

**PowerMOS transistor****PHP5N40E****GENERAL DESCRIPTION**

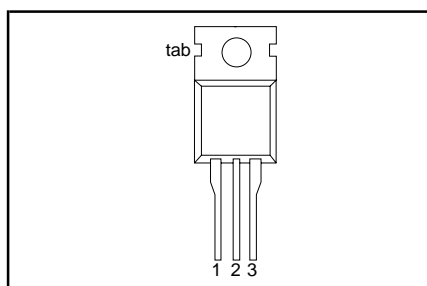
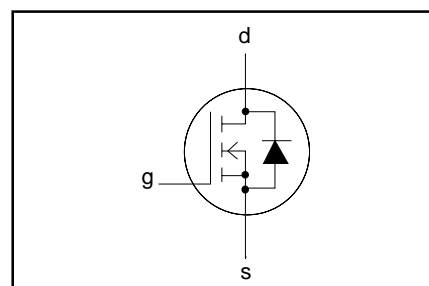
N-channel enhancement mode field-effect power transistor in a plastic envelope featuring high avalanche energy capability, stable blocking voltage, fast switching and high thermal cycling performance with low thermal resistance. Intended for use in Switched Mode Power Supplies (SMPS), motor control circuits and general purpose switching applications.

**QUICK REFERENCE DATA**

| SYMBOL       | PARAMETER                        | MAX. | UNIT     |
|--------------|----------------------------------|------|----------|
| $V_{DS}$     | Drain-source voltage             | 400  | V        |
| $I_D$        | Drain current (DC)               | 6.5  | A        |
| $P_{tot}$    | Total power dissipation          | 100  | W        |
| $R_{DS(ON)}$ | Drain-source on-state resistance | 1.0  | $\Omega$ |

**PINNING - TO220AB**

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | gate        |
| 2   | drain       |
| 3   | source      |
| tab | drain       |

**PIN CONFIGURATION****SYMBOL****LIMITING VALUES**

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

| SYMBOL       | PARAMETER                                     | CONDITIONS                    | MIN. | MAX. | UNIT             |
|--------------|---|-------------------------------|------|------|------------------|
| $V_{DS}$     | Drain-source voltage                          |                               | -    | 400  | V                |
| $V_{DGR}$    | Drain-gate voltage                            | $R_{GS} = 20 \text{ k}\Omega$ | -    | 400  | V                |
| $\pm V_{GS}$ | Gate-source voltage                           |                               | -    | 30   | V                |
| $I_D$        | Drain current (DC)                            | $T_{mb} = 25^\circ\text{C}$   | -    | 6.5  | A                |
|              |   | $T_{mb} = 100^\circ\text{C}$  | -    | 4.1  | A                |
| $I_{DM}$     | Drain current (pulse peak value)              | $T_{mb} = 25^\circ\text{C}$   | -    | 26   | A                |
| $I_{DR}$     | Source-drain diode current (DC)               | $T_{mb} = 25^\circ\text{C}$   | -    | 6.5  | A                |
| $I_{DRM}$    | Source-drain diode current (pulse peak value) | $T_{mb} = 25^\circ\text{C}$   | -    | 26   | A                |
| $P_{tot}$    | Total power dissipation                       | $T_{mb} = 25^\circ\text{C}$   | -    | 100  | W                |
| $T_{stg}$    | Storage temperature                           |                               | -55  | 150  | $^\circ\text{C}$ |
| $T_j$        | Junction temperature                          |                               | -    | 150  | $^\circ\text{C}$ |

**AVALANCHE LIMITING VALUE**

| SYMBOL      | PARAMETER   | CONDITIONS  | MIN. | MAX. | UNIT |
|-------------|---|---|------|------|------|
| $W_{DSS}$   | Drain-source non-repetitive unclamped inductive turn-off energy | $I_D = 6.5 \text{ A}$ ; $V_{DD} \leq 50 \text{ V}$ ; $V_{GS} = 10 \text{ V}$ ;<br>$R_{GS} = 50 \Omega$<br>$T_j = 25^\circ\text{C}$ prior to surge<br>$T_j = 100^\circ\text{C}$ prior to surge | -    | 290  | mJ   |
| $W_{DSR}^1$ | Drain-source repetitive unclamped inductive turn-off energy     | $I_D = 6.5 \text{ A}$ ; $V_{DD} \leq 50 \text{ V}$ ; $V_{GS} = 10 \text{ V}$ ;<br>$R_{GS} = 50 \Omega$ ; $T_j \leq 150^\circ\text{C}$   | -    | 46   | mJ   |
|             |   |   | -    | 7.4  | mJ   |

1. Pulse width and frequency limited by  $T_{j(max)}$

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## THERMAL RESISTANCES

| SYMBOL         | PARAMETER                                    | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|----------------|--|------------|------|------|------|------|
| $R_{th\ j-mb}$ | Thermal resistance junction to mounting base |            | -    | -    | 1.25 | K/W  |
| $R_{th\ j-a}$  | Thermal resistance junction to ambient       |            | -    | 60   | -    | K/W  |

## STATIC CHARACTERISTICS

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

| SYMBOL        | PARAMETER                          | CONDITIONS  | MIN. | TYP. | MAX. | UNIT          |
|---------------|------------------------------------|---|------|------|------|---------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage     | $V_{GS} = 0\text{ V}; I_D = 0.25\text{ mA}$   | 400  | -    | -    | V             |
| $V_{GS(TO)}$  | Gate threshold voltage             | $V_{DS} = V_{GS}; I_D = 0.25\text{ mA}$   | 2.0  | 3.0  | 4.0  | V             |
| $I_{DSS}$     | Drain-source leakage current       | $V_{DS} = 400\text{ V}; V_{GS} = 0\text{ V}; T_j = 25\ ^\circ\text{C}$<br>$V_{DS} = 320\text{ V}; V_{GS} = 0\text{ V}; T_j = 125\ ^\circ\text{C}$ | -    | 10   | 100  | $\mu\text{A}$ |
| $I_{GSS}$     | Gate-source leakage current        | $V_{GS} = \pm 30\text{ V}; V_{DS} = 0\text{ V}$   | -    | 10   | 100  | nA            |
| $R_{DS(ON)}$  | Drain-source on-state resistance   | $V_{GS} = 10\text{ V}; I_D = 3.25\text{ A}$   | -    | 0.8  | 1.0  | $\Omega$      |
| $V_{SD}$      | Source-drain diode forward voltage | $I_F = 6.5\text{ A}; V_{GS} = 0\text{ V}$   | -    | 1.1  | 1.4  | V             |

## DYNAMIC CHARACTERISTICS

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

| SYMBOL       | PARAMETER                                  | CONDITIONS  | MIN. | TYP. | MAX. | UNIT          |
|--------------|--|---|------|------|------|---------------|
| $g_{fs}$     | Forward transconductance                   | $V_{DS} = 15\text{ V}; I_D = 3.25\text{ A}$   | 2.0  | 3.5  | -    | S             |
| $C_{iss}$    | Input capacitance                          | $V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz}$   | -    | 750  | 1000 | pF            |
| $C_{oss}$    | Output capacitance                         |   | -    | 120  | 180  | pF            |
| $C_{rss}$    | Feedback capacitance                       |   | -    | 50   | 70   | pF            |
| $Q_{g(tot)}$ | Total gate charge                          | $V_{GS} = 10\text{ V}; I_D = 6.5\text{ A}; V_{DS} = 320\text{ V}$   | -    | 35   | -    | nC            |
| $Q_{gs}$     | Gate to source charge                      |   | -    | 4    | -    | nC            |
| $Q_{gd}$     | Gate to drain (Miller) charge              |   | -    | 18   | -    | nC            |
| $t_{d\ on}$  | Turn-on delay time                         | $V_{DD} = 30\text{ V}; I_D = 2.7\text{ A};$<br>$V_{GS} = 10\text{ V}; R_{GS} = 50\ \Omega;$<br>$R_{GEN} = 50\ \Omega$ | -    | 10   | 25   | ns            |
| $t_r$        | Turn-on rise time                          |   | -    | 25   | 40   | ns            |
| $t_{d\ off}$ | Turn-off delay time                        |   | -    | 120  | 140  | ns            |
| $t_f$        | Turn-off fall time                         |   | -    | 40   | 65   | ns            |
| $t_{rr}$     | Source-drain diode reverse recovery time   | $I_F = 6.5\text{ A}; -dI_F/dt = 100\text{ A}/\mu\text{s};$  | -    | 1200 | -    | ns            |
| $Q_{rr}$     | Source-drain diode reverse recovery charge | $V_{GS} = 0\text{ V}; V_R = 100\text{ V}$   | -    | 6.0  | -    | $\mu\text{C}$ |
| $L_d$        | Internal drain inductance                  | Measured from contact screw on tab to centre of die   | -    | 3.5  | -    | nH            |
| $L_d$        | Internal drain inductance                  | Measured from drain lead 6 mm from package to centre of die   | -    | 4.5  | -    | nH            |
| $L_s$        | Internal source inductance                 | Measured from source lead 6 mm from package to source bond pad  | -    | 7.5  | -    | nH            |

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## MECHANICAL DATA

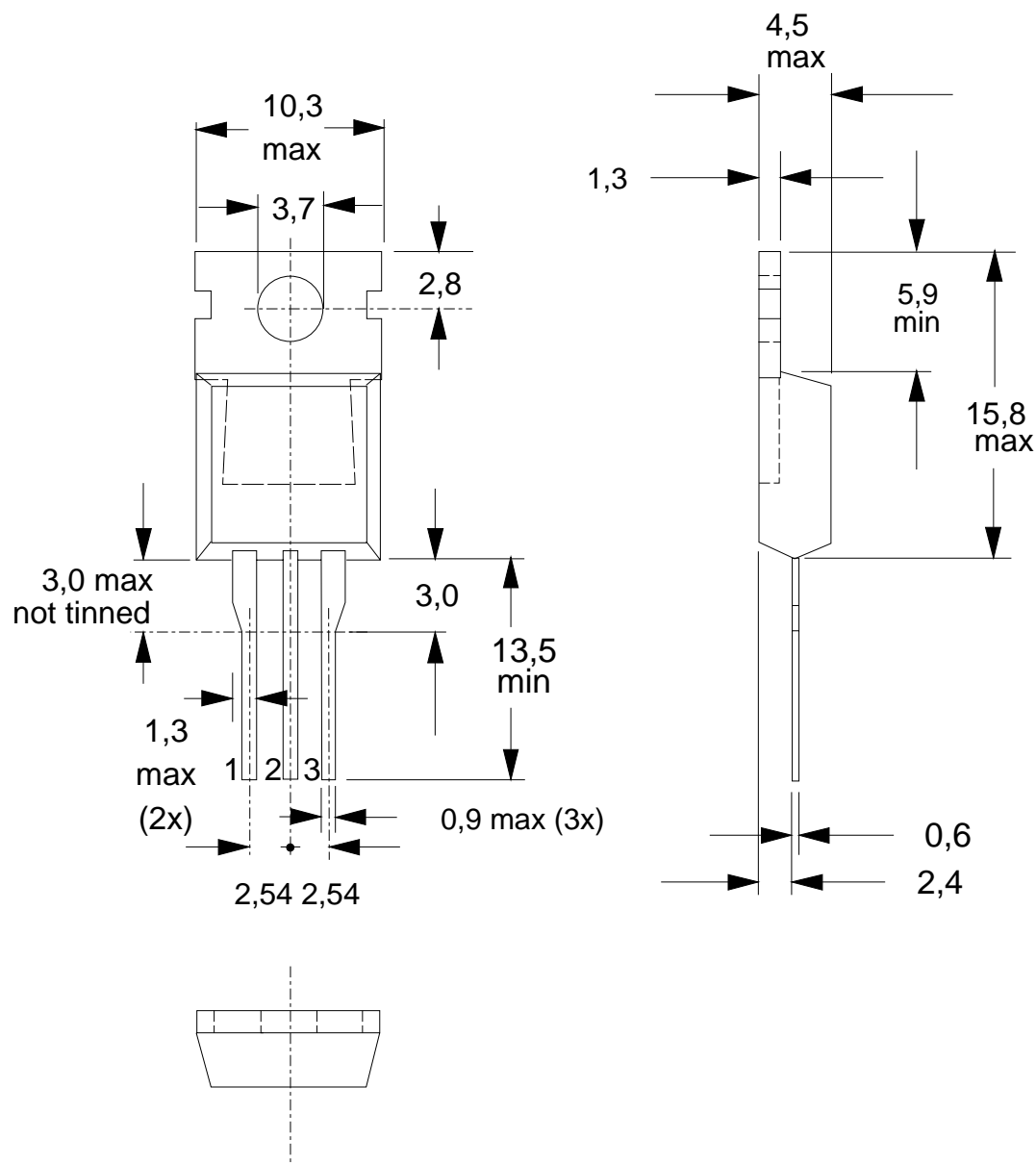
*Dimensions in mm**Net Mass: 2 g*

Fig.1. TO220AB; pin 2 connected to mounting base.

**Notes**

1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. Refer to mounting instructions for TO220 envelopes.
3. Epoxy meets UL94 V0 at 1/8".

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**DEFINITIONS**

| <b>Data sheet status</b>   |   |
|--|---|
| 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.                                |
| <b>Limiting values</b>   |   |
| 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. |   |
| <b>Application information</b>   |   |
| Where application information is given, it is advisory and does not form part of the specification.  |   |
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