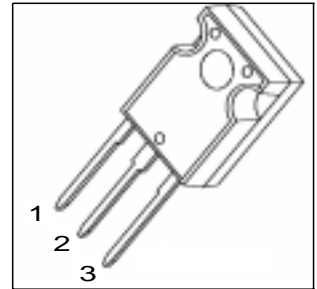
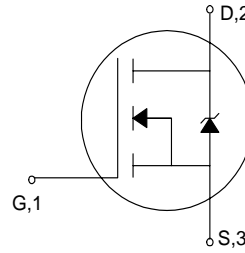


### Cool MOS™ Power Transistor

- 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 $\Omega$	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 $I_D = 20\text{ A}$ , $V_{DD} = 50\text{ V}$ , $R_{GS} = 25\text{ }\Omega$ 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/ $\mu\text{s}$
Gate source voltage	$V_{GS}$	$\pm 20$	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 at $T_j = 25\text{ °C}$ , unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	

## 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	25 250	$\mu\text{A}$
Gate-source leakage current $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$	$I_{GSS}$	-	-	100	
Drain-Source on-state resistance $V_{GS} = 10\text{ V}$ , $I_D = 13\text{ A}$	$R_{DS(on)}$	-	0.16	0.19	$\Omega$

<sup>1</sup>current limited by  $T_{jmax}$

## Electrical Characteristics

Parameter at $T_j = 25\text{ }^{\circ}\text{C}$ , 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 $V_{DD} = 350\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$ , $R_G = 3.6\text{ }\Omega$	$t_{d(on)}$	-	50	-	
Rise time $V_{DD} = 350\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$ , $R_G = 3.6\text{ }\Omega$	$t_r$	-	40	-	
Turn-off delay time $V_{DD} = 350\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$ , $R_G = 3.6\text{ }\Omega$	$t_{d(off)}$	-	100	-	
Fall time $V_{DD} = 350\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$ , $R_G = 3.6\text{ }\Omega$	$t_f$	-	20	-	

## Electrical Characteristics

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

## Gate Charge Characteristics

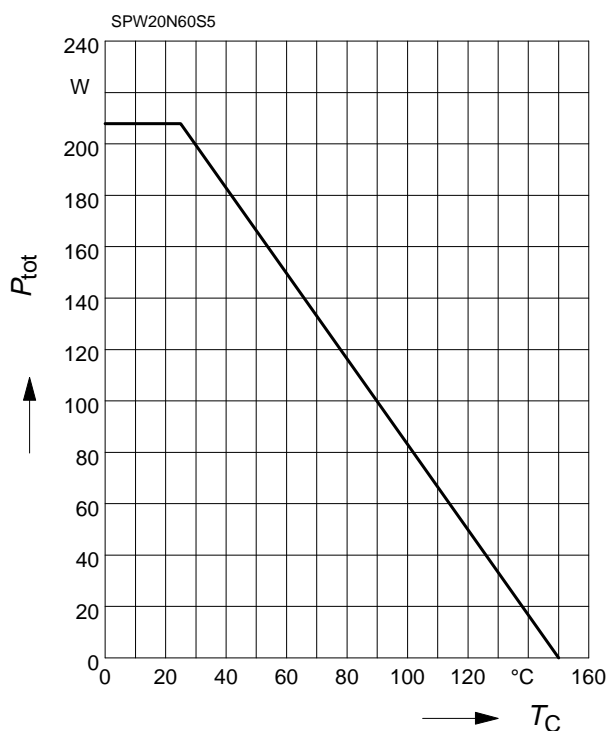
Gate to source charge $V_{DD} = 350\text{ V}$ , $I_D = 20\text{ A}$	$Q_{gs}$	-	16	-	nC
Gate to drain charge $V_{DD} = 350\text{ V}$ , $I_D = 20\text{ A}$	$Q_{gd}$	-	44	-	
Total gate charge $V_{DD} = 350\text{ V}$ , $I_D = 20\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$	$Q_g$	-	88	-	

## 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

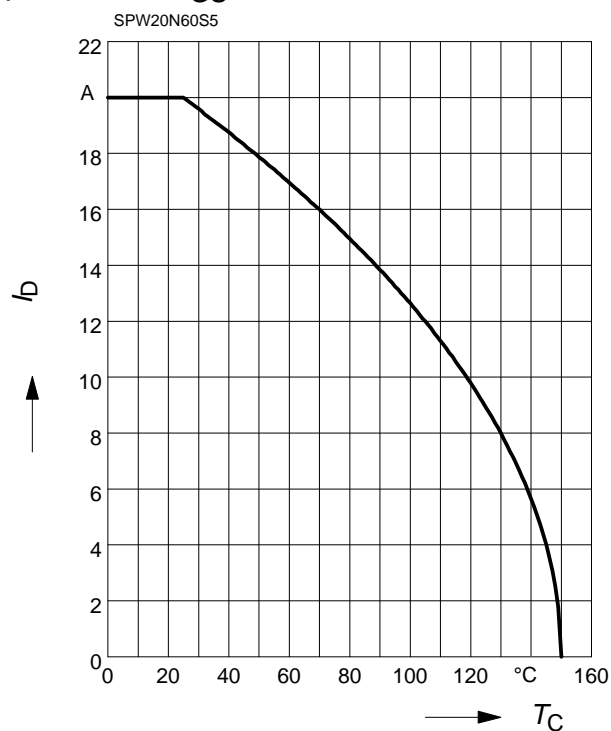
$$P_{\text{tot}} = f(T_C)$$



## Drain current

$$I_D = f(T_C)$$

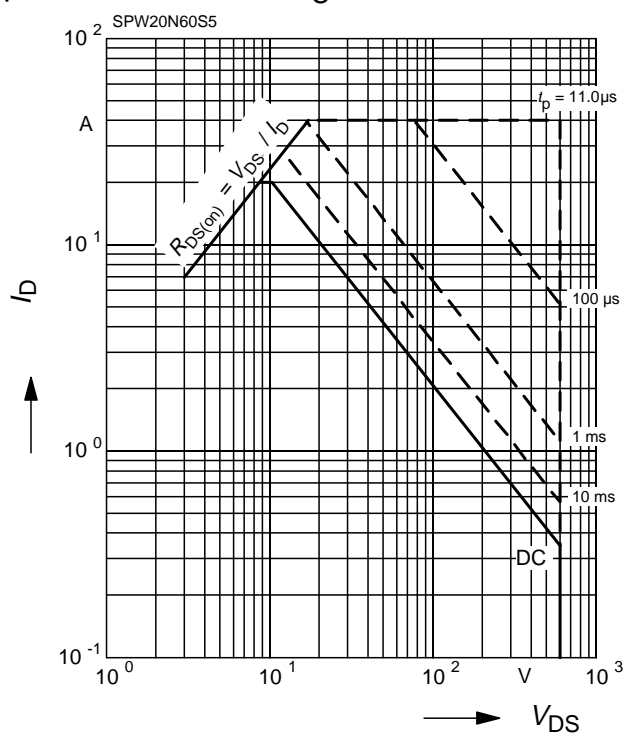
parameter:  $V_{GS} \geq 10 \text{ V}$



## Safe operating area

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

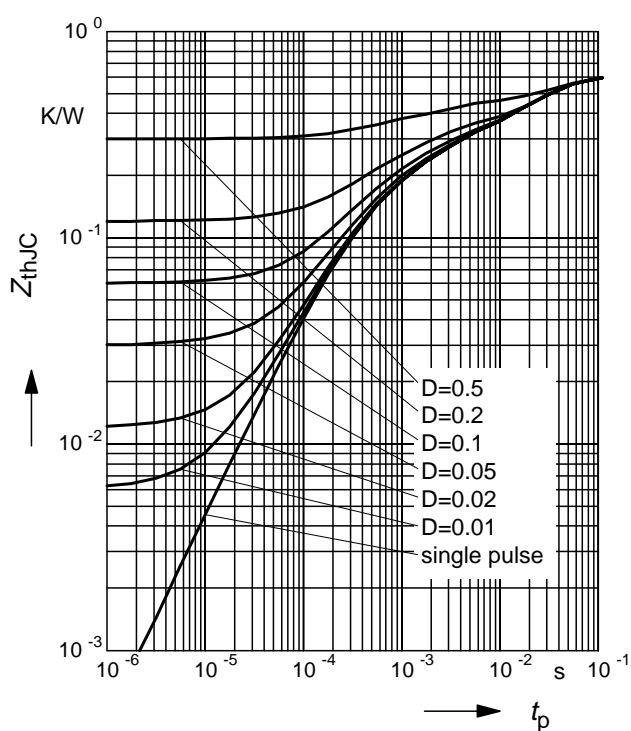
parameter:  $D=0.01$ ,  $T_C=25^{\circ}\text{C}$



## Transient thermal impedance

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

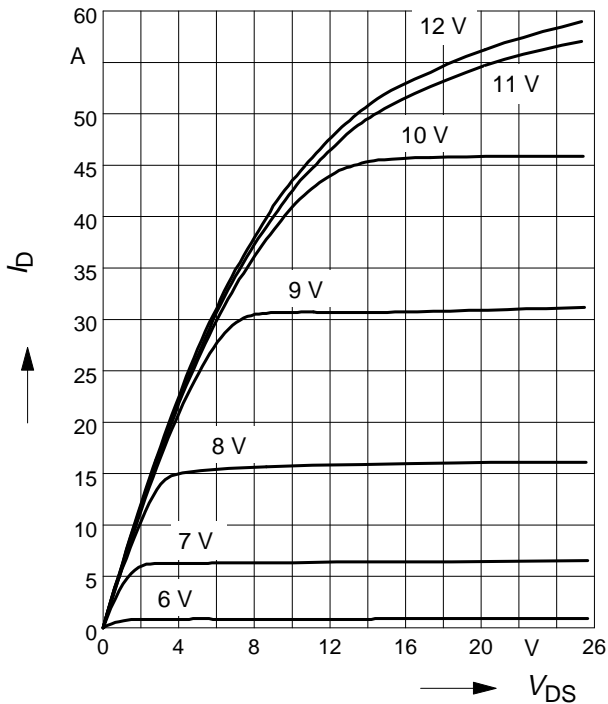
Parameter:  $D=t_p/T$



## Typ. output characteristic

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

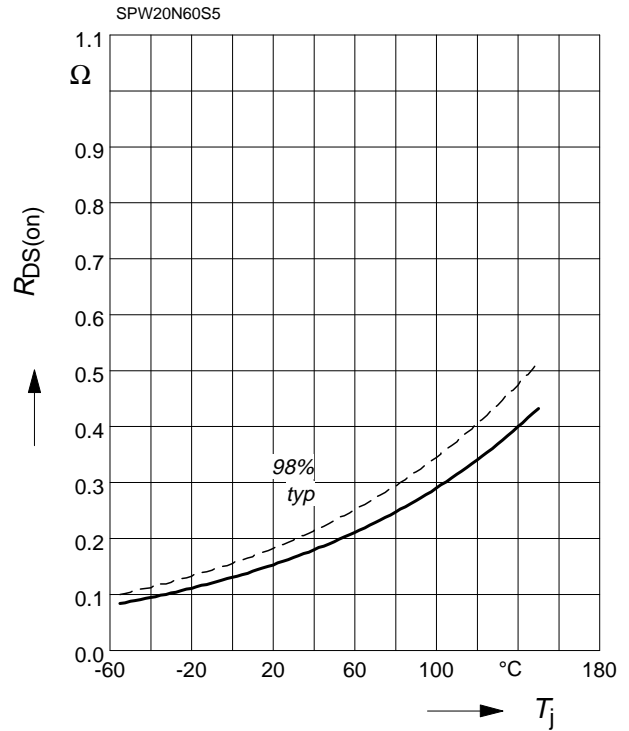
Parameter:  $V_{GS}$



## Drain-source on-resistance

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

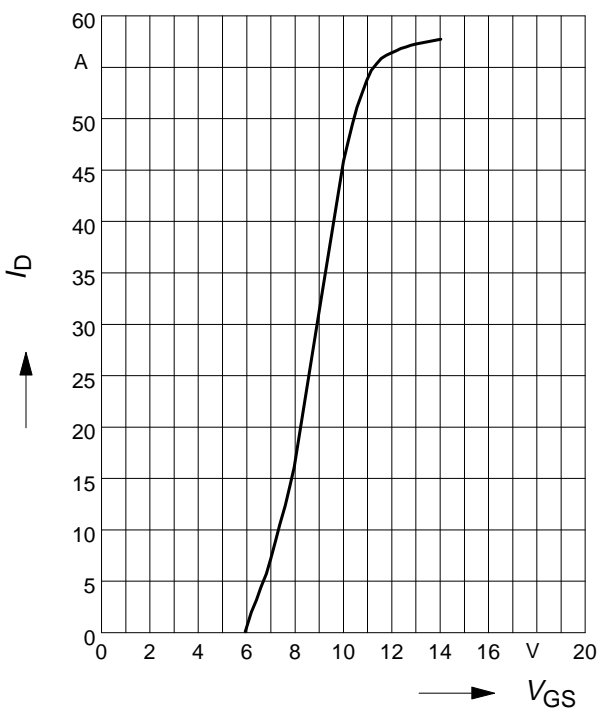
parameter:  $I_D = 13 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



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

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

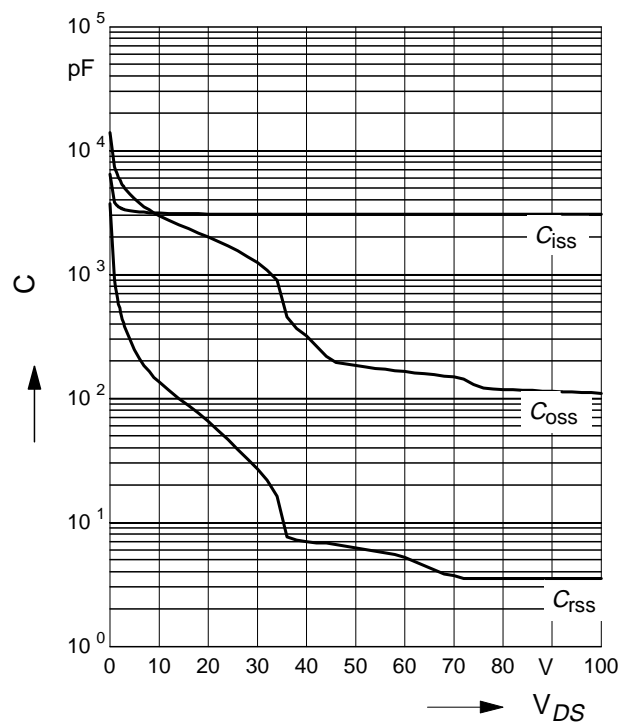
$V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$



## Typ. capacitances

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

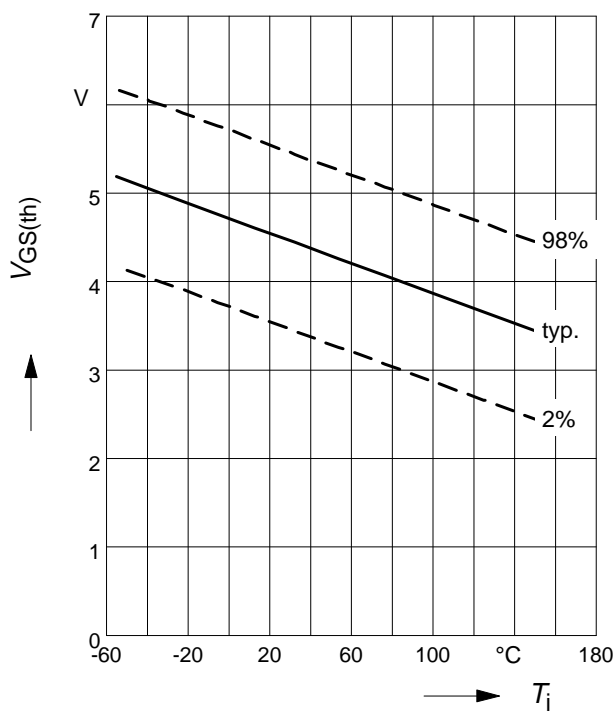
Parameter:  $V_{GS} = 0 \text{ V}$ ,  $f = 1 \text{ MHz}$



## Gate threshold voltage

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

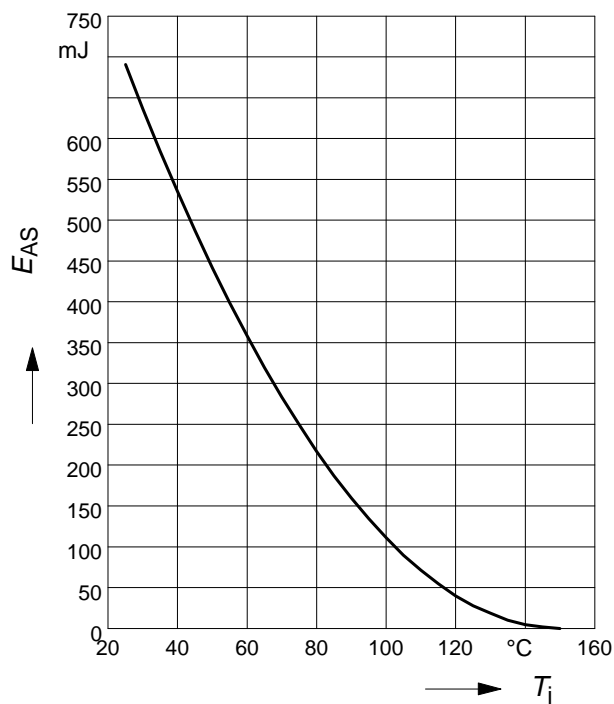
parameter:  $V_{GS} = V_{DS}$ ,  $I_D = 1 \text{ mA}$



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

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

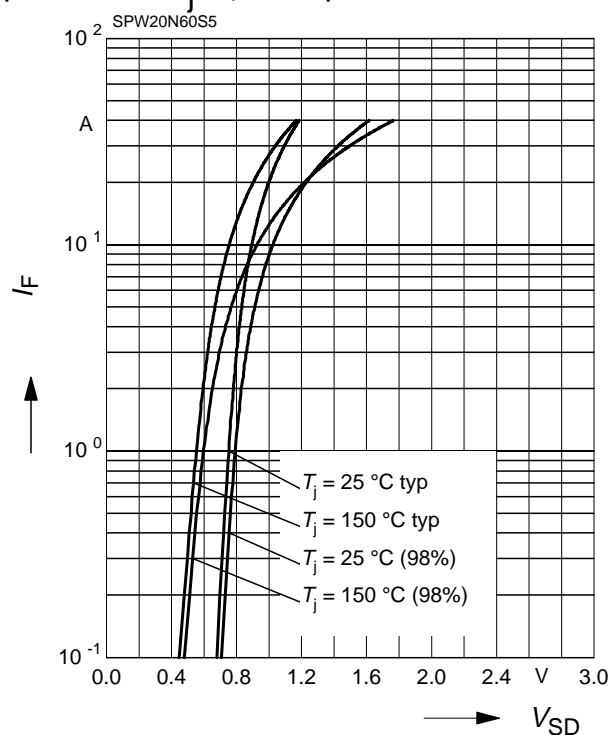
$R_{GS} = 25 \Omega$



## Forward characteristics of reverse diode

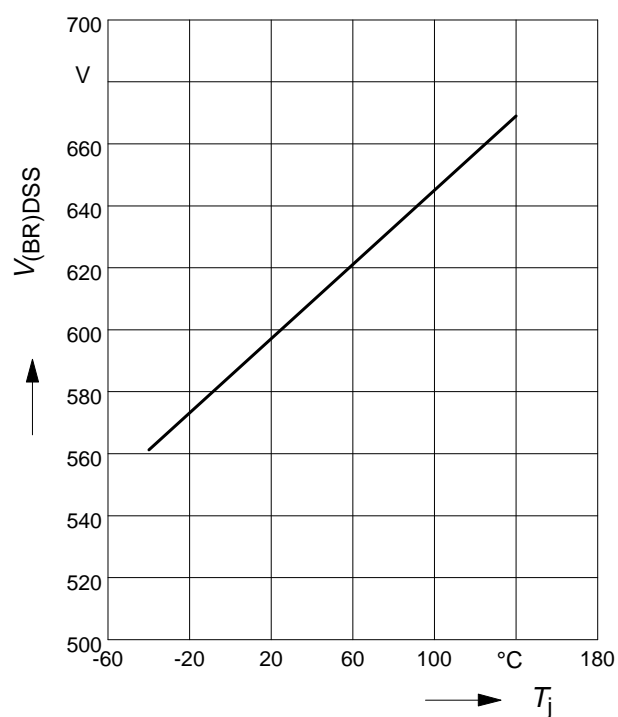
$$I_F = f(V_{SD})$$

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



## Drain-source break down voltage

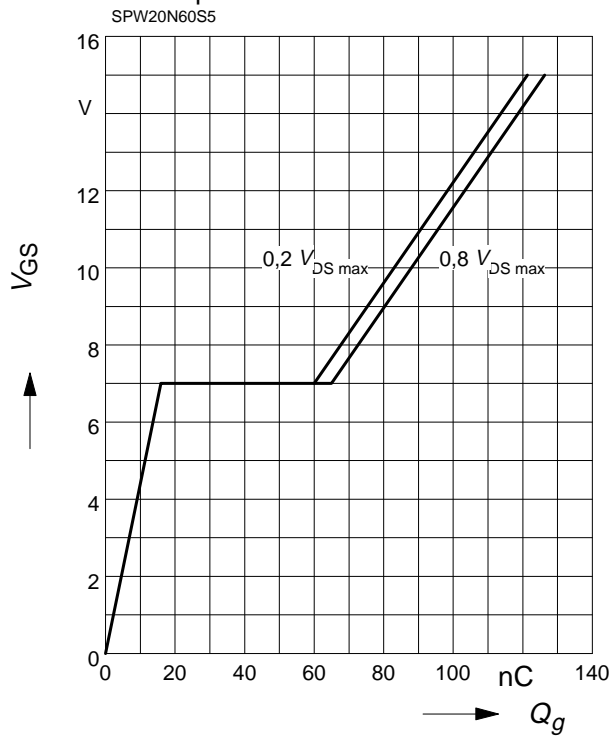
$$V_{(BR)DSS} = f(T_j)$$



## Typ. gate charge

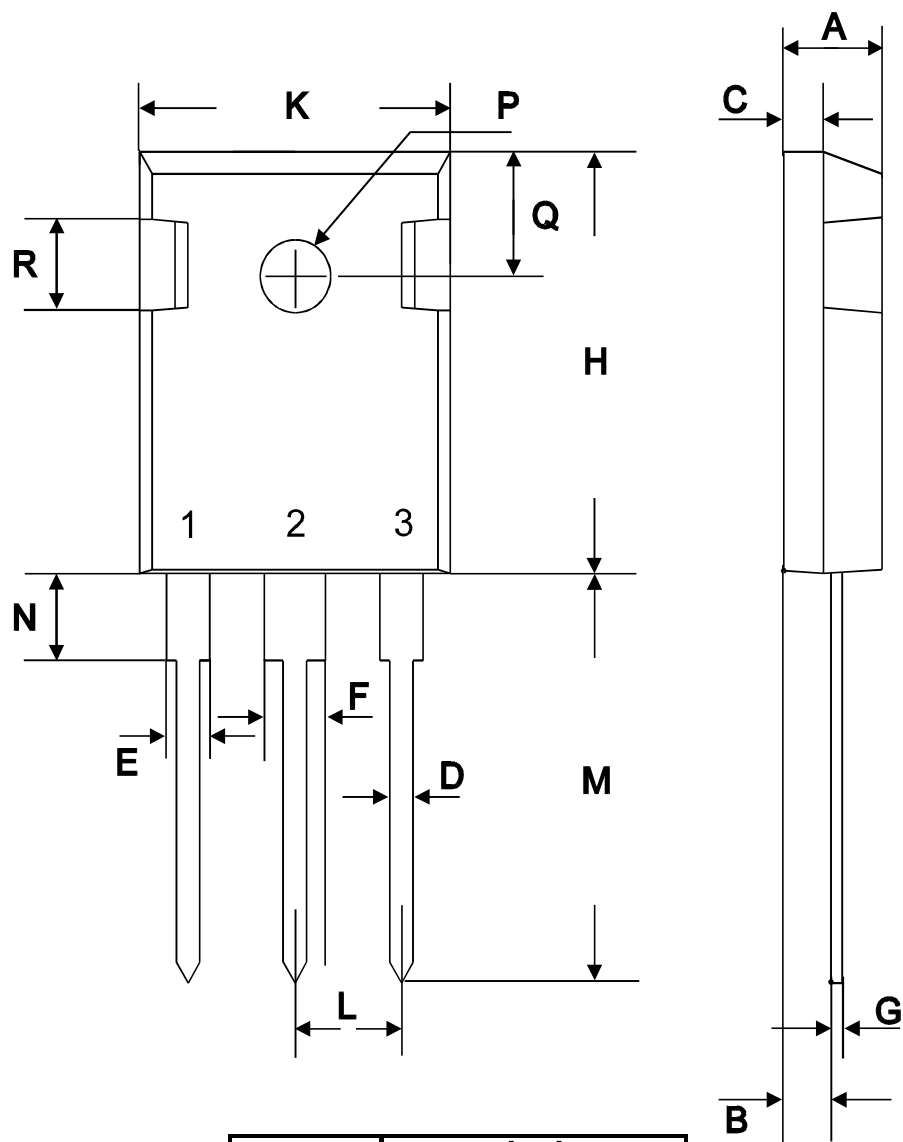
$$V_{GS} = f(Q_{Gate})$$

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
ØP	3.61	
Q	6.12	6.22

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