



**THE DATASHEET OF
2N7002BKMB**





2N7002BKMB

60 V, single N-channel Trench MOSFET

Rev. 2 — 13 June 2012

Product data sheet

1. Product profile

1.1 General description

N-channel enhancement mode Field-Effect Transistor (FET) in a leadless ultra small DFN1006B-3 (SOT883B) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

1.2 Features and benefits

- Very fast switching
- Trench MOSFET technology
- ESD protection up to 2 kV
- Logic-level compatible
- Ultra thin package profile with 0.37 mm height

1.3 Applications

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

1.4 Quick reference data

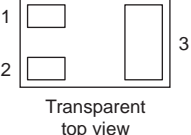
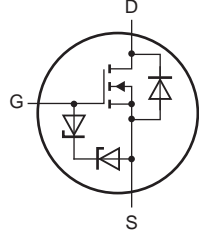
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|---|---------------------|-----|-----|----------|
| 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] | - | 450 | mA |
| Static characteristics | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 450\text{ mA}; T_j = 25\text{ °C}$ | - | 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 information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-------------|---|--|
| 1 | G | gate |  <p>Transparent top view</p> <p>SOT883B (DFN1006B-3)</p> |  <p>017aaa255</p> |
| 2 | S | source | | |
| 3 | D | drain | | |

3. Ordering information

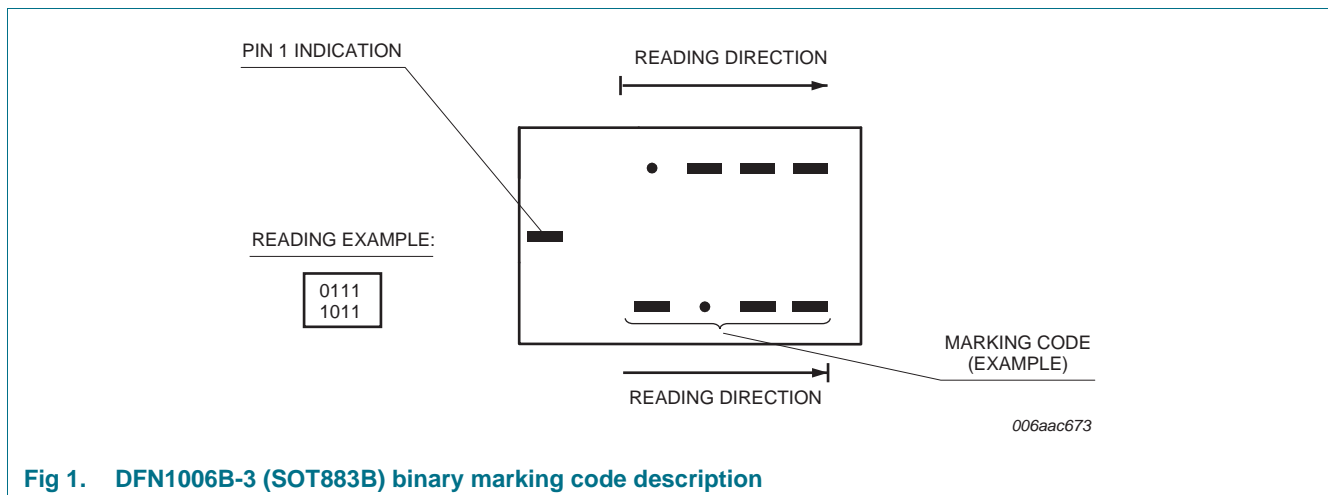
Table 3. Ordering information

| Type number | Package | | |
|-------------|------------|--|---------|
| | Name | Description | Version |
| 2N7002BKMB | DFN1006B-3 | Leadless ultra small plastic package; 3 solder lands; body 1.0 x 0.6 x 0.37 mm | SOT883B |

4. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| 2N7002BKMB | 0000 0001 |



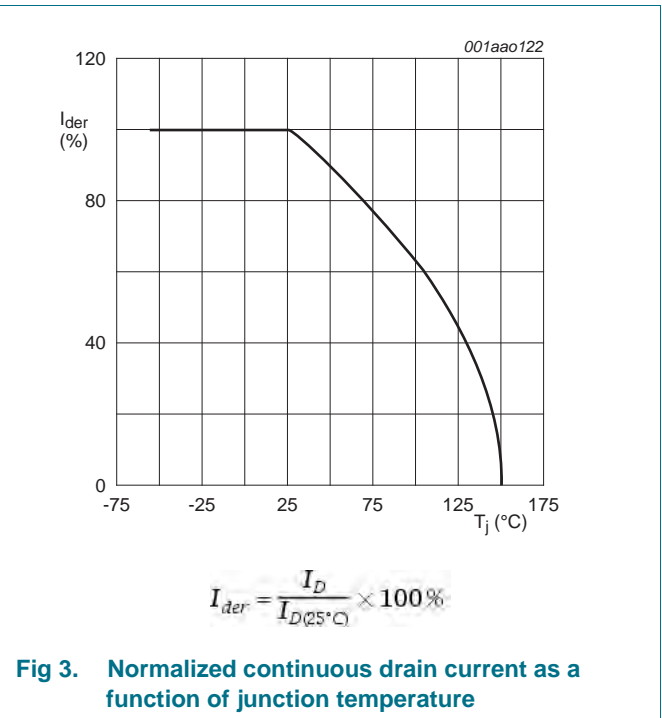
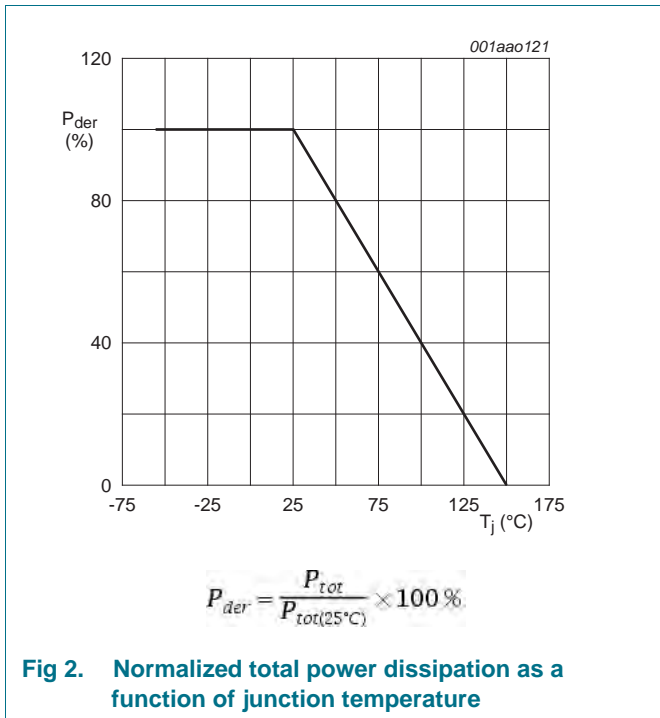
5. Limiting values

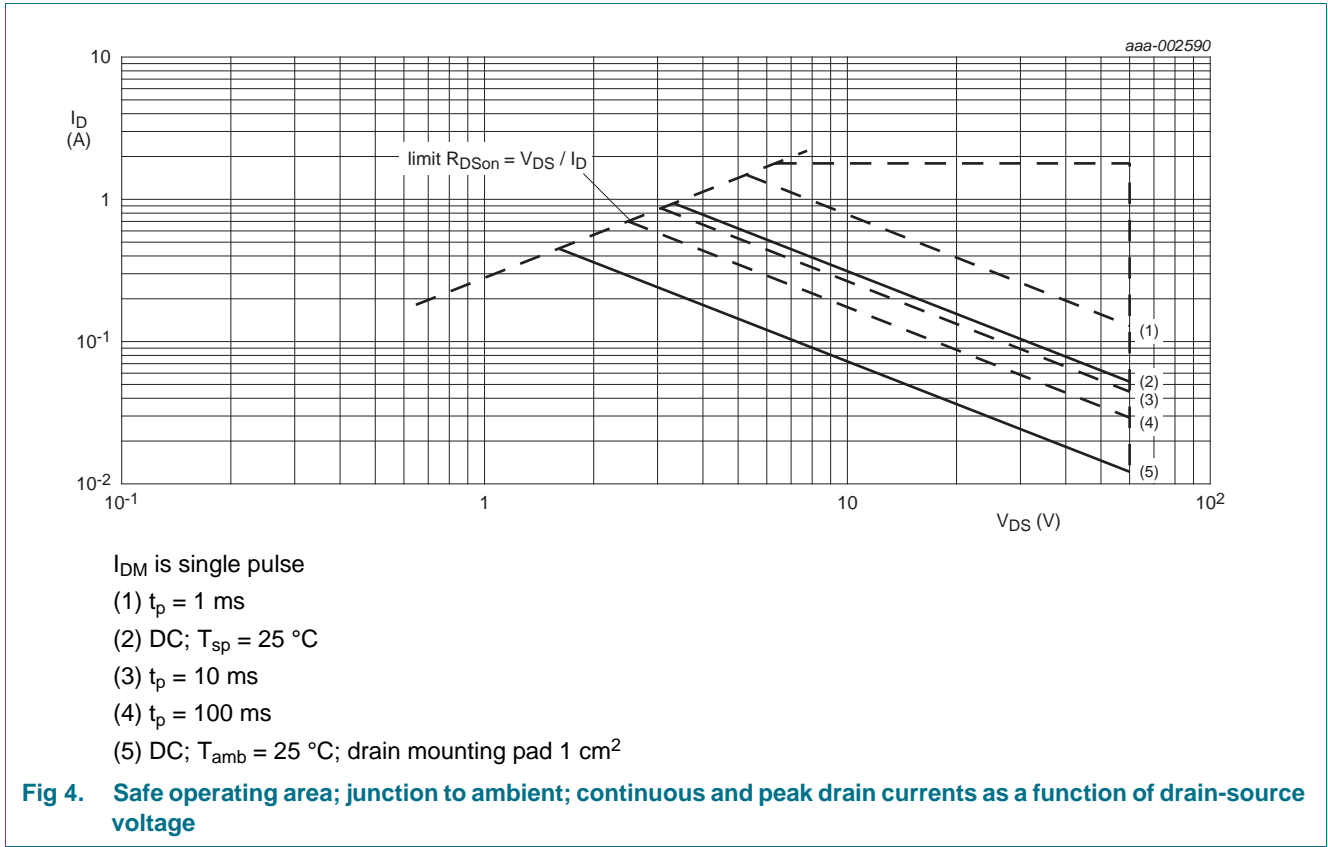
Table 5. Limiting values

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 | - | 60 | V | |
| V _{GS} | gate-source voltage | | -20 | 20 | V | |
| I _D | drain current | V _{GS} = 10 V; T _{amb} = 25 °C | [1] | - | 450 | mA |
| | | V _{GS} = 10 V; T _{amb} = 100 °C | [1] | - | 220 | mA |
| I _{DM} | peak drain current | T _{amb} = 25 °C; single pulse; t _p ≤ 10 μs | - | 1.8 | A | |
| P _{tot} | total power dissipation | T _{amb} = 25 °C | [2] | - | 360 | mW |
| | | | [1] | - | 715 | mW |
| | | T _{sp} = 25 °C | | - | 2700 | 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] | - | 450 | mA |
| 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 1 cm².
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [3] Measured between all pins.





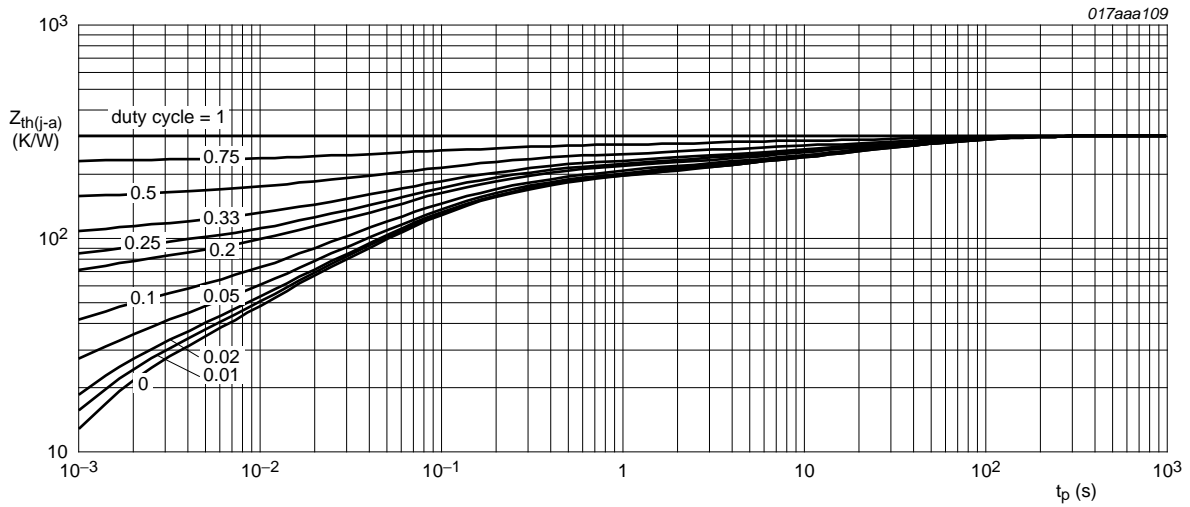
6. Thermal characteristics

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] | - | 305 | 350 | K/W |
| | | | [2] | - | 150 | 175 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | - | - | 40 | K/W | |

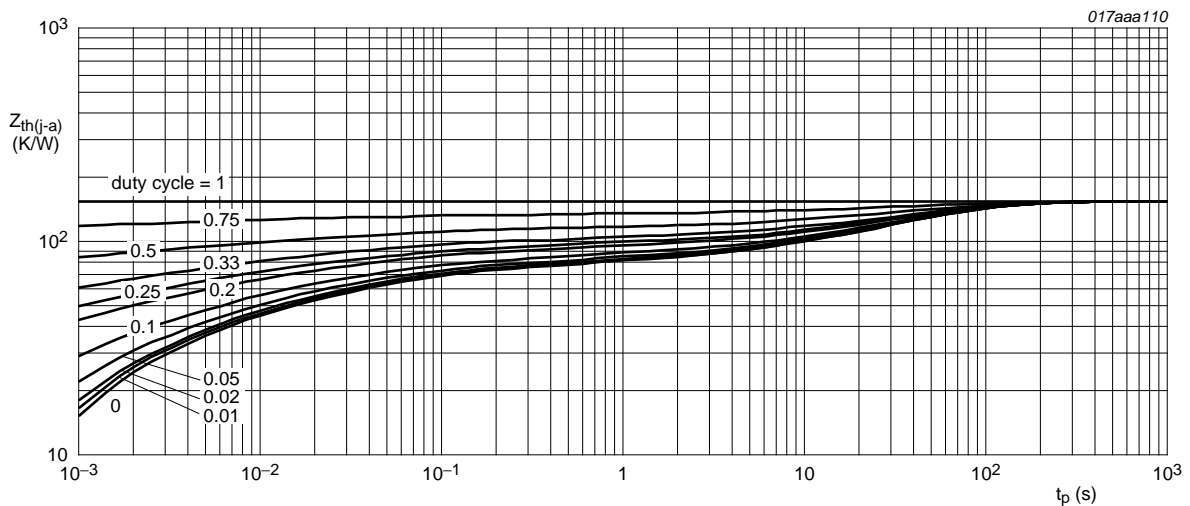
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

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



FR4 PCB, standard footprint

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



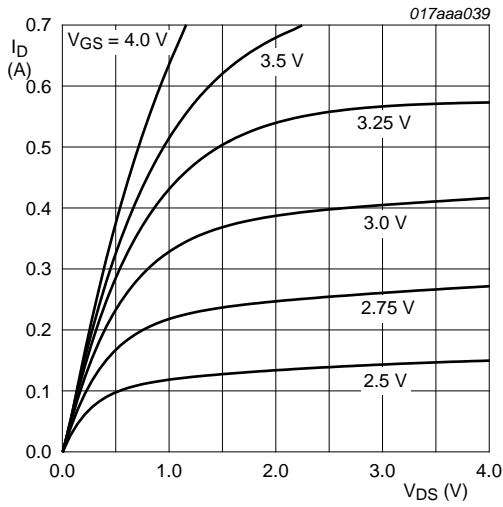
FR4 PCB, mounting pad for drain 1 cm²

Fig 6. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

7. Characteristics

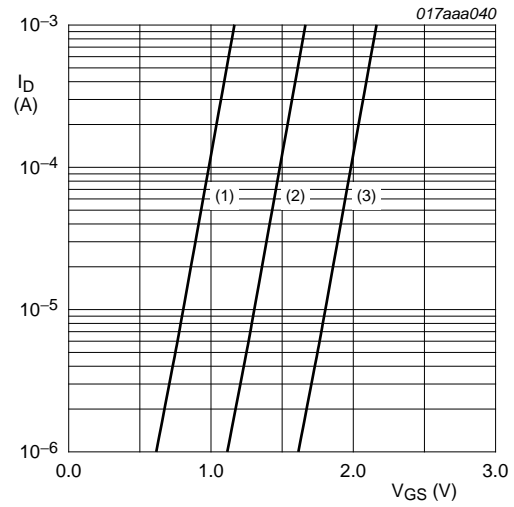
Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|------|------|-----|----------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 10 \mu A$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | 60 | - | - | V |
| V_{GSth} | gate-source threshold voltage | $I_D = 250 \mu A$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ C$ | 1.1 | 1.6 | 2.1 | V |
| I_{DSS} | drain leakage current | $V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 1 | μA |
| | | $V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 150 \text{ }^\circ C$ | - | - | 10 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = -20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 10 | μA |
| | | $V_{GS} = 20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | - | 10 | μA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 V$; $I_D = 450 \text{ mA}$; $T_j = 25 \text{ }^\circ C$ | - | 1 | 1.6 | Ω |
| | | $V_{GS} = 10 V$; $I_D = 450 \text{ mA}$; $T_j = 150 \text{ }^\circ C$ | - | 2.2 | 3.5 | Ω |
| | | $V_{GS} = 5 V$; $I_D = 50 \text{ mA}$; $T_j = 25 \text{ }^\circ C$ | - | 1.3 | 2 | Ω |
| g_{fs} | forward transconductance | $V_{DS} = 10 V$; $I_D = 200 \text{ mA}$; $T_j = 25 \text{ }^\circ C$ | - | 550 | - | mS |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS} = 30 V$; $I_D = 300 \text{ mA}$; $V_{GS} = 4.5 V$; $T_j = 25 \text{ }^\circ C$ | - | 0.5 | 0.6 | nC |
| Q_{GS} | gate-source charge | | - | 0.2 | - | nC |
| Q_{GD} | gate-drain charge | | - | 0.1 | - | nC |
| C_{iss} | input capacitance | $V_{DS} = 10 V$; $f = 1 \text{ MHz}$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | - | 33 | 50 | pF |
| C_{oss} | output capacitance | | - | 7 | - | pF |
| C_{rss} | reverse transfer capacitance | | - | 4 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 50 V$; $R_L = 250 \Omega$; $V_{GS} = 10 V$; $R_{G(ext)} = 6 \Omega$; $T_j = 25 \text{ }^\circ C$ | - | 5 | 10 | ns |
| t_r | rise time | | - | 6 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 12 | 24 | ns |
| t_f | fall time | | - | 7 | - | ns |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 115 \text{ mA}$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$ | 0.47 | 0.75 | 1.1 | V |



$T_j = 25\text{ }^\circ\text{C}$

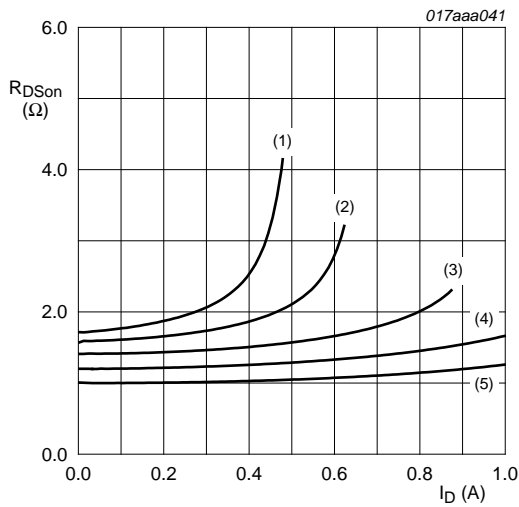
Fig 7. Output characteristics: drain current as a function of drain-source voltage; typical values



$T_j = 25\text{ }^\circ\text{C}; V_{DS} = 5\text{ V}$

- (1) minimum values
- (2) typical values
- (3) maximum values

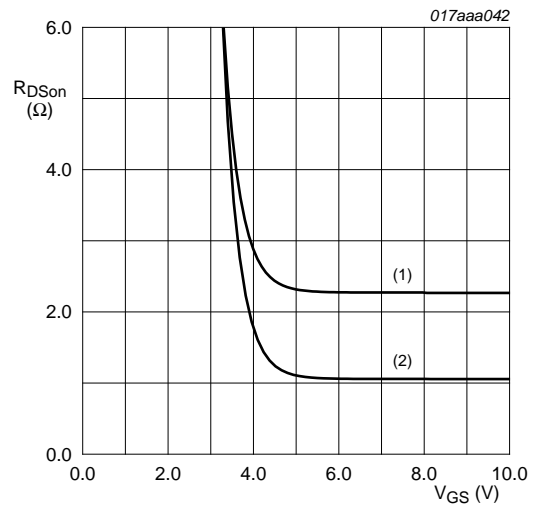
Fig 8. Sub-threshold drain current as a function of gate-source voltage



$T_j = 25\text{ }^\circ\text{C}$

- (1) $V_{GS} = 3.25\text{ V}$
- (2) $V_{GS} = 3.5\text{ V}$
- (3) $V_{GS} = 4\text{ V}$
- (4) $V_{GS} = 5\text{ V}$
- (5) $V_{GS} = 10\text{ V}$

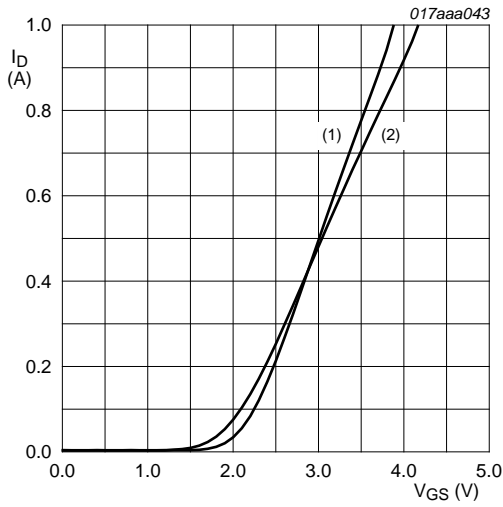
Fig 9. Drain-source on-state resistance as a function of drain current; typical values



$I_D = 500\text{ mA}$

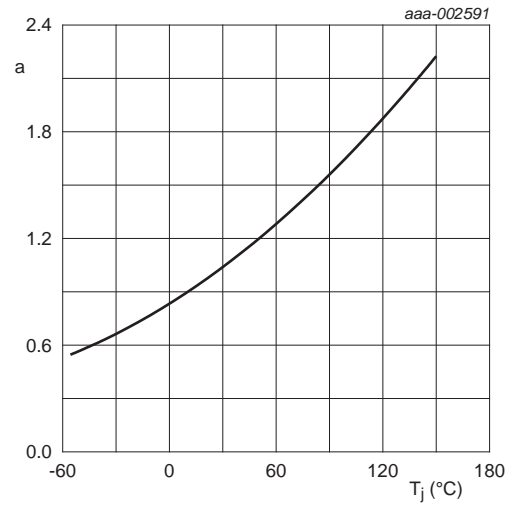
- (1) $T_j = 150\text{ }^\circ\text{C}$
- (2) $T_j = 25\text{ }^\circ\text{C}$

Fig 10. Drain-source on-state resistance as a function of gate-source voltage; typical values



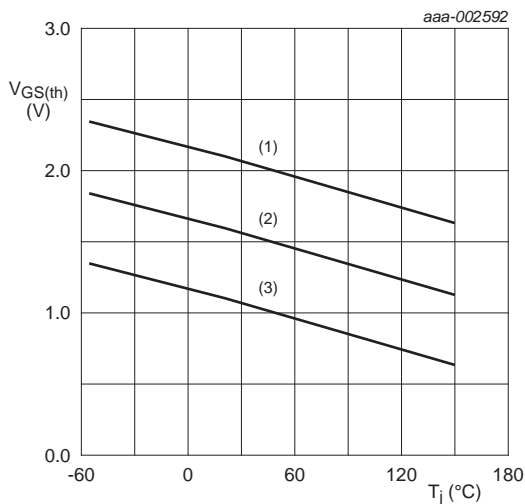
$V_{DS} > I_D \times R_{DS(on)}$
 (1) $T_j = 25\text{ °C}$
 (2) $T_j = 150\text{ °C}$

Fig 11. Transfer characteristics: drain current as a function of gate-source voltage; typical values



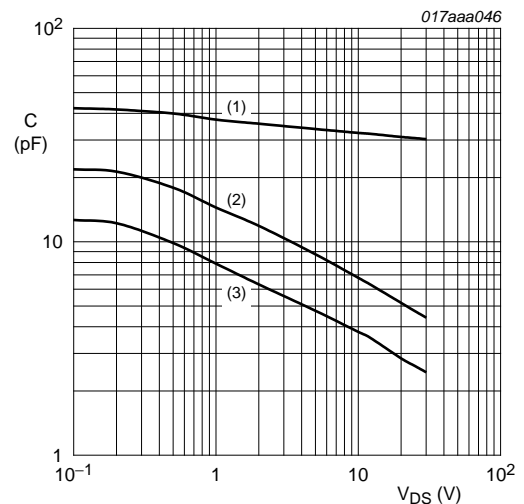
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25\text{°C})}}$$

Fig 12. Normalized drain-source on-state resistance as a function of junction temperature; typical values



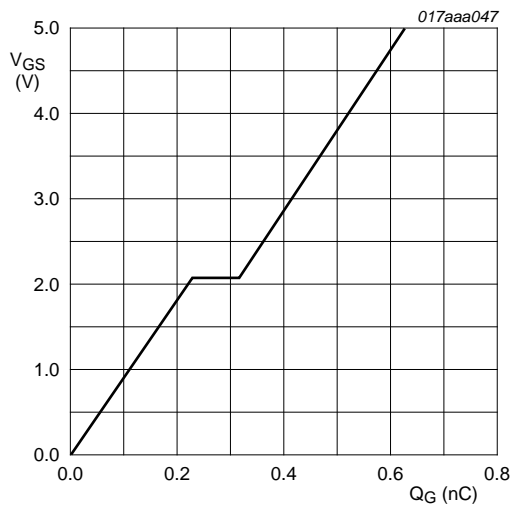
$I_D = 0.25\text{ A}; V_{DS} = V_{GS}$
 (1) maximum values
 (2) typical values
 (3) minimum values

Fig 13. Gate-source threshold voltage as a function of junction temperature



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

Fig 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



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

Fig 15. Gate-source voltage as a function of gate charge; typical values

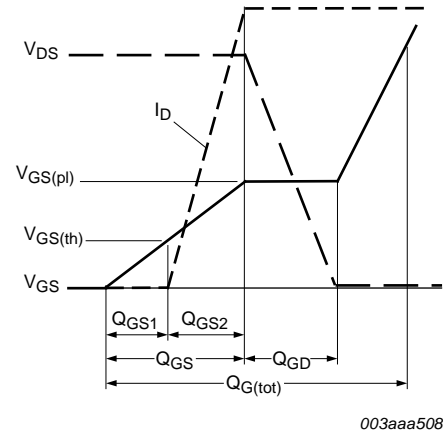
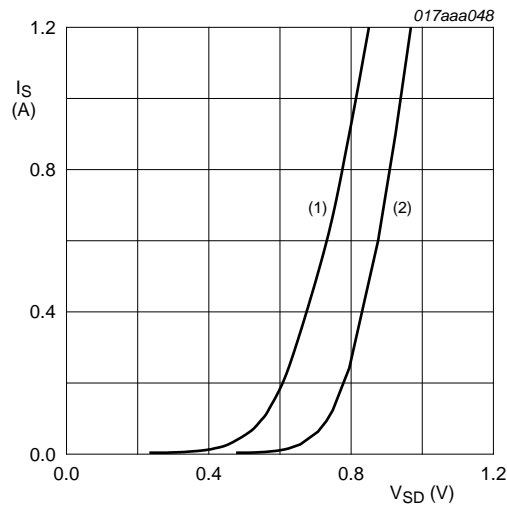


Fig 16. Gate charge waveform definitions



$V_{GS} = 0 \text{ V}$
 (1) $T_j = 150 \text{ }^\circ\text{C}$
 (2) $T_j = 25 \text{ }^\circ\text{C}$

Fig 17. Source current as a function of source-drain voltage; typical values

8. Test information

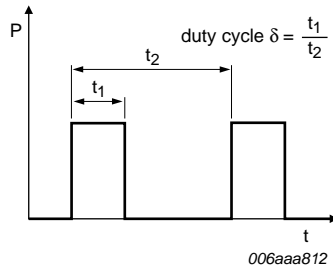


Fig 18. Duty cycle definition

9. Package outline

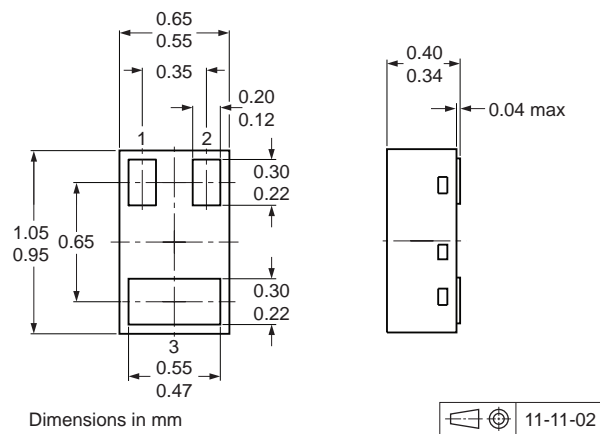
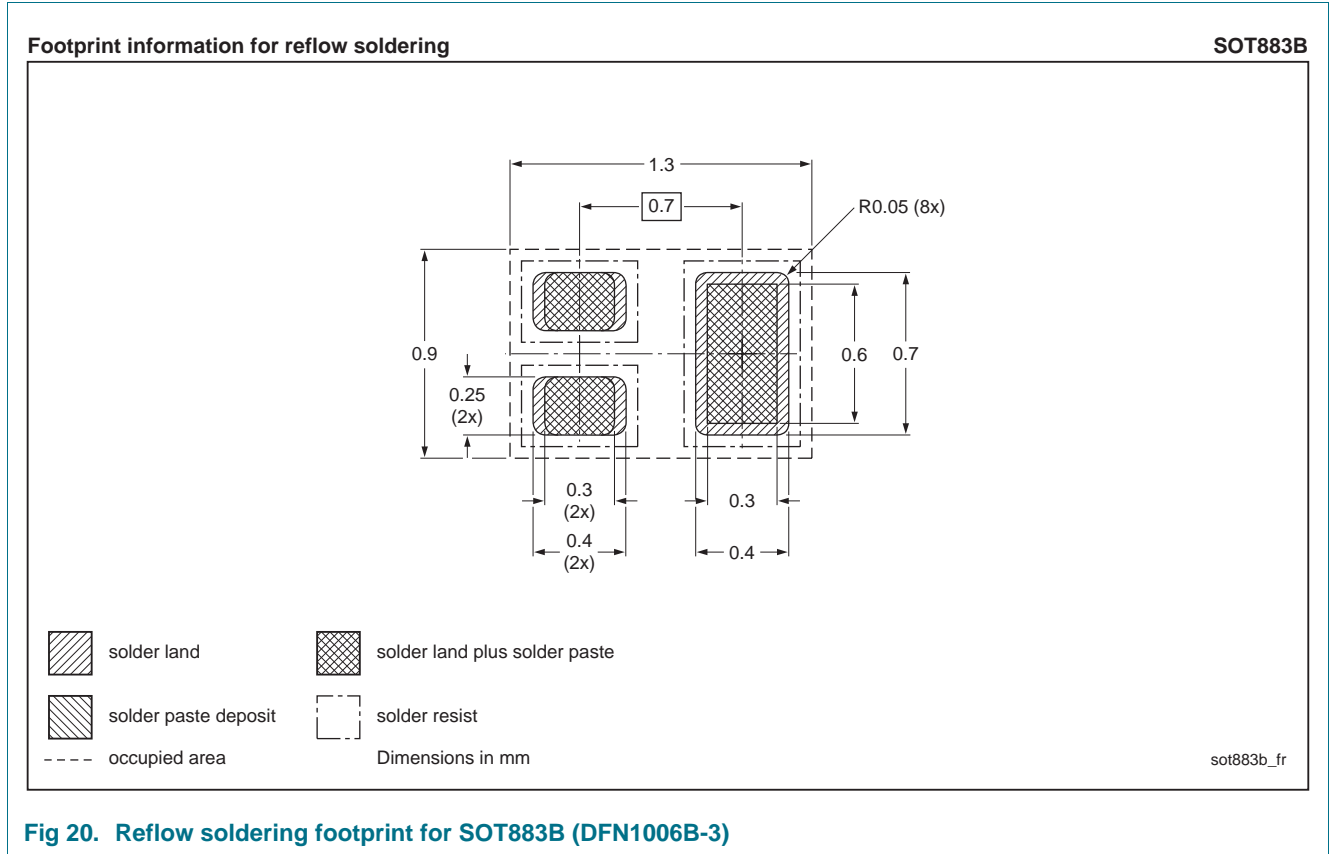


Fig 19. Package outline SOT883B (DFN1006B-3)

10. Soldering



11. Revision history

Table 8. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|--------------------|---------------|----------------|
| 2N7002BKMB v.2 | 20120613 | Product data sheet | - | 2N7002BKMB v.1 |
| Modifications: | • 7 "Characteristics" : $R_{DS(on)}$ condition corrected | | | |
| 2N7002BKMB v.1 | 20120511 | 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. |
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