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# PHU101NQ03LT

## N-channel TrenchMOS logic level FET

Rev. 04 — 30 June 2009 Product data sheet

# 1. Product profile

## 1.1 General description

Logic level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. This product is designed and qualified for use in computing, communications, consumer and industrial applications only.

## 1.2 Features and benefits

- Low conduction losses due to low on-state resistance
- Simple gate drive required due to low gate charge
- Suitable for logic level gate drive sources

## 1.3 Applications

- DC-to-DC convertors

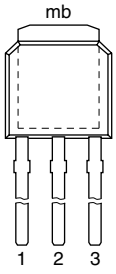
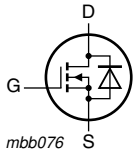
## 1.4 Quick reference data

**Table 1. Quick reference**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | - | - | 30 | V |
| $I_D$ | drain current | $T_{mb}$ = 25 °C; $V_{GS}$ = 10 V; see Figure 1; see Figure 3 | - | - | 75 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | - | - | 166 | W |
| **Dynamic characteristics** | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS}$ = 5 V; $I_D$ = 50 A; $V_{DS}$ = 15 V; $T_j$ = 25 °C; see Figure 11 | - | 8 | - | nC |
| **Static characteristics** | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 °C; see Figure 9; see Figure 10 | - | 4.5 | 5.5 | mΩ |

## 2. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | G | gate |   SOT533 (IPAK) |   |
| 2 | D | drain | | |
| 3 | S | source | | |
| mb | D | mounting base; connected to drain | | |

## 3. Ordering information

**Table 3. Ordering information**

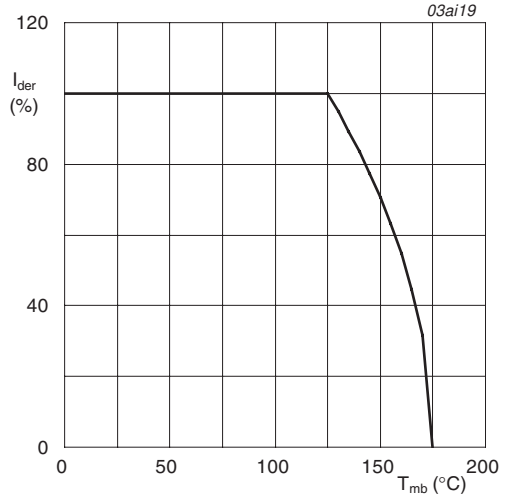
| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PHU101NQ03LT | IPAK | plastic single-ended package (IPAK); 3 leads (in-line) | SOT533 |

# 4. Limiting values

**Table 4. Limiting values**

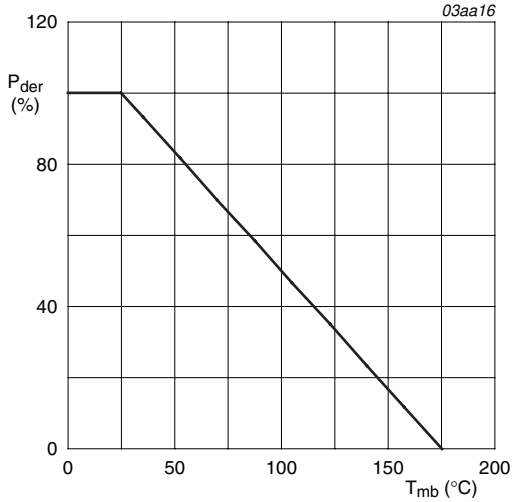
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | - | 30 | V |
| $V_{DGR}$ | drain-gate voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C; $R_{GS} = 20$ kΩ | - | 30 | V |
| $V_{GS}$ | gate-source voltage | | -20 | 20 | V |
| $I_D$ | drain current | $V_{GS} = 10$ V; $T_{mb} = 100$ °C; see Figure 1 | - | 75 | A |
| | | $V_{GS} = 10$ V; $T_{mb} = 25$ °C; see Figure 1; see Figure 3 | - | 75 | A |
| $I_{DM}$ | peak drain current | $t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C; see Figure 3 | - | 240 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25$ °C; see Figure 2 | - | 166 | W |
| $T_{stg}$ | storage temperature | | -55 | 175 | °C |
| $T_j$ | junction temperature | | -55 | 175 | °C |
| $V_{GSM}$ | peak gate-source voltage | pulsed; δ = 25 %; $T_j \leq 150$ °C; $t_p \leq 50$ µs | -25 | 25 | V |
| **Source-drain diode** | | | | | |
| $I_S$ | source current | $T_{mb} = 25$ °C | - | 75 | A |
| $I_{SM}$ | peak source current | $t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C | - | 240 | A |
| **Avalanche ruggedness** | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS} = 10$ V; $T_{j(init)} = 25$ °C; $I_D = 43$ A; $V_{sup} \leq 15$ V; unclamped; $t_p = 0.19$ ms; $R_{GS} = 50$ Ω | - | 185 | mJ |



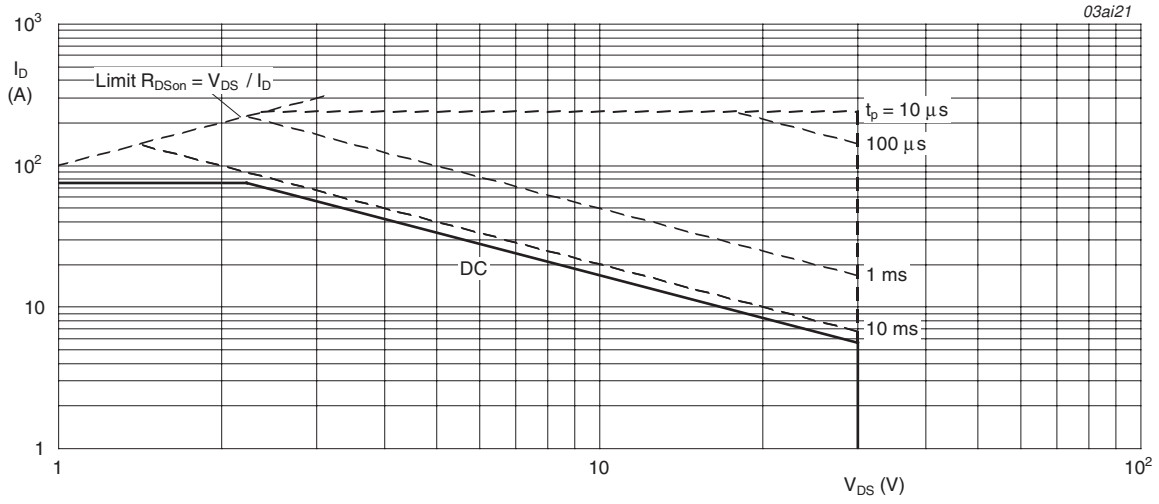

$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\,\%$$

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




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

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




$T_{mb} = 25°C; I_{DM}$ is single pulse; $V_{GS} = 10V$

**Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

## 5. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | see Figure 4 | - | - | 0.19 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | vertical in free air | - | 70 | - | K/W |

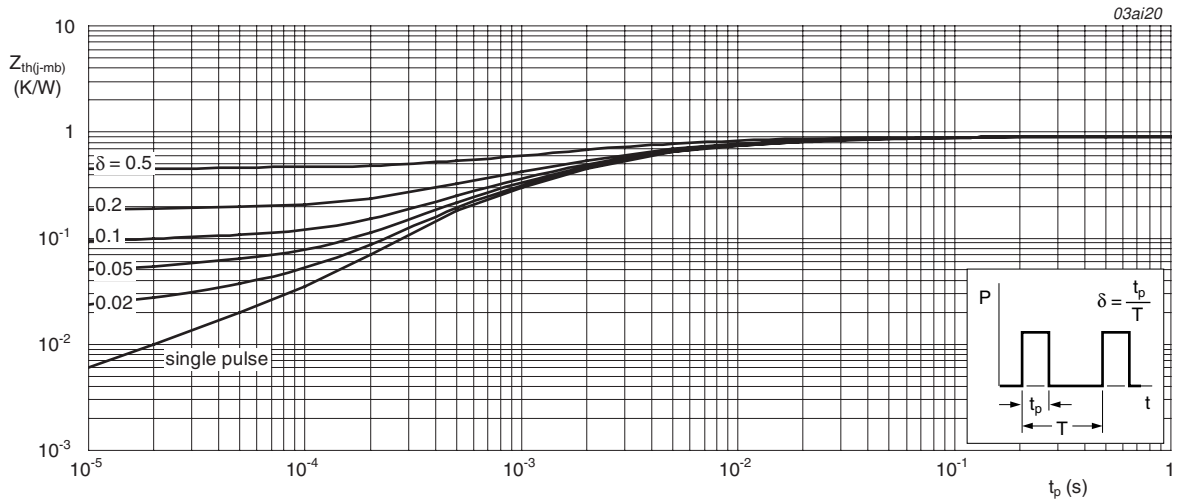
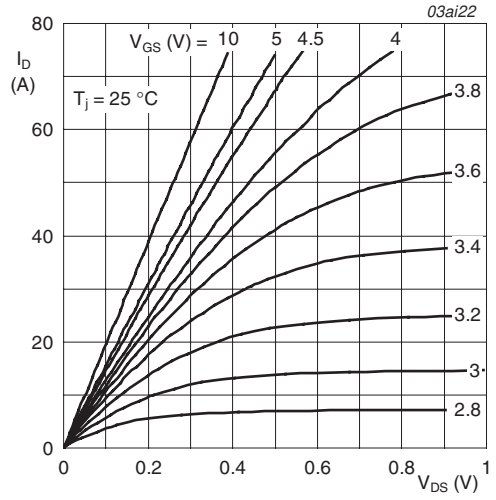



**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

# 6. Characteristics

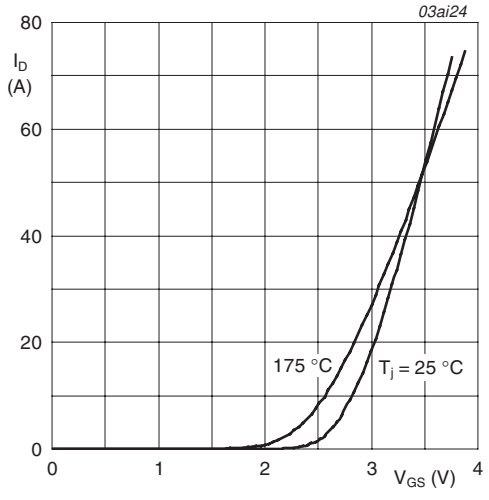
**Table 6. Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | 27 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | 30 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; see Figure 7; see Figure 8 | - | - | 2.9 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; see Figure 7; see Figure 8 | 0.6 | - | - | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; see Figure 7; see Figure 8 | 1 | 1.9 | 2.5 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | - | 0.05 | 1 | µA |
| | | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; $T_j$ = 175 °C | - | - | 500 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | - | 10 | 100 | nA |
| | | $V_{GS}$ = -20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | - | 10 | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 °C; see Figure 9; see Figure 10 | - | 4.5 | 5.5 | mΩ |
| | | $V_{GS}$ = 5 V; $I_D$ = 25 A; $T_j$ = 175 °C; see Figure 9; see Figure 10 | - | 10.5 | 13.5 | mΩ |
| | | $V_{GS}$ = 5 V; $I_D$ = 25 A; $T_j$ = 25 °C; see Figure 9; see Figure 10 | - | 5.8 | 7.5 | mΩ |
| **Dynamic characteristics** | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 50 A; $V_{DS}$ = 15 V; $V_{GS}$ = 5 V; $T_j$ = 25 °C; see Figure 11 | - | 23 | - | nC |
| $Q_{GS}$ | gate-source charge | | - | 10.5 | - | nC |
| $Q_{GD}$ | gate-drain charge | | - | 8 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 25 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; see Figure 12 | - | 2180 | - | pF |
| $C_{oss}$ | output capacitance | | - | 600 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | - | 225 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 15 V; $R_L$ = 0.6 Ω; $V_{GS}$ = 4.5 V; $R_{G(ext)}$ = 5.6 Ω; $T_j$ = 25 °C; $I_D$ = 25 A | - | 23 | - | ns |
| $t_r$ | rise time | | - | 90 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 37 | - | ns |
| $t_f$ | fall time | | - | 33 | - | ns |
| **Source-drain diode** | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 25 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C; see Figure 13 | - | 0.85 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 10 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = 0 V; $V_{DS}$ = 25 V; $T_j$ = 25 °C | - | 37 | - | ns |
| $Q_r$ | recovered charge | | - | 33 | - | nC |



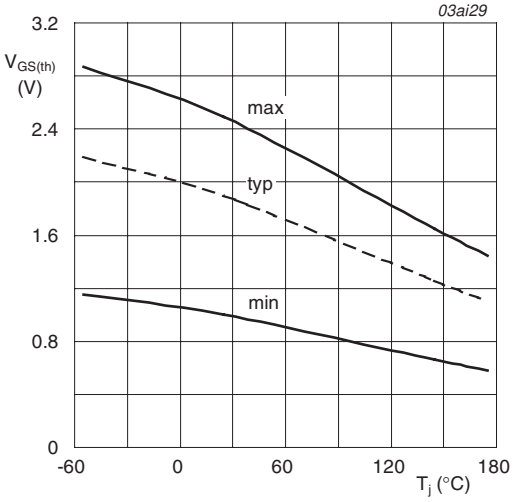

$T_j = 25°C$

**Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values**



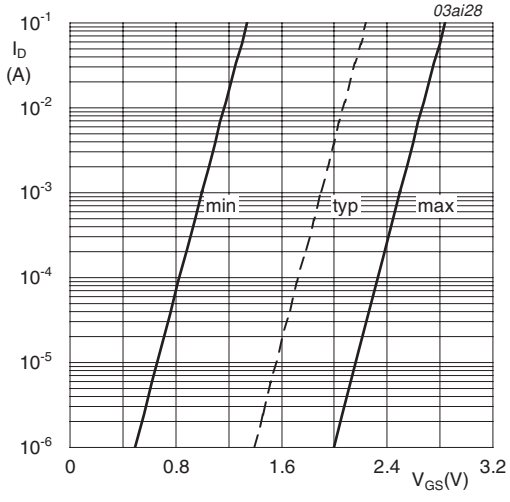

$T_j = 25°C \text{ and } 175°C; V_{DS} > I_D \times R_{DSon}$

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



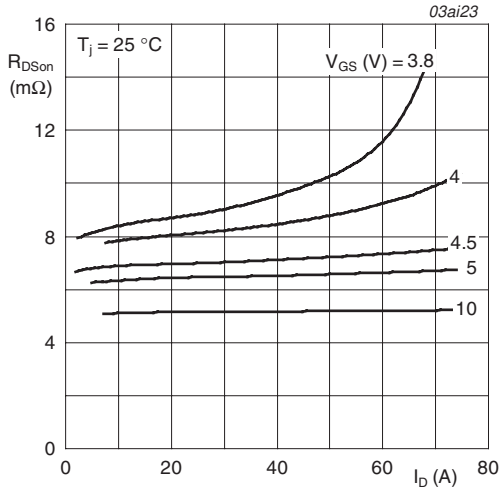

$I_D = 1mA; V_{DS} = V_{GS}$

**Fig 7. Gate-source threshold voltage as a function of junction temperature**



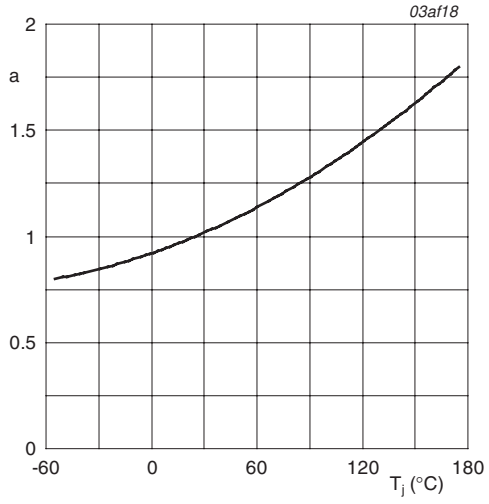

$T_j = 25°C; V_{DS} = 5V$

**Fig 8. Sub-threshold drain current as a function of gate-source voltage**



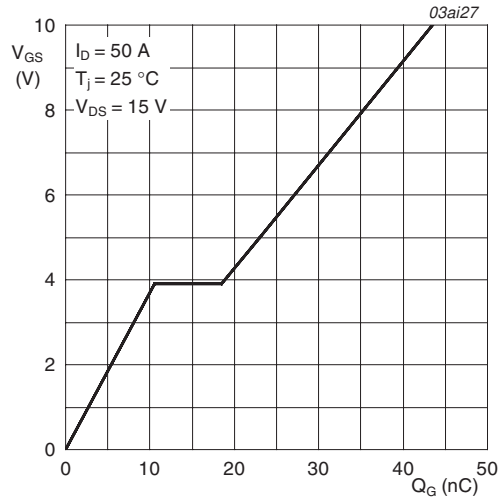

$T_j = 25°C$

**Fig 9. Drain-source on-state resistance as a function of drain current; typical values**



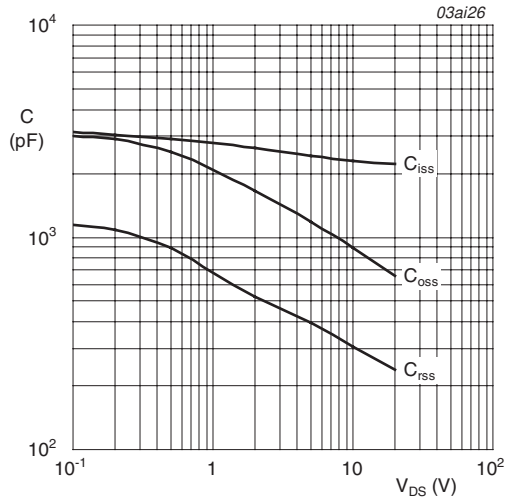

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

**Fig 10. Normalized drain-source on-state resistance factor as a function of junction temperature**



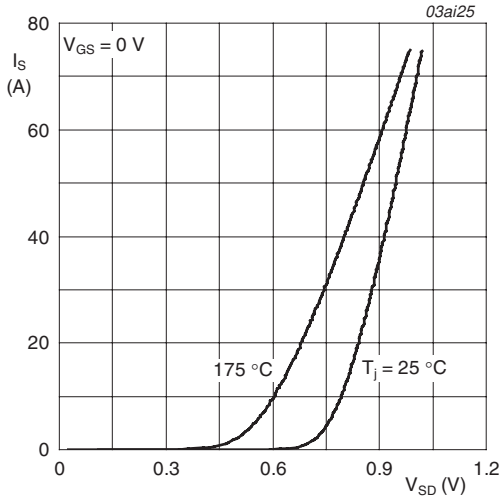

$I_D = 50A; V_{DS} = 15V$

**Fig 11. Gate-source voltage as a function of gate charge; typical values**




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

**Fig 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

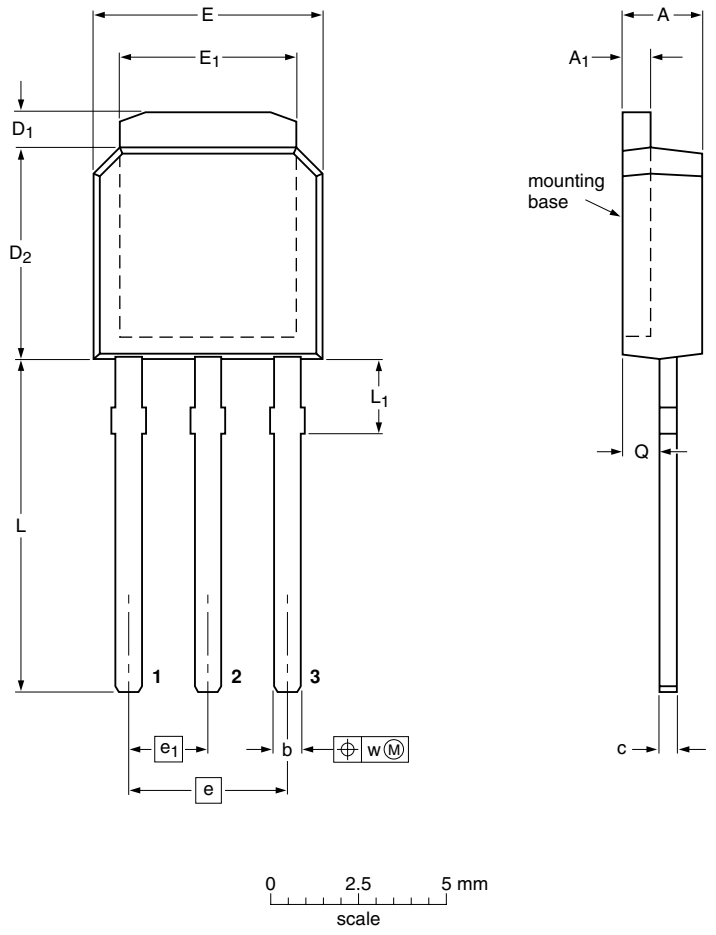



$T_j = 25°C \text{ and } 175°C; V_{GS} = 0V$

**Fig 13. Source current as a function of source-drain voltage; typical values**

## 7. Package outline

**Plastic single-ended package (IPAK); 3 leads (in-line)** **SOT533**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | b | c | $D_1$ | $D_2$ | E | $E_1$ | e | $e_1$ | L | $L_1$ (2) max | Q | w |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 2.38<br>2.22 | 0.93<br>0.46 | 0.89<br>0.71 | 0.56<br>0.46 | 1.10<br>0.96 | 6.22<br>5.98 | 6.73<br>6.47 | 5.21<br>5.00 | 4.57<br>BSC (1) | 2.285<br>BSC (1) | 9.6<br>9.2 | 2.7 | 1.1<br>1.0 | 0.3 |

**Notes**

1. Basic spacing between centers.
2. Terminal dimensions are uncontrolled within zone $L_1$.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT533 | | TO-251 | | | | ~~05-02-11~~<br>06-02-14 |

**Fig 14. Package outline SOT533 (IPAK)**

## 8. Revision history

**Table 7. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PHU101NQ03LT_4 | 20090630 | Product data sheet | - | PHP_PHU101NQ03LT_3 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.<br>• Legal texts have been adapted to the new company name where appropriate.<br>• Type number PHU101NQ03LT separated from data sheet PHP_PHU101NQ03LT_3. | | | |
| PHP_PHU101NQ03LT_3 | 20051117 | Product data sheet | CPC # 200309016 | PHP_PHU101NQ03LT-02 |
| PHP_PHU101NQ03LT-02 (9397 750 10927) | 20030225 | Product data | - | PHP_PHD_PHB_PHU101 NQ03LT-01 |
| PHP_PHD_PHB_PHU101 NQ03LT-01 (9397 750 09307) | 20020220 | Product data | - | - |

# 9. Legal information

## 9.1 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".

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# 10. Contact information

For more information, please visit: http://www.nxp.com

For sales office addresses, please send an email to: salesaddresses@nxp.com

## 11. Contents





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**Document identifier: PHU101NQ03LT_4**