



# PMV88ENEA

60 V, N-channel Trench MOSFET

7 May 2019

Product data sheet

## 1. General description

N-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

- Logic-level compatible
- Extended temperature range  $T_j = 175\text{ °C}$
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection  $> 2\text{ kV HBM (class H2)}$
- AEC-Q101 qualified

## 3. Applications

- Relay driver
- High-speed line driver
- Low-side load switch
- Switching circuits

## 4. Quick reference data

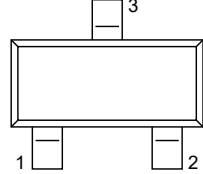
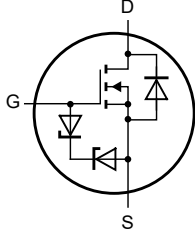
Table 1. Quick reference data

| Symbol                        | Parameter                        | Conditions   | Min | Typ | Max | Unit       |
|-------------------------------|----------------------------------|--|-----|-----|-----|------------|
| $V_{DS}$                      | drain-source voltage             | $T_j = 25\text{ °C}$   | -   | -   | 60  | V          |
| $V_{GS}$                      | gate-source voltage              |  | -20 | -   | 20  | V          |
| $I_D$                         | drain current                    | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$                 | [1] | -   | 2.2 | A          |
| <b>Static characteristics</b> |                                  |  |     |     |     |            |
| $R_{DS(on)}$                  | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 2.2\text{ A}; T_j = 25\text{ °C}$ | -   | 88  | 117 | m $\Omega$ |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain  $6\text{ cm}^2$ .

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline  | Graphic symbol   |
|-----|--------|-------------|---|--|
| 1   | G      | gate        |  <p>TO-236AB (SOT23)</p> |  <p>017aaa255</p> |
| 2   | S      | source      |   |  |
| 3   | D      | drain       |   |  |

## 6. Ordering information

Table 3. Ordering information

| Type number | Package  |  |         |
|-------------|----------|--|---------|
|             | Name     | Description                              | Version |
| PMV88ENEA   | TO-236AB | plastic surface-mounted package; 3 leads | SOT23   |

## 7. Marking

Table 4. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| PMV88ENEA   | HT%                         |

[1] % = placeholder for manufacturing site code

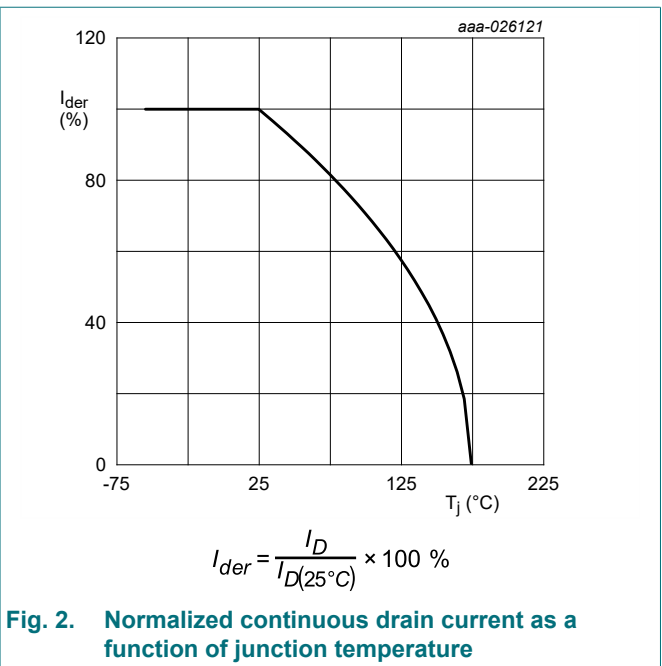
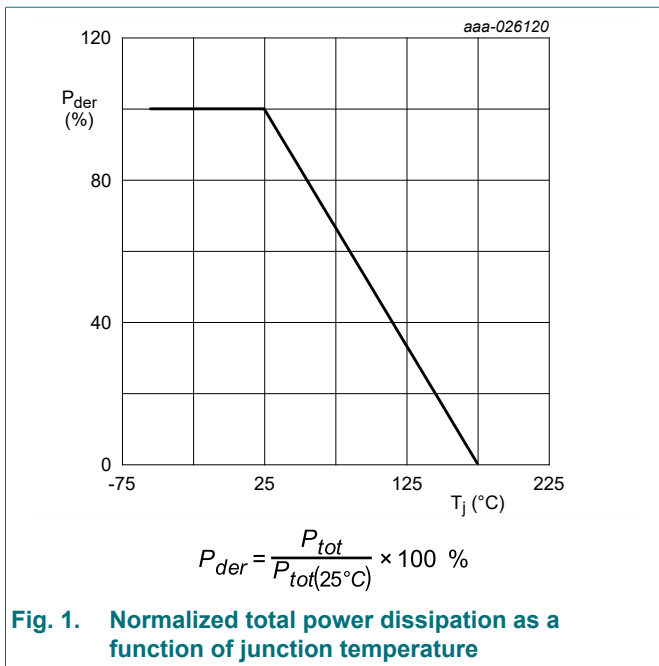
## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol                      | Parameter                                    | Conditions  |     | Min | Max  | Unit |
|-----------------------------|--|---|-----|-----|------|------|
| V <sub>DS</sub>             | drain-source voltage                         | T <sub>j</sub> = 25 °C  |     | -   | 60   | V    |
| V <sub>GS</sub>             | gate-source voltage                          |   |     | -20 | 20   | V    |
| I <sub>D</sub>              | drain current                                | V <sub>GS</sub> = 10 V; T <sub>amb</sub> = 25 °C                                    | [1] | -   | 2.2  | A    |
|                             |  | V <sub>GS</sub> = 10 V; T <sub>amb</sub> = 100 °C                                   | [1] | -   | 1.6  | A    |
| I <sub>DM</sub>             | peak drain current                           | T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs                      |     | -   | 8.9  | A    |
| P <sub>tot</sub>            | total power dissipation                      | T <sub>amb</sub> = 25 °C  | [2] | -   | 615  | mW   |
|                             |  |   | [1] | -   | 1.26 | W    |
|                             |  | T <sub>sp</sub> = 25 °C   |     | -   | 7.5  | W    |
| T <sub>j</sub>              | junction temperature                         |   |     | -55 | 175  | °C   |
| T <sub>amb</sub>            | ambient temperature                          |   |     | -55 | 175  | °C   |
| T <sub>stg</sub>            | storage temperature                          |   |     | -65 | 175  | °C   |
| <b>Source-drain diode</b>   |  |   |     |     |      |      |
| I <sub>S</sub>              | source current                               | T <sub>amb</sub> = 25 °C  | [1] | -   | 1.3  | A    |
| <b>ESD maximum rating</b>   |  |   |     |     |      |      |
| V <sub>ESD</sub>            | electrostatic discharge voltage              | HBM   | [3] | -   | 2000 | V    |
| <b>Avalanche ruggedness</b> |  |   |     |     |      |      |
| E <sub>DS(AL)S</sub>        | non-repetitive drain-source avalanche energy | T <sub>j(init)</sub> = 25 °C; I <sub>D</sub> = 0.25 A; DUT in avalanche (unclamped) |     | -   | 8    | mJ   |

- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm<sup>2</sup>.
- [2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [3] Measured between all pins.



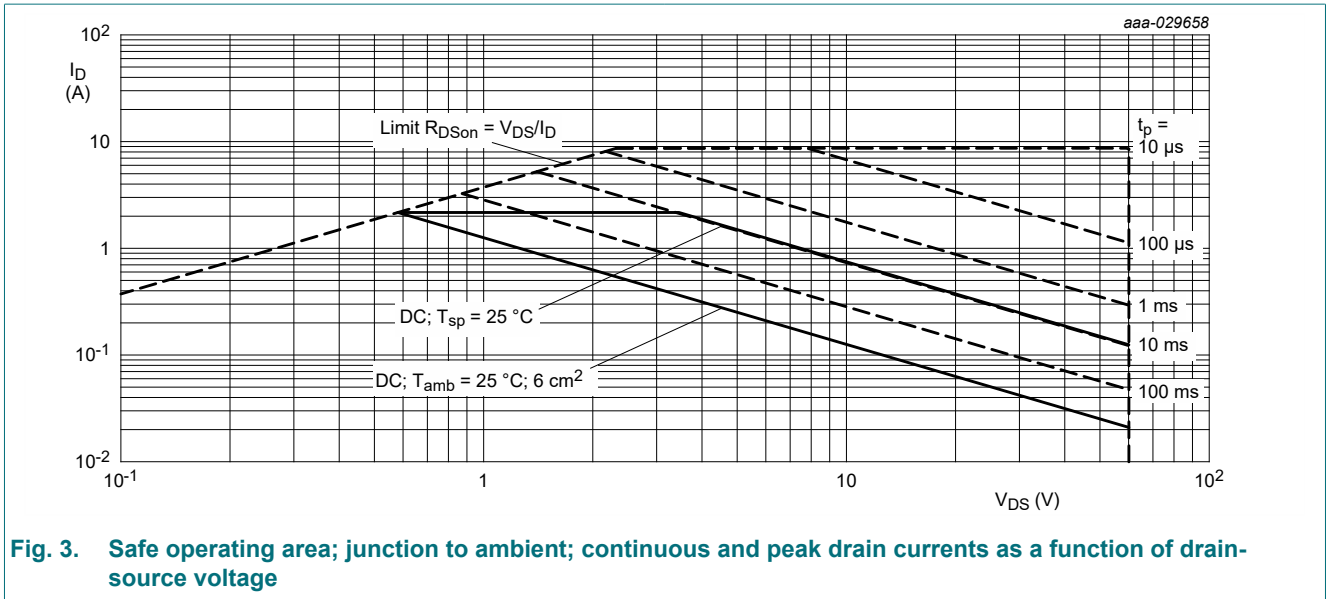


Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

## 9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol         | Parameter  | Conditions  |     | Min | Typ | Max | Unit |
|----------------|--|-------------|-----|-----|-----|-----|------|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air | [1] | -   | 212 | 244 | K/W  |
|                |  |             | [2] | -   | 104 | 119 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             |     | -   | 17  | 20  | K/W  |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 6 cm<sup>2</sup>.

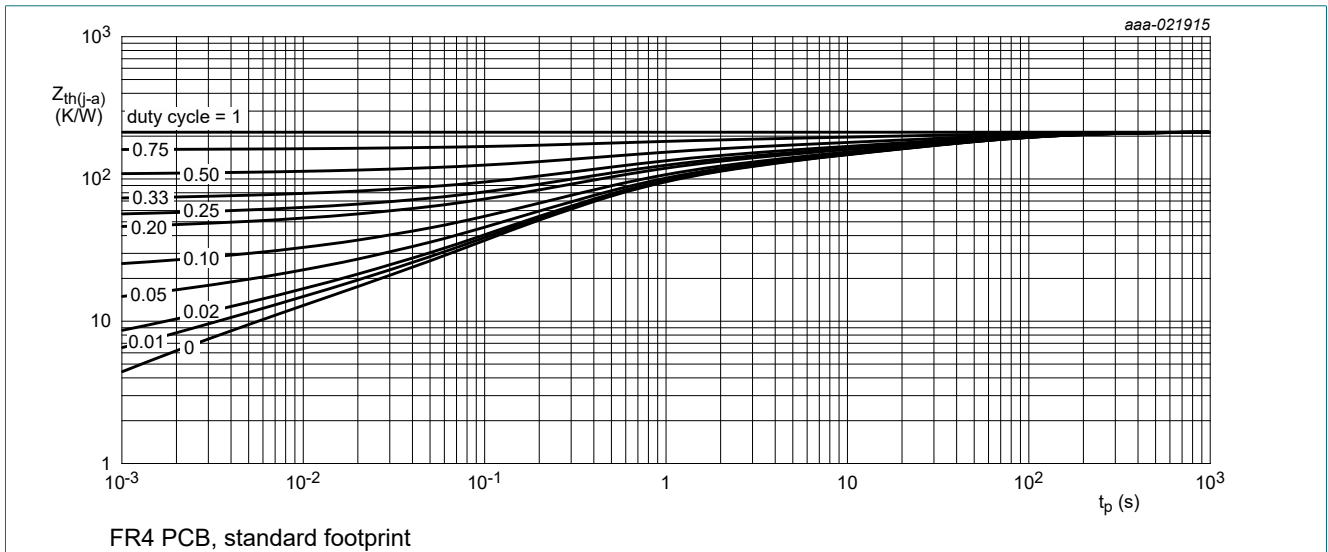


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

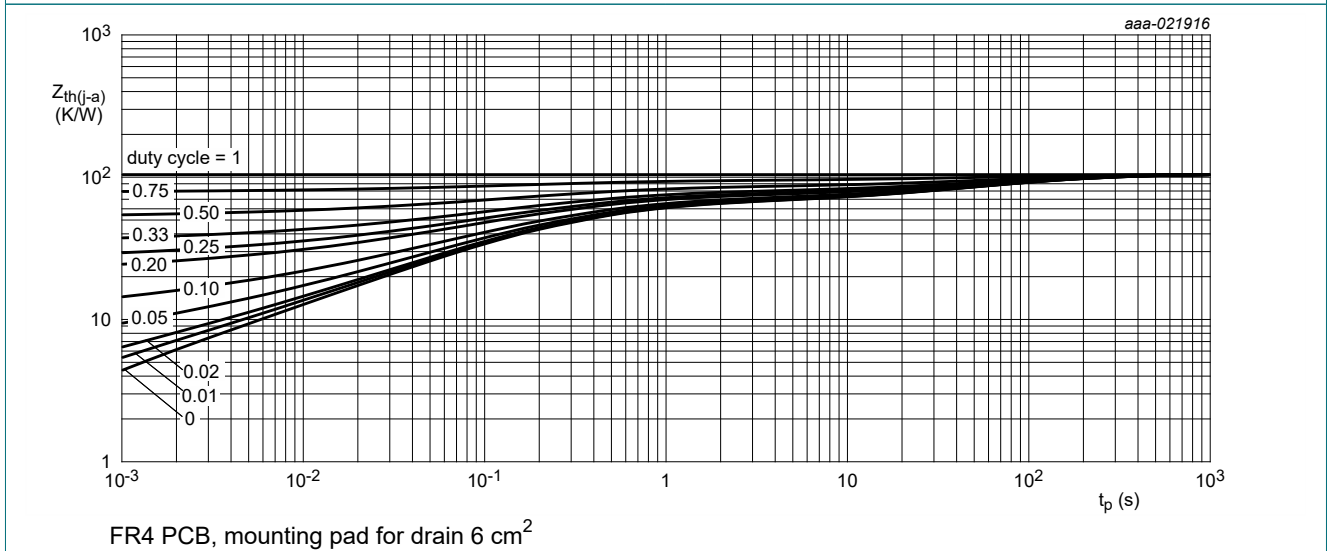


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

**Table 7. Characteristics**

| Symbol                         | Parameter                        | Conditions   | Min | Typ | Max | Unit       |
|--------------------------------|----------------------------------|--|-----|-----|-----|------------|
| <b>Static characteristics</b>  |                                  |  |     |     |     |            |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage   | $I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$   | 60  | -   | -   | V          |
| $V_{GSth}$                     | gate-source threshold voltage    | $I_D = 250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ C$  | 1.3 | 1.7 | 2.7 | V          |
| $I_{DSS}$                      | drain leakage current            | $V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$   | -   | -   | 1   | $\mu A$    |
| $I_{GSS}$                      | gate leakage current             | $V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$   | -   | -   | 10  | $\mu A$    |
|                                |                                  | $V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$  | -   | -   | -10 | $\mu A$    |
|                                |                                  | $V_{GS} = 10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$   | -   | -   | 1   | $\mu A$    |
|                                |                                  | $V_{GS} = -10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$  | -   | -   | -1  | $\mu A$    |
| $R_{DSon}$                     | drain-source on-state resistance | $V_{GS} = 10 V$ ; $I_D = 2.2 A$ ; $T_j = 25 \text{ }^\circ C$  | -   | 88  | 117 | m $\Omega$ |
|                                |                                  | $V_{GS} = 10 V$ ; $I_D = 2.2 A$ ; $T_j = 175 \text{ }^\circ C$   | -   | 191 | 254 | m $\Omega$ |
|                                |                                  | $V_{GS} = 4.5 V$ ; $I_D = 2 A$ ; $T_j = 25 \text{ }^\circ C$   | -   | 104 | 146 | m $\Omega$ |
| $g_{fs}$                       | forward transconductance         | $V_{DS} = 10 V$ ; $I_D = 2 A$ ; $T_j = 25 \text{ }^\circ C$  | -   | 8.5 | -   | S          |
| $R_G$                          | gate resistance                  | $f = 1 \text{ MHz}$  | -   | 10  | -   | $\Omega$   |
| <b>Dynamic characteristics</b> |                                  |  |     |     |     |            |
| $Q_{G(tot)}$                   | total gate charge                | $V_{DS} = 30 V$ ; $I_D = 2.2 A$ ; $V_{GS} = 10 V$ ;<br>$T_j = 25 \text{ }^\circ C$                           | -   | 4   | 6   | nC         |
| $Q_{GS}$                       | gate-source charge               |  | -   | 0.5 | -   | nC         |
| $Q_{GD}$                       | gate-drain charge                |  | -   | 0.9 | -   | nC         |
| $C_{iss}$                      | input capacitance                | $V_{DS} = 30 V$ ; $f = 1 \text{ MHz}$ ; $V_{GS} = 0 V$ ;<br>$T_j = 25 \text{ }^\circ C$                      | -   | 196 | -   | pF         |
| $C_{oss}$                      | output capacitance               |  | -   | 24  | -   | pF         |
| $C_{rss}$                      | reverse transfer capacitance     |  | -   | 15  | -   | pF         |
| $t_{d(on)}$                    | turn-on delay time               | $V_{DS} = 30 V$ ; $I_D = 2.2 A$ ; $V_{GS} = 10 V$ ;<br>$R_{G(ext)} = 6 \Omega$ ; $T_j = 25 \text{ }^\circ C$ | -   | 3   | -   | ns         |
| $t_r$                          | rise time                        |  | -   | 6   | -   | ns         |
| $t_{d(off)}$                   | turn-off delay time              |  | -   | 8   | -   | ns         |
| $t_f$                          | fall time                        |  | -   | 3   | -   | ns         |
| <b>Source-drain diode</b>      |                                  |  |     |     |     |            |
| $V_{SD}$                       | source-drain voltage             | $I_S = 1.3 A$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$   | -   | 0.8 | 1.2 | V          |
| $t_{rr}$                       | reverse recovery time            | $I_S = 0.8 A$ ; $dI_S/dt = -100 A/\mu s$ ;<br>$V_{GS} = 0 V$ ; $V_{DS} = 30 V$ ; $T_j = 25 \text{ }^\circ C$ | -   | 11  | -   | ns         |
| $Q_r$                          | recovered charge                 |  | -   | 4   | -   | nC         |

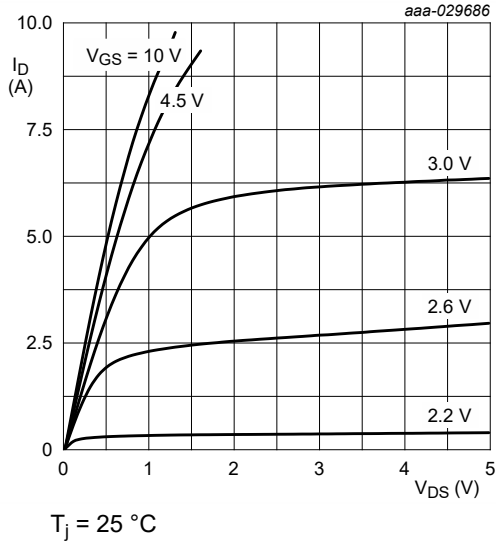


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

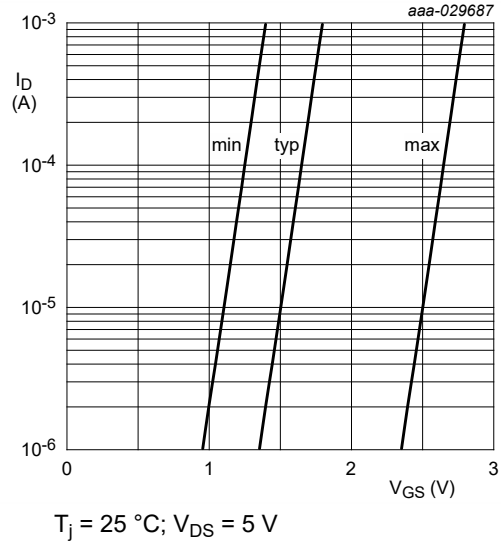


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

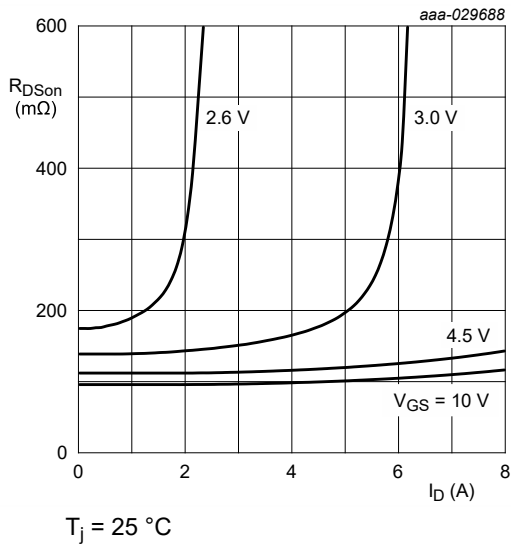


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

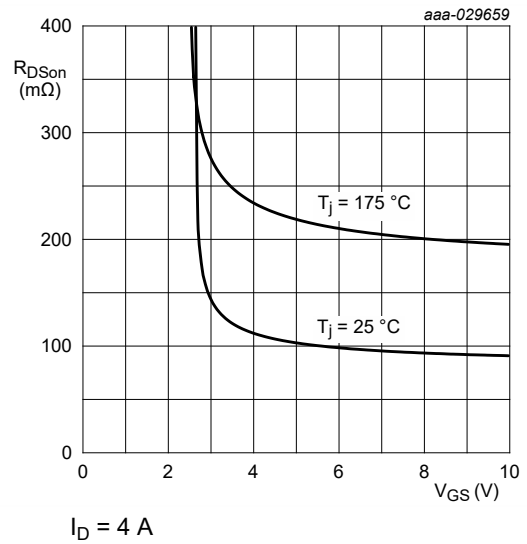
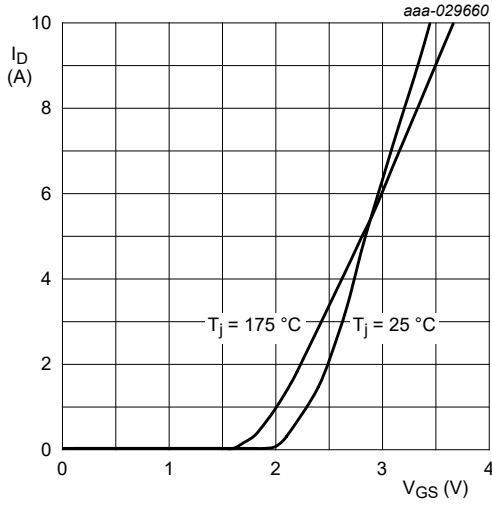
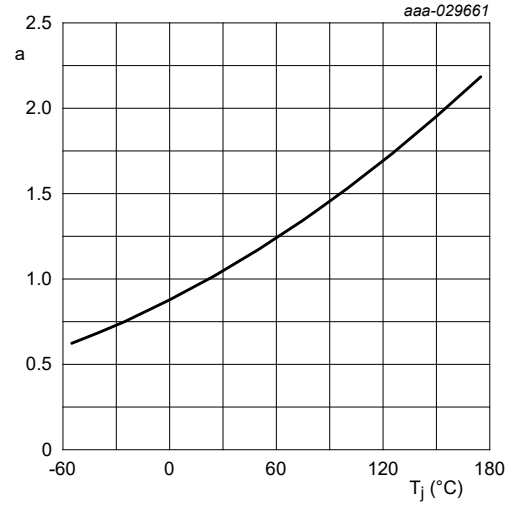


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



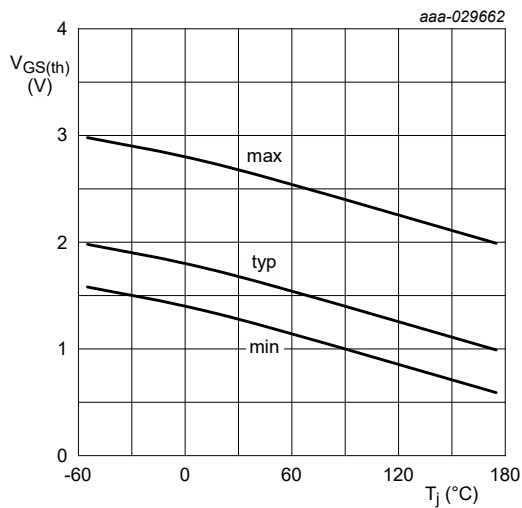
$$V_{DS} > I_D \times R_{DSon}$$

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



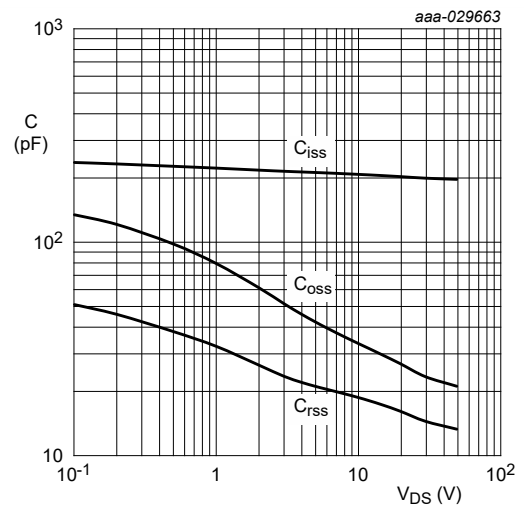
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ C)}}$$

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



$$I_D = 250\mu A; V_{DS} = V_{GS}$$

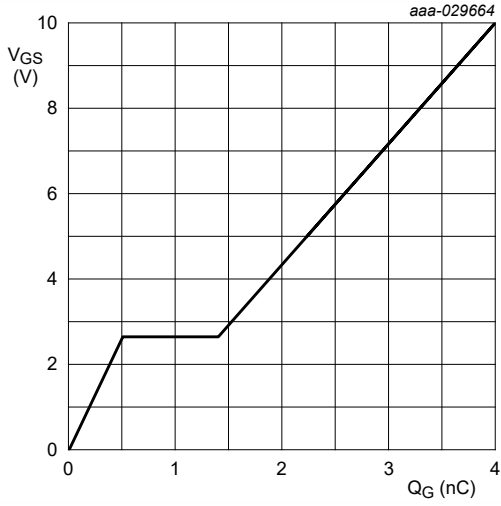
Fig. 12. Gate-source threshold voltage as a function of junction temperature



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

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





$V_{DS} = 30$  V;  $I_D = 2.2$  A

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

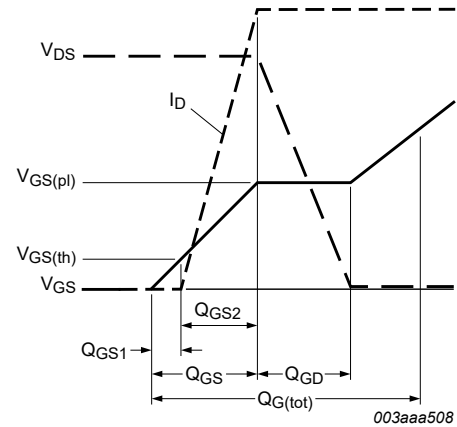
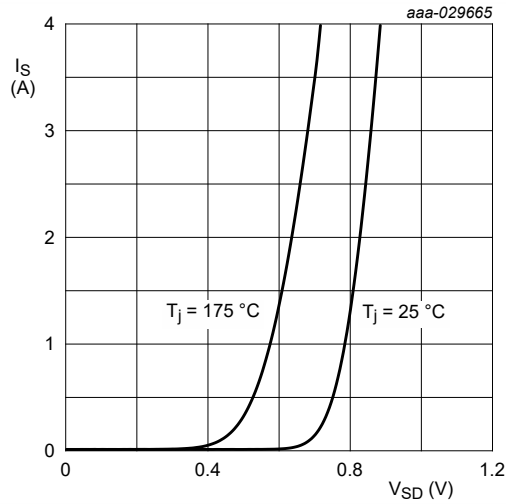


Fig. 15. Gate charge waveform definitions



$V_{GS} = 0$  V

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

## 11. Test information

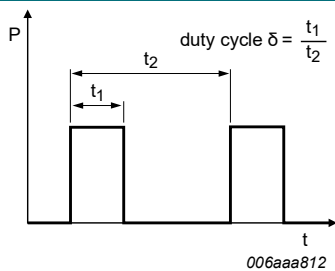


Fig. 17. Duty cycle definition

### Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - *Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

12. Package outline

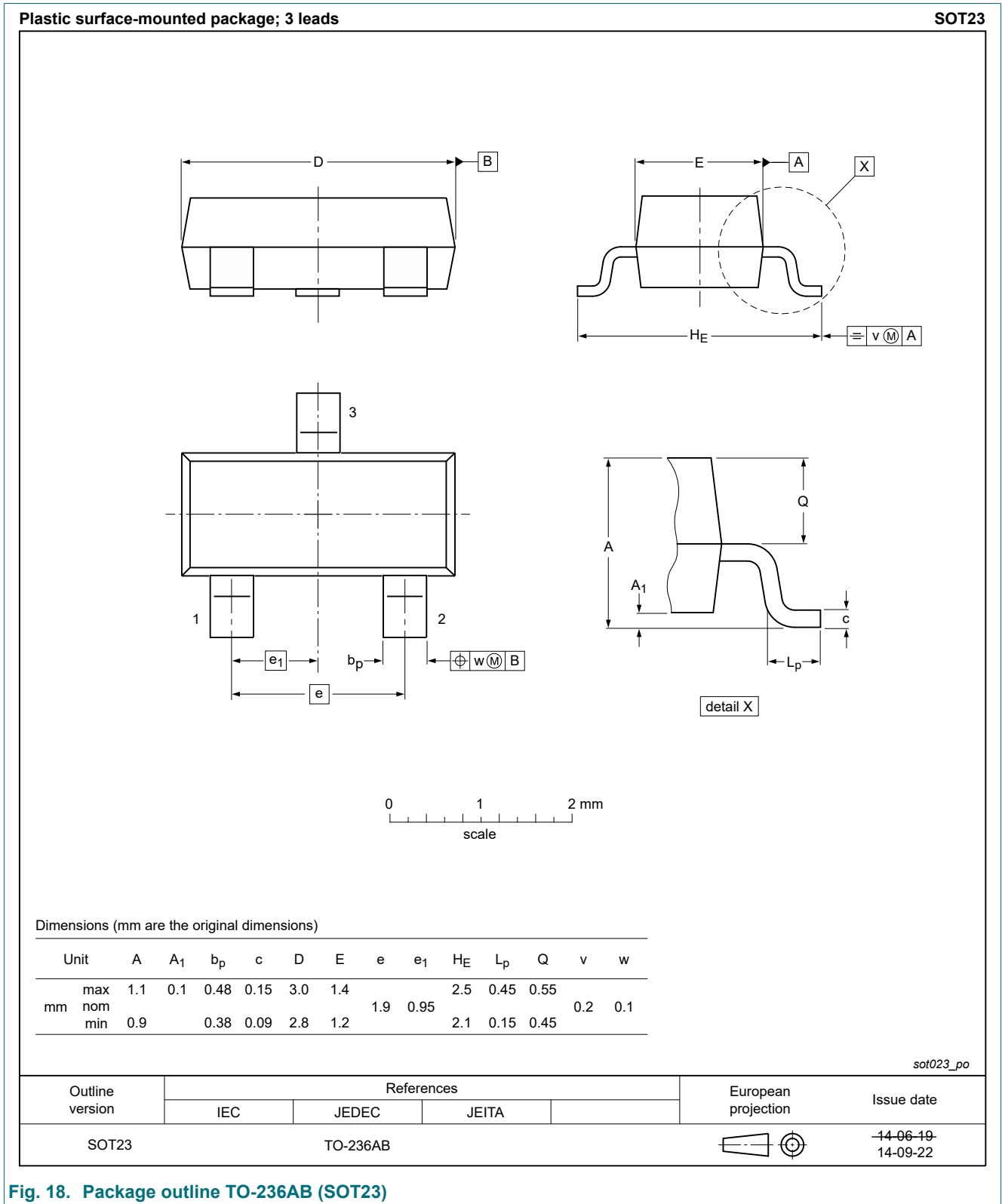


Fig. 18. Package outline TO-236AB (SOT23)

### 13. Soldering

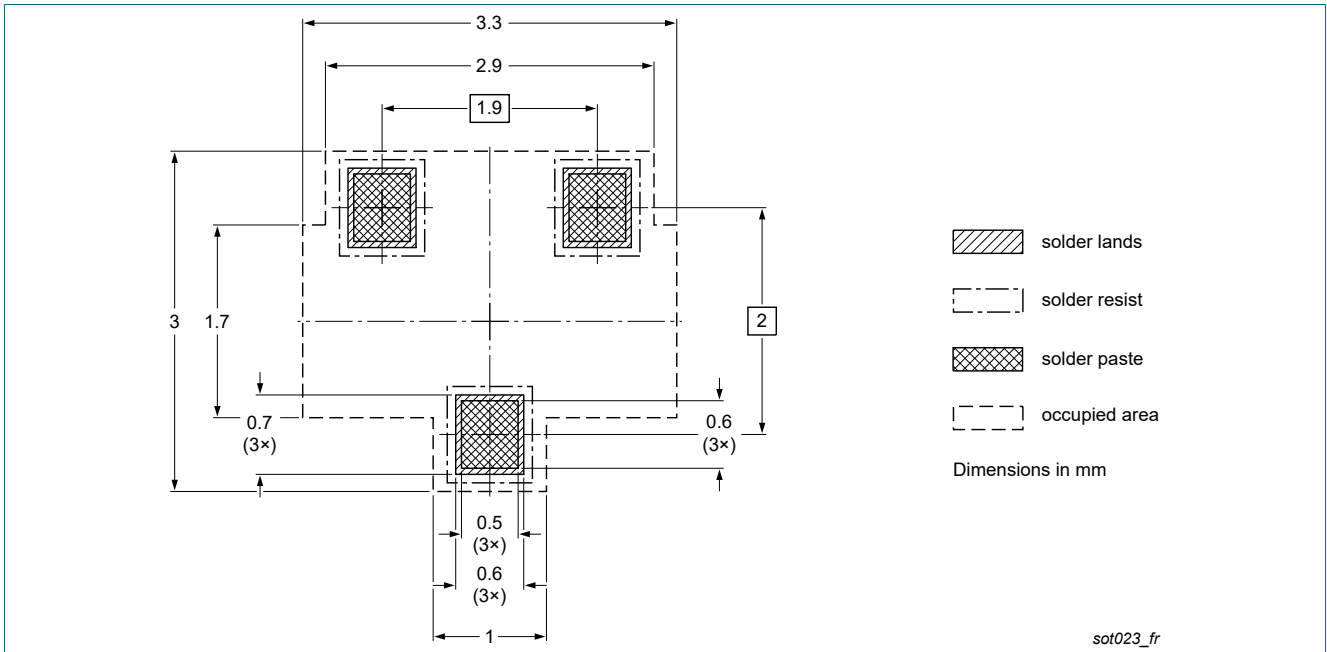


Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

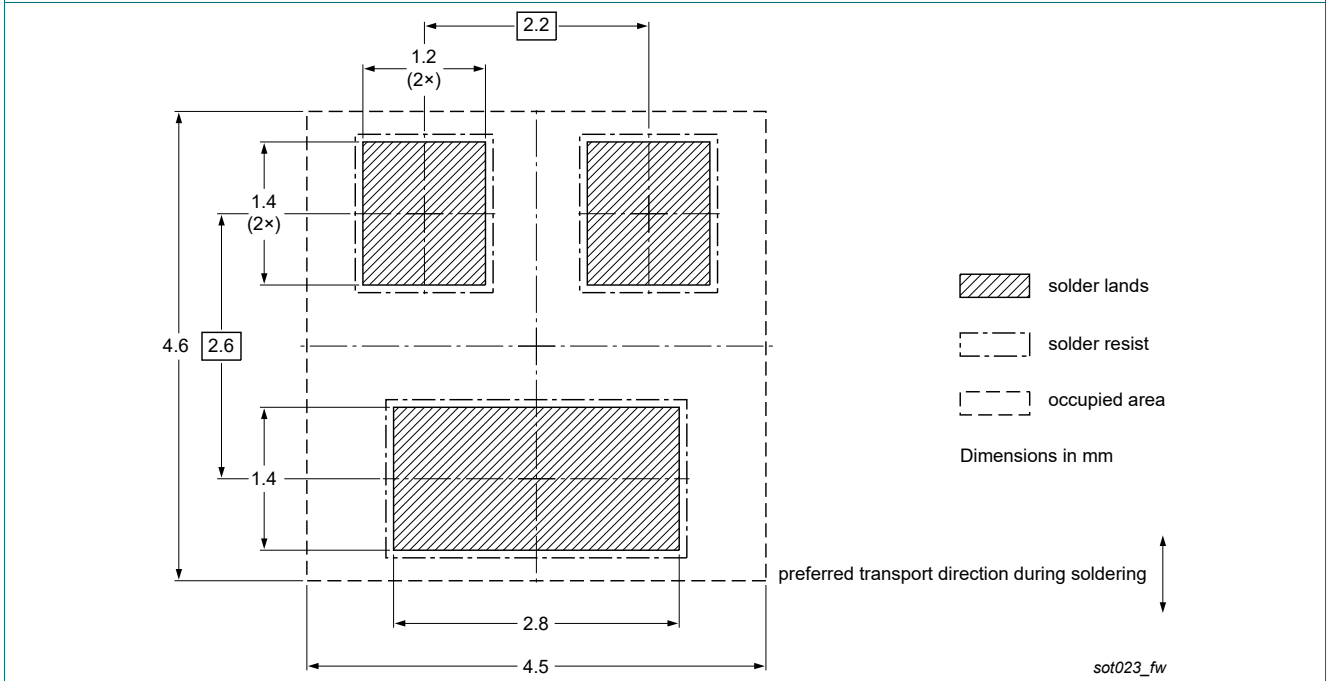


Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

## 14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status  | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| PMV88ENEA v.1 | 20190507     | Product data sheet | -             | -          |

## 15. Legal information

### Data sheet status

| Document status [1][2]         | Product status [3] | 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.                                     |

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- [2] The term 'short data sheet' is explained in section "Definitions".
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[NTE2903](#) [NTE2941](#) [NTE2945](#) [NTE2946](#) [NTE2960](#) [NTE2967](#) [NTE2969](#) [NTE2976](#) [NTE455](#) [NTE6400A](#) [NTE2910](#) [NTE2916](#) [NTE2956](#)  
[NTE2911](#) [US6M2GTR](#) [TK10A80W,S4X\(S](#) [SSM6P69NU,LF](#)