

CoolMOS® Power Transistor

Features

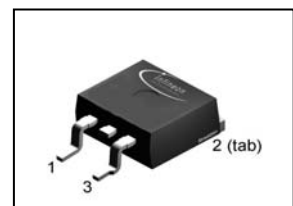
- Lowest figure-of-merit $R_{on} \times Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Automotive AEC Q101 qualified
- Green package (RoHS compliant)

CoolMOS CPA is specially designed for:

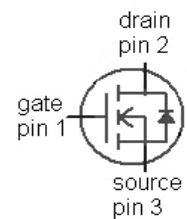
- DC/DC converters for Automotive Applications

Product Summary

| | | |
|------------------|-------|----------|
| V_{DS} | 600 | V |
| $R_{DS(on),max}$ | 0.199 | Ω |
| $Q_{g,typ}$ | 33 | nC |

PG-TO263-3


| Type | Package | Marking |
|--------------|------------|---------|
| IPB60R199CPA | PG-TO263-3 | 6R199A |


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

| Parameter | Symbol | Conditions | Value | Unit |
|---|---------------|---|-------------|------------------|
| Continuous drain current | I_D | $T_C=25\text{ }^\circ\text{C}$ | 16 | A |
| | | $T_C=100\text{ }^\circ\text{C}$ | 10 | |
| Pulsed drain current ¹⁾ | $I_{D,pulse}$ | $T_C=25\text{ }^\circ\text{C}$ | 51 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=6.6\text{ A}$, $V_{DD}=50\text{ V}$ | 436 | mJ |
| Avalanche energy, repetitive t_{AR} ^{1),2)} | E_{AR} | $I_D=6.6\text{ A}$, $V_{DD}=50\text{ V}$ | 0.66 | |
| Avalanche current, repetitive t_{AR} ^{1),2)} | I_{AR} | | 6.6 | A |
| MOSFET dv/dt ruggedness | dv/dt | $V_{DS}=0\dots480\text{ V}$ | 50 | V/ns |
| Gate source voltage | V_{GS} | static | ± 20 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ }^\circ\text{C}$ | 139 | 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 | $T_C=25\text{ °C}$ | 9.9 | A |
| Diode pulse current ¹⁾ | $I_{S,pulse}$ | | 51 | |
| Reverse diode dv/dt ³⁾ | dv/dt | | 15 | V/ns |

| Parameter | Symbol | Conditions | Values | | | Unit |
|-----------|--------|------------|--------|------|------|------|
| | | | min. | typ. | max. | |

Thermal characteristics

| | | | | | | |
|---|------------|--|---|----|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 0.9 | K/W |
| Thermal resistance, junction - ambient | R_{thJA} | SMD version, device on PCB, minimal footprint | - | - | 62 | |
| | | SMD version, device on PCB, 6 cm ² cooling area ⁴⁾ | - | 35 | - | |
| Soldering temperature, reflow soldering | T_{sold} | MSL 1 | - | - | 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 | $V_{GS(th)}$ | $V_{DS}=V_{GS}$, $I_D=1.1\text{ mA}$ | 2.5 | 3 | 3.5 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ | - | - | 1 | μA |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10\text{ V}$, $I_D=9.9\text{ A}$, $T_j=25\text{ °C}$ | - | 0.18 | 0.199 | Ω |
| | | $V_{GS}=10\text{ V}$, $I_D=9.9\text{ A}$, $T_j=150\text{ °C}$ | - | 0.49 | - | |
| Gate resistance | R_G | $f=1\text{ MHz}$, open drain | - | 2 | - | Ω |

| Parameter | Symbol | Conditions | Values | | | Unit |
|-----------|--------|------------|--------|------|------|------|
| | | | min. | typ. | max. | |

Dynamic characteristics

| | | | | | | |
|--|--------------|--|---|------|---|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$ | - | 1520 | - | pF |
| Output capacitance | C_{oss} | | - | 72 | - | |
| Effective output capacitance, energy related ⁵⁾ | $C_{o(er)}$ | $V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V | - | 69 | - | |
| Effective output capacitance, time related ⁶⁾ | $C_{o(tr)}$ | | - | 180 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=9.9\text{ A},$ $R_G=3.3\ \Omega$ | - | 10 | - | 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} | $V_{DD}=400\text{ V}, I_D=9.9\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 8 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 11 | - | |
| Gate charge total | Q_g | | - | 32 | 43 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.0 | - | V |

Reverse Diode

| | | | | | | |
|-------------------------------|-----------|--|---|-----|-----|---------------|
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=9.9\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.9 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 340 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 5.5 | - | μC |
| Peak reverse recovery current | I_{rrm} | | - | 33 | - | A |

¹⁾ Pulse width t_p limited by $T_{j,max}$

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

³⁾ $I_{SD} \leq I_D, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$, identical low side and high side switch.

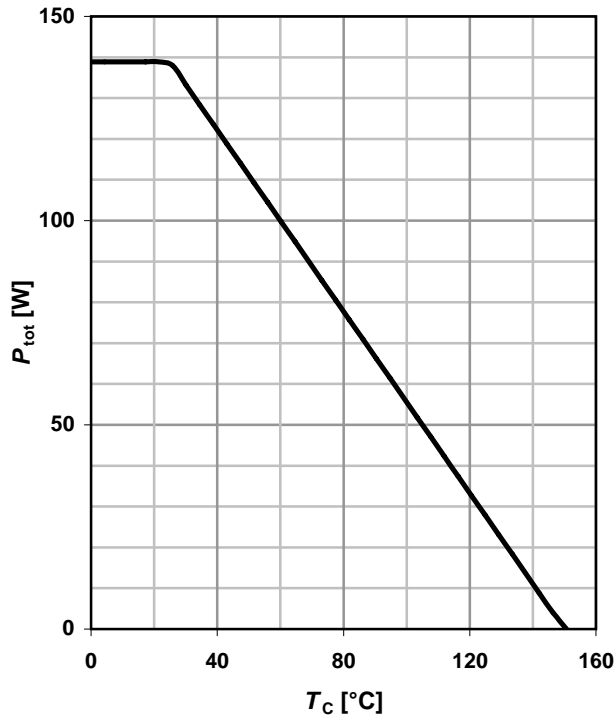
⁴⁾ Device on 40mm*40mm*1.5 epoxy PCB FR4 with 6cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical without blown air.

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

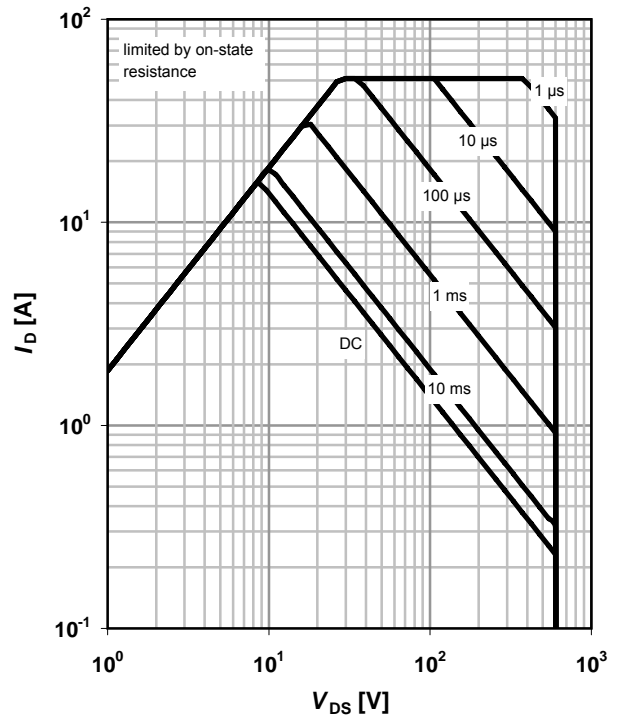
$P_{tot}=f(T_C)$



2 Safe operating area

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

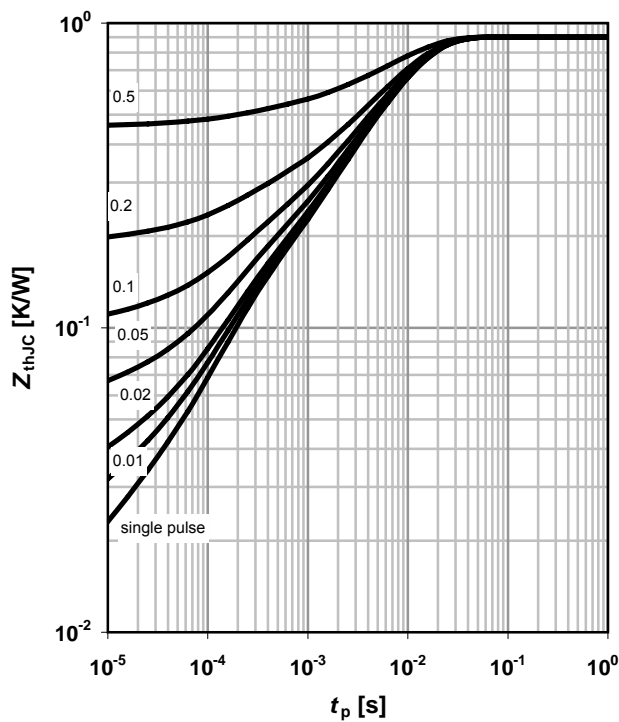
parameter: t_p



3 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

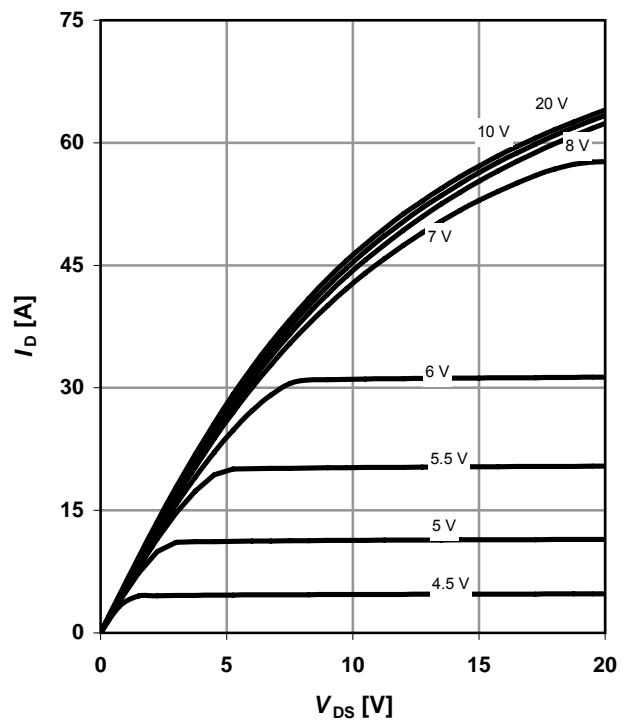
parameter: $D=t_p/T$



4 Typ. output characteristics

$I_D=f(V_{DS}); T_j=25\text{ °C}$

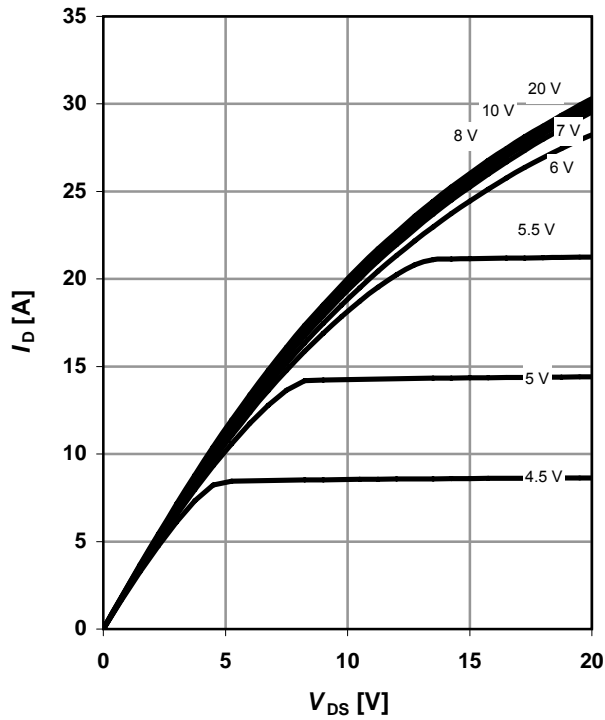
parameter: V_{GS}



5 Typ. output characteristics

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

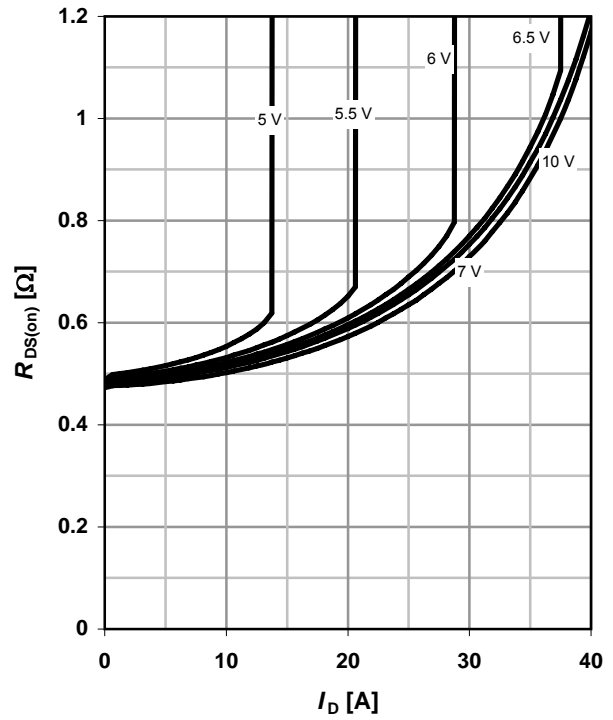
parameter: V_{GS}



6 Typ. drain-source on-state resistance

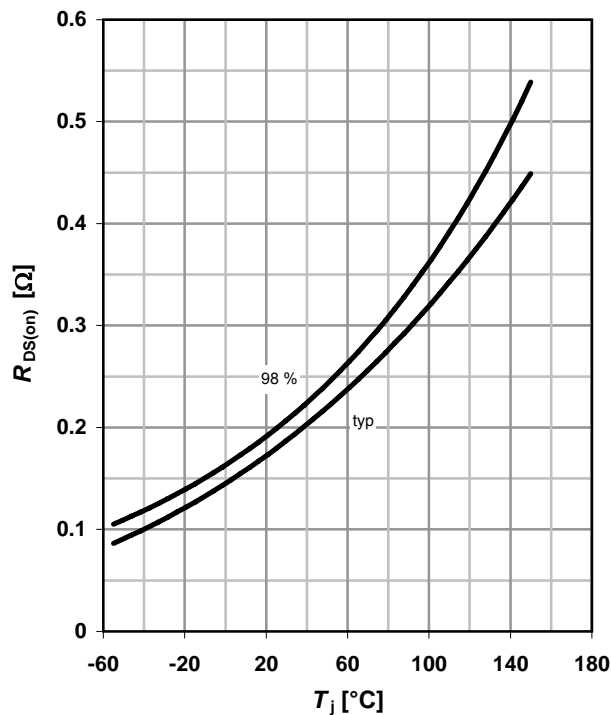
$R_{DS(on)} = f(I_D); T_j = 150\text{ °C}$

parameter: V_{GS}



7 Drain-source on-state resistance

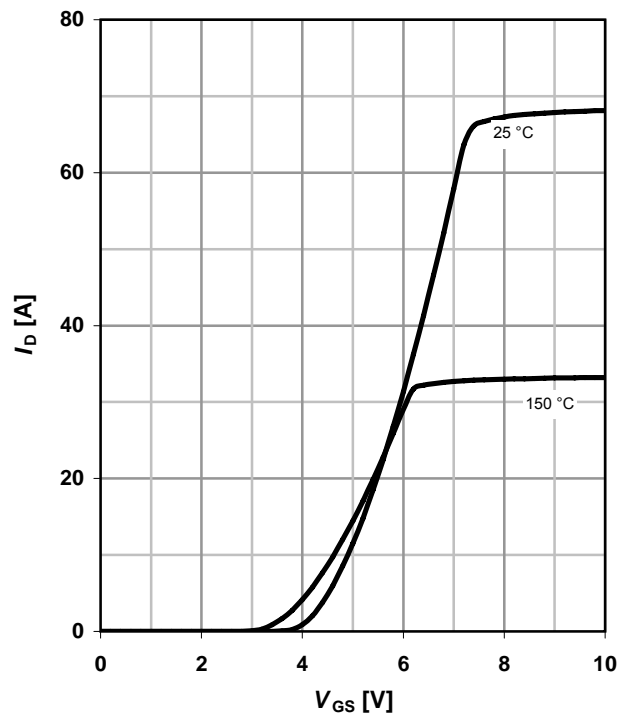
$R_{DS(on)} = f(T_j); I_D = 9.9\text{ A}; V_{GS} = 10\text{ V}$



8 Typ. transfer characteristics

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

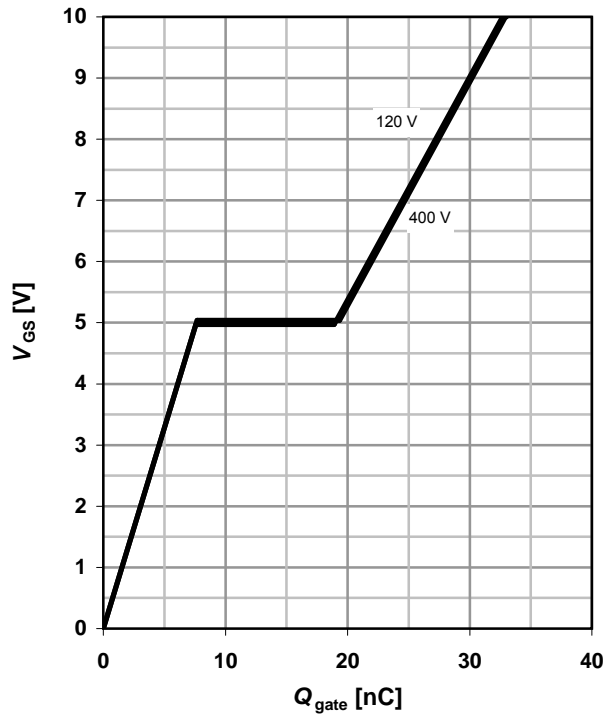
parameter: T_j



9 Typ. gate charge

$V_{GS}=f(Q_{gate}); I_D=9.9\text{ A pulsed}$

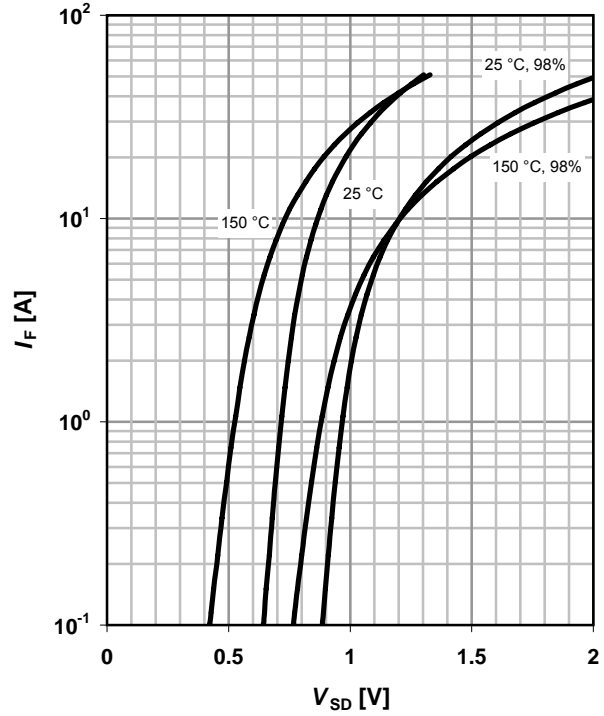
parameter: V_{DD}



10 Forward characteristics of reverse diode

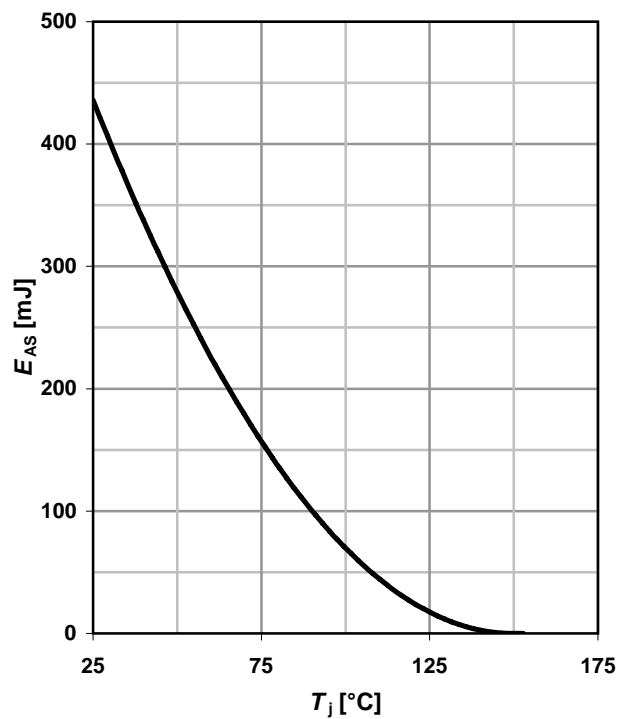
$I_F=f(V_{SD})$

parameter: T_j



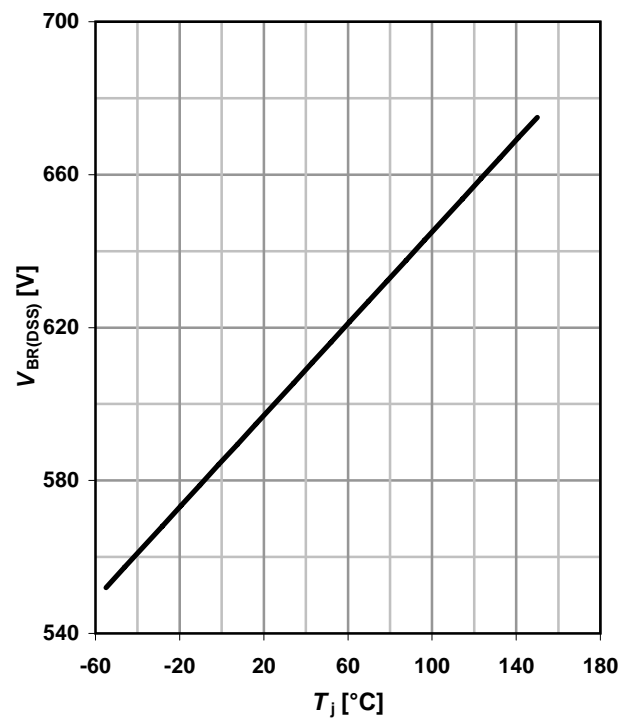
11 Avalanche energy

$E_{AS}=f(T_j); I_D=6.6\text{ A}; V_{DD}=50\text{ V}$



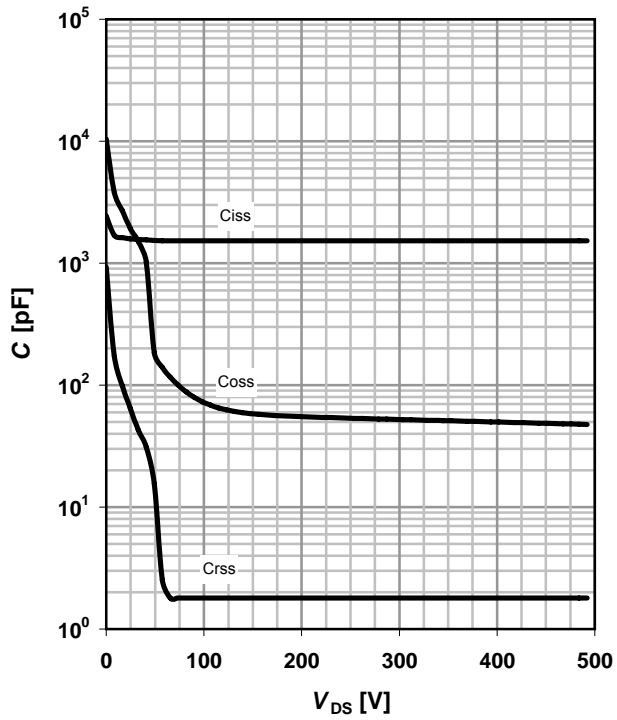
12 Drain-source breakdown voltage

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



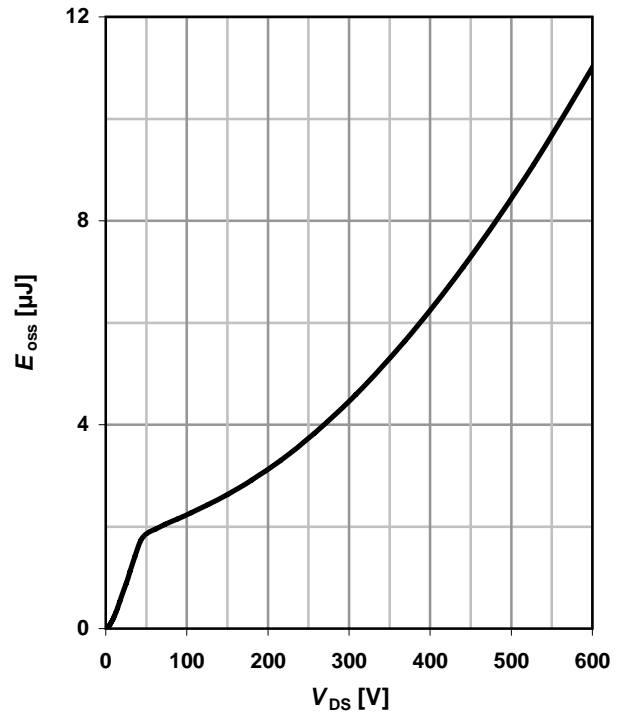
13 Typ. capacitances

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

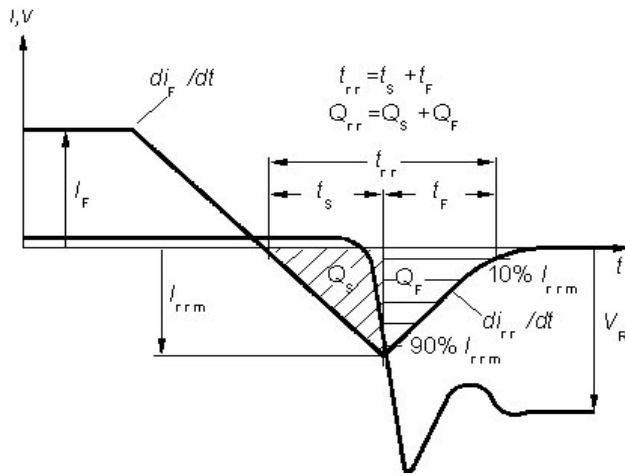


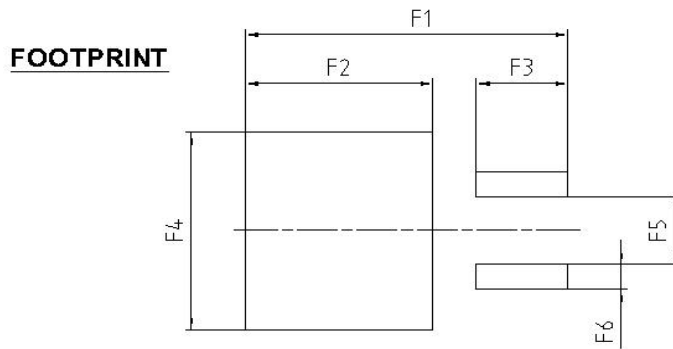
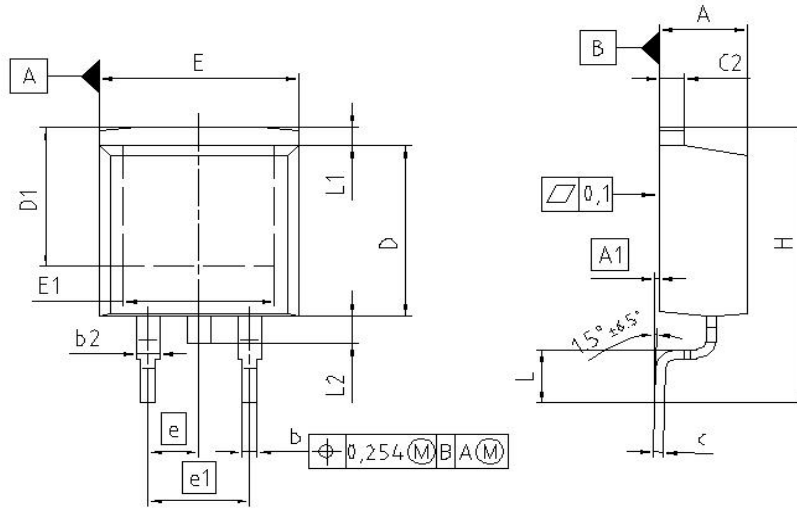
14 Typ. Coss stored energy

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



Definition of diode switching characteristics



PG-TO263-3: Outlines


| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|--------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.300 | 4.572 | 0.169 | 0.180 |
| A1 | 0.000 | 0.254 | 0.000 | 0.010 |
| b | 0.650 | 0.850 | 0.026 | 0.033 |
| b2 | 0.950 | 1.321 | 0.037 | 0.052 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c2 | 0.170 | 1.400 | 0.046 | 0.055 |
| D | 8.509 | 9.450 | 0.335 | 0.372 |
| D1 | 7.100 | - | 0.280 | - |
| E | 9.800 | 10.312 | 0.386 | 0.406 |
| E1 | 6.500 | - | 0.256 | - |
| e | 2.540 | | 0.100 | |
| e1 | 5.080 | | 0.200 | |
| N | 2 | | 2 | |
| H | 14.605 | 15.875 | 0.575 | 0.625 |
| L | 2.200 | 3.000 | 0.087 | 0.118 |
| L1 | - | 1.600 | - | 0.063 |
| L2 | 1.000 | 1.778 | 0.039 | 0.070 |
| F1 | 16.050 | 16.250 | 0.632 | 0.640 |
| F2 | 9.300 | 9.500 | 0.366 | 0.374 |
| F3 | 4.500 | 4.700 | 0.177 | 0.185 |
| F4 | 10.700 | 10.900 | 0.421 | 0.429 |
| F5 | 3.630 | 3.830 | 0.143 | 0.151 |
| F6 | 1.100 | 1.300 | 0.043 | 0.051 |

REFERENCE
JEDEC TO263

SCALE

0 5 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
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FILE
TO263_2

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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.

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