

# PHP18NQ11T

## N-channel TrenchMOS standard level FET

Rev. 02 — 10 March 2010

Product data sheet

## 1. Product profile

### 1.1 General description

Standard 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

- Higher operating power due to low thermal resistance
- Suitable for high frequency applications due to fast switching characteristics

### 1.3 Applications

- Class-D audio amplifiers
- Inverters
- DC-to-DC convertors
- Switched-mode power supplies

### 1.4 Quick reference data

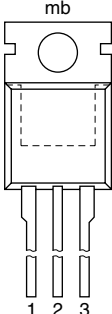
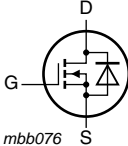
Table 1. Quick reference

| Symbol                         | Parameter                        | Conditions   | Min | Typ | Max | Unit       |
|--------------------------------|----------------------------------|--|-----|-----|-----|------------|
| $V_{DS}$                       | drain-source voltage             | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$   | -   | -   | 110 | V          |
| $I_D$                          | drain current                    | $T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ;<br>see <a href="#">Figure 1</a> and <a href="#">3</a>                           | -   | -   | 18  | A          |
| $P_{tot}$                      | total power dissipation          | $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>   | -   | -   | 79  | W          |
| <b>Dynamic characteristics</b> |                                  |  |     |     |     |            |
| $Q_{GD}$                       | gate-drain charge                | $V_{GS} = 10\text{ V}$ ; $I_D = 18\text{ A}$ ;<br>$V_{DS} = 80\text{ V}$ ; $T_j = 25\text{ °C}$ ;<br>see <a href="#">Figure 11</a> | -   | 8   | -   | nC         |
| <b>Static characteristics</b>  |                                  |  |     |     |     |            |
| $R_{DS(on)}$                   | drain-source on-state resistance | $V_{GS} = 10\text{ V}$ ; $I_D = 9\text{ A}$ ;<br>$T_j = 25\text{ °C}$ ;<br>see <a href="#">Figure 9</a> and <a href="#">10</a>     | -   | 80  | 90  | m $\Omega$ |



## 2. Pinning information

Table 2. Pinning information

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

**SOT78 (TO-220AB)**

## 3. Ordering information

Table 3. Ordering information

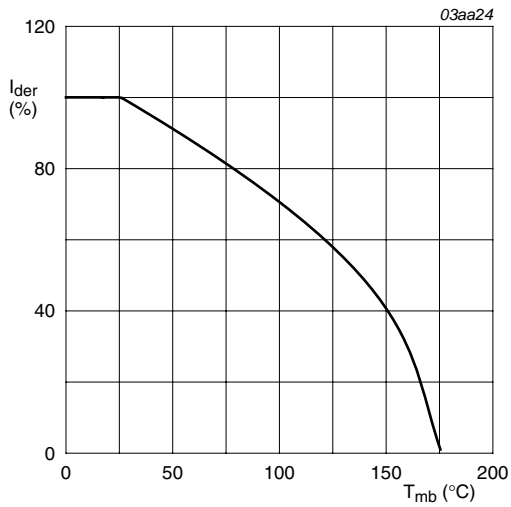
| Type number | Package  |  |         |
|-------------|----------|--|---------|
|             | Name     | Description  | Version |
| PHP18NQ11T  | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78   |

## 4. Limiting values

Table 4. Limiting values

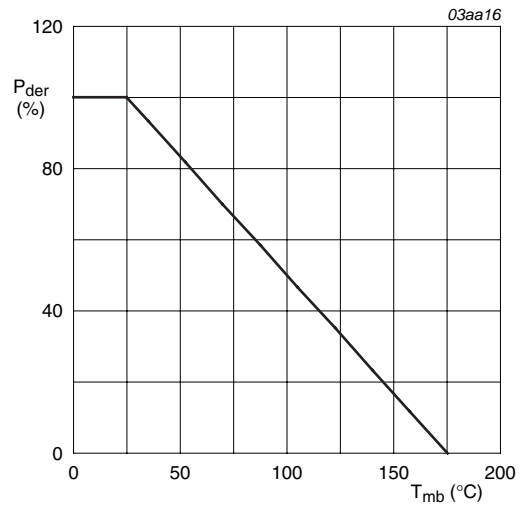
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol                      | Parameter                                    | Conditions   | Min | Max | Unit |
|-----------------------------|--|--|-----|-----|------|
| $V_{DS}$                    | drain-source voltage                         | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$   | -   | 110 | V    |
| $V_{DGR}$                   | drain-gate voltage                           | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$  | -   | 110 | V    |
| $V_{GS}$                    | gate-source voltage                          |  | -20 | 20  | V    |
| $I_D$                       | drain current                                | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; see <a href="#">Figure 1</a>   | -   | 13  | A    |
|                             |  | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a> and <a href="#">3</a>  | -   | 18  | A    |
| $I_{DM}$                    | peak drain current                           | $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 3</a>  | -   | 72  | A    |
| $P_{tot}$                   | total power dissipation                      | $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>   | -   | 79  | W    |
| $T_{stg}$                   | storage temperature                          |  | -55 | 175 | °C   |
| $T_j$                       | junction temperature                         |  | -55 | 175 | °C   |
| <b>Source-drain diode</b>   |  |  |     |     |      |
| $I_S$                       | source current                               | $T_{mb} = 25\text{ °C}$  | -   | 18  | A    |
| $I_{SM}$                    | peak source current                          | $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$   | -   | 72  | A    |
| <b>Avalanche ruggedness</b> |  |  |     |     |      |
| $E_{DS(AL)S}$               | non-repetitive drain-source avalanche energy | $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 11\text{ A}$ ; $V_{sup} \leq 25\text{ V}$ ; unclamped; $t_p = 0.1\text{ ms}$ ; $R_{GS} = 50\text{ }\Omega$ | -   | 70  | mJ   |



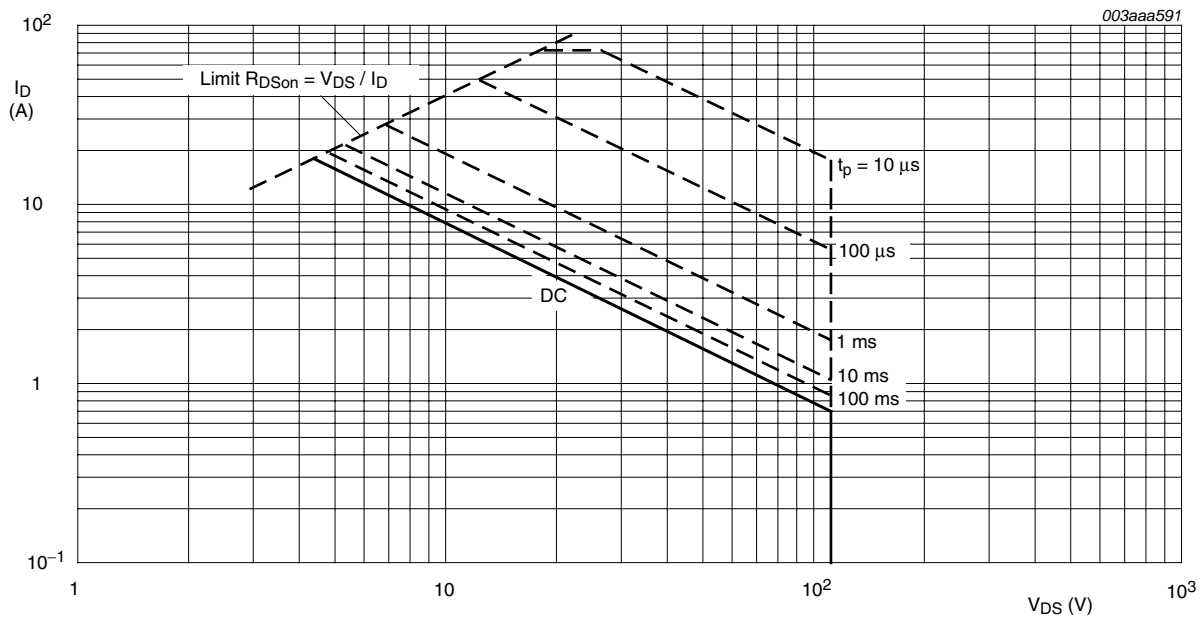
$$I_{der} = \frac{I_D}{I_{D(25^\circ C)}} \times 100\%$$

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



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

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



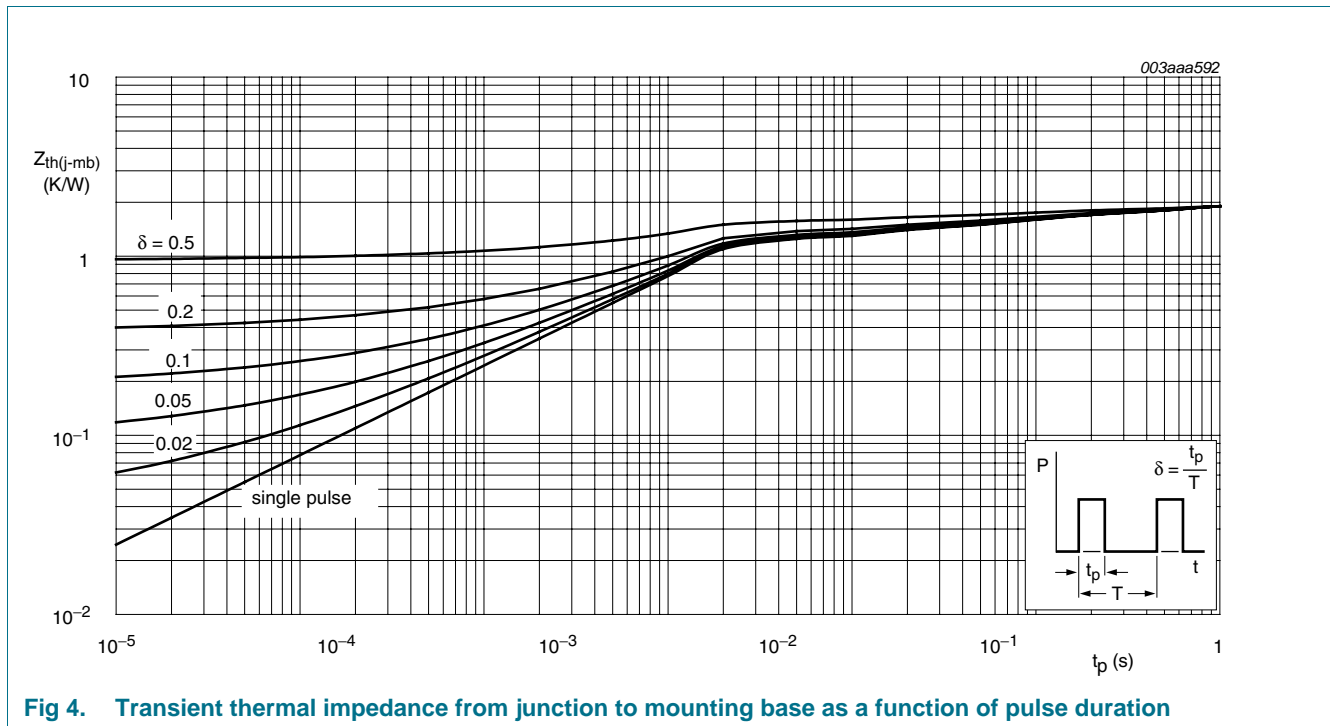
$T_{mb} = 25^\circ C; I_{DM}$  is single pulse;  $V_{GS} = 10V$

Fig 3. Safe operating area: continuous and peak 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 <a href="#">Figure 4</a> | -   | -   | 1.9 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | in free air                  | -   | 60  | -   | K/W  |

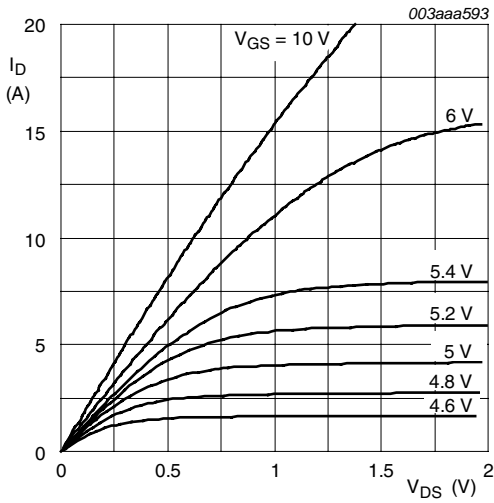


**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 6. Characteristics

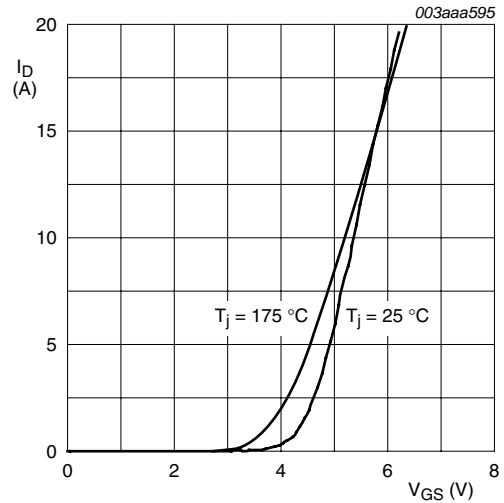
Table 6. Characteristics

| Symbol                         | Parameter                        | Conditions   | Min | Typ  | Max | Unit       |
|--------------------------------|----------------------------------|--|-----|------|-----|------------|
| <b>Static characteristics</b>  |                                  |  |     |      |     |            |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage   | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$  | 98  | -    | -   | V          |
|                                |                                  | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$   | 110 | -    | -   | V          |
| $V_{GS(th)}$                   | gate-source threshold voltage    | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C$ ; see <a href="#">Figure 8</a>                                     | 1   | -    | -   | V          |
|                                |                                  | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 8</a>                                      | 2   | 3    | 4   | V          |
|                                |                                  | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C$ ; see <a href="#">Figure 8</a>                                     | -   | -    | 4.4 | V          |
| $I_{DSS}$                      | drain leakage current            | $V_{DS} = 110 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$  | -   | 0.05 | 10  | $\mu A$    |
|                                |                                  | $V_{DS} = 110 V; V_{GS} = 0 V; T_j = 175 \text{ }^\circ C$   | -   | -    | 500 | $\mu A$    |
| $I_{GSS}$                      | gate leakage current             | $V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$   | -   | 10   | 100 | nA         |
|                                |                                  | $V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$  | -   | 10   | 100 | nA         |
| $R_{DS(on)}$                   | drain-source on-state resistance | $V_{GS} = 10 V; I_D = 9 A; T_j = 175 \text{ }^\circ C$ ; see <a href="#">Figure 9</a> and <a href="#">10</a>                         | -   | -    | 243 | m $\Omega$ |
|                                |                                  | $V_{GS} = 10 V; I_D = 9 A; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 9</a> and <a href="#">10</a>                          | -   | 80   | 90  | m $\Omega$ |
| <b>Dynamic characteristics</b> |                                  |  |     |      |     |            |
| $Q_{G(tot)}$                   | total gate charge                | $I_D = 18 A; V_{DS} = 80 V; V_{GS} = 10 V; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 11</a>                                | -   | 21   | -   | nC         |
| $Q_{GS}$                       | gate-source charge               |  | -   | 4    | -   | nC         |
| $Q_{GD}$                       | gate-drain charge                |  | -   | 8    | -   | nC         |
| $C_{iss}$                      | input capacitance                | $V_{DS} = 25 V; V_{GS} = 0 V; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 12</a>                          | -   | 633  | -   | pF         |
| $C_{oss}$                      | output capacitance               |  | -   | 103  | -   | pF         |
| $C_{rss}$                      | reverse transfer capacitance     |  | -   | 61   | -   | pF         |
| $t_{d(on)}$                    | turn-on delay time               | $V_{DS} = 50 V; R_L = 2.7 \text{ } \Omega; V_{GS} = 10 V; R_{G(ext)} = 5.6 \text{ } \Omega; T_j = 25 \text{ }^\circ C; I_D = 18.5 A$ | -   | 6    | -   | ns         |
| $t_r$                          | rise time                        |  | -   | 36   | -   | ns         |
| $t_{d(off)}$                   | turn-off delay time              |  | -   | 18   | -   | ns         |
| $t_f$                          | fall time                        |  | -   | 12   | -   | ns         |
| <b>Source-drain diode</b>      |                                  |  |     |      |     |            |
| $V_{SD}$                       | source-drain voltage             | $I_S = 18 A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 13</a>  | -   | 0.92 | 1.2 | V          |
| $t_{rr}$                       | reverse recovery time            | $I_S = 18 A; di_S/dt = 100 A/\mu s; V_{GS} = 0 V; V_{DS} = 25 V; T_j = 25 \text{ }^\circ C$  | -   | 55   | -   | ns         |
| $Q_r$                          | recovered charge                 |  | -   | 135  | -   | nC         |



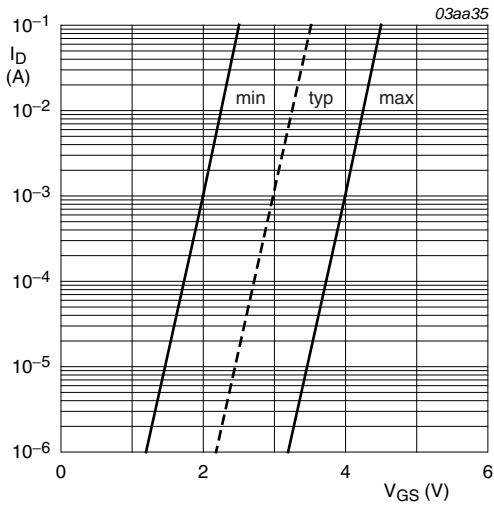
$T_j = 25^\circ\text{C}$

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



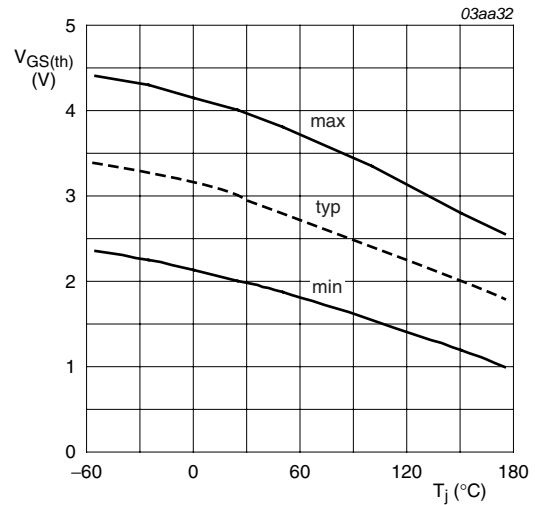
$T_j = 25^\circ\text{C}$  and  $175^\circ\text{C}; V_{DS} > I_D \times R_{DS(on)}$

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



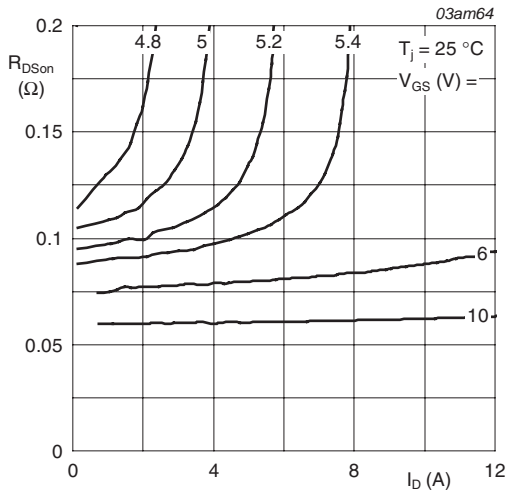
$T_j = 25^\circ\text{C}; V_{DS} = 5\text{ V}$

Fig 7. Sub-threshold drain current as a function of gate-source voltage



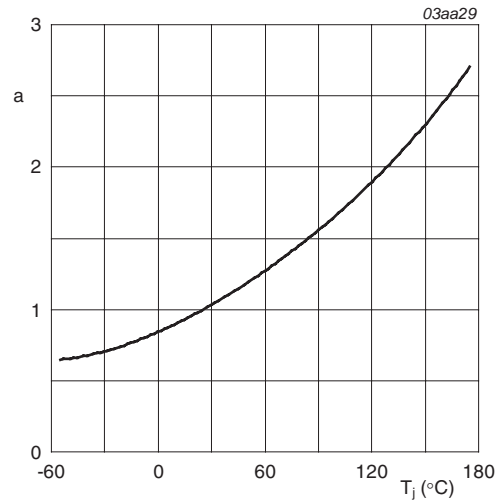
$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

Fig 8. Gate-source threshold voltage as a function of junction temperature



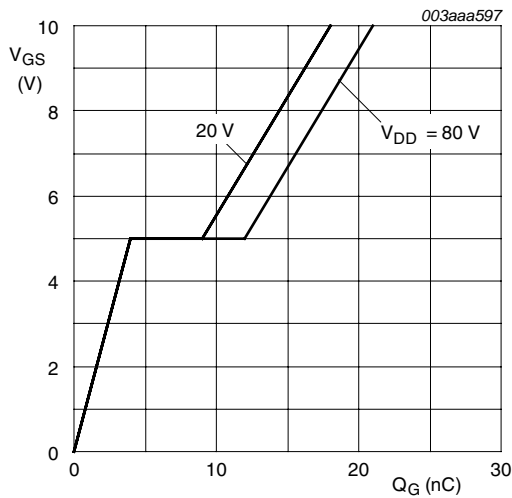
$T_j = 25^\circ\text{C}$

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



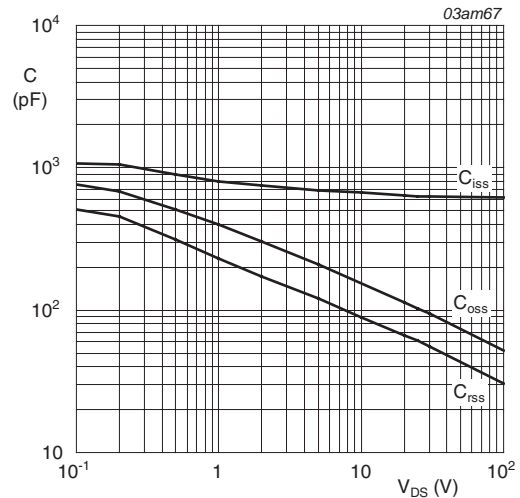
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



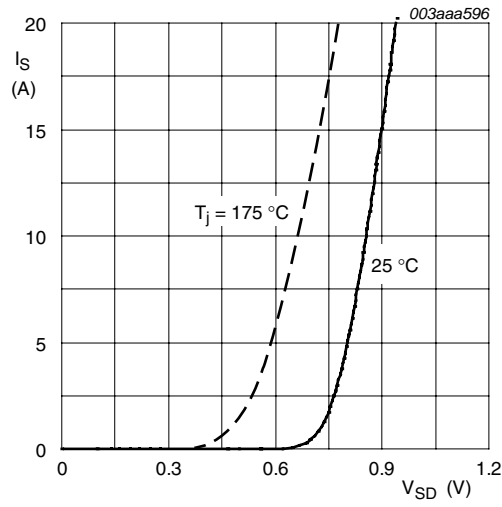
$I_D = 3\text{A}; V_{DD} = 20\text{V and } 80\text{V}$

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



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

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



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

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



7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78

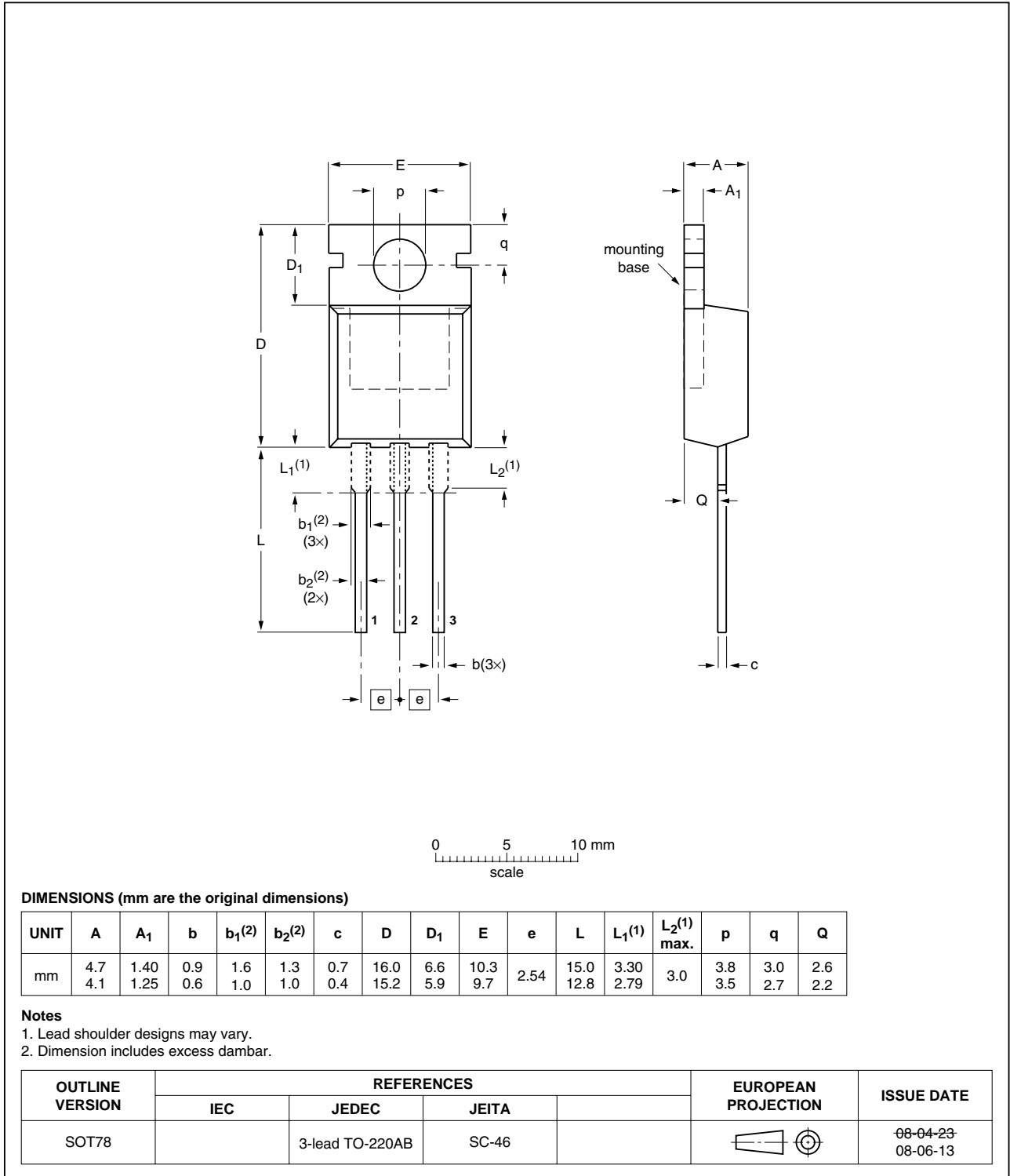


Fig 14. Package outline SOT78 (TO-220AB)

## 8. Revision history

Table 7. Revision history

| Document ID                    | Release date | Data sheet status  | Change notice | Supersedes    |
|--------------------------------|--------------|--|---------------|---------------|
| PHP18NQ11T_2                   | 20100310     | Product data sheet   | -             | PHP18NQ11T-01 |
| Modifications:                 |              | <ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li></ul> |               |               |
| PHP18NQ11T-01 (9397 750 12305) | 20031113     | Product data   | -             | -             |

## 9. Legal information

### 9.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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