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IPW50R250CP

CoolMOS™ Power Transistor

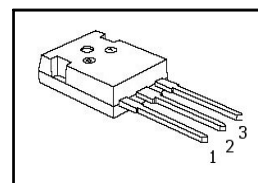
Features

- Lowest figure-of-merit $R_{ON} \times Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Pb-free lead plating; RoHS compliant
- Qualified for industrial grade applications according to JEDEC¹⁾

Product Summary

| | | |
|---------------------|-------|----------|
| $V_{DS} @ T_{jmax}$ | 550 | V |
| $R_{DS(on),max}$ | 0.250 | Ω |
| $Q_{g,typ}$ | 27 | nC |

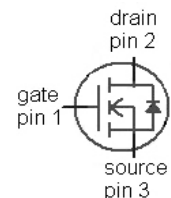
PG-TO247



CoolMOS CP is designed for:

- Hard & soft switching SMPS topologies
- CCM PFC for ATX, Notebook adapter, PDP and LCD TV
- PWM Stages for ATX, Notebook adapter, PDP and LCD TV

| Type | Package | Marking |
|-------------|----------|---------|
| IPW50R250CP | PG-TO247 | 5R250P |



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

| Parameter | Symbol | Conditions | Value | Unit |
|---------------------------------------------------------|----------------|----------------------------------------|-------------|--------------------|
| Continuous drain current | I_D | $T_C=25\text{ °C}$ | 13 | A |
| | | $T_C=100\text{ °C}$ | 9 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 31 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=5.2\text{ A}, V_{DD}=50\text{ V}$ | 345 | mJ |
| Avalanche energy, repetitive t_{AR} ^{2),3)} | E_{AR} | $I_D=5.2\text{ A}, V_{DD}=50\text{ V}$ | 0.52 | |
| Avalanche current, repetitive t_{AR} ^{2),3)} | I_{AR} | | 5.2 | A |
| MOSFET dv/dt ruggedness | dv/dt | $V_{DS}=0\text{...}400\text{ V}$ | 50 | V/ns |
| Gate source voltage | V_{GS} | static | ± 20 | V |
| | | AC ($f>1\text{ Hz}$) | ± 30 | |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 114 | W |
| Operating and storage temperature | T_j, T_{stg} | | -55 ... 150 | $^{\circ}\text{C}$ |
| Mounting torque | | M3 and M3.5 screws | 60 | Ncm |



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

| Parameter | Symbol | Conditions | Value | Unit |
|-------------------------------------|---------------|--------------------------------|-------|------|
| Continuous diode forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | 7.8 | A |
| Diode pulse current ²⁾ | $I_{S,pulse}$ | | 31 | |
| 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} | | - | - | 1.1 | K/W |
| Thermal resistance, junction - ambient | R_{thJA} | lead | - | - | 62 | |
| Soldering temperature, wavesoldering only allowed at leads | T_{solder} | 1.6 mm (0.063 in.) from case for 10 s | - | - | 260 | $^\circ\text{C}$ |

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

Static characteristics

| | | | | | | |
|----------------------------------|---------------|-------------------------------------------------------------------------|-----|------|------|---------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$ | 500 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=0.52\text{ mA}$ | 2.5 | 3 | 3.5 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$ | - | - | 1 | μA |
| | | $V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ }^\circ\text{C}$ | - | 10 | - | |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$ | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=7.8\text{ A}, T_j=25\text{ }^\circ\text{C}$ | - | 0.22 | 0.25 | Ω |
| | | $V_{GS}=10\text{ V}, I_D=7.8\text{ A}, T_j=150\text{ }^\circ\text{C}$ | - | 0.54 | - | |
| Gate resistance | R_G | $f=1\text{ MHz}, \text{open drain}$ | - | 2.2 | - | Ω |



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

Dynamic characteristics

| | | | | | | |
|------------------------------------------------------------|--------------|---------------------------------------------------------------------------------------|---|------|---|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$ | - | 1420 | - | pF |
| Output capacitance | C_{oss} | | - | 63 | - | |
| Effective output capacitance, energy related ⁵⁾ | $C_{o(er)}$ | $V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V | - | 60 | - | |
| Effective output capacitance, time related ⁶⁾ | $C_{o(tr)}$ | | - | 130 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=7.8\text{ A},$ $R_G=23.1\Omega$ | - | 35 | - | ns |
| Rise time | t_r | | - | 14 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 80 | - | |
| Fall time | t_f | | - | 11 | - | |

Gate Charge Characteristics

| | | | | | | |
|-----------------------|---------------|------------------------------------------------------------------------------|---|-----|----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=400\text{ V}, I_D=7.8\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 6 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 9 | - | |
| Gate charge total | Q_g | | - | 27 | 36 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.2 | - | V |

Reverse Diode

| | | | | | | |
|-------------------------------|----------|--------------------------------------------------------------------------|---|-----|-----|---------------|
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=7.8\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.9 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 300 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 3.1 | - | μC |
| Peak reverse recovery current | I_{rm} | | - | 23 | - | 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⁾ $I_{SD} \leq I_D, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$, identical low and high side switch

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} .

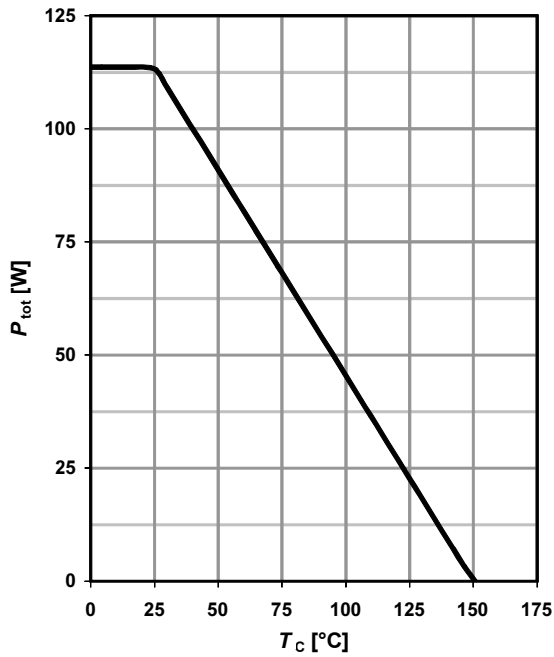
⁶⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .



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1 Power dissipation

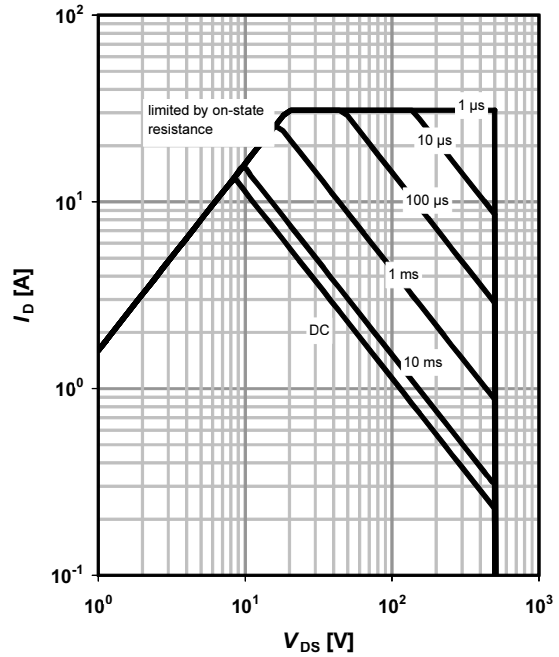
$P_{tot} = f(T_C)$



2 Safe operating area

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

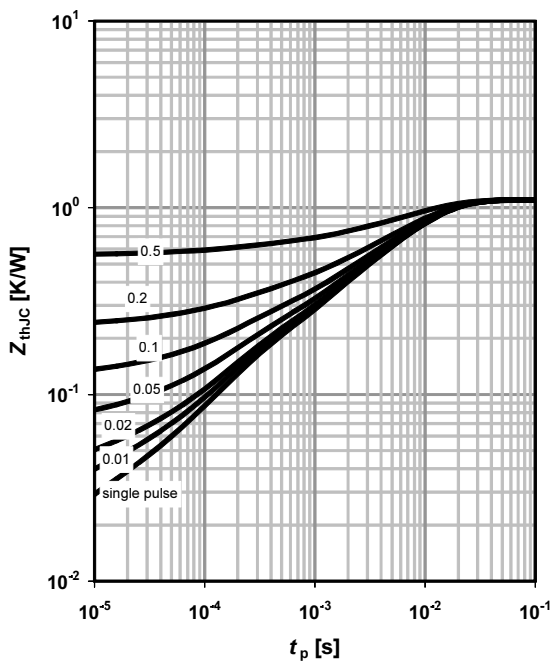
parameter: t_p



3 Max. transient thermal impedance

$Z_{(th)JC} = f(t_p)$

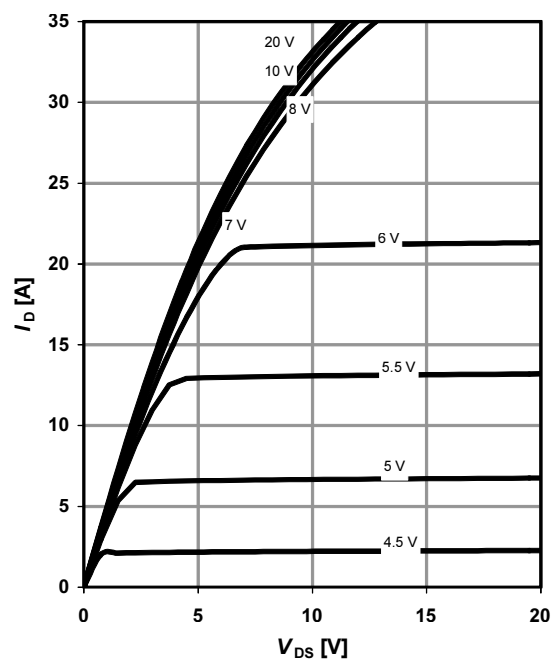
parameter: $D = t_p / T$



4 Typ. output characteristics

$I_D = f(V_{DS}); T_J = 25^\circ\text{C}$

parameter: V_{GS}



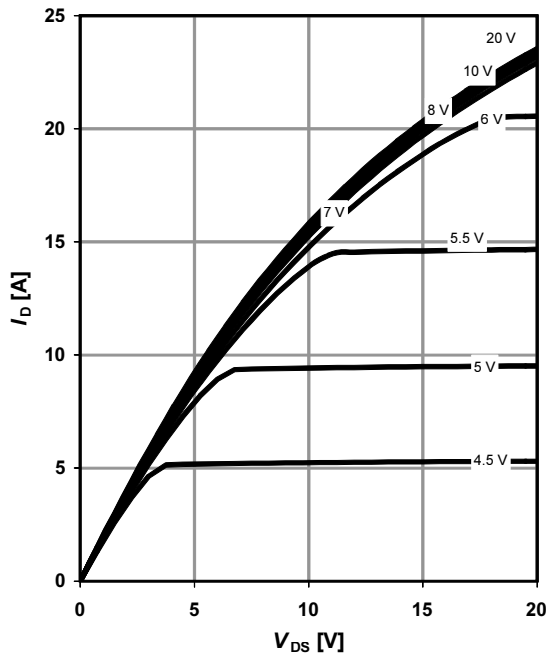


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5 Typ. output characteristics

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

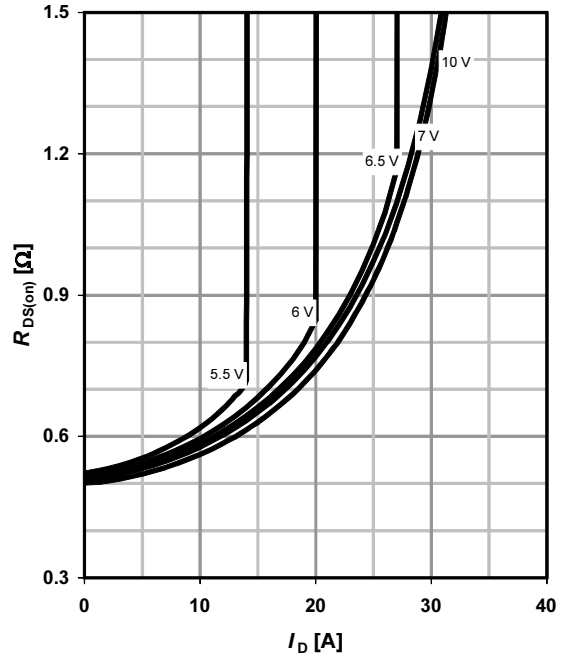
parameter: V_{GS}



6 Typ. drain-source on-state resistance

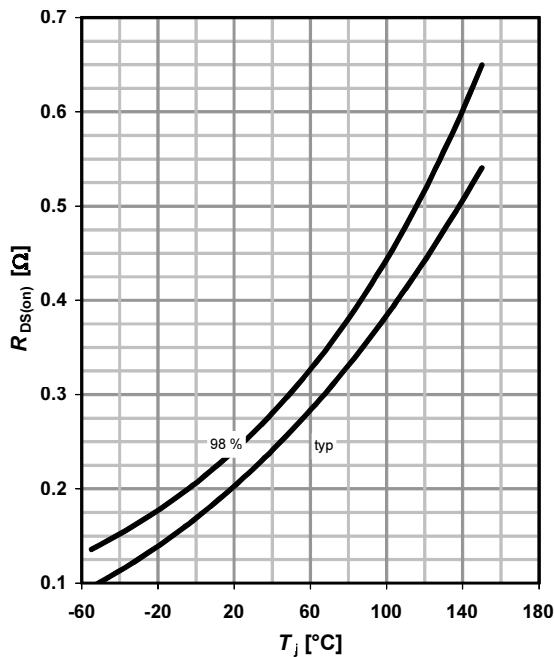
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter: V_{GS}



7 Drain-source on-state resistance

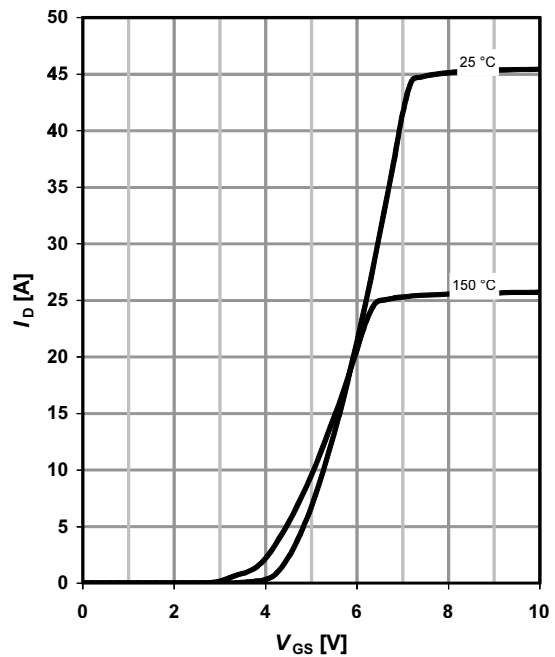
$R_{DS(on)} = f(T_j); I_D = 7.8\text{ A}; V_{GS} = 10\text{ V}$



8 Typ. transfer characteristics

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

parameter: T_j



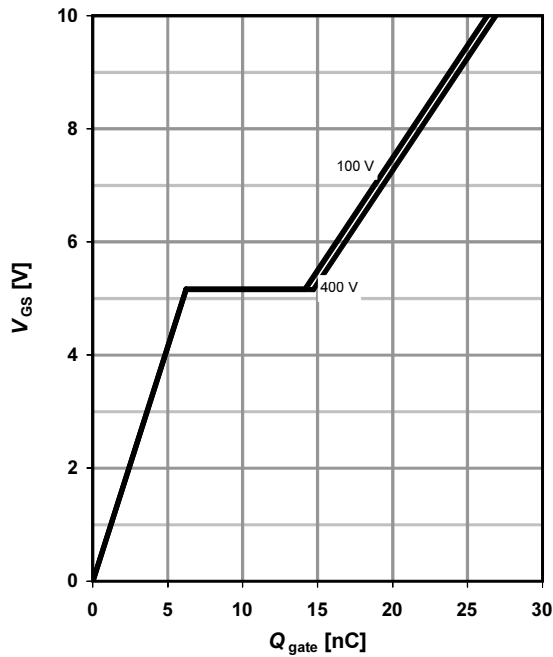


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9 Typ. gate charge

$V_{GS}=f(Q_{gate}); I_D=7.8 \text{ A pulsed}$

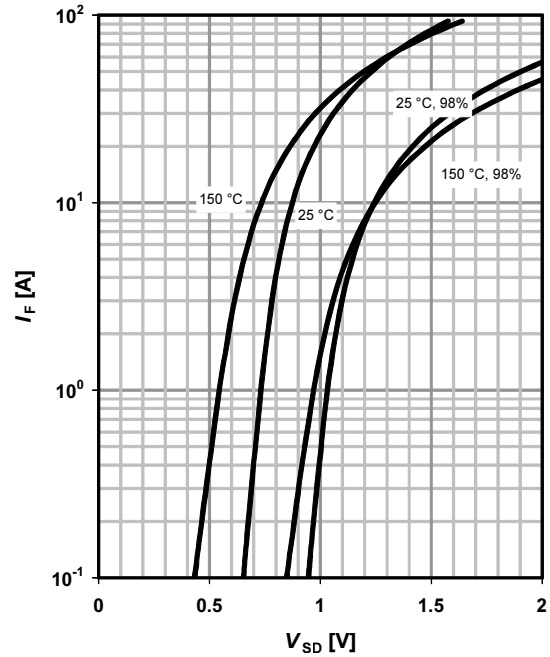
parameter: V_{DD}



10 Forward characteristics of reverse diode

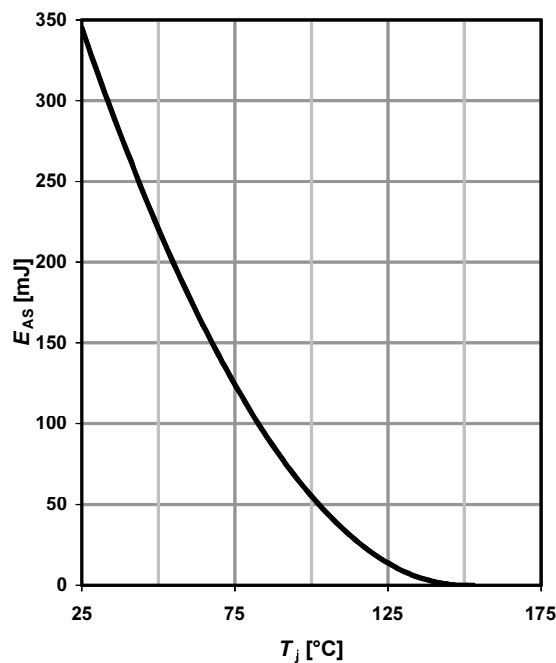
$I_F=f(V_{SD})$

parameter: T_j



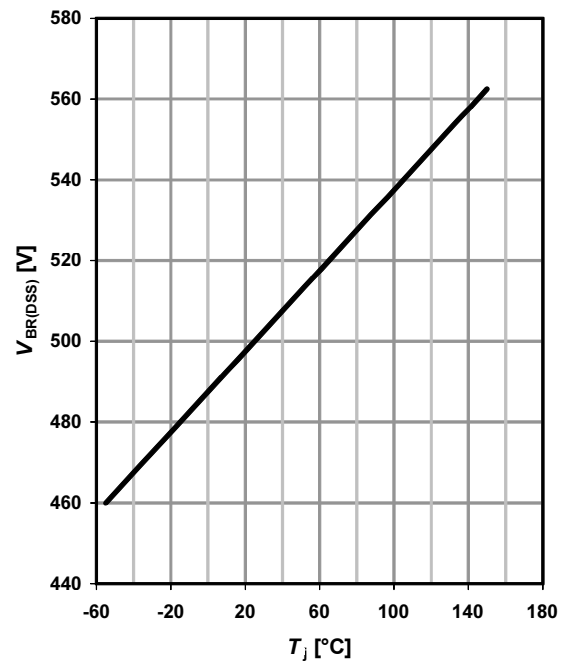
11 Avalanche energy

$E_{AS}=f(T_j); I_D=5.2 \text{ A}; V_{DD}=50 \text{ V}$



12 Drain-source breakdown voltage

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

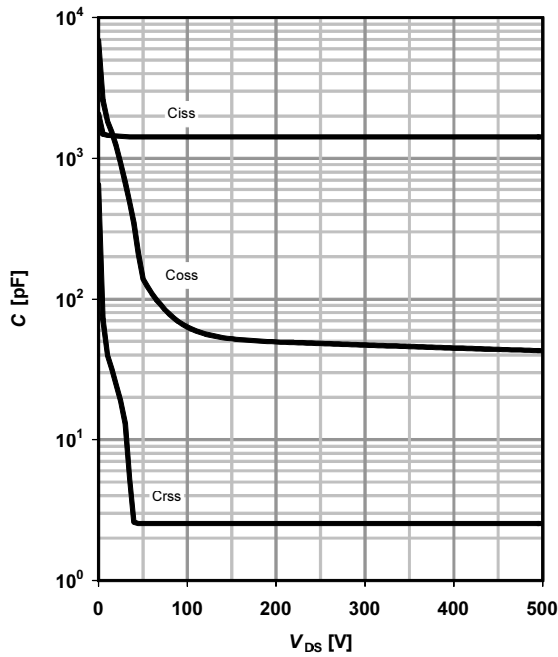




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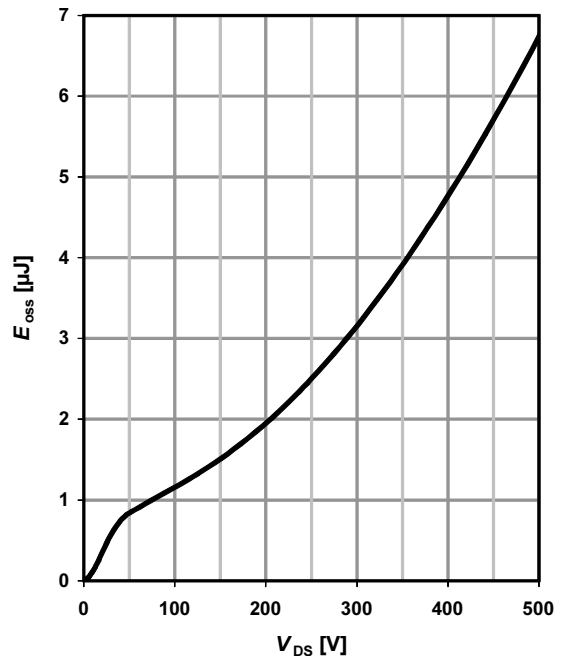
13 Typ. capacitances

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



14 Typ. Coss stored energy

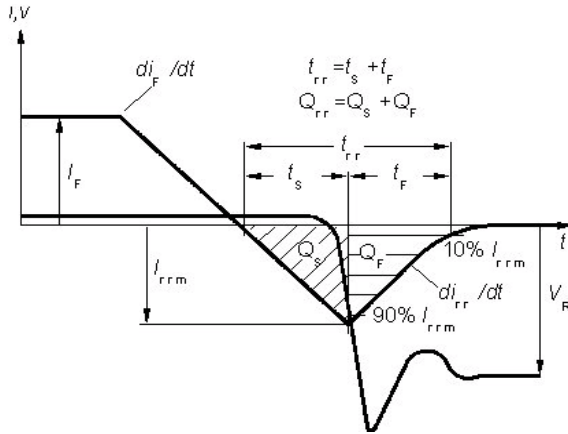
$E_{oss}=f(V_{DS})$





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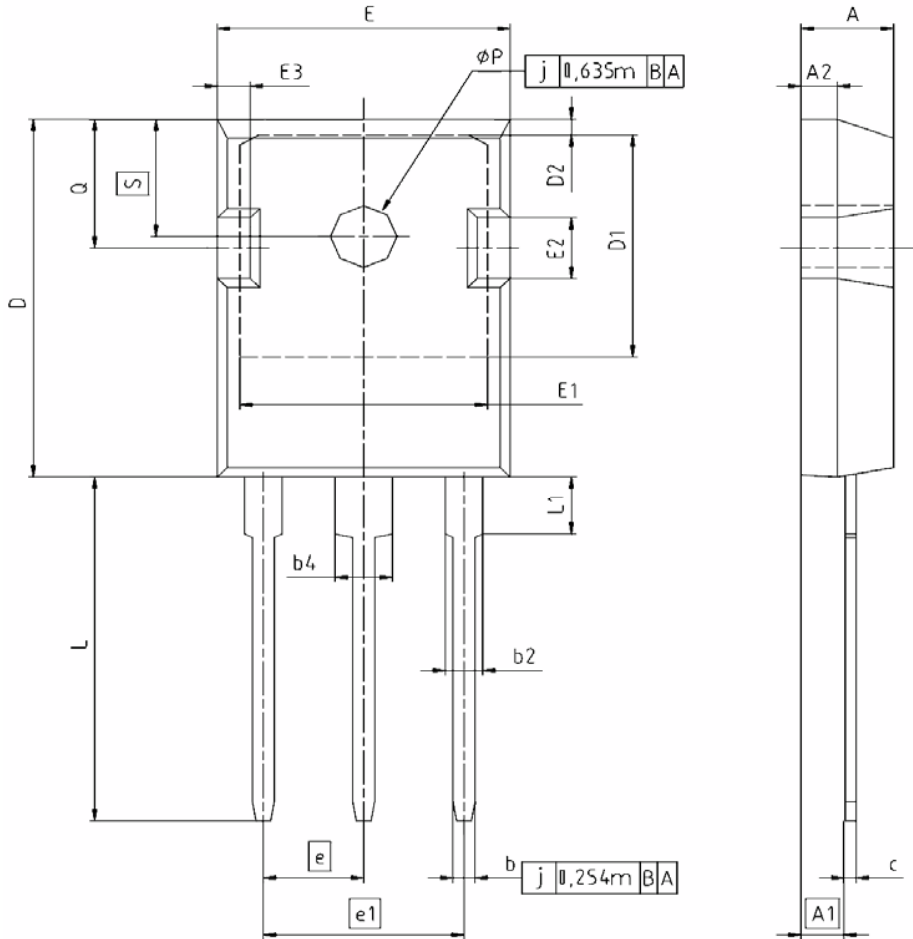
Definition of diode switching characteristics





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PG-TO247 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 |
| b2 | 1.90 | 2.39 | 0.075 | 0.094 |
| b4 | 2.87 | 3.45 | 0.113 | 0.136 |
| c | 0.55 | 0.75 | 0.022 | 0.030 |
| D | 20.82 | 21.10 | 0.820 | 0.831 |
| D1 | 16.25 | 17.83 | 0.640 | 0.702 |
| 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 | |
| e1 | 10.90 | | 0.429 | |
| N | 3 | | 3 | |
| L | 19.80 | 20.31 | 0.780 | 0.799 |
| L1 | 4.17 | 4.47 | 0.164 | 0.176 |
| øP | 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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02

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1 New package outlines TO-247

Assembly capacity extension for CoolMOSTM technology products assembled in lead-free package PG-TO247-3 at subcontractor ASE (Weihai) Inc., China (Changes are marked in blue.)

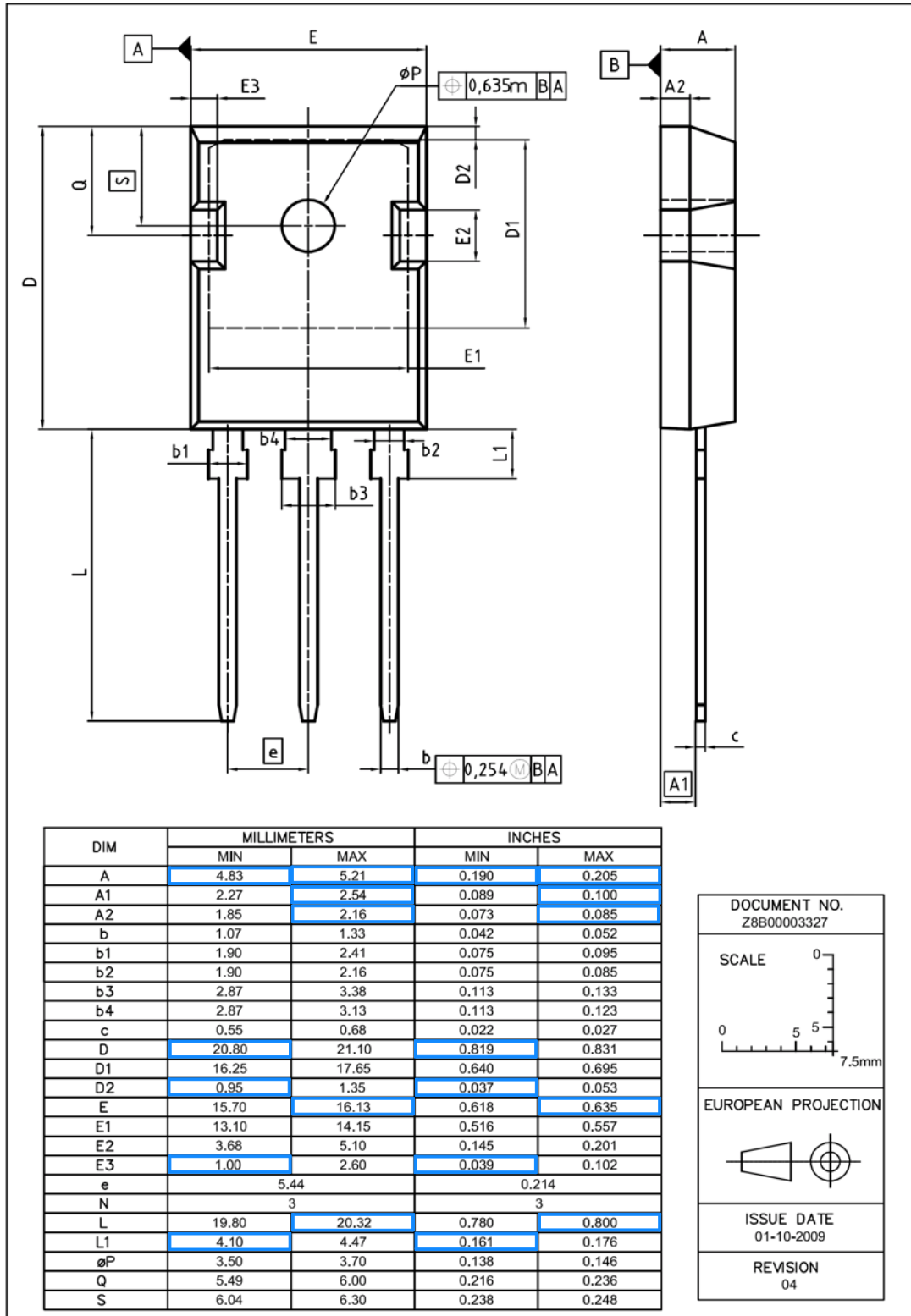


Figure 1 Outlines TO-247, dimensions in mm/inches