

## 50V(D-S) N-Channel Enhancement Mode Power MOS FET

### General Features

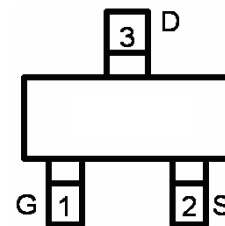
- $V_{DS} = 50V, I_D = 0.22A$   
 $R_{DS(ON)} < 3\Omega @ V_{GS}=5V$   
 $R_{DS(ON)} < 2\Omega @ V_{GS}=10V$
- Lead free product is acquired
- Surface mount package



Lead Free

### Application

- Direct logic-level interface: TTL/CMOS
- Drivers: relays, solenoids, lamps, hammers, display, memories, transistors, etc.
- Battery operated systems
- Solid-state relays

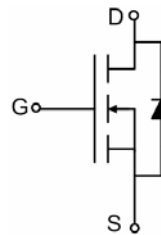


Marking and pin assignment

### PIN Configuration



SOT-23 top view



Schematic diagram

### Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity   |
|----------------|--------|----------------|-----------|------------|------------|
|                | MSN138 | SOT-23         | Ø180mm    | 8 mm       | 3000 units |

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

| Parameter                                        | Symbol         | Limit      | Unit             |
|--------------------------------------------------|----------------|------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 50         | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | V                |
| Drain Current-Continuous                         | $I_D$          | 0.22       | A                |
| Drain Current-Pulsed (Note 1)                    | $I_{DM}$       | 0.88       | A                |
| Maximum Power Dissipation                        | $P_D$          | 0.35       | W                |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 150 | $^\circ\text{C}$ |

### Thermal Characteristic

|                                                  |                 |     |                    |
|--------------------------------------------------|-----------------|-----|--------------------|
| Thermal Resistance, Junction-to-Ambient (Note 2) | $R_{\theta JA}$ | 350 | $^\circ\text{C/W}$ |
|--------------------------------------------------|-----------------|-----|--------------------|

**Electrical Characteristics ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)**

| Parameter                                     | Symbol       | Condition                                                | Min  | Typ | Max       | Unit     |
|-----------------------------------------------|--------------|----------------------------------------------------------|------|-----|-----------|----------|
| Off Characteristics                           |              |                                                          |      |     |           |          |
| Drain-Source Breakdown Voltage                | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                                | 50   | 65  | -         | V        |
| Zero Gate Voltage Drain Current               | $I_{DSS}$    | $V_{DS}=50V, V_{GS}=0V$                                  | -    | -   | 0.5       | $\mu A$  |
| Gate-Body Leakage Current                     | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                              | -    | -   | $\pm 100$ | nA       |
| On Characteristics <sup>(Note 3)</sup>        |              |                                                          |      |     |           |          |
| Gate Threshold Voltage                        | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                            | 0.8  | 1.2 | 1.6       | V        |
| Drain-Source On-State Resistance              | $R_{DS(ON)}$ | $V_{GS}=5V, I_D=0.05A$                                   | -    | 1.2 | 3         | $\Omega$ |
|                                               |              | $V_{GS}=10V, I_D=0.5A$                                   | -    | 1   | 2         | $\Omega$ |
| Forward Transconductance                      | $g_{FS}$     | $V_{DS}=10V, I_D=0.2A$                                   | 0.12 | -   | -         | S        |
| Dynamic Characteristics <sup>(Note4)</sup>    |              |                                                          |      |     |           |          |
| Input Capacitance                             | $C_{ISS}$    | $V_{DS}=25V, V_{GS}=0V,$<br>$F=1.0MHz$                   | -    | 27  | -         | PF       |
| Output Capacitance                            | $C_{OSS}$    |                                                          | -    | 12  | -         | PF       |
| Reverse Transfer Capacitance                  | $C_{RSS}$    |                                                          | -    | 6   | -         | PF       |
| Switching Characteristics <sup>(Note 4)</sup> |              |                                                          |      |     |           |          |
| Turn-on Delay Time                            | $t_{d(on)}$  | $V_{DD}=30V, I_D=0.22A$<br>$V_{GS}=10V, R_{GEN}=6\Omega$ | -    | 2.5 | -         | nS       |
| Turn-on Rise Time                             | $t_r$        |                                                          | -    | 6   | -         | nS       |
| Turn-Off Delay Time                           | $t_{d(off)}$ |                                                          | -    | 20  | -         | nS       |
| Turn-Off Fall Time                            | $t_f$        |                                                          | -    | 7   | -         | nS       |
| Total Gate Charge                             | $Q_g$        | $V_{DS}=25V, I_D=0.3A,$<br>$V_{GS}=10V$                  | -    | 1.7 | 2.4       | nC       |
| Drain-Source Diode Characteristics            |              |                                                          |      |     |           |          |
| Diode Forward Voltage <sup>(Note 3)</sup>     | $V_{SD}$     | $V_{GS}=0V, I_S=0.22A$                                   | -    | -   | 1.3       | V        |
| Diode Forward Current <sup>(Note 2)</sup>     | $I_S$        | -                                                        | -    | -   | 0.22      | A        |

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

## Typical Electrical and Thermal Characteristics

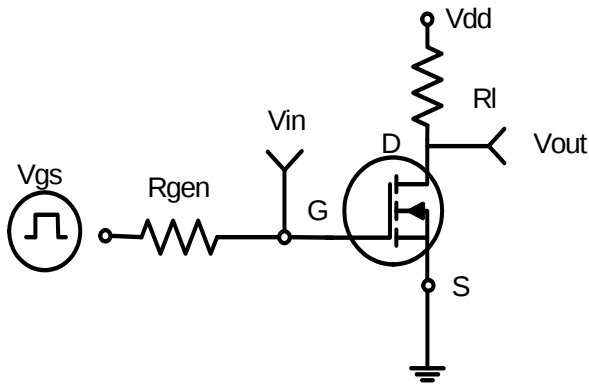


Figure 1: Switching Test Circuit

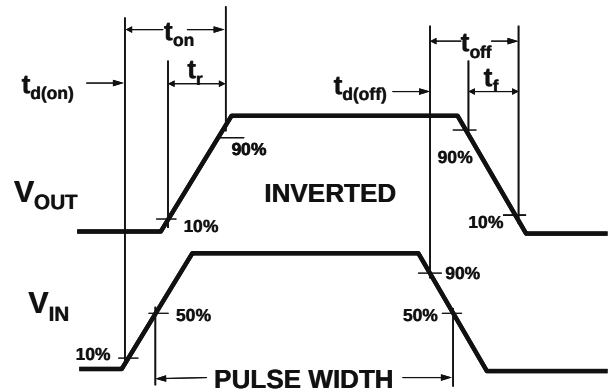


Figure 2: Switching Waveforms

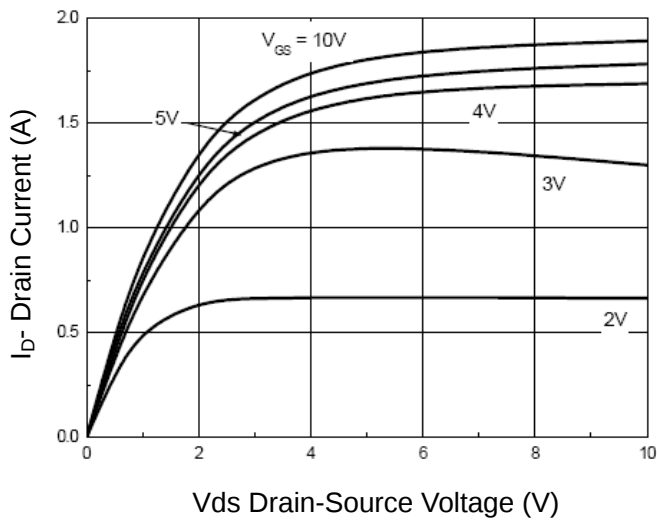


Figure 3 Output Characteristics

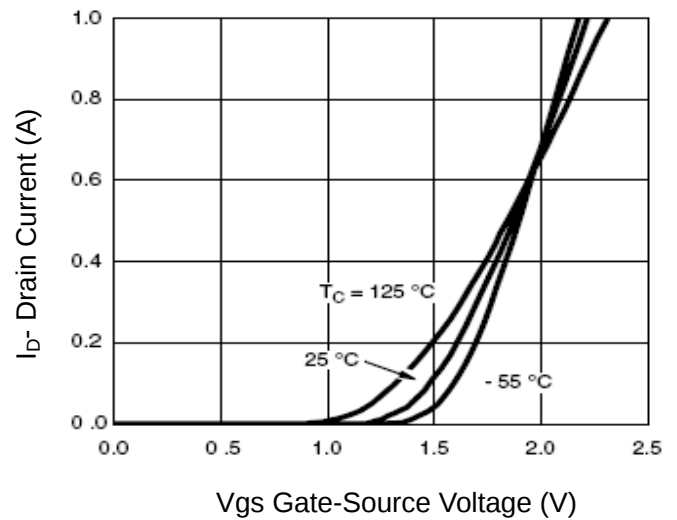


Figure 4 Transfer Characteristics

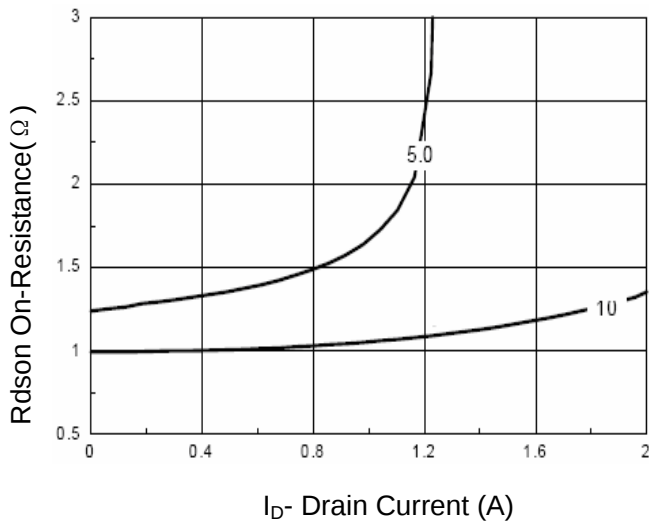


Figure 5 Drain-Source On-Resistance

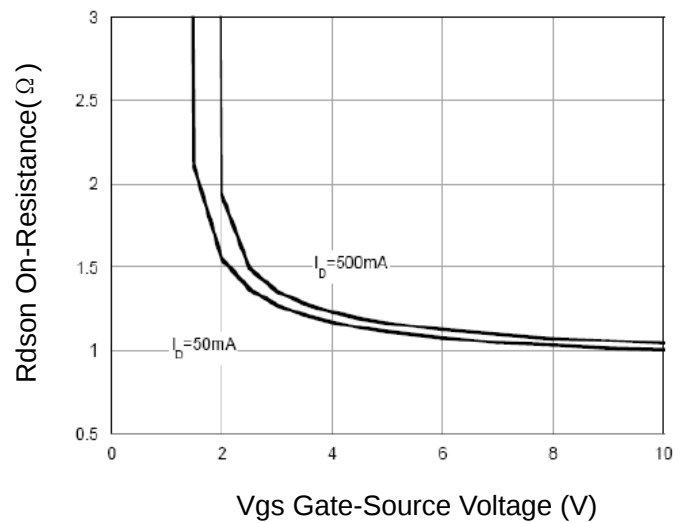
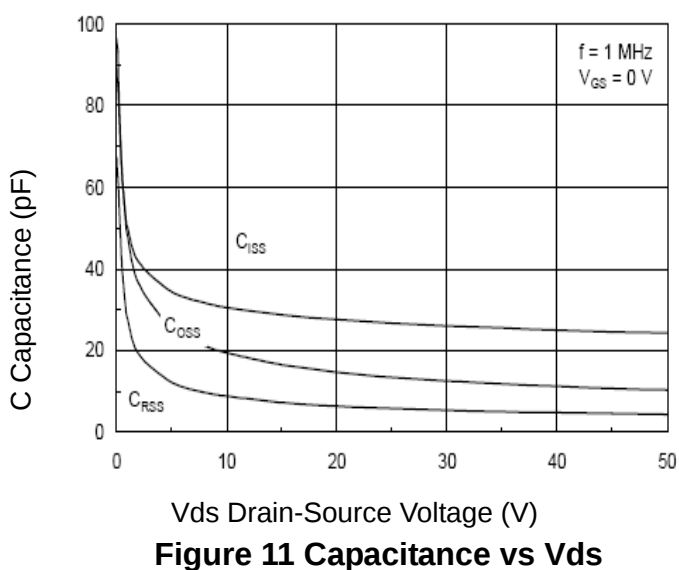
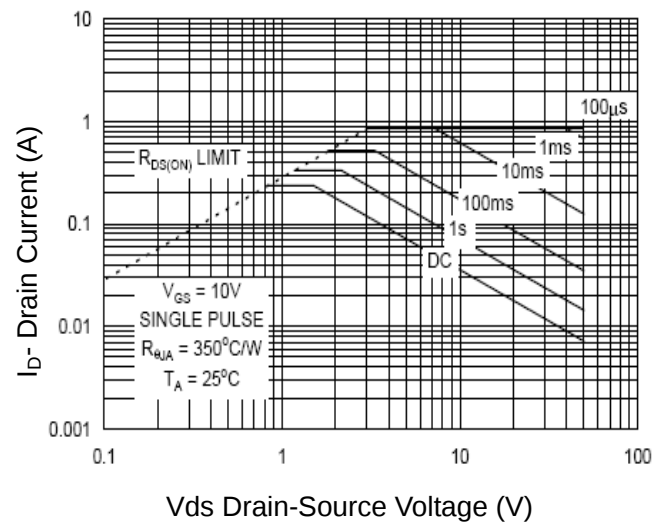
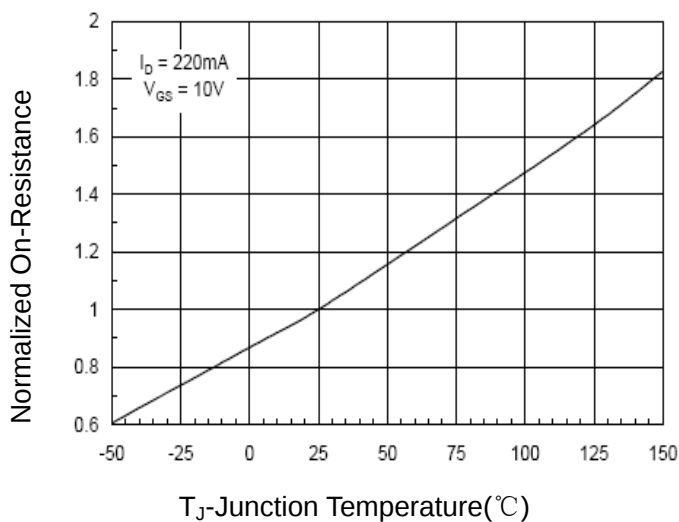
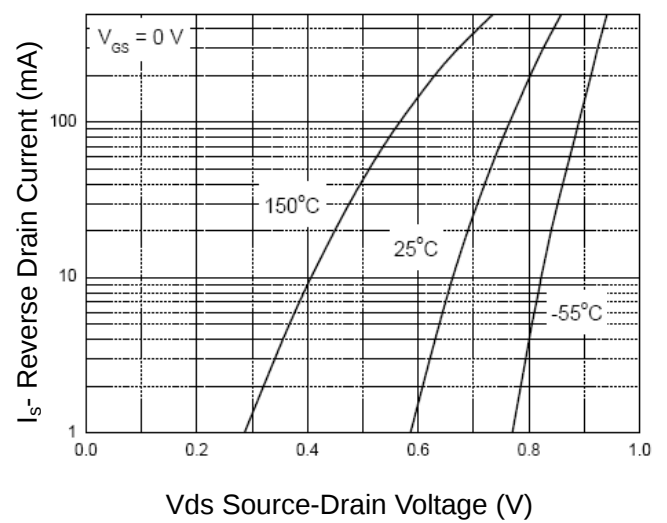
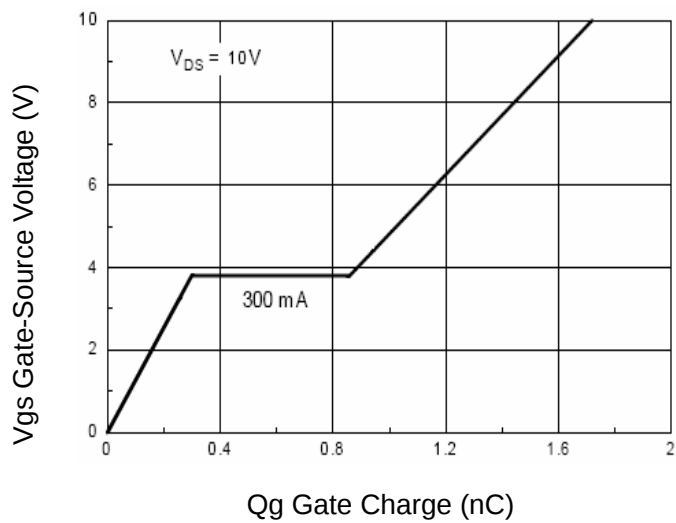
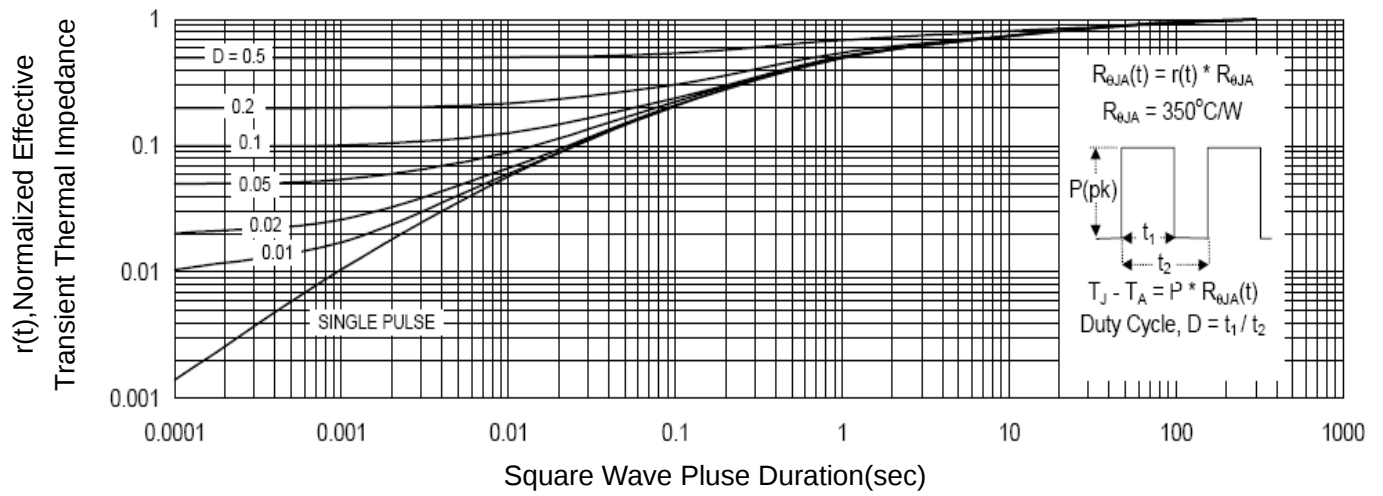


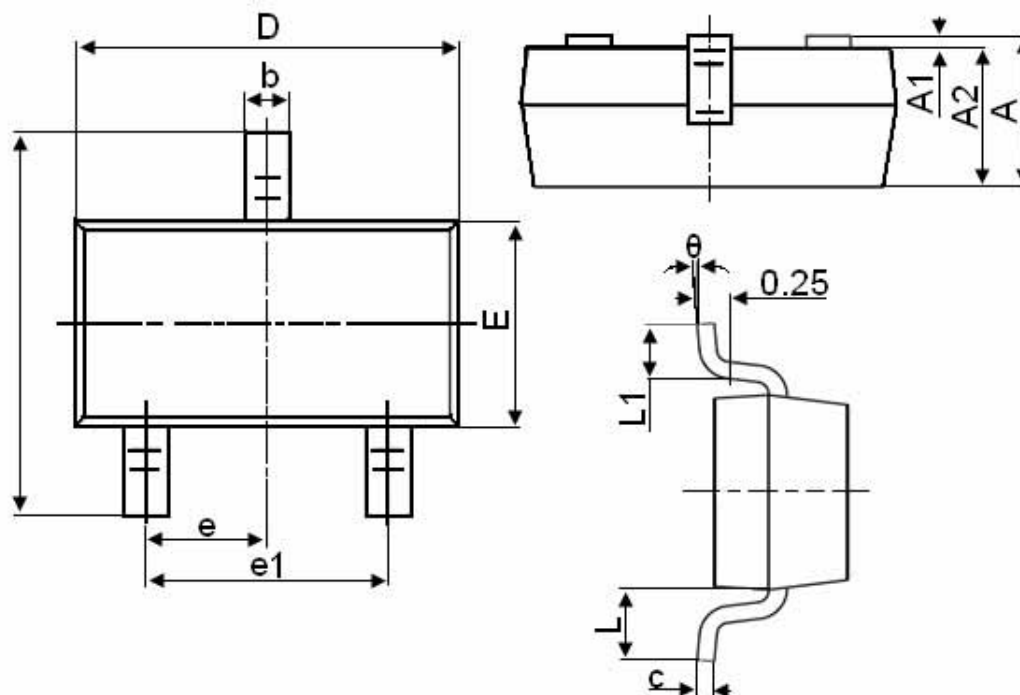
Figure 6 Rdson vs Vgs





**Figure 12 Normalized Maximum Transient Thermal Impedance**

## SOT-23 Package Information



| 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°    |

### Notes

1. All dimensions are in millimeters.
2. Tolerance  $\pm 0.10\text{mm}$  (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.