

CoolMOS™ Power Transistor

Package

- Lowest figure of merit $R_{ON} \times Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Pb-free lead plating; RoHS compliant; Halogen free for mold compound
- Qualified for industrial grade applications according to JEDEC⁰⁾

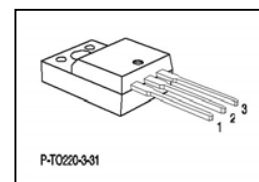
Product Summary

$V_{DS} @ T_{jmax}$	550	V
$R_{DS(on),max}$	0.520	Ω
$Q_{g,typ}$	13	nC

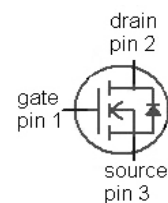
CoolMOS CP is designed for:

- Hard- & Softswitching SMPS for server power supplies
- DCM PFC for Lamp Ballast
- PWM for Lamp Ballast, PDP and LCD TV

PG-TO220 FP



Type	Package	Marking
IPA50R520CP	PG-TO220FP	5R520P



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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current ¹⁾	I_D	$T_C = 25^\circ\text{C}$	7.1	A
		$T_C = 100^\circ\text{C}$	4.5	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C = 25^\circ\text{C}$	15	
Avalanche energy, single pulse	E_{AS}	$I_D = 2.5\text{ A}$, $V_{DD} = 50\text{ V}$	166	mJ
Avalanche energy, repetitive $t_{AR}^{2),3)}$	E_{AR}	$I_D = 2.5\text{ A}$, $V_{DD} = 50\text{ V}$	0.25	
Avalanche current, repetitive $t_{AR}^{2),3)}$	I_{AR}		2.5	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS} = 0 \dots 400\text{ V}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f > 1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C = 25^\circ\text{C}$	66	W
Operating and storage temperature	T_j , T_{stg}		-55 ... 150	$^\circ\text{C}$
Mounting torque		M2.5 screws	60	Ncm

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

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current ¹⁾	I_S	$T_C=25\text{ °C}$	3.8	A
Diode pulse current ²⁾	$I_{S,pulse}$		15	
Reverse diode dv/dt ⁴⁾	dv/dt		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	4.2	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	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$	500	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=0.25\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=500\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$	-	-	1	μA
		$V_{DS}=500\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$	-	10	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=3.8\text{ A}$, $T_j=25\text{ °C}$	-	0.47	0.52	Ω
		$V_{GS}=10\text{ V}$, $I_D=3.8\text{ A}$, $T_j=150\text{ °C}$	-	1.2	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	2.2	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	680	-	pF
Output capacitance	C_{oss}		-	31	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	29	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	63	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=3.8\text{ A},$ $R_G=48.3\ \Omega$	-	35	-	ns
Rise time	t_r		-	14	-	
Turn-off delay time	$t_{d(off)}$		-	80	-	
Fall time	t_f		-	17	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=400\text{ V}, I_D=3.8\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	3	-	nC
Gate to drain charge	Q_{gd}		-	5	-	
Gate charge total	Q_g		-	13	17	
Gate plateau voltage	$V_{plateau}$		-	5.2	-	V

Reverse Diode

Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=3.8\text{ A},$ $T_j=25\text{ °C}$	-	0.9	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}, I_F=I_S,$ $di/dt=100\text{ A}/\mu\text{s}$	-	240	-	ns
Reverse recovery charge	Q_{rr}		-	1.6	-	μC
Peak reverse recovery current	I_{rrm}		-	13	-	A

⁰⁾ J-STD20 and JESD22

¹⁾ Limited only by maximum temperature T_j .

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

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

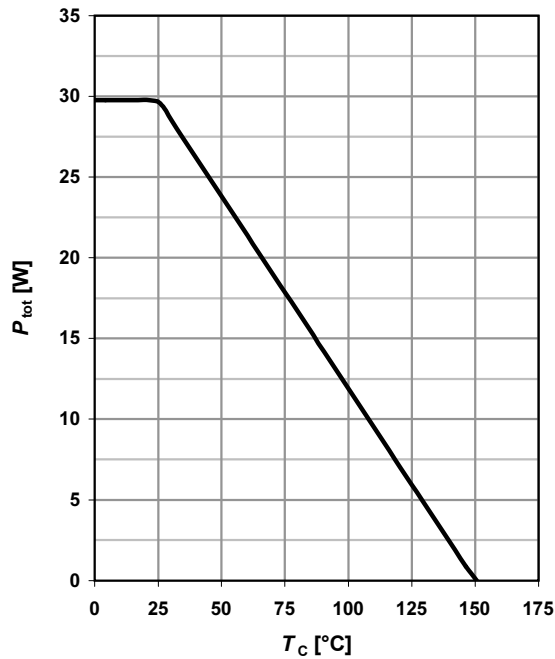
⁴⁾ $I_{SD} \leq I_D, di/dt \leq 400\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$, identical low and high side switch

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

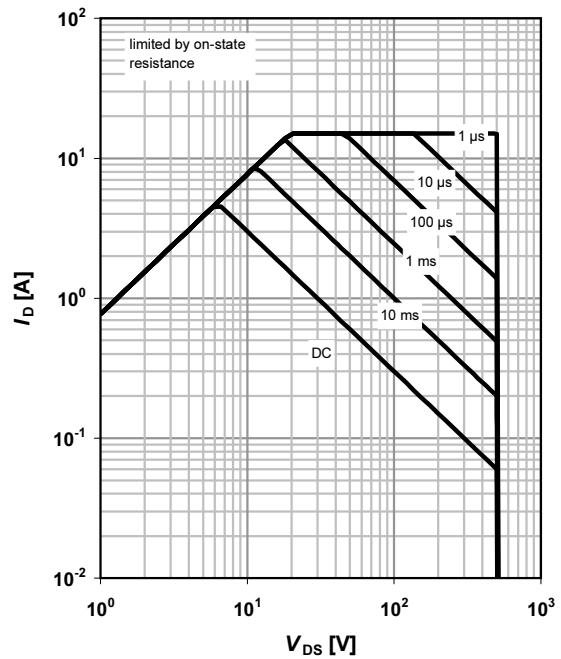
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

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

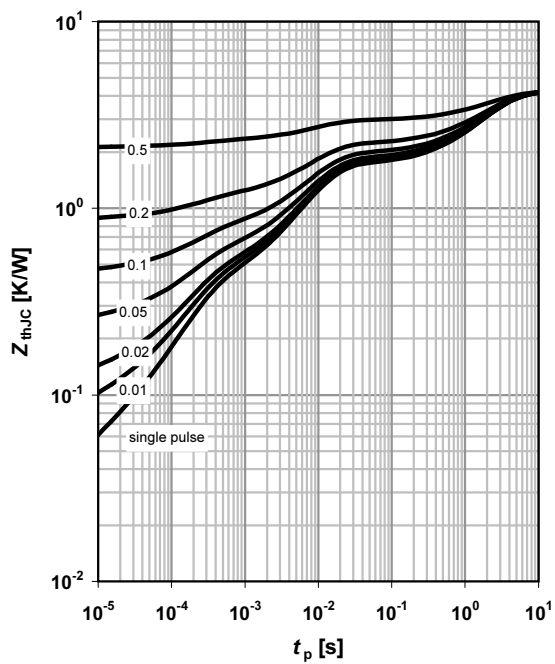
parameter: t_p



3 Max. transient thermal impedance

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

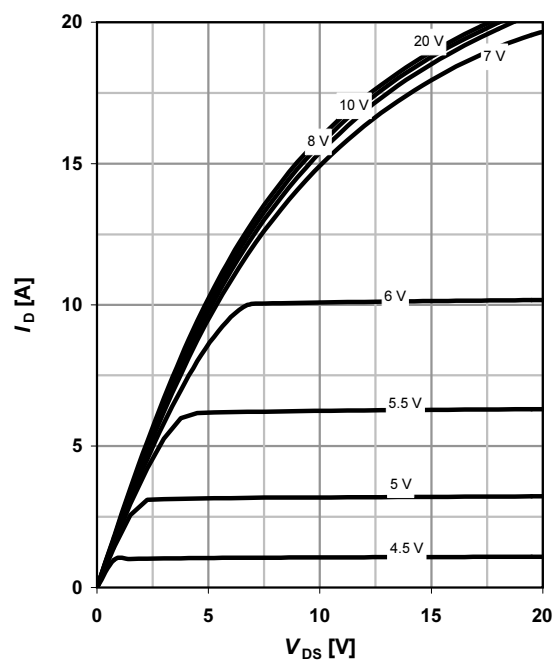
parameter: $D = t_p / T$



4 Typ. output characteristics

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

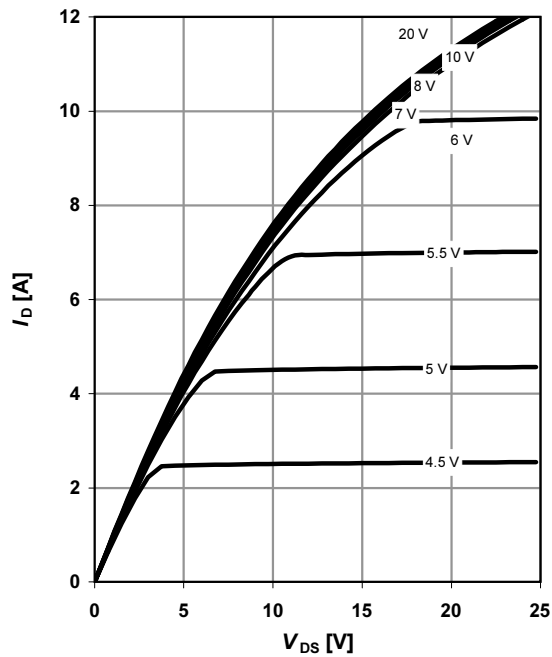
parameter: V_{GS}



5 Typ. output characteristics

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

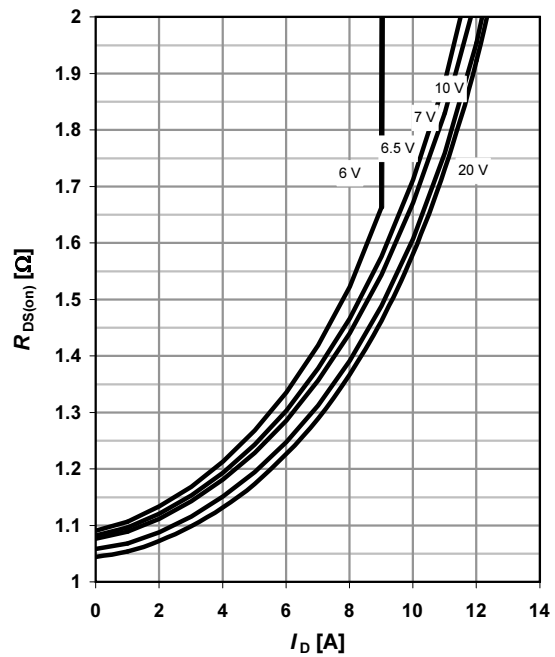
parameter: V_{GS}



6 Typ. drain-source on-state resistance

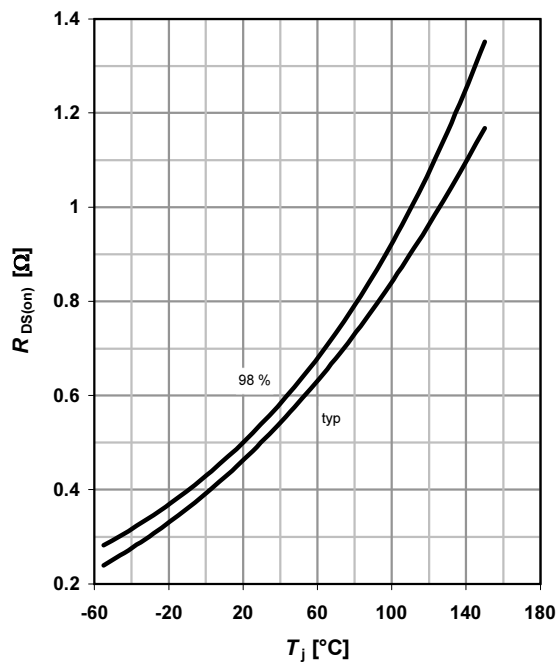
$$R_{DS(on)} = f(I_D); T_j = 150^\circ\text{C}$$

parameter: V_{GS}



7 Drain-source on-state resistance

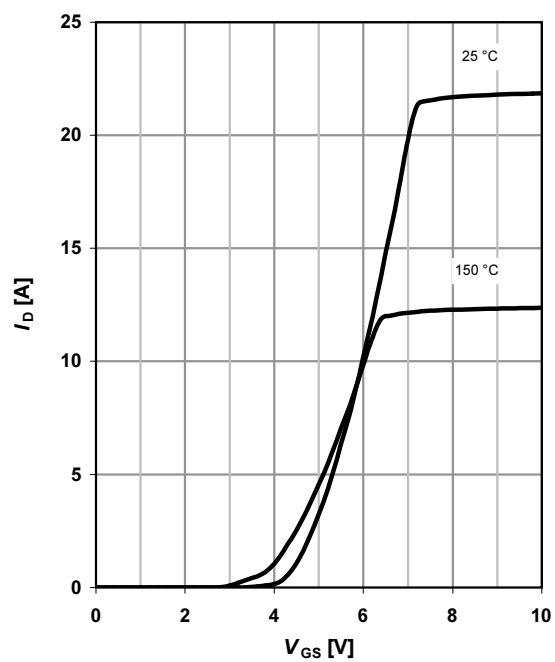
$$R_{DS(on)} = f(T_j); I_D = 3.8\text{ A}; V_{GS} = 10\text{ V}$$



8 Typ. transfer characteristics

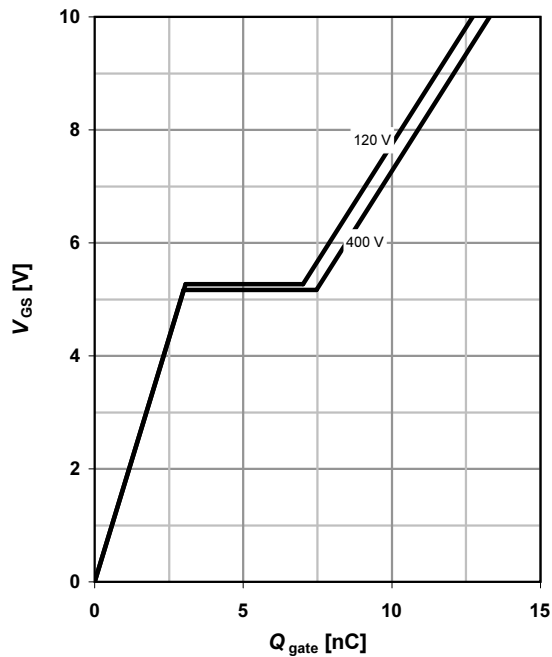
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$$

parameter: T_j



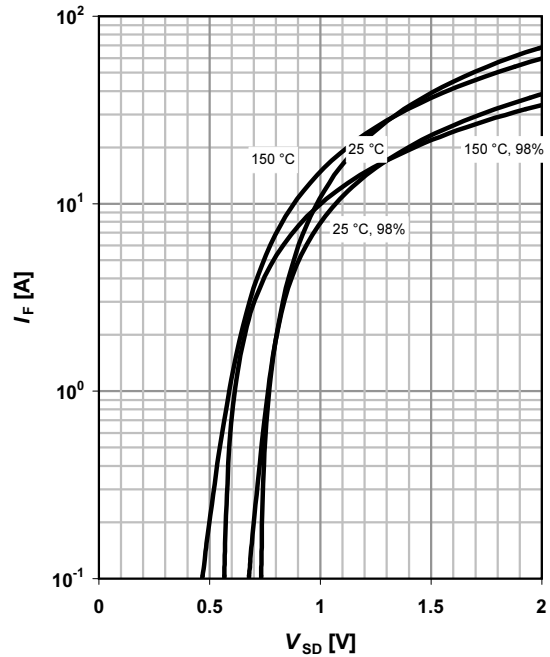
9 Typ. gate charge

 $V_{GS}=f(Q_{gate}); I_D=3.8 \text{ A pulsed}$

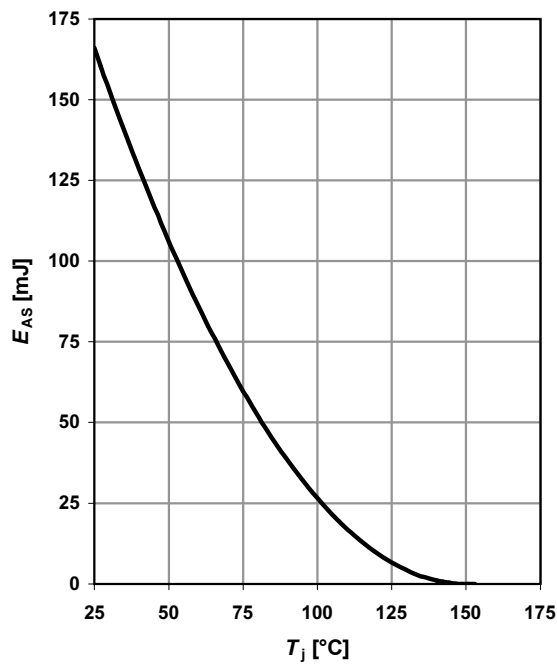
parameter: V_{DD}


10 Forward characteristics of reverse diode

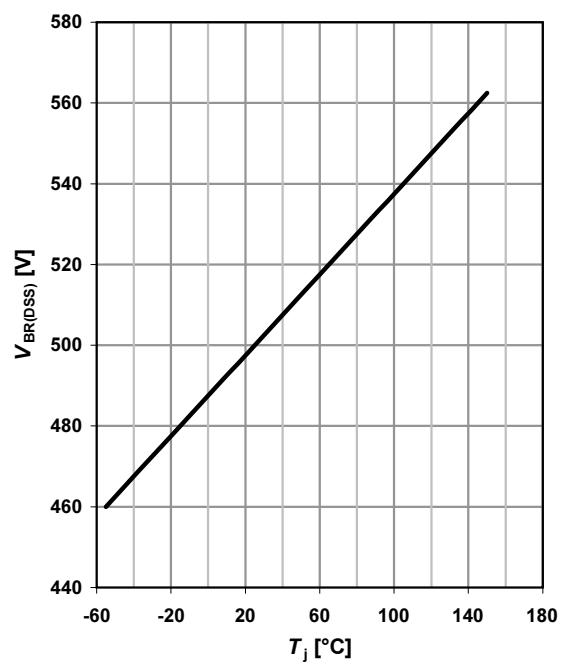
 $I_F=f(V_{SD})$

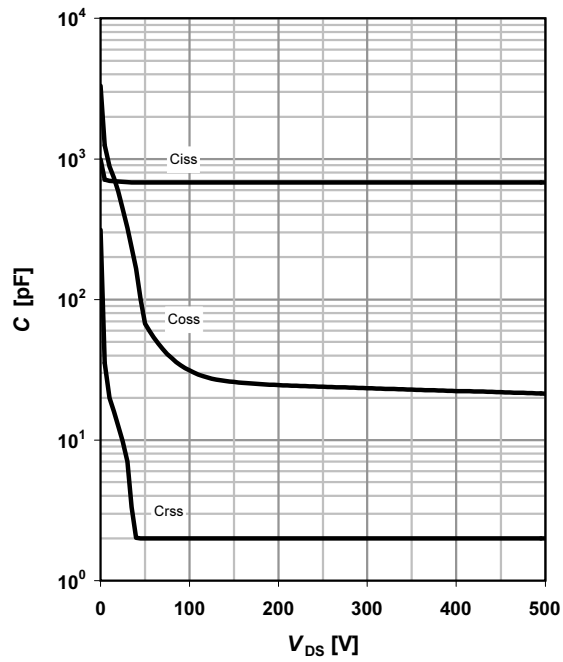
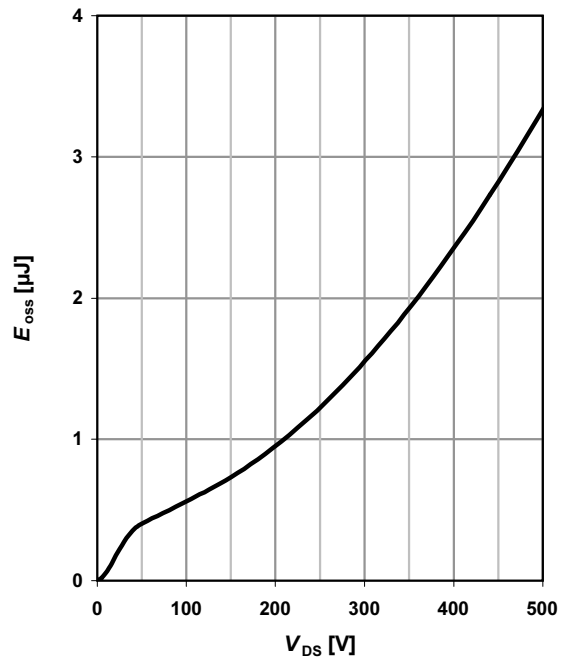
parameter: T_j


11 Avalanche energy

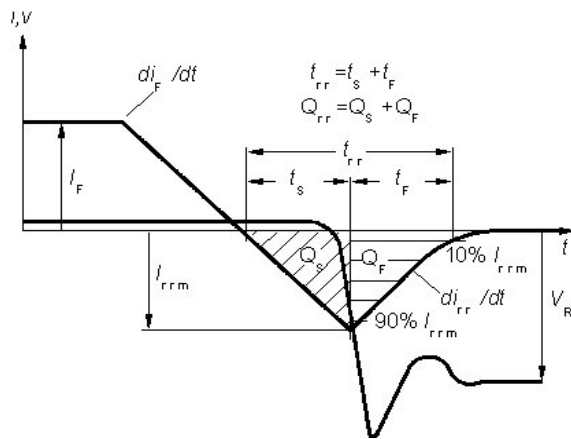
 $E_{AS}=f(T_j); I_D=2.5 \text{ A}; V_{DD}=50 \text{ V}$


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



Technical drawing of a mechanical part, showing front, side, and detail views with dimensions and tolerances.

Front View Dimensions:

- A : Distance from the left edge to the center of the top hole.
- E : Total width of the part.
- D : Total height of the part.
- $D1$: Height of the upper section.
- H : Height of the lower section.
- L : Total length of the part.
- $L1$: Length of the lower section.
- $b1, b2, b3, b4$: Widths of the lower section features.
- $e, e1$: Widths of the bottom features.
- b : Width of the bottom flange.

Top View Dimensions:

- A : Total width of the part.
- $A1$: Distance from the left edge to the center of the top hole.
- $A2$: Distance from the left edge to the center of the bottom hole.

Detail View Dimensions:

- ϕP : Diameter of the hole.
- $\phi 0.355(M)$: Diameter of the hole with tolerance.
- B : Distance from the left edge to the center of the hole.
- $A(M)$: Distance from the left edge to the center of the hole with tolerance.

Bottom View Dimensions:

- $\phi 0.381(M)$: Diameter of the hole with tolerance.
- B : Distance from the left edge to the center of the hole.
- $A(M)$: Distance from the left edge to the center of the hole with tolerance.

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	0.95	1.33	0.037	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

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