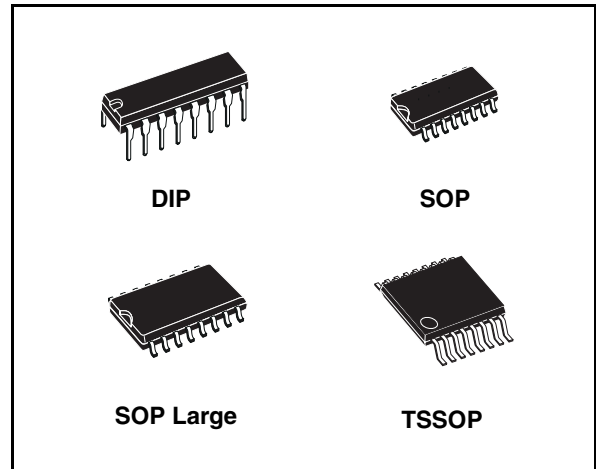


## 5 V powered multi-channel RS-232 drivers and receivers

### Features

- Supply voltage range: 4.5 to 5.5 V
- Supply current no load (typ.): 5 mA
- Transmitter output voltage swing (typ):  $\pm 7.8$  V
- Controlled output slew rate
- Receiver input voltage range:  $\pm 30$  V
- Data rate (typ.): 220 kbps
- Operating temperature range:
  - $-40^{\circ}$  to  $85^{\circ}$  °C
  - $0^{\circ}$  to  $70^{\circ}$  °C
- Compatible with MAX232 and MAX202



### Description

The ST232 is a 2 driver, 2 receiver device following EIA/TIA-232 and V.28 communication standard. It is particularly suitable for applications where  $\pm 12$  V is not available. The ST232 uses a single 5 V power supply and only four external capacitors (0.1  $\mu$ F). Typical applications are in: portable computers, low power modems, interfaces translation, battery powered RS-232 system, multi-drop RS-232 networks.

**Table 1. Device summary**

Order code	Temperature range	Package	Packaging
ST232CN	0 to 70 °C	DIP-16	25 parts per tube / 40 tube per box
ST232CDR	0 to 70 °C	SO-16 (tape and reel)	2500 parts per reel
ST232BDR	-40 to 85 °C	SO-16 (tape and reel)	2500 parts per reel
ST232CWR	0 to 70 °C	SO-16 Large (tape and reel)	1000 parts per reel
ST232BWR	-40 to 85 °C	SO-16 Large (tape and reel)	1000 parts per reel
ST232CTR	0 to 70 °C	TSSOP16 (tape and reel)	2500 parts per reel
ST232BTR	-40 to 85 °C	TSSOP16 (tape and reel)	2500 parts per reel

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# 1 Pin configuration

Figure 1. Pin connections (top view)

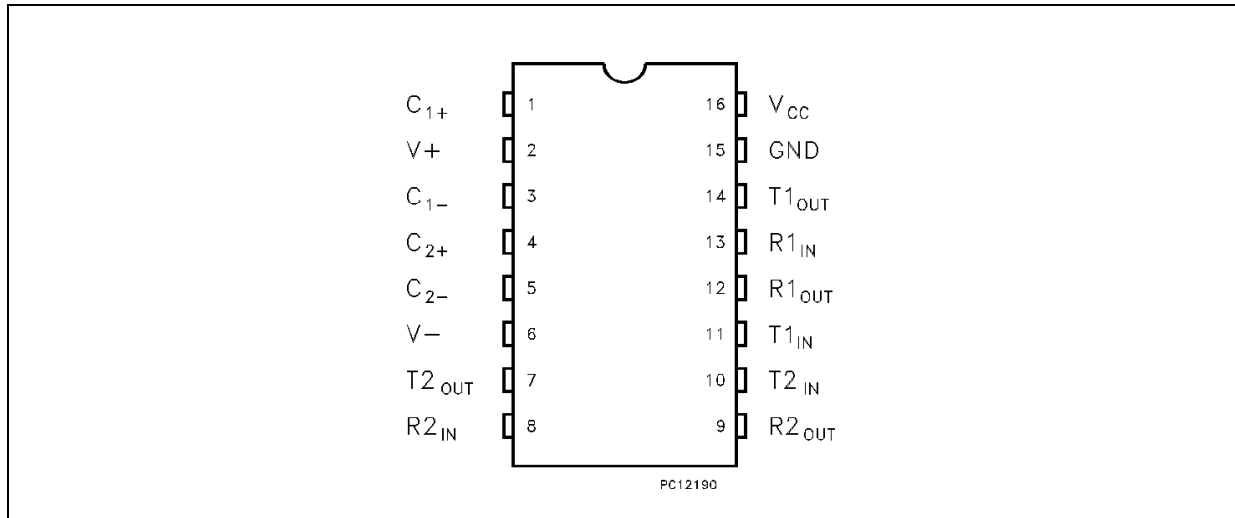


Table 2. Pin description

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>2</sub> OUT	Second transmitter output voltage
8	R <sub>2</sub> IN	Second receiver input voltage
9	R <sub>2</sub> OUT	Second receiver output voltage
10	T <sub>2</sub> IN	Second transmitter input voltage
11	T <sub>1</sub> IN	First transmitter input voltage
12	R <sub>1</sub> OUT	First receiver output voltage
13	R <sub>1</sub> IN	First receiver input voltage
14	T <sub>1</sub> OUT	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
$T_{IN}$	Transmitter input voltage range	-0.3 to ( $V_{CC} + 0.3$ )	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	

- Note:*
- 1 *Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.*
  - 2 *No external supply can be applied to  $V_+$  terminal and  $V_-$  terminal.*

### 3 Electrical characteristics

**Table 4. 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
$I_{\text{SUPPLY}}$	$V_{\text{CC}}$ Power supply current	No Load, $T_A = 25^\circ\text{C}$		5	10	mA

**Table 5. 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	$\pm 5$	$\pm 7.8$		V
$I_{\text{TIL}}$	Input leakage current				$\pm 40$	$\mu\text{A}$
$V_{\text{TIL}}$	Input logic threshold low		0.8			V
$V_{\text{TIH}}$	Input logic threshold high				2	V
$\text{SR}_{\text{T}}$	Transition slew rate	$T_A = 25^\circ\text{C}$ , $V_{\text{CC}} = 5\text{V}$ $R_L = 3$ to $7\text{k}\Omega$ , $C_L = 50$ to $2500\text{pF}$ (1)		7	30	$\text{V}/\mu\text{s}$
$D_{\text{R}}$	Data rate	(2)	120	220		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	One $T_{\text{XOUT}}$ to GND		$\pm 10$	$\pm 60$	mA

1. Measured from 3 V to -3 V or from -3 V to 3 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 6. Receiver electrical characteristics**

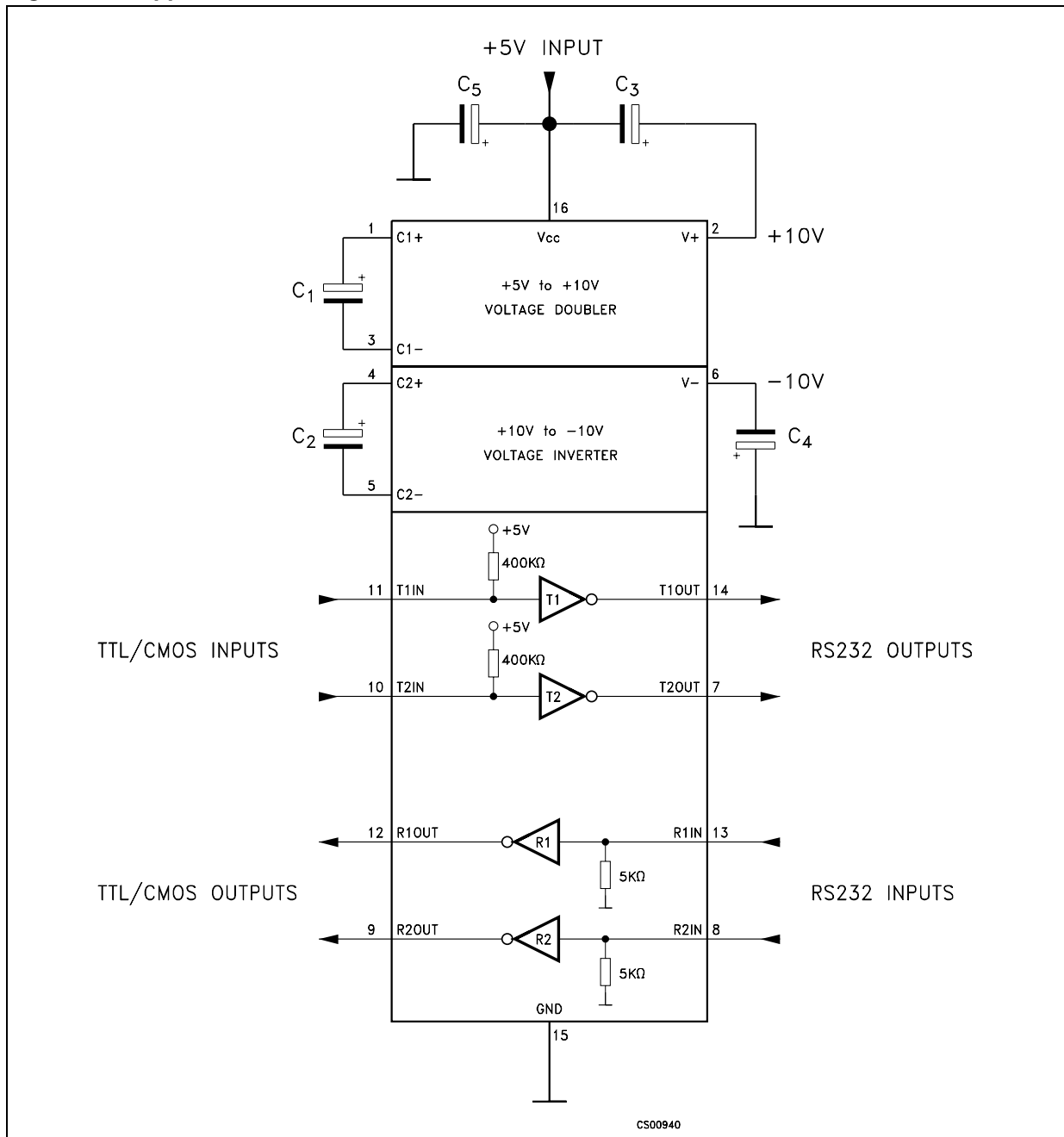
( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{CC} = 5 \text{ V} \pm 10 \%$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ ).

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{RIN}$	Receiver input voltage operating range		-30		30	V
$R_{RIN}$	RS-232 input resistance	$T_A = 25^\circ\text{C}$ , $V_{CC} = 5 \text{ V}$ , $V_{RIN} = 5\text{V}$	3	5	7	k $\Omega$
$V_{RIL}$	RS-232 input threshold low	$T_A = 25^\circ\text{C}$ , $V_{CC} = 5 \text{ V}$	0.8	1.2		V
$V_{RIH}$	RS-232 input 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	$I_{OUT} = 3.2\text{mA}$ (to $V_{CC}$ )			0.4	V
$V_{ROH}$	TTL/CMOS output voltage high	$I_{OUT} = -1\text{mA}$ (to GND)	3.5	$V_{CC}-0.4$		V
$I_{SCR}$	Receiver output short circuit current			$\pm 10$		mA
$t_{DR}$	Receiver propagation delay	$C_L = 150\text{pF}$ <sup>(1)</sup>		0.3	1	$\mu\text{s}$

1. RS-232 in to TTL-CMOS out (from 50% to 50%)

# 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

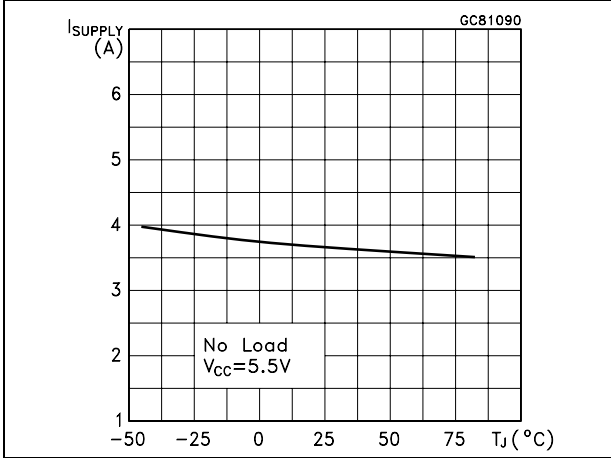
Table 7. Capacitance value (μF)

C1	C2	C3	C4	C5
0.1	0.1	0.1	0.1	0.1

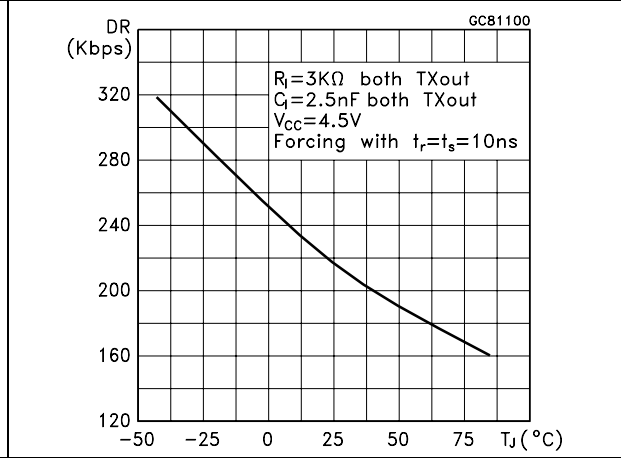
# 5 Typical performance characteristics

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

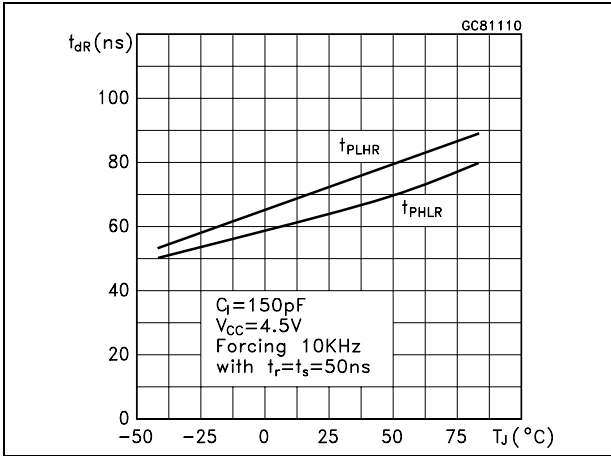
**Figure 3. Supply current vs temperature**



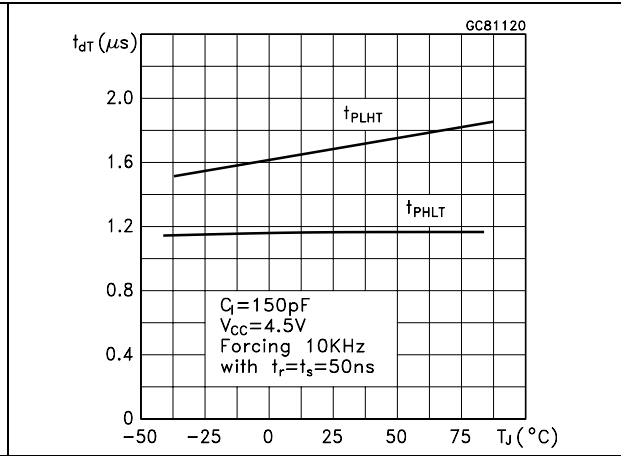
**Figure 4. Data rate vs temperature**



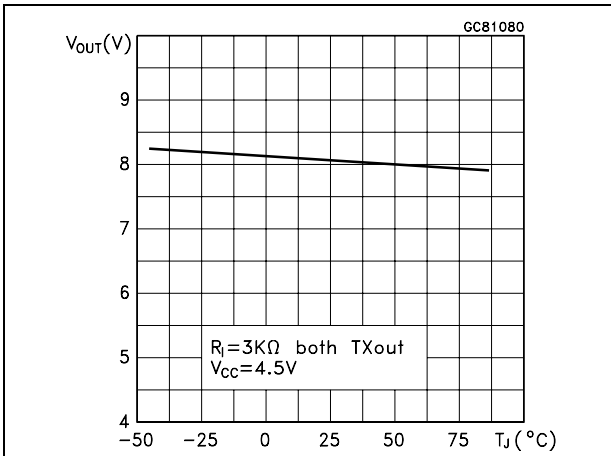
**Figure 5. Receiver propagation delay**



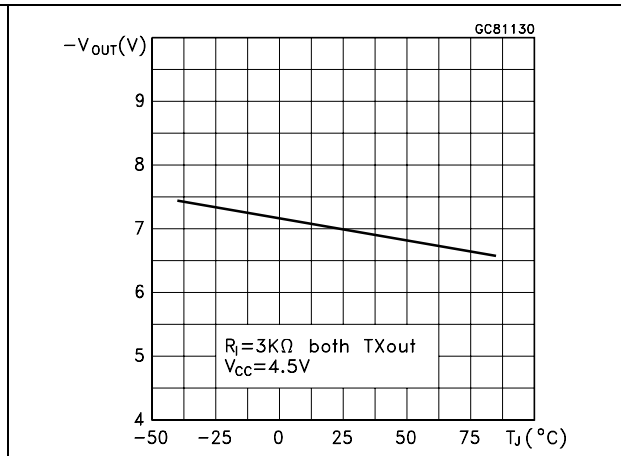
**Figure 6. Driver propagation delay**



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

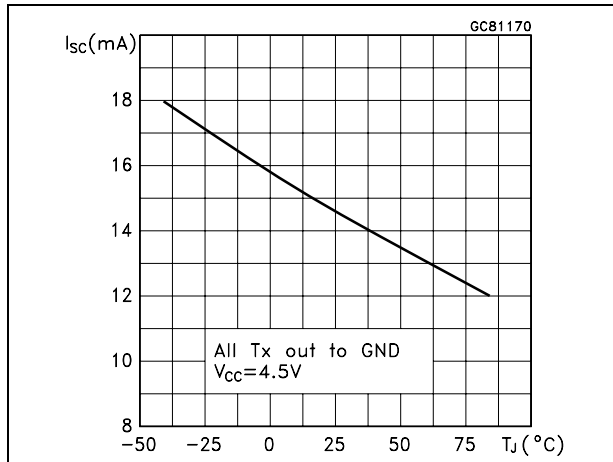


**Figure 8. Low level output voltage swing vs temperature**

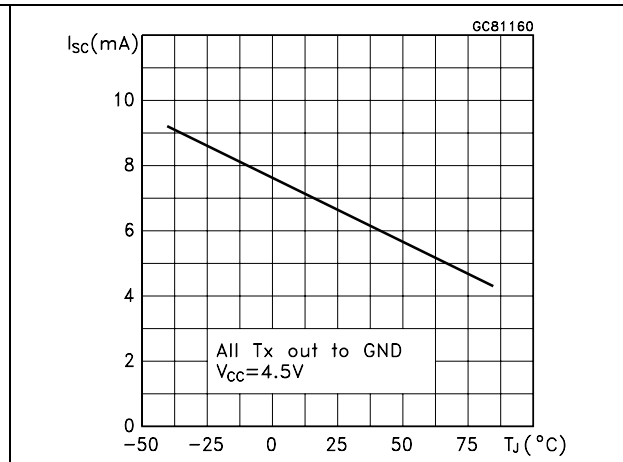




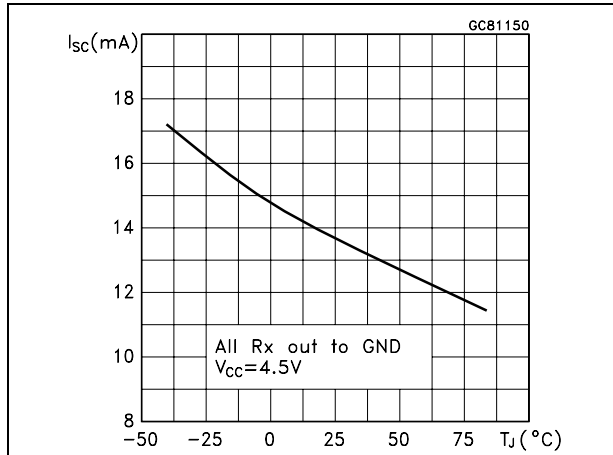
**Figure 9. High level transmitter output short circuit current vs temperature**



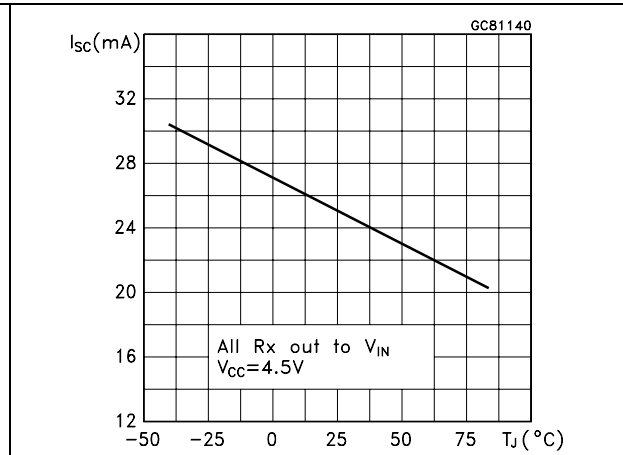
**Figure 10. Low level transmitter output short circuit current vs temperature**



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



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

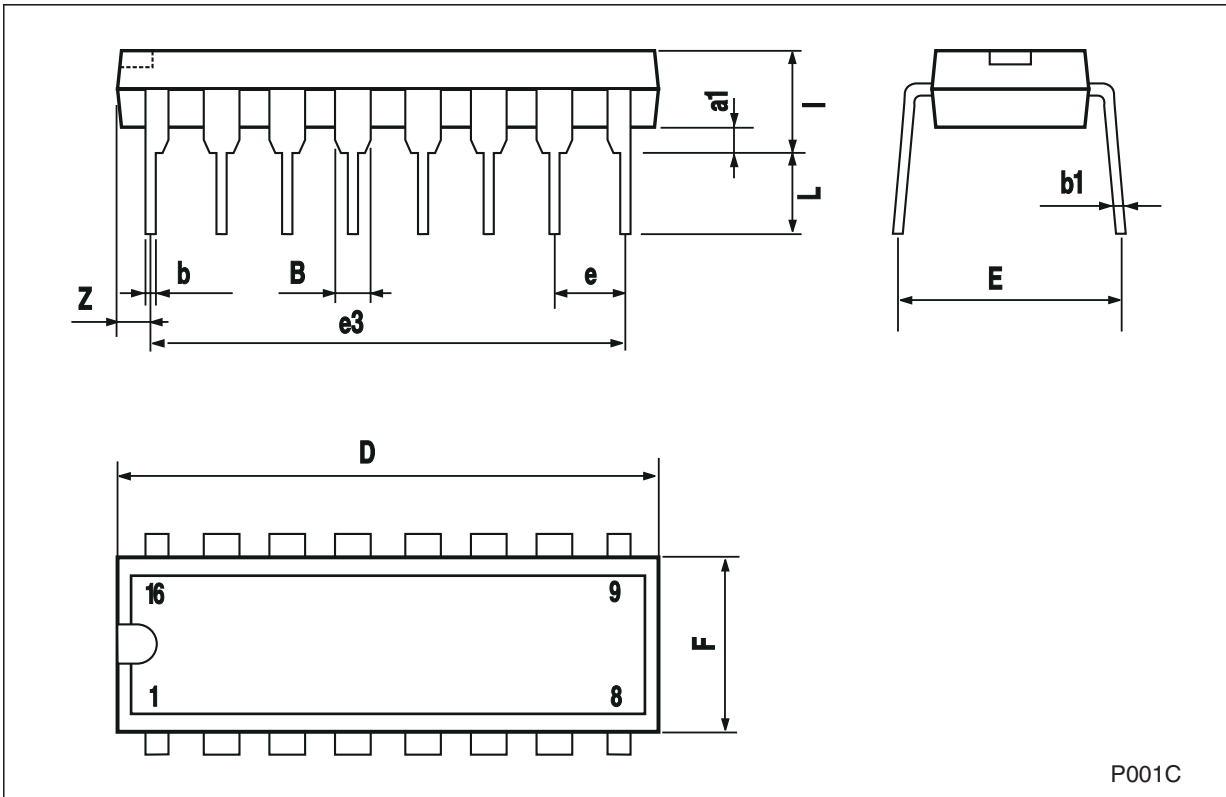


## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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).

**Plastic DIP-16 (0.25) mechanical data**

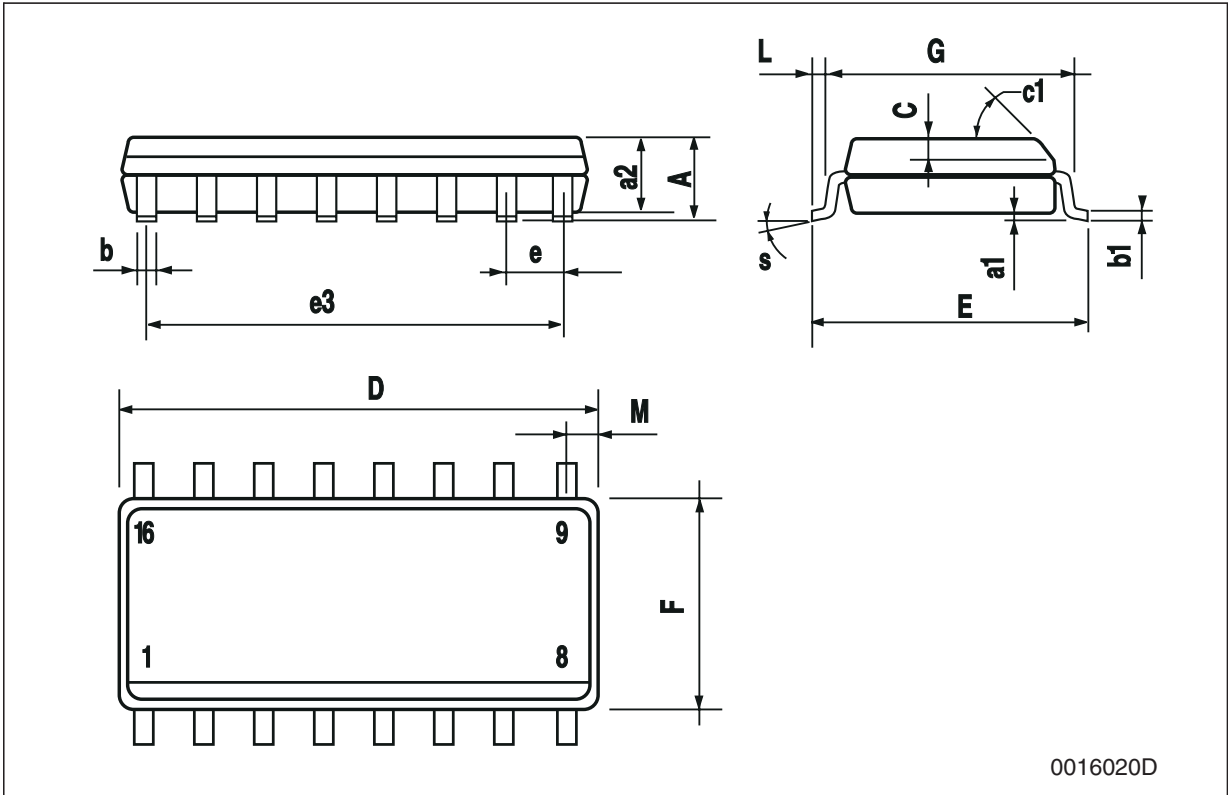
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

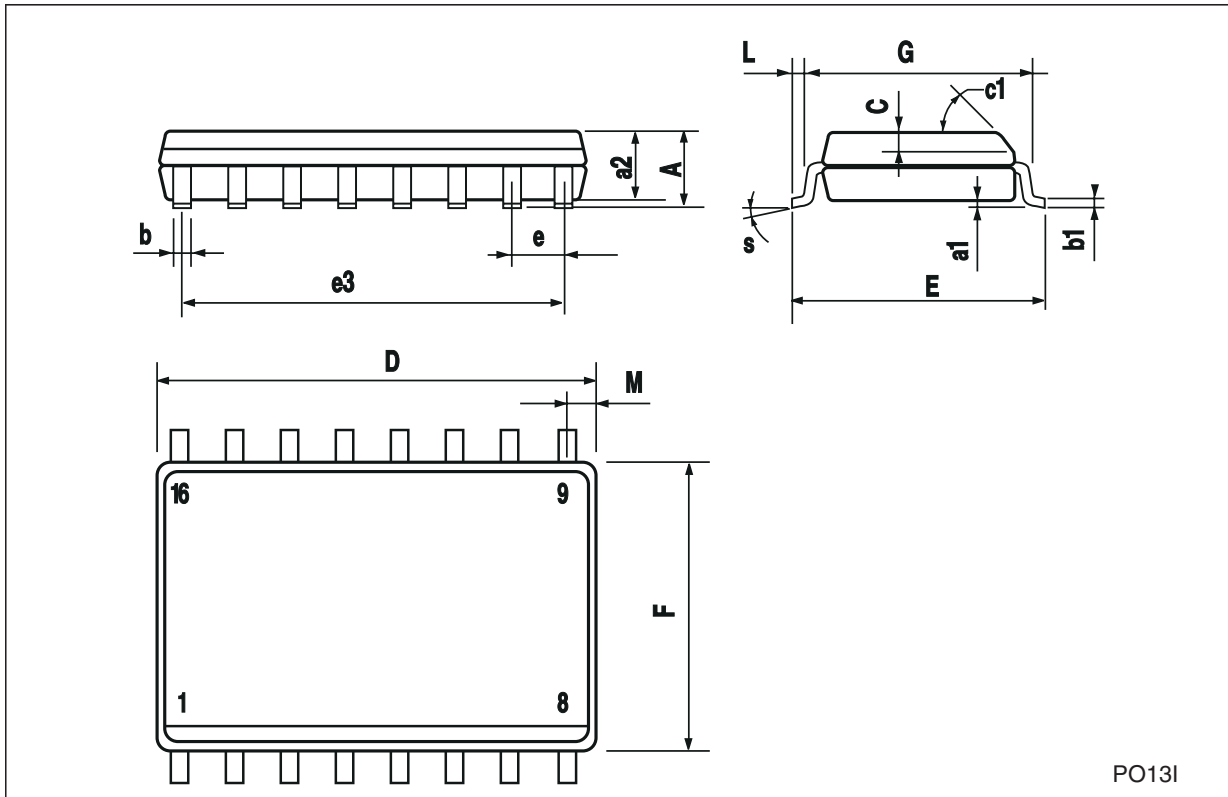
**SO-16 mechanical data**

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**

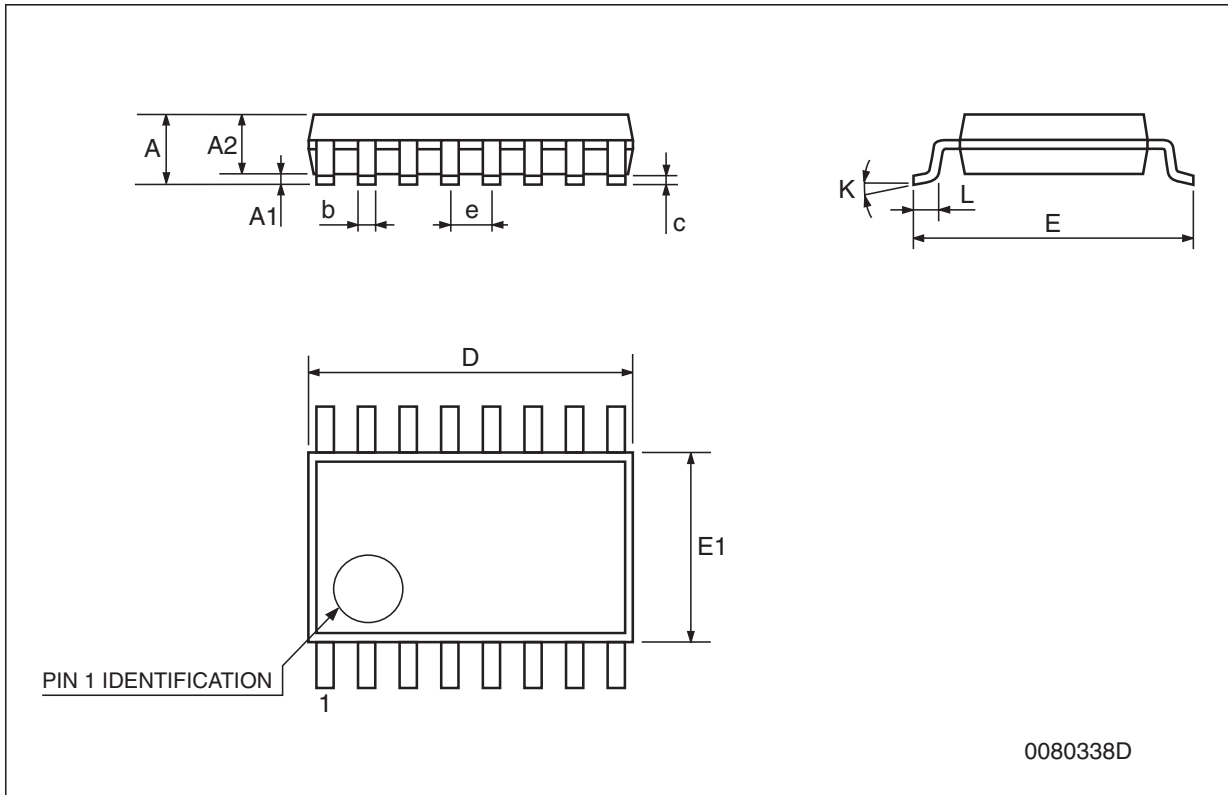
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.012
C		0.5			0.020	
c1	45° (typ.)					
D	10.1		10.5	0.397		0.413
E	10.0		10.65	0.393		0.419
e		1.27			0.050	
e3		8.89			0.350	
F	7.4		7.6	0.291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



PO131

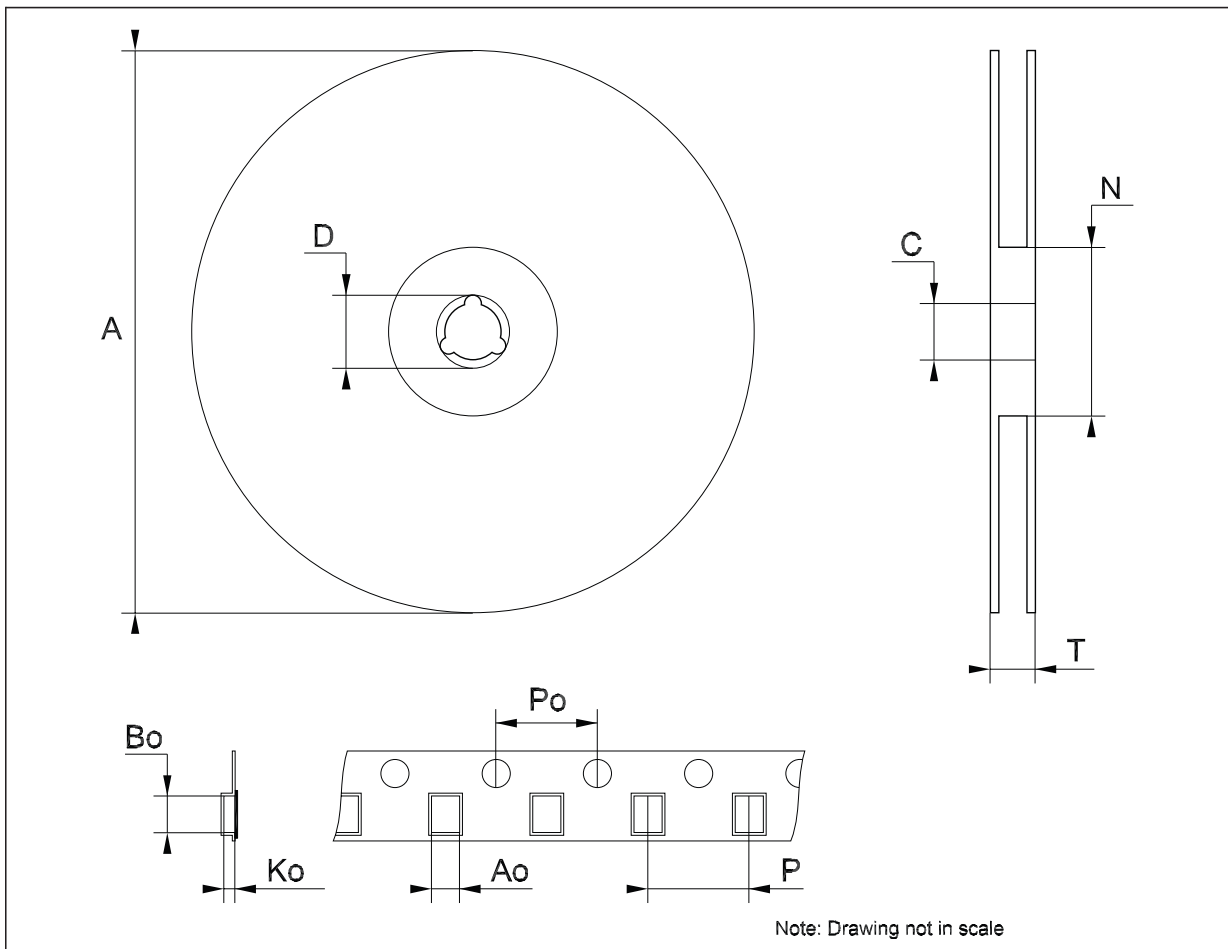
**TSSOP16 mechanical data**

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



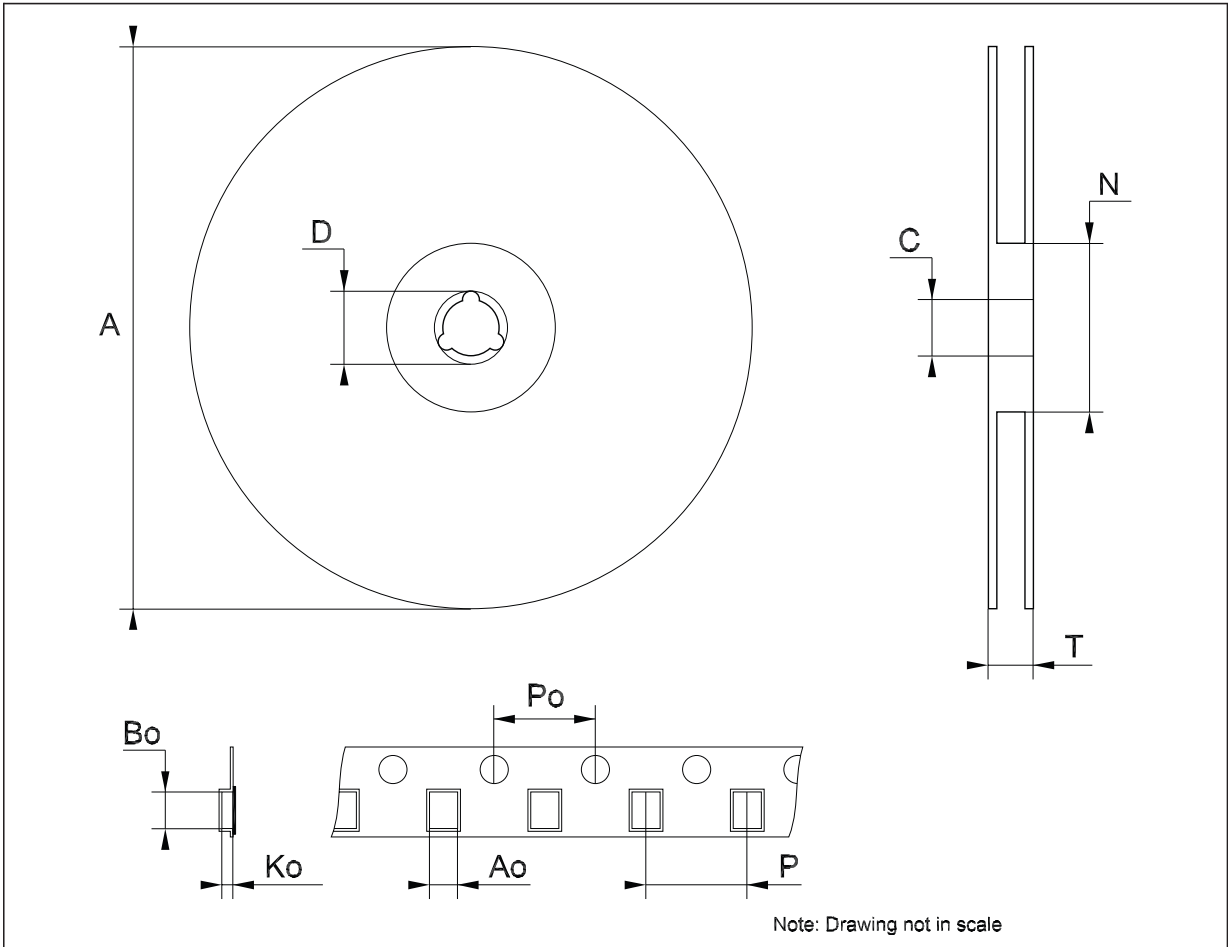
**Tape & reel SO-16 mechanical data**

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**

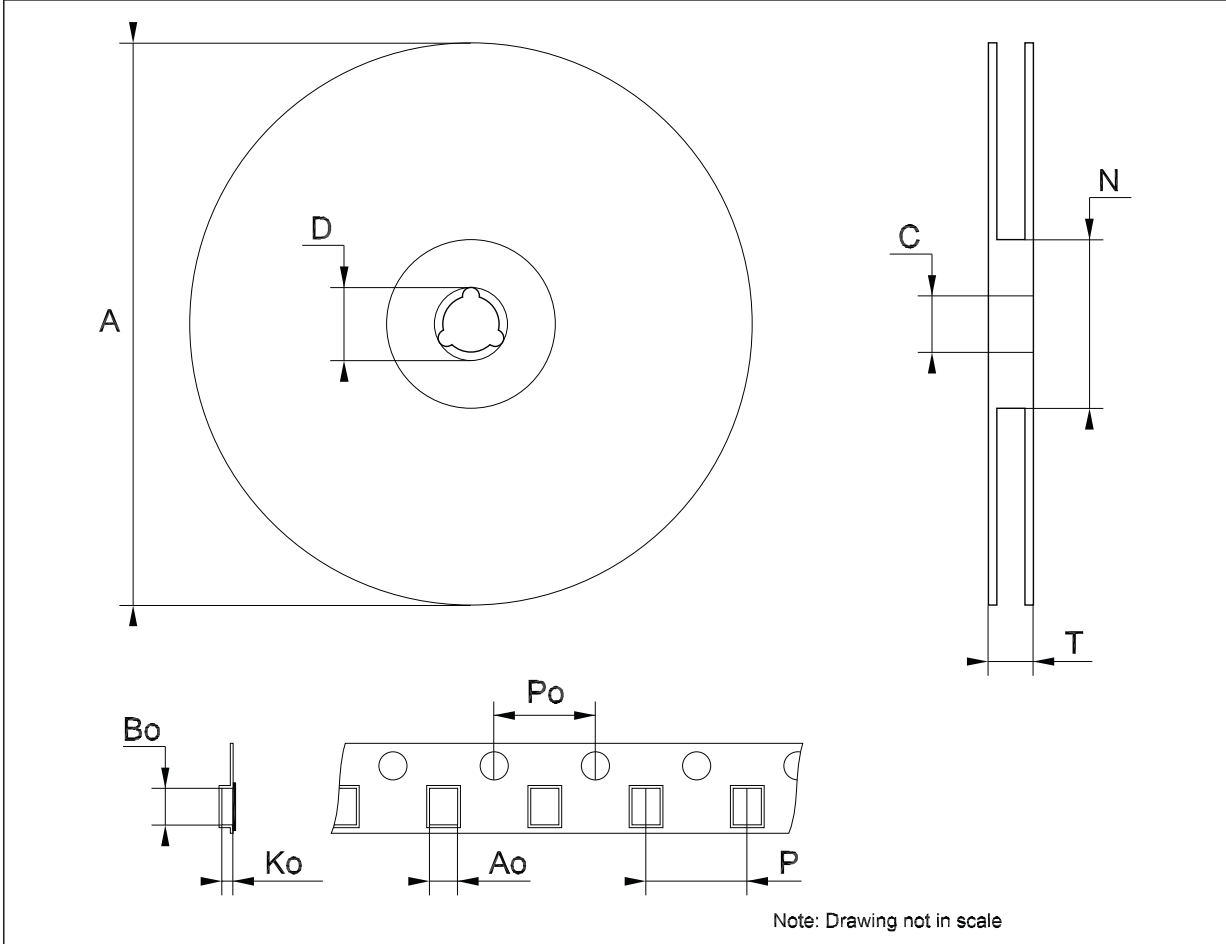
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	10.8		11.0	0.425		0.433
Bo	10.7		10.9	0.421		0.429
Ko	2.9		3.1	0.114		0.122
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476





**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 8. Document revision history**

Date	Revision	Changes
02-Sep-2005	11	Mistake $I_{TIL}$ max. on table 5.
27-Oct-2006	12	Order codes updated.
14-Nov-2007	13	Added <a href="#">Table 1</a> .
08-Feb-2008	14	Modified: <a href="#">Table 1 on page 1</a> .

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