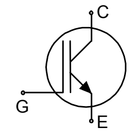
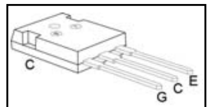
High Speed IGBT in NPT-technology





PG-TO-247-3

- 30% lower E_{off} compared to previous generation
- Short circuit withstand time – 10 µs
- Designed for operation above 30 kHz
- NPT-Technology for 600V applications offers:
  - parallel switching capability
  - moderate E_{off} increase with temperature
  - very tight parameter distribution

- High ruggedness, temperature stable behaviour
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[1] for target applications
- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

Type	V_{CE}	I_C	E_{off25}	T_j	**Marking**	**Package**
SGW50N60HS	600V	50A	0.88mJ	150°C	G50N60HS	PG-TO-247-3

Maximum Ratings

Parameter	**Symbol**	**Value**	**Unit**
Collector-emitter voltage	V_{CE}	600	V
DC collector current T_C = 25°C T_C = 100°C	I_C	 100 50	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	150	
Turn off safe operating area $V_{CE} \leq 600V$, $T_j \leq 150°C$	-	150	
Avalanche energy single pulse I_C = 50A, V_{CC}=50V, R_{GE}=25Ω start T_J=25°C	E_{AS}	280	mJ
Gate-emitter voltage static transient (t_p<1µs, D<0.05)	V_{GE}	±20 ±30	V
Short circuit withstand time[2)] V_{GE} = 15V, $V_{CC} \leq 600V$, $T_j \leq 150°C$	t_{SC}	10	µs
Power dissipation T_C = 25°C	P_{tot}	416	W
Operating junction and storage temperature	T_j , T_{stg}	-55...+150	°C
Time limited operating junction temperature for t < 150h	$T_{j(tl)}$	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.

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Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		0.3	K/W
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=500µA	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=50A				
		T_j=25°C	-	2.8	3.15	
		T_j=150°C	-	3.15	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=1mA, V_{CE}=V_{GE}	3	4	5	
Zero gate voltage collector current	I_{CES}	V_{CE}=600V, V_{GE}=0V				µA
		T_j=25°C	-	-	40	
		T_j=150°C	-	-	3000	
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=50A	-	31	-	S

Dynamic Characteristic

Parameter	Symbol	Conditions	min.	Typ.	max.	Unit
Input capacitance	C_{iss}	V_{CE}=25V,	-	2572	-	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	245	-	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	158	-	
Gate charge	Q_{Gate}	V_{CC}=480V, I_C=50A V_{GE}=15V	-	179	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH
Short circuit collector current[1)]	$I_{C(SC)}$	V_{GE}=15V, t_{SC}≤10µs V_{CC} ≤ 600V, T_j ≤ 150°C	-	471	-	A

1) Allowed number of short circuits: <1000; time between short circuits: >1s.

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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=50A, V_{GE}=0/15V, R_G=6.8Ω, L_σ[1] =55nH, C_σ[1] =40pF Energy losses include “tail” and diode reverse recovery[2].	-	47	-	ns
Rise time	t_r		-	32	-	
Turn-off delay time	$t_{d(off)}$		-	310	-	
Fall time	t_f		-	16	-	
Turn-on energy	E_{on}		-	1.08	-	mJ
Turn-off energy	E_{off}		-	0.88	-	
Total switching energy	E_{ts}		-	1.96	-	

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Switching Characteristic, Inductive Load, at T_j=150 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=150°C V_{CC}=400V, I_C=50A, V_{GE}=0/15V, R_G= 1.8Ω L_σ[1] =60nH, C_σ[1] =40pF Energy losses include “tail” and diode reverse recovery[2].	-	50	-	ns
Rise time	t_r		-	28	-	
Turn-off delay time	$t_{d(off)}$		-	225	-	
Fall time	t_f		-	14	-	
Turn-on energy	E_{on}		-	1	-	mJ
Turn-off energy	E_{off}		-	0.90	-	
Total switching energy	E_{ts}		-	1.9	-	
Turn-on delay time	$t_{d(on)}$	T_j=150°C V_{CC}=400V, I_C=50A, V_{GE}=0/15V, R_G= 6.8Ω L_σ[1] =60nH, C_σ[1] =40pF Energy losses include “tail” and diode reverse recovery[2].	-	48	-	ns
Rise time	t_r		-	31	-	
Turn-off delay time	$t_{d(off)}$		-	350	-	
Fall time	t_f		-	20	-	
Turn-on energy	E_{on}		-	1.5	-	mJ
Turn-off energy	E_{off}		-	1.1	-	
Total switching energy	E_{ts}		-	2.6	-	

[1] Leakage inductance L_σ and Stray capacity C_σ due to test circuit in Figure E.
[2] Diode used in this test is IDP45E60

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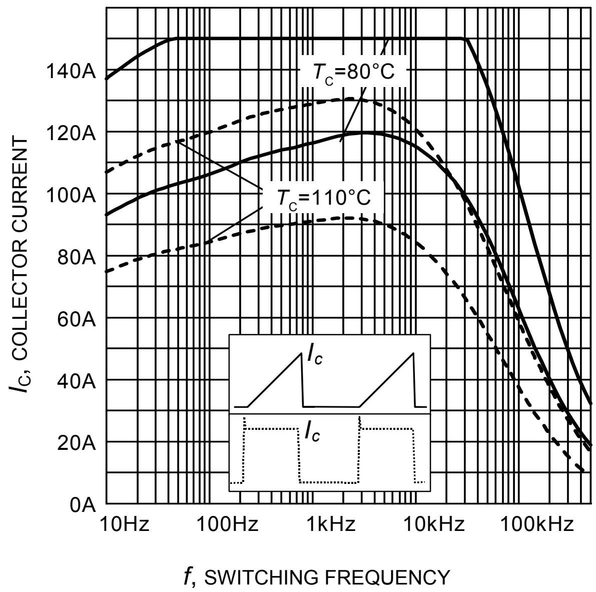

Figure 1. Collector current as a function of switching frequency
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 400V$, $V_{GE} = 0/+15V$, $R_G = 6.8\Omega$)

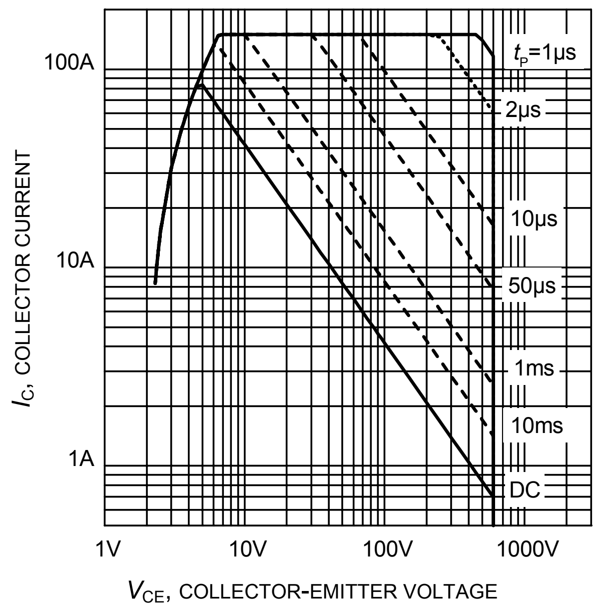

Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$; V_{GE}=15V)

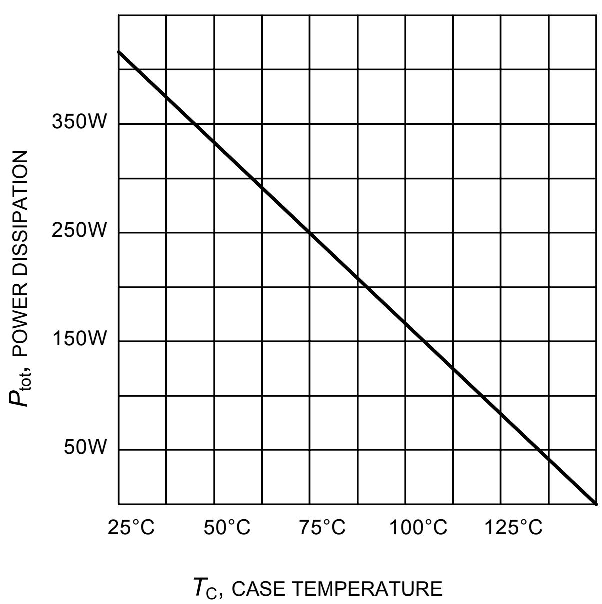

Figure 3. Power dissipation as a function of case temperature
($T_j \leq 150°C$)

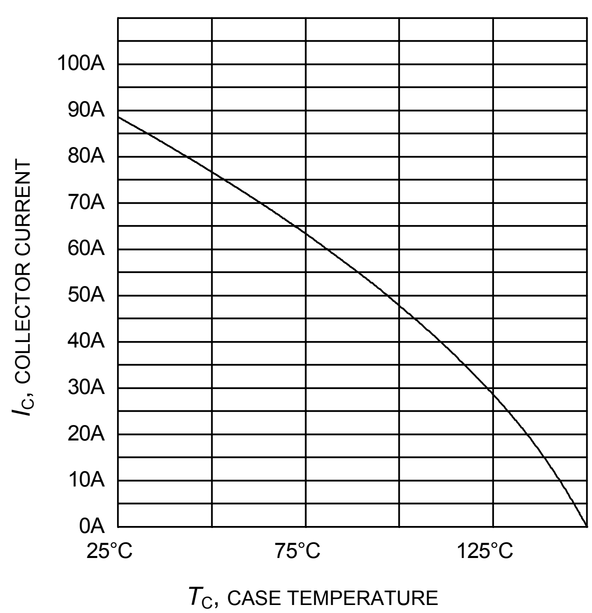

Figure 4. Collector current as a function of case temperature
($V_{GE} \leq 15V$, $T_j \leq 150°C$)

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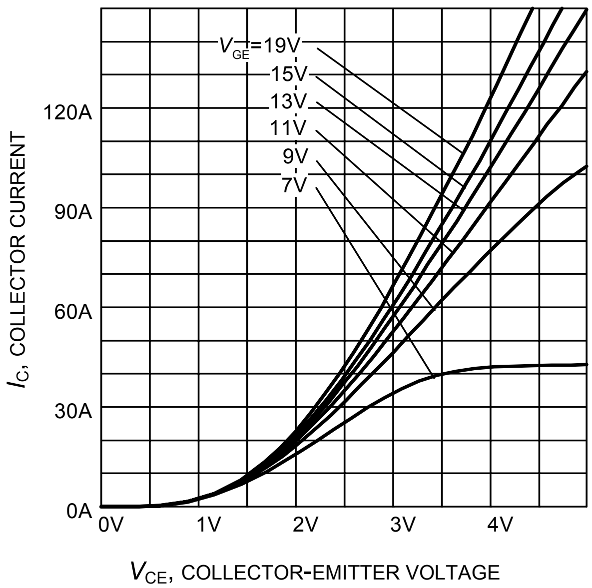

Figure 5. Typical output characteristic
(T_j = 25°C)

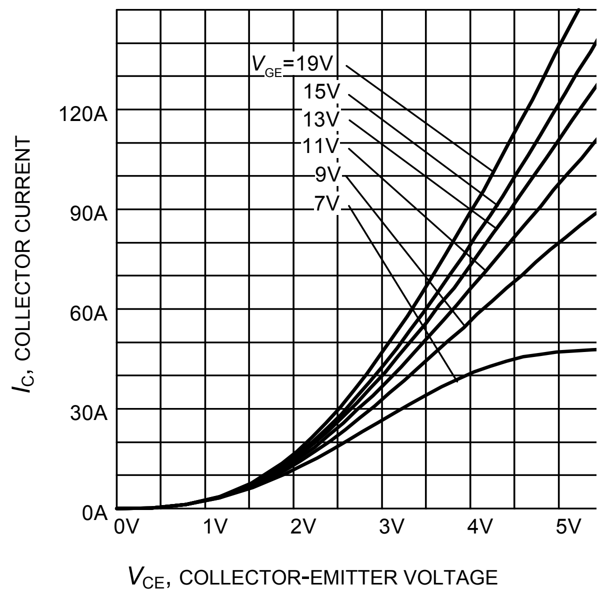

Figure 6. Typical output characteristic
(T_j = 150°C)

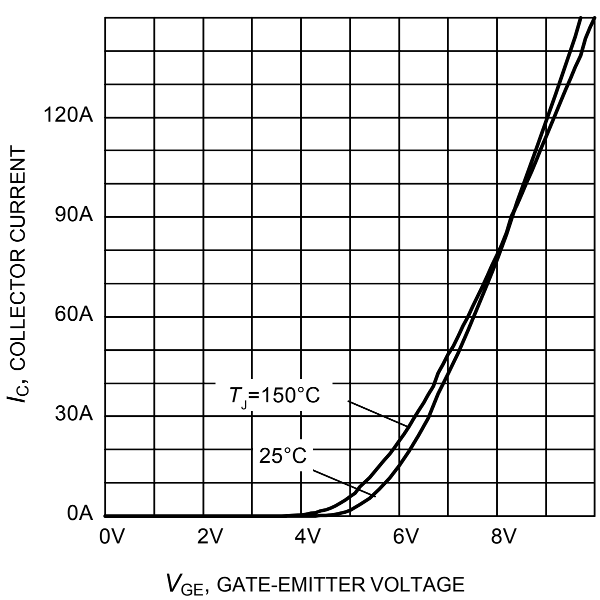

Figure 7. Typical transfer characteristic
(V_{CE}=10V)

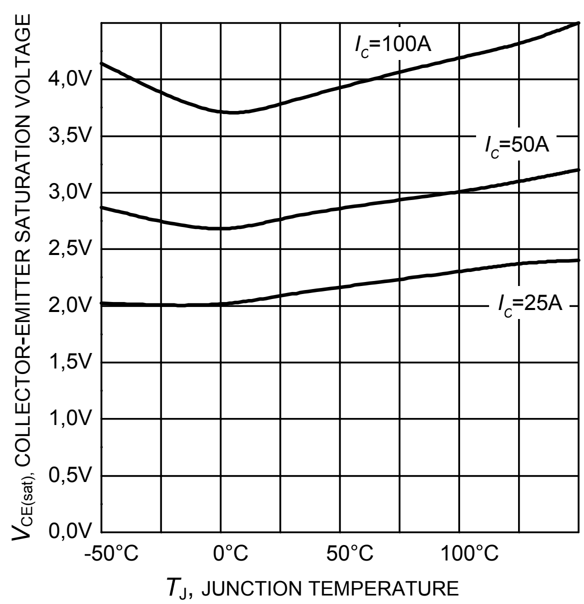

Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

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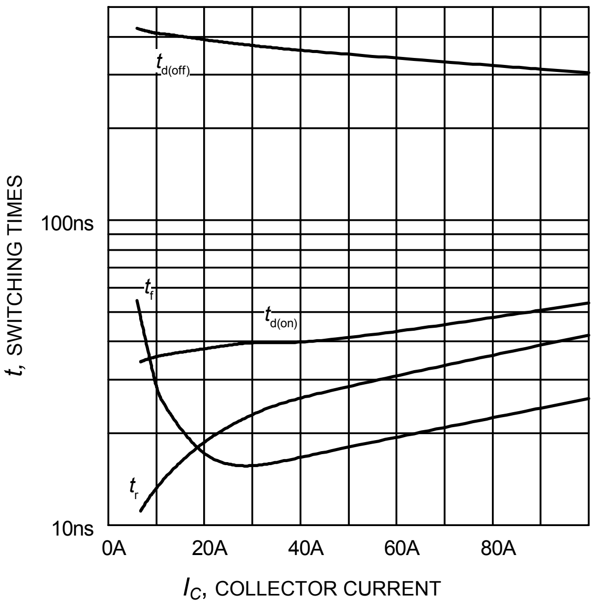

Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, R_G=6.8Ω, Dynamic test circuit in Figure E)

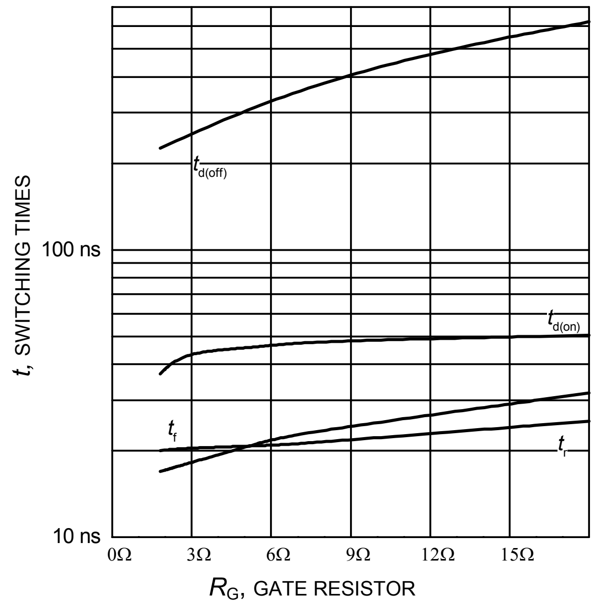

Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, Dynamic test circuit in Figure E)

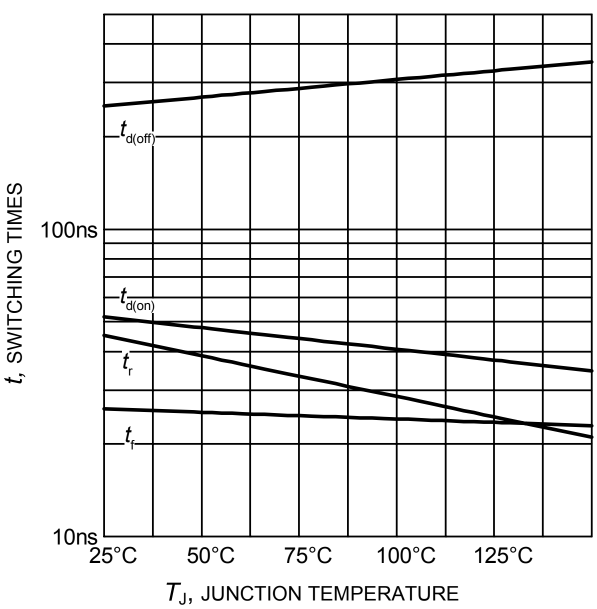

Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, R_G=6.8Ω, Dynamic test circuit in Figure E)

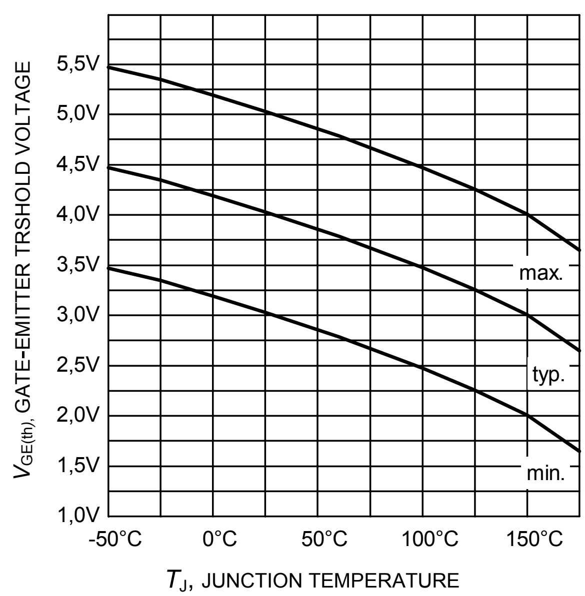

Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 1mA)

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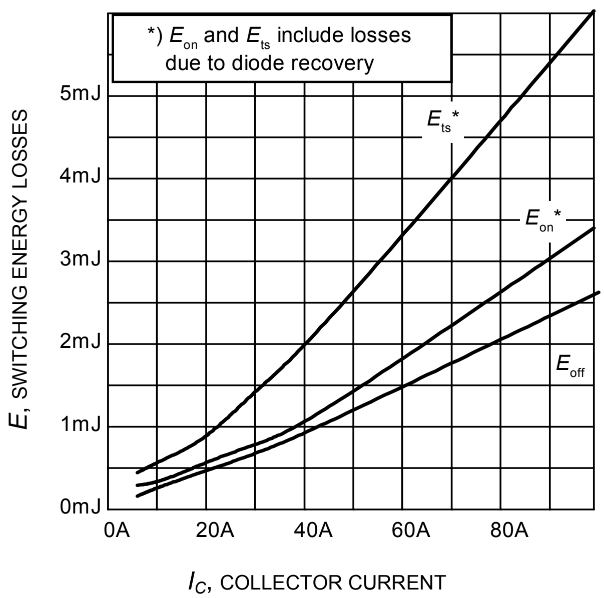

Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, R_G=6.8Ω, Dynamic test circuit in Figure E)

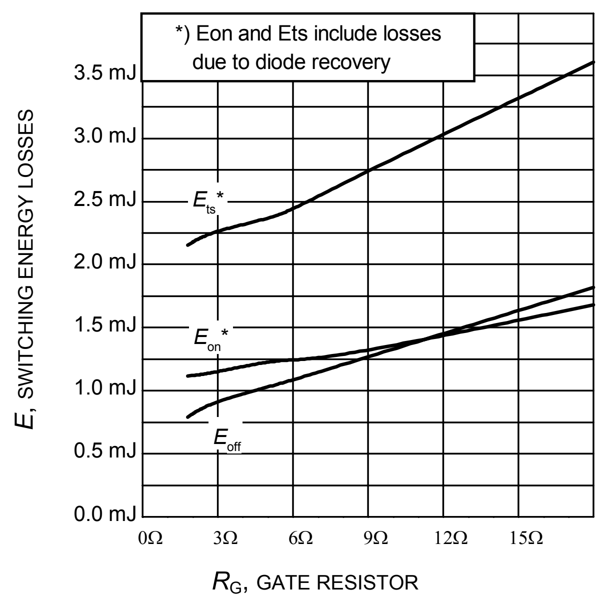

Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, Dynamic test circuit in Figure E)

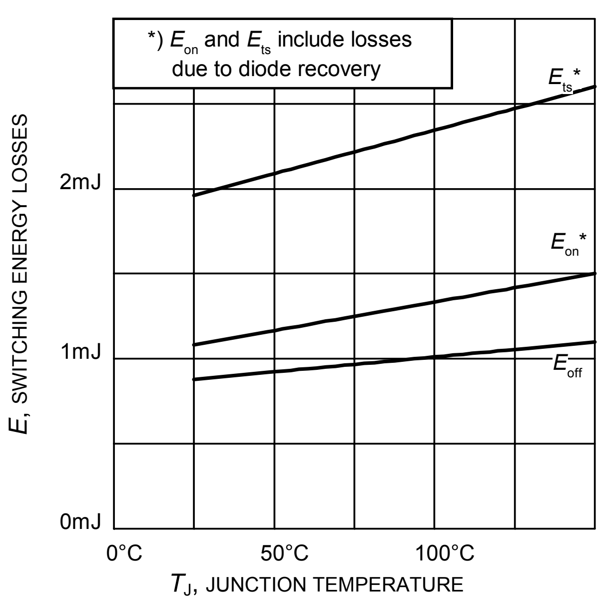

Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, R_G=6.8Ω, Dynamic test circuit in Figure E)

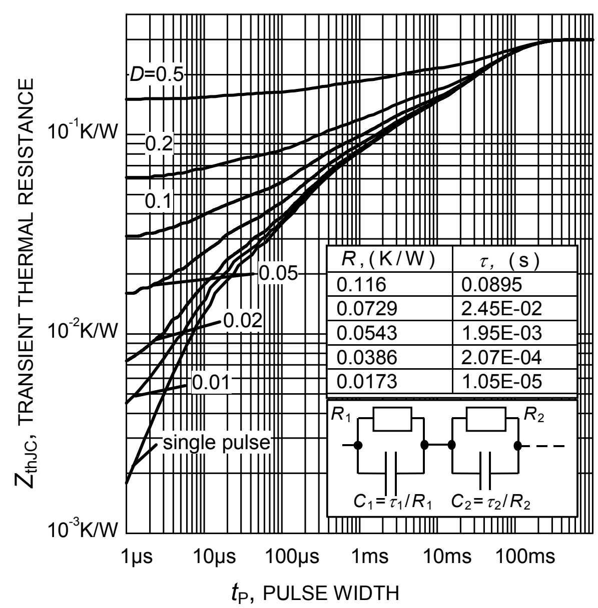

Figure 16. IGBT transient thermal resistance
($D = t_p / T$)

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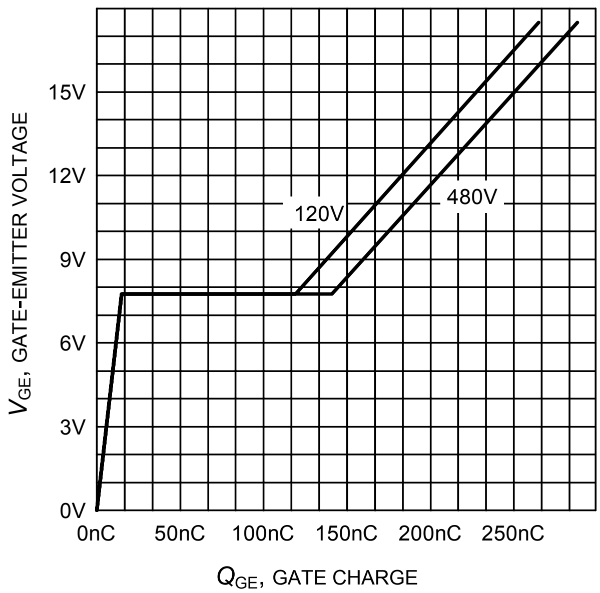

Figure 17. Typical gate charge
(I_C=50 A)

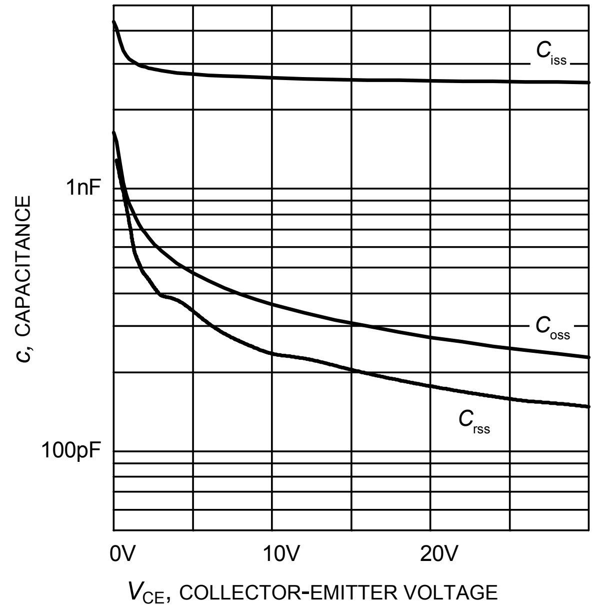

Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

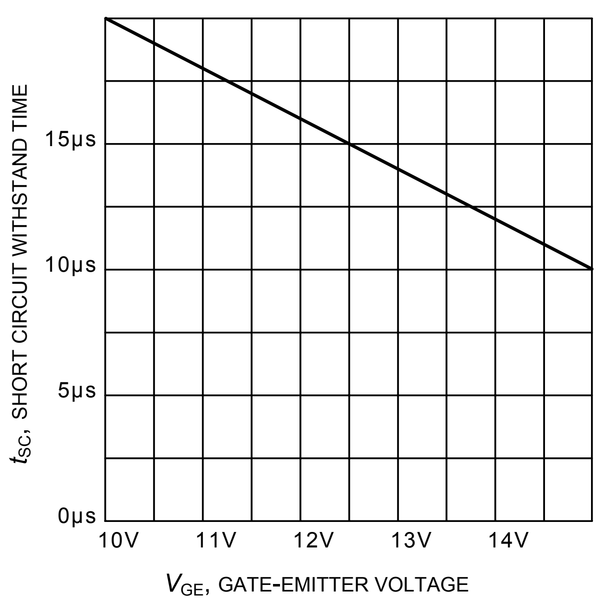

Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=600V, start at T_J=25°C)

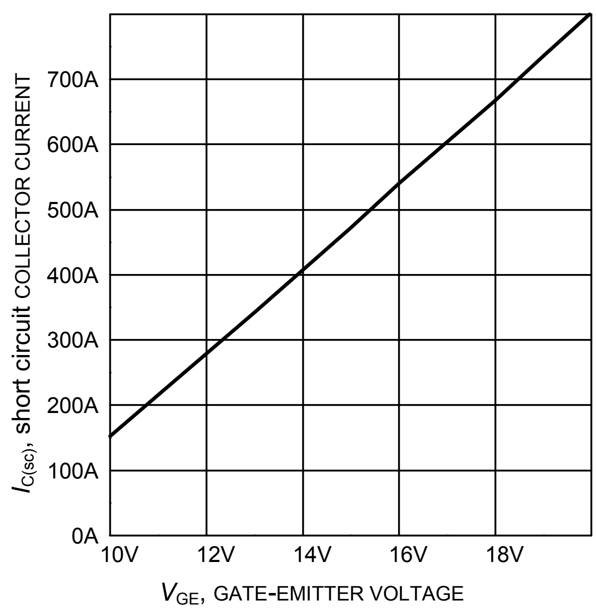

Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq$ 600V, $T_j \leq$ 150°C)

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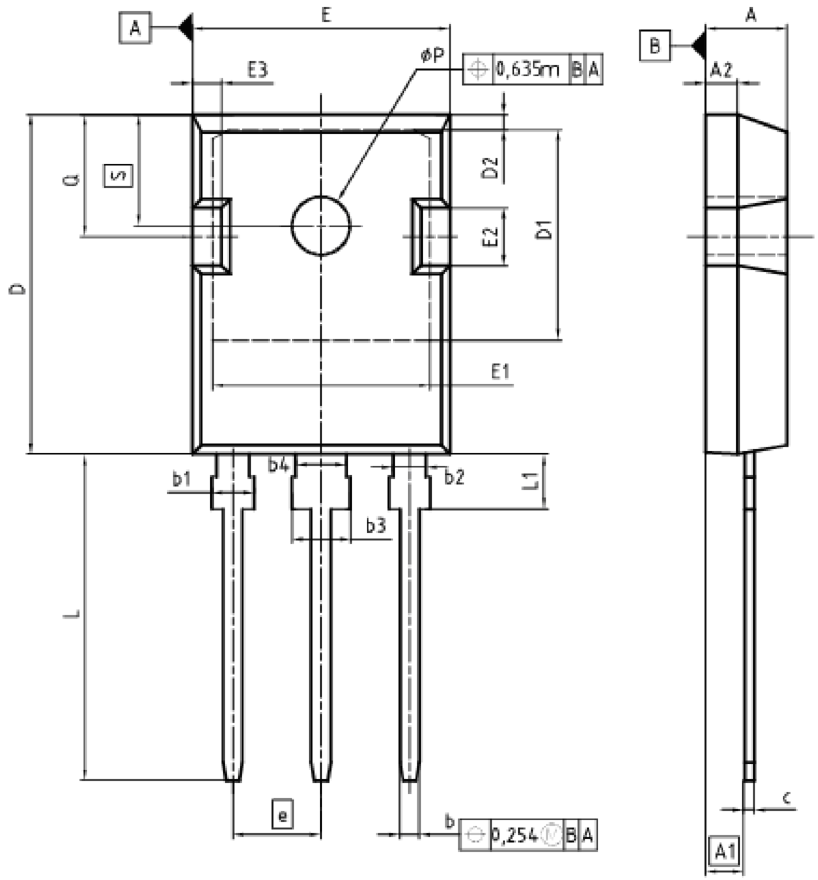

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

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SCALE 0 5 7.5mm

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04

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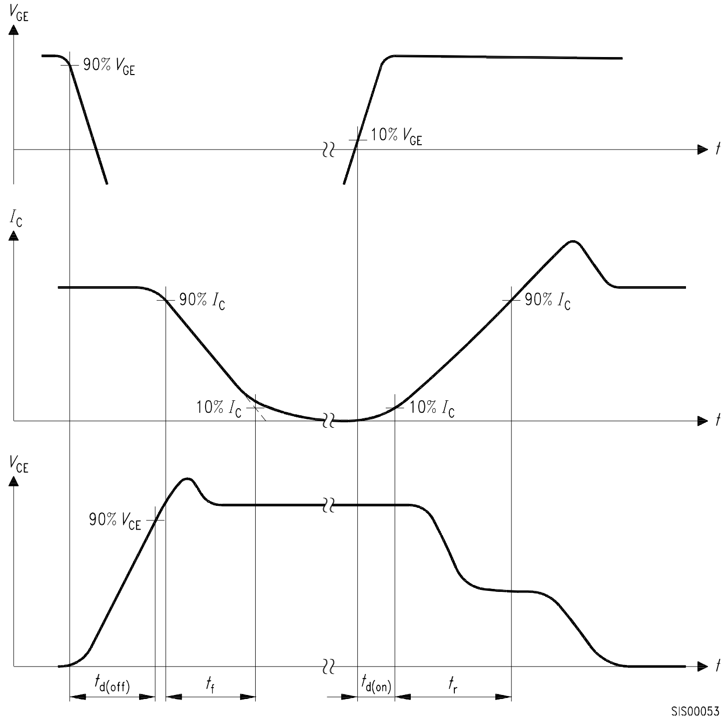

Figure A. Definition of switching times

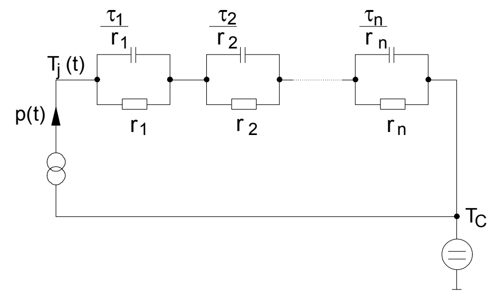

Figure D. Thermal equivalent circuit

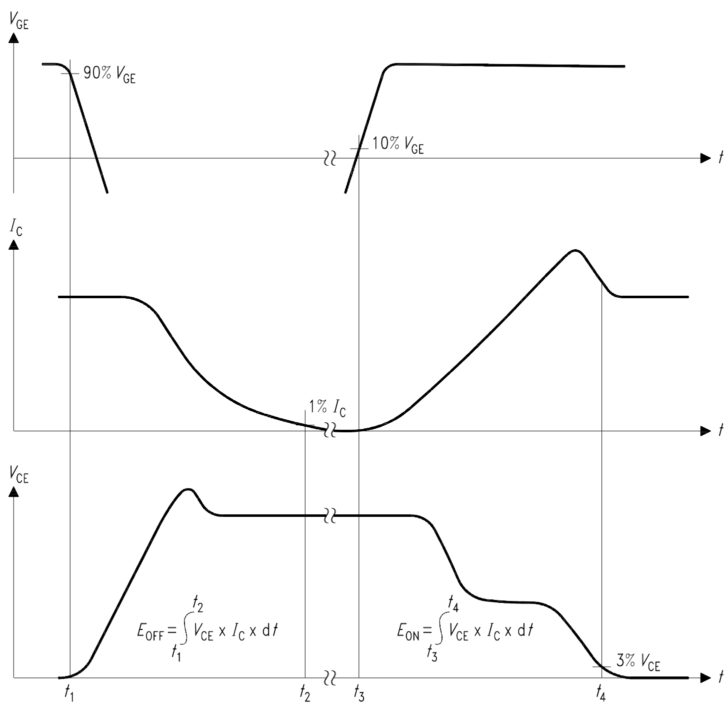

Figure B. Definition of switching losses

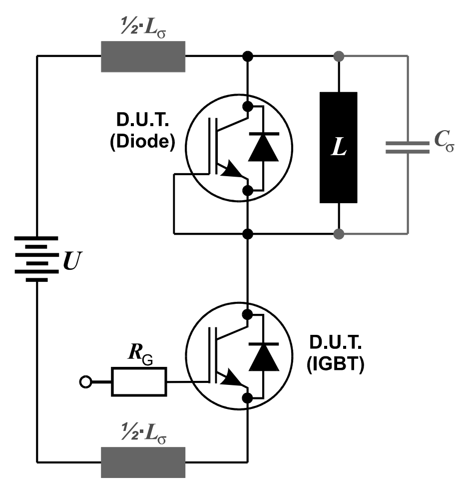

Figure E. Dynamic test circuit
Leakage inductance L_{σ} =55nH
and Stray capacity C_{σ} =40pF.

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