

**OptiMOS<sup>(TM)</sup>3 Power-Transistor**
**Features**

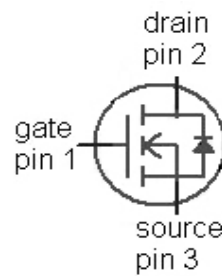
- Ideal for high frequency switching and sync. rec.
- Optimized technology for DC/DC converters
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- N-channel, normal level
- 100% avalanche tested
- Pb-free plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target applications

**Product Summary**

|                  |     |            |
|------------------|-----|------------|
| $V_{DS}$         | 60  | V          |
| $R_{DS(on),max}$ | 5.3 | m $\Omega$ |
| $I_D$            | 90  | A          |



|                |               |
|----------------|---------------|
| <b>Type</b>    | IPD053N06N3 G |
|                |               |
| <b>Package</b> | PG-TO252-3    |
| <b>Marking</b> | 053N06N       |


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

| Parameter                                    | Symbol        | Conditions  | Value    | Unit |
|--|---------------|---|----------|------|
| Continuous drain current                     | $I_D$         | $V_{GS}=10\text{ V}, T_C=25\text{ }^\circ\text{C}^{2)}$ | 90       | A    |
|  |               | $V_{GS}=10\text{ V}, T_C=100\text{ }^\circ\text{C}$     | 78       |      |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$ | $T_C=25\text{ }^\circ\text{C}$                          | 360      | mJ   |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$      | $I_D=90\text{ A}, R_{GS}=25\text{ }\Omega$              | 68       |      |
| Gate source voltage                          | $V_{GS}$      |   | $\pm 20$ | V    |

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

<sup>2)</sup> Current is limited by bondwire; with an  $R_{thJC}=1.3\text{ K/W}$  the chip is able to carry 109 A.

<sup>3)</sup> See figure 3 for more detailed information

<sup>4)</sup> See figure 13 for more detailed information

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

| Parameter                           | Symbol                | Conditions         | Value       | Unit |
|-------------------------------------|-----------------------|--------------------|-------------|------|
| Power dissipation                   | $P_{\text{tot}}$      | $T_c=25\text{ °C}$ | 115         | W    |
| Operating and storage temperature   | $T_j, T_{\text{stg}}$ |                    | -55 ... 175 | °C   |
| IEC climatic category; DIN IEC 68-1 |                       |                    | 55/175/56   |      |

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

**Thermal characteristics**

|                                     |                   |  |   |   |     |     |
|-------------------------------------|-------------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | $R_{\text{thJC}}$ |  | - | - | 1.3 | K/W |
| SMD version, device on PCB          | $R_{\text{thJA}}$ | minimal footprint                            | - | - | 75  |     |
|                                     |                   | 6 cm <sup>2</sup> cooling area <sup>5)</sup> | - | - | 50  |     |

**Electrical characteristics, at  $T_j=25\text{ °C}$ , unless otherwise specified**
**Static characteristics**

|                                  |                             |   |    |     |     |               |
|----------------------------------|-----------------------------|---|----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(\text{BR})\text{DSS}}$ | $V_{\text{GS}}=0\text{ V}, I_{\text{D}}=1\text{ mA}$                            | 60 | -   | -   | V             |
| Gate threshold voltage           | $V_{\text{GS(th)}}$         | $V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=58\text{ }\mu\text{A}$               | 2  | 3   | 4   |               |
| Zero gate voltage drain current  | $I_{\text{DSS}}$            | $V_{\text{DS}}=60\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ °C}$         | -  | 0.1 | 1   | $\mu\text{A}$ |
|                                  |                             | $V_{\text{DS}}=60\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ °C}$        | -  | 10  | 100 |               |
| Gate-source leakage current      | $I_{\text{GSS}}$            | $V_{\text{GS}}=20\text{ V}, V_{\text{DS}}=0\text{ V}$                           | -  | 10  | 100 | nA            |
| Drain-source on-state resistance | $R_{\text{DS(on)}}$         | $V_{\text{GS}}=10\text{ V}, I_{\text{D}}=90\text{ A}$                           | -  | 4.2 | 5.3 | m $\Omega$    |
| Gate resistance                  | $R_{\text{G}}$              |   | -  | 1.2 | -   | $\Omega$      |
| Transconductance                 | $g_{\text{fs}}$             | $ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=90\text{ A}$ | 50 | 100 | -   | S             |

<sup>5)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical in still air.

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

**Dynamic characteristics**

|                              |              |   |   |      |      |    |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=30\text{ V},$<br>$f=1\text{ MHz}$                    | - | 5000 | 6600 | pF |
| Output capacitance           | $C_{oss}$    |   | - | 1100 | 1500 |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 38   | 57   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=90\text{ A}, R_G=1.6\ \Omega$ | - | 24   | -    | ns |
| Rise time                    | $t_r$        |   | - | 68   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 32   | -    |    |
| Fall time                    | $t_f$        |   | - | 9    | -    |    |

**Gate Charge Characteristics<sup>6)</sup>**

|                          |               |  |   |     |    |    |
|--------------------------|---------------|--|---|-----|----|----|
| Gate to source charge    | $Q_{gs}$      | $V_{DD}=30\text{ V}, I_D=90\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 28  | -  | nC |
| Gate charge at threshold | $Q_{g(th)}$   |  | - | 15  | -  |    |
| Gate to drain charge     | $Q_{gd}$      |  | - | 6   | -  |    |
| Switching charge         | $Q_{sw}$      |  | - | 19  | -  |    |
| Gate charge total        | $Q_g$         |  | - | 61  | 82 |    |
| Gate plateau voltage     | $V_{plateau}$ |  | - | 5.7 | -  |    |
| Output charge            | $Q_{oss}$     | $V_{DD}=30\text{ V}, V_{GS}=0\text{ V}$                                    | - | 50  | 66 |    |

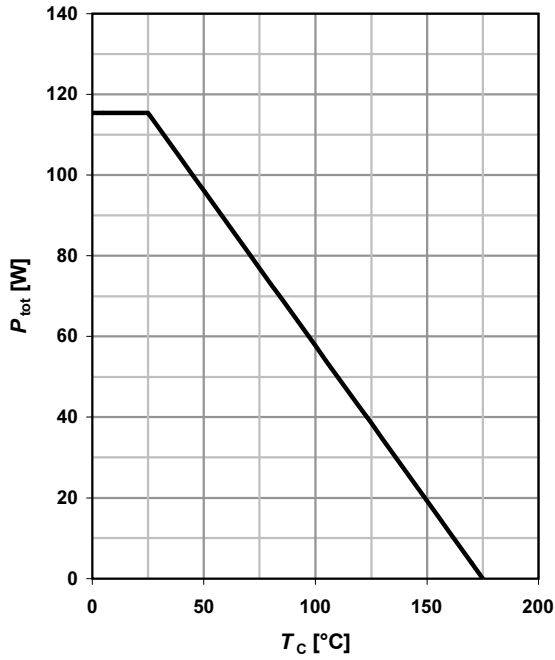
**Reverse Diode**

|                                  |               |   |   |     |     |    |
|----------------------------------|---------------|---|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$  | - | -   | 90  | A  |
| Diode pulse current              | $I_{S,pulse}$ |   | - | -   | 360 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=90\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$ | - | 1.0 | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=30\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$       | - | 52  | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |   | - | 59  | -   | nC |

<sup>6)</sup> See figure 16 for gate charge parameter definition

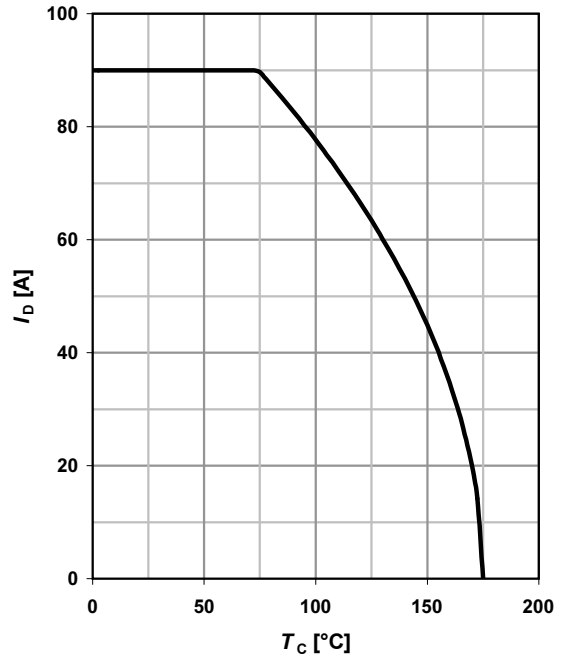
**1 Power dissipation**

$P_{tot}=f(T_C)$



**2 Drain current**

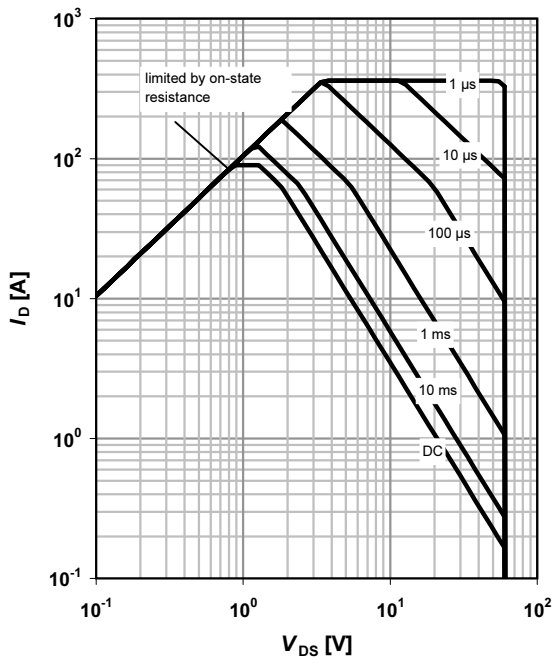
$I_D=f(T_C); V_{GS} \geq 10 V$



**3 Safe operating area**

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

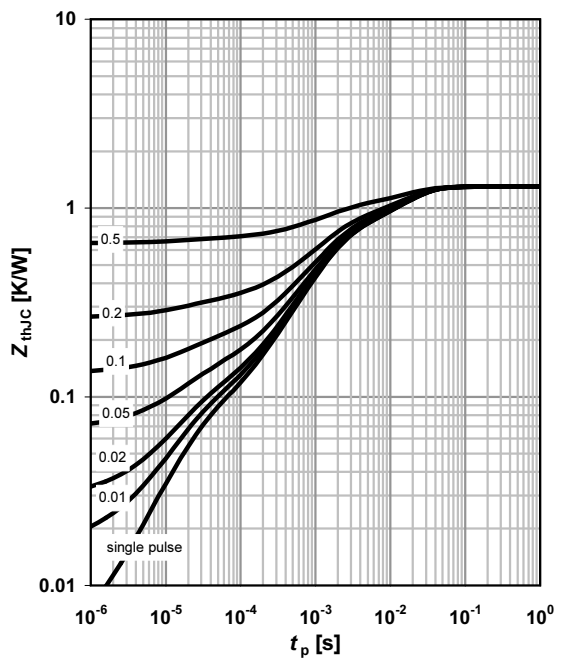
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

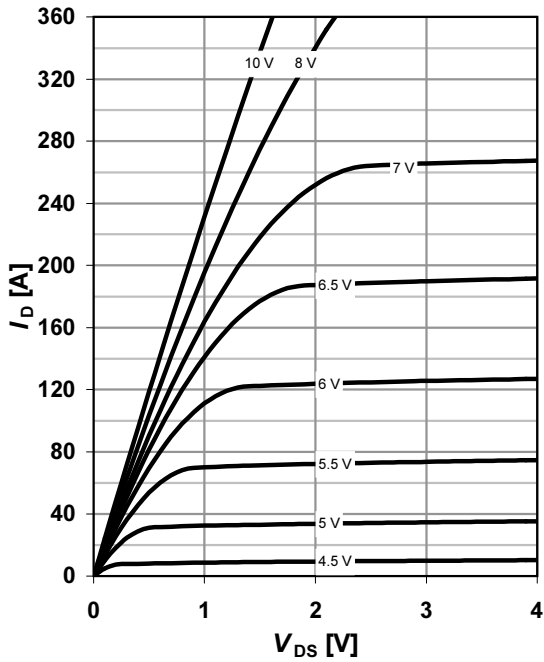
parameter:  $D=t_p/T$



**5 Typ. output characteristics**

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

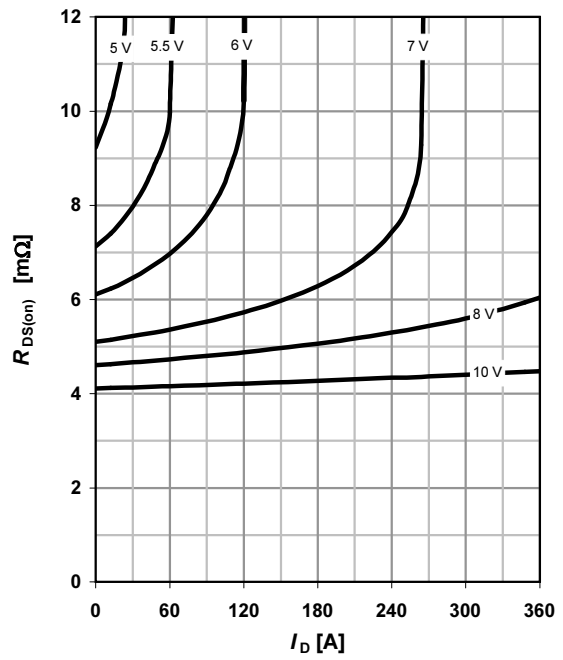
parameter:  $V_{GS}$



**6 Typ. drain-source on resistance**

$R_{DS(on)} = f(I_D); T_j = 25\text{ }^\circ\text{C}$

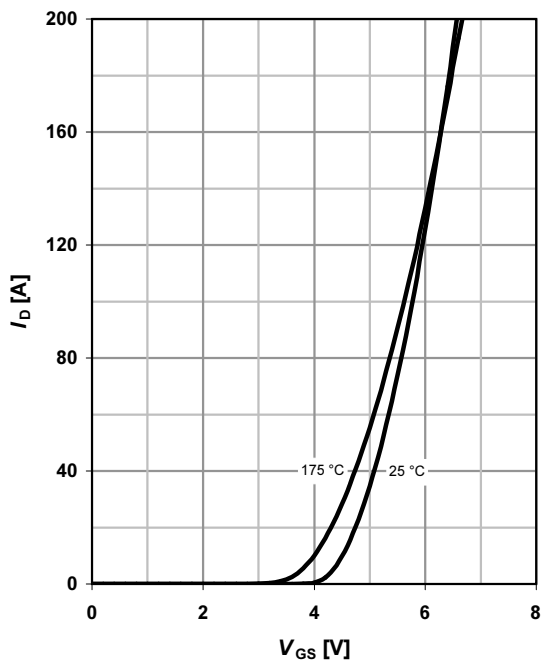
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

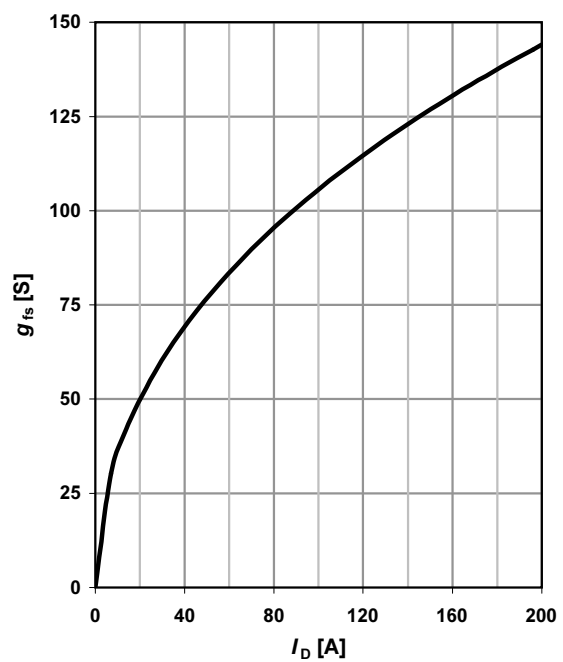
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



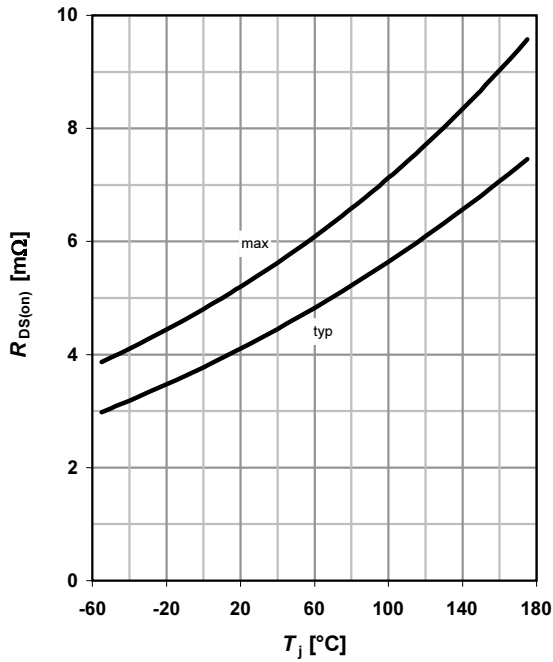
**8 Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25\text{ }^\circ\text{C}$



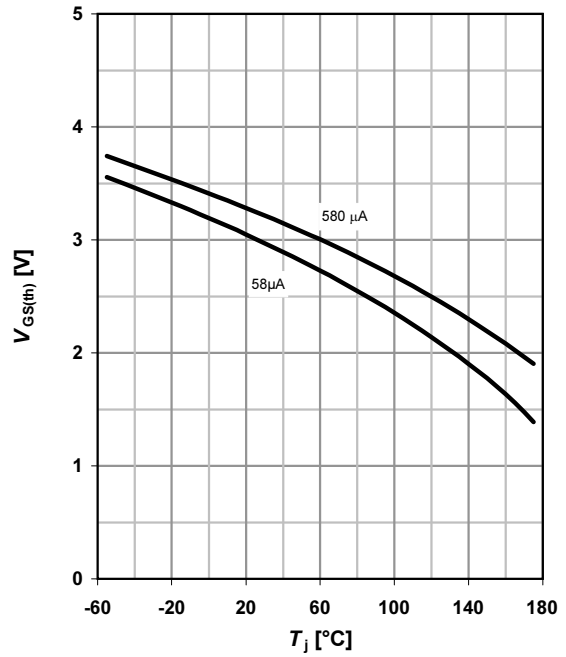
**9 Drain-source on-state resistance**

$R_{DS(on)} = f(T_j); I_D = 90 \text{ A}; V_{GS} = 10 \text{ V}$



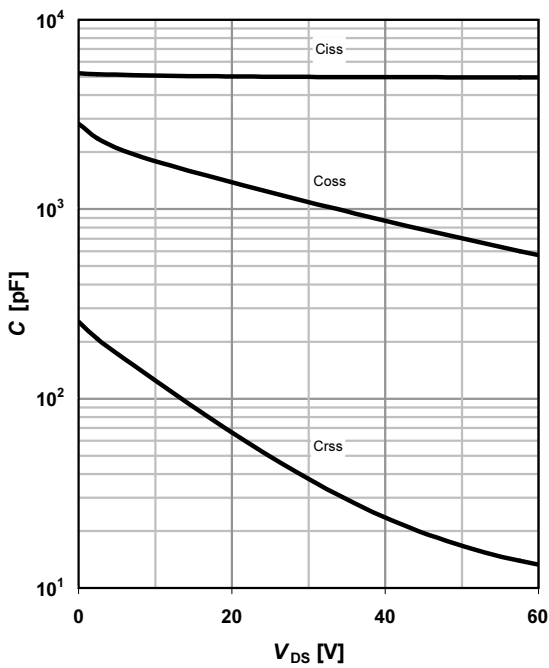
**10 Typ. gate threshold voltage**

$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$



**11 Typ. capacitances**

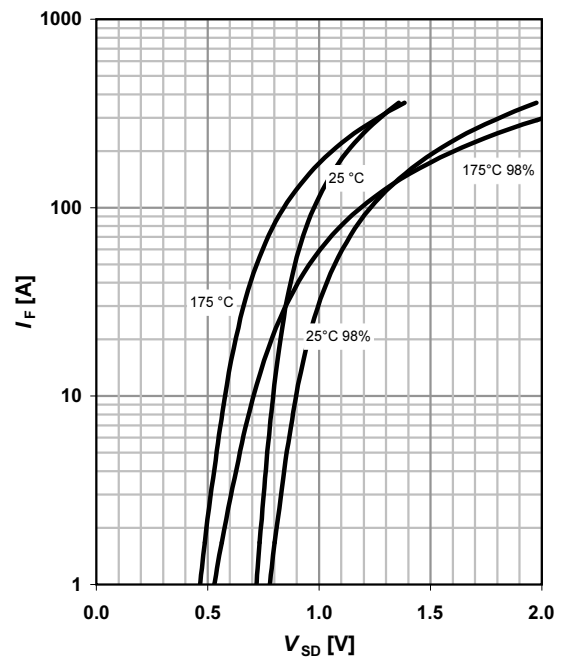
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F = f(V_{SD})$

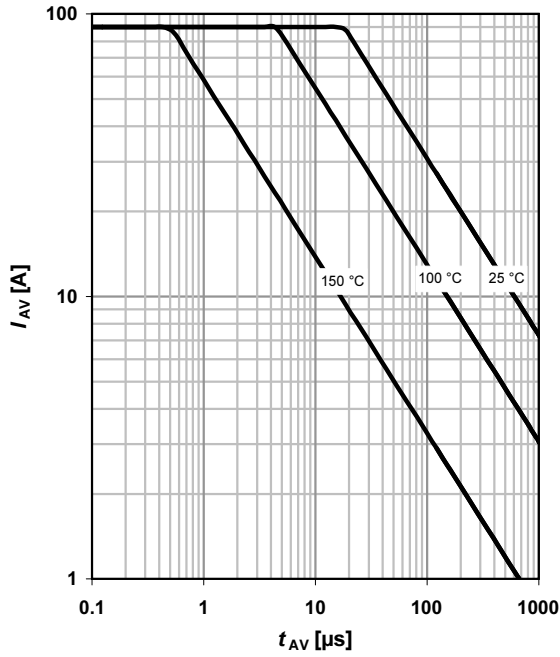
parameter:  $T_j$



**13 Avalanche characteristics**

$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$

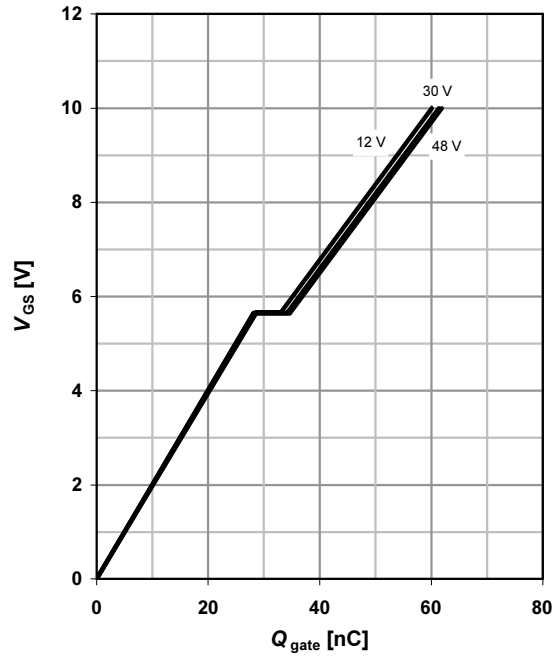
parameter:  $T_{j(start)}$



**14 Typ. gate charge**

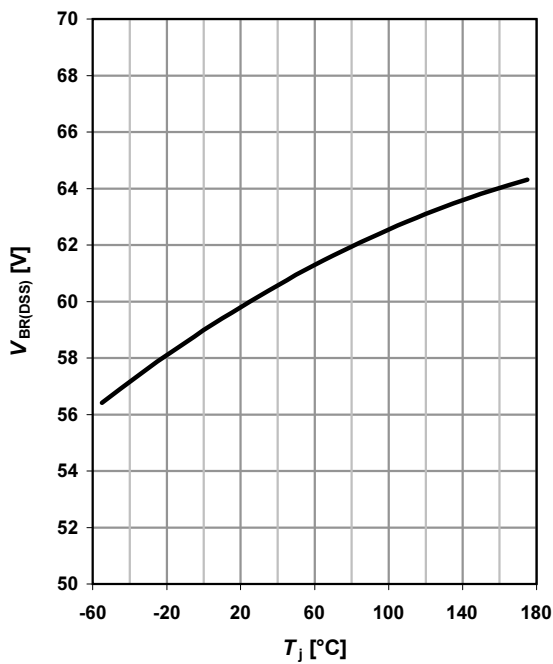
$V_{GS}=f(Q_{gate}); I_D=90 \text{ A pulsed}$

parameter:  $V_{DD}$

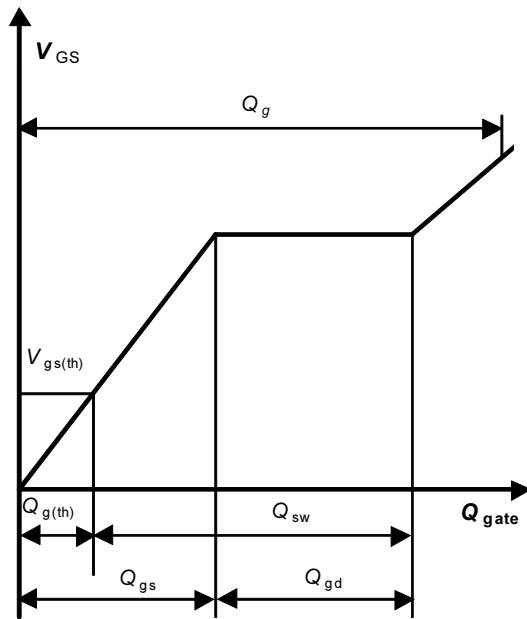


**15 Drain-source breakdown voltage**

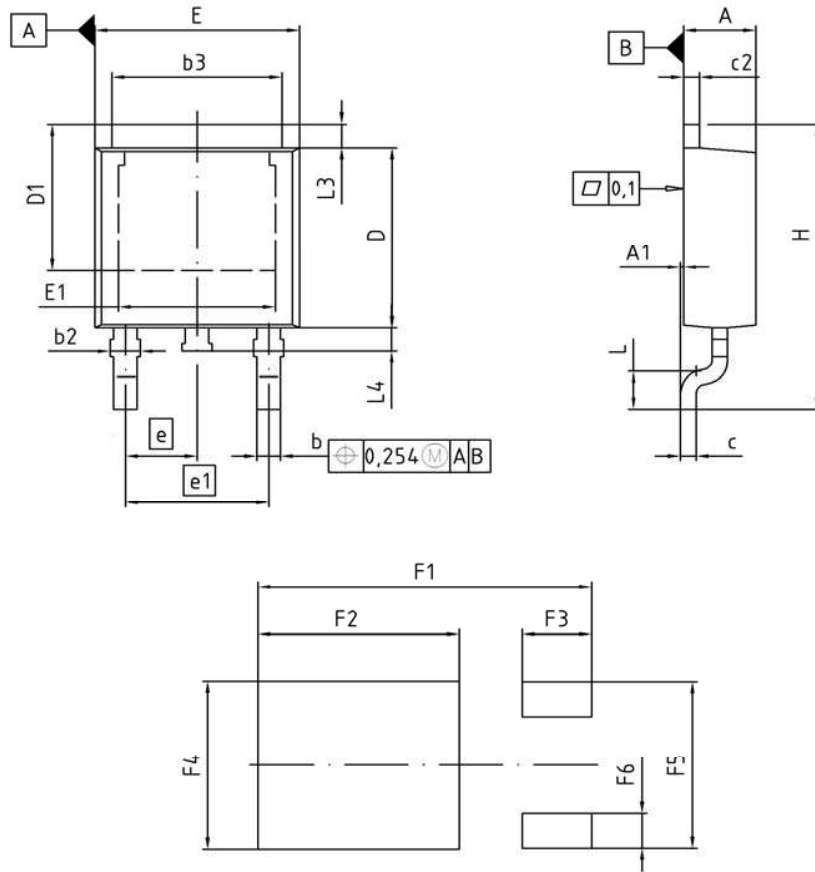
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



**16 Gate charge waveforms**



PG-TO252-3 (D-Pak)



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 2.16        | 2.41  | 0.085  | 0.095 |
| A1  | 0.00        | 0.15  | 0.000  | 0.006 |
| b   | 0.64        | 0.89  | 0.025  | 0.035 |
| b2  | 0.65        | 1.15  | 0.026  | 0.045 |
| b3  | 5.00        | 5.50  | 0.197  | 0.217 |
| c   | 0.46        | 0.60  | 0.018  | 0.024 |
| c2  | 0.46        | 0.98  | 0.018  | 0.039 |
| D   | 5.97        | 6.22  | 0.235  | 0.245 |
| D1  | 5.02        | 5.84  | 0.198  | 0.230 |
| E   | 6.40        | 6.73  | 0.252  | 0.265 |
| E1  | 4.70        | 5.21  | 0.185  | 0.205 |
| e   | 2.29        |       | 0.090  |       |
| e1  | 4.57        |       | 0.180  |       |
| N   | 3           |       | 3      |       |
| H   | 9.40        | 10.48 | 0.370  | 0.413 |
| L   | 1.18        | 1.70  | 0.046  | 0.067 |
| L3  | 0.90        | 1.25  | 0.035  | 0.049 |
| L4  | 0.51        | 1.00  | 0.020  | 0.039 |
| F1  | 10.50       | 10.70 | 0.413  | 0.421 |
| F2  | 6.30        | 6.50  | 0.248  | 0.256 |
| F3  | 2.10        | 2.30  | 0.083  | 0.091 |
| F4  | 5.70        | 5.90  | 0.224  | 0.232 |
| F5  | 5.66        | 5.86  | 0.223  | 0.231 |
| F6  | 1.10        | 1.30  | 0.043  | 0.051 |

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