

3 to 5.5 V, low power, up to 400 kbps  
RS-232 drivers and receivers

## Features

- 300  $\mu$ A supply current
- 300 kbps minimum guaranteed data rate
- 6 V/ $\mu$ s minimum guaranteed slew rate
- Meet EIA/TIA-232 specifications down to 3 V
- Available in SO-16, SO-16 large and TSSOP16

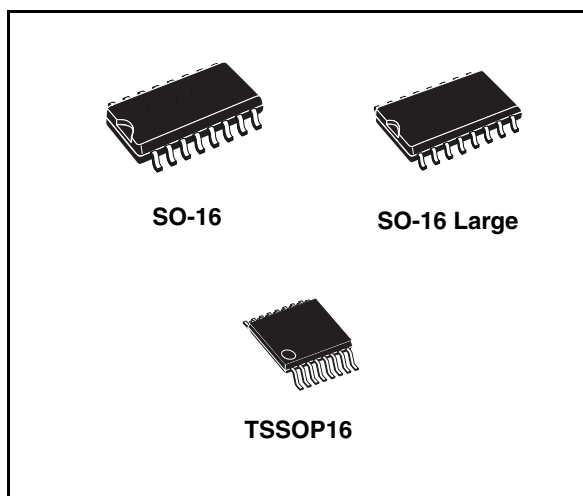
## Description

The ST3232 is a 3 V powered EIA/TIA-232 and V.28/V.24 communication interface with low power requirements, high data-rate capabilities.

ST3232 has a proprietary low dropout transmitter output stage providing true RS-232 performance from 3 to 5.5 V supplies. The device requires only four small 0.1 mF standard external capacitors for operations from 3 V supply.

The ST3232 has two receivers and two drivers.

The device is guaranteed to run at data rates of 250 kbps while maintaining RS-232 output levels. Typical applications are Notebook, Subnotebook and Palmtop Computers, Battery Powered



Equipment, Hand-Held Equipment, Peripherals and Printers.

**Table 1. Device summary**

| Order codes | Temp. range  | Package                     | Packaging           |
|-------------|--------------|-----------------------------|---------------------|
| ST3232CDR   | 0 to 70 °C   | SO-16 (tape and reel)       | 2500 parts per reel |
| ST3232BDR   | -40 to 85 °C | SO-16 (tape and reel)       | 2500 parts per reel |
| ST3232CWR   | 0 to 70 °C   | SO-16 Large (tape and reel) | 1000 parts per reel |
| ST3232BWR   | -40 to 85 °C | SO-16 Large (tape and reel) | 1000 parts per reel |
| ST3232CTR   | 0 to 70 °C   | TSSOP16 (tape and reel)     | 2500 parts per reel |
| ST3232BTR   | -40 to 85 °C | TSSOP16 (tape and reel)     | 2500 parts per reel |

# Contents

|   |                                           |    |
|---|-------------------------------------------|----|
| 1 | Pin configuration .....                   | 3  |
| 2 | Absolute maximum ratings .....            | 4  |
| 3 | Electrical characteristics .....          | 5  |
| 4 | Application .....                         | 7  |
| 5 | Typical performance characteristics ..... | 8  |
| 6 | Package mechanical data .....             | 10 |
| 7 | Revision history .....                    | 17 |



# 1 Pin configuration

Figure 1. Pin connection

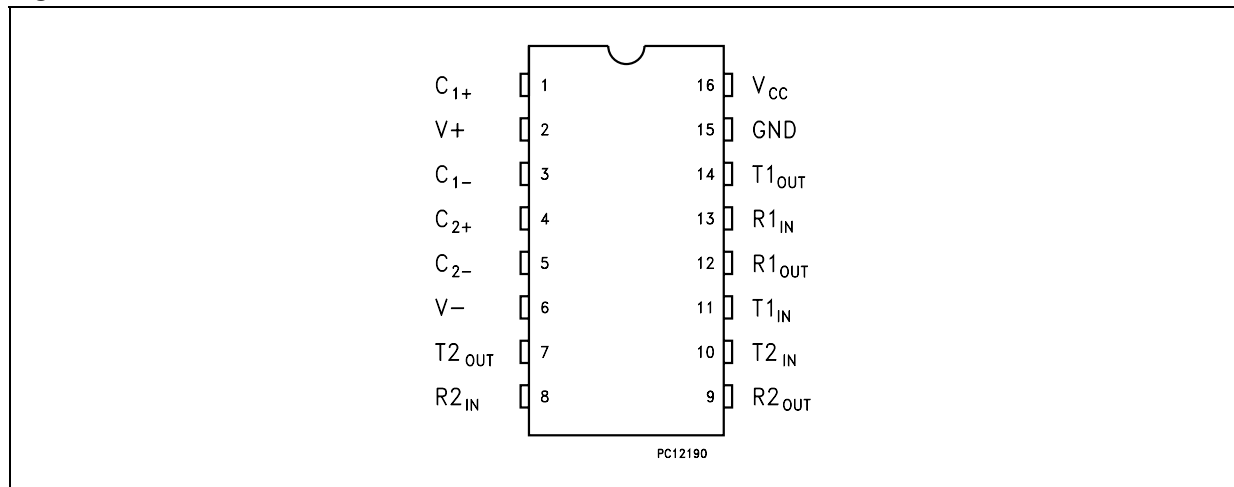


Table 2. Pin description

| 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                                         |

## 2 Absolute maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol            | Parameter                            | Value                    | Unit |
|-------------------|--------------------------------------|--------------------------|------|
| $V_{CC}$          | Supply voltage                       | -0.3 to 6                | V    |
| $V_{+}$           | Doubled voltage terminal             | $(V_{CC} - 0.3)$ to 7    | V    |
| $V_{-}$           | Inverted voltage terminal            | 0.3 to -7                | V    |
| $V_{+} +  V_{-} $ |                                      | 13                       | V    |
| $T_{IN}$          | Transmitter input voltage range      | -0.3 to 6                | V    |
| $R_{IN}$          | Receiver input voltage range         | $\pm 25$                 | V    |
| $T_{OUT}$         | Transmitter output voltage range     | $\pm 13.2$               | V    |
| $R_{OUT}$         | Receiver output voltage range        | -0.3 to $(V_{CC} + 0.3)$ | V    |
| $t_{SHORT}$       | Transmitter output short to gnd time | Continuous               |      |

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

*Externally applied  $V_{+}$  and  $V_{-}$  can have a maximum magnitude of +7 V, but their absolute addition can not exceed 13 V.*

*Running on internal charge pump, intrinsic self limitation allows exceeding those values without any damage.*

*Startup voltage sequence ( $V_{CC}$ , then  $V_{+}$ , then  $V_{-}$ ) is critical, therefore it is not recommended to use this device using externally applied voltage to  $V_{+}$  and  $V_{-}$ .*

### 3 Electrical characteristics

**Table 4. Electrical characteristics** ( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{CC} = 3 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

| Symbol              | Parameter                     | Test conditions                                                   | Min. | Typ. | Max. | Unit |
|---------------------|-------------------------------|-------------------------------------------------------------------|------|------|------|------|
| $I_{\text{SUPPLY}}$ | $V_{CC}$ Power supply current | No Load, $V_{CC} = 3\text{V} \pm 10\%$ , $T_A = 25^\circ\text{C}$ |      | 0.3  | 1    | mA   |
|                     |                               | No Load, $V_{CC} = 5\text{V} \pm 10\%$ , $T_A = 25^\circ\text{C}$ |      | 1    | 2    | mA   |

**Table 5. Logic input** ( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{CC} = 3 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

| Symbol           | Parameter                  | Test conditions        | Min. | Typ.       | Max.    | Unit          |
|------------------|----------------------------|------------------------|------|------------|---------|---------------|
| $V_{\text{TIL}}$ | Input logic threshold low  | T-IN <sup>(1)</sup>    |      |            | 0.8     | V             |
| $V_{\text{TIH}}$ | Input logic threshold high | $V_{CC} = 3.3\text{V}$ | 2    |            |         | V             |
|                  |                            | $V_{CC} = 5\text{V}$   | 2.4  |            |         |               |
| $I_{\text{IL}}$  | Input leakage current      | T-IN                   |      | $\pm 0.01$ | $\pm 1$ | $\mu\text{A}$ |

1. Transmitter input hysteresis is typically 250mV.

**Table 6. Transmitter** ( $C_1 - C_4 = 0.1 \mu\text{F}$  tested at  $3.3 \text{ V} \pm 10 \%$ ,  $V_{CC} = 3 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

| Symbol            | Parameter                     | Test conditions                                                     | Min.    | Typ.      | Max.     | Unit     |
|-------------------|-------------------------------|---------------------------------------------------------------------|---------|-----------|----------|----------|
| $V_{\text{TOUT}}$ | Output voltage swing          | All transmitter outputs are loaded with $3\text{k}\Omega$ to GND    | $\pm 5$ | $\pm 5.4$ |          | V        |
| $R_{\text{TOUT}}$ | Transmitter output resistance | $V_{CC} = V_+ = V_- = 0\text{V}$ , $V_{\text{OUT}} = \pm 2\text{V}$ | 300     | 10M       |          | $\Omega$ |
| $I_{\text{TSC}}$  | Output short circuit current  | $V_{CC} = 3\text{V}$ or $5\text{V}$ , $V_{\text{OUT}} = \pm 12$     |         |           | $\pm 60$ | mA       |

**Table 7. Receiver** ( $C_1 - C_4 = 0.1 \mu\text{F}$  tested at  $3.3 \text{ V} \pm 10 \%$ ,  $V_{CC} = 3 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

| Symbol             | Parameter                              | Test conditions                                   | Min.         | Typ.         | Max. | Unit             |
|--------------------|----------------------------------------|---------------------------------------------------|--------------|--------------|------|------------------|
| $V_{\text{RIN}}$   | Receiver input voltage operating range |                                                   | -25          |              | 25   | V                |
| $V_{\text{RIL}}$   | RS-232 Input threshold low             | $T_A = 25^\circ\text{C}$ , $V_{CC} = 3.3\text{V}$ | 0.6          | 1.1          |      | V                |
|                    |                                        | $T_A = 25^\circ\text{C}$ , $V_{CC} = 5\text{V}$   | 0.8          | 1.5          |      |                  |
| $V_{\text{RIH}}$   | RS-232 Input threshold high            | $T_A = 25^\circ\text{C}$ , $V_{CC} = 3.3\text{V}$ |              | 1.5          | 2.4  | V                |
|                    |                                        | $T_A = 25^\circ\text{C}$ , $V_{CC} = 5\text{V}$   |              | 1.8          | 2.4  |                  |
| $V_{\text{RIHYS}}$ | Input hysteresis                       |                                                   |              | 0.3          |      | V                |
| $R_{\text{RIN}}$   | Input resistance                       | $T_A = 25^\circ\text{C}$                          | 3            | 5            | 7    | $\text{k}\Omega$ |
| $V_{\text{ROL}}$   | TTL/CMOS Output voltage low            | $I_{\text{OUT}} = 1.6\text{mA}$                   |              |              | 0.4  | V                |
| $V_{\text{ROH}}$   | TTL/CMOS Output voltage high           | $I_{\text{OUT}} = -1\text{mA}$                    | $V_{CC}-0.6$ | $V_{CC}-0.1$ |      | V                |

**Table 8. Timing characteristics** ( $C_1 - C_4 = 0.1 \mu\text{F}$  tested at  $3.3 \text{ V} \pm 10 \%$ ,  $V_{CC} = 3 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

| Symbol                   | Parameter                                | Test conditions                                                                                                                                                                                                                                                  | Min.   | Typ. | Max.     | Unit                                             |
|--------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|----------|--------------------------------------------------|
| $D_R$                    | Data transfer rate                       | $R_L = 3\text{k}\Omega$ $C_{L2} = 1000\text{pF}$<br>one transmitter switching                                                                                                                                                                                    | 300    | 400  |          | kbps                                             |
| $t_{PHLR}$<br>$t_{PLHR}$ | Propagation delay input to output        | $R_{XIN} = R_{XOUT}$ , $C_L = 150\text{pF}$                                                                                                                                                                                                                      |        | 0.2  |          | $\mu\text{s}$                                    |
| $ t_{PHLT} - t_{THL} $   | Transmitter propagation delay difference | (Note 1)                                                                                                                                                                                                                                                         |        | 100  |          | ns                                               |
| $ t_{PHLR} - t_{THR} $   | Receiver propagation delay difference    |                                                                                                                                                                                                                                                                  |        | 50   |          | ns                                               |
| $S_{RT}$                 | Transition slew rate                     | $T_A = 25^\circ\text{C}$ $R_L = 3\text{k}\Omega$ to $7\text{k}\Omega$ $V_{CC} = 3.3\text{V}$<br>measured from $+3\text{V}$ to $-3\text{V}$ or $-3\text{V}$ to $+3\text{V}$<br>$C_L = 150\text{pF}$ to $1000\text{pF}$<br>$C_L = 150\text{pF}$ to $2500\text{pF}$ | 6<br>4 |      | 30<br>30 | $\text{V}/\mu\text{s}$<br>$\text{V}/\mu\text{s}$ |

Note: 1 Transmitter skew is measured at the transmitter zero cross points.

## 4 Application

Figure 2. Application circuits

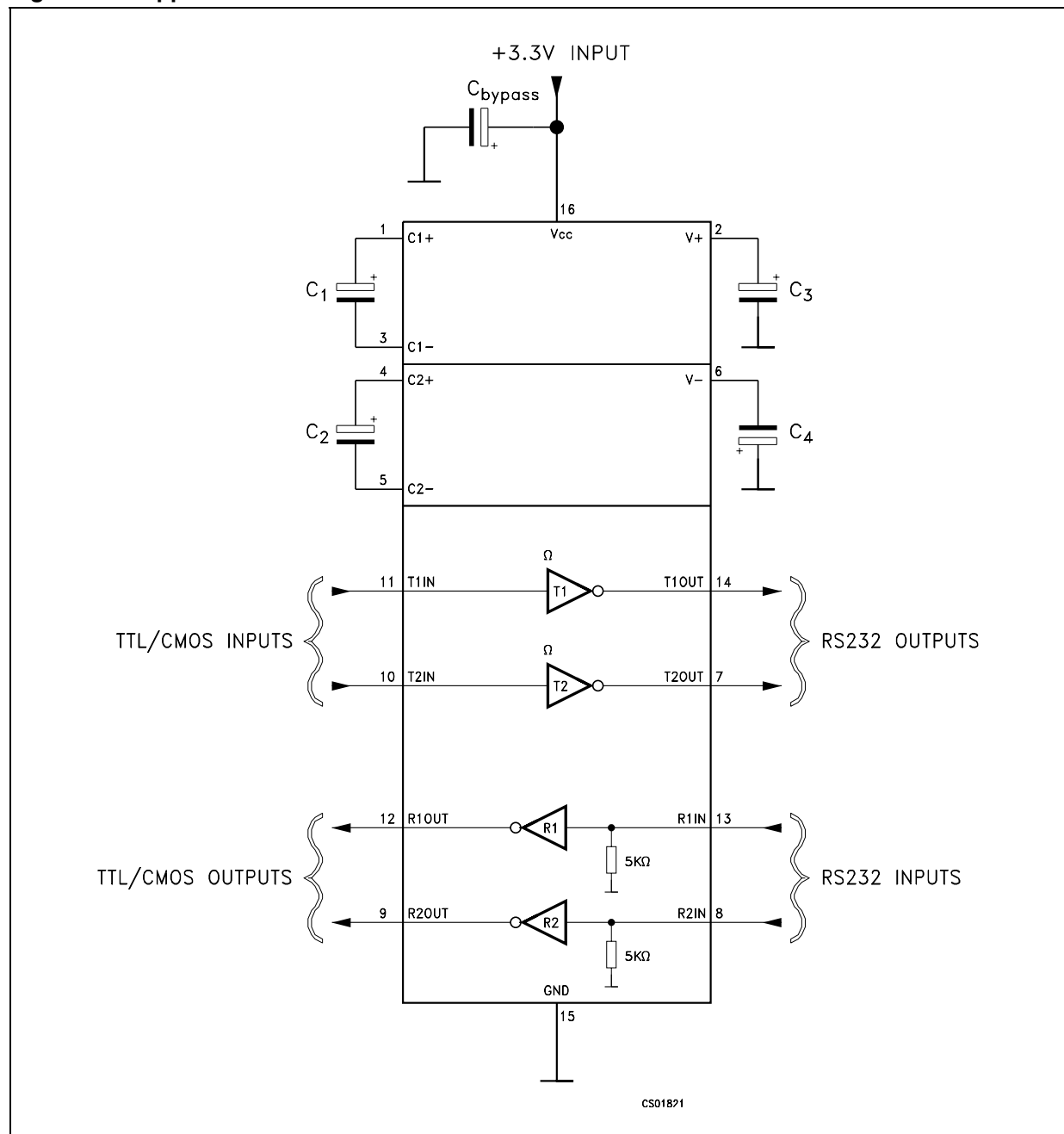


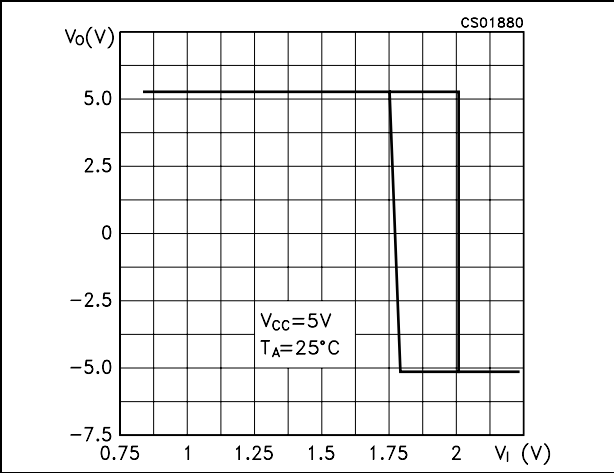
Table 9. Capacitance value ( $\mu\text{F}$ )

| $V_{CC}$   | C1    | C2   | C3   | C4   | $C_{bypass}$ |
|------------|-------|------|------|------|--------------|
| 3.0 to 3.6 | 0.1   | 0.1  | 0.1  | 0.1  | 0.1          |
| 4.5 to 5.5 | 0.047 | 0.33 | 0.33 | 0.33 | 0.33         |

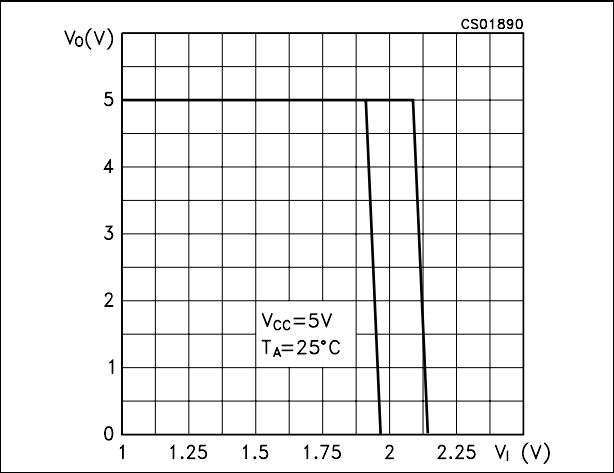
# 5 Typical performance characteristics

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

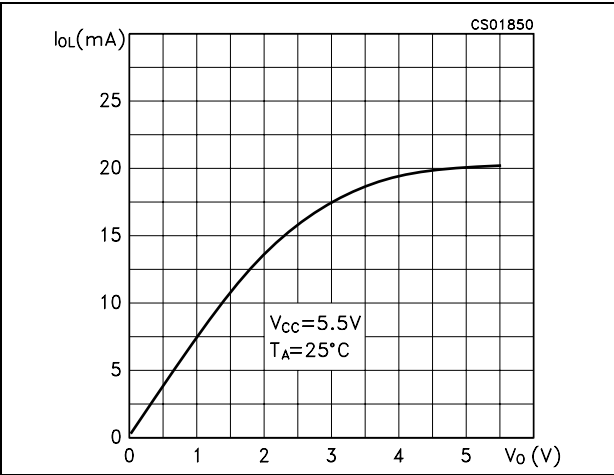
**Figure 3. Driver voltage transfer characteristics for transmitter input**



**Figure 4. Driver voltage transfer characteristics for receiver inputs**



**Figure 5. Output current vs output low voltage**



**Figure 6. Output current vs output low voltage**

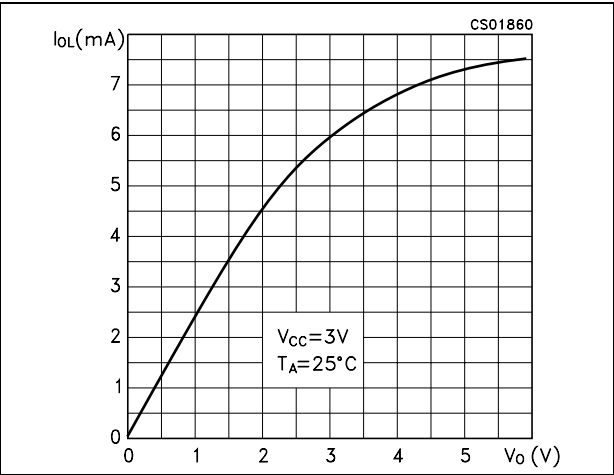




Figure 7. Output current vs output high voltage

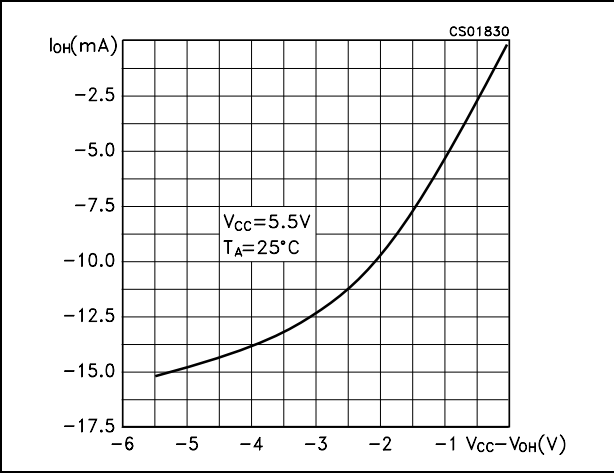


Figure 8. Output current vs output high voltage

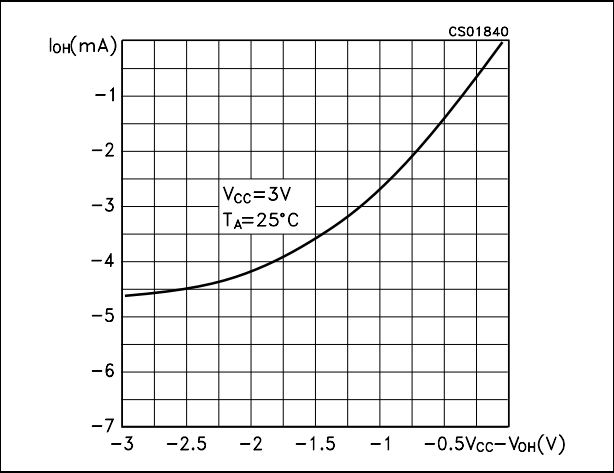
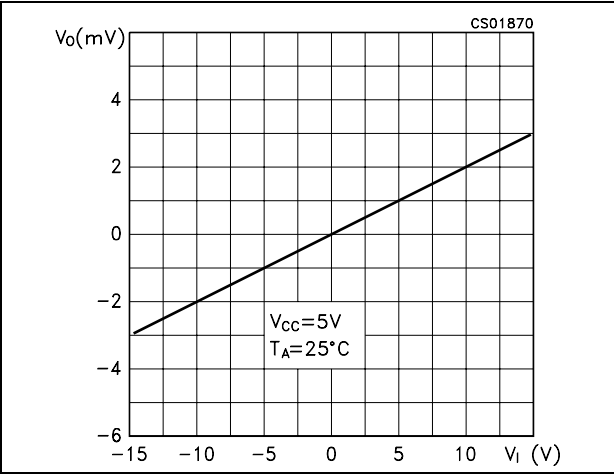


Figure 9. Receiver input resistance

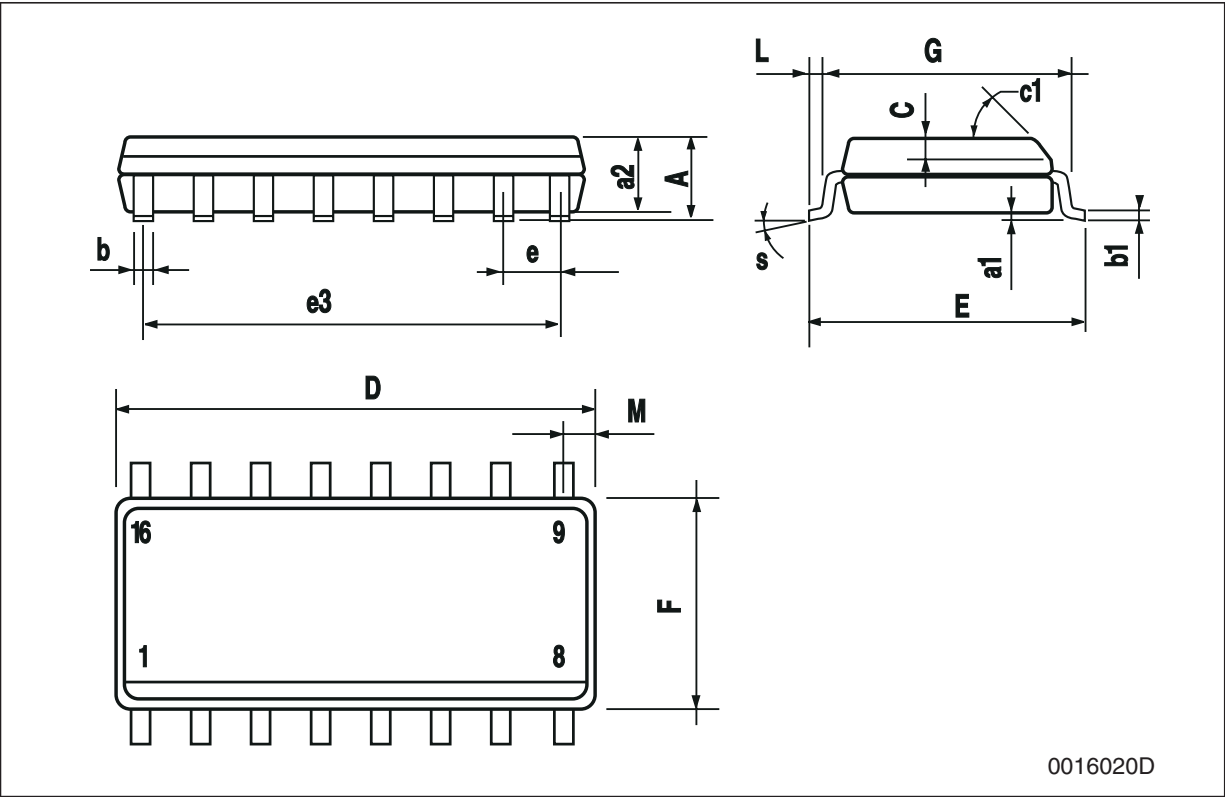


## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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](http://www.st.com).

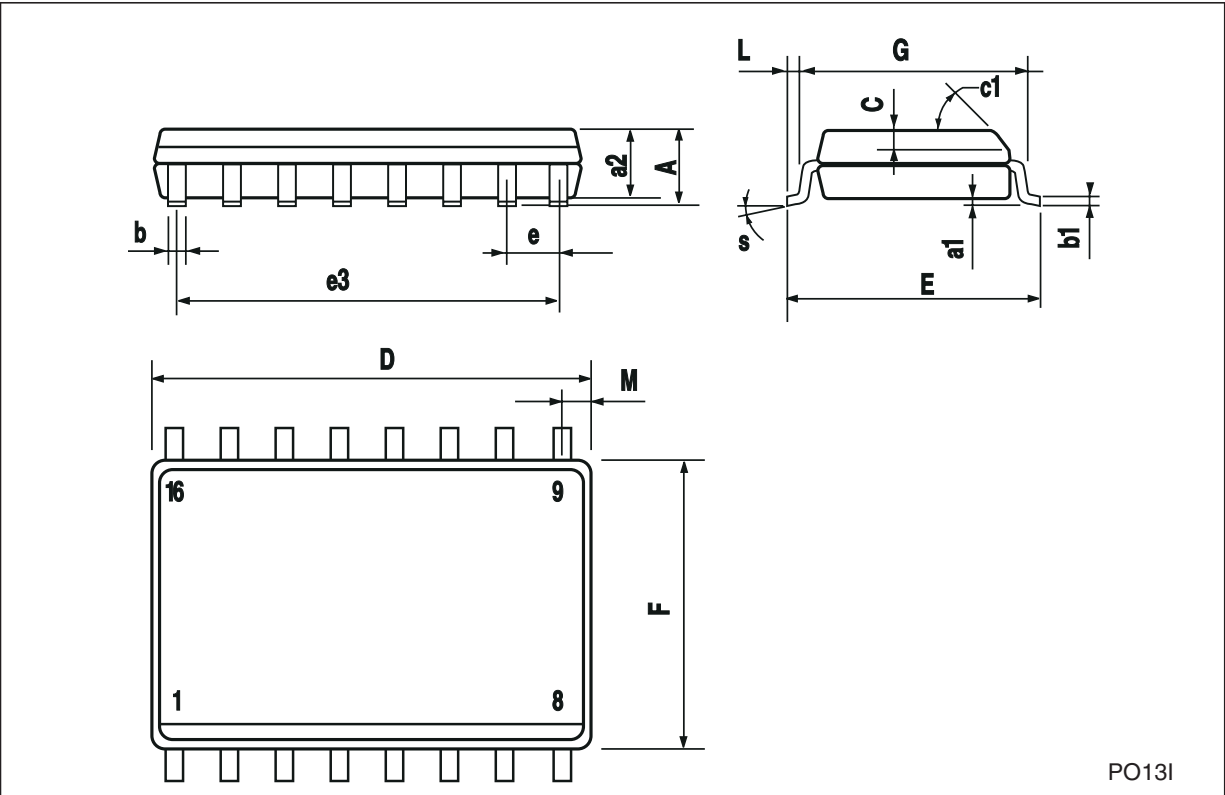
SO-16 mechanical data

| 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.)  |      |      |       |       |       |



SO-16L mechanical data

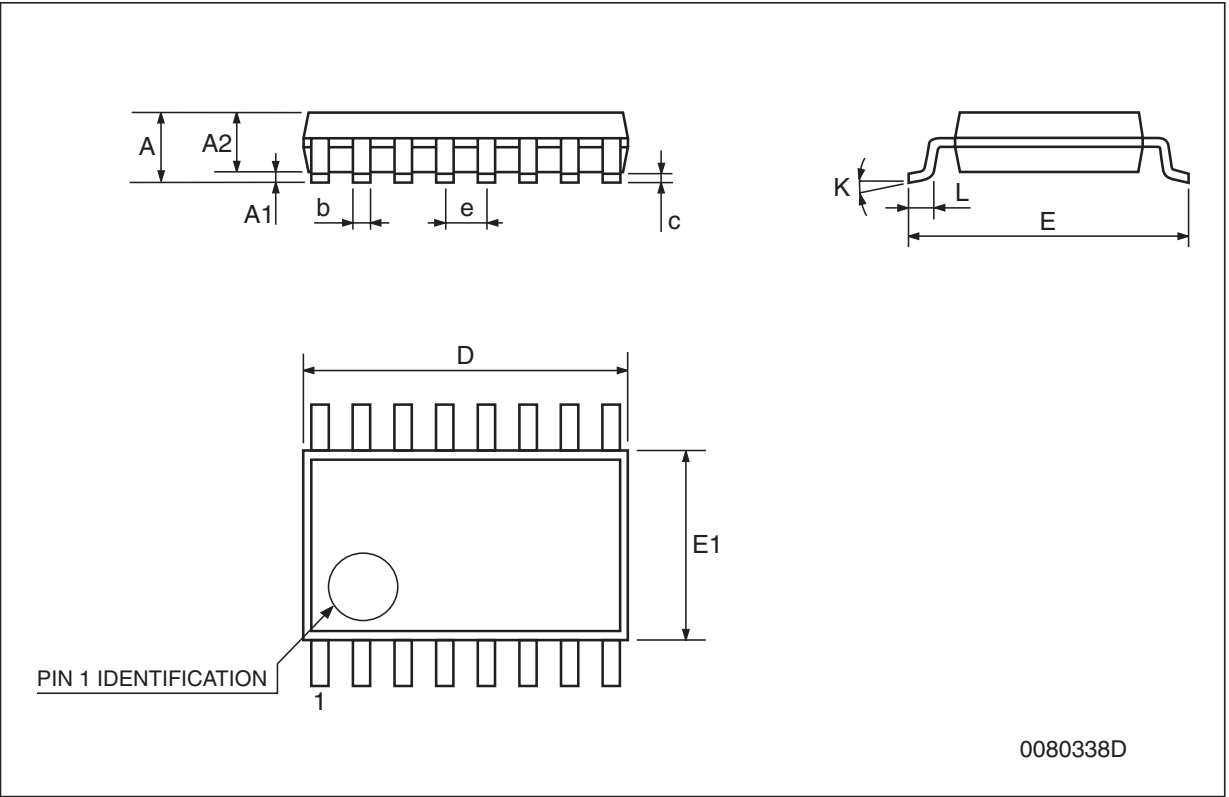
| Dim. | mm.        |      |       | inch. |       |       |
|------|------------|------|-------|-------|-------|-------|
|      | Min.       | Typ. | Max.  | Min.  | Typ.  | Max.  |
| A    |            |      | 2.65  |       |       | 0.104 |
| a1   | 0.1        |      | 0.2   | 0.004 |       | 0.008 |
| 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

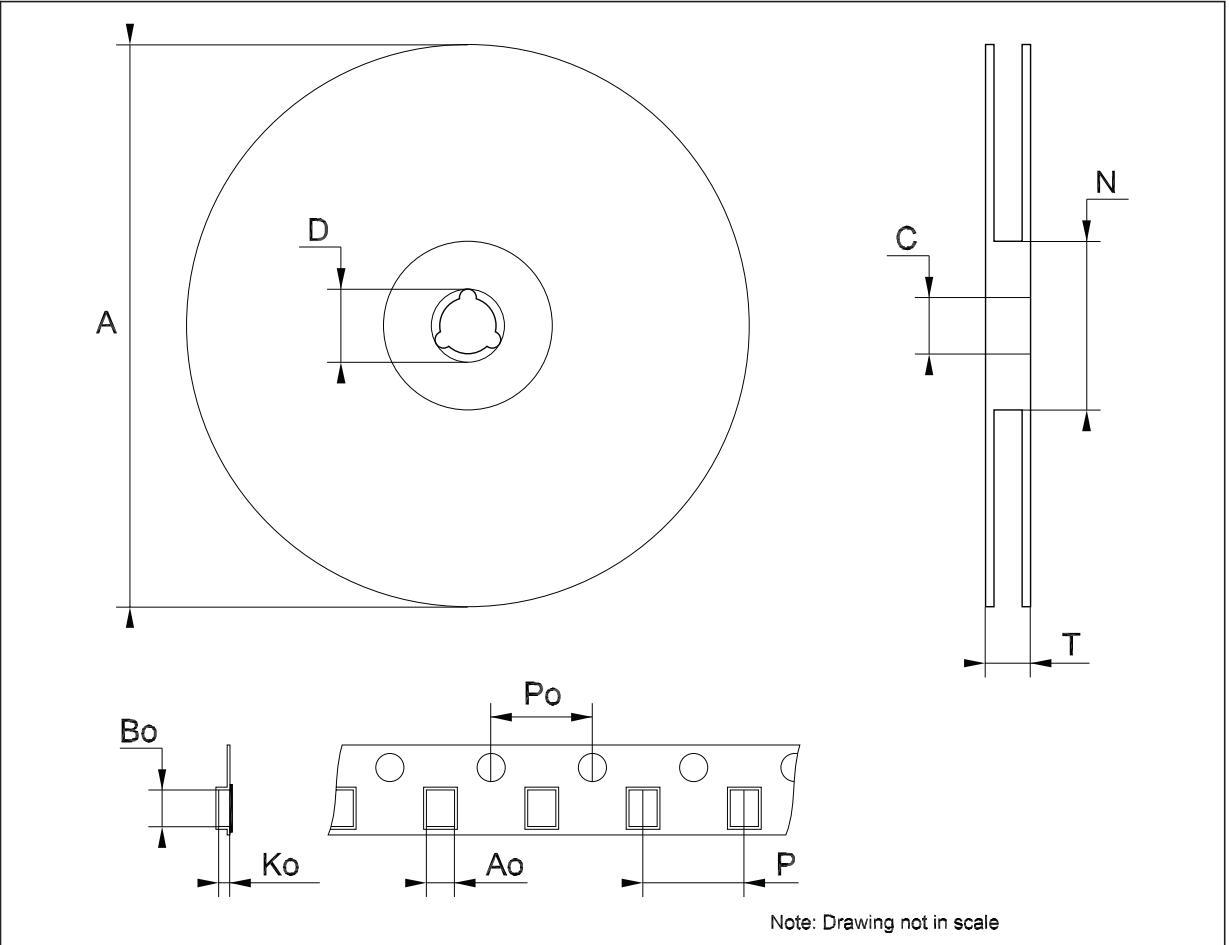
TSSOP16 mechanical data

| 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  |



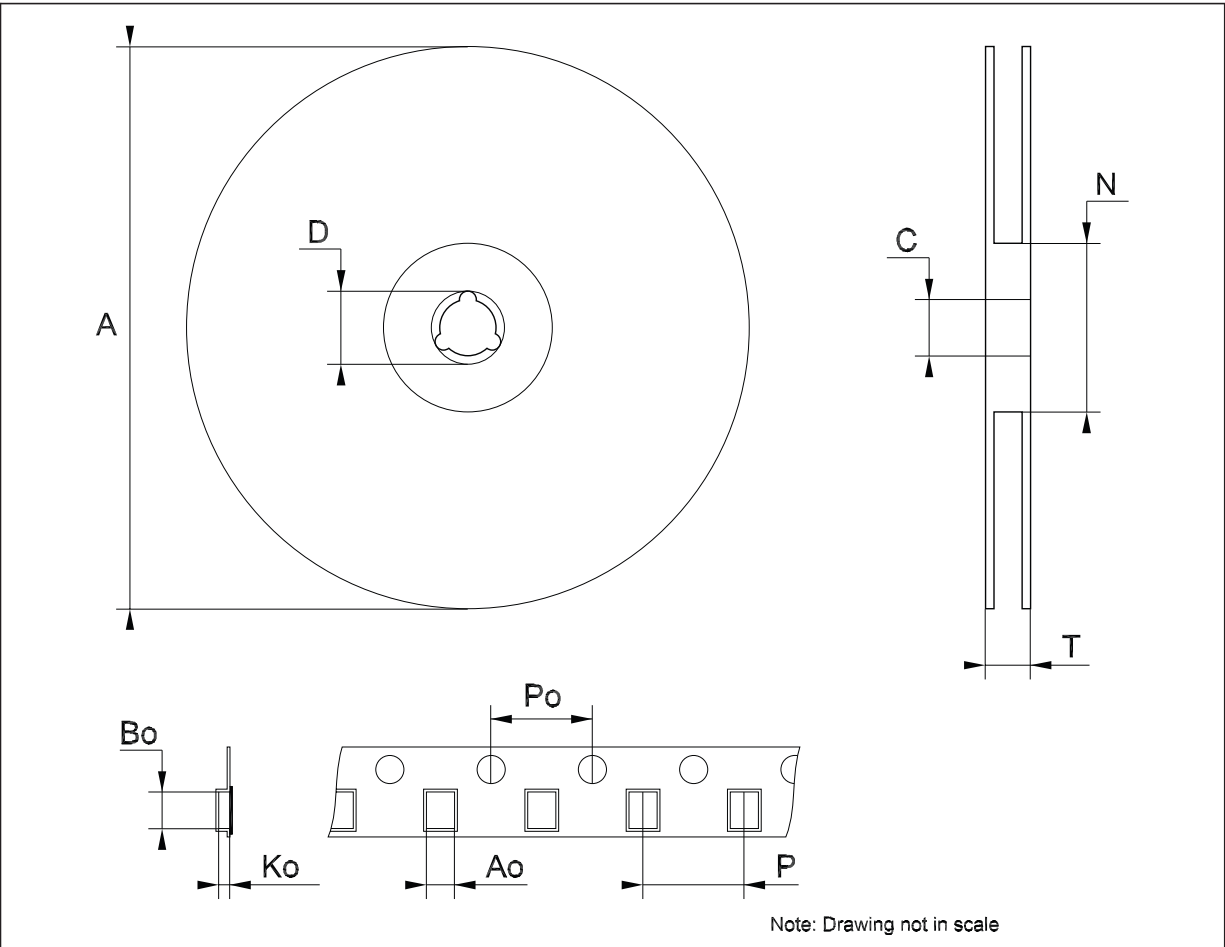
Tape & reel SO-16 mechanical data

| 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  |



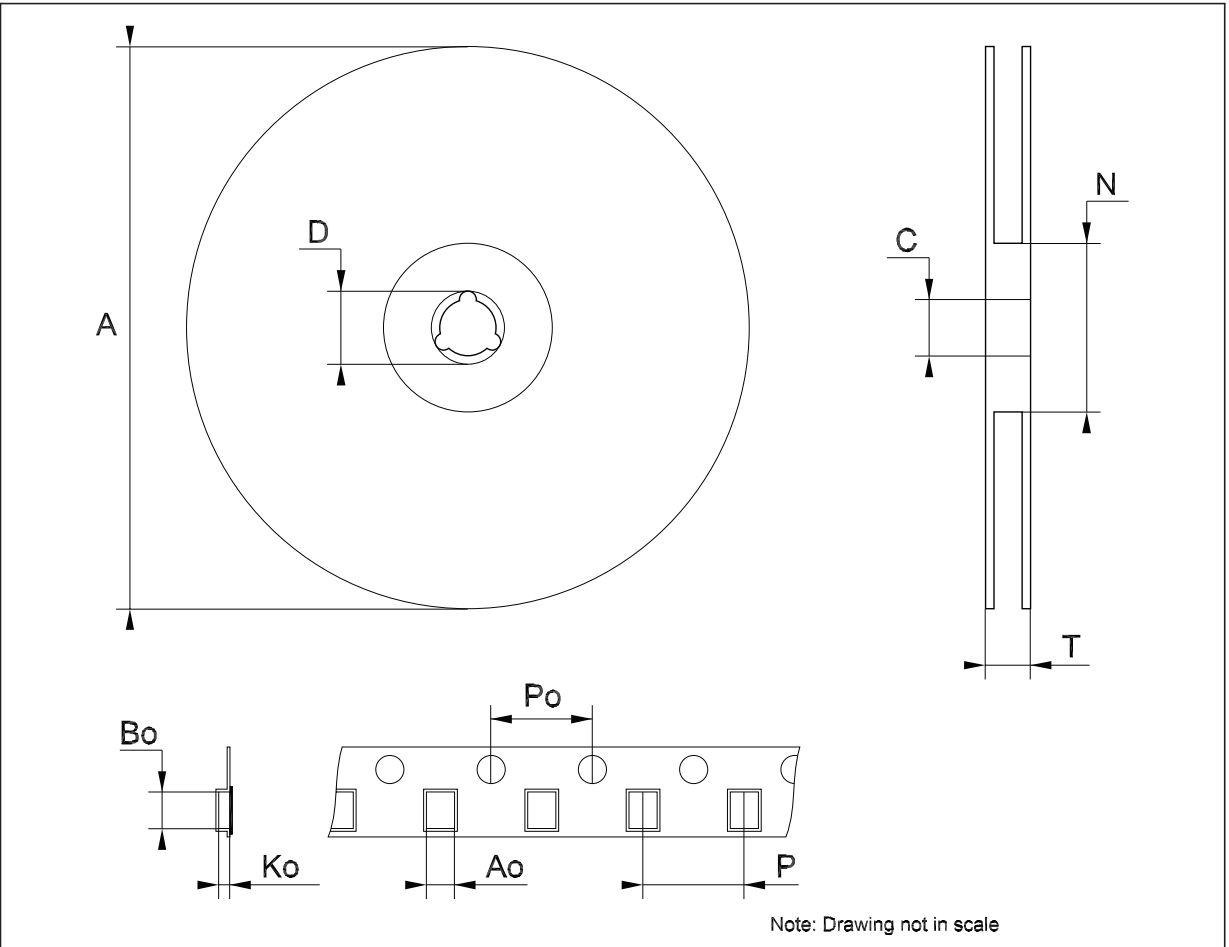
Tape & reel SO-16L mechanical data

| 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  |



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  |





## 7 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                        |
|-------------|----------|------------------------------------------------|
| 06-Sep-2006 | 8        | Order codes has been updated and new template. |
| 25-Oct-2006 | 9        | Order codes has been updated.                  |
| 21-Jan-2008 | 10       | Added note on <a href="#">Table 3</a> .        |
| 08-Feb-2008 | 11       | Modified: <a href="#">Table 1 on page 1</a> .  |

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