



# NX138BKS

60 V, dual N-channel Trench MOSFET

15 June 2016

Product data sheet

## 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.

## 2. Features and benefits

- Low threshold voltage
- Very fast switching
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 2 kV HBM

## 3. Applications

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

## 4. Quick reference data

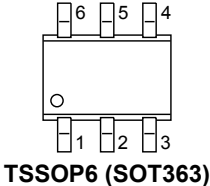
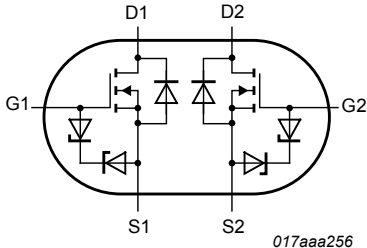
Table 1. Quick reference data

| Symbol                                         | Parameter                        | Conditions                                                      | Min | Typ | Max | Unit     |
|------------------------------------------------|----------------------------------|-----------------------------------------------------------------|-----|-----|-----|----------|
| <b>Per transistor</b>                          |                                  |                                                                 |     |     |     |          |
| $V_{DS}$                                       | 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] | -   | 210 | mA       |
| <b>Static characteristics (per transistor)</b> |                                  |                                                                 |     |     |     |          |
| $R_{DS(on)}$                                   | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 200\text{ mA}; T_j = 25\text{ °C}$ | -   | 2.1 | 3.5 | $\Omega$ |

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

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                                       | Graphic symbol                                                                                       |
|-----|--------|-------------|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 1   | S1     | source TR1  |  <p>TSSOP6 (SOT363)</p> |  <p>017aaa256</p> |
| 2   | G1     | gate TR1    |                                                                                                          |                                                                                                      |
| 3   | D2     | drain TR2   |                                                                                                          |                                                                                                      |
| 4   | S2     | source TR2  |                                                                                                          |                                                                                                      |
| 5   | G2     | gate TR2    |                                                                                                          |                                                                                                      |
| 6   | D1     | drain TR1   |                                                                                                          |                                                                                                      |

6. Ordering information

Table 3. Ordering information

| Type number | Package |                                          |         |
|-------------|---------|------------------------------------------|---------|
|             | Name    | Description                              | Version |
| NX138BKS    | TSSOP6  | plastic surface-mounted package; 6 leads | SOT363  |

## 7. Limiting values

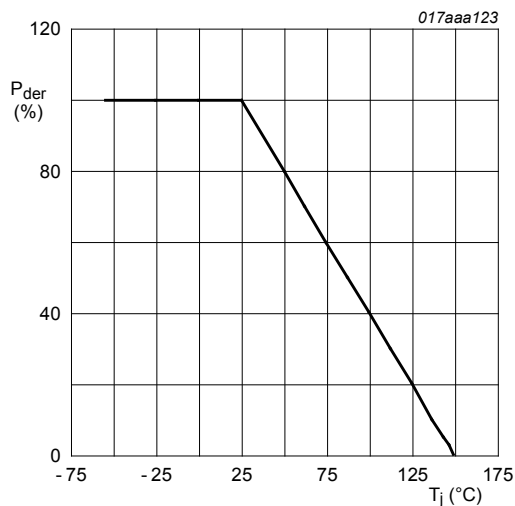
**Table 4. Limiting values**

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

| Symbol             | Parameter               | Conditions                                                     |     | Min | Max | Unit |
|--------------------|-------------------------|----------------------------------------------------------------|-----|-----|-----|------|
| Per transistor     |                         |                                                                |     |     |     |      |
| V <sub>DS</sub>    | drain-source voltage    | T <sub>J</sub> = 25 °C                                         |     | -   | 60  | 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] | -   | 210 | mA   |
|                    |                         | V <sub>GS</sub> = 10 V; T <sub>amb</sub> = 100 °C              | [1] | -   | 135 | mA   |
|                    |                         | V <sub>GS</sub> = 10 V; T <sub>sp</sub> = 25 °C                |     | -   | 330 | mA   |
| I <sub>DM</sub>    | peak drain current      | T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs |     | -   | 855 | mA   |
| P <sub>tot</sub>   | total power dissipation | T <sub>amb</sub> = 25 °C                                       | [2] | -   | 285 | mW   |
|                    |                         |                                                                | [1] | -   | 320 | mW   |
|                    |                         | T <sub>sp</sub> = 25 °C                                        |     | -   | 860 | mW   |
| Per device         |                         |                                                                |     |     |     |      |
| T <sub>j</sub>     | junction temperature    |                                                                |     | -55 | 150 | °C   |
| T <sub>amb</sub>   | ambient temperature     |                                                                |     | -55 | 150 | °C   |
| T <sub>stg</sub>   | storage temperature     |                                                                |     | -65 | 150 | °C   |
| Source-drain diode |                         |                                                                |     |     |     |      |
| I <sub>S</sub>     | source current          | T <sub>amb</sub> = 25 °C                                       | [1] | -   | 170 | mA   |

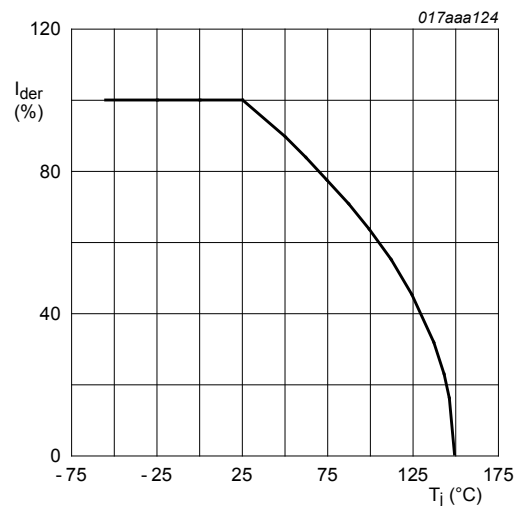
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 1 cm<sup>2</sup>.

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



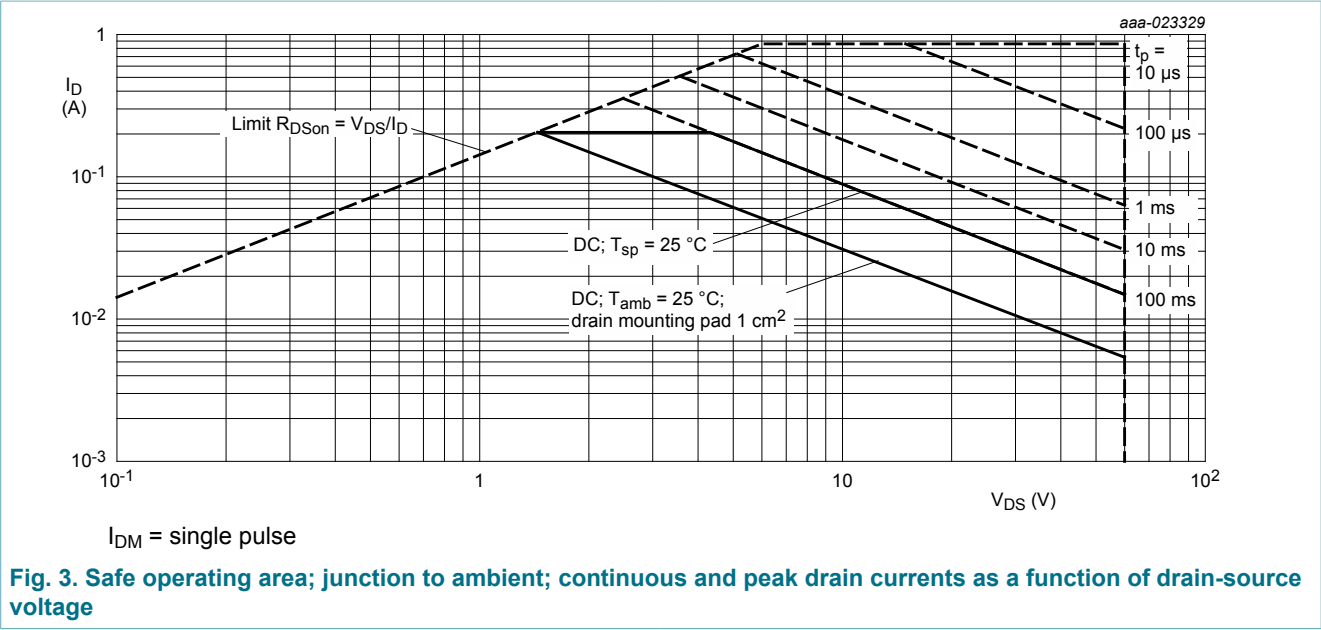
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ\text{C})}} \times 100 \%$$

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



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

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

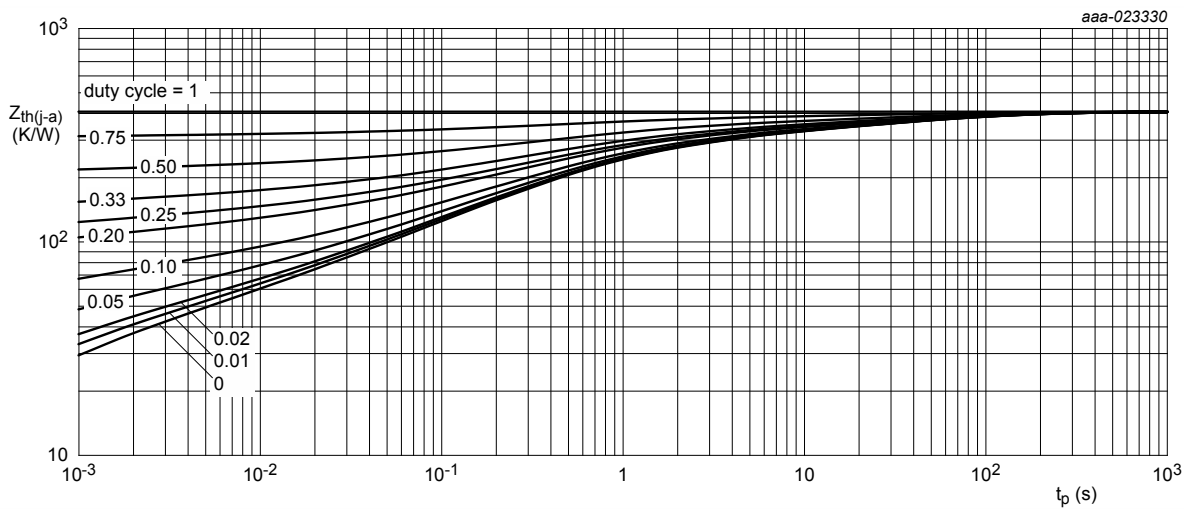


8. Thermal characteristics

Table 5. Thermal characteristics

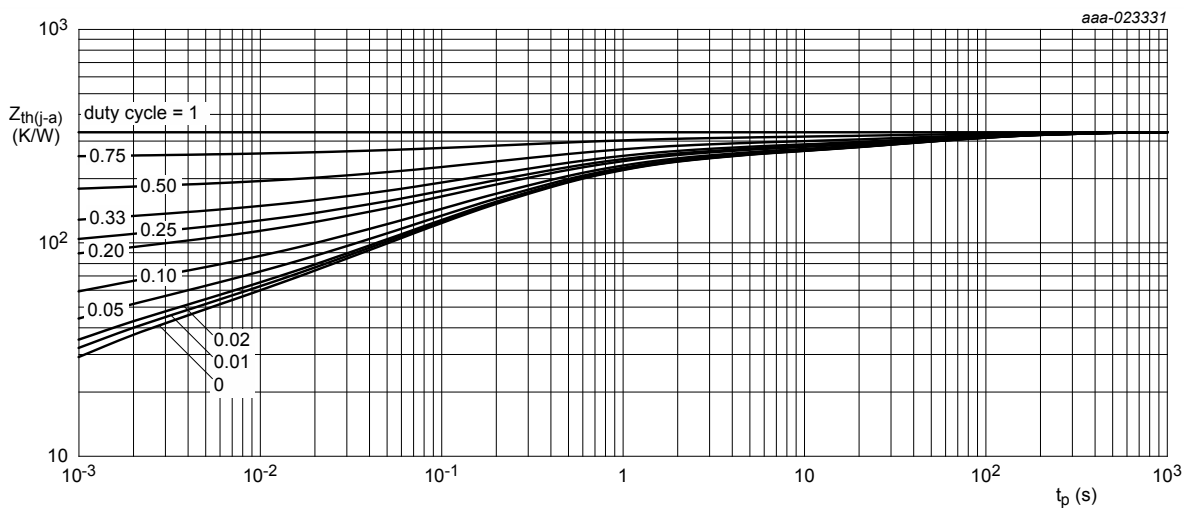
| Symbol                | Parameter                                        | Conditions  |     | Min | Typ | Max | Unit |
|-----------------------|--------------------------------------------------|-------------|-----|-----|-----|-----|------|
| Per transistor        |                                                  |             |     |     |     |     |      |
| R <sub>th(j-a)</sub>  | thermal resistance from junction to ambient      | in free air | [1] | -   | 380 | 440 | K/W  |
|                       |                                                  |             | [2] | -   | 340 | 390 | K/W  |
| R <sub>th(j-sp)</sub> | thermal resistance from junction to solder point |             |     | -   | 125 | 145 | 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 1 cm<sup>2</sup>.



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 1 cm<sup>2</sup>

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

## 9. Characteristics

Table 6. Characteristics

| Symbol                                   | Parameter                        | Conditions                                                                                                                 |  | Min | Typ  | Max  | Unit |
|------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------|--|-----|------|------|------|
| Static characteristics (per transistor)  |                                  |                                                                                                                            |  |     |      |      |      |
| 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                                                     |  | 60  | -    | -    | 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                                         |  | 0.5 | 1    | 1.5  | V    |
| I <sub>DSS</sub>                         | drain leakage current            | V <sub>DS</sub> = 60 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                                                      |  | -   | -    | 1    | μA   |
|                                          |                                  | V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                     |  | -   | -    | -1   | μA   |
|                                          |                                  | V <sub>GS</sub> = 5 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                       |  | -   | -    | 0.3  | μA   |
|                                          |                                  | V <sub>GS</sub> = -5 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                      |  | -   | -    | -0.3 | μA   |
| R <sub>DSon</sub>                        | drain-source on-state resistance | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 200 mA; T <sub>j</sub> = 25 °C                                                    |  | -   | 2.1  | 3.5  | Ω    |
|                                          |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 200 mA; T <sub>j</sub> = 150 °C                                                   |  | -   | 4.3  | 7.2  | Ω    |
|                                          |                                  | V <sub>GS</sub> = 5 V; I <sub>D</sub> = 170 mA; T <sub>j</sub> = 25 °C                                                     |  | -   | 2.2  | 3.8  | Ω    |
|                                          |                                  | V <sub>GS</sub> = 2.5 V; I <sub>D</sub> = 75 mA; T <sub>j</sub> = 25 °C                                                    |  | -   | 2.6  | 5    | Ω    |
| g <sub>fs</sub>                          | forward transconductance         | V <sub>DS</sub> = 10 V; I <sub>D</sub> = 200 mA; T <sub>j</sub> = 25 °C                                                    |  | -   | 0.7  | -    | S    |
| Dynamic characteristics (per transistor) |                                  |                                                                                                                            |  |     |      |      |      |
| Q <sub>G(tot)</sub>                      | total gate charge                | V <sub>DS</sub> = 30 V; I <sub>D</sub> = 200 mA; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C                            |  | -   | 0.5  | 0.7  | nC   |
| Q <sub>GS</sub>                          | gate-source charge               |                                                                                                                            |  | -   | 0.12 | -    | nC   |
| Q <sub>GD</sub>                          | gate-drain charge                |                                                                                                                            |  | -   | 0.12 | -    | nC   |
| C <sub>iss</sub>                         | input capacitance                | V <sub>DS</sub> = 30 V; f = 1 MHz; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                           |  | -   | 20   | -    | pF   |
| C <sub>oss</sub>                         | output capacitance               |                                                                                                                            |  | -   | 3.1  | -    | pF   |
| C <sub>rss</sub>                         | reverse transfer capacitance     |                                                                                                                            |  | -   | 2    | -    | pF   |
| t <sub>d(on)</sub>                       | turn-on delay time               | V <sub>DS</sub> = 30 V; I <sub>D</sub> = 200 mA; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 6 Ω; T <sub>j</sub> = 25 °C |  | -   | 8    | -    | ns   |
| t <sub>r</sub>                           | rise time                        |                                                                                                                            |  | -   | 8    | -    | ns   |
| t <sub>d(off)</sub>                      | turn-off delay time              |                                                                                                                            |  | -   | 13   | -    | ns   |
| t <sub>f</sub>                           | fall time                        |                                                                                                                            |  | -   | 5    | -    | ns   |
| Source-drain diode (per transistor)      |                                  |                                                                                                                            |  |     |      |      |      |
| V <sub>SD</sub>                          | source-drain voltage             | I <sub>S</sub> = 200 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                     |  | -   | 0.9  | 1.2  | V    |

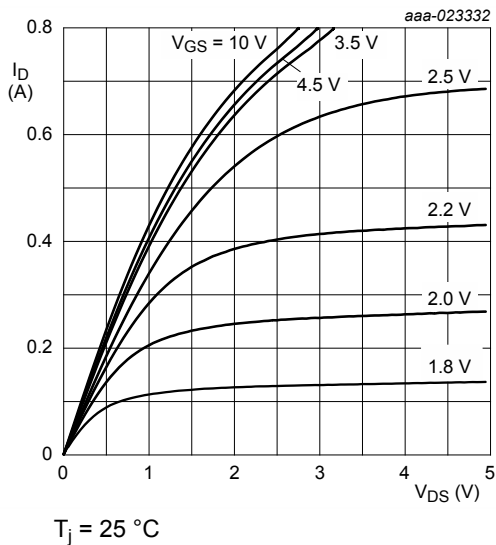


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

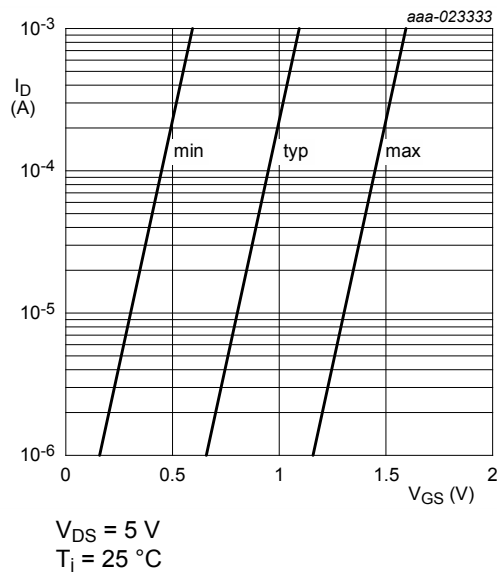


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

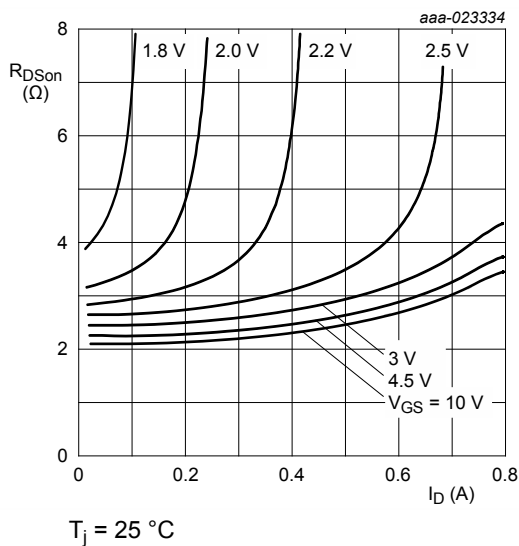


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

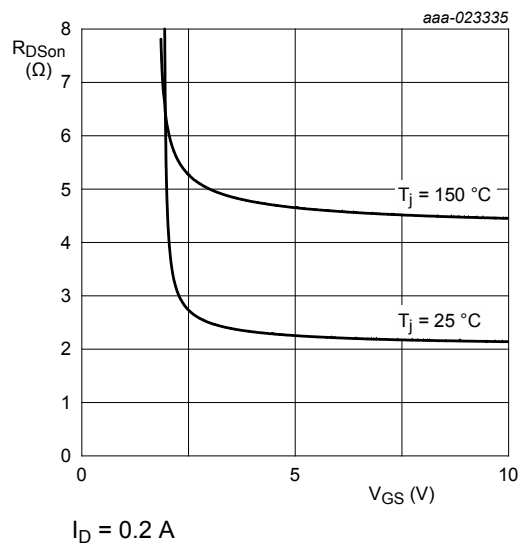


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

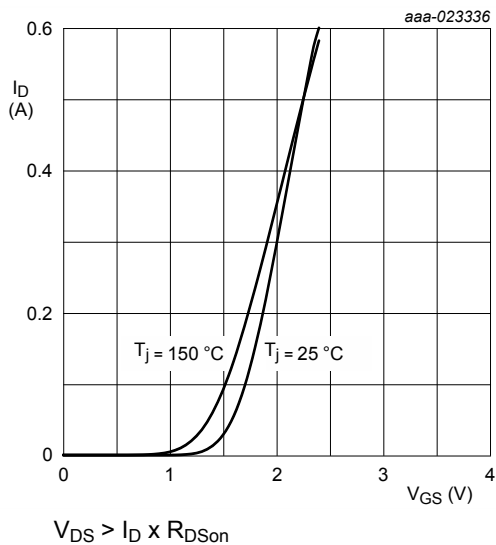


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

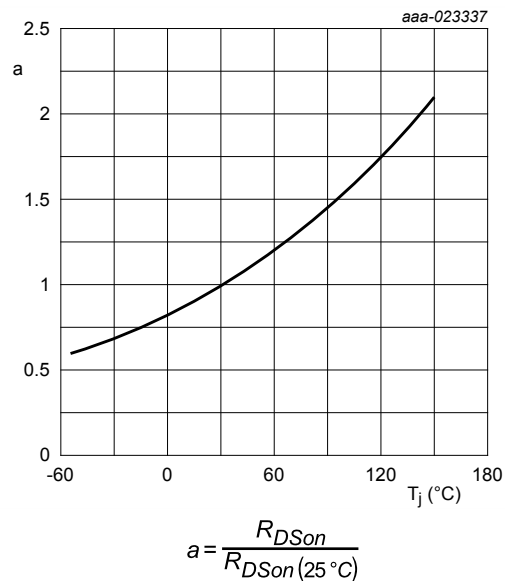


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

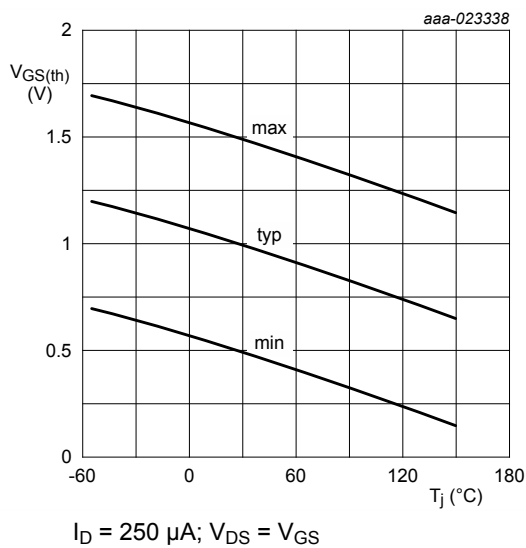


Fig. 12. Gate-source threshold voltage as a function of junction temperature

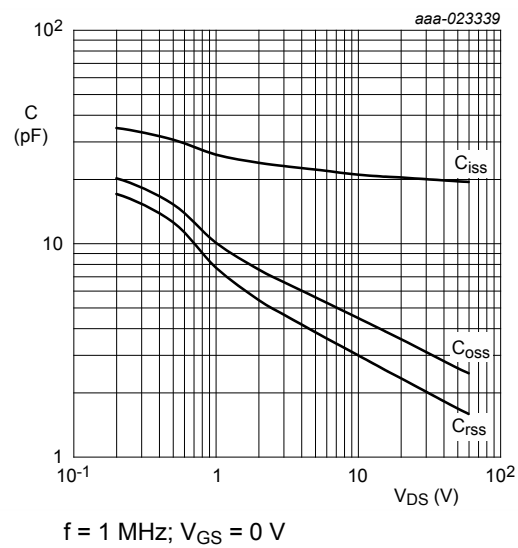


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

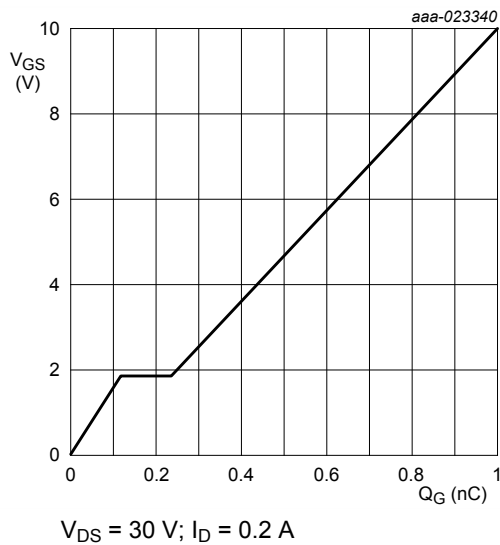


Fig. 14. Gate-source voltage as a function of gate charge; typical values

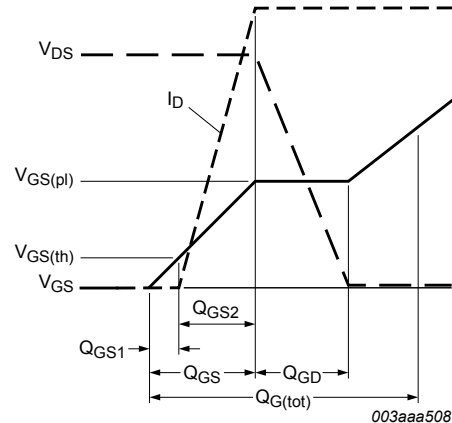


Fig. 15. MOSFET transistor: Gate charge waveform definitions

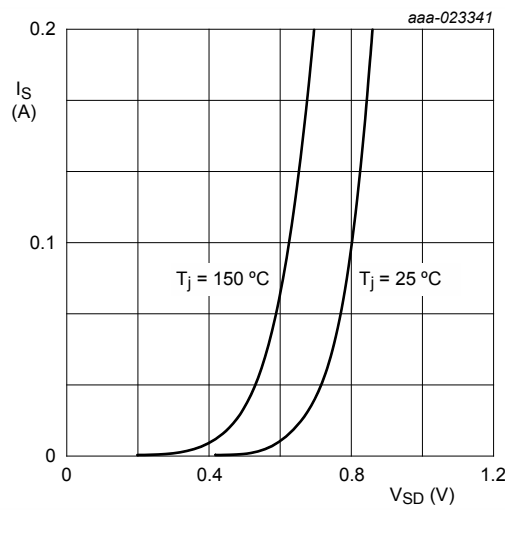


Fig. 16. Source current as a function of source-drain voltage; typical values

## 10. Test information

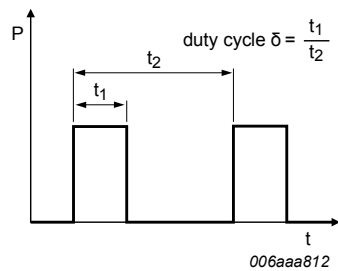


Fig. 17. Duty cycle definition

11. Package outline

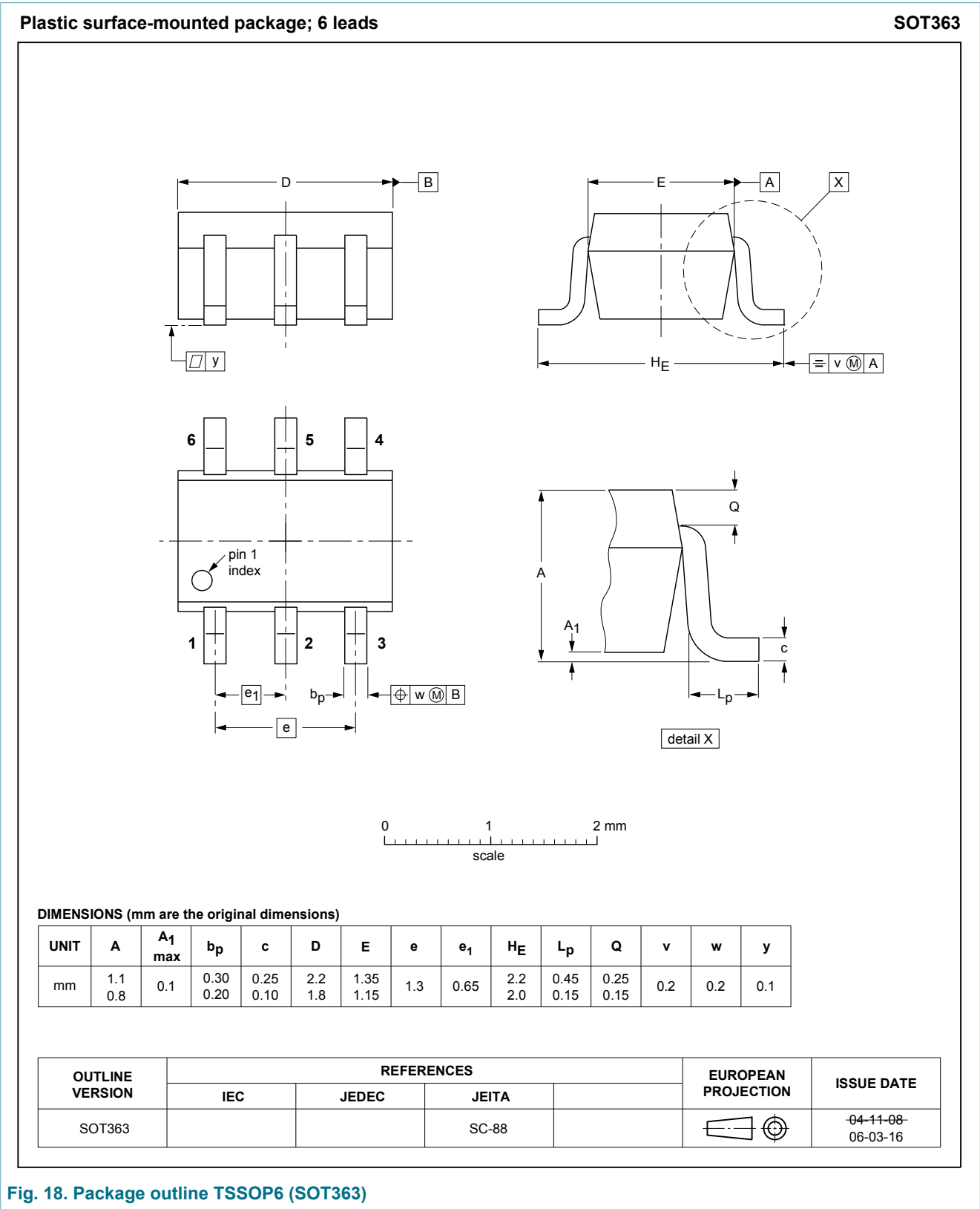


Fig. 18. Package outline TSSOP6 (SOT363)

12. Soldering

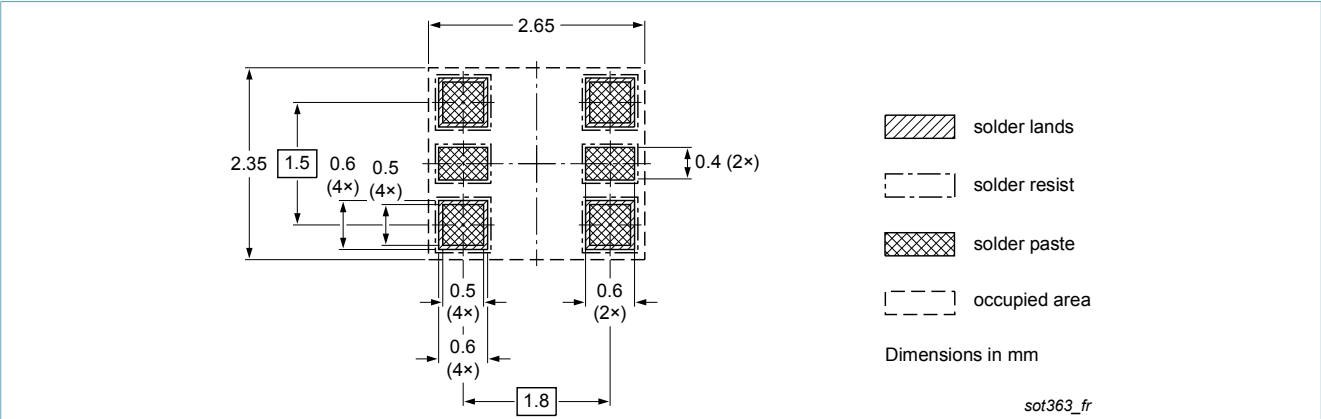


Fig. 19. Reflow soldering footprint for TSSOP6 (SOT363)

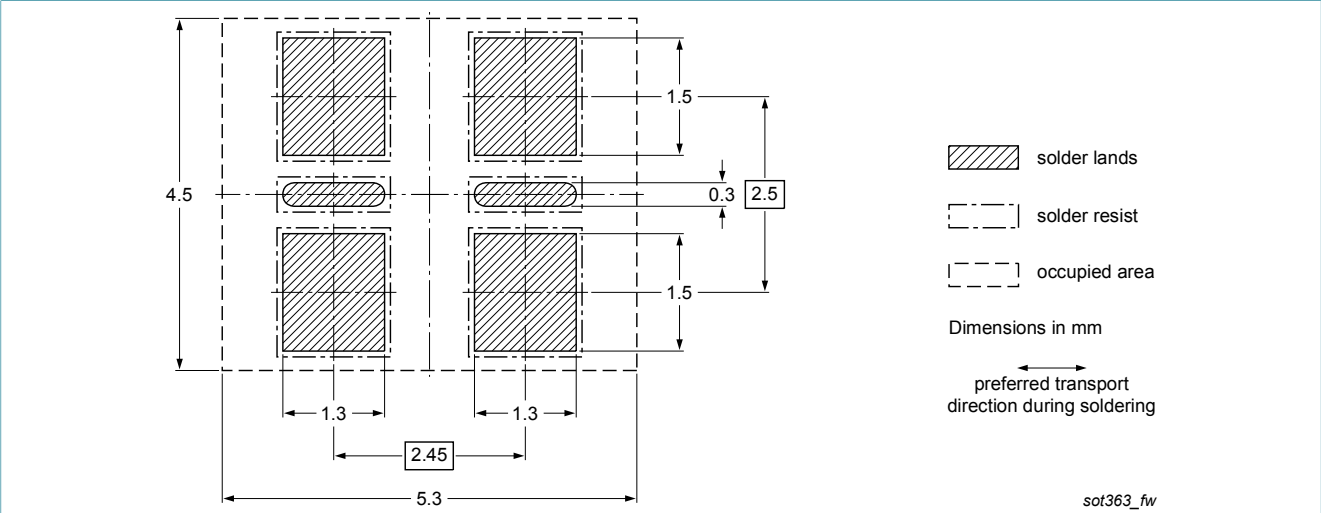


Fig. 20. Wave soldering footprint for TSSOP6 (SOT363)

### 13. Revision history

Table 7. Revision history

| Data sheet ID | Release date | Data sheet status  | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| NX138BKS v.1  | 20160615     | Product data sheet | -             | -          |

## 14. Legal information

### 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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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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