
# PSMN011-60ML

## N-channel 60 V 11.3 mΩ logic level MOSFET in LFPAK33

4 June 2013 Product data sheet

## 1. General description

Logic level enhancement mode N-channel MOSFET in LFPAK33 package. This product is designed and qualified for use in a wide range of industrial, communications and domestic equipment.

## 2. Features and benefits

- High efficiency due to low switching and conduction losses
- Suitable for standard level gate drive sources
- LFPAK33 package is footprint compatible with other 3.3mm types
- Qualified to 175 °C

## 3. Applications

- AC-to-DC converters
- Synchronous rectification
- DC-DC converters

## 4. Quick reference data

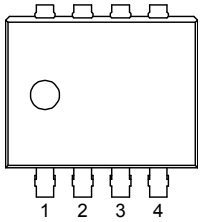
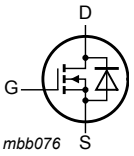
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | - | - | 60 | V |
| $I_D$ | drain current | $T_{mb}$ = 25 °C; $V_{GS}$ = 10 V; Fig. 1 | | - | - | 61 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; Fig. 2 | | - | - | 91 | W |
| $T_j$ | junction temperature | | | -55 | - | 175 | °C |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; Fig. 12 | | - | 9.35 | 11.3 | mΩ |
| | | $V_{GS}$ = 4.5 V; $I_D$ = 15 A; $T_j$ = 25 °C; Fig. 12 | | - | 11 | 13.1 | mΩ |
| **Dynamic characteristics** | | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS}$ = 4.5 V; $I_D$ = 15 A; $V_{DS}$ = 30 V; $T_j$ = 25 °C; Fig. 14; Fig. 15 | | - | 5.1 | - | nC |

Scan or click this QR code to view the latest information for this product

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | S | source |   LFPAK33 (SOT1210) |   |
| 2 | S | source | | |
| 3 | S | source | | |
| 4 | G | gate | | |
| mb | D | mounting base; connected to drain | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PSMN011-60ML | LFPAK33 | Plastic single ended surface mounted package (LFPAK33); 4 leads | SOT1210 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| PSMN011-60ML | M11L60 |

## 8. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | - | 60 | V |
| $V_{GS}$ | gate-source voltage | | | -20 | 20 | V |
| $I_D$ | drain current | $V_{GS}$ = 10 V; $T_{mb}$ = 25 °C; Fig. 1 | | - | 61 | A |
| | | $V_{GS}$ = 10 V; $T_{mb}$ = 100 °C; Fig. 1 | | - | 43 | A |
| $I_{DM}$ | peak drain current | pulsed; $t_p \leq 10$ µs; $T_{mb}$ = 25 °C; Fig. 4 | | - | 242 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; Fig. 2 | | - | 91 | W |
| $T_{stg}$ | storage temperature | | | -55 | 175 | °C |
| $T_j$ | junction temperature | | | -55 | 175 | °C |

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $T_{sld(M)}$ | peak soldering temperature | | | - | 260 | °C |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{mb}$ = 25 °C | [1] | - | 70 | A |
| $I_{SM}$ | peak source current | pulsed; $t_p \leq 10$ µs; $T_{mb}$ = 25 °C | | - | 242 | A |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; $I_D$ = 61 A; $V_{sup} \leq 60$ V; $R_{GS}$ = 50 Ω; unclamped; Fig. 3 | | - | 48.5 | mJ |

[1] Continuous current is limited by package

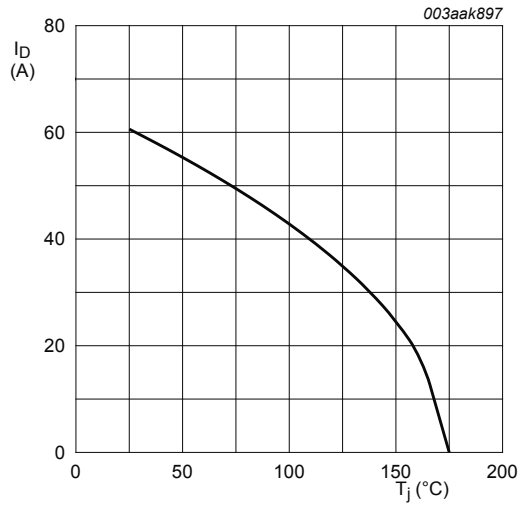



**Fig. 1. Continuous drain current as a function of mounting base temperature**

$V_{GS} \geq 10V$

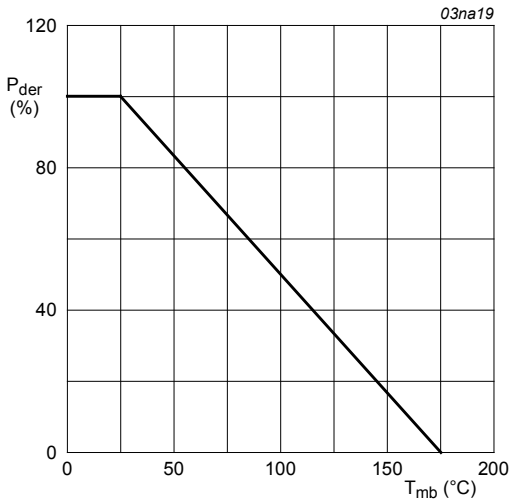



**Fig. 2. Normalized total power dissipation as a function of mounting base temperature**

$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

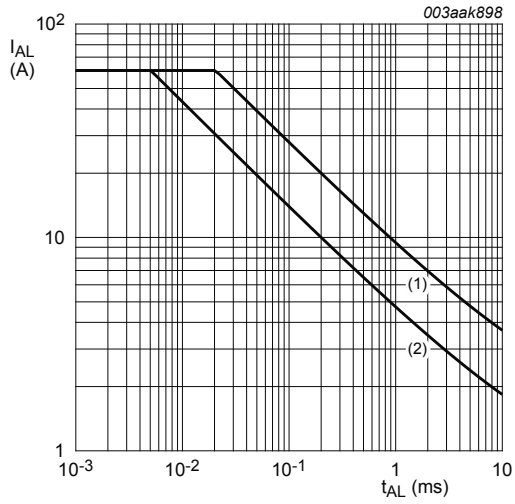



**Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time**

(1) $T_{j\ (init)} = 25°C$; (2) $T_{j\ (init)} = 100°C$

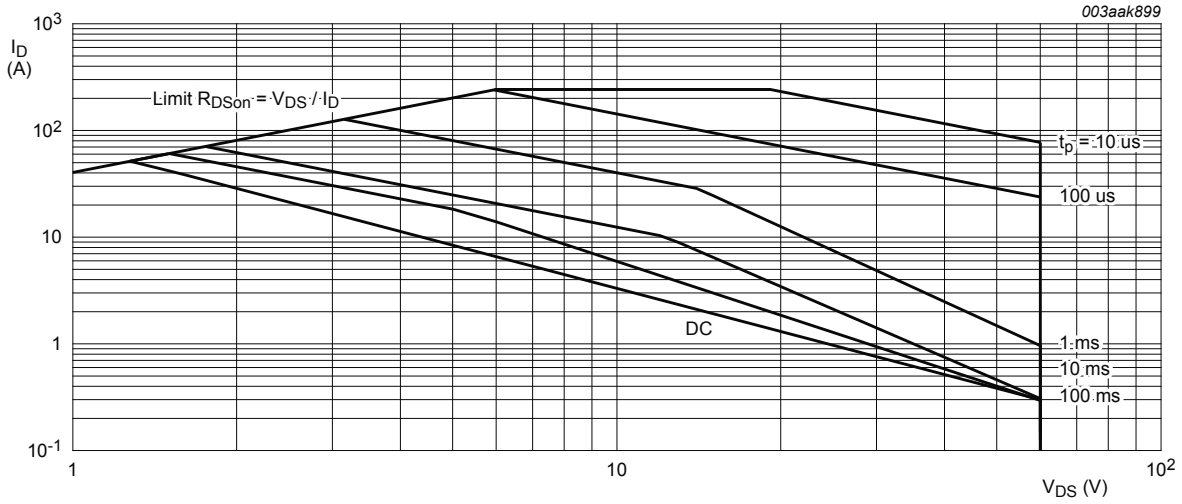



**Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

$T_{mb} = 25°C$; $I_{DM}$ *is a single pulse*

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j\text{-}mb)}$ | thermal resistance from junction to mounting base | Fig. 5 | | - | 1.44 | 1.65 | K/W |

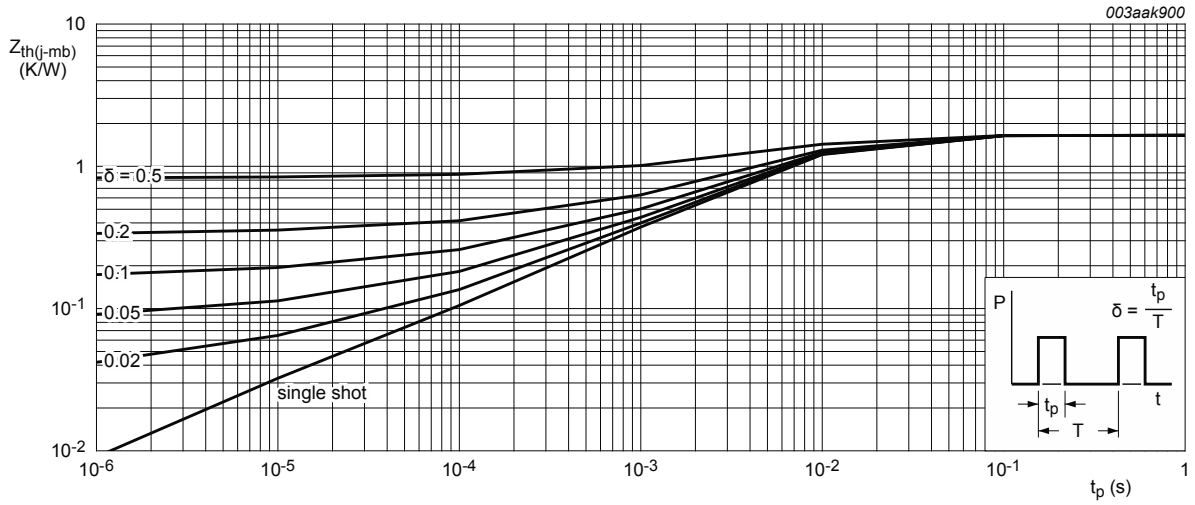



**Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 10. Characteristics

**Table 7. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | 60 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | | 54 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; Fig. 10 | | - | - | 2.45 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; Fig. 11; Fig. 10 | | 1.3 | 1.7 | 2.15 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; Fig. 10 | | 0.5 | - | - | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 0.03 | 1 | µA |
| | | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 175 °C | | - | - | 500 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 16 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 100 | nA |
| | | $V_{GS}$ = -16 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; Fig. 12 | | - | 9.35 | 11.3 | mΩ |
| | | $V_{GS}$ = 4.5 V; $I_D$ = 15 A; $T_j$ = 25 °C; Fig. 12 | | - | 11 | 13.1 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 175 °C; Fig. 12; Fig. 13 | | - | - | 24.8 | mΩ |
| | | $V_{GS}$ = 4.5 V; $I_D$ = 15 A; $T_j$ = 175 °C; Fig. 12; Fig. 13 | | - | - | 28.8 | mΩ |
| $R_G$ | gate resistance | f = 1 MHz | | - | 1.86 | - | Ω |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 15 A; $V_{DS}$ = 30 V; $V_{GS}$ = 10 V; $T_j$ = 25 °C; Fig. 14; Fig. 15 | | - | 37.2 | - | nC |
| | | $I_D$ = 15 A; $V_{DS}$ = 30 V; $V_{GS}$ = 4.5 V; $T_j$ = 25 °C; Fig. 14; Fig. 15 | | - | 16.6 | - | nC |
| $Q_{GS}$ | gate-source charge | | | - | 5 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 5.1 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $I_D$ = 15 A; $V_{DS}$ = 30 V; $T_j$ = 25 °C; Fig. 14; Fig. 15 | | - | 2.75 | - | V |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; Fig. 16 | | - | 2191 | - | pF |
| $C_{oss}$ | output capacitance | $V_{DS}$ 30 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; Fig. 16 | | - | 199 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; Fig. 16 | | - | 111 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 30 V; $R_L$ = 2 Ω; $V_{GS}$ = 4.5 V; $R_{G(ext)}$ = 5 Ω; $T_j$ = 25 °C | | - | 13.3 | - | ns |
| $t_r$ | rise time | | | - | 20.2 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 27.7 | - | ns |
| $t_f$ | fall time | | | - | 15.5 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 15 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C; Fig. 17 | | - | 0.84 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 15 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = 0 V; $V_{DS}$ = 30 V; $T_j$ = 25 °C | | - | 20.7 | - | ns |
| $Q_r$ | recovered charge | | | - | 15.7 | - | nC |

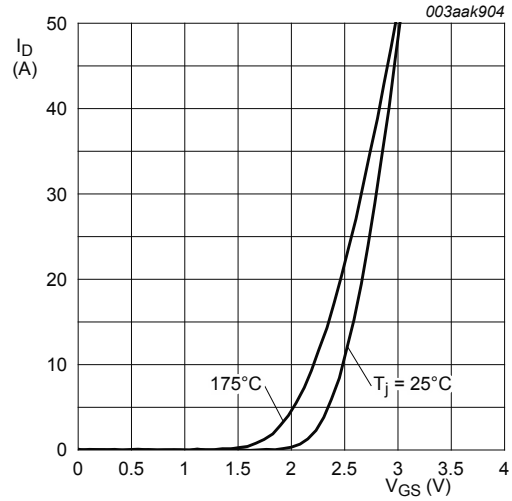
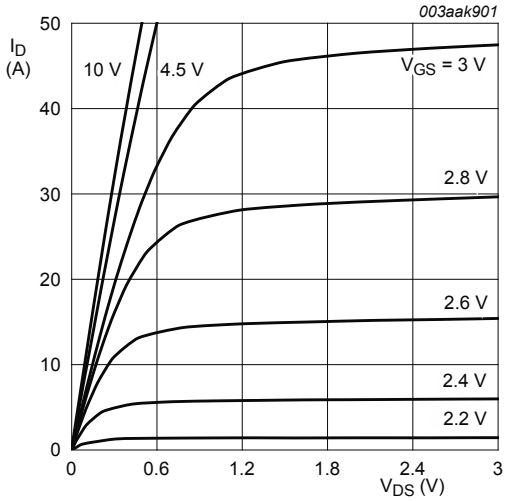



Fig. 6. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10V$




$T_j$ = 25 °C; $t_p$ = 300 µs

Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

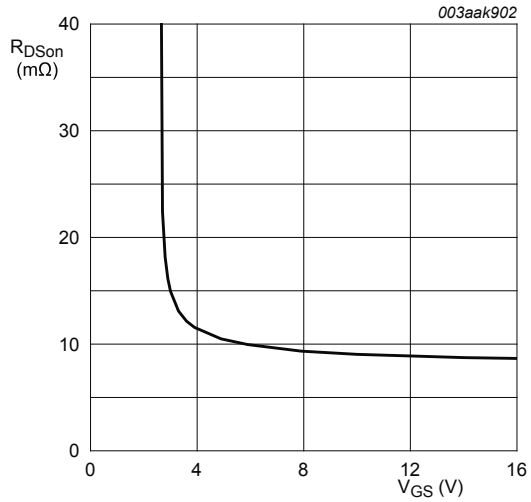



**Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values**

$T_j = 25°C;\ I_D = 15A$

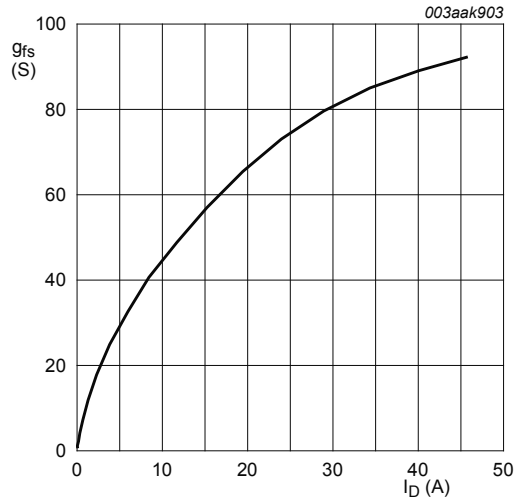



**Fig. 9. Forward transconductance as a function of drain current; typical values**

$T_j = 25°C;\ V_{DS} = 10V$

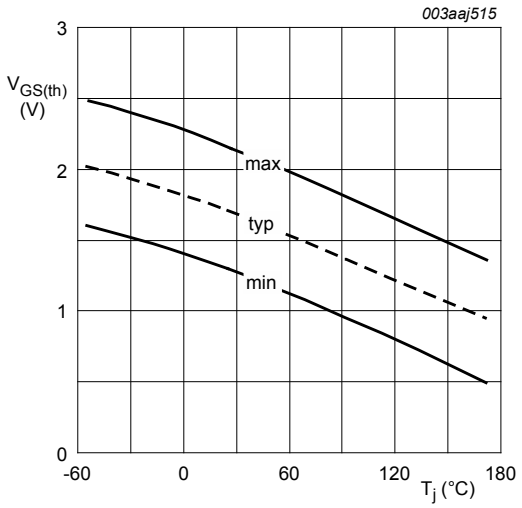



**Fig. 10. Gate-source threshold voltage as a function of junction temperature**

$I_D = 1\ mA;\ V_{DS} = V_{GS}$

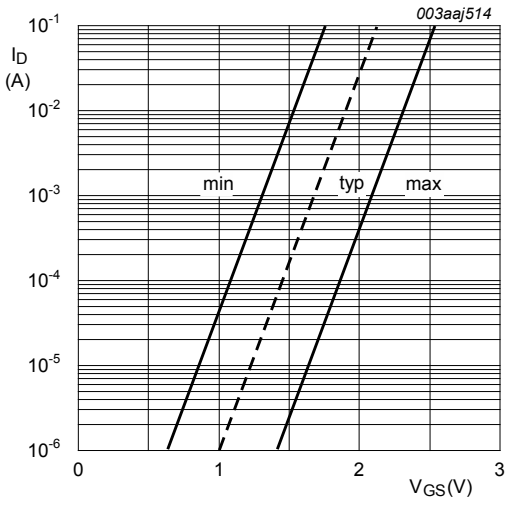
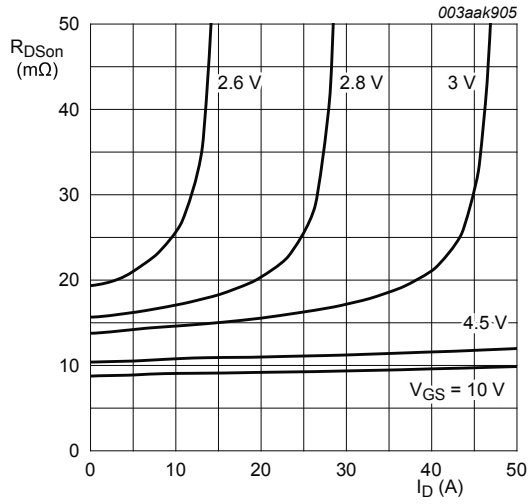



**Fig. 11. Sub-threshold drain current as a function of gate-source voltage**

$T_j = 25°C;\ V_{DS} = 5V$




$T_j$ = 25 °C; $t_p$ = 300 µs

**Fig. 12. Drain-source on-state resistance as a function of drain current; typical values**

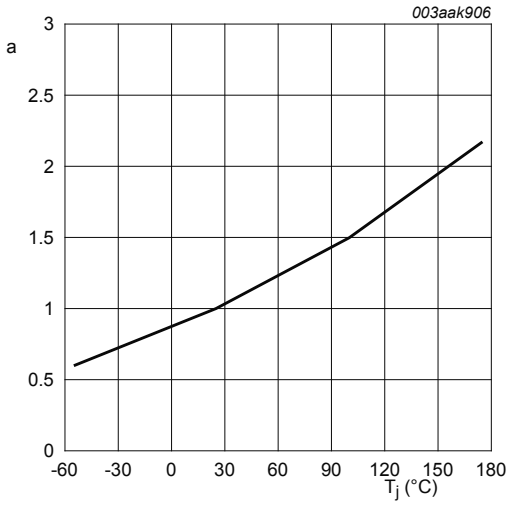



**Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature**

$$a = \frac{R_{DSon}}{R_{DSon\,(25°C)}}$$

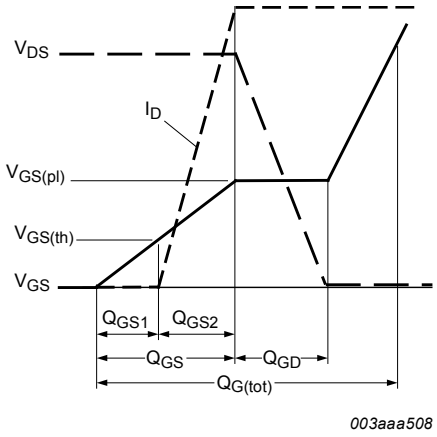



**Fig. 14. Gate charge waveform definitions**

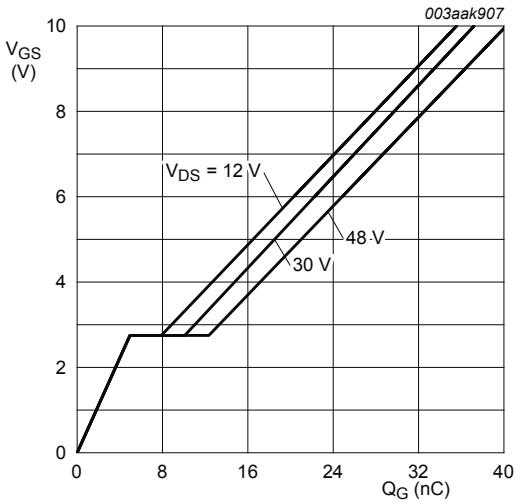



**Fig. 15. Gate-source voltage as a function of gate charge; typical values**

$T_j = 25°C;\ I_D = 15A$

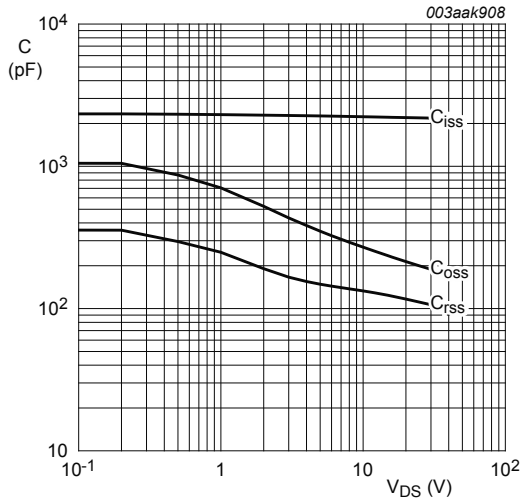



**Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

$V_{GS} = 0V;\ f = 1MHz$

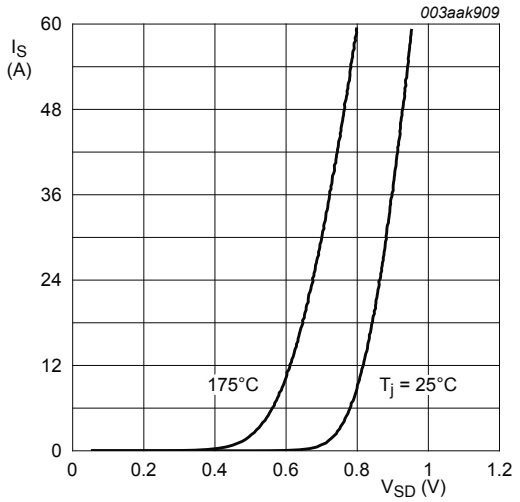
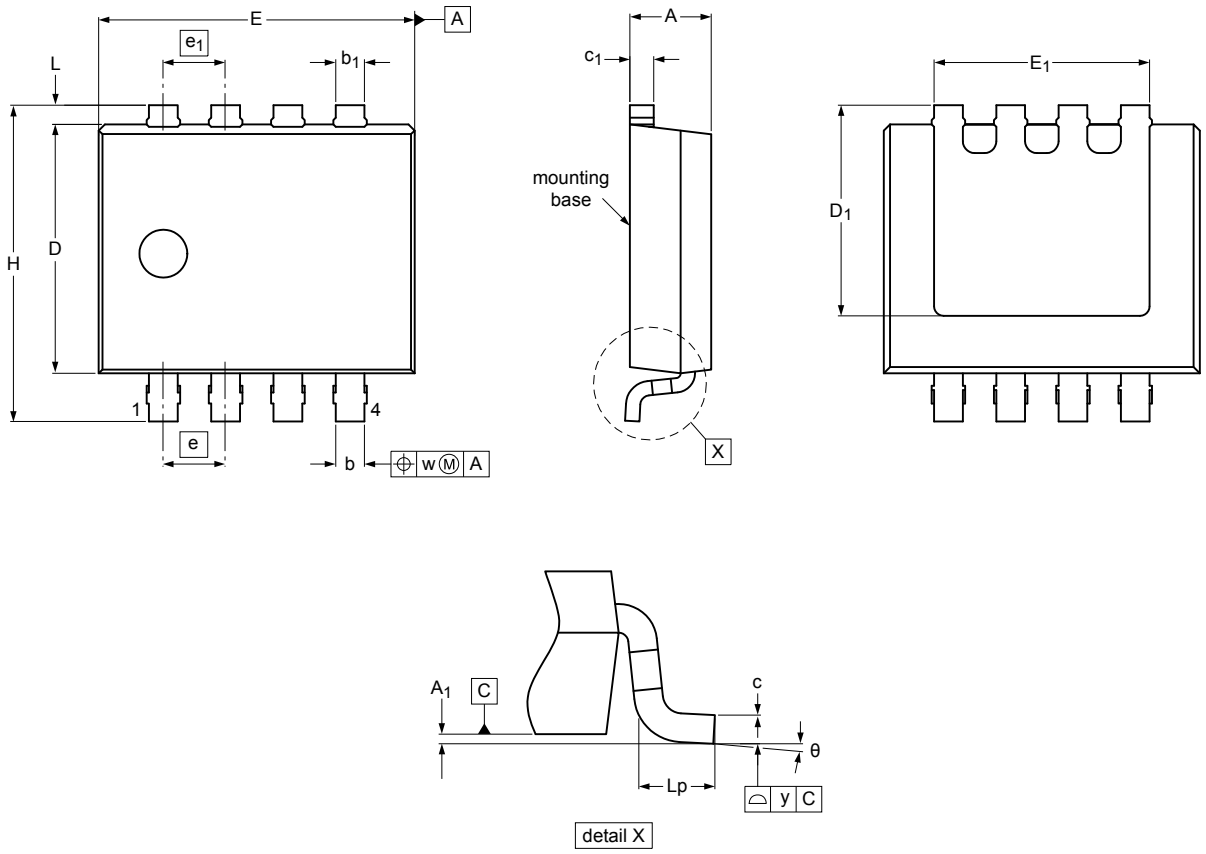



**Fig. 17. Source current as a function of source-drain voltage; typical values**

$V_{GS} = 0V$

# 11. Package outline

**Plastic single ended surface mounted package (LFPAK33); 8 leads** **SOT1210**




Dimensions

| Unit(1) | | A | $A_1$ | b | $b_1$ | c | $c_1$ | D(1) | $D_1$ | E(1) | $E_1$ | e | $e_1$ | H | L | $L_p$ | w | y | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.90 | 0.10 | 0.35 | 0.35 | 0.20 | 0.30 | 2.70 | 2.35 | 3.40 | 2.45 | | | 3.40 | 0.25 | 0.50 | | | 8° |
| | nom | | | | | | | | | | | 0.65 | 0.65 | | | | 0.20 | 0.10 | |
| | min | 0.80 | 0.00 | 0.25 | 0.25 | 0.10 | 0.20 | 2.50 | 1.90 | 3.20 | 2.00 | | | 3.20 | 0.13 | 0.30 | | | 0° |

Note
1. Plastic or metal protrusions of 0.15 mm per side are not included.

*sot1210_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1210 | | | | | | ~~11-12-19~~ 12-03-12 |

**Fig. 18. Package outline LFPAK33 (SOT1210)**

# 12. Legal information

## 12.1 Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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