1. General description

Dual Logic level N-channel MOSFET in an LFPAK56D (Dual Power-SO8) package using TrenchMOS technology. This product has been designed and qualified to AEC-Q101 standard for use in high performance automotive applications.

2. Features and benefits

- Dual MOSFET
- AEC-Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True logic level gate with $V_{GS(th)}$ rating of greater than 0.5 V at 175 °C

3. Applications

- 12 V, 24 V and 48 V automotive systems
- Motors, lamps and solenoid control
- Transmission control
- Ultra high performance power switching

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>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DS}$</td>
<td>drain-source voltage</td>
<td>$25 ^\circ C \leq T_j \leq 175 ^\circ C$</td>
<td>-</td>
<td>-</td>
<td>80</td>
<td>V</td>
</tr>
<tr>
<td>$I_D$</td>
<td>drain current</td>
<td>$V_{GS} = 5 V; T_{mb} = 25 ^\circ C; \text{Fig. 2}$</td>
<td>-</td>
<td>-</td>
<td>21</td>
<td>A</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_{mb} = 25 ^\circ C; \text{Fig. 1}$</td>
<td>-</td>
<td>-</td>
<td>64</td>
<td>W</td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td></td>
<td>-55</td>
<td>-</td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>

Static characteristics FET1 and FET2

<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>$R_{DSon}$</td>
<td>drain-source on-state resistance</td>
<td>$V_{GS} = 5 V; I_D = 10 A; T_j = 175 ^\circ C; \text{Fig. 12}$</td>
<td>-</td>
<td>-</td>
<td>54.5</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = 5 V; I_D = 10 A; T_j = 25 ^\circ C; \text{Fig. 11}$</td>
<td>-</td>
<td>15.7</td>
<td>21.7</td>
<td>mΩ</td>
</tr>
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</table>

Dynamic characteristics FET1 and FET2

<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>$Q_{GD}$</td>
<td>gate-drain charge</td>
<td>$I_D = 10 A; V_{DS} = 64 V; V_{GS} = 5 V; T_j = 25 ^\circ C; \text{Fig. 13; Fig. 14}$</td>
<td>-</td>
<td>8.4</td>
<td>-</td>
<td>nC</td>
</tr>
<tr>
<td>$Q_{G(tot)}$</td>
<td>total gate charge</td>
<td></td>
<td>-</td>
<td>23.1</td>
<td>-</td>
<td>nC</td>
</tr>
</tbody>
</table>
5. Pinning information

Table 2. Pinning information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
<th>Simplified outline</th>
<th>Graphic symbol</th>
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<tbody>
<tr>
<td>1</td>
<td>S1</td>
<td>source1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>gate1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>S2</td>
<td>source2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>G2</td>
<td>gate2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>D2</td>
<td>drain2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>D2</td>
<td>drain2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>D1</td>
<td>drain1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>D1</td>
<td>drain1</td>
<td></td>
<td></td>
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6. Ordering information

Table 3. Ordering information

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<thead>
<tr>
<th>Package</th>
<th>Type number</th>
<th>Description</th>
<th>Version</th>
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</thead>
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<tr>
<td>LFPAK56D</td>
<td>BUK9K22-80E</td>
<td>plastic, single ended surface mounted package (LFPAK56D); 8 leads</td>
<td>SOT1205</td>
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</tbody>
</table>

7. Marking

Table 4. Marking codes

<table>
<thead>
<tr>
<th>Type number</th>
<th>Marking code</th>
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<tr>
<td>BUK9K22-80E</td>
<td>92280E</td>
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</table>
8. Limiting values

Table 5. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

<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>$V_{DS}$</td>
<td>drain-source voltage</td>
<td>$25 , ^\circ C \leq T_j \leq 175 , ^\circ C$</td>
<td>-</td>
<td>80</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DGR}$</td>
<td>drain-gate voltage</td>
<td>$R_{GS} = 20 , k\Omega$</td>
<td>-</td>
<td>80</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GS}$</td>
<td>gate-source voltage</td>
<td>DC; $T_j \leq 175 , ^\circ C$</td>
<td>-10</td>
<td>10</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulsed; $T_j \leq 175 , ^\circ C$</td>
<td>[1]</td>
<td>[2]</td>
<td></td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_{mb} = 25 , ^\circ C$; Fig. 1</td>
<td>-</td>
<td>64</td>
<td>W</td>
</tr>
<tr>
<td>$I_D$</td>
<td>drain current</td>
<td>$V_{GS} = 5 , V$; $T_{mb} = 25 , ^\circ C$; Fig. 2</td>
<td>-</td>
<td>21</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = 5 , V$; $T_{sp} = 100 , ^\circ C$; Fig. 2</td>
<td>-</td>
<td>15</td>
<td>A</td>
</tr>
<tr>
<td>$I_{DM}$</td>
<td>peak drain current</td>
<td>pulsed; $t_p \leq 10 , \mu s$; $T_{mb} = 25 , ^\circ C$; Fig. 3</td>
<td>-</td>
<td>84</td>
<td>A</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>storage temperature</td>
<td>-55</td>
<td>175</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td>-55</td>
<td>175</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

Source-drain diode FET1 and FET2

| $I_S$ | source current | $T_{mb} = 25 \, ^\circ C$ | - | 21 | A |
| $I_{SM}$ | peak source current | pulsed; $t_p \leq 10 \, \mu s$; $T_{mb} = 25 \, ^\circ C$ | - | 84 | A |

Avalanche ruggedness FET1 and FET2

| $E_{DS(AlS)}$ | non-repetitive drain-source avalanche energy | $I_D = 21 \, A$; $V_{sup} \leq 80 \, V$; $R_{GS} = 50 \, \Omega$; $V_{GS} = 5 \, V$; $T_{j(init)} = 25 \, ^\circ C$; unclamped; Fig. 4 | 116 | mJ |

[1] Accumulated pulse duration up to 50 hours delivers zero defect ppm
[2] Significantly longer life times are achieved by lowering $T_j$ and or $V_{GS}$
[3] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C
[4] Refer to application note AN10273 for further information
**Fig. 1.** Normalized total power dissipation as a function of mounting base temperature

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

**Fig. 2.** Continuous drain current as a function of mounting base temperature, FET1 and FET2

**Fig. 3.** Safe operating area; continuous and peak drain currents as a function of drain-source voltage, FET1 and FET2

\[ T_{mb} = 25 ^\circ\text{C}; \ I_{DM} \text{ is a single pulse} \]
9. Thermal characteristics

Table 6. Thermal 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>$R_{th(j-mb)}$</td>
<td>thermal resistance from junction to mounting base</td>
<td>Fig. 5</td>
<td>-</td>
<td>-</td>
<td>2.36</td>
<td>K/W</td>
</tr>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>Minimum footprint; mounted on a printed circuit board</td>
<td>-</td>
<td>95</td>
<td>-</td>
<td>K/W</td>
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</tbody>
</table>

Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration, FET1 and FET2
10. Characteristics

<table>
<thead>
<tr>
<th>Table 7. Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
</tr>
<tr>
<td>( V_{\text{BRDSS}} )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( V_{\text{GS(\text{th})}} )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( I_{\text{DSS}} )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( I_{\text{GSS}} )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( R_{\text{DSon}} )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( Q_{\text{G(tot)}} )</td>
</tr>
<tr>
<td>( Q_{\text{GS}} )</td>
</tr>
<tr>
<td>( Q_{\text{GD}} )</td>
</tr>
<tr>
<td>( C_{\text{iss}} )</td>
</tr>
<tr>
<td>( C_{\text{oss}} )</td>
</tr>
<tr>
<td>( C_{\text{rss}} )</td>
</tr>
<tr>
<td>( t_{\text{d(on)}} )</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>( t_r )</td>
</tr>
<tr>
<td>( t_{\text{d(off)}} )</td>
</tr>
<tr>
<td>( t_f )</td>
</tr>
</tbody>
</table>

Source-drain diode FET1 and FET2

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|
| \( V_{\text{SD}} \) | source-drain voltage | \( I_S = 10 \, A; V_{GS} = 0 \, V; T_j = 25 \, ^\circ C; \) | - | 0.8 | 1.2 | V |
| \( t_{\text{tr}} \) | reverse recovery time | \( I_S = 10 \, A; \) | - | 28.4 | - | ns |
| \( Q_r \) | recovered charge | \( V_{DS} = 25 \, V; T_j = 25 \, ^\circ C; \) | - | 33 | - | nC |

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**BUK9K22-80E**  
Dual N-channel 80 V, 22 mΩ logic level MOSFET

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**Fig. 6.** Output characteristics; drain current as a function of drain-source voltage; typical values, FET1 and FET2  
- $V_{DS} = 12$ V  
- $I_D = 10$ A  
- $T_j = 25$ °C

**Fig. 7.** Drain-source on-state resistance as a function of gate-source voltage; typical values, FET1 and FET2  
- $R_{DSon} = 25$ °C; $I_D = 10$ A

---

**Fig. 8.** Transfer characteristics; drain current as a function of gate-source voltage; typical values, FET1 and FET2  
- $V_{DS} = 12$ V  
- $T_j = 25$ °C

**Fig. 9.** Sub-threshold drain current as a function of gate-source voltage, FET1 and FET2  
- $T_j = 25$ °C; $V_{DS} = 5$ V

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**Fig. 10.** Gate-source threshold voltage as a function of junction temperature, FET1 and FET2

**Fig. 11.** Drain-source on-state resistance as a function of drain current; typical values, FET1 and FET2

**Fig. 12.** Normalized drain-source on-state resistance factor as a function of junction temperature, FET1 and FET2

**Fig. 13.** Gate-source voltage as a function of gate charge; typical values, FET1 and FET2
Fig. 14. Gate charge waveform definitions

Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values, FET1 and FET2

Fig. 16. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values, FET1 and FET2
11. Package outline

Plastic single ended surface mounted package LFPAK56D; 8 leads

SOT1205

Fig. 17. Package outline LFPAK56D (SOT1205)
12. Legal information

Data sheet status

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

[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 https://www.nexperia.com.

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