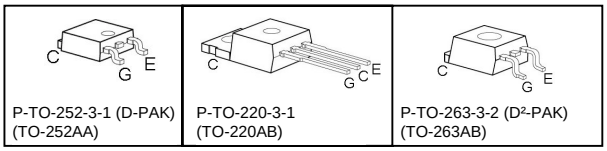
SGP02N60, SGB02N60 SGD02N60

Fast IGBT in NPT-technology

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



- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

Type	V_{CE}	I_C	$V_{CE(sat)}$	T_j	Package	Ordering Code
SGP02N60	600V	2A	2.2V	150°C	TO-220AB	Q67040-S4504
SGB02N60					TO-263AB	Q67040-S4505
SGD02N60					TO-252AA(DPAK)	Q67041-A4707

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	 6.0 2.9	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	12	
Turn off safe operating area $V_{CE} \le 600V$, $T_j \le 150°C$	-	12	
Gate-emitter voltage	V_{GE}	±20	V
Avalanche energy, single pulse I_C = 2 A, V_{CC} = 50 V, R_{GE} = 25 Ω, start at T_j = 25°C	E_{AS}	13	mJ
Short circuit withstand time[1)] V_{GE} = 15V, $V_{CC} \le 600V$, $T_j \le 150°C$	t_{SC}	10	µs
Power dissipation T_C = 25°C	P_{tot}	30	W
Operating junction and storage temperature	T_j , T_{stg}	-55...+150	°C

[1)] 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}		4.2	K/W
Thermal resistance, junction – ambient	R_{thJA}	TO-220AB	62	
SMD version, device on PCB[1)]	R_{thJA}	TO-252AA TO-263AB	50 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=2A T_j=25°C T_j=150°C	 1.7 -	 1.9 2.2	 2.4 2.7	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=150µA, 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	 - -	 - -	 20 250	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=2A	-	1.6	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE}=25V,	-	142	170	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	18	22	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	10	12	
Gate charge	Q_{Gate}	V_{CC}=480V, I_C=2A V_{GE}=15V	-	14	18	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	TO-220AB	-	7	-	nH
Short circuit collector current[2)]	$I_{C(SC)}$	V_{GE}=15V, t_{SC}≤10µs V_{CC} ≤ 600V, T_j ≤ 150°C	-	20	-	A

[1)] Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm^2 (one layer, 70µm thick) copper area for collector connection. PCB is vertical without blown air.
[2)] 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=2A, V_{GE}=0/15V, R_G=118Ω, L_σ [1)] =180nH, C_σ [1)] =180pF Energy losses include "tail" and diode reverse recovery.	-	20	24	ns
Rise time	t_r		-	13	16	
Turn-off delay time	$t_{d(off)}$		-	259	311	
Fall time	t_f		-	52	62	
Turn-on energy	E_{on}		-	0.036	0.041	mJ
Turn-off energy	E_{off}		-	0.028	0.036	
Total switching energy	E_{ts}		-	0.064	0.078	

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=2A, V_{GE}=0/15V, R_G=118Ω, L_σ [1)] =180nH, C_σ [1)] =180pF Energy losses include "tail" and diode reverse recovery.	-	20	24	ns
Rise time	t_r		-	14	17	
Turn-off delay time	$t_{d(off)}$		-	287	344	
Fall time	t_f		-	67	80	
Turn-on energy	E_{on}		-	0.054	0.062	mJ
Turn-off energy	E_{off}		-	0.043	0.056	
Total switching energy	E_{ts}		-	0.097	0.118	

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

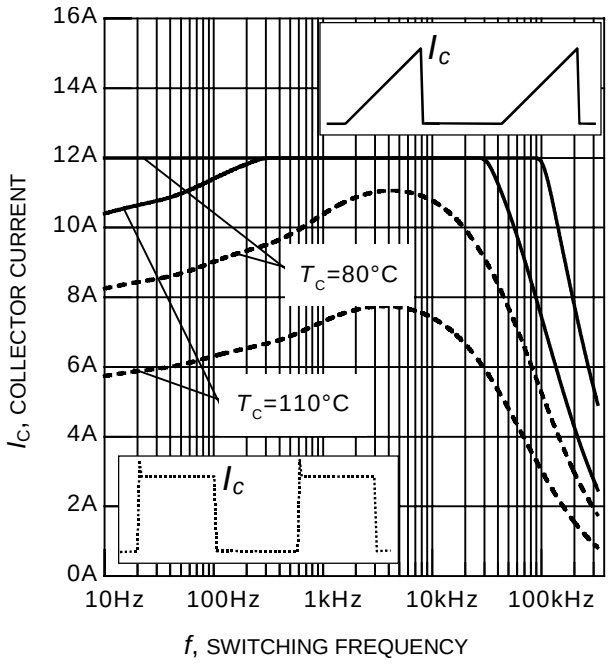


Figure 1. Collector current as a function of switching frequency
($T_j \le 150°C$, $D = 0.5$, $V_{CE} = 400V$, $V_{GE} = 0/+15V$, $R_G = 118\Omega$)

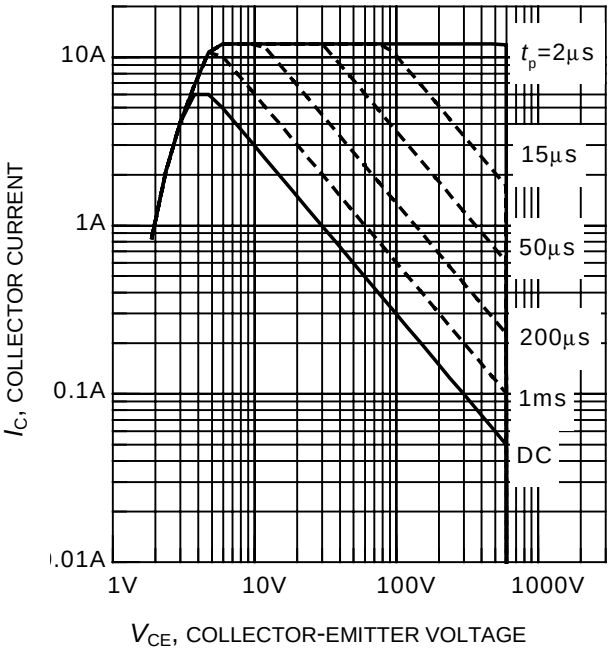


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \le 150°C$)

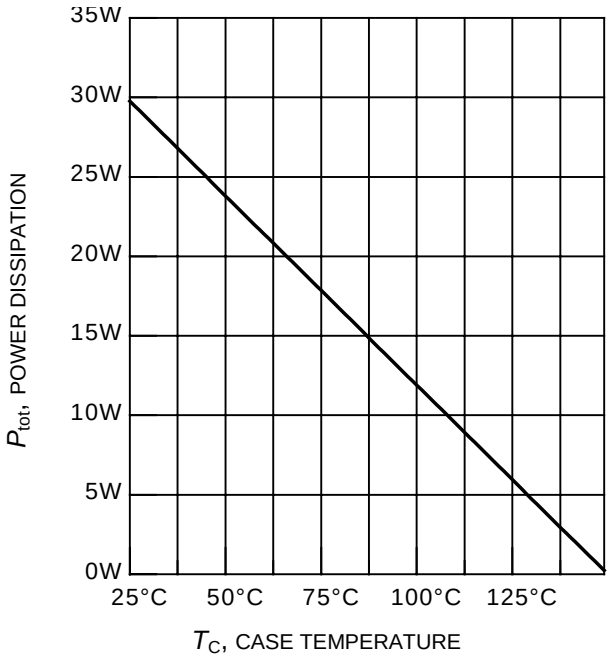


Figure 3. Power dissipation (IGBT) as a function of case temperature
($T_j \le 150°C$)

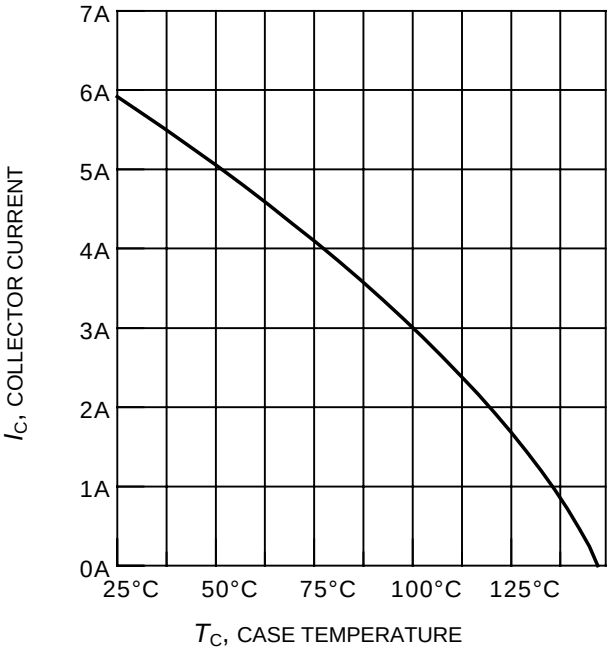


Figure 4. Collector current as a function of case temperature
($V_{GE} \le 15V$, $T_j \le 150°C$)

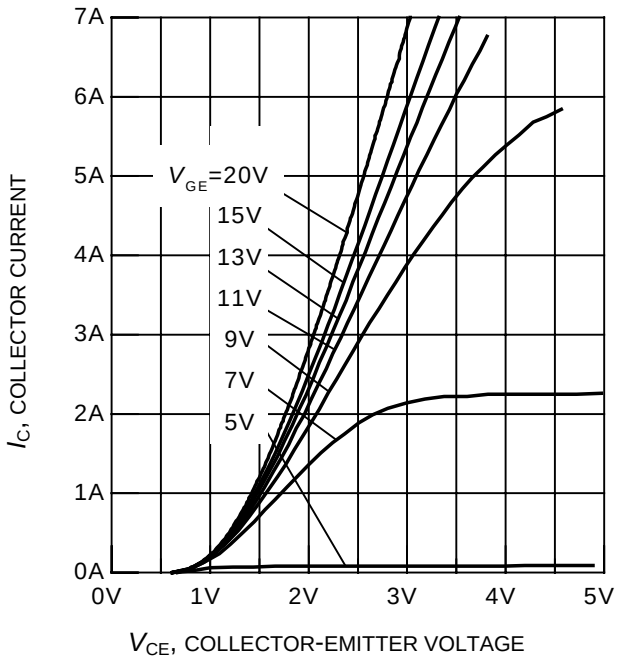


Figure 5. Typical output characteristics
(T_j = 25°C)

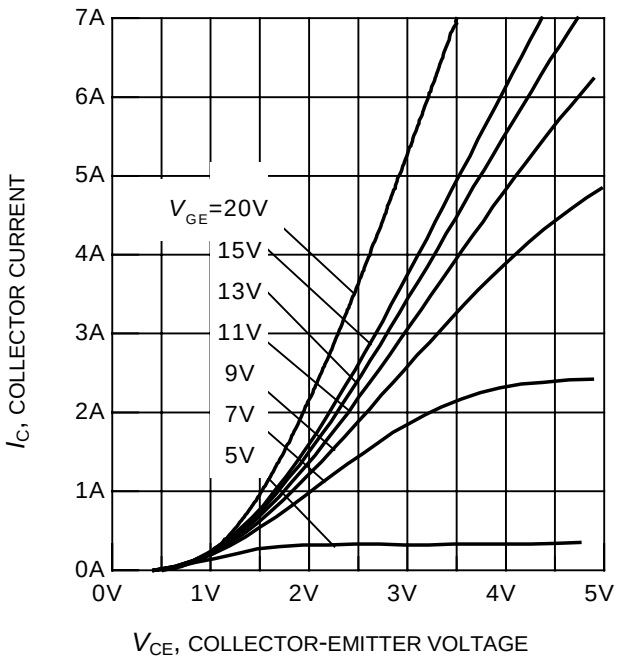


Figure 6. Typical output characteristics
(T_j = 150°C)

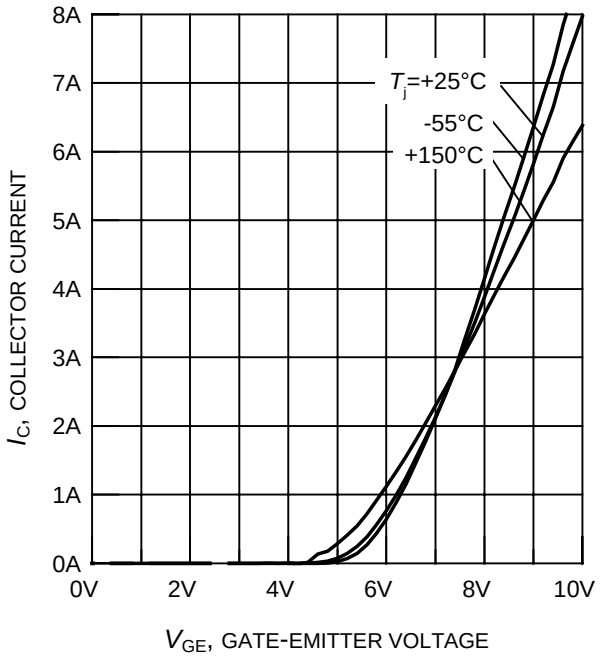


Figure 7. Typical transfer characteristics
(V_{CE} = 10V)

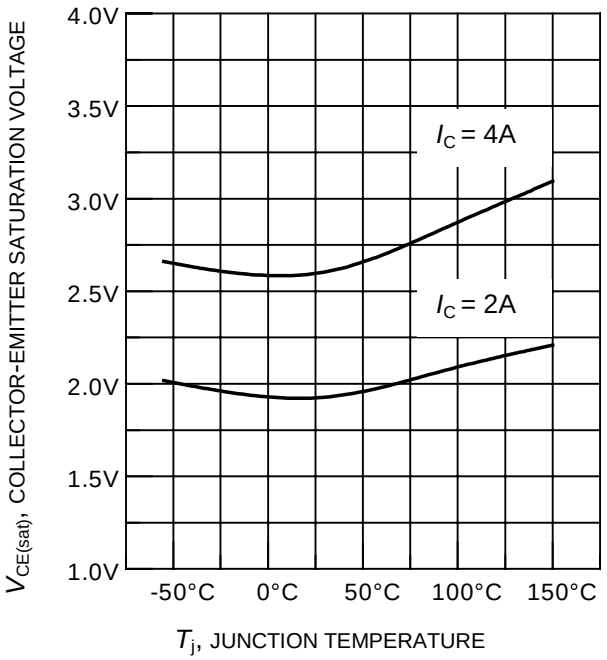


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

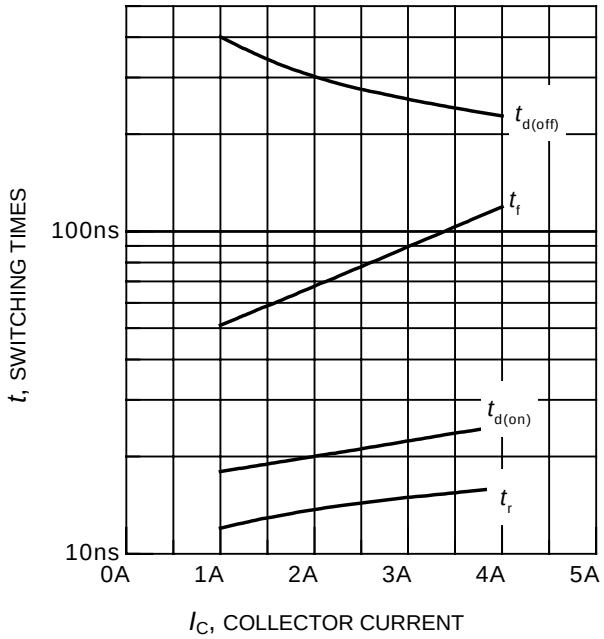


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j = 150°C, V_{CE} = 400V, V_{GE} = 0/+15V, R_G = 118Ω, Dynamic test circuit in Figure E)

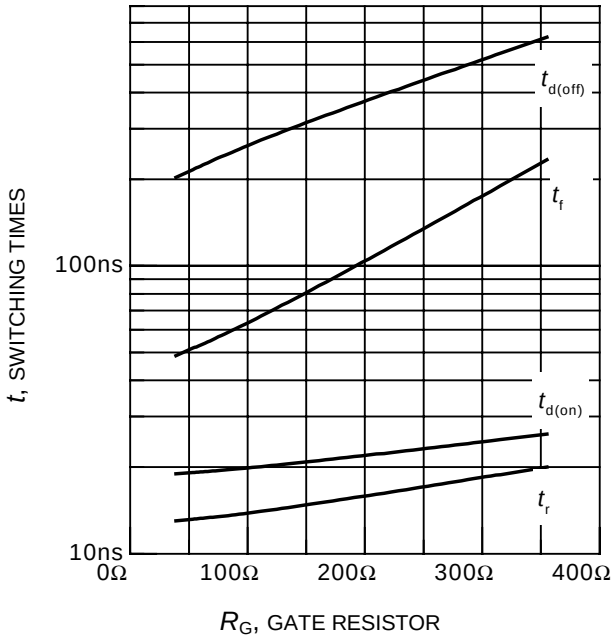


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j = 150°C, V_{CE} = 400V, V_{GE} = 0/+15V, I_C = 2A, Dynamic test circuit in Figure E)

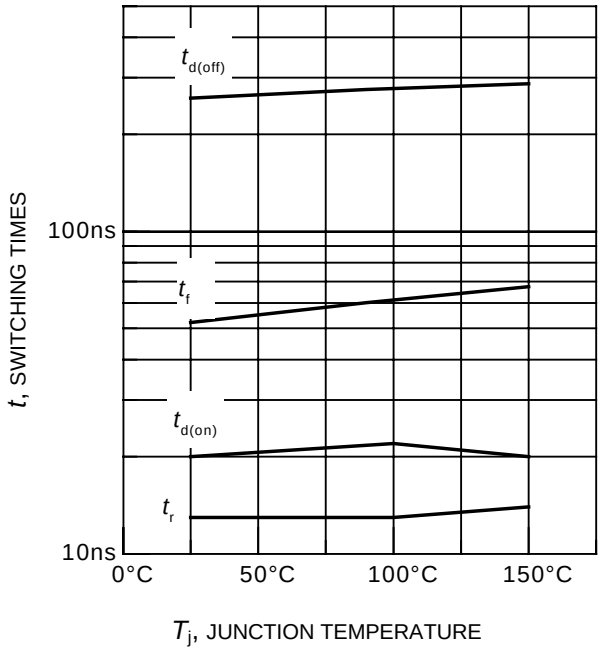


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/+15V, I_C = 2A, R_G = 118Ω, Dynamic test circuit in Figure E)

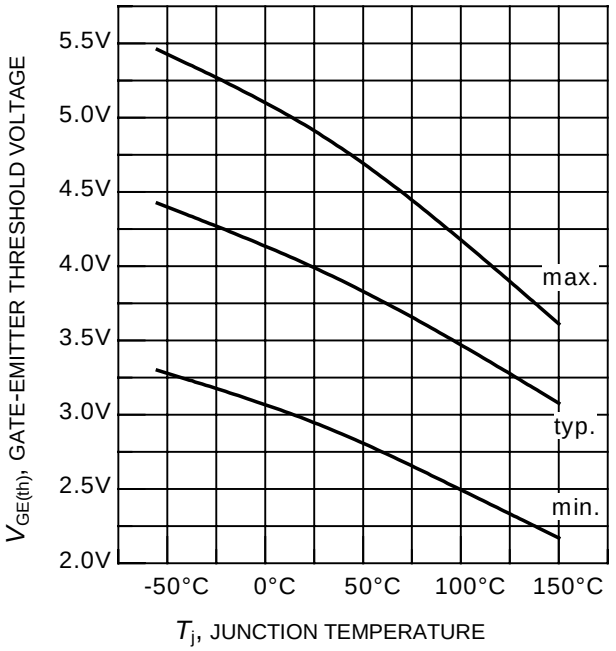


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.15mA)

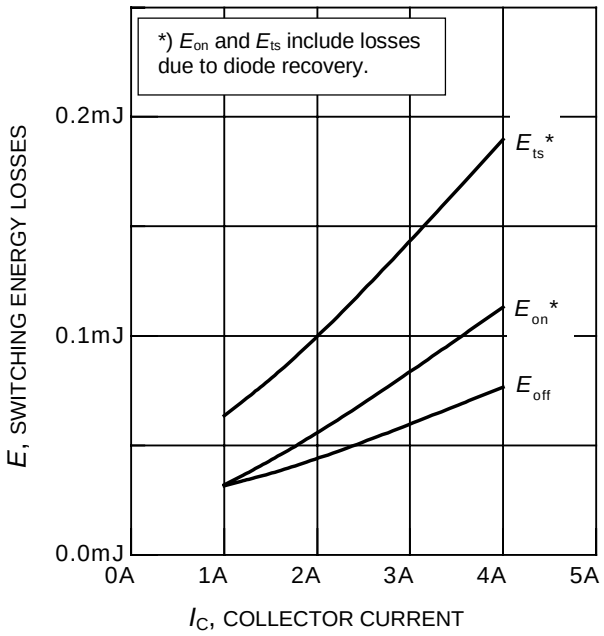


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j = 150°C, V_{CE} = 400V, V_{GE} = 0/+15V, R_G = 118Ω, Dynamic test circuit in Figure E)

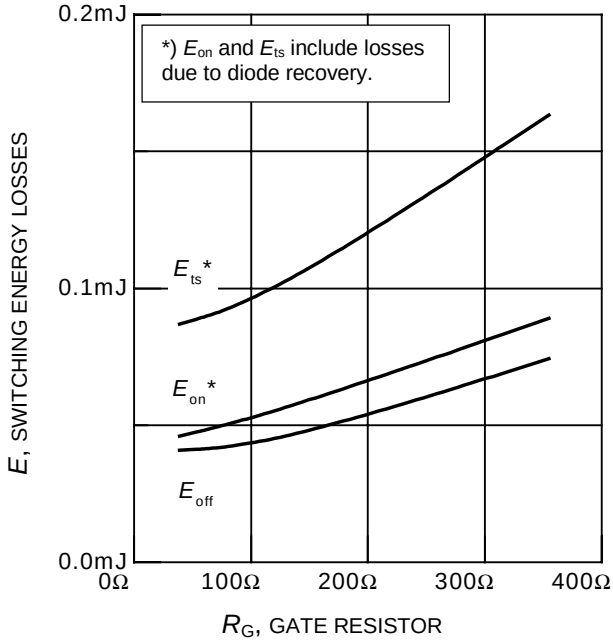


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j = 150°C, V_{CE} = 400V, V_{GE} = 0/+15V, I_C = 2A, Dynamic test circuit in Figure E)

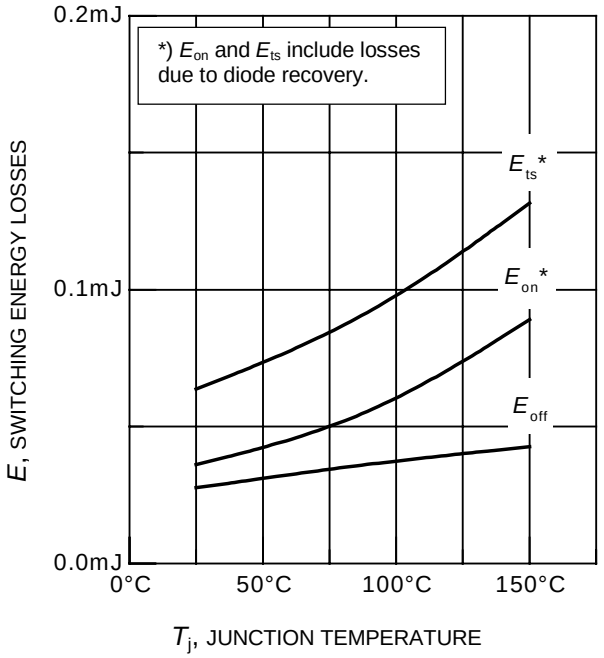


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/+15V, I_C = 2A, R_G = 118Ω, Dynamic test circuit in Figure E)

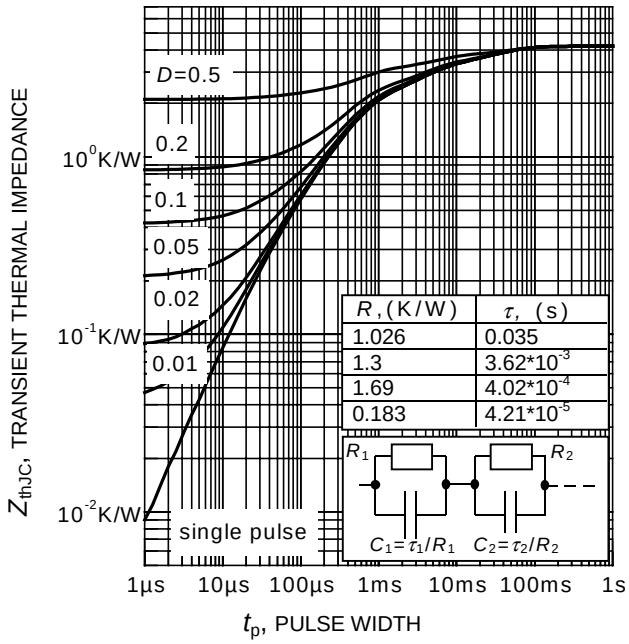


Figure 16. IGBT transient thermal impedance as a function of pulse width
($D = t_p / T$)

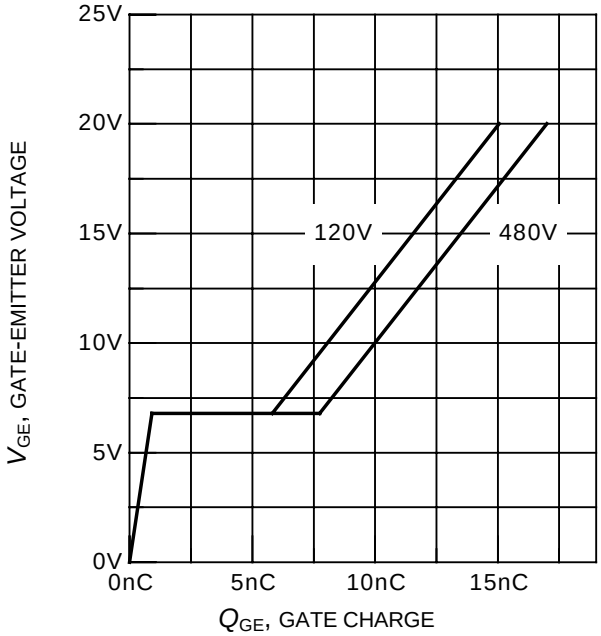


Figure 17. Typical gate charge
(I_C = 2A)

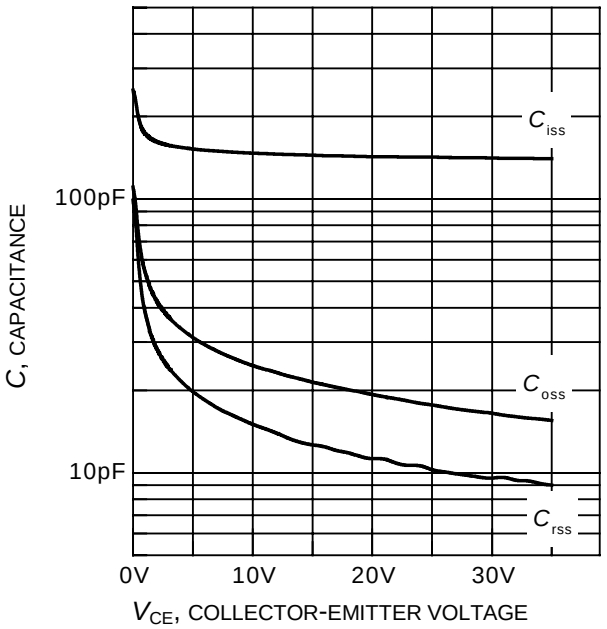


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE} = 0V, f = 1MHz)

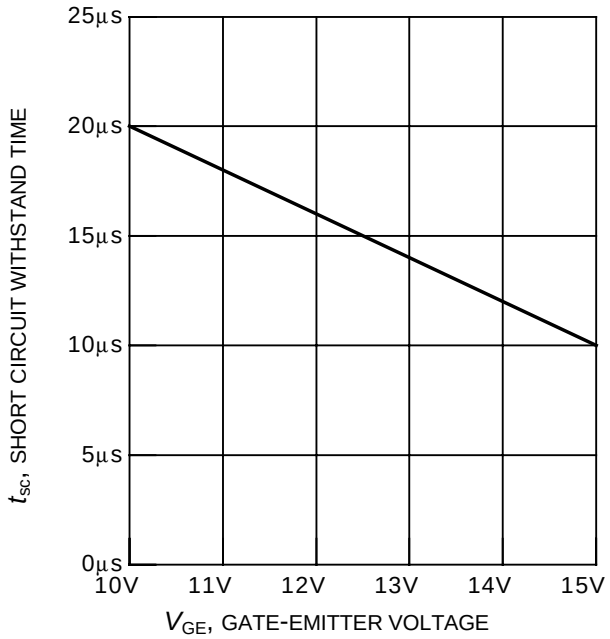


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE} = 600V, start at T_j = 25°C)

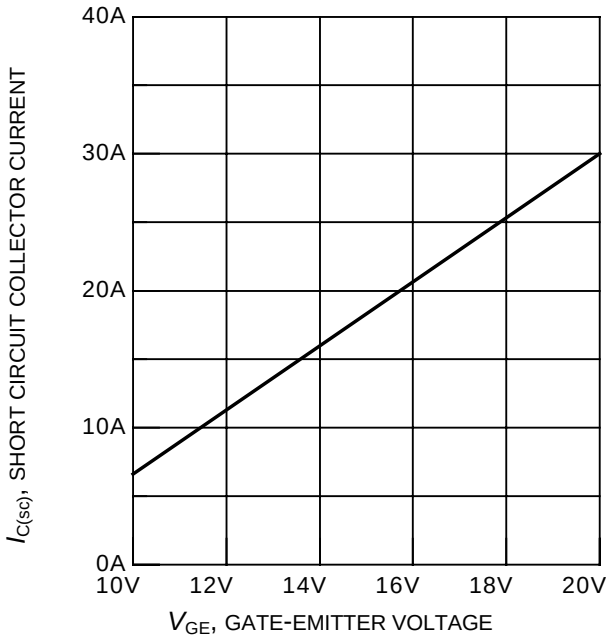
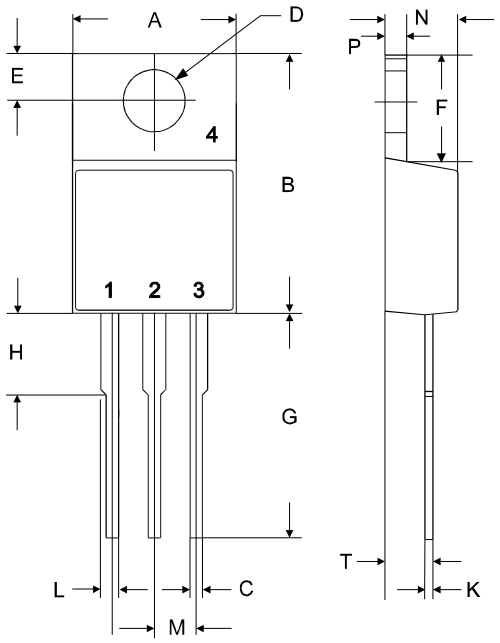


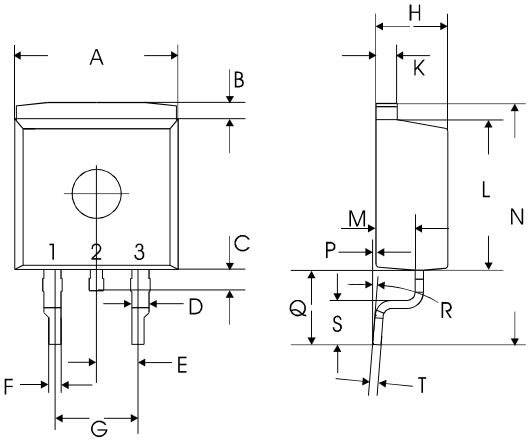
Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \le$ 600V, T_j = 150°C)

TO-220AB

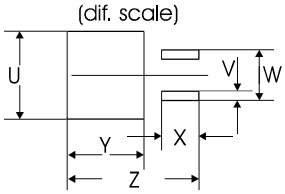


symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.70	10.30	0.3819	0.4055
B	14.88	15.95	0.5858	0.6280
C	0.65	0.86	0.0256	0.0339
D	3.55	3.89	0.1398	0.1531
E	2.60	3.00	0.1024	0.1181
F	6.00	6.80	0.2362	0.2677
G	13.00	14.00	0.5118	0.5512
H	4.35	4.75	0.1713	0.1870
K	0.38	0.65	0.0150	0.0256
L	0.95	1.32	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

TO-263AB (D^2Pak)

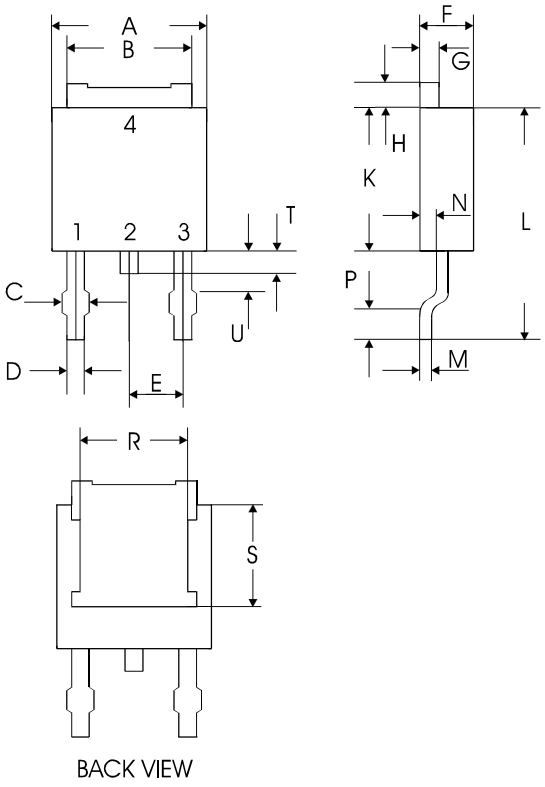


Footprint
(dif. scale)



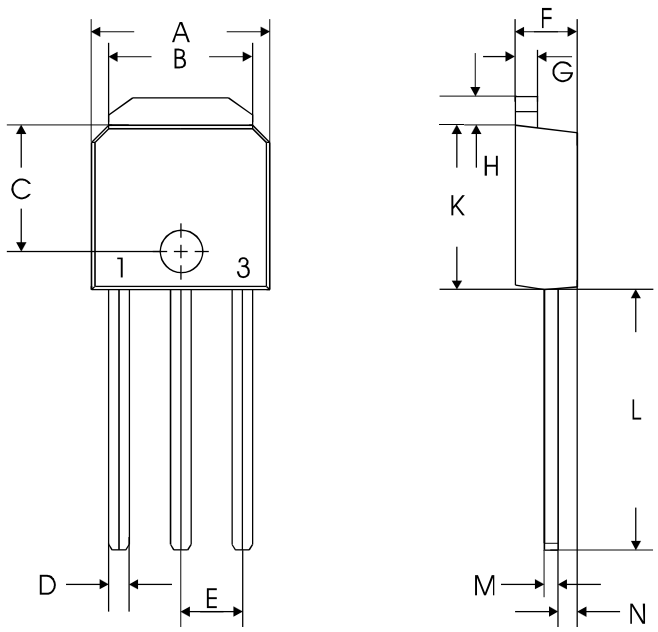
symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.80	10.20	0.3858	0.4016
B	0.70	1.30	0.0276	0.0512
C	1.00	1.60	0.0394	0.0630
D	1.03	1.07	0.0406	0.0421
E	2.54 typ.		0.1 typ.	
F	0.65	0.85	0.0256	0.0335
G	5.08 typ.		0.2 typ.	
H	4.30	4.50	0.1693	0.1772
K	1.17	1.37	0.0461	0.0539
L	9.05	9.45	0.3563	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	

P-TO252 (D-Pak)



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	6.40	6.73	0.2520	0.2650
B	5.25	5.50	0.2067	0.2165
C	(0.65)	(1.15)	(0.0256)	(0.0453)
D	0.63	0.89	0.0248	0.0350
E	2.28		0.2520	
F	2.19	2.39	0.0862	0.0941
G	0.76	0.98	0.0299	0.0386
H	0.90	1.21	0.0354	0.0476
K	5.97	6.23	0.2350	0.2453
L	9.40	10.40	0.3701	0.4094
M	0.46	0.58	0.0181	0.0228
N	0.87	1.15	0.0343	0.0453
P	0.51	-	0.0201	-
R	5.00	-	0.1969	-
S	4.17	-	0.1642	-
T	0.26	1.02	0.0102	0.0402
U	-	-	-	-

P-TO251 (I-Pak)



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	6.47	6.73	0.2547	0.2650
B	5.25	5.41	0.2067	0.2130
C	4.19	4.43	0.1650	0.1744
D	0.63	0.89	0.0248	0.0350
E	2.29 typ.		0.0902 typ.	
F	2.18	2.39	0.0858	0.0941
G	0.76	0.86	0.0299	0.0339
H	1.01	1.11	0.0398	0.0437
K	5.97	6.23	0.2350	0.2453
L	9.14	9.65	0.3598	0.3799
M	0.46	0.56	0.0181	0.0220
N	0.98	1.15	0.0386	0.0453

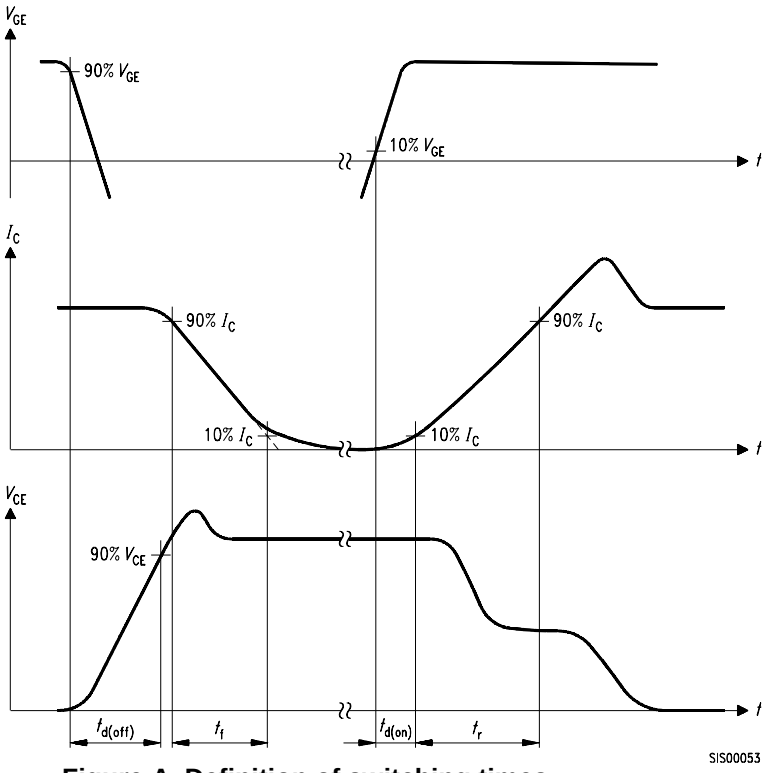


Figure A. Definition of switching times

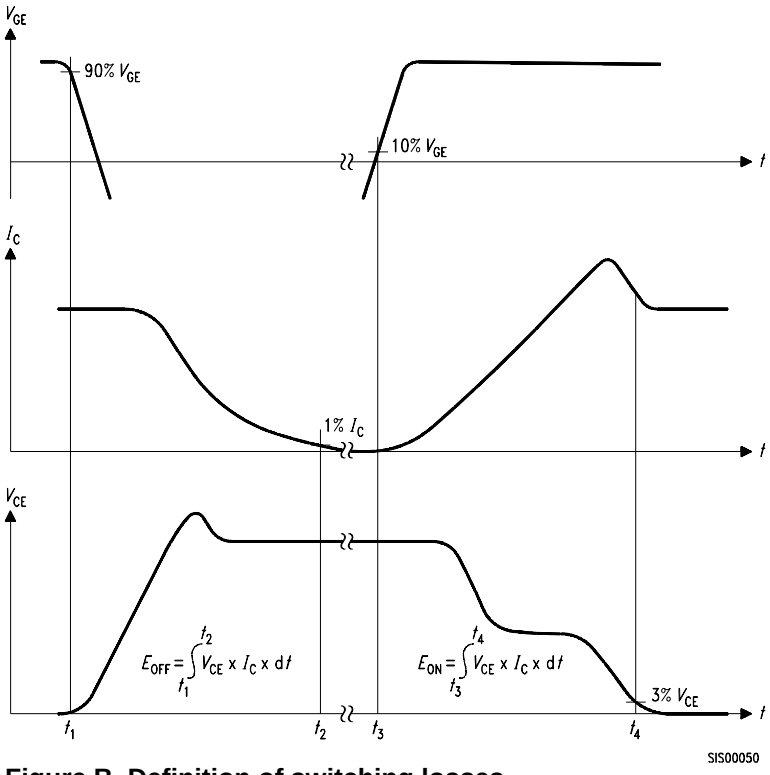


Figure B. Definition of switching losses

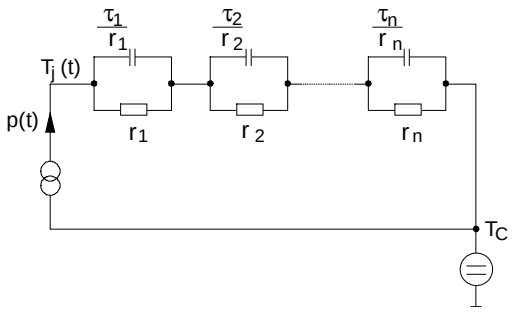


Figure D. Thermal equivalent circuit

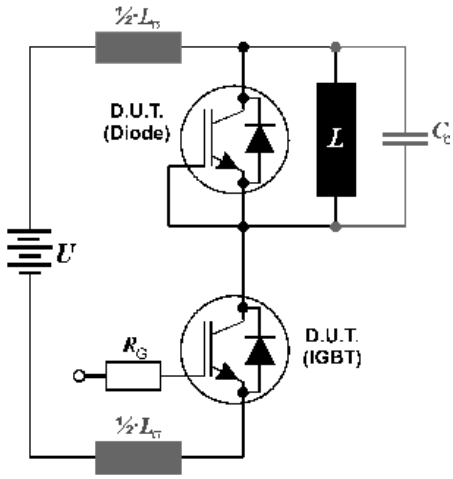


Figure E. Dynamic test circuit
Leakage inductance L_σ =180nH
and Stray capacity C_σ =180pF.

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D-81541 München

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Infineon Technologies is an approved CECC manufacturer.

Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Representatives worldwide (see address list).

Warnings

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.