

**TM09N02I**

**N-Channel Enhancement Mosfet**

**General Description**

- Low  $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

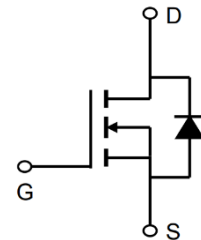
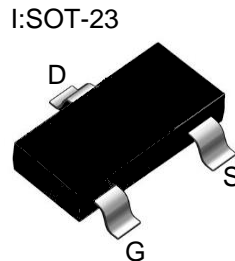
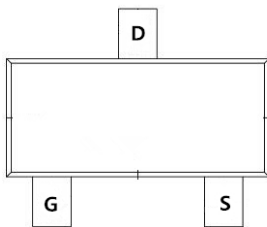
**Applications**

- Load switch
- PWM

**Product Summary**

$V_{DS} = 20V$   $I_D = 9.0A$   
 $R_{DS(ON)} = 11\text{ m}\Omega(\text{Typ.}) @ V_{GS}=4.5V$

100% UIS Tested  
 100%  $R_g$  Tested



Marking: 07N02 OR 2312

**Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$  unless otherwise noted)**

| Symbol                     | Parameter                                   | Rating     | Units            |
|----------------------------|---|------------|------------------|
| $V_{DS}$                   | Drain-Source Voltage                        | 20         | V                |
| $V_{GS}$                   | Gate-Source Voltage                         | $\pm 12$   | V                |
| $I_D@T_A=25^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 4.5V^1$ | 7.5        | A                |
| $I_D@T_A=70^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 4.5V^1$ | 5.0        | A                |
| $I_{DM}$                   | Pulsed Drain Current <sup>2</sup>           | 32         | A                |
| $P_D@T_A=25^\circ\text{C}$ | Total Power Dissipation <sup>3</sup>        | 2          | W                |
| $P_D@T_A=70^\circ\text{C}$ | Total Power Dissipation <sup>3</sup>        | 0.66       | W                |
| $T_{STG}$                  | Storage Temperature Range                   | -55 to 150 | $^\circ\text{C}$ |
| $T_J$                      | Operating Junction Temperature Range        | -55 to 150 | $^\circ\text{C}$ |

**Thermal Data**

| Symbol          | Parameter  | Max. | Unit               |
|-----------------|--|------|--------------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-ambient <sup>1</sup> | 120  | $^\circ\text{C/W}$ |

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Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise specified)

| Symbol  | Parameter  | Test Condition  | Min. | Typ. | Max. | Units |
|---|--|---|------|------|------|-------|
| <b>Off Characteristic</b>                                     |  |   |      |      |      |       |
| V <sub>(BR)DSS</sub>  | Drain-Source Breakdown Voltage                           | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA  | 20   | -    | -    | V     |
| I <sub>DSS</sub>  | Zero Gate Voltage Drain Current                          | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V,  | -    | -    | 1.0  | μA    |
| I <sub>GSS</sub>  | Gate to Body Leakage Current                             | V <sub>DS</sub> =0V, V <sub>GS</sub> =±12V  | -    | -    | ±100 | nA    |
| <b>On Characteristics</b>                                     |  |   |      |      |      |       |
| V <sub>GS(th)</sub>   | Gate Threshold Voltage                                   | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                    | 0.5  | 0.7  | 1.2  | V     |
| R <sub>DS(on)</sub>   | Static Drain-Source on-Resistance<br>note2               | V <sub>GS</sub> =4.5V, I <sub>D</sub> =8A   | -    | 11   | 16   | mΩ    |
|   |  | V <sub>GS</sub> =2.5V, I <sub>D</sub> =5A   | -    | 15   | 22.5 |       |
| <b>Dynamic Characteristics</b>                                |  |   |      |      |      |       |
| C <sub>iss</sub>  | Input Capacitance  | V <sub>DS</sub> =10V, V <sub>GS</sub> =0V,<br>f=1.0MHz                                      | -    | 700  | -    | pF    |
| C <sub>oss</sub>  | Output Capacitance                                       |   | -    | 132  | -    | pF    |
| C <sub>rss</sub>  | Reverse Transfer Capacitance                             |   | -    | 114  | -    | pF    |
| Q <sub>g</sub>  | Total Gate Charge  | V <sub>DS</sub> =10V, I <sub>D</sub> =4A,<br>V <sub>GS</sub> =4.5V                          | -    | 15   | -    | nC    |
| Q <sub>gs</sub>   | Gate-Source Charge                                       |   | -    | 2    | -    | nC    |
| Q <sub>gd</sub>   | Gate-Drain("Miller") Charge                              |   | -    | 5.2  | -    | nC    |
| <b>Switching Characteristics</b>                              |  |   |      |      |      |       |
| t <sub>d(on)</sub>  | Turn-on Delay Time                                       | V <sub>DS</sub> =10V,<br>I <sub>D</sub> =4A, R <sub>GEN</sub> =3Ω,<br>V <sub>GS</sub> =4.5V | -    | 9    | -    | ns    |
| t <sub>r</sub>  | Turn-on Rise Time  |   | -    | 25   | -    | ns    |
| t <sub>d(off)</sub>   | Turn-off Delay Time                                      |   | -    | 37   | -    | ns    |
| t <sub>f</sub>  | Turn-off Fall Time                                       |   | -    | 14   | -    | ns    |
| <b>Drain-Source Diode Characteristics and Maximum Ratings</b> |  |   |      |      |      |       |
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current |   | -    | -    | 9.0  | A     |
| I <sub>SM</sub>   | Maximum Pulsed Drain to Source Diode Forward Current     |   | -    | -    | 32   | A     |
| V <sub>SD</sub>   | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> =0V, I <sub>S</sub> =8A   | -    | -    | 1.2  | V     |

Notes:1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature

2. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%

### Typical Performance Characteristics

Figure 1: Output Characteristics

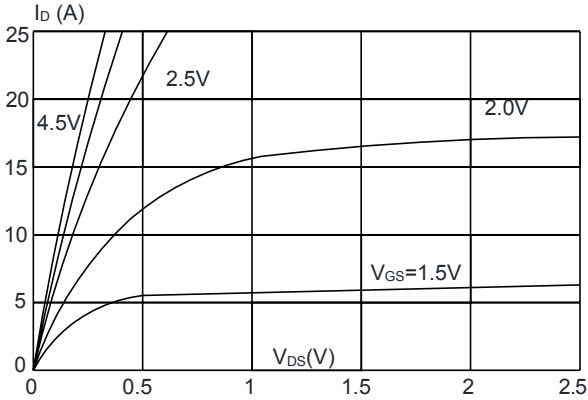


Figure 2: Typical Transfer Characteristics

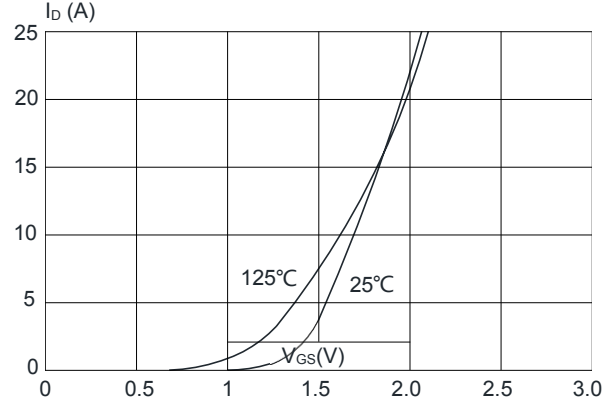


Figure 3: On-resistance vs. Drain Current

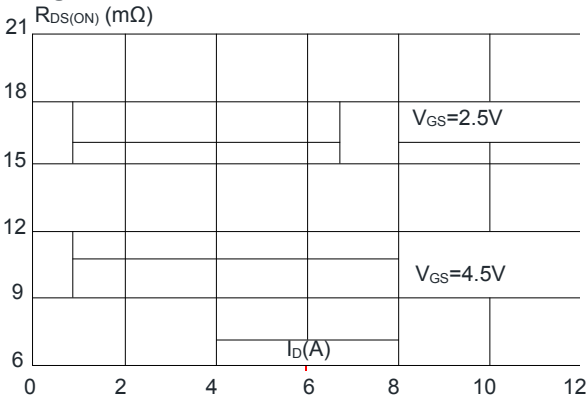


Figure 4: Body Diode Characteristics

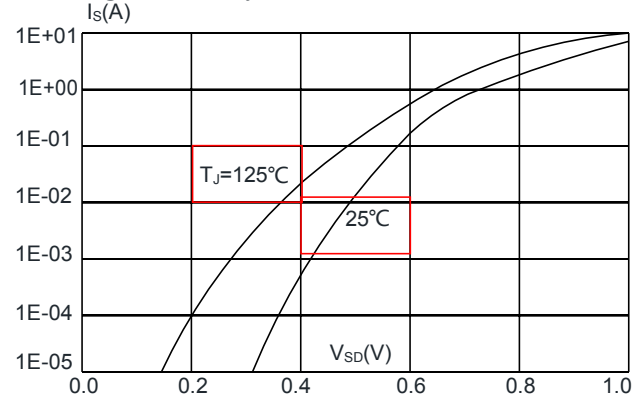


Figure 5: Gate Charge Characteristics

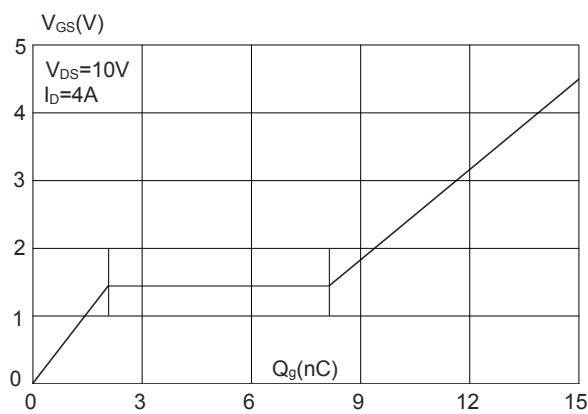
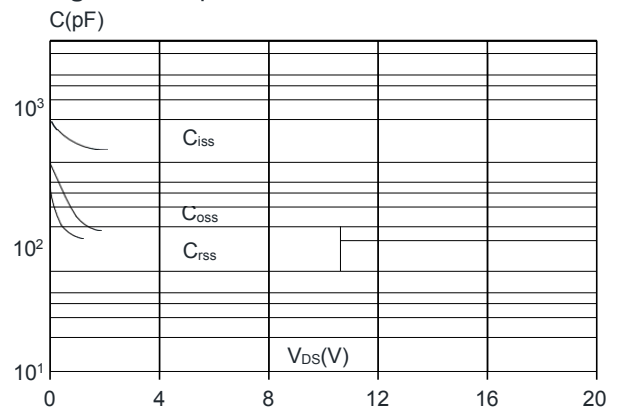


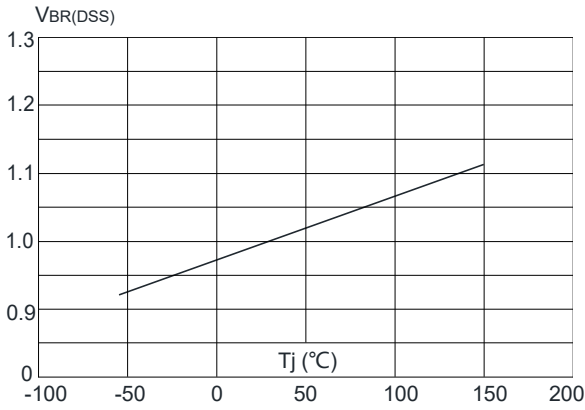
Figure 6: Capacitance Characteristics



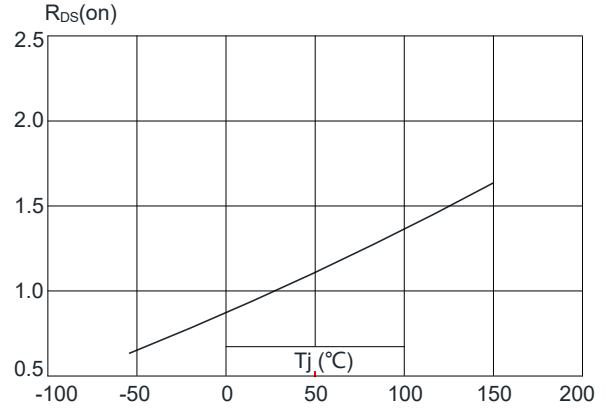
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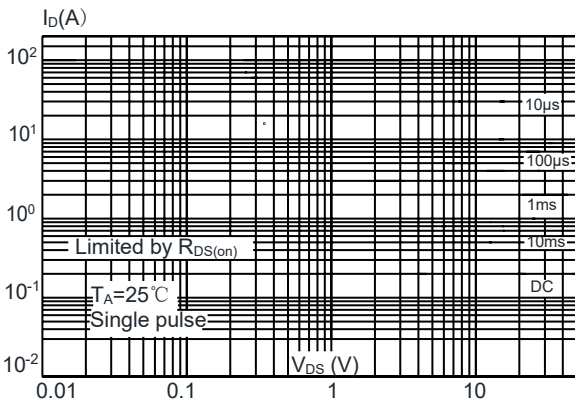
**Figure 7:** Normalized Breakdown Voltage vs. Junction Temperature



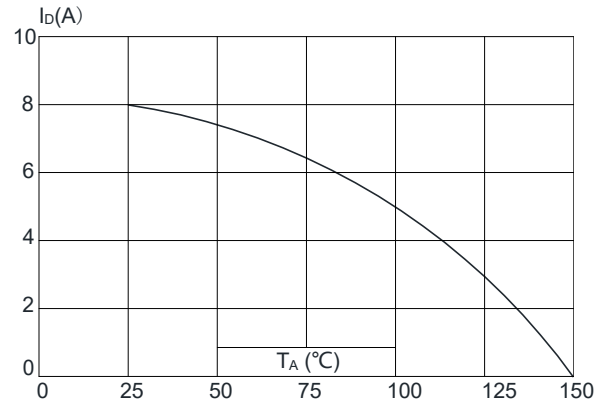
**Figure 8:** Normalized on Resistance vs. Junction Temperature



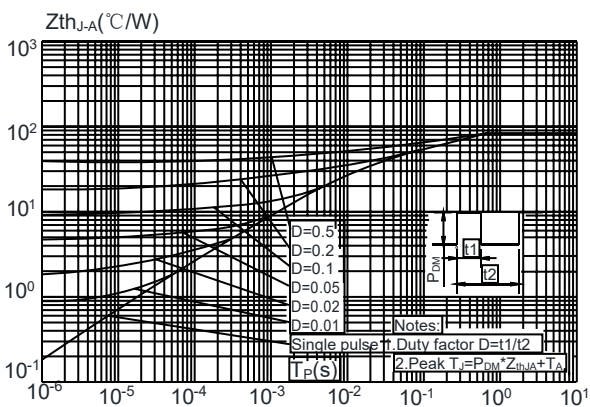
**Figure 9:** Maximum Safe Operating Area



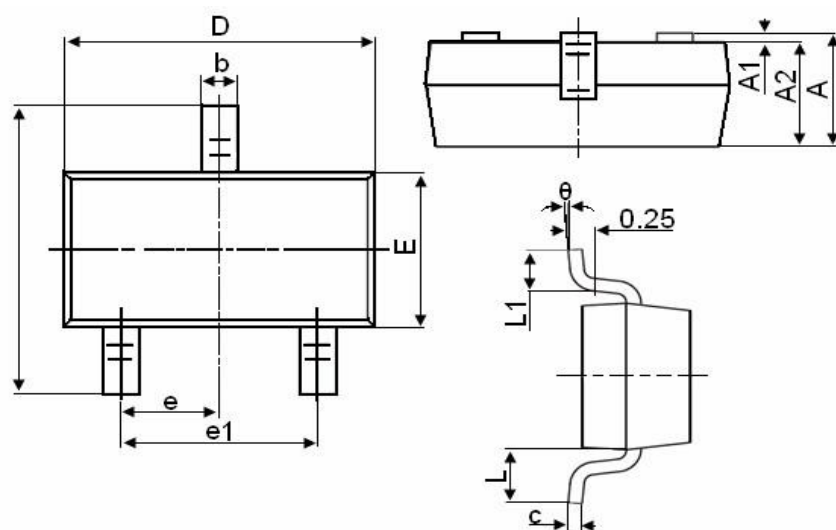
**Figure 10:** Maximum Continuous Drain Current vs. Ambient Temperature



**Figure.11:** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient



## Package Mechanical Data: SOT-23



| Symbol | Dimensions in Millimeters |       |
|--------|---------------------------|-------|
|        | MIN.                      | MAX.  |
| A      | 0.900                     | 1.150 |
| A1     | 0.000                     | 0.100 |
| A2     | 0.900                     | 1.050 |
| b      | 0.300                     | 0.500 |
| c      | 0.080                     | 0.150 |
| D      | 2.800                     | 3.000 |
| E      | 1.200                     | 1.400 |
| E1     | 2.250                     | 2.550 |
| e      | 0.950TYP                  |       |
| e1     | 1.800                     | 2.000 |
| L      | 0.550REF                  |       |
| L1     | 0.300                     | 0.500 |
| θ      | 0°                        | 8°    |