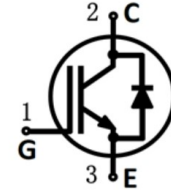


# 1200V40A 绝缘栅双极型晶体管

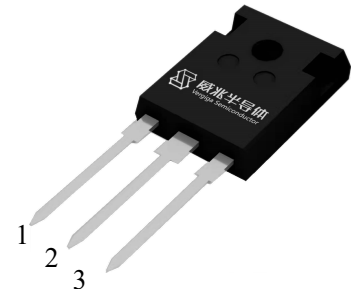
## ■ 特点/Features

- CoolWatt® I 沟槽栅场截止技术/CoolWatt® I 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

- 逆变电源/Inverter power supply
- 备用电源/UPS
- 太阳能光伏/PV



TO-247

型号/Part ID	$V_{CE}(V)$	$I_{CNOM}(A)$	$V_{CESAT@25^{\circ}C}(V)$	封装/Package	丝印/Marking
HCKW40N120BH1	1200	40	1.85	TO-247	K40H120B1

## ■ 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	$T_{vj}=25^{\circ}C$	1200	V
$I_C$	集电极连续直流电流 DC collector current	$T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$	80 40	A
$I_{Cpuls}$	集电极可重复脉冲电流 Pulse collector current	$T_{vj}\leq 150^{\circ}C$	120	A
$V_{RRM}$	二极管反向峰值电压 Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C$	1200	V
$I_F$	二极管连续直流电流 Diode continuous forward current	$T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$	80 40	A
$I_{Fpuls}$	二极管可重复脉冲电流 Diode pulse current	$T_{vj}\leq 150^{\circ}C$	120	A

$V_{GE}$	栅极-发射极电压 Gate-emitter voltage	$T_{vj}=25^{\circ}\text{C}$	$\pm 20$	V
$P_{tot}$	总耗散功率 Power dissipation	$T_C = 25^{\circ}\text{C}$	484	W
$T_{vj}$	可工作结温 Operating junction temperature		-40~+ 175	$^{\circ}\text{C}$
$T_{stg}$	储存温度 Storage temperature		-50~ + 150	$^{\circ}\text{C}$
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	0.31	K/W
$R_{thJC-FRD}$	二极管芯片到底板热阻 FRD thermal resistance junction-case	0.85	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			单位 Unit
			最小 Min.	典型 Typ.	最大 Max.	
$V_{(BR)CES}$	集电极-发射极击穿电压 Collector-emitter breakdown voltage	$V_{GE} = 0V,$ $I_C=0.5mA, T_{vj}=25^{\circ}\text{C}$	1200	—	—	V
$V_{CE(sat)}$	集电极-发射极饱和压降 Collector-emitter saturation voltage	$V_{GE}=15V, I_C=40A, T_{vj}=25^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	— —	1.85 2.25	2.20 —	
$V_{GE(th)}$	门极开启阈值电压 Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C=1.5mA, T_{vj}=25^{\circ}\text{C}$	4.80	5.60	6.40	
$V_F$	二极管正向导通压降 Diode forward voltage	$V_{GE} = 0V, I_F=40A, T_{vj}=25^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	— —	1.75 1.60	2.20 —	
$I_{GES}$	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-发射极漏电流 Zero gate voltage collector current	$V_{CE} = 1200V, V_{GE}=0V, T_{vj}=25^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	— —	— —	0.25 0.50	mA
$R_{Gin}$	内部门极电阻 Integrated gate resistor	—	—	0	—	$\Omega$
$C_{ies}$	输入电容 Input capacitance	$V_{GE} = 0V, V_{CE}= 30V,$	—	4920	—	pF

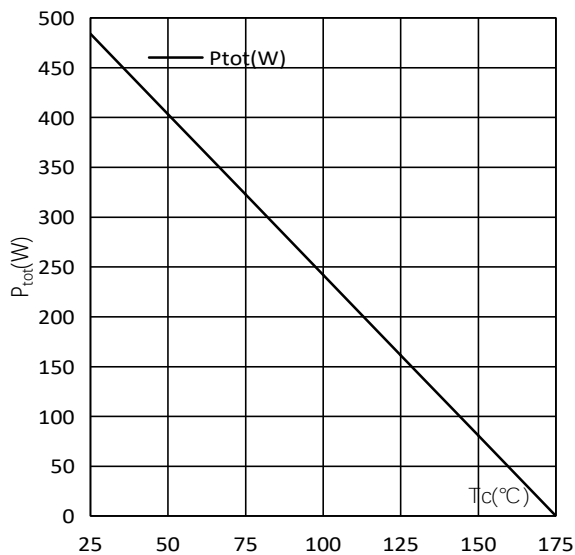
$C_{oes}$	输出电容 Output capacitance	$f = 1\text{MHz}, T_{vj}=25^\circ\text{C}$	—	186	—	
$C_{res}$	反向传输电容 Reverse transfer capacitance		—	113	—	
$Q_g$	门极电量 Gate charge	$I_c = 40\text{A}, V_{CE}=960\text{V},$ $V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$	—	268	—	nC
$Q_{ge}$	门极-发射极电量 Gate-emitter charge		—	37.9	—	
$Q_{gc}$	门极-集电极电量 Gate-collector charge		—	143	—	
$V_{GE(pl)}$	米勒平台电压 Gate-emitter plateau voltage	$I_c = 40\text{A}, V_{CE}=960\text{V},$ $V_{GE}=0/15\text{V}, T_{vj}=25^\circ\text{C}$	—	8.53	—	V

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

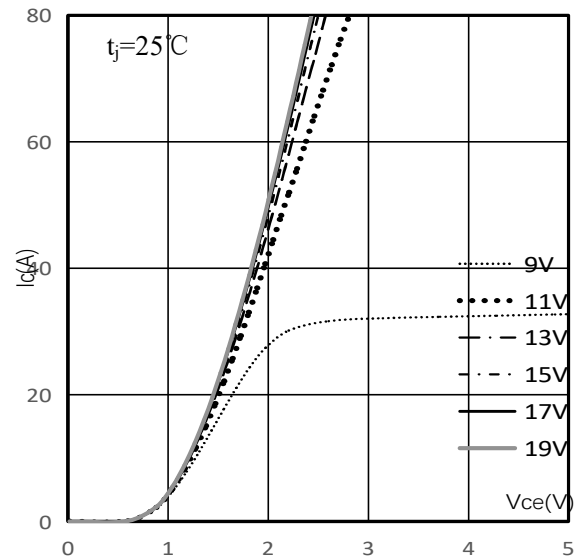
符号 Symbol	参数 Parameter	测试条件 Test conditions	值Value			单位 Unit
			最小 Min.	典型 Typ.	最大 Max.	
<b>IGBT 特性_25°C/IGBT Characteristic_25°C:</b>						
$T_{d(on)}$	开启延迟时间 Turn-on delay time	$V_{cc}=600\text{V}, I_c=40\text{A},$ $R_{on}=10\ \Omega, R_{off}=10\ \Omega,$ $C_{ge}=0\text{nF}, V_{GE}=0/15\text{V},$ $L_{load}=100\ \mu\text{H}, T_{vj}=25^\circ\text{C}$	—	82.1	—	ns
$T_r$	上升时间 Rise time		—	78.9	—	
$T_{d(off)}$	关闭延迟时间 Turn-off delay time		—	365	—	
$t_f$	下降时间 Fall time		—	46.4	—	
$E_{on}$	单次开启损耗 Turn-on energy		mJ	—	3.65	—
$E_{off}$	单次关闭损耗 Turn-off energy			—	1.58	—
$E_{total}$	单脉冲总损耗 Total switch energy			—	5.23	—
<b>IGBT 特性_150°C/IGBT Characteristic_150°C:</b>						
$T_{d(on)}$	开启延迟时间 Turn-on delay time	$V_{cc}=600\text{V}, I_c=40\text{A},$ $R_{on}=10\ \Omega, R_{off}=10\ \Omega,$ $C_{ge}=0\text{nF}, V_{GE}=0/15\text{V},$ $L_{load}=100\ \mu\text{H}, T_{vj}=150^\circ\text{C}$	—	71.4	—	ns
$T_r$	上升时间 Rise time		—	81.2	—	
$T_{d(off)}$	关闭延迟时间 Turn-off delay time		—	409	—	
$t_f$	下降时间 Fall time		—	57.7	—	
$E_{on}$	单次开启损耗 Turn-on energy		mJ	—	6.14	—
$E_{off}$	单次关闭损耗 Turn-off energy			—	1.98	—
$E_{total}$	单脉冲总损耗 Total switch energy			—	8.12	—
<b>二极管特性_25°C/Diode Characteristic_25°C:</b>						
$E_{rec}$	反向恢复损耗 Reverse recovery energy	$I_F = 40\ \text{A}, V_R=600\text{V},$ $V_{GE} = 0/15\ \text{V}, R_{ON}=10\ \Omega, T_{vj}=25^\circ\text{C}$	—	710	—	uJ
$t_{rr}$	二极管反向恢复时间 Diode reverse recovery time		—	152	—	nS
$Q_{rr}$	二极管反向恢复电量 Diode reverse recovery charge		—	2447	—	nC
$I_{rrm}$	反向恢复峰值电流 Diode peak reverse recovery current		—	26.3	—	A
$di_{rr}/dt$	恢复下降电流最大电流变化率 Recovery current during $t_{rr}$		—	402	—	A/uS

二极管特性_150°C/Diode Characteristic_150°C:						
Erec	反向恢复损耗 Reverse recovery energy	$I_F = 40\text{ A}, V_R = 600\text{ V},$ $V_{GE} = 0/15\text{ V}, R_{ON} = 10\ \Omega,$ $T_{vj} = 150^\circ\text{C}$	—	1849	—	uJ
trr	二极管反向恢复时间 Diode reverse recovery time		—	269	—	nS
Qrr	二极管反向恢复电量 Diode reverse recovery charge		—	6387	—	nC
Irrm	反向恢复峰值电流 Diode peak reverse recovery current		—	39.8	—	A
di <sub>r</sub> /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 <sub>r</sub>		—	253	—	A/uS

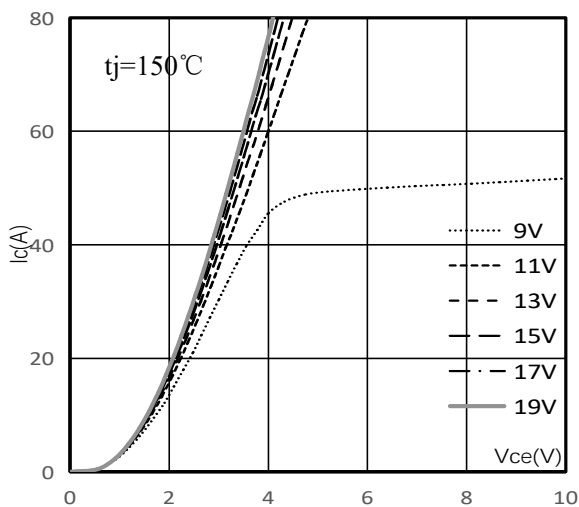
### ■ 特征曲线/ Characteristic Curve



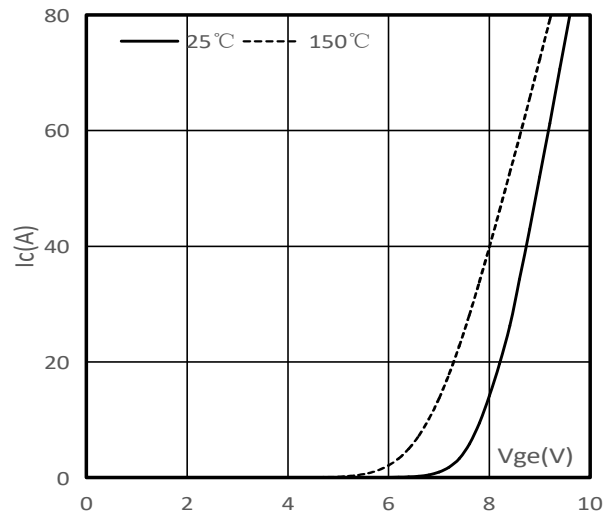
耗散功率-温度特性/ $P_{tot}$  as a function of case Temperature



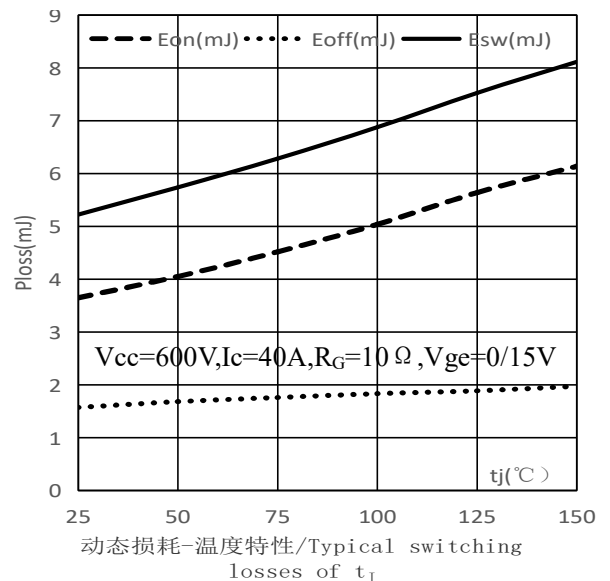
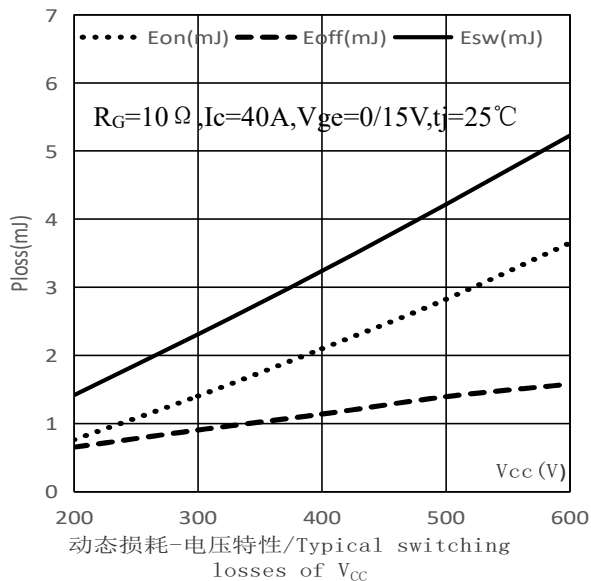
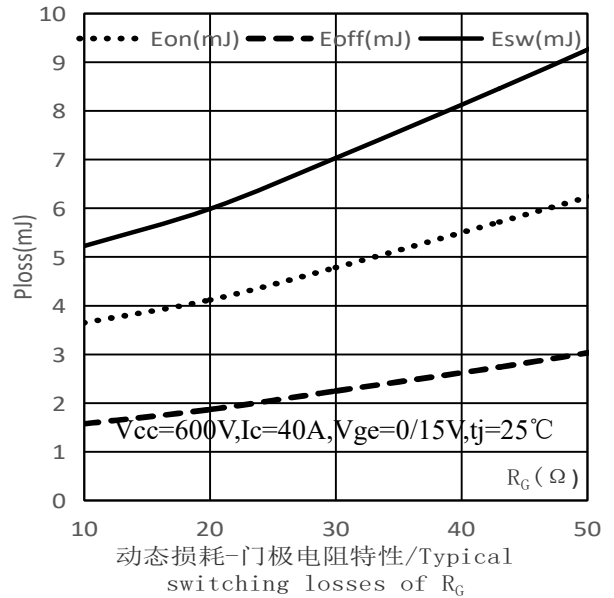
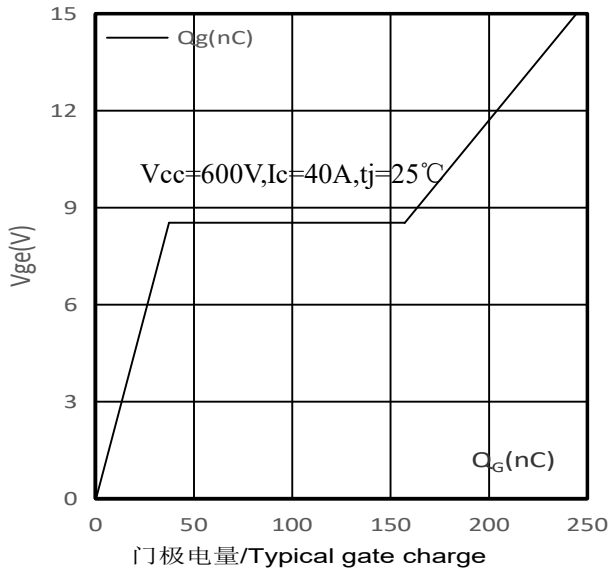
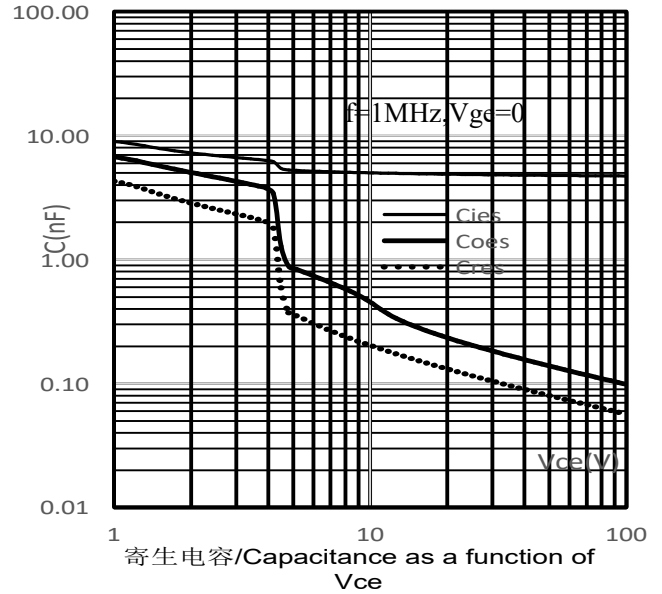
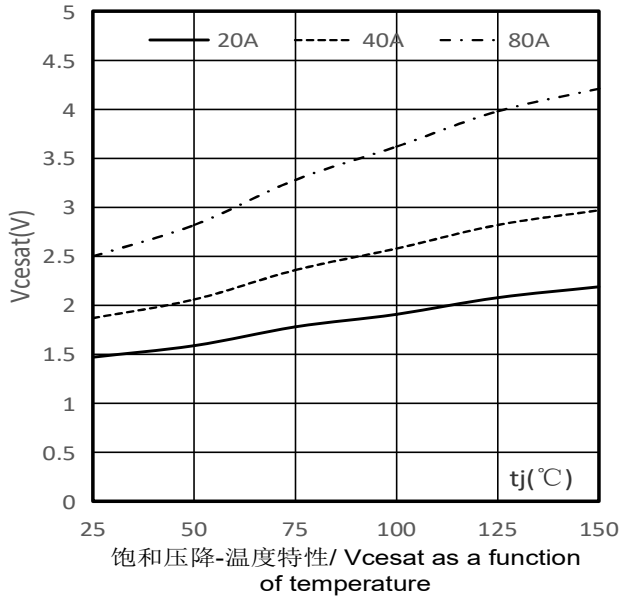
输出特性\_25°C/ Typical Output Characteristic\_25°C

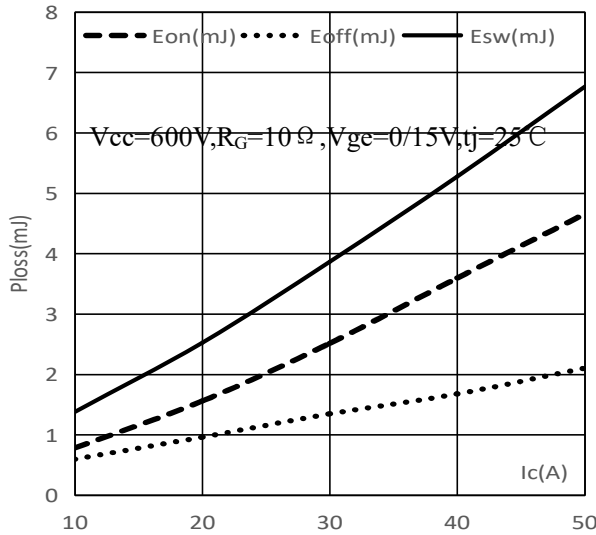


输出特性\_150°C/ Typical Output Characteristic\_150°C

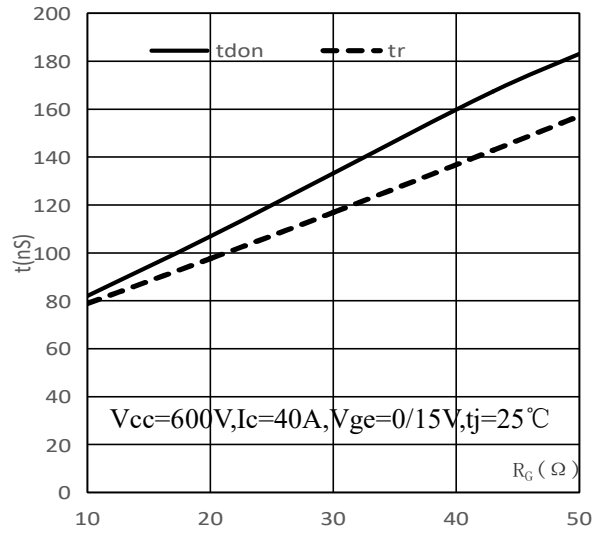


输出特性/ Typical Output Characteristic

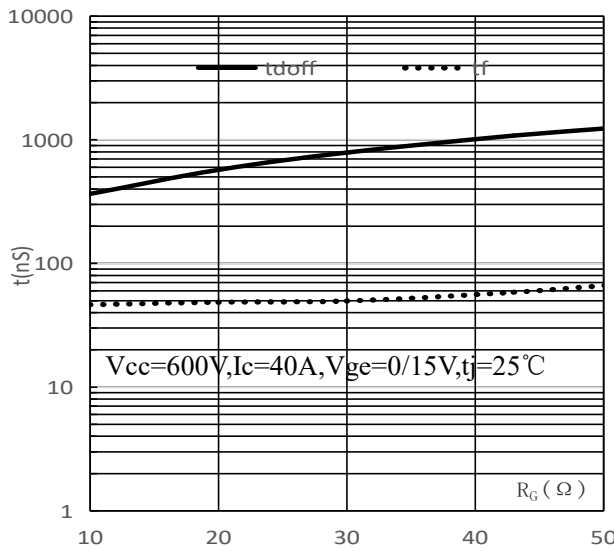




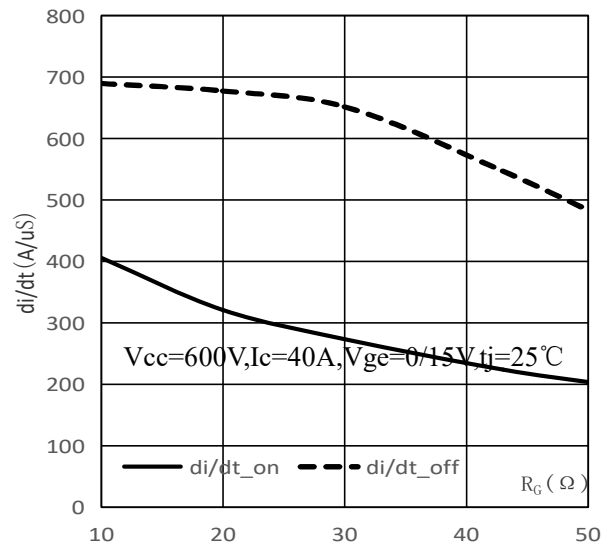
动态损耗-电流特性/Typical switching losses of  $I_C$



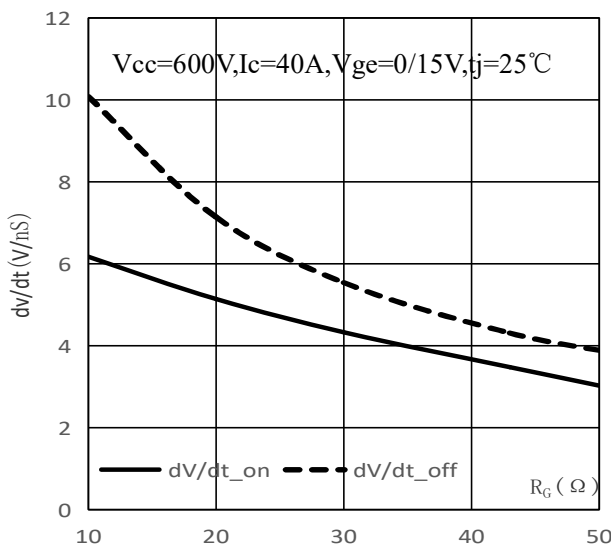
开启时间-门极电阻特性/Typical switching times as a function of  $R_G$



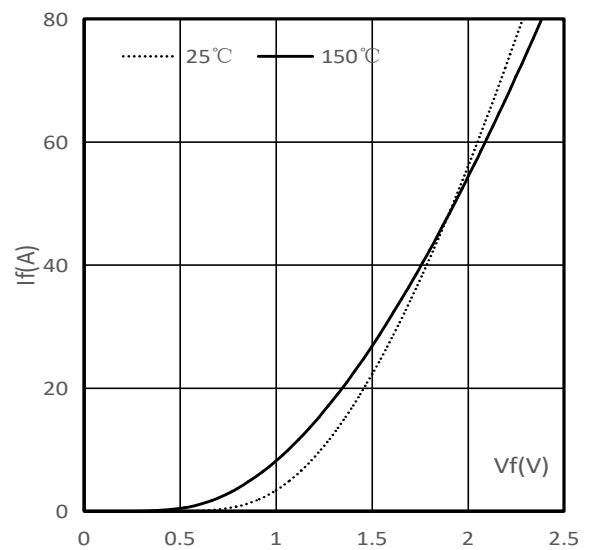
关闭时间-门极电阻特性/Typical switching times as a function of  $R_G$



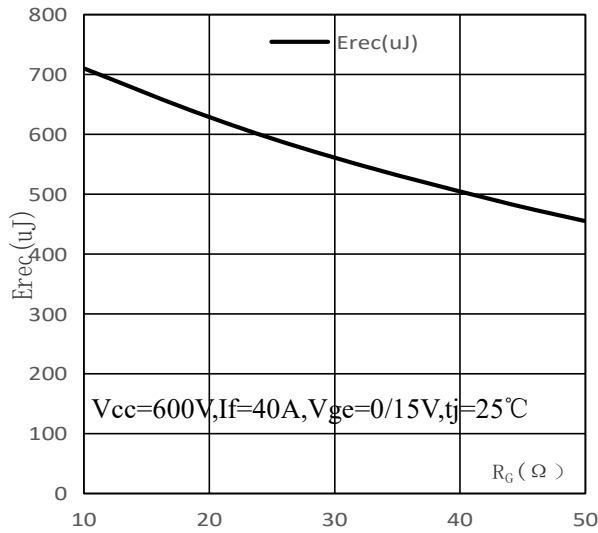
电流变化率-门极电阻特性/Typical  $di/dt$  as a function of  $R_G$



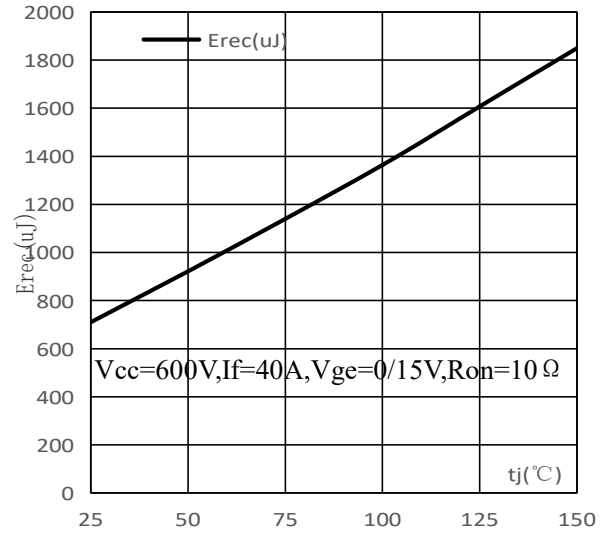
电压变化率-门极电阻特性/Typical  $dv/dt$  as a function of  $R_G$



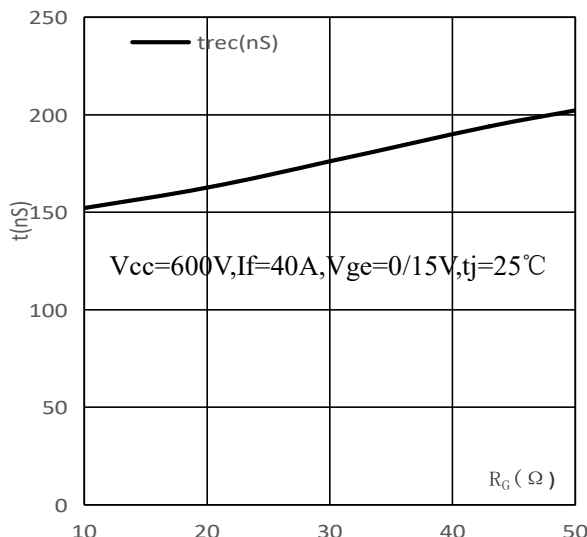
二极管压降/Typical  $I_F$  as a function of  $V_F$



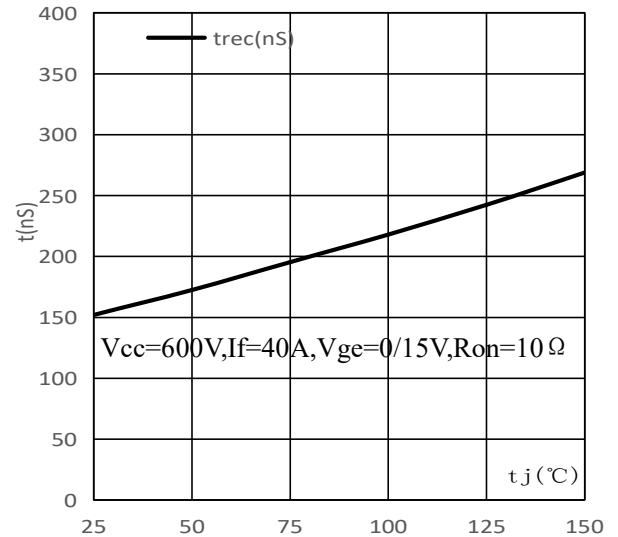
反向恢复损耗-门极电阻特性/Typical  $E_{REC}$  as a function of  $R_G$



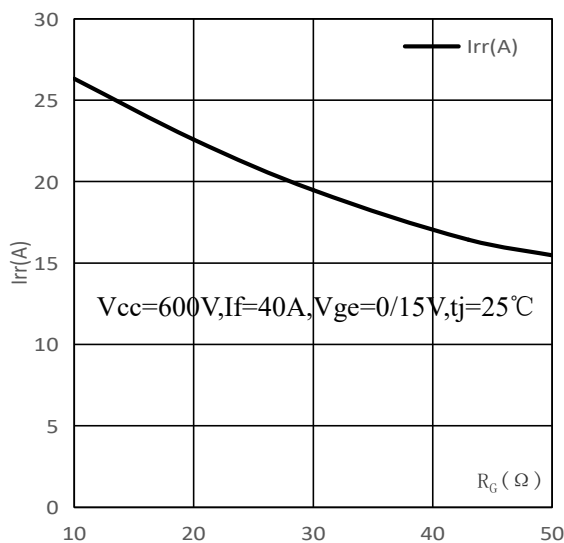
反向恢复损耗-温度特性/Typical  $E_{REC}$  as a function of  $t_j$



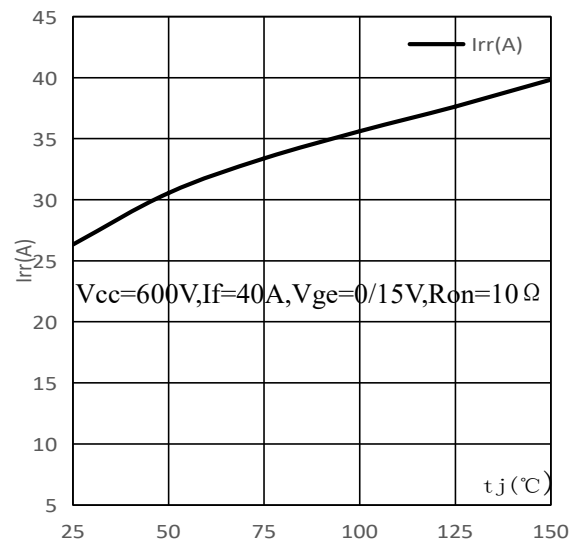
反向恢复时间-门极电阻特性/Typical  $t_{rec}$  as a function of  $R_G$



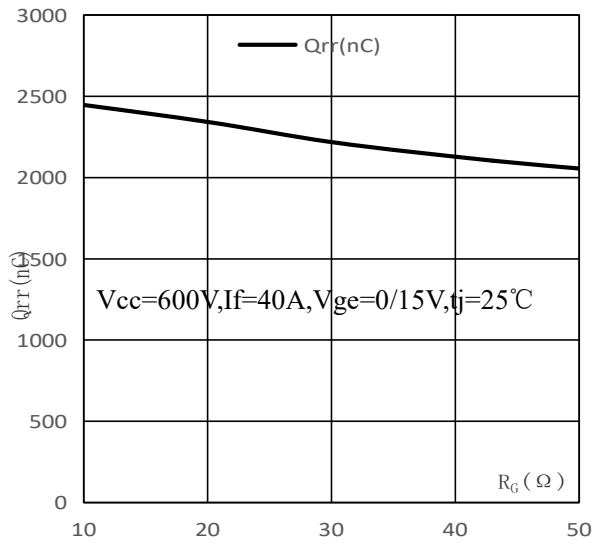
反向恢复时间-温度特性/Typical  $t_{rec}$  as a function of  $t_j$



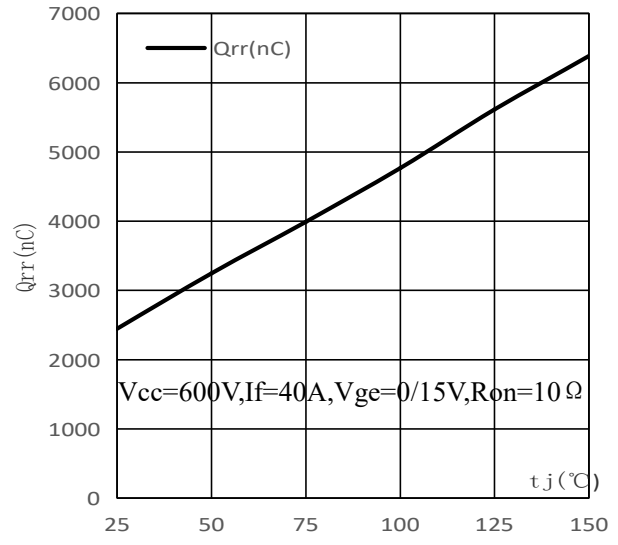
反向恢复电流峰值-门极电阻特性/Typical  $I_{rr}$  as a function of  $R_G$



反向恢复电流峰值-温度特性/Typical  $I_{rr}$  as a function of  $t_j$

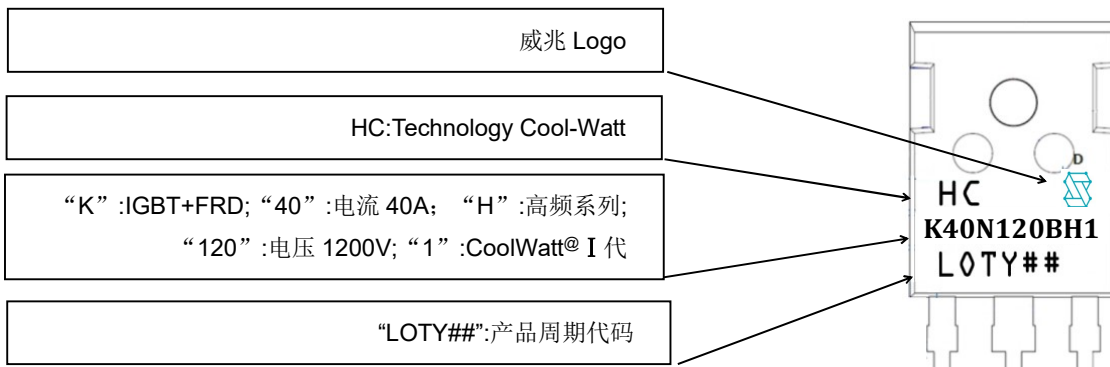


反向恢复电量-门极电阻特性/Typical  
Qrr as a function of  $R_G$

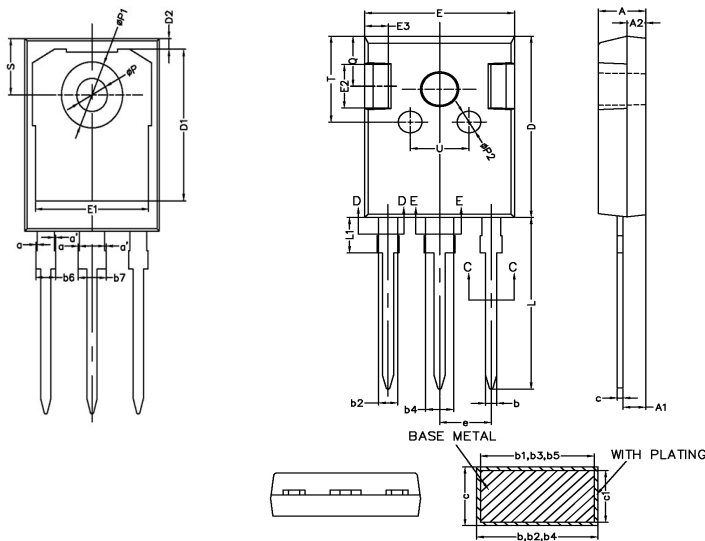


反向恢复电量-温度特性/Typical Qrr as  
a function of  $t_j$

### ■ 丝印信息/Marking Information



### ■ 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