



ST3243EB ST3243EC

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

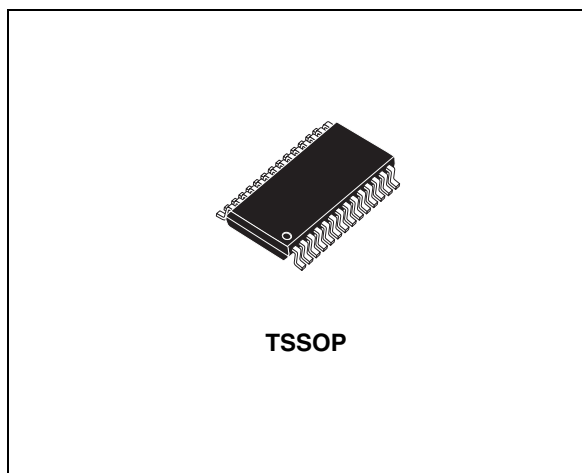
Features

- 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 |

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1 Pin configuration

Figure 1. Pin configuration

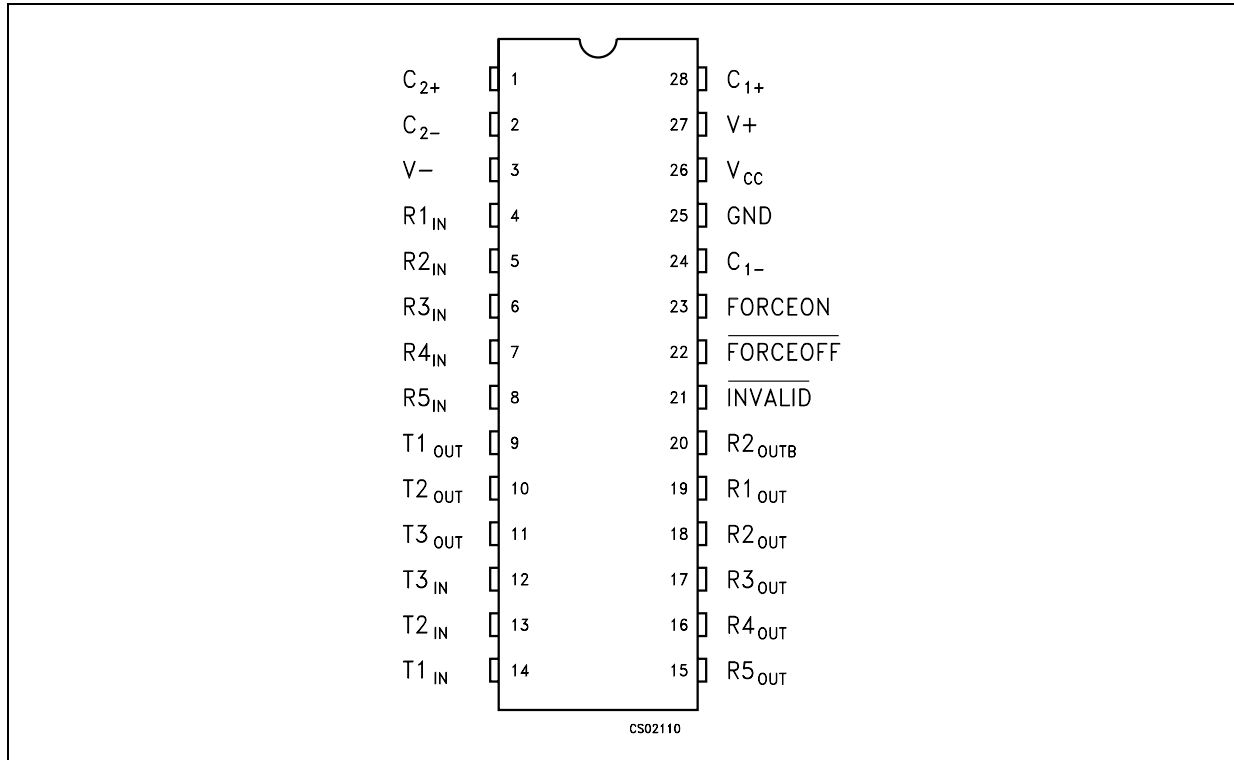


Table 2. Pin description

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

Table 2. Pin description (continued)

| Pin n° | Symbol | Name and function |
|--------|--------------------|--|
| 15 | R5 _{OUT} | Fifth receiver output voltage |
| 16 | R4 _{OUT} | Fourth receiver output voltage |
| 17 | R3 _{OUT} | Third receiver output voltage |
| 18 | R2 _{OUT} | Second receiver output voltage |
| 19 | R1 _{OUT} | First receiver output voltage |
| 20 | R2 _{OUTB} | 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 ₁₋ | Negative terminal of voltage-charge pump capacitor |
| 25 | GND | Ground |
| 26 | V _{CC} | Supply voltage |
| 27 | V+ | 5.5 V Generated by the charge pump |
| 28 | C ₁₊ | 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 _{OUT} | R _{OUT} | R _{2OUTB} |
|----------|-----------|----------------------|------------------------------------|------------------|------------------|--------------------|
| 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 |
| $\overline{FORCEON}$, $\overline{FORCEOFF}$, T_{IN} | Input voltage | -0.3 to 6 | V |
| R_{IN} | Receiver input voltage range | ± 25 | V |
| T_{OUT} | Transmitter output voltage range | ± 13.2 | V |
| R_{OUT} R_{OUTB} 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 | ± 15 | | | kV |
| ESD | ESD protection voltage | IEC 1000-4-2 (contact discharge) | ± 8 | | | kV |

4 Electrical characteristics

C1 - C4 = 0.1 μ 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 | $\overline{FORCEOFF} = GND, \overline{FORCEON} = V_{CC}$ All R_IN open or grounded | | 1 | 10 | μ 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 | μ A |

C1 - C4 = 0.1 μ 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, $\overline{FORCEON}$, $\overline{FORCEOFF}$ $V_{CC} = 3.3$ V $V_{CC} = 5$ V | 2 2.4 | | | V V |
| V_{THYS} | Transmitter input hysteresis | | | 0.5 | | V |
| I_{IL} | Input leakage current | T-IN, $\overline{FORCEON}$, $\overline{FORCEOFF}$ | | ± 0.01 | ± 1.0 | μ A |
| I_{OL} | Output leakage current | Receiver disabled | | ± 0.05 | ± 10 | μ 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 μF, 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 INVALID output voltage HIGH (see Figure 3) | Positive threshold | | | 2.7 | V |
| | | Negative threshold | 2.7 | | | V |
| V _{RITD} | Receiver input threshold to INVALID output voltage LOW (see Figure 3) | | -0.3 | | 0.3 | V |
| V _{IO_L} | INVALID output voltage LOW | I _{OUT} = 1.6 mA | | | 0.4 | V |
| V _{IO_H} | INVALID output voltage HIGH | I _{OUT} = -1 mA | V _{CC} -0.6 | | | V |
| t _{WU} | Receiver or transmitter edge transmitter enabled (see Figure 3) | | | 100 | | μs |
| t _{INVH} | Receiver positive or negative threshold to INVALID HIGH (see Figure 3) | | | 0.2 | | μs |
| t _{INVL} | Receiver positive or negative threshold to INVALID LOW (see Figure 3) | | | 30 | | μs |

C1 - C4 = 0.1 μF, 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 3kΩ to GND | ± 5 | ± 5.4 | | V |
| R _{OUT} | Output resistance | V _{CC} = V+ = V- = 0 V, V _{OUT} = ± 2 V | 300 | 10M | | Ω |
| I _{SC} | Output short circuit current | V _{CC} = 3.3 V | | ± 40 | ± 60 | mA |
| I _L | Output leakage current | V _{CC} = 0 to 5.5V, transmitter output = ±12 V, transmitter disabled | | | ± 25 | μA |
| V _{OT} | Transmitter output voltage | T1IN = T2IN = GND, T3IN = V _{CC} T3OUT loaded with 3 kΩ to GND T1OUT and T2OUT loaded with 2.5mA each | ± 5 | | | V |

C1 - C4 = 0.1 μ 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 | $T_A = 25^\circ\text{C}$, $V_{CC} = 3.3\text{ V}$ $T_A = 25^\circ\text{C}$, $V_{CC} = 5.0\text{ V}$ | 0.6 0.8 | 1.1 1.4 | | V |
| V_{RIH} | RS-232 Input threshold high | $T_A = 25^\circ\text{C}$, $V_{CC} = 3.3\text{ V}$ $T_A = 25^\circ\text{C}$, $V_{CC} = 5.0\text{ V}$ | | 1.6 1.9 | 2.4 2.4 | V |
| V_{RIHYS} | Input hysteresis | | | 0.5 | | V |
| R_{RIN} | Input resistance | $T_A = 25^\circ\text{C}$ | 3 | 5 | 7 | k Ω |

C1 - C4 = 0.1 μ 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} t_{PLH} | Receiver propagation delay | R_{IN} to R_{OUT} , $C_L = 150\text{ pF}$ | | 0.15 | | μ 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 $7\text{k}\Omega$, $V_{CC} = 3.3\text{ V}$ measured from +3 V to -3 V or -3 V to +3 V $C_L = 150\text{ pF}$ to 1000 pF $C_L = 150\text{ pF}$ to 2500 pF | 6 4 | | 30 30 | V/ μ s V/ μ s |

5 Application circuits

Figure 2. Application circuits

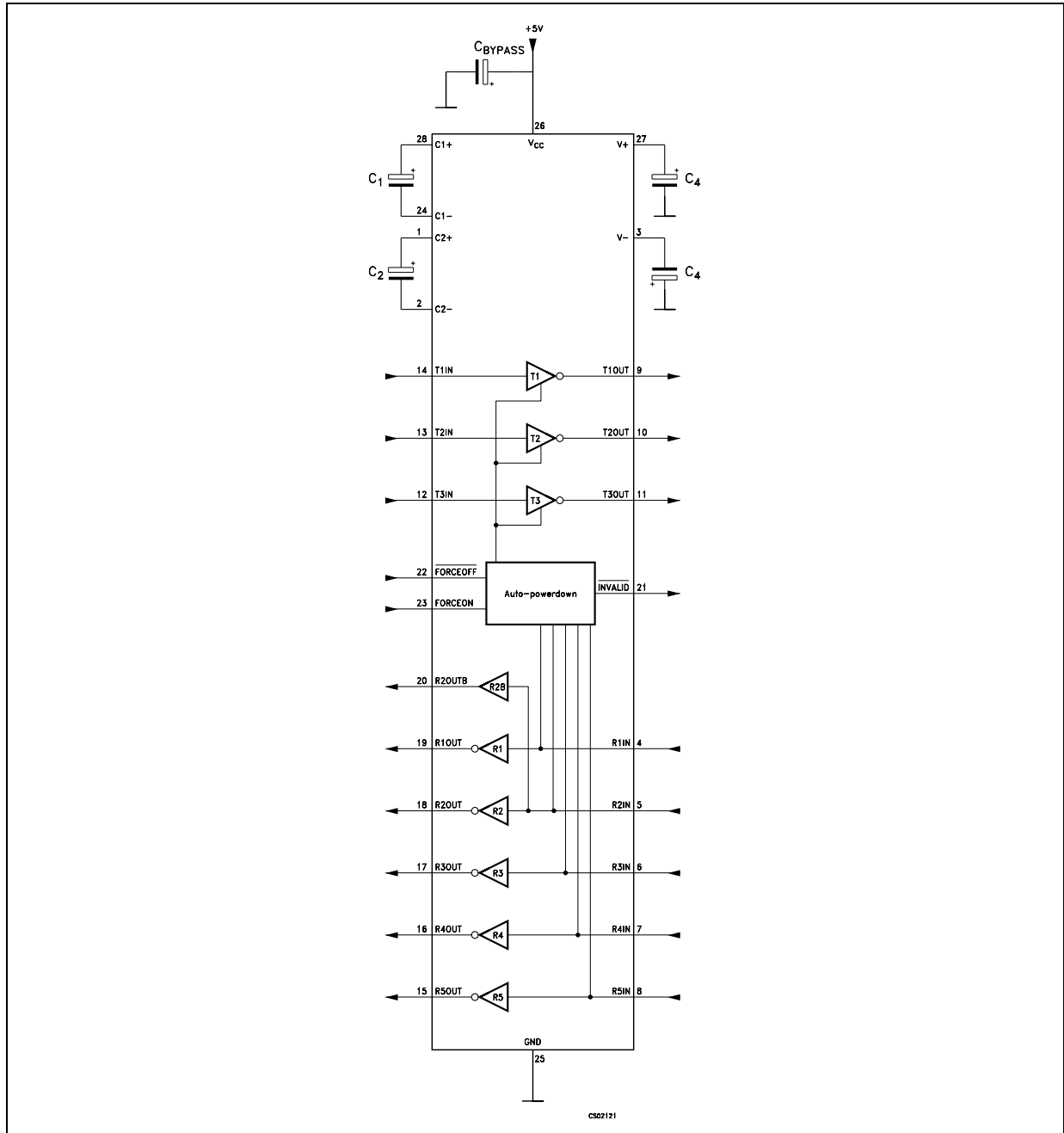


Table 13. Required minimum capacitance value (μF)

| V_{CC} (V) | C_1 | $C_2, C_3, C_4, C_{BYPASS}$ |
|--------------|-------|-----------------------------|
| 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

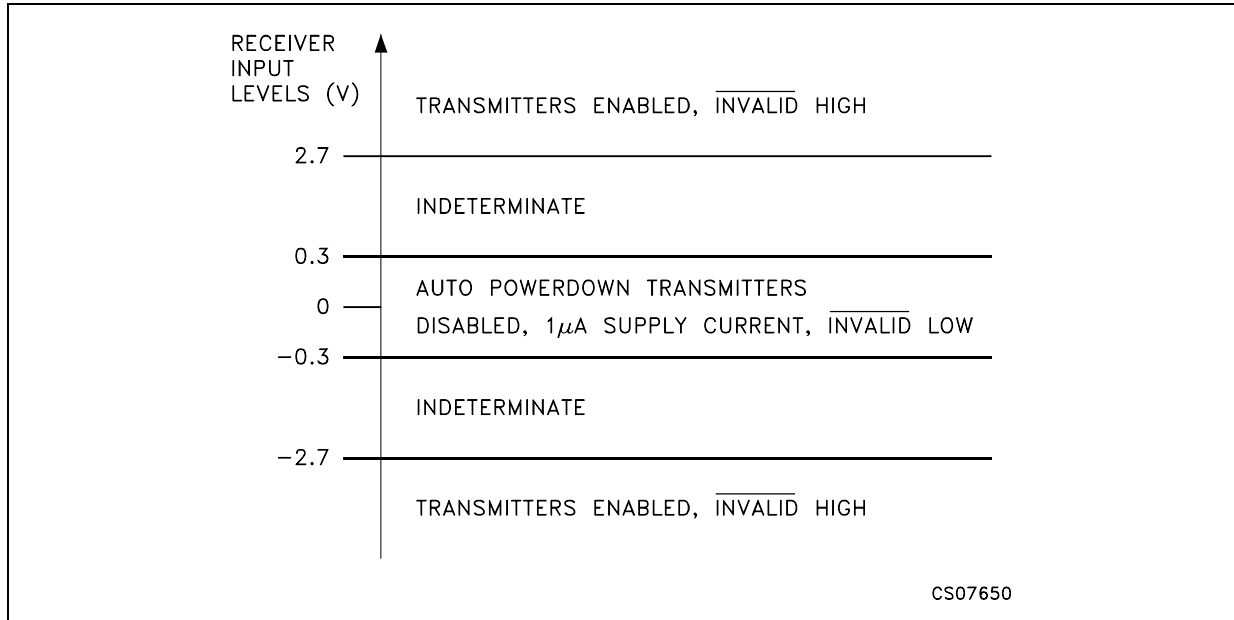
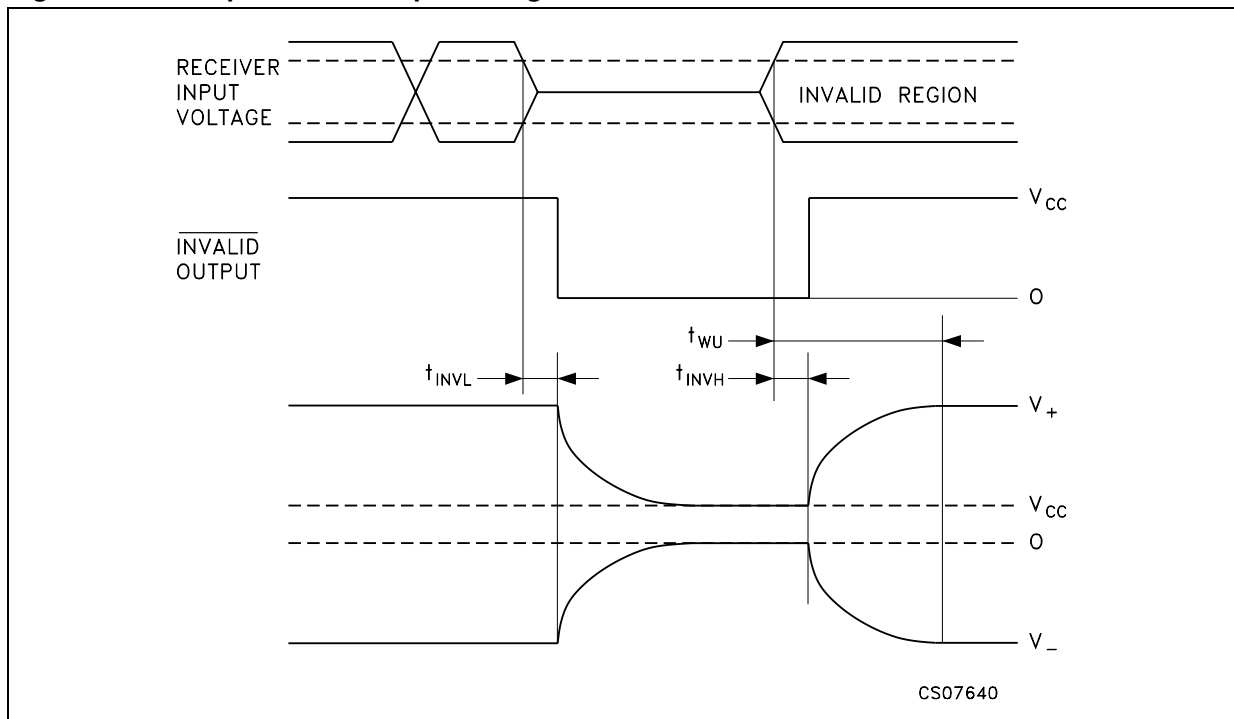


Figure 4. Auto power-down input timing

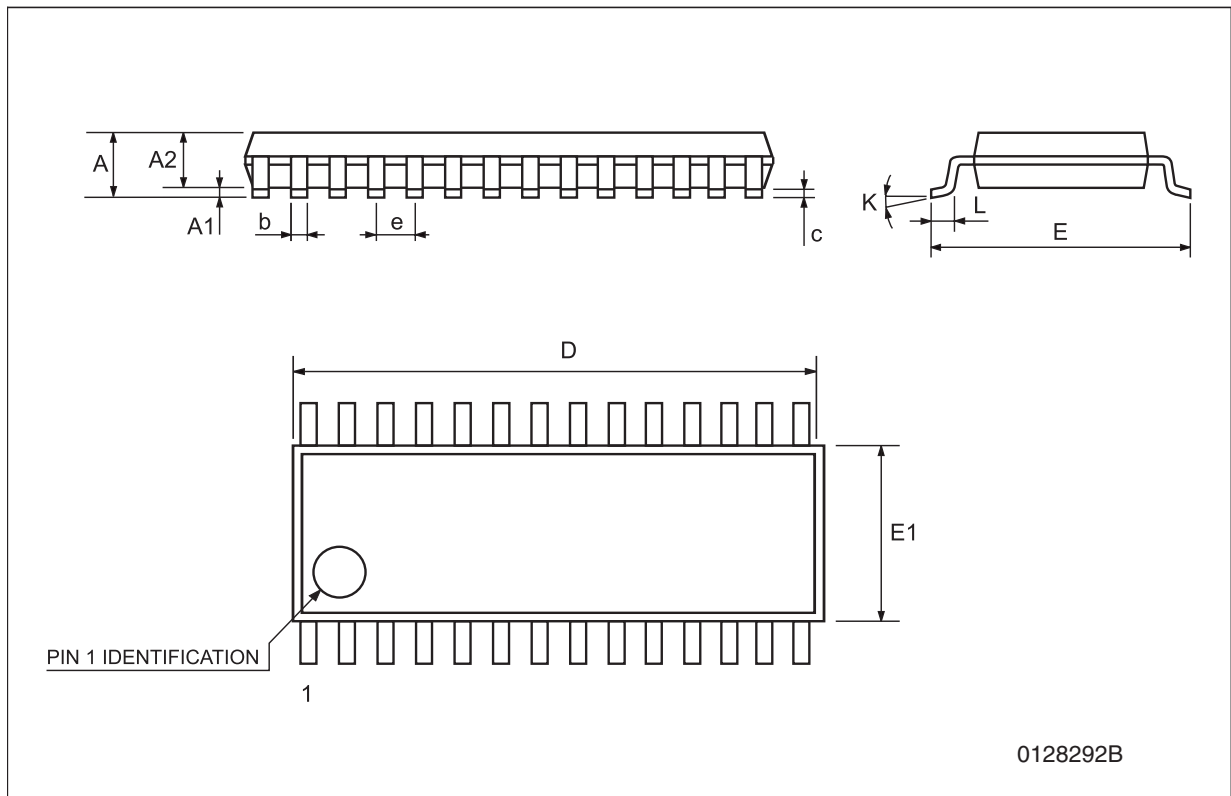


7 Package mechanical data

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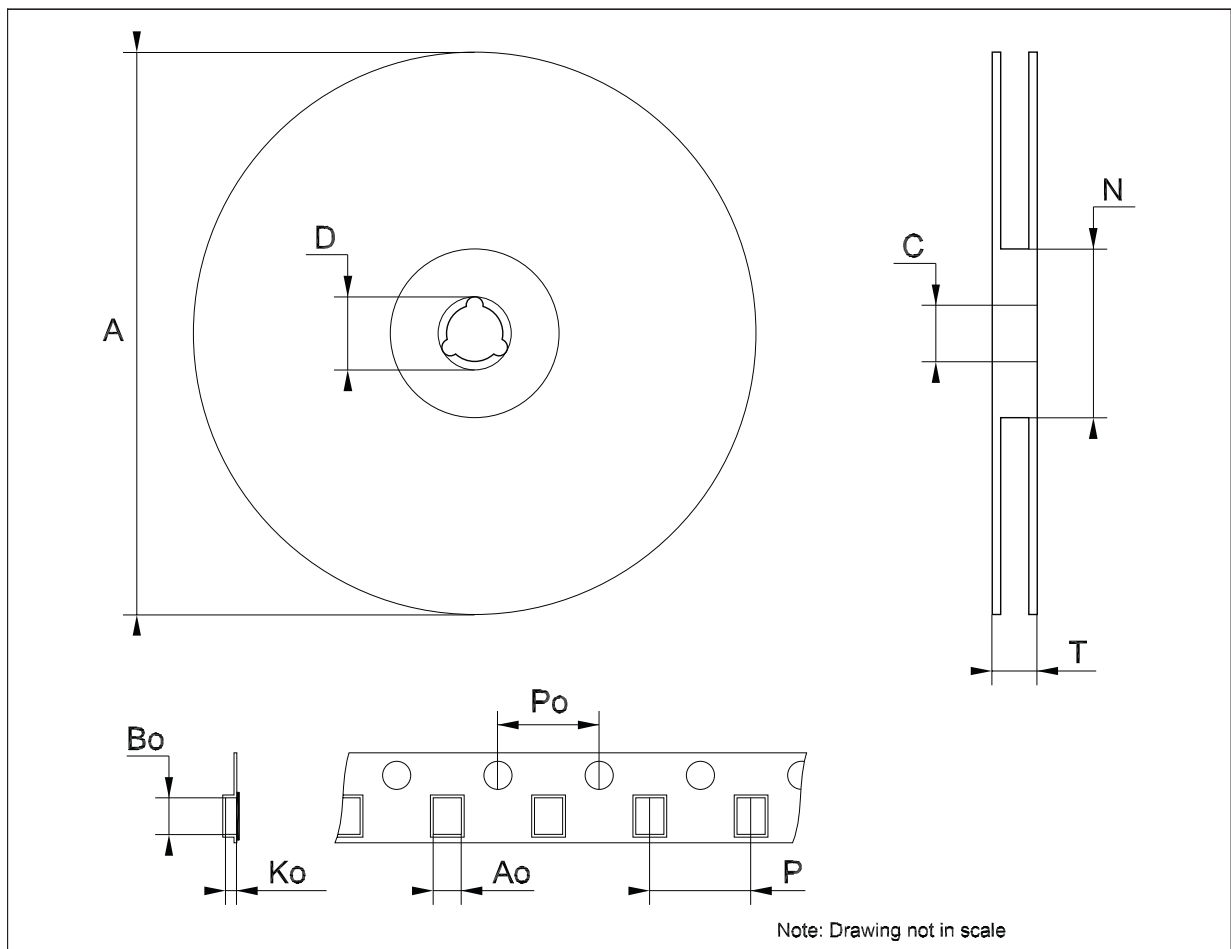
TSSOP28 mechanical data

| 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 ==> μA |
| 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 Table 1 on page 1 . |
| 16-Oct-2009 | 12 | Modified Table 9 on page 8 . |

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