

# MT2301

## Single P-Channel Power MOSFET

### General Description

This P-Channel Power MOSFET is produced using MOS-TECH Semiconductor's advanced Power -Trench process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

### Features

- -3.3 A, -20 V.  $R_{DS(ON)} = 0.072 \Omega @ V_{GS} = -4.5 \text{ V}$   
 $R_{DS(ON)} = 0.096 \Omega @ V_{GS} = -2.5 \text{ V}$
- Low gate charge (3.6 nC typical)
- High performance trench technology for extremely low  $R_{DS(ON)}$
- SuperSOT™-23 provides low  $R_{DS(ON)}$  and 30% higher power handling capability than SOT-23 in the same footprint

### Applications

- Portable electronics
- DC/DC conversion
- Power management
- Battery charging circuits
- Load switching

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

| Symbol         | Parameter  | Ratings     | Units            |
|----------------|--|-------------|------------------|
| $V_{DSS}$      | Drain-Source Voltage                             | -20         | V                |
| $V_{GSS}$      | Gate-Source Voltage                              | $\pm 12$    | V                |
| $I_D$          | Drain Current – Continuous (Note 1a)<br>– Pulsed | -3.3        | A                |
|                |  | -10         |                  |
| $P_D$          | Maximum Power Dissipation (Note 1a)<br>(Note 1b) | 0.5         | W                |
|                |  | 0.46        |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150 | $^\circ\text{C}$ |

### Thermal Characteristics

|                 |   |     |                    |
|-----------------|---|-----|--------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (Note 1a) | 138 | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case (Note 1)     | 75  | $^\circ\text{C/W}$ |

### Package Marking and Ordering Information

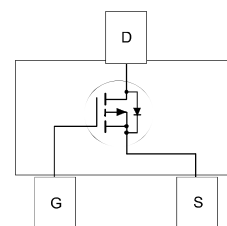
| Device Marking | Device | Reel Size | Tape width | Quantity   |
|----------------|--------|-----------|------------|------------|
| 010X           | MT2301 | 7"        | 8mm        | 3000 units |



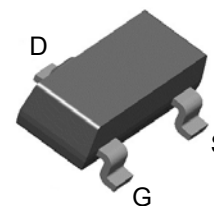
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### Simplified Schematic



### MARKING DIAGRAM & PIN ASSIGNMENT



**SOT-23**

| Electrical Characteristics ( $T_A = 25\text{ }^\circ\text{C}$ unless otherwise noted)  |   |   |      |                        |                      |                      |
|--|---|---|------|------------------------|----------------------|----------------------|
| Symbol   | Parameter   | Conditions  | Min  | Typ                    | Max                  | Units                |
| <b>OFF CHARACTERISTICS</b>   |   |   |      |                        |                      |                      |
| $BV_{DSS}$   | Drain-Source Breakdown Voltage                        | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$  | -20  |                        |                      | V                    |
| $\Delta BV_{DSS}/\Delta T_J$   | Breakdown Voltage Temp. Coefficient                   | $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25\text{ }^\circ\text{C}$  |      | 16                     |                      | mV/ $^\circ\text{C}$ |
| $I_{DSS}$  | Zero Gate Voltage Drain Current                       | $V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$<br>$T_J = 55\text{ }^\circ\text{C}$  |      |                        | -1                   | $\mu\text{A}$        |
| $I_{GSSF}$   | Gate - Body Leakage, Forward                          | $V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$  |      |                        | 100                  | nA                   |
| $I_{GSSR}$   | Gate - Body Leakage, Reverse                          | $V_{GS} = -8\text{ V}, V_{DS} = 0\text{ V}$   |      |                        | -100                 | nA                   |
| <b>ON CHARACTERISTICS</b> (Note 2)   |   |   |      |                        |                      |                      |
| $V_{GS(th)}$   | Gate Threshold Voltage                                | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$  | -0.8 | -1.1                   | -1.5                 | V                    |
| $\Delta V_{GS(th)}/\Delta T_J$   | Gate Threshold Voltage Temp. Coefficient              | $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25\text{ }^\circ\text{C}$  |      | -3                     |                      | mV/ $^\circ\text{C}$ |
| $R_{DS(on)}$   | Static Drain-Source On-Resistance                     | $V_{GS} = -4.5\text{ V}, I_D = -1.3\text{ A}$<br>$T_J = 125\text{ }^\circ\text{C}$<br>$V_{GS} = -2.5\text{ V}, I_D = -1.1\text{ A}$ |      | 0.072<br>0.12<br>0.096 | 0.08<br>0.15<br>0.15 | $\Omega$             |
| $I_{D(on)}$  | On-State Drain Current                                | $V_{GS} = -4.5\text{ V}, V_{DS} = -5\text{ V}$  | -3.3 |                        |                      | A                    |
| $g_{FS}$   | Forward Transconductance                              | $V_{DS} = -4.5\text{ V}, I_D = -2\text{ A}$   |      | 4                      |                      | S                    |
| <b>DYNAMIC CHARACTERISTICS</b>   |   |   |      |                        |                      |                      |
| $C_{iss}$  | Input Capacitance                                     | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$   |      | 330                    |                      | pF                   |
| $C_{oss}$  | Output Capacitance                                    |   |      | 80                     |                      | pF                   |
| $C_{rss}$  | Reverse Transfer Capacitance                          |   |      | 35                     |                      | pF                   |
| <b>SWITCHING CHARACTERISTICS</b> (Note 2)  |   |   |      |                        |                      |                      |
| $t_{D(on)}$  | Turn - On Delay Time                                  | $V_{DD} = -5\text{ V}, I_D = -0.5\text{ A},$<br>$V_{GS} = -4.5\text{ V}, R_{GEN} = 6\text{ }\Omega$                                 |      | 7                      | 15                   | ns                   |
| $t_r$  | Turn - On Rise Time                                   |   |      | 12                     | 22                   | ns                   |
| $t_{D(off)}$   | Turn - Off Delay Time                                 |   |      | 16                     | 26                   | ns                   |
| $t_f$  | Turn - Off Fall Time                                  |   |      | 5                      | 12                   | ns                   |
| $Q_g$  | Total Gate Charge                                     | $V_{DS} = -10\text{ V}, I_D = -2\text{ A},$<br>$V_{GS} = -4.5\text{ V}$   |      | 3.6                    | 5                    | nC                   |
| $Q_{gs}$   | Gate-Source Charge                                    |   |      | 0.8                    |                      | nC                   |
| $Q_{gd}$   | Gate-Drain Charge                                     |   |      | 0.7                    |                      | nC                   |
| <b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>  |   |   |      |                        |                      |                      |
| $I_S$  | Maximum Continuous Drain-Source Diode Forward Current |   | -3.3 |                        |                      | A                    |
| $V_{SD}$   | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = -0.42\text{ A}$ (Note)  |      | -0.7                   | -1.2                 | V                    |
| Note:  |   |   |      |                        |                      |                      |
| 1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design. |   |   |      |                        |                      |                      |
| 2. Pulse Test: Pulse Width $\leq 300\mu\text{s}$ , Duty Cycle $\leq 2.0\%$ .   |   |   |      |                        |                      |                      |

Typical Electrical and Thermal Characteristics

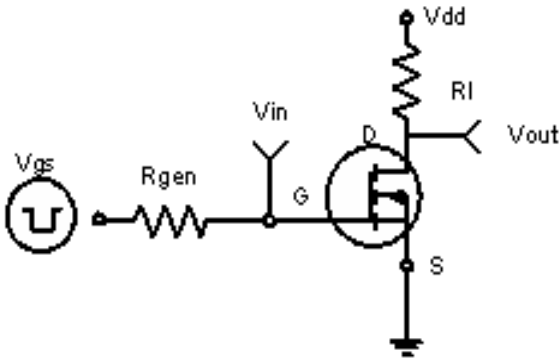


Figure 1: Switching Test Circuit

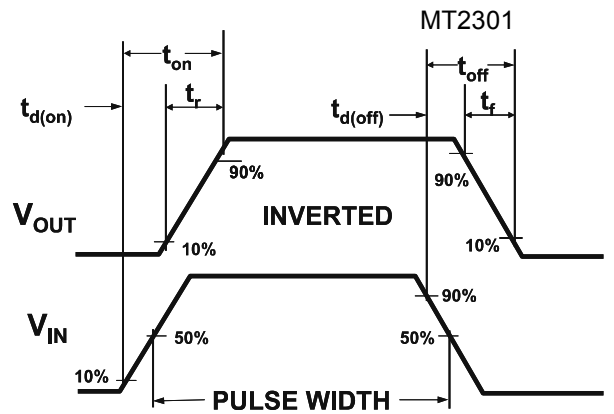


Figure 2: Switching Waveforms

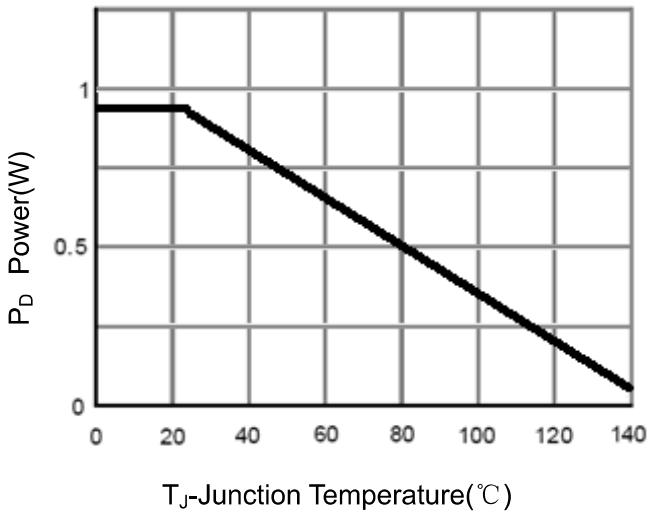


Figure 3 Power Dissipation

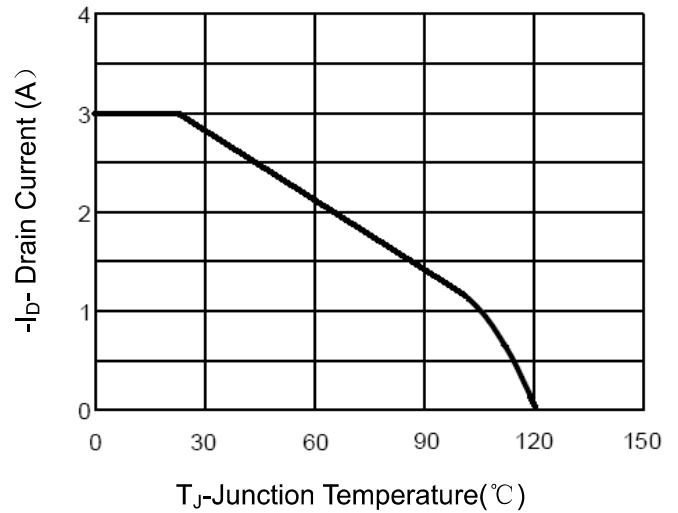


Figure 4 Drain Current

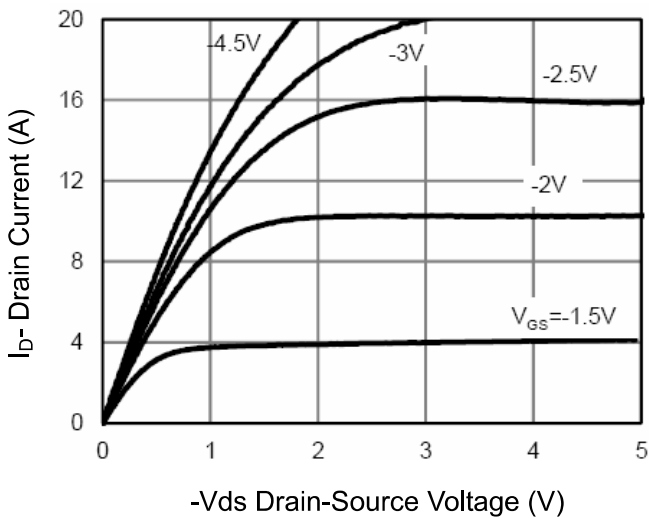


Figure 5 Output Characteristics

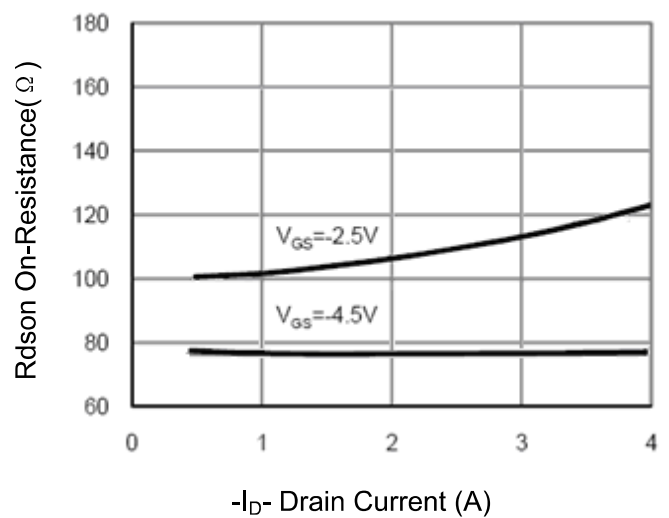
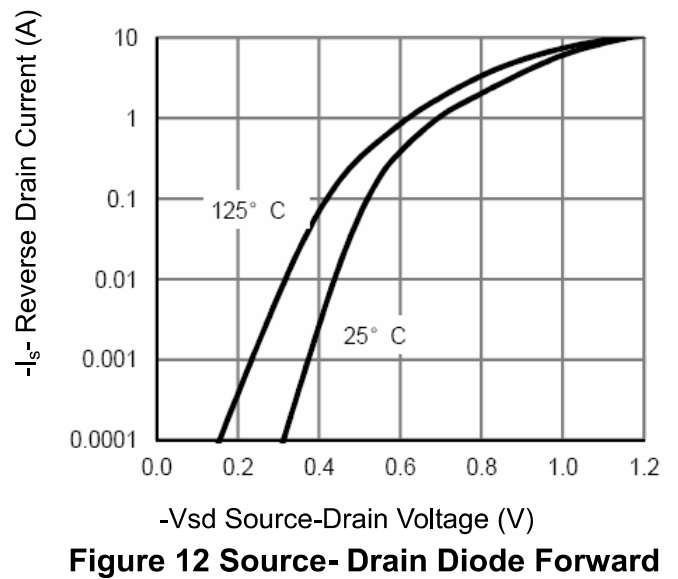
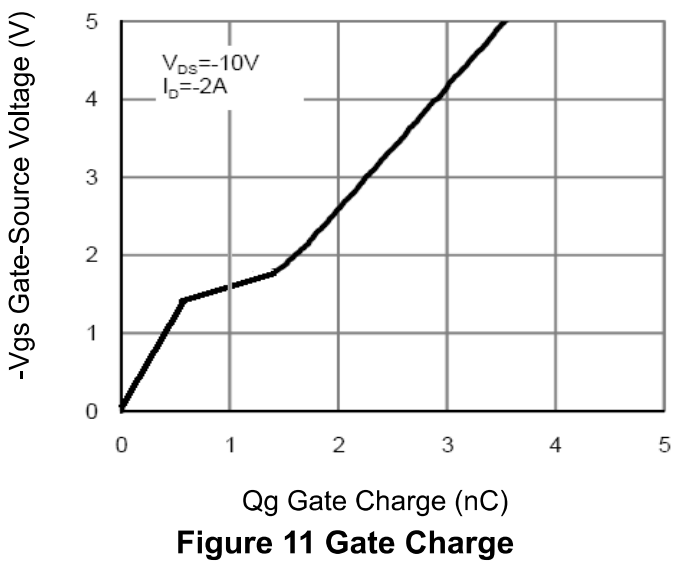
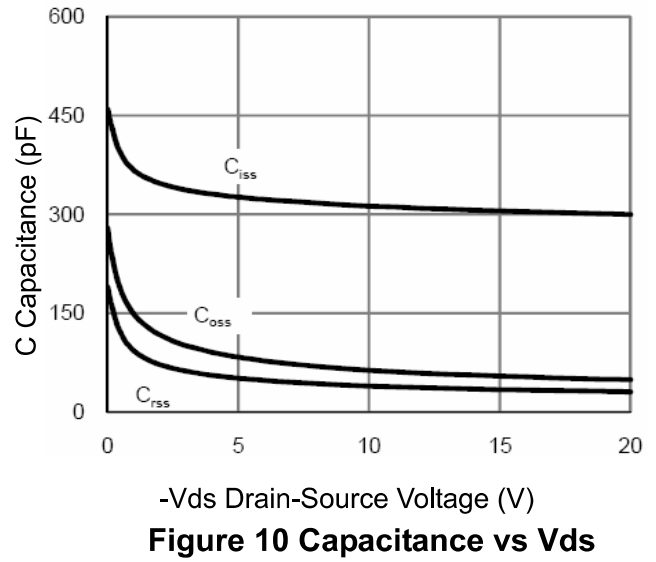
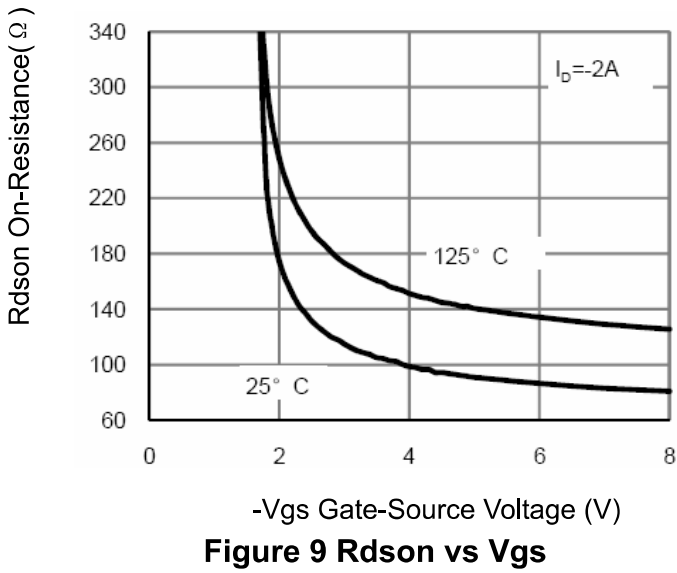
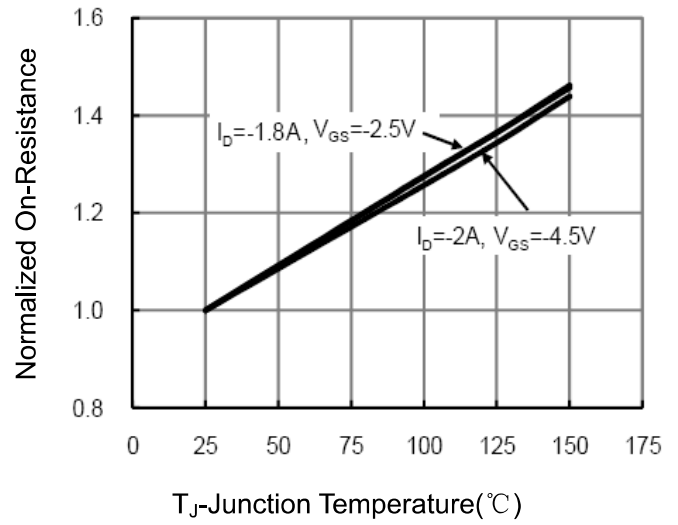
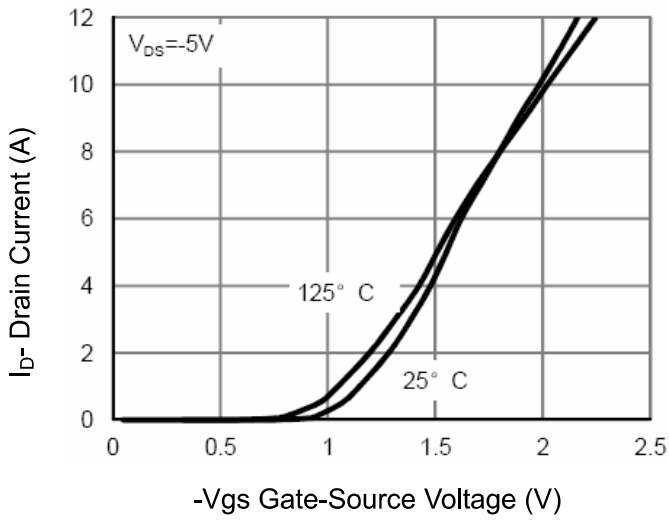
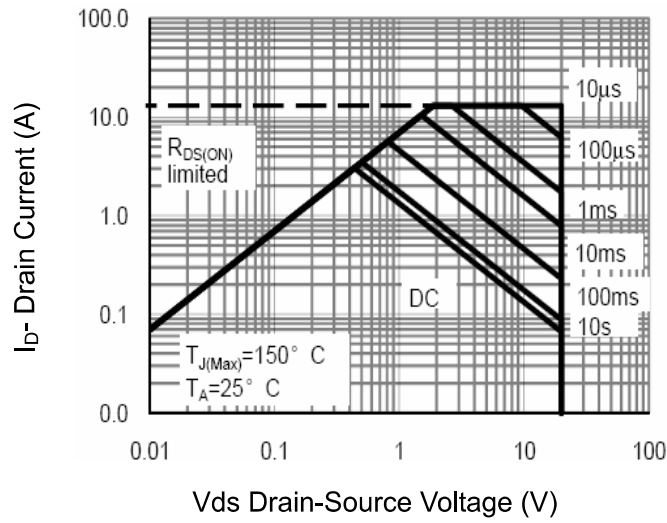
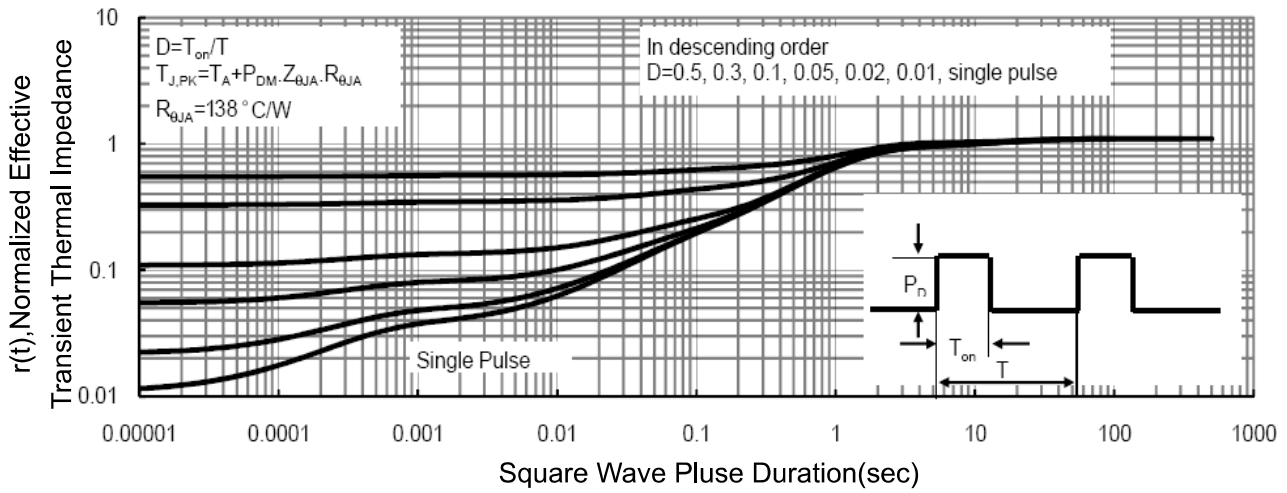


Figure 6 Drain-Source On-Resistance





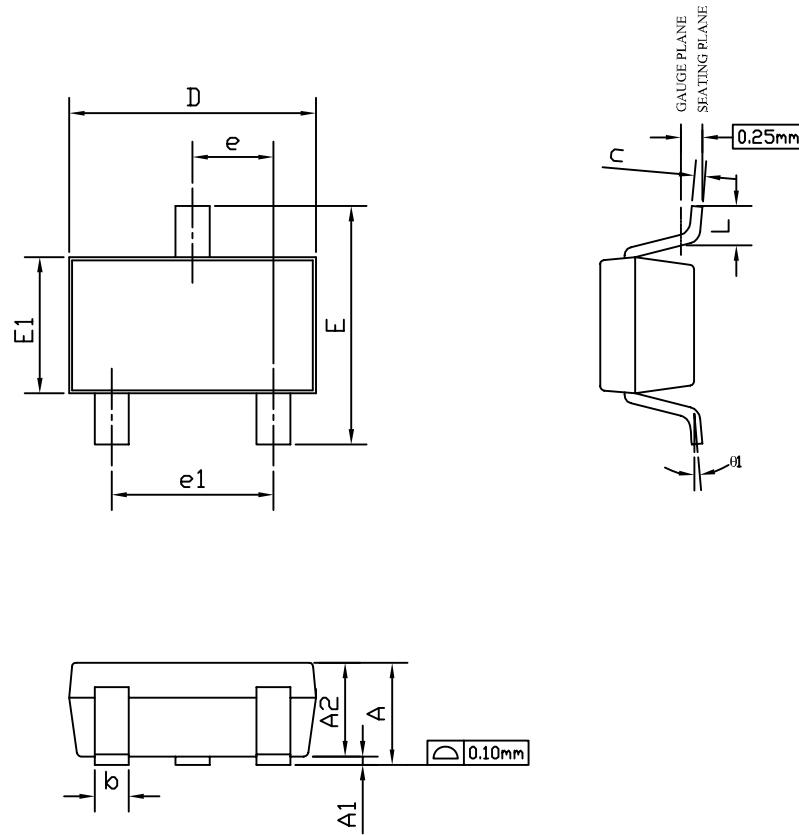
**Figure 13 Safe Operation Area**



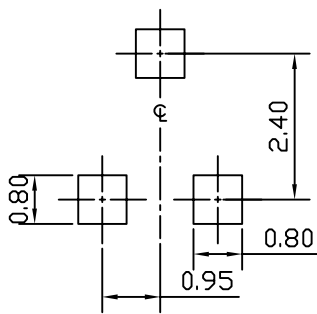
**Figure 14 Normalized Maximum Transient Thermal Impedance**

|              |          |
|--------------|----------|
| Document No. | PO-00001 |
| Version      | L        |

SOT23 PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



UNIT: mm

| SYMBOLS | DIMENSIONS IN MILLIMETERS |      |      | DIMENSIONS IN INCHES |       |       |
|---------|---------------------------|------|------|----------------------|-------|-------|
|         | MIN                       | NOM  | MAX  | MIN                  | NOM   | MAX   |
| A       | 0.85                      | ---  | 1.25 | 0.033                | ---   | 0.049 |
| A1      | 0.00                      | ---  | 0.13 | 0.000                | ---   | 0.005 |
| A2      | 0.70                      | 1.00 | 1.15 | 0.028                | 0.039 | 0.045 |
| b       | 0.30                      | 0.40 | 0.50 | 0.012                | 0.016 | 0.020 |
| c       | 0.08                      | 0.13 | 0.20 | 0.003                | 0.005 | 0.008 |
| D       | 2.80                      | 2.90 | 3.10 | 0.110                | 0.114 | 0.122 |
| E       | 2.60                      | 2.80 | 3.00 | 0.102                | 0.110 | 0.118 |
| E1      | 1.40                      | 1.60 | 1.80 | 0.055                | 0.063 | 0.071 |
| e       | 0.95 BSC                  |      |      | 0.037 BSC            |       |       |
| e1      | 1.90 BSC                  |      |      | 0.075 BSC            |       |       |
| L       | 0.30                      | ---  | 0.60 | 0.012                | ---   | 0.024 |
| θ1      | 0°                        | 5°   | 8°   | 0°                   | 5°    | 8°    |

NOTE

1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH OR GATE BURRS.  
MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 5 MILS EACH.
2. TOLERANCE ±0.100 mm (4 mil) UNLESS OTHERWISE SPECIFIED.
3. DIMENSION L IS MEASURED IN GAUGE PLANE.
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. ALL DIMENSIONS ARE IN MILLIMETERS.

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