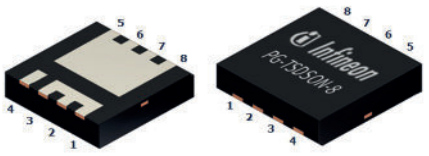
# MOSFET

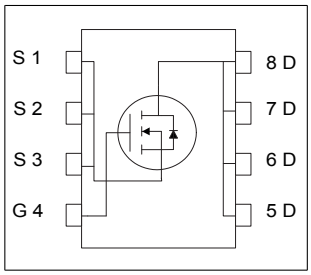
## OptiMOS™ Power-MOSFET, 40 V

TSDSON-8 FL
(enlarged source interconnection)



### Features

- Optimized for high performance SMPS, e.g. sync. rec.
- Very low on-resistance $R_{DS(on)}$ @ $V_{GS}$=4.5 V
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Qualified according to JEDEC[1)] for target applications
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- Higher solder joint reliability with enlarged source interconnection




### Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ | 40 | V |
| $R_{DS(on),max}$ | 2.8 | mΩ |
| $I_D$ | 40 | A |
| $Q_{OSS}$ | 28 | nC |
| $Q_G$(0V..10V) | 32 | nC |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| BSZ028N04LS | PG-TSDSON-8 FL | 028N04L | - |

[1)] J-STD20 and JESD22

## Table of Contents

# 1 Maximum ratings

at $T_A$=25 °C, unless otherwise specified

## Table 2 Maximum ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current | $I_D$ | -<br>-<br>-<br>-<br>- | -<br>-<br>-<br>-<br>- | 40<br>40<br>40<br>40<br>21 | A | $V_{GS}$=10 V, $T_C$=25 °C<br>$V_{GS}$=10 V, $T_C$=100 °C<br>$V_{GS}$=4.5 V, $T_C$=25 °C<br>$V_{GS}$=4.5V, $T_C$=100 °C<br>$V_{GS}$=10 V, $T_A$=25 °C, $R_{thJA}$=60 K/W[1)] |
| Pulsed drain current[2)] | $I_{D,pulse}$ | - | - | 160 | A | $T_C$=25 °C |
| Avalanche energy, single pulse[3)] | $E_{AS}$ | - | - | 100 | mJ | $I_D$=20 A, $R_{GS}$=25 Ω |
| Gate source voltage | $V_{GS}$ | -20 | - | 20 | V | - |
| Power dissipation | $P_{tot}$ | -<br>- | -<br>- | 63<br>2.1 | W | $T_C$=25 °C<br>$T_A$=25 °C, $R_{thJA}$=60 K/W[1)] |
| Operating and storage temperature | $T_j$, $T_{stg}$ | -55 | - | 150 | °C | IEC climatic category;<br>DIN IEC 68-1: 55/150/56 |

# 2 Thermal characteristics

## Table 3 Thermal characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | 1.2 | 2 | K/W | - |
| Device on PCB,<br>6 cm² cooling area[1)] | $R_{thJA}$ | - | - | 60 | K/W | - |

[1)] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.
[2)] See Diagram 3 for more detailed information
[3)] See Diagram 13 for more detailed information

# 3 Electrical characteristics

## Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 40 | - | - | V | $V_{GS}$=0 V, $I_D$=1 mA |
| Gate threshold voltage | $V_{GS(th)}$ | 1.2 | - | 2 | V | $V_{GS}$=4.5V, $T_C$=100 °C |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | 0.1<br>10 | 1<br>100 | µA | $V_{DS}$=40 V, $V_{GS}$=0 V, $T_j$=25 °C<br>$V_{DS}$=40 V, $V_{GS}$=0 V, $T_j$=125 °C |
| Gate-source leakage current | $I_{GSS}$ | - | 10 | 100 | nA | $V_{GS}$=20 V, $V_{DS}$=0 V |
| Drain-source on-state resistance | $R_{DS(on)}$ | -<br>- | 2.2<br>2.7 | 2.8<br>3.8 | mΩ | $V_{GS}$=10 V, $I_D$=20 A<br>$V_{GS}$=4.5 V, $I_D$=20 A |
| Gate resistance[1)] | $R_G$ | - | 0.9 | 1.8 | Ω | - |
| Transconductance | $g_{fs}$ | 50 | 100 | - | S | $\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, $I_D$=20 A |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance[1)] | $C_{iss}$ | - | 2300 | 3220 | pF | $V_{GS}$=0 V, $V_{DS}$=20 V, $f$=1 MHz |
| Output capacitance[1)] | $C_{oss}$ | - | 640 | 900 | pF | $V_{GS}$=0 V, $V_{DS}$=20 V, $f$=1 MHz |
| Reverse transfer capacitance[1)] | $C_{rss}$ | - | 52 | 104 | pF | $V_{GS}$=0 V, $V_{DS}$=20 V, $f$=1 MHz |
| Turn-on delay time | $t_{d(on)}$ | - | 5 | - | ns | $V_{DD}$=20 V, $V_{GS}$=10 V, $I_D$=20 A, $R_{G,ext}$=1.6 Ω |
| Rise time | $t_r$ | - | 4 | - | ns | $V_{DD}$=20 V, $V_{GS}$=10 V, $I_D$=20 A, $R_{G,ext}$=1.6 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 37 | - | ns | $V_{DD}$=20 V, $V_{GS}$=10 V, $I_D$=20 A, $R_{G,ext}$=1.6 Ω |
| Fall time | $t_f$ | - | 4 | - | ns | $V_{DD}$=20 V, $V_{GS}$=10 V, $I_D$=20 A, $R_{G,ext}$=1.6 Ω |

## Table 6 Gate charge characteristics[2)]

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 5.5 | - | nC | $V_{DD}$=20 V, $I_D$=20 A, $V_{GS}$=0 to 10 V |
| Gate charge at threshold | $Q_{g(th)}$ | - | 3.6 | - | nC | $V_{DD}$=20 V, $I_D$=20 A, $V_{GS}$=0 to 10 V |
| Gate to drain charge[1)] | $Q_{gd}$ | - | 5.1 | 7.1 | nC | $V_{DD}$=20 V, $I_D$=20 A, $V_{GS}$=0 to 10 V |
| Switching charge | $Q_{sw}$ | - | 6.9 | - | nC | $V_{DD}$=20 V, $I_D$=20 A, $V_{GS}$=0 to 10 V |
| Gate charge total[1)] | $Q_g$ | - | 32 | 45 | nC | $V_{DD}$=20 V, $I_D$=20 A, $V_{GS}$=0 to 10 V |
| Gate plateau voltage | $V_{plateau}$ | - | 2.4 | - | V | $V_{DD}$=20 V, $I_D$=20 A, $V_{GS}$=0 to 10 V |
| Gate charge total[1)] | $Q_g$ | - | 16 | 22 | nC | $V_{DD}$=20 V, $I_D$=20 A, $V_{GS}$=0 to 4.5 V |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 13 | - | nC | $V_{DS}$=0.1 V, $V_{GS}$=0 to 4.5 V |
| Output charge[1)] | $Q_{oss}$ | - | 28 | 39 | nC | $V_{DD}$=20 V, $V_{GS}$=0 V |

[1)] Defined by design. Not subject to production test
[2)] See ″Gate charge waveforms″ for parameter definition

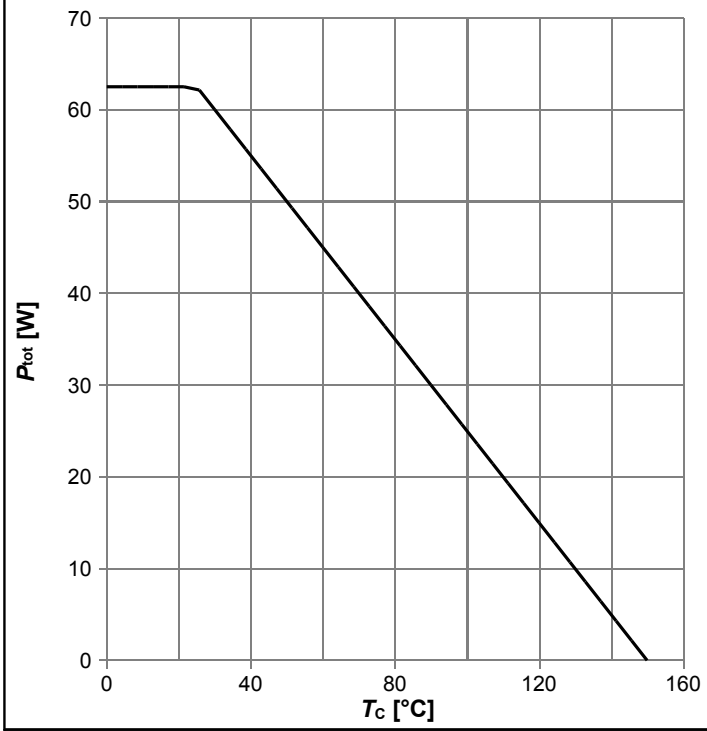
## Table 7 Reverse diode

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | 40 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 160 | A | $T_C$=25 °C |
| Diode forward voltage | $V_{SD}$ | - | 0.81 | 1 | V | $V_{GS}$=0 V, $I_F$=20 A, $T_j$=25 °C |
| Reverse recovery time[1)] | $t_{rr}$ | - | 24 | 48 | ns | $V_R$=20 V, $I_F$=20A, d$i_F$/d$t$=400 A/µs |
| Reverse recovery charge | $Q_{rr}$ | - | 57 | - | nC | $V_R$=20 V, $I_F$=20A, d$i_F$/d$t$=400 A/µs |

[1)] Defined by design. Not subject to production test

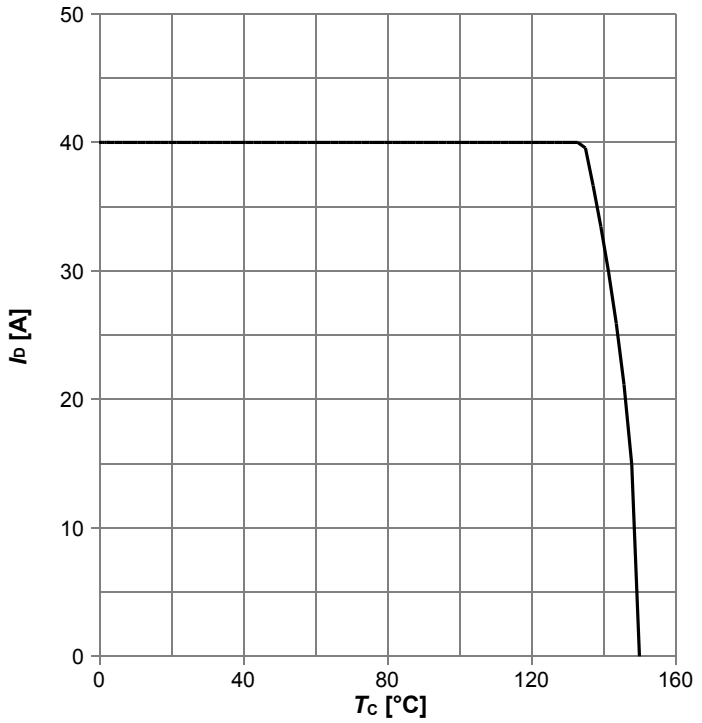
# 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



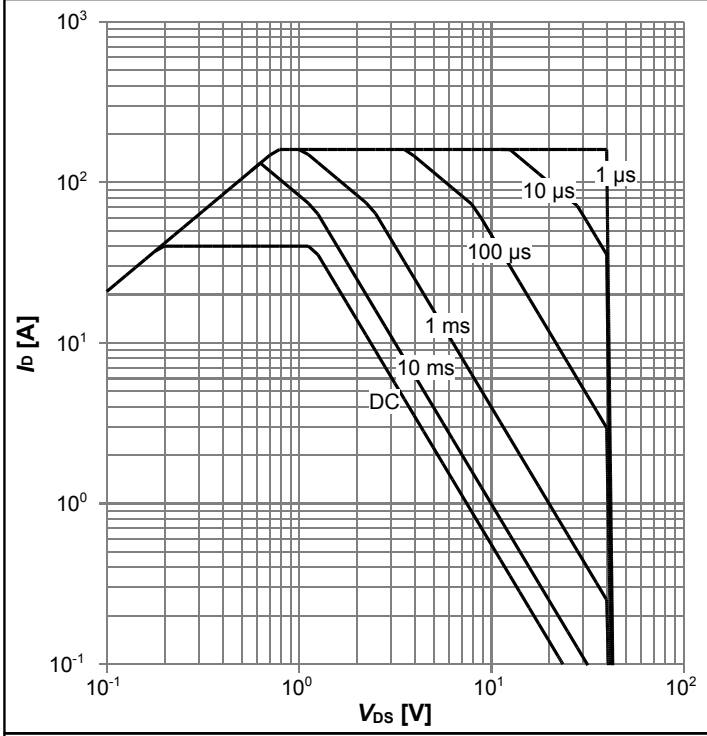

$P_{tot}=f(T_C)$

**Diagram 2: Drain current**



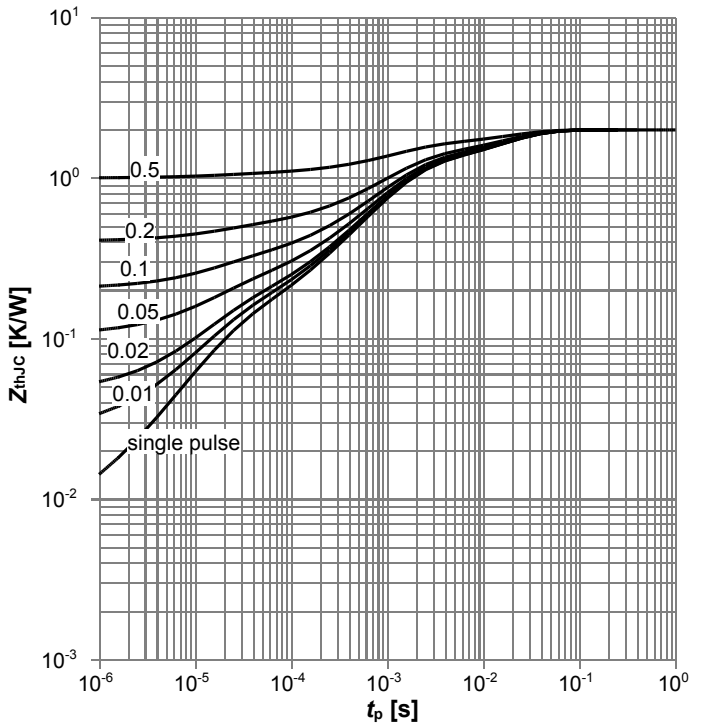

$I_D=f(T_C)$; $V_{GS}\geq 10$ V

**Diagram 3: Safe operating area**



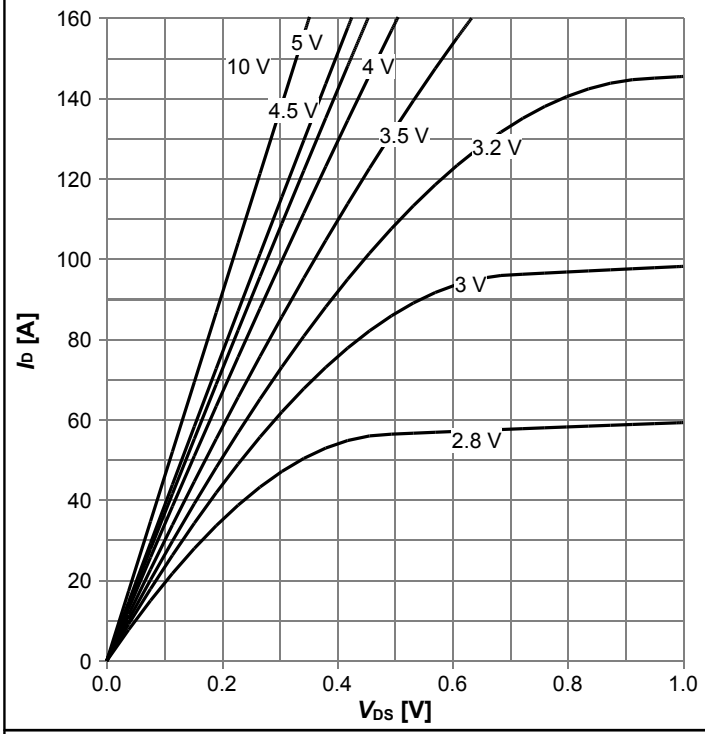

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: $t_p$

**Diagram 4: Max. transient thermal impedance**



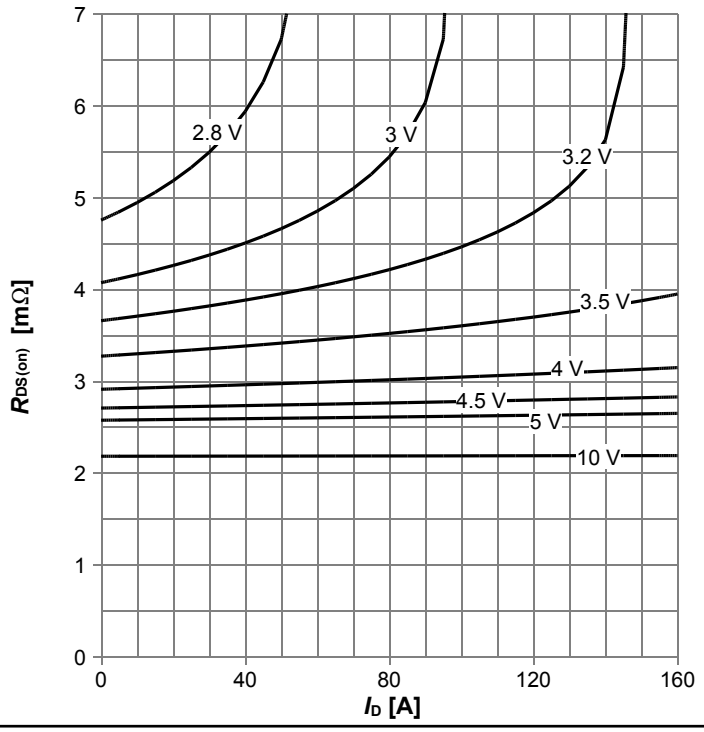

$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

**Diagram 5: Typ. output characteristics**



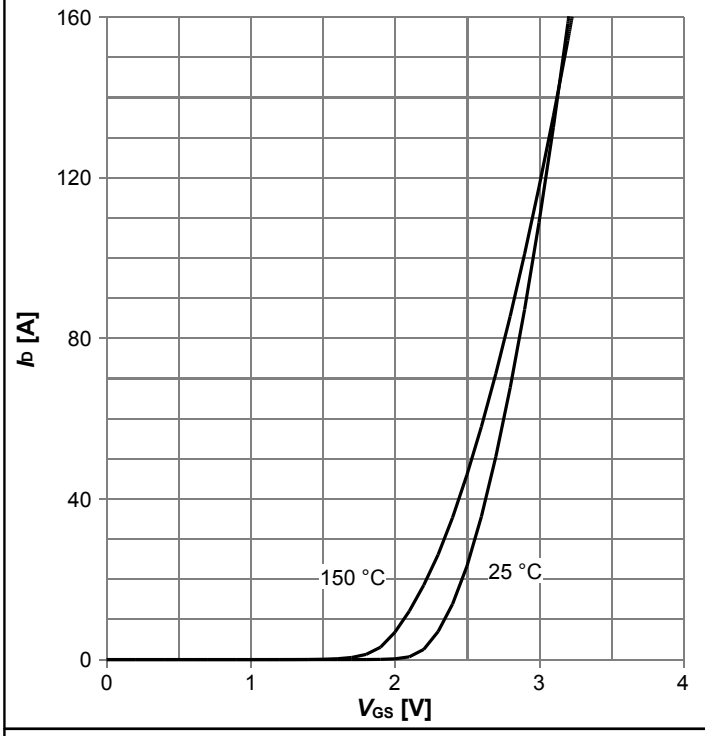

$I_D$=f($V_{DS}$); $T_j$=25 °C; parameter: $V_{GS}$

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



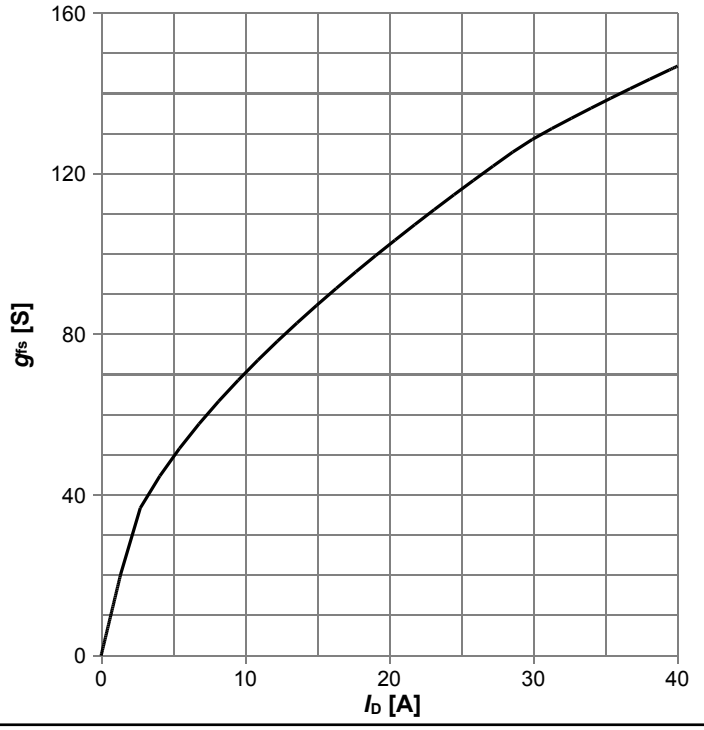

$R_{DS(on)}$=f($I_D$); $T_j$=25 °C; parameter: $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



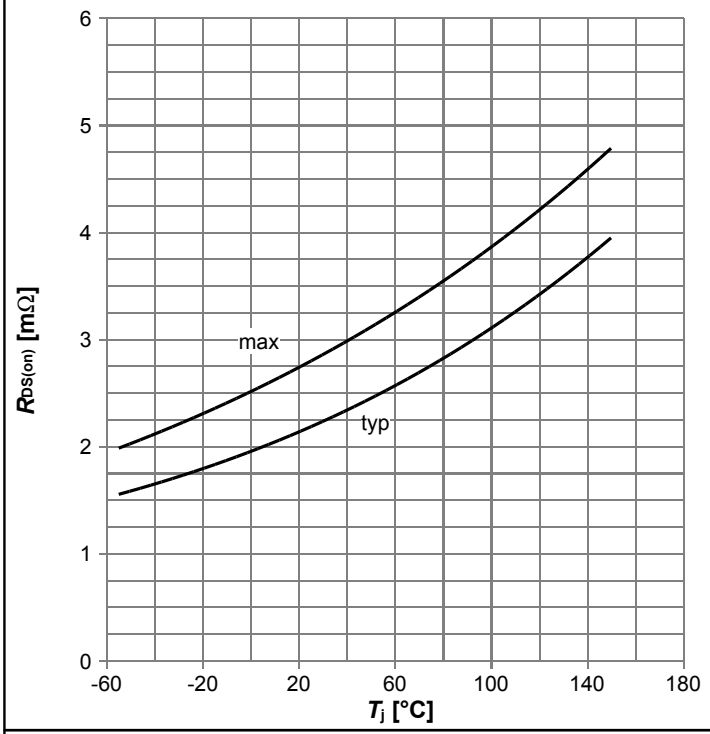

$I_D$=f($V_{GS}$); |$V_{DS}$|>2|$I_D$|$R_{DS(on)max}$; parameter: $T_j$

**Diagram 8: Typ. forward transconductance**



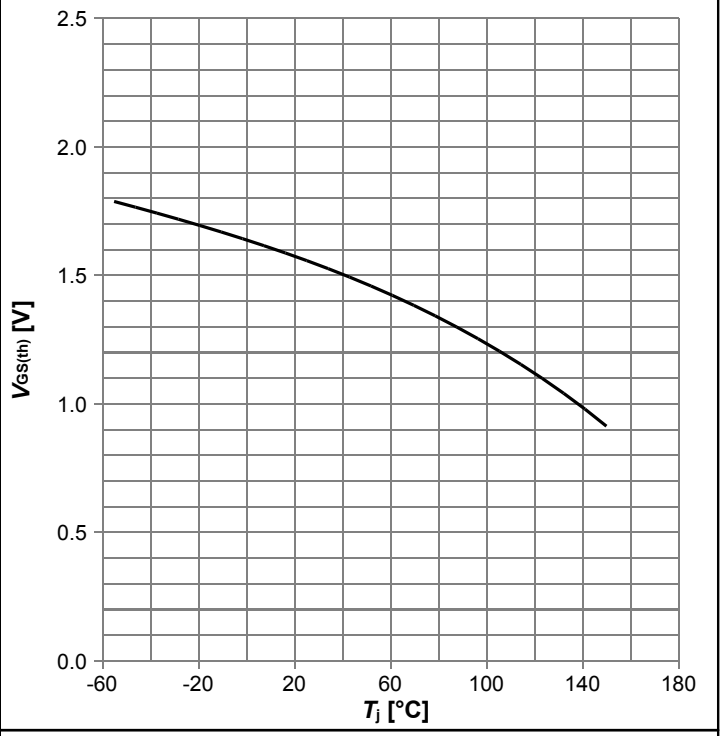

$g_{fs}$=f($I_D$); $T_j$=25 °C

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



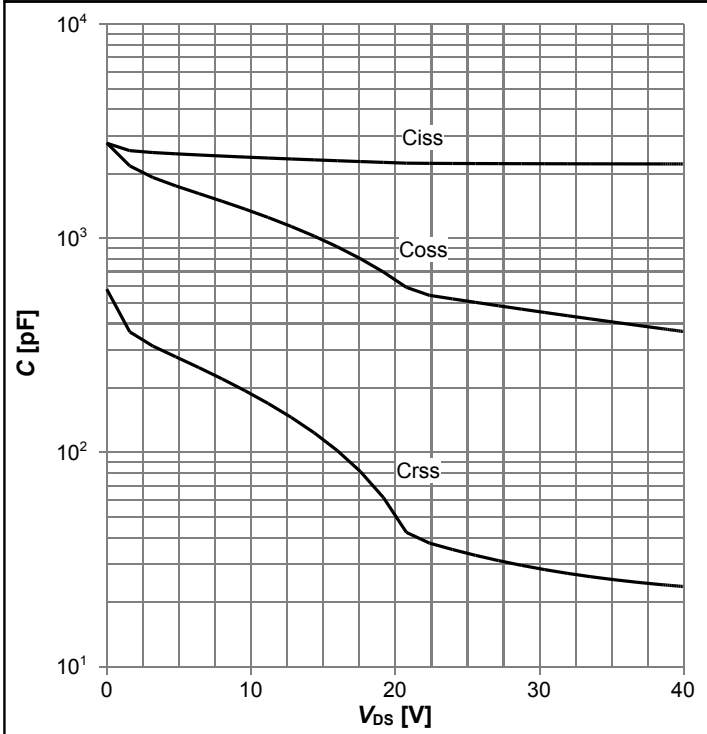

$R_{DS(on)}$=f($T_j$); $I_D$=20 A; $V_{GS}$=10 V

**Diagram 10: Typ. gate threshold voltage**



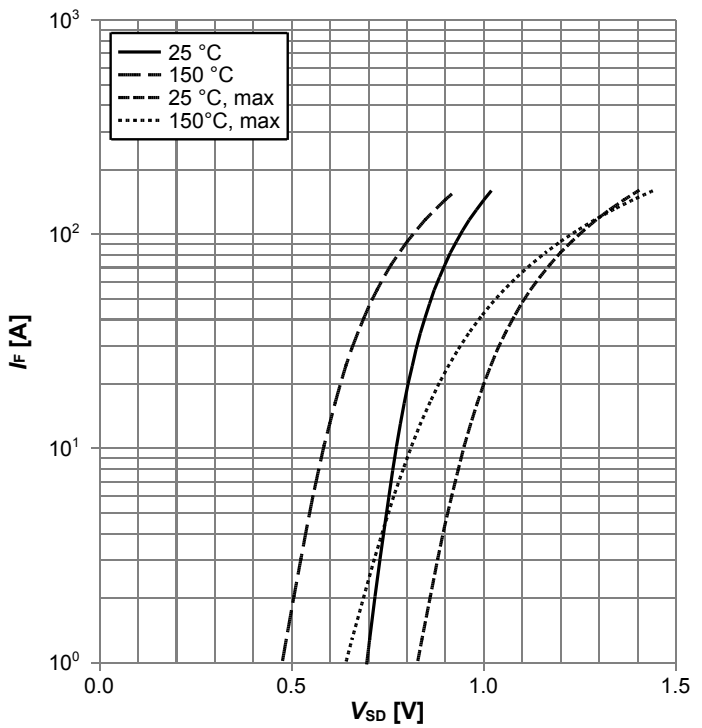

$V_{GS(th)}$=f($T_j$); $V_{GS}$=$V_{DS}$; $I_D$=250 µA

**Diagram 11: Typ. capacitances**



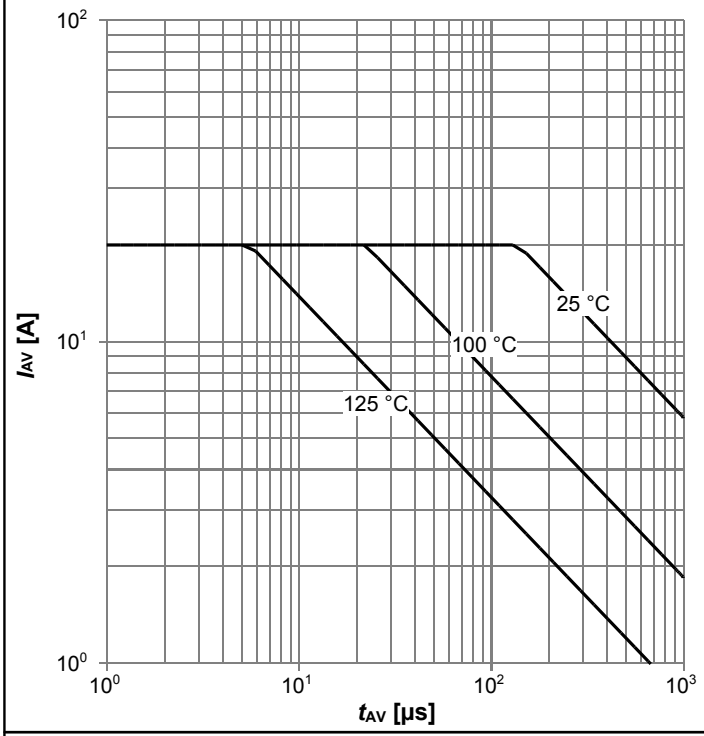

$C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz

**Diagram 12: Forward characteristics of reverse diode**



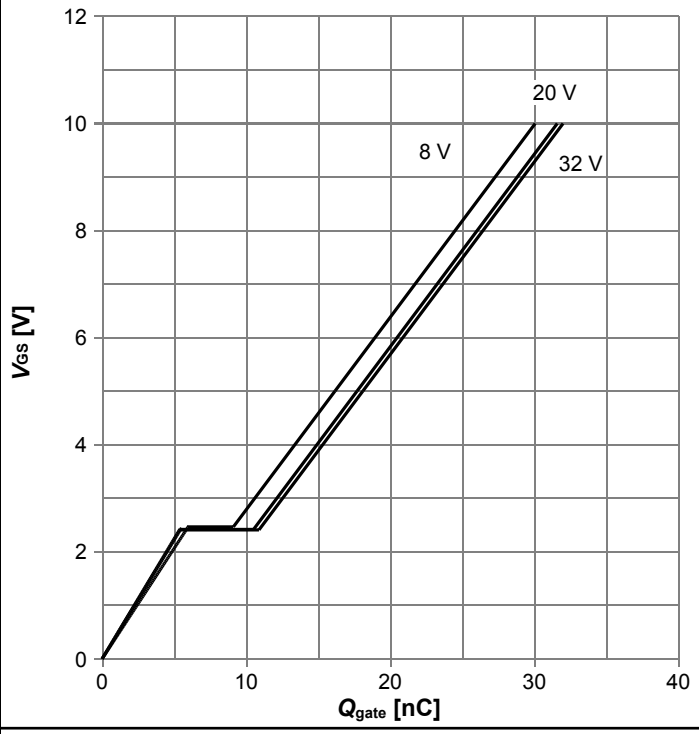

$I_F$=f($V_{SD}$); parameter: $T_j$

**Diagram 13: Avalanche characteristics**



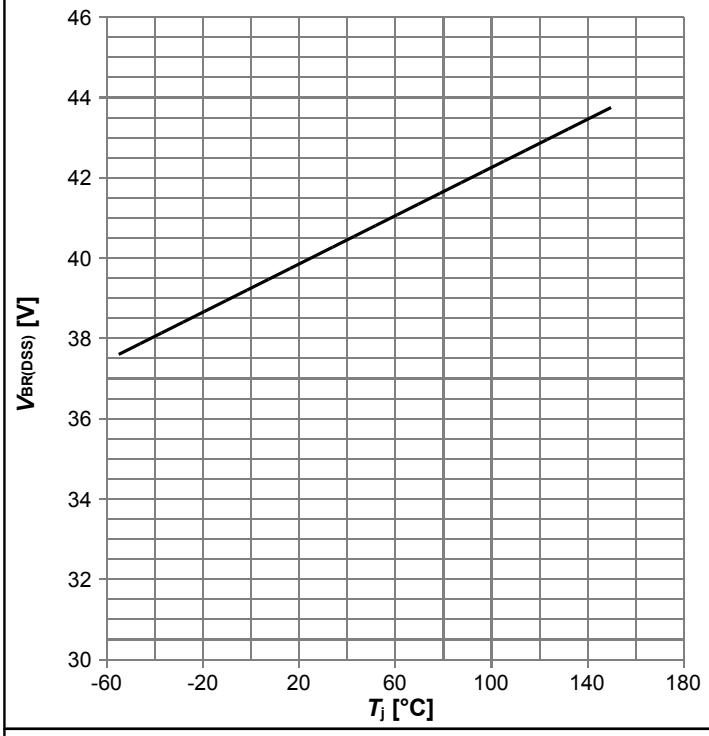

$I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω; parameter: $T_{j(start)}$

**Diagram 14: Typ. gate charge**



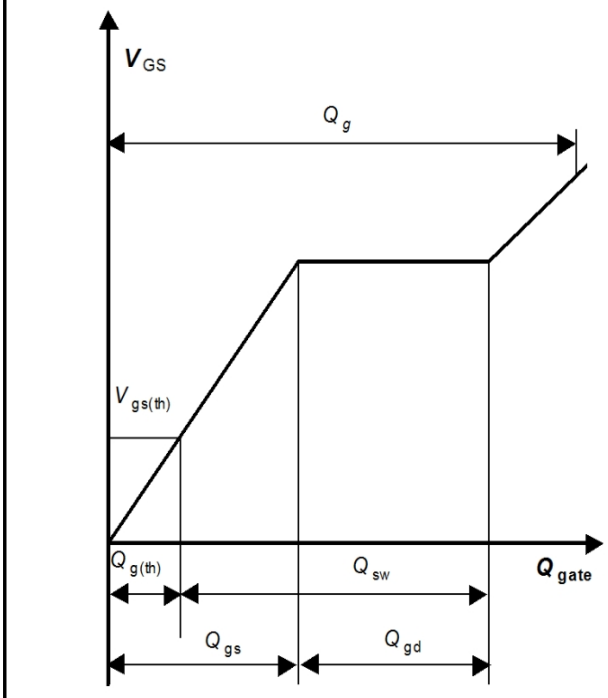

$V_{GS}$=f($Q_{gate}$); $I_D$=20 A pulsed; parameter: $V_{DD}$

**Diagram 15: Drain-source breakdown voltage**

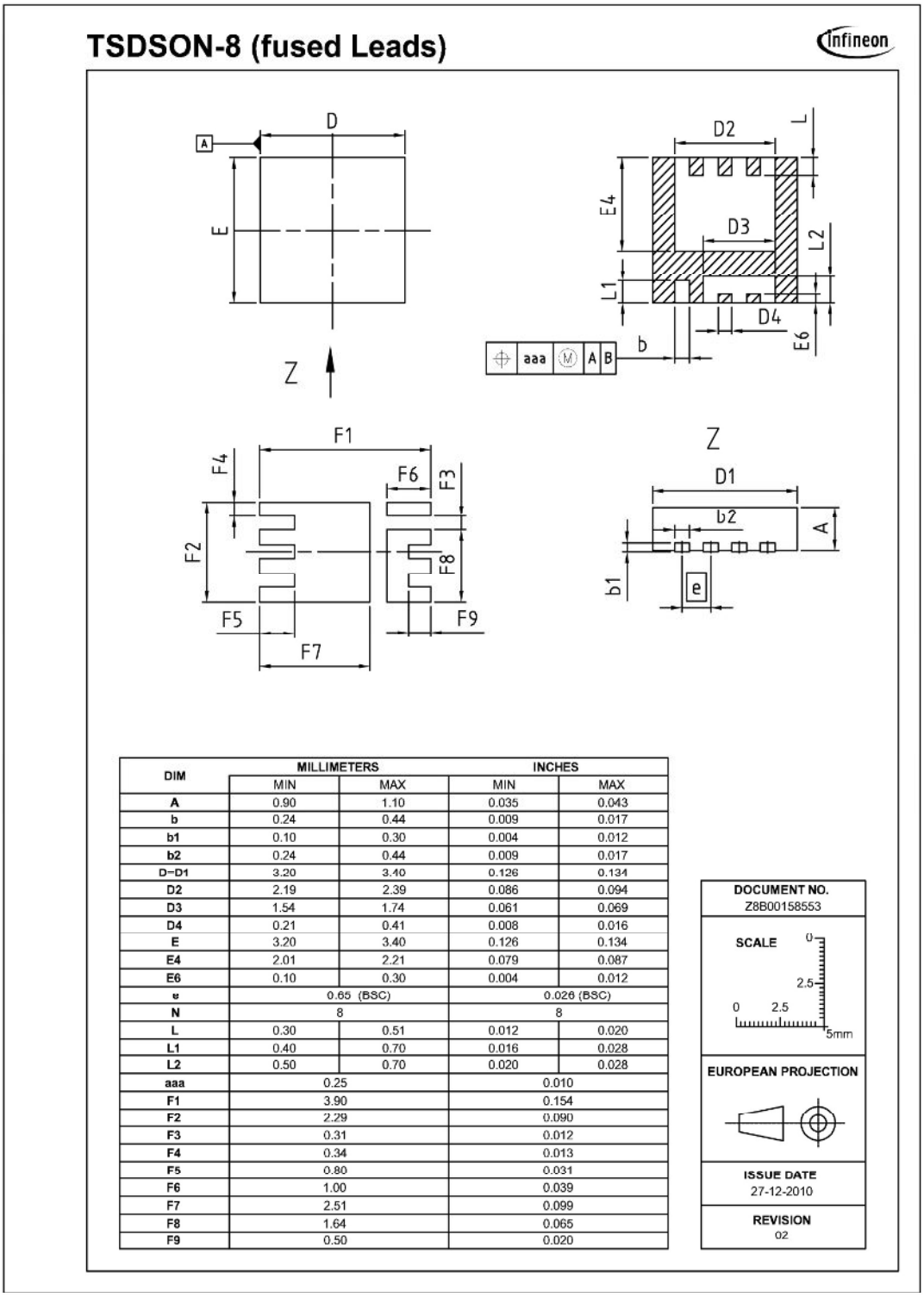



$V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA

Gate charge waveforms



# 5 Package Outlines




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.90 | 1.10 | 0.035 | 0.043 |
| b | 0.24 | 0.44 | 0.009 | 0.017 |
| b1 | 0.10 | 0.30 | 0.004 | 0.012 |
| b2 | 0.24 | 0.44 | 0.009 | 0.017 |
| D–D1 | 3.20 | 3.40 | 0.126 | 0.134 |
| D2 | 2.19 | 2.39 | 0.086 | 0.094 |
| D3 | 1.54 | 1.74 | 0.061 | 0.069 |
| D4 | 0.21 | 0.41 | 0.008 | 0.016 |
| E | 3.20 | 3.40 | 0.126 | 0.134 |
| E4 | 2.01 | 2.21 | 0.079 | 0.087 |
| E6 | 0.10 | 0.30 | 0.004 | 0.012 |
| e | 0.65 (BSC) | | 0.026 (BSC) | |
| N | 8 | | 8 | |
| L | 0.30 | 0.51 | 0.012 | 0.020 |
| L1 | 0.40 | 0.70 | 0.016 | 0.028 |
| L2 | 0.50 | 0.70 | 0.020 | 0.028 |
| aaa | 0.25 | | 0.010 | |
| F1 | 3.90 | | 0.154 | |
| F2 | 2.29 | | 0.090 | |
| F3 | 0.31 | | 0.012 | |
| F4 | 0.34 | | 0.013 | |
| F5 | 0.80 | | 0.031 | |
| F6 | 1.00 | | 0.039 | |
| F7 | 2.51 | | 0.099 | |
| F8 | 1.64 | | 0.065 | |
| F9 | 0.50 | | 0.020 | |

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REVISION
02

**Figure 1 Outline PG-TSDSON-8 FL, dimensions in mm/inches**

## Revision History

BSZ028N04LS

**Revision: 2016-06-09, Rev. 2.1**

| Previous Revision | | |
|---|---|---|
| Revision | Date | Subjects (major changes since last revision) |
| 2.1 | 2016-06-09 | Insert max values and update footnotes |



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