

**CoolMOS® Power Transistor**

**Product Summary**

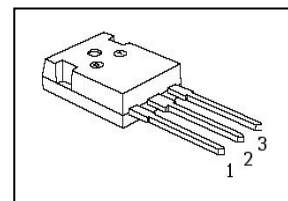
$V_{DS}$	600	V
$R_{DS(on),max}$	0.045	$\Omega$
$Q_{g,typ}$	150	nC

**Features**

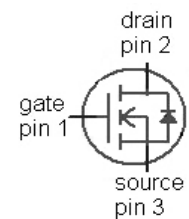
- Worldwide best  $R_{ds,on}$  in TO247
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Automotive AEC Q101 qualified
- Green package (RoHS compliant)

**CoolMOS CPA is specially designed for:**

- DC/DC converters for Automotive Applications

**PG-TO247-3**


Type	Package	Marking
IPW60R045CPA	PG-TO247-3	6R045A


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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ }^\circ\text{C}$	60	A
		$T_C=100\text{ }^\circ\text{C}$	38	
Pulsed drain current <sup>1)</sup>	$I_{D,pulse}$	$T_C=25\text{ }^\circ\text{C}$	230	
Avalanche energy, single pulse	$E_{AS}$	$I_D=11\text{ A}, V_{DD}=50\text{ V}$	1950	mJ
Avalanche energy, repetitive $t_{AR}$ <sup>1),2)</sup>	$E_{AR}$	$I_D=11\text{ A}, V_{DD}=50\text{ V}$	3	
Avalanche current, repetitive $t_{AR}$ <sup>1),2)</sup>	$I_{AR}$		11	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\dots480\text{ V}$	50	V/ns
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
Power dissipation	$P_{tot}$	$T_C=25\text{ }^\circ\text{C}$	431	W
Operating temperature	$T_j$		-40 ... 150	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-40 ... 150	
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	$I_S$	$T_C=25\text{ °C}$	44	A
Diode pulse current <sup>1)</sup>	$I_{S,pulse}$		230	
Reverse diode $dv/dt$ <sup>3)</sup>	$dv/dt$		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{thJC}$		-	-	0.29	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	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$	600	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$ , $I_D=3\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$	-	-	10	$\mu\text{A}$
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$ , $T_j=25\text{ °C}$	-	0.04	0.045	$\Omega$
		$V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$ , $T_j=150\text{ °C}$	-	0.11	-	
Gate resistance	$R_G$	$f=1\text{ MHz}$ , open drain	-	1.3	-	$\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	6800	-	pF
Output capacitance	$C_{oss}$		-	320	-	
Effective output capacitance, energy related <sup>4)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	310	-	
Effective output capacitance, time related <sup>5)</sup>	$C_{o(tr)}$		-	820	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=44\text{ A},$ $R_G=3.3\ \Omega$	-	30	-	ns
Rise time	$t_r$		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	100	-	
Fall time	$t_f$		-	10	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD}=400\text{ V}, I_D=44\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	34	-	nC
Gate to drain charge	$Q_{gd}$		-	51	-	
Gate charge total	$Q_g$		-	150	190	
Gate plateau voltage	$V_{plateau}$		-	5.0	-	V

**Reverse Diode**

Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=44\text{ A},$ $T_J=25\text{ }^\circ\text{C}$	-	0.9	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	600	-	ns
Reverse recovery charge	$Q_{rr}$		-	17	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	60	-	A

<sup>1)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>2)</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .

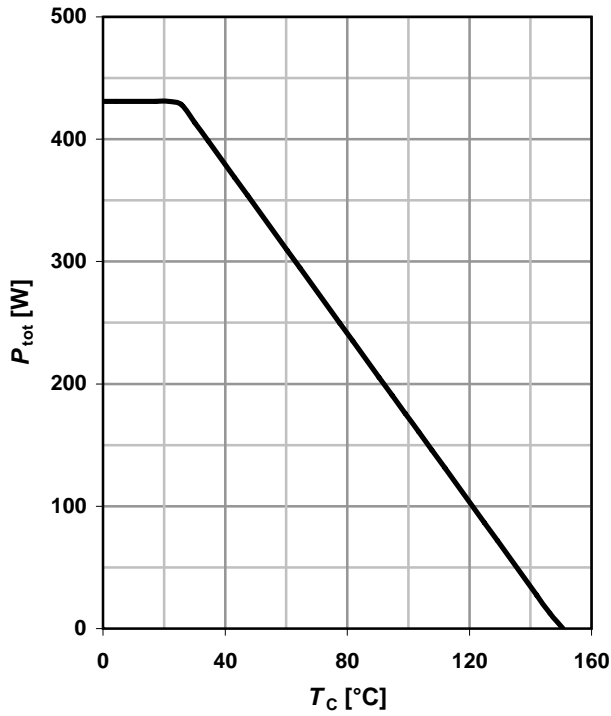
<sup>3)</sup>  $I_{SD} \leq I_D, di/dt \leq 100\text{ A}/\mu\text{s}, V_{DClink} = 400\text{ V}, V_{peak} < V_{(BR)DSS}, T_J < T_{j,max}$ , identical low side and high side switch

<sup>4)</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 80%  $V_{DSS}$ .

<sup>5)</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 80%  $V_{DSS}$ .

**1 Power dissipation**

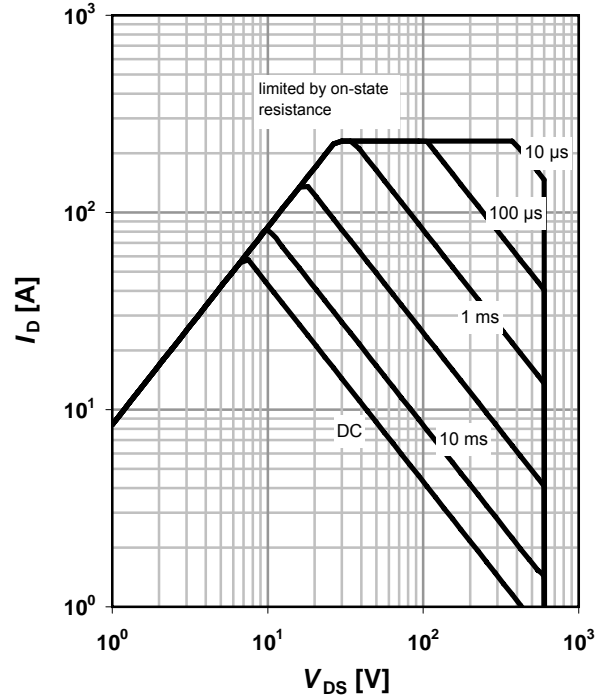
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

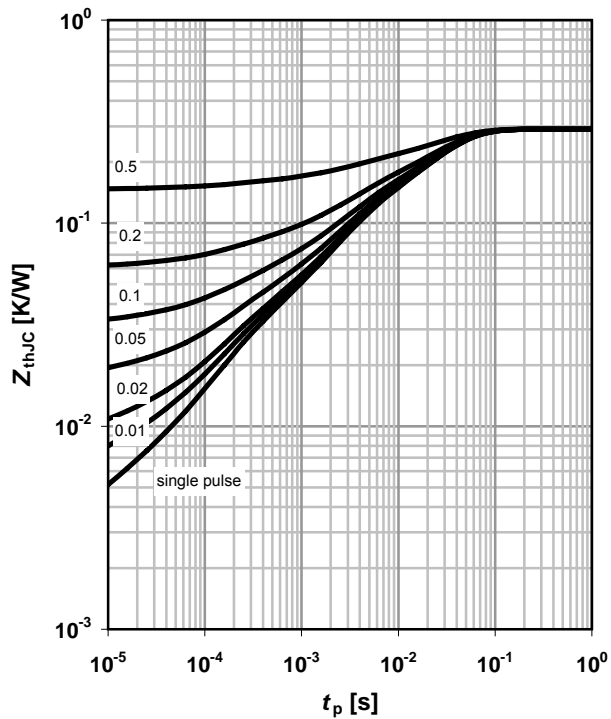
parameter:  $t_p$



**3 Max. transient thermal impedance**

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

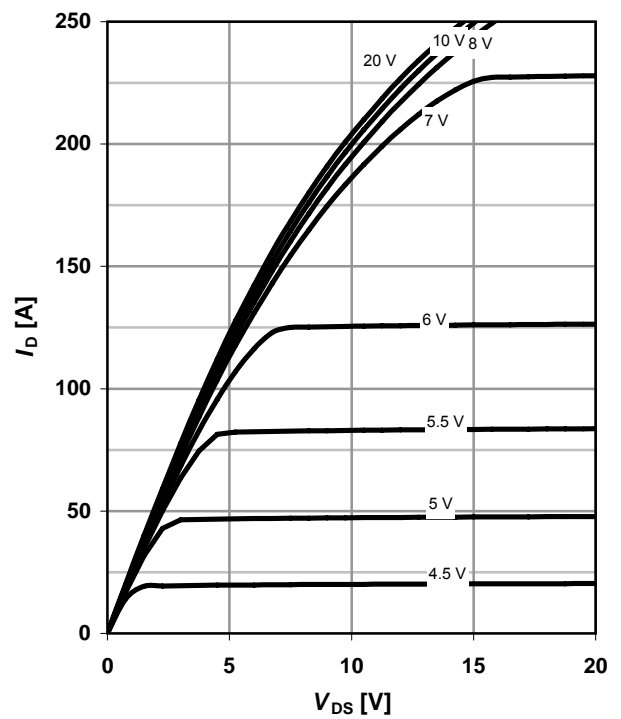
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

$I_D=f(V_{DS}); T_j=25\text{ °C}$

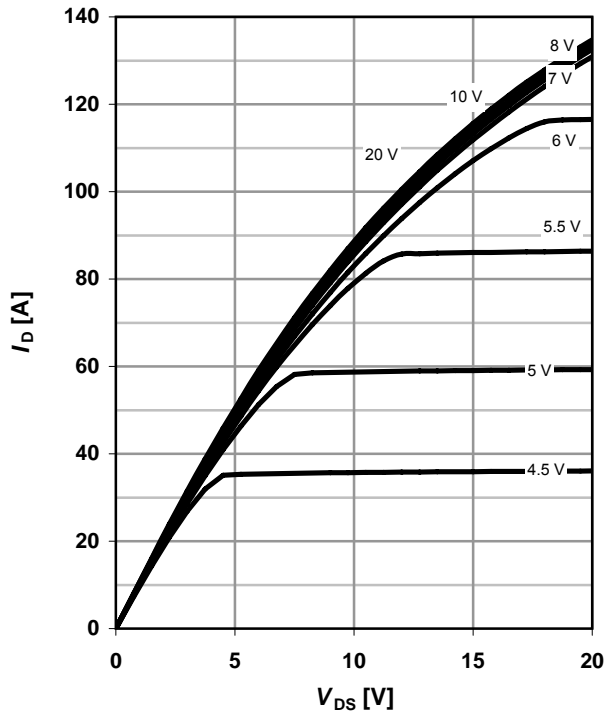
parameter:  $V_{GS}$



**5 Typ. output characteristics**

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

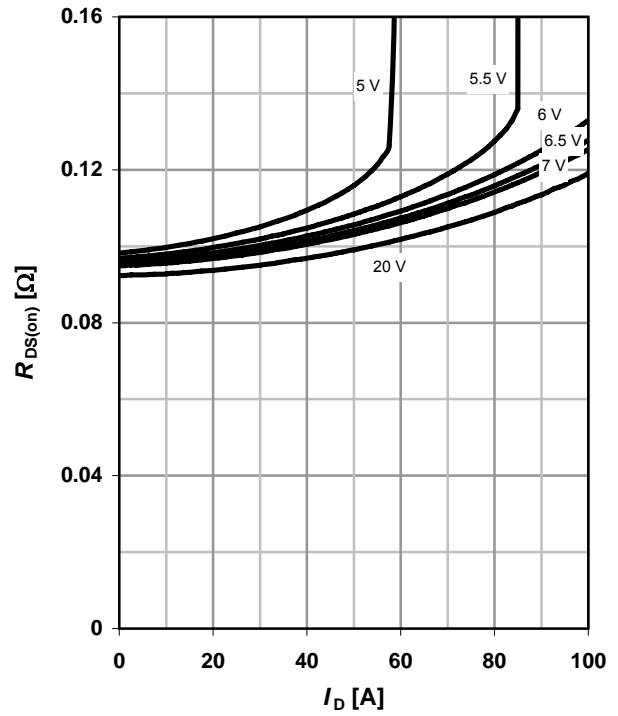
parameter:  $V_{GS}$



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

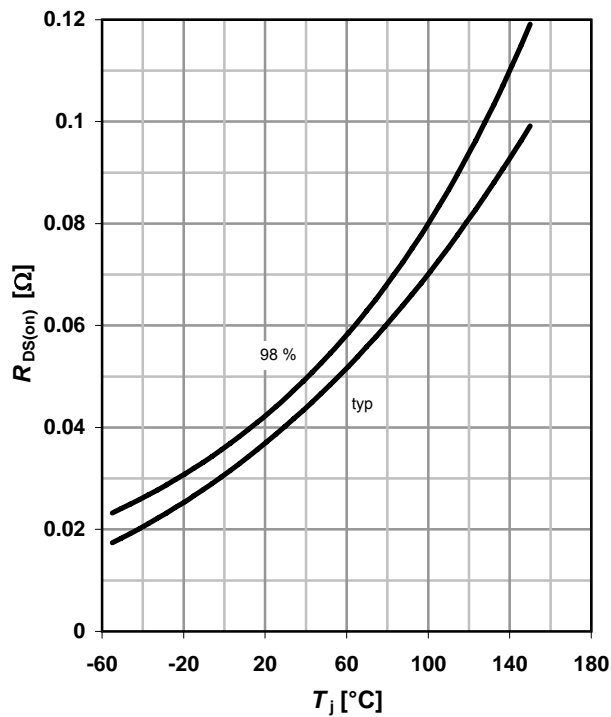
$R_{DS(on)} = f(I_D); T_j = 150\text{ °C}$

parameter:  $V_{GS}$



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

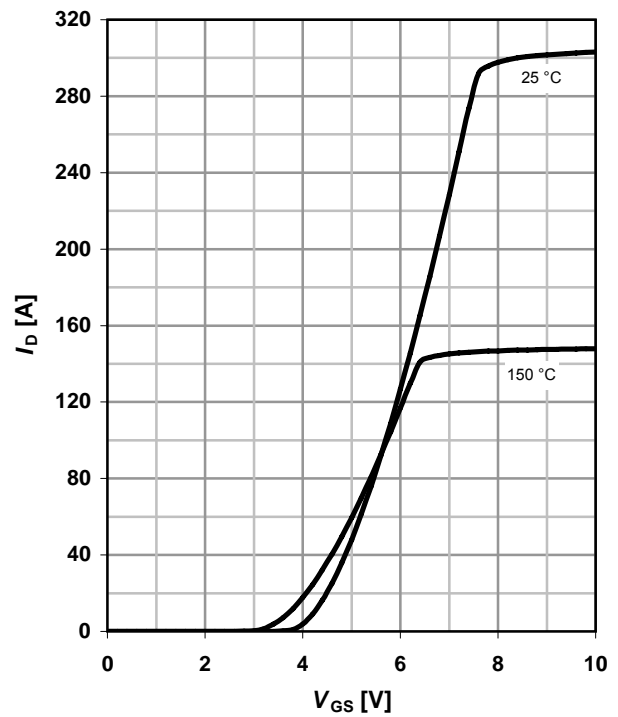
$R_{DS(on)} = f(T_j); I_D = 44\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

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

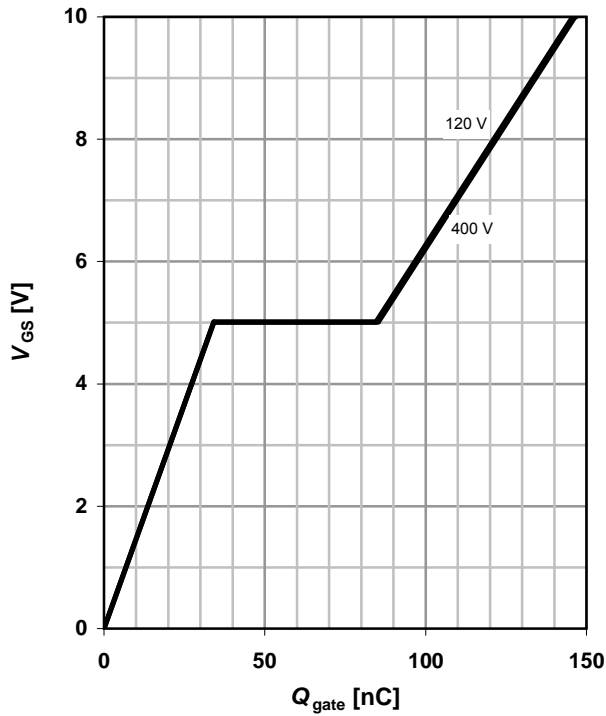
parameter:  $T_j$



**9 Typ. gate charge**

$V_{GS}=f(Q_{gate}); I_D=44\text{ A pulsed}$

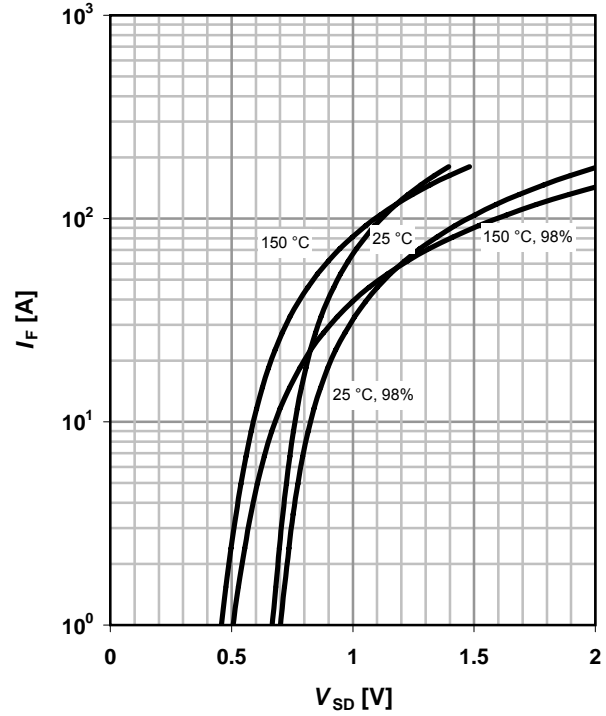
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

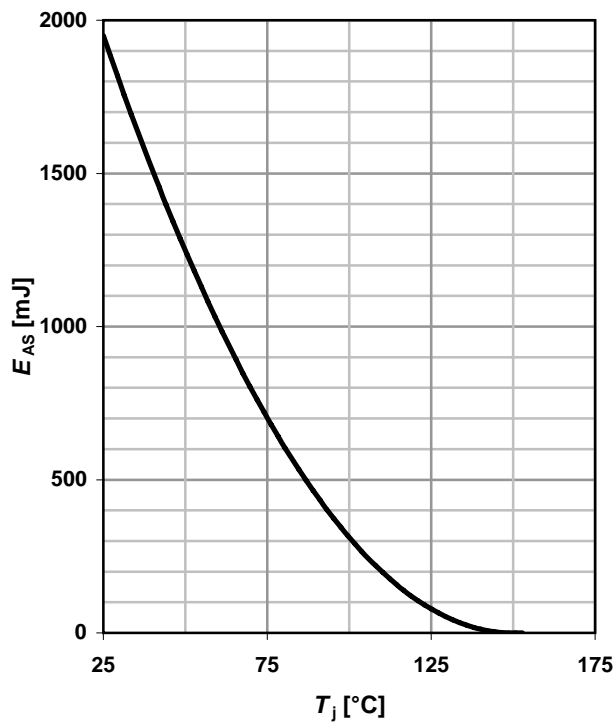
$I_F=f(V_{SD})$

parameter:  $T_j$



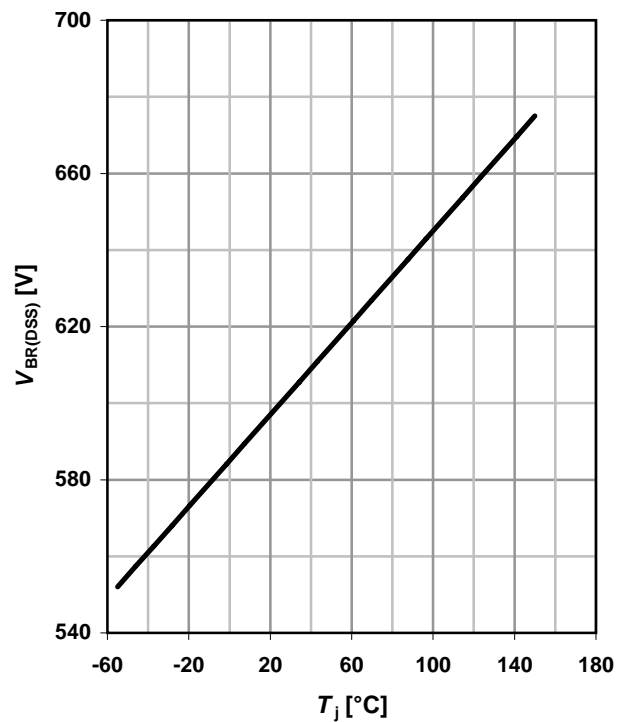
**11 Avalanche energy**

$E_{AS}=f(T_j); I_D=11\text{ A}; V_{DD}=50\text{ V}$



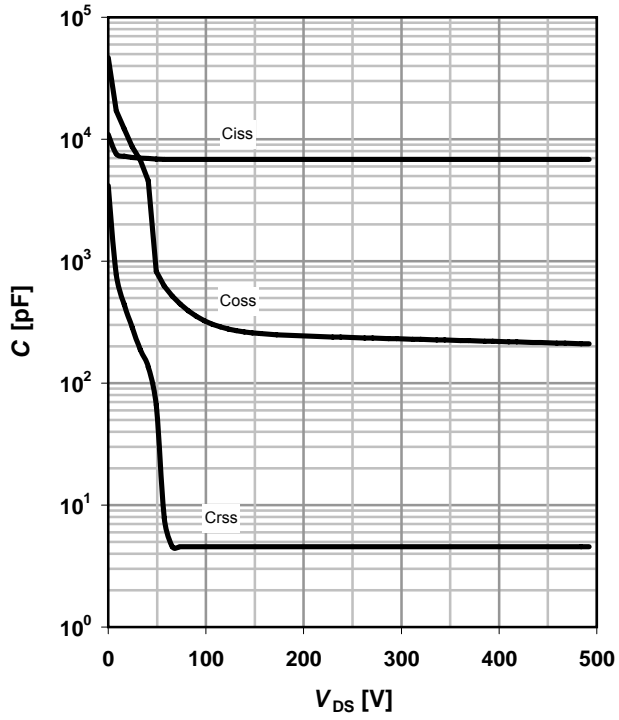
**12 Drain-source breakdown voltage**

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



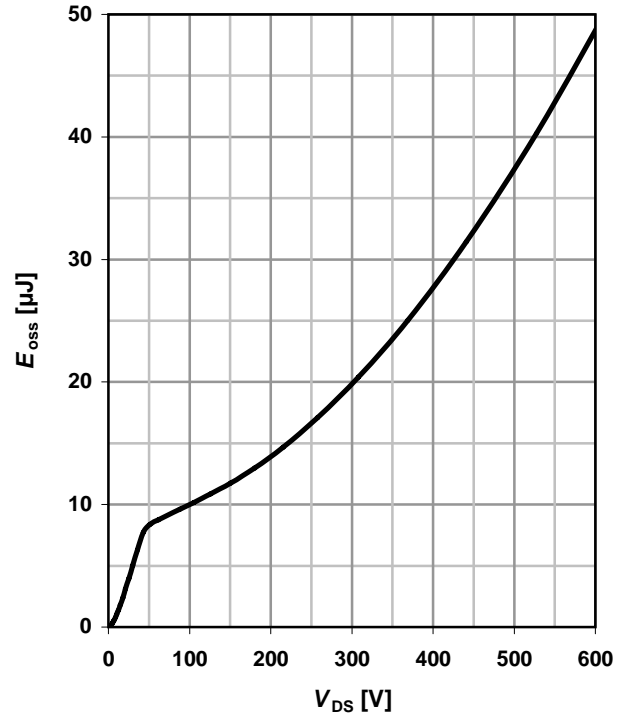
13 Typ. capacitances

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

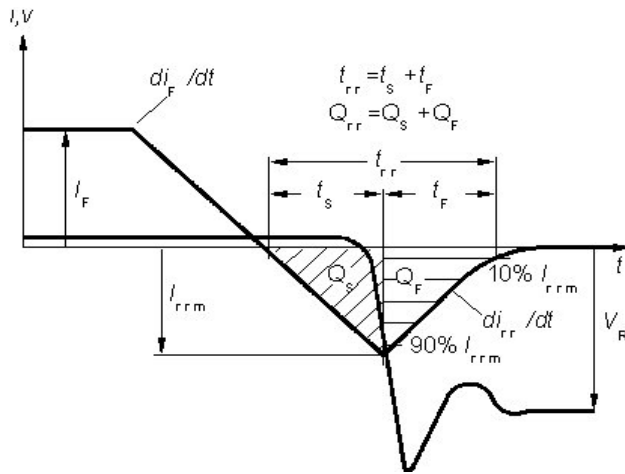


14 Typ. Coss stored energy

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

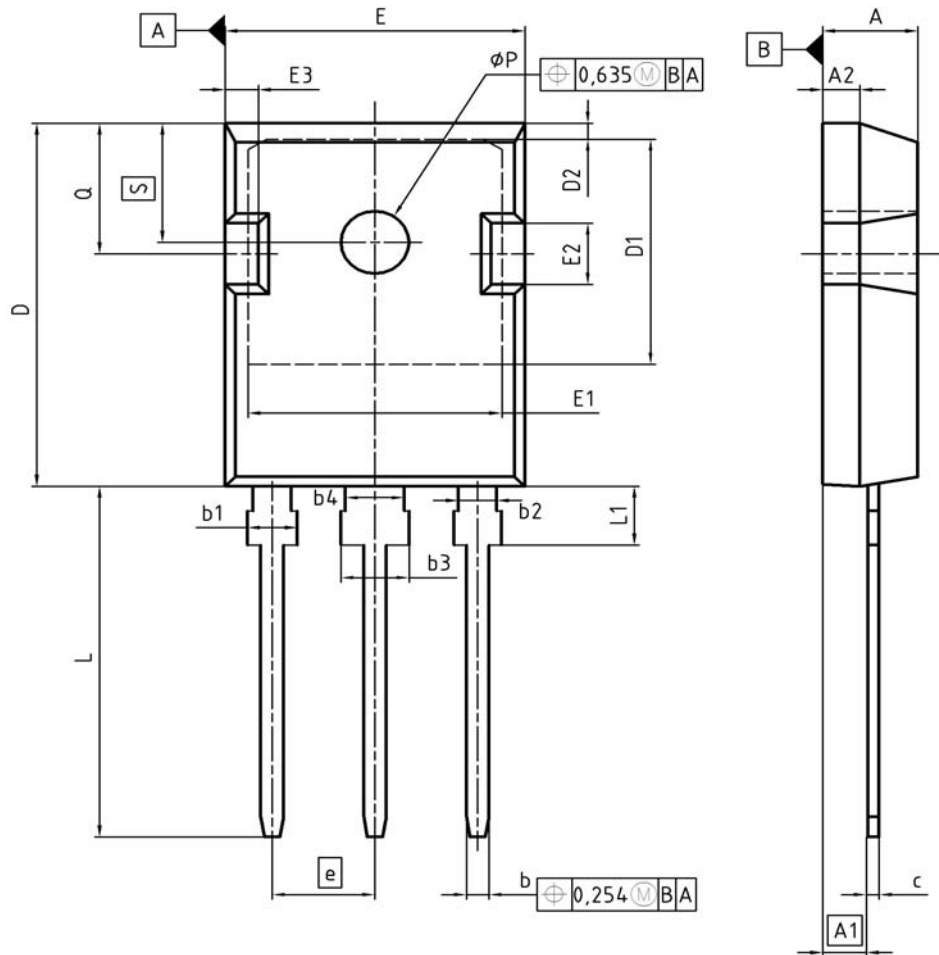


Definition of diode switching characteristics





PG-TO-247-3: Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.16	0.193	0.203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.82	21.10	0.820	0.831
D1	16.25	17.65	0.640	0.695
D2	1.05	1.35	0.041	0.053
E	15.70	16.03	0.618	0.631
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.68	2.60	0.066	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	0.176
$\phi P$	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

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# NOTIFICATION



N° 040/10

## Information on N-Channel MOSFET products designed for automotive applications

<b>Products affected:</b>	<b>SalesName</b>	<b>Package</b>
	IPB60R099CPA	PG-TO263-3-2
	IPB60R199CPA	PG-TO263-3-2
	IPB60R299CPA	PG-TO263-3-2
	IPC60R075CPA	Bare Die
	IPI60R099CPA	PG-TO262-3-1
	IPP60R099CPA	PG-TO220-3-1
	IPW60R045CPA	PG-TO247-3-41
	IPW60R075CPA	PG-TO247-3-41
	IPW60R099CPA	PG-TO247-3-41

Dear Customer,

The devices listed for this notification are sensitive to hard commutation of the conducting body diode. This operating condition can occur in half-bridge configurations used in ZVS phase shift and resonant switching PWM converters. Using the device under such conditions may result in violation of the datasheet specification limits and may lead to permanent damage of the device.

Please take care that in the context of the application described above the datasheet limits are not exceeded.

Best Regards

Michael Paulu

If you have any questions, please do not hesitate to contact your local Sales office.