

CoolMOS™ Power Transistor

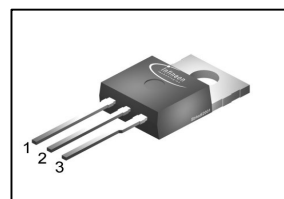
Features

- New revolutionary high voltage technology
- Extreme dv/dt rated
- High peak current capability
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free lead plating; RoHS compliant
- Ultra low gate charge
- Ultra low effective capacitances

Product Summary

V_{DS}	800	V
$R_{DS(on)max}$ @ $T_j = 25^\circ\text{C}$	1.3	Ω
$Q_{g,typ}$	23	nC

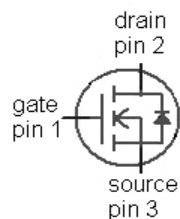
PG-TO220-3



CoolMOS™ 800V designed for:

- Industrial application with high DC bulk voltage
- Switching Application (i.e. active clamp forward)

Type	Package	Marking
SPP04N80C3	PG-TO220-3	04N80C3



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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25^\circ\text{C}$	4	A
		$T_C=100^\circ\text{C}$	2.5	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	12	
Avalanche energy, single pulse	E_{AS}	$I_D=0.8\text{ A}$, $V_{DD}=50\text{ V}$	170	mJ
Avalanche energy, repetitive $t_{AR}^{2),3)}$	E_{AR}	$I_D=4\text{ A}$, $V_{DD}=50\text{ V}$	0.1	
Avalanche current, repetitive $t_{AR}^{2),3)}$	I_{AR}		4	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\dots640\text{ V}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25^\circ\text{C}$	63	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	$^\circ\text{C}$
Mounting torque		M3 and M3.5 screws	60	Ncm

Maximum ratings, at $T_j=25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	I_S	$T_C=25\text{ °C}$	4	A
Diode pulse current ²⁾	$I_{S,pulse}$		12	
Reverse diode dv/dt ⁴⁾	dv/dt		4	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	2	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wave soldering only allowed at leads	T_{solder}	1.6 mm (0.063 in.) from case for 10s	-	-	260	°C

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

Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$	800	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{ V}$, $I_D=4\text{ A}$	-	870	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=0.24\text{ mA}$	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=800\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$	-	-	10	μA
		$V_{DS}=800\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$	-	50	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=2.5\text{ A}$, $T_j=25\text{ °C}$	-	1.1	1.3	Ω
		$V_{GS}=10\text{ V}$, $I_D=2.5\text{ A}$, $T_j=150\text{ °C}$	-	3	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	1.2	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	570	-	pF
Output capacitance	C_{oss}		-	25	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	19	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	51	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=0/10\text{ V}, I_D=4\text{ A},$ $R_G=22\text{ }\Omega, T_j=25\text{ }^\circ\text{C}$	-	25	-	ns
Rise time	t_r		-	15	-	
Turn-off delay time	$t_{d(off)}$		-	72	-	
Fall time	t_f		-	12	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=640\text{ V}, I_D=4\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	3	-	nC
Gate to drain charge	Q_{gd}		-	12	-	
Gate charge total	Q_g		-	23	31	
Gate plateau voltage	$V_{plateau}$		-	5.5	-	V

Reverse Diode

Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=I_S=4\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	1	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}, I_F=I_S=4\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	520	-	ns
Reverse recovery charge	Q_{rr}		-	4	-	μC
Peak reverse recovery current	I_{rrm}		-	12	-	A

¹⁾ J-STD20 and JESD22

²⁾ Pulse width t_p limited by $T_{j,max}$

³⁾ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

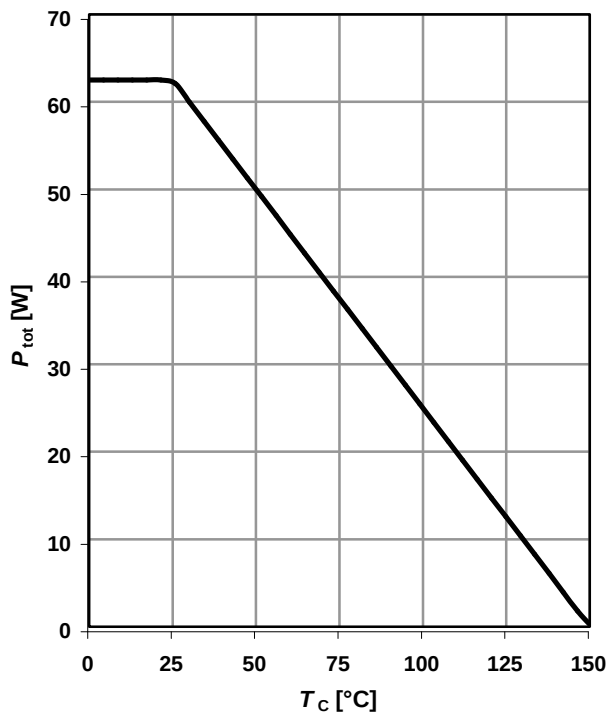
⁴⁾ $I_{SD}=I_D, di/dt=400\text{ A}/\mu\text{s}, V_{DClk}=400\text{ V}, V_{peak}<V_{(BR)DSS}, T_j<T_{j,max}$, identical low side and high side switch

⁵⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

⁶⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

1 Power dissipation

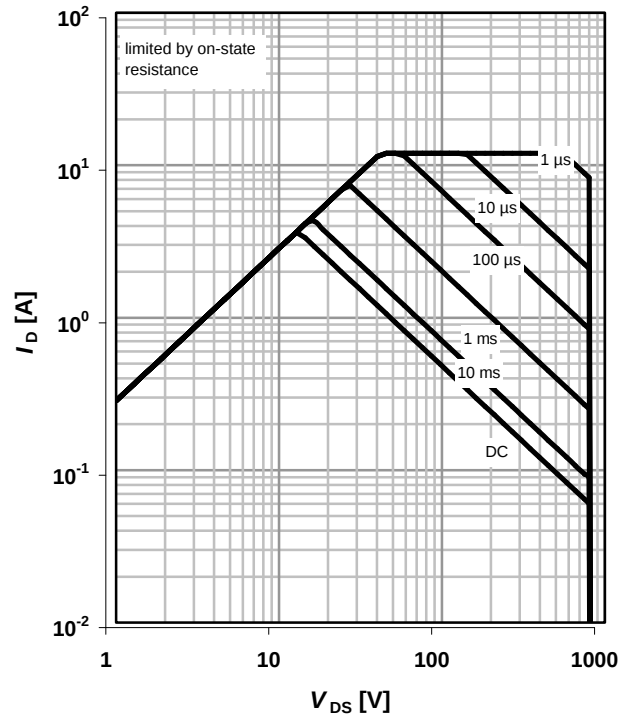
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

$$I_D = f(V_{DS}); T_C = 25^\circ\text{C}; D = 0$$

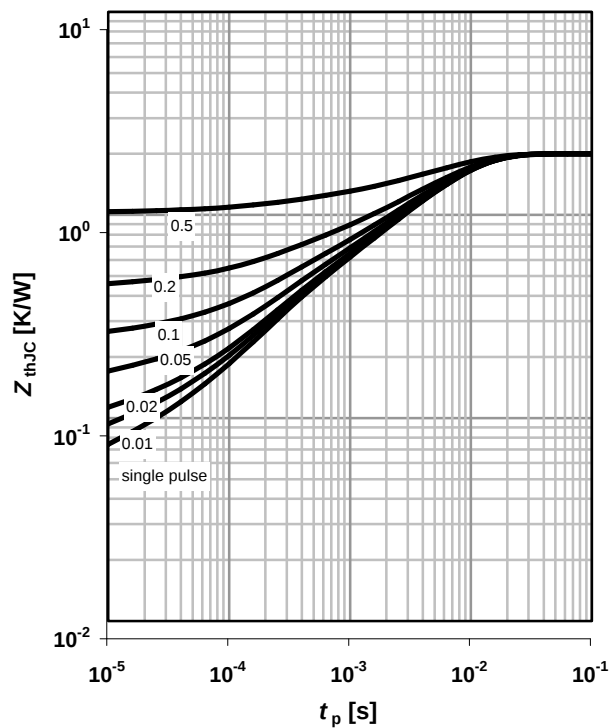
parameter: t_p



3 Max. transient thermal impedance

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

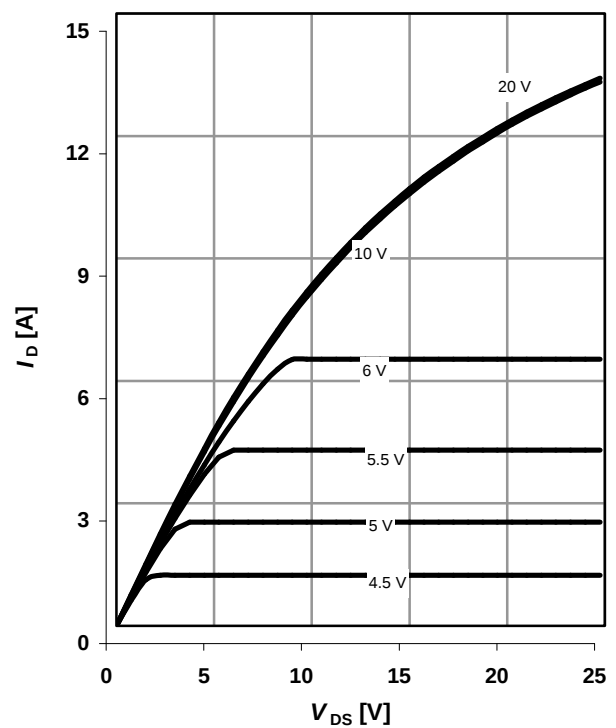
parameter: $D = t_p / T$



4 Typ. output characteristics

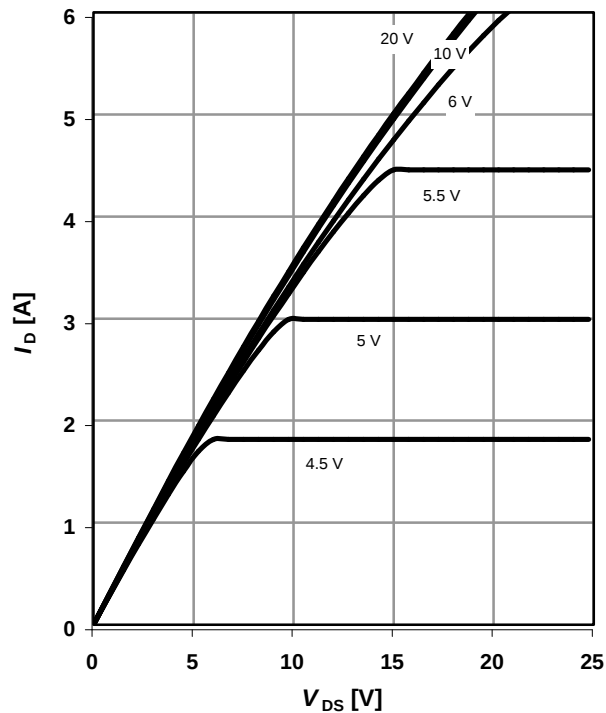
$$I_D = f(V_{DS}); T_j = 25^\circ\text{C}; t_p = 10 \mu\text{s}$$

parameter: V_{GS}



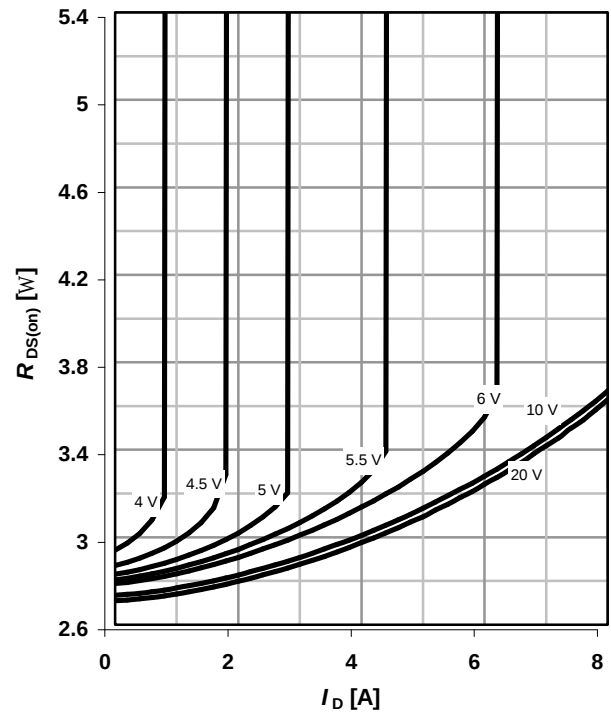
5 Typ. output characteristics

 $I_D = f(V_{DS}); T_j = 150^\circ\text{C}; t_p = 10\ \mu\text{s}$

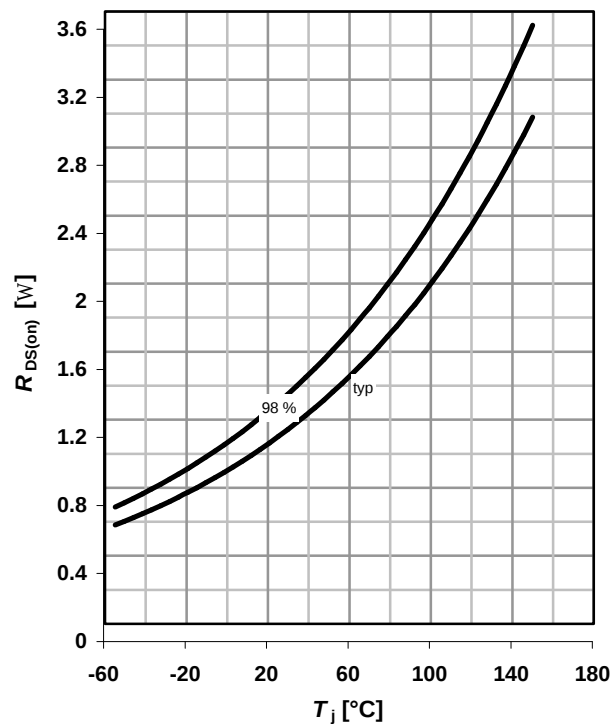
parameter: V_{GS}


6 Typ. drain-source on-state resistance

 $R_{DS(on)} = f(I_D); T_j = 150^\circ\text{C}$

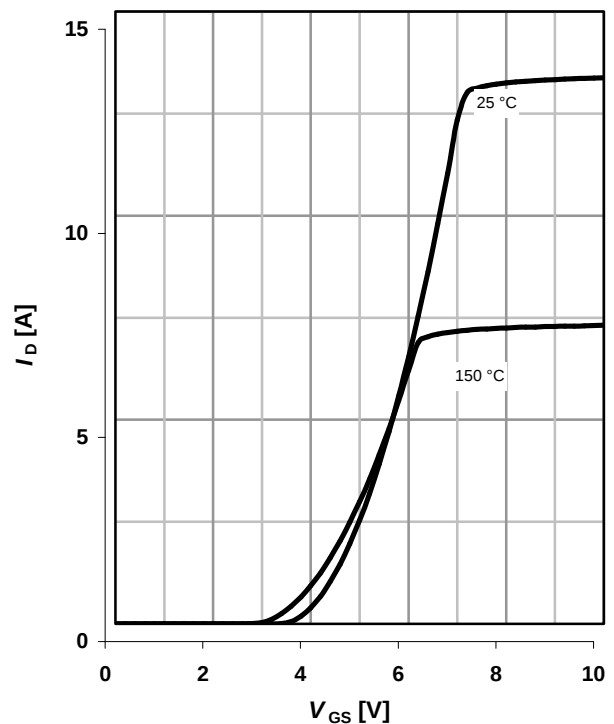
parameter: V_{GS}


7 Drain-source on-state resistance

 $R_{DS(on)} = f(T_j); I_D = 2.5\ \text{A}; V_{GS} = 10\ \text{V}$


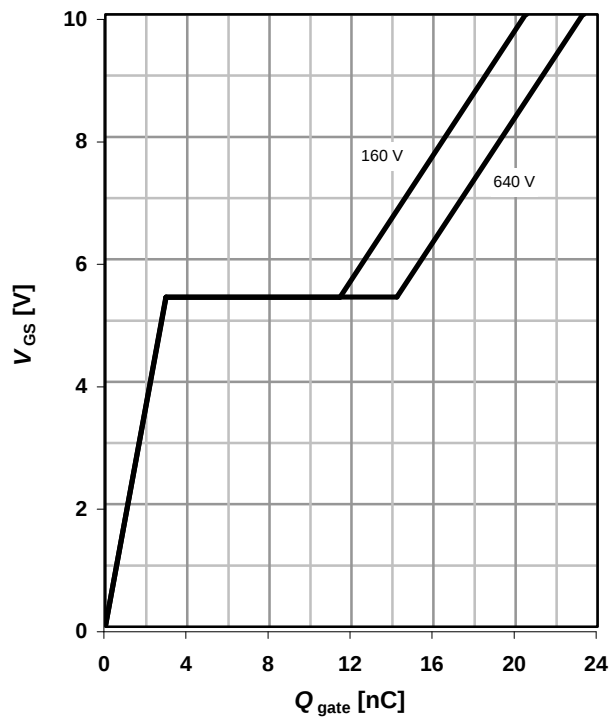
8 Typ. transfer characteristics

 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)\text{max}}; t_p = 10\ \mu\text{s}$

parameter: T_j


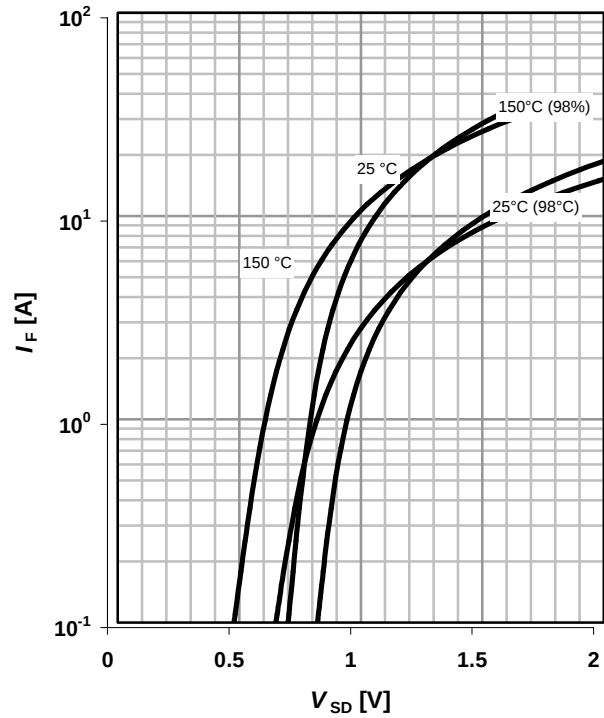
9 Typ. gate charge

 $V_{GS}=f(Q_{gate}); I_D=4\text{ A pulsed}$

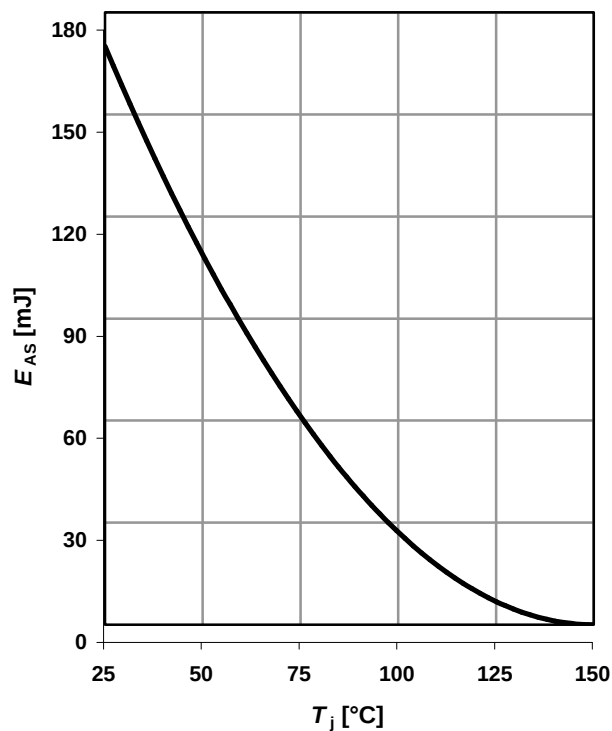
parameter: V_{DD}


10 Forward characteristics of reverse diode

 $I_F=f(V_{SD}); t_p=10\text{ }\mu\text{s}$

parameter: T_j


11 Avalanche energy

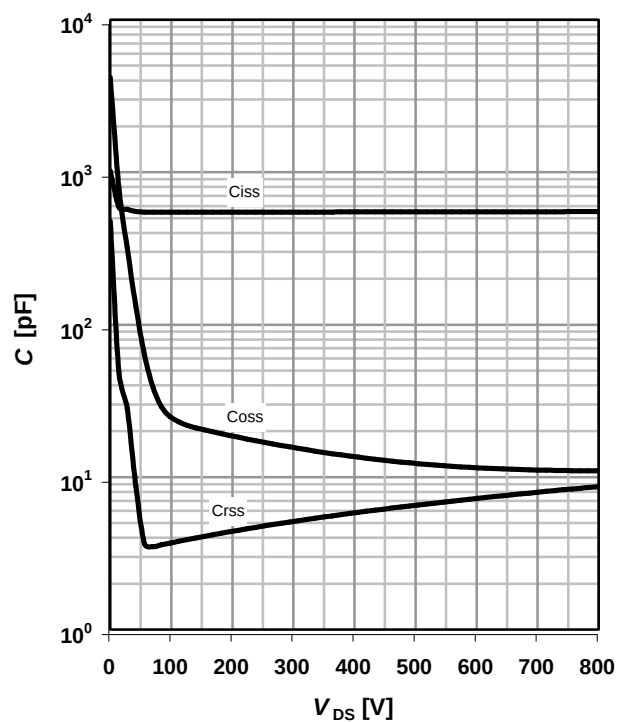
 $E_{AS}=f(T_j); I_D=0.8\text{ A}; V_{DD}=50\text{ V}$


12 Drain-source breakdown voltage

 $V_{BR(DSS)}=f(T_j); I_D=0.25\text{ mA}$

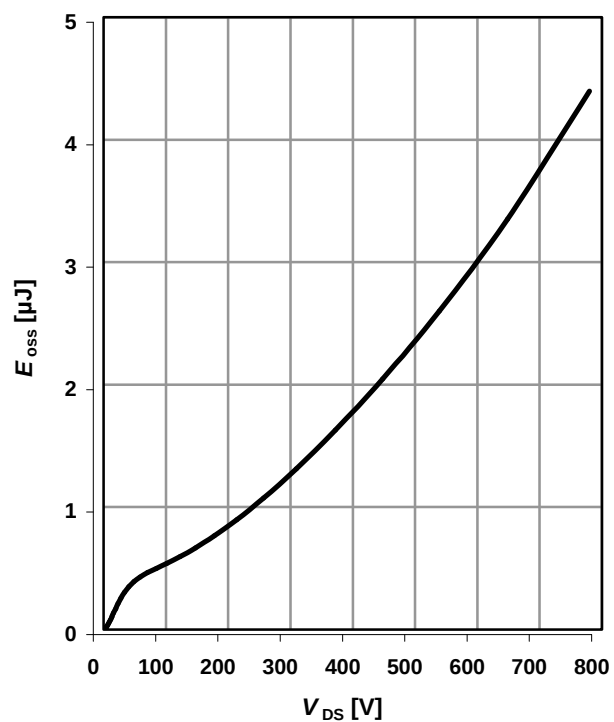

13 Typ. capacitances

$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



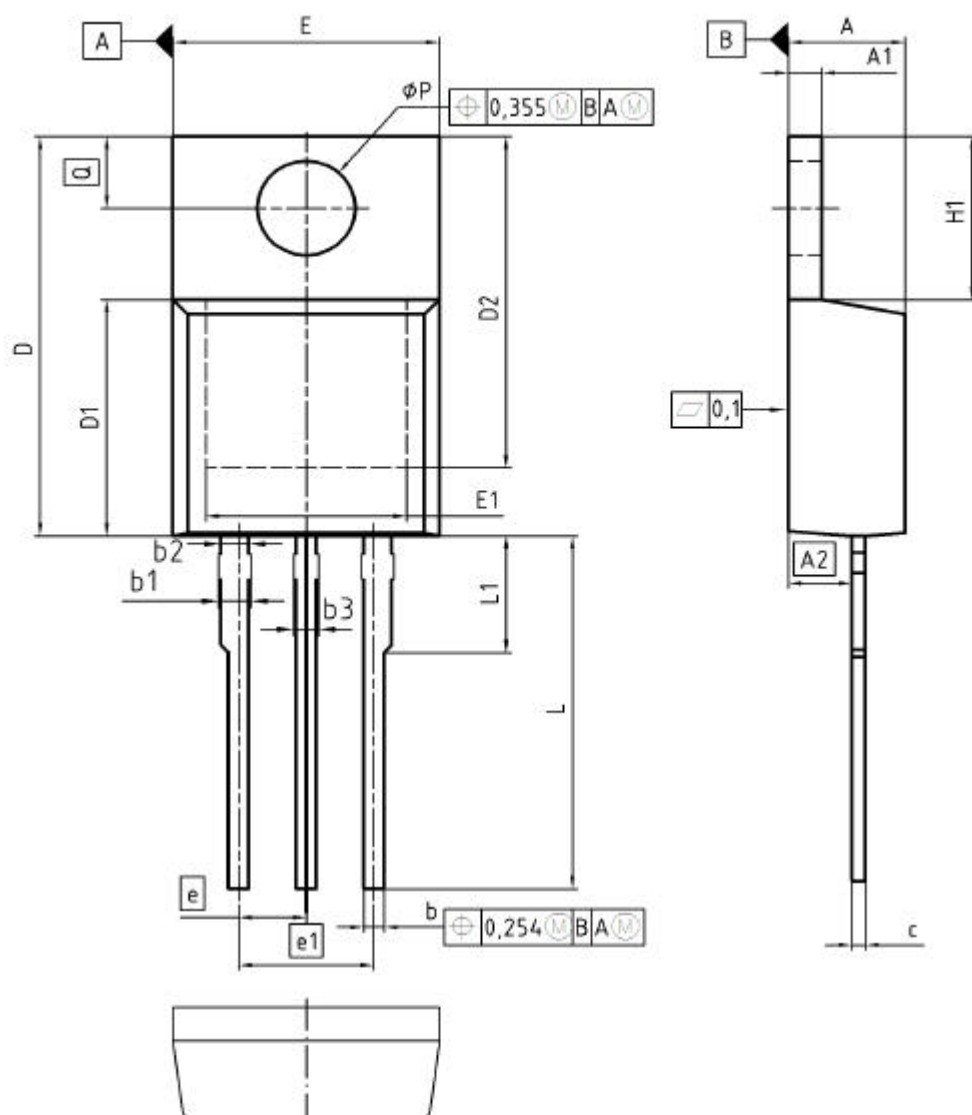
14 Typ. Coss stored energy

$E_{oss} = f(V_{DS})$

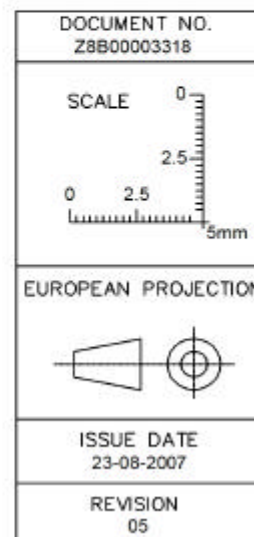


Definition of diode switching characteristics



PG-TO220-3: Outline


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
φP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118



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