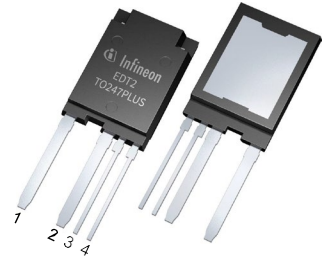


**最终数据手册**

英飞凌 耐短路 750 V EDT2 IGBT，采用可回流焊接的封装，与 软、快速恢复二极管共同封装

**特性**

- $V_{CE} = 750\text{ V}$
- $I_C = 120\text{ A}$
- 适用于 470 V  $V_{DC}$  系统，并增加了 400 V  $V_{DC}$  系统的过压裕量
- 极低  $V_{CEsat}(C-KE) = 1.21\text{ V (typ.)}$ ， $I_{Cnom} = 120\text{ A}$ ， $25^\circ\text{C}$
- 由于回流焊能力，系统  $R_{th}$  可降低至 40%，增加功率输出
- 由于开尔文发射极，与 3 引脚器件相比，开通损耗减少 30%
- 短路耐受时间  $t_{sc} = 3\text{ }\mu\text{s}$  ( $V_{CE} = 470\text{ V}$ 、 $V_{GE} = 15\text{ V}$ )
- 短路条件下的自限电流
- 正温度系数和非常紧密的参数分布，易于并联
- 优异的并联均流能力
- 平滑的开关特性
- 低栅极电荷  $Q_G$
- 简单的栅极驱动器设计
- 配备快速软恢复发射极控制二极管 (Emcon3)
- 低EMI特征
- TO247PLUS 封装，高爬电距离 6.6 mm， $400 \leq CTI < 600$
- 高可靠性和使用寿命，经过验证的秒级功率循环。鲁棒性
- 适用于高电流母线的宽电源引脚 (2 mm)
- 用于直接母线连接的阻性焊接引脚
- 无铅镀层的引脚和背板



**潜在应用**

- 电动汽车牵引逆变器
- DC母线放电开关
- 汽车辅助驱动

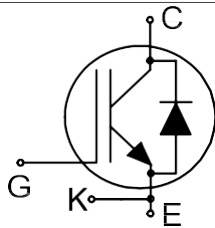
**产品验证**

- 符合 AEC-Q101 标准，适用于汽车应用
- 符合 JEDEC J-STD-020 MSL2 标准的回流焊 260°C

**描述**

封装引脚定义：

- 引脚 C (1) & 背面 - 集电极
- 引脚 E (2) - 发射极
- 引脚 K (3) - 开尔文发射极
- 引脚 G (4) - 栅极



Type	Package	Marking
AIKYX120N75CP2	PG-TO247-4-U06	AKYX12FCP

本数据手册的原文使用英文撰写。为方便起见，英飞凌提供了译文；由于翻译过程中可能使用了自动化工具，英飞凌不保证译文的准确性。为确认准确性，请务必访问 [infineon.com](http://infineon.com) 参考最新的英文版本（控制文档）。

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## 1 封装

## 1 封装

表 1 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance	$L_E$	simulated starting from L2 at 1 MHz		3.8		nH
Collector-emitter loop inductance	$L_{CE}$	simulated starting from L2 at 1 MHz		6.2		nH
Main emitter pin resistance	$R_E$	Simulated starting from L2 at 10 kHz		0.41		mΩ
Storage temperature	$T_{stg}$		-55		150	°C
Soldering temperature	$T_{sold}$	reflow soldering (MSL2 according to JEDEC J-STD-020)			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$			40		K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.2	0.26 <sup>1)</sup>	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.35	0.45 <sup>1)</sup>	K/W

1) 通过仿真定义，不进行生产测试

## 2 IGBT

表 2 最大额定值

Parameter	Symbol	Note or test condition	Values	Unit	
Collector-emitter voltage	$V_{CE}$	$T_{vj} \geq 25\text{ °C}$	750	V	
DC collector current, limited by $T_{vjmax}$	$I_c$		$T_c = 25\text{ °C}$	150	A
			$T_c = 100\text{ °C}$	120	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{cpulse}$		360	A	
Turn-off safe operating area		$V_{CE} \leq 750\text{ V}, T_{vj} \leq 175\text{ °C}$	360	A	
Gate-emitter voltage	$V_{GE}$		±20	V	
Transient gate-emitter voltage	$V_{GE}$	$t_p = 10\text{ }\mu\text{s}, D < 0.01$	±30	V	
Short-circuit withstand time	$t_{SC}$	$V_{CC} \leq 470\text{ V}, V_{GE} = -8/15\text{ V}$ , Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}, T_{vj} = 25\text{ °C}$	3	μs	
Power dissipation	$P_{tot}$	$T_{vj} = 175\text{ °C}$	$T_c = 25\text{ °C}$	577	W
			$T_c = 100\text{ °C}$	288	

表3 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 120\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1.2	1.35	1.5	V
			$T_{vj} = 175\text{ }^\circ\text{C}$		1.55		
Collector-Kelvin emitter saturation voltage	$V_{CEsat} (C-KE)$	$I_C = 120\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1.21		V
Gate-emitter threshold voltage	$V_{GEth}$	$I_C = 1.6\text{ mA}, V_{CE} = V_{GE}$		5.2	5.8	6.4	V
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 750\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$			200	$\mu\text{A}$
			$T_{vj} = 175\text{ }^\circ\text{C}$		5		mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}$				100	nA
Transconductance	$g_{fs}$	$I_C = 120\text{ A}, V_{CE} = 20\text{ V}$			89		S
Short-circuit collector current	$I_{SC}$	$V_{CC} \leq 470\text{ V}, V_{GE} = -8/15\text{ V}, t_{SC} \leq 3\text{ }\mu\text{s},$ Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s},$ $T_{vj} = 25\text{ }^\circ\text{C}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1150		A
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			13500		pF
Output capacitance	$C_{oes}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			337		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			59		pF
Gate charge	$Q_G$	$V_{CC} = 600\text{ V}, I_C = 120\text{ A}, V_{GE} = -8/15\text{ V}$			765		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 4.8\text{ }\Omega, L_\sigma = 20\text{ nH}, C_\sigma = 15\text{ pF}$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 120\text{ A}$		48		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 120\text{ A}$		48		
Rise time (inductive load)	$t_r$	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 4.8\text{ }\Omega, L_\sigma = 20\text{ nH}, C_\sigma = 15\text{ pF}$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 120\text{ A}$		27		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 120\text{ A}$		32		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 4.8\text{ }\Omega, L_\sigma = 20\text{ nH}, C_\sigma = 15\text{ pF}$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 120\text{ A}$		202		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 120\text{ A}$		276		
Fall time (inductive load)	$t_f$	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 4.8\text{ }\Omega, L_\sigma = 20\text{ nH}, C_\sigma = 15\text{ pF}$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 120\text{ A}$		65		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 120\text{ A}$		129		

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## 3 二极管

表3 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Turn-on energy <sup>1)</sup>	$E_{on}$	$V_{CC} = 470 \text{ V}$ , $V_{GE} = -8/15 \text{ V}$ , $R_{G(on)} = 4.8 \text{ } \Omega$ , $L_{\sigma} = 20 \text{ nH}$ , $C_{\sigma} = 15 \text{ pF}$	$T_{vj} = 25 \text{ } ^\circ\text{C}$ , $I_C = 120 \text{ A}$		3.3		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C}$ , $I_C = 120 \text{ A}$		5		
Turn-off energy	$E_{off}$	$V_{CC} = 470 \text{ V}$ , $V_{GE} = -8/15 \text{ V}$ , $R_{G(on)} = 4.8 \text{ } \Omega$ , $L_{\sigma} = 20 \text{ nH}$ , $C_{\sigma} = 15 \text{ pF}$	$T_{vj} = 25 \text{ } ^\circ\text{C}$ , $I_C = 120 \text{ A}$		3.6		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C}$ , $I_C = 120 \text{ A}$		6.4		
Total switching energy	$E_{ts}$	$V_{CC} = 470 \text{ V}$ , $V_{GE} = -8/15 \text{ V}$ , $R_{G(on)} = 4.8 \text{ } \Omega$ , $L_{\sigma} = 20 \text{ nH}$ , $C_{\sigma} = 15 \text{ pF}$	$T_{vj} = 25 \text{ } ^\circ\text{C}$ , $I_C = 120 \text{ A}$		6.9		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C}$ , $I_C = 120 \text{ A}$		11.4		
Operating junction temperature	$T_{vj}$			-40		175	$^\circ\text{C}$

1) 包括反向恢复电流引起的 IGBT 损耗

注：特征参数，在  $T_{vj} = 25 \text{ } ^\circ\text{C}$  下测定，除非另有说明。

## 3 二极管

表4 最大额定值

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} \geq 25 \text{ } ^\circ\text{C}$	750	V	
Diode forward current, limited by $T_{vjmax}$	$I_F$		$T_C = 25 \text{ } ^\circ\text{C}$	150	A
			$T_C = 100 \text{ } ^\circ\text{C}$	120	
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpulse}$		360	A	
Power dissipation	$P_{tot}$	$T_{vj} = 175 \text{ } ^\circ\text{C}$	$T_C = 25 \text{ } ^\circ\text{C}$	333	W
			$T_C = 100 \text{ } ^\circ\text{C}$	167	

表5 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	$V_F$	$I_F = 120 \text{ A}$	$T_{vj} = 25 \text{ } ^\circ\text{C}$	1.6	1.8	2	V
			$T_{vj} = 175 \text{ } ^\circ\text{C}$		1.8		

(表格续下页.....)

表 5 (续) 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery charge	$Q_{rr}$	$V_R = 470 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_F = 120 \text{ A}$ , $-di_F/dt = 4282 \text{ A}/\mu\text{s}$		4.1		$\mu\text{C}$
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_F = 120 \text{ A}$ , $-di_F/dt = 3628 \text{ A}/\mu\text{s}$		10.9		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 470 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_F = 120 \text{ A}$ , $-di_F/dt = 4282 \text{ A}/\mu\text{s}$		60.8		A
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_F = 120 \text{ A}$ , $-di_F/dt = 3628 \text{ A}/\mu\text{s}$		90.9		
Reverse recovery energy	$E_{rec}$	$V_R = 470 \text{ V}$ , $L_\sigma = 20 \text{ nH}$ , $C_\sigma = 15 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , $I_F = 120 \text{ A}$ , $-di_F/dt = 4282 \text{ A}/\mu\text{s}$		1.6		mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$ , $I_F = 120 \text{ A}$ , $-di_F/dt = 3628 \text{ A}/\mu\text{s}$		3.9		
Operating junction temperature	$T_{vj}$			-40		175	$^\circ\text{C}$

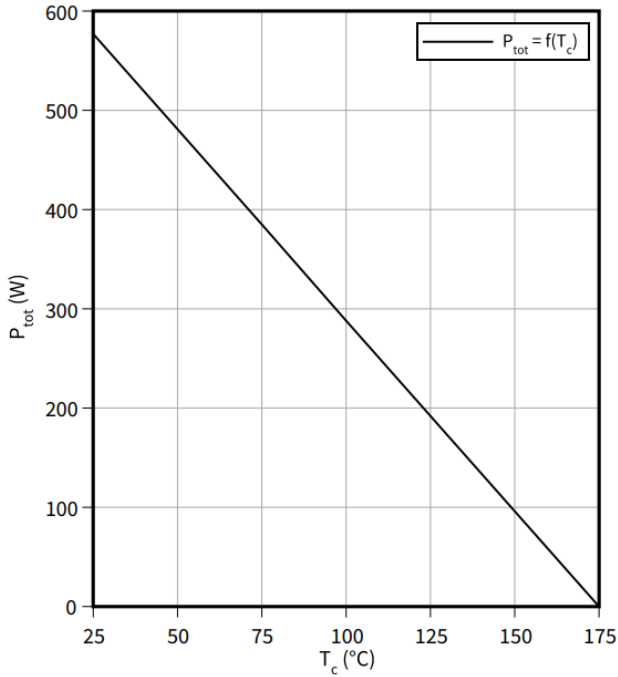
**注：** 为了获得最佳的使用寿命和可靠性，英飞凌建议工作条件不超过本数据手册中所述最大额定值的 80%。

4 特性图

4 特性图

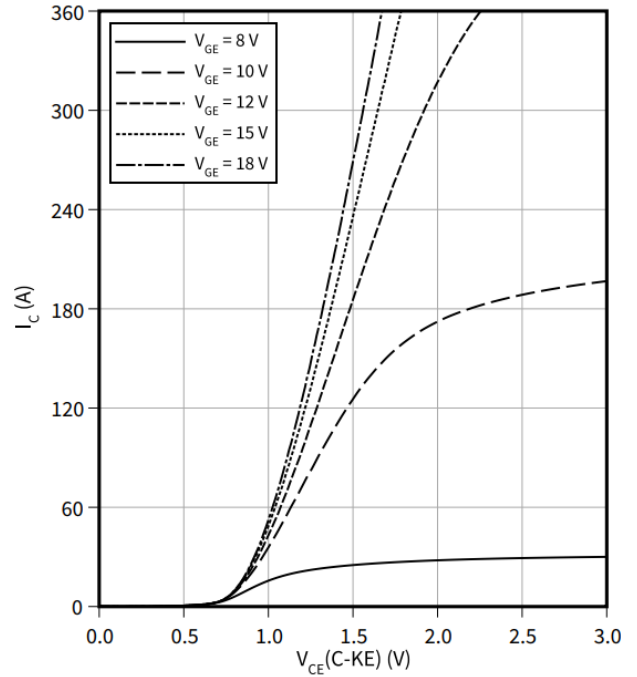
**Power dissipation as a function of case temperature**

$P_{tot} = f(T_c)$   
 $T_{vj} \leq 175\text{ }^\circ\text{C}$



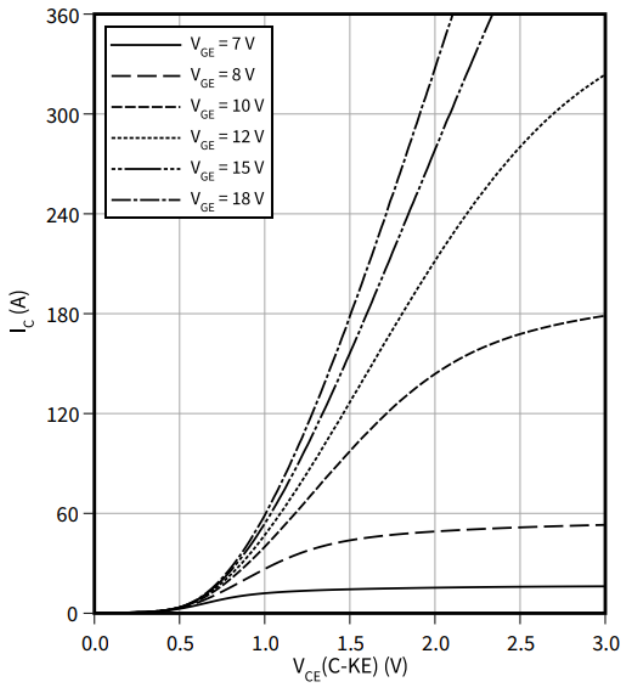
**Typical output characteristic**

$I_C = f(V_{CE(C-KE)})$   
 $T_{vj} = 25\text{ }^\circ\text{C}$



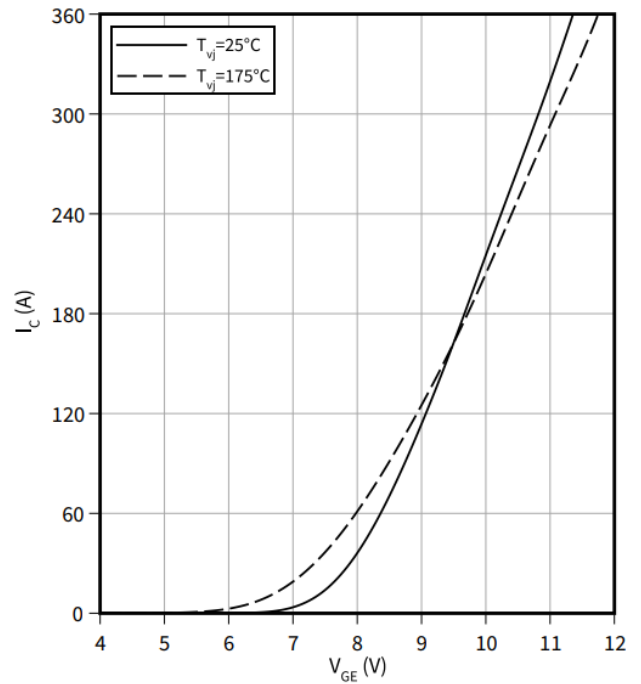
**Typical output characteristic**

$I_C = f(V_{CE(C-KE)})$   
 $T_{vj} = 175\text{ }^\circ\text{C}$



**Typical transfer characteristic**

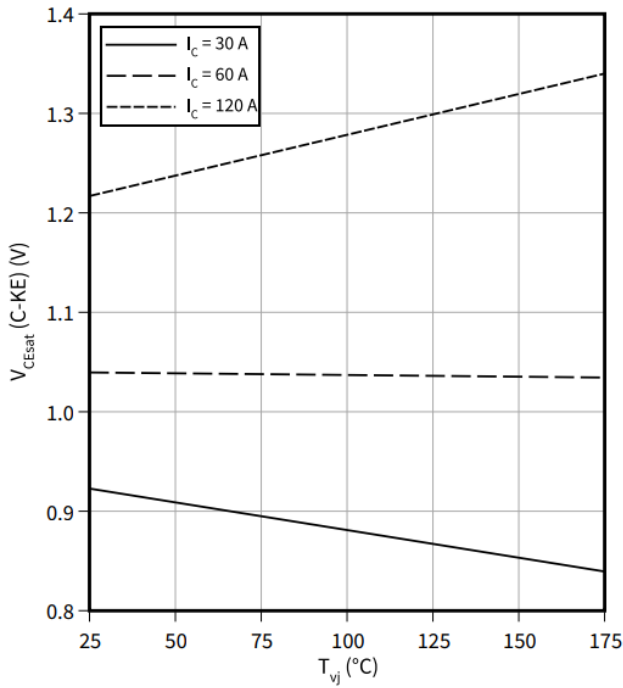
$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



4 特性图

**Typical collector-Kelvin emitter saturation voltage as a function of junction temperature**

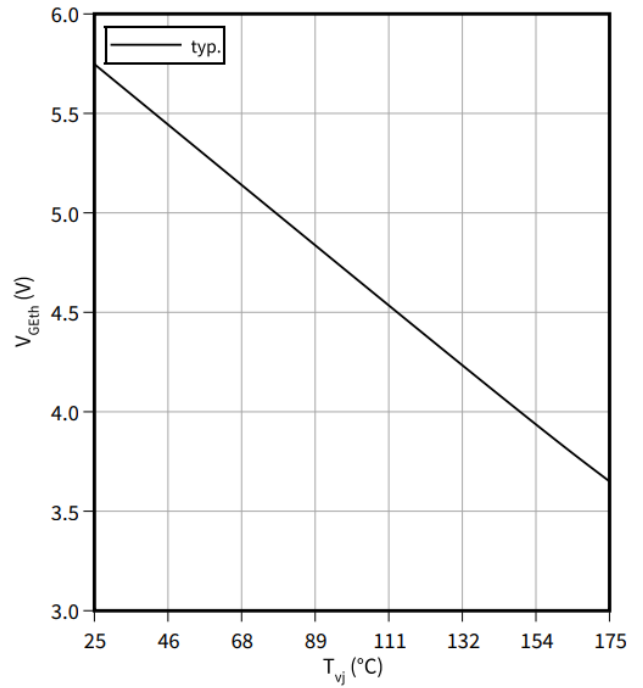
$V_{CEsat} (C-KE) = f(T_{vj})$



**Gate-emitter threshold voltage as a function of junction temperature**

$V_{GEth} = f(T_{vj})$

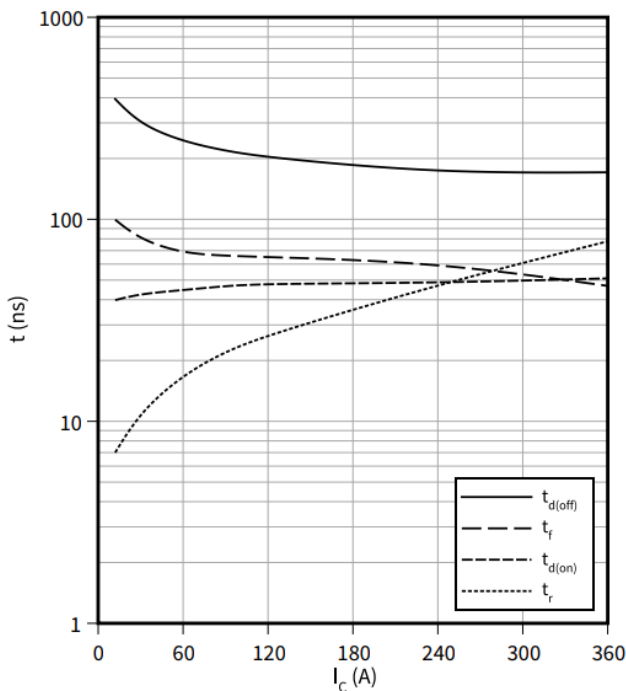
$I_C = 1.6$  mA



**Typical switching times as a function of collector current**

$t = f(I_C)$

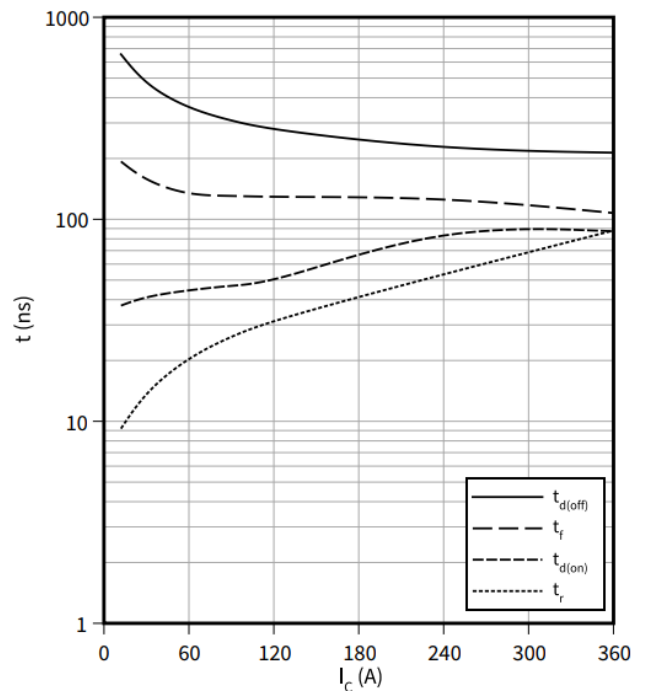
$V_{CC} = 470$  V,  $T_{vj} = 25$  °C,  $R_G = 4.8$   $\Omega$



**Typical switching times as a function of collector current**

$t = f(I_C)$

$V_{CC} = 470$  V,  $T_{vj} = 175$  °C,  $R_G = 4.8$   $\Omega$

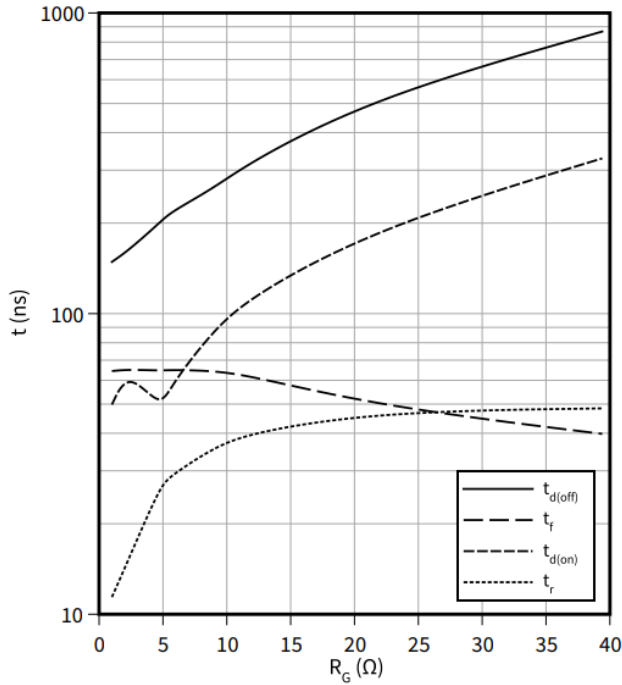


4 特性图

Typical switching times as a function of gate resistor

$t = f(R_G)$

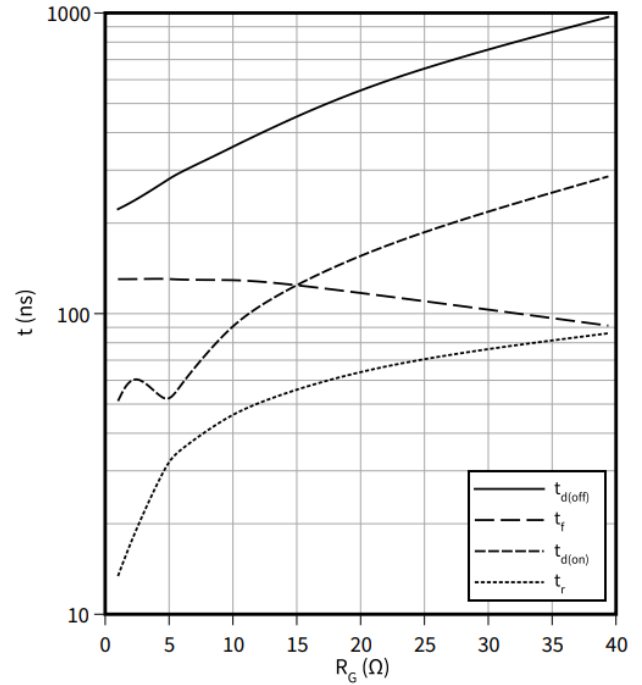
$I_C = 120 \text{ A}, V_{CC} = 470 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



Typical switching times as a function of gate resistor

$t = f(R_G)$

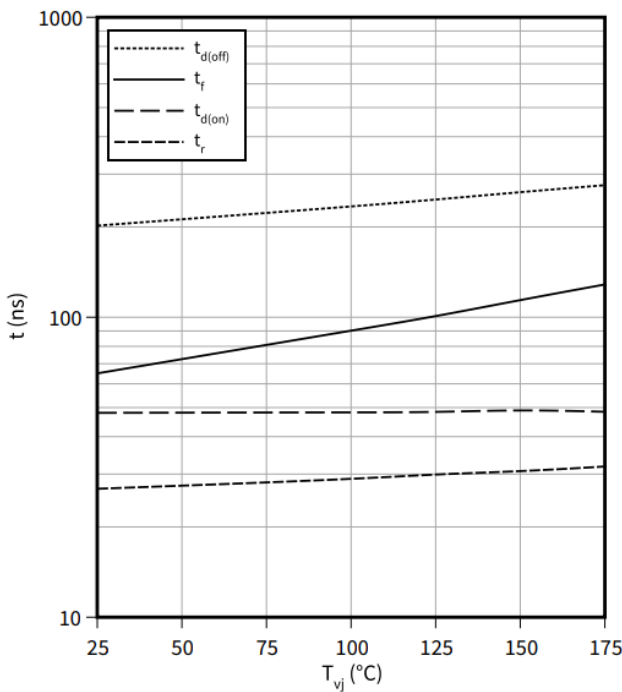
$I_C = 120 \text{ A}, V_{CC} = 470 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

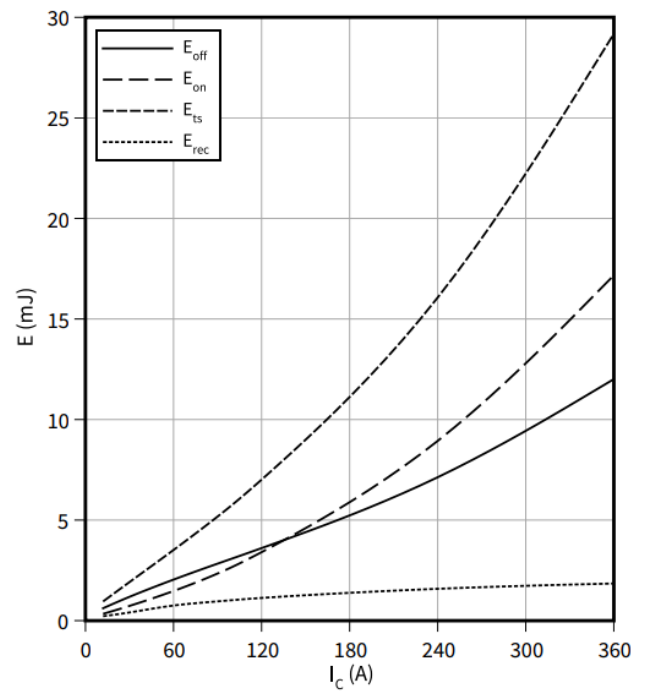
$I_C = 120 \text{ A}, V_{CC} = 470 \text{ V}, R_G = 4.8 \text{ }^\circ\Omega$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

$V_{CC} = 470 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}, R_G = 4.8 \text{ }^\circ\Omega$

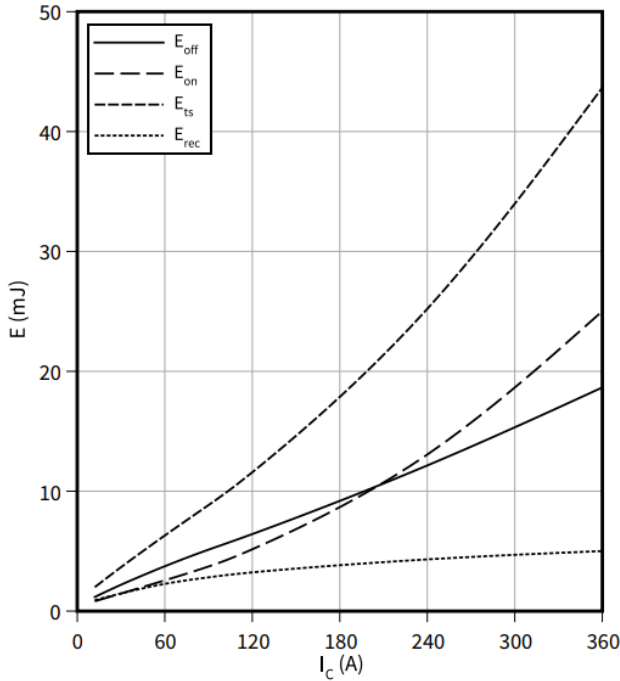


4 特性图

**Typical switching energy losses as a function of collector current**

$E = f(I_C)$

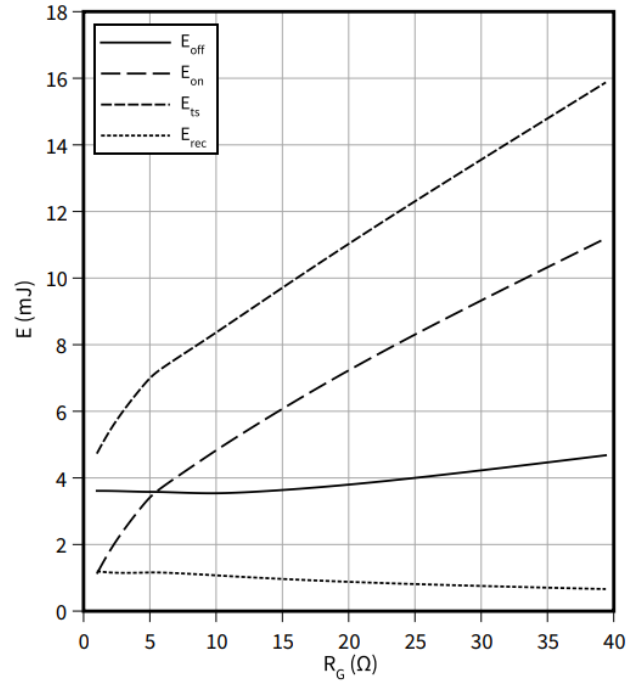
$V_{CC} = 470 \text{ V}$ ,  $T_{vj} = 175 \text{ }^\circ\text{C}$ ,  $R_G = 4.8 \text{ } \Omega$



**Typical switching energy losses as a function of gate resistor**

$E = f(R_G)$

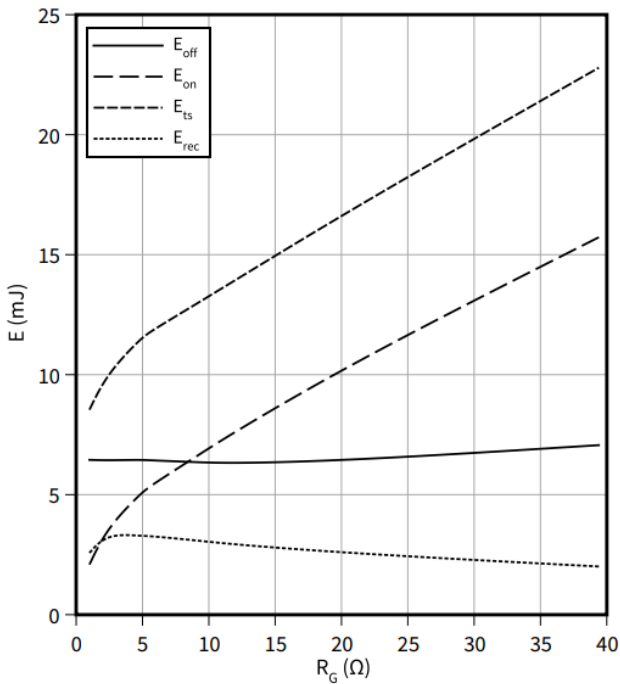
$I_C = 120 \text{ A}$ ,  $V_{CC} = 470 \text{ V}$ ,  $T_{vj} = 25 \text{ }^\circ\text{C}$



**Typical switching energy losses as a function of gate resistor**

$E = f(R_G)$

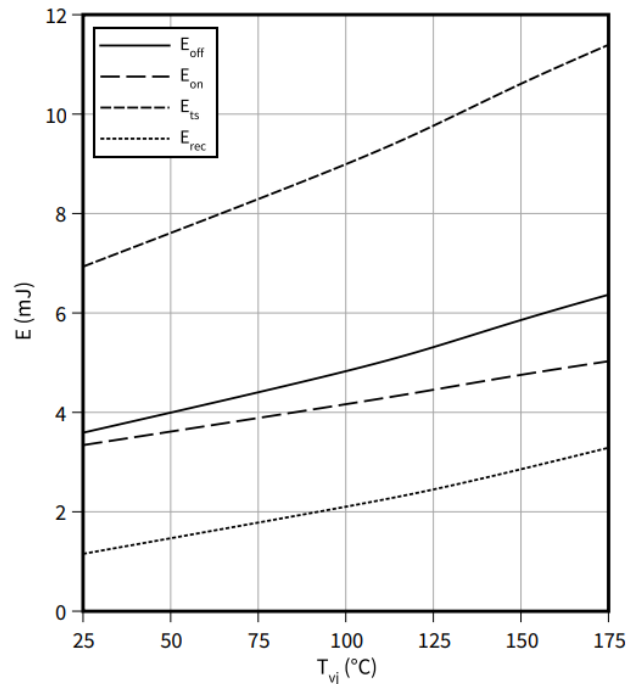
$I_C = 120 \text{ A}$ ,  $V_{CC} = 470 \text{ V}$ ,  $T_{vj} = 175 \text{ }^\circ\text{C}$



**Typical switching energy losses as a function of junction temperature**

$E = f(T_{vj})$

$I_C = 120 \text{ A}$ ,  $V_{CC} = 470 \text{ V}$ ,  $R_G = 4.8 \text{ } \Omega$

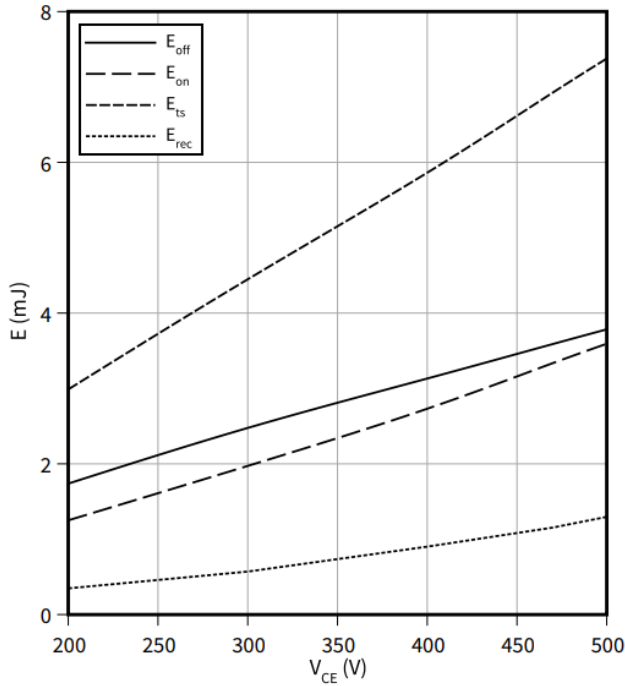


4 特性图

**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

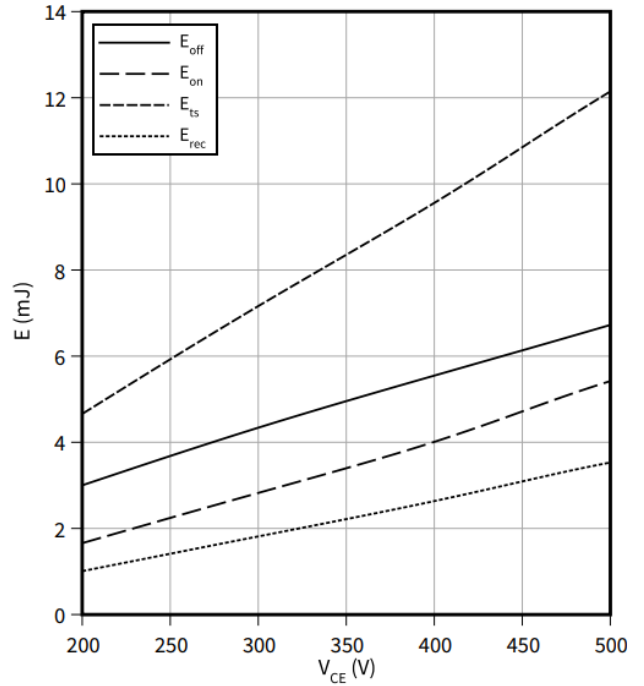
$I_C = 120\text{ A}$ ,  $T_{vj} = 25\text{ }^\circ\text{C}$ ,  $R_G = 4.8\ \Omega$



**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

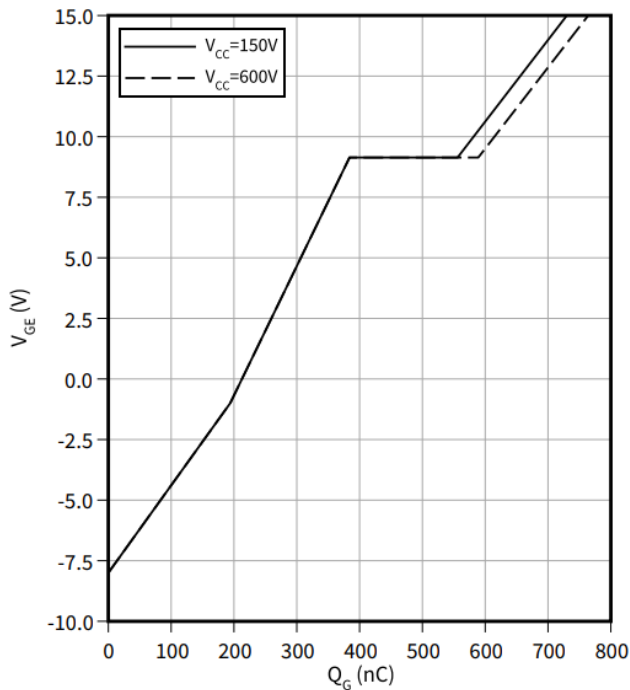
$I_C = 120\text{ A}$ ,  $T_{vj} = 175\text{ }^\circ\text{C}$ ,  $R_G = 4.8\ \Omega$



**Typical gate charge**

$V_{GE} = f(Q_G)$

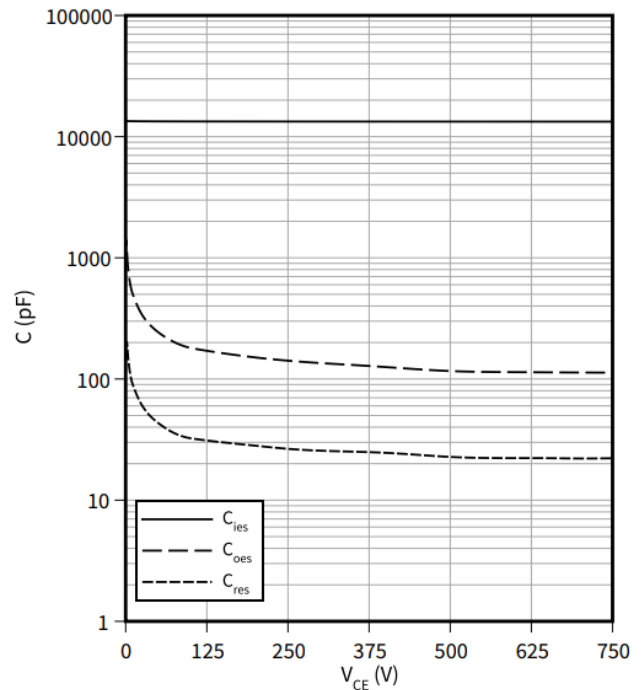
$I_C = 120\text{ A}$



**Typical capacitance as a function of collector-emitter voltage**

$C = f(V_{CE})$

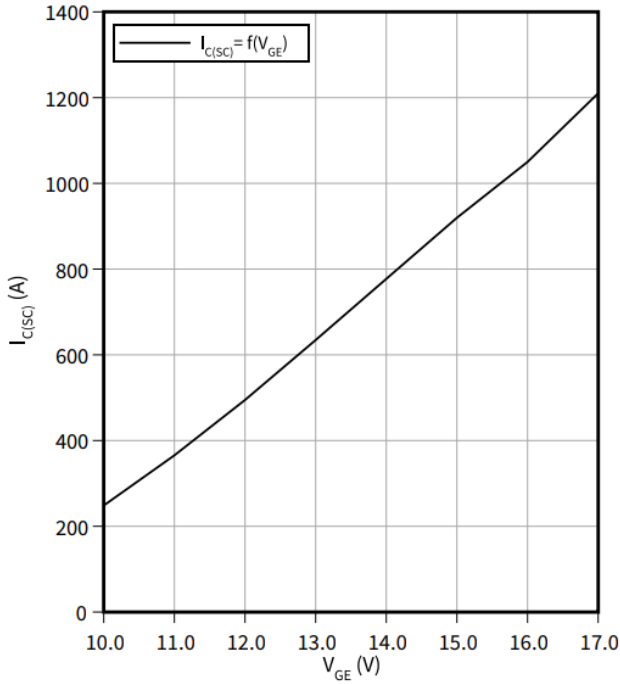
$f = 100\text{ kHz}$



4 特性图

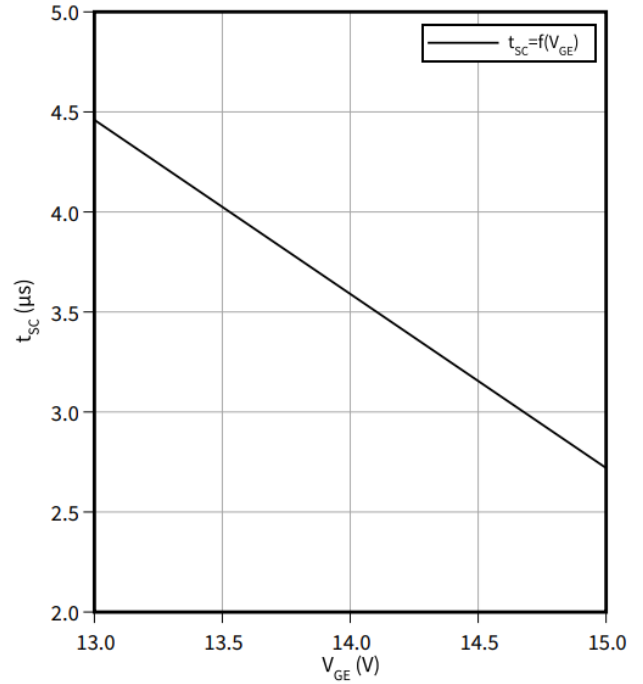
Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$   
 $T_{vj} = 175\text{ }^{\circ}\text{C}$ ,  $V_{CC} = 470\text{ V}$



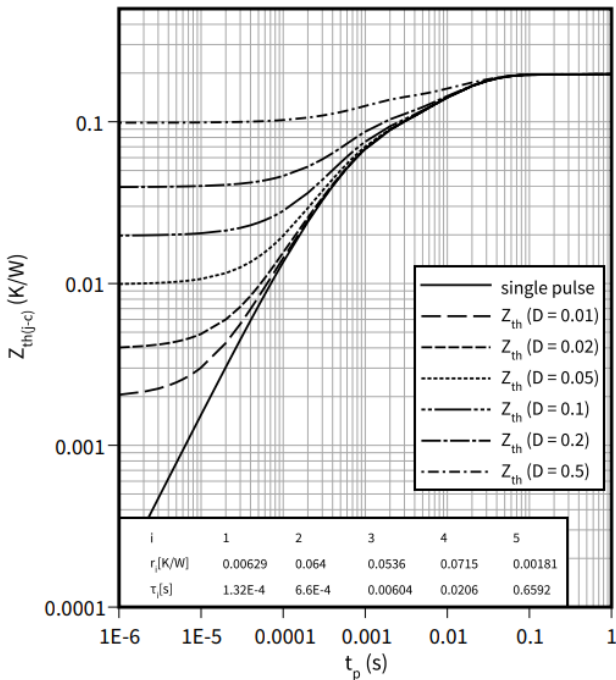
Short circuit withstand time as a function of gate-emitter voltage

$t_{SC} = f(V_{GE})$   
 $T_{vj} = 175\text{ }^{\circ}\text{C}$ ,  $V_{CC} = 470\text{ V}$



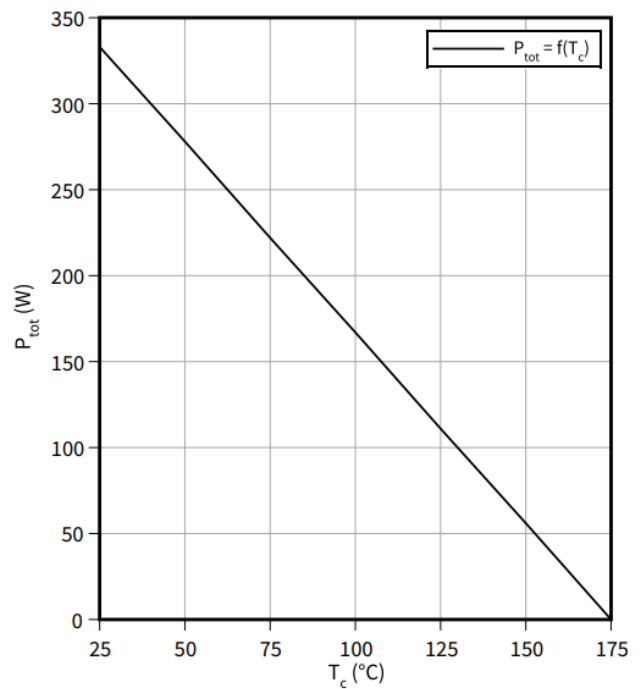
IGBT typical transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$   
 $D = t_p/T$



Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$   
 $T_{vj} \leq 175\text{ }^{\circ}\text{C}$

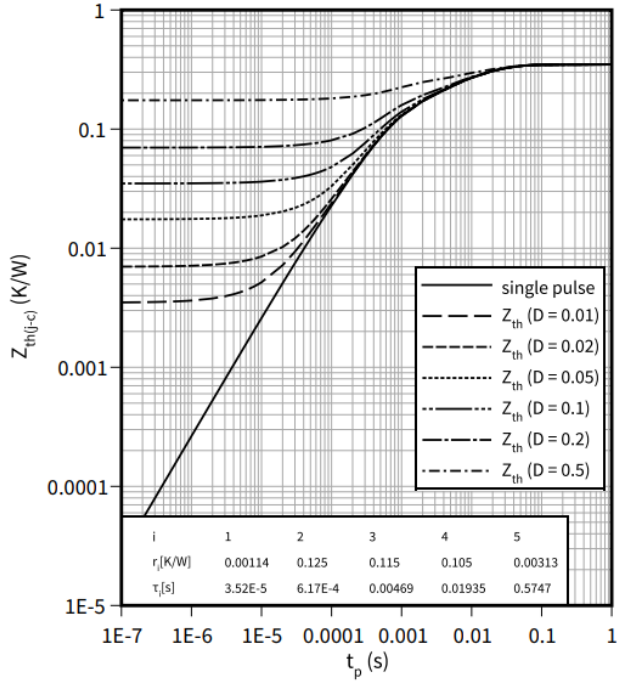


4 特性图

Diode typical transient thermal impedance as a function of pulse width

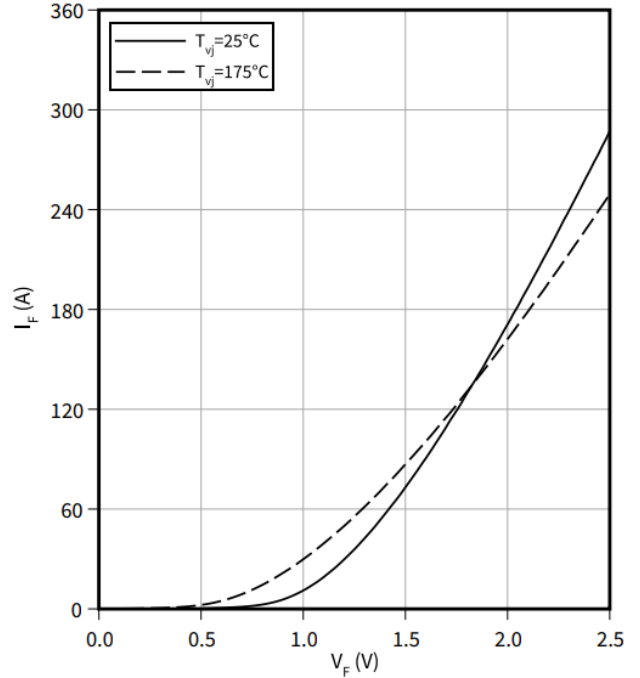
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p/T$$



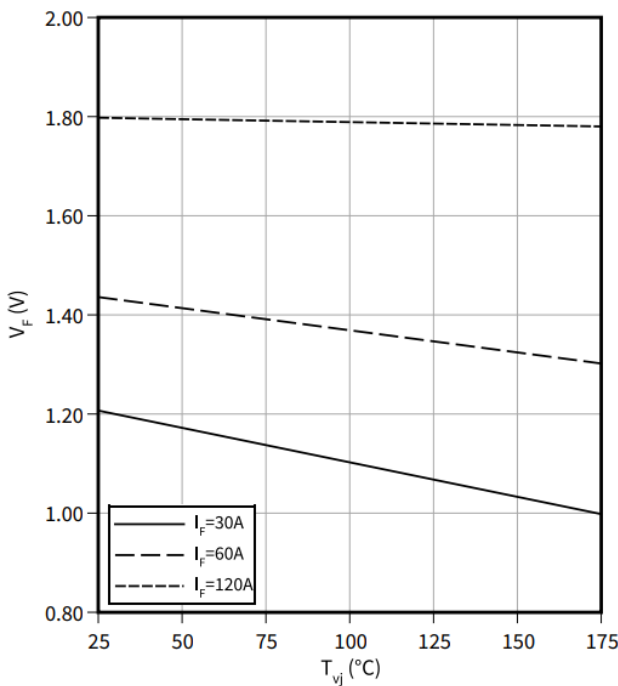
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



Typical diode forward voltage as a function of junction temperature

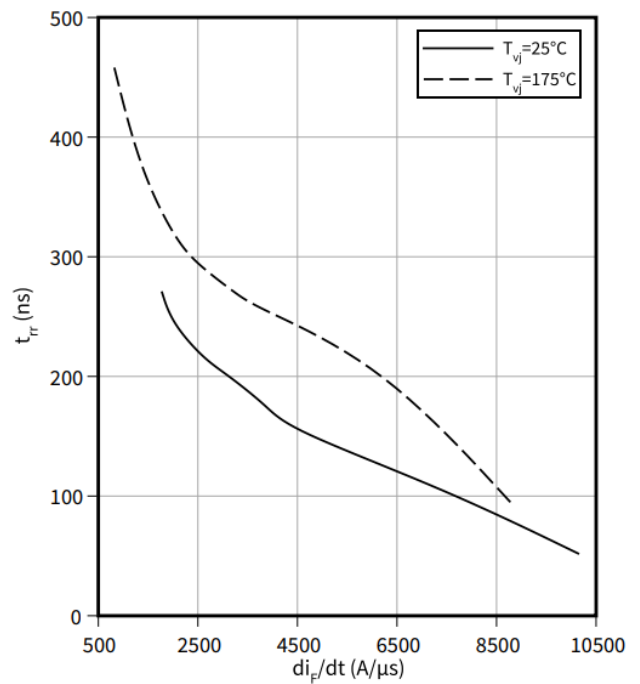
$$V_F = f(T_{vj})$$



Typical reverse recovery time as a function of diode current slope

$$t_{rr} = f(di_F/dt)$$

$$V_R = 470 \text{ V}, I_F = 120 \text{ A}$$

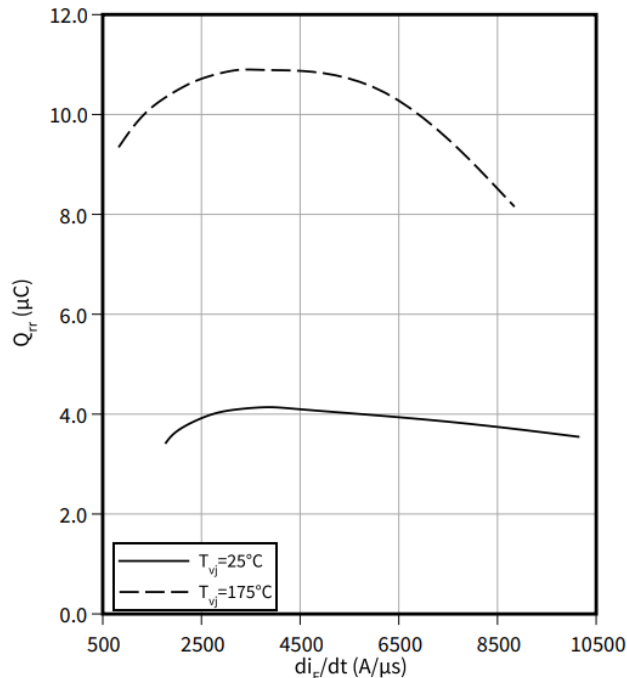


4 特性图

**Typical reverse recovery charge as a function of diode current slope**

$Q_{rr} = f(di_F/dt)$

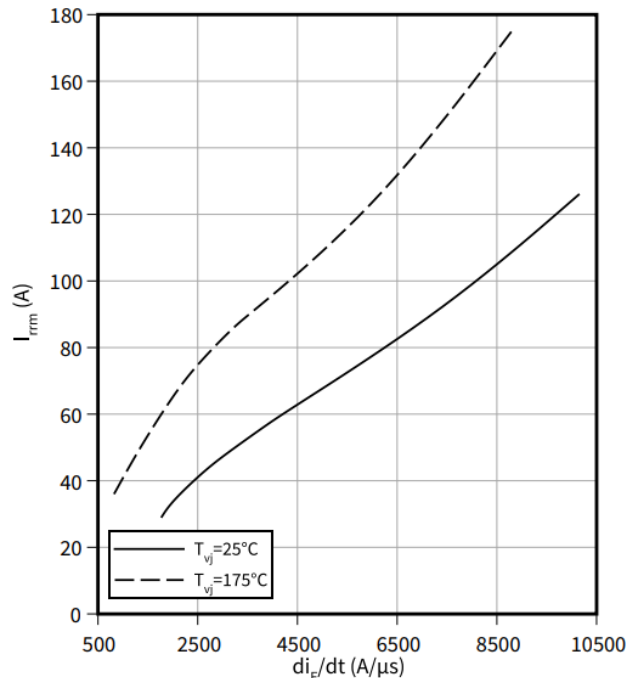
$V_R = 470 \text{ V}, I_F = 120 \text{ A}$



**Typical reverse recovery current as a function of diode current slope**

$I_{rrm} = f(di_F/dt)$

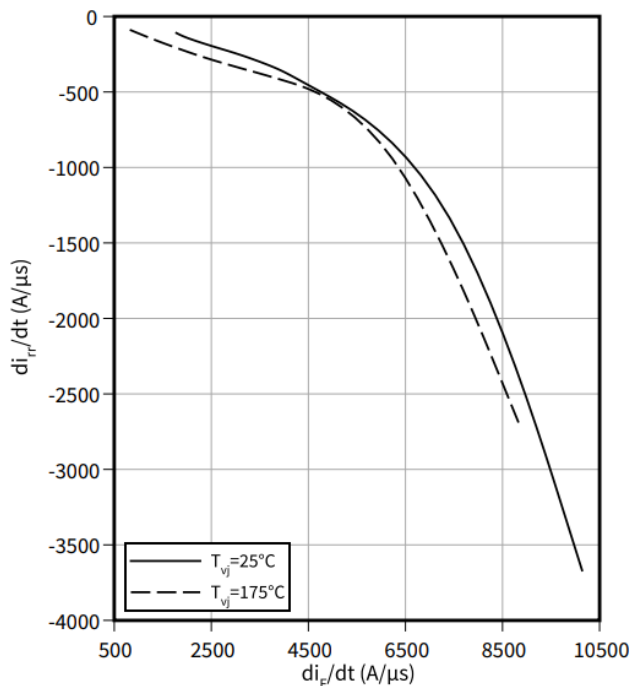
$V_R = 470 \text{ V}, I_F = 120 \text{ A}$



**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**

$di_{rr}/dt = f(di_F/dt)$

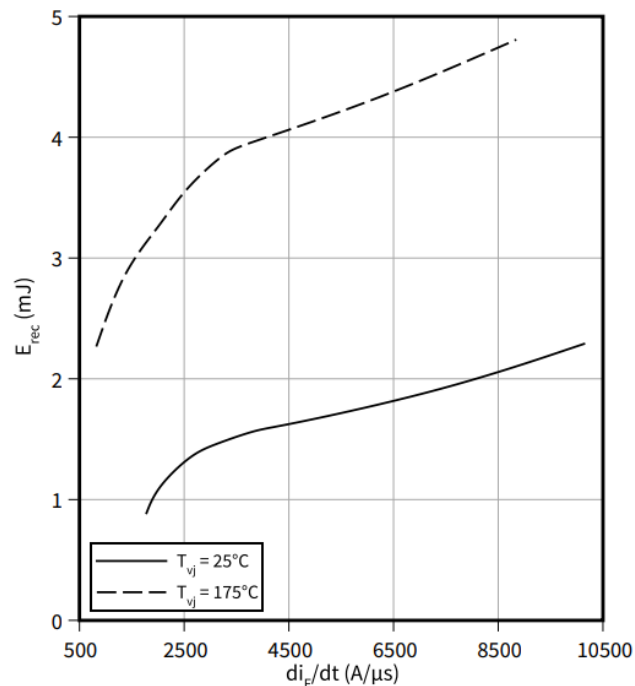
$V_R = 470 \text{ V}, I_F = 120 \text{ A}$



**Typical reverse energy losses as a function of diode current slope**

$E_{rec} = f(di_F/dt)$

$V_R = 470 \text{ V}, I_F = 120 \text{ A}$

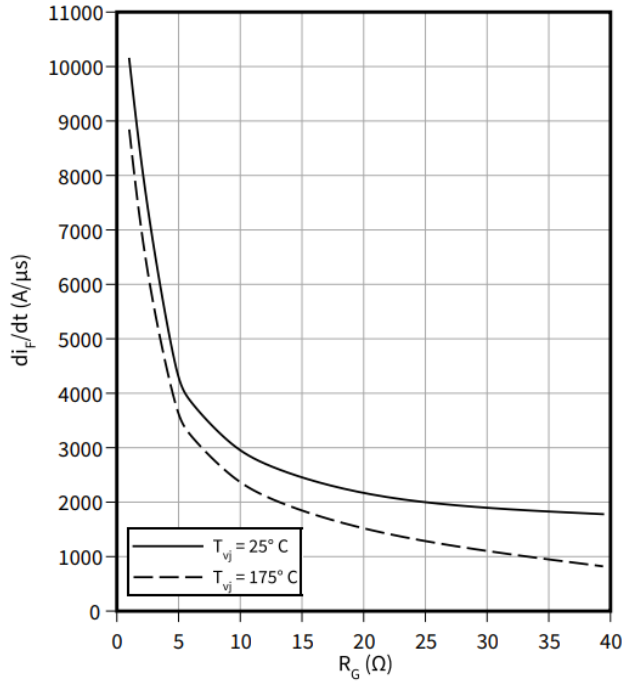


## 4 特性图

**Typical diode current slope as a function of gate resistor**

$$di_F/dt = f(R_G)$$

$$V_R = 470 \text{ V}, I_F = 120 \text{ A}$$





## 6 测试条件

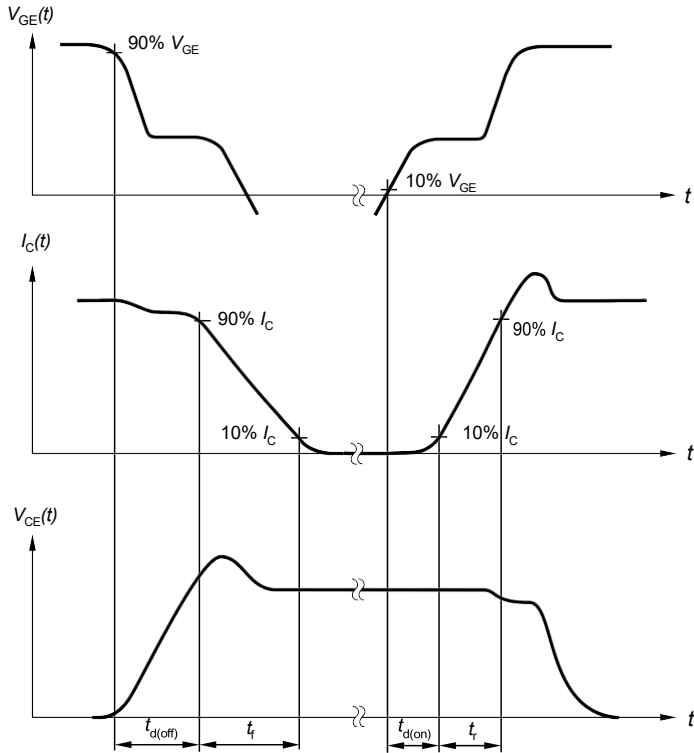


Figure A. Definition of switching times

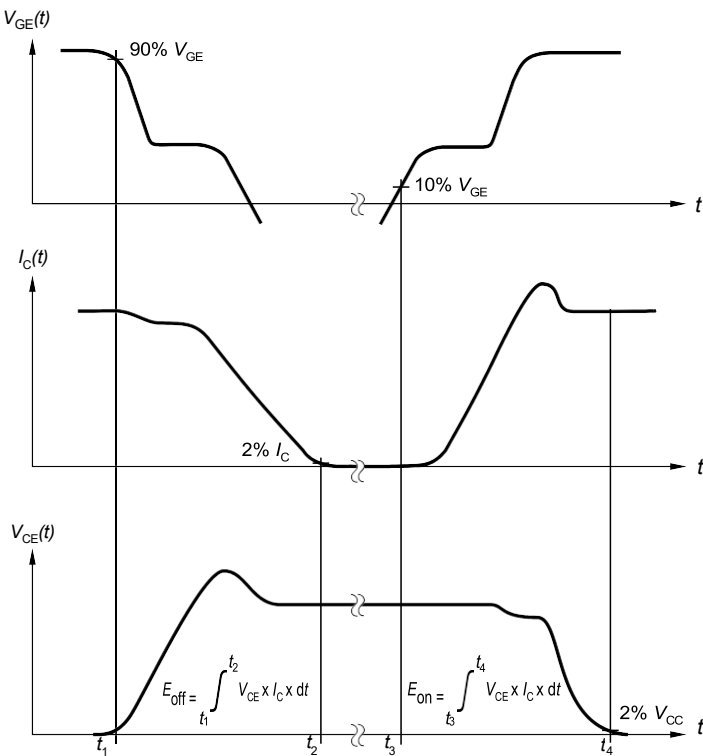


Figure B. Definition of switching losses

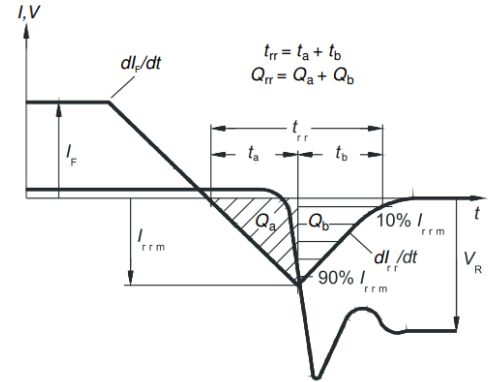


Figure C. Definition of diode switching characteristics

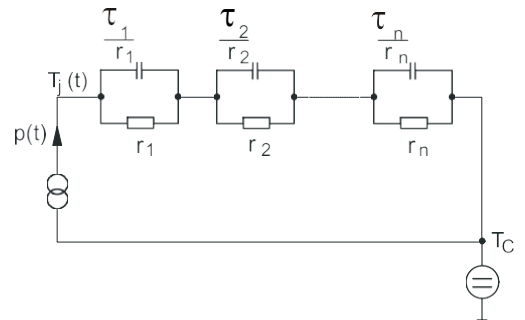


Figure D. Thermal equivalent circuit

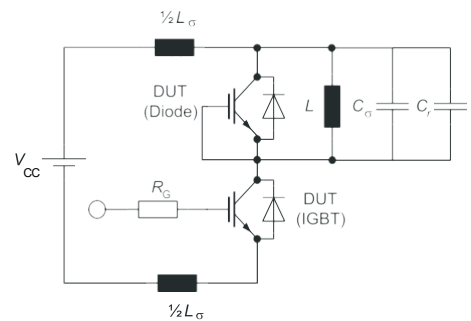


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_\alpha$ ,  
parasitic capacitor  $C_\alpha$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

## 修订记录

Document revision	Date of release	Description of changes
0.10	2024-03-26	Preliminary datasheet
1.00	2024-07-24	Final datasheet
1.10	2024-07-29	Update graph with Output Characteristics at 175°C
1.20	2025-06-11	Transient thermal impedance plots, package naming convention, and qualification labels updated according to the latest guidelines



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