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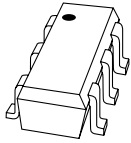
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Kind regards,

Team Nexperia



2N7002PS

60 V, 320 mA N-channel Trench MOSFET

Rev. 1 — 1 July 2010

Product data sheet

1. Product profile

1.1 General description

Dual N-channel enhancement mode Field-Effect Transistor (FET) in a very small SOT363 (SC-88) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

1.2 Features and benefits

- Logic-level compatible
- Very fast switching
- Trench MOSFET technology
- AEC-Q101 qualified

1.3 Applications

- Relay driver
- High-speed line driver
- Low-side loadswitch
- Switching circuits

1.4 Quick reference data

Table 1. Quick reference data

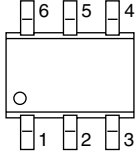
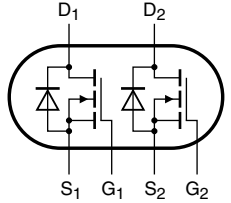
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------|----------------------------------|---|-----|-----|----------|----------|
| Per transistor | | | | | | |
| V_{DS} | drain-source voltage | $T_{amb} = 25\text{ °C}$ | - | - | 60 | V |
| V_{GS} | gate-source voltage | $T_{amb} = 25\text{ °C}$ | - | - | ± 20 | V |
| I_D | drain current | $T_{amb} = 25\text{ °C};$ $V_{GS} = 10\text{ V}$ | [1] | - | 320 | mA |
| $R_{DS(on)}$ | drain-source on-state resistance | $T_j = 25\text{ °C};$ $V_{GS} = 10\text{ V};$ $I_D = 500\text{ mA}$ | - | 1 | 1.6 | Ω |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm².



2. Pinning information

Table 2. Pinning

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-------------|--|---|
| 1 | S1 | source1 |  |  |
| 2 | G1 | gate1 | | |
| 3 | D2 | drain2 | | |
| 4 | S2 | source2 | | |
| 5 | G2 | gate2 | | |
| 6 | D1 | drain1 | | |

msd901

3. Ordering information

Table 3. Ordering information

| Type number | Package | | Version |
|-------------|---------|--|---------|
| | Name | Description | |
| 2N7002PS | SC-88 | plastic surface-mounted package; 6 leads | SOT363 |

4. Marking

Table 4. Marking codes

| Type number | Marking code ^[1] |
|-------------|-----------------------------|
| 2N7002PS | M8* |

- [1] * = -: made in Hong Kong
 * = p: made in Hong Kong
 * = t: made in Malaysia
 * = W: made in China

5. Limiting values

Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------------|----------------------|--|-----|-----|------|
| Per transistor | | | | | |
| V_{DS} | drain-source voltage | $T_{amb} = 25\text{ °C}$ | - | 60 | V |
| V_{GS} | gate-source voltage | $T_{amb} = 25\text{ °C}$ | - | ±20 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}$ | [1] | | |
| | | $T_{amb} = 25\text{ °C}$ | - | 320 | mA |
| | | $T_{amb} = 100\text{ °C}$ | - | 240 | mA |
| I_{DM} | peak drain current | $T_{amb} = 25\text{ °C}$; single pulse; $t_p \leq 10\text{ }\mu\text{s}$ | - | 1.2 | A |

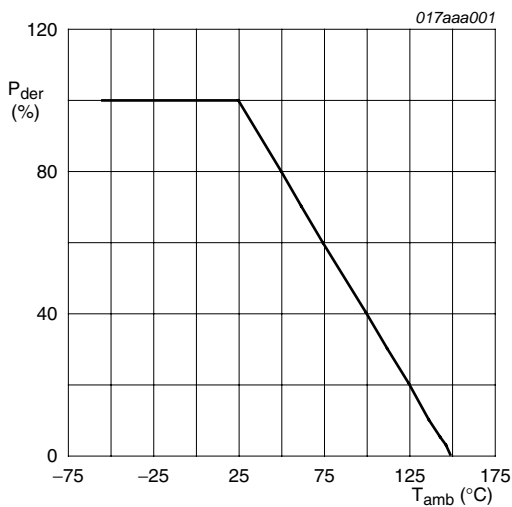
Table 5. Limiting values ...continued

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

| Symbol | Parameter | Conditions | Min | Max | Unit | |
|---------------------------|-------------------------|--------------------------|-----|------|------|----|
| P _{tot} | total power dissipation | T _{amb} = 25 °C | [2] | - | 280 | mW |
| | | | [1] | - | 320 | mW |
| | | T _{sp} = 25 °C | - | 990 | mW | |
| Source-drain diode | | | | | | |
| I _S | source current | T _{amb} = 25 °C | [1] | - | 320 | mA |
| Per device | | | | | | |
| P _{tot} | total power dissipation | T _{amb} = 25 °C | [2] | - | 420 | mW |
| T _j | junction temperature | | | 150 | °C | |
| T _{amb} | ambient temperature | | -55 | +150 | °C | |
| T _{stg} | storage temperature | | -65 | +150 | °C | |

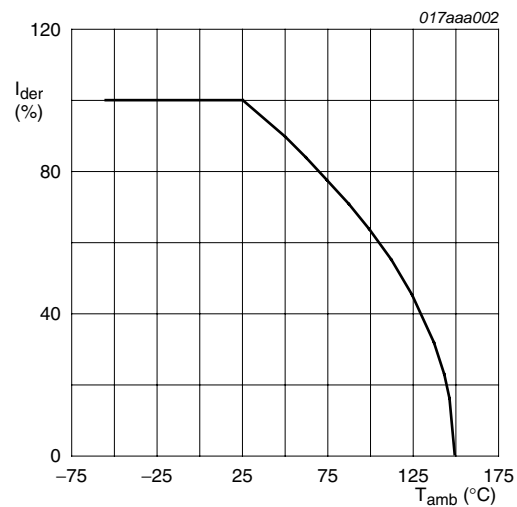
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².

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



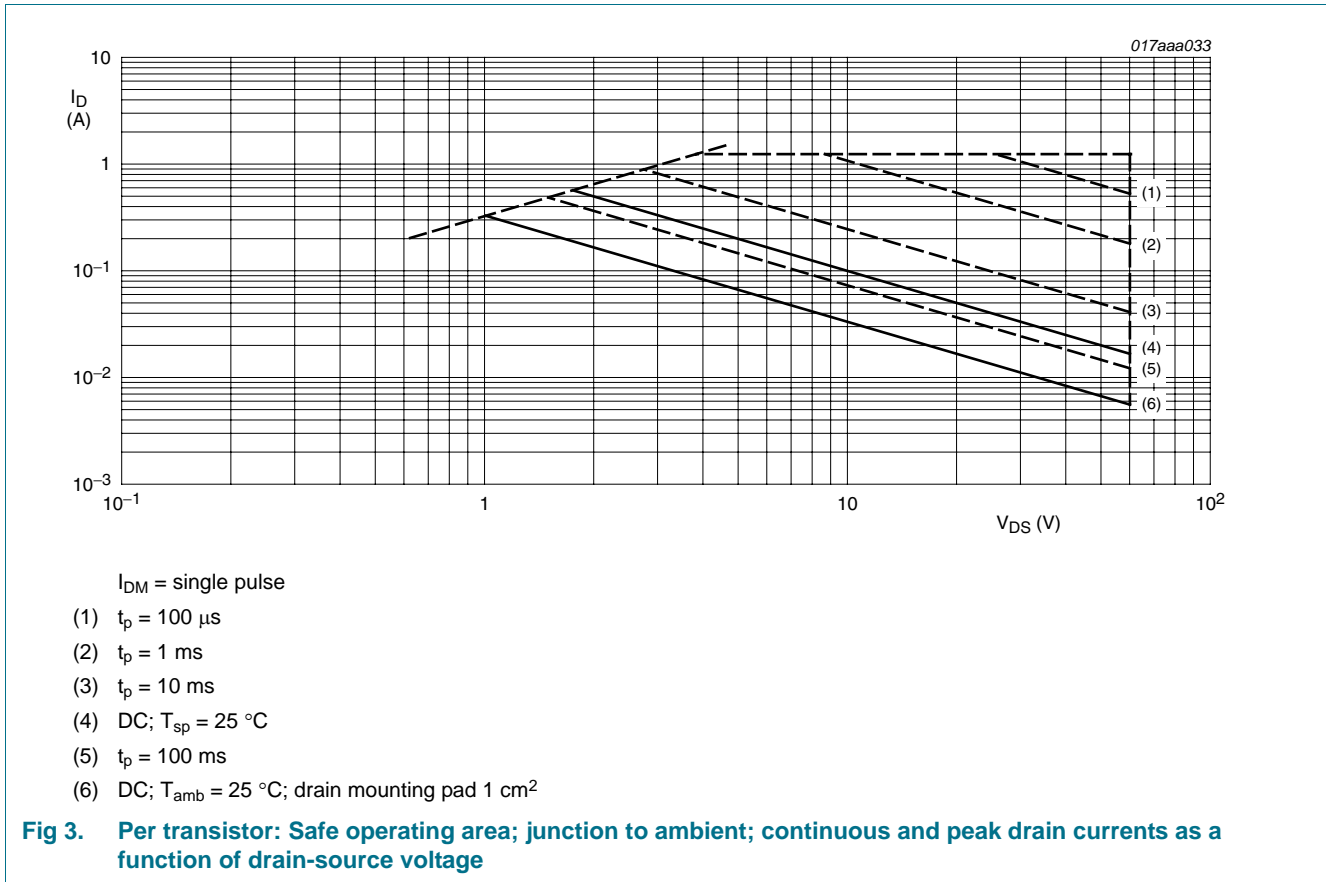
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



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

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



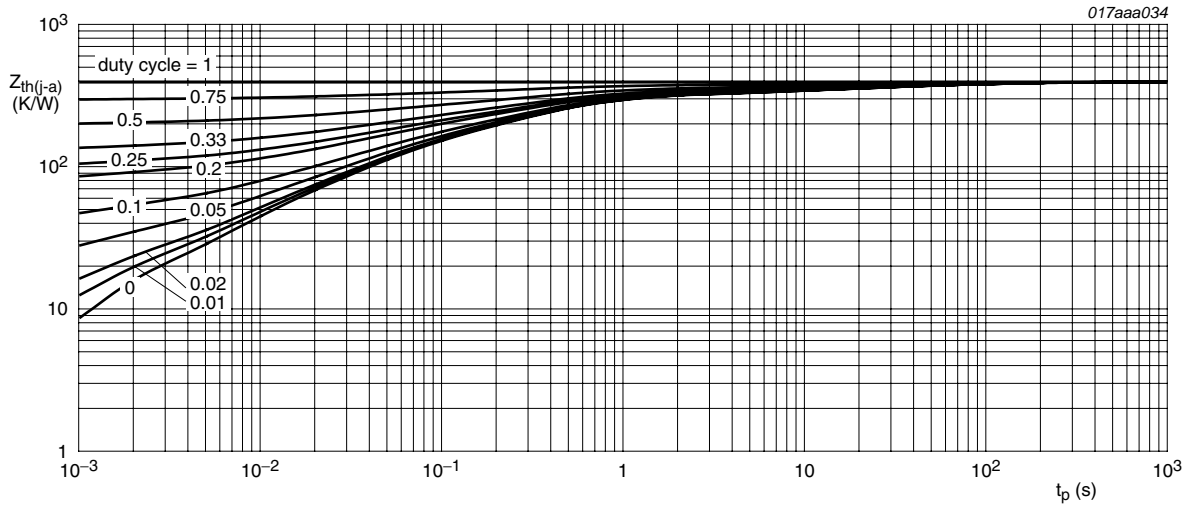
6. Thermal characteristics

Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------|--|-------------|-----|-----|-----|---------|
| Per transistor | | | | | | |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | 390 | 445 K/W |
| | | | [2] | - | 340 | 390 K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | - | - | 130 | K/W |
| Per device | | | | | | |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 300 K/W |

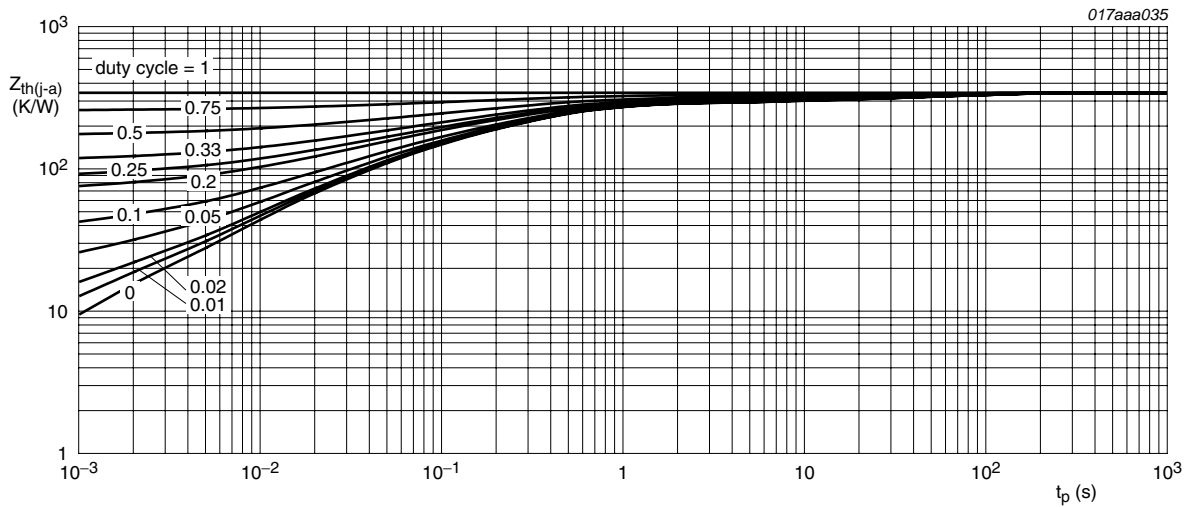
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm^2 .



FR4 PCB, standard footprint

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



FR4 PCB, mounting pad for drain 1 cm²

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

7. Characteristics

Table 7. Characteristics
T_j = 25 °C unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|--|------|------|-----|------|
| Per transistor | | | | | | |
| Static characteristics | | | | | | |
| V _{(BR)DSS} | drain-source breakdown voltage | I _D = 10 μA; V _{GS} = 0 V | 60 | - | - | V |
| V _{GS(th)} | gate-source threshold voltage | I _D = 250 μA; V _{DS} = V _{GS} | 1.1 | 1.75 | 2.4 | V |
| I _{DSS} | drain leakage current | V _{DS} = 60 V; V _{GS} = 0 V | | | | |
| | | T _j = 25 °C | - | - | 1 | μA |
| | | T _j = 150 °C | - | - | 10 | μA |
| I _{GSS} | gate leakage current | V _{GS} = ±20 V; V _{DS} = 0 V | - | - | 100 | nA |
| R _{DS(on)} | drain-source on-state resistance | | [1] | | | |
| | | V _{GS} = 5 V; I _D = 50 mA | - | 1.3 | 2 | Ω |
| | | V _{GS} = 10 V; I _D = 500 mA | - | 1 | 1.6 | Ω |
| g _{fs} | forward transconductance | V _{DS} = 10 V; I _D = 200 mA | [1] | 400 | - | mS |
| Dynamic characteristics | | | | | | |
| Q _{G(tot)} | total gate charge | I _D = 300 mA; | - | 0.6 | 0.8 | nC |
| Q _{GS} | gate-source charge | V _{DS} = 30 V; | - | 0.2 | - | nC |
| Q _{GD} | gate-drain charge | V _{GS} = 4.5 V | - | 0.2 | - | nC |
| C _{iss} | input capacitance | V _{GS} = 0 V; V _{DS} = 10 V; | - | 30 | 50 | pF |
| C _{oss} | output capacitance | f = 1 MHz | - | 7 | - | pF |
| C _{rss} | reverse transfer capacitance | | - | 4 | - | pF |
| t _{d(on)} | turn-on delay time | V _{DD} = 50 V; | - | 3 | 6 | ns |
| t _r | rise time | R _L = 250 Ω; | - | 4 | - | ns |
| t _{d(off)} | turn-off delay time | V _{GS} = 10 V; | - | 10 | 20 | ns |
| t _f | fall time | R _G = 6 Ω | - | 5 | - | ns |
| Source-drain diode | | | | | | |
| V _{SD} | source-drain voltage | I _S = 115 mA; V _{GS} = 0 V | 0.47 | 0.75 | 1.1 | V |

 [1] Pulse test: t_p ≤ 300 μs; δ ≤ 0.01.

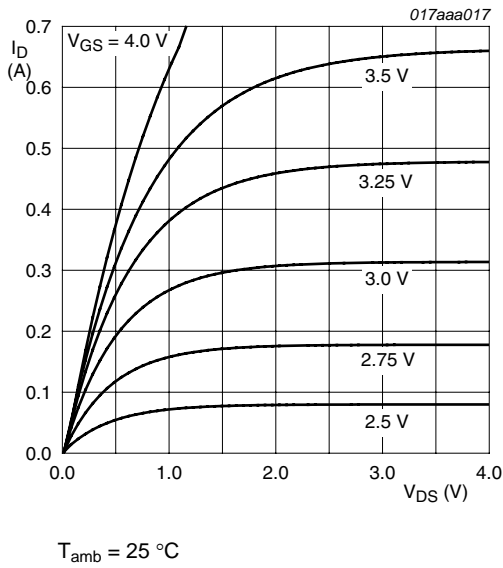


Fig 6. Per transistor: Output characteristics: drain current as a function of drain-source voltage; typical values

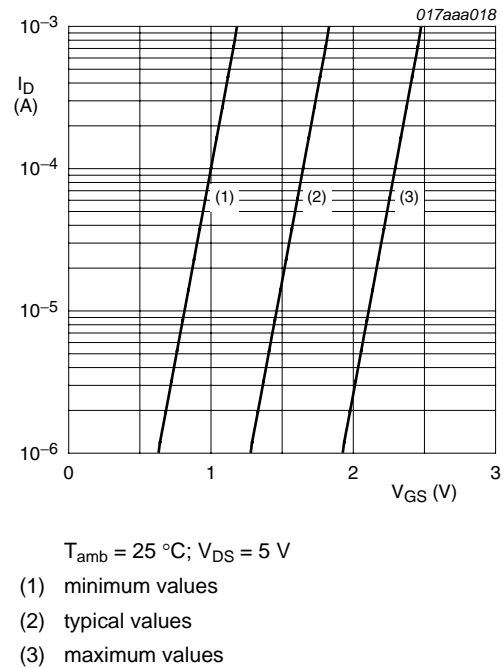


Fig 7. Per transistor: Sub-threshold drain current as a function of gate-source voltage

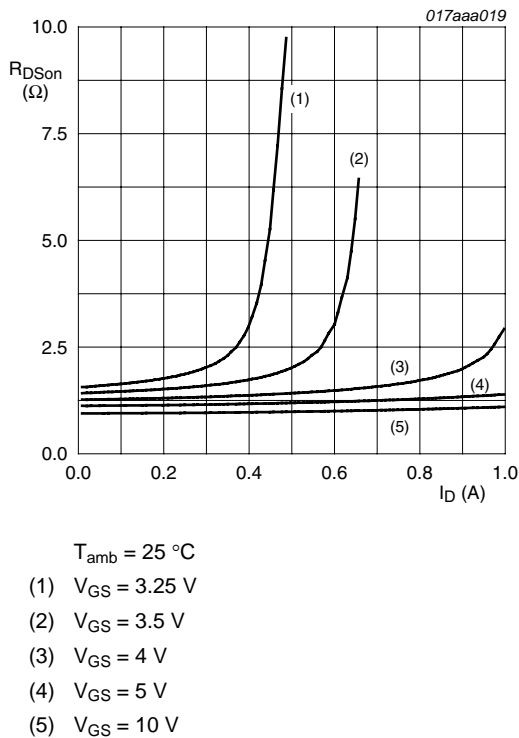


Fig 8. Per transistor: Drain-source on-state resistance as a function of drain current; typical values

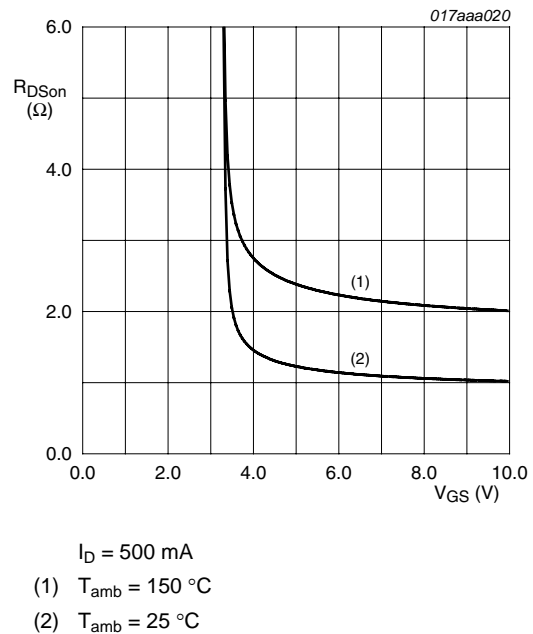
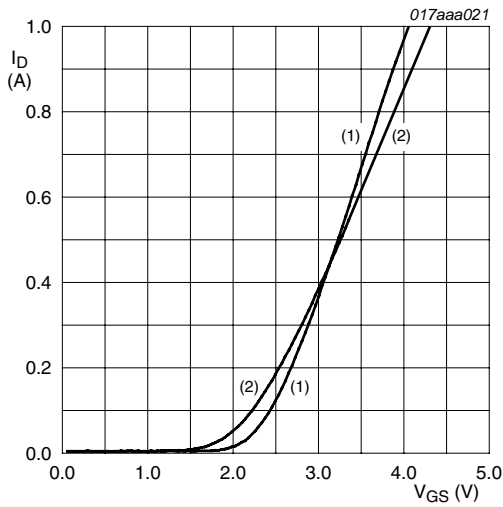
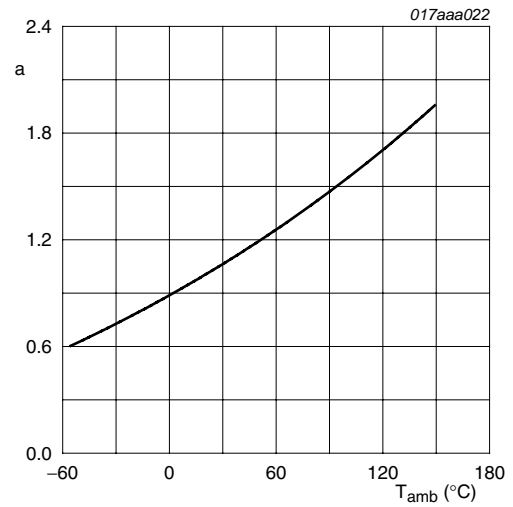


Fig 9. Per transistor: Drain-source on-state resistance as a function of gate-source voltage; typical values



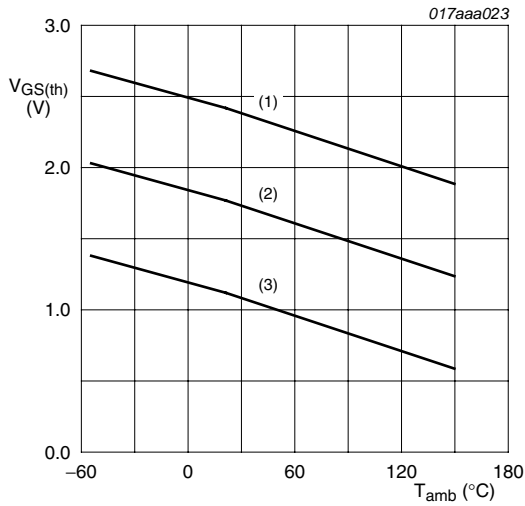
$V_{DS} > I_D \times R_{DS(on)}$
 (1) $T_{amb} = 25\text{ °C}$
 (2) $T_{amb} = 150\text{ °C}$

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



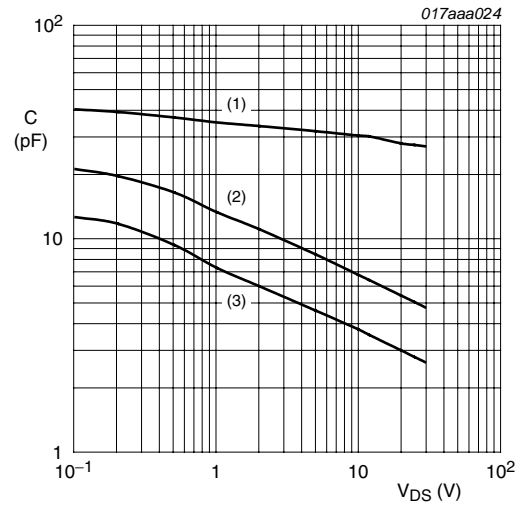
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ C)}}$$

Fig 11. Per transistor: Normalized drain-source on-state resistance as a function of ambient temperature; typical values



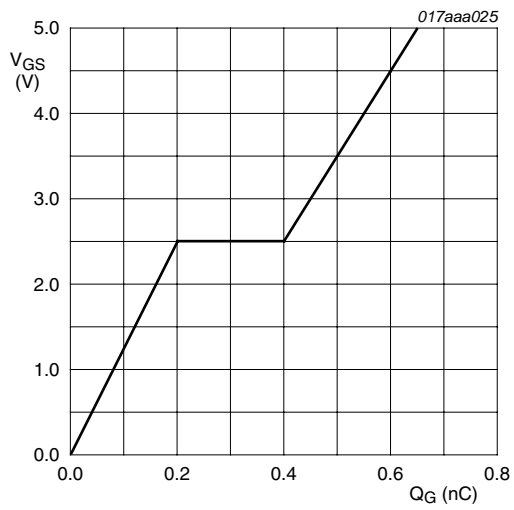
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$
 (1) maximum values
 (2) typical values
 (3) minimum values

Fig 12. Per transistor: Gate-source threshold voltage as a function of ambient temperature



$f = 1\text{ MHz}; V_{GS} = 0\text{ V}$
 (1) C_{iss}
 (2) C_{oss}
 (3) C_{rss}

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



$I_D = 300 \text{ mA}$; $V_{DS} = 30 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$

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

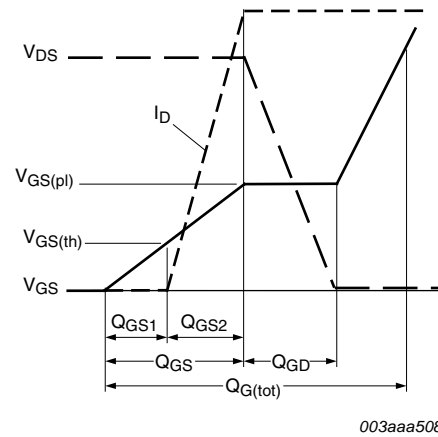
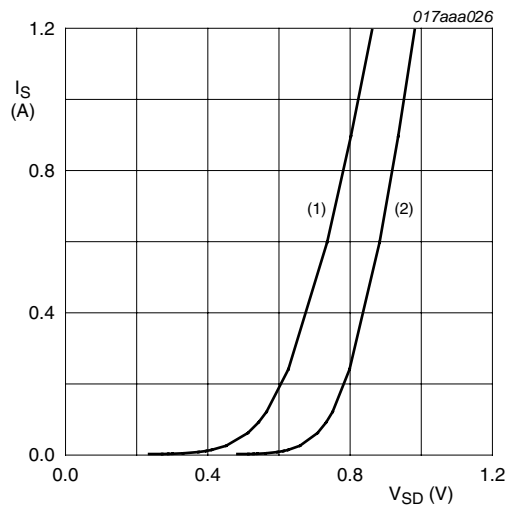


Fig 15. Per transistor: Gate charge waveform definitions

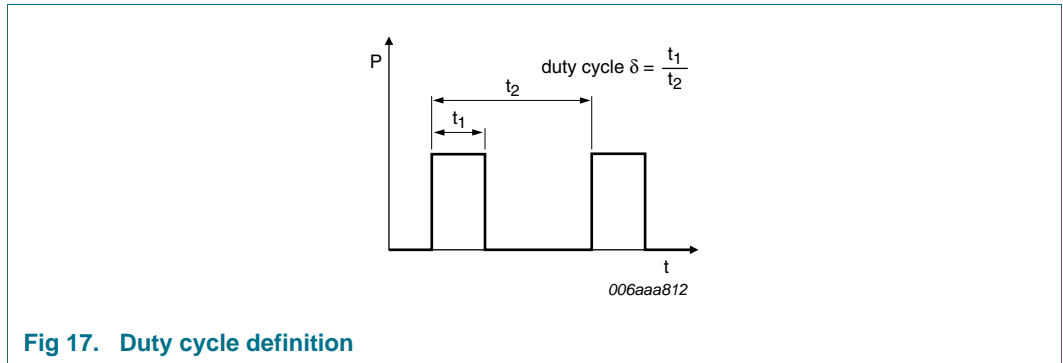


$V_{GS} = 0 \text{ V}$

- (1) $T_{amb} = 150 \text{ }^\circ\text{C}$
- (2) $T_{amb} = 25 \text{ }^\circ\text{C}$

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

8. Test information



8.1 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.

9. Package outline

Plastic surface-mounted package; 6 leads

SOT363

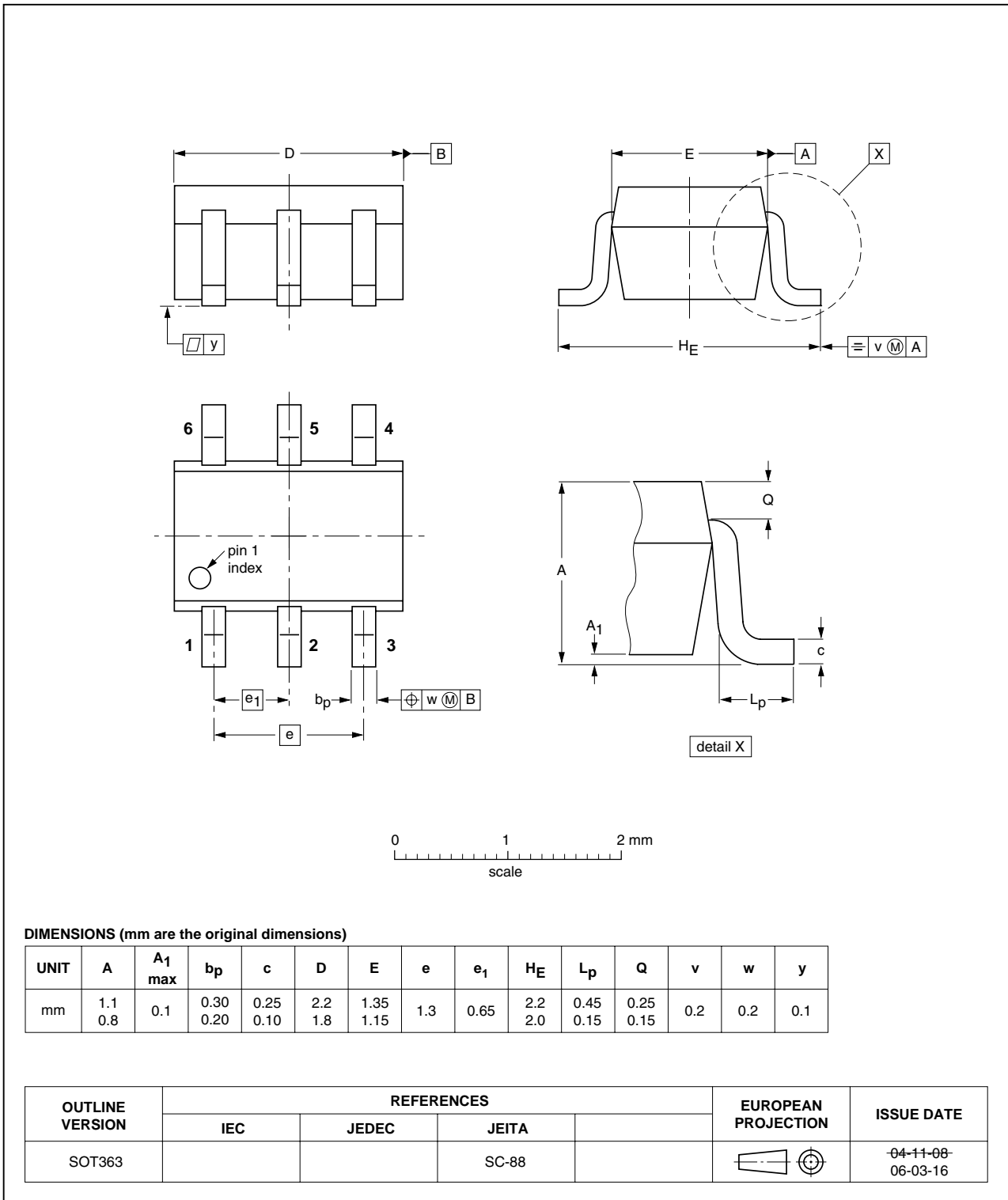


Fig 18. Package outline SOT363 (SC-88)

10. Soldering

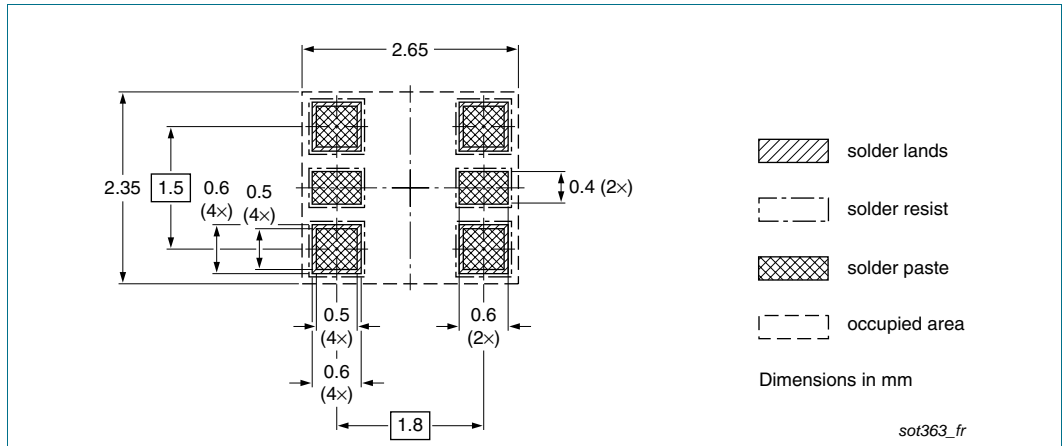


Fig 19. Reflow soldering footprint SOT363 (SC-88)

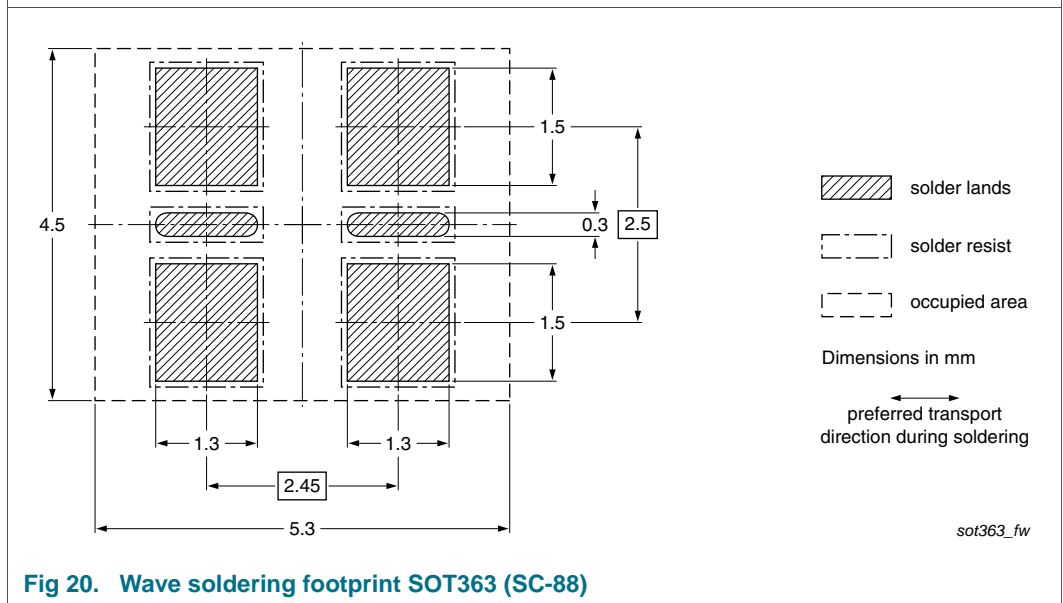


Fig 20. Wave soldering footprint SOT363 (SC-88)

11. Revision history

Table 8. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--------------|--------------|--------------------|---------------|------------|
| 2N7002PS v.1 | 20100701 | Product data sheet | - | - |

12. Legal information

12.1 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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