

## CoolMOS™ Power Transistor

### Features

- Lowest figure-of-merit  $R_{ON} \times Q_g$
- Extreme dv/dt rated
- High peak current capability
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Pb-free lead plating; RoHS compliant
- Ultra low gate charge

### CoolMOS™ 900V is designed for:

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

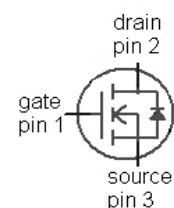
### Product Summary

|                                           |     |          |
|-------------------------------------------|-----|----------|
| $V_{DS} @ T_J=25^{\circ}\text{C}$         | 900 | V        |
| $R_{DS(on),max} @ T_J=25^{\circ}\text{C}$ | 0.5 | $\Omega$ |
| $Q_{g,typ}$                               | 68  | nC       |

PG-TO262



| Type        | Package  | Marking |
|-------------|----------|---------|
| IPI90R500C3 | PG-TO262 | 9R500C  |



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

| Parameter                                      | Symbol         | Conditions                             | Value       | Unit               |
|------------------------------------------------|----------------|----------------------------------------|-------------|--------------------|
| Continuous drain current                       | $I_D$          | $T_C=25^{\circ}\text{C}$               | 11          | A                  |
|                                                |                | $T_C=100^{\circ}\text{C}$              | 6.8         |                    |
| Pulsed drain current <sup>2)</sup>             | $I_{D,pulse}$  | $T_C=25^{\circ}\text{C}$               | 24          |                    |
| Avalanche energy, single pulse                 | $E_{AS}$       | $I_D=2.2\text{ A}, V_{DD}=50\text{ V}$ | 388         | mJ                 |
| Avalanche energy, repetitive $t_{AR}^{2),3)}$  | $E_{AR}$       | $I_D=2.2\text{ A}, V_{DD}=50\text{ V}$ | 0.74        |                    |
| Avalanche current, repetitive $t_{AR}^{2),3)}$ | $I_{AR}$       |                                        | 2.2         | A                  |
| MOSFET dv/dt ruggedness                        | dv/dt          | $V_{DS}=0...400\text{ V}$              | 50          | V/ns               |
| Gate source voltage                            | $V_{GS}$       | static                                 | $\pm 20$    | V                  |
|                                                |                | AC ( $f>1\text{ Hz}$ )                 | $\pm 30$    |                    |
| Power dissipation                              | $P_{tot}$      | $T_C=25^{\circ}\text{C}$               | 156         | W                  |
| Operating and storage temperature              | $T_J, T_{stg}$ |                                        | -55 ... 150 | $^{\circ}\text{C}$ |

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

| Parameter                           | Symbol        | Conditions                       | Value | Unit |
|-------------------------------------|---------------|----------------------------------|-------|------|
| Continuous diode forward current    | $I_S$         | $T_C=25\text{ }^{\circ}\text{C}$ | 6.6   | A    |
| Diode pulse current <sup>2)</sup>   | $I_{S,pulse}$ |                                  | 23    |      |
| Reverse diode $dv/dt$ <sup>4)</sup> | $dv/dt$       |                                  | 4     | V/ns |

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

#### Thermal characteristics

|                                                            |              |                                       |   |   |     |                    |
|------------------------------------------------------------|--------------|---------------------------------------|---|---|-----|--------------------|
| Thermal resistance, junction - case                        | $R_{thJC}$   |                                       | - | - | 0.8 | K/W                |
| Thermal resistance, junction - ambient                     | $R_{thJA}$   | leaded                                | - | - | 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   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$                           | 900 | -    | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=0.74\text{ mA}$                                       | 2.5 | 3    | 3.5 |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=900\text{ V}, V_{GS}=0\text{ V}, T_J=25\text{ }^{\circ}\text{C}$  | -   | -    | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=900\text{ V}, V_{GS}=0\text{ V}, T_J=150\text{ }^{\circ}\text{C}$ | -   | 10   | -   |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$                                   | -   | -    | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=6.6\text{ A}, T_J=25\text{ }^{\circ}\text{C}$    | -   | 0.39 | 0.5 | $\Omega$      |
|                                  |               | $V_{GS}=10\text{ V}, I_D=6.6\text{ A}, T_J=150\text{ }^{\circ}\text{C}$   | -   | 1.1  | -   |               |
| 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                                          | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$<br>$f=1\text{ MHz}$                           | - | 1700 | - | pF |
| Output capacitance                                         | $C_{oss}$    |                                                                                         | - | 83   | - |    |
| Effective output capacitance, energy related <sup>5)</sup> | $C_{o(er)}$  | $V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$<br>to 500 V                                      | - | 52   | - |    |
| Effective output capacitance, time related <sup>6)</sup>   | $C_{o(tr)}$  |                                                                                         | - | 200  | - |    |
| Turn-on delay time                                         | $t_{d(on)}$  | $V_{DD}=400\text{ V},$<br>$V_{GS}=10\text{ V}, I_D=6.6\text{ A},$<br>$R_G=30.9\ \Omega$ | - | 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 | $Q_{gs}$      | $V_{DD}=400\text{ V}, I_D=6.6\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 8   | -   | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                              | - | 29  | -   |    |
| Gate charge total     | $Q_g$         |                                                                              | - | 68  | tbd |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                              | - | 4.6 | -   | V  |

**Reverse Diode**

|                               |           |                                                                          |   |     |     |               |
|-------------------------------|-----------|--------------------------------------------------------------------------|---|-----|-----|---------------|
| Diode forward voltage         | $V_{SD}$  | $V_{GS}=0\text{ V}, I_F=6.6\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$ | - | 0.8 | 1.2 | V             |
| Reverse recovery time         | $t_{rr}$  | $V_R=400\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$       | - | 480 | -   | ns            |
| Reverse recovery charge       | $Q_{rr}$  |                                                                          | - | 8.5 | -   | $\mu\text{C}$ |
| Peak reverse recovery current | $I_{rrm}$ |                                                                          | - | 31  | -   | A             |

<sup>1)</sup> J-STD20 and JESD22

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .

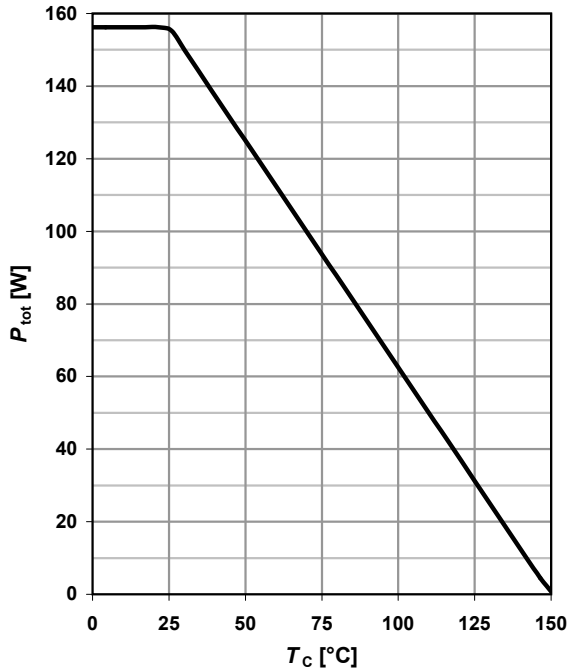
<sup>4)</sup>  $I_{SD} \leq I_D$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DClk} = 400\text{ V}$ ,  $V_{peak} < V_{(BR)DSS}$ ,  $T_J < T_{j,max}$ , identical low side and high side switch

<sup>5)</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 50%  $V_{DSS}$ .

<sup>6)</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 50%  $V_{DSS}$ .

## 1 Power dissipation

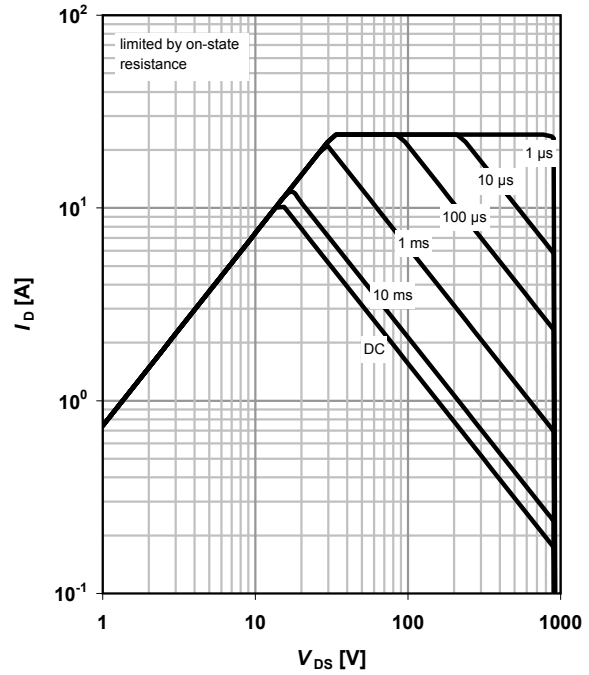
$$P_{\text{tot}} = f(T_C)$$



## 2 Safe operating area

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

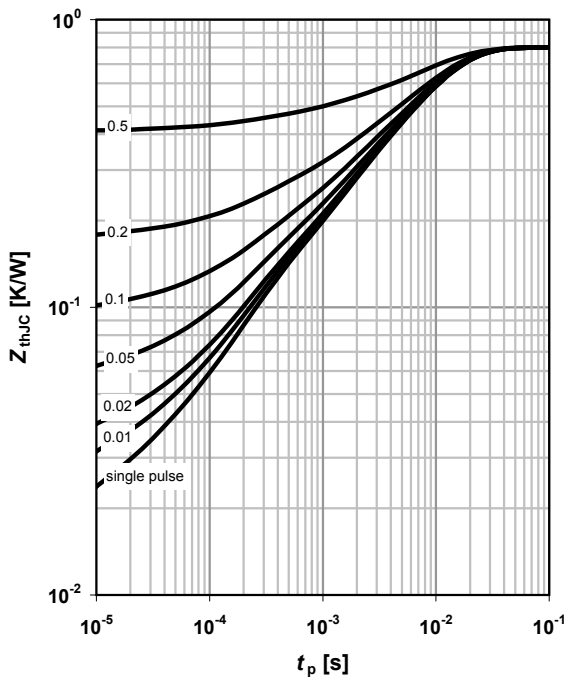
parameter:  $t_p$



## 3 Max. transient thermal impedance

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

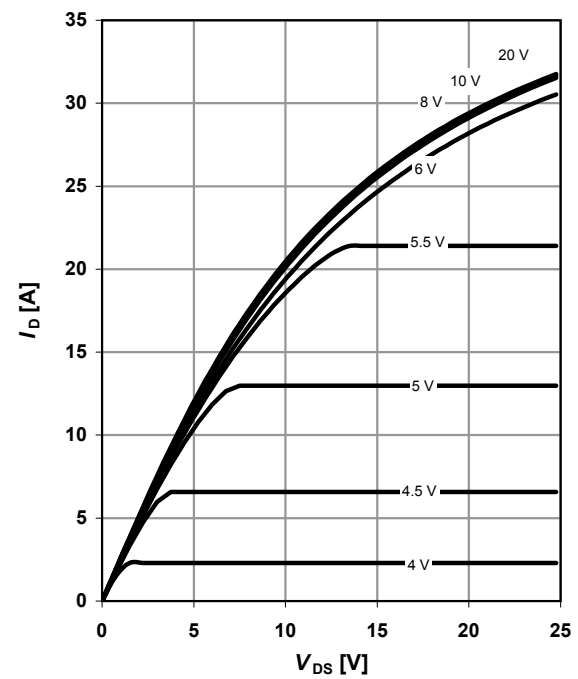
parameter:  $D = t_p / T$



## 4 Typ. output characteristics

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

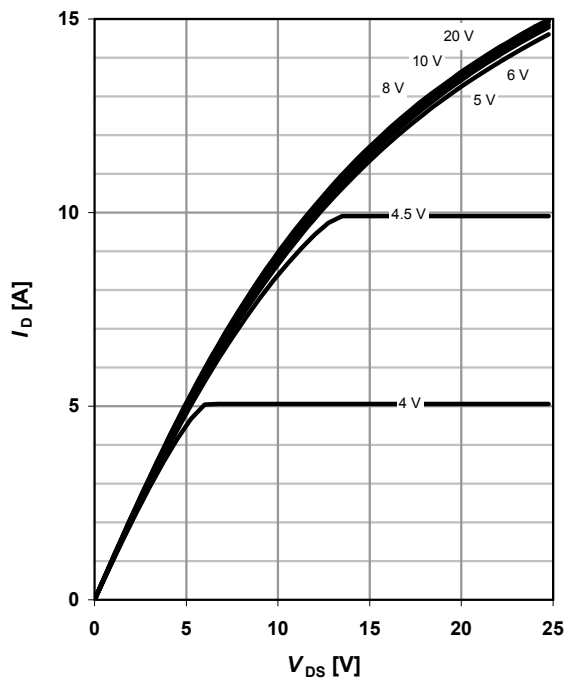
parameter:  $V_{GS}$



### 5 Typ. output characteristics

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

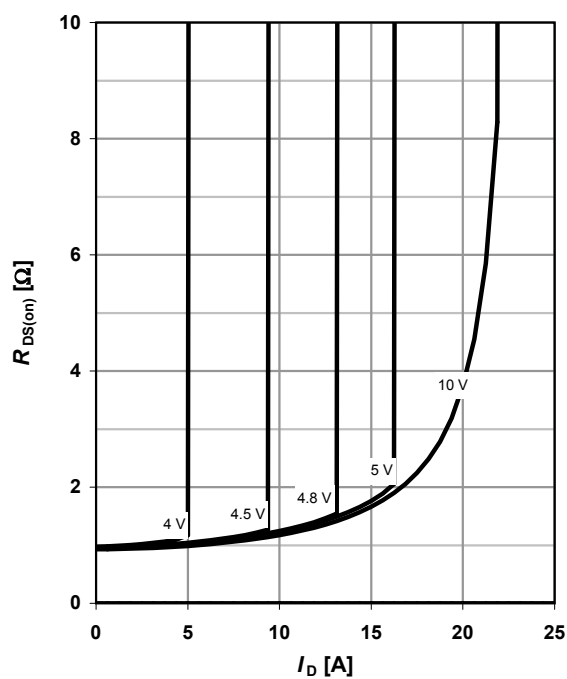
parameter:  $V_{GS}$



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

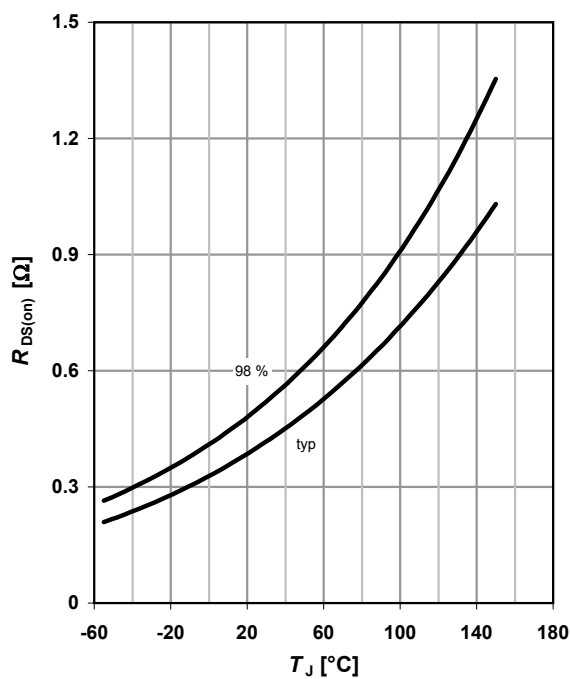
$$R_{DS(on)} = f(I_D); T_J = 150^\circ\text{C}$$

parameter:  $V_{GS}$



### 7 Drain-source on-state resistance

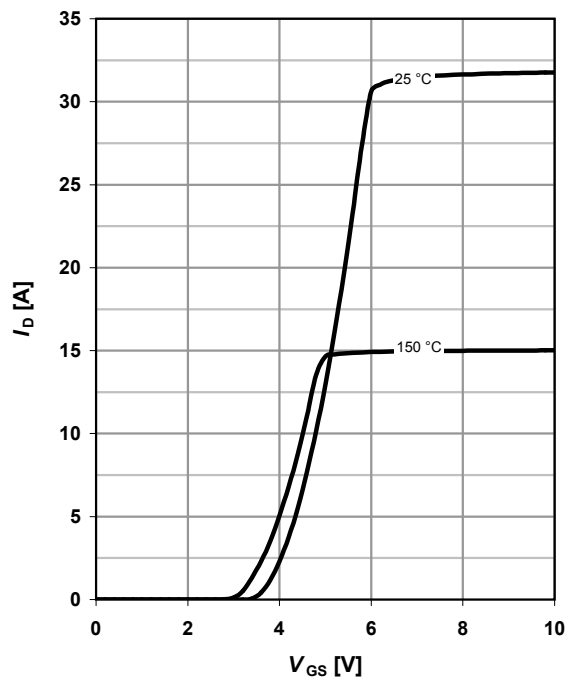
$$R_{DS(on)} = f(T_J); I_D = 6.6\text{ A}; V_{GS} = 10\text{ V}$$



### 8 Typ. transfer characteristics

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

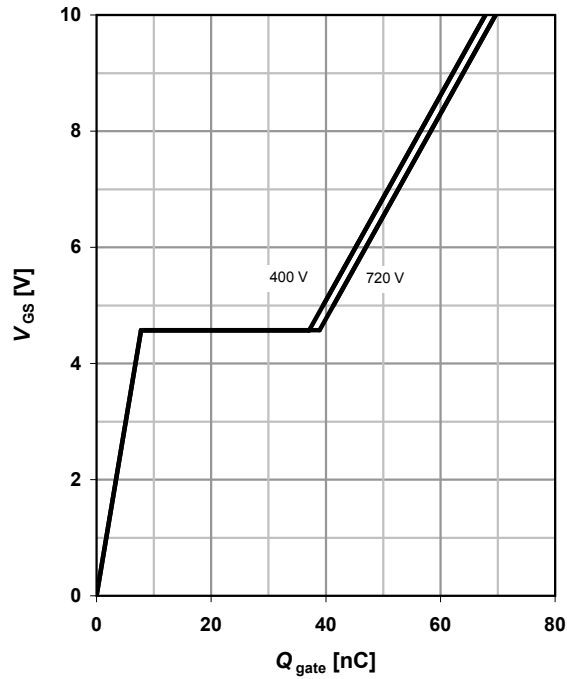
parameter:  $T_J$



### 9 Typ. gate charge

$V_{GS}=f(Q_{gate}); I_D=6.6 \text{ A pulsed}$

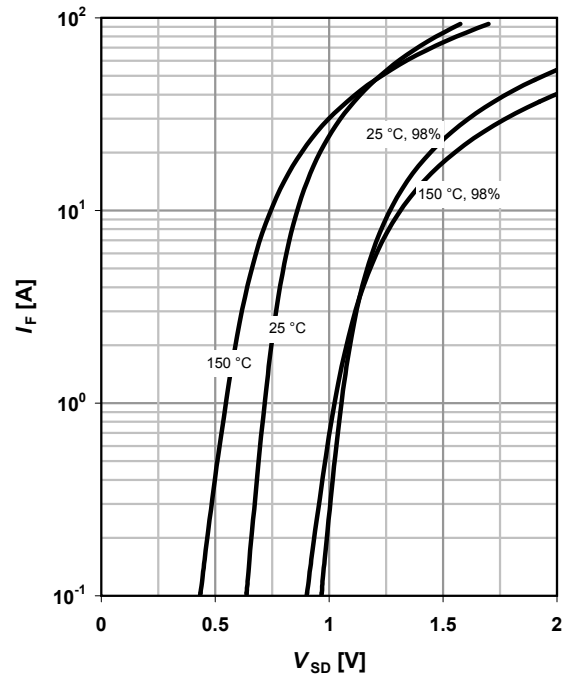
parameter:  $V_{DD}$



### 10 Forward characteristics of reverse diode

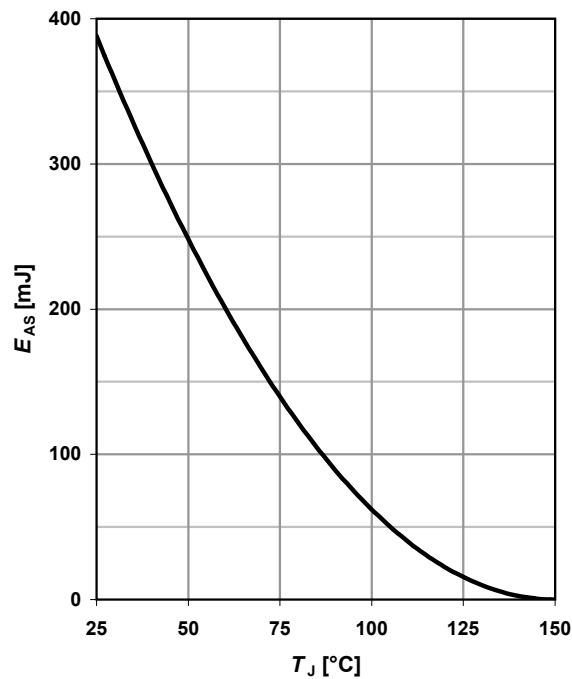
$I_F=f(V_{SD})$

parameter:  $T_J$



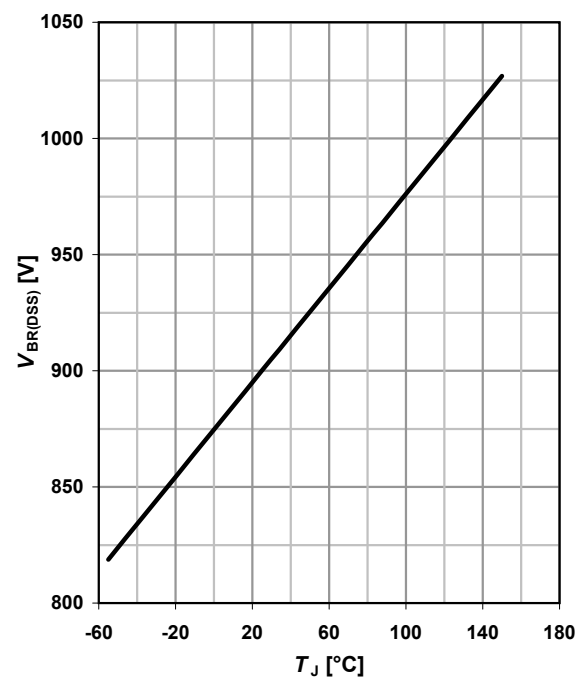
### 11 Avalanche energy

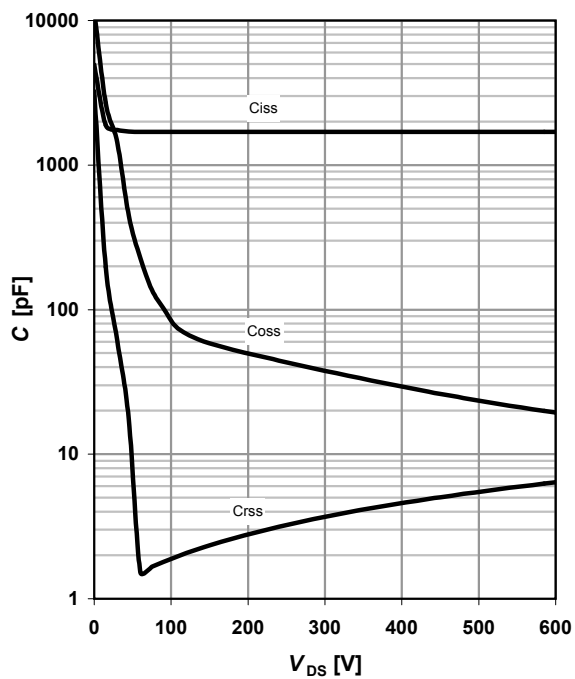
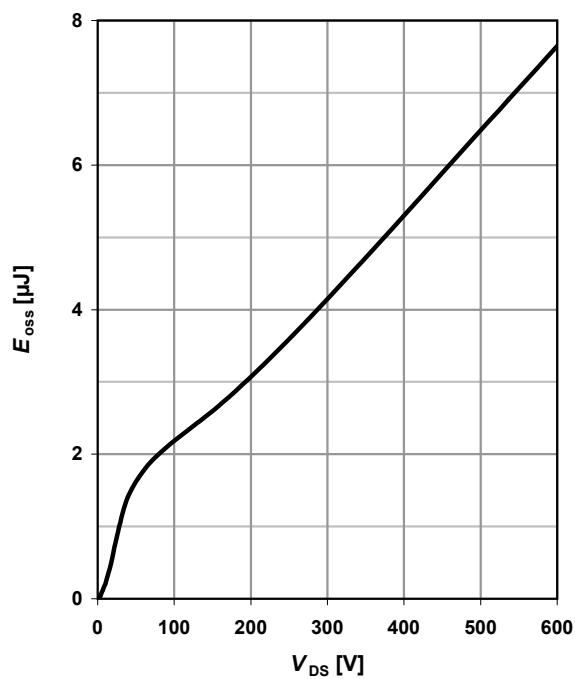
$E_{AS}=f(T_J); I_D=2.2 \text{ A}; V_{DD}=50 \text{ V}$



### 12 Drain-source breakdown voltage

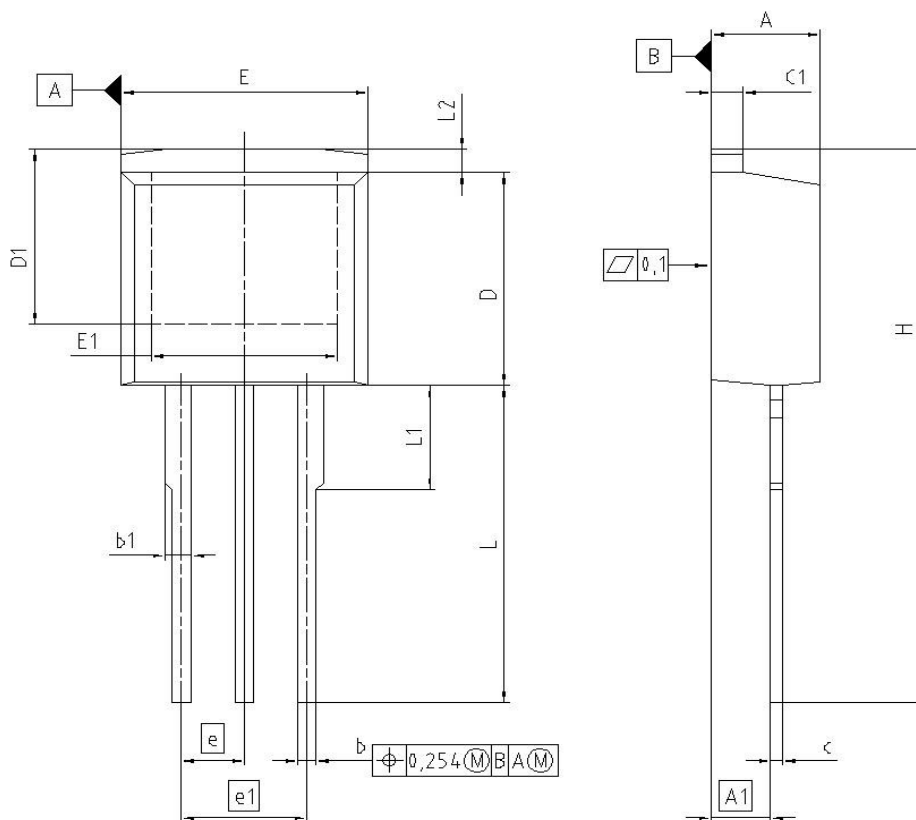
$V_{BR(DSS)}=f(T_J); I_D=0.25 \text{ mA}$



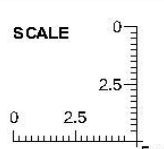
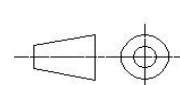
**13 Typ. capacitances**
 $C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$ 

**14 Typ.  $C_{oss}$  stored energy**
 $E_{oss} = f(V_{DS})$ 


# Definition of diode switching characteristics





| DIM       | MILLIMETERS |        | INCHES |       |
|-----------|-------------|--------|--------|-------|
|           | MIN         | MAX    | MIN    | MAX   |
| <b>A</b>  | 4.300       | 4.500  | 0.169  | 0.177 |
| <b>A1</b> | 2.150       | 2.650  | 0.085  | 0.104 |
| <b>b</b>  | 0.650       | 0.850  | 0.026  | 0.033 |
| <b>b1</b> | 0.635       | 1.400  | 0.025  | 0.055 |
| <b>c</b>  | 0.400       | 0.600  | 0.016  | 0.024 |
| <b>c1</b> | 1.170       | 1.370  | 0.046  | 0.054 |
| <b>D</b>  | 9.050       | 9.450  | 0.356  | 0.372 |
| <b>D1</b> | 6.900       | 7.650  | 0.272  | 0.301 |
| <b>E</b>  | 9.800       | 10.200 | 0.386  | 0.402 |
| <b>E1</b> | 7.250       | 8.600  | 0.285  | 0.339 |
| <b>e</b>  | 2.540       |        | 0.100  |       |
| <b>e1</b> | 5.080       |        | 0.200  |       |
| <b>N</b>  | 3           |        | 3      |       |
| <b>L</b>  | 13.000      | 14.000 | 0.512  | 0.551 |
| <b>L1</b> | 4.350       | 4.750  | 0.171  | 0.187 |
| <b>L2</b> | 0.700       | 1.300  | 0.028  | 0.051 |

|                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------|
| <b>REFERENCE</b><br>JEDEC TO262                                                                                     |
| <b>SCALE</b>                   |
| <b>EUROPEAN PROJECTION</b><br> |
| <b>ISSUE DATE</b><br>01-06-2005                                                                                     |
| <b>FILE</b><br>TO262_1                                                                                              |

Dimensions in mm/inches

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