

**OptiMOS™ Power-MOSFET**
**Features**

- Optimized for high performance Buck converter
- Very low parasitic inductance
- Low profile (<0.5 mm)
- Double side cooling
- N-channel
- 100% avalanche tested
- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5\text{ V}$
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- Qualified according to JEDEC<sup>1)</sup> for target applications


**Product Summary**

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 25  | V  |
| $R_{DS(on),max}$ | 4.5 | mΩ |
| $I_D$            | 50  | A  |
| $Q_{OSS}$        | 7.6 | nC |
| $Q_G(0V..10V)$   | 11  | nC |

**LG-USON-6-1**


| Type        | Package     | Marking |
|-------------|-------------|---------|
| BSN045NE2LS | LG-USON-6-1 | 045NE2L |

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

| Parameter                                     | Symbol        | Conditions   | Value | Unit |
|---|---------------|--|-------|------|
| Continuous drain current                      | $I_D$         | $V_{GS}=10\text{ V}, T_C=25\text{ °C}$                           | 50    | A    |
|   |               | $V_{GS}=10\text{ V}, T_C=100\text{ °C}$                          | 47    |      |
|   |               | $V_{GS}=4.5\text{ V}, T_C=25\text{ °C}$                          | 50    |      |
|   |               | $V_{GS}=4.5\text{ V}, T_C=100\text{ °C}$                         | 39    |      |
|   |               | $V_{GS}=10\text{ V}, T_A=25\text{ °C}, R_{thJA}=50\text{ K/W}^2$ | 19    |      |
| Pulsed drain current <sup>3)</sup>            | $I_{D,pulse}$ | $T_C=25\text{ °C}$   | 200   |      |
| Avalanche current, single pulse <sup>4)</sup> | $I_{AS}$      | $T_C=25\text{ °C}$   | 35    |      |
| Avalanche energy, single pulse                | $E_{AS}$      | $I_D=35\text{ A}, R_{GS}=25\text{ Ω}$                            | 5     | mJ   |
| Gate source voltage                           | $V_{GS}$      |  | ±20   | V    |

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

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

| Parameter                           | Symbol                | Conditions   | Value       | Unit |
|-------------------------------------|-----------------------|--|-------------|------|
| Power dissipation                   | $P_{\text{tot}}$      | $T_C=25\text{ °C}$   | 39          | 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 | $R_{\text{thJC}}$ | bottom                                       | - | - | 3.2 | K/W |
|                                     |                   | top  | - | - | 1   |     |
| Device on PCB                       | $R_{\text{thJA}}$ | 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   | $V_{(\text{BR})\text{DSS}}$ | $V_{\text{GS}}=0\text{ V}, I_{\text{D}}=1\text{ mA}$                            | 25  | -   | -   | V             |
| Gate threshold voltage           | $V_{\text{GS(th)}}$         | $V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=250\text{ }\mu\text{A}$              | 1.2 | -   | 2   |               |
| Zero gate voltage drain current  | $I_{\text{DSS}}$            | $V_{\text{DS}}=30\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ °C}$         | -   | 0.1 | 1   | $\mu\text{A}$ |
|                                  |                             | $V_{\text{DS}}=30\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ °C}$        | -   | 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 | $R_{\text{DS(on)}}$         | $V_{\text{GS}}=4.5\text{ V}, I_{\text{D}}=30\text{ A}$                          | -   | 5.2 | 6.5 | m $\Omega$    |
|                                  |                             | $V_{\text{GS}}=10\text{ V}, I_{\text{D}}=30\text{ A}$                           | -   | 3.8 | 4.5 |               |
| Gate resistance                  | $R_{\text{G}}$              |   | 0.4 | 0.8 | 1.6 | $\Omega$      |
| Transconductance                 | $g_{\text{fs}}$             | $ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=30\text{ A}$ | 39  | 78  | -   | S             |

<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

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

**Dynamic characteristics**

|                              |              |  |   |     |      |    |
|------------------------------|--------------|--|---|-----|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=15\text{ V}, f=1\text{ MHz}$                          | - | 780 | 1100 | pF |
| Output capacitance           | $C_{oss}$    |  | - | 290 | 400  |    |
| Reverse transfer capacitance | $C_{rss}$    |  | - | 32  | -    |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=15\text{ V}, V_{GS}=10\text{ V}, I_D=30\text{ A}, R_{G,ext}=1.6\ \Omega$ | - | 1.8 | -    | ns |
| Rise time                    | $t_r$        |  | - | 3.4 | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |  | - | 12  | -    |    |
| Fall time                    | $t_f$        |  | - | 2.4 | -    |    |

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

|                              |               |  |   |     |    |    |
|------------------------------|---------------|--|---|-----|----|----|
| Gate to source charge        | $Q_{gs}$      | $V_{DD}=15\text{ V}, I_D=30\text{ A}, V_{GS}=0\text{ to }4.5\text{ V}$ | - | 2.2 | 3  | nC |
| Gate charge at threshold     | $Q_{g(th)}$   |  | - | 1.3 | -  |    |
| Gate to drain charge         | $Q_{gd}$      |  | - | 1.4 | 2  |    |
| Switching charge             | $Q_{sw}$      |  | - | 2.4 | -  |    |
| Gate charge total            | $Q_g$         |  | - | 5.3 | 7  |    |
| Gate plateau voltage         | $V_{plateau}$ |  | - | 2.8 | -  | V  |
| Gate charge total            | $Q_g$         | $V_{DD}=15\text{ V}, I_D=30\text{ A}, V_{GS}=0\text{ to }10\text{ V}$  | - | 11  | 15 | nC |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | $V_{DS}=0.1\text{ V}, V_{GS}=0\text{ to }4.5\text{ V}$                 | - | 4.5 | -  |    |
| Output charge                | $Q_{oss}$     | $V_{DD}=15\text{ V}, V_{GS}=0\text{ V}$                                | - | 7.6 | 10 |    |

**Reverse Diode**

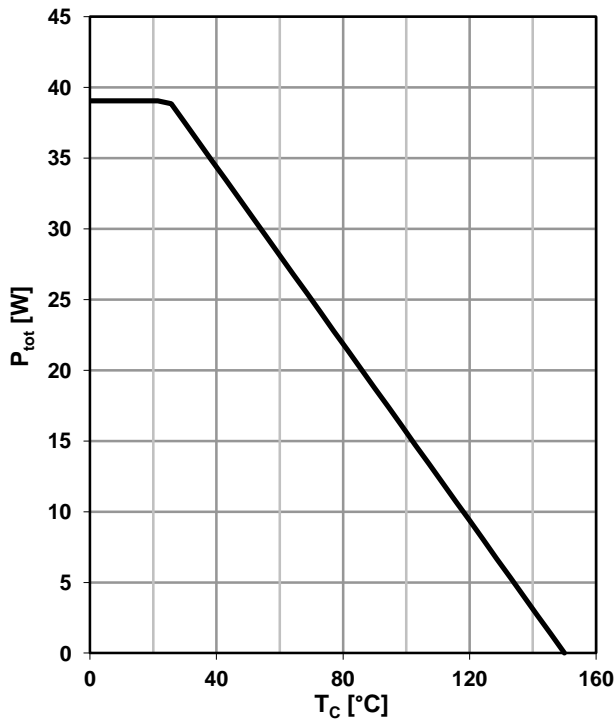
|                                  |               |  |   |     |     |    |
|----------------------------------|---------------|--|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$                                     | - | -   | 36  | A  |
| Diode pulse current              | $I_{S,pulse}$ |  | - | -   | 200 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=30\text{ A}, T_j=25\text{ }^\circ\text{C}$ | - | 0.9 | -   | V  |
| Reverse recovery charge          | $Q_{rr}$      | $V_R=15\text{ V}, I_F=I_S, di_F/dt=400\text{ A}/\mu\text{s}$       | - | 5   | -   | nC |

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

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

**1 Power dissipation**

$P_{tot}=f(T_C)$



**2 Drain current**

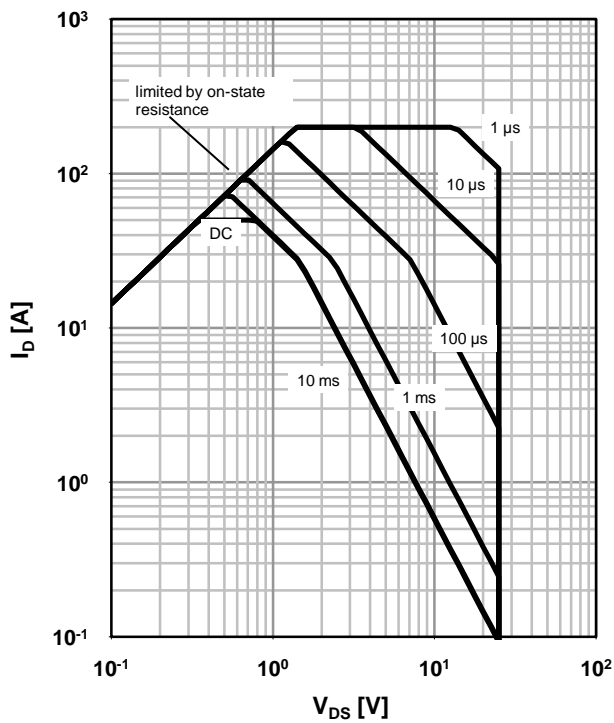
$I_D=f(T_C); V_{GS} \geq 10\text{ V}$



**3 Safe operating area**

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

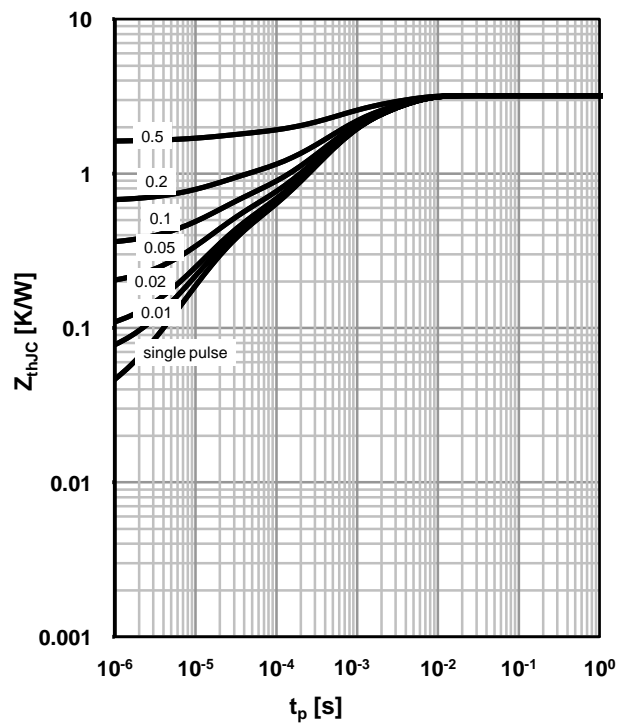
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

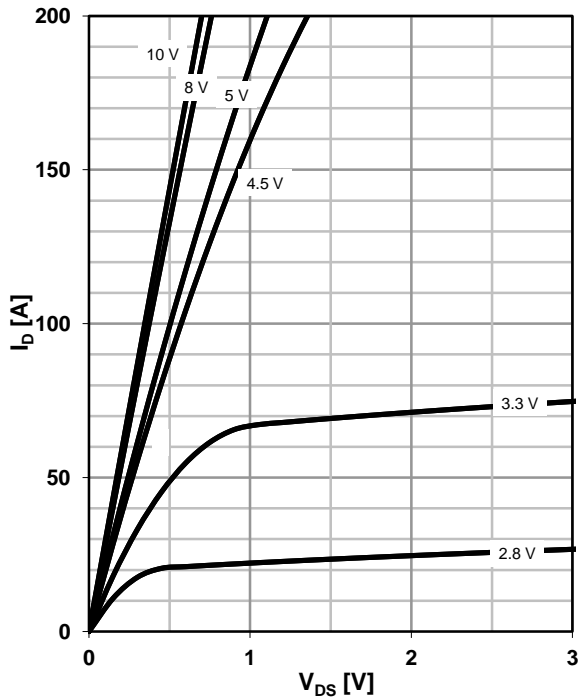
parameter:  $D=t_p/T$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

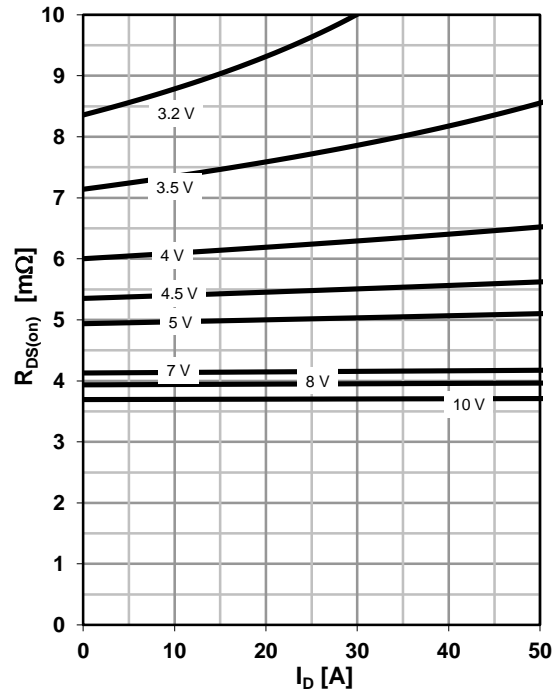
parameter:  $V_{GS}$



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

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

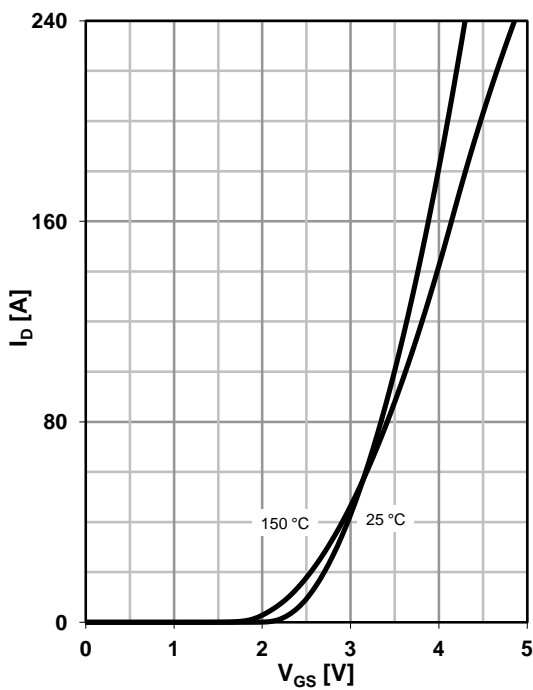
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

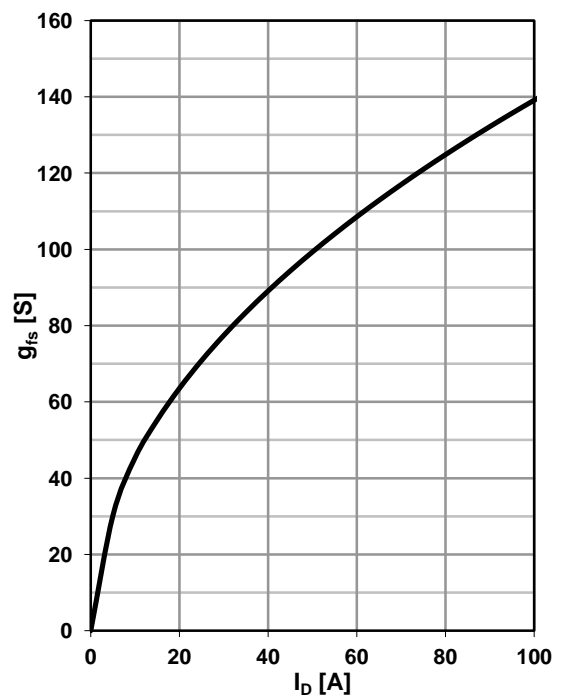
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



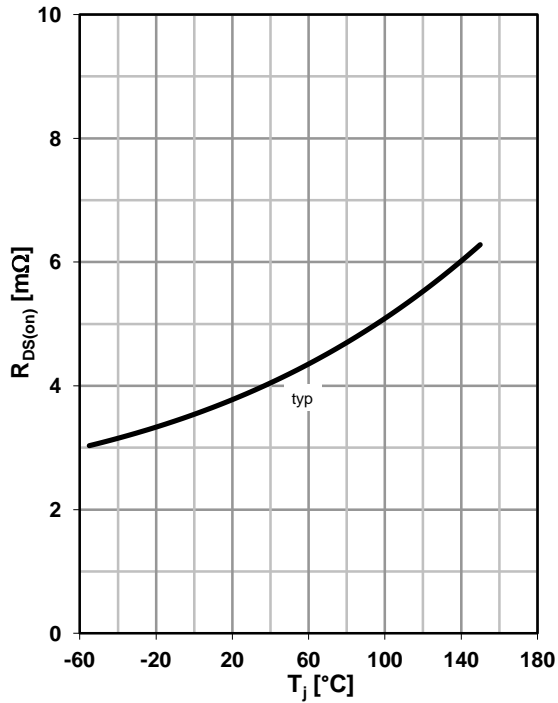
**8 Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



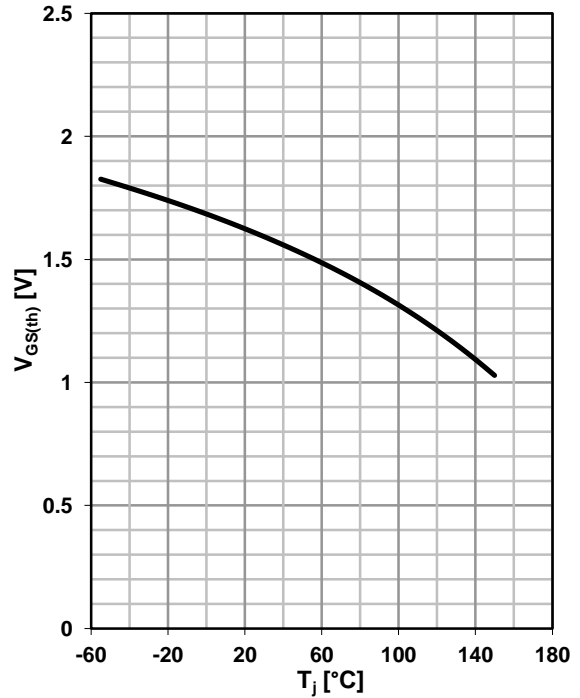
**9 Drain-source on-state resistance**

$R_{DS(on)}=f(T_j); I_D=30\text{ A}; V_{GS}=10\text{ V}$



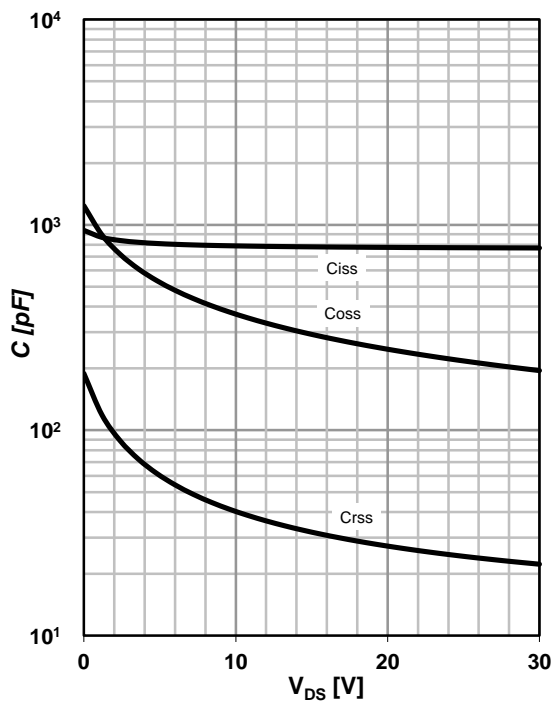
**10 Typ. gate threshold voltage**

$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}; I_D=250\text{ }\mu\text{A}$



**11 Typ. capacitances**

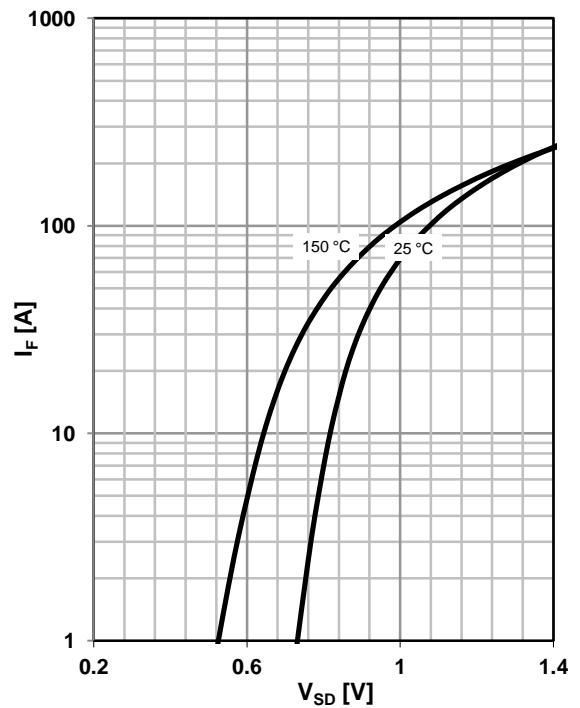
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

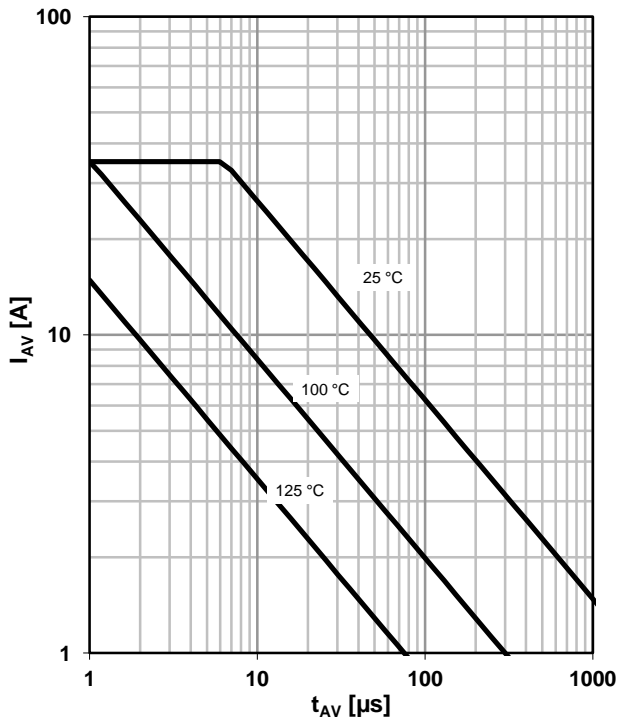
parameter:  $T_j$



**13 Avalanche characteristics**

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

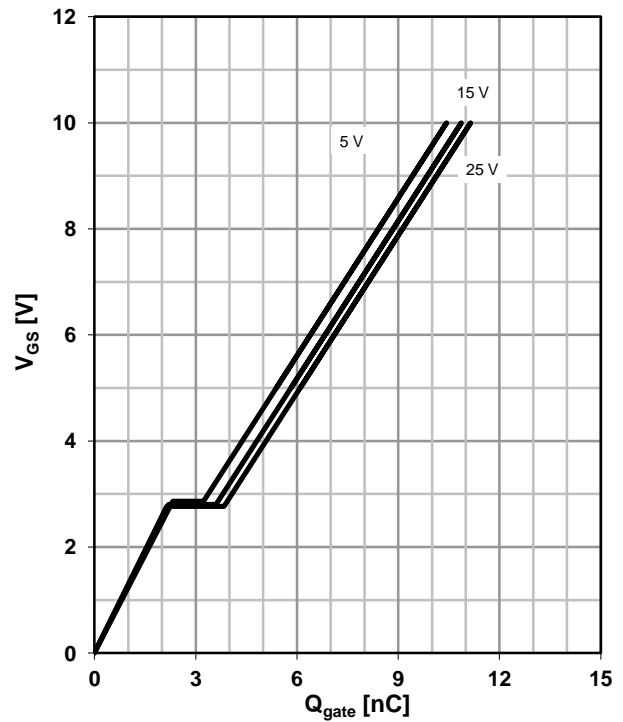
parameter:  $T_{j(\text{start})}$



**14 Typ. gate charge**

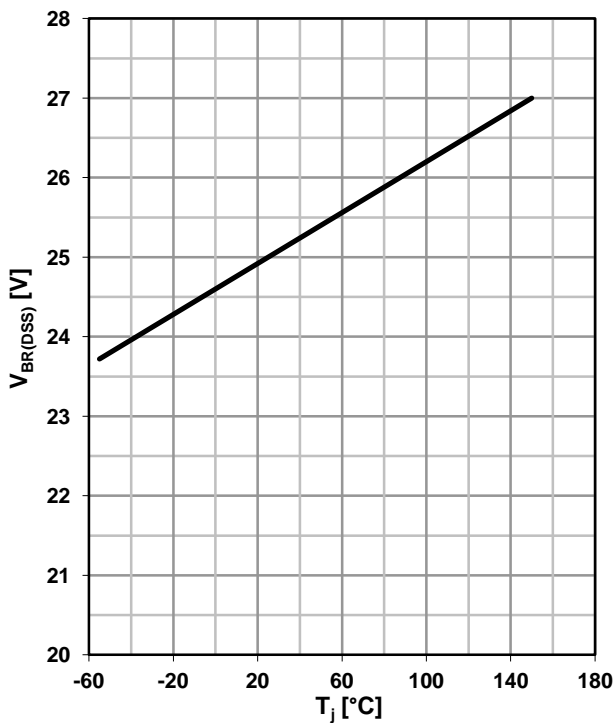
$V_{GS}=f(Q_{\text{gate}}); I_D=30 \text{ A pulsed}$

parameter:  $V_{DD}$

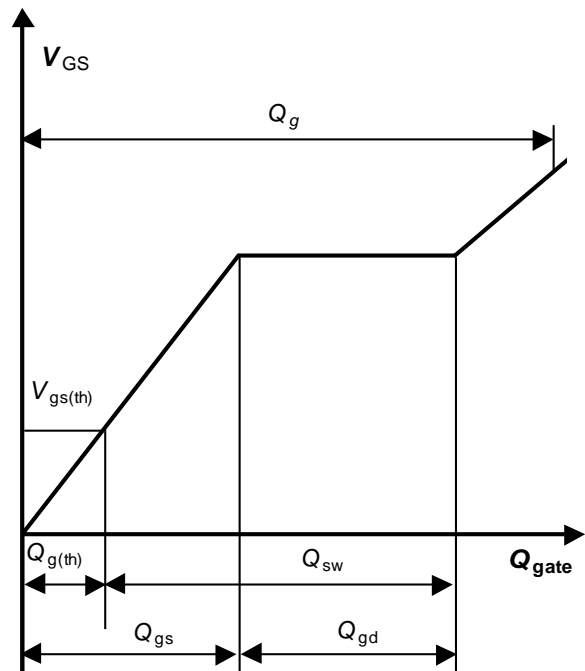


**15 Drain-source breakdown voltage**

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



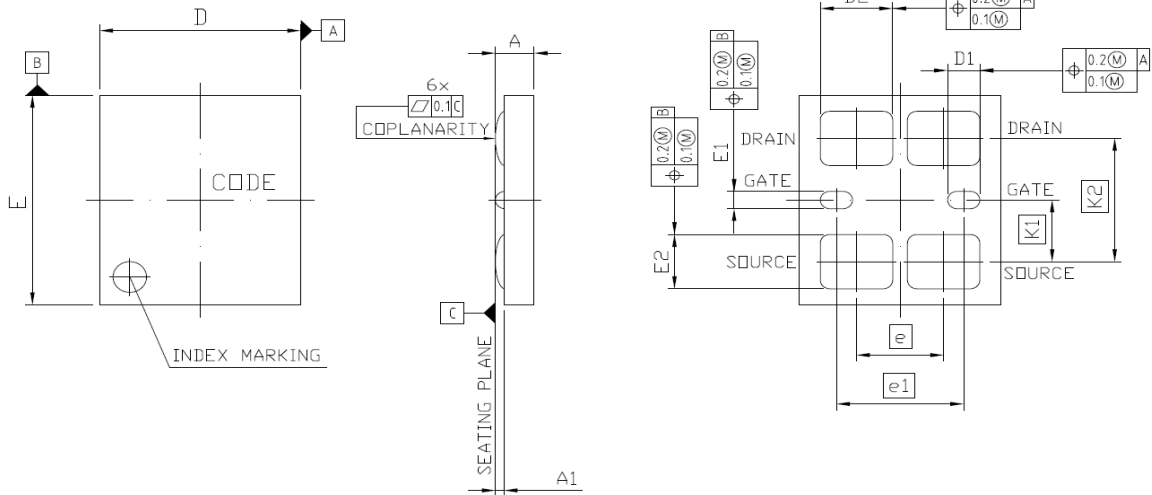
**16 Gate charge waveforms**



Package Outline

LG-USON-6-1

LG-USON-6-1: Outline



| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | -           | 0.65 | -      | 0.026 |
| A1  | 0.08        | -    | 0.003  | -     |
| D   | 2.90        | 3.10 | 0.114  | 0.122 |
| D1  | 0.38        | 0.58 | 0.015  | 0.023 |
| D2  | 0.98        | 1.18 | 0.039  | 0.046 |
| e   | 1.30        |      | 0.051  |       |
| e1  | 1.90        |      | 0.075  |       |
| E   | 3.30        | 3.50 | 0.130  | 0.138 |
| E1  | 0.18        | 0.38 | 0.007  | 0.015 |
| E2  | 0.78        | 0.98 | 0.031  | 0.039 |
| K1  | 1.00        |      | 0.039  |       |
| K2  | 2.00        |      | 0.079  |       |

**DOCUMENT NO.**  
Z8B00170449

**SCALE**

**EUROPEAN PROJECTION**

**ISSUE DATE**  
03.09.2013

**REVISION**  
01



**Published by**  
**Infineon Technologies AG**  
**81726 Munich, Germany**  
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