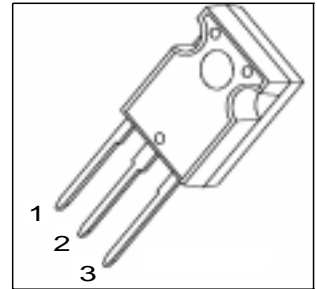
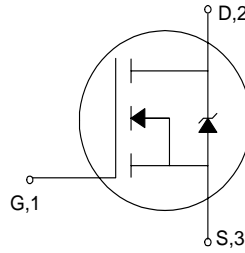


Cool MOS™ Power Transistor

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche proved
- Extreme dv/dt rated
- Optimized capacitances
- Improved noise immunity
- Former development designation:
SPWx1N60S5



Type	V_{DS}	I_D	$R_{DS(on)}$	Package	Marking	Ordering Code
SPW20N60S5	600 V	20 A	0.19 Ω	P-TO247	20N60S5	Q67040-S4238

Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current $T_C = 25\text{ }^\circ\text{C}$ $T_C = 100\text{ }^\circ\text{C}$	I_D	20 13	A
Pulsed drain current, $t_p = 1\text{ ms}^1)$ $T_C = 25\text{ }^\circ\text{C}$	$I_{D\text{ puls}}$	40	
Avalanche energy, single pulse $I_D = 20\text{ A}$, $V_{DD} = 50\text{ V}$, $R_{GS} = 25\text{ }^\circ\Omega$ Periodic avalanche energy E_{AR} only limited by T_{jmax}	E_{AS}	690	mJ
Reverse diode dv/dt $I_S = 20\text{ A}$, $V_{DS} < V_{DSS}$, $di/dt = 100\text{ A}/\mu\text{s}$, $T_{jmax} = 150\text{ }^\circ\text{C}$	dv/dt	6	kV/ μs
Gate source voltage	V_{GS}	± 20	V
Power dissipation $T_C = 25\text{ }^\circ\text{C}$	P_{tot}	208	W
Operating and storage temperature	T_j, T_{stg}	-55... +150	$^\circ\text{C}$

Electrical Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
at $T_j = 25\text{ °C}$, unless otherwise specified					

Thermal Characteristics

Thermal resistance, junction - case	R_{thJC}	-	-	0.6	K/W
Thermal resistance, junction - ambient (Leaded and through-hole packages)	R_{thJA}	-	-	62	

Static Characteristics

Drain- source breakdown voltage $V_{GS} = 0\text{ V}$, $I_D = 0.25\text{ mA}$	$V_{(BR)DSS}$	600	-	-	V
Gate threshold voltage, $V_{GS} = V_{DS}$ $I_D = 1\text{ mA}$, $T_j = 25\text{ °C}$	$V_{GS(th)}$	3.5	4.5	5.5	
Zero gate voltage drain current, $V_{DS} = V_{DSS}$ $V_{GS} = 0\text{ V}$, $T_j = 25\text{ °C}$ $V_{GS} = 0\text{ V}$, $T_j = 150\text{ °C}$	I_{DSS}	-	0.5	25	μA
		-	-	250	
Gate-source leakage current $V_{GS} = 20\text{ V}$, $V_{DS} = 0\text{ V}$	I_{GSS}	-	-	100	nA
Drain-Source on-state resistance $V_{GS} = 10\text{ V}$, $I_D = 13\text{ A}$	$R_{DS(on)}$	-	0.16	0.19	Ω

¹current limited by T_{jmax}

Electrical Characteristics

Parameter at $T_j = 25\text{ °C}$, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Transconductance $V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 13\text{ A}$	g_{fs}	-	12	-	S
Input capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$	C_{iss}	-	3000	-	pF
Output capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$	C_{oss}	-	1700	-	
Reverse transfer capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$	C_{rss}	-	50	-	
Turn-on delay time $V_{DD} = 350\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 20\text{ A}$, $R_G = 3.6\ \Omega$	$t_{d(on)}$	-	50	-	ns
Rise time $V_{DD} = 350\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 20\text{ A}$, $R_G = 3.6\ \Omega$	t_r	-	40	-	
Turn-off delay time $V_{DD} = 350\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 20\text{ A}$, $R_G = 3.6\ \Omega$	$t_{d(off)}$	-	100	-	
Fall time $V_{DD} = 350\text{ V}$, $V_{GS} = 10\text{ V}$, $I_D = 20\text{ A}$, $R_G = 3.6\ \Omega$	t_f	-	20	-	

Electrical Characteristics

Parameter at $T_j = 25\text{ °C}$, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	

Gate Charge Characteristics

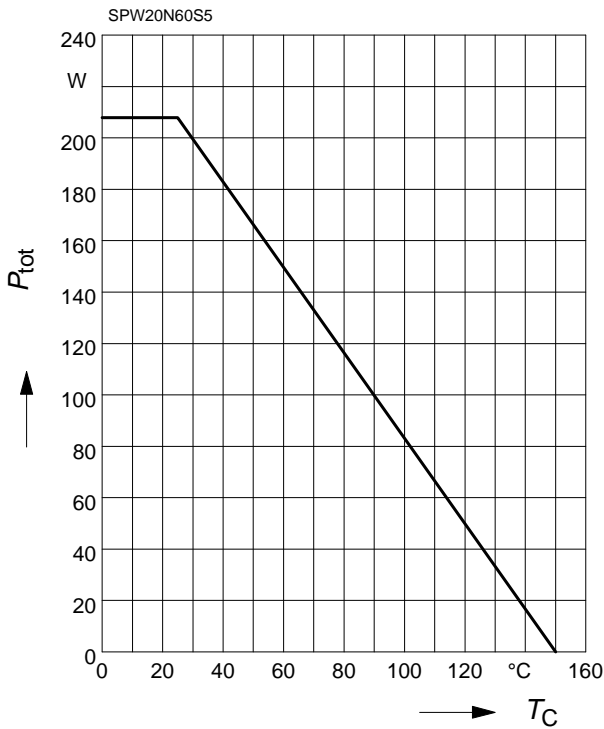
Gate to source charge $V_{DD} = 350\text{ V}$, $I_D = 20\text{ A}$	Q_{gs}	-	16	-	nC
Gate to drain charge $V_{DD} = 350\text{ V}$, $I_D = 20\text{ A}$	Q_{gd}	-	44	-	
Total gate charge $V_{DD} = 350\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$	Q_g	-	88	-	

Reverse Diode

Inverse diode continuous forward current $T_C = 25\text{ °C}$	I_S	-	-	20	A
Inverse diode direct current, pulsed $T_C = 25\text{ °C}$	I_{SM}	-	-	40	
Inverse diode forward voltage $V_{GS} = 0\text{ V}$, $I_F = 20\text{ A}$	V_{SD}	-	1	1.2	V
Reverse recovery time $V_R = 350\text{ V}$, $I_F = I_S$, $di_F/dt = 100\text{ A}/\mu\text{s}$	t_{rr}	-	610	-	ns
Reverse recovery charge $V_R = 350\text{ V}$, $I_F = I_S$, $di_F/dt = 100\text{ A}/\mu\text{s}$	Q_{rr}	-	12	-	nC

Power Dissipation

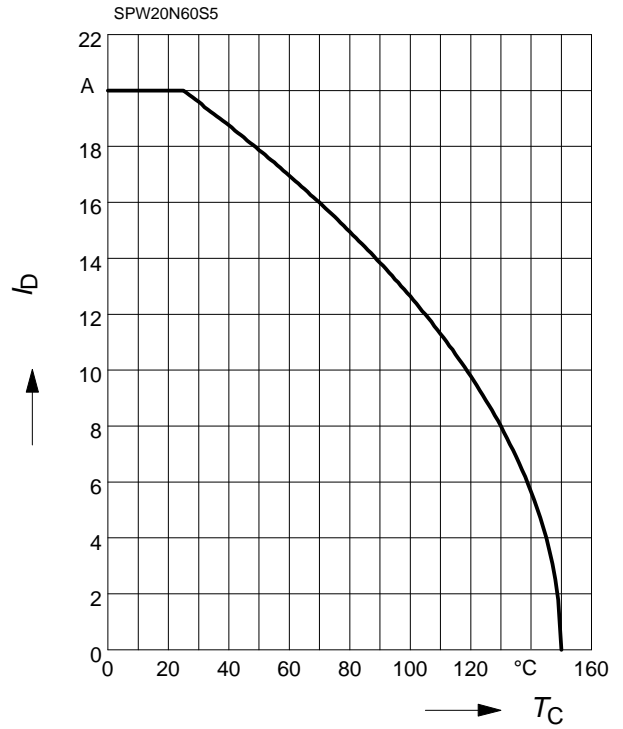
$$P_{\text{tot}} = f(T_C)$$



Drain current

$$I_D = f(T_C)$$

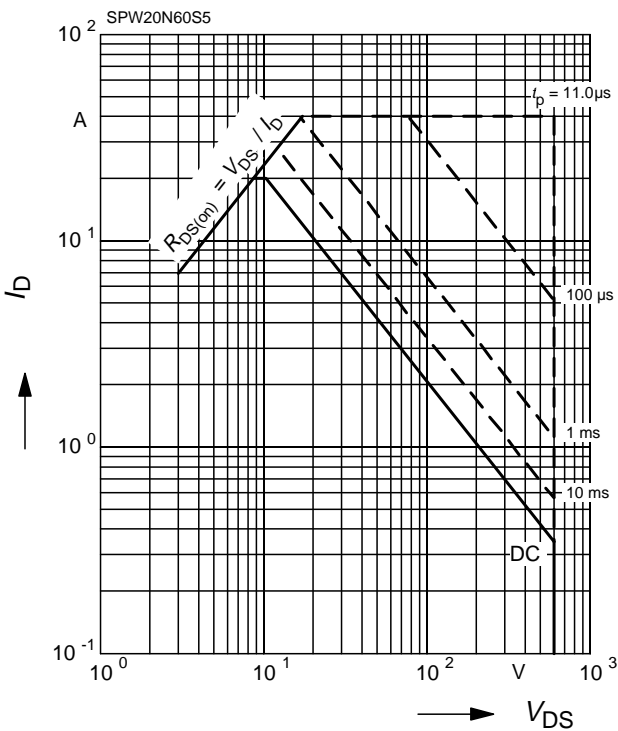
parameter: $V_{GS} \geq 10 \text{ V}$



Safe operating area

$$I_D = f(V_{DS})$$

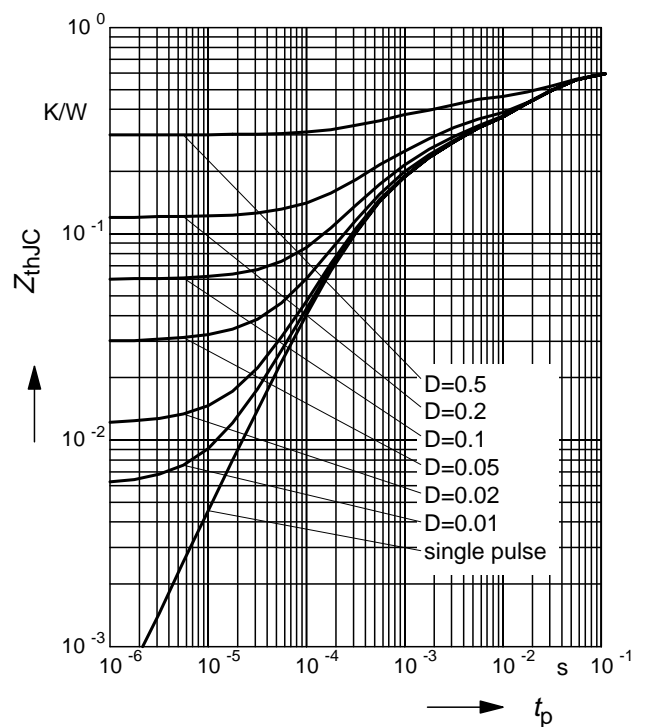
parameter: $D=0.01, T_C=25^\circ\text{C}$



Transient thermal impedance

$$Z_{\text{thJC}} = f(t_p)$$

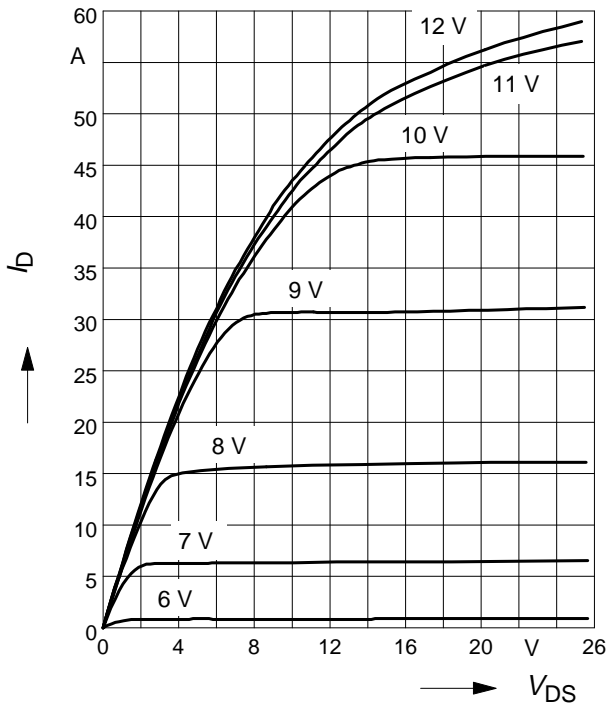
Parameter: $D=t_p/T$



Typ. output characteristic

$$I_D = f(V_{DS}); T_j = 25^\circ\text{C}$$

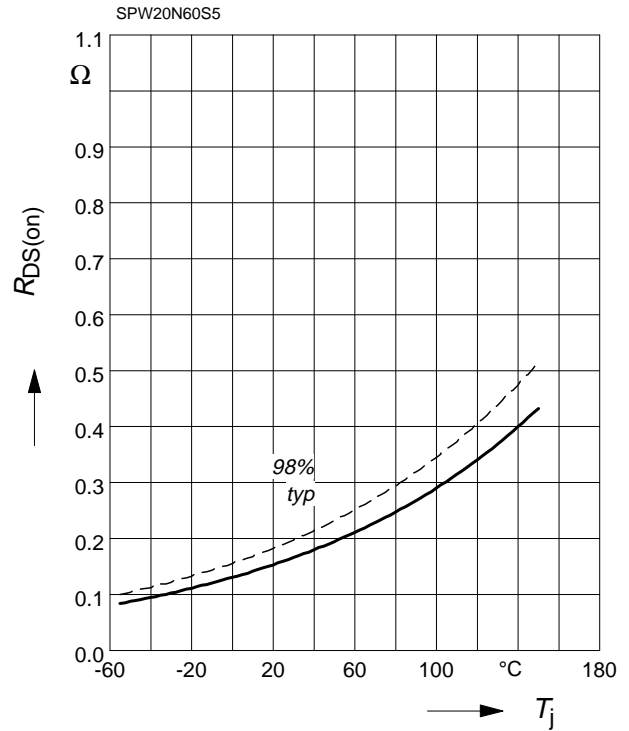
Parameter: V_{GS}



Drain-source on-resistance

$$R_{DS(on)} = f(T_j)$$

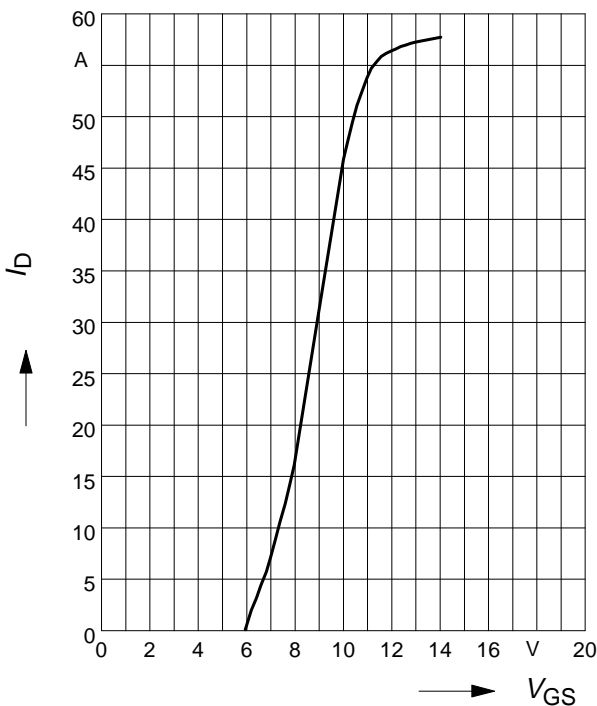
parameter: $I_D = 13\text{ A}, V_{GS} = 10\text{ V}$



Typ. transfer characteristics $I_D = f(V_{GS})$

parameter: $t_p = 80\ \mu\text{s}$

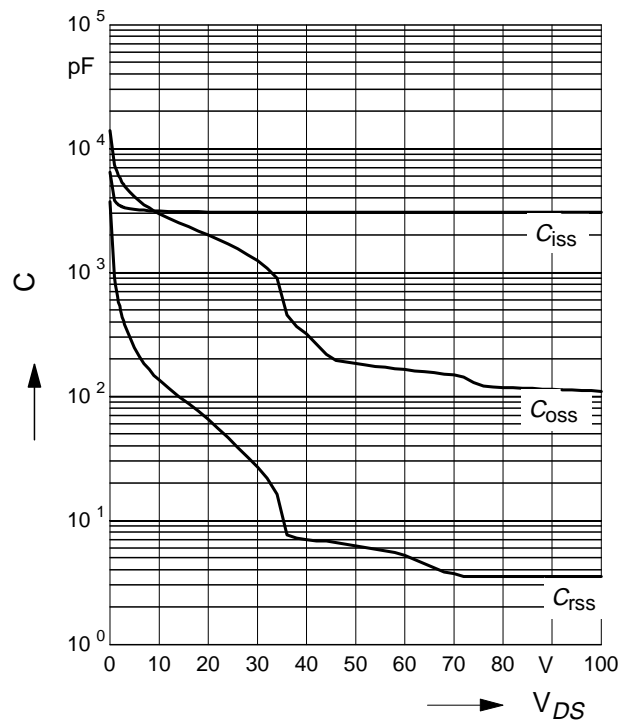
$V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$



Typ. capacitances

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

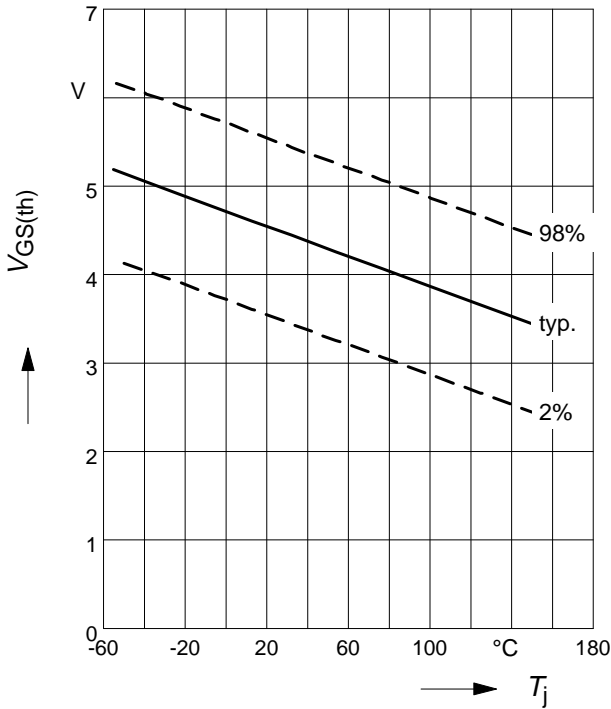
Parameter: $V_{GS} = 0\text{ V}, f = 1\text{ MHz}$



Gate threshold voltage

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

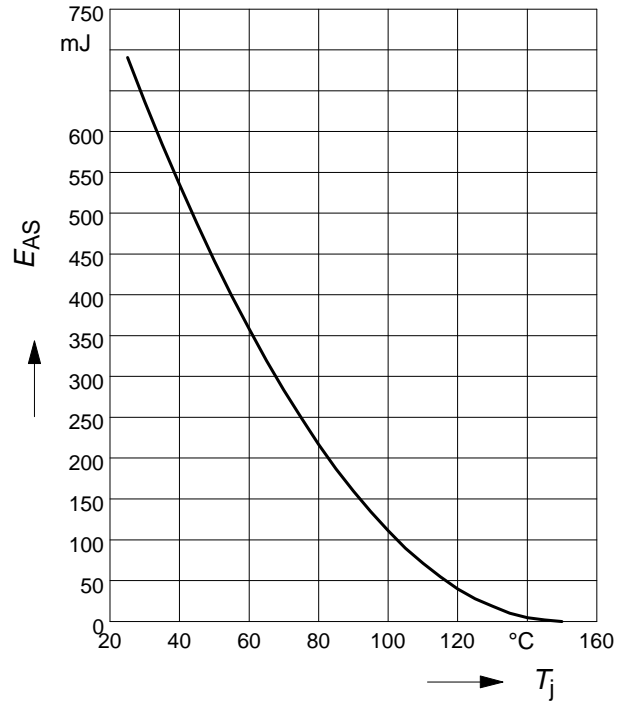
parameter: $V_{GS} = V_{DS}$, $I_D = 1 \text{ mA}$



Avalanche Energy $E_{AS} = f(T_j)$

parameter: $I_D = 20 \text{ A}$, $V_{DD} = 50 \text{ V}$

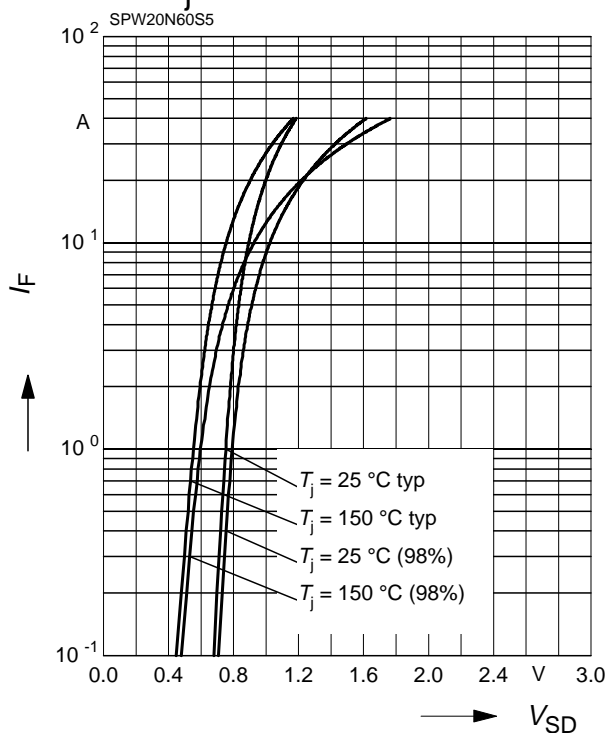
$R_{GS} = 25 \Omega$



Forward characteristics of reverse diode

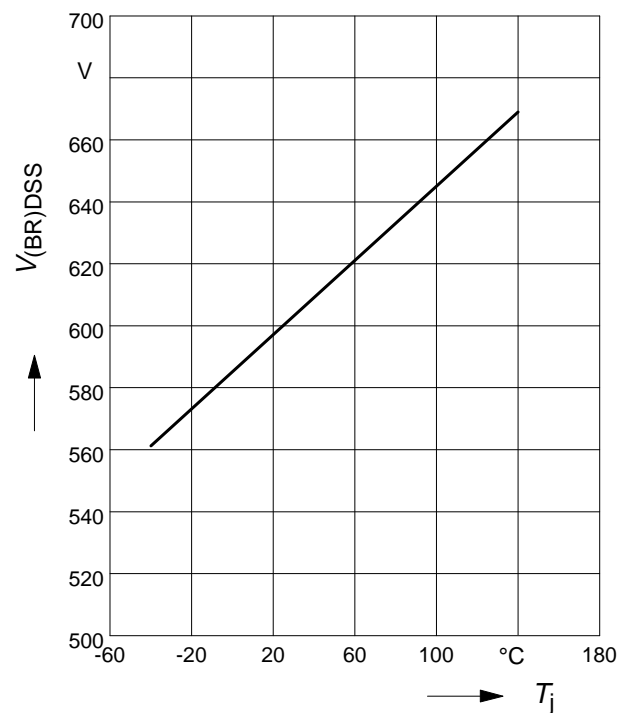
$$I_F = f(V_{SD})$$

parameter: T_j , $t_p = 80 \mu\text{s}$



Drain-source break down voltage

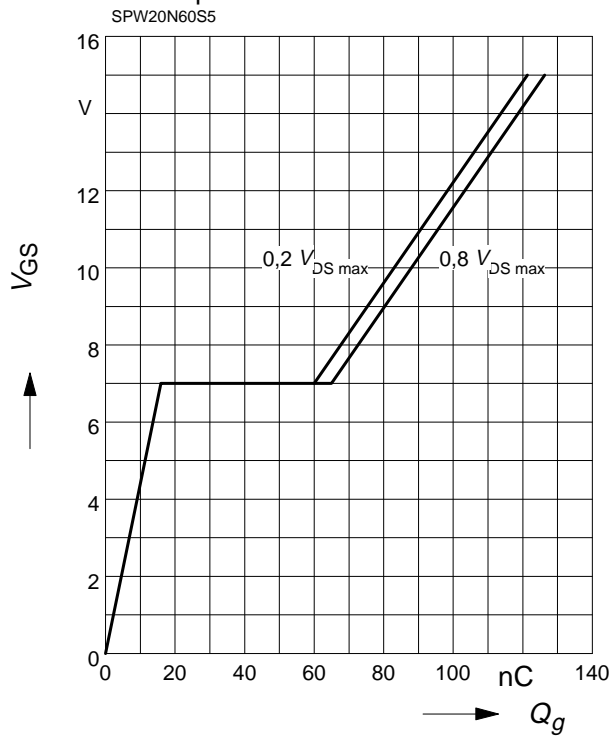
$$V_{(BR)DSS} = f(T_j)$$



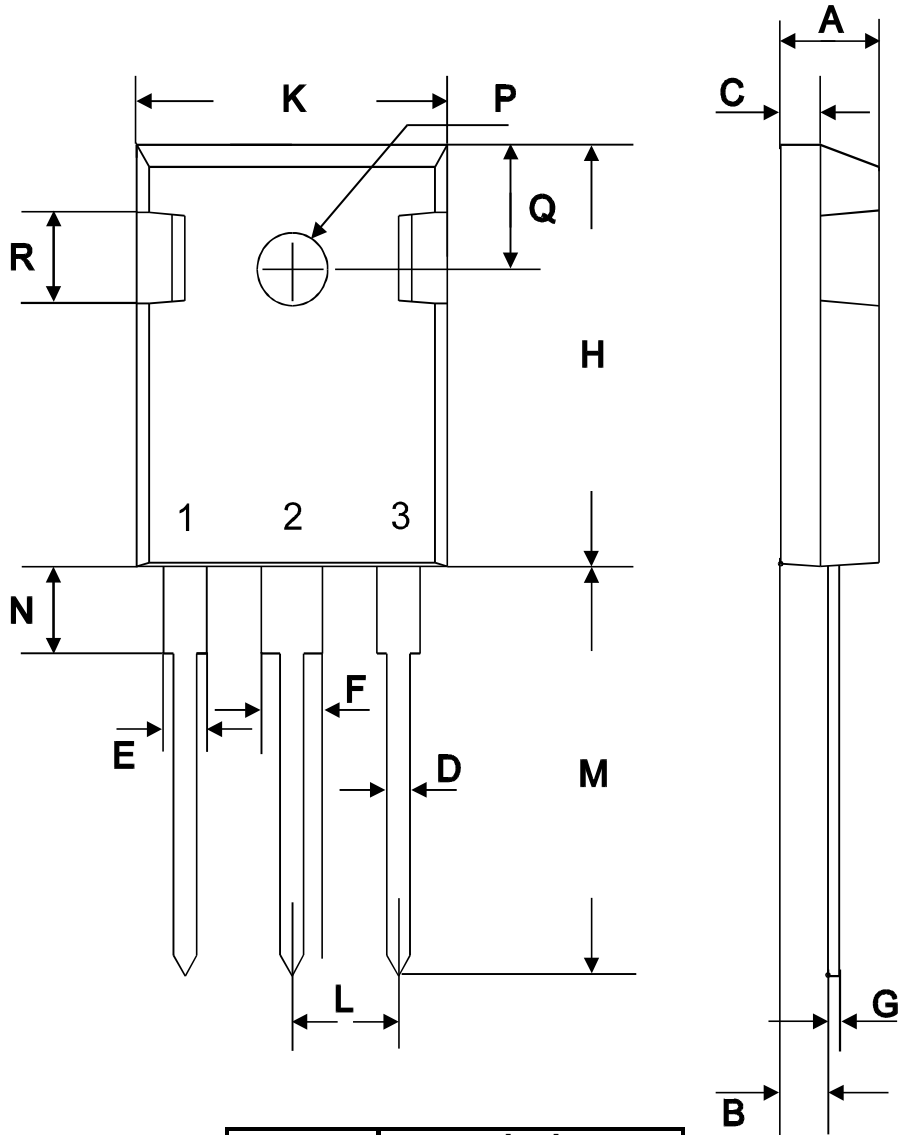
Typ. gate charge

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

parameter: $I_{Dpuls} = 20\text{ A}$



P-TO247



symbol	[mm]	
	min	max
A	4.78	5.28
B	2.29	2.51
C	1.78	2.29
D	1.09	1.32
E	1.73	2.06
F	2.67	3.18
G	0.76 max	
H	20.80	21.16
K	15.65	16.15
L	5.21	5.72
M	19.81	20.68
N	3.560	4.930
∅P	3.61	
Q	6.12	6.22

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