

**CoolMOS™ Power Transistor**
**Product Summary**


$V_{DS}$	600	V
$R_{DS(on),max}$	0.105	$\Omega$
$Q_{g,typ}$	60	nC

**Features**

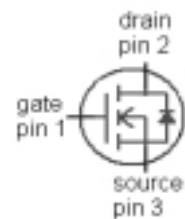
- Worldwide best  $R_{ds,on}$  in TO262
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Automotive AEC Q101 qualified
- Green package (RoHS compliant)

PG-TO262-3-1


**CoolMOS CPA is specially designed for:**

- DC/DC converters for Automotive Applications

Type	Package	Marking
IPI60R099CPA	PG-TO262-3-1	6R099A


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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25^\circ\text{C}$	31	A
		$T_C=100^\circ\text{C}$	19	
Pulsed drain current <sup>1)</sup>	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	93	
Avalanche energy, single pulse	$E_{AS}$	$I_D=11\text{ A}, V_{DD}=50\text{ V}$	800	mJ
Avalanche energy, repetitive $t_{AR}^{1),2)}$	$E_{AR}$	$I_D=11\text{ A}, V_{DD}=50\text{ V}$	1.2	
Avalanche current, repetitive $t_{AR}^{1),2)}$	$I_{AR}$		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	$P_{tot}$	$T_C=25^\circ\text{C}$	255	W
Operating temperature	$T_j$		-40 ... 150	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-40 ... 150	

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

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	$I_S$	$T_C=25\text{ °C}$	18	A
Diode pulse current <sup>1)</sup>	$I_{S,pulse}$		93	
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	$R_{thJC}$		-	-	0.5	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
Soldering temperature, reflow soldering	$T_{sold}$	MSL1, reflow acc. to IPC-JEDEC J-STD-020C	-	-	245	°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	$V_{GS(th)}$	$V_{DS}=V_{GS}$ , $I_D=1.2\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$	-	-	5	$\mu\text{A}$
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$ , $I_D=18\text{ A}$ , $T_j=25\text{ °C}$	-	0.09	0.105	$\Omega$
		$V_{GS}=10\text{ V}$ , $I_D=18\text{ A}$ , $T_j=150\text{ °C}$	-	0.24	-	
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	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	2800	-	pF
Output capacitance	$C_{oss}$		-	130	-	
Effective output capacitance, energy related <sup>4)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	130	-	
Effective output capacitance, time related <sup>5)</sup>	$C_{o(tr)}$		-	340	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=18\text{ A},$ $R_G=3.3\ \Omega$	-	10	-	ns
Rise time	$t_r$		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	60	-	
Fall time	$t_f$		-	5	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD}=400\text{ V}, I_D=18\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	14	-	nC
Gate to drain charge	$Q_{gd}$		-	20	-	
Gate charge total	$Q_g$		-	60	80	
Gate plateau voltage	$V_{plateau}$		-	5.0	-	V

**Reverse Diode**

Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=18\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.9	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	450	-	ns
Reverse recovery charge	$Q_{rr}$		-	12	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	70	-	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  $P_{AV}=E_{AR} \cdot f$ .

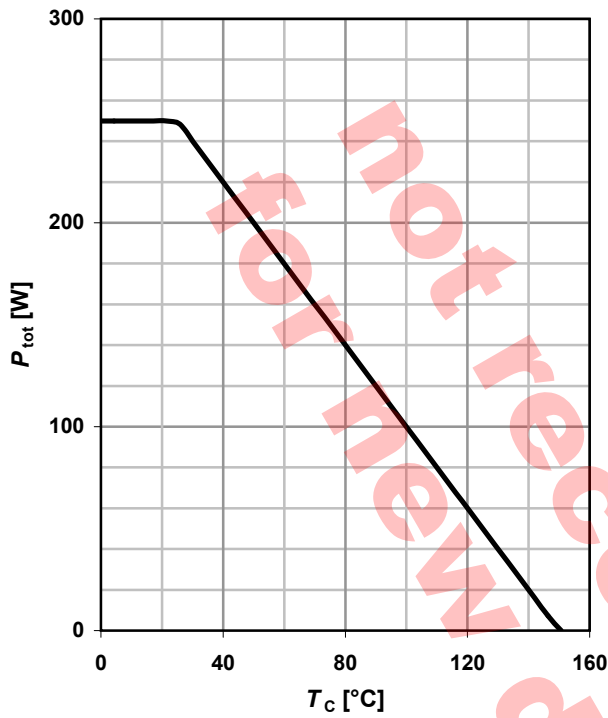
<sup>3)</sup>  $I_{SD} \leq I_D, di/dt \leq 100\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$ , identical low side and high side switch

<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**

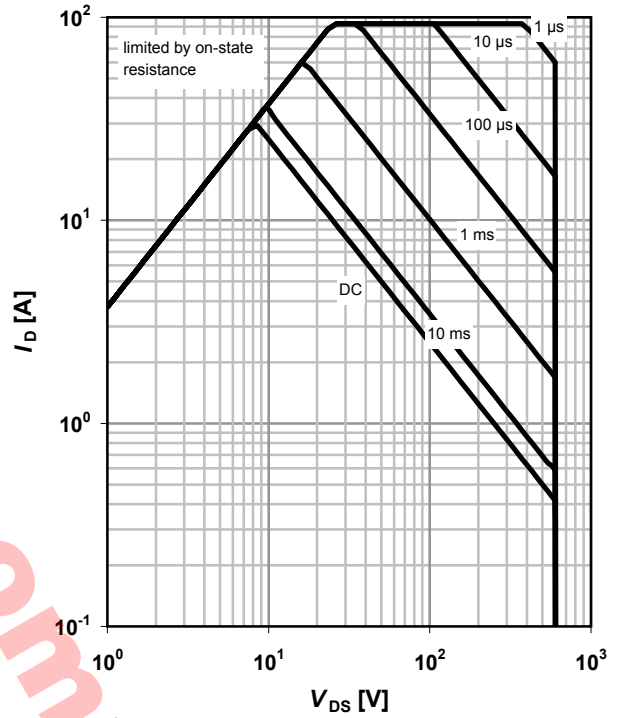
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

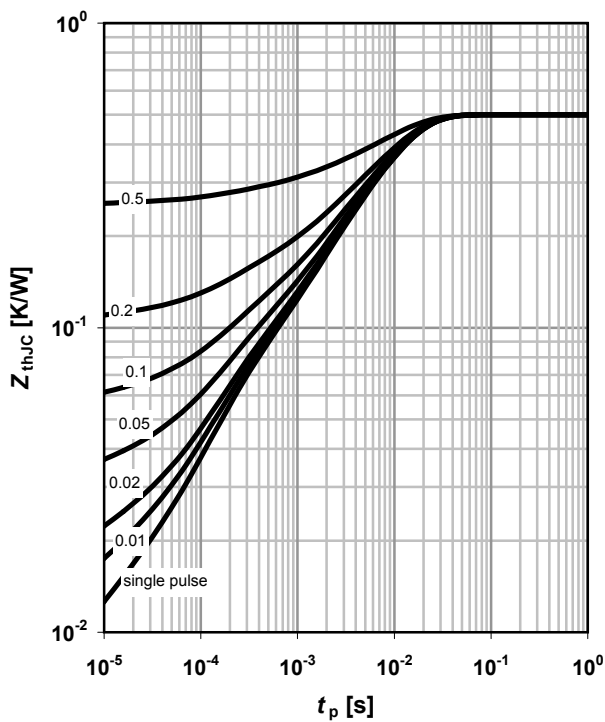
parameter:  $t_p$



**3 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

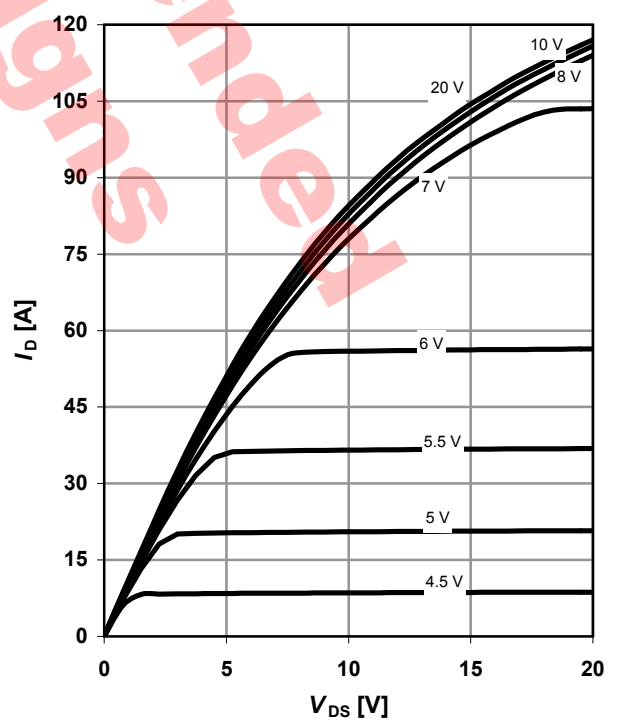
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

$I_D=f(V_{DS}); T_j=25\text{ °C}$

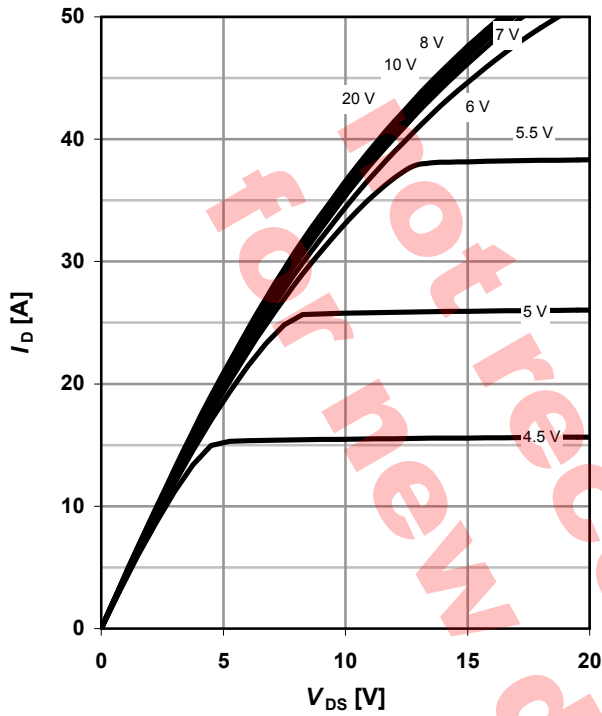
parameter:  $V_{GS}$



**5 Typ. output characteristics**

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

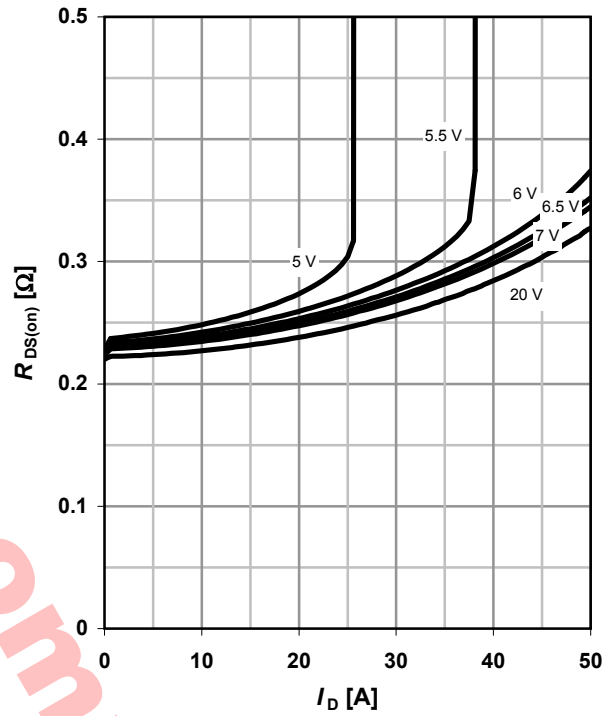
parameter:  $V_{GS}$



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

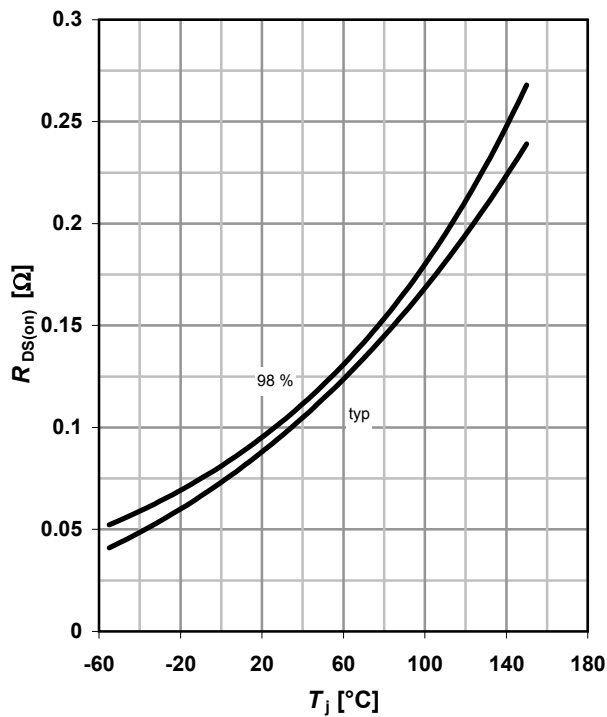
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter:  $V_{GS}$



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

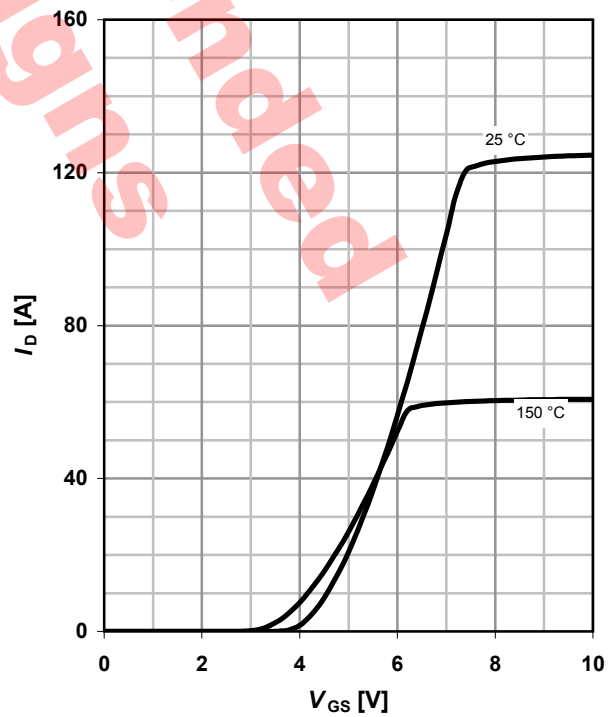
$R_{DS(on)} = f(T_j); I_D = 18\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

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

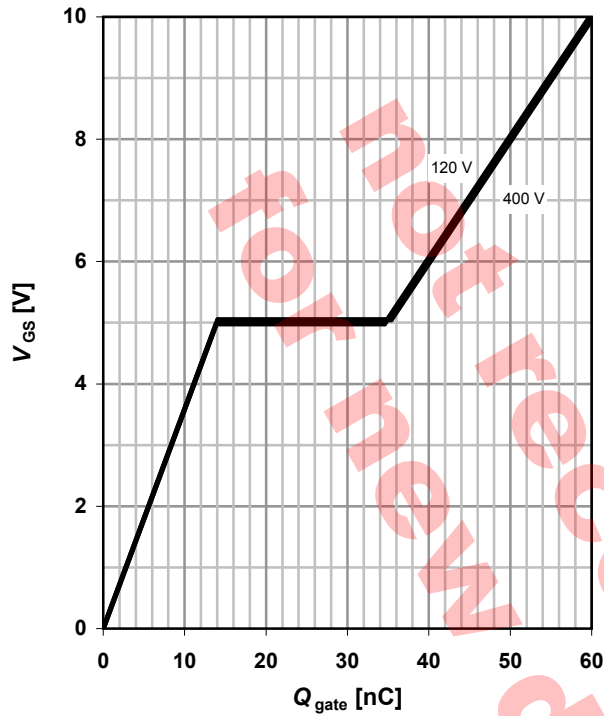
parameter:  $T_j$



**9 Typ. gate charge**

$V_{GS}=f(Q_{gate}); I_D=18\text{ A pulsed}$

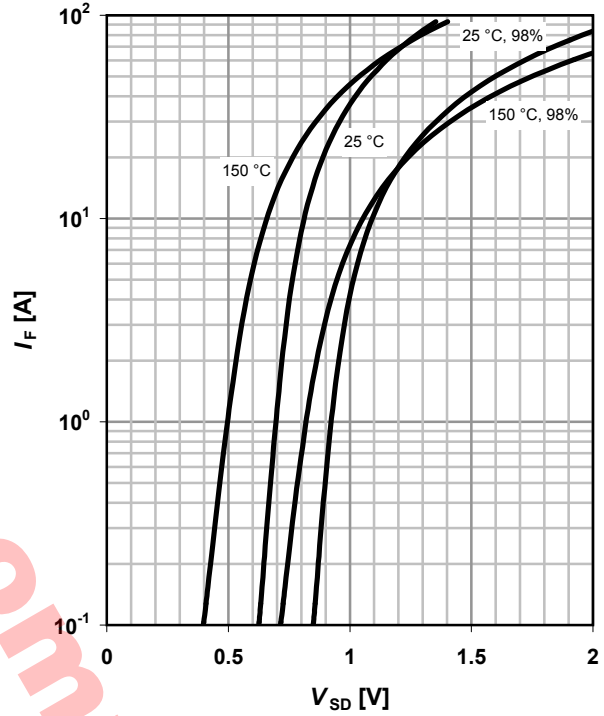
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

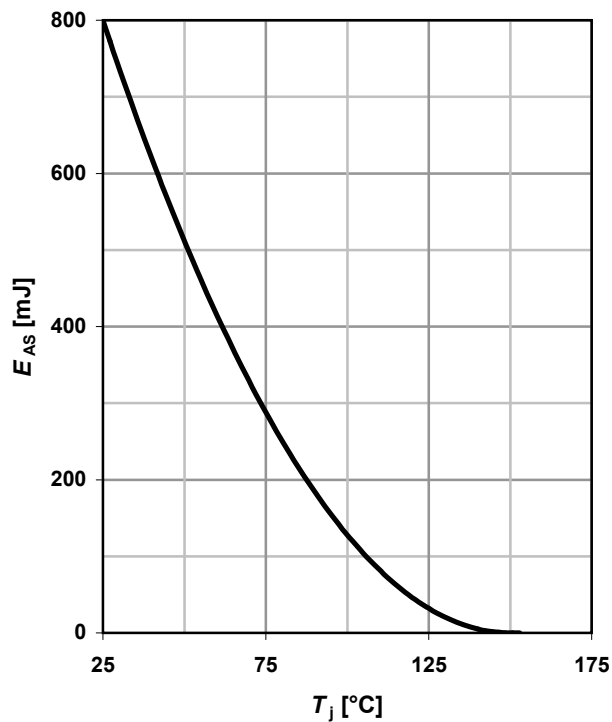
$I_F=f(V_{SD})$

parameter:  $T_j$



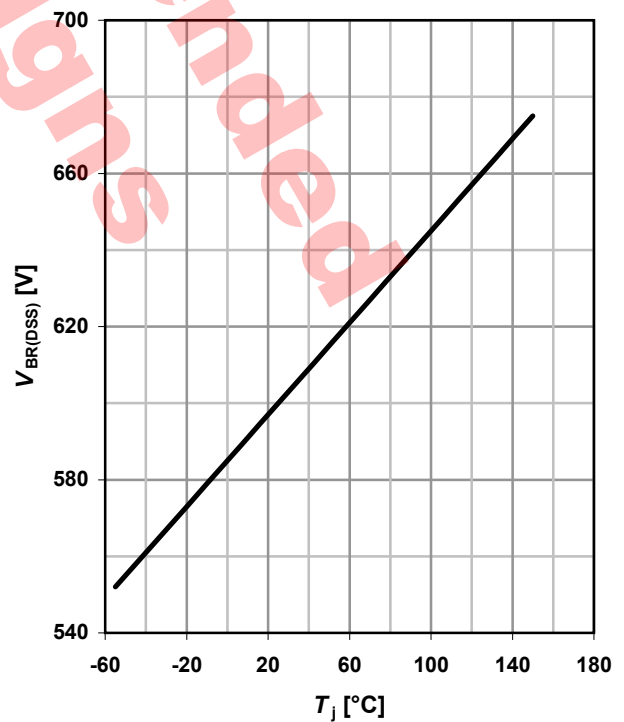
**11 Avalanche energy**

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



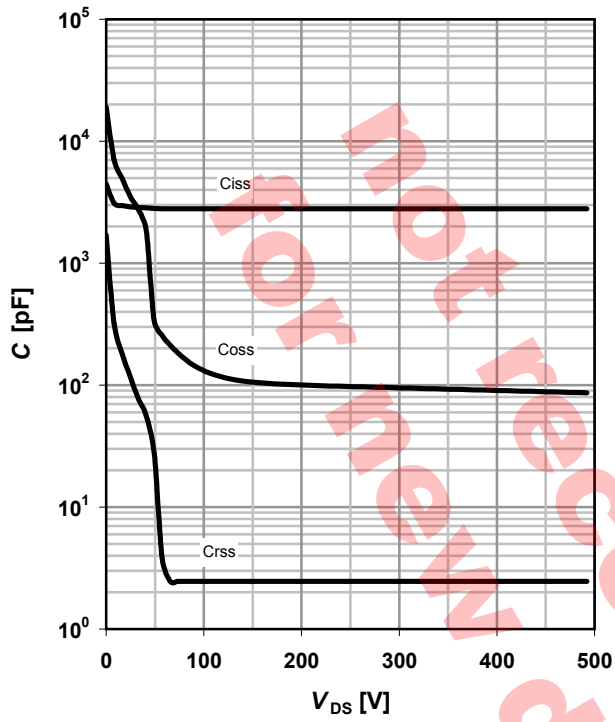
**12 Drain-source breakdown voltage**

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



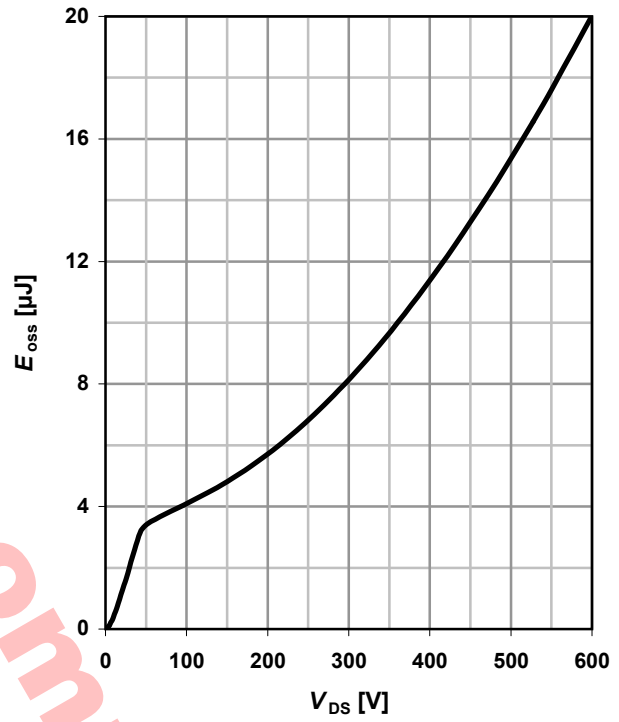
13 Typ. capacitances

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

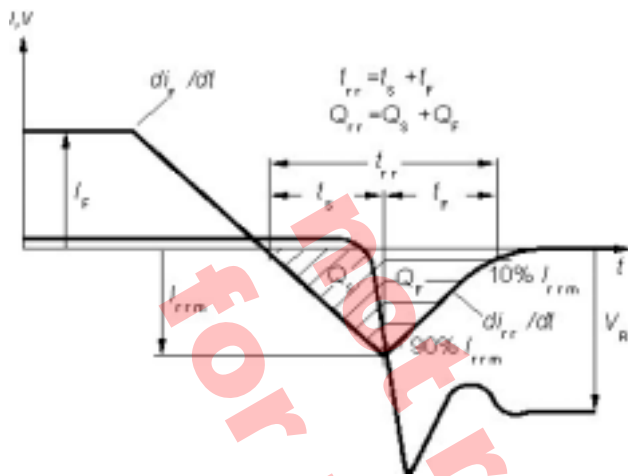


14 Typ. Coss stored energy

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



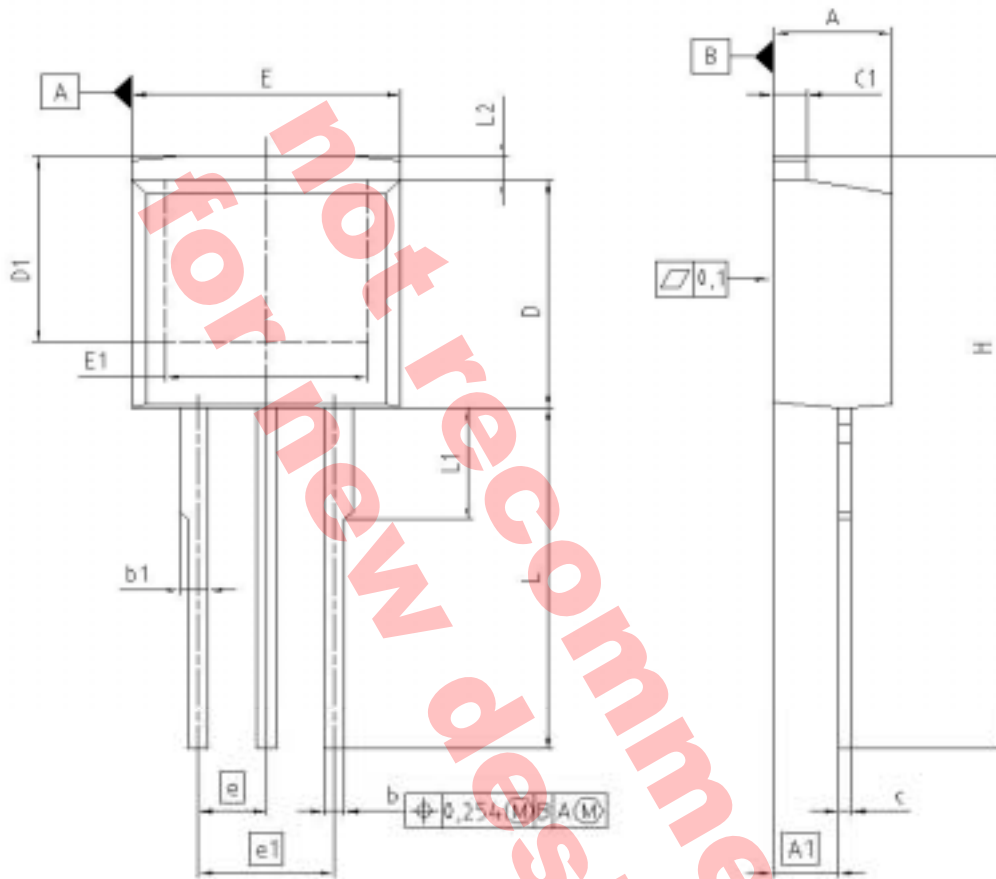
Definition of diode switching characteristics



For new designs recommended



PG-TO262-3-1: Outlines



to

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.300	4.500	0.169	0.177
A1	2.150	2.650	0.085	0.104
b	0.850	0.850	0.026	0.033
b1	0.635	1.400	0.025	0.055
e	0.400	0.600	0.016	0.024
e1	1.170	1.370	0.046	0.054
D	8.050	8.450	0.356	0.372
D1	6.900	7.650	0.272	0.301
E	9.800	10.200	0.386	0.402
E1	7.250	8.600	0.285	0.339
e	2.540		0.100	
e1	5.080		0.200	
N	3		3	
L	13.000	14.000	0.512	0.551
L1	4.350	4.750	0.171	0.187
L2	0.700	1.300	0.028	0.051

REFERENCE  
JEDEC TO262

SCALE

EUROPEAN PROJECTION

ISSUE DATE  
01-06-2005

FILE  
TO262\_1

Dimensions in mm/inches

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# NOTIFICATION



N° 040/10

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

### Products affected:

SalesName	Package
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.