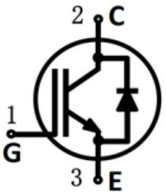
650V60A 绝缘栅双极型晶体管

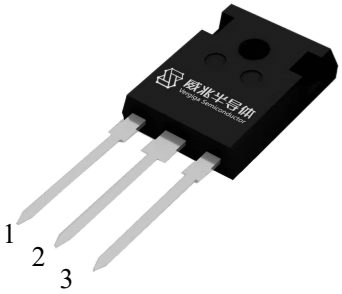
■ 特点/Features

- CoolWatt®Ⅱ沟槽栅场截止技术/CoolWatt®Ⅱ Trench-FS technology
- 低饱和压降/Low V_{CESAT}
- 低动态损耗/Low switching losses
- 反并联快恢复二极管/With anti-parallel fast recovery diode
- 正温度系数/Positive temperature coefficient
- 高可靠性/High reliability



■ 应用领域/Applications

- 电源类/Power
- PV/光伏领域
- 工业焊机/Industrial welding



TO-247

型号/Part ID	V_{CE}(V)	I_{CNOM}(A)	$V_{CESAT@25℃}$(V)	封装/Package	丝印/Marking
HCKW60N65BH2A	650	60	1.65	TO-247	K60H65B2A

■ 最大额定值/Maximum Rated Values

符号 Symbol	参数 Parameter	条件 Condition	值 Value	单位 Unit
V_{CES}	集电极-发射极电压 Collector-emitter voltage	T_{vj}=25℃	650	V
I_C	集电极连续直流电流 DC collector current	T_C = 25℃ T_C =100℃	120 60	A
I_{Cpuls}	集电极可重复脉冲电流 Pulse collector current	T_{vj}≤150℃	180	A
V_{RRM}	二极管反向峰值电压 Repetitive peak reverse voltage	T_{vj}=25℃	650	V
I_F	二极管连续直流电流 Diode continuous forward current	T_C = 25℃ T_C = 100℃	120 60	A
I_{Fpuls}	二极管可重复脉冲电流 Diode pulse current	T_{vj}≤150℃	180	A

V_{GE}	栅极-发射极电压 Gate-emitter voltage	T_{vj}=25℃	±20	V
P_{tot}	总耗散功率 Power dissipation	T_C = 25℃	375	W
T_{vj}	可工作结温 Operating junction temperature		-40~+ 175	℃
T_{stg}	储存温度 Storage temperature		-50~ + 150	℃
M	安装扭矩 Mounting torque	M3	0.6	Nm

■ 热特性/Thermal Characteristic

符号 Symbol	参数 Parameter	最大值 Maximum	单位 Unit
$R_{thJC-IGBT}$	IGBT 芯片到底板热阻 IGBT thermal resistance junction-case	0.40	K/W
$R_{thJC-FRD}$	二极管芯片到底板热阻 FRD thermal resistance junction-case	0.65	K/W
R_{thJA}	芯片到环境热阻 Thermal resistance junction-ambient	40	K/W

■ 电气特性/Electrical Characteristic

符号 Symbol	参数 Parameter	测试条件 Test conditions	值Value 最小 Min.	 典型 Typ.	 最大 Max.	单位 Unit
$V_{(BR)CES}$	集电极-发射极击穿电压 Collector-emitter breakdown voltage	V_{GE} = 0V, I_C=0.25mA,T_{vj}=25℃	650	—	—	V
$V_{CE(sat)}$	集电极-发射极饱和压降 Collector-emitter saturation voltage	V_{GE}=15V, I_C=60A, T_{vj}=25℃ T_{vj}=150℃	— —	1.65 1.95	1.85 —	
$V_{GE(th)}$	门极开启阀值电压 Gate-emitter threshold voltage	V_{GE}= V_{CE},I_C=1.5mA,T_{vj}=25℃	5.50	6.05	6.50	
V_F	二极管正向导通压降 Diode forward voltage	V_{GE}= 0V,I_F=60A, T_{vj}=25℃ T_{vj}=150℃	— —	1.45 1.25	1.75 —	
I_{GES}	门极-发射极漏电流 Zero collector voltage gate current	V_{GE}=30V,V_{CE}=0V	—	—	200	nA
I_{CES}	集电极-发射极漏电 Zero gate voltage collector current	V_{CE} =650V,V_{GE}=0V, T_{vj}=25℃ T_{vj}=150℃	— —	— —	0.20 0.50	mA
R_{Gin}	内部门极电阻 Integrated gate resistor	—	—	0	—	Ω
C_{ies}	输入电容 Input capacitance	V_{GE} = 0V,V_{CE}= 30V,	—	5050	—	pF

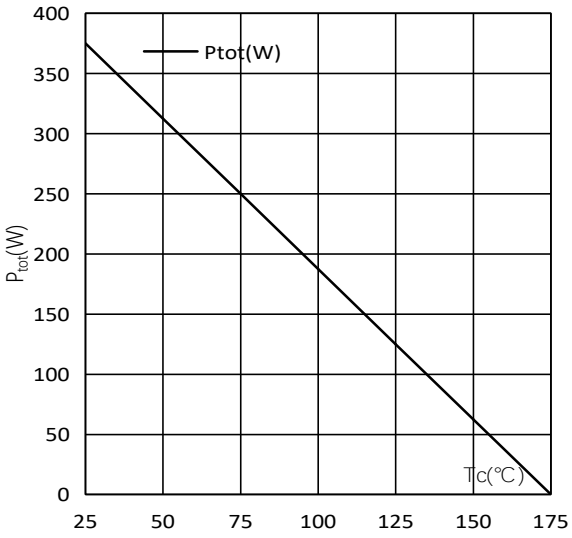
C_{oes}	输出电容 Output capacitance	f = 1MHz, T_{vj}=25℃	—	190	—	
C_{res}	反向传输电容 Reverse transfer capacitance		—	91.7	—	
Q_g	门极电量 Gate charge	I_C =60A,V_{CE}=520V, V_{GE}=15V, T_{vj}=25℃	—	252	—	nC
Q_{ge}	门极-发射极电量 Gate-emitter charge		—	39	—	
Q_{gc}	门极-集电极电量 Gate-collector charge		—	132	—	
V_{GE}(pl)	米勒平台电压 Gate-emitter plateau voltage	I_C =60A,V_{CE}=520V, V_{GE}=0/15V, T_{vj}=25℃	—	8.80	—	V

■ 动态特性/Dynamic Characteristic（With inductive load）

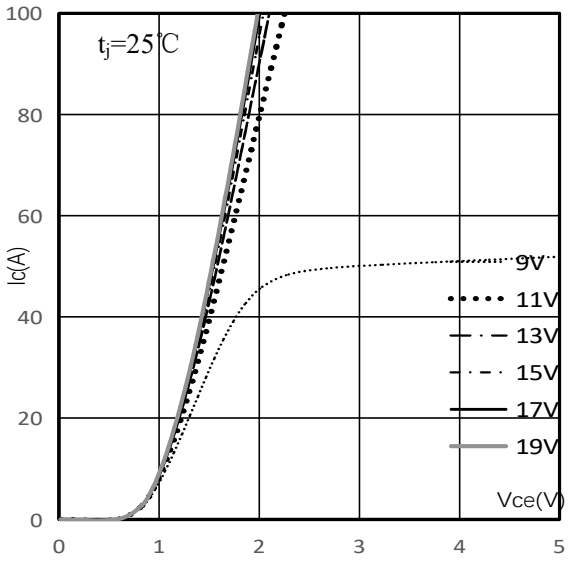
符号 Symbol	参数 Parameter	测试条件 Test conditions	值Value 最小 Min.	 典型 Typ.	 最大 Max.	单位 Unit
IGBT 特性_25℃/IGBT Characteristic_25℃：						
$T_{d(on)}$	开启延迟时间 Turn-on delay time	Vcc=400V,Ic=60A, Ron=20Ω, Roff=20Ω, Cge=0nF,V_{GE}=0/15V, L_{load}=100uH,T_{vj}=25℃	—	126	—	ns
T_r	上升时间 Rise time		—	136	—	
$T_{d(off)}$	关闭延迟时间 Turn-off delay time		—	546	—	
t_f	下降时间 Fall time		—	66	—	
E_{on}	单次开启损耗 Turn-on energy		—	2.52	—	mJ
E_{off}	单次关闭损耗 Turn-off energy		—	2.13	—	
E_{total}	单脉冲总损耗 Total switch energy		—	4.65	—	
IGBT 特性_150℃/IGBT Characteristic_150℃：						
$T_{d(on)}$	开启延迟时间 Turn-on delay time	Vcc=400V,Ic=60A, Ron=20Ω, Roff=20Ω, Cge=0nF,V_{GE}=0/15V, L_{load}=100uH,T_{vj}=150℃	—	109	—	ns
T_r	上升时间 Rise time		—	135	—	
$T_{d(off)}$	关闭延迟时间 Turn-off delay time		—	587	—	
t_f	下降时间 Fall time		—	76	—	
E_{on}	单次开启损耗 Turn-on energy		—	3.43	—	mJ
E_{off}	单次关闭损耗 Turn-off energy		—	2.44	—	
E_{total}	单脉冲总损耗 Total switch energy		—	5.87	—	
二极管特性_25℃/Diode Characteristic_25℃：						
Erec	反向恢复损耗 Reverse recovery energy	I_F = 60 A,V_R=400V, V_{GE} =0/15 V,R_{ON}=20Ω,T_{vj}=25℃	—	190	—	uJ
trr	二极管反向恢复时间 Diode reverse recovery time		—	142	—	nS
Qrr	二极管反向恢复电量 Diode reverse recovery charge		—	890	—	nC
Irrm	反向恢复峰值电流 Diode peak reverse recovery current		—	12.6	—	A
di_{rr}/dt	恢复下降电流最大电流变化率 Diode peak rate of fall of reverse Recovery current during t_{rr}		—	289	—	A/uS

二极管特性_150℃/Diode Characteristic_150℃：						
Erec	反向恢复损耗 Reverse recovery energy	I_F = 60 A,V_R=400V, V_{GE} =0/15 V,R_{ON}=20Ω, T_{vj}=150℃	—	902	—	uJ
trr	二极管反向恢复时间 Diode reverse recovery time		—	285	—	nS
Qrr	二极管反向恢复电量 Diode reverse recovery charge		—	3850	—	nC
Irrm	反向恢复峰值电流 Diode peak reverse recovery current		—	31	—	A
di_{rr}/dt	恢复下降电流最大电流变化率 Diode peak rate of fall of reverse Recovery current during t_{rr}		—	201	—	A/uS

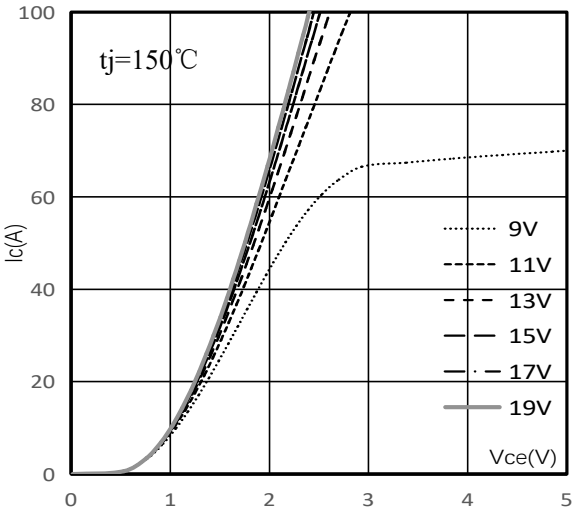
■ 特征曲线/ Characteristic Curve



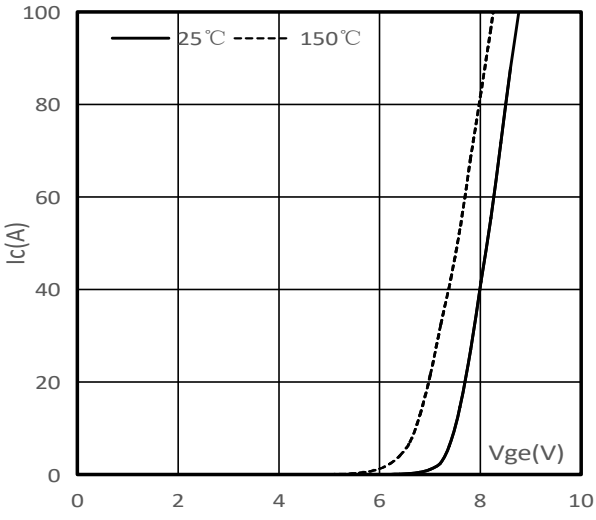
耗散功率-温度特性/P_{tot} as a function of case Temperature



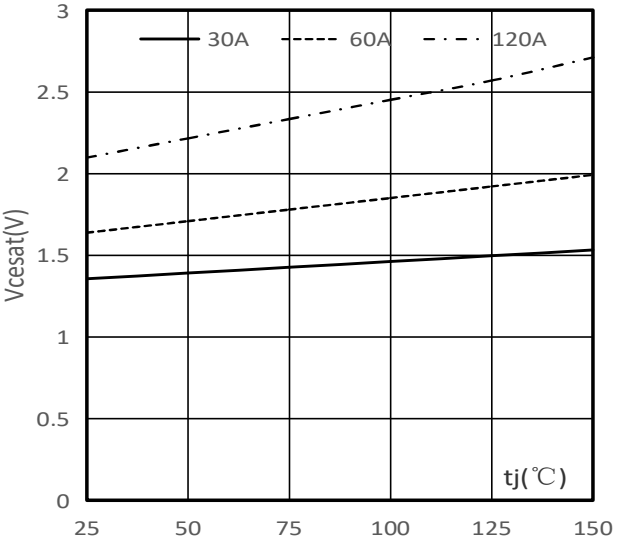
输出特性_25℃/ Typical Output Characteristic_25℃



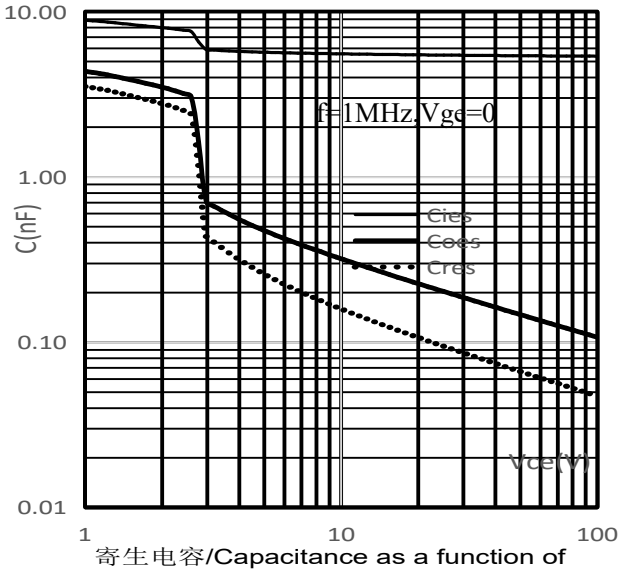
输出特性_150℃/ Typical Output Characteristic_150℃



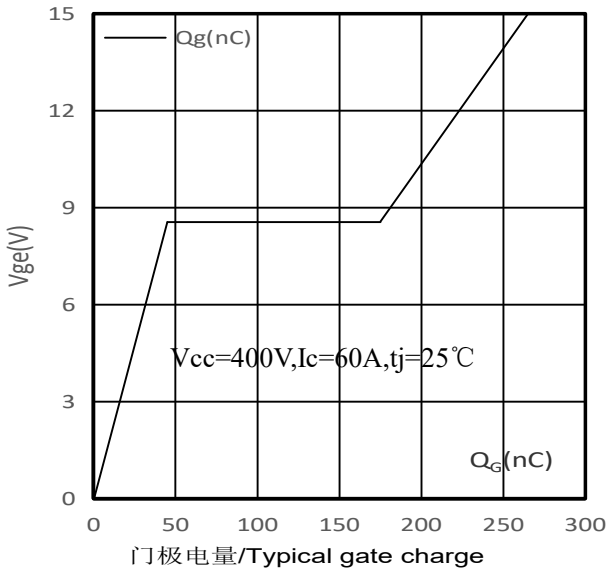
输出特性/ Typical Output Characteristic



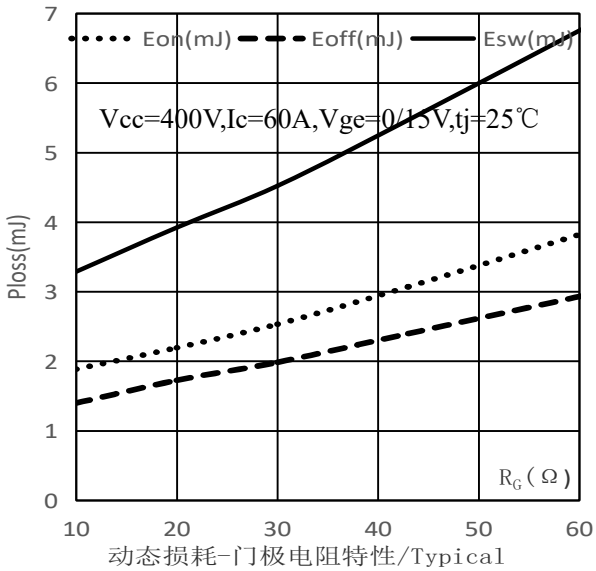
饱和压降-温度特性/ Vcesat as a function of temperature



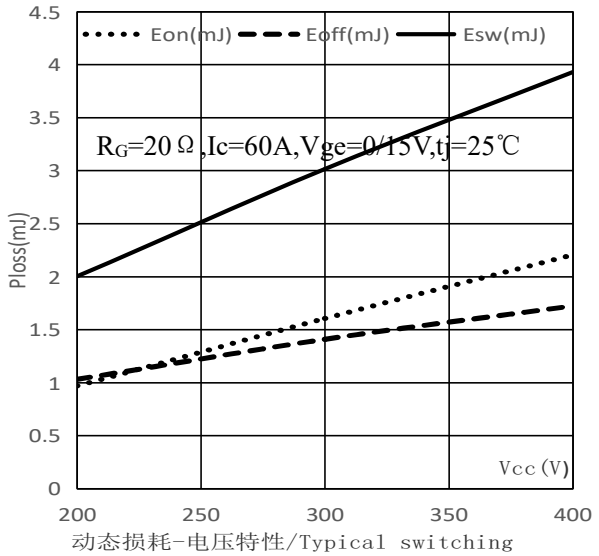
寄生电容/Capacitance as a function of Vce



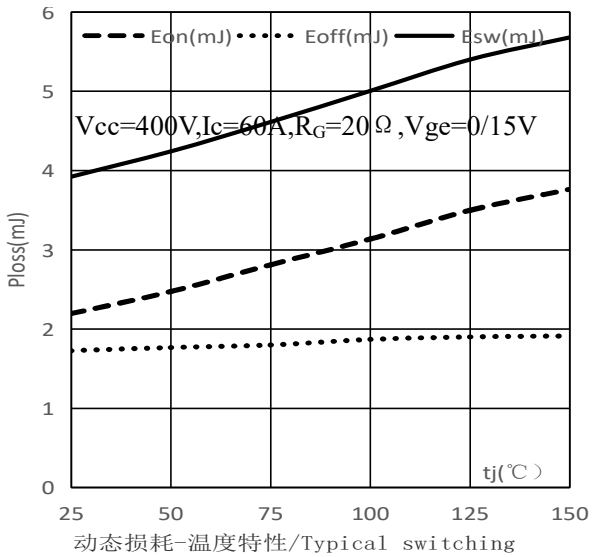
门极电量/Typical gate charge



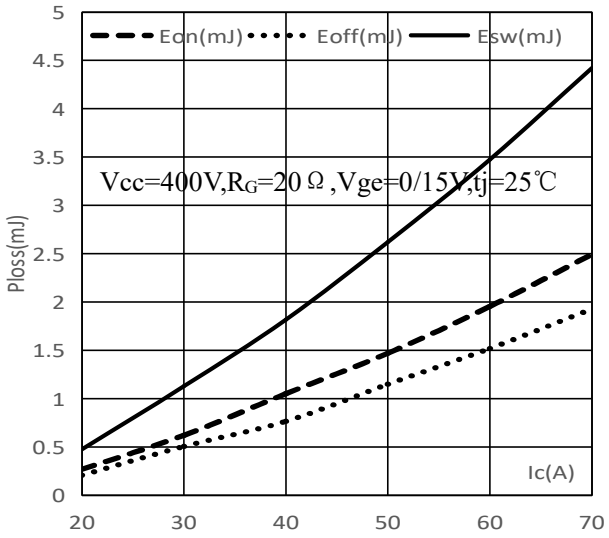
动态损耗-门极电阻特性/Typical switching losses of R_G



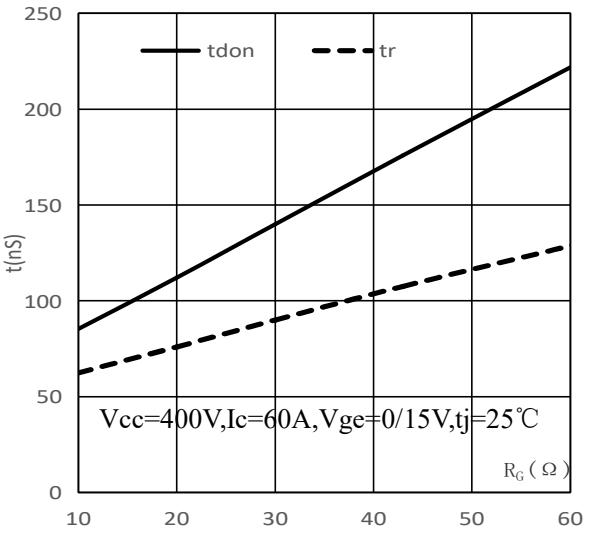
动态损耗-电压特性/Typical switching losses of V_{CC}



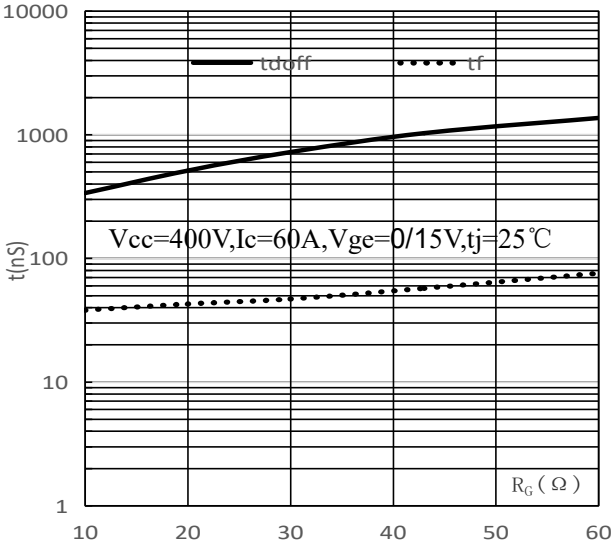
动态损耗-温度特性/Typical switching losses of t_J



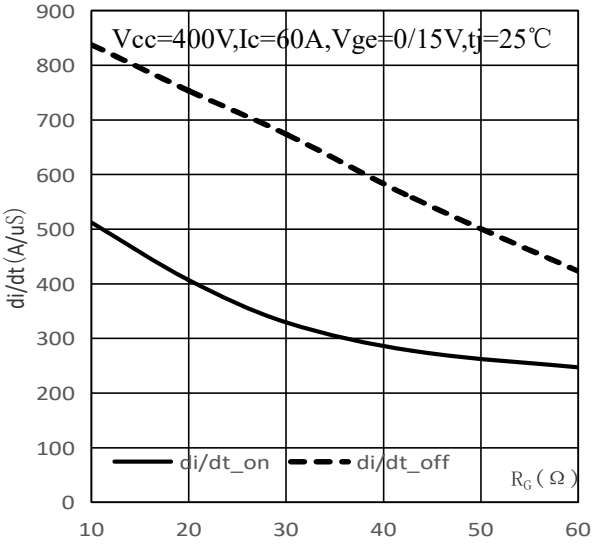
动态损耗-电流特性/Typical switching losses of I_C



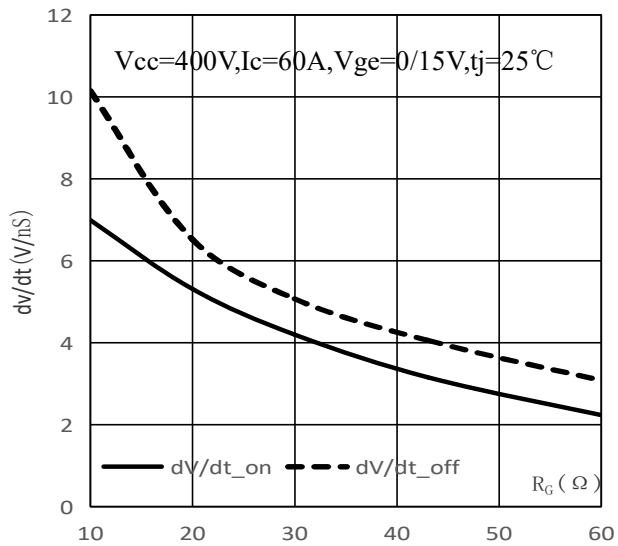
开启时间-门极电阻特性/Typical switching times as a function of R_G



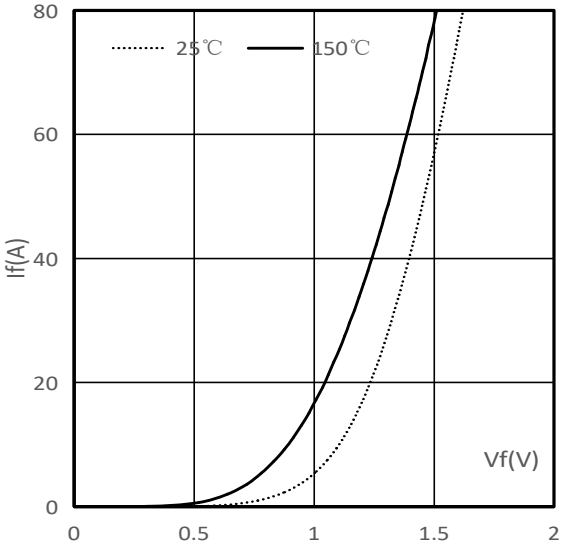
关闭时间-门极电阻特性/Typical switching times as a function of R_G



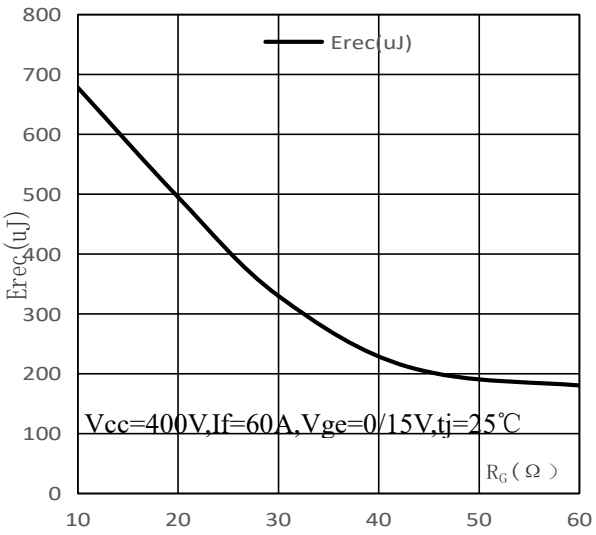
电流变化率-门极电阻特性/Typical di/dt as a function of R_G



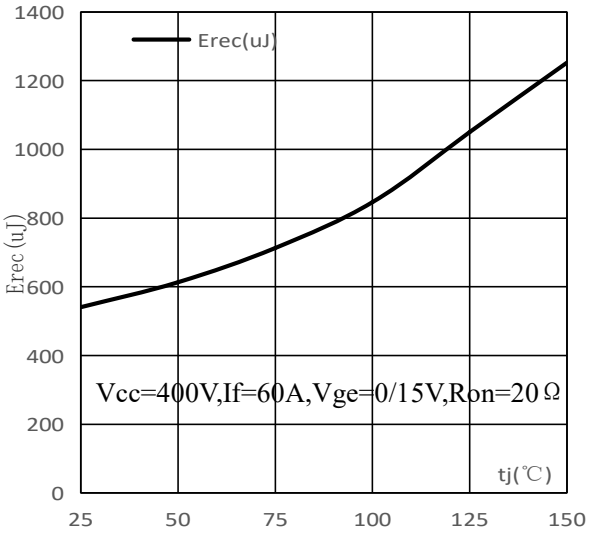
电压变化率-门极电阻特性/Typical dv/dt as a function of R_G



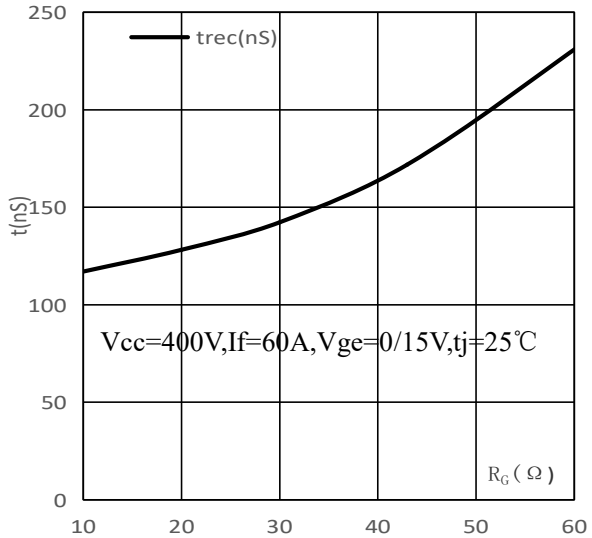
二极管压降/Typical I_F as a function of V_F



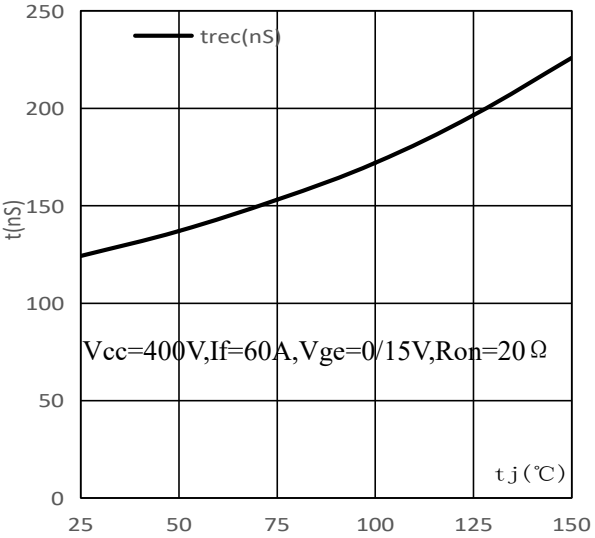
反向恢复损耗-门极电阻特性/Typical E_{REC} as a function of R_G



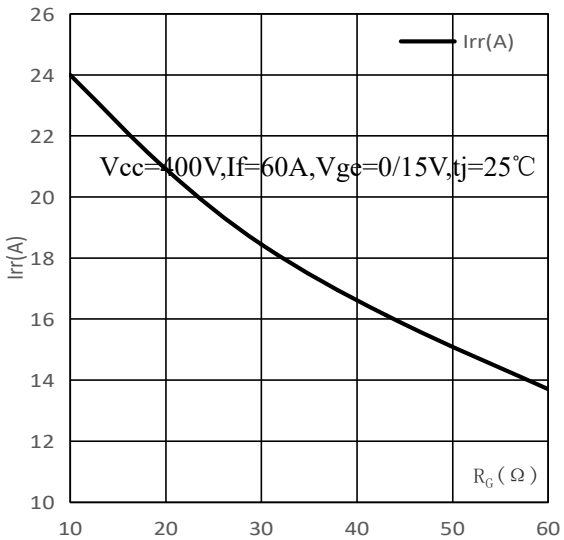
反向恢复损耗-温度特性/Typical E_{REC} as a function of t_J



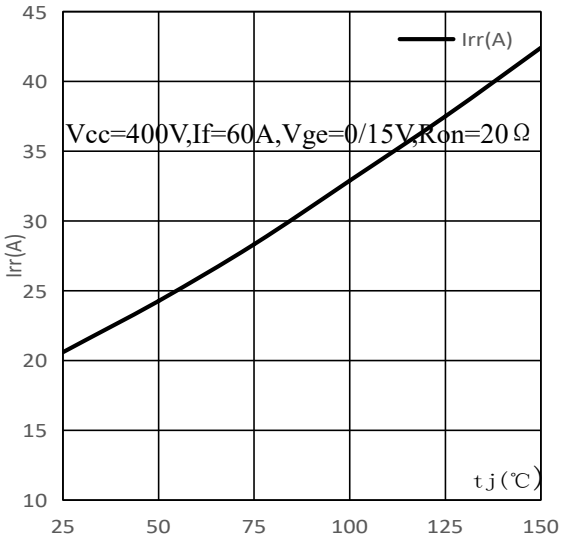
反向恢复时间-门极电阻特性/Typical t_{rec} as a function of R_G



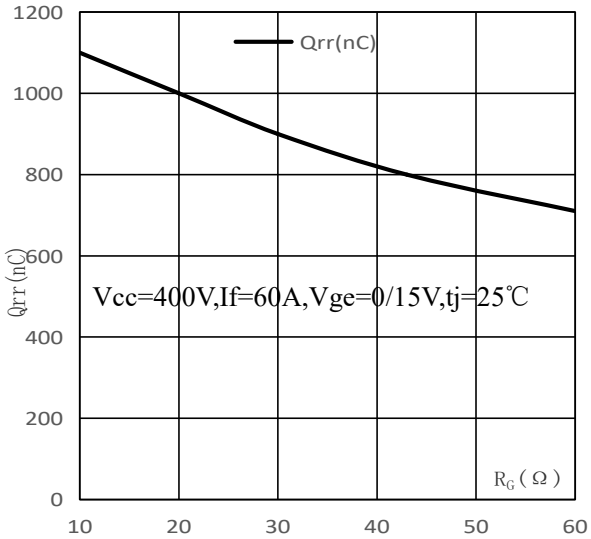
反向恢复时间-温度特性/Typical trec as a function of tJ



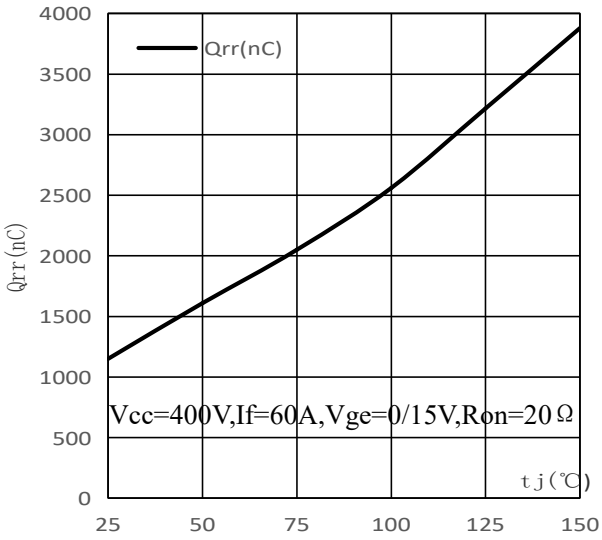
反向恢复电流峰值-门极电阻特性 /Typical Irr as a function of R_G



反向恢复电流峰值-温度特性/Typical Irr as a function of tj

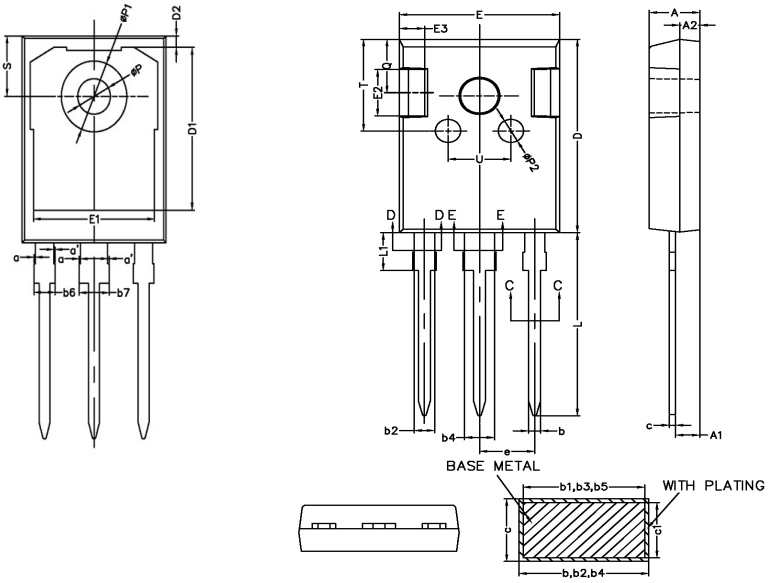


反向恢复电量-门极电阻特性/Typical Qrr as a function of R_G



反向恢复电量-温度特性/Typical Qrr as a function of t_J

■ To-247 尺寸数据/TO-247 Package Outline Data



单位:mm/Unit:mm

SYMBOL	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
a	0	–	0.15
a'	0	–	0.15
b	1.16	–	1.26
b1	1.15	1.2	1.22
b2	1.96	–	2.06
b3	1.95	2.00	2.02
b4	2.96	–	3.06
b5	2.95	3.00	3.02
b6	–	–	2.25
b7	–	–	3.25
c	0.59	–	0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1	–	–	4.30
P	3.50	3.60	3.70
P1	–	–	7.40
P2	2.40	2.50	2.60
Q	5.60	–	6.00
S	6.05	6.15	6.25
T	9.80	–	10.20
U	6.00	–	6.40