# MSL60N05

## N-Channel 60-V (D-S) MOSFET

### Description

The MSL60N05 is a high performance trench N-ch MOSFETs with extreme high cell density, which provide excellent $R_{DS(ON)}$ and gate charge for most of the small power switching and load switch applications.

The device meets the RoHS and Green Product requirement with full function reliability approved.

### Features

- Advanced high cell density Trench technology
- Low On-Resistance
- Low Gate Charge
- Low Input Capacitance
- Green Device Available

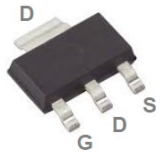
### Typical Applications

- Motor Drive
- Power Tools
- LED Lighting

### Package type：SOT-223

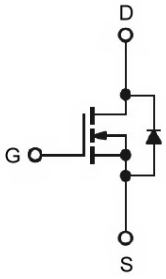
### Packing & Order Information

2,500/Reel

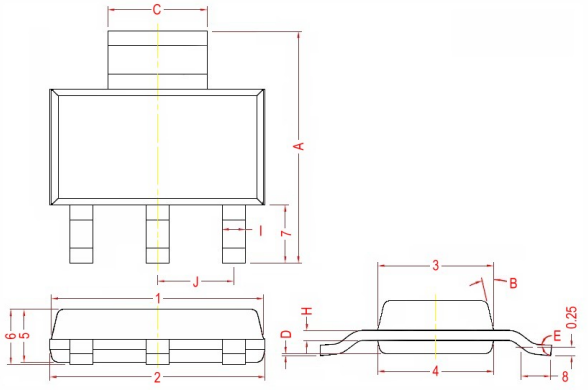



RoHS Compliant

### Graphic Symbol

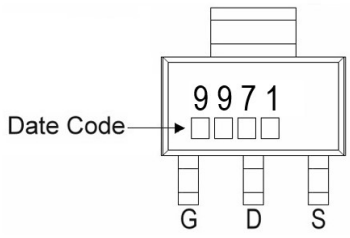



### Package Dimension




| REF. | Millimeter | | REF. | Millimeter | |
|---|---|---|---|---|---|
| | Min. | Max. | | Min. | Max. |
| A | 6.70 | 7.30 | 1 | 6.30 | 6.80 |
| C | 2.90 | 3.10 | 2 | 6.30 | 6.80 |
| D | 0.02 | 0.10 | 3 | 3.30 | 3.70 |
| E | 0° | 10° | 4 | 3.30 | 3.70 |
| I | 0.60 | 0.80 | 5 | 1.40 | 1.80 |
| H | 0.25 | 0.35 | 6 | 1.50 | 1.80 |
| B | 13° Typ. | | 7 | 1.55 | 1.95 |
| J | 2.30 Ref. | | 8 | 0.80 | 1.10 |

### Marking



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N-Channel 60-V (D-S) MOSFET

**MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS**

| Absolute Maximum Ratings (unless otherwise specified) | | | |
|---|---|---|---|
| **Symbol** | **Parameter** | **Value** | **Units** |
| $V_{DS}$ | Drain-Source Voltage | 60 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | V |
| $I_D$ | Continuous Drain Current[1] ($T_A$ =25°C) | 5 | A |
| | Continuous Drain Current[1] ($T_A$ =70°C) | 3.5 | A |
| $I_{DM}$ | Pulsed Drain Current[1,2] ($T_A$ =25°C) | 30 | A |
| EAS | Single Pulse Avalanche Energy[3] | 22 | mj |
| IAS | Single Pulse Avalanche Current[3] | 21 | A |
| $P_D$ | Power Dissipation[4] ($T_A$ =25°C) | 2.7 | W |
| $T_J/T_{STG}$ | Operating Junction and Storage Temperature | -55 to +150 | °C |

| Thermal Resistance Ratings | | | |
|---|---|---|---|
| **Symbol** | **Parameter** | **Maximum** | **Units** |
| $R_{\theta JA}$ | Maximum Junction-to-Ambient[1] | 85 | °C/W |
| $R_{\theta JC}$ | Maximum Junction-to-case[1] | 45 | °C/W |

| Electrical Characteristics($T_J$ =25°C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Parameter** | **Test Conditions** | **Min.** | **Typ.** | **Max.** | **Units** |
| $V_{GS\ (th)}$ | Gate Threshold Voltage | $V_{DS}$ =$V_{GS}$, $I_D$ =250μA | 1.0 | - | 2.5 | V |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ =0V, $I_D$ =250μA | 60 | - | - | V |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{DS}$ =0V, $V_{GS}$ =±20V | - | - | ±100 | nA |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$ =48V, $V_{GS}$ =0V, $T_J$ =25°C<br>$V_{DS}$ =48V, $V_{GS}$ =0V, $T_J$ =55°C | - | - | 1<br>5 | μA |
| $R_{DS\ (on)}$ | Static Drain-Source On-Resistance[2] | $V_{GS}$ =10V, $I_D$ =4A<br>$V_{GS}$ =4.5V, $I_D$ =2A | -<br>- | -<br>- | 50<br>60 | mΩ |
| $V_{SD}$ | Diode Forward Voltage[2] | $I_S$ =1A, $V_{GS}$ =0V, $T_J$ =25°C | - | - | 1.2 | V |
| $I_S$ | Continuous Source Current[1,5] **(Diode)** | $V_G$ =$V_D$ =0V, Force Current | - | - | 5 | A |

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| Dynamic and switching Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Parameter** | **Test Conditions** | **Min.** | **Typ.** | **Max.** | **Units** |
| $Q_g$ | Total Gate Charge[2] | $V_{DS}$ =48V<br>$I_D$ =4A<br>$V_{GS}$ =10V | -- | 19 | -- | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 2.6 | -- | |
| $Q_{gd}$ | Gate-Drain (“Miller”) Charge | | -- | 4.1 | -- | |
| $t_{d(on)}$ | Turn-On Delay Time[2] | $V_{DS}$ =30V<br>$I_D$ =4A<br>$V_{GS}$ =10V<br>$R_G$ =3.3Ω | -- | 3 | -- | ns |
| $t_r$ | Rise Time | | -- | 34 | -- | |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 23 | -- | |
| $t_f$ | Fall Time | | -- | 6 | -- | |
| $C_{ISS}$ | Input Capacitance | $V_{DS}$ =15V<br>$V_{GS}$ =0V<br>f =1.0MHz | -- | 1027 | -- | pF |
| $C_{OSS}$ | Output Capacitance | | -- | 65 | -- | |
| $C_{RSS}$ | Reverse Transfer Capacitance | | -- | 46 | -- | |

**Notes**

1. Surface mounted on a 1 inch$^2$ FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows Max. rating with test condition $V_{DD}$=25V, $V_{GS}$=10V, L=0.1mH, $I_{AS}$=21A
4. The power dissipation is limited by 150℃ junction temperature.
5. The data is theoretically the same as $I_D$ and $I_{DM}$, in real applications, should be limited by total power dissipation.

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- **Typical Electrical Characteristics**

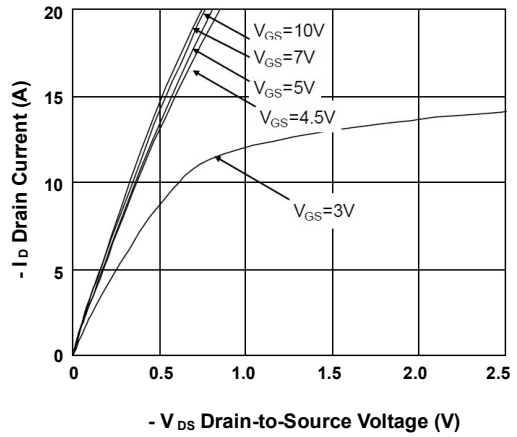


FIG.1-Typical Output Characteristics

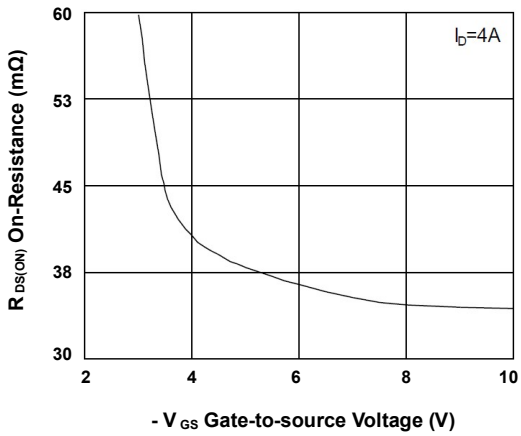


FIG.2-On-Resistance vs. G-S Voltage

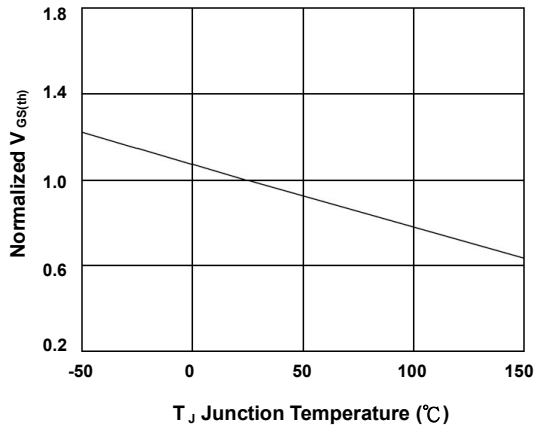


FIG.3-Normalized $V_{GS(th)}$ vs. $T_J$

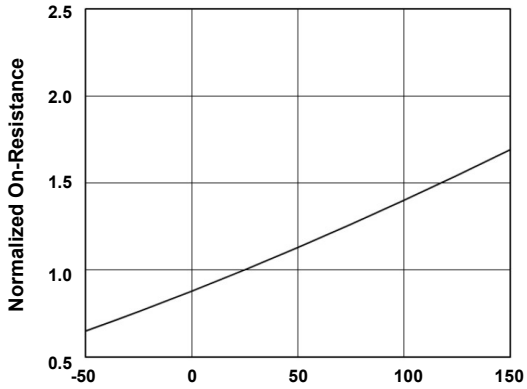


FIG.4-Normalized $R_{DSON}$ vs. $T_J$

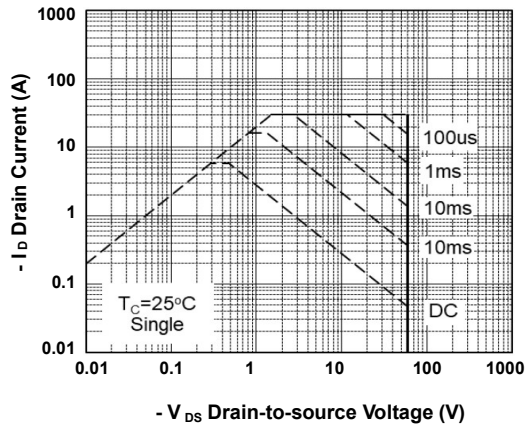


FIG.5-Safe Operating Area

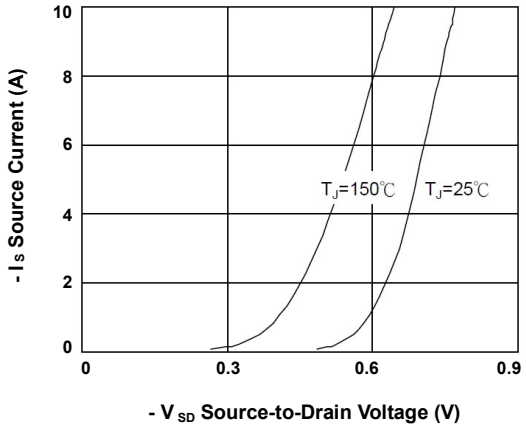


FIG.6-Forward Characteristics of Reverse

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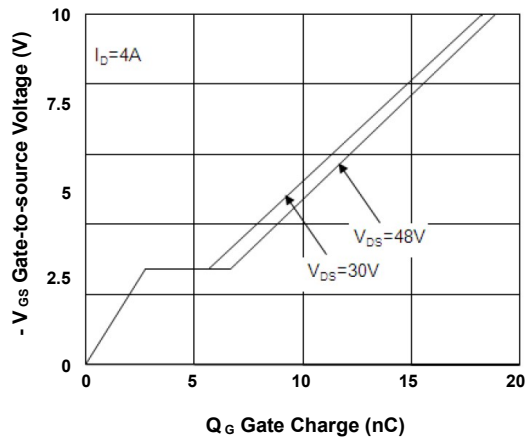


FIG.7-Gate Charge Characteristics

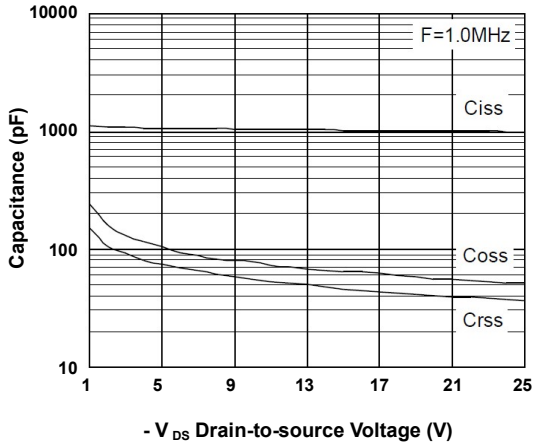


FIG.8-Capacitance Characteristics

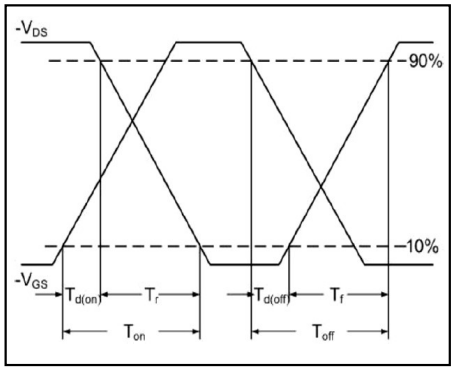


FIG.9-Switching Time Waveform

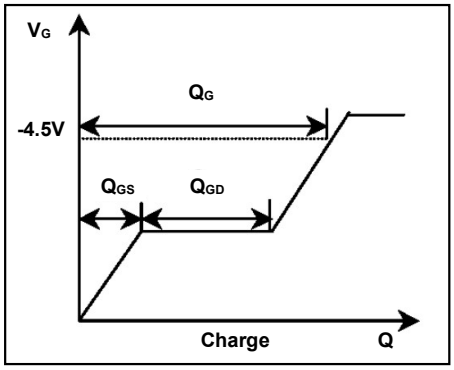


FIG.10-Gate Charge Waveform

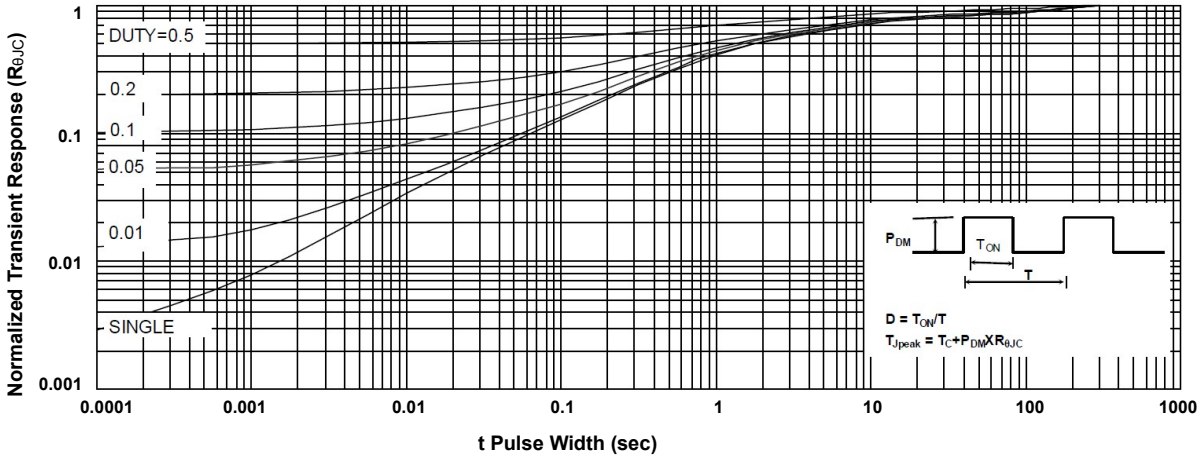


FIG.11-Normalized Maximum Transient Thermal Impedance

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