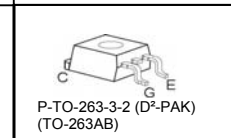
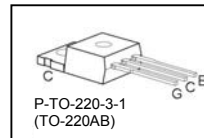
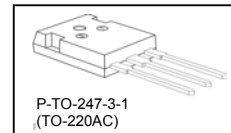
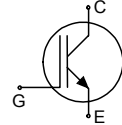


## Low Loss IGBT in Trench and Fieldstop technology

- Very low  $V_{CE(sat)}$  1.5 V (typ.)
- Maximum Junction Temperature 175 °C
- Short circuit withstand time – 5 $\mu$ s
- Designed for :
  - Frequency Converters
  - Uninterrupted Power Supply
- Trench and Fieldstop technology for 600 V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - very high switching speed
  - low  $V_{CE(sat)}$
- Positive temperature coefficient in  $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



Type	$V_{CE}$	$I_C$	$V_{CE(sat), T_j=25^\circ C}$	$T_{j,max}$	Marking Code	Package	Ordering Code
IGP50N60T	600 V	50 A	1.5 V	175 °C	G50T60	TO-220	Q67040S4723
IGB50N60T	600 V	50 A	1.5 V	175 °C	G50T60	TO-263	Q67040S4721
IGW50N60T	600 V	50 A	1.5 V	175 °C	G50T60	TO-247	Q67040S4725

### Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CE}$	600	V
DC collector current, limited by $T_{jmax}$	$I_C$		A
$T_C = 25^\circ C$		100	
$T_C = 100^\circ C$		50	
Pulsed collector current, $t_p$ limited by $T_{jmax}$	$I_{Cpuls}$	150	
Turn off safe operating area ( $V_{CE} \leq 600V, T_j \leq 175^\circ C$ )	-	150	
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Short circuit withstand time <sup>1)</sup>	$t_{SC}$	5	$\mu s$
$V_{GE} = 15V, V_{CC} \leq 400V, T_j \leq 150^\circ C$			
Power dissipation $T_C = 25^\circ C$	$P_{tot}$	333	W
Operating junction temperature	$T_j$	-40...+175	$^\circ C$
Storage temperature	$T_{stg}$	-55...+175	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

<sup>1)</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	$R_{thJC}$		0.45	K/W
Thermal resistance, junction – ambient	$R_{thJA}$	TO-220-3-1	62	
		TO-247-3-1	40	
		TO-263-3-2 (6cm <sup>2</sup> Cu)	40	

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

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
<b>Static Characteristic</b>						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0\text{V}, I_C=0.2\text{mA}$	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{V}, I_C=50\text{A}$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$	-	1.5	2.0	
			-	1.9	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=0.8\text{mA}, V_{CE}=V_{GE}$	4.1	4.9	5.7	
Zero gate voltage collector current	$I_{CES}$	$V_{CE}=600\text{V},$ $V_{GE}=0\text{V}$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$	-	-	40	$\mu\text{A}$
			-	-	1000	
Gate-emitter leakage current	$I_{GES}$	$V_{CE}=0\text{V}, V_{GE}=20\text{V}$	-	-	100	nA
Transconductance	$g_{fs}$	$V_{CE}=20\text{V}, I_C=50\text{A}$	-	31	-	S
Integrated gate resistor	$R_{Gint}$			-		$\Omega$

### Dynamic Characteristic

Input capacitance	$C_{iss}$	$V_{CE}=25\text{V},$ $V_{GE}=0\text{V},$ $f=1\text{MHz}$	-	3140	-	pF
Output capacitance	$C_{oss}$		-	200	-	
Reverse transfer capacitance	$C_{riss}$		-	93	-	
Gate charge	$Q_{Gate}$	$V_{CC}=480\text{V}, I_C=50\text{A}$ $V_{GE}=15\text{V}$	-	310	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	$L_E$	TO-247-3-1	-	7	-	nH
Short circuit collector current <sup>1)</sup>	$I_{C(SC)}$	$V_{GE}=15\text{V}, t_{SC}\leq 5\mu\text{s}$ $V_{CC}=400\text{V},$ $T_j\leq 150^\circ\text{C}$	-	458.3	-	A

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

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

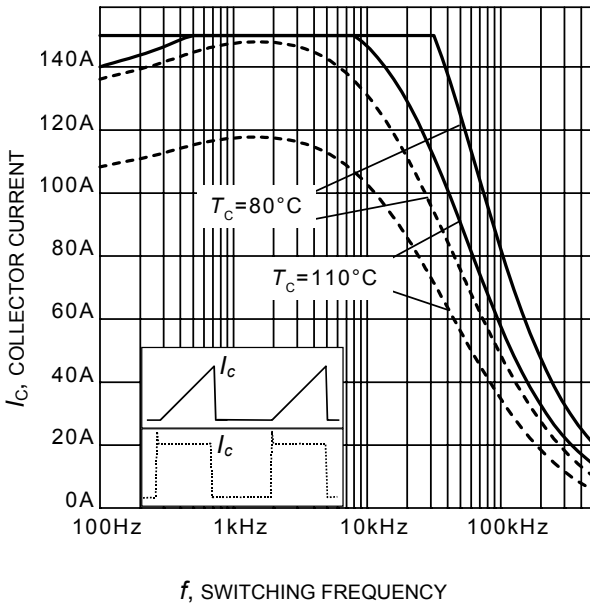
Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(on)}$	$T_j=25^\circ\text{C}$ , $V_{CC}=400\text{V}$ , $I_C=50\text{A}$ , $V_{GE}=0/15\text{V}$ , $R_G=7\ \Omega$ , $L_\sigma^{1)}$ = 103nH, $C_\sigma^{1)}$ = 39pF Energy losses include "tail" and diode reverse recovery. <sup>2)</sup>	-	26	-	ns
Rise time	$t_r$		-	29	-	
Turn-off delay time	$t_{d(off)}$		-	299	-	
Fall time	$t_f$		-	29	-	
Turn-on energy	$E_{on}$		-	1.2	-	mJ
Turn-off energy	$E_{off}$		-	1.4	-	
Total switching energy	$E_{ts}$		-	2.6	-	

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

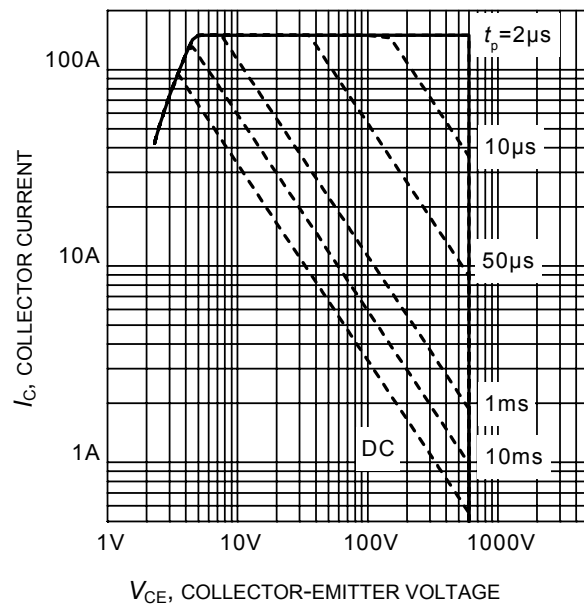
Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(on)}$	$T_j=175^\circ\text{C}$ , $V_{CC}=400\text{V}$ , $I_C=50\text{A}$ , $V_{GE}=0/15\text{V}$ , $R_G=7\ \Omega$ , $L_\sigma^{1)}$ = 103nH, $C_\sigma^{1)}$ = 39pF Energy losses include "tail" and diode reverse recovery. <sup>2)</sup>	-	27	-	ns
Rise time	$t_r$		-	33	-	
Turn-off delay time	$t_{d(off)}$		-	341	-	
Fall time	$t_f$		-	55	-	
Turn-on energy	$E_{on}$		-	1.8	-	mJ
Turn-off energy	$E_{off}$		-	1.8	-	
Total switching energy	$E_{ts}$		-	3.6	-	

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

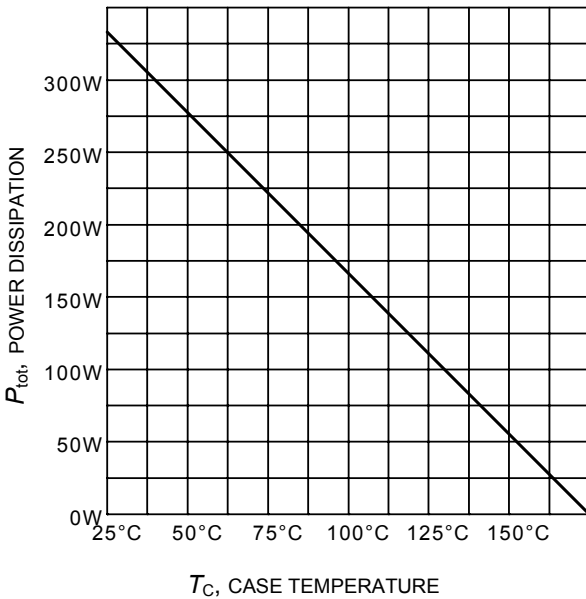
<sup>2)</sup> Includes Reverse Recovery Losses from IKW50N60T due to dynamic test circuit in Figure E.



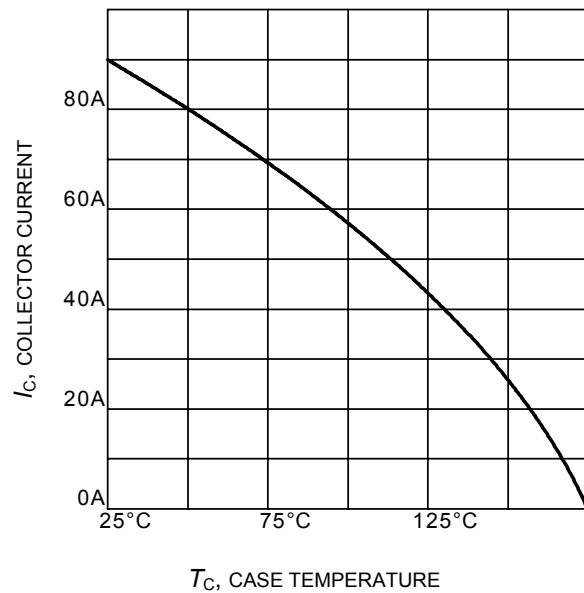
**Figure 1. Collector current as a function of switching frequency**  
 $(T_j \leq 175^\circ\text{C}, D = 0.5, V_{CE} = 400\text{V}, V_{GE} = 0/+15\text{V}, R_G = 7\Omega)$



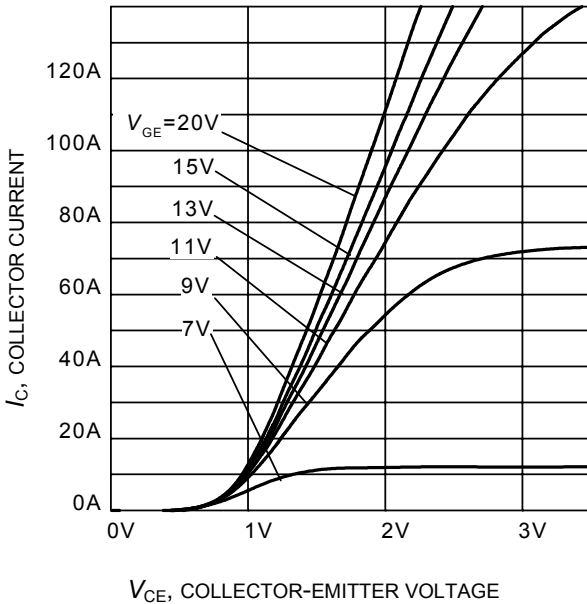
**Figure 2. Safe operating area**  
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 175^\circ\text{C}; V_{GE} = 15\text{V})$



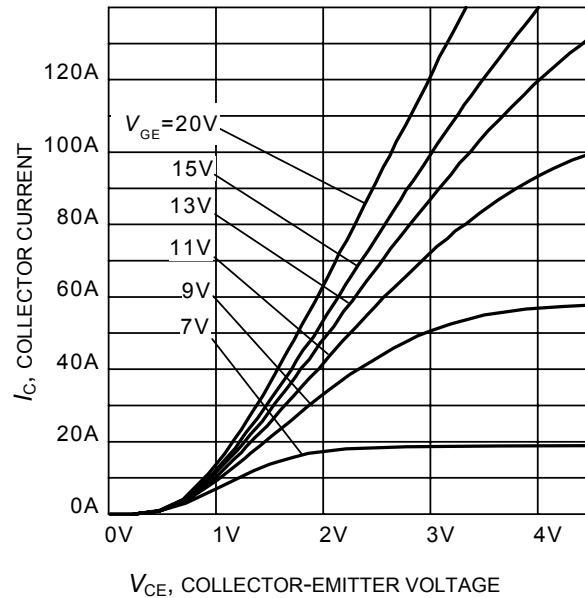
**Figure 3. Power dissipation as a function of case temperature**  
 $(T_j \leq 175^\circ\text{C})$



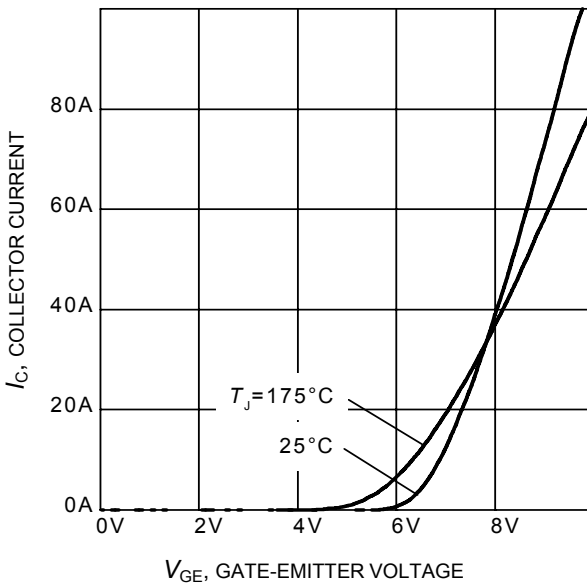
**Figure 4. Collector current as a function of case temperature**  
 $(V_{GE} \geq 15\text{V}, T_j \leq 175^\circ\text{C})$



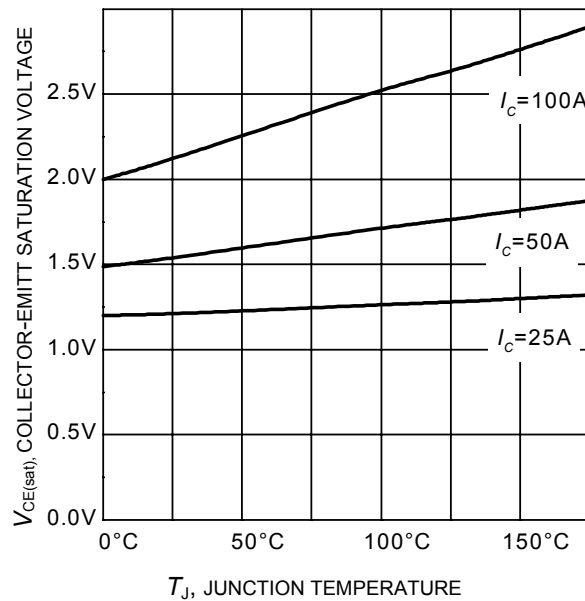
**Figure 5. Typical output characteristic**  
( $T_J = 25^\circ\text{C}$ )



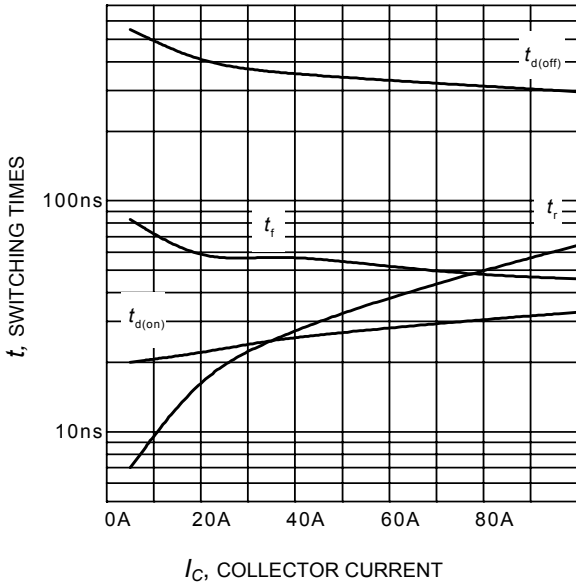
**Figure 6. Typical output characteristic**  
( $T_J = 175^\circ\text{C}$ )



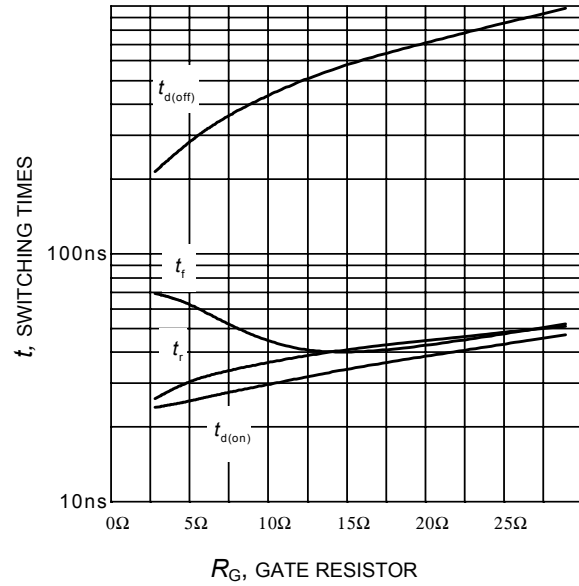
**Figure 7. Typical transfer characteristic**  
( $V_{CE} = 20\text{V}$ )



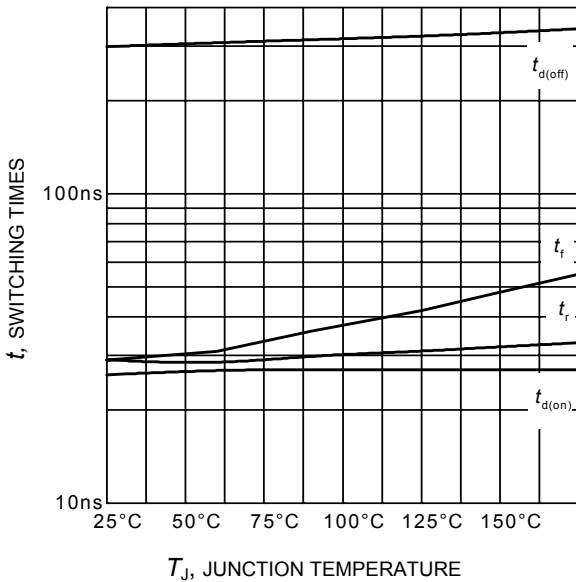
**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE} = 15\text{V}$ )



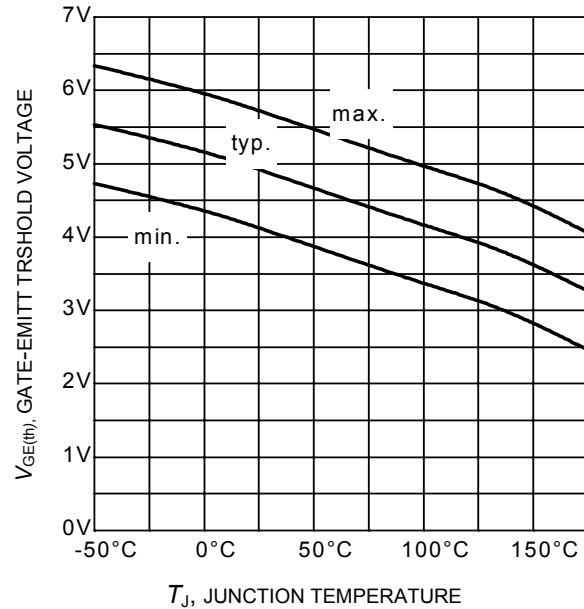
**Figure 9. Typical switching times as a function of collector current**  
(inductive load,  $T_J=175^\circ\text{C}$ ,  
 $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $R_G = 7\Omega$ ,  
Dynamic test circuit in Figure E)



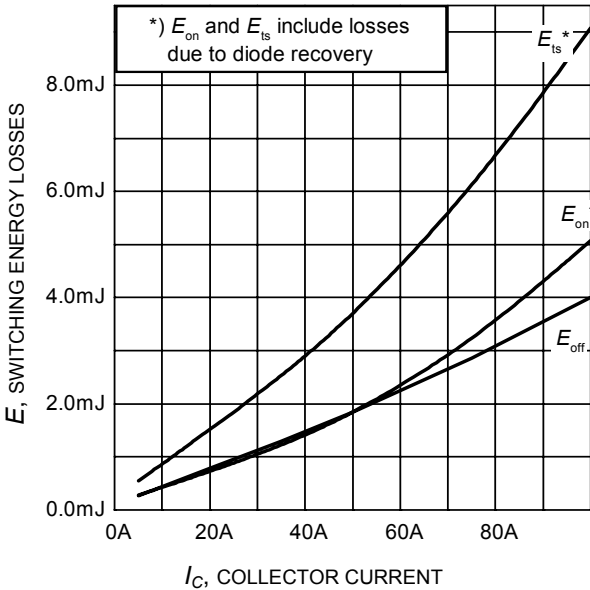
**Figure 10. Typical switching times as a function of gate resistor**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  
 $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 50\text{A}$ ,  
Dynamic test circuit in Figure E)



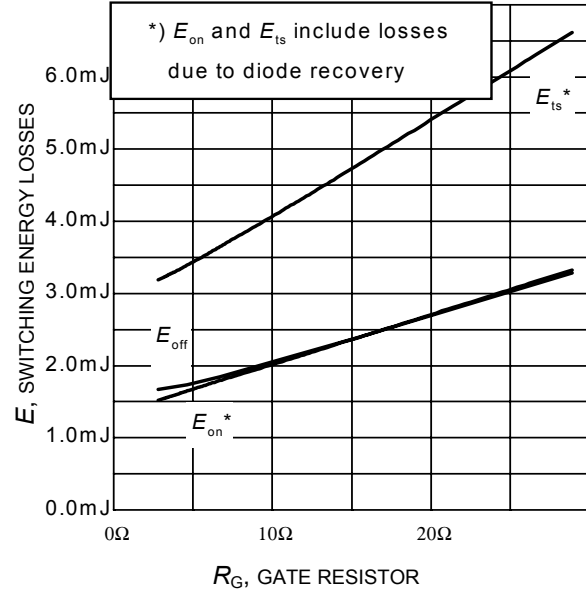
**Figure 11. Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE} = 400\text{V}$ ,  
 $V_{GE} = 0/15\text{V}$ ,  $I_C = 50\text{A}$ ,  $R_G = 7\Omega$ ,  
Dynamic test circuit in Figure E)



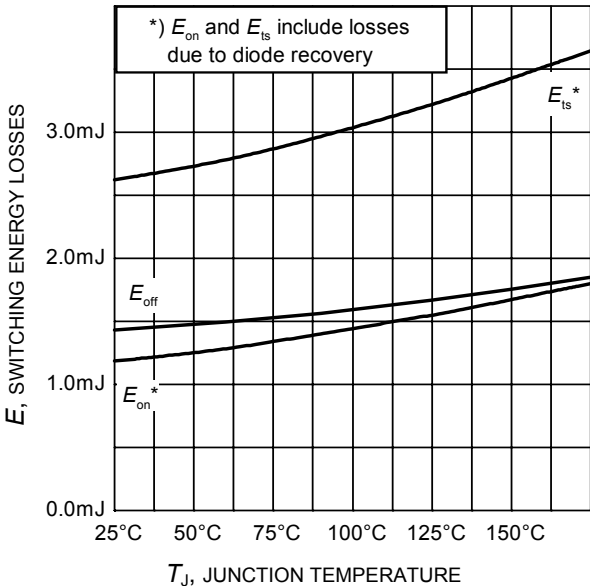
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C = 0.8\text{mA}$ )



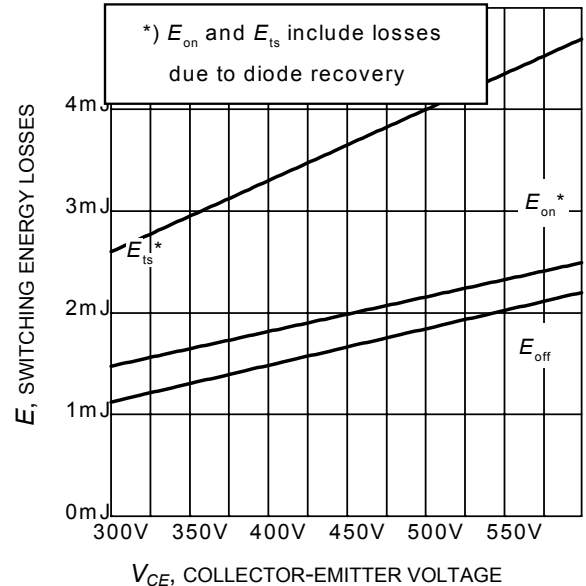
**Figure 13. Typical switching energy losses as a function of collector current**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $R_G = 7\Omega$ , Dynamic test circuit in Figure E)



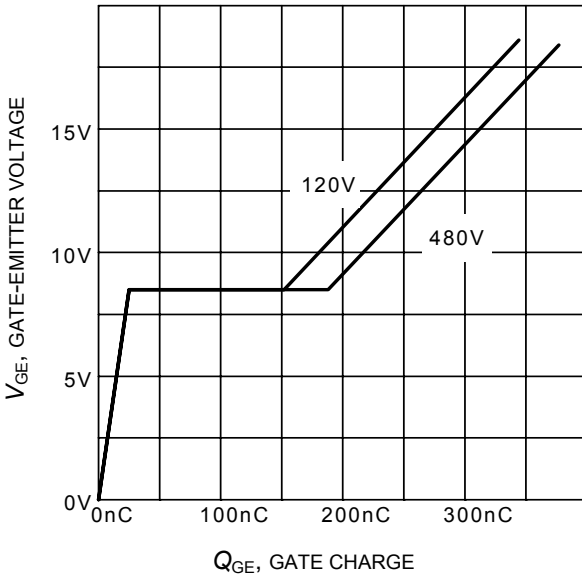
**Figure 14. Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 50\text{A}$ , Dynamic test circuit in Figure E)



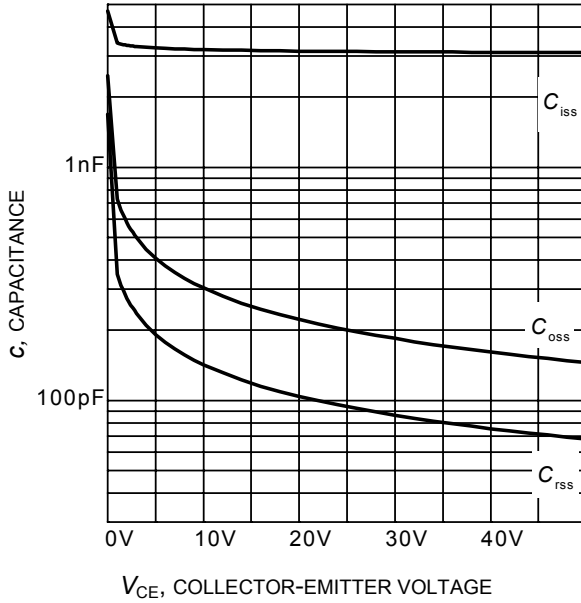
**Figure 15. Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 50\text{A}$ ,  $R_G = 7\Omega$ , Dynamic test circuit in Figure E)



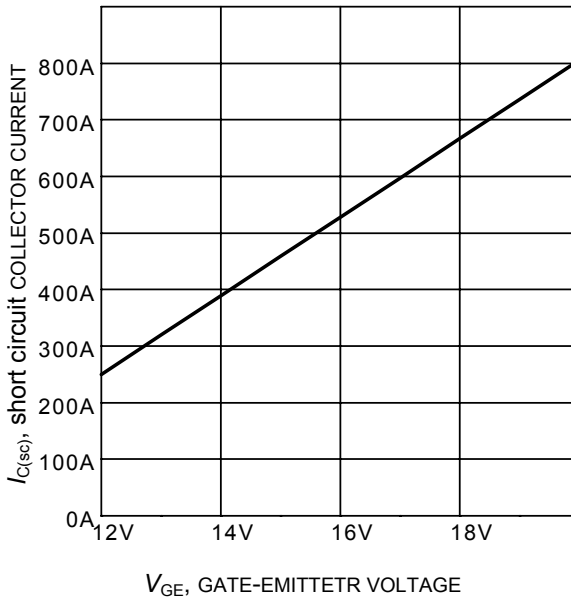
**Figure 16. Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 50\text{A}$ ,  $R_G = 7\Omega$ , Dynamic test circuit in Figure E)



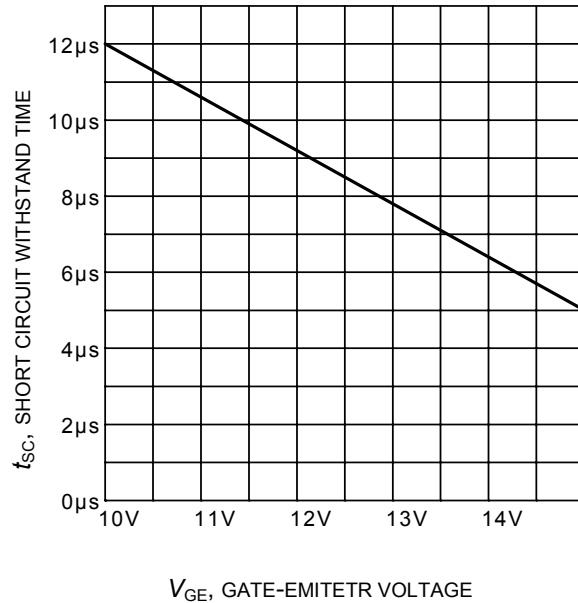
**Figure 17. Typical gate charge**  
( $I_C=50\text{ A}$ )



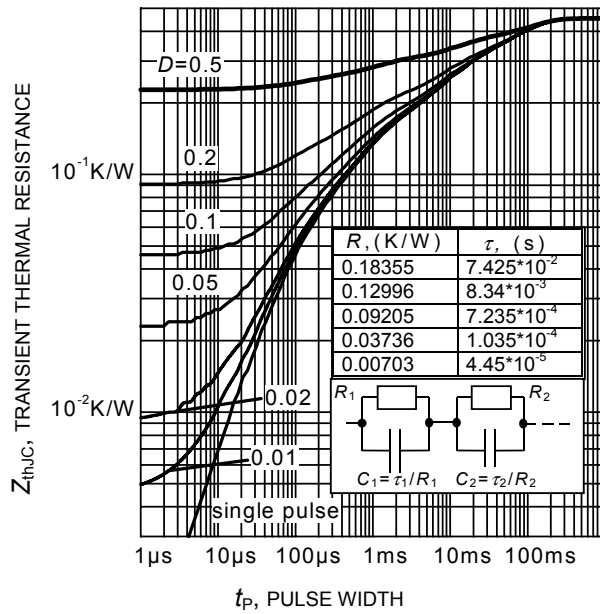
**Figure 18. Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0\text{V}$ ,  $f=1\text{ MHz}$ )



**Figure 19. Typical short circuit collector current as a function of gate-emitter voltage**  
( $V_{CE} \leq 400\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )

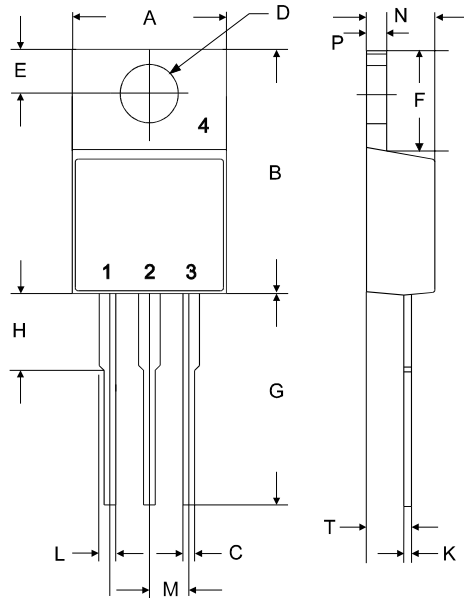


**Figure 20. Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE}=600\text{V}$ , start at  $T_j=25^\circ\text{C}$ ,  $T_{jmax}<150^\circ\text{C}$ )



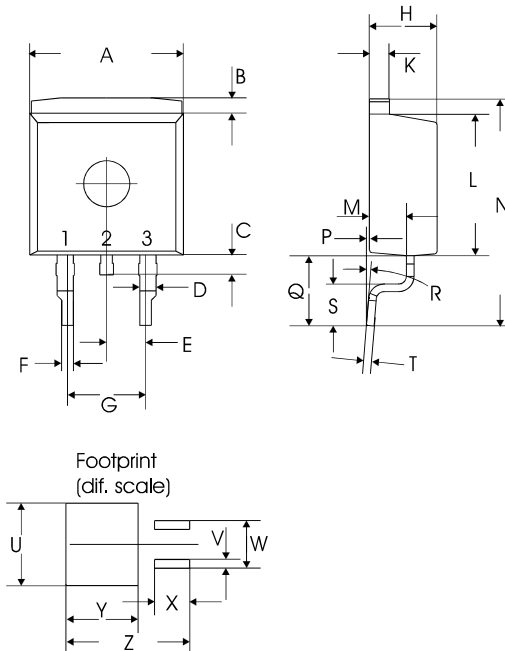
**Figure 21. IGBT transient thermal resistance**  
( $D = t_p / T$ )

TO-220AB

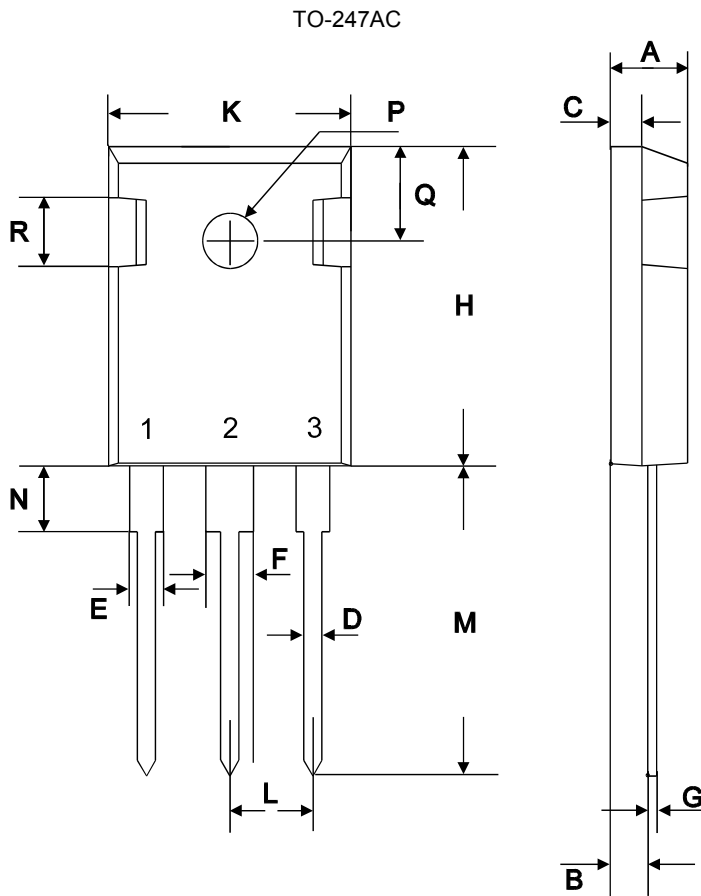


symbol	Dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.70	10.30	0.3819	0.4055
B	14.88	15.95	0.5858	0.6280
C	0.65	0.86	0.0256	0.0339
D	3.55	3.7	0.1398	0.1457
E	2.60	3.00	0.1024	0.1181
F	6.00	6.80	0.2362	0.2677
G	13.00	14.00	0.5118	0.5512
H	4.35	4.75	0.1713	0.1870
K	0.38	0.65	0.0150	0.0256
L	0.95	1.32	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

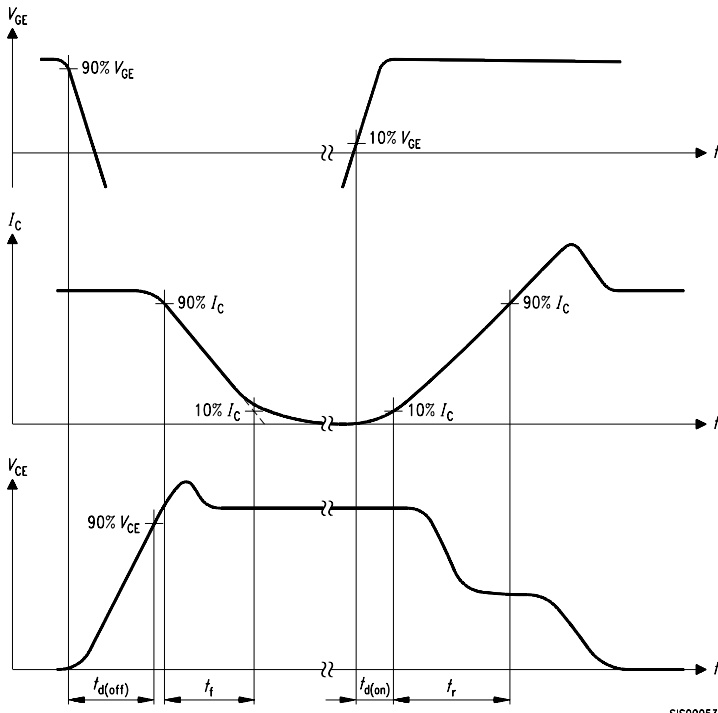
TO-263AB (D<sup>2</sup>Pak)



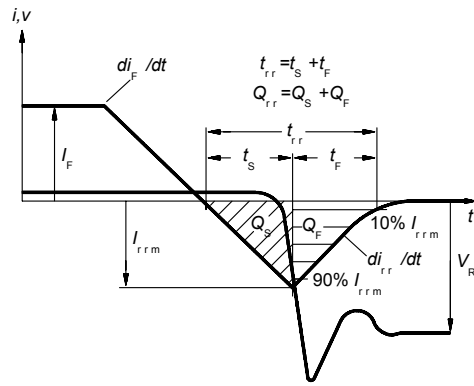
symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.80	10.20	0.3858	0.4016
B	0.70	1.30	0.0276	0.0512
C	1.00	1.60	0.0394	0.0630
D	1.03	1.07	0.0406	0.0421
E	2.54 typ.		0.1 typ.	
F	0.65	0.85	0.0256	0.0335
G	5.08 typ.		0.2 typ.	
H	4.30	4.50	0.1693	0.1772
K	1.17	1.37	0.0461	0.0539
L	9.05	9.45	0.3563	0.3720
M	2.30	2.50	0.0906	0.0984
N	15 typ.		0.5906 typ.	
P	0.00	0.20	0.0000	0.0079
Q	4.20	5.20	0.1654	0.2047
R	8° max		8° max	
S	2.40	3.00	0.0945	0.1181
T	0.40	0.60	0.0157	0.0236
U	10.80		0.4252	
V	1.15		0.0453	
W	6.23		0.2453	
X	4.60		0.1811	
Y	9.40		0.3701	
Z	16.15		0.6358	



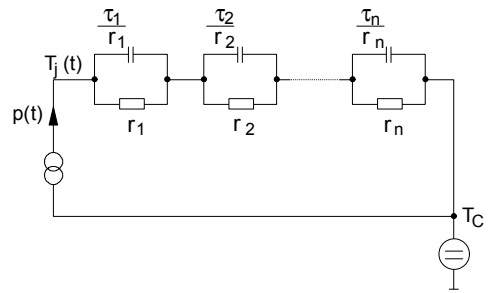
symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	4.78	5.28	0.1882	0.2079
B	2.29	2.51	0.0902	0.0988
C	1.78	2.29	0.0701	0.0902
D	1.09	1.32	0.0429	0.0520
E	1.73	2.06	0.0681	0.0811
F	2.67	3.18	0.1051	0.1252
G	0.76 max		0.0299 max	
H	20.80	21.16	0.8189	0.8331
K	15.65	16.15	0.6161	0.6358
L	5.21	5.72	0.2051	0.2252
M	19.81	20.68	0.7799	0.8142
N	3.560	4.930	0.1402	0.1941
ØP	3.61		0.1421	
Q	6.12	6.22	0.2409	0.2449



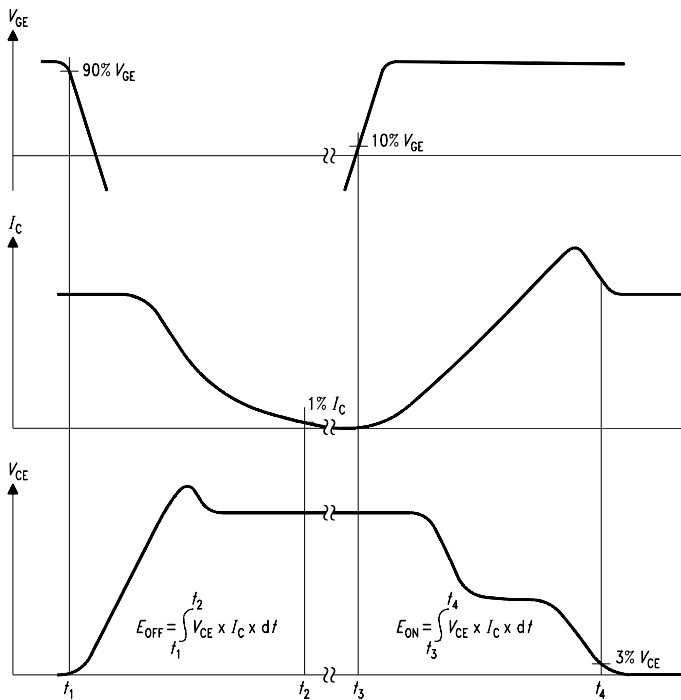
**Figure A. Definition of switching times**



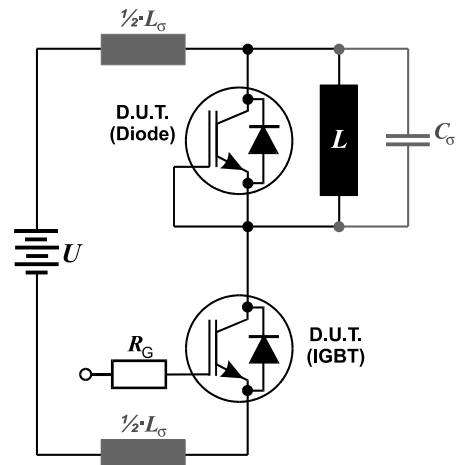
**Figure C. Definition of diodes switching characteristics**



**Figure D. Thermal equivalent circuit**



**Figure B. Definition of switching losses**



**Figure E. Dynamic test circuit**



# IGP50N60T, IGB50N60T TrenchStop Series IGW50N60T

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