

CoolMOS™ Power Transistor
Features

- Lowest figure-of-merit $R_{ON} \times Q_g$
- Extreme dv/dt rated
- High peak current capability
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free lead plating; RoHS compliant
- Worldwide best $R_{DS,on}$ in TO220 Fullpak
- Ultra low gate charge

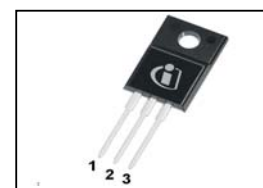
CoolMOS™ 900V is designed for:

- Quasi Resonant Flyback / Forward topologies
- PC Silverbox and consumer applications
- Industrial SMPS

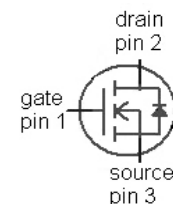
Product Summary

| | | |
|---|------|----------|
| $V_{DS} @ T_J=25^\circ\text{C}$ | 900 | V |
| $R_{DS(on),max} @ T_J = 25^\circ\text{C}$ | 0.34 | Ω |
| $Q_{g,typ}$ | 94 | nC |

PG-TO220 FP



| Type | Package | Marking |
|-------------|-------------|---------|
| IPA90R340C3 | PG-TO220 FP | 9R340C |


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

| Parameter | Symbol | Conditions | Value | Unit |
|---|----------------|--|-------------|------------------|
| Continuous drain current ²⁾ | I_D | $T_C=25^\circ\text{C}$ | 15 | A |
| | | $T_C=100^\circ\text{C}$ | 9.5 | |
| Pulsed drain current ³⁾ | $I_{D,pulse}$ | $T_C=25^\circ\text{C}$ | 34 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=3.1\text{ A}, V_{DD}=50\text{ V}$ | 678 | mJ |
| Avalanche energy, repetitive t_{AR} ^{3),4)} | E_{AR} | $I_D=3.1\text{ A}, V_{DD}=50\text{ V}$ | 1 | |
| Avalanche current, repetitive t_{AR} ^{3),4)} | I_{AR} | | 3.1 | A |
| MOSFET dv/dt ruggedness | dv/dt | $V_{DS}=0\dots400\text{ V}$ | 50 | V/ns |
| Gate source voltage | V_{GS} | static | ± 20 | V |
| | | AC (f>1 Hz) | ± 30 | |
| Power dissipation | P_{tot} | $T_C=25^\circ\text{C}$ | 35 | W |
| Operating and storage temperature | T_J, T_{stg} | | -55 ... 150 | $^\circ\text{C}$ |
| Mounting torque | | M2.5 screws | 50 | Ncm |

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

| Parameter | Symbol | Conditions | Value | Unit |
|--|---------------|--------------------|-------|------|
| Continuous diode forward current ²⁾ | I_S | $T_C=25\text{ °C}$ | 9.2 | A |
| Diode pulse current ³⁾ | $I_{S,pulse}$ | | 34 | |
| Reverse diode dv/dt ⁵⁾ | dv/dt | | 4 | V/ns |

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

Thermal characteristics

| | | | | | | |
|--|------------|---------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 3.6 | 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 | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$ | 900 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}$, $I_D=1\text{ mA}$ | 2.5 | 3 | 3.5 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ | - | - | 2 | μA |
| | | $V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$ | - | 20 | - | |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10\text{ V}$, $I_D=9.2\text{ A}$, $T_j=25\text{ °C}$ | - | 0.28 | 0.34 | Ω |
| | | $V_{GS}=10\text{ V}$, $I_D=9.2\text{ A}$, $T_j=150\text{ °C}$ | - | 0.76 | - | |
| Gate resistance | R_G | $f=1\text{ MHz}$, open drain | - | 1.3 | - | Ω |

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

Dynamic characteristics

| | | | | | | |
|--|--------------|---|---|------|---|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$ | - | 2400 | - | pF |
| Output capacitance | C_{oss} | | - | 120 | - | |
| Effective output capacitance, energy related ⁶⁾ | $C_{o(er)}$ | $V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 500 V | - | 71 | - | |
| Effective output capacitance, time related ⁷⁾ | $C_{o(tr)}$ | | - | 280 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=9.2\text{ A},$ $R_G=23.1\ \Omega$ | - | 70 | - | ns |
| Rise time | t_r | | - | 20 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 400 | - | |
| Fall time | t_f | | - | 25 | - | |

Gate Charge Characteristics

| | | | | | | |
|-----------------------|---------------|--|---|-----|-----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=400\text{ V}, I_D=9.2\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 11 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 41 | - | |
| Gate charge total | Q_g | | - | 94 | tbd | |
| Gate plateau voltage | $V_{plateau}$ | | - | 4.6 | - | V |

Reverse Diode

| | | | | | | |
|-------------------------------|-----------|--|---|-----|-----|---------------|
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=9.2\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.8 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 510 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 11 | - | μC |
| Peak reverse recovery current | I_{rrm} | | - | 41 | - | A |

¹⁾ J-STD20 and JESD22

²⁾ Limited only by maximum temperature

³⁾ Pulse width t_p limited by $T_{J,max}$
⁴⁾ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR} \cdot f$.

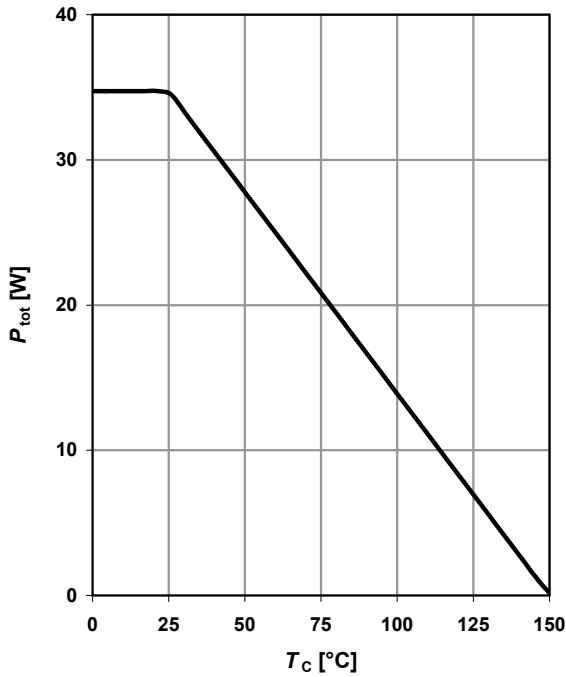
⁵⁾ $I_{SD} \leq I_D$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DClk} = 400\text{ V}$, $V_{peak} < V_{(BR)DSS}$, $T_j < T_{J,max}$, identical low side and high side switch

⁶⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 50% V_{DSS} .

⁷⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 50% V_{DSS} .

1 Power dissipation

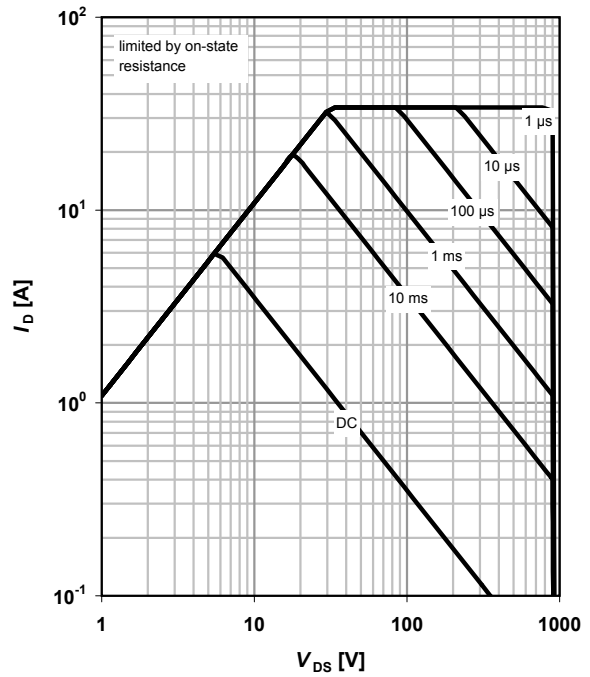
$$P_{tot} = f(T_C)$$



2 Safe operating area

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

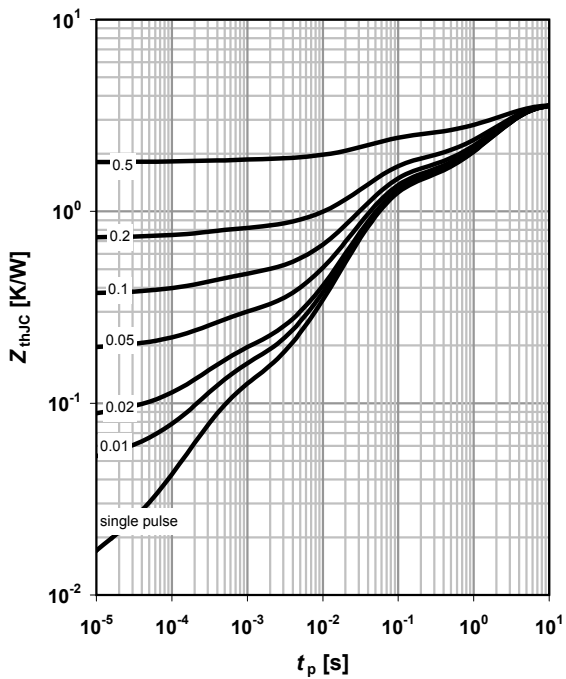
parameter: t_p



3 Max. transient thermal impedance

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

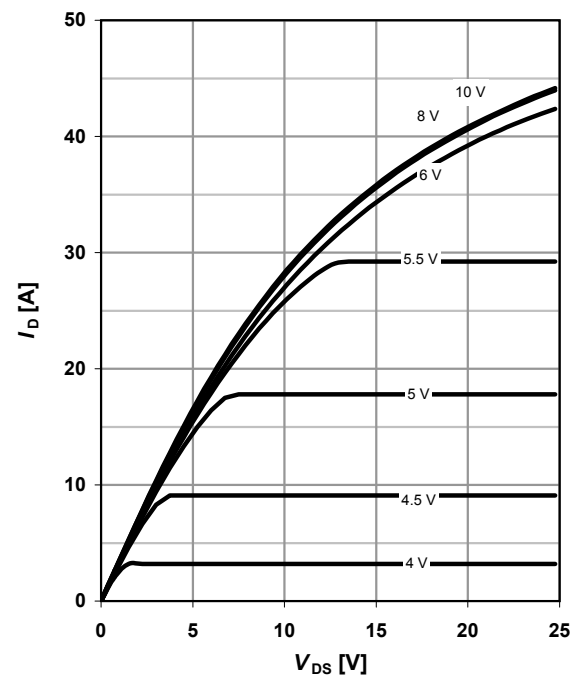
parameter: $D = t_p / T$



4 Typ. output characteristics

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

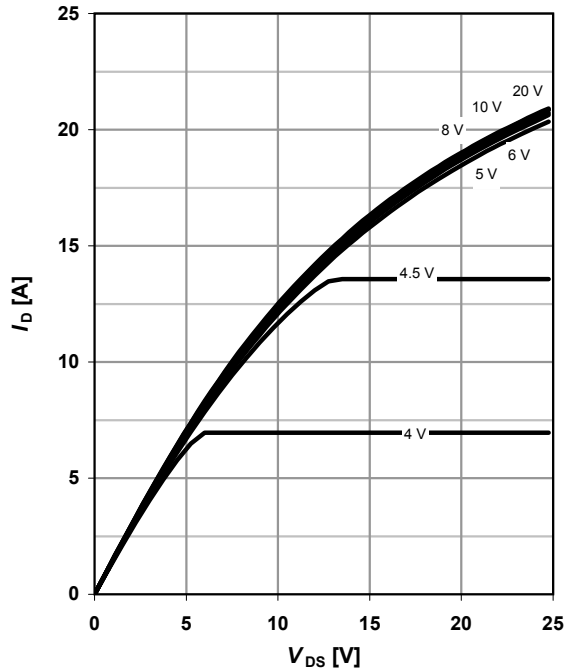
parameter: V_{GS}



5 Typ. output characteristics

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

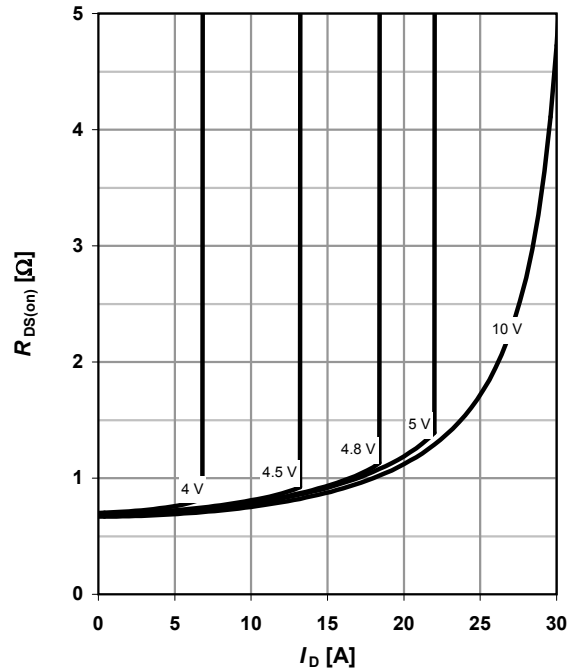
parameter: V_{GS}



6 Typ. drain-source on-state resistance

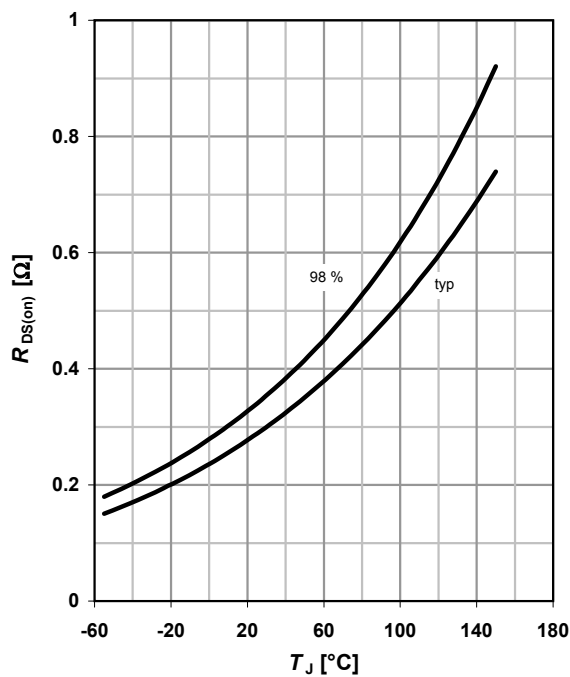
$R_{DS(on)} = f(I_D); T_J = 150\text{ }^\circ\text{C}$

parameter: V_{GS}



7 Drain-source on-state resistance

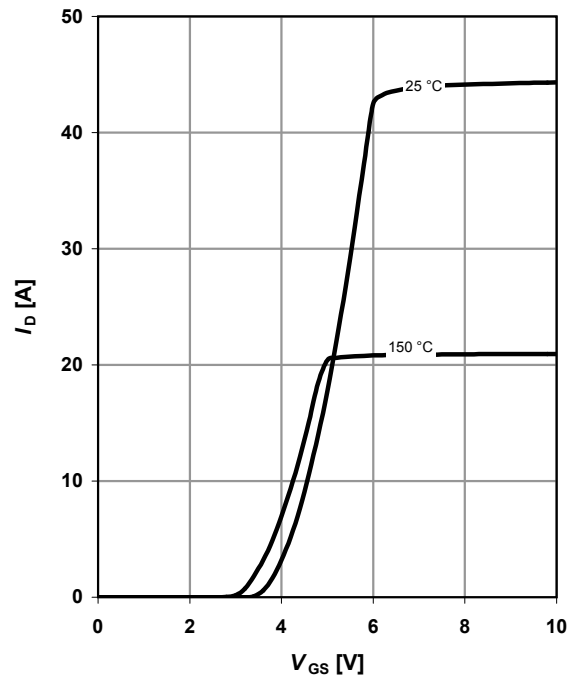
$R_{DS(on)} = f(T_J); I_D = 9.2\text{ A}; V_{GS} = 10\text{ V}$



8 Typ. transfer characteristics

$I_D = f(V_{GS}); V_{DS} = 20\text{ V}$

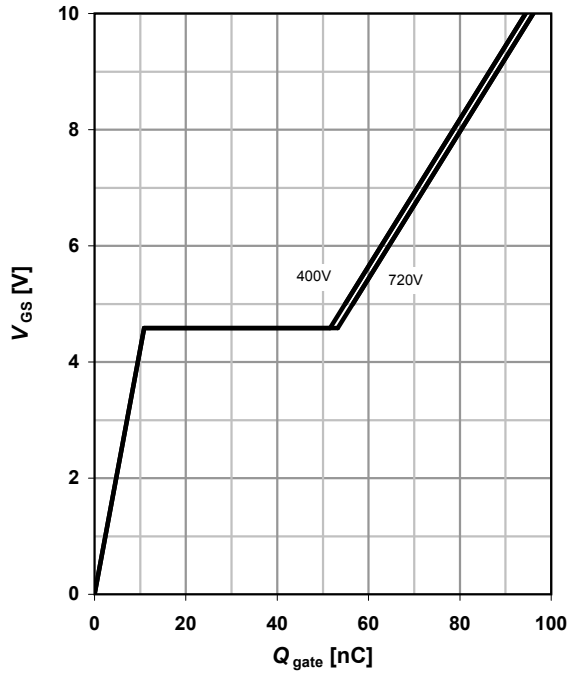
parameter: T_J



9 Typ. gate charge

$V_{GS}=f(Q_{gate}); I_D=9.2\text{ A pulsed}$

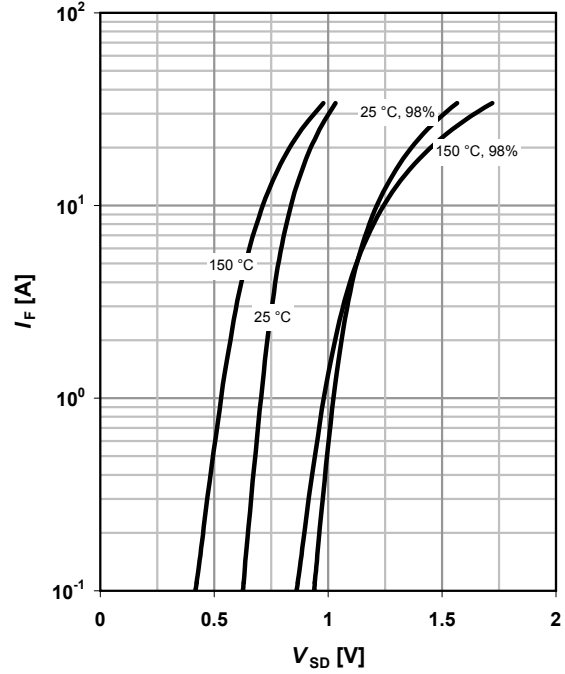
parameter: V_{DD}



10 Forward characteristics of reverse diode

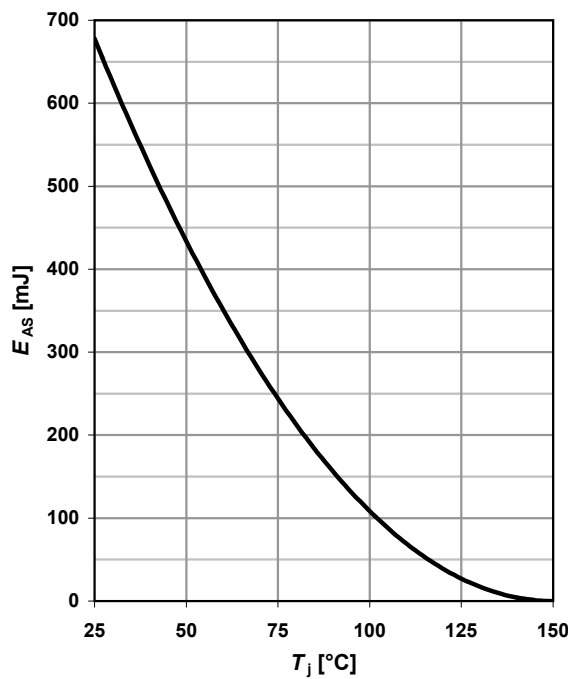
$I_F=f(V_{SD})$

parameter: T_J



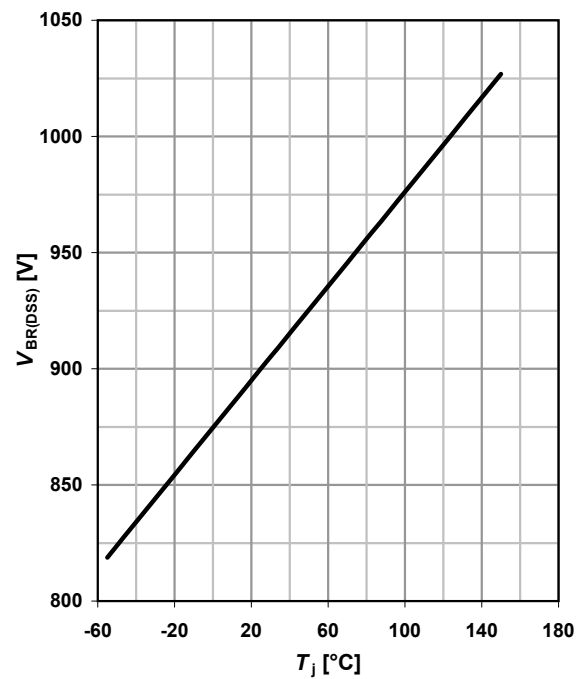
11 Avalanche energy

$E_{AS}=f(T_j); I_D=3.1\text{ A}; V_{DD}=50\text{ V}$



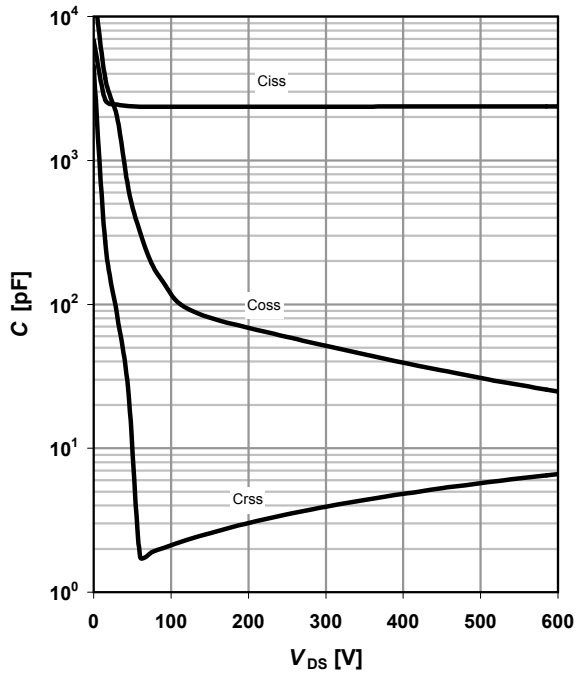
12 Drain-source breakdown voltage

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



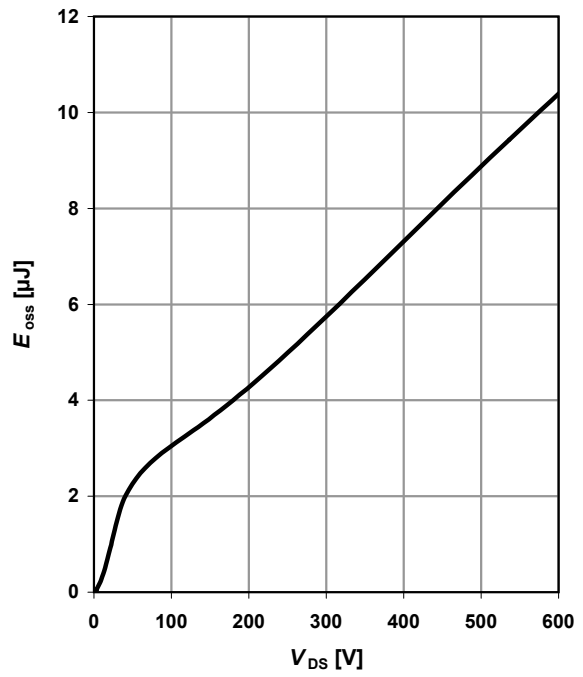
13 Typ. capacitances

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



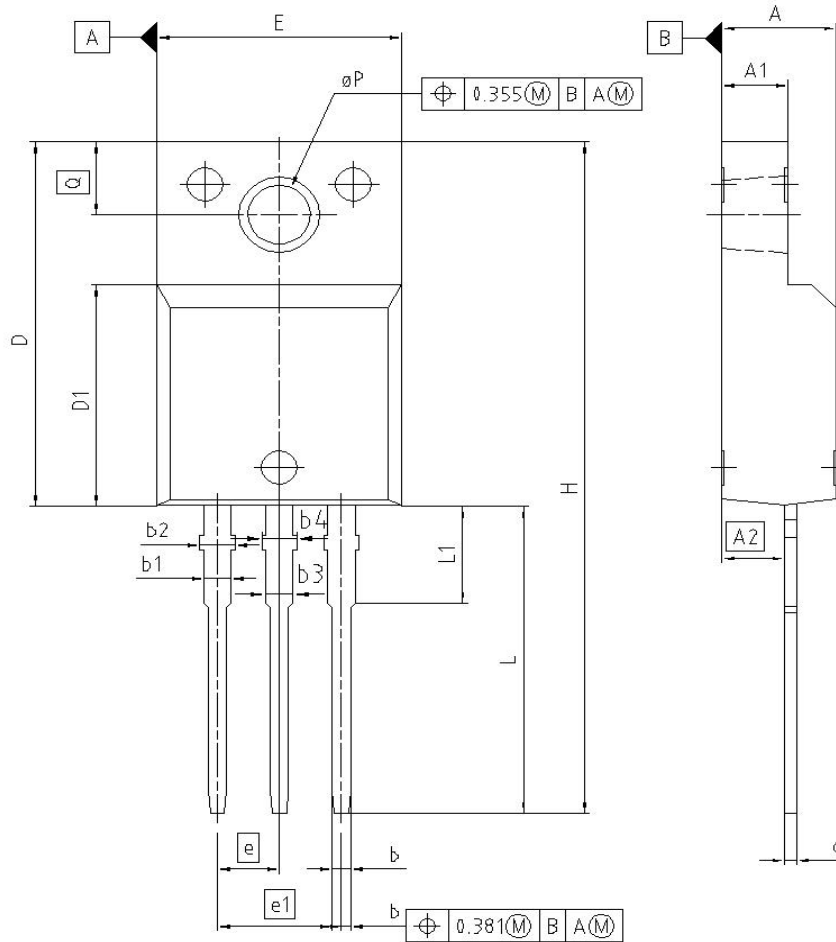
14 Typ. C_{oss} stored energy

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



Definition of diode switching characteristics



PG-TO220 FP Outline/Fully isolated package (2500VAC; 1minute)


| DIM | MILLIMETERS | | INCHES | |
|-----------------|-------------|-------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.55 | 4.85 | 0.179 | 0.191 |
| A1 | 2.55 | 2.85 | 0.100 | 0.112 |
| A2 | 2.42 | 2.72 | 0.095 | 0.107 |
| b | 0.65 | 0.85 | 0.026 | 0.033 |
| b1 | 0.95 | 1.33 | 0.037 | 0.052 |
| b2 | 0.95 | 1.51 | 0.037 | 0.059 |
| b3 | 0.65 | 1.33 | 0.026 | 0.052 |
| b4 | 0.65 | 1.51 | 0.026 | 0.059 |
| c | 0.40 | 0.63 | 0.016 | 0.025 |
| D | 15.85 | 16.15 | 0.624 | 0.636 |
| D1 | 9.53 | 9.83 | 0.375 | 0.387 |
| E | 10.35 | 10.65 | 0.407 | 0.419 |
| e | 2.54 | | 0.100 | |
| e1 | 5.08 | | 0.200 | |
| N | 3 | | 3 | |
| H | 29.45 | 29.75 | 1.159 | 1.171 |
| L | 13.45 | 13.75 | 0.530 | 0.541 |
| L1 | 3.15 | 3.45 | 0.124 | 0.136 |
| $\varnothing P$ | 2.95 | 3.20 | 0.116 | 0.126 |
| Q | 3.15 | 3.50 | 0.124 | 0.138 |

REFERENCE
...

SCALE

EUROPEAN PROJECTION

ISSUE DATE
08-01-2007

FILE
TO220_2

Dimensions in mm/inches

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