



# PMN30ENEA

## 40 V N-channel Trench MOSFET

2 April 2019

Product data sheet

### 1. General description

N-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

- Logic-level compatible
- Extended temperature range  $T_j = 175\text{ }^{\circ}\text{C}$
- 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

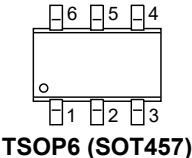
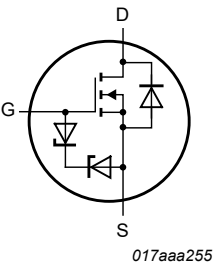
Table 1. Quick reference data

| Symbol                        | Parameter                        | Conditions                                                                   | Min | Typ | Max | Unit       |
|-------------------------------|----------------------------------|------------------------------------------------------------------------------|-----|-----|-----|------------|
| $V_{DS}$                      | drain-source voltage             | $T_j = 25\text{ }^{\circ}\text{C}$                                           | -   | -   | 40  | V          |
| $V_{GS}$                      | gate-source voltage              |                                                                              | -20 | -   | 20  | V          |
| $I_D$                         | drain current                    | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$                 | [1] | -   | 5.4 | A          |
| <b>Static characteristics</b> |                                  |                                                                              |     |     |     |            |
| $R_{DS(on)}$                  | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 5.4\text{ A}; T_j = 25\text{ }^{\circ}\text{C}$ | -   | 23  | 30  | 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   | D      | drain       | <br>TSOP6 (SOT457) | <br>017aaa255 |
| 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 |
| PMN30ENEA   | TSOP6   | plastic surface-mounted package (TSOP6); 6 leads | SOT457  |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PMN30ENEA   | 3Q           |

## 8. Limiting values

**Table 5. Limiting values**

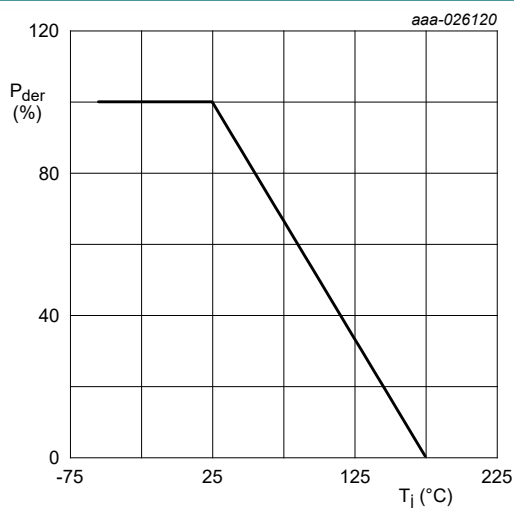
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol                      | Parameter                                    | Conditions                                                                             |     | Min | Max  | Unit |
|-----------------------------|----------------------------------------------|----------------------------------------------------------------------------------------|-----|-----|------|------|
| V <sub>DS</sub>             | drain-source voltage                         | T <sub>j</sub> = 25 °C                                                                 |     | -   | 40   | 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] | -   | 5.4  | A    |
|                             |                                              | V <sub>GS</sub> = 10 V; T <sub>amb</sub> = 100 °C                                      | [1] | -   | 3.8  | A    |
| I <sub>DM</sub>             | peak drain current                           | T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs                         |     | -   | 22   | A    |
| P <sub>tot</sub>            | total power dissipation                      | T <sub>amb</sub> = 25 °C                                                               | [2] | -   | 667  | mW   |
|                             |                                              |                                                                                        | [1] | -   | 1.7  | 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] | -   | 1.6  | 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(initial)</sub> = 25 °C; I <sub>D</sub> = 0.83 A; DUT in avalanche (unclamped) |     | -   | 16.7 | mJ   |

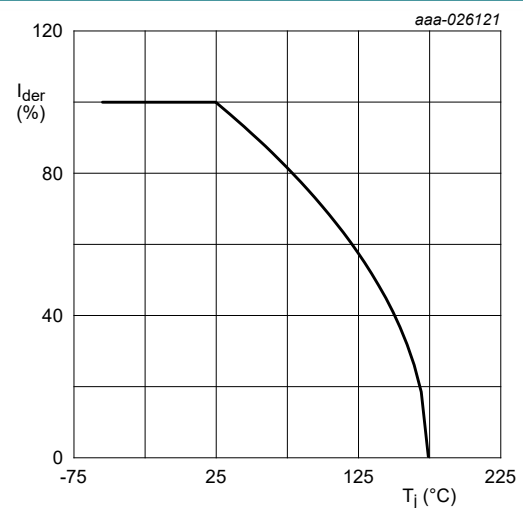
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 6 cm<sup>2</sup>.

[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

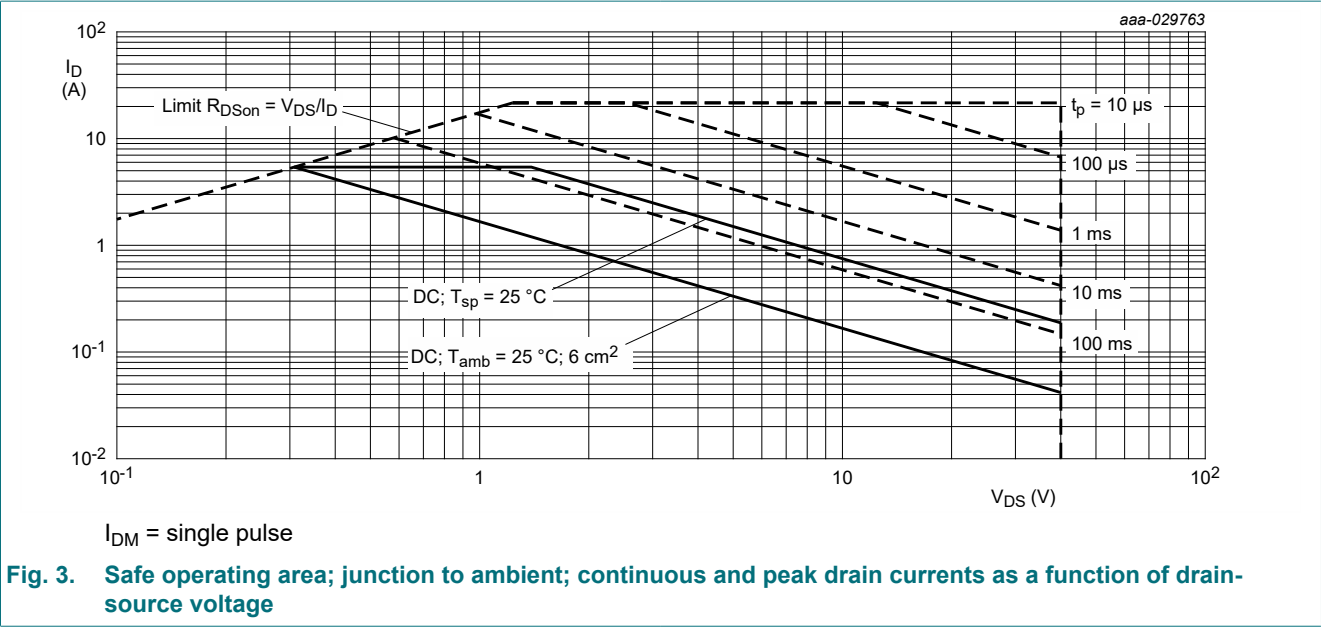
[3] Measured between all pins.



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



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



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] | -   | 195 | 225 | K/W  |
|                |                                                  |             | [2] | -   | 78  | 90  | 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 and mounting pad for drain 6 cm<sup>2</sup>.

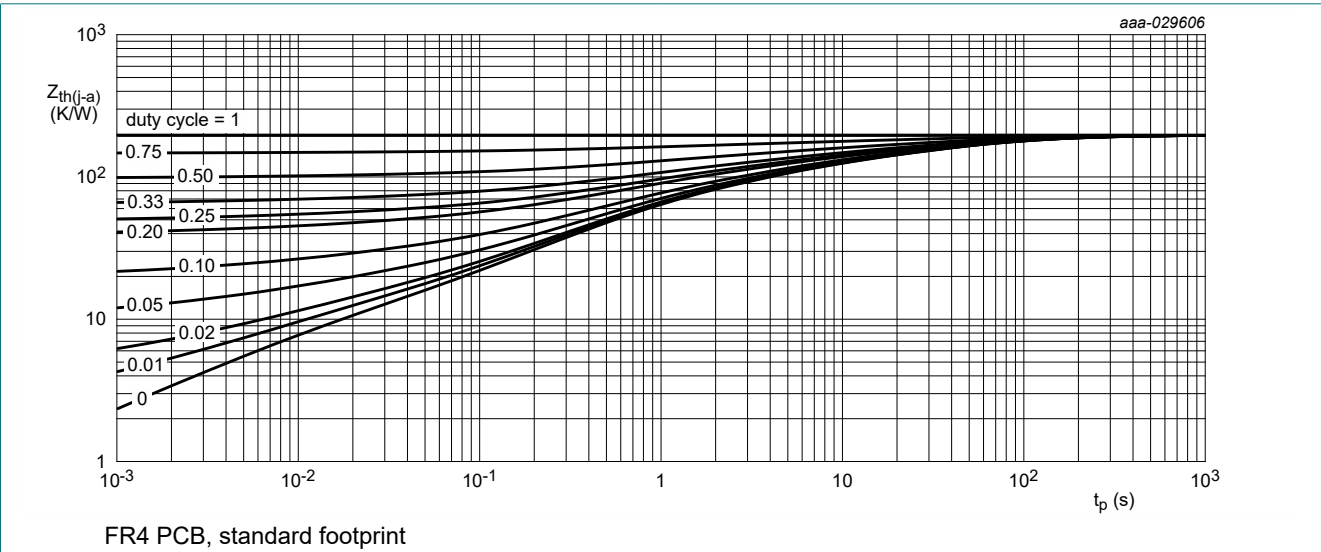


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

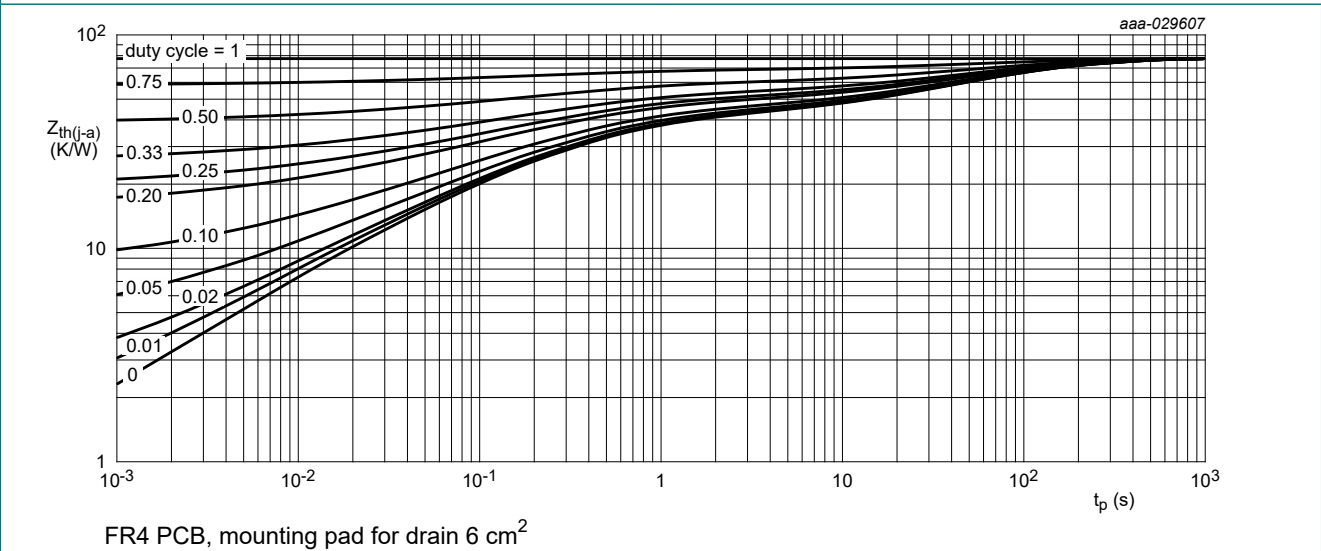


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

| Symbol                  | Parameter                        | Conditions                                                                                                                     |  | Min | Typ | Max  | Unit |
|-------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--|-----|-----|------|------|
| Static characteristics  |                                  |                                                                                                                                |  |     |     |      |      |
| V <sub>(BR)DSS</sub>    | drain-source breakdown voltage   | I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                         |  | 40  | -   | -    | V    |
| V <sub>GSth</sub>       | gate-source threshold voltage    | I <sub>D</sub> = 250 μA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = 25 °C                                            |  | 1   | 1.6 | 2.5  | V    |
| I <sub>DSS</sub>        | drain leakage current            | V <sub>DS</sub> = 40 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                          |  | -   | -   | 1    | μA   |
| I <sub>GSS</sub>        | gate leakage current             | V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                          |  | -   | -   | 10   | μA   |
|                         |                                  | V <sub>GS</sub> = -20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                         |  | -   | -   | -10  | μA   |
|                         |                                  | V <sub>GS</sub> = 10 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                          |  | -   | -   | 2    | μA   |
|                         |                                  | V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                         |  | -   | -   | -2   | μA   |
| R <sub>DSon</sub>       | drain-source on-state resistance | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 5.4 A; T <sub>j</sub> = 25 °C                                                         |  | -   | 23  | 30   | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 5.4 A; T <sub>j</sub> = 175 °C                                                        |  | -   | 44  | 57   | mΩ   |
|                         |                                  | V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 4.7 A; T <sub>j</sub> = 25 °C                                                        |  | -   | 30  | 40   | mΩ   |
| g <sub>fs</sub>         | forward transconductance         | V <sub>DS</sub> = 10 V; I <sub>D</sub> = 2 A; T <sub>j</sub> = 25 °C                                                           |  | -   | 19  | -    | S    |
| R <sub>G</sub>          | gate resistance                  | f = 1 MHz                                                                                                                      |  | -   | 2   | -    | Ω    |
| Dynamic characteristics |                                  |                                                                                                                                |  |     |     |      |      |
| Q <sub>G(tot)</sub>     | total gate charge                | V <sub>DS</sub> = 20 V; I <sub>D</sub> = 5 A; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C                                   |  | -   | 7.8 | 11.7 | nC   |
| Q <sub>GS</sub>         | gate-source charge               |                                                                                                                                |  | -   | 1.2 | -    | nC   |
| Q <sub>GD</sub>         | gate-drain charge                |                                                                                                                                |  | -   | 1.6 | -    | nC   |
| C <sub>iss</sub>        | input capacitance                | V <sub>DS</sub> = 20 V; f = 1 MHz; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                               |  | -   | 440 | -    | pF   |
| C <sub>oss</sub>        | output capacitance               |                                                                                                                                |  | -   | 76  | -    | pF   |
| C <sub>rss</sub>        | reverse transfer capacitance     |                                                                                                                                |  | -   | 39  | -    | pF   |
| t <sub>d(on)</sub>      | turn-on delay time               | V <sub>DS</sub> = 20 V; I <sub>D</sub> = 5 A; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 6 Ω; T <sub>j</sub> = 25 °C        |  | -   | 4   | -    | ns   |
| t <sub>r</sub>          | rise time                        |                                                                                                                                |  | -   | 2   | -    | ns   |
| t <sub>d(off)</sub>     | turn-off delay time              |                                                                                                                                |  | -   | 20  | -    | ns   |
| t <sub>f</sub>          | fall time                        |                                                                                                                                |  | -   | 33  | -    | ns   |
| Source-drain diode      |                                  |                                                                                                                                |  |     |     |      |      |
| V <sub>SD</sub>         | source-drain voltage             | I <sub>S</sub> = 1.6 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                          |  | -   | 0.8 | 1.2  | V    |
| t <sub>rr</sub>         | reverse recovery time            | I <sub>S</sub> = 1.6 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 20 V; T <sub>j</sub> = 25 °C |  | -   | 11  | -    | ns   |
| Q <sub>r</sub>          | recovered charge                 |                                                                                                                                |  | -   | 4   | -    | nC   |

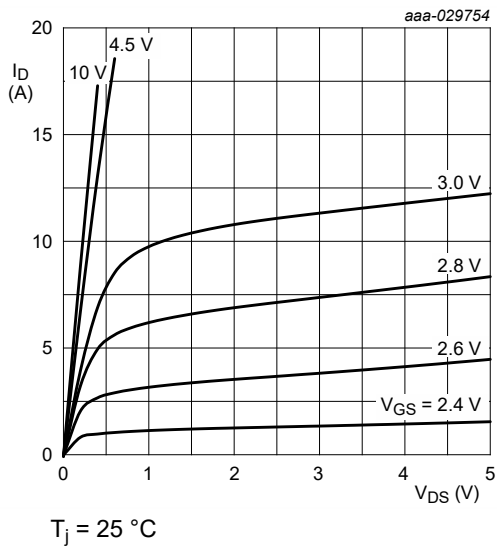


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

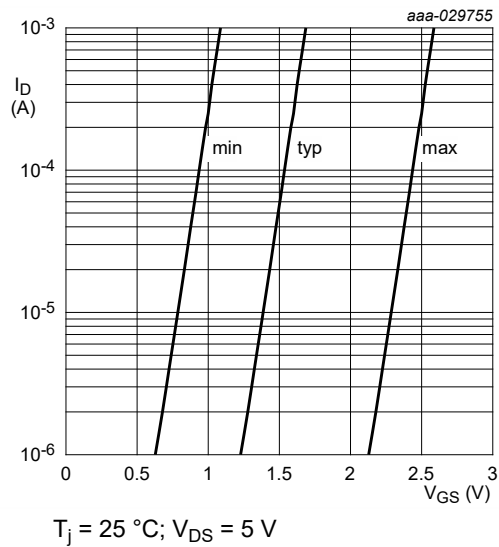


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

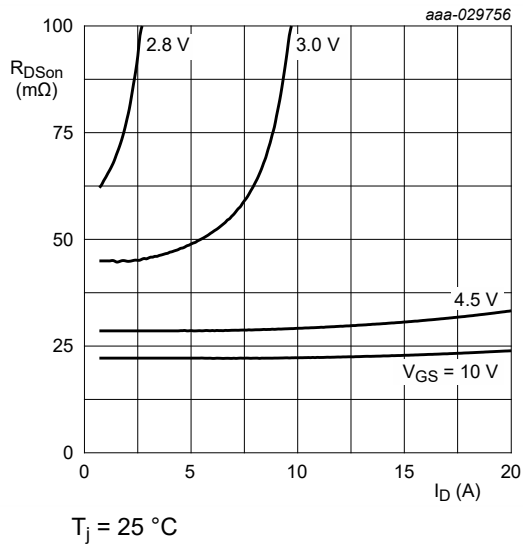


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

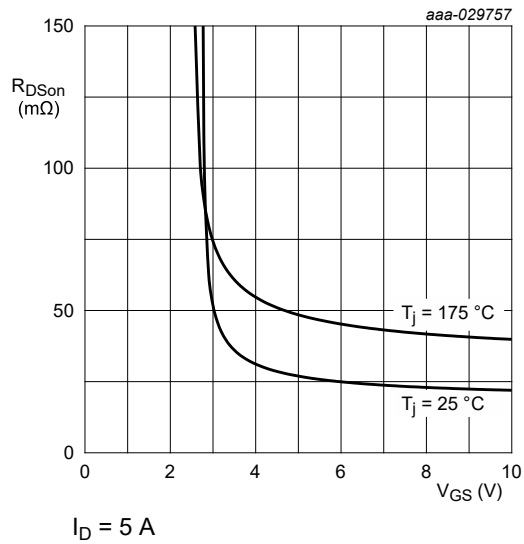


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

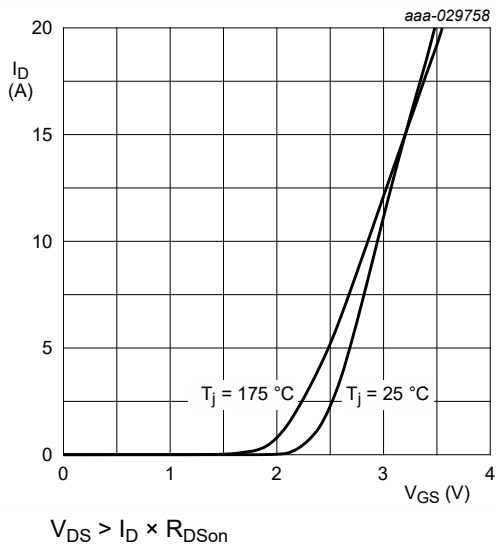


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

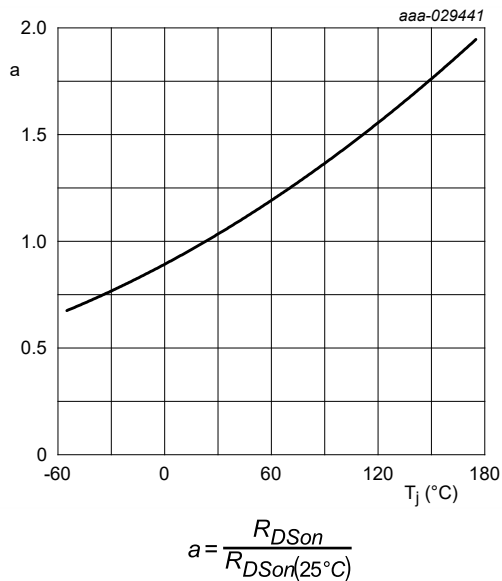


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

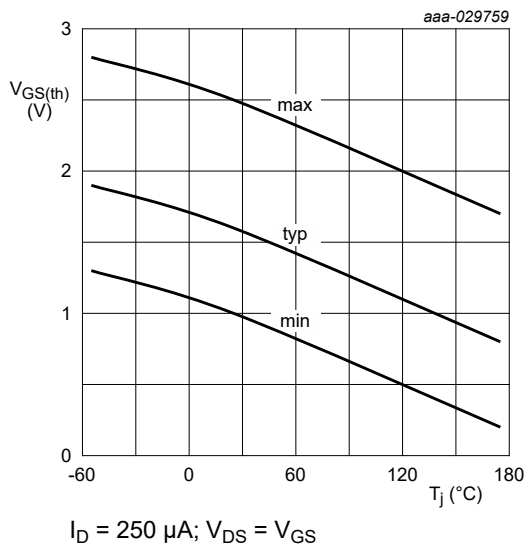


Fig. 12. Gate-source threshold voltage as a function of junction temperature

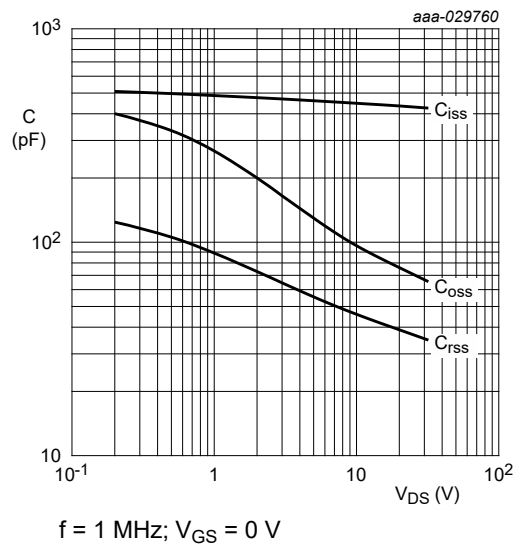
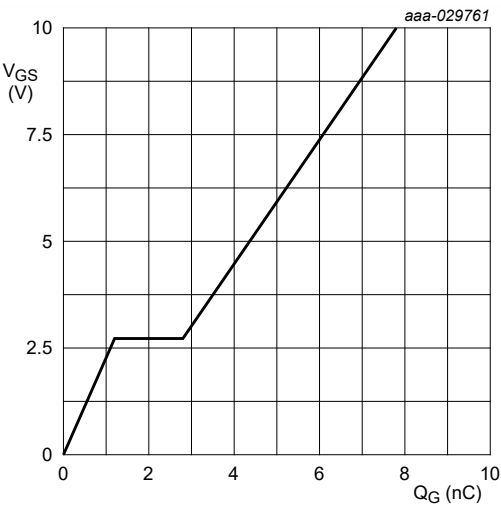


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$V_{DS} = 20\text{ V}$ ;  $I_D = 4.8\text{ A}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$

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

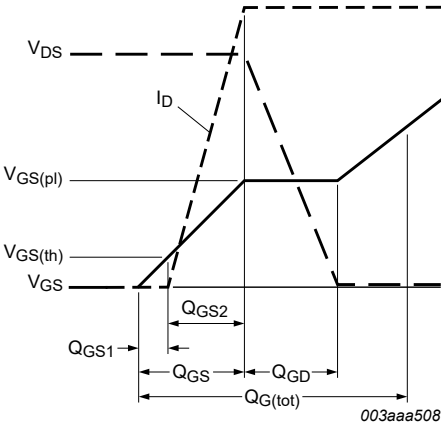
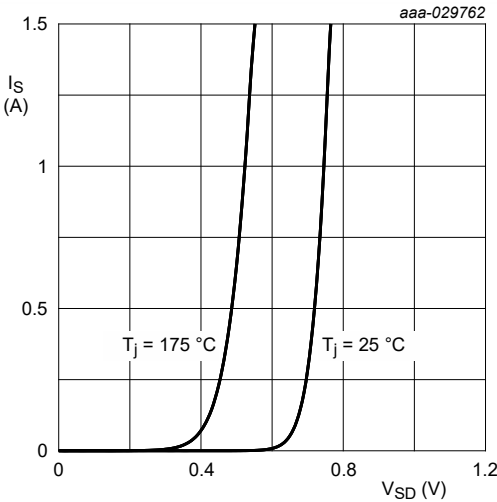


Fig. 15. Gate charge waveform definitions



$V_{GS} = 0\text{ V}$

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

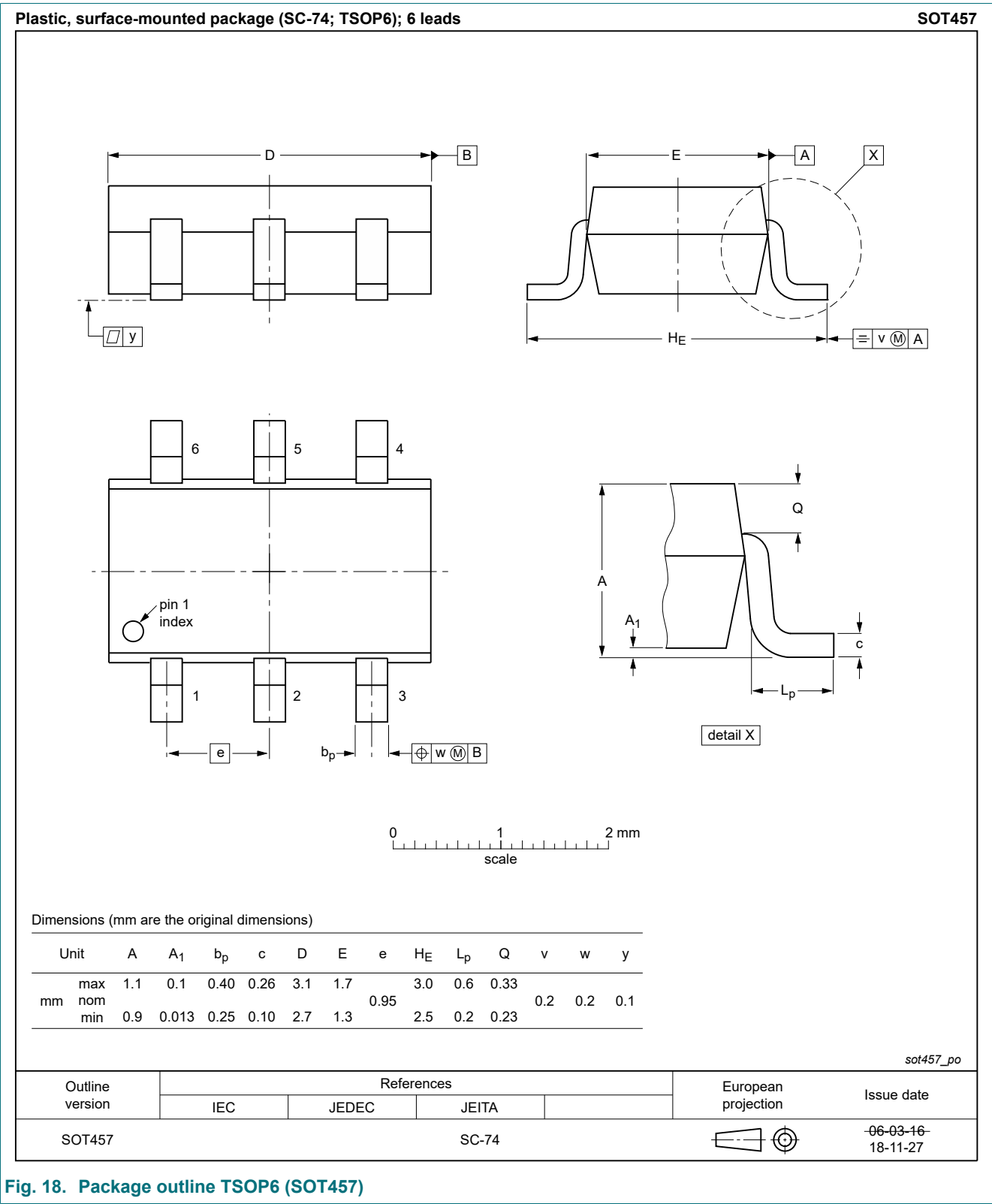


Fig. 18. Package outline TSOP6 (SOT457)

13. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status  | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| PMN30ENEA v.1 | 20190402     | Product data sheet | -             | -          |

## 14. Legal information

### Data sheet status

| Document status<br>[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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Date of release: 2 April 2019

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