



# ST3243EB ST3243EC

± 15 kV ESD protected 3 to 5.5 V, 400 kbps, RS-232 transceiver with auto power-down

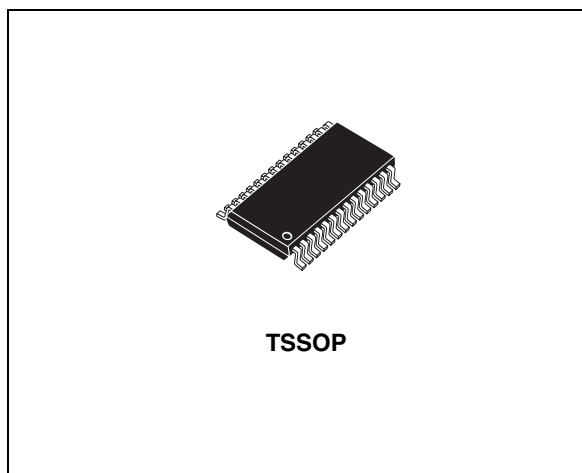
## Features

- ESD protection for RS-232 I/O pins:
  - ± 8 kV IEC 1000-4-2 contact discharge
  - ± 15 kV human body model
- 1 µA supply current achieved when in auto power-down
- 250 kbps minimum guaranteed data rate
- Guaranteed 6 V/ms slew rate range
- Guaranteed mouse drive ability
- 0.1 µF external capacitors
- Meet EIA/TIA-232 specifications down to 3 V
- Available in TSSOP28 package

## Description

The ST3243E device consists of 3 drivers, 5 receivers and a dual charge-pump circuit. The device meets the requirements of EIA/TIA and V.28/V.24 communication standards providing high data rate capability and enhanced electrostatic discharge (ESD) protection. All transmitter outputs and receiver input are protected to ± 8 kV USING IEC 1000-4-2 contact discharge and ± 15 kV using the human body model. The receiver R2 is always active to implement a wake-up feature for serial port.

The ST3243E has a proprietary low-dropout transmitter output stage enabling true RS-232 performance from a 3.0 V to 5.5 V supply with a dual charge pump. The device is guaranteed to run at data rates of 250 kbps while maintaining RS-232 output levels.



The auto power-down feature functions when FORCEON is low and FORCEOFF is high. During this mode of operation, if the device does not sense a valid RS-232 signal, the driver outputs are disabled. If FORCEOFF is set low, both drivers and receivers (except R2B) are shut off, and supply current is reduced to 1 µA. Disconnecting the serial port or turning off the peripheral drives causes the auto power-down condition to occur.

Auto power-down can be disabled when FORCEON and FORCEOFF are high, and should be done when driving a serial mouse. With auto power-down enabled, the device is activated automatically when a valid signal is applied to any receiver input.

Typical application are in notebook, subnotebook, palmtop computers, battery-powered equipment, handheld equipment, peripherals and printers.

Table 1. Device summary

| Order codes  | Temperature range | Package                 | Packaging           |
|--------------|-------------------|-------------------------|---------------------|
| ST3243ECTR-E | 0 to 70 °C        | TSSOP28 (tape and reel) | 2500 parts per reel |
| ST3243EBTR   | - 40 to 85 °C     | TSSOP28 (tape and reel) | 2500 parts per reel |

# Contents

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# 1 Pin configuration

Figure 1. Pin configuration

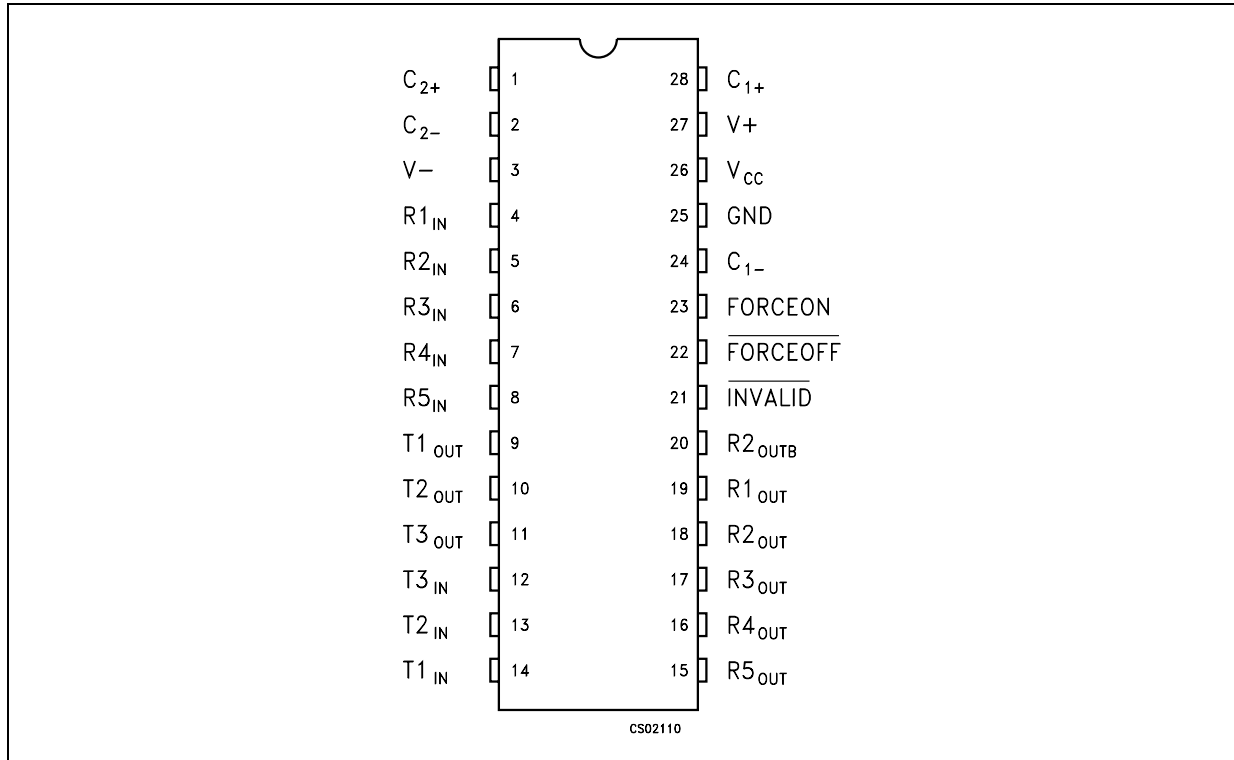


Table 2. Pin description

| Pin n° | Symbol            | Name and function                                    |
|--------|-------------------|--|
| 1      | C <sub>2+</sub>   | Positive terminal of inverting charge pump capacitor |
| 2      | C <sub>2-</sub>   | Negative terminal of inverting charge pump capacitor |
| 3      | V-                | -5.5 V Generated by the charge pump                  |
| 4      | R1 <sub>IN</sub>  | First receiver input voltage                         |
| 5      | R2 <sub>IN</sub>  | Second receiver input voltage                        |
| 6      | R3 <sub>IN</sub>  | Third receiver input voltage                         |
| 7      | R4 <sub>IN</sub>  | Fourth receiver input voltage                        |
| 8      | R5 <sub>IN</sub>  | Fifth receiver input voltage                         |
| 9      | T1 <sub>OUT</sub> | First transmitter output voltage                     |
| 10     | T2 <sub>OUT</sub> | Second transmitter output voltage                    |
| 11     | T3 <sub>OUT</sub> | Third transmitter output voltage                     |
| 12     | T3 <sub>IN</sub>  | Third transmitter input voltage                      |
| 13     | T2 <sub>IN</sub>  | Second transmitter input voltage                     |
| 14     | T1 <sub>IN</sub>  | First transmitter input voltage                      |

Table 2. Pin description (continued)

| Pin n° | Symbol             | Name and function  |
|--------|--------------------|--|
| 15     | R5 <sub>OUT</sub>  | Fifth receiver output voltage  |
| 16     | R4 <sub>OUT</sub>  | Fourth receiver output voltage   |
| 17     | R3 <sub>OUT</sub>  | Third receiver output voltage  |
| 18     | R2 <sub>OUT</sub>  | Second receiver output voltage   |
| 19     | R1 <sub>OUT</sub>  | First receiver output voltage  |
| 20     | R2 <sub>OUTB</sub> | Non-inverting complementary receiver output, always active for wake-up   |
| 21     | INVALID            | Output of the valid signal detector. Indicates if a valid RS-232 level is present on receiver inputs logic "1"     |
| 22     | FORCEOFF           | Drive low to shut down transmitters and on-board power supply. This over-rides all automatic circuitry and FORCEON |
| 23     | FORCEON            | Drive high to override automatic circuitry keeping transmitters on (FORCEOFF must be high)                         |
| 24     | C <sub>1-</sub>    | Negative terminal of voltage-charge pump capacitor   |
| 25     | GND                | Ground   |
| 26     | V <sub>CC</sub>    | Supply voltage   |
| 27     | V+                 | 5.5 V Generated by the charge pump   |
| 28     | C <sub>1+</sub>    | Positive terminal of voltage-charge pump capacitor   |

## 2 Truth tables

**Table 3. Invalid truth table**

| RS-232 Signal present at any receiver input | $\overline{\text{INVALID}}$ output |
|---|------------------------------------|
| YES   | H                                  |
| NO  | L                                  |

**Table 4. Output control truth table**

| Force ON | Force OFF | Valid receiver level | Operation status                   | T <sub>OUT</sub> | R <sub>OUT</sub> | R <sub>2OUTB</sub> |
|----------|-----------|----------------------|------------------------------------|------------------|------------------|--------------------|
| X        | 0         | X                    | Shutdown (Force OFF)               | HIGH Z           | HIGH Z           | ACTIVE             |
| 1        | 1         | X                    | Normal operating (Force ON)        | ACTIVE           | ACTIVE           | ACTIVE             |
| 0        | 1         | YES                  | Normal operating (Auto power-down) | ACTIVE           | ACTIVE           | ACTIVE             |
| 0        | 1         | NO                   | Shutdown (Auto power-down)         | HIGH Z           | ACTIVE           | ACTIVE             |

### 3 Maximum ratings

**Table 5. 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    |
| $\overline{FORCEON}$ ,<br>$\overline{FORCEOFF}$ ,<br>$T_{IN}$ | Input voltage                                       | -0.3 to 6                | V    |
| $R_{IN}$  | Receiver input voltage range                        | $\pm 25$                 | V    |
| $T_{OUT}$   | Transmitter output voltage range                    | $\pm 13.2$               | V    |
| $R_{OUT}$ $R_{OUTB}$<br>INVALID                               | Receiver output voltage range                       | -0.3 to $(V_{CC} + 0.3)$ | V    |
| $t_{SHORT}$   | Short circuit duration on $T_{OUT}$ (one at a time) | Continuous               |      |
| $T_{stg}$   | Storage temperature range                           | -65 to 150               | °C   |

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

**Table 6. ESD performance: transmitter outputs, receiver inputs**

| Symbol | Parameter              | Test conditions                  | Min.     | Typ. | Max. | Unit |
|--------|------------------------|----------------------------------|----------|------|------|------|
| ESD    | ESD protection voltage | Human body model                 | $\pm 15$ |      |      | kV   |
| ESD    | ESD protection voltage | IEC 1000-4-2 (contact discharge) | $\pm 8$  |      |      | kV   |

## 4 Electrical characteristics

C1 - C4 = 0.1  $\mu$ F,  $V_{CC}$  = 3 V to 5.5 V,  $T_A$  = -40 to 85  $^{\circ}$ C, unless otherwise specified.  
Typical values are referred to  $T_A$  = 25  $^{\circ}$ C.

**Table 7. Electrical characteristics**

| Symbol       | Parameter                      | Test conditions   | Min. | Typ. | Max. | Unit    |
|--------------|--------------------------------|---|------|------|------|---------|
| $I_{ASHDN}$  | Supply current auto power-down | $\overline{FORCEOFF} = GND, \overline{FORCEON} = V_{CC}$<br>All R_IN open or grounded |      | 1    | 10   | $\mu$ A |
| $I_{SUPPLY}$ | Supply current                 | $\overline{FORCEON} = \overline{FORCEOFF} = V_{CC}$                                   |      | 0.3  | 1    | mA      |
| $I_{SHDN}$   | Shutdown supply current        | $\overline{FORCEOFF} = GND$   |      | 1    | 10   | $\mu$ A |

C1 - C4 = 0.1  $\mu$ F,  $V_{CC}$  = 3 V to 5.5 V,  $T_A$  = -40 to 85  $^{\circ}$ C, unless otherwise specified.  
Typical values are referred to  $T_A$  = 25  $^{\circ}$ C.

**Table 8. Logic input electrical characteristics**

| Symbol     | Parameter                    | Test conditions  | Min.         | Typ.         | Max.      | Unit    |
|------------|------------------------------|--|--------------|--------------|-----------|---------|
| $V_{TIL}$  | Input logic threshold low    | T-IN, $\overline{FORCEON}$ , $\overline{FORCEOFF}$                                       |              |              | 0.8       | V       |
| $V_{TIH}$  | Input logic threshold high   | T-IN, $\overline{FORCEON}$ , $\overline{FORCEOFF}$<br>$V_{CC} = 3.3$ V<br>$V_{CC} = 5$ V | 2<br>2.4     |              |           | V<br>V  |
| $V_{THYS}$ | Transmitter input hysteresis |  |              | 0.5          |           | V       |
| $I_{IL}$   | Input leakage current        | T-IN, $\overline{FORCEON}$ , $\overline{FORCEOFF}$                                       |              | $\pm 0.01$   | $\pm 1.0$ | $\mu$ A |
| $I_{OL}$   | Output leakage current       | Receiver disabled  |              | $\pm 0.05$   | $\pm 10$  | $\mu$ A |
| $V_{OL}$   | Output voltage low           | $I_{OUT} = 1.6$ mA   |              |              | 0.4       | V       |
| $V_{OH}$   | Output voltage high          | $I_{OUT} = -1$ mA  | $V_{CC}-0.6$ | $V_{CC}-0.1$ |           | V       |

C1 - C4 = 0.1  $\mu$ F,  $V_{CC}$  = 3 V to 5.5 V,  $T_A$  = -40 to 85 °C, unless otherwise specified.  
 Typical values are referred to  $T_A$  = 25 °C, FORCEON = GND, FORCEOFF =  $V_{CC}$ .

**Table 9. Auto power-down electrical characteristics**

| Symbol     | Parameter  | Test conditions    | Min.         | Typ. | Max. | Unit    |
|------------|--|--------------------|--------------|------|------|---------|
| $V_{RITE}$ | Receiver input threshold to $\overline{INVALID}$ output voltage HIGH (see <a href="#">Figure 3</a> ) | Positive threshold |              |      | 2.7  | V       |
|            |  | Negative threshold | 2.7          |      |      | V       |
| $V_{RITD}$ | Receiver input threshold to $\overline{INVALID}$ output voltage LOW (see <a href="#">Figure 3</a> )  |                    | -0.3         |      | 0.3  | V       |
| $V_{IOL}$  | $\overline{INVALID}$ output voltage LOW  | $I_{OUT} = 1.6$ mA |              |      | 0.4  | V       |
| $V_{IOH}$  | $\overline{INVALID}$ output voltage HIGH   | $I_{OUT} = -1$ mA  | $V_{CC}-0.6$ |      |      | V       |
| $t_{WU}$   | Receiver or transmitter edge transmitter enabled (see <a href="#">Figure 3</a> )                     |                    |              | 100  |      | $\mu$ s |
| $t_{INVH}$ | Receiver positive or negative threshold to $\overline{INVALID}$ HIGH (see <a href="#">Figure 3</a> ) |                    |              | 0.2  |      | $\mu$ s |
| $t_{INVL}$ | Receiver positive or negative threshold to $\overline{INVALID}$ LOW (see <a href="#">Figure 3</a> )  |                    |              | 30   |      | $\mu$ s |

C1 - C4 = 0.1  $\mu$ F,  $V_{CC}$  = 3 V to 5.5 V,  $T_A$  = -40 to 85 °C, unless otherwise specified.  
 Typical values are referred to  $T_A$  = 25 °C.

**Table 10. Transmitter electrical characteristics**

| Symbol     | Parameter                    | Test conditions   | Min.    | Typ.      | Max.     | Unit     |
|------------|------------------------------|---|---------|-----------|----------|----------|
| $V_{TOUT}$ | Output voltage swing         | All Transmitter outputs are loaded with 3k $\Omega$ to GND  | $\pm 5$ | $\pm 5.4$ |          | V        |
| $R_{OUT}$  | Output resistance            | $V_{CC} = V+ = V- = 0$ V, $V_{OUT} = \pm 2$ V   | 300     | 10M       |          | $\Omega$ |
| $I_{SC}$   | Output short circuit current | $V_{CC} = 3.3$ V  |         | $\pm 40$  | $\pm 60$ | mA       |
| $I_L$      | Output leakage current       | $V_{CC} = 0$ to 5.5V, transmitter output = $\pm 12$ V, transmitter disabled   |         |           | $\pm 25$ | $\mu$ A  |
| $V_{OT}$   | Transmitter output voltage   | T1IN = T2IN = GND, T3IN = $V_{CC}$<br>T3OUT loaded with 3 k $\Omega$ to GND<br>T1OUT and T2OUT loaded with 2.5mA each | $\pm 5$ |           |          | V        |



C1 - C4 = 0.1  $\mu$ F,  $V_{CC}$  = 3 V to 5.5 V,  $T_A$  = -40 to 85 °C, unless otherwise specified.  
Typical values are referred to  $T_A$  = 25 °C.

**Table 11. Receiver electrical characteristics**

| Symbol      | Parameter                              | Test conditions  | Min.       | Typ.       | Max.       | Unit       |
|-------------|--|--|------------|------------|------------|------------|
| $V_{RIN}$   | Receiver input voltage operating range |  | -25        |            | 25         | V          |
| $V_{RIL}$   | RS-232 Input threshold low             | $T_A = 25^\circ\text{C}$ , $V_{CC} = 3.3\text{ V}$<br>$T_A = 25^\circ\text{C}$ , $V_{CC} = 5.0\text{ V}$ | 0.6<br>0.8 | 1.1<br>1.4 |            | V          |
| $V_{RIH}$   | RS-232 Input threshold high            | $T_A = 25^\circ\text{C}$ , $V_{CC} = 3.3\text{ V}$<br>$T_A = 25^\circ\text{C}$ , $V_{CC} = 5.0\text{ V}$ |            | 1.6<br>1.9 | 2.4<br>2.4 | V          |
| $V_{RIHYS}$ | Input hysteresis                       |  |            | 0.5        |            | V          |
| $R_{RIN}$   | Input resistance                       | $T_A = 25^\circ\text{C}$   | 3          | 5          | 7          | k $\Omega$ |

C1 - C4 = 0.1  $\mu$ F,  $V_{CC}$  = 3 V to 5.5 V,  $T_A$  = -40 to 85 °C, unless otherwise specified.  
Typical values are referred to  $T_A$  = 25 °C.

**Table 12. Timing characteristics**

| Symbol                 | Parameter                  | Test conditions   | Min.   | Typ. | Max.     | Unit                     |
|------------------------|----------------------------|---|--------|------|----------|--------------------------|
| $D_R$                  | Maximum data rate          | $R_L = 3\text{k}\Omega$ , $C_L = 1000\text{ pF}$ one transmitter switching  | 250    | 400  |          | kbps                     |
| $t_{PHL}$<br>$t_{PLH}$ | Receiver propagation delay | $R_{IN}$ to $R_{OUT}$ , $C_L = 150\text{ pF}$   |        | 0.15 |          | $\mu$ s                  |
| $t_{T\_SKEW}$          | Transmitter skew           |   |        | 150  |          | ns                       |
| $t_{R\_SKEW}$          | Receiver skew              |   |        | 70   |          | ns                       |
| $S_{RT}$               | Transition slew rate       | $T_A = 25^\circ\text{C}$ $R_L = 3\text{k}$ to $7\text{k}\Omega$ , $V_{CC} = 3.3\text{ V}$<br>measured from +3 V to -3 V or -3 V to +3 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 | V/ $\mu$ s<br>V/ $\mu$ s |

# 5 Application circuits

Figure 2. Application circuits

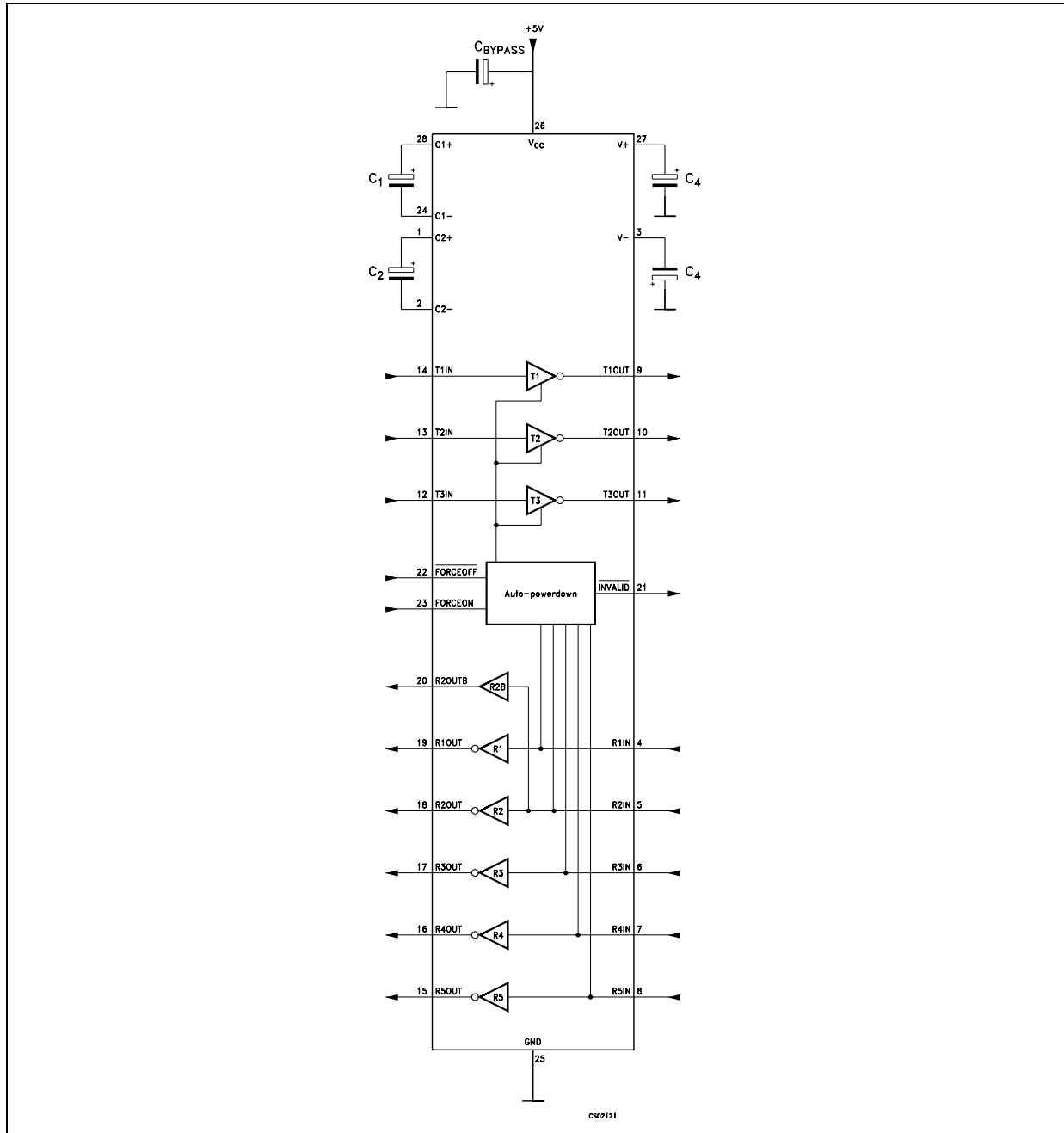


Table 13. Required minimum capacitance value (µF)

| V <sub>CC</sub> (V) | C <sub>1</sub> | C <sub>2</sub> , C <sub>3</sub> , C <sub>4</sub> , C <sub>BYPASS</sub> |
|---------------------|----------------|--|
| 3 to 3.6            | 0.1            | 0.1  |
| 4.5 to 5.5          | 0.047          | 0.33   |

## 6 Timing diagrams

Figure 3. Auto power-down input levels

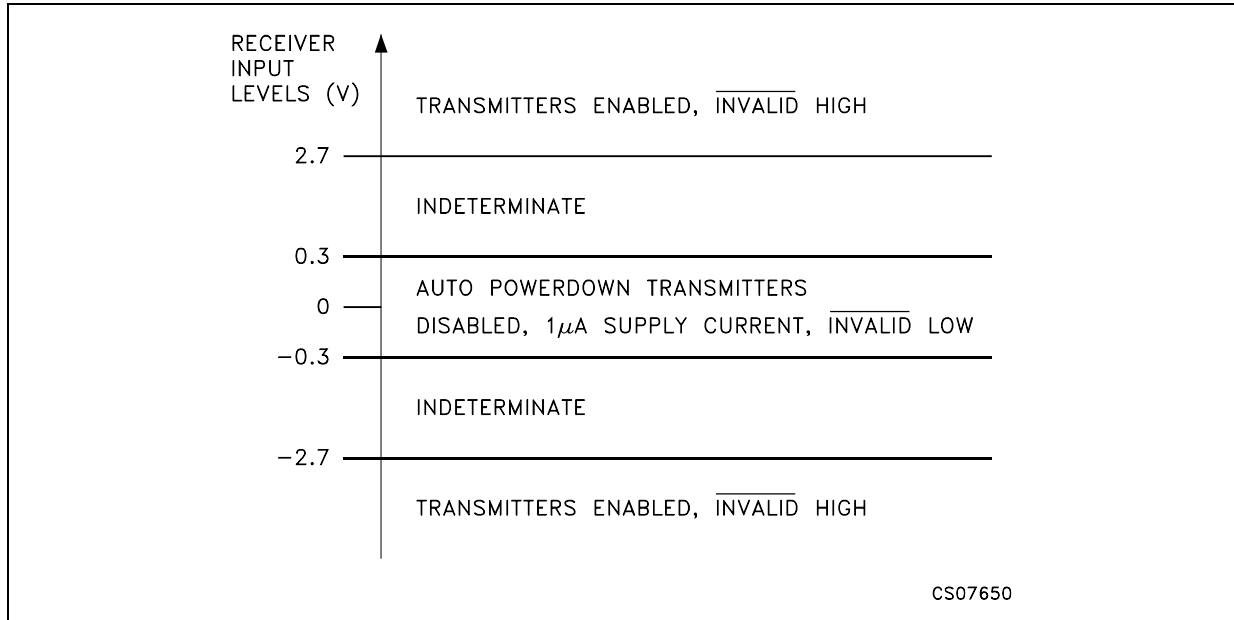
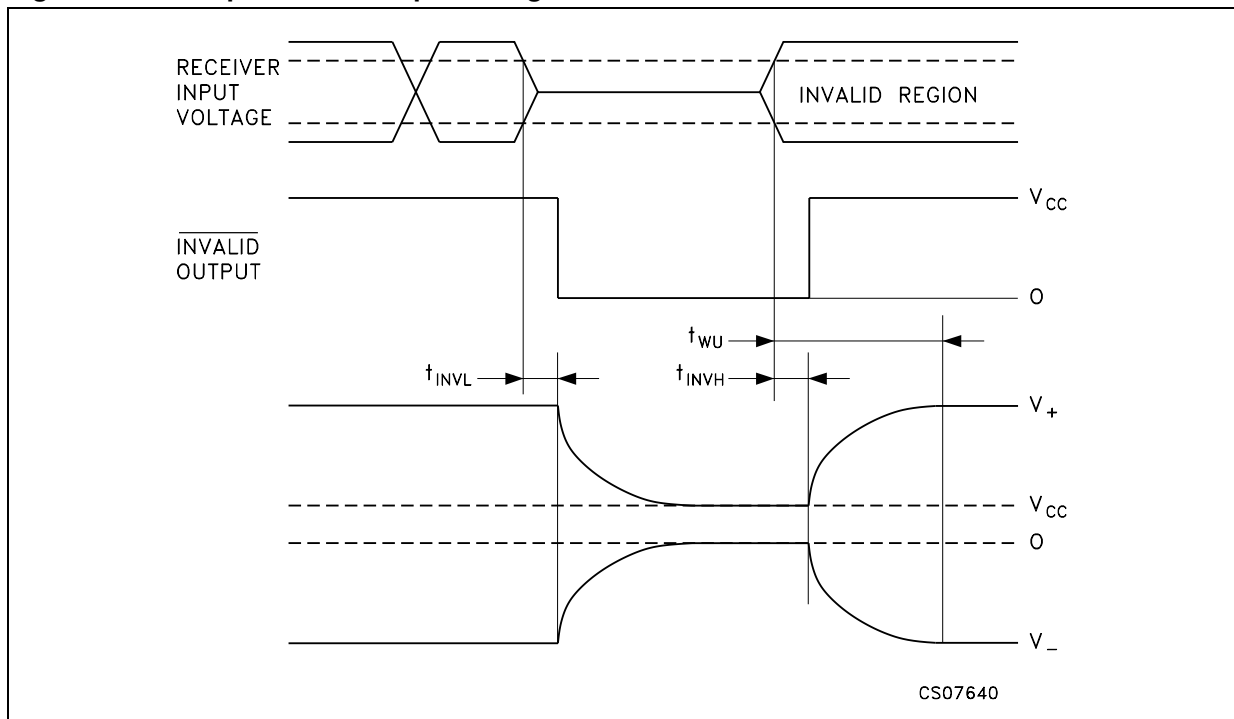


Figure 4. Auto power-down input timing

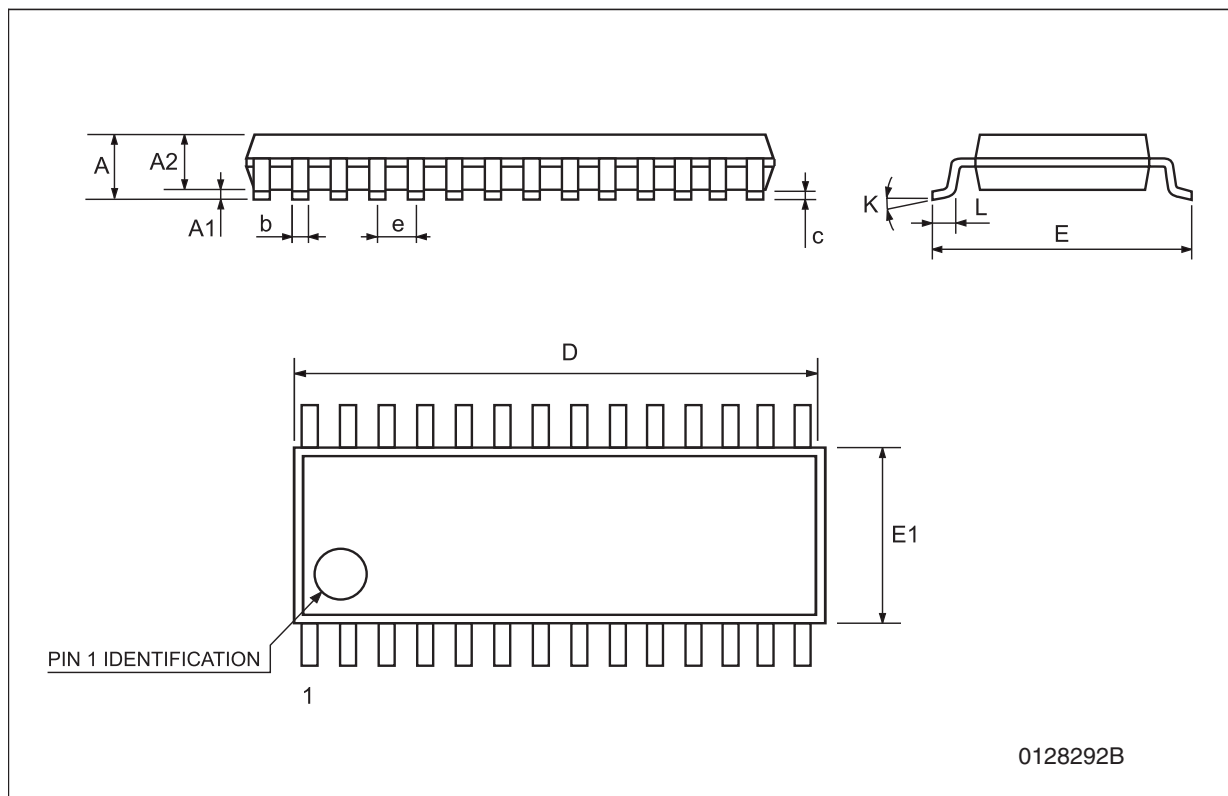


## 7 Package mechanical data

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.

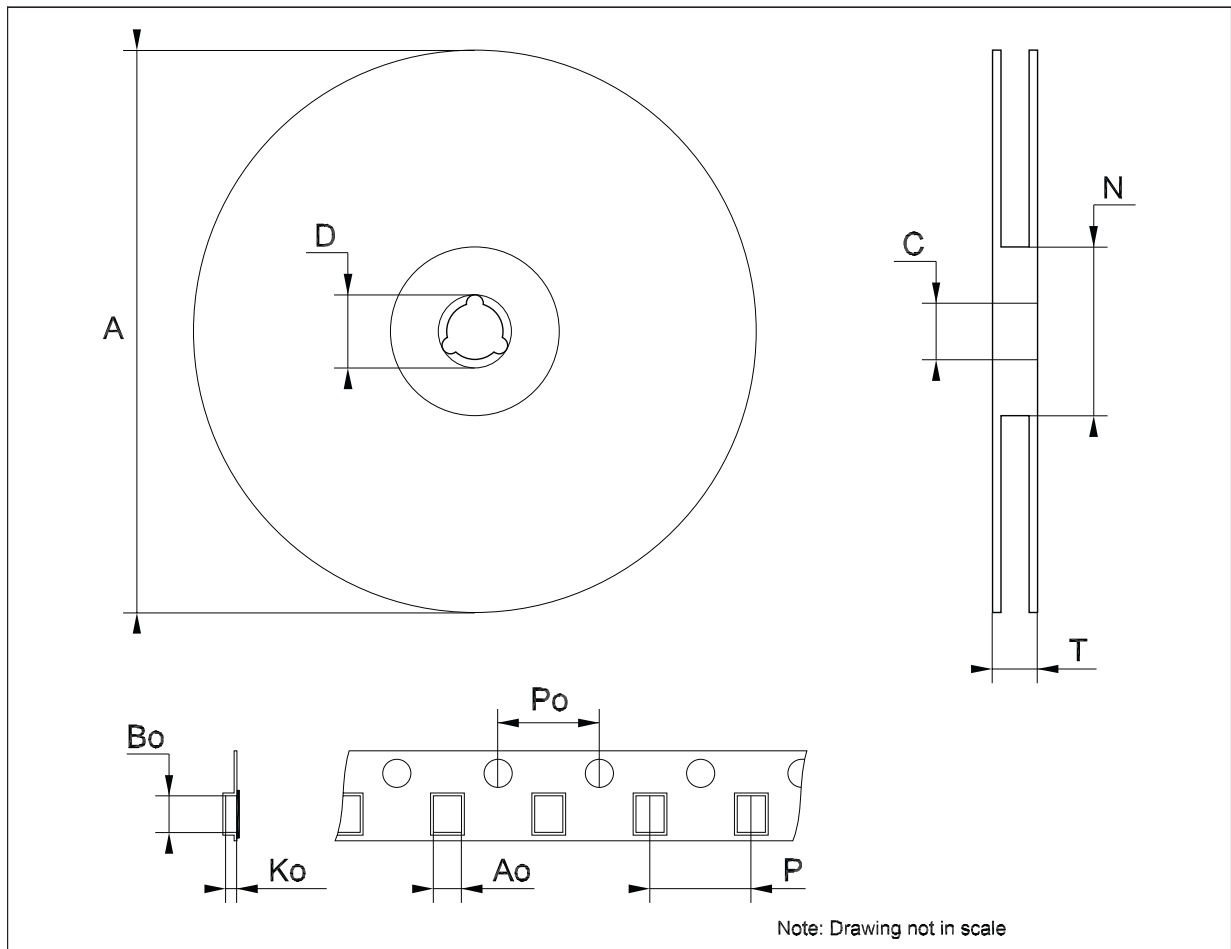
## TSSOP28 mechanical data

| 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    | 9.6  | 9.7      | 9.8  | 0.378 | 0.382      | 0.386  |
| 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 TSSOP28 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   | 6.8  |      | 7    | 0.268 |      | 0.276  |
| Bo   | 10.1 |      | 10.3 | 0.398 |      | 0.406  |
| Ko   | 1.7  |      | 1.9  | 0.067 |      | 0.075  |
| Po   | 3.9  |      | 4.1  | 0.153 |      | 0.161  |
| P    | 11.9 |      | 12.1 | 0.468 |      | 0.476  |



## 8 Revision history

**Table 14. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 21-Jun-2004 | 6        | Page 6 - $I_L$ (output leakage current) mA ==> $\mu A$                     |
| 31-Mar-2006 | 7        | Order codes updated and new template.                                      |
| 25-Oct-2006 | 8        | Order codes updated.   |
| 24-Aug-2007 | 9        | Order codes updated.   |
| 09-Jul-2008 | 10       | Removed: SO-28 and SSOP28 packages.  |
| 28-Jul-2009 | 11       | Removed: Flip-chip28 package, modified <a href="#">Table 1 on page 1</a> . |
| 16-Oct-2009 | 12       | Modified <a href="#">Table 9 on page 8</a> .                               |

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