

**CoolMOS™ Power Transistor**
**Features**

- Lowest figure-of-merit  $R_{ON} \times Q_g$
- Extreme dv/dt rated
- High peak current capability
- Qualified for industrial grade applications according to JEDEC<sup>1)</sup>
- Pb-free lead plating; RoHS compliant
- Ultra low gate charge

**Product Summary**

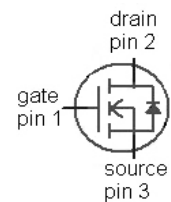
$V_{DS} @ T_J=25^\circ\text{C}$	900	V
$R_{DS(on),max} @ T_J=25^\circ\text{C}$	1.0	$\Omega$
$Q_{g,typ}$	34	nC

**CoolMOS™ 900V is designed for:**

- Quasi Resonant Flyback / Forward topologies
- PC Silverbox and consumer applications
- Industrial SMPS


**PG-TO220 FP**


Type	Package	Marking
IPA90R1K0C3	PG-TO220 FP	9R1K0C


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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current <sup>2)</sup>	$I_D$	$T_C=25^\circ\text{C}$	5.7	A
		$T_C=100^\circ\text{C}$	3.6	
Pulsed drain current <sup>3)</sup>	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	12	
Avalanche energy, single pulse	$E_{AS}$	$I_D=1.1\text{ A}, V_{DD}=50\text{ V}$	97	mJ
Avalanche energy, repetitive $t_{AR}$ <sup>3),4)</sup>	$E_{AR}$	$I_D=1.1\text{ A}, V_{DD}=50\text{ V}$	0.37	
Avalanche current, repetitive $t_{AR}$ <sup>3),4)</sup>	$I_{AR}$		1.1	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\dots 400\text{ V}$	50	V/ns
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
		AC (f>1 Hz)	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25^\circ\text{C}$	32	W
Operating and storage temperature	$T_J, T_{stg}$		-55 ... 150	$^\circ\text{C}$
Mounting torque		M2.5 screws	50	Ncm

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

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current <sup>2)</sup>	$I_S$	$T_C=25\text{ °C}$	3.3	A
Diode pulse current <sup>3)</sup>	$I_{S,pulse}$		13	
Reverse diode $dv/dt$ <sup>5)</sup>	$dv/dt$		4	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{thJC}$		-	-	3.9	K/W
Thermal resistance, junction - ambient	$R_{thJA}$	leaded	-	-	62	
Soldering temperature, wavesoldering only allowed at leads	$T_{sold}$	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$	900	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.37\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=900\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	-	1	$\mu\text{A}$
		$V_{DS}=900\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ °C}$	-	10	-	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=3.3\text{ A}, T_j=25\text{ °C}$	-	0.78	1	$\Omega$
		$V_{GS}=10\text{ V}, I_D=3.3\text{ A}, T_j=150\text{ °C}$	-	2.1	-	
Gate resistance	$R_G$	$f=1\text{ MHz}, \text{open drain}$	-	1.3	-	$\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	850	-	pF
Output capacitance	$C_{oss}$		-	42	-	
Effective output capacitance, energy related <sup>6)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 500 V	-	28	-	
Effective output capacitance, time related <sup>7)</sup>	$C_{o(tr)}$		-	100	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=3.3\text{ A},$ $R_G=62.4\ \Omega$	-	70	-	ns
Rise time	$t_r$		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	400	-	
Fall time	$t_f$		-	35	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD}=400\text{ V}, I_D=3.3\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	4	-	nC
Gate to drain charge	$Q_{gd}$		-	15	-	
Gate charge total	$Q_g$		-	34	tbd	
Gate plateau voltage	$V_{plateau}$		-	4.5	-	V

**Reverse Diode**

Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=3.3\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.8	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	340	-	ns
Reverse recovery charge	$Q_{rr}$		-	4.1	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	21	-	A

<sup>1)</sup> J-STD20 and JESD22

<sup>2)</sup> Limited only by maximum temperature

<sup>3)</sup> Pulse width  $t_p$  limited by  $T_{J,max}$ 
<sup>4)</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .

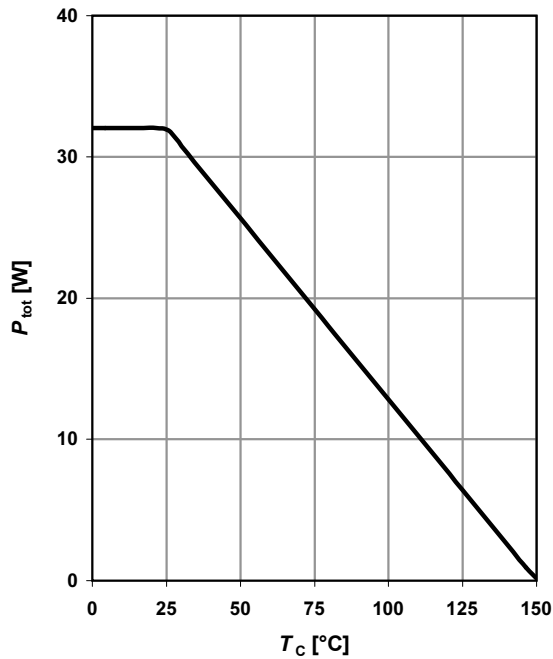
<sup>5)</sup>  $I_{SD} \leq I_D$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DClink}=400\text{ V}$ ,  $V_{peak} < V_{(BR)DSS}$ ,  $T_j < T_{J,max}$ , identical low side and high side switch

<sup>6)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 50%  $V_{DSS}$ .

<sup>7)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 50%  $V_{DSS}$ .

**1 Power dissipation**

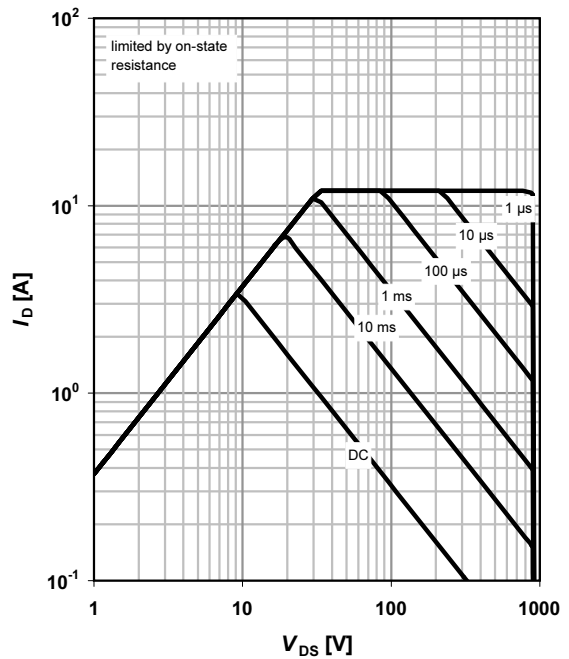
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

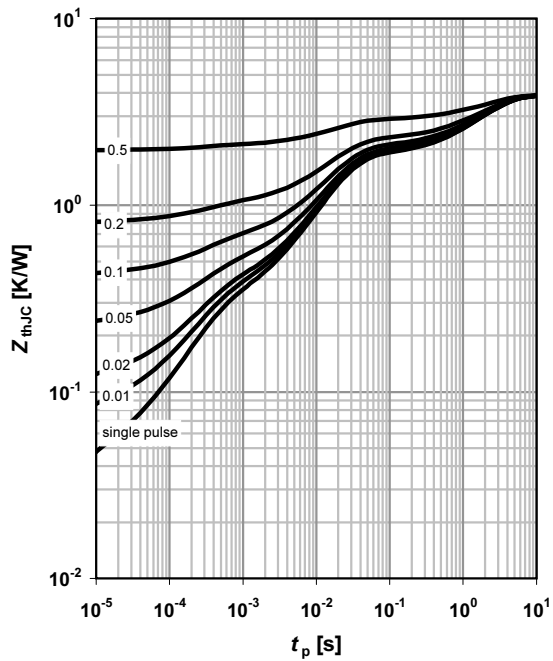
parameter:  $t_p$



**3 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

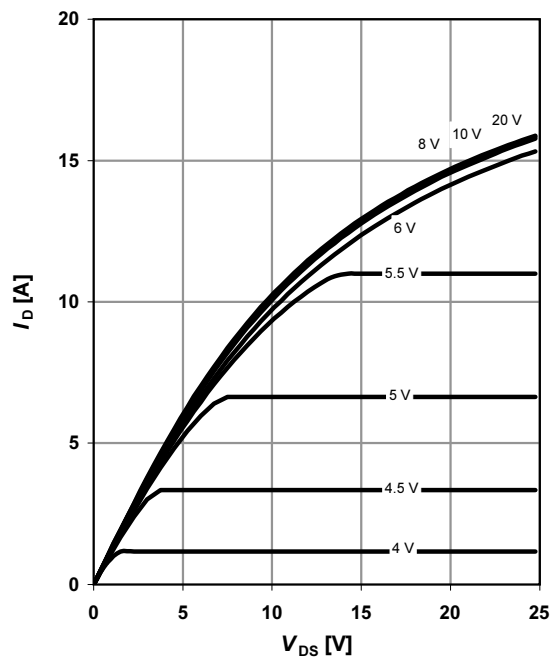
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

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

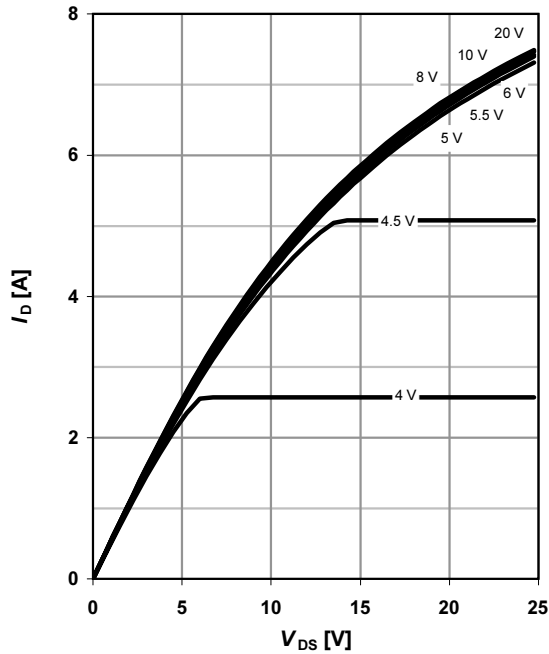
parameter:  $V_{GS}$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_J = 150\text{ }^\circ\text{C}$

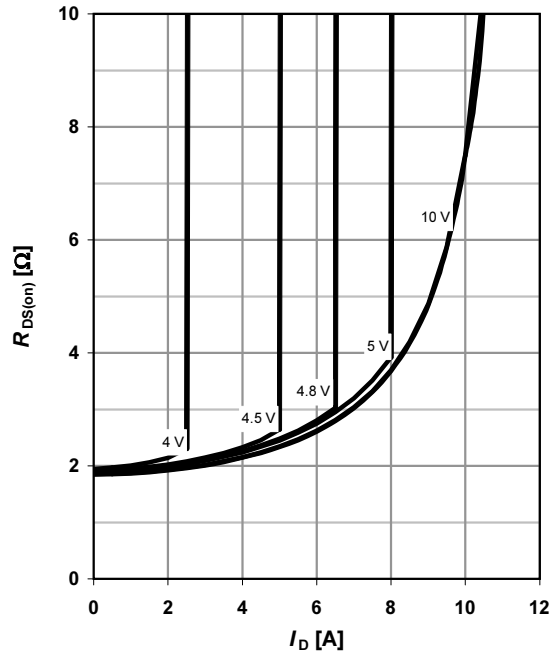
parameter:  $V_{GS}$



**6 Typ. drain-source on-state resistance**

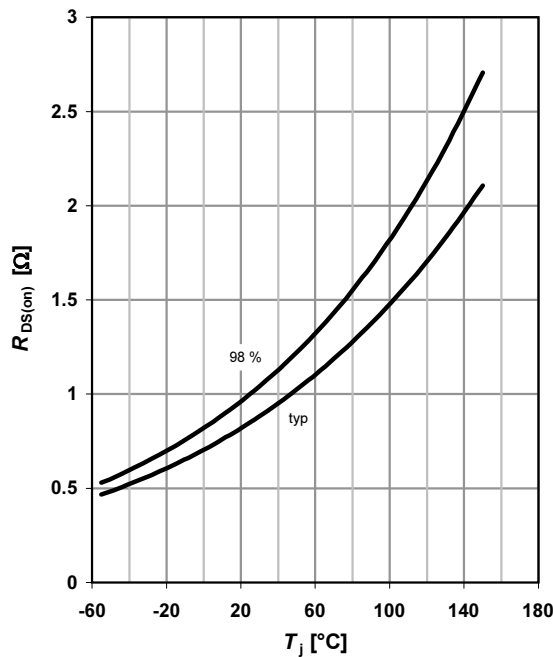
$R_{DS(on)} = f(I_D); T_J = 150\text{ }^\circ\text{C}$

parameter:  $V_{GS}$



**7 Drain-source on-state resistance**

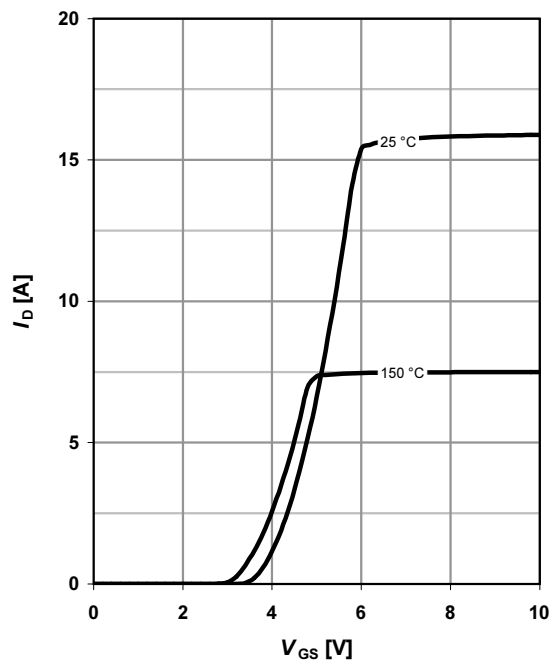
$R_{DS(on)} = f(T_J); I_D = 3.3\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

$I_D = f(V_{GS}); V_{DS} \geq 20\text{ V}$

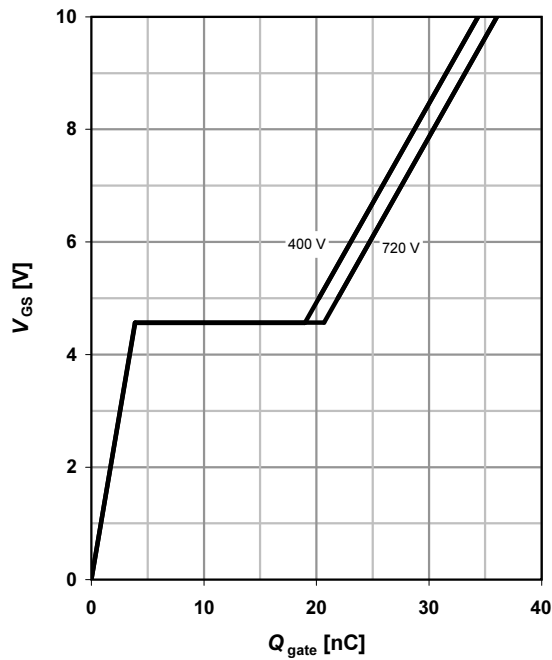
parameter:  $T_J$



**9 Typ. gate charge**

$V_{GS}=f(Q_{gate}); I_D=3.3 \text{ A pulsed}$

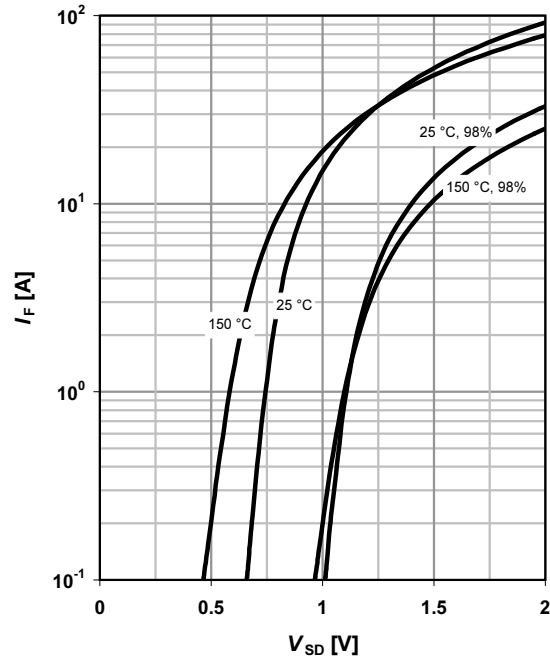
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

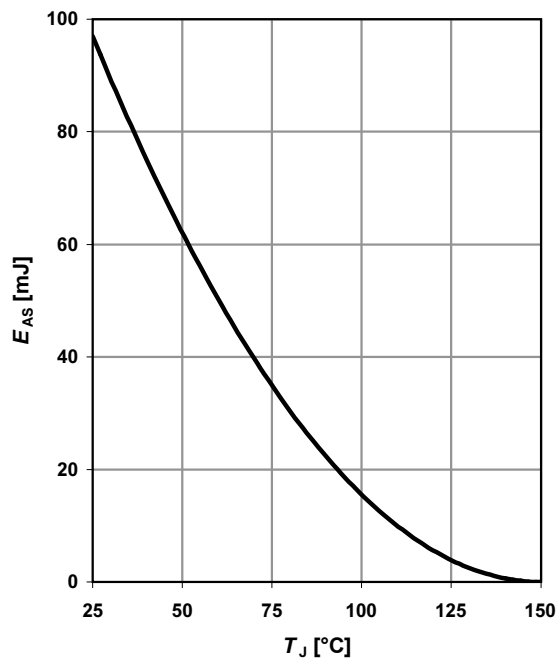
$I_F=f(V_{SD})$

parameter:  $T_J$



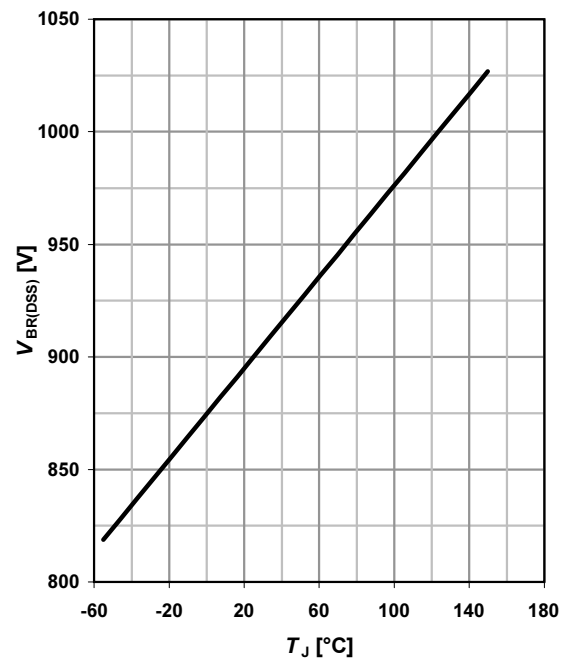
**11 Avalanche energy**

$E_{AS}=f(T_j); I_D=1.1 \text{ A}; V_{DD}=50 \text{ V}$



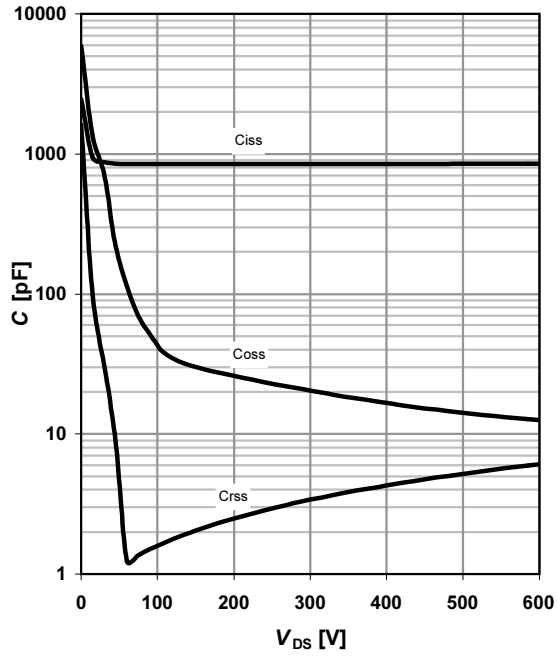
**12 Drain-source breakdown voltage**

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



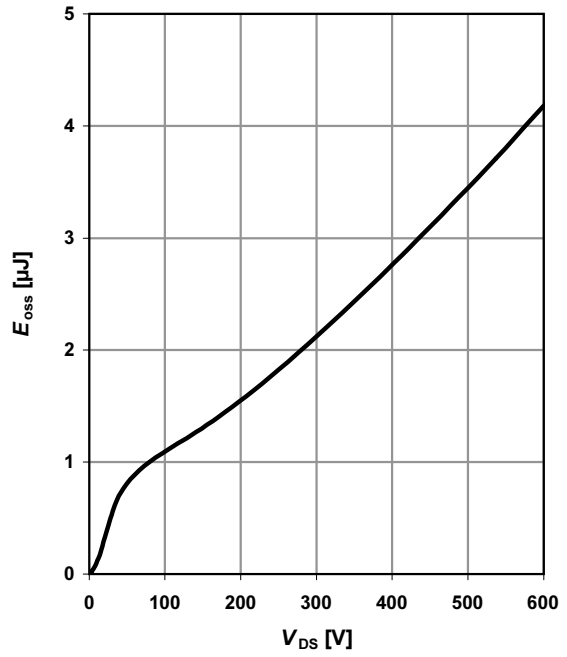
13 Typ. capacitances

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

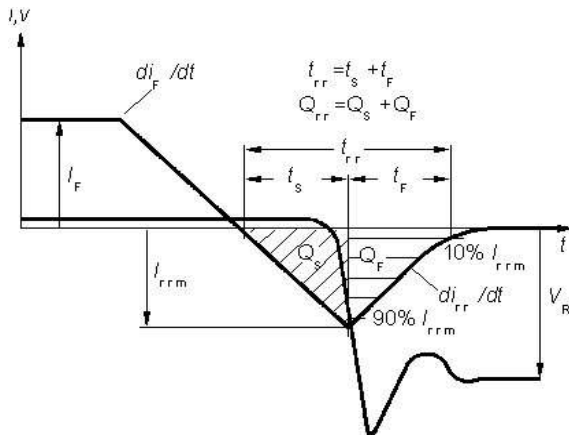


14 Typ. C<sub>oss</sub> stored energy

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

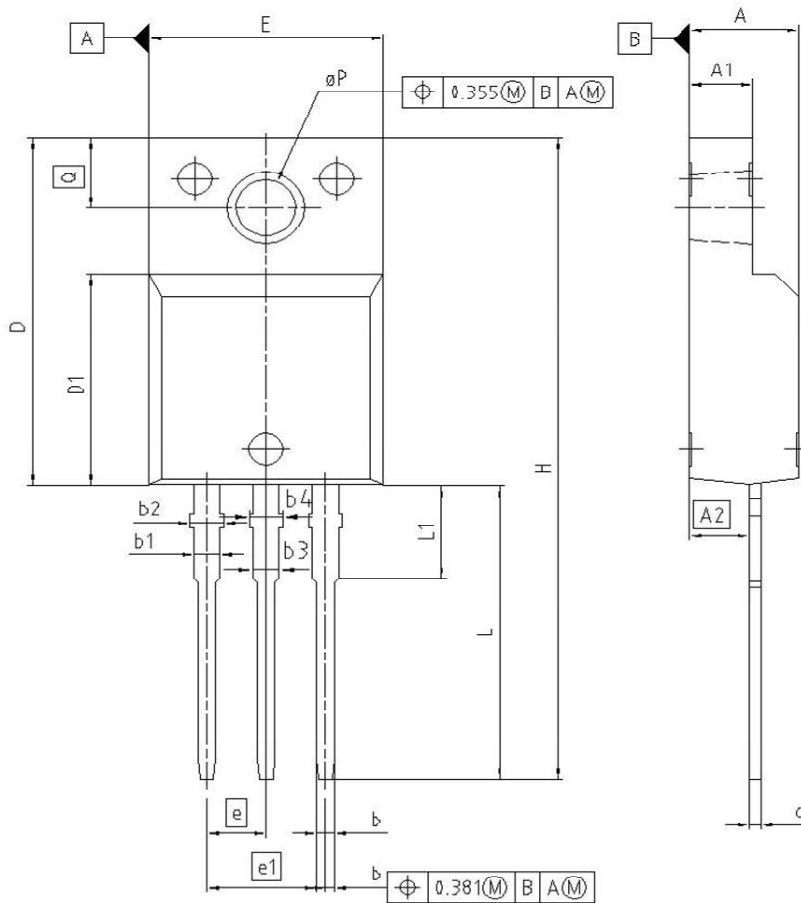


Definition of diode switching characteristics





PG-TO220 FP Outline/Fully isolated package (2500VAC; 1 minute)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.55	4.85	0.179	0.191
A1	2.55	2.85	0.100	0.112
A2	2.42	2.72	0.095	0.107
b	0.65	0.85	0.026	0.033
b1	0.06	1.33	0.007	0.052
b2	0.95	1.51	0.037	0.059
b3	0.65	1.33	0.026	0.052
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.85	16.15	0.624	0.636
D1	9.53	9.83	0.375	0.387
E	10.35	10.65	0.407	0.419
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H	29.45	29.75	1.159	1.171
L	13.45	13.75	0.530	0.541
L1	3.15	3.45	0.124	0.136
pP	2.95	3.20	0.116	0.126
q	3.15	3.50	0.124	0.138

REFERENCE  
...

SCALE  
0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE  
08-01-2007

FILE  
TO220\_2

Dimensions in mm/inches

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