



## ST3243E

### ±15KV ESD PROTECTED 3 TO 5.5V, 400KBPS, RS-232 TRANSCEIVER WITH AUTO-POWERDOWN

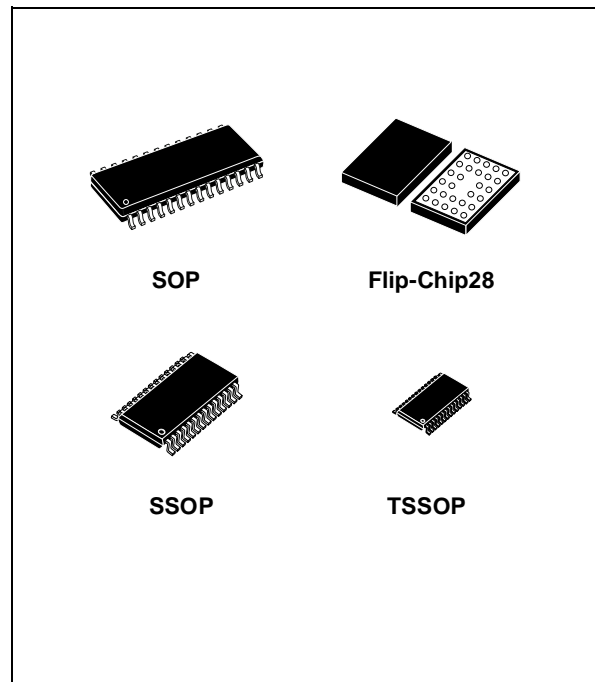
- ESD PROTECTION FOR RS-232 I/O PINS:  
±8KV IEC 1000-4-2 CONTACT DISCHARGE  
±15KV HUMAN BODY MODEL
- 1µA SUPPLY CURRENT ACHIEVED WHEN  
IN AUTO-POWERDOWN
- 250Kbps MINIMUM GUARANTEED DATA  
RATE
- GUARANTEED 6V/µs SLEW RATE RANGE
- GUARANTEED MOUSE DRIVEABILITY
- 0.1µF EXTERNAL CAPACITORS
- MEET EIA/TIA-232 SPECIFICATIONS DOWN  
TO 3V
- AVAILABLE IN SO-28, SSOP-28, TSSOP28  
AND FLIP-CHIP28 PACKAGES

#### 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 ±8KV USING IEC 1000-4-2 contact discharge and ±15KV 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 3.0V to 5.5V supply with a dual charge pump. The device is guaranteed to run at data rates of 250kbps while maintaining RS-232 output levels.

The Auto-powerdown 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  $\overline{\text{FORCEOFF}}$  is set low, both drivers and receivers (except R2B) are shut off, and supply current is reduced to 1µA. Disconnecting the serial port or turning off the peripheral drives causes the auto-powerdown condition to occur.

Auto-powerdown can be disabled when FORCEON and  $\overline{\text{FORCEOFF}}$  are high, and should be done when driving a serial mouse. With Auto-powerdown 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, hand-held equipment, peripherals and printers.

## ST3243E

### ORDERING CODES

| Type       | Temperature Range | Package               | Comments                          |
|------------|-------------------|-----------------------|-----------------------------------|
| ST3243ECD  | 0 to 70°C         | SO-28 (Tube)          | 27parts per tube / 12tube per box |
| ST3243EBD  | -40 to 85°C       | SO-28 (Tube)          | 27parts per tube / 12tube per box |
| ST3243ECDR | 0 to 70°C         | SO-28 (Tape & Reel)   | 1000 parts per reel               |
| ST3243EBDR | -40 to 85°C       | SO-28 (Tape & Reel)   | 1000 parts per reel               |
| ST3243ECPR | 0 to 70°C         | SSOP-28 (Tape & Reel) | 1350 parts per reel               |
| ST3243EBPR | -40 to 85°C       | SSOP-28 (Tape & Reel) | 1350 parts per reel               |
| ST3243ECTR | 0 to 70°C         | TSSOP28 (Tape & Reel) | 2500 parts per reel               |
| ST3243EBTR | -40 to 85°C       | TSSOP28 (Tape & Reel) | 2500 parts per reel               |
| ST3243ECJ  | 0 to 70°C         | FLIP-CHIP28           | coming soon                       |
| ST3243EBJ  | -40 to 85°C       | FLIP-CHIP28           | coming soon                       |

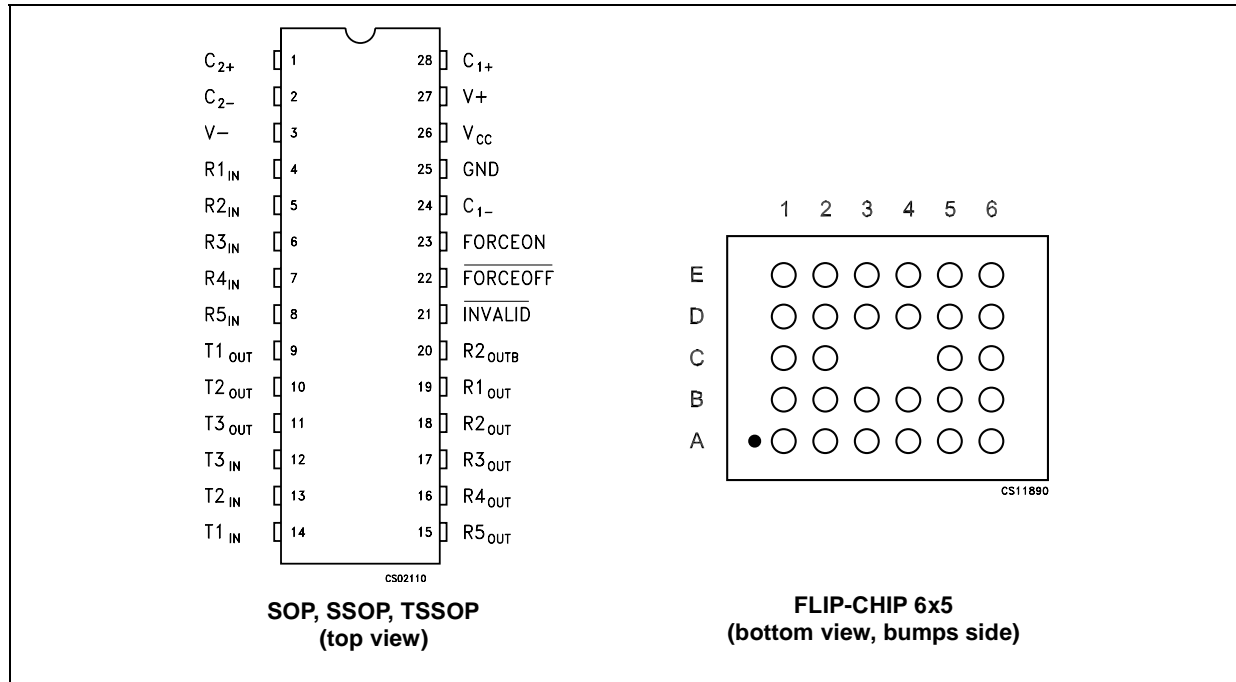
### PIN DESCRIPTION

| 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-                 | -5.5V 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  |
| 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+                 | 5.5V Generated by the Charge Pump  |
| 28     | C <sub>1+</sub>    | Positive Terminal of Voltage- Charge Pump Capacitor  |

## PIN DESCRIPTION

| PIN N° | SYMBOL             | NAME AND FUNCTION  |
|--------|--------------------|--|
| A1     | R2 <sub>IN</sub>   | Second Receiver Input Voltage  |
| A2     | R3 <sub>IN</sub>   | Third Receiver Input Voltage   |
| A3     | R4 <sub>IN</sub>   | Fourth Receiver Input Voltage  |
| A4     | R5 <sub>IN</sub>   | Fifth Receiver Input Voltage   |
| A5     | T1 <sub>OUT</sub>  | First Transmitter Output Voltage   |
| A6     | T2 <sub>OUT</sub>  | Second Transmitter Output Voltage  |
| B1     | V-                 | -5.5V Generated by the Charge Pump   |
| B2     | R1 <sub>IN</sub>   | First Receiver Input Voltage   |
| B3     | T3 <sub>OUT</sub>  | Third Transmitter Output Voltage   |
| B4     | T3 <sub>IN</sub>   | Third Transmitter Input Voltage  |
| B5     | T1 <sub>IN</sub>   | First Transmitter Input Voltage  |
| B6     | T2 <sub>IN</sub>   | Second Transmitter Input Voltage   |
| C1     | C <sub>2+</sub>    | Positive Terminal of Inverting Charge Pump Capacitor   |
| C2     | C <sub>2-</sub>    | Negative Terminal of Inverting Charge Pump Capacitor   |
| C5     | R4 <sub>OUT</sub>  | Fourth Receiver Output Voltage   |
| C6     | R5 <sub>OUT</sub>  | Fifth Receiver Output Voltage  |
| D1     | C <sub>1+</sub>    | Positive Terminal of Voltage- Charge Pump Capacitor  |
| D2     | V+                 | 5.5V Generated by the Charge Pump  |
| D3     | V <sub>CC</sub>    | Supply Voltage   |
| D4     | FORCEON            | Drive high to override automatic circuitry keeping transmitters on (FORCEOFF must be high)                         |
| D5     | R1 <sub>OUT</sub>  | First Receiver Output Voltage  |
| D6     | R3 <sub>OUT</sub>  | Third Receiver Output Voltage  |
| E1     | GND                | Ground   |
| E2     | C <sub>1-</sub>    | Negative Terminal of Voltage- Charge Pump Capacitor  |
| E3     | FORCEOFF           | Drive low to shut down transmitters and on-board power supply. This over-rides all automatic circuitry and FORCEON |
| E4     | INVALID            | Output of the valid signal detector. Indicates if a valid RS-232 level is present on receiver inputs logic "1"     |
| E5     | R2 <sub>OUTB</sub> | Non-inverting Complementary Receiver Output, always active for wake-up   |
| E6     | R2 <sub>OUT</sub>  | Second Receiver Output Voltage   |

**PIN CONFIGURATION**



**INVALID TRUTH TABLE**

| RS-232 SIGNAL PRESENT AT ANY RECEIVER INPUT | INVALID OUTPUT |
|---|----------------|
| YES   | H              |
| NO  | L              |

**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-powerdown) | ACTIVE           | ACTIVE           | ACTIVE             |
| 0        | 1         | NO                   | Shutdown (Auto-powerdown)         | HIGH Z           | ACTIVE           | ACTIVE             |

## 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    |
| FORCEON,<br>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   |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

## 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   |

## 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  $85^\circ\text{C}$ , unless otherwise specified.)

Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol       | Parameter                        | Test Conditions   | Min. | Typ. | Max. | Unit          |
|--------------|----------------------------------|---|------|------|------|---------------|
| $I_{ASHDN}$  | Supply Current<br>Auto-powerdown | FORCEOFF = GND<br>FORCEON = $V_{CC}$<br>All $R_{IN}$ open or grounded |      | 1    | 10   | $\mu\text{A}$ |
| $I_{SUPPLY}$ | Supply Current                   | FORCEON = FORCEOFF = $V_{CC}$   |      | 0.3  | 1    | mA            |
| $I_{SHDN}$   | Shutdown Supply Current          | FORCEOFF = GND  |      | 1    | 10   | $\mu\text{A}$ |

## LOGIC INPUT 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  $85^\circ\text{C}$ , unless otherwise specified.)

Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol     | Parameter                       | Test Conditions          | Min.         | Typ.         | Max.      | Unit          |
|------------|---------------------------------|--------------------------|--------------|--------------|-----------|---------------|
| $V_{TIL}$  | Input Logic Threshold Low       | T-IN, FORCEON, FORCEOFF  |              |              | 0.8       | V             |
| $V_{TIH}$  | Input Logic Threshold High      | T-IN, FORCEON, FORCEOFF  | 2<br>2.4     |              |           | V<br>V        |
| $V_{THYS}$ | Transmitter Input<br>Hysteresis |                          |              | 0.5          |           | V             |
| $I_{IL}$   | Input Leakage Current           | T-IN, FORCEON, FORCEOFF  |              | $\pm 0.01$   | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{OL}$   | Output Leakage Current          | Receiver Disabled        |              | $\pm 0.05$   | $\pm 10$  | $\mu\text{A}$ |
| $V_{OL}$   | Output Voltage Low              | $I_{OUT} = 1.6\text{mA}$ |              |              | 0.4       | V             |
| $V_{OH}$   | Output Voltage High             | $I_{OUT} = -1\text{mA}$  | $V_{CC}-0.6$ | $V_{CC}-0.1$ |           | V             |

**AUTO-POWERDOWN ELECTRICAL CHARACTERISTICS**(C<sub>1</sub> - C<sub>4</sub> = 0.1μF, V<sub>CC</sub> = 3V to 5.5V, T<sub>A</sub> = -40 to 85°C, unless otherwise specified.Typical values are referred to T<sub>A</sub> = 25°C, FORCEON = GND, FORCEOFF = V<sub>CC</sub>)

| Symbol                      | Parameter  | Test Conditions          | Min.                 | Typ. | Max. | Unit |
|-----------------------------|--|--------------------------|----------------------|------|------|------|
| V <sub>RITE</sub>           | Receiver Input Threshold to INVALID Output Voltage HIGH (Fig. 1) | Positive Threshold       |                      |      | 2.7  | V    |
|                             |  | Negative Threshold       | 2.7                  |      |      | V    |
| V <sub>RITD</sub>           | Receiver Input Threshold to INVALID Output Voltage LOW (Fig. 1)  |                          | -0.3                 |      | 0.3  | V    |
| V <sub>IO<sub>L</sub></sub> | INVALID Output Voltage LOW                                       | I <sub>OUT</sub> = 1.6mA |                      |      | 0.4  | V    |
| V <sub>IO<sub>H</sub></sub> | INVALID Output Voltage HIGH                                      | I <sub>OUT</sub> = -1mA  | V <sub>CC</sub> -0.6 |      |      | V    |
| t <sub>WU</sub>             | Receiver or Transmitter Edge Transmitter Enabled (Fig. 1)        |                          |                      | 100  |      | μs   |
| t <sub>INVH</sub>           | Receiver Positive or Negative Threshold to INVALID HIGH (Fig. 1) |                          |                      | 0.2  |      | μs   |
| t <sub>INVL</sub>           | Receiver Positive or Negative Threshold to INVALID LOW (Fig. 1)  |                          |                      | 30   |      | μs   |

**TRANSMITTER ELECTRICAL CHARACTERISTICS**(C<sub>1</sub> - C<sub>4</sub> = 0.1μF, V<sub>CC</sub> = 3V to 5.5V, T<sub>A</sub> = -40 to 85°C, unless otherwise specified.Typical values are referred to T<sub>A</sub> = 25°C)

| Symbol                       | Parameter                    | Test Conditions  | Min. | Typ.  | Max. | Unit |
|------------------------------|------------------------------|--|------|-------|------|------|
| V <sub>TO<sub>UT</sub></sub> | Output Voltage Swing         | All Transmitter outputs are loaded with 3KΩ to GND   | ± 5  | ± 5.4 |      | V    |
| R <sub>OUT</sub>             | Output Resistance            | V <sub>CC</sub> = V+ = V- = 0V    V <sub>OUT</sub> = ± 2V  | 300  | 10M   |      | Ω    |
| I <sub>SC</sub>              | Output Short Circuit Current | V <sub>CC</sub> = 3.3V   |      | ± 40  | ± 60 | mA   |
| I <sub>L</sub>               | Output Leakage Current       | V <sub>CC</sub> = 0 to 5.5V, transmitter output=± 12V, transmitter disabled  |      |       | ± 25 | μA   |
| V <sub>OT</sub>              | Transmitter Output Voltage   | T1IN = T2IN = GND,    T3IN = V <sub>CC</sub><br>T3OUT loaded with 3KΩ to GND<br>T1OUT and T2OUT loaded with 2.5mA each | ± 5  |       |      | V    |

**RECEIVER ELECTRICAL CHARACTERISTICS**(C<sub>1</sub> - C<sub>4</sub> = 0.1μF, V<sub>CC</sub> = 3V to 5.5V, T<sub>A</sub> = -40 to 85°C, unless otherwise specified.Typical values are referred to T<sub>A</sub> = 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> = 3.3V | 0.6  | 1.1  |      | V    |
|                    |  | T <sub>A</sub> = 25°C    V <sub>CC</sub> = 5.0V | 0.8  | 1.4  |      | V    |
| V <sub>RIH</sub>   | RS-232 Input Threshold High            | T <sub>A</sub> = 25°C    V <sub>CC</sub> = 3.3V |      | 1.6  | 2.4  | V    |
|                    |  | T <sub>A</sub> = 25°C    V <sub>CC</sub> = 5.0V |      | 1.9  | 2.4  | V    |
| V <sub>RIHYS</sub> | Input Hysteresis                       |   |      | 0.5  |      | V    |
| R <sub>RIN</sub>   | Input Resistance                       | T <sub>A</sub> = 25°C                           | 3    | 5    | 7    | KΩ   |

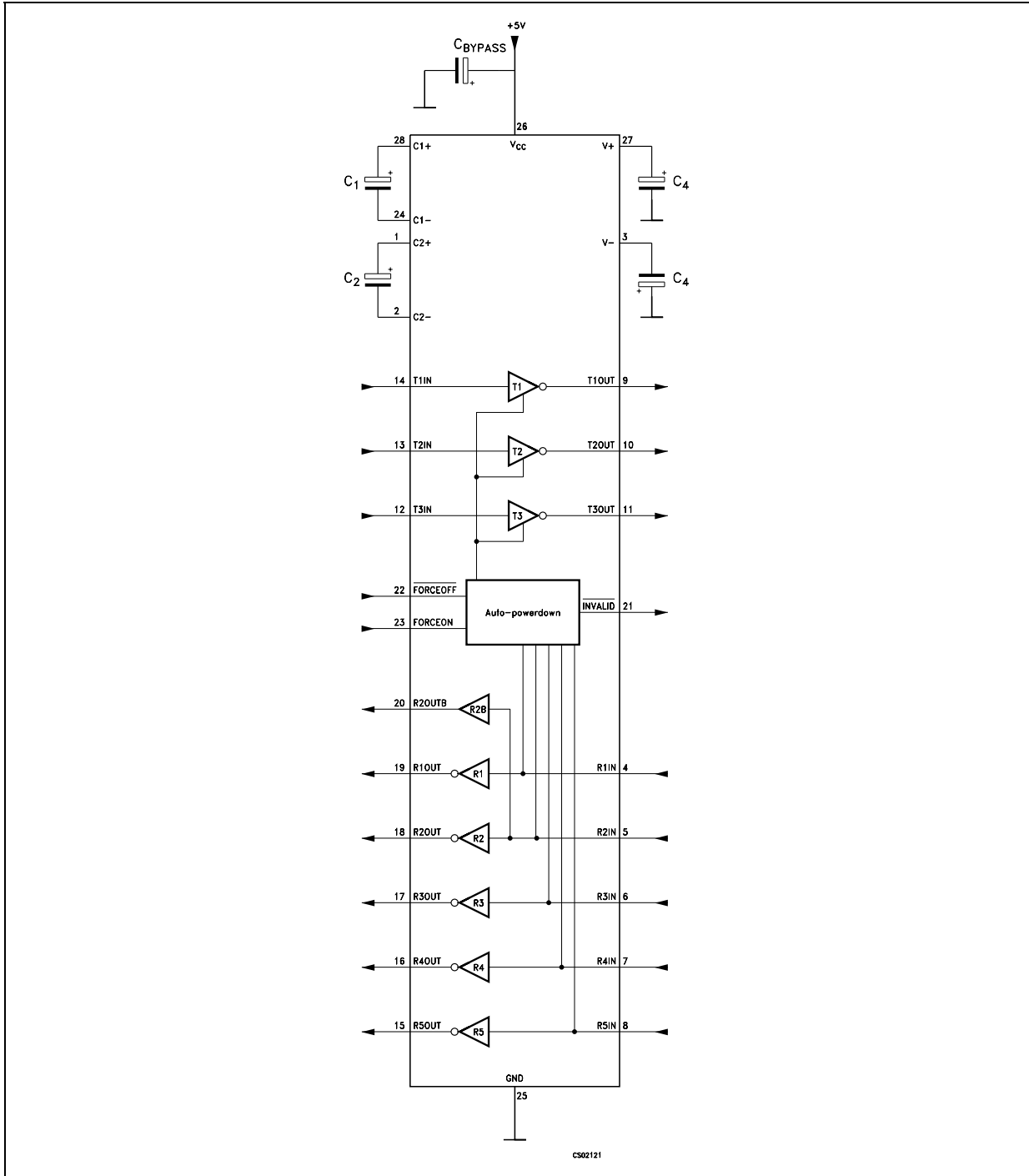
**TIMING CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$ ,  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ ,  $T_A = -40$  to  $85^\circ\text{C}$ , unless otherwise specified.

Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol                 | Parameter                  | Test Conditions  | Min.   | Typ. | Max.     | Unit   |
|------------------------|----------------------------|--|--------|------|----------|--|
| $D_R$                  | Maximum Data Rate          | $R_L = 3\text{K}\Omega$ $C_L = 1000\text{pF}$<br>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 |          | $\mu\text{s}$                                    |
| $t_{T\_SKEW}$          | 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 $+3\text{V}$ 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>$\text{V}/\mu\text{s}$ |

APPLICATION CIRCUITS

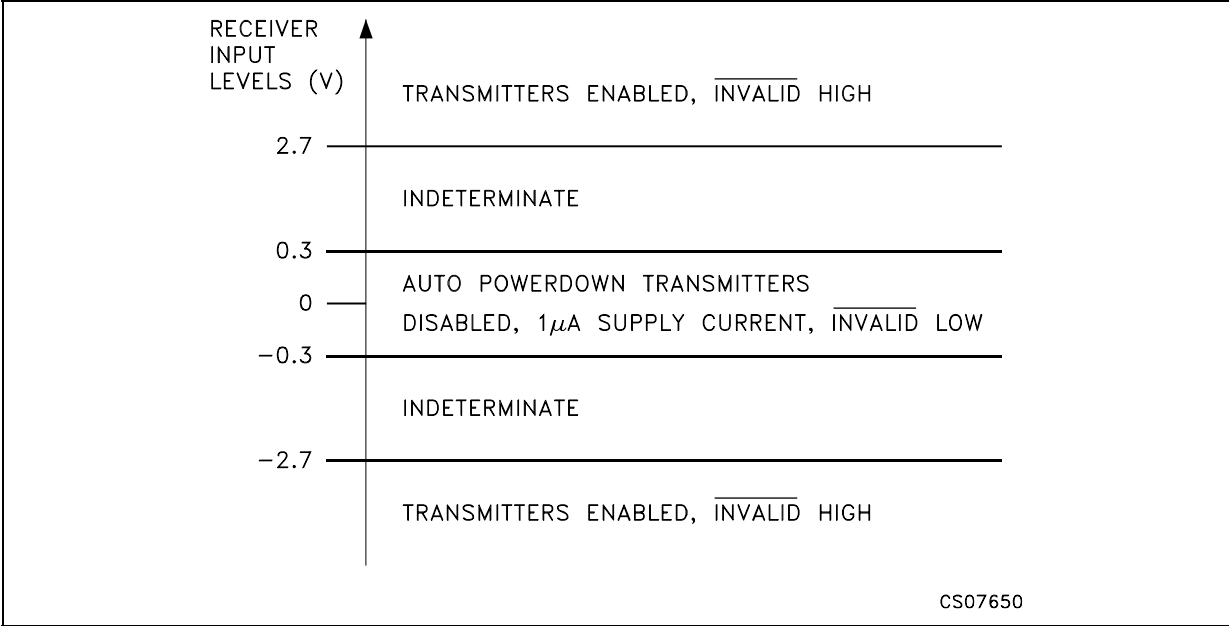


REQUIRED MINIMUM CAPACITANCE VALUE (μF)

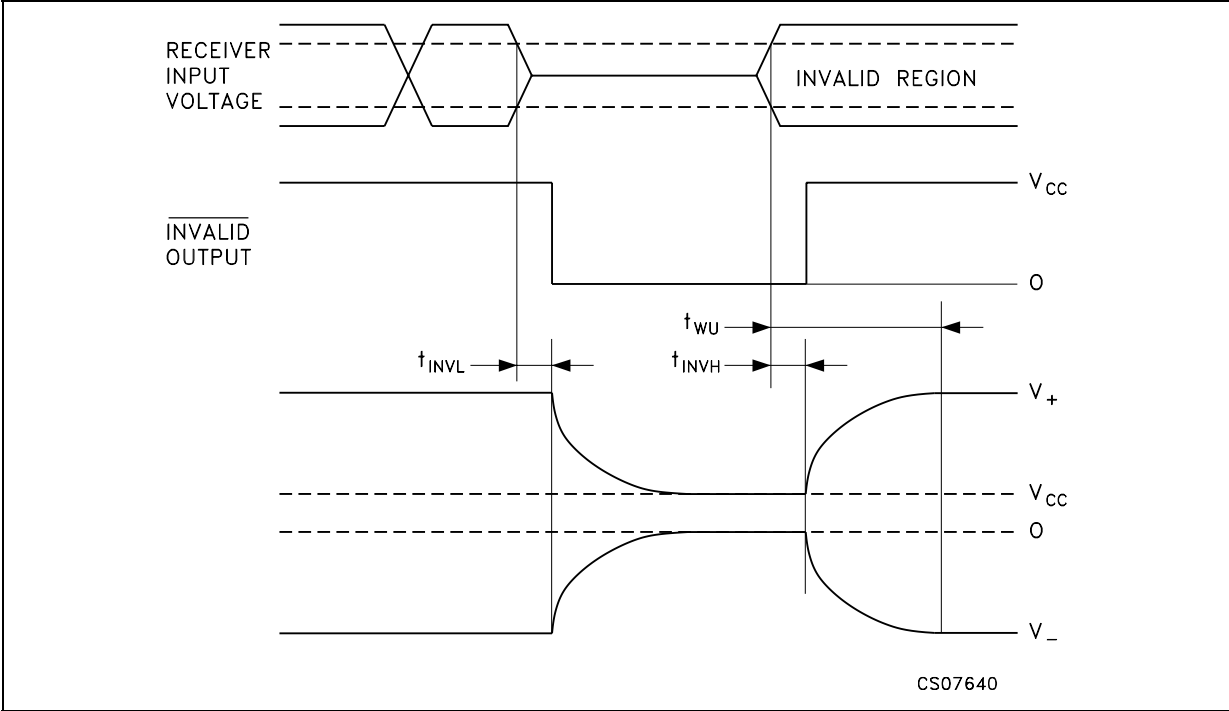
| V <sub>CC</sub> (V) | C <sub>1</sub> | C <sub>2</sub> , C <sub>3</sub> , C <sub>4</sub> , C <sub>BYPASS</sub> |
|---------------------|----------------|--|
| 3 to 3.6            | 0.1            | 0.1  |
| 4.5 to 5.5          | 0.047          | 0.33   |



**AUTOPOWERDOWN INPUT LEVELS**

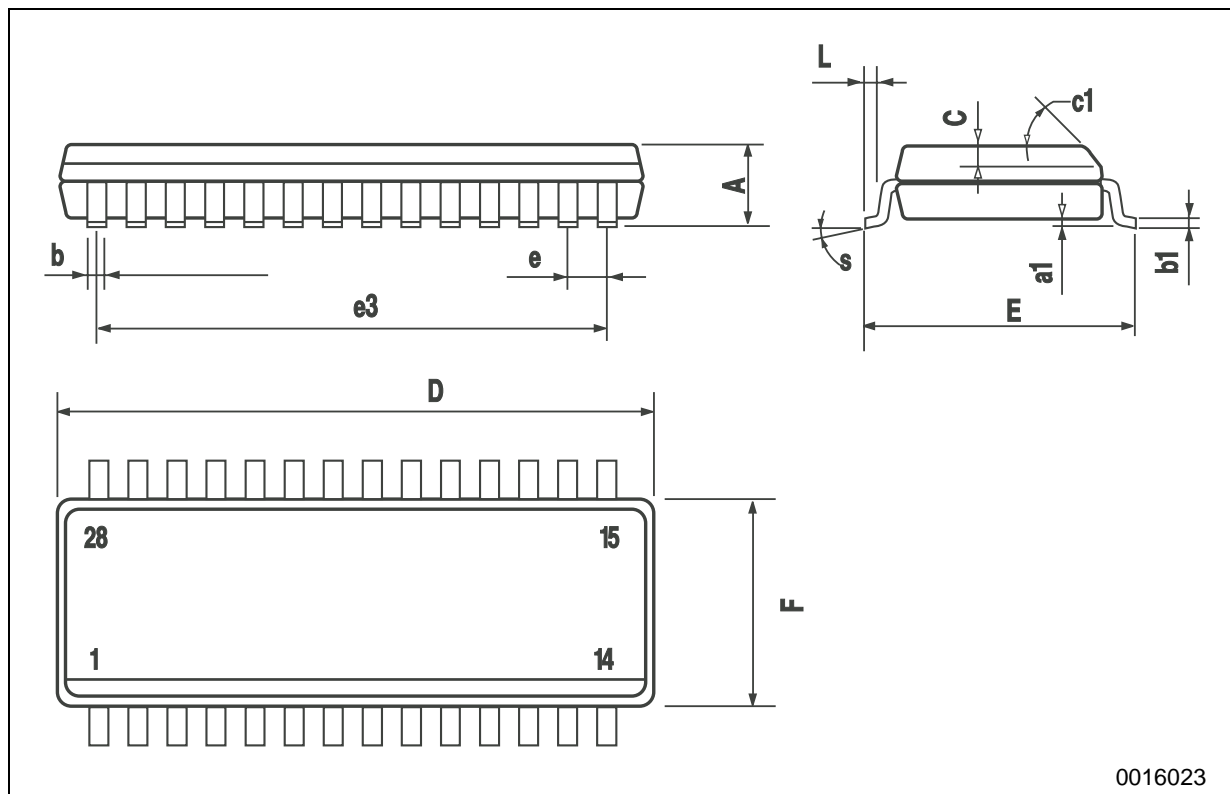


**AUTOPOWERDOWN INPUT TIMING**



## SO-28 MECHANICAL DATA

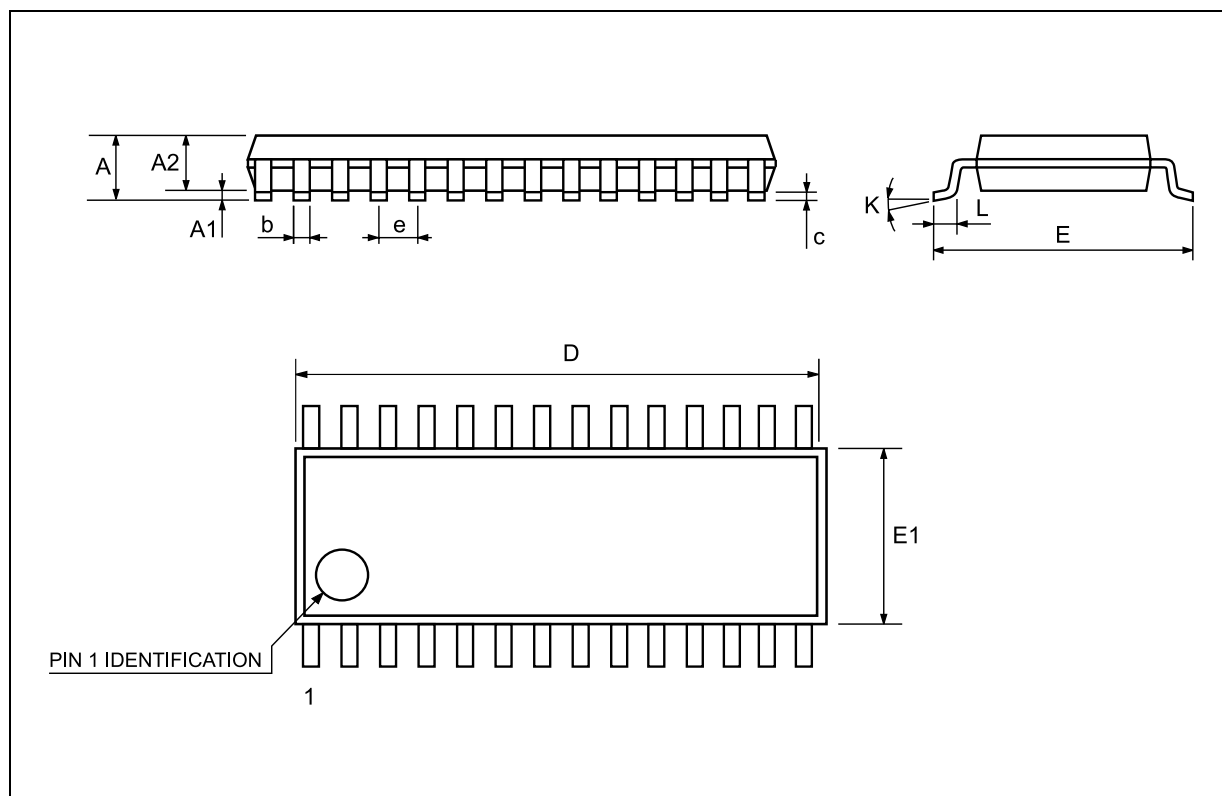
| DIM. | mm.        |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP   | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 2.65  |       |       | 0.104 |
| a1   | 0.1        |       | 0.3   | 0.004 |       | 0.012 |
| 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    | 17.70      |       | 18.10 | 0.697 |       | 0.713 |
| E    | 10.00      |       | 10.65 | 0.393 |       | 0.419 |
| e    |            | 1.27  |       |       | 0.050 |       |
| e3   |            | 16.51 |       |       | 0.650 |       |
| F    | 7.40       |       | 7.60  | 0.291 |       | 0.300 |
| L    | 0.50       |       | 1.27  | 0.020 |       | 0.050 |
| S    | 8° (max.)  |       |       |       |       |       |



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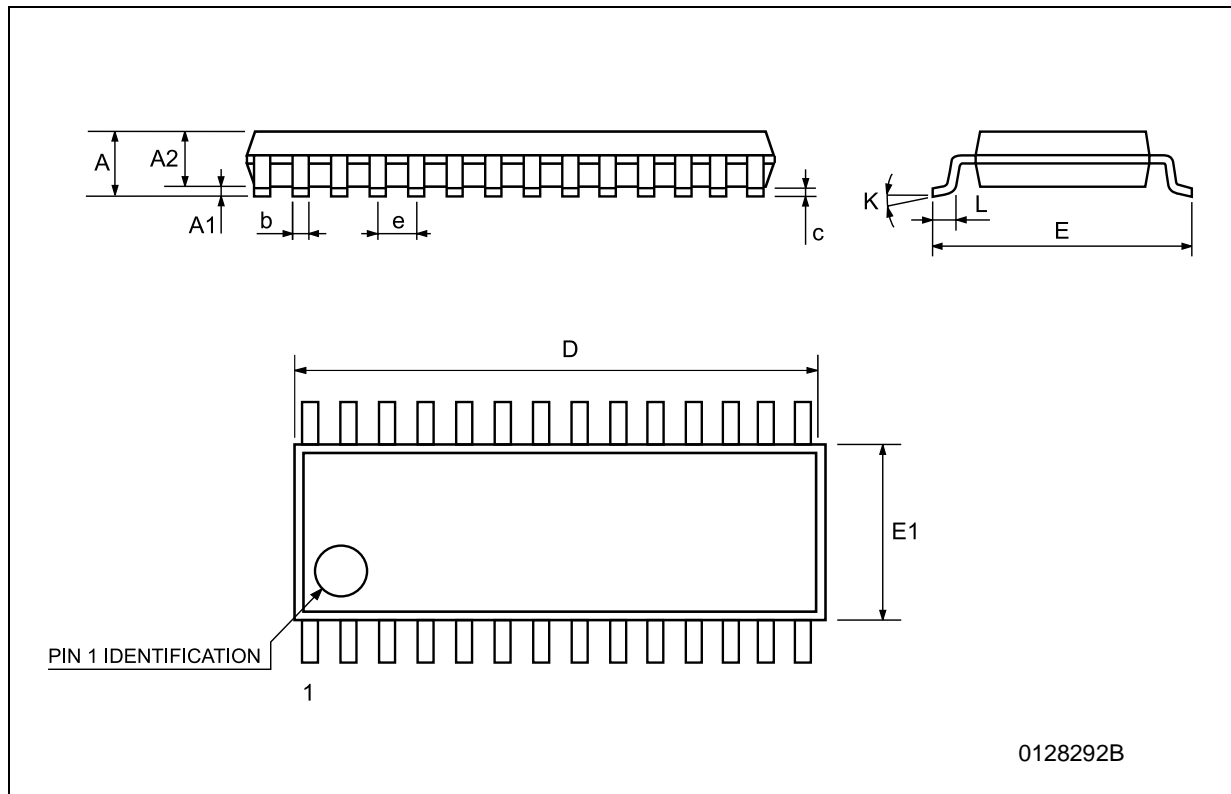
## SSOP28 MECHANICAL DATA

| DIM. | mm.   |          |      | inch  |            |       |
|------|-------|----------|------|-------|------------|-------|
|      | MIN.  | TYP      | MAX. | MIN.  | TYP.       | MAX.  |
| A    |       |          | 2    |       |            | 0.079 |
| A1   | 0.050 |          |      | 0.002 |            |       |
| A2   | 1.65  | 1.75     | 1.85 | 0.065 | 0.069      | 0.073 |
| b    | 0.22  |          | 0.38 | 0.009 |            | 0.015 |
| c    | 0.09  |          | 0.25 | 0.004 |            | 0.010 |
| D    | 9.9   | 10.2     | 10.5 | 0.390 | 0.402      | 0.413 |
| E    | 7.4   | 7.8      | 8.2  | 0.291 | 0.307      | 0.323 |
| E1   | 5     | 5.3      | 5.6  | 0.197 | 0.209      | 0.220 |
| e    |       | 0.65 BSC |      |       | 0.0256 BSC |       |
| K    | 0°    |          | 10°  | 0°    |            | 10°   |
| L    | 0.55  | 0.75     | 0.95 | 0.022 | 0.030      | 0.037 |



**TSSOP28 MECHANICAL DATA**

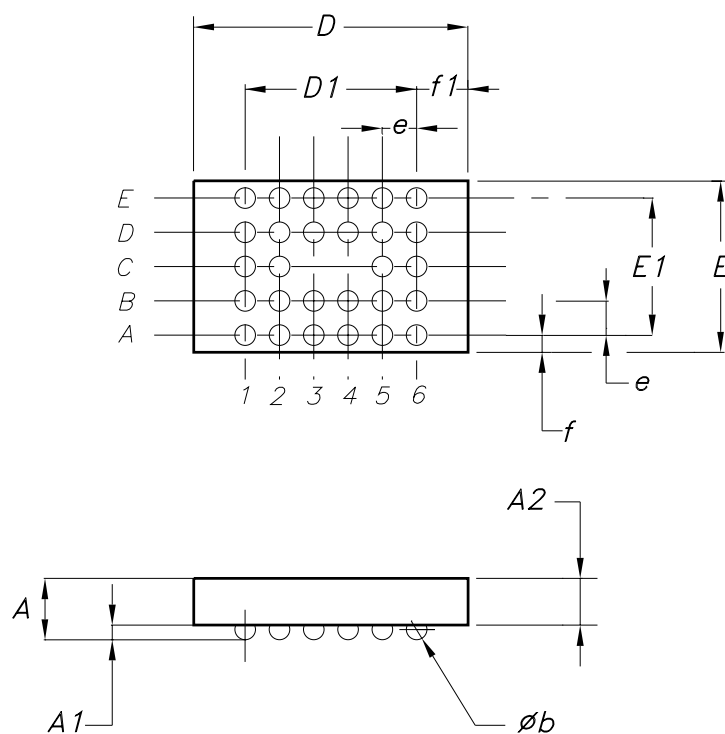
| DIM. | mm.  |          |      | inch  |            |        |
|------|------|----------|------|-------|------------|--------|
|      | MIN. | TYP      | MAX. | MIN.  | TYP.       | MAX.   |
| A    |      |          | 1.2  |       |            | 0.047  |
| A1   | 0.05 |          | 0.15 | 0.002 | 0.004      | 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  |



### Flip-Chip28 MECHANICAL DATA

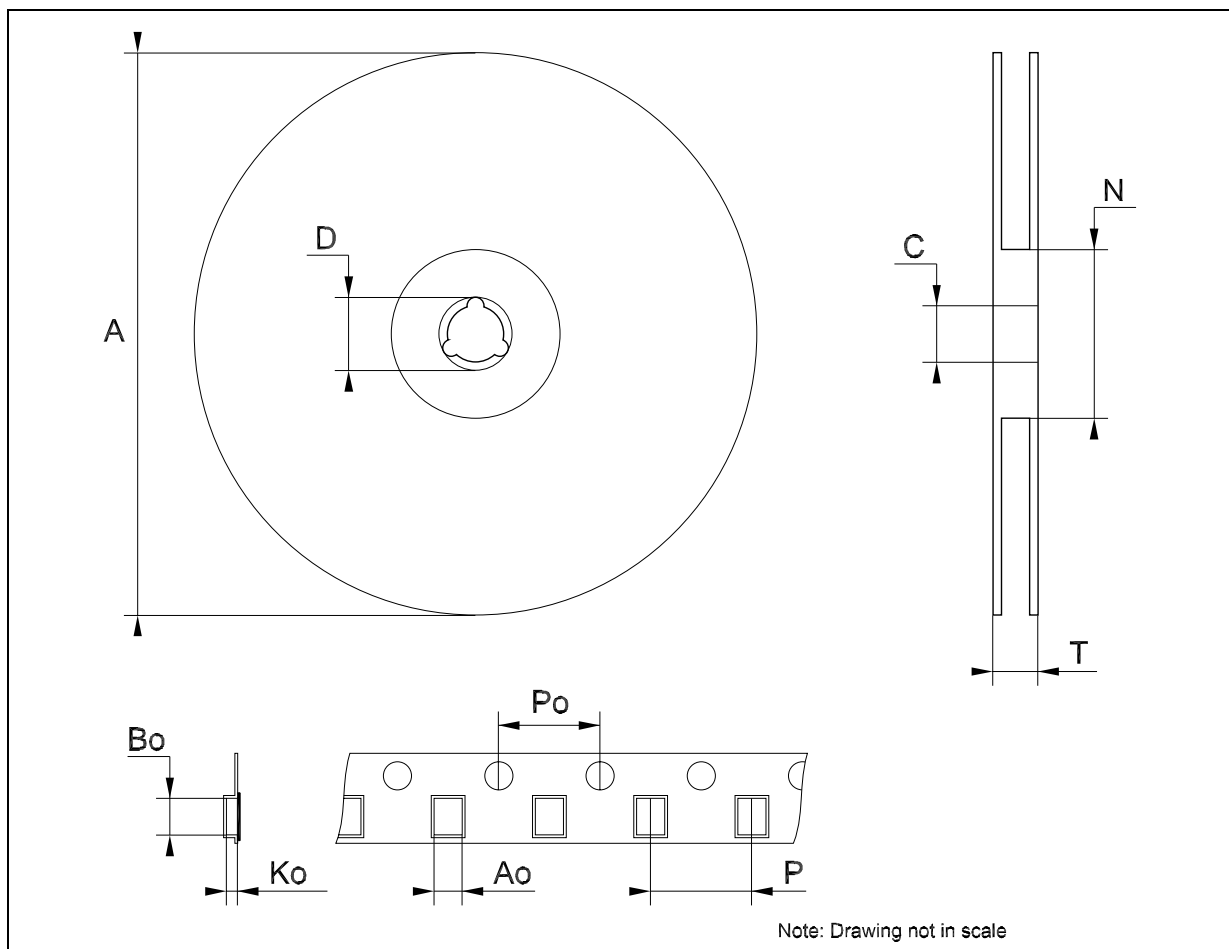
| DIM. | mm.  |      |      | mils  |      |       |
|------|------|------|------|-------|------|-------|
|      | MIN. | TYP  | MAX. | MIN.  | TYP. | MAX.  |
| A    | 0.58 |      | 0.95 | 22.8  |      | 37.4  |
| A1   |      | 0.24 |      |       | 9.4  |       |
| A2   |      | 0.65 |      |       | 25.6 |       |
| b    | 0.25 | 0.30 | 0.35 | 9.8   | 11.8 | 13.8  |
| D    | 3.97 |      | 4.17 | 156.3 |      | 164.2 |
| D1   |      | 2.5  |      |       | 98.4 |       |
| E    | 2.47 |      | 2.67 | 97.2  |      | 105.1 |
| E1   |      | 2    |      |       | 78.7 |       |
| e    | 0.45 |      | 0.55 | 17.7  |      | 21.7  |
| f    | 0.23 |      | 0.34 | 9.1   |      | 13.4  |
| f1   | 0.80 |      | 0.91 | 31.5  |      | 31.8  |

*BOTTOM VIEW (BUMPS SIDE)*



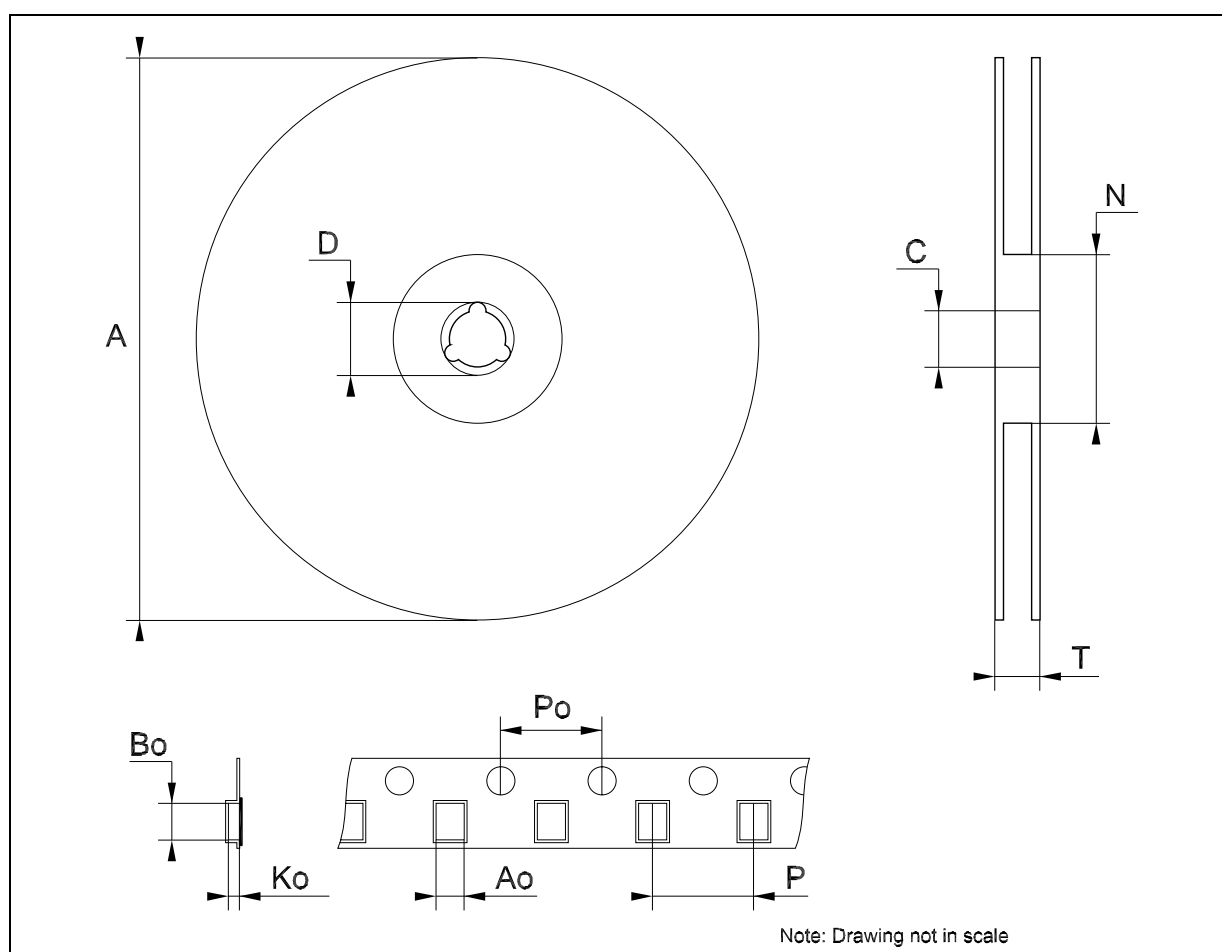
**Tape & Reel SO-28 MECHANICAL DATA**

| 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    |      |     | 30.4 |       |      | 1.197  |
| Ao   | 10.8 |     | 11.0 | 0.425 |      | 0.433  |
| Bo   | 18.2 |     | 18.4 | 0.716 |      | 0.724  |
| 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  |



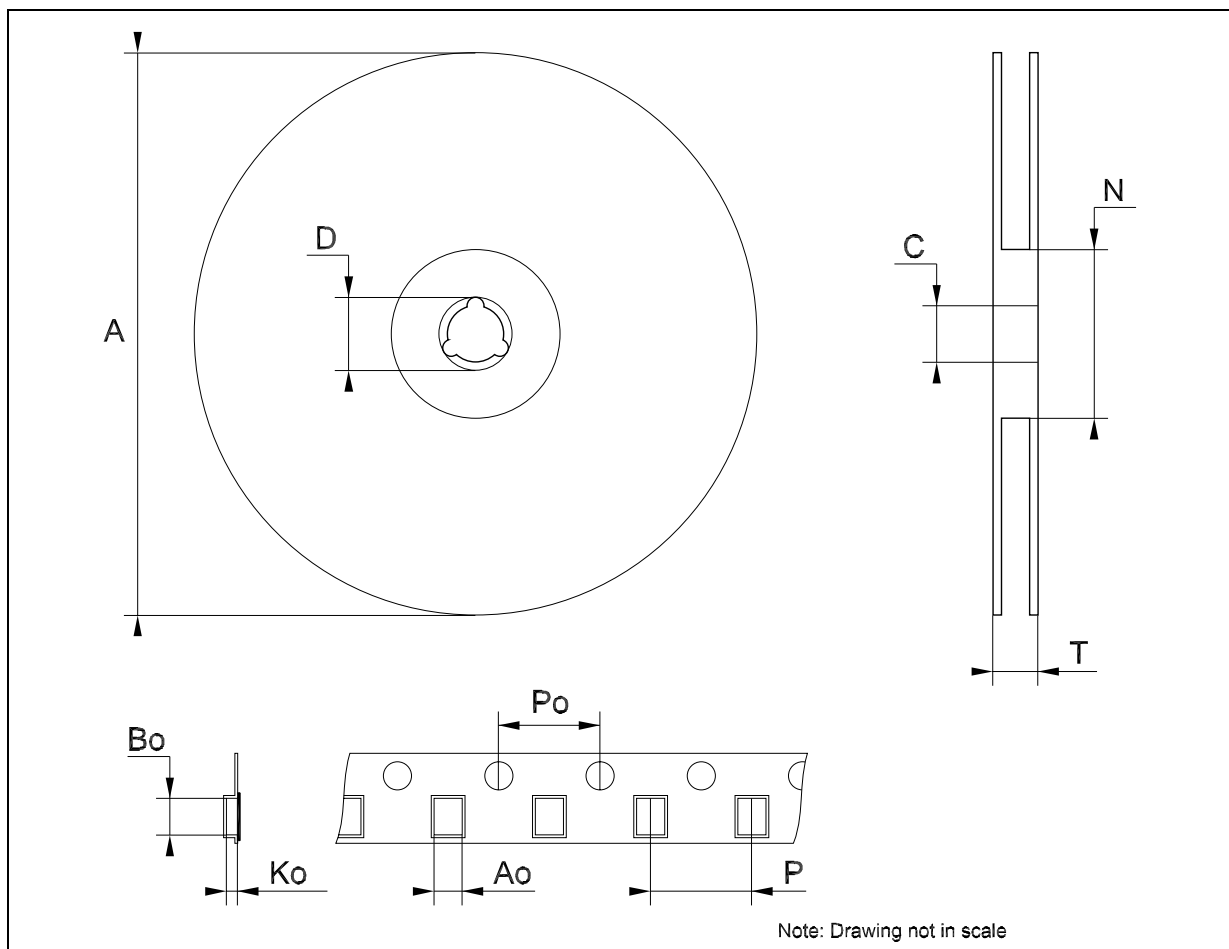
## Tape &amp; Reel SSOP28 MECHANICAL DATA

| 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   | 8.4  |     | 8.6  | 0.331 |      | 0.339  |
| 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 TSSOP28 MECHANICAL DATA**

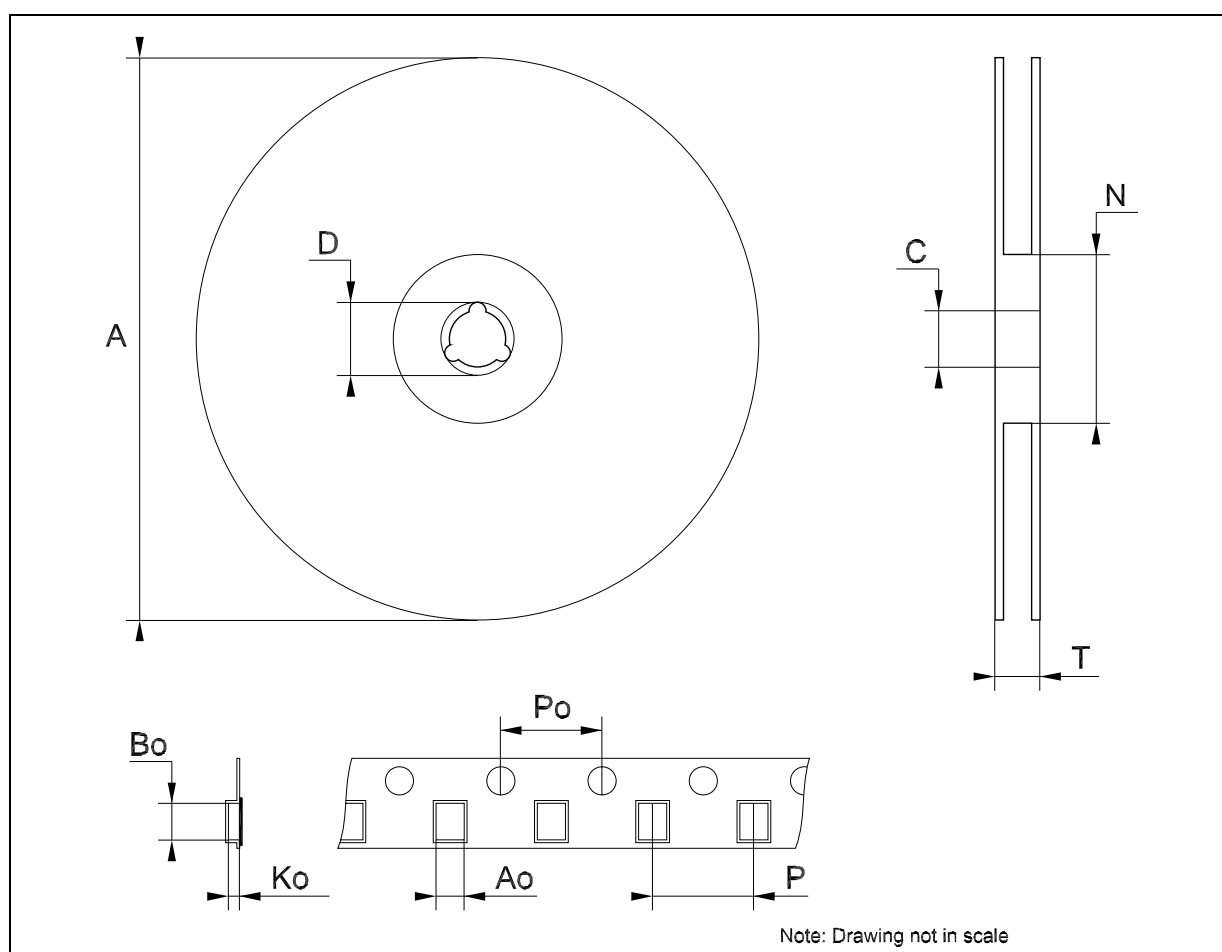
| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| 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  |





## Tape &amp; Reel Flip-Chip28 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    |      |     | 18.4 |       |      | 0.882  |
| Ao   | 2.6  |     | 2.8  | 0.102 |      | 0.110  |
| Bo   | 4.1  |     | 4.3  | 0.161 |      | 0.169  |
| Ko   | 1.1  |     | 1.3  | 0.043 |      | 0.051  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 3.9  |     | 4.1  | 0.153 |      | 0.161  |



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