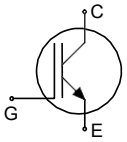
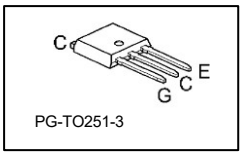
低损耗 IGBT：采用 TRENCHSTOP™ 技术的 IGBT





- 极低 $V_{CE(sat)}$ 1.5V（典型值）
- 最高结温 175°C
- 短路耐受时间 5 µs
- 设计用于：
  - 变频器
  - 驱动器
- 适用于 600V 应用的 TRENCHSTOP™提供：
  - 参数分布紧密
  - 高稳健性、温度稳定性
  - 切换速度快
  - 低 $V_{CE(sat)}$
- $V_{CE(sat)}$ 正温度系数
- 低电磁干扰
- 低栅极电荷
  符合 JEDEC[1)]目标应用要求
- 完整的产品品类和 PSpice 模型： http://www.infineon.cn/igbt/

Type	V_{CE}	I_C	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	Marking	Package
IGU04N60T	600 V	4 A	1.5 V	175 °C	G04T60	PG-TO251-3

最大额定值

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current, limited by T_{jmax} T_C = 25°C T_C = 100°C	I_C	 9.5 6.5	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	12	
Turn off safe operating area ($V_{CE} \le$ 600V, $T_j \le$ 175°C)	-	12	
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[2)] V_{GE} = 15V, $V_{CC} \le$ 400V, $T_j \le$ 150°C	t_{SC}	5	µs
Power dissipation T_C = 25°C	P_{tot}	42	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	
Soldering temperature, wave soldering, 1.6mm (0.063 in.) from case for 10s.	T_s	260	°C

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 参考最新的英文版本（控制文档）。

[1] J-STD-020 and JESD-022

[2)] 允许短路次数低于1000次；允许短路间隔时间大于1s

热阻

Parameter	Symbol	Conditions	Max. Value	Unit
特性				
IGBT thermal resistance, junction – case	R_{thJC}		3.5	K/W
Thermal resistance, junction – ambient	R_{thJA}		75	

电气特性，测于T_j=25 °C的条件下，除非另有规定

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
静态特性						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE}= 0 V, I_C= 0 . 2 mA	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE}= 15 V, I_C= 4 A T_j= 25 °C T_j= 175 °C	 - -	 1.5 1.9	 2.05 -	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C= 60 µ A, V_{CE}= V_{GE}	4.1	4.9	5.7	
Zero gate voltage collector current	I_{CES}	V_{CE}= 600V, V_{GE}= 0 V T_j= 25 °C T_j=175 °C	 - -	 - 40	 40 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE}= 0 V, V_{GE}= 20 V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}= 20 V, I_C= 4 A	-	2.2	-	S

动态特性

Input capacitance	C_{iss}	V_{CE}= 25 V,	-	252	-	pF
Output capacitance	C_{oss}	V_{GE}= 0 V,	-	20	-	
Reverse transfer capacitance	C_{rss}	f= 1 MHz	-	7.5	-	
Gate charge	Q_{Gate}	V_{CC}= 480 V, I_C= 4 A V_{GE}= 15 V	-	27	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7	-	nH
Short circuit collector current[1)]	$I_{C(SC)}$	V_{GE}= 15 V, t_{SC}≤ 5 µs V_{CC}= 400 V, T_j≤ 150° C	-	36	-	A

[1)] 允许短路次数低于1000次；允许短路间隔时间大于1s

开关特性，感性负载，测于T_j = 25 °C的条件下

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT特性						
Turn-on delay time	$t_{d(on)}$	T_j = 25 °C, V_{CC} = 400 V, I_C =4 A, V_{GE} = 0 / 15 V, r_G = 47 Ω , L_σ = 150 n H, C_σ = 47 p F L_σ, C_σ f rom Fig. E Energy losses include “tail” and diode reverse recovery.	-	14	-	ns
Rise time	t_r		-	7	-	
Turn-off delay time	$t_{d(off)}$		-	164	-	
Fall time	t_f		-	43	-	
Turn-on energy	E_{on}		-	61	-	µJ
Turn-off energy	E_{off}		-	84	-	
Total switching energy	E_{ts}		-	145	-	

开关特性，感性负载， 测于T_j = 175 °C的条件下

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT特性						
Turn-on delay time	$t_{d(on)}$	T_j = 175 °C, V_{CC} = 400 V, I_C =4 A, V_{GE} = 0 / 15 V, r_G = 47 Ω , L_σ = 150 n H, C_σ = 47 p F L_σ, C_σ f rom Fig. E Energy losses include “tail” and diode reverse recovery.	-	14	-	ns
Rise time	t_r		-	10	-	
Turn-off delay time	$t_{d(off)}$		-	185	-	
Fall time	t_f		-	83	-	
Turn-on energy	E_{on}		-	99	-	µJ
Turn-off energy	E_{off}		-	97	-	
Total switching energy	E_{ts}		-	196	-	

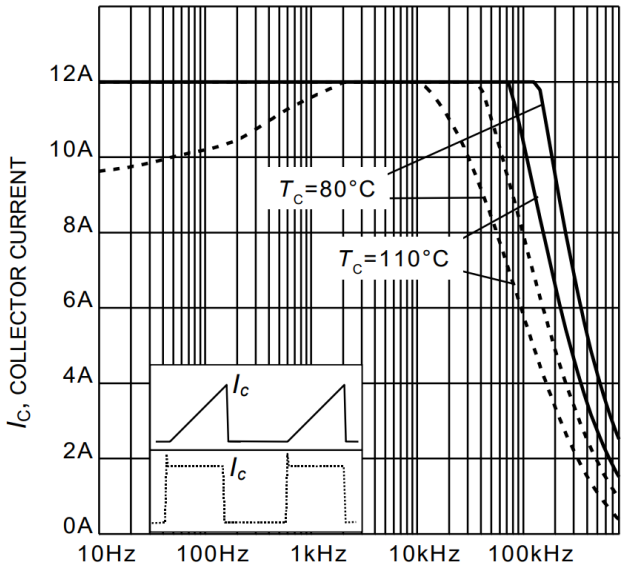


Figure 1. Collector current as a function of switching frequency
($T_j \leq 175°C$, $D = 0.5$, $V_{CE} = 400V$, $V_{GE} = 0/15V$, $r_G = 47\Omega$)

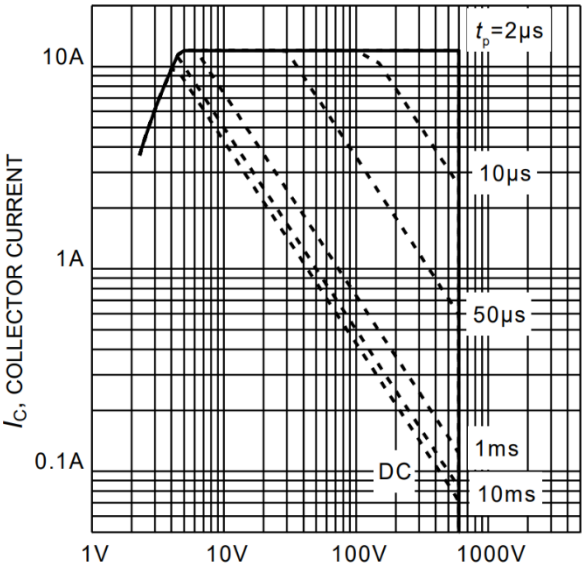


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$; V_{GE}=0/15V)

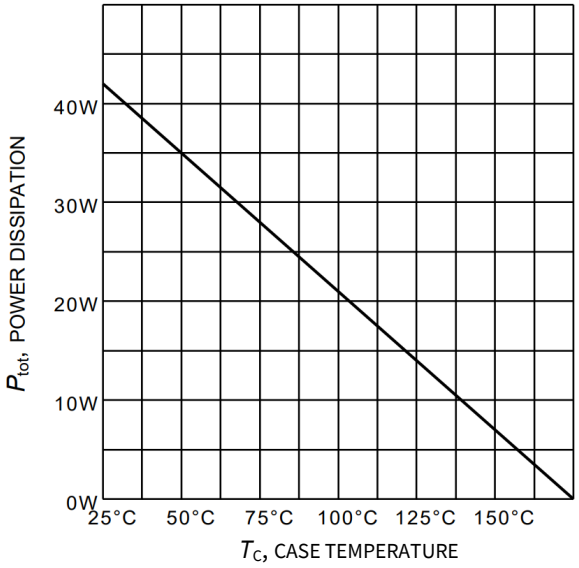


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 175°C$)

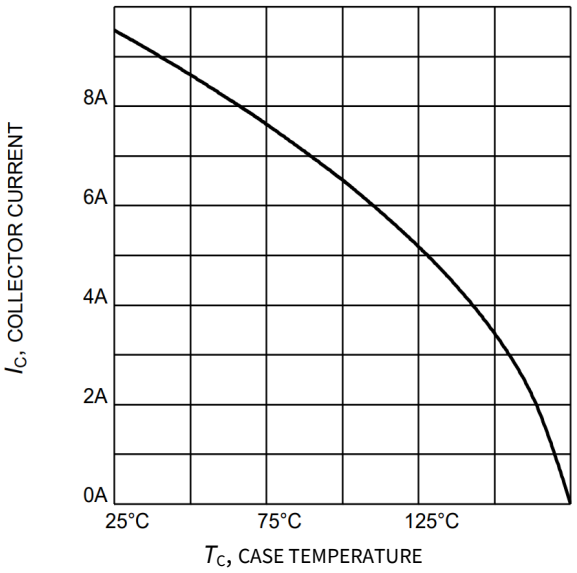


Figure 4. Collector current as a function of case temperature
($V_{GE} \geq 15V$, $T_j \leq 175°C$)

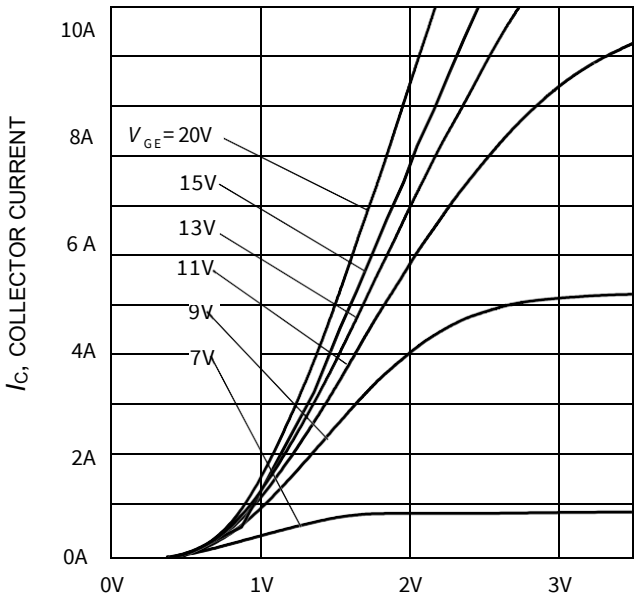


Figure 5. Typical output characteristic
(T_j=25°C)

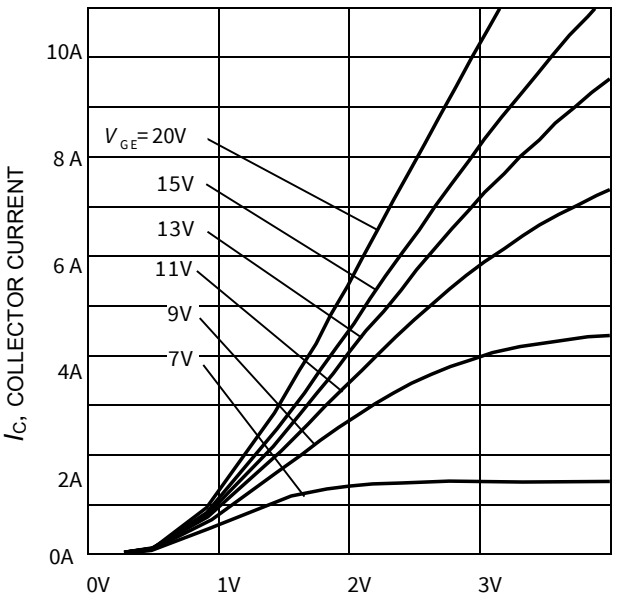


Figure 6. Typical output characteristic
(T_j=175°C)

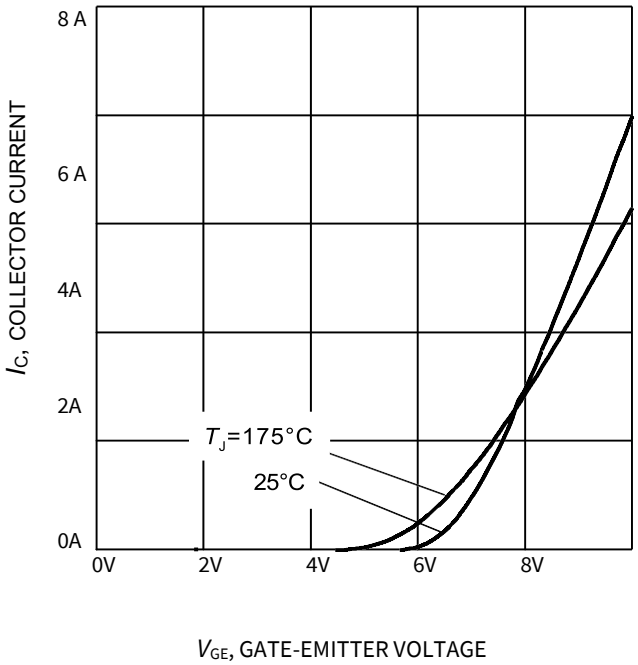


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

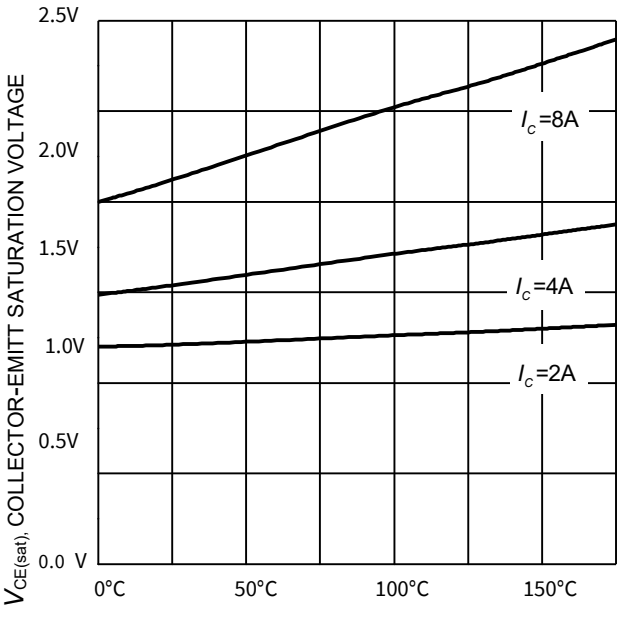


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

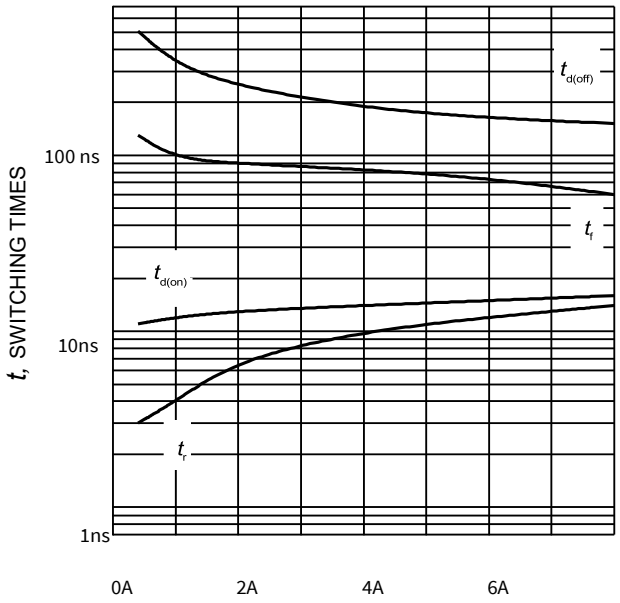


Figure 9. Typical switching times as a function of collector current
(inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, r_G = 47Ω, Dynamic test circuit in Figure E)

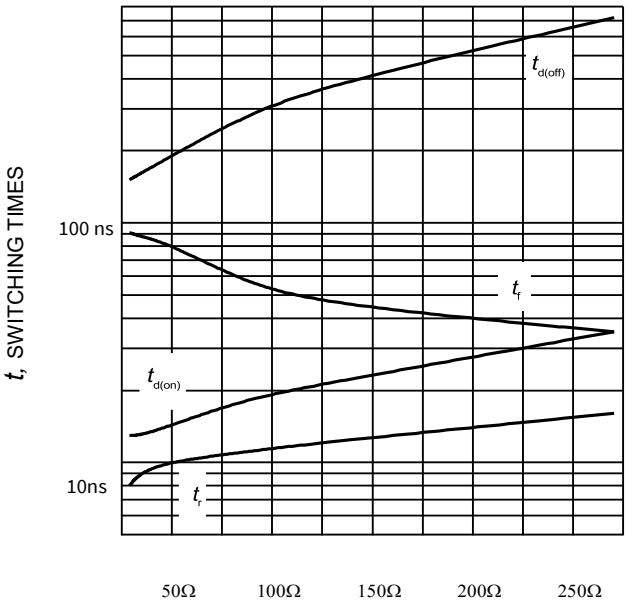


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J = 175°C, V_{CE}= 400V, V_{GE} = 0/15V, I_C = 4A, Dynamic test circuit in Figure E

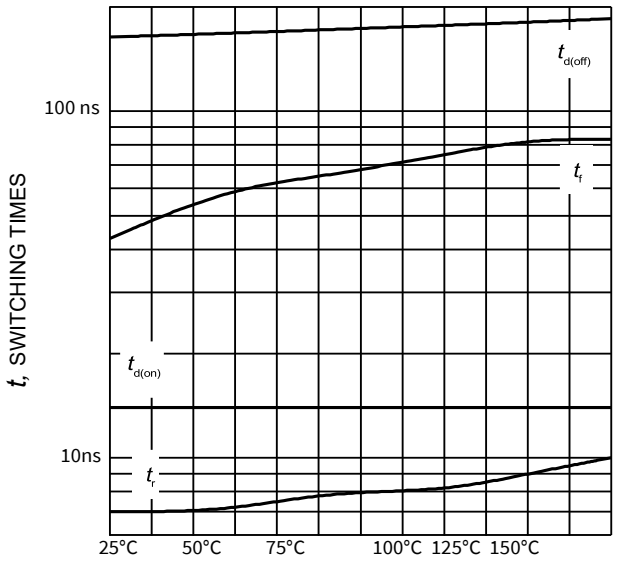


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 4A, r_G = 47Ω, Dynamic test circuit in Figure E)

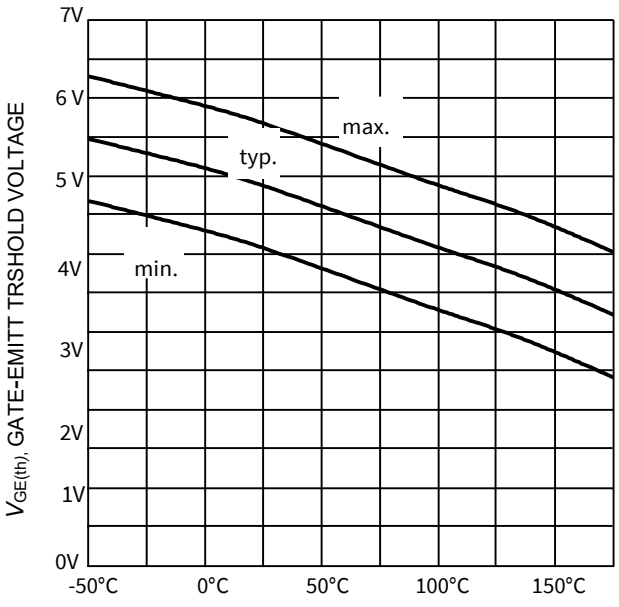


Figure 12. Gate-emitter threshold voltage as a function of junction temperature (I_C = 60 µA)

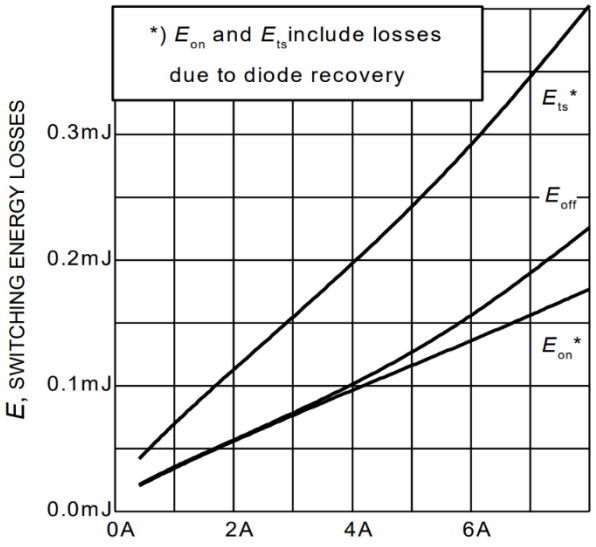


Figure 13. Typical switching energy losses as a function of collector current (inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, r_G = 47Ω, Dynamic test circuit in Figure E)

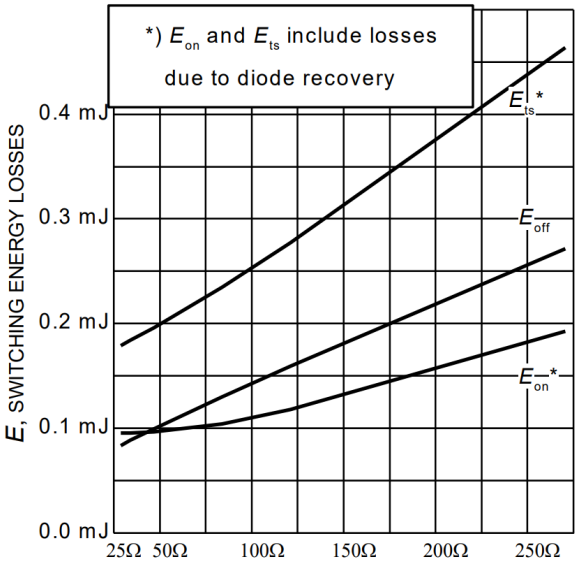


Figure 14. Typical switching energy losses as a function of gate resistor (inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 4A, Dynamic test circuit in Figure E

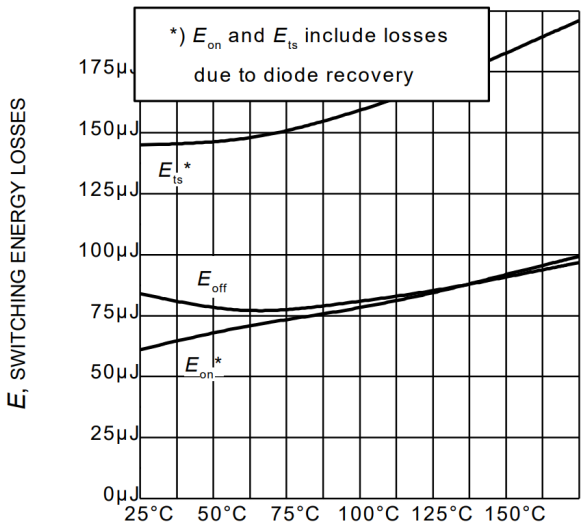


Figure 15. Typical switching energy losses as a function of junction temperature (inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 4A, r_G = 47Ω, Dynamic test circuit in Figure E)

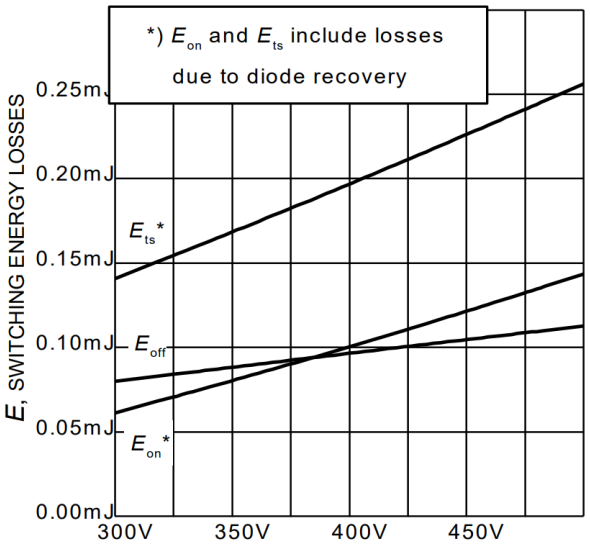


Figure 16. Typical switching energy losses as a function of collector emitter voltage (inductive load, T_J = 175°C, V_{GE} = 0/15V, I_C = 4A, r_G = 47Ω, Dynamic test circuit in Figure E)

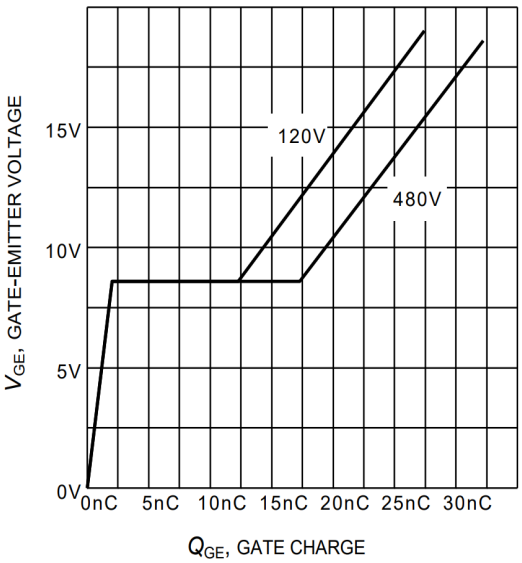


Figure 17. Typical gate charge
(I_C=4A)

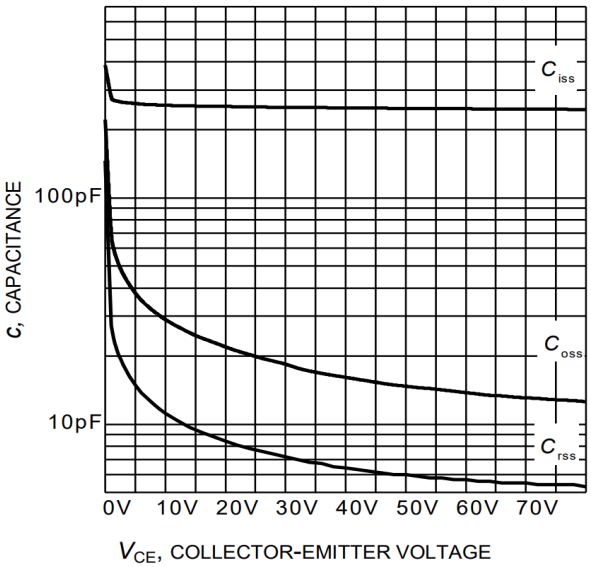


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

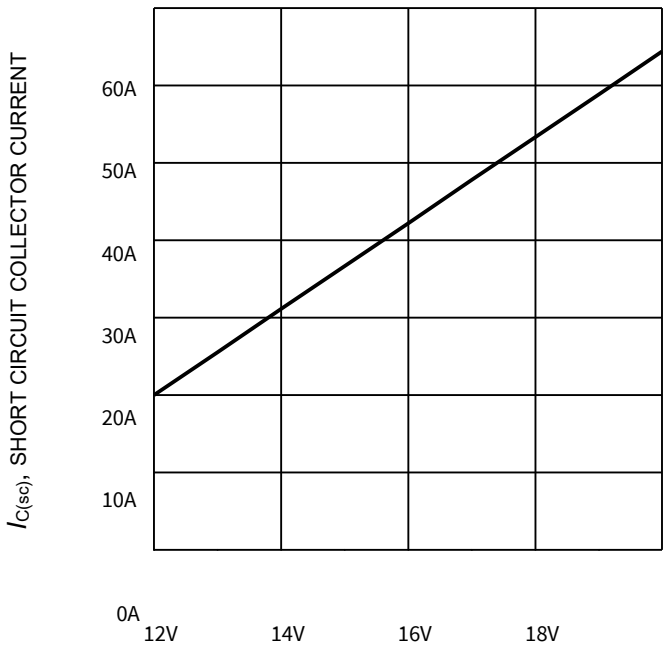


Figure 19. Typical short circuit collector current as a function of gate-emitter voltage
(VCE ≤ 400V, Tj ≤ 150°C)

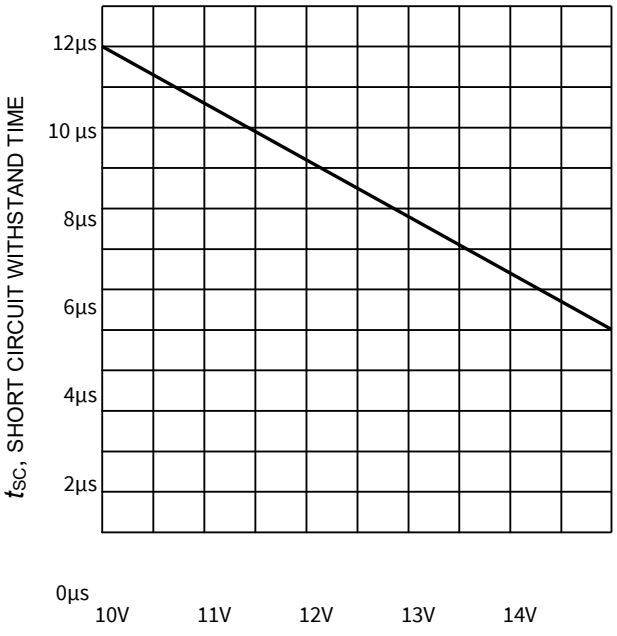


Figure 20. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=400V, start at T_j=25°C, $T_{j,max}$<150°C)

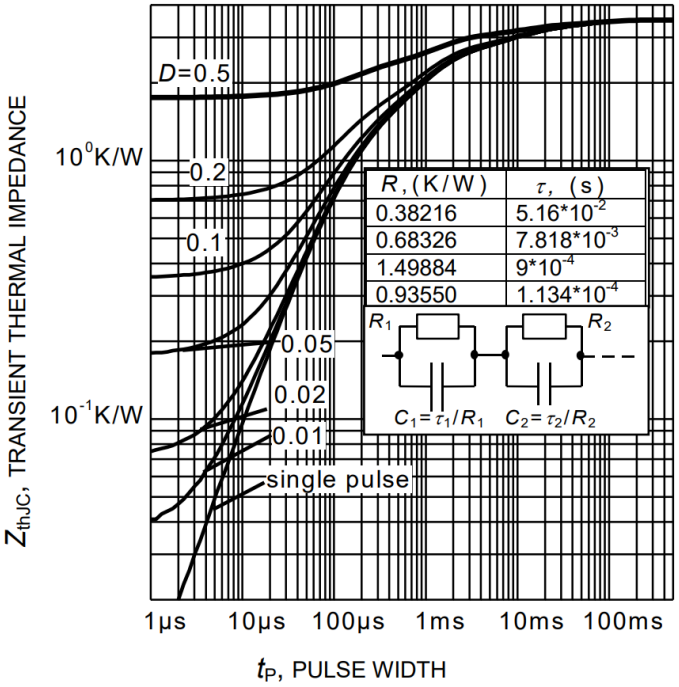
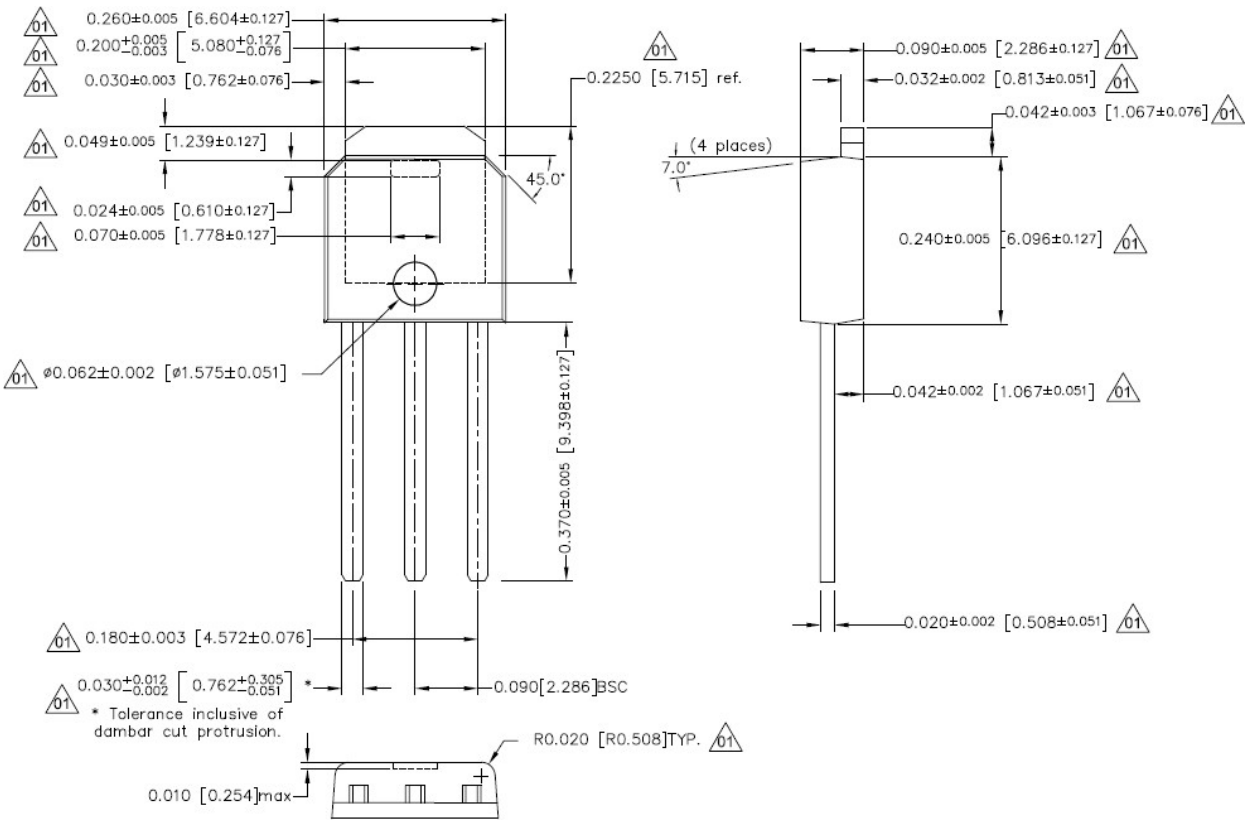
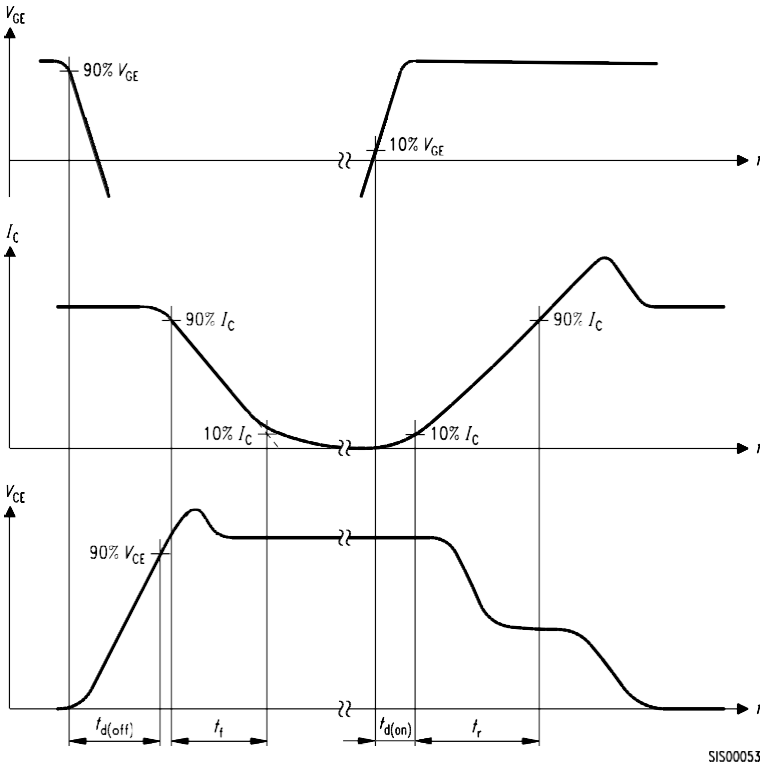


Figure 21. IGBT transient thermal impedance
($D = t_p / T$)

PG-TO251-3


0.260±0.005 [6.604±0.127]
0.200+0.005 −0.003 [5.080+0.127 −0.076]
0.030±0.003 [0.762±0.076]
0.049±0.005 [1.239±0.127]
0.024±0.005 [0.610±0.127]
0.070±0.005 [1.778±0.127]
ø0.062±0.002 [ø1.575±0.051]
0.2250 [5.715] ref.
45.0°
0.370±0.005 [9.398±0.127]
0.180±0.003 [4.572±0.076]
0.030+0.012 −0.002 [0.762+0.305 −0.051] *
* Tolerance inclusive of dambar cut protrusion.
0.090[2.286]BSC
R0.020 [R0.508]TYP.
0.010 [0.254]max
(4 places)
7.0°
0.090±0.005 [2.286±0.127]
0.032±0.002 [0.813±0.051]
0.042±0.003 [1.067±0.076]
0.240±0.005 [6.096±0.127]
0.042±0.002 [1.067±0.051]
0.020±0.002 [0.508±0.051]



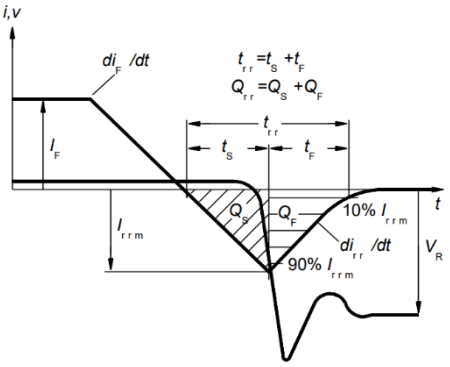


Figure C. Definition of diodes switching characteristics

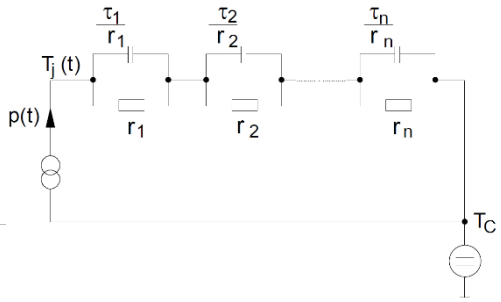


Figure D. Thermal equivalent circuit

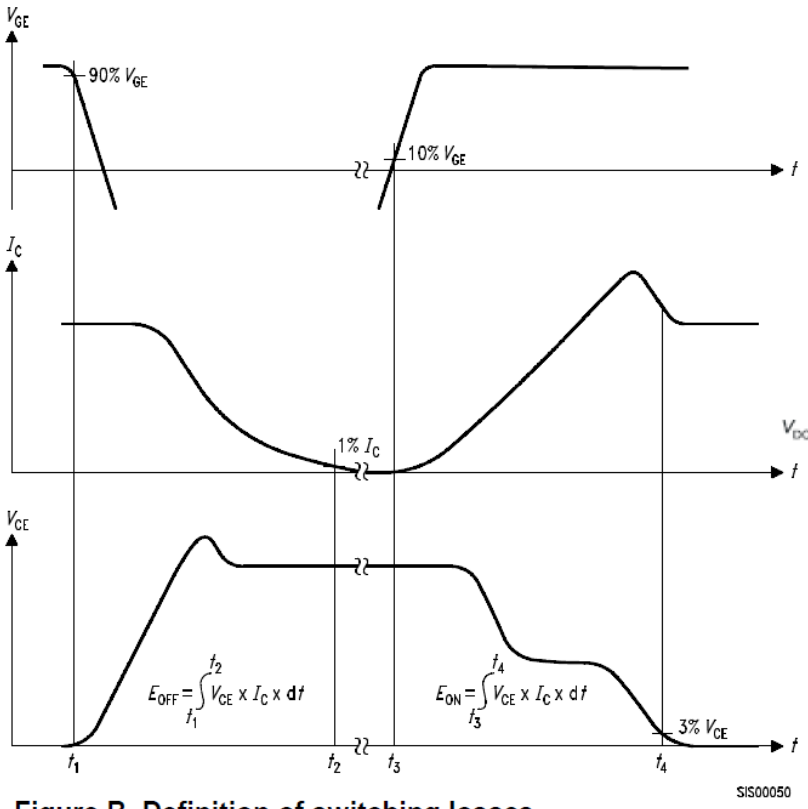


Figure B. Definition of switching losses

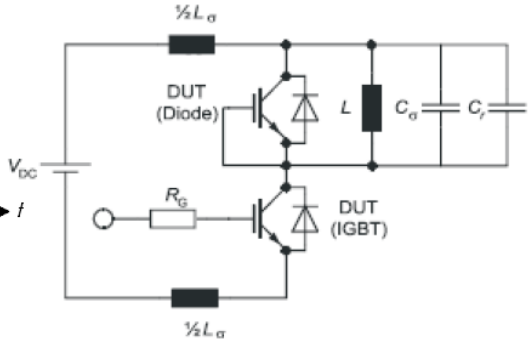


Figure E. Dynamic test circuit
Parasitic inductance L_σ,
Parasitic capacitor C_σ,
Relief capacitor C_r
(only for ZVT switching)

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