

### Features

- ESD protection for RS-232 I/O pins: ± 15 kV human body model
- Guaranteed 230 kbps data rate
- Guaranteed slew rate range 3 to 30 V/μs
- Operates from a single 5 V power supply

### Description

The ST202EB, ST202EC, ST232EB, and ST232EC are two-driver, two-receiver devices designed for RS-232 and V.28 communications in harsh environments. Each transmitter output and receiver input is protected against ± 15 kV electrostatic discharge (ESD) shocks. The drivers meet all EIA/TIA-232E and CCITT V.28 specifications at data rates up to 230 kbps, when loaded in accordance with the EIA/TIA-232E specification. The ST202EB, ST202EC, ST232EB, and ST232EC use a single 5 V supply voltage.

The ST232EB and ST232EC operate with four 1 μF capacitors, while the ST202EB and ST202EC operate with four 0.1 μF capacitors, further reducing cost and board space.

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# 1 Pinout information

Figure 1: Pin connections (top view)

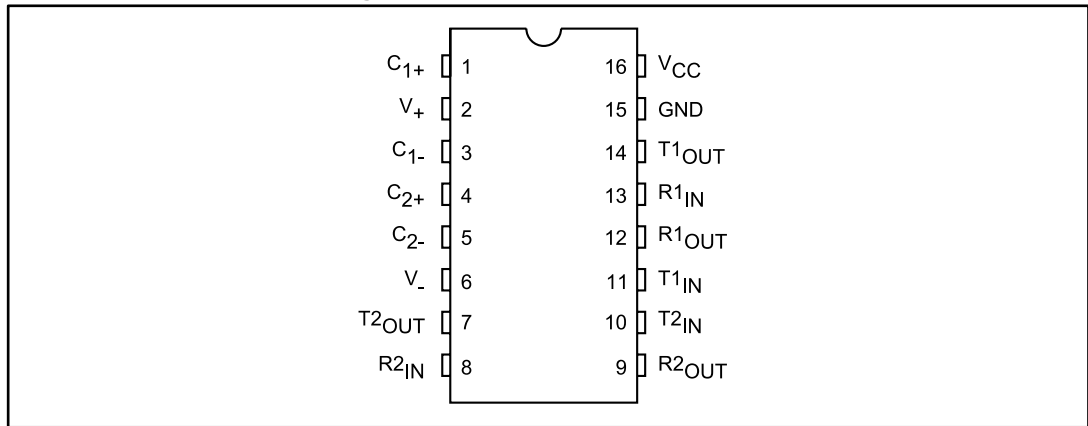


Table 1: Pin description

Pin n°	Symbol	Name and function
1	C <sub>1+</sub>	Positive terminal for the first charge pump capacitor
2	V <sub>+</sub>	Doubled voltage terminal
3	C <sub>1-</sub>	Negative terminal for the first charge pump capacitor
4	C <sub>2+</sub>	Positive terminal for the second charge pump capacitor
5	C <sub>2-</sub>	Negative terminal for the second charge pump capacitor
6	V <sub>-</sub>	Inverted voltage terminal
7	T <sub>2OUT</sub>	Second transmitter output voltage
8	R <sub>2IN</sub>	Second receiver input voltage
9	R <sub>2OUT</sub>	Second receiver output voltage
10	T <sub>2IN</sub>	Second transmitter input voltage
11	T <sub>1IN</sub>	First transmitter input voltage
12	R <sub>1OUT</sub>	First receiver output voltage
13	R <sub>1IN</sub>	First receiver input voltage
14	T <sub>1OUT</sub>	First transmitter output voltage
15	GND	Ground
16	V <sub>CC</sub>	Supply voltage

## 2 Absolute maximum ratings

Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	-0.3 to 6	V
$V_+$	Extra positive voltage	$(V_{CC} - 0.3)$ to 14	
$V_-$	Extra negative voltage	-14 to 0.3	
$T_{IN}$	Transmitter input voltage range	-0.3 to $(V_+ + 0.3)$	
$R_{IN}$	Receiver input voltage range	$\pm 30$	
$T_{OUT}$	Transmitter output voltage range	$(V_- - 0.3)$ to $(V_+ + 0.3)$	
$R_{OUT}$	Receiver output voltage range	-0.3 to $(V_{CC} + 0.3)$	
$T_{SCTOUT}$	Short circuit duration on $T_{OUT}$	Infinite	
$T_{STG}$	Storage temperature range	-65 to 150	°C

### 3 Electrical characteristics

Table 3: ESD performance: transmitter outputs, receiver inputs

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
ESD	ESD protection voltage	Human body model	± 15	—	—	kV
		IEC 1000-4-2 (contact discharge)	± 6			
		IEC 1000-4-2 (air discharge)	± 8			

Table 4: Electrical characteristics, C1 - C4 = 0.1 µF, V<sub>CC</sub> = 5 V ± 10 %, T<sub>A</sub> = -40 to 125 °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>	V <sub>CC</sub> power supply current	No load, T <sub>A</sub> = 25 °C	—	5	10	mA

Table 5: Transmitter electrical characteristics, C1 - C4 = 0.1 µF, V<sub>CC</sub> = 5 V ± 10 %, 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>TOUT</sub>	Output voltage swing	All transmitter outputs are loaded with 3 kΩ to GND	± 5	± 9		V
I <sub>TIL</sub>	Input leakage current				± 10	µA
V <sub>TIL</sub>	Input logic threshold low		0.8			V
V <sub>TIH</sub>	Input logic threshold high				2	
SR <sub>T</sub>	Transition slew rate	T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 3 to 7 kΩ, C <sub>L</sub> = 50 to 1000 pF <sup>(1)</sup>	3	6	30	V/µs
D <sub>R</sub>	Data rate	R <sub>L</sub> = 3 to 7 kΩ, C <sub>L</sub> = 50 to 1000 pF, one transmitter switching	230	400		kbits/s
R <sub>TOUT</sub>	Transmitter output resistance	V <sub>CC</sub> = V <sub>+</sub> = V <sub>-</sub> = 0 V, V <sub>OUT</sub> = ± 2 V	300			Ω
I <sub>SC</sub>	Transmitter output short circuit current			± 10	± 60	mA
t <sub>DT</sub>	Propagation delay time	R <sub>L</sub> = 3 to 7 kΩ, C <sub>L</sub> = 50 to 2500 pF, all transmitters loaded		2		µA

**Notes:**

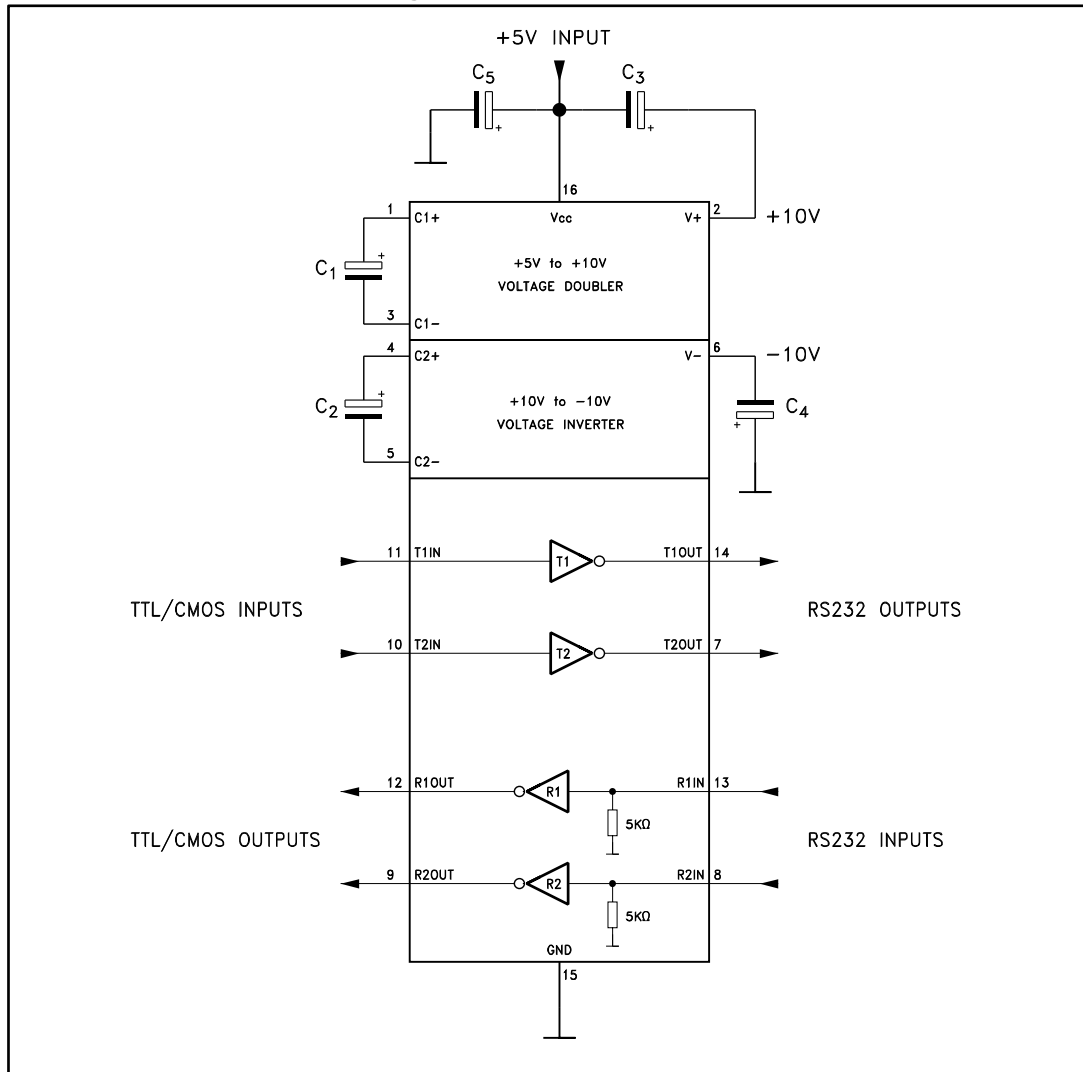
<sup>(1)</sup>Measured from 3 V to -3 V or from -3 V to 3 V

**Table 6: Receiver electrical characteristics, C1 - C4 = 0.1  $\mu$ F, V<sub>CC</sub> = 5 V  $\pm$  10 %, 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		-30		30	V
R <sub>RIN</sub>	RS-232 input resistance	T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5 V	3	5	7	k $\Omega$
V <sub>RIL</sub>	RS-232 input logic threshold low		0.8	1.2		V
V <sub>RIH</sub>	RS-232 input logic threshold high			1.7	2.4	
V <sub>RIHYS</sub>	RS-232 input hysteresis	V <sub>CC</sub> = 5 V	0.2	0.5	1	
V <sub>ROL</sub>	TTL/CMOS output voltage low	I <sub>OUT</sub> = 3.2 mA			0.4	
V <sub>ROH</sub>	TTL/CMOS output voltage high	I <sub>OUT</sub> = -1 mA	3.5	V <sub>CC</sub> - 0.4		
t <sub>DR</sub>	Propagation delay time	C <sub>L</sub> = 150 pF		0.5	10	$\mu$ s

## 4 Typical application

Figure 2: Application circuit



1. C<sub>1-4</sub> can be replaced by the 1 μF capacitors
2. C<sub>1-4</sub> can be common or biased capacitors

Table 7: Capacitance value (μF)

Device	C2	C3	C4	C5
ST202E				0.1
ST232E				1

## 5 Typical performance characteristics

Unless otherwise specified  $T_J = 25\text{ }^\circ\text{C}$

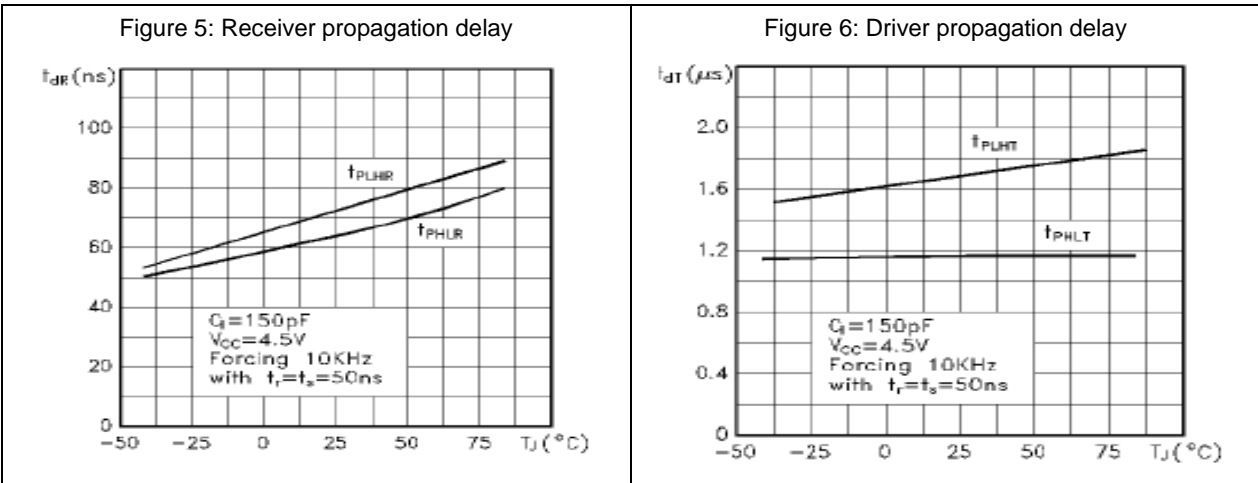
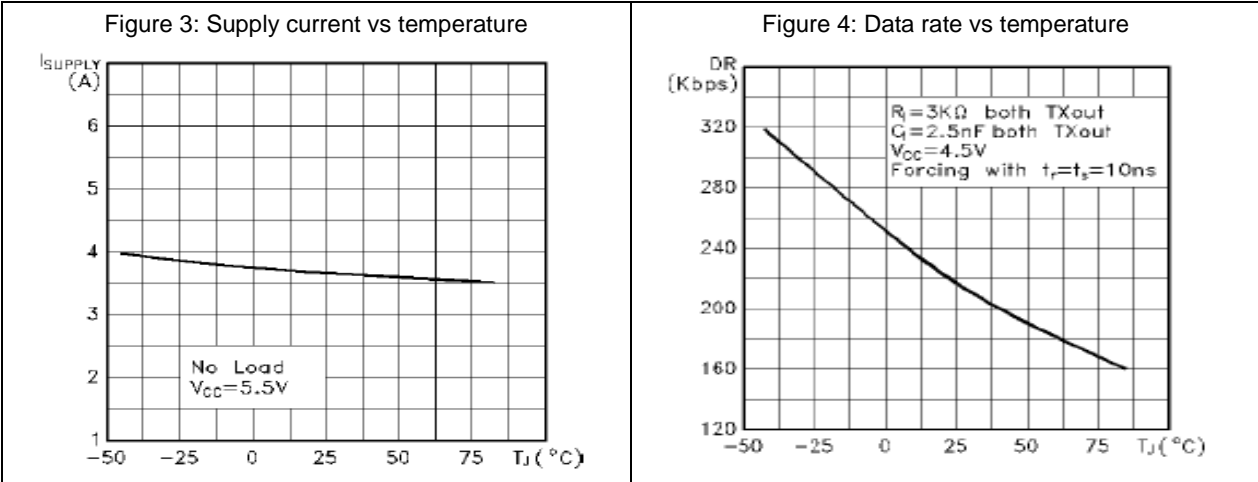




Figure 7: High level output voltage swing vs temperature

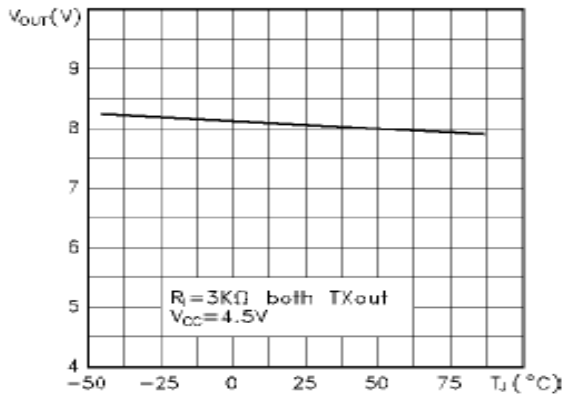


Figure 8: Low level output voltage swing vs temperature

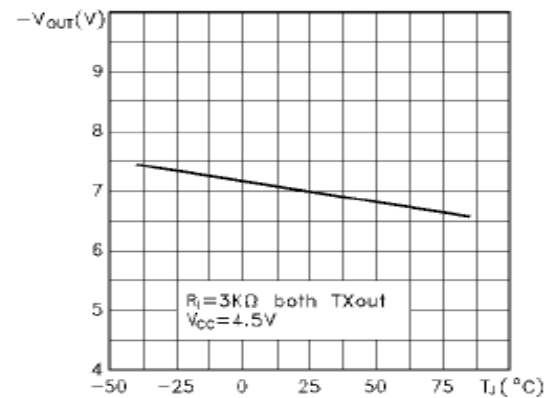


Figure 9: High level transmitter output short circuit current vs temperature

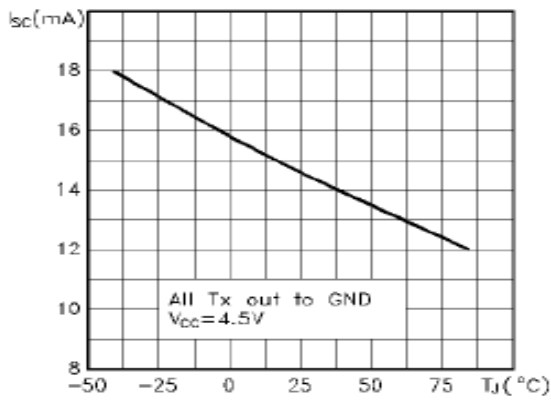


Figure 10: Low level transmitter output short circuit current vs temperature

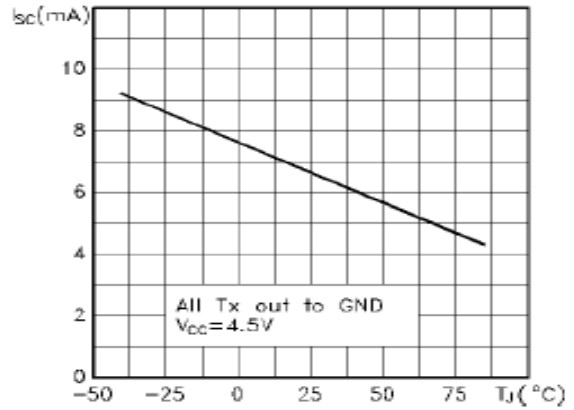


Figure 11: High level receiver output short circuit current vs temperature

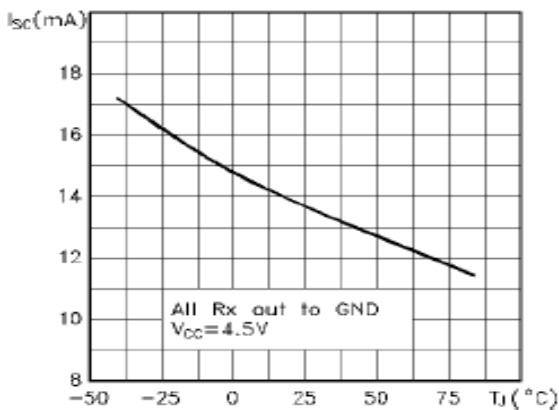
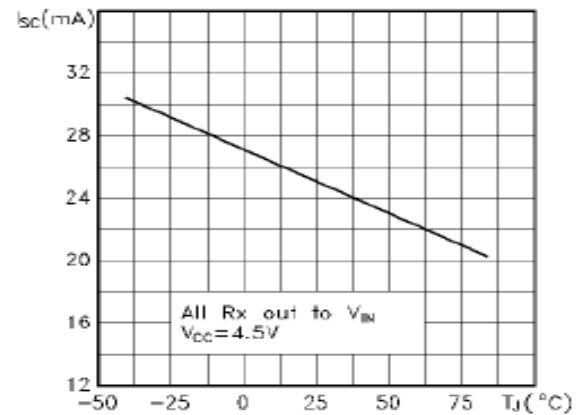


Figure 12: Low level receiver output short circuit current vs temperature



## 6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

### 6.1 SO16 package information

Figure 13: SO16 package outline

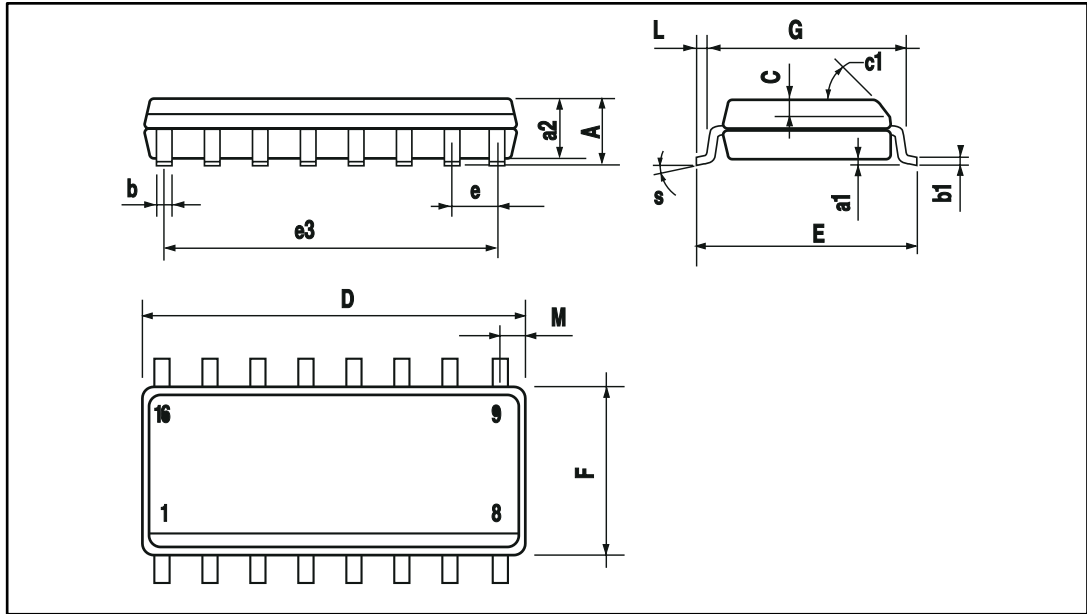


Table 8: SO16 mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.25	0.004		0.010
a2			1.64			0.063
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1		45 °			45 °	
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S			8 °			8 °

## 6.2 TSSOP16 package information

Figure 14: TSSOP16 package outline

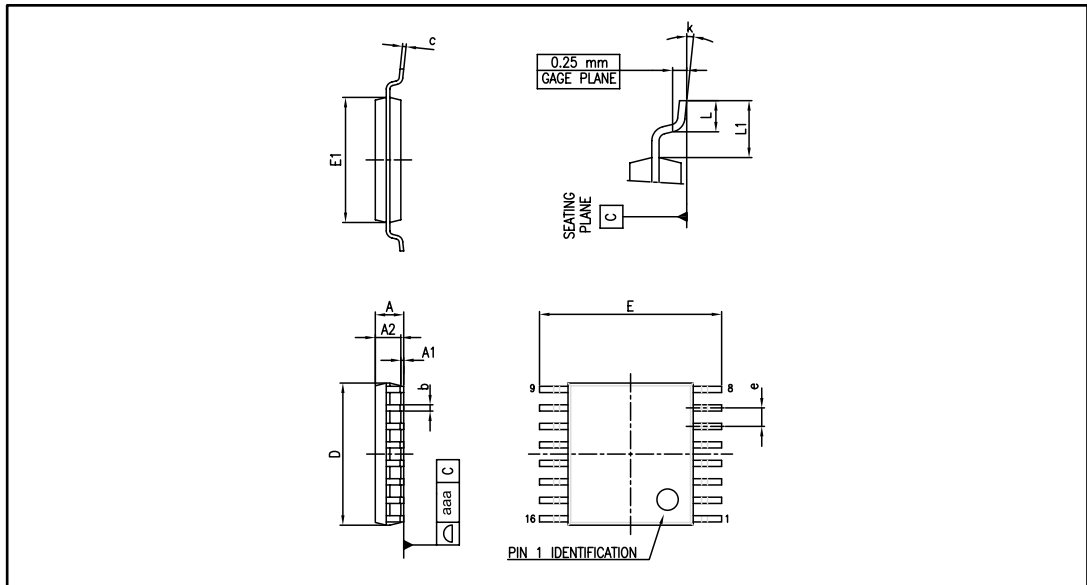
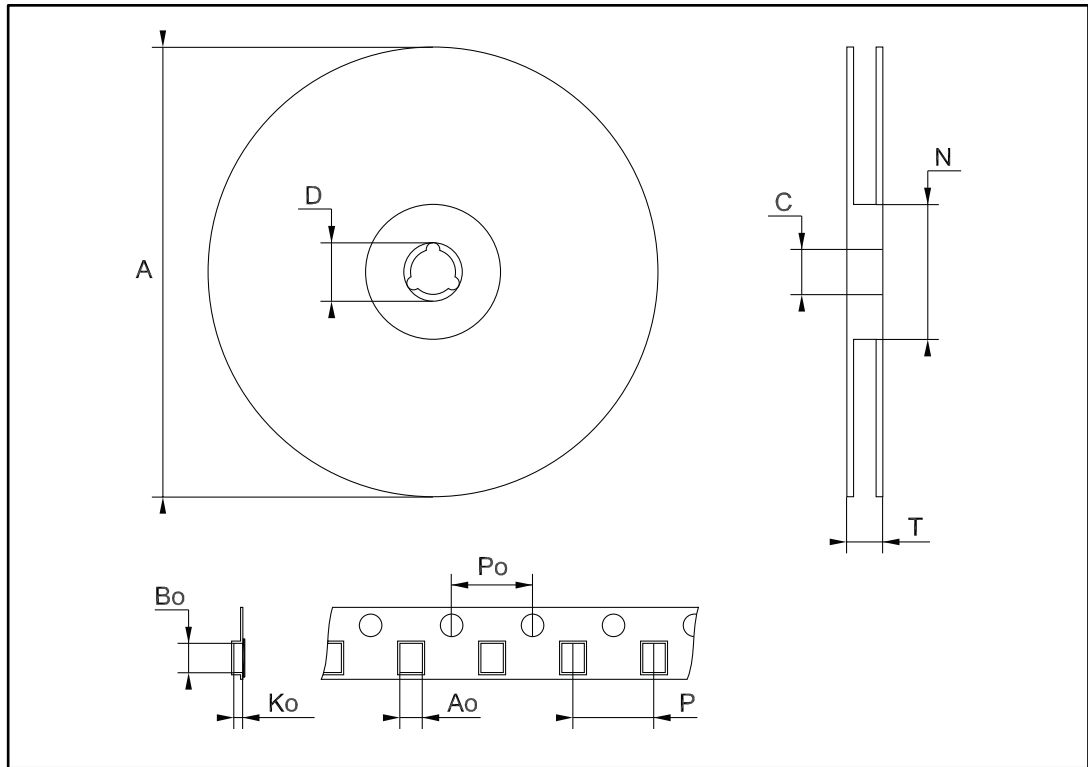


Table 9: TSSOP16 mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	Min	Typ	Max	Min	Typ	Max
A			1.20			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	4.90	5.00	5.10	0.193	0.197	0.201
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.026	
k	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1.00			0.039	
aaa			0.10			0.004

### 6.3 SO16 tape and reel package information

Figure 15: SO16 tape and reel package outline



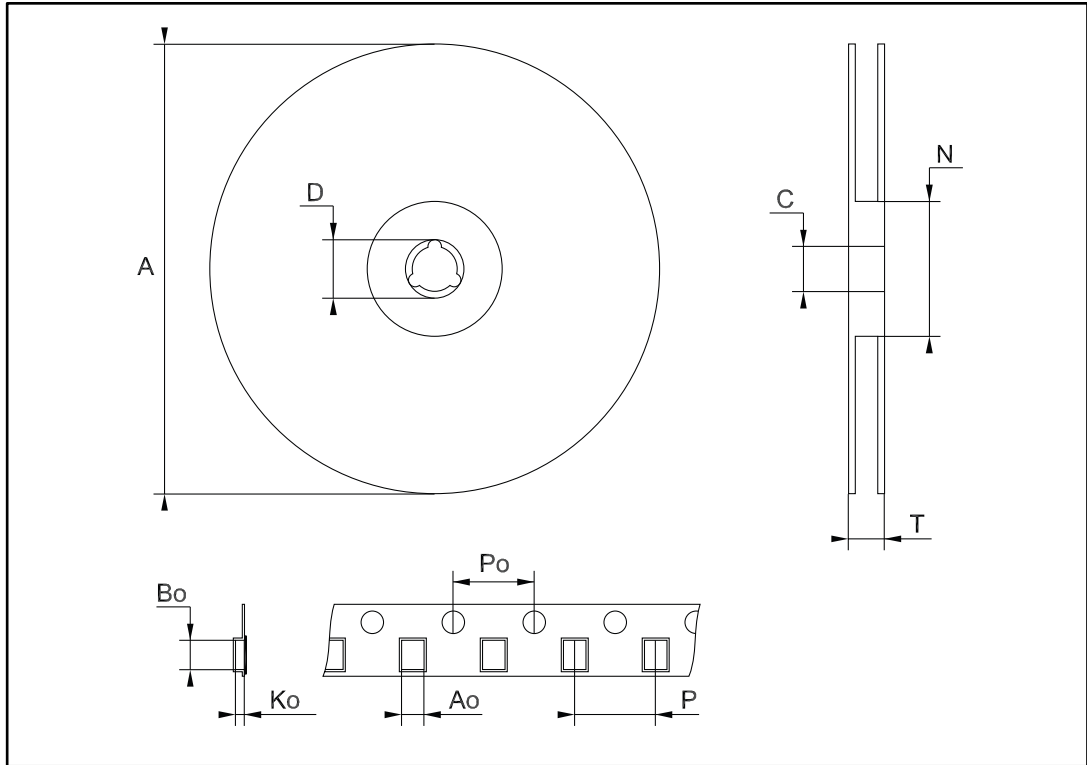
1. Drawing not to scale

Table 10: SO16 tape and reel mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	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	6.45	—	6.65	0.254	—	0.262
Bo	10.3		10.5	0.406		0.414
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319

### 6.4 TSSOP16 tape and reel package information

Figure 16: TSSOP16 tape and reel package outline



1. Drawing not to scale

Table 11: TSSOP16 tape and reel mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	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	6.7	—	6.9	0.264	—	0.272
Bo	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319

## 6.5 Thermal characteristics

Table 12: Absolute maximum ratings

Package	Symbol	Value	Board type	Unit
SO16	R <sub>thja</sub> <sup>(1)</sup>	115	1-layer board	°C/W
		80	4-layer board	
	R <sub>thjc</sub> <sup>(2)</sup>	30	1-layer board	
TSSOP16	R <sub>thja</sub> <sup>(1)</sup>	140	1-layer board	
		95	2-layer board	
	R <sub>thjc</sub> <sup>(2)</sup>	25		

**Notes:**

<sup>(1)</sup>R<sub>thja</sub> is the package junction-to-ambient thermal resistance in °C/W

<sup>(2)</sup>R<sub>thjc</sub> is the package junction-to-case thermal resistance in °C/W

## 7 Ordering information

Table 13: Order codes

Order code		Temperature range	Package	Packaging	Marking
ST202EBDR	ST232EBDR	-40 to 85 °C	S016 (tape and reel)	2500 parts per reel	ST202B
ST202ECDR	ST232ECDR	0 to 70 °C			ST202C
ST202EBTR	ST232EBTR	-40 to 85 °C	TSSOP16 (tape and reel)		ST202B
ST202ECTR	ST232ECTR	0 to 70 °C			ST202C



## 8 Revision history

Table 14: Document revision history

Date	Revision	Changes
21-Feb-2006	12	Change value of $I_{TIL}$ on transmitter characteristics, $\pm 1\mu A \Rightarrow \pm 10\mu A$ .
14-Mar-2006	13	Order codes has been updated and new template.
27-Aug-2007	14	Added Table 1 in cover page.
13-Nov-2007	15	Modified: Table 1.
08-Feb-2008	16	Modified: Table 1 on page 1.
15-Jan-2014	17	Updated ECOPACK® information Added Section 6.1: Package thermal characteristics Updated disclaimer
08-Mar-2017	18	Removed SO16L package <i>Features</i> : updated units of guaranteed slew rate range from V/ms to V/ $\mu$ s. Moved "Device summary" table to <i>Section 7: "Ordering information"</i> . Removed obsolete order codes ST202EBWR and ST232ECWR from this table and added "Marking". <i>Section 6.2: "TSSOP16 package information"</i> : added dimensions "L1" and "aaa", and replaced dimension "K" with "k".