

# 2N7002KL

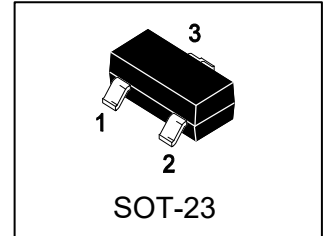
# S-2N7002KL

Small Signal MOSFET

380 mAmps, 60 Volts N-Channel SOT-23

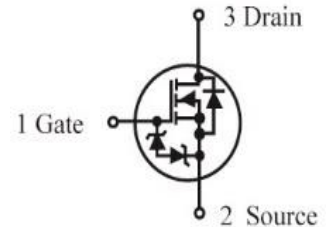
## 1. FEATURES

- We declare that the material of product compliance with RoHS requirements and Halogen Free.
- S- prefix for automotive and other applications requiring unique site and control change requirements; AEC-Q101 qualified and PPAP capable.
- ESD Protected



## 2. DEVICE MARKING AND ORDERING INFORMATION

| Device   | Marking | Shipping       |
|----------|---------|----------------|
| 2N7002KL | RK      | 3000/Tape&Reel |



## 3. MAXIMUM RATINGS(Ta = 25°C)

| Parameter                      | Symbol | Limits | Unit |
|--------------------------------|--------|--------|------|
| Drain-Source Voltage           | VDSS   | 60     | Vdc  |
| Gate-Source Voltage            | VGS    | ±20    | Vdc  |
| Drain Current                  | ID     |        | mAdc |
| – Steady State TA = 25°C       |        | 320    |      |
| TA = 85°C                      |        | 230    |      |
| – t<5s TA = 25°C               |        | 380    |      |
| TA = 85°C                      |        | 270    |      |
| Pulsed Drain Current (tp=10µs) | IDM    | 1.5    | A    |
| Source Current (Body Diode)    | IS     | 300    | mA   |

## 4. THERMAL CHARACTERISTICS

| Parameter  | Symbol  | Limits   | Unit |
|--|---------|----------|------|
| Total Device Dissipation(Note 1)                                   | PD      |          | mW   |
| – Steady State   |         | 300      |      |
| – t<5s   |         | 420      |      |
| Junction-to-Ambient(Note 1)  | ROJA    |          | °C/W |
| – Steady State   |         | 417      |      |
| – t<5s   |         | 300      |      |
| Lead Temperature for Soldering Purposes (1/8 " from case for 10 s) | TL      | 260      | °C   |
| Junction and Storage temperature                                   | TJ,Tstg | -55~+150 | °C   |
| Gate-Source ESD Rating(HBM, Method 3015)                           | ESD     | 2000     | V    |

1. FR-5 = 1.0×0.75×0.062 in.



## 5. ELECTRICAL CHARACTERISTICS (Ta= 25°C)

### OFF CHARACTERISTICS

| Characteristic   | Symbol    | Min.       | Typ. | Max. | Unit  |
|--|-----------|------------|------|------|-------|
| Drain–Source Breakdown Voltage<br>(VGS = 0, ID = 250μAdc)    | VBRDSS    | 60         | -    | -    | Vdc   |
| Drain-to–Source Breakdown Voltage<br>Temperature Coefficient | VBRDSS/TJ | -          | 71   | -    | mV/°C |
| Zero Gate Voltage Drain Current<br>(VGS = 0, VDS = 60 Vdc)   | IDSS      | TJ = 25°C  | -    | 1.0  | μAdc  |
|  |           | TJ = 125°C | -    | 500  |       |
| (VGS = 0, VDS = 50 Vdc)<br>TJ = 25°C                         |           | -          | -    | 100  | nAdc  |
| Gate–Body Leakage Current, Forward<br>(VGS = 20 Vdc)         | IGSSF     | -          | -    | 10   | μAdc  |
| Gate–Body Leakage Current, Reverse<br>(VGS = - 20 Vdc)       | IGSSR     | -          | -    | -10  | μAdc  |

### ON CHARACTERISTICS (Note 2)

| Characteristic   | Symbol     | Min.                          | Typ. | Max. | Unit  |
|--|------------|-------------------------------|------|------|-------|
| Gate Threshold Voltage<br>(VDS = VGS, ID = 250μAdc)                      | VGS(th)    | 1.0                           | -    | 2.5  | Vdc   |
| Negative Threshold Temperature Coefficient                               | VGS(TH)/TJ | -                             | 4    | -    | mV/°C |
| Static Drain–Source On–State Resistance<br>(VGS = 10 Vdc, ID = 500 mAdc) | RDS(on)    | -                             | -    | 2.3  | Ohm   |
|  |            | (VGS = 5.0 Vdc, ID = 50 mAdc) | -    | -    |       |
| Forward Transconductance<br>(VDS = 5.0 Vdc, ID = 200 mAdc)               | gfs        | 80                            | -    | -    | mS    |

### DYNAMIC CHARACTERISTICS

| Characteristic   | Symbol | Min. | Typ. | Max. | Unit |
|--|--------|------|------|------|------|
| Total Gate Charge<br>(VDS = 10V, VGS = 4.5V, ID = 0.5A)              | Qg     | -    | 360  | -    | pC   |
| Gate-Source Charge<br>(VDS = 10V, VGS = 4.5V, ID = 0.5A)             | Qgs    | -    | 90   | -    |      |
| Gate-Drain Charge<br>(VDS = 10V, VGS = 4.5V, ID = 0.5A)              | Qgd    | -    | 210  | -    |      |
| Input Capacitance<br>(VDS = 25 Vdc, VGS = 0, f = 1.0 MHz)            | Ciss   | -    | 34   | -    | pF   |
| Output Capacitance<br>(VDS = 25 Vdc, VGS = 0, f = 1.0 MHz)           | Coss   | -    | 3    | -    | pF   |
| Reverse Transfer Capacitance<br>(VDS = 25 Vdc, VGS = 0, f = 1.0 MHz) | Crss   | -    | 2.2  | -    | pF   |

### SWITCHING CHARACTERISTICS

| Characteristic      | Symbol  | Min. | Typ. | Max. | Unit |
|---------------------|---------|------|------|------|------|
| Turn-On Delay Time  | td(on)  | -    | 3.8  | -    | ns   |
| Rise Time           | tr      | -    | 3.4  | -    |      |
| Turn-Off Delay Time | td(off) | -    | 19   | -    |      |
| Fall Time           | tf      | -    | 12   | -    |      |

VDS = 10 V, VGEN = 10 V,  
ID = 500 mA

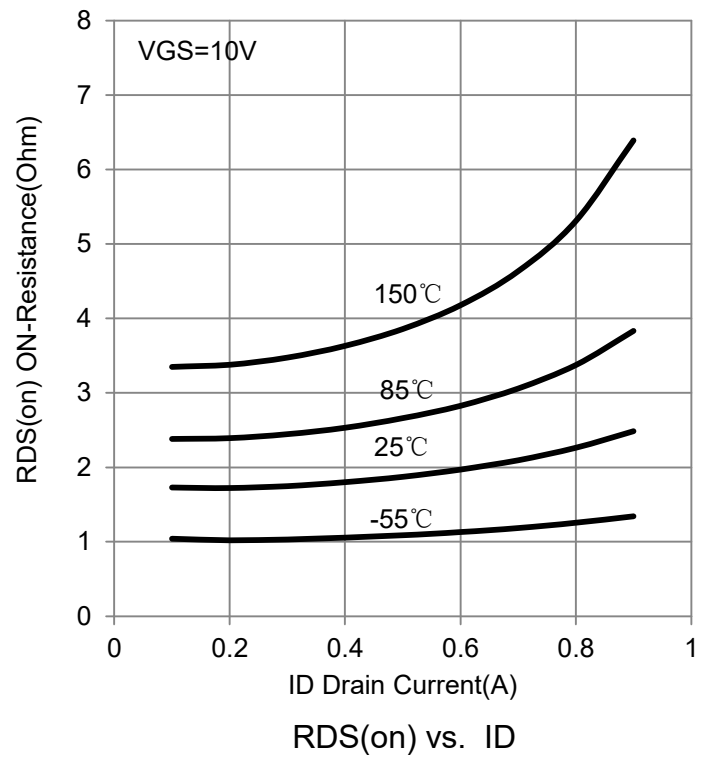
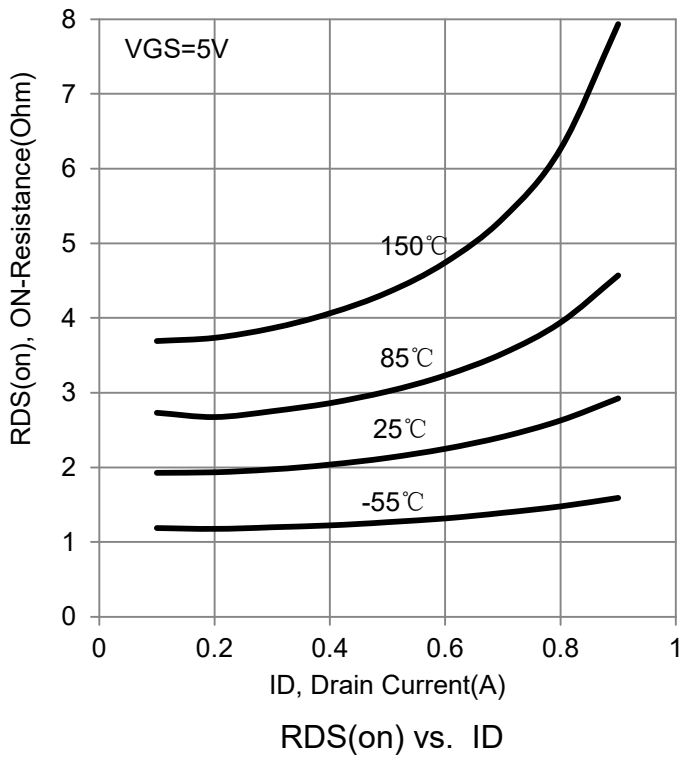
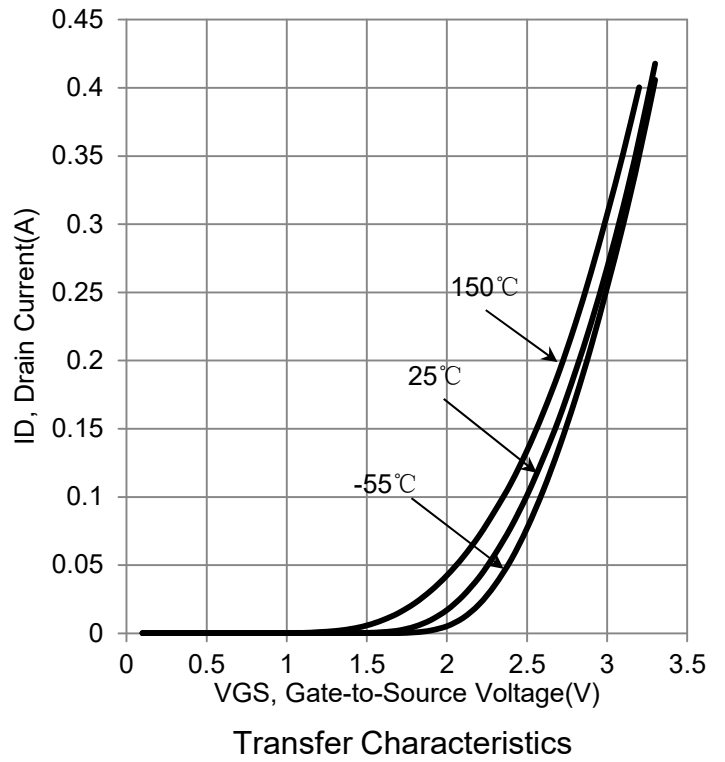
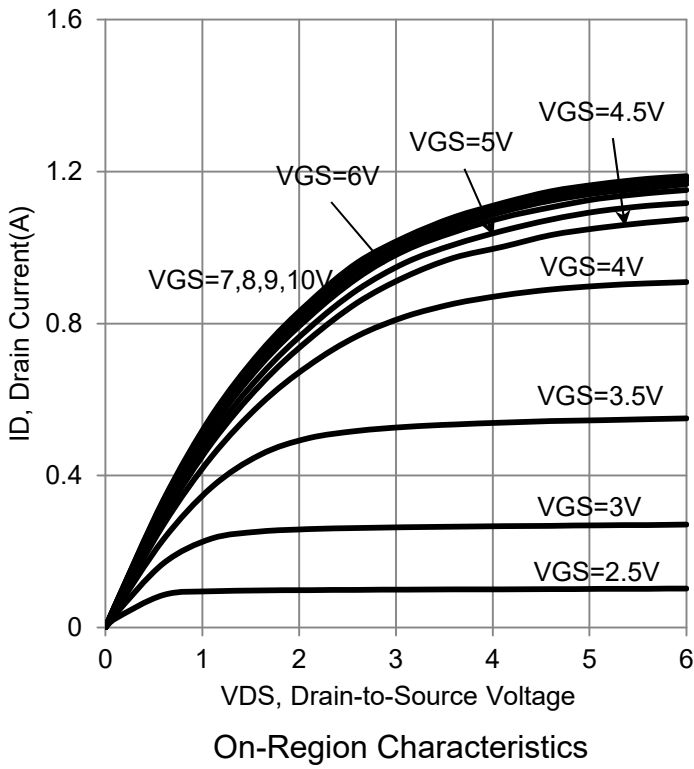
### BODY–DRAIN DIODE RATINGS

| Characteristic   | Symbol | Min. | Typ. | Max. | Unit |
|--|--------|------|------|------|------|
| Diode Forward On–Voltage<br>(IS = 115 mAdc, VGS = 0 V) | VSD    | -    | -    | 1.4  | Vdc  |
| TJ = 85°C  |        | -    | 0.7  | -    |      |

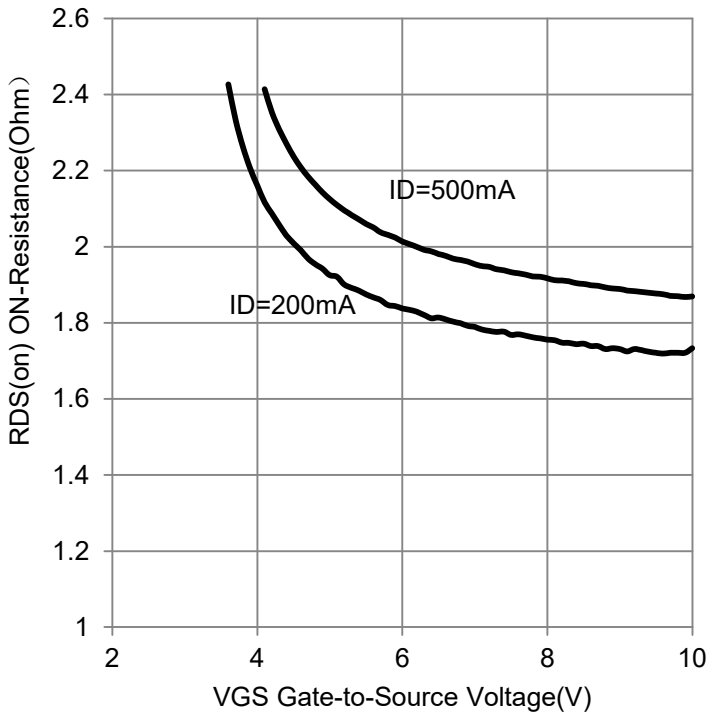
2.Pulse Test: Pulse Width ≤300 μs, Duty Cycle ≤2.0%.



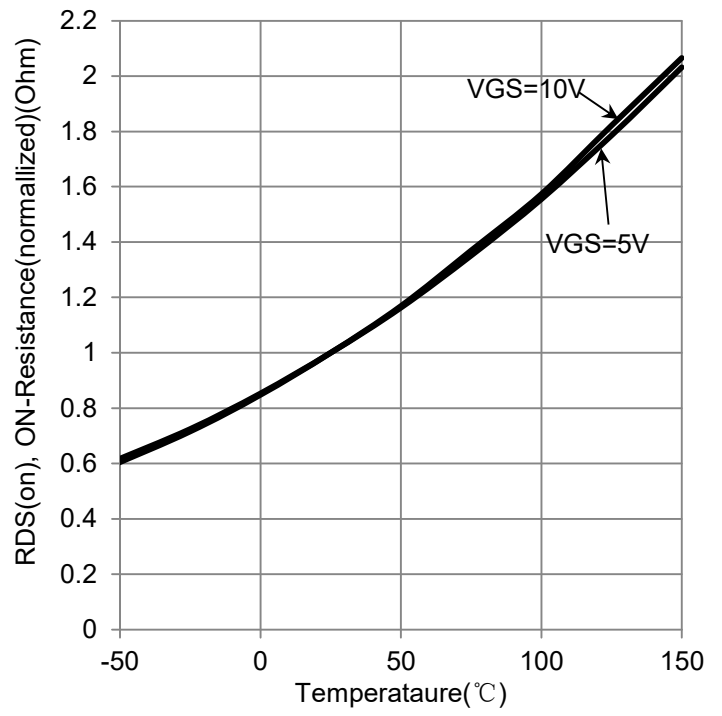
## 6. ELECTRICAL CHARACTERISTICS CURVES



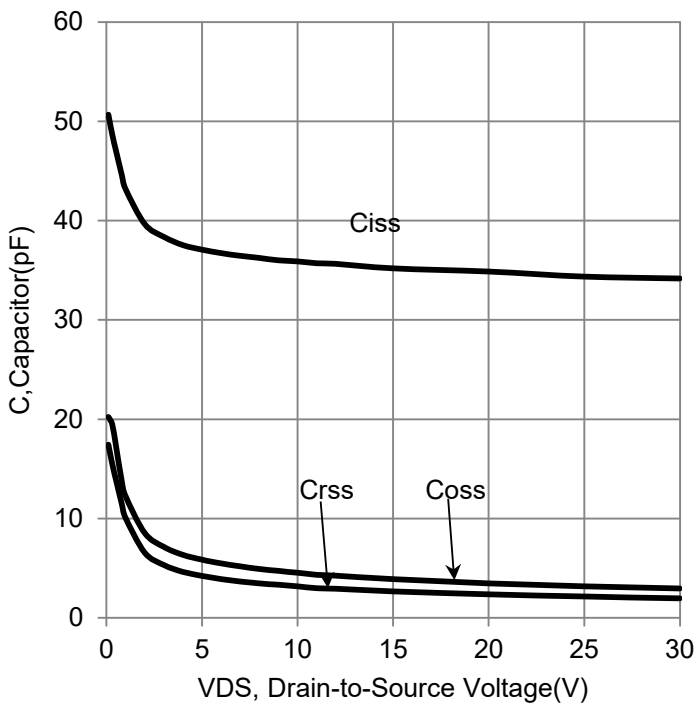
## 6. ELECTRICAL CHARACTERISTICS CURVES (Con.)



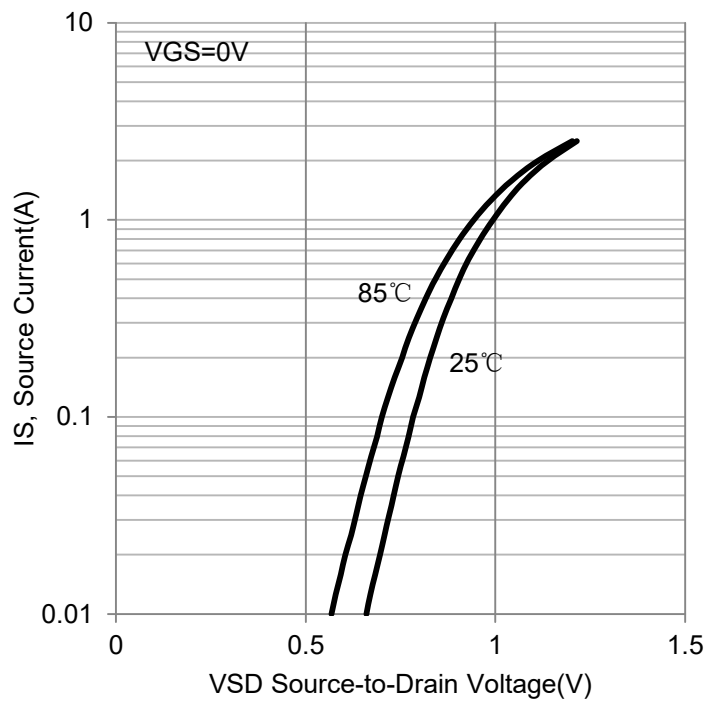
RDS(on) vs. VGS



RDS(on) vs. Temperature



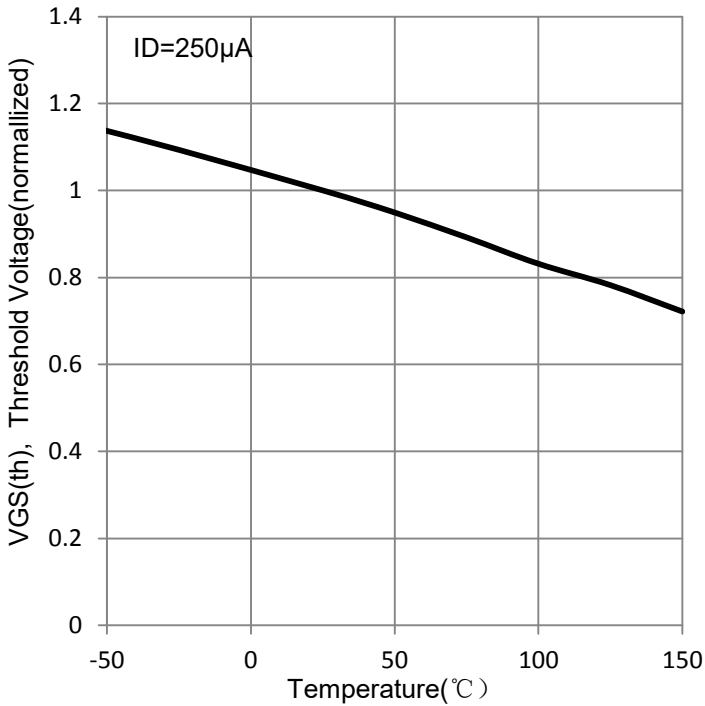
Capacitor vs. VDS



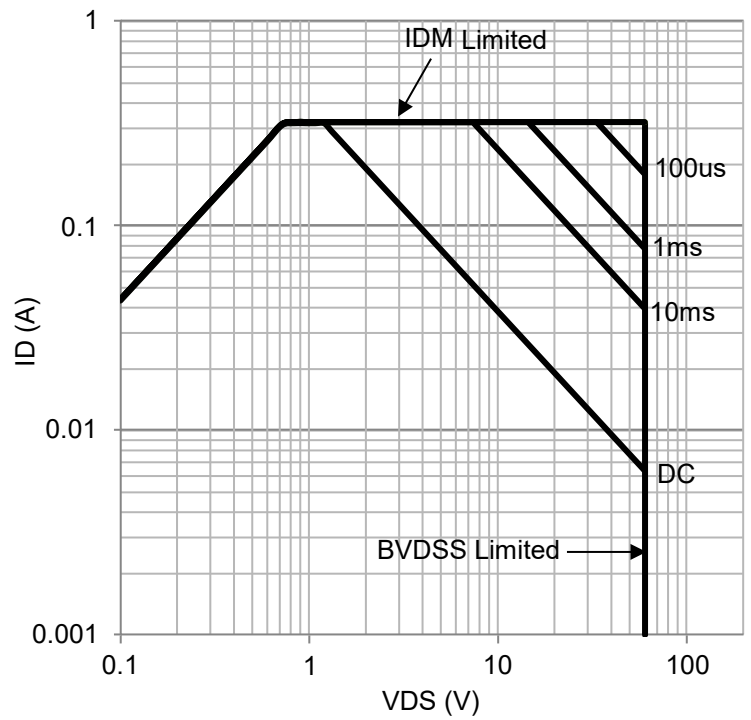
$I_S$  vs.  $V_{SD}$



**6. ELECTRICAL CHARACTERISTICS CURVES (Con.)**



VGS(th) vs. Temperature



Safe Operating Area

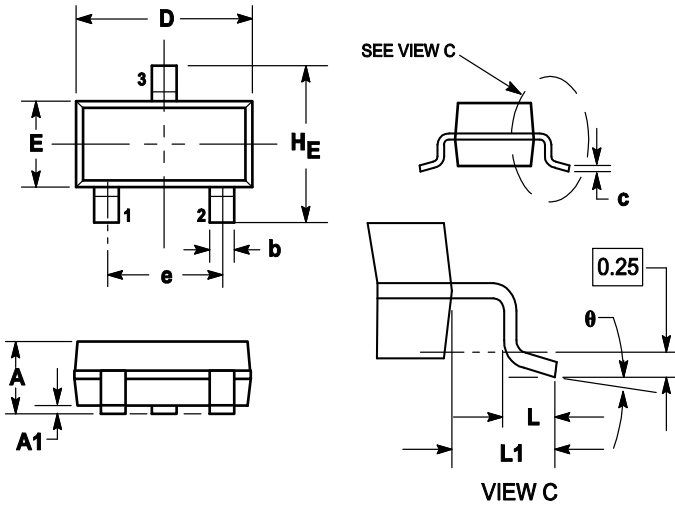


## 7. OUTLINE AND DIMENSIONS

SOT-23

Notes:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.



| DIM            | MILLIMETERS |      |      | INCHES |       |       |
|----------------|-------------|------|------|--------|-------|-------|
|                | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A              | 0.89        | 1    | 1.11 | 0.035  | 0.04  | 0.044 |
| A1             | 0.01        | 0.06 | 0.1  | 0.001  | 0.002 | 0.004 |
| b              | 0.37        | 0.44 | 0.5  | 0.015  | 0.018 | 0.02  |
| c              | 0.09        | 0.13 | 0.18 | 0.003  | 0.005 | 0.007 |
| D              | 2.80        | 2.9  | 3.04 | 0.11   | 0.114 | 0.12  |
| E              | 1.20        | 1.3  | 1.4  | 0.047  | 0.051 | 0.055 |
| e              | 1.78        | 1.9  | 2.04 | 0.07   | 0.075 | 0.081 |
| L              | 0.10        | 0.2  | 0.3  | 0.004  | 0.008 | 0.012 |
| L1             | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.029 |
| H <sub>E</sub> | 2.10        | 2.4  | 2.64 | 0.083  | 0.094 | 0.104 |
| θ              | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

## 8. SOLDERING FOOTPRINT

