CoolMOS® Power Transistor

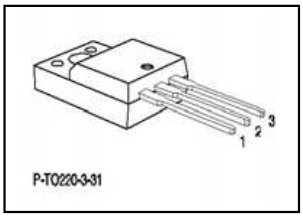
Features

- Lowest figure-of-merit $R_{ON}xQ_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Qualified for industrial grade applications according to JEDEC[1)]
- Pb-free lead plating; RoHS compliant; Halogen free mold compound

Product Summary

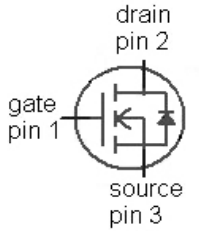
V_{DS} @ $T_{j,max}$	650	V
$R_{DS(on),max}$ @ T_j = 25°C	0.165	Ω
$Q_{g,typ}$	39	nC

PG-TO220



CoolMOS CP is designed for:

- Hard switching SMPS topologies



Type	Package	Ordering Code	Marking
IPA60R165CP	PG-TO220	SP000096437	6R165P

Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current[2)]	I_D	T_C=25 °C	21	A
		T_C=100 °C	13	
Pulsed drain current[3)]	$I_{D,pulse}$	T_C=25 °C	61	
Avalanche energy, single pulse	E_{AS}	I_D=7.9 A, V_{DD}=50 V	522	mJ
Avalanche energy, repetitive t_{AR}[3),4)]	E_{AR}	I_D=7.9 A, V_{DD}=50 V	0.79	
Avalanche current, repetitive t_{AR}[3),4)]	I_{AR}		7.9	A
MOSFET dv/dt ruggedness	dv/dt	V_{DS}=0...480 V	50	V/ns
Gate source voltage	V_{GS}	static	±20	V
		AC (f>1 Hz)	±30	
Power dissipation	P_{tot}	T_C=25 °C	34	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	°C
Mounting torque		M2.5 screws	50	Ncm
Insulation withstand voltage	V_{ISO}	Vrms, TC=25°C, t=1min	2500	V

Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current[2)]	I_S	T_C=25 °C	21	A
Diode pulse curren[3)]	$I_{S,pulse}$		61	
Reverse diode dv/dt[5)]	dv/dt		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics						
Thermal resistance, junction - case	R_{thJC}		-		3.65	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	80	
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 °C, unless otherwise specified

Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=250 µA	600	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=0.79 mA	2.5	3	3.5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	-	1	µA
		V_{DS}=25 V, V_{GS}=0 V, T_j=150 °C	-	10	-	
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=12 A, T_j=25 °C	-	0.15	0.165	Ω
		V_{GS}=10 V, I_D=12 A, T_j=150 °C	-	0.40	-	
Gate resistance	R_G	f=1 MHz, open drain	-	1.9	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=100 V, f=1 MHz	-	2000	-	pF
Output capacitance	C_{oss}		-	100	-	
Effective output capacitance, energy related[6]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	83	-	
Effective output capacitance, time related[7]	$C_{o(tr)}$		-	220	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=400 V, V_{GS}=10 V, I_D=12 A, R_G=3.3 Ω	-	12	-	ns
Rise time	t_r		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	50	-	
Fall time	t_f		-	5	-	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DD}=400 V, I_D=12 A, V_{GS}=0 to 10 V	-	9	-	nC
Gate to drain charge	Q_{gd}		-	13.0	-	
Gate charge total	Q_g		-	39	52	
Gate plateau voltage	$V_{plateau}$		-	5.0	-	V
Reverse Diode						
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=12 A, T_j=25 °C	-	0.9	1.2	V
Reverse recovery time	t_{rr}	V_R=400 V, I_F=I_S, di_F/dt=100 A/µs	-	390	-	ns
Reverse recovery charge	Q_{rr}		-	7.5	-	µC
Peak reverse recovery current	I_{rrm}		-	38	-	A

[1] J-STD20 and JESD22

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

[3] Limited only by maximum temperature

[4] Repetitive avalanche causes additional power losses that can be calculated as P_{AV}=E_{AR}*f.

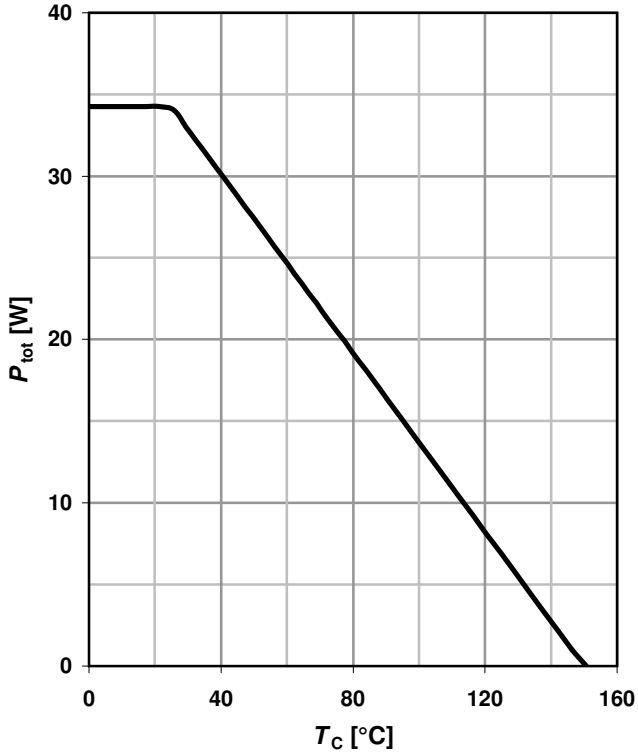
[5] I_{SD}≤I_D, di/dt≤200A/µs, V_{DClink}=400V, V_{peak}<$V_{(BR)DSS}$, T_j<T_{jmax}, identical low side and high side switch.

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

[7] $C_{o(tr)}$ 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

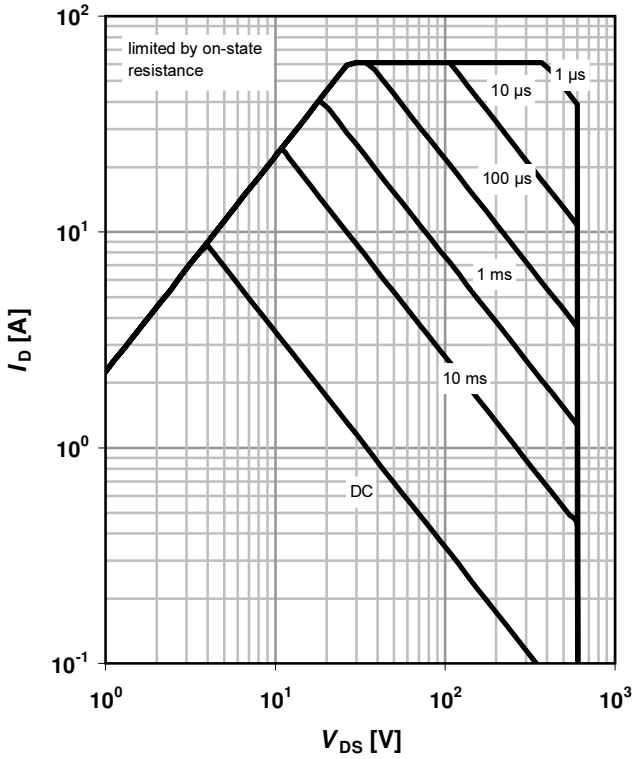
$P_{tot}=f(T_C)$



2 Safe operating area

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$

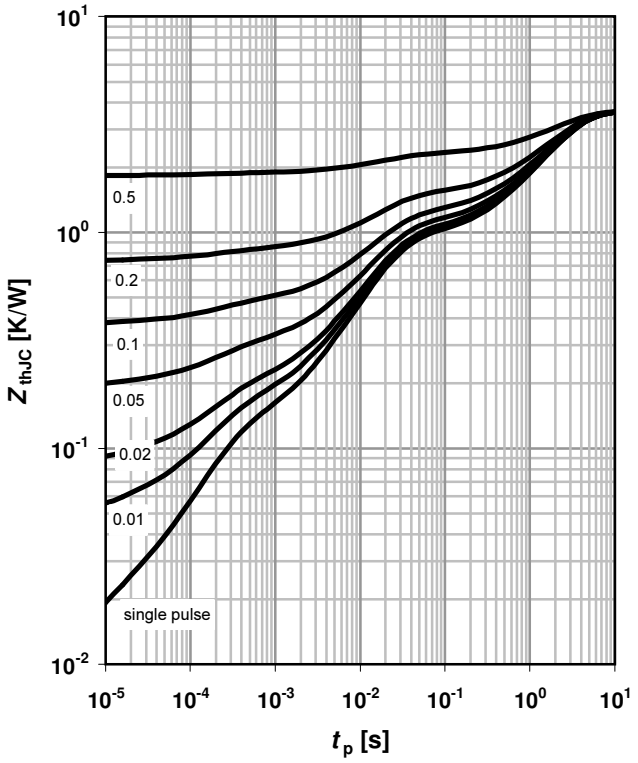
parameter: t_p



3 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

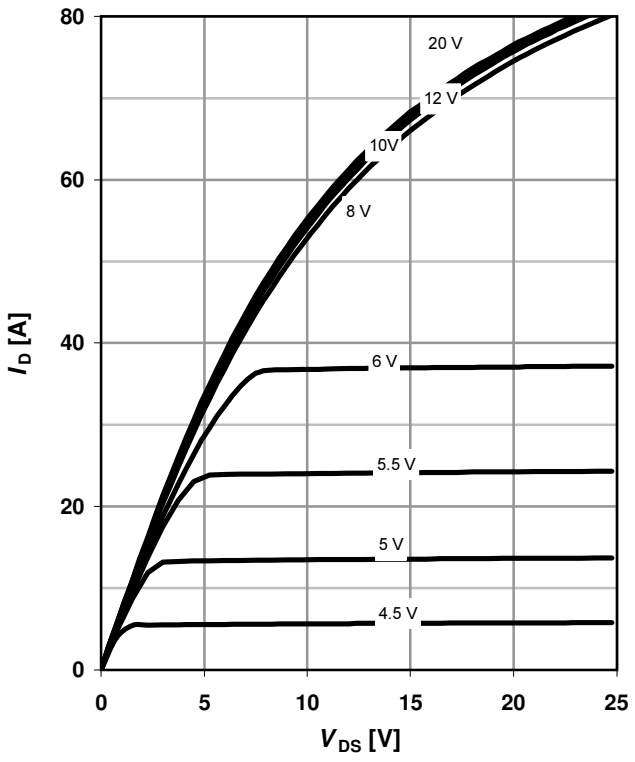
parameter: $D=t_p/T$



4 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=25$ °C

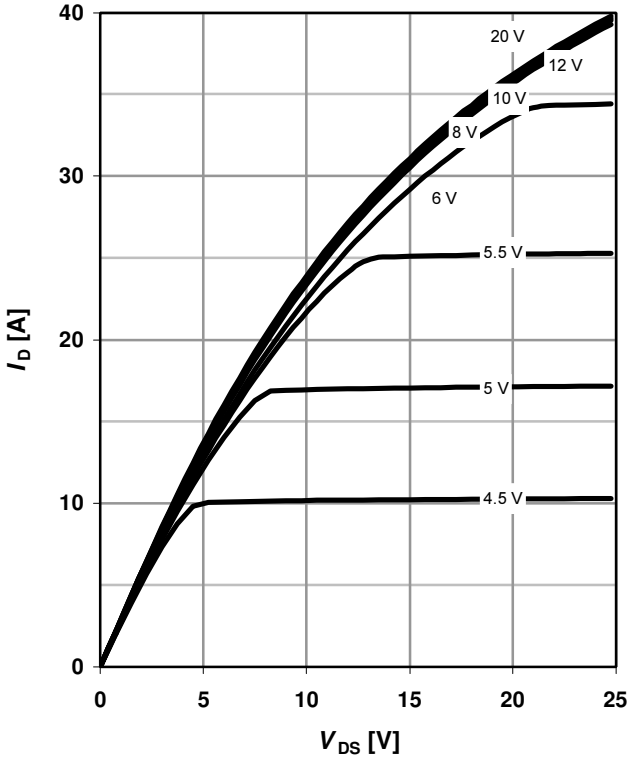
parameter: V_{GS}



5 Typ. output characteristics

I_D=f(V_{DS}); T_j=150 °C

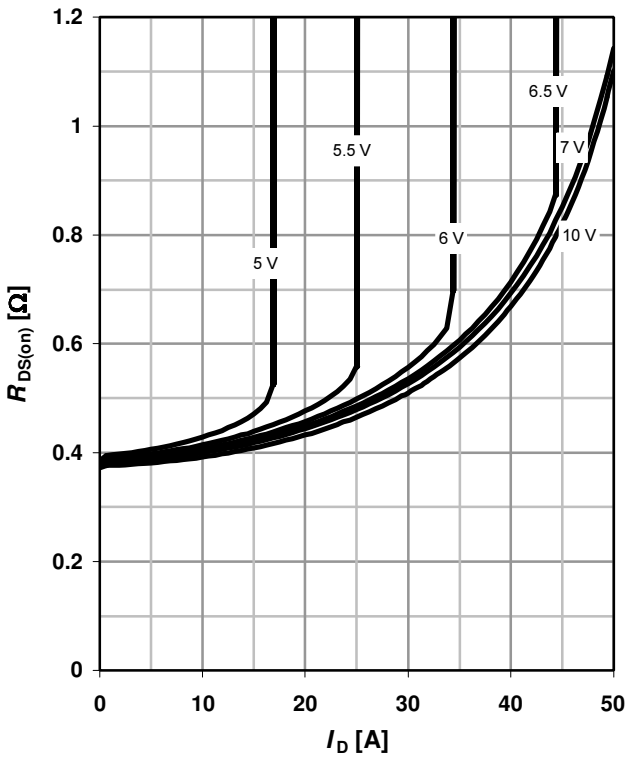
parameter: V_{GS}



6 Typ. drain-source on-state resistance

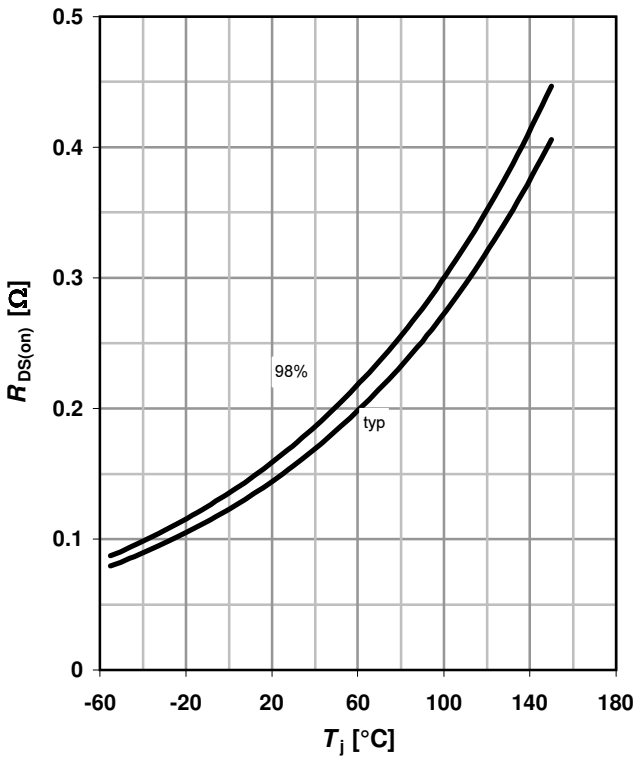
$R_{DS(on)}$=f(I_D); T_j=150 °C

parameter: V_{GS}



7 Drain-source on-state resistance

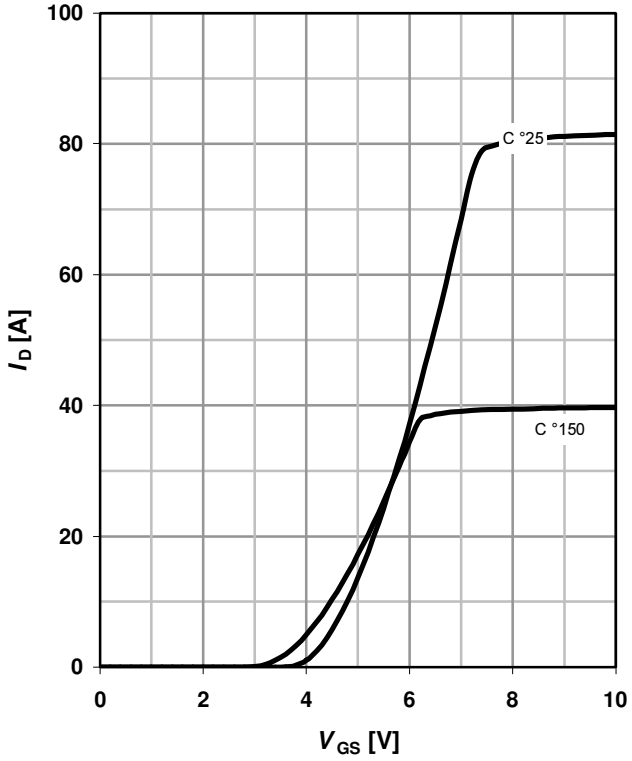
$R_{DS(on)}$=f(T_j); I_D=12 A; V_{GS}=10 V



8 Typ. transfer characteristics

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

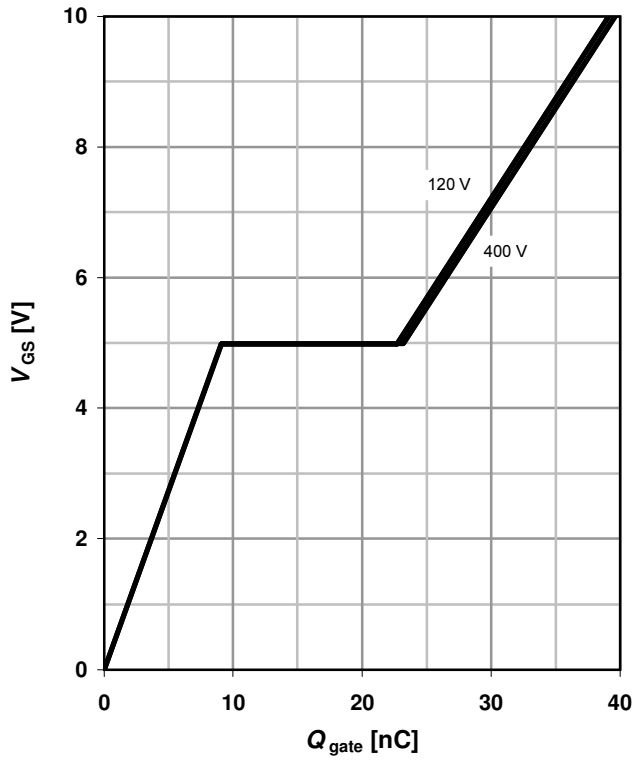
parameter: T_j



9 Typ. gate charge

V_{GS}=f(Q_{gate}); I_D=12 A pulsed

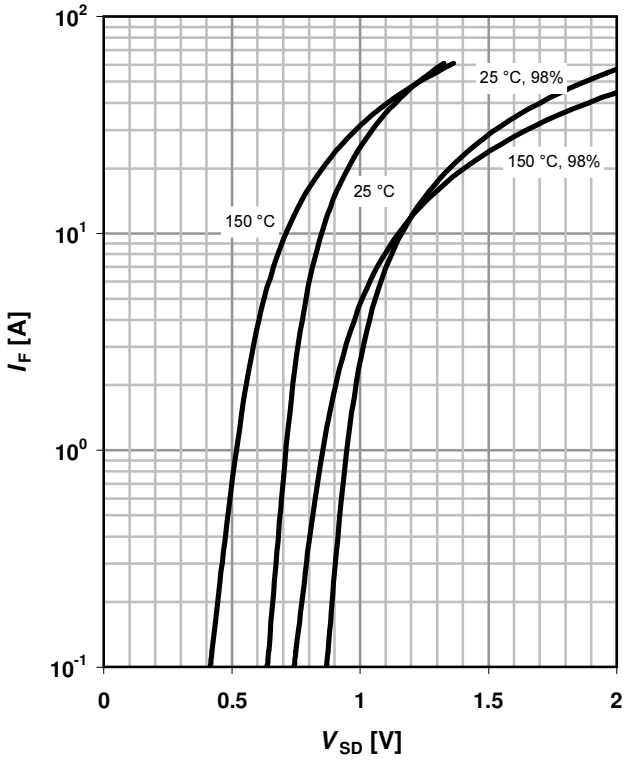
parameter: V_{DD}



10 Forward characteristics of reverse diode

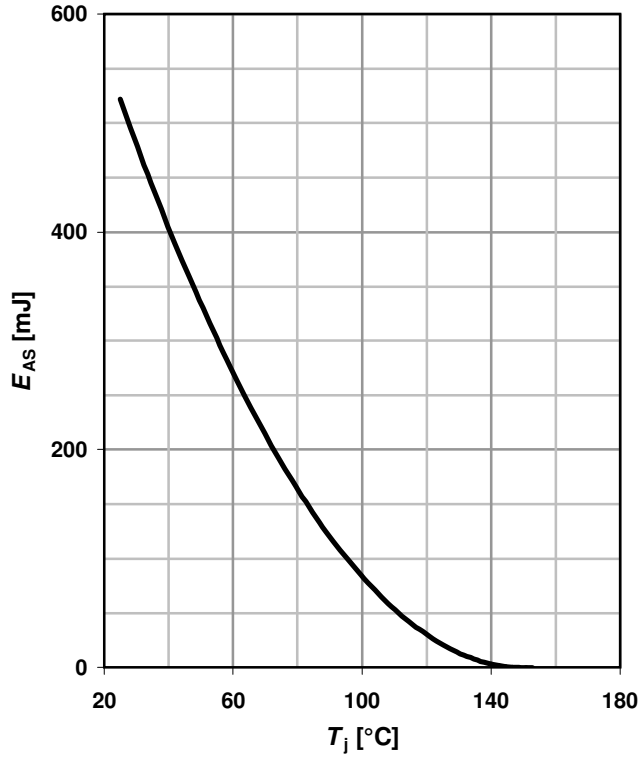
I_F=f(V_{SD})

parameter: T_j



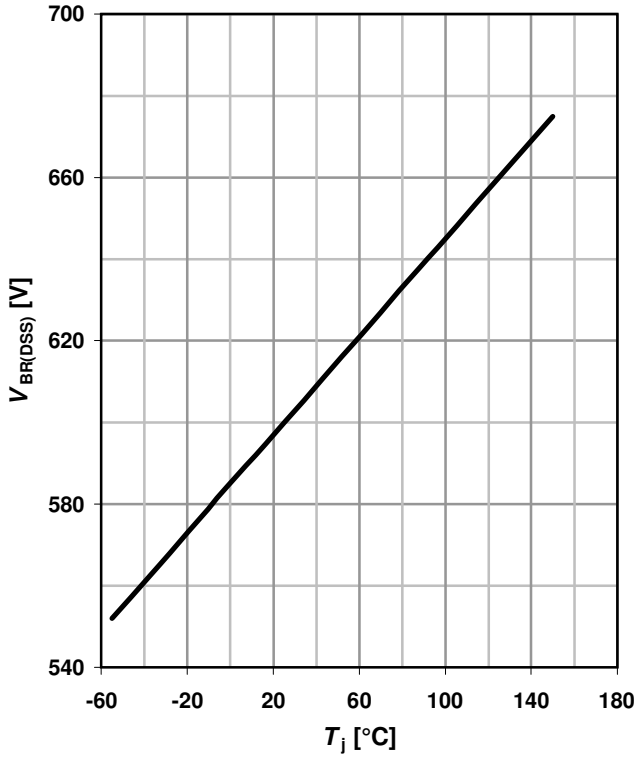
11 Avalanche energy

E_{AS}=f(T_j); I_D=7.9 A; V_{DD}=50 V



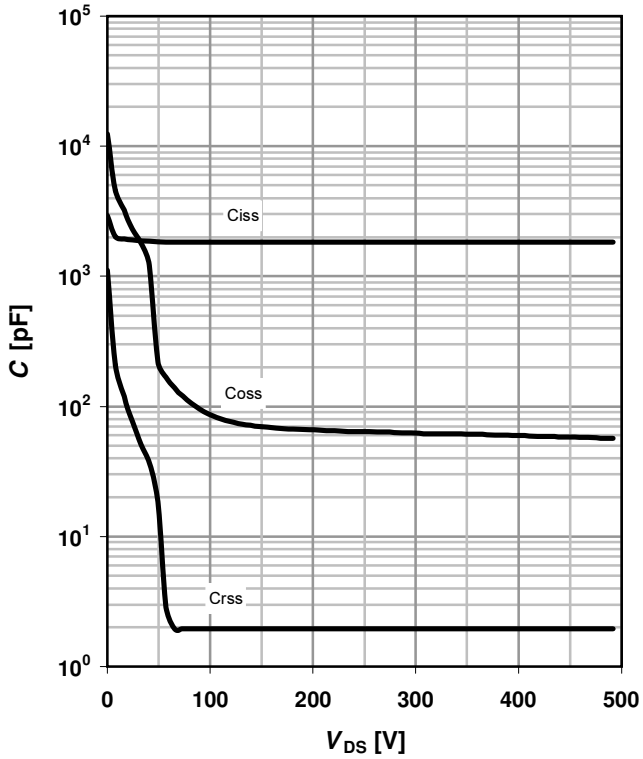
12 Drain-source breakdown voltage

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



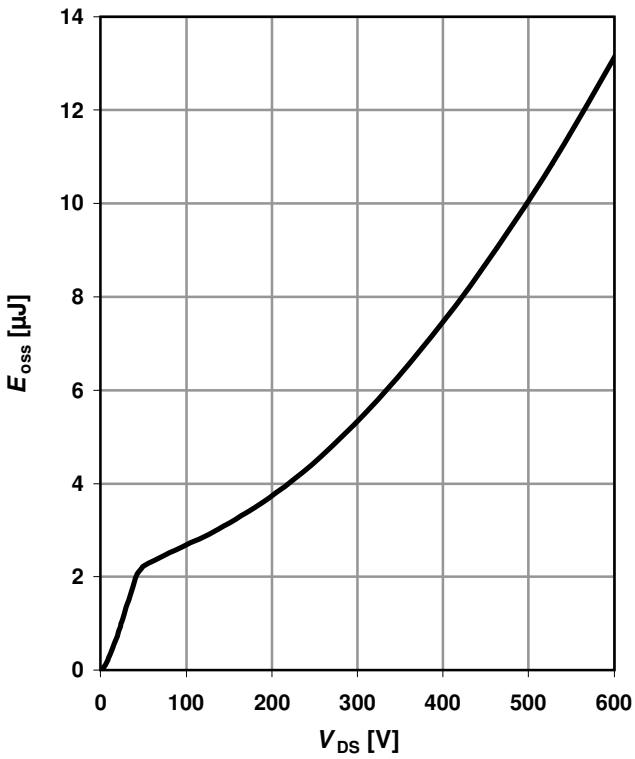
13 Typ. capacitances

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

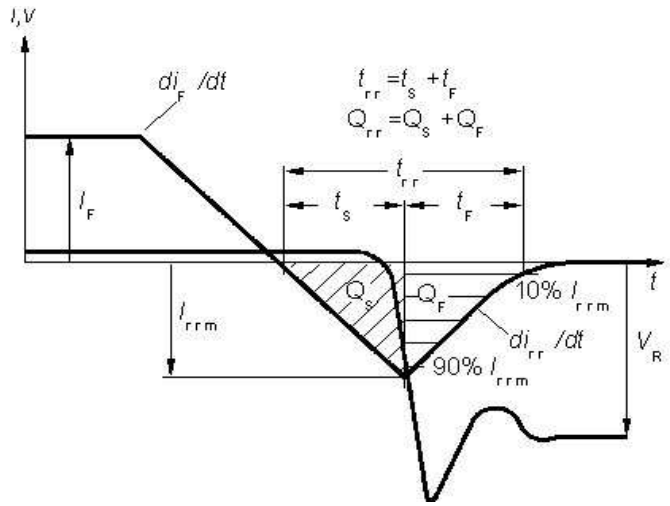


14 Typ. Coss stored energy

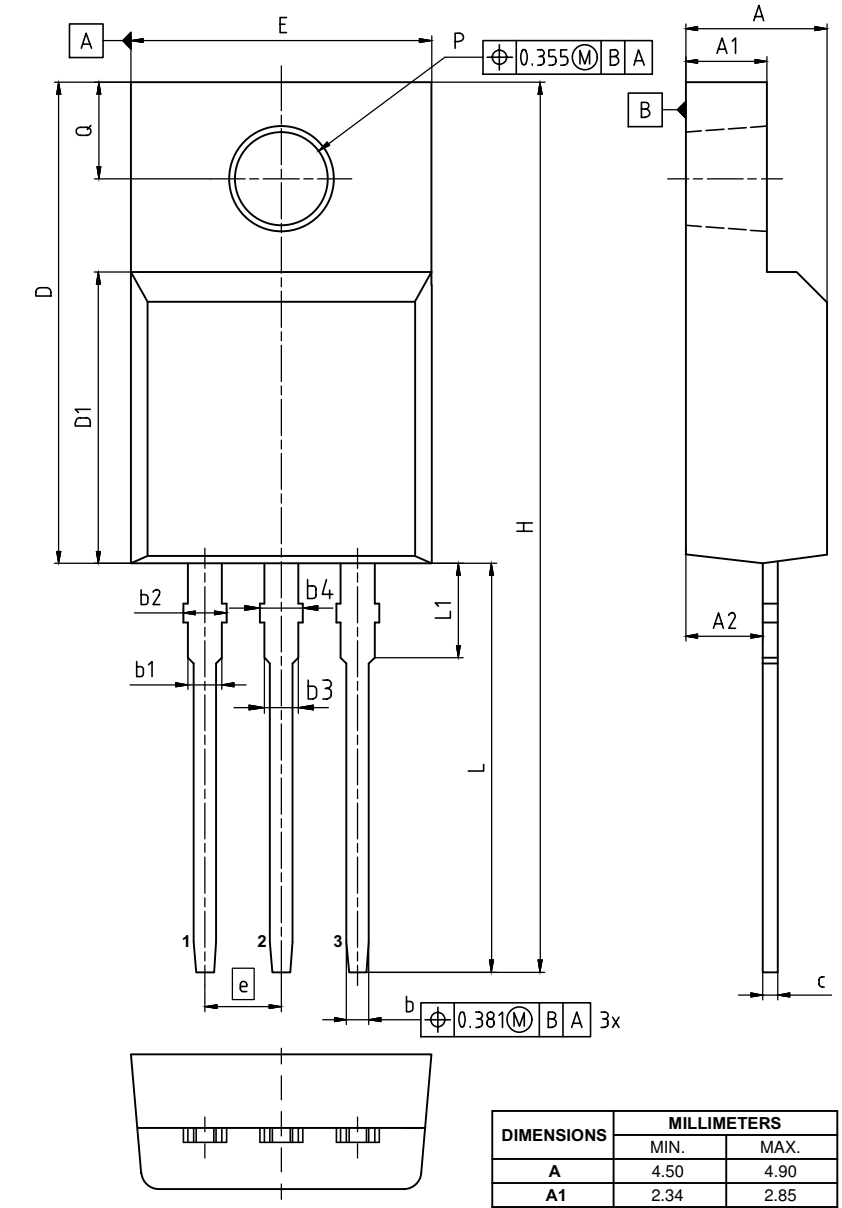
E_{oss}= f(V_{DS})



Definition of diode switching characteristics



Package Outlines



NOTES:
ALL DIMENSIONS REFER TO JEDEC STANDARD TO-281 AND DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS
GATE BURRS ARE LESS THAN 0.5 mm

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.50	4.90
A1	2.34	2.85
A2	2.42	2.86
b	0.65	0.90
b1	0.95	1.38
b2	0.95	1.51
b3	0.65	1.38
b4	0.65	1.51
c	0.40	0.63
D	15.67	16.15
D1	8.97	9.83
E	10.00	10.65
e	2.54	
H	28.70	29.75
L	12.78	13.75
L1	2.83	3.45
øP	3.00	3.30
Q	3.15	3.50

DOCUMENT NO.
Z8B00003319

REVISION
07

SCALE 5:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

ISSUE DATE
27.01.2017

Figure 1 Outline PG-TO 220 FullPAK, dimensions in mm/inches

Revision History

IPA60R165CP

Revision: 2018-01-25, Rev. 2.3

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.3	2018-01-25	Updated Isolation voltage on page 1 and revised package drawing on page 9

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