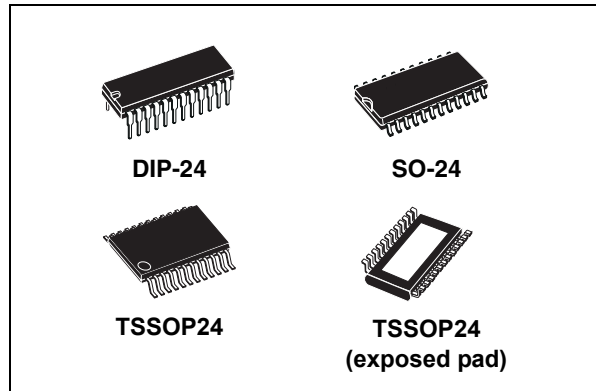


## 16-Bit, constant current LED sink driver

### Features

- 16 constant current output channels
- Adjustable output current through external resistor
- Serial data IN/parallel data OUT
- Serial out change state on the falling edges of clock
- Output current: 15-120 ma
- 25MHz clock frequency
- Available in high thermal TSSOP exposed pad
- Efficiency package



### Description

The STP16C596 is a monolithic, medium-voltage, low current power 16-bit shift register designed for LED panel displays. The STP16C596 contains a 16-bit serial-IN, parallel-OUT shift register that feeds a 16-bit, D-type storage register. In the output stage, sixteen regulated current sources are designed to provide 15-120mA constant current to drive the LEDs.

The serial output change state on the falling edges of clock, this special feature will provide an improved performance of the application when the clock signal is skewed because the daisy chain is too long.

Through an external resistor, users may adjust the STP16C596 output current, controlling in this way the light intensity of LEDs.

The STP16C596 guarantees a 16V output driving capability, allowing users to connect more LEDs in series. The high clock frequency, 25MHz, also satisfies the system demand for high volume data transmission. Compared with a standard TSSOP package, the TSSOP exposed pad increases heat dissipation capability by a 2.5 factor.

### Order codes

Part Number	Package	Packaging
STP16C596B1R	DIP-24	15 parts per tube
STP16C596M	SO-24 (Tube)	40 parts per tube
STP16C596MTR	SO-24 (Tape & Reel)	1000 parts per reel
STP16C596TTR	TSSOP24 (Tape & Reel)	2500 parts per reel
STP16C596XTTR	TSSOP24 Exposed-Pad (Tape & Reel)	2500 parts per reel

# Contents

<b>1</b>	<b>Summary description</b> .....	<b>3</b>
1.1	Pin connection and description .....	3
1.2	Equivalent circuit of inputs and outputs .....	4
1.3	Block diagram .....	5
1.4	Truth table .....	6
1.5	Timing diagrams .....	6
<b>2</b>	<b>Maximum rating</b> .....	<b>9</b>
2.1	Thermal data .....	9
2.2	Recommended operating conditions .....	10
<b>3</b>	<b>Electrical characteristics</b> .....	<b>11</b>
<b>4</b>	<b>Switching characteristics</b> .....	<b>12</b>
<b>5</b>	<b>Test circuit</b> .....	<b>13</b>
<b>6</b>	<b>Typical characteristics</b> .....	<b>14</b>
<b>7</b>	<b>Package mechanical data</b> .....	<b>16</b>
<b>8</b>	<b>Revision history</b> .....	<b>23</b>

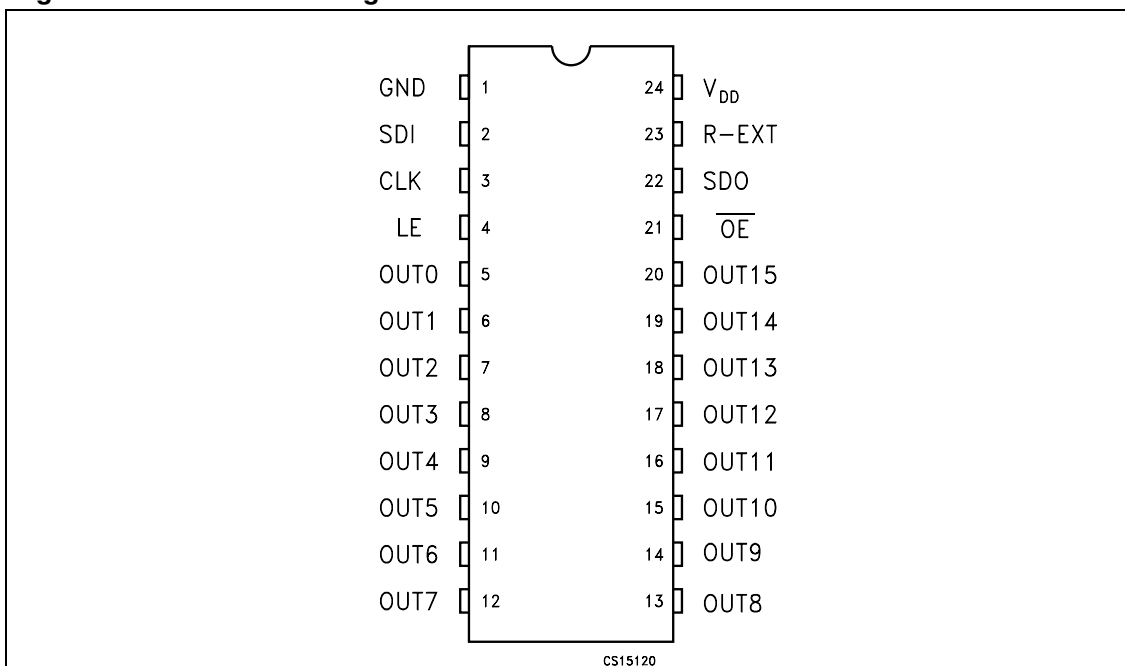
# 1 Summary description

**Table 1. Current accuracy**

Output voltage	Current accuracy		Output current
	Between bits	Between ICs	
≥ 0.7V	Typ. ± 3%	± 10%	15 to 120mA

## 1.1 Pin connection and description

**Figure 1. Connections diagram**



*Note: The Exposed-Pad is electrically not connected*

**Table 2. Pin description**

PIN N°	Symbol	Name and function
1	GND	Ground terminal
2	SDI	Serial data input terminal
3	CLK	Clock input terminal
4	LE	Latch input terminal
5-20	OUT 0-15	Output terminal
21	$\overline{OE}$	Input terminal of output enable (active low)
22	SDO	Serial data out terminal
23	R-EXT	Input terminal of an external resistor for constant current programing
24	$V_{DD}$	Supply voltage terminal

## 1.2 Equivalent circuit of inputs and outputs

Figure 2.  $\overline{OE}$  terminal

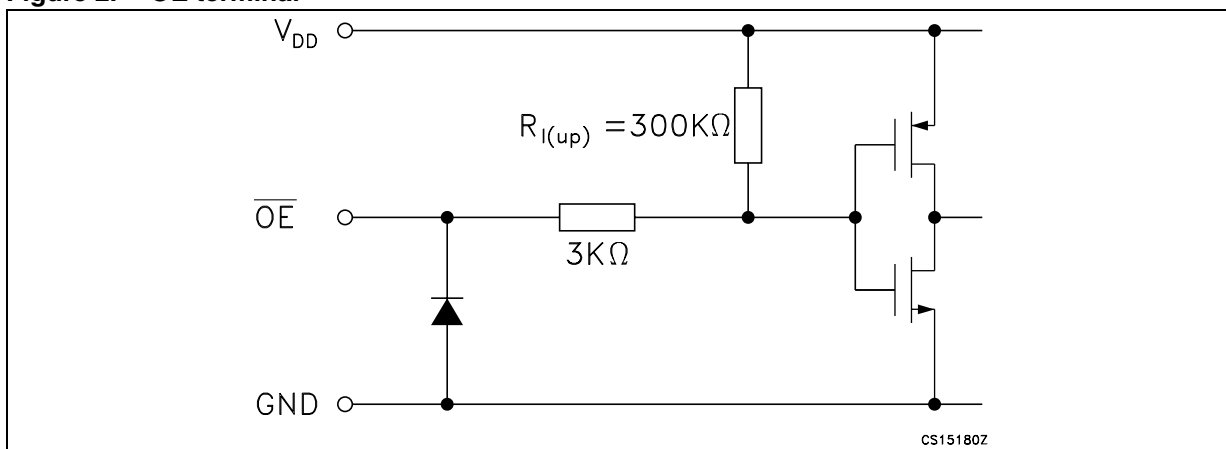


Figure 3. LE terminal

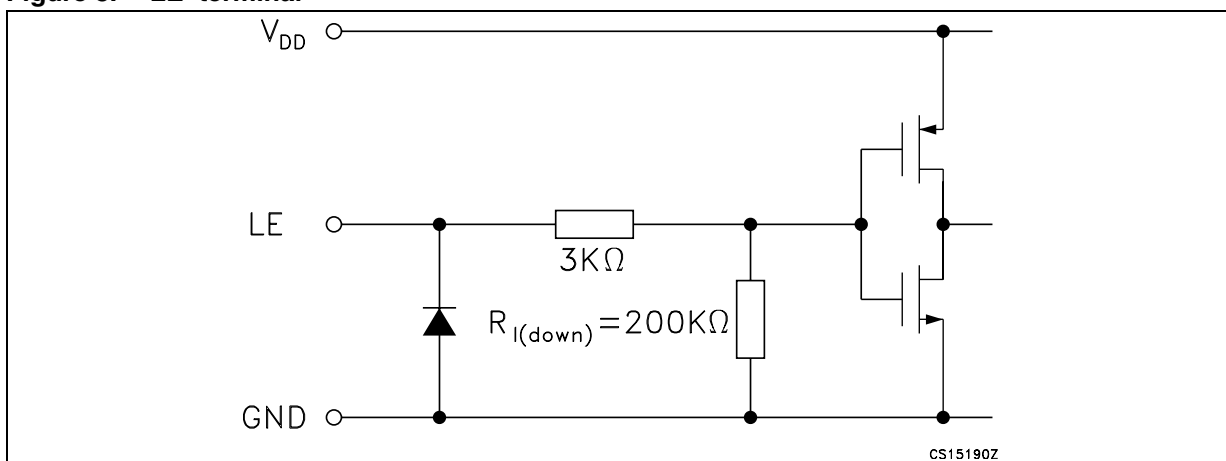
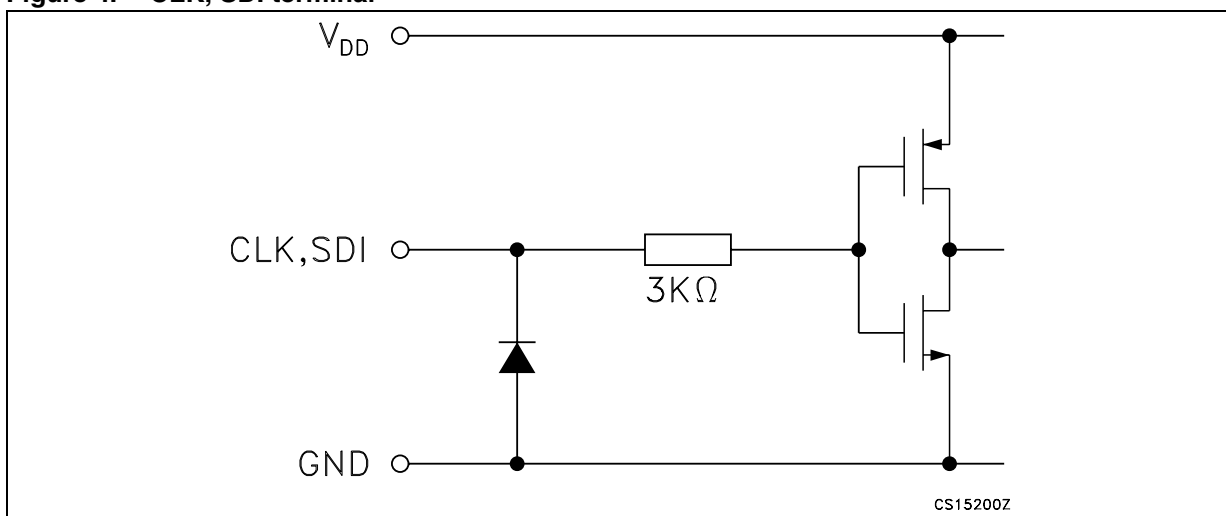


Figure 4. CLK, SDI terminal





### 1.4 Truth table

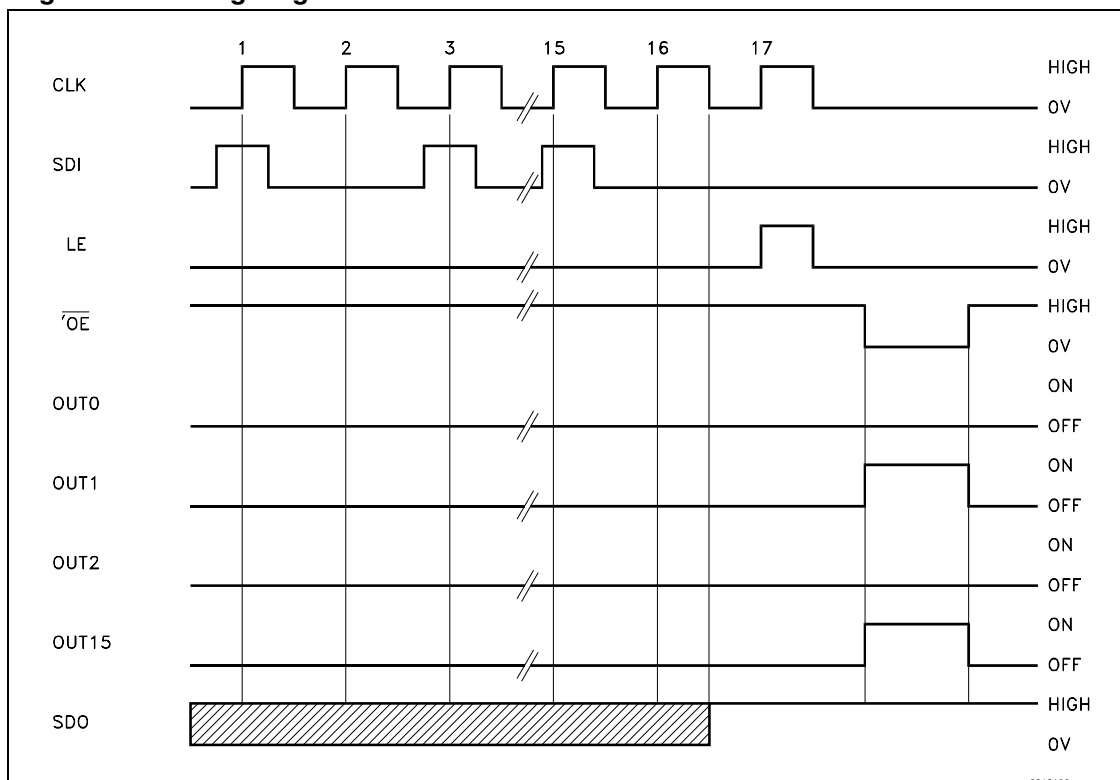
Table 3. Truth table

Clock	LE	$\overline{OE}$	SERIAL-IN	OUT0 ..... OUT7 ..... OUT15	SDO
	H	L	Dn	Dn ..... Dn -7 ..... Dn -15	Dn -15
	L	L	Dn + 1	No Change	Dn -14
	H	L	Dn + 2	Dn -2 ..... Dn -5 ..... Dn -13	Dn -13
	X	L	Dn + 3	Dn -2 ..... Dn -5 ..... Dn -13	Dn -13
	X	L	Dn + 3	ON	Dn -13

Note: *OUT0 to OUT15 = ON when Dn = H; OUT0 to OUT15 = OFF when Dn = L.*

### 1.5 Timing diagrams

Figure 7. Timing diagram - normal mode



Note: *Note: The latches circuit holds data when the LE terminal is Low.  
 When the LE terminal is at High level, latch circuit doesn't hold the data it passes from the input to the output.  
 When the  $\overline{OE}$  terminal is at Low level, output terminals OUT0 to OUT15 respond to the data, either ON or OFF.  
 When the  $\overline{OE}$  terminal is at High level, it switches off all the data on the output terminal.*

Figure 8. Clock, Serial-In, Serial-Out

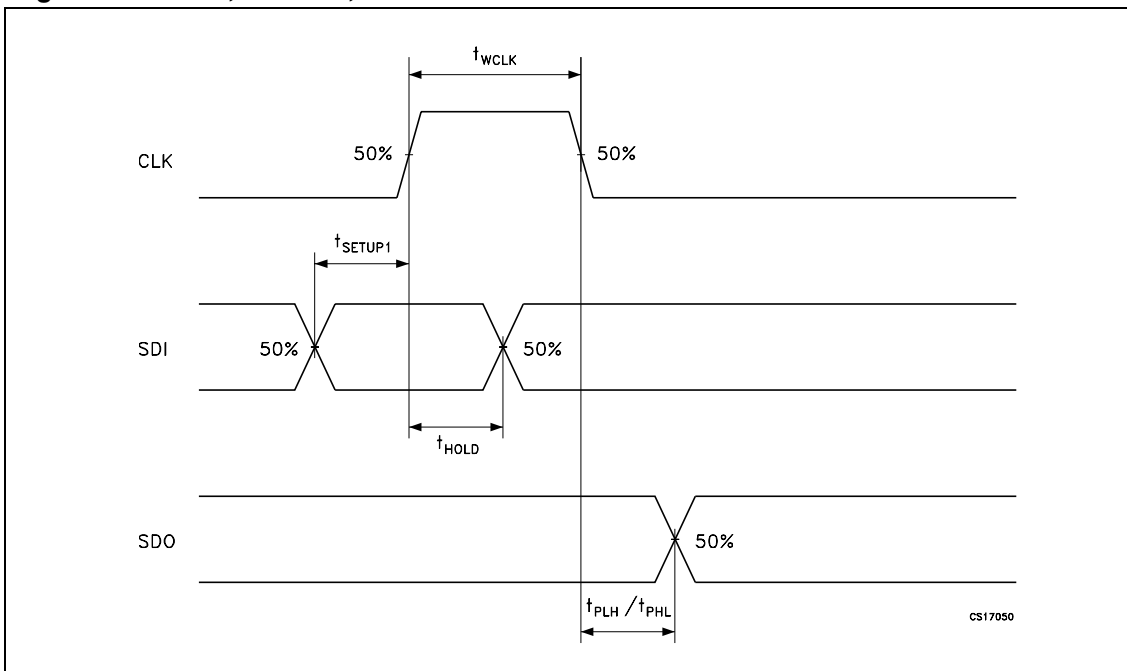


Figure 9. Clock, Serial-In, Latch, Enable, Outputs

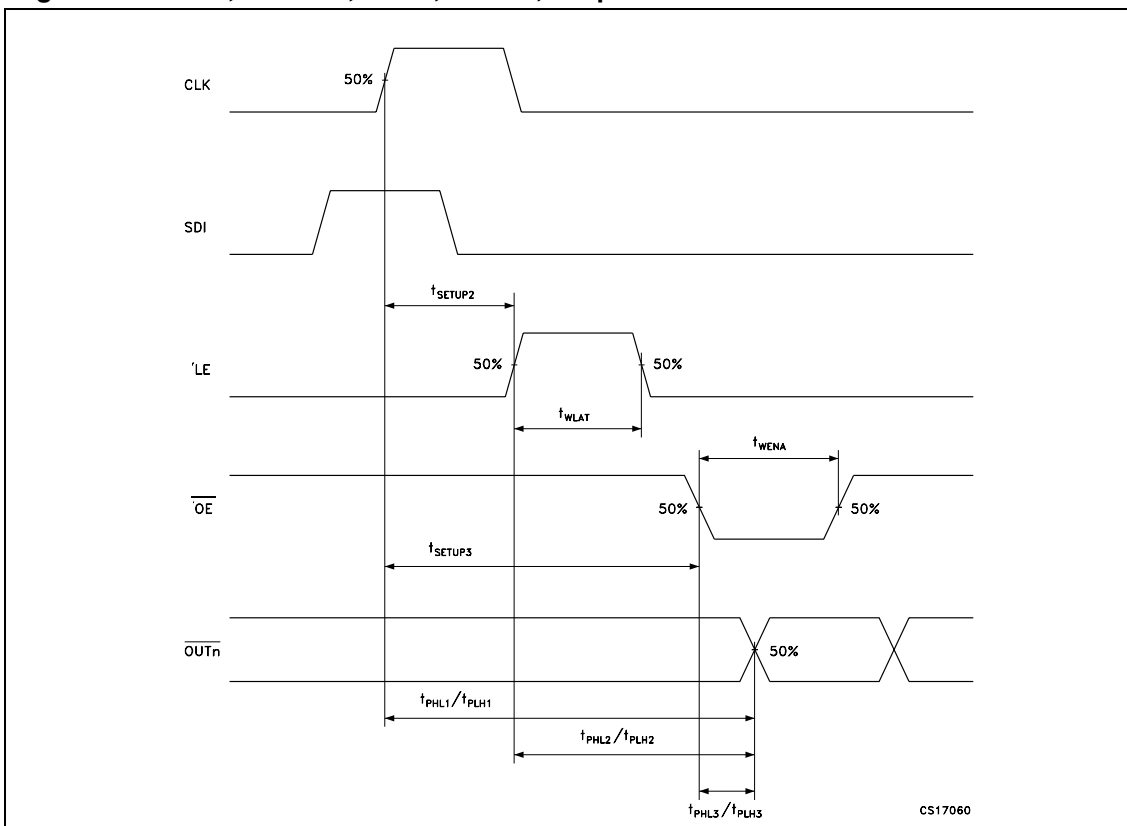
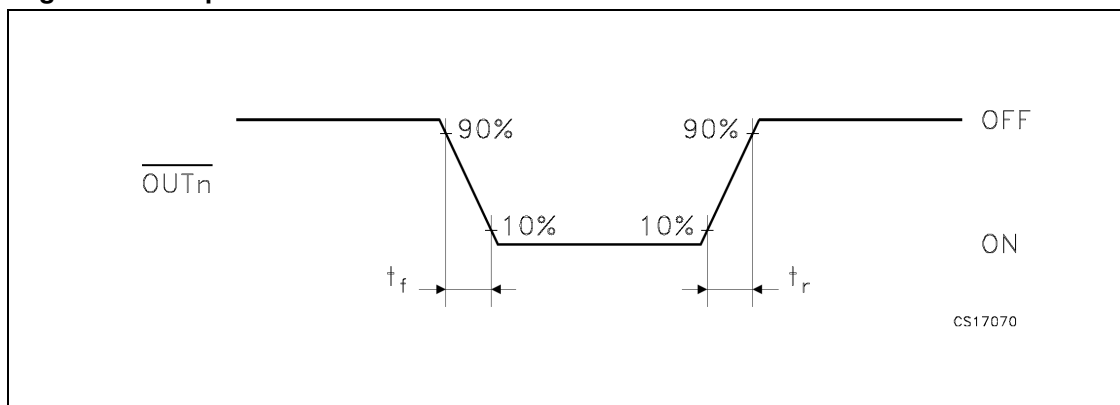


Figure 10. Outputs





## 2 Maximum rating

Stressing the device above the rating listed in the “Absolute Maximum Ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the Operating sections of this specification is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 4. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply voltage	0 to 7	V
$V_O$	Output voltage	-0.5 to 16	V
$I_O$	Output current	120	mA
$V_I$	Input voltage	-0.4 to $V_{DD}+0.4$	V
$I_{GND}$	GND terminal current	1920	mA
$f_{CLK}$	Clock frequency	25	MHz
$T_{OPR}$	Operating temperature range	-40 to +125	°C
$T_{STG}$	Storage temperature range	-65 to +150	°C

### 2.1 Thermal data

**Table 5. Thermal data**

Symbol	Parameter	DIP-24	SO-24	TSSOP-24	TSSOP-24 <sup>(1)</sup> (exposed pad)	Unit
$R_{thJA}$	Thermal resistance junction-ambient	60	75	85	37.5	°C/W

1. The Exposed-Pad should be soldered to the PBC to realize the thermal benefits

## 2.2 Recommended operating conditions

**Table 6. Recommended operating conditions**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{DD}$	Supply voltage		4.5	5.0	5.5	V
$V_O$	Output voltage				16.0	V
$I_O$	Output current	OUTn	5		120	mA
$I_{OH}$	Output current	SERIAL-OUT			+1	mA
$I_{OL}$	Output current	SERIAL-OUT			-1	mA
$V_{IH}$	Input voltage		$0.7V_{DD}$		$V_{DD}+0.3$	V
$V_{IL}$	Input voltage		-0.3		$0.3V_{DD}$	V
$t_{wLAT}$	LE pulse width	$V_{DD} = 4.5$ to $5.5V$	20			ns
$t_{wCLK}$	CLK pulse width		20			ns
$t_{wEN}$	$\overline{OE}$ pulse width		400			ns
$t_{SETUP(D)}$	Setup time for DATA		20			ns
$t_{HOLD(D)}$	Hold time for DATA		15			ns
$t_{SETUP(L)}$	Setup time for LATCH		15			ns
$f_{CLK}$	Clock frequency		Cascade operation <sup>(1)</sup>			25

1. If the device is connected in cascade, it may not be possible to achieve the maximum data transfer. Please consider the timings carefully.

### 3 Electrical characteristics

**Table 7. Electrical characteristics** ( $V_{DD} = 5V$ ,  $T = 25^{\circ}C$ , unless otherwise specified.)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{IH}$	Input voltage high level		$0.7V_{DD}$		$V_{DD}$	V
$V_{IL}$	Input voltage low level		GND		$0.3V_{DD}$	V
$I_{OH}$	Output leakage current	$V_{OH} = 16V$			10	$\mu A$
$V_{OL}$	Output voltage (Serial-OUT)	$I_{OL} = 1mA$			0.4	V
$V_{OH}$	Output voltage (Serial-OUT)	$I_{OH} = -1mA$	$V_{DD} - 0.4V$			V
$I_{OL1}$	Output current	$V_O = 0.7V$ $R_{EXT} = 910\Omega$	18.6	20.4	22.4	mA
$I_{OL2}$		$V_O = 0.7V$ $R_{EXT} = 360\Omega$	45.7	50.2	55.2	
$\Delta I_{OL1}$	Output current error between bit (All Output ON)	$V_O = 0.7V$ $R_{EXT} = 910\Omega$		$\pm 3$	$\pm 4$	%
$\Delta I_{OL2}$		$V_O = 0.7V$ $R_{EXT} = 360\Omega$		$\pm 3$	$\pm 4$	
$R_{SIN(up)}$	Pull-up resistor		150	300	600	$K\Omega$
$R_{SIN(down)}$	Pull-down resistor		100	200	400	$K\Omega$
$I_{DD(OFF1)}$	Supply current (OFF)	$R_{EXT} = OPEN$ OUT 0 to 15 = OFF		0.3	0.6	mA
$I_{DD(OFF2)}$		$R_{EXT} = 470\Omega$ OUT 0 to 15 = OFF		5.5	7.7	
$I_{DD(OFF3)}$		$R_{EXT} = 250\Omega$ OUT 0 to 15 = OFF		10.1	14.1	
$I_{DD(ON1)}$	Supply current (ON)	$R_{EXT} = 470\Omega$ OUT 0 to 15 = ON		5.5	7.7	
$I_{DD(ON2)}$		$R_{EXT} = 250\Omega$ OUT 0 to 15 = ON		10.1	14.1	

## 4 Switching characteristics

**Table 8. Switching characteristics** ( $V_{DD} = 5V$ ,  $T = 25^{\circ}C$ , unless otherwise specified.)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{PLH1}$	Propagation delay time, CLK- $\overline{OUTn}$ , LE = H, $\overline{OE} = L$	$V_{DD} = 5V$ $V_{IH} = V_{DD}$ $V_{IL} = GND$ $C_L = 13pF$ $I_O = 40mA$ $V_L = 3V$ $R_{EXT} = 470\Omega$ $R_L = 65\Omega$ $CLK = 1MHz$		200	280	ns	
$t_{PLH2}$	Propagation delay time, LE- $\overline{OUTn}$ , $\overline{OE} = L$			160	250	ns	
$t_{PLH3}$	Propagation delay time, OE- $\overline{OUTn}$ , LE = H			145	200	ns	
$t_{PLH}$	Propagation delay time, CLK-SDO			15	30	ns	
$t_{PHL1}$	Propagation delay time, CLK- $\overline{OUTn}$ , LE = H, $\overline{OE} = L$			15	30	ns	
$t_{PHL2}$	Propagation delay time, LE- $\overline{OUTn}$ , $\overline{OE} = L$			15	30	ns	
$t_{PHL3}$	Propagation delay time, OE- $\overline{OUTn}$ , LE = H			45	60	ns	
$t_{PHL}$	Propagation delay time, CLK-SDO			15	30	ns	
$t_r$	Output rise time				160	200	ns
$t_f$	Output fall time				15	25	ns

Note: 1 To prevent current overshoot, during the Outputs switching, the overhead output voltage must be less than 1V

2 The Maximum suggested swithing frequency is up to 10KHz

## 5 Test circuit

Figure 11. DC characteristics

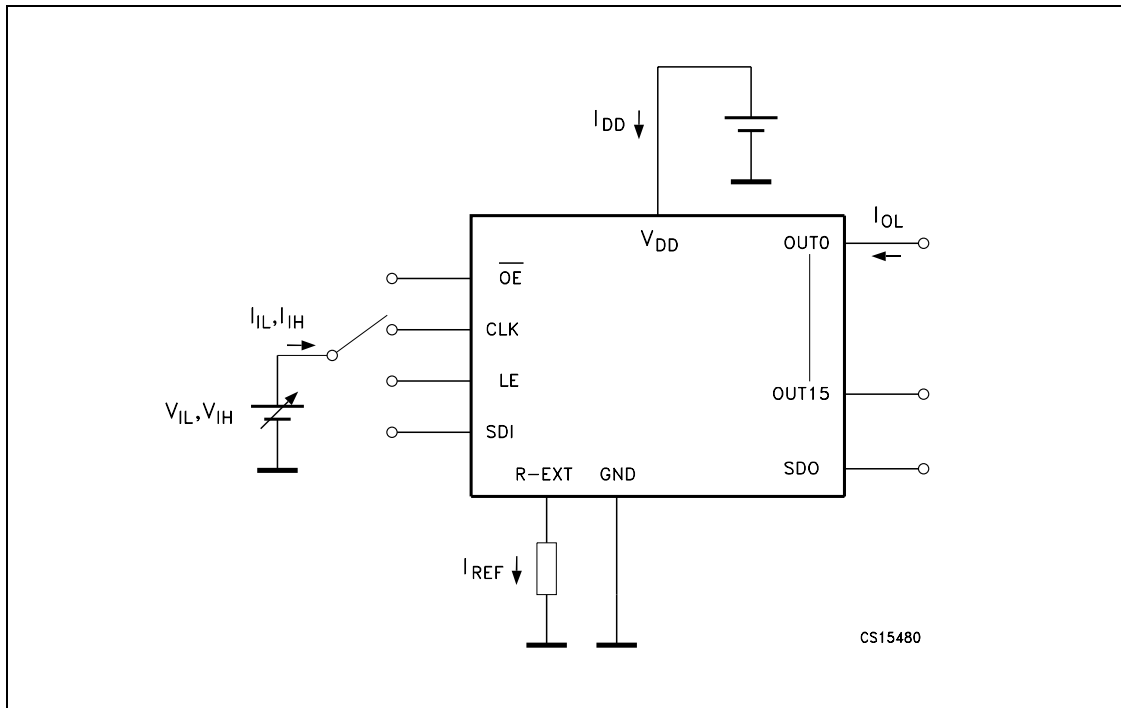
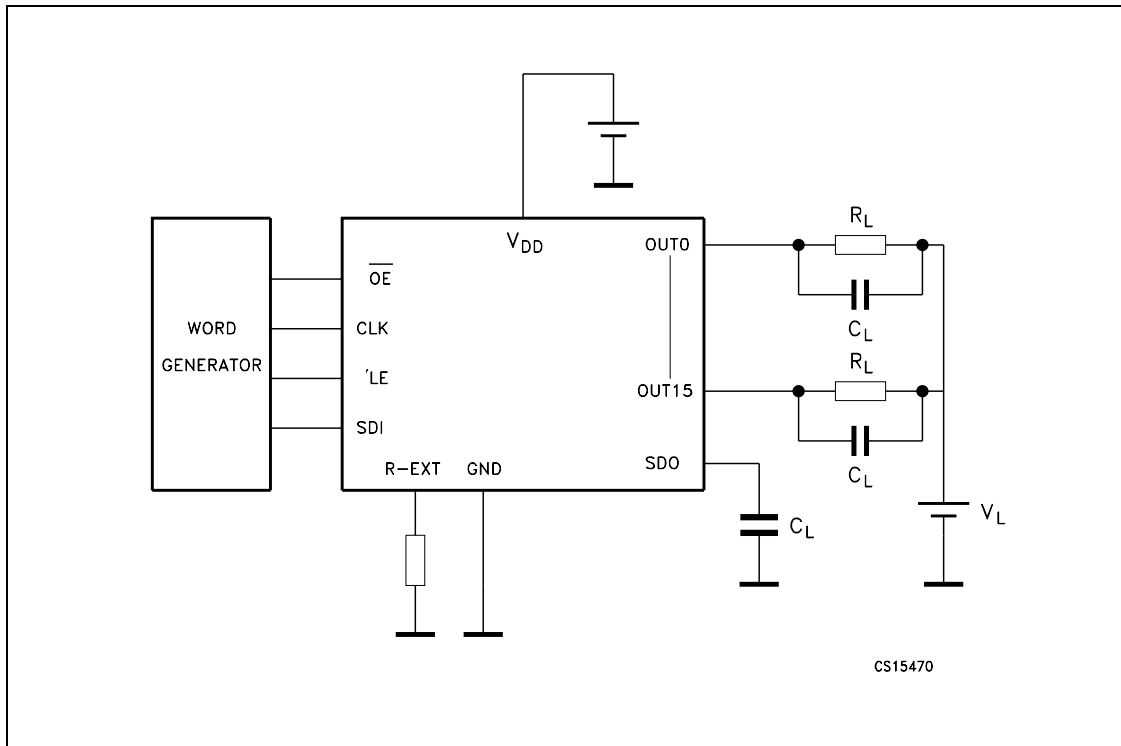


Figure 12. AC characteristics



## 6 Typical characteristics

Figure 13. Output current- $R_{EXT}$  resistor

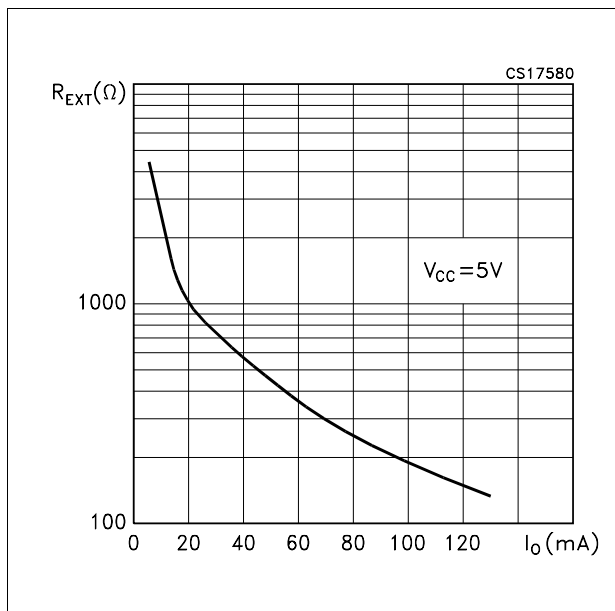


Figure 14. Power dissipation vs. temperature package

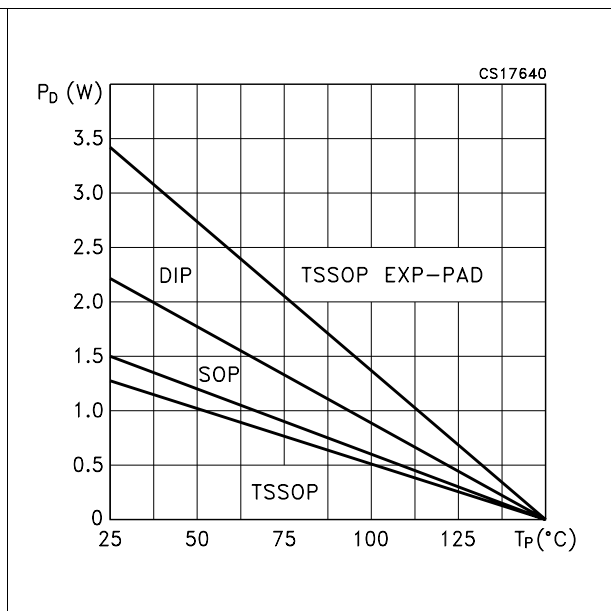


Figure 15. Output current vs. drop voltage

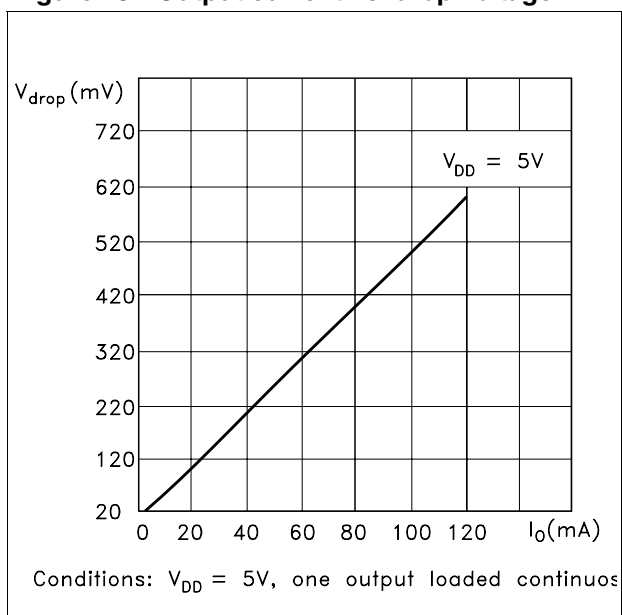
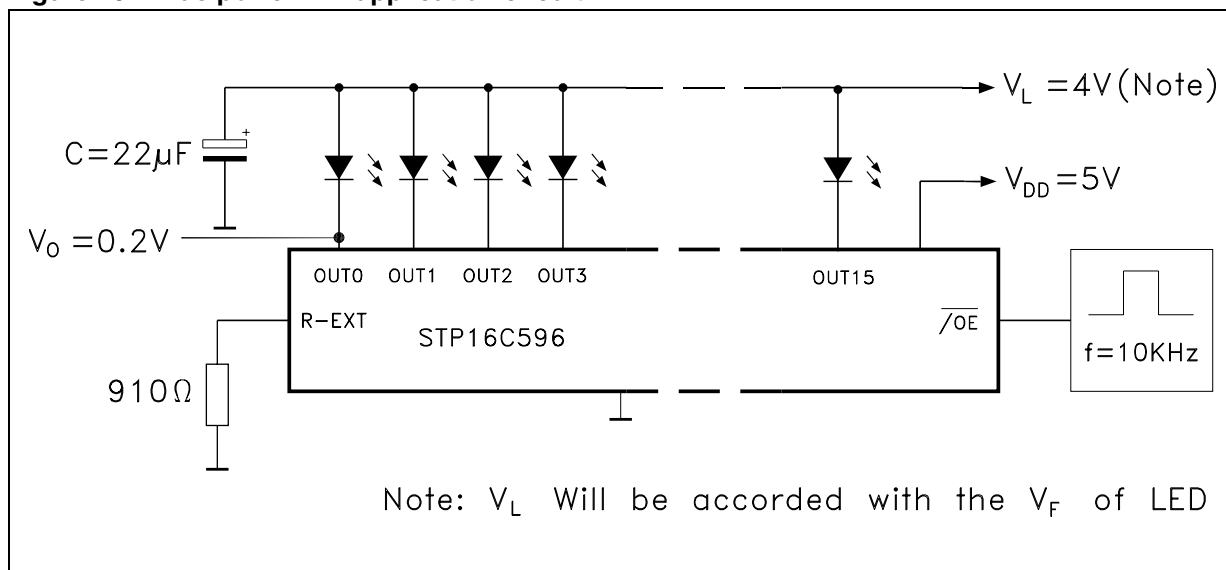


Figure 16. Blue powerLED application circuit



## 7 Package mechanical data

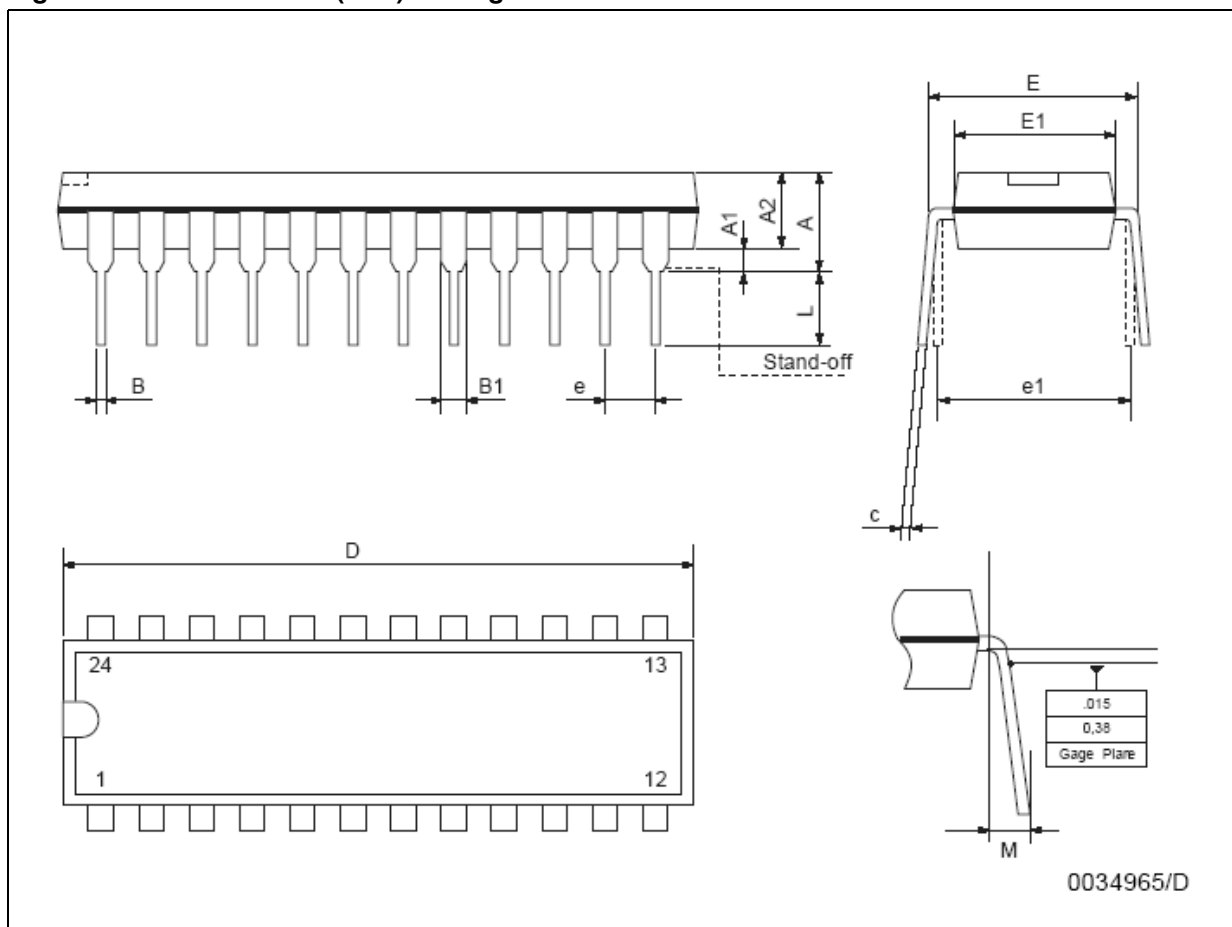
In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The 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).



Table 9. Plastic DIP-24 (0.25) Mechanical data

Ref	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A			4.32			0.170
A1	0.38			0.015		
A2		3.3			0.130	
B	0.41	0.46	0.51	0.016	0.018	0.020
B1	1.40	1.52	1.65	0.055	0.060	0.065
c	0.20	0.25	0.30	0.008	0.010	0.012
D	31.62	31.75	31.88	1.245	1.250	1.255
E	7.62		8.26	0.300		0.325
E1	6.35	6.60	6.86	0.250	0.260	0.270
e		2.54			0.100	
E1		7.62			0.300	
L	3.18		3.43	0.125		0.135
M	0°		15°	0°		15°

Figure 17. Plastic DIP-24 (0.25) Package dimensions



**Table 10. TSSOP24 Mechanical data**

Ref	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A			1.1			0.043
A1	0.05		0.15	0.002		0.006
A2		0.9			0.035	
b	0.19		0.30	0.0075		0.0118
c	0.09		0.20	0.0035		0.0079
D	7.7		7.9	0.303		0.311
E	4.3		4.5	0.169		0.177
e		0.65 BSC			0.0256 BSC	
H	6.25		6.5	0.246		0.256
K	0°		8°	0°		8°
L	0.50		0.70	0.020		0.028

**Figure 18. TSSOP24 Package dimensions**

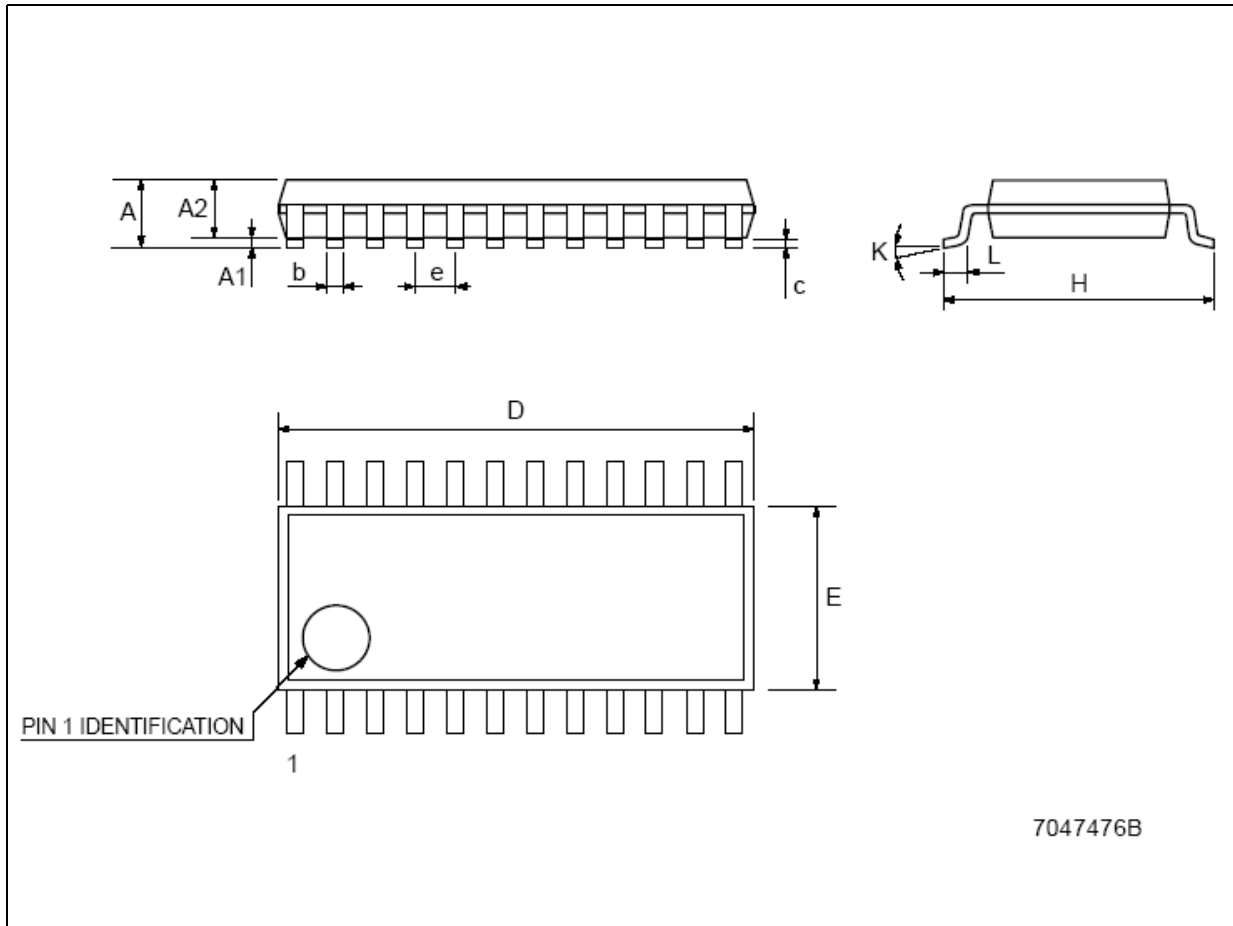
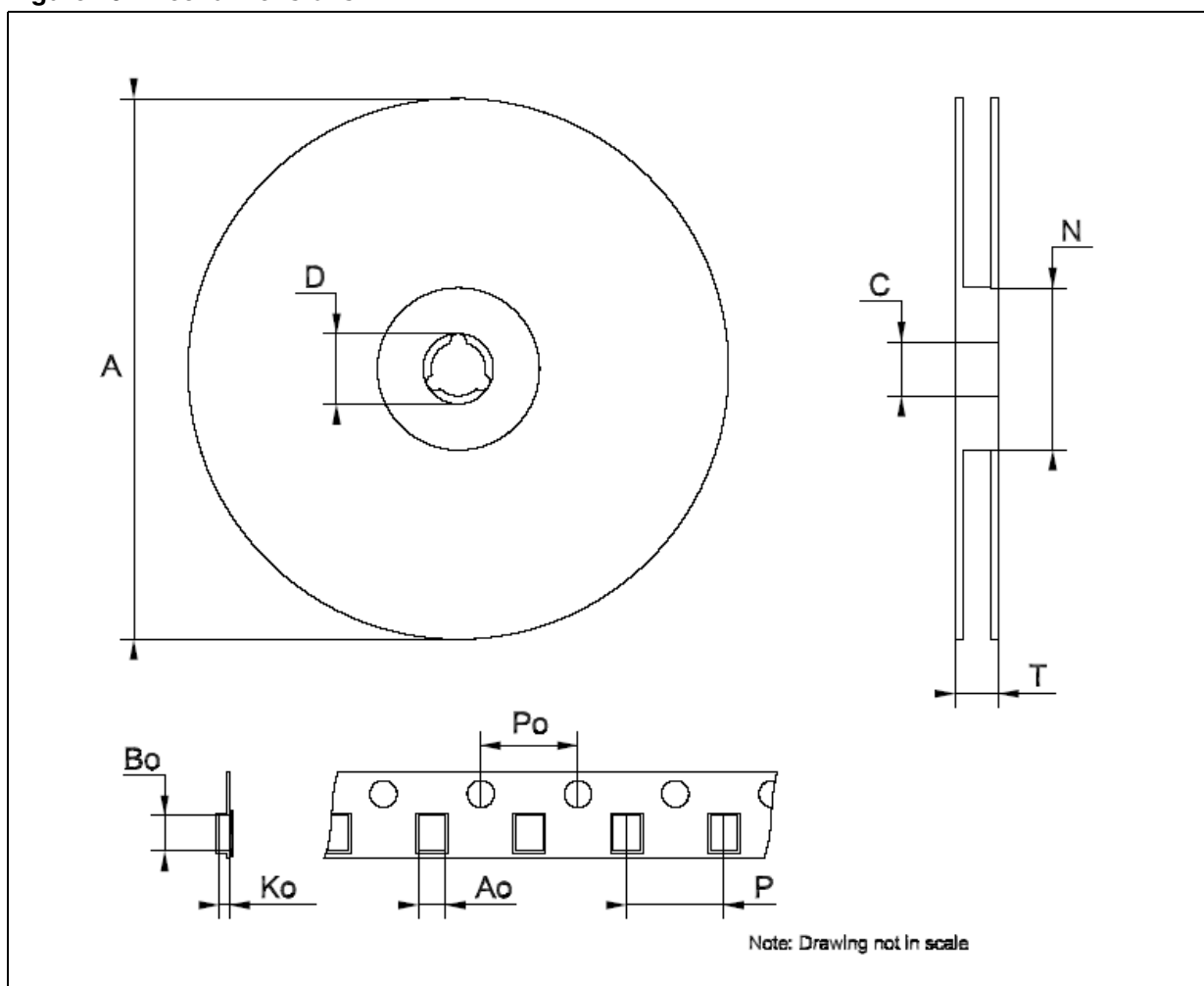


Table 11. Tape & Reel TSSOP24

Ref	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	6.8		7	0.268		0.276
Bo	8.2		8.4	0.323		0.331
Ko	1.7		1.9	0.067		0.075
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476

Figure 19. Reel dimensions



**Table 12. SO-24 Mechanical data**

Ref	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	15.20		15.60	0.598		0.614
E	10.00		10.65	0.393		0.419
e		1.27			0.050	
e3		13.97			0.550	
F	7.40		7.60	0.291		0.300
L	0.50		1.27	0.020		0.050
S	°(max.) 8					

**Figure 20. SO-24 Package dimensions**

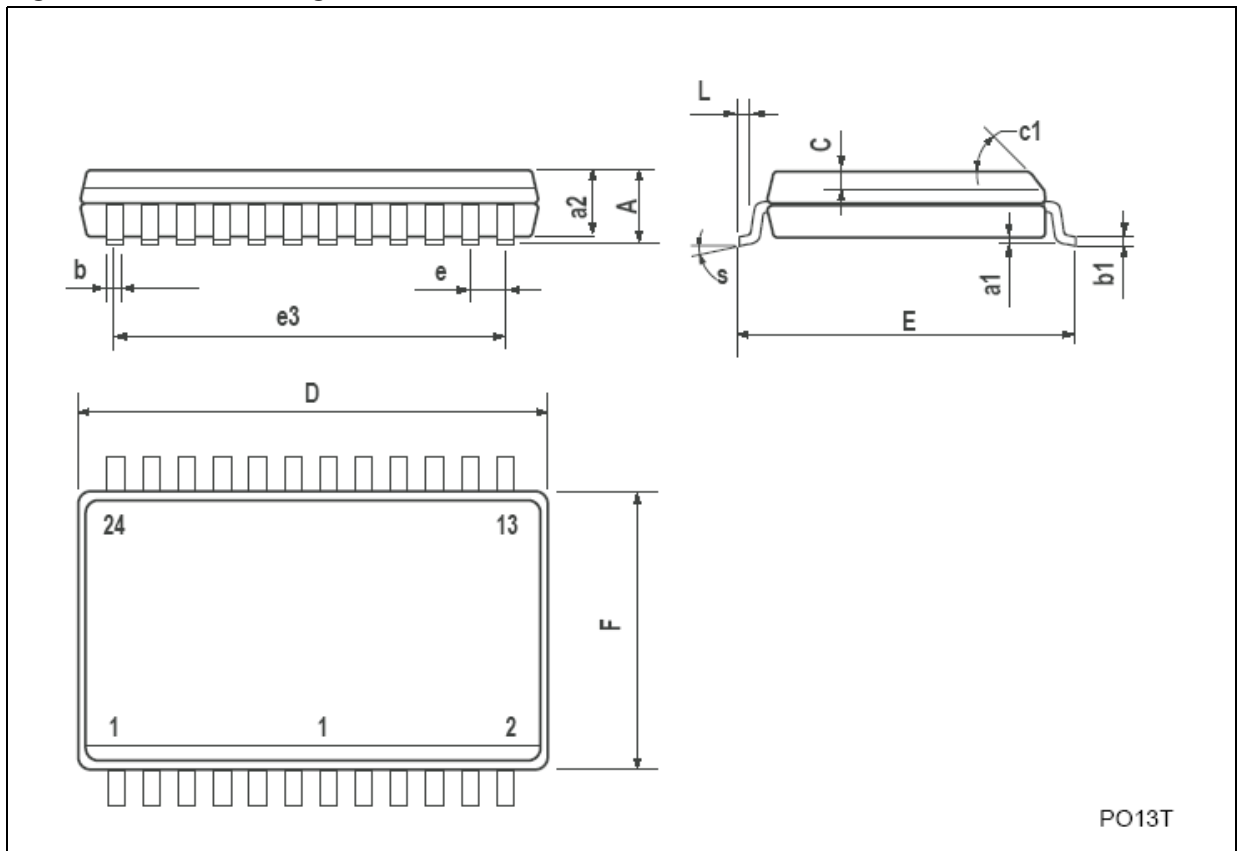


Table 13. Tape &amp; Reel SO-24

Ref	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	15.7		15.9	0.618		0.626
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

Figure 21. Reel dimensions

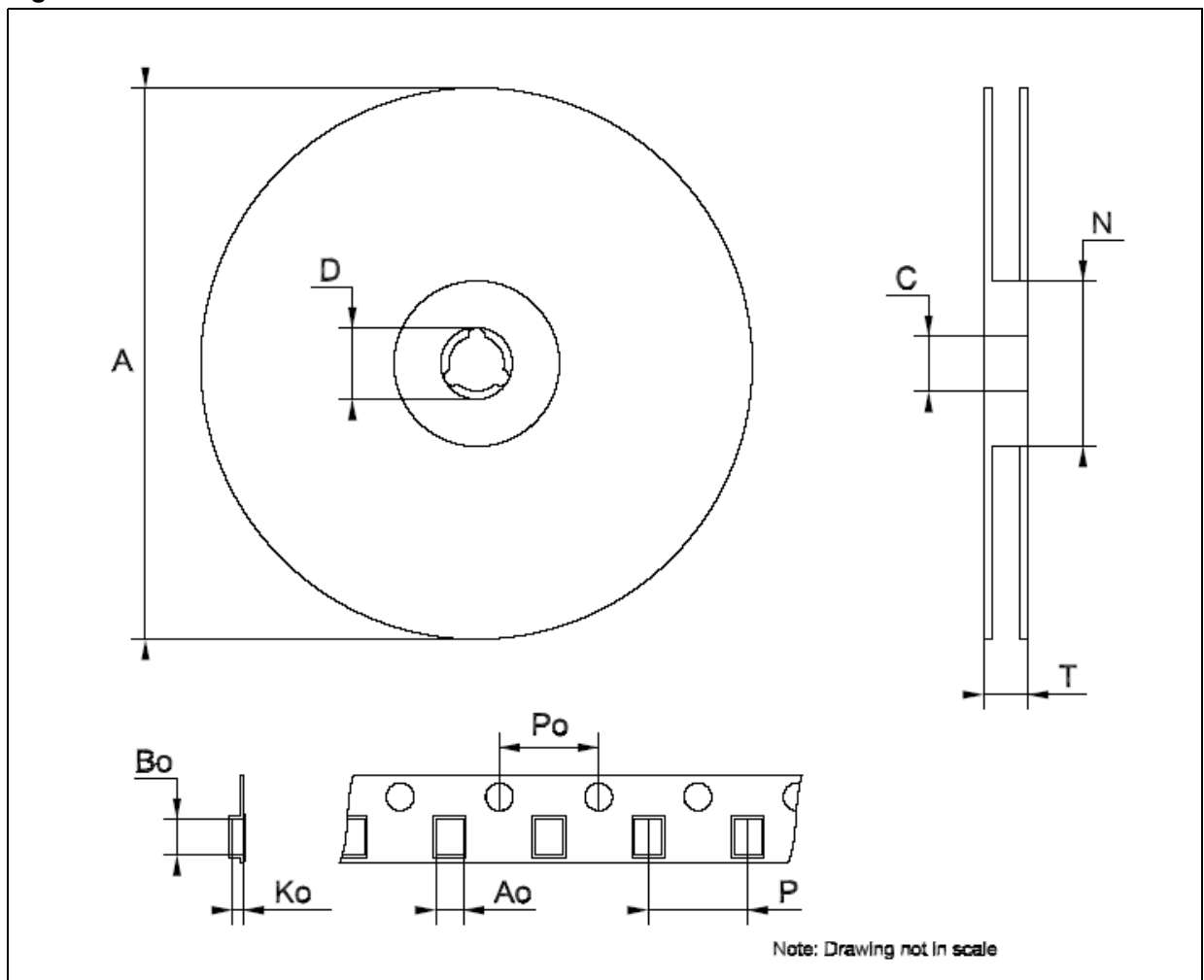
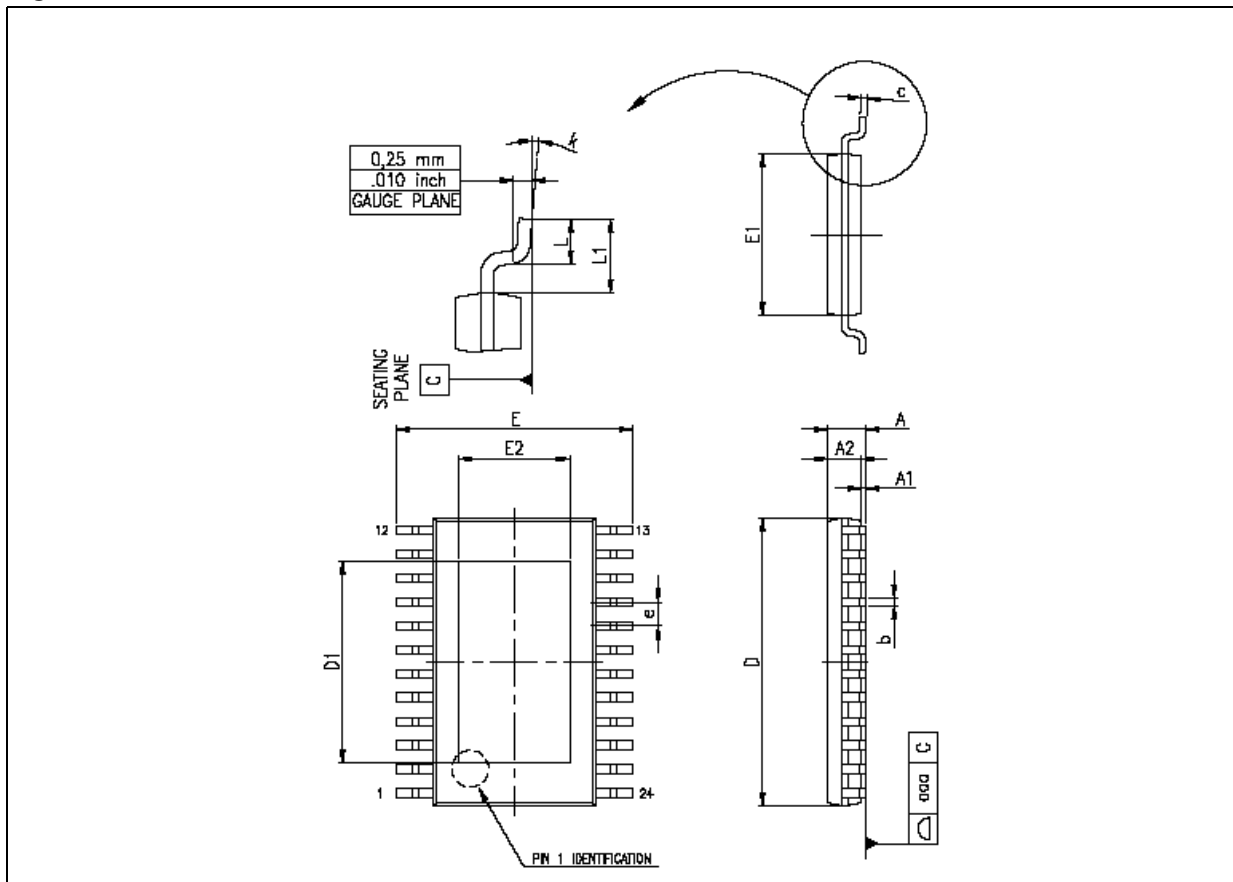


Table 14. TSSOP24 Exposed-pad

Ref	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A			1.2			0.047
A1			0.15		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		0.0089
D	7.7	7.8	7.9	0.303	0.307	0.311
D1		2.7		0.106		
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.5	0.169	0.173	0.177
E2		1.5		0.059		
e		0.65			0.0256	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030

Figure 22. TSSOP24 Dimensions



## 8 Revision history

**Table 15. Revision history**

<b>Date</b>	<b>Revision</b>	<b>Change</b>
06-May-2004	4	Table 6 and Table 7 parameters changed.
03-Aug-2004	5	Figure 14 - pag. 10 is changed.
31-Mar-2005	6	Mistake on Fig. 7.
02-May-2005	7	Typing Error on the description features.
22-Jul-2005	8	Add note on Fig. 1 and Table 5.
16-May-2006	9	New template
26-Jul-2006	10	Block diagram <i>Figure 6 on page 5</i> and <i>Section 1.2: Equivalent circuit of inputs and outputs on page 4</i>

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