
# PMN40UPEA

## 20 V, single P-channel Trench MOSFET

19 June 2014 **Product data sheet**

## 1. General description

P-channel enhancement mode Field-Effect Transistor (FET) in a small SOT457 (SC-74) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

## 2. Features and benefits

- Low threshold voltage
- Fast switching
- Trench MOSFET technology
- 4 kV ESD protection
- 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 | | | -8 | - | 8 | V |
| $I_D$ | drain current | $V_{GS}$ = -4.5 V; $T_{amb}$ = 25 °C; t ≤ 5 s | [1] | - | - | -6 | A |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = -4.5 V; $I_D$ = -3 A; $T_j$ = 25 °C | | - | 37 | 43 | 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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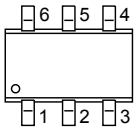
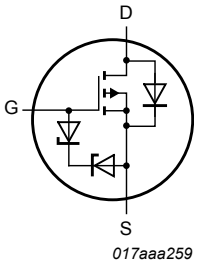
## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | D | drain |  **TSOP6 (SOT457)** |  |
| 2 | D | drain | | |
| 3 | G | gate | | |
| 4 | S | source | | |
| 5 | D | drain | | |
| 6 | D | drain | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PMN40UPEA | TSOP6 | plastic surface-mounted package (TSOP6); 6 leads | SOT457 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| PMN40UPEA | BC |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# 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 | | | -8 | 8 | V |
| $I_D$ | drain current | $V_{GS}$ = -4.5 V; $T_{amb}$ = 25 °C; t ≤ 5 s | [1] | - | -6 | A |
| | | $V_{GS}$ = -4.5 V; $T_{amb}$ = 25 °C | [1] | - | -4.7 | A |
| | | $V_{GS}$ = -4.5 V; $T_{amb}$ = 100 °C | [1] | - | -3.5 | A |
| $I_{DM}$ | peak drain current | $T_{amb}$ = 25 °C; single pulse; $t_p$ ≤ 10 µs | | - | -16 | A |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = 25 °C | [2] | - | 500 | mW |
| | | | [1] | - | 1220 | mW |
| | | $T_{sp}$ = 25 °C | | - | 8330 | 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] | - | -1.3 | A |
| **ESD maximum rating** | | | | | | |
| $V_{ESD}$ | electrostatic discharge voltage | HBM | [3] | - | 4000 | 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.


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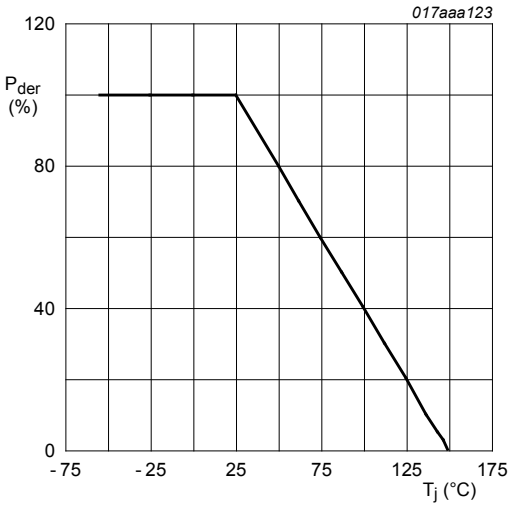



**Fig. 1. Normalized total power dissipation as a function of junction temperature**

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

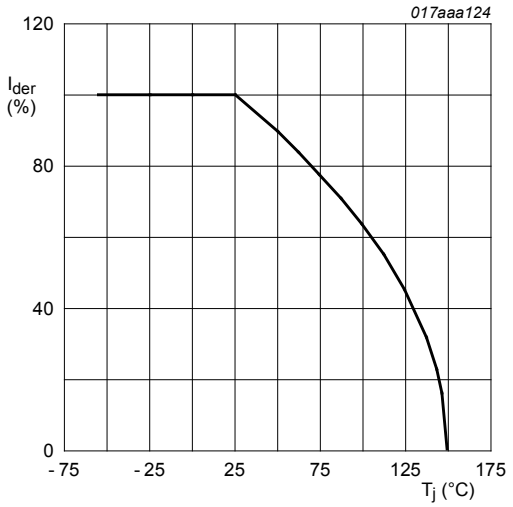
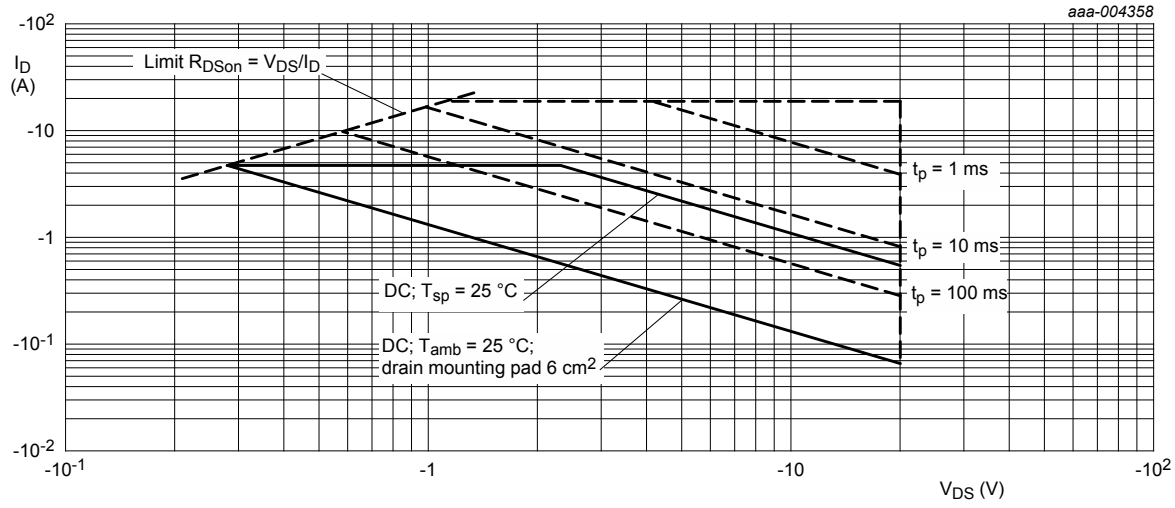



**Fig. 2. Normalized continuous drain current as a function of junction temperature**

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




$I_{DM}$ = 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] | - | 216 | 250 | K/W |
| | | | [2] | - | 83 | 95 | K/W |
| | | in free air; t ≤ 5 s | [2] | - | 51 | 60 | K/W |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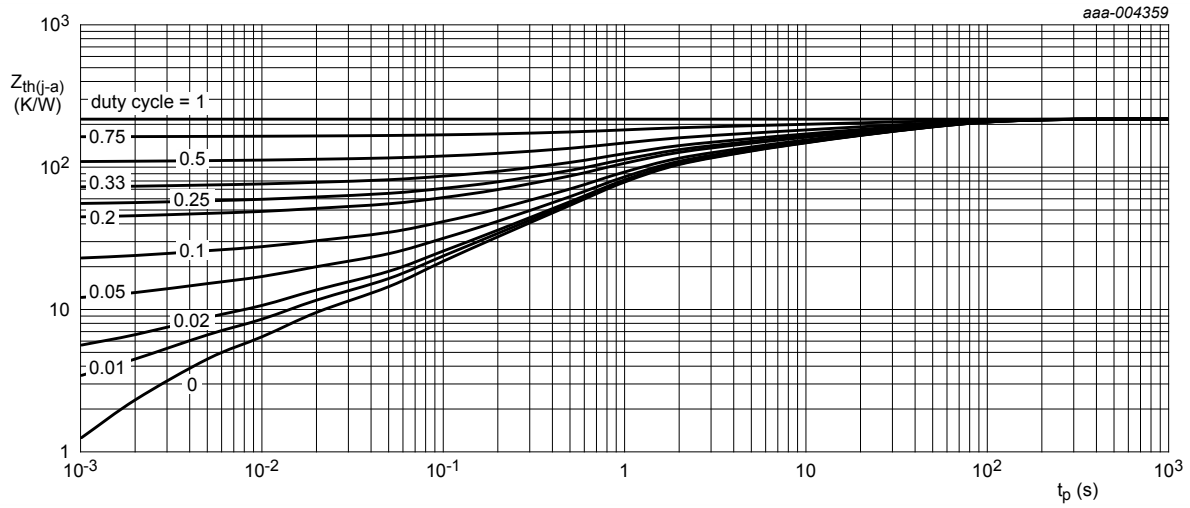
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | 10 | 15 | K/W |

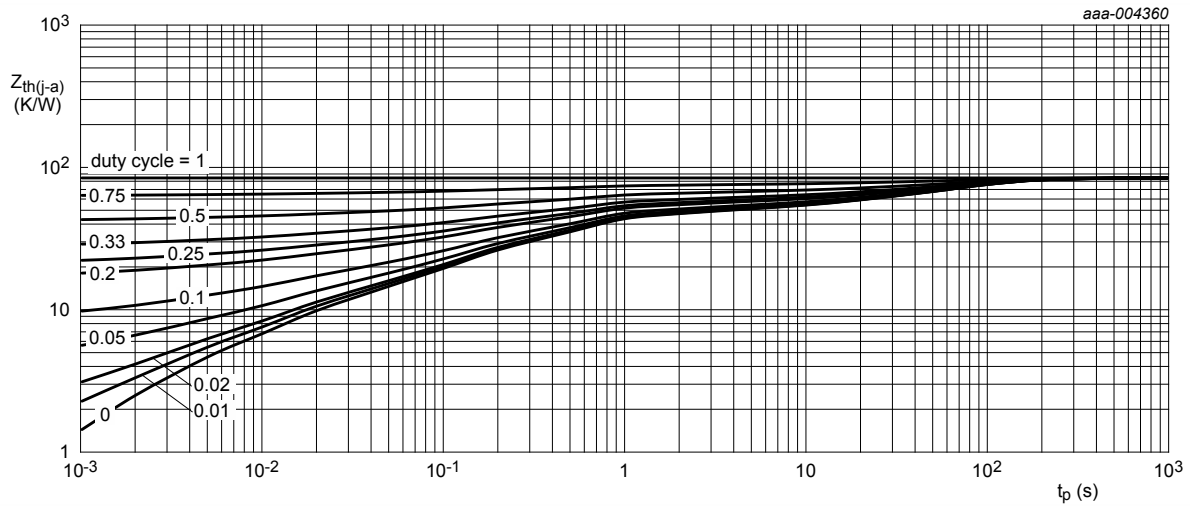
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[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**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# 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 | | -0.45 | -0.7 | -0.95 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = -20 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | - | -1 | µA |
| | | $V_{DS}$ = -20 V; $V_{GS}$ = 0 V; $T_{amb}$ = 150 °C | | - | - | -15 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 8 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 10 | µA |
| | | $V_{GS}$ = -8 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | -10 | µA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = -4.5 V; $I_D$ = -3 A; $T_j$ = 25 °C | | - | 37 | 43 | mΩ |
| | | $V_{GS}$ = -4.5 V; $I_D$ = -3 A; $T_j$ = 150 °C | | - | 51 | 59 | mΩ |
| | | $V_{GS}$ = -2.5 V; $I_D$ = -3 A; $T_j$ = 25 °C | | - | 45 | 55 | mΩ |
| | | $V_{GS}$ = -1.8 V; $I_D$ = -3 A; $T_j$ = 25 °C | | - | 59 | 72 | mΩ |
| $g_{fs}$ | forward transconductance | $V_{DS}$ = -10 V; $I_D$ = -4 A; $T_j$ = 25 °C | | - | 15 | - | S |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS}$ = -10 V; $I_D$ = -4.4 A; $V_{GS}$ = -4.5 V; $T_j$ = 25 °C | | - | 15.6 | 23 | nC |
| $Q_{GS}$ | gate-source charge | | | - | 2.5 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 2.8 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = -10 V; f = 1 MHz; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 1820 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 207 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 146 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = -10 V; $I_D$ = -4 A; $V_{GS}$ = -4.5 V; $R_{G(ext)}$ = 6 Ω; $T_j$ = 25 °C | | - | 8 | - | ns |
| $t_r$ | rise time | | | - | 21 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 50 | - | ns |
| $t_f$ | fall time | | | - | 34 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = -1.2 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | -0.7 | -1.2 | V |


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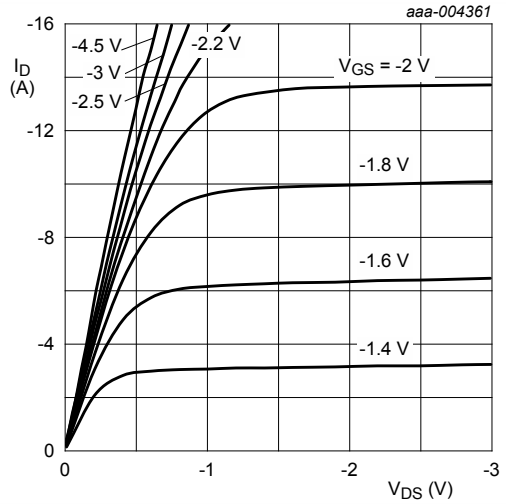
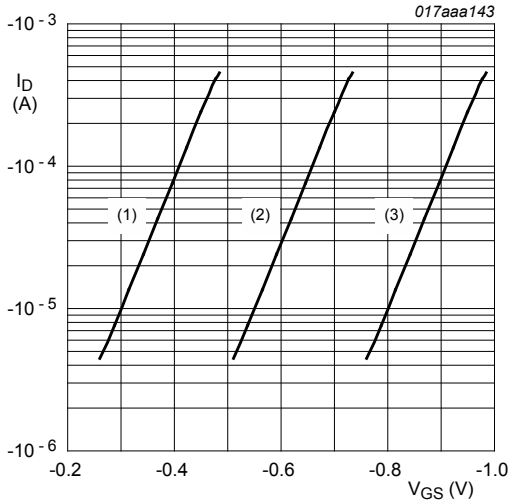



$T_j$ = 25 °C

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



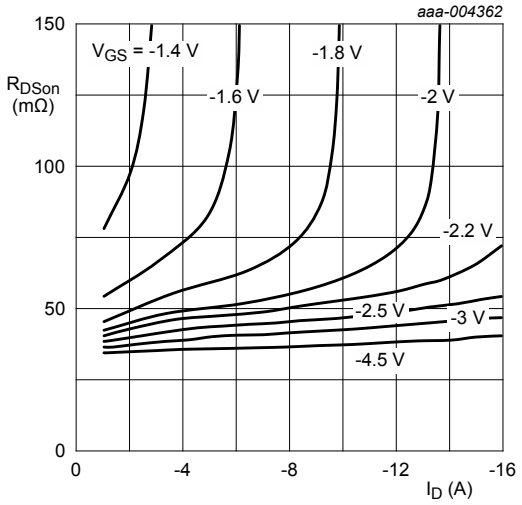

$T_j$ = 25 °C; $V_{DS}$ = -3 V

(1) minimum values

(2) typical values

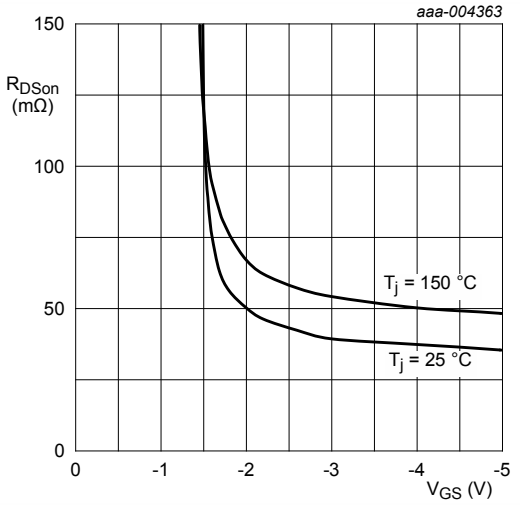
(3) maximum values

**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**




$I_D$ = -4 A

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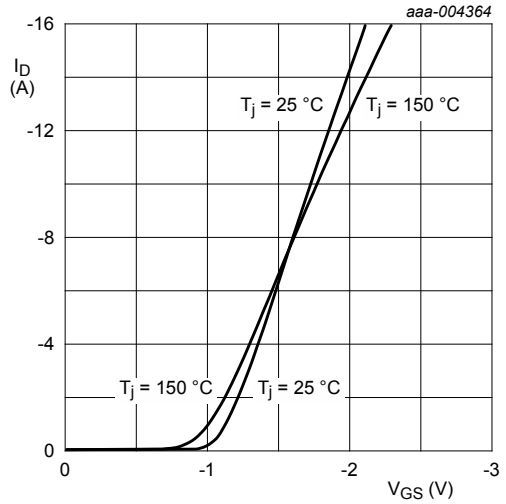



$V_{DS} > I_D \times R_{DSon}$

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

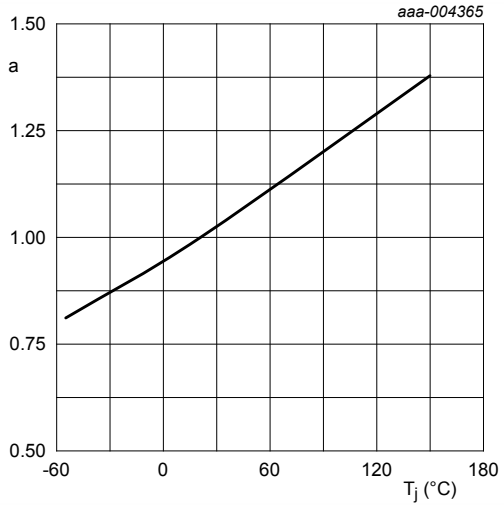
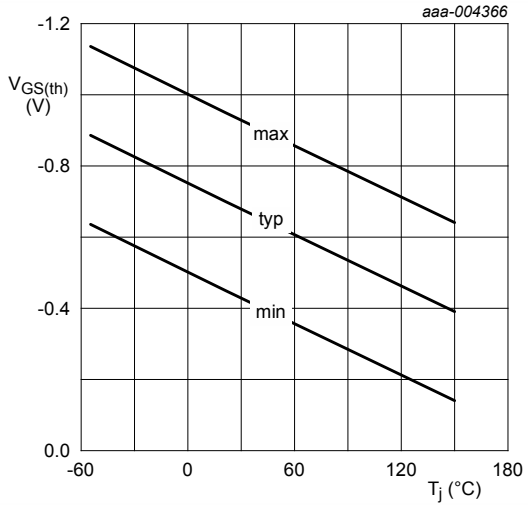


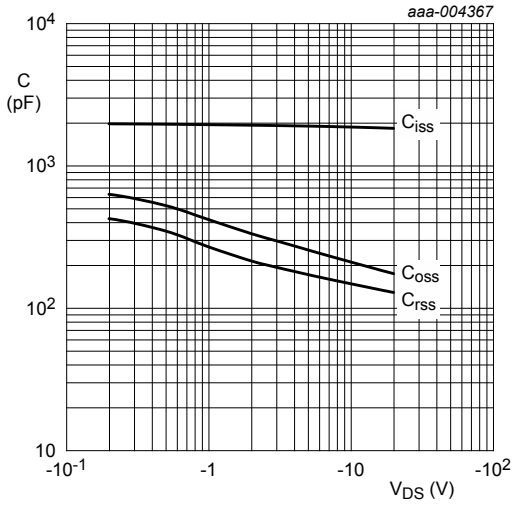

**Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values**

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




$I_D$ = -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**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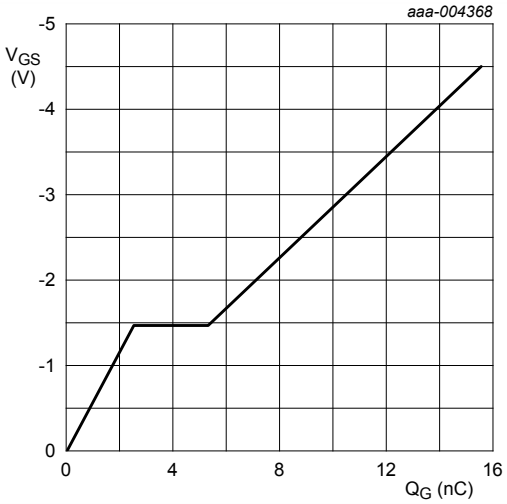



$I_D$ = -4 A; $V_{DS}$ = -10 V; $T_{amb}$ = 25 °C

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

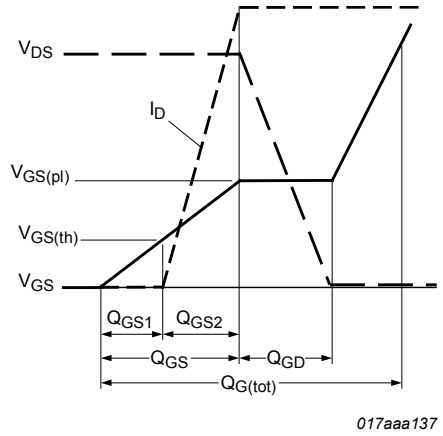
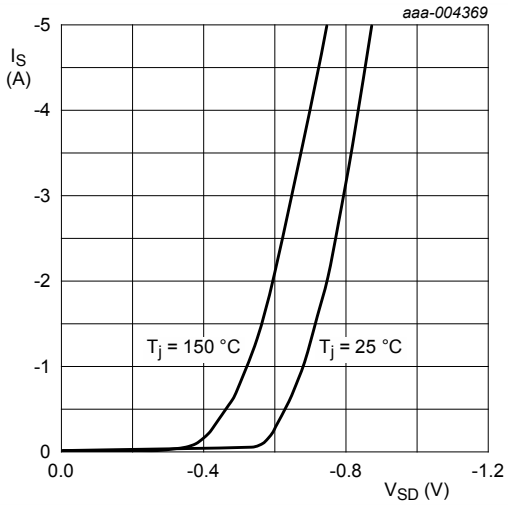



**Fig. 15. Gate charge waveform definitions**




$V_{GS}$ = 0 V

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

## 11. Test information

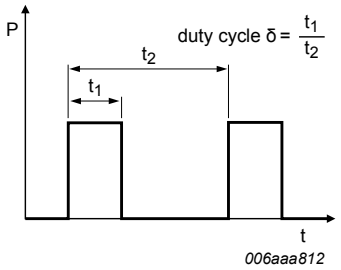



**Fig. 17. Duty cycle definition**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## 11.1 Quality information

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.


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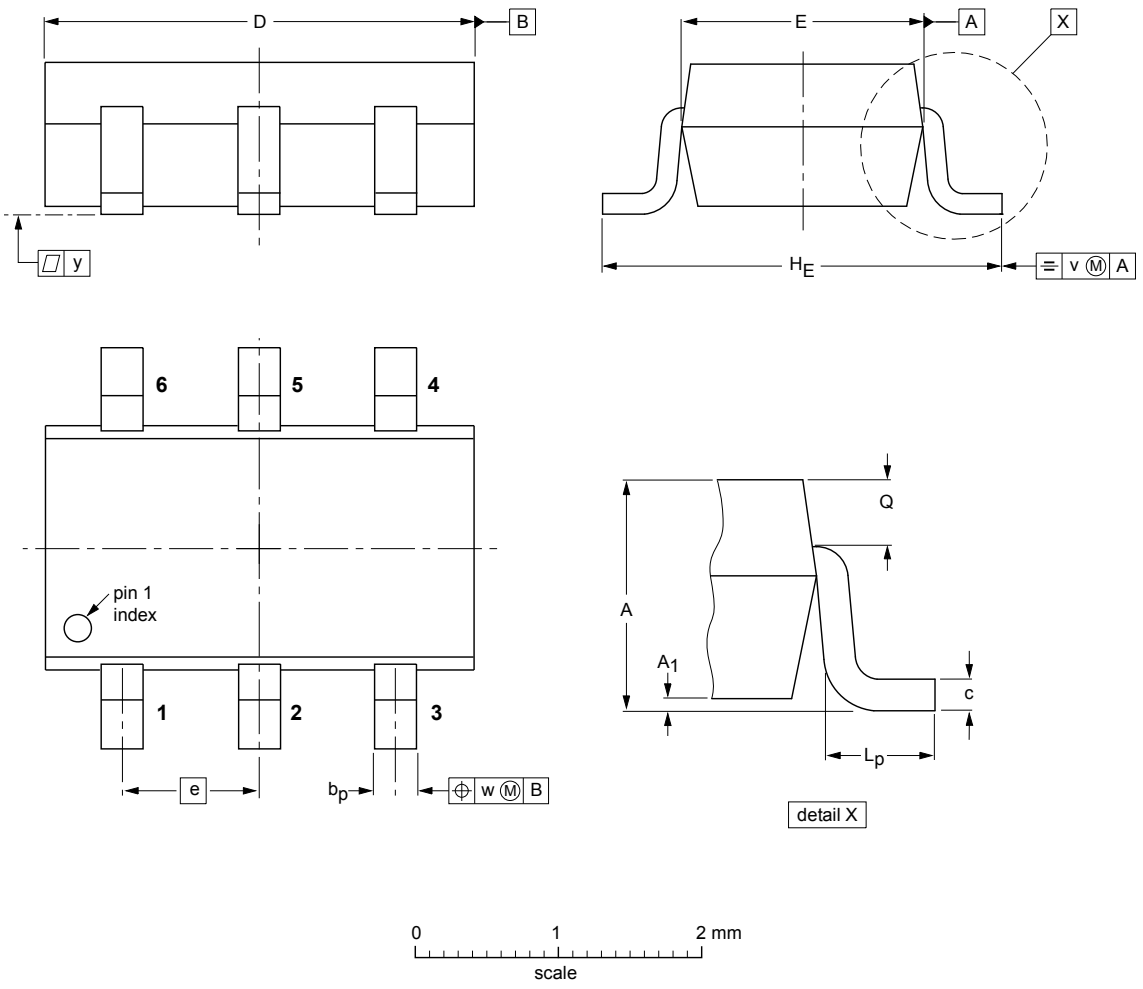
## 12. Package outline

**Plastic surface-mounted package (TSOP6); 6 leads** **SOT457**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | $b_p$ | c | D | E | e | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1<br>0.013 | 0.40<br>0.25 | 0.26<br>0.10 | 3.1<br>2.7 | 1.7<br>1.3 | 0.95 | 3.0<br>2.5 | 0.6<br>0.2 | 0.33<br>0.23 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT457 | | | SC-74 | | | ~~05-11-07~~<br>06-03-16 |

**Fig. 18. Package outline TSOP6 (SOT457)**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## 13. Soldering

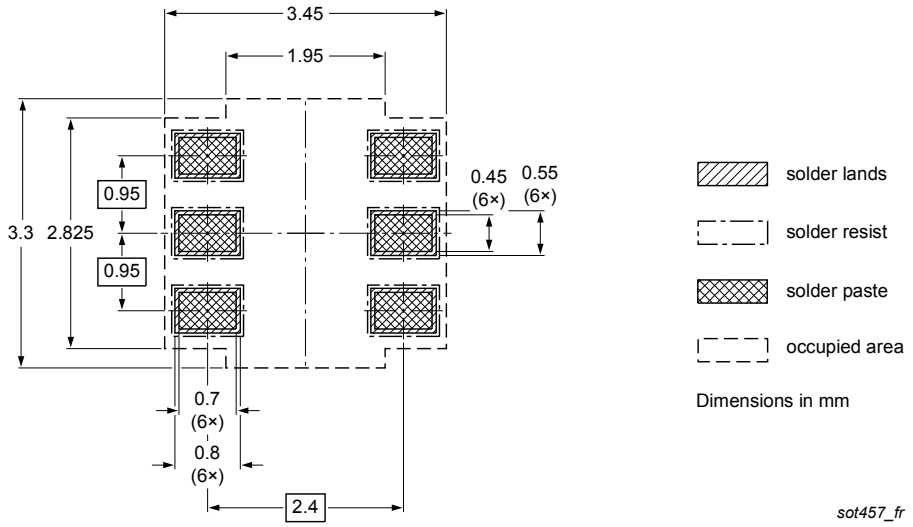


**Fig. 19. Reflow soldering footprint for TSOP6 (SOT457)**

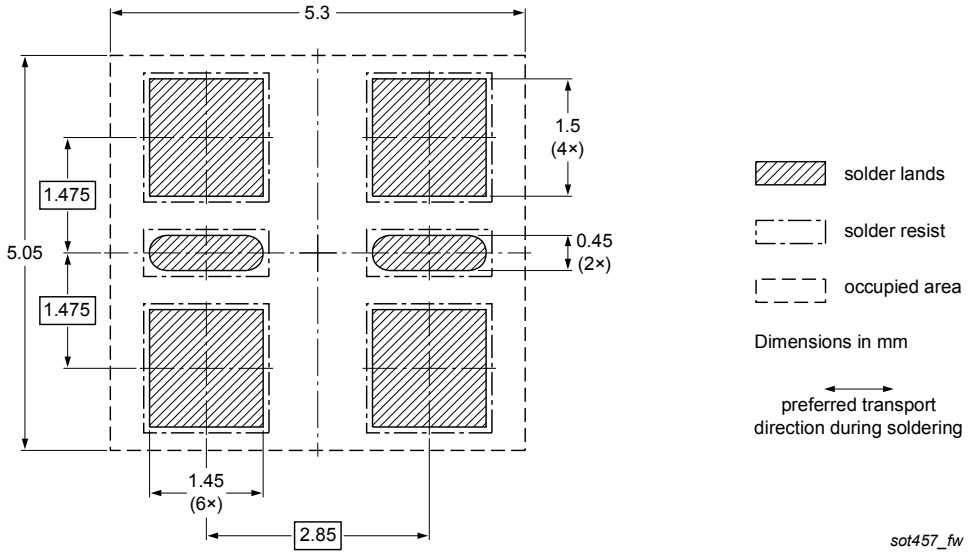


**Fig. 20. Wave soldering footprint for TSOP6 (SOT457)**


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## 14. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PMN40UPEA v.1 | 20140619 | Product data sheet | - | - |


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# 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. |

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
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