

± 15 kV ESD protected 5 V RS-232 transceiver

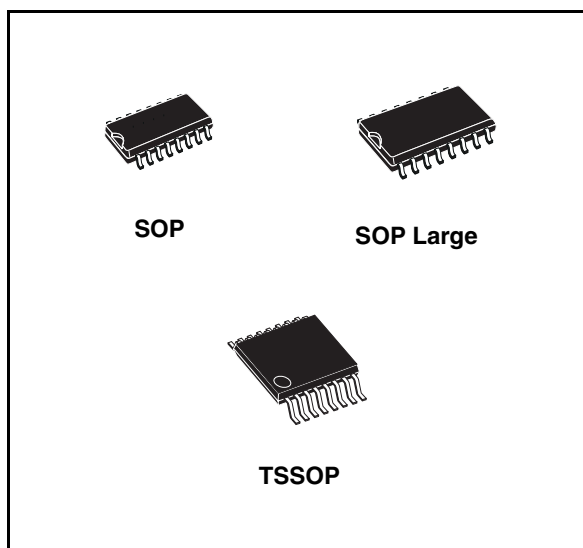
## Features

- 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/ms
- Operate from a single 5 V power supply

## Description

The ST202E/ST232E are a 2 driver 2 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 ST202E/232E use a single 5 V supply voltage.

The ST232E operates with four 1 µF capacitors, while the ST202E operates with four 0.1 µF capacitors, further reducing cost and board space.



**Table 1. Device summary**

Order codes		Temperature range	Packages	Packaging
ST202ECDR	ST232ECDR	0 to 70 °C	SO-16 (tape & reel)	2500 parts per reel
ST202EBDR	ST232EBDR	-40 to 85 °C	SO-16 (tape & reel)	2500 parts per reel
	ST232ECWR	0 to 70 °C	SO-16 large (tape & reel)	1000 parts per reel
ST202EBWR		-40 to 85 °C	SO-16 large (tape & reel)	1000 parts per reel
ST202ECTR	ST232ECTR	0 to 70 °C	TSSOP16 (tape & reel)	2500 parts per reel
ST202EBTR	ST232EBTR	-40 to 85 °C	TSSOP16 (tape & reel)	2500 parts per reel

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# 1 Pin configuration

Figure 1. Pin connections (top view)

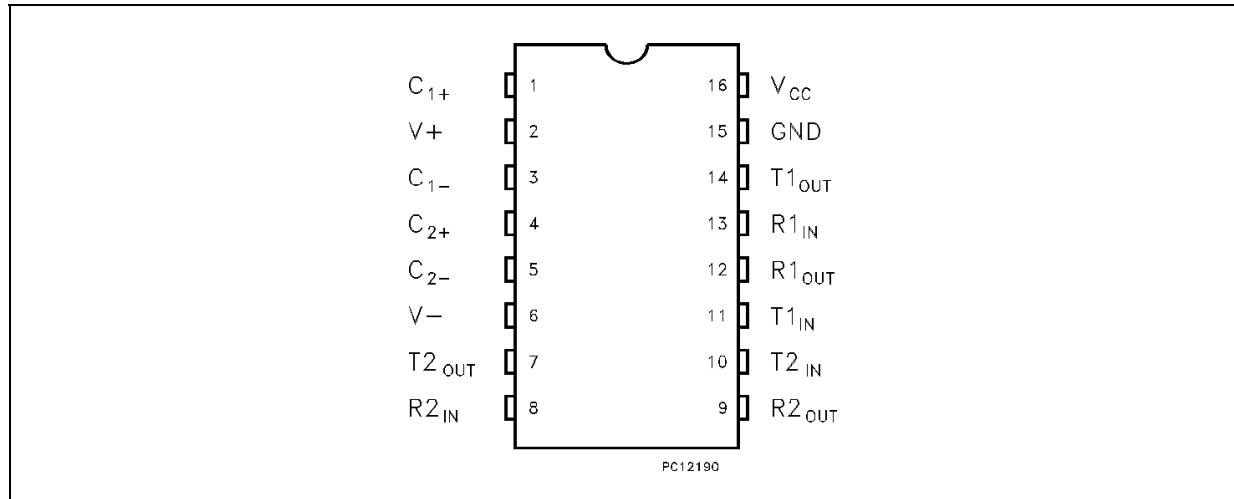


Table 2. Pin description

Pin n°	Symbol	Note
1	C <sub>1+</sub>	Positive terminal for the first charge pump capacitor
2	V+	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-	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 Maximum ratings

**Table 3. 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
$V_-$	Extra negative voltage	-14 to 0.3	V
$T_{IN}$	Transmitter input voltage range	-0.3 to $(V_+ + 0.3)$	V
$R_{IN}$	Receiver input voltage range	$\pm 30$	V
$T_{OUT}$	Transmitter output voltage range	$(V_- - 0.3)$ to $(V_+ + 0.3)$	V
$R_{OUT}$	Receiver output voltage range	-0.3 to $(V_{CC} + 0.3)$	V
$T_{SCTOUT}$	Short circuit duration on $T_{OUT}$	infinite	
$T_{STG}$	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.

### 3 Electrical characteristics

**Table 4. ESD performance: transmitter outputs, receiver inputs**

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
ESD	ESD protection voltage	Human Body Model	± 15			kV
ESD	ESD protection voltage	IEC 1000-4-2 (Contact Discharge)	± 6			kV
ESD	ESD protection voltage	IEC 1000-4-2 (Air Discharge)	± 8			kV

Note: All test versus GND.

**Table 5. Electrical characteristics**

( $C_1 - C_4 = 0.1 \mu\text{F}$  for ST202E,  $C_1 - C_4 = 0.1 \mu\text{F}$  for ST232E,  $V_{\text{CC}} = 5 \text{ V} \pm 10 \%$ ,  $T_A = -40$  to  $125 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ ).

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$I_{\text{SUPPLY}}$	$V_{\text{CC}}$ power supply current	No Load, $T_A = 25 \text{ }^\circ\text{C}$		5	10	mA

**Table 6. Transmitter electrical characteristics**

( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{\text{CC}} = 5 \text{ V} \pm 10 \%$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ ).

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{\text{TOUT}}$	Output voltage swing	All Transmitter outputs are loaded with $3 \text{ k}\Omega$ to GND	± 5	± 9		V
$I_{\text{TIL}}$	Input leakage current				± 10	$\mu\text{A}$
$V_{\text{TIL}}$	Input logic threshold low		0.8			V
$V_{\text{TIH}}$	Input logic threshold high				2	V
$\text{SR}_T$	Transition slew rate	$T_A = 25 \text{ }^\circ\text{C}$ , $V_{\text{CC}} = 5 \text{ V}$ $R_L = 3$ to $7 \text{ k}\Omega$ , $C_L = 50$ to $1000 \text{ pF}$ <sup>(1)</sup>	3	6	30	$\text{V}/\mu\text{s}$
$D_R$	Data rate	$R_L = 3$ to $7 \text{ k}\Omega$ , $C_L = 50$ to $1000 \text{ pF}$ one transmitter switching	230	400		kbits/s
$R_{\text{TOUT}}$	Transmitter output resistance	$V_{\text{CC}} = V_+ = V_- = 0 \text{ V}$ $V_{\text{OUT}} = \pm 2 \text{ V}$	300			$\Omega$
$I_{\text{SC}}$	Transmitter output short circuit current			±10	±60	mA
$t_{\text{DT}}$	Transmitter propagation delay	$R_L = 3$ to $7 \text{ k}\Omega$ , $C_L = 50$ to $2500 \text{ pF}$ All transmitter loaded		2		$\mu\text{s}$

1. Measured from  $3 \text{ V}$  to  $-3 \text{ V}$  or from  $-3 \text{ V}$  to  $3 \text{ V}$

2. One transmitter output is loaded with  $R_L = 3 \text{ k}\Omega$  to  $7 \text{ k}\Omega$ ,  $C_L = 50$  to  $1000 \text{ pF}$

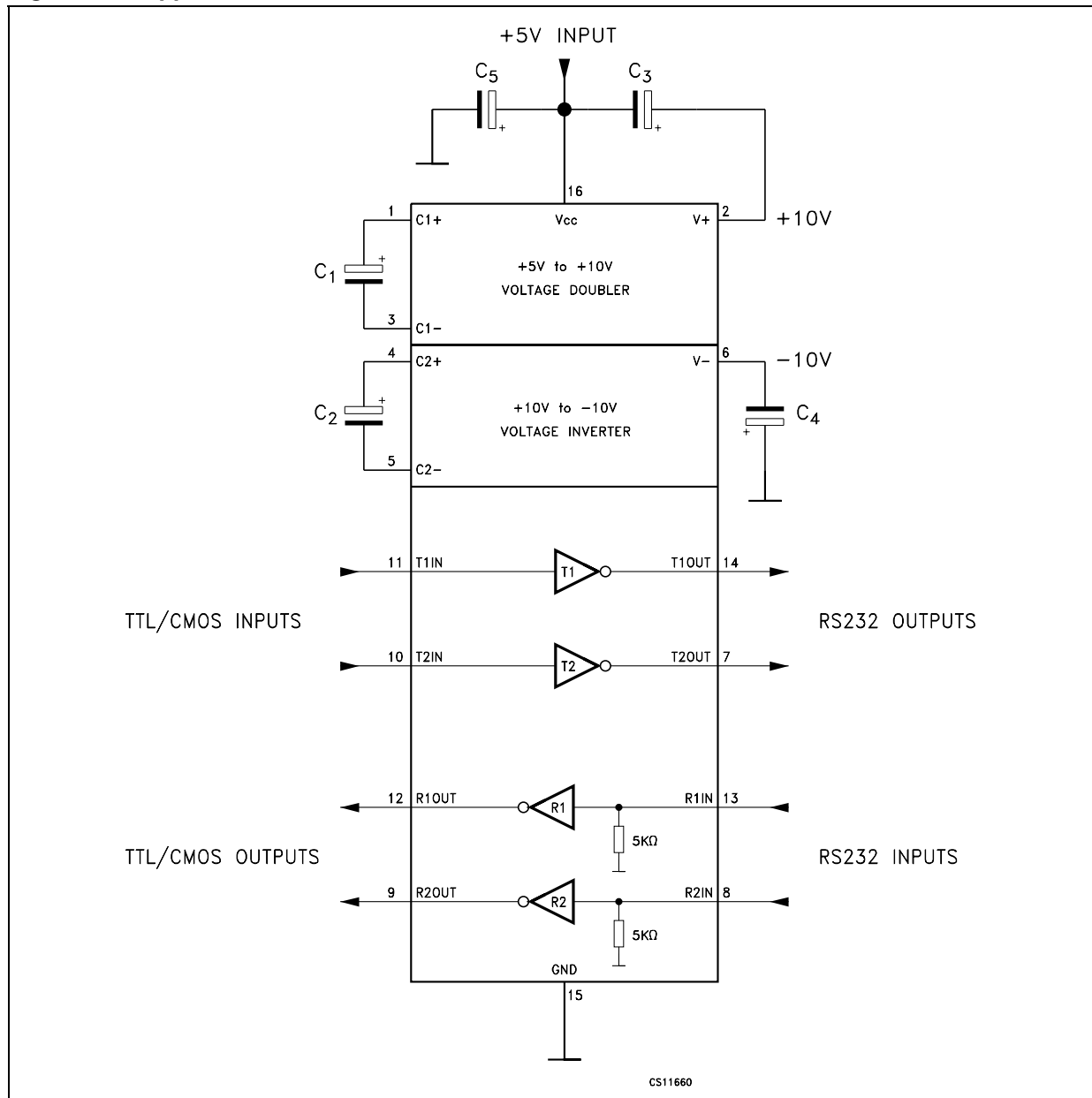
**Table 7. Receiver electrical characteristics**

( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{CC} = 5 \text{ V} \pm 10 \%$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ ).

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{RIN}$	Receiver input voltage operating range		-30		30	V
$R_{RIN}$	RS-232 input resistance	$T_A = 25^\circ\text{C}$ , $V_{CC} = 5 \text{ V}$	3	5	7	k $\Omega$
$V_{RIL}$	RS-232 input logic threshold low	$T_A = 25^\circ\text{C}$ , $V_{CC} = 5 \text{ V}$	0.8	1.2		V
$V_{RIH}$	RS-232 input logic threshold high	$T_A = 25^\circ\text{C}$ , $V_{CC} = 5 \text{ V}$		1.7	2.4	V
$V_{RIHYS}$	RS-232 input hysteresis	$V_{CC} = 5 \text{ V}$	0.2	0.5	1	V
$V_{ROL}$	TTL/CMOS output voltage low	$I_{OUT} = 3.2 \text{ mA}$			0.4	V
$V_{ROH}$	TTL/CMOS output voltage high	$I_{OUT} = -1 \text{ mA}$	3.5	$V_{CC}-0.4$		V
$t_{DR}$	Receiver propagation delay	$C_L = 150 \text{ pF}$		0.5	10	$\mu\text{s}$

# 4 Typical application

Figure 2. Application circuit (1) (2)



1. C<sub>1-4</sub> capacitors can even be 1μF ones
2. C<sub>1-4</sub> can be common or biased capacitors

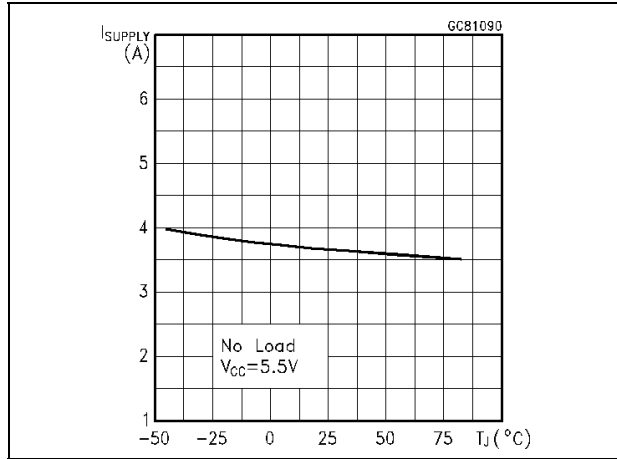
Table 8. Capacitance value (μF)

Devices	C2	C3	C4	C5	C5
ST202E	0.1	0.1	0.1	0.1	0.1
ST232E	1	1	1	1	1

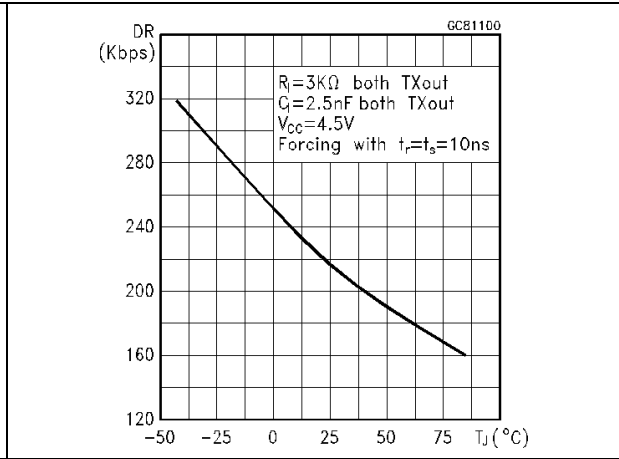
# 5 Typical performance characteristics

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

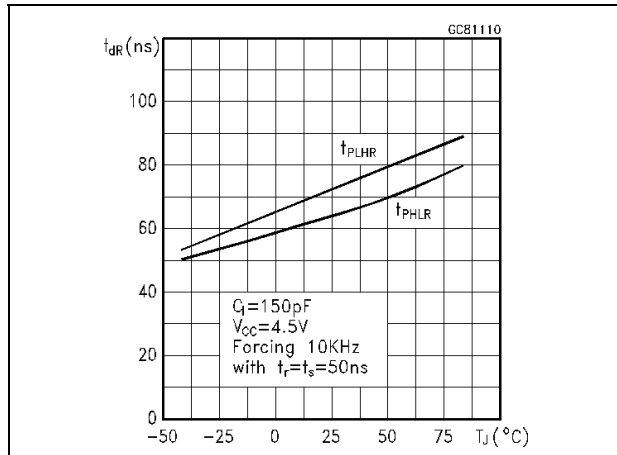
**Figure 3. Supply current vs temperature**



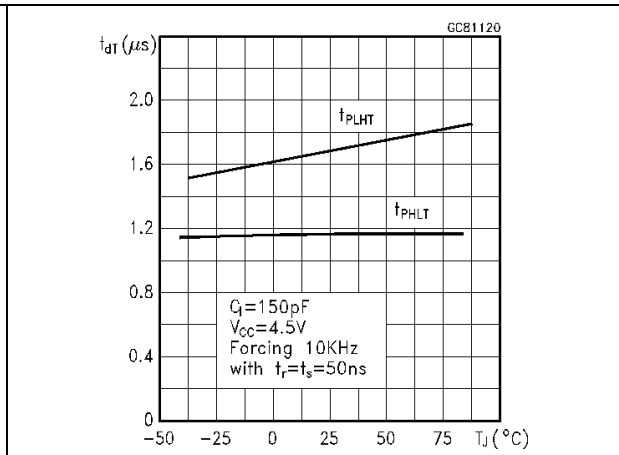
**Figure 4. Data rate vs temperature**



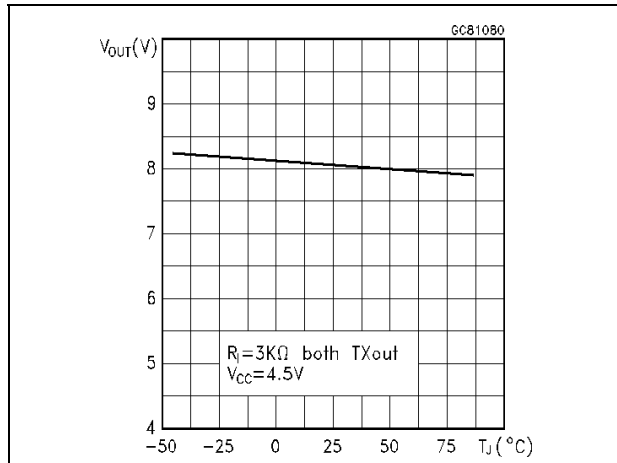
**Figure 5. Receiver propagation delay**



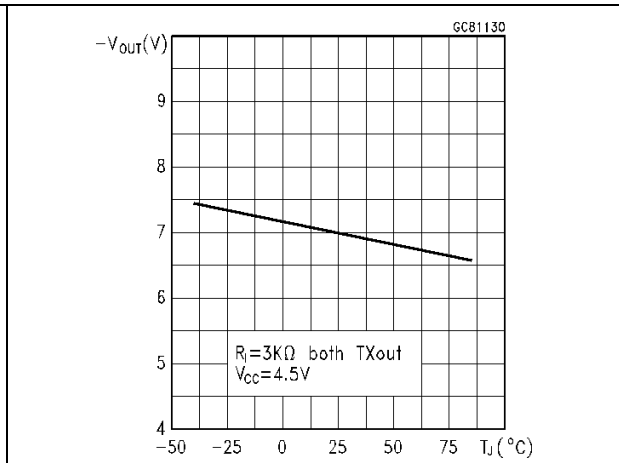
**Figure 6. Driver propagation delay**



**Figure 7. High level output voltage swing vs temperature**

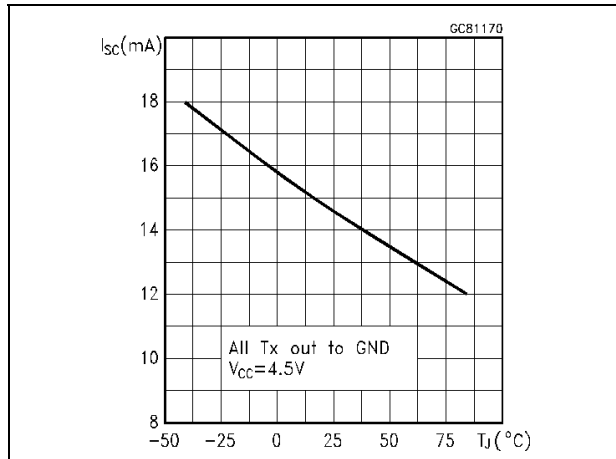


**Figure 8. Low level output voltage swing vs temperature**

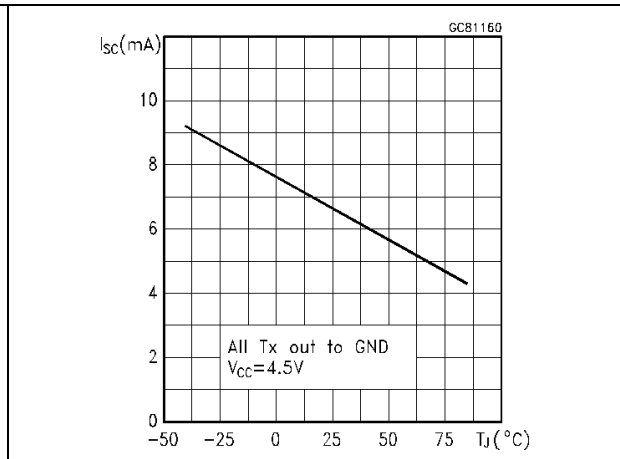




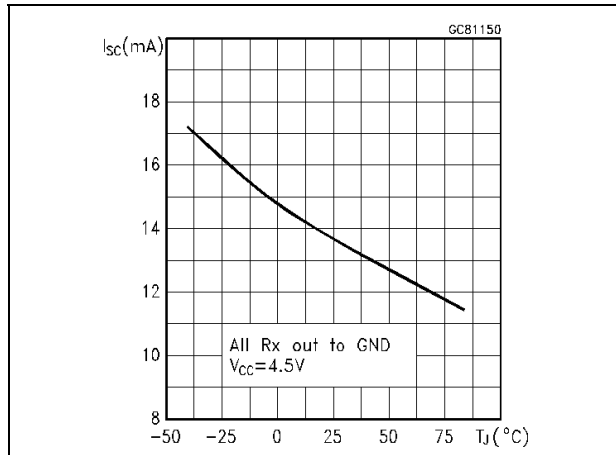
**Figure 9. High level transmitter output short circuit current vs temperature**



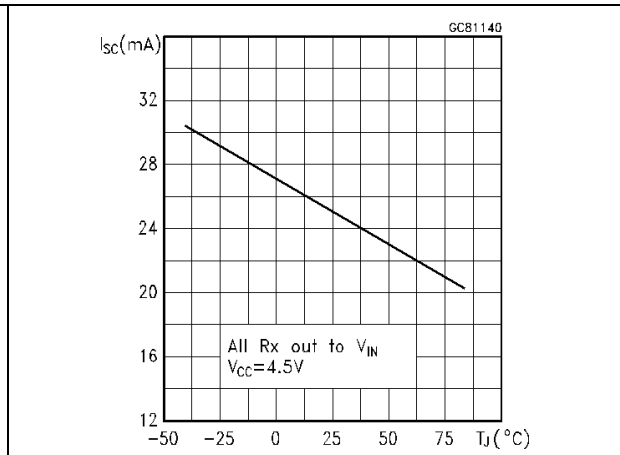
**Figure 10. Low level transmitter output short circuit current vs temperature**



**Figure 11. High level receiver output short circuit current vs temperature**



**Figure 12. Low level receiver output short circuit current vs temperature**

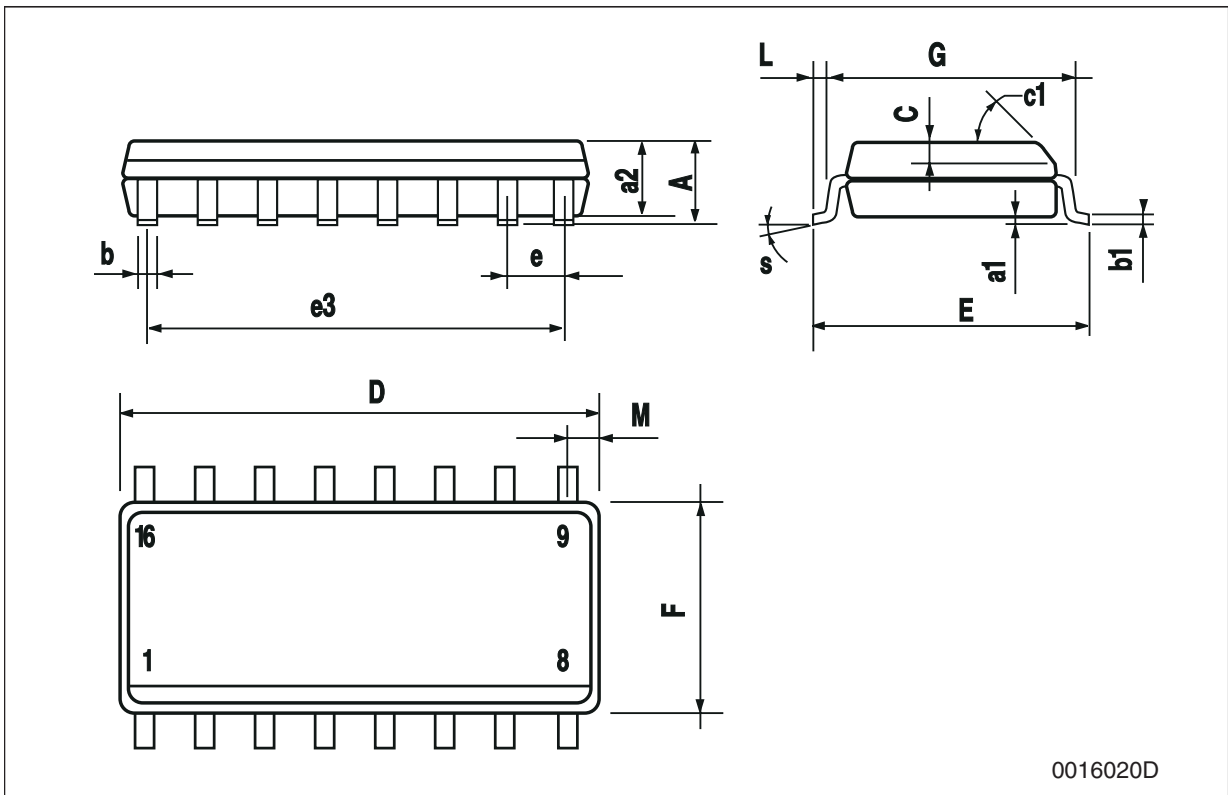


## 6 Package mechanical data

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).

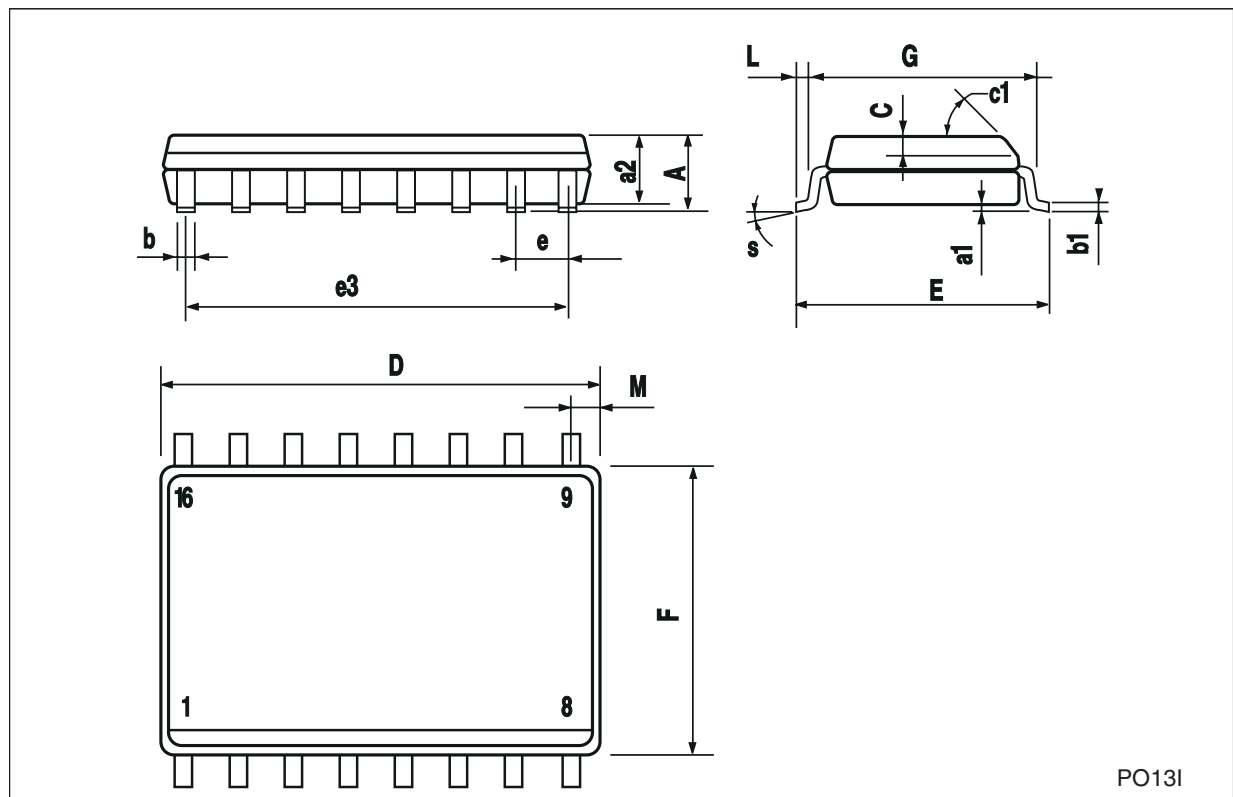
**SO-16 mechanical data**

Dim.	mm.			inch.		
	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° (typ.)					
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° (max.)					



**SO-16L mechanical data**

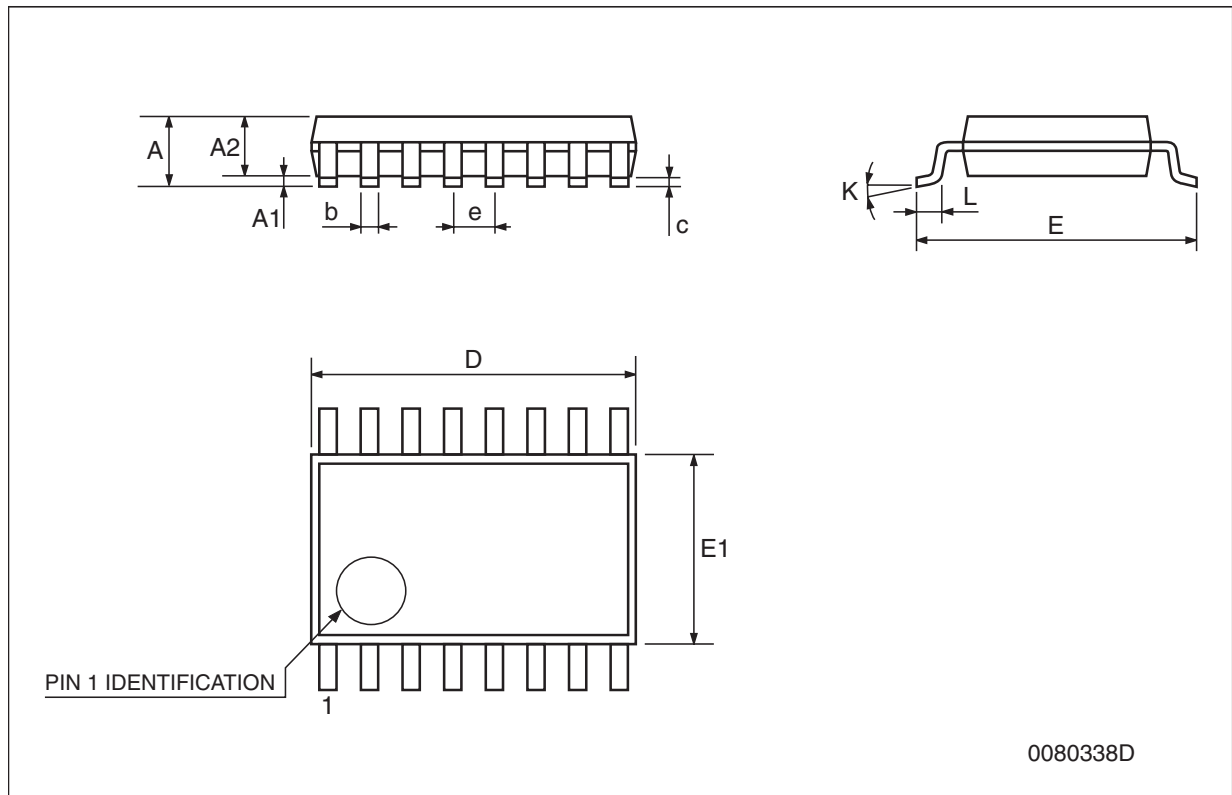
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.012
C		0.5			0.020	
c1	45° (typ.)					
D	10.1		10.5	0.397		0.413
E	10.0		10.65	0.393		0.419
e		1.27			0.050	
e3		8.89			0.350	
F	7.4		7.6	0.291		0.300
G						
L	0.5		1.27	0.020		0.050
M			0.75			0.029
S	8° (max.)					



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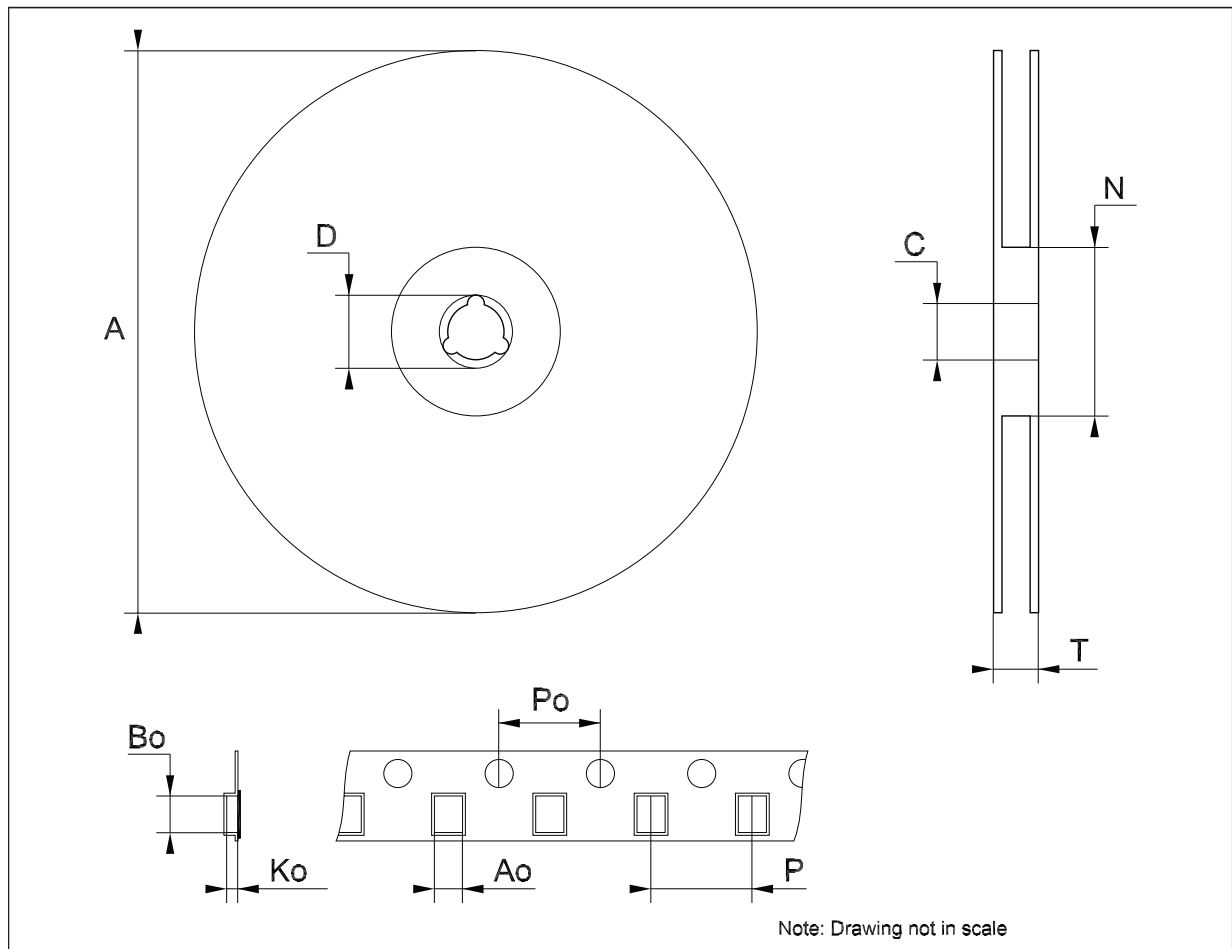
**TSSOP16 mechanical data**

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	4.9	5	5.1	0.193	0.197	0.201
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



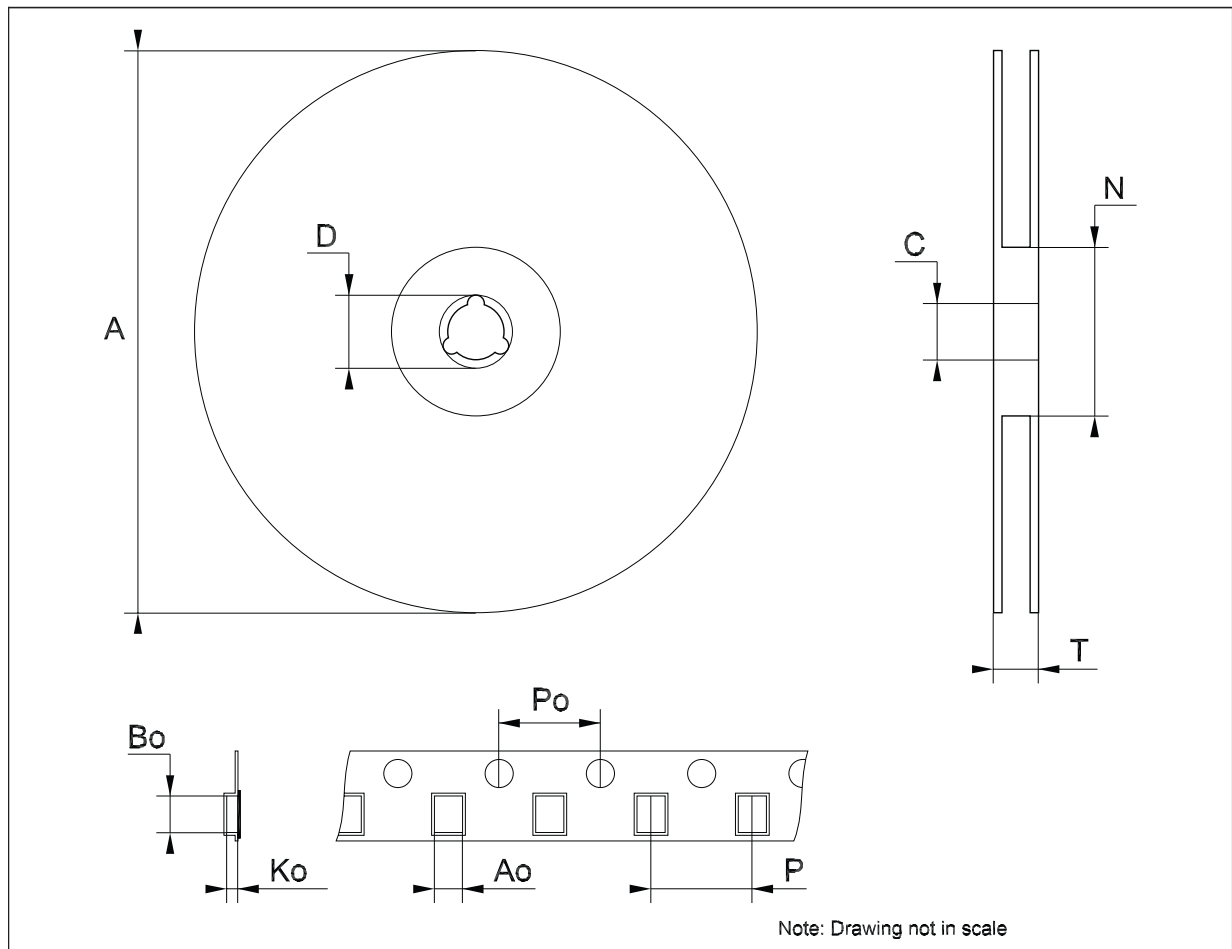
**Tape & reel SO-16 mechanical data**

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	6.45		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



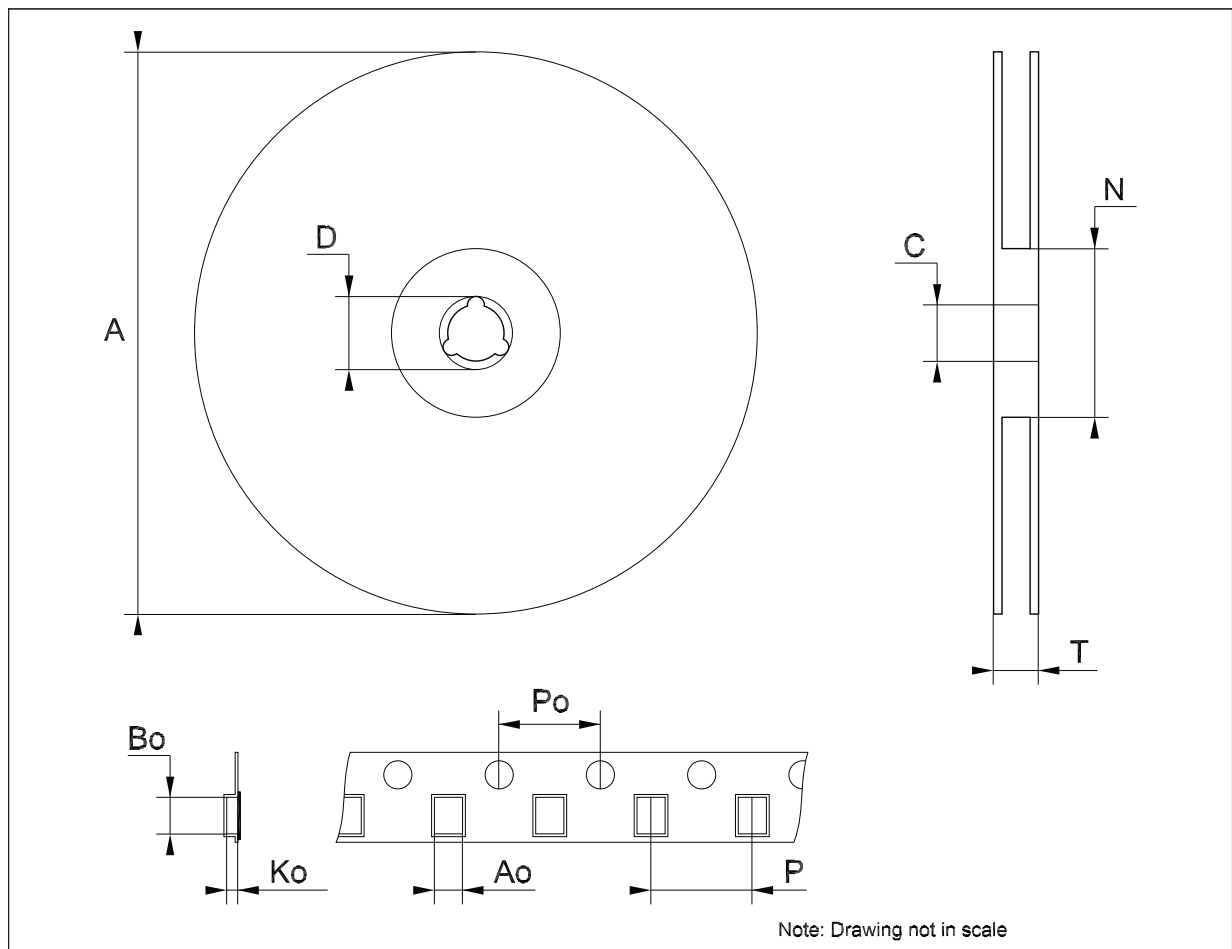
**Tape & reel SO-16L mechanical data**

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	10.8		11.0	0.425		0.433
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 TSSOP16 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	6.7		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





## 7 Revision history

**Table 9. 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 <a href="#">Table 1</a> in cover page.
13-Nov-2007	15	Modified: <a href="#">Table 1</a> .
08-feb-2008	16	Modified: <a href="#">Table 1 on page 1</a> .

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