



# 74LX1GU04

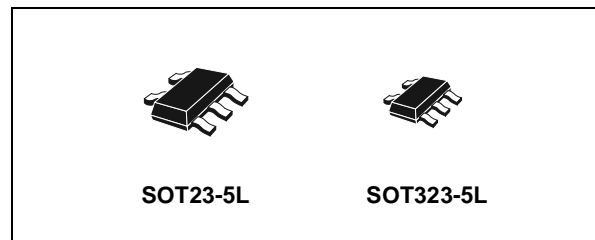
## LOW VOLTAGE CMOS SINGLE INVERTER WITH 5V TOLERANT INPUT

- 5V TOLERANT INPUTS
- HIGH SPEED:  $t_{PD} = 4.2\text{ns}$  (MAX.) at  $V_{CC} = 3\text{V}$
- LOW POWER DISSIPATION:  
 $I_{CC} = 1\mu\text{A}$  (MAX.) at  $T_A = 25^\circ\text{C}$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 24\text{mA}$  (MIN) at  $V_{CC} = 3\text{V}$
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}(\text{OPR}) = 1.65\text{V}$  to  $5.5\text{V}$   
(1.2V Data Retention)
- IMPROVED LATCH-UP IMMUNITY

### DESCRIPTION

The 74LX1GU04 is a low voltage CMOS SINGLE INVERTER (SINGLE STAGE) fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

It is ideal for 1.65 to 5.5  $V_{CC}$  operations and low power and low noise applications. The internal circuit is composed of 3 stages including buffer



### ORDER CODES

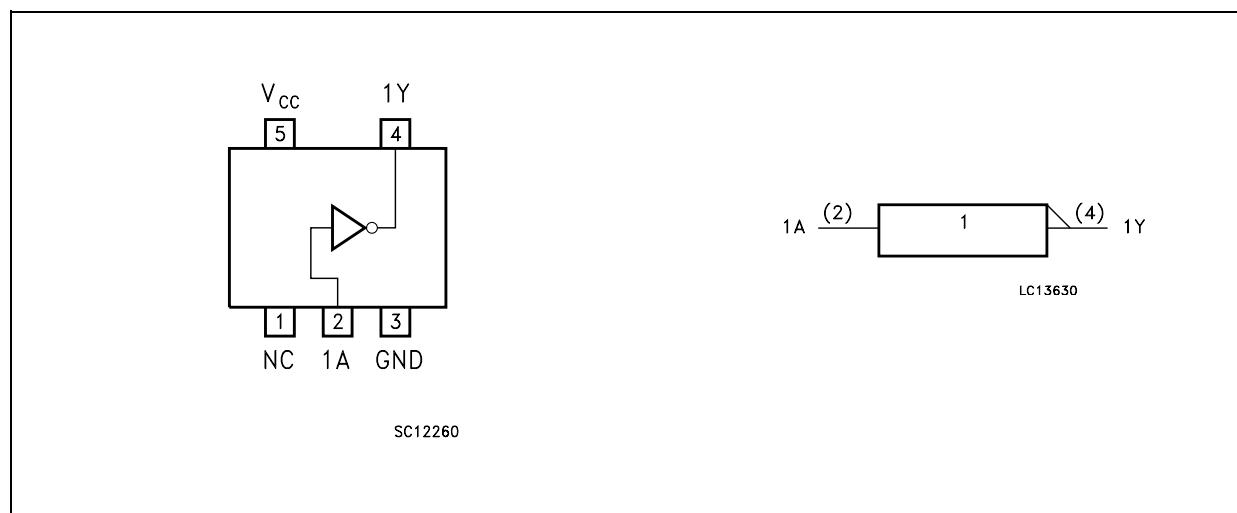
| PACKAGE   | T & R        |
|-----------|--------------|
| SOT23-5L  | 74LX1GU04STR |
| SOT323-5L | 74LX1GU04CTR |

output, which provide high noise immunity and stable output.

Power down protection is provided on input and output and 0 to 7V can be accepted on inputs with no regard to the supply voltage. It can be interfaced to 5V signal environment for inputs in mixed 3.3/5V system.

All inputs and outputs are equipped with protection circuits against static discharge.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



# 74LX1GU04

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



### PIN DESCRIPTION

| PIN N° | SYMBOL          | NAME AND FUNCTION       |
|--------|-----------------|-------------------------|
| 1      | N.C.            | Not connected           |
| 2      | 1A              | Data Inputs             |
| 4      | 1Y              | Data Outputs            |
| 3      | GND             | Ground (0V)             |
| 5      | V <sub>CC</sub> | Positive Supply Voltage |

### TRUTH TABLE

| A | Y |
|---|---|
| L | H |
| H | L |

### ABSOLUTE MAXIMUM RATINGS

| Symbol                              | Parameter   | Value                         | Unit |
|-------------------------------------|---|-------------------------------|------|
| V <sub>CC</sub>                     | Supply Voltage                                      | -0.5 to +7.0                  | V    |
| V <sub>I</sub>                      | DC Input Voltage                                    | -0.5 to +7.0                  | V    |
| V <sub>O</sub>                      | DC Output Voltage (V <sub>CC</sub> = 0V)            | -0.5 to +7.0                  | V    |
| V <sub>O</sub>                      | DC Output Voltage (High or Low State) (note 1)      | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| I <sub>IK</sub>                     | DC Input Diode Current                              | - 50                          | mA   |
| I <sub>OK</sub>                     | DC Output Diode Current (note 2)                    | - 50                          | mA   |
| I <sub>O</sub>                      | DC Output Current                                   | ± 50                          | mA   |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current per Supply Pin | ± 50                          | mA   |
| T <sub>stg</sub>                    | Storage Temperature                                 | -65 to +150                   | °C   |
| T <sub>L</sub>                      | Lead Temperature (10 sec)                           | 300                           | °C   |

Absolute Maximum Rating are those value beyond which damage to the device may occur. Functional operation under these condition is not implied

1) I<sub>O</sub> absolute maximum rating must be observed

2) V<sub>O</sub> < GND, V<sub>O</sub> > V<sub>CC</sub>

## RECOMMENDED OPERATING CONDITIONS

| Symbol           | Parameter  | Value         | Unit        |
|------------------|--|---------------|-------------|
| $V_{CC}$         | Supply Voltage (note 1)  | 1.65 to 5.5   | V           |
| $V_I$            | Input Voltage  | 0 to 5.5      | V           |
| $V_O$            | Output Voltage ( $V_{CC} = 0V$ )                               | 0 to 5.5      | V           |
| $V_O$            | Output Voltage (High or Low State)                             | 0 to $V_{CC}$ | V           |
| $I_{OH}, I_{OL}$ | High or Low Level Output Current ( $V_{CC} = 4.5$ to $5.5V$ )  | $\pm 32$      | mA          |
| $I_{OH}, I_{OL}$ | High or Low Level Output Current ( $V_{CC} = 3.0$ to $3.6V$ )  | $\pm 24$      | mA          |
| $I_{OH}, I_{OL}$ | High or Low Level Output Current ( $V_{CC} = 2.7$ to $3.0V$ )  | $\pm 12$      | mA          |
| $I_{OH}, I_{OL}$ | High or Low Level Output Current ( $V_{CC} = 2.3$ to $2.7V$ )  | $\pm 8$       | mA          |
| $I_{OH}, I_{OL}$ | High or Low Level Output Current ( $V_{CC} = 1.65$ to $2.3V$ ) | $\pm 4$       | mA          |
| $T_{op}$         | Operating Temperature  | -55 to 125    | $^{\circ}C$ |
| dt/dv            | Input Rise and Fall Time (note 2)                              | 0 to 10       | ns/V        |

1) Truth Table guaranteed: 1.2V to 3.6V

2)  $V_{IN}$  from 0.8V to 2V at  $V_{CC} = 3.0V$ 

## DC SPECIFICATIONS

| Symbol    | Parameter                 | Test Condition  |                        | Value                 |              |                        |              | Unit    |
|-----------|---------------------------|-----------------|------------------------|-----------------------|--------------|------------------------|--------------|---------|
|           |                           | $V_{CC}$<br>(V) |                        | -40 to 85 $^{\circ}C$ |              | -55 to 125 $^{\circ}C$ |              |         |
|           |                           |                 |                        | Min.                  | Max.         | Min.                   | Max.         |         |
| $V_{IH}$  | High Level Input Voltage  | 1.65 to 1.95    |                        | $0.75V_{CC}$          |              | $0.75V_{CC}$           |              | V       |
|           |                           | 2.3 to 2.7      |                        | $0.7V_{CC}$           |              | $0.7V_{CC}$            |              |         |
|           |                           | 3.0 to 5.5      |                        | $0.7V_{CC}$           |              | $0.7V_{CC}$            |              |         |
| $V_{IL}$  | Low Level Input Voltage   | 1.65 to 1.95    |                        |                       | $0.25V_{CC}$ |                        | $0.25V_{CC}$ | V       |
|           |                           | 2.3 to 2.7      |                        |                       | $0.3V_{CC}$  |                        | $0.3V_{CC}$  |         |
|           |                           | 3.0 to 5.5      |                        |                       | $0.3V_{CC}$  |                        | $0.3V_{CC}$  |         |
| $V_{OH}$  | High Level Output Voltage | 1.65 to 4.5     | $I_O = -100 \mu A$     | $V_{CC} - 0.1$        |              | $V_{CC} - 0.1$         |              | V       |
|           |                           | 1.65            | $I_O = -4 \text{ mA}$  | 1.2                   |              | 1.2                    |              |         |
|           |                           | 2.3             | $I_O = -8 \text{ mA}$  | 1.9                   |              | 1.9                    |              |         |
|           |                           | 3.0             | $I_O = -16 \text{ mA}$ | 2.4                   |              | 2.4                    |              |         |
|           |                           |                 | $I_O = -24 \text{ mA}$ | 2.2                   |              | 2.2                    |              |         |
| 4.5       | $I_O = -32 \text{ mA}$    | 3.8             |                        | 3.8                   |              |                        |              |         |
| $V_{OL}$  | Low Level Output Voltage  | 1.65 to 4.5     | $I_O = 100 \mu A$      |                       | 0.1          |                        | 0.1          | V       |
|           |                           | 1.65            | $I_O = 4 \text{ mA}$   |                       | 0.45         |                        | 0.45         |         |
|           |                           | 2.3             | $I_O = 8 \text{ mA}$   |                       | 0.3          |                        | 0.3          |         |
|           |                           | 3.0             | $I_O = 16 \text{ mA}$  |                       | 0.4          |                        | 0.4          |         |
|           |                           |                 | $I_O = 24 \text{ mA}$  |                       | 0.55         |                        | 0.55         |         |
| 4.5       | $I_O = 32 \text{ mA}$     |                 | 0.55                   |                       | 0.55         |                        |              |         |
| $I_I$     | Input Leakage Current     | 1.65 to 5.5     | $V_I = 0$ to $5.5V$    |                       | $\pm 10$     |                        | $\pm 10$     | $\mu A$ |
| $I_{off}$ | Power Off Leakage Current | 0               | $V_I = 5.5V$           |                       | 10           |                        | 10           | $\mu A$ |
| $I_{CC}$  | Quiescent Supply Current  | 1.65 to 5.5     | $V_I = V_{CC}$ or GND  |                       | 10           |                        | 10           | $\mu A$ |

## AC ELECTRICAL CHARACTERISTICS

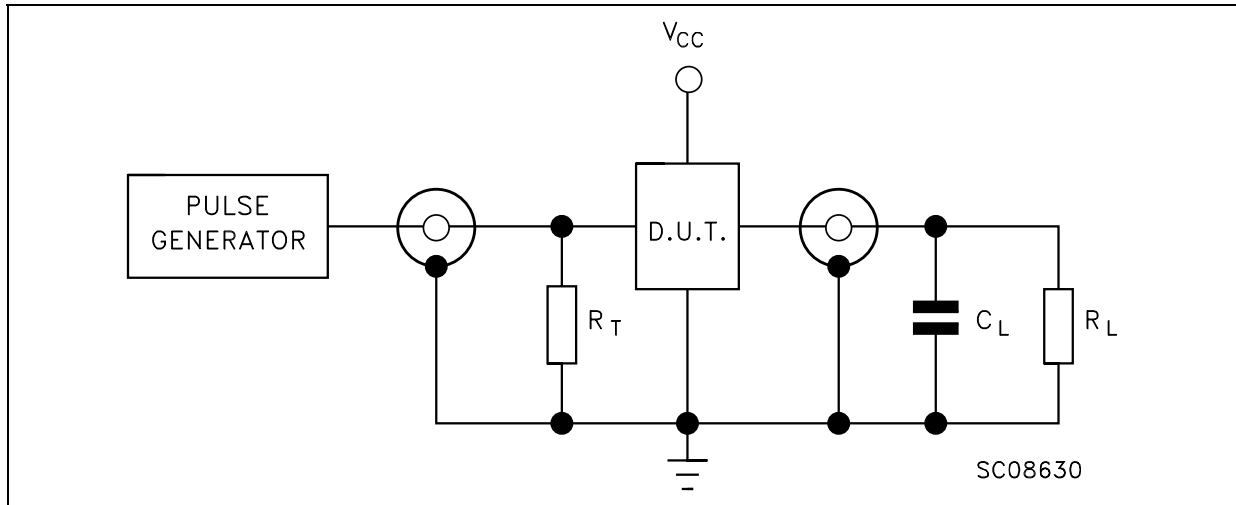
| Symbol                            | Parameter              | Test Condition         |                        |                       |   | Value        |      |               |      | Unit |
|-----------------------------------|------------------------|------------------------|------------------------|-----------------------|---|--------------|------|---------------|------|------|
|                                   |                        | V <sub>CC</sub><br>(V) | C <sub>L</sub><br>(pF) | R <sub>L</sub><br>(Ω) | t <sub>s</sub> = t <sub>r</sub><br>(ns) | -40 to 85 °C |      | -55 to 125 °C |      |      |
|                                   |                        |                        |                        |                       |   | Min.         | Max. | Min.          | Max. |      |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation Delay Time | 1.65 to 1.95           | 15                     | 1MΩ                   | 3.0                                     | 2            | 7    | 2             | 7    | ns   |
|                                   |                        | 2.3 to 2.7             |                        |                       |   | 2            | 5.5  | 2             | 5.5  |      |
|                                   |                        | 3.0 to 3.6             |                        |                       |   | 1            | 4.7  | 1             | 4.7  |      |
|                                   |                        | 4.5 to 5.5             |                        |                       |   | 1            | 4    | 1             | 4    |      |
|                                   |                        | 1.65 to 1.95           | 30                     | 1000                  | 2.0                                     | 2            | 5    | 2             | 5    |      |
|                                   |                        | 2.3 to 2.7             | 30                     | 500                   | 2.0                                     | 2            | 4    | 2             | 4    |      |
|                                   |                        | 2.7                    | 50                     | 500                   | 2.5                                     | 1            | 4    | 1             | 4    |      |
|                                   |                        | 3.0 to 3.6             | 50                     | 500                   | 2.5                                     | 1            | 3.7  | 1             | 3.7  |      |
|                                   |                        | 4.5 to 5.5             | 50                     | 500                   | 2.5                                     | 1            | 3    | 1             | 3    |      |

## CAPACITANCE CHARACTERISTICS

| Symbol          | Parameter                                 | Test Condition         |                         | Value                  |      |      | Unit |
|-----------------|---|------------------------|-------------------------|------------------------|------|------|------|
|                 |   | V <sub>CC</sub><br>(V) |                         | T <sub>A</sub> = 25 °C |      |      |      |
|                 |   |                        |                         | Min.                   | Typ. | Max. |      |
| C <sub>IN</sub> | Input Capacitance                         | 0                      |                         |                        | 4    |      | pF   |
| C <sub>PD</sub> | Power Dissipation Capacitance<br>(note 1) | 1.8                    | f <sub>IN</sub> = 10MHz |                        | 9    |      | pF   |
|                 |   | 2.5                    |                         |                        | 11   |      |      |
|                 |   | 3.3                    |                         |                        | 13   |      |      |

1) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

TEST CIRCUIT

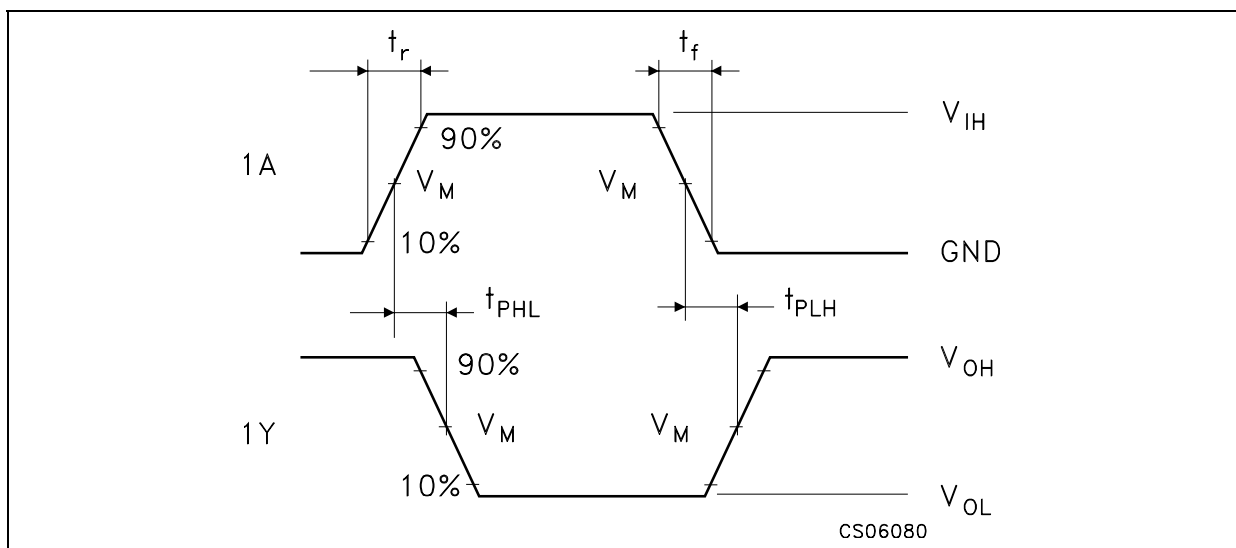


$R_T = Z_{OUT}$  of pulse generator (typically 50Ω)

TEST CIRCUIT AND WAVEFORM SYMBOL VALUE

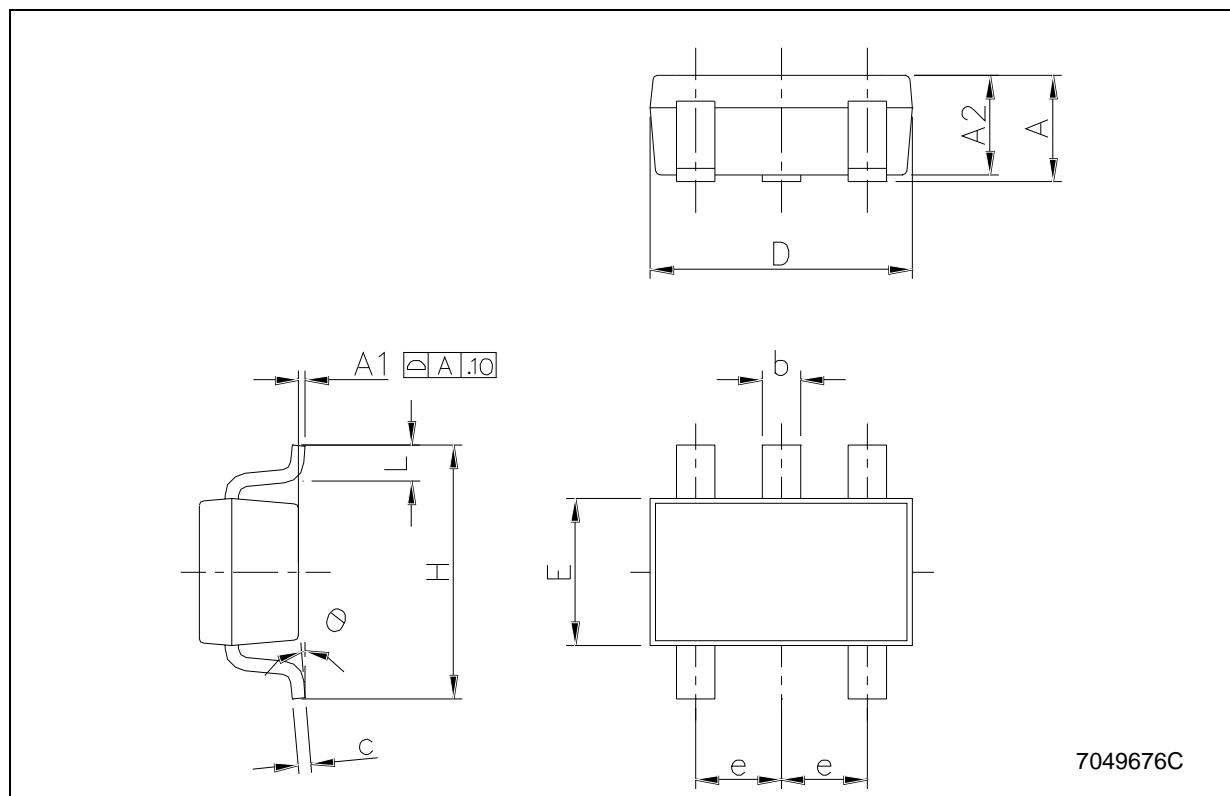
| Symbol      | $V_{CC}$      |             |             |
|-------------|---------------|-------------|-------------|
|             | 1.65 to 1.95V | 2.3 to 2.7V | 2.7 to 5.5V |
| $C_L$       | 15pF/30pF     | 15pF/30pF   | 15pF/50pF   |
| $R_L$       | 1MΩ/1000Ω     | 500Ω        | 500Ω        |
| $V_{IH}$    | $V_{CC}$      | $V_{CC}$    | $V_{CC}$    |
| $V_M$       | $V_{CC}/2$    | $V_{CC}/2$  | $V_{CC}/2$  |
| $t_r = t_f$ | <2.0ns        | <2.0ns      | <2.5ns      |

WAVEFORM: PROPAGATION DELAY (f=1MHz; 50% duty cycle)



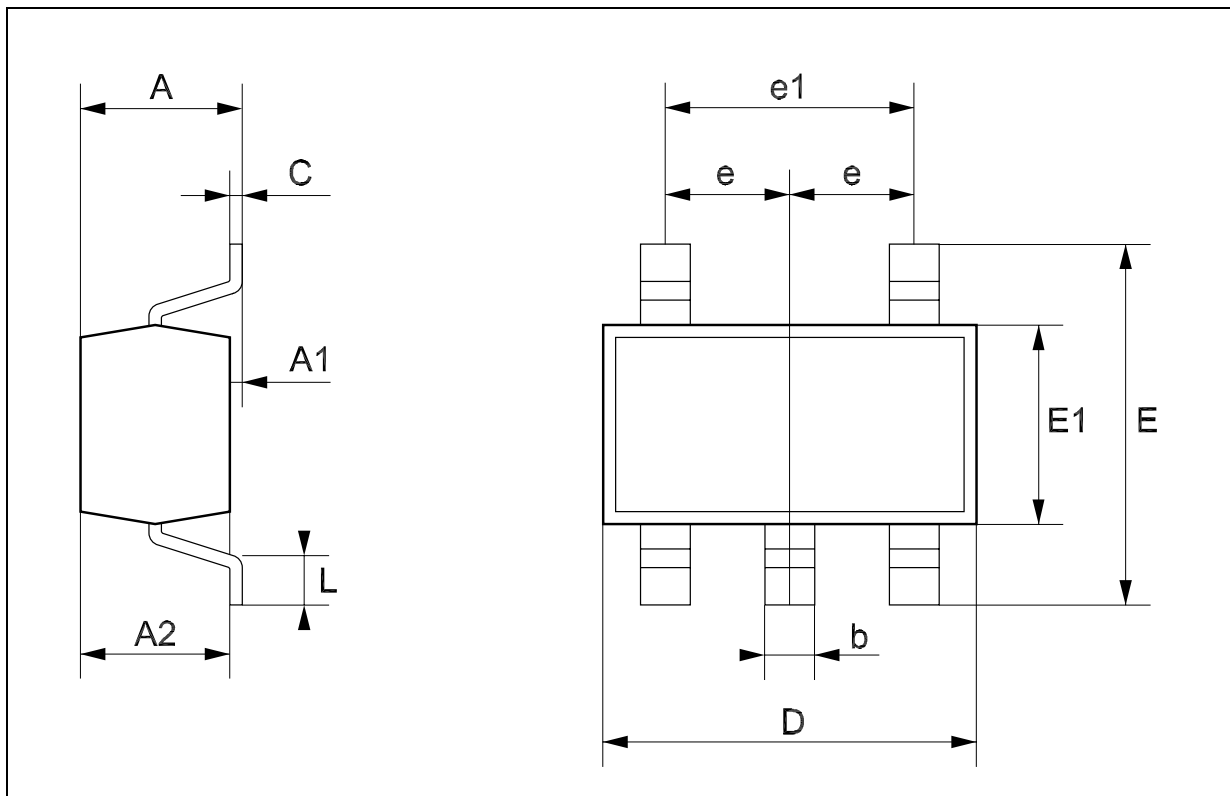
## SOT23-5L MECHANICAL DATA

| DIM. | mm.  |      |      | mils  |      |       |
|------|------|------|------|-------|------|-------|
|      | MIN. | TYP  | MAX. | MIN.  | TYP. | MAX.  |
| A    | 0.90 |      | 1.45 | 35.4  |      | 57.1  |
| A1   | 0.00 |      | 0.10 | 0.0   |      | 3.9   |
| A2   | 0.90 |      | 1.30 | 35.4  |      | 51.2  |
| b    | 0.35 |      | 0.50 | 13.7  |      | 19.7  |
| C    | 0.09 |      | 0.20 | 3.5   |      | 7.8   |
| D    | 2.80 |      | 3.00 | 110.2 |      | 118.1 |
| E    | 1.50 |      | 1.75 | 59.0  |      | 68.8  |
| e    |      | 0.95 |      |       | 37.4 |       |
| H    | 2.60 |      | 3.00 | 102.3 |      | 118.1 |
| L    | 0.10 |      | 0.60 | 3.9   |      | 23.6  |



## SOT323-5L MECHANICAL DATA

| DIM. | mm.  |      |      | mils |      |      |
|------|------|------|------|------|------|------|
|      | MIN. | TYP  | MAX. | MIN. | TYP. | MAX. |
| A    | 0.80 |      | 1.10 | 31.5 |      | 43.3 |
| A1   | 0.00 |      | 0.10 | 0.0  |      | 3.9  |
| A2   | 0.80 |      | 1.00 | 31.5 |      | 39.4 |
| b    | 0.15 |      | 0.30 | 5.9  |      | 11.8 |
| C    | 0.10 |      | 0.18 | 3.9  |      | 7.1  |
| D    | 1.80 |      | 2.20 | 70.9 |      | 86.6 |
| E    | 1.80 |      | 2.40 | 70.9 |      | 94.5 |
| E1   | 1.15 |      | 1.35 | 45.3 |      | 53.1 |
| e    |      | 0.65 |      |      | 25.6 |      |
| e1   |      | 1.3  |      |      | 51.2 |      |
| L    | 0.10 |      | 0.30 | 3.9  |      | 11.8 |



## Tape &amp; Reel SOT23-xL MECHANICAL DATA

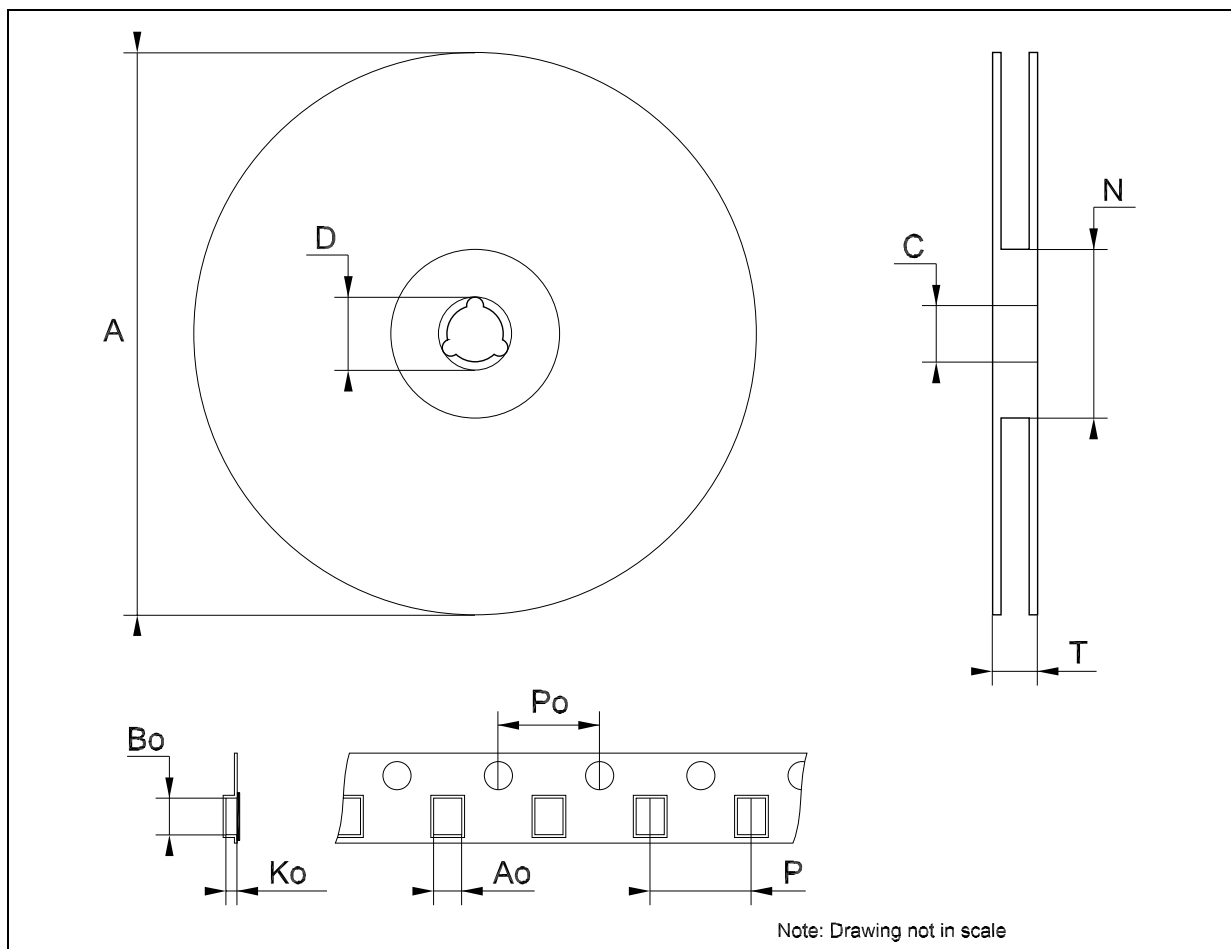
| DIM. | mm.  |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |      | 180  |       |       | 7.086 |
| C    | 12.8 | 13.0 | 13.2 | 0.504 | 0.512 | 0.519 |
| D    | 20.2 |      |      | 0.795 |       |       |
| N    | 60   |      |      | 2.362 |       |       |
| T    |      |      | 14.4 |       |       | 0.567 |
| Ao   | 3.13 | 3.23 | 3.33 | 0.123 | 0.127 | 0.131 |
| Bo   | 3.07 | 3.17 | 3.27 | 0.120 | 0.124 | 0.128 |
| Ko   | 1.27 | 1.37 | 1.47 | 0.050 | 0.054 | 0.058 |
| Po   | 3.9  | 4.0  | 4.1  | 0.153 | 0.157 | 0.161 |
| P    | 3.9  | 4.0  | 4.1  | 0.153 | 0.157 | 0.161 |





### Tape & Reel SOT323-xL MECHANICAL DATA

| DIM. | mm.  |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 175  | 180  | 185  | 6.889 | 7.086 | 7.283 |
| C    | 12.8 | 13   | 13.2 | 0.504 | 0.512 | 0.519 |
| D    | 20.2 |      |      | 0.795 |       |       |
| N    | 59.5 | 60   | 60.5 |       | 2.362 |       |
| T    |      |      | 14.4 |       |       | 0.567 |
| Ao   |      | 2.25 |      |       | 0.088 |       |
| Bo   |      | 2.7  |      |       | 0.106 |       |
| Ko   |      | 1.2  |      |       | 0.047 |       |
| Po   | 3.9  | 4    | 4.1  | 0.153 | 0.157 | 0.161 |
| P    | 3.8  | 4    | 4.2  | 0.149 | 0.157 | 0.165 |



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