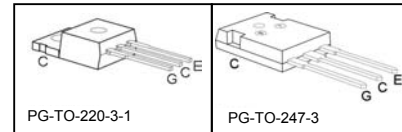
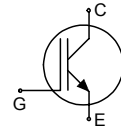


High Speed IGBT in NPT-technology

- 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_{off}	T_j	Marking	Package
SGP20N60HS	600V	20	240 μ J	150°C	G20N60HS	PG-TO-220-3-1
SGW20N60HS	600V	20	240 μ J	150°C	G20N60HS	PG-TO-247-3

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current	I_C		A
$T_C = 25^\circ\text{C}$		36	
$T_C = 100^\circ\text{C}$		20	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	80	
Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_j \leq 150^\circ\text{C}$	-	80	
Avalanche energy single pulse $I_C = 20\text{A}$, $V_{CC} = 50\text{V}$, $R_{GE} = 25\Omega$ start $T_j = 25^\circ\text{C}$	E_{AS}	115	mJ
Gate-emitter voltage static transient ($t_p < 1\mu\text{s}$, $D < 0.05$)	V_{GE}	± 20 ± 30	V
Short circuit withstand time ²⁾ $V_{GE} = 15\text{V}$, $V_{CC} \leq 600\text{V}$, $T_j \leq 150^\circ\text{C}$	t_{SC}	10	μs
Power dissipation $T_C = 25^\circ\text{C}$	P_{tot}	178	W
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}		0.7	K/W
Thermal resistance, junction – ambient	R_{thJA}	PG-TO-220-3-1 PG-TO-247-3-21	62 40	

Electrical Characteristic, at $T_j = 25\text{ }^\circ\text{C}$, 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	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=20A$ $T_j=25\text{ }^\circ\text{C}$ $T_j=150\text{ }^\circ\text{C}$		2.8 3.5	3.15 4.00	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=500\mu A, V_{CE}=V_{GE}$	3	4	5	
Zero gate voltage collector current	I_{CES}	$V_{CE}=600V, V_{GE}=0V$ $T_j=25\text{ }^\circ\text{C}$ $T_j=150\text{ }^\circ\text{C}$	- -	- -	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

Input capacitance	C_{iss}	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1MHz$	-	1100		pF
Output capacitance	C_{oss}		-	105		
Reverse transfer capacitance	C_{rfs}		-	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⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC}\leq 600V,$ $T_j\leq 150\text{ }^\circ\text{C}$	-	170		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	$t_{d(on)}$	$T_j=25^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=20\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=16\Omega$ $L_{\sigma}^{1)}$ = 60nH, $C_{\sigma}^{1)}$ = 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		mJ
Turn-on energy	E_{on}		-	0.39			
Turn-off energy	E_{off}		-	0.30			
Total switching energy	E_{ts}		-	0.69			

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	$t_{d(on)}$	$T_j=150^\circ\text{C}$ $V_{CC}=400\text{V}$, $I_C=20\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=2.2\Omega$ $L_{\sigma}^{1)}$ = 60nH, $C_{\sigma}^{1)}$ = 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		mJ
Turn-on energy	E_{on}		-	0.46			
Turn-off energy	E_{off}		-	0.24			
Total switching energy	E_{ts}		-	0.7			
Turn-on delay time	$t_{d(on)}$	$T_j=150^\circ\text{C}$ $V_{CC}=400\text{V}$, $I_C=20\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=16\Omega$ $L_{\sigma}^{1)}$ = 60nH, $C_{\sigma}^{1)}$ = 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		mJ
Turn-on energy	E_{on}		-	0.6			
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.

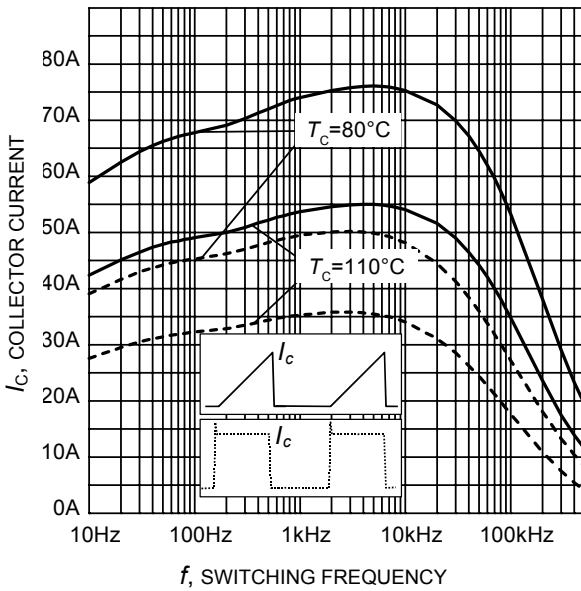


Figure 1. Collector current as a function of switching frequency
 $(T_j \leq 150^\circ\text{C}, D = 0.5, V_{CE} = 400\text{V}, V_{GE} = 0/+15\text{V}, R_G = 16\Omega)$

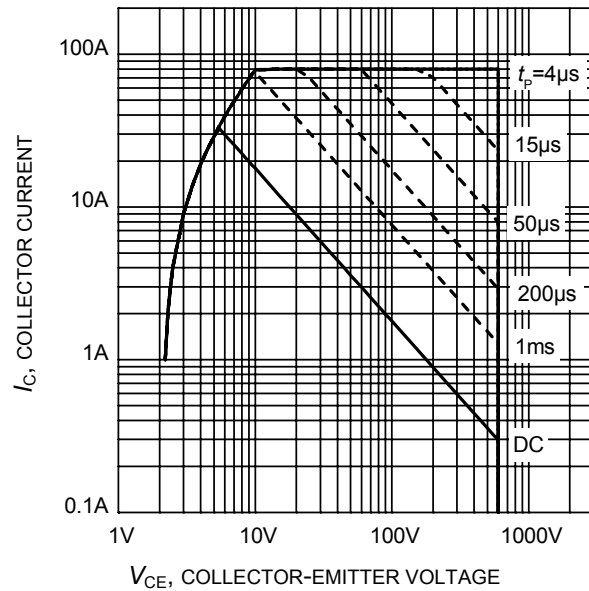


Figure 2. Safe operating area
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 150^\circ\text{C}; V_{GE} = 15\text{V})$

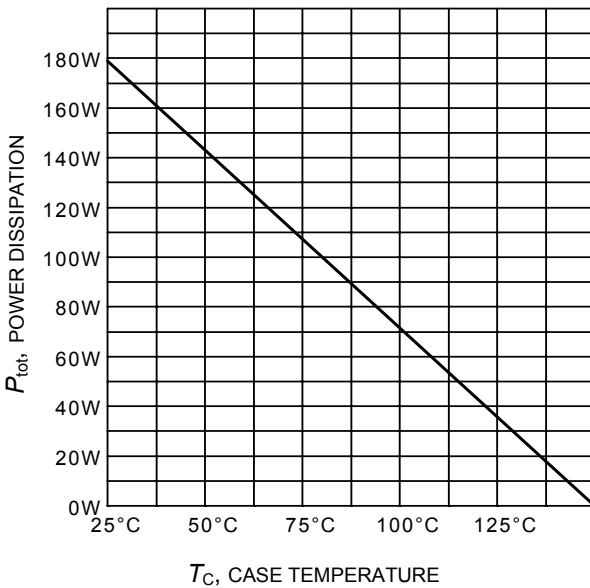


Figure 3. Power dissipation as a function of case temperature
 $(T_j \leq 150^\circ\text{C})$

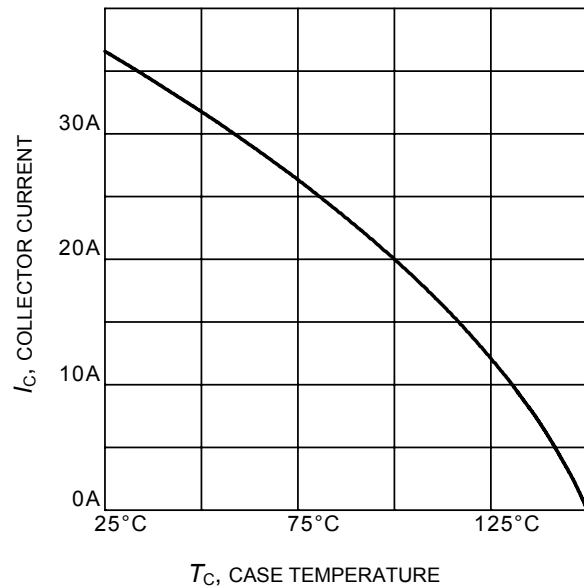


Figure 4. Collector current as a function of case temperature
 $(V_{GE} \leq 15\text{V}, T_j \leq 150^\circ\text{C})$

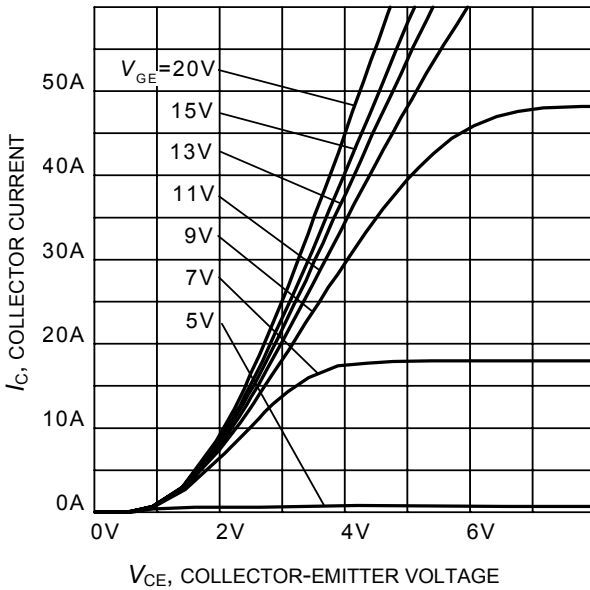


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

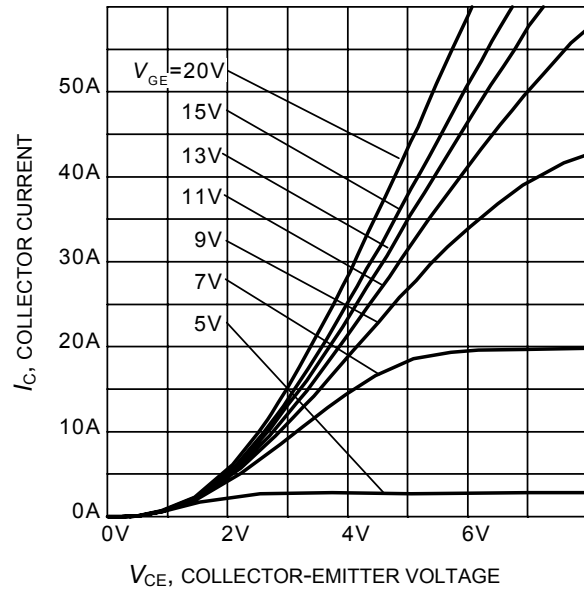


Figure 6. Typical output characteristic
($T_j = 150^\circ\text{C}$)

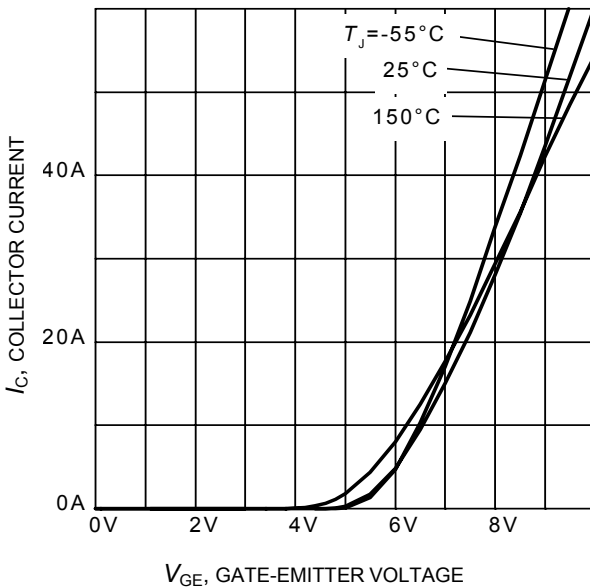


Figure 7. Typical transfer characteristic
($V_{CE} = 10\text{V}$)

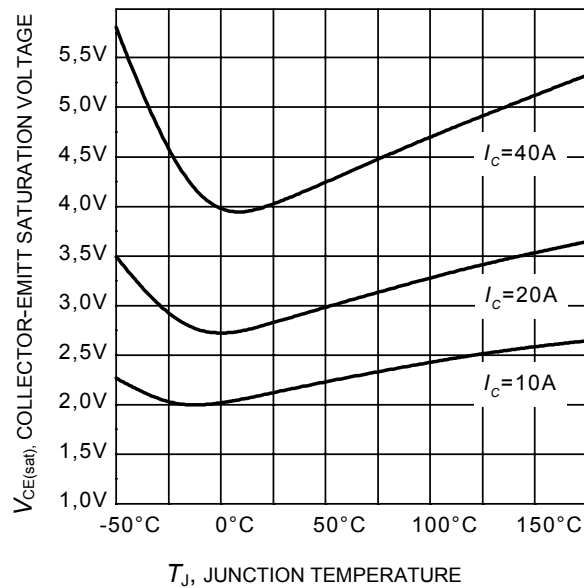


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

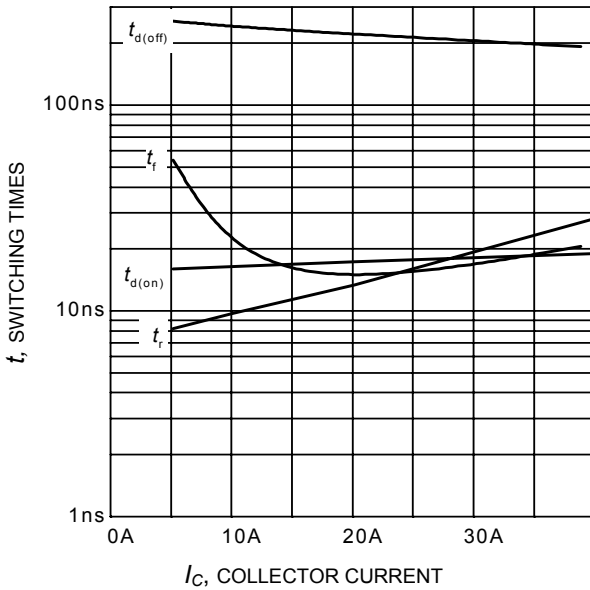


Figure 9. Typical switching times as a function of collector current
(inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=16\Omega$, Dynamic test circuit in Figure E)

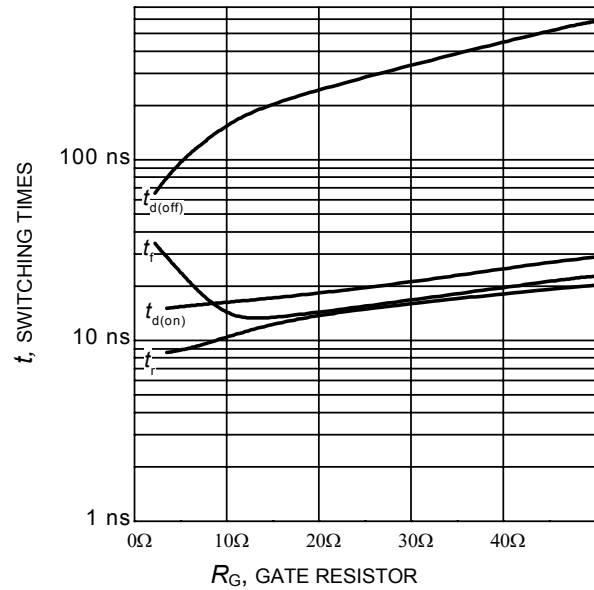


Figure 10. Typical switching times as a function of gate resistor
(inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, Dynamic test circuit in Figure E)

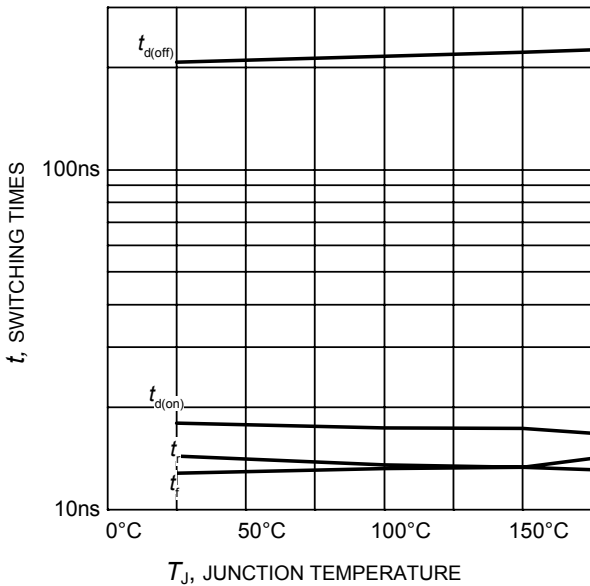


Figure 11. Typical switching times as a function of junction temperature
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=16\Omega$, Dynamic test circuit in Figure E)

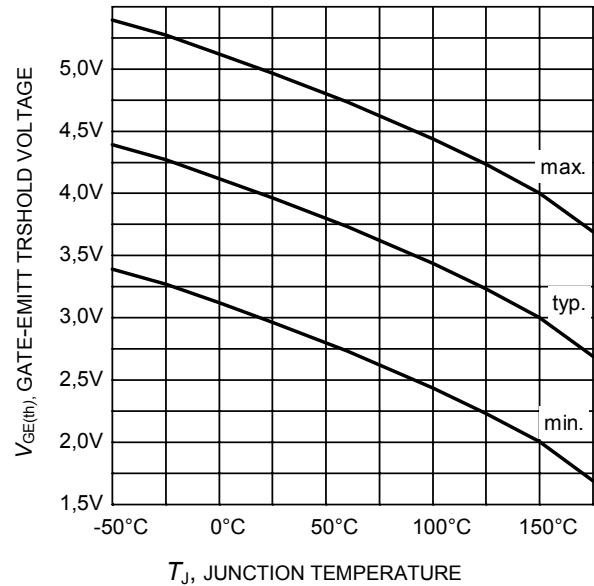


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_C = 0.5\text{mA}$)

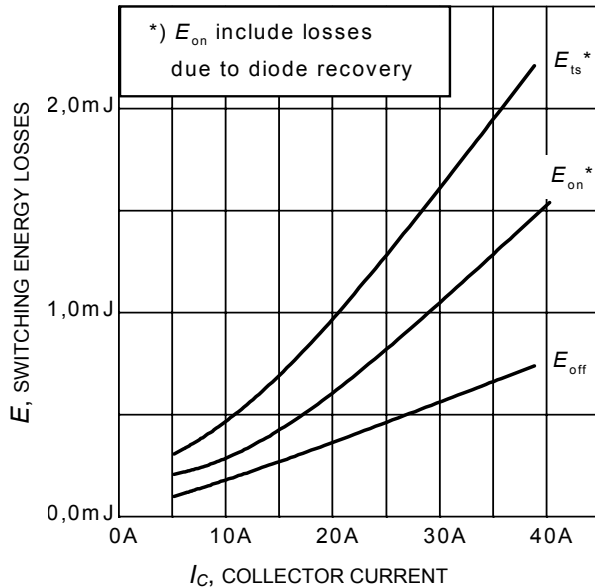


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=16\Omega$, Dynamic test circuit in Figure E)

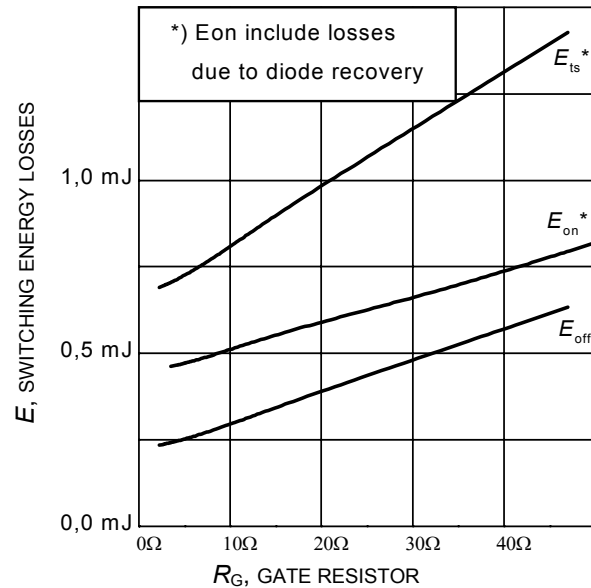


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, Dynamic test circuit in Figure E)

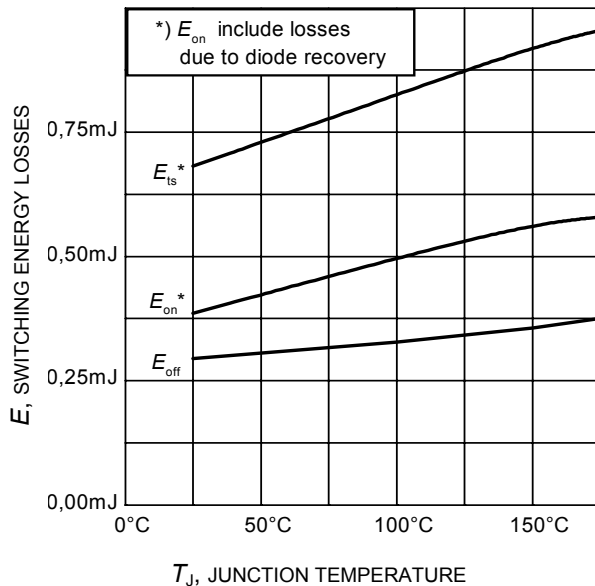


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=16\Omega$, Dynamic test circuit in Figure E)

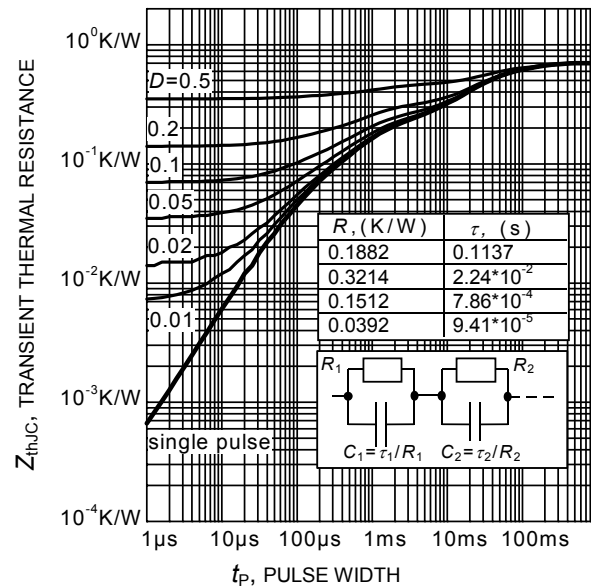


Figure 16. IGBT transient thermal resistance
($D = t_p / T$)

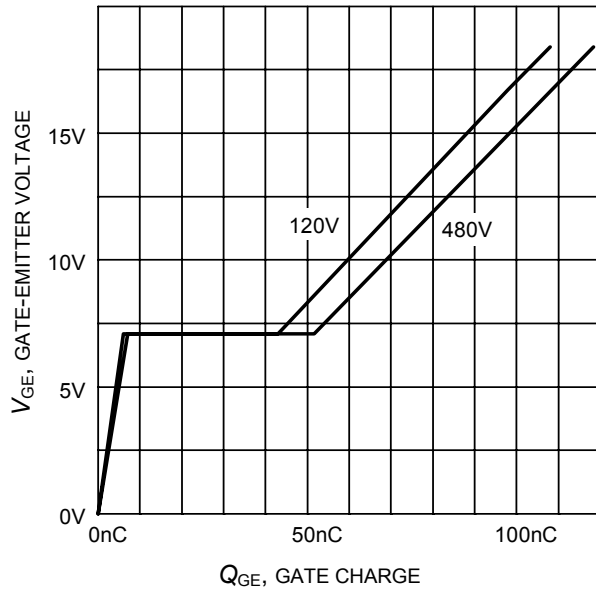


Figure 17. Typical gate charge
($I_C=20\text{ A}$)

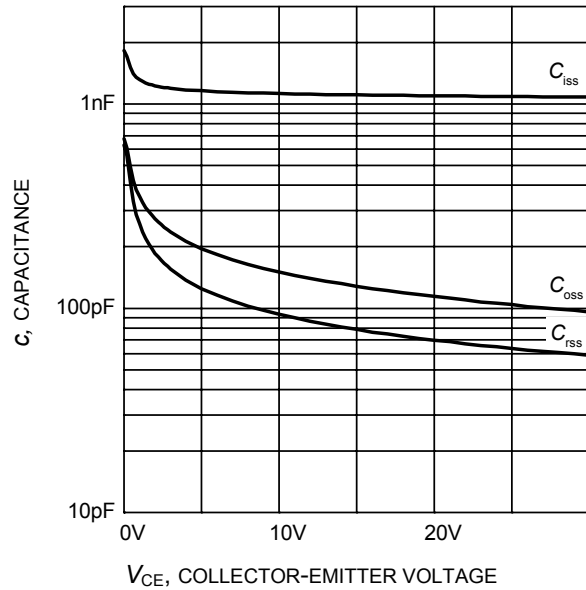


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{V}$, $f = 1\text{ MHz}$)

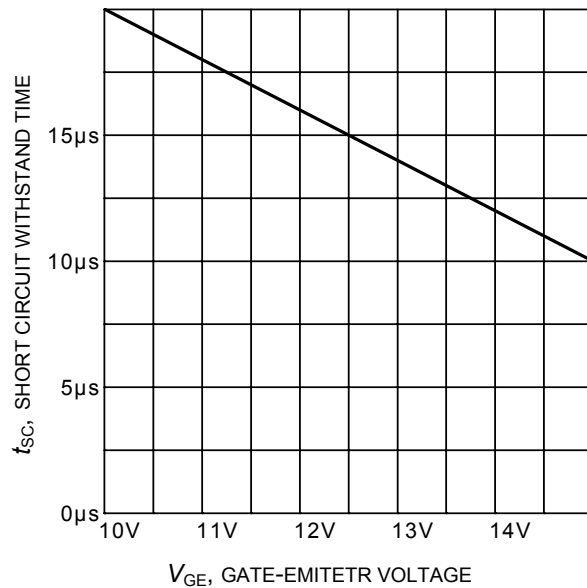


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE}=600\text{V}$, start at $T_J=25^\circ\text{C}$)

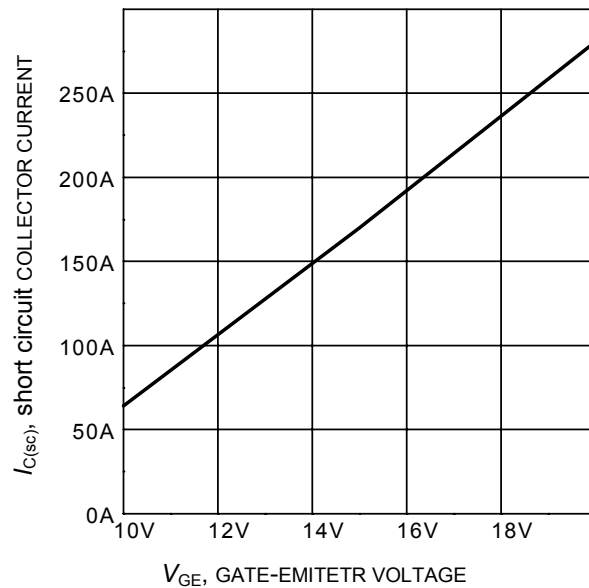
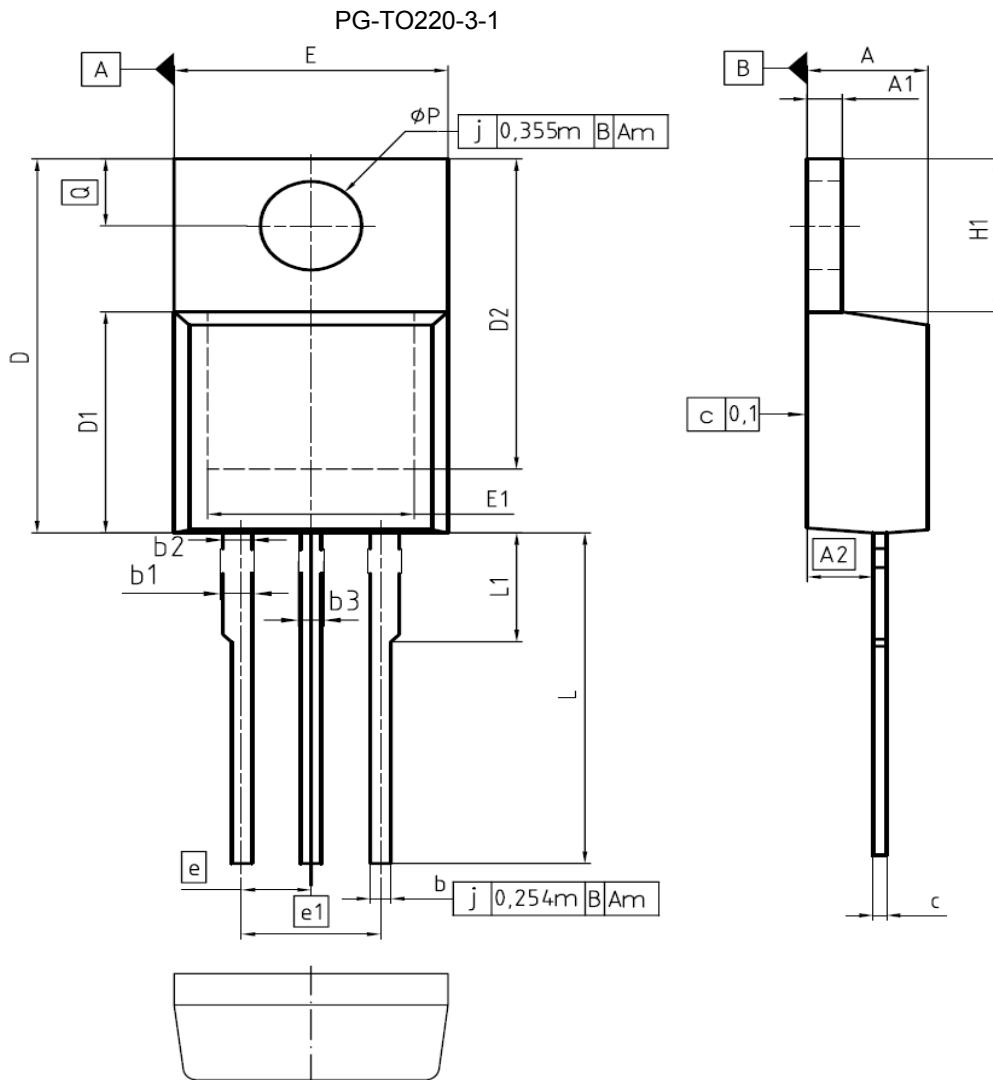


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600\text{V}$, $T_J \leq 150^\circ\text{C}$)



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
ϕP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

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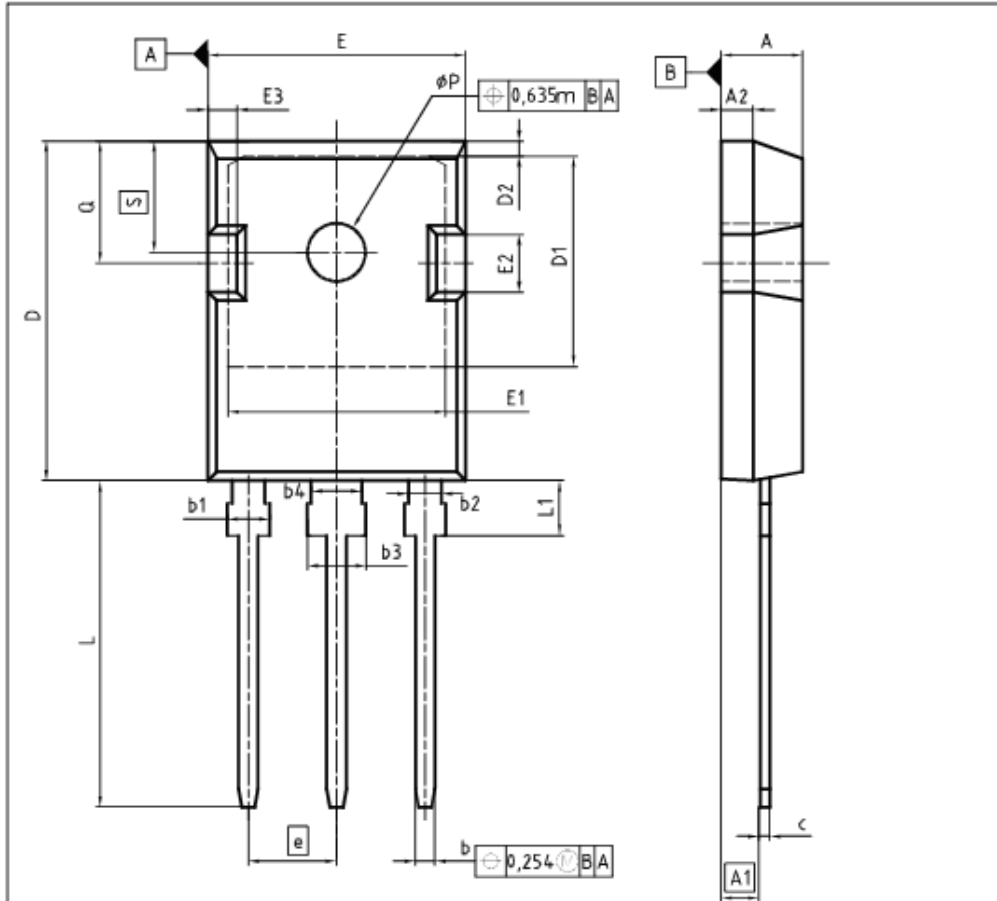
SCALE

EUROPEAN PROJECTION

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REVISION
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T0247-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.180	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
phi P	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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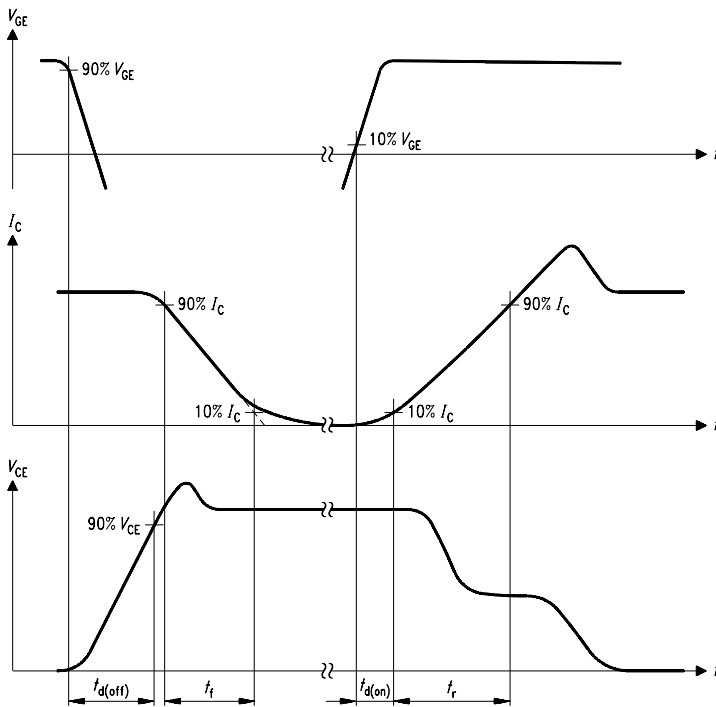


Figure A. Definition of switching times

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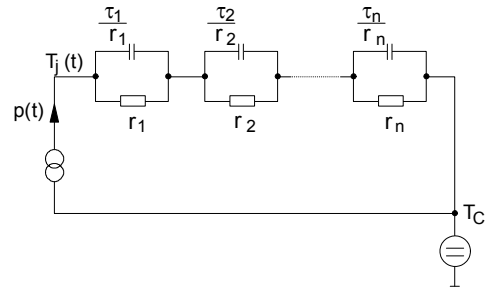


Figure D. Thermal equivalent circuit

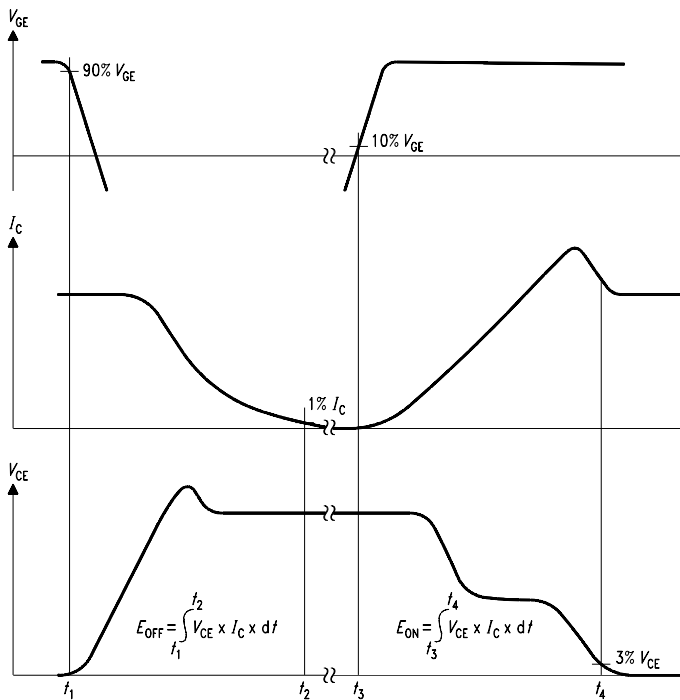


Figure B. Definition of switching losses

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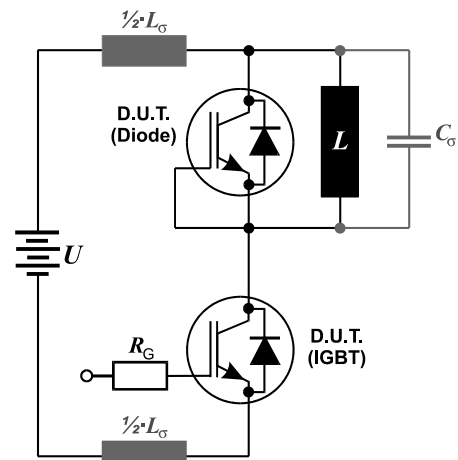


Figure E. Dynamic test circuit
Leakage inductance $L_\sigma = 60\text{nH}$
and Stray capacity $C_\sigma = 40\text{pF}$.

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