

## 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.

**Contents**

**1 Pin configuration ..... 3**

**2 Absolute maximum ratings..... 4**

**3 Electrical characteristics ..... 5**

**4 Application information ..... 7**

**5 Typical performance characteristics ..... 8**

**6 Package information ..... 10**

    6.1 SO16 package information..... 11

    6.2 SO16L package information..... 12

    6.3 TSSOP16 package information..... 13

    6.4 SO16 tape and reel package information ..... 14

    6.5 SO16L tape and reel package information ..... 15

    6.6 TSSOP16 tape and reel package information ..... 16

**7 Revision history ..... 17**



# 1 Pin configuration

Figure 1: Pin connections



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 <sub>+</sub>    | 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 <sub>-</sub>    | Inverted voltage terminal                              |
| 7      | T2 <sub>OUT</sub> | Second transmitter output voltage                      |
| 8      | R2 <sub>IN</sub>  | Second receiver input voltage                          |
| 9      | R2 <sub>OUT</sub> | Second receiver output voltage                         |
| 10     | T2 <sub>IN</sub>  | Second transmitter input voltage                       |
| 11     | T1 <sub>IN</sub>  | First transmitter input voltage                        |
| 12     | R1 <sub>OUT</sub> | First receiver output voltage                          |
| 13     | R1 <sub>IN</sub>  | First receiver input voltage                           |
| 14     | T1 <sub>OUT</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-          | 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

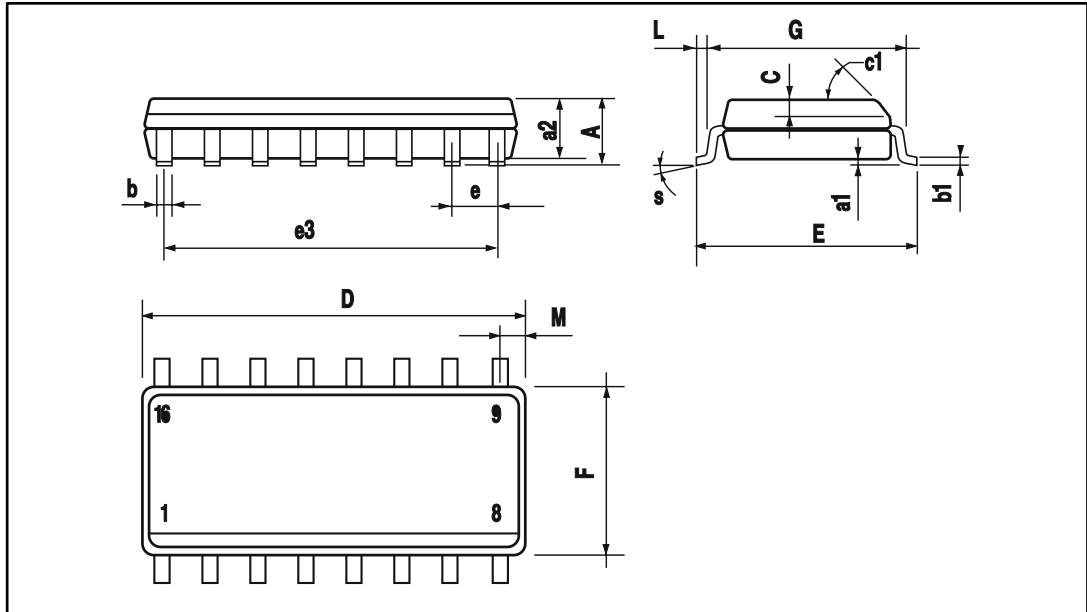


Table 10: SO16 mechanical data

| 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

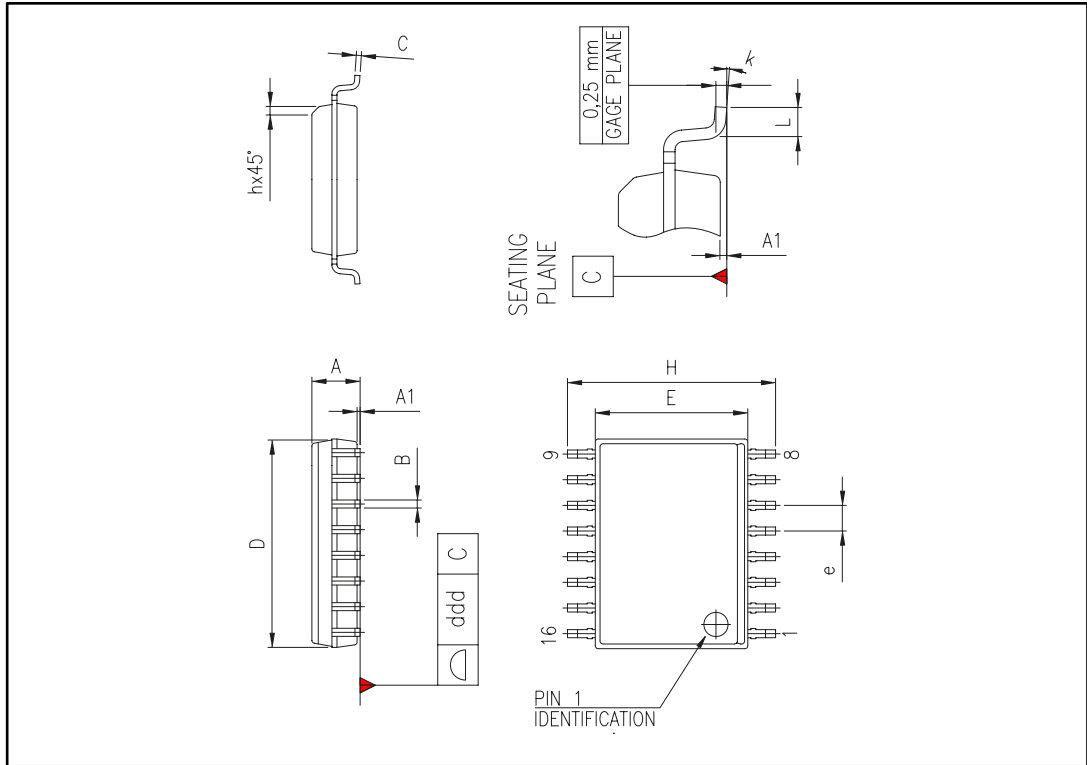


Table 11: SO16L mechanical data

| 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

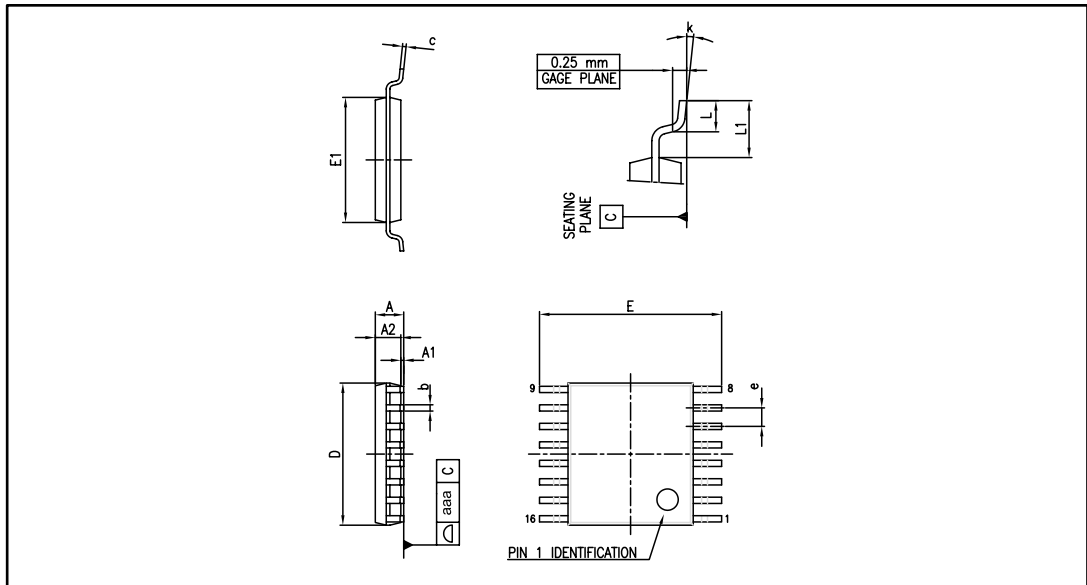


Table 12: TSSOP16 mechanical data

| 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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