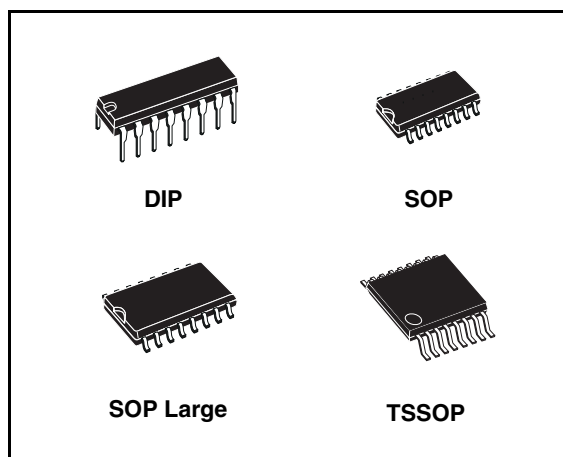


## 5 V powered multi-channel RS-232 drivers and receivers

### 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 ( $0.1 \mu\text{F}$ ). 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 $70^{\circ}$ C	DIP-16	25 parts per tube / 40 tube per box
ST232CDR	0 to $70^{\circ}$ C	SO-16 (tape and reel)	2500 parts per reel
ST232BDR	$-40$ to $85^{\circ}$ C	SO-16 (tape and reel)	2500 parts per reel
ST232CWR	0 to $70^{\circ}$ C	SO-16 Large (tape and reel)	1000 parts per reel
ST232BWR	$-40$ to $85^{\circ}$ C	SO-16 Large (tape and reel)	1000 parts per reel
ST232CTR	0 to $70^{\circ}$ C	TSSOP16 (tape and reel)	2500 parts per reel
ST232BTR	$-40$ to $85^{\circ}$ C	TSSOP16 (tape and reel)	2500 parts per reel

---

## Contents

1	Pin configuration .....	3
2	Maximum ratings .....	4
3	Electrical characteristics .....	5
4	Typical application .....	7
5	Typical performance characteristics .....	8
6	Package mechanical data .....	10
7	Revision history .....	18

# 1 Pin configuration

Figure 1. Pin connections (top view)

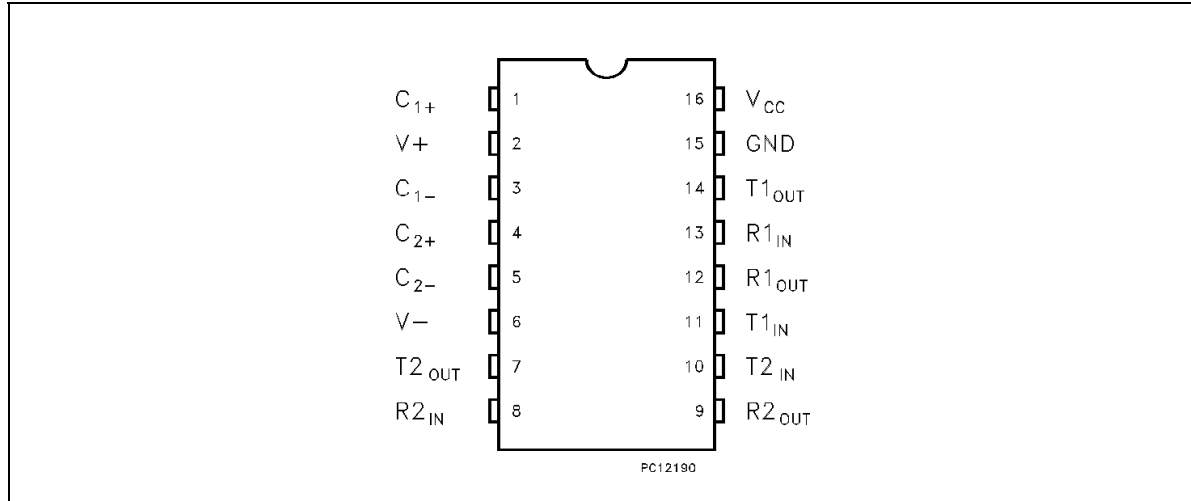


Table 2. Pin description

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	T2 <sub>OUT</sub>	Second transmitter output voltage
8	R2 <sub>IN</sub>	Second receiver input voltage
9	R2 <sub>OUT</sub>	Second receiver output voltage
10	T2 <sub>IN</sub>	Second transmitter input voltage
11	T1 <sub>IN</sub>	First transmitter input voltage
12	R1 <sub>OUT</sub>	First receiver output voltage
13	R1 <sub>IN</sub>	First receiver input voltage
14	T1 <sub>OUT</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
$T_{IN}$	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
$\text{SR}_T$	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	$\text{V}/\mu\text{s}$
$D_R$	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  $3 \text{ V}$  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 6. Receiver electrical characteristics**

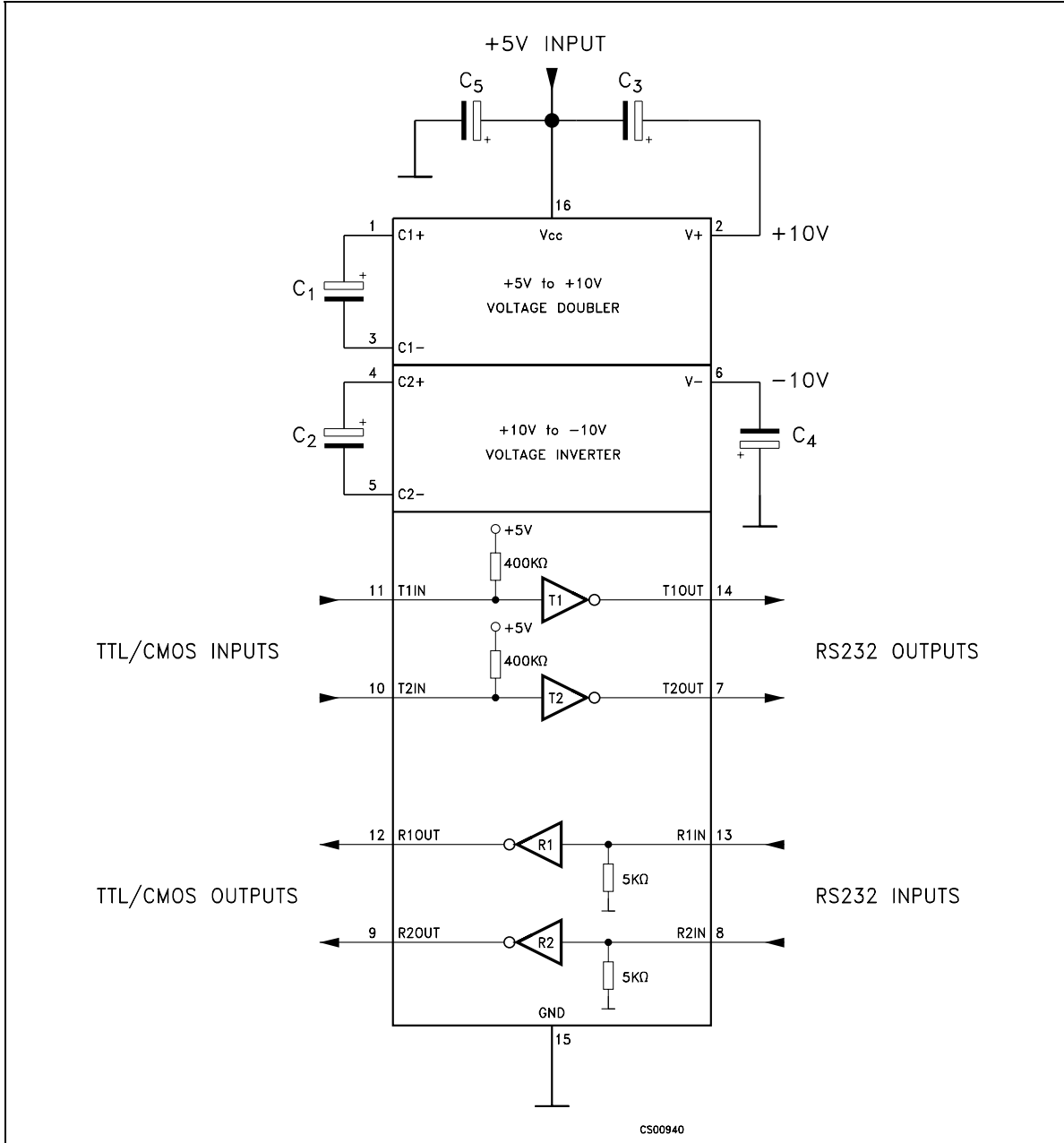
( $C_1 - C_4 = 0.1 \mu\text{F}$ ,  $V_{CC} = 5 \text{ V} \pm 10 \%$ ,  $T_A = -40$  to  $85 \text{ }^\circ\text{C}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$ ).

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	$\text{k}\Omega$
$V_{RIL}$	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

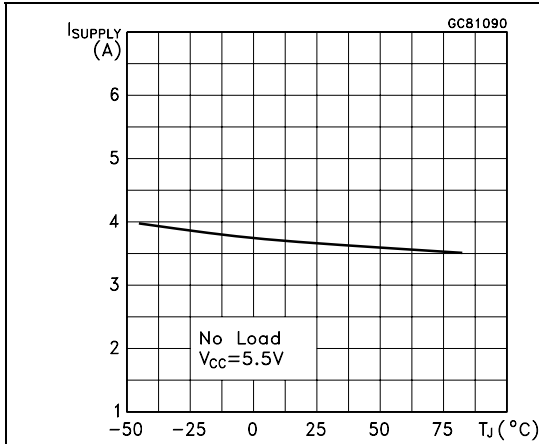
Table 7. Capacitance value (μF)

C1	C2	C3	C4	C5
0.1	0.1	0.1	0.1	0.1

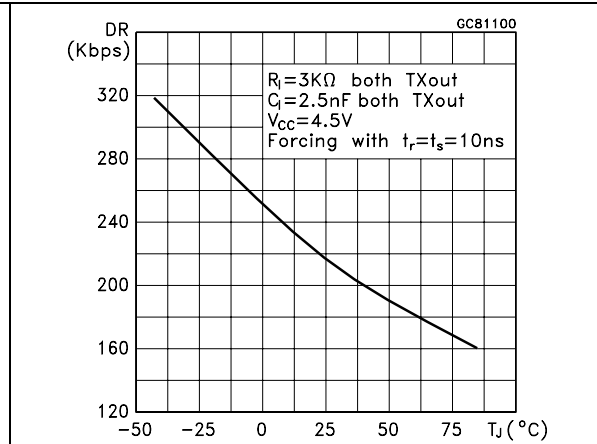
## 5 Typical performance characteristics

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

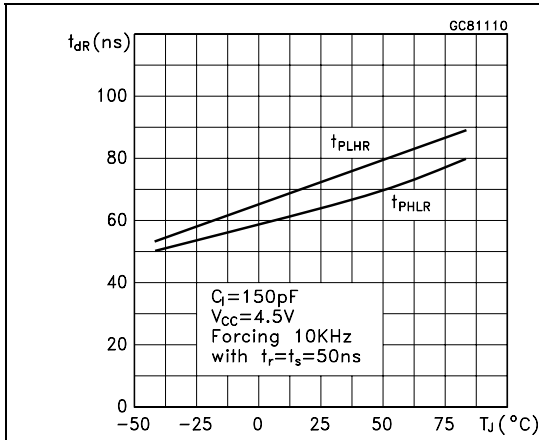
**Figure 3. Supply current vs temperature**



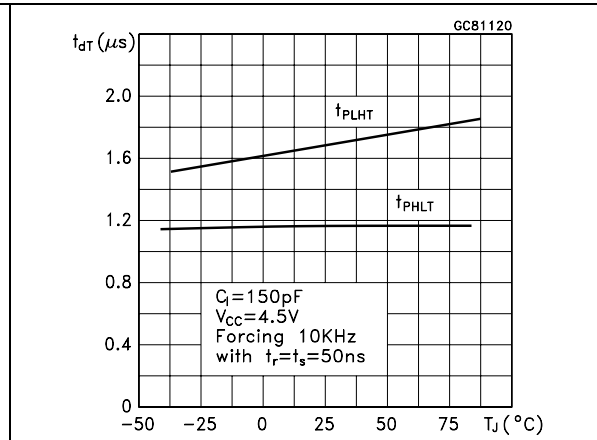
**Figure 4. Data rate vs temperature**



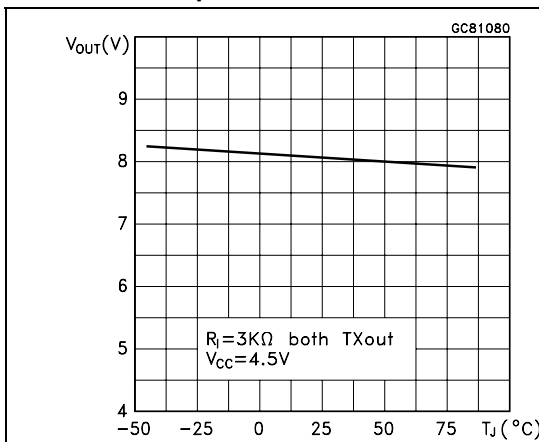
**Figure 5. Receiver propagation delay**



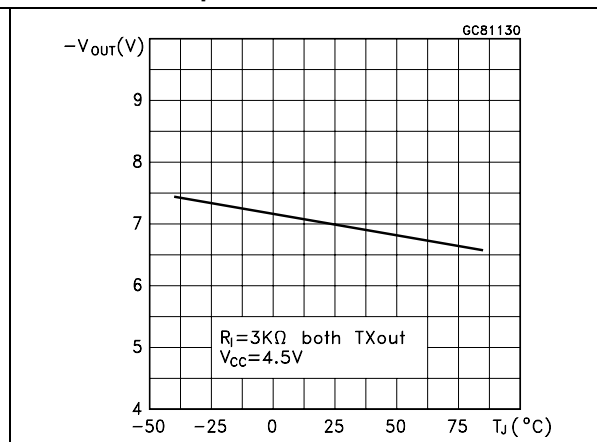
**Figure 6. Driver propagation delay**



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

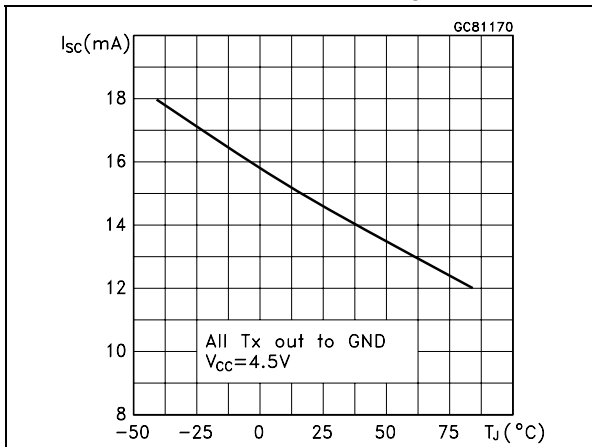


**Figure 8. Low level output voltage swing vs temperature**

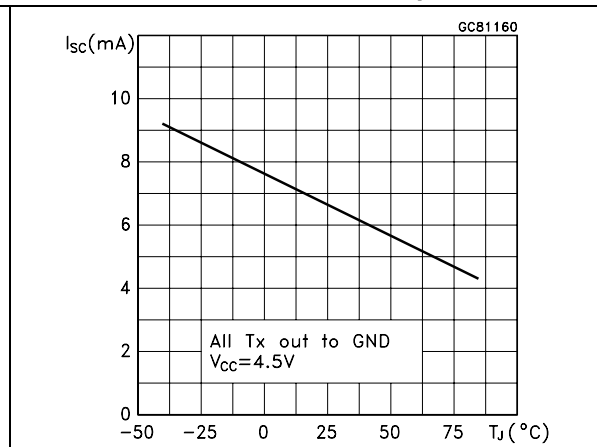




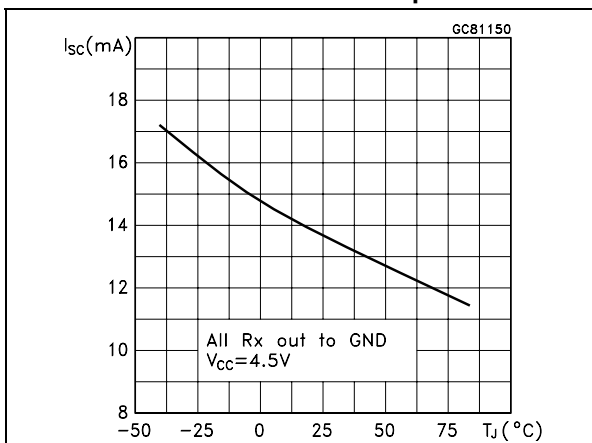
**Figure 9. High level transmitter output short circuit current vs temperature**



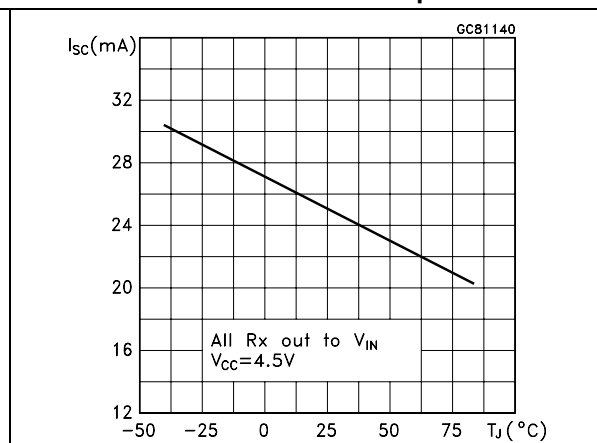
**Figure 10. Low level transmitter output short circuit current vs temperature**



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



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

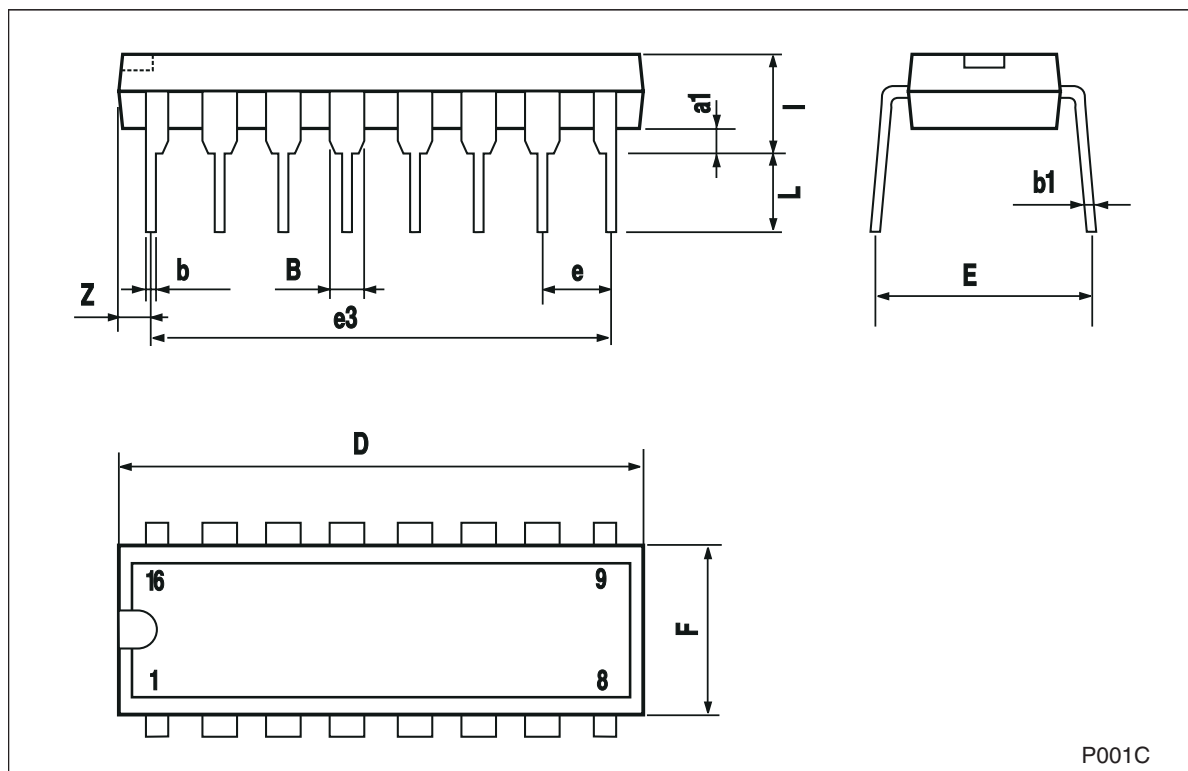


## 6 Package mechanical data

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).

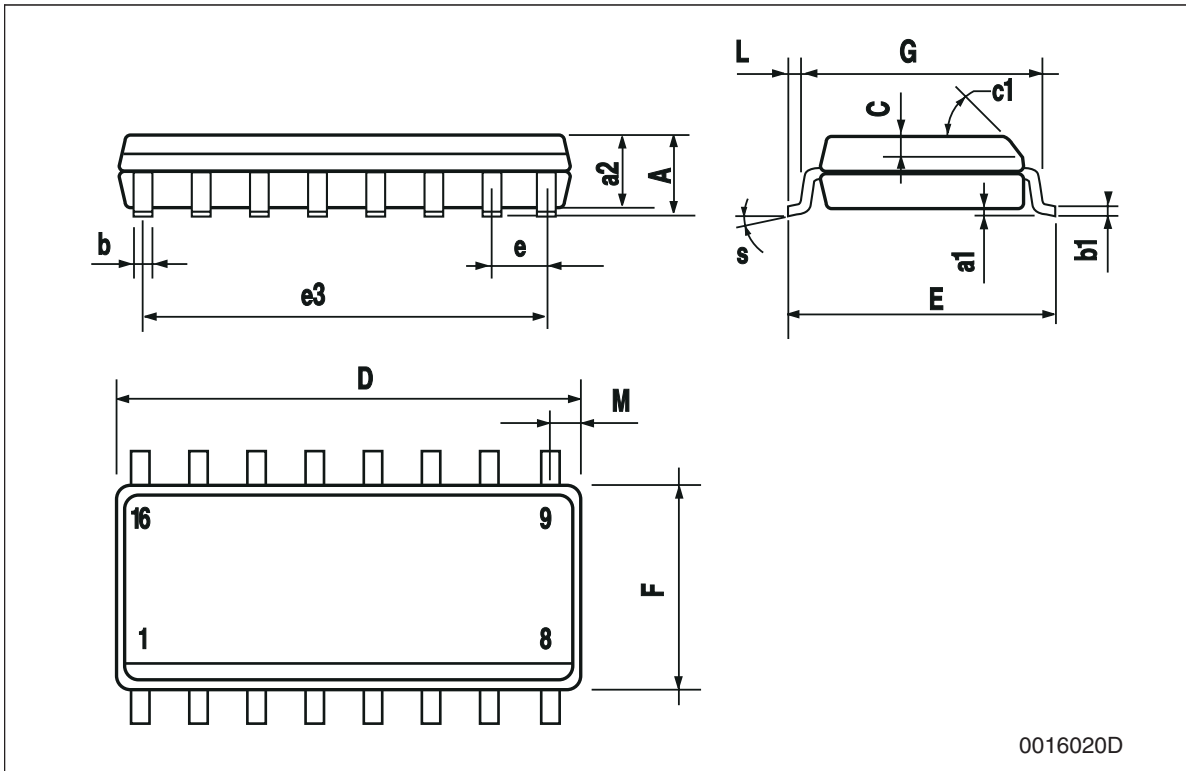
## Plastic DIP-16 (0.25) mechanical data

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
l			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



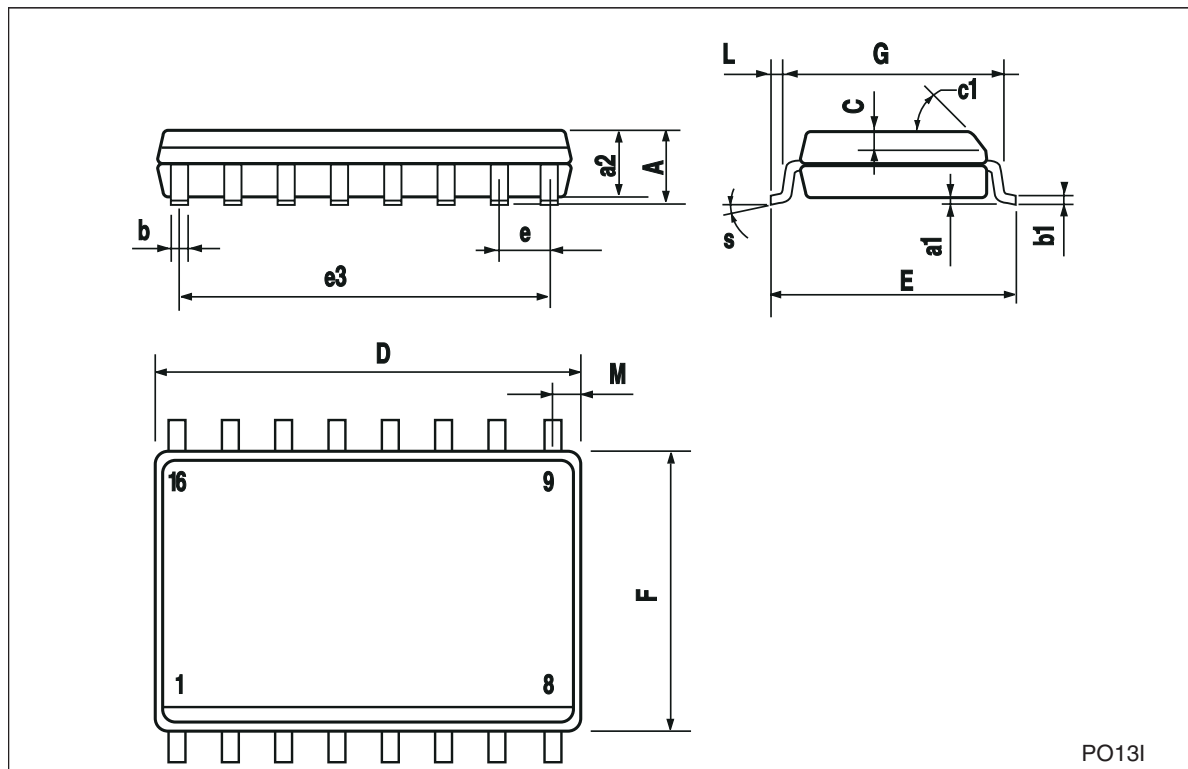
**SO-16 mechanical data**

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

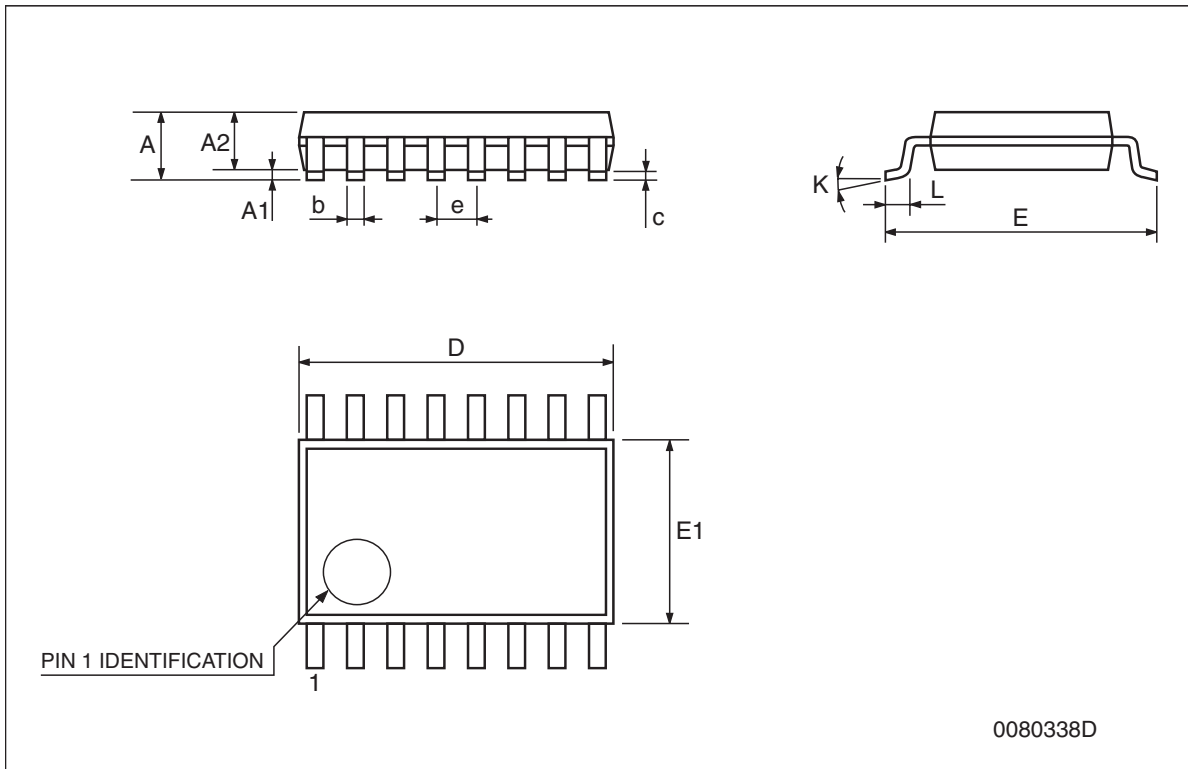
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.012
C		0.5			0.020	
c1	45° (typ.)					
D	10.1		10.5	0.397		0.413
E	10.0		10.65	0.393		0.419
e		1.27			0.050	
e3		8.89			0.350	
F	7.4		7.6	0.291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



PO13I

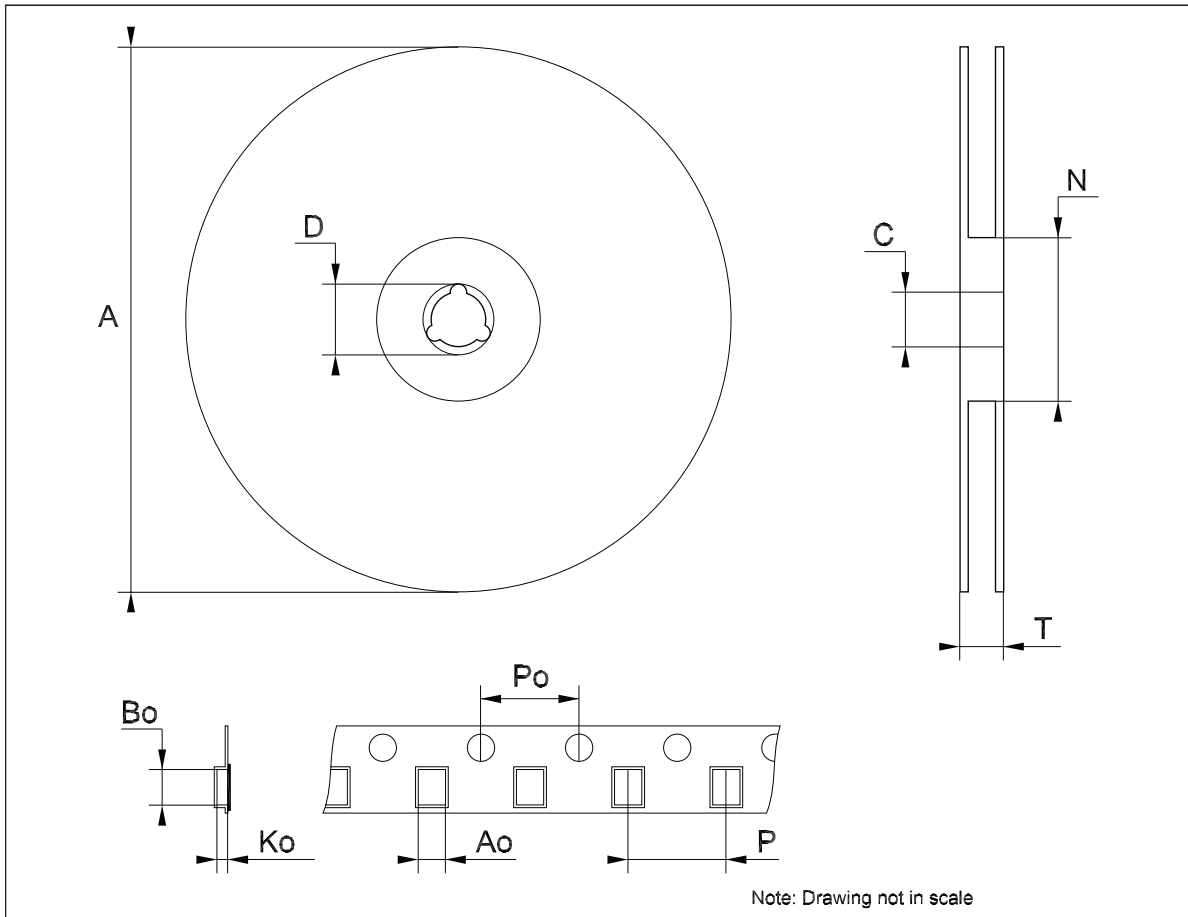
**TSSOP16 mechanical data**

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



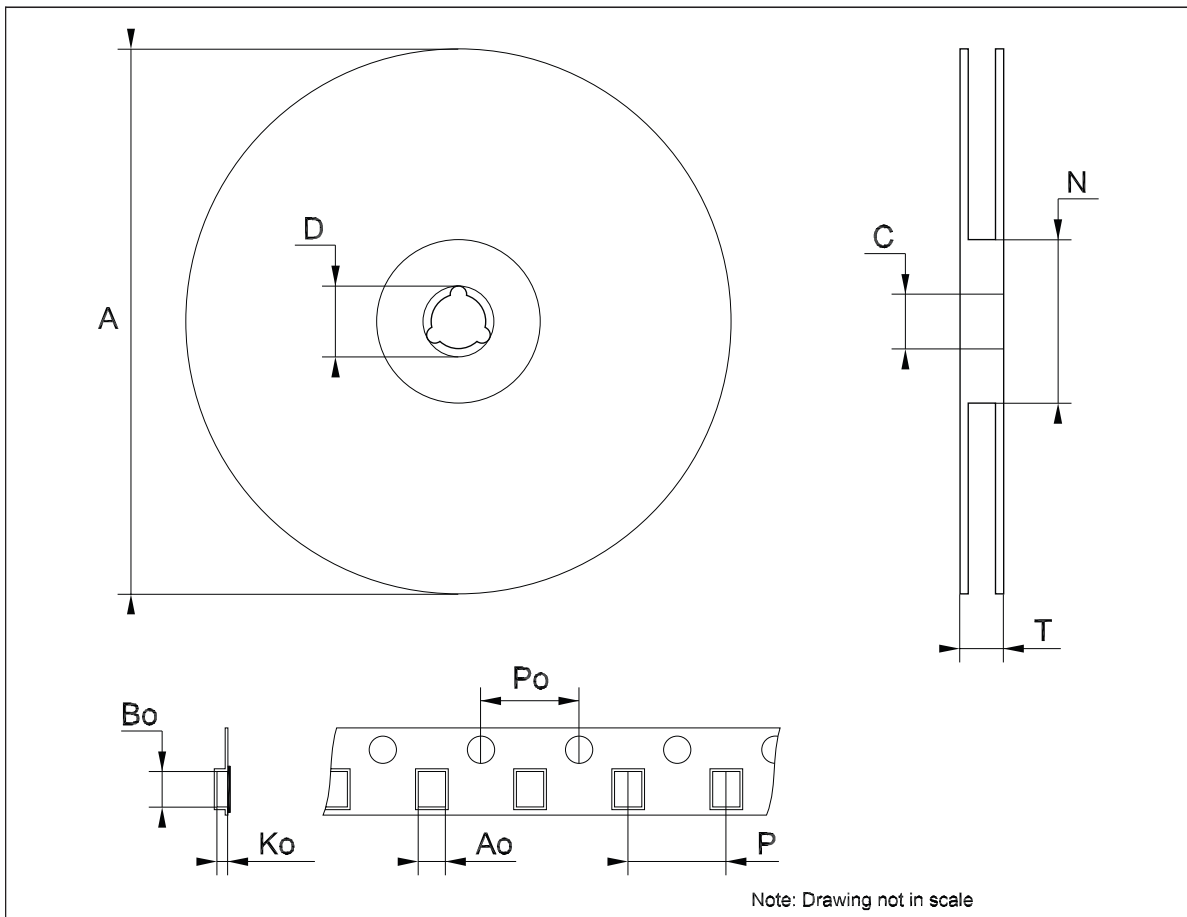
**Tape & reel SO-16 mechanical data**

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**

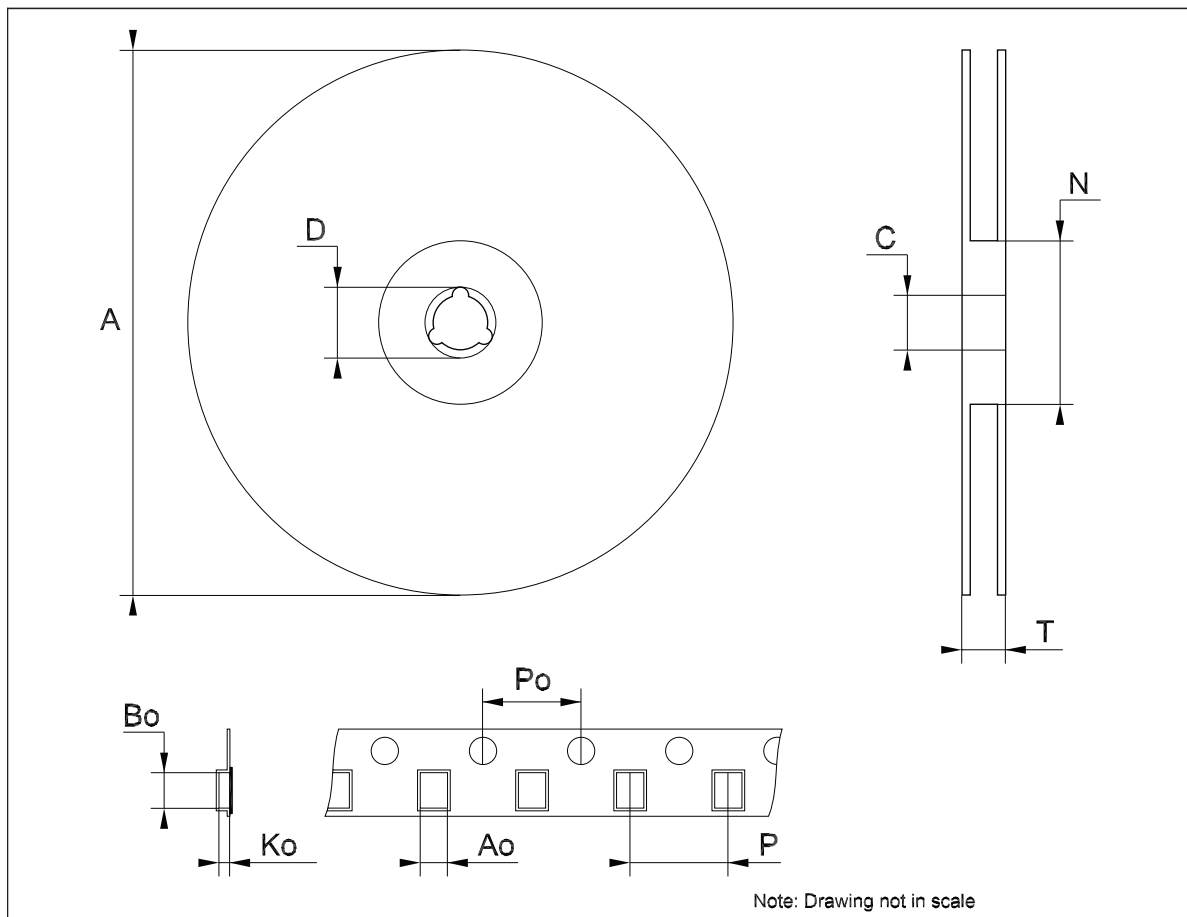
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	10.8		11.0	0.425		0.433
Bo	10.7		10.9	0.421		0.429
Ko	2.9		3.1	0.114		0.122
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476





## Tape &amp; 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> .

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2008 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)

