

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

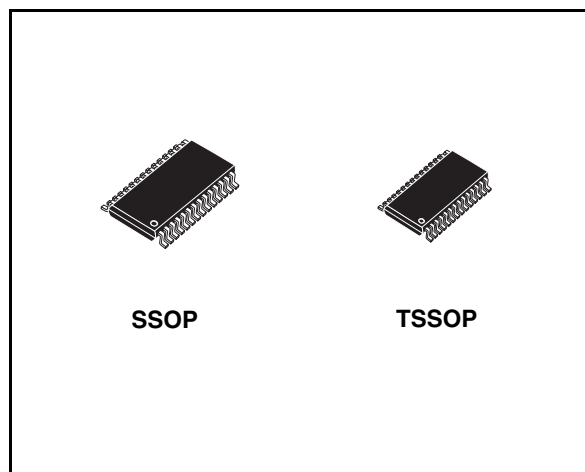
## Features

- 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 SSOP-28 and TSSOP28 packages

## Description

The ST3241E 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 ST3241E 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.



It is a complete serial port (3 drivers, 5 receivers) intended for notebook or sub-notebook computers. Receivers R1 and R2 have extra outputs in addition to their standard outputs. These extra output are always active.

Typical application are in notebook, sub-notebook, palmtop computers, battery-powered equipment, hand-held equipment, peripherals and printers.

**Table 1. Device summary**

Order code	Temperature range	Package	Packaging
ST3241ECPR	0 to 70°C	SSOP-28 (tape and reel)	1350 parts per reel
ST3241EBPR	-40 to 85°C	SSOP-28 (tape and reel)	1350 parts per reel
ST3241EBTR	-40 to 85°C	TSSOP28 (tape and reel)	2500 parts per reel

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# 1 Pin configuration

Figure 1. Pin configuration

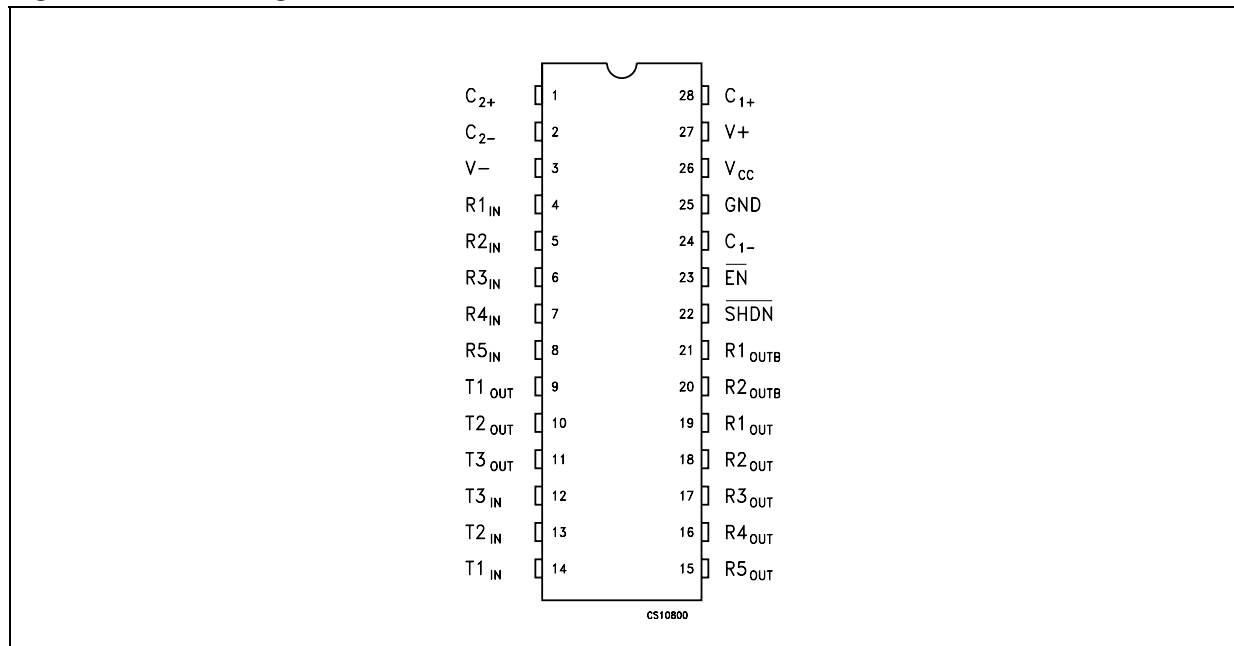


Table 2. Pin description

Pin n°	Symbol	Name and function
1	C <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

**Table 2. Pin description (continued)**

Pin n°	Symbol	Name and function
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	R1 <sub>OUTB</sub>	Non-inverting complementary receiver output, always active for wake-up
22	SHDN	Shutdown control. Active low.
23	EN	Receiver enable. Active low
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

**Table 3. Shutdown and enable control truth table**

SHDN	EN	T <sub>OUT</sub>	R <sub>OUT</sub>	R <sub>OUTB</sub>
0	0	HIGH Z	ACTIVE	ACTIVE
0	1	HIGH Z	HIGH Z	ACTIVE
1	0	ACTIVE	ACTIVE	ACTIVE
1	1	ACTIVE	HIGH Z	ACTIVE

## 2 Maximum ratings

**Table 4. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	-0.3 to 6	V
$V+$	Extra positive voltage ( <i>Note: 1</i> )	$(V_{CC} - 0.3)$ to 7	V
$V-$	Extra negative voltage ( <i>Note: 1</i> )	0.3 to -7	V
$V+ +  V- $	( <i>Note: 1</i> )	13	V
$\overline{SHDN}$ , $\overline{EN}$ , $T_{IN}$	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
$R_{OUT}$ , $R_{OUTB}$ 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.

*Note: 1*  $V+$  and  $V-$  can have a maximum magnitude of +7 V, but their absolute addition cannot exceed 13 V.

**Table 5. 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

### 3 Electrical characteristics

**Table 6. Electrical characteristics**

(C1 - C4 = 0.1  $\mu$ F, V<sub>CC</sub> = 3 V to 5.5 V, 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
I <sub>SUPPLY</sub>	Supply current	No load V <sub>CC</sub> = 3.3V or 5V, T <sub>A</sub> = 25°C		0.3	1	mA
I <sub>SHDN</sub>	Shutdown supply current	$\overline{\text{SHDN}}$ = GND, T <sub>A</sub> = 25°C		1	10	$\mu$ A

**Table 7. Logic input and receiver output electrical characteristics**

(C<sub>1</sub> - C<sub>4</sub> = 0.1  $\mu$ F, V<sub>CC</sub> = 3 V to 5.5 V, T<sub>A</sub> = -40 to 85 °C, unless otherwise specified.

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>TIL</sub>	Input logic threshold low	T <sub>IN</sub> , $\overline{\text{EN}}$ , $\overline{\text{SHDN}}$			0.8	V
V <sub>TIH</sub>	Input logic threshold high	V <sub>CC</sub> = 3.3V V <sub>CC</sub> = 5V	2 2.4			V V
I <sub>IL</sub>	Input leakage current	T <sub>IN</sub> , $\overline{\text{EN}}$ , $\overline{\text{SHDN}}$		$\pm 0.01$	$\pm 1.0$	$\mu$ A

**Table 8. Receiver output electrical characteristics**

(C<sub>1</sub> - C<sub>4</sub> = 0.1  $\mu$ F, V<sub>CC</sub> = 3 V to 5.5 V, T<sub>A</sub> = -40 to 85 °C, unless otherwise specified.

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I <sub>OL</sub>	Output Leakage Current	R <sub>OUT</sub> , $\overline{\text{EN}}$ , Receiver Disabled		$\pm 0.05$	$\pm 10$	$\mu$ A
V <sub>OL</sub>	Output Voltage Low	I <sub>OUT</sub> = 1.6mA			0.4	V
V <sub>OH</sub>	Output Voltage High	I <sub>OUT</sub> = -1mA		V <sub>CC</sub> -0.6	V <sub>CC</sub> -0.1	V

**Table 9. Transmitter electrical characteristics**

(C<sub>1</sub> - C<sub>4</sub> = 0.1  $\mu$ F, V<sub>CC</sub> = 3 V to 5.5 V, T<sub>A</sub> = -40 to 85 °C, unless otherwise specified.

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>TOUT</sub>	Output voltage swing	All transmitter outputs are loaded with 3k $\Omega$ to GND	$\pm 5$	$\pm 5.4$		V
R <sub>OUT</sub>	Output resistance	V <sub>CC</sub> = V+ = V- = 0V, V <sub>OUT</sub> = $\pm 2$ V	300	10M		$\Omega$
I <sub>SC</sub>	Output short circuit current			$\pm 35$	$\pm 60$	mA
I <sub>L</sub>	Output leakage current	V <sub>CC</sub> = 0 to 5.5V, transmitter output = $\pm 12$ V, transmitter disabled			$\pm 25$	$\mu$ A
V <sub>TO</sub>	Transmitter output voltage	T1IN = T2IN = GND, T3IN = V <sub>CC</sub> T3OUT loaded with 3k $\Omega$ to GND T1OUT and T2OUT loaded with 2.5mA each	$\pm 5$			V

**Table 10. Receiver electrical characteristics** $(C_1 - C_4 = 0.1 \mu\text{F}, V_{\text{CC}} = 3 \text{ V to } 5.5 \text{ V}, T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}, \text{ unless otherwise specified.})$ 

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{\text{RIN}}$	Receiver input voltage operating range		-25		25	V
$V_{\text{RIL}}$	RS-232 Input threshold low	$T_A = 25^\circ\text{C}, V_{\text{CC}} = 3.3\text{V}$ $T_A = 25^\circ\text{C}, V_{\text{CC}} = 5.0\text{V}$	0.6 0.8	1.2 1.5		V
$V_{\text{RIH}}$	RS-232 Input threshold high	$T_A = 25^\circ\text{C}, V_{\text{CC}} = 3.3\text{V}$ $T_A = 25^\circ\text{C}, V_{\text{CC}} = 5.0\text{V}$		1.5 1.8	2.4 2.4	V
$V_{\text{RIHYS}}$	Input hysteresis			0.3		V
$R_{\text{RIN}}$	Input resistance	$T_A = 25^\circ\text{C}$	3	5	7	k $\Omega$

**Table 11. Timing characteristics** $(C_1 - C_4 = 0.1 \mu\text{F}, V_{\text{CC}} = 3 \text{ V to } 5.5 \text{ V}, T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}, \text{ unless otherwise specified.})$ 

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$D_{\text{R}}$	Maximum data rate	$R_L = 3\text{k}\Omega, C_L = 1000\text{pF}$ one transmitter switching	250			kbps
$t_{\text{PHL}}$ $t_{\text{PLH}}$	Receiver propagation delay	$R_{\text{IN}}$ to $R_{\text{OUT}}, C_L = 150\text{pF}$		0.15		$\mu\text{s}$
$t_{\text{T\_SKEW}}$	Transmitter skew			100		ns
$t_{\text{R\_SKEW}}$	Receiver skew			300		ns
$S_{\text{RT}}$	Transition slew rate	$T_A = 25^\circ\text{C}, R_L = 3\text{k to } 7\text{k}\Omega, V_{\text{CC}} = 3.3\text{V}$ measured from +3V to -3V or -3V to +3V $C_L = 150\text{pF to } 1000\text{pF}$ $C_L = 150\text{pF to } 2500\text{pF}$	6 4		30 30	V/ $\mu\text{s}$ V/ $\mu\text{s}$

# 4 Application

Figure 2. Application circuits

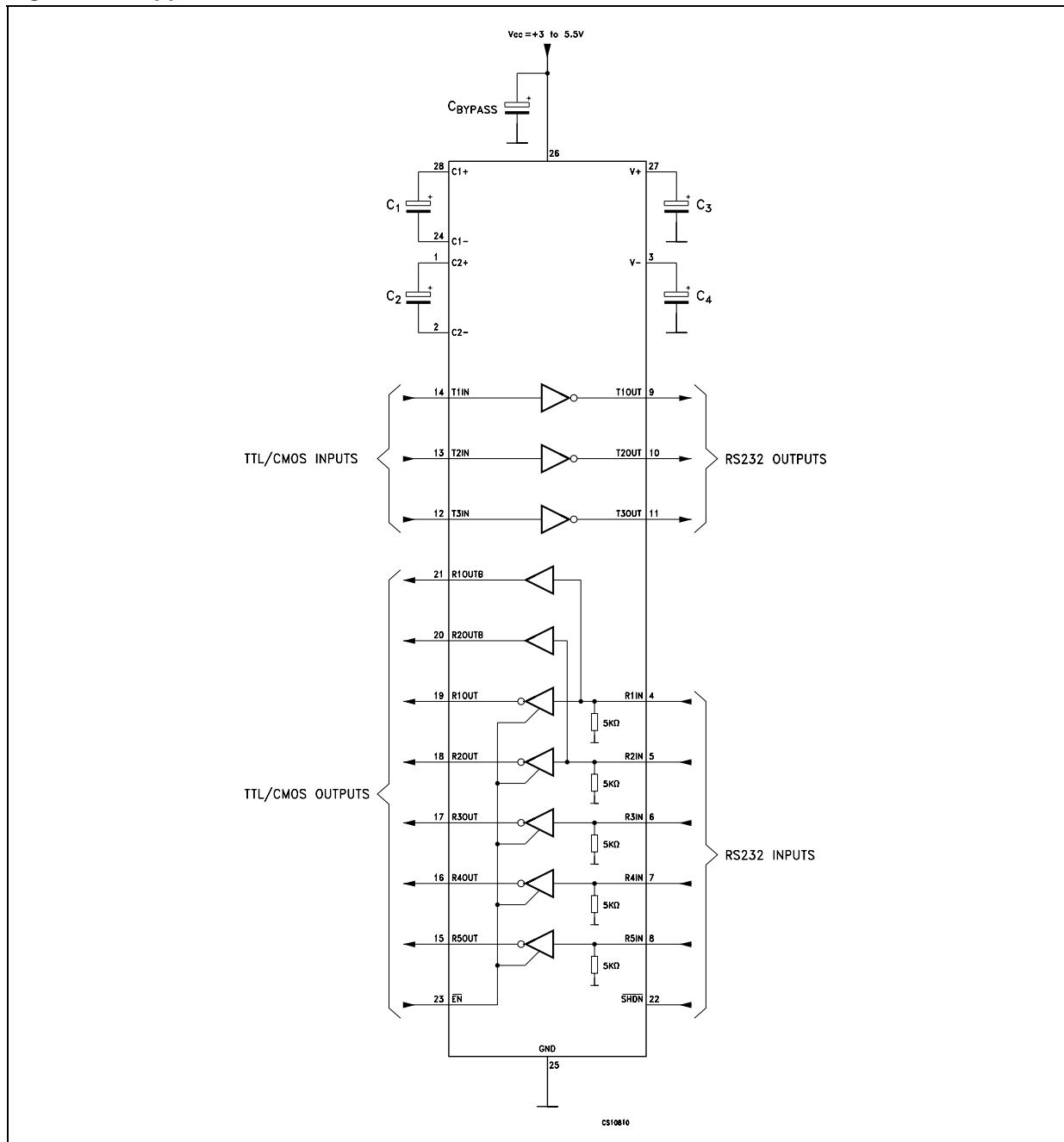


Table 12. Required minimum capacitance value (μF)

V <sub>CC</sub>	C1	C2	C3	C4	Cbypass
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	0.1
3.0 to 5.5	0.1	0.47	0.47	0.47	0.1

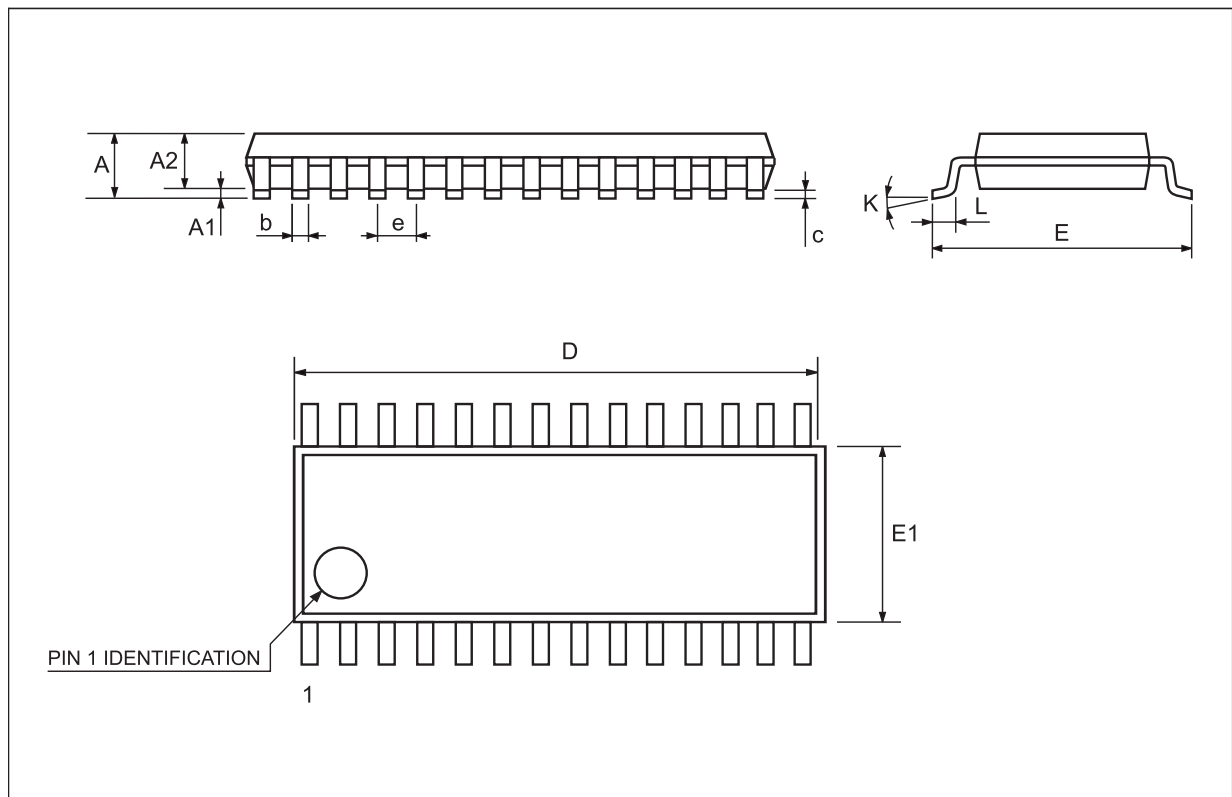


## 5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

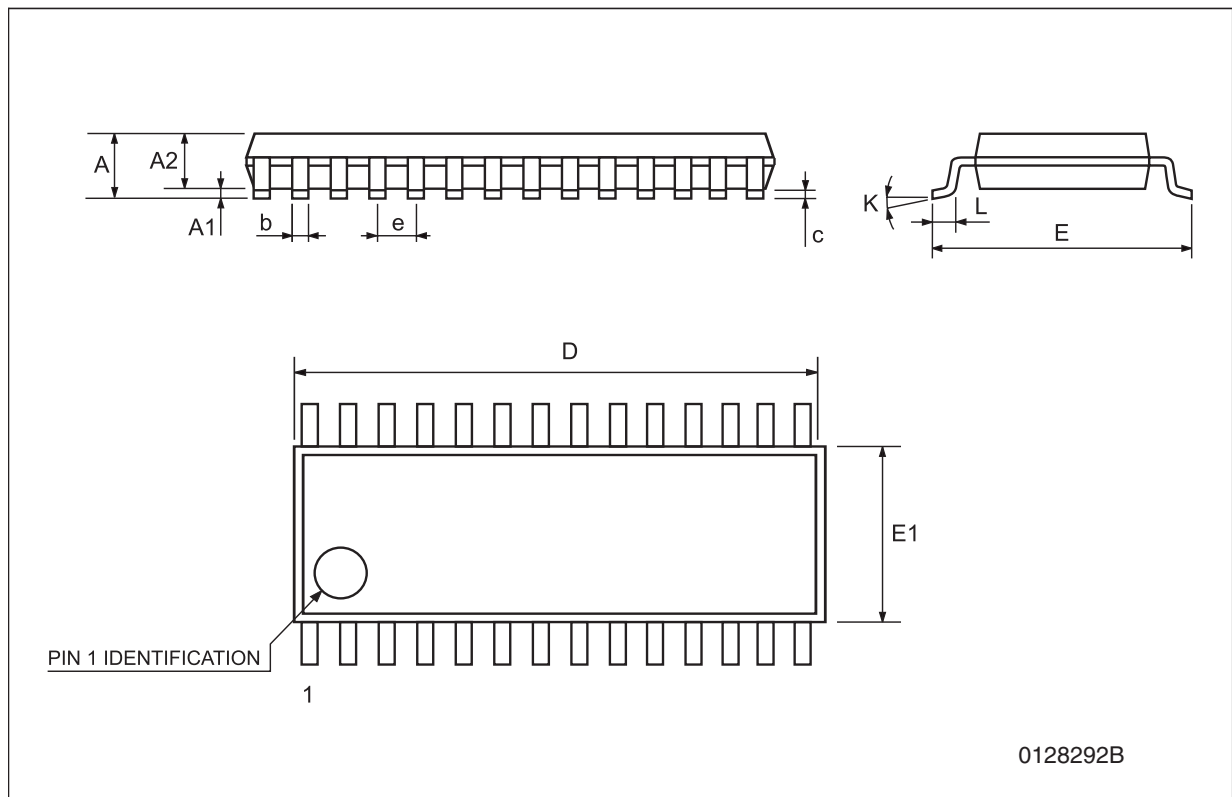
**SSOP28 mechanical data**

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



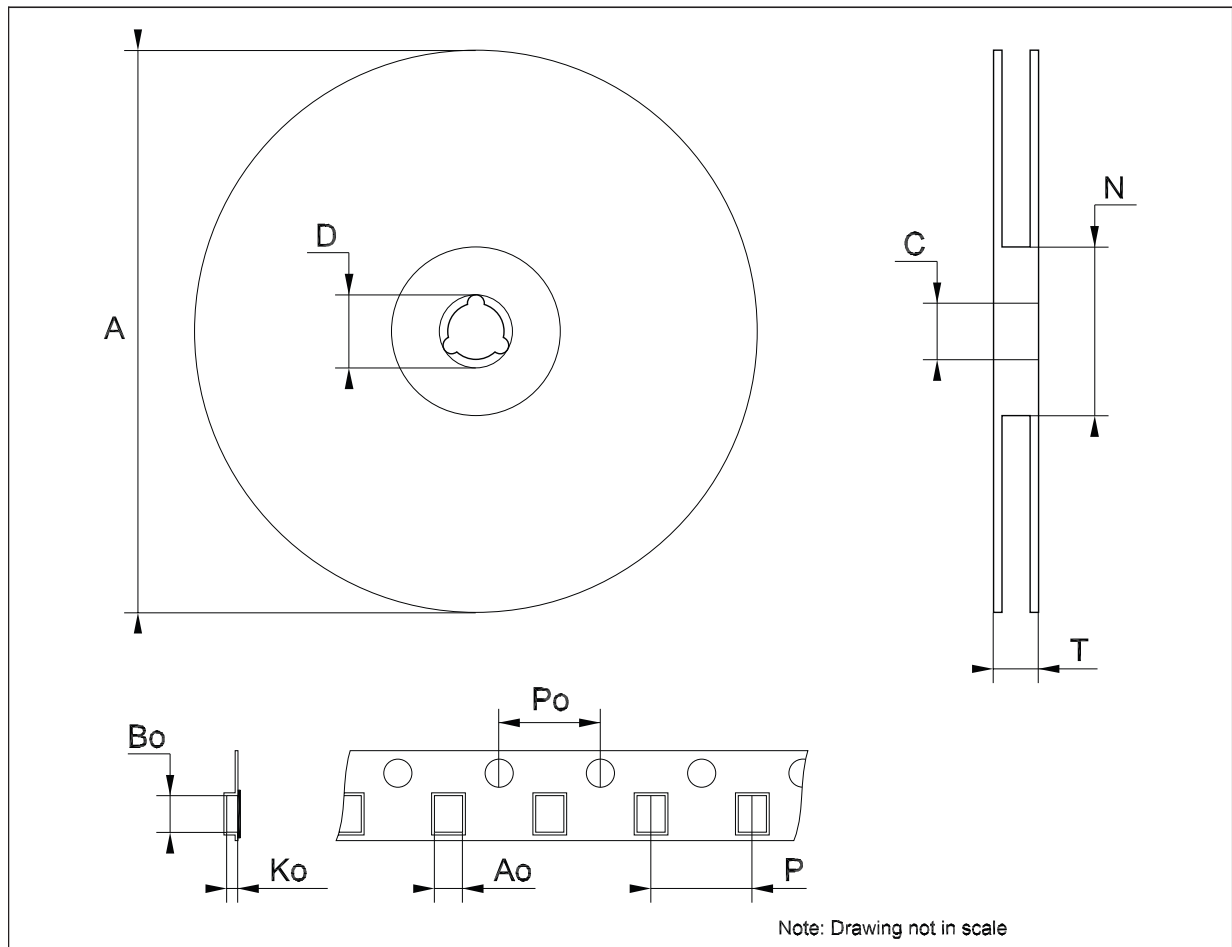
**TSSOP28 mechanical data**

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



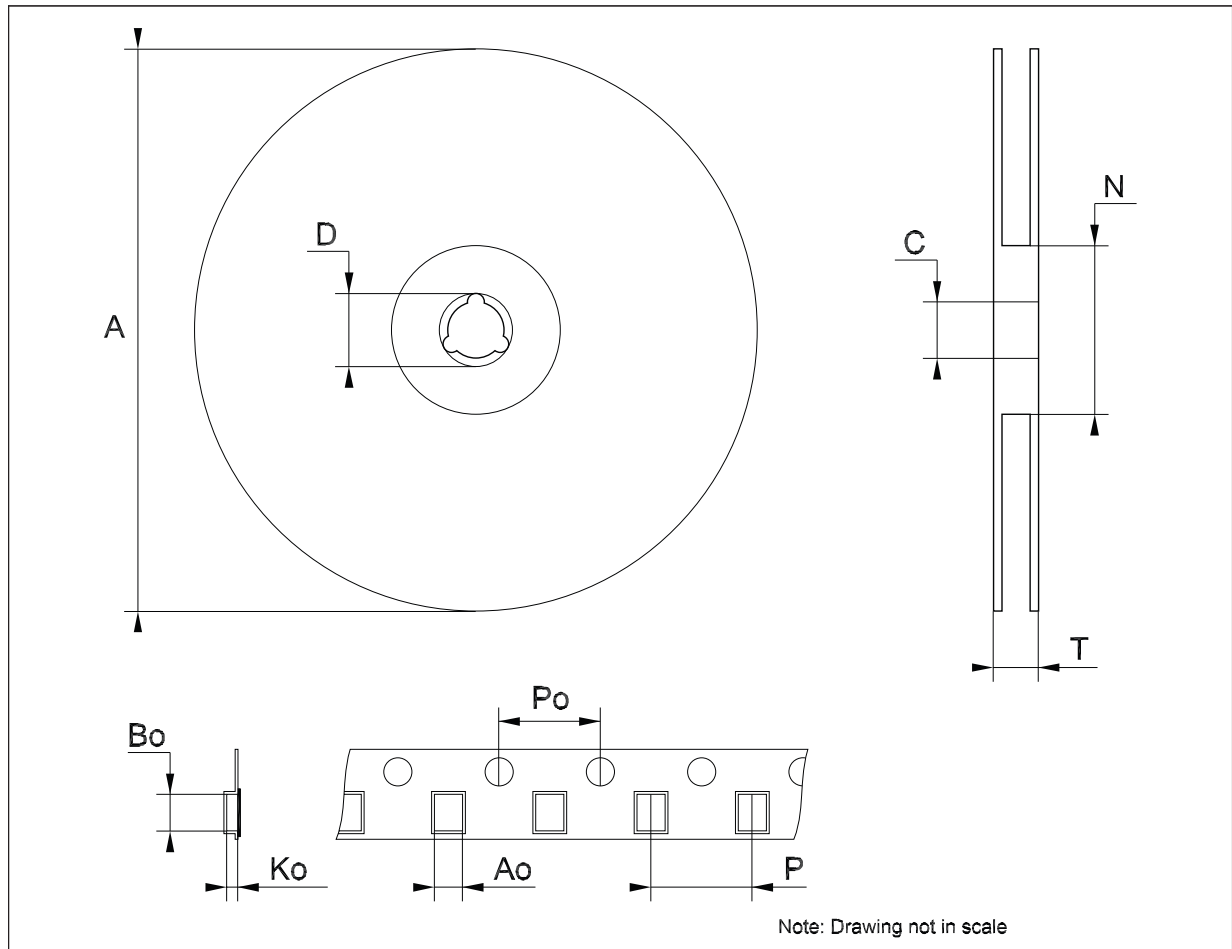
**Tape & reel SSOP28 mechanical data**

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



## 6 Revision history

Table 13. Document revision history

Date	Revision	Changes
21-Jun-2004	2	The $I_L$ (Output Leakage Current) mA ==> $\mu$ A in table 8.
03-Apr-2006	3	Order code updated.
13-Nov-2007	4	Added <a href="#">Table 1</a> .

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