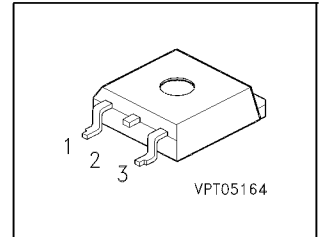
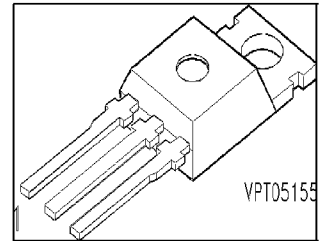
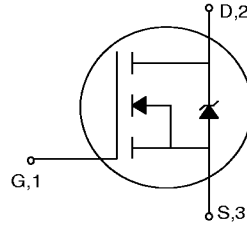


Cool MOS™ Power Transistor

- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO 220
- Ultra low gate charge
- Periodic avalanche proved
- Extreme dv/dt rated
- Optimized capacitances
- Improved noise immunity
- Former development designation:
SPPx1N60S5/SPBx1N60S5



Type	V_{DS}	I_D	$R_{DS(on)}$	Package	Marking	Ordering Code
SPP20N60S5	600 V	20 A	0.19 Ω	P-TO220-3-1	20N60S5	Q67040-S4751
SPB20N60S5				P-TO263-3-2	20N60S5	Q67040-S4171

Maximum Ratings , at $T_j = 25^\circ \text{C}$, unless otherwise specified

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

Electrical Characteristics

Parameter at $T_j = 25\text{ }^{\circ}\text{C}$, 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	
SMD version, device on PCB: @ min. footprint @ 6 cm ² cooling area ²⁾	R_{thJA}	- -	- 35	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, $V_{GS} = V_{DS}$ $I_D = 1\text{ mA}$, $T_j = 25\text{ }^{\circ}\text{C}$	$V_{GS(th)}$	3.5	4.5	5.5	
Zero gate voltage drain current, $V_{DS} = V_{DSS}$ $V_{GS} = 0\text{ V}$, $T_j = 25\text{ }^{\circ}\text{C}$ $V_{GS} = 0\text{ V}$, $T_j = 150\text{ }^{\circ}\text{C}$	I_{DSS}	- -	0.5 -	25 250	μA
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	Ω

¹ current limited by T_{jmax}

² Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical without blown air.

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	3750	pF
Output capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$	C_{oss}	-	1700	2040	
Reverse transfer capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$	C_{rss}	-	50	60	
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	-	ns
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 $T_j = 25\text{ }^{\circ}\text{C}$, unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	

Gate Charge Characteristics

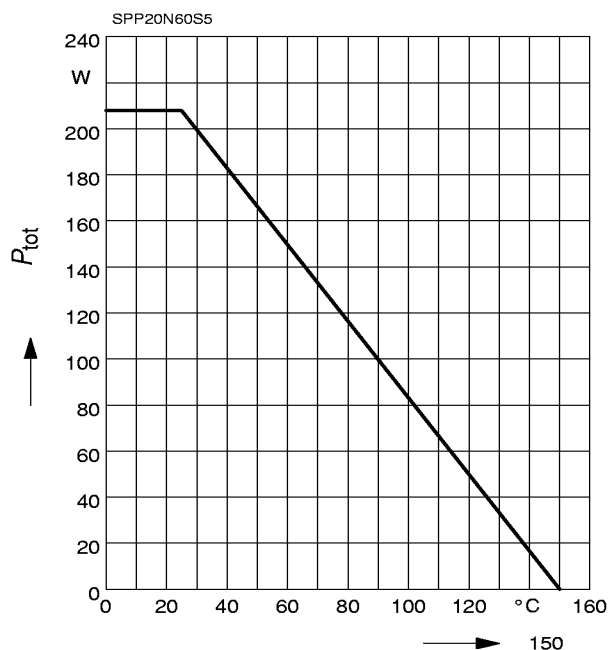
Gate-source charge $I_D = 20\text{ A}$, $V_{DD} = 350\text{ V}$	Q_{gs}	-	16	-	nC
Gate-drain charge $I_D = 20\text{ A}$, $V_{DD} = 350\text{ V}$	Q_{gd}	-	44	-	
Total gate charge $V_{DD} = 350\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$	Q_g	-	88	-	

Reverse Diode

Inverse diode continuous forward current $T_C = 25\text{ }^{\circ}\text{C}$	I_S	-	-	20	A
Inverse diode direct current,pulsed $T_C = 25\text{ }^{\circ}\text{C}$	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 $V_R = 100\text{ V}$, $I_F = I_S$, $di_F/dt = 100\text{ A}/\mu\text{s}$	t_{rr}	-	610	-	ns
Reverse recovery charge $V_R = 100\text{ V}$, $I_F = I_S$, $di_F/dt = 100\text{ A}/\mu\text{s}$	Q_{rr}	-	12	-	μC

Power Dissipation

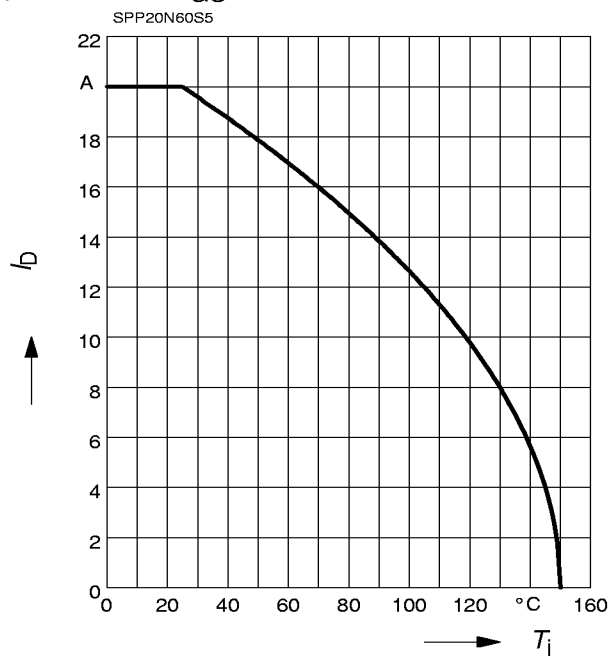
$$P_{\text{tot}} = f(T_C)$$



Drain current

$$I_D = f(T_C)$$

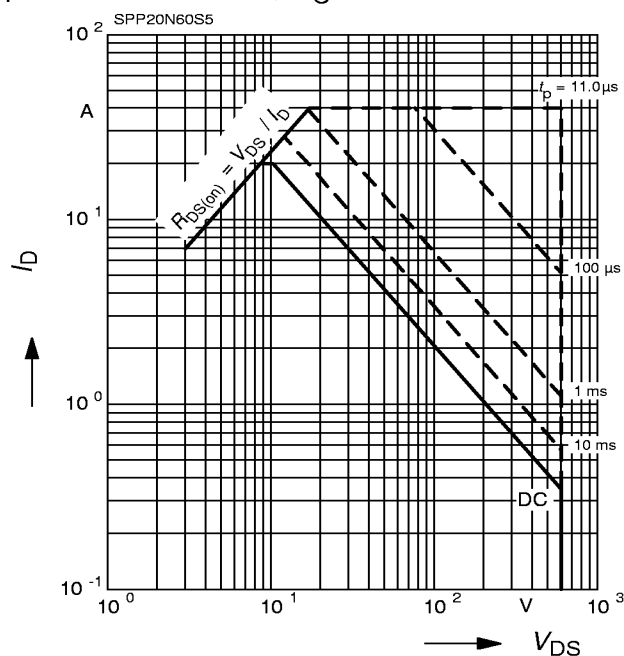
parameter: $V_{GS} \geq 10 \text{ V}$



Safe operating area

$$I_D = f(T_C)$$

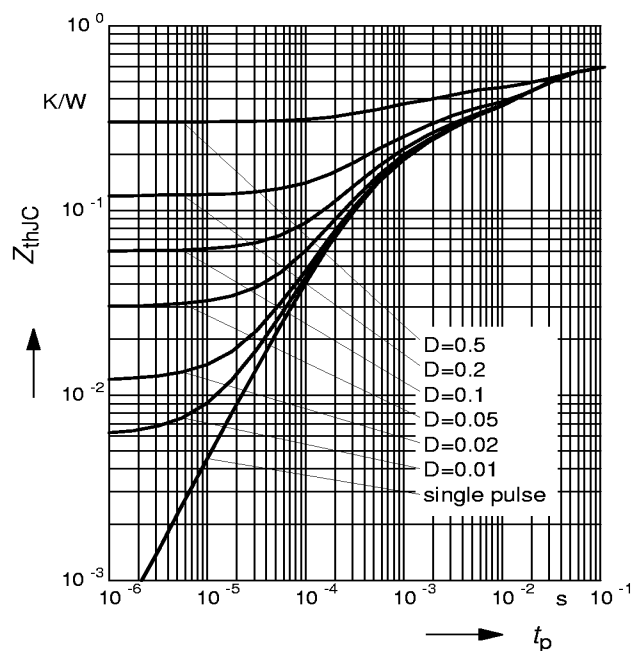
parameter: $D=0.01$, $T_C=25^\circ\text{C}$



Transient thermal impedance

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

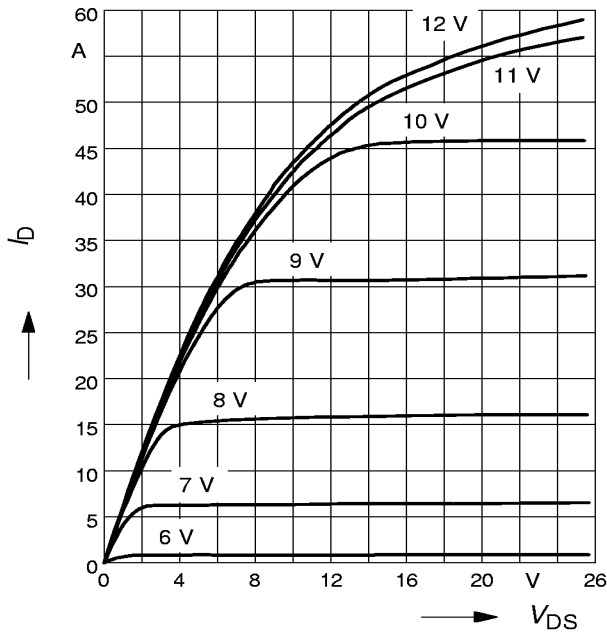
Parameter: $D=t_p/T$



Typ. output characteristic

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

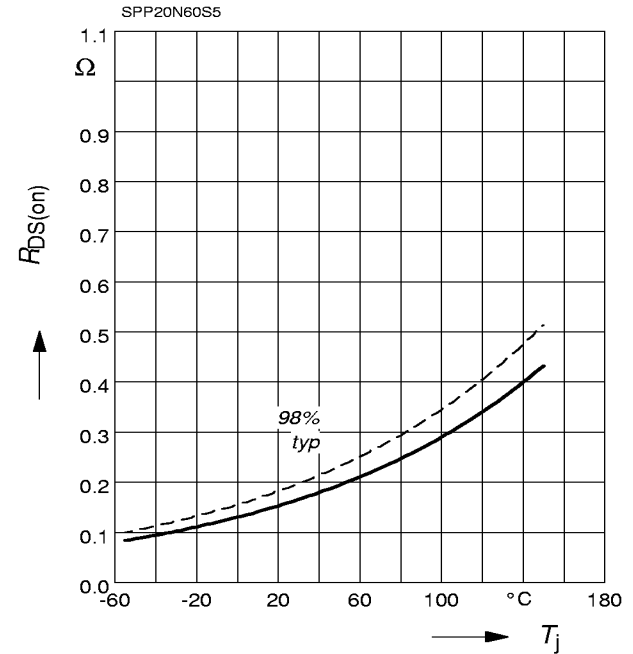
Parameter: V_{GS}



Drain-source on-resistance

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

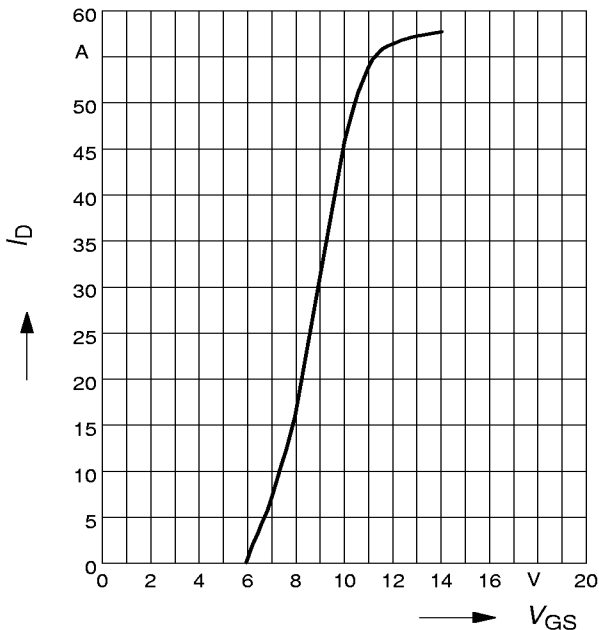
parameter : $I_D = 13\text{ A}$, $V_{GS} = 10\text{ V}$



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

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

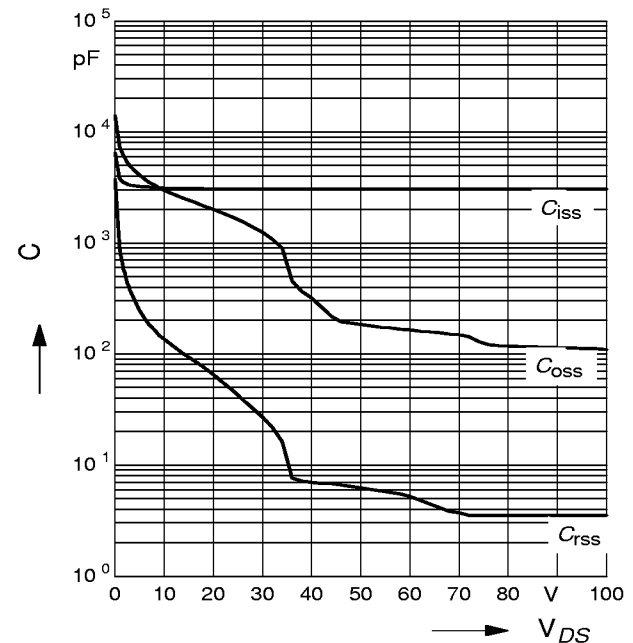
$V_{DS} \geq 2 \times I_D \times R_{DS(on)\text{max}}$



Typ. capacitances

$C = f(V_{DS})$

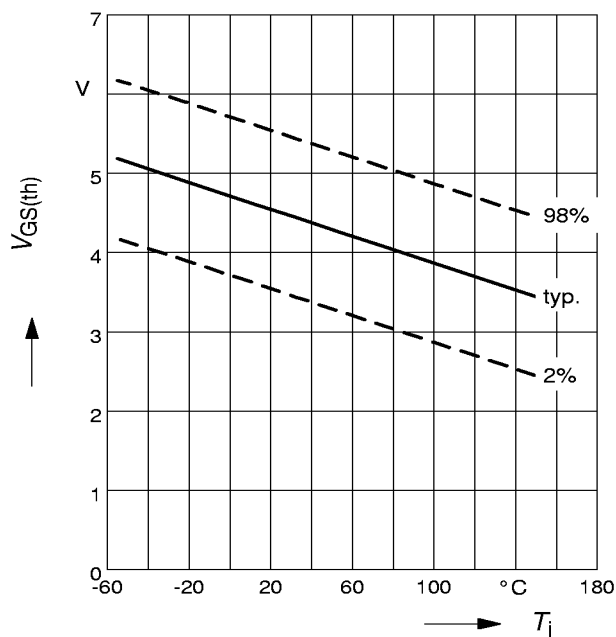
Parameter: $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$



Gate threshold voltage

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

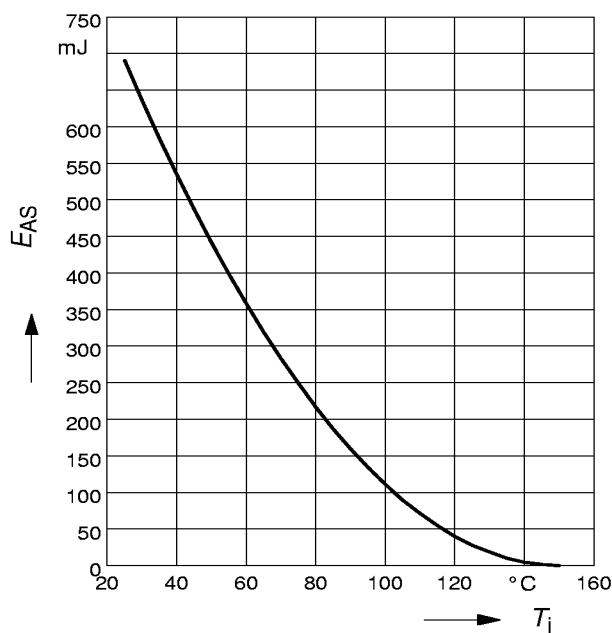
parameter: $V_{GS} = V_{DS}$, $I_D = 1 \text{ mA}$



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

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

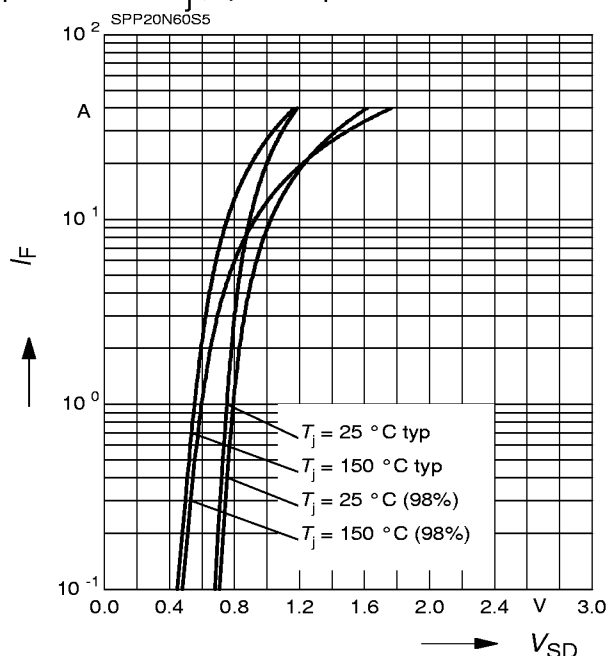
$R_{GS} = 25 \Omega$



Forward characteristics of reverse diode

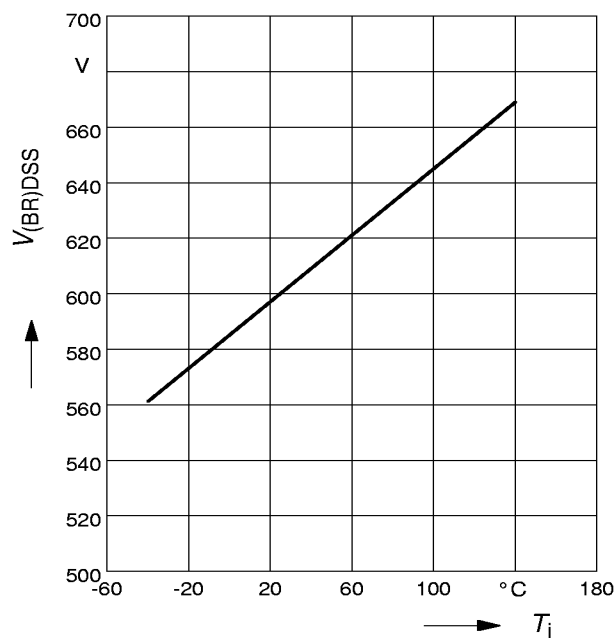
$$I_F = f(V_{SD})$$

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



Drain-source break down voltage

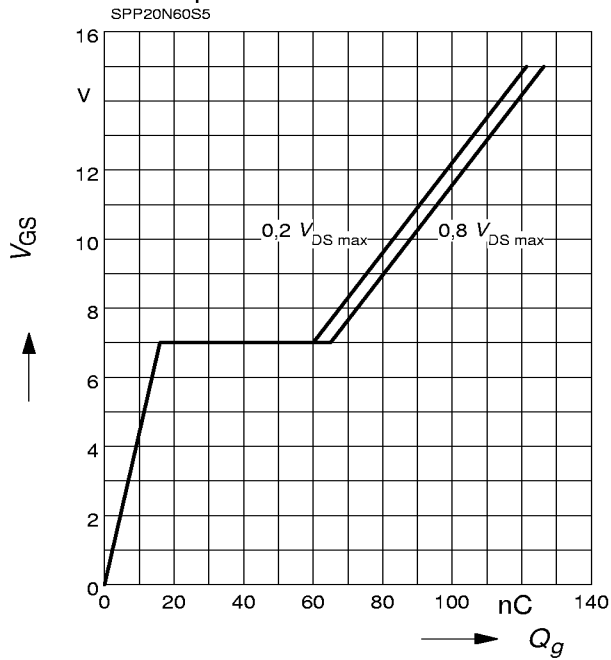
$$V_{(BR)DSS} = f(T_j)$$

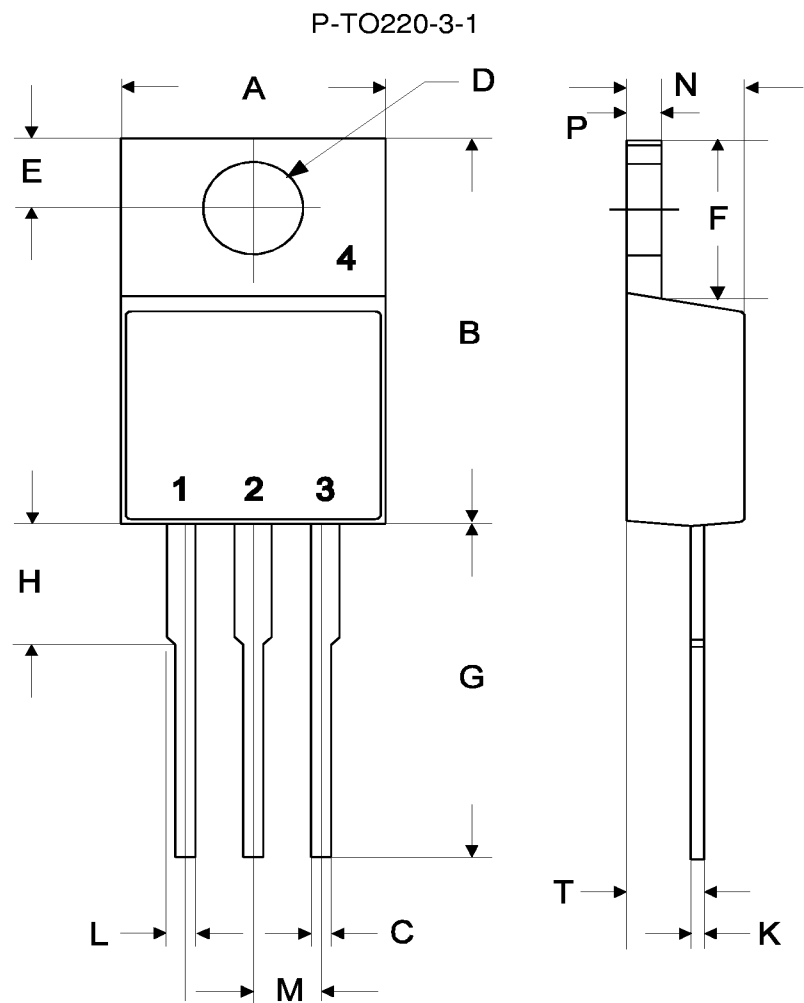


Typ. gate charge

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

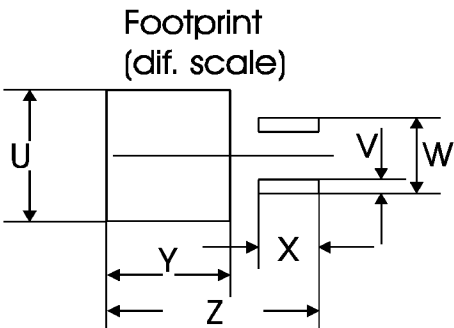
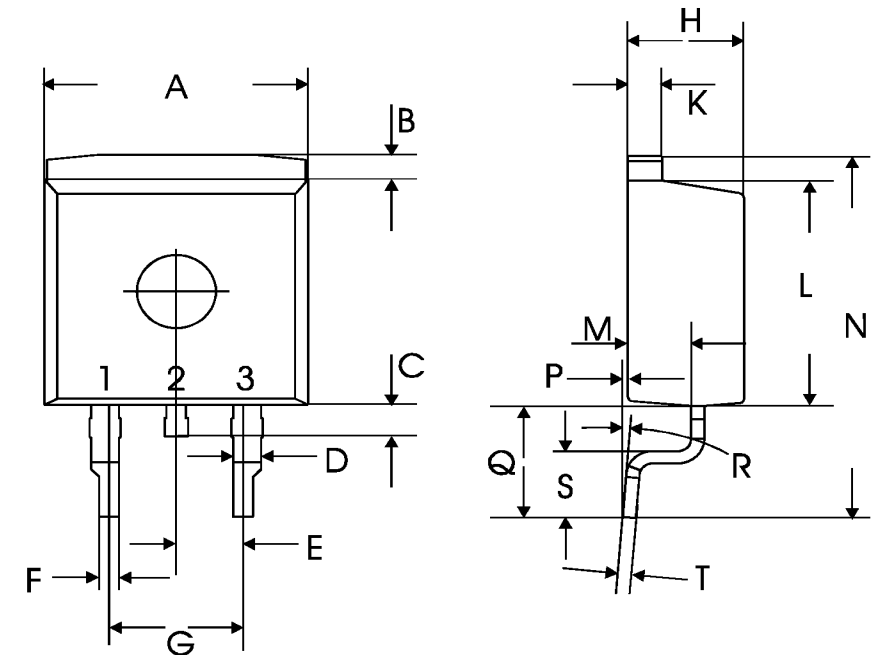
parameter: $I_{DpulS} = 20\text{ A}$





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

P-TO263-3-2



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	