

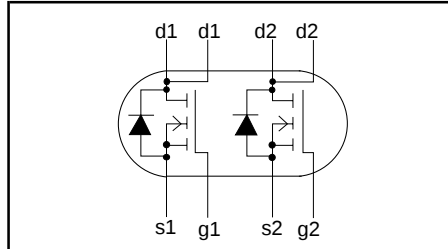
## Dual N-channel enhancement mode TrenchMOS™ transistor

PHN210

### FEATURES

- Dual device
- Low threshold voltage
- Fast switching
- Logic level compatible
- Surface mount package

### SYMBOL



### QUICK REFERENCE DATA

$$V_{DS} = 30 \text{ V}$$

$$I_D = 3.4 \text{ A}$$

$$R_{DS(ON)} \leq 100 \text{ m}\Omega \text{ (} V_{GS} = 10 \text{ V)}$$

$$R_{DS(ON)} \leq 200 \text{ m}\Omega \text{ (} V_{GS} = 4.5 \text{ V)}$$

### GENERAL DESCRIPTION

Dual N-channel enhancement mode field-effect transistor in a plastic envelope using 'trench' technology.

#### Applications:-

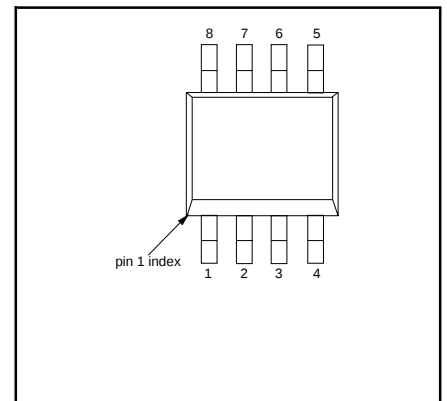
- Motor and relay drivers
- d.c. to d.c. converters
- Logic level translator

The PHN210 is supplied in the SOT96-1 (SO8) surface mounting package.

### PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | source 1    |
| 2   | gate 1      |
| 3   | source 2    |
| 4   | gate 2      |
| 5,6 | drain 2     |
| 7,8 | drain 1     |

### SOT96-1



### LIMITING VALUES

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

| SYMBOL         | PARAMETER                                                                | CONDITIONS                                      | MIN. | MAX.     | UNIT             |
|----------------|--------------------------------------------------------------------------|-------------------------------------------------|------|----------|------------------|
| $V_{DS}$       | Repetitive peak drain-source voltage                                     | $T_j = 25^\circ\text{C}$ to $150^\circ\text{C}$ | -    | 30       | V                |
| $V_{DS}$       | Continuous drain-source voltage                                          |                                                 | -    | 30       | V                |
| $V_{DGR}$      | Drain-gate voltage                                                       | $R_{GS} = 20 \text{ k}\Omega$                   | -    | 30       | V                |
| $V_{GS}$       | Gate-source voltage                                                      |                                                 | -    | $\pm 20$ | V                |
| $I_D$          | Drain current per MOSFET <sup>1</sup>                                    | $T_a = 25^\circ\text{C}$                        | -    | 3.4      | A                |
|                |                                                                          | $T_a = 70^\circ\text{C}$                        | -    | 2.8      | A                |
| $I_D$          | Drain current per MOSFET (both MOSFETs conducting) <sup>1</sup>          | $T_a = 25^\circ\text{C}$                        | -    | 2.4      | A                |
|                |                                                                          | $T_a = 70^\circ\text{C}$                        | -    | 1.9      | A                |
| $I_{DM}$       | Drain current per MOSFET (pulse peak value)                              | $T_a = 25^\circ\text{C}$                        | -    | 14       | A                |
| $P_{tot}$      | Total power dissipation (either or both MOSFETs conducting) <sup>1</sup> | $T_a = 25^\circ\text{C}$                        | -    | 2        | W                |
|                |                                                                          | $T_a = 70^\circ\text{C}$                        | -    | 1.3      | W                |
| $T_{stg}, T_j$ | Storage & operating temperature                                          |                                                 | - 65 | 150      | $^\circ\text{C}$ |

<sup>1</sup> Surface mounted on FR4 board,  $t \leq 10 \text{ sec}$

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## THERMAL RESISTANCES

| SYMBOL        | PARAMETER                              | CONDITIONS                                  | TYP. | MAX. | UNIT |
|---------------|----------------------------------------|---------------------------------------------|------|------|------|
| $R_{th\ j-a}$ | Thermal resistance junction to ambient | Surface mounted, FR4 board, $t \leq 10$ sec | -    | 62.5 | K/W  |
| $R_{th\ j-a}$ | Thermal resistance junction to ambient | Surface mounted, FR4 board                  | 150  | -    | K/W  |

## 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 (per MOSFET)  | Unclamped inductive load, $I_{AS} = 3.4$ A;<br>$t_b = 0.2$ ms; $T_j$ prior to avalanche = $25^\circ\text{C}$ ;<br>$V_{DD} \leq 15$ V; $R_{GS} = 50\ \Omega$ ; $V_{GS} = 10$ V | -    | 13   | mJ   |
| $I_{AS}$ | Non-repetitive avalanche current (per MOSFET) |                                                                                                                                                                               | -    | 3.4  | A    |

## ELECTRICAL CHARACTERISTICS

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

| SYMBOL        | PARAMETER                        | CONDITIONS                                                                                                                   | MIN.          | TYP.           | MAX.              | UNIT                                   |
|---------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|-------------------|----------------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage   | $V_{GS} = 0$ V; $I_D = 10\ \mu\text{A}$ ;<br>$T_j = -55^\circ\text{C}$                                                       | 30<br>27      | -<br>-         | -<br>-            | V<br>V                                 |
| $V_{GS(TO)}$  | Gate threshold voltage           | $V_{DS} = V_{GS}$ ; $I_D = 1$ mA<br>$T_j = 150^\circ\text{C}$<br>$T_j = -55^\circ\text{C}$                                   | 1<br>0.4<br>- | 2<br>-<br>-    | 2.8<br>-<br>3.2   | V<br>V<br>V                            |
| $R_{DS(ON)}$  | Drain-source on-state resistance | $V_{GS} = 10$ V; $I_D = 2.2$ A<br>$V_{GS} = 4.5$ V; $I_D = 1$ A<br>$V_{GS} = 10$ V; $I_D = 2.2$ A; $T_j = 150^\circ\text{C}$ | -<br>-<br>-   | 80<br>120<br>- | 100<br>200<br>170 | m $\Omega$<br>m $\Omega$<br>m $\Omega$ |
| $g_{fs}$      | Forward transconductance         | $V_{DS} = 20$ V; $I_D = 2.2$ A                                                                                               | 2             | 4.5            | -                 | S                                      |
| $I_{D(ON)}$   | On-state drain current           | $V_{GS} = 10$ V; $V_{DS} = 1$ V;<br>$V_{GS} = 4.5$ V; $V_{DS} = 5$ V                                                         | 3.5<br>2      | -<br>-         | -<br>-            | A<br>A                                 |
| $I_{DSS}$     | Zero gate voltage drain current  | $V_{DS} = 24$ V; $V_{GS} = 0$ V;<br>$V_{DS} = 24$ V; $V_{GS} = 0$ V; $T_j = 150^\circ\text{C}$                               | -<br>-        | 10<br>0.6      | 100<br>10         | nA<br>$\mu\text{A}$                    |
| $I_{GSS}$     | Gate source leakage current      | $V_{GS} = \pm 20$ V; $V_{DS} = 0$ V                                                                                          | -             | 10             | 100               | nA                                     |
| $Q_{g(tot)}$  | Total gate charge                | $I_D = 2.3$ A; $V_{DD} = 15$ V; $V_{GS} = 10$ V                                                                              | -             | 6              | -                 | nC                                     |
| $Q_{gs}$      | Gate-source charge               |                                                                                                                              | -             | 0.7            | -                 | nC                                     |
| $Q_{gd}$      | Gate-drain (Miller) charge       |                                                                                                                              | -             | 0.7            | -                 | nC                                     |
| $t_{d\ on}$   | Turn-on delay time               | $V_{DD} = 20$ V; $R_D = 18\ \Omega$ ;<br>$V_{GS} = 10$ V; $R_G = 6\ \Omega$                                                  | -             | 6<br>8         | -<br>-            | ns<br>ns                               |
| $t_r$         | Turn-on rise time                |                                                                                                                              | -             | 21             | -                 | ns                                     |
| $t_{d\ off}$  | Turn-off delay time              | Resistive load                                                                                                               | -             | 15             | -                 | ns                                     |
| $t_f$         | Turn-off fall time               |                                                                                                                              | -             | 15             | -                 | ns                                     |
| $L_d$         | Internal drain inductance        | Measured from drain lead to centre of die                                                                                    | -             | 2.5            | -                 | nH                                     |
| $L_s$         | Internal source inductance       | Measured from source lead to source bond pad                                                                                 | -             | 5              | -                 | nH                                     |
| $C_{iss}$     | Input capacitance                | $V_{GS} = 0$ V; $V_{DS} = 20$ V; $f = 1$ MHz                                                                                 | -             | 250            | -                 | pF                                     |
| $C_{oss}$     | Output capacitance               |                                                                                                                              | -             | 88             | -                 | pF                                     |
| $C_{rss}$     | Feedback capacitance             |                                                                                                                              | -             | 54             | -                 | pF                                     |

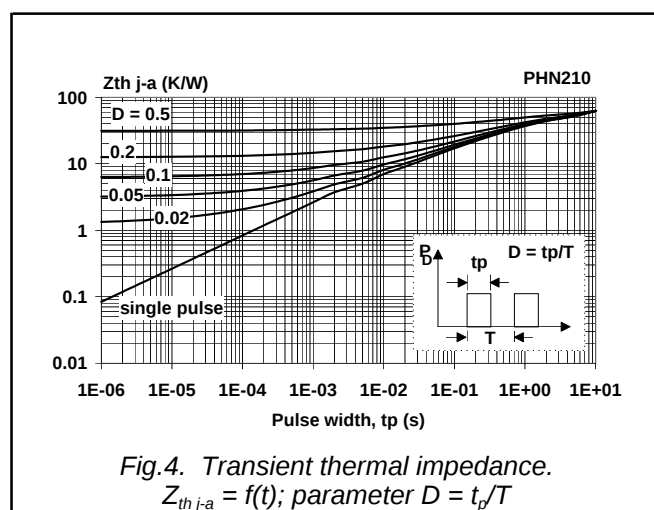
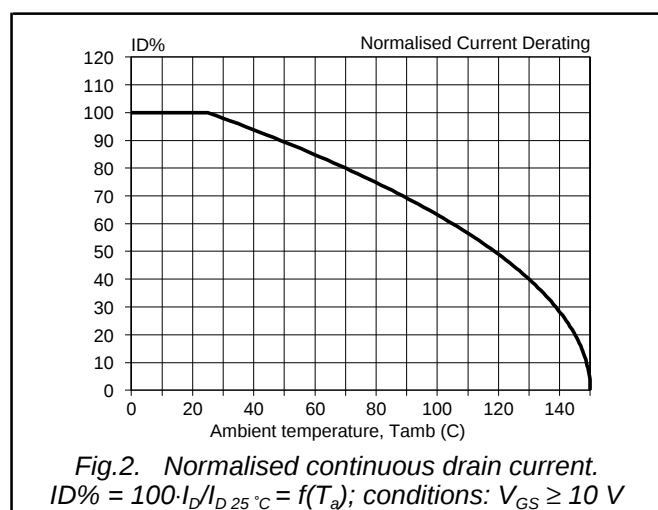
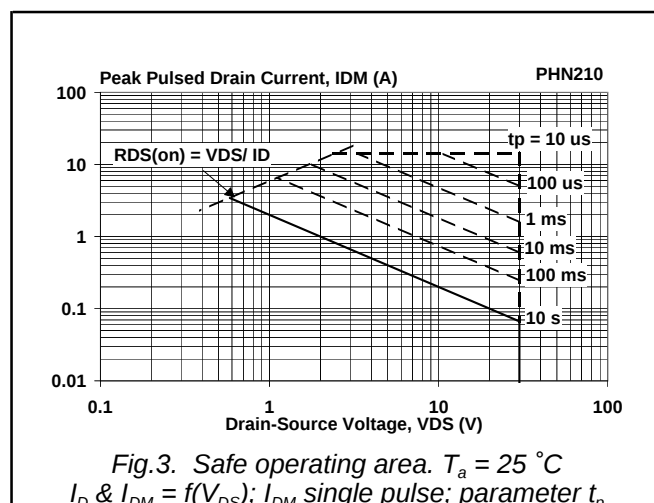
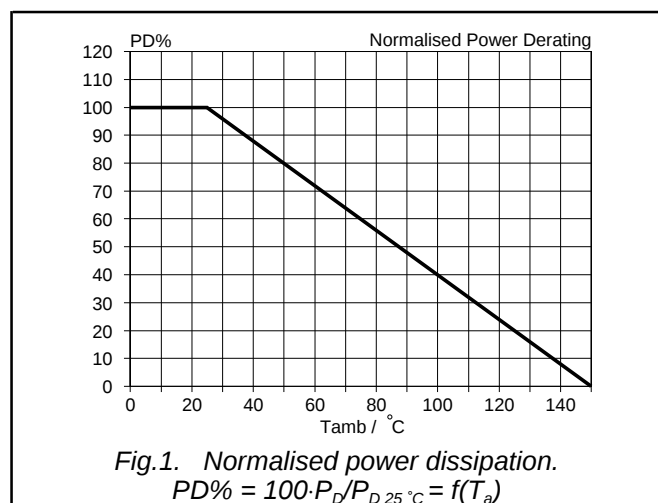
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## REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

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

| SYMBOL   | PARAMETER                                    | CONDITIONS                                                      | MIN. | TYP. | MAX. | UNIT |
|----------|----------------------------------------------|-----------------------------------------------------------------|------|------|------|------|
| $I_S$    | Continuous source diode current (per MOSFET) | $T_a = 25^\circ\text{C}$                                        | -    | -    | 2.2  | A    |
| $I_{SM}$ | Pulsed source diode current (per MOSFET)     |                                                                 | -    | -    | 14   | A    |
| $V_{SD}$ | Diode forward voltage                        | $I_F = 1.25\text{ A}$ ; $V_{GS} = 0\text{ V}$                   | -    | 0.82 | 1.2  | V    |
| $t_{rr}$ | Reverse recovery time                        | $I_F = 1.25\text{ A}$ ; $-di_F/dt = 100\text{ A}/\mu\text{s}$ ; | -    | 69   | -    | ns   |
| $Q_{rr}$ | Reverse recovery charge                      | $V_{GS} = 0\text{ V}$ ; $V_R = 25\text{ V}$                     | -    | 55   | -    | nC   |



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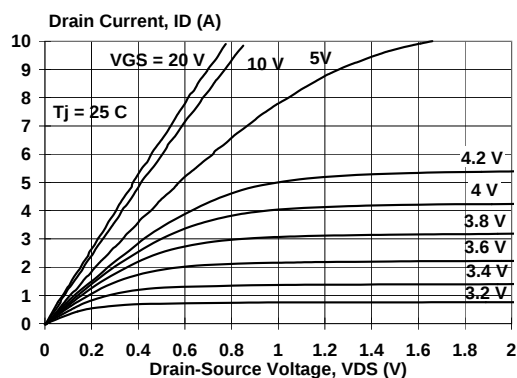


Fig. 5. Typical output characteristics,  $T_j = 25\text{ }^{\circ}\text{C}$ .  
 $I_D = f(V_{DS})$ ; parameter  $V_{GS}$

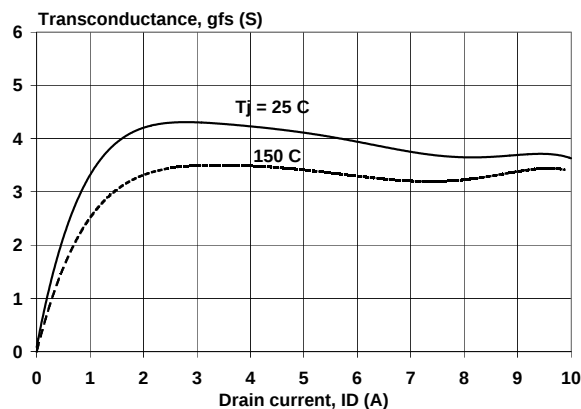


Fig. 8. Typical transconductance,  $T_j = 25\text{ }^{\circ}\text{C}$ .  
 $g_{fs} = f(I_D)$ ; parameter  $T_j$

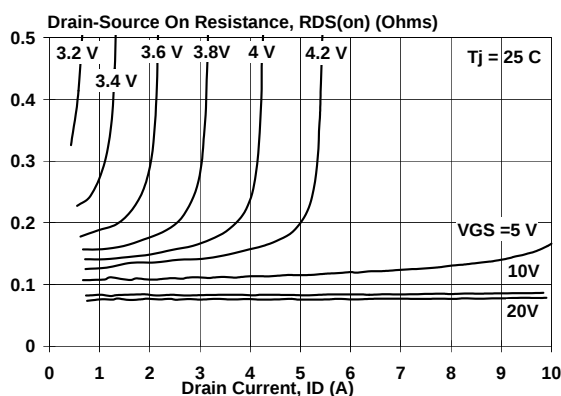


Fig. 6. Typical on-state resistance,  $T_j = 25\text{ }^{\circ}\text{C}$ .  
 $R_{DS(ON)} = f(I_D)$ ; parameter  $V_{GS}$

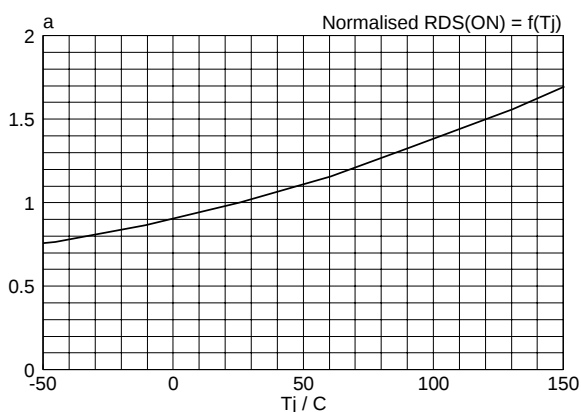


Fig. 9. Normalised drain-source on-state resistance.  
 $a = R_{DS(ON)}/R_{DS(ON)25\text{ }^{\circ}\text{C}} = f(T_j)$

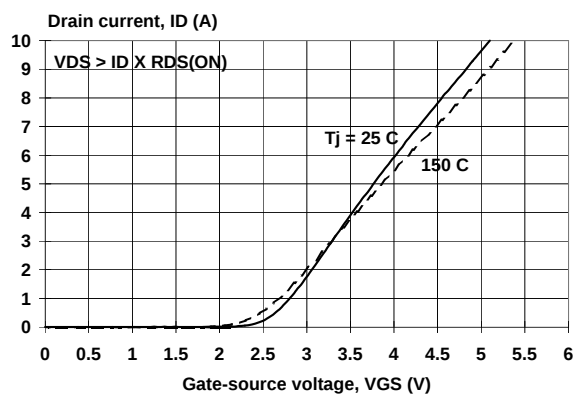


Fig. 7. Typical transfer characteristics.  
 $I_D = f(V_{GS})$ ; parameter  $T_j$

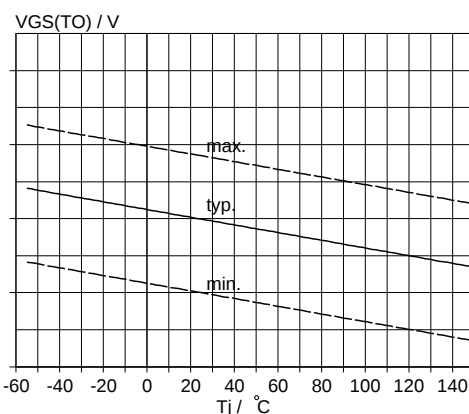
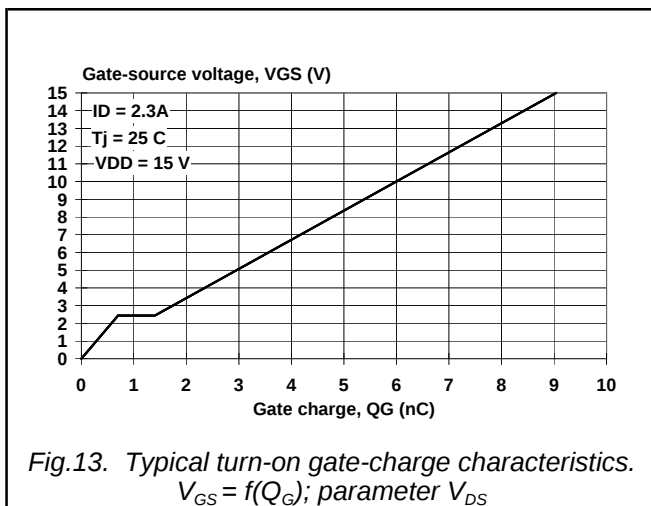
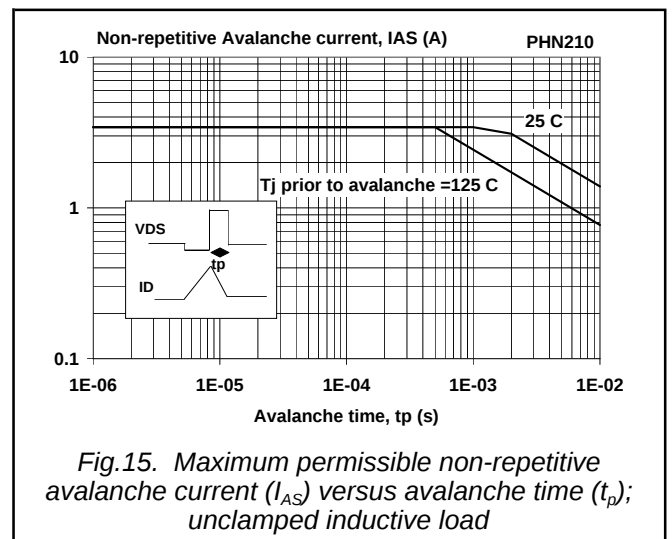
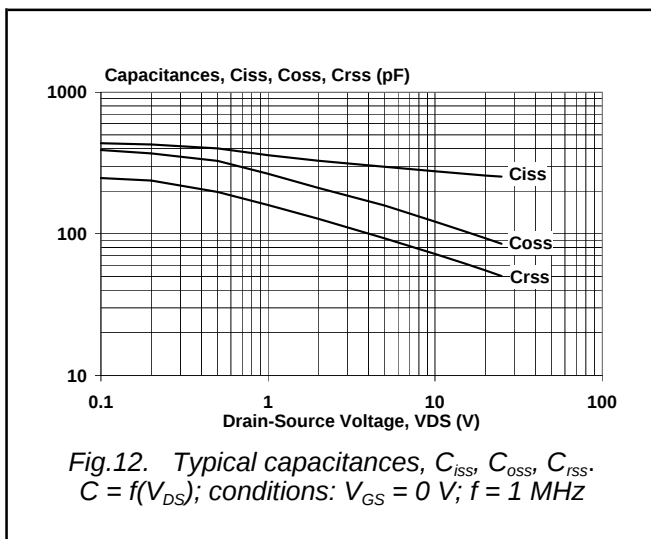
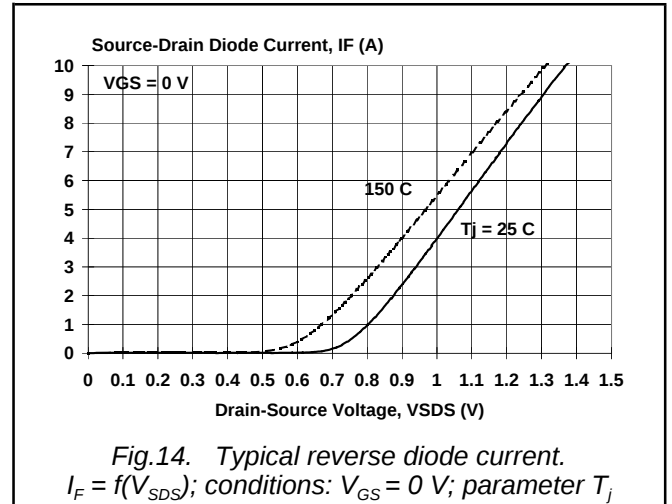
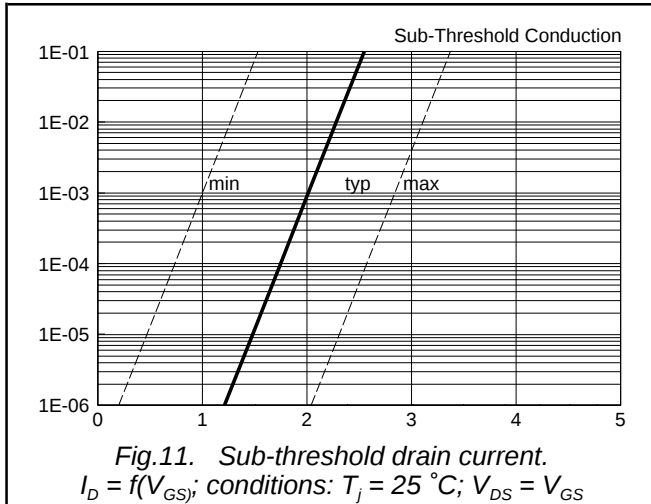


Fig. 10. Gate threshold voltage.  
 $V_{GS(TO)} = f(T_j)$ ; conditions:  $I_D = 1\text{ mA}$ ;  $V_{DS} = V_{GS}$

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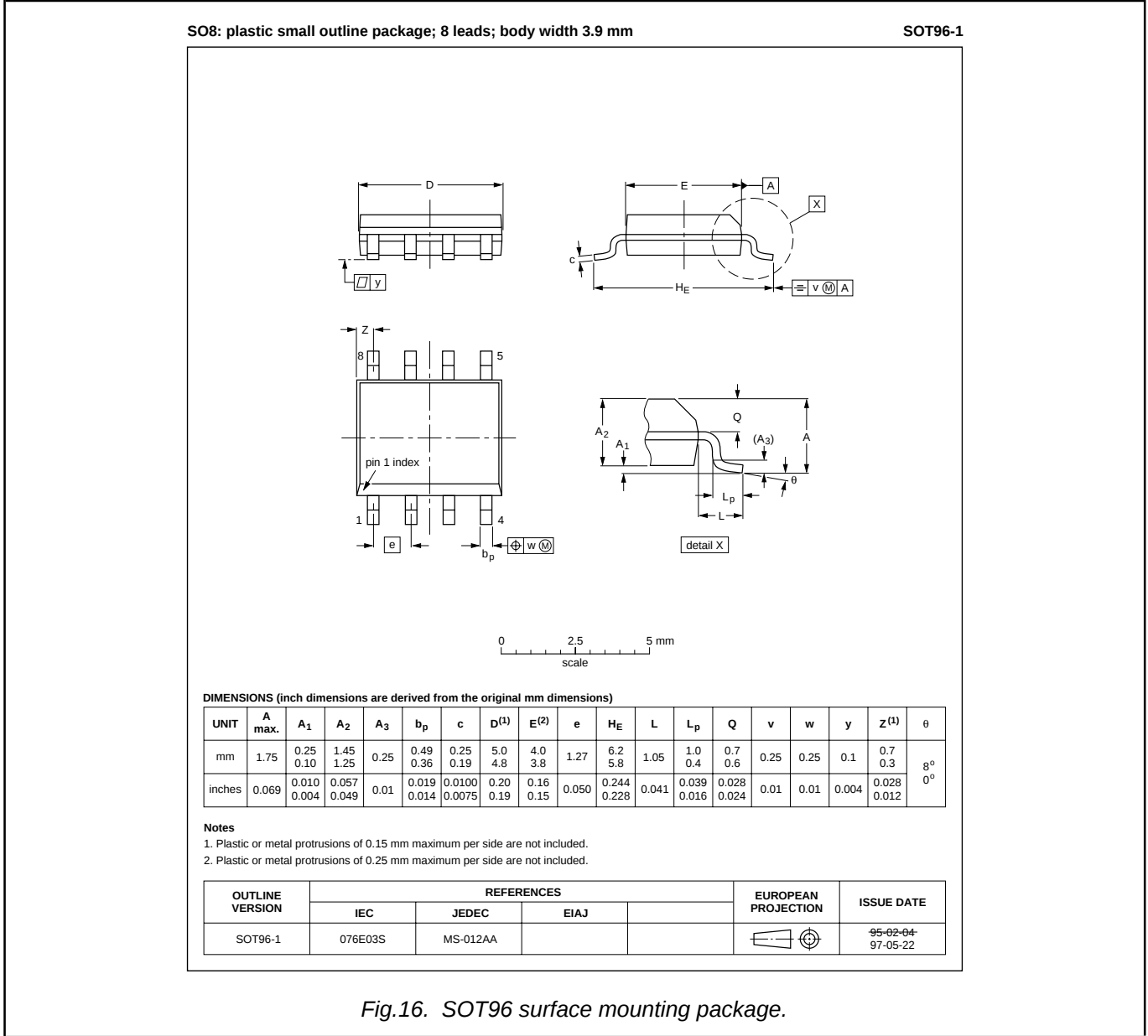
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Dual N-channel enhancement mode  
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MECHANICAL DATA



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 Integrated Circuit Packages, Data Handbook IC26.
3. Epoxy meets UL94 V0 at 1/8".

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## DEFINITIONS

| DATA SHEET STATUS                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             |                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DATA SHEET STATUS <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                             | PRODUCT STATUS <sup>3</sup> | DEFINITIONS                                                                                                                                                                                                                                                                                                           |
| Objective data                                                                                                                                                                                                                                                                                                                                                                                                                                             | Development                 | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice                                                                                                                            |
| Preliminary data                                                                                                                                                                                                                                                                                                                                                                                                                                           | Qualification               | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product                                     |
| Product data                                                                                                                                                                                                                                                                                                                                                                                                                                               | Production                  | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A |
| <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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## LIFE SUPPORT APPLICATIONS

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<sup>2</sup> Please consult the most recently issued datasheet before initiating or completing a design.

<sup>3</sup> The product status of the device(s) described in this datasheet may have changed since this datasheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.