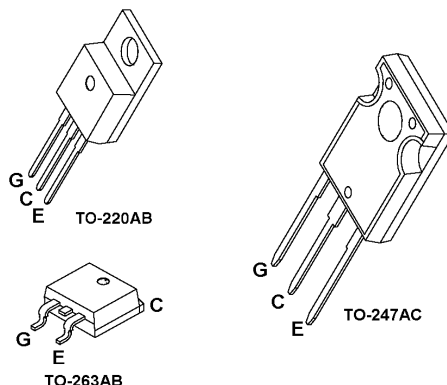


### Fast S-IGBT in NPT-Technology

- 75 % lower  $E_{off}$  compared to previous generation combined with low conduction losses
- Short circuit withstand time 10  $\mu$ 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
SGP20N60	600 V	20 A	2.4 V	150 °C	TO-220AB	Q67041-A4712-A2
SGB20N60					TO-263AB	Q67041-A4712-A3
SGW20N60					TO-247AC	Q67040-S4236

### Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CE}$	600	V
DC collector current	$I_C$		A
$T_C = 25\text{ °C}$		40	
$T_C = 100\text{ °C}$		20	
Pulsed collector current, $t_p$ limited by $T_{jmax}$	$I_{Cpuls}$	80	
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Avalanche energy, single pulse $I_C = 20\text{ A}$ , $V_{CC} = 50\text{ V}$ , $R_{GE} = 25\ \Omega$ , start at $T_j = 25\text{ °C}$	$E_{AS}$	115	mJ
Short circuit withstand time <sup>1)</sup> $V_{GE} = 15\text{ V}$ , $V_{CC} = 600\text{ V}$ , $T_j \leq 150\text{ °C}$	$t_{sc}$	10	$\mu$ s
Power dissipation $T_C = 25\text{ °C}$	$P_{tot}$	178	W
Operating junction and storage temperature	$T_j, T_{stg}$	-55...+150	°C
Soldering temperature, 1.6mm from case for 10s	-	260	

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

Thermal Resistance					
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Characteristics</b>					
Thermal resistance, junction - case	$R_{thJC}$	-	-	0.7	K/W
Thermal resistance, junction - ambient	$R_{thJA}$				
TO-220AB		-	-	62	
TO-247AC		-	-	40	
SMD version, device on PCB: <sup>1)</sup>	$R_{thJA}$	-	-	40	
TO-263AB					

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Static Characteristics</b>					
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 $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $T_j = 25\text{ °C}$ $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $T_j = 150\text{ °C}$	$V_{CE(sat)}$	1.6 -	2 2.4	2.5 2.9	
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 2500	$\mu\text{A}$
Gate-emitter leakage current $V_{GE} = 20\text{ V}$ , $V_{CE} = 0\text{ V}$	$I_{GES}$	-	-	100	

<sup>1)</sup> Device on 50mm\*50mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70  $\mu\text{m}$  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.	
<b>Characteristics</b>					
Transconductance $V_{CE} = 20\text{ V}, I_C = 20\text{ A}$	$g_{fs}$	-	14	-	S
Input capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{iss}$	-	1100	1320	pF
Output capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{oss}$	-	107	128	
Reverse transfer capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{rss}$	-	63	75	

### Characteristics

Gate charge $V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, I_C = 20\text{ A}$	$Q_{Gate}$	-	100	130	nC
Internal emitter inductance measured 5mm from case	$L_E$	-	7	-	nH

### Safe Operating Area Characteristics

Short circuit collector current 1) $V_{CE} \leq 600\text{ V}, V_{GE} = 15\text{ V}, t_{sc} \leq 10\text{ }\mu\text{s},$ $T_j \leq 150\text{ °C}$	-	-	-	200	A
Turn off safe operating area $V_{CE} \leq 600\text{ V}, T_j \leq 150\text{ °C}$	-	-	-	80	

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

**SIEMENS****SGP20N60, SGB20N60, SGW20N60****Switching Characteristics, Inductive Load (Diode: BUP602D), at  $T_j = 25\text{ °C}$** 

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Characteristics</b>					
Turn-on delay time $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Gon} = 16\text{ }\Omega$	$t_{d(on)}$	-	24	29	ns
Rise time $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Gon} = 16\text{ }\Omega$	$t_r$	-	38	46	
Turn-off delay time $V_{CC} = 400\text{ V}$ , $V_{GE} = 0\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Goff} = 16\text{ }\Omega$	$t_{d(off)}$	-	225	270	
Fall time $V_{CC} = 400\text{ V}$ , $V_{GE} = 0\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Goff} = 16\text{ }\Omega$	$t_f$	-	54	65	
Turn-on energy <sup>1)</sup> $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Gon} = 16\text{ }\Omega$	$E_{on}$	-	0.87	1	mJ
Turn-off energy $V_{CC} = 400\text{ V}$ , $V_{GE} = 0\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Goff} = 16\text{ }\Omega$	$E_{off}$	-	0.33	0.43	
Total switching energy <sup>1)</sup> $V_{CC} = 400\text{ V}$ , $V_{GE} = 0/+15\text{ V}$ , $I_C = 20\text{ A}$ , $R_G = 16\text{ }\Omega$	$E_{ts}$	-	1.2	1.43	

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

**SIEMENS****SGP20N60, SGB20N60, SGW20N60****Switching Characteristics, Inductive Load (Diode: BUP602D), at  $T_j = 150\text{ °C}$** 

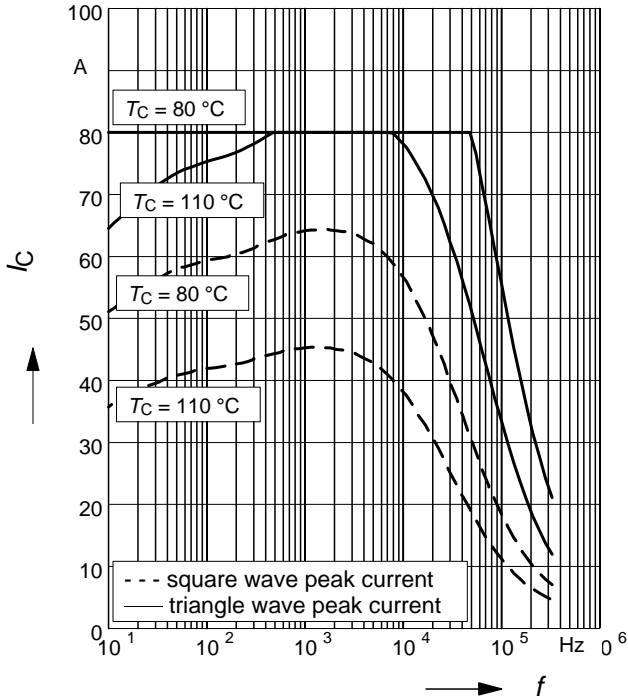
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Characteristics</b>					
Turn-on delay time $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Gon} = 16\text{ }\Omega$	$t_{d(on)}$	-	22	27	ns
Rise time $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Gon} = 16\text{ }\Omega$	$t_r$	-	35	42	
Turn-off delay time $V_{CC} = 400\text{ V}$ , $V_{GE} = 0\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Goff} = 16\text{ }\Omega$	$t_{d(off)}$	-	250	300	
Fall time $V_{CC} = 400\text{ V}$ , $V_{GE} = 0\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Goff} = 16\text{ }\Omega$	$t_f$	-	63	76	
Turn-on energy <sup>1)</sup> $V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Gon} = 16\text{ }\Omega$	$E_{on}$	-	1.18	1.36	mJ
Turn-off energy $V_{CC} = 400\text{ V}$ , $V_{GE} = 0\text{ V}$ , $I_C = 20\text{ A}$ , $R_{Goff} = 16\text{ }\Omega$	$E_{off}$	-	0.49	0.64	
Total switching energy <sup>1)</sup> $V_{CC} = 400\text{ V}$ , $V_{GE} = 0/+15\text{ V}$ , $I_C = 20\text{ A}$ , $R_G = 16\text{ }\Omega$	$E_{ts}$	-	1.67	2	

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

### Typ. collector current

$$I_C = f(f)$$

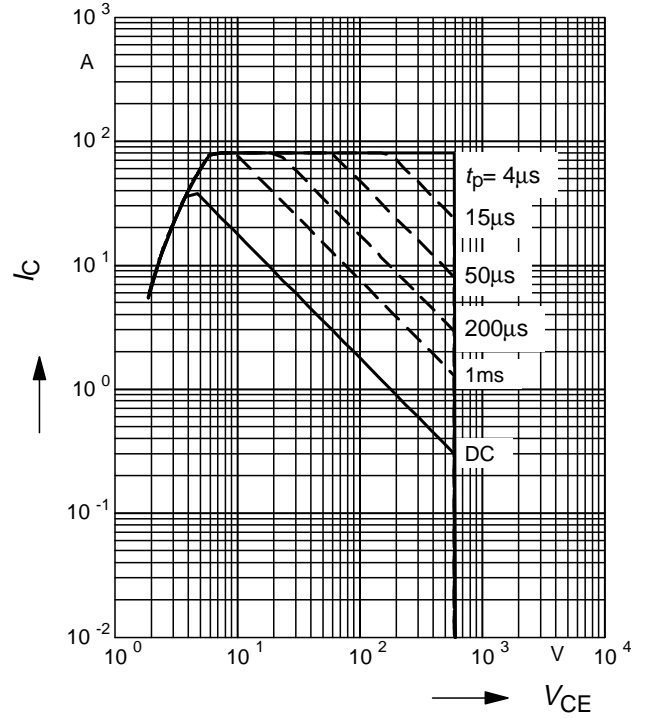
parameter:  $D = 0.5, T_j \leq 150\text{ °C}$



### Safe operating area

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

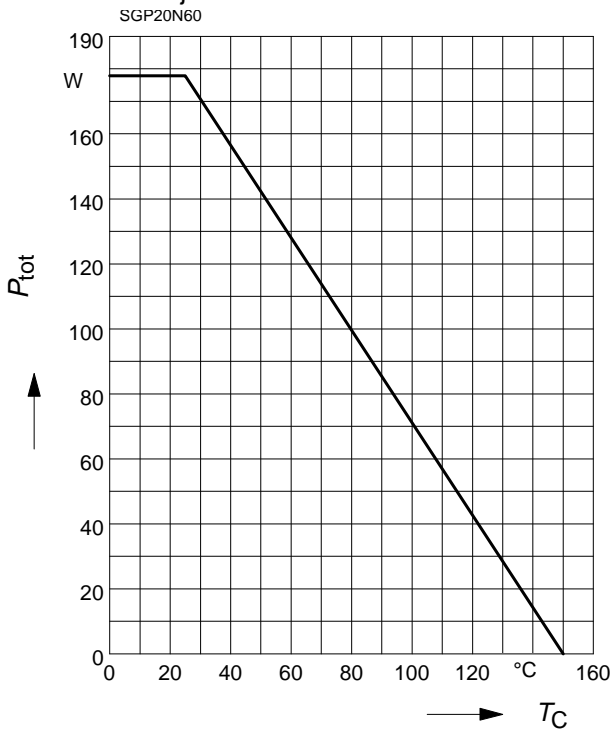
parameter:  $D = 0, T_C = 25\text{ °C}, T_j \leq 150\text{ °C}$



### Power dissipation

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

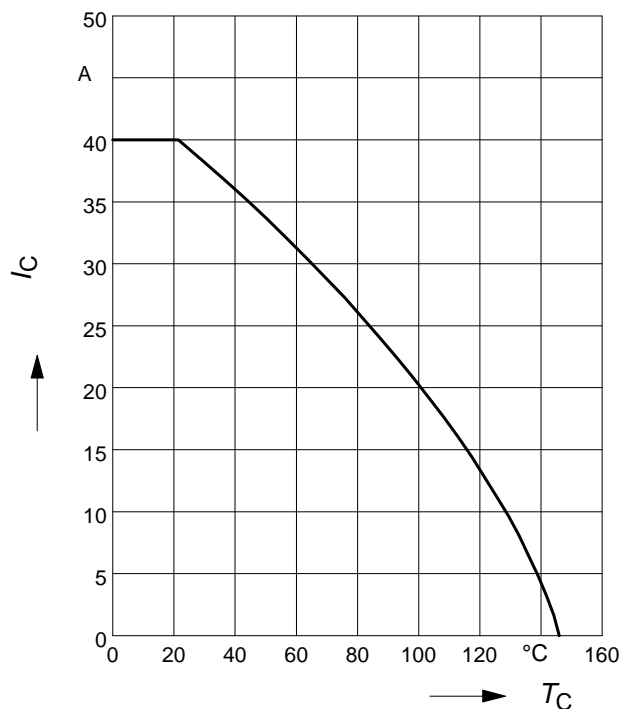
parameter:  $T_j \leq 150\text{ °C}$



### Collector current

$$I_C = f(T_C)$$

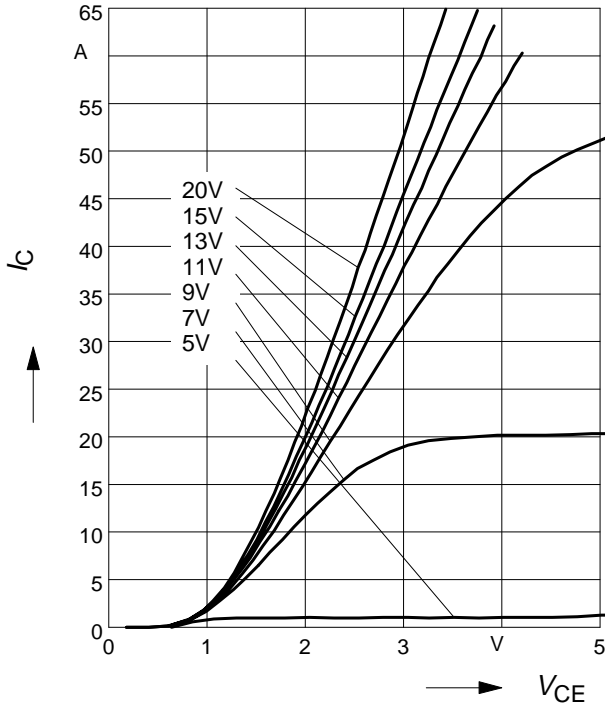
parameter:  $V_{GE} \geq 15\text{ V}, T_j \leq 150\text{ °C}$



### Typ. output characteristics

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

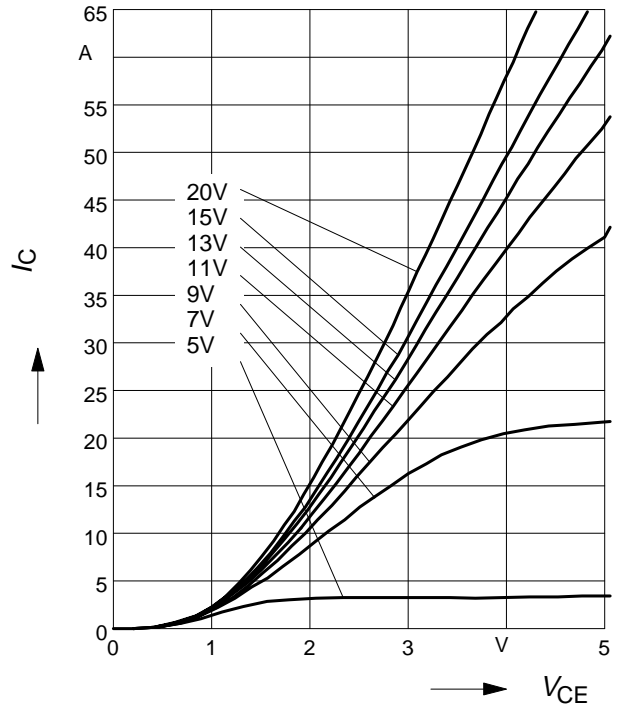
parameter:  $t_p = 80 \mu s$ ,  $T_j = 25 \text{ }^\circ\text{C}$



### Typ. output characteristics

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

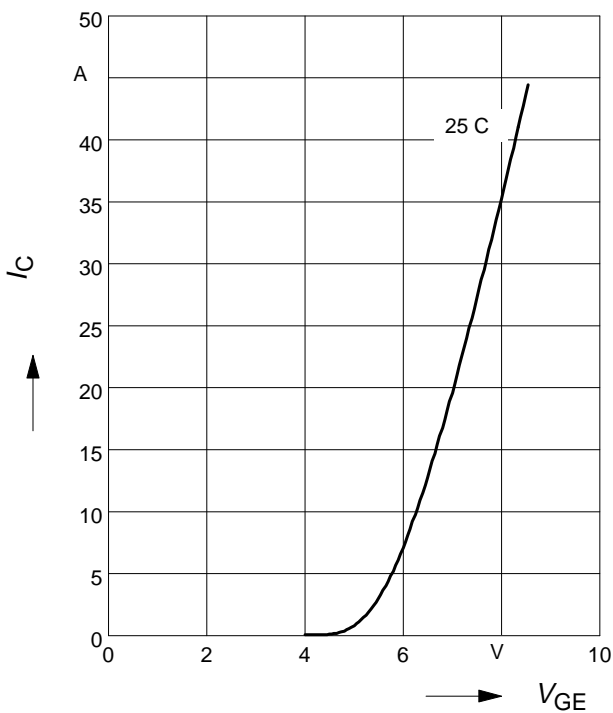
parameter:  $t_p = 80 \mu s$ ,  $T_j = 150 \text{ }^\circ\text{C}$



### Typ. transfer characteristics

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

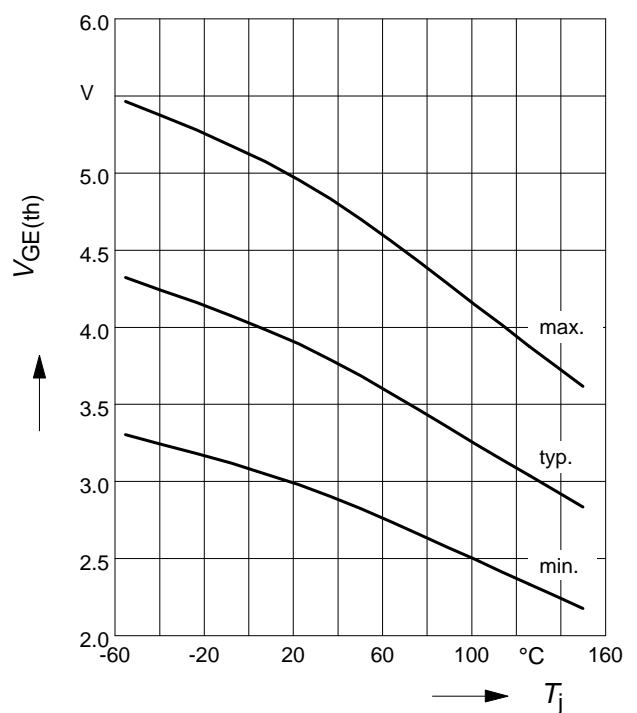
parameter:  $t_p = 80 \mu s$ ,  $V_{CE} = 10 \text{ V}$



### Gate-emitter threshold voltage

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

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



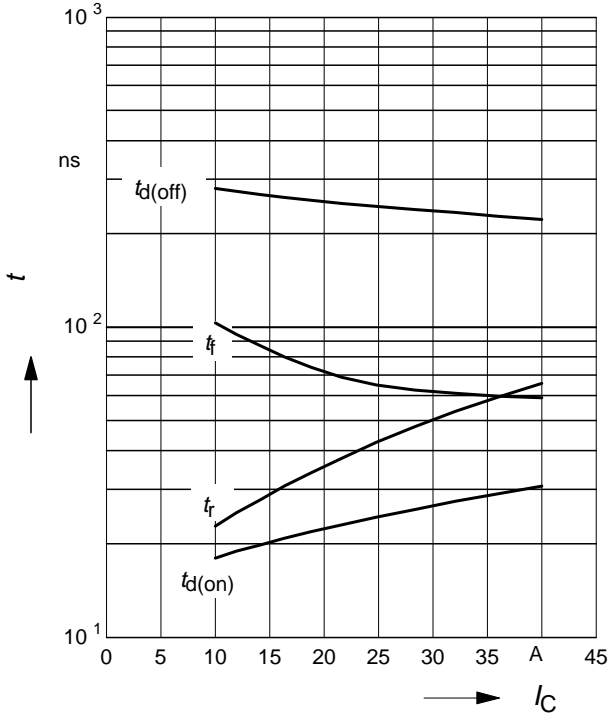
# SIEMENS

## SGP20N60, SGB20N60, SGW20N60

**Typ. switching time**

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

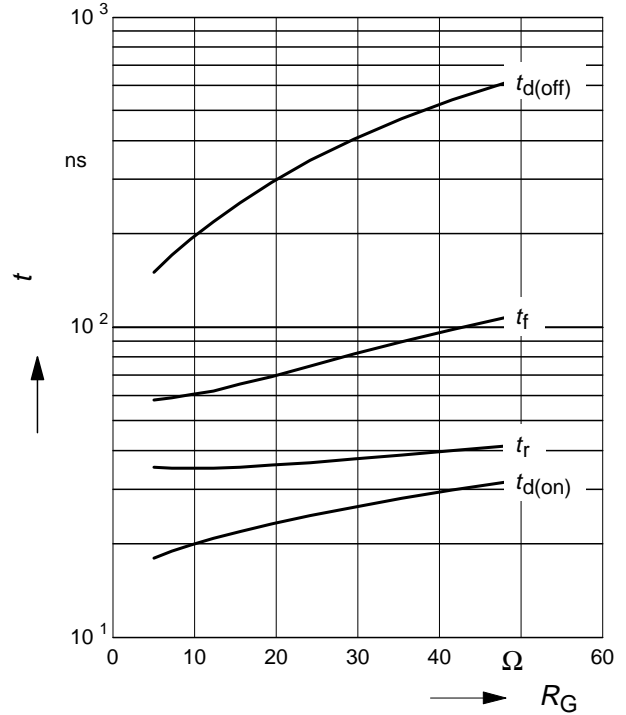
par.:  $V_{CE} = 400\text{ V}$ ,  $V_{GE} = 0/+15\text{ V}$ ,  $R_G = 16\ \Omega$



**Typ. switching time**

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

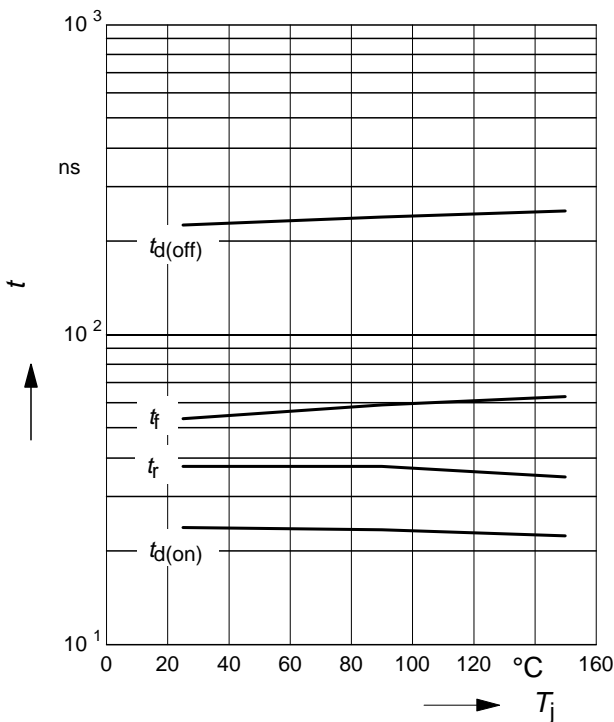
par.:  $V_{CE} = 400\text{ V}$ ,  $V_{GE} = 0/+15\text{ V}$ ,  $I_C = 20\text{ A}$



**Typ. switching time**

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

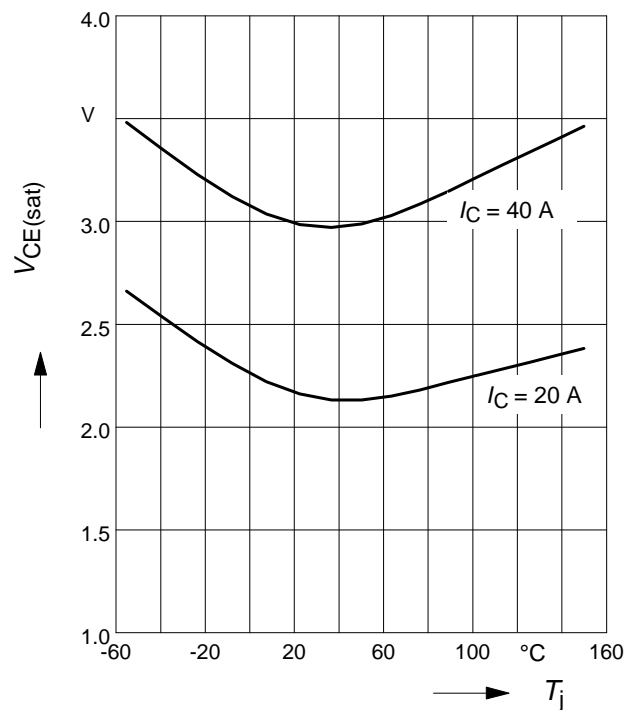
$V_{GE} = 0/+15\text{ V}$ ,  $I_C = 20\text{ A}$ ,  $R_G = 16\ \Omega$



**Typ. collector-emitter saturation voltage**

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

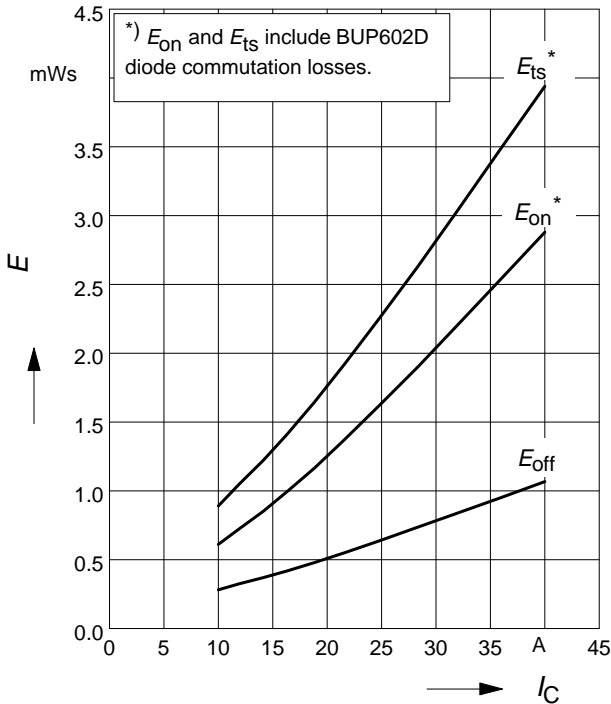
parameter:  $V_{GE} = 15\text{ V}$





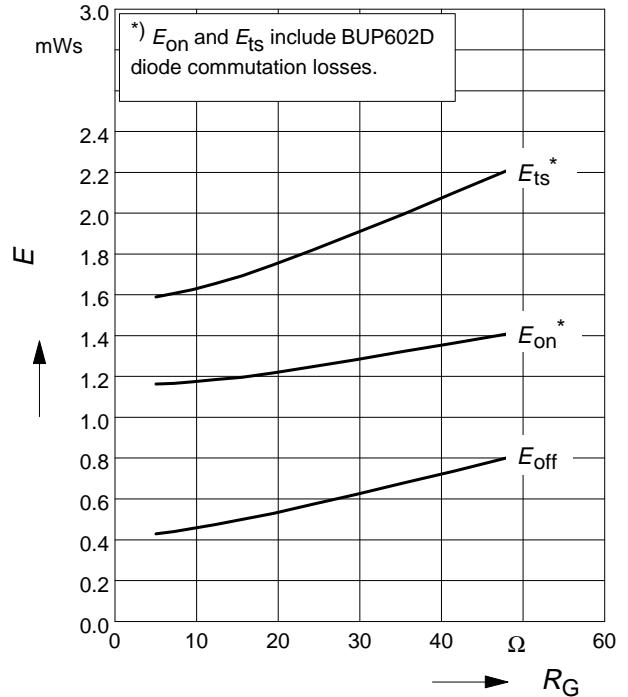
### Typ. switching losses

$E = f(I_C)$ , inductive load,  $T_j = 150^\circ\text{C}$   
 par.:  $V_{CE} = 400\text{ V}$ ,  $V_{GE} = 0/+15\text{V}$ ,  $R_G = 16\ \Omega$



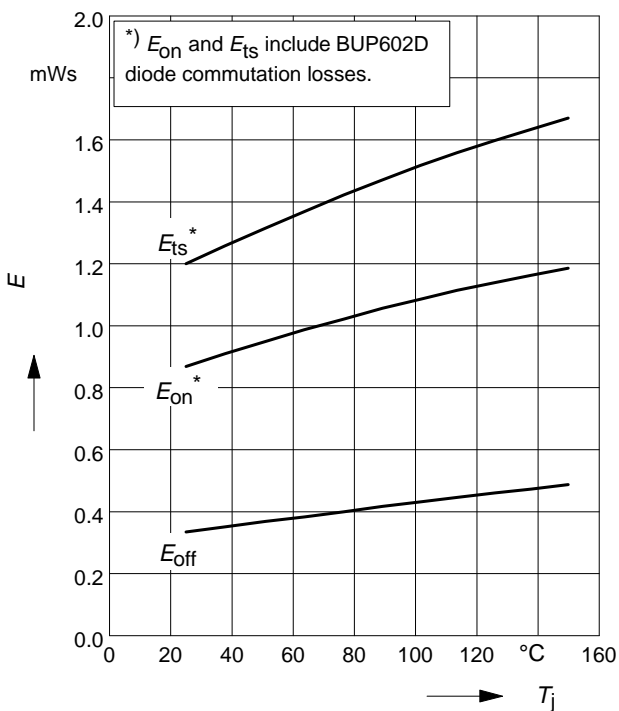
### Typ. switching losses

$E = f(R_G)$ , inductive load,  $T_j = 150^\circ\text{C}$   
 par.:  $V_{CE} = 400\text{ V}$ ,  $V_{GE} = 0/+15\text{ V}$ ,  $I_C = 20\text{ A}$



### Typ. switching losses

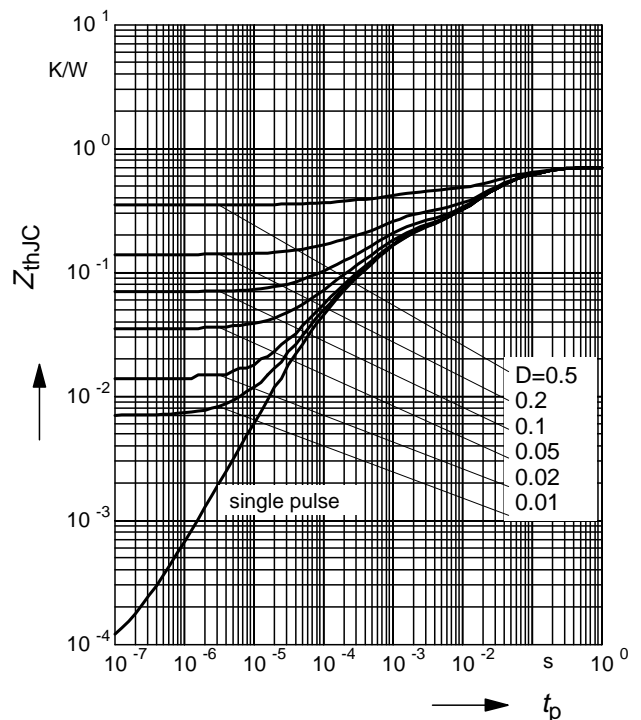
$E = f(T_j)$ , inductive load,  $V_{CE} = 400\text{ V}$ ,  
 $V_{GE} = 0/+15\text{ V}$ ,  $I_C = 20\text{ A}$ ,  $R_G = 16\ \Omega$



### Transient thermal impedance

$Z_{thJC} = f(t_p)$

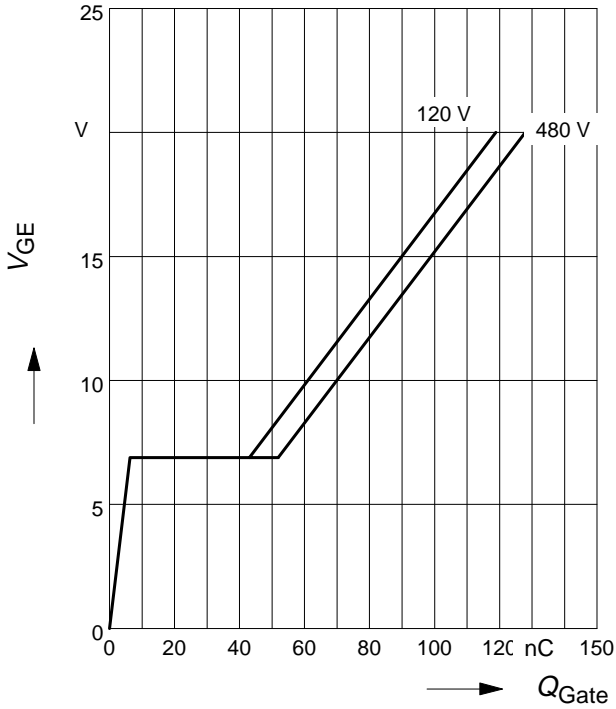
parameter:  $D = t_p / T$



### Typ. gate charge

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

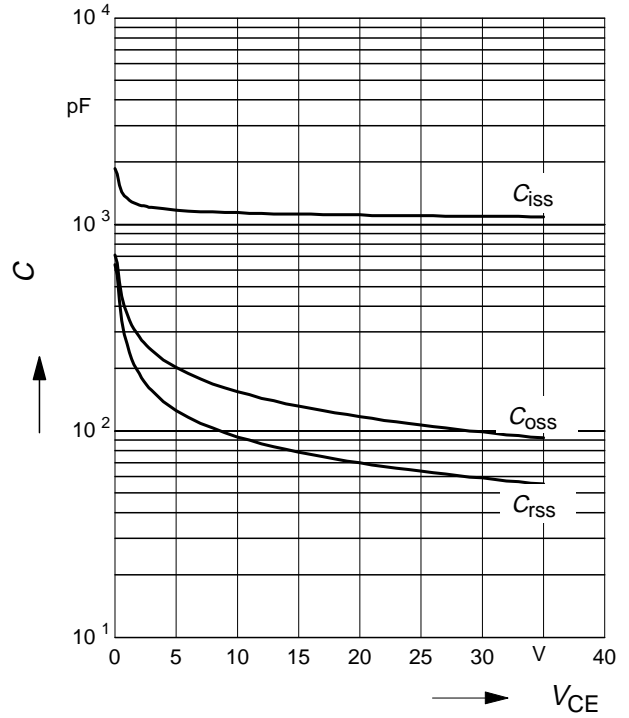
parameter:  $I_C = 20 \text{ A}$



### Typ. capacitances

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

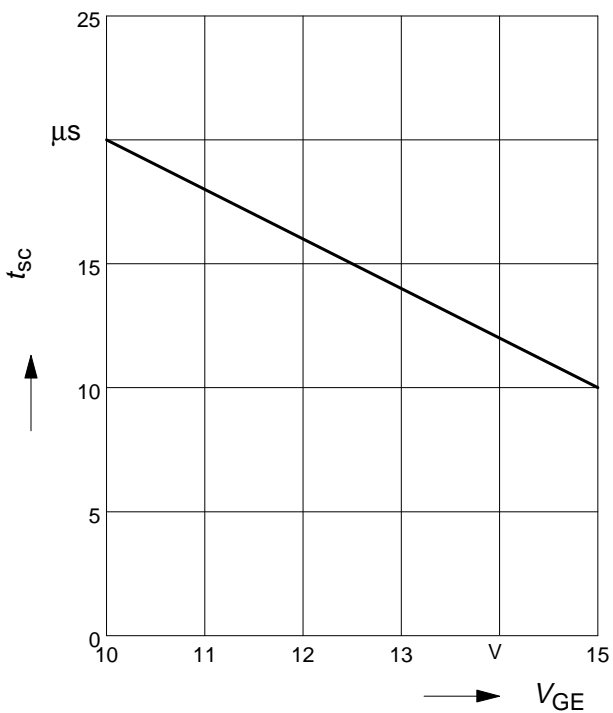
parameter:  $V_{GE} = 0 \text{ V}$ ,  $f = 1 \text{ MHz}$



### Short circuit withstand time

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

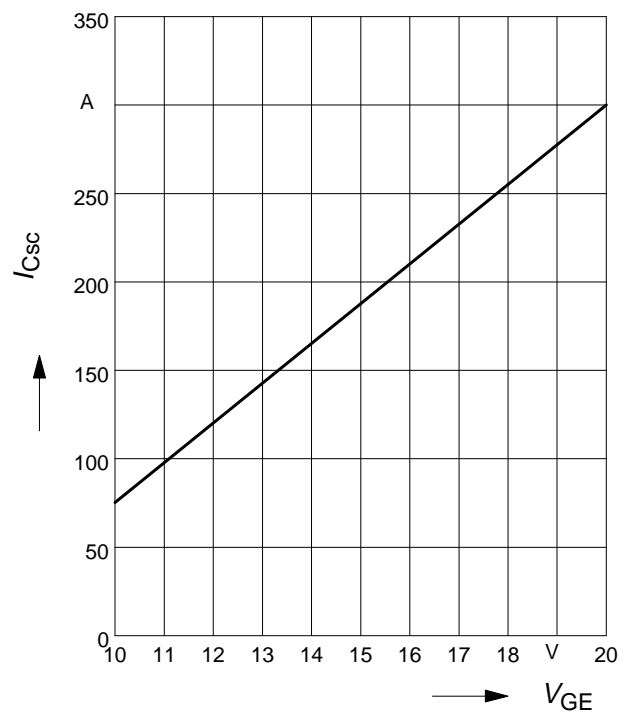
par.:  $V_{CE} = 600 \text{ V}$ , start at  $T_j = 25 \text{ }^\circ\text{C}$



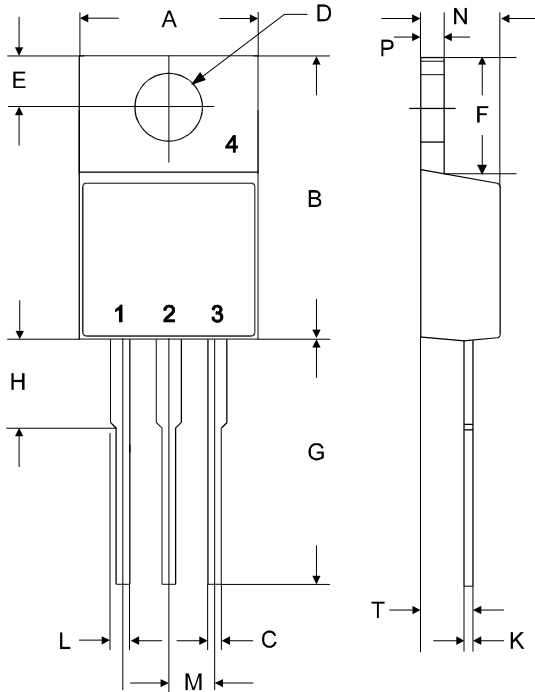
### Typ. short circuit current

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

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

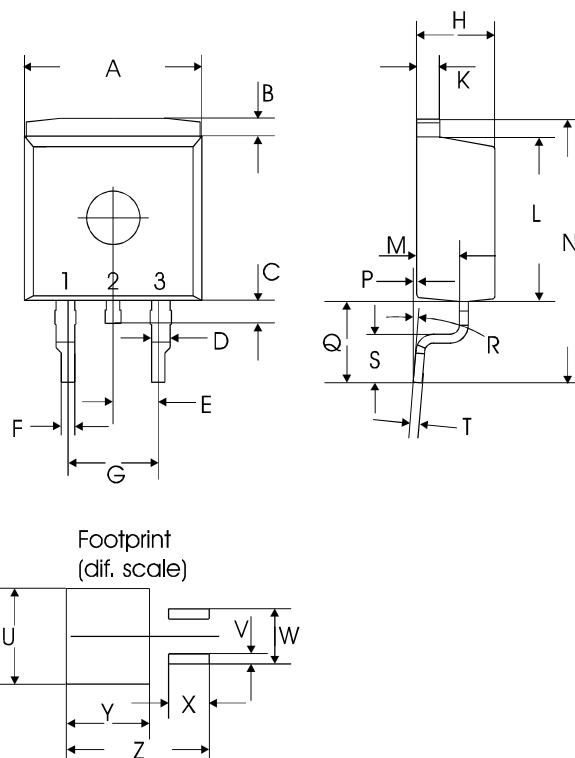


TO-220AB



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	

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