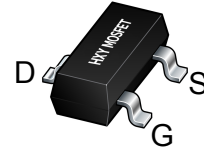




### Description

The SI2309 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This device is well suited for use as a load switch or in PWM applications.



SOT-23

### General Features

$V_{DS} = -60V, I_D = -2A$

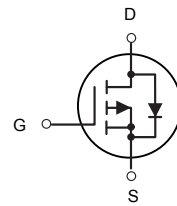
$R_{DS(ON)} < 160m\Omega @ V_{GS} = -10V$

$R_{DS(ON)} < 200m\Omega @ V_{GS} = -4.5V$

### Application

Load switch

PWM application



P-Channel MOSFET

### Package Marking and Ordering Information

| Product ID | Pack   | Marking | Qty(PCS) |
|------------|--------|---------|----------|
| SI2309     | SOT-23 | N9ADE   | 3000     |

### Absolute Maximum Ratings (TA=25°C unless otherwise noted)

| Symbol          | Parameter  | Limit      | Unit |
|-----------------|--|------------|------|
| $V_{DS}$        | Drain-Source Voltage                             | -60        | V    |
| $V_{GS}$        | Gate-Source Voltage                              | $\pm 20$   | V    |
| $I_D$           | Drain Current-Continuous                         | -2         | A    |
| $I_{DM}$        | Drain Current-Pulsed (Note 1)                    | -8         | A    |
| $P_D$           | Maximum Power Dissipation                        | 1.5        | W    |
| $T_J, T_{STG}$  | Operating Junction and Storage Temperature Range | -55 To 150 | °C   |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (Note 2) | 83.3       | °C/W |



**Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise noted)**

| Parameter                                 | Symbol              | Condition  | Min  | Typ   | Max  | Unit |
|---|---------------------|--|------|-------|------|------|
| <b>Off Characteristics</b>                |                     |  |      |       |      |      |
| Drain-Source Breakdown Voltage            | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =-250μA   | -60  | -     | -    | V    |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>    | V <sub>DS</sub> =-60V, V <sub>GS</sub> =0V   | -    | -     | -1   | μA   |
| Gate-Body Leakage Current                 | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V   | -    | -     | ±100 | nA   |
| <b>On Characteristics</b> (Note 3)        |                     |  |      |       |      |      |
| Gate Threshold Voltage                    | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                  | -1.4 | -2.0  | -2.6 | V    |
| Drain-Source On-State Resistance          | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-1.5A   | -    | 140   | 160  | mΩ   |
|   |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-1.5A  | -    | 160   | 200  | mΩ   |
| Forward Transconductance                  | g <sub>FS</sub>     | V <sub>DS</sub> =-5V, I <sub>D</sub> =-1.5A  | -    | 3     | -    | S    |
| <b>Dynamic Characteristics</b> (Note 4)   |                     |  |      |       |      |      |
| Input Capacitance                         | C <sub>iss</sub>    | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                    | -    | 444.2 | -    | PF   |
| Output Capacitance                        | C <sub>oss</sub>    |  | -    | 19.6  | -    | PF   |
| Reverse Transfer Capacitance              | C <sub>rss</sub>    |  | -    | 17.9  | -    | PF   |
| <b>Switching Characteristics</b> (Note 4) |                     |  |      |       |      |      |
| Turn-on Delay Time                        | t <sub>d(on)</sub>  | V <sub>DD</sub> =-30V, I <sub>D</sub> =-1.5A,<br>V <sub>GS</sub> =-10V, R <sub>G</sub> =3Ω | -    | 40    | -    | nS   |
| Turn-on Rise Time                         | t <sub>r</sub>      |  | -    | 35    | -    | nS   |
| Turn-Off Delay Time                       | t <sub>d(off)</sub> |  | -    | 15    | -    | nS   |
| Turn-Off Fall Time                        | t <sub>f</sub>      |  | -    | 10    | -    | nS   |
| Total Gate Charge                         | Q <sub>g</sub>      | V <sub>DS</sub> =-30V, I <sub>D</sub> =-1.5A,<br>V <sub>GS</sub> =-10V                     | -    | 11.3  | -    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>     |  | -    | 2.7   | -    | nC   |
| Gate-Drain Charge                         | Q <sub>gd</sub>     |  | -    | 1.6   | -    | nC   |
| <b>Drain-Source Diode Characteristics</b> |                     |  |      |       |      |      |
| Diode Forward Voltage (Note 3)            | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =-1.5A   | -    | -     | -1.2 | V    |
| Diode Forward Current (Note 2)            | I <sub>S</sub>      |  | -    | -     | -1.6 | A    |
| Reverse Recovery Time                     | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = -1.5A<br>di/dt = -100A/μs (Note 3)                 | -    | 25    |      | nS   |
| Reverse Recovery Charge                   | Q <sub>rr</sub>     |  | -    | 31    |      | nC   |

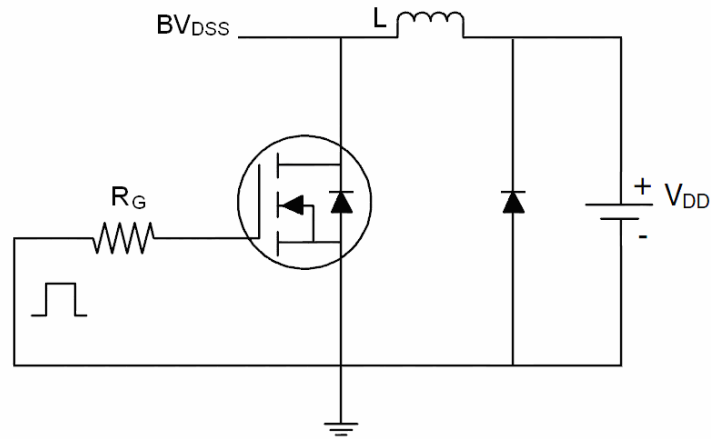
**Notes:**

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

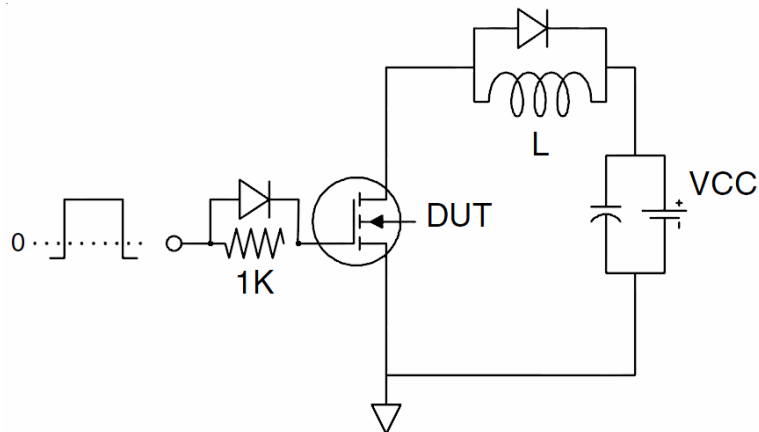


## Test Circuit

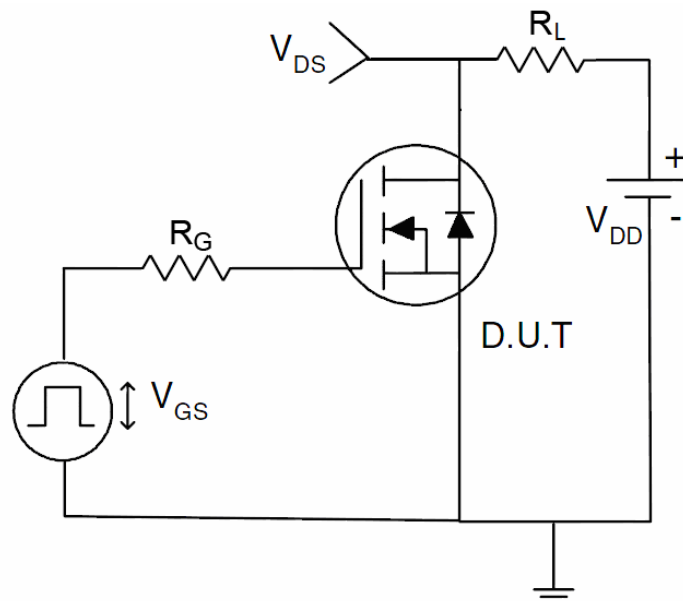
### 1) $E_{AS}$ test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit





### Typical Electrical and Thermal Characteristics (Curves)

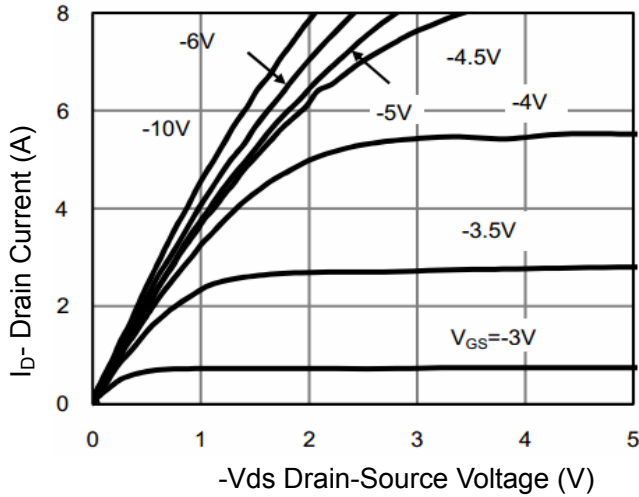


Figure 1 Output Characteristics

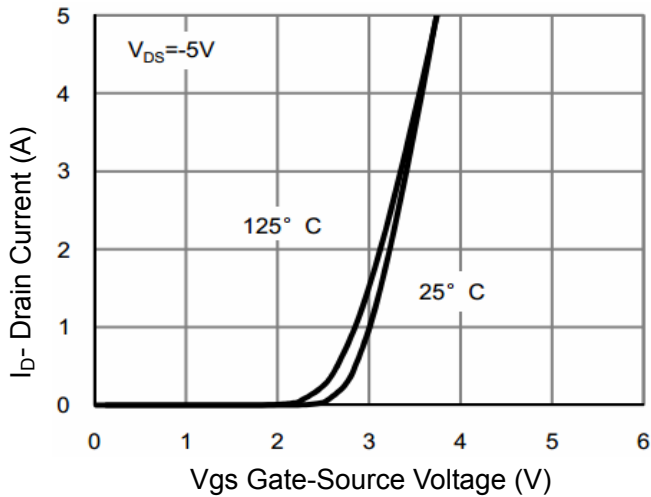


Figure 2 Transfer Characteristics

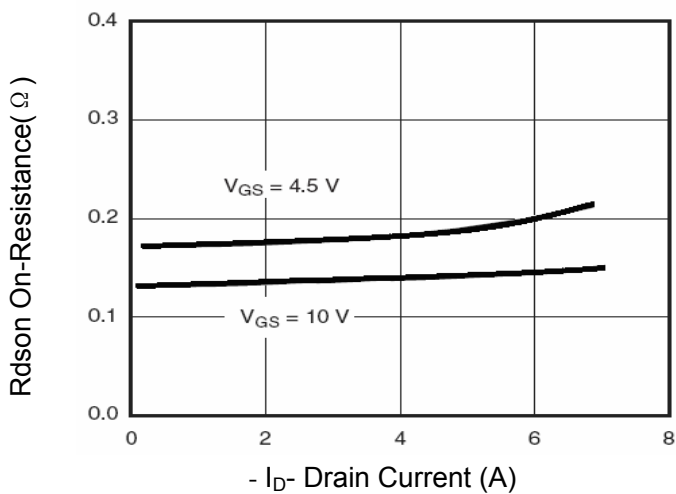


Figure 3 Rdson- Drain Current

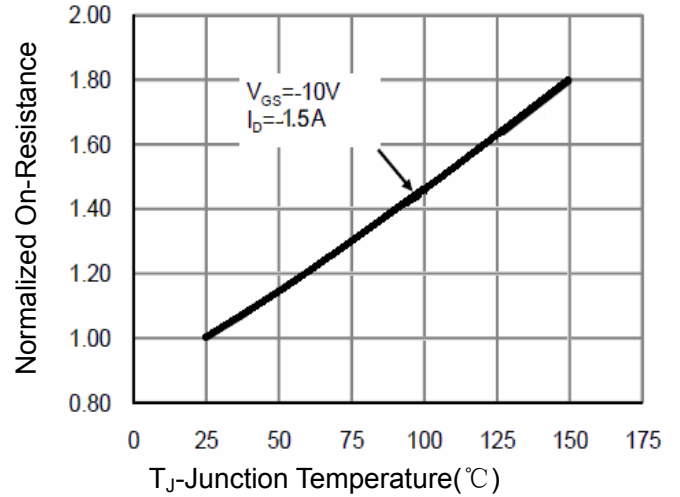


Figure 4 Rdson-Junction Temperature

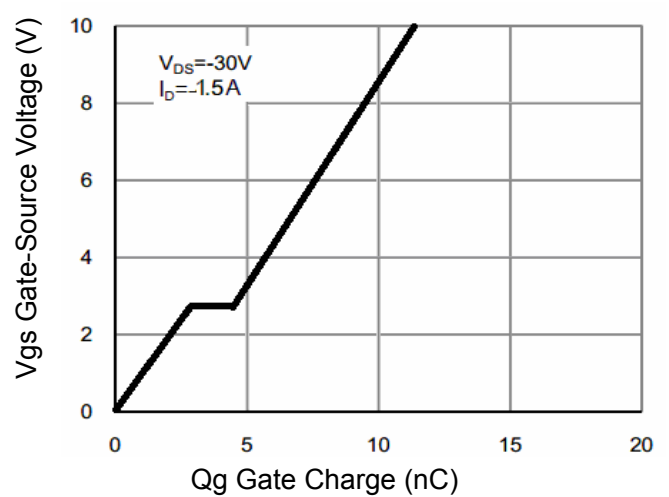


Figure 5 Gate Charge

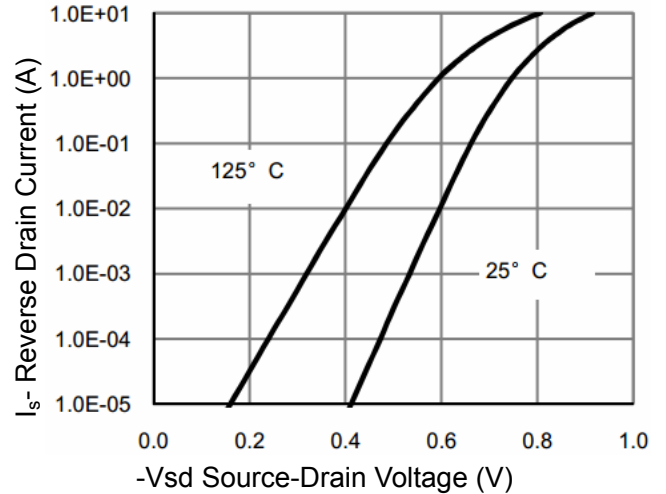


Figure 6 Source- Drain Diode Forward

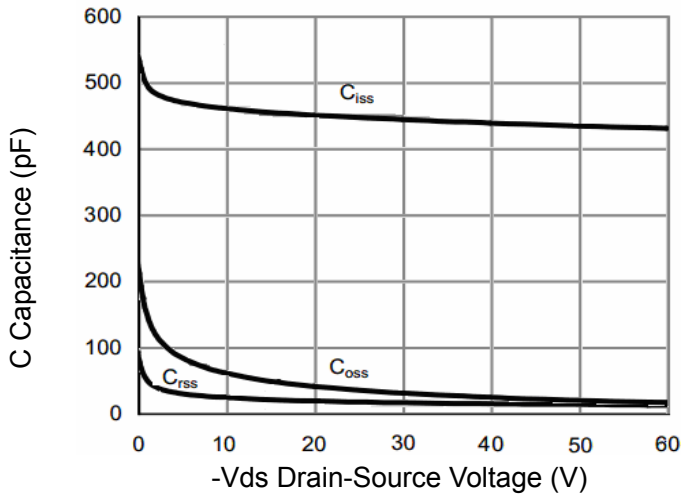


Figure 7 Capacitance vs Vds

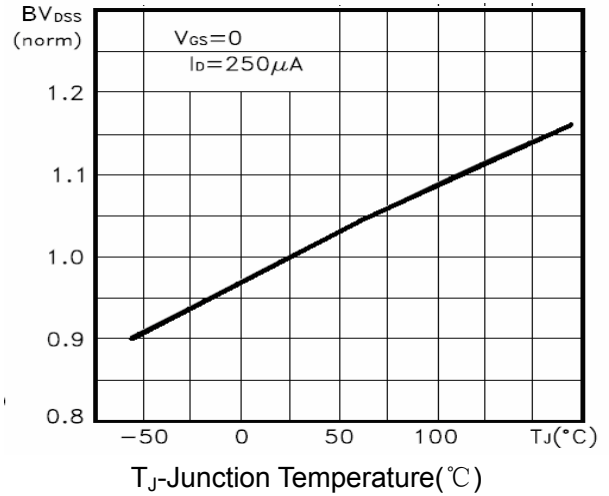


Figure 9  $BV_{DSS}$  vs Junction Temperature

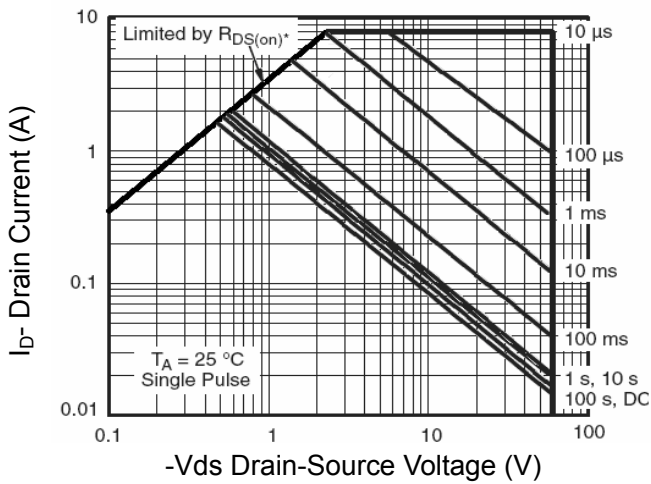


Figure 8 Safe Operation Area

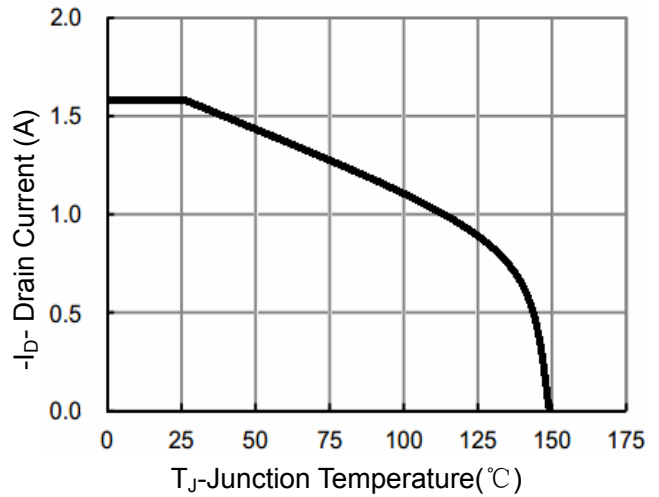


Figure 10  $I_D$  Current De-rating

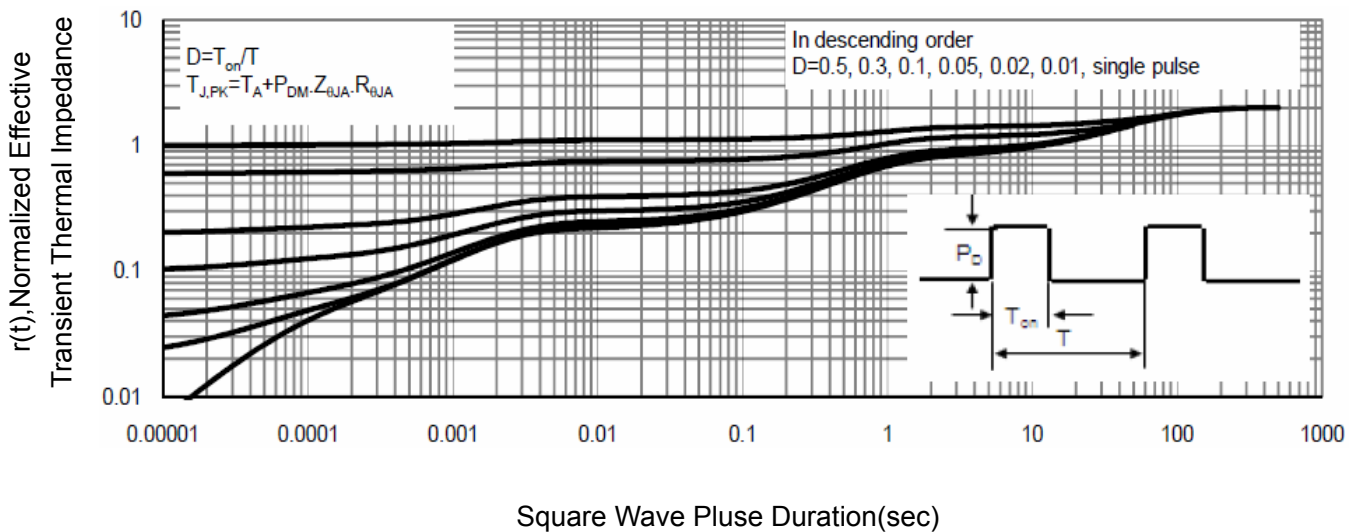
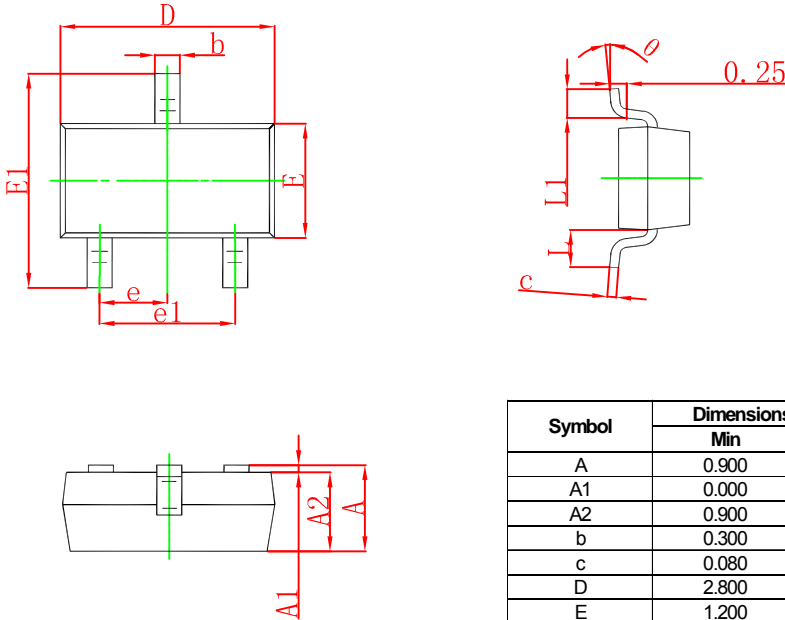


Figure 11 Normalized Maximum Transient Thermal Impedance

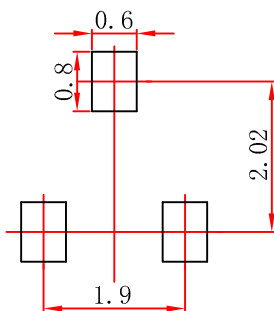


### SOT-23 Package Outline Dimensions



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 0.900                     | 1.150 | 0.035                | 0.045 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 0.900                     | 1.050 | 0.035                | 0.041 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.080                     | 0.150 | 0.003                | 0.006 |
| D      | 2.800                     | 3.000 | 0.110                | 0.118 |
| E      | 1.200                     | 1.400 | 0.047                | 0.055 |
| E1     | 2.250                     | 2.550 | 0.089                | 0.100 |
| e      | 0.950 TYP                 |       | 0.037 TYP            |       |
| e1     | 1.800                     | 2.000 | 0.071                | 0.079 |
| L      | 0.550 REF                 |       | 0.022 REF            |       |
| L1     | 0.300                     | 0.500 | 0.012                | 0.020 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |

### SOT-23 Suggested Pad Layout



- Note:
1. Controlling dimension: in millimeters.
  2. General tolerance:  $\pm 0.05\text{mm}$ .
  3. The pad layout is for reference purposes only.



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