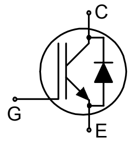
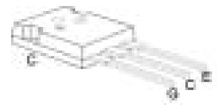
Low Loss DuoPack : IGBT in TrenchStop® -technology with anti-parallel diode

Features:





PG-TO-247-3-21

- Very low $V_{CE(sat)}$ 1.5 V (typ.)
- Maximum Junction Temperature 175 °C
- Short circuit withstand time – 5µs
- TrenchStop® and Fieldstop technology for 600 V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - low $V_{CE(sat)}$
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Qualified according to JEDEC[1] for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

Applications:

- Inductive Cooking
- Soft Switching Applications

Type	V_{CE}	I_C	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	Marking	Package
IHW40N60T	600V	40A	1.55V	175°C	H40T60	PG-TO-247-3-21

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current, limited by T_{jmax}	I_C		A
T_C = 25°C		80	
T_C = 100°C		40	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	120	
Turn off safe operating area ($V_{CE} \leq$ 600V, $T_j \leq$ 175°C)	-	120	
Diode forward current, limited by T_{jmax}	I_F		
T_C = 25°C		40	
T_C = 100°C		20	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	60	
Gate-emitter voltage	V_{GE}	±20	V
Transient Gate-emitter voltage (t_p < 5 ms)		±25	
Short circuit withstand time[2)] V_{GE} = 15V, $V_{CC} \leq$ 400V, $T_j \leq$ 150°C	t_{SC}	5	µs
Power dissipation T_C = 25°C	P_{tot}	303	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+175	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

[1] J-STD-020 and JESD-022
[2)] Allowed number of short circuits: <1000; time between short circuits: >1s.

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		0.49	K/W
Diode thermal resistance, junction – case	R_{thJCD}		0.76	
Thermal resistance, junction – ambient	R_{thJA}		40	

Electrical Characteristic, at T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE}=0V, I_C=0.5mA	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=40A T_j=25°C T_j=175°C	- -	1.55 1.9	2.05 -	
Diode forward voltage	V_F	V_{GE}=0V, I_F=20A T_j=25°C T_j=175°C	- -	1.1 1.05	- -	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=0.8mA, V_{CE}=V_{GE}	4.1	4.9	5.7	
Zero gate voltage collector current	I_{CES}	V_{CE}=600V, V_{GE}=0V T_j=25°C T_j=175°C	- -	- -	40 1000	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V,V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=40A	-	22	-	S
Integrated gate resistor	R_{Gint}			-		Ω

Dynamic Characteristic

Parameter	Symbol	Conditions	min.	Typ.	max.	Unit
Input capacitance	C_{iss}	V_{CE}=25V,	-	2423	-	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	113	-	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	72	-	
Gate charge	Q_{Gate}	V_{CC}=480V, I_C=40A V_{GE}=15V	-	215	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH

Switching Characteristic, Inductive Load, at T_j=25 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=25°C, V_{CC}=400V, I_C=40A, V_{GE}=0/15V, R_G=5.6 Ω, L_σ[1]=40nH, C_σ[1]=30pF Energy losses include “tail” and diode reverse recovery.	-	-	-	ns
Rise time	t_r		-	-	-	
Turn-off delay time	$t_{d(off)}$		-	186	-	
Fall time	t_f		-	66.3	-	
Turn-on energy	E_{on}		-	-	-	mJ
Turn-off energy	E_{off}		-	0.92	-	
Total switching energy	E_{ts}		-	0.92	-	

Switching Characteristic, Inductive Load, at T_j=175 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=175°C, V_{CC}=400V, I_C=40A, V_{GE}=0/15V, R_G= 5.6 Ω L_σ[1]=40nH, C_σ[1]=30pF Energy losses include “tail” and diode reverse recovery.	-	-	-	ns
Rise time	t_r		-	-	-	
Turn-off delay time	$t_{d(off)}$		-	196	-	
Fall time	t_f		-	76.5	-	
Turn-on energy	E_{on}		-	-	-	mJ
Turn-off energy	E_{off}		-	1.4	-	
Total switching energy	E_{ts}		-	1.4	-	

[1] Leakage inductance L_σ and Stray capacity C_σ due to dynamic test circuit in Figure E.

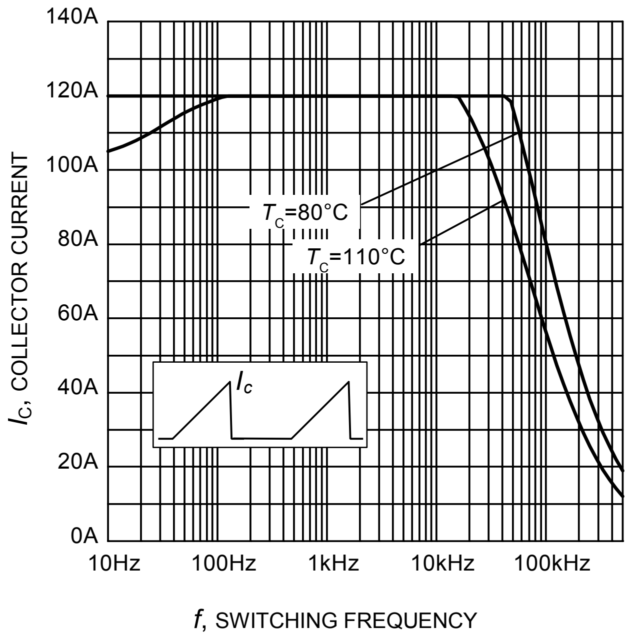


Figure 1. Collector current as a function of switching frequency for triangular current (E_{on} = 0, hard turn-off)
($T_j \leq$ 175°C, D = 0.5, V_{CE} = 400V, V_{GE} = 0/+15V, R_G = 5.6Ω)

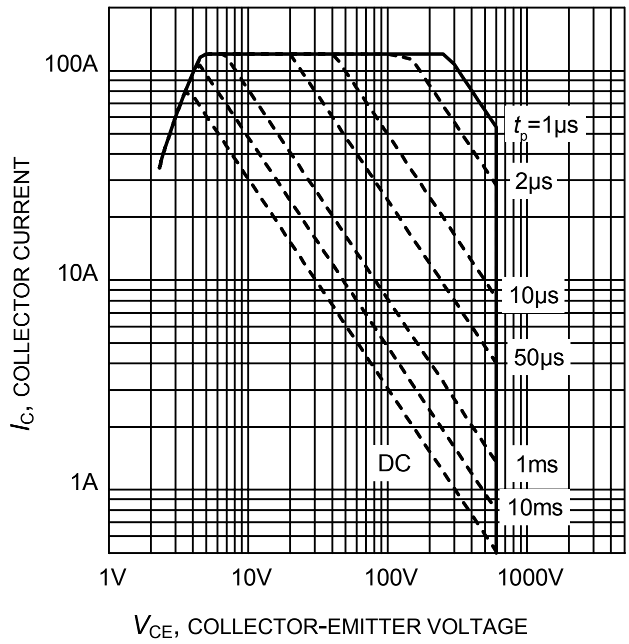


Figure 2. Safe operating area
(D = 0, T_C = 25°C, $T_j \leq$175°C; V_{GE}=15V)

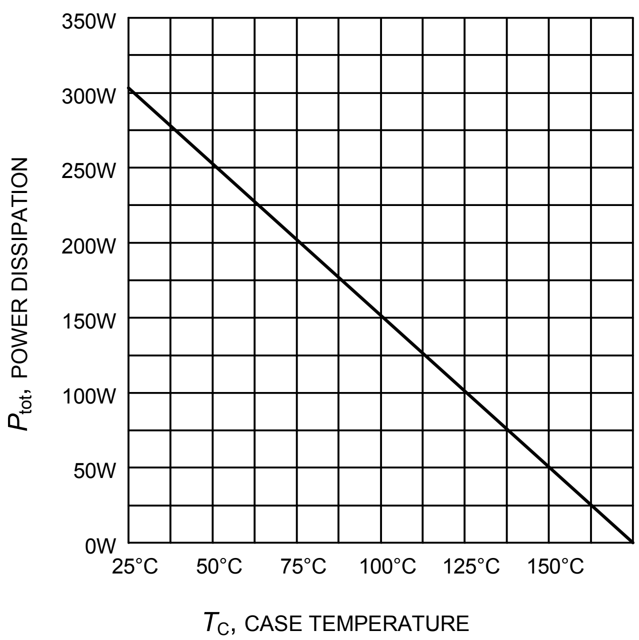


Figure 3. Power dissipation as a function of case temperature
($T_j \leq$ 175°C)

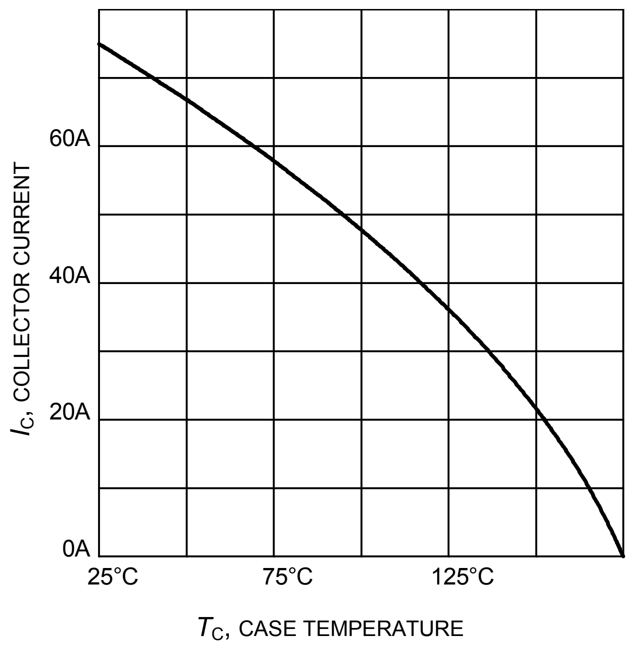


Figure 4. Collector current as a function of case temperature
($V_{GE} \geq$ 15V, $T_j \leq$ 175°C)

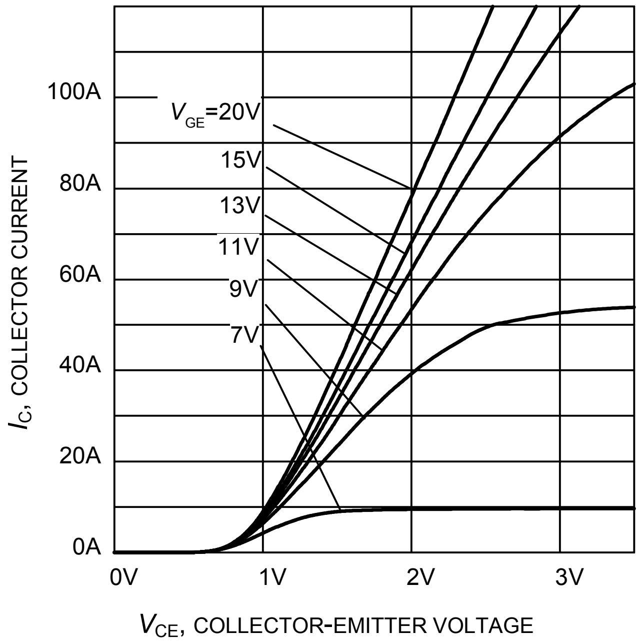


Figure 5. Typical output characteristic
(T_j = 25°C)

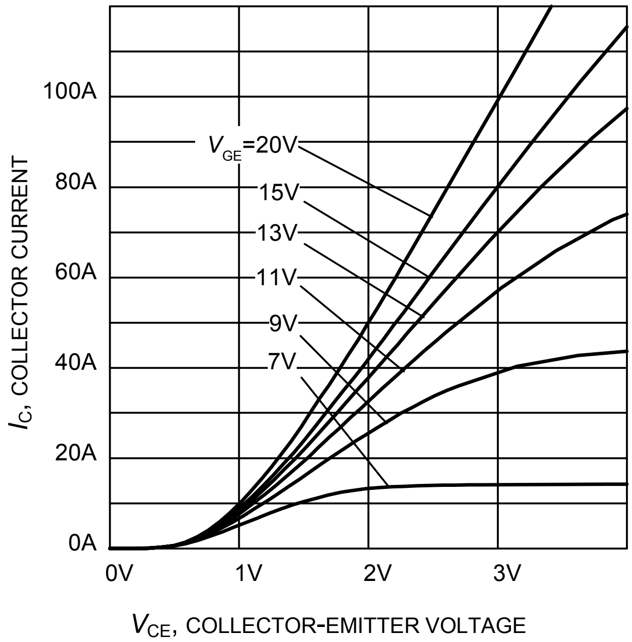


Figure 6. Typical output characteristic
(T_j = 175°C)

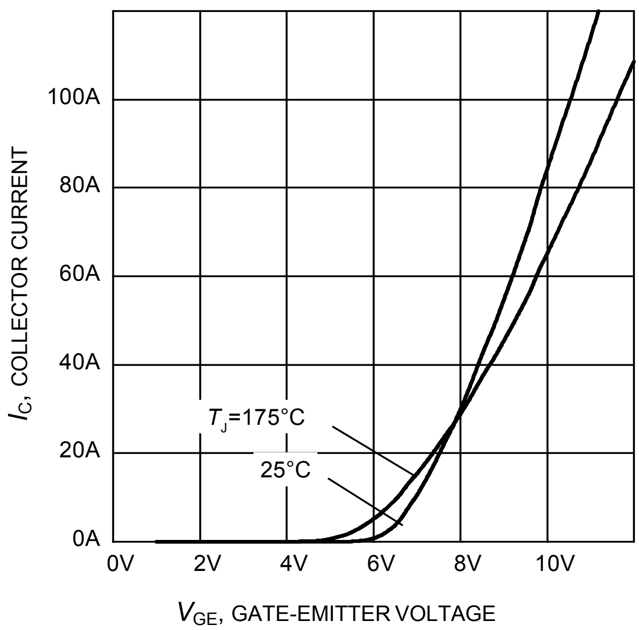


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

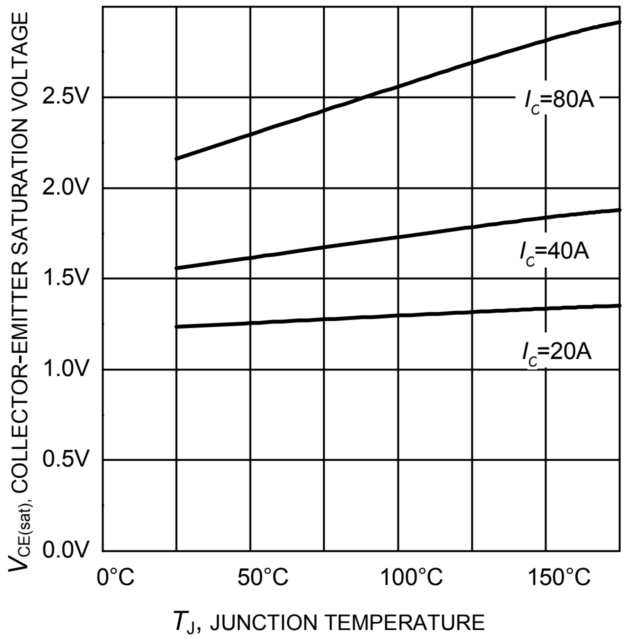


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

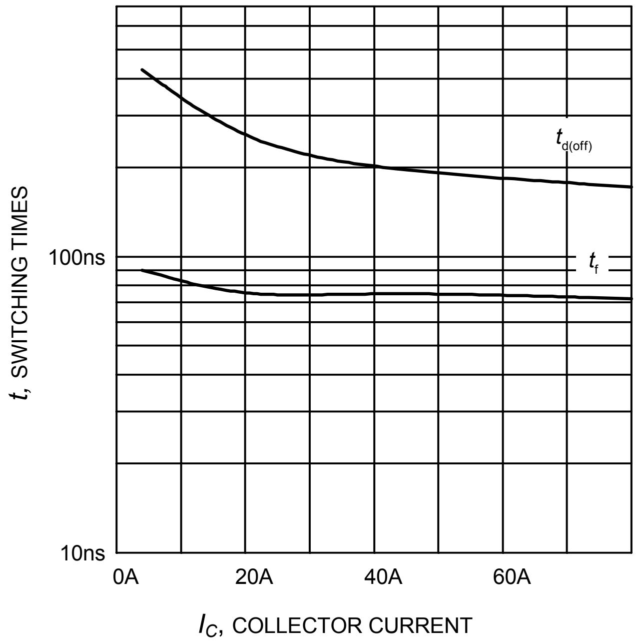


Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=175°C, V_{CE} = 400V, V_{GE} = 0/15V, R_G = 5.6Ω, Dynamic test circuit in Figure E)

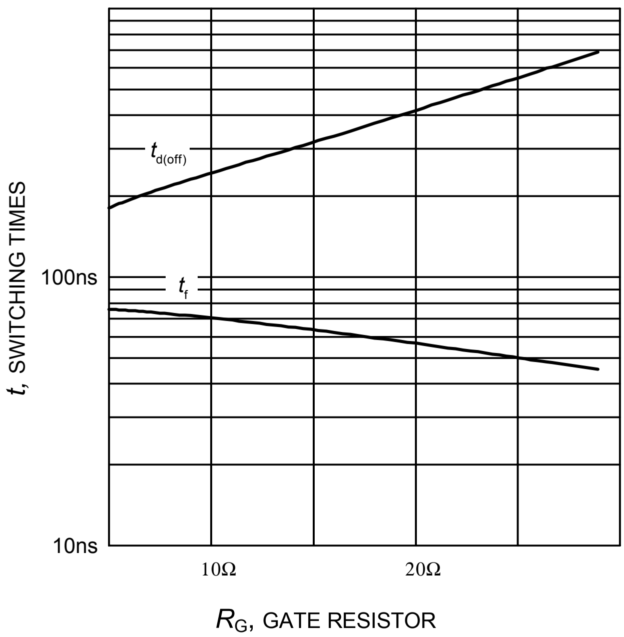


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J = 175°C, V_{CE}= 400V, V_{GE} = 0/15V, I_C = 40A, Dynamic test circuit in Figure E)

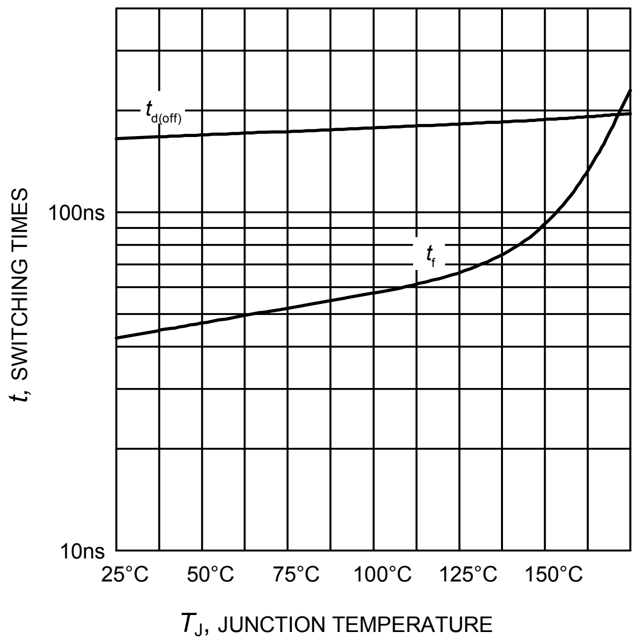


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 40A, R_G=5.6Ω, Dynamic test circuit in Figure E)

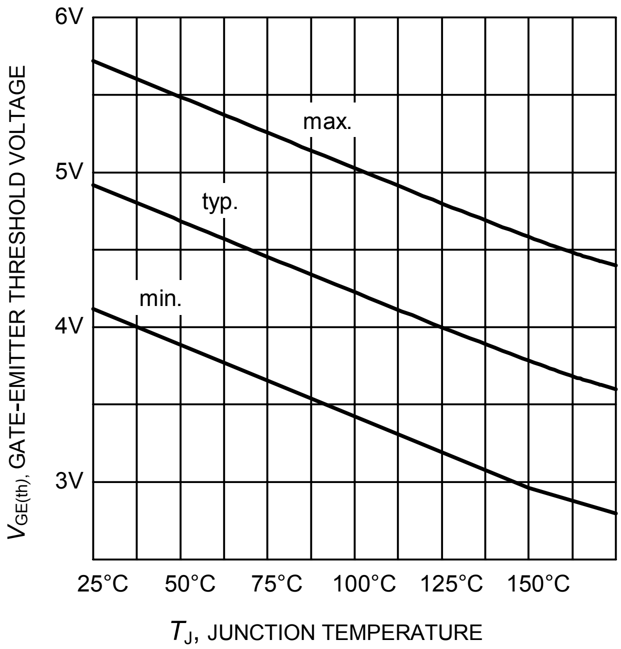


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.8mA)

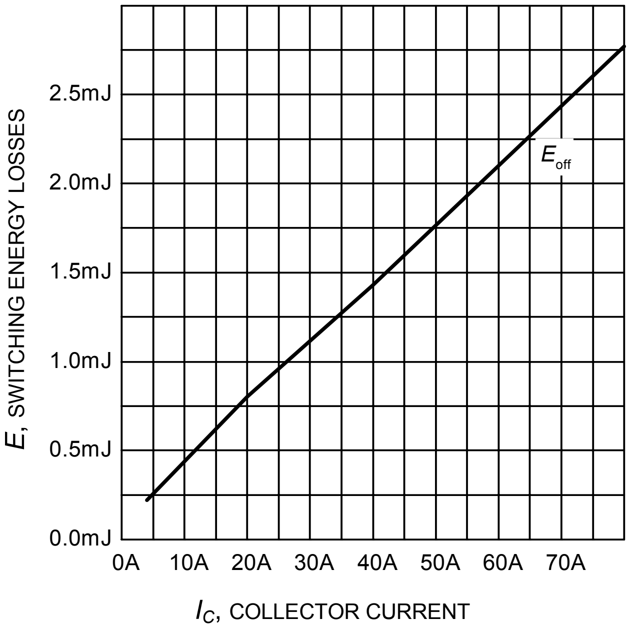


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, R_G = 5.6Ω, Dynamic test circuit in Figure E)

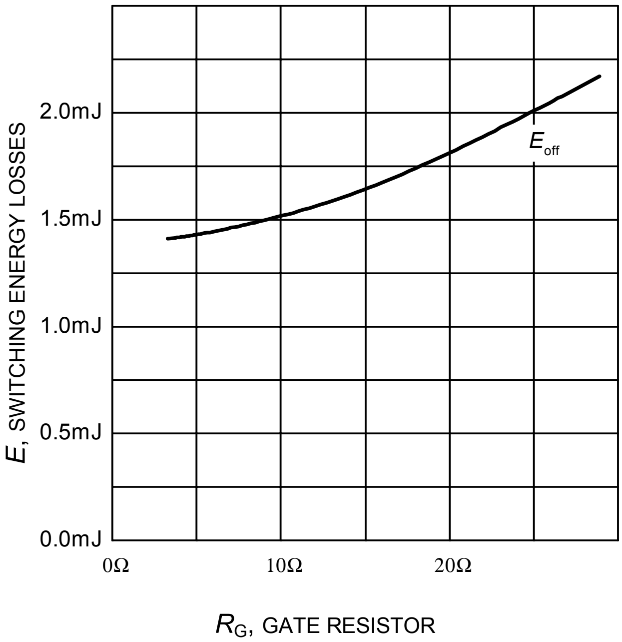


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 40A, Dynamic test circuit in Figure E)

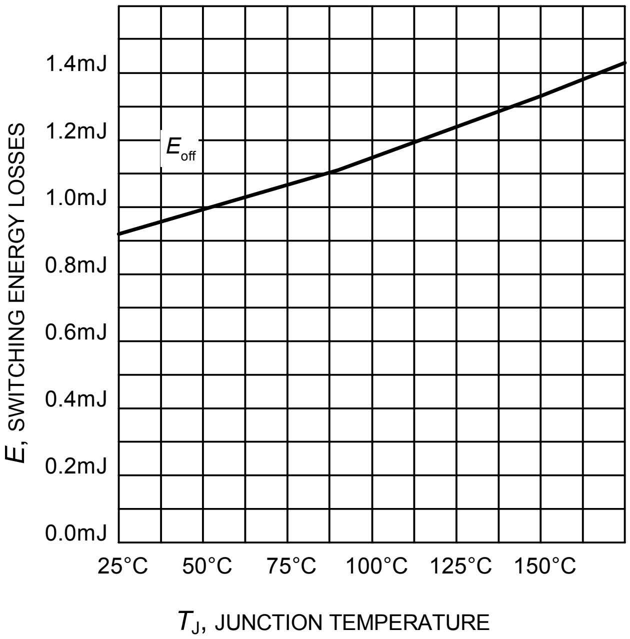


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 40A, R_G = 5.6Ω, Dynamic test circuit in Figure E)

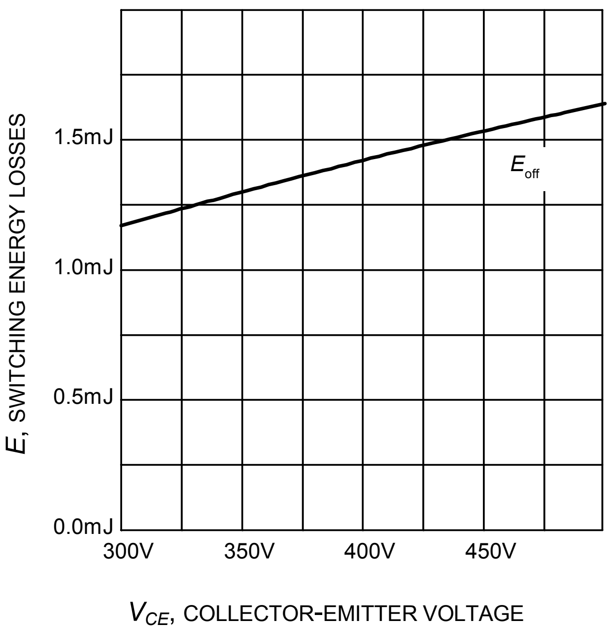


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_J = 175°C, V_{GE} = 0/15V, I_C = 40A, R_G = 5.6Ω, Dynamic test circuit in Figure E)

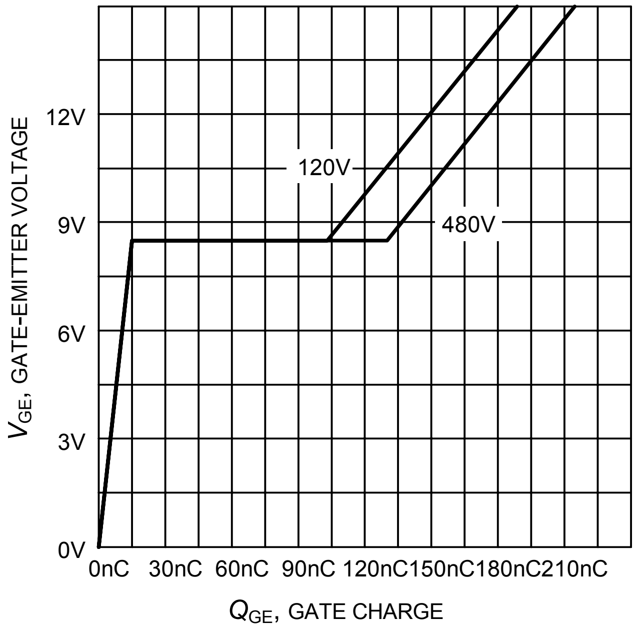


Figure 17. Typical gate charge
(I_C=40 A)

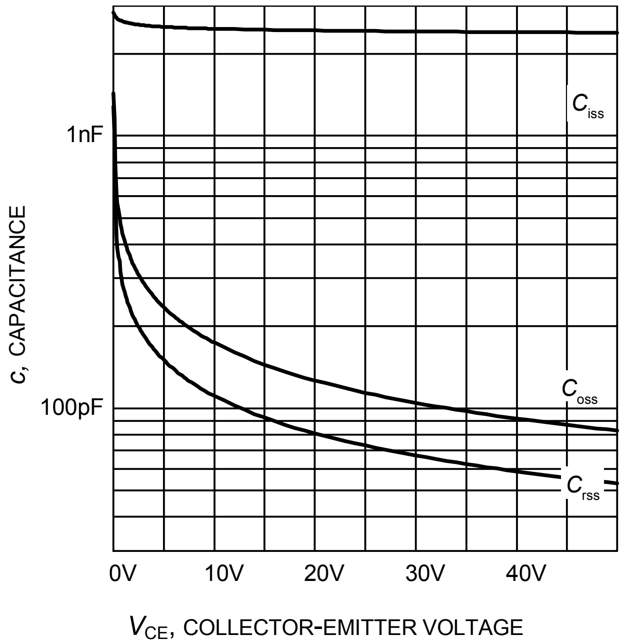


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

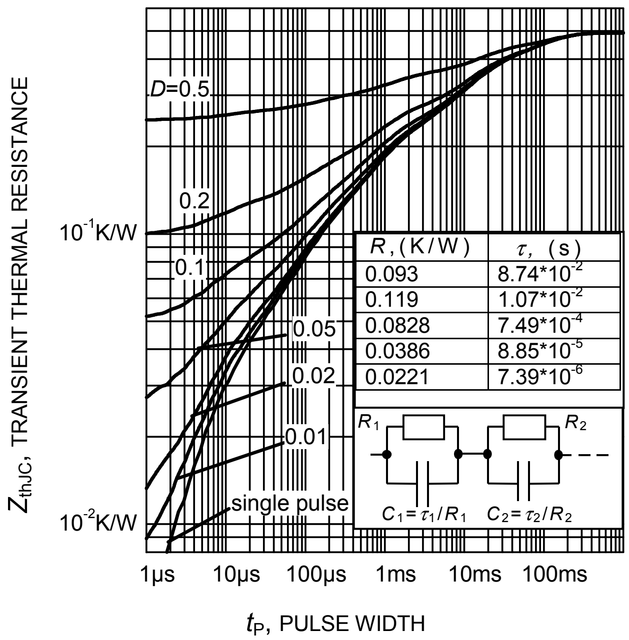


Figure 19. IGBT transient thermal resistance
($D = t_p / T$)

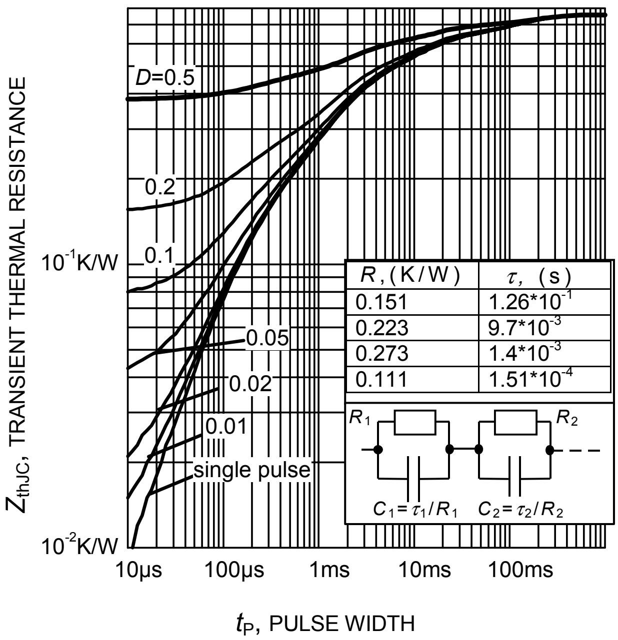


Figure 20. Diode transient thermal impedance as a function of pulse width
(D=t_P/T)

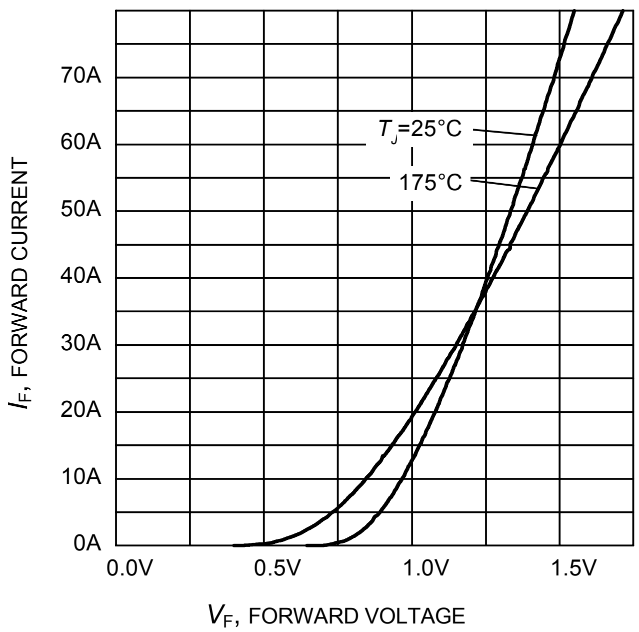


Figure 21. Typical diode forward current as a function of forward voltage

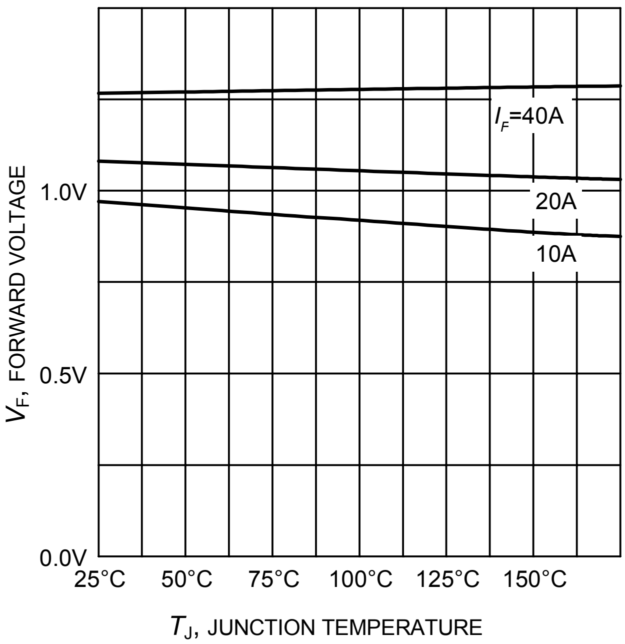


Figure 22. Typical diode forward voltage as a function of junction temperature

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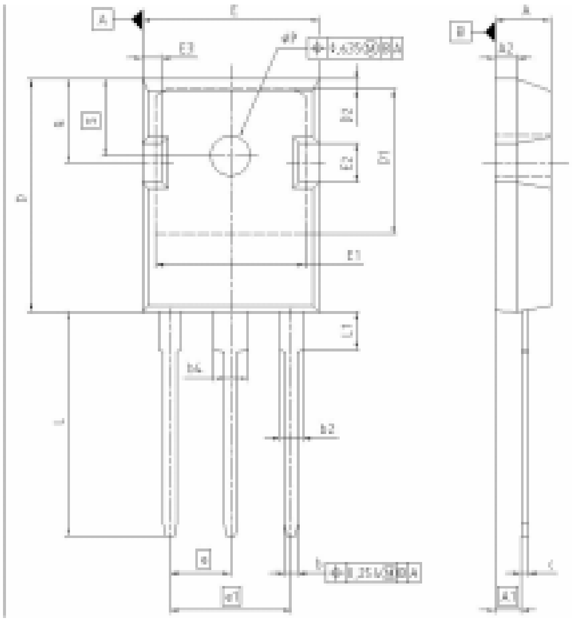

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.903	5.157	0.193	0.203
A1	2.273	2.527	0.092	0.098
A2	1.853	2.107	0.075	0.081
b	1.073	1.327	0.047	0.052
b2	1.903	2.386	0.075	0.094
b4	2.870	3.454	0.113	0.136
c	0.549	0.752	0.024	0.030
D	20.823	21.077	0.820	0.830
D1	17.323	17.831	0.682	0.702
D2	1.083	1.317	0.042	0.052
E	15.773	16.027	0.621	0.631
E1	13.893	14.147	0.547	0.557
E2	3.683	3.937	0.145	0.155
E3	1.683	1.937	0.066	0.076
e	5.450		0.215	
e1	10.900		0.430	
N	3		3	
L	20.053	20.307	0.789	0.799
L1	4.168	4.472	0.164	0.176
øP	3.558	3.661	0.140	0.144
Q	5.493	5.747	0.216	0.226
S	6.043	6.297	0.238	0.248

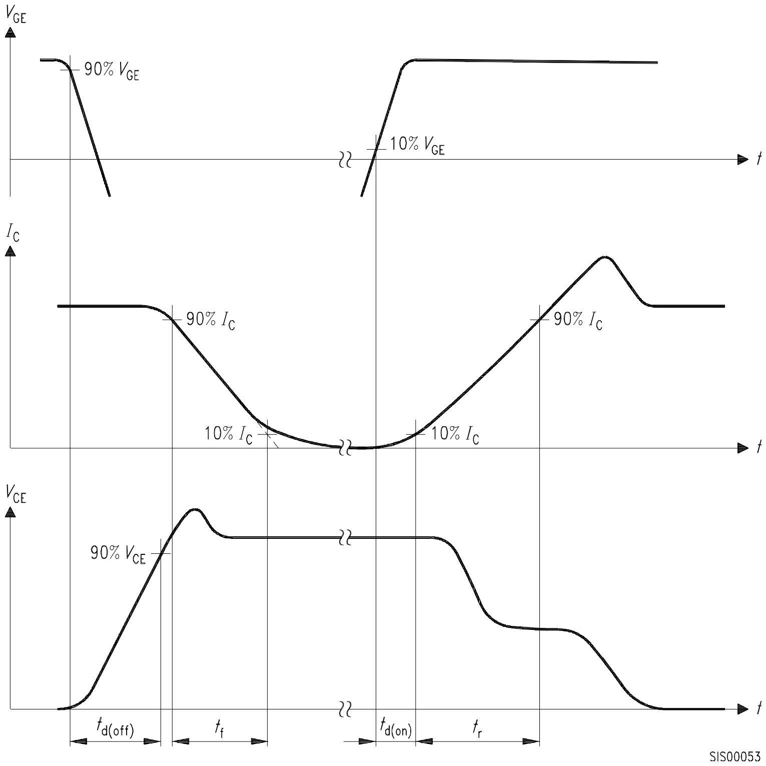

Figure A. Definition of switching times

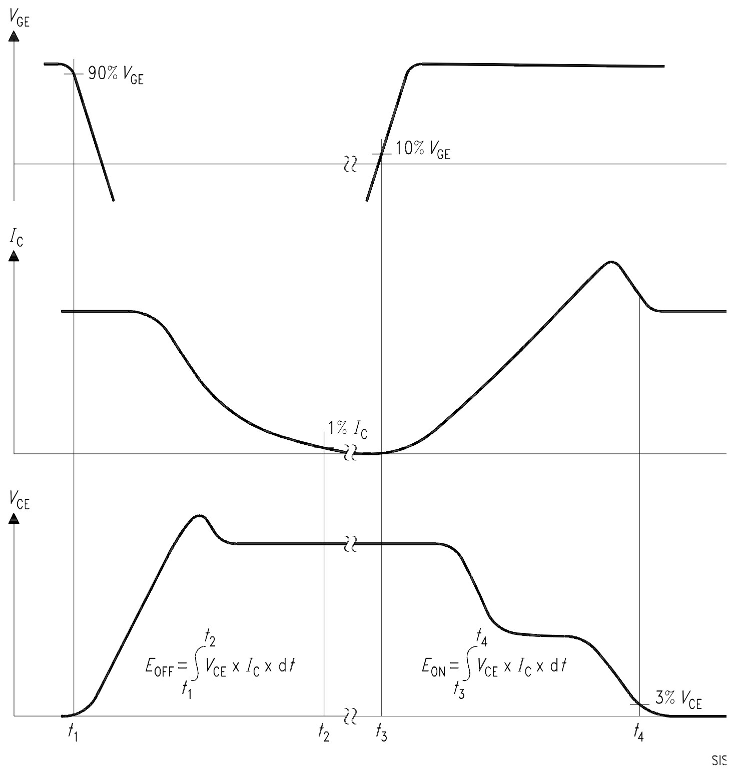

Figure B. Definition of switching losses

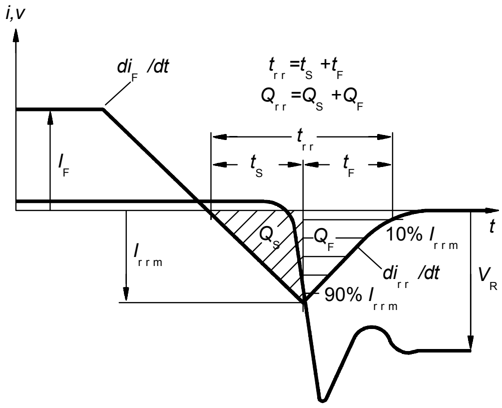

Figure C. Definition of diodes switching characteristics

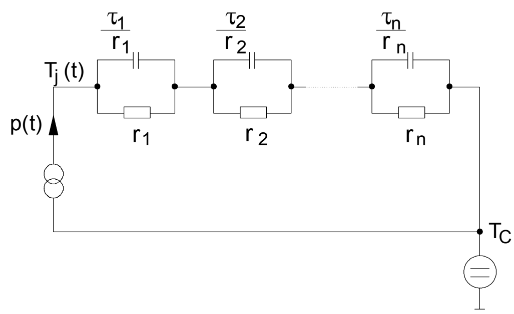

Figure D. Thermal equivalent circuit

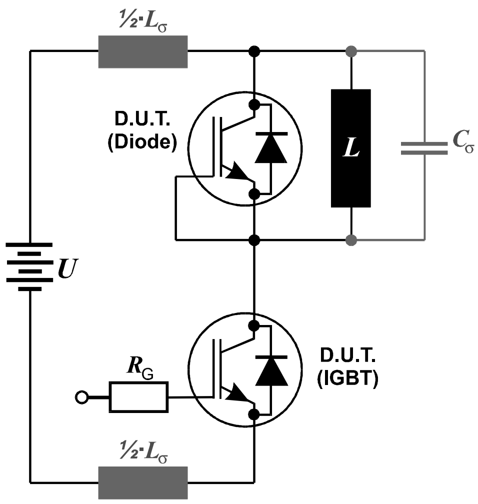

Figure E. Dynamic test circuit

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