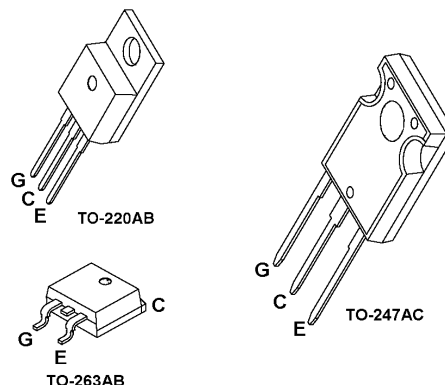


Fast S-IGBT in NPT-Technology

- 75 % lower E_{off} compared to previous generation combined with low conduction losses
- Short circuit withstand time 10 μ s
- Designed for moderate and high frequency applications:
 - SMPS and PFC up to 150 kHz
 - Inverter, Motor controls
- NPT-Technology for 600V applications offers:
 - tighter parameter distribution
 - higher ruggedness, temperature stable behaviour
 - parallel switching capability



Type	V_{CE}	I_C	$V_{CE(sat)}$	T_j	Package	Ordering Code
SGP15N60	600 V	15 A	2.3 V	150 °C	TO-220AB	Q67041-A4711-A2
SGB15N60					TO-263AB	Q67041-A4711-A3
SGW15N60					TO-247AC	Q67040-S4235

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current	I_C		A
$T_C = 25\text{ °C}$		31	
$T_C = 100\text{ °C}$		15	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	62	
Gate-emitter voltage	V_{GE}	± 20	V
Avalanche energy, single pulse $I_C = 15\text{ A}$, $V_{CC} = 50\text{ V}$, $R_{GE} = 25\ \Omega$, start at $T_j = 25\text{ °C}$	E_{AS}	85	mJ
Short circuit withstand time ¹⁾ $V_{GE} = 15\text{ V}$, $V_{CC} = 600\text{ V}$, $T_j \leq 150\text{ °C}$	t_{sc}	10	μ s
Power dissipation $T_C = 25\text{ °C}$	P_{tot}	138	W
Operating junction and storage temperature	T_j, T_{stg}	-55...+150	°C
Soldering temperature, 1.6mm from case for 10s	-	260	

¹⁾ allowed number of short circuits: <1000; time between short circuits: >1s

Thermal Resistance					
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Thermal resistance, junction - case	R_{thJC}	-	-	0.9	K/W
Thermal resistance, junction - ambient	R_{thJA}				
TO-220AB		-	-	62	
TO-247AC		-	-	40	
SMD version, device on PCB: ¹⁾	R_{thJA}	-	-	40	
TO-263AB					

Electrical Characteristics, at $T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Static Characteristics					
Collector-emitter breakdown voltage $V_{GE} = 0\text{ V}$, $I_C = 500\text{ }\mu\text{A}$	$V_{(BR)CES}$	600	-	-	V
Collector-emitter saturation voltage $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $T_j = 25\text{ °C}$ $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $T_j = 150\text{ °C}$	$V_{CE(sat)}$	1.6 -	2 2.3	2.5 2.7	
Gate-emitter threshold voltage $I_C = 300\text{ }\mu\text{A}$, $V_{CE} = V_{GE}$	$V_{GE(th)}$	3	4	5	
Zero gate voltage collector current $V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$, $T_j = 25\text{ °C}$ $V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$, $T_j = 150\text{ °C}$	I_{CES}	-	-	40 2000	μA
Gate-emitter leakage current $V_{GE} = 20\text{ V}$, $V_{CE} = 0\text{ V}$	I_{GES}	-	-	100	

¹⁾ Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 μm thick) copper area for collector connection. PCB is vertical without blown air.

Electrical Characteristics, at $T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Transconductance $V_{CE} = 20\text{ V}, I_C = 15\text{ A}$	g_{fs}	3	10.9	-	S
Input capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{iss}	-	800	960	pF
Output capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{oss}	-	84	100	
Reverse transfer capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{rss}	-	52	63	

Characteristics

Gate charge $V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, I_C = 15\text{ A}$	Q_{Gate}	-	76	100	nC
Internal emitter inductance measured 5mm from case	L_E	-	7	-	nH

Safe Operating Area Characteristics

Short circuit collector current 1) $V_{CE} \leq 600\text{ V}, V_{GE} = 15\text{ V}, t_{sc} \leq 10\text{ }\mu\text{s},$ $T_j \leq 150\text{ °C}$	-	-	-	150	A
Turn off safe operating area $V_{CE} \leq 600\text{ V}, T_j \leq 150\text{ °C}$	-	-	-	62	

1) allowed number of short circuits: <1000; time between short circuits: >1s

SIEMENS**SGP15N60, SGB15N60, SGW15N60**

Switching Characteristics, Inductive Load (Diode: BUP602D), at $T_j = 25\text{ °C}$					
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Turn-on delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = 21\ \Omega$	$t_{d(on)}$	-	24	29	ns
Rise time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = 21\ \Omega$	t_r	-	33	40	
Turn-off delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 15\text{ A}$, $R_{Goff} = 21\ \Omega$	$t_{d(off)}$	-	234	280	
Fall time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 15\text{ A}$, $R_{Goff} = 21\ \Omega$	t_f	-	46	55	
Turn-on energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = 21\ \Omega$	E_{on}	-	0.66	0.77	mJ
Turn-off energy $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 15\text{ A}$, $R_{Goff} = 21\ \Omega$	E_{off}	-	0.27	0.35	
Total switching energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 15\text{ A}$, $R_G = 25\ \Omega$	E_{ts}	-	0.93	1.12	

¹⁾ E_{on} and E_{ts} include BUP602D diode commutation losses.

SIEMENS**SGP15N60, SGB15N60, SGW15N60****Switching Characteristics, Inductive Load (Diode: BUP602D), at $T_j = 150\text{ °C}$**

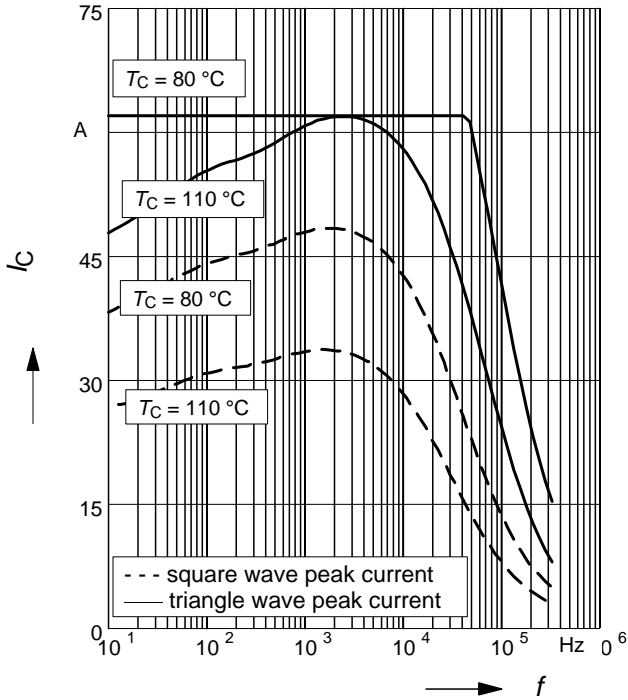
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Turn-on delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = 21\ \Omega$	$t_{d(on)}$	-	23	28	ns
Rise time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = 21\ \Omega$	t_r	-	30	36	
Turn-off delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 15\text{ A}$, $R_{Goff} = 21\ \Omega$	$t_{d(off)}$	-	261	313	
Fall time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 15\text{ A}$, $R_{Goff} = 21\ \Omega$	t_f	-	54	65	
Turn-on energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$, $R_{Gon} = 21\ \Omega$	E_{on}	-	0.92	1.05	mJ
Turn-off energy $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 15\text{ A}$, $R_{Goff} = 21\ \Omega$	E_{off}	-	0.41	0.53	
Total switching energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 15\text{ A}$, $R_G = 21\ \Omega$	E_{ts}	-	1.33	1.58	

1) E_{on} and E_{ts} include BUP602D diode commutation losses.

Typ. collector current

$$I_C = f(f)$$

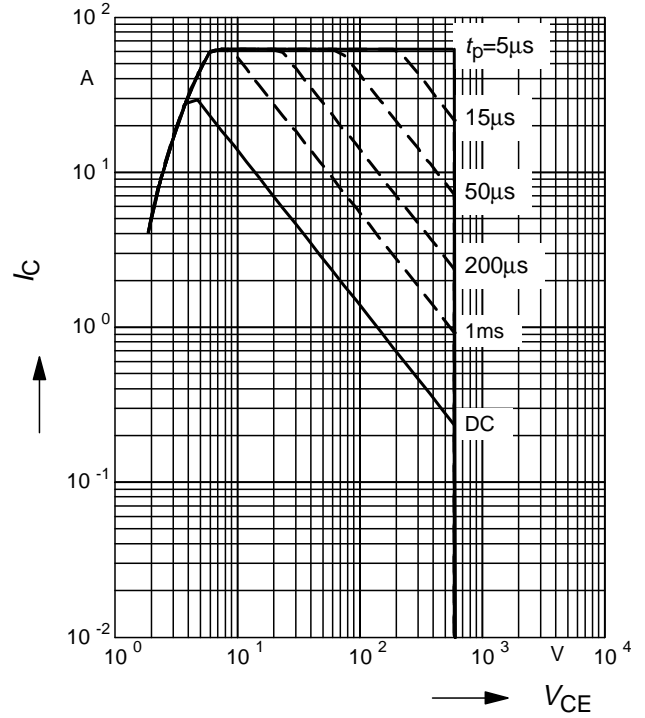
parameter: $D = 0.5, T_j \leq 150\text{ °C}$



Safe operating area

$$I_C = f(V_{CE})$$

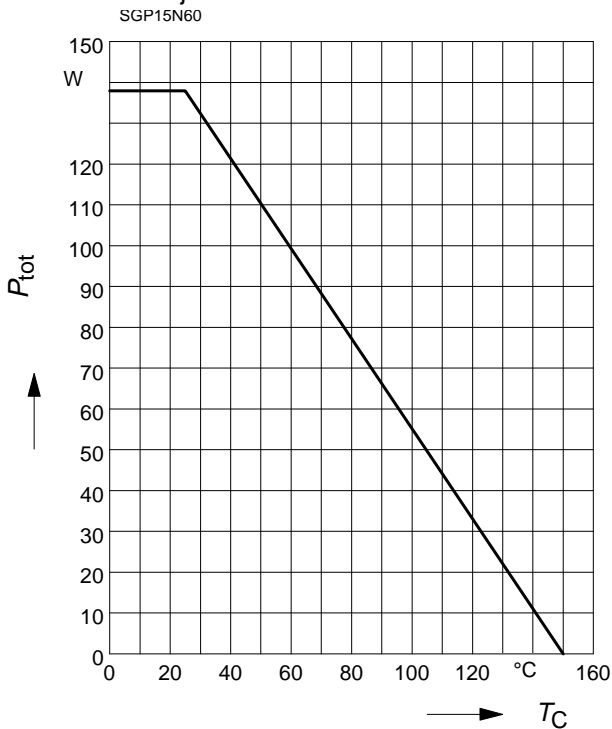
parameter: $D = 0, T_C = 25\text{ °C}, T_j \leq 150\text{ °C}$



Power dissipation

$$P_{\text{tot}} = f(T_C)$$

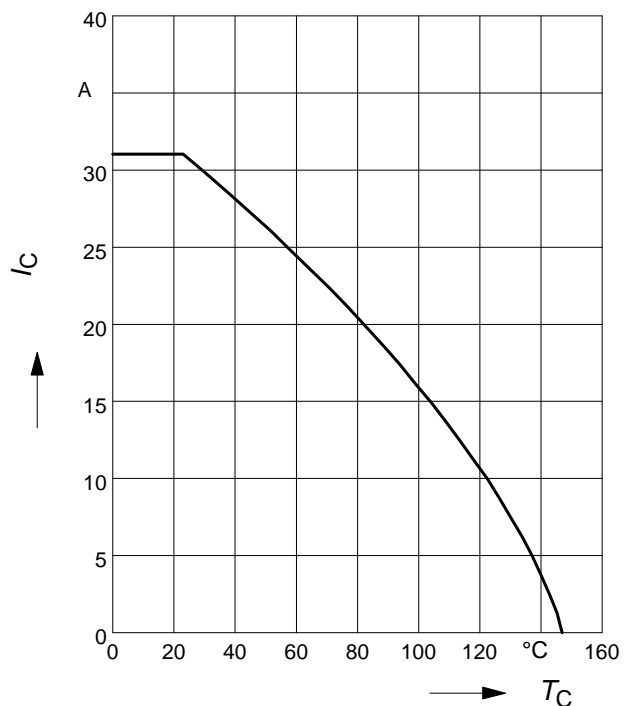
parameter: $T_j \leq 150\text{ °C}$



Collector current

$$I_C = f(T_C)$$

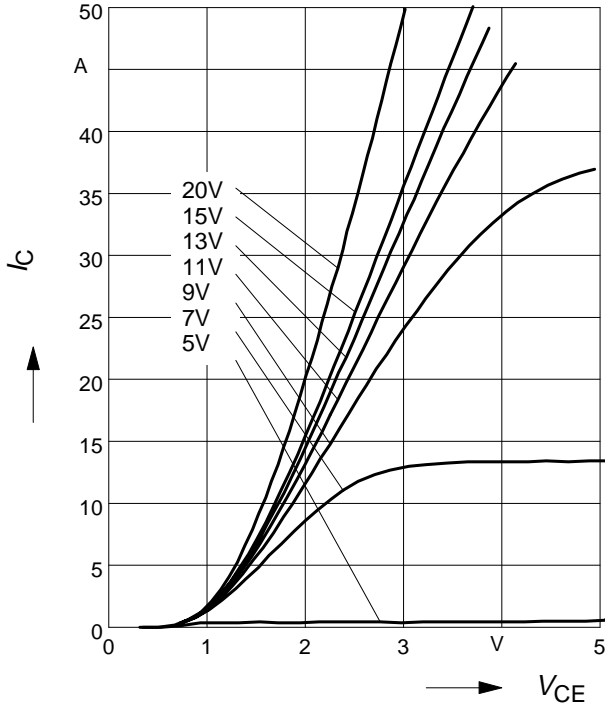
parameter: $V_{GE} \geq 15\text{ V}, T_j \leq 150\text{ °C}$



Typ. output characteristics

$$I_C = f(V_{CE})$$

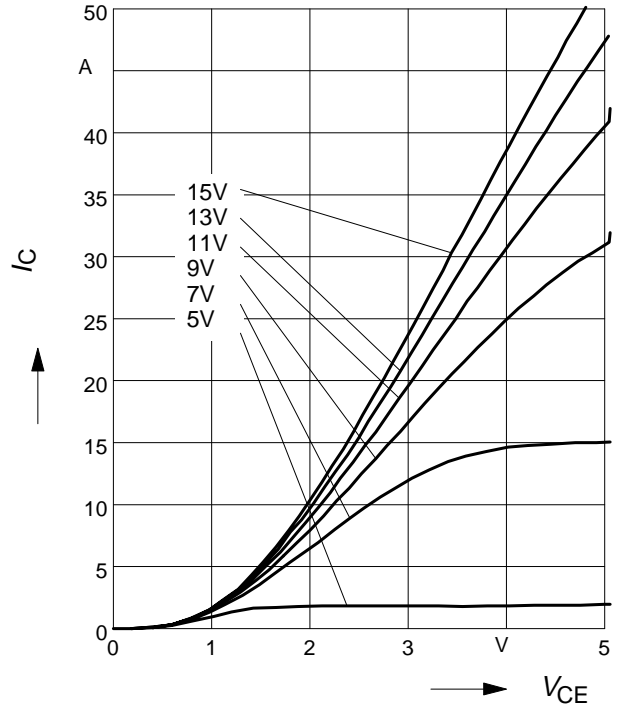
parameter: $t_p = 80 \mu s$, $T_j = 25 \text{ }^\circ\text{C}$



Typ. output characteristics

$$I_C = f(V_{CE})$$

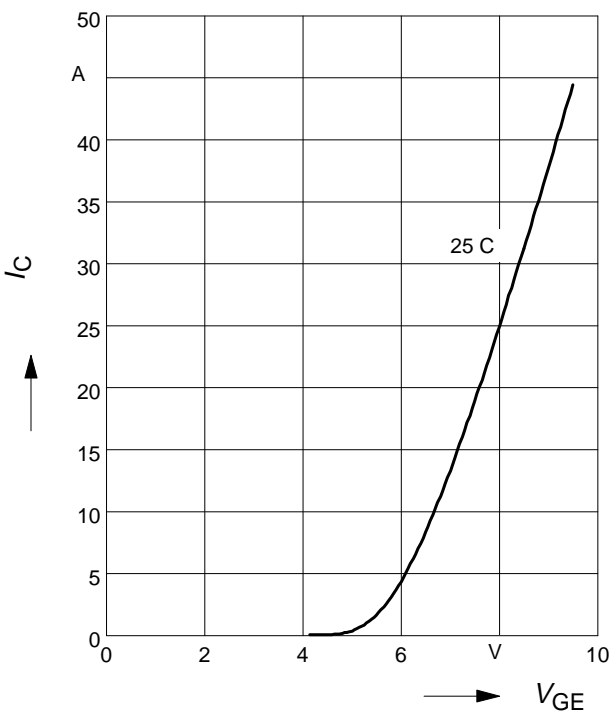
parameter: $t_p = 80 \mu s$, $T_j = 150 \text{ }^\circ\text{C}$



Typ. transfer characteristics

$$I_C = f(V_{GE})$$

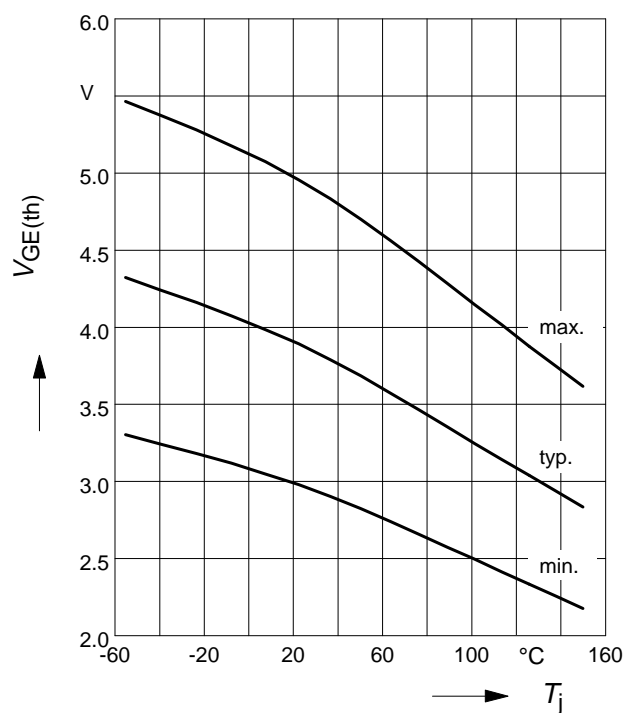
parameter: $t_p = 80 \mu s$, $V_{CE} = 10 \text{ V}$



Gate-emitter threshold voltage

$$V_{GE(th)} = f(T_j)$$

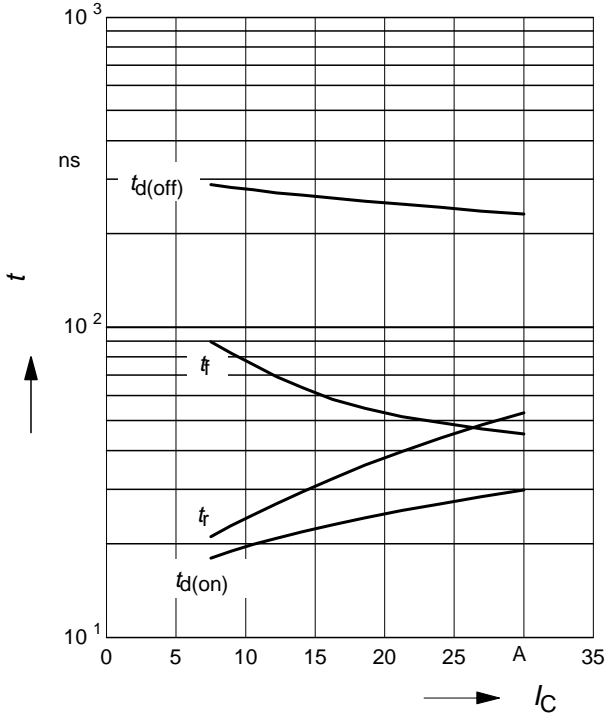
parameter: $I_C = 0.3 \text{ mA}$



Typ. switching time

$t = f(I_C)$, inductive load, $T_j = 150^\circ\text{C}$

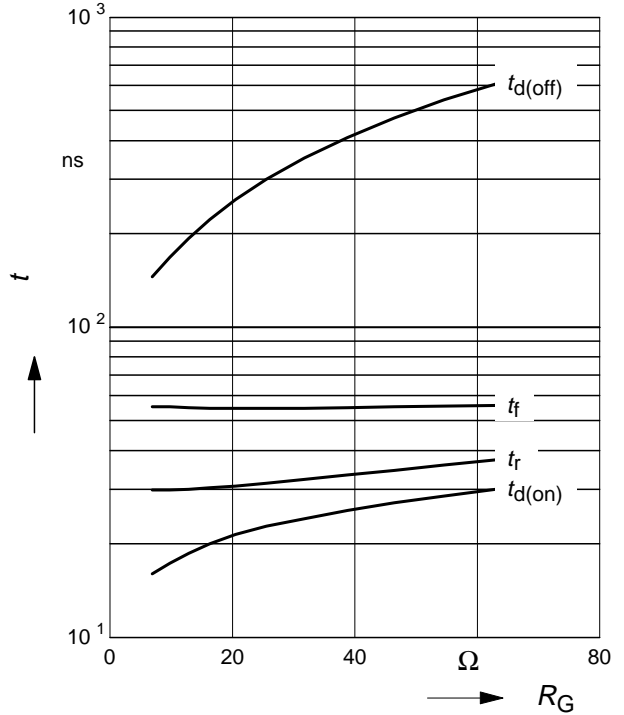
par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $R_G = 21\ \Omega$



Typ. switching time

$t = f(R_G)$, inductive load, $T_j = 150^\circ\text{C}$

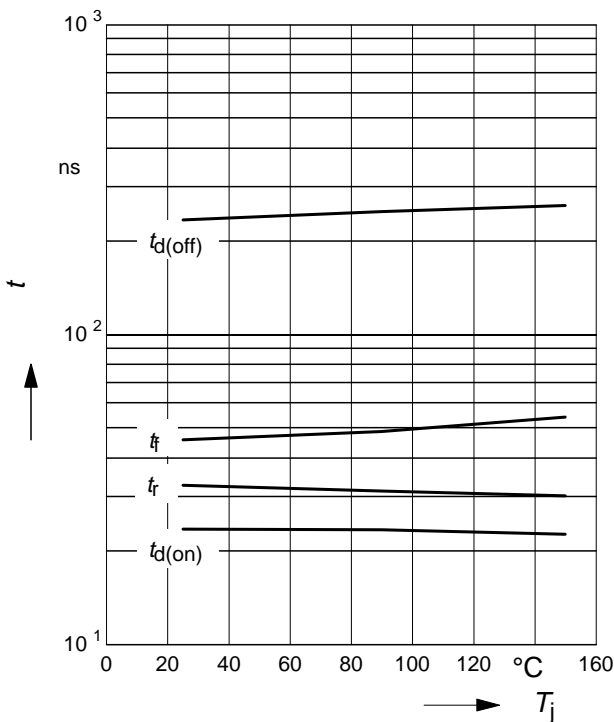
par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 15\text{ A}$



Typ. switching time

$t = f(T_j)$, inductive load, $V_{CE} = 400\text{ V}$

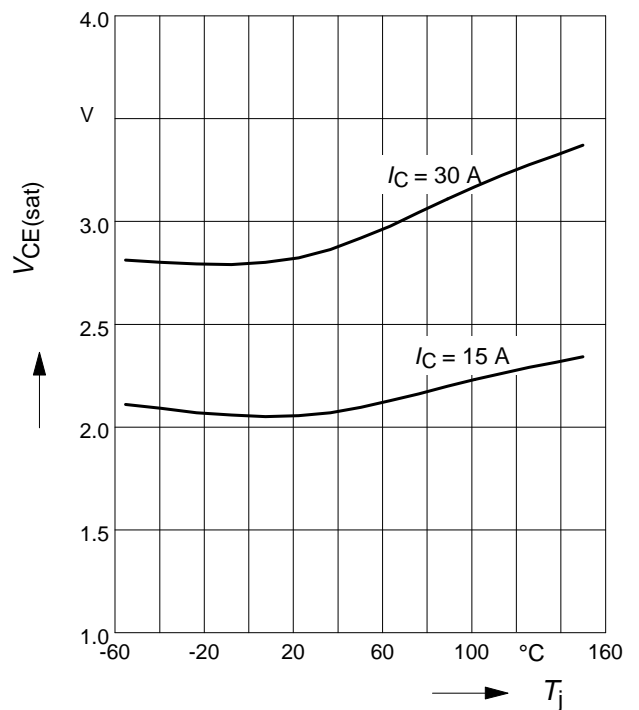
$V_{GE} = 0/+15\text{ V}$, $I_C = 15\text{ A}$, $R_G = 21\ \Omega$



Typ. collector-emitter saturation voltage

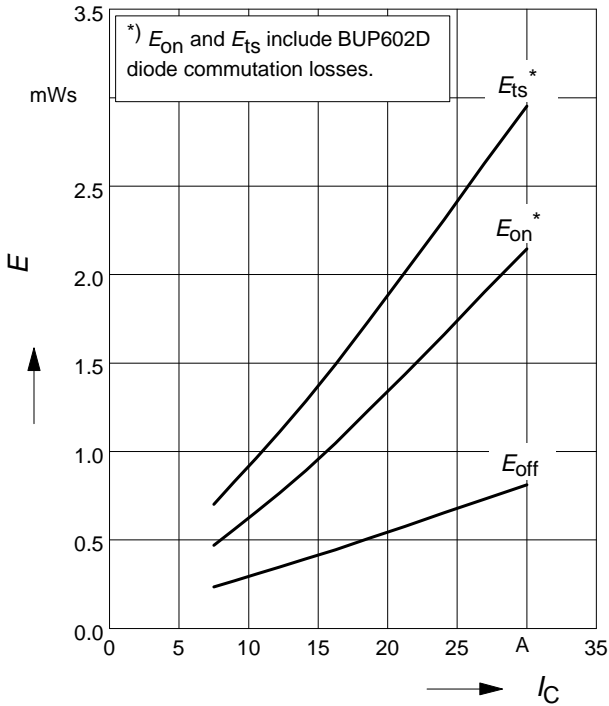
$V_{CE(sat)} = f(T_j)$

parameter: $V_{GE} = 15\text{ V}$



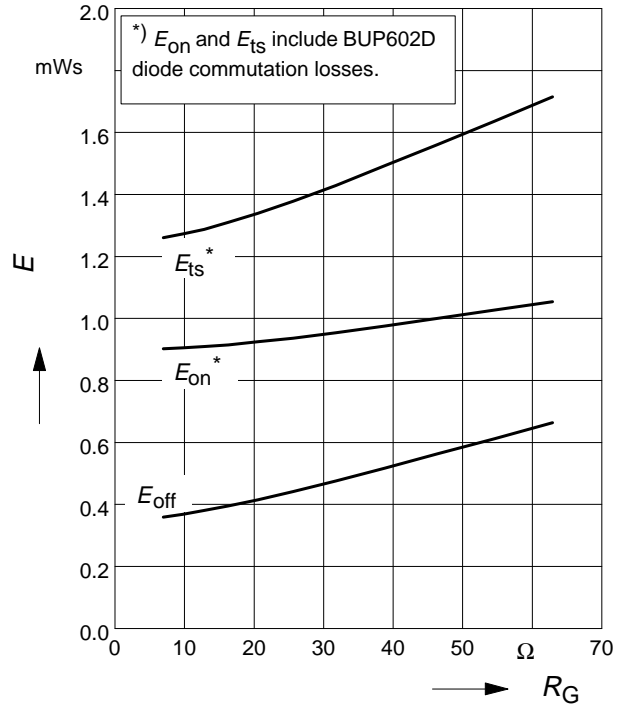
Typ. switching losses

$E = f(I_C)$, inductive load, $T_j = 150^\circ\text{C}$
 par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 21\ \Omega$



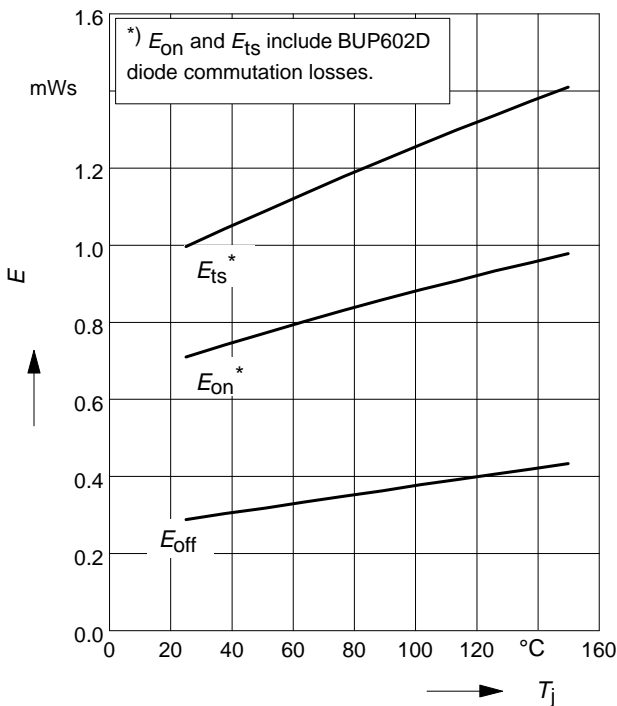
Typ. switching losses

$E = f(R_G)$, inductive load, $T_j = 150^\circ\text{C}$
 par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 15\text{ A}$



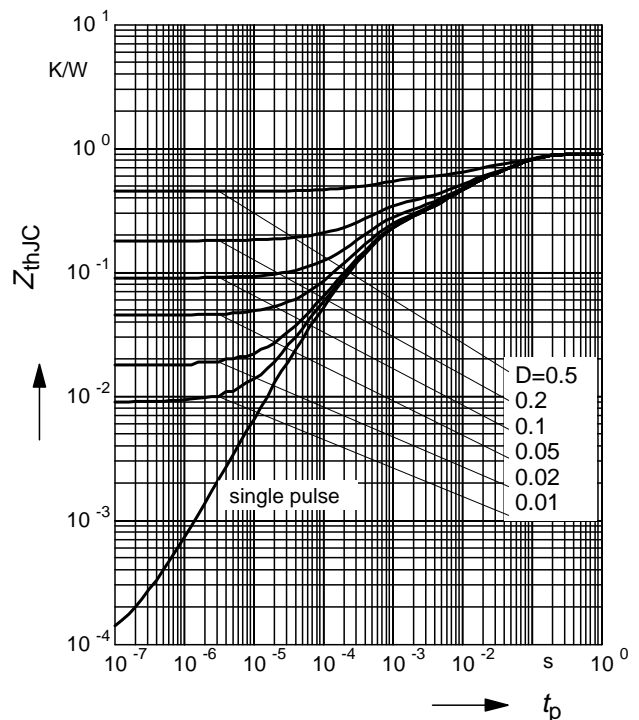
Typ. switching losses

$E = f(T_j)$, inductive load, $V_{CE} = 400\text{ V}$,
 $V_{GE} = 0/+15\text{ V}$, $I_C = 15\text{ A}$, $R_G = 21\ \Omega$



Transient thermal impedance

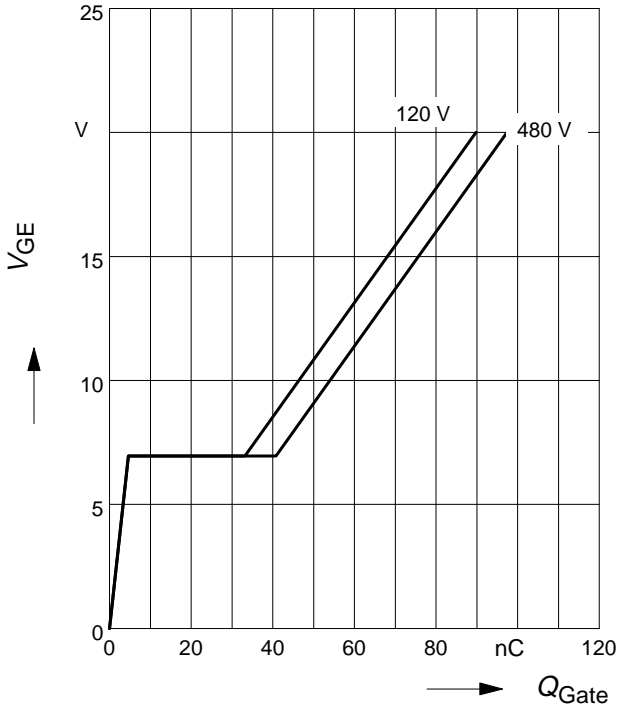
$Z_{thJC} = f(t_p)$
 parameter: $D = t_p / T$



Typ. gate charge

$$V_{GE} = f(Q_{Gate})$$

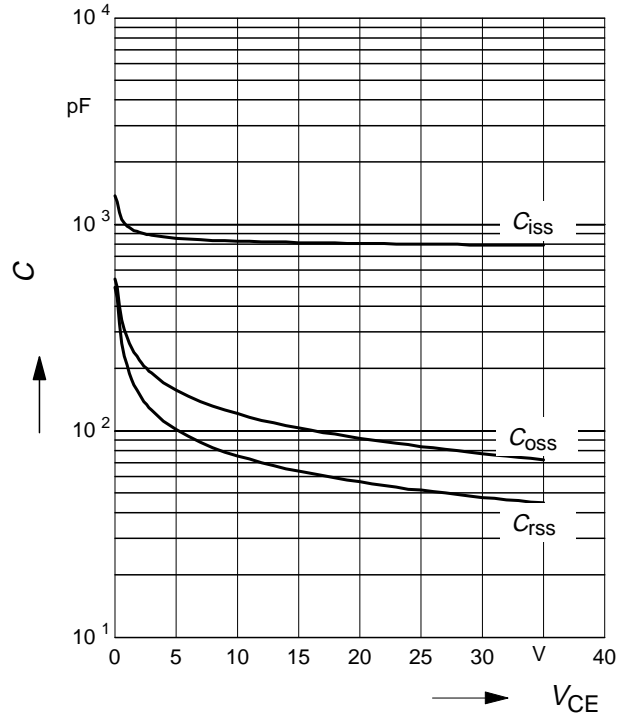
parameter: $I_C = 15 \text{ A}$



Typ. capacitances

$$C = f(V_{CE})$$

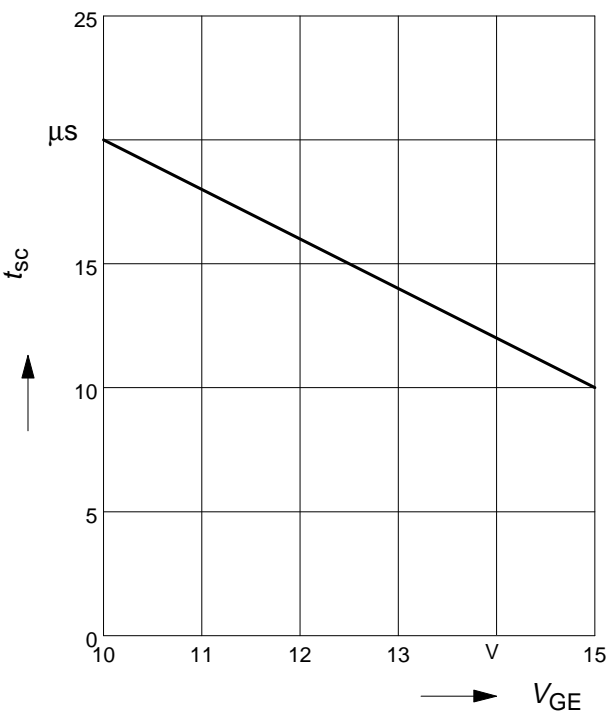
parameter: $V_{GE} = 0 \text{ V}, f = 1 \text{ MHz}$



Short circuit withstand time

$$t_{sc} = f(V_{GE})$$

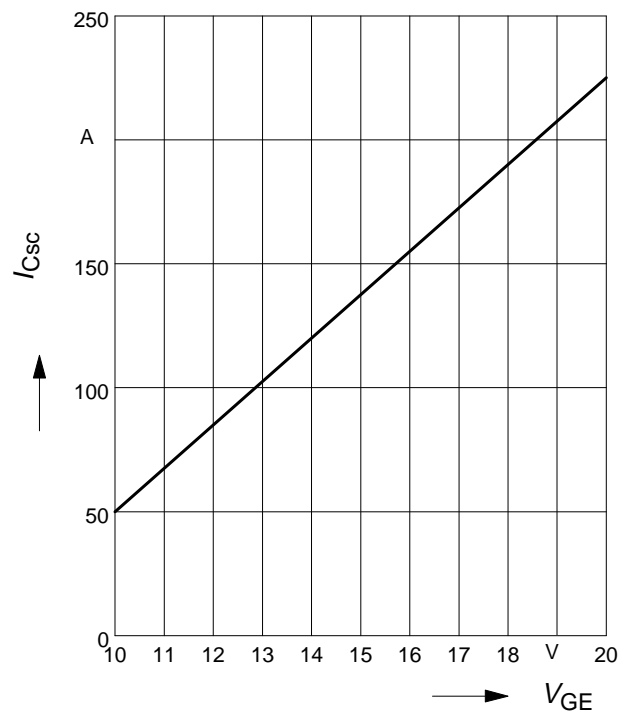
par.: $V_{CE} = 600 \text{ V}$, start at $T_j = 25 \text{ }^\circ\text{C}$



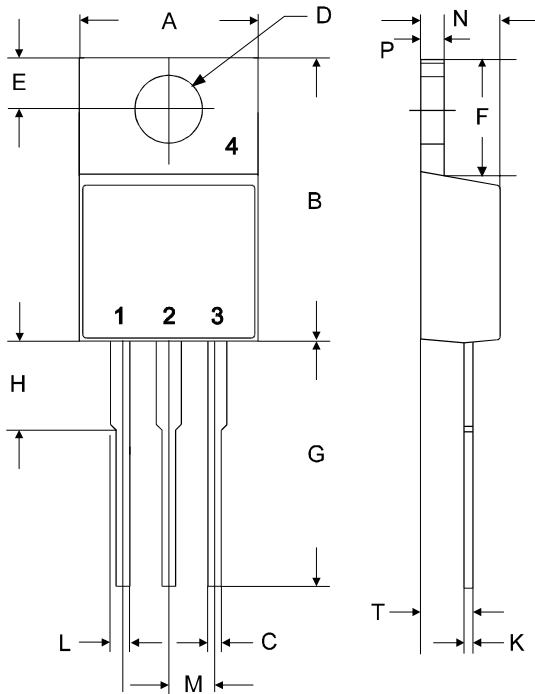
Typ. short circuit current

$$I_{Csc} = f(V_{GE})$$

par.: $V_{CE} \leq 600 \text{ V}$, $T_C = 25 \text{ }^\circ\text{C}$, $T_j \leq 150 \text{ }^\circ\text{C}$

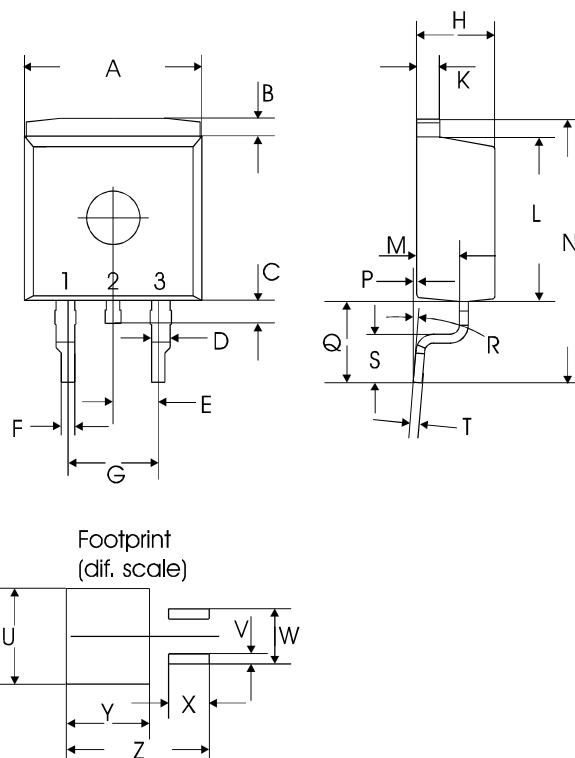


TO-220AB



symbol	dimensions [mm]	
	min	max
A	9.70	10.30
B	14.88	15.95
C	0.65	0.86
D	3.55	3.89
E	2.60	3.00
F	6.00	6.80
G	13.00	14.00
H	4.35	4.75
K	0.38	0.65
L	0.95	1.32
M	2.54 typ.	
N	4.30	4.50
P	1.17	1.40
T	2.30	2.72

TO-263AB



symbol	dimensions [mm]	
	min	max
A	9.80	10.20
B	0.70	1.30
C	1.00	1.60
D	1.03	1.07
E	2.54 typ.	
F	0.65	0.85
G	5.08 typ.	
H	4.30	4.50
K	1.17	1.37
L	9.05	9.45
M	2.30	2.50
N	15 typ.	
P	0.00	0.20
Q	4.20	5.20
R	8° max	
S	2.40	3.00
T	0.40	0.60
U	10.80	
V	1.15	
W	6.23	
X	4.60	
Y	9.40	
Z	16.15	

Edition 02 / 1999

**Published by Siemens AG,
Bereich Halbleiter Vertrieb,
Werbung, Balanstraße 73,
81541 München**

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