WINSOURCE ELECTRONICS

# THE DATASHEET OF

# PMV65XPEAR


# PMV65XPEA

## 20 V, P-channel Trench MOSFET

27 November 2014 | Product data sheet

## 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

- Trench MOSFET technology
- Very fast switching
- Enhanced power dissipation capability: $P_{tot}$ = 890 mW
- ElectroStatic Discharge (ESD) protection 2 kV HBM
- AEC-Q101 qualified

## 3. Applications

- Relay driver
- High speed line driver
- High-side loadswitch
- 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 °C | | - | - | -20 | V |
| $V_{GS}$ | gate-source voltage | | | -12 | - | 12 | V |
| $I_D$ | drain current | $V_{GS}$ = -4.5 V; $T_{amb}$ = 25 °C; t ≤ 5 s | [1] | - | - | -3.3 | A |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = -4.5 V; $I_D$ = -2.8 A; $T_j$ = 25 °C | | - | 67 | 78 | mΩ |

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

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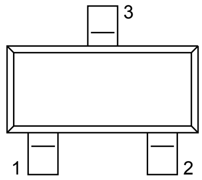
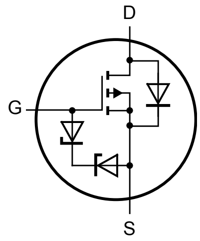
## 5. Pinning information

**Table 2. Pinning information**

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

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PMV65XPEA | TO-236AB | plastic surface-mounted package; 3 leads | SOT23 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code [1] |
|---|---|
| PMV65XPEA | DN% |

[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 |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j$ = 25 °C | | - | -20 | V |
| $V_{GS}$ | gate-source voltage | | | -12 | 12 | V |
| $I_D$ | drain current | $V_{GS}$ = -4.5 V; $T_{amb}$ = 25 °C; t ≤ 5 s | [1] | - | -3.3 | A |
| | | $V_{GS}$ = -4.5 V; $T_{amb}$ = 25 °C | [1] | - | -2.8 | A |
| | | $V_{GS}$ = -4.5 V; $T_{amb}$ = 100 °C | [1] | - | -1.8 | A |
| $I_{DM}$ | peak drain current | $T_{amb}$ = 25 °C; single pulse; $t_p$ ≤ 10 µs | | - | -12 | A |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $T_{j(init)}$ = 25 °C; $I_D$ = -0.52 A; DUT in avalanche (unclamped) | | - | 5.4 | mJ |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = 25 °C | [2] | - | 480 | mW |
| | | | [1] | - | 890 | mW |
| | | $T_{sp}$ = 25 °C | | - | 6250 | mW |
| $T_j$ | junction temperature | | | -55 | 150 | °C |
| $T_{amb}$ | ambient temperature | | | -55 | 150 | °C |
| $T_{stg}$ | storage temperature | | | -65 | 150 | °C |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{amb}$ = 25 °C | [1] | - | -0.9 | A |
| **ESD maximum rating** | | | | | | |
| $V_{ESD}$ | electrostatic discharge voltage | HBM | [3] | - | 2000 | V |

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

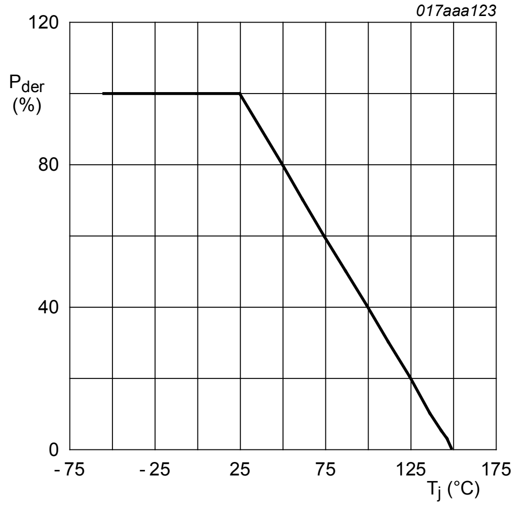



**Fig. 1. Normalized total power dissipation as a function of junction temperature**

$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\ \%$$

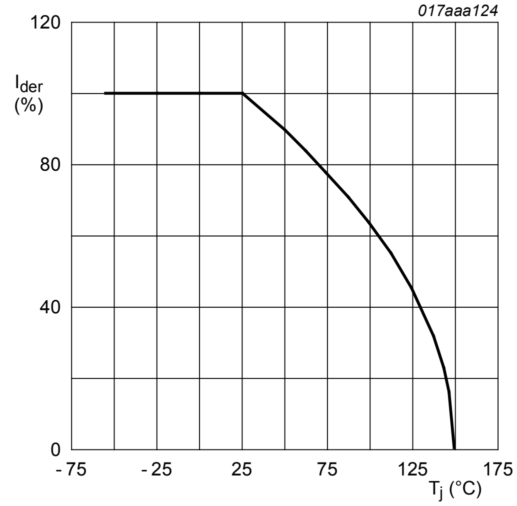
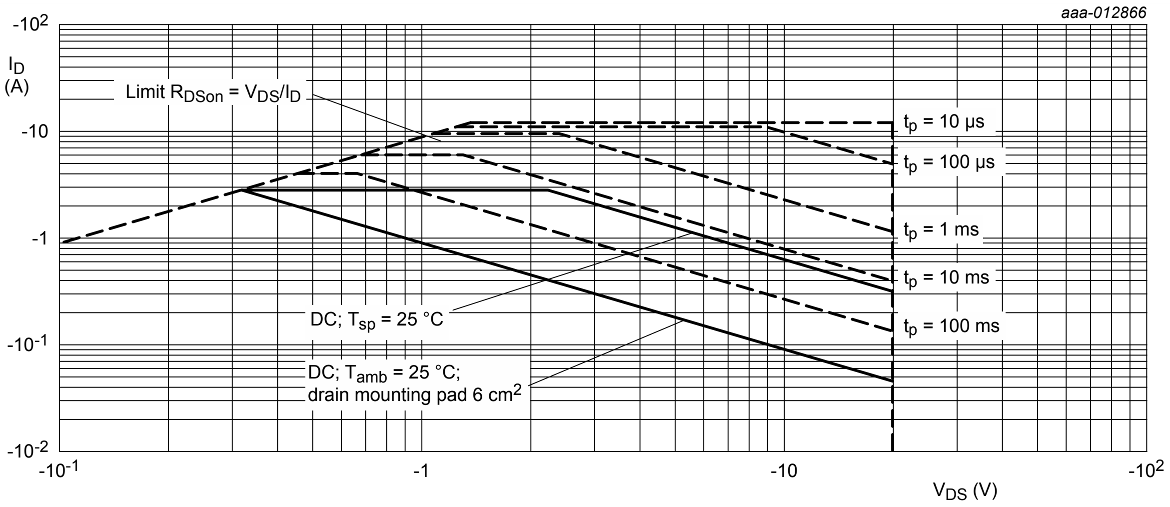



**Fig. 2. Normalized continuous drain current as a function of junction temperature**

$$I_{der} = \frac{I_D}{I_{D(25^{\circ}C)}} \times 100\ \%$$




$I_{DM}$ = single pulse

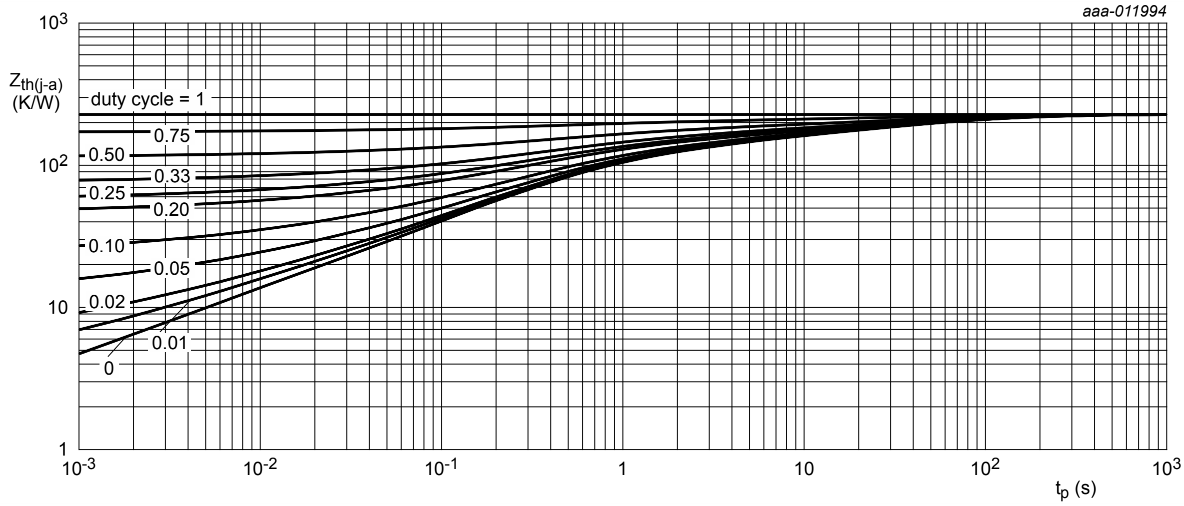
**Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage**

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

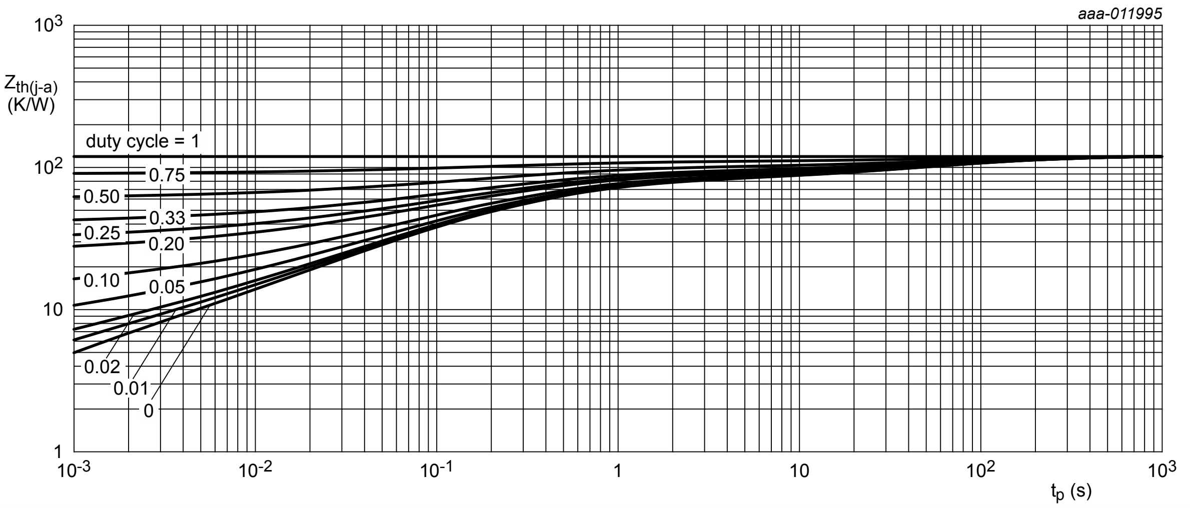
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | 230 | 260 | K/W |
| | | | [2] | - | 120 | 140 | K/W |
| | | in free air; t ≤ 5 s | [2] | - | 85 | 100 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | 15 | 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, mounting pad for drain 6 $cm^2$.




FR4 PCB, standard footprint

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



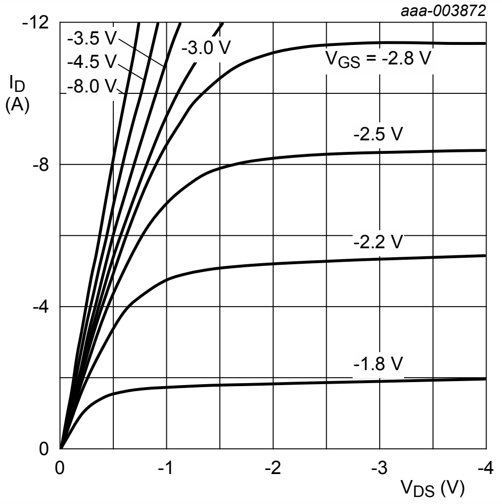

FR4 PCB, mounting pad for drain 6 $cm^2$

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

## 10. Characteristics

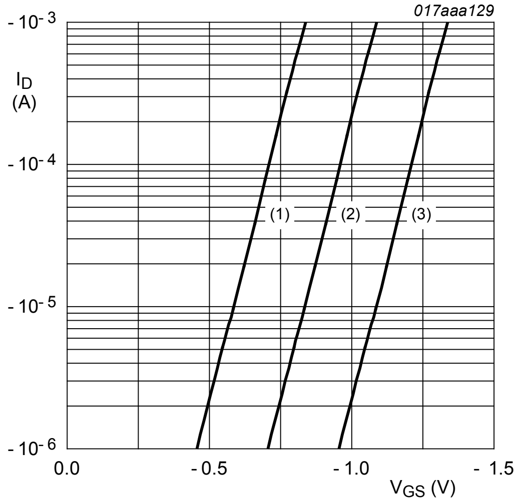
**Table 7. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = -250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | -20 | - | - | V |
| $V_{GSth}$ | gate-source threshold voltage | $I_D$ = -250 µA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C | | -0.75 | -1 | -1.25 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = -20 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | - | -1 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 12 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 10 | µA |
| | | $V_{GS}$ = -12 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | -10 | µA |
| | | $V_{GS}$ = 4.5 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 2 | µA |
| | | $V_{GS}$ = -4.5 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | -2 | µA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = -4.5 V; $I_D$ = -2.8 A; $T_j$ = 25 °C | | - | 67 | 78 | mΩ |
| | | $V_{GS}$ = -4.5 V; $I_D$ = -2.8 A; $T_j$ = 150 °C | | - | 98 | 114 | mΩ |
| | | $V_{GS}$ = -2.5 V; $I_D$ = -2.2 A; $T_j$ = 25 °C | | - | 99 | 125 | mΩ |
| $g_{fs}$ | forward transconductance | $V_{DS}$ = -10 V; $I_D$ = -2 A; $T_j$ = 25 °C | | - | 7.4 | - | S |
| $R_G$ | gate resistance | f = 1 MHz | | - | 11.6 | - | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS}$ = -10 V; $I_D$ = -2.8 A; $V_{GS}$ = -4.5 V; $T_j$ = 25 °C | | - | 5 | 9 | nC |
| $Q_{GS}$ | gate-source charge | | | - | 1.1 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 1.1 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = -10 V; f = 1 MHz; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 618 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 80 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 58 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = -10 V; $I_D$ = -2.8 A; $V_{GS}$ = -4.5 V; $R_{G(ext)}$ = 6 Ω; $T_j$ = 25 °C | | - | 7 | - | ns |
| $t_r$ | rise time | | | - | 19 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 36 | - | ns |
| $t_f$ | fall time | | | - | 17 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = -0.85 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | -0.75 | -1.2 | V |




$T_j$ = 25 °C

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



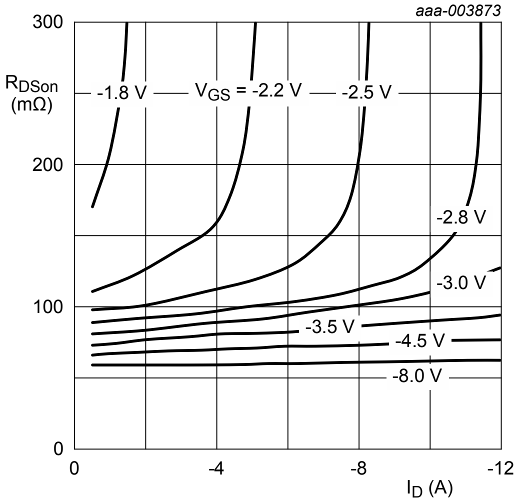

$T_j$ = 25 °C; $V_{DS}$ = -3 V

(1) minimum values

(2) typical values

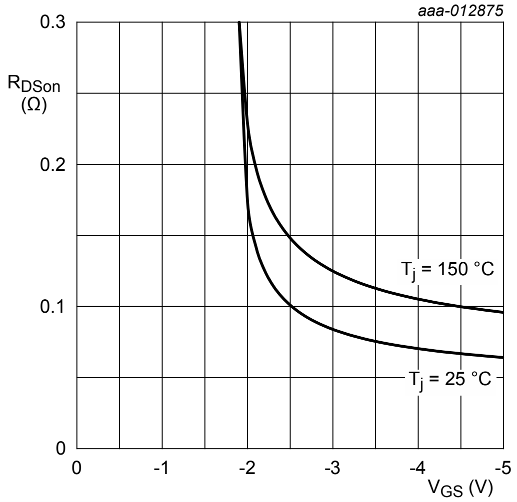
(3) maximum values

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



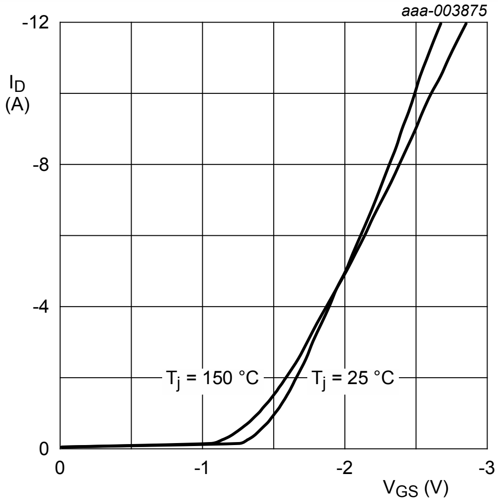

$T_j$ = 25 °C

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




$I_D$ = -2.8 A

**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**

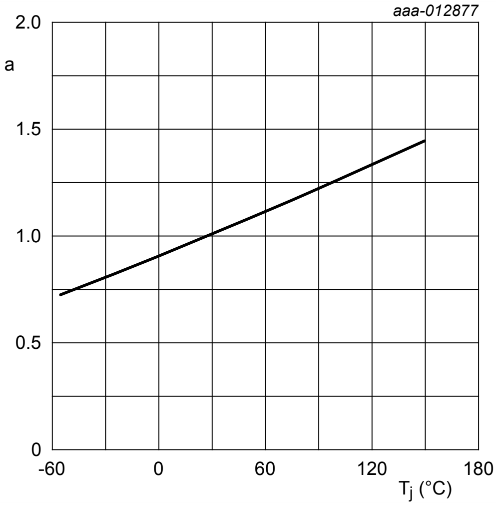
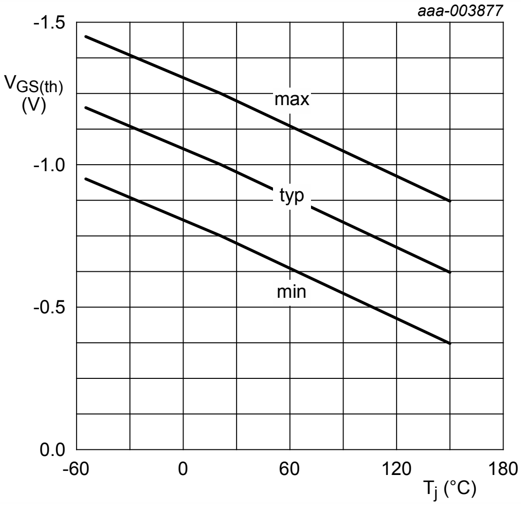


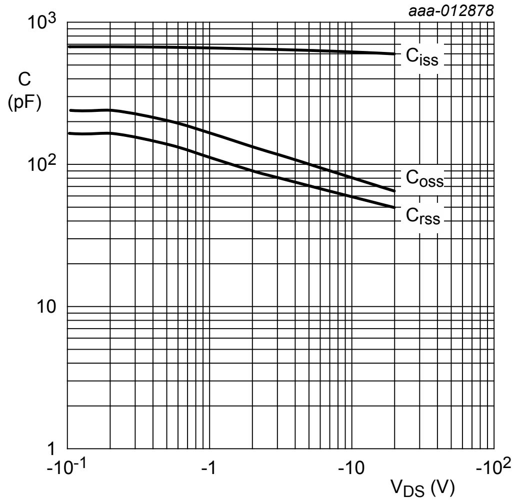

**Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values**

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



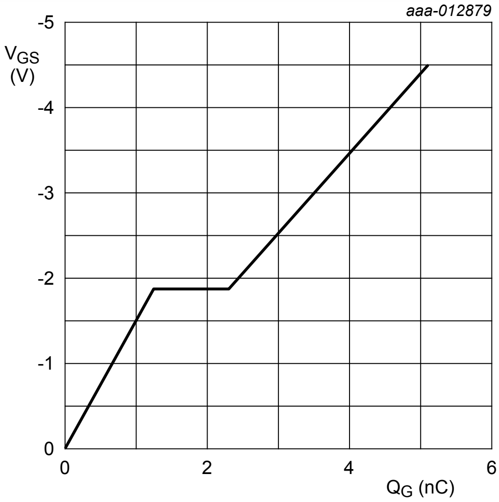

$I_D$ = -0.25 mA; $V_{DS} = V_{GS}$

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




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

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




$I_D$ = -2.8 A; $V_{DS}$ = -10 V; $T_{amb}$ = 25 °C

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

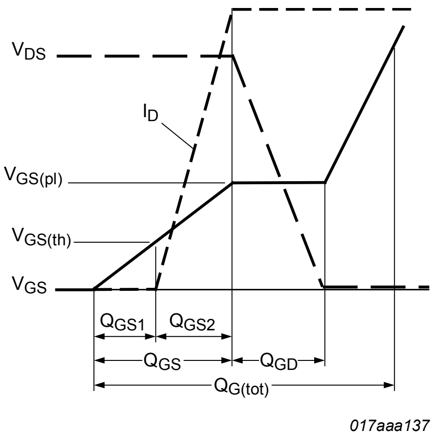
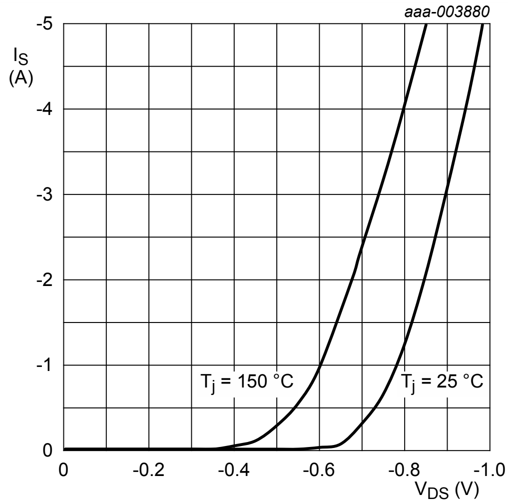



**Fig. 15. MOSFET transistor: Gate charge waveform definitions**




$V_{GS}$ = 0 V

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

# 11. Test information

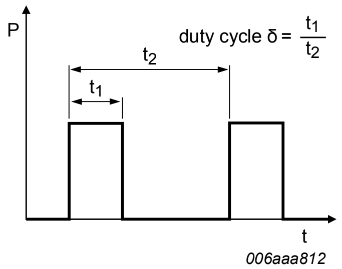



**Fig. 17. Duty cycle definition**

## 11.1 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

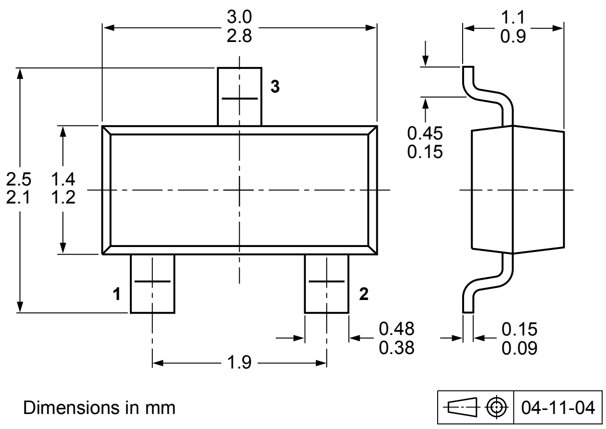



**Fig. 18. Package outline TO-236AB (SOT23)**

## 13. Soldering

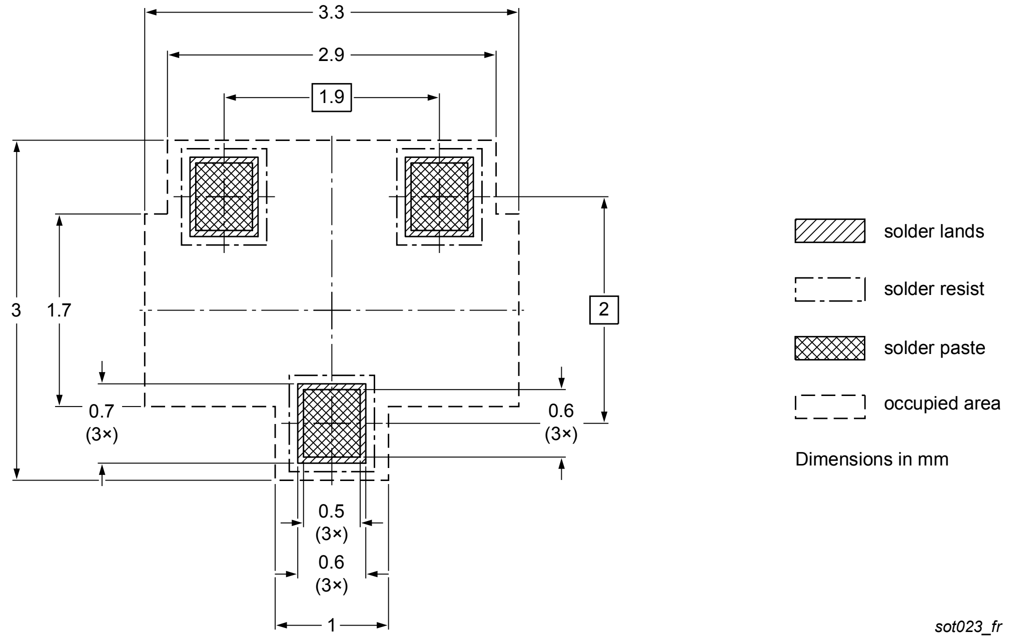



**Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)**

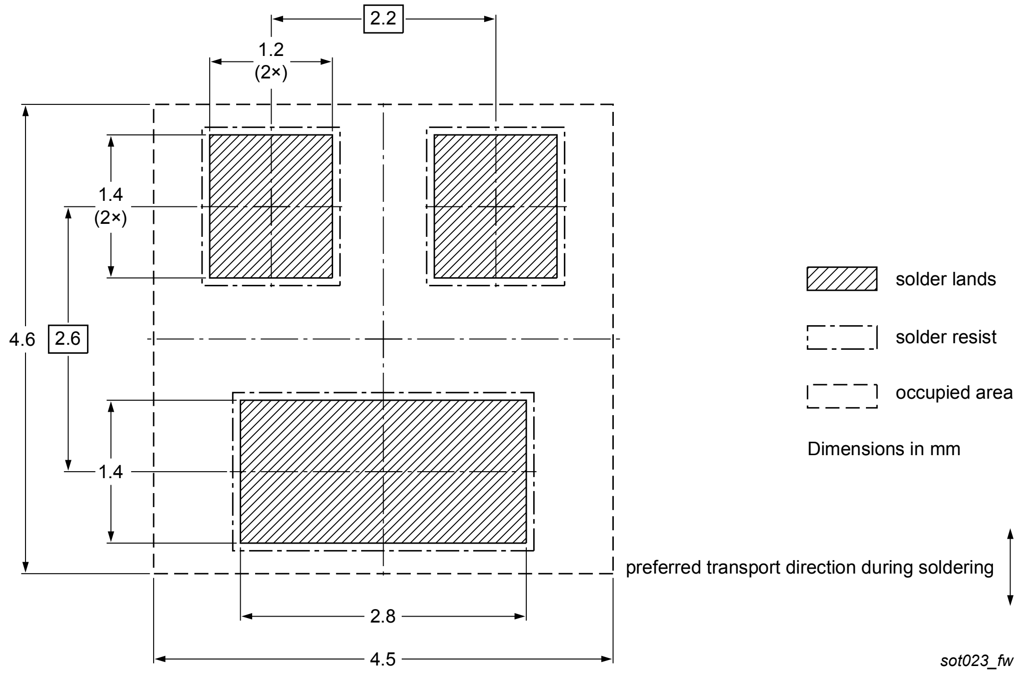



**Fig. 20. Wave soldering footprint for TO-236AB (SOT23)**

## 14. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PMV65XPEA v.1 | 20141127 | Product data sheet | - | - |

# 15. Legal information

## 15.1 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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## 16. Contents





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**Date of release: 27 November 2014**