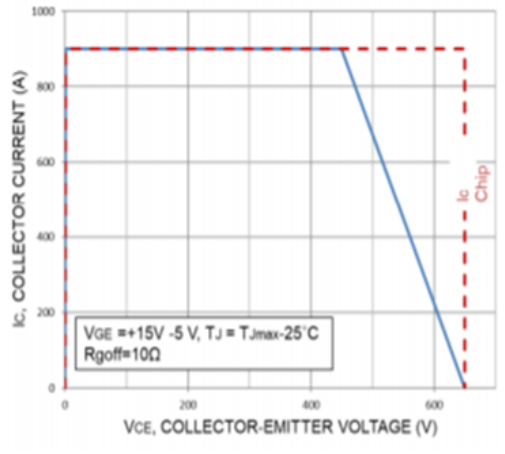


正向偏压特性FRD，逆变器(典型)
IF=f(VF)

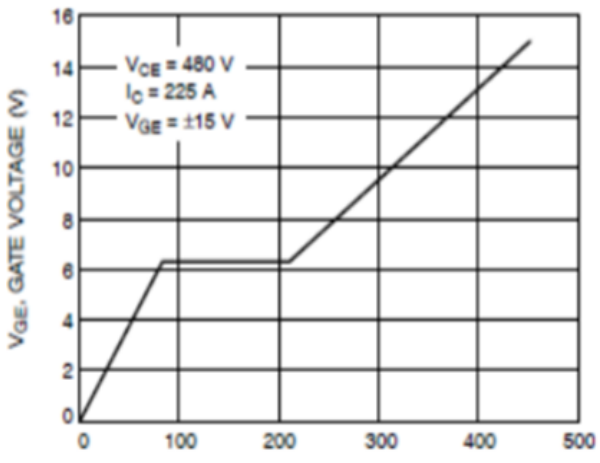


反偏安全工作区Q1/Q4IGBT，逆变器(典型)

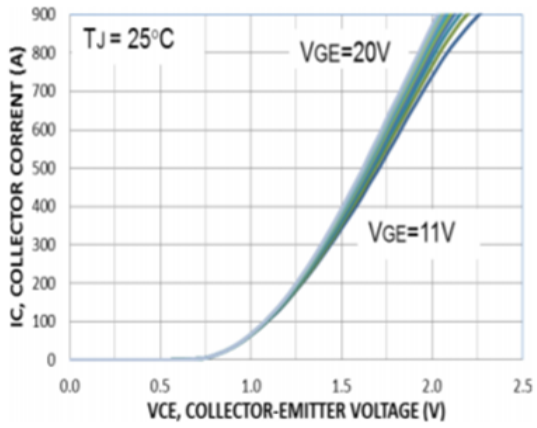
IC =f(VCE)，Tvj = 25°C，VGE =±15V，Rg=5Ω



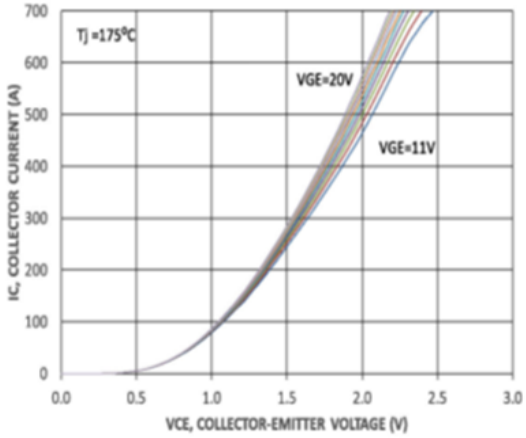
门极电压VS 门极电荷Q1/Q4IGBT，逆变器(典型)
VGE =±15V, VCE = 480V, IC = 225A



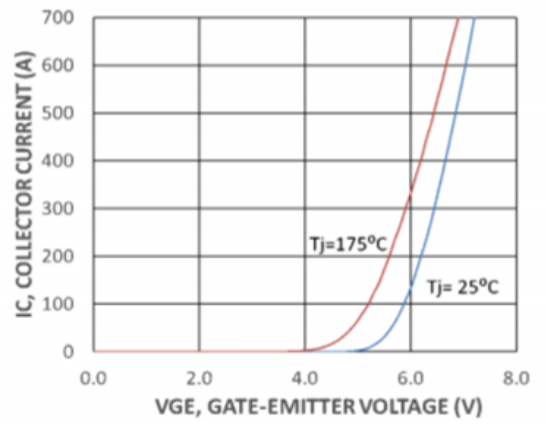
输出特性Q2/Q3IGBT，逆变器(典型)
IC=f(VCE)
Tvj = 25°C



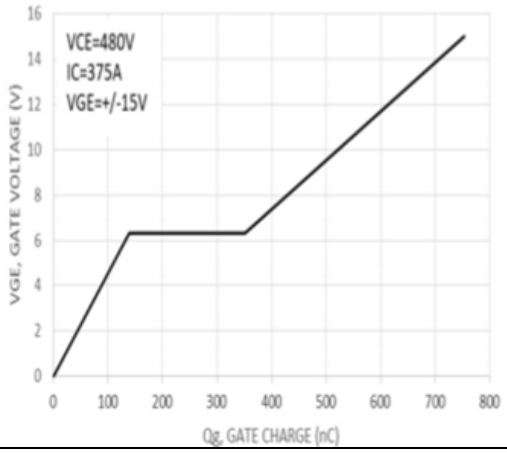
输出特性Q2/Q3IGBT，逆变器(典型)
IC=f(VCE)
Tvj = 175°C



传输特性Q2/Q3IGBT，逆变器(典型)
IC=f(VGE),
VCE=20V

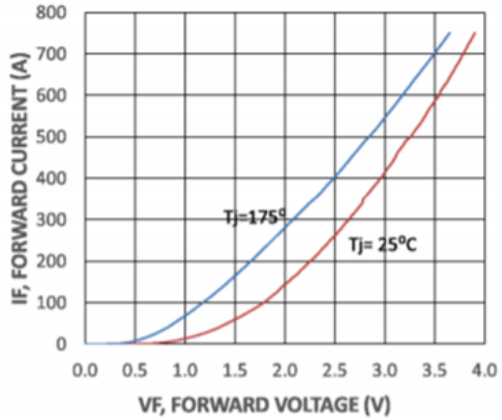


门极电压VS 门极电荷Q2/Q3IGBT，逆变器(典型)
VGE =±15V,
VCE = 480V, IC = 375A

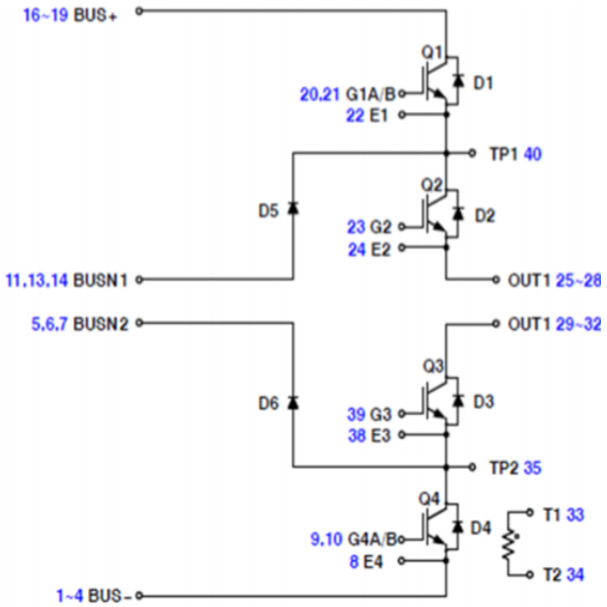


正向偏压特性D5/D6 FRD，中性点钳位(典型)

IF=f(VF)



Circuit diagram headline / 接线图



Package outlines / 封装尺寸