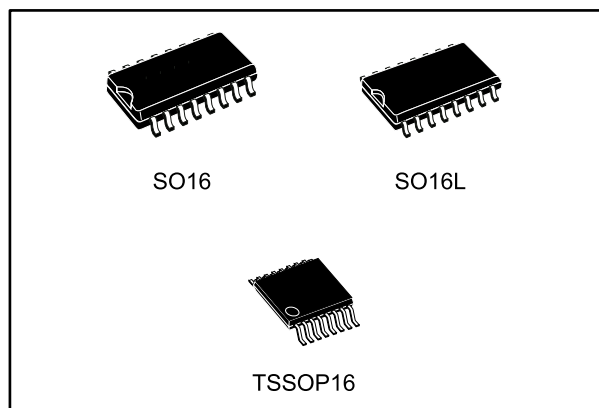


## 3 to 5.5 V, low-power, up to 400 kbs RS-232 drivers and receivers

Datasheet - production data



The ST3232B and ST3232C have two receivers and two drivers.

The devices are guaranteed to run at data rates of 250 kbps while maintaining RS-232 output levels. Typical applications are notebooks, subnotebooks and palmtop computers, battery-powered equipment, hand-held equipment, peripherals, and printers.

**Table 1: Device summary**

| Order code | Temp. range  | Package                    | Packaging           |
|------------|--------------|----------------------------|---------------------|
| ST3232CDR  | 0 to 70 °C   | SO16<br>(tape and reel)    | 2500 parts per reel |
| ST3232BDR  | -40 to 85 °C |                            |                     |
| ST3232CWR  | 0 to 70 °C   | SO16L<br>(tape and reel)   | 1000 parts per reel |
| ST3232BWR  | -40 to 85 °C |                            |                     |
| ST3232CTR  | 0 to 70 °C   | TSSOP16<br>(tape and reel) | 2500 parts per reel |
| ST3232BTR  | -40 to 85 °C |                            |                     |

### Features

- 300  $\mu$ A supply current
- 300 kbps minimum guaranteed data rate
- 6 V/ $\mu$ s minimum guaranteed slew rate
- Meets EIA/TIA-232 specifications down to 3 V
- Available in SO16, SO16L, and TSSOP16 packages

### Description

The ST3232B and ST3232C devices are 3 V powered EIA/TIA-232 and V.28/V.24 communication interfaces with low power requirements and high data-rate capabilities.

These devices have a proprietary low dropout transmitter output stage providing true RS-232 performance from 3 to 5.5 V supplies. The devices require only four small 0.1 mF standard external capacitors for operation from a 3 V supply.

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# 1 Pin configuration

Figure 1: Pin connections

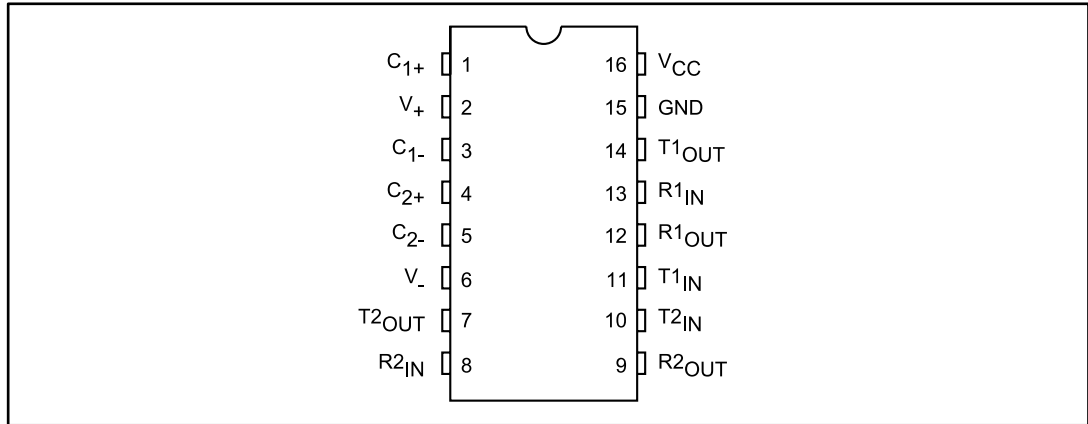


Table 2: Pin description

| Pin n° | Symbol     | Name and function                                      |
|--------|------------|--|
| 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 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-          | Inverted voltage terminal            | 0.3 to -7                |      |
| $V+ +  V- $ |                                      | 13                       |      |
| $T_{IN}$    | Transmitter input voltage range      | -0.3 to 6                |      |
| $R_{IN}$    | Receiver input voltage range         | $\pm 25$                 |      |
| $T_{OUT}$   | Transmitter output voltage range     | $\pm 13.2$               |      |
| $R_{OUT}$   | Receiver output voltage range        | -0.3 to $(V_{CC} + 0.3)$ |      |
| $t_{SHORT}$ | Transmitter output short to gnd time | Continuous               |      |
| $T_{stg}$   | Storage temperature                  | -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.

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 (C1 - C4 = 0.1  $\mu$ F, VCC = 3 V to 5.5 V, TA = -40 to 85 °C, unless otherwise specified. Typical values are referred to TA = 25 °C)**

| Symbol              | Parameter                            | Test conditions   | Min. | Typ. | Max. | Unit |
|---------------------|--------------------------------------|---|------|------|------|------|
| I <sub>SUPPLY</sub> | V <sub>CC</sub> power supply current | No load, V <sub>CC</sub> = 3 V $\pm$ 10 %, T <sub>A</sub> = 25 °C |      | 0.3  | 1    | mA   |
|                     |                                      | No load, V <sub>CC</sub> = 5 V $\pm$ 10 %, T <sub>A</sub> = 25 °C |      | 1    | 2    |      |

**Table 5: Logic input (C1 - C4 = 0.1  $\mu$ F, VCC = 3 V to 5.5 V, TA = -40 to 85 °C, unless otherwise specified. Typical values are referred to TA = 25 °C)**

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

**Notes:**

<sup>(1)</sup>Transmitter input hysteresis is typically 250 mV.

**Table 6: Transmitter (C1 - C4 = 0.1  $\mu$ F tested at 3.3 V  $\pm$ 10 %, VCC = 3 V to 5.5 V, TA = -40 to 85 °C, unless otherwise specified. Typical values are referred to TA = 25 °C)**

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

**Table 7: Receiver (C1 - C4 = 0.1  $\mu$ F tested at 3.3 V  $\pm$ 10 %, VCC = 3 V to 5.5 V, TA = -40 to 85 °C, unless otherwise specified. Typical values are referred to TA = 25 °C)**

| Symbol             | Parameter                              | Test conditions                                 | Min.                  | Typ.                  | Max. | Unit       |
|--------------------|--|---|-----------------------|-----------------------|------|------------|
| V <sub>RIN</sub>   | Receiver input voltage operating range |   | -25                   |                       | 25   | V          |
| V <sub>RIL</sub>   | RS-232 Input threshold low             | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 3.3 V | 0.6                   | 1.1                   |      |            |
|                    |  | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5 V   | 0.8                   | 1.5                   |      |            |
| V <sub>RIH</sub>   | RS-232 Input threshold high            | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 3.3 V |                       | 1.5                   | 2.4  |            |
|                    |  | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5 V   |                       | 1.8                   | 2.4  |            |
| V <sub>RIHYS</sub> | Input hysteresis                       |   |                       | 0.3                   |      |            |
| R <sub>RIN</sub>   | Input resistance                       | T <sub>A</sub> = 25 °C                          | 3                     | 5                     | 7    | k $\Omega$ |
| V <sub>ROL</sub>   | TTL/CMOS output voltage low            | I <sub>OUT</sub> = 1.6 mA                       |                       |                       | 0.4  | V          |
| V <sub>ROH</sub>   | TTL/CMOS output voltage high           | I <sub>OUT</sub> = -1 mA                        | V <sub>CC</sub> - 0.6 | V <sub>CC</sub> - 0.1 |      |            |

**Table 8: Timing characteristics (C1 - C4 = 0.1  $\mu$ F tested at 3.3 V  $\pm$ 10 %, VCC = 3 V to 5.5 V, TA = -40 to 85  $^{\circ}$ C, unless otherwise specified. Typical values are referred to TA = 25  $^{\circ}$ C)**

| Symbol                                   | Parameter                                | Test conditions  | Min. | Typ. | Max. | Unit       |
|--|--|--|------|------|------|------------|
| D <sub>R</sub>                           | Data transfer rate                       | R <sub>L</sub> = 3 k $\Omega$ , C <sub>L2</sub> = 1000 pF one transmitter switching  | 300  | 400  |      | kbps       |
| t <sub>PHLR</sub> ,<br>t <sub>PLHR</sub> | Propagation delay input to output        | R <sub>XIN</sub> = R <sub>XOUT</sub> , C <sub>L</sub> = 150 pF   |      | 0.2  |      | $\mu$ s    |
| t <sub>PHLT</sub> -<br>t <sub>THL</sub>  | Transmitter propagation delay difference | See <sup>(1)</sup>   |      | 100  |      | ns         |
| t <sub>PHLR</sub> -<br>t <sub>THR</sub>  | Receiver propagation delay difference    |  |      | 50   |      |            |
| S <sub>RT</sub>                          | Transition slew rate                     | T <sub>A</sub> = 25 $^{\circ}$ C, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$ , V <sub>CC</sub> = 3.3 V measured from 3 V to -3 V or -3 V to 3 V, C <sub>L</sub> = 150 pF to 1000 pF | 6    |      | 30   | V/ $\mu$ s |
|  |  | T <sub>A</sub> = 25 $^{\circ}$ C, R <sub>L</sub> = 3 k $\Omega$ to 7 k $\Omega$ , V <sub>CC</sub> = 3.3 V measured from 3 V to -3 V or -3 V to 3 V, C <sub>L</sub> = 150 pF to 2500 pF | 4    |      | 30   |            |

**Notes:**

<sup>(1)</sup> Transmitter skew is measured at the transmitter zero cross points

## 4 Application information

Figure 2: Application circuits

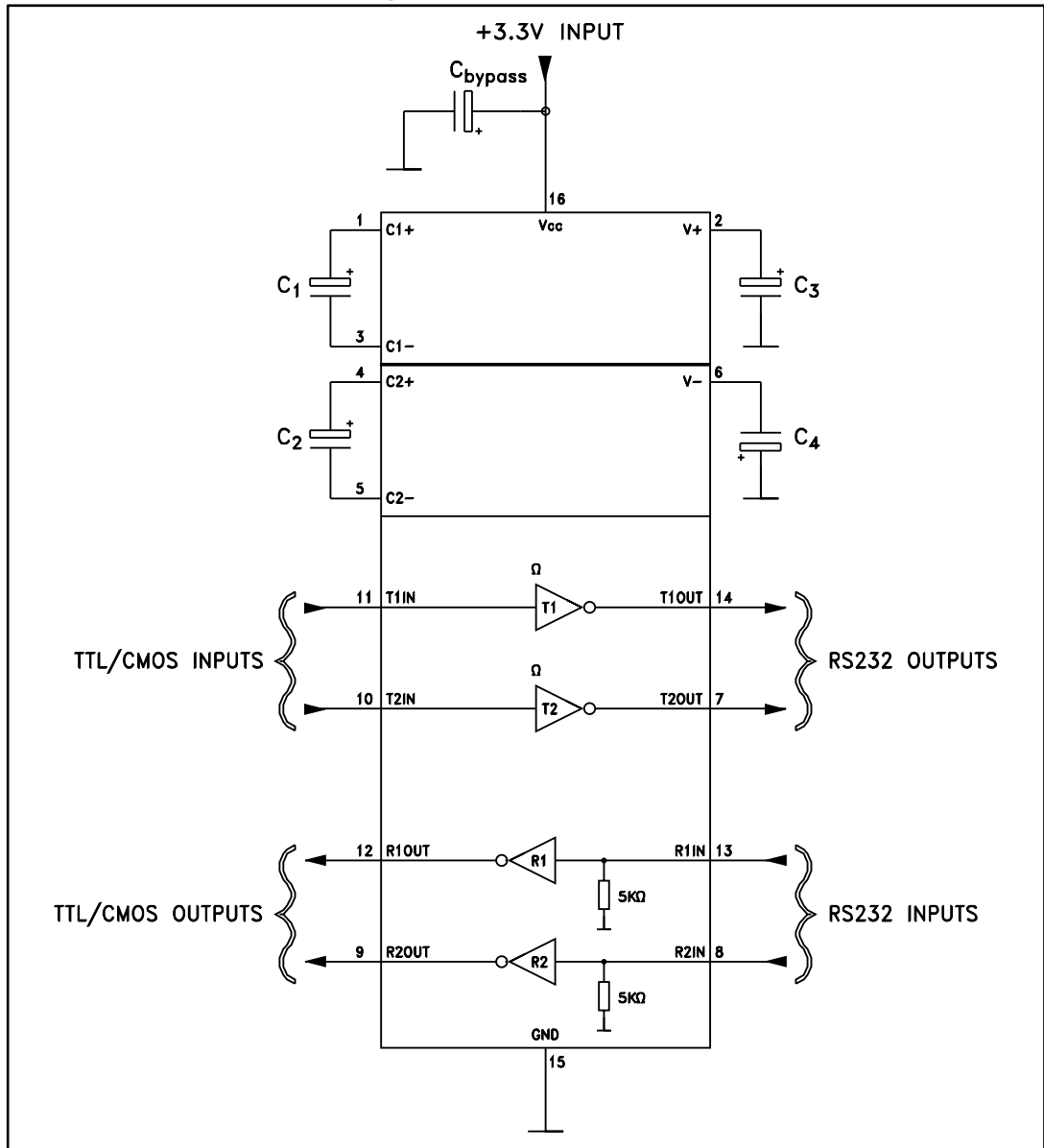


Table 9: Capacitance value ( $\mu\text{F}$ )

| $V_{CC}$   | 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  $T_J = 25\text{ }^\circ\text{C}$

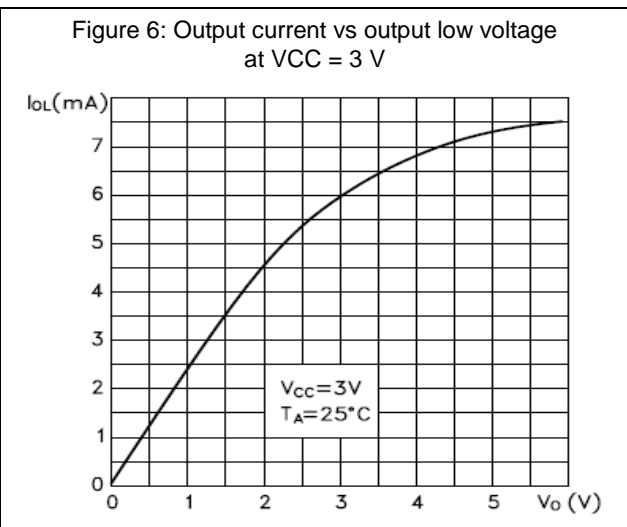
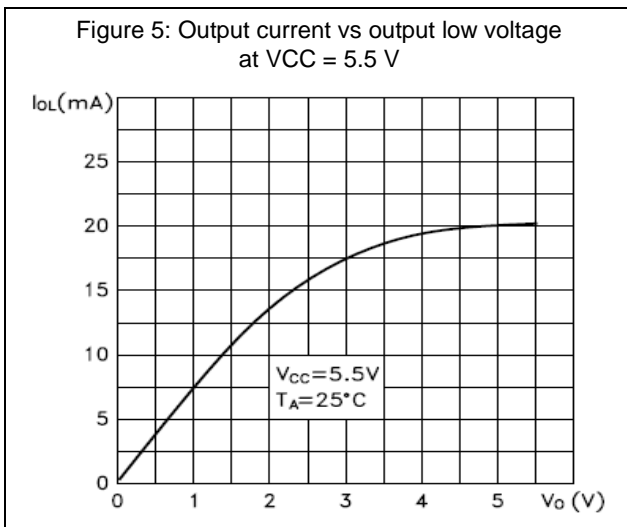
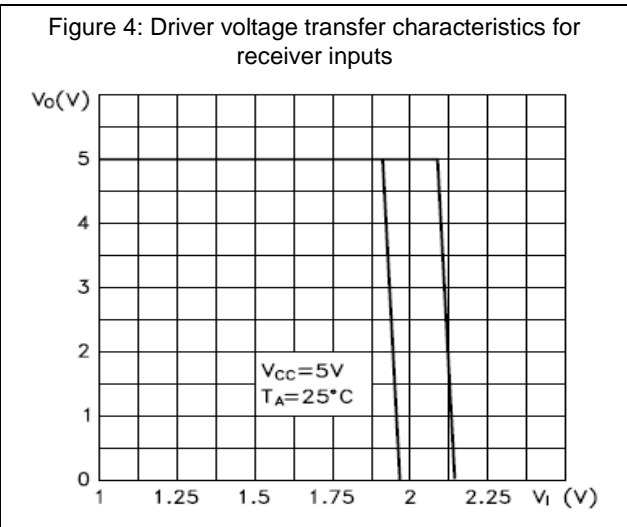
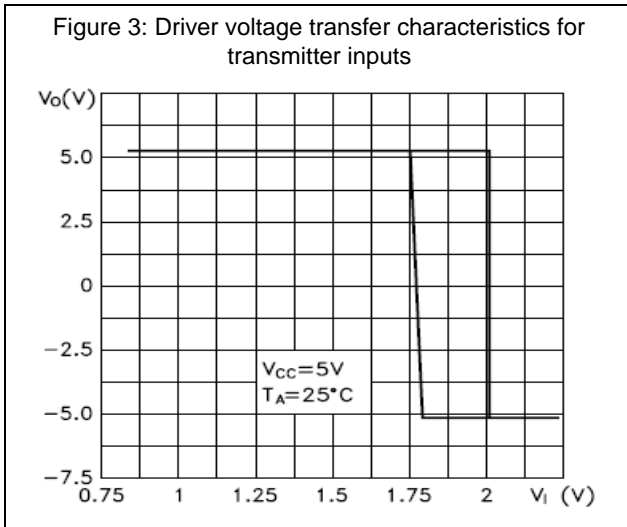




Figure 7: Output current vs output high voltage at VCC = 5.5 V

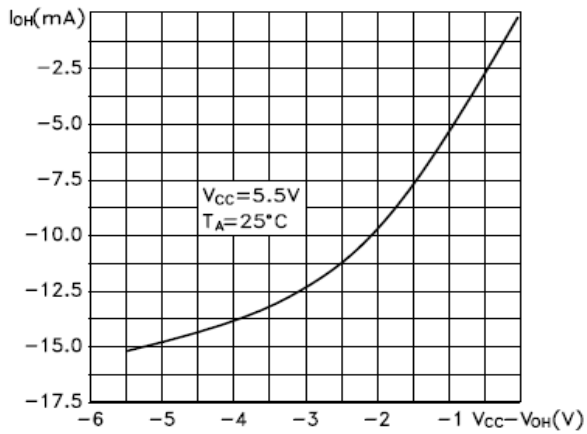


Figure 8: Output current vs output high voltage at VCC = 3 V

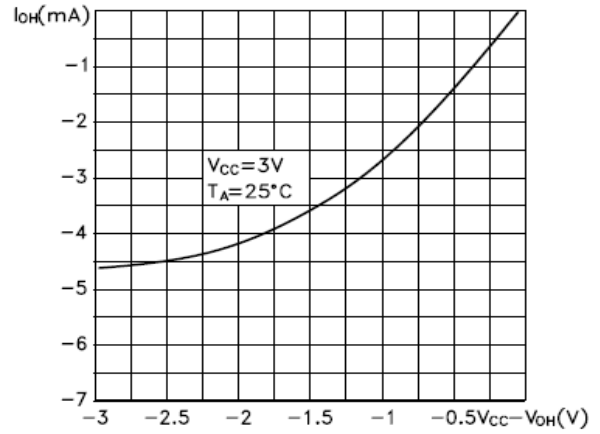
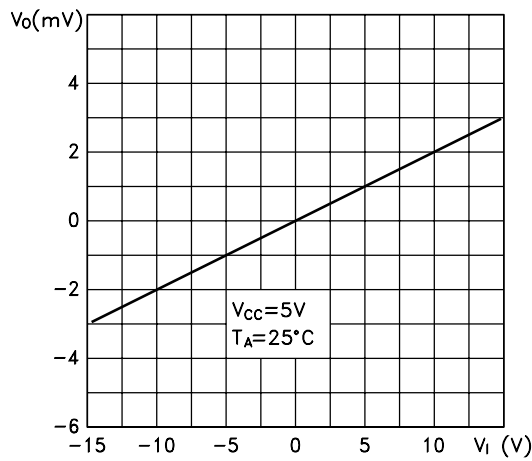


Figure 9: Receiver input resistance



## 6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 6.1 SO16 package information

Figure 10: SO16 package outline

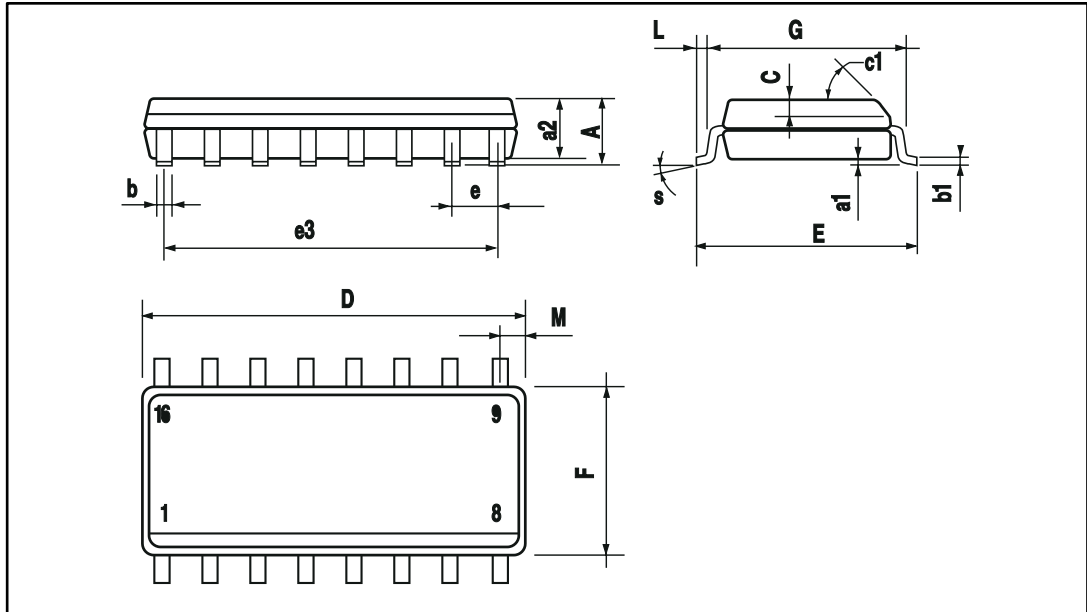


Table 10: SO16 mechanical data

| Ref | Dimensions  |      |      |        |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | Millimeters |      |      | Inches |       |       |
|     | 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 ° |      |        | 45 °  |       |
| 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 °  |        |       | 8 °   |

## 6.2 SO16L package information

Figure 11: SO16L package outline

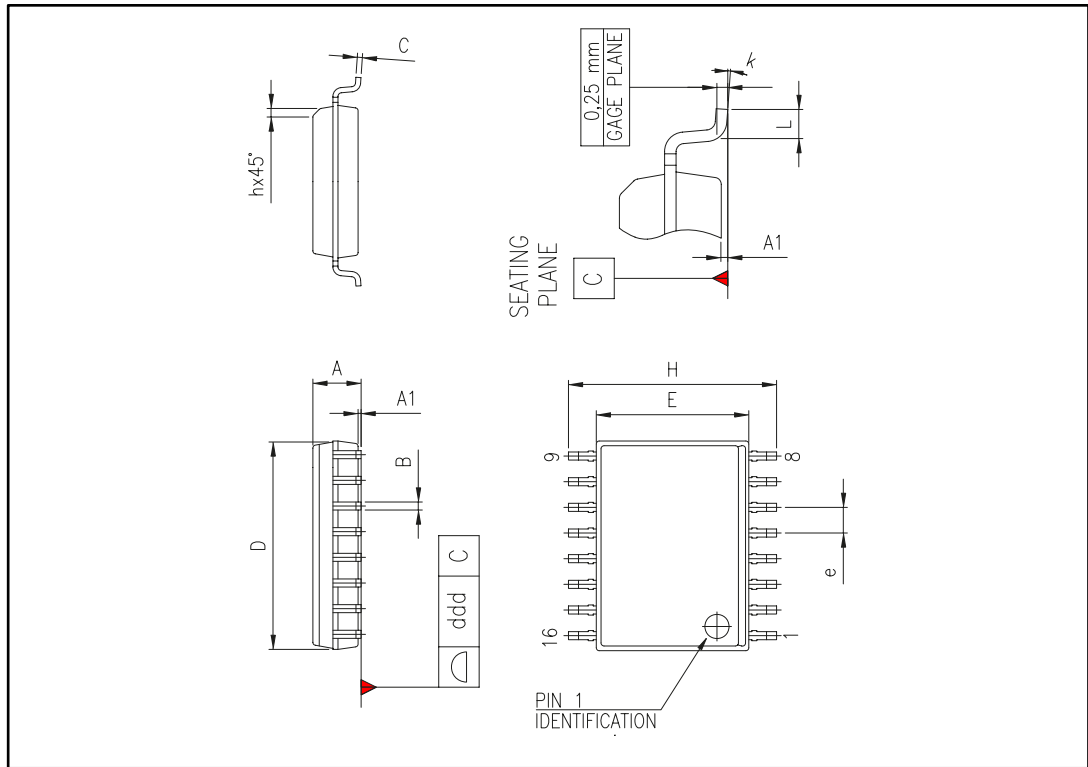


Table 11: SO16L mechanical data

| Ref | Dimensions  |      |       |        |      |       |
|-----|-------------|------|-------|--------|------|-------|
|     | Millimeters |      |       | Inches |      |       |
|     | Min.        | Typ. | Max   | Min.   | Typ. | Max.  |
| A   | 2.35        |      | 2.65  | 0.093  |      | 0.104 |
| A1  | 0.1         |      | 0.3   | 0.004  |      | 0.012 |
| B   | 0.33        |      | 0.51  | 0.013  |      | 0.02  |
| C   | 0.23        |      | 0.32  | 0.009  |      | 0.013 |
| D   | 10.1        |      | 10.5  | 0.398  |      | 0.413 |
| E   | 7.4         |      | 7.6   | 0.291  |      | 0.299 |
| e   |             | 1.27 |       |        | 0.05 |       |
| H   | 10          |      | 10.65 | 0.394  |      | 0.419 |
| h   | 0.25        |      | 0.75  | 0.01   |      | 0.03  |
| L   | 0.4         |      | 1.27  | 0.016  |      | 0.05  |
| k   | 0 °         |      | 8 °   | 0 °    |      | 8 °   |
| ddd |             |      | 0.1   |        |      | 0.004 |

### 6.3 TSSOP16 package information

Figure 12: TSSOP16 package outline

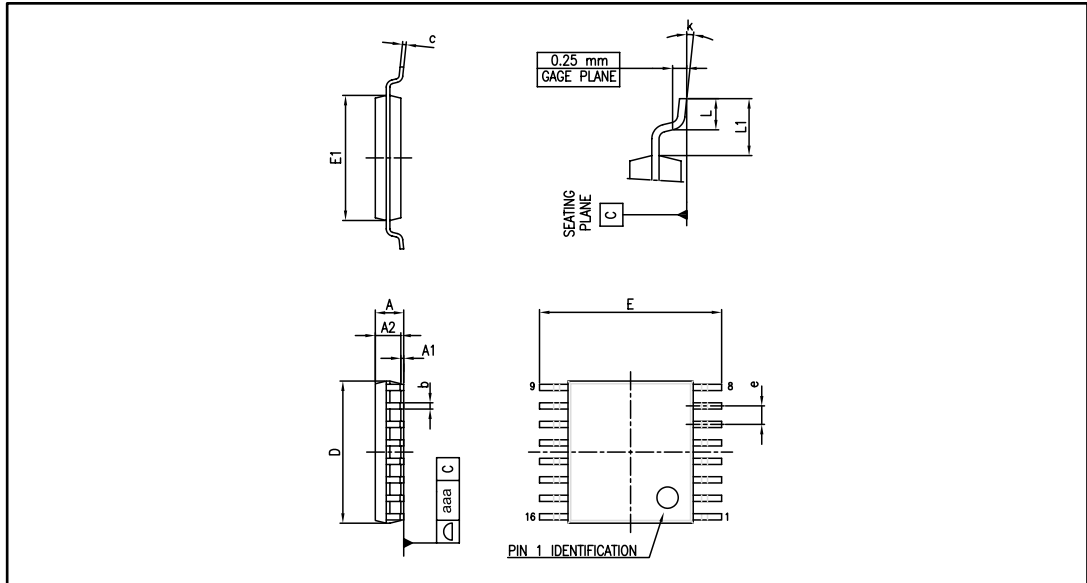
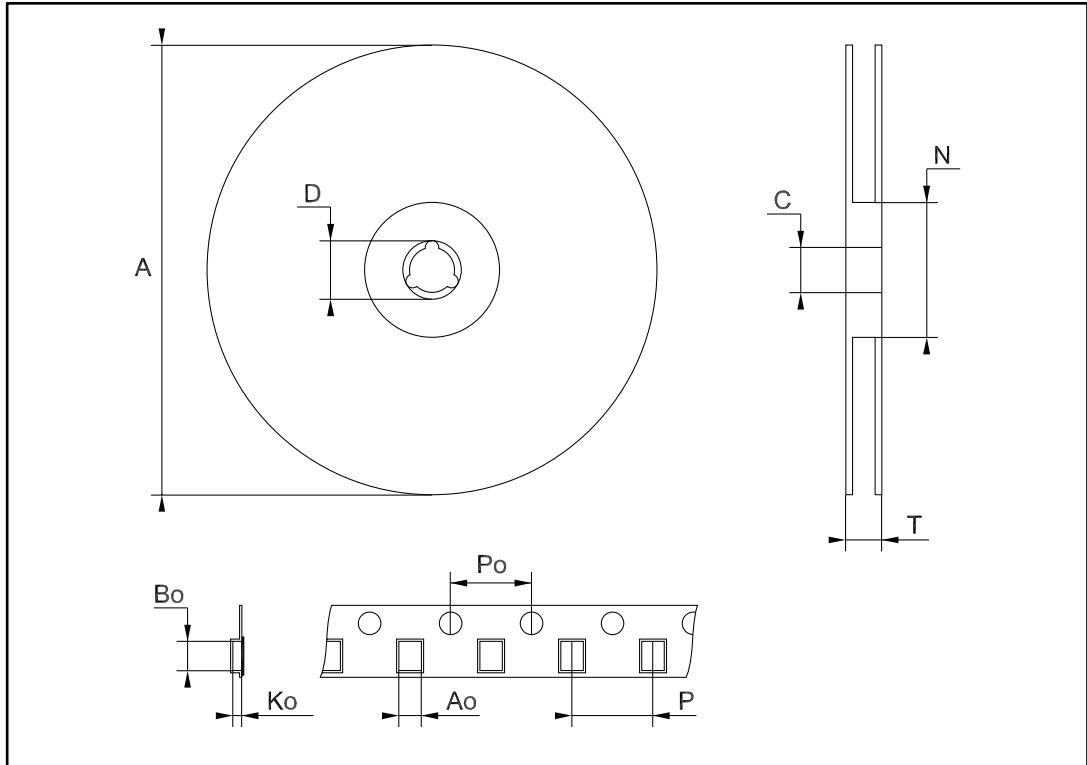


Table 12: TSSOP16 mechanical data

| Ref | Dimensions  |      |      |        |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | Millimeters |      |      | Inches |       |       |
|     | Min         | Typ  | Max  | Min    | Typ   | Max   |
| A   |             |      | 1.20 |        |       | 0.047 |
| A1  | 0.05        |      | 0.15 | 0.002  |       | 0.006 |
| A2  | 0.80        | 1.00 | 1.05 | 0.031  | 0.039 | 0.041 |
| b   | 0.19        |      | 0.30 | 0.007  |       | 0.012 |
| c   | 0.09        |      | 0.20 | 0.004  |       | 0.008 |
| D   | 4.90        | 5.00 | 5.10 | 0.193  | 0.197 | 0.201 |
| E   | 6.20        | 6.40 | 6.60 | 0.244  | 0.252 | 0.260 |
| E1  | 4.30        | 4.40 | 4.50 | 0.169  | 0.173 | 0.177 |
| e   |             | 0.65 |      |        | 0.026 |       |
| k   | 0°          |      | 8°   | 0°     |       | 8°    |
| L   | 0.45        | 0.60 | 0.75 | 0.018  | 0.024 | 0.030 |
| L1  |             | 1.00 |      |        | 0.039 |       |
| aaa |             |      | 0.10 |        |       | 0.004 |

### 6.4 SO16 tape and reel package information

Figure 13: SO16 tape and reel package outline



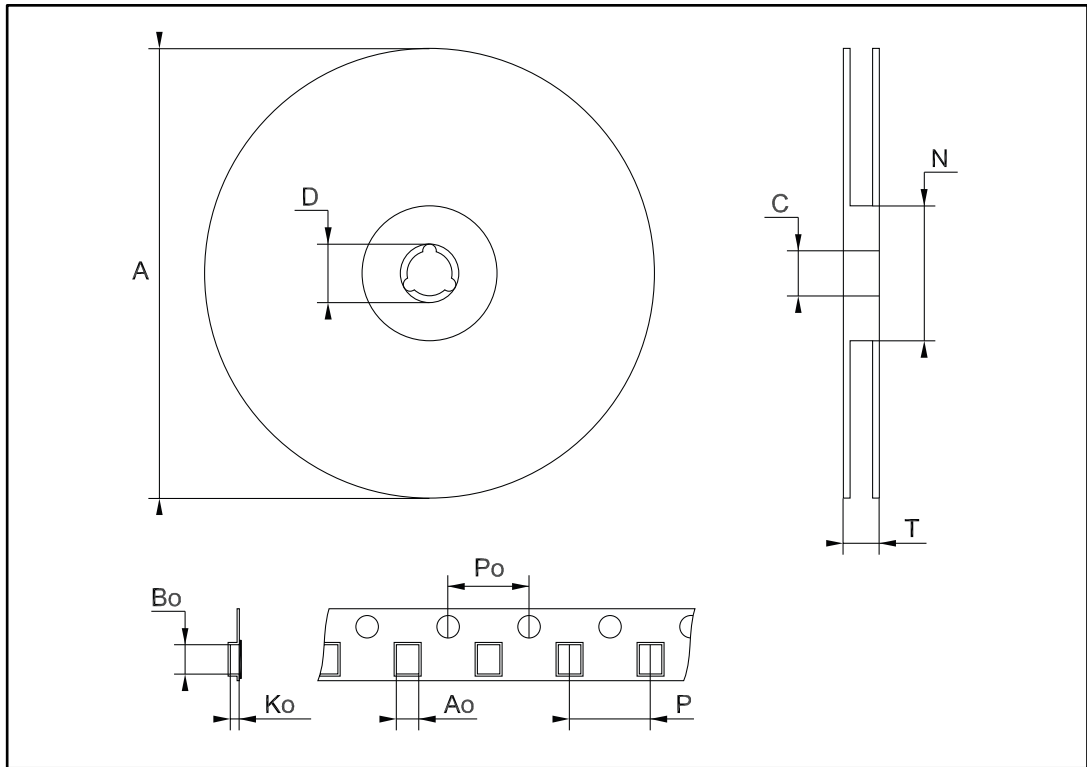
1. Drawing not to scale

Table 13: SO16 tape and reel mechanical data

| Ref | Dimensions  |      |      |        |      |        |
|-----|-------------|------|------|--------|------|--------|
|     | Millimeters |      |      | Inches |      |        |
|     | 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  |

### 6.5 SO16L tape and reel package information

Figure 14: SO16L tape and reel package outline



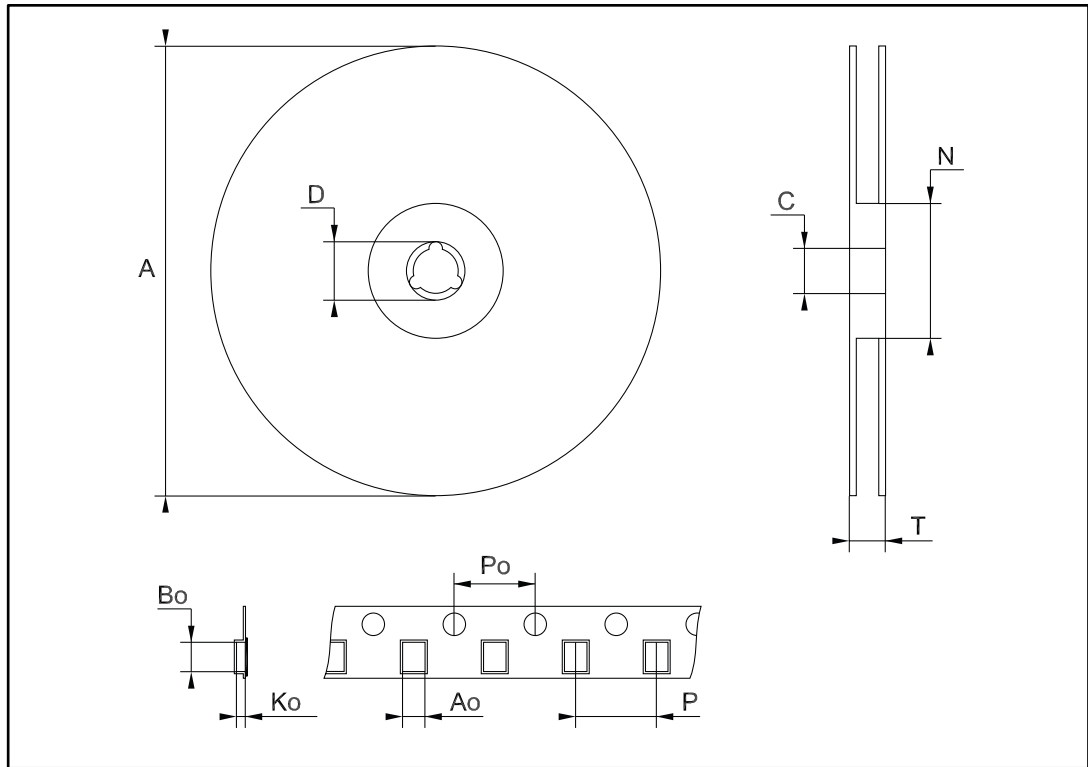
1. Drawing not to scale

Table 14: SO16L tape and reel mechanical data

| Ref | Dimensions  |      |      |        |      |        |
|-----|-------------|------|------|--------|------|--------|
|     | Millimeters |      |      | Inches |      |        |
|     | 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  |

## 6.6 TSSOP16 tape and reel package information

Figure 15: TSSOP16 tape and reel package outline



1. Drawing not to scale

Table 15: TSSOP16 tape and reel mechanical data

| Ref | Dimensions  |      |      |        |      |        |
|-----|-------------|------|------|--------|------|--------|
|     | Millimeters |      |      | Inches |      |        |
|     | 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 16: 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 Table 3.   |
| 08-Feb-2008 | 11       | Modified: Table 1 on page 1.   |
| 25-Jan-2016 | 12       | Updated document layout<br><i>Table 3: "Absolute maximum ratings"</i> : added $T_{stg}$<br>Updated titles of <i>Figure 5</i> , <i>Figure 6</i> , <i>Figure 7</i> , and <i>Figure 8</i><br><i>Section 6.2</i> : replaced SO16L package outline and mechanical data<br><i>Section 6.3</i> : removed A1 (typ: inches), updated E1 (max: mm and inches), added L1 and aaa. |

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