1. General description

P-channel enhancement mode Field-Effect Transistor (FET) in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Low threshold voltage
- Low on-state resistance
- Trench MOSFET technology

3. Applications

- Low power DC-to-DC converters
- Load switching
- Battery management
- Battery powered portable equipment

4. Quick reference data

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<th>Parameter</th>
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<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tr>
<td>V_DS</td>
<td>drain-source voltage</td>
<td>$T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>-20</td>
<td>V</td>
</tr>
<tr>
<td>V_GS</td>
<td>gate-source voltage</td>
<td></td>
<td>-12</td>
<td>-</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>I_D</td>
<td>drain current</td>
<td>$V_{GS} = -4.5 , V; , T_{sp} = 25 , ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>-4.3</td>
<td>A</td>
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Static characteristics

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<th>Unit</th>
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<tr>
<td>R_DSon</td>
<td>drain-source on-state resistance</td>
<td>$V_{GS} = -4.5 , V; , I_D = -2.8 , A; , T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>58</td>
<td>74</td>
<td>mΩ</td>
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</table>
5. Pinning information

Table 2. Pinning information

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<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
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<tr>
<td>1</td>
<td>G</td>
<td>gate</td>
</tr>
<tr>
<td>2</td>
<td>S</td>
<td>source</td>
</tr>
<tr>
<td>3</td>
<td>D</td>
<td>drain</td>
</tr>
</tbody>
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Simplified outline and Graphic symbol:

![TO-236AB (SOT23)](image)

6. Ordering information

Table 3. Ordering information

<table>
<thead>
<tr>
<th>Type number</th>
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<th>Description</th>
<th>Version</th>
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<td>PMV65XP</td>
<td>TO-236AB</td>
<td>plastic surface-mounted package; 3 leads</td>
<td>SOT23</td>
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7. Marking

Table 4. Marking codes

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<tr>
<td>PMV65XP</td>
<td>%M9</td>
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[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

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

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<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{DS}</td>
<td>drain-source voltage</td>
<td>T_j = 25 °C</td>
<td>-</td>
<td>-20</td>
<td>V</td>
</tr>
<tr>
<td>V_{GS}</td>
<td>gate-source voltage</td>
<td></td>
<td>-12</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>I_D</td>
<td>drain current</td>
<td>V_{GS} = -4.5 V; T_sp = 25 °C</td>
<td>-</td>
<td>-4.3</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{GS} = -4.5 V; T_amb = 25 °C [1]</td>
<td>-</td>
<td>-2.8</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{GS} = -4.5 V; T_amb = 100 °C [1]</td>
<td>-</td>
<td>-1.8</td>
<td>A</td>
</tr>
<tr>
<td>I_DM</td>
<td>peak drain current</td>
<td>T_amb = 25 °C; single pulse; t_p ≤ 10 μs</td>
<td>-</td>
<td>-16</td>
<td>A</td>
</tr>
<tr>
<td>P_tot</td>
<td>total power dissipation</td>
<td>T_amb = 25 °C</td>
<td>[2]</td>
<td>480</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T_sp = 25 °C [1]</td>
<td>[1]</td>
<td>833</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4165</td>
<td>mW</td>
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PMV65XP

20 V, single P-channel Trench MOSFET

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td></td>
<td>-55</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{amb}$</td>
<td>ambient temperature</td>
<td></td>
<td>-55</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td></td>
<td>-65</td>
<td>150</td>
<td>°C</td>
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Source-drain diode

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_S$</td>
<td>source current</td>
<td>$T_{sp} = 25 , ^\circ\text{C}$</td>
<td>-</td>
<td>-1.6</td>
<td>A</td>
</tr>
</tbody>
</table>


![Diagram 1](017aaa123)

**Fig. 1.** Normalized total power dissipation as a function of junction temperature

$$P_{der} = \frac{P_{der}}{P_{NO\,C5^\circ\text{C}}} \times 100 \, \%$$

![Diagram 2](017aaa124)

**Fig. 2.** Normalized continuous drain current as a function of junction temperature

$$I_{der} = \frac{I_D}{I_D(C5^\circ\text{C})} \times 100 \, \%$$
9. Thermal characteristics

Table 6. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>in free air</td>
<td>[1] 230</td>
<td>260</td>
<td>K/W</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[2] -</td>
<td>125</td>
<td>150</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th(j-sp)}$</td>
<td>thermal resistance from junction to solder point</td>
<td>-</td>
<td>25</td>
<td>30</td>
<td>K/W</td>
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Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage
10. Characteristics

Table 7. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>$V_{BRDSS}$</td>
<td>drain-source breakdown voltage</td>
<td>$I_D = -250 \mu A; V_{GS} = 0 V; T_J = 25 ^\circ C$</td>
<td>-20</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GSth}$</td>
<td>gate-source threshold voltage</td>
<td>$I_D = -250 \mu A; V_{DS} = V_{GS}; T_J = 25 ^\circ C$</td>
<td>-0.47</td>
<td>-0.65</td>
<td>-0.9</td>
<td>V</td>
</tr>
<tr>
<td>$I_{DSS}$</td>
<td>drain leakage current</td>
<td>$V_{DS} = -20 V; V_{GS} = 0 V; T_J = 25 ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>-1</td>
<td>$\mu A$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DS} = -20 V; V_{GS} = 0 V; T_J = 150 ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>-100</td>
<td>$\mu A$</td>
</tr>
</tbody>
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FR4 PCB, standard footprint

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB, mounting pad for drain 6 cm²

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values
### Symbol | Parameter | Conditions | Min | Typ | Max | Unit
---|---|---|---|---|---|---
$I_{GSS}$ | gate leakage current | $V_{GS} = -12 \, V; V_{DS} = 0 \, V; T_{j} = 25 \, ^{\circ}C$ | - | - | -100 | nA
 | | $V_{GS} = 12 \, V; V_{DS} = 0 \, V; T_{j} = 25 \, ^{\circ}C$ | - | - | 100 | nA
$R_{DSon}$ | drain-source on-state resistance | $V_{GS} = -4.5 \, V; I_{D} = -2.8 \, A; T_{j} = 25 \, ^{\circ}C$ | - | 58 | 74 | mΩ
 | | $V_{GS} = -4.5 \, V; I_{D} = -2.8 \, A; T_{j} = 150 \, ^{\circ}C$ | - | 67 | 92 | mΩ
 | | $V_{GS} = -1.8 \, V; I_{D} = -1 \, A; T_{j} = 25 \, ^{\circ}C$ | - | 87 | 135 | mΩ
$g_{fs}$ | forward transconductance | $V_{DS} = -10 \, V; I_{D} = -2.8 \, A; T_{j} = 25 \, ^{\circ}C$ | - | 15 | - | S

### Dynamic characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit
---|---|---|---|---|---|---
$Q_{G(tot)}$ | total gate charge | $V_{DS} = -6 \, V; I_{D} = -2.8 \, A; V_{GS} = -4.5 \, V; T_{j} = 25 \, ^{\circ}C$ | - | 7.7 | - | nC
$Q_{GS}$ | gate-source charge | | - | 1 | - | nC
$Q_{GD}$ | gate-drain charge | | 1.65 | - | nC
$C_{iss}$ | input capacitance | $V_{DS} = -20 \, V; f = 1 \, MHz; V_{GS} = 0 \, V; T_{j} = 25 \, ^{\circ}C$ | - | 744 | - | pF
$C_{oss}$ | output capacitance | | 65 | - | pF
$C_{rss}$ | reverse transfer capacitance | | 53 | - | pF
$t_{(on)}$ | turn-on delay time | $V_{DS} = -6 \, V; V_{GS} = -4.5 \, V; R_{G(Ext)} = 6 \, \Omega; T_{j} = 25 \, ^{\circ}C; I_{D} = -1 \, A$ | - | 7 | - | ns
$t_{r}$ | rise time | | 18 | - | ns
$t_{(off)}$ | turn-off delay time | | 135 | - | ns
$t_{f}$ | fall time | | 68 | - | ns

### Source-drain diode

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit
---|---|---|---|---|---|---
$V_{SD}$ | source-drain voltage | $I_{S} = -0.9 \, A; V_{GS} = 0 \, V; T_{j} = 25 \, ^{\circ}C$ | - | -0.8 | -1.2 | V

---

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

**Fig. 7.** Sub-threshold drain current as a function of gate-source voltage
**PMV65XP**

20 V, single P-channel Trench MOSFET

---

**Fig. 8.** Drain-source on-state resistance as a function of drain current; typical values

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

**Fig. 10.** Transfer characteristics: drain current as a function of gate-source voltage; typical values

**Fig. 11.** Normalized drain-source on-state resistance as a function of junction temperature; typical values

\[
\frac{a}{a_{25°C}} = \frac{R_{DS(on)}(T)}{R_{DS(on)25°C}}
\]
**PMV65XP**

20 V, single P-channel Trench MOSFET

---

**Fig. 12.** Gate-source threshold voltage as a function of junction temperature

\[ V_{GS(th)} = \text{min}, \text{typ}, \text{max} \]

\[ T_j (°C) \]

\[ I_D = -0.25 \text{ mA}; V_{DS} = V_{GS} \]

**Fig. 13.** Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

\[ C (\text{pF}) \]

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

**Fig. 14.** Gate-source voltage as a function of gate charge; typical values

\[ V_G (\text{V}) \]

\[ Q_G (\text{nC}) \]

\[ I_D = -2.8 \text{ A}; V_{DS} = -6 \text{ V}; T_{amb} = 25 °C \]

**Fig. 15.** Gate charge waveform definitions

\[ V_{DS} \]

\[ V_{GS} \]

\[ Q_{G1} \]

\[ Q_{G2} \]

\[ Q_G \]

\[ Q_{Gth} \]

\[ Q_{G(t)} \]
VGS = 0 V
(1) TJ = 150 °C
(2) TJ = 25 °C

Fig. 16. Source current as a function of source-drain voltage; typical values

11. Test information

Fig. 17. Duty cycle definition
12. Package outline

Fig. 18. Package outline TO-236AB (SOT23)

13. Soldering

Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)
Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

### 14. Revision history

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<td>• Pinning information corrected</td>
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15. Legal information

15.1 Data sheet status

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[2] The term "short data sheet" is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nexperia.com.

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