



# ST202E ST232E

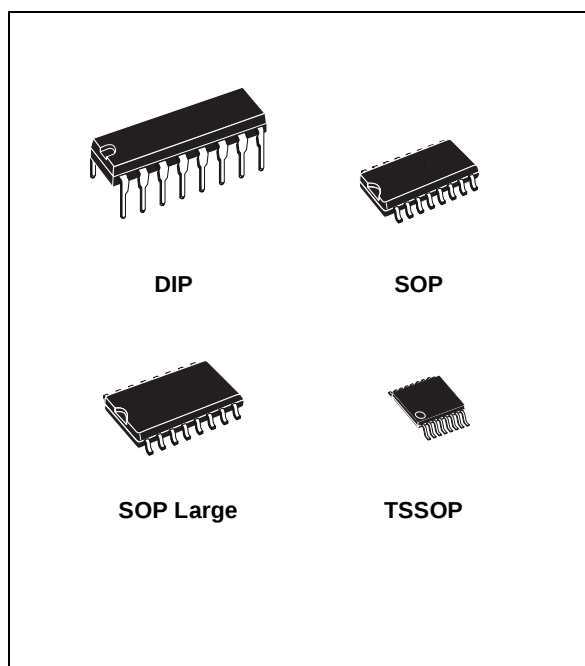
## ± 15KV ESD PROTECTED 5V RS-232 TRANSCEIVER

- ESD PROTECTION FOR RS-232 I/O PINS:  
± 15KV HUMAN BODY MODEL
- GUARANTEED 230kbps DATA RATE
- GUARANTEED SLEW RATE RANGE 3 to 30V/μs
- OPERATE FROM A SINGLE 5V POWER SUPPLY

### DESCRIPTION

The ST202E/ST232E are a 2 driver 2 receiver devices designed for RS-232 and V.28 communications in harsh environments. Each transmitter output and receiver input is protected against ± 15KV electrostatic discharge (ESD) shocks. The drivers meet all EIA/TIA-232E and CCITT V.28 specifications at data rates up to 230Kbps, when loaded in accordance with the EIA/TIA-232E specification. The ST202E/232E use a single 5V supply voltage.

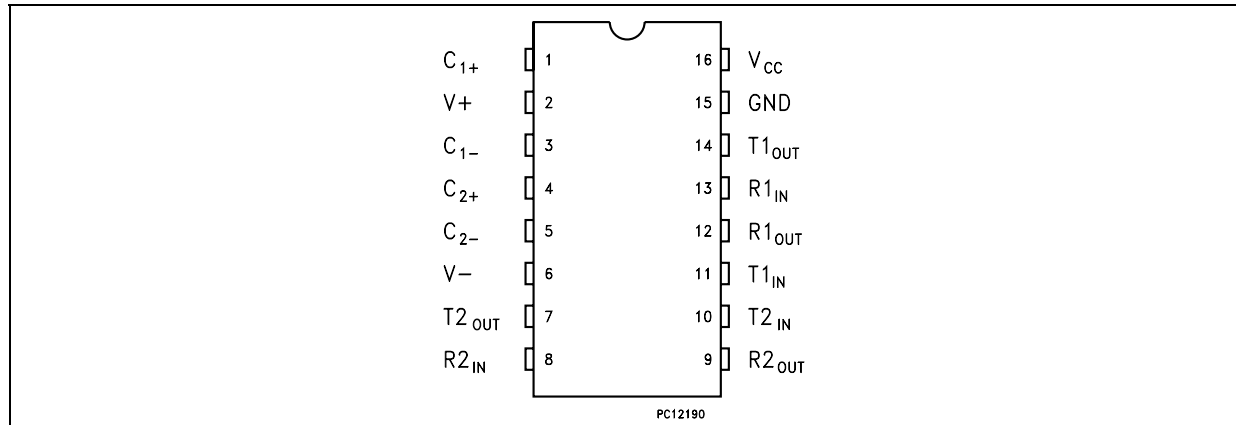
The ST232E operates with four 1μF capacitors, while the ST202E operates with four 0.1μF capacitors, further reducing cost and board space.



### ORDERING CODES

| Type      |           | Temperature Range | Package                   | Comments                            |
|-----------|-----------|-------------------|---------------------------|-------------------------------------|
| ST202ECN  | ST232ECN  | 0 to 70 °C        | DIP-16                    | 25 parts per tube / 40 tube per box |
| ST202EBN  | ST232EBN  | -40 to 85 °C      | DIP-16                    | 25 parts per tube / 40 tube per box |
| ST202EAN  | ST232EAN  | -40 to 125 °C     | DIP-16                    | 25 parts per tube / 40 tube per box |
| ST202ECD  | ST232ECD  | 0 to 70 °C        | SO-16 (Tube)              | 50 parts per tube / 20 tube per box |
| ST202EBD  | ST232EBD  | -40 to 85 °C      | SO-16 (Tube)              | 50 parts per tube / 20 tube per box |
| ST202EAD  | ST232EAD  | -40 to 125 °C     | SO-16 (Tube)              | 50 parts per tube / 20 tube per box |
| ST202ECDR | ST232ECDR | 0 to 70 °C        | SO-16 (Tape & Reel)       | 2500 parts per reel                 |
| ST202EBDR | ST232EBDR | -40 to 85 °C      | SO-16 (Tape & Reel)       | 2500 parts per reel                 |
| ST202EADR | ST232EADR | -40 to 125 °C     | SO-16 (Tape & Reel)       | 2500 parts per reel                 |
| ST202ECW  | ST232ECW  | 0 to 70 °C        | SO-16 Large (Tube)        | 49 parts per tube / 25 tube per box |
| ST202EBW  | ST232EBW  | -40 to 85 °C      | SO-16 Large (Tube)        | 49 parts per tube / 25 tube per box |
| ST202EAW  | ST232EAW  | -40 to 125 °C     | SO-16 Large (Tube)        | 49 parts per tube / 25 tube per box |
| ST202ECWR | ST232ECWR | 0 to 70 °C        | SO-16 Large (Tape & Reel) | 1000 parts per reel                 |
| ST202EBWR | ST232EBWR | -40 to 85 °C      | SO-16 Large (Tape & Reel) | 1000 parts per reel                 |
| ST202EAWR | ST232EAWR | -40 to 125 °C     | SO-16 Large (Tape & Reel) | 1000 parts per reel                 |
| ST202ECTR | ST232ECTR | 0 to 70 °C        | TSSOP16 (Tape & Reel)     | 2500 parts per reel                 |
| ST202EBTR | ST232EBTR | -40 to 85 °C      | TSSOP16 (Tape & Reel)     | 2500 parts per reel                 |
| ST202EATR | ST232EATR | -40 to 125 °C     | TSSOP16 (Tape & Reel)     | 2500 parts per reel                 |

## PIN CONFIGURATION



## PIN DESCRIPTION

| PIN N° | SYMBOL            | NAME AND FUNCTION                                      |
|--------|-------------------|--------------------------------------------------------|
| 1      | C <sub>1+</sub>   | Positive Terminal for the first Charge Pump Capacitor  |
| 2      | V+                | Doubled Voltage Terminal                               |
| 3      | C <sub>1-</sub>   | Negative Terminal for the first Charge Pump Capacitor  |
| 4      | C <sub>2+</sub>   | Positive Terminal for the second Charge Pump Capacitor |
| 5      | C <sub>2-</sub>   | Negative Terminal for the second Charge Pump Capacitor |
| 6      | V-                | Inverted Voltage Terminal                              |
| 7      | T <sub>2OUT</sub> | Second Transmitter Output Voltage                      |
| 8      | R <sub>2IN</sub>  | Second Receiver Input Voltage                          |
| 9      | R <sub>2OUT</sub> | Second Receiver Output Voltage                         |
| 10     | T <sub>2IN</sub>  | Second Transmitter Input Voltage                       |
| 11     | T <sub>1IN</sub>  | First Transmitter Input Voltage                        |
| 12     | R <sub>1OUT</sub> | First Receiver Output Voltage                          |
| 13     | R <sub>1IN</sub>  | First Receiver Input Voltage                           |
| 14     | T <sub>1OUT</sub> | First Transmitter Output Voltage                       |
| 15     | GND               | Ground                                                 |
| 16     | V <sub>CC</sub>   | Supply Voltage                                         |

## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                  | Value                                            | Unit |
|---------------------|--------------------------------------------|--------------------------------------------------|------|
| V <sub>CC</sub>     | Supply Voltage                             | -0.3 to 6                                        | V    |
| V+                  | Extra Positive Voltage                     | (V <sub>CC</sub> - 0.3) to 14                    | V    |
| V-                  | Extra Negative Voltage                     | -14 to 0.3                                       | V    |
| T <sub>IN</sub>     | Transmitter Input Voltage Range            | -0.3 to (V <sub>+</sub> + 0.3)                   | V    |
| R <sub>IN</sub>     | Receiver Input Voltage Range               | ± 30                                             | V    |
| T <sub>OUT</sub>    | Transmitter Output Voltage Range           | (V <sub>-</sub> - 0.3) to (V <sub>+</sub> + 0.3) | V    |
| R <sub>OUT</sub>    | Receiver Output Voltage Range              | -0.3 to (V <sub>CC</sub> + 0.3)                  | V    |
| T <sub>SCTOUT</sub> | Short Circuit Duration on T <sub>OUT</sub> | infinite                                         |      |
| T <sub>stg</sub>    | Storage Temperature Range                  | -65 to + 150                                     | °C   |

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

**ESD PERFORMANCE: TRANSMITTER OUTPUTS, RECEIVER INPUTS**

| Symbol | Parameter              | Test Conditions                  | Min. | Typ. | Max. | Unit |
|--------|------------------------|----------------------------------|------|------|------|------|
| ESD    | ESD Protection Voltage | Human Body Model                 | ± 15 |      |      | KV   |
| ESD    | ESD Protection Voltage | IEC 1000-4-2 (Contact Discharge) | ± 6  |      |      | KV   |
| ESD    | ESD Protection Voltage | IEC 1000-4-2 (Air Discharge)     | ± 8  |      |      | KV   |

Note: All test versus GND.

**ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  for ST202E,  $C_1 - C_4 = 1\mu\text{F}$  for ST232E,  $V_{CC} = 5V \pm 10\%$ ,  $T_A = -40$  to  $125^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol       | Parameter                     | Test Conditions                   | Min. | Typ. | Max. | Unit |
|--------------|-------------------------------|-----------------------------------|------|------|------|------|
| $I_{SUPPLY}$ | $V_{CC}$ Power Supply Current | No Load, $T_A = 25^\circ\text{C}$ |      | 5    | 10   | mA   |

**TRANSMITTER ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  for ST202E,  $C_1 - C_4 = 1\mu\text{F}$  for ST232E,  $V_{CC} = 5V \pm 10\%$ ,  $T_A = -40$  to  $125^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol     | Parameter                                | Test Conditions                                                                                                | Min. | Typ. | Max. | Unit                   |
|------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------|------|------|------|------------------------|
| $V_{TOUT}$ | Output Voltage Swing                     | All Transmitter outputs are loaded with $3K\Omega$ to GND                                                      | ± 5  | ± 9  |      | V                      |
| $I_{TIL}$  | Input Leakage Current                    |                                                                                                                |      |      | ± 1  | $\mu\text{A}$          |
| $V_{TIL}$  | Input Logic Threshold Low                |                                                                                                                | 0.8  |      |      | V                      |
| $V_{TIH}$  | Input Logic Threshold High               |                                                                                                                |      |      | 2    | V                      |
| $SR_T$     | Transition Slew Rate                     | $T_A = 25^\circ\text{C}$ , $V_{CC} = 5V$<br>$R_L = 3$ to $7K\Omega$ , $C_L = 50$ to $1000\text{pF}$<br>(Note1) | 3    | 6    | 30   | $\text{V}/\mu\text{s}$ |
| $D_R$      | Data Rate                                | $R_L = 3$ to $7K\Omega$ , $C_L = 50$ to $1000\text{pF}$<br>one transmitter switching                           | 230  | 400  |      | Kbits/s                |
| $R_{TOUT}$ | Transmitter Output Resistance            | $V_{CC} = V+ = V- = 0V$ $V_{OUT} = \pm 2V$                                                                     | 300  |      |      | $\Omega$               |
| $I_{SC}$   | Transmitter Output Short Circuit Current |                                                                                                                |      | ±10  | ±60  | mA                     |
| $t_{DT}$   | Transmitter Propagation Delay            | $R_L = 3$ to $7K\Omega$ , $C_L = 50$ to $2500\text{pF}$<br>All transmitter loaded                              |      | 2    |      | $\mu\text{A}$          |

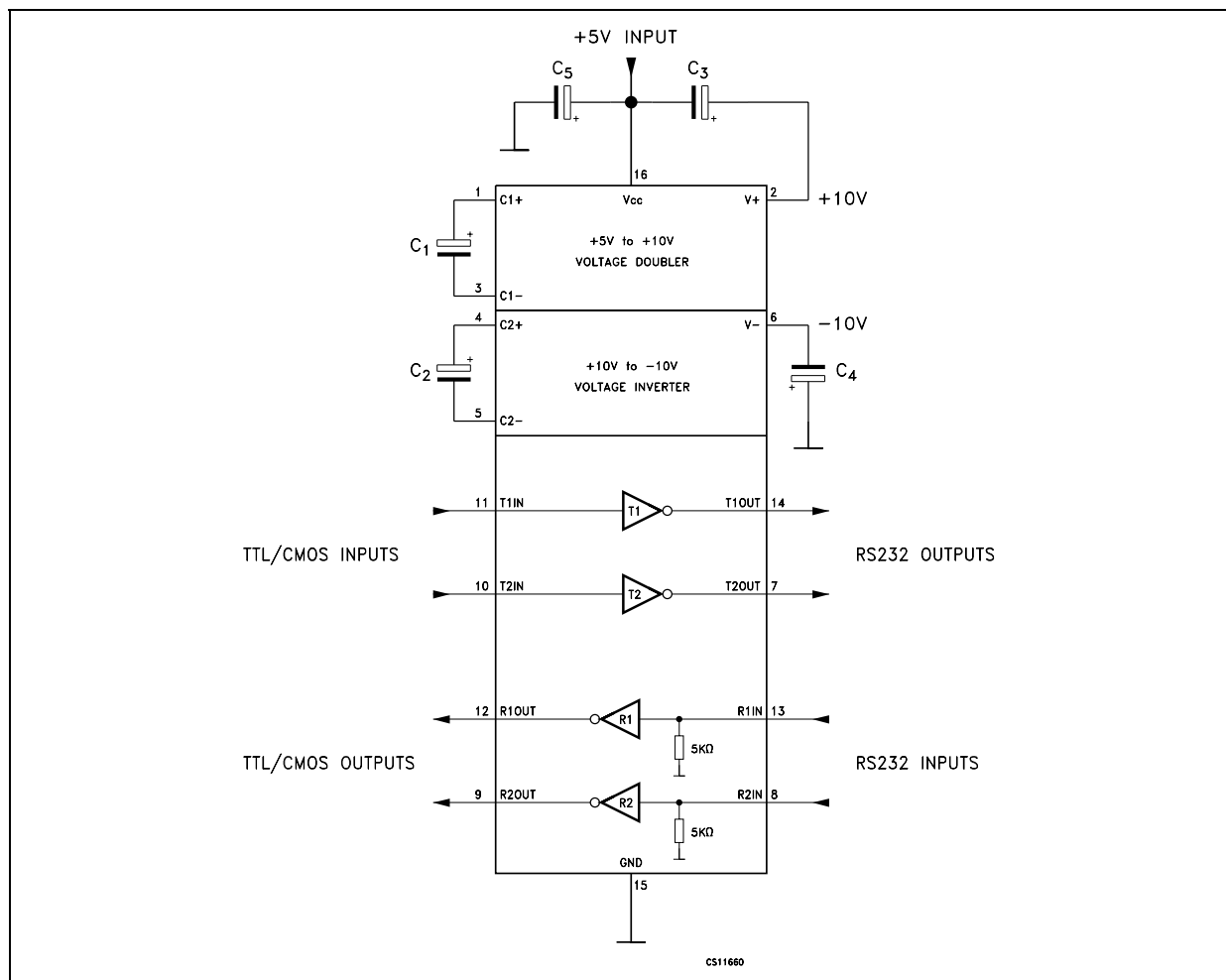
Note 1: Measured from 3V to -3V or from -3V to 3V.

Note2: One transmitter output is loaded with  $R_L = 3K\Omega$  to  $7K\Omega$ ,  $C_L = 50$  to  $1000\text{pF}$

**RECEIVER ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  for ST202E,  $C_1 - C_4 = 1\mu\text{F}$  for ST232E,  $V_{CC} = 5\text{V} \pm 10\%$ ,  $T_A = -40$  to  $125^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol      | Parameter                              | Test Conditions                                 | Min. | Typ.         | Max. | Unit             |
|-------------|----------------------------------------|-------------------------------------------------|------|--------------|------|------------------|
| $V_{RIN}$   | Receiver Input Voltage Operating Range |                                                 | -30  |              | 30   | V                |
| $R_{RIN}$   | RS-232 Input Resistance                | $T_A = 25^\circ\text{C}$ , $V_{CC} = 5\text{V}$ | 3    | 5            | 7    | $\text{K}\Omega$ |
| $V_{RIL}$   | RS-232 Input Logic Threshold Low       | $T_A = 25^\circ\text{C}$ , $V_{CC} = 5\text{V}$ | 0.8  | 1.2          |      | V                |
| $V_{RIH}$   | RS-232 Input Logic Threshold High      | $T_A = 25^\circ\text{C}$ , $V_{CC} = 5\text{V}$ |      | 1.7          | 2.4  | V                |
| $V_{RIHYS}$ | RS-232 Input Hysteresis                | $V_{CC} = 5\text{V}$                            | 0.2  | 0.5          | 1    | V                |
| $V_{ROL}$   | TTL/CMOS Output Voltage Low            | $I_{OUT} = 3.2\text{mA}$                        |      |              | 0.4  | V                |
| $V_{ROH}$   | TTL/CMOS Output Voltage High           | $I_{OUT} = -1\text{mA}$                         | 3.5  | $V_{CC}-0.4$ |      | V                |
| $t_{DR}$    | Receiver Propagation Delay             | $C_L = 150\text{pF}$                            |      | 0.5          | 10   | $\mu\text{s}$    |

**APPLICATION CIRCUITS** (note 1, note 2)

Note 1:  $C_{1-4}$  capacitors can even be  $1\mu\text{F}$  ones.

Note 2:  $C_{1-4}$  can be common or biased capacitors.

CAPACITANCE VALUE ( $\mu\text{F}$ )

| DEVICES | C1  | C2. | C3  | C4  | C5  |
|---------|-----|-----|-----|-----|-----|
| ST202E  | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| ST232E  | 1   | 1   | 1   | 1   | 1   |

TYPICAL PERFORMANCE CHARACTERISTICS (unless otherwise specified  $T_J = 25^\circ\text{C}$ )

Figure 1 : Supply Current vs Temperature

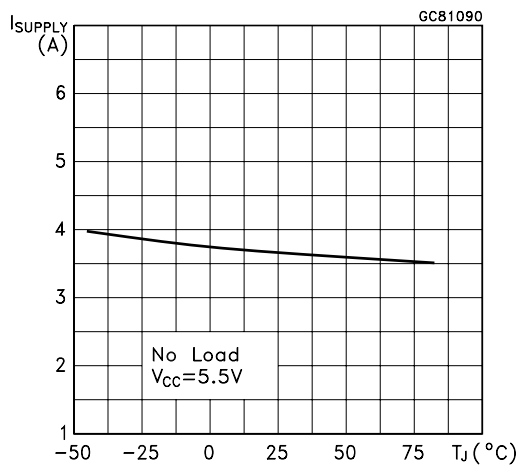


Figure 2 : Data Rate vs Temperature

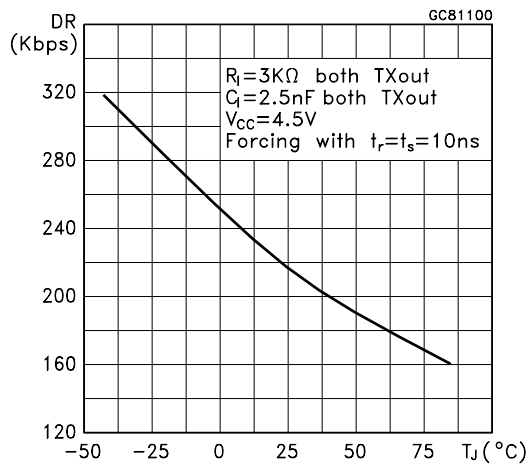


Figure 3 : Receiver Propagation Delay

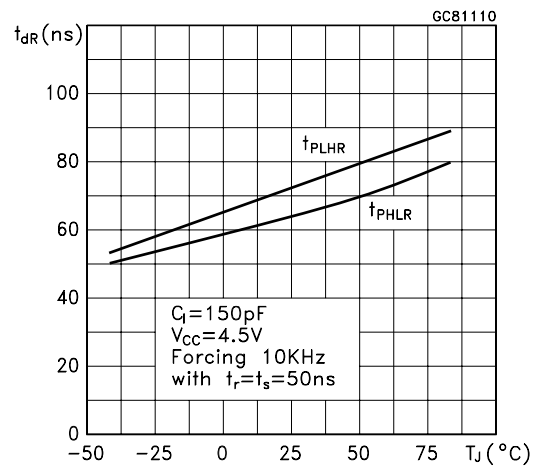
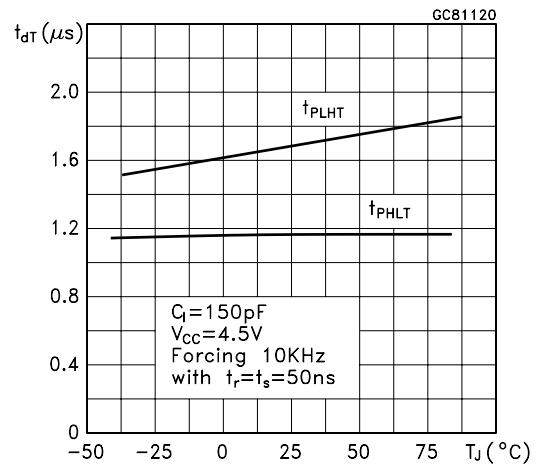
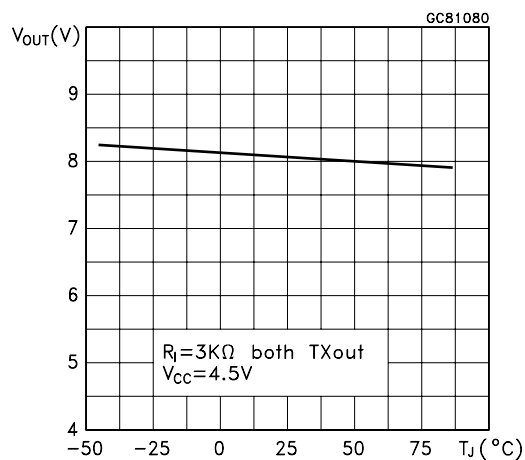
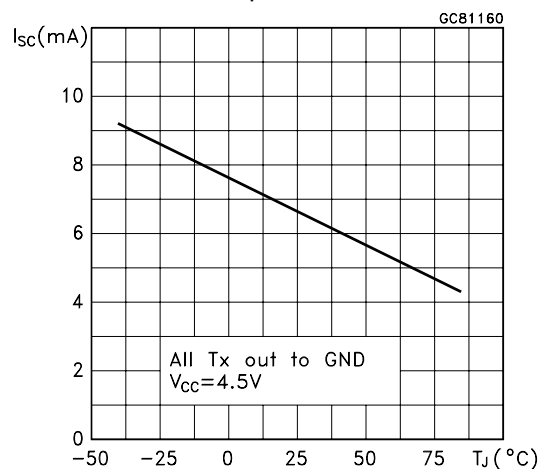
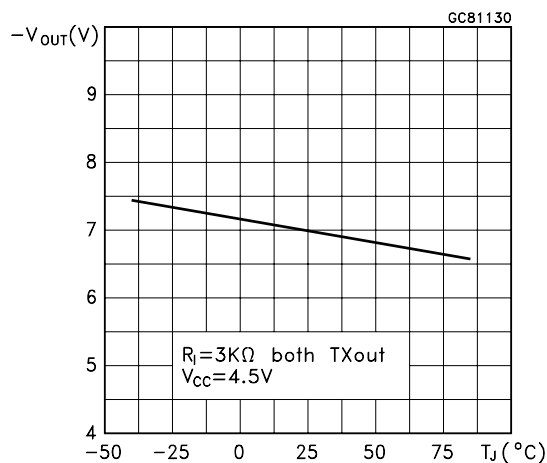
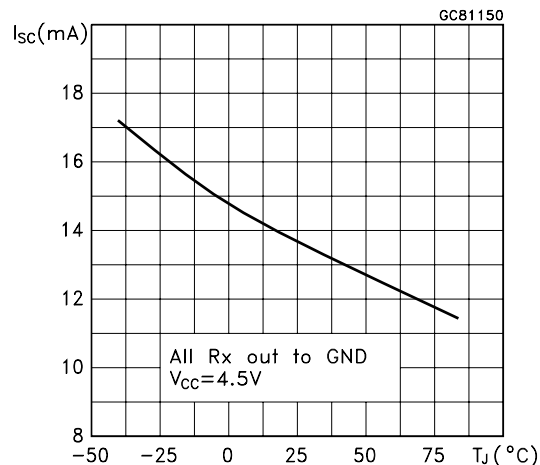
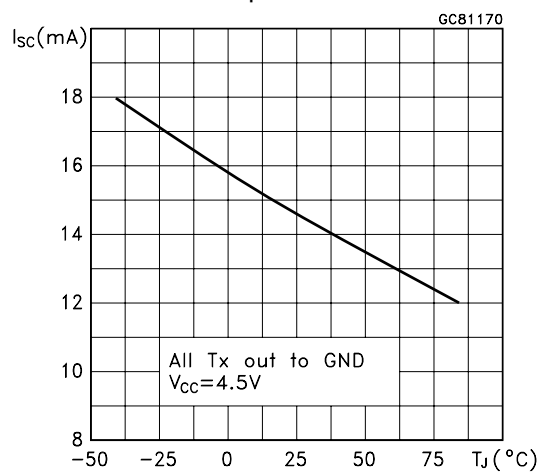
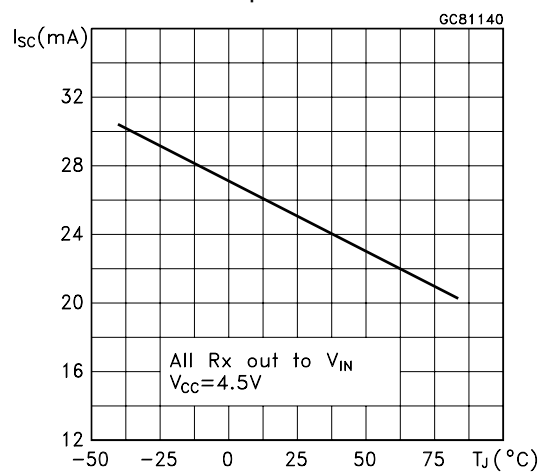


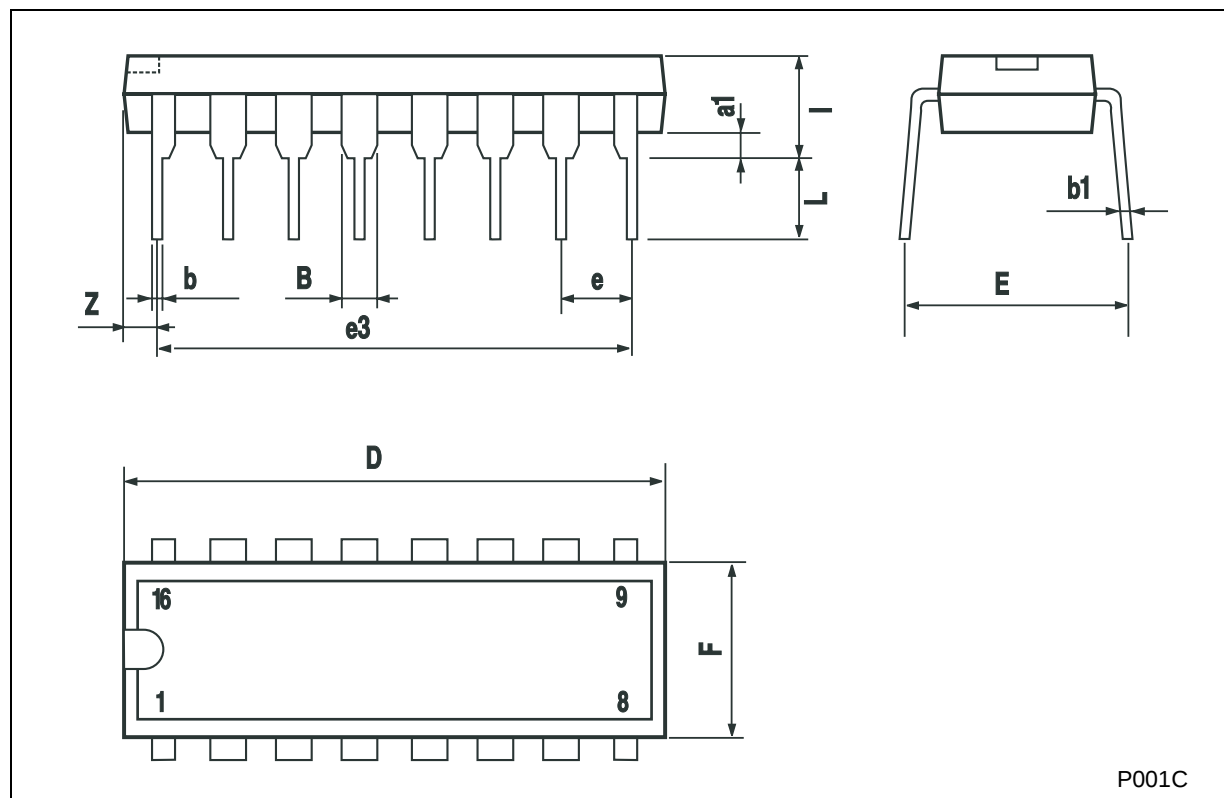
Figure 4 : Driver Propagation Delay



**Figure 5 : High Level Output Voltage Swing vs Temperature****Figure 8 : Low Level Transmitter Output Short Circuit Current vs Temperature****Figure 6 : Low Level Output Voltage Swing vs Temperature****Figure 9 : High Level Receiver Output Short Circuit Current vs Temperature****Figure 7 : High Level Transmitter Output Short Circuit Current vs Temperature****Figure 10 : Low Level Receiver Output Short Circuit Current vs Temperature**

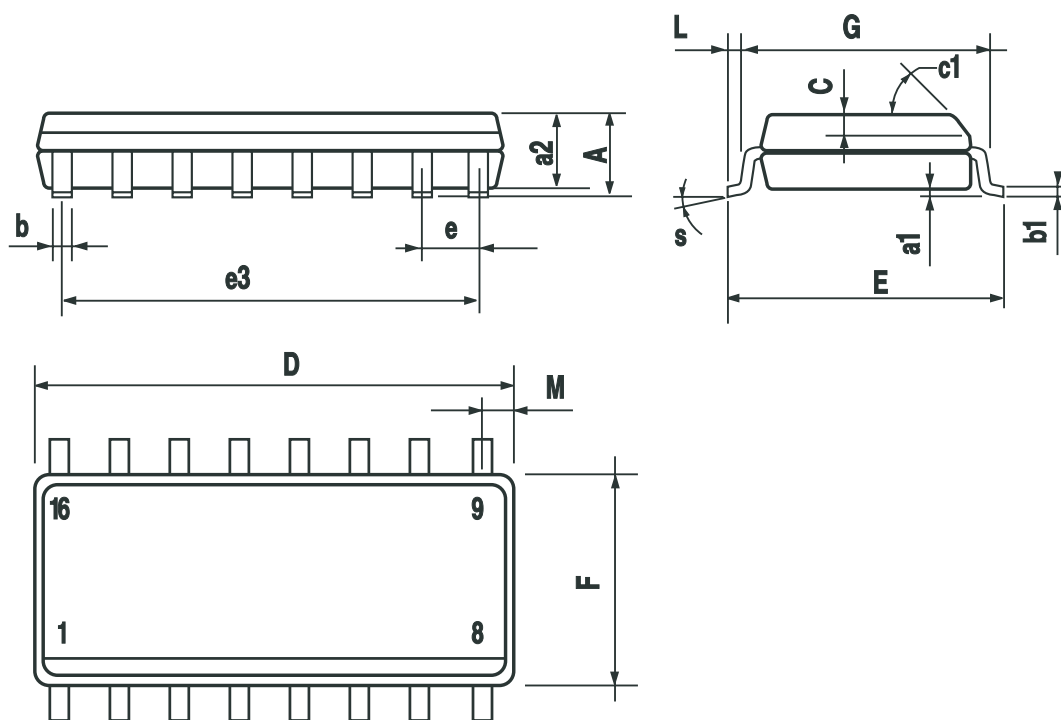
### Plastic DIP-16 (0.25) MECHANICAL DATA

| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |



## SO-16 MECHANICAL DATA

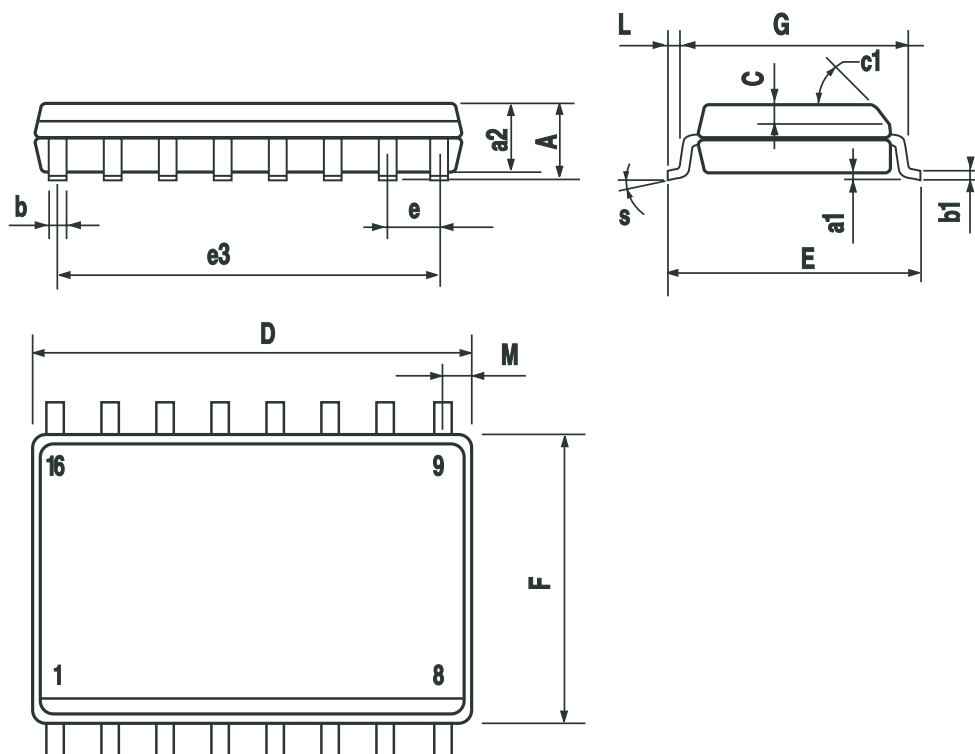
| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 0.008 |
| a2   |            |      | 1.65 |       |       | 0.064 |
| b    | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C    |            | 0.5  |      |       | 0.019 |       |
| c1   | 45° (typ.) |      |      |       |       |       |
| D    | 9.8        |      | 10   | 0.385 |       | 0.393 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 8.89 |      |       | 0.350 |       |
| F    | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M    |            |      | 0.62 |       |       | 0.024 |
| S    | 8° (max.)  |      |      |       |       |       |



PO13H

## SO-16L MECHANICAL DATA

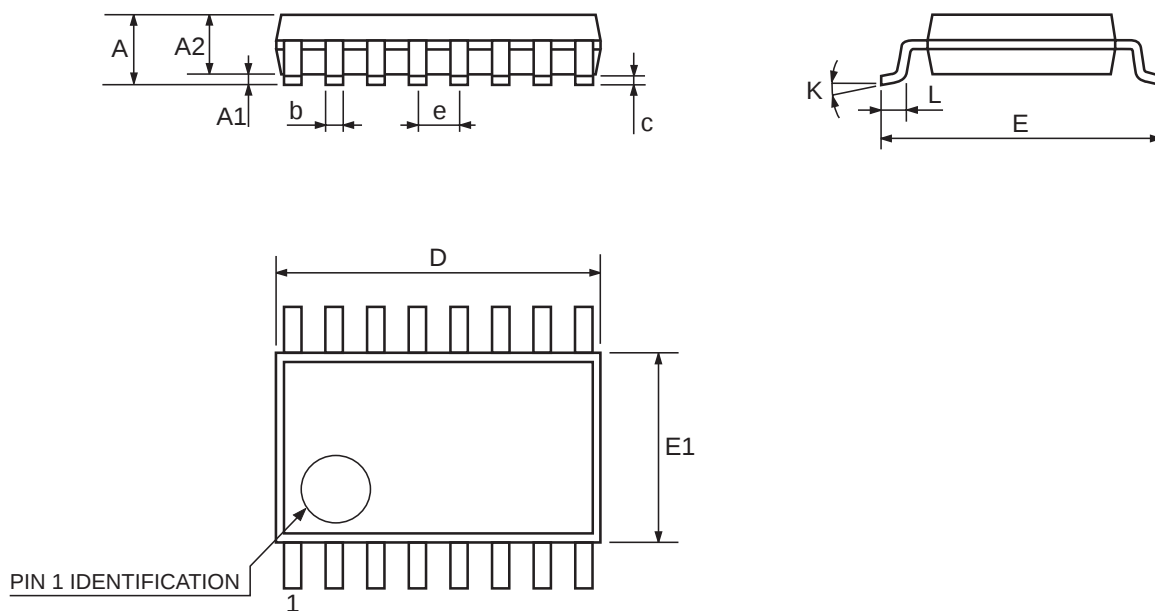
| DIM. | mm.        |      |       | inch  |       |       |
|------|------------|------|-------|-------|-------|-------|
|      | MIN.       | TYP  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |      | 2.65  |       |       | 0.104 |
| a1   | 0.1        |      | 0.2   | 0.004 |       | 0.008 |
| a2   |            |      | 2.45  |       |       | 0.096 |
| b    | 0.35       |      | 0.49  | 0.014 |       | 0.019 |
| b1   | 0.23       |      | 0.32  | 0.009 |       | 0.012 |
| C    |            | 0.5  |       |       | 0.020 |       |
| c1   | 45° (typ.) |      |       |       |       |       |
| D    | 10.1       |      | 10.5  | 0.397 |       | 0.413 |
| E    | 10.0       |      | 10.65 | 0.393 |       | 0.419 |
| e    |            | 1.27 |       |       | 0.050 |       |
| e3   |            | 8.89 |       |       | 0.350 |       |
| F    | 7.4        |      | 7.6   | 0.291 |       | 0.300 |
| G    |            |      |       |       |       |       |
| L    | 0.5        |      | 1.27  | 0.020 |       | 0.050 |
| M    |            |      | 0.75  |       |       | 0.029 |
| S    | 8          |      |       |       |       |       |



PO131

## TSSOP16 MECHANICAL DATA

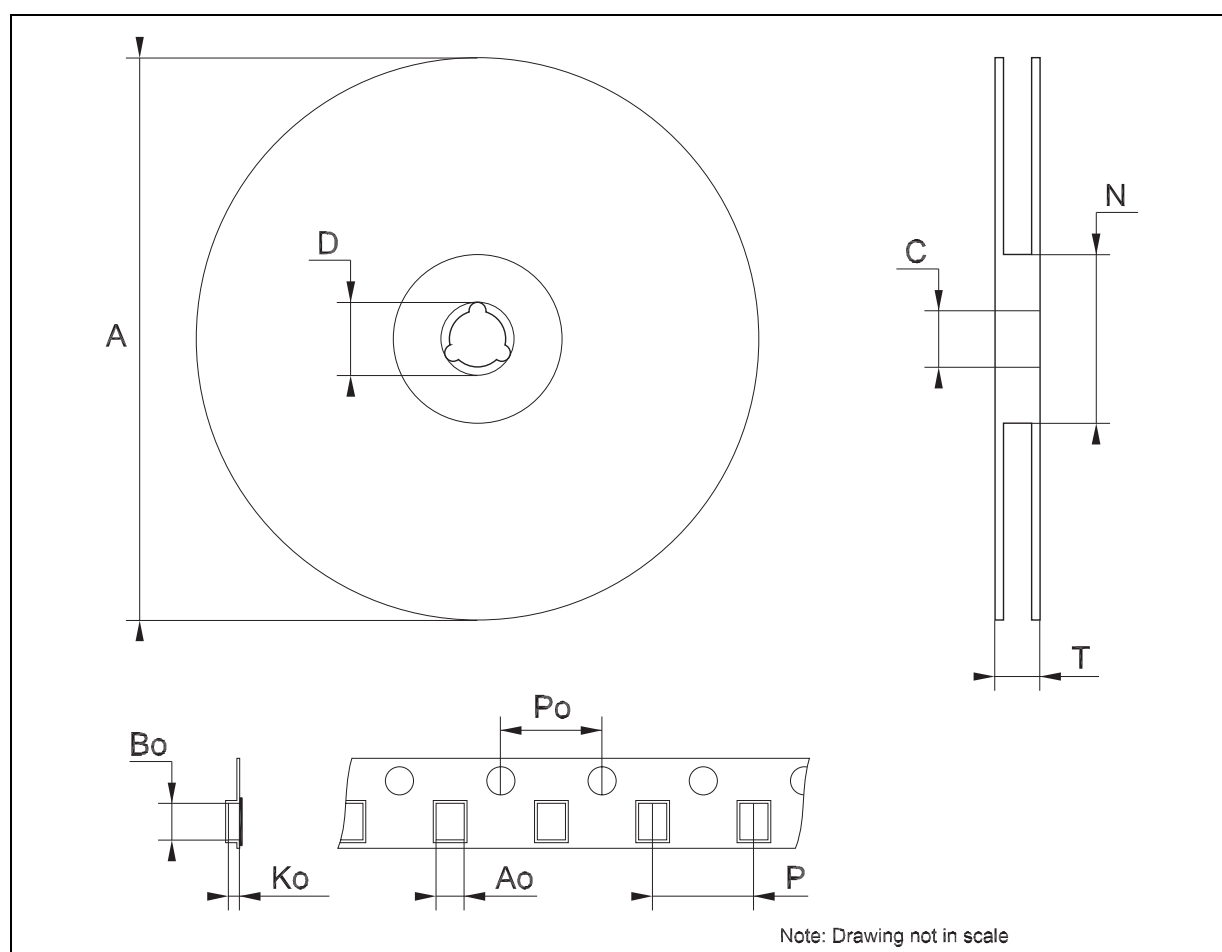
| DIM. | mm.  |          |      | inch  |            |        |
|------|------|----------|------|-------|------------|--------|
|      | MIN. | TYP      | MAX. | MIN.  | TYP.       | MAX.   |
| A    |      |          | 1.2  |       |            | 0.047  |
| A1   | 0.05 |          | 0.15 | 0.002 | 0.004      | 0.006  |
| A2   | 0.8  | 1        | 1.05 | 0.031 | 0.039      | 0.041  |
| b    | 0.19 |          | 0.30 | 0.007 |            | 0.012  |
| c    | 0.09 |          | 0.20 | 0.004 |            | 0.0079 |
| D    | 4.9  | 5        | 5.1  | 0.193 | 0.197      | 0.201  |
| E    | 6.2  | 6.4      | 6.6  | 0.244 | 0.252      | 0.260  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169 | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |       | 0.0256 BSC |        |
| K    | 0°   |          | 8°   | 0°    |            | 8°     |
| L    | 0.45 | 0.60     | 0.75 | 0.018 | 0.024      | 0.030  |



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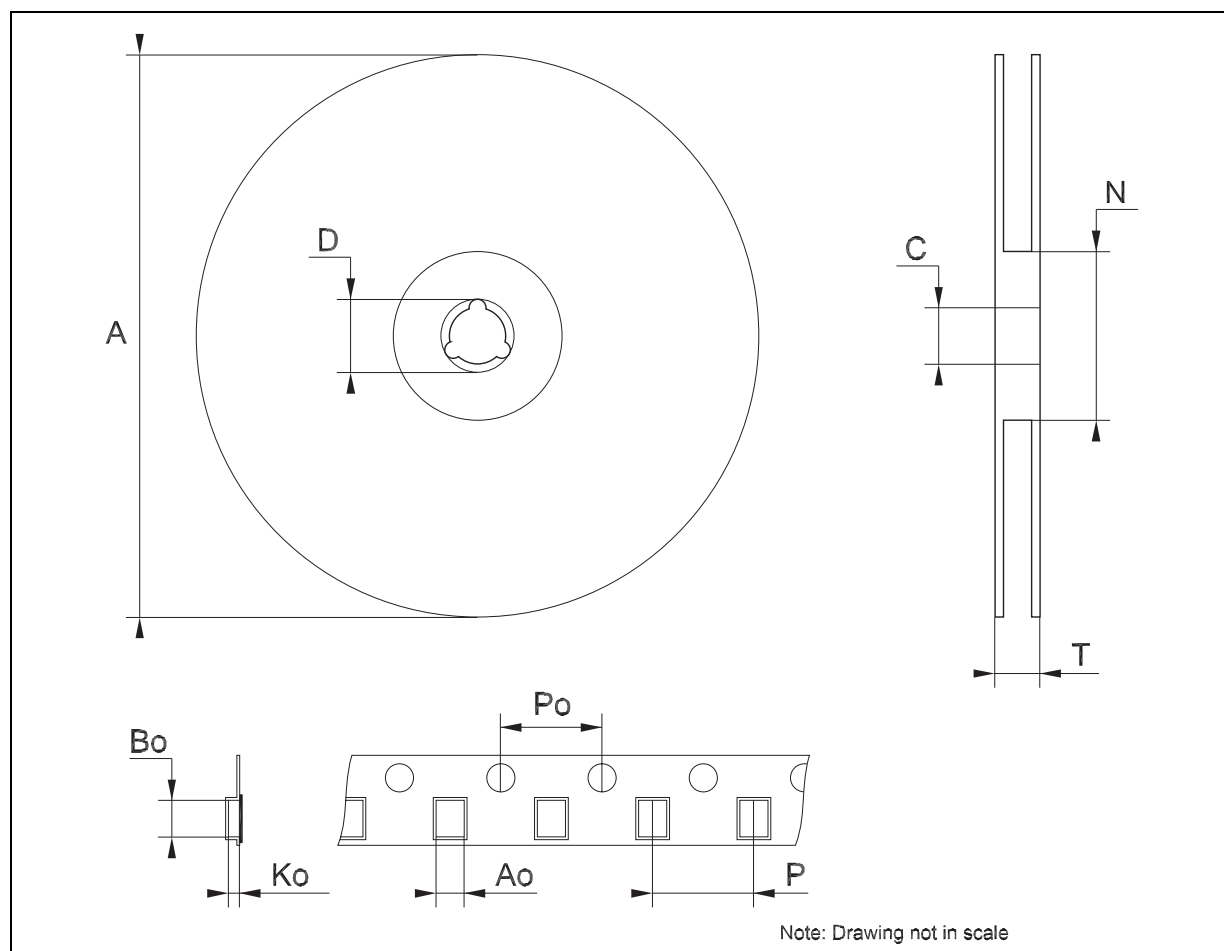
## Tape &amp; Reel SO-16 MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| N    | 60   |     |      | 2.362 |      |        |
| T    |      |     | 22.4 |       |      | 0.882  |
| Ao   | 6.45 |     | 6.65 | 0.254 |      | 0.262  |
| Bo   | 10.3 |     | 10.5 | 0.406 |      | 0.414  |
| Ko   | 2.1  |     | 2.3  | 0.082 |      | 0.090  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |     | 8.1  | 0.311 |      | 0.319  |



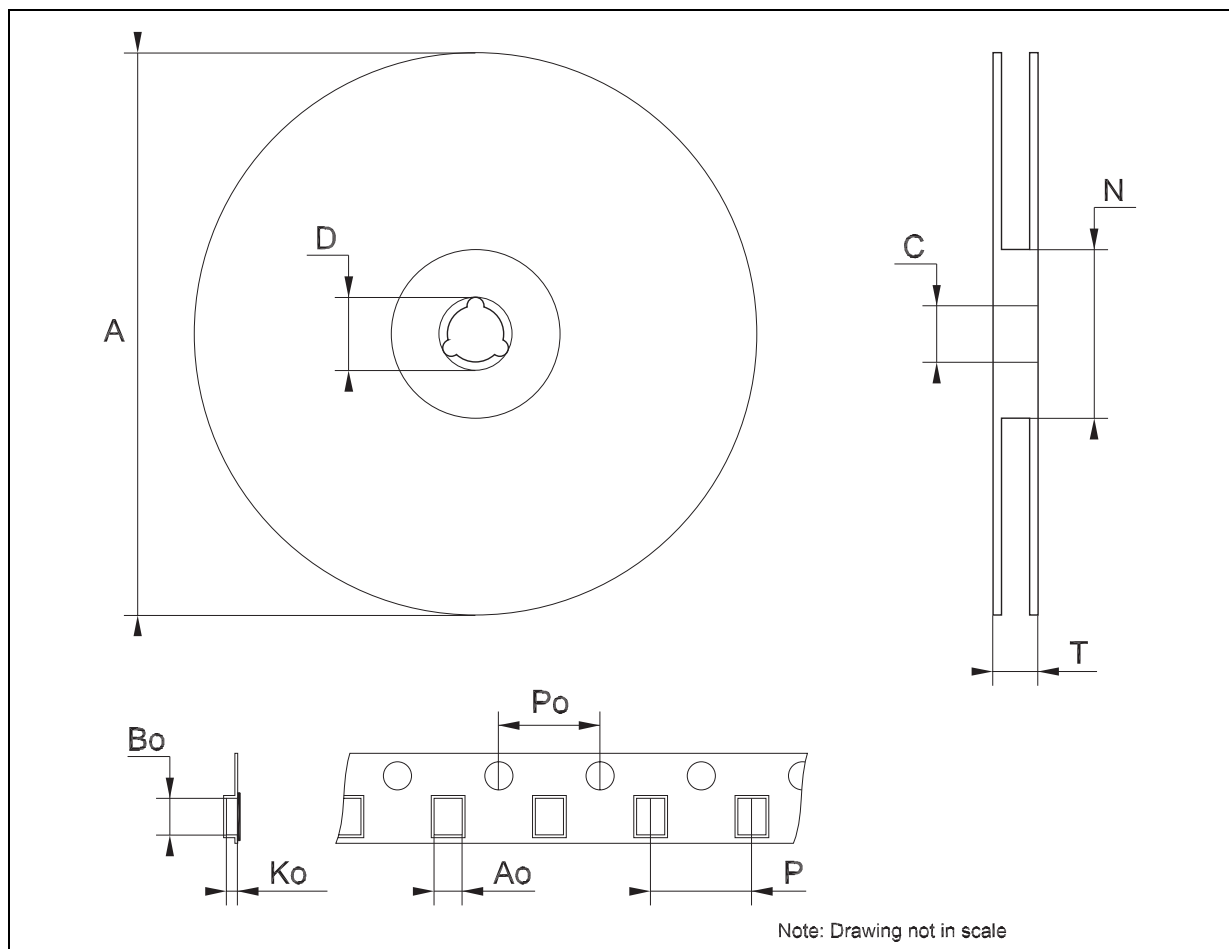
## Tape &amp; Reel SO-16L MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| N    | 60   |     |      | 2.362 |      |        |
| T    |      |     | 22.4 |       |      | 0.882  |
| Ao   | 10.8 |     | 11.0 | 0.425 |      | 0.433  |
| Bo   | 10.7 |     | 10.9 | 0.421 |      | 0.429  |
| Ko   | 2.9  |     | 3.1  | 0.114 |      | 0.122  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 11.9 |     | 12.1 | 0.468 |      | 0.476  |



### Tape & Reel TSSOP16 MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| N    | 60   |     |      | 2.362 |      |        |
| T    |      |     | 22.4 |       |      | 0.882  |
| Ao   | 6.7  |     | 6.9  | 0.264 |      | 0.272  |
| Bo   | 5.3  |     | 5.5  | 0.209 |      | 0.217  |
| Ko   | 1.6  |     | 1.8  | 0.063 |      | 0.071  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |     | 8.1  | 0.311 |      | 0.319  |



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