

## TM09N02I

## N-Channel Enhancement Mosfet

### General Description

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

### Applications

- Load switch
- PWM

### Product Summary

$V_{DS} = 20V$   $I_D = 8.8A$

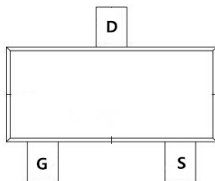
$R_{DS(ON)} = 11 m\Omega (Typ.) @ V_{GS} = 4.5V$

100% UIS Tested

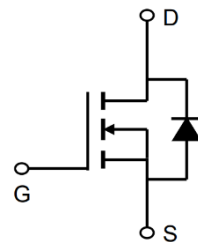
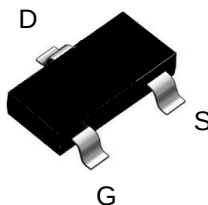
100%  $R_g$  Tested



I:SOT-23



Marking: 2312



### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise noted)

| Symbol                   | Parameter                                   | Rating     | Units      |
|--------------------------|---------------------------------------------|------------|------------|
| $V_{DS}$                 | Drain-Source Voltage                        | 20         | V          |
| $V_{GS}$                 | Gate-Source Voltage                         | $\pm 12$   | V          |
| $I_D @ T_A = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 4.5V^1$ | 8.8        | A          |
| $I_D @ T_A = 70^\circ C$ | Continuous Drain Current, $V_{GS} @ 4.5V^1$ | 4.9        | A          |
| $I_{DM}$                 | Pulsed Drain Current <sup>2</sup>           | 30         | A          |
| $P_D @ T_A = 25^\circ C$ | Total Power Dissipation <sup>3</sup>        | 2          | W          |
| $P_D @ T_A = 70^\circ C$ | Total Power Dissipation <sup>3</sup>        | 0.66       | W          |
| $T_{STG}$                | Storage Temperature Range                   | -55 to 150 | $^\circ C$ |
| $T_J$                    | Operating Junction Temperature Range        | -55 to 150 | $^\circ C$ |

### Thermal Data

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

**TM09N02I****N-Channel Enhancement Mosfet****Electrical Characteristics** ( $T_J=25^{\circ}\text{C}$  unless otherwise specified)

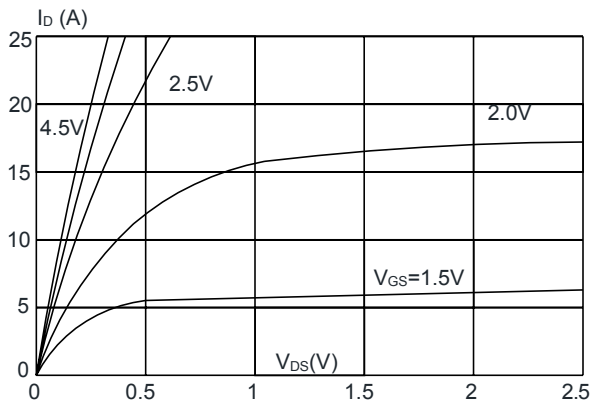
| Symbol                                                 | Parameter                                                 | Test Condition                                                                              | Min. | Typ. | Max. | Units |
|--------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------|------|------|------|-------|
| Off Characteristic                                     |                                                           |                                                                                             |      |      |      |       |
| 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    |
| On Characteristics                                     |                                                           |                                                                                             |      |      |      |       |
| 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><small>note2</small> | 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 |       |
| Dynamic Characteristics                                |                                                           |                                                                                             |      |      |      |       |
| 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    |
| Switching Characteristics                              |                                                           |                                                                                             |      |      |      |       |
| 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    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                           |                                                                                             |      |      |      |       |
| 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

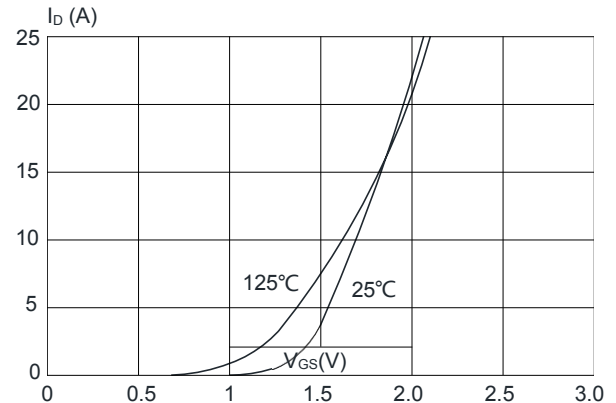
2. Pulse Test: Pulse Width $\leq 300\mu s$ , Duty Cycle $\leq 0.5\%$

## Typical Performance Characteristics

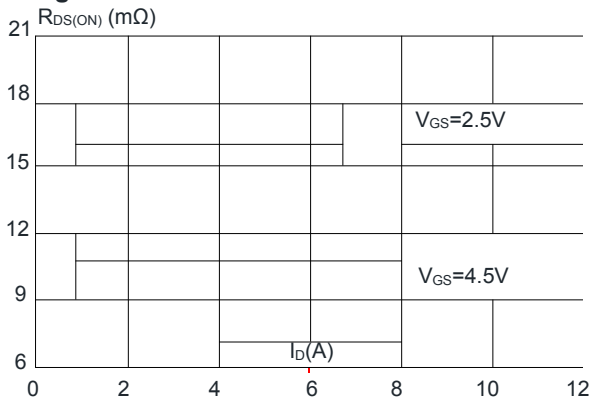
**Figure1: Output Characteristics**



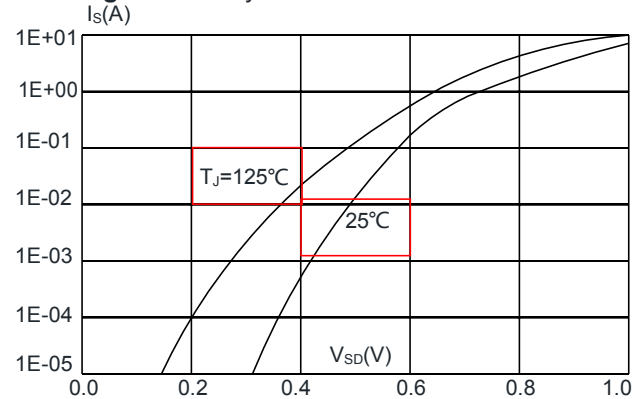
**Figure 2: Typical Transfer Characteristics**



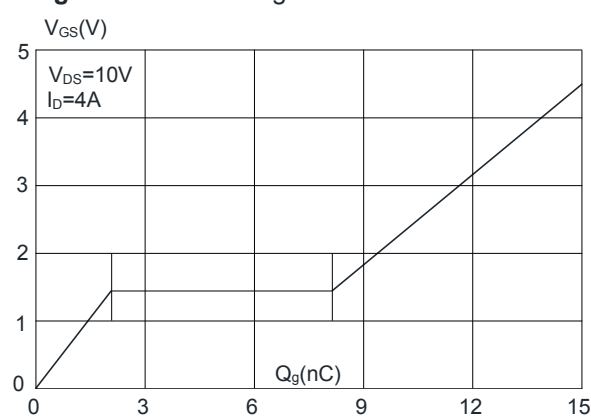
**Figure 3: On-resistance vs. Drain Current**



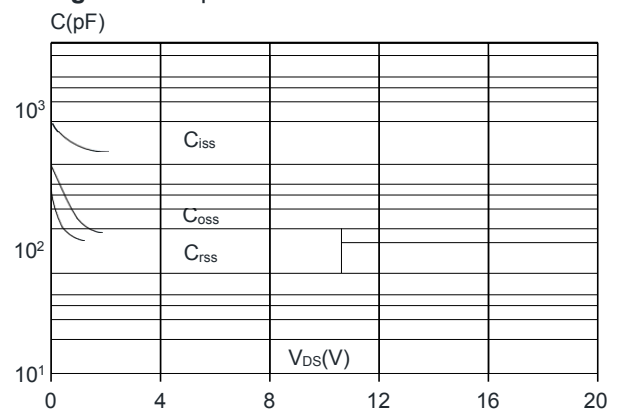
**Figure 4: Body Diode Characteristics**



**Figure 5: Gate Charge Characteristics**



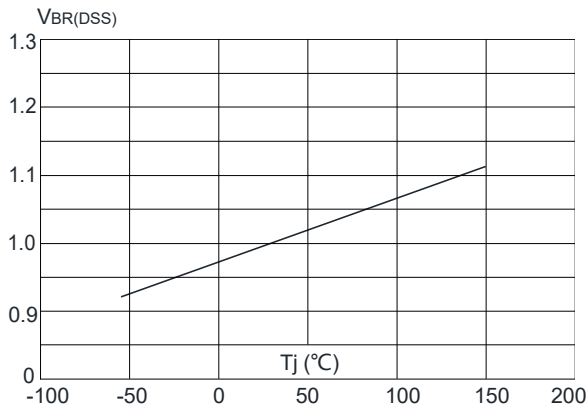
**Figure 6: Capacitance Characteristics**



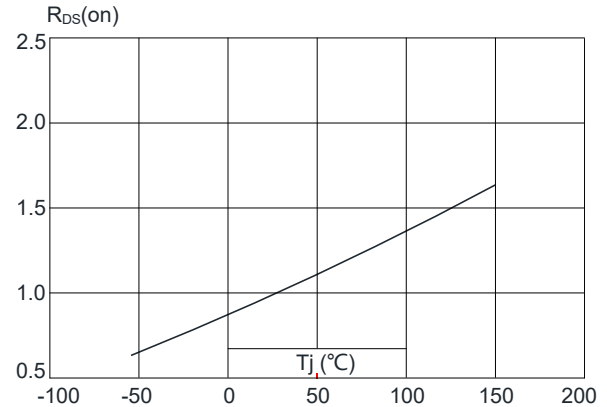
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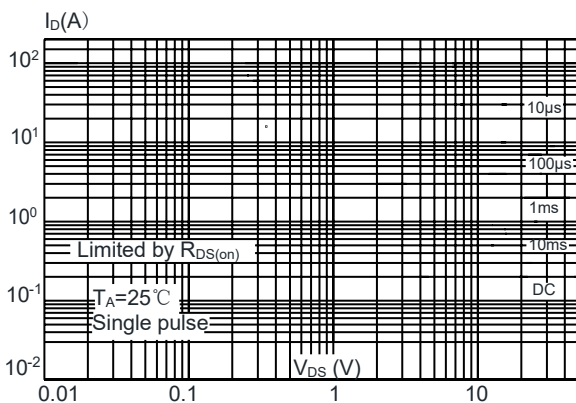
**Figure 7:** Normalized Breakdown Voltage vs. Junction Temperature



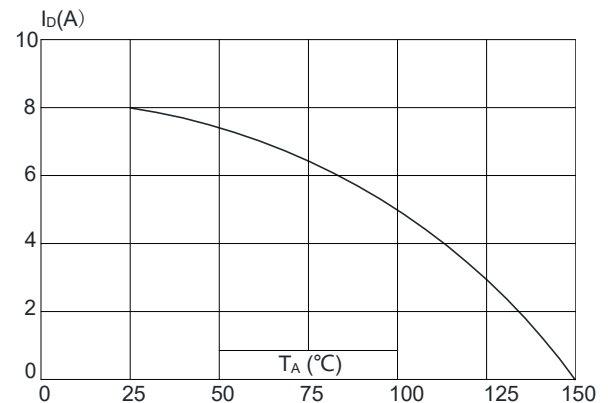
**Figure 8:** Normalized on Resistance vs. Junction Temperature



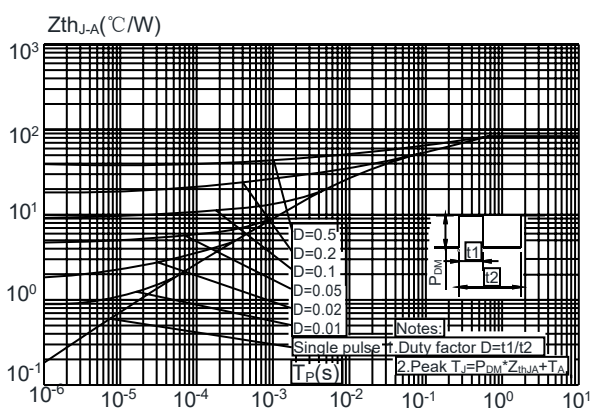
**Figure 9:** Maximum Safe Operating Area



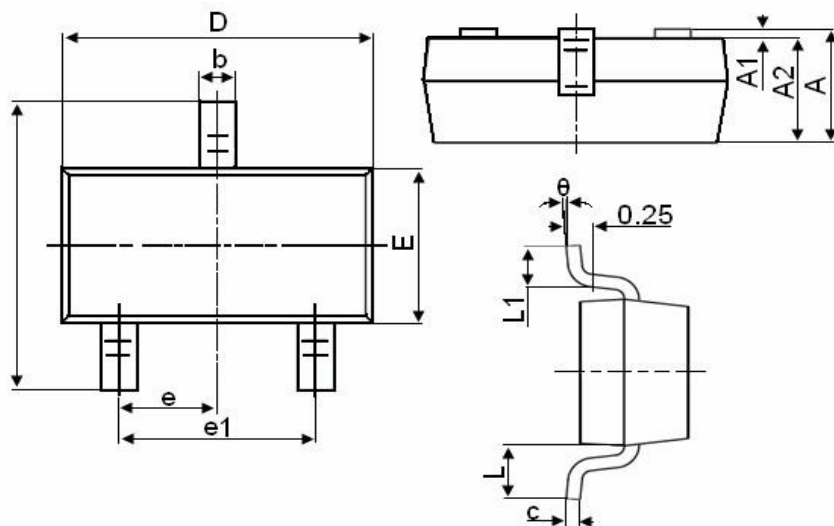
**Figure 10:** Maximum Continuous Drain Current vs. Ambient Temperature



**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 |
| $\theta$ | 0°                        | 8°    |