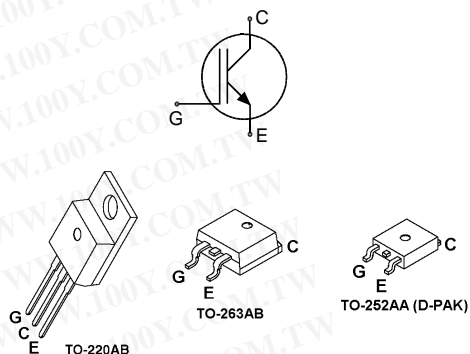


Fast S-IGBT in NPT-technology

- 40% lower E_{off} compared to previous generation
- Short circuit withstand time – 10 μ s
- Designed for:
 - Motor controls
 - Inverter
 - SMPS
- NPT-Technology offers:
 - very tight parameter distribution
 - high ruggedness, temperature stable behaviour
 - parallel switching capability



Type	V_{CE}	I_C	E_{off}	T_j	Package	Ordering Code
SGP02N120	1200V	2A	0.11mJ	150°C	TO-220AB	Q67040-S4270
SGB02N120					TO-263AB(D2PAK)	Q67040-S4271
SGD02N120					TO-252AA(DPAK)	Q67040-S4269
SGI02N120					TO-262	Q67040-S4291

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C	6.2	A
$T_C = 25^\circ\text{C}$		2.8	
$T_C = 100^\circ\text{C}$			
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	9.6	
Turn off safe operating area	-	9.6	
$V_{CE} \leq 1200\text{V}, T_j \leq 150^\circ\text{C}$			
Gate-emitter voltage	V_{GE}	± 20	V
Avalanche energy, single pulse	E_{AS}	10	mJ
$I_C = 2\text{A}, V_{CC} = 50\text{V}, R_{GE} = 25\Omega$, start at $T_j = 25^\circ\text{C}$			
Short circuit withstand time ¹⁾	t_{SC}	10	μ s
$V_{GE} = 15\text{V}, 100\text{V} \leq V_{CC} \leq 1200\text{V}, T_j \leq 150^\circ\text{C}$			
Power dissipation	P_{tot}	62	W
$T_C = 25^\circ\text{C}$			
Operating junction and storage temperature	T_j, T_{stg}	-55...+150	°C
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

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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}		2.0	K/W
Thermal resistance, junction – ambient	R_{thJA}	TO-220AB	62	
SMD version, device on PCB ¹⁾	R_{thJA}	TO-263AB(D2PAK)	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	$V_{(BR)CES}$	$V_{GE}=0V, I_C=100\mu A$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=2A$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	2.5 -	3.1 3.7	3.6 4.3	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=100\mu A, V_{CE}=V_{GE}$	3	4	5	
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	- -	- -	25 100	μA
Gate-emitter leakage current	I_{GES}	$V_{CE}=1200V, V_{GE}=0V$	-	-	100	
Transconductance	g_{fs}	$V_{CE}=20V, I_C=2A$		1.5	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	$V_{CE}=25V,$	-	205	250	pF
Output capacitance	C_{oss}	$V_{GE}=0V,$	-	28	34	
Reverse transfer capacitance	C_{riss}	$f=1\text{MHz}$	-	17	21	
Gate charge	Q_{Gate}	$V_{CC}=960V, I_C=2A$ $V_{GE}=15V$	-	11	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	TO-220AB	-	7	-	nH
Short circuit collector current ²⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $100V\leq V_{CC}\leq 1200V,$ $T_j\leq 150^\circ\text{C}$	-	24	-	A

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¹⁾ Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 μ m 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 $T_j=25^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=25^\circ\text{C}$,	-	23	30	ns
Rise time	t_r	$V_{CC}=800\text{V}$, $I_C=2\text{A}$,	-	16	21	
Turn-off delay time	$t_{d(off)}$	$V_{GE}=15\text{V}/0\text{V}$,	-	260	340	
Fall time	t_f	$R_G=91\Omega$,	-	61	80	
Turn-on energy	E_{on}	Energy losses include "tail" and diode reverse recovery.	-	0.16	0.21	mJ
Turn-off energy	E_{off}		-	0.06	0.08	
Total switching energy	E_{ts}		-	0.22	0.29	

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	$t_{d(on)}$	$T_j=150^\circ\text{C}$	-	26	31	ns
Rise time	t_r	$V_{CC}=800\text{V}$,	-	14	17	
Turn-off delay time	$t_{d(off)}$	$I_C=2\text{A}$,	-	290	350	
Fall time	t_f	$V_{GE}=15\text{V}/0\text{V}$,	-	85	102	
Turn-on energy	E_{on}	$R_G=91\Omega$	-	0.27	0.33	mJ
Turn-off energy	E_{off}	Energy losses include "tail" and diode reverse recovery.	-	0.11	0.15	
Total switching energy	E_{ts}		-	0.38	0.48	

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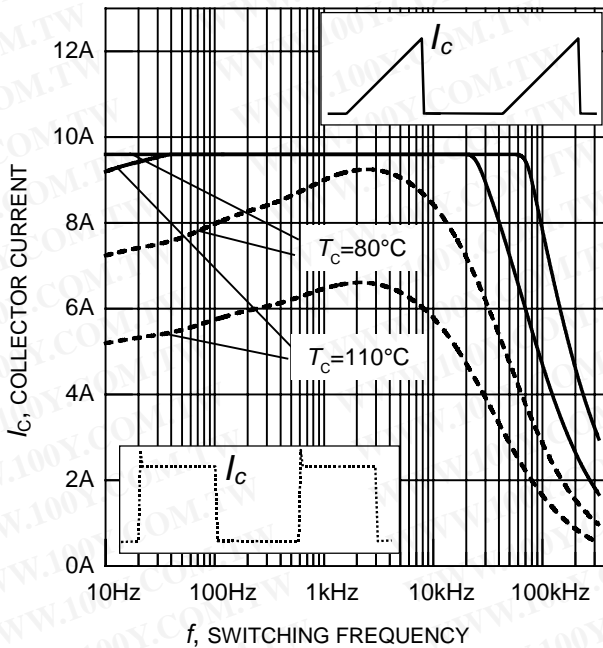


Figure 1. Collector current as a function of switching frequency
 ($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 800\text{V}$,
 $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 91\Omega$)

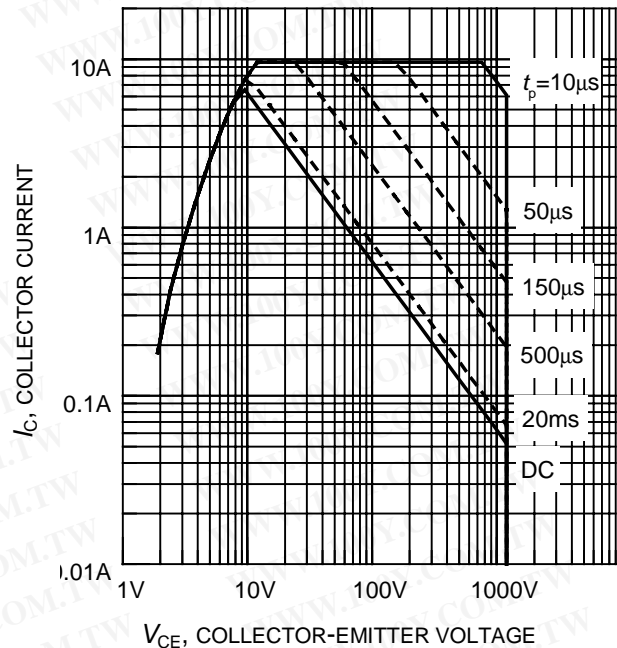


Figure 2. Safe operating area
 ($D = 0$, $T_C = 25^\circ\text{C}$, $T_j \leq 150^\circ\text{C}$)

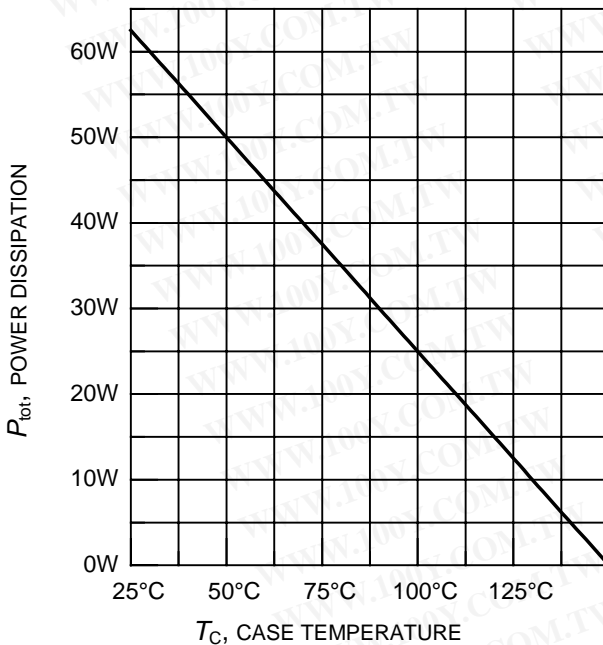


Figure 3. Power dissipation as a function of case temperature
 ($T_j \leq 150^\circ\text{C}$)

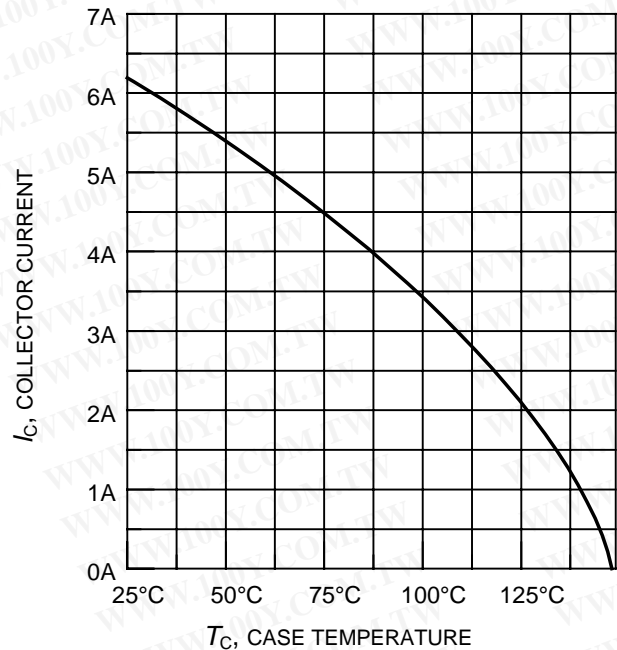


Figure 4. Collector current as a function of case temperature
 ($V_{GE} \leq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

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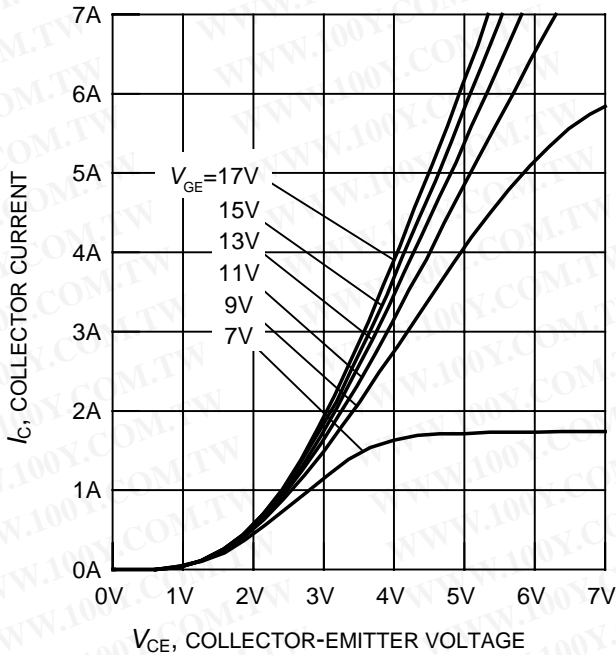


Figure 5. Typical output characteristics
 $(T_j = 25^\circ\text{C})$

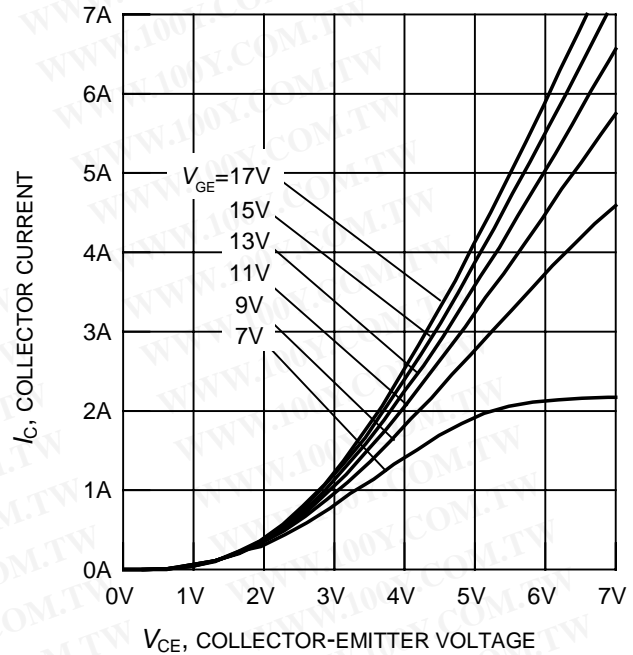


Figure 6. Typical output characteristics
 $(T_j = 150^\circ\text{C})$

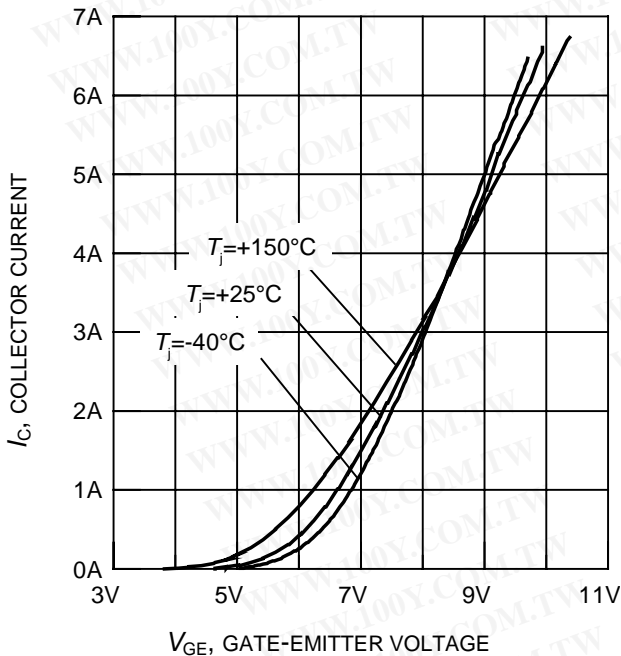


Figure 7. Typical transfer characteristics
 $(V_{CE} = 20\text{V})$

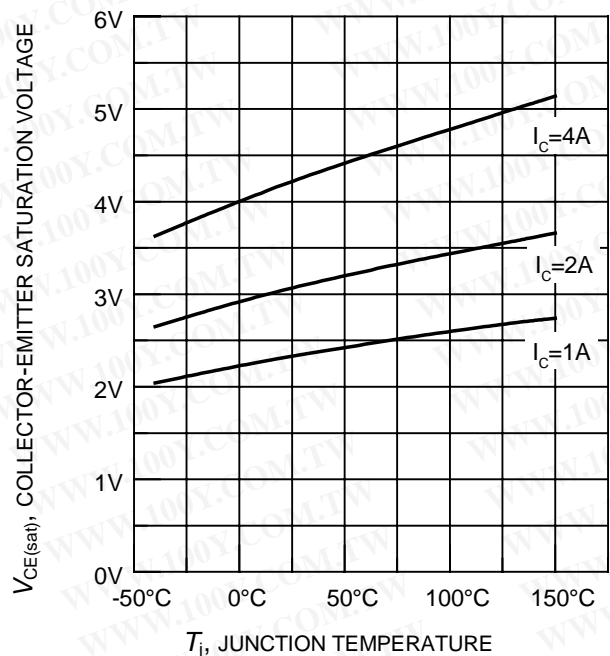


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
 $(V_{GE} = 15\text{V})$

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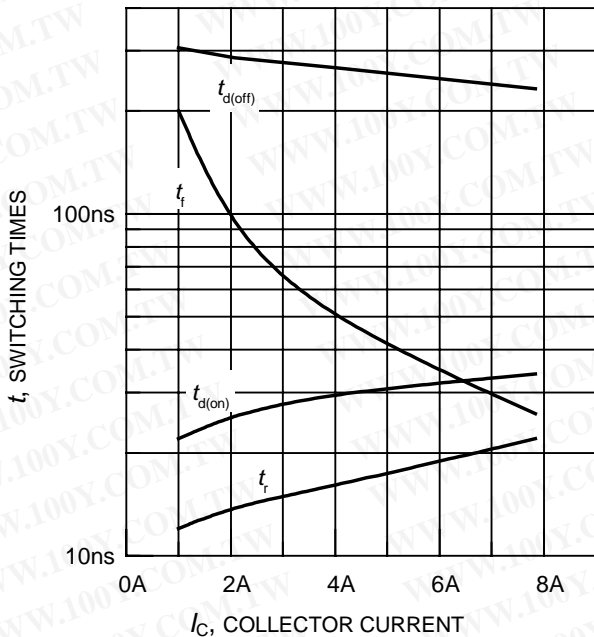


Figure 9. Typical switching times as a function of collector current
(inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 91\Omega$)

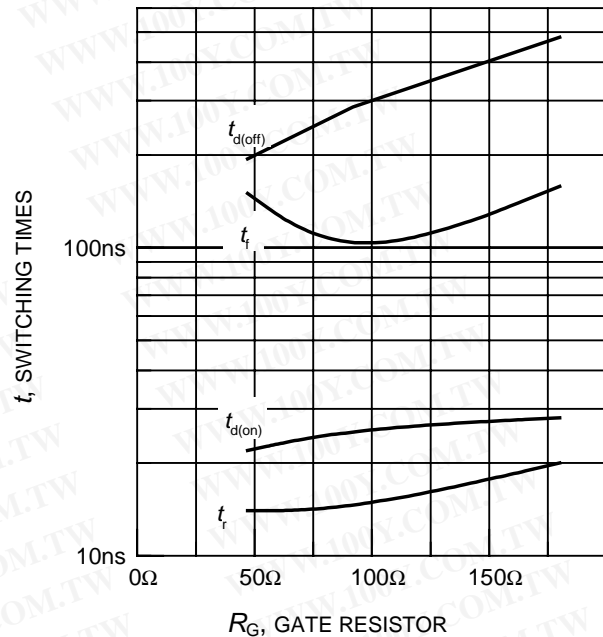


Figure 10. Typical switching times as a function of gate resistor
(inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 2\text{A}$)

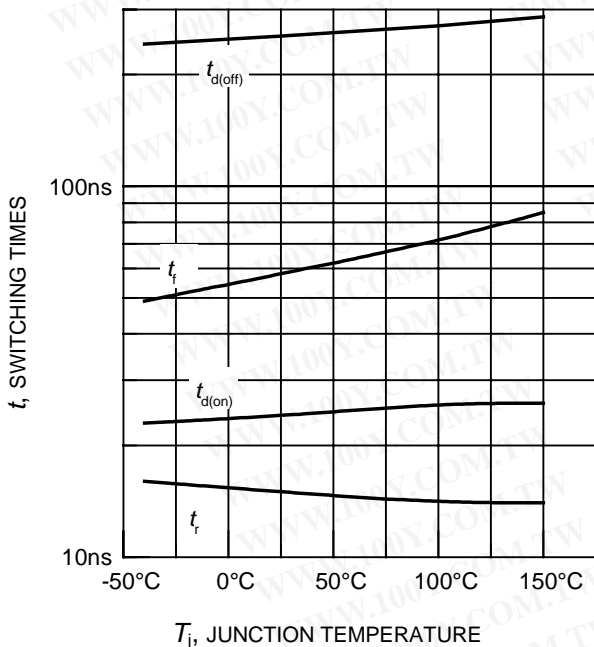


Figure 11. Typical switching times as a function of junction temperature
(inductive load, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 2\text{A}$, $R_G = 91\Omega$)

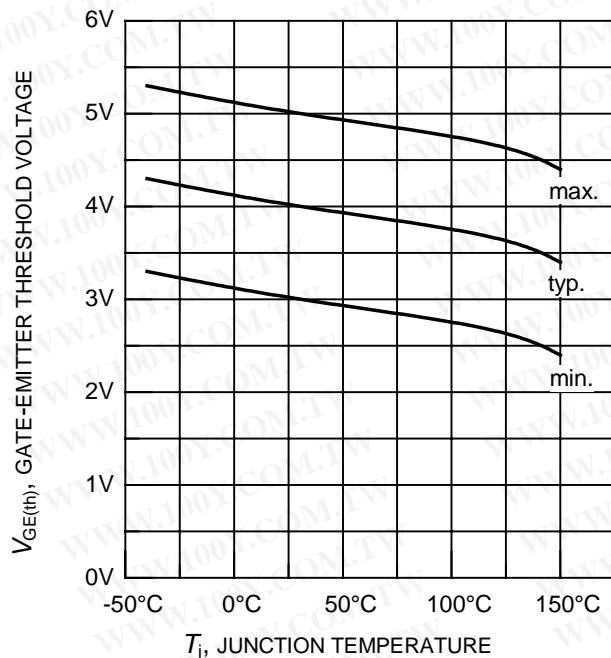


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_C = 0.3\text{mA}$)

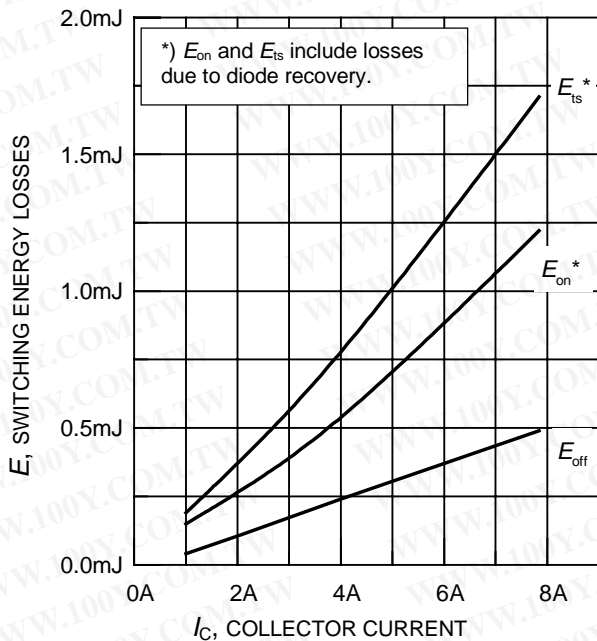


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 91\ \Omega$)

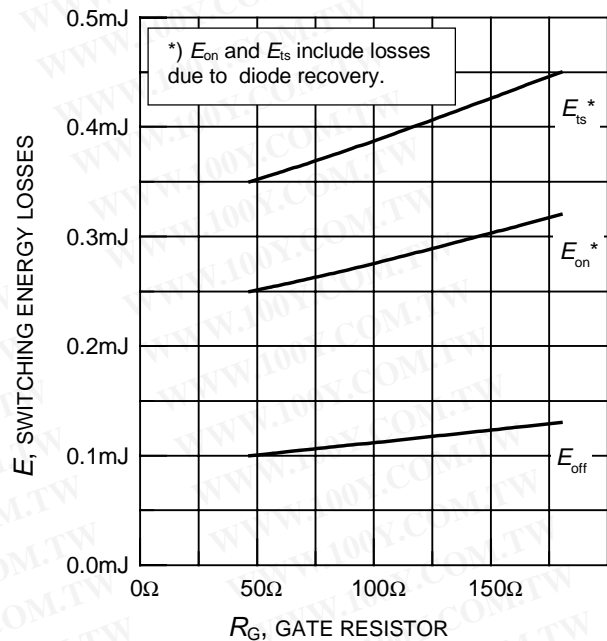


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 2\text{A}$)

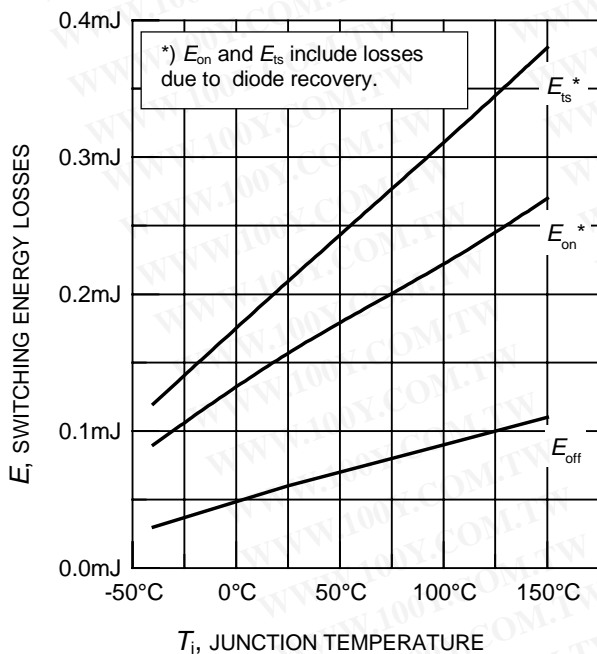


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 2\text{A}$, $R_G = 91\ \Omega$)

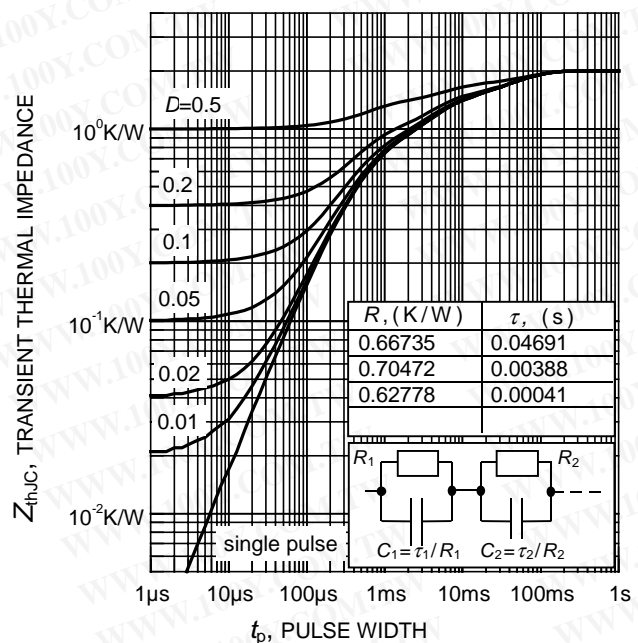


Figure 16. IGBT transient thermal impedance as a function of pulse width
 ($D = t_p / T$)

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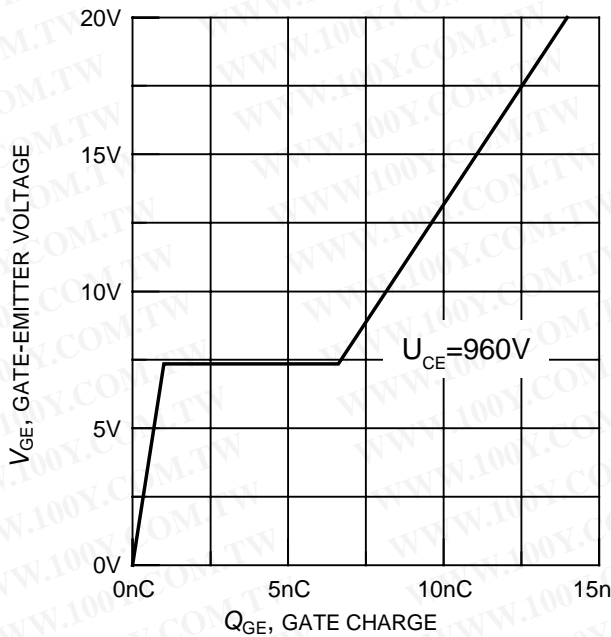


Figure 17. Typical gate charge
 ($I_C = 2A$)

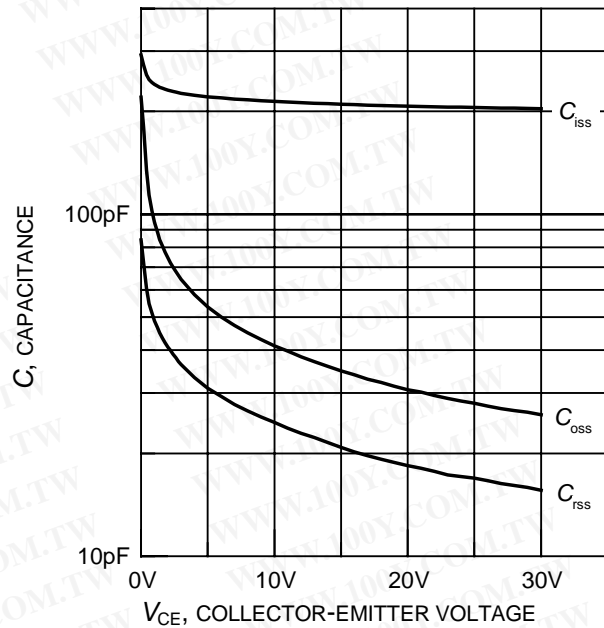


Figure 18. Typical capacitance as a function of collector-emitter voltage
 ($V_{GE} = 0V, f = 1MHz$)

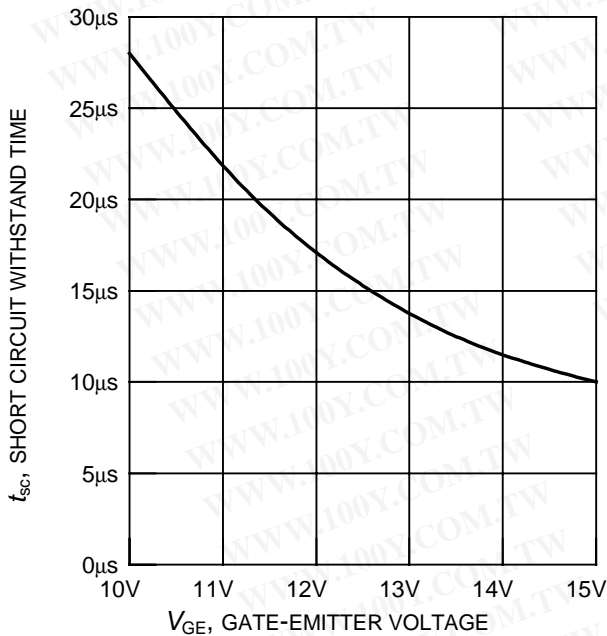


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
 ($V_{CE} = 1200V$, start at $T_j = 25^\circ C$)

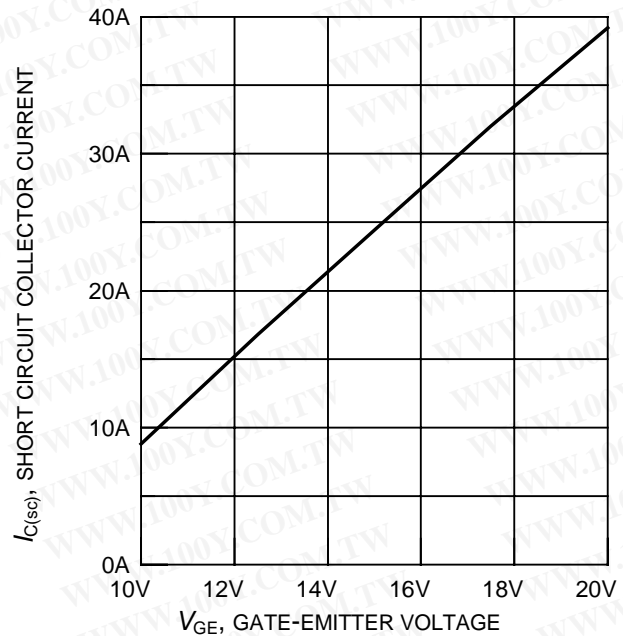
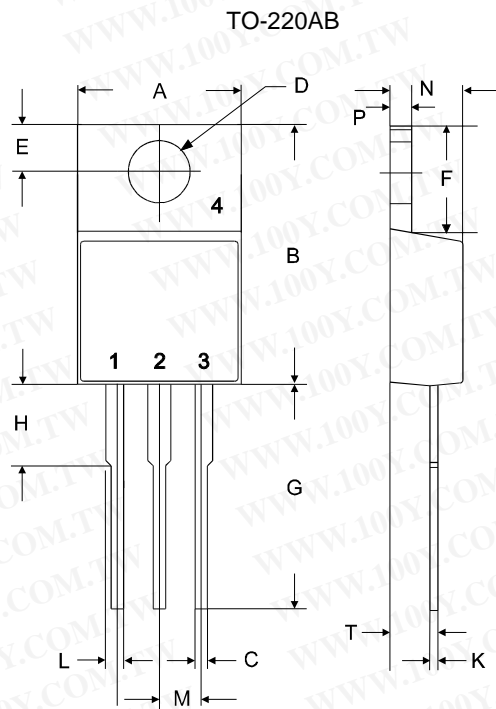
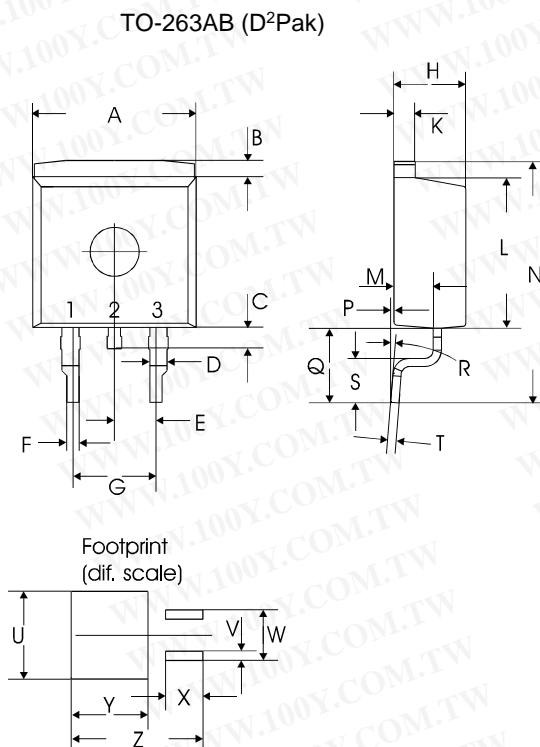


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
 ($100V \leq V_{CE} \leq 1200V, T_C = 25^\circ C, T_j \leq 150^\circ C$)

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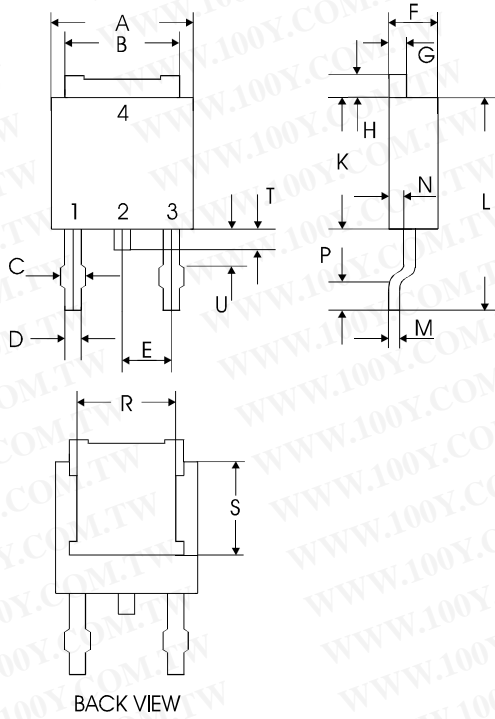
symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.70	10.30	0.3819	0.4055
B	14.88	15.95	0.5858	0.6280
C	0.65	0.86	0.0256	0.0339
D	3.55	3.89	0.1398	0.1531
E	2.60	3.00	0.1024	0.1181
F	6.00	6.80	0.2362	0.2677
G	13.00	14.00	0.5118	0.5512
H	4.35	4.75	0.1713	0.1870
K	0.38	0.65	0.0150	0.0256
L	0.95	1.32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



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	

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TO-252AA (DPak)



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	-	-	-	-

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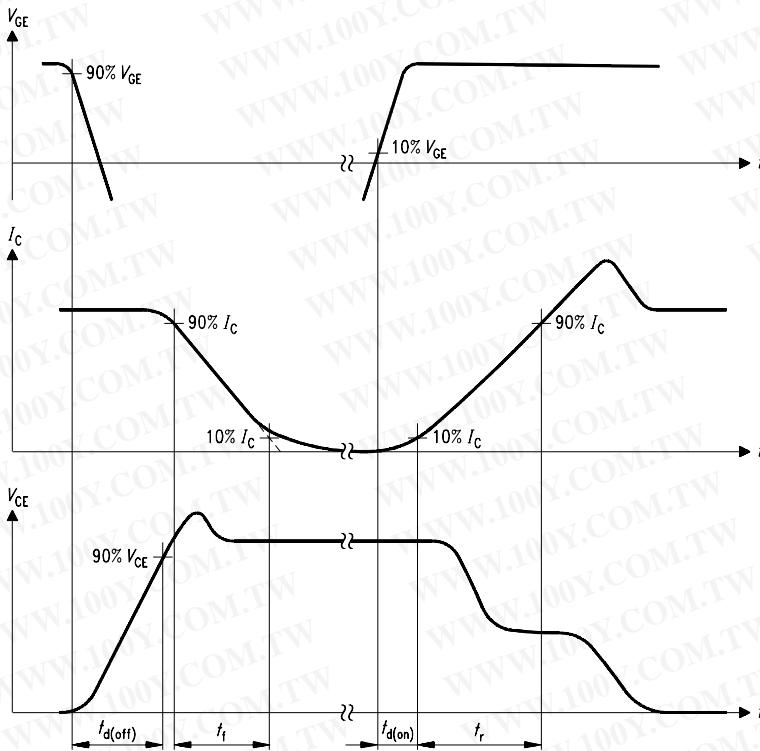


Figure A. Definition of switching times

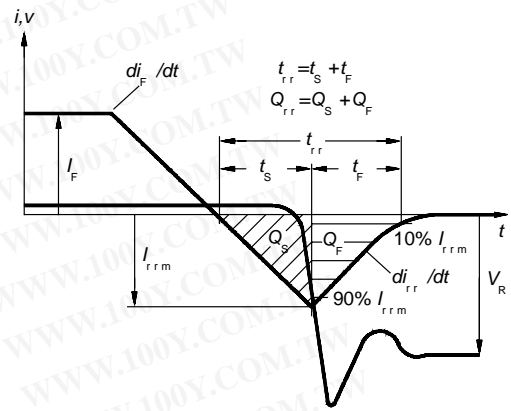


Figure C. Definition of diodes switching characteristics

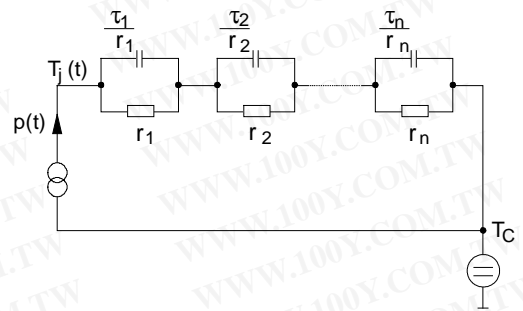


Figure D. Thermal equivalent circuit

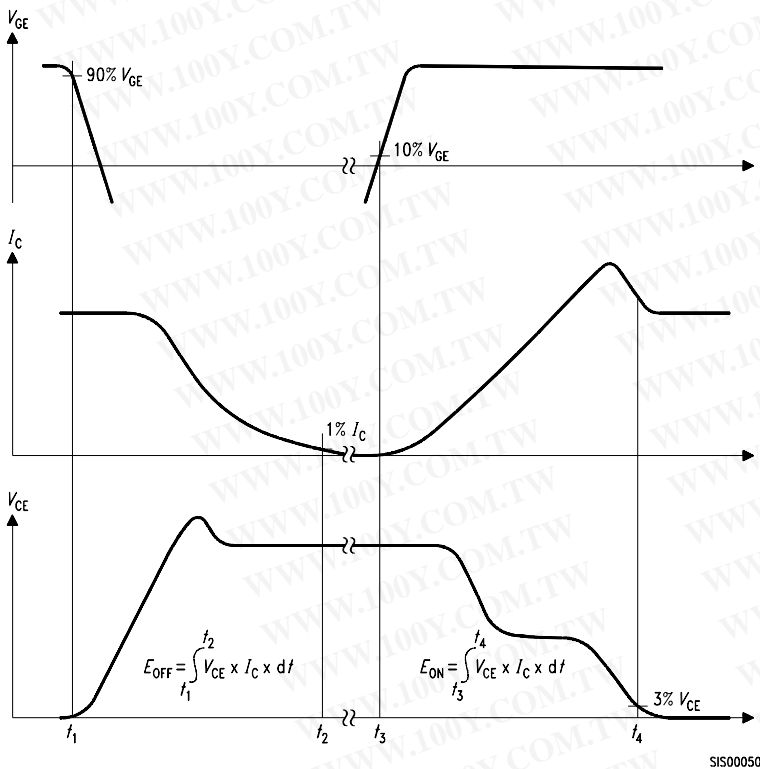


Figure B. Definition of switching losses

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Preliminary **SGP02N120**
SGB02N120, SGD02N120

Published by
Infineon Technologies AG i Gr.,
Bereich Kommunikation
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