



# ST3237EB

± 15 kV ESD protected, 1  $\mu$ A, 3 to 5.5 V, 250 kbps  
RS-232 transceiver with stand-by

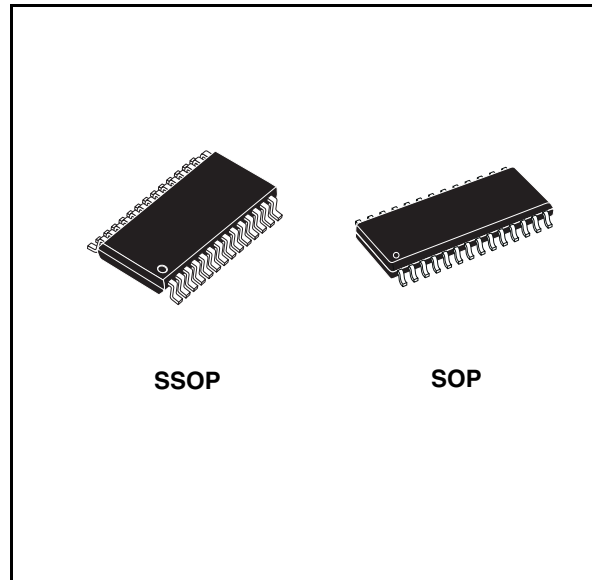
## Features

- ESD protection for RS-232 I/O pins
  - ±15 kV human body model
  - ±8 kV IEC 1000-4-2 contacts discharge
- 1  $\mu$ A low power shutdown with receivers active
- Guaranteed data rate
  - 250 kbps (normal operation)
  - 1 Mbps (very high speed operation)
- Guaranteed slew rate range
  - 6 V/ $\mu$ s (normal operation)
  - 24 V/ $\mu$ s (very high speed operation)
- 0.1  $\mu$ F external capacitors
- Flow-through pinout
- Low supply current 300  $\mu$ A
- Available in SSOP28 and SO-28

## Description

The ST3237E is a 3 V to 5.5 V powered EIA/TIA-232 and V.28/V.24 communication interfaces high data-rate capability and enhanced electrostatic discharge (ESD) protection at ±8 kV using IEC1000-4-2 contact discharge and ±15 kV using Human Body Model (HBM). The other pins are protected with standard ESD protection at ±2 kV using HBM method. The ST3237C is a transceiver (5 drivers, 3 receivers) for fast modem applications.

The device has a proprietary low-dropout transmitter output stage providing true RS-232 performance from a 3 V to 5.5 V supply using a dual charge pump. The device is guaranteed to run at data rates of 250 kbps in the normal



operation mode and 1 Mbps in the very high speed operation mode while maintaining RS-232 output levels.

**Table 1. Device summary**

Order code	Temperature range	Package	Packaging
ST3237EBDR	-40 to 85 °C	SO-28 (tape and reel)	1000 parts per reel
ST3237EBPR	-40 to 85 °C	SSOP28 (tape and reel)	1350 parts per reel

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# 1 Pin configuration

Figure 1. Pin connection

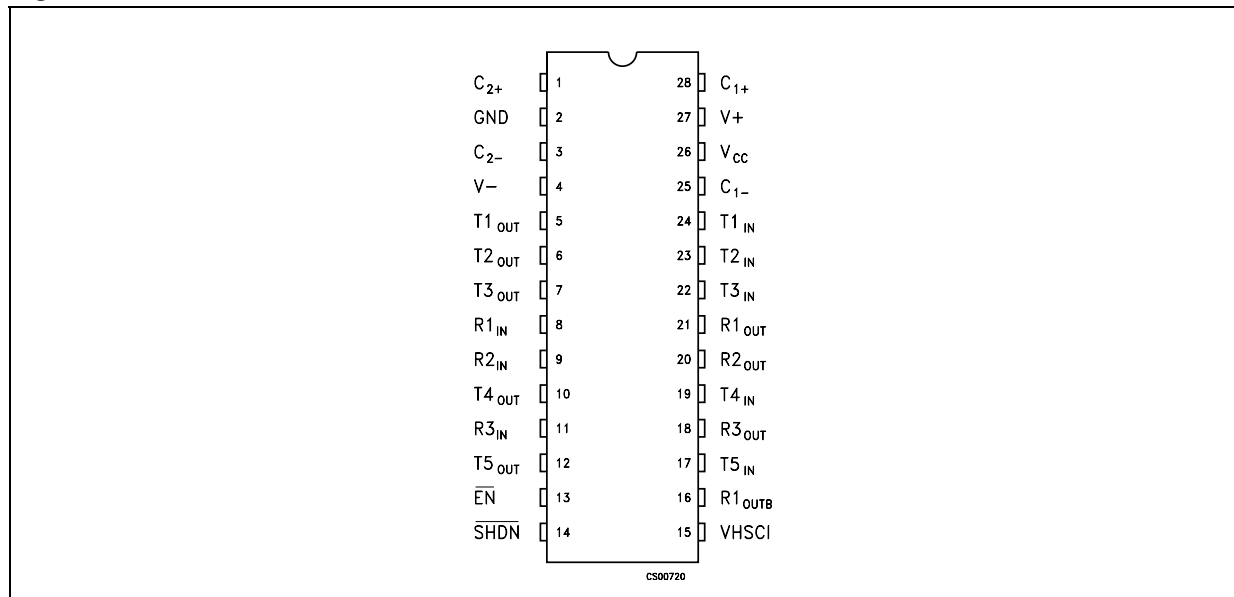


Table 2. Pin description

Pin n°	Symbol	Name and function
1	C <sub>2+</sub>	Positive Terminal of Inverting Charge Pump Capacitor
2	GND	Ground
3	C <sub>2-</sub>	Negative terminal of inverting charge pump capacitor
4	V-	5.5V generated by the charge pump
5	T1 <sub>OUT</sub>	First transmitter output voltage
6	T2 <sub>OUT</sub>	Second transmitter output voltage
7	T3 <sub>OUT</sub>	Third transmitter output voltage
8	R1 <sub>IN</sub>	First receiver input voltage
9	R2 <sub>IN</sub>	Second receiver input voltage
10	T4 <sub>OUT</sub>	Fourth transmitter output voltage
11	R3 <sub>IN</sub>	Third receiver input voltage
12	T5 <sub>OUT</sub>	Fifth transmitter output voltage
13	EN	Receiver enable, active low
14	SHDN	Shutdown control, active low
15	VHSCI	Very high speed control input. Connect to GND for normal operation; connect to V <sub>CC</sub> for 1 Mbps transmission rates.
16	R1 <sub>OUTB</sub>	Non inverting complementary receiver output. Always active.
17	T5 <sub>IN</sub>	Fifth transmitter input voltage
18	R3 <sub>OUT</sub>	Third receiver output voltage

Table 2. Pin description (continued)

Pin n°	Symbol	Name and function
19	T4 <sub>IN</sub>	Fourth transmitter input voltage
20	R2 <sub>OUT</sub>	Second receiver output voltage
21	R1 <sub>OUT</sub>	First receiver output voltage
22	T3 <sub>IN</sub>	Third transmitter input voltage
23	T2 <sub>IN</sub>	Second transmitter input voltage
24	T1 <sub>N</sub>	First transmitter input voltage
25	C <sub>1-</sub>	Negative terminal of voltage- charge pump capacitor
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

## 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	-0.3 to 7	V
V-	Inverted voltage terminal	0.3 to -7	V
$V+ + V- $		13	V
$T_{IN}$	Transmitter input voltage range	-0.3 to 6	V
$\overline{SHDN}$ , $\overline{EN}$		-0.3 to 6	V
VHSCI	Very high speed control input	-0.3 to ( $V_{CC} + 0.3$ )	V
$R_{IN}$	Receiver input voltage range	$\pm 25$	V
$T_{OUT}$	Transmitter output voltage range	$\pm 13.2$	V
$R_{OUT}$ , $R_{OUTB}$	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. V+ and V- can have a maximum magnitude of +7 V, but their absolute addition can not exceed 13 V.

**Table 4. Shutdown and enable control truth table**

SHDN	EN	T-OUT	R-OUT	R-OUTB
0	0	High Z	Active	Active
0	1	High Z	High Z	Active
1	0	Active	Active	Active
1	1	Active	High Z	Active

**Figure 2. 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 5. Electrical characteristics** ( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{CC} = 3 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{\text{SUPPLY}}$	$V_{CC}$ power supply current	$\overline{\text{SHDN}}=V_{CC}$ , No Load		0.3	1	mA
$I_{\text{SHDN}}$	Shutdown supply current	$\overline{\text{SHDN}}=\text{GND}$ , $V_{T\_IN}=\text{GND}$ or $V_{CC}$		1	5	$\mu\text{A}$

**Table 6. Logic input** ( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{CC} = 3 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{\text{TIL}}$	Input logic threshold low (1)	T-IN, VHSCI, $\overline{\text{EN}}$ , $\overline{\text{SHDN}}$			0.8	V
$V_{\text{TIH}}$	Input logic threshold high	T-IN, VHSCI, $\overline{\text{EN}}$ , $\overline{\text{SHDN}}$	$V_{CC} = 3.3\text{V}$	2		V
			$V_{CC} = 5\text{V}$	2.4		
$I_{\text{IL}}$	Input leakage current	T-IN, VHSCI, $\overline{\text{EN}}$ , $\overline{\text{SHDN}}$			$\pm 1.0$	$\mu\text{A}$
$V_{\text{HYS}}$	Transmitter input hysteresis			0.25		V

1. Transmitter input hysteresis is typically 250 mV

**Table 7. Transmitter** ( $C_1 - C_4 = 0.1 \mu\text{F}$  tested at  $3.3 \text{ V} \pm 10 \%$ ,  $V_{CC} = 3 \text{ V to } 5.5 \text{ V}$ ,  $T_A = -40 \text{ to } 85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{\text{TOUT}}$	Output voltage swing	All transmitter outputs are loaded with $3\text{K}\Omega$ to GND	$\pm 5$	$\pm 5.4$		V
$R_{\text{TOUT}}$	Transmitter output resistance	$V_{CC} = 0\text{V}$ , $V_{\text{OUT}} = \pm 2\text{V}$	300	10M		$\Omega$
$I_{\text{SC}}$	Output short circuit current			$\pm 60$		mA
$I_{\text{TOL}}$	Output leakage current	$V_{CC} = 0\text{V}$ or $3.3\text{V to } 5.5\text{V}$ $V_{\text{OUT}} = \pm 12\text{V}$ Transmitters disable			$\pm 25$	$\mu\text{A}$

**Table 8. Receiver** ( $C_1 - C_4 = 0.1 \mu\text{F}$  tested at  $3.3 \text{ V} \pm 10 \%$ ,  $V_{\text{CC}} = 3 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25^\circ\text{C}$ )

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{\text{OL}}$	Output leakage current	Receiver disabled, $\overline{\text{EN}} = V_{\text{CC}}$		$\pm 0.05$	$\pm 10$	$\mu\text{A}$
$V_{\text{OL}}$	Output voltage low	$I_{\text{OUT}} = 1\text{mA}$			0.4	V
$V_{\text{OH}}$	Output voltage high	$I_{\text{OUT}} = -1\text{mA}$	$V_{\text{CC}} - 0.6$	$V_{\text{CC}} - 0.1$		V
$V_{\text{RIN}}$	Receiver input voltage operating range		-25		25	V
$V_{\text{RIL}}$	RS-232 input threshold low	$T_A = 25^\circ\text{C}$ , $V_{\text{CC}} = 3.3\text{V}$	0.6	1.1		V
		$T_A = 25^\circ\text{C}$ , $V_{\text{CC}} = 5\text{V}$	0.8	1.5		
$V_{\text{RIH}}$	RS-232 input threshold high	$T_A = 25^\circ\text{C}$ , $V_{\text{CC}} = 3.3\text{V}$		1.5	2.4	V
		$T_A = 25^\circ\text{C}$ , $V_{\text{CC}} = 5\text{V}$		1.2	2.4	
$V_{\text{RIHYS}}$	Input hysteresis			0.3		V
$R_{\text{RIN}}$	Input resistance	$T_A = 25^\circ\text{C}$	3	5	7	$\text{K}\Omega$

**Table 9. Timing characteristics** ( $C_1 - C_4 = 0.1 \mu\text{F}$  tested at  $3.3 \text{ V} \pm 10 \%$ ,  $V_{\text{CC}} = 3 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ )

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, $\text{VHSCI} = \text{GND}$	250			Kbps
		$R_L = 3\text{K}\Omega$ , $C_L = 250\text{pF}$ one transmitter switching, $\text{VHSCI} = V_{\text{CC}}$ $V_{\text{CC}} = 3$ to $4.5\text{V}$	1000			Kbps
		$R_L = 3\text{K}\Omega$ , $C_L = 1000\text{pF}$ one transmitter switching, $\text{VHSCI} = V_{\text{CC}}$ $V_{\text{CC}} = 4.5$ to $5.5\text{V}$	1000			Kbps
$t_{\text{PHLR}}$ $t_{\text{PLHR}}$	Propagation delay input to output	$R_{\text{IN}}$ to $R_{\text{OUT}}$ , $C_L = 150\text{pF}$		0.15		$\mu\text{s}$
$t_{\text{PHLR}}$ $t_{\text{PLHR}}$	Propagation delay input to output	$R_L = 3\text{k}\Omega$ , $C_L = 1000\text{pF}$ , $\text{VHSCI} = V_{\text{CC}}$ $\text{VHSCI} = \text{GND}$		400 1000		ns ns
$t_{\text{T\_SKEW}}$	Transmitter skew	$ t_{\text{PHL}} - t_{\text{TLH}} $ , $\text{VHSCI} = \text{GND}$		300		ns
		$ t_{\text{PHL}} - t_{\text{TLH}} $ , $\text{VHSCI} = V_{\text{CC}}$		50		ns
$t_{\text{R\_SKEW}}$	Receiver skew	$ t_{\text{PHL}} - t_{\text{TLH}} $		100		ns
$t_{\text{OER}}$	Receiver output enable time	Normal operation		50		ns
$t_{\text{ODR}}$	Receiver output disable time	Normal operation		120		ns
$S_{\text{RT}}$	Transition slew rate	$T_A = 25^\circ\text{C}$ $R_L = 3$ to $7\text{K}\Omega$ , $V_{\text{CC}} = 3.3\text{V}$ measured from $+3\text{V}$ to $-3\text{V}$ or $-3\text{V}$ to $+3\text{V}$ $C_L = 150\text{pF}$ to $1000\text{pF}$ , $\text{VHSCI} = \text{GND}$	6		30	$\text{V}/\mu\text{s}$
		$C_L = 150\text{pF}$ to $1000\text{pF}$ , $\text{VHSCI} = V_{\text{CC}}$	24		150	$\text{V}/\mu\text{s}$
		$C_L = 150\text{pF}$ to $2500\text{pF}$ , $\text{VHSCI} = \text{GND}$	4		30	$\text{V}/\mu\text{s}$

Note: Transmitter skew is measured at the transmitter zero cross points

# 4 Application

Figure 3. Application circuits

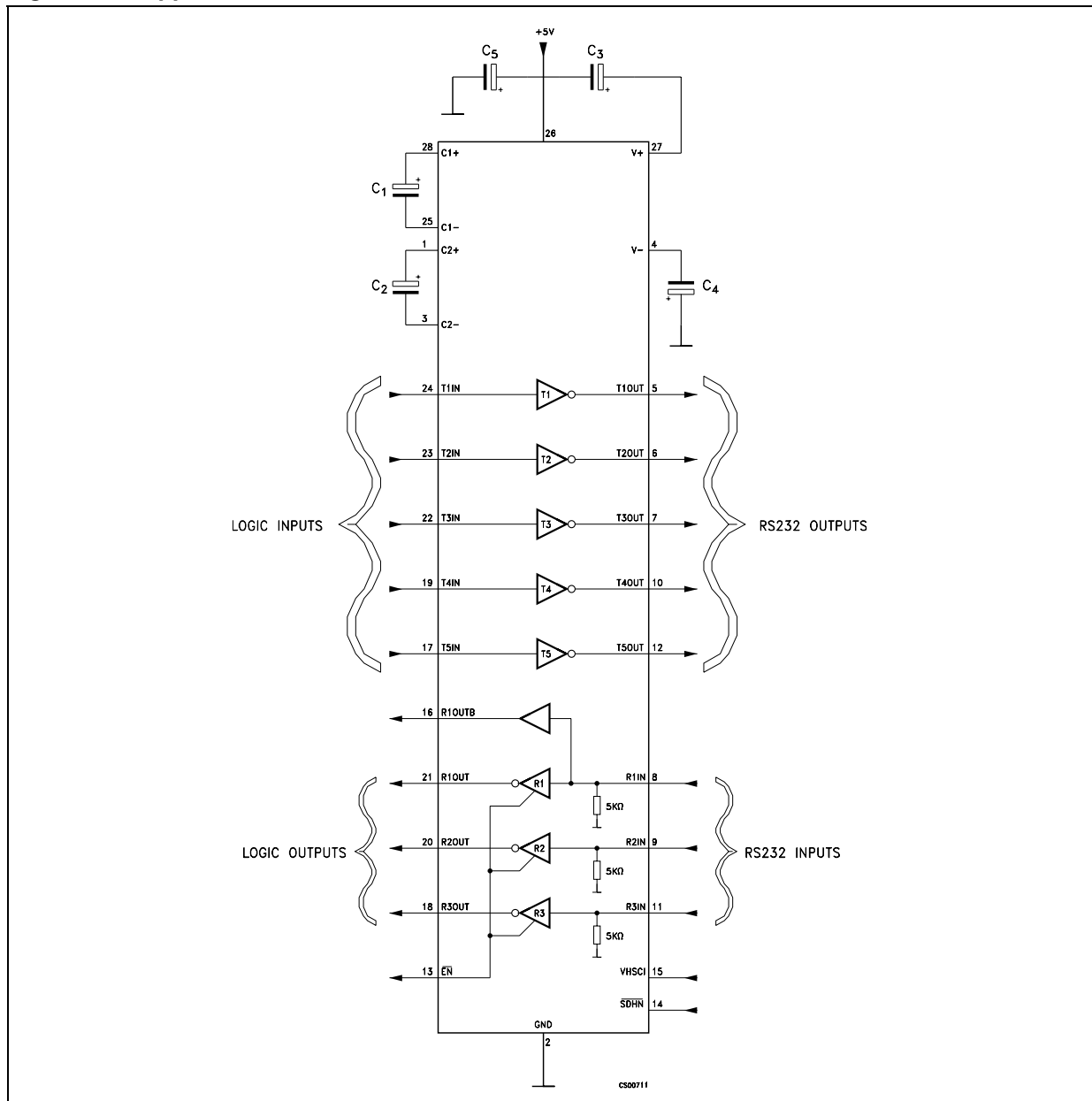


Table 10. Capacitance value (μF)

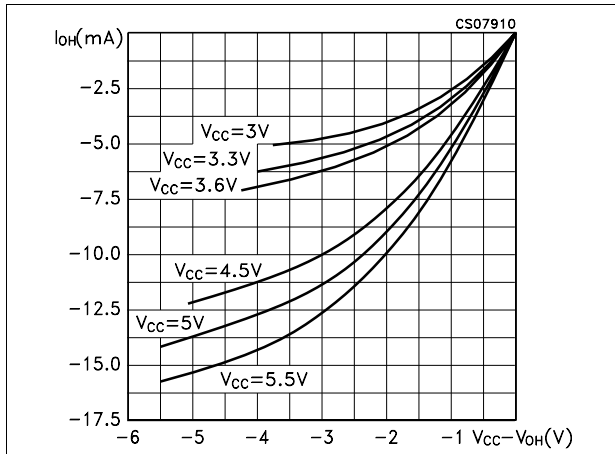
V <sub>CC</sub>	C1	C2	C3	C4	Cbypass
3.0 to 3.6	0.22	0.22	0.22	0.22	0.1
3.1 to 3.6	0.1	0.1	0.1	0.1	0.1
4.5 to 5.5	0.047	0.33	0.33	0.33	0.1
3.0 to 5.5	0.22	0.1	0.1	0.1	0.1



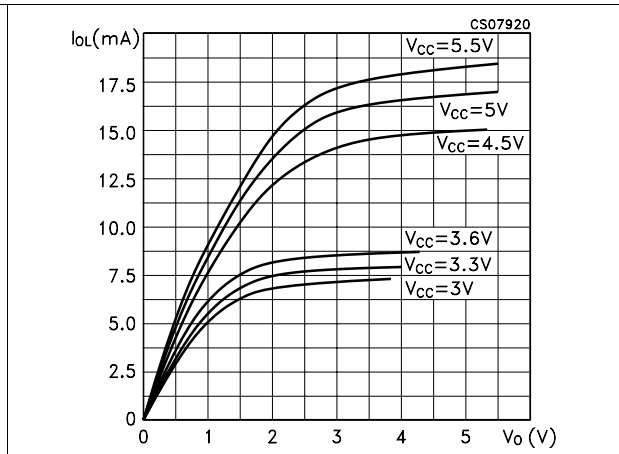
# 5 Typical performance characteristics

(unless otherwise specified  $T_J = 25^\circ\text{C}$ )

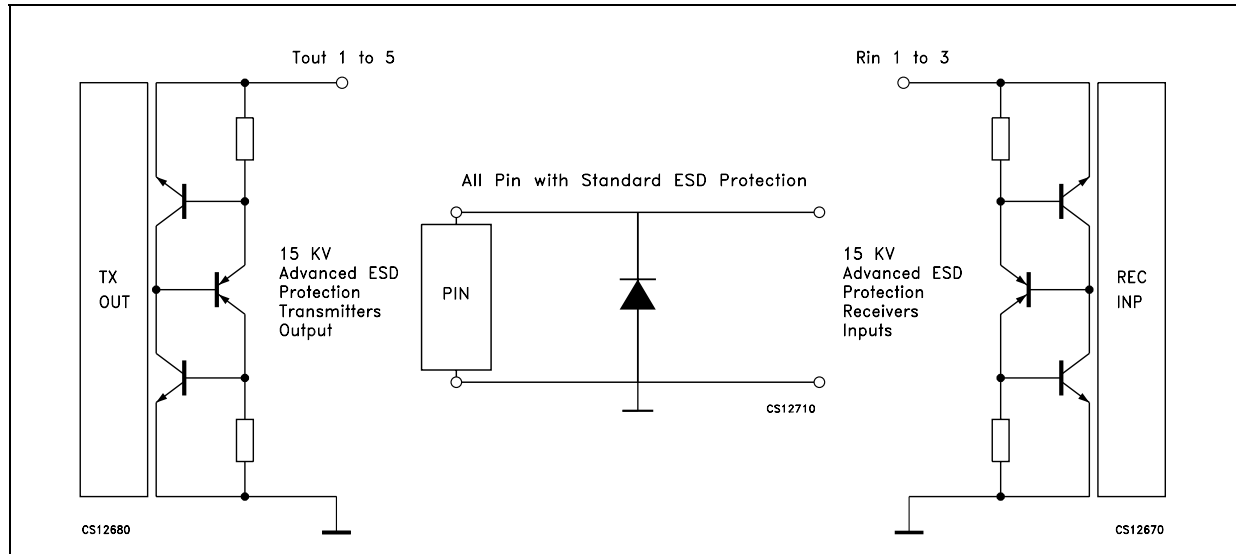
**Figure 4. Low level receiver output current**



**Figure 5. High level receiver output current**



**Figure 6. ESD protection**



*Note: The high ESD protected pins are the I/O RS232 line, transmitter out and receiver in. The other pins guarantee  $\pm 2$  kV HBM ESD protection versus ground by means of diodes.*

## 6 Application note

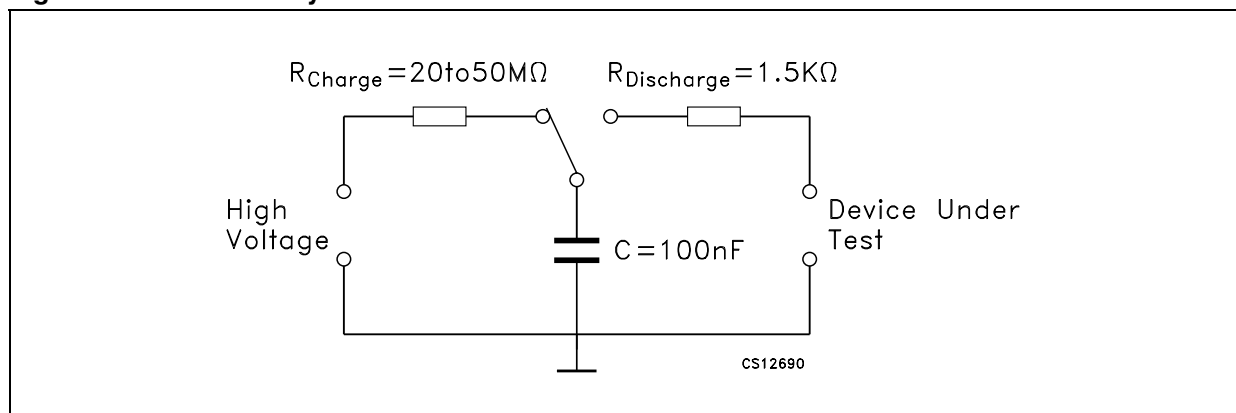
This application note describes the procedure for determining the susceptibility and the test method to verify ST ESD advanced protection on RS-232 or RS485 I/O device.

Static electricity is defined as an electrical charge caused by an imbalance of electrons on the surface of a material. This imbalance of electrons produces an electric field that can be measured and that can influence other objects at a distance. Electrostatic discharge is defined as the transfer of charge between bodies at different electrical potentials.

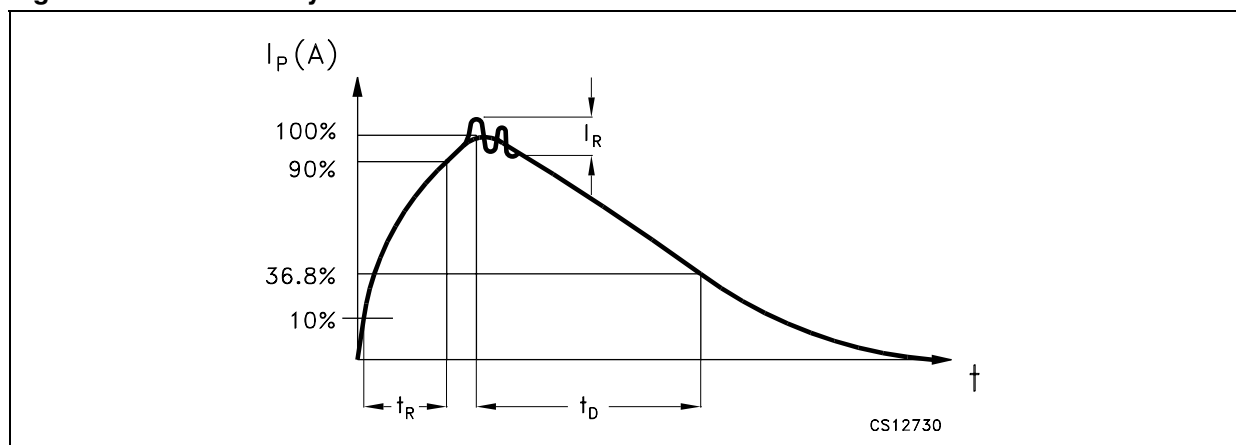
Electrostatic discharge (ESD) can change the electrical characteristics of a semiconductor device, degrading or destroying it. Any input or output port (I/O) allows access communication with other pieces of equipment by external connectors. These connectors are directly linked by the I/O pins of RS-232 or RS485 interface. ST provides the E-series by advanced high ESD protection structure. The protection functionality is tested in two different conditions:

The first model is used to simulate the HUMAN BODY MODEL (HBM) event. A similar discharge can occur from a charged conductive object, such as a metallic tool or fixture. The model used to characterize this event is known as the machine model. A human body model circuit and waveform is presented in figures below.

**Figure 7. Human body model circuit**

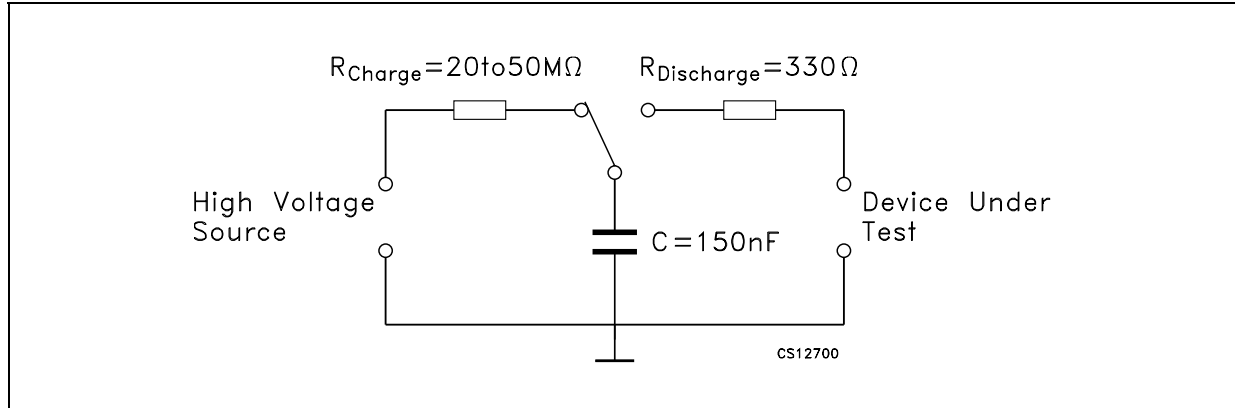


**Figure 8. Human body model current waveform**

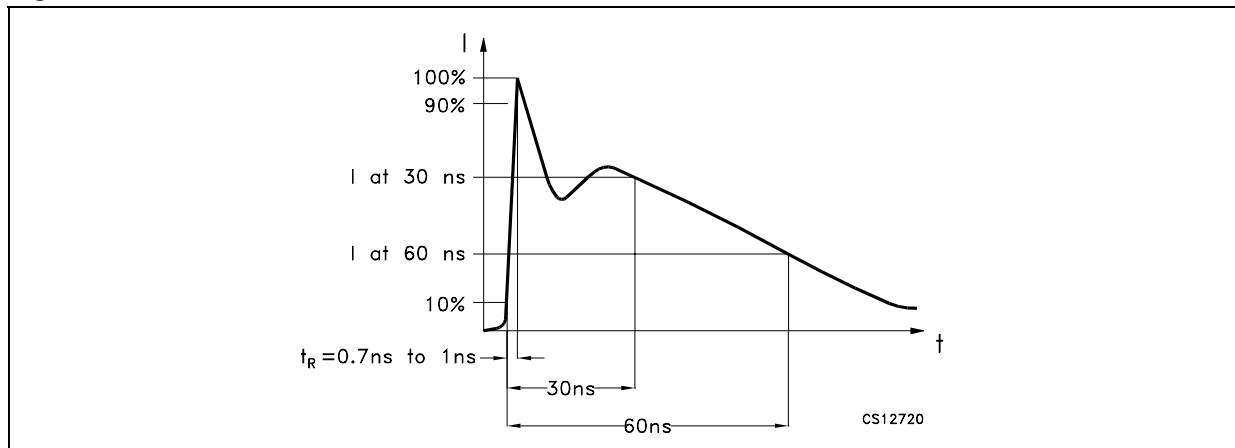


The second model is IEC 1000-4-2 and is used to simulate the reaction of the device on equipment when subjected to electrostatic discharges, which may occur from personnel to objects near vital instrumentation. Direct (Contact) and indirect (Air Gap) applications of discharges to the equipment under test (EUT) are possible. Test characteristics are shown in circuit, waveform and table below.

**Figure 9. IEC 1000-4-2 circuit**



**Figure 10. IEC 1000-4-2 current waveform**



**Table 11. Characteristics of the ESD generator**

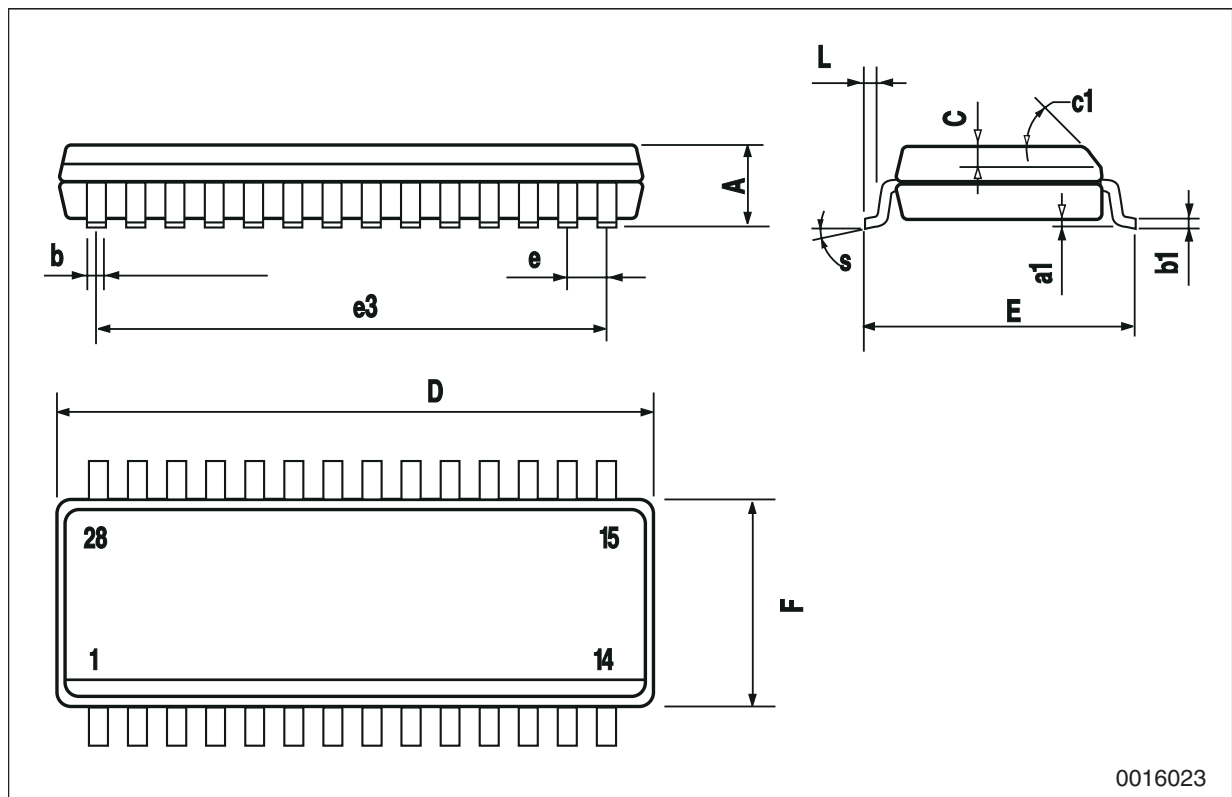
Level	Indicated voltage	First peak current of discharge ( $\pm 10\%$ )	Rise time with discharge switch	Current at 30 ns ( $\pm 30\%$ )	Current at 60 ns ( $\pm 30\%$ )
1	2 kV	7.5 A	0.7 to 1ns	4 A	2 A
2	4 kV	15 A	0.7 to 1ns	8 A	4 A
3	6 kV	22.5 A	0.7 to 1ns	12 A	6 A
4	8 kV	30 A	0.7 to 1ns	16 A	8 A

## 7 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).

**SO-28 mechanical data**

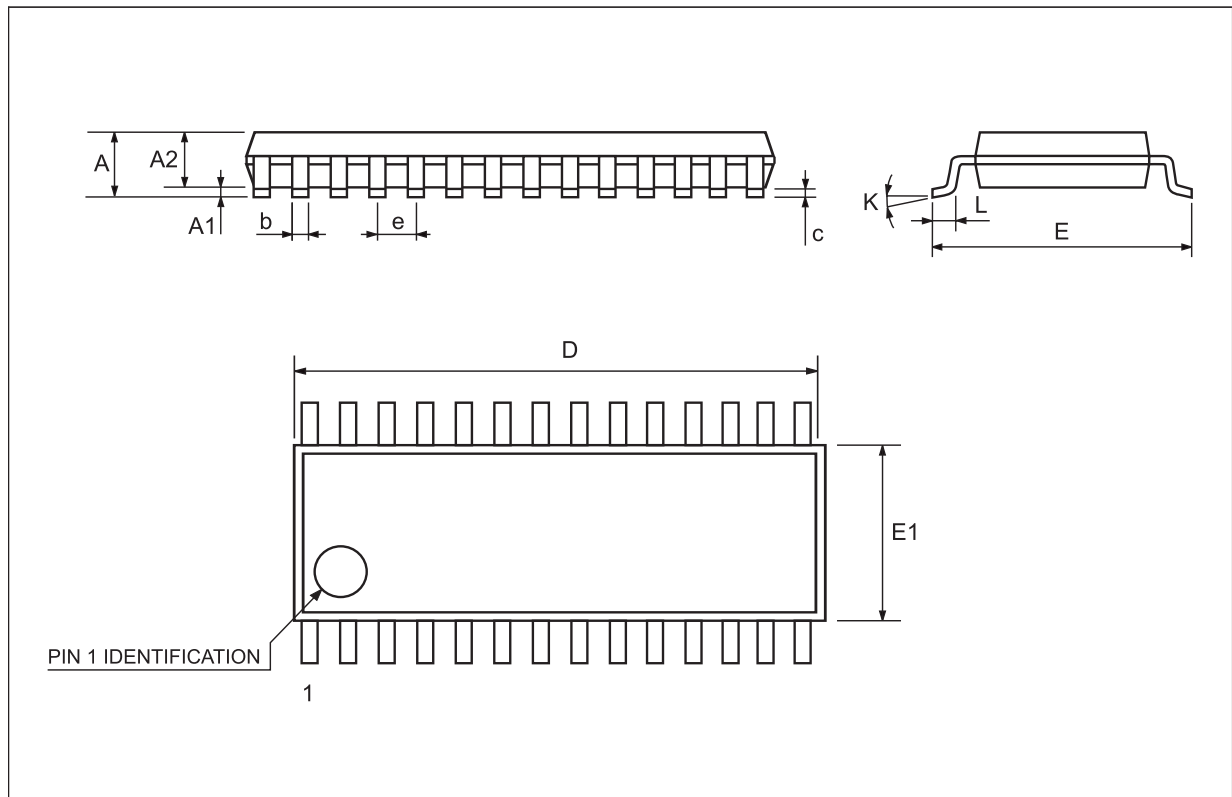
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			2.65			0.104
a1	0.1		0.3	0.004		0.012
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.012
C		0.5			0.020	
c1	45° (typ.)					
D	17.70		18.10	0.697		0.713
E	10.00		10.65	0.393		0.419
e		1.27			0.050	
e3		16.51			0.650	
F	7.40		7.60	0.291		0.300
L	0.50		1.27	0.020		0.050
S	8° (max.)					



0016023

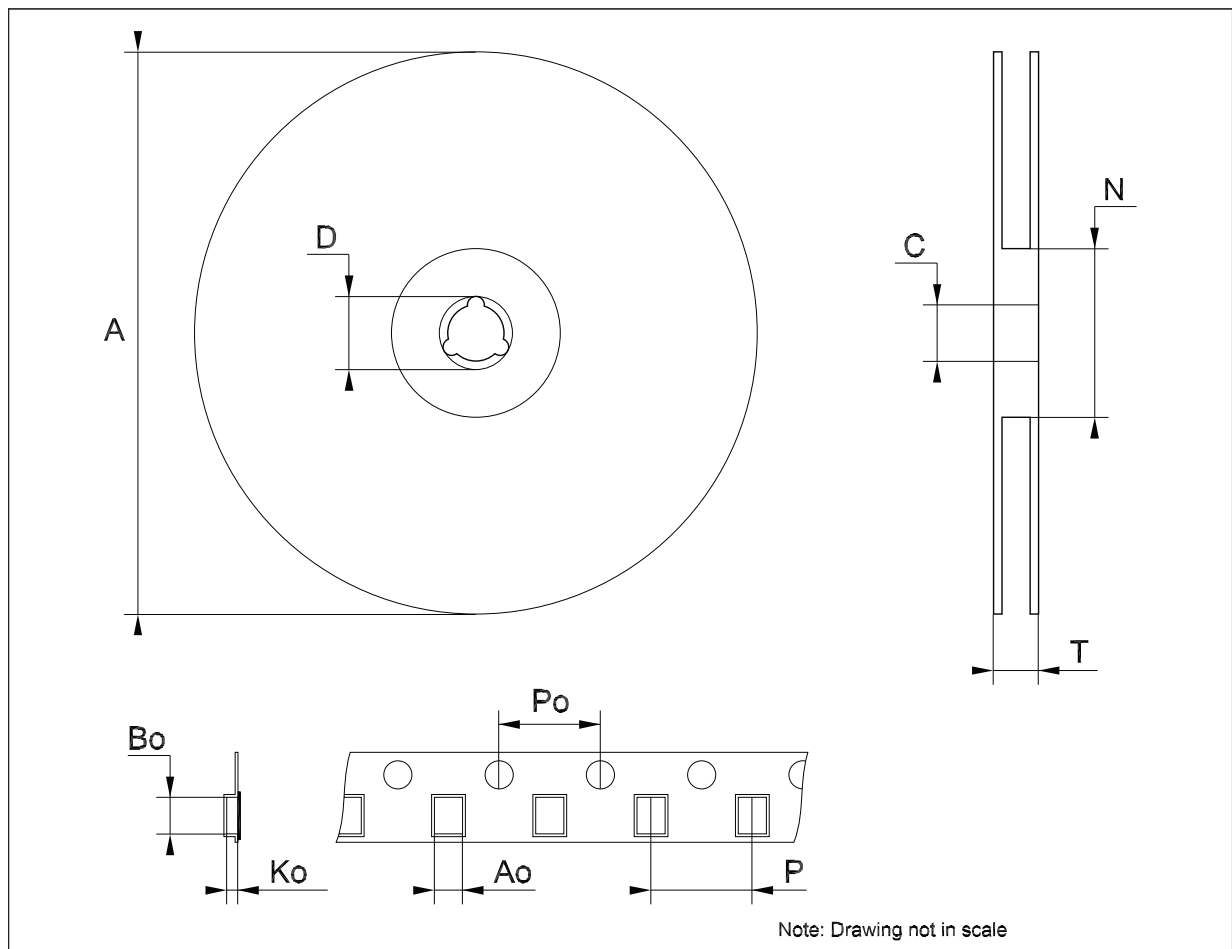
**SSOP28 mechanical data**

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



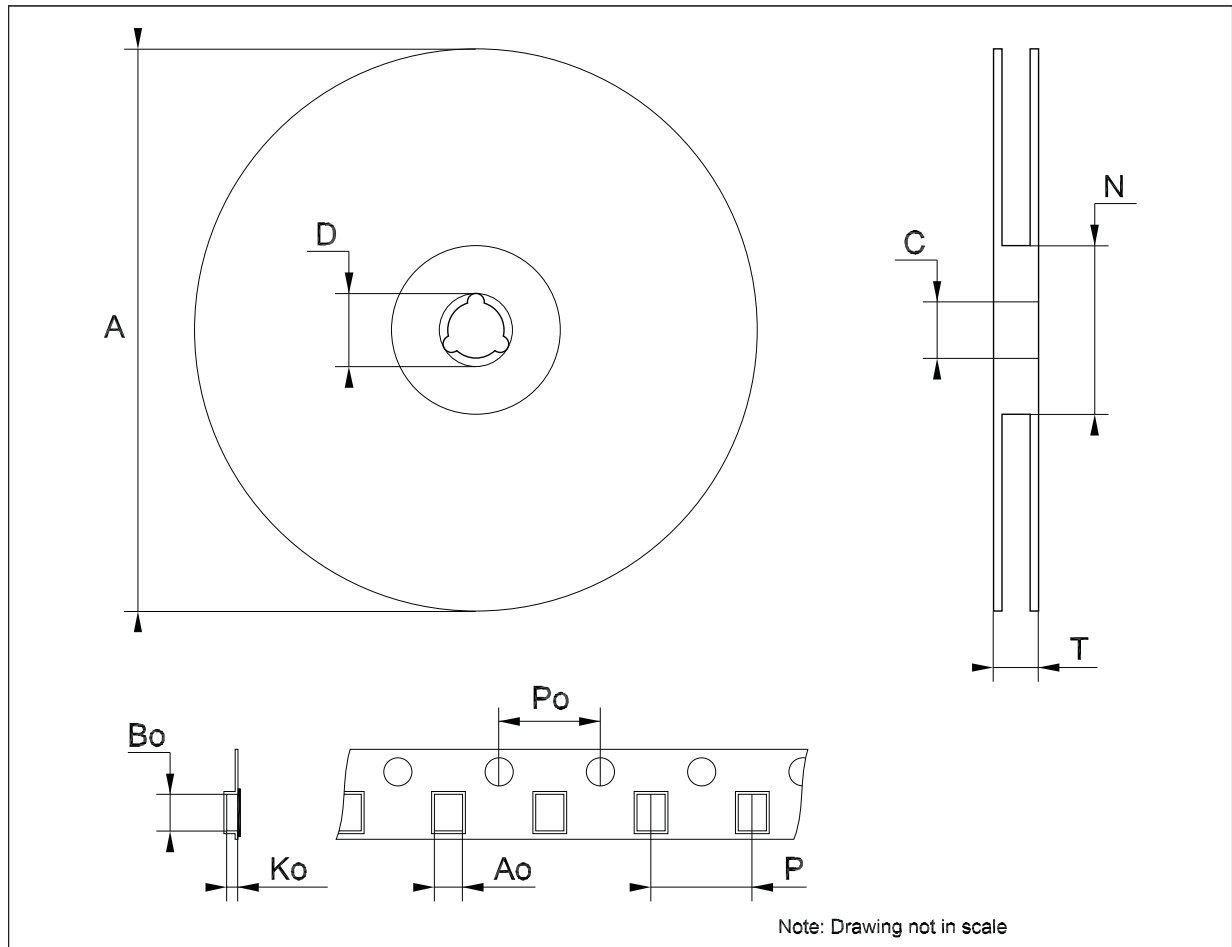
**Tape & reel SO-28 mechanical data**

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 & 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





## 8 Revision history

Table 12. Document revision history

Date	Revision	Changes
21-Mar-2005	5	TSSOP has been removed.
24-Mar-2006	6	Order codes updated.
13-Nov-2007	7	Added <a href="#">Table 1</a> .