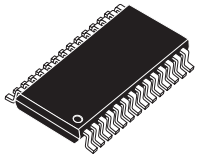
ST3237EB

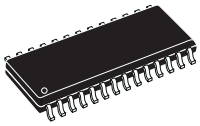
± 15 kV ESD protected, 1 µA, 3 to 5.5 V, 250 kbps RS-232 transceiver with stand-by

Features

- ESD protection for RS-232 I/O pins
  - ±15 kV human body model
  - ±8 kV IEC 1000-4-2 contacts discharge
- 1 µA 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/µs (normal operation)
  - 24 V/µs (very high speed operation)
- 0.1 µF external capacitors
- Flow-through pinout
- Low supply current 300 µA
- Available in SSOP28 and SO-28



SSOP



SOP

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

Contents

1 Pin configuration

Figure 1. Pin connection

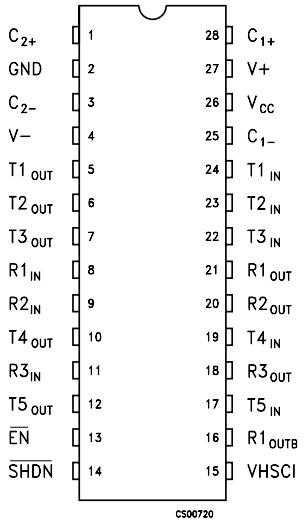


Table 2. Pin description

Pin n°	Symbol	Name and function
1	C_2+	Positive Terminal of Inverting Charge Pump Capacitor
2	GND	Ground
3	C_2-	Negative terminal of inverting charge pump capacitor
4	V-	5.5V generated by the charge pump
5	$T1_{OUT}$	First transmitter output voltage
6	$T2_{OUT}$	Second transmitter output voltage
7	$T3_{OUT}$	Third transmitter output voltage
8	$R1_{IN}$	First receiver input voltage
9	$R2_{IN}$	Second receiver input voltage
10	$T4_{OUT}$	Fourth transmitter output voltage
11	$R3_{IN}$	Third receiver input voltage
12	$T5_{OUT}$	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_{CC} for 1 Mbps transmission rates.
16	$R1_{OUTB}$	Non inverting complementary receiver output. Always active.
17	$T5_{IN}$	Fifth transmitter input voltage
18	$R3_{OUT}$	Third receiver output voltage

Table 2. Pin description (continued)

Pin n°	Symbol	Name and function
19	$T4_{IN}$	Fourth transmitter input voltage
20	$R2_{OUT}$	Second receiver output voltage
21	$R1_{OUT}$	First receiver output voltage
22	$T3_{IN}$	Third transmitter input voltage
23	$T2_{IN}$	Second transmitter input voltage
24	$T1_{N}$	First transmitter input voltage
25	C_1-	Negative terminal of voltage- charge pump capacitor
26	V_{CC}	Supply voltage
27	V+	-5.5V generated by the charge pump
28	C_1+	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	±25	V
T_{OUT}	Transmitter output voltage range	±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	±15			kV
ESD	ESD protection voltage	IEC-1000-4-2 contact discharge	±8			kV

3 Electrical characteristics

Table 5. Electrical characteristics (C_1 - C_4 = 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)

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

Table 6. Logic input (C_1 - C_4 = 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)

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

1. Transmitter input hysteresis is typically 250 mV

Table 7. Transmitter (C_1 - C_4 = 0.1 µF tested at 3.3 V ± 10 %, 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)

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_{TOUT}	Transmitter output resistance	V_{CC} = 0V, V_{OUT} = ±2V	300	10M		Ω
I_{SC}	Output short circuit current			±60		mA
I_{TOL}	Output leakage current	V_{CC} = 0V or 3.3V to 5.5V V_{OUT} = ±12V Transmitters disable			±25	µA

Table 8. **Receiver** (C_1 - C_4 = 0.1 µF tested at 3.3 V ±10 %, 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)

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

Table 9. **Timing characteristics** (C_1 - C_4 = 0.1 µF tested at 3.3 V ±10 %, 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)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
D_R	Maximum data rate	R_L = 3KΩ, C_L= 1000pF one transmitter switching, VHSCI=GND	250			Kbps
		R_L = 3KΩ, C_L= 250pF one transmitter switching, VHSCI=V_{CC} V_{CC}= 3 to 4.5V	1000			Kbps
		R_L = 3KΩ, C_L= 1000pF one transmitter switching, VHSCI=V_{CC} V_{CC}= 4.5 to 5.5V	1000			Kbps
t_{PHLR} t_{PLHR}	Propagation delay input to output	R_{IN} to R_{OUT}, C_L = 150pF		0.15		µs
t_{PHLR} t_{PLHR}	Propagation delay input to output	R_L = 3kΩ, C_L = 1000pF, VHSCI=V_{CC} VHSCI=GND		400 1000		ns ns
t_{T_SKEW}	Transmitter skew	$\lvert t_{PHL} - t_{TLH} \rvert$, VHSCI=GND		300		ns
		$\lvert t_{PHL} - t_{TLH} \rvert$, VHSCI=$V_{CC}$		50		ns
t_{R_SKEW}	Receiver skew	$\lvert t_{PHL} - t_{TLH} \rvert$		100		ns
t_{OER}	Receiver output enable time	Normal operation		50		ns
t_{ODR}	Receiver output disable time	Normal operation		120		ns
S_{RT}	Transition slew rate	T_A = 25°C R_L = 3 to 7KΩ, V_{CC} = 3.3V measured from +3V to -3V or -3V to +3V C_L = 150pF to 1000pF, VHSCI=GND C_L = 150pF to 1000pF, VHSCI=V_{CC} C_L = 150pF to 2500pF, VHSCI=GND	 6 24 4		 30 150 30	 V/µs V/µs V/µs

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

4 Application

Figure 3. Application circuits

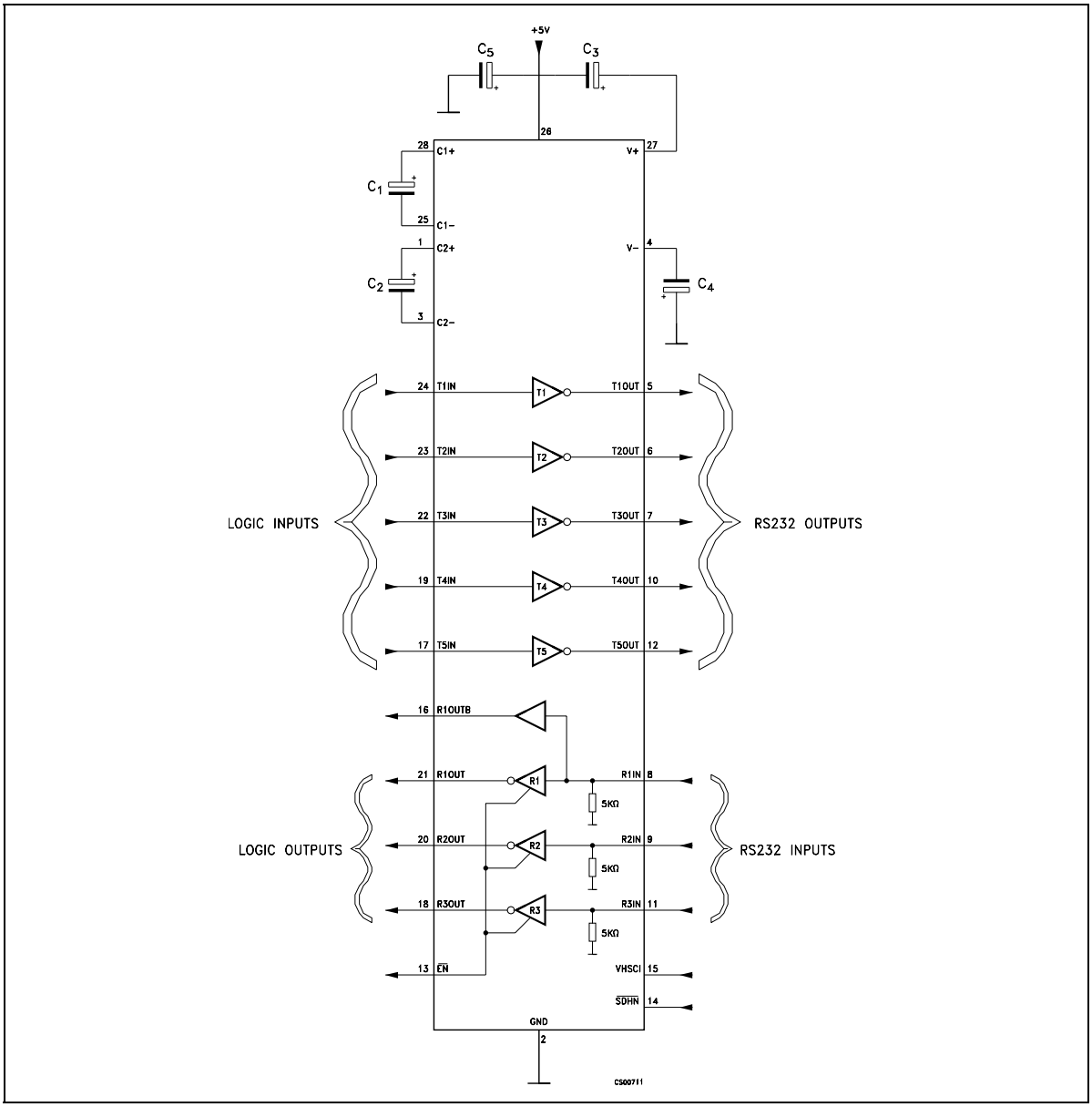


Table 10. Capacitance value (µF)

V_{CC}	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°C)

Figure 4. Low level receiver output current

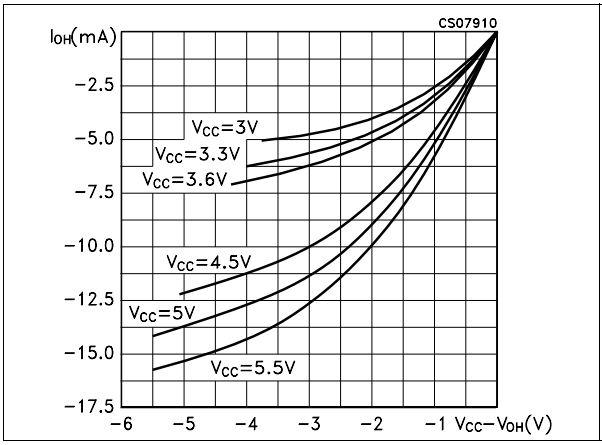


Figure 5. High level receiver output current

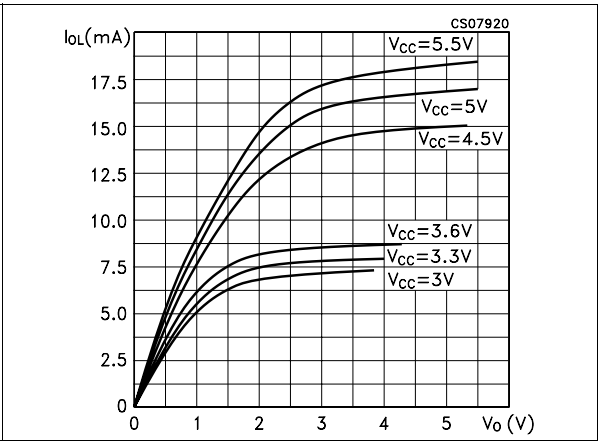
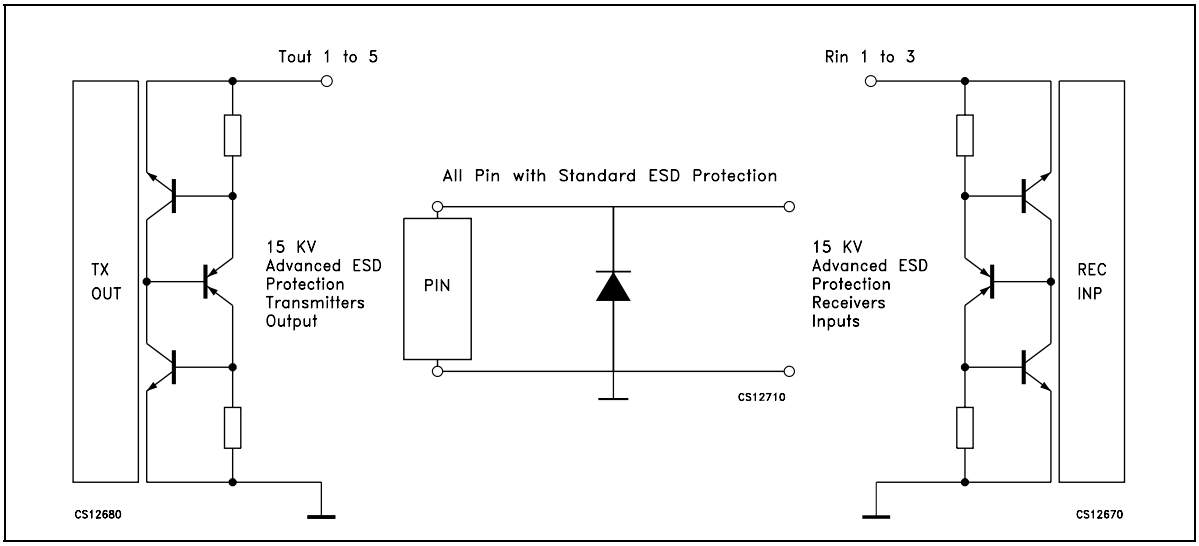


Figure 6. ESD protection



Note: The high ESD protected pins are the I/O RS232 line, transmitter out and receiver in. The other pins guarantee ± 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

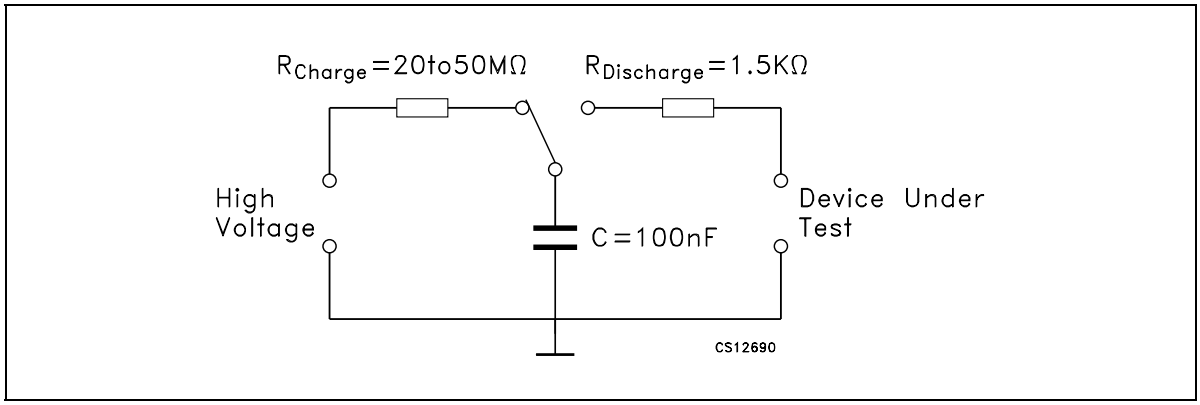
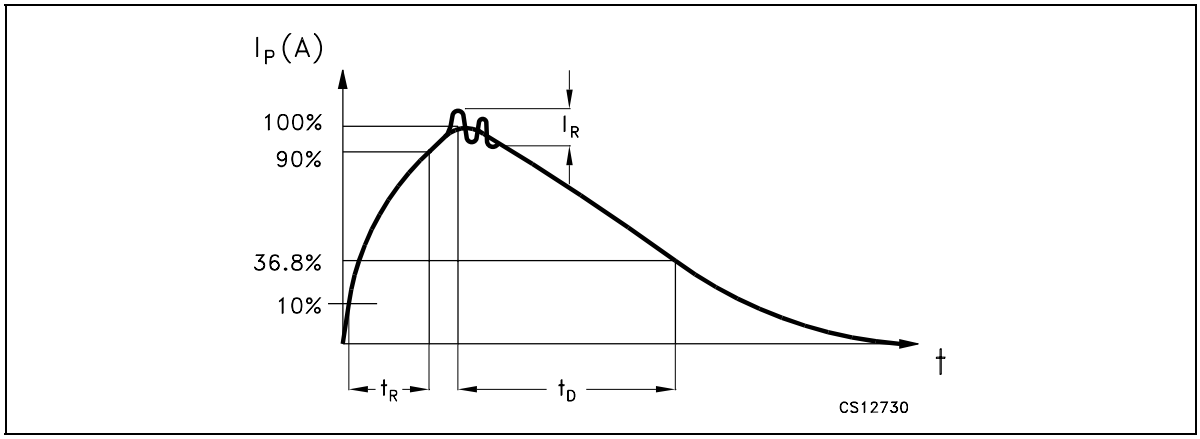


Figure 8. Human body model current waveform



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

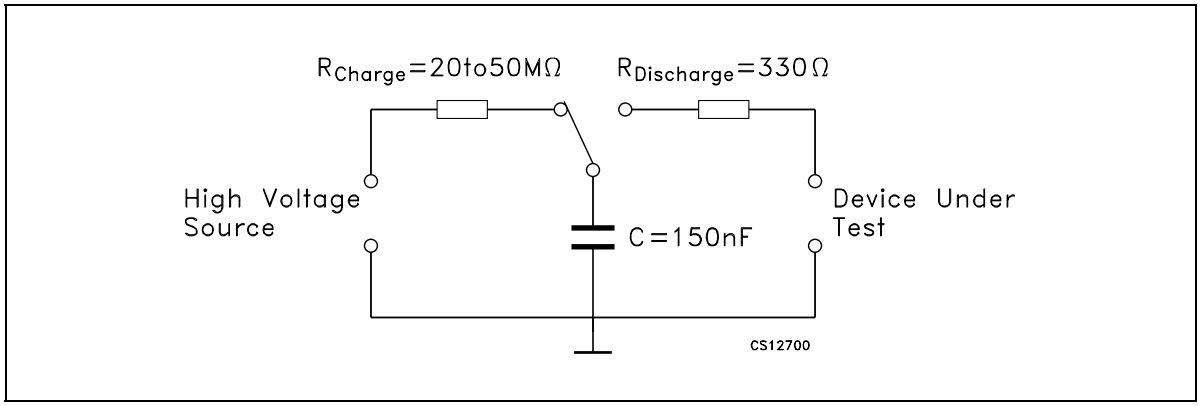


Figure 10. IEC 1000-4-2 current waveform

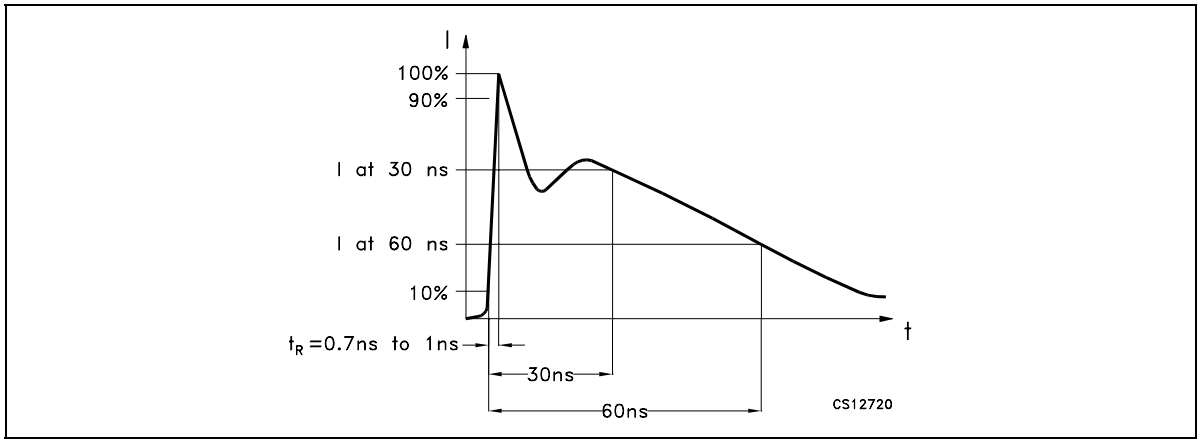


Table 11. Characteristics of the ESD generator

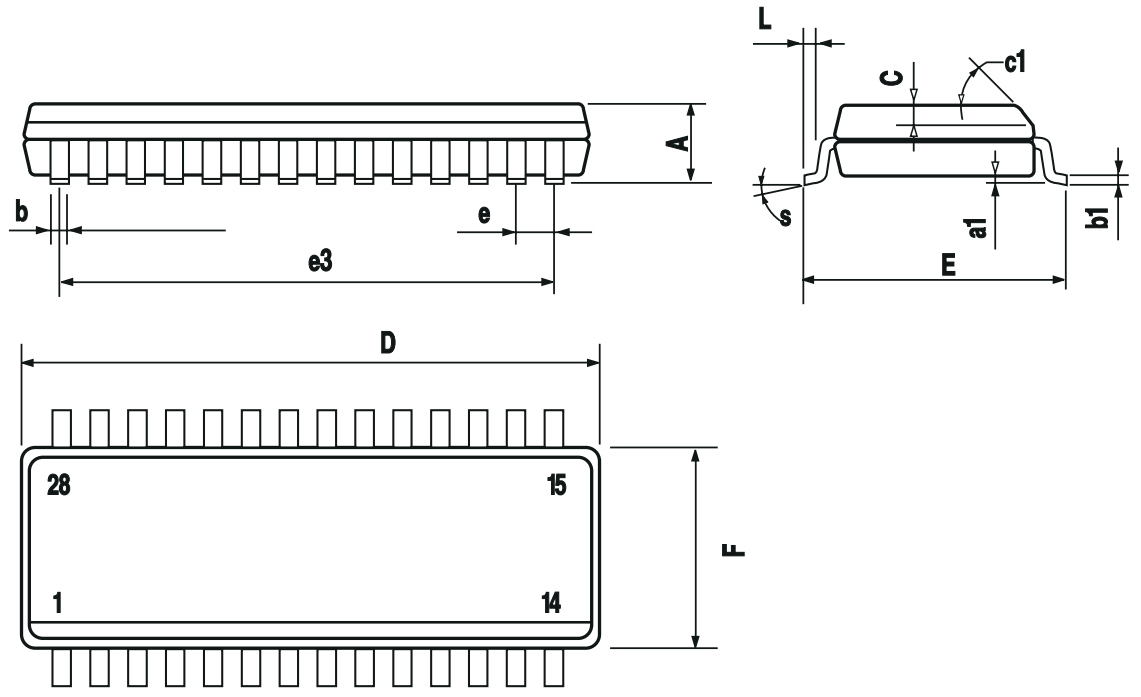
Level	Indicated voltage	First peak current of discharge (± 10%)	Rise time with discharge switch	Current at 30 ns (± 30%)	Current at 60 ns (± 30%)
1	2 kV	7.5 A	0.7 to 1ns	4 A	2 A
2	4 kV	15 A	0.7 to 1ns	8 A	4 A
3	6 kV	22.5 A	0.7 to 1ns	12 A	6 A
4	8 kV	30 A	0.7 to 1ns	16 A	8 A

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.

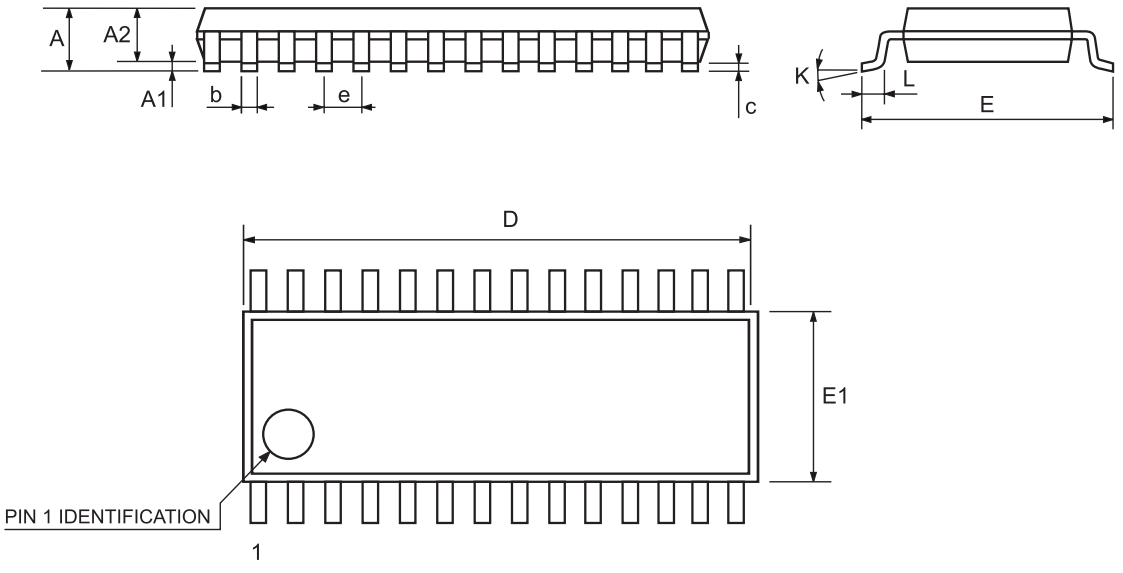
SO-28 mechanical data

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.)					



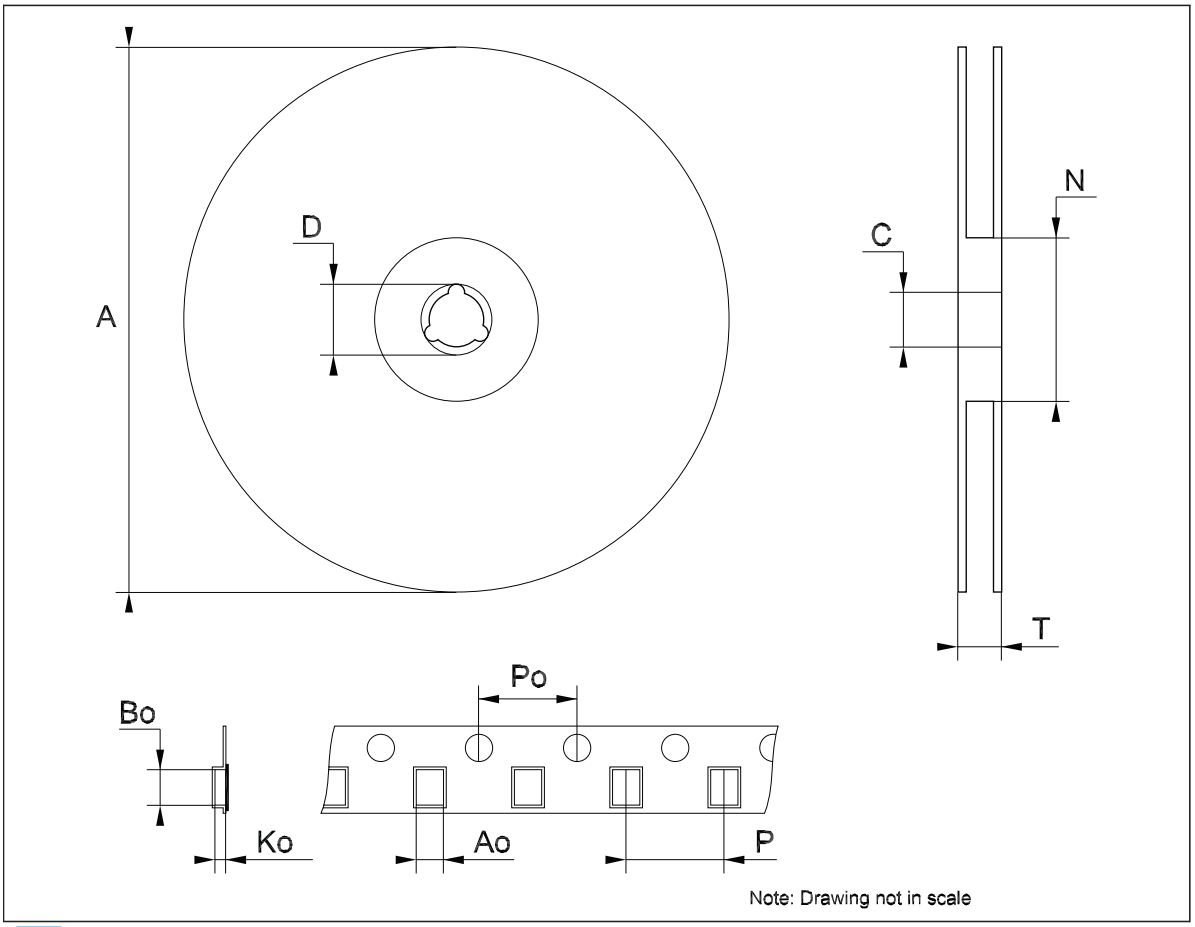
SSOP28 mechanical data

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

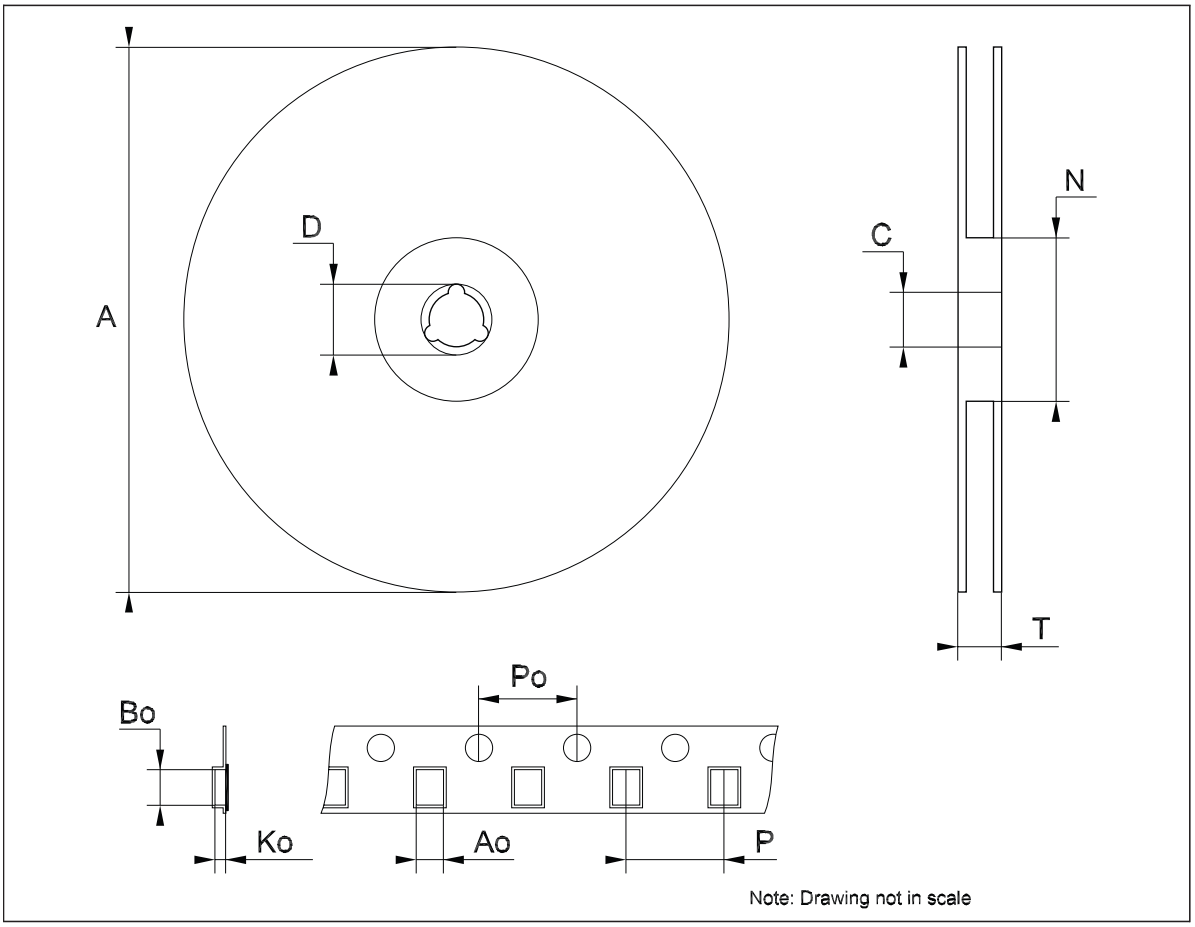
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			30.4			1.197
Ao	10.8		11.0	0.425		0.433
Bo	18.2		18.4	0.716		0.724
Ko	2.9		3.1	0.114		0.122
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476



Note: Drawing not in scale

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



Note: Drawing not in scale

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 *Table 1*.

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