



# NX3020NAKS

30 V, 180 mA dual N-channel Trench MOSFET

11 November 2013

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

- Very fast switching
- Trench MOSFET technology
- ESD protection
- Low threshold voltage

## 3. Applications

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

## 4. Quick reference data

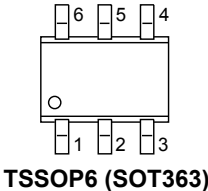
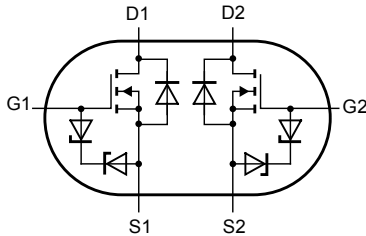
Table 1. Quick reference data

| Symbol                                         | Parameter                        | Conditions                                                      |     | Min | Typ | Max | Unit     |
|------------------------------------------------|----------------------------------|-----------------------------------------------------------------|-----|-----|-----|-----|----------|
| <b>Per transistor</b>                          |                                  |                                                                 |     |     |     |     |          |
| $V_{DS}$                                       | drain-source voltage             | $T_j = 25\text{ °C}$                                            |     | -   | -   | 30  | V        |
| $V_{GS}$                                       | gate-source voltage              |                                                                 |     | -20 | -   | 20  | V        |
| $I_D$                                          | drain current                    | $V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}$                 | [1] | -   | -   | 180 | mA       |
| <b>Static characteristics (per transistor)</b> |                                  |                                                                 |     |     |     |     |          |
| $R_{DS(on)}$                                   | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 100\text{ mA}; T_j = 25\text{ °C}$ |     | -   | 2.7 | 4.5 | $\Omega$ |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain  $1\text{ cm}^2$ .

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline                                                                                   | Graphic symbol                                                                                   |
|-----|--------|-------------|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1   | S1     | source TR1  | <br>TSSOP6 (SOT363) | <br>017aaa256 |
| 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 |
| NX3020NAKS  | TSSOP6  | plastic surface-mounted package; 6 leads | SOT363  |

## 7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
|             | [1]          |
| NX3020NAKS  | Ua%          |

[1] % = placeholder for manufacturing site code

## 8. Limiting values

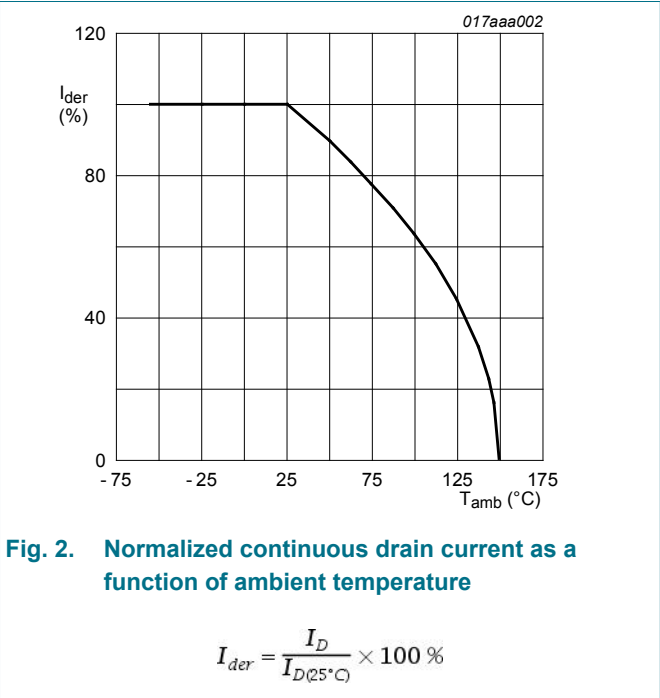
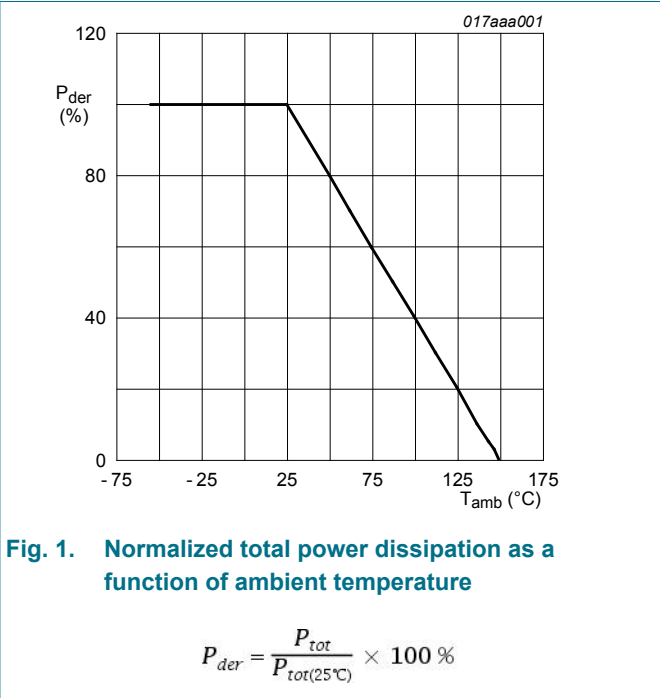
Table 5. Limiting values

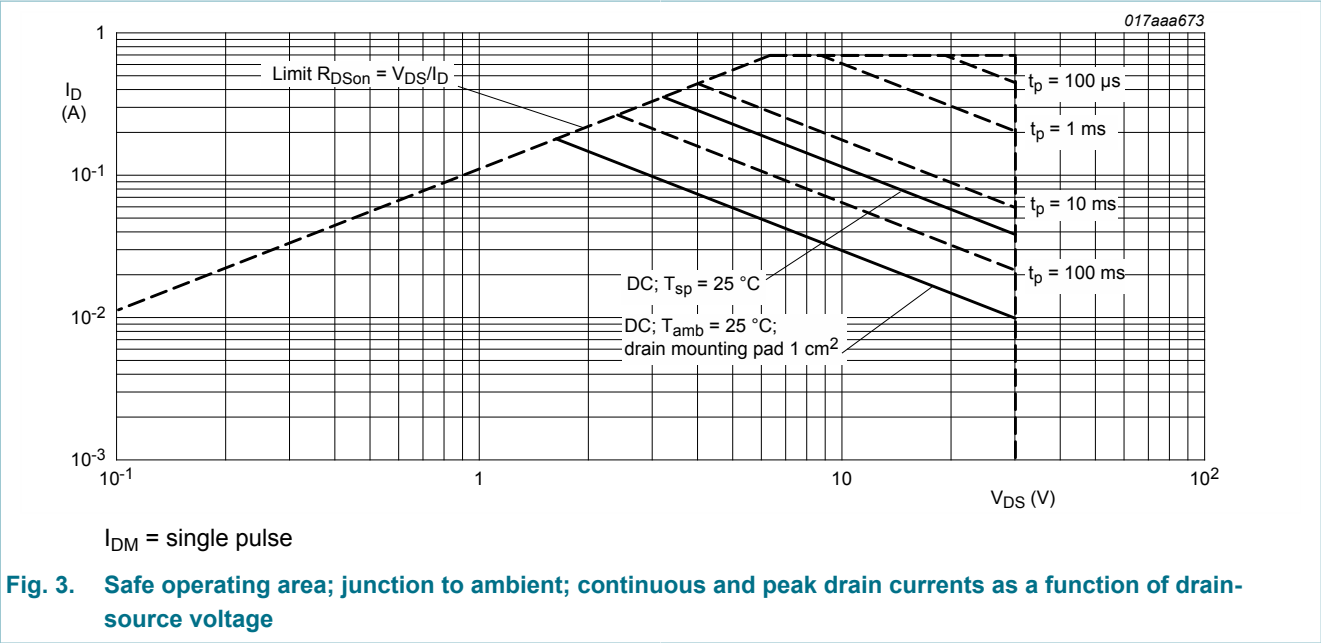
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol                | Parameter               | Conditions                                                                    |     | Min | Max | Unit |
|-----------------------|-------------------------|-------------------------------------------------------------------------------|-----|-----|-----|------|
| <b>Per transistor</b> |                         |                                                                               |     |     |     |      |
| $V_{DS}$              | drain-source voltage    | $T_j = 25\text{ °C}$                                                          |     | -   | 30  | V    |
| $V_{GS}$              | gate-source voltage     |                                                                               |     | -20 | 20  | V    |
| $I_D$                 | drain current           | $V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}$                               | [1] | -   | 180 | mA   |
|                       |                         | $V_{GS} = 4.5\text{ V}; T_{amb} = 100\text{ °C}$                              | [1] | -   | 110 | mA   |
| $I_{DM}$              | peak drain current      | $T_{amb} = 25\text{ °C}; \text{single pulse}; t_p \leq 10\text{ }\mu\text{s}$ |     | -   | 720 | mA   |
| $P_{tot}$             | total power dissipation | $T_{amb} = 25\text{ °C}$                                                      | [2] | -   | 260 | mW   |
|                       |                         |                                                                               | [1] | -   | 280 | mW   |

| Symbol             | Parameter               | Conditions               |     | Min | Max  | Unit |
|--------------------|-------------------------|--------------------------|-----|-----|------|------|
|                    |                         | T <sub>sp</sub> = 25 °C  |     | -   | 1100 | mW   |
| Source-drain diode |                         |                          |     |     |      |      |
| I <sub>S</sub>     | source current          | T <sub>amb</sub> = 25 °C |     | -   | 180  | mA   |
| Per device         |                         |                          |     |     |      |      |
| P <sub>tot</sub>   | total power dissipation | T <sub>amb</sub> = 25 °C | [2] | -   | 375  | mW   |
| 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   |

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



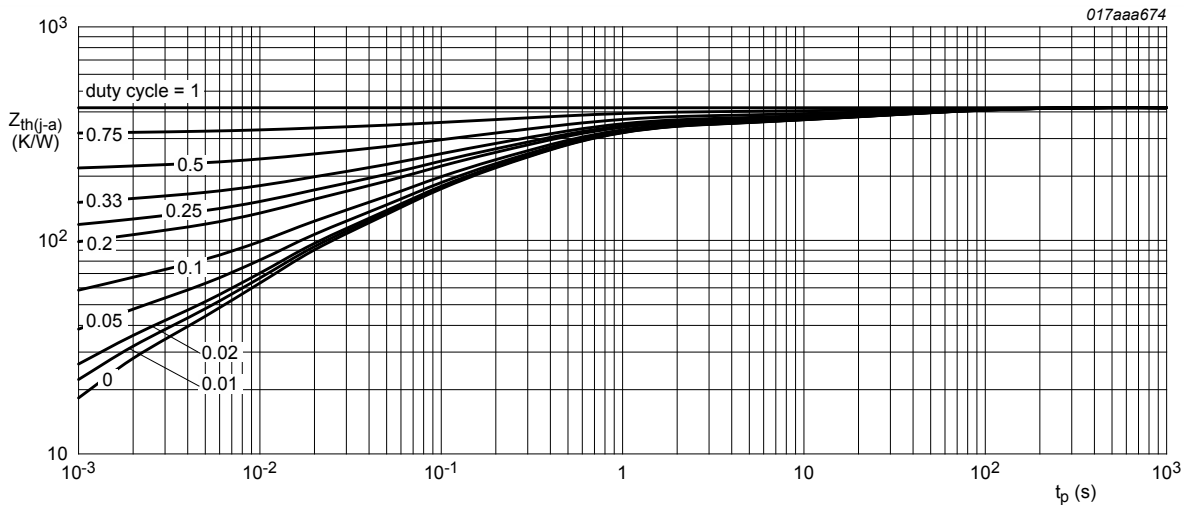


9. Thermal characteristics

Table 6. Thermal characteristics

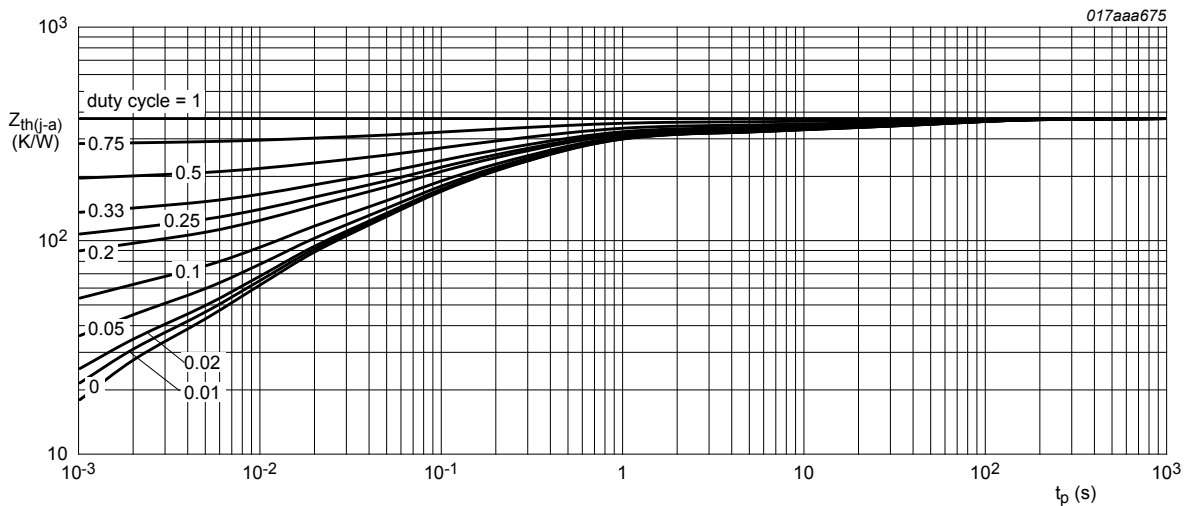
| Symbol         | Parameter                                        | Conditions  |     | Min | Typ | Max | Unit |
|----------------|--------------------------------------------------|-------------|-----|-----|-----|-----|------|
| Per transistor |                                                  |             |     |     |     |     |      |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air | [1] | -   | 390 | 480 | K/W  |
|                |                                                  |             | [2] | -   | 380 | 430 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             |     | -   | -   | 110 | 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  $1\text{ cm}^2$ .



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 1 cm<sup>2</sup>

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 (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                                                    |  | 30   | -    | -    | 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                                       |  | 0.8  | 1.2  | 1.5  | V    |
| I <sub>DSS</sub>                         | drain leakage current            | V <sub>DS</sub> = 30 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                     |  | -    | -    | 1    | μA   |
|                                          |                                  | V <sub>DS</sub> = 30 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 150 °C                                                    |  | -    | -    | 10   | 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                                                     |  | -    | -    | 3.5  | μA   |
|                                          |                                  | V <sub>GS</sub> = -20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                    |  | -    | -    | 3.5  | 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> = 4.5 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                    |  | -    | -    | 0.5  | μA   |
|                                          |                                  | V <sub>GS</sub> = -4.5 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                   |  | -    | -    | 0.5  | μA   |
|                                          |                                  |                                                                                                                           |  |      |      |      |      |
| R <sub>DSon</sub>                        | drain-source on-state resistance | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 100 mA; T <sub>j</sub> = 25 °C                                                   |  | -    | 2.7  | 4.5  | Ω    |
|                                          |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 100 mA; T <sub>j</sub> = 150 °C                                                  |  | -    | 5.5  | 9.2  | Ω    |
|                                          |                                  | V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 100 mA; T <sub>j</sub> = 25 °C                                                  |  | -    | 3    | 5.2  | Ω    |
|                                          |                                  | V <sub>GS</sub> = 2.5 V; I <sub>D</sub> = 10 mA; T <sub>j</sub> = 25 °C                                                   |  | -    | 4    | 13   | Ω    |
| g <sub>fs</sub>                          | forward transconductance         | V <sub>DS</sub> = 10 V; I <sub>D</sub> = 150 mA; T <sub>j</sub> = 25 °C                                                   |  | -    | 320  | -    | mS   |
| Dynamic characteristics (per transistor) |                                  |                                                                                                                           |  |      |      |      |      |
| Q <sub>G(tot)</sub>                      | total gate charge                | V <sub>DS</sub> = 15 V; I <sub>D</sub> = 150 mA; V <sub>GS</sub> = 4.5 V; T <sub>j</sub> = 25 °C                          |  | -    | 0.34 | 0.44 | nC   |
| Q <sub>GS</sub>                          | gate-source charge               |                                                                                                                           |  | -    | 0.11 | -    | nC   |
| Q <sub>GD</sub>                          | gate-drain charge                |                                                                                                                           |  | -    | 0.06 | -    | nC   |
| C <sub>iss</sub>                         | input capacitance                | V <sub>DS</sub> = 10 V; f = 1 MHz; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                          |  | -    | 13   | 20   | pF   |
| C <sub>oss</sub>                         | output capacitance               |                                                                                                                           |  | -    | 2.6  | -    | pF   |
| C <sub>rss</sub>                         | reverse transfer capacitance     |                                                                                                                           |  | -    | 1.1  | -    | pF   |
| t <sub>d(on)</sub>                       | turn-on delay time               | V <sub>DS</sub> = 20 V; R <sub>L</sub> = 250 Ω; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 6 Ω; T <sub>j</sub> = 25 °C |  | -    | 5    | 10   | ns   |
| t <sub>r</sub>                           | rise time                        |                                                                                                                           |  | -    | 5    | -    | ns   |
| t <sub>d(off)</sub>                      | turn-off delay time              |                                                                                                                           |  | -    | 34   | 68   | ns   |
| t <sub>f</sub>                           | fall time                        |                                                                                                                           |  | -    | 17   | -    | ns   |
| Source-drain diode (per transistor)      |                                  |                                                                                                                           |  |      |      |      |      |
| V <sub>SD</sub>                          | source-drain voltage             | I <sub>S</sub> = 115 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C                                                    |  | 0.47 | 0.7  | 1.2  | V    |

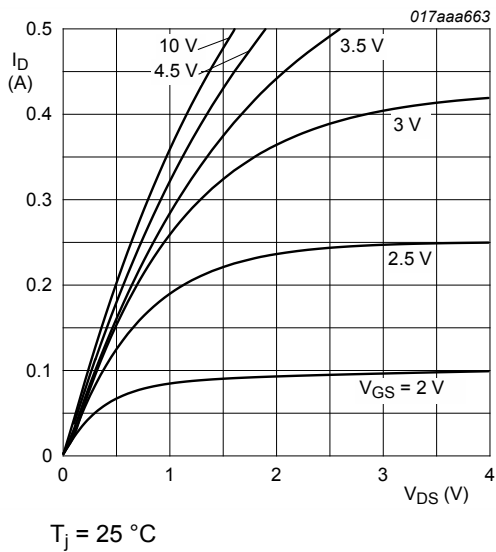


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

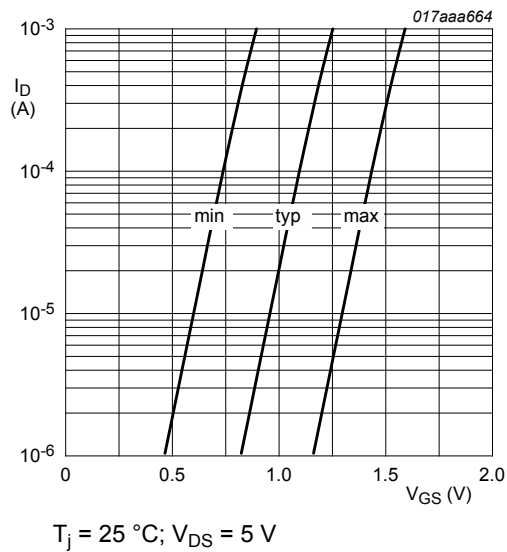


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

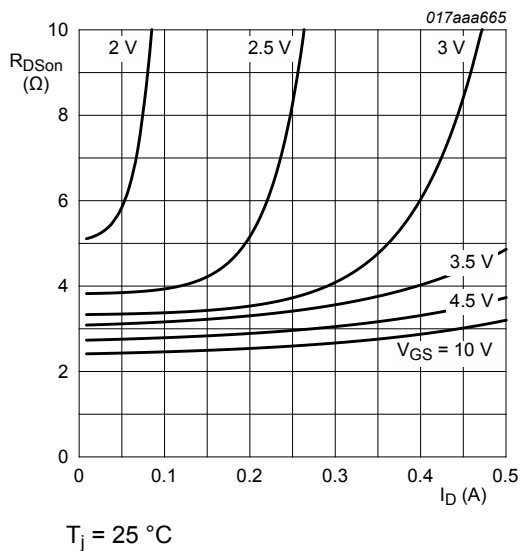


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

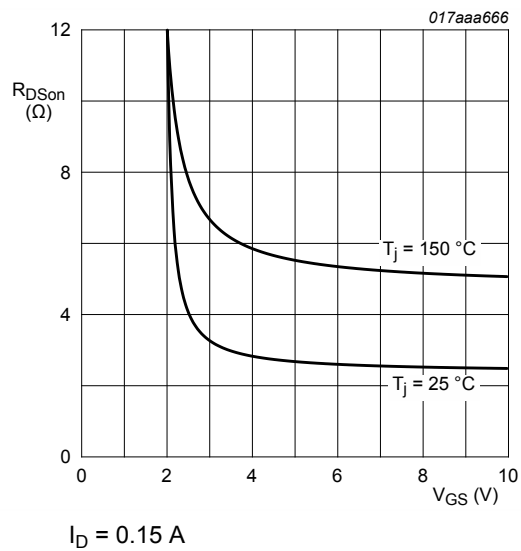


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

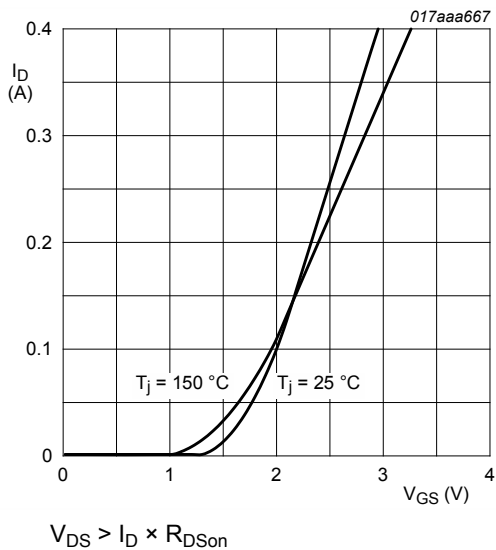


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

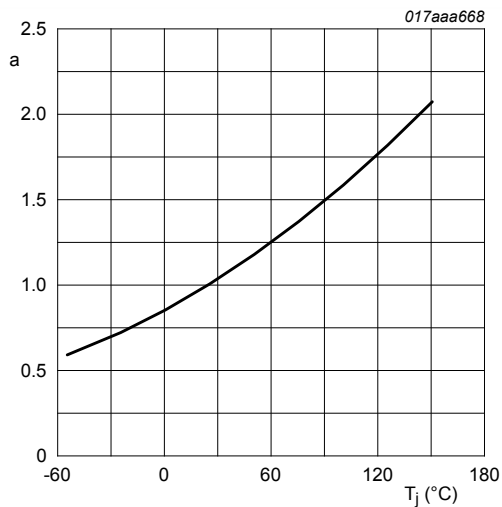


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}\text{C})}}$$

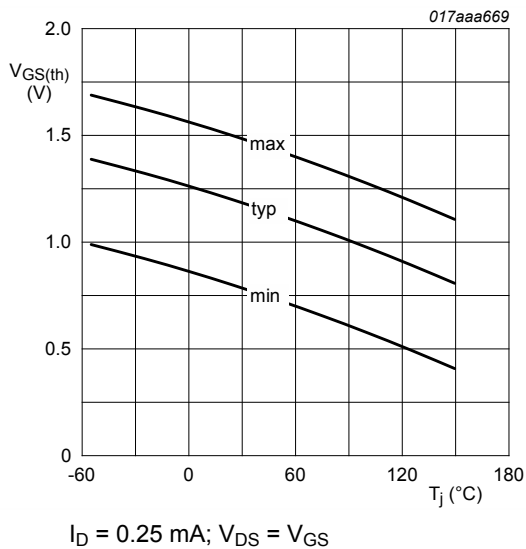


Fig. 12. Gate-source threshold voltage as a function of junction temperature

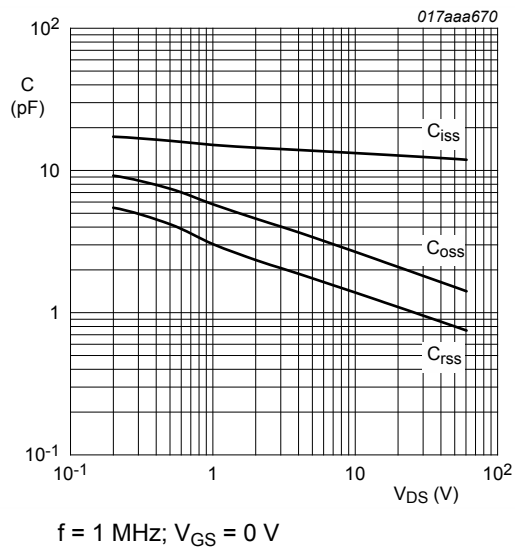


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

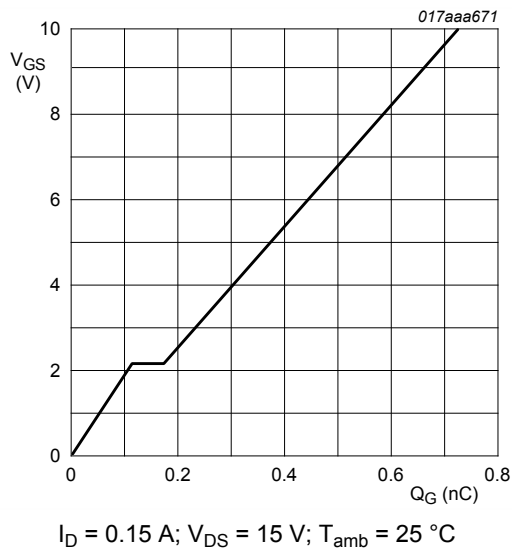


Fig. 14. Gate-source voltage as a function of gate charge; typical values

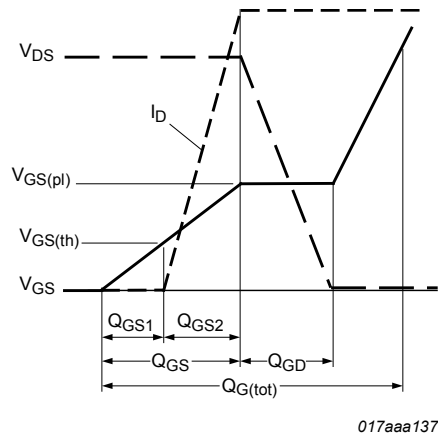


Fig. 15. Gate charge waveform definitions

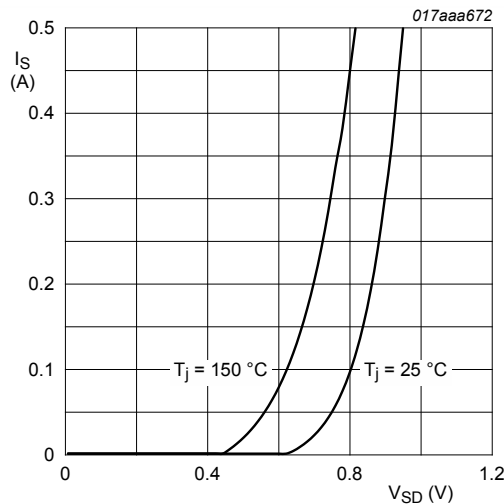


Fig. 16. Source current as a function of source-drain voltage; typical values

11. Test information

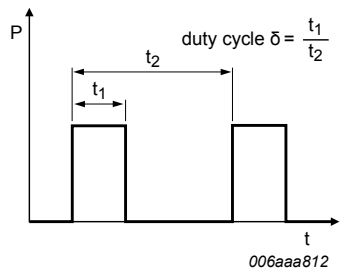
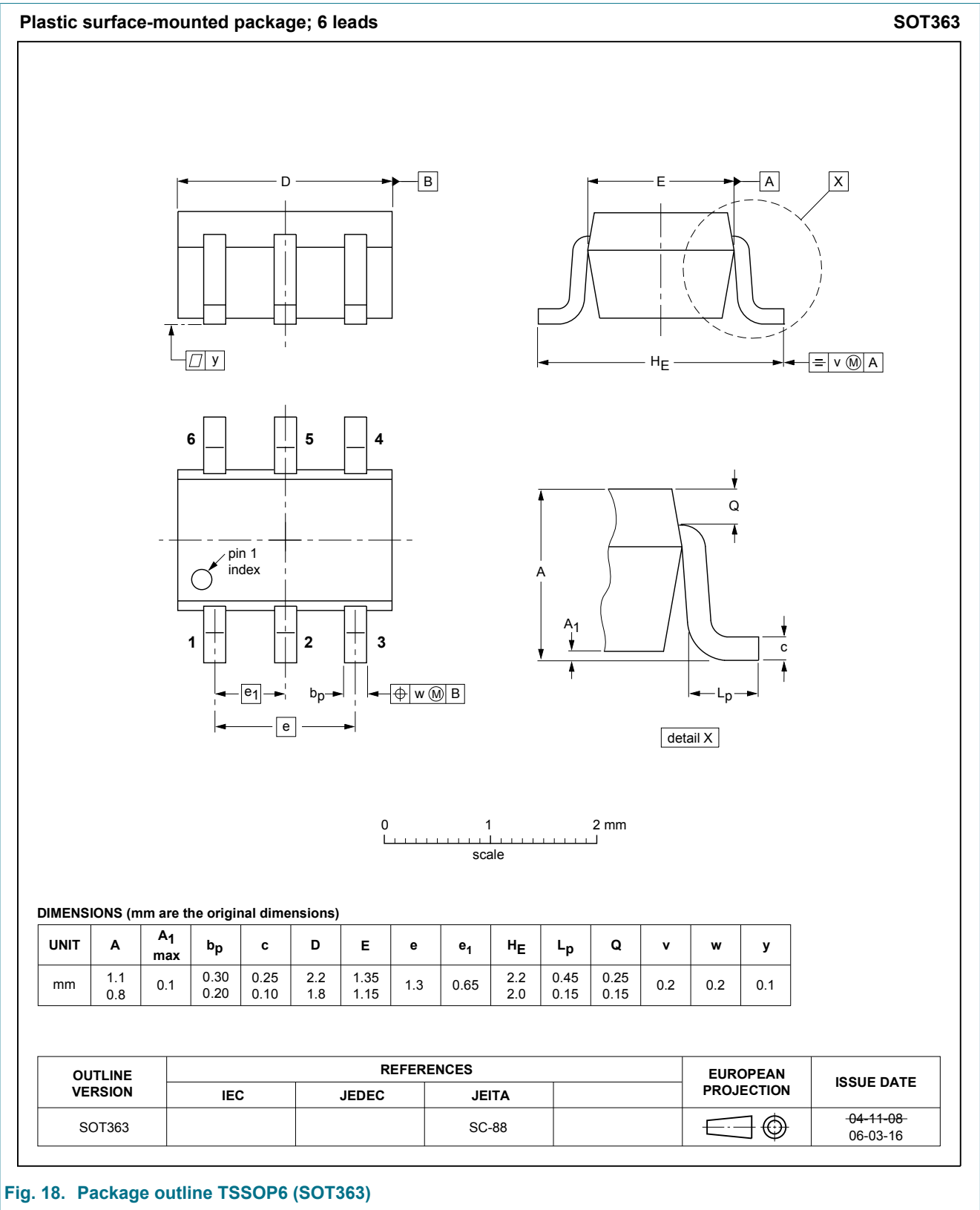


Fig. 17. Duty cycle definition

12. Package outline



13. Soldering

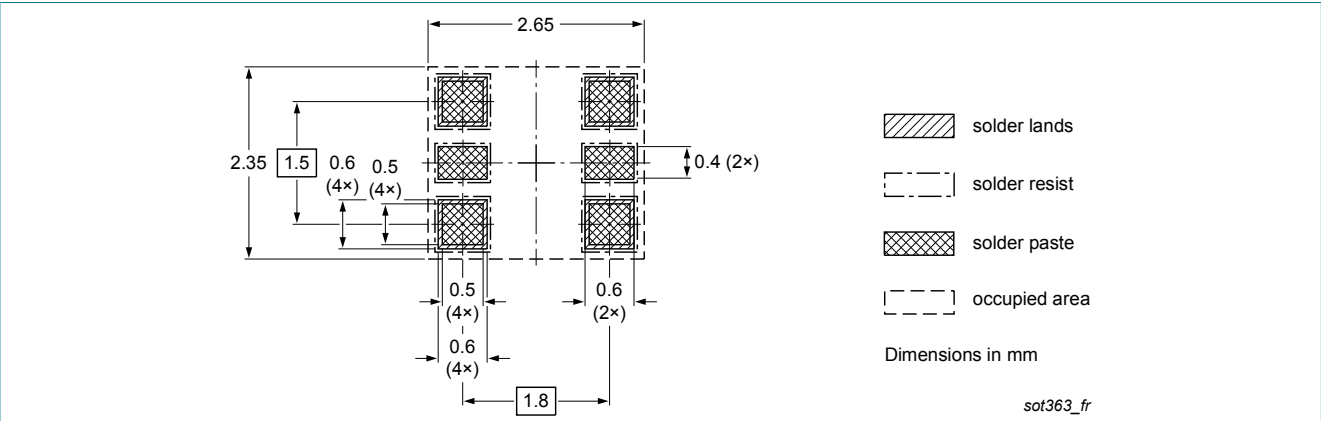


Fig. 19. Reflow soldering footprint for TSSOP6 (SOT363)

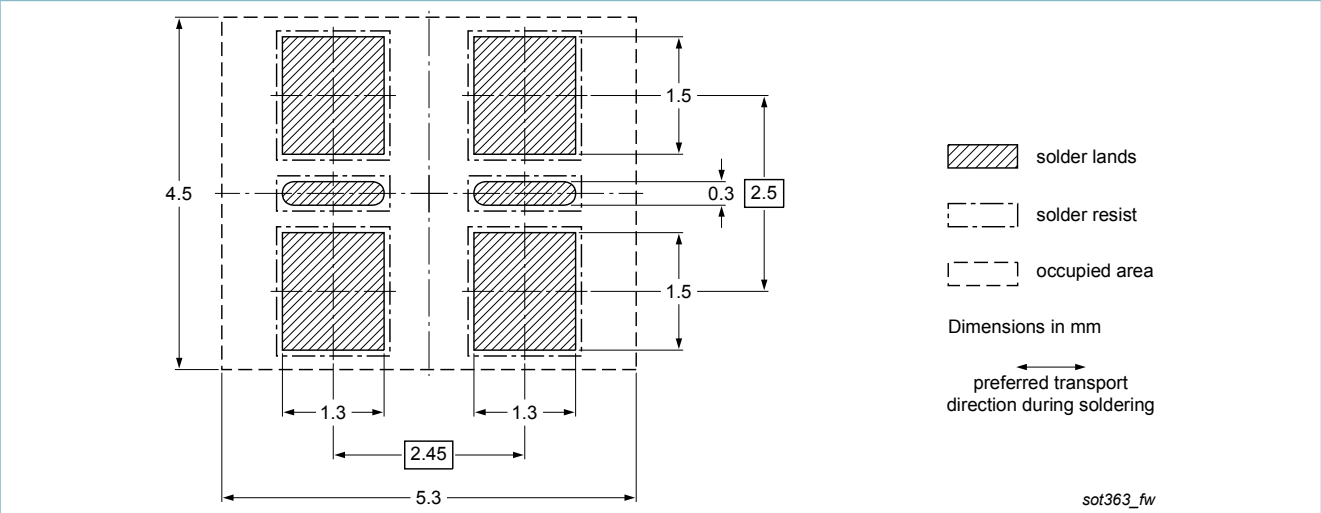


Fig. 20. Wave soldering footprint for TSSOP6 (SOT363)

## 14. Revision history

Table 8. Revision history

| Data sheet ID  | Release date                                                           | Data sheet status  | Change notice | Supersedes     |
|----------------|------------------------------------------------------------------------|--------------------|---------------|----------------|
| NX3020NAKS v.3 | 20131111                                                               | Product data sheet | -             | NX3020NAKS v.2 |
| Modifications: | <ul style="list-style-type: none"><li>Marking code corrected</li></ul> |                    |               |                |
| NX3020NAKS v.2 | 20131029                                                               | Product data sheet | -             | NX3020NAKS v.1 |
| NX3020NAKS v.1 | 20120706                                                               | Product data sheet | -             | -              |

## 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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

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