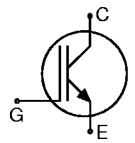
Preliminary

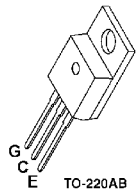
SGW15N120

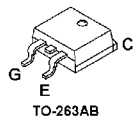
SGP15N120, SGB15N120

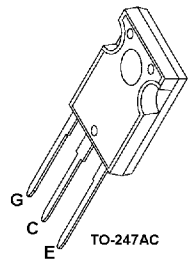
Fast S-IGBT in NPT-technology

- 50% lower E_{off} compared to previous generation
- Short circuit withstand time – 5 µs
- 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
SGP15N120	1200V	15A	0.68mJ	150°C	TO-220AB	Q67040-S4274
SGB15N120					TO-263AB(D2PAK)	Q67040-S4275
SGW15N120					TO-247AC	Q67040-S4276

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C		A
T_C = 25°C		32	
T_C = 100°C		15	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	52	
Turn off safe operating area $V_{CE} \le$ 1200V, $T_j \le$ 150°C	-	52	
Gate-emitter voltage	V_{GE}	±20	V
Avalanche energy, single pulse I_C = 15A, V_{CC} = 50V, R_{GE} = 25Ω, start at T_j = 25°C	E_{AS}	50	mJ
Short circuit withstand time[1)] V_{GE} = 15V, $V_{CC} \le$ 1200V, $T_j \le$ 150°C	t_{SC}	5	µs
Power dissipation T_C = 25°C	P_{tot}	198	W
Operating junction and storage temperature	T_j , T_{stg}	-55...+150	°C
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

[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}		0.63	K/W
Thermal resistance, junction – ambient	R_{thJA}	TO-220AB TO-247AC	62 40	
SMD version, device on PCB[1)]	R_{thJA}	TO-263AB(D2PAK)	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=1000µA	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=15A				
		T_j=25°C	2.6	3.1	3.6	
		T_j=150°C	-	3.7	4.3	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=600µA, V_{CE}= V_{GE}	3	4	5	
Zero gate voltage collector current	I_{CES}	V_{CE}=1200V,V_{GE}=0V				µA
		T_j=25°C	-	-	200	
		T_j=150°C	-	-	800	
Gate-emitter leakage current	I_{GES}	V_{CE}=1200V,V_{GE}=0V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=15A		12	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE}=25V,	-	1000	1200	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	150	180	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	70	84	
Gate charge	Q_{Gate}	V_{CC}=960V, I_C=15A	-	85	111	nC
		V_{GE}=15V				
Internal emitter inductance	L_E	TO-220AB	-	7	-	nH
measured 5mm (0.197 in.) from case		TO-247AC		13		
Short circuit collector current[2)]	$I_{C(SC)}$	V_{GE}=15V,t_{SC}≤5µs V_{CC} ≤ 1200V, T_j ≤ 150°C	-	150	-	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,	-	22	26	ns
Rise time	t_r	V_{CC}=600V, I_C=15A,	-	20	24	
Turn-off delay time	$t_{d(off)}$	V_{GE}=-15/15V,	-	234	281	
Fall time	t_f	R_G=33Ω,	-	22	26	
Turn-on energy	E_{on}	Energy losses include	-	0.92	1.06	mJ
Turn-off energy	E_{off}	"tail" and BYP301	-	0.42	0.55	
Total switching energy	E_{ts}	diode reverse recovery.	-	1.34	1.60	

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	-	20	24	ns
Rise time	t_r	V_{CC}=600V,	-	21	25	
Turn-off delay time	$t_{d(off)}$	I_C=15A,	-	258	310	
Fall time	t_f	V_{GE}=-15/15V,	-	26	31	
Turn-on energy	E_{on}	R_G=33Ω	-	2.0	2.3	mJ
Turn-off energy	E_{off}	Energy losses include	-	0.68	0.88	
Total switching energy	E_{ts}	"tail" and BYP301 diode reverse recovery.	-	2.68	3.18	

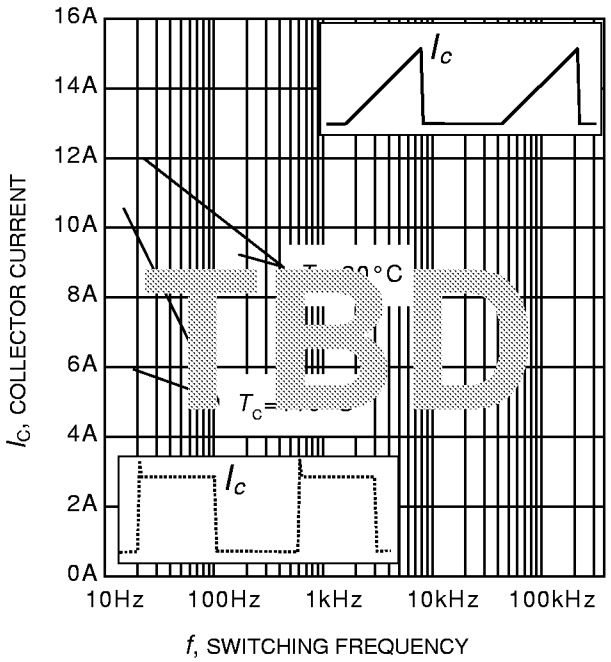


Figure 1. Collector current as a function of switching frequency
($T_j \le 150°C$, $D = 0.5$, $V_{CE} = 600V$, $V_{GE} = -15V/+15V$, $R_G = 33\Omega$)

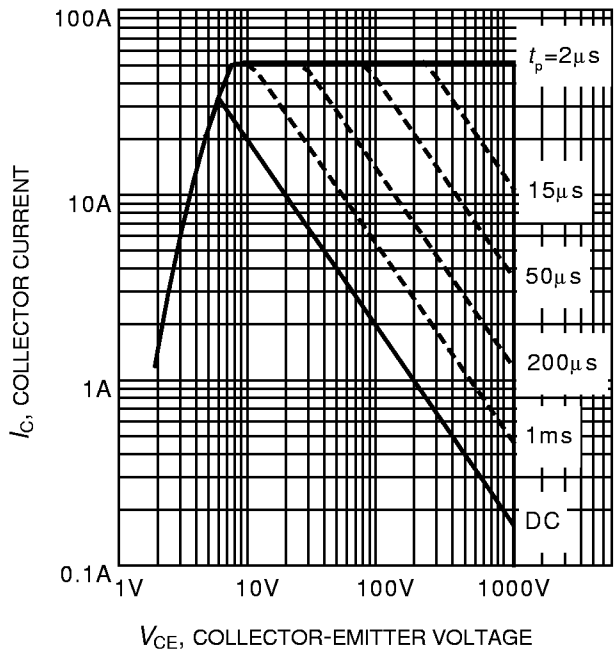


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \le 150°C$)

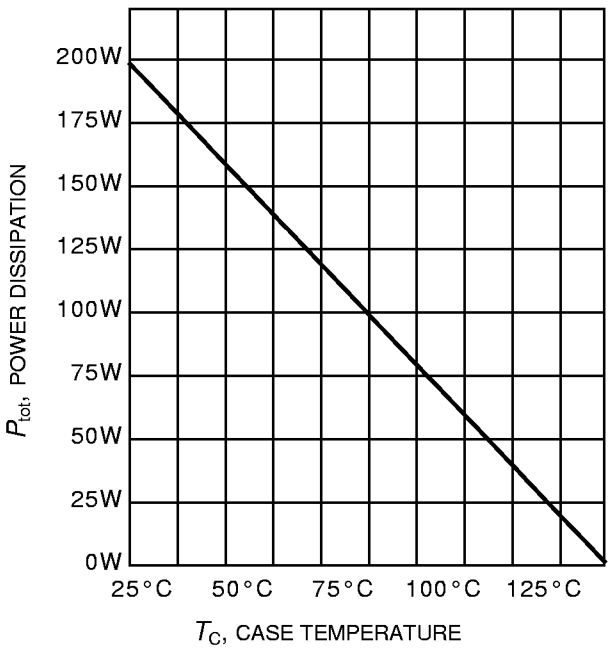


Figure 3. Power dissipation as a function of case temperature
($T_j \le 150°C$)

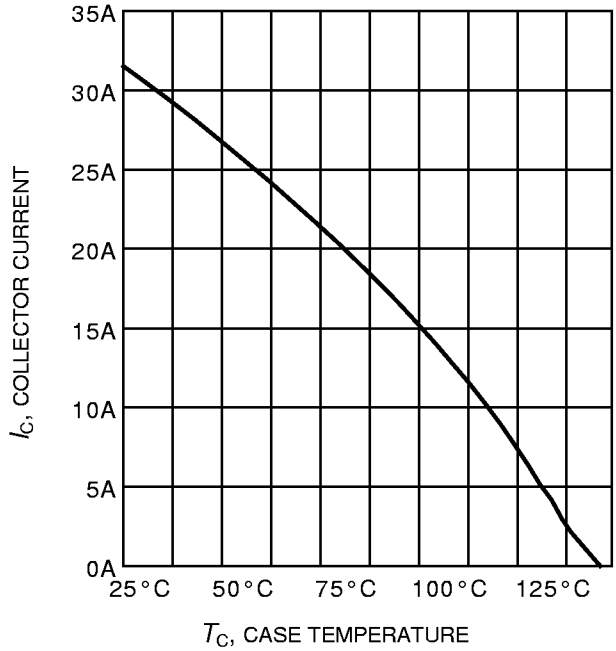


Figure 4. Collector current as a function of case temperature
($V_{GE} \le 15V$, $T_j \le 150°C$)

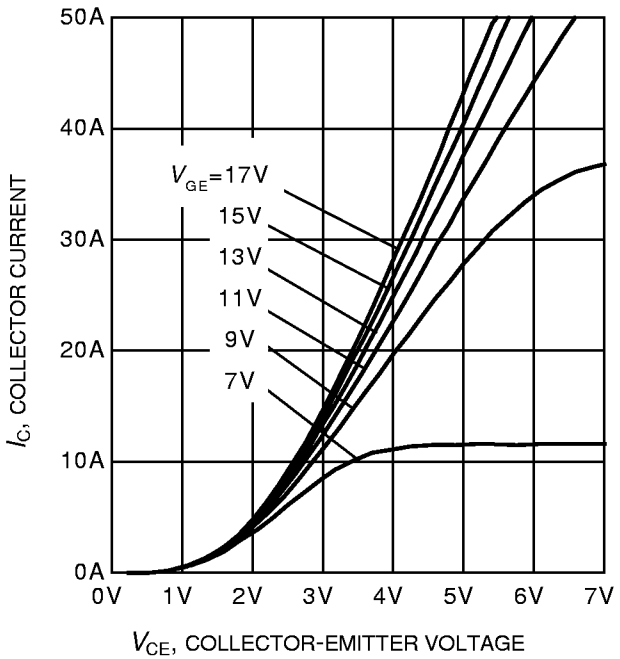


Figure 5. Typical output characteristics
(T_j = 25°C)

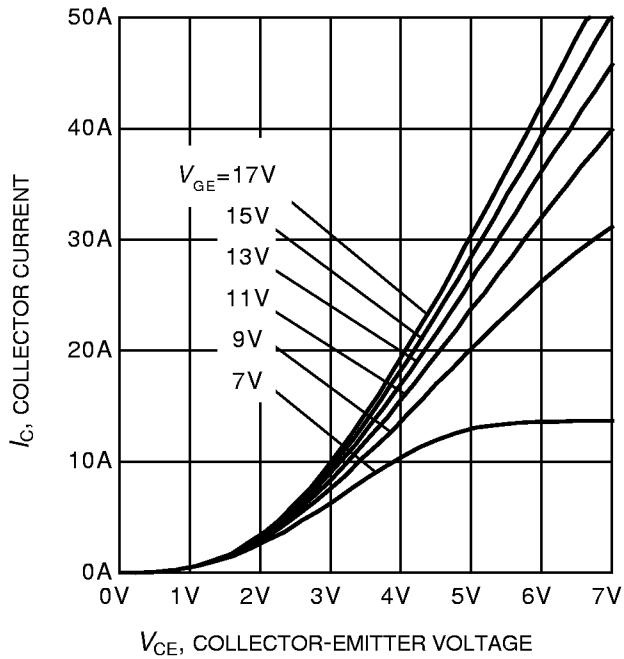


Figure 6. Typical output characteristics
(T_j = 150°C)

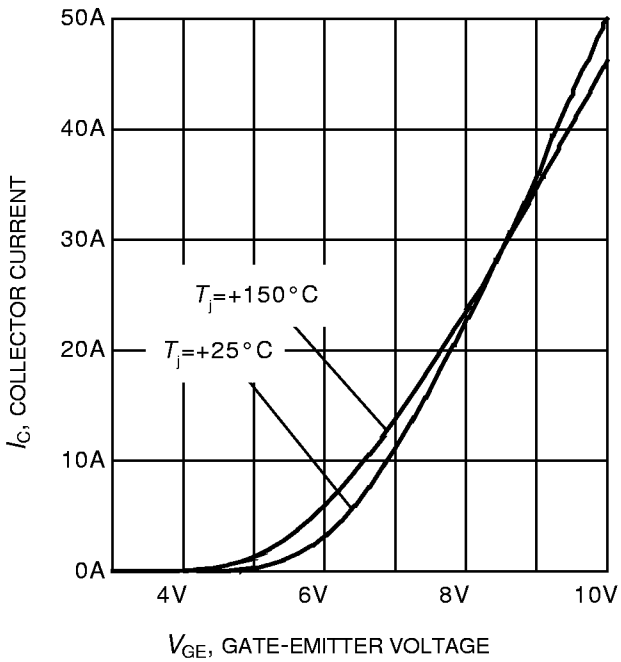


Figure 7. Typical transfer characteristics
(V_{CE} = 10V)

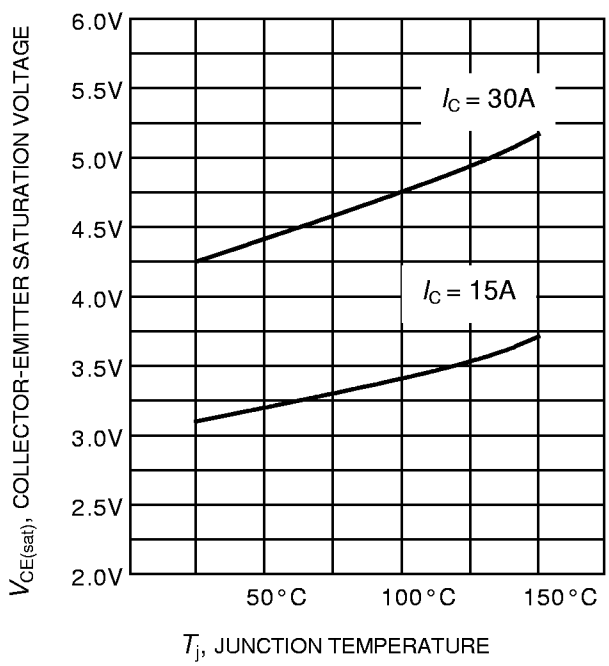


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

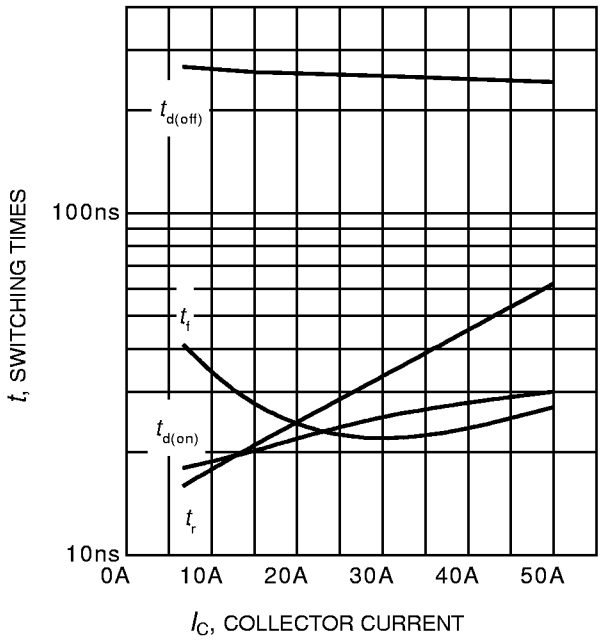


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j = 150°C, V_{CE} = 600V, V_{GE} = -15V/+15V, R_G = 33Ω)

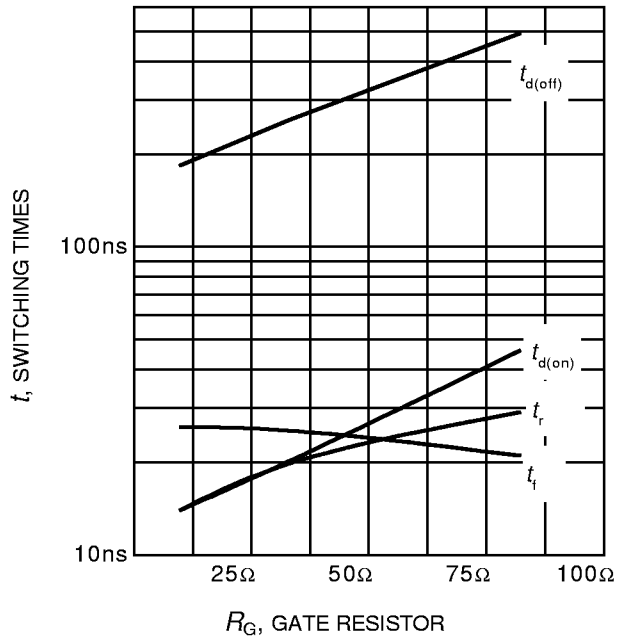


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j = 150°C, V_{CE} = 600V, V_{GE} = -15V/+15V, I_C = 15A)

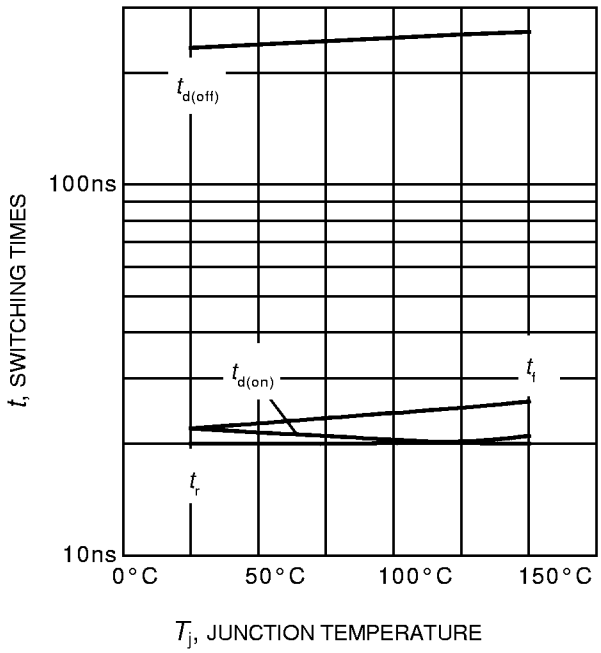


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 600V, V_{GE} = -15V/+15V, I_C = 15A, R_G = 33Ω)

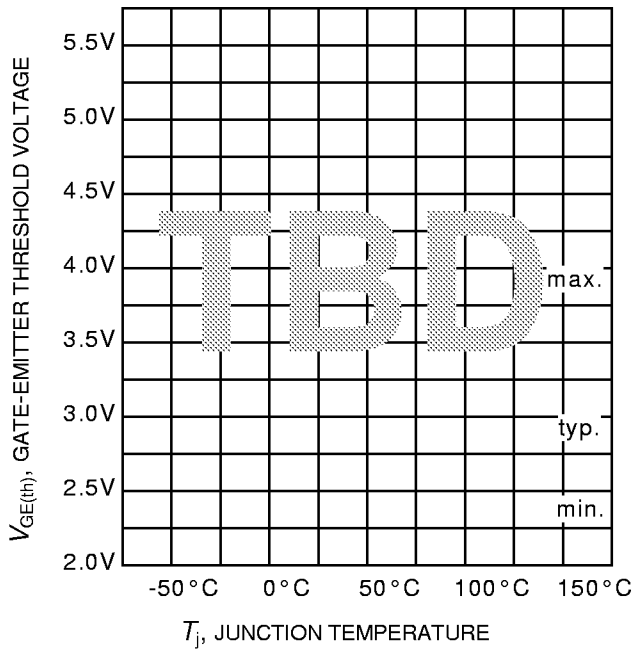


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.6mA)

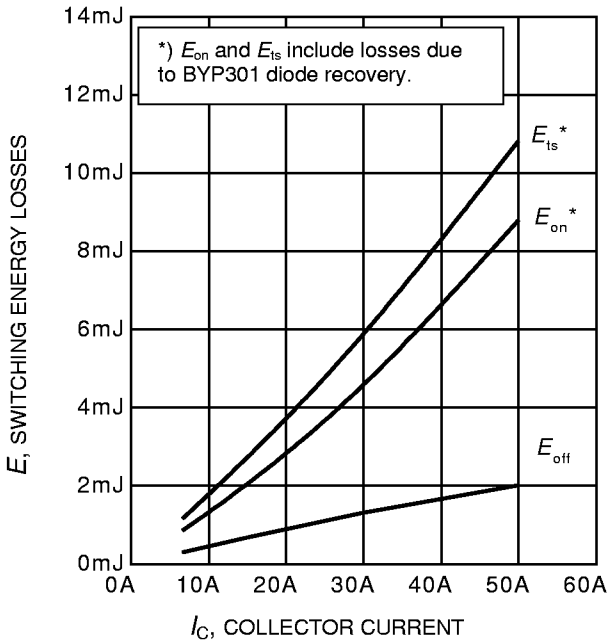


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j = 150°C, V_{CE} = 600V, V_{GE} = -15V/+15V, R_G = 33Ω)

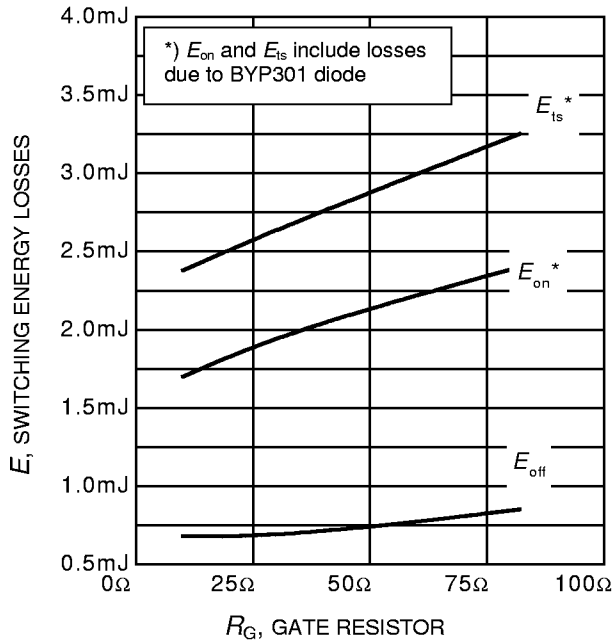


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j = 150°C, V_{CE} = 600V, V_{GE} = -15V/+15V, I_C = 15A)

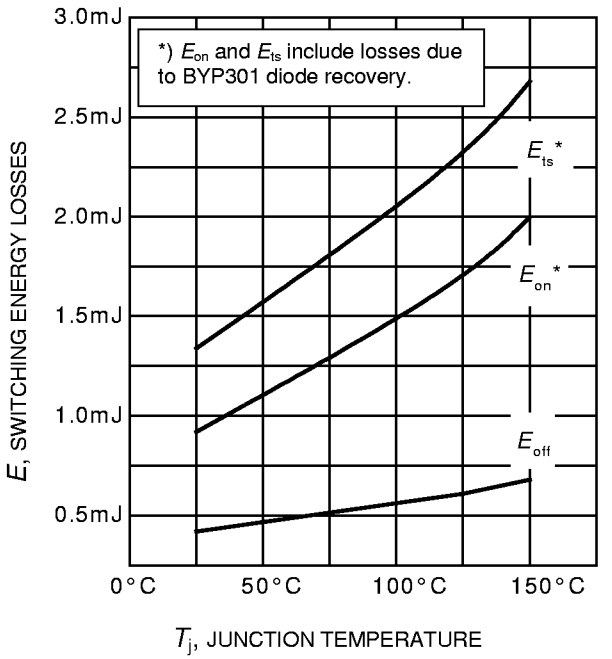


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 600V, V_{GE} = -15V/+15V, I_C = 15A, R_G = 33Ω)

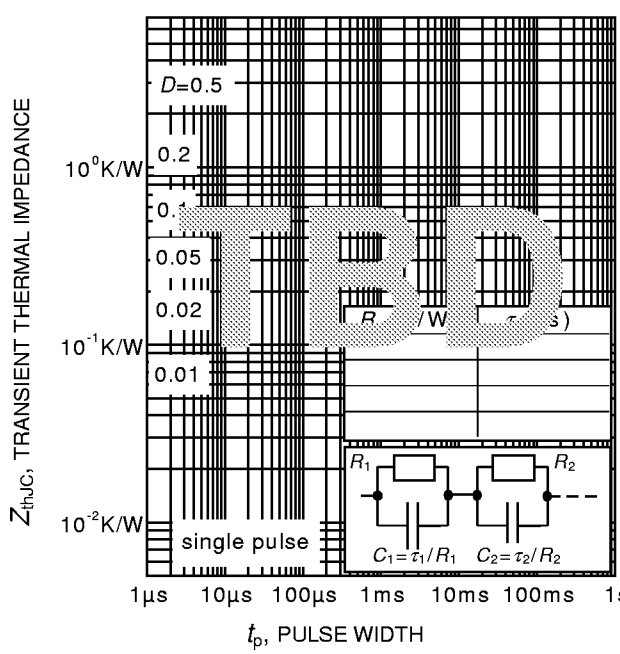


Figure 16. IGBT transient thermal impedance as a function of pulse width
($D = t_p / T$)

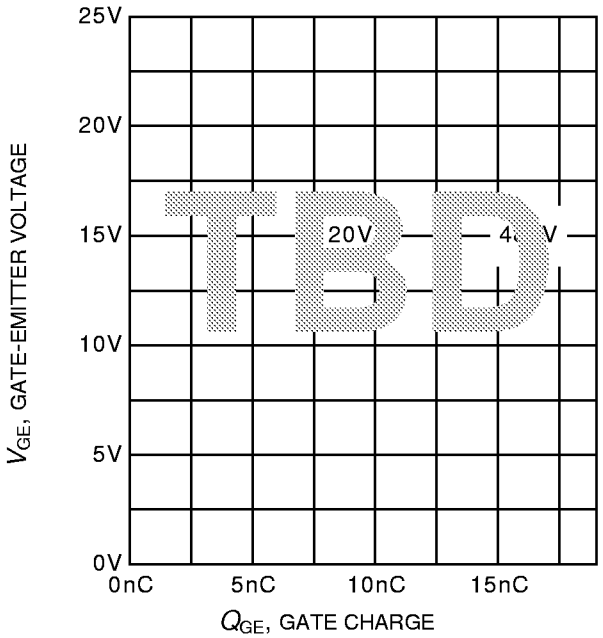


Figure 17. Typical gate charge
(I_C = 15A)

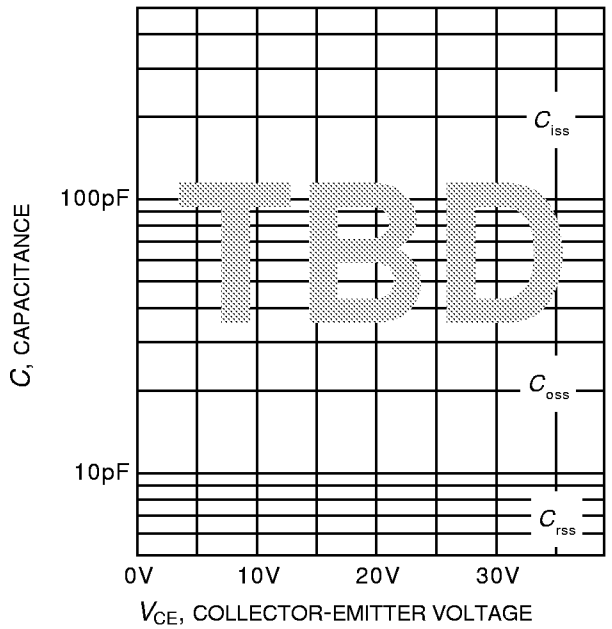


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE} = 0V, f = 1MHz)

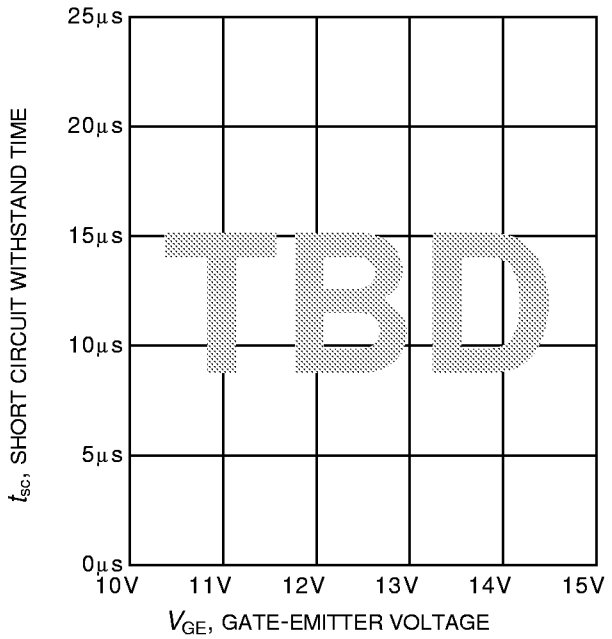


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE} = 1200V, start at T_j = 25°C)

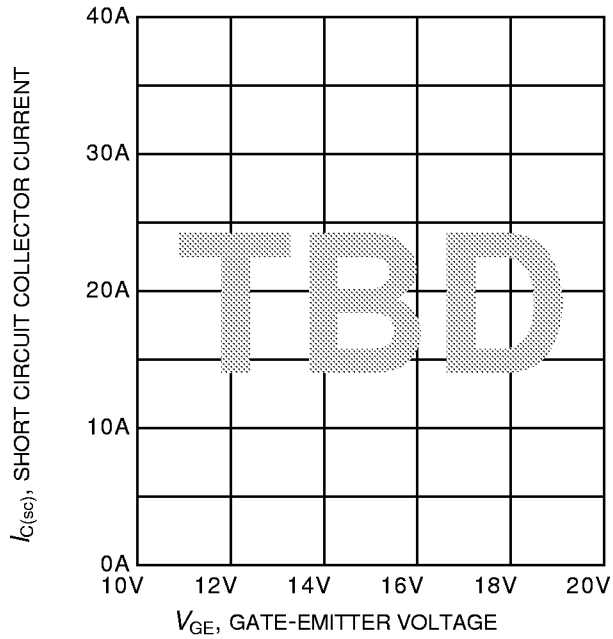
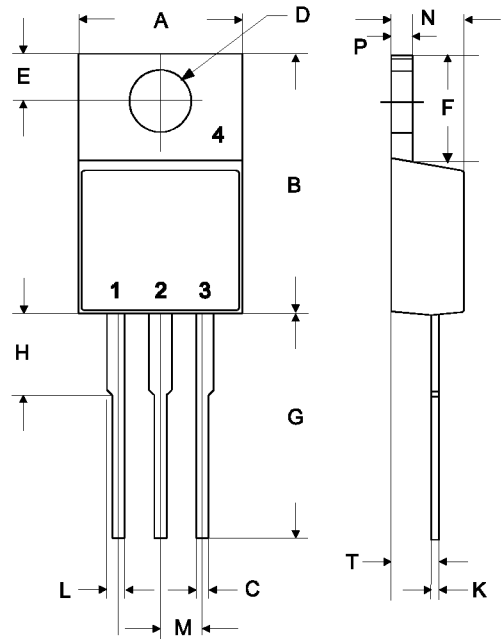


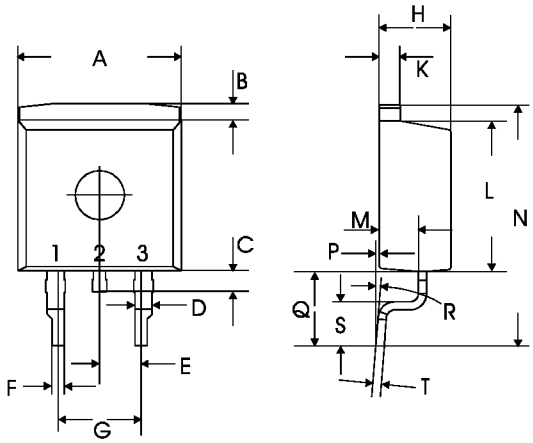
Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \le$ 1200V, T_C = 25°C, $T_j \le$ 150°C)

TO-220AB

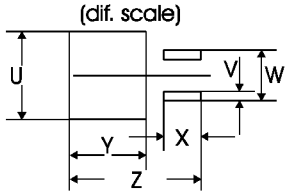


symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.70	10.30	0.3819	0.4055
B	14.88	15.95	0.5858	0.6280
C	0.65	0.86	0.0256	0.0339
D	3.55	3.89	0.1398	0.1531
E	2.60	3.00	0.1024	0.1181
F	6.00	6.80	0.2362	0.2677
G	13.00	14.00	0.5118	0.5512
H	4.35	4.75	0.1713	0.1870
K	0.38	0.65	0.0150	0.0256
L	0.95	1.32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

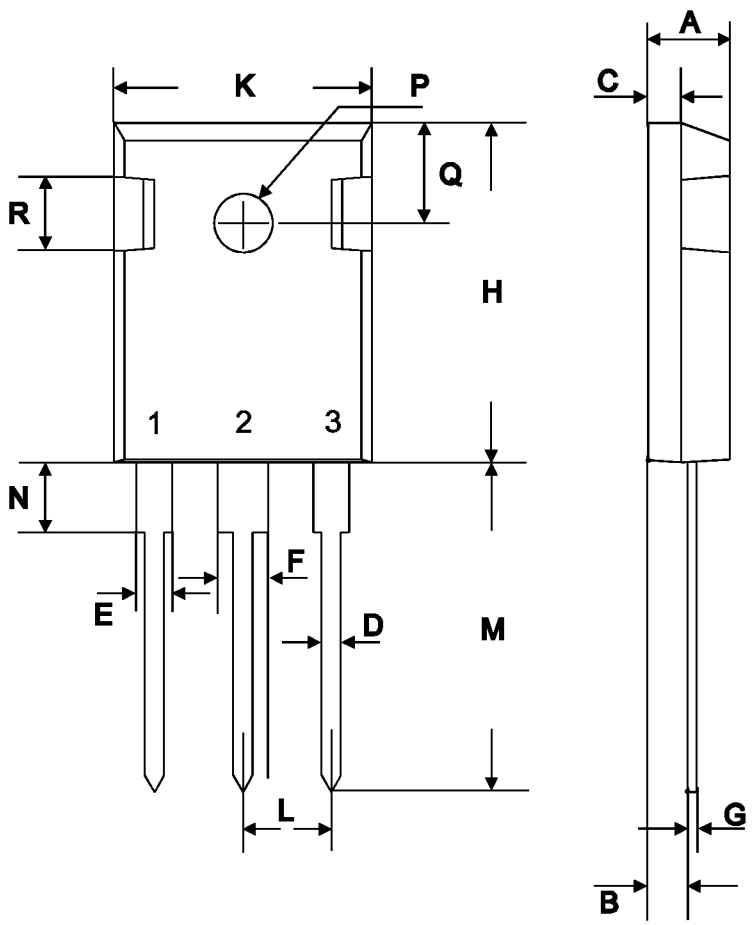


Footprint
(dif. scale)



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	

TO-247AC



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
∅P	3.61		0.1421	
Q	6.12	6.22	0.2409	0.2449

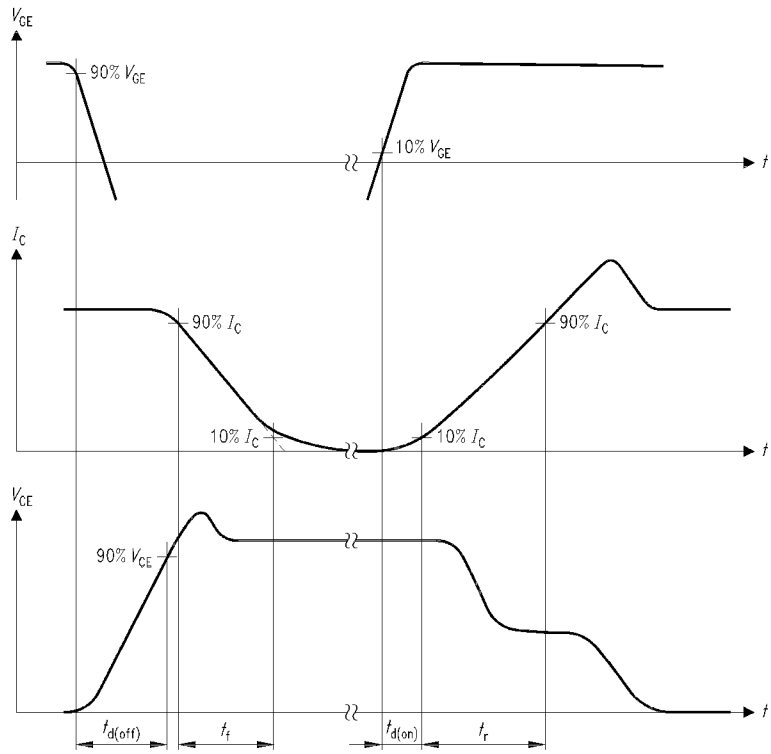


Figure A. Definition of switching times

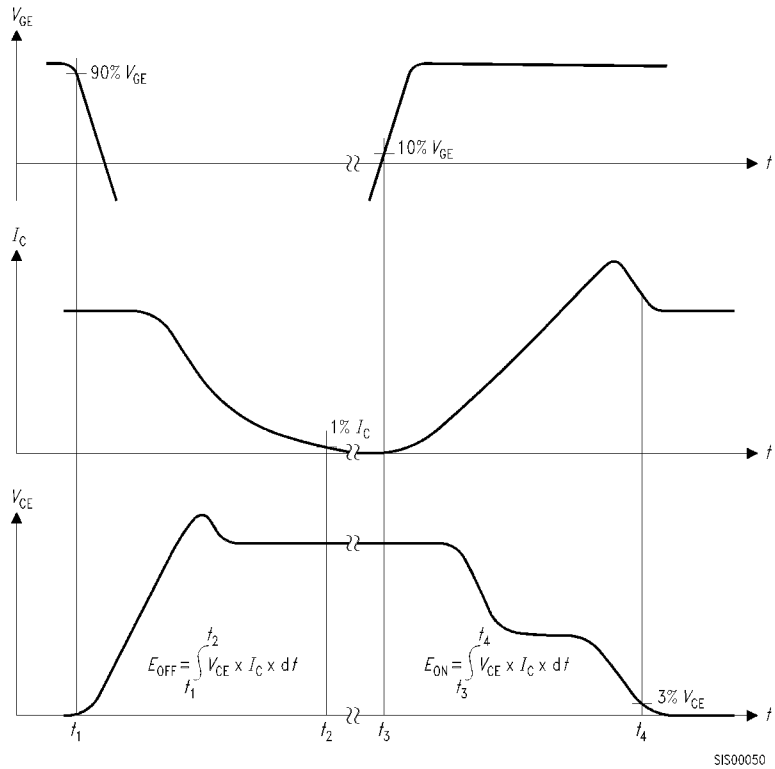


Figure B. Definition of switching losses

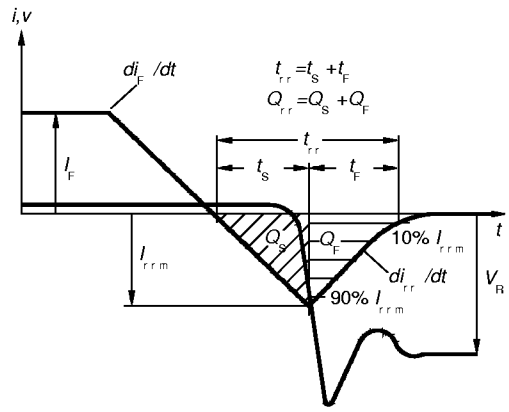


Figure C. Definition of diodes switching characteristics

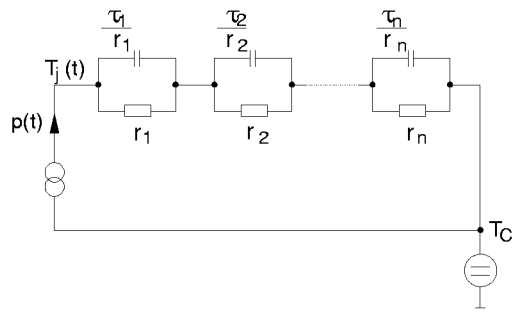


Figure D. Thermal equivalent circuit