

## Features

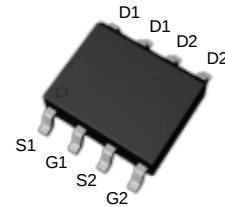
- **N Channel**  
30V/11A,  
 $R_{DS(ON)} = 11.5m\Omega$  (typ.) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 17m\Omega$  (typ.) @  $V_{GS} = 4.5V$
- **P Channel**  
-30V/-9A,  
 $R_{DS(ON)} = 23.5m\Omega$  (typ.) @  $V_{GS} = -10V$   
 $R_{DS(ON)} = 31m\Omega$  (typ.) @  $V_{GS} = -4.5V$
- 100% UIS Tested
- Reliable and Rugged
- Lead Free Available (RoHS Compliant)

**Note :** The diode connected between the gate and source serves only as protection against ESD. No gate overvoltage rating is implied.

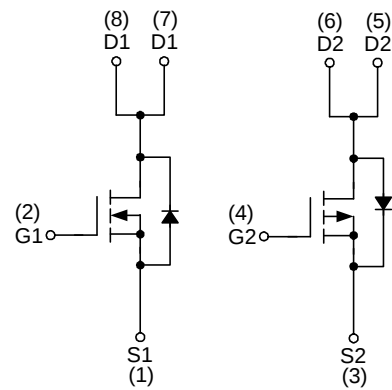
## Applications

- Synchronous Rectification.
- Motor Control.
- High Current, High Speed Switching.

## Pin Description



Top View of SOP-8



N-Channel MOSFET

P-Channel MOSFET

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

| Symbol                        | Parameter                              |                                                  | N Channel            | P Channel | Unit |   |
|-------------------------------|----------------------------------------|--------------------------------------------------|----------------------|-----------|------|---|
| Common Ratings                |                                        |                                                  |                      |           |      |   |
| V <sub>DSS</sub>              | Drain-Source Voltage                   |                                                  | 30                   | -30       | V    |   |
| V <sub>GSS</sub>              | Gate-Source Voltage                    |                                                  | ±20                  | ±20       | V    |   |
| T <sub>J</sub>                | Maximum Junction Temperature           |                                                  | 150                  |           | °C   |   |
| T <sub>STG</sub>              | Storage Temperature Range              |                                                  | -55 to 150           |           | °C   |   |
| I <sub>S</sub>                | Diode Continuous Forward Current       |                                                  | 11                   | -9        | A    |   |
| I <sub>DP</sub> <sup>a</sup>  | Pulse Drain Current Tested             | V <sub>GS</sub> =10V(N),V <sub>GS</sub> =-10V(P) | 33                   | -27       | A    |   |
| I <sub>D</sub>                | Continuous Drain Current               |                                                  | T <sub>A</sub> =25°C | 11        | -9   | A |
|                               |                                        |                                                  | T <sub>A</sub> =70°C | 8.3       | -6.7 |   |
| P <sub>D</sub> <sup>b</sup>   | Maximum Power Dissipation              | T <sub>A</sub> =25°C                             | 2.08                 | 2.08      | W    |   |
|                               |                                        | T <sub>A</sub> =70°C                             | 1.33                 | 1.33      |      |   |
| R <sub>θJL</sub>              | Thermal Resistance-Junction to Lead    | Steady State                                     | 50                   | 50        | °C/W |   |
| R <sub>θJA</sub> <sup>c</sup> | Thermal Resistance-Junction to Ambient | t ≤ 10s                                          | 60                   | 60        | °C/W |   |
|                               |                                        | Steady State                                     | 100                  | 100       |      |   |
| I <sub>AS</sub> <sup>d</sup>  | Avalanche Current, Single pulse        | L=0.5mH                                          | 7.2                  | 11        | A    |   |
| E <sub>AS</sub> <sup>d</sup>  | Avalanche Energy, Single pulse         | L=0.5mH                                          | 13                   | 30        | mJ   |   |

Note a : Pulse width limited by max. junction temperature.

Note b :  $t < 10\text{sec}$ .

Note c :  $R_{\theta JA}$  steady state  $t=999\text{s}$ .  $R_{\theta JA}$  is measured with the device mounted on  $1\text{in}^2$ , FR-4 board with 2oz. Copper.

Note d : UIS tested and pulse width limited by maximum junction temperature  $150^\circ\text{C}$  (initial temperature  $T_J=25^\circ\text{C}$ ).

## N Channel Electrical Characteristics (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol                                   | Parameter                        | Test Conditions                                                                                                 | N Channel |      |      | Unit |
|------------------------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------|------|------|------|
|                                          |                                  |                                                                                                                 | Min.      | Typ. | Max. |      |
| Static Characteristics                   |                                  |                                                                                                                 |           |      |      |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA                                                                     | 30        | -    | -    | V    |
| I <sub>DSS</sub>                         | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =24V, V <sub>GS</sub> =0V                                                                       | -         | -    | 1    | μA   |
|                                          |                                  | T <sub>J</sub> =85°C                                                                                            | -         | -    | 30   |      |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA                                                       | 1.0       | 1.7  | 2.2  | V    |
| I <sub>GSS</sub>                         | Gate Leakage Current             | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                                                      | -         | -    | ±100 | nA   |
| R <sub>DS(ON)</sub> <sup>e</sup>         | Drain-Source On-state Resistance | V <sub>GS</sub> =10V, I <sub>DS</sub> =8A                                                                       | -         | 11.5 | 14.5 | mΩ   |
|                                          |                                  | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =5A                                                                      | -         | 17   | 23   |      |
| Diode Characteristics                    |                                  |                                                                                                                 |           |      |      |      |
| V <sub>SD</sub> <sup>e</sup>             | Diode Forward Voltage            | I <sub>SD</sub> =1A, V <sub>GS</sub> =0V                                                                        | -         | 0.75 | 1.1  | V    |
| t <sub>rr</sub>                          | Reverse Recovery Time            | I <sub>DS</sub> =8A, dI <sub>SD</sub> /dt=100A/μs                                                               | -         | 12   | -    | ns   |
| Q <sub>rr</sub>                          | Reverse Recovery Charge          |                                                                                                                 | -         | 3.5  | -    | nC   |
| Dynamic Characteristics <sup>f</sup>     |                                  |                                                                                                                 |           |      |      |      |
| R <sub>G</sub>                           | Gate Resistance                  | V <sub>GS</sub> =0V,V <sub>DS</sub> =0V,F=1MHz                                                                  | -         | 1.8  | -    | Ω    |
| C <sub>iss</sub>                         | Input Capacitance                | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =15V,<br>Frequency=1.0MHz                                               | -         | 408  | -    | pF   |
| C <sub>oss</sub>                         | Output Capacitance               |                                                                                                                 | -         | 72   | -    |      |
| C <sub>rss</sub>                         | Reverse Transfer Capacitance     |                                                                                                                 | -         | 40   | -    |      |
| t <sub>d(ON)</sub>                       | Turn-on Delay Time               | V <sub>DD</sub> =15V, R <sub>L</sub> =15Ω,<br>I <sub>DS</sub> =1A, V <sub>GEN</sub> =10V,<br>R <sub>G</sub> =6Ω | -         | 5.2  | -    | ns   |
| t <sub>r</sub>                           | Turn-on Rise Time                |                                                                                                                 | -         | 8.6  | -    |      |
| t <sub>d(OFF)</sub>                      | Turn-off Delay Time              |                                                                                                                 | -         | 13.5 | -    |      |
| t <sub>f</sub>                           | Turn-off Fall Time               |                                                                                                                 | -         | 3.4  | -    |      |
| Gate Charge Characteristics <sup>f</sup> |                                  |                                                                                                                 |           |      |      |      |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =15V, V <sub>GS</sub> =10V,<br>I <sub>DS</sub> =8A                                              | -         | 8.3  | 12   | nC   |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =15V, V <sub>GS</sub> =4.5V,<br>I <sub>DS</sub> =8A                                             | -         | 3.9  | 6    |      |
| Q <sub>gth</sub>                         | Threshold Gate Charge            |                                                                                                                 | -         | 0.73 | -    |      |
| Q <sub>gs</sub>                          | Gate-Source Charge               |                                                                                                                 | -         | 1.6  | -    |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge                |                                                                                                                 | -         | 1.4  | -    |      |

Note e : Pulse test ; pulse width≤300μs, duty cycle≤2%.

Note f : Guaranteed by design, not subject to production testing.

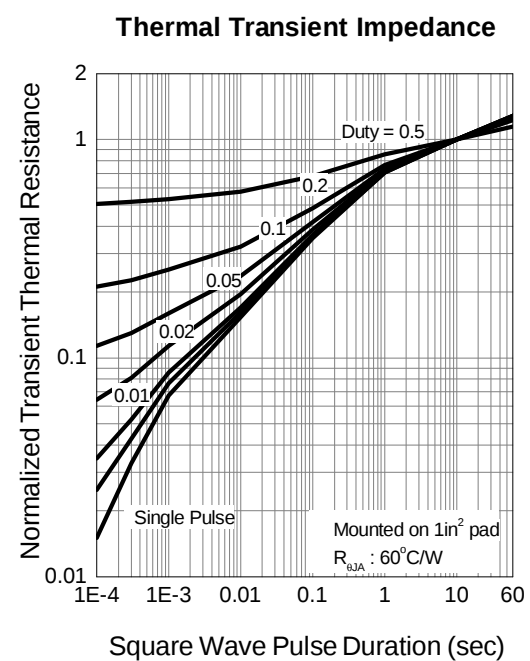
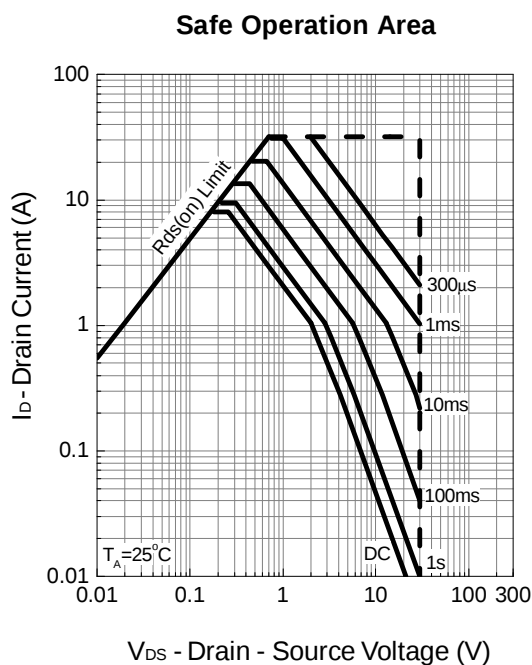
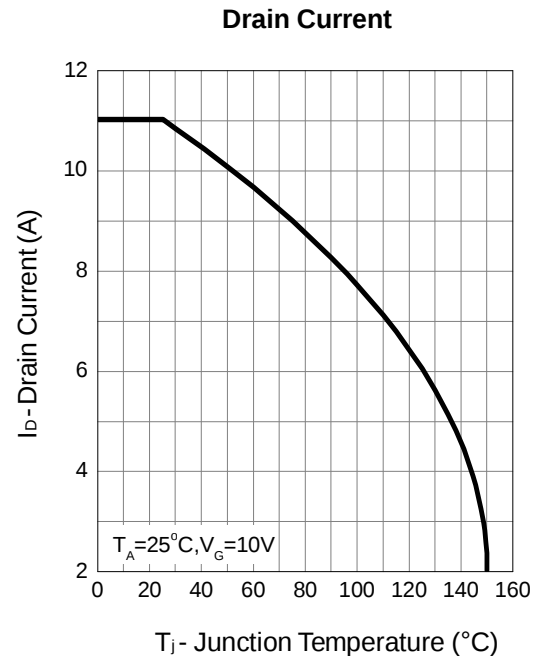
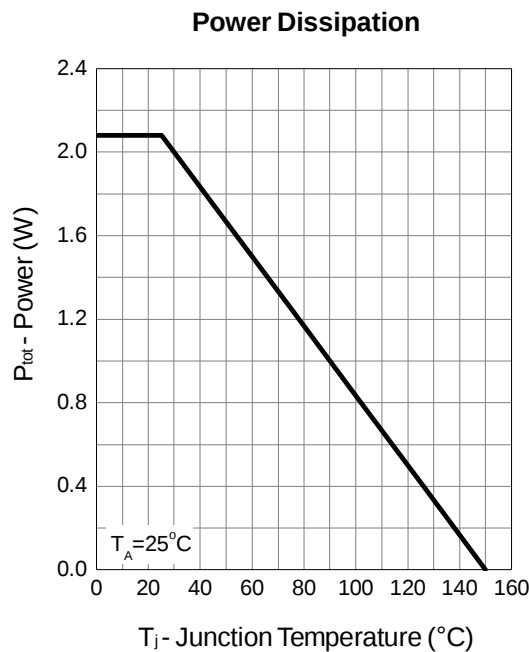
## P Channel Electrical Characteristics (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol                                   | Parameter                        | Test Conditions                                                                                                    | P Channel |       |      | Unit |
|------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------|-------|------|------|
|                                          |                                  |                                                                                                                    | Min.      | Typ.  | Max. |      |
| Static Characteristics                   |                                  |                                                                                                                    |           |       |      |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =-250μA                                                                       | -30       | -     | -    | V    |
| I <sub>DSS</sub>                         | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =-24V, V <sub>GS</sub> =0V                                                                         | -         | -     | -1   | μA   |
|                                          |                                  | T <sub>J</sub> =85°C                                                                                               | -         | -     | -30  | mA   |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =-250μA                                                         | -1.0      | -1.5  | -2.5 | V    |
| I <sub>GSS</sub>                         | Gate Leakage Current             | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                                                         | -         | -     | ±100 | nA   |
| R <sub>DS(ON)</sub> <sup>e</sup>         | Drain-Source On-state Resistance | V <sub>GS</sub> =-10V, I <sub>DS</sub> =-7A                                                                        | -         | 23.5  | 29.5 | mΩ   |
|                                          |                                  | V <sub>GS</sub> =-4.5V, I <sub>DS</sub> =-4A                                                                       | -         | 31    | 39   |      |
| Diode Characteristics                    |                                  |                                                                                                                    |           |       |      |      |
| V <sub>SD</sub> <sup>e</sup>             | Diode Forward Voltage            | I <sub>SD</sub> =-1A, V <sub>GS</sub> =0V                                                                          | -         | -0.75 | -1   | V    |
| t <sub>rr</sub>                          | Reverse Recovery Time            | I <sub>DS</sub> =-7A, dI <sub>SD</sub> /dt=100A/μs                                                                 | -         | 14    | -    | ns   |
| Q <sub>rr</sub>                          | Reverse Recovery Charge          |                                                                                                                    | -         | 7     | -    | nC   |
| Dynamic Characteristics <sup>f</sup>     |                                  |                                                                                                                    |           |       |      |      |
| R <sub>G</sub>                           | Gate Resistance                  | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz                                                                   | -         | 12    | -    | Ω    |
| C <sub>iss</sub>                         | Input Capacitance                | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =-15V,<br>Frequency=1.0MHz                                                 | -         | 750   | -    | pF   |
| C <sub>oss</sub>                         | Output Capacitance               |                                                                                                                    | -         | 142   | -    |      |
| C <sub>rss</sub>                         | Reverse Transfer Capacitance     |                                                                                                                    | -         | 102   | -    |      |
| t <sub>d(ON)</sub>                       | Turn-on Delay Time               | V <sub>DD</sub> =-15V, R <sub>L</sub> =15Ω,<br>I <sub>DS</sub> =-1A, V <sub>GEN</sub> =-10V,<br>R <sub>G</sub> =6Ω | -         | 9     | -    | ns   |
| t <sub>r</sub>                           | Turn-on Rise Time                |                                                                                                                    | -         | 11    | -    |      |
| t <sub>d(OFF)</sub>                      | Turn-off Delay Time              |                                                                                                                    | -         | 55    | -    |      |
| t <sub>f</sub>                           | Turn-off Fall Time               |                                                                                                                    | -         | 34    | -    |      |
| Gate Charge Characteristics <sup>f</sup> |                                  |                                                                                                                    |           |       |      |      |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-10V,<br>I <sub>DS</sub> =-7A                                              | -         | 17    | -    | nC   |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-4.5V,<br>I <sub>DS</sub> =-7A                                             | -         | 8     | -    |      |
| Q <sub>gth</sub>                         | Threshold Gate Charge            |                                                                                                                    | -         | 1     | -    |      |
| Q <sub>gs</sub>                          | Gate-Source Charge               |                                                                                                                    | -         | 2     | -    |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge                |                                                                                                                    | -         | 4     | -    |      |

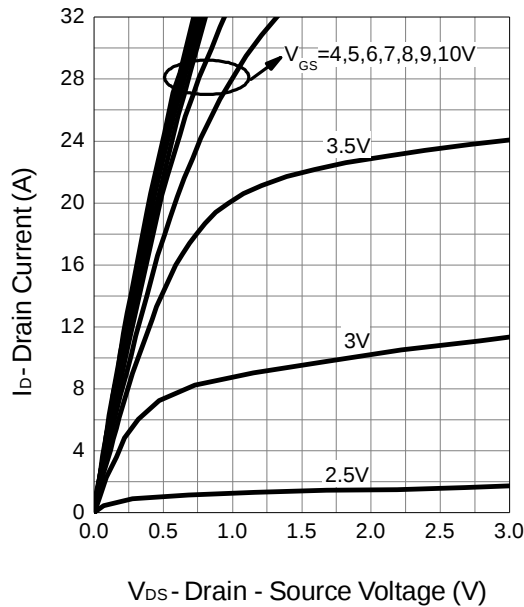
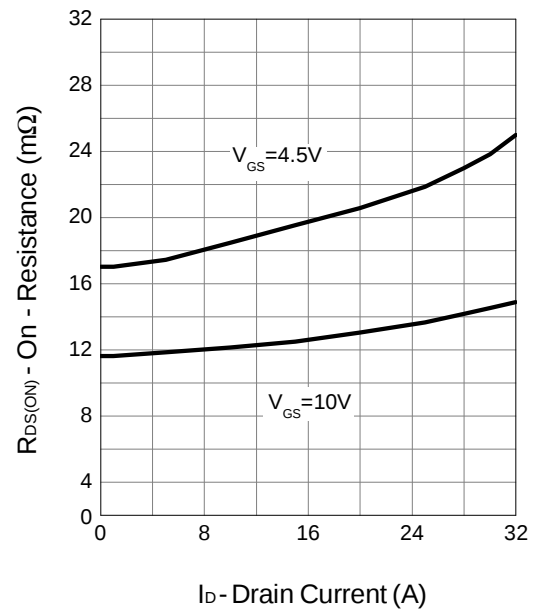
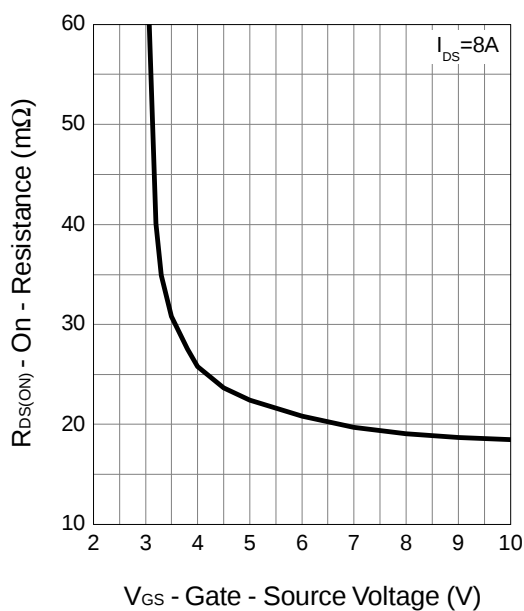
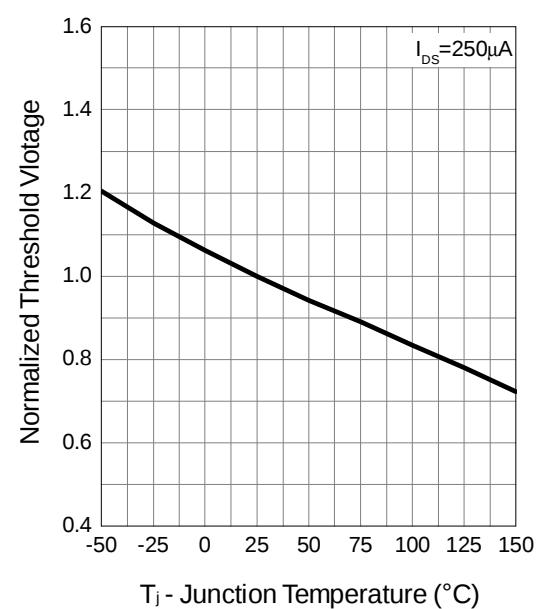
Note e : Pulse test; pulse width≤300μs, duty cycle≤2%.

Note f : Guaranteed by design, not subject to production testing.

## N Channel Typical Operating Characteristics

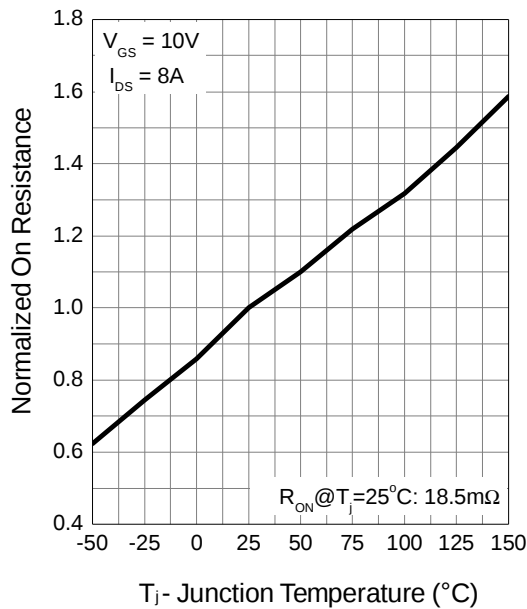


## N Channel Typical Operating Characteristics (Cont.)

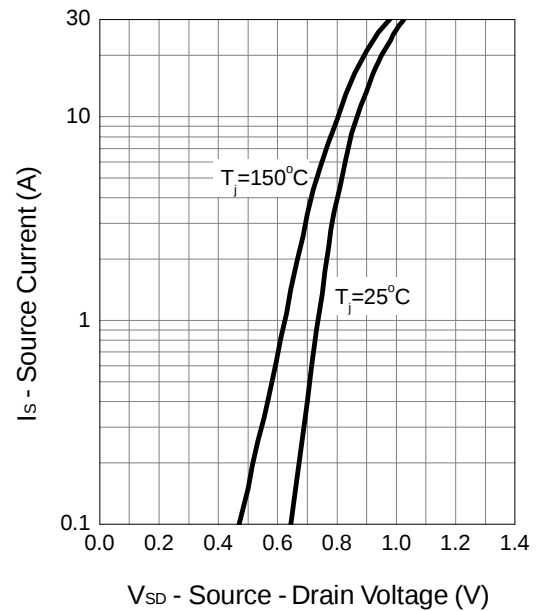
**Output Characteristics**

**Drain-Source On Resistance**

**Gate-Source On Resistance**

**Gate Threshold Voltage**


## N Channel Typical Operating Characteristics (Cont.)

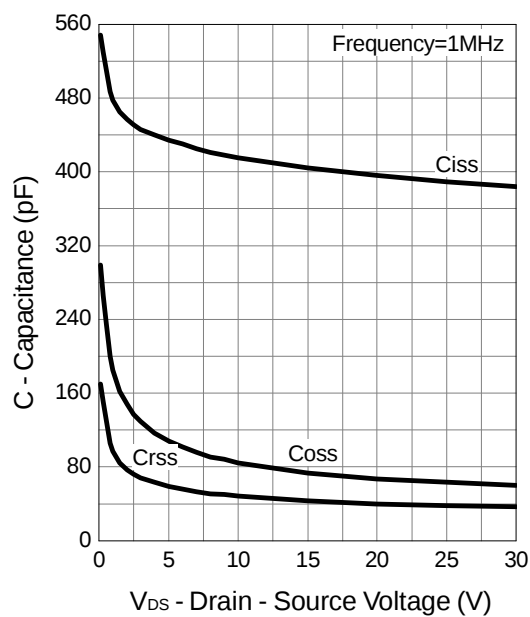
Drain-Source On Resistance



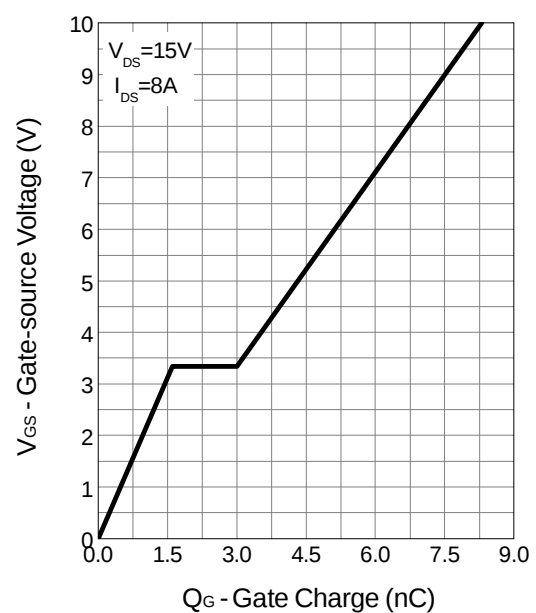
Source-Drain Diode Forward



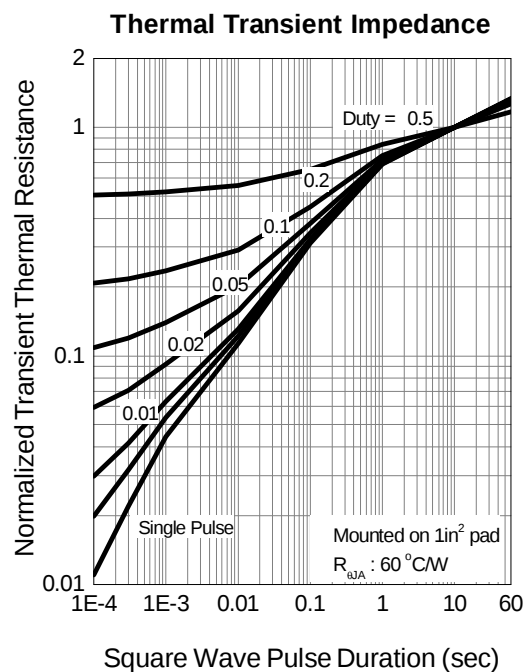
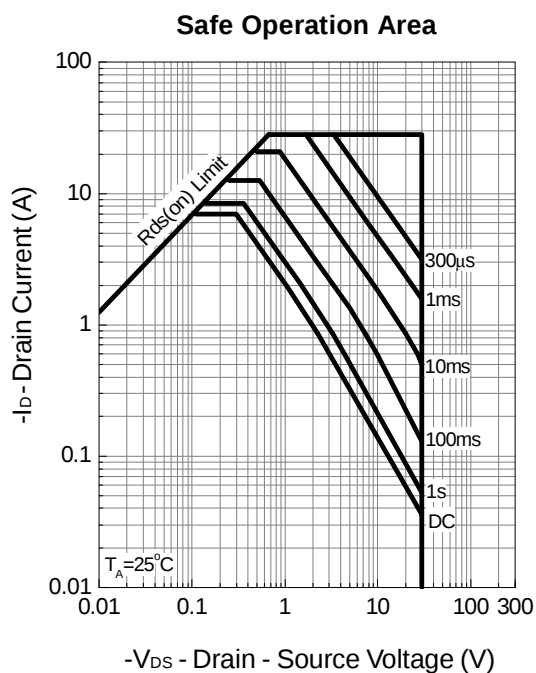
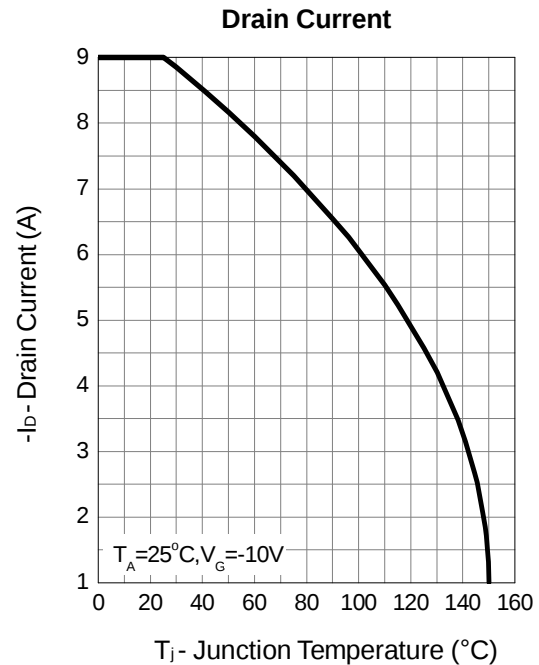
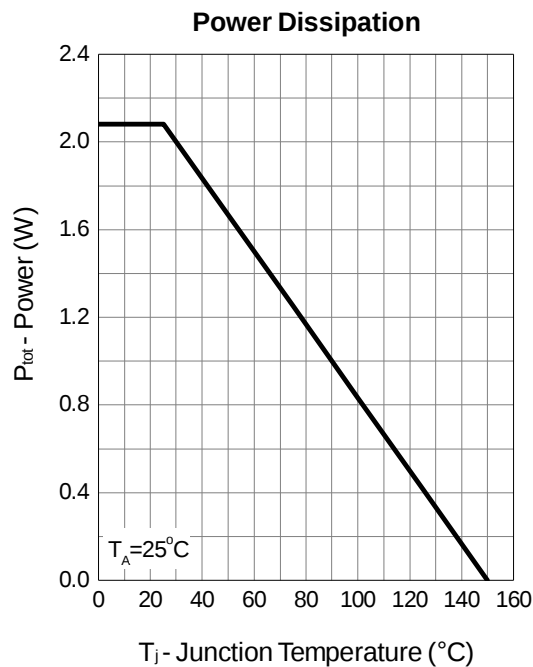
Capacitance



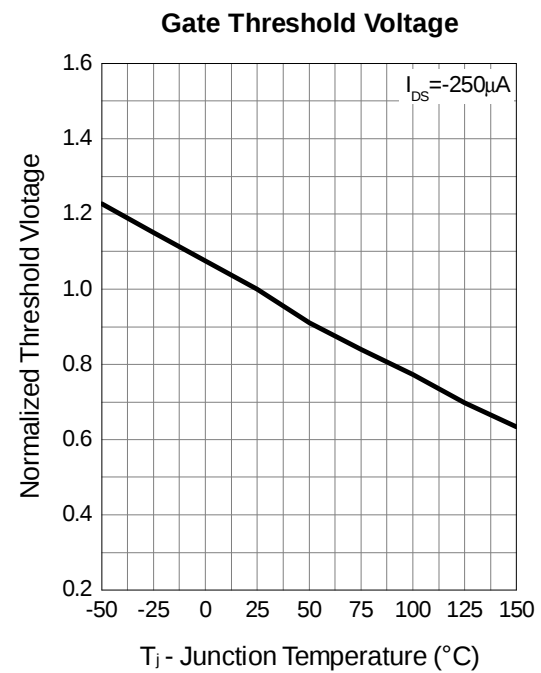
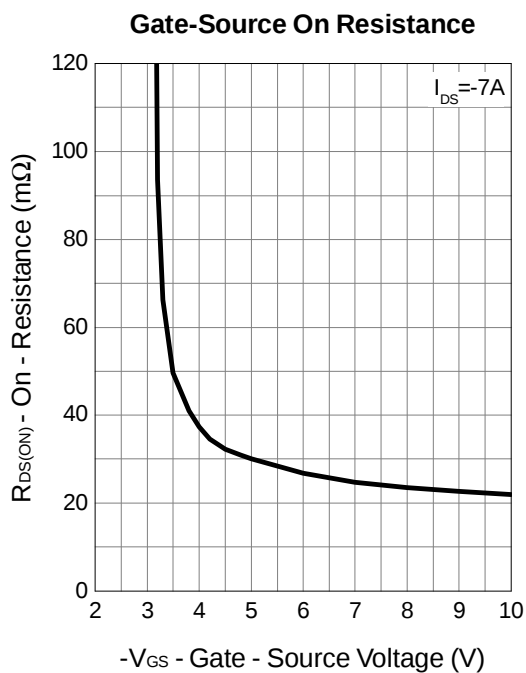
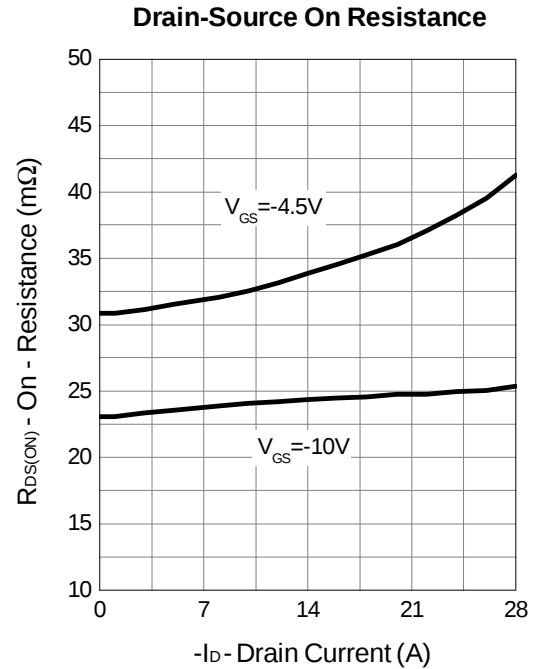
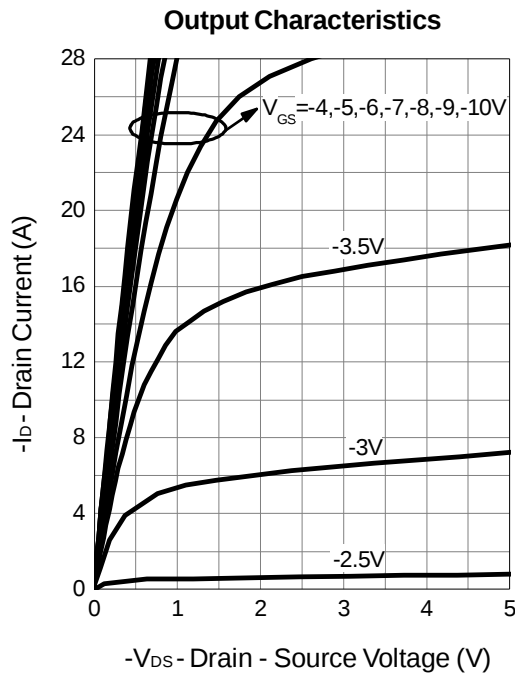
Gate Charge



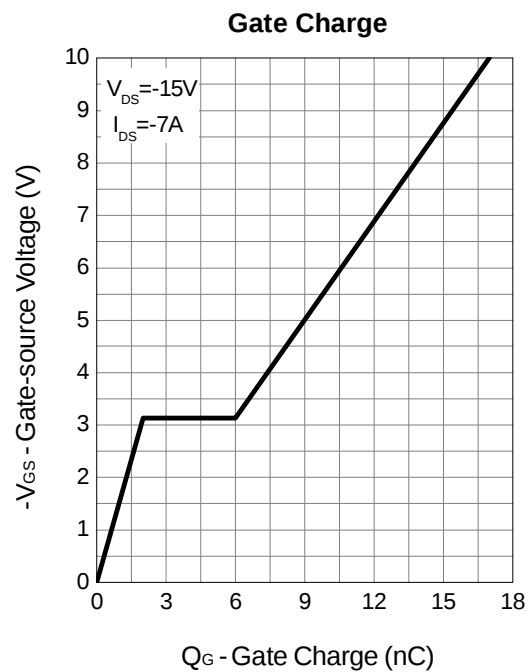
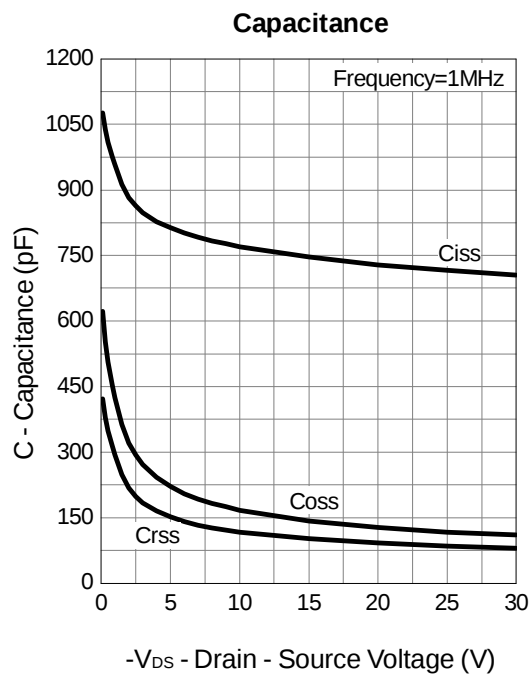
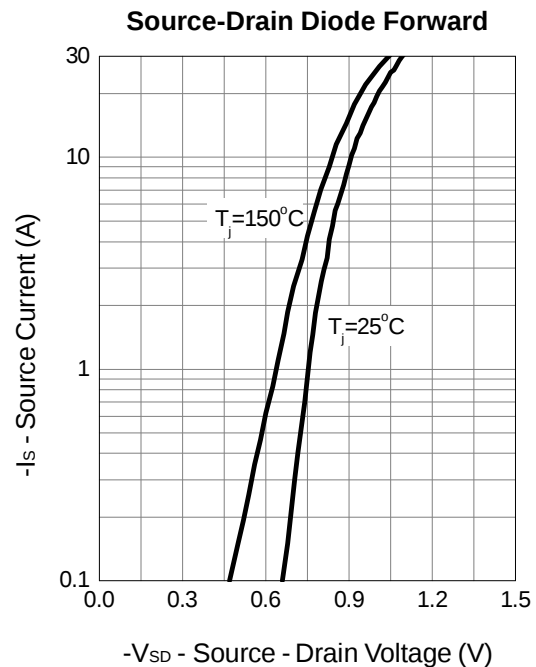
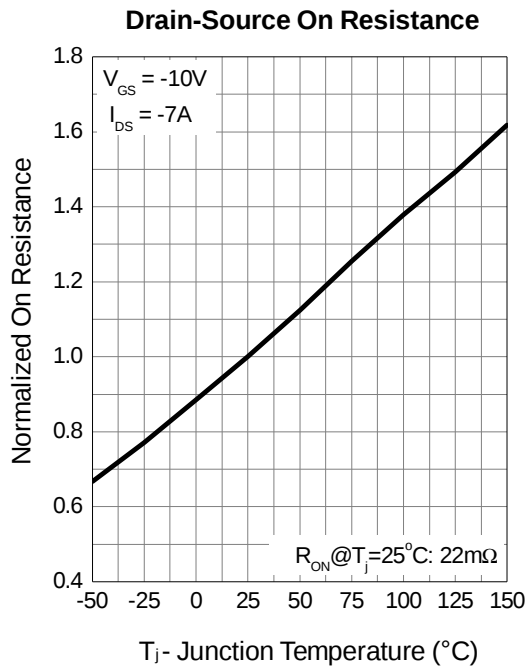
## P Channel Typical Operating Characteristics



## P Channel Typical Operating Characteristics (Cont.)

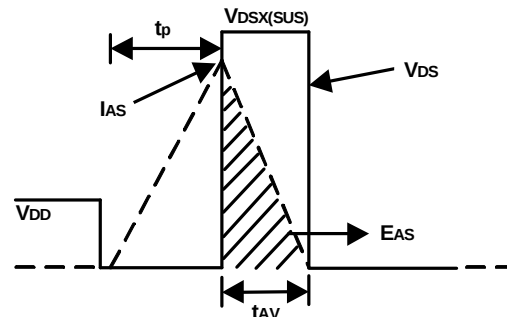
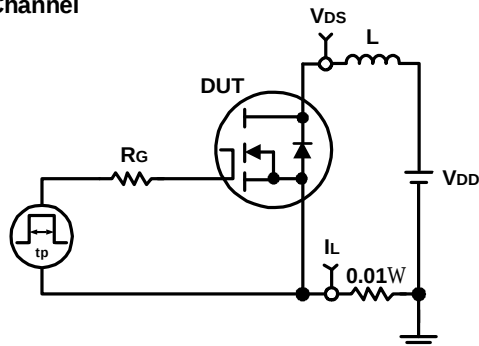


## P Channel Typical Operating Characteristics (Cont.)

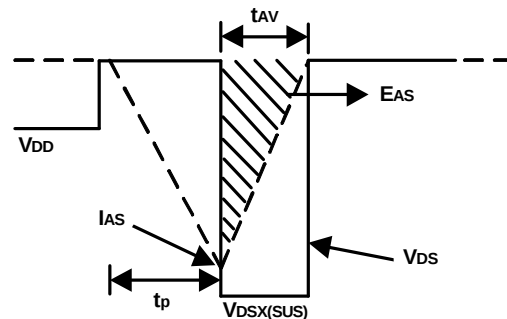
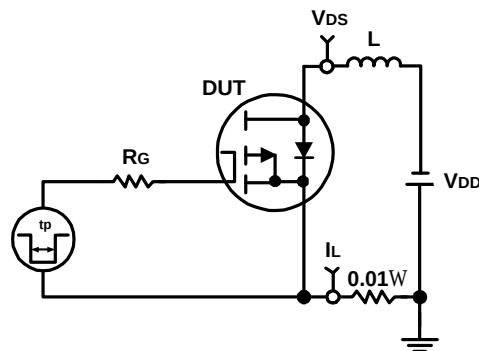


## Avalanche Test Circuit and Waveforms

N Channel

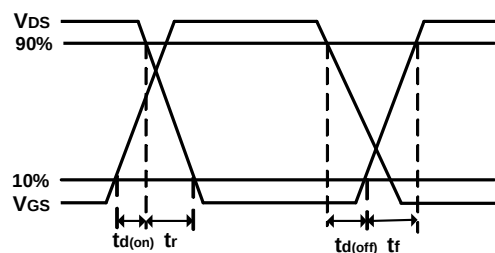
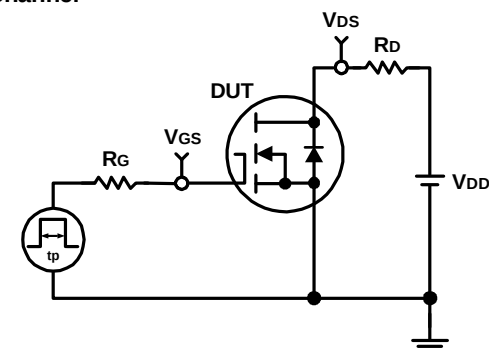


P Channel

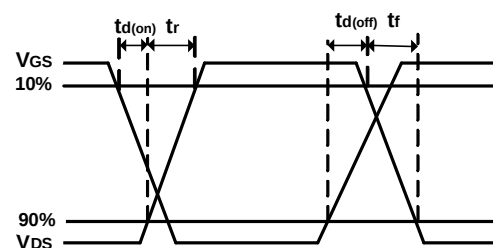
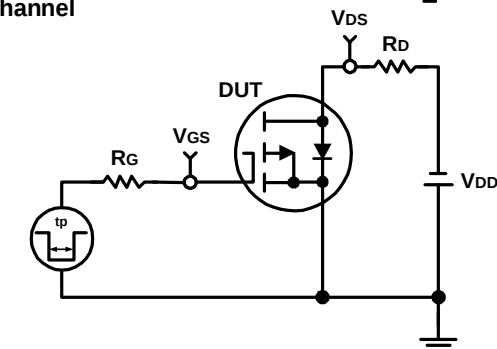


## Switching Time Test Circuit and Waveforms

N Channel

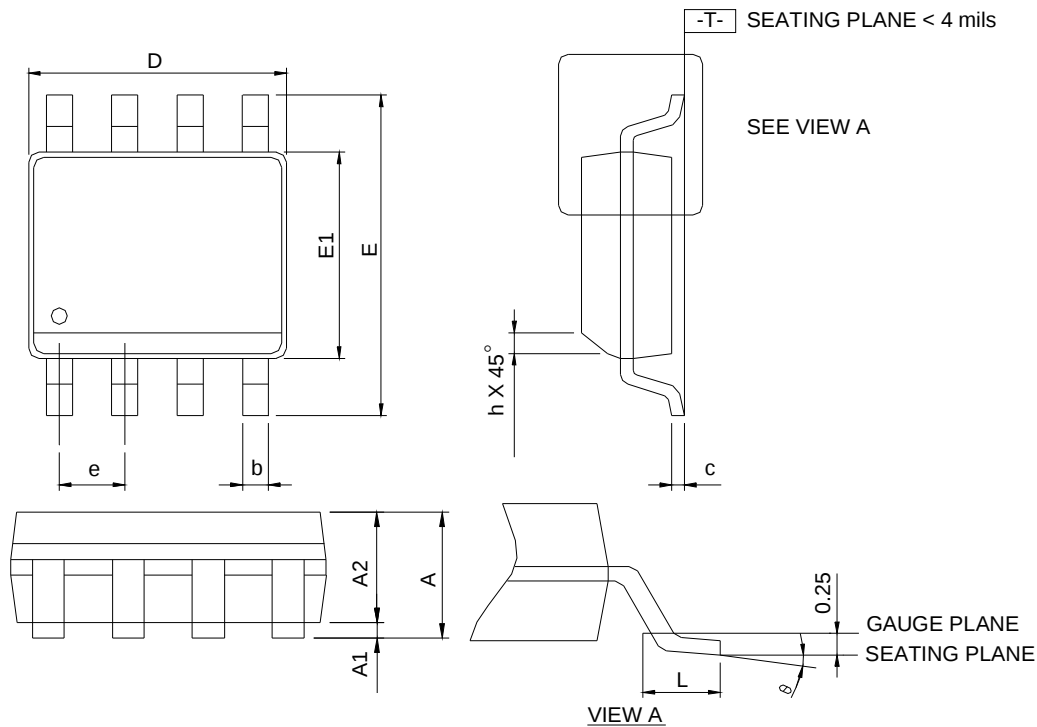


P Channel



## Package Information

### SOP-8



| DIMENSIONS | SOP-8       |      |           |       |
|------------|-------------|------|-----------|-------|
|            | MILLIMETERS |      | INCHES    |       |
|            | MIN.        | MAX. | MIN.      | MAX.  |
| A          | -           | 1.75 | -         | 0.069 |
| A1         | 0.10        | 0.25 | 0.004     | 0.010 |
| A2         | 1.25        | -    | 0.049     | -     |
| b          | 0.31        | 0.51 | 0.012     | 0.020 |
| c          | 0.17        | 0.25 | 0.007     | 0.010 |
| D          | 4.80        | 5.00 | 0.189     | 0.197 |
| E          | 5.80        | 6.20 | 0.228     | 0.244 |
| E1         | 3.80        | 4.00 | 0.150     | 0.157 |
| e          | 1.27 BSC    |      | 0.050 BSC |       |
| h          | 0.25        | 0.50 | 0.010     | 0.020 |
| L          | 0.40        | 1.27 | 0.016     | 0.050 |
| θ          | 0°          | 8°   | 0°        | 8°    |

Note: 1. Follow JEDEC MS-012 AA.

2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.

3. Dimension "E" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

### RECOMMENDED LAND PATTERN

