N-CHANNEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR

Product Summary

<table>
<thead>
<tr>
<th>Bvoss</th>
<th>Rds(On) Max</th>
<th>Id Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>60V</td>
<td>7.5Ω @ Vgs = 5V</td>
<td>210mA</td>
</tr>
</tbody>
</table>

Description and Applications

This MOSFET has been designed to minimize the on-state resistance (Rds(On)) and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

- Motor Control
- Power Management Functions

Features and Benefits

- Low On-Resistance
- Low Gate Threshold Voltage
- Low Input Capacitance
- Fast Switching Speed
- Small Surface Mount Package
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. “Green” Device (Notes 3)
- Qualified to AEC-Q101 Standards for High Reliability
- PPAP Capable (Note 4)

Mechanical Data

- Case: SOT23
- UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections: See Diagram
- Weight: 0.009 grams (Approximate)

Ordering Information (Note 5)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Compliance</th>
<th>Case</th>
<th>Packaging</th>
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<tbody>
<tr>
<td>2N7002-7-F</td>
<td>Standard</td>
<td>SOT23</td>
<td>3,000/Tape &amp; Reel</td>
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<tr>
<td>2N7002-13-F</td>
<td>Standard</td>
<td>SOT23</td>
<td>10,000/Tape &amp; Reel</td>
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<tr>
<td>2N7002Q-7-F</td>
<td>Automotive</td>
<td>SOT23</td>
<td>3,000/Tape &amp; Reel</td>
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</table>

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, “Green” and Lead-free.
3. Halogen- and Antimony-free “Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. Automotive products are AEC-Q101 qualified and are PPAP capable. Automotive, AEC-Q101 and standard products are electrically and thermally the same, except where specified. For more information, please refer to https://www.diodes.com/quality/.
5. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information

K72 = Product Type Marking Code
YM = Date Code Marking
Y or Y = Year (ex: F = 2018)
M = Month (ex: 9 = September)

Date Code Key

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<th>Year</th>
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<th>~</th>
<th>2018</th>
<th>2019</th>
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<td>F</td>
<td>G</td>
<td>H</td>
<td>I</td>
<td>J</td>
<td>K</td>
<td>L</td>
<td>M</td>
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<th>Month</th>
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<th>Feb</th>
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<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<td>7</td>
<td>8</td>
<td>9</td>
<td>O</td>
<td>N</td>
<td>D</td>
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### Electrical Characteristics

<table>
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<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Condition</th>
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<tbody>
<tr>
<td>OFF CHARACTERISTICS (Note 8)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Drain-Source Breakdown Voltage</td>
<td>BV_{DSS}</td>
<td>60</td>
<td>70</td>
<td>—</td>
<td>V</td>
<td>V_{GS} = 0V, I_{D} = 10\mu A</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>I_{DSS}</td>
<td>—</td>
<td>—</td>
<td>1.0</td>
<td>500</td>
<td>V_{GS} = 60V, V_{GS} = 0V</td>
</tr>
<tr>
<td>Gate-Body Leakage</td>
<td>I_{GS}</td>
<td>—</td>
<td>—</td>
<td>±10</td>
<td>nA</td>
<td>V_{GS} = ±20V, V_{DS} = 0V</td>
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<tr>
<td>ON CHARACTERISTICS (Note 8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>V_{GS(TH)}</td>
<td>1.0</td>
<td>—</td>
<td>2.5</td>
<td>V</td>
<td>V_{DS} = V_{GS}, I_{D} = 250\mu A</td>
</tr>
<tr>
<td>Static Drain-Source On-Resistance</td>
<td>R_{DSS(ON)}</td>
<td>—</td>
<td>3.2</td>
<td>7.5</td>
<td>Ω</td>
<td>V_{GS} = 5.0V, I_{D} = 0.05A</td>
</tr>
<tr>
<td>On-State Drain Current</td>
<td>I_{D(ON)}</td>
<td>0.5</td>
<td>1.0</td>
<td>—</td>
<td>A</td>
<td>V_{GS} = 10V, V_{DS} = 7.5V</td>
</tr>
<tr>
<td>Forward Transconductance</td>
<td>g_{FS}</td>
<td>80</td>
<td>—</td>
<td>—</td>
<td>mS</td>
<td>V_{DS}=10V, I_{D} = 0.2A</td>
</tr>
<tr>
<td>Diode Forward Voltage</td>
<td>V_{FD}</td>
<td>0.78</td>
<td>—</td>
<td>1.5</td>
<td>V</td>
<td>V_{GS} = 0V, I_{S} = 115mA</td>
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<tr>
<td>DYNAMIC CHARACTERISTICS (Note 9)</td>
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<td></td>
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<tr>
<td>Input Capacitance</td>
<td>C_{iss}</td>
<td>—</td>
<td>22</td>
<td>50</td>
<td>pF</td>
<td>V_{DS} = 25V, V_{GS} = 0V</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>C_{oss}</td>
<td>—</td>
<td>11</td>
<td>25</td>
<td>pF</td>
<td>f = 1.0MHz</td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>C_{rss}</td>
<td>—</td>
<td>2.0</td>
<td>5.0</td>
<td>pF</td>
<td>V_{DS} = 0V, V_{GS} = 0V</td>
</tr>
<tr>
<td>Gate Resistance</td>
<td>R_{g}</td>
<td>—</td>
<td>120</td>
<td>—</td>
<td>Ω</td>
<td>f = 1.0MHz</td>
</tr>
<tr>
<td>Total Gate Charge (V_{GS} = 4.5V)</td>
<td>Q_{g}</td>
<td>—</td>
<td>223</td>
<td>—</td>
<td>pC</td>
<td>V_{DS} = 10V, I_{D} = 250mA</td>
</tr>
<tr>
<td>Gate-Source Charge</td>
<td>Q_{gs}</td>
<td>—</td>
<td>82</td>
<td>—</td>
<td>pC</td>
<td>V_{DS} = 10V, I_{D} = 250mA</td>
</tr>
<tr>
<td>Gate-Drain Charge</td>
<td>Q_{gd}</td>
<td>—</td>
<td>178</td>
<td>—</td>
<td></td>
<td>V_{DS} = 20V, I_{D} = 0.2A</td>
</tr>
<tr>
<td>SWITCHING CHARACTERISTICS (Note 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>I_{D(ON)}</td>
<td>—</td>
<td>2.8</td>
<td>—</td>
<td>ns</td>
<td>V_{DD} = 30V, I_{D} = 0.2A</td>
</tr>
<tr>
<td>Turn-On Rise Time</td>
<td>I_{R}</td>
<td>—</td>
<td>3.0</td>
<td>—</td>
<td></td>
<td>R_{L} = 150Ω, V_{GEN} = 10V, R_{GEN} = 250Ω</td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>I_{D(OFF)}</td>
<td>—</td>
<td>7.6</td>
<td>—</td>
<td></td>
<td>V_{DS} = 20V, I_{D} = 0.2A</td>
</tr>
<tr>
<td>Turn-Off Fall Time</td>
<td>I_{f}</td>
<td>—</td>
<td>5.6</td>
<td>—</td>
<td></td>
<td>V_{DS} = 20V, I_{D} = 0.2A</td>
</tr>
</tbody>
</table>

**Notes:**
6. Device mounted on FR-4 PCB, with minimum recommended pad layout.
7. Device mounted on 1" x 1" FR-4 PCB with high coverage 2oz. Copper, single sided.
8. Short duration pulse test used to minimize self-heating effect.
9. Guaranteed by design. Not subject to product testing.
**Fig. 1** On-Region Characteristics

**Fig. 2** On-Resistance vs. Drain Current

**Fig. 3** On-Resistance vs. Junction Temperature

**Fig. 4** On-Resistance vs. Gate-Source Voltage

**Fig. 5** Typical Transfer Characteristics

**Fig. 6** Max Power Dissipation vs. Ambient Temperature
Package Outline Dimensions
Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT23

<table>
<thead>
<tr>
<th>Dim</th>
<th>Min</th>
<th>Max</th>
<th>Typ</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.37</td>
<td>0.51</td>
<td>0.40</td>
</tr>
<tr>
<td>B</td>
<td>1.20</td>
<td>1.40</td>
<td>1.30</td>
</tr>
<tr>
<td>C</td>
<td>2.30</td>
<td>2.50</td>
<td>2.40</td>
</tr>
<tr>
<td>D</td>
<td>0.89</td>
<td>1.03</td>
<td>0.915</td>
</tr>
<tr>
<td>F</td>
<td>0.45</td>
<td>0.60</td>
<td>0.535</td>
</tr>
<tr>
<td>G</td>
<td>1.78</td>
<td>2.05</td>
<td>1.83</td>
</tr>
<tr>
<td>H</td>
<td>2.80</td>
<td>3.00</td>
<td>2.90</td>
</tr>
<tr>
<td>J</td>
<td>0.013</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>K</td>
<td>0.890</td>
<td>1.00</td>
<td>0.975</td>
</tr>
<tr>
<td>K1</td>
<td>0.903</td>
<td>1.10</td>
<td>1.025</td>
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<tr>
<td>L</td>
<td>0.45</td>
<td>0.61</td>
<td>0.55</td>
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<tr>
<td>L1</td>
<td>0.25</td>
<td>0.55</td>
<td>0.40</td>
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<tr>
<td>M</td>
<td>0.085</td>
<td>0.150</td>
<td>0.110</td>
</tr>
<tr>
<td>a</td>
<td>0°</td>
<td>8°</td>
<td>--</td>
</tr>
</tbody>
</table>

All Dimensions in mm

Suggested Pad Layout
Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT23

Dimensions Value (in mm)
| C   | 2.0 |
| X   | 0.8 |
| X1  | 1.35|
| Y   | 0.9 |
| Y1  | 2.9 |
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