1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a small SOT323 (SC-70) 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>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tbody>
<tr>
<td>V_Ds</td>
<td>drain-source voltage</td>
<td>T_j = 25 °C</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>V</td>
</tr>
<tr>
<td>V_Gs</td>
<td>gate-source voltage</td>
<td></td>
<td>-20</td>
<td>-</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>I_D</td>
<td>drain current</td>
<td>V_Gs = 10 V; T_amb = 25 °C</td>
<td>[1]</td>
<td>-</td>
<td>180</td>
<td>mA</td>
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**Static characteristics**

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<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_Dson</td>
<td>drain-source on-state</td>
<td>V_Gs = 10 V; I_D = 100 mA; T_j = 25 °C</td>
<td>-</td>
<td>2.7</td>
<td>4.5</td>
<td>Ω</td>
</tr>
</tbody>
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[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².
5. Pinning information

Table 2. Pinning information

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<th>Pin</th>
<th>Symbol</th>
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<td>1</td>
<td>G</td>
<td>gate</td>
</tr>
<tr>
<td>2</td>
<td>S</td>
<td>source</td>
</tr>
<tr>
<td>3</td>
<td>D</td>
<td>drain</td>
</tr>
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SC-70 (SOT323)

6. Ordering information

Table 3. Ordering information

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<th>Name</th>
<th>Description</th>
<th>Version</th>
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<td>NX3020NAKW</td>
<td>SC-70</td>
<td>plastic surface-mounted package; 3 leads</td>
<td>SOT323</td>
<td></td>
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</table>

7. Marking

Table 4. Marking codes

<table>
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<tr>
<td>NX3020NAKW</td>
<td>%3A</td>
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[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

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

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<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V&lt;sub&gt;DS&lt;/sub&gt;</td>
<td>drain-source voltage</td>
<td>T&lt;sub&gt;j&lt;/sub&gt; = 25 °C</td>
<td>-</td>
<td>30</td>
<td>V</td>
</tr>
<tr>
<td>V&lt;sub&gt;GS&lt;/sub&gt;</td>
<td>gate-source voltage</td>
<td></td>
<td>-20</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>I&lt;sub&gt;D&lt;/sub&gt;</td>
<td>drain current</td>
<td></td>
<td>-</td>
<td>180</td>
<td>mA</td>
</tr>
<tr>
<td>I&lt;sub&gt;DM&lt;/sub&gt;</td>
<td>peak drain current</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 10 V; T&lt;sub&gt;amb&lt;/sub&gt; = 25 °C</td>
<td>-1</td>
<td>110</td>
<td>mA</td>
</tr>
<tr>
<td>P&lt;sub&gt;tot&lt;/sub&gt;</td>
<td>total power dissipation</td>
<td>T&lt;sub&gt;amb&lt;/sub&gt; = 25 °C; single pulse; t&lt;sub&gt;p&lt;/sub&gt; ≤ 10 μs</td>
<td>-</td>
<td>260</td>
<td>mW</td>
</tr>
</tbody>
</table>
30 V, 180 mA N-channel Trench MOSFET

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td>$T_{sp} = 25 , ^\circ C$</td>
<td>-55</td>
<td>1100</td>
<td>mW</td>
</tr>
<tr>
<td>$T_{amb}$</td>
<td>ambient temperature</td>
<td>-55</td>
<td>150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td>-65</td>
<td>150</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

### Source-drain diode

| $I_S$ | source current | $T_{amb} = 25 \, ^\circ C$ | [1] | - | 180 mA |

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


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

\[ P_{der} = \left( \frac{P_{tot}}{P_{tot(25^\circ C)}} \right) \times 100 \% \]

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

\[ I_{der} = \left( \frac{I_{D}}{I_{D(25^\circ C)}} \right) \times 100 \% \]
9. Thermal characteristics

Table 6. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Description</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>in free air</td>
<td>[1] -</td>
<td>415</td>
<td>480</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th(j-sp)}$</td>
<td>thermal resistance from junction to solder point</td>
<td>-</td>
<td>-</td>
<td>350</td>
<td>400</td>
<td>K/W</td>
</tr>
</tbody>
</table>


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

$I_{DM}$ = single pulse
Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

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

### 10. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{BRDSS}$</td>
<td>drain-source breakdown voltage</td>
<td>$I_D = 250 , \mu A; , V_{GS} = 0 , V; , T_J = 25 , ^\circ \text{C}$</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GSth}$</td>
<td>gate-source threshold voltage</td>
<td>$I_D = 250 , \mu A; , V_{DS} = V_{GS}; , T_J = 25 , ^\circ \text{C}$</td>
<td>0.8</td>
<td>1.2</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td>$I_{DSS}$</td>
<td>drain leakage current</td>
<td>$V_{DS} = 30 , V; , V_{GS} = 0 , V; , T_J = 25 , ^\circ \text{C}$</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>$\mu A$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DS} = 30 , V; , V_{GS} = 0 , V; , T_J = 150 , ^\circ \text{C}$</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>$\mu A$</td>
</tr>
</tbody>
</table>
## Symbol | Parameter | Conditions | Min | Typ | Max | Unit
---|---|---|---|---|---|---
$I_{GSS}$ | gate leakage current | $V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | - | - | 3.5 | µA
| | | $V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | - | - | 3.5 | µA
| | | $V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | - | - | 1 | µA
| | | $V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | - | - | 1 | µA
| | | $V_{GS} = 4.5 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | - | - | 0.5 | µA
| | | $V_{GS} = -4.5 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | - | - | 0.5 | µA
$R_{DSon}$ | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 100 \text{ mA}; T_j = 25 \degree \text{C}$ | - | 2.7 | 4.5 | Ω
| | | $V_{GS} = 10 \text{ V}; I_D = 100 \text{ mA}; T_j = 150 \degree \text{C}$ | - | 5.5 | 9.2 | Ω
| | | $V_{GS} = 4.5 \text{ V}; I_D = 100 \text{ mA}; T_j = 25 \degree \text{C}$ | - | 3 | 5.2 | Ω
| | | $V_{GS} = 2.5 \text{ V}; I_D = 10 \text{ mA}; T_j = 25 \degree \text{C}$ | - | 4 | 13 | Ω
$g_{fs}$ | forward transconductance | $V_{DS} = 10 \text{ V}; I_D = 150 \text{ mA}; T_j = 25 \degree \text{C}$ | - | 320 | - | S

### Dynamic characteristics

| $Q_{G(tot)}$ | total gate charge | $V_{DS} = 15 \text{ V}; I_D = 150 \text{ mA}; V_{GS} = 4.5 \text{ V}; T_j = 25 \degree \text{C}$ | - | 0.34 | 0.44 | nC
| $Q_{GS}$ | gate-source charge | - | 0.11 | - | nC
| $Q_{GD}$ | gate-drain charge | - | 0.06 | - | nC
| $C_{iss}$ | input capacitance | $V_{DS} = 10 \text{ V}; f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | - | 13 | 20 | pF
| $C_{oss}$ | output capacitance | - | 2.6 | - | pF
| $C_{rss}$ | reverse transfer capacitance | - | 1.1 | - | pF
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 20 \text{ V}; R_L = 250 \Omega; V_{GS} = 10 \text{ V}; R_{G(ext)} = 6 \Omega; T_j = 25 \degree \text{C}$ | - | 5 | 10 | ns
| $t_r$ | rise time | - | 5 | - | ns
| $t_{d(off)}$ | turn-off delay time | - | 34 | 68 | ns
| $t_f$ | fall time | - | 17 | - | ns

### Source-drain diode

| $V_{SD}$ | source-drain voltage | $I_S = 115 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \degree \text{C}$ | 0.47 | 0.7 | 1.2 | V
**Fig. 6.** Output characteristics: drain current as a function of drain-source voltage; typical values

\[ T_j = 25 \, ^\circ C \]

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

\[ T_j = 25 \, ^\circ C; \, V_{DS} = 5 \, V \]

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

\[ T_j = 25 \, ^\circ C \]

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

\[ I_D = 0.15 \, A \]

---

Nexperia NX3020NAKW
30 V, 180 mA N-channel Trench MOSFET

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**Nexperia**

**NX3020NAKW**

30 V, 180 mA N-channel Trench MOSFET

---

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

\[
V_{DS} > I_D \times R_{DS(on)}
\]

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

\[
\alpha = \frac{R_{DS(on)}}{R_{DS(on)25°C}}
\]

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

\[I_D = 0.25 \text{ mA}; \quad V_{DS} = V_{GS}\]

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

\[f = 1 \text{ MHz}; \quad V_{GS} = 0 \text{ V}\]
11. Test information

Fig. 17. Duty cycle definition
12. Package outline

**Plastic surface-mounted package; 3 leads**

**SOT323**

**Fig. 18. Package outline SC-70 (SOT323)**

**DIMENSIONS (mm are the original dimensions)**

<table>
<thead>
<tr>
<th>UNIT</th>
<th>A</th>
<th>A_y max</th>
<th>b_p</th>
<th>c</th>
<th>D</th>
<th>E</th>
<th>e</th>
<th>e_t</th>
<th>H_E</th>
<th>L_p</th>
<th>Q</th>
<th>v</th>
<th>w</th>
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<td>mm</td>
<td>1.1</td>
<td>0.8</td>
<td>0.1</td>
<td>0.4</td>
<td>0.25</td>
<td>1.8</td>
<td>1.35</td>
<td>1.3</td>
<td>0.65</td>
<td>2.2</td>
<td>0.45</td>
<td>0.23</td>
<td>0.2</td>
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**OUTLINE VERSION**

| SOT323 |

**REFERENCES**

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**EUROPEAN PROJECTION**

| SC-70 |

**ISSUE DATE**

| 04-11-04 | 06-03-16 |
13. Soldering

![Soldering Footprint Diagrams]

Fig. 19. Reflow soldering footprint for SC-70 (SOT323)

Fig. 20. Wave soldering footprint for SC-70 (SOT323)
14. Revision history

Table 8. Revision history

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<th>Release date</th>
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<th>Change notice</th>
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<tr>
<td>• 3D package outline added</td>
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<tr>
<td>• Table 7 values of capacitance parameters corrected</td>
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<tr>
<td>• Figure 13 corrected</td>
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15. Legal information

15.1 Data sheet status

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<tr>
<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
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<tr>
<td>Objective [short] data sheet</td>
<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
</tr>
<tr>
<td>Preliminary [short] data sheet</td>
<td>Qualification</td>
<td>This document contains data from the preliminary specification.</td>
</tr>
<tr>
<td>Product [short] data sheet</td>
<td>Production</td>
<td>This document contains the product specification.</td>
</tr>
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</table>

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[2] The term ‘short data sheet’ is explained in section “Definitions”.

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