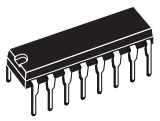
# ST232B
# ST232C

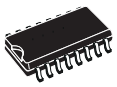
## 5 V powered multi-channel RS-232 drivers and receivers

## Features

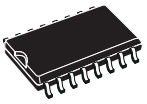
- Supply voltage range: 4.5 to 5.5 V
- Supply current no load (typ.): 5 mA
- Transmitter output voltage swing (typ): ±7.8 V
- Controlled output slew rate
- Receiver input voltage range: ± 30 V
- Data rate (typ.): 220 kbps
- Operating temperature range:
  - -40 ° to 85 °C
  - 0 ° to 70 °C
- Compatible with MAX232 and MAX202



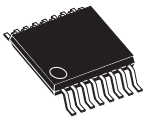
DIP



SOP



SOP Large



TSSOP

## Description

The ST232 is a 2 driver, 2 receiver device following EIA/TIA-232 and V.28 communication standard. It is particularly suitable for applications where ±12 V is not available. The ST232 uses a single 5 V power supply and only four external capacitors (0.1 µF). Typical applications are in: portable computers, low power modems, interfaces translation, battery powered RS-232 system, multi-drop RS-232 networks.

**Table 1. Device summary**

| Order code | Temperature range | Package | Packaging |
|---|---|---|---|
| ST232CN | 0 to 70 °C | DIP-16 | 25 parts per tube / 40 tube per box |
| ST232CDR | 0 to 70 °C | SO-16 (tape and reel) | 2500 parts per reel |
| ST232BDR | -40 to 85 °C | SO-16 (tape and reel) | 2500 parts per reel |
| ST232CWR | 0 to 70 °C | SO-16 Large (tape and reel) | 1000 parts per reel |
| ST232BWR | -40 to 85 °C | SO-16 Large (tape and reel) | 1000 parts per reel |
| ST232CTR | 0 to 70 °C | TSSOP16 (tape and reel) | 2500 parts per reel |
| ST232BTR | -40 to 85 °C | TSSOP16 (tape and reel) | 2500 parts per reel |

# Contents

# 1 Pin configuration

**Figure 1. Pin connections (top view)**

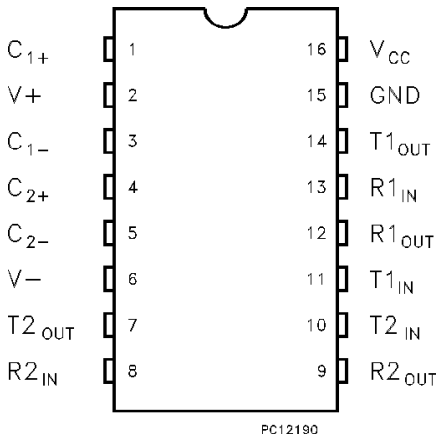



**Table 2. Pin description**

| Pin n° | Symbol | Note |
|---|---|---|
| 1 | $C_1$+ | Positive terminal for the first charge pump capacitor |
| 2 | V+ | Doubled voltage terminal |
| 3 | $C_1$- | Negative terminal for the first charge pump capacitor |
| 4 | $C_2$+ | Positive terminal for the second charge pump capacitor |
| 5 | $C_2$- | Negative terminal for the second charge pump capacitor |
| 6 | V- | Inverted voltage terminal |
| 7 | $T2_{OUT}$ | Second transmitter output voltage |
| 8 | $R2_{IN}$ | Second receiver input voltage |
| 9 | $R2_{OUT}$ | Second receiver output voltage |
| 10 | $T2_{IN}$ | Second transmitter input voltage |
| 11 | $T1_{IN}$ | First transmitter input voltage |
| 12 | $R1_{OUT}$ | First receiver output voltage |
| 13 | $R1_{IN}$ | First receiver input voltage |
| 14 | $T1_{OUT}$ | First transmitter output voltage |
| 15 | GND | Ground |
| 16 | $V_{CC}$ | Supply voltage |

# 2 Maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply voltage | -0.3 to 6 | V |
| $T_{IN}$ | Transmitter input voltage range | -0.3 to ($V_{CC}$ + 0.3) | V |
| $R_{IN}$ | Receiver input voltage range | ±30 | V |
| $T_{OUT}$ | Transmitter output voltage range | ($V_+$ + 0.3) to ($V_-$ - 0.3) | V |
| $R_{OUT}$ | Receiver output voltage range | -0.3 to ($V_{CC}$ + 0.3) | V |
| $T_{SCTOUT}$ | Short circuit duration on $T_{OUT}$ | infinite | |
| $T_{STG}$ | Storage temperature range | -65 to + 150 | |

*Note: 1 Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.*

*2 No external supply can be applied to V+ terminal and V- terminal.*

# 3 Electrical characteristics

**Table 4. Electrical characteristics**

($C_1$ - $C_4$ = 0.1 µF, $V_{CC}$ = 5 V ± 10 %, $T_A$ = -40 to 85 °C, unless otherwise specified. Typical values are referred to $T_A$ = 25 °C).

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SUPPLY}$ | $V_{CC}$ Power supply current | No Load, $T_A$ = 25°C | | 5 | 10 | mA |

**Table 5. Transmitter electrical characteristics**

($C_1$ - $C_4$ = 0.1 µF, $V_{CC}$ = 5 V ± 10 %, $T_A$ = -40 to 85 °C, unless otherwise specified. Typical values are referred to $T_A$ = 25 °C).

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{TOUT}$ | Output voltage swing | All transmitter outputs are loaded with 3kΩ to GND | ±5 | ±7.8 | | V |
| $I_{TIL}$ | Input leakage current | | | | ±40 | µA |
| $V_{TIL}$ | Input logic threshold low | | 0.8 | | | V |
| $V_{TIH}$ | Input logic threshold high | | | | 2 | V |
| $SR_T$ | Transition slew rate | $T_A$ = 25°C, $V_{CC}$ = 5V<br>$R_L$ = 3 to 7kΩ, $C_L$ = 50 to 2500pF (1) | | 7 | 30 | V/µs |
| $D_R$ | Data rate | (2) | 120 | 220 | | kbits/s |
| $R_{TOUT}$ | Transmitter output resistance | $V_{CC}$ = V+ = V- = 0V $V_{OUT}$ = ±2V | 300 | | | Ω |
| $I_{SC}$ | Transmitter output short circuit current | One $T_{XOUT}$ to GND | | ±10 | ±60 | mA |

1. Measured from 3 V to -3 V or from -3 V to 3 V
2. One transmitter output is loaded with $R_L$ = 3 kΩ to 7 kΩ, $C_L$ = 50 to 1000 pF

**Table 6. Receiver electrical characteristics**

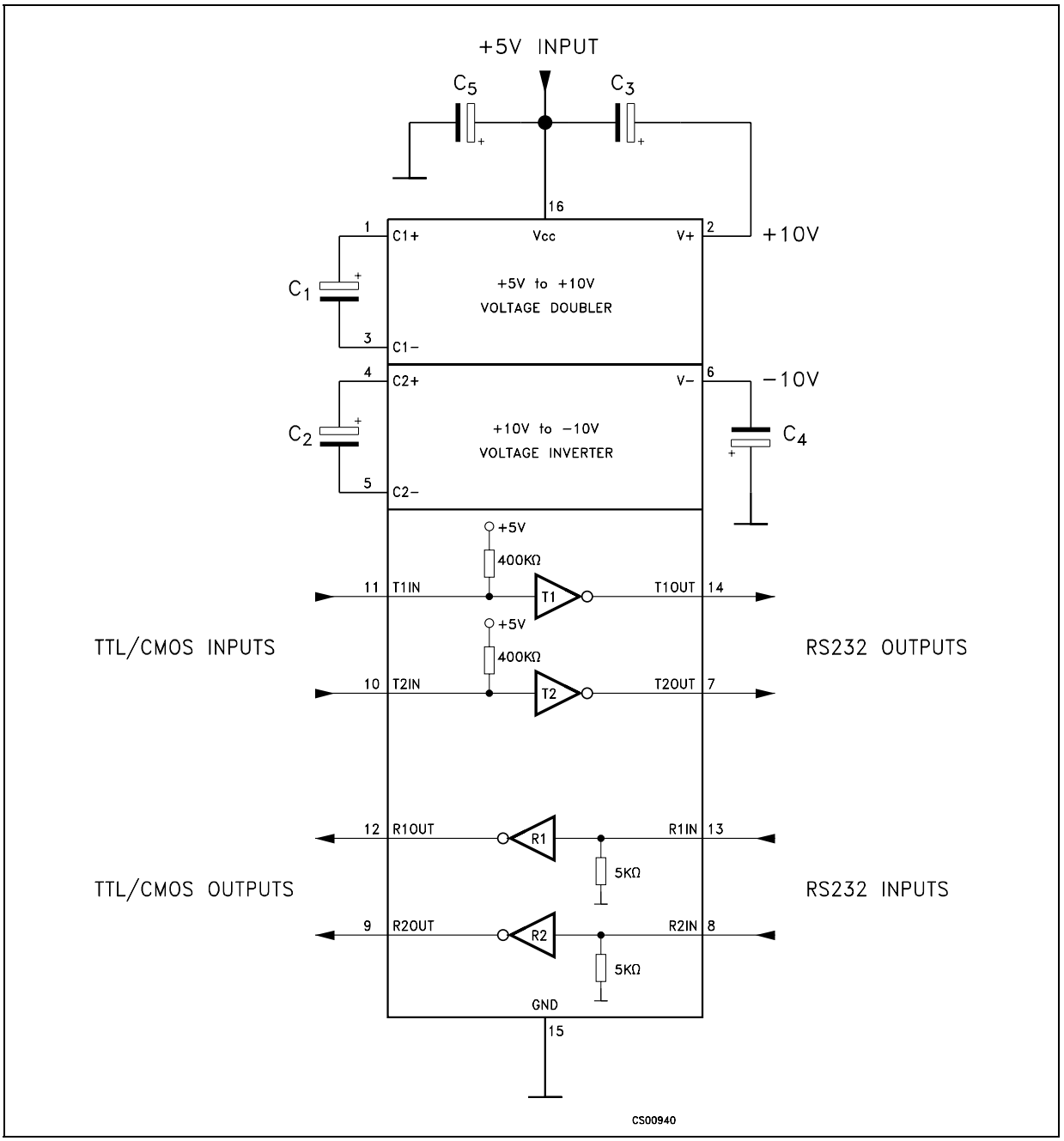
($C_1$ - $C_4$ = 0.1 µF, $V_{CC}$ = 5 V ± 10 %, $T_A$ = -40 to 85 °C, unless otherwise specified. Typical values are referred to $T_A$ = 25 °C).

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{RIN}$ | Receiver input voltage operating range | | -30 | | 30 | V |
| $R_{RIN}$ | RS-232 input resistance | $T_A$ = 25°C, $V_{CC}$ = 5 V, $V_{RIN}$ = 5V | 3 | 5 | 7 | kΩ |
| $V_{RIL}$ | RS-232 input threshold low | $T_A$ = 25°C, $V_{CC}$ = 5 V | 0.8 | 1.2 | | V |
| $V_{RIH}$ | RS-232 input threshold high | $T_A$ = 25°C, $V_{CC}$ = 5 V | | 1.7 | 2.4 | V |
| $V_{RIHYS}$ | RS-232 input hysteresis | $V_{CC}$ = 5V | 0.2 | 0.5 | 1 | V |
| $V_{ROL}$ | TTL/CMOS output voltage low | $I_{OUT}$ = 3.2mA (to $V_{CC}$) | | | 0.4 | V |
| $V_{ROH}$ | TTL/CMOS output voltage high | $I_{OUT}$ = -1mA (to GND) | 3.5 | $V_{CC}$-0.4 | | V |
| $I_{SCR}$ | Receiver output short circuit current | | | ±10 | | mA |
| $t_{DR}$ | Receiver propagation delay | $C_L$ = 150pF (1) | | 0.3 | 1 | µs |

1. RS-232 in to TTL-CMOS out (from 50% to 50%)

# 4 Typical application

**Figure 2. Application circuit (1) (2)**




1. $C_{1\text{-}4}$ capacitors can even be 1µF ones
2. $C_{1\text{-}4}$ can be common or biased capacitors

**Table 7. Capacitance value (µF)**

| C1 | C2 | C3 | C4 | C5 |
|---|---|---|---|---|
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |

# 5 Typical performance characteristics

(Unless otherwise specified $T_J$ = 25 °C)

**Figure 3. Supply current vs temperature**

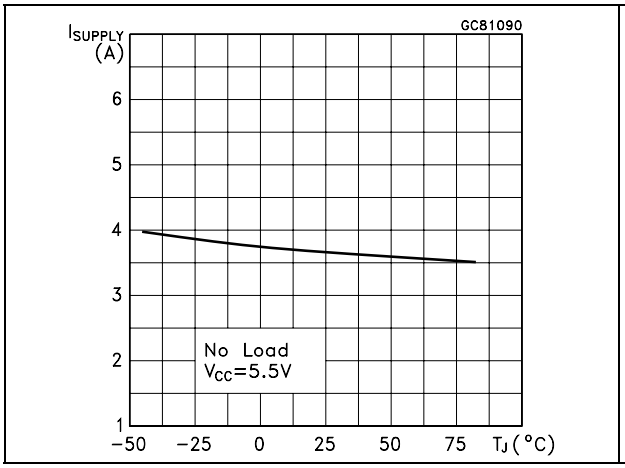



**Figure 4. Data rate vs temperature**

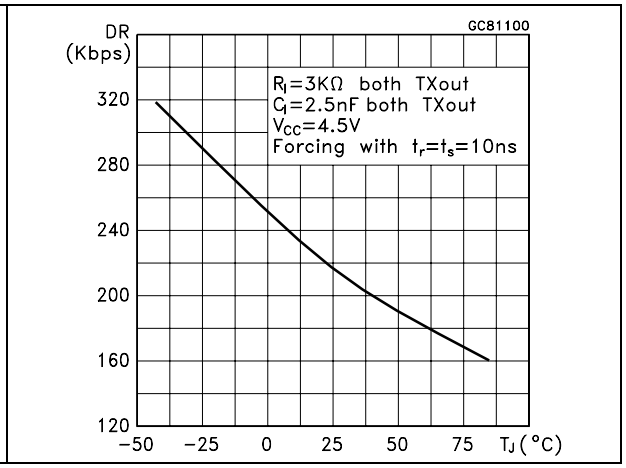



**Figure 5. Receiver propagation delay**

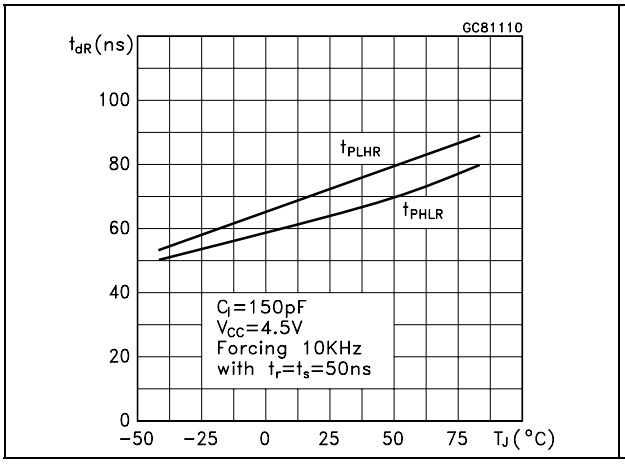



**Figure 6. Driver propagation delay**

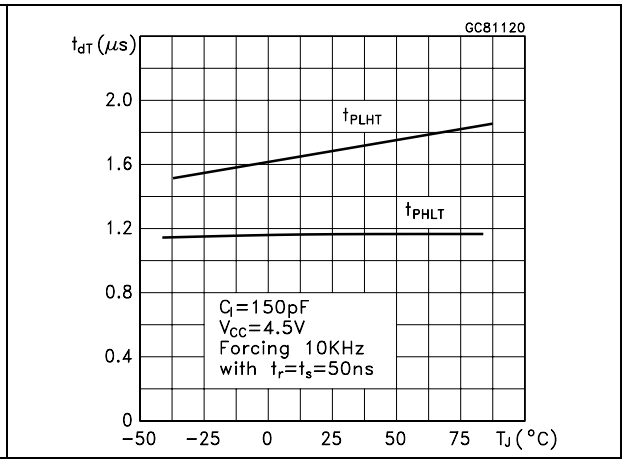



**Figure 7. High level output voltage swing vs temperature**

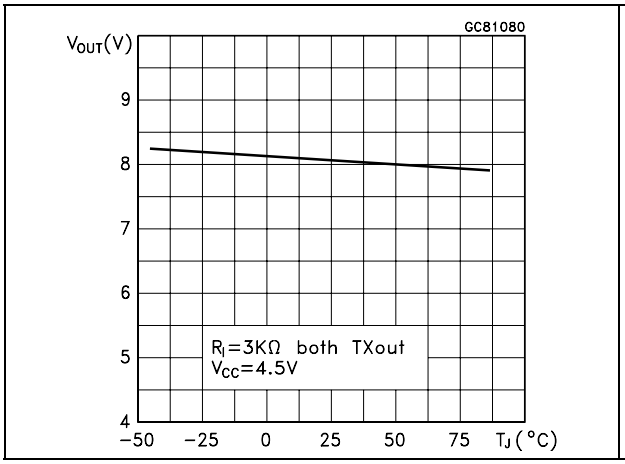



**Figure 8. Low level output voltage swing vs temperature**

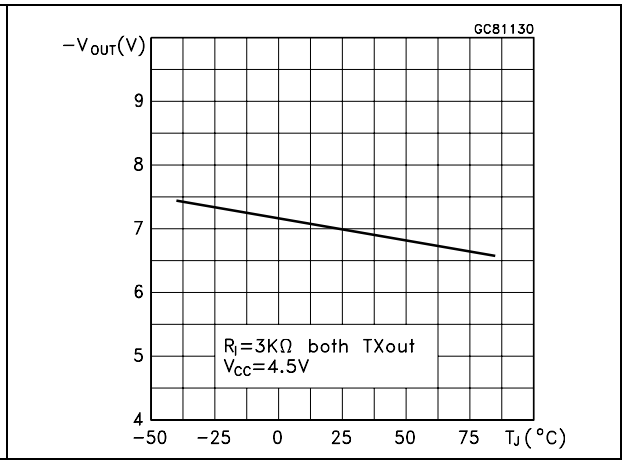


**Figure 9. High level transmitter output short circuit current vs temperature**

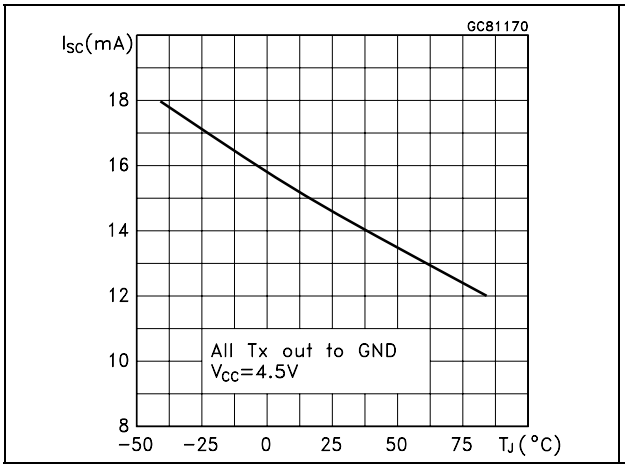



**Figure 10. Low level transmitter output short circuit current vs temperature**

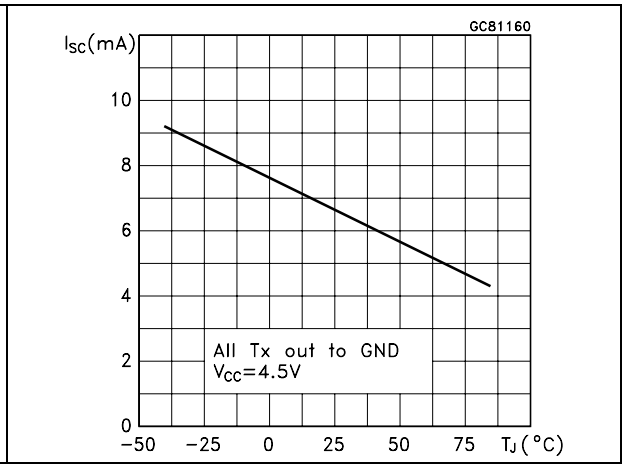



**Figure 11. High level receiver output short circuit current vs temperature**

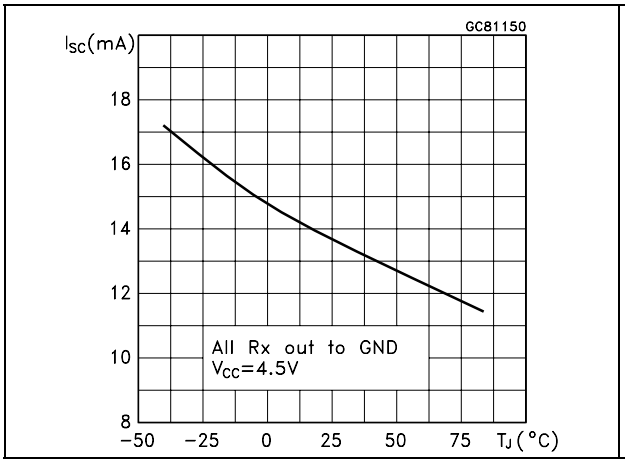
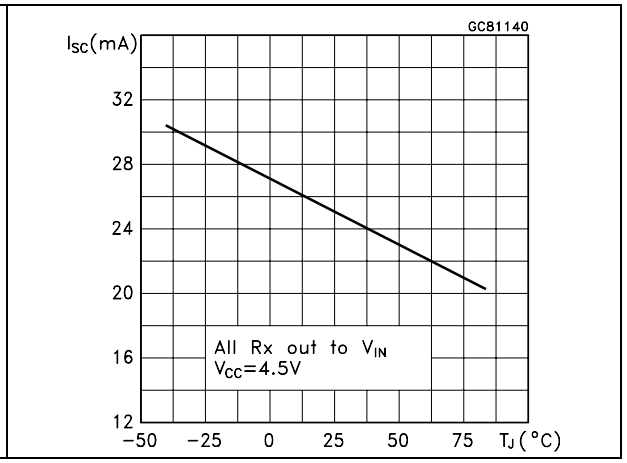



**Figure 12. Low level receiver output short circuit current vs temperature**

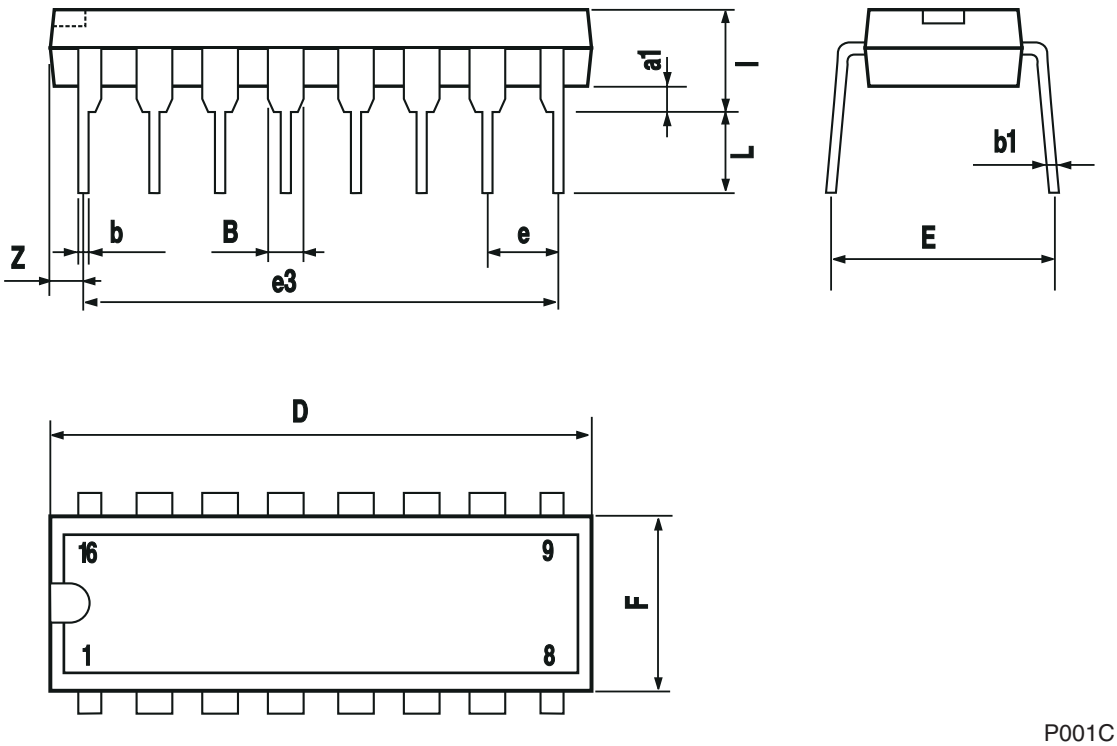


# 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

## Plastic DIP-16 (0.25) mechanical data

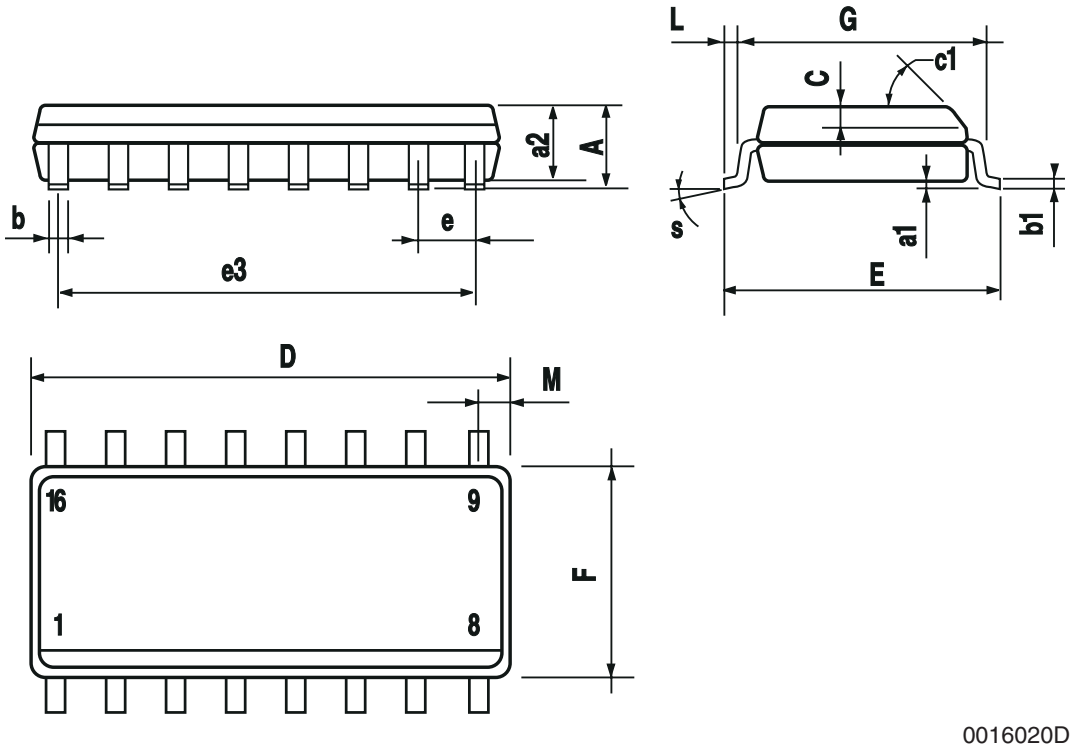
| Dim. | mm. | | | inch. | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 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 |




P001C

## SO-16 mechanical data

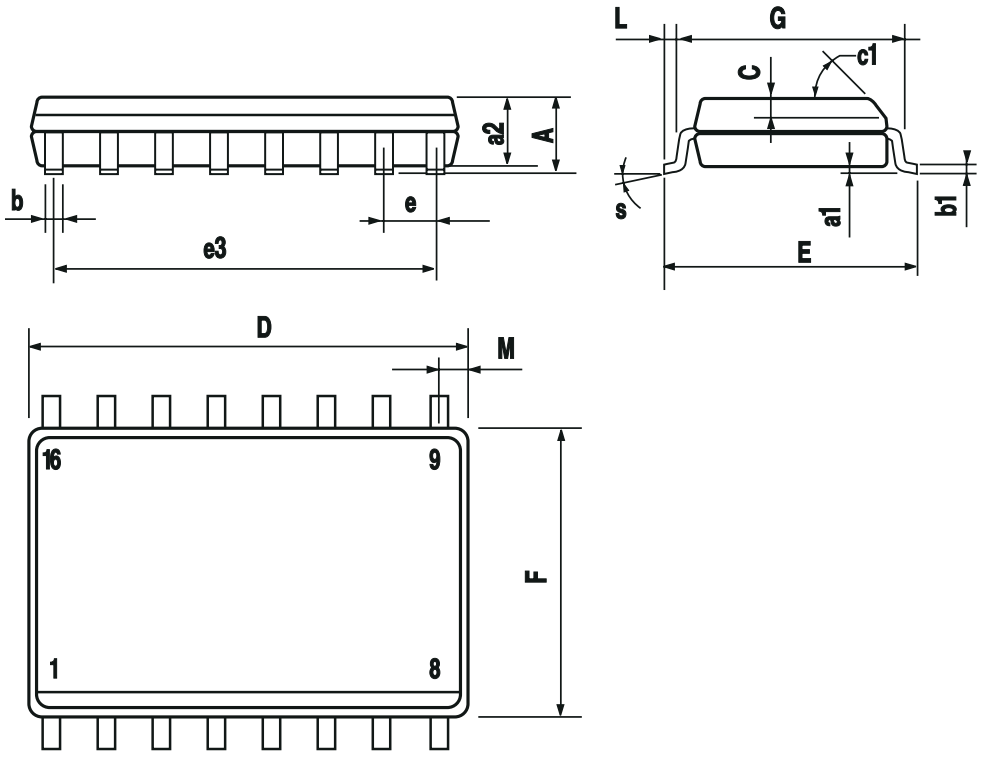
| Dim. | mm. | | | inch. | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.25 | 0.004 | | 0.010 |
| a2 | | | 1.64 | | | 0.063 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 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.) | | | | | |




0016020D

## SO-16L mechanical data

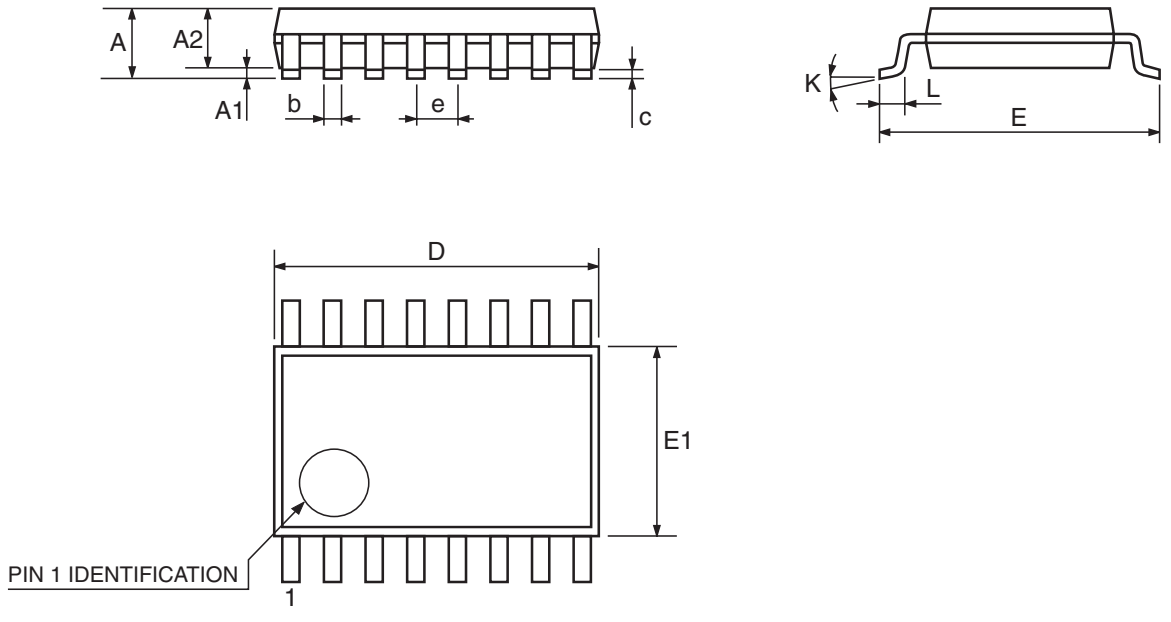
| Dim. | mm. | | | inch. | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 2.65 | | | 0.104 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.008 |
| a2 | | | 2.45 | | | 0.096 |
| b | 0.35 | | 0.49 | 0.014 | | 0.019 |
| b1 | 0.23 | | 0.32 | 0.009 | | 0.012 |
| C | | 0.5 | | | 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° (max.) | | | | | |




PO13I

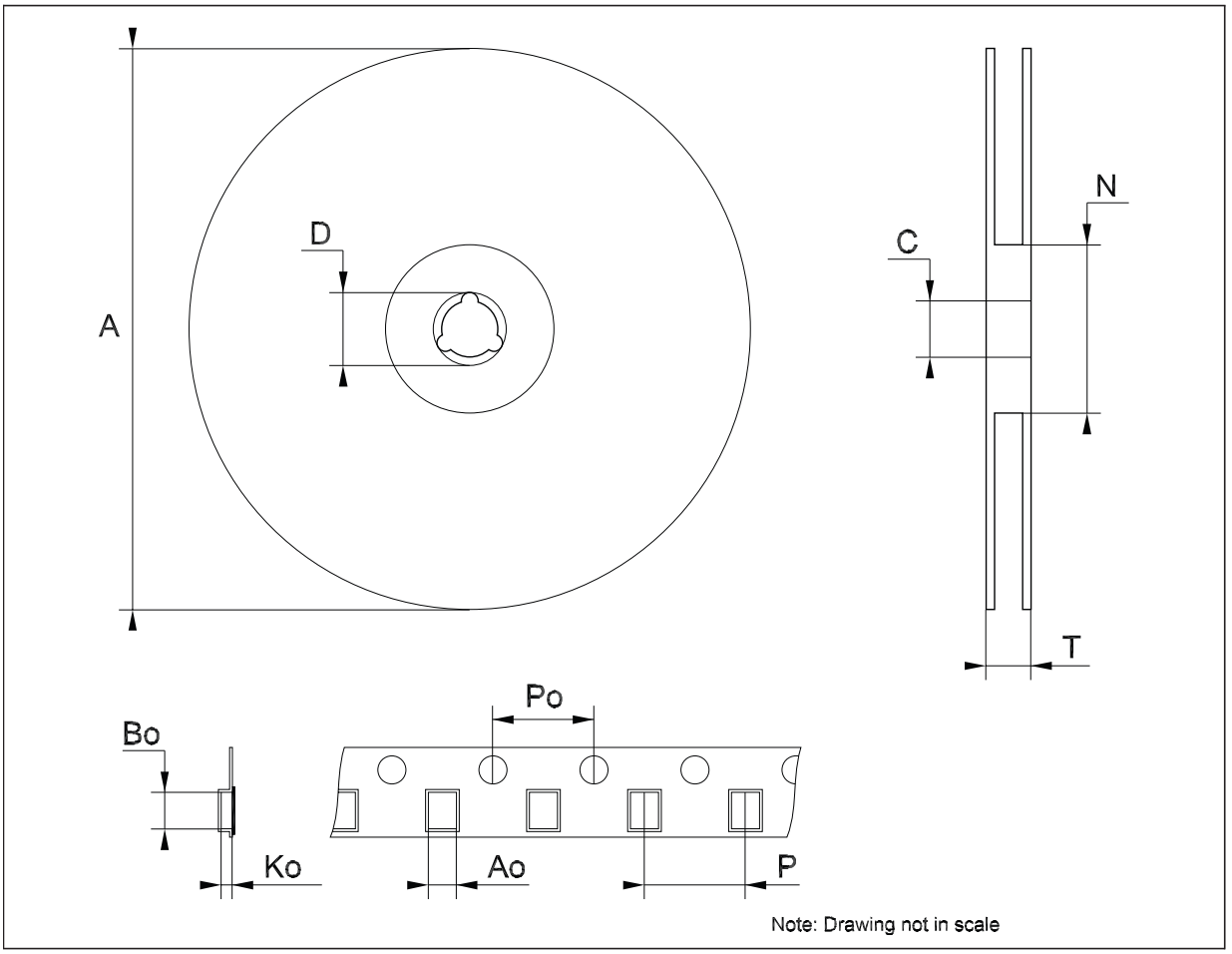
## TSSOP16 mechanical data

| 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 |



## Tape & reel SO-16 mechanical data

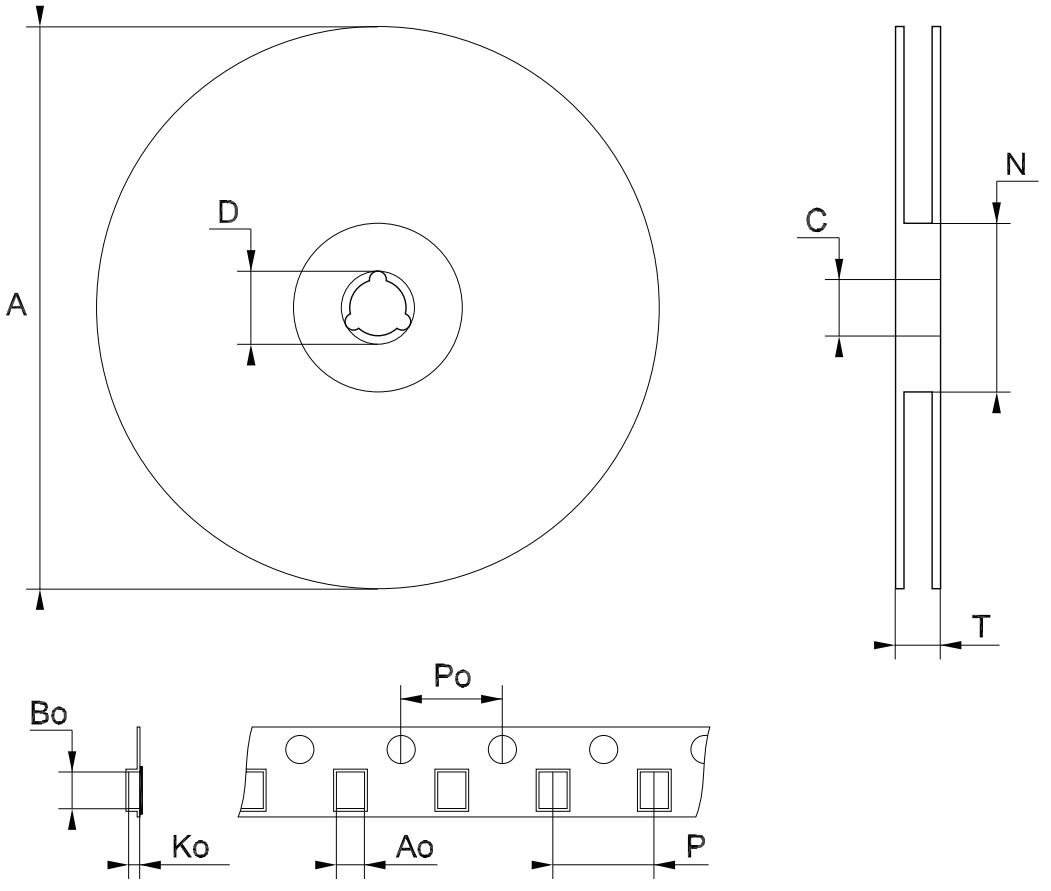
| Dim. | mm. | | | inch. | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 330 | | | 12.992 |
| C | 12.8 | | 13.2 | 0.504 | | 0.519 |
| D | 20.2 | | | 0.795 | | |
| N | 60 | | | 2.362 | | |
| T | | | 22.4 | | | 0.882 |
| Ao | 6.45 | | 6.65 | 0.254 | | 0.262 |
| 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 |




Note: Drawing not in scale

## Tape & reel SO-16L mechanical data

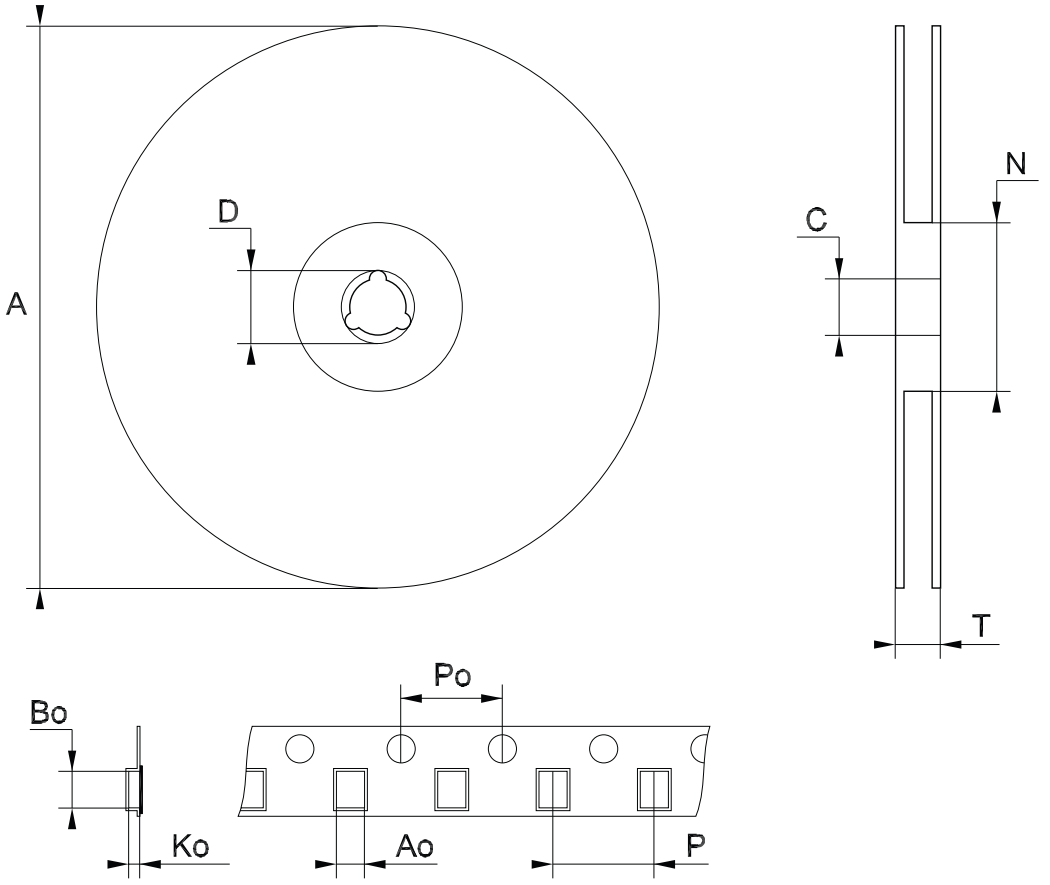
| Dim. | mm. | | | inch. | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 330 | | | 12.992 |
| C | 12.8 | | 13.2 | 0.504 | | 0.519 |
| D | 20.2 | | | 0.795 | | |
| N | 60 | | | 2.362 | | |
| T | | | 22.4 | | | 0.882 |
| Ao | 10.8 | | 11.0 | 0.425 | | 0.433 |
| 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 |




Note: Drawing not in scale

## 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 |




Note: Drawing not in scale

# 7 Revision history

**Table 8. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 02-Sep-2005 | 11 | Mistake $I_{TIL}$ max. on table 5. |
| 27-Oct-2006 | 12 | Order codes updated. |
| 14-Nov-2007 | 13 | Added *Table 1*. |
| 08-Feb-2008 | 14 | Modified: *Table 1 on page 1*. |