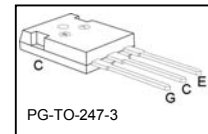
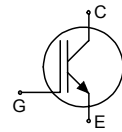


High Speed IGBT in NPT-technology

- 30% lower E_{off} compared to previous generation
- Short circuit withstand time – 10 μ s
- 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 JEDEC¹ 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	I_C	100	A
$T_C = 25^\circ\text{C}$		100	
$T_C = 100^\circ\text{C}$		50	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	150	
Turn off safe operating area	-	150	
$V_{CE} \leq 600\text{V}$, $T_j \leq 150^\circ\text{C}$			
Avalanche energy single pulse	E_{AS}	280	mJ
$I_C = 50\text{A}$, $V_{CC} = 50\text{V}$, $R_{GE} = 25\Omega$ start $T_j = 25^\circ\text{C}$			
Gate-emitter voltage static	V_{GE}	± 20	V
transient ($t_p < 1\mu\text{s}$, $D < 0.05$)		± 30	
Short circuit withstand time ²⁾	t_{SC}	10	μs
$V_{GE} = 15\text{V}$, $V_{CC} \leq 600\text{V}$, $T_j \leq 150^\circ\text{C}$			
Power dissipation	P_{tot}	416	W
$T_C = 25^\circ\text{C}$			
Operating junction and storage temperature	T_j , T_{stg}	-55...+150	$^\circ\text{C}$
Time limited operating junction temperature for $t < 150\text{h}$	$T_{j(tl)}$	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}		0.3	K/W
Thermal resistance, junction – ambient	R_{thJA}		40	

Electrical Characteristic, at $T_j = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=500\mu A$	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=50A$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	- -	2.8 3.15	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}	$V_{CE}=600V, V_{GE}=0V$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	- -	- -	40 3000	μA
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

Input capacitance	C_{iss}	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1MHz$	-	2572	-	pF
Output capacitance	C_{oss}		-	245	-	
Reverse transfer capacitance	C_{rfs}		-	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⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC}\leq 600V,$ $T_j\leq 150^\circ\text{C}$	-	471	-	A

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

Switching Characteristic, Inductive Load, at $T_j=25^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=25^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=50\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=6.8\Omega$ $L_{\sigma}^{1)}$ = 55nH, $C_{\sigma}^{1)}$ = 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	-	mJ
Turn-on energy	E_{on}		-	1.08	-	
Turn-off energy	E_{off}		-	0.88	-	
Total switching energy	E_{ts}		-	1.96	-	

Switching Characteristic, Inductive Load, at $T_j=150^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=150^\circ\text{C}$ $V_{CC}=400\text{V}$, $I_C=50\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=1.8\Omega$ $L_{\sigma}^{1)}$ = 60nH, $C_{\sigma}^{1)}$ = 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	-	mJ
Turn-on energy	E_{on}		-	1	-	
Turn-off energy	E_{off}		-	0.90	-	
Total switching energy	E_{ts}		-	1.9	-	
Turn-on delay time	$t_{d(on)}$	$T_j=150^\circ\text{C}$ $V_{CC}=400\text{V}$, $I_C=50\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=6.8\Omega$ $L_{\sigma}^{1)}$ = 60nH, $C_{\sigma}^{1)}$ = 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	-	mJ
Turn-on energy	E_{on}		-	1.5	-	
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

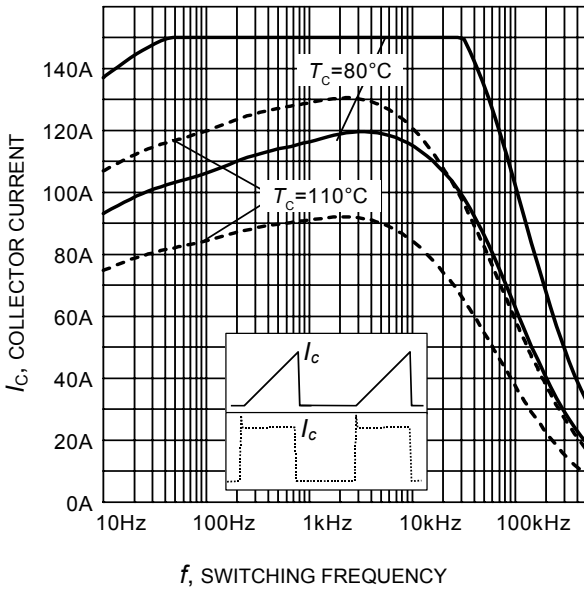


Figure 1. Collector current as a function of switching frequency
 ($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 400\text{V}$,
 $V_{GE} = 0/+15\text{V}$, $R_G = 6.8\Omega$)

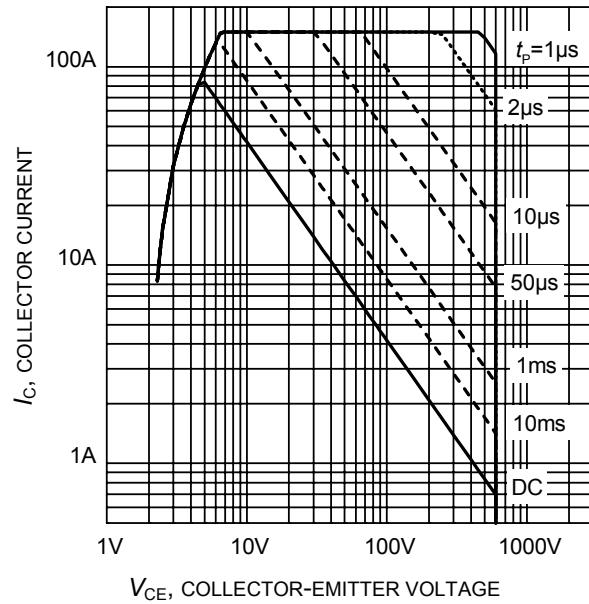


Figure 2. Safe operating area
 ($D = 0$, $T_C = 25^\circ\text{C}$, $T_j \leq 150^\circ\text{C}$;
 $V_{GE} = 15\text{V}$)

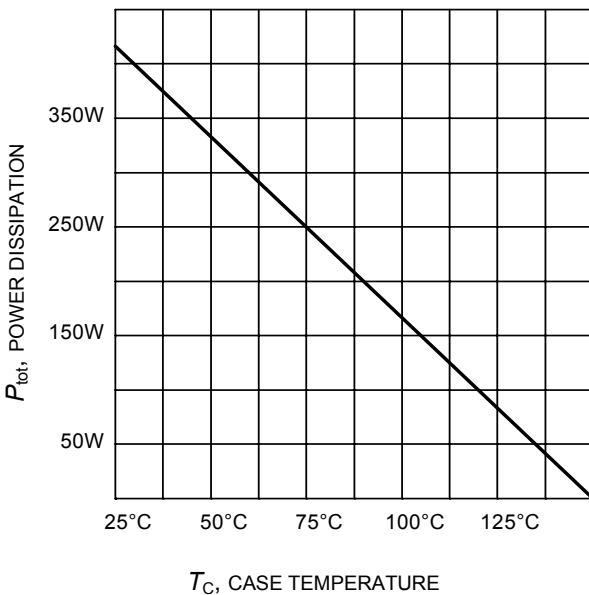


Figure 3. Power dissipation as a function of case temperature
 ($T_j \leq 150^\circ\text{C}$)

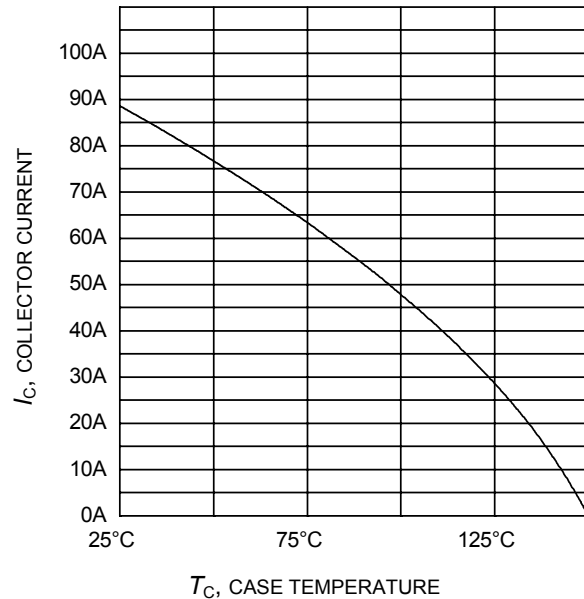


Figure 4. Collector current as a function of case temperature
 ($V_{GE} \leq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

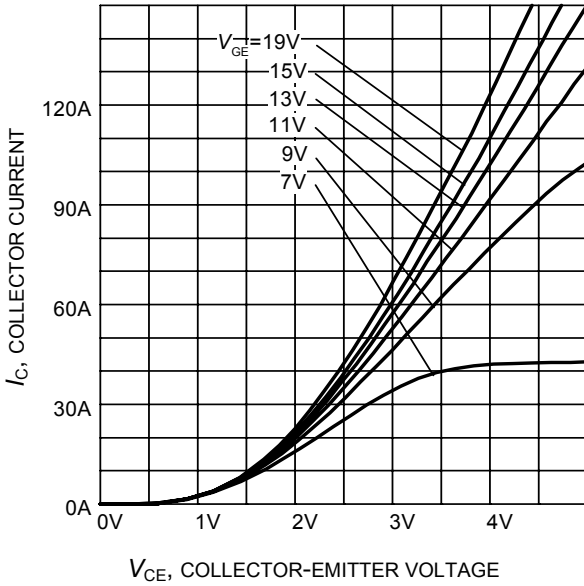


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

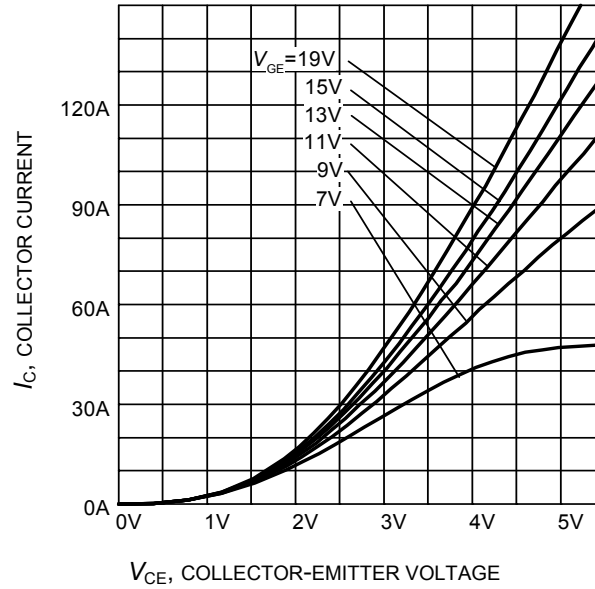


Figure 6. Typical output characteristic
($T_j = 150^\circ\text{C}$)

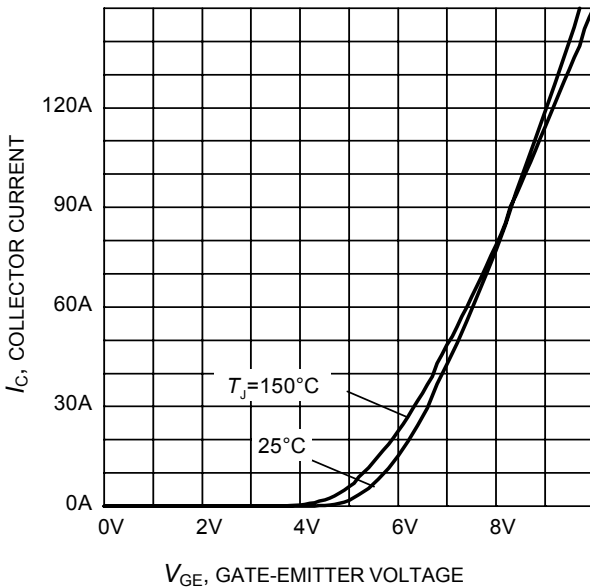


Figure 7. Gate transfer characteristic
($V_{CE} = 10\text{V}$)

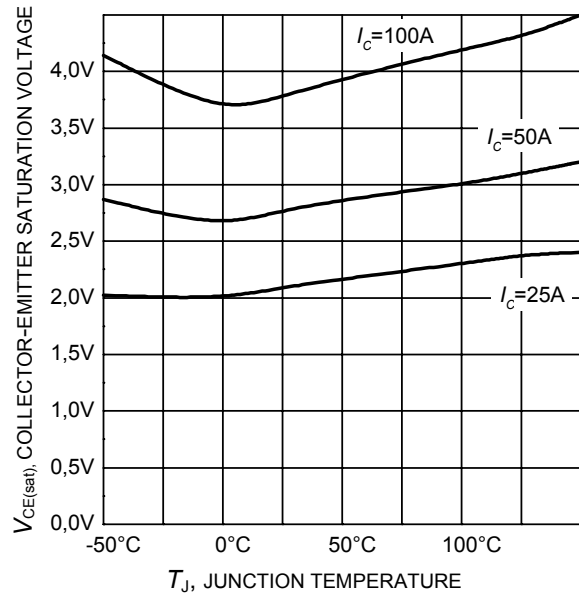


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

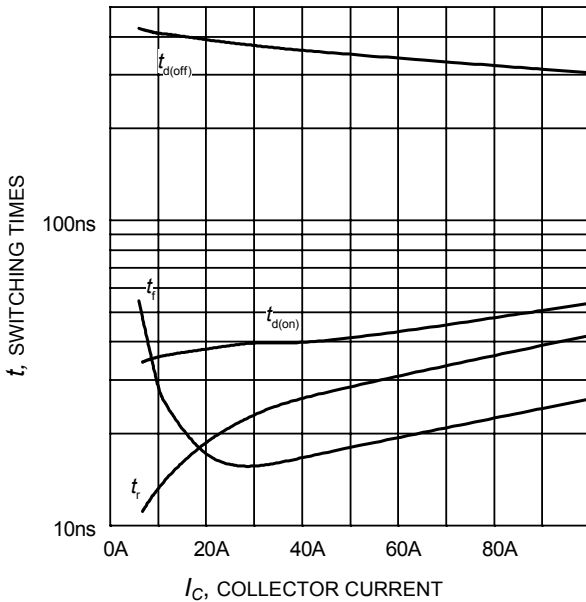


Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=6.8\Omega$, Dynamic test circuit in Figure E)

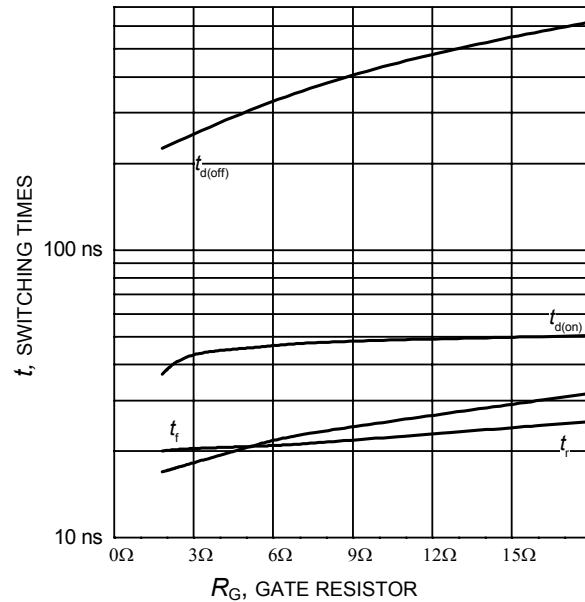


Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=50\text{A}$, Dynamic test circuit in Figure E)

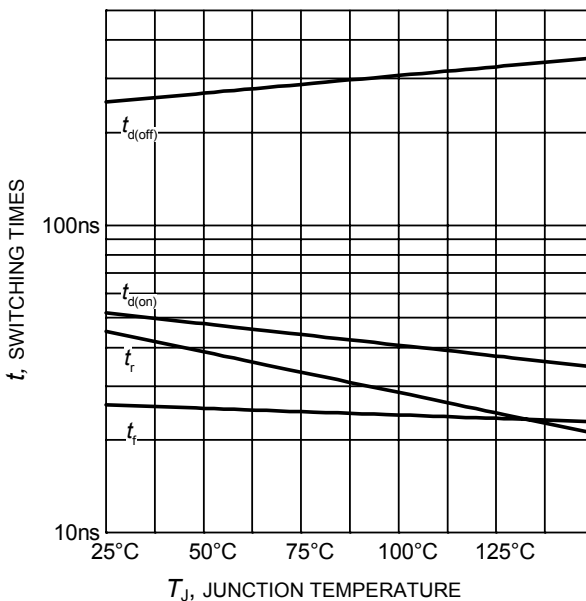


Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=50\text{A}$, $R_G=6.8\Omega$, Dynamic test circuit in Figure E)

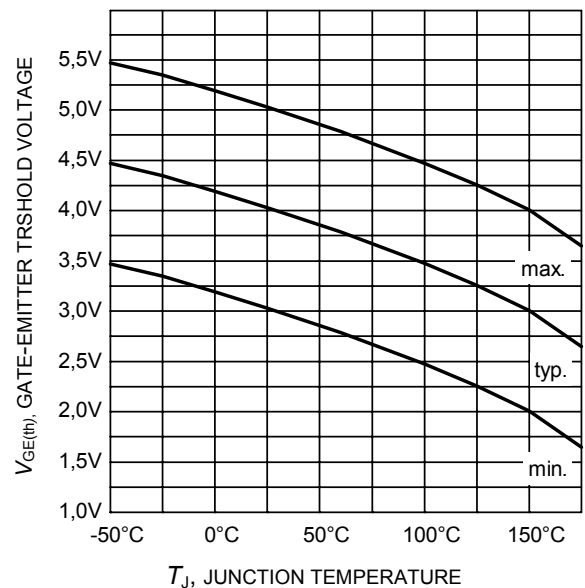


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 ($I_C = 1\text{mA}$)

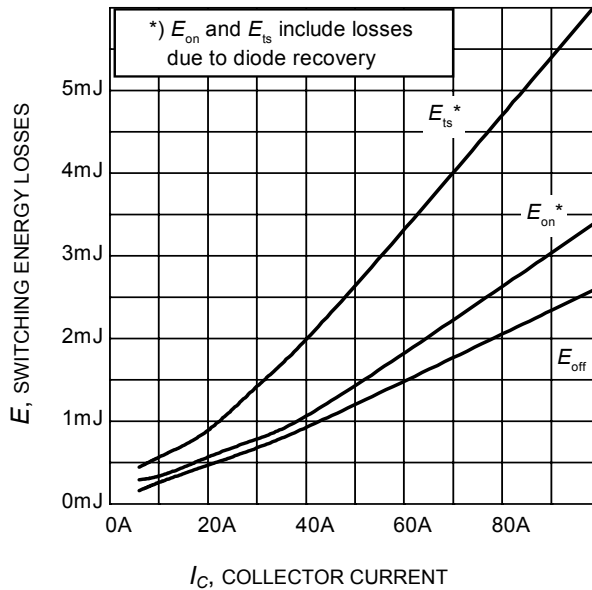


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=6.8\Omega$, Dynamic test circuit in Figure E)

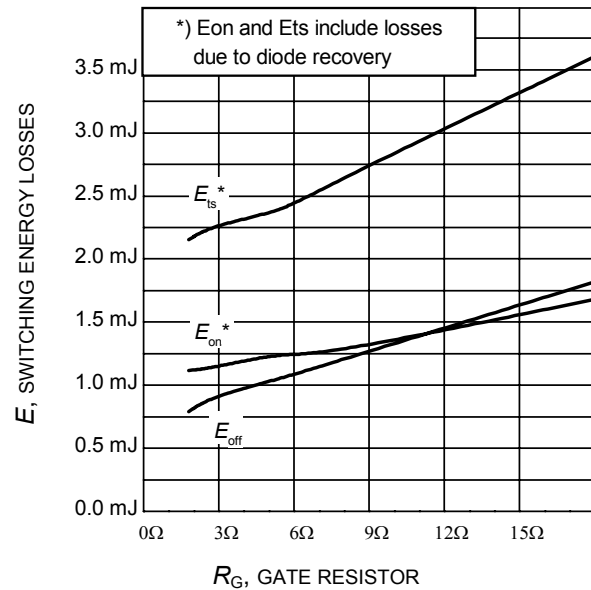


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=50\text{A}$, Dynamic test circuit in Figure E)

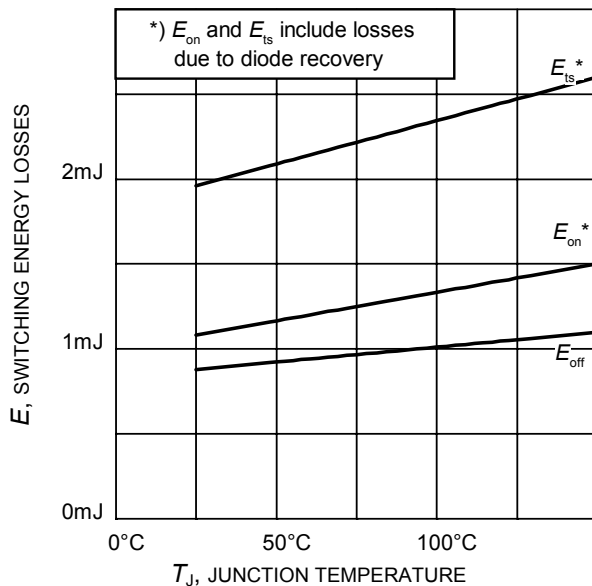


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=50\text{A}$, $R_G=6.8\Omega$, Dynamic test circuit in Figure E)

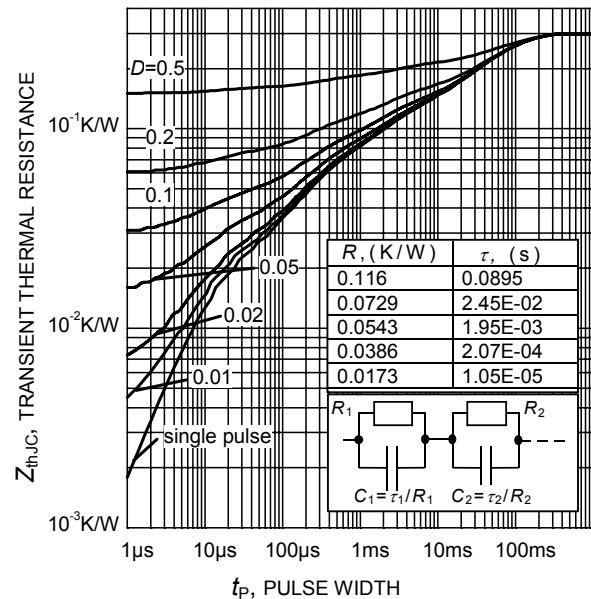


Figure 16. IGBT transient thermal resistance
 ($D = t_p / T$)

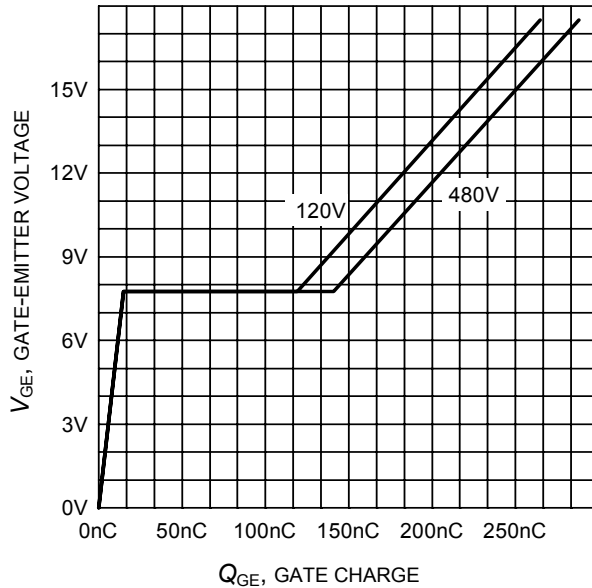


Figure 17. Typical gate charge
($I_C=50\text{ A}$)

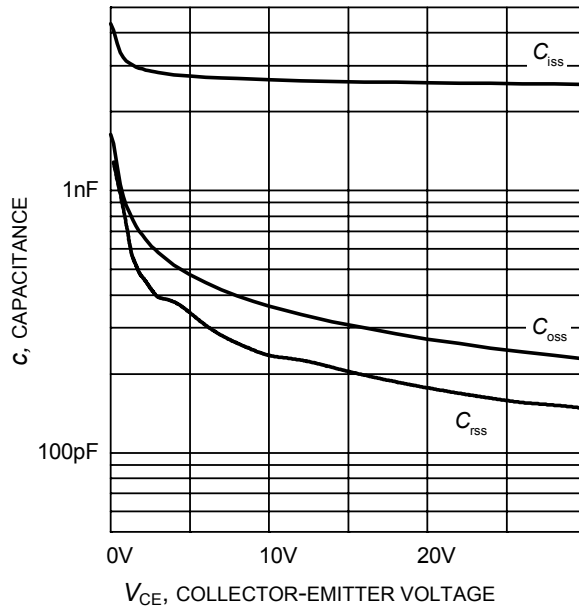


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{V}$, $f=1\text{ MHz}$)

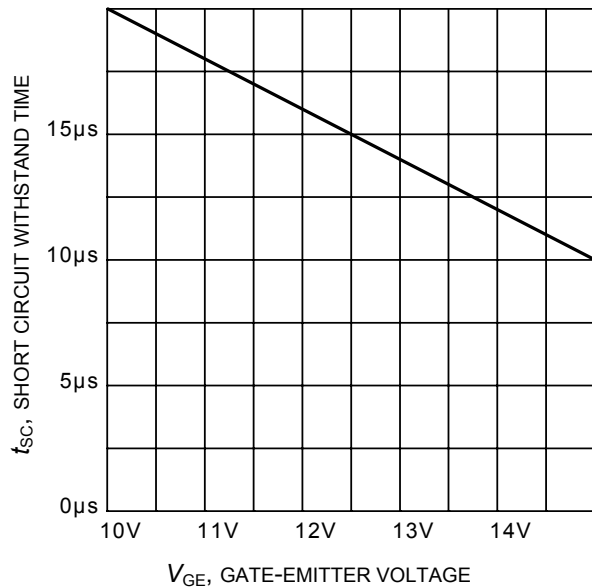


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE}=600\text{V}$, start at $T_J=25^\circ\text{C}$)

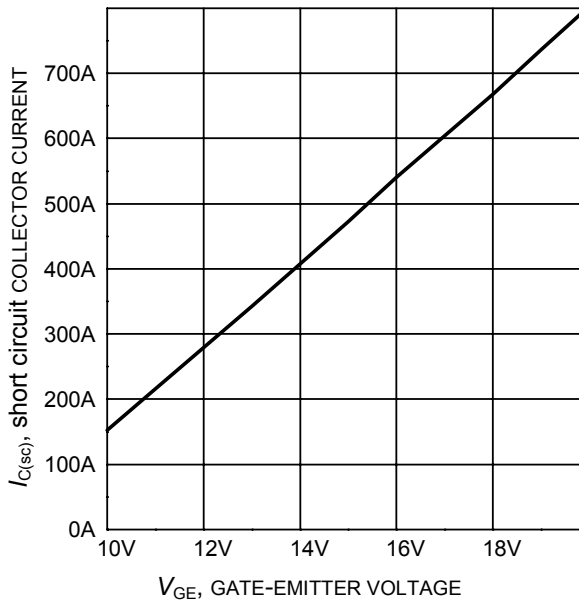
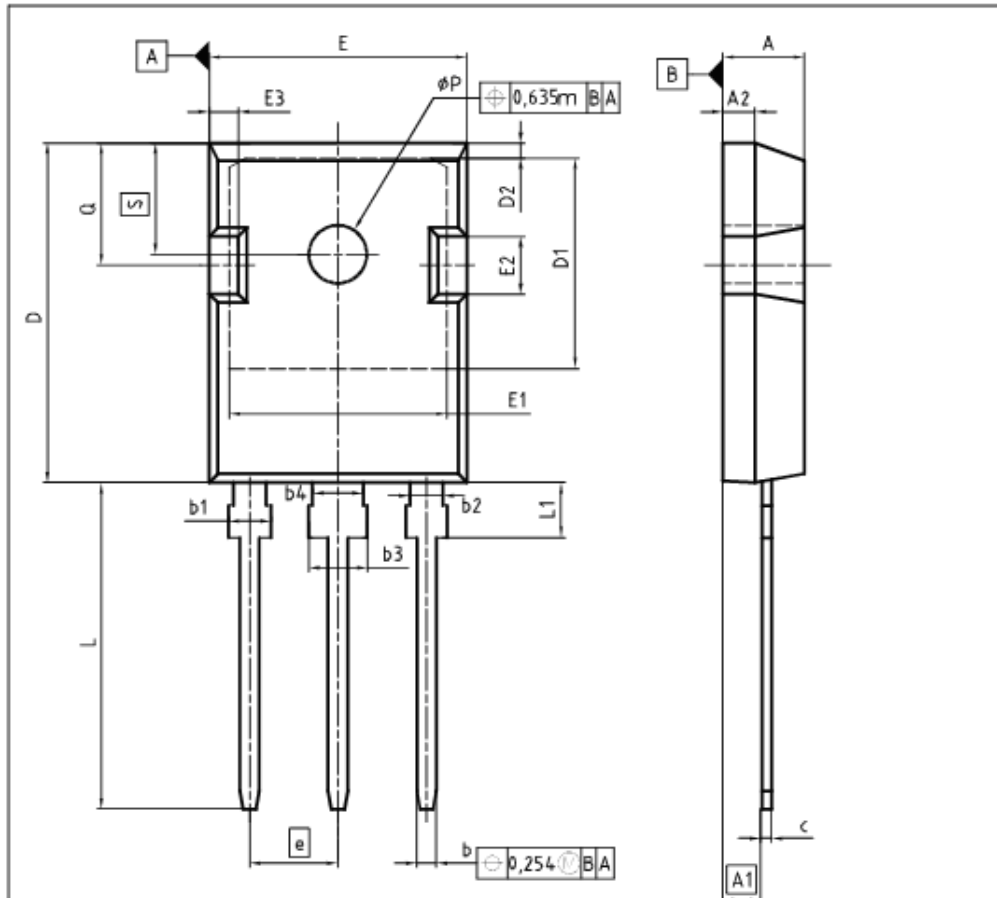


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600\text{V}$, $T_J \leq 150^\circ\text{C}$)

T0247-3



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
ϕP	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

EUROPEAN PROJECTION

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01-10-2009

REVISION
04

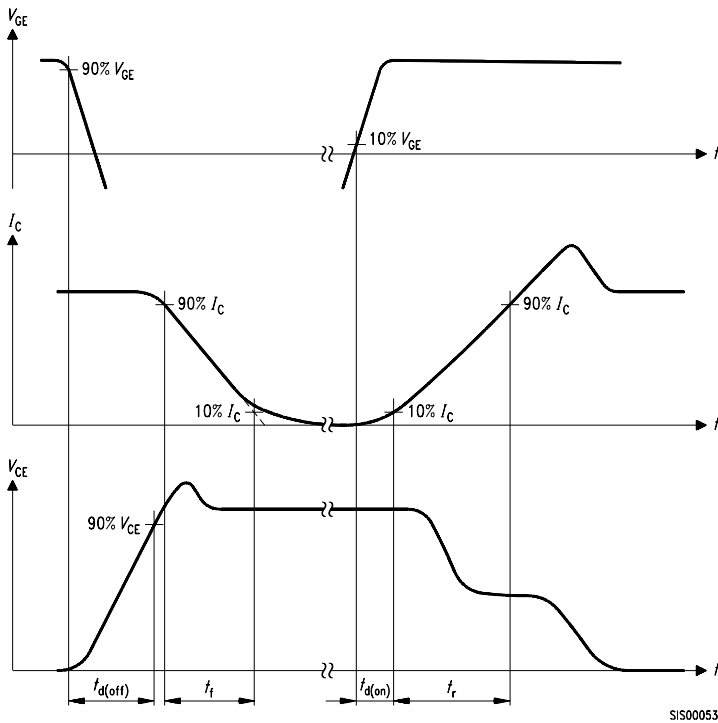


Figure A. Definition of switching times

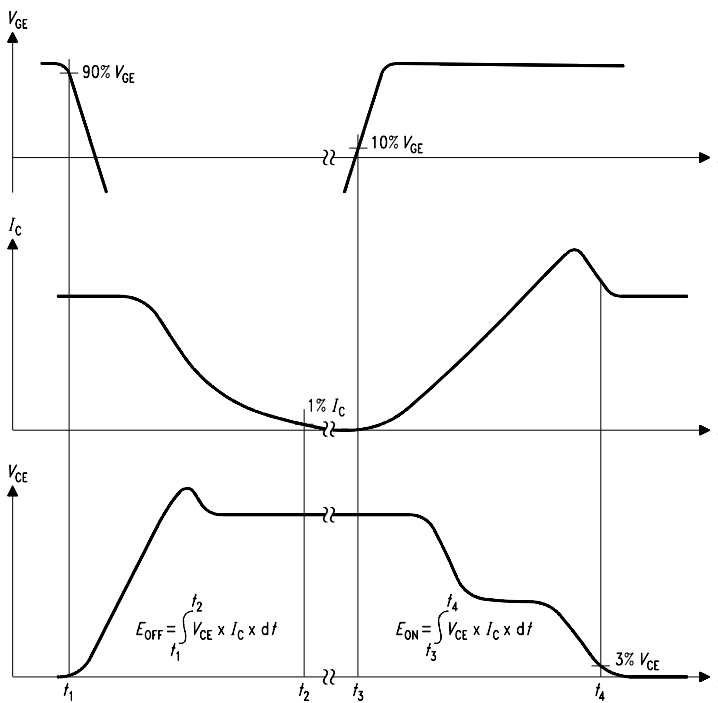


Figure B. Definition of switching losses

$$E_{OFF} = \int_{t_1}^{t_2} V_{CE} \times I_C \times dt$$

$$E_{ON} = \int_{t_3}^{t_4} V_{CE} \times I_C \times dt$$

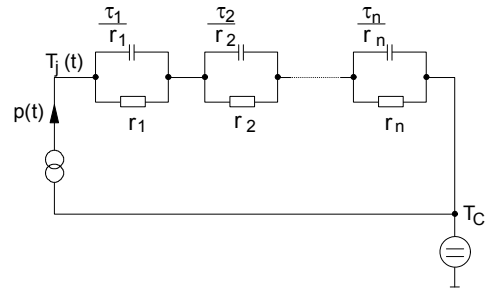


Figure D. Thermal equivalent circuit

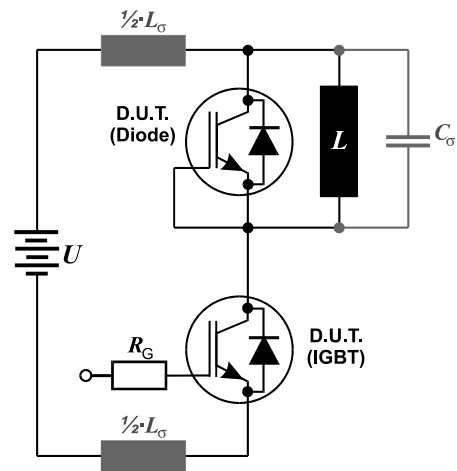


Figure E. Dynamic test circuit
Leakage inductance $L_\sigma = 55\text{nH}$
and Stray capacity $C_\sigma = 40\text{pF}$.

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