



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
- Qualified according to JEDEC⁽¹⁾ for target applications
- Pb-free lead plating; RoHS compliant

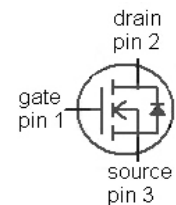
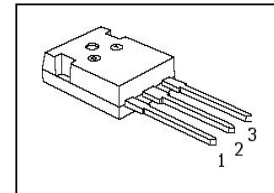
CoolMOS CP is specially designed for:

- Hard switching topologies, for Server and Telecom

Product Summary

| | | |
|----------------------|-------|----------|
| $V_{DS} @ T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 0.165 | Ω |
| $Q_{g,typ}$ | 39 | nC |

PG-TO247-3-1



| Type | Package | Ordering Code | Marking |
|-------------|--------------|---------------|---------|
| IPW60R165CP | PG-TO247-3-1 | SP000095483 | 6R165P |

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

| Parameter | Symbol | Conditions | Value | Unit |
|--|----------------|---|-------------|--------------------|
| Continuous drain current | I_D | $T_C=25\text{ °C}$ | 21 | A |
| | | $T_C=100\text{ °C}$ | 13 | |
| Pulsed drain current ⁽²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 61 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=7.9\text{ A}$, $V_{DD}=50\text{ V}$ | 522 | mJ |
| Avalanche energy, repetitive t_{AR} ^(2),3) | E_{AR} | $I_D=7.9\text{ A}$, $V_{DD}=50\text{ V}$ | 0.79 | |
| Avalanche current, repetitive t_{AR} ^(2),3) | I_{AR} | | 7.9 | A |
| MOSFET dv/dt ruggedness | dv/dt | $V_{DS}=0\dots480\text{ V}$ | 50 | V/ns |
| Gate source voltage | V_{GS} | static | ± 20 | V |
| | | AC ($f>1\text{ Hz}$) | ± 30 | |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 192 | W |
| Operating and storage temperature | T_j, T_{stg} | | -55 ... 150 | $^{\circ}\text{C}$ |
| 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 | $T_C=25\text{ °C}$ | 12 | A |
| Diode pulse current ²⁾ | $I_{S,pulse}$ | | 61 | |
| 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} | | - | - | 0.65 | 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 | $V_{GS(th)}$ | $V_{DS}=V_{GS}$, $I_D=0,09\text{ mA}$ | 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 |
| | | $V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$ | - | 10 | - | |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10\text{ V}$, $I_D=12\text{ A}$, $T_j=25\text{ °C}$ | - | 0.15 | 0.165 | Ω |
| | | $V_{GS}=10\text{ V}$, $I_D=12\text{ A}$, $T_j=150\text{ °C}$ | - | 0.40 | - | |
| Gate resistance | R_G | $f=1\text{ MHz}$, open drain | - | 1.9 | - | Ω |



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

Dynamic characteristics

| | | | | | | |
|--|--------------|--|---|------|---|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$ | - | 2000 | - | pF |
| Output capacitance | C_{oss} | | - | 100 | - | |
| Effective output capacitance, energy related ⁵⁾ | $C_{o(er)}$ | $V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V | - | 83 | - | |
| Effective output capacitance, time related ⁶⁾ | $C_{o(tr)}$ | | - | 220 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=400\text{ V}, V_{GS}=10\text{ V},$ $I_D=12\text{ A}, R_G=3.3\ \Omega$ | - | 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} | $V_{DD}=400\text{ V}, I_D=12\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 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} | $V_{GS}=0\text{ V}, I_F=12\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.9 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 390 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 7.5 | - | μC |
| Peak reverse recovery current | I_{rrm} | | - | 38 | - | A |

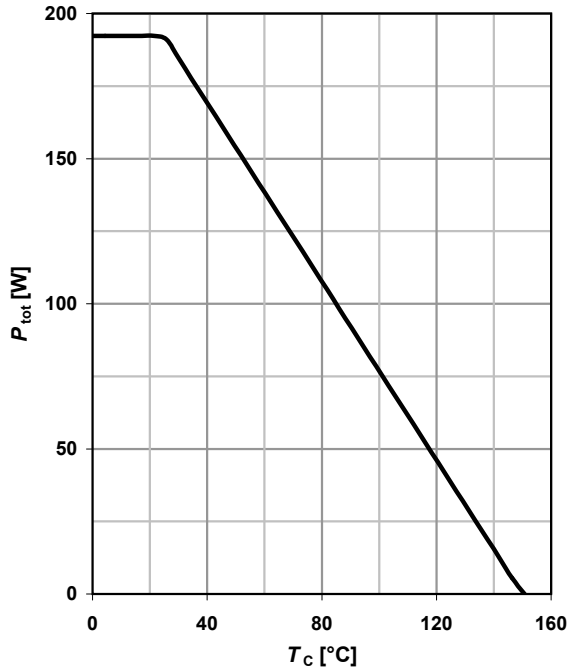
1) J-STD20 and JESD22

2) Pulse width t_p limited by $T_{j,max}$ 3) Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR} \cdot f$.4) $I_{SD}=I_D, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$, identical low side and high side switch5) $C_{o(er)}$ 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

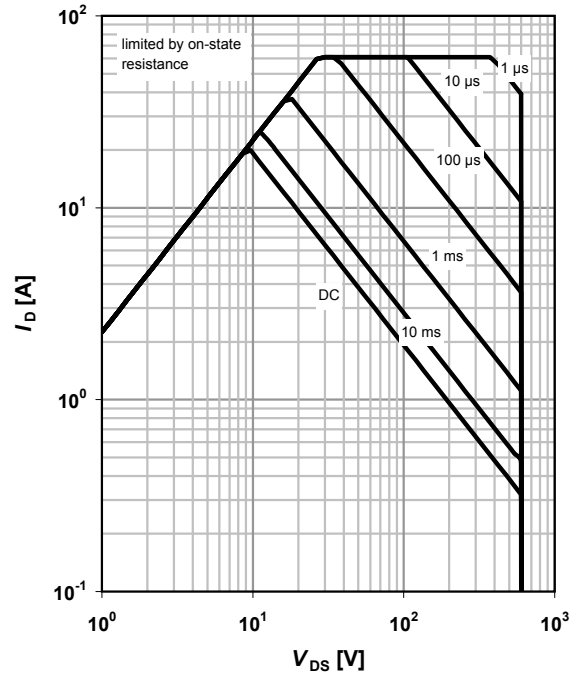
$P_{tot}=f(T_c)$



2 Safe operating area

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

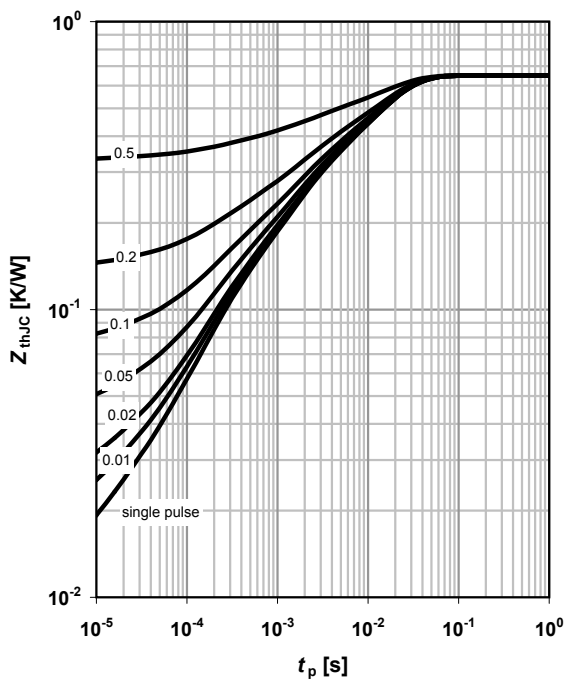
parameter: t_p



3 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

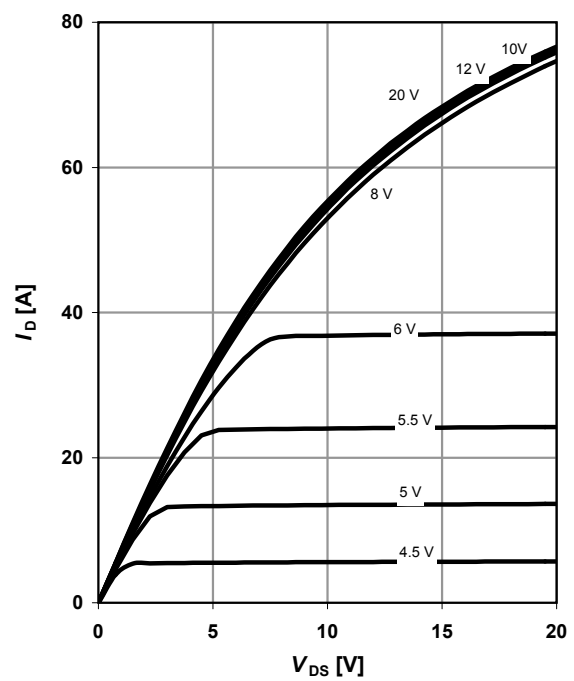
parameter: $D=t_p/T$



4 Typ. output characteristics

$I_D=f(V_{DS}); T_j=25\text{ °C}$

parameter: V_{GS}

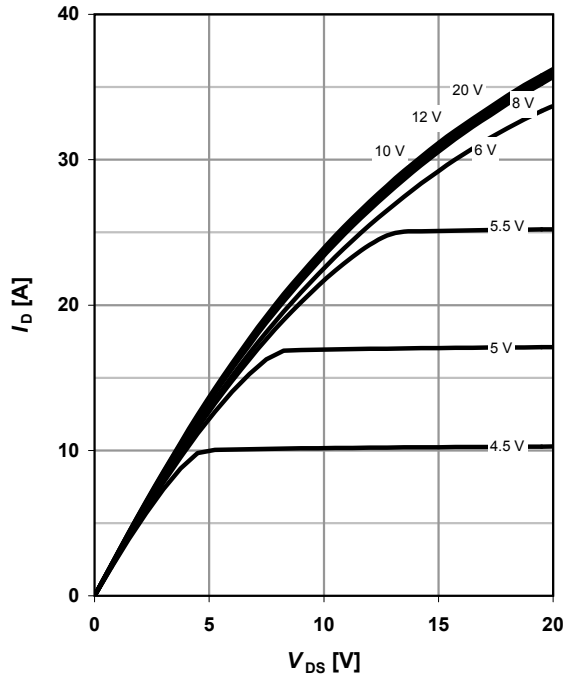




5 Typ. output characteristics

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

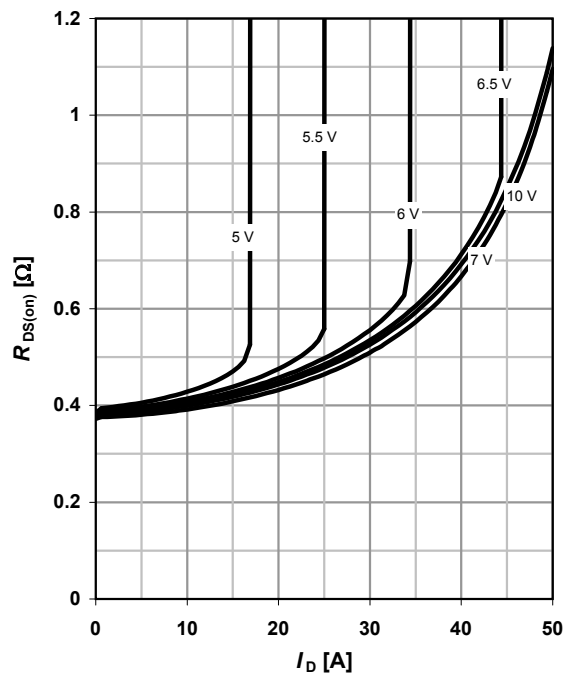
parameter: V_{GS}



6 Typ. drain-source on-state resistance

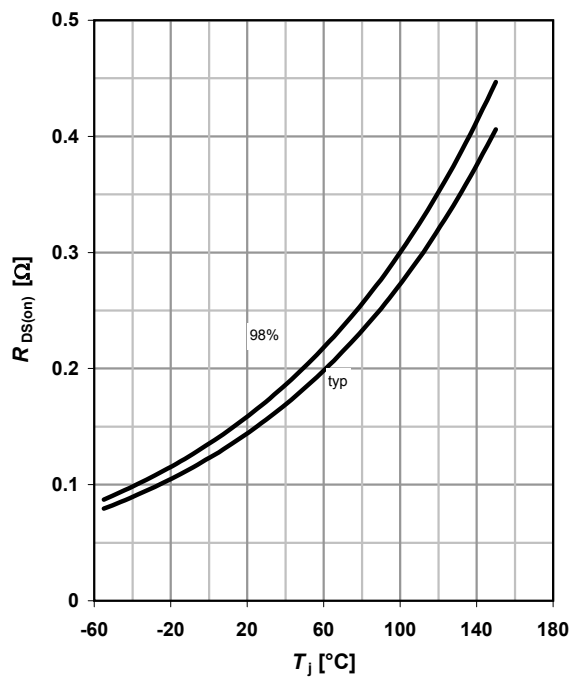
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter: V_{GS}



7 Drain-source on-state resistance

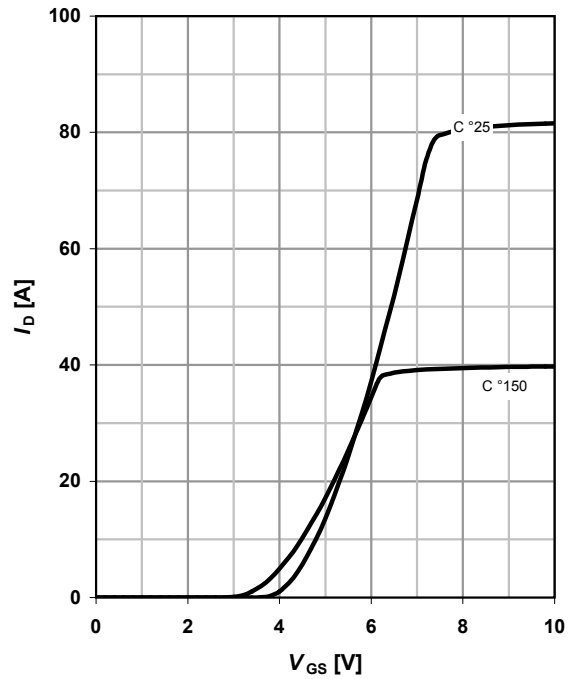
$R_{DS(on)} = f(T_j); I_D = 12\text{ A}; V_{GS} = 10\text{ V}$



8 Typ. transfer characteristics

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

parameter: T_j

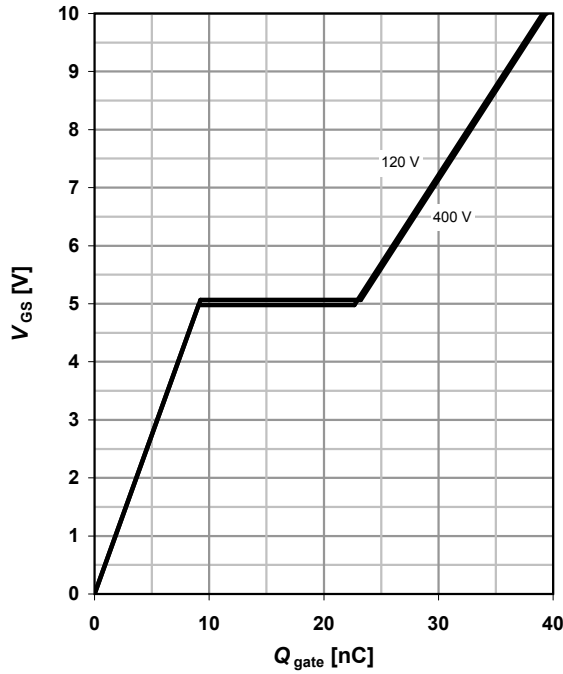




9 Typ. gate charge

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

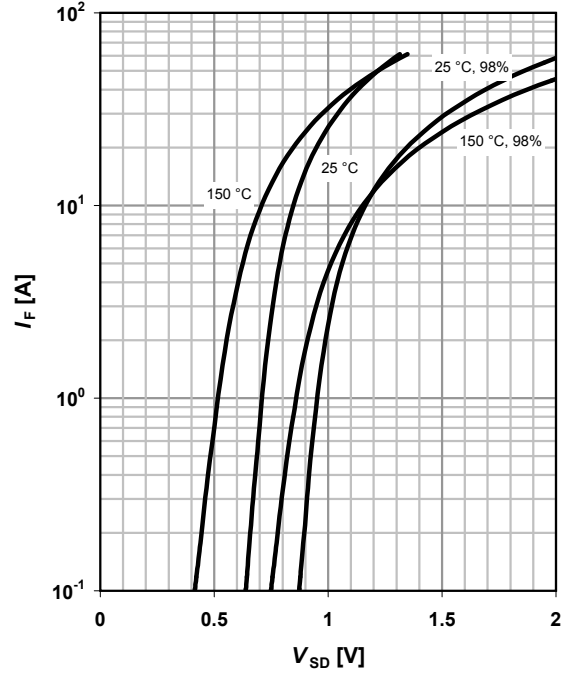
parameter: V_{DD}



10 Forward characteristics of reverse diode

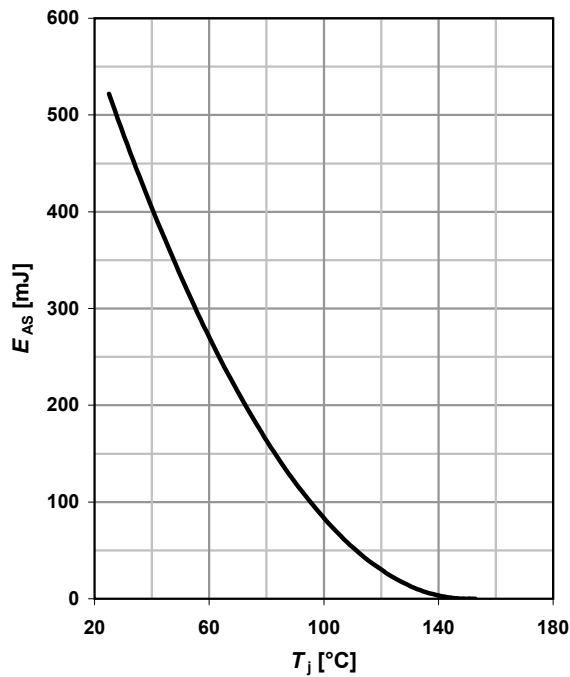
$I_F=f(V_{SD})$

parameter: T_j



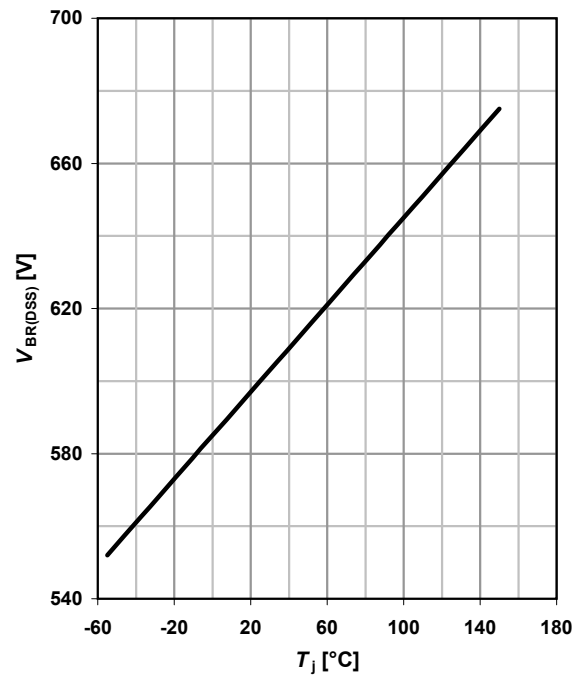
11 Avalanche energy

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



12 Drain-source breakdown voltage

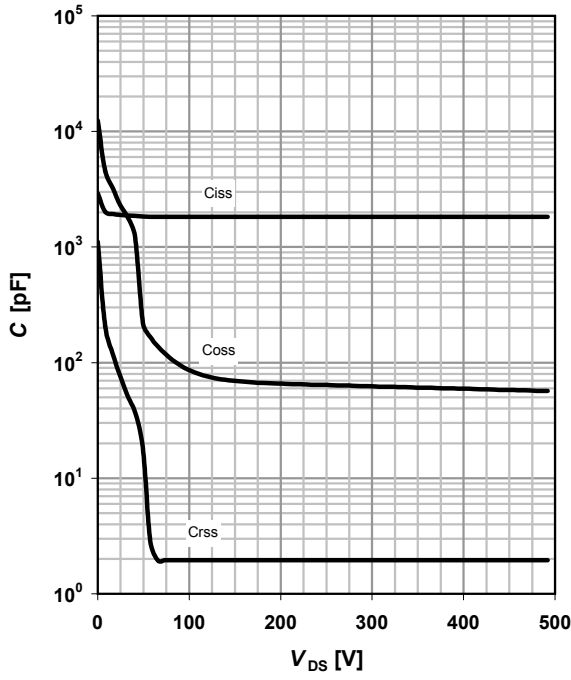
$V_{BR(DSS)}=f(T_j); I_D=0.25\text{ mA}$





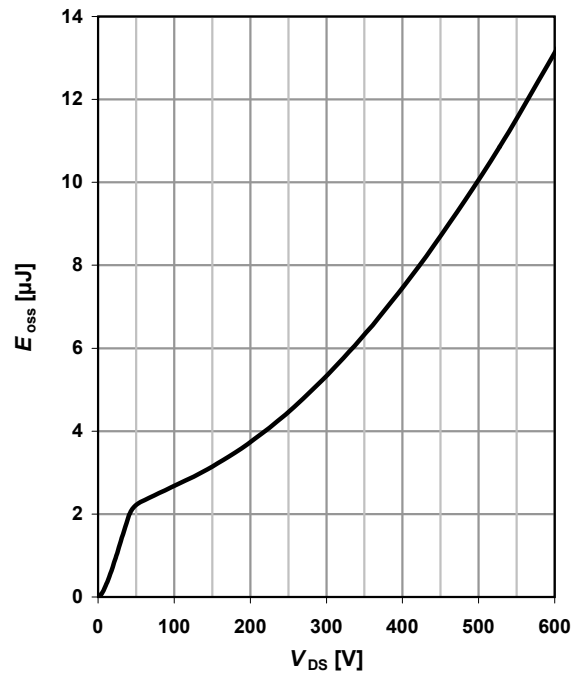
13 Typ. capacitances

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



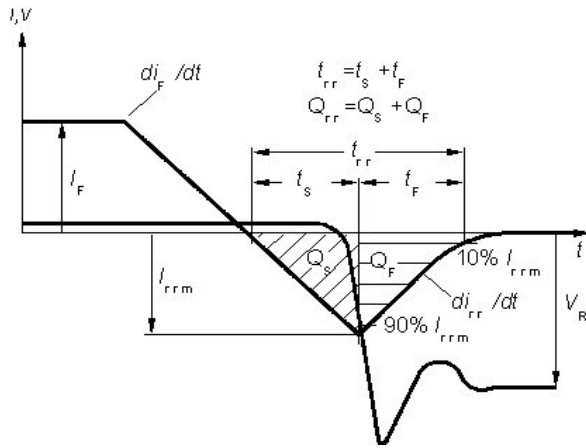
14 Typ. Coss stored energy

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



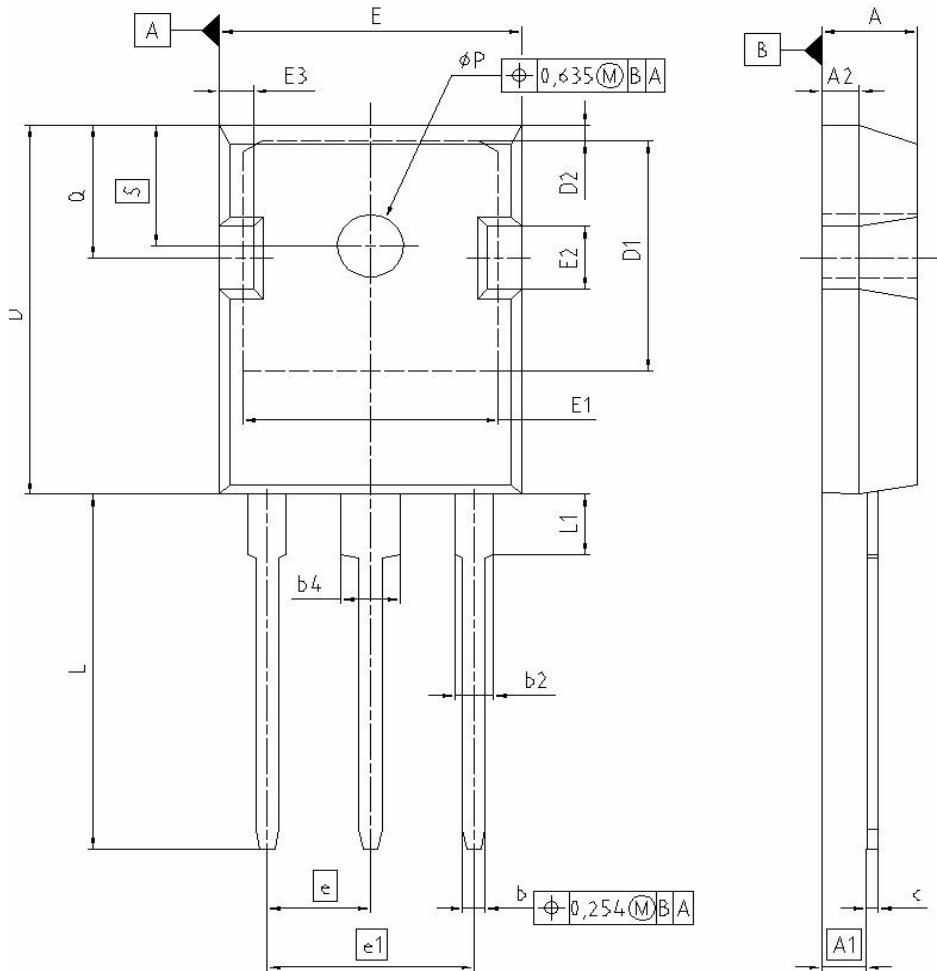


Definition of diode switching characteristics





PG-TO247-3-1: Outline



| DIM | MILLIMETERS | | INCHES | |
|-------|-------------|--------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.903 | 5.157 | 0.193 | 0.203 |
| A1 | 2.273 | 2.527 | 0.092 | 0.096 |
| A2 | 1.853 | 2.107 | 0.075 | 0.081 |
| b | 1.073 | 1.327 | 0.047 | 0.052 |
| b2 | 1.903 | 2.386 | 0.075 | 0.094 |
| b4 | 2.870 | 3.454 | 0.113 | 0.136 |
| c | 0.549 | 0.752 | 0.024 | 0.030 |
| D | 20.823 | 21.077 | 0.820 | 0.830 |
| D1 | 17.323 | 17.831 | 0.682 | 0.702 |
| D2 | 1.063 | 1.317 | 0.042 | 0.052 |
| E | 15.773 | 16.027 | 0.621 | 0.631 |
| E1 | 13.893 | 14.147 | 0.547 | 0.557 |
| E2 | 3.683 | 3.937 | 0.145 | 0.155 |
| E3 | 1.683 | 1.937 | 0.066 | 0.076 |
| e | 5.450 | | 0.215 | |
| e1 | 10.900 | | 0.430 | |
| N | 3 | | 3 | |
| L | 20.053 | 20.307 | 0.789 | 0.799 |
| L1 | 4.168 | 4.472 | 0.164 | 0.176 |
| phi P | 3.559 | 3.661 | 0.140 | 0.144 |
| Q | 5.493 | 5.747 | 0.216 | 0.226 |
| S | 6.043 | 6.297 | 0.238 | 0.248 |

REFERENCE
JEDEC TO247-AD

SCALE

EUROPEAN PROJECTION

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FILE
TO247_1

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