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Kind regards,

Team Nexperia



# NX7002AKS

60 V, dual N-channel Trench MOSFET

Rev. 1 — 1 March 2012

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

- Very fast switching
- ESD protection
- Trench MOSFET technology

### 1.3 Applications

- Relay driver
- Low-side load switch
- High-speed line driver
- Switching circuits

### 1.4 Quick reference data

Table 1. Quick reference data

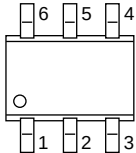
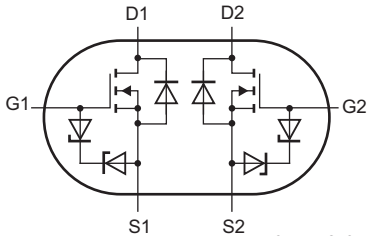
| Symbol                        | Parameter                        | Conditions                                                            | Min                 | Typ | Max | Unit     |
|-------------------------------|----------------------------------|-----------------------------------------------------------------------|---------------------|-----|-----|----------|
| <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                    | $V_{GS} = 10\text{ V}$ ; $T_{amb} = 25\text{ °C}$                     | <a href="#">[1]</a> | -   | 170 | mA       |
| <b>Static characteristics</b> |                                  |                                                                       |                     |     |     |          |
| $R_{DS(on)}$                  | drain-source on-state resistance | $V_{GS} = 10\text{ V}$ ; $I_D = 100\text{ mA}$ ; $T_j = 25\text{ °C}$ | -                   | 3   | 4.5 | $\Omega$ |

[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. Pinning information

Table 2. Pinning information

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

3. Ordering information

Table 3. Ordering information

| Type number | Package |                                          |         |
|-------------|---------|------------------------------------------|---------|
|             | Name    | Description                              | Version |
| NX7002AKS   | TSSOP6  | plastic surface-mounted package; 6 leads | SOT363  |

4. Marking

Table 4. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| NX7002AKS   | TD%                         |

[1] % = placeholder for manufacturing site code

## 5. Limiting values

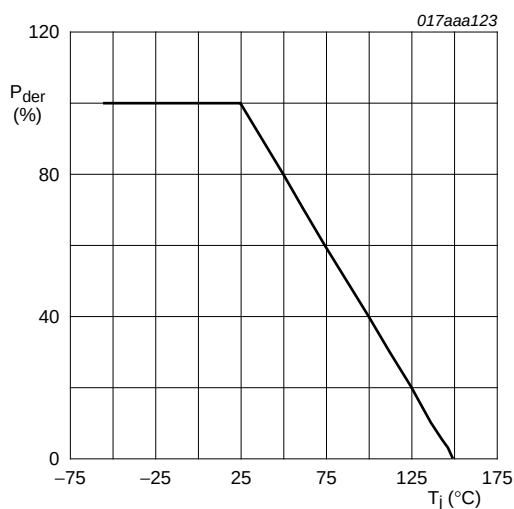
**Table 5. Limiting values**

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    | $T_J = 25\text{ }^{\circ}\text{C}$                                                      | -   | 60   | V                  |
| $V_{GS}$                  | gate-source voltage     |                                                                                         | -20 | 20   | V                  |
| $I_D$                     | drain current           | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$                            | [1] | 170  | mA                 |
|                           |                         | $V_{GS} = 10\text{ V}; T_{amb} = 100\text{ }^{\circ}\text{C}$                           | [1] | 100  | mA                 |
| $I_{DM}$                  | peak drain current      | $T_{amb} = 25\text{ }^{\circ}\text{C}$ ; single pulse; $t_p \leq 10\text{ }\mu\text{s}$ | -   | 680  | mA                 |
| $P_{tot}$                 | total power dissipation | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                  | [2] | 220  | mW                 |
|                           |                         |                                                                                         | [1] | 255  | mW                 |
|                           |                         | $T_{sp} = 25\text{ }^{\circ}\text{C}$                                                   | -   | 1060 | mW                 |
| <b>Source-drain diode</b> |                         |                                                                                         |     |      |                    |
| $I_S$                     | source current          | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                  | [1] | 170  | mA                 |
| <b>Per device</b>         |                         |                                                                                         |     |      |                    |
| $P_{tot}$                 | total power dissipation | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                  | [2] | 330  | mW                 |
| $T_J$                     | junction temperature    |                                                                                         | -55 | 150  | $^{\circ}\text{C}$ |
| $T_{amb}$                 | ambient temperature     |                                                                                         | -55 | 150  | $^{\circ}\text{C}$ |
| $T_{stg}$                 | storage temperature     |                                                                                         | -65 | 150  | $^{\circ}\text{C}$ |

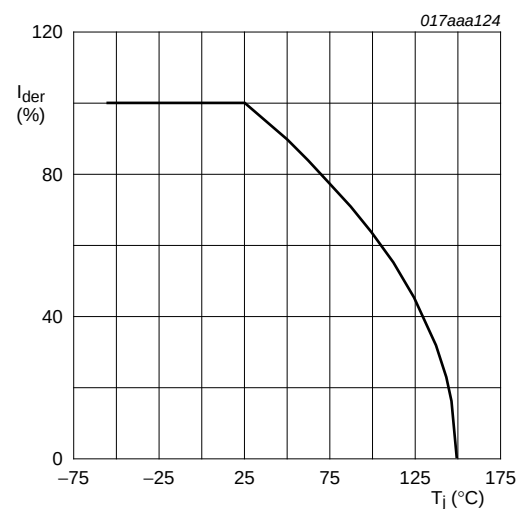
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated, mounting pad for drain 1 cm<sup>2</sup>.

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



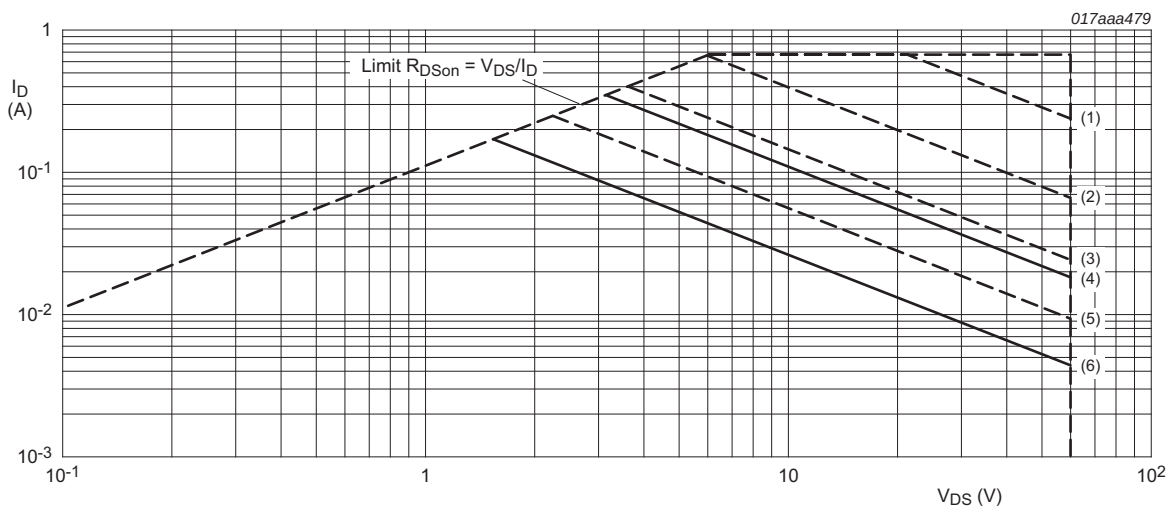
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}\text{C})}} \times 100\%$$

**Fig 1. 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. Normalized continuous drain current as a function of junction temperature**



IDM = single pulse  
(1) tp = 100 μs  
(2) tp = 1 ms  
(3) tp = 10 ms  
(4) DC; Tsp = 25 °C  
(5) tp = 100 ms  
(6) DC; Tamb = 25 °C; drain mounting pad 1 cm²

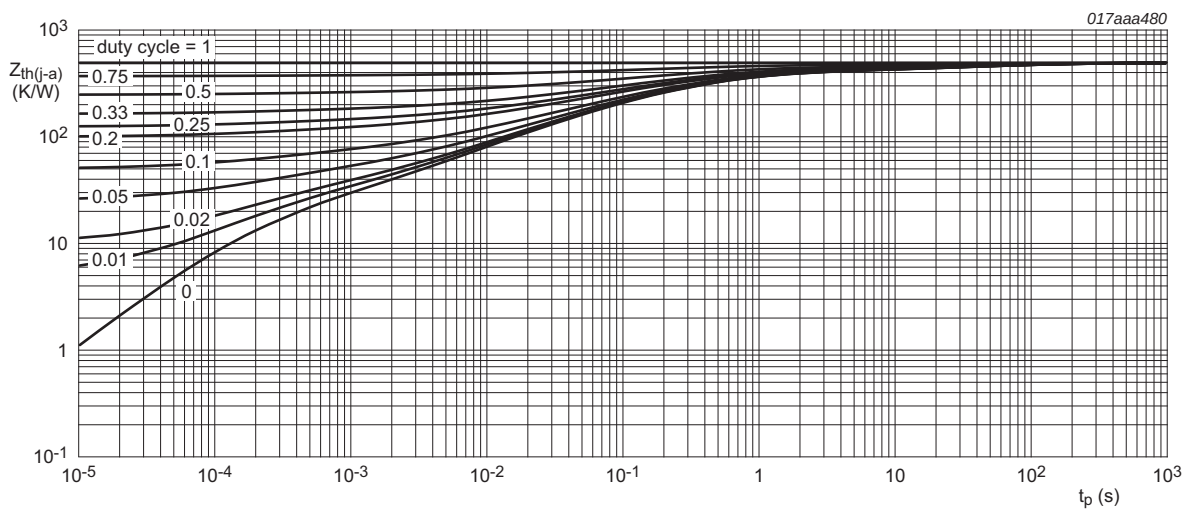
Fig 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

6. Thermal characteristics

Table 6. Thermal characteristics

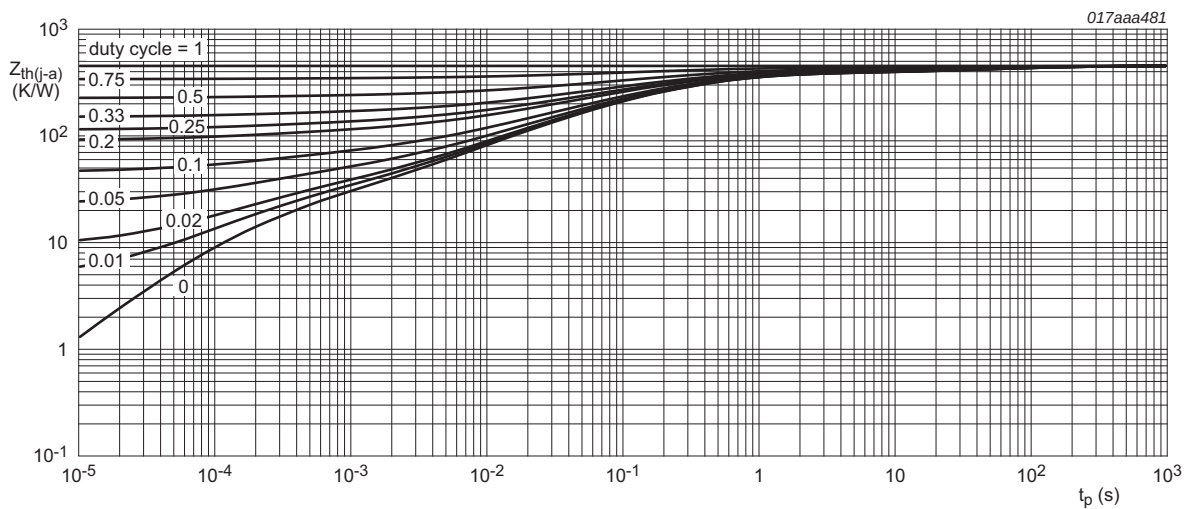
| Symbol         | Parameter                                        | Conditions  | Min | Typ | Max | Unit |
|----------------|--------------------------------------------------|-------------|-----|-----|-----|------|
| Per transistor |                                                  |             |     |     |     |      |
| Rth(j-a)       | thermal resistance from junction to ambient      | in free air | [1] | -   | 500 | K/W  |
|                |                                                  |             | [2] | -   | 450 | K/W  |
| Rth(j-sp)      | thermal resistance from junction to solder point |             | -   | -   | 115 | 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 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

## 7. Characteristics

**Table 7. Characteristics**

| Symbol                         | Parameter                        | Conditions                                                                                                  | Min  | Typ  | Max  | Unit     |
|--------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| <b>Static characteristics</b>  |                                  |                                                                                                             |      |      |      |          |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage   | $I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                 | 60   | -    | -    | V        |
| $V_{GSth}$                     | gate-source threshold voltage    | $I_D = 250\ \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25\ ^\circ C$                                               | 1.1  | 1.6  | 2.1  | V        |
| $I_{DSS}$                      | drain leakage current            | $V_{DS} = 60\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                   | -    | -    | 1    | $\mu A$  |
|                                |                                  | $V_{DS} = 60\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 150\ ^\circ C$                                                  | -    | -    | 10   | $\mu A$  |
| $I_{GSS}$                      | gate leakage current             | $V_{GS} = 20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                   | -    | -    | 2    | $\mu A$  |
|                                |                                  | $V_{GS} = -20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                  | -    | -    | 2    | $\mu A$  |
|                                |                                  | $V_{GS} = 10\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                   | -    | -    | 0.5  | $\mu A$  |
|                                |                                  | $V_{GS} = -10\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                  | -    | -    | 0.5  | $\mu A$  |
|                                |                                  | $V_{GS} = 5\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                    | -    | -    | 100  | nA       |
|                                |                                  | $V_{GS} = -5\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                   | -    | -    | 100  | nA       |
|                                |                                  |                                                                                                             |      |      |      |          |
| $R_{DSon}$                     | drain-source on-state resistance | $V_{GS} = 10\ V$ ; $I_D = 100\ mA$ ; $T_j = 25\ ^\circ C$                                                   | -    | 3    | 4.5  | $\Omega$ |
|                                |                                  | $V_{GS} = 10\ V$ ; $I_D = 100\ mA$ ; $T_j = 150\ ^\circ C$                                                  | -    | 6.2  | 9.2  | $\Omega$ |
|                                |                                  | $V_{GS} = 5\ V$ ; $I_D = 100\ mA$ ; $T_j = 25\ ^\circ C$                                                    | -    | 3.7  | 5.2  | $\Omega$ |
| $g_{fs}$                       | forward transconductance         | $V_{DS} = 10\ V$ ; $I_D = 200\ mA$ ; $T_j = 25\ ^\circ C$                                                   | -    | 230  | -    | mS       |
| <b>Dynamic characteristics</b> |                                  |                                                                                                             |      |      |      |          |
| $Q_{G(tot)}$                   | total gate charge                | $V_{DS} = 30\ V$ ; $I_D = 200\ mA$ ; $V_{GS} = 4.5\ V$ ; $T_j = 25\ ^\circ C$                               | -    | 0.33 | 0.43 | nC       |
| $Q_{GS}$                       | gate-source charge               |                                                                                                             | -    | 0.12 | -    | nC       |
| $Q_{GD}$                       | gate-drain charge                |                                                                                                             | -    | 0.09 | -    | nC       |
| $C_{iss}$                      | input capacitance                | $V_{DS} = 10\ V$ ; $f = 1\ MHz$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                    | -    | 11   | 17   | pF       |
| $C_{oss}$                      | output capacitance               |                                                                                                             | -    | 3.4  | -    | pF       |
| $C_{rss}$                      | reverse transfer capacitance     |                                                                                                             | -    | 1.4  | -    | pF       |
| $t_{d(on)}$                    | turn-on delay time               | $V_{DS} = 40\ V$ ; $R_L = 250\ \Omega$ ; $V_{GS} = 10\ V$ ; $R_{G(ext)} = 6\ \Omega$ ; $T_j = 25\ ^\circ C$ | -    | 6    | 12   | ns       |
| $t_r$                          | rise time                        |                                                                                                             | -    | 7    | -    | ns       |
| $t_{d(off)}$                   | turn-off delay time              |                                                                                                             | -    | 20   | 40   | ns       |
| $t_f$                          | fall time                        |                                                                                                             | -    | 14   | -    | ns       |
| <b>Source-drain diode</b>      |                                  |                                                                                                             |      |      |      |          |
| $V_{SD}$                       | source-drain voltage             | $I_S = 115\ mA$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                    | 0.47 | 0.7  | 1.2  | V        |

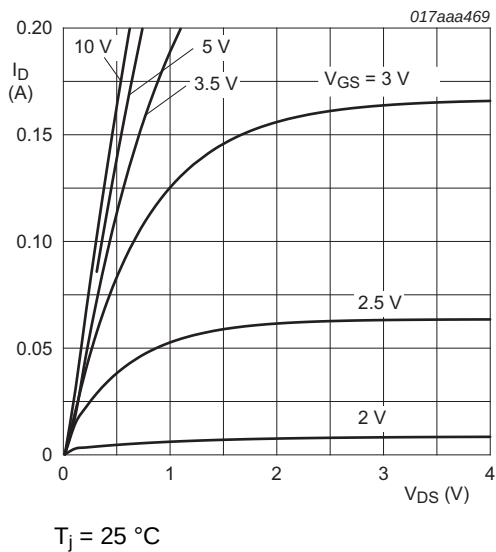


Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values

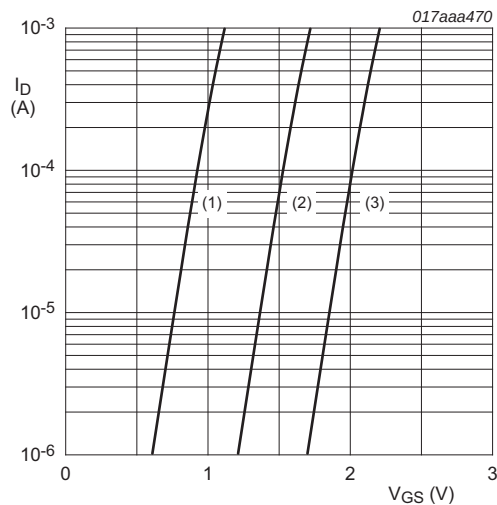


Fig 7. Subthreshold drain current as a function of gate-source voltage

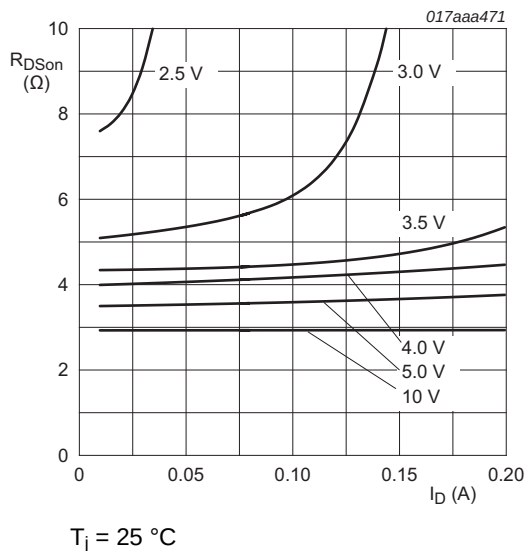


Fig 8. Drain-source on-state resistance as a function of drain current; typical values

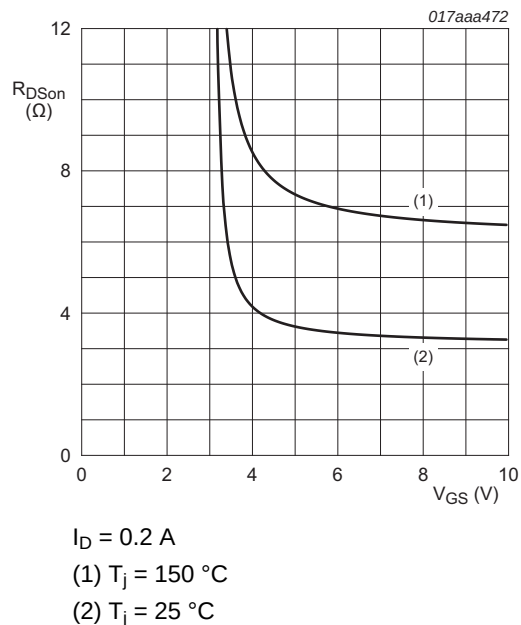
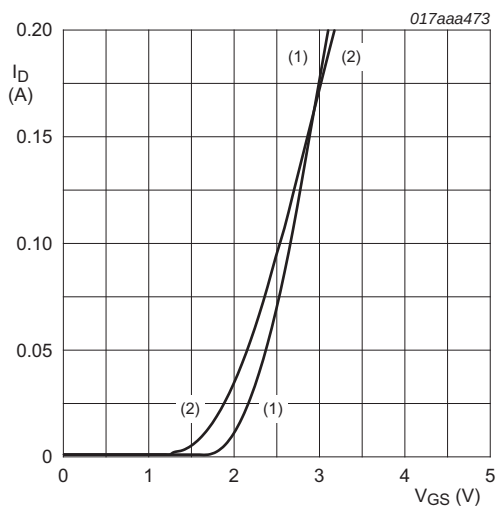


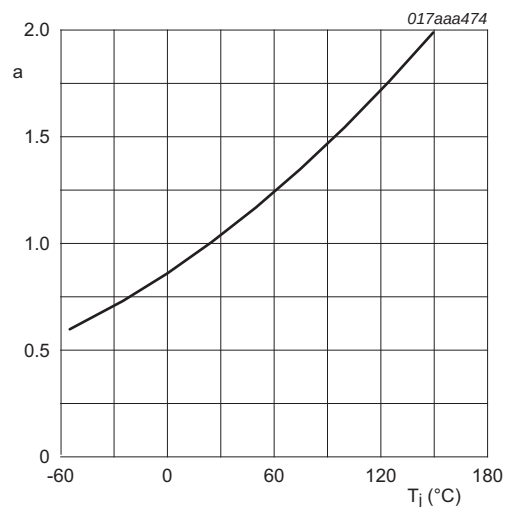
Fig 9. Drain-source on-state resistance as a function of gate-source voltage; typical values





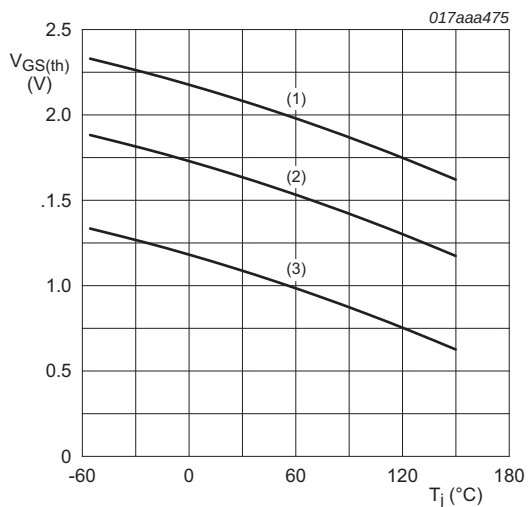
$V_{DS} > I_D \times R_{DSon}$   
(1)  $T_j = 25\text{ }^{\circ}\text{C}$   
(2)  $T_j = 150\text{ }^{\circ}\text{C}$

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



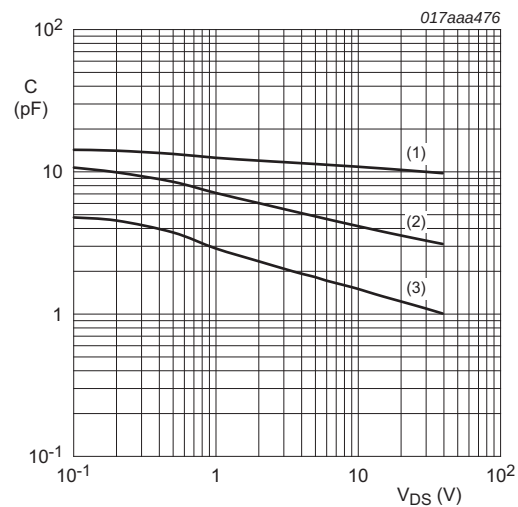
$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}\text{C})}}$$

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



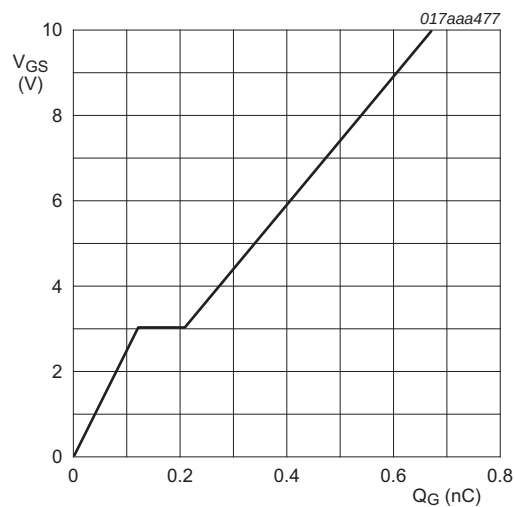
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$   
(1) maximum values  
(2) typical values  
(3) minimum values

Fig 12. 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 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$I_D = 0.2$  A;  $V_{DS} = 30$  V;  $T_{amb} = 25$  °C

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

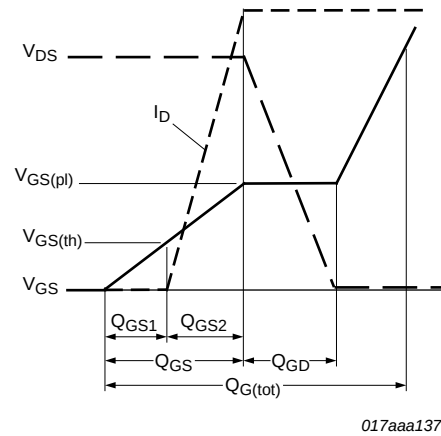
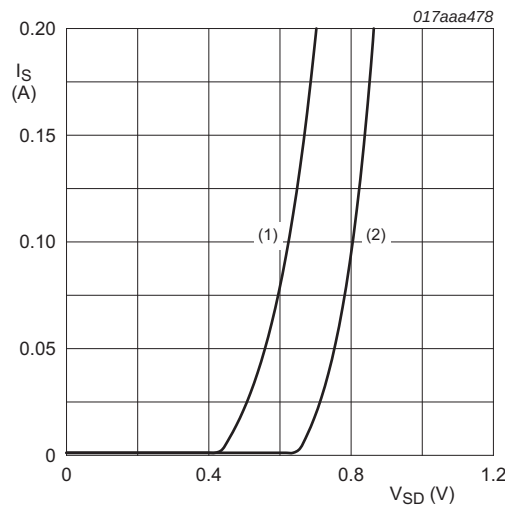


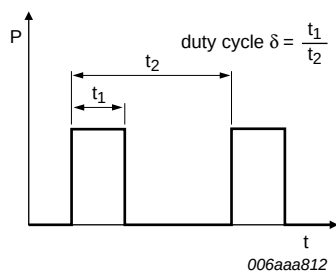
Fig 15. Gate charge waveform definitions



$V_{GS} = 0$  V  
(1)  $T_j = 150$  °C  
(2)  $T_j = 25$  °C

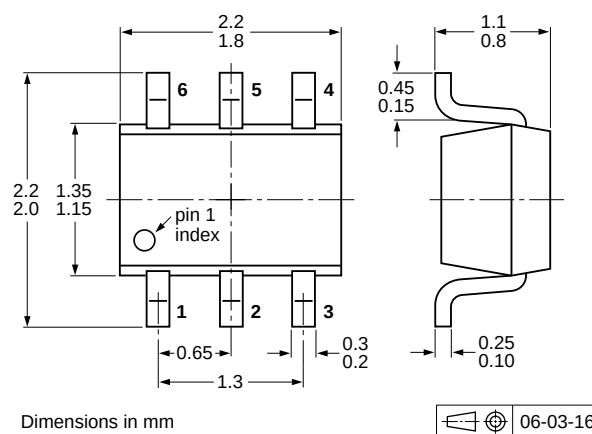
Fig 16. Source current as a function of source-drain voltage; typical values

## 8. Test information



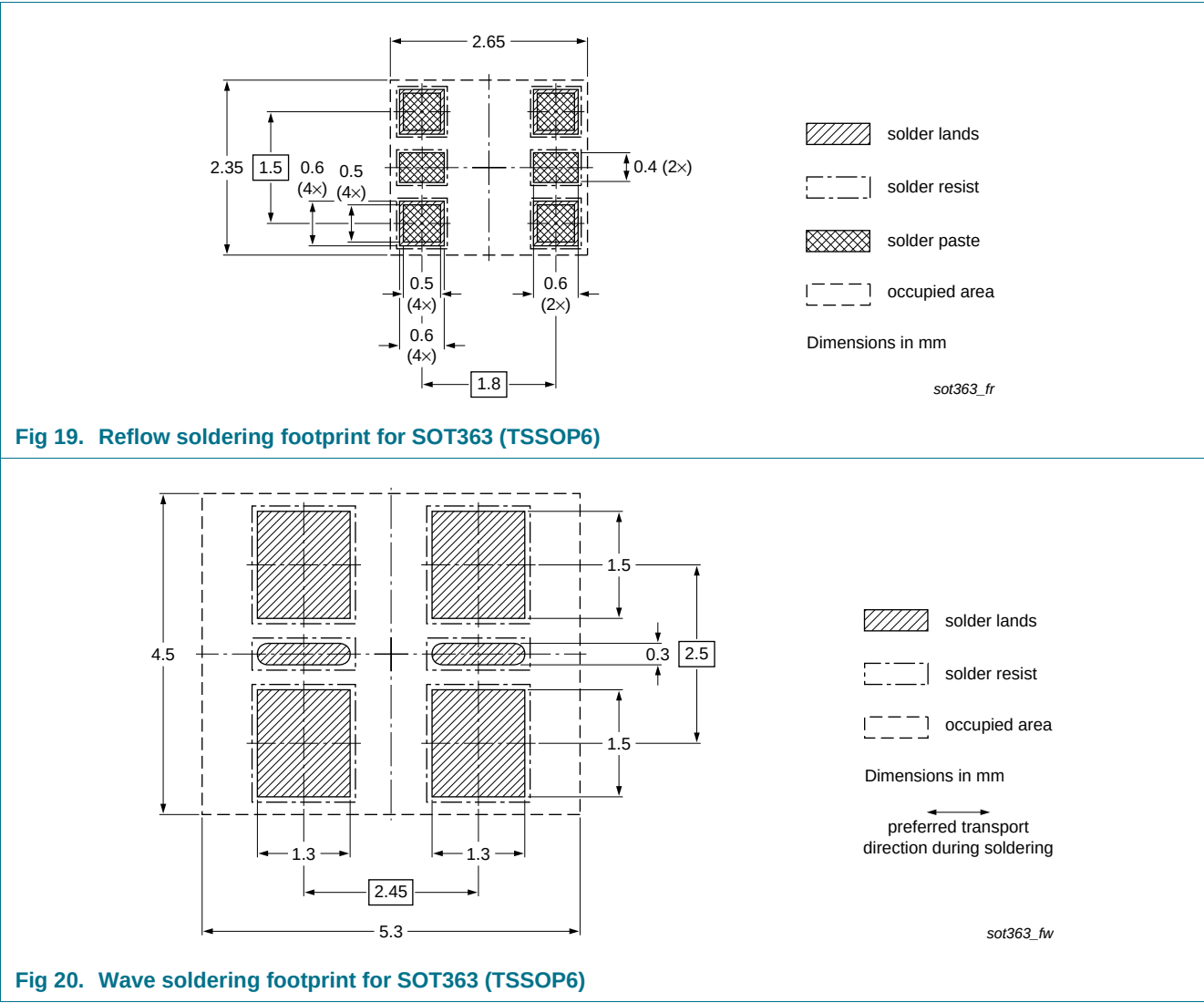
### Fig 17. Duty cycle definition

## 9. Package outline



**Fig 18. Package outline SOT363 (TSSOP6)**

10. Soldering



## 11. Revision history

Table 8. Revision history

| Document ID   | Release date | Data sheet status  | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| NX7002AKS v.1 | 20120301     | Product data sheet | -             | -          |

## 12. Legal information

### 12.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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.nxp.com>.

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## 13. Contact information

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Date of release: 1 March 2012

Document identifier: NX7002AKS