

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

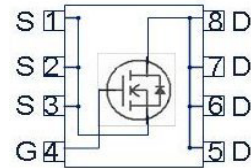
- Ideal for high frequency switching and sync. rec.
- Optimized technology for DC/DC converters
- Excellent gate charge  $\times R_{DS(on)}$  product (FOM)
- Superior thermal resistance
- N-channel, normal level
- 100% avalanche tested
- Pb-free plating; RoHS compliant
- Qualified according to JEDEC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

**Product Summary**

|                  |      |            |
|------------------|------|------------|
| $V_{DS}$         | 80   | V          |
| $R_{DS(on),max}$ | 12.3 | m $\Omega$ |
| $I_D$            | 55   | A          |



|                |                |
|----------------|----------------|
| <b>Type</b>    | BSC123N08NS3 G |
|                |                |
| <b>Package</b> | PG-TDSON-8     |
| <b>Marking</b> | 123N08NS       |


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

| Parameter                          | Symbol        | Conditions  | Value    | Unit |
|------------------------------------|---------------|---|----------|------|
| Continuous drain current           | $I_D$         | $V_{GS}=10\text{ V}, T_C=25\text{ }^\circ\text{C}$                              | 55       | A    |
|                                    |               | $V_{GS}=10\text{ V}, T_C=100\text{ }^\circ\text{C}$                             | 35       |      |
|                                    |               | $V_{GS}=10\text{ V}, T_A=25\text{ }^\circ\text{C}, R_{thJA}=50\text{ K/W}^{2)}$ | 11       |      |
| Pulsed drain current <sup>3)</sup> | $I_{D,pulse}$ | $T_C=25\text{ }^\circ\text{C}$  | 220      |      |
| Avalanche energy, single pulse     | $E_{AS}$      | $I_D=33\text{ A}, R_{GS}=25\text{ }\Omega$                                      | 70       | mJ   |
| Gate source voltage                | $V_{GS}$      |   | $\pm 20$ | V    |

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

<sup>2)</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.

<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                   | $P_{\text{tot}}$      | $T_C=25\text{ °C}$  | 66          | W    |
|                                     |                       | $T_A=25\text{ °C}$ ,<br>$R_{\text{thJA}}=50\text{ K/W}^2$ | 2.5         |      |
| Operating and storage temperature   | $T_j, T_{\text{stg}}$ |   | -55 ... 150 | °C   |
| IEC climatic category; DIN IEC 68-1 |                       |   | 55/150/56   |      |

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

#### Thermal characteristics

|                                     |                   |  |   |   |     |     |
|-------------------------------------|-------------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | $R_{\text{thJC}}$ |  | - | - | 1.9 | K/W |
| Device on PCB                       | $R_{\text{thJA}}$ | minimal footprint                            | - | - | 62  |     |
|                                     |                   | 6 cm <sup>2</sup> cooling area <sup>2)</sup> | - | - | 50  |     |

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

#### Static characteristics

|                                  |                             |   |    |      |      |               |
|----------------------------------|-----------------------------|---|----|------|------|---------------|
| Drain-source breakdown voltage   | $V_{(\text{BR})\text{DSS}}$ | $V_{\text{GS}}=0\text{ V}, I_{\text{D}}=1\text{ mA}$                            | 80 | -    | -    | V             |
| Gate threshold voltage           | $V_{\text{GS(th)}}$         | $V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=33\text{ }\mu\text{A}$               | 2  | 2.8  | 3.5  |               |
| Zero gate voltage drain current  | $I_{\text{DSS}}$            | $V_{\text{DS}}=80\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ °C}$         | -  | 0.1  | 1    | $\mu\text{A}$ |
|                                  |                             | $V_{\text{DS}}=80\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ °C}$        | -  | 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 | $R_{\text{DS(on)}}$         | $V_{\text{GS}}=10\text{ V}, I_{\text{D}}=33\text{ A}$                           | -  | 10.3 | 12.3 | m $\Omega$    |
|                                  |                             | $V_{\text{GS}}=6\text{ V}, I_{\text{D}}=16\text{ A}$                            | -  | 14.1 | 24   |               |
| Gate resistance                  | $R_{\text{G}}$              |   | -  | 2    | -    | $\Omega$      |
| Transconductance                 | $g_{\text{fs}}$             | $ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=33\text{ A}$ | 22 | 44   | -    | S             |

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

**Dynamic characteristics**

|                              |              |   |   |      |      |    |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=40\text{ V},$<br>$f=1\text{ MHz}$                    | - | 1430 | 1870 | pF |
| Output capacitance           | $C_{oss}$    |   | - | 385  | 517  |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 15   | -    |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=40\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=20\text{ A}, R_G=1.6\ \Omega$ | - | 12   | -    | ns |
| Rise time                    | $t_r$        |   | - | 18   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 19   | -    |    |
| Fall time                    | $t_f$        |   | - | 4    | -    |    |

**Gate Charge Characteristics<sup>5)</sup>**

|                          |               |  |   |     |    |    |
|--------------------------|---------------|--|---|-----|----|----|
| Gate to source charge    | $Q_{gs}$      | $V_{DD}=40\text{ V}, I_D=20\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 6.3 | -  | nC |
| Gate charge at threshold | $Q_{g(th)}$   |  | - | 3.6 | -  |    |
| Gate to drain charge     | $Q_{gd}$      |  | - | 3.8 | -  |    |
| Switching charge         | $Q_{sw}$      |  | - | 6.5 | -  |    |
| Gate charge total        | $Q_g$         |  | - | 19  | 25 |    |
| Gate plateau voltage     | $V_{plateau}$ |  | - | 4.9 | -  | V  |
| Output charge            | $Q_{oss}$     | $V_{DD}=40\text{ V}, V_{GS}=0\text{ V}$                                    | - | 25  | 34 |    |

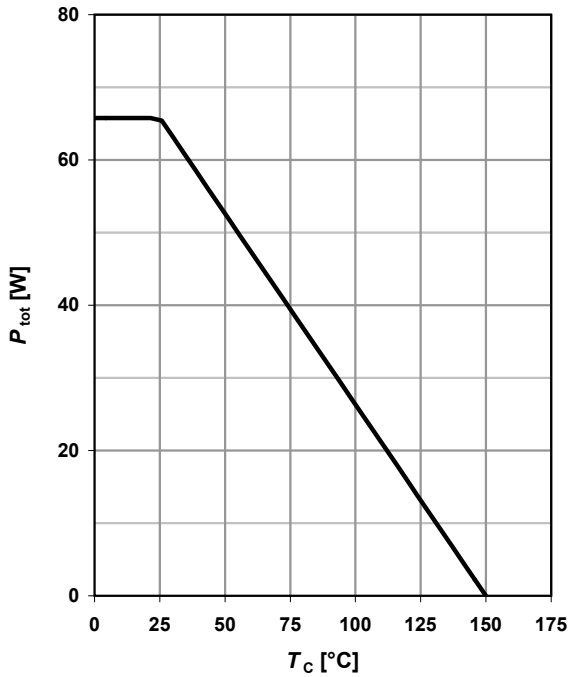
**Reverse Diode**

|                                  |               |   |   |     |     |    |
|----------------------------------|---------------|---|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$  | - | -   | 55  | A  |
| Diode pulse current              | $I_{S,pulse}$ |   | - | -   | 220 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=33\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$   | - | 0.9 | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=40\text{ V}, I_F=20\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 45  | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |   | - | 54  | -   |    |

<sup>5)</sup> See figure 16 for gate charge parameter definition

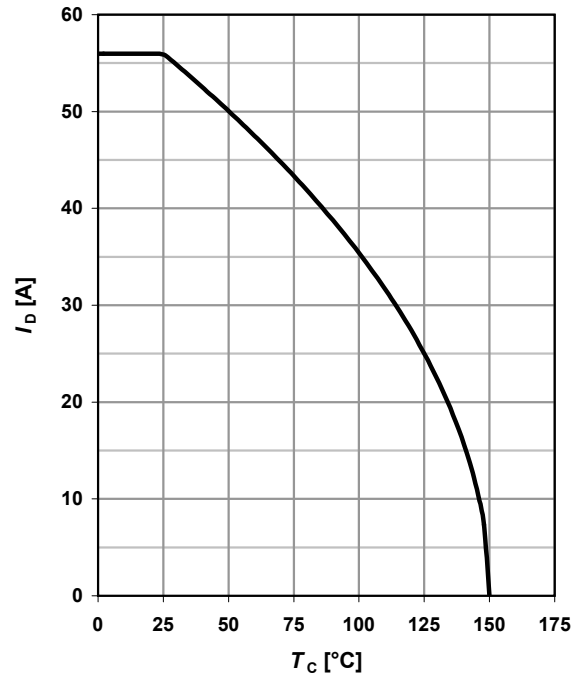
**1 Power dissipation**

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



**2 Drain current**

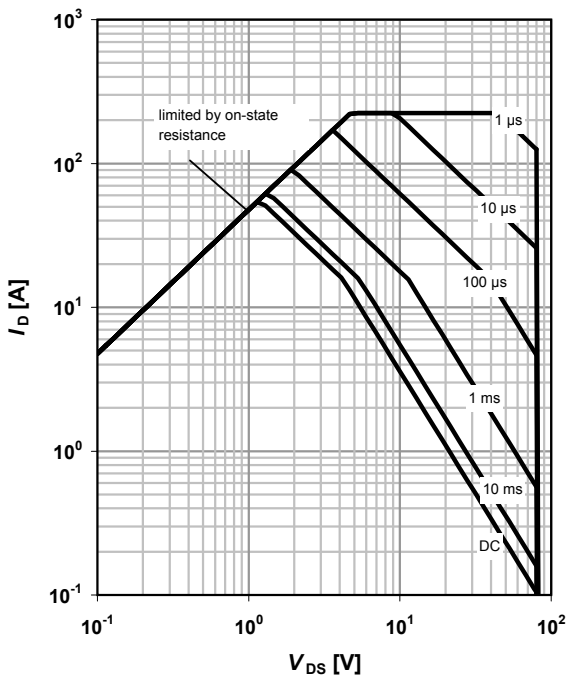
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



**3 Safe operating area**

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

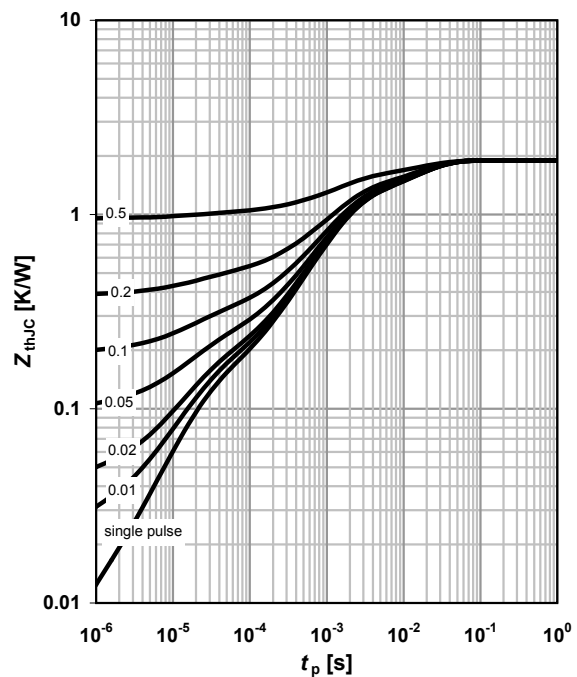
parameter:  $t_p$



**4 Max. transient thermal impedance**

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

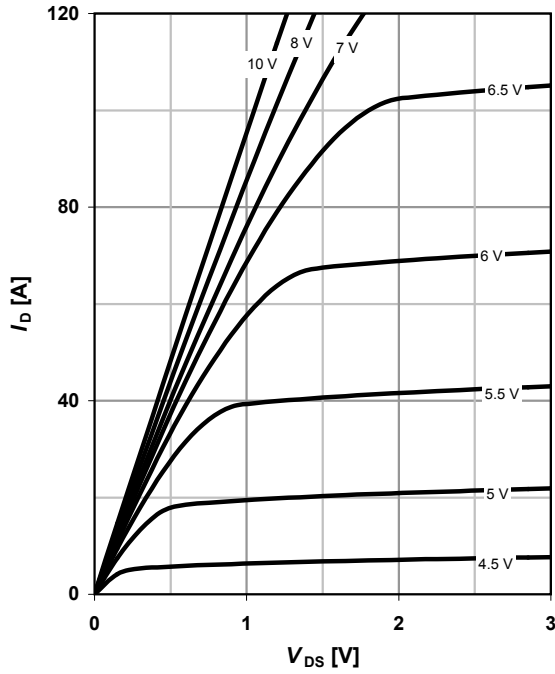
parameter:  $D = t_p / T$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

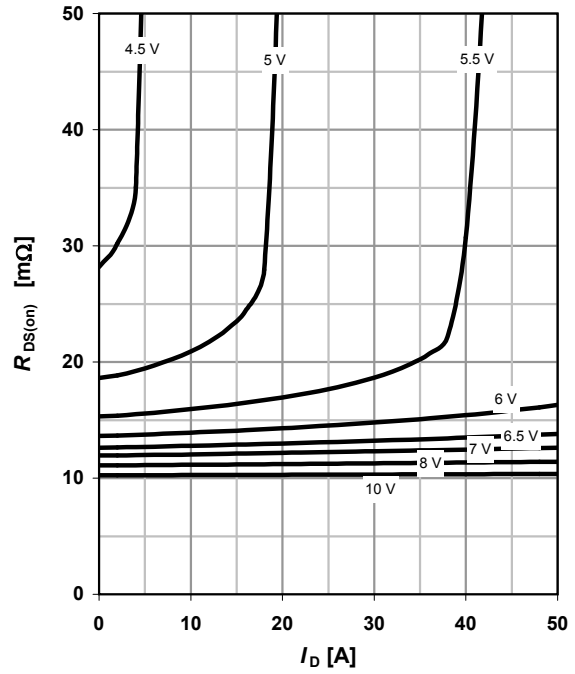
parameter:  $V_{GS}$



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

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

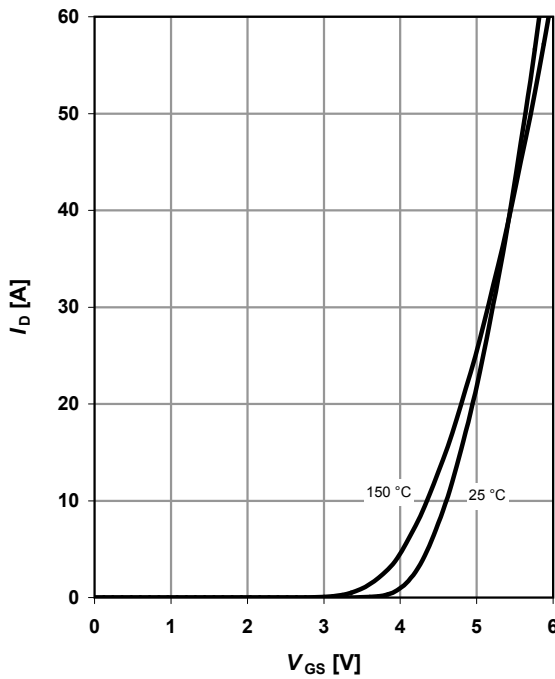
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

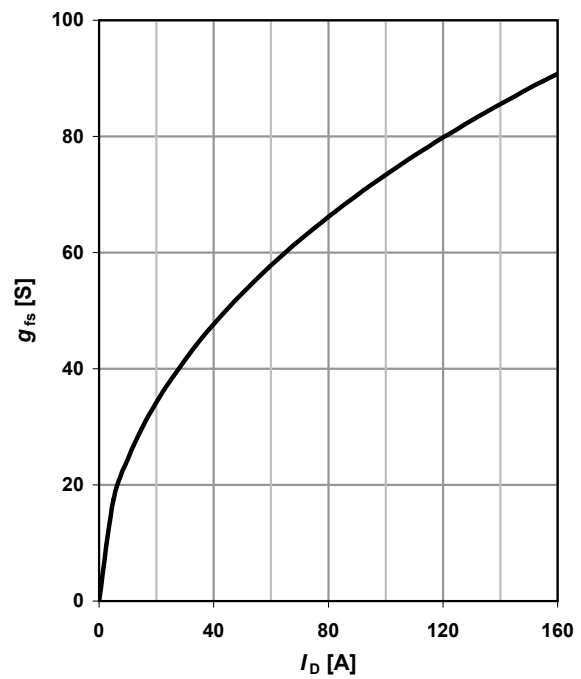
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



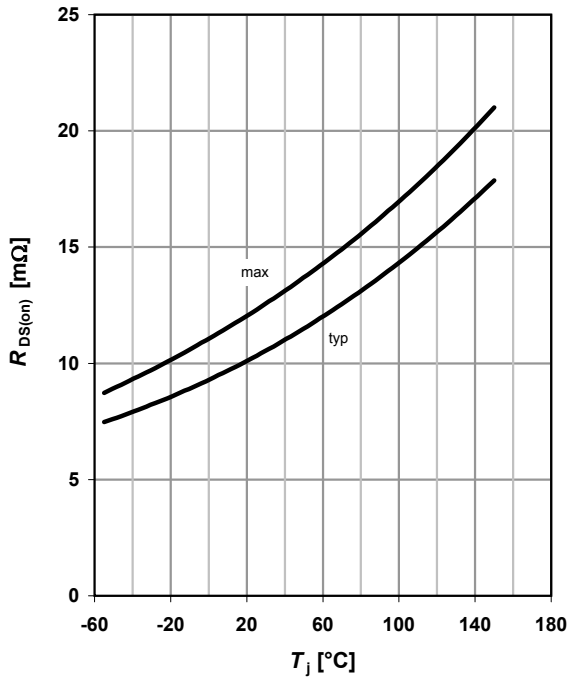
**8 Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



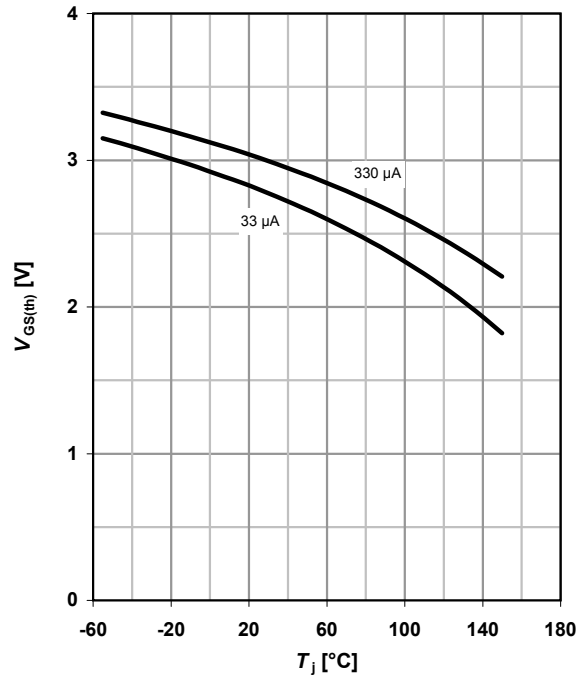
**9 Drain-source on-state resistance**

$R_{DS(on)} = f(T_j); I_D = 33 \text{ A}; V_{GS} = 10 \text{ V}$



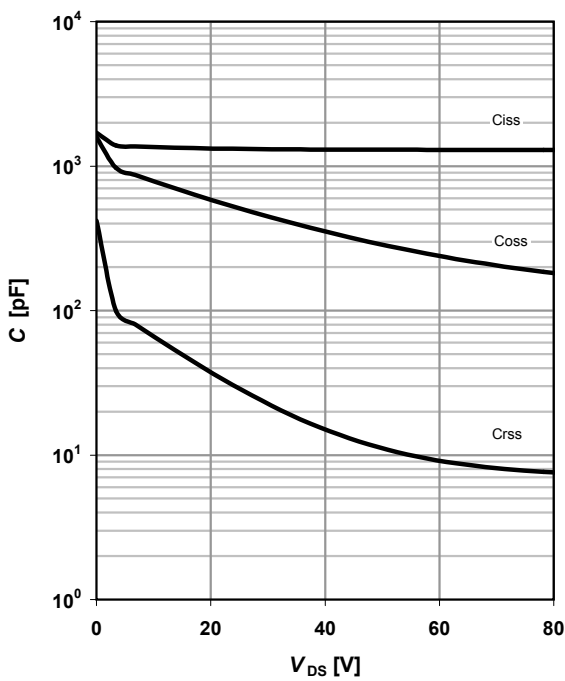
**10 Typ. gate threshold voltage**

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



**11 Typ. capacitances**

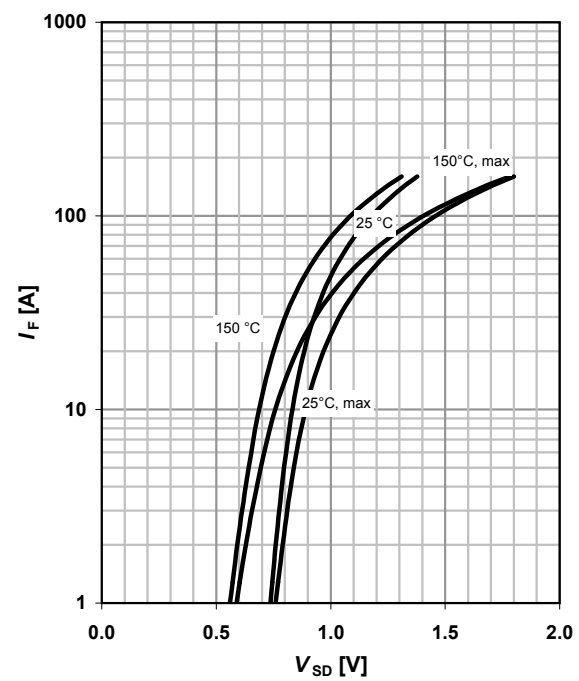
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F = f(V_{SD})$

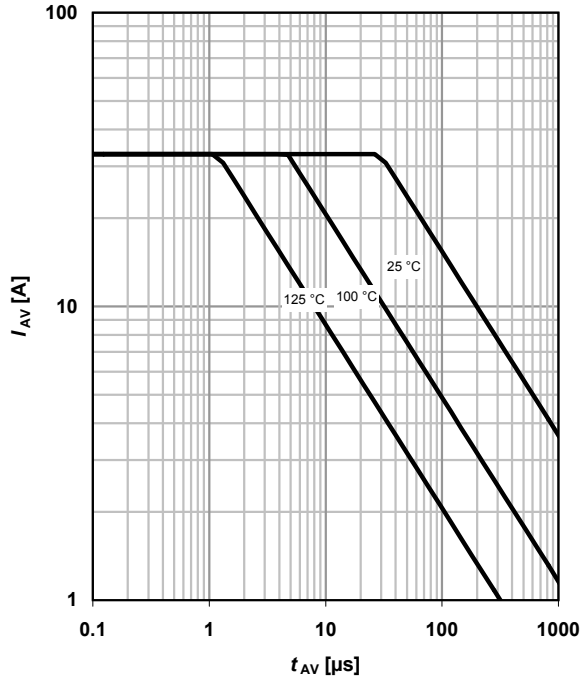
parameter:  $T_j$



**13 Avalanche characteristics**

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

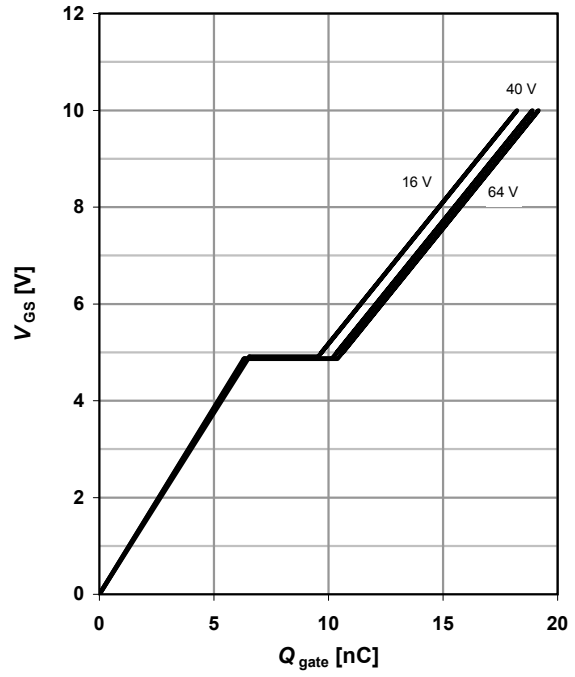
parameter:  $T_{j(start)}$



**14 Typ. gate charge**

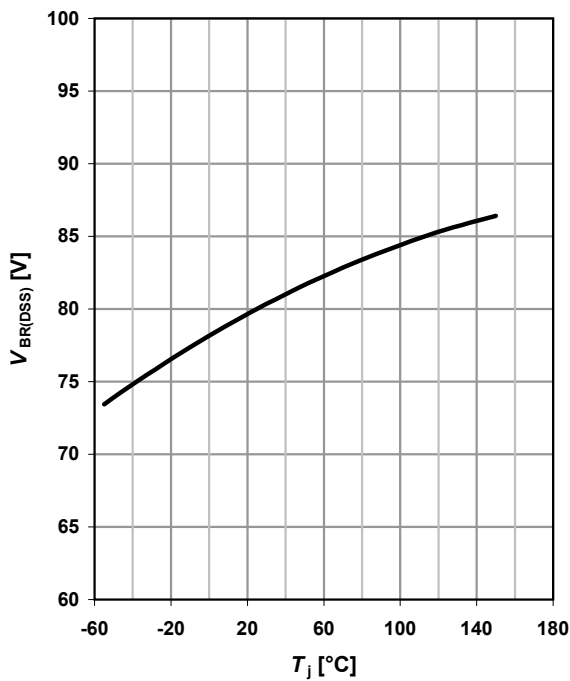
$V_{GS}=f(Q_{gate}); I_D=20 \text{ A pulsed}$

parameter:  $V_{DD}$



**15 Drain-source breakdown voltage**

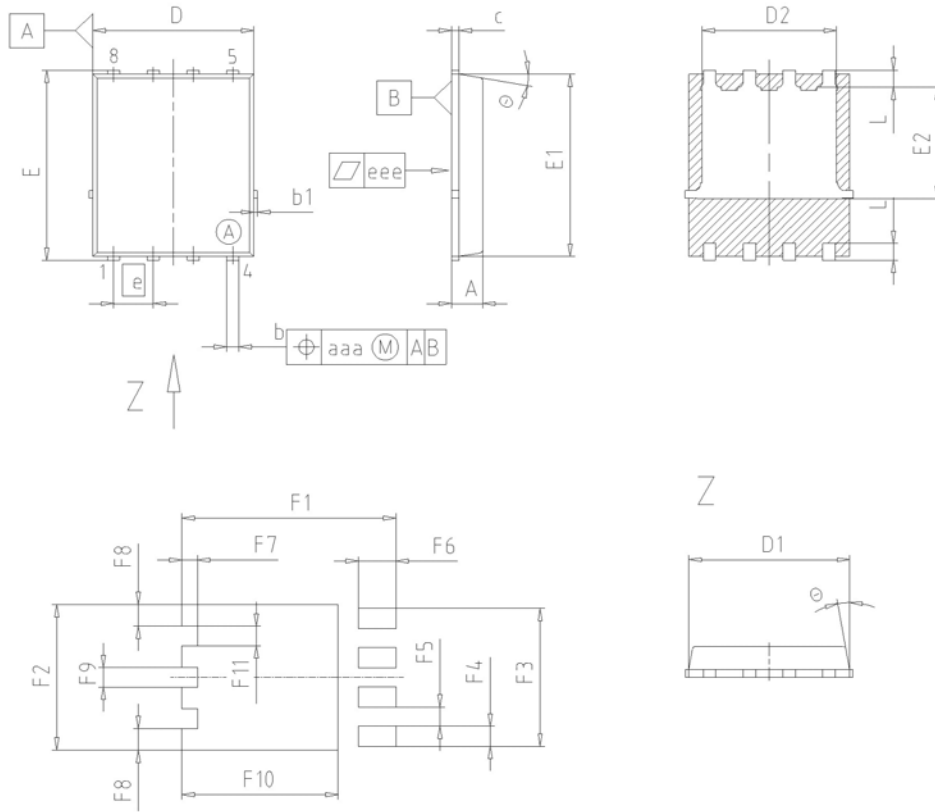
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



**16 Gate charge waveforms**



PG-TDSON-8



| DIM  | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN         | MAX   | MIN    | MAX   |
| A    | 0.90        | 1.10  | 0.035  | 0.043 |
| b    | 0.34        | 0.54  | 0.013  | 0.021 |
| b1   | 0.02        | 0.22  | 0.001  | 0.008 |
| c    | 0.15        | 0.35  | 0.006  | 0.014 |
| D=D1 | 4.95        | 5.35  | 0.195  | 0.211 |
| D2   | 4.20        | 4.40  | 0.165  | 0.173 |
| E    | 5.95        | 6.35  | 0.234  | 0.250 |
| E1   | 5.70        | 6.10  | 0.224  | 0.240 |
| E2   | 3.40        | 3.80  | 0.134  | 0.150 |
| e    | 1.27        |       | 0.050  |       |
| N    | 8           |       | 8      |       |
| L    | 0.45        | 0.65  | 0.018  | 0.026 |
| □    | 8.5°        | 11.5° | 8.5°   | 11.5° |
| aaa  | 0.25        |       | 0.010  |       |
| eee  | 0.05        |       | 0.002  |       |
| F1   | 6.75        | 6.95  | 0.266  | 0.274 |
| F2   | 4.60        | 4.80  | 0.181  | 0.189 |
| F3   | 4.36        | 4.56  | 0.172  | 0.180 |
| F4   | 0.55        | 0.75  | 0.022  | 0.030 |
| F5   | 0.52        | 0.72  | 0.020  | 0.028 |
| F6   | 1.10        | 1.30  | 0.043  | 0.051 |
| F7   | 0.40        | 0.60  | 0.016  | 0.024 |
| F8   | 0.60        | 0.80  | 0.024  | 0.031 |
| F9   | 0.53        | 0.73  | 0.021  | 0.029 |
| F10  | 4.90        | 5.10  | 0.193  | 0.201 |
| F11  | 0.53        | 0.73  | 0.021  | 0.029 |

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