Never stop thinking

# n-Channel Power MOSFET

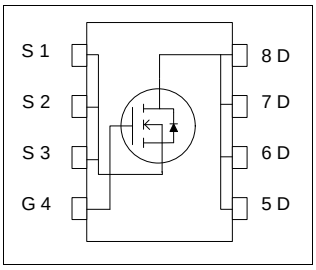
OptiMOS™
BSZ060NE2LS

## Data Sheet

2.1, 2011-09-19
Final

## Industrial & Multimarket

# 1 Description




OptiMOS™25V products are class leading power MOSFETs for highest power density and energy efficient solutions. Ultra low gate- and output charges together with lowest on state resistance in small footprint packages make OptiMOS™ 25V the best choice for the demanding requirements of voltage regulator solutions in Servers, Datacom and Telecom applications. Super fast switching Control FETs together with low EMI Sync FETs provide solutions that are easy to design in. OptiMOS™ products are available in high performance packages to tackle your most challenging applications giving full flexibility in optimizing space, efficiency and cost. OptiMOS™ products are designed to meet and exceed the energy efficiency and power density requirements of the sharpened next generation voltage regulation standards in computing applications.

### Features

- Optimized for high performance buck converters
- 100% avalanche tested
- N-channel
- Very low on-resistance $R_{DS(on)}$ @ $V_{GS}$=4.5 V
- Very low $FOM_{QOSS}$ for high frequency SMPS
- Low $FOM_{SW}$ for high frequency SMPS
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Qualified according to JEDEC[1)] for target applications
- Superior thermal resistance
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

### Applications

- On board power for server
- Power managment for high performance computing
- Synchronous rectification
- High power density point of load converters

**Table 1 Key Performance Parameters**

| Parameter | Value | Unit | | Related Links |
|---|---|---|---|---|
| $V_{DS}$ | 25 | V | | IFX OptiMOS webpage |
| $R_{DS(on),max}$ | 6 | mΩ | | IFX OptiMOS product brief |
| $I_D$ | 40 | A | | IFX OptiMOS spice models |
| $Q_{OSS}$ | 5.8 | nC | | IFX Design tools |
| $Q_{g\cdot typ}$ | 9.1 | | | |

| Type | Package | Marking |
|---|---|---|
| BSZ060NE2LS | PG-TSDSON-8 (fused leads) | 060NE2L |

1) J-STD20 and JESD22

## 2 Maximum ratings

at $T_j$ = 25 °C, unless otherwise specified.

**Table 2 Maximum ratings**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current | $I_D$ | - | - | 40 | A | $V_{GS}$=10 V, $T_C$=25 °C |
| | | - | - | 32 | | $V_{GS}$=10 V, $T_C$=100 °C |
| | | - | - | 40 | | $V_{GS}$=4.5 V, $T_C$=25 °C |
| | | - | - | 28 | | $V_{GS}$=4.5 V, $T_C$=100 °C |
| | | - | - | 12 | | $V_{GS}$=4.5 V, $T_A$=25 °C, $R_{thJA}$=60 K/W |
| Pulsed drain current[1] | $I_{D,pulse}$ | - | - | 160 | | $T_C$=25 °C |
| Avalanche current, single pulse[2] | $I_{AS}$ | - | - | 20 | | |
| Avalanche energy, single pulse | $E_{AS}$ | - | - | 16 | mJ | $I_D$=20 A,$R_{GS}$=25 Ω |
| Gate source voltage | $V_{GS}$ | -20 | - | 20 | V | |
| Power dissipation | $P_{tot}$ | - | - | 26 | W | $T_C$=25 °C |
| | | - | - | 2.1 | | $T_A$=25 °C, $R_{thJA}$=60 K/W |
| Operating and storage temperature | $T_j$,$T_{stg}$ | -55 | - | 150 | °C | |
| IEC climatic category; DIN IEC 68-1 | | 55/150/56 | | | | |

1) See figure 3 for more detailed information
2) See figure 13 for more detailed information

## 3 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 4.9 | K/W | |
| Device on PCB | $R_{thJA}$ | - | - | 60 | | 6 cm$^2$ cooling area[1] |

1) Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm$^2$ (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air

# 4 Electrical characteristics

Electrical characteristics, at $T$j=25 °C, unless otherwise specified.

**Table 4 Static characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 25 | - | - | V | $V_{GS}$=0 V, $I_D$=1.0 mA |
| Gate threshold voltage | $V_{GS(th)}$ | 1.2 | - | 2 | | $V_{DS}$=$V_{GS}$, $I_D$=250 µA |
| Zero gate voltage drain current | $I_{DSS}$ | - | 0.1 | 1 | µA | $V_{DS}$=25 V, $V_{GS}$=0 V, $T_j$=25 °C |
| | | - | 10 | 100 | | $V_{DS}$=25 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 | $R_{DS(on)}$ | - | 6.5 | 8.1 | mΩ | $V_{GS}$=4.5 V, $I_D$=20 A |
| | | - | 5 | 6 | | $V_{GS}$=10 V, $I_D$=20 A |
| Gate resistance | $R_G$ | - | 1 | - | Ω | |
| Transconductance | $g_{fs}$ | 34 | 67 | - | S | $\|V_{DS}\|>2\|I_D\|_{RDS(on)max}$, $I_D$=30 A |

**Table 5 Dynamic characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 670 | - | pF | $V_{GS}$=0 V, $V_{DS}$=12 V, $f$=1 MHz |
| Output capacitance | $C_{oss}$ | - | 290 | - | | |
| Reverse transfer capacitance | $C_{rss}$ | - | 31 | - | | |
| Turn-on delay time | $t_{d(on)}$ | - | 2.5 | - | ns | $V_{DD}$=12 V, $V_{GS}$=10 V, $I_D$=30 A, $R_G$= 1.6 Ω |
| Rise time | $t_r$ | - | 2.2 | - | | |
| Turn-off delay time | $t_{d(off)}$ | - | 11 | - | | |
| Fall time | $t_f$ | - | 1.8 | - | | |

**Table 6 Gate charge characteristics[1)]**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 1.9 | - | nC | $V_{DD}$=12 V, $I_D$=30 A, $V_{GS}$=0 to 4.5 V |
| Gate charge at threshold | $Q_{g(th)}$ | - | 1.1 | - | | |
| Gate to drain charge | $Q_{gd}$ | - | 1.1 | - | | |
| Switching charge | $Q_{sw}$ | - | 2 | - | | |
| Gate charge total | $Q_g$ | - | 4.4 | - | | |
| Gate plateau voltage | $V_{plateau}$ | - | 2.9 | - | V | |
| Gate charge total | $Q_g$ | - | 9.1 | - | nC | $V_{DD}$=12 V, $I_D$=30 A, $V_{GS}$=0 to 10V |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 3.8 | - | | $V_{DS}$=0.1 V, $V_{GS}$=0 to 4.5 V |
| Output charge | $Q_{oss}$ | - | 5.8 | - | | $V_{DD}$=12V, $V_{GS}$=0 V |

1) See figure 16 for gate charge parameter definition

**Table 7 Reverse diode characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | 25 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 100 | | |
| Diode forward voltage | $V_{SD}$ | - | 0.87 | 1 | V | $V_{GS}$=0 V, $I_F$=20 A, $T_j$=25 °C |
| Reverse recovery charge | $Q_{rr}$ | - | 5 | - | nC | $V_R$=15 V, $I_F$=$I_S$, $dI_F/dt$=400 A/µs |

# 5 Electrical characteristics diagrams

**Table 8**

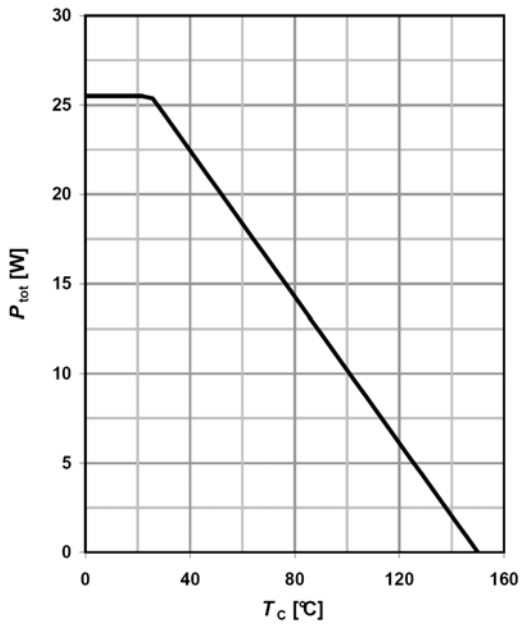
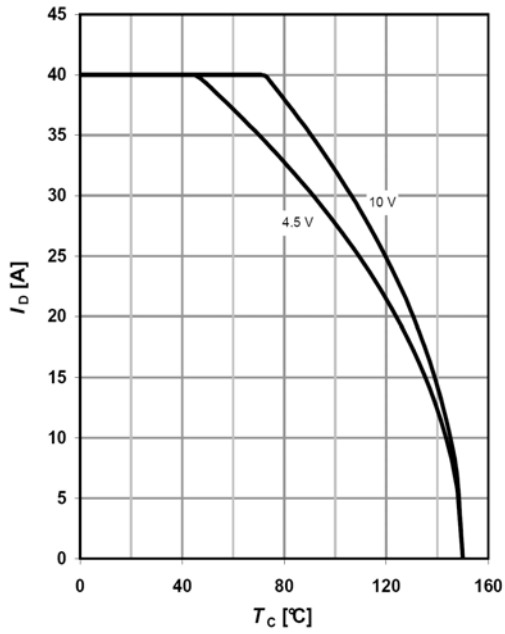
| 1 Power dissipation | 2 Drain current |
|---|---|
|  |  |
| $P_{tot} = f(T_C)$ | $I_D=f(T_C)$; parameter:$V_{GS}$ |

**Table 9**

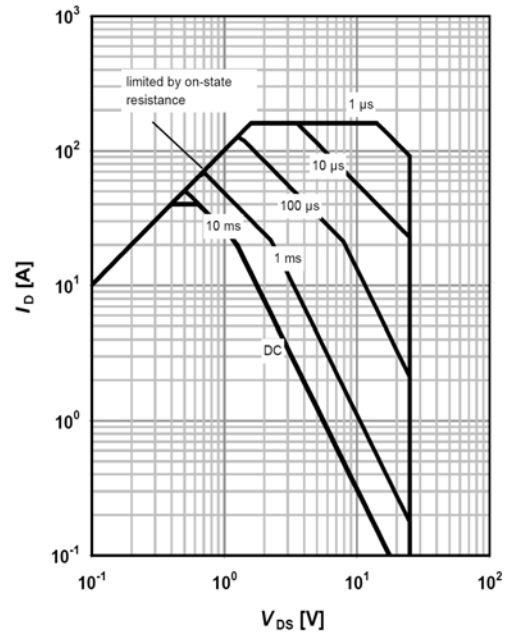
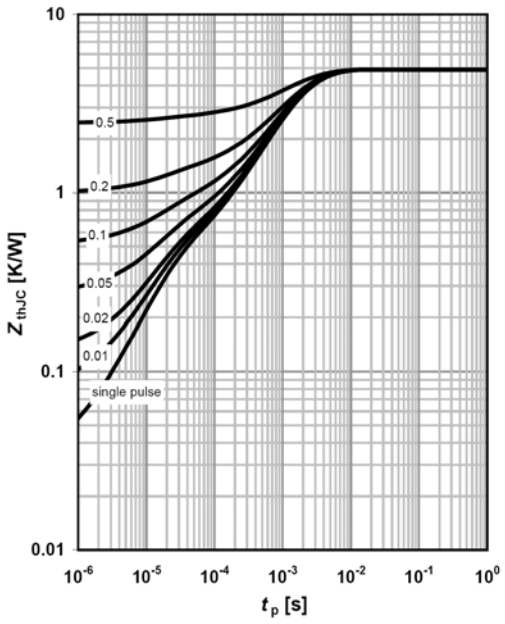
| 3 Safe operating area $T_C$=25 °C | 4 Max. transient thermal impedance |
|---|---|
|  |  |
| $I_D=f(V_{DS})$; $T_j$=25 °C; D=0; parameter: $T_p$ | $Z_{(thJC)}=f(t_p)$; parameter: D=$t_p/T$ |

**Table 10**

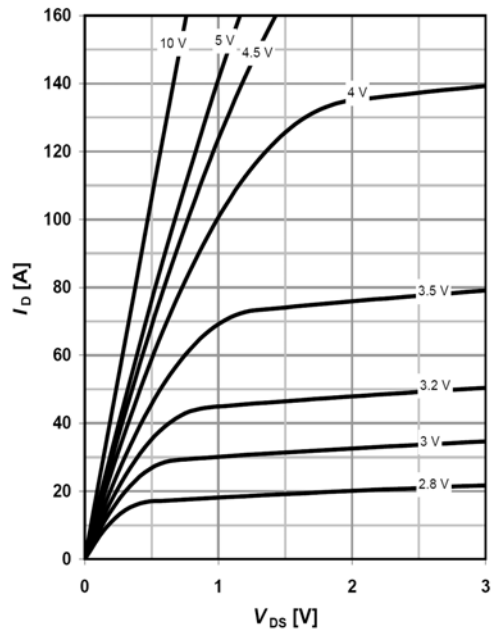
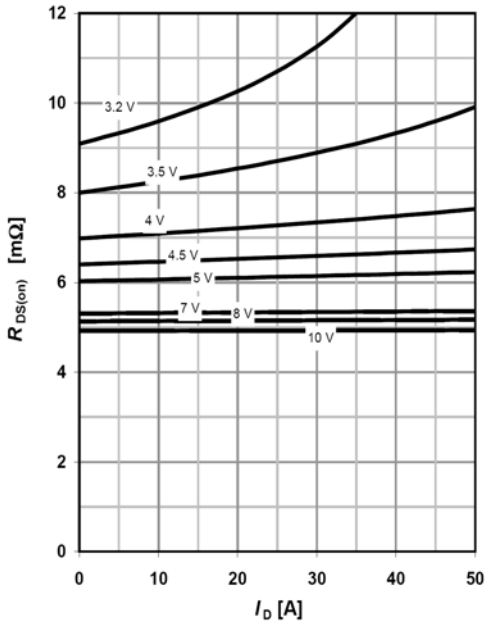
| 5 Typ. output characteristics $T_C$=25 °C | 6 Typ. drain-source on-state resistance |
|---|---|
|  |  |
| $I_D$=f($V_{DS}$); $T_j$=25 °C; parameter: $V_{GS}$ | $R_{DS(on)}$=f($I_D$); $T_j$=25 °C; parameter: $V_{GS}$ |

**Table 11**

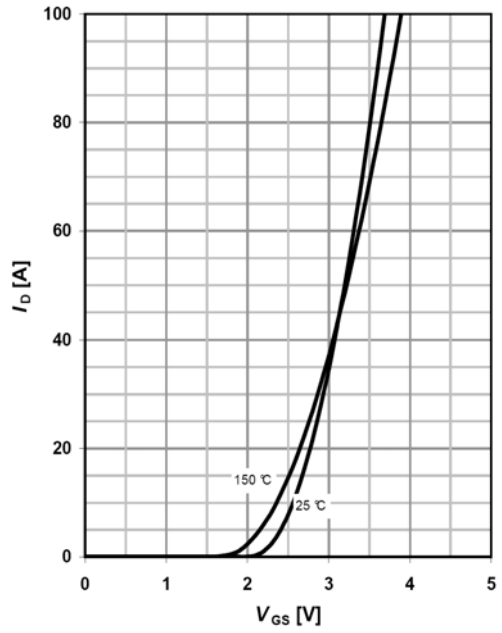
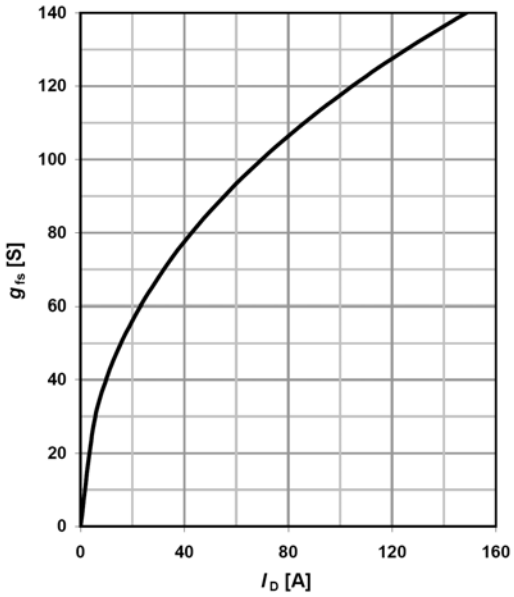
| 7 Typ. transfer characteristics | 8 Typ. forward transconductance |
|---|---|
|  |  |
| $I_D$=f(VGS); $\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$ | $g_{fs}$=f($I_D$); $T_j$=25 °C |

**Table 12**

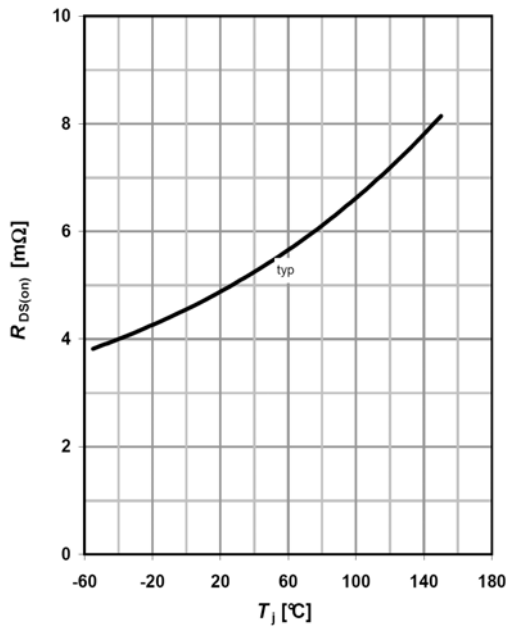
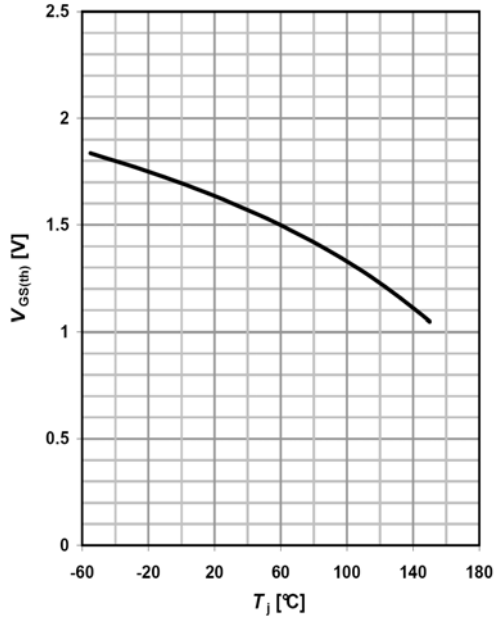
| 9 Drain-source on-state resistance | 10 Typ. gate threshold voltage |
|---|---|
|  |  |
| $R_{DS(on)}=f(T_j)$; $I_D$=30 A; $V_{GS}$=10 V | $V_{GS(th)}=f(T_j)$; $V_{GS}=V_{DS}$; $I_D$=250 µA |

**Table 13**

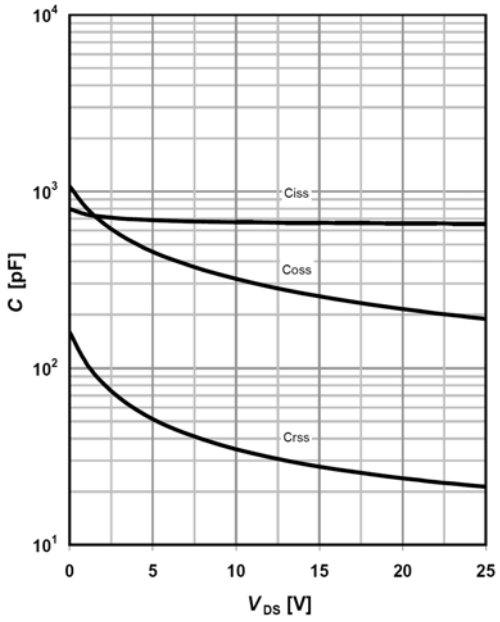
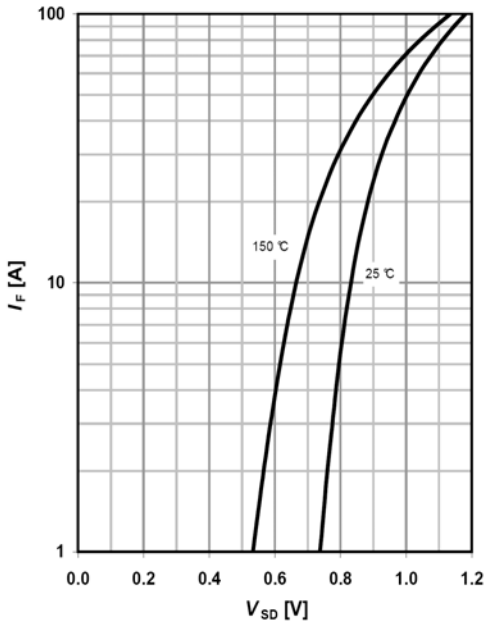
| 11 Typ. capacitances | 12 Forward characteristics of reverse diode |
|---|---|
|  |  |
| C=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz | $I_F=f(V_{SD})$; parameter: $T_j$ |

**Table 14**

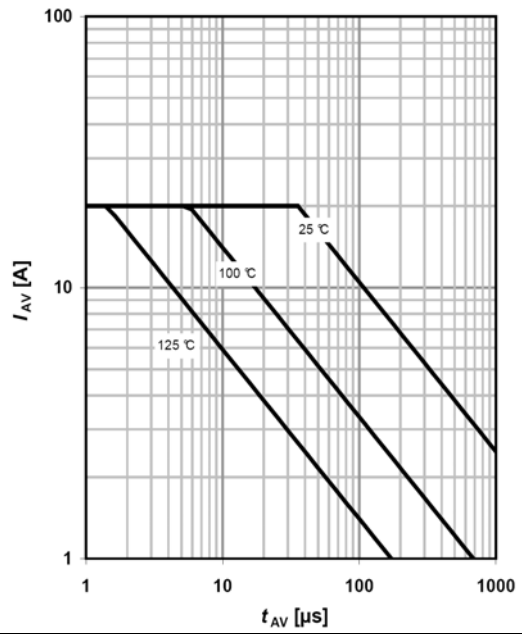
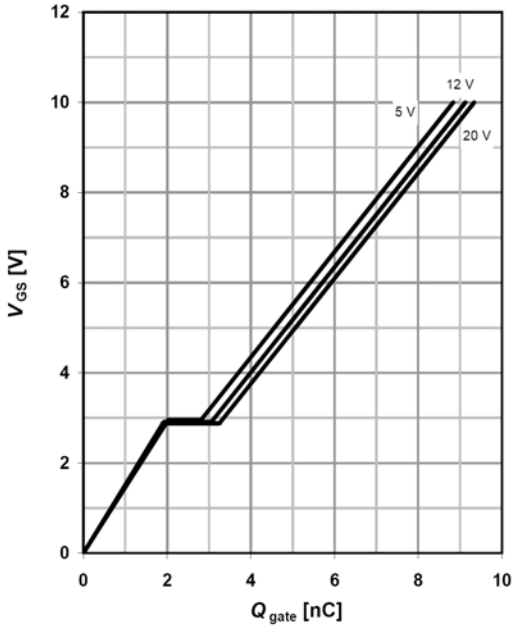
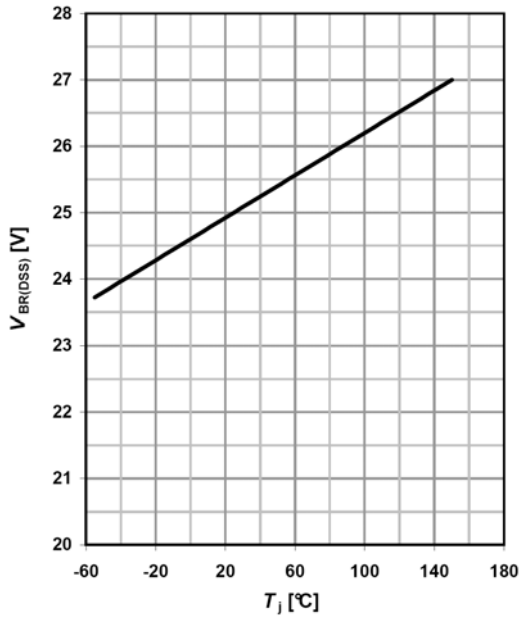
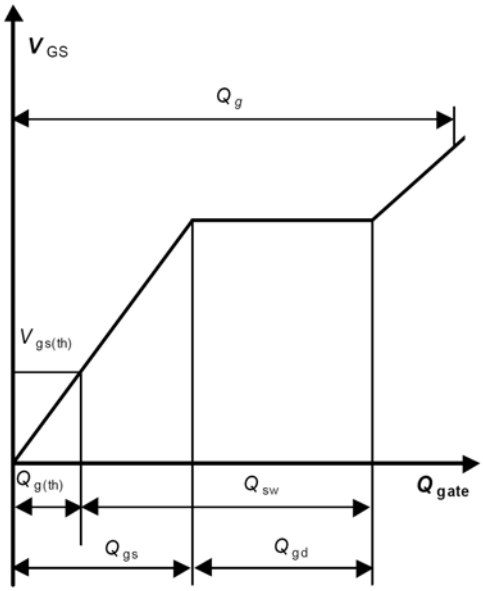
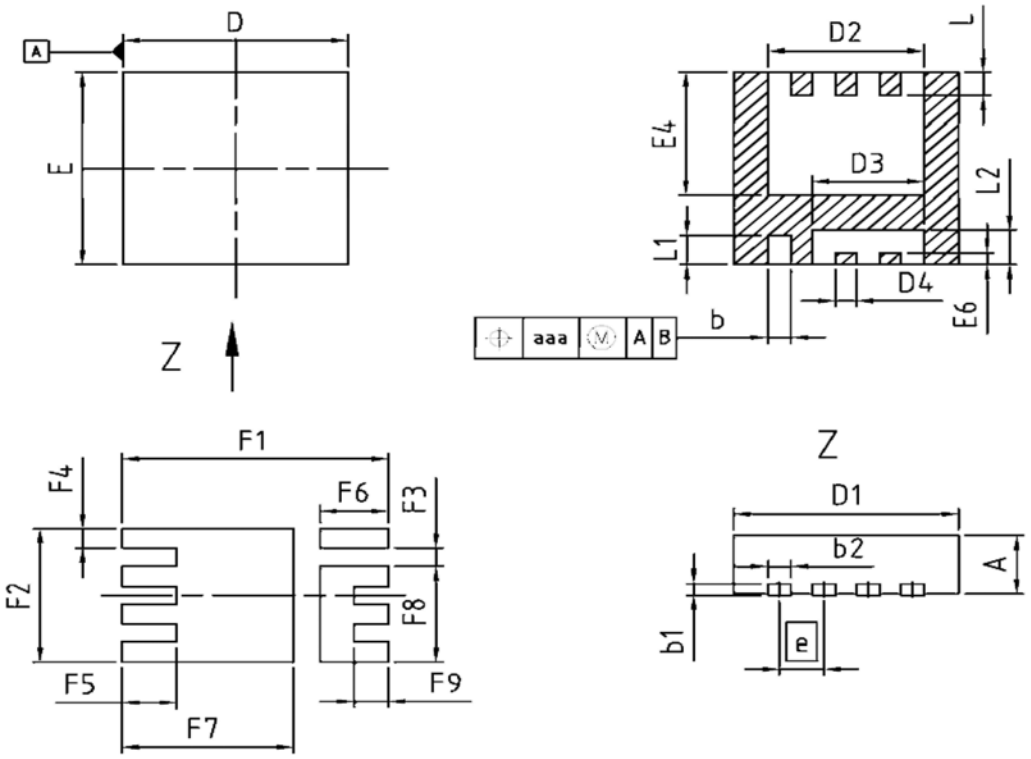
| 13 Avalanche characteristics | 14 Typ. gate charge |
|---|---|
|  |  |
| $I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω; parameter: $T_{j(start)}$ | $V_{GS}$=f($Q_{gate}$); $I_D$=30 A pulsed; parameter: $V_{DD}$ |

**Table 15**

| 15 Drain-source breakdown voltage | 16 Gate charge waveforms |
|---|---|
|  |  |
| $V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA | |

# 6 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 | |

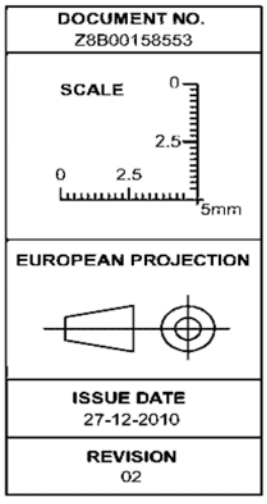



**Figure 1 Outlines PG-TSDSON-8 ( fused leads ), dimensions in mm/inches**

# 7 Revision History

**Revision History: 2011-09-19, 2.1**

**Previous Revision:**

| Revision | Subjects (major changes since last revision) |
|---|---|
| 0.1 | Release of target data sheet |
| 2.0 | Release Final version |
| 2.1 | Update VGS(th) |
| | |

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