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Kind regards,

Team Nexperia

# N-channel TrenchMOS™ transistor

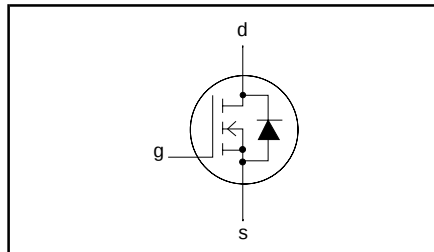
## Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

### FEATURES

- 'Trench' technology
- Low on-state resistance
- Fast switching
- Logic level compatible

### SYMBOL



### QUICK REFERENCE DATA

|                                                                       |
|-----------------------------------------------------------------------|
| $V_{DSS} = 55 \text{ V}$                                              |
| $I_D = 19 \text{ A}$                                                  |
| $R_{DS(ON)} \leq 75 \text{ m}\Omega \text{ (} V_{GS} = 5 \text{ V)}$  |
| $R_{DS(ON)} \leq 70 \text{ m}\Omega \text{ (} V_{GS} = 10 \text{ V)}$ |

### GENERAL DESCRIPTION

N-channel enhancement mode, logic level, field-effect power transistor in a plastic envelope using 'trench' technology.

#### Applications:-

- d.c. to d.c. converters
- switched mode power supplies

The PHP21N06LT is supplied in the SOT78 (TO220AB) conventional leaded package.

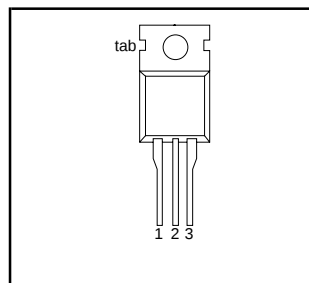
The PHB21N06LT is supplied in the SOT404 (D<sup>2</sup>PAK) surface mounting package.

The PHD21N06LT is supplied in the SOT428 (DPAK) surface mounting package.

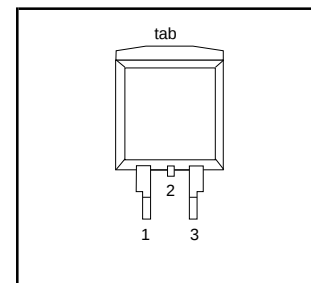
### PINNING

| PIN | DESCRIPTION        |
|-----|--------------------|
| 1   | gate               |
| 2   | drain <sup>1</sup> |
| 3   | source             |
| tab | drain              |

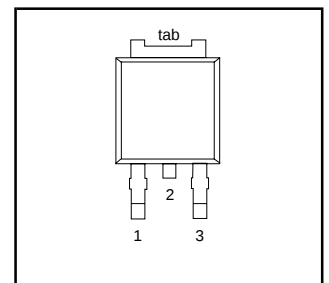
#### SOT78 (TO220AB)



#### SOT404 (D<sup>2</sup>PAK)



#### SOT428 (DPAK)



### LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| SYMBOL         | PARAMETER                                  | CONDITIONS                                                                      | MIN. | MAX.     | UNIT             |
|----------------|--------------------------------------------|---------------------------------------------------------------------------------|------|----------|------------------|
| $V_{DSS}$      | Drain-source voltage                       | $T_j = 25^\circ\text{C}$ to $175^\circ\text{C}$                                 | -    | 55       | V                |
| $V_{DGR}$      | Drain-gate voltage                         | $T_j = 25^\circ\text{C}$ to $175^\circ\text{C}$ ; $R_{GS} = 20 \text{ k}\Omega$ | -    | 55       | V                |
| $V_{GS}$       | Gate-source voltage                        |                                                                                 | -    | $\pm 15$ | V                |
| $V_{GSM}$      | Pulsed gate-source voltage                 | $T_j \leq 150^\circ\text{C}$                                                    | -    | $\pm 20$ | V                |
| $I_D$          | Continuous drain current                   | $T_{mb} = 25^\circ\text{C}$                                                     | -    | 19       | A                |
|                |                                            | $T_{mb} = 100^\circ\text{C}$                                                    | -    | 13       | A                |
| $I_{DM}$       | Pulsed drain current                       | $T_{mb} = 25^\circ\text{C}$                                                     | -    | 76       | A                |
| $P_D$          | Total power dissipation                    | $T_{mb} = 25^\circ\text{C}$                                                     | -    | 56       | W                |
| $T_j, T_{stg}$ | Operating junction and storage temperature |                                                                                 | - 55 | 175      | $^\circ\text{C}$ |

<sup>1</sup> It is not possible to make connection to pin:2 of the SOT404 or SOT428 packages.

# N-channel TrenchMOS™ transistor

## Logic level FET

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PHD21N06LT

### AVALANCHE ENERGY LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| SYMBOL   | PARAMETER                             | CONDITIONS                                                                                                                                                                           | MIN. | MAX. | UNIT |
|----------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|
| $E_{AS}$ | Non-repetitive avalanche energy       | Unclamped inductive load, $I_{AS} = 9.7$ A;<br>$t_p = 100$ $\mu$ s; $T_j$ prior to avalanche = 25°C;<br>$V_{DD} \leq 25$ V; $R_{GS} = 50$ $\Omega$ ; $V_{GS} = 5$ V; refer to fig:15 | -    | 34   | mJ   |
| $I_{AS}$ | Peak non-repetitive avalanche current |                                                                                                                                                                                      | -    | 19   | A    |

### THERMAL RESISTANCES

| SYMBOL         | PARAMETER                                    | CONDITIONS                                                                              | TYP.     | MAX.   | UNIT       |
|----------------|----------------------------------------------|-----------------------------------------------------------------------------------------|----------|--------|------------|
| $R_{th\ j-mb}$ | Thermal resistance junction to mounting base |                                                                                         | -        | 2.7    | K/W        |
| $R_{th\ j-a}$  | Thermal resistance junction to ambient       | SOT78 package, in free air<br>SOT428 and SOT404 package, pcb mounted, minimum footprint | 60<br>50 | -<br>- | K/W<br>K/W |

### ELECTRICAL CHARACTERISTICS

$T_j = 25^\circ\text{C}$  unless otherwise specified

| SYMBOL        | PARAMETER                        | CONDITIONS                                                                                 | MIN.            | TYP.          | MAX.            | UNIT                                   |
|---------------|----------------------------------|--------------------------------------------------------------------------------------------|-----------------|---------------|-----------------|----------------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage   | $V_{GS} = 0$ V; $I_D = 0.25$ mA;<br>$T_j = -55^\circ\text{C}$                              | 55<br>50        | -<br>-        | -<br>-          | V<br>V                                 |
| $V_{GS(TO)}$  | Gate threshold voltage           | $V_{DS} = V_{GS}$ ; $I_D = 1$ mA<br>$T_j = 175^\circ\text{C}$<br>$T_j = -55^\circ\text{C}$ | 1.0<br>0.5<br>- | 1.5<br>-<br>- | 2.0<br>-<br>2.3 | V<br>V<br>V                            |
| $R_{DS(ON)}$  | Drain-source on-state resistance | $V_{GS} = 10$ V; $I_D = 10$ A<br>$V_{GS} = 5$ V; $I_D = 10$ A<br>$T_j = 175^\circ\text{C}$ | -<br>-<br>-     | 55<br>60<br>- | 70<br>75<br>158 | m $\Omega$<br>m $\Omega$<br>m $\Omega$ |
| $g_{fs}$      | Forward transconductance         | $V_{DS} = 25$ V; $I_D = 10$ A                                                              | 5               | 13            | -               | S                                      |
| $I_{GSS}$     | Gate source leakage current      | $V_{GS} = \pm 5$ V; $V_{DS} = 0$ V                                                         | -               | 10            | 100             | nA                                     |
| $I_{DSS}$     | Zero gate voltage drain current  | $V_{DS} = 55$ V; $V_{GS} = 0$ V;<br>$T_j = 175^\circ\text{C}$                              | -               | 0.05          | 10              | $\mu$ A                                |
|               |                                  |                                                                                            | -               | -             | 500             | $\mu$ A                                |
| $Q_{g(tot)}$  | Total gate charge                | $I_D = 20$ A; $V_{DD} = 44$ V; $V_{GS} = 5$ V                                              | -               | 9.4           | -               | nC                                     |
| $Q_{gs}$      | Gate-source charge               |                                                                                            | -               | 2.2           | -               | nC                                     |
| $Q_{gd}$      | Gate-drain (Miller) charge       |                                                                                            | -               | 5.4           | -               | nC                                     |
| $t_{d\ on}$   | Turn-on delay time               | $V_{DD} = 30$ V; $R_D = 1.2$ $\Omega$ ;<br>$R_G = 10$ $\Omega$ ; $V_{GS} = 5$ V            | -               | 7             | 15              | ns                                     |
| $t_r$         | Turn-on rise time                | Resistive load                                                                             | -               | 88            | 120             | ns                                     |
| $t_{d\ off}$  | Turn-off delay time              |                                                                                            | -               | 25            | 40              | ns                                     |
| $t_f$         | Turn-off fall time               |                                                                                            | -               | 25            | 45              | ns                                     |
| $L_d$         | Internal drain inductance        | Measured from tab to centre of die                                                         | -               | 3.5           | -               | nH                                     |
| $L_d$         | Internal drain inductance        | Measured from drain lead to centre of die (SOT78 package only)                             | -               | 4.5           | -               | nH                                     |
| $L_s$         | Internal source inductance       | Measured from source lead to source bond pad                                               | -               | 7.5           | -               | nH                                     |
| $C_{iss}$     | Input capacitance                | $V_{GS} = 0$ V; $V_{DS} = 25$ V; $f = 1$ MHz                                               | -               | 466           | 650             | pF                                     |
| $C_{oss}$     | Output capacitance               |                                                                                            | -               | 95            | 135             | pF                                     |
| $C_{rss}$     | Feedback capacitance             |                                                                                            | -               | 71            | 85              | pF                                     |

# N-channel TrenchMOS™ transistor

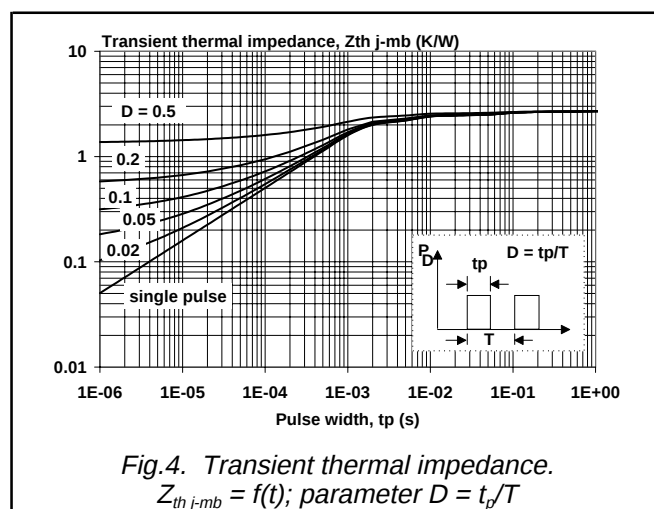
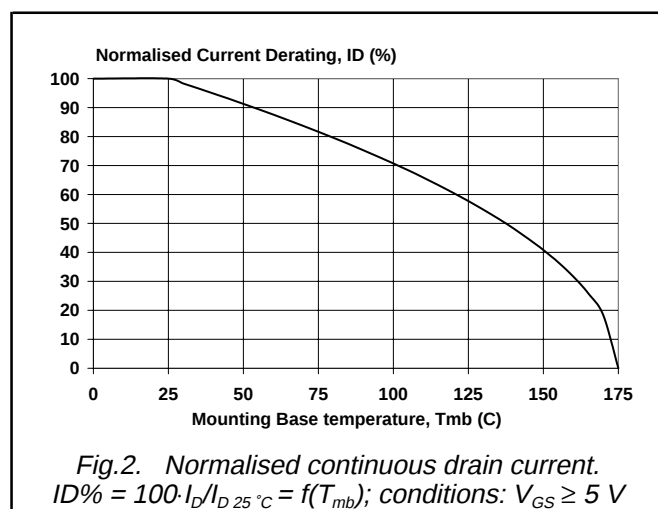
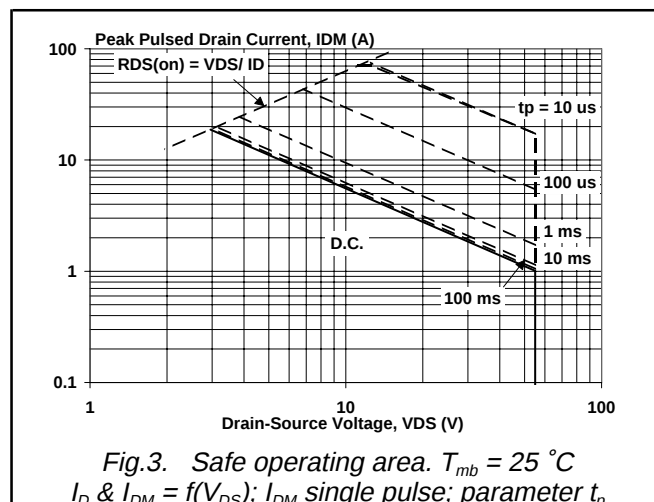
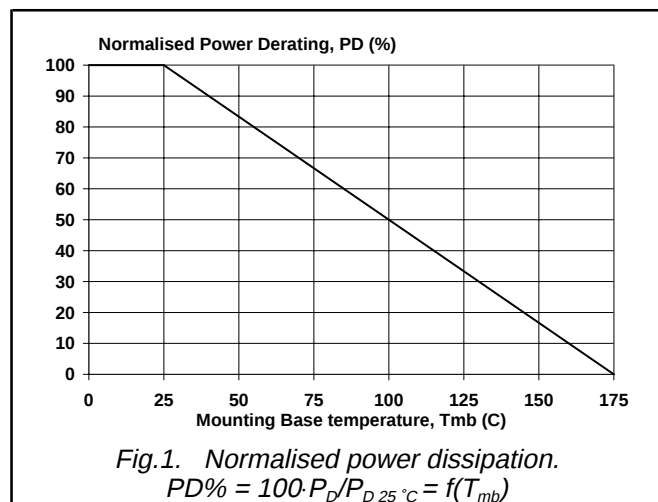
## Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

### REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

$T_j = 25^\circ\text{C}$  unless otherwise specified

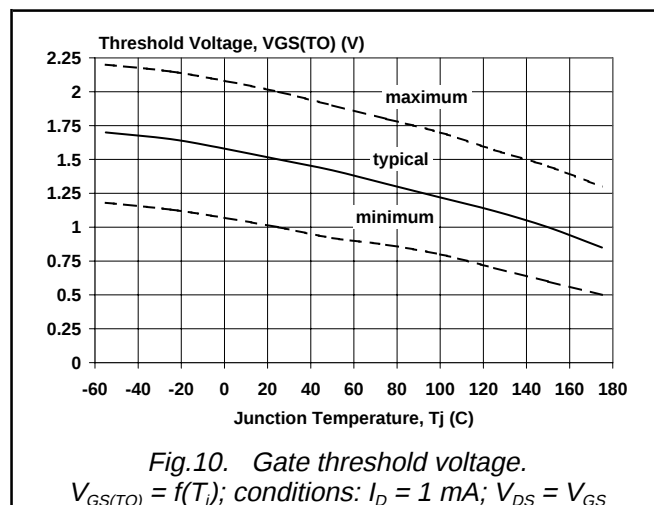
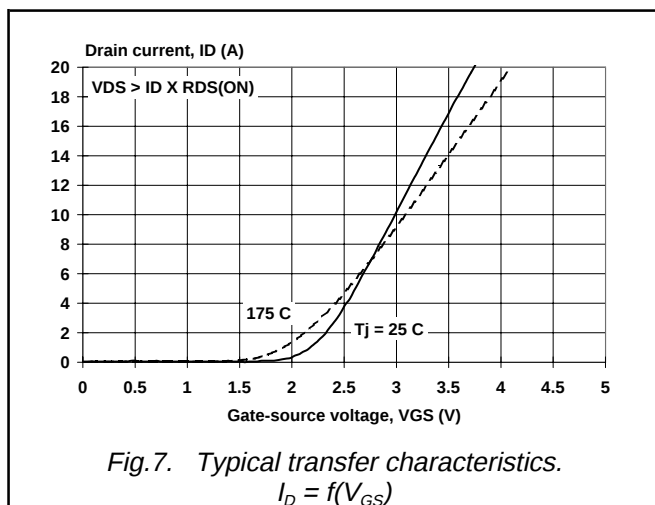
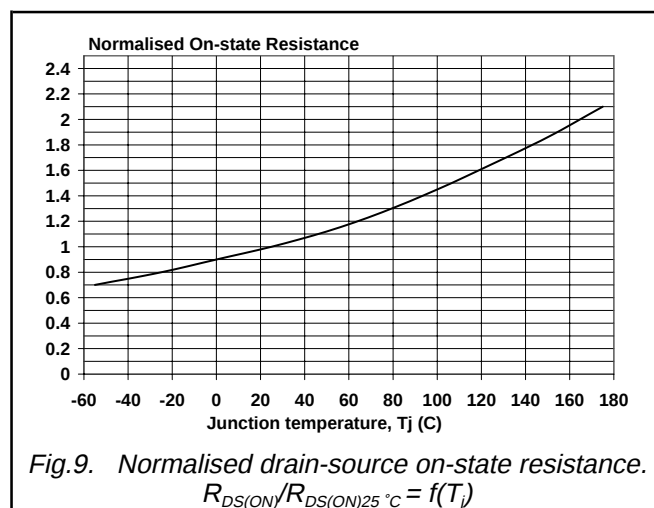
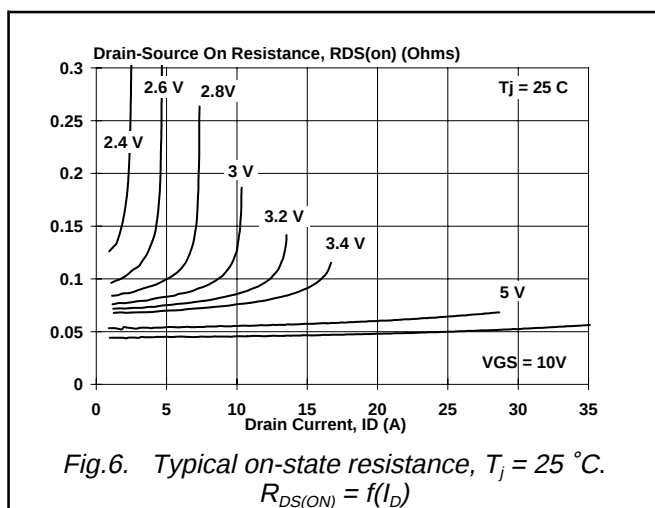
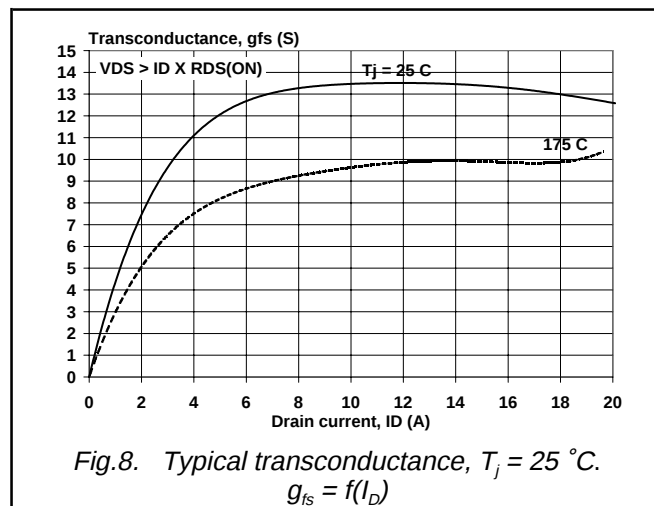
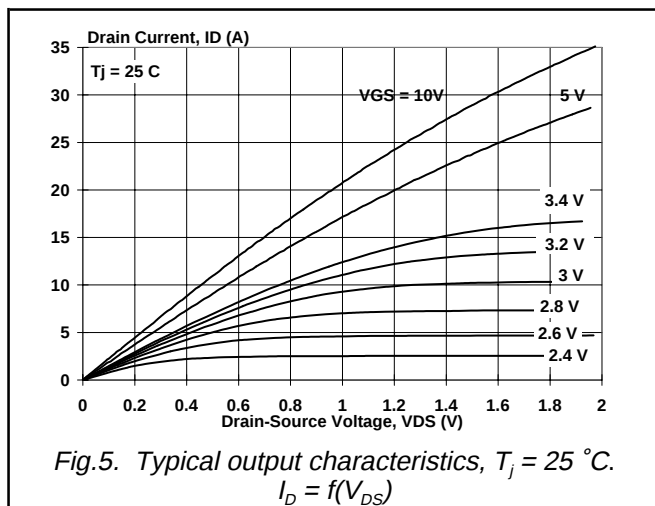
| SYMBOL   | PARAMETER                              | CONDITIONS                                                                                                   | MIN. | TYP. | MAX. | UNIT |
|----------|----------------------------------------|--------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_S$    | Continuous source current (body diode) |                                                                                                              | -    | -    | 19   | A    |
| $I_{SM}$ | Pulsed source current (body diode)     |                                                                                                              | -    | -    | 76   | A    |
| $V_{SD}$ | Diode forward voltage                  | $I_F = 20\text{ A}$ ; $V_{GS} = 0\text{ V}$                                                                  | -    | 1.2  | 1.5  | V    |
| $t_{rr}$ | Reverse recovery time                  | $I_F = 20\text{ A}$ ; $-di_F/dt = 100\text{ A}/\mu\text{s}$ ;<br>$V_{GS} = 0\text{ V}$ ; $V_R = 30\text{ V}$ | -    | 43   | -    | ns   |
| $Q_{rr}$ | Reverse recovery charge                |                                                                                                              | -    | 94   | -    | nC   |



# N-channel TrenchMOS™ transistor

## Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT



# N-channel TrenchMOS™ transistor

## Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

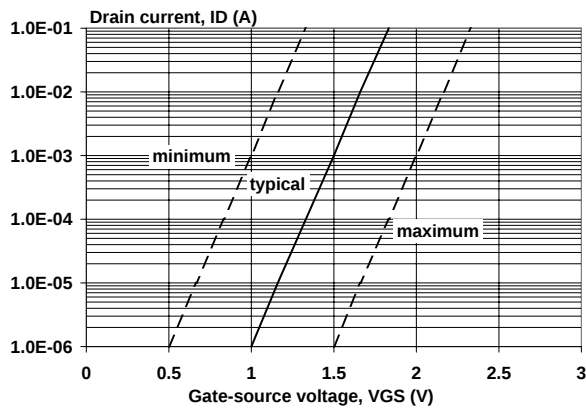


Fig.11. Sub-threshold drain current.  
 $I_D = f(V_{GS})$ ; conditions:  $T_j = 25^\circ\text{C}$ ;  $V_{DS} = V_{GS}$

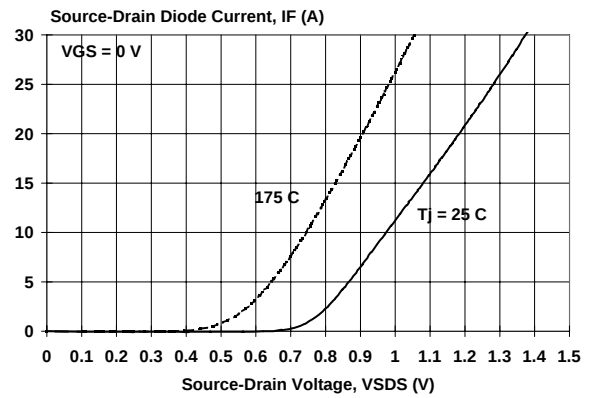


Fig.14. Typical reverse diode current.  
 $I_F = f(V_{SDS})$ ; conditions:  $V_{GS} = 0\text{ V}$ ; parameter  $T_j$

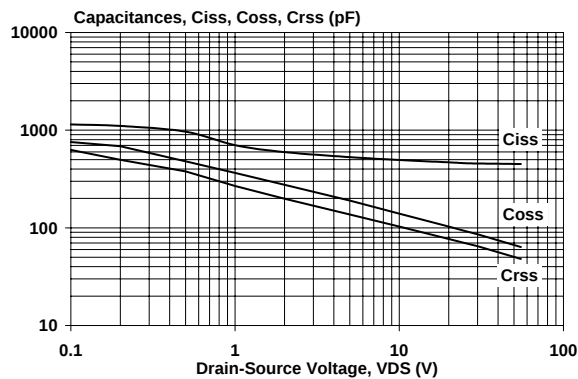


Fig.12. Typical capacitances,  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ .  
 $C = f(V_{DS})$ ; conditions:  $V_{GS} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

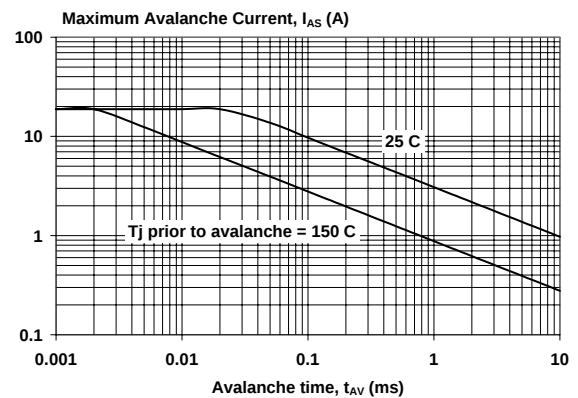


Fig.15. Maximum permissible non-repetitive avalanche current ( $I_{AS}$ ) versus avalanche time ( $t_{AV}$ ); unclamped inductive load

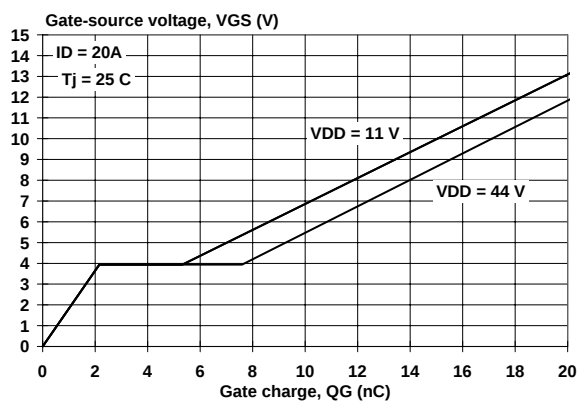
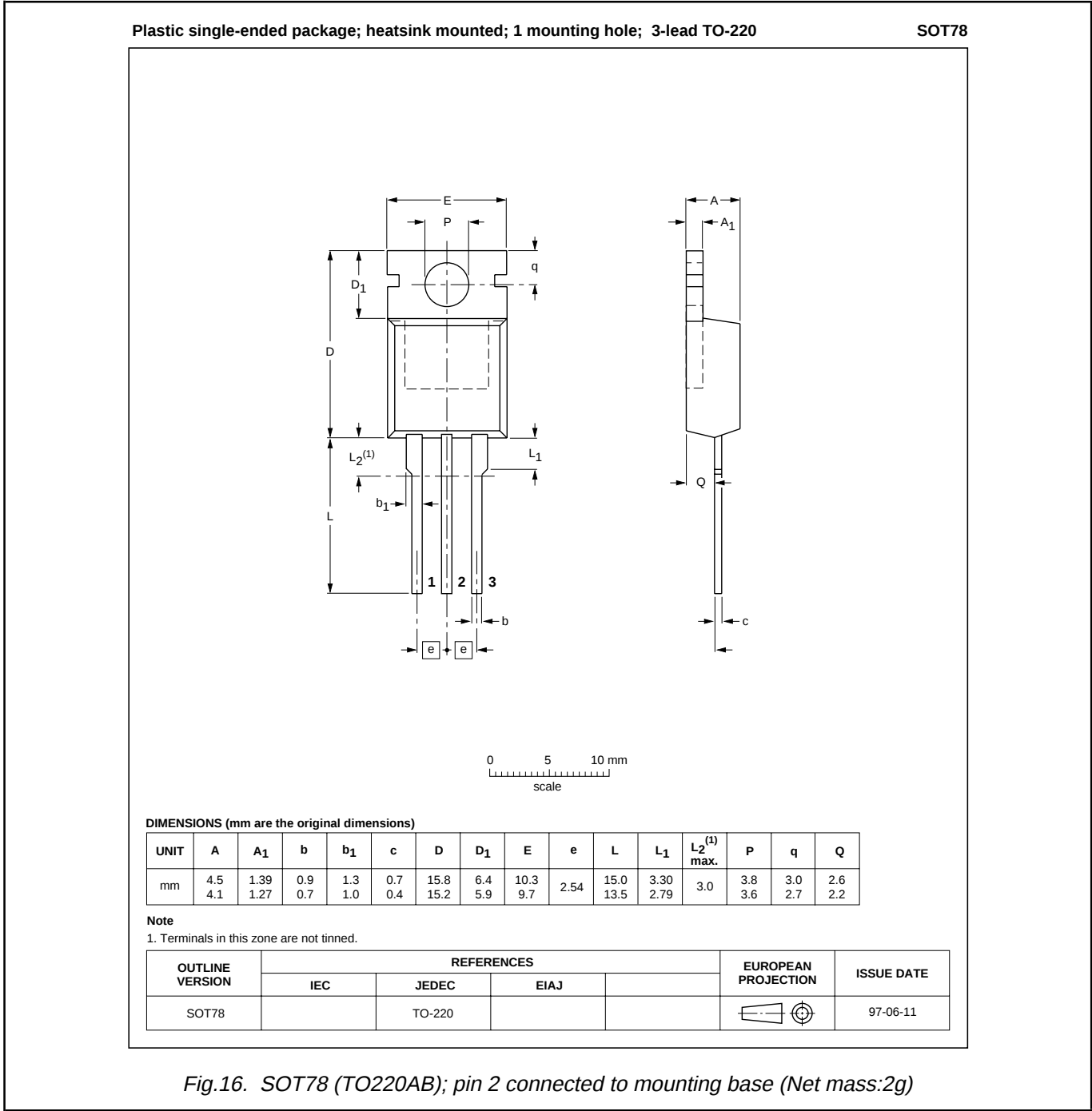


Fig.13. Typical turn-on gate-charge characteristics.  
 $V_{GS} = f(Q_G)$

N-channel TrenchMOS™ transistor  
Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

MECHANICAL DATA



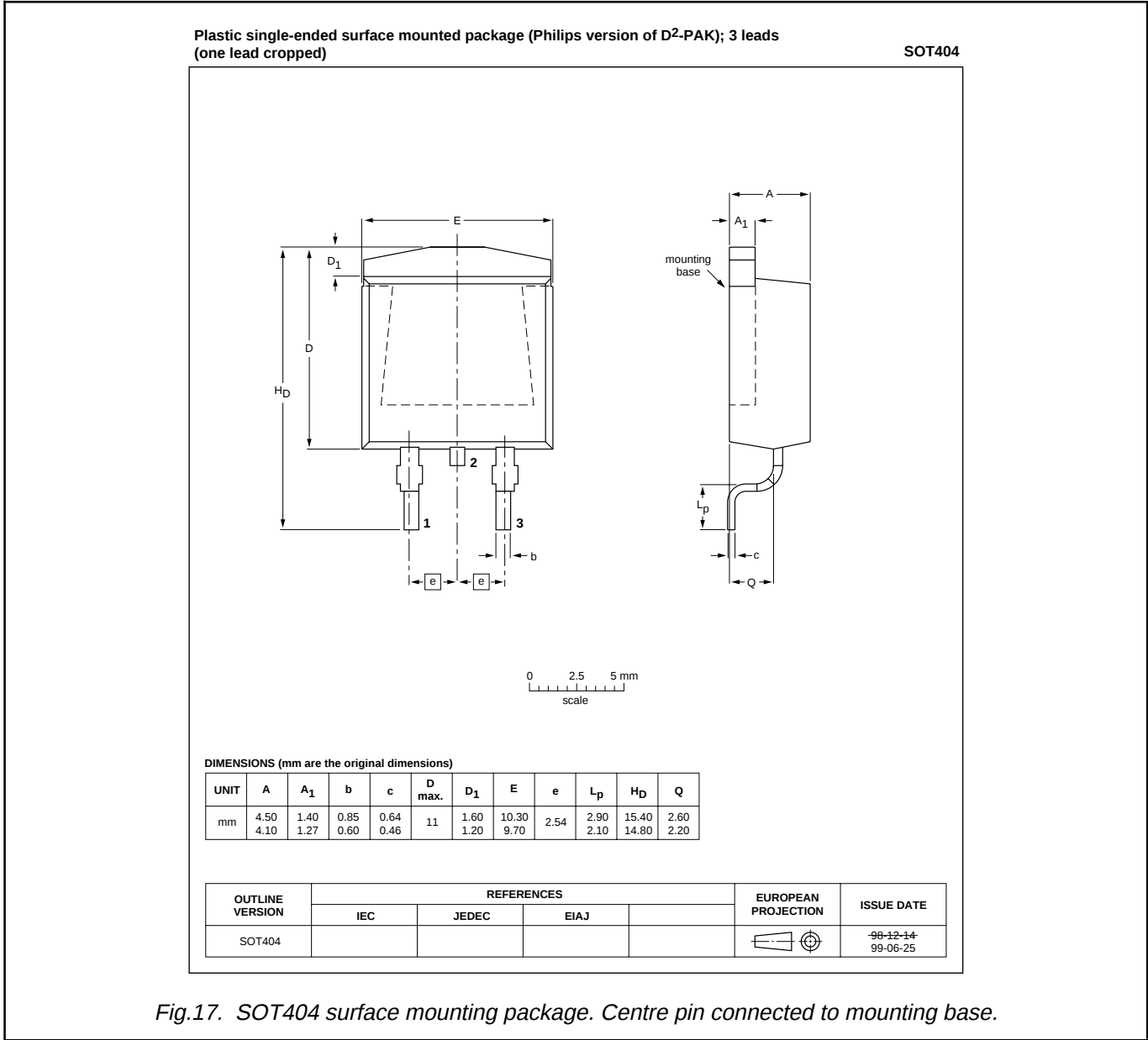
Notes

1. This product is supplied in anti-static packaging. The gate-source input must be protected against static discharge during transport or handling.
2. Refer to mounting instructions for SOT78 (TO220AB) package.
3. Epoxy meets UL94 V0 at 1/8".

N-channel TrenchMOS™ transistor  
Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

MECHANICAL DATA



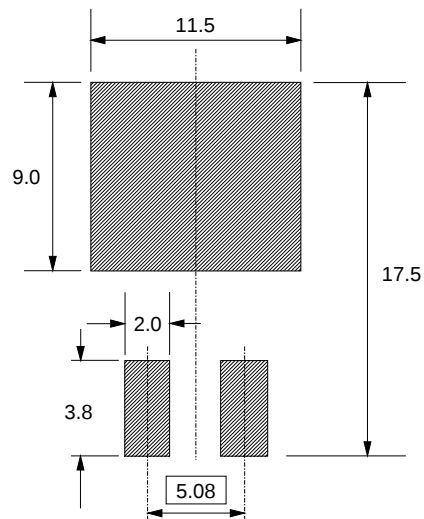
- Notes**
1. This product is supplied in anti-static packaging. The gate-source input must be protected against static discharge during transport or handling.
  2. Refer to SMD Footprint Design and Soldering Guidelines, Data Handbook SC18.
  3. Epoxy meets UL94 V0 at 1/8".

N-channel TrenchMOS<sup>TM</sup> transistor  
Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

## MOUNTING INSTRUCTIONS

*Dimensions in mm*

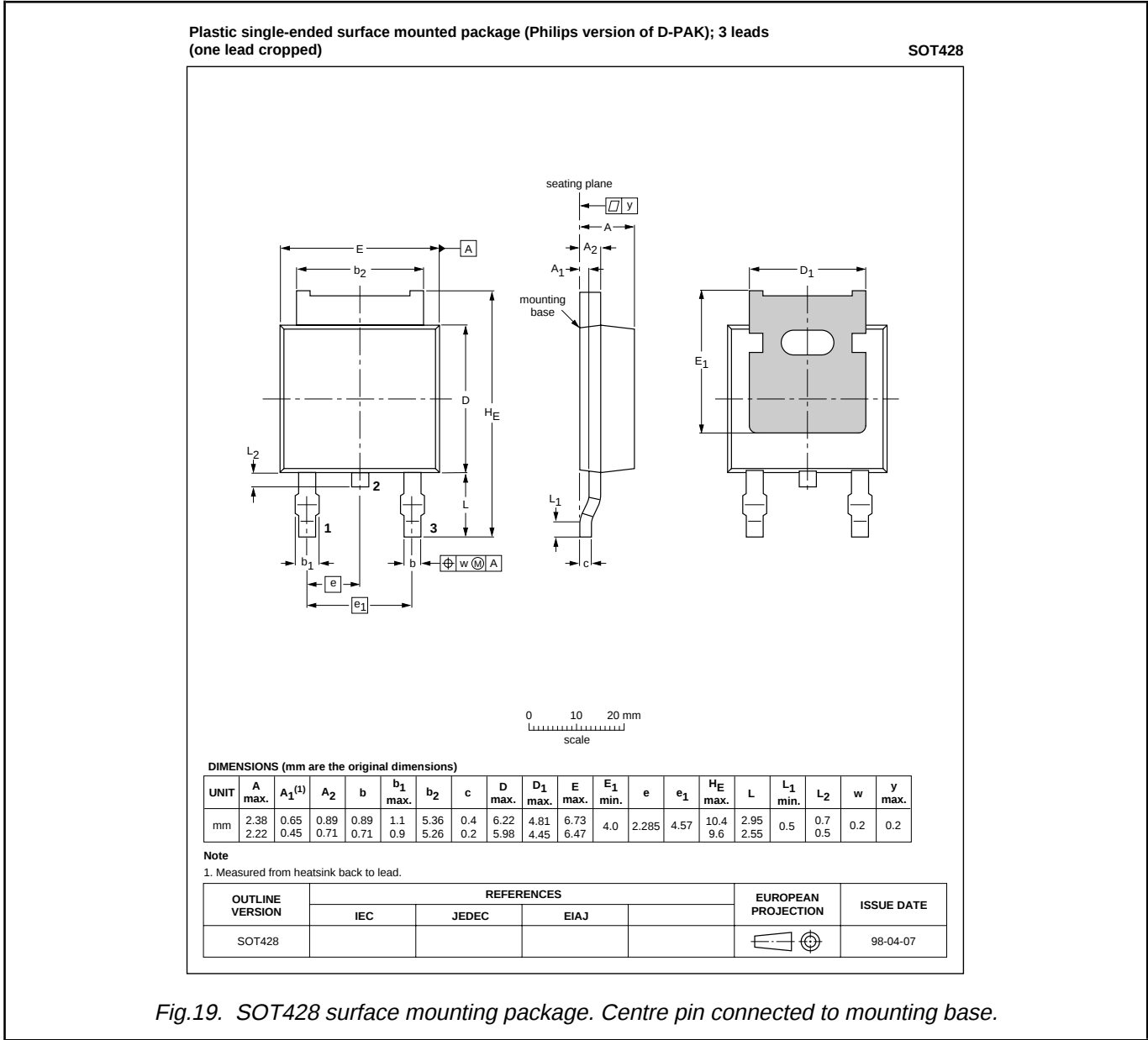


*Fig.18. SOT404 : soldering pattern for surface mounting.*

N-channel TrenchMOS™ transistor  
Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

MECHANICAL DATA



- Notes**
1. This product is supplied in anti-static packaging. The gate-source input must be protected against static discharge during transport or handling.
  2. Refer to SMD Footprint Design and Soldering Guidelines, Data Handbook SC18.
  3. Epoxy meets UL94 V0 at 1/8".

MOUNTING INSTRUCTIONS

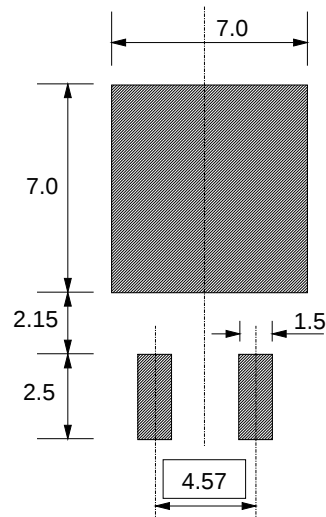
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**N-channel TrenchMOS™ transistor**  
**Logic level FET**

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**PHP21N06LT, PHB21N06LT**  
**PHD21N06LT**

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*Dimensions in mm*

*Fig.20. SOT428 : soldering pattern for surface mounting.*

## N-channel TrenchMOS<sup>TM</sup> transistor Logic level FET

PHP21N06LT, PHB21N06LT  
PHD21N06LT

### DEFINITIONS

| Data sheet status                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Objective specification                                                                                                                                                                                                                                                                                                                                                                                                                                    | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification                                                                                                                                                                                                                                                                                                                                                                                                                                  | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification                                                                                                                                                                                                                                                                                                                                                                                                                                      | This data sheet contains final product specifications.                                |
| Limiting values                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                       |
| Limiting values are given in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability. |                                                                                       |
| Application information                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
| Where application information is given, it is advisory and does not form part of the specification.                                                                                                                                                                                                                                                                                                                                                        |                                                                                       |
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