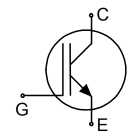
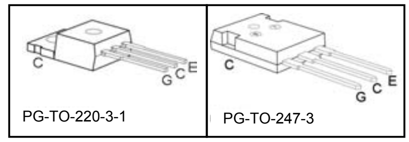
High Speed IGBT in NPT-technology



- 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_{off}	T_j	Marking	Package
SGP20N60HS	600V	20	240µJ	150°C	G20N60HS	PG-TO-220-3-1
SGW20N60HS	600V	20	240µJ	150°C	G20N60HS	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	 36 20	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	80	
Turn off safe operating area $V_{CE} \leq 600V$, $T_j \leq 150°C$	-	80	
Avalanche energy single pulse I_C = 20A, V_{CC}=50V, R_{GE}=25Ω start T_J=25°C	E_{AS}	115	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}	178	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.

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		0.7	K/W
Thermal resistance, junction – ambient	R_{thJA}	PG-TO-220-3-1 PG-TO-247-3-21	62 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=20A T_j=25°C T_j=150°C		 2.8 3.5	 3.15 4.00	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=500µA, V_{CE}=V_{GE}	3	4	5	
Zero gate voltage collector current	I_{CES}	V_{CE}=600V, V_{GE}=0V T_j=25°C T_j=150°C	 - -	 - -	 40 2500	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=20A	-	14		S

Dynamic Characteristic

Parameter	Symbol	Conditions	min.	Typ.	max.	Unit
Input capacitance	C_{iss}	V_{CE}=25V,	-	1100		pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	105		
Reverse transfer capacitance	C_{rss}	f=1MHz	-	64		
Gate charge	Q_{Gate}	V_{CC}=480V, I_C=20A V_{GE}=15V	-	100		nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	PG-TO-220-3-1 PG-TO-247-3-21	-	7 13		nH
Short circuit collector current[1)]	$I_{C(SC)}$	V_{GE}=15V, t_{SC}≤10µs V_{CC} ≤ 600V, T_j ≤ 150°C	-	170		A

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

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=20A, V_{GE}=0/15V, R_G=16Ω, L_σ [1)]=60nH, C_σ [1)] =40pF Energy losses include "tail" and diode reverse recovery.	-	18		ns
Rise time	t_r		-	15		
Turn-off delay time	$t_{d(off)}$		-	207		
Fall time	t_f		-	13		
Turn-on energy	E_{on}		-	0.39		mJ
Turn-off energy	E_{off}		-	0.30		
Total switching energy	E_{ts}		-	0.69		

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=20A, V_{GE}=0/15V, R_G= 2.2Ω L_σ [1)] =60nH, C_σ [1)] =40pF Energy losses include "tail" and diode reverse recovery.	-	15		ns
Rise time	t_r		-	8.5		
Turn-off delay time	$t_{d(off)}$		-	65		
Fall time	t_f		-	35		
Turn-on energy	E_{on}		-	0.46		mJ
Turn-off energy	E_{off}		-	0.24		
Total switching energy	E_{ts}		-	0.7		
Turn-on delay time	$t_{d(on)}$	T_j=150°C V_{CC}=400V, I_C=20A, V_{GE}=0/15V, R_G= 16Ω L_σ [1)] =60nH, C_σ [1)] =40pF Energy losses include "tail" and diode reverse recovery.	-	17		ns
Rise time	t_r		-	13		
Turn-off delay time	$t_{d(off)}$		-	222		
Fall time	t_f		-	13		
Turn-on energy	E_{on}		-	0.6		mJ
Turn-off energy	E_{off}		-	0.36		
Total switching energy	E_{ts}		-	0.96		

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

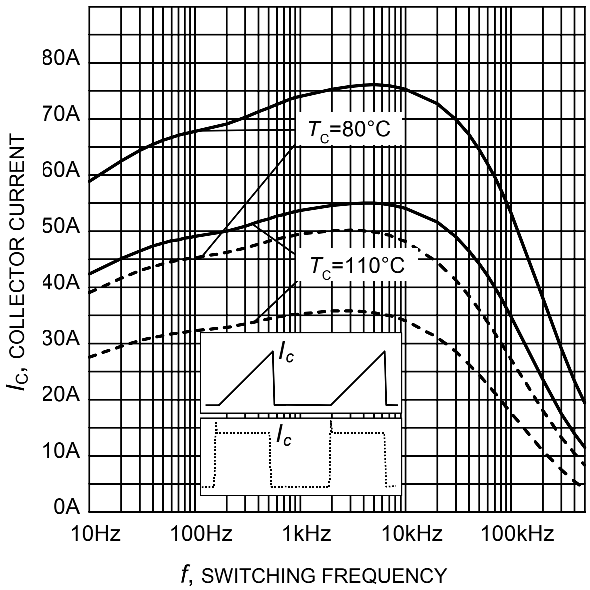


Figure 1. Collector current as a function of switching frequency
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 400V$, $V_{GE} = 0/+15V$, $R_G = 16\Omega$)

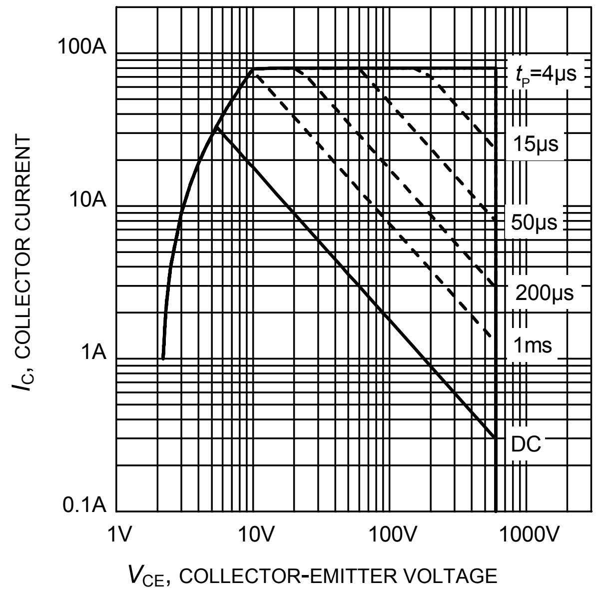


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$; $V_{GE}=15V$)

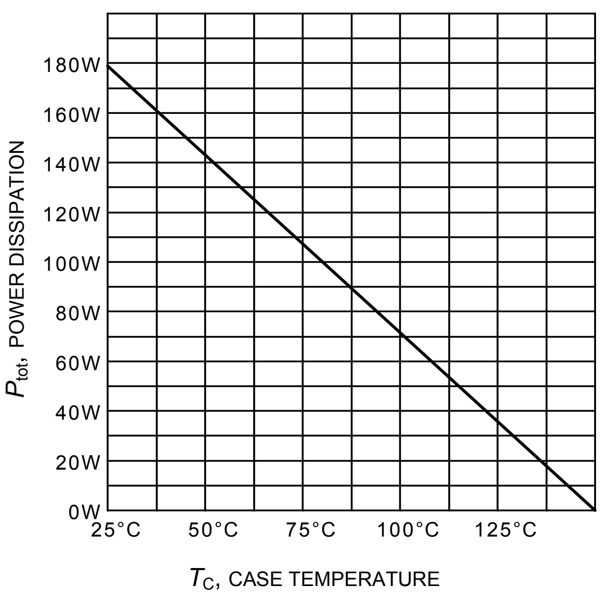


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 150°C$)

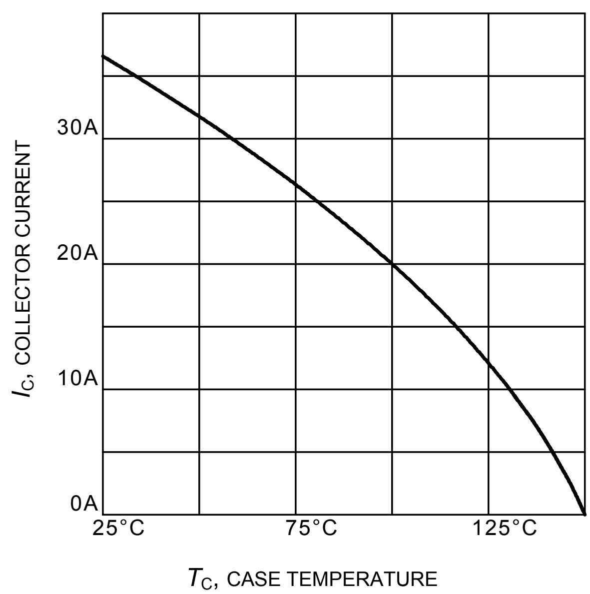


Figure 4. Collector current as a function of case temperature
($V_{GE} \leq 15V$, $T_j \leq 150°C$)

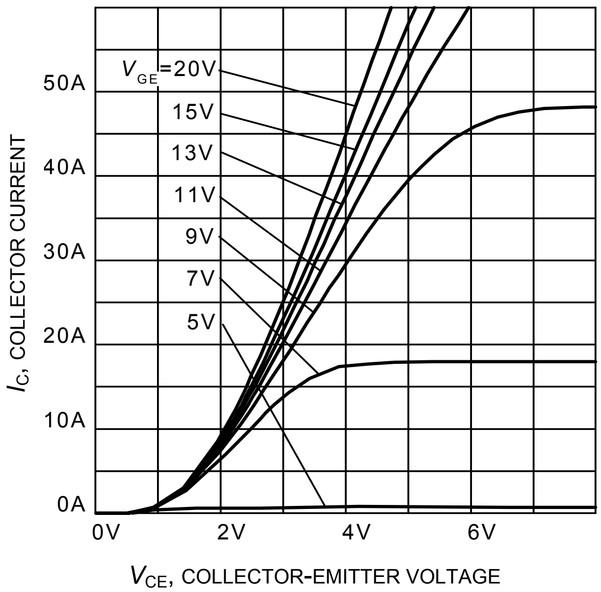


Figure 5. Typical output characteristic
(T_j = 25°C)

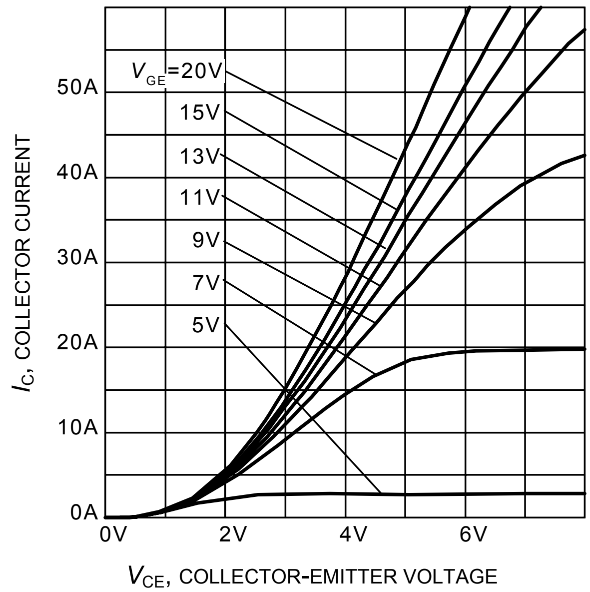


Figure 6. Typical output characteristic
(T_j = 150°C)

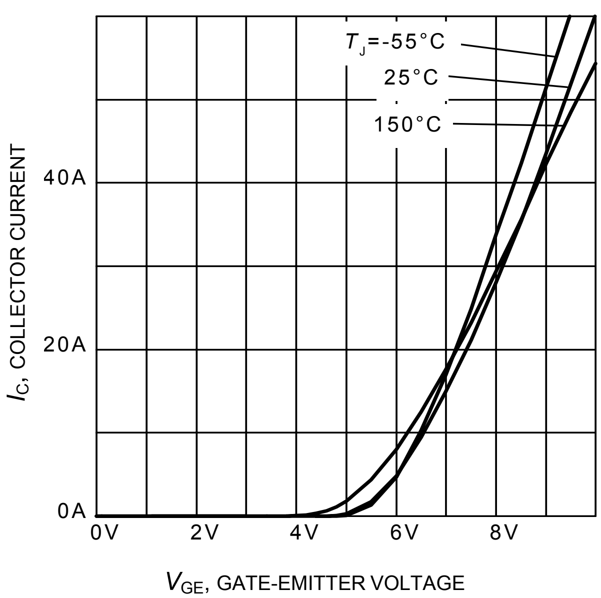


Figure 7. Typical transfer characteristic
(V_{CE}=10V)

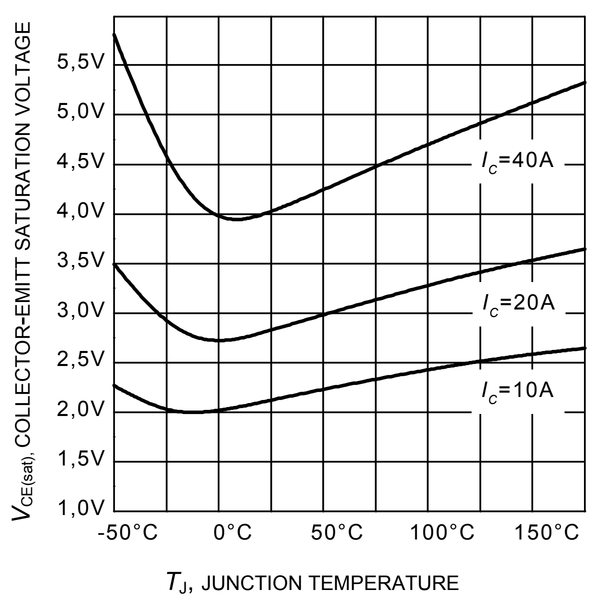


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

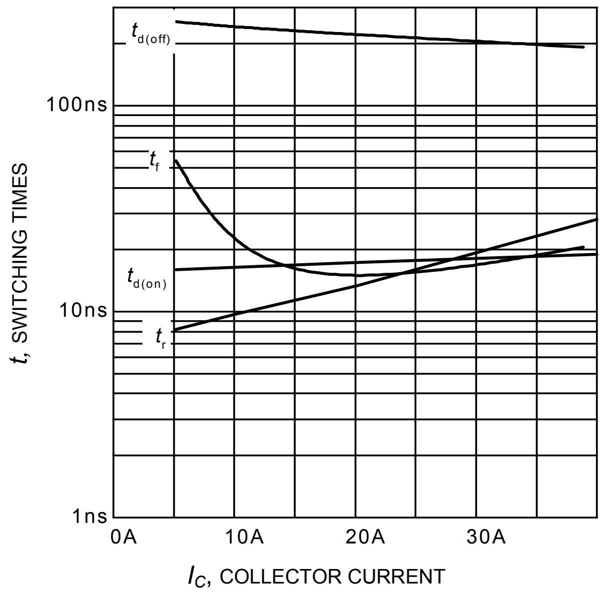


Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, R_G=16Ω, Dynamic test circuit in Figure E)

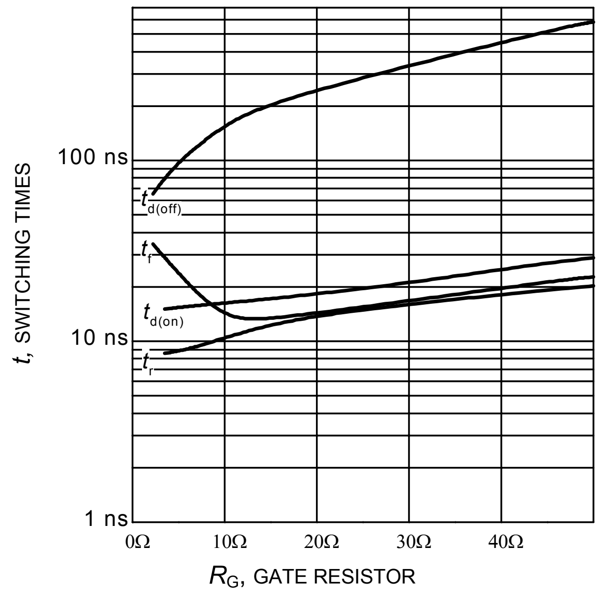


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=20A, Dynamic test circuit in Figure E)

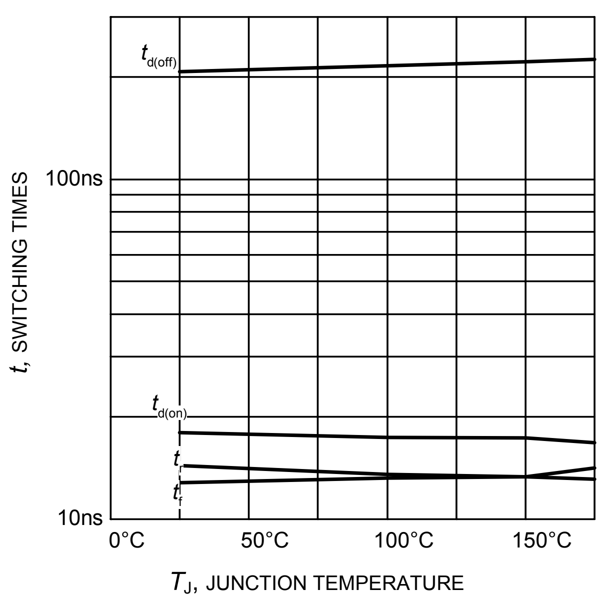


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=20A, R_G=16Ω, Dynamic test circuit in Figure E)

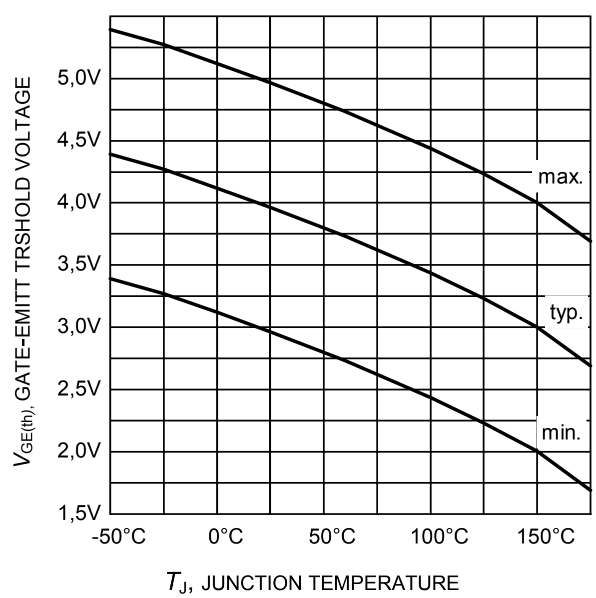


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.5mA)

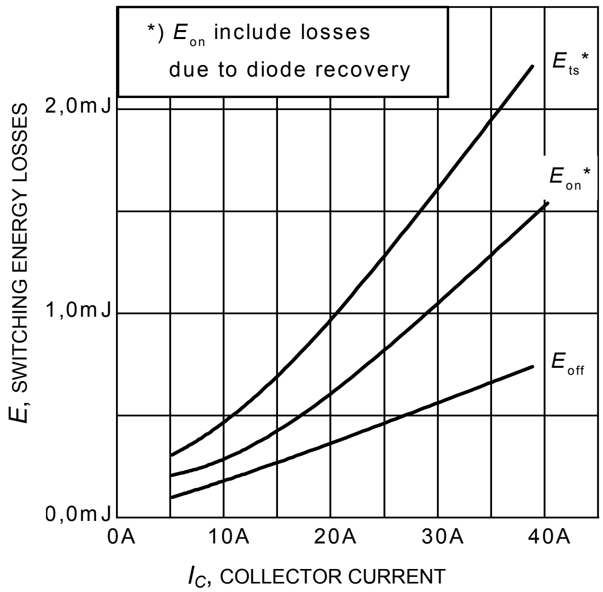


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, R_G=16Ω, Dynamic test circuit in Figure E)

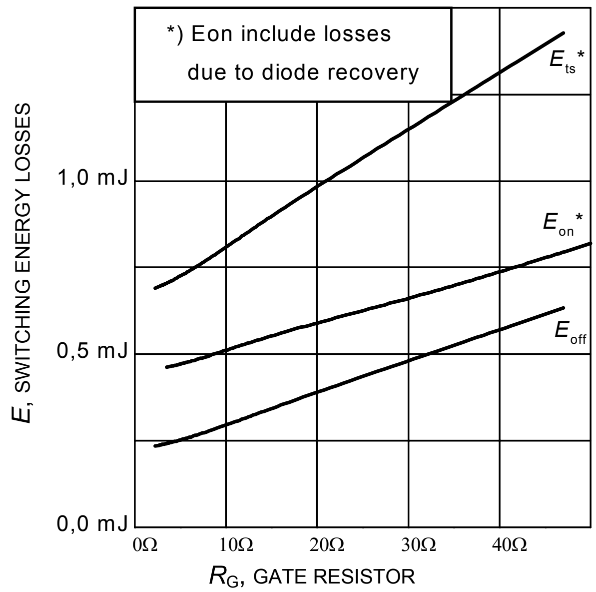


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=20A, Dynamic test circuit in Figure E)

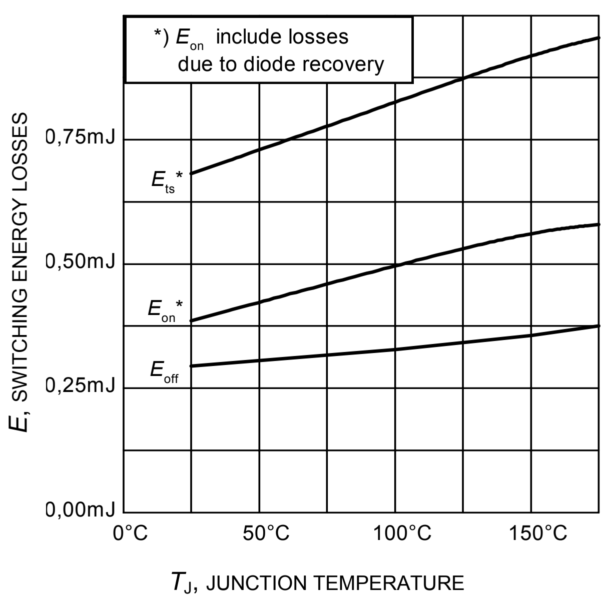
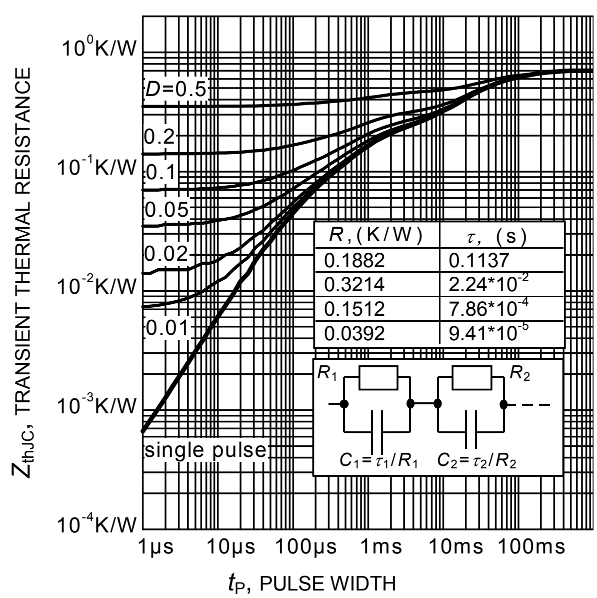


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=400V, VGE=0/15V, I_C=20A, R_G=16Ω, Dynamic test circuit in Figure E)



R,(K/W)	τ, (s)
0.1882	0.1137
0.3214	$2.24*10^{-2}$
0.1512	$7.86*10^{-4}$
0.0392	$9.41*10^{-5}$

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

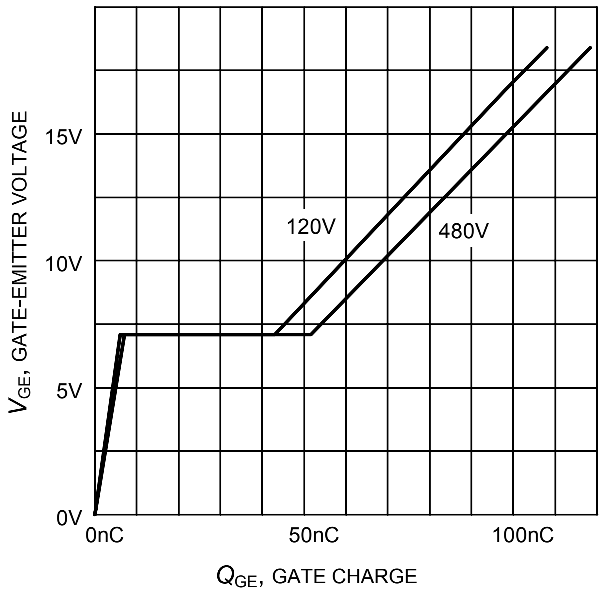


Figure 17. Typical gate charge
(I_C=20 A)

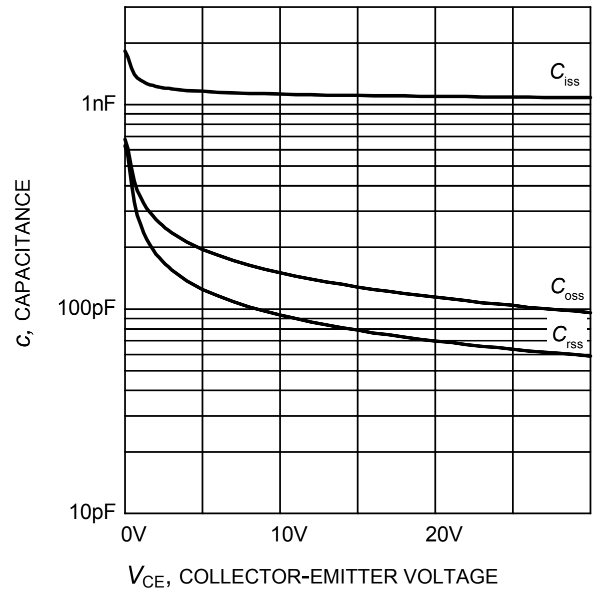


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

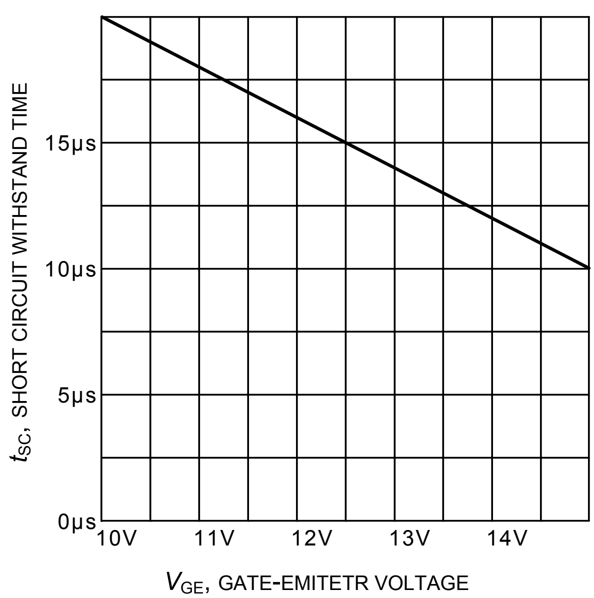


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=600V, start at T_J=25°C)

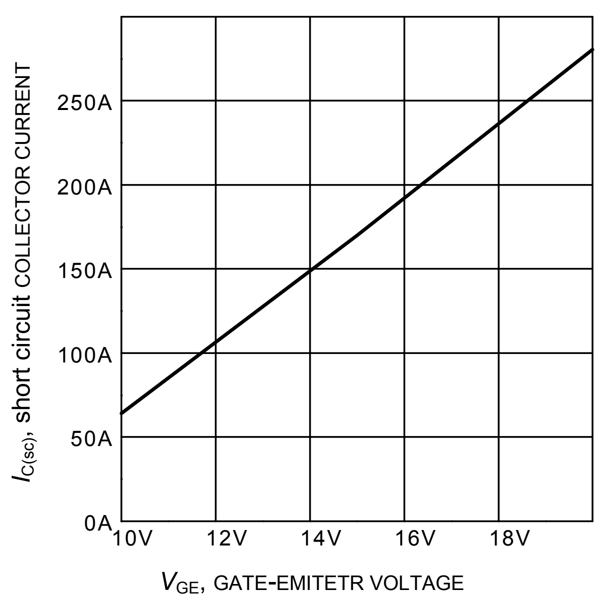
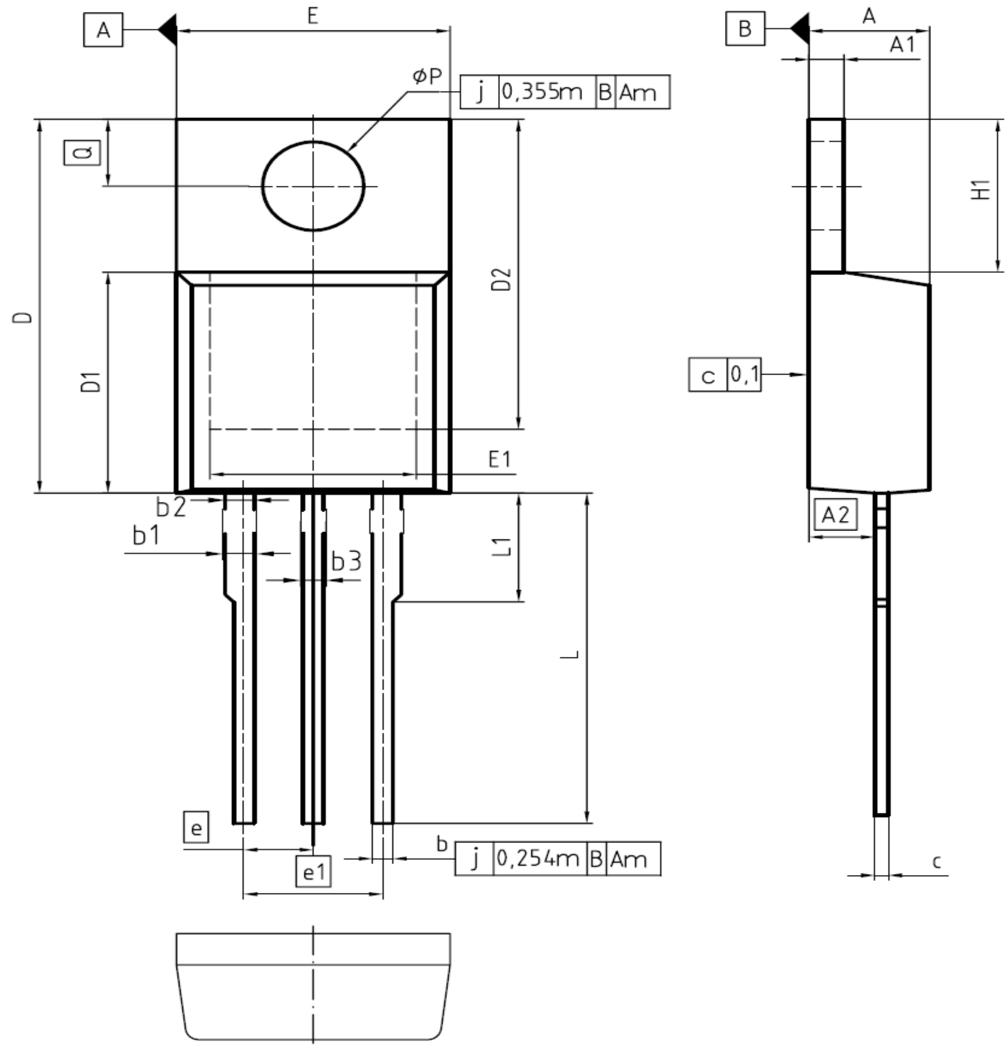


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600$V, $T_j \leq 150$°C)

PG-TO220-3-1

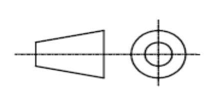


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

DOCUMENT NO.
Z8B00003318

SCALE 0 2.5 5mm

EUROPEAN PROJECTION



ISSUE DATE
23-08-2007

REVISION
05

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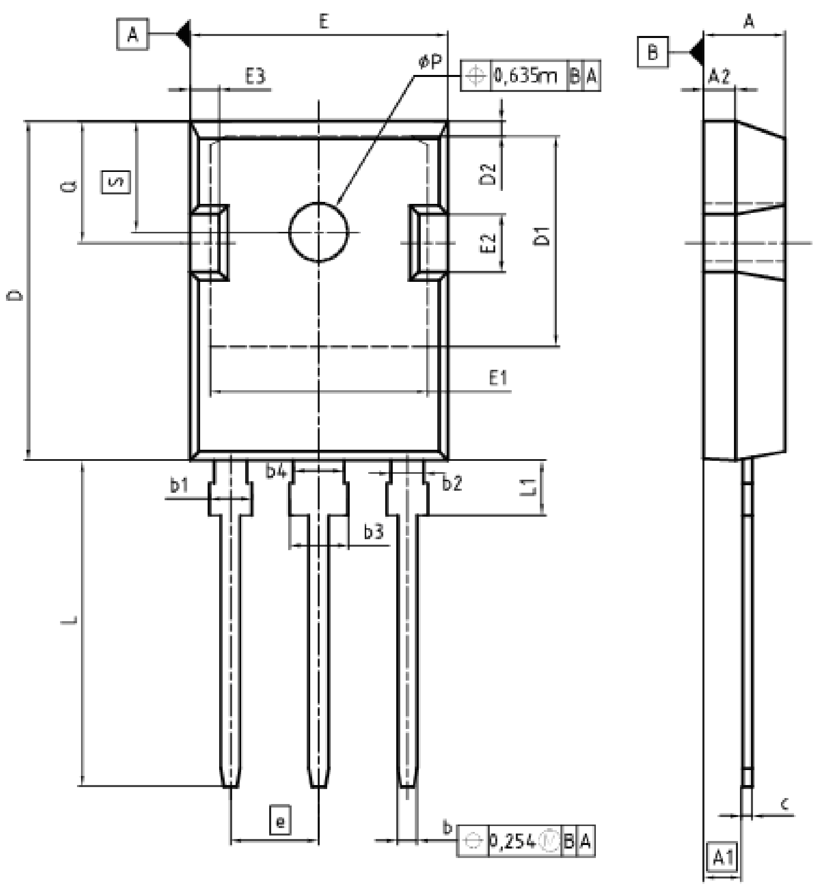

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	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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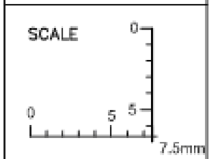

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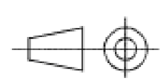

ISSUE DATE
01-10-2009

REVISION
04

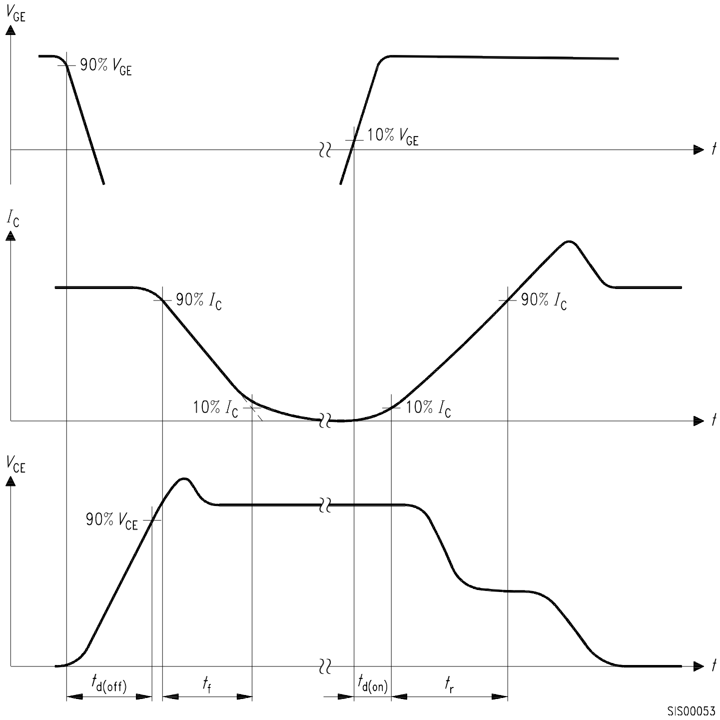

Figure A. Definition of switching times

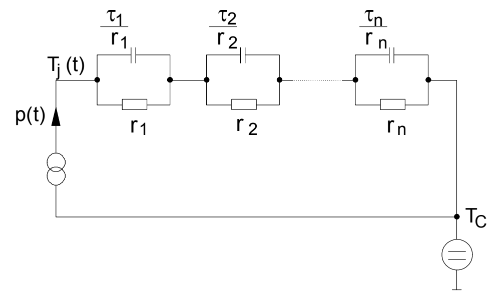

Figure D. Thermal equivalent circuit

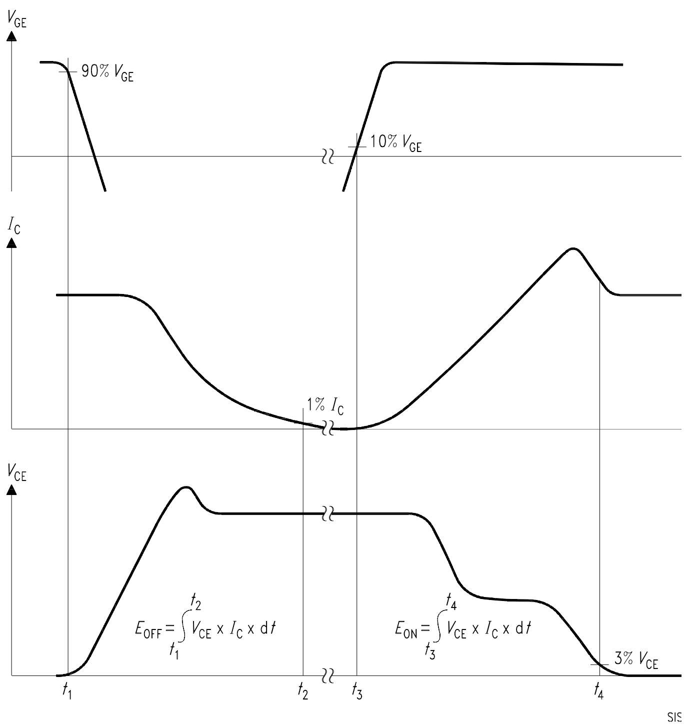

Figure B. Definition of switching losses

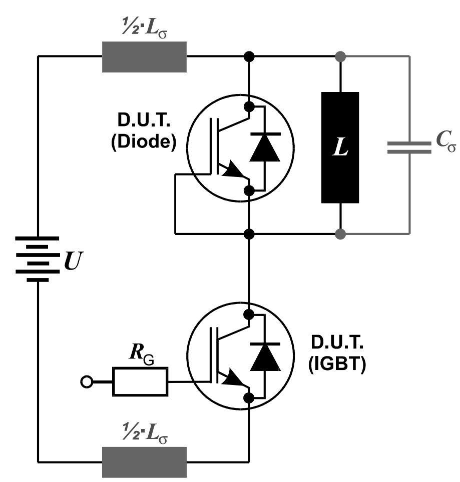

Figure E. Dynamic test circuit
Leakage inductance L_σ =60nH
and Stray capacity C_σ =40pF.

Published by
Infineon Technologies AG
81726 Munich, Germany

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