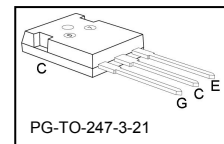
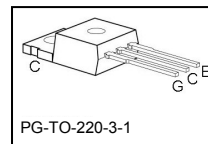
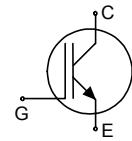


## Fast IGBT in NPT-technology

- 75% lower  $E_{off}$  compared to previous generation combined with low conduction losses
- Short circuit withstand time – 10  $\mu$ s
- Designed for:
  - Motor controls
  - Inverter
- NPT-Technology for 600V applications offers:
  - very tight parameter distribution
  - high ruggedness, temperature stable behaviour
  - parallel switching capability



- Qualified according to JEDEC<sup>1</sup> for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>

Type	$V_{CE}$	$I_C$	$V_{CE(sat)}$	$T_j$	Marking	Package
SGP15N60	600V	15A	2.3V	150°C	G15N60	PG-TO-220-3-1
SGW15N60	600V	15A	2.3V	150°C	G15N60	PG-TO-247-3-21

### Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CE}$	600	V
DC collector current	$I_C$		A
$T_C = 25^\circ\text{C}$		31	
$T_C = 100^\circ\text{C}$		15	
Pulsed collector current, $t_p$ limited by $T_{jmax}$	$I_{Cpuls}$	62	
Turn off safe operating area	-	62	
$V_{CE} \leq 600\text{V}, T_j \leq 150^\circ\text{C}$			
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Avalanche energy, single pulse	$E_{AS}$	85	mJ
$I_C = 15\text{A}, V_{CC} = 50\text{V}, R_{GE} = 25\ \Omega$ , start at $T_j = 25^\circ\text{C}$			
Short circuit withstand time <sup>2</sup>	$t_{SC}$	10	$\mu$ s
$V_{GE} = 15\text{V}, V_{CC} \leq 600\text{V}, T_j \leq 150^\circ\text{C}$			
Power dissipation	$P_{tot}$	139	W
$T_C = 25^\circ\text{C}$			
Operating junction and storage temperature	$T_j, T_{stg}$	-55...+150	$^\circ\text{C}$
Soldering temperature, wavesoldering, 1.6mm (0.063 in.) from case for 10s	$T_s$	260	

<sup>1</sup> J-STD-020 and JESD-022

<sup>2</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

### Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
<b>Characteristic</b>				
IGBT thermal resistance, junction – case	$R_{thJC}$		0.9	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.	
<b>Static Characteristic</b>						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=500\mu A$	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=15A$ $T_j=25^\circ C$ $T_j=150^\circ C$	1.7 -	2 2.3	2.4 2.8	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=400\mu A, V_{CE}=V_{GE}$	3	4	5	
Zero gate voltage collector current	$I_{CES}$	$V_{CE}=600V, V_{GE}=0V$ $T_j=25^\circ C$ $T_j=150^\circ C$	- -	- -	40 2000	$\mu A$
Gate-emitter leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V$	-	-	100	nA
Transconductance	$g_{fs}$	$V_{CE}=20V, I_C=15A$	3	10.9	-	S
<b>Dynamic Characteristic</b>						
Input capacitance	$C_{iss}$	$V_{CE}=25V,$	-	800	960	pF
Output capacitance	$C_{oss}$	$V_{GE}=0V,$	-	84	101	
Reverse transfer capacitance	$C_{riss}$	$f=1MHz$	-	52	62	
Gate charge	$Q_{Gate}$	$V_{CC}=480V, I_C=15A$ $V_{GE}=15V$	-	76	99	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 <sup>2)</sup>	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC}\leq 600V,$ $T_j\leq 150^\circ C$	-	150	-	A

<sup>2)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

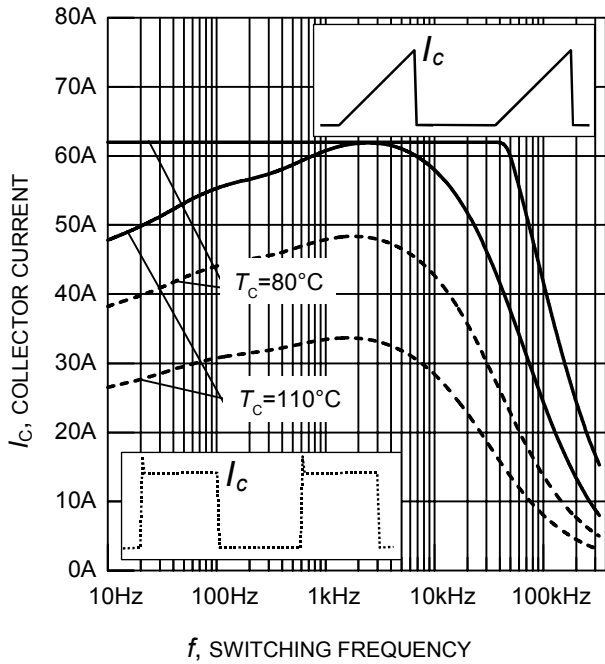
### Switching Characteristic, Inductive Load, at $T_j=25^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(\text{on})}$	$T_j=25^\circ\text{C}$ , $V_{CC}=400\text{V}$ , $I_C=15\text{A}$ , $V_{GE}=0/15\text{V}$ , $R_G=21\Omega$ , $L_{\sigma}^{1)}=180\text{nH}$ , $C_{\sigma}^{1)}=250\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	32	38	ns
Rise time	$t_r$		-	23	28	
Turn-off delay time	$t_{d(\text{off})}$		-	234	281	
Fall time	$t_f$		-	46	55	
Turn-on energy	$E_{\text{on}}$		-	0.30	0.36	mJ
Turn-off energy	$E_{\text{off}}$		-	0.27	0.35	
Total switching energy	$E_{\text{ts}}$		-	0.57	0.71	

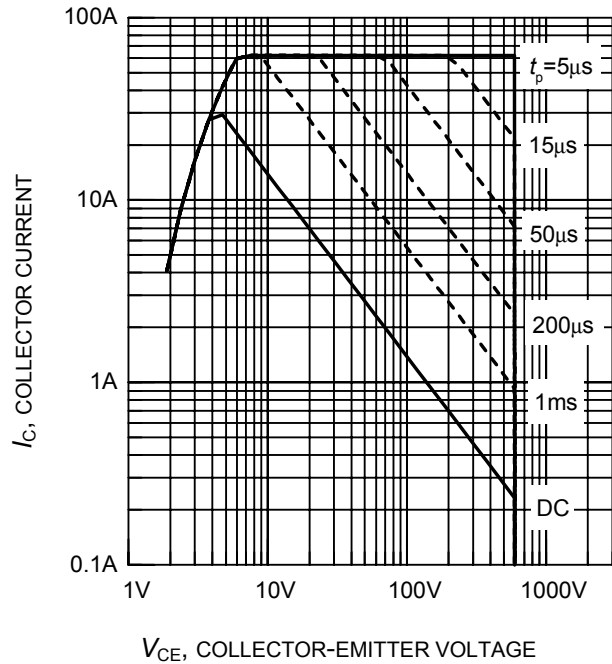
### Switching Characteristic, Inductive Load, at $T_j=150^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(\text{on})}$	$T_j=150^\circ\text{C}$ $V_{CC}=400\text{V}$ , $I_C=15\text{A}$ , $L_{\sigma}^{1)}=180\text{nH}$ , $C_{\sigma}^{1)}=250\text{pF}$ $V_{GE}=0/15\text{V}$ , $R_G=21\Omega$ Energy losses include "tail" and diode reverse recovery.	-	31	38	ns
Rise time	$t_r$		-	23	28	
Turn-off delay time	$t_{d(\text{off})}$		-	261	313	
Fall time	$t_f$		-	54	65	
Turn-on energy	$E_{\text{on}}$		-	0.45	0.54	mJ
Turn-off energy	$E_{\text{off}}$		-	0.41	0.53	
Total switching energy	$E_{\text{ts}}$		-	0.86	1.07	

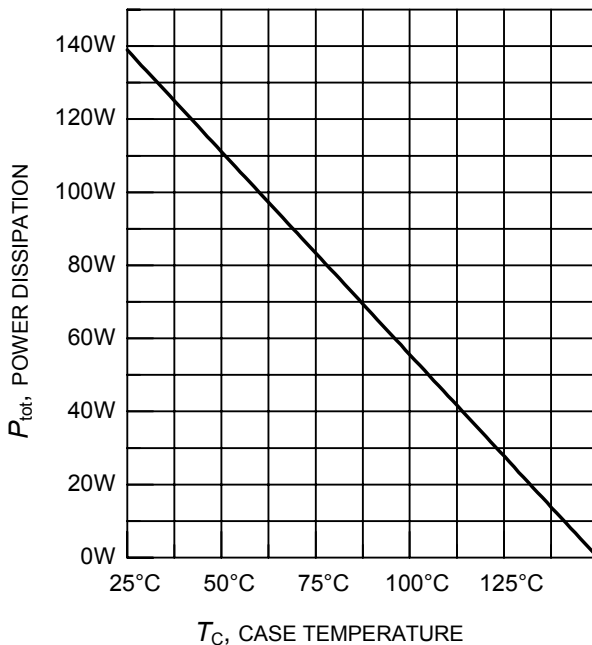
<sup>1)</sup> Leakage inductance  $L_{\sigma}$  and Stray capacity  $C_{\sigma}$  due to dynamic test circuit in Figure E.



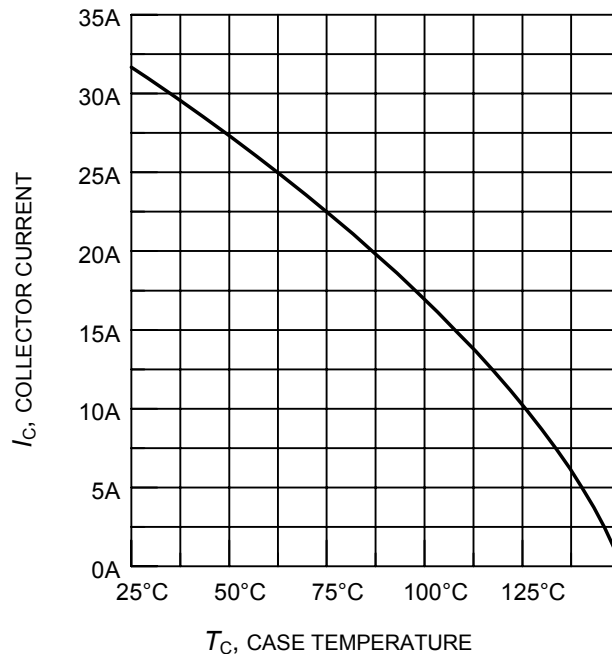
**Figure 1. Collector current as a function of switching frequency**  
 ( $T_j \leq 150^\circ\text{C}$ ,  $D = 0.5$ ,  $V_{CE} = 400\text{V}$ ,  
 $V_{GE} = 0/+15\text{V}$ ,  $R_G = 21\Omega$ )



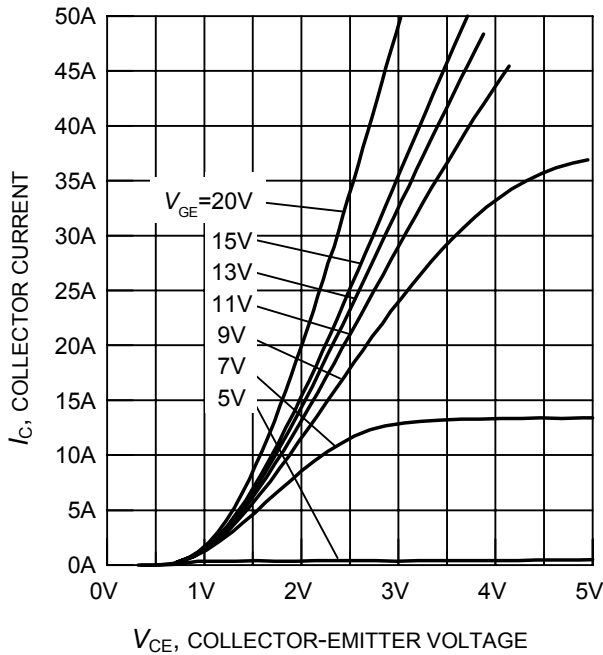
**Figure 2. Safe operating area**  
 ( $D = 0$ ,  $T_C = 25^\circ\text{C}$ ,  $T_j \leq 150^\circ\text{C}$ )



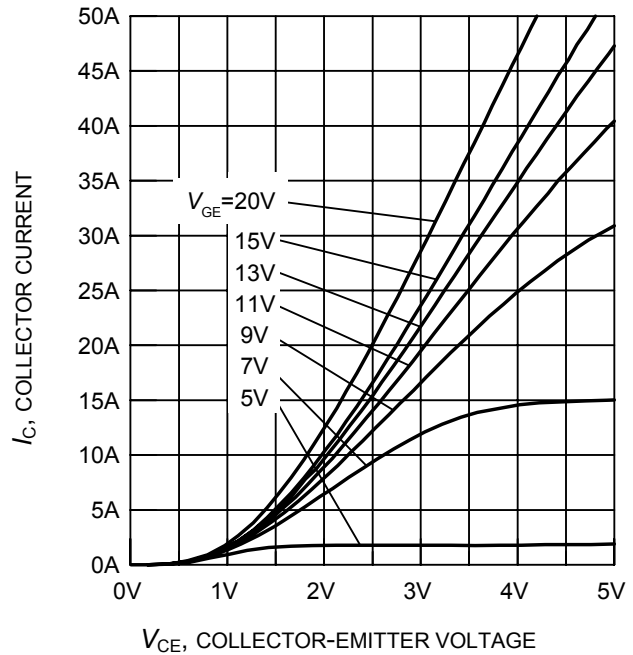
**Figure 3. Power dissipation as a function of case temperature**  
 ( $T_j \leq 150^\circ\text{C}$ )



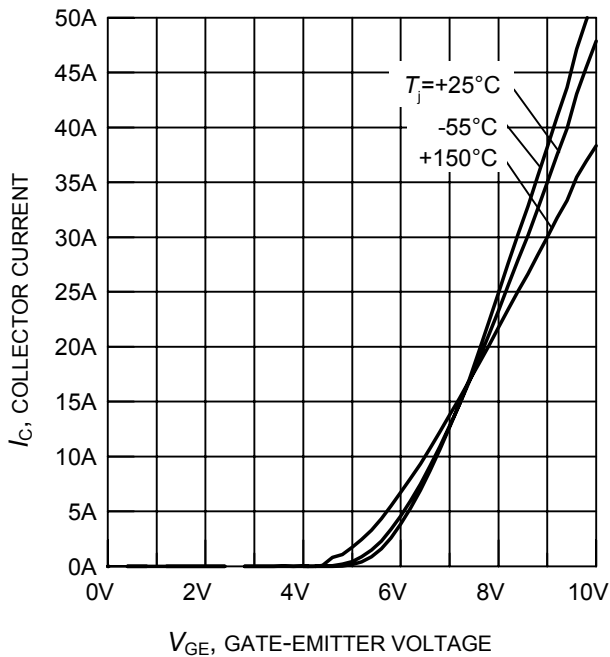
**Figure 4. Collector current as a function of case temperature**  
 ( $V_{GE} \leq 15\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )



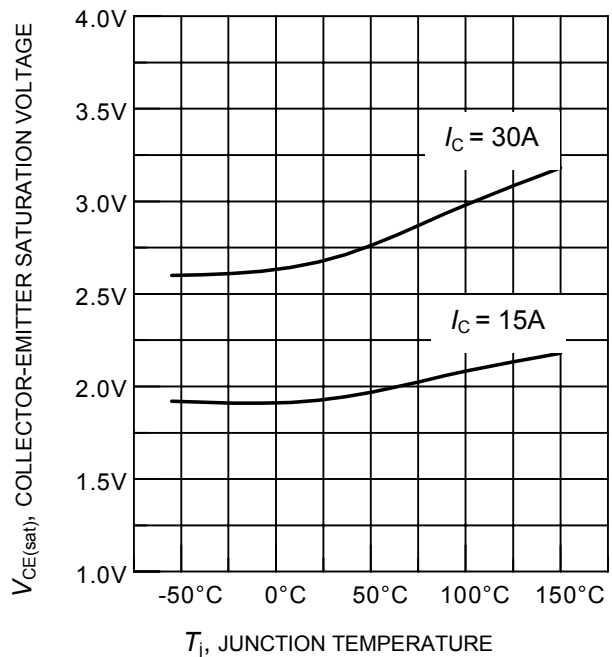
**Figure 5. Typical output characteristics**  
( $T_j = 25^\circ\text{C}$ )



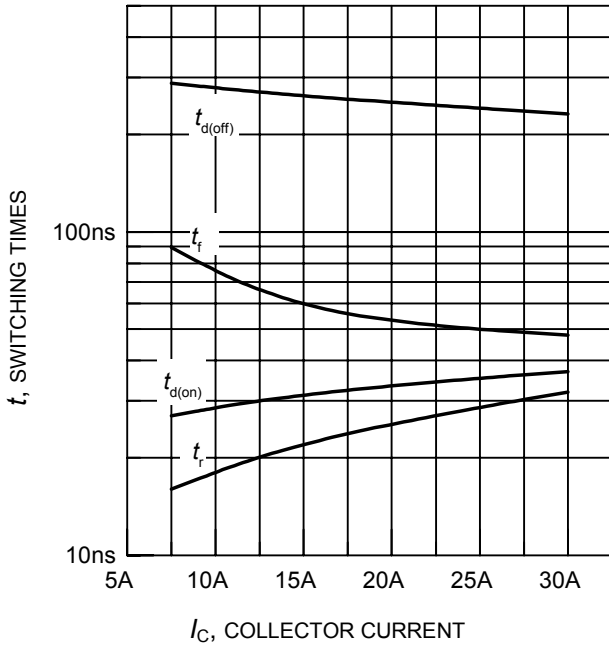
**Figure 6. Typical output characteristics**  
( $T_j = 150^\circ\text{C}$ )



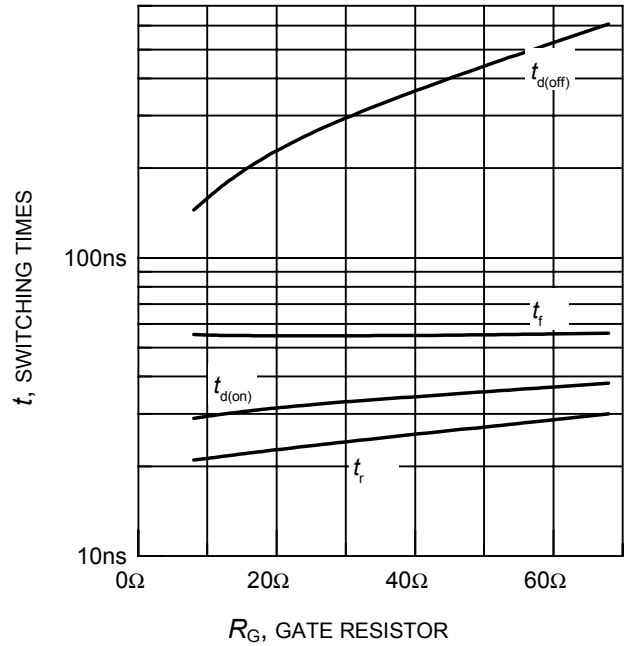
**Figure 7. Typical transfer characteristics**  
( $V_{CE} = 10\text{V}$ )



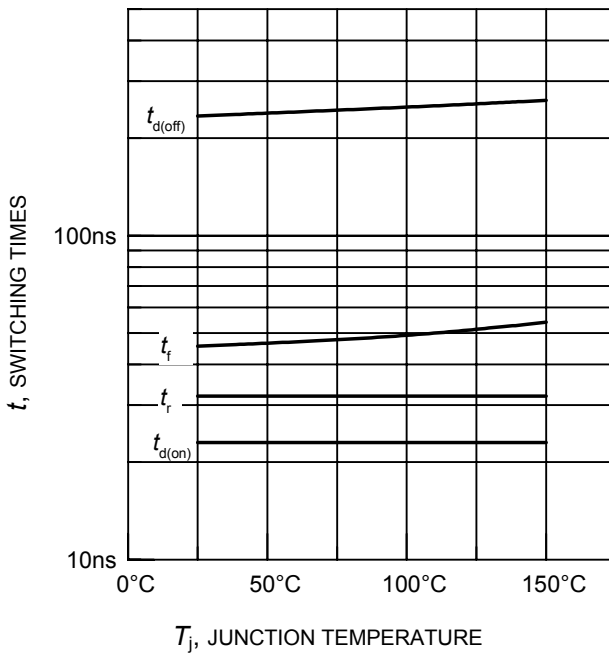
**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE} = 15\text{V}$ )



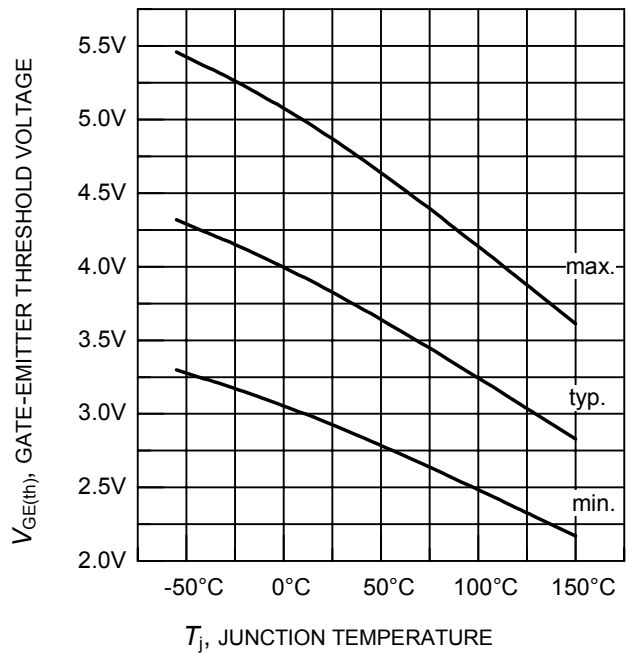
**Figure 9. Typical switching times as a function of collector current**  
 (inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/+15\text{V}$ ,  $R_G = 21\Omega$ ,  
 $I_C = 15\text{A}$ ,  $R_G = 21\Omega$ ,  
 Dynamic test circuit in Figure E)



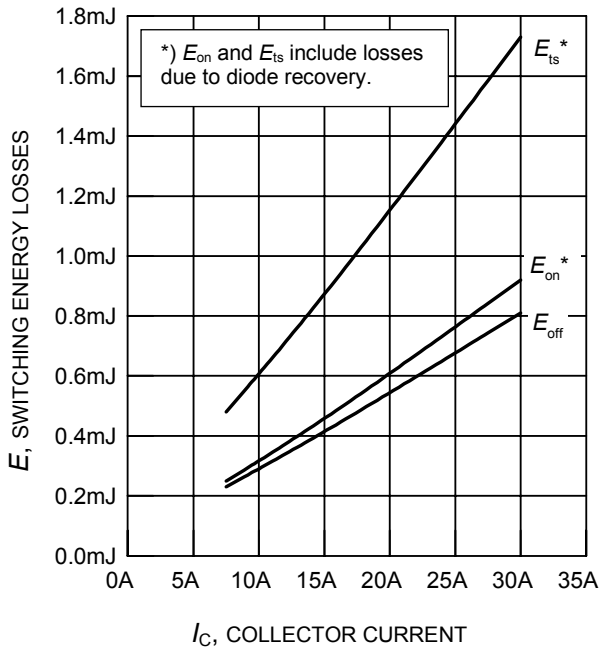
**Figure 10. Typical switching times as a function of gate resistor**  
 (inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/+15\text{V}$ ,  $I_C = 15\text{A}$ ,  
 $V_{GE} = 0/+15\text{V}$ ,  $I_C = 15\text{A}$ ,  
 Dynamic test circuit in Figure E)



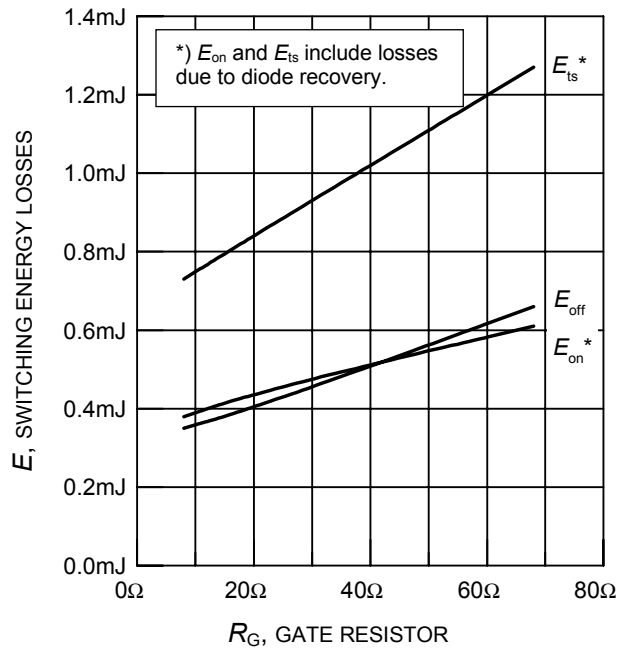
**Figure 11. Typical switching times as a function of junction temperature**  
 (inductive load,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/+15\text{V}$ ,  
 $I_C = 15\text{A}$ ,  $R_G = 21\Omega$ ,  
 Dynamic test circuit in Figure E)



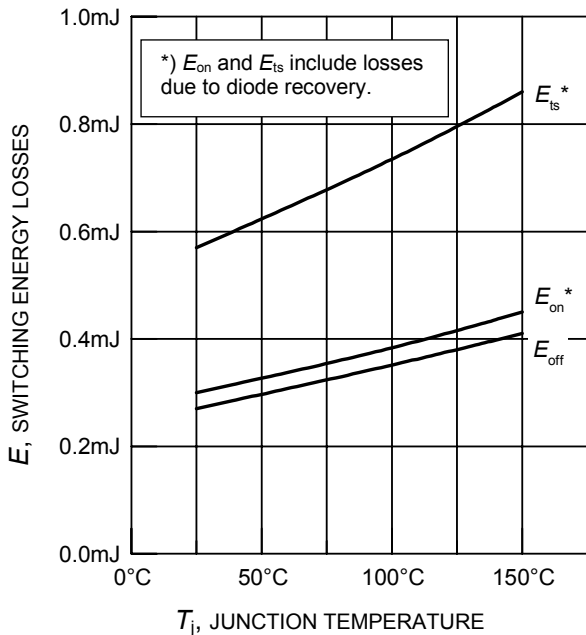
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
 ( $I_C = 0.4\text{mA}$ )



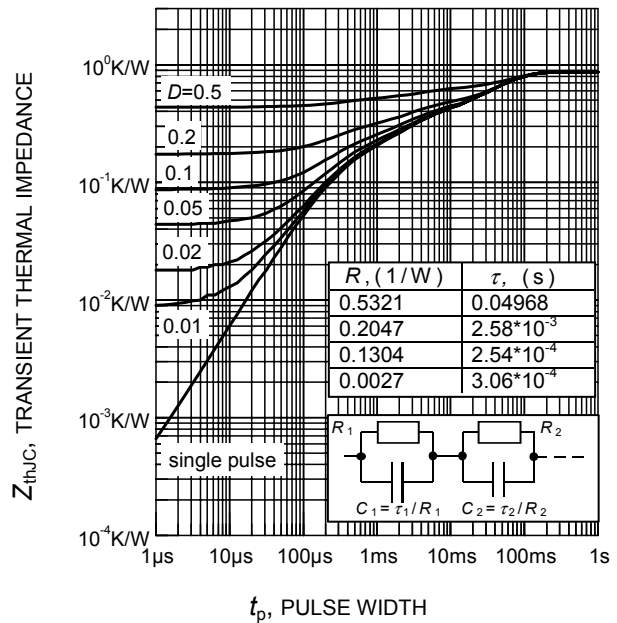
**Figure 13. Typical switching energy losses as a function of collector current**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/+15\text{V}$ ,  $R_G = 21\Omega$ , Dynamic test circuit in Figure E)



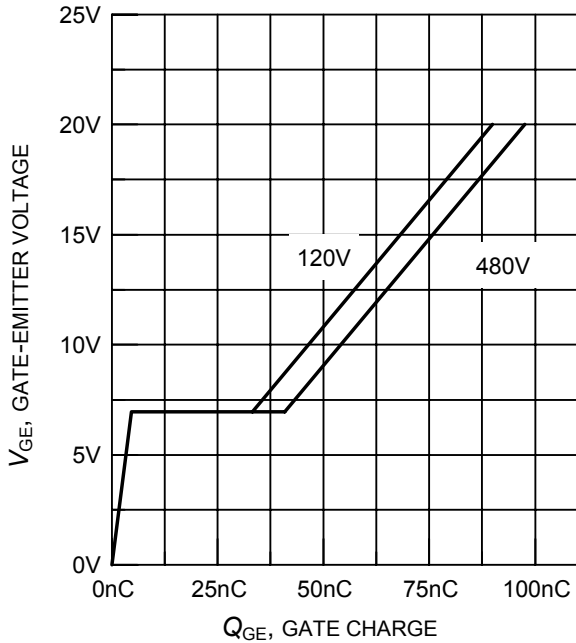
**Figure 14. Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/+15\text{V}$ ,  $I_C = 15\text{A}$ , Dynamic test circuit in Figure E)



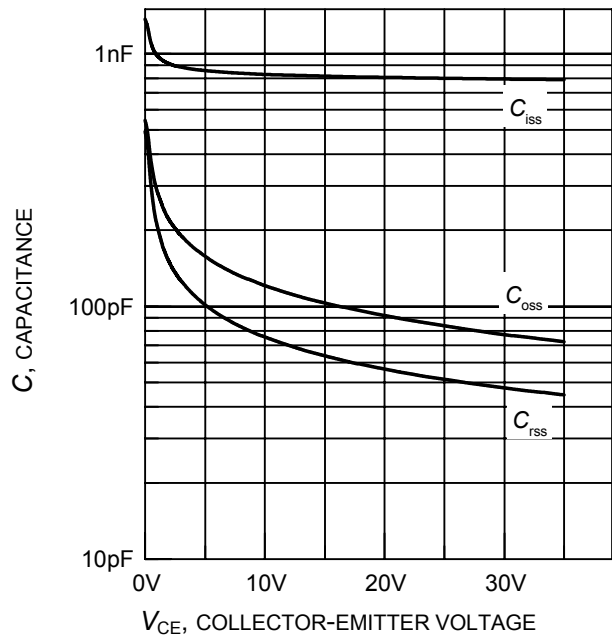
**Figure 15. Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/+15\text{V}$ ,  $I_C = 15\text{A}$ ,  $R_G = 21\Omega$ , Dynamic test circuit in Figure E)



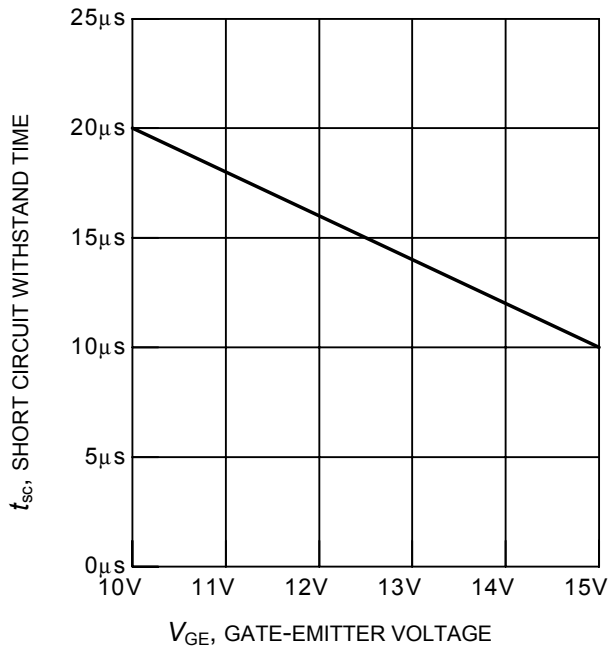
**Figure 16. IGBT transient thermal impedance as a function of pulse width**  
( $D = t_p / T$ )



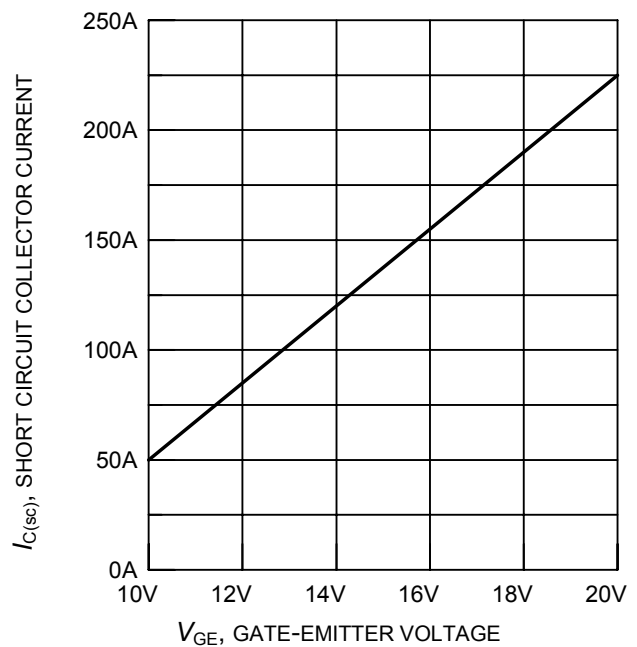
**Figure 17. Typical gate charge**  
( $I_C = 15A$ )



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



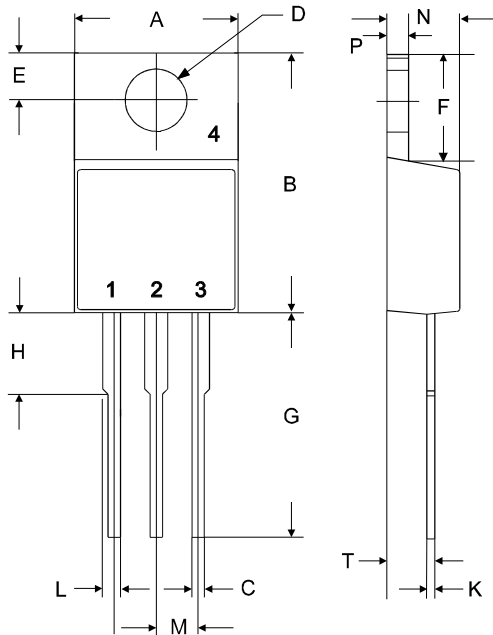
**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE} = 600V$ , start at  $T_j = 25^\circ C$ )



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

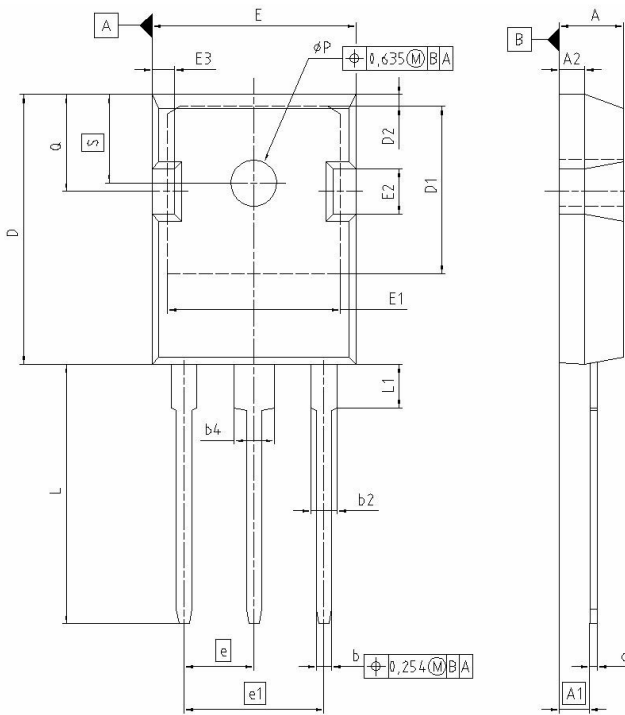


PG-TO220-3-1

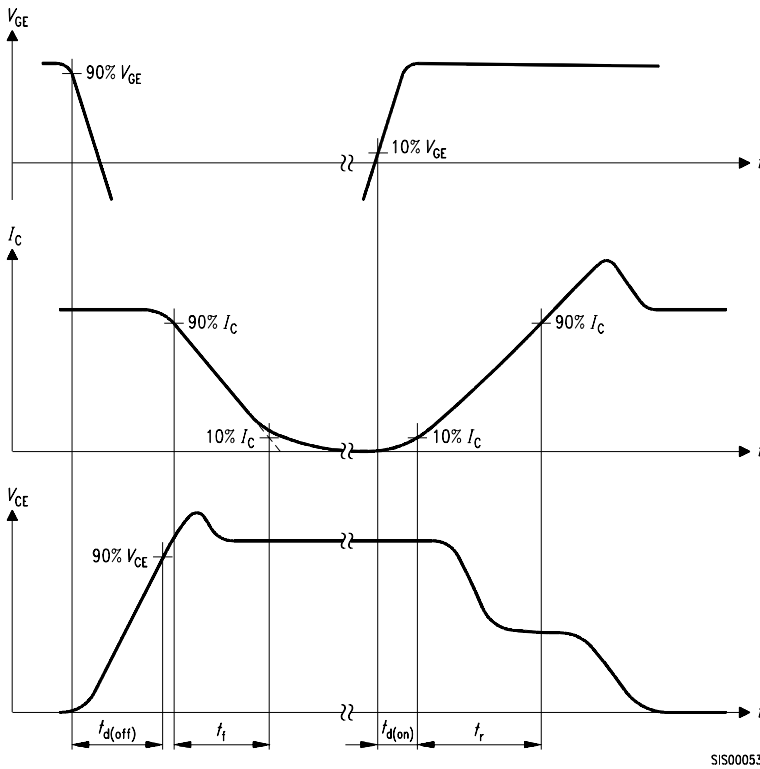


symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.70	10.30	0.3819	0.4055
B	14.88	15.95	0.5858	0.6280
C	0.65	0.86	0.0256	0.0339
D	3.55	3.89	0.1398	0.1531
E	2.60	3.00	0.1024	0.1181
F	6.00	6.80	0.2362	0.2677
G	13.00	14.00	0.5118	0.5512
H	4.35	4.75	0.1713	0.1870
K	0.38	0.65	0.0150	0.0256
L	0.95	1.32	0.0374	0.0520
M	2.54 typ.		0.1 typ.	
N	4.30	4.50	0.1693	0.1772
P	1.17	1.40	0.0461	0.0551
T	2.30	2.72	0.0906	0.1071

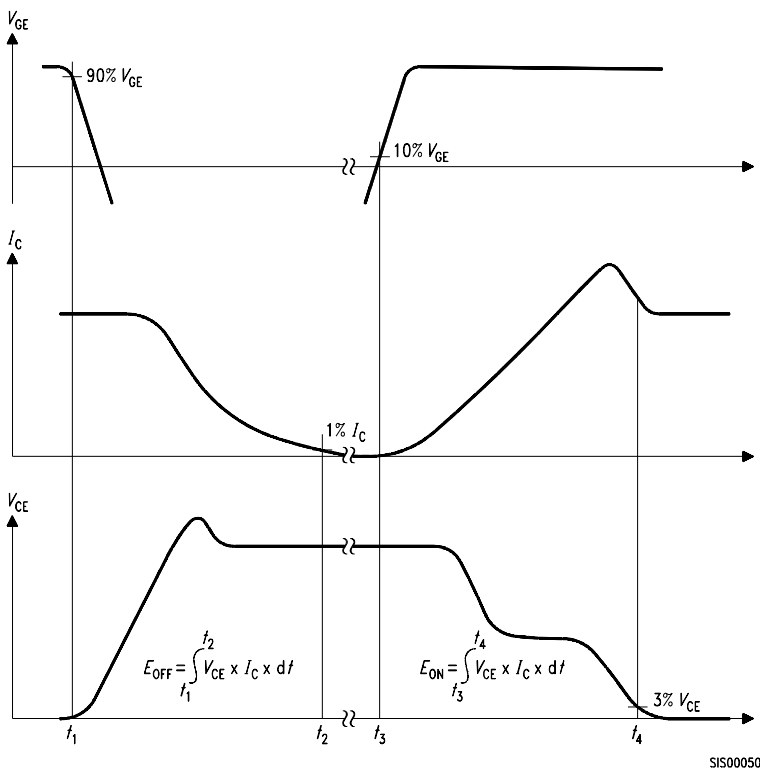
PG-TO247-3-21



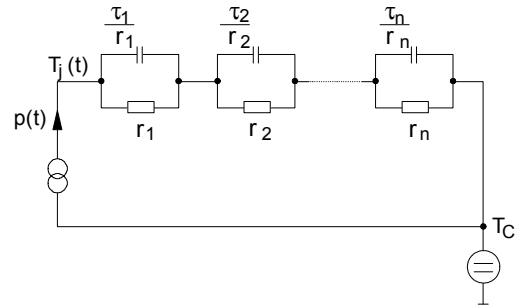
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.903	5.157	0.193	0.203
A1	2.273	2.527	0.092	0.096
A2	1.853	2.107	0.075	0.081
b	1.073	1.327	0.047	0.052
b2	1.903	2.386	0.075	0.094
b4	2.870	3.454	0.113	0.136
c	0.549	0.752	0.024	0.030
D	20.823	21.077	0.820	0.830
D1	17.323	17.831	0.682	0.702
D2	1.063	1.317	0.042	0.052
E	15.773	16.027	0.621	0.631
E1	13.893	14.147	0.547	0.557
E2	3.883	3.937	0.145	0.155
E3	1.883	1.937	0.068	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
φP	3.559	3.661	0.140	0.144
Q	5.493	5.747	0.216	0.226
S	6.043	6.297	0.238	0.248



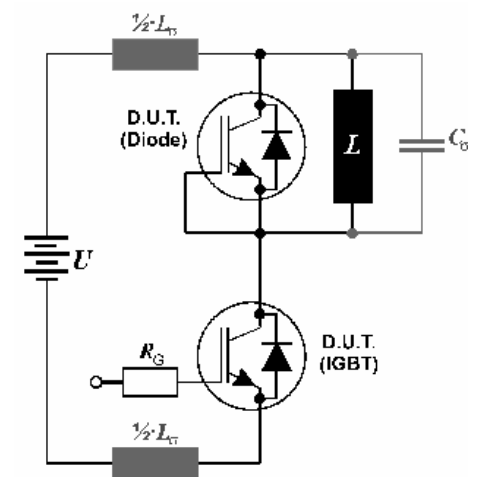
**Figure A. Definition of switching times**



**Figure B. Definition of switching losses**



**Figure D. Thermal equivalent circuit**



**Figure E. Dynamic test circuit**  
Leakage inductance  $L_{\sigma} = 180\text{nH}$   
and Stray capacity  $C_{\sigma} = 250\text{pF}$ .

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