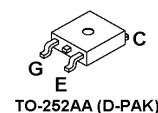
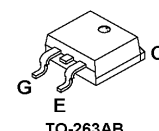
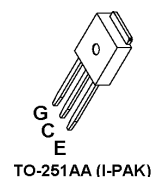
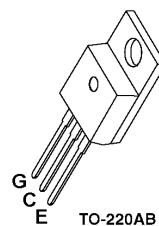


Fast S-IGBT in NPT-Technology

- 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
SGP04N60	600 V	4 A	2.3 V	150 °C	TO-220AB	Q67041-A4708-A2
SGB04N60					TO-263AB	Q67041-A4708-A4
SGD04N60					TO-252AA(DPak)	Q67041-A4708-A5
SGU04N60					TO-251AA(IPak)	Q67041-A4708-A6

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current	I_C		A
$T_C = 25\text{ °C}$		9.4	
$T_C = 100\text{ °C}$		4.9	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	19	
Gate-emitter voltage	V_{GE}	± 20	V
Avalanche energy, single pulse $I_C = 4\text{ A}$, $V_{CC} = 50\text{ V}$, $R_{GE} = 25\ \Omega$, start at $T_j = 25\text{ °C}$	E_{AS}	25	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}	50	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

SIEMENS**SGP04N60, SGB04N60, SGD04N60, SGU04N60**

Thermal Resistance					
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Thermal resistance, junction - case	R_{thJC}	-	-	2.5	K/W
Thermal resistance, junction - ambient	R_{thJA}				
TO-220AB		-	-	62	
TO-251AA(IPak)		-	-	110	
SMD version, device on PCB: ¹⁾	R_{thJA}				
TO-263AB		-	-	40	
TO-252AA(DPak)		-	-	50	

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 $V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $T_j = 25\text{ °C}$	$V_{CE(sat)}$	1.6	2	2.5	
$V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $T_j = 150\text{ °C}$		-	2.3	2.8	
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 $V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$, $T_j = 25\text{ °C}$	I_{CES}	-	-	20	μA
$V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$, $T_j = 150\text{ °C}$		-	-	500	
Gate-emitter leakage current $V_{GE} = 25\text{ V}$, $V_{CE} = 0\text{ V}$	I_{GES}	-	-	100	nA

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 $V_{CE} = 20\text{ V}, I_C = 4\text{ A}$	g_{fs}	-	3.1	-	S
Input capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{iss}	-	264	317	pF
Output capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{oss}	-	29	35	
Reverse transfer capacitance $V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{rss}	-	17	21	

Characteristics

Gate charge $V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, I_C = 4\text{ A}$	Q_{Gate}	-	24	32	nC
Internal emitter inductance measured 5mm from case	L_E	-	7	-	nH

Safe Operating Area Characteristics

Short circuit collector current 1) $V_{CE} \leq 600\text{ V}, V_{GE} = 15\text{ V}, t_{sc} \leq 10\text{ }\mu\text{s},$ $T_j \leq 150\text{ °C}$	-	-	-	40	A
Turn off safe operating area $V_{CE} \leq 600\text{ V}, T_j \leq 150\text{ °C}$	-	-	-	19	

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

SIEMENS**SGP04N60, SGB04N60, SGD04N60, SGU04N60****Switching Characteristics, Inductive Load (Diode: BUP410D), at $T_j = 25\text{ °C}$**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Turn-on delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $R_{Gon} = 67\ \Omega$	$t_{d(on)}$	-	20	24	ns
Rise time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $R_{Gon} = 67\ \Omega$	t_r	-	18	22	
Turn-off delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 4\text{ A}$, $R_{Goff} = 67\ \Omega$	$t_{d(off)}$	-	237	284	
Fall time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 4\text{ A}$, $R_{Goff} = 67\ \Omega$	t_f	-	70	84	
Turn-on energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $R_{Gon} = 67\ \Omega$	E_{on}	-	0.136	0.157	mJ
Turn-off energy $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 4\text{ A}$, $R_{Goff} = 67\ \Omega$	E_{off}	-	0.061	0.08	
Total switching energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 4\text{ A}$, $R_G = 67\ \Omega$	E_{ts}	-	0.197	0.237	

1) E_{on} and E_{ts} include BUP410D diode commutation losses.

SIEMENS**SGP04N60, SGB04N60, SGD04N60, SGU04N60****Switching Characteristics, Inductive Load (Diode: BUP410D), at $T_j = 150\text{ °C}$**

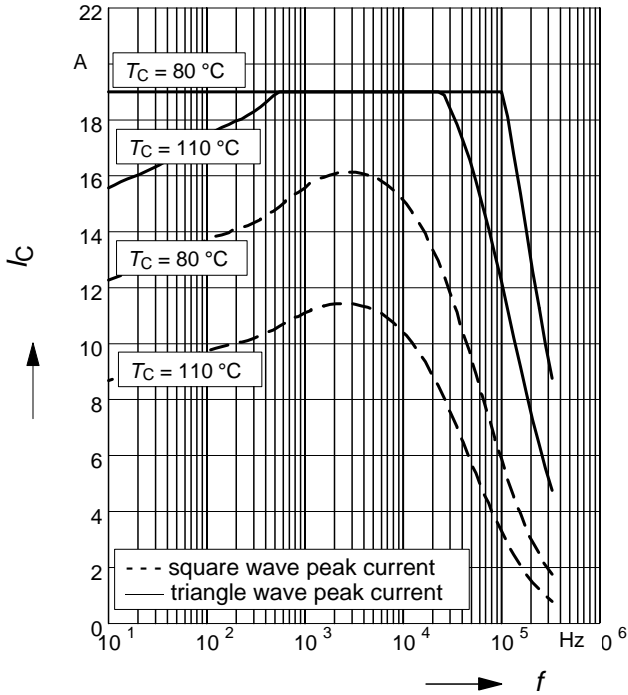
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Turn-on delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $R_{Gon} = 67\ \Omega$	$t_{d(on)}$	-	18	22	ns
Rise time $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $R_{Gon} = 67\ \Omega$	t_r	-	18	22	
Turn-off delay time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 4\text{ A}$, $R_{Goff} = 67\ \Omega$	$t_{d(off)}$	-	264	317	
Fall time $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 4\text{ A}$, $R_{Goff} = 67\ \Omega$	t_f	-	104	125	
Turn-on energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 4\text{ A}$, $R_{Gon} = 67\ \Omega$	E_{on}	-	0.208	0.24	mJ
Turn-off energy $V_{CC} = 400\text{ V}$, $V_{GE} = 0\text{ V}$, $I_C = 4\text{ A}$, $R_{Goff} = 67\ \Omega$	E_{off}	-	0.111	0.145	
Total switching energy ¹⁾ $V_{CC} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 4\text{ A}$, $R_G = 67\ \Omega$	E_{ts}	-	0.319	0.385	

1) E_{on} and E_{ts} include BUP410D diode commutation losses.

Typ. collector current

$I_C = f(f)$

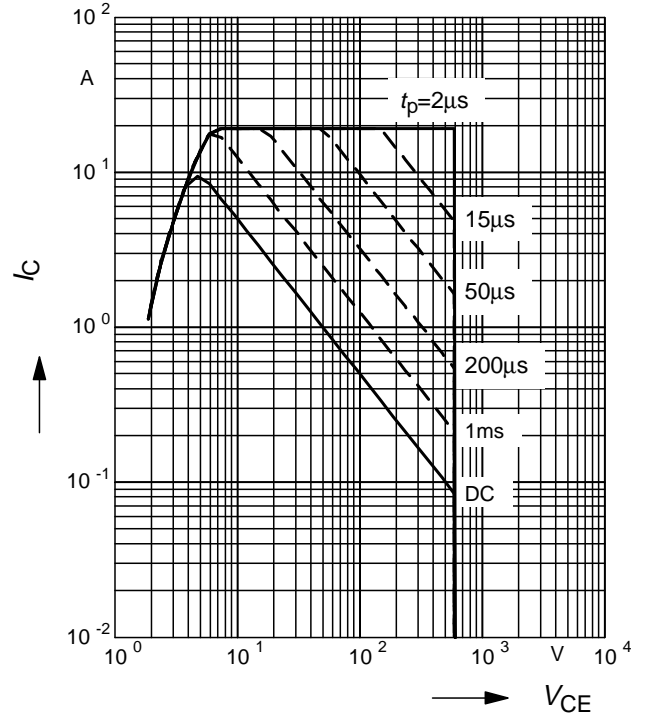
parameter: $D = 0.5, T_j \leq 150\text{ °C}$



Safe operating area

$I_C = f(V_{CE})$

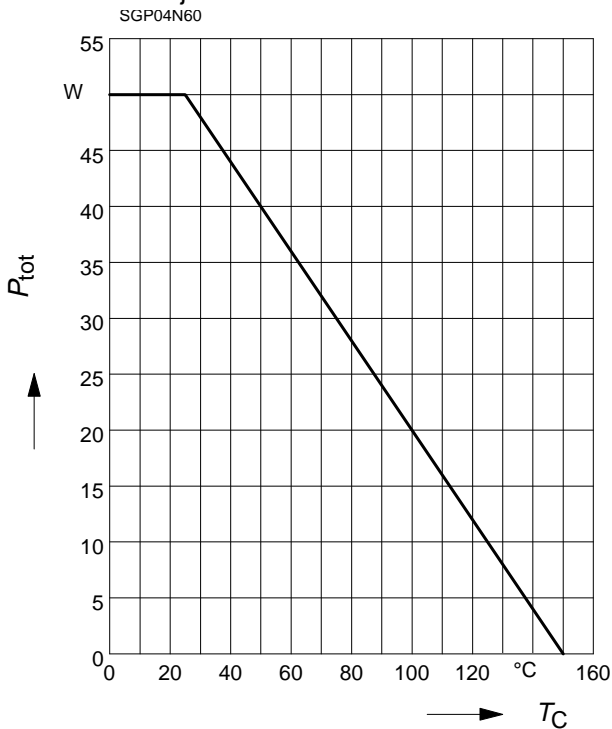
parameter: $D = 0, T_C = 25\text{ °C}, T_j \leq 150\text{ °C}$



Power dissipation

$P_{tot} = f(T_C)$

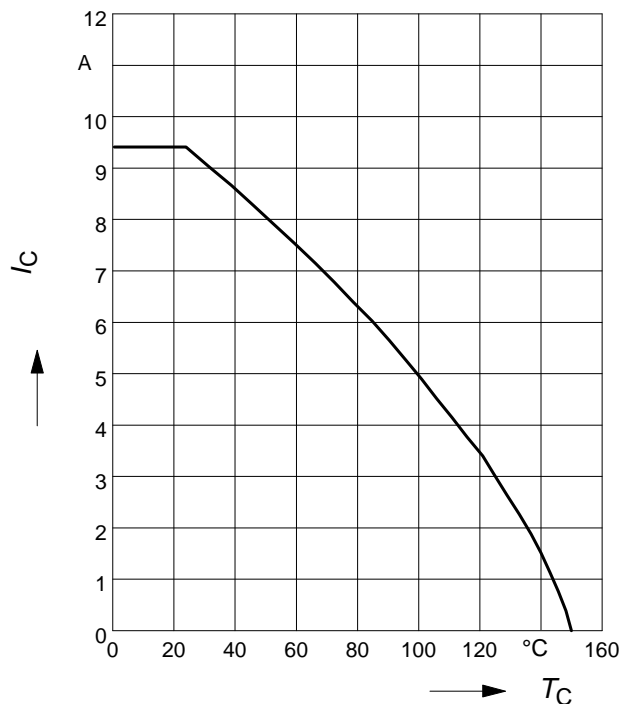
parameter: $T_j \leq 150\text{ °C}$



Collector current

$I_C = f(T_C)$

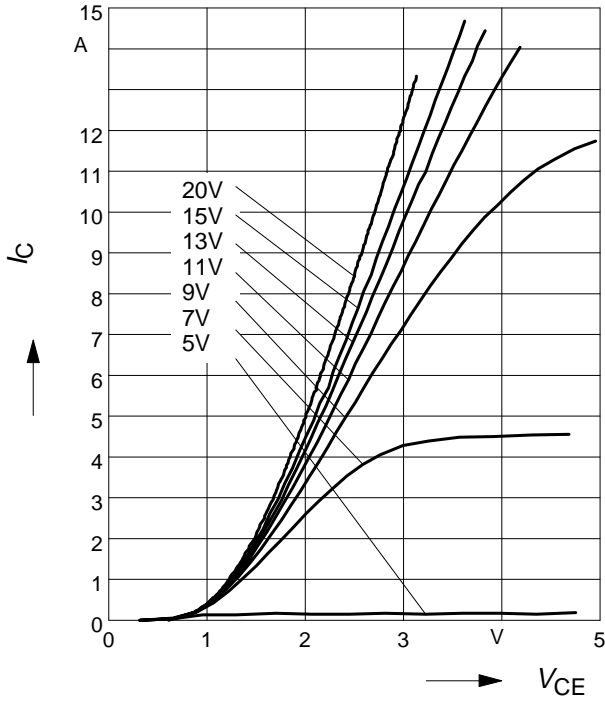
parameter: $V_{GE} \geq 15\text{ V}, T_j \leq 150\text{ °C}$



Typ. output characteristics

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

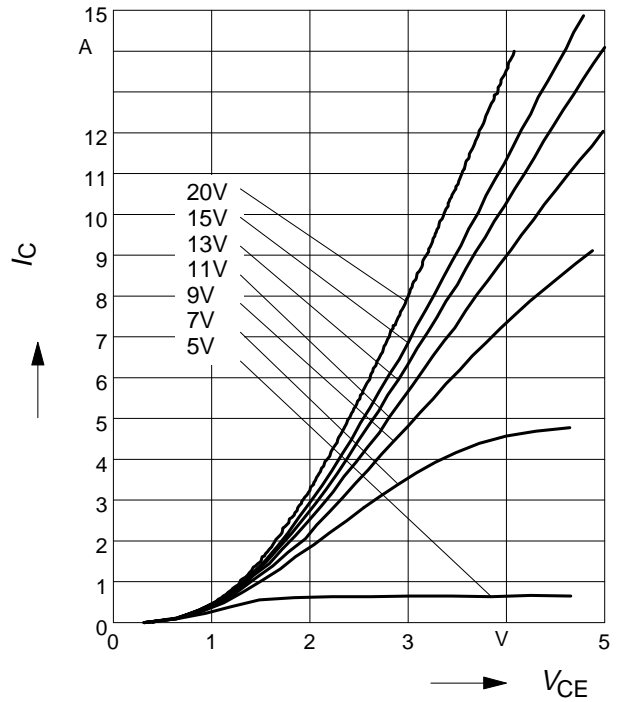
parameter: $t_p = 80 \mu s$, $T_j = 25 \text{ }^\circ\text{C}$



Typ. output characteristics

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

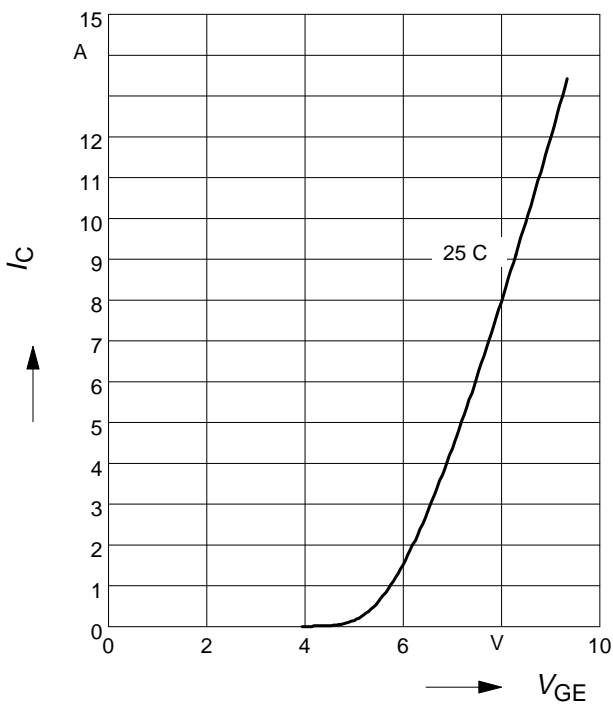
parameter: $t_p = 80 \mu s$, $T_j = 150 \text{ }^\circ\text{C}$



Typ. transfer characteristics

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

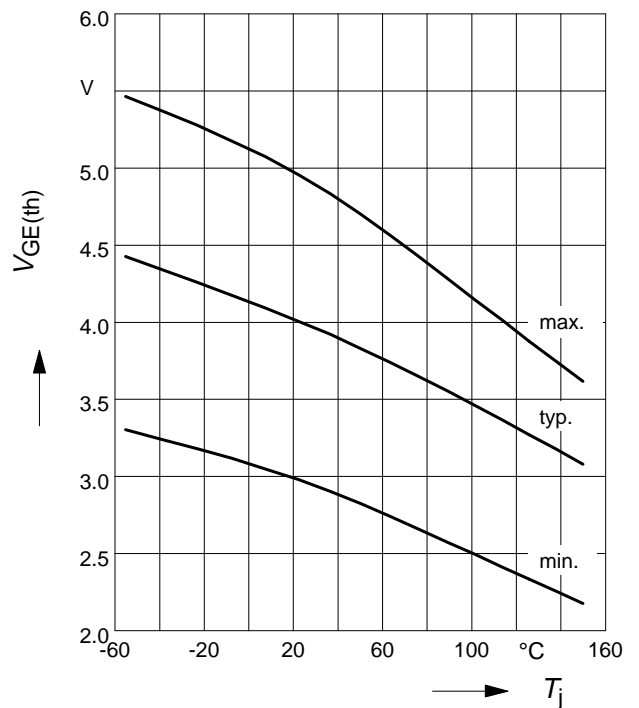
parameter: $t_p = 80 \mu s$, $V_{CE} = 10 \text{ V}$



Gate-emitter threshold voltage

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

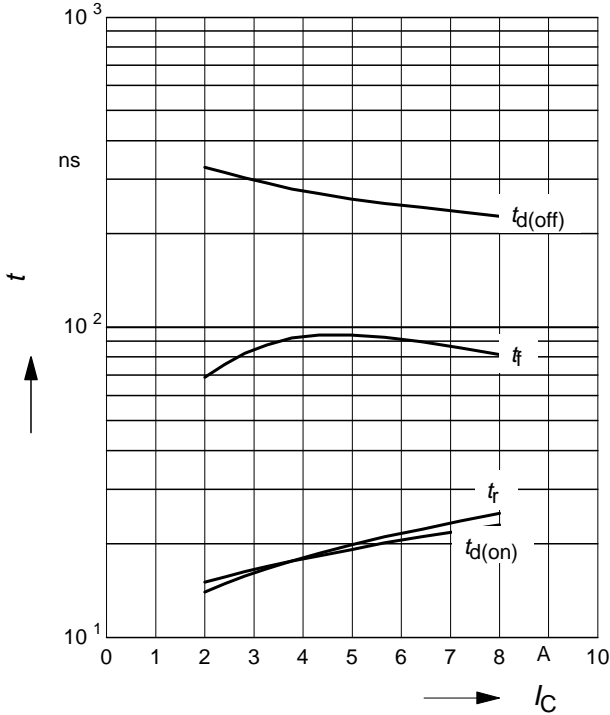
parameter: $I_C = 0.2 \text{ mA}$



Typ. switching time

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

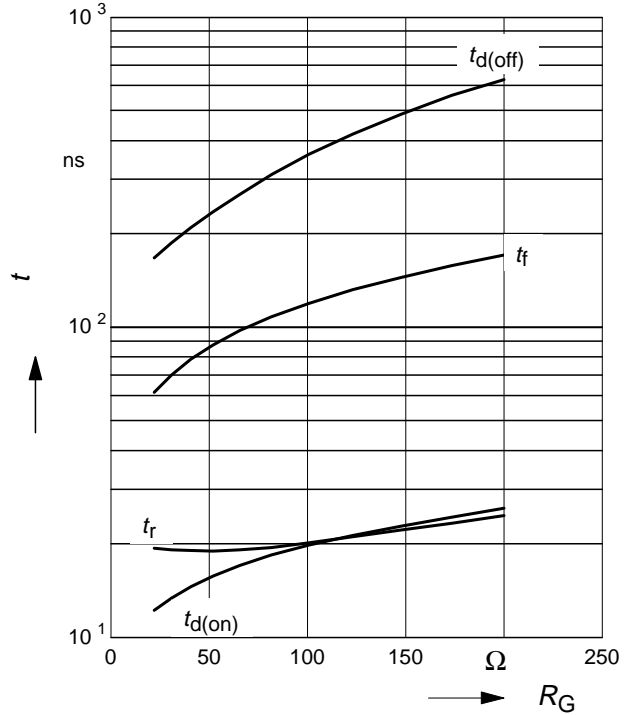
par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $R_G = 67\ \Omega$



Typ. switching time

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

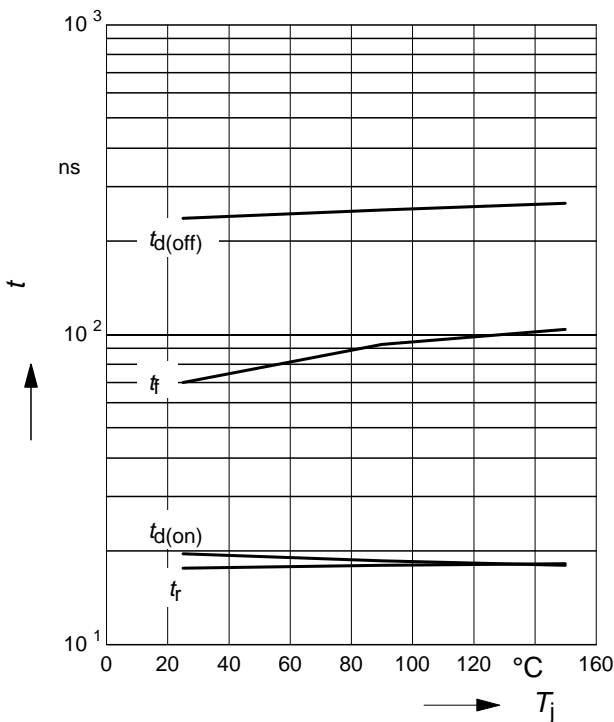
par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 4\text{ A}$



Typ. switching time

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

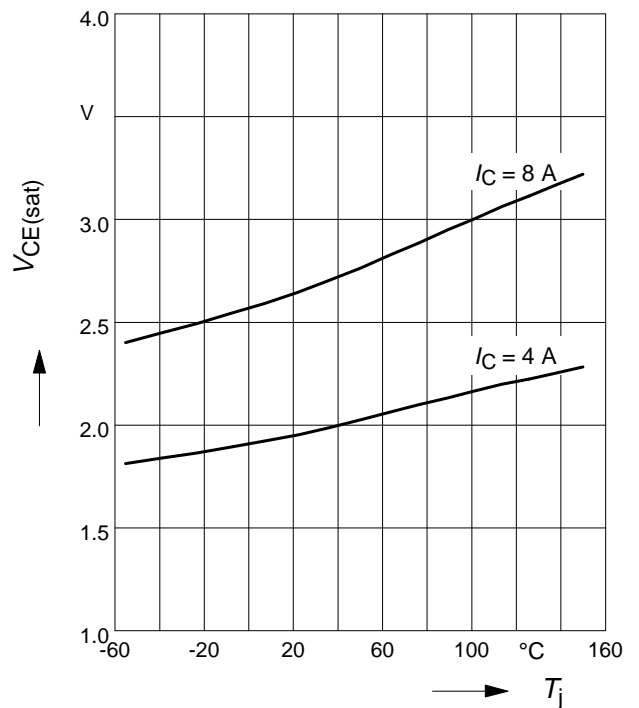
$V_{GE} = 0/+15\text{ V}$, $I_C = 4\text{ A}$, $R_G = 67\ \Omega$



Typ. collector-emitter saturation voltage

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

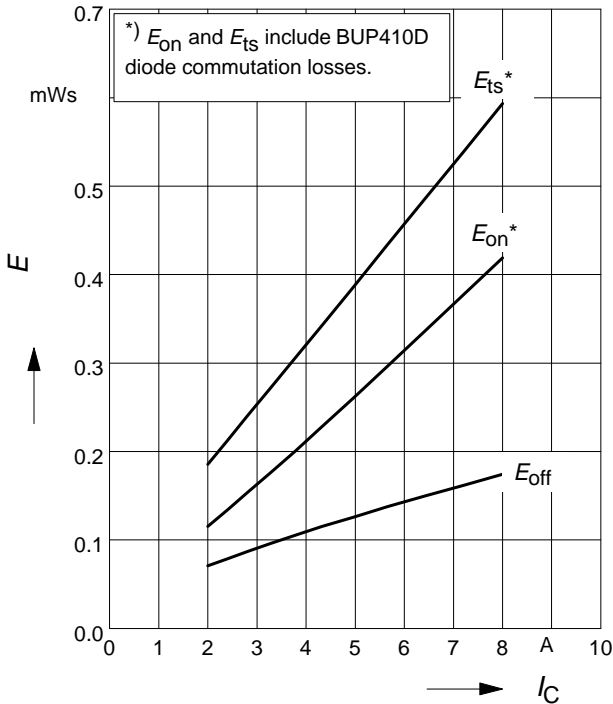
parameter: $V_{GE} = 15\text{ V}$



Typ. switching losses

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

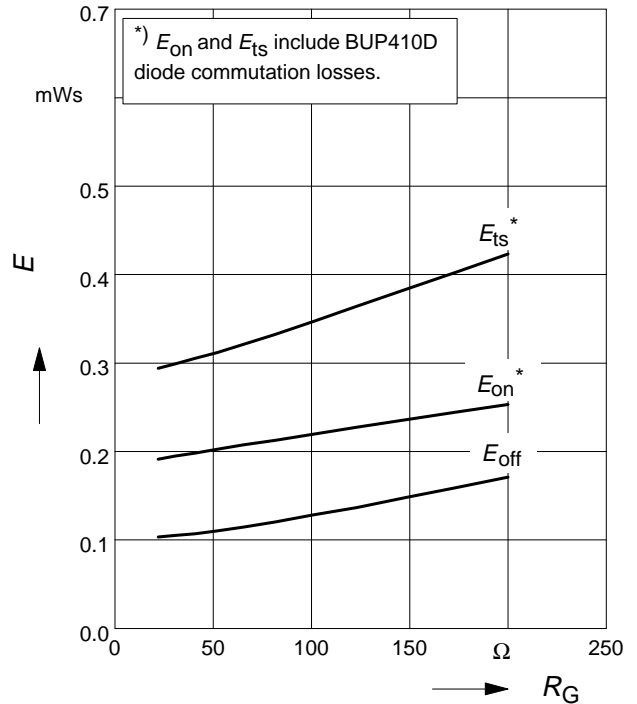
par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $R_G = 67\ \Omega$



Typ. switching losses

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

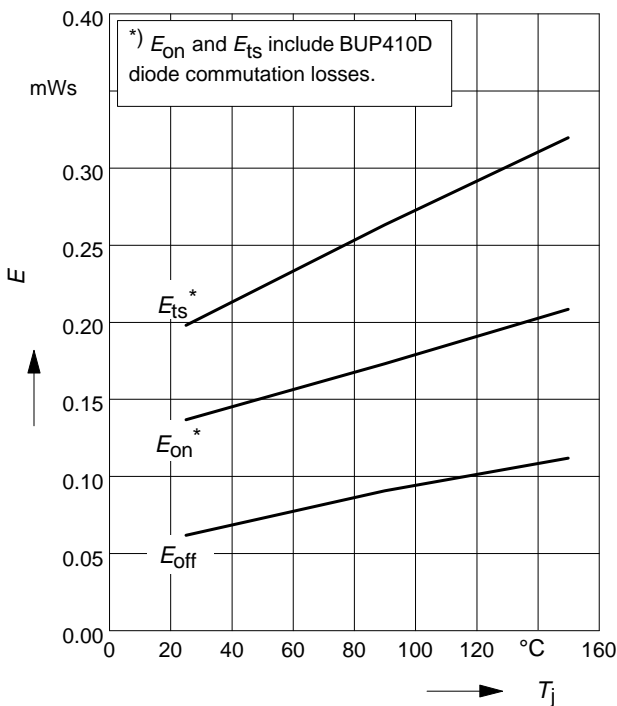
par.: $V_{CE} = 400\text{ V}$, $V_{GE} = 0/+15\text{ V}$, $I_C = 4\text{ A}$



Typ. switching losses

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

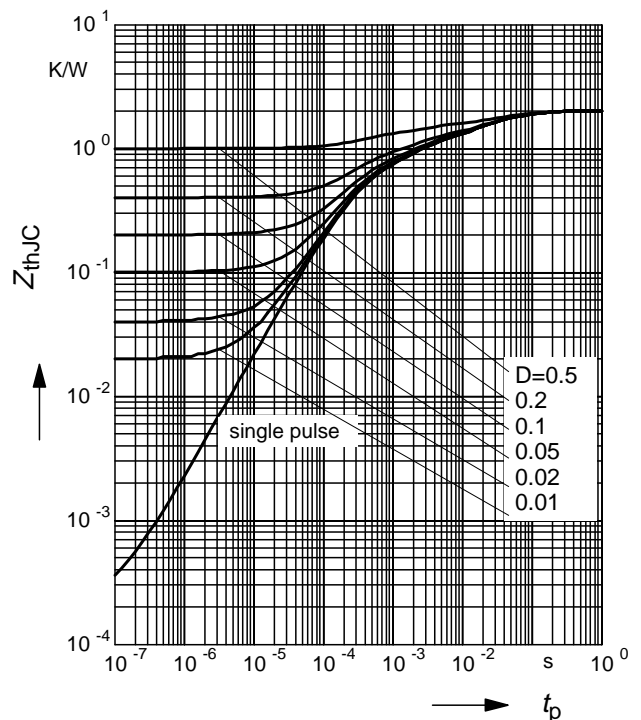
$V_{GE} = 0/+15\text{ V}$, $I_C = 4\text{ A}$, $R_G = 67\ \Omega$



Transient thermal impedance

$Z_{thJC} = f(t_p)$

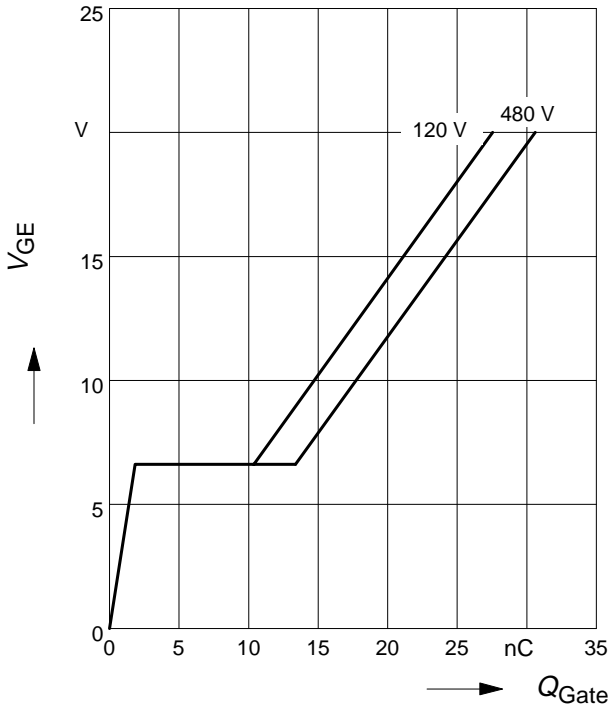
parameter: $D = t_p / T$



Typ. gate charge

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

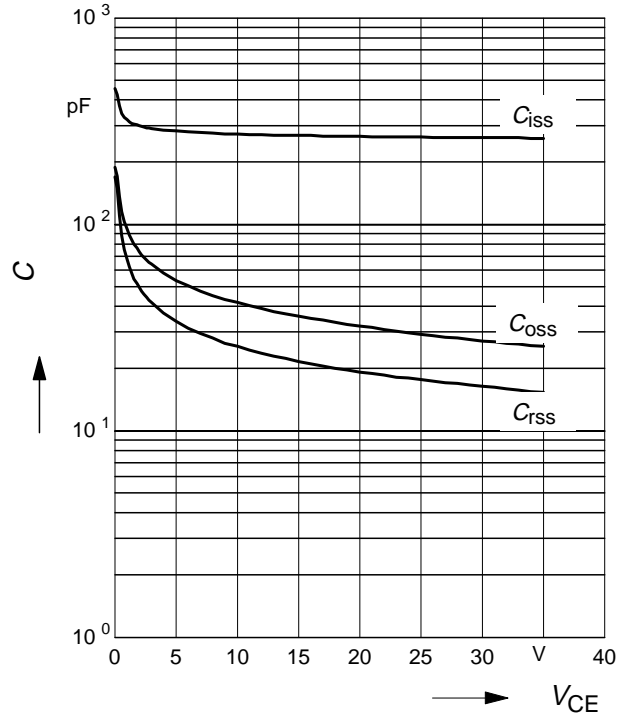
parameter: $I_C = 4 \text{ A}$



Typ. capacitances

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

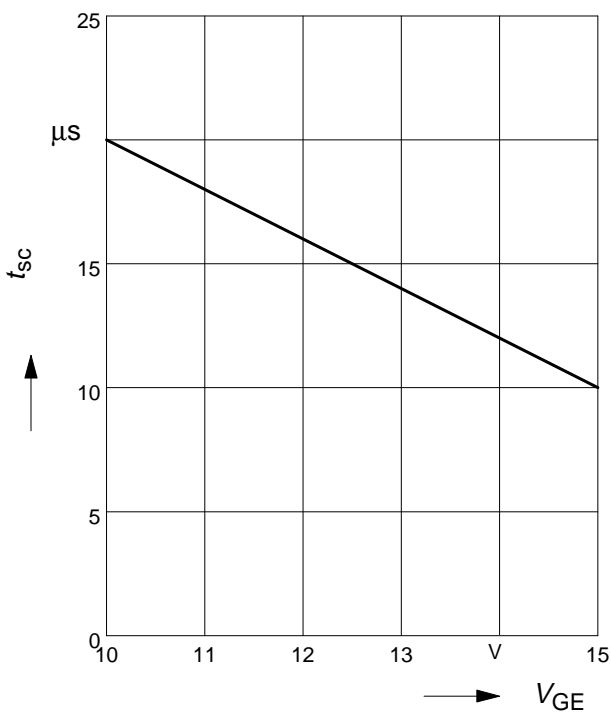
parameter: $V_{GE} = 0 \text{ V}, f = 1 \text{ MHz}$



Short circuit withstand time

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

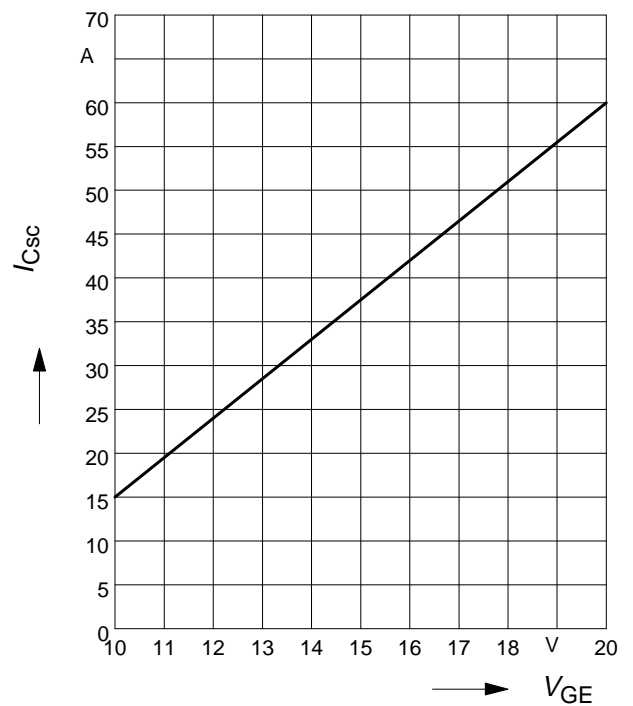
par.: $V_{CE} = 600 \text{ V}$, start at $T_j = 25 \text{ }^\circ\text{C}$



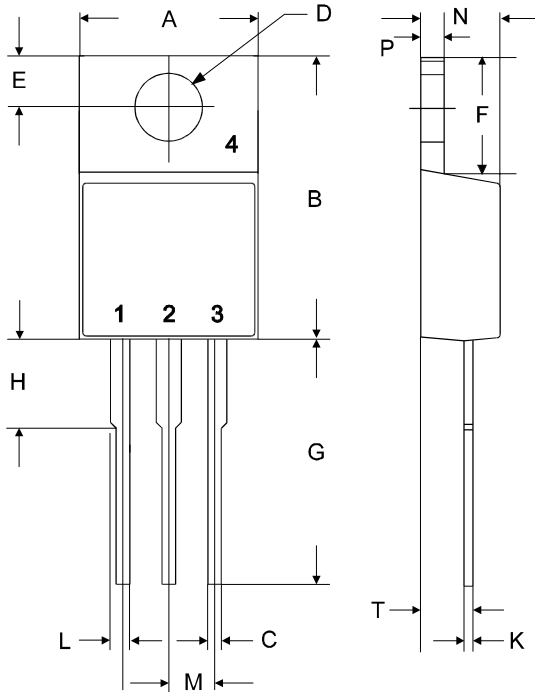
Typ. short circuit current

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

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

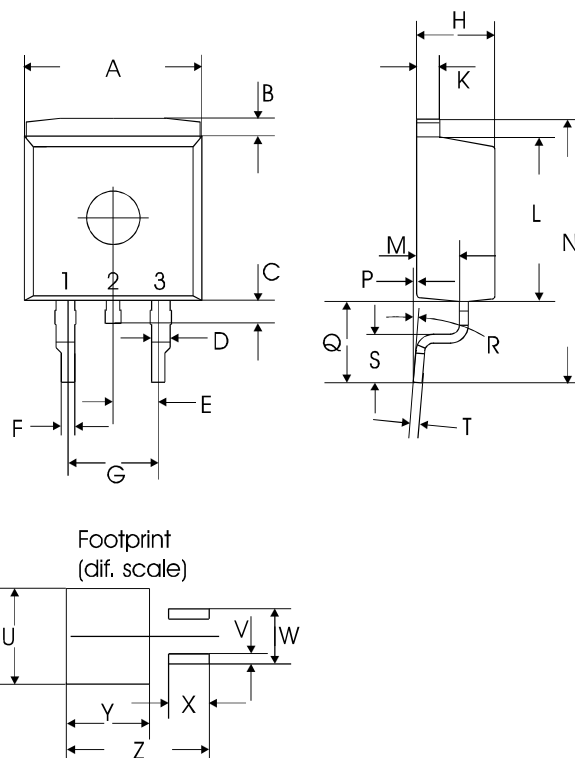


TO-220AB



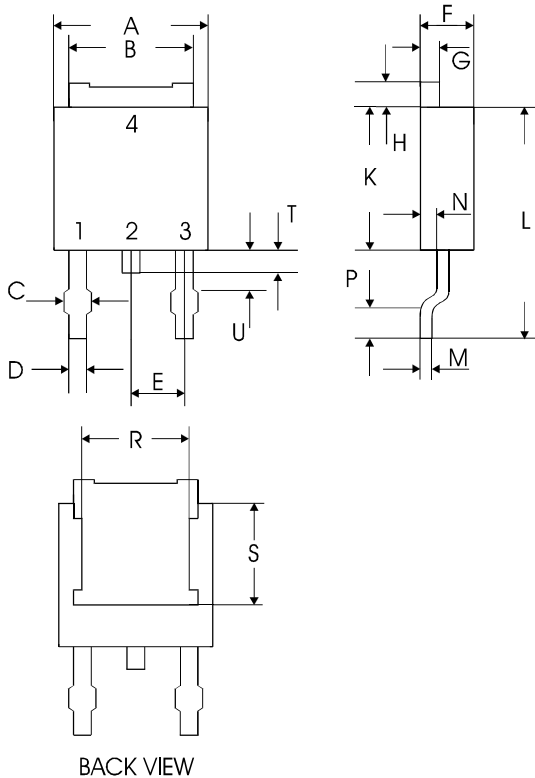
symbol	dimensions [mm]	
	min	max
A	9.70	10.30
B	14.88	15.95
C	0.65	0.86
D	3.55	3.89
E	2.60	3.00
F	6.00	6.80
G	13.00	14.00
H	4.35	4.75
K	0.38	0.65
L	0.95	1.32
M	2.54 typ.	
N	4.30	4.50
P	1.17	1.40
T	2.30	2.72

TO-263AB



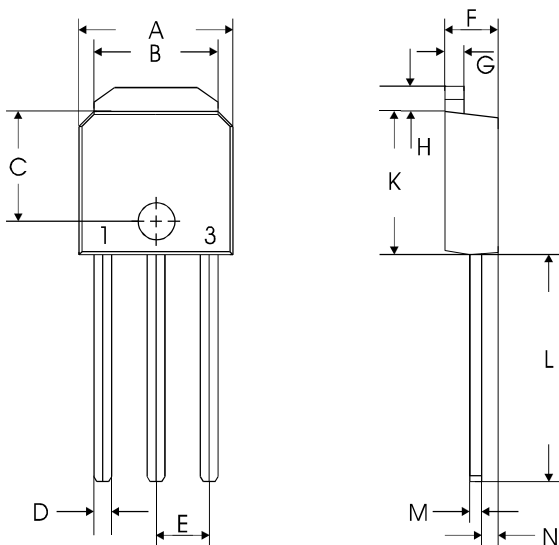
symbol	dimensions [mm]	
	min	max
A	9.80	10.20
B	0.70	1.30
C	1.00	1.60
D	1.03	1.07
E	2.54 typ.	
F	0.65	0.85
G	5.08 typ.	
H	4.30	4.50
K	1.17	1.37
L	9.05	9.45
M	2.30	2.50
N	15 typ.	
P	0.00	0.20
Q	4.20	5.20
R	8° max	
S	2.40	3.00
T	0.40	0.60
U	10.80	
V	1.15	
W	6.23	
X	4.60	
Y	9.40	
Z	16.15	

TO-252AA (DPak)



symbol	dimensions [mm]	
	min	max
A	6.40	6.73
B	5.25	5.50
C	(0.65)	(1.15)
D	0.63	0.89
E	2.28	
F	2.19	2.39
G	0.76	0.98
H	0.90	1.21
K	5.97	6.23
L	9.40	10.40
M	0.46	0.58
N	0.87	1.15
P	0.51	-
R	5.00	-
S	4.17	-
T	0.26	1.02
U	-	-

TO-251AA (IPak)



symbol	dimensions [mm]	
	min	max
A	6.47	6.73
B	5.25	5.41
C	4.19	4.43
D	0.63	0.89
E	2.29 typ.	
F	2.18	2.39
G	0.76	0.86
H	1.01	1.11
K	5.97	6.23
L	9.14	9.65
M	0.46	0.56
N	0.98	1.15

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